



# **ST-880 SkyLink™**

## **Remote Subscriber Unit**

Guide to  
Installation and Operation

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To assist us in providing the highest quality to our customers, please contact the factory if you encounter any deficiencies in our products or documentation.

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**SmarTrunk Systems, Inc., has a continuing objective to enhance our worldwide reputation as a supplier of products and services which meet or exceed customer requirements.**

**With personal commitment and pride in everything we do, all officers, managers, and employees will work together for continuous improvement in the processes and procedures which affect SmarTrunk product quality and customer service.**



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ST-880 SkyLink™ Remote Subscriber Unit

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# I

## INTRODUCTION

### INTRODUCTION

This document describes the installation, operation and alignment procedure for the ST-880 SkyLink™ Remote Subscriber Unit (RSU). The Model ST-880 RSU is designed to operate in the SkyLink Wireless Local Loop System.

To program the ST-880, you will need to order the 502-7101 Programming Kit, which consists of the following three items:

- ◆ A custom interface cable between a PC computer and the ST-880 (502-5900)
- ◆ Windows programming software (502-7108)
- ◆ The ST-880 Guide to Installation and Operation (502-7107)

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**SPECIFICATIONS****ST-880 Skylink Remote Subscriber Unit****GENERAL**

Transmit Frequency Range	806-825MHz
Receive Frequency Range	851-870MHz
Operating Mode	Full Duplex
Transmit/Receive Separation	45MHz
Channel Spacing	25KHz
Channel Spread	19MHz
Number of Channels	24
Channel Signalling	BPSK
Signalling Protocol	Proprietary, FDMA
Modulation Type	F3E
Deviation	+/-5KHz
RF Impedance	50 ohms
Frequency Stability	+/-2.5ppm
Temperature Range	-30°C to +60°C
Antenna Connector	Female SMA
Enclosure	7 <sup>1</sup> / <sub>4</sub> x 5 <sup>1</sup> / <sub>2</sub> x 1 <sup>1</sup> / <sub>2 (19.69cm x 13.97cm x 3.81cm)</sub>
RSU Programming	By Computer under Windows '95 or Windows 3.1
Compliance	FCC Part 15/90

**TELEPHONE INTERFACE**

Telephone Interface	Standard RJ-11 Jack which supplies talk battery to a standard telephone
Talk Battery	48 Volts
Ringer Equivalence	4.0 REN
Ringing Voltage	.90V at 20Hz

**TRANSMITTER**

RF Output	+28-30dbm
Spurious and Harmonic	-60db
Hum and Noise	-40db
Audio Distortion	<5%
Audio Response	300 to 3000Hz 6db pre-emphasis
Duty Cycle	100% Continuous

**RECEIVER**

Sensitivity	-112dbm
Selectivity	-65db
Spurious and Image Rejection	-70db
Intermodulation	-65db
Hum and Noise	-40db
Audio Distortion	<5%
Audio Response	300 to 3000Hz -6db de-emphasis
IF Frequencies	1st IF: 45.1MHz 2nd IF: 455KHz

*Specifications and descriptions subject to change without notice*

# 1

SECTION

## INSTALLATION

### Mounting

The ST-880 RSU should be mounted to an interior wall in a location that is close to an AC power outlet. In addition, in order to reduce RF signal losses, the RSU should be located such that the length of the feedline coax to the antenna is minimized.

### Power

The ST-880 RSU is powered by a small step down AC to AC wall plug-in transformer specified for your local power. Connect the wall plug-in transformer supplied with the RSU to the power connector on the RSU.

### Telephone Set

The ST-880 RSU uses a standard RJ-11 modular telephone jack. Connect your telephone equipment to this jack. The ST-880 RSU provides ringing voltage sufficient to ring up to four telephone devices.

If telephone audio level adjustments are required, refer to *Telephone Level Adjustments* which is located in the Service Alignment section, on page 4-1.

### Antenna

Several antenna options are available for the ST-880 RSU, depending on the distance from the SkyLink radio base station. If your installation uses the 3 dB glass mount antenna option, attach it to the SMA connector on the RSU so that the whip antenna is in a vertical position pointed up.

# 1

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If your installation uses a directional yagi antenna, mount the yagi antenna at a high location that is above any obstructions that might hinder the signal to the SkyLink base station. Point the yagi so that it is pointed directly at the base station (RS-HUB).

When using heavier, low loss cable (LMR 400 or 600), use a LMR240 jumper cable to connect between the main feedline and the RSU. In order to minimize signal loss, keep the feedline as short as possible.

## SUBSCRIBER OPERATION

# 2

SECTION

### SUBSCRIBER OPERATION

#### Making Calls

The ST-880 RSU with a telephone, FAX or modem operates just like a standard 'POTS' telephone. To initiate a telephone call, remove the telephone handset from the cradle, wait for a dial tone, and proceed to dial. To end a telephone call, replace the telephone handset back on the cradle.

If the SkyLink system is busy and cannot accept a call, the RSU will generate a busy signal to the user. The user should hang-up, and try the call again at a later time.

If the user has the Priority User option enabled, then user may optionally press the '#' key for about 1 second on the telephone (before hanging up) to activate this feature. A dial tone should then appear momentarily. The user may then proceed with dialing.

If the user has the Clear Channel Alert feature enabled, and the SkyLink system is not available for a call, the user must hang-up the telephone handset. When the SkyLink system is no longer busy, the telephone will generate one short ring to let the user know that a call may now be tried once again.

#### Receiving Calls

Incoming calls are handled just like a standard telephone. When the telephone rings, remove the telephone handset from the cradle, and begin to speak. Return the handset to the cradle when the call is completed.

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### 3 SECTION

## PROGRAMMING

### Computer Connection

The internal serial port (J3) is used for the programming and configuration of the RSU. The computer used to program the RSU must be an IBM compatible computer running Microsoft Windows 3.1 or higher.

To program the RSU, first remove the bottom cover from the RSU. Using the Programming Cable supplied with this manual, plug the six pin female connector into the Internal Serial Port connector on the RF PCB as shown in figure 4-1 on page 4-2. Connect the DB-25 connector on the other end of the programming cable to a serial port on your computer. Note which Serial Port (COM1, 2, 3 or 4) is being used. Apply power to the RSU using the wall plug-in transformer. The RSU is now ready to be programmed.

### Software Operation

The ST-880 RSU software has been designed to be easy to use and operate. This software conforms to generally accepted Windows operation. This section describes the functional aspects of the software. To load the program on your computer system, run the 'SETUP.exe' program on the installation disk and follow the on-line instructions.

To start the ST-880 RSU software, double click on the ST-880 RSU program icon in the SmarTrunk Systems Program Group, or make the selection from the Start Menu if you are using Windows 95.

## Main Screen

The main screen displays all the RSU programmed data. The upper section of the screen displays the RSU's Line 1 configuration, Line 2 configuration, and Global Options. The lower part of the screen displays the Radio Channel Data.

### **Line 1 (Line 2) Configuration**

The ST-880 RSU has two "virtual" phone lines which share a single RJ-11 modular telephone jack. Each virtual phone line has a unique subscriber ID number and can be programmed with a distinctive ringing sequence. This allows the user to have one published phone number for phone (voice) calls and a different number for fax (data) calls. **Line 1 can be used to receive a call and to place an outgoing call, but line 2 is receive only.**

There are three configuration options available for each line. The options are selected by clicking the button next to the option.

#### ♦ **User ID Numbers**

Note that the **User ID Numbers** are "read only" from the RSU and cannot be changed or reprogrammed. The User ID is a fixed six digit number that is pre-programmed at the factory. When reading data from an RSU, the unique User ID for the RSU will appear in the highlighted box.

#### ♦ **Ring Style**

The **Ring Style** option determines the ring cadence for each virtual phone line. There are three choices for each line: single ring, double ring, and triple ring. The dealer can program a distinctive ring for each virtual line to indicate which line is being called.

#### ♦ **Voice Encryption**

The **Voice Encryption** option activates an analog speech inversion voice scrambler. If this option is activated, all calls will use the voice scrambler. The encryption code for each line must correspond to the code setting in the base controllers. If the telephone is used for data or fax communications, this option should be turned off, so as to provide the least amount of channel distortion and highest data transfer rate.

**Global Options:**◆ **System Tone**

The **System Tone** is used as a channel busy indicator to the RSU. A connection to a voice channel will continue as long as the System Tone is present. The System Tone may be programmed from 0 to 6. However, the default value of '3' should always be used unless a co-channel user is already using the default value.

◆ **Priority User**

The **Priority User** option allows a user to initiate a telephone call even if the WLL system has no available voice channels. The WLL system accomplishes this by terminating a call from another user (who is not a Priority User), in order to free a voice channel for the priority user. If all channels are in use with Priority Users, when another Priority User tries to initiate a telephone call, that user will be denied access.

Note: A priority user can only disable a call if the strength of his transmitted signal is stronger than that of other users. Only special 'value added' users should have this feature enabled.

◆ **Clear Channel Alert**

If all voice channels are busy, the **Clear Channel Alert** option will briefly ring the telephone set to alert the user that a clear channel is now available for use. The user may then proceed to initiate a call. This is also a good feature for a 'value added service'.

**Radio Channel Data**

The Radio Channel Data contains all of the RF channels that are used in the WLL system. Only those channels that are used in the WLL system should be programmed. Begin with Channel 1, Channel 2, Channel 3, and so on, until all channels in your system are programmed. Do not skip any channel numbers as these channels will be ignored by the RSU.

When entering channel data, enter the Transmit or Receive frequency in the data field. The duplex channel will be automatically calculated, and the data will appear in the associated data field. The channel separation is 45Mhz, with the receive frequency 45Mhz above the transmit frequency. Any 25Khz standard 800Mhz channel in the SMR band may be entered. The 12.5Khz offset channels are also supported. Invalid frequencies entered will generate an error message. To disable any channel, set the channel frequency to '0'. An example of a valid transmit frequency is '815.5125'. The receive frequency is automatically calculated as '860.5125'.

#### **FILE MENU BAR**

The File Menu Bar contains operations for reading and writing data files, and for printing screen data. The file 'default.dat' contains the default data that is programmed into the RSU when it is received from the factory. This file can be opened, and the default data will appear on the screen. This file contains the standard options and three frequencies that can be used for testing.

Once all the option and channel data is entered for your WLL system, the data can be saved to a filename of your choice. This eliminates the need to re-enter the data for each RSU to be programmed. Be sure to always use the file extension of '.dat'.

Information displayed on the screen may also be printed by selecting 'File-Print' from the menu.

#### **OPERATIONS MENU BAR**

This menu item is used to read and write data to the RSU by way of the RS-232 connection. This menu is also used for entering Alignment & Test. To read data from the RSU memory, select 'Read RSU'. The data will be loaded and displayed on the screen. To write data to the RSU memory, select 'Write RSU' from the menu bar. The data shown on the screen will then be written to the non-volatile memory chip in the RSU. An error message will be displayed if there is a problem with the serial connection.

#### **CONFIGURATION MENU BAR**

This menu item is used for setting the communications serial port that will be connected to the RSU. Any valid communications serial port 1-4 may be selected. The selected port is indicated by a 'check mark'. Be sure to configure the correct serial port from this menu before attempting to communicate with the RSU, or an error message will be displayed.

#### **ABOUT MENU BAR**

This menu item provides information about this software program, and provides access to a help file.

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# 4

SECTION

### SERVICE ALIGNMENT

This section describes the complete alignment procedure for the ST-880 RSU. The RSU is fully tested and aligned at the factory. With the possible exception of the Mic Audio Gain and the Rx Audio Gain, no other field adjustments are necessary. These two adjustments are only required in cases where performance is to be optimized with special telephone equipment. When making these adjustments, be sure to use the actual telephone set, or telephone equipment that will be used in at the subscriber location. The RSU contains an RF PCB and a CPU PCB. Refer to the Parts Layout Diagram for the location of the various adjustments.

When testing the transmitter on the RSU, be sure a proper 50 ohm load is connected to the RSU antenna port. Operation of the transmitter without a proper load may damage the transmitter output stage of the RSU!

#### Telephone Level Adjustments

In most cases no RSU adjustments are required; however, if minor adjustments are required to telephone audio levels, remove the back cover and perform the following procedure, referring to figure 4-1 for the location of R91 and R37.

1. Listen to the audio in the handset. Adjust the Rx Audio Gain R91 on the CPU PCB for a comfortable listening level. Be careful not to adjust the level too high as this will cause distortion.
2. While speaking into the handset, adjust the Mic Audio Gain R37 on the CPU PCB for a comfortable level on the telephone side. Be careful not to adjust the level too high as this will cause distortion.

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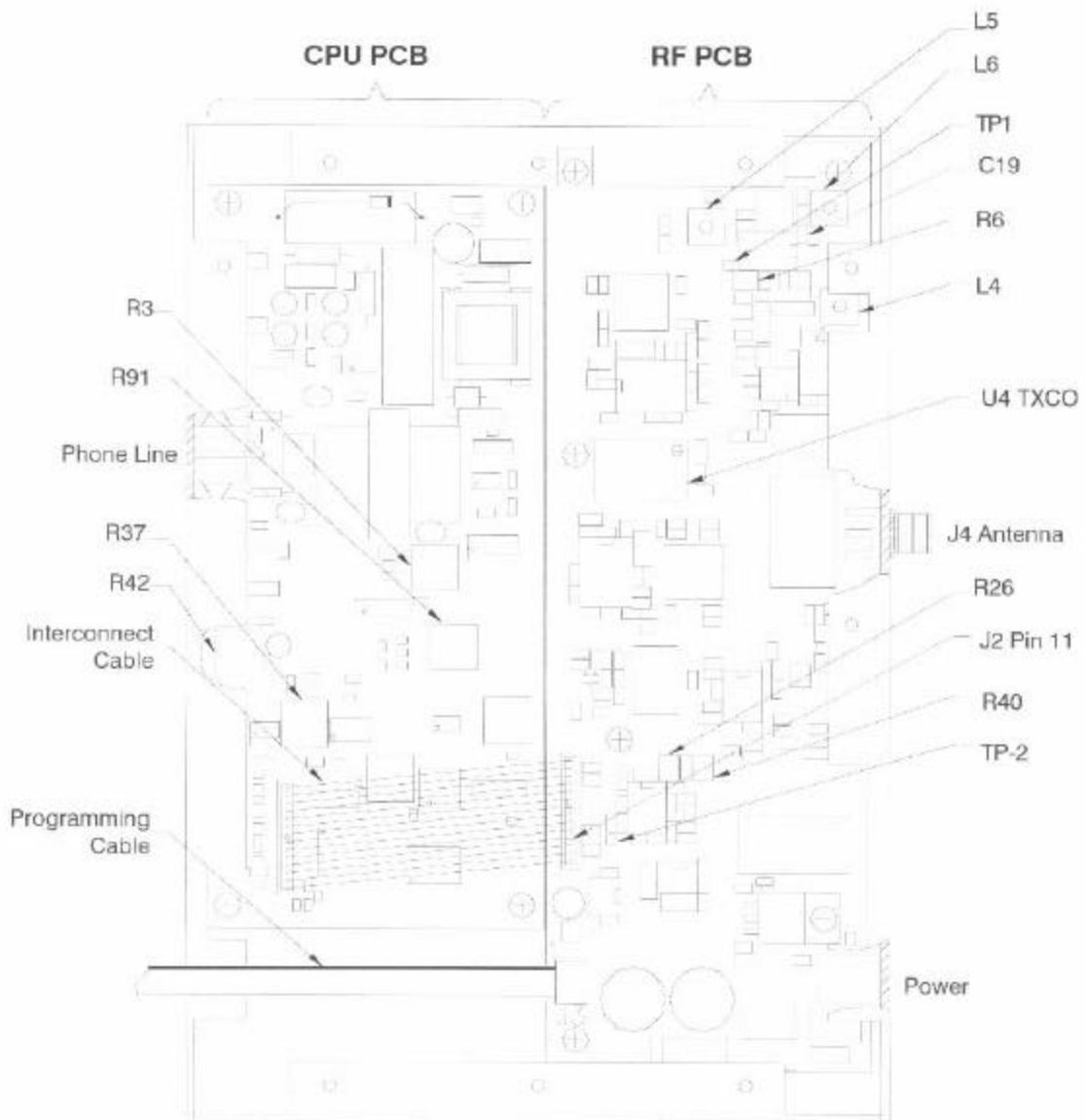


Figure 4-1

## Service Alignment Procedure

To begin the test procedure, first connect the RSU to the programming PC as described in the CONNECTIONS section of these instructions. Also connect a telephone set to the RJ-11 telephone jack. Start the ST-880 program by double clicking the program icon, or selecting the ST-880 program from the Start Menu if you are using Windows 95. Select the 'Operations-Alignment & Test' menu bar item. Click on the 'Establish Comm Link' button to verify a proper communications link with the RSU. Select one of the three RF channels available for testing. Then use the following procedure for testing and aligning the RSU:

### Receiver Adjustments

1. Using a frequency counter, adjust the 2nd IF oscillator frequency by placing a RF coupling probe (no direct connection) near C19 on the RF PCB. Adjust L6 for a frequency reading of 44.6450 MHz +/- 1hz.
2. Set an RF signal generator to the receive frequency. Connect the generator output to the antenna port on the RSU. Now generate a signal modulated with a 1Khz tone at a deviation level of 5Khz at a -90dbm signal level. Using an oscilloscope, probe the discriminator output on TP-1 on the RF PCB, and adjust the discriminator coil, L5, so that the recovered signal is 2 volts P-PK centered in the middle of the discriminator output range (4 volts P-PK).
3. While monitoring the discriminator output on TP-1, tune the 1st IF coil, L4, for minimum distortion. The signal level on TP-1 will now be 2 volts peak to peak.
4. Click on the Open RX Audio Path box using transmission line tester in Receiver Mode with a 600ohm load. Adjust the RX Gain, R91, on the CPU PCB. The signal level should be about -13dbm at maximum signal level.
5. Reduce the RF signal generator output to -110dbm. Click on the Set Squelch box. While listening to the audio in the telephone handset, adjust the Squelch Control, R6, on the RF PCB, so that the squelch just opens at the -110dbm signal level. Since there are no stops on the Squelch Control, do not adjust the Squelch Control more than 1/4 turn from its center adjustment. The Squelch Control should be very close to the center of its adjustment range. Click the Set Squelch box when finished.

## Transmitter Adjustments

1. Using a frequency counter with a RF coupling probe, place on top of U4 TCXO on the RF PCB. Adjust U4 TCXO for a frequency reading of 12.8Mhz +/- 1Hz.
2. Adjust the RF service monitor receiver to the transmit frequency. Click the Key Transmitter box to key up the transmitter on the selected frequency.
3. Adjust the Power Control, R40 on the RF PCB for an RF output level of +27.0 dbm (.5 watt).
4. AC couple a 300hz tone at 500mv to J2 Pin 11 on the RF PCB board, near U2. Then adjust the Maximum Deviation Control, R26 on the RF PCB for a maximum deviation of 4.8KHz.
5. Click on the Set Signaling Level box. Set the Deviation Adjustment, R42 on the CPU PCB for 3.0Khz of deviation. After the adjustment is complete, click again on the Set Signaling Level box.
6. Using a transmission line tester, set the tone for 1Kz at 0dbm and click on the Open Mic Audio box. Adjust the Mic Audio Gain, R37 on the CPU PCB for 2.0Khz of deviation. Click again on the Open Mic Audio box when finished.
7. With the telephone handset off-hook, click on the Set Hybrid Balance box. Adjust the Hybrid Adjustment, R3 on the CPU PCB for a minimum (null) amount of transmit deviation. This null provides maximum isolation between the transmit audio and the receive audio. Click again on the Set Hybrid Balance box when finished with the adjustment.
8. Unkey the transmitter when finished by clicking the Key Transmitter box.

This completes the Alignment & Test of the RSU. When finished with the Alignment & Test, press the 'Quit' button to exit this mode. The RSU may now be re-assembled.

