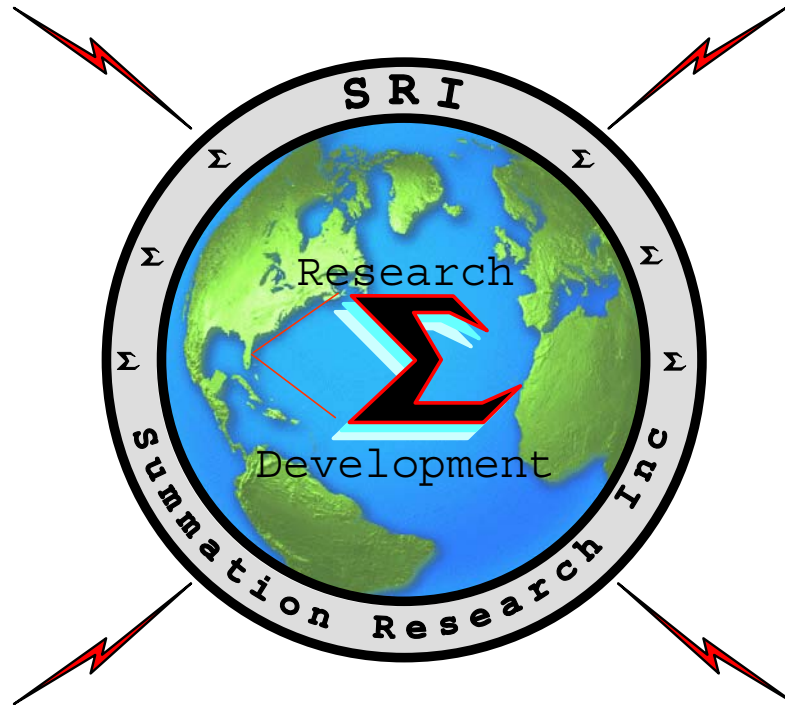


Summation Research Inc

STR-1800 Land Mobile Data Radio

Operations and Maintenance Manual



Meeting 21st Century Challenges

- with -

Technically Appropriate Solutions

Prepared by: Summation Research Inc – Melbourne, FL
SRI Document Number: 70-STR1800-00 O&M
Revision: A

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SRI • 3950 DOW ROAD • MELBOURNE, FLORIDA 32934
(321) 254-2580 • FAX (321) 254-2492 • Internet : <http://www.summationresearch.com>
Email : info@summationresearch.com
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LIMITED WARRANTY

Summation Research, Inc. (herein called SRI) warrants that the equipment's of its manufacture as identified and described within this manual shall, at the time of shipment to the original purchaser, be free from defects in material and workmanship. This warranty applies only to equipment installed, operated, and maintained in accordance with SRI recommendations. This warranty does not apply where SRI determines that installation, repair, alteration, or accidents have caused any claimed defect, or that excessive deterioration due to environmental contamination has occurred.

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All specifications within this document are subject to change without prior written notice.

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RF Exposure Statement

The radio generates RF electromagnetic energy during transmit mode. This radio is designed for and classified as “Occupational Use Only”, meaning it must be used only during the course of employment by individuals aware of the hazards, and the ways to minimize such hazards. This radio is NOT intended for use by the “General Population” in an uncontrolled environment.

For compliance with FCC and Industry Canada RF Exposure Requirements, the transmitter antenna installation shall comply with the following two conditions:

1. The transmitter antenna gain shall not exceed a limit necessary for the application.
2. The transmitter antenna is required to be located outside of a vehicle and kept at a separation distance of 45 centimeters or more between the transmitter antenna of this device and persons during operation.

To ensure that your exposure to RF electromagnetic energy is within the FCC allowable limits for occupational use, always adhere to the following guidelines:

- DO NOT operate the radio without a proper antenna attached, as this may damage the radio and may also cause you to exceed FCC RF exposure limits. A proper antenna is the antenna supplied with this radio by the manufacturer or an antenna specifically required to meet application requirements.
- DO NOT transmit for more than 50% of total radio use time (“50% duty cycle”). Transmitting more than 50% of the time can cause FCC RF exposure compliance requirements to be exceeded.

Electromagnetic Interference/Compatibility

During transmissions, the radio generates RF energy that can possibly cause interference with other devices or systems. To avoid such interference, turn off the radio in areas where signs are posted to do so. DO NOT operate the transmitter in areas that are sensitive to electromagnetic radiation such as hospitals, aircraft, and blasting sites.

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Record of Changes

Dates of issue for original and each revision of this document are:

<i>REVISION</i>	<i>DATE</i>	<i>TITLE OR BRIEF DESCRIPTION</i>	<i>ISSUED BY</i>
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LIST OF EFFECTIVE PAGES

This document is arranged in the following four (4) parts:

- 1 Document Cover
- 2 Warranty Statement
- 3 RF Exposure Statement
- 4 Record of Changes
- 5 Table of Contents
- 6 Document Main Text

NOTE: On document revisions, a vertical line in the outer margin of the page indicates the portion of the text affected by the revision. A vertical line in the outer margin of the Figure or Table name indicates changes to illustrations or tables.

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SECTION 1 INTRODUCTION

The STR-1800 series of UHF radio product represents a state-of-the-art communications line providing multi-mode, half-duplex audio to radio frequency (RF) transmit and receive functions. Consisting of multiple models, the series provides analog FM transceiver functions in the 400 to 470 MHz frequency bands. The design has been tailored towards narrowband data telemetry applications requiring fast transmit/receive response times with compact size and high reliability.

1.1 Scope

This manual describes the Summation Research, Incorporated STR-1800 series of Land Mobile Radios. The manual includes specifications, design description, installation, and operation instructions along with routine maintenance requirements for the STR-1800.

1.2 Product Description

The STR-1800 is a modified version of a standard Model IC-F6061 UHF radio product produced by ICOM. Future versions of this product may support VHF and extended UHF frequency bands. In order to make the product more applicable for data communications functions, the STR-1800 product line incorporates a custom front panel as depicted in the following picture.



Figure 1 *STR-1800 Multi-Mode Land Mobile Data Radio*

The custom front panel replaces the normal operator oriented local status/control interface and audio interface connector with a DB-25 connector targeted for computer control. The DB-25 provides both the audio interface and a selection capability for frequency select. A secondary connector provides for diagnostic and programming functions. These features are incorporated via a custom printed circuit board (PCB) located within the STR-1800 front panel known as a Front Panel Card (FPC). This card in-turn interfaces with an internal daughter card known as the Modem Card (MDC).

Figure 2 depicts a top level overview of the STR-1800 Radio.

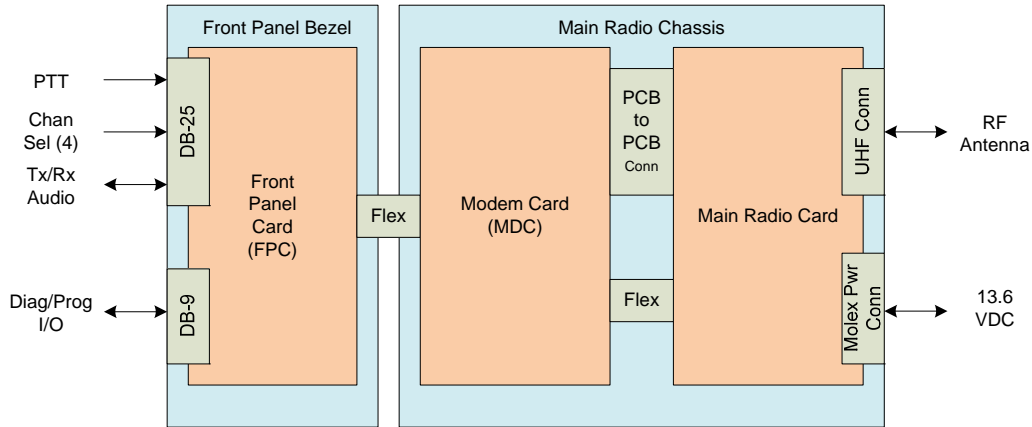


Figure 2 **System Overview**

1.3 Technical Specifications

The technical capabilities of the STR-1800 radios are summarized in the following table.

Table 1 Specifications

PARAMETER	SPECIFICATION
Frequency Range	STR-1820: 400-470 MHz Consult factory for future versions
Number of Channels	16 preset channels selected from 510 factory configured frequencies
Frequency Stability	$\pm 0.0005\%$ of assigned center frequency from -30°C to $+60^{\circ}\text{C}$ ($+25^{\circ}\text{C}$ reference)
Compliance	FCC type certified (FCC 47 CFR 90) as well as Industry Canada.
Operating Power	13.6 VDC $\pm 15\%$ (current @ 13.6 V: transmit 9 A, receive 0.7 A)
Operator Adjustments	None
Reliability	25,000 hr MBTF
Antenna Connector	UHF PL-259 type female located on rear panel
Audio Interface and Control Connector	DB-25 socket on front panel including 4 channel select lines, audio in/out, push-to-talk. Separate DB-9 socket for diagnostic and programming interface.
Power Connector	Tyco/AMP Electronics P/N 172129-1 (female housing with male contact pins)
Channel Spacing	Selectable to either 25 KHz or 12.5 KHz channel spacing. Hardware capable for future 6.25 KHz channel spacing.
RF Output Power	Selectable as 3 factory set discrete power levels from 0 and 30 watts ($\pm 2\%$) into a VSWR of 2:1 or better.
Output Impedance	50 ohms, nominal
Output Protection	Operating into a 10:1 VSWR of any phase angle without damage
Modulation	FM with a rated deviation of ± 5 KHz for 25 KHz channel spacing and ± 2.5 KHz for 12.5 KHz channel spacing.

Modulation Sensitivity	Radio achieves 80% (+/- 5%) of rated system deviation is for a 1 KHz input tone between 40mV RMS and 1V RMS.
Turn-On Time	Within 20 msec (of application of the keying signal, the transceiver reaches 90% of programmed output power and is capable of transmitting an on frequency signal with a SINAD of 30 dB or greater.
Spurious and Harmonic Output	-70 dB below rated power
Audio Input Impedance	1200 Ohm \pm 20%
Transmit Audio Frequency Response	Flat response over the 300-3000 Hz range with no pre-emphasis.
Minimum Duty Cycle	25% transmit duty cycle continuous. Capable of 15 s continuous keying
Output S/N Ratio	30 dB minimum fully modulated
Spurious Leakage	-57 dBm maximum
Selectivity	70 dB min @ 25 KHz channel spacing, 60 dB min. @ 12.5 KHz spacing
Intermodulation	65 dB minimum
Dynamic Range	With input signals ranging from -100 dBm to 0 dBm, the SINAD at the receiver is 23 dB minimum when receiving a signal modulated with a 1 KHz tone at 60% rated deviation
Sensitivity	12 dB SINAD minimum for input signal level of -116 dBm
Spurious and Image Rejection	70 dB minimum
Transmit to Receive Recovery Time	30 msec maximum measured from removal of keying signal to the transmitter
Audio Output	A 1 KHz signal at 80% rated deviation produces a 1 V p-p audio output into a 600 ohm resistive load.
Receive Frequency Response	Flat response over the 300-3000 Hz range with no de-emphasis.
Receiver Overload	A +28 dBm signal continuously for 30 minutes applied to the antenna input will not cause any permanent damage.
Dimensions	Approximately 1.8" high x 6.35" wide x 7" deep
Weight	4.5 pounds
Vibration	Per EN 50155 Railway Applications - Electronic Equipment Used on Rolling Stock
Shock	Per EN 50155 Railway Applications - Electronic Equipment Used on Rolling Stock
Temperature	-30°C to +60°C (operating and storage)
Humidity	Per EN 50155 Railway Applications - Electronic Equipment Used on Rolling Stock
Altitude	Sea level to 12,000 feet operating and 50,00 feet non-operating

1.4 Reference Documentation

The following documents, or the latest revision of these documents, serve as an addendum to this document. Users are referred to these documents for maintenance and design information pertaining to the standard ICOM radio circuitry.

Service Manual – UHF Transceivers – IC-F6061/6062/6063 © 2007 Icom Inc.)

SECTION 2 RECEIVING, INSPECTION AND INSTALLATION

2.1 Unloading and Unpacking

NOTE

If shipping carton is damaged upon receipt, request carriers agent be present during unpacking and inspection of the system.

Upon receipt of the equipment, inspect the shipping container for damage. If the container or the cushioning material is found damaged, they should be kept until the contents of the shipment have been verified for completeness and the equipment has been inspected for mechanical and electrical defects. If the contents are incomplete or if there is a mechanical or electrical defect, please notify:

SUMMATION RESEARCH, INCORPORATED
3950 Dow Road
Melbourne, Florida 32934

2.2 Receiving Documentation

Each STR-1800 radio is shipped with a packing slip. The packing slip should be carefully checked against the contents of the shipping container.

2.3 Installation and Connection Requirements

The STR-1800 has Six (6) connectors. These are:

- 1) Primary Power
- 2) Antenna
- 3) Audio/control
- 4) Programming/diagnostic
- 5) Unused Rear DB25
- 6) Unused Rear Phono Jack

After carefully reviewing the connector and signal descriptions below, the user should establish all connections, making sure that the primary power input is turned off at the source. Once all interconnections are in place, primary power may be applied.

2.4 Connector Descriptions and Signal Definitions

This section describes the types of connectors used on the STR-1800 and provides the definition of the signals associated with each.

2.4.1 Primary Power

The Primary Power connector is located on the rear of the STR-1800 and is attached to the unit itself via approximately 6 inches of 14 gage wire. Characteristics of this connector are as indicated in the following table.

Table 2 Primary Power Connector Characteristics

PARAMETER	VALUES
Part number	Tyco/AMP Electronics P/N 172129-1 Female housing with male contact pins
Pin Assignments	When viewing contacts as a T, top horizontal pin is +13.6 VDC while vertical descending pin is Ground
Input Voltage Range	13.6 VDC +/- 15%
Current Drain	9 Amps maximum
Connector to Radio Color Coding	13.6 VDC Contact – Red Ground Contact - Black

2.4.2 Antenna

The Antenna connector is located on the rear of the STR-1800 and is mounted directly to the main housing of the radio. Characteristics of this connector are as indicated in the following table.

Table 3 Antenna Port Connector Characteristics

PARAMETER	VALUES
Connector Type	UHF PL-259 Type Female
Antenna Impedance	50 Ohms
Maximum Output Power	45 Watts
Output Frequency Range	STR-1820: 400-470 MHz Consult factory for future versions

2.4.3 Audio/Control

The Audio/Control connector is located on the front of the STR-1800 and is mounted directly to the front panel mold of the radio. Characteristics of this connector are as indicated in the following table.

Table 4 *Audio/Control Connector Characteristics*

<u>PINS (+/-)</u>	<u>SIGNAL</u>
Connector Part Number	DB-25 Female
Mating (User Supplied) Connector Part Number	DB-25 Male

The following table defines the signal contents of all assigned pins on this connector

Table 5 *Audio/Control Connector Pin Assignments*

PIN	SIGNAL	DESCRIPTION AND CHARACTERISTICS
2	Audio Isolated Ground	Ground for the audio inputs/outputs of the radio
4	Receive Audio	Recovered audio signal output from the radio.
5	Channel Select 3	Control signal which when combined with Channel Select 0/1/2 forms a 4-bit binary channel selection control.
6	RXD+	Future RS485 digital interface
7	Push-to-Talk (PTT)	Places the radio into transmit mode when low (i.e., grounded) or receive mode when high or floating.
8	RXD-	Future RS485 digital interface
11	Audio Isolated Ground	Ground for the audio inputs/outputs of the radio
14	Channel Select 2	See pin 5 description above
17	Transmit Audio	Audio signal input to the radio when transmit operation is active.
18	Channel Select Lines Ground	Ground for the Channel Select 0/1/2/3 lines
19	Channel Select 0	See pin 5 description above
21	PTT Isolated Ground	Ground for the PTT signal
23	Channel Select 1	See pin 5 description above
24	TXD+	Future RS485 digital interface
25	TXD-	Future RS485 digital interface

Pins not listed within this table are all defined as no connects.

For the channel select lines described above, the following table defines the control functions of these inputs.

Table 6 *Channel Selection Control Settings*

FRONT PANEL 25 PIN D SIGNAL STATES				DEFINITION
CHANNEL SELECT 3	CHANNEL SELECT 2	CHANNEL SELECT 1	CHANNEL SELECT 0	
High	High	High	High	Select Chan 1
High	High	High	Low	Select Chan 2
High	High	Low	High	Select Chan 3
High	High	Low	Low	Select Chan 4
High	Low	High	High	Select Chan 5
High	Low	High	Low	Select Chan 6
High	Low	Low	High	Select Chan 7
High	Low	Low	Low	Select Chan 8
Low	High	High	High	Select Chan 9
Low	High	High	Low	Select Chan 10
Low	High	Low	High	Select Chan 11
Low	High	Low	Low	Select Chan 12
Low	Low	High	High	Select Chan 13
Low	Low	High	Low	Select Chan 14
Low	Low	Low	High	Select Chan 15
Low	Low	Low	Low	Select Chan 16

2.4.4 Diagnostic/Programming

The diagnostic/programming interface provides 3 different interfaces into the radio as follows:

- 1) RS-232 serial port interface for status/control and reprogramming of the modem processor contained on the MDC of the design.
- 2) USB universal serial bus interface for the same purpose to the MDC modem processor.
- 3) A full duplex interface with power to a remote front panel for the unit.

The pinouts associated with this connector are as follows:

Table 7 *Reference Input Connectors*

Pin	Signal	DESCRIPTION AND CHARACTERISTICS
1	RD (Input)	Data input to radio. RS-232 electrical levels.
2	Conn Key	A stubbed (i.e.; filled) pin location which prevents users from connecting a standard UART DB-9 cable into the radio.
3	TD (Output)	Data output from radio. RS-232 electrical levels.
4	RFPDO	Remote front panel data output. TTL electrical levels.
5	GND	Ground
6	USBD+	Universal serial data bus positive. USB electrical levels.
7	USBD-	Universal serial data bus negative. USB electrical levels.
8	RFPDI	Remote front panel data input. TTL electrical levels.
9	RFP+8 V	Remote front panel +8 Volt output. DC output power.

As identified in the section that follows this, these interfaces should only be used with cable assemblies provided by SRI.

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SECTION 3 OPERATION

Operation of the STR-1800 is accomplished by utilizing a special software program to configure the radio for the proper configuration and then connecting the system into the target platform for audio data transmission and reception.

The following sections describe the STR-1800 operations from the perspective of configuring the unit for the proper radio channel characteristics prior to final system installation.

3.1 Minimum System Requirements

This package requires a PC executing under the Windows XP or Windows 7 operating system.

3.2 Software Installation

The control software for the STR-1800 is provided as a standard installation program from the factory. Executing this program activates a standard windows software installation process with full instructions as to required user actions. The installation will create the program “STR1800.exe” in the specified install directory.

3.3 Conventions

The STR-1800 control software supports standard Windows type operation, including menu based selection processes. The STR-1800 control program utilizes Labview, a software package from National Instruments. The install directory also contains other support files associated with the run-time version capability required of Labview for the control program.

3.4 Getting Started

3.4.1 Radio Interconnect

Before taking any actions from the control program with an STR-1800 radio, the radio must be connected to a primary power source and to the PC via a special programming interface cable and adapter. The exact configuration and cable assembly number used varies based on the type of user.

Field users are limited to controlling channel specific information including frequency, transmit power level (Hi, Med, Lo), operational mode (V.23 analog or future), and channel bandwidth (currently 12.5 or 25 KHz). The configuration for these users is as shown below.

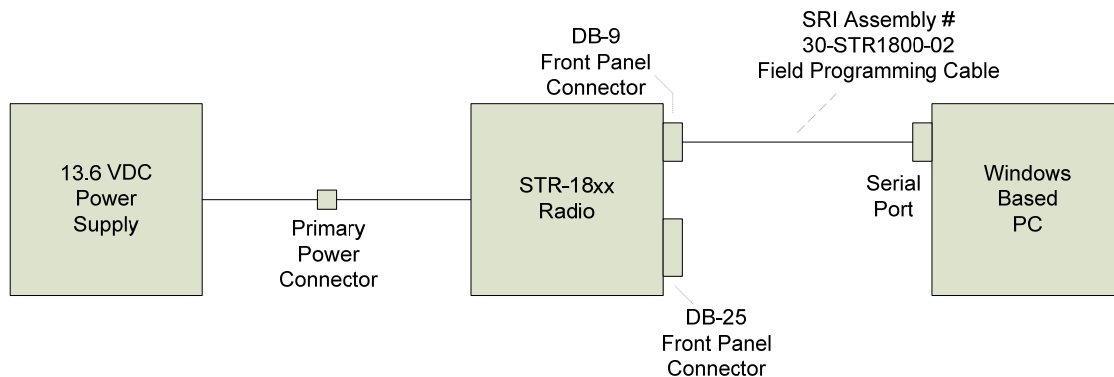


Figure 3 *Field Radio to PC Interconnect Configuration*

Factory users are allowed to control radio settings pertaining to output power level calibration. The following figure depicts this expanded configuration.

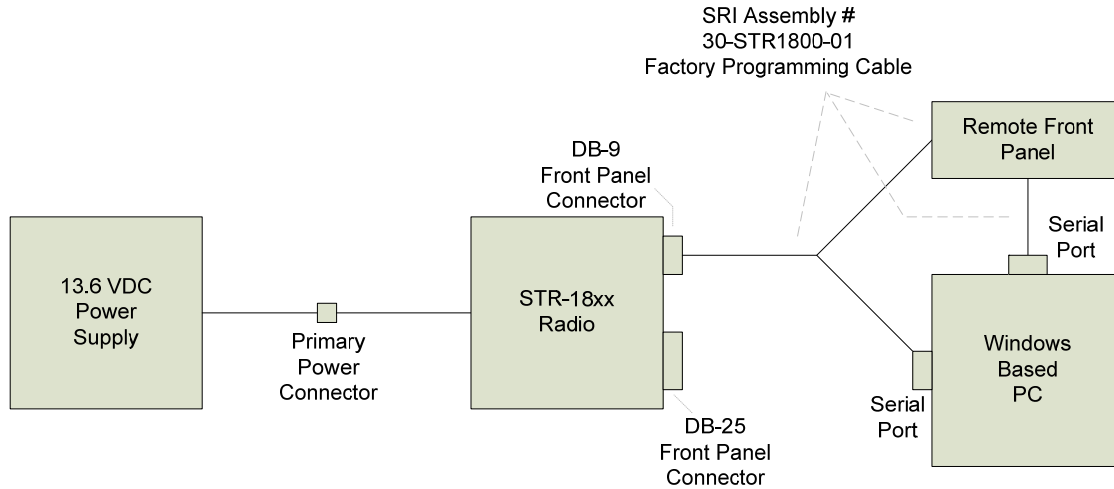


Figure 4 *Factory Radio to PC Interconnect Configuration*

For either mode, the 13.6 VDC power supply need only support the radio operation in a quiescent mode (i.e., < 0.7 A).

3.4.2. Power-on Sequence

Once the above configuration has been established, the primary power supply and PC should be powered on and initialized. The power up sequence of the radio versus the PC is not critical. However for the factory configuration the 30-STR-1800-01 cable assembly must be connected to the radio prior to powering on the radio. In this configuration the primary power will cause the remote front panel unit display to activate and display configuration information. No such indication is available on the field configuration

3.4.3. Reading the Radio Configuration

Assuming the above process is successful, the user can proceed to activate the *STR1800.exe* program. This will result in the following sample screen on the PC's monitor.

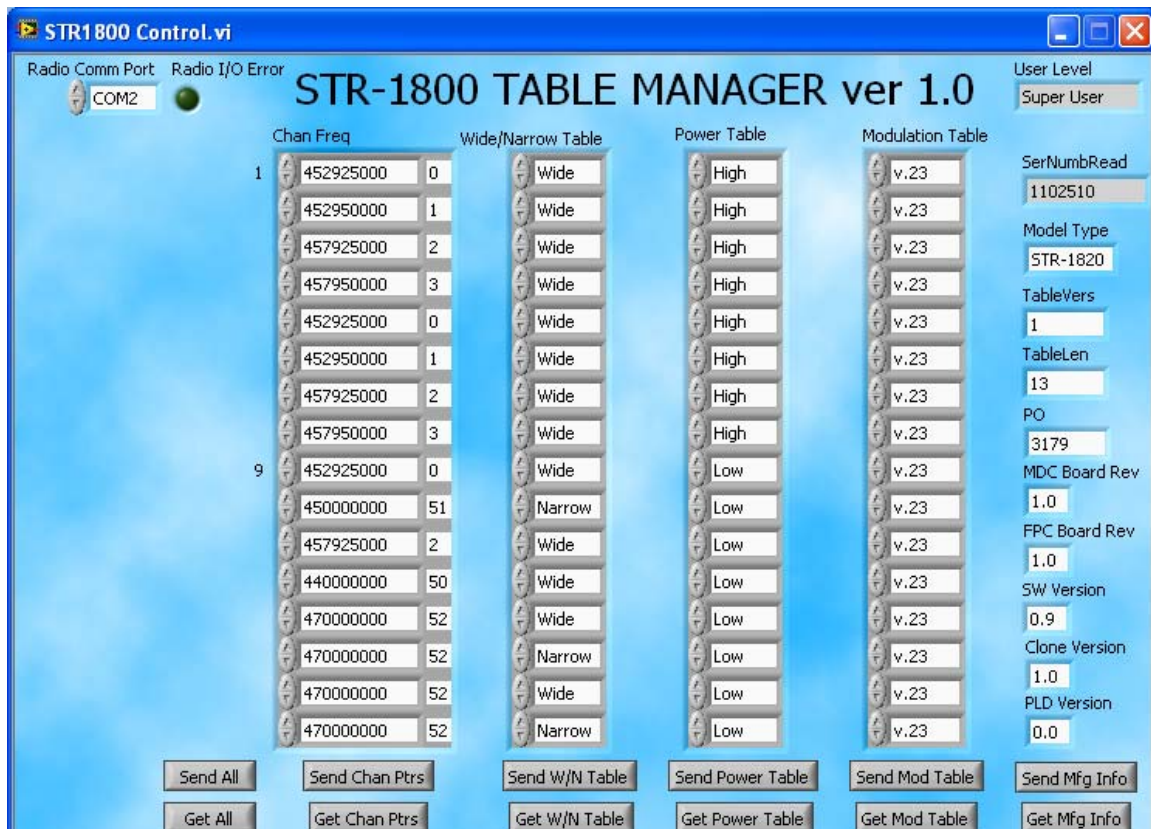


Figure 5 *Control Software Initial Screen*

If this is the first time the program is being utilized or if the operator has changed the PC's serial communications port being utilized, the first action taken by the user should be to establish the correct port selection. This can be accomplished by doing a menu selection from the "Radio Comm Port" selection.

After this action, the user may select "Get All". This will cause the software to interrogate the interconnected STR-1800 and then update the displayed fields. The Serial Number field should reflect the five (5) digit serial number from the product label on the STR-1800. The model number will indicate the specific model of the radio and the various version numbers will reflect the hardware and software versions of the radio.

The main part of the screen indicates the current settings for the sixteen (16) preset channel selections of the radio. This includes the channel frequency, bandwidth (i.e., wideband at 25 KHz or narrowband at 12.5 KHz) and output power level (i.e., "High" of 30 Watts, "Medium" (Undefined) or "Low" of 5 watts.).

3.4 Altering the Radio Configuration

3.5.1 Changing Individual Channel Settings

Once a radio has been read as described above, the channel configuration fields may be edited. The frequency field may be changed by selecting appropriate field and holding it to show a menu list of all available frequencies. Radios may be factory programmed for up to 512 frequencies. The frequencies of all defined items will be displayed when the field is selected. The bandwidth and power selections are toggle controls operate in a similar manner.

After establishing the changes to all channel settings, the user should select “Send All”. The system will again interrogate the radio as to its current settings, modify the channel configurations according to the edited fields, and then write the new configuration back to the radio.

By interrogating the radio again prior to modifying its settings, the software insures the correct configuration update even if a new radio has been connected to the PC since the last read radio action. As such, a user may establish a channel configuration and then write the data to multiple radios simply by connecting a new radio to the PC and invoking “Send All”. The fields on the screen will be updated each time this action is taken.

3.5.2 Saving/Restoring Channel Parameters

This capability of the control program will be added on a future release.

3.5.3 Power Output Control

This capability of the control program will be added on a future release.

3.6 *Radio Operation*

Having established the proper channel configuration for the radio, the STR-1800 is now ready for target platform installation. The following operational considerations should be noted:

- 1) Radios take up to 5 seconds to boot up.
- 2) Radios which are powered up with an active push-to-talk condition will not operate until the push-to-talk is removed and stay's in a non-active condition for a period of 2 seconds.
- 3) On initial power up or on any change of the frequency select lines into the radio, the target frequency setting may take up to 100 msec to obtain.
- 4) If push-to-talk is active at any time during the tuning period outlined in note 2 above, the tuning action will not complete until push-to-talk is removed and stay's in a non-active condition for a period of 2 seconds.
- 5) Radios which have a push-to-talk condition activated for more than 15 seconds will automatically shut down transmit operation and stay inactive until push-to-talk returns to a non-active condition for a period of 2 seconds.

SECTION 4 MAINTENANCE

In order to ensure that the STR-1800 system is always ready for operation, it should be checked periodically so that potential defects may be discovered and corrected before they develop into any serious damage or system failure. A minimal preventive maintenance program will significantly increase the systems life span.

This section describes the necessary preventive maintenance checks and tests the user can perform to easily identify most defects and problems. Any other defects or problems discovered during the normal operation of the system should be noted for future corrective measures.

CAUTION

Stop the operation of the system immediately if a problem is noted during normal operation which can otherwise damage the system.

This section also describes the corrective maintenance checks that can be performed on the STR-1800 system.

4.1 Maintenance Concept

The maintenance concept for the STR-1800 system is limited to the removal and replacement of the entire unit.

4.2 Preventive Maintenance Requirements

The following is a recommended timetable for performing preventive maintenance checks on the STR-1800.

CAUTION

Primary power to the radio must be turned OFF when performing preventive maintenance on the equipment

4.2.1 Inspection

The STR-1800 system should be inspected periodically for defects or physical damage developed during operation. Inspect all the interface cables to and from the system for cracks, breaks and proper seating with their mating connectors on the card. Inspect all cables for frayed, broken or damaged wires. In addition, inspect all STR-1800 connections for accumulation of dirt, grease, or any foreign material that can cause a non-connection. If a cable is found damaged or non-repairable, it should be replaced before operating the system again.

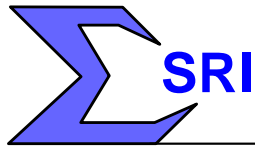
Inspection should be performed at least once every month. The frequency of inspection should be increased for units exposed to dusty or heavy particulate environments.

5.2.2 Cleaning

Clean the outside surfaces and areas around the connectors periodically. Clean the surfaces with a clean, soft, lint-free cloth. Clean the areas around the connectors with a soft bristle brush. To remove grease, fungus, or corrosion, use a cloth dampened with an appropriate electronics cleaning fluid. Cleaning should be done at least once every month. The frequency of cleaning should be increased for units exposed to dusty or heavy particulate environments.

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EMAIL TO: info@summationresearch.com

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