TS0520
Redundancy Switch
Installation and
Operations Manual

Version 2.00

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Disclaimer This manual has been thoroughly reviewed for accuracy, and every effort has been made to ensure that the information is accurate and complete. However, different versions of this product have different features and capabilities, and this manual reflects only one of those versions. Therefore, Teledesign Systems Inc. assumes no responsibility for errors, omissions or defects in this material, and shall not be liable for any damages resulting from their use.

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Emissions

FCC

Part 15 The TS4000s used with the TS0520 Redundancy Switch have been tested and found to comply with the limits for a Class B digital device, pursuant to Part15 of the FCC rules (Code of Federal Regulations 47CFR Part 15). Operation is subject to the condition that these devices do not cause harmful interference.

Part 90 The TS4000s used with the TS0520 Redundancy Switch have been type accepted for operation by the FCC in accordance with Part 90 of the FCC rules (47CFR Part 90). See the label on the units for the specific FCC ID and any other certification designations.

Part 101 The TS4000s used with the TS0520 Redundancy Switch have been type accepted for operation by the FCC in accordance with Part 101 of the FCC rules (47CFR Part 101). See the label on the units for the specific FCC ID and any other certification designations.

Industry Canada

ICES-003 The TS4000 Class B digital apparatus used with the TS0520 Redundancy Switch meets all requirements of the Canadian Interference-Causing Equipment Regulations.

RSS-119 The TS4000s used with the TS0520 Redundancy Switch have been certified for operation by Industry Canada in accordance with RSS-119 and RSS-210 of the Industry Canada rules. See the label on the units for the specific Industry Canada certification number and any other certification designations.

Notice

Changes or modifications not expressly approved by Teledesign Systems Inc. could void the user's authority to operate this equipment.

Shielded cable must be used with this equipment in order to ensure that it meets the emissions limits for which it was designed. It is the responsibility of the user to obtain and use good quality shielded cables with this device. Shielded cables are available from most retail and commercial suppliers of cables designed to work with radio equipment and personal computer peripherals.

Safety Warning

In order to ensure the safe operation of this radio equipment, the following practices should be observed.

- DO NOT operate radio equipment near electrical blasting caps or in an explosive atmosphere.
- DO NOT operate any radio transmitter unless all RF connectors are secure and any open connectors are properly terminated.
- DO NOT allow the antenna to come close to, or touch, the eyes, face, or any exposed body parts while the radio is transmitting.

Table of Contents

Introduction

The TS0520 redundancy switch provides automatic switchover from a primary TS4000 radio modem to a backup TS4000 radio modem in the event the primary radio modem fails. The redundancy switch can be setup to switch between just the two TS4000 radio modems, or can include switching between redundant power supplies, redundant RF amplifiers and redundant antenna systems. The TS0520 is designed to be rack mounted in a standard 19" EIA equipment rack and requires only 2U (3.5 inches) of vertical rack space.

Features

Main Features

- Automatic data and antenna port switchover from primary radio modem to backup radio modem if primary radio modem fails.
- Front panel selection of the primary (online) radio modem.
- Front panel display of each radio modem's receive, transmit, fault and online status.
- Redundancy switch power supplied through each radio modem. No separate power supply required.
- Remote selection of the online radio modem.
- Remote status of operate/fault condition of both the primary and backup radio modems.

Flexible Equipment Configurations

- TS4000 Power Supply Options
  - Single external power supply can power both radio modems.
  - Separate external power supplies can power individual radio modems. Redundancy switch detects power supply failure via the radio modem.
- Serial Port Connection Options
  - A common serial port connection can be automatically switched to the online radio modem.
  - Separate serial port connections can be fed directly to each radio modem.
- Antenna Connection Options
  - A common antenna can be automatically switched to the online radio modem. The offline radio modem's antenna port is terminated into a dummy load for offline testing.
  - Separate antennas can be connected directly to each radio modem.
- Redundant RF Power Amplifier Option
  - Separate RF amplifiers can be connected between each radio modem and the internal antenna transfer switch supporting a common antenna. Optional RF amplifier output monitoring kit will detect RF amplifier failure or high VSWR and automatically switch to the backup radio modem/amplifier pair.
  - Separate RF amplifiers can be connected between each radio modem and separate antennas. Optional RF amplifier output monitoring kit will detect RF amplifier failure or high VSWR and automatically switch to the backup radio modem/amplifier/antenna equipment.
- External RF Power Monitoring Option
  - External forward and reflected RF power detectors will fault on low forward power or high reflective power readings.
  - RF detectors can be used to monitor the output of each radio modem or RF amplifier.

Hardware Configurations

The TS0520 redundancy switch is supplied in eight different models. The models differ in the input supply voltage range and type of antenna connector supported. All TS0520 models include an N female antenna connector for the switched antenna port. Conversion kits are included with the BNC, TNC and SMA models to convert the antenna port connector and the antenna connectors on the TS4000s to the appropriate connector type. The items supplied with each model are shown in the following table.

Part Number	Voltage Range	Items Supplied
TS0520-12/N	9-18 VDC	1 TS0520-12/N Redundancy Switch 1 TS0060 Rack Mount Hardware Kit
TS0520-12/B	9-18 VDC	1 TS0520-12/N Redundancy Switch 1 TS0520 BNC Connector Conversion Kit 1 TS0060 Rack Mount Hardware Kit
TS0520-12/T	9-18 VDC	1 TS0520-12/N Redundancy Switch 1 TS0520 TNC Connector Conversion Kit 1 TS0060 Rack Mount Hardware Kit
TS0520-12/S	9-18 VDC	1 TS0520-12/N Redundancy Switch 1 TS0520 SMA Connector Conversion Kit 1 TS0060 Rack Mount Hardware Kit
TS0520-24/N	18-28 VDC	1 TS0520-24/N Redundancy Switch 1 TS0060 Rack Mount Hardware Kit
TS0520-24/B	18-28 VDC	1 TS0520-24/N Redundancy Switch 1 TS0520 BNC Connector Conversion Kit 1 TS0060 Rack Mount Hardware Kit
TS0520-24/T	18-28 VDC	1 TS0520-24/N Redundancy Switch 1 TS0520 TNC Connector Conversion Kit 1 TS0060 Rack Mount Hardware Kit
TS0520-24/S	18-28 VDC	1 TS0520-24/N Redundancy Switch 1 TS0520 SMA Connector Conversion Kit 1 TS0060 Rack Mount Hardware Kit

The TS0060 rack mount hardware kit provided with the TS0520 redundancy switch includes socket head screws for both 10-32 and 12-24 threaded EIA racks. The nylon washers supplied will fit on either screw size.

Each TS4000 radio modem installed on a TS0520 redundancy switch must be configured to work with the redundancy switch. The specific items that need to be setup are:

- Configure Data Port 2 of each radio modem to supply power to the redundancy switch.
- Upgrade the firmware of older versions of TS4000 radio modems to the newer firmware that supports redundancy switch operation.
- Configure each radio modem for redundancy switch operation.
- Set the packet addresses of the redundant radio modems if they will be operating in AirNet packet data mode.

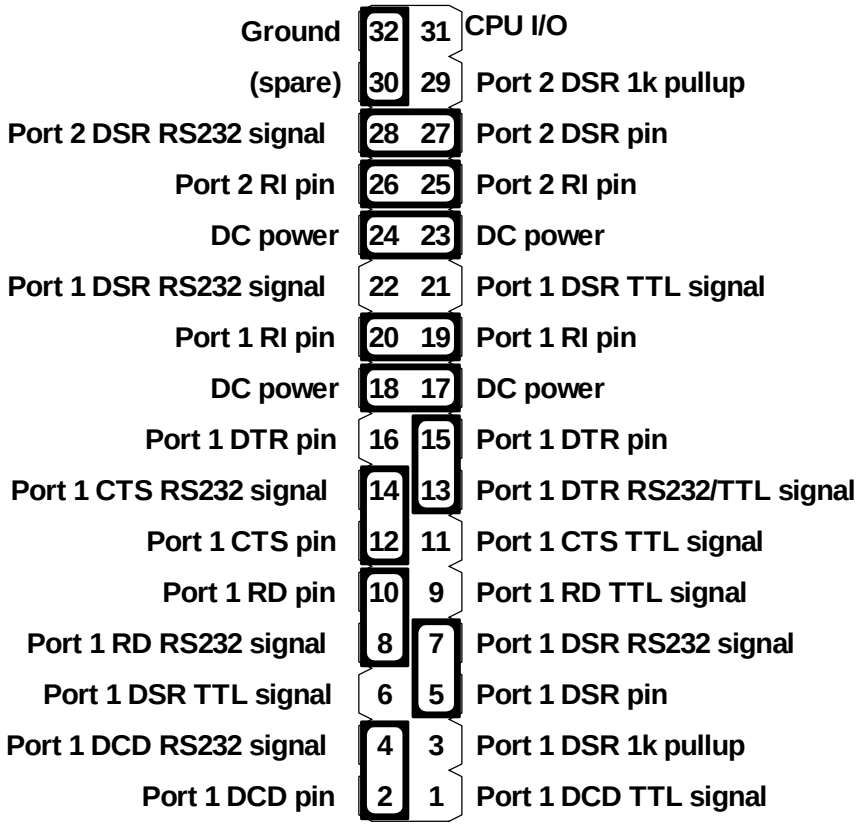
Follow the procedures below to prepare a TS4000 for use with the redundancy switch.

Enabling Power on Data Port 2

The redundancy switch is powered from the TS4000 radio modems installed on it. Jumpers inside the radio modem can be set to enable power on pin 9 of Data Port 2. The radio modem's JB1 jumper block lies between the J11 connector and Data Port 1 connector on the modem circuit board. With the J11 connector on the right side of the jumper block, the jumper block will be oriented as shown below with pin 1 located at the bottom right corner. The radio modem is shipped from the factory with eleven jumpers installed as shown in the diagram.

Factory Default Jumper Settings

TS4000 32-Pin JB1 Jumper Block



Jumper Configuration for Redundancy Switch Operation

Follow the instructions below to enable the TS4000 to supply modem power to the redundancy switch on pin 9 of Data Port 2.

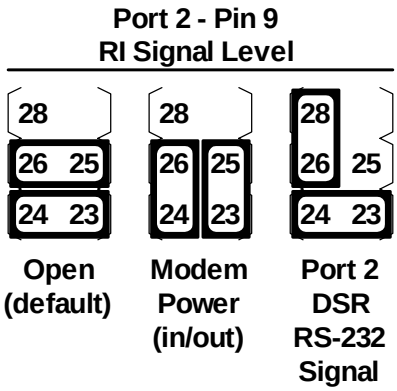
Tools Required

- 3/32” Hex Socket Driver or Allen Wrench.
- 3/16” Hex Nut Driver.
- Small (1/16” to 1/8” wide) Flat Blade Screw Driver.
- Small Needle-Nose Pliers or Medium Sized Tweezers.

Step by Step Instructions

Caution: This procedure must be performed on an Electro-Static Discharge (ESD) safe work surface to insure that the internal circuitry of the TS4000 radio modem is not damaged.

- Remove the four 4-40 x 3/8” hex socket head screws on the outside corners of the TS4000’s front face plate.
- Place the small flat blade screw driver between the front face plate and the case on the bottom of the radio modem near the Data Port 1 connector. Gently pry the front face plate away from the edge of the case until the front face plate and radio modem subassembly releases from the thermal pad at the rear of the case.
- Slide the radio modem subassembly completely out of the case.
- Remove the two 3/16” hex jack screws holding the Data Port 2 connector to the front face plate.
- Using the small flat blade screw driver, gently rock the 50 pin flex circuit connector out of the J11 connector on the modem circuit board. Rock the connector out of J11by placing the small flat blade screw driver under the brown end tabs of the connector and against the silver brackets on the sides of the modem circuit board. Apply pressure to gently lift up each end of the flex connector, alternating sides until the flex connector pops free of J11. **Do not pull on the flex circuit to remove the flex connector from J11 as this will damage the flex circuit**.
- Lift the body of the Data Port 2 connector up and on top of the radio module circuit board to move the flex circuit away from the JB1 jumper block. The jumper block lies between the J11 connector and Data Port 1 connector on the modem circuit board. With the J11 connector on the right side of the jumper block, the jumper block will be oriented as shown above with pin 1 located at the bottom right corner. Locate the jumpers across pins 23 and 24, and pins 25 and 26. Remove these two jumpers using the small needle-nose pliers or tweezers and reinstall the jumpers across pins 23 and 25, and pins 24 and 26, as shown below to enable modem power on pin 9 of Data Port 2.



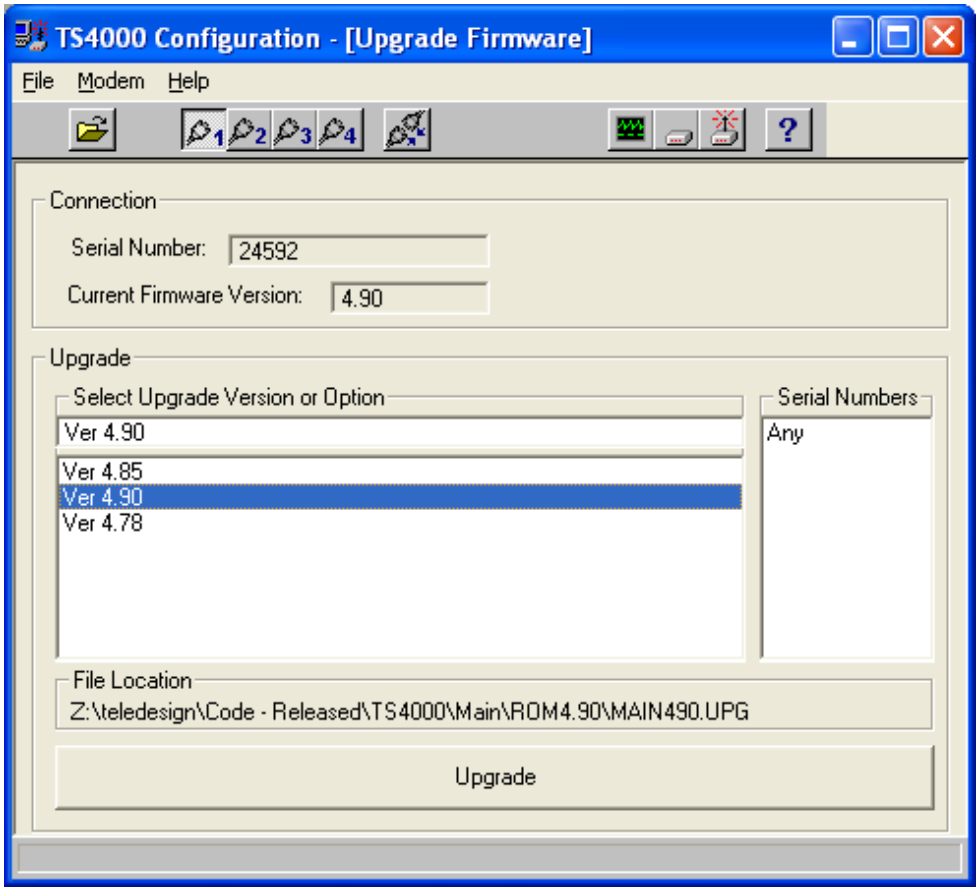
- Reinstall the 50 pin flex connector into connector J11. Use the small flat blade screw driver to alternately press on the end tabs of the flex connector to rock the connector into place.
- Reinstall the Data Port 2 connector into the front face plate using the two 3/16” hex jack screws. Center the connector in the face plate cut-out before tightening the screws.
- Align the sides of the modem circuit board with the extruded card guides on the inside of the radio modem case. Slide the radio modem subassembly back into the case. **Do not force the subassembly into its case, it should slide freely along the card guides**.
- Reinstall the four 4-40 x 3/8” hex socket head screws through the holes in the outside corners of the front face plate and tighten the screws securely into the radio modem case.

Upgrading Firmware

The radio modems installed in the redundancy switch must be running 4.90 or higher firmware to work correctly with the redundancy switch. Firmware is upgraded using the upgrade program included in the TS4000 configuration software. Follow the procedure below if the firmware version in the radio modems being installed on the redundancy switch is not 4.90 or higher.

- Connect the TS4000 to a COM port on a Windows compatible computer.
- Start the upgrade program on the computer by pressing the Upgrade Firmware button on the main screen of the configuration software.
- Select firmware version 4.90 or higher.
- If version 4.90 or higher is not displayed as a selectable version, use the Find File button (or menu) to manually search for the necessary file.
- Press the Connect to Modem button to connect the upgrade program to the TS4000.
- Press the Upgrade button and wait for the upgrade to complete.

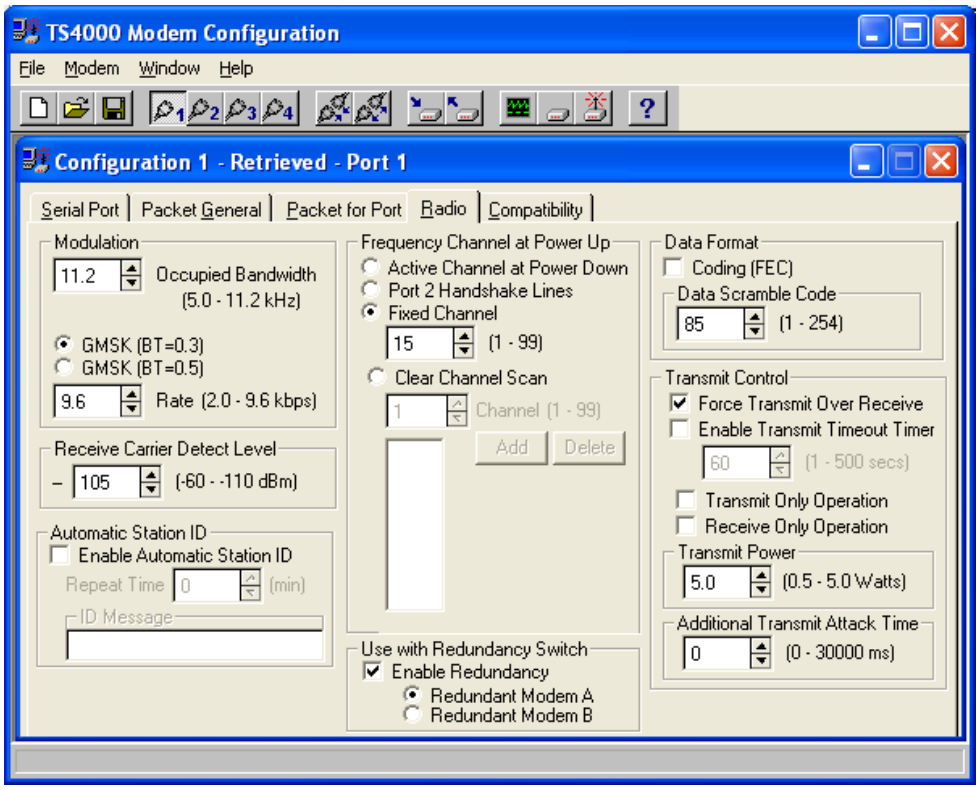
TS4000 Firmware Upgrade Menu



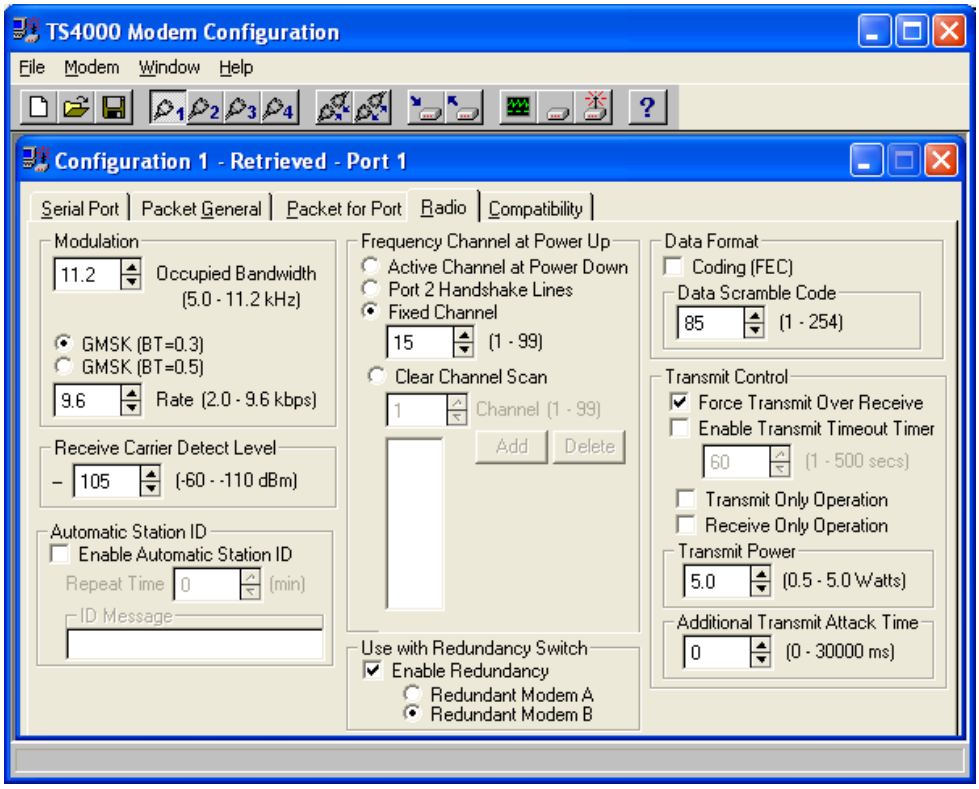
Enabling Redundancy Operation

For operation with the redundancy switch, the radio modem installed in the Modem A position must have the Enable Redundancy option checked and Redundant Modem A selected on the Radio tab of the Modem Configuration screens. The radio modem installed in the Modem B position must have the Enable Redundancy option checked and Redundant Modem B selected. Refer to the two diagrams below for the location of these selections.

TS4000 Modem A Configuration



TS4000 Modem B Configuration

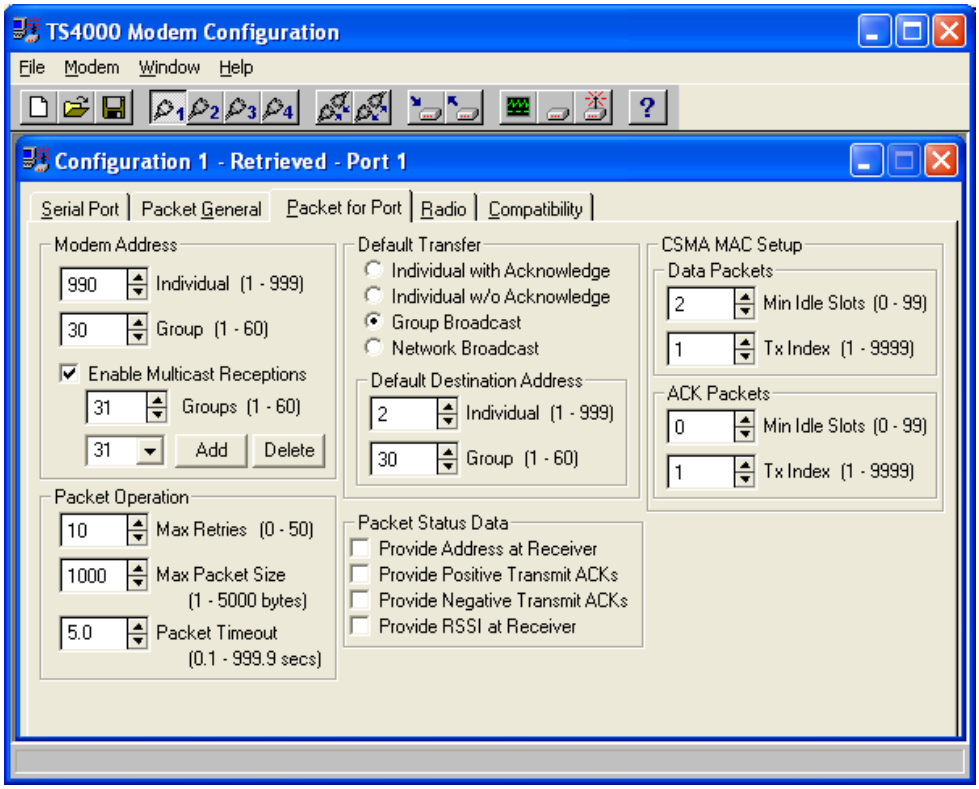


Configuring AirNet Packet Addresses

For redundant radio modems that are configured for AirNet packet data operation, the modem address of Modem A and Modem B must be set to the same group and individual address. In addition, the next higher individual address is used by the redundancy switch radio modems and must not be assigned to any other TS4000s in the radio network. Therefore, the highest individual address that can be assigned to a pair of redundant radio modems is 998.

The modem address for radio modems configured for AirNet operation is defined in the Modem Address “Individual” and “Group” fields in the upper left corner of the Packet for Port screen shown below.

AirNet Packet Address Screen



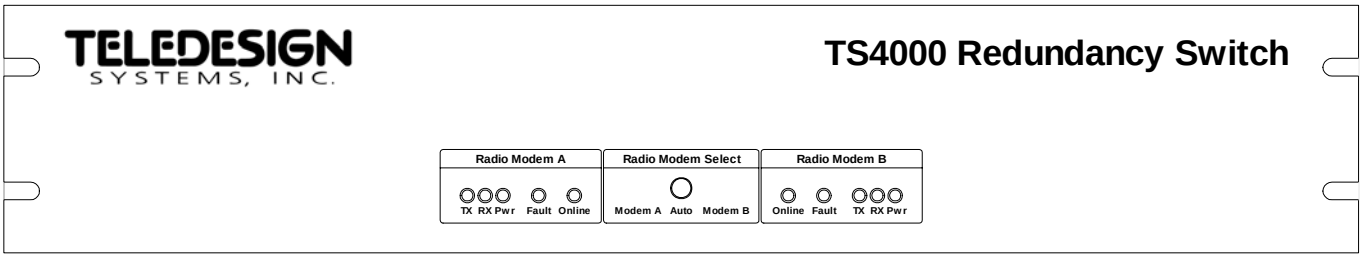
The TS0520 redundancy switch is designed to be installed in a standard 19” EIA equipment rack. The TS4000 radio modems are positioned within the redundancy switch to provide maximum natural air flow from below each radio modem to above each radio modem. This natural air flow should be adequate for most installations. If the redundancy switch is installed where the ambient air temperature is above 55 degrees centigrade, 1U (1.75”) of rack space should be free of equipment above and below the redundancy switch to increase air flow around the redundancy switch, or forced air cooling should be used within the equipment rack.

The redundancy switch is 3.5 inches (2U) high, 19 inches wide and 12 inches deep measured from the front tip of the Radio Modem Select switch selector to the back end of the J20 antenna connector. From the mounting surface of the equipment rack, a typical installation will require approximately 15 inches of depth into the rack to allow ample room for routing customer supplied cables installed on the switched data port, remote port and antenna connectors.

Caution: Installation of this equipment should be performed only by qualified personnel.

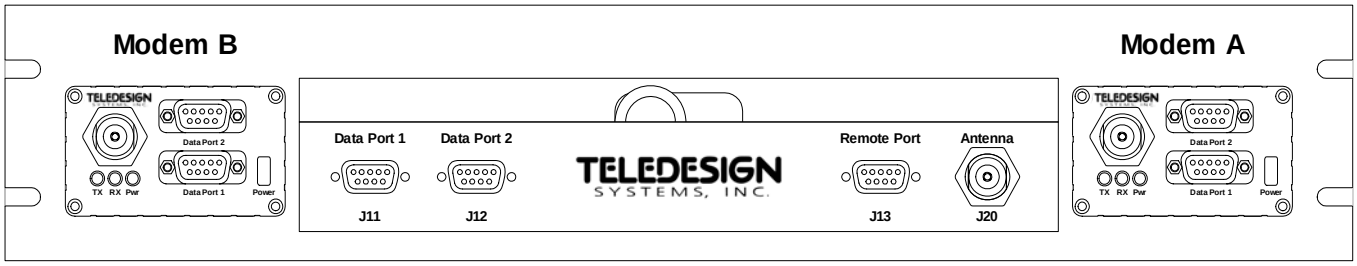
Front View

The front view of the TS0520 redundancy switch is shown below. All primary controls and status displays associated with operation of the redundancy switch are located on the front panel of the unit.



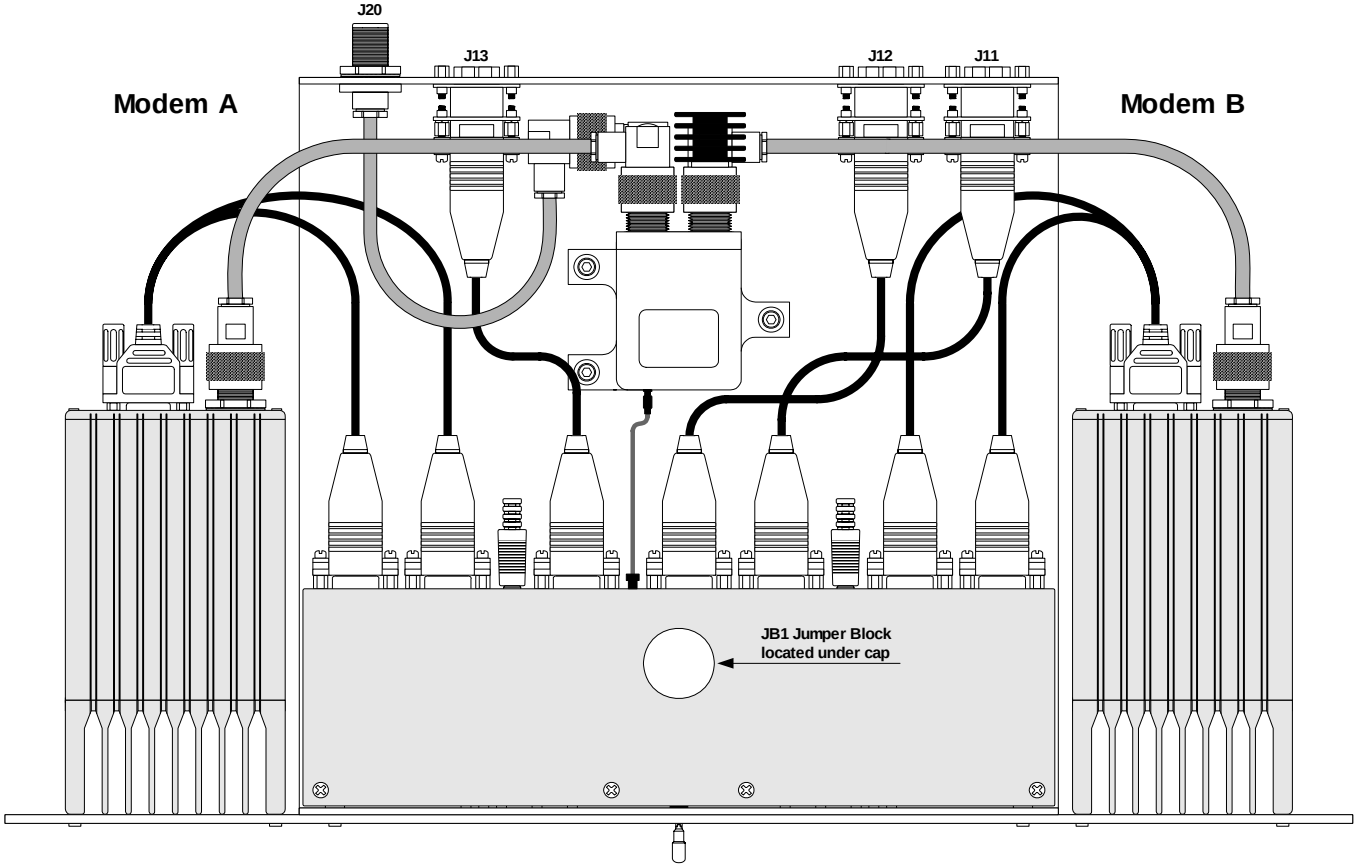
Rear View

The rear view of the TS0520 redundancy switch is shown below. This view is shown with the radio modem antenna and data port cables removed.



Top View

The top view of the basic TS0520 redundancy switch is shown below. EMI filters are integrated into connectors J11, J12 and J13 to suppress stray RF noise picked up in the customer supplied switched data port and remote port cables. Jumper block JB1 is located under the removable metal cap on the top of the redundancy switch control board cover plate.



Installation

Step by step instructions for installation of the TS0520 redundancy switch is provided below. The tools required to perform the installation are:

Tools Required

- 7/64” Hex Socket Driver or Allen Wrench.
- 5/32” Hex Socket Driver or Allen Wrench.
- Wire cutters to trim excess length of cable ties or straps used to dress the power, RF and data cables within the equipment rack.

Step by Step Instructions

Follow the instructions below to install the TS0520 redundancy switch into a customer supplied EIA equipment rack.

Warning

If you did not purchase a TS0520 redundancy switch with the radio modems pre-installed, the radio modems should be installed on the redundancy switch before the switch is installed in the equipment rack. Refer to the TS4000 Configuration section of this manual to pre-set the radio modems for use with the redundancy switch before proceeding with this installation.

Installing TS4000s on the Redundancy Switch

- Install the TS4000 radio modem pre-configured as Modem A on the left side of the redundancy switch using four 6-32 x 3/8" hex socket head screws supplied with the redundancy switch.
- Install the TS4000 radio modem pre-configured as Modem B on the right side of the redundancy switch using four 6-32 x 3/8" hex socket head screws supplied with the redundancy switch.
- Install the Data Port 1 cable onto Modem A. Hand tighten the thumbscrews on the cable connector to secure the connector in to place.
- Install the Data Port 2 cable onto Modem A. Hand tighten the thumbscrews on the cable connector to secure the connector in to place.
- Install the antenna cable onto Modem A. Use the BNC, TNC or SMA adapter supplied with the redundancy switch to convert Modem A's antenna connector to a female N connector to mate with the redundancy switch cable. Hand tighten the antenna connector(s) in to place.
- Install the Data Port 1 cable onto Modem B. Hand tighten the thumbscrews on the cable connector to secure the connector in to place.
- Install the Data Port 2 cable onto Modem B. Hand tighten the thumbscrews on the cable connector to secure the connector in to place.
- Install the antenna cable onto Modem B. Use the BNC, TNC or SMA adapter supplied with the redundancy switch to convert Modem B's antenna connector to a female N connector to mate with the redundancy switch cable. Hand tighten the antenna connector(s) in to place.

Installing the Redundancy Switch in Equipment Rack

- Install the TS0520 redundancy switch in an equipment rack using the TS0060 rack mount hardware kit supplied with the redundancy switch. Each TS0060 rack hardware kit includes socket head screws for both 10-32 and 12-24 threaded EIA racks. The nylon washers supplied will fit on either screw size.
- Install the TS0123M DC power cables from Modem A and Modem B to either a common power supply or separate (redundant) power supplies. Verify that the power supply is turned off before connecting the TS0123M power leads to the power supply terminals.
- Install customer supplied data, remote and RF cables on to connectors J11, J12, J13 and J20 as required. If necessary, use the BNC, TNC or SMA adapter supplied with the redundancy switch to convert the J20 female N connector to the appropriate connector type for connection to the antenna cable.
- If you purchased a TS009x series installation kit with your TS0520 redundancy switch, follow the instructions included with the kit to install the additional rack equipment, DC power cables, RF cables and serial data cables supplied.
- If you purchased a TS0520-RFMON/xxx series external RF power monitoring kit with your TS0520 redundancy switch, follow the instructions included with the kit to install the RF power sensors, RF cables and sensor telemetry cables supplied.
- Secure all power, RF and data cables using cable ties or straps (not supplied) to create a clean professional look for the installation.

Testing the Installation

After installation of the TS0520 redundancy switch, perform the tests below to verify that the cables are connected correctly, that power is being supplied to each component of the redundancy switch, and that the equipment can send and receive wireless data. If you purchased a TS009x series installation kit or TS0520-RFMON/xxx series external RF power monitoring kit with your

redundancy switch, follow the additional test procedures supplied with those kits to test the optional features provided.

- Turn on the power supply or power supplies supplying power to radio modem A and radio modem B.
- Verify that the green power light on radio modem A and radio modem B are illuminated.
- Verify that the Radio Modem A and Radio Modem B green power lights on the front panel of the redundancy switch are illuminated.
- Connect the COM port of a Windows compatible computer to connector J11 (switched Data Port 1) on the redundancy switch using a standard RS-232 cable.
- Place the Radio Modem Select switch on the front panel of the redundancy switch in the “Modem B” position. Using the TS4000 configuration software running on the Windows compatible computer, connect to radio modem B via the software and select the Diagnostic screen for display. Verify that the “Input Voltage” value shown on the Diagnostic screen reads approximately 0.3 volts below the supply voltage being supplied by the power supply connected to radio modem B.
- Place the Radio Modem Select switch on the front panel of the redundancy switch in the “Modem A” position. Using the TS4000 configuration software running on the Windows compatible computer, connect to radio modem A via the software and select the Diagnostic screen for display. Verify that the “Input Voltage” value shown on the Diagnostic screen reads approximately 0.3 volts below the supply voltage being supplied by the power supply connected to radio modem A.
- Place the Radio Modem Select switch on the front panel of the redundancy switch in the “Auto” position.
- Using the AirTest wireless data test software, verify that radio modem A and radio modem B can send and receive wireless data to and from other properly configured TS4000 radio modems. Refer to the Operation section of this manual for information on selecting the online radio modem.

The operation of the TS0520 redundancy switch is designed to be as simple as possible to maximize reliability of the redundancy switch itself. Once the redundancy switch is installed and verified to be working properly, it operates unattended and will automatically switch between two powered (Hot Standby) TS4000 radio modems.

Basic Operation

Each radio modem installed on the redundancy switch constantly performs internal and external tests to determine its ability to operate correctly. A status line fed from each radio modem to the redundancy switch tells the redundancy switch the operational status of the radio modems. The redundancy switch then selects on a first come, first selected basis which radio modem will be selected as the online radio modem. The online radio modem's data and antenna ports are passed through the redundancy switch to the data and antenna ports on the rear panel of the unit. If the online radio modem detects a fault condition, the redundancy switch will switch to the alternate radio modem.

Online Radio Modem

There are three ways a radio modem can be selected to be the online radio modem.

- Automatic selection by the redundancy switch control circuitry.
- Manual selection by the front panel Radio Modem Select switch.
- Remote selection via the rear panel remote control port.

Automatic selection is performed on a first come, first selected basis. The control circuitry in the redundancy switch monitors a fault status signal from each radio modem. The radio modem having the first status line to indicate that the radio modem is working correctly is selected as the online radio modem.

Manual selection of the online radio modem is controlled by the front panel Radio Modem Select switch. When this switch is moved from the "Auto" position to "Modem A" or "Modem B" positions, the corresponding radio modem is selected as the online radio modem.

Remote selection of the online radio modem is available through the Remote Port on the rear panel of the redundancy switch. Either radio modem can be selected as the online radio modem by a customer supplied external selection device or process controller such as a programmable logic device (PLC) or remote terminal unit (RTU).

Offline Radio Modem

The radio modem not selected as the online radio modem is set in an offline condition. The offline radio modem's data ports are put into an inactive state with the input lines pulled to ground. The offline radio modem's antenna port is connected to a 50 ohm RF termination capable of dissipating up to 5 watts. By connecting directly to Data Port 1 of the offline radio modem, some testing of the offline unit can be preformed while the online radio modem is operating normally in the radio network.

Failsafe Mode

In the event both radio modems detect a common failure such as a low supply voltage from a shared power supply or high VSWR from a common antenna,

Modem A will be enabled as the online radio modem and will operate as if it was selected as the online radio modem. In this mode of operation, neither Online status LED will illuminate as long as the Radio Modem Select switch is in the "Auto" position. The Failsafe mode allows the possibility of at least some communications to still occur by leaving a radio modem active instead of completely shutting down both radio modems.

Front Panel Controls

The front panel controls of the redundancy switch consist of a selector switch and LED indicators. The selector switch selects between automatic and manual selection of the online radio modem, and the LED status indicators display the current operating conditions of each radio modem.

Radio Modem Select Switch

The Radio Modem Select switch is a three position, locking actuator switch. The locking actuator feature minimizes accidental repositioning of the switch. To move the switch from one position to another, the actuator must first be pulled out away from the front panel, placed in the newly desired position, and then released.

The normal position for this switch is the "Auto" position. This position allows the redundancy switch to switch automatically between the radio modems when one of the radio modem fails.

The "Modem A" and "Modem B" positions force the selected radio modem to be the online radio modem independent of any fault conditions being detected by either radio modem.

For proper operation of the Modem Select inputs of the Remote Port, the Radio Modem Select switch should be in the "Auto" position.

Status LEDs

The redundancy switch has five LED indicators for Modem A and five LED indicators for Modem B that provide transmit (TX), receive (RX), power (Pwr), fault (Fault) and online (Online) status for each radio modem. The function of the transmit, receive and power LEDs on the redundancy switch are slightly different than the transmit, receive and power LEDs on the radio modem. The status indicated by the LEDs on the redundancy switch is:

Transmit Indicates when the radio modem is transmitting an RF signal.

Receive Indicates when the radio modem is detecting RF activity on the radio channel.

Power Indicates power is being supplied from the radio modem to the redundancy switch.

Fault Indicates the radio modem has detected a fault condition and should not be used as the online radio modem.

Online Indicates the radio modem has been selected as the online radio modem.

We at Teledesign Systems are committed to providing excellent service and support to our customers. Our goal is to make using our products as easy and painless as possible. To accomplish this Teledesign provides free technical support for all our products during all phases of sales, installation, and use.

Contacting Teledesign

Service and technical support can be reached during our normal business hours of 8 AM to 5 PM (Pacific Standard Time) Monday through Friday. Teledesign Systems can be reached at the following phone numbers.

(800) 663-3674 or (800) MODEMS-4 (USA & Canada)
(408) 941-1808
(408) 941-1818 (Fax)

We can reached by email at:
techsupport@teledesignsystems.com
productsales@teledesignsystems.com

We can be reached by mail at:
Teledesign Systems Inc.
1729 South Main Street
Milpitas, CA 95035
USA

In addition we have a web site which contains our latest product information and downloads:
www.teledesignsystems.com

Returning Equipment

Before returning equipment to Teledesign, please call for an RMA number and shipping information. This allows us to plan for your shipment in order to provide the best possible service. When returning equipment, please include a note indicating the symptoms of the failure and any other pertinent information.

Warranty

Two Year Warranty

Teledesign Systems Inc. warrants this product to be free from defects in materials and workmanship for a period of two (2) years from the date of shipment. During the warranty period, Teledesign Systems Inc. will, at its option, either repair of replace products that prove to be defective.

Exclusions

This warranty shall not apply to any defect, failure or damage caused by misuse, abuse, improper application, alteration, accident, disaster, negligence, use outside of the environmental specifications, improper or inadequate maintenance, or incorrect repair or servicing not performed or authorized by Teledesign Systems Inc.

Limitations

TELEDESIGN SYSTEMS INC. SHALL IN NO EVENT HAVE OBLIGATIONS OR LIABILITIES TO BUYER OR ANY OTHER PERSON FOR LOSS OF PROFITS, LOSS OF USE OR INCIDENTAL, SPECIAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT (INCLUDING NEGLIGENCE), STRICT LIABILITY, OR ANY OTHER THEORY OR FORM OF ACTION, EVEN IF TELEDESIGN SYSTEMS INC. HAS BEEN ADVISED OF THE POSSIBILITY THEREOF, ARISING OUT OF OR IN CONNECTION WITH THE SALE, DELIVERY, USE, REPAIR, OR PERFORMANCE OF THIS PRODUCT (INCLUDING EQUIPMENT, DOCUMENTATION AND SOFTWARE). IN NO EVENT SHALL THE LIABILITY OF TELEDESIGN SYSTEMS INC. ARISING IN CONNECTION WITH ANY PRODUCT EXCEED THE ACTUAL AMOUNT PAID FOR SUCH PRODUCT.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, WRITTEN OR ORAL, EXPRESSED OR IMPLIED, INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Serial Data Ports

The TS0520 redundancy switch provides two switched serial data ports, J11 and J12, on the rear panel of the redundancy switch that are connected to the online radio modem's Data Port 1 and Data Port 2 respectively.

Switched Data Port 1 (J11)

The Switched Data Port 1 J11 connector is a 9-pin female D connector located on the real panel of the redundancy switch. The signals on all nine pins of Data Port 1 of the online radio modem are passed through the redundancy switch to this connector. The signals on these lines conform to either RS-232 or TTL levels depending on the settings in the online radio modem.

Switched Data Port 1 Pin Assignments

Pin	Signal	Direction	Notes
1	Data Carrier Detect (DCD)	Output	
2	Receive Data (RD)	Output	
3	Transmit Data (TD)	Input	
4	Data Terminal Ready (DTR) (default TS4000 setting)	Input	[1]
	Modem Power (alternate TS4000 setting)	Input/ Output	
5	Signal Ground (SG)	--	
6	Data Set Ready (DSR) (default TS4000 setting)	Output	[2]
	Always in high state (alternate TS4000 setting)	Output	
7	Request to Send (RTS)	Input	
8	Clear to Send (CTS)	Output	
9	Not Connected (default TS4000 setting)	--	[3]
	Data Set Ready (DSR) (alternate TS4000 setting)	Output	
	Modem Power (alternate TS4000 setting)	Input/ Output	

Notes

[1] This pin is normally setup as the serial port Data Terminal Ready (DTR) line, which is an input for DCEs (input to the TS4000). As an alternative, this pin is jumper selectable in the TS4000 to feed DC power into or out of the radio modem. ***Caution: The use of the DTR pin for a DC power input or output connection is non-standard. Therefore the TS4000 serial port must not be connected to a standard serial device that drives the DTR pin (i.e. a PC).*** This results in the power supply voltage of the TS4000 being shorted to the DTR output of the host serial port, which could damage to the host device. Therefore, when connecting the TS4000 to a PC for configuration, make sure that the cable does not have a DTR (pin 4) connection.

[2] This pin is normally setup as the serial port Data Set Ready (DSR) line, which is an output for DCEs (output of the TS4000). As an alternative, this pin is jumper selectable in the TS4000 to always be in the active high state. In this case the pin is internally connected to +5VDC through a 1kΩ resistor.

[3] For standard RS-232 ports this pin is the Ring Indicator (RI) line, which is an output for DCEs (the TS4000). However, the TS4000 does not have an RI line internally. Instead, this pin can be jumper selected in the TS4000 to be the serial port Data Set Ready (DSR) line which is an output for DCEs (output of the TS4000), or this pin can be selected to provide DC power into or out of the TS4000.

The use of this pin as a power pin is non-standard and therefore care should be taken when connecting J11 to standard serial devices. For most serial ports this is not a problem because RI is a terminal device (DTE) input and the TS4000 power supply mostly falls within the allowed voltage range for RS-232 signals. Therefore the voltage on this pin is interpreted as an active RI signal. For systems that use the RI signal differently, or that cannot operate with power on this pin, this pin should be disconnected between the TS0520 and the host equipment.

Switched Data Port 2 (J12)

The Switched Data Port 2 J12 connector is a 9-pin female D connector located on the real panel of the redundancy switch. The signals on pins 2, 3 and 5 of Data Port 2 of the online radio modem are passed through the redundancy switch to this connector. The signals on pins 1, 6 and 8 of this connector are forced to an active high RS-232 state to facilitate connection of this port to a data terminal device (DTE). The signals on pins 7 and 9 of this connector are jumper selectable within the TS0520 redundancy switch as shown below.

Switched Data Port 2 Pin Assignments

Pin	Signal	Direction	Notes
1	Data Carrier Detect (DCD)	Output	[1]
2	Receive Data (RD)	Output	
3	Transmit Data (TD)	Input	
4	(not used)	--	[2]
5	Signal Ground (SG)	--	
6	Data Set Ready (DSR)	Output	[1]
7	Not Connected (default TS0520 setting)	--	[3]
	Request to Send (RTS) (alternate TS0520 setting)	Input	
8	Clear to Send (CTS)	Output	[1]
9	Not Connected (default TS0520 setting)	--	[4]
	Modem Power Out (alternate TS0520 setting)	Output	

Notes

[1] This pin is pulled high through a 4.7kΩ resistor to the modem power of the online radio modem.

[2] This pin is not used. It is not connected internally in the TS0520 redundancy switch.

[3] This pin is normally not used. This pin can be connected to the request to send (RTS) input to the online radio modem.

[4] For standard RS-232 ports this pin is the Ring Indicator (RI) line, which is an output for DCEs (the TS4000). However, the TS4000 does not have an RI line internally. Instead, this pin can be jumper selected in the TS0520 to supply modem power out of this pin to power to auxiliary interface equipment. The use of this pin as a power pin is non-standard and therefore care should be taken when connecting J12 to standard serial devices. For most serial ports this is not a problem because RI is a terminal device (DTE) input and the TS4000 power supply mostly falls within the allowed voltage range for RS-232 signals. Therefore the voltage on this pin is interpreted as an active RI signal. For systems that use the RI signal differently, or that cannot operate with power on this pin, this pin should be disconnected between the TS0520 and the host equipment.

Switched Data Port Signal Levels

The signal levels for Data Port 2 are hardwired inside the TS4000 for RS-232 levels. The signal levels for Data Port 1 are jumper selectable in the TS4000 for either RS-232 or TTL signal levels. Please reference the TS4000 Radio Modem User's Manual for details on setting these jumpers.

RS-232 Signal Levels (Data Ports 1 and 2)

The RS-232 standard defines minimum and maximum voltage levels for the drivers and receivers. However, in practice the drivers and receivers work correctly with signal levels that are different from the specification.

	Level (volts DC)	
Type	**Low**	**High**
Drivers (into a 3kΩ to 7kΩ load)		
RS-232 Specification	-15 to -5	+5 to +15
Actual TS4000 Drive Levels	-9 to -6	+6 to +9
Receivers (with 3kΩ to 7kΩ load)		
RS-232 Specification	-25 to -3	+3 to +25
Actual TS4000 Receive Levels	-25 to +0.8	+2.4 to +25

TTL Signal Levels (Data Port 1 only)

	Level (volts DC)	
Type	**Low**	**High**
Output (Driver)	0.0 to +0.4 (sinking up to 4 mA)	+3.0 to +5.0 (sourcing up to 4 mA)
Input (Receiver)	-25 to +0.8 (3kΩ to 7kΩ load)	+2.4 to +25

Signal Polarity

The signal polarity is the same for both RS-232 and TTL operation.

Level	State
Voltage Low	Mark Control signal inactive Stop bit state (end of async character) Logic one data bit state (within async character)
Voltage High	Space Control signal active Start bit state (beginning of async character) Logic zero data bit state (within async character)

General RS-232 Serial Data Port Information

The EIA (Electronic Industries Association) RS-232C standard is a standard for short distance (less than 50 feet) serial communications. The standard defines the electrical signal levels, interface characteristics and the operation of the control signals (handshake lines). Although the standard defines the operation of the handshake lines, there is significant variation in the way these signals are used by different equipment.

Connectors

The RS-232 standard does not require the use of a specific connector. However, most asynchronous RS-232 serial ports use either a 9 pin or 25 pin subminiature

D connector. The same signals are provided with both connectors, but the pinouts are different.

DCE verses DTE Equipment

RS-232 serial ports come in two varieties - DCE (Data Communication Equipment) and DTE (Data Terminal Equipment). This defines the direction of the serial port's lines (driven or received). It also typically defines the polarity of the connector. DCEs typically use female pin connectors and DTEs typically use male pin connectors.

Connecting a DCE port to a DTE is the most common setup and requires a standard straight through cable (i.e. pin 1 to pin 1, pin 2 to pin 2, etc.). When connecting two DCEs or two DTEs together a null modem cable is required. The purpose of a null modem cable is to cross connect the appropriate signals. However, null modem cables are not all the same and therefore it is important to verify that a specific cable is appropriate for a specific application.

Asynchronous Data

The TS4000 is designed to work with asynchronous serial ports. Asynchronous ports do not use clocks or timing signals to synchronize data transfers. Instead data is framed into asynchronous characters which the ports synchronize to.

An asynchronous character consists of a start bit, data bits and stop bits. The start bit indicates the beginning of a character. The number of data bits varies, but is typically between 7 and 9 bits. The data bits sometimes include a parity bit that provides error check information with each character. The number of stop bits also varies but is typically 1 or 2 bits.

Flow Control

Flow control is the method for controlling the flow of data between the DCE and DTE. Flow control is used to prevent the DTE and DCE data receive buffers from overflowing. There are several different methods used for flow control and as with everything related to RS-232 there is no one standard. The two main variations of flow control are hardware flow control that utilizes the RS-232 handshake lines and software flow control that utilizes characters sent along with the normal data.

Hardware Flow Control

Hardware flow control typically uses two control lines, one for each direction of data. When a port activates its flow control signal it is indicating its readiness to receive data. Deactivating the flow control signal indicates that the port can no longer receive data because its buffer is full or close to full.

The most common form of hardware flow control, and the one used by most full duplex wired (as opposed to wireless) modems, is RTS/CTS. With RTS/CTS flow control, RTS provides flow control for the DTE and CTS provides flow control for the DCE. One problem with RTS/CTS flow control is that for many half duplex modems (most wireless modems) the RTS signal is used to frame transmit data going from the DTE to the DCE. This use of RTS conflicts with using RTS for flow control of data to the DTE.

An alternative form of hardware flow control is DTR/DSR. With DTR/DSR flow control, DTR provides the flow control for the DTE and DSR provides the flow control for the DCE.

Software Flow Control

Software flow control uses characters sent over the data lines to control data flow. These characters are sent along with the normal flow of data between the DTE and DCE. There is typically one character that is used to stop the flow of data and a different character to restart data flow. Software flow control can use any characters to start and stop flow. However the most common characters used are the ASCII XON (starts flow) and XOFF (stops flow) characters. Because these are the most common characters used, software flow control is

often referred to as XON/XOFF flow control. The ASCII XON character is the decimal character 17 (0x11 hex) and is also known as DC1 or Ctrl-Q. The ASCII XOFF character is the decimal character 19 (0x13 hex) and is also known as DC3 or Ctrl-S.

A problem with software flow control is that the normal data passed over the communications link cannot include the flow control characters. If it does, the flow of data will be incorrectly stopped or started. This limits the characters that can be used by the host application and also prevents the sending of binary (all character numbers) data.

RS-232 Serial Port Pinout

	Signal	Connector Pinout		Direction	
Signal Name	**Mnemonic**	**9 Pin**	**25 Pin**	**DCE**	**DTE**
Signal Ground	SG	5	1, 7	--	--
Transmit Data	TD	3	2	Input	Output
Receive Data	RD	2	3	Output	Input
Request to Send	RTS	7	4	Input	Output
Clear to Send	CTS	8	5	Output	Input
Data Carrier Detect	DCD	1	8	Output	Input
Ring Indicator	RI	9	22	Output	Input
Data Set Ready	DSR	6	6	Output	Input
Data Terminal Ready	DTR	4	20	Input	Output

Standard Usage of the RS-232 Control Signals

Signal	Description
Request to Send (RTS)	Request for transmission from the DTE.
Clear to Send (CTS)	Response (to the Request to Send) from the DCE indicating a readiness to transmit data.
Data Carrier Detect (DCD)	Status from the DCE indicating that it is receiving.
Ring Indicator (RI)	Status from the DCE indicating that it has detected the ring state.
Data Set Ready (DSR)	Status from the DCE indicating that it is operational.
Data Terminal Ready (DTR)	Status from the DTE indicating that it is operational.

Remote Port

The TS0520 redundancy switch provides connections to remotely detect and display the fault status of each radio modem and remotely select the online radio modem.

Remote Port (J13)

The Remote Port J13 connector is a 9-pin female D connector located on the rear panel of the redundancy switch. The pin assignments for this connector are:

Remote Port Pin Assignments

Pin	Signal	Direction
1	Modem A Fault Normally Open	Output
2	Modem A Fault Common	Output
3	Modem A Fault Normally Closed	Output
4	Modem A Select	input
5	Ground	--
6	Modem B Fault Normally Open	Output
7	Modem B Fault Common	Output
8	Modem B Fault Normally Closed	Output
9	Modem B Select	Input

Remote Modem Fault Status

The fault or ready to operate status of each radio modem can be determined using the normally open, common and normally closed contacts of each radio modem's fault status relay. A low impedance between the normally open and common contacts indicates the radio modem is operational and can be used as the online radio modem. A high impedance or open between the normally open and common contacts indicates the radio modem has detected a fault condition and should not be used as the online radio modem.

Remote Online Modem Select

The radio modem select inputs allow either radio modem to be remotely selected as the online radio modem when the front panel Radio Modem Select switch is in the "Auto" position. These control lines override the automatic selection circuitry in the TS0520 redundancy switch. The online selection produced by these control lines is forced even if the radio modem being selected has detected a fault condition. Either radio modem can be forced to be the online radio modem as long as at least one radio modem is supplying power to the redundancy switch.

Remote Port Signal Levels

The signal levels for remote modem fault status outputs and online modem select inputs are defined below. Care must be taken to maintain these lines within the limits specified.

Radio Modem Fault Signal Levels

The Modem Fault output lines are controlled by a Form C relay. The contact ratings of the relays are specified below.

Type	Contact Rating – Volts / Amperes
Form C Relay	
AC Load Rating (switching)	60V maximum at 0.25 amperes maximum
DC Load Rating (switching)	100V maximum at 0.5 amperes maximum

Radio Modem Select Signal Levels

The Modem Select input lines are designed to be pulled to ground (pin 5 of the Remote Port connector) to activate the selection. Maximum impedance from the input pin to ground to activate the selection is 4.3kΩ. The input can be driven from a voltage source as long as the control voltage is within the limits shown below.

	Level - Volts DC	
Type	**Radio Modem Selected**	**Radio Modem Not Selected**
Input (internal 47kΩ pullup to +4.7VDC)	-25 to +0.4	+2.4 to +25

Appendix C - Specifications

Electrical

General	Operating Modes	Hot Standby with Automatic Switchover and Cold Standby with Manual Switchover
	Redundant I/O Interfaces	Switched Data Port 1 Switched Data Port 2 Switched Antenna Port Remote Control/Status Port
	System Compatibility	Compatible with all TS4000 radio modem networks
Serial Data Interface	Data Format	Asynchronous, 7 or 8 bit characters, Odd, Even or No Parity
	Signal Levels	RS-232 (Data Ports 1 and 2), RS-485 or TTL (Data Port 1)
	Handshake Protocols	Data Activation (3 wire): requires only TD, RD and ground Full Handshake: supports RTS, CTS, DCD, DSR and DTR
	Handshake Line Control	All standard TS4000 configurations
System Diagnostics	Internally Monitored Levels	Supply Voltages, Temperature, Transmit Power and Data Processing Metrics
	Data Network Measurements	Outbound/Inbound Bit Error Rates between master and remote nodes using AirTest test software
Interface Connections	Data Port 1 and 2 Connectors	DE-9, female, DCE configuration
	Remote Port Connector	DE-9, female
	Antenna Connector	N female, 50 ohms (adapters supplied with some models)
	DC Power Connectors	MicroFit 3.0, 2-pin male (on Modem A and Modem B)
Power Requirements	DC Supply Voltages	9 to 18VDC or 18 to 28VDC
	DC Power Consumption	(redundancy switch only, does not include radio modems)
	9 to 18VDC	0.2A Modem A selected, 0.8A Modem B selected
	18 to 28VDC	0.2A Modem A selected, 0.5A Modem B selected

Mechanical

Installation	Configuration	19” EIA Rack Mount, 2U High
	Dimensions	3.5” H x 19” W x 12.0” D (89mm H x 483mm W x 305mm D)
	LED Indicators	Transmit, Receive, Power, Fault, Online (Modem A and B)
	Operating Temperature	-22 to +140F (-30 to +60C)
	Weight	7.8lbs (3.6kg) with Modem A and Modem B installed
	Hardware Supplied	TS0060 Rack Mount Hardware Kit

Agency Approvals

Federal Communications Commission (FCC)	FCC CFR Regulations	Part 15 Class B, Part 90 and Part 101
	FCC Equipment Identifiers	JWFTS4000A, JWFTS4000B, JWFTS4000C and JWFTS4000D
	FCC Emission Authorizations	6K00F1D, 11K2F1D, 12K5F1D, 16K0F1D, 20K0F1D, 25K0F1D
Industry Canada (IC)	IC Regulations	ICES-003 and RSS-119
	IC Equipment Identifiers	3163195426, 3163195542A, 3163195539A and 3163195541A
	IC Emission Authorizations	6K00F1D, 11K2F1D, 12K5F1D, 16K0F1D, 20K0F1D, 25K0F1D