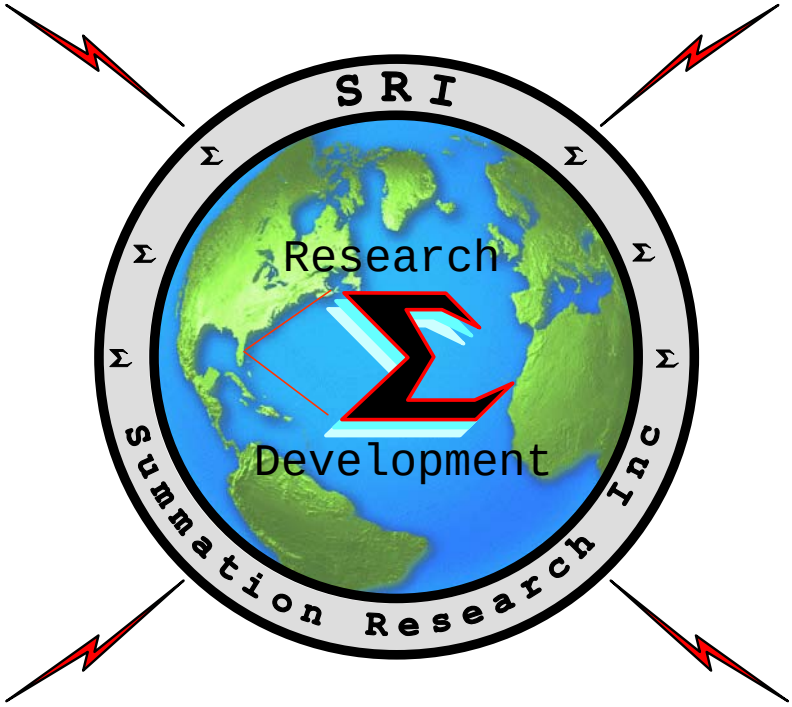
SRI PMD

Operations and Maintenance Manual

STR-590 Digital Telemetry Radio Board



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Prepared by:
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Revision A January 2007

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LIST OF EFFECTIVE PAGES

Dates of issue for original and changed pages are:

Revision A January 2007

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

1 Document Cover
2 Record of Changes
3 Table of Contents
4 Document Main Text

NOTE: On partial document updates, insert latest changed pages and destroy superseded pages. A vertical line in the outer margin of the page indicates the portion of the text affected by changes for partial revisions. A vertical line in the outer margin of the Figure or Table name indicates changes to illustrations or tables.

RECORD OF CHANGES

REVISION	DATE	TITLE OR BRIEF DESCRIPTION
A	January 2007	New document for STR-590 Preproduction Release.

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SECTION 1 INTRODUCTION

The STR-590 Digital Telemetry Radio Board is a custom product based on SRI/PMD's highly successful Wireless Link Series 500 product line. Due to a unique mixture of high technology RF and digital circuitry, a highly accurate pulse train wireless detector is provided in a compact package fully supporting applications requiring high levels of communications performance along with high reliability while still being offered at an affordable price.

1.1 Scope

This manual describes the SRI/PMD STR-590 Digital Telemetry Radio Board, including both transmit and receive processing characteristics. The manual includes specifications, design description, installation, and operation instructions along with routine maintenance requirements for these products.

1.2 Product Description

The STR-590 Digital Telemetry Radio Board is a product specifically produced for Dynalco Controls Corporation under a Technology Use Agreement with SRI/PMD. The basic operation of the system is depicted in the following top level block diagram.

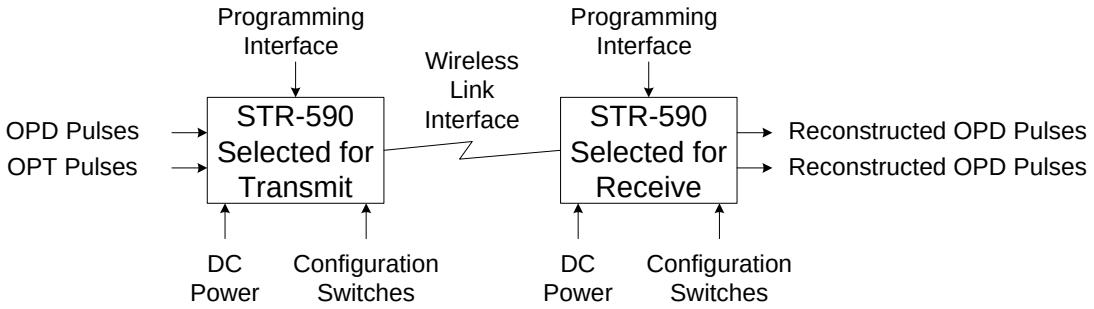

Figure 1 STR-590 Operational Block Diagram

On the transmit side, the system accepts a pulse train representing "Once Per Degree" timing (OPD) and a "Once Per Turn" timing (OPT). OPT occurs synchronously every 360 or 720 occurrences of the OPD pulses. The transmit logic encodes these pulse trains into a scrambled digital representation and then transmits this information across a wireless link interface operating in the 915 MHz ISM band.

Since the STR-590 operational environment is frequently plagued with high level interfering signals, an optional "spread-spectrum" mode of operation is supported. This capability reduces the effective sampling rate of the system, but provides enhanced communications noise performance.

The receive side captures the digital data stream and decodes the information to produce reconstructed OPD and OPT outputs. The receive logic automatically processes the despreading and descrambling of the encoded pulse data.

1.3 Technical Specifications

A summary of the technical specifications and characteristics of the referenced telemetry equipment is presented in the tables that follow.

Table 1 Electrical Specifications and Characteristics

Operation:	Two-Way, Half-Duplex
Data Rate	
Narrowband Mode:	152.3 kbps
Spread Spectrum Mode:	19.0 kbps
Edge Accuracy	
Narrowband Mode:	≥0.05°
Spread Spectrum Mode:	≥0.33°
Radio Frequency:	Unlicensed ISM, 915MHz Band
Power Output (ERP):	+11dBm
Modulation:	FSK with Optional Direct Spread Spectrum
Inputs:	Two (OPT & OPD), TTL (0-5Vdc)
Outputs:	Two (OPT & OPD), TTL (0-5Vdc)
Status Indicator:	TTL, Data Error Detect
Multiplexing Modes	Auto-select Mux Modes based on presence of OPD
Mode 1:	OPT/OPD Multiplex (≥90RPM)
Mode 2:	OPT Only
Programming:	RS-232, DTE, 9600 bps, 4 pin header
	Firmware Upgrade
RF Channels:	15 User Selectable
Operating Temp:	-30° to +85° C
Primary Power:	5Vdc conditioned
Emission Designator/Type	508K0F1D, DSS operation under 15.247(a)(2)

Table 2 Physical Specifications and Characteristics

Size:	92mm x 56mm x 16mm
Mounting:	Two 1.9mm holes
Transmit Header:	8 position 0.100” spaced male header
	Power, Ground, OPT In, OPD In, TX Strap
Receive Header:	8 position 0.100” spaced male header
	Power, Ground, OPT Out, OPD Out, RX Strap, Key
Programming:	4 position 0.100” spaced male header
	TD, RD, Ground
Configuration Switch:	8 position Dip Switch
	Frequency Select (4), Spread, Program, Test
RF I/O Connector:	Hirose – H.FL-R-SMT

SECTION 2 DIGITAL TELEMETRY SYSTEM DESCRIPTION

2.1 Normal Operation

When operating as a regular transmitter, the processor within the design samples the incoming OPD and OPT signals at the transmit bit rate. For non-spread-spectrum operational mode, this equates to a sample rate of approximately 152.3 KHz. For spread, it is at a rate of approximately 19 KHz. For OPD pulse periods without a corresponding OPT, the data passes the initial encode logic as is. When OPT occurs, the logic “blanks” the corresponding OPD pulse to indicate this occurrence. This is depicted in the top section of the figure on the following page.

On the receive side for this mode, the logic detects a period of a missing pulse and automatically reinserts the missing OPD. Concurrently, the OPT line is also driven high to indicate its occurrence. When operating in this mode, the logic drives an Error indicator line high any time the OPT is not detected to have occurred on exactly a 360 or 720 OPD timing basis. Otherwise, the Error line is driven low.

If the transmit logic detects OPT with no OPD pulses, it changes to where only the OPT pulse is transmitted. This is represented as a low going pulse as opposed to the normal high going pulses of the combined OPD/OPT operation. The receive side for this mode detects a normally high state and interprets this as a OPT only mode. In this case, the Error indicator line is drive high if the OPT to OPT pulse timing is indicating too much variance.

Not depicted in the diagram is the insertion of scrambling and direct spread sequencing. The first is required by FCC in order to be compatible with non-licensed spectrum requirements. The algorithm used for the data scrambling is self-synchronizing and thus requires no acquisition logic on the receive side.

Spread-spectrum operation is optionally added by a dip-switch selection. When active (the default), the logic spreads the transmit data with a PN sequence which is in-turn recovered and de-spread on the receive side. This allows the communications link to tolerate significant RF interference and still produce good communications performance data results. The unit is designed to operate under FCC Part 15.247(a)(2) in DSS (spread spectrum) mode.

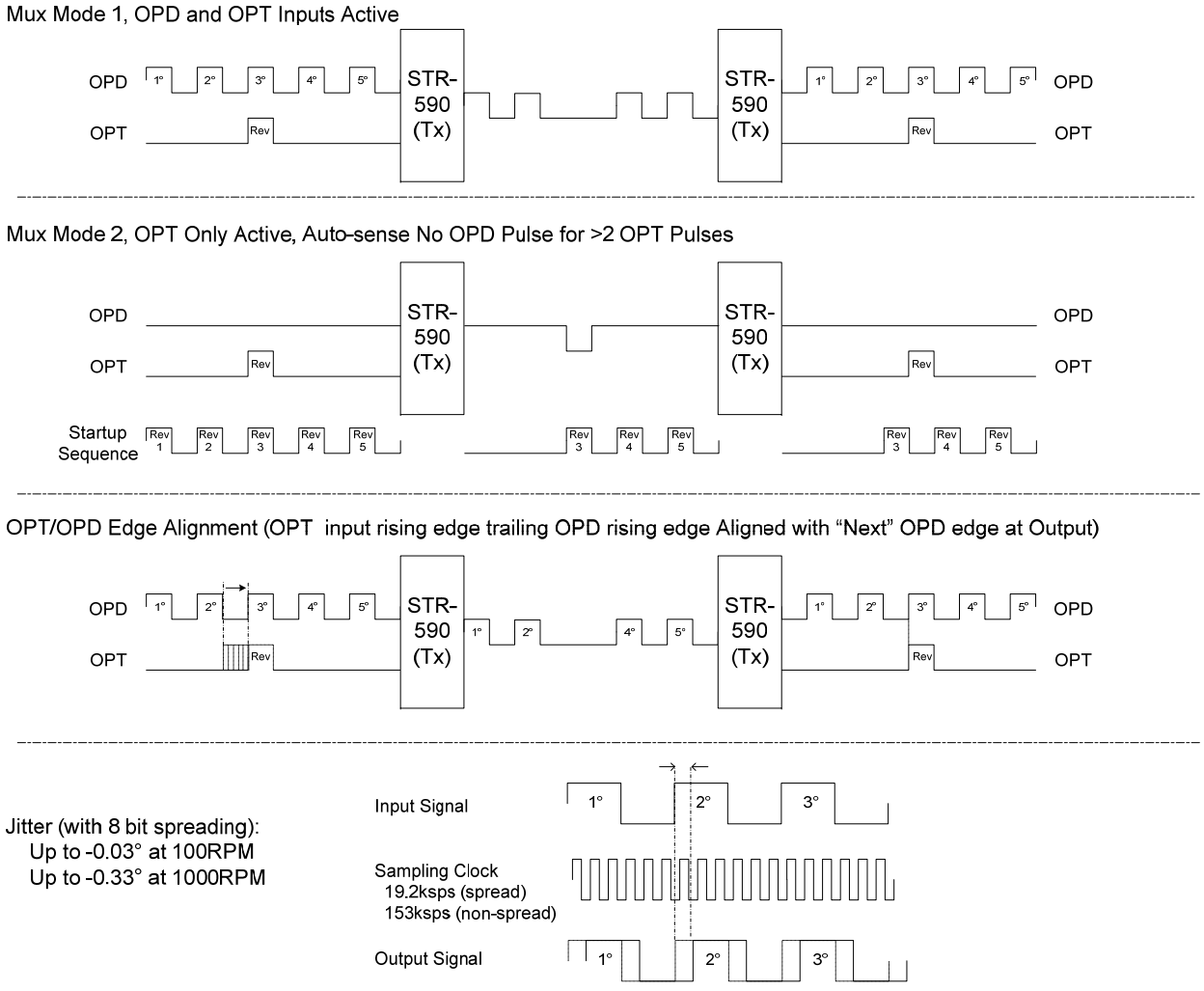

Figure 2 Multiplexing Operation of OPD/OPT Signals

2.2 Test Operation

Test mode of operation is activated via a dip switch setting on both transmit and receive elements of a test configuration. When operating in this mode, the transmitter accepts a data/clock input on the OPD/OPT input lines. For proper operation, the clock should be at approximately a 152.3 KHz data rate. On each rising edge of the clock line, the data line is sampled and issued to the RF transmitter.

On the receive side in test mode, the data is recovered and issued as a data/clock output on the OPD/OPT output lines. This allows the entire system to be connected to a bit-error-rate tester and communications link performance to be analyzed. Note that spread spectrum operation is not supported when test mode is active, but the various RF frequency selections for the wireless link interface are supported.

During this mode, the Error indicator line is pulsed high and then low to provide a means of validating its operation. The pulse rate of this change is at one rate if the Spread Spectrum select switch is low, and another rate when the Spread Spectrum select switch is high. As such, an STR_590 that is placed into test mode as a transmit and then as a receive can easily have all switches and inputs/outputs verified for correct operation.

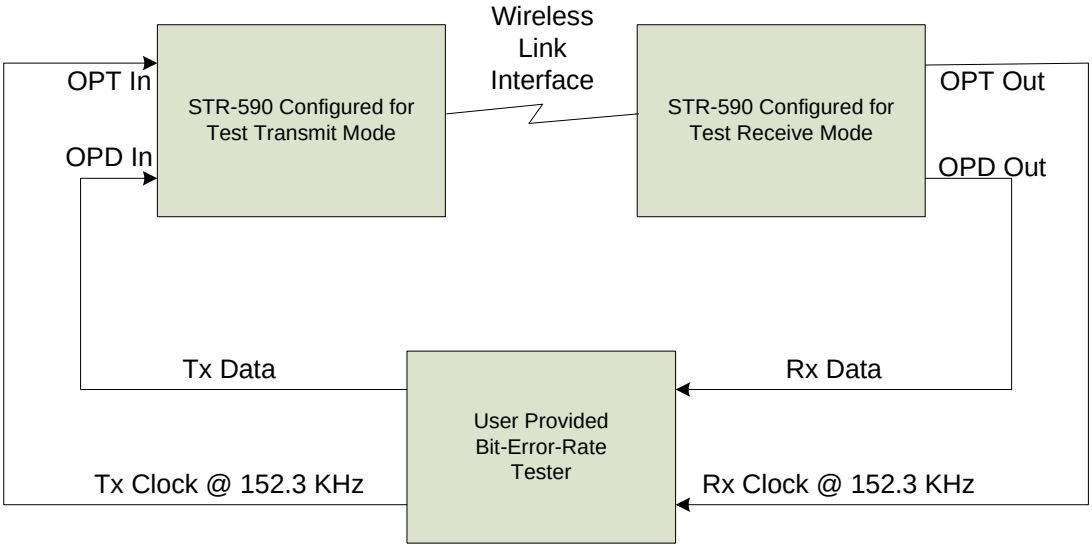

Figure 3 Test Mode of Operation

SECTION 3 RECEIVING, INSPECTION AND INSTALLATION

3.1 Unloading and Unpacking

NOTE

If shipping carton is damaged upon receipt, request carrier's 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:

SRI/PMD
751 North Drive
Melbourne, Florida 32934

3.2 Board Layout and Connector Locations

Users should be aware that the STR-590 Digital Telemetry Radio Board contains sensitive electronic components. Proper "Electrostatic Discharge" (ESD) handling procedures should be utilized for this equipment as with any other electronic apparatus.

The following diagram depicts the layout of the STR-590 board, showing the exact dimension of the board itself as well as the locations of the mounting holes. It also gives a general idea of the location of each of the connectors and the dip switch used for configuring each unit.

Since the STR-590 is a half-duplex transceiver, it should either be configured as a transmitter or a receiver. This is accomplished by interconnecting an appropriate cable to either the receive or transmit header. The cable itself provides a strap which notifies the onboard processor to operate in transmit or receive mode of operation. Simultaneous connection to both the receive and transmit headers is not recommended.

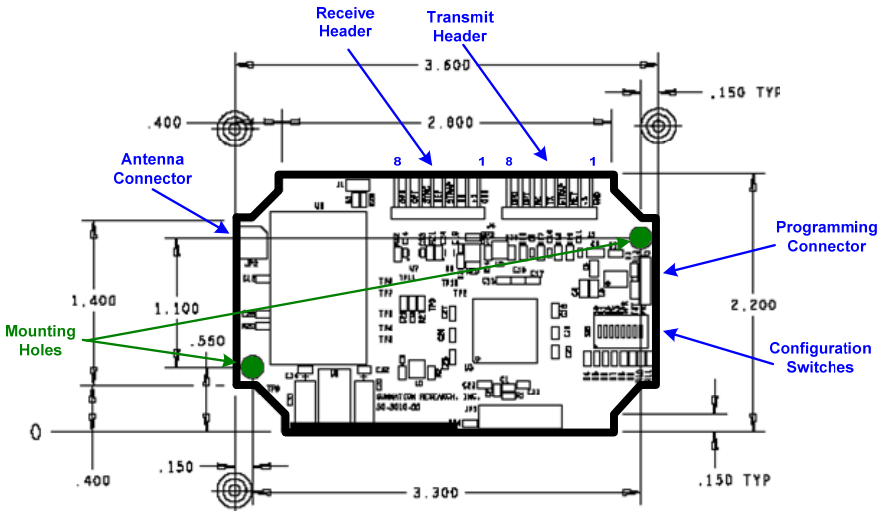

Figure 4 Board Layout and Connector Locations

3.3 Signal Definitions

3.3.1 Transmit Header

The transmit header (connector J3 on the board) contains the following signals at the pin locations as indicated by the previous drawing. Note that the "SIGNAL" column in this table reflects the name of the signal as shown on the silkscreen of the J3 header on the top side of the board.

Table 3 Transmit Header Signal and Pin Definitions

PIN	SIGNAL	DESCRIPTION
1	GND	GROUND FOR THE STR-590 BOARD.
2	+5	+5 VDC INPUT FOR THE BOARD IN TRANSMIT MODE. INPUT SHOULD BE AT +5 VDC +/- 5% AND SHOULD SUPPORT AN IN-RUSH CURRENT OF 200 MILLI-AMPS AND A STEADY STATE CURRENT OF 125 MILLI-AMPS.
3	KEY	NON-FUNCTIONAL PIN WHICH CAN BE USED AS A KEY LOCATION IF SO DESIRED SUCH THAT A CABLE BUILT FOR THE RECEIVE HEADER WILL NOT BE COMPATIBLE WITH THE TRANSMIT HEADER.
4	STRAP	SIGNAL WHICH WHEN CONNECTED VIA THE CABLE TO THE TX PIN WHICH FOLLOWS INSTRUCTS THE STR-590 PROCESSOR TO OPERATE AS A TRANSMITTER.
5	TX	SEE ABOVE EXPLANATION
6	NC	PIN NOT CONNECTED TO STR-590 LOGIC
7	OPT	ONCE PER TURN SIGNAL FOR TRANSMIT OPERATION. THIS INPUT SIGNAL SHOULD BE AT STANDARD TTL LEVELS. WHEN OPERATING IN TEST MODE, THIS PIN SHOULD BE DRIVEN WITH THE TEST CLOCK INPUT SIGNAL AT 152.3 KHZ +/- 2%.
8	OPD	ONCE PER DEGREE SIGNAL FOR TRANSMIT OPERATION. THIS INPUT SIGNAL SHOULD BE AT STANDARD TTL LEVELS. WHEN OPERATING IN TEST MODE, THIS PIN SHOULD BE DRIVEN WITH THE TEST DATA INPUT SIGNAL.

3.3.2 Receive Header

The receive header (connector J4 on the board) contains the following signals at the pin locations as indicated by the previous drawing. Note that the “SIGNAL” column in this table reflects the name of the signal as shown on the silkscreen of the J4 header on the top side of the board.

Table 4 Receive Header Signal and Pin Definitions

PIN	SIGNAL	DESCRIPTION
1	GND	GROUND FOR THE STR-590 BOARD.
2	+5	+5 VDC INPUT FOR THE BOARD IN RECEIVE MODE. INPUT SHOULD BE AT +5 VDC +/- 5% AND SHOULD SUPPORT AN IN-RUSH CURRENT OF 200 MILLI-AMPS AND A STEADY STATE CURRENT OF 50 MILLI-AMPS.
3	RX	SIGNAL WHICH WHEN CONNECTED VIA THE CABLE TO THE STRAP PIN WHICH FOLLOWS INSTRUCTS THE STR-590 PROCESSOR TO OPERATE AS A RECEIVER.
4	STRAP	SEE ABOVE EXPLANATION
5	KEY	NON-FUNCTIONAL PIN WHICH CAN BE USED AS A KEY LOCATION IF SO DESIRED SUCH THAT A CABLE BUILT FOR THE RECEIVE HEADER WILL NOT BE COMPATIBLE WITH THE TRANSMIT HEADER.
6	SYNC	PIN NOT CONNECTED TO STR-590 LOGIC
7	OPT	ONCE PER TURN SIGNAL FROM RECEIVE OPERATION. THIS OUTPUT SIGNAL WILL BE AT STANDARD TTL LEVELS. WHEN OPERATING IN TEST MODE, THIS PIN WILL BE DRIVEN WITH THE RECOVERED TEST CLOCK OUTPUT SIGNAL (NOMINALLY AT 152.3 KHZ).
8	OPD	ONCE PER DEGREE SIGNAL FROM RECEIVE OPERATION. THIS OUTPUT SIGNAL WILL BE AT STANDARD TTL LEVELS. WHEN OPERATING IN TEST MODE, THIS PIN WILL BE DRIVEN WITH THE RECOVERED TEST DATA OUTPUT SIGNAL.

3.3.3 Antenna

The antenna connector is labeled JP2 on the board. The connector is a H.FL-R-SMT connector from Hirose. The center conductor for the connector contains the RF input/output to/from the transceiver logic which should be at 915 MHz +/- 15 MHz. In transmit mode, the signal may be as high as +15 dBm. A continuous input signal of +10 dBm into the unit in receive mode will not damage the item.

3.3.4 Programming Header

The programming header (connector J2 on the board) contains the signals required to reprogram the processor on the board. This header should only be used with an appropriate adaptor connector provided by SRI which will allow the interface to be connected to a DE-9 cable to a standard PC RS-232 serial port. PC Software and instructions on utilizing the interface are provided when a field upgrade is required of STR-590 Digital Telemetry Radio Boards.

3.4 Switch Definitions

An 8 position dip switch on the board is labeled SW1. It contains the switches to control the configuration of the unit as described in the following table. Note that the “LABEL” column in this table reflects the name of the switch as shown on the silkscreen of the SW1 dipswitch on the top side of the board.

Table 5 Switch Definitions and Assignments

SWITCH	LABEL	DESCRIPTION
1	S0	LEAST SIGNIFICANT BIT OF A 4 BIT VALUE FORMED BY S3/S2/S1/S0. THE VALUE OF THESE SWITCHES CONTROL THE TRANSMIT/RECEIVE FREQUENCY OF THE STR-590 AS FOLLOWS:
		0 – 915 MHZ — 15 – 913.976 MHZ
		1 – 916.024 MHZ — 14 – 912.952 MHZ
		2 – 917.048 MHZ — 13 – 911.928 MHZ
		3 – 918.072 MHZ — 12 – 910.904 MHZ
		4 – 919.096 MHZ — 11 – 909.880 MHZ
		5 – 920.120 MHZ — 10 – 908.856 MHZ
		6 – 921.144 MHZ — 9 – 907.832 MHZ
		7 – 922.168 MHZ — 8 – 906.808 MHZ
2	S1	SEE ABOVE EXPLANATION
3	S2	SEE ABOVE EXPLANATION
4	S3	SEE ABOVE EXPLANATION
5	SPR	WHEN SET, ENABLES SPREAD SPECTRUM MODE OF OPERATION OF THE UNIT.
6		SPARE SWITCH – NOT CURRENTLY USED BY STR-590.
7	TST	SWITCH WHICH ENABLED TEST MODE OF OPERATION OF THE STR-590.
8	PR	SWITCH WHICH ENABLES PROGRAMMING MODE OF THE PROCESSOR OF THE STR-590.

SECTION 4 MAINTENANCE

In order to ensure that the STR-590 Digital Telemetry Radio Board is always ready for operation, it should be checked periodically such that 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 that can otherwise damage the system.

This section also describes the corrective maintenance checks that can be performed on the STR-590 Digital Telemetry Radio Board.

4.1 Maintenance Concept

The maintenance concept for the STR-590 Digital Telemetry Radio Board is limited to period preventive maintenance actions as identified in the following sections.

4.2 Preventive Maintenance Requirements

The following is a recommended timetable for performing preventive maintenance checks on Series STR-590 Digital Telemetry Radio Board.

CAUTION

Power to the unit must be turned OFF when performing preventive maintenance on the equipment.

4.2.1 Inspection

The STR-590 Digital Telemetry Radio Board and all associated interface cables should be inspected periodically for defects or physical damage developed during operation. Inspect all the interface cables for cracks, breaks and proper seating with their mating connectors. Inspect all cables for frayed, broken or damaged wires. In addition, inspect all 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.

4.2.2 Cleaning

Clean the outside surfaces and areas around the connectors periodically. Clean the surfaces with a clean, soft, lint-free cloth. To remove grease, fungus, or corrosion, use a cloth dampened in high quality electronic cleansing solution.

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.

4.3 Corrective Maintenance Requirements

SRI/PMD does not recommend any corrective maintenance actions be performed for fielded units except as specifically directed by SRI/PMD during any potential service assistance calls. In general, if a unit is exhibiting suspect behaviors, SRI/PMD should be contacted directly for further maintenance recommendations.

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