

# **SUR-3**

**Submersible  
Ultrasonic  
Receiver**

**Operation Manual**



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Updated 7/30/10 Accompanies v6.0+ firmware

## **SUR Submersible Ultrasonic Receiver**

The SUR is a submersible ultrasonic receiver designed to detect and log to flash memory the presence and telemetry of an animal tagged with Sonotronics ultrasonic transmitters. The SUR is a stand-alone device consisting of a battery system, micro-processor, flash memory, real time clock, hydrophone, ultrasonic receiver, and RS-232 serial port.

### **Specifications:**

**Weight:** 1kg, Positively Buoyant (w 2xBatteries)  
**Sensitivity:** >35dB (S+N)/N with 10uV input  
**Length:** 38cm from transducer to end cap  
**Diameter:** 60mm  
**Memory:** 2 Megabyte—Over 100000 detections  
**Lifetime<sup>1</sup>:** 7-11 months (2 batteries)  
**Battery:** Tadiran TL5930 (1 or 2 batteries)  
**Depth Rating:** 200m recommended, 270m tested

<sup>1</sup>See section on blanking times for an explanation of lifetime and blanking times.

### **Basic Operation:**

Similar to a 'police scanner', the SUR scans up to 15 different frequencies, measuring and recording the intervals between successive pings from individual transmitters. This allows multiple 'continuous pinging' transmitters to be used by both passive receivers, like the SUR, as well as active tracking receivers found in the MANTRAK and diver receivers, such as the UDR. The SUR employs proprietary techniques to reduce the effects of environmental noise, and adjustable gain to allow maximum flexibility whether deployed in marine, lake or riverine systems. While the SUR is highly configurable, factory default settings are suitable for most studies: generally the user needs only verify the frequencies scanned and the correct current time and date before deployment.

### **Understanding the data being logged:**

The detection algorithm relies on the uniqueness of the combination of frequency and interval time (time in milliseconds between pings) combinations. An example datum:

00>09:06:55 09/28/04,76.0,990

would indicate a transmitter at 76 kHz was detected with a pulse interval of 990ms, at 9:06 am 9/28/04.

For additional details, see the support page of the Sonotronics website:  
[www.sonotronics.com](http://www.sonotronics.com) .

**Anatomy of an SUR:**



**Caution!!** Never hold the transducer or Serial Port connector when opening: use the rim of the gray cap only. (A 'grip wrench' is recommended for loosening the SUR caps.)

The SUR is intended to be opened on the top (connector and transducer) for replacing batteries, and opened on the bottom (eye bolt) for turning the unit on and off.

**Initial Power On Sequence:**

The SUR is shipped in the 'off' state - to activate, remove the bottom (eye bolt) end cap, and move the small switch toward the outside of the SUR housing. The SUR operating LED will blink 3 times, with a period of 1 second, indicating a successful power on sequence. During normal operation, this LED blinks once per complete frequency scan, and will blink twice upon successful detection of transmitter. These simple steps confirm proper operation prior to deployment.

**SURsoft SUR Interface software:**

SURsoft is a Windows XP application that allows the user to download data from the SUR, erase memory, program frequencies to scan, and configure several operating parameters. SURsoftDPC is a separate application, typically installed with SURsoft,, used to post process retrieved data: identifying particular transmitters, decoding telemetry, and providing for several types of data presentation.

**Pre-Deployment:**

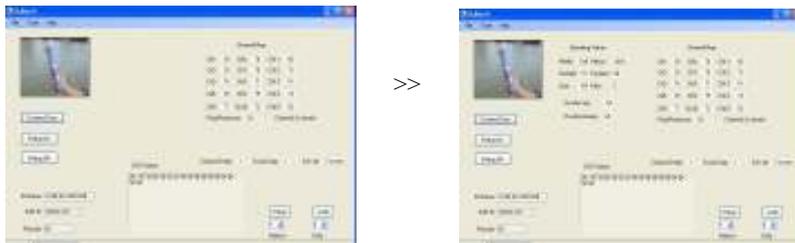
Prior to deployment, SURsoft should be installed on the computer that will later be used to recover field data using either the included CD or from the Sonotronics web-site. Optionally, an additional ‘lab’ computer may also be designated, allowing an installation of an additional instance of SURsoft. Note that some computers may not contain legacy serial ports, or may have those ports already dedicated: in these cases, it is possible to operate SURsoft from so called ‘USB dongles’.

After successful software installation, connect the SUR to the selected PC via the included cable - remove the protective cap from the top of the SUR, and carefully plug the adapter cable between the SUR and the PC 9 pin serial port (take care to not misplace the serial port cap as this must be replaced prior to deployment).



Switch on the SUR, then launch SURsoft, and begin communication with the SUR by selecting the Connect command from the File menu of SURsoft:

Operating values, including the frequency scan map will be updated. At this time, click the “Time Sync...” button, and the appropriate messages will indicate a successful update. Note that the time is maintained while the SUR is switched off for several *hours*, and it is recommended to leave the SUR powered on if deployment is expected within 1-2 days. Modification of scanned frequencies is accomplished by clicking on the particular channel and making a selection from the resultant pop-up window. Additional operating parameters, including Rcode frequency selection, remain hidden until the SUR picture is clicked:

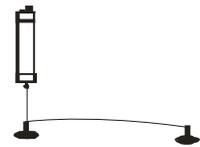


### **Pre-Deployment (continued):**

A quick bench test may be performed in air to verify proper operation: using SURsoft verify the test transmitter frequency is included in channel map, erase the SUR memory, and place the test transmitter 2” away from the transducer while remaining connected to the PC. It is possible to observe the SUR detections by viewing the on-board LED blinking twice in quick succession, and by selecting ‘Connect’ repeatedly on the File menu of SURsoft: the “Stored Records” value will update at this time. Note that detections may require several seconds depending on selected number of frequencies scanned, and chosen delays.

### **Deployment/Mounting:**

The most common deployment configuration is shown in the diagram on the right. The eye bolt on the bottom of the SUR is intended for running a cable or rope for mooring the unit. Having two anchor points (in the picture, mushroom anchors) allows for simple recovery. When deploying, it is important to ensure the communication port cap is secured on the top of the unit before deploying. The SUR outside diameter is designed so that a 2” PVC coupler may be snapped onto the top of the SUR to protect the transducer without affecting performance. Additional methods include:



Attaching the SUR to a known object, such as a dock piling or an anchor chain, using wire ties or stainless steel hose clamps to secure the SUR body. It is recommended to acoustically isolate the SUR body from a solid structure such as a piling by wrapping it in neoprene or other closed cell foam.

Use a single anchor attached to the SUR, and attach a rope from the anchor to shore, keeping the end just underwater where it is easy to find from shore, but hidden from casual view.

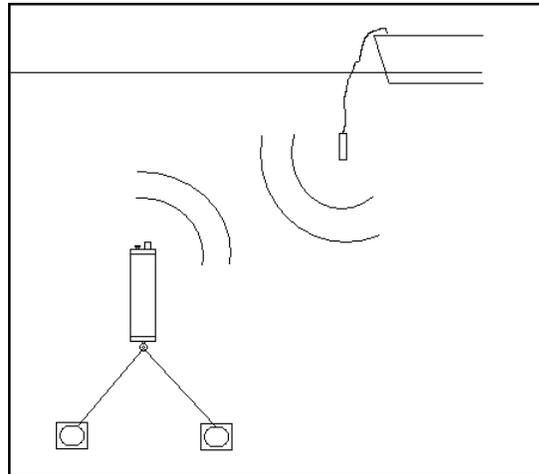
In addition, in areas where barnacles accumulate, use a simple nylon stocking as a sacrificial membrane by covering the entire SUR, and replacing the stocking during each deployment. This method may be helpful in rivers with high sediment flow: in this case, remove the protective coupler prior to using the nylon to prevent sediment build-up inside the coupler.

***Ping and Response function:***

The ping and Response function allows the user to determine the presence/absence of data in the SUR, and is used along with an active receiver such as the USR-96. To implement the feature, set the USR-96 to receive 32.75kHz, and lower the special interrogator transmitter (SIT) into the water within 100m of the SUR. The SUR will respond with one of the following codes:

- 3 pings, with no successive pings= Zero data hits
- 3 pings, followed by 3 fast pings= greater than 0 and less than 100 data hits
- 3 pings, followed by 6 fast pings = greater than 100 data hits

The SIT transmits at 60kHz with an interval of 528ms and is NOT logged as data.



### ***Replacing Batteries:***

To replace the batteries in an SUR, follow these steps:

1. Unscrew the top cap of the SUR. DO NOT unscrew holding the transducer or serial connector. Grip the circumference of the grey cap itself (an oil filter wrench may be helpful in loosening this cap).
2. Slide the PCB out of the SUR housing
3. Turn off the power using the switch at the end of the board. The SUR is on when the switch is towards the outside world.
4. Replace batteries, being careful to keep the same orientation. The positive end should be towards the eye bolt. The onboard clock will continue to function for 2-4 hours during the battery change, else re-sync the SUR with the PC clock using SURsoft as shown in previous steps. Frequency map and all other operating values are not affected by loss of power
5. When reassembling the unit, it should be observed that the LED on the end of the battery compartment board will blink three times when the unit is powered on with the switch.
6. **IMPORTANT!!** Inspect the O-ring while screwing the top end back into the unit. If the O-ring is not seated properly, the units will not be waterproof. Hand tighten securely. Occasionally it is recommended that you add Vaseline or O-ring grease to this O-ring as this will help it seat properly.

Replacement Batteries can be ordered from Sonotronics. Do not replace the battery with a standard D cell alkaline battery. The SUR requires Lithium 3.65v battery in order to operate, and may be ordered using the ordering code SUR-BAT from Sonotronics. Due to the high energy content of these batteries, freight restrictions may apply.

It is good practice to write the date on the batteries prior to deployment, providing a helpful reminder when the next replacement should occur.

### ***Understanding Blanking Times:***

For increased battery life, the SUR's allow for a blanking time during which certain subsystems in the SUR are powered down in order to reduce power consumption. In most applications, it is not necessary for the SUR to be continuously monitoring as an animal will take time to move through an area. The default blanking times and their meanings are listed below:

1. 1 second **channel delay**: the SUR will listening for approximately 2 seconds on a particular frequency for the presence of a transmitter, then it will power down for 1 second, then power up and listen to the next frequency, and continue.
2. 1 second **scan delay**: the SUR will power down for 1 second after the channel map is complete, then power up and begin to scan the frequencies listed in the channel map.
3. Due to the two algorithms above, the total time for an SUR to check each frequency map is as follows:  
 $(15 \text{ channels (default)} \times 2 \text{ sec/channel}) + (1 \text{ sec channel delay} \times 15 \text{ channels}) + 1 \text{ sec scan delay} = 46 \text{ seconds to complete sequence}$

This means that a particular frequency will be checked for transmitters every 46 seconds.

The default blanking times result in an SUR lifetime of 7 months on a 2 D cell batteries, and this is expanded to 11 months with a 6 second channel delay and 10 second scan delay: these parameters can be changed using SURmanager software, which provides an estimated lifetime when these parameters are changed. Note that the SUR may be operated on a single lithium D cell, however these lifetime estimates should be halved.

## ***Ranging and Testing SUR's:***

The actual range achievable with an SUR is the result of a number of factors: Transmitter power level, receiver sensitivity and SNR (signal to noise ratio), and a variety of factors in the environment. The factors in the environment are always the most difficult to characterize. This section is a simple guide to give the user some idea of what kind of range to expect, as well as techniques for quantifying the range more closely.

Here is a preliminary table of information:

<b>Range</b>	<b>Transmitter Type</b>	<b>Depth</b>
600m	High Power: DT, CHP, AST	>60 feet depth
400m	Medium Power: CT, CTT	>60 feet depth
200m	Low Power: IBT, PT	>60 feet depth

Depth is one of the main environmental influences that determines range. A quick way to adjust the table above is to halve the range if the depth is less than 60 feet. If you were in a deep open water environment, the ranges listed above would increase.

Some other factors that compromise range:

1. Any form of trapped air between pinger and receiver: Vegetation containing air, air mixed in water, air trapped in a log or other object.
2. Objects not containing air between pinger and hydrophone can cause scattering and reflection of signals.
3. Acoustic noise: Machinery, spill over (dam or any other source), depth finders, snapping shrimp, or any other source of noise in the water.
4. Thermal or salinity stratification in the water.
5. Turbidity caused by suspended sediments.

### **Test#1:** Determining SUR range

1. Setting up the SUR: Reduce **the frequency map to one frequency** (of the tag to be used in the test), and **reduce blanking times to zero**. Leaving blanking times in will cause it to take considerable time before listening to a particular transmitter (45 seconds or so by default). Be sure to set the time and date in the SUR and make sure you have a watch or clock with the same time.

***Ranging and Testing SUR's continued:***

2. Deploy the SUR in its actual location, and move away from the SUR periodically placing the transmitter in the water for a couple of minutes at important sample points (ie, 50m, 100m, 150m, 200m ...). A GPS is the easiest tool for determining your range from the SUR. It is important to note the times at each distance so you can correlate it with the data in the SUR.
3. The final step is to correlate the data with the times at each range. You will see at which range the SUR begins to have difficulty in picking up transmitters.

**Test#2:** Determining SUR range—using ping and response—works well in deeper waters

1. An advantage to the ping and response feature inherent on SUR's is the fact that it can be used to aid in range testing. To do this, like in the other test, place only 60kHz in your frequency map and reduce the blanking times to zero.
2. Use your GPS to fix your position at the SUR.
3. Tune your manual tracking receiver to 32.75kHz and begin floating away from the SUR with the SIT (SUR Interrogator Transmitter) in the water.
4. Listen for the SUR to respond to the SIT and note the distance away from the SUR on the GPS.

Please contact Sonotronics for more help with range issues.

**Ordering Information:**

Descriptive title	Part Number	Comments
Replacement Batteries for SUR's	SUR-BAT	Tadiran TL-5930 D cell replacement batteries for SUR's.
SIT-1 SUR interrogator transmitter	SIT-1	This special pinger interrogates the SUR's, initiating the ping and response function. Only one SIT is needed to service an array of SUR's.
USB Dongle	USB Dongle	Provides legacy COM port function via a USB port.

## Using BlueTooth enabled SUR (SUR-3BT)

### Overview:

The Sonotronics' SUR-3BT is a Bluetooth enabled unit, allowing wireless configuration and downloads. In particular, the SUR-3BT uses a standard protocol called SPP (serial port protocol) allowing use of embedded or factory installed Bluetooth adapters in laptops, a variety of aftermarket adapters, and even PDAs and smartphones equipped with Windows Mobile 6 or higher. In addition, PCs operating Windows XP SP2 or higher have "built in" Bluetooth support, allowing for many options in communicating with the SUR-3BT: PC implementations allow the use of a "virtual serial port" which allow existing software such as SURsoft to be used without modification. In short, the concept of Sonotronics' data management is to allow collection and limited configuration from a wide variety of host computers, including small hardened field PCs and PDA like the Archer PC, and then allowing the data files collected from these various devices to be examined and unified using SURsoftDPC, allowing a unified interface to other high-level software tools.

It is important to note that since Bluetooth is a special implementation of a two-way radio, leaving this unit powered on, especially when submerged for long periods of time, would waste precious battery capacity. Consequently, the radio is turned on for 5 minutes only during the following: 1) power-on, 2) detection of SIT (ping and response) transmitter, 3) detection of an rcode transmitter with a specified range of addresses. Note that this 5 minute limit is extended during a data download as this may take 10-15 minutes for large data sets.

The act of communicating with a Bluetooth device in general, and the SUR-3BT in particular, consists of 3 phases: 1) discovery, 2) pairing, 3) connecting: these will be described using the Microsoft implementation of Bluetooth under Windows XP. It is assumed that a Bluetooth adapter is already installed and functioning (this may be verified by searching Device Manager for Bluetooth devices).

### **Discovery**

During this initial phase, on the system tray of the PC, or under Control Panel a Bluetooth icon  should be seen, labeled either "Bluetooth Places" or "Bluetooth Devices". Click on this icon to display a screen to allow adding of new devices:



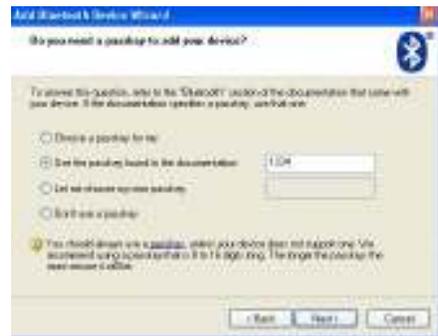
At this time, before clicking on "Add", be sure the SUR-3BT is powered up, and the Bluetooth active LED is blinking:



Note that the SUR-3BT will never attempt to connect to the PC, so for this use, it is acceptable to not allow other devices to discover the host PC. Once the SUR-3BT is discovered, a screen showing SURxxxxx, where xxxxxx is the serial number of the SUR (printed on the large label inside the SUR):



The SUR is now 'discovered', which leads to the next step, pairing. This step involves establishing a unique relationship between the host PC and the Bluetooth device, exchanging a 'passkey' to allow error free communication between these devices. Unless otherwise specified, all SUR-3BT units have a passkey of "1234", and is provided in the next step by highlighting the SUR device, clicking "Next", and filling in the subsequent screen:



After this key is successfully exchanged, the SUR is now 'paired' with the host PC. Please be sure to make note of the name of the **Outgoing Serial Port** (for example, COM3), as this will be used in connecting the PC to the SUR. In fact, at this time the wizard may be closed, and SURsoft started, using the provided name of the Outgoing Serial Port when prompted using "Connect" in SURsoft. During this time, the Bluetooth Status LED should be on solid (not blinking), and remain on until SURsoft is exited. At this time, the LED will return to a slow blinking state. Depending on the chosen configuration, an SUR may be provided a unique COM port name, or duplicates may be selected, in which case it will be necessary to 'connect' the SUR by using "Bluetooth Devices" or "Bluetooth Places" and highlighting the desired SUR, prior to using the connect feature of SURsoft. Once SURsoft is connected and operating, there are no further data distinctions between a wired SUR and a Bluetooth enabled SUR.

**NOTES:**

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