tau-tron
A UNIT OF
GENERAL SIGNAL

S5250 DS3

DIGITAL TRANSMISSION TEST SET

OPERATION MANUAL

FORM 0320-0984B

(617) 692-5100 Telex 750245 1-800-TAU-TRON (Outside MA)

WARRANTY

All Tau-tron products are warranted against any defects in material and workmanship. This warranty applies for one year from the date of delivery for all Tau-tron manufactured products. The warranty period for OEM products sold by Tau-tron will depend on the original OEM warranty (consult factory for specific products). We will repair or replace products which, upon our examination, prove to be defective during the warranty period.

NO OTHER WARRANTY, EXPRESS OR IMPLIED, INCLUDING FITNESS FOR PURPOSE, MERCHANTABILITY OR OTHERWISE, IS GIVEN.

For assistance, contact Customer Service with details of the instrument model, serial numbers, and malfunction; see Repair Returns below.

SHIPPING DAMAGE

If any signs of damage are noted on the outside of the carton, request that the carrier's agent be present during unpacking. If external damage is found on the instrument, follow Repair Returns procedure below.

Check the electrical performance of the instrument as soon as possible after receipt. If any malfunctions are observed, follow Repair Returns procedure below.

REPAIR RETURNS

For mechanical damage or electrical malfunctions, notify Tau-tron immediately. If the damage occurred during shipping, also notify the carrier. To return a unit for repair:

1. Call the Customer Service Department, (617) 692-5100, for a Repair Authorization Number. This will reduce administrative delays and ensure prompt return of your unit.

2. Complete and attach the Repair Tag, in the rear of the manual, to your unit for positive identification.

3. Pack the unit in the original shipping carton and packing materials, if available. Otherwise use a double-walled carton (test strength of 350 lb; 159 kg) and shock-absorbing material such as bubblewrap to prevent the unit from moving in the carton during transit. Secure the carton by sealing with heavy paper tape.

4. Send to: Tau-tron Inc.
   10 Lyberty Way
   Westford, MA 01886
   Attn: Customer Service

S5250

DIGITAL TRANSMISSION TEST SET

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SECTION 1
INTRODUCTION

1. INTRODUCTION

A. General

1.01 This manual provides the user with all information required for the installation, operation, and maintenance of the Tau-tron S5250 DS3 Digital Transmission Test Set.

1.02 Whenever this manual is reissued, the reason for the reissue will be given in this paragraph.

B. Scope

1.03 The following information is provided:

- Equipment description
- Specifications
- Installation instructions and site requirements
- Operation instructions
- Theory of operation
- Maintenance.

C. Errors, Omissions, and Recommendations

1.04 Errors or omissions discovered in this manual should be reported immediately. When reporting errors or omissions, please be specific and indicate the section number, title, and page number. Also, indicate the paragraph number, figure number, or table designation.

1.05 Your recommendations for improving the quality, contents, and usability of this document are requested and solicited. Please address all correspondence to:

Tau-tron Inc.
ATTN: PUBLICATIONS MANAGER
10 Lyberty Way
Westford, MA 01886

SECTION 2

DESCRIPTION

2. DESCRIPTION

A. General

2.01 The Tau-tron S5250 DS3 Digital Transmission Test Set is intended for use by craftspersons in a field environment for go-no-go maintenance testing, short-term monitoring for proof-of-performance, and various system installation procedures.

2.02 The S5250 measures Parity, Bit, Bipolar Violations (BPV), and DS3 Frame Bit Errors. All digital transmission systems and components, that use the DS3 rate, can be tested with this system. This includes radio and fiber optic systems.

2.03 The S5250 DS3 Digital Transmission Test Set is a compact unit with controls accessible from front, side, and rear panels. Data recording can be performed via an RS-232C or an RS-449 interface (selected at time of purchase) output-to-printer connection on the rear panel.

2.04 The following features are incorporated in the S5250:

- DS3 Parity, DS3 Frame, Bit and Bipolar Violation (BPV) Measurements
- Simultaneous Measurement and Monitoring of System Error Parameters and Status Functions
- Timed Measurement Modes for System Monitoring and Proof-of-Performance
- Field-Type Go-No-Go Maintenance Tests
- Transmitter and Receiver in One Compact Unit
- Live Traffic, Pseudorandom Short Pattern, and "Blue" Signal Testing
- Printer Capability for Data Recording (Optional).

B. Functional Control Areas

2.05 The S5250 is operated by controls and connectors located on the front, side, and rear panels. Figs. 1-3 illustrate the panels and the corresponding functional control areas. The functional control areas fall into one of the following sections or subsystems:

- Power
- Transmitter
- Receiver
- Interface
- Clock.

Power

2.06 The Power section is composed of the POWER switch/indicator located on the front panel (Fig. 1 (#4)) and the AC power/fuse block located on the rear panel (Fig. 3 (#3)). A fan (Fig. 3 (#4)) is located on the rear panel for heat dissipation.

Transmitter

2.07 The Transmitter section is composed of the following areas:

Fig. 1-Front Panel

- DS3 OUTPUTS (#1)
- ERROR INJECT (#2)
- OUTPUT (#3)

Fig. 2-Side Panel

- NRZ OUT (#7)
- FRAME ON/OFF (#2). (Note: Affects the Receiver simultaneously)

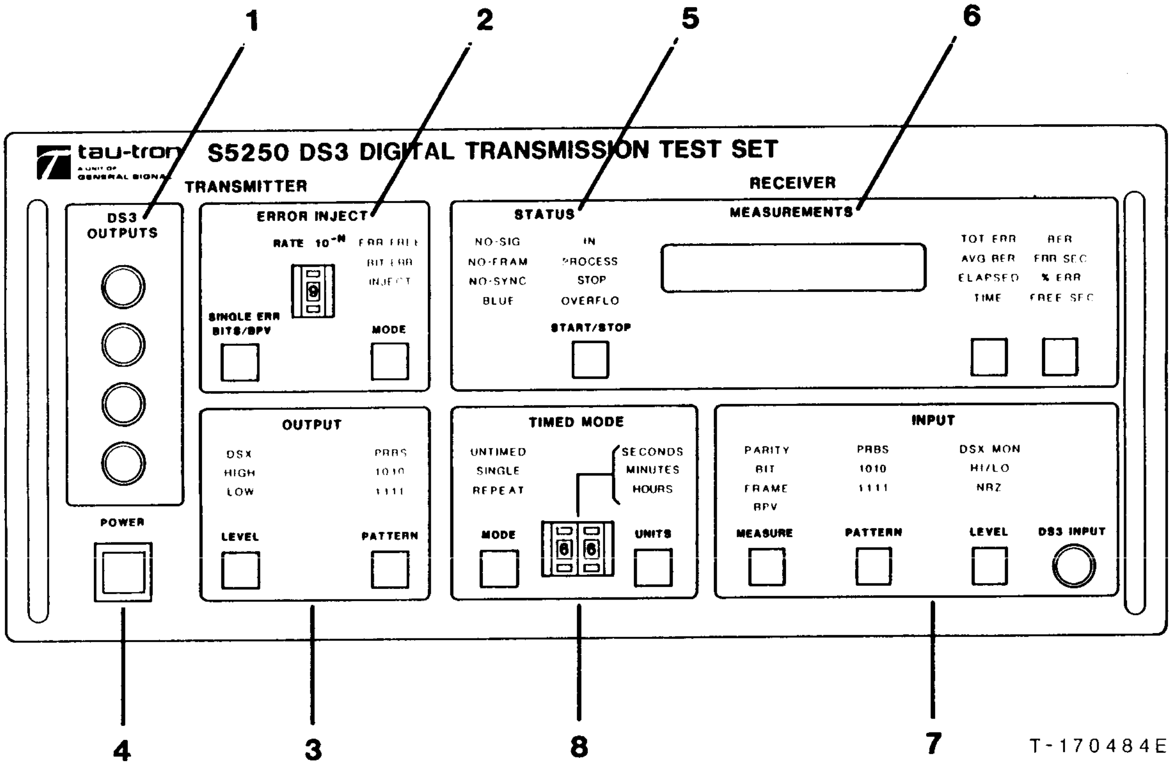


Fig. 1-S5250 Front Panel

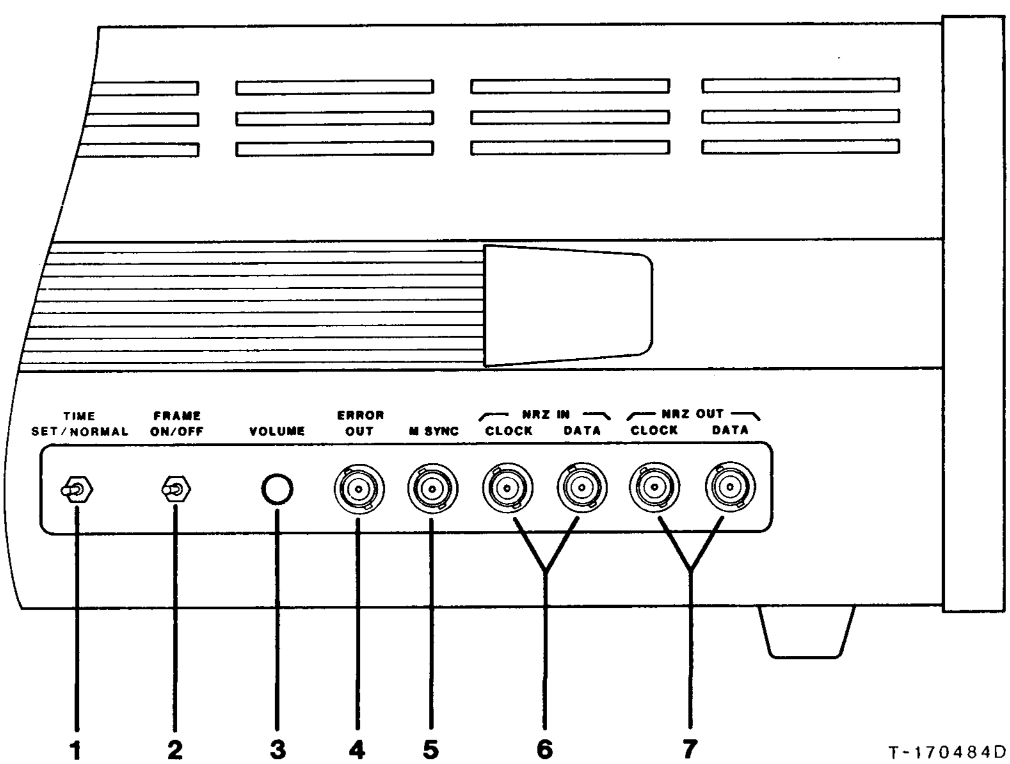


Fig. 2-S5250 Side Panel

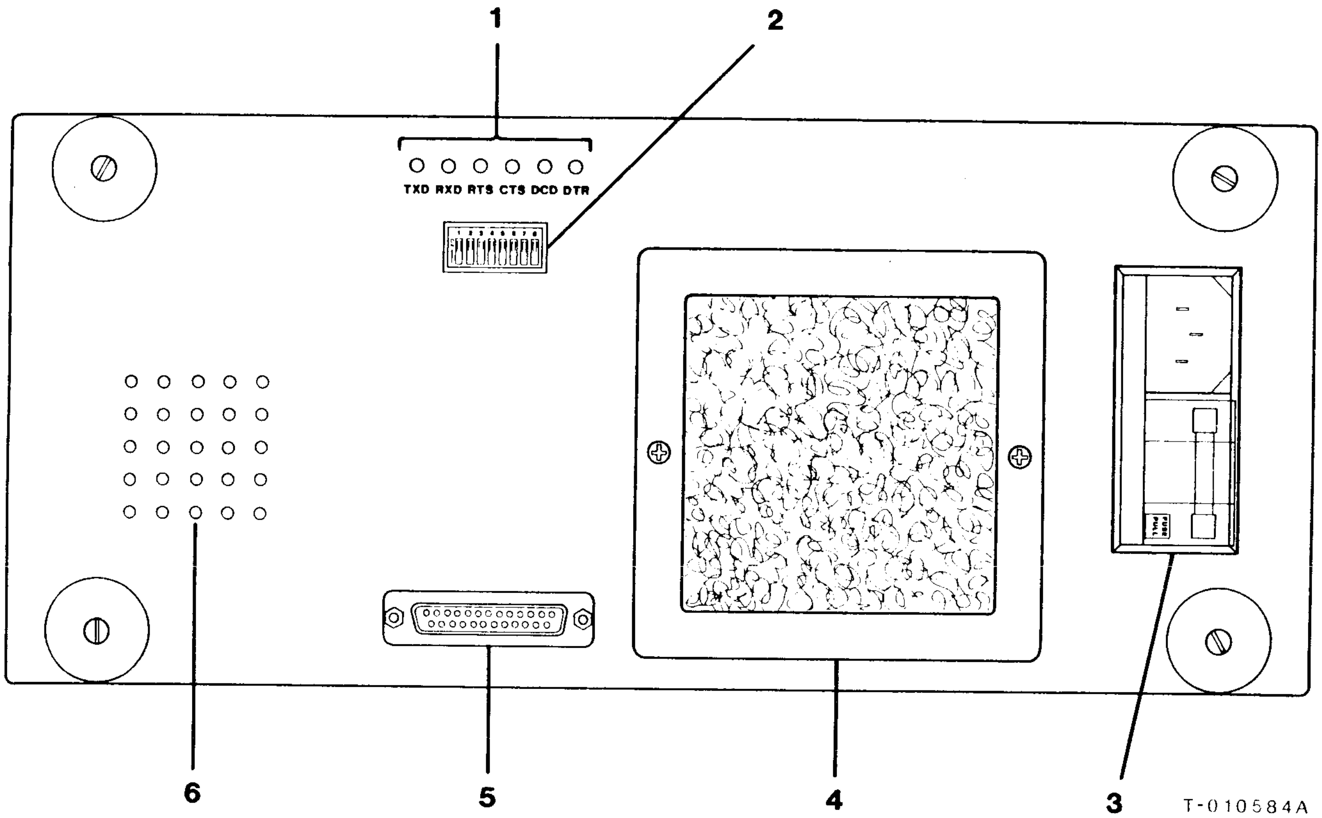


Fig. 3-S5250 Rear Panel

Receiver

2.08 The Receiver section is composed of the following areas:

Fig. 1-Front Panel

- STATUS (#5)
- MEASUREMENTS (#6)
- TIMED MODE (#8)
- INPUT (#7)

Fig. 2-Side Panel

- VOLUME-Audio Alarm (#3)
- ERROR OUT (#4)
- M SYNC (#5)
- NRZ IN (#6)

Fig. 3-Rear Panel

- Audio Alarm Speaker (#6).

Interface

2.09 The Interface section is located on the rear panel (Fig. 3). This section is composed of:

- An RS-232C Interface Connector, or an RS-449 Interface Connector (#5)
- RS-232C/RS-449 Interface DIP switches (#2)
- Six LED indicators (#1).

Clock

2.10 Located on the side panel (Fig. 2) is the TIME SET/NORMAL toggle switch (#1).

SECTION 3
SPECIFICATIONS

3. SPECIFICATIONS

A. General

3.01 This section describes, in Table A, the transmitter, receiver, mechanical, and environmental specifications of the S5250 DS3 Digital Transmission Test Set. All accessories and options are listed in this section. Specifications are subject to change without notice.

TABLE A

SPECIFICATIONS

ITEM	SIGNAL	DESCRIPTION
TRANSMITTER	OUTPUTS:	
	<u>Bipolar</u>	
	Rate	44.736 Mb/s ± 10 ppm.
	Quantity	Four output jacks, that accept WECo 358 or optional WECo 440 plugs.
	Code	B3ZS.
	Impedance	75 ohms.
	Level	HIGH, 0.91V peak.
		DSX, high passed through cable simulator, equivalent to 450 feet of 728A cable.
		LOW, 13.8 dB below high.
	<u>Binary</u>	CLOCK and DATA Output, BNC connectors.
	Format	NRZ (Non-Return to zero).
	Level	0V threshold, 1V peak, with 75 ohm source and load impedance; internally strappable (at the factory) to ECL with -2V termination.
	DATA PATTERNS:	
	PRBS	Industry-compatible pseudorandom bit sequence of 2^{15}-1=32,767 bits.
	Short Patterns	All ones and alternating 1010.

TABLE A (CON'T)

SPECIFICATIONS

ITEM	SIGNAL	DESCRIPTION
TRANSMITTER	Blue Signal	Alternating 1010 pattern with DS3 framing.
	FRAMING:	
	Framed	Bell-compatible DS3 framing bits and data.
	Unframed	Data pattern with no DS3 framing bits.
	ERROR INJECT MODES:	
	Error-Free	No errors injected into data stream.
	Single Error	Bit error and bipolar violation (BPV) inserted. Valid in error-free and error-inject modes. Error on all bits, internally strappable (at the factory) to data bits only. If framed, error is placed after DS3 parity calculation.
	Error Rate Inject	Permits bit error rate of 1 X 10^{-N} where N = 2 to 9.
RECEIVER	INPUT:	
	Frequency	44.736 MHz ± 1.5 MHz.
	Bipolar	B3ZS coding, WECo 358 or optional WECo 440 connector, 75 ohms.
	DSX	+6 dB to below -26 dB about nominal DSX level.
	HIGH/LOW	+6 dB to below -26 dB about nominal high input level.
	Binary	CLOCK and DATA Input BNC connectors, internally strappable (at the factory) to data only.
	Format	NRZ.
	Level	0V threshold, 1V peak, internally strappable to ECL level threshold.

TABLE A (CON'T)

SPECIFICATIONS

ITEM	SIGNAL	DESCRIPTION
RECEIVER	Impedance	75 ohms.
	Phasing	Rising clock edge in center of data.
	DATA PATTERNS:	
	PRBS	Industry-compatible pseudorandom bit sequence of $2^{15}-1=32,767$ bits.
	Short Patterns	All ones and alternating 1010.
	Blue Signal	Automatic recognition in framed mode regardless of pattern setting.
	FRAMING:	
	Framed	Bell-compatible DS3 framing bits and data.
	Unframed	Data pattern with no DS3 framing bits.
	MEASUREMENT CATEGORIES:	
	General	Measurement categories selected from front panel. Measurements in any category are simultaneous.
	Categories	
	Parity	DS3 parity error measurements.
	Bit (Data)	Data bit error measurements.
	BPV	Bipolar violation measurements.
	Frame	DS3 "F-bit" frame error measurements.
	MEASUREMENTS:	
	General	Measurements made simultaneously for any measurement function.
	Total Errors	Total measurement errors accumulated during test.

TABLE A (CON'T)

SPECIFICATIONS

ITEM	SIGNAL	DESCRIPTION
RECEIVER	Current Error Rate	Error rate calculation is continuously measured every 10^8 bits.
	Average Error Rate	Error rate is continuously measured over time of test. Calculation to 10^{-16} error rate.
	Error Seconds	Synchronous error seconds.
	Percent Error-Free Seconds	Continuous calculation over time of test. Calculation to 0.0001%.
	Elapsed Time	Elapsed time of test displayed. Units correspond to D,HH,MM,SS.
	STATUS INDICATORS:	
	Display	LED with flashing history indication and continuous ON for present status.
	Status	No signal, DS3 frame loss, data sync loss, blue signal detect.
	TIMED MODES:	
	General	Untimed, repeat, and single tests. Timed tests from 1 to 99 seconds, 1 to 99 minutes, and 1 to 99 hours. Inprocess and stop indicators.
	Untimed	Continuous accumulated measurements.
	Repeat	Measurements accumulated for programmable period. At end of test time, the test automatically restarts.
	Single	Measurements accumulated for programmable period, then results held at end.
	DISPLAY:	
	7-Character LED Display	Total error 7 digits with overflow. Error rate auto range to 0.1E-15 (0.1 X 10^{-15}). Error second 7 digits.

TABLE A (CON'T)

SPECIFICATIONS

ITEM	SIGNAL	DESCRIPTION
RECEIVER		Percent error-free seconds to 0.0001% accuracy.
	MONITORS:	
	Errors Out	TTL logic level into 75-ohm BNC connector. Positive pulse for errors according to bit, parity, BPV, or frame category.
	Audio Alarm	Audible tone with volume control. Pitch proportional to error rate, with single errors distinguishable.
	M Sync Out	TTL into high impedance BNC connector. Single pulse per DS3 frame.
MECHANICAL		Height: 6.6 in. (16.8 cm) Weight: 13.6 in. (34.4 cm) Depth: 18.8 in. (47.8 cm) Rear, bottom, and side feet. Removable cover with storage capability.
ENVIRONMENTAL		Operational Temperature Range: 32°F to 120°F (0°C to 50°C). Operating Altitude: Up to 15,000 ASL.
POWER		90-130 Vac rear-panel right-angle connector, specified at order.
OPTIONS AND ACCESSORIES		WECo 560 jacks, accepts WECo 440 plug. RS-232C Interface: Output interface provides measurements and time to RS-232C compatible printers or other devices, 110-9,600 baud selectable. RS-449 Interface: Output interface provides measurements and time to RS-449 compatible printers or other devices.

TABLE A (CON'T)

SPECIFICATIONS

ITEM	SIGNAL	DESCRIPTION
OPTIONS AND ACCESSORIES		Rack Mount kit: Rack Mount to install the S5250 in a standard 19-inch rack. Model PD-3 Output Power Splitter: Passive 75-ohm power splitter, WECo 358 plug, 1 to 2 split. Model LB-25 728A Cable Simulator: Passive simulator equivalent to 250 feet of 728A cable. WECo 358 plug, nominal 5.5 dB loss. Model LB-45 728A Cable Simulator: Passive simulator equivalent to 450 feet of 728A cable. WECo 385 plug, nominal 5.5 dB loss. Model 5901 40 Column Printer: RS-232C compatible, must have RS-232C option on S5250. Model 5910 Power Converter: DC to AC converter, converts -20V to -60V input to 115 Vac output.
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.		

SECTION 4

INSTALLATION

4. INSTALLATION

A. General

4.01 Before installing the S5250, specific site requirements must be met, and preliminary checks must be made. This section supplies the site requirements, power conditions, and option requirements for the proper installation of the S5250.

B. Site Requirements

4.02 The basic requirements for the proper installation and operation of the S5250 are as follows:

AC POWER:	90-130 Vac, 47 to 66 Hz, 2A (Slo-Blo) 47 to 66 Hz, 1A.
TEMPERATURE:	32°F to 120°F (0°C to 50°C).
HUMIDITY:	0 to 95% relative humidity, non-condensing.
ALTITUDE:	Operational up to 15,000 feet ASL.
CLEARANCE:	At least 3 in. (7.5 cm) behind and 1 in. (2.5 cm) above, below, and to each side of the S5250.

C. Power Connection and Power-Up Procedure

4.03 The correct procedure for making power connections and powering ON the S5250 is as follows:

STEP	PROCEDURE
1	Remove the detachable front cover.
2	Check that the POWER Switch/Indicator is in the OFF position (In = ON, Out = OFF).
3	At the fuse housing on the rear panel, slide the plastic cover to the left to expose the fuse (see Fig. 4).
4	Push the FUSE PULL lever to the left, remove the fuse, and check to see that it is rated for 2A SB for 110 Volts.
5	Push FUSE PULL lever to the right, the normal operating position, re-install the fuse, and slide the cover over the fuse.
6	Connect the 3-wire AC power cord to the 3-prong connector of the S5250. Green = Ground, Black = Hot, White = Neutral.
7	Connect the male end of the AC power cord to a convenient 115 power source.
8	Push the POWER Switch/Indicator in to the ON position. The Indicator should light showing that the unit is ON.

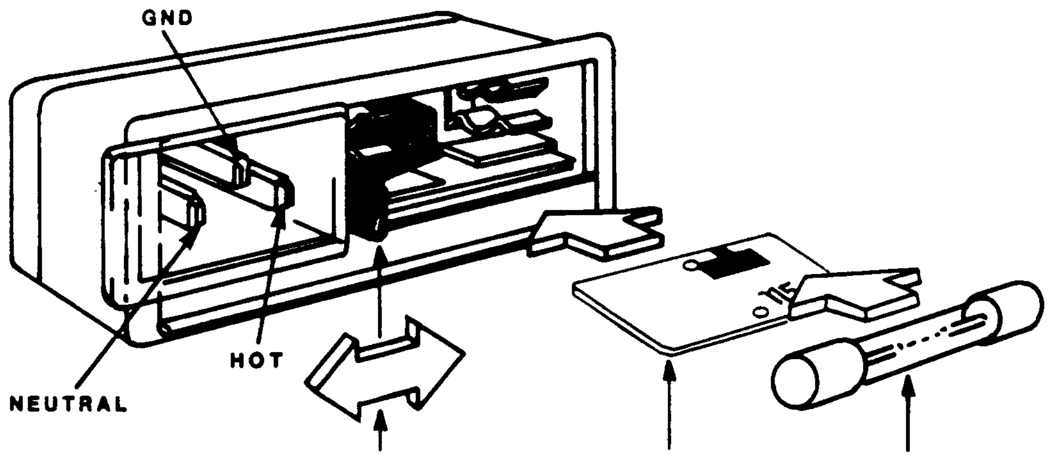


Fig. 4-AC Power Connector and Fuse Housing

D. Rack Mount Option

4.04 The Rack Mount Option is designed to secure the S5250 in a vertical rack mount installation. It fits the standard 19-inch (48 cm) rack and requires only 8.8 inches (22 cm) in height. The depth behind the front panel is 18.5 inches (47 cm). For cooling, allow 3 inches (7.5 cm) clearance at the rear, and 1 inch (2.5 cm) on each side. To install the rack mount, use the following installation procedure, and see Fig. 5.

STEP	PROCEDURE
1	Remove any AC power cord from the S5250.
2	Remove the two front-top and two front-bottom screws from the S5250.
3	Slide the rack front panel over the front of the unit and secure with screws removed in Step 2.
4	Reconnect the AC power cord removed in Step 1.
5	Mount the rack mounting bracket to the desired level on the rack, and secure with four mounting screws.
6	Install the S5250 unit with the rack front panel into the rack mounting bracket, and secure the rack front panel to the rack with four front panel mounting screws.

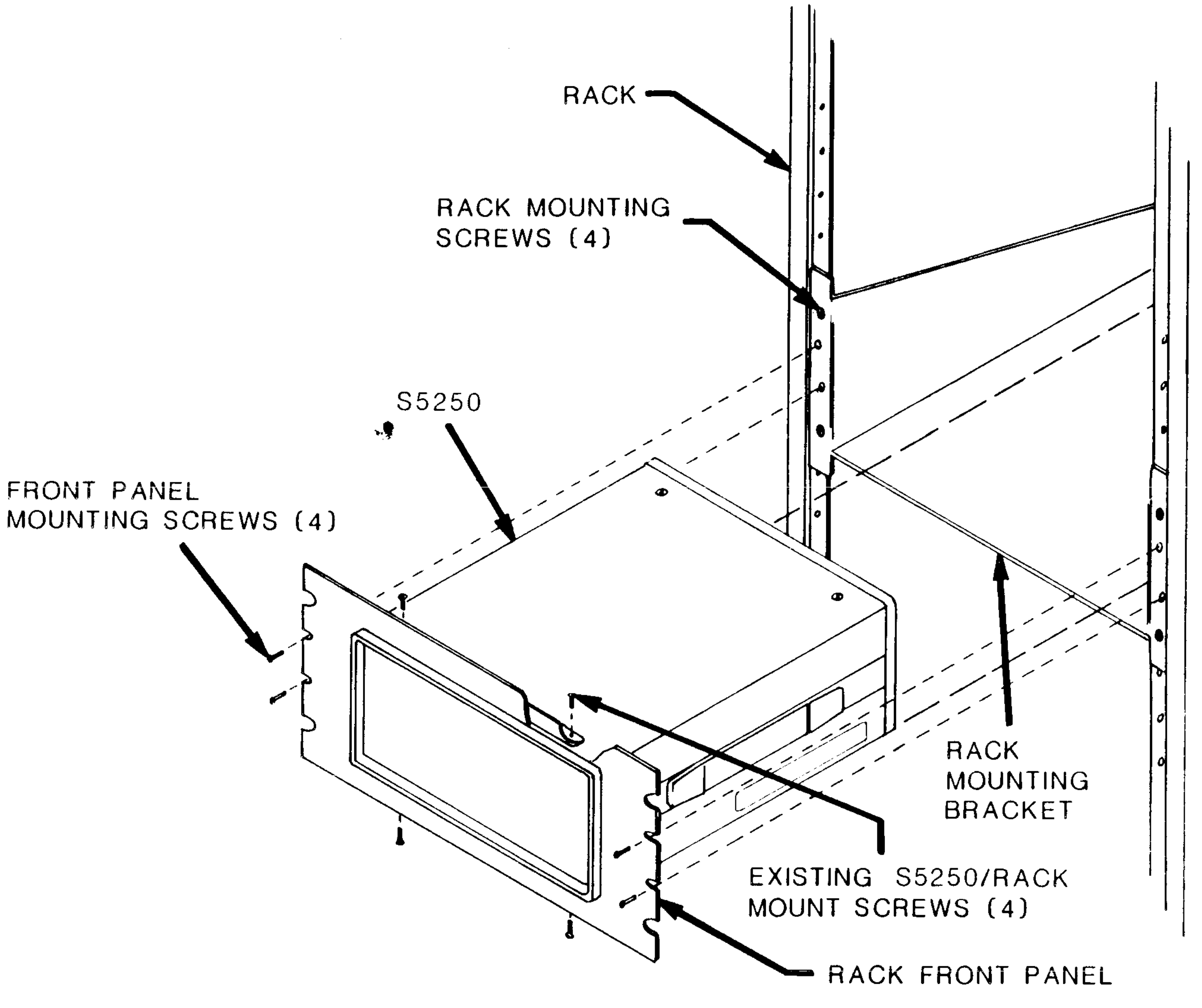


Fig. 5-Rack Mount Option Installation

SECTION 5
OPERATION

5. OPERATION

A. General

5.01 This section describes the use of all controls, indicators, connectors, and displays of the S5250 DS3 Digital Transmission Test Set. Also, verification checks for the initial power-up and measurement checks are supplied at the end of this section.

B. Front Panel Controls and Indicators

5.02 The Transmitter section of the S5250 provides the ability to select the desired Error Rate, Mode, Level, and Pattern of the DS3 signal output.

5.03 The Receiver section of the S5250 performs measurements of Bit Errors and Bipolar Violations (BPVs) on incoming data.

5.04 The front panel controls and indicators, as illustrated in Fig. 6, show the functional areas. In Table B, the functional areas are further defined, giving descriptive information of each control and indicator.

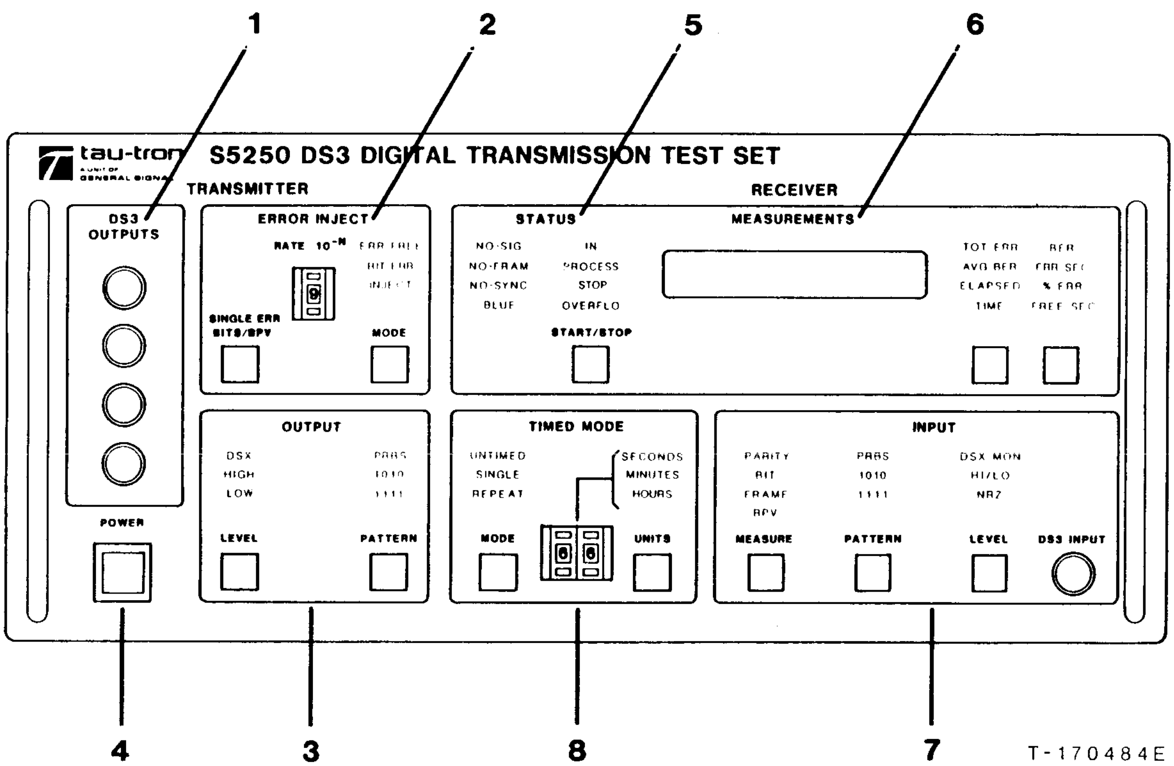


Fig. 6-S5250 Front Panel Controls and Indicators

TABLE B

S5250 FRONT PANEL CONTROLS AND INDICATORS

NO.	DESIGNATION	DESCRIPTION
1	DS3 OUTPUTS (Jacks)	Four identical output jacks that accept WECo 358 or optional WECo 440 plugs from 75-ohm cables. Jacks may be used simultaneously.
2	ERROR INJECT	This functional area selects the Error Rate, Error Mode, and Single Error Bit/BPV injection.
	SINGLE ERR BITS/BPV (pushbutton)	Every time the SINGLE ERR BITS/BPV pushbutton is pressed, an error bit/BPV is injected into the output, whether the S5250 transmitter is in the error-free mode (ERR FREE) or the error-inject mode (BIT ERR INJECT).
	MODE (pushbutton)	When pressed, selects either the error-free (ERR FREE) or the error rate inject (BIT ERR INJECT) mode.
	ERR FREE (indicator)	Lights when the ERR FREE mode is selected.
	BIT ERR INJECT (indicator)	Lights when the BIT ERR INJECT mode is selected. In this mode, errors are injected at a 10^{-N} error rate, where N is determined by the RATE 10^{-N} thumbwheel.
	RATE 10^{-N} (thumbwheel)	The error rate of the BIT ERR INJECT mode is selected by the RATE 10^{-N} thumbwheel. The value of N can be selected from 2 to 9, representing a bit error rate from 10^{-2} to 10^{-9}.
3	OUTPUT	This functional control area contains two output control switches which select output level (LEVEL) and output pattern (PATTERN).
	LEVEL (pushbutton)	Selects one of three output levels: DSX, HIGH, or LOW. Each time the LEVEL pushbutton is pressed, it selects the next output level, lighting its indicator.
	DSX (indicator)	Lights when the DSX output level is selected.
	HIGH (indicator)	Lights when the HIGH output level is selected.
	LOW (indicator)	Lights when the LOW output level is selected.

TABLE B (CON'T)

S5250 FRONT PANEL CONTROLS AND INDICATORS

NO.	DESIGNATION	DESCRIPTION
3	PATTERN (pushbutton)	Selects one of three output patterns: PRBS (pseudorandom bit sequence), 1010, and 1111. Each time the PATTERN pushbutton is pressed, it selects the next output pattern, lighting its indicator.
	PRBS (indicator)	Lights when the PRBS pattern is selected. PRBS is a $2^{15}-1$ pseudorandom sequence.
	1010 (indicator)	Lights when the 1010 pattern is selected.
	1111 (indicator)	Lights when the 1111 pattern is selected.
4	POWER (switch/indicator)	Main AC power switch for operating the S5250. When pushed in, the switch/indicator lights, showing that the unit is ON.
5	STATUS	This functional area is composed of two columns of status indicators. The left column is the Input Signal Status (NO-SIG, NO-FRAM, NO-SYNC, and BLUE). The right column is the test status (IN PROCESS, STOP, and OVERFLO).
	NO-SIG (indicator)	Lights when the DS-3 signal is lost. If no bipolar pulses are detected for 44μs±20%, the NO-SIG indicator lights continuously, indicating a current signal loss. If bipolar pulses are then detected (signal regained) during the test interval, the NO-SIG indicator will flash, indicating a history of signal loss and that currently a signal is detected.
	NO-FRAM (indicator)	Lights continuously while no-frame (NO-FRAM) condition is true (No signal to Receiver or no DS3 frame information present at receiver input). Flashes when the condition is not true, if there is a history during the test. Forced to off (indicator does not light) if the S5250 is in the unframed mode.
	NO-SYNC (indicator)	Lights when signal sync is lost. A signal is considered in sync if less than 40 Bit Errors occur over a period of 100 clock cycles. When 40 or more Bit Errors occur in 100 clock cycles for 8 successive tries, the signal will be consid-

TABLE B (CON'T)

S5250 FRONT PANEL CONTROLS AND INDICATORS

NO.	DESIGNATION	DESCRIPTION
5	NO-SYNC (indicator)	ered out of sync and the NO-SYNC indicator will light continuously. If signal sync is regained the NO-SYNC indicator will flash indicating a history of sync loss during the current test time interval.
	BLUE (indicator)	Lights continuously while a Blue signal is detected (A Blue signal is a 1010 signal every 84 bits followed by one frame bit). Flashes if there has been a history (a Blue signal has been detected) during the test. Forced to off (indicator does not light) if the S5250 is in the unframed mode.
	IN PROCESS (indicator)	Lights if a test is in progress.
	STOP (indicator)	Flashes, denoting test is not currently being made.
	OVERFLO (indicator)	Flashes when a measurement has overflowed the 7-Digit Display.
6	MEASUREMENTS	This functional area contains a 7-Character Display, a START/STOP pushbutton, and a 2-column display selection section.
	7-Character Display	Seven-character LED display that shows the results of measurements and system-error codes.
	Error Message Codes	Illegal combinations of states will cause an error message to appear on the Display. An error message is displayed in the form Op Err. n, where n is an integer from 1 to 8. The following list explains all error messages: • Op Err. 1- Occurs when the S5250 is in the SINGLE time mode and the thumbwheel switches are set for 00. • Op Err. 2- Occurs when the S5250 is in the REPEAT time mode and the thumbwheel switches are set for 00. • Op Err. 3- Occurs when BER is selected while the S5250 is in the FRAME measurement mode.

TABLE B (CON'T)

S5250 FRONT PANEL CONTROLS AND INDICATORS

NO.	DESIGNATION	DESCRIPTION
6	Error Message Display	• Op Err. 4- Occurs when BPV measurements are selected while the input level is set for NRZ. • Op Err. 5- Has no meaning. Not used. • Op Err. 6- Occurs when PARITY measurements are selected while the S5250 is in the unframed mode. • Op Err. 7- Occurs when FRAME measurements are selected while the S5250 is in the unframed mode. • Op Err. 8- Indicates that the battery-backed ram, which contains the front panel status information, has failed. This failure indicates that the S5250 did not retain the front panel setup after the S5250 was powered down. However, this failure does not impair the operation of the S5250. In the default power-up mode, after an OP Err. 8, the following indicators will be lit: • ERR FREE • (OUTPUT) DSX • (OUTPUT) PRBS • IN PROCESS • UNTIMED • SECONDS • TOT ERR • PARITY • (INPUT) PRBS • DSX MON To clear the OP Err. 8 display, press any front panel pushbutton, except POWER, and the current in process measurement information will be displayed.
	START/STOP	Starts a test. If a test is in progress, it stops (pushbutton) the test when pressed.

TABLE B (CON'T)

S5250 FRONT PANEL CONTROLS AND INDICATORS

NO.	DESIGNATION	DESCRIPTION
6	Display Selection	Six types of measurement display are available for (pushbuttons) selection: TOT ERR, AVG BER, ELAPSED TIME, BER, ERR SEC, and % ERR-FREE SEC. These measurement display types are arranged in two columns. Under each column is a pushbutton that, when pressed, steps to the next display type, lighting its indicator. Only one column and one display in that column can be used at a time.
	TOT ERR (indicator)	Lights when total error measurement is selected. The number of total errors is shown on the 7-Digit Display. If the 7-Digit Display overflows, the OVERFLO indicator will flash, and the total will continue to accumulate. There is leading zero suppression except on overflow.
	AVG BER (indicator)	Lights when average BER measurement is selected. The 7-Digit Display displays the average BER in the form n.nE-xx. The n.n represents the mantissa of the error rate, and the xx represents the power-of- ten exponent. The range is from 0.0E-15 (no errors) to 1.0E-00 (100% error rate). If the error counter overflows, the OVERFLO indicator will flash.
	ELAPSED TIME (indicator)	Lights when elapsed time measurement is selected. Elapsed time is shown on the 7-Digit Display in the form D.HHMM.SS where D = days, HH = hours, MM = minutes, and SS = seconds. The time is kept in 24-hour time.
	BER (indicator)	Lights when current BER measurement is selected. The 7-Digit Display displays the current BER in the form n.nE-x, where n.n. represents the mantissa, and x represents the power-of-ten exponent. The range is from 0.0E-8 (no errors) to 1.0E-0 (100% errors). Current BER is not valid when the S5250 is in the Framed mode and FRAME measurement is selected, as it takes too long for a current BER to complete.
	ERR SEC (indicator)	Lights when error-second measurement is selected. Total error seconds are displayed on the 7-Digit Display. Up to 194 days of consecutive

TABLE B (CON'T)

S5250 FRONT PANEL CONTROLS AND INDICATORS

NO.	DESIGNATION	DESCRIPTION
6	ERR SEC (indicator)	error seconds can be run without overflow occurring. If the display overflows, the OVERFLO indicator will light and flash, and the total will continue.
	% ERR FREE SEC (indicator)	Lights when percent error-free second measurement is selected. The 7-Digit Display displays the percent of error-free seconds in the form 00.0000 to 100.00. If the elapsed test time overflows (>194 days), invalid results will be displayed. No overflow checking is performed.
7	INPUT	This functional area controls three categories of Receiver INPUT: MEASURE (measurement type), PATTERN, and LEVEL.
	MEASURE (pushbutton)	Selects measurement category; either PARITY, BIT, FRAME, or BPV. Each time the MEASURE pushbutton is pressed, it steps to the next category, lighting that category's indicator. Only one category can be selected at a time, and if a category is changed during a test, the test will restart. Illegal combinations, such as PARITY and Unframed, will cause an error message to be displayed on the 7-Digit Display, and all tests will stop.
	PARITY (indicator)	Lights when PARITY measurement is selected.
	BIT (indicator)	Lights when BIT measurement is selected.
	FRAME (indicator)	Lights when FRAME measurement is selected.
	BPV (indicator)	Lights when BPV measurement is selected.
	PATTERN (pushbutton)	Selects INPUT PATTERN; either PRBS, 1010, or 1111. Each time the PATTERN pushbutton is pressed, it steps to the next pattern category, lighting its indicator. If the input pattern category is changed during a test, the test will restart.
	PRBS (indicator)	Lights when PRBS pattern is selected.
	1010 (indicator)	Lights when 1010 pattern is selected.

TABLE B (CON'T)

S5250 FRONT PANEL CONTROLS AND INDICATORS

NO.	DESIGNATION	DESCRIPTION
7	1111 (indicator)	Lights when 1111 pattern is selected.
	LEVEL (pushbutton)	Selects INPUT LEVEL, either DSX MON, HI/LOW, or NRZ. Each time the LEVEL pushbutton is pressed, it steps to the next input-level category, lighting its indicator. If the input-level category is changed during a test, the test will restart.
	DSX MON (indicator)	Lights when DSX MON level is selected.
	HI/LOW (indicator)	Lights when HI/LOW level is selected.
	NRZ (indicator)	Lights when NRZ level is selected.
	DS3 INPUT	Input jack (for DS3 signal) that accepts WECo 358 or optional WECo 440 plugs from 75-ohm cables.
8	TIMED MODES	This functional area selects the TIMED MODE and the interval of the TIMED MODE.
	MODE (pushbutton)	Selects the timed-mode category, either UNTIMED, SINGLE, or REPEAT. Each time the MODE pushbutton is pressed, it steps to the next mode category, lighting its indicator. The time interval of the timed-mode selection is set by the two thumbwheel switches and the UNITS pushbutton.
	UNTIMED (indicator)	Lights when UNTIMED mode is selected. In the UNTIMED mode, the test will be timed (elapsed time), but will not automatically stop or repeat.
	SINGLE (indicator)	Lights when SINGLE mode is selected. In the SINGLE mode, the test will automatically stop when the set-time interval has elapsed. Elapsed time and measurements are held for display.
	REPEAT (indicator)	Lights when REPEAT mode is selected. When the set-time interval has elapsed, the test will automatically stop, reset, and start again. The results at the end of the test are displayed as follows:

TABLE B (CON'T)

S5250 FRONT PANEL CONTROLS AND INDICATORS

NO.	DESIGNATION	DESCRIPTION
8	REPEAT (indicator)	• In the SECONDS mode: Previous test results are held in the Display for 1 second. • In the MINUTES mode: Previous test results are held in the display for 10 seconds. • In the HOURS mode: Previous test results are held in the display until the next interval test results are displayed.
	UNITS (pushbutton)	Selects UNITS of time, either SECONDS, MINUTES, or HOURS. Each time the UNITS pushbutton is pressed, it steps to the next time-unit category and lights its indicator. Used in conjunction with the Interval Thumbwheel Switches to set the time interval of the TIMED MODE. Any change in UNITS during a test will stop the test.
	SECONDS (indicator)	Lights when the SECONDS time unit is selected.
	MINUTES (indicator)	Lights when the MINUTES time unit is selected.
	HOURS (indicator)	Lights when the HOURS time unit is selected.
	Interval Thumbwheel Switches	Programs the interval of a timed test from 01 to 99 time UNITS. 00 is an error condition. Any change in the Interval Thumbwheel Switches during a test will cause the test to stop.

C. Side Panel Controls and Connectors

5.05 The side panel controls and connectors are illustrated in Fig. 7 and further defined in Table C, which completely describes each control and connector.

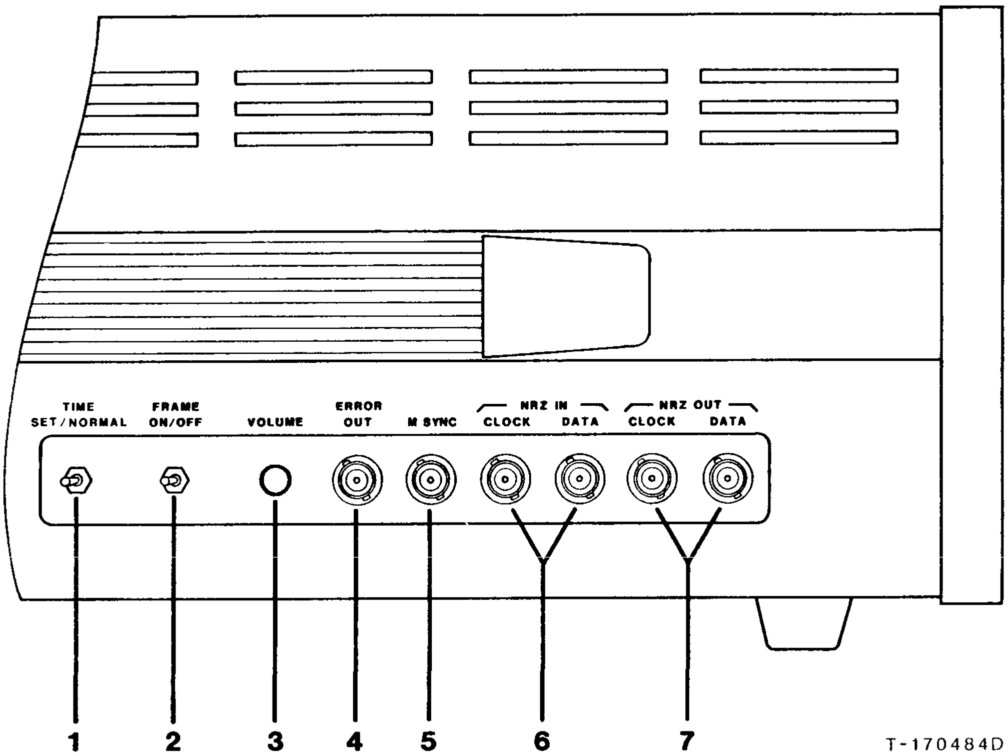


Fig. 7-S5250 Side Panel Controls and Connectors

TABLE C

S5250 SIDE PANEL CONTROLS AND CONNECTORS

NO.	DESIGNATION	DESCRIPTION
1	TIME (toggle switch)	Selects either SET (sets time display) or NORMAL (normal measurement operation).
	NORMAL	Setting for normal operation of the S5250. In this setting, test results are displayed as usual.
	SET	Displays the Time-of-Day (in 24-hour time) on the 7-Digit Display, and blanks out the measurement type indicators. If a test is in progress, it continues uninterrupted. Every time the S5250 is powered ON, the time is reset to 0000.00, and the Time-of-Day must be reset. This setting allows the Time-of-Day to be set in the following manner:

TABLE C (CON'T)

S5250 SIDE PANEL CONTROLS AND CONNECTORS

NO.	DESIGNATION	DESCRIPTION
1		STEP — PROCEDURE 1 — Press the MODE pushbutton. The Hours segments of the 7-Digit Display and the HOURS UNITS indicator flash. 2 — To set the Hours, dial the Thumbwheel Switches to the desired setting and press the MODE pushbutton. If an invalid number (e.g., >23) is selected, nothing will happen. 3 — The Minutes segments of the 7-Character Display and the MINUTES UNITS indicator flash. Set Minutes as for Hours in Step 2. 4 — The Seconds segments of the 7-Character Display and the SECONDS UNITS indicator flash. Set Seconds as in previous steps. 5 — If no change is desired, push the UNITS pushbutton. The fields (UNITS category) will change with no change in time setting.
2	FRAME ON/OFF (toggle switch)	Selects either ON (FRAMED) or OFF (UNFRAMED) mode. The selection effects the Transmitter and Receiver simultaneously. Bell-compatible DS3 framing format.
3	VOLUME (rotary control)	Controls the Tone Volume of the Audio-Alarm. The pitch is proportional to the error rate. Single errors are discernible.
4	ERROR OUT (connector)	BNC output connector for errors (Bit, Parity, BPV, or Frame). TTL (Transistor to Transistor Logic) compatible. 75 ohm impedance and 3V amplitude. BPV/BIT pulse width= 11 $\pm 3\mu s$. Frame/Parity pulse width= 300 $\pm 50\mu s$.

TABLE C (CON'T)

S5250 SIDE PANEL CONTROLS AND CONNECTORS

NO.	DESIGNATION	DESCRIPTION
5	M SYNC (connector)	BNC output connector for Mark Sync. TTL compatible. High impedance. Single pulse per DS3 frame.
6	NRZ IN	Non-Return to Zero Receiver inputs.
	CLOCK (connector)	BNC input connector for NRZ CLOCK unipolar format. Binary Clock input, 0V threshold with 1V peak.
	DATA (connector)	BNC input connector for NRZ DATA unipolar format. Binary Data input, 0V threshold with 1V peak.
7	NRZ OUT	Non-Return to Zero Transmitter outputs.
	CLOCK (connector)	BNC output connector for NRZ CLOCK unipolar format. Binary Clock output, ±1V peak centered at 0V. 75 ohm impedance.
	DATA (connector)	BNC output connector for NRZ DATA unipolar format. Binary Data output, ±1V peak centered at 0V. 75 ohm impedance.

D. Rear Panel Indicators, Interfaces, and Connectors

5.06 The rear panel indicator, interfaces, and connectors are illustrated in Fig. 8 and further defined in Table D, giving descriptive information of each item.

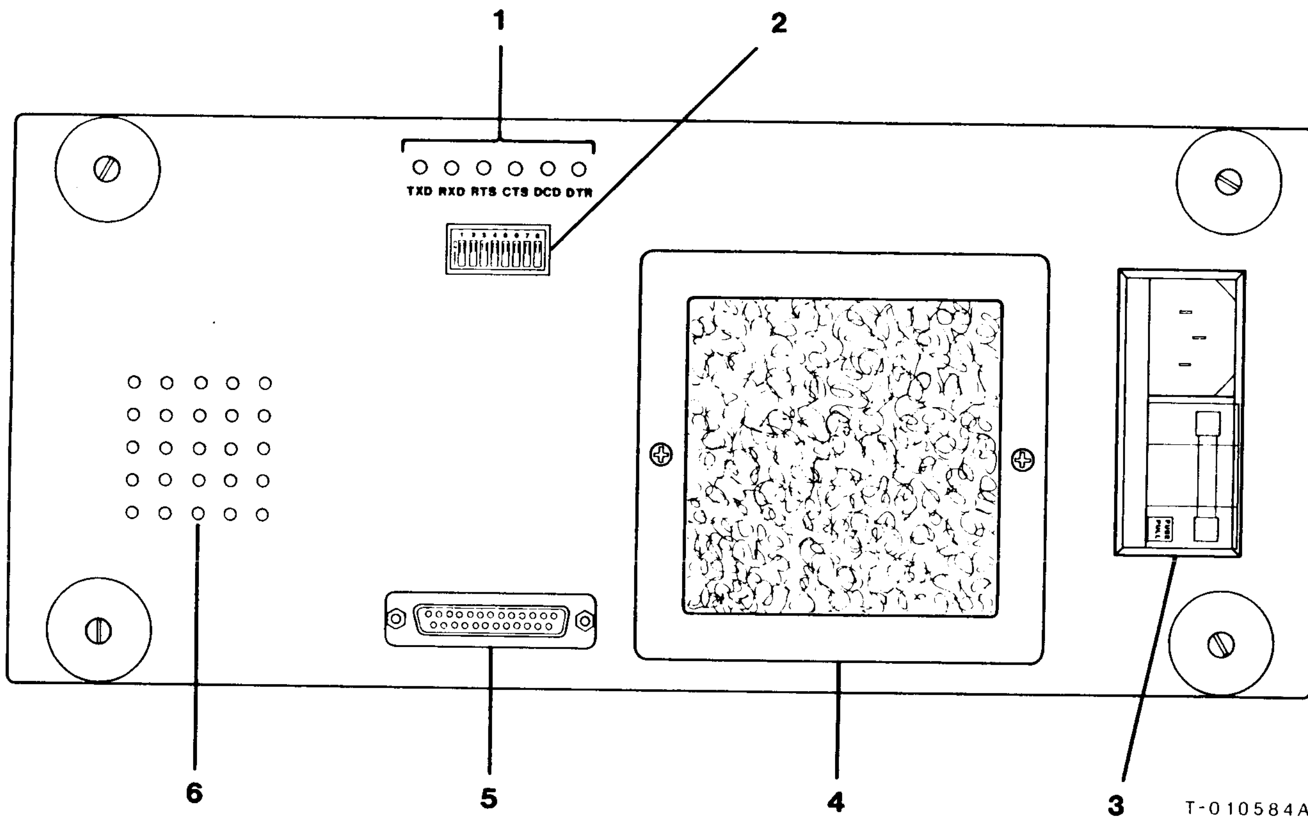


Fig. 8-S5250 Rear Panel Indicators, Interfaces, and Connectors

TABLE D

S5250 REAR PANEL INDICATORS, INTERFACES, AND CONNECTORS

NO.	DESIGNATION	DESCRIPTION
1	Interface Indicators	Six indicators indicate the status of supported data and handshake lines to aid the setup of RS-232C or RS-449 Interfaces.
	TXD (indicator)	Indicates activity on the Interface's Transmit Data line. Flashes rapidly when output occurs. Printer data is output via this line (S5250 output).
	RXD (indicator)	Lights to indicate activity on the Interface's Receive Data line. The S5250 ignores data present on this line (S5250 input).
	RTS (indicator)	Lights when the S5250 has printer data to output. Indicates activity on the Interface's Request-To-Send handshake line (S5250 input).

TABLE D (CON'T)

S5250 REAR PANEL INDICATORS, INTERFACES, CONNECTORS

NO.	DESIGNATION	DESCRIPTION
1	CTS (indicator)	If this indicator is OFF (not lit), the S5250 will not output printer data. Indicates the status of the Interface's Clear-To-Send handshake line (S5250 input).
	DCD (indicator)	Indicates the status of the Data Carrier Detect (Received Line Signal Detect) handshake line. The S5250 ignores this handshake line (S5250 input).
	DTR (indicator)	Lights when the S5250, equipped with either an RS-232C or RS-449 Interface, is powered ON. Indicates the status of the Data Terminal Ready handshake line (S5250 output).
2	Configuration DIP Switch	Selects baud rate, bits per character, parity, and number of Stop bits for the Interface.
3	AC Power/Fuse Block Connector	Input for AC voltage.
4	Fan	Provides heat ventilation and dissipation for the S5250.
5	RS-449 or RS-232C Interface (connector)	Used to output measurements and data to other devices.
6	Audio Alarm Speaker	Pitch is proportional to Error Rate, with Single Errors distinguishable.

E. Printer Output Function

5.07 The printer output function of the S5250 allows the printout of Error-Second Printouts and Summary Prints. The printer software is always active. To stop a print, either turn off or disconnect the printer. Stopping a print in this manner does not stop the queueing of data. The only way to empty the queue is by resetting the Time-of-Day.

Error-Second Prints

5.08 Error-second printouts occur for each error second. The Error-Second printout contains the following information:

- Time of Day at End of Error-Second
- Error Type (PARITY, BIT, FRAME, or BPV)

- Total Errors in Error-Second
- Status (SIGNAL LOSS, DATA SYNC LOSS, FRAME LOSS, or BLUE DETECTED).

The format and a sample Error-Second printout are illustrated in Fig. 9. Printouts are squelched as follows: If framed, then 60 consecutive seconds of frame loss; if unframed, then 60 consecutive seconds of sync loss. To reactivate printing, the squelching condition must be absent for ten consecutive seconds. The Time-of-Day and a message are printed when Error-Second printouts are squelched or enabled.

```
0000:42 BIT=45147408 Sigls Sync Frm
0000:43 BIT=22578354 Sigls Sync Frm
0000:44 BIT=22578603 Sigls Sync Frm
0000:45 BIT=22579150 Sigls Sync Frm
0000:45 BIT=11376    Sigls Sync Frm
0000:47 BIT=45164585 Sigls Sync Frm
0000:51 BIT=90314807 Sigls Sync Frm
0000:52 BIT=22578641 Sigls Sync Frm
0000:53 BIT=22578680 Sigls Sync Frm
0000:54 BIT=22578826 Sigls Sync Frm
0000:55 BIT=22578810 Sigls Sync Frm
```

T-011084A

Fig. 9-Error Second Printout Sample

Summary Prints

5.09 At the end of every test, the printer will print a summary print. This is true whether the test stopped as a result of a timed test or stopped in another way; i.e., START/STOP pushbutton or measurement category. The summary printout contains the following information:

- Time-of-Day of Summary
- Measurement Category (i.e., End of Interval)
- Elapsed Test Time
- Total Errors
- Average Error Rate
- Total Error Seconds
- % Error-Free Seconds
- Status and Event Seconds (SIGNAL LOSS, SYNC LOSS, FRAME LOSS, and BLUE DETECTED).

The format and a sample Summary Printout are illustrated in Fig. 10.

```
0000:57  End of interval  BIT      Summary
Elap time=  0:0000:02 (            2 Secs)

TotErrs= 45157614      AvgErrRate= 5.1E-01
ErrSecs= 1             %ErrFrSec=  50.0000

STATUS AND EVENT SECONDS:
Sigloss=  2           Frameloss= 2
Syncloss= 2           Blue=      0
```

T-011084B

Fig. 10-Summary Printout Sample

F. RS-232C/RS-449 Serial Interfaces

RS-232C Interface Option

5.10 The RS-232C Interface provides the S5250 with a standard one-way serial interface. The interface may be used to output measurements to any device with an RS-232C Interface. This section describes in detail the RS-232C Interface, and serial data format, and explains how to connect the S5250 to the RS-232C devices.

Interface Connections

5.11 A 25-pin D-connector labeled RS-232 is provided on the rear panel of the S5250 for use with external equipment. The signals used are wired in accordance with EIA RS-232C standards for Data Terminal Equipment (DTE). Table E lists the pins used on the RS-232C Interface. Refer to Appendix D for additional pinout information.

TABLE E

RS-232C PIN NUMBERS AND FUNCTIONS

PIN NO.	NAME	FUNCTION
1	GND	Protective Ground. (Must be used)
2	TXD	Transmitted Data Output: Bit-serial data stream. Format is selected by rear-panel DIP switch. (Must be used)
4	RTS	Request-To-Send Output: High-level when S5250 has data for output.
5	CTS	Clear-To-Send Input: High level indicates external device, such as printer, is ready to accept data. This line must be high to enable the S5250 to output data. A low level indicates the output device is busy, or its buffer is full. (Must be used)
7	GND	Signal Ground. (Must be used)
20	DTR	Data Terminal Ready Output: Set to ON (> + 3V) by S5250.
All Other Pins		No connection.
NOTE: The Interface Indicators on the S5250 rear panel (see Table D) will aid in setting up and troubleshooting.		

Interface PCB Jumper Configuration

5.12 The Interface PC Board can be configured for either RS-232C or RS-449 Interfaces by the use of jumpers. The Board is mounted on the interior side of the rear panel and includes the rear panel DIP switches, which are mounted on the back of the Board and are accessible externally.

5.13 The jumper configuration for the RS-232C Interface is shown in Fig. 11.

Serial Data Format

5.14 Data is output from the S5250 in an asynchronous bit-serial manner at one of eight selectable baud rates. The format of the bit-serial data stream is illustrated in Fig. 12.

Baud Rate and Option Selection

5.15 The DIP switch on the rear panel of the S5250 is used to select the following:

- Data baud rate
- Number of bits per character
- Parity selection
- Number of stop bits.

Table F shows the DIP switch assignments.

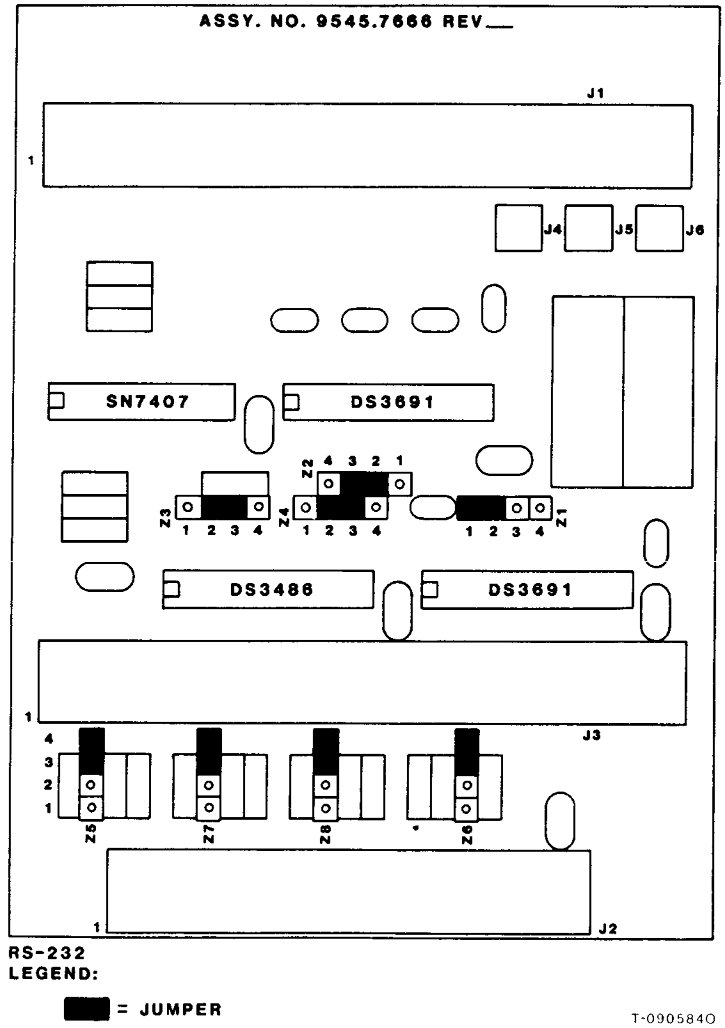
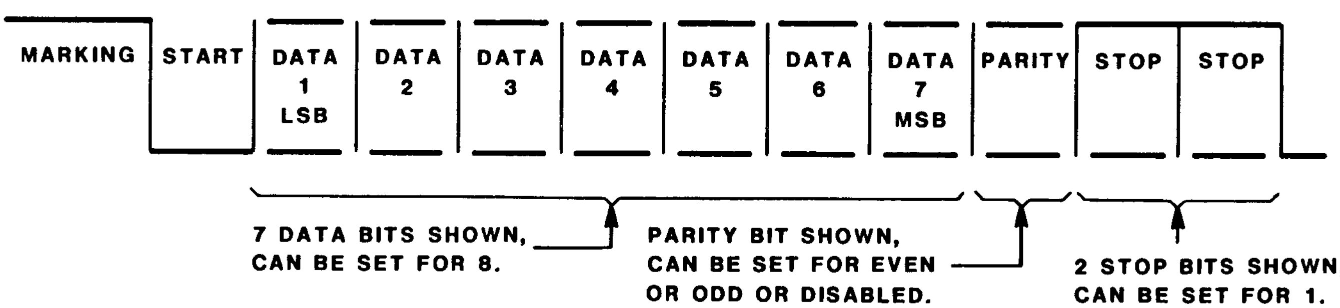


Fig. 11-RS-232C Interface PC Board Jumper Configuration



	RS-232C	RS-449/423	RS-449/422
MARKING LINE	< -3V	< -3.6V	< -2.0V
SPACING LINE	> +3V	> +3.6V	>+2.0V

T-100584E

Fig. 12-Bit-Serial Data Stream Format

TABLE F

REAR PANEL DIP SWITCH ASSIGNMENTS

DIP SWITCH	BAUD RATE (b/s)	SW SEC. (1 = ON) 1 2 3
1 Leftmost switch	110	0 0 0
2	150	1 0 0
3	300	0 1 0
	600	1 1 0
	1200	0 0 1
	2400	1 0 1
	4800	0 1 1
	9600	1 1 1
4	Bits/Char	0=7 1=8
5	Parity Disable	0
	Parity Enable	1
6	Odd Parity	0
	Even Parity	1
7	1 Stop Bit	0
	2 Stop Bits	1
8 Rightmost Switch	Do not print ERROR SECS	0
	Print ERROR SECS	1

NOTE: The DIP switch is read on Power-up only. To change the baud rate or other characteristics, the S5250 must be turned off, then back on.

Interfacing with RS-232C Devices

5.16 For interfacing RS-232C devices, equipment is classified as either Data Terminal Equipment or Data Communications Equipment (DTE or DCE). Similarly configured equipment require a null modem to talk to each other. The S5250 is configured as DTE.

5.17 Interfacing the S5250 to other RS-232C devices is simple if the pinout and configuration of the other device is known. All DTE transmits on line 2 and receives on line 3. All DCE transmits on line 3 and receives on line 2. Different printers typically provide their Clear-To-Send (printer ready for data) handshake on different lines. A null modem may be required to cross-connect the printer handshake to the S5250's Clear-To-Send input.

5.18 The S5250 must see Clear-To-Send active before it will transmit data. It will continue to transmit data, at the specified baud rate, until the Clear-To-Send line goes low, or there is no more data to be output.

5.19 The S5250 must be set (by the rear panel DIP switches) to transmit at the same baud rate, parity selection, and data word length as the receiving device. Generally, the S5250 should be set to transmit two stop bits. This gives the receiving device a better chance to resync to the next start bit.

RS-232C Interface Troubleshooting

5.20 The S5250 rear panel DIP switches permit the user to configure the RS-232C Interface to match the characteristics of many RS-232C peripherals. This section describes commonly encountered problems and their solutions when trying to make the S5250 communicate via the RS-232C Interface.

5.21 Separate Transmit and Receive Data lines are defined by the RS-232C specifications. The S5250 outputs bit-serial information over the Transmit Data line (pin 2 of the connector). Many printers expect data on the Receive Data line (pin 3). If this is the case, the S5250's Transmit Data line must be connected to the printer's Receive Data line. A null modem is required to accomplish this cross-connection.

5.22 The S5250 will transmit data only if its Clear-To-Send input (pin 5) is active (> + 3V). The printer sends this signal on its Data-Terminal-Ready line (pin 20). A null modem is required to make the cross-connection. If the printer is off-line or busy (not ready to accept data), it will drive this line inactive, signaling the S5250 to stop sending data to the printer.

5.23 The serial data stream consists of a start bit, seven or eight data bits, possibly a parity bit, and one or two stop bits. The baud rate, number of data bits per character, and parity bit selection must match the format expected by the printer. The S5250 should generally transmit two stop bits, while the printer should receive one. The configuration of these interface characteristics is controlled by the S5250 rear panel DIP switches. Paragraph 5.15 describes DIP switch settings and meanings.

Note: DIP switches are read only on Power-Up. If a configuration change must be made, the S5250 must be turned off, the appropriate DIP switches toggled, and the S5250 powered on.

5.24 If the rate of the printer output generated by the S5250 exceeds the printer's capability to print it, then some data may be lost. The RS-232C Clear-To-Send handshake line must be active for the S5250 to output data to the printer. When the printer is busy, off line, or out of paper, it may deactivate this line, signaling the S5250 to discontinue output. As more error seconds occur, print messages will continue to be generated in the S5250. 1,024 bytes of queue storage are provided for backing up data. When this queue space is filled, the S5250 will keep track of the number of buffers lost. Each print buffer corresponds to a 40-character print line. When the printer is again ready for data, the number of lost buffers will be reported.

Note: The lost buffer count is reported in hexadecimal form.

5.25 The source of nearly all interface problems is improper connections and/or mismatches in the transmitted and expected data rate or format. Several commonly encountered problem symptoms, their likely causes, and their solutions are listed in Table G.

TABLE G

PRINTER/INTERFACE TROUBLESHOOTING

PROBLEM SYMPTOM	POSSIBLE CAUSE	SOLUTION
Printer fails to print any data	Printer off	Plug in printer and turn it on.
	Printer off-line	Some printers have an on-line/ off-line switch. Make sure the printer is on-line (up position).
	Cable not connected	Connect RS-232C cable.
	Improper connection	Make sure Pin 2 from the S5250 is wired to the printer's input data line. Make sure Pin 5 input at the S5250 is receiving Clear-To-Send indication from the printer.
	Internal DIP switches improperly set	Consult Tau-tron Customer Service Personnel.
Printout is garbled	Data rate or format mismatch	Set the S5250 to OFF and toggle rear panel DIP switches to select proper baud rate, parity, and number of data bits/ character to match printer setup. Set the S5250 to ON.
Character occasionally lost in printout	Sync loss	Set the S5250 to OFF and set the rear panel DIP switch for two stop bits. Set the printer for one stop bit. Set the S5250 to ON.
Multiple characters occasionally lost in printout	Data overrun	Printer is not toggling the S5250's Clear-To-Send line when it is busy and unable to accept data. S5250 keeps transmitting and data is lost. Provide signal from printer to Pin 5 of the S5250 interface. Signal must be active (>3V) when the printer is ready to accept data, and inactive (<3V) when the printer is busy.

RS-449 Interface Option

5.26 The operation of the S5250, with the RS-449 Interface option, is the same as with the RS-232C Interface. However, the electrical configuration (pinouts, DTE to DCE interconnection, and jumper configuration) of the RS-449 differs from the RS-232C.

Interface Connections

5.27 A 37-pin D-connector labeled RS-449 is provided on the rear panel of the S5250 for use with external equipment. The pin numbers and layout are illustrated in Fig. 13. Table H lists the pin numbers and their functions used with the S5250 RS-449 Interface. Refer to Appendix D for additional pinout information.

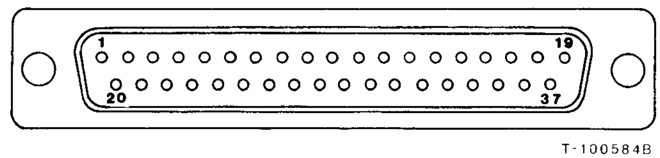


Fig. 13-RS-449 Interface Connector (User Side)

TABLE H

S5250 RS-449 PIN NUMBERS AND FUNCTIONS

PIN NO.	NAME	FUNCTION
1	GND	Protective Ground
4	TXD	Transmitted Data Output
22	TXD R	Transmitted Data Output Return
7	RTS	Request-To-Send Output
25	RTS R	Request-To-Send Output Return
9	CTS	Clear-To-Send Input
27	CTS R	Clear-To-Send Input Return
12	DTR	Data Terminal Ready Output
30	DTR R	Data Terminal Ready Output Return
19	GND	Signal Ground
NOTE:	Pins 6,11,13,24,29,31 are connected but not used. All other pins are not connected.	

Interface PC Board Jumper Configuration

5.28 The Interface PC Board is mounted on the interior side of the rear panel and includes the rear panel DIP switches, which are mounted on the back of the Board and are accessible externally. There are two RS-449 Interface jumper configurations, RS-422 and RS-423. The jumper configurations of the Interface PC Board are illustrated in Fig. 14.

RS-449 DTE to DCE Interconnection

5.29 The S5250 can be interfaced with RS-449 peripheral equipment (printers, terminals, computers, etc.) if the other device's pinout and configuration are known. Appendix D will aid the S5250 user in setting up RS-449 DTE to DCE interfaces.

G. Power Up After Power Loss

5.30 If the S5250 is turned OFF or suffers a power loss, the software retains the settings the S5250 had prior to power loss. Therefore, when the S5250 is powered ON, or regains power, it will come up with the last settings that occurred prior to the last power loss.

H. Performance Verification

5.31 The following Performance Verification Test provides a check of the Transmitter, Receiver, and Timing operation of the S5250. This is a general test to ensure that the unit is operating properly.

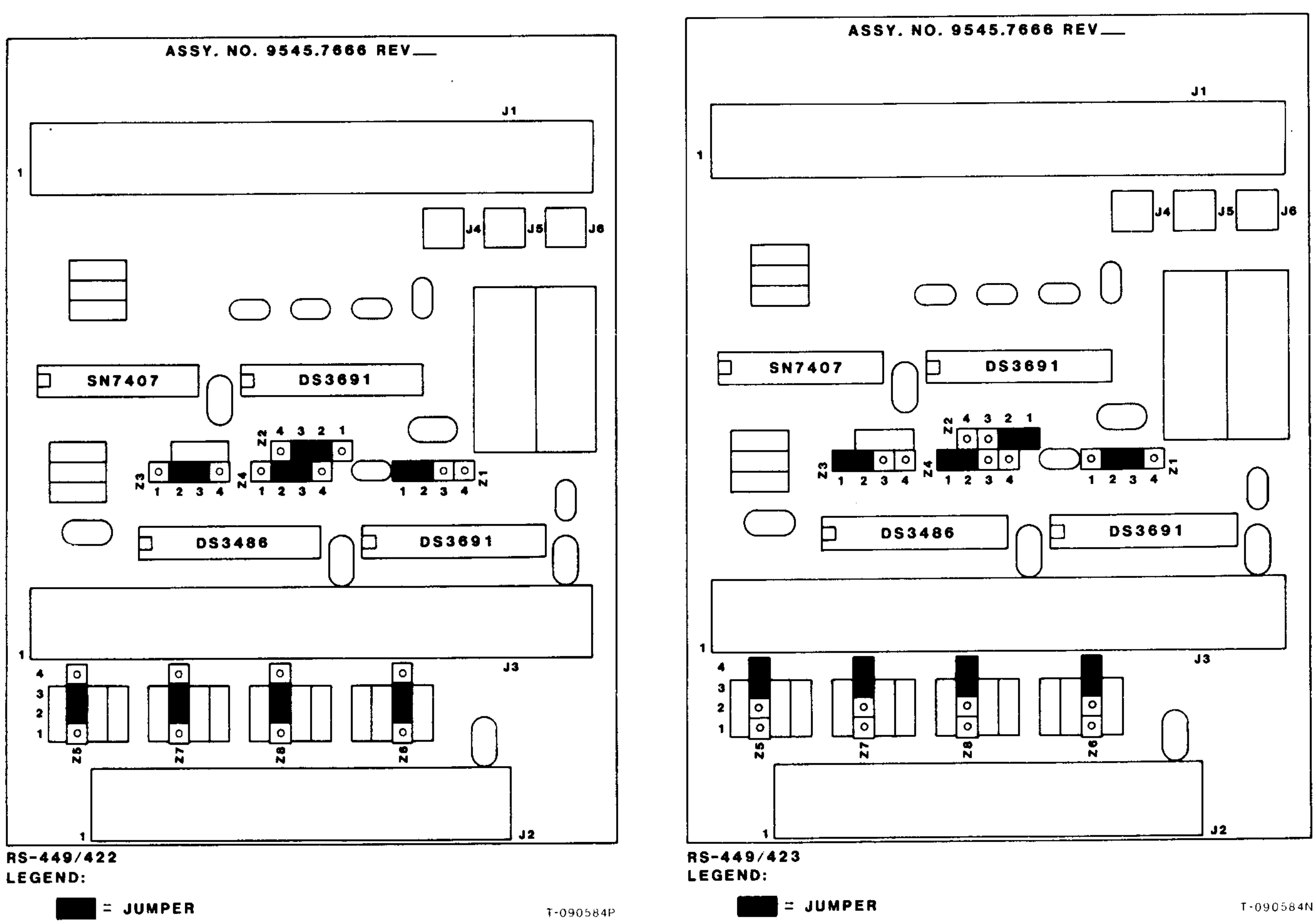


Fig. 14-RS-449 Interface PC Board Jumper Configurations

STEP	ACTION	VERIFICATION
1	Connect the S5250 to a 115 Vac 50/60 Hz power source	
2	Connect a 75 ohm cable with WECo 358 (or WECo 440) plugs connectors between one of the DS3 OUTPUTS and the DS3 INPUT on the front panel.	
3	On the side panel, set the TIME toggle switch to RUN and the FRAME toggle switch to ON. Then press in the POWER switch/indicator.	The POWER switch/indicator and all other indicators on the front panel light for approximately two seconds. The indicators will then reset to the last setting they were in prior to the last time the S5250 was powered ON. The 7-Digit Display will read 0.
4	Press the ERROR INJECT MODE pushbutton twice.	This switches between the ERR FREE and BIT ERR INJECT indicators, which light when selected.
5	Press the left MEASUREMENTS pushbutton 3 times.	This sequences through the 3 types of measurement (TOT ERR, AVG ERR, and ELAPSED TIME) that can be selected with this pushbutton. The lit indicator is the selected measurement type.
6	Press the right MEASUREMENTS pushbutton 3 times.	This sequences through the 3 types of measurement (BER, ERR SEC, and % ERR FREE SEC) that can be selected with this pushbutton. Pressing this pushbutton extinguishes the indicator above the left pushbutton.
7	Press the OUTPUT LEVEL pushbutton 3 times.	This sequences through the 3 OUTPUT LEVEL types (DSX, HIGH, and LOW), lighting the appropriate indicator when selected.
8	Press the OUTPUT PATTERN pushbutton 3 times.	This sequences through the 3 OUTPUT PATTERN types (PRBS, 1010, and 1111), lighting the appropriate indicator when selected.
9	Press the TIMED MODE, MODE pushbutton 3 times.	This sequences through the 3 MODE types (UNTIMED, SINGLE, and REPEAT), lighting the appropriate indicator when selected.

STEP	ACTION	VERIFICATION
10	Press the TIMED MODE UNITS pushbutton 3 times.	This sequences through the 3 UNITS categories (SECONDS, MINUTES, and HOURS), lighting the appropriate indicator when selected.
11	Press the INPUT MEASURE pushbutton 4 times.	This sequences through the 4 INPUT MEASURE types (PARITY, BIT, FRAME, and BPV), lighting the appropriate indicator when selected.
12	Press the INPUT PATTERN pushbutton 3 times.	This sequences through the 3 INPUT PATTERN types (PRBS, 1010, and 1111), lighting the appropriate indicator when selected.
13	Press the INPUT LEVEL pushbutton 3 times.	This sequences through the 3 INPUT LEVEL types (DSX MON, HI/LO, and NRZ), lighting the appropriate indicator when selected.
14	Set the front panel switches and indicators as follows: RATE^{-N} = 6 ERROR INJECT MODE = ERR FREE MEASUREMENTS = ELAPSED TIME OUTPUT LEVEL = DSX OUTPUT PATTERN = PRBS TIMED MODE = SINGLE, 10 SECONDS INPUT MEASURE = BIT INPUT PATTERN = PRBS INPUT LEVEL = DSX MON	
15	Press the START/STOP pushbutton.	The IN-PROCESS STATUS indicator lights and the 7-Digit Display advances from 0 to 10. The IN-PROCESS indicator then extinguishes and the STOP STATUS indicator flashes.
16	Switch the TIME toggle switch to DISPLAY.	The Display will change to the 24-Hour Display Mode, advancing once each second. The TIMED MODE indicators (SINGLE and SECONDS) and the MEASUREMENTS indicator (ELAPSED TIME) extinguish.

STEP	ACTION	VERIFICATION
17	Perform the following actions: • Switch the TIME toggle switch to RUN. • Set the ERROR INJECT MODE to BIT ERR INJECT. • Set the MEASUREMENTS category to TOT ERR.	
18	Press the START/STOP pushbutton.	The IN-PROCESS indicator lights, and the Display shows increasing numbers until it stops at 442 ± 1, at which time the STOP indicator lights and flashes.
19	Set the INPUT PATTERN to 1010.	The NO-SYNC STATUS indicator lights and the OVERFLO STATUS indicator flashes. The IN-PROCESS indicator lights and then extinguishes in 10 seconds, replaced by the STOP indicator, which flashes.
20	Set the OUTPUT PATTERN 1010. Press the START/STOP pushbutton.	The NO-SYNC and the OVERFLO indicators extinguish. The BLUE STATUS indicator and the IN-PROCESS indicators light. The Display will advance until it reaches 442 ± 1. The STOP indicator then flashes and the IN-PROCESS indicator extinguishes.
21	Set the INPUT LEVEL to NRZ.	The BLUE STATUS indicator extinguishes. The NO-SIG STATUS indicator and the IN-PROCESS indicators light. The Display reads 0 and after ten seconds the IN- PROCESS indicator extinguishes and the STOP indicator flashes.
22	Perform the following actions: • Set the TIMED MODE to UNTIMED. • Set the INPUT LEVEL to DSX MON. • Set the INPUT MEASURE to BPV.	

STEP	ACTION	VERIFICATION
23	Press the SINGLE ERR BITS/BPV pushbutton several times.	Each time the SINGLE ERR BITS/BPV pushbutton is pressed, the Display advances by one.
24	End of Verification Procedure.	

SECTION 6

THEORY OF OPERATION

6. THEORY OF OPERATION

A. General

6.01 This section explains the theory of operation and the power distribution of the S5250 DS3 Digital Transmission Test Set.

6.02 The S5250 (Fig. 15) consists of seven plug-in PC boards, a motherboard, a front panel PC board, an interface PC board, and two associated power supplies. The S5250 is powered by 115 Vac input and, through the power supply, converts it to +5V for internal power distribution.

6.03 In general, the S5250 can be divided into three functional systems: Receiver, Transmitter, and Power Distribution.

B. Transmitter

6.04 The Transmitter consists of two PC boards that plug into the motherboard. These are the Oscillator-Output Driver PC Board and the Transmit Generator PC Board.

Oscillator/Output Driver PC Board

6.05 The Oscillator/Output Driver PC Board (Fig. 16) is composed of

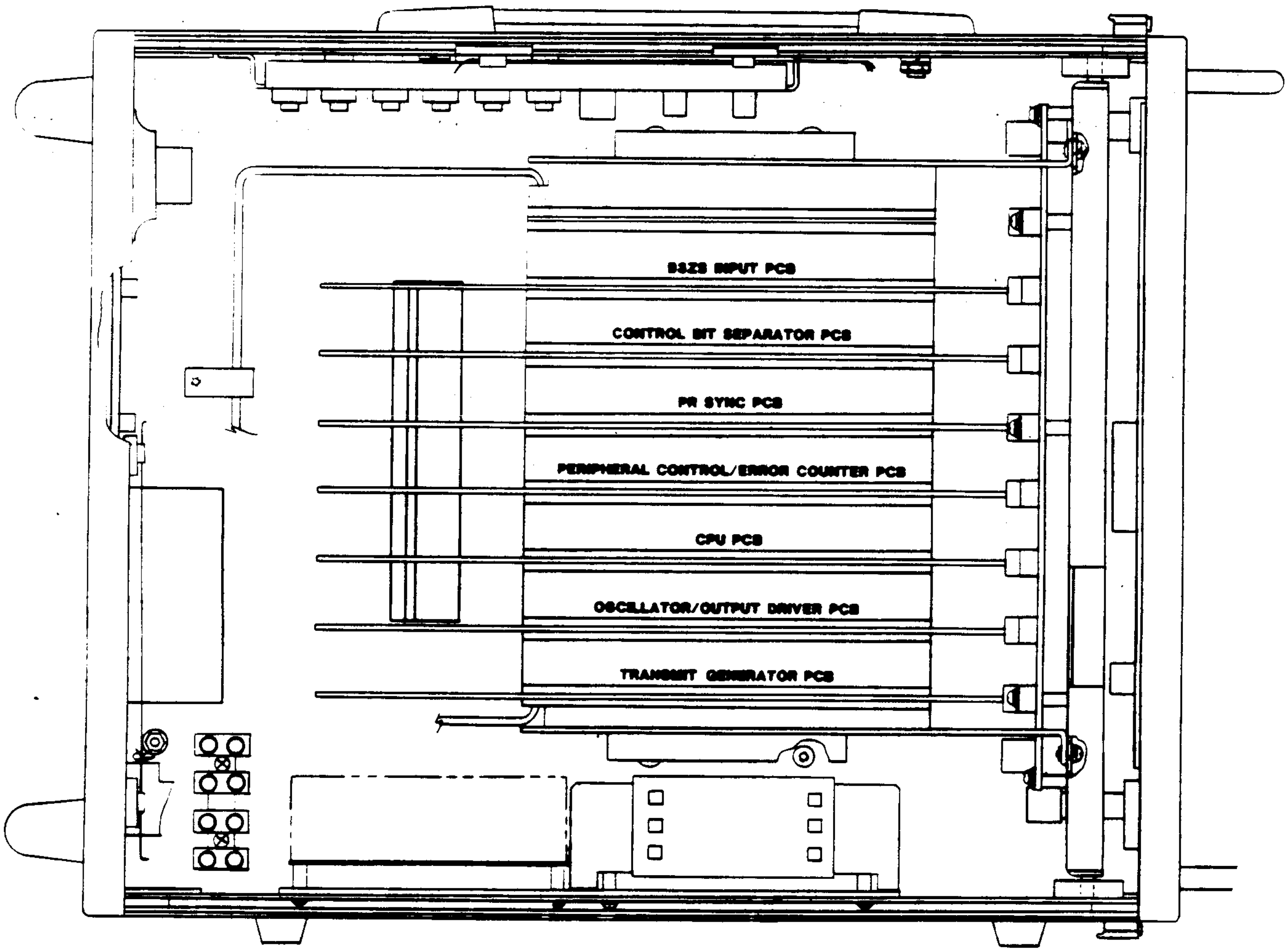


Fig. 15-S5250 PC Board Configuration

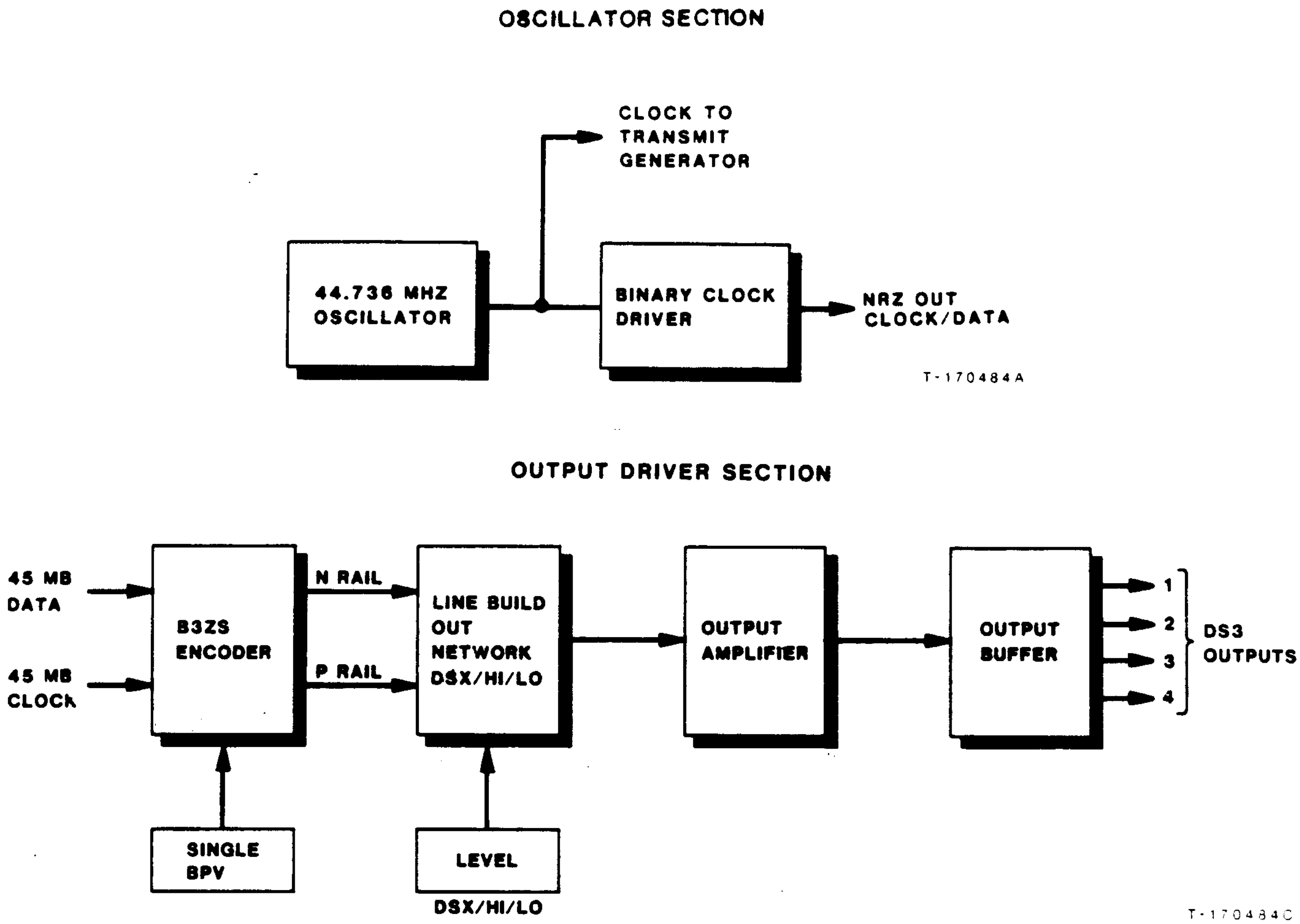


Fig. 16-Oscillator/Output Driver PC Board Functional Block Diagram

two functional sections, an Oscillator and an Output Driver.

6.06 The Oscillator section contains a 44.736 MHz crystal-controlled ›cillator. The Oscillator's output is through an ECL (Emitter-Coupled :) driver circuit to the Transmit ›ator PC Board.

›lso contained in the Oscillator ›tion is a circuit that converts ›data and timing signals, from ›nit Generator PC Board, to Return to Zero) signals. › are sent to the side panel ›OCK and DATA output

6.08 The Output Driver section converts the NRZ data to B3ZS format, sets the output level of the signal, and injects single bipolar-pulse-violations into the B3ZS output when the front panel SINGLE ERR BITS/BPV pushbutton is pressed.

6.09 The binary NRZ data and the timing information from the Transmit Generator are sent to the B3ZS encoder on the Output Driver section of the Oscillator/Output Driver PC Board. Two RZ rails are generated by the B3ZS encoder: a P rail, and an N rail. These two rails are combined and amplified, sent through a pulse amplifier, and applied to a line-build-out network. There are three sections of this network (DSX, HIGH, and LOW) which are selected by the front panel OUTPUT LEVEL pushbutton. DSX builds out 450 feet of cable, HIGH is straight 3, and LOW builds out 13.8 dB pad. The output of the amplitude-and-line-build-out network is fed to an output driver that drives four output buffers, each of which is connected to one of the four DS3 OUTPUTS connectors on the front panel.

Transmit Generator PC Board

6.10 The Transmit Generator PC Board (Fig. 17) generates the DS3 Master Frame data format and the $2^{15}-1$ (32,767) bit pseudorandom (PRBS) sequence for bit error measurements. It controls the following:

- Framed and unframed modes of operation
- Insertion of bit errors in the output data format
- Pseudorandom (PRBS) sequence
- Short patterns (1010 and 1111)
- Insertion of the "Blue Signal."

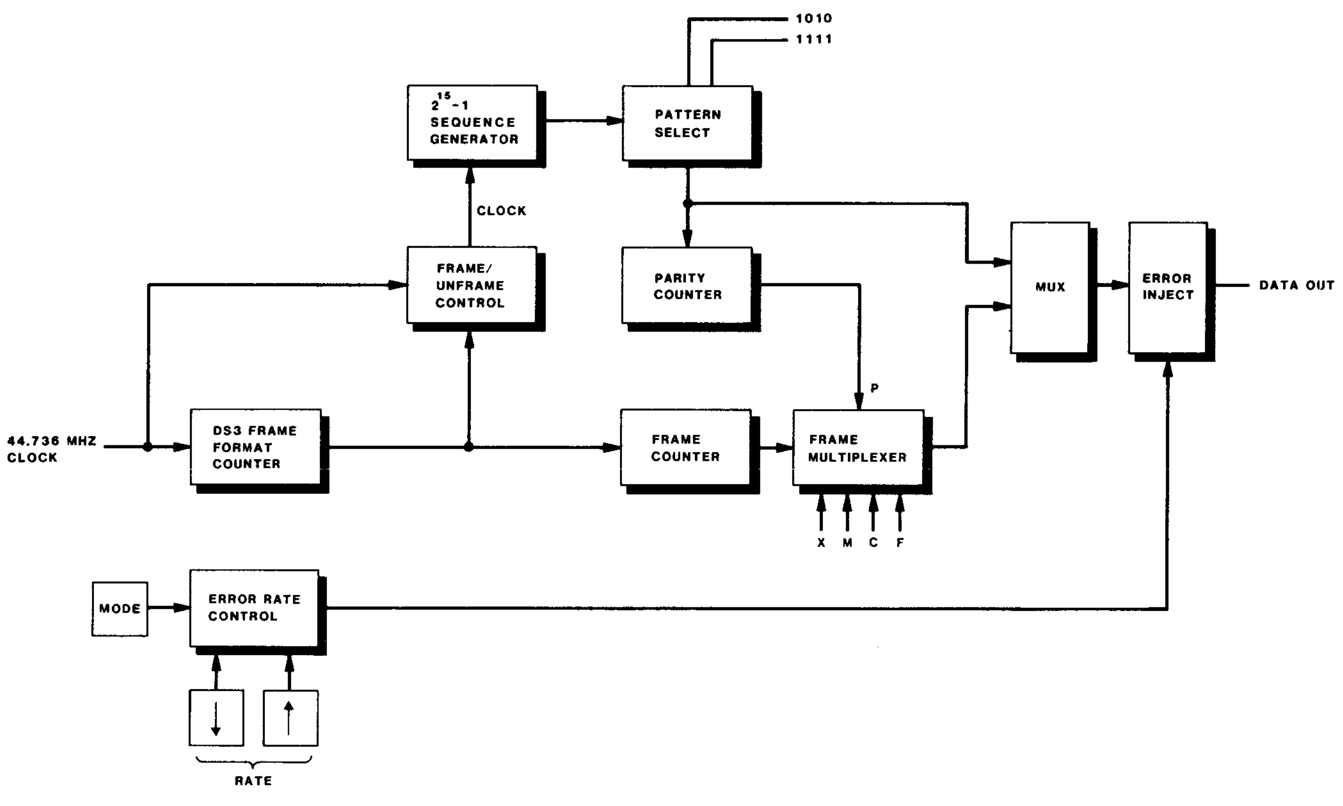


Fig. 17-Transmit Generator PC Board Functional Block Diagram

6.11 In the unframed mode of operation, the information bits are transmitted without insertion of the DS3 Master Frame format. The PRBS and short patterns (1010 and 1111) can be transmitted in the unframed mode of operation by selecting the desired pattern with the OUTPUT PATTERN pushbutton.

6.12 In the framed mode of operation, the DS3 Master Frame data bits are inserted into the information bits.

6.13 The DS3 format contains 4,760 bits per Master Frame, 56 of which are frame bits. The Transmit Generator generates the proper X, F, C, P, and M frame bits and inserts them into the data pattern.

6.14 A 44.2 MHz gapped clock is generated so that the pseudorandom sequence operates at the information bit rate. During the gapped output of the sequence, the frame bits are inserted.

6.15 In the framed mode of operation, the Transmit Generator counts all the information bits in the Master Frame. If the digital sum of all 4,704 information bits is 1, then the PP frame bits in the next Master Frame are 11. If the sum is 0, then PP = 00. These are the parity bits in the DS3 format that are used for measuring live traffic in a DS3 transmission system.

6.16 The Transmit Generator PC Board contains circuitry to inject bit error rates in multiples of 10 from 10^{-9} to 10^{-2}. The rate is set by the ERROR INJECT MODE pushbutton and RATE 10^{-N} Thumbwheel Switch. The errors are injected in an asynchronous manner. Therefore, errors are applied to all bits within the 4,760 bit format, including the frame bits.

6.17 A Blue Signal can be generated in the framed mode. It is a 1010 pattern with DS3 frame bits inserted.

6.18 The Transmit Generator also generates the PR-Sync and MSync pulses. The PR-Sync occurs once every 32,767 bit pseudorandom sequence. The M-Sync occurs once every 4,760 bit DS3 Master Frame and is transmitted out the M SYNC BNC connector on the side panel.

C. Receiver

6.19 The Receiver consists of five plug-in PC boards and the front panel PC Board.

B3ZS Input PC Board

6.20 When the INPUT DSX MON or HI/LO LEVEL is selected, the DS3 signal goes through an AGC (Automatic Gain Control) amplifier that works with an input signal level approximately 30 db below the normal DSX3 cross-connect level (see Fig. 18). The signal from

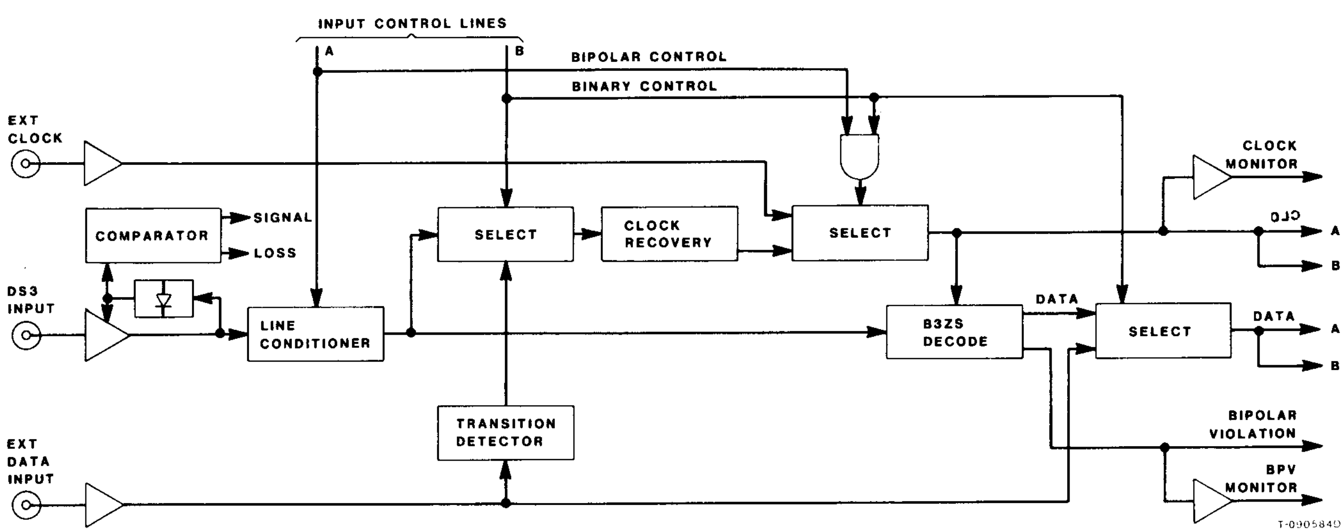


Fig. 18-B3ZS PC Board Functional Block Diagram

the AGC amplifier is converted to RZ (Return to Zero) data, which is then fed to a phase-locked loop for timing recovery. The RZ data and timing information are sent to the B3ZS decoder where it is converted to NRZ data and sent to the Control Bit Separator PC Board and PR Sync PC Board.

6.21 The B3ZS Input PC Board also detects bipolar violations (BPV) in the B3ZS signal. The BPV output is sent to the Error Counter section of the Peripheral Control/Error Counter PC Board.

6.22 When the NRZ IN CLOCK and DATA connectors, on the side panel, are used, the AGC amplifier and phase-locked loop are bypassed.

6.23 The no-signal (NO-SIG) alarm is generated on the B3ZS Input PC Board and applied to the Peripheral Control/Error Counter PC Board where it is read by the system software and displayed on the NO-SIG indicator on the front panel.

6.24 The B3ZS Input PC Board can be strapped for different binary data and clock input options. There are four jumper plugs located in the lower left-hand corner of the PC Board as viewed from the component side with the connector fingers positioned to the left.

Control Bit Separator PC Board

6.25 The Control Bit Separator PC Board (Fig. 19) is used only when the Receiver is in the framed mode of operation.

6.26 The 44.736 Mb/s data and the timing (clock) signals are input to the Control Bit Separator PC Board from the B3ZS Input PC Board. The output is a 44.2 MHz gapped clock that is sent to the PR Sync PC Board.

6.27 The Control Bit Separator PC Board performs the following functions:

- Locates the DS3 frame information
- Counts parity on the incoming data and compares it to the transmitted parity bit
- Generates parity errors whenever the parity bits do not compare. The parity errors are sent to the Error Counter section of the Peripheral Control/Error Counter PC Board
- Removes the information data from the DS3 signal and sends it to the PR Sync PC Board.

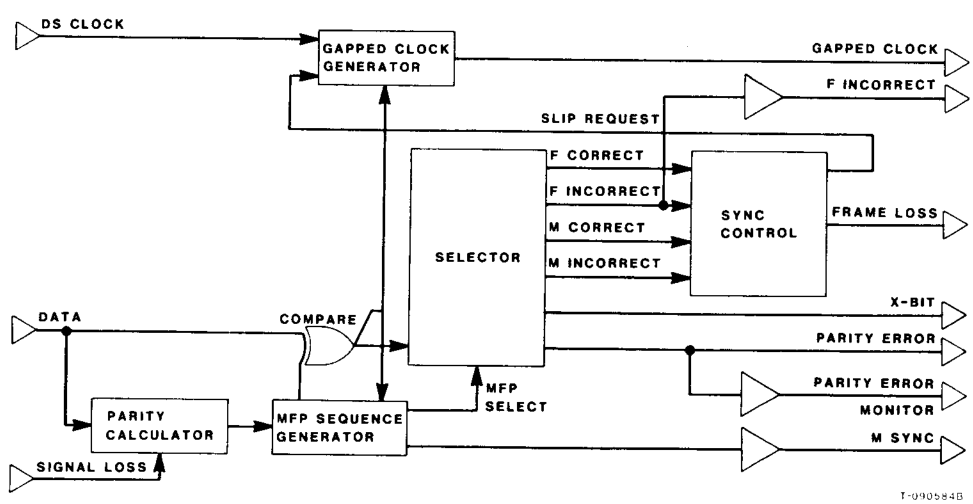


Fig. 19-Control Bit Separator PC Board Functional Block Diagram

PR Sync PC Board

6.28 The PR Sync PC Board (Fig. 20) consists of the following:

- 2^{15}-1 pseudorandom (PRBS) sequence generator
- Clock-select circuit
- Blue signal detector
- Data-sync circuit.

6.29 The PR Sync PC Board synchronizes to the incoming data and searches for errors in the data.

6.30 In the unframed mode, the B3ZS Input PC Board inputs a 44.736 Mb/s data and timing (clock) signal to the PR Sync PC Board. The data input is a 2^{15}-1 pseudorandom (PRBS) sequence that is generated by the Transmitter. The data signals are forced into the 2^{15}-1 sequence generator to synchronize the generator with the incoming data pattern. The generator is forced into its free-running mode when it is synchronized. The incoming data is then compared to the sequence generator data on a bit-by-bit basis. If any bit does not compare, then a bit error is generated and sent to the Error Counter section of the Peripheral Control/Error Counter PC Board.

6.31 In the framed mode, the operation is the same, except the timing input is selected from the Control Bit Separator PC Board. This timing input, the gapped clock, is the DS3 clock, except it has a pulse missing every 85th clock pulse. The missing pulse represents the frame information in the DS3 format. The gapped clock input reads the 2^{15}-1 data pattern into the sequence generator. However, due to the missing clock pulse, it does not read the frame information into the sequence generator.

6.32 The PR Sync PC Board also detects the Blue signal in the framed mode of operation. The Blue signal is a 1010 signal every 84 bits followed by one frame bit. When the Receiver is monitoring live traffic, the PR Sync PC Board's only function is the detection of the Blue signal.

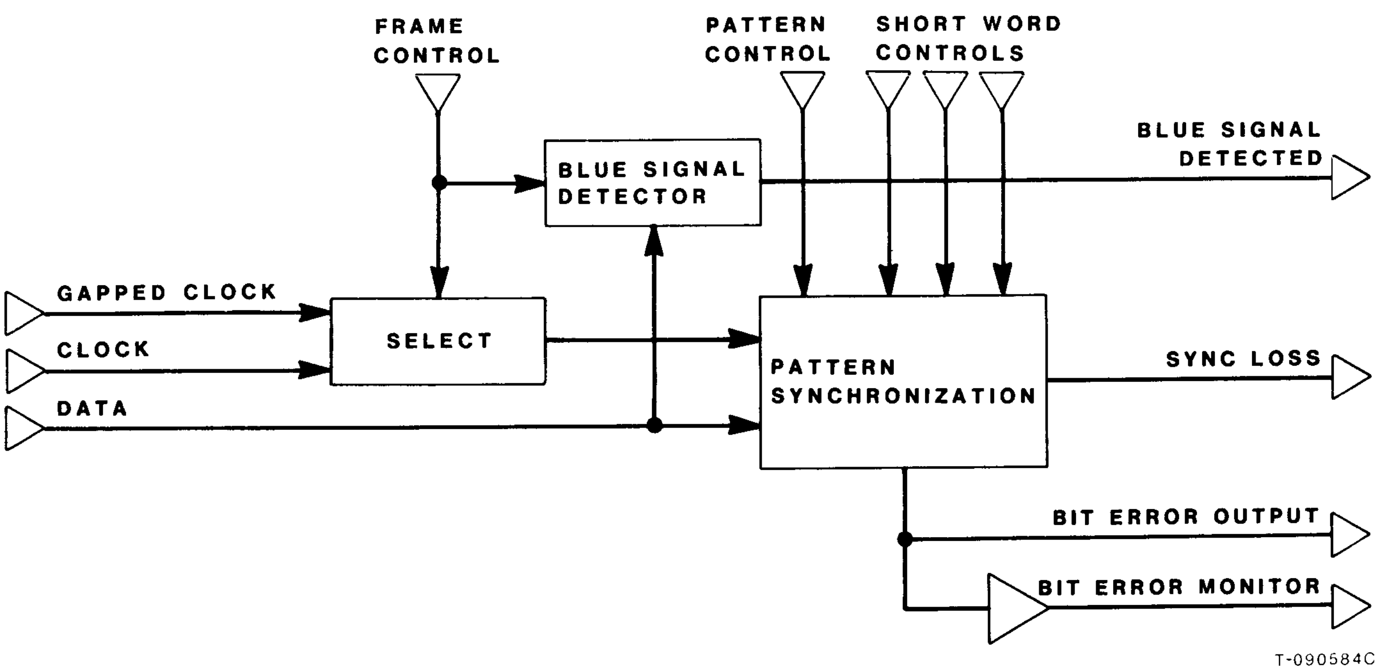


Fig. 20-PR Sync PC Board Functional Block Diagram

6.33 The sync-loss alarm and Blue signal detected signals are generated by the PR Sync PC Board and sent to the Peripheral Control/Error Counter PC Board where they are read by the system software and displayed on the NO-SYNC and BLUE front panel STATUS indicators.

CPU PC Board

6.34 The CPU PC Board (Fig. 21) performs the central processing functions and the serial interfacing function. It uses a Z80 microprocessor and generates all the signals used to control the 8-bit STD bus. The input-output of the bus is through a 56-pin edge connector on the front of the board.

6.35 The CPU PC Board contains the following:

- Microprocessor system 2.4576 MHz clock
- 2K of RAM used for system software
- Z80 microprocessor
- Input/output bus interface circuitry.

6.36 The RS-232C serial interface is an option and, when installed, the circuitry that controls the interface is located on the CPU PC Board.

6.37 The information from the 8-bit microprocessor bus is fed into a Universal Asynchronous Receiver Transmitter (UART) and fed out of the UART in serial form to the RS-232C level interface circuitry.

6.38 The output baud rate of the interface is set by a baud rate 8-section DIP switch located on the rear panel of the S5250.

Peripheral Control/Error Counter PC Board

6.39 The Peripheral Control/Error Counter PC Board (Fig. 22) interfaces all system control and status lines with the CPU PC Board. The CPU BUS INTERFACE and ADDRESS DECODE circuitry enables the CPU to retrieve or output data.

6.40 The F/P (Front Panel) CONTROL circuit contains the main F/P CONTROLLER, which receives pushbutton inputs from the front panel and outputs all display information to the front panel.

6.41 All the system status information is collected by the STATUS LATCH and is output to the CPU BUS INTERFACE for retrieval by the CPU.

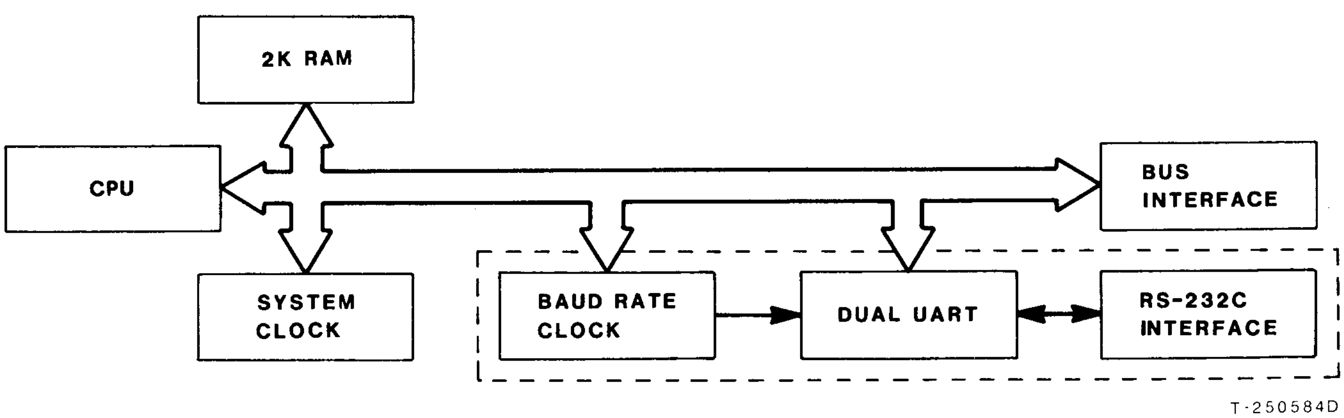


Fig. 21-CPU PC Board Functional Block Diagram

6.42 The SYSTEM CONTROL circuit contains three latches: TX CNTRL LATCH, ERROR INJ. CENTRL LATCH, and RX CNTRL LATCH. All control lines for the Transmitter section of the S5250 are contained in the TX CNTRL LATCH. The internal Error Inject section of the Transmitter and the Audio Alarm circuit are controlled by the CPU through the ERROR INJ. CNTRL LATCH. The RX CNTRL LATCH contains all Receiver control lines.

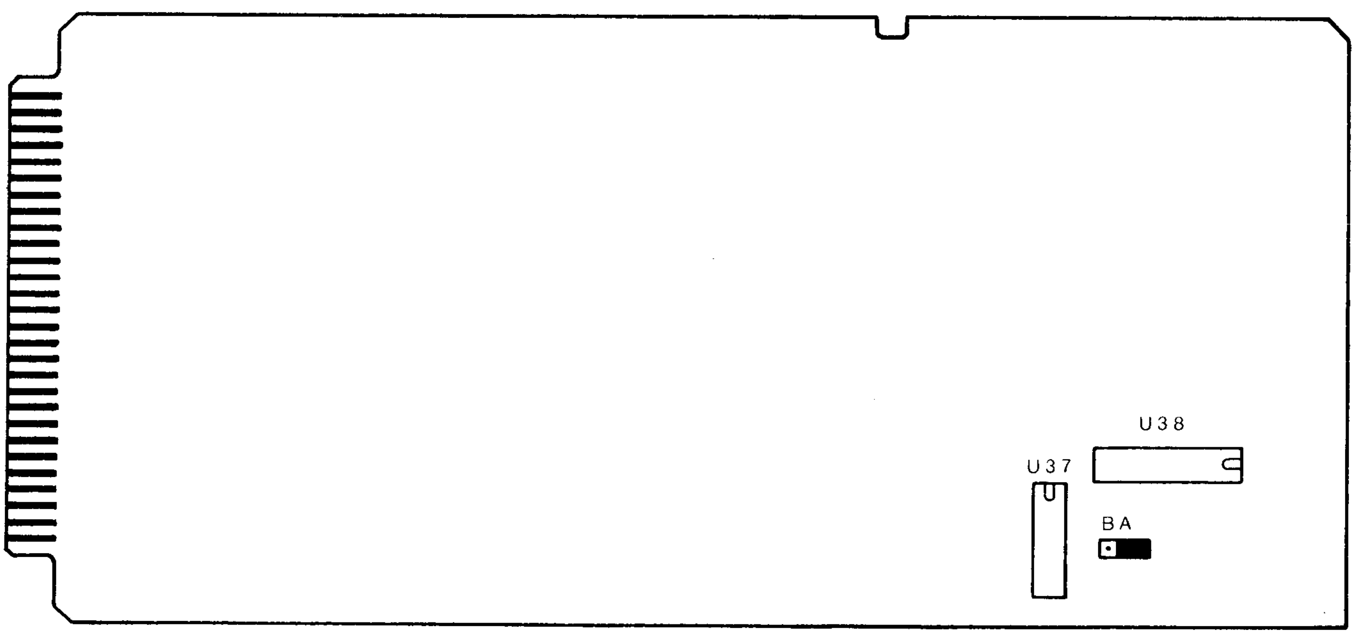
6.43 All the ERROR INPUT circuitry and the ERROR MUX are contained in the ERROR SELECT circuit. The CPU selects one of the available Error Inputs through the two MUX CNTRL lines from the RX CNTRL LATCH.

6.44 The type of error selected by the ERROR SELECT circuit is sent to the ERROR CNTRL circuit, which includes a 24-bit ERROR COUNTER. The present error count is made available to the CPU through three 8-bit latches. The ERROR SECOND CONTROL accepts the Error Input from the ERROR MUX and times out one second. The output is then made available to the CPU through the STATUS LATCH.

6.45 A jumper (see Fig. 23) on the Peripheral Control/Error Counter PC Board allows the selection of synchronous or asynchronous error-seconds. The S5250 is configured, at the factory, for synchronous error seconds.

Front Panel PC Board

6.46 The Front Panel PC Board (Fig. 24) is the user interface to the S5250 and contains all the Decode and LED Driver circuitry. The main Front Panel Control circuitry is located on the Peripheral Control/Error Counter PC Board.



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NOTE: THE CONFIGURATION SHOWN (BLACK IS JUMPER POSITION) IS THE FACTORY SET POSITION. THIS SETTING IS FOR SYNCHRONOUS ERROR SECONDS. TO SET FOR ASYNCHRONOUS ERROR SECONDS, PLACE THE JUMPER OVER THE TWO PINS DIRECTLY BELOW THE LETTERS BA.

Fig. 23-Synchronous/Asynchronous Error Second Jumper Configurations

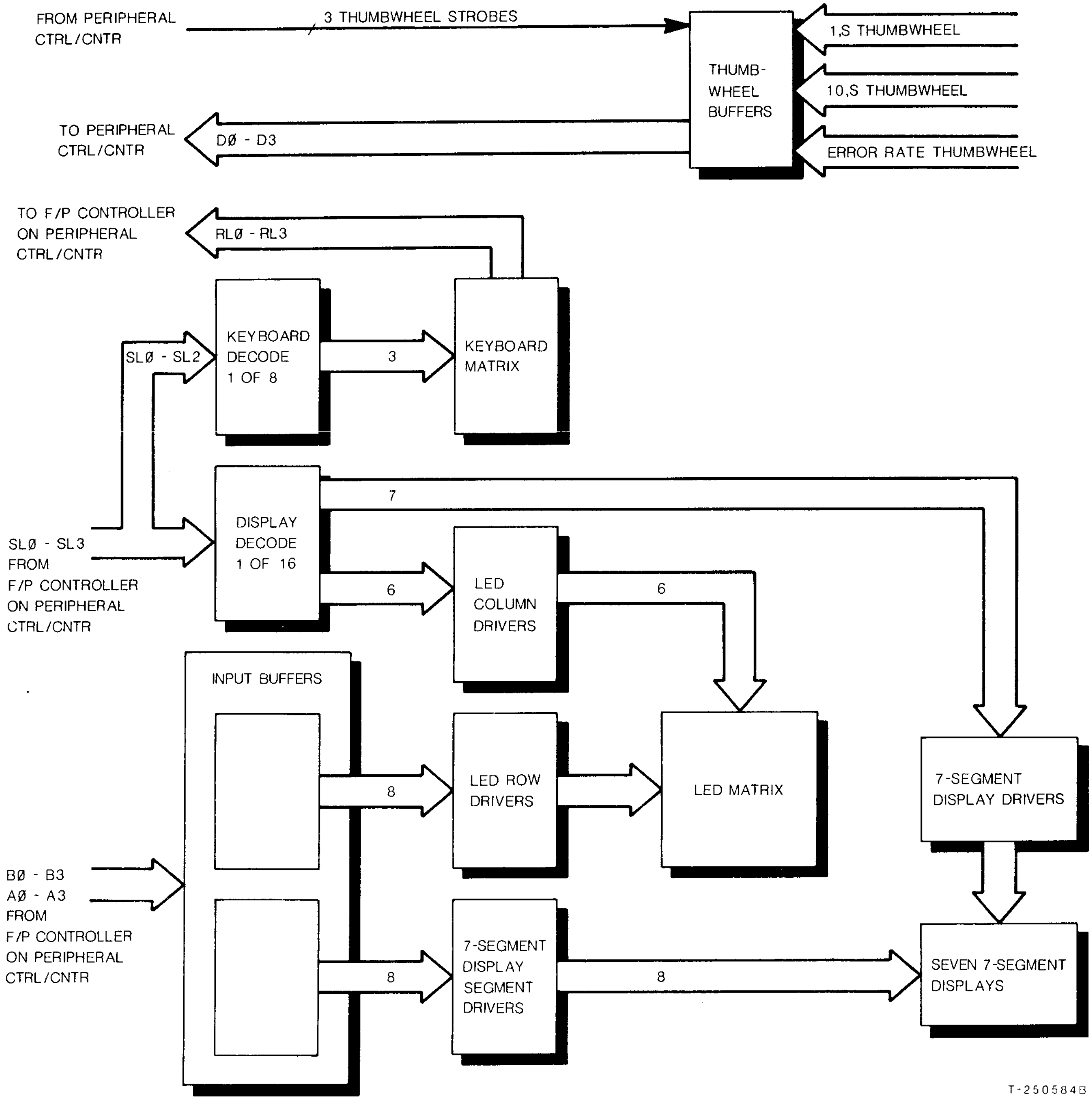


Fig. 24-Front Panel PC Board Functional Block Diagram

6.47 The KEYBOARD DECODE circuit decodes three of the four scan lines (SL0-SL2) from the F/P CONTROLLER. The decoded lines are sent to the KEYBOARD MATRIX, where any key pressed results in one of the Return Lines (RL0-RL3) going active. RL0-RL3 go to the F/P CONTROLLER where the key bit data is read by the CPU.

6.48 The DISPLAY DECODE circuit decodes the SL0-SL3 Scan Lines and feeds the LED COLUMN DRIVERS and the 7-SEGMENT DISPLAY DRIVERS. The LED COLUMN DRIVERS drive the six columns of the LED MATRIX. Only one column at a time is enabled by both the LED COLUMN DRIVERS and the 7-SEGMENT DISPLAY DRIVERS.

6.49 The F/P CONTROLLER sends data, that determines which display lights, to the INPUT BUFFERS. This data is sent from the INPUT BUFFERS to the LED ROW DRIVERS and the 7-SEGMENT DISPLAY SEGMENT DRIVERS. These drivers are used with the enabled column or 7-segment display to light any LED.

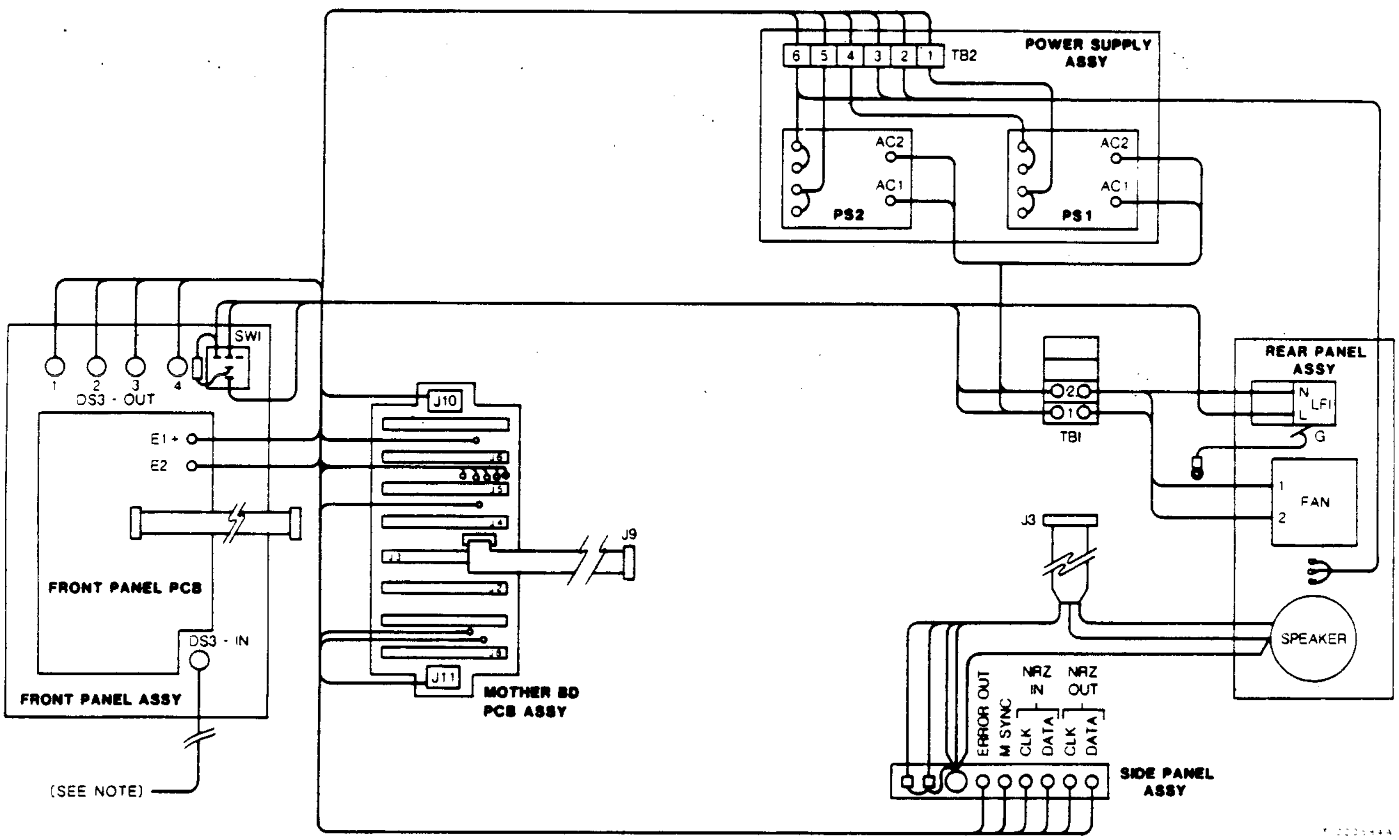
6.50 The LED MATRIX is composed of all the system status and set-up parameters displayed on the front panel.

6.51 All processed test data is displayed on the 7-SEGMENT DISPLAY.

6.52 The three THUMBWHEELS located on the front panel are strobed by the CPU approximately once every 25 milliseconds. The THUMBWHEEL (BCD) is the output to the Peripheral Control-Error Counter PC Board.

D. Power Distribution

6.53 The primary 115 power input is converted to +5V and -5.2 Vdc by the S5250 power supplies (PS1 and PS2) and distributed to the S5250 system, as illustrated in Fig. 25.



NOTE: FLOATING LEAD WITH NO ELECTRICAL CONNECTION.

Fig. 25-S5250 Power Distibution

SECTION 7

SERVICE AND MAINTENANCE

7. SERVICE AND MAINTENANCE

A. Assistance

7.01 For service assistance, call the Tau-tron Customer Service Department, (617) 256-9013 or 1-800-TAUTRON. Their experience and expertise can often save you valuable time in correcting any equipment malfunction.

B. Repair Returns

7.02 If it is determined that the S5250 must be returned to the factory for repair, use the Repair Returns Card at the back of this manual and follow the directions to ensure prompt service.

C. Routine Service

7.03 The fan air filter on the S5250 rear panel must be vacuumed periodically. The dustier the working environment is, the more frequently this task must be performed.

Warning: Failure to keep the fan air filter clean may result in overheating of the S5250, causing damage to the unit.

7.04 Other than occasionally cleaning the exterior surface with a mild cleaner, no other periodic maintenance of the S5250 is required.

APPENDIX A

DS3 TESTING

APPENDIX A DS3 TESTING

A. General

A.01 This section explains the DS3 testing function of the S5250. The following information is emphasized:

- DS3 Signal Format
- Parity Error Testing
- Bit Error Testing
- Bipolar-Pulse-Violation (BPV) Testing
- System Characterization Using Error-Seconds.

B. DS3 Signal Format

A.02 The 44.736 Mb/s DS3 signal format generated by the Transmitter section of the S5250, MX3, and other multiplexers provide the basis for all DS3 framed measurements. Parity measurements on live traffic signals are made utilizing the DS3 format, as shown in Fig. 26.

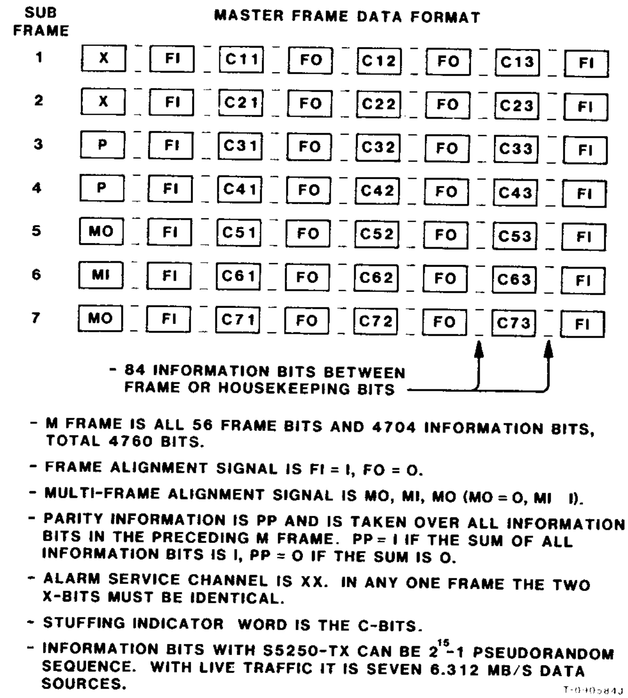


Fig. 26-DS3 Signal Format

A.03 There are seven subframes in the Master, or M Frame. Each subframe consists of eight groups of one housekeeping bit and 84 information bits.

A.04 The groups of 84 information bits can consist of sequences such as pseudorandom bit sequences (PRBS), short repeating bit sequences generated by test sets, system information such as live traffic, or patterns such as "Blue Signal" codes. When live traffic is being transmitted, the 84 data bits consist of 7 DS2 signals sampled 12 times. The 6.312 Mb/s DS2 signal is made of four 1.544 Mb/s DS1 signals. The DS1 signal can contain 24 PCM encoded voice channels. Therefore, a complete DS3 signal can contain 24 x 4 x 7 = 672 voice channels.

A.05 The DS3 housekeeping bits occur once every 85 bits and serve a variety of purposes. The 2nd, 4th, 6th, and 8th housekeeping bit in each subframe is termed the F-bit, or Frame Alignment signal. This 4-bit sequence of F1, F0, F0, F1 = 1001 is identical for each subframe. This known, repeating sequence is searched for and located by demultiplexing or test equipment so that the positions of the 84 information bits and housekeeping bits can be determined.

A.06 Demultiplexing or test equipment circuitry then must locate the seven subframes. The Marker bits, or M bits, are a sequence of M0, M1, M0 = 010 in the 5th, 6th, and 7th subframe of each Master Frame that serves this purpose. The method of locating the F and M bits is determined by the framing algorithm used in the communications equipment and is an important parameter in any system. The time to acquire DS3 Frame Synchronization depends on the algorithm used, and typically takes two to three milliseconds.

A.07 Once the subframes are located, the seven stuffing indicator words corresponding to the seven multiplexed DS2 channels are known. These 3-bit words (C11, C12, and C13 in Subframe 1) are always all zeros, or all ones, indicating the absence or presence of stuffing bits necessary for the asynchronous multiplexing and demultiplexing of the DS2 channels.

A.08 Subframe location also defines the Parity (or P-bit) and X-bit locations. The P bits in a Master Frame are used to provide a measure of error performance in the previous Master Frame. If the digital module-2 sum of all 7 x 8 x 84 = 4,704 information bits in a Master Frame is 1, then PP = 11 is output by the multiplexing or transmitting equipment in the next Master Frame. If the sum is 0, then PP = 00 is output. The demultiplexing equipment or test set receiver counts the 4,704 information bits in the Master Frame and compares this sum to the PP bits in the incoming format. If a transmission error has occurred in the information bits, the PP will not compare. The parity bits can be used to detect transmission errors in live traffic. However, if the error rate is such that double or even numbers of errors occur in a Master Frame, the parity error measuring becomes invalid. This occurs at error rates worse than $1/4{,}704 = 2.1 \times 10^{-4}$.

C. Parity Error Testing

Use

A.09 The parity-error mode is used to measure live traffic on standard data format DS3 signals generated by MX3 or M13 multiplexers (see Fig. 27). Parity measurements can be made on

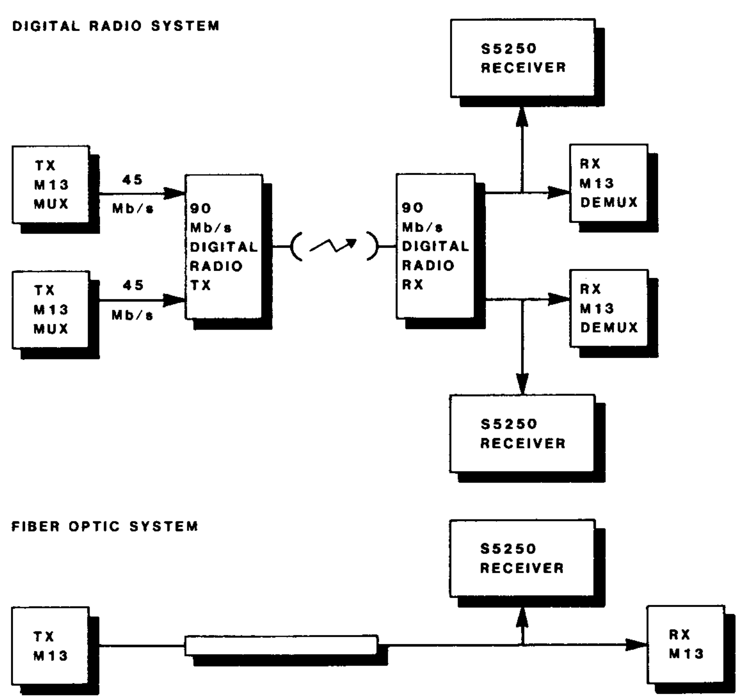


Fig. 27-System Testing for Parity Errors

single hops or multi-hops if the parity is not restored at each repeater in the multi-hop system.

Parity Code

A.10 The multiplexer counts all the information bits in one Master Frame of 4,760 bits (see Fig. 26). If the digital sum of all 4,704 information bits is 1, then PP = 11 in the next Master Frame. If the sum is 0, then PP = 00 in the next Master Frame.

Parity Measurement

A.11 The S5250 Receiver monitors the DS3 signal at the receive end of the transmission system, finds the frame, and counts all of the 4,704 information bits in the Master Frame. It then compares the digital sum to the PP bits in the incoming format and, if they do not agree, generates a parity error.

Even Number of Errors

A.12 At the Transmitter, if the digital sum is 1 and one bit error is made in one detected Master Frame during transmission, the digital sum at the Receiver will be 0 for that Master Frame, and one parity error will be generated. Any odd number of bit errors (1, 3, 5, etc.) made in one Master Frame during transmission will be detected at the Receiver as one parity error. Any even number of bit errors (2, 4, 6, etc.) made in one Master Frame during transmission will not be detected at the Receiver.

Parity Errors vs. Bit Errors

A.13 The even/odd information from one frame is stored and compared to the parity bit received in the next frame. A difference indicates at least one data bit was in error. In general, the parity error rate will track the bit error rate, but is limited to representing one data bit error in a frame (1 error bit divided by 4,704 data bits = 2.1×10^{-4} error rate). For error rates greater than this, bit errors will often be greater than parity errors.

Error Multiplication Factor

A.14 Most designers of digital systems use scramblers and descramblers and/or modulation schemes that cause a multiplication effect. This effect may result in three or more received errors from a single transmitted error. Fortunately, the error multiplication effect typically is contained within the 4,704-bit frame. Usually system designers have made assurances that a statistically defined number of odd error sequences will occur so that the parity will still reflect bit errors. System manufacturers can supply the error multiplication factor for any particular system to allow the effective bit error rate to be determined by measuring the parity error rate.

D. Frame Error Testing

Use

A.15 The frame-error mode is used to measure live traffic on standard data format DS3 signals generated by MX3 or M13 multiplexers (see Fig. 27). Generally, parity measurements can be made on single hops or multi-hops if the parity is not restored at each repeater in the multi-hop system. Most multi-hop systems that restore parity do not generally restore or correct the frame, F1 and F0, bits. For these systems, frame error measurements may be the only way to detect system errors on live traffic. Also, for systems with error rates exceeding 2.1×10^{-4} error rate (the parity error measurement limit), frame error measurements provide and accurate way to determine error rate.

A:16 There only 28 frame alignment bits (F1 and F0) in a Master Frame, as compared to the 4704 information bits used in a parity measurement. Therefore, longer measurement times are required for frame measurements to achieve the same statistical accuracy as a parity measurement.

E. Bit Error Testing

Use

A.17 Bit error measurements are usually made during the initial installation of digital transmission systems (see Fig. 28). They are made using either the 2^{15}-1 (32,767) bit pseudorandom (PRBS) pattern, or short patterns generated by an S5250 Transmitter. Bit measurements can be made in the framed or unframed mode, depending on the system requirements.

Test Patterns

A.18 Bit error test equipment utilizes pseudorandom binary sequences or short patterns as the test pattern. The PRBS sequences, also called quasi-random sequences, are generated using digital shift register techniques. Their properties are such that the patterns appear to be random in nature, because the density of 1s and 0s in the sequence are approximately equal. Another characteristic of these sequences is that they repeat after some number of bits. The length of the sequence in terms of its number of bits is 2^n-1, where n is the number of stages in the shift register generating the sequence. For the S5250, n equals 15. Therefore, the length of the pseudorandom binary sequence before it repeats is 32,767 bits. Since the sequences repeat, it is easy to synchronize an incoming sequence received by a Receiver with a locally generated version of the same sequence.

Bit Measurements

A.19 The S5250 Transmitter output is applied to the transmit end of the system, and the S5250 Receiver input is connected to the receive end. The Receiver synchronizes to the incoming pattern and compares it, bit by bit, to its own internal pseudorandom generator reference pattern. Any difference is counted as an error.

A.20 For systems not carrying live traffic, bit error measurements provide the most accurate assessment of system performance. With bit testing, several configurations are possible. Some parts of the systems do not require the DS3 format to operate properly. Inputs and outputs to some digital radio and fiber optic systems often only require the 44.736 Mb/s DS3 rate and do not require framing bits. For these situations, it may be desirable to utilize the unframed mode of the test set to eliminate the DS3 frame acquisition time of the receiver. For example, short patterns can be used in bit testing and a comparison of system performance between pseudorandom and short patterns can often be used in some systems to detect misalignment problems or timing recovery problems.

F. Bipolar-Pulse-Violation (BPV) Testing

A.21 Bipolar-Pulse-Violation (BPV) testing is valid for live traffic testing of cable systems and entrance links even though this type of testing has limited usefulness for DS3 systems.

A.22 The DS3 signal has a bipolar signal format. This means that all binary logical zeros are transmitted as a 0V signal, and all binary logical ones are transmitted as positive or negative pulses of widths equal to one-half the clock period. Bipolar coding requires that these pulses alternate in polarity. A noise impulse on a cable system or entrance link may cause a 0V logical zero to be recognized as a bipolar pulse or may cause a legitimate bipolar pulse to be recognized as a 0V logical zero. Either impairment will result in received bipolar pulses

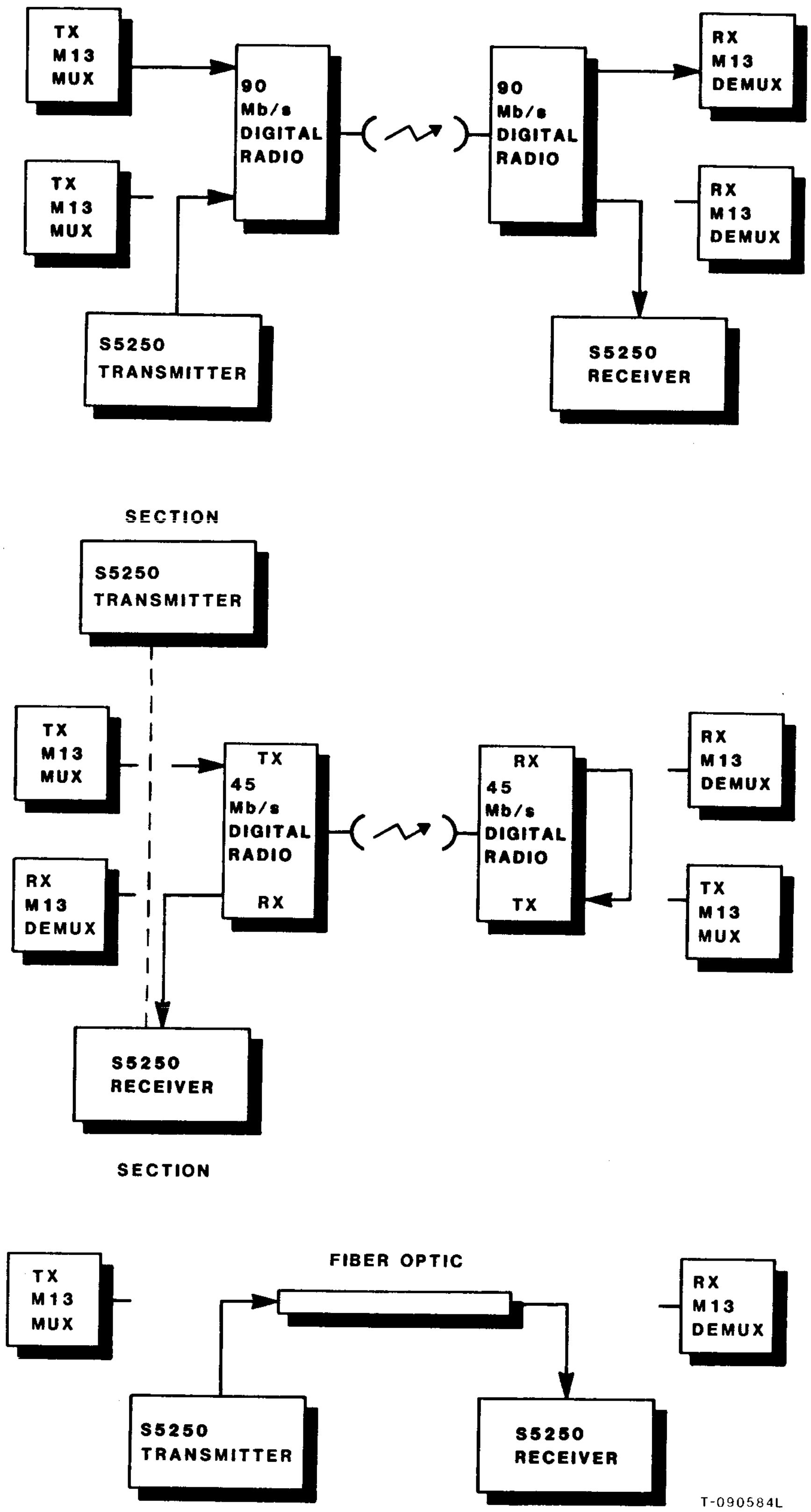


Fig. 28-System Testing for Bit Errors

that do not alternate in polarity, but are of the same polarity. Therefore, a performance determination can be made on a signal with a bipolar format without regard for data content or framing format.

A.23 The DS3 signal coding also requires a Bipolar 3 Zero Substitution (B3ZS) code. When three zeros are present in the binary data, substitution codes consisting, in part, of a bipolar violation are transmitted instead. The codes are varied to maintain the 0V average DC level of the bipolar signal and are transmitted to guarantee activity on the line as some minimal activity is a requirement of some regenerative repeaters and DS3 terminating equipment. This B3ZS coding makes BPV error measurements slightly more complex in that legitimate violation codes are not recorded as errors.

A.24 The S5250 Receiver is excellent for BPV error measurements with its high input sensitivity and cable equalization optimized for 450 to 900 feet of 728A cable. However, BPV measurements of the DS3 signal have limited usefulness. Since the DS3 format includes a parity check, live traffic parity measurements are usually used. When bipolar pulses are passed through digital processing circuitry, the bipolar pulses are converted to binary logic levels and then processed. When these binary levels are then converted back to bipolar signals, any input bipolar violations are lost and not retransmitted. Therefore, BPV measurements can only be used to test a single section of a system. Where the DS3 framing format is available, parity measurements often provide useful results.

G. System Characterization Using Error-Seconds

Synchronous Error-Seconds

A.25 The error-second is one measurement accepted as an indicator of performance. It is defined as a one-second period in which there are one or more errors. Specified limits for error-seconds are required for some systems. Error-seconds have been used to compare systems and evaluate the effects of various parameters on system performance.

A.26 Two types of error-second measurements are in general use, synchronous and asynchronous (see Fig. 29).

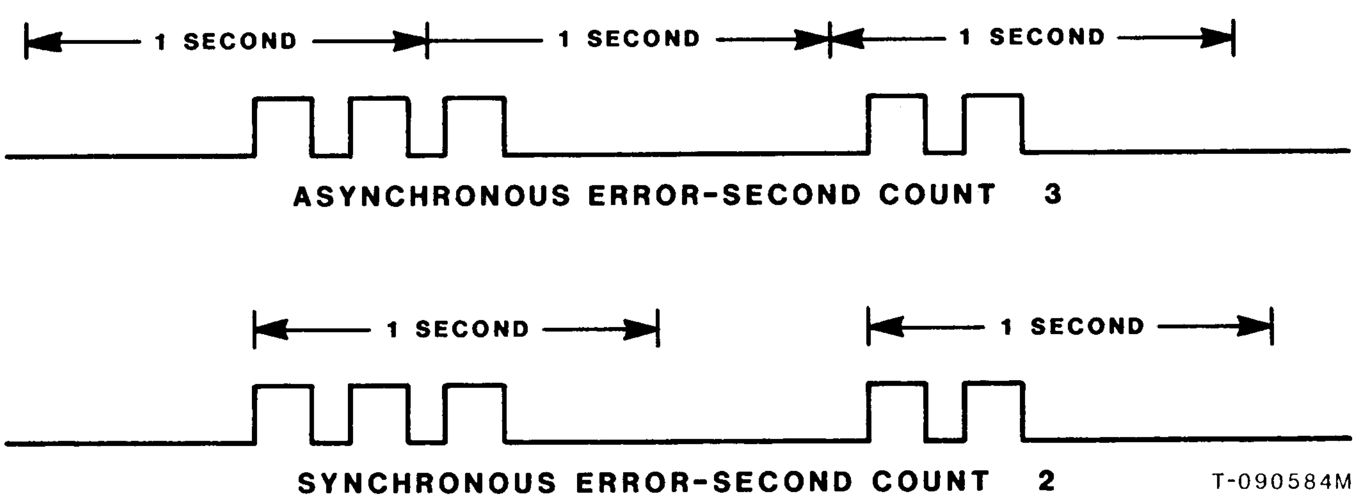


Fig. 29-Synchronous and Asynchronous Error Second Format

A.27 With asynchronous measurements, contiguous one-second measurements are made starting at some time independent of the errors. Any error or errors occurring during any one-second interval registers as an error second. With synchronous measurements, the one-second measurements are triggered by the errors.

A.28 Synchronous error-second measurements always give the lowest possible count and always give consistent counts. Two test sets making the same measurement will always read the same. For these reasons, synchronous error-second measurements are used by Tau-tron and are preferred by industry.

APPENDIX B

FAIL CODE DISPLAYS

APPENDIX B FAIL CODE DISPLAYS

B.01 Under certain unusual conditions, a FAIL code may appear on the Display. If one of these codes appears and persists, the user should contact a factory representative for assistance. Following below are the FAIL codes and their meanings:

- FAIL 0- The exponent of the current error rate is greater than 9 (over the acceptable range)
- FAIL 1- The number of errored seconds is greater than the elapsed time
- FAIL 2- Tried to loop an extra time in order to read input BIT errors
- FAIL 3- No longer implemented
- FAIL 8- Tried to access beyond the range of measurement catagories
- FAIL 9- Tried to repeat a test with a value greater than hours
- FAIL 10- A non-supported interrupt vector is generated
- FAIL 11- Prom test failed
- FAIL 12- Ram test failed.

APPENDIX C

MODEL 5901 PRINTER

APPENDIX C MODEL 5901 PRINTER

C.01 When using the RS-232C compatible Tau-tron Model 5901 Printer, set the DIP switches on the S5250 as shown below.

DIP SWITCH SETTING FOR TAU-TRON PRINTER

Switch	1	2	3	4	5	6	7	8
Setting	OFF	OFF	ON	OFF	OFF	OFF	ON	OFF

OFF = 0 (Down); ON = 1 (UP)

C.02 The 5901 Printer is designed for S5250 applications. Interfacing the printer to the S5250 requires a null modem and 9-wire RS-232C cable.

C.03 For RS-232C interfacing, equipment is classified as either Data Terminal Equipment or Data Communications Equipment (DTE or DCE). When similarly configured equipment tries to talk to each other, a null modem is required. Since both the S5250 and the printer are configured as DTE, a null modem allows each device to interpret the other as DCE. Table I lists RS232C pin connections on both the S5250 and the printer showing the null modem wiring.

TABLE I

S5250 TO PRINTER NULL MODEM WIRING

S5250 PINOUT			PRINTER PINOUT
Protective Ground	1	1	Protective Ground
Transmitted Data Out	2	2	Transmitted Data Out - Unused
Received Data In	3	3	Received Data In - Data to be printed
Request To Send Out	4	4	Request To Send Out - Unused
Clear To Send In	5	5	Clear To Send In - Unused
Data Set Ready In	6	6	Data Set Ready In - Unused
Signal Ground	7	7	Signal Ground
Received Line Signal Detect In	8	8	Received Line Signal Detect In - Unused
Data Terminal Ready Out	20	20	Data Terminal Ready Out - Printer ready to accept data

C.04 All other wires in the 25-wire interface are not connected. A null modem with the configuration in Table I is shipped with the 40-Column (5901) Printer Option.

C.05 The RS-232C cable shipped with the printer is a 9-wire, 10-foot cable. The pinout is straight-through (no cross-connection) on pins 1-8 and 20. All other pins are not connected.

The printer is shipped from Tau-tron in the following configuration:

- 1200 baud
- 7-bit word length
- One stop bit
- No parity.

C.06 The DIP switches on the rear panel of the S5250 should be configured as follows to talk to the printer:

- 1200 baud
- 7-bit word length
- Two stop bits
- No parity.

Note: Configuring the S5250 to transmit two stop bits ensures the printer will detect the next start bit and re-sync to it.

APPENDIX D

RS-232C/RS-449 PINOUT REFERENCES

APPENDIX D RS-232C/RS-449 PINOUT REFERENCES

D.01 The Table below can be used as a reference for configuring RS-232C and RS-449 devices with the S5250.

TABLE J

PINOUT TABLE FOR EIA RS-449, EIA RS-232C/CCITT V.24

RS-449 Interface				RS-232 Interface				Signal Type & Direction						
37 PIN A	37 PIN B	RS449 CIRCUIT	RS449 DESCRIPTION	25 PIN	EIA-RS232C CIRCUIT	CCITT-V.24 CIRCUIT	RS232 DESCRIPTION	GND	DATA To S5250	DATA From S5250	CONTROL To S5250	CONTROL From S5250	TIMING To S5250	TIMING From S5250
1			Shield	1	AA	101	Protective Ground	X						
19		SG	Signal Ground	7	AB	102	Signal Ground/Common Return	X						
37		SC	Send Common			102a	DTE Common	X						
20		RC	Receive Common			102b	DCE Common	X						
4	22	SD	Send Data	2	BA	103	Transmitted Data			X				
6	24	RD	Receive Data	3	BB	104	Received Data		X					
7	25	RS	Request to Send	4	CA	105	Request to Send					X		
9	27	CS	Clear to Send	5	CB	106	Clear to Send				X			
11	29	DM	Data Mode	6	CC	107	Data Set Ready				X			
12	30	TR	Terminal Ready	20	CD	108.2	Data Terminal Ready					X		
15		IC	Incoming Call	22	CE	125	Ring Indicator				X			
13	31	RR	Receiver Ready	8	CF	109	Received Line Signal Detector			X				
33		SQ	Signal Quality	21	CG	110	Signal Quality Detector				X			
16		SR	Signaling Rate Selector	23	CH	111	Data Signal Rate Selector (DTE)					X		
2		SI	Signaling Rate Indicator	23	CI	112	Data Signal Rate Selector (DCE)				X			
17	35	TT	Terminal Timing	24	DA	113	Transmitter Signal Element Timing (DTE)							X
5	23	ST	Send Timing	15	DB	114	Transmitter Signal Element Timing (DCE)						X	
8	26	RT	Receive Timing	17	DD	115	Receiver Signal Element Timing (DCE)						X	
		SSD	Secondary Send Data	14	SBA	118	Secondary Transmitted Data			X				
		SRD	Secondary Receive Data	16	SBB	119	Secondary Received Data		X					
		SRS	Secondary Request to Send	19	SCA	120	Secondary Request to Send					X		
		SCS	Secondary Clear to Send	13	SCB	121	Secondary Clear to Send				X			
		SRR	Secondary Receiver Ready	12	SCF	122	Secondary Received Line Signal Detector				X			
10		LL	Local Loopback			141	Local Loopback					X		
14		RL	Remote Loopback			140	Remote Loopback					X		
18		TM	Test Mode			142	Test Indicator				X			
32		SS	Select Standby			116	Select Standby					X		
36		SB	Standby Indicator			117	Standby Indicator				X			
16		SF	Select Frequency			126	Select Transmit Frequency				X			
28		IS	Terminal in Service									X		
34		NS	New Signal									X		

NOTES:
References DB25 (25 pin) connector that is commonly used for RS232 & V.24 Pins 9 & 10 are reserved for data set testing. Pins 11, 18 and 25 are undefined. Pins 3 & 21 of RS449 interface connector are undefined.
Lead #23 of RS-232 connector may be defined as CH or CI. 37 pin designation B = return.