User Guide

Subterranean Tactical Radio

STR-1000

Sandia Research Corporation

www.sandiaresearch.com

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1. The Front Panel

The front panel has two areas for connectors and antennas, as shown in Figure 1.

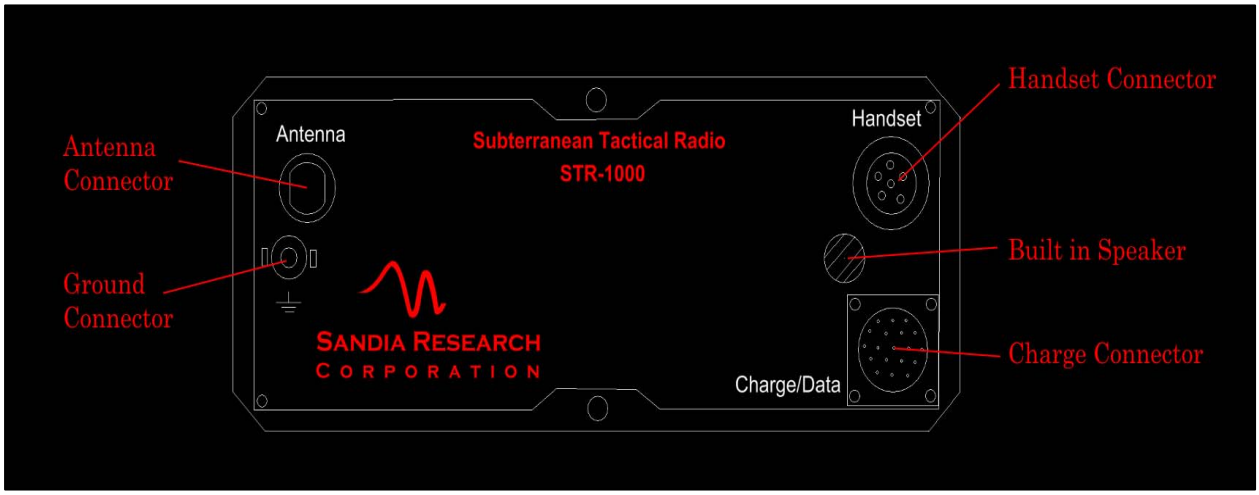

Figure 1. STR-1000 Front Panel.

The Antenna Connector is keyed to receive the Sandia Research antennas.

The Ground Connector is only used when a counterpoise (ground wire) is desired and is not used in normal operations.

The Handset Connector is where the Smart Handset attaches. All controls are located on the Smart Handset.

The Built in Speaker provides audio from the radio receiver. It may be turned on or off by using the Smart Handset.

The Charge Connector (also marked Data for future use) is where the battery charger attaches. The battery does not need to be removed from the radio for charging.

2. The Bottom

Figure 2. STR-1000 Rear Panel - battery removed.

The rear of the radio includes the connector for the battery.

3. Battery

The battery has a mating connection to the bottom of the radio. It is only possible to fully seat the battery in one orientation.

Figure 3. Top of battery.

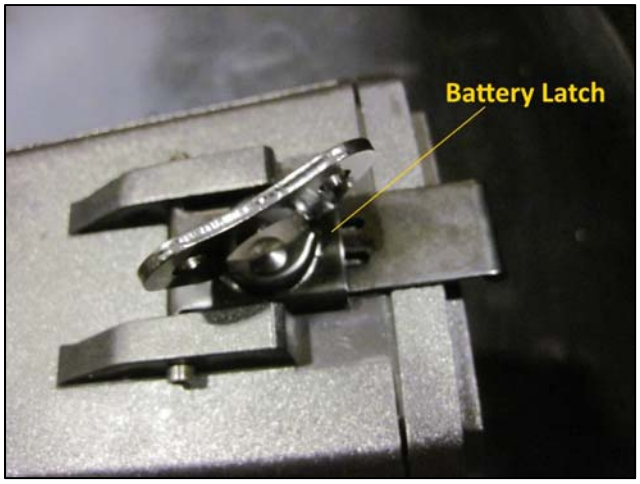

Figure 4. Battery latch.

When fully seated on the radio, locking latches are engaged to the radio body to hold the battery in place. Use the attached key to tighten the latch. To remove the battery (usually not needed), use the attached key to loosen the latch and then move it off of the mating part on the battery box.

The battery is charged by attaching the 19 pin circular connector to the radio Charge/Data port on the lower right portion of the front panel. The charger itself is plugged into a standard 120 volt AC outlet. The charging time for a fully discharged battery will be up to 16 hours. The charger will automatically go to a standby mode when charging is complete. When plugged into the AC outlet the charger will display a green light in the upper right corner. During the charging phase, the charger will display a yellow light in the Output graphic on the charger. See Figure 5.

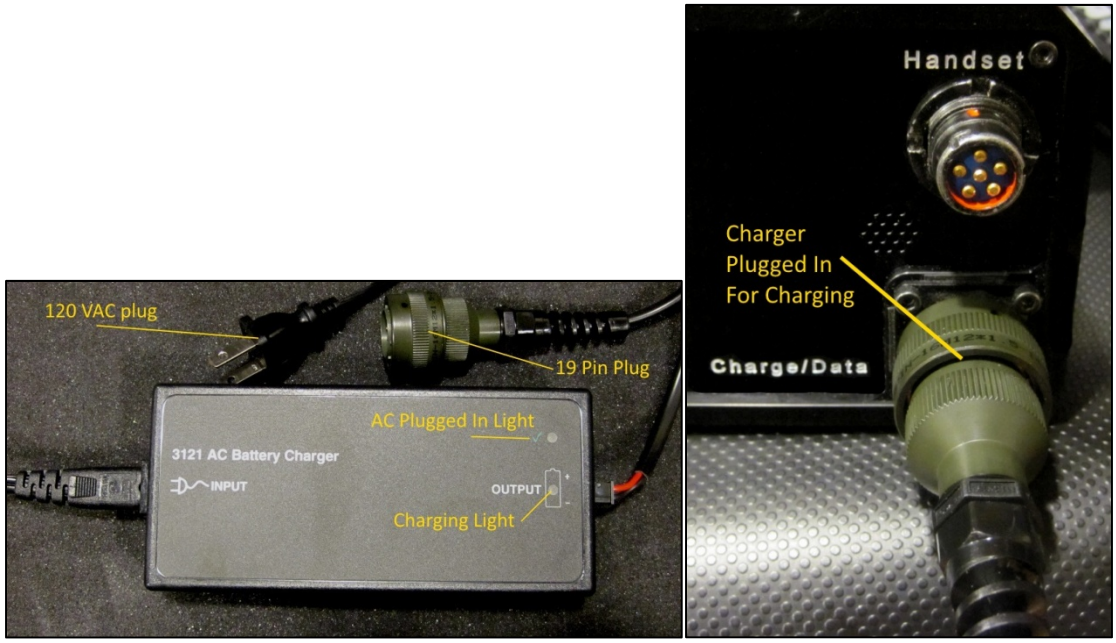

Figure 5. Charger and charger plugged into radio 19 pin Charge port.

There is also a fast battery charger cable provided to directly connect to the battery. Remove the battery from the radio to charge. Plug the 6 pin cable into the output side of the charger body, replacing the 19 pin normal charger plug.

The battery charging temperature is recommended to be between 32 degrees F (0 degrees C) to 104 degrees F (40 degrees C). If the temperature of the battery is above 104 degrees F (40 degrees C) the charger will not operate. If charging is underway and the temperature rises to 122 degrees F (50 degrees C) the charging will be stopped automatically.

During the first 20 cycles of a new battery, it is recommended that the battery not be discharged fully. After every 20 charge cycles, the battery should be fully discharged (leave the radio on – it will shut off automatically) and then fully charged again. This procedure will give maximum battery life.

If the batteries are to be stored for an extended amount of time, they should be fully charged beforehand. When batteries are taken out of storage, they should be fully charged before use. The length of time that a battery can be stored before recharging depends upon the storage temperature. At 85 degrees F (30 degrees C) the storage time is 6 months, at 70 degrees F (20 degrees C) the storage time is 12 months.

When a battery is no longer serviceable, it should be recycled in accordance with local regulations and environmental acts. Batteries should not be burned or disposed of in landfills.

4. Smart Handset

Figure 6. The Smart Handset.

The Smart Handset controls all of the functions of the radio and displays information about the status of the radio.

The Smart Handset connects to the Front Panel upper right hand connector labeled “Handset.”

The upper left area of the Handset has the On-Off Power button (green). Press this button for a few seconds to turn the radio on. The same button may be used to turn the radio off with a long press (about 2 seconds) or the red button in the upper right part of the handset may be used to alternately turn the radio off with a long press (about 2 seconds).

The speaker is on the upper end of the handset and the microphone is on the lower end. The handset functions similar to a conventional telephone handset. The “Push To Talk” (PTT) button

is located on the side of the handset body. The PTT is depressed when the user wants to transmit and is released when listening. The Volume Control is on the central right side of the handset – pressing the top half increases the volume and pressing the lower half of the button decreases the volume to the speaker.

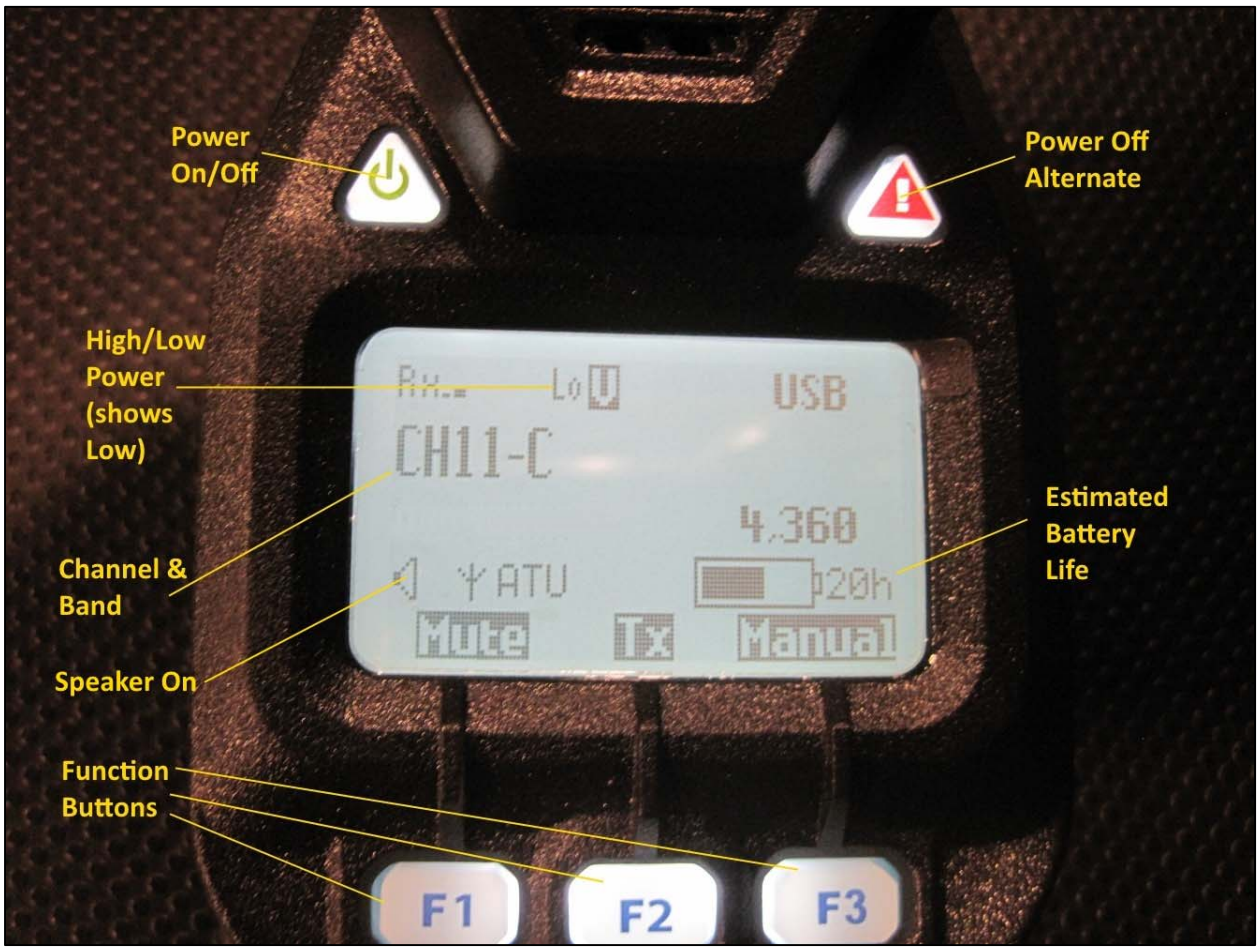

Figure 7. Handset upper half – display and function buttons.

The upper half of the handset has Function Buttons (F1, F2, F3) which work directly with the display above them. The display indicates that the F1 button (Figure 7) controls the MUTE function (turns the receive channel squelch on or off – incoming voice will be received). The F2 key changes the TX (transmit) power level from High to Low and back. In Figure 7 above, the power level is set to Lo (low). The F3 key starts the Manual Tune process which will be covered in a later section of this User Guide.

The display also shows the active channel and channel band designation (CH11-C is shown in Figure 7 above). The active channel is changed to what is desired by the control button shown in Figure 8. Press the top half of the button to change to a higher channel number and the bottom of the button to change to a lower channel number. When the maximum or minimum channel is reached, the channel switches to the lowest channel or the highest channel (the channel list can be thought of as a circular selection – See Figure 9). The exact number and frequencies of the

channels to be used will be determined by the frequency coordinating authorities responsible for the individual user group.

Figure 7 also shows the Estimated Battery Life indication. The calculation for battery life is based on the radio mostly listening and transmitting occasionally. If the opposite condition occurs, the battery life will decrease much more rapidly than the indication.

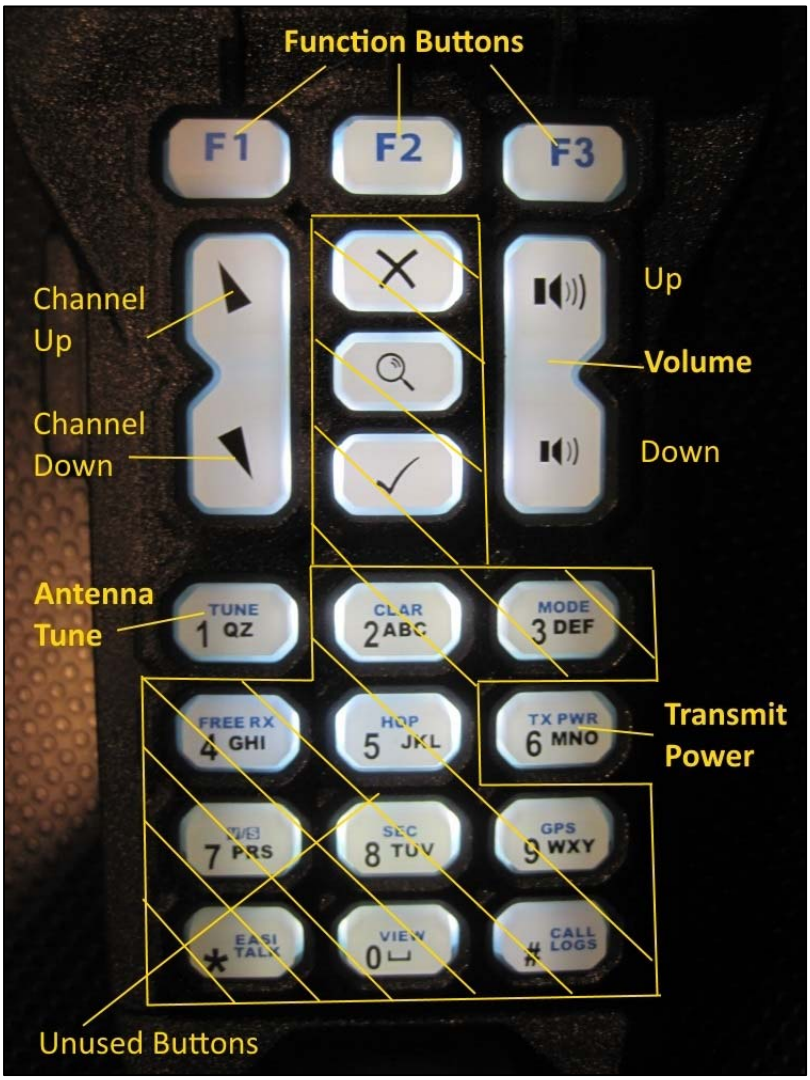

Figure 8. Handset buttons.

Figure 8 shows the location of the Channel UP/DOWN button, the Volume UP/DOWN button and, the Function Buttons (F1, F2, and F3). The two other buttons on are used to control the Antenna Tune and Transmit Power function. All other buttons on the handset are currently unused but available for future functionality.

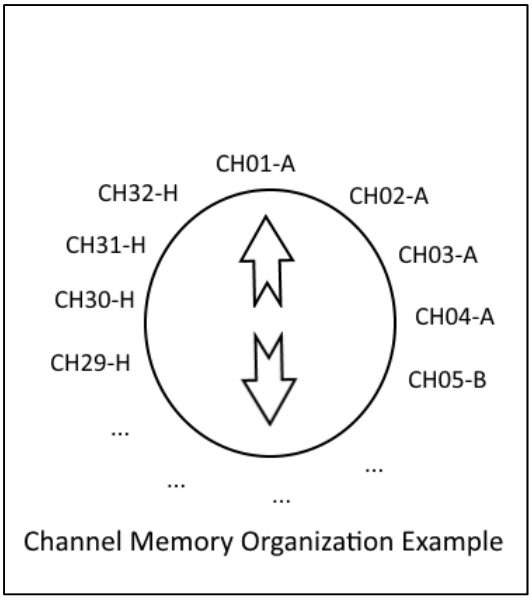

Figure 9. Channel Memory Example.

5. Antennas

Figure 1 and Figure 10 show the location of the antenna connection in the upper left corner of the front panel. The connectors are keyed – the red dots must be aligned before the antenna connector can be fully seated in the mating jack on the radio body. When the red dots are aligned, insert the connector and push it in until fully engaged.

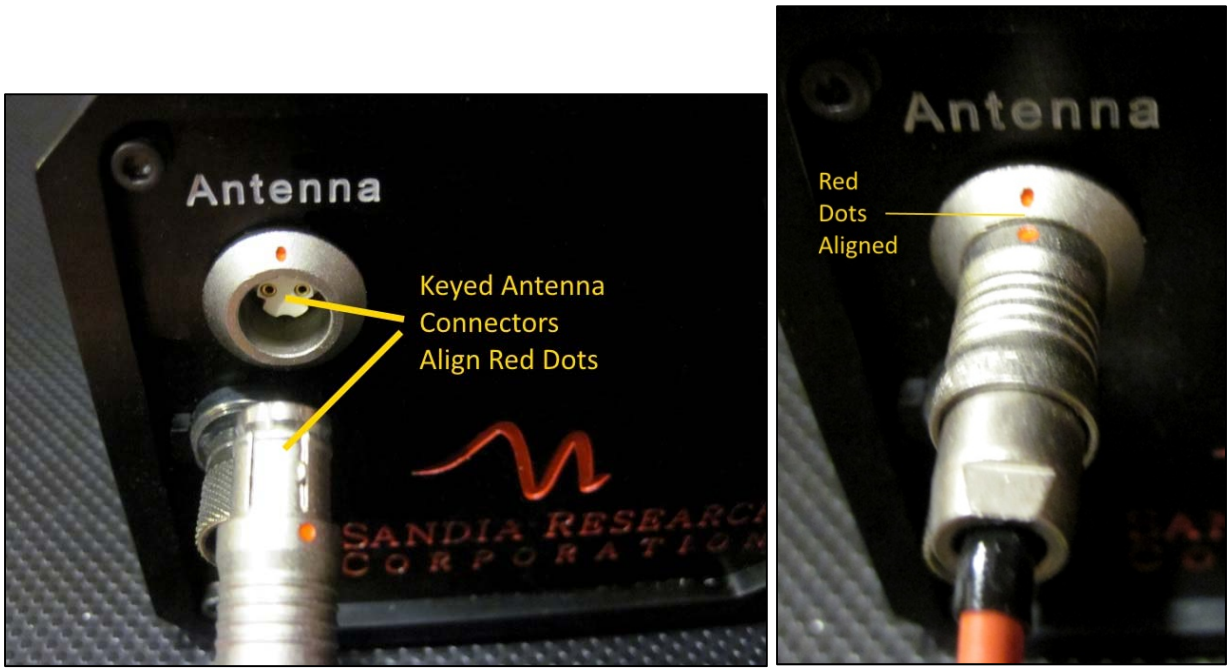

Figure 10. Antenna jack and connector fully engaged.

The STR-1000 has several different lengths of wire antenna which are laid out behind the user and allowed to lay on the ground as the user moves in the underground or surface environment. The low drag of the wire will prevent the antenna from getting snagged on rocks or other protrusions when in use.

The STR-1000 can also use one of the very short stainless whip antennas. These should only be used in a fixed, non mobile, location. In addition, telescoping short antennas are provided which should also only be used in fixed locations.

Recommendations for which wire antenna will give the best results for a frequency/depth/distance on the surface combination, are given in Tables 1 and 2.

Table 1. STR-1000 Antenna Selection for Frequency (1st to 3rd choice) Recommendation.

	Antenna Color Code		
Frequency	Green (long)	Yellow (medium)	Red (short)
< 5 MHz	1st	2nd	3rd
5 to 10 MHz	2nd	1st	3rd
> 10 MHz	3rd	2nd	1st

Table 2. STR-1000 Depth vs. Surface Distance Recommendation (* = only in optimal conditions).

Antenna Selection Guide					
Depth/Distance	< 1 mile	1 – 2 miles	2 – 3 miles	3 - 4 miles	4-5 miles
< 50 feet	Red (short)	Yellow (medium)	Yellow (medium)	Green (long)	Green (long)
50 - 100 feet	Yellow (medium)	Yellow (medium)	Green (long)	Green (long)	Green (long)
100 – 200 feet	Yellow (medium)	Green (long)	Green (long)	Green (long)	Green (long)
200 – 300 feet	Green (long)	Green (Long)	*	*	*

Note: Lower frequencies and longer antenna lengths will give the best depth penetration at all distances.

6. Antenna Tuning

The STR-1000 has an efficient Automatic Tuner Unit (ATU). After the desired antenna is firmly attached to the radio body and the desired operating channel is selected, the antenna should be "tuned". Press the F3 function key (or the number 1 key on the keypad which says tune) and the antenna status page will display. If the display says that the antenna is "Unturned" pressing the PTT with a short press will initiate the tuning process (PTT tunes is also displayed on this screen).

The display will change to state "Tuning…" and a series of clicks will be heard inside the radio, followed by a beep. The antenna status page will change to show a number after "SWR:". If this number is 2.0 or less, then the tuning was completely successful and transmissions may begin.

Figure 11. Antenna Status – Un-tuned and during Tuning.

After tuning or if the antenna was previously tuned on the frequency selected, the display will show the antenna status as "Tuned" along with the SWR number. See Figures 11 and 12.

Figure 12. Antenna Status showing Tuned with a good SWR.

If the Antenna Status shows “Tune Failed” or a SWR value over 2.0, then selecting a different antenna length (from the table in Section 5 above) or re-orienting the antenna may allow it to tune properly.

When operating in the underground environment or on the surface with changing operating conditions (people or vehicles moving close to the antenna, different location, etc.) the tuning of the antenna may change and require a new manual tune sequence.

The Automatic Tuner Unit also senses the conditions that the antenna is operating in during transmissions and will initiate an automatic re-tune sequence if needed. During a tuning or re-tuning sequence (clicking heard inside the radio) voice transmissions are not possible. Allow the sequence to finish before initiating a call.

7. Speakers and Mute

The audio from the receiver may be muted to reduce the background “hiss” on the open channel. To change the status of the Mute, press the F1 function key. The display will change to either a normal or inverted “V” (for voice) character, at the upper center of the Smart Handset display.

Figure 13. Mute status on display.

Receive audio will always be available on the Smart Handset speaker. At times, it may be useful to have audio also come out of the built in speaker on the body of the radio. To change the speaker function, press had hold the F1 function key until the display beeps and turns off or turns on the speaker as desired. Figure 7 shows the location of the speaker icon – when visible the speaker on the body of the radio is active, if the speaker icon is not visible then the audio will only be in the Smart Handset.

If the received signal strength is very low, “opening” or turning off the mute may allow successful communications that might be “clipped” or interrupted or not received at all with the mute function active. This is often the case when approaching the limit of a particular transmission path for a given frequency and antenna combination.

8. Backpack

The STR-1000 is supplied with a backpack for carrying the radio and storing the antennas not in use. On the surface or in large passages underground, the pack may be worn in the normal fashion on the back. Underground in smaller passages, wearing the pack on the front of the body will allow the user to crawl on hands and knees without having the pack drag or get stuck on the ceiling of the passage. In even smaller passages, the pack may be taken off and pushed along the travel route as the user belly crawls through the passage.

The pack has access holes to either side of the top carrying handle which provide access to pass the Smart Handset cord and the antenna through to the radio (Figure 14). This will allow the pack zippers to remain closed during travel.

During extended transmit conditions or excessive heat conditions, the pack zipper should be opened to allow air to circulate, cooling the radio case. In case of excess heat which may cause the radio to self protect (not transmit), remove the radio from the backpack to increase the cooling circulation.

Figure 14. Backpack cord access holes for Smart Handset and Antenna.

9. Basic Operation

First, install the recommended antenna, turn on the radio, select the channel agreed upon between stations (surface and underground), and tune the antenna. Adjust the speaker volume as needed on the receiver.

To make a voice call after the radio is ready, hold down on the PTT then speak into the Smart Handset microphone. When finished speaking, release the PTT and listen for responses from the other station using the Smart Handset speaker and/or the built in speaker in the radio.

Ensure that the STR-1000 is always operated within the temperature range of -30 to +60 degrees C
(-22 to +140 degrees F).

Important Note: Avoid keeping the radio in an excessively hot vehicle before operation. This is especially true in the Desert Southwest.

A grounding cable is provided for surface operations where antenna tuning is difficult or excessive receive static interference may occur. The grounding cable plugs into the Grounding Connector (see Figure 1 for location) and clipped to a grounding rod (not provided).

10. Basic Troubleshooting

Some things to check if there is trouble communicating.

Check that:

- All connections are dry and free of dirt
- All connections are sound
- The battery is connected and has some charge
- The antenna is connected
- Change frequencies and/or antennas
- Go back to the last known point with good communications

11. Operation Specifications

Temperature Range: -30 to +60 degrees C (-22 to +140 degrees F)
Derate upper temperature limit by 1 degree C (1.8 degree F) for each 1000 feet above sea level.
Cooling is convection from case – remove from or open backpack as needed.

Relative Humidity: up to 95%, non-condensing

Maximum battery life (TX:RX ratio 1:9): 30 hours

RF Power Output: 25 watts PEP (high) and 5 watts PEP (low)

Duty Cycle: 50% normal speech over full temperature range

Channel Capacity: up to 400 channels (factory programmed only)