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User Manual

Tektronix

CSA 907A
Bit Error Rate Test Set

070-8685-00

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Instrument Serial Numbers

Each instrument manufactured by Tektronix has a serial number on a panel insert or tag, or stamped on the chassis. The first letter in the serial number designates the country of manufacture. The last five digits of the serial number are assigned sequentially and are unique to each instrument. Those manufactured in the United States have six unique digits. The country of manufacture is identified as follows:

B010000	Tektronix, Inc., Beaverton, Oregon, USA
E200000	*Tektronix United Kingdom, Ltd., London*
J300000	Sony/Tektronix, Japan
H700000	Tektronix Holland, NV, Heerenveen, The Netherlands

Instruments manufactured for Tektronix by external vendors outside the United States are assigned a two digit alpha code to identify the country of manufacture (e.g., JP for Japan, HK for Hong Kong, IL for Israel, etc.).

Tektronix, Inc., P.O. Box 500, Beaverton, OR 97077

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German Postal Information

Certificate of the Manufacturer/Importer

We hereby certify that the CSA 907A Bit Error Rate Test Set and all factory-installed options complies with the RF Interference Suppression requirements of Postal Regulation Vfg. 243/1991, Amended per Vfg. 46/1992

The German Postal Service was notified that the equipment is being marketed.

The German Postal Service has the right to re-test the series and to verify that it complies.

TEKTRONIX

Bescheinigung des Herstellers/Importeurs

Hiermit wird bescheingt, daß der/die/das CSA 907A Bit Error Rate Test Set and all factory-installed options in Übereinstimmung mit den Bestimmungen der Amtsblatt-Verfügung Vfg. 243/1991 funkentstört ist.

Der Deutschen Bundespost wurde das Inverkehrbringen dieses Gerätes angezeight und die Berechtigung zur Überprüfung der Serie auf Einhalten der Bestimmungen eingeräumt.

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NOTICE to the user/operator:

The German Postal Service requires that Systems assembled by the operator/user of this instrument must also comply with Postal Regulation, Vfg. 243/1991, Par. 2, Sect. 1.

HINWEIS für den Benutzer/Betreiber:

Die vom Betreiber zusammengestellte Anlage, innerhalb derer dieses Gerät eingesetzt wird, muß ebenfalls den Voraussetzungen nach Par. 2, Ziff. 1 der Vfg. 243/1991, genugen.

NOTICE to the user/operator:

The German Postal Service requires that this equipment, when used in a test setup, may only be operated if the requirements of Postal Regulation, Vfg. 243/1991, Par. 2, Sect. 1.8.1 are complied with.

HINWEIS für den Benutzer/Betreiber:

Dieses Gerät darf in Meßaufbauten nur betrieben werden, wenn die Voraussetzungen des Par. 2, Ziff. 1. 8.1 der Vfg. 243/1991 eingehalten werden.

001−0386−00D (Updated 10−16−92 by Tektronix EMC Lab JJ) To be included in manual or in the packaging of the instrument when certified to Vfg. 243/1991 as described in article 2 section 3 and 4 of Vfg. 243 for the declaration from the manufacturer.

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CSA 907A Description

The Tektronix CSA 907A Pattern Generator and CSA 907A Error Detector are bit error rate (BER) test devices for system and device evaluation in the frequency range of 150 kHz to 700 MHz. The CSA 907A Pattern Generator (transmitter) and CSA 907A Error Detector (receiver) can be used together as a bit error rate test set, or separately with other test equipment.

CSA 907A Functional Overview

The CSA 907A Bit Error Rate Test Set consists of a Pattern Generator, also known as the transmitter (T_X) and an Error Detector, also known as the receiver (R_X), each contained in a portable package. The basic application of the CSA 907A is illustrated by the block diagram, Figure 1-1, showing how the Pattern Generator, the Device-Under-Test (DUT), and the Error Detector are connected to perform a measurement. The Pattern Generator sends data and clock signals to the DUT which performs some transmission function and sends the resulting data and clock signals to the Error Detector for error measurement.

The Pattern Generator sends data on the rising edge of the Pattern Generator clock, and the Error Detector samples incoming data on the falling edge of the clock. The Pattern Generator clock can be sourced from a resident oscillator or from an external clock source.

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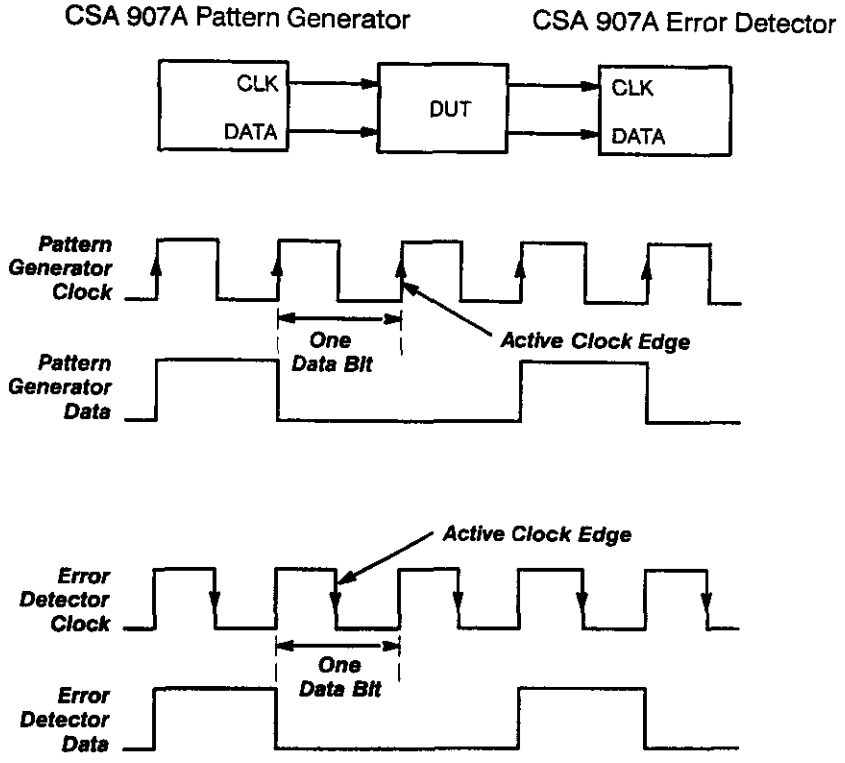


Figure 1-1: Basic System Connections

Operation with a Continuous Clock

The Error Detector first achieves synchronization and then performs the error measurement function. Time to achieve synchronization is a function of the pattern length, the specific pattern involved, and the clock frequency. See Figure 1-2.

If the error rate exceeds a certain level, the Error Detector ceases error measurement and attempts to achieve synchronization again. The error rate at which this occurs is operator selectable, and is called the Sync Threshold.

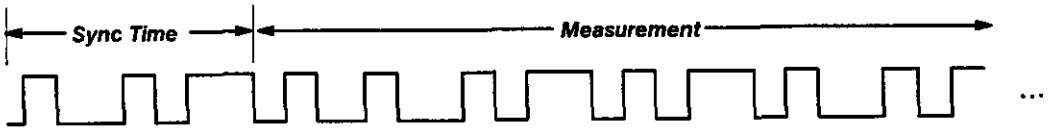


Figure 1-2: Error Detector Basic Behavior With Continuous Clock and Data

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Burst Mode Operation

The CSA 907A clock and data stream can be started and stopped without loss of synchronization or error measurement function. Burst Mode operation requires use of an external clock source to the Pattern Generator CLOCK EXT input which is started and stopped with full clock cycles. The Pattern Generator will use that clock and produce data and clock outputs for delivery to the DUT. The Error Detector will accept data and clock inputs that start and stop with full clock cycles and for which the data to clock relationship is consistent. See Figure 1-3.

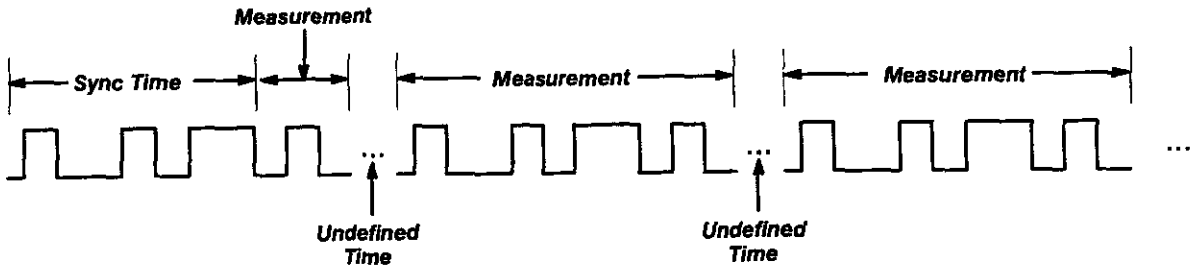


Figure 1-3: Error Detector Basic Behavior With Burst Clock and Data

CSA 907A Pattern Generator Description

The CSA 907A Pattern Generator (Tx) is a 700 MHz pseudorandom and programmable word pattern generator, designed for system and device evaluation in the frequency range of 150 kHz to 700 MHz. The integrated crystal locked clock source, 16-bit (128K with Option 3A/3T/3R Extended Memory) programmable word, 5 PRBS patterns ($2^n - 1$, n=7, 15, 17, 20, and 23) and complementary, programmable output Data and Clock amplifiers, enable a wide range of tests to be performed on high-speed components and systems.

In addition to its front-panel controls, the CSA 907A Pattern Generator supports both RS-232C and GPIB interfaces for remote control, allowing test repeatability and output of unit status and memory contents. The battery backed-up nonvolatile RAM provides storage of 10 word patterns (8 if Option 3A/3T/3R is installed), 10 clock frequencies, and unit setup for future recall.

Front panel outputs provide Clock/4 and Pattern Sync signals for eye-diagram and waveform analysis on an oscilloscope.

Rear-panel inputs for External Error inject and Data Inhibit allow user-defined variations to the generated data streams.

The CSA 907A Pattern Generator is provided with an adjustable carrying handle for easy benchtop angle adjustment. The supplied front-panel cover protects the unit during transit.

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CSA 907A Error Detector Description

The CSA 907A Error Detector is a bit error rate receiver and detector, suitable for system and device evaluation in the frequency range of 150 kHz to 700 MHz. The five pseudorandom patterns and 16-bit programmable word (128K with Option 3A/3T/3R Extended Memory), provide a variety of built-in data patterns for BER evaluation.

The CSA 907A Error Detector autoset feature allows effortless system setup and operation. Automatically setting the proper Input Data/Clock phase relationship, threshold level, data pattern and polarity, the autoset feature allows the user to immediately perform a wide range of tests on systems and components, eliminating the time and frustration associated with adjusting a multiple of input parameters.

The Error Detector provides three error rate display modes: Totalize, Window, and Test. All three modes are calculated simultaneously, with only one can be displayed at a time.

In Totalize BER mode, the Error Detector averages errors over the time of test. In Window BER mode, the Error Detector calculates errors over a programmable sliding window. In Test mode, the Error Detector calculates errors over a programmable length of time.

In addition to its front-panel controls, the CSA 907A Error Detector supports both RS-232C and GPIB interfaces for remote control, allowing test repeatability and output of unit status and memory contents. The battery backed-up nonvolatile RAM provides storage of 10 word patterns (8 if Option 3A/3T/3R is installed), error measurements and unit setup for future recall.

Front-panel output monitors of received Data and Clock provide convenient access to the received data signal. Pattern Sync provides a trigger for waveform analysis on an oscilloscope.

Rear-panel output of RZ Errors and Error Inhibit input allow custom BER and support asynchronous Burst error measurements.

The Error Detector is is provided with an adjustable carrying handle for easy benchtop angle adjustment. The supplied front-panel cover protects the unit during transit.

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Installation

Before installing or using the CSA 907A Pattern Generator or CSA 907A Error Detector, read the safety information at the beginning of this manual.

Safety

This safety information applies to all operators and service personnel.

Terms in Manuals

CAUTION statements identify conditions or practices that could result in damage to the equipment or other property.

WARNING statements identify conditions or practices that could result in *personal injury or loss of life.*

Terms on Equipment

CAUTION indicates a personal injury hazard not immediately accessible as one reads the marking, or a hazard to property including the equipment itself.

DANGER indicates a personal injury hazard immediately accessible as one reads the marking.

Symbols in Manuals



Static Sensitive Devices

Symbols on Equipment



DANGER
High Voltage



Protective ground (earth) terminal



ATTENTION
Refer to manual

Power Source

This product is intended to operate from a power source that will not apply more than 250 V_{RMS} between the supply conductors or between either supply conductor and ground.

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Grounding the Instrument

The CSA 907A Pattern Generator and CSA 907A Error Detector are grounded through their power cords. To avoid electric shock, plug the power cord into a properly wired receptacle where earth ground has been verified by a qualified service person. Do this before making connections to the input or output terminals of the instrument.

Without the protective ground, all parts of the instrument are shock hazards. This includes knobs and controls that may appear to be insulators.

Use the Proper Fuse

Using an improper fuse can create a fire hazard. Match fuse type, voltage rating, and current rating. Use a 2 Amp Slo-Blo fuse for 115 VAC operation, or 1 Amp Time Delay for 230 VAC operation.

Do Not Operate in Explosive Atmospheres

The instrument provides no explosion protection from static discharges or arcing components. Do not operate the instrument in an atmosphere of explosive gases.

Do Not Remove Covers or Panels

To avoid personal injury, do not operate this instrument without the panels or covers.

CAUTION

Operating the instrument without the covers in place can cause overheating and harm the instrument.

Electrical Connections

You must attach cables to SMA-compatible connectors carefully to prevent damage to the cable or the instrument connector.

CAUTION

Do not overtighten SMA-compatible connectors.

When attaching a cable to or removing a cable from an SMA-compatible connector, do not turn the cable, turn only the nut. Align the two connectors carefully and engage the connector nut over the exposed threads on the

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other connector. Use only finger pressure to make this initial connection. Then use a torque wrench *only* to tighten the connection to the range of 7–10 lb-in (79–112 N-cm).

Output Amplifier Power Cycle Sequence

During unit power up and power down, the transmitter output amplifiers may saturate to their specified positive or negative rail, (+2.8 V, or −2 V) for a minimum of 200 milliseconds.

If the the device under test can be damaged by the +2.8 V to −2 V output, disconnect the **DATA** and **CLOCK** signals from the circuitry before cycling power.

Electrostatic Discharge

The CSA 907A Pattern Generator output amplifiers are of GaAs FET design, and are susceptible to damage from overdriven DC voltage and from electrostatic damage. Never apply reverse voltage sources to the **DATA** or **CLOCK** outputs. Operate the instruments only in a static-controlled environment.



Applying reverse voltage sources to the transmitter outputs can cause damage. Static electricity is also a hazard.

Packaging for Shipment

If you ship the instrument, pack it in the original shipping carton and packing material. If the original packing material is unavailable, package the instrument as follows:

- ☐ **Step 1:** Obtain a corrugated cardboard shipping carton with inside dimensions at least 15 cm (6 in) taller, wider, and deeper than the instrument. The shipping carton must be constructed of cardboard with 375 pound test strength.
- ☐ **Step 2:** If you are shipping the instrument to a Tektronix field office for *repair*, attach a tag to the instrument showing the instrument owner and address, the name of the person to contact about the instrument, the instrument type, and the serial number.
- ☐ **Step 3:** Wrap the instrument with polyethylene sheeting or equivalent material to protect the finish.
- ☐ **Step 4:** Cushion the instrument on all sides by tightly packing dunnage or urethane foam between the carton and and the instrument, allowing 7.5 cm (3 in) on each side.

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☐ **Step 5:** Seal the carton with shipping tape or an industrial stapler.

Installation

The CSA 907A Pattern Generator and CSA 907A Error Detector are designed to be placed flat on a level surface, or angled from the surface using the unit's feet or rotating carrying handle. To alter the handle's orientation, press both handle locking buttons, rotate the handle to the desired angle, release the buttons; the handle will click into a locked position. Be sure the handle is locked before placing the unit on the work surface.

AC Power Setup

The AC power connector on the Pattern Generator or Error Detector rear panel is set at the factory to accept nominal input voltage requirements for the instrument's original destination.

The correct fuse should be installed for the voltage and current rating of your power source. The line voltage may be for either 115 VAC or 230 VAC; the instrument will automatically adjust to voltages within ±10% of the nominal voltage. To change the line fuse, remove the power cord, then use a slotted screwdriver or similar instrument to pull out the fuse holder (just below the power cord connector; the slot is normally covered by the power cord) and unlatch and remove the fuse.

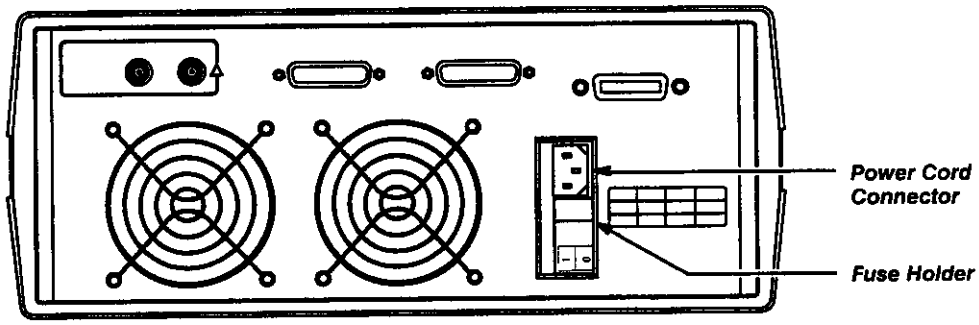


Figure 1-4: Location of Power Cord Connector and Fuse Holder on Rear Panel (CSA 907A Error Detector Shown)

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Install correct value fuse (2 Amp Slo-Blo fuse for 115 VAC operation, or 1 Amp Time Delay for 230 VAC operation) into holder (fuse dimensions are 5 mm × 20 mm). Replace the fuse holder and plug in the line cord. The unit is now ready for power up. Use the front-panel **POWER** switch to turn the unit on and off.

Unit Cooling Requirements

The rear panel fan openings and top-mounted ventilation slots must be kept clear for proper cooling of the unit. Allow a minimum of 3 inches of rear panel clearance while operating the unit.

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Tutorial

The examples in this chapter provide a quick introduction to the CSA 907A Pattern Generator and the CSA 907A Error Detector. For detailed information about specific functions, *refer to the Reference section of this manual.*

To perform these examples, you will need:

- CSA 907A Pattern Generator
- CSA 907A Error Detector
- *Two signal cables, preferably of equal length. 50 Ω SMA or 75 Ω if* Option 2A/2T/2R is installed

If you have not purchased both the CSA 907A Pattern Generator and CSA 907A Error Detector, you can substitute your own pattern generator or error detector.

Basic Bit Error Testing

This example demonstrates basic Bit Error Rate measurement.

NOTE

In these procedures, the Pattern Generator (Tx) and Error Detector (Rx) are returned to their default settings. The word memories will be reset. If you have entered word patterns that you do not want to lose, use a GPIB or RS-232-C controller to save them before beginning these procedures.

Setting up the Instruments

☐ **Step 1:** Connect a 50 Ω SMA cable from the pattern generator **CLOCK** output to the error detector **CLOCK** input.

☐ **Step 2:** Connect a 50 Ω SMA cable from the pattern generator **DATA** output to the error detector **DATA** input.

☐ **Step 3:** Reset both the Pattern Generator and the Error Detector to their factory default setting: Depress the **CLEAR** key in the **PATTERN** section, the **MSB** (1) key, and the **VIEW ANGLE** key, and hold down all three keys while cycling the power. A master power switch is located on the rear panel of the instrument.

The message Default Settings should appear briefly on the display of each unit, followed by the CSA 907A logo, before the functional display appears.

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Setting the CSA 907A Output Amplitude and Offset

You will need to set the output amplitude and baseline offset of the CSA 907A's clock and data outputs. In the next few steps, you will set the pattern generator's **CLOCK** output amplitude to 2 V and its baseline offset to −1 V.

☐ **Step 4:** Press the **CLOCK** button in the pattern generator's **OUTPUT** section to select the clock signal. The **CLOCK** LED should light to show that it is selected. If not, press the **CLOCK** button again.

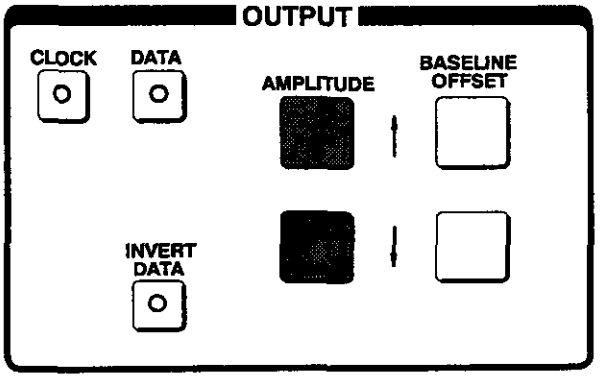


Figure 2-1: The Pattern Generator OUTPUT Section

While the **CLOCK** signal is selected, its amplitude and offset appear in the right corners of the display and the **AMPLITUDE** and **BASELINE OFFSET** up/down keys in the **OUTPUT** section apply to the **CLOCK** signal.

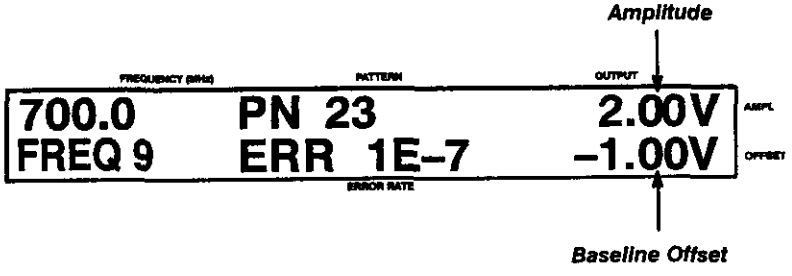


Figure 2-2: Output Readouts on the Pattern Generator Display

☐ **Step 5:** Use the **AMPLITUDE** keys to set the clock amplitude to 2 volts.

☐ **Step 6:** Use the **BASELINE OFFSET** keys to set the clock signal's baseline offset to −1 volt.

You set the pattern generator's **DATA** output amplitude and offset in the same way:

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☐ **Step 7:** Press the **DATA** button in the pattern generator's **OUTPUT** section to select the data signal. (The **DATA** LED should light to show that it is selected.)

With the **DATA** signal selected, its amplitude and offset in the right corners of the display and the **AMPLITUDE** and **BASELINE OFFSET** up/down keys in the **OUTPUT** section apply to it.

☐ **Step 8:** Use the **AMPLITUDE** keys to set the data amplitude to 2 volts.

☐ **Step 9:** Use the **BASELINE OFFSET** keys to set the data signal's baseline offset to −1 volt.

Selecting the Pattern Type

The CSA 907A Pattern Generator can transmit PRBS (pseudorandom binary sequence) or word patterns. For this example, you will want to use PRBS patterns.

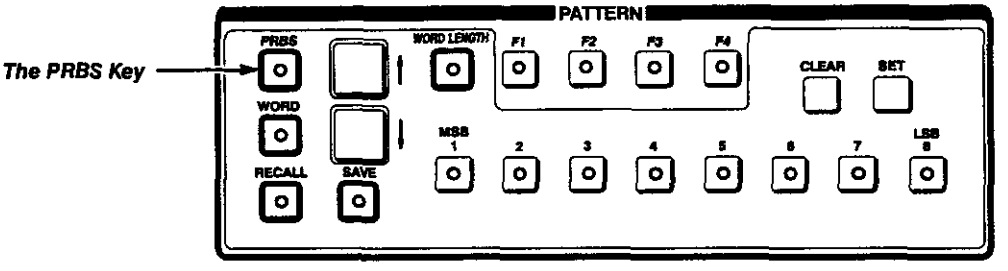


Figure 2-3: The Pattern Generator PATTERN Section

☐ **Step 10:** Select **PRBS** mode in the pattern generator **PATTERN** section. The **PRBS** LED should light.

Initial Setup of the CSA 907A Error Detector

☐ **Step 11:** Verify that the following are set on the CSA 907A Error Detector:

AUTOSET is on. (The **AUTOSET** LED should be on.)

Termination is set to GND. (The LCD should display GND when the **TERM** button is pressed.)

The reference data input is off. (The LED in the **EXT** key, above the **REF DATA INPUT**, is off.)

The Error Detector is in Single-Ended Mode (the LED in the **DIFF** button should be off.)

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Using Autoset on the CSA 907A Error Detector

Next, you will set the CSA 907A Error Detector's parameters. The autoset *feature makes this a one-step procedure:*

☐ **Step 12:** Select **AUTOSET** in the Error Detector's **SYNC** section. When autoset is on, the LED in the **AUTOSET** button will be lighted. The Error Detector will select its code, input level, polarity, and phase delay based on the input signal.

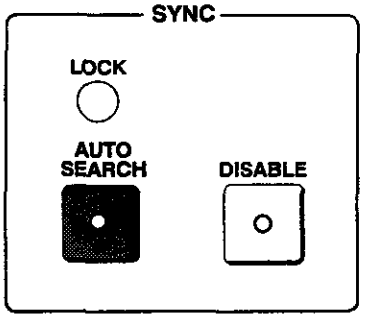


Figure 2-4: The Error Detector SYNC Section

Clearing the Error Display and History to Begin Testing

Once the Error Detector synchronizes on the input signal, the **LOCK** LED in the **SYNC** section will light. You should clear the error numeric display at this point.

☐ **Step 13:** To clear the display, press the **START/STOP** key in the Error Detector **ERROR DETECTION** section.

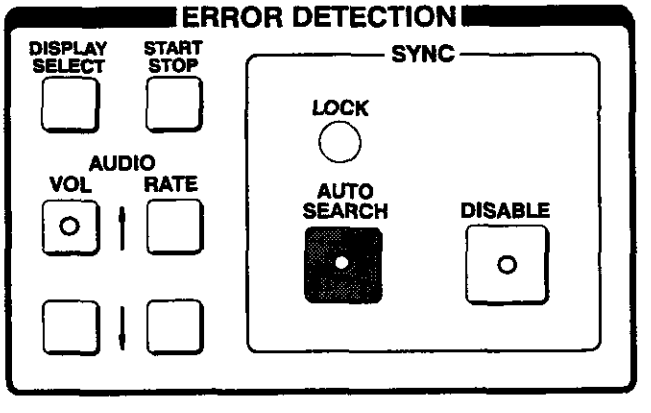


Figure 2-5: The Error Detector ERROR DETECTION Section

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You should also clear the four **ERROR HISTORY** LEDs, which show loss of synchronization, bit error, phase error, and power loss.

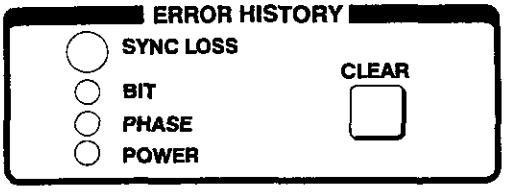


Figure 2-6: The Error Detector ERROR HISTORY Section

☐ **Step 14:** To clear the **ERROR HISTORY** LEDs, press the **CLEAR** key in the Error Detector **ERROR HISTORY** section.

You are now making basic Bit Error Rate tests on your SMA cable. Do not modify this setup before proceeding to the next example.

Advanced Pattern Generator Example

This example assumes you have already set up your CSA 907A Pattern Generator and your Error Detector as described in the first example, Basic Bit Error Rate Testing. In this example, you will modify the pattern generator's output parameters. Because the Error Detector is in autoset mode, it will automatically adjust to the changes.

Modifying the Frequency of the Test

The Pattern Generator clock frequency controls are grouped in the front-panel **CLOCK** section. See Figure 2-7.

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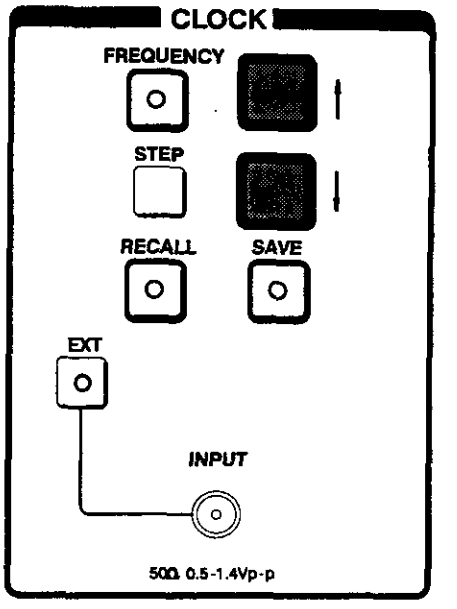


Figure 2-7: The Pattern Generator CLOCK Section

☐ **Step 1:** Press the **FREQUENCY** key in the **CLOCK** section. (The **FREQUENCY** LED should light.)

☐ **Step 2:** Use the up/down keys in the **CLOCK** section to change the frequency. The selected frequency is displayed in the upper left corner of the Pattern Generator display.

Use the **STEP** key to select the digit to be affected.



Figure 2-8: Clock Frequency Readout on the Pattern Generator Display

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Modifying the Data Pattern

In the previous example, you selected a PRBS pattern.The CSA 907A Pattern Generator supports five Pseudo-Random Binary Sequence patterns: 2^7-1, 2^{15}-1, 2^{17}-1, 2^{20}-1, and 2^{23}-1.

☐ **Step 3:** Use the up/down keys in the Pattern Generator **PATTERN** section to change the PRBS pattern. The selected pattern appears on the display under the label **PATTERN**.

Injecting Errors into the Data Stream

You can inject a single error into the Pattern Generator's data stream by pressing the **SINGLE** key in the **ERROR INJECT** section, or you can inject errors at a specified rate using the **RATE** key.

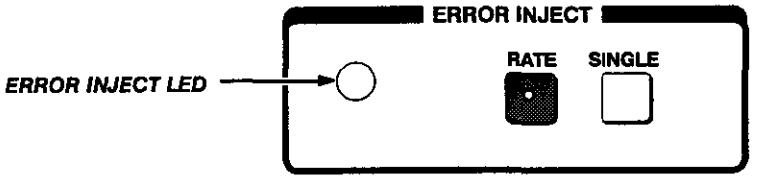


Figure 2-9: The Pattern Generator ERROR INJECT Section

The error inject rate selections are 10^{-n}, *where n is 7,6,5,4,or 3. Pressing* **RATE** cycles through these options.

☐ **Step 4:** Press the **RATE** key repeatedly to select an error injection rate. The error injection rate is shown in the lower center of the display, over the label **ERROR RATE**.

The **ERROR INJECT** LED will light to show that bit errors are being generated internally at a specified rate.

When an error injection rate is selected, the **SINGLE** key acts as an off switch for error injection.

☐ **Step 5:** Press **SINGLE** to shut off error injection.

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Advanced Error Detector Example

This example assumes you have already set up your CSA 907A Error Detector and your Pattern Generator as described in the first example, *Basic Bit Error Rate Testing*. In this example, you will modify the Error Detector error display and change its parameters in manual mode.

Clearing the Error Display and History

☐ **Step 1:** Press the **START/STOP** key in the Error Detector **ERROR DETECTION** section to clear the error rate display.

☐ **Step 2:** Press the **CLEAR** key in the **ERROR HISTORY** section to clear the error history LEDs.

Selecting the Error Rate Display Mode

The CSA 907A Error Detector has three error rate display modes: Totalize, Window, and Test.

In Totalize BER mode, the Error Detector averages errors over the time of test, starting at power-up or when the **START/STOP** key is pressed. Totalize BER results are preceded by the ∞ (infinity) symbol on the display.

In Window BER mode, the Error Detector calculates errors over a programmable sliding window, controlled by the **WINDOW** menu. Window BER results have no symbol preceding the displayed rate.

In Test mode, the Error Detector calculates errors over a programmable length of time, controlled by the **TEST** menu.

Although all three modes are calculated simultaneously, only one can be displayed at a time. The **DISPLAY SELECT** key determines the type of error rate display.

☐ **Step 3:** Press the **DISPLAY SELECT** key repetitively to select among Totalize, Window, and Test modes. Leave the Error Detector in Totalize mode (with the ∞ symbol preceding the error rate on the display).

Setting the Error Detector Parameters in Manual Mode

Up to this point, the Error Detector has been in autoset mode. To change the input parameters of the error detector manually, you must disable autoset. This example illustrates some basic ideas; refer to the section on synchronization mode for more details.

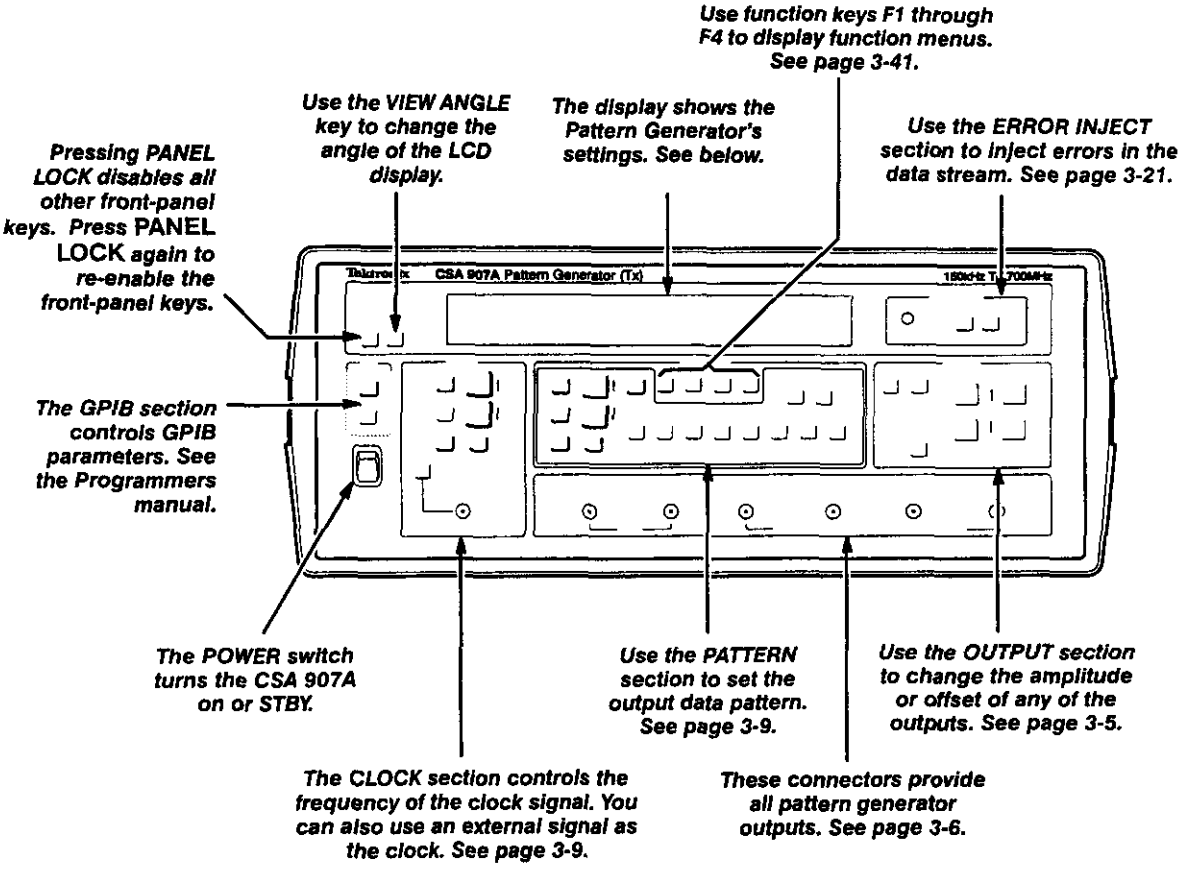
☐ **Step 4:** Press the **AUTOSET** key, in the **SYNC** section, to disable autoset. the **AUTOSET** LED should turn off, and the **PRBS** LED should turn on.

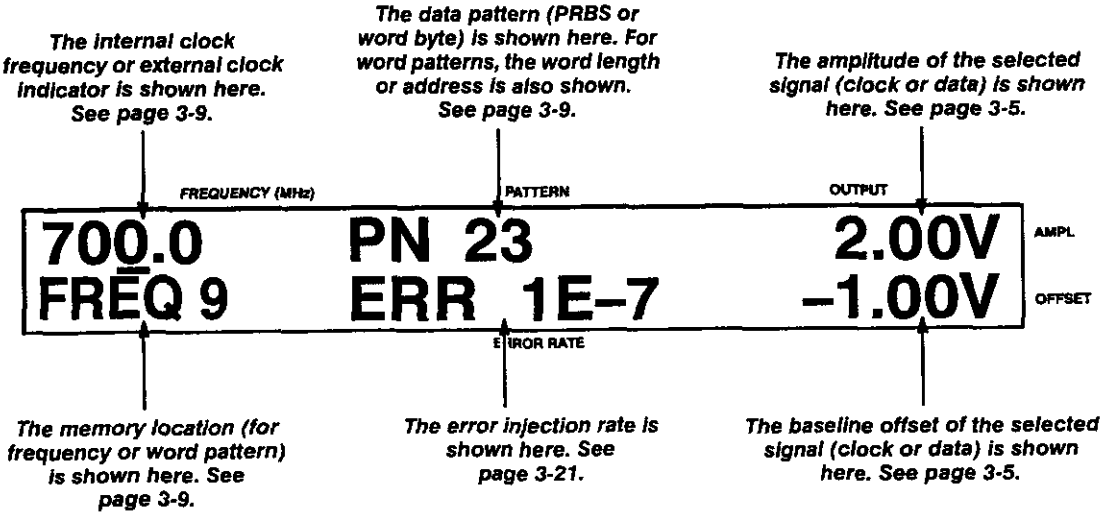
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☐ **Step 5:** Select one of the five Pattern Generator PRBS patterns by pressing the **PRBS** key in the **PATTERN** section. Each time you press the **PRBS** up/down keys, the pattern set will change, as shown on the display. The Error Detector PN will not change to follow the Pattern Generator, SYNC will be lost, and error will be detected. (In autoset mode, the Error Detector automatically selects the pattern based on the input signal.)

☐ **Step 6:** *Manually select the Error Detector* **PRBS** *pattern* to match that the Pattern Generator. The **SYNC** lock light will illuminate. The Error Detector Delay and Threshold controls must also be manually set when **AUTOSET** is disabled.

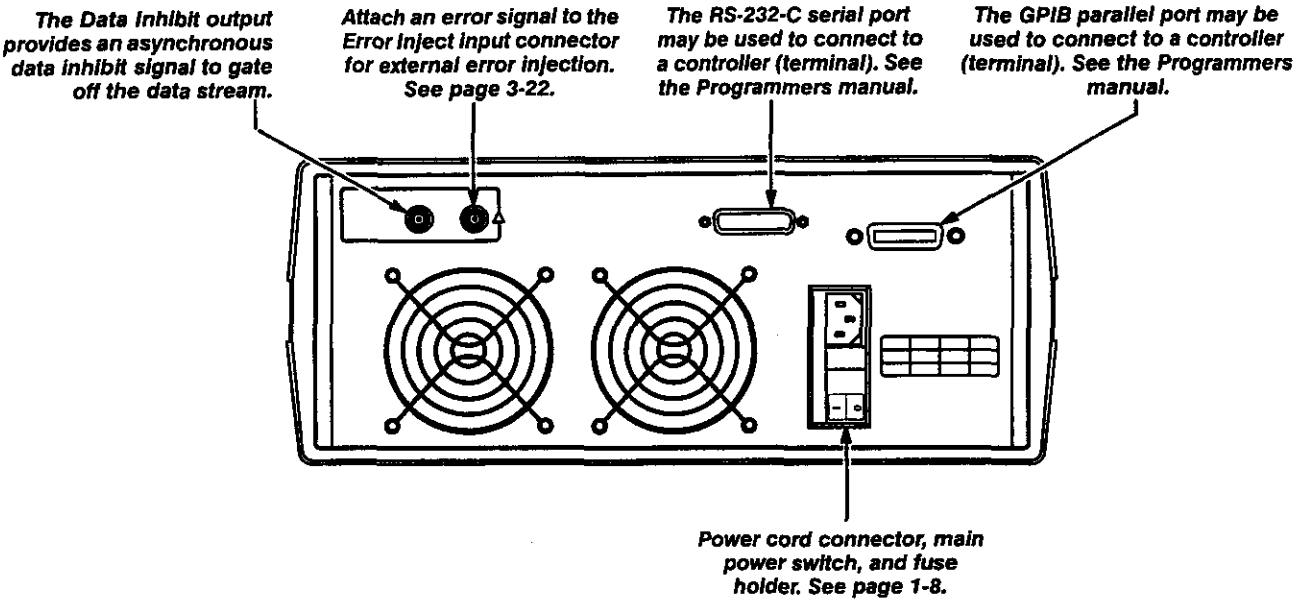
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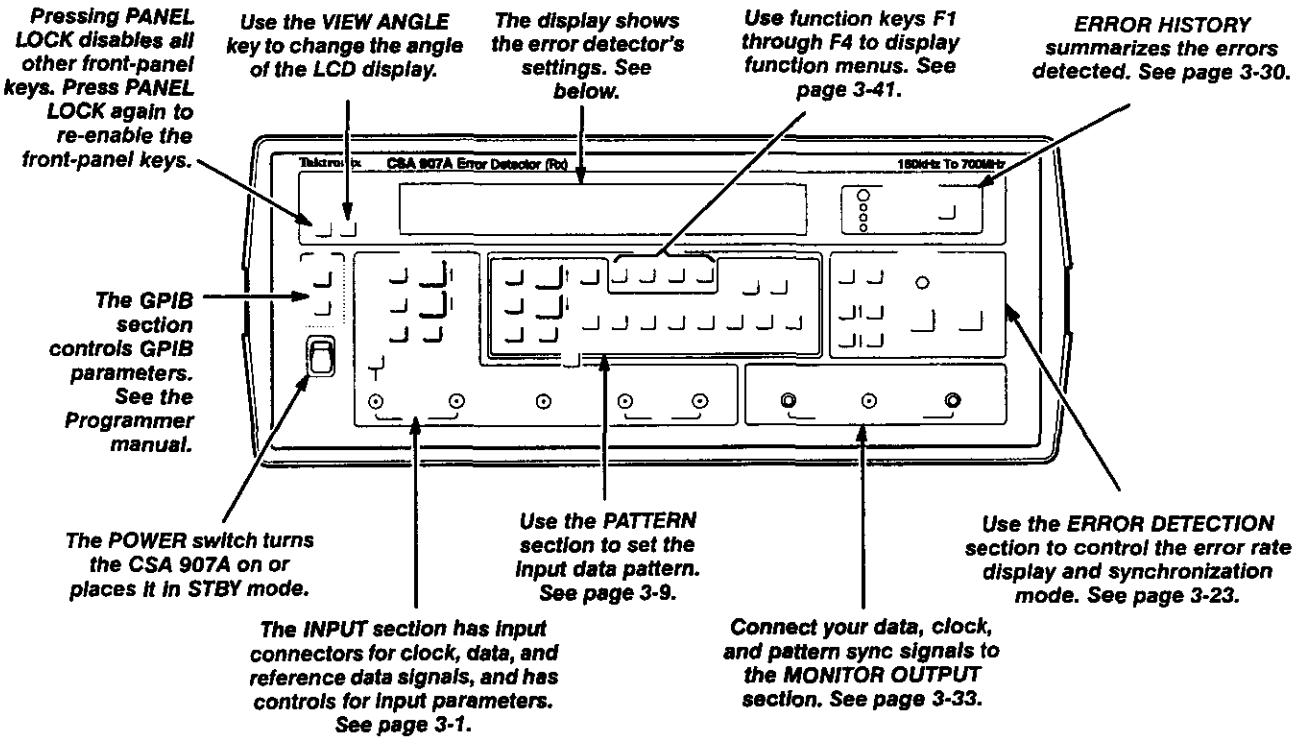


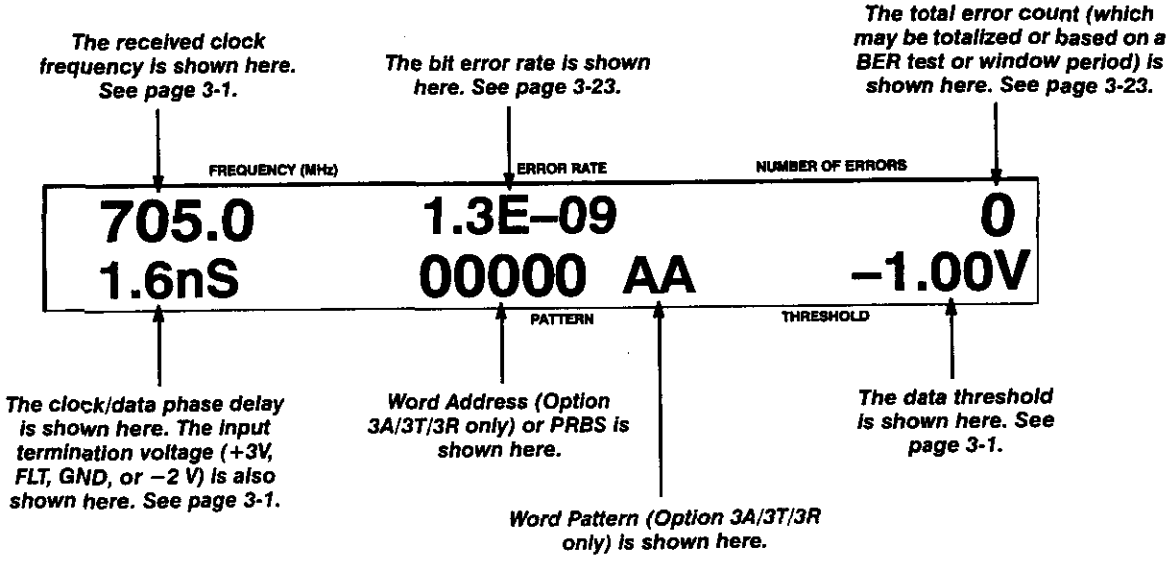
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CSA 907A Pattern Generator Front and Rear Panels



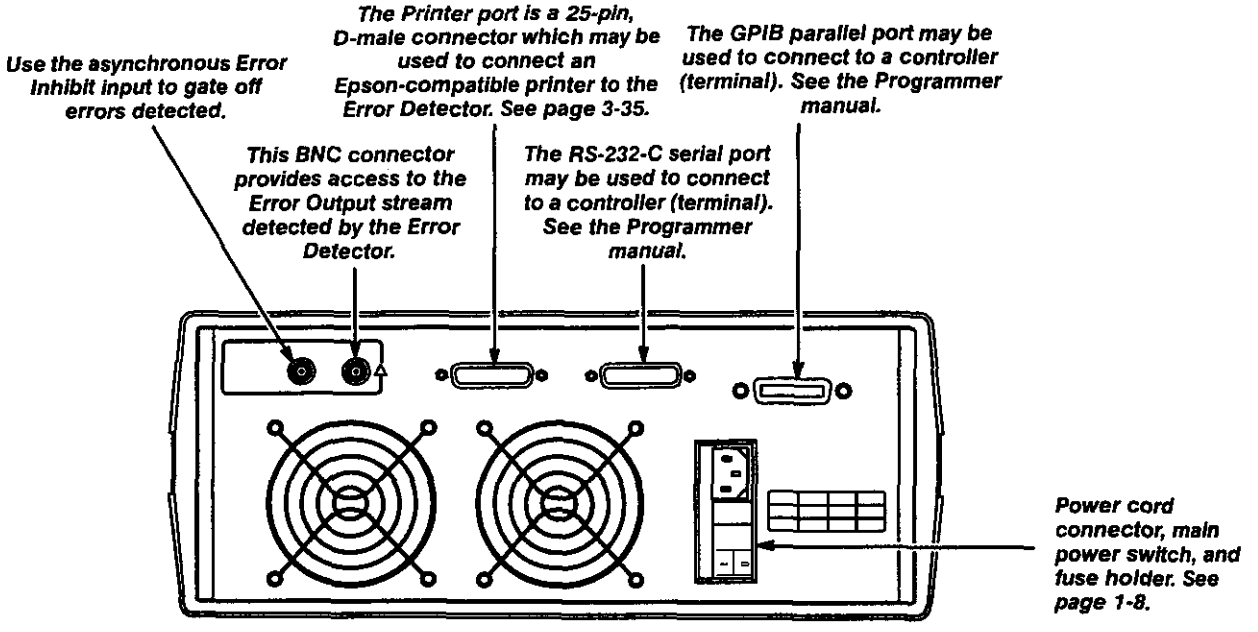
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CSA 907A Error Detector Front and Rear Panels



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Error Detector Inputs

The **INPUT** section of the CSA 907A Error Detector front panel has input connectors for clock, data, and reference data signals, and controls for input parameters (input termination, threshold, logic polarity and data/clock phase delay) for the data, clock, and reference data signals. It may be helpful to refer to the Error Detector Block Diagram (please refer to Appendix E) while reading this section.

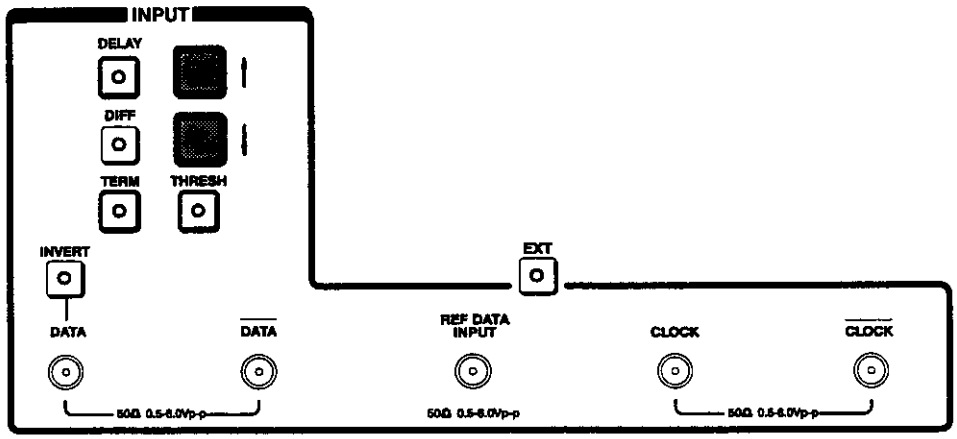


Figure 3-1: The Error Detector INPUT Section

Input Connectors

The five input connectors in the Error Detector **INPUT** section accept data, clock, and reference data input.

- The **DATA** SMA connectors are the inputs for the data to the receiver for bit error analysis. Data can be selected for operation in differential or single-ended mode, and the termination it provides may be selected from a variety of conditions (see the description of Data Controls). When in single-ended mode and terminated with 50 Ω to ground, the Data input is used, the threshold can be set from −2 V to +4.0 V (selectable in 50 mV steps), and the input level can be from −2.0 V to +6.0 V peak-to-peak. In automatic threshold mode, the Error Detector will display the message **NO DATA** when it does not detect an input signal. The threshold has no function when Differential Mode is selected.

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- The **CLOCK** SMA connectors are the inputs to the receiver clock circuit. The Data Input is sampled on the falling edge of the input clock for bit error analysis. The clock can be selected for operation in differential or single-ended mode, and the termination it provides can be selected from a variety of conditions (see the description of Clock Controls). When in single-ended mode and terminated with 50 Ω to ground, the CLOCK input is used, the threshold can be set from −2.0 V to +4.0 V (selectable in 50 mV steps), and the input level can be from −2.0 V to +6.0 V peak-to-peak. In automatic threshold mode, the Error Detector will display the message **NO CLOCK** when it does not detect an input signal. The threshold has no function when Differential Mode is selected.

NOTE

Proper operation of the Error Detector depends on the CLOCK duty cycle being 50%. The CLOCK threshold setting can significantly affect the duty cycle as seen by the decision circuit and therefore requires care in selection of a value. The duty cycle shown on the MONITOR CLOCK output reflects the outcome of the CLOCK decision circuit and can be viewed on an oscilloscope for verification.

- The **REF DATA INPUT** SMA connector is the input for reference data to the receiver for bit error analysis. When the Error Detector is in reference data mode, it performs a bit-by-bit comparison of the data patterns at the **DATA** and **REF DATA INPUT** connectors, and measures the bit error rate between them. The reference data input threshold may be from −2.0 V to +4.0 V (selectable in 50 mV steps), and the input level may be from 500 mV to 6.0 V peak-to-peak.

  To select reference data mode, press the **EXT** key, directly above the **REF DATA INPUT** connector. The **EXT** LED will light to show that reference data mode is selected. Pressing **EXT** again returns to normal data mode.

Input Controls

NOTE

*The Delay, Invert, and Threshold controls are adjusted by the **AUTOSET** algorithm. You may wish to disable **AUTOSET** before making manual adjustments via the input controls.*

The controls in the INPUT section are assigned to the DATA inputs, the CLOCK inputs, or the REF DATA input by the state of the F2 and F3 keys in the PATTERN section, as shown in Table 3-1.

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Table 3-1: Input Control Assignments

F2 (Clock) LED Status	F3 (REF DATA) LED Status	INPUT Controls Assigned To
Off	Off	DATA
On	Off	CLOCK
Off	On	REF DATA
On	On	Not Allowed

To adjust delay for DATA or REF DATA, with respect to CLOCK:

1. Specify the input to be affected by assigning the **INPUT** controls as described in Table 3-1.
2. Press **DELAY** to assign the up/down keys to that function; the **DELAY** LED should light.
3. Press the up/down keys to set the delay value; the acceptable range is 0.0 ns to 4.0 ns. The delay value appears in the lower left corner of the display.

- Single-ended Clock or Data Input is indicated by the LED in the DIFF button. Single-ended operation is enabled when the LED in the DIFF button is off.
- Differential Clock or Data Input is indicated by the LED in the DIFF button. Differential operation is enabled when the LED in the DIFF button is on.
- REF DATA is always single-ended. When the F3 LED is illuminated, the DIFF LED applies to DATA.
- You can toggle between single-ended and differential input by pressing the **DIFF** button.

To adjust the DATA, CLOCK, or REF DATA INPUT threshold voltage:

1. Specify the input to be affected by assigning the **INPUT** controls as described in Table 3-1.
2. Confirm single-ended operation by verifying that the **DIFF** LED is off.
3. Assign the up/down keys to the threshold function by pressing **THRESH**. The **THRESH** LED should light.
4. Set the threshold by pressing the up/down keys; the threshold setting appears on the lower right corner of the display. The range is affected by the termination; the step size is 50 mV.

To set the DATA, CLOCK, or REF DATA INPUT termination:

1. Specify the input to be affected by assigning the **INPUT** controls as described in Table 3-1.

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2. Assign the up/down keys to the termination function by pressing **TERM**. The **TERM** LED should light and the termination effect will appear on the display.
3. Select the termination using the up/down keys. Settings are shown in Table 3-2.

Table 3-2: Input Termination Settings

Displayed Setting	Description
GND	50 Ω to ground
−2 V	50 Ω to −2 V
+3 V	50 Ω to +3 V
FLT	50 Ω to 0.01 µF to ground

- Select DATA polarity by pressing **DATA INVERT**. The DATA INVERT LED lights when the polarity is inverted and the LED is off when the polarity is unaltered.

NOTE

The FLT termination provides a means of terminating to a floating reference. When driving the inputs differentially, the voltage level of the reference becomes the midpoint of the input swing, and there is no DC load on the driver. This application allows operation at all frequencies the Error Detector can handle.

The FLT termination can also be used on single-ended inputs, but the input impedance becomes a function of frequency due to the RC network that comprises the input. The result is that the lower limit on useful frequency of the input becomes 10 MHz. This frequency can be reached on the DATA input when clock rates approach 20 MHz, or when data contains long strings of high or low levels.

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Pattern Generator Outputs

The **OUTPUT** section of the CSA 907A Pattern Generator front panel controls the amplitude and offset of the clock and data outputs. Press the **DATA** key to select the data signal, or the **CLOCK** key to select the clock signal. The LED for the selected output signal will always be lighted. It may be helpful to refer to the Pattern Generator block diagram (please refer to Appendix E) while reading this section.

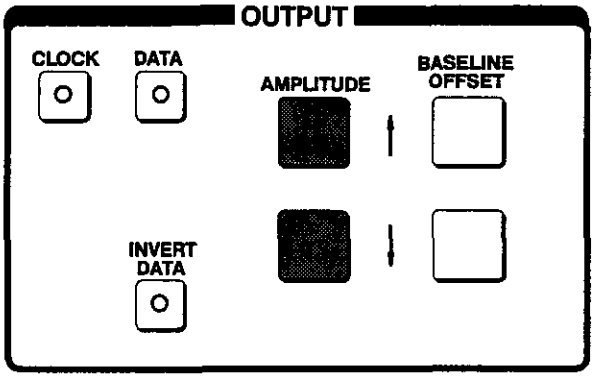


Figure 3-2: The Pattern Generator OUTPUT Section

The **AMPLITUDE** up/down keys adjust the amplitude of the selected output signal by 50 mV increments. See Figure 3-3. The output amplitude is shown in the upper right corner of the display.

The **BASELINE OFFSET** up/down keys adjust the baseline offset of the selected output signal by 50 mV increments. See Figure 3-3. The output baseline offset is displayed in the lower right corner of the display.

Press the **INVERT DATA** key to invert the output data signal. Whenever the data output is inverted, the **INVERT DATA** LED will light.

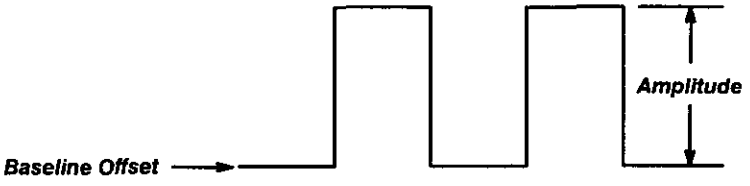


Figure 3-3: Baseline Offset and Amplitude

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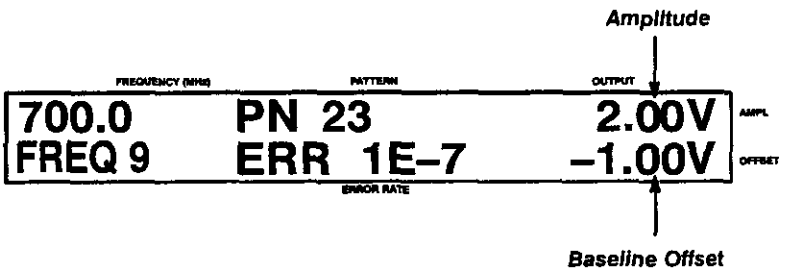


Figure 3-4: Output Readouts on the Pattern Generator Display

Note that the amplitude and offset readouts on the display always apply to the selected output signal (clock or data). See Figure 3-4.

Pattern Generator Output Connectors

The Pattern Generator output connectors are grouped along the bottom edge of the front panel. These connectors provide *data*, *clock*, *and pattern* synchronization signals. See Figure 3-5.

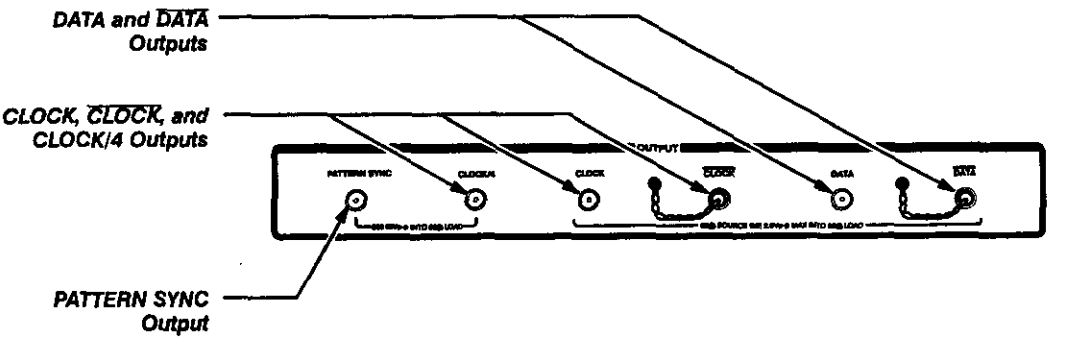


Figure 3-5: Pattern Generator Output Connectors

The following restrictions apply to the **CLOCK**, **CLOCK**, **DATA**,and **DATA** *output connectors:*

- The output amplifiers will drive a 50 Ω load (terminated to ground) to 2 V peak-to-peak maximum. The maximum pulse top is +2.8 VDC. If the baseline is raised above 0 V, the maximum possible amplitude is reduced respectively.
- If left unterminated (termination resistance greater than 2 kΩ), the output amplifiers will drive an unterminated load to 4 VDC peak-to-peak maximum. The maximum pulse top is +5.6 VDC. If the baseline is raised above 0 V, the maximum possible amplitude is reduced respectively.
- The offset is displayed and calibrated as specified into a 50 Ω to GND load. Terminating the signal to other voltages will introduce a DC shift in offset.

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The equivalent circuit model for the DATA and CLOCK outputs is shown in Figure 3-6.

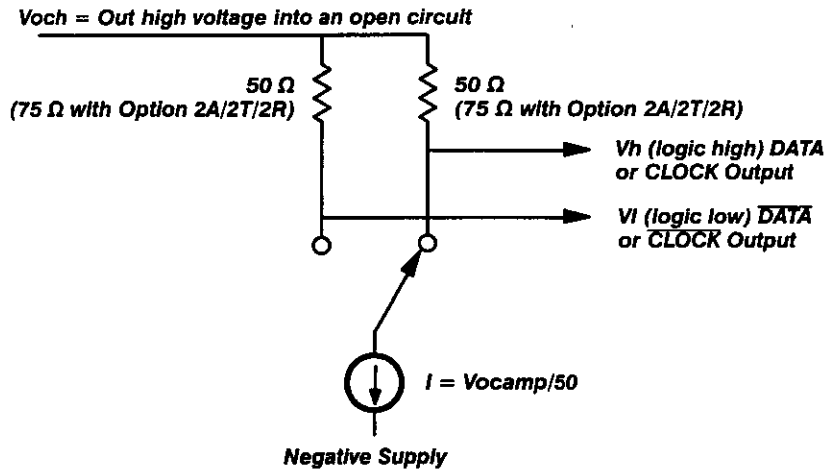


Figure 3-6: Model for Pattern Generator CLOCK and DATA Driver

The relationship between display values and load termination is shown in Table 3-3.

Table 3-3: Effect of Load Termination on Baseline Offset and Output Amplitude

Load Termination	Actual Baseline Offset	Actual Amplitude
50 Ω to ground	As displayed	As displayed
50 Ω to +3 V	Displayed value + 1.5 V	As displayed
50 Ω to −2 V	Displayed value − 1.0 V	As displayed
FLT	(As displayed X 2) + (displayed Amplitude/2)	As displayed
Open Circuit	As displayed	2 X displayed value

Data Outputs

The **DATA** and **$\overline{\text{DATA}}$** SMA connectors provide differential data outputs for connection to an error detector such as the CSA 907A Error Detector.

- **DATA** provides true NRZ-L data. The source impedance of this output is 50 Ω.
- **$\overline{\text{DATA}}$** provides inverted NRZ-L data. The source impedance of this output is 50 Ω.

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Clock Outputs

The **CLOCK**, $\overline{\text{CLOCK}}$, and **CLOCK/4** SMA connectors provide the clock signal for connection to an error detector or other device.

- **CLOCK** provides a True Clock signal. The source impedance of this output is 50 Ω.
- $\overline{\text{CLOCK}}$ provides an Inverted Clock output. The source impedance of this output is 50 Ω.
- **CLOCK/4** provides a system clock/4 signal suitable for oscilloscope trigger for analysis of output data eye diagrams. The **CLOCK/4** signal is DC coupled. The output level is 500 mV peak-to-peak (±250 mV) into 50 Ω to ground.

Pattern Synchronization Output

The **PATTERN SYNC** SMA connector provides a signal suitable for oscilloscope trigger, occurring once per pattern frame. The **PATTERN SYNC** signal is DC coupled. The output level is 500 mV peak-to-peak (±250 mV around ground) into 50 Ω load to ground.

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Pattern Generator Clock Controls

You can adjust the frequency of the CSA 907A Pattern Generator clock output using the **CLOCK** section of the front panel. This section also includes an input connector for an external clock source.

Frequency Controls

The **CLOCK** section on the Pattern Generator front panel controls, see Figure 3-7, the programmable clock source, selects between the internal and external clock input, and accesses the clock memory.

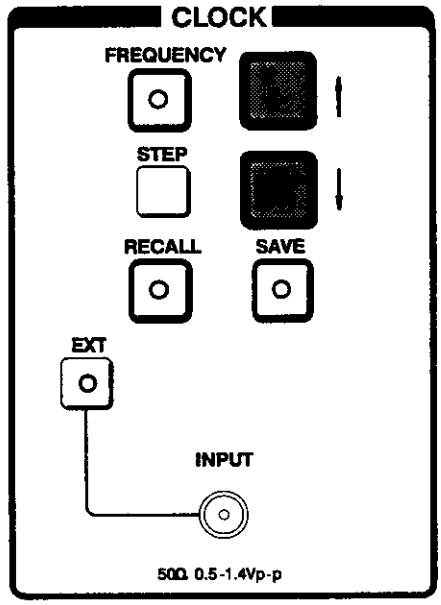


Figure 3-7: The Pattern Generator CLOCK Section

Selecting **FREQUENCY**, **RECALL** or **SAVE** assigns the **CLOCK** up/down keys to the selected function. The **STEP** key directly modifies the step size for frequency adjustment.

- **FREQUENCY** selects the frequency mode. In this mode the Pattern Generator internal clock frequency is modified by changing the desired digit with the **CLOCK** up/down keys. The current operating frequency is displayed on the upper left row of the display, as shown in Figure 3-8.

  When **FREQUENCY** is selected, the **FREQUENCY** LED lights to show that the unit's frequency can be modified by the **CLOCK** up/down keys.

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- **STEP** selects the digit to modify with the up/down keys in **FREQUENCY** mode. The digit is marked with an underscore on the display. The underscore (and step size) moves one digit to the right each time you press **STEP**. When the desired step size is selected, press the **CLOCK** up/down keys to adjust the frequency.

- **RECALL** selects clock memory mode. Ten programmed clock frequencies can be stored and recalled. The selected clock memory location is displayed in the lower left corner of the display. Use the **CLOCK** up/down keys to select the memory location (0 to 9). The frequency stored in memory is output immediately upon selection.

  When **RECALL** is selected, the **RECALL** LED lights to show that the **CLOCK** up/down keys may be used to select a stored frequency.

- **SAVE** selects clock save mode. Use the **CLOCK** up/down keys to select the memory location (0 to 9), and press **SAVE** a second time to store the currently programmed clock frequency in that memory location. Pressing any other key will escape from clock save mode. The selected clock memory location is displayed in the lower left corner of the display.

  When **SAVE** is selected, the **SAVE** LED lights to show that the **CLOCK** up/down keys are assigned to memory location.

- **EXT** selects between the internal clock and an external clock signal applied at the **CLOCK INPUT** connector. While **EXT** mode is selected, the other **CLOCK** keys are locked out. Press **EXT** to return the Pattern Generator to internal clock mode.

  When **EXT** (external clock mode) is selected, the **EXT** LED lights and the display shows **EXT CLK** in the frequency field.

  The clock **INPUT** SMA connector is used to operate the CSA 907A Pattern Generator using an external clock source. The input frequency must be in the range of 150 kHz to 700 MHz. It may start and stop so long as the beginning and ending consists of full clock cycles. The input voltage is dependent on the input termination which has been selected from the two possibilities: 50 Ω to ground or 50 Ω to −2 V. See Table 3-4.

Table 3-4: EXT CLK IN Termination Dependencies

Termination	Input Range	Switching Threshold	Amplitude Range
50 Ω to ground	−2 to +2 V	Ground ±50 mV	500 mV to 2 V peak-to-peak centered on Ground
50 Ω to −2 V	−2 to +2 V	−1.31 V ±50 mV	500 mV to 2 V peak-to-peak centered on Ground

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The termination for the **EXT CLK** Input is selected as follows:

1. Press **F1** to enter the menu system.
2. Press **F1** (More). The display should show **F2** to be **CLOCK**.
3. Press **F2** (CLOCK).
4. Use the Up/Down keys in the **PATTERN** section to select between **−2 V** and **GND**.
5. Press **F4** to set.
6. Press **F1** to exit the menu system.

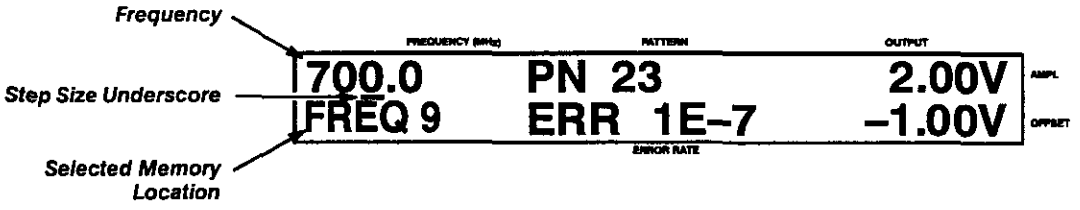


Figure 3-8: Clock Frequency Readouts on the Pattern Generator Display

Amplitude and Offset Controls

The **OUTPUT** section of the CSA 907A Pattern Generator front panel controls the amplitude and offset of the clock output. Press the **CLOCK** key to select the clock signal. The **CLOCK** LED will light to show that the clock output is selected.

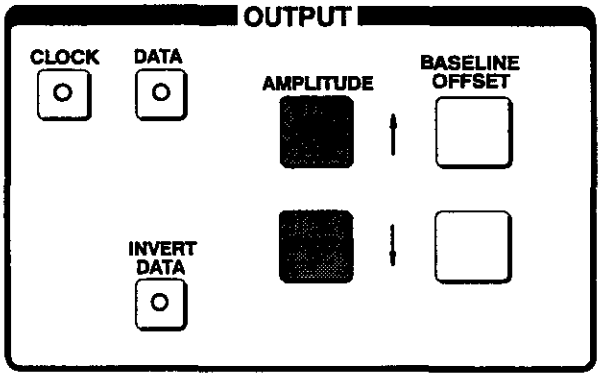


Figure 3-9: The Pattern Generator OUTPUT Section

The **AMPLITUDE** up/down keys adjust the amplitude by 50 mV increments. The output amplitude is shown in the upper right corner of the display.

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The **BASELINE OFFSET** up/down keys adjust the output baseline offset by 50 mV increments. The output baseline offset is displayed in the lower right corner of the display.

Note that the amplitude and offset readouts on the display apply to the clock only when **CLOCK** is selected in the **OUTPUT** section.

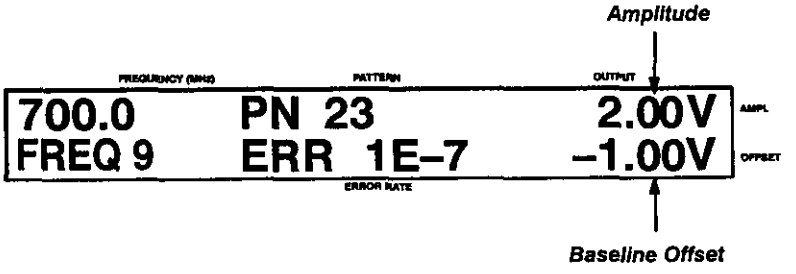


Figure 3-10: Clock Output Readouts on the Pattern Generator Display

Clock Outputs

The **CLOCK**, **$\overline{\text{CLOCK}}$**, and **CLOCK/4** SMA connectors provide the clock signal for connection to an error detector or other device.

- **CLOCK** provides a True Clock signal. The source impedance of this output is 50 Ω.
- **$\overline{\text{CLOCK}}$** provides an Inverted Clock output. The source impedance of this output is 50 Ω.
- **CLOCK/4** provides a system clock/4 signal suitable for oscilloscope trigger for analysis of output data eye diagrams in cases where the trigger system of the oscilloscope has inadequate bandwidth to use **CLOCK**. Clock/4 voltages are fixed.

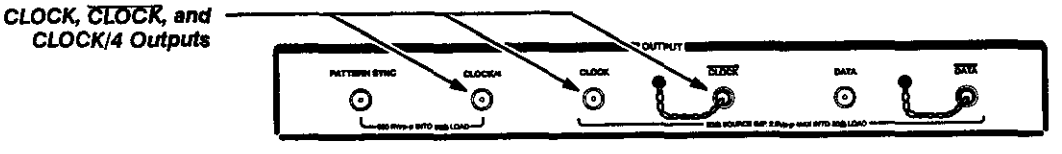


Figure 3-11: Pattern Generator Output Connectors

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Setting the Data Pattern

The data pattern controls on the CSA 907A Pattern Generator and the CSA 907A Error Detector are identical.

The front-panel **PATTERN** section controls the internal pattern generator, selects between PRBS (pseudo-random binary sequence) and programmable word pattern, programs pattern and word length, and accesses the word memory.

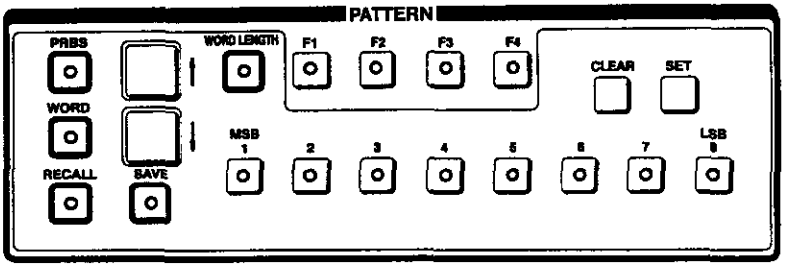


Figure 3-12: The PATTERN Section

PRBS Patterns

The CSA 907A supports five Pseudo-Random Binary Sequence patterns: 2^7-1, 2^{15}-1, 2^{17}-1, 2^{20}-1, and 2^{23}-1. Press the **PRBS** key to select Pseudo-Random Binary Sequence mode, and use the **PATTERN** up/down keys to select the PRBS pattern. When selected, the pattern is shown on the display as PN [x] where x=7, 15, 17, 20, or 23.

When **PRBS** is selected, the **PRBS** LED lights to show that a PRBS pattern is selected, and that the **PATTERN** up/down keys can be used to select the PRBS pattern.

The Error Detector automatically selects the proper **PRBS** pattern when **AUTOSET** is invoked.

Word Patterns

Data patterns in a programmable word can be modified, recalled, or stored in memory. The *Programmer Manual* describes how to program the word via the remote interface. It also includes FrameWriter software which was designed to simplify the process of editing the 128K Programmable Word.

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Setting the 128K Programmable Word through the Front Panel Controls

This section applies to your instrument if it is equipped with Option 3A/3T/3R (128K) Programmable Word Memory. If Option 3A/3T/3R is not installed in your instrument, please refer to page 3-17 for instructions on setting the programmable word in your instrument.

Setting the Programmable Word

Press the **WORD** key to select word mode. The **WORD** LED will light to show that the programmable word pattern is selected. The programmable word can be modified, recalled, or stored in memory. The programmable pattern's byte address can be selected using the **PATTERN** up/down keys, and is displayed on the upper row of the display as

AAAAA HH

where **AAAAA** is the byte address (0 to 16,383), and **HH** is the hexadecimal byte value.

You can edit the programmable word from the CSA 907A front panel in eight-bit bytes by use of the pushbuttons labeled 1, 2, ..., 8. The LCD displays in hex the binary pattern defined. The number of bytes available is dependent on the word length.

To set the word length — press the **WORD LENGTH** key and use the **PATTERN** up/down keys to adjust the length value. The length is displayed on the upper row of the LCD. Word length may also be adjusted by the Word Menu (described below).

The word length may be changed in increments of 1 bit for lengths of 1 to 2048 bytes, and in increments of 1 byte for lengths of 2048 to 16,384 bytes.

The Word Menu

The Word menu allows programming of word length, editing of word contents, and filling of word contents over a specified range. For the Error Detector, this menu also allows programming of the word sync threshold.

To select the Word menu, press **F1** to enter the main menu, then press **F4** for the Word menu. The menu selections are:

- **EDIT** allows you to edit the word.
- **LENGTH** allows you to select the number of bytes and bits (after the last byte) in the programmable word.
- **FILL** allows you to fill the 128K memory with a hexadecimal word value.
- **SYNC** *(Error Detector only)* allows you to set a word sync threshold, which is used to determine synchronization locking.
- **ORDER** allows you to specify the serial output order of each byte, that is, *MSB first or LSB first.*

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- **PSYNC** allows you to control the location in the **DATA** where **PATTERN SYNC** will occur.

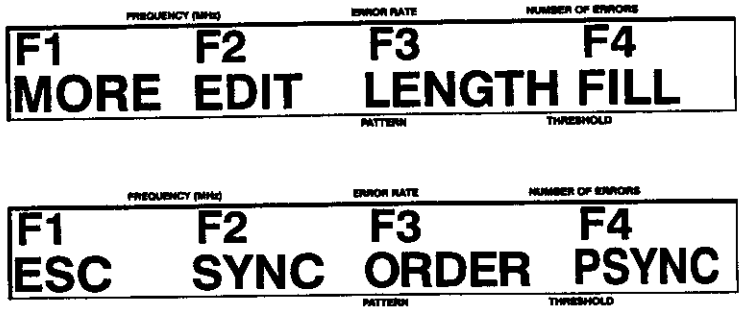


Figure 3-13: The Word Menu (Error Detector Shown)

EDIT — selects the word edit submenu. On the second line of the display, the address of the displayed byte (00000 to 16,383) is shown, followed by the binary value of the byte.

Use the **PATTERN** up/down keys to select the byte address, using the **F2** (left) and **F3** (right) keys to select the address character to change. Use the bit keys (**1** through **8**) to change the byte value.

For example, to modify word bit 13 with the **EDIT** menu:

☐ **Step 1:** Press **F1** to enter the Menu system. Press **F4** to enter the **WORD** menu. Press **F2** to enter the **EDIT** menu.

☐ **Step 2:** Set the Word address to 1. This is done by using **F2** and **F3** to select an address digit, and using the **PATTERN** up/down keys to select the number of each digit.

☐ **Step 3:** Press bit key **5** to toggle bit 13. Alternately, **F2** and **F3** can be used to select bit **5** and the up/down keys used to toggle it.

When you have finished editing, press **F4** to set the value. (If you press **F1** to exit the menu without pressing **F4**, no changes will be made.)

LENGTH — selects the word length submenu. On the second line of the display, the length is shown in bytes and bits, for example **LEN: 100 BYTES + 7 BITS.**

Use the **PATTERN** up/down keys to change the number of bytes and bits, using **F2** (left) and **F3** (right) keys to select the character to change, then press **F4** to set the length. (If you press **F1** to exit the menu, no changes will be made.)

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FILL — selects the word fill submenu. Use this menu to fill the entire word memory with a particular value. On the second line of the display, the message **FILL MEMORY WITH: XX** is displayed, where **XX** is a hexadecimal value.

Use the **PATTERN** up/down keys to change the hexadecimal value, using the **F2** (left) and **F3** (right) keys to select the character to change. Press **F4** to fill the memory with the set value. (If you press **F1** to exit the menu, no changes will be made.)

SYNC (Error Detector only) — selects the word sync menu, which allows you to set the word synchronization threshold. The threshold may be from 1 to 9, where 1 makes sync lock easiest to attain and harder to lose, and 9 makes sync lock harder to attain, and easier to lose.

The word synchronization threshold level appears on the second line of the display, following the text **WORD SYNC THRES LEVEL=**.

Use the **PATTERN** up/down keys to change the level, then press **F4** to set the value. (If you press **F1** to exit the menu, no changes will be made.)

Table 3-5: Synchronization Thresholds

Level	BER	RATIO (errors/bits)
1	3.1E-2	256/8192
2	7.8E-3	256/32768
3	1.9E-3	256/131072
4	9.7E-4	256/262144
5	4.8E-4	256/524288
6	2.4E-4	256/1048576
7	1.2E-4	256/2097152
8	6.1E-5	256/4194304
9	3.0E-5	256/8388608

The synchronization threshold is used by the Error Detector to decide if synchronization has been lost. An error rate higher than the selected threshold causes the Error Detector to stop counting error and to attempt to establish synchronization.

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Setting the Programmable Word If Option 3A/3T/3R (128K) is Not Installed

Data patterns in programmable word can be modified, recalled, or stored in memory. Press the **WORD** key to select word mode. The **WORD** LED will light to show that the programmable word pattern is selected. The word pattern is shown on the display in hexadecimal notation.

The programmable word can be 8 bits (one byte) or 16 bits (two bytes) long. To set the word length, press the **WORD LENGTH** key and use the **PATTERN** up/down keys to change the length. The word length (8 or 16) is shown on the display following the word pattern.

The keys **1** through **8** in the **PATTERN** section may be used to set the word pattern, one byte at a time. When **WORD** is selected, the LEDs in these keys display the bit pattern of the selected word byte. Key **1** shows the most significant bit.

To set the selected word byte, press the **1** through **8** keys to toggle their bit values. Pressing **CLEAR** sets all the bits to 0 (LED off), and pressing **SET** sets all the bits to 1 (LED on).

To select a byte of a two-byte word, use the **PATTERN** up/down keys. The display shows an arrow pointing toward the selected byte; pressing either of the up/down keys toggles the byte selection.

For example to modify word bit 13;

☐ **Step 1:** Press the **WORD** key to select word mode.

☐ **Step 2:** Note the direction of the arrow in the word readout on the display. If it does not point toward the second byte, press one of the **PATTERN** up/down keys to select the second byte.

☐ **Step 3:** Press key **5** to toggle bit 13.

Storing and Recalling Words

You can use the **SAVE** and **RECALL** keys to store and recall word patterns in the word memory. You can store up to 10 words in memory locations 0 through 9 (8 if Option 3A/3T/3R is installed). Word mode must be selected (by pressing the **WORD** key) before the **SAVE** and **RECALL** keys can be used.

To save a programmed word, press **SAVE**, then use the **PATTERN** up/down keys to select a memory location. The memory location will be shown in the lower left corner of the display, for example **WORD 3**. Once the correct location is selected, press **SAVE** again to store the word in that location. Pressing any other key will exit save mode without storing the programmed word.

When you enter save mode, the **SAVE** LED lights and the word memory location on the display blinks until you exit save mode (by storing the word in memory, or by pressing another key).

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To recall a stored word, press **RECALL**, then use the **PATTERN** up/down keys to select the word memory location to recall. The **RECALL** LED will light to show that the **PATTERN** up/down keys are assigned to select a location to recall from word memory.

For example, to modify the programmed data pattern stored in memory location 6:

- ☐ **Step 1:** Press the **RECALL** key.
- ☐ **Step 2:** Use the **PATTERN** up/down keys to select memory location 6.
- ☐ **Step 3:** Press the **WORD** key and modify the word pattern, as described earlier in this section.
- ☐ **Step 4:** Press **SAVE** twice.

SONET/FDDI Pattern ROM

This section describes the 128K SONET/FDDI Pattern ROM, and provides operating information for the pattern ROM, through front panel control. Note that the SONET/FDDI Pattern ROM is included when Option 3A/3T/3R 128K RAM Extended Memory is ordered.

Front-Panel Pattern Recall Control

The following section replaces the pattern recall control information in Setting the Data Pattern. All other pattern controls remain unchanged.

Pressing **RECALL** selects word memory mode. Eight words can be stored and recalled. There are an additional 10 programmed words permanently stored in Pattern ROM. The selected word memory location is displayed on the lower row of the display. The memory location (0 to 9, or P0 to P9) is selected using the **PATTERN** up/down keys. Locations P0 through P9 indicate the Pattern ROM. The data pattern stored in memory is output immediately upon selection.

Table 3-6: SONET/FDDI Pattern Locations

FDDI Pattern	Memory Number	Length (bits)
ANSI DDJ NRZ	0	1,280
ANSI DDJ NRZI	1	2,560
SONET Pattern	**Memory Number**	**Length (bits)**
STS1	2	6,480
STS1, Scrambled	3	6,480
STS1 X 4	4	25,920
STS1 X 4, Scrambled	5	25,920

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Table 3-6: SONET/FDDI Pattern Locations (Cont.)

FDDI Pattern	Memory Number	Length (bits)
STS3	6	19,440
STS3, Scrambled	7	19,440
STS3c	8	19,440
STS3c, Scrambled	9	19,440

FDDI Pattern Definitions

The DDJ (Data Dependent Jitter) NRZ Pattern is defined in ANSI X3.166-1990, Annex A, A.5, and is used for making jitter tests. The DDJ NRZI Pattern is identical to DDJ NRZ except that it is encoded.

The NRZI Pattern is two times the length of the NRZ Pattern because the encoding algorithm would otherwise be violated when the Pattern is repeatedly transmitted.

SONET Pattern Definitions

Appendix B of the Programmer Manual includes an overview of SONET frame structures.The payload consist of hexadecimal As for all patterns.

- STS1 is an STS-1 frame. The size is 9 rows by 90 columns.
- STS1 X 4 is four STS-1 frames packaged together and is 36 rows by 90 columns in size.
- STS3 is an STS-3 frame, which consists of three STS-1 frames multiplexed together and therefore is 9 rows by 270 columns.
- STS3c is a concatenated STS-3 payload which consists of one serial data stream. The size is 9 rows by 270 columns.

Scrambling does an XOR (exclusive OR) with 2^{7-1} PRBS on the data leaving bytes A1, A2, and ID alone.

NOTE

The Sync Threshold (In the Error Detector Word Menu) should be set to 9 when using the ROM Patterns. Failure to do so will result in an improper SYNC and the false detection of errors.

Suggestion: Error Detector **AUTOSET** is disabled when operating in **WORD** Mode. Some of the convenience **AUTOSET** provides can be retained by using the following sequence:

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- ☐ **Step 1:** Drive a **PRBS** pattern into the Error Detector and allow **AUTOSET** to find frequency, Threshold, and Delay values. This will be *indicated* by **SYNC LOCK**.
- ☐ **Step 2:** Disable **AUTOSET**.
- ☐ **Step 3:** Change the pattern to the desired **WORD**.

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Pattern Generator Error Injection

You can introduce errors into the data stream generated by the CSA 907A Pattern Generator, either as single events or at a specified rate. You can also attach an error injection signal to the Pattern Generator rear panel. The front-panel **ERROR INJECT** section controls error injection.

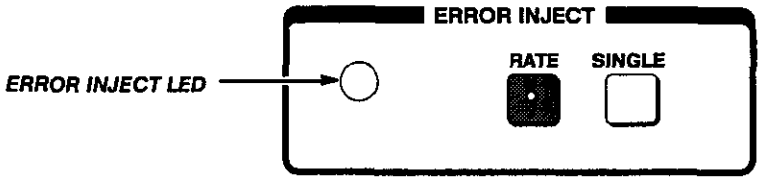


Figure 3-14: The Pattern Generator ERROR INJECT Section

Press the **RATE** key to select the internal error injection rate. The range selections are 10^{-n}, where n is 7,6,5,4,or 3. Pressing **RATE** cycles through these options. The **ERROR INJECT** LED will light to show that bit errors are being generated internally at a specified rate. The error injection rate is shown in the lower center of the display, over the label **ERROR RATE**.

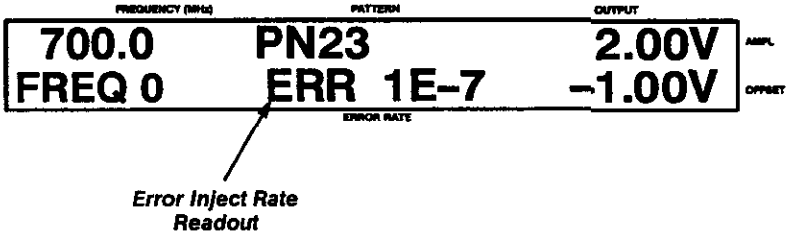


Figure 3-15: The Pattern Generator Display

Pressing **SINGLE** disables internally generated errors. Pressing **RATE** again returns the Pattern Generator to the previously selected error injection rate.

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Pressing **RATE** a sixth time selects external error injection mode. Attach the externally generated error signal to the error injection connector on the rear panel. The display will show **ERR EXT**.

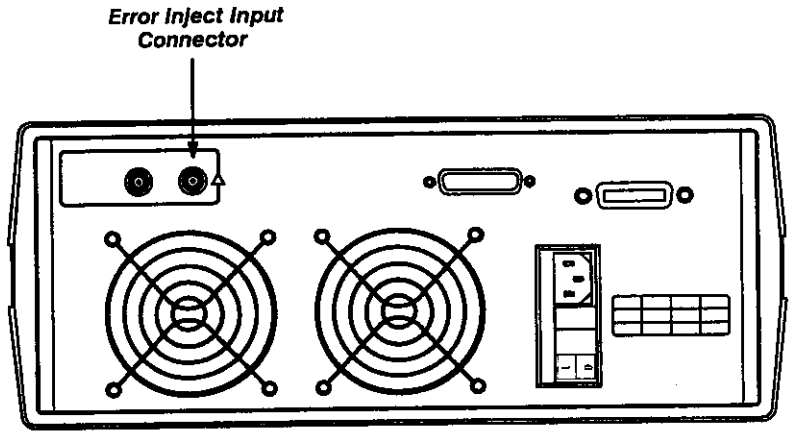


Figure 3-16: Location of the Error Inject Connector on the Pattern Generator Rear Panel

When error injection is off, pressing the **SINGLE** key injects a single bit error into the output data stream. The **ERROR INJECT** LED flashes as the error is injected into the output stream.

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Error Detection

The CSA 907A Error Detector **ERROR DETECTION** section includes controls for the error measurement display, bit error rate "beeper," and synchronization mode.

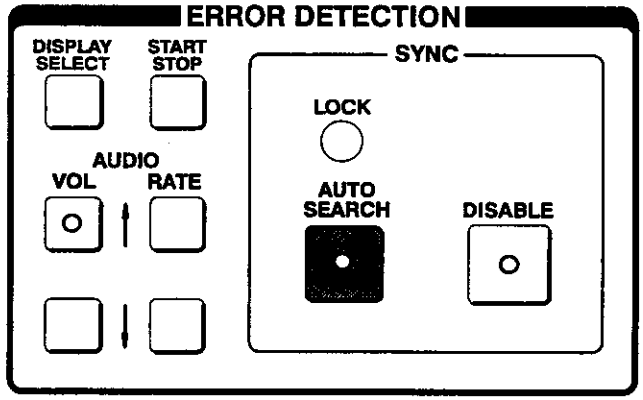


Figure 3-17: The ERROR DETECTION Section

Error Rate Display Controls

The **DISPLAY SELECT** and **START/STOP** keys control the bit error rate display. The bit error rate is always displayed along the top right of the display, under the labels **ERROR RATE** and **NUMBER OF ERRORS**.

The **START/STOP** key clears the error rate and total errors display.

DISPLAY SELECT toggles the three error rate display modes: Totalize, Window, and Test mode. The Error Detector always performs bit error rate analysis in all three modes, but displays only the selected mode.

In Totalize BER mode, the Error Detector averages errors over the time of test, starting at power-up or when the **START/STOP** key is pressed. Totalize BER results are preceded by the ∞ (infinity) symbol on the display.

In Window BER mode, the Error Detector calculates errors over a programmable sliding window, controlled by the Window menu. Window BER results have no symbol preceding the displayed rate. The Window menu is described in more detail later in this section.

In Test mode, the Error Detector calculates errors over a programmable length of time, controlled by the Test menu. Test BER results are preceded by a T, U, or R on the display, depending on the type of test. The Test menu is described in more detail later in this section.

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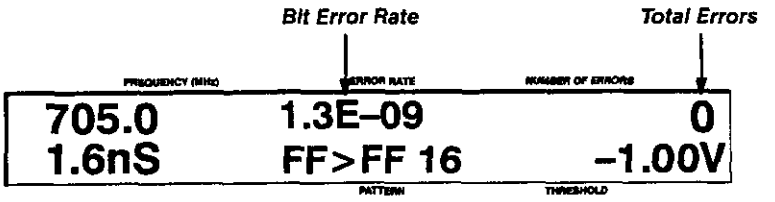


Figure 3-18: The Bit Error Rate Readout on the Display

The Test Menu

The Test menu provides control of Bit Error Rate Test (BERT) parameters. These parameters control the Bit Error Rate display while in test mode. (For an explanation of the CSA 907A Menu Structure, see page 3-41.) The Test menu selections are:

- **LENGTH** is the length (duration in time) of the test.
- **MODE** is the test mode, which may be Timed, Untimed, or Repeat.
- **REPORT** determines when the Error Detector provides a bit error rate test report, and may be Print On Error, End of Test, or both.
- **THRES** provides Threshold Errored Seconds (TES) control.
- **SQUEL**, when selected, automatically "squelches" bit error rate test reports when the Test Threshold has been exceeded for 10 consecutive seconds.
- **PRINT** provides immediate hardcopy of current test results.
- **VIEW-CUR** provides access to the current test measurement results, to be displayed on the LCD.
- **VIEW-PRE** allows you to view the previous test measurement results on the display.

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You must press **F1**: **MORE** to access the second and third pages of the Test menu.

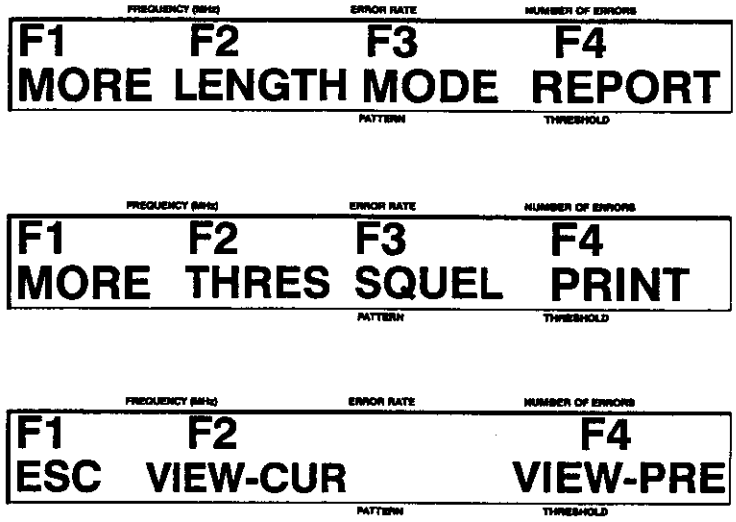


Figure 3-19: Error Detector Test Menu

LENGTH — allows programming of the test length over the range of 1 second to 23 hours, 59 minutes, and 59 seconds, in HH:MM:SS format. The length is set by selecting the character to edit with the **F2** (left) and **F3** (right) keys (the selected character will blink).

Once you have selected the character to change, use the **PATTERN** up/down keys to change its value, then press **F4** to set the value and exit the menu. (If you press **F1** to exit the menu, the value will not be changed.)

MODE — allows selection of the test mode among the values of **TIMED**, **UNTIMED**, and **REPEAT**. This provides the ability to start/stop current Bit Error measurements using front-panel, remote, or software control.

- **TIMED** tests continue until the test length (specified by **LENGTH** passes, unless stopped by the front-panel **START/STOP** key, a remote **STOP** command, or a power loss.

  Timed tests are identified by the letter **T** on the display.

- **UNTIMED** tests continue indefinitely until stopped by the front-panel **START/STOP** key, a remote **STOP** command, or a power loss.

  Untimed tests are identified by the letter **U** on the display.

- **REPEAT** tests continue until the test length (specified by **LENGTH** passes, unless stopped by the front-panel **START/STOP** key, a remote **STOP** command, or a power loss. The test will repeat continuously if not interrupted.

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Repeat tests are identified by the letter **R** on the display.

In the **MODE** menu, the test mode is displayed as

TEST MODE = XXXXX

where **XXXXX** is **TIMED**, **UNTIMED**, or **REPEAT**.

To change the test mode, use the **PATTERN** up/down keys to cycle through the three modes. When the mode you want is displayed, press **F4** to set the mode. (If you press **F1** to exit the menu, the test mode will not be changed.)

REPORT — allows selection of the test report mode. Test reports will be printed automatically to an attached printer or controller as determined by the report mode:

- **NONE** produces no test reports.
- **END OF TEST** produces a report at the end of a test.
- **ON ERROR** produces a report when the error rate exceeds the user-specified threshold. To set the threshold, use the **THRES** selection described below.
- **EOT/ERROR** produces test reports both at the end of the test and on error.

The test report mode is displayed as

REPORTS ON = XXXXXX

where **XXXXXX** is **NONE**, **END OF TEST**, **ON ERROR**, or **EOT/ERROR**.

To change the test report mode, use the **PATTERN** up/down keys to cycle through the four modes. When the mode you want is displayed, press **F4** to set the mode. (If you press **F1** to exit the menu, the test report mode will not be changed.)

You must enable printing by selecting **ON** from the **PRINT** menu in order to have test reports printed. See page 3-47 for information on the **PRINT** menu.

THRES — allows programming of the test threshold over the range of 1E−02 to 1E−16. This provides control of Threshold Errored Seconds (TES) calculations. The TES threshold determines the **ON ERROR** condition, and will generate a report if either **ON ERROR** or **BOTH** has been selected from the **TEST REPORT** submenu.

You must enable printing by selecting **ON** from the **PRINT** menu in order to have test reports printed. See page 3-47 for information on the **PRINT** menu.

The test threshold is shown on the display as

ERROR THRESHOLD = 1E−XX.

where **XX** is the test threshold exponent (2−16), over which an Errored Second (ES) occurred.

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To change the threshold exponent, use the **PATTERN** up/down keys to change the exponent on the display, then press **F4** to set the exponent. (If you press **F1** to exit the menu, the threshold will not be changed.)

SQUEL — may be set to **ON** or **OFF**. When set to **ON**, test report squelch limits the frequency of test report printouts for the **ON ERROR** condition. The report output is squelched if the test threshold has been exceeded for 10 consecutive seconds. Once squelched, the reports will resume after 5 consecutive seconds in which the error rate remains below the threshold.

The display will show **ON ERROR SQUELCH = XXX**, where **XXX** is **ON** or **OFF**. To change the squelch mode, use the **PATTERN** up/down keys to toggle the displayed mode, and press **F4** (**SET**) to set the mode. (If you press **F1** to exit the menu, the squelch mode will not be changed.)

PRINT — provides immediate hardcopy printout of current test results. Once in the **PRINT** menu, press **F4** to print a hardcopy of the test results.

VIEW-CUR — provides access to the current test measurement results on the display. Sixteen lines of test data are available for display.

The current line of measurement results appears as

TTTT : DDDDDDDDDDDDDDDD

where **TTTT** is the test parameter, and **DDDD** is the test data.

After selecting **VIEW-CUR**, use the **PATTERN** up/down keys to view the 16 lines of test data.

VIEW-PRE — provides access to the previous test measurement results. Data are displayed in the same format as for **VIEW-CUR**. After selecting **VIEW-PRE**, use the **PATTERN** up/down keys to view the 16 lines of test data.

The Window Menu

The Window menu provides control of a programmable sliding window over which errors are calculated when in Window BER mode. (For an explanation of the CSA 907A Menu Structure, see page 3-41.) Window BER results are displayed with no preceding symbol. The Window menu selections are:

- **MODE** allows selection of the window measurement unit, which may be **BITS** or **SECOND**.
- **BITS** sets the Window size in bits, with a range of 10^8 to 10^{16} bits.
- **SECOND** sets the Window size in hours, minutes, and seconds, with a range of 1 second to 23:59:59 (23 hours, 59 minutes, and 59 seconds).

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- **REPORT** determines whether a report is printed (or sent to a controller) for End of Window tests. (Note that the Print menu **ON/OFF** selection must be set to **ON** in order to print. See page 3-47 for information on the Print menu.)

You must press **F1: MORE** to access the second page of the Window menu.

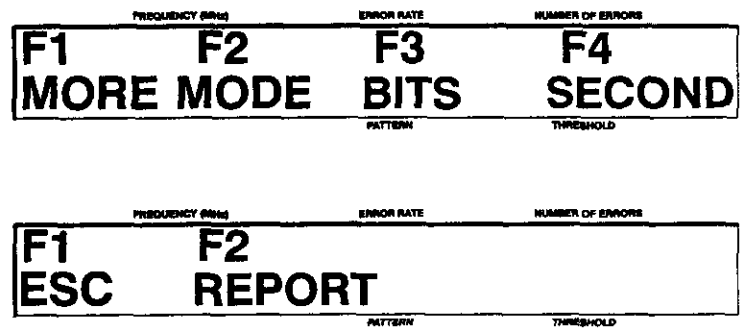


Figure 3-20: Error Detector Window Menu

MODE — allows selection of the window mode as either bits or seconds.

To change the window mode, use the **PATTERN** up/down keys to toggle between **BITS** and **SECOND**, then use the **F4** key to set the mode. (If you use **F1** to exit the mode menu, the mode will not be changed.)

BITS — allows programming of bit window length over the range 10^8 to 10^{16} bits (1E8 to 1E16).

To set the window length, use the **PATTERN** up/down keys to change the exponent, then use the **F4** key to set the length. (If you use **F1** to exit the mode menu, the mode will not be changed.)

SECOND — allows programming of seconds window length over the range of 1 second to 23 hours, 59 minutes, and 59 seconds, in HH:MM:SS format. The length is set by selecting the character to edit with the **F2** (left) and **F3** (right) keys (the selected character will blink).

Once you have selected the character to change, use the **PATTERN** up/down keys to change its value, then press **F4** to set the value. (If you press **F1** to exit the menu, the value will not be changed.)

REPORT — allows activation (**ON**) or deactivation (**OFF**) of report output (to printer or controller) for End Of Window tests.

To set the report mode, use the **PATTERN** up/down keys to toggle between **ON** and **OFF**, then use the **F4** key to set the mode. (If you use **F1** to exit the menu, the report mode will not be changed.)

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Error Rate Beeper

The **AUDIO VOL** and **RATE** up/down keys control the audible error rate detector, which allows "eye-off" detection of error rate at a programmable threshold.

The error rate beeper volume has a range of four steps, the lowest of which turns off the beeper. Pressing the **AUDIO VOL** up/down keys adjusts the volume. The **AUDIO VOL** LED lights when the beeper is on.

The beeper error rate threshold has a range of 1E−2 to 1E−16. Pressing the **RATE** up/down keys adjusts the exponent (−2 to −16).

Synchronization Mode

The CSA 907A Error Detector has three synchronization modes: Autoset, Manual, and Sync Disabled. These modes determine whether the Error Detector automatically synchronizes with the input data. The front-panel **SYNC** section (within the **ERROR DETECTION** section) controls the synchronization mode.

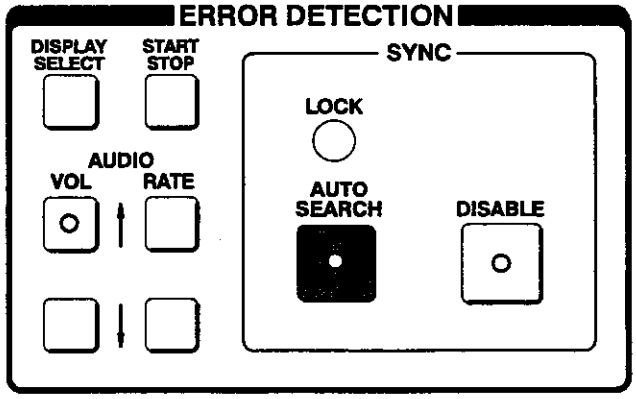


Figure 3-21: The ERROR DETECTION Section

In any synchronization mode, the **LOCK** LED lights when the Error Detector has synchronized on the incoming data pattern.

Autoset Mode

Select **AUTOSET** to have the Error Detector automatically search for and set the input parameters to synchronize with the input data.

In autoset mode, the Pattern Generator automatically sets:

- clock and data phase delay
- clock and data input threshold (provided single-ended operation is selected)
- **PRBS** pattern
- data polarity

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- pattern alignment (sync)

The Error Detector will automatically reset its input parameters whenever it loses synchronization, and will clear the **BIT** and **PHASE** error history LEDs when the new pattern is found. The **SYNC LOSS** LED remains lighted.

The error rate at which the Error Detector determines synchronization has been lost is defined by the Sync Threshold. See *Sync Thresholds*, in Table 4-2 in the Programmer manual, for details.

The **AUTOSET** LED lights when autoset mode is selected.

Manual Mode

When neither **AUTOSET** nor **DISABLE** is selected, the Error Detector is in manual mode, and you must set the input parameters and pattern to synchronize with the input data.

- *pattern alignment (sync)*

  The Error Detector will automatically resynchronize on the user-set pattern if sync loss occurs.

Sync Disabled Mode

Press the **DISABLE** key to select sync disabled mode. In this mode, the Error Detector will not attempt to resynchronize on the input data, regardless of the error rate. This mode is useful for data streams with error rates exceeding the Error Detector's sync threshold. *Pressing* ***DISABLE*** *overrides* the **AUTOSET** key.

The **DISABLE** LED will light to show that the synchronization circuitry is disabled.

Error History

The CSA 907A Error Detector **ERROR HISTORY** section contains four history LEDs, which show loss of *synchronization, bit error, phase error,* and power loss.

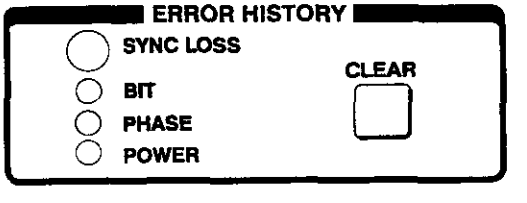


Figure 3-22: The Error Detector ERROR HISTORY Section

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- The **SYNC LOSS** LED lights when the input data error rate has exceeded the sync threshold. If synchronization is not disabled, the Error Detector will attempt to resynchronize, but will leave the **SYNC LOSS** LED lighted.
- The **BIT** LED lights when a bit error has occurred.
- The **PHASE** LED lights when the error detector's guaranteed setup and hold time requirement has been violated, between either CLOCK and DATA or CLOCK and REF DATA.
- The **POWER** LED lights when a power loss has occurred.

Pressing **CLEAR** clears all four history LEDs. The **BIT**, **PHASE**, and **POWER** LEDs are also cleared automatically when the error detector resynchronizes after a sync loss.

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Error Detector Monitor Outputs

The section of the CSA 907A Error Detector front panel provides SMA connectors for Data and Clock monitor outputs, and a Pattern Sync signal for use as an oscilloscope trigger signal.

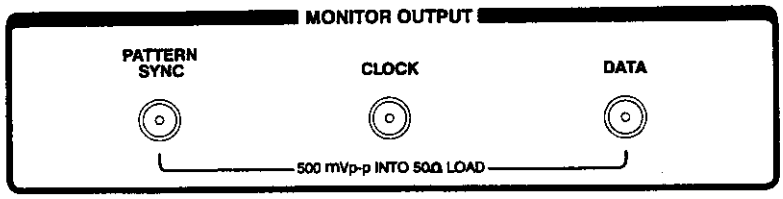


Figure 3-23: The Error Detector MONITOR OUTPUT Section

- The **DATA** output provides relatched input NRZ-L data. The pattern of this signal matches that of the incoming data signal, but it is not a feedthrough of the input data. It can be used as an indication of what the error detector is "seeing" for an incoming data signal.
- The **CLOCK** output provides a buffered version of the input clock signal.
- The **PATTERN SYNC** connector provides a trigger signal occurring once per pattern frame. It is suitable for oscilloscope trigger.

The electrical output characteristics for the **MONITOR OUTPUT** section are shown in Table 3-7.

Table 3-7: Electrical Characteristics for DATA, CLOCK, and PATTERN SYNC Connectors

Connector	Maximum Output Voltage	Coupling	Output Impedance
PATTERN SYNC	500 mV_{p-p} (±250 mV around ground)	DC	50 Ω
CLOCK	500 mV_{p-p} (±250 mV around ground)	DC	50 Ω
DATA	500 mV_{p-p} (±250 mV around ground)	DC	50 Ω

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Error Detector Hardcopy Output

The CSA 907A Error Detector provides a parallel Centronics printer interface for hardcopy output. You can print a single test report at any time, or you can set the Error Detector to print a report automatically based on the error rate, at the end of a test, or at the end of a BER window. You can also print a hardcopy of the unit setup.

In addition to the parallel printer port, you can direct the print output to the RS-232-C or GPIB ports, to send the report to a terminal or controller. All data output ports are located on the Error Detector rear panel, as shown in Figure 3-24.

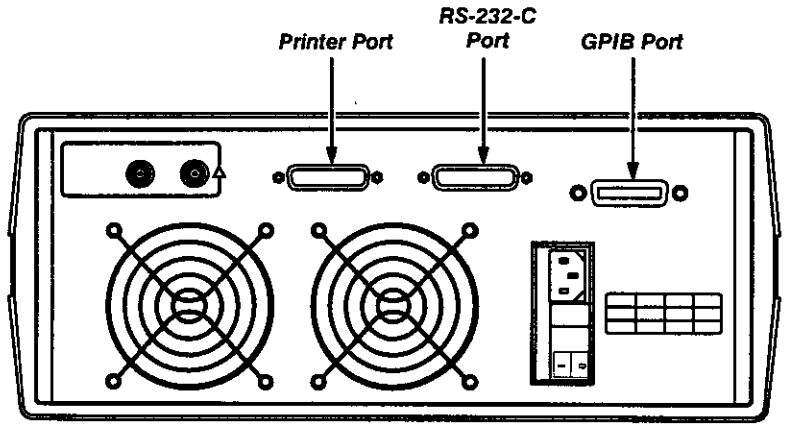


Figure 3-24: Error Detector Data Output Ports

Setting the Print Parameters

Before printing any hardcopies from the Error Detector, you must select the appropriate hardcopy output port and enable printing. Use the Print menu to set these parameters.

The Print Menu

To access the Print menu, press the **F1** key twice (once to enter the menu structure and once to display the second page of selections (**MORE**), then press **F4** to select Print. (For more information on the CSA 907A menu structure, see page 3-41.)

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The Print menu provides control of hardcopy output parameters:

- **PORT** allows selection of the printer **PORT**, which may be **PARALLEL**, **GPIB**, or **SERIAL**. Use the **GPIB** port only to send a printout to a controller; it will not communicate with a listener printer.

  To change the port selection, use the **PATTERN** up/down keys to cycle through the port selections, then press **F4** to set the selection. (If you press **F1** to escape the menu, the port selection will not be changed.)

- **ON/OFF** allows activation (**ON**) or deactivation (**OFF**) of printouts. Must be set to **ON** for any report outputs (unit setup reports from pressing the **F4** key or automatic test reports) to occur.

  To activate or deactivate printouts, use the **PATTERN** up/down keys to toggle between **ON** and **OFF**, then press **F4** to set the selection. (If you press **F1** to escape the menu, the port selection will not be changed.)

Printing the Unit Setup

You can create a hardcopy of the Error Detector status at any time by pressing the **F4** key. The setup report shows the value of all user-adjustable parameters, identified by their command names. (By sending this report to a controller and saving it, you can create a setup file to return the Error Detector to the same state later on.)

A sample report appears in Figure 3-25.

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```
**** Tektronix CSA 907AR Jun/14/92 02:14:29
AUTO_SET AUTO
DATA_DELAY 1.800E-9
DATA_THRES 0.05
RDATA_DELAY 0.000E-9
RDATA_THRES -1.50
DATA_TERM GND
CLOCK_TERM GND
RDATA_TERM GND
TEST_LENGTH "00:00:30"
TEST_MODE TIMED
TEST_PREV PRE
TEST_REP ON_ERR
TEST_STATE STOP
TEST_SQUELCH OFF
TEST_THRES OFF
WIN_MODE SEC
WIN_PREV CUR
WIN_REP OFF
WIN_BIT_LEN 09
WIN_SEC_LEN "00:00:01"
PRINT_ENABLE ON
PRINT_PORT PARALLEL
AUDIO_VOL 0
AUDIO_RATE 3
PRBS_LENGTH 23
WORD_BITS 16,#HAA,#H55
DATA_PATTERN WORD
DATA_INVERT ON
WORD_MEMORY 0,16,#HAA,#H55
WORD_MEMORY 1,16,#HAA,#H55
WORD_MEMORY 2,16,#HAA,#H55
WORD_MEMORY 3,16,#HAA,#H55
WORD_MEMORY 4,16,#HAA,#H55
WORD_MEMORY 5,16,#HAA,#H55
WORD_MEMORY 6,16,#HAA,#H55
WORD_MEMORY 7,16,#HAA,#H55
WORD_MEMORY 8,16,#HAA,#H55
WORD_MEMORY 9,16,#HAA,#H55
VIEW_ANGLE 0
GPIB_ADDRESS 14
GPIB_BUS OFF_BUS
```

Figure 3-25: A Typical Error Detector Setup Hardcopy

End-of-Test Printouts

You can set the Error Detector to provide a hardcopy automatically at the end of a Timed, Untimed, or Repeat BER test. The Error Detector will produce the hardcopy when the test ends by completion, power loss, or remote control.

Use the Test menu to set up the Error Detector for End-of-Test reports. (BER tests and the Test menu, are described in Error Detection, on page 3-23.) To access the Test menu, press **F1** to enter the menu structure, then press **F2**.

In the Test menu, set **REPORT** to **EOT** or **BOTH**. Press **F4** to access the **REPORT** submenu, then press the **PATTERN** up/down keys until **EOT** (or **BOTH**) is displayed, and press **F4** to set the report mode.

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End-of-Test reports are separated by dashed lines to indicate the start and end of the test. See Figure 3-26.

```
-----------------------------------------------------------------
Tektronix CSA 907AR TEST SUMMARY  Jun/14/92 02:42:48

TEST MODE: TIMED              FREQ: 100.0 MHz   ERROR THRES: E-05

        TIME                        ALARMS              PERFORMANCE
START Jun/14/92 02:43:26 SIG LOSS  OS US  0 0.0%
STOP Jun/14/92 02:43:31 SYNC LOSS  OS SES  0 0.0%
ELAPSED  000-00:00:05 PHASE ERR  OS TES  5 100.0%
             ES  5 100.0%
     ERRORS/BITS     EFS  0 0.0%
TOTAL ERRS   000050000 AVG RATE 1.0E-04 DM  0 0.0%
TOTAL BITS   500002816 CUR RATE 1.0E-04

-----------------------------------------------------------------
```

Figure 3-26: A Typical Error Detector End-of-Test Report

On-Demand Test Reports

You can print a test report at any time during a BER test by selecting **PRINT** from the Test menu, then press **F4** to start the hardcopy. The Error Detector will print a current test report, without stopping the tests in progress.

On-Error Reports

The Error Detector can also be set to print a report automatically whenever it *detects errors above a threshold* you determine.

Use the Test menu to set up the Error Detector for On-Error reports. To access the Test menu, press **F1** to enter the menu structure, then press **F2**.

In the Test menu, set **REPORT** to **ON ERROR** or **BOTH**. Press **F4** to access the **REPORT** submenu, then press the **PATTERN** up/down keys until **ON ERROR** (or **BOTH**) is displayed, and press **F4** to set the report mode.

To set the error threshold, select the **THRES** submenu from the Test menu. (See page 3-24 for a complete *description of the Test menu and its* selections.)

The Error Detector will print an On-Error report every second that the error rate exceeds the threshold you set, unless you have set **SQUELCH** to **ON** in the Test menu. When **SQUELCH** is on, reports will cease if the test threshold is exceeded for ten consecutive seconds, and will resume only after the error rate has been below the threshold for five consecutive seconds.

On-Error reports are separated by dashed lines to indicate the start and end of the test. See Figure 3-27.

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```
------------------------------------------------------------------
Tektronix CSA 907AR TEST START  Jun/14/92 02:42:48

TIME: 02:42:48     ERRORS: 10000     RATE: 1.00e-004
TIME: 02:42:49     ERRORS: 10000     RATE: 1.00e-004     SynLos
TIME: 02:42:50  ERRORS: 10000     RATE: 1.00e-004
------------------------------------------------------------------
```

Figure 3-27: A Typical Error Detector On-Error Report

End-of-Window Reports

The Error Detector may also be set to print a report automatically at then end of a BER window. Window BER parameters and results are described in Error Detection on page 3-23.

To set the Error Detector to produce End-of-Window reports, enter the Window menu (press **F1** to enter the menu structure, then press **F3** for the Window menu), then select **REPORT**. **REPORT** is on the second page of the Window menu, so you must press **F1**: **MORE**, then press **F2** for the **REPORT** submenu. Press the **PATTERN** up/down keys until **ON** is displayed, and press **F4** to set the report mode. See Figure 3-28.

```
Date: Jun/14/92 Time: 02:42:34.46
  Bits= 5.00e+08     Errs= 50000   Err rate= 1.0e-04    Freq= 100.00 MHz
  Pattern= AA55      Data Los= 0   Sync Los= 0          Phase Err= 0
```

Figure 3-28: A Typical Error Detector End-of-Window Report

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Menu Structure

Function keys **F1** through **F4** provide access to menus. The function keys are located in the PATTERN section of the front panel. See Figure 3-29. The menus allow you to program a variety of features, including most instrument options. Normal instrument operation continues while in menu mode.

The menu functions of the CSA 907A Pattern Generator and the CSA 907A Error Detector differ. Most instrument options also add menu functions. However, the basic operation of the menus remains the same, as described in this section.

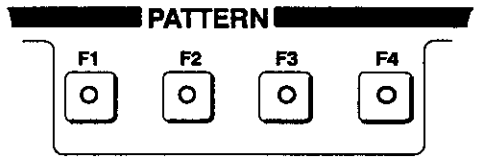


Figure 3-29: Function Keys F1 through F4

Function key **F1**, the "escape key," traverses the menus. **F1** function depends on context, but is always one of:

- enter menu mode,
- provide **MORE** selections,
- **ESCAPE** from an editing level, or
- **EXIT** from menu mode.

F1 will either escape or access more menus. Pushing **F1** repetitively will eventually exit menu mode without changing previously set conditions.

Menu keys **F2**, **F3**, and **F4** are editing keys. Their functions are re-assigned for each submenu.

When you press **F1** to enter menu mode, the top-level, or main, menu will appear on the display, as shown in the following illustration. In menu mode, the function assigned to each key appears on the second line of the display, beneath the key name. See Figure 3-30.

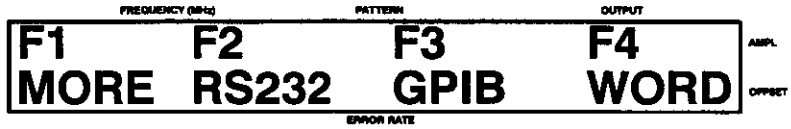


Figure 3-30: A Sample Menu (Pattern Generator Main Menu)

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Pressing **F1** while in this menu displays the next three top-level menu options under **F2**, **F3**, and **F4**.

Pressing **F2**, **F3**, *or* **F4** *enters a submenu.* Submenus may provide additional options. For example, the **RS232** submenu has selections for **BAUD**, **PARITY**, **SIZE**, **EOL**, **XON/XOFF**, and **ECHO**.

At the lowest level, a submenu allows you to adjust a selected parameter using the **PATTERN** up/down keys. *This type of submenu has only two selections:* **F1** to escape to the next higher menu level, and **F4** to set the *selected parameter. The parameter value is shown on the display, as in* Figure 3-31 below.

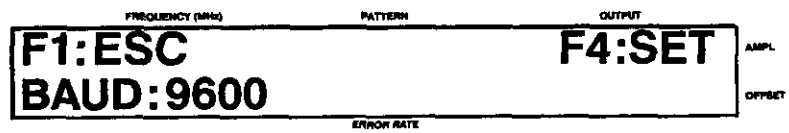


Figure 3-31: *The Baud Submenu*

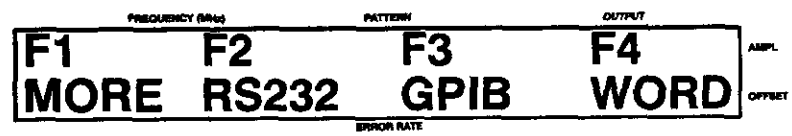
To adjust the selected parameter, first use the **PATTERN** up/down keys to display the value you want on the second line of the display, then press **F4** to set the value.

Pattern Generator Menus

This section provides a brief overview of the CSA 907A Pattern Generator menus. Some menu functions, as noted, are discussed in more detail elsewhere in this manual.

The Main Menu

The top-level menu *includes* **RS232**, **GPIB**, **WORD**, *and* **UTIL** selections, as shown below. (You must press **F1**: **MORE** to reach the **EXIT**, **CLOCK**, and **UTIL** *selections.*)



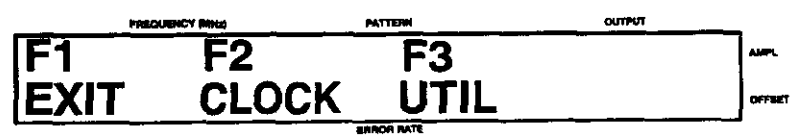


Figure 3-32: Pattern Generator Main Menu

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MORE accesses the second page of the main menu (the **EXIT**, **CLOCK**, and **UTIL** selections). **EXIT** exits from menu mode.

The RS232 Menu

RS232 selects the RS232 (RS-232-C) menu. RS-232-C remote interface parameters can be set using the selections of this menu, as summarized briefly below. RS-232-C setup is described in more detail in the Programmer manual.

- **BAUD** allows selection of baud rate among the values of 300, 600, 1200, 2400, 4800, and 9600.
- **PARITY** allows selection of parity as NONE, EVEN, or ODD.
- **SIZE** allows selection of RS-232-C word size, which may be 7 or 8.
- **EOL** allows selection of EOL (end-of-line) character as LF, CR, CR/LF, or LF/CR.
- **XON/XOFF** allows activation (ON) or deactivation (OFF) of RS-232-C XON/XOFF protocol.
- **ECHO** allows activation (ON) or deactivation (OFF) of RS-232-C echo feature, which echoes back to the terminal all characters entered.

The GPIB Menu

GPIB selects the GPIB menu. GPIB operation is described in more detail in the CSA 907A Programmer Manual.

The GPIB menu allows you to set the GPIB **EOI** (End or Identify) line. Possible selections are EOI and EOI/LF.

The Word Menu (Option 3A/3T/3R)

WORD selects the Word menu, which controls the 128K Programmable Word Memory (Option 3A/3T/3R). Word parameters are described in more detail in Setting The Data Pattern on page 3-13. For the Pattern Generator, the Word menu selections are:

- **EDIT** allows you to edit the word.
- **LENGTH** allows you to select the number of bytes and bits (after the last byte) in the programmable word.
- **FILL** allows you to fill the word memory with a hexadecimal word value.

The Util Menu

UTIL selects the Util (Utility) menu, which provides information about the instrument options and software version of your instrument. This menu provides two selections:

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- **OPTION** displays installed instrument options. See Appendix A for a complete list of available options.
- **VER** displays the software version in your instrument.

The Clock Menu

CLOCK selects the Clock menu, which is used to select the termination for the EXT Clock Input from GND or −2 V. Once selected, the termination is activated by pressing **F4** (SET), or the extant setting is retained unchanged by pressing **F1** (ESCAPE).

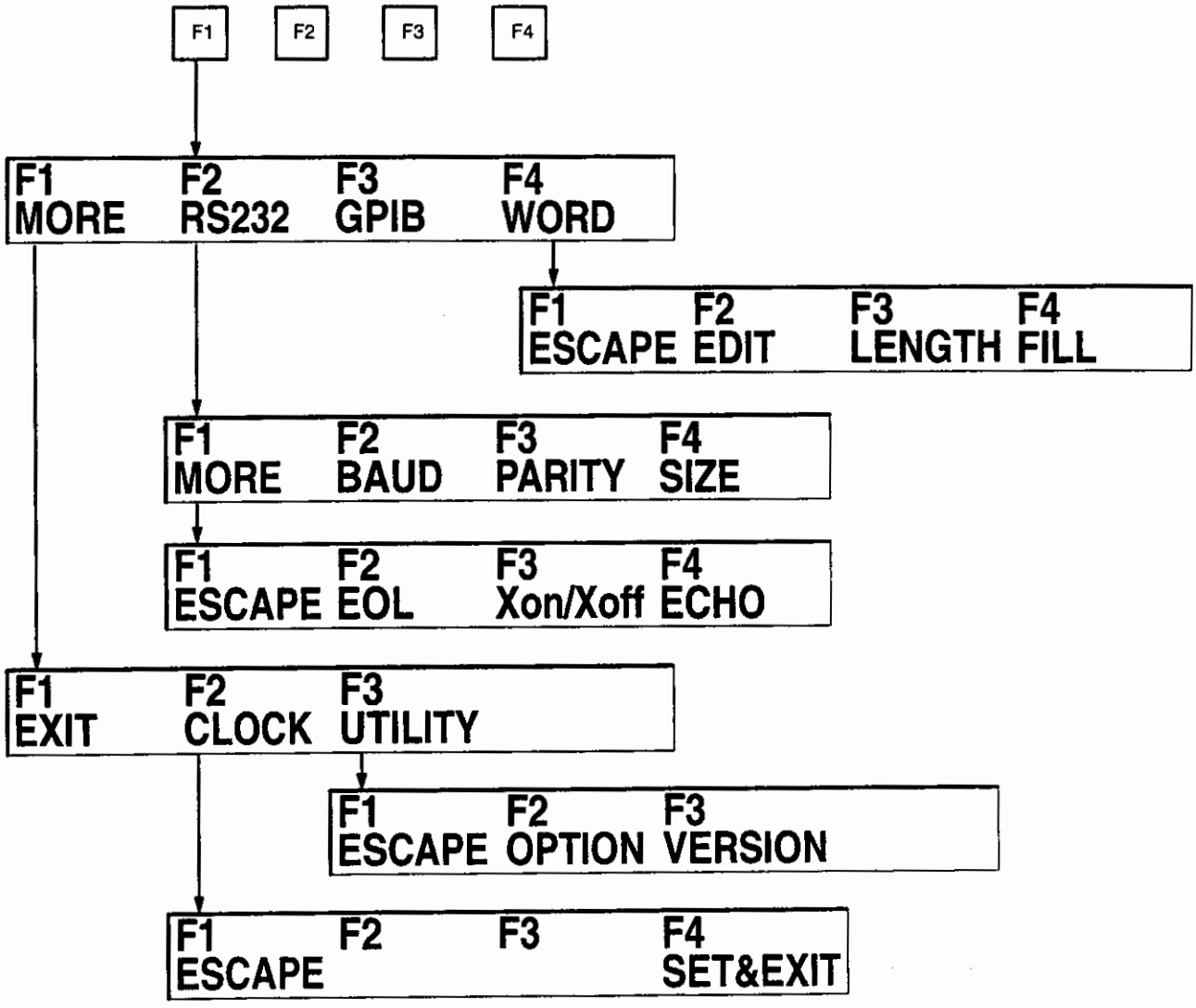


Figure 3-33: Pattern Generator Menu Structure Chart

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Error Detector Menus

This section provides a brief overview of the CSA 907A Error Detector menus. Some menu functions, as noted, are discussed in more detail elsewhere in this manual.

The Main Menu

The top-level menu includes **TEST**, **WINDOW**, **WORD**, **RS232**, **GPIB**, **PRINT**, **DATE**, **TIME**, and **UTIL** selections, as shown below. (You must press **F1: MORE** to reach the second and third "pages" of the menu.)

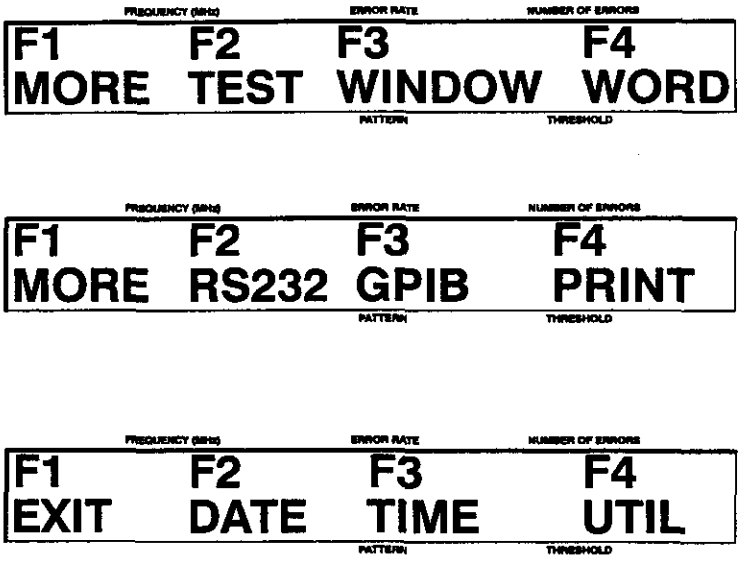


Figure 3-34: Error Detector Main Menu

MORE accesses the second and third pages of the main menu. **EXIT** exits from menu mode.

The Test Menu

The Test menu provides control of Bit Error Rate Test (BERT) parameters, and is described in greater detail within the section Error Detection, on page 3-24. These parameters control the Bit Error Rate display while in test mode. Briefly, the Test menu selections are:

- **LENGTH** is the length (duration in time) of the test.
- **MODE** is the test mode, which may be Timed, Untimed, or Repeat.
- **REPORT** determines when the Error Detector provides a bit error rate test report, and may be None, Print On Error, End of Test, or both.
- **THRES** provides Threshold Errored Seconds (TES) control.

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- **SQUEL**, when selected, automatically "squelches" bit error rate test reports when the Test Threshold has been exceeded for 10 consecutive seconds.
- **PRINT** provides immediate hardcopy of current test results.
- **VIEW-CUR** provides access to the current test measurement results, to be displayed on the LCD.
- **VIEW-PRE** allows you to view the previous test measurement results on the display.

The Window Menu

The Window menu provides control of the Bit Error Rate measurement window parameters, which control the BER sliding window display. These parameters are described in greater detail within the section CSA 907R Error Detection, on page 3-27. Briefly, the Window menu selections are:

- **MODE** allows selection of the Window mode as either bits or seconds.
- **BITS** *sets the Window size in bits, with a range of* 10^8 to 10^{16} bits.
- **SECOND** sets the Window size in hours, minutes, and seconds, with a range of 1 second to 23:59:59 (23 hours, 59 minutes, and 59 seconds).
- **REPORT** determines whether a report is printed (or sent to a controller) for End of Window tests. (Note that the Print menu **ON/OFF** selection must be set to **ON** in order to print. See The Print Menu, later in this section.)

The Word Menu (Option 3A/3T/3R)

WORD selects the Word menu, which controls the 128K Programmable Word Memory (Option 3A/3T/3R). This option is described in more detail in Setting the Data Pattern on page 3-13. For the Error Detector, the Word menu selections are:

- **EDIT** allows you to edit the word.
- **LENGTH** allows you to select the number of bytes and bits (after the last byte) in the programmable word.
- **FILL** allows you to fill the word memory with a hexadecimal word value.
- **SYNC** allows you to set a word sync threshold, which is used to determine synchronization locking. Refer to Setting the Data Pattern on page 3-13 for more details.
- **ORDER** allows you to define whether the **LSB** or **MSB** comes first.
- **PSYNC** allows you to define the location in the **WORD** of the **PATTERN SYNC**.

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The RS232 Menu

RS232 selects the RS232 (RS-232-C) menu. RS-232-C remote interface parameters can be set using the selections of this menu, as summarized briefly below. RS-232-C setup is described in more detail in the Programmer manual.

- **BAUD** allows selection of baud rate among the values of 300, 600, 1200, 2400, 4800, and 9600.
- **PARITY** allows selection of parity as NONE, EVEN, or ODD.
- **SIZE** allows selection of RS-232-C word size, which may be 7 or 8.
- **EOL** allows selection of EOL (end-of-line) character as LF, CR, CR/LF, or LF/CR.
- **XON/XOFF** allows activation (ON) or deactivation (OFF) of RS-232-C XON/XOFF protocol.
- **ECHO** allows activation (ON) or deactivation (OFF) of RS-232-C echo feature, which echoes back to the terminal all characters entered.

The GPIB Menu

GPIB selects the GPIB menu. GPIB operation is described in detail in the Programmer Manual.

The GPIB menu allows you to set the GPIB **EOI** (End or Identify) line. Possible selections are EOI and EOI/LF.

The Print Menu

The Print menu provides control of hardcopy output parameters:

- **PORT** allows selection of the printer port, which may be Parallel, GPIB, or Serial.

  To change the port selection, use the **PATTERN** up/down keys to cycle through the port selections, then press **F4** to set the selection.

- **ON/OFF** allows activation (**ON**) or deactivation (**OFF**) of printouts. Must be set to **ON** for any report outputs (unit setup reports from pressing the **F4** key or automatic test reports) to occur.

  To activate or deactivate printouts, use the **PATTERN** up/down keys to toggle between **ON** and **OFF**, then press **F4** to set the selection.

Printing is covered in detail in Error Detector Hardcopy Output, on page 3-35.

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The Date Menu

The Date menu allows you to set the date of the Error Detector's internal clock. The date is shown on the second line of the display, in month-day-year format.

To set the date, use keys **F2** and **F3** to move the cursor to the month, date, or year on the display. **F2** moves the cursor to the left; **F3** moves it to the right. Then use the **PATTERN** up/down keys to change the selected value. When the correct date is displayed, press **F4** to set it.

The Time Menu

The Time menu allows you to set the time of the Error Detector's internal clock. The time is shown on the second line of the display, in hours-minutes-seconds format.

To set the time, use keys **F2** and **F3** to move the cursor to the hours, minutes, or seconds on the display. **F2** moves the cursor to the left; **F3** moves it to the right. Then use the **PATTERN** up/down keys to change the selected value. When the correct time is displayed, press **F4** to set it.

The Util Menu

UTIL selects the Util (Utility) menu, which provides information about the instrument options and software version of your instrument. This menu provides two selections:

- **OPTION** displays installed instrument options. See Appendix A for a complete list of available options.
- **VER** displays the software version in your instrument.

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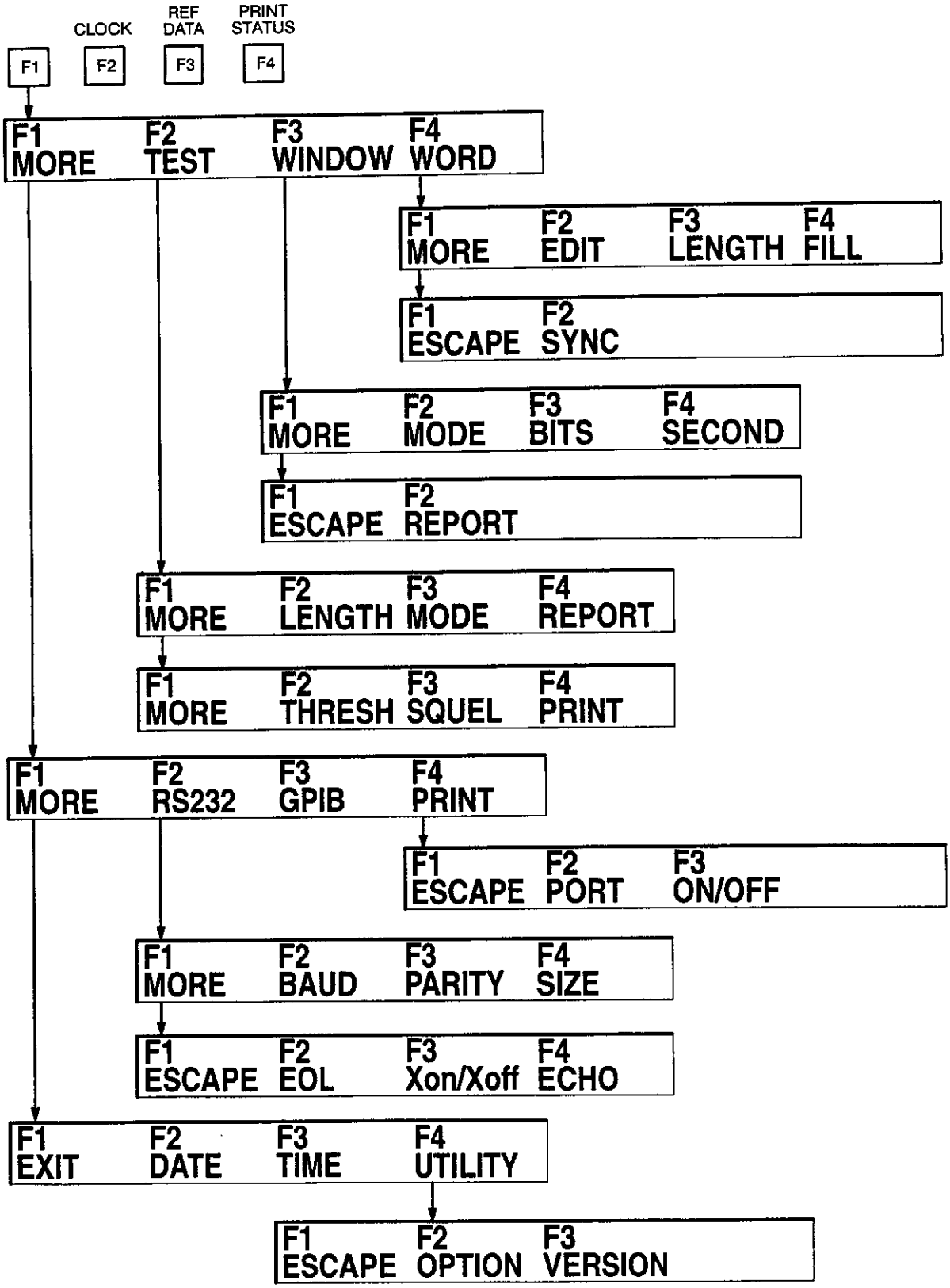


Figure 3-35: Error Detector Menu Structure Chart

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Appendix A: Options and Accessories

Standard Accessories

The CSA 907A instrument package includes the following standard accessories:

- CSA 907A Bit Error Rate Test Set User manual (this manual).
- CSA 907A Bit Error Rate Test Set Programmer Manual (Tektronix part number 070–8686–00).
- 3½ inch floppy disk and 5¼ inch floppy disk with FrameWriter software (Tektronix part number 063–1522–00, included with the Programmer manual).
- Power Cord (North American 120 V), Tektronix part number 161–0066–00.

To obtain replacements, refer to a Tektronix products catalog or contact your local Tektronix field representative.

Optional Accessories

The following optional accessories have been selected from our catalog specifically for the CSA 907A. For detailed information and prices, see a Tektronix products catalog or contact your local Tektronix field representative.

- Option 1M Rack Mount, provides material to convert one CSA 907A instrument for rack mounting. This option is intended for static use and is not suitable for mobile applications.
- Option 2M Rack Mount, provides material to convert two CSA 907A instruments for rack mounting. This option is intended for static use and is not suitable for mobile applications.
- Option 2A, 75 Ω I/O termination for both the Pattern Generator and Error Detector.
- Option 2T, 75 Ω I/O termination for the Pattern Generator only.
- Option 2R, 75 Ω I/O termination for the Error Detector only.
- Option 3A, 128K Extended Pattern Memory. Option 3A provides 128K programmable word memory for both the Pattern Generator, and the Error Detector. This option is described in detail in the Programmers manual. Includes SONET/FDDI Pattern ROM.

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- Option 3T, 128K Extended Pattern Memory. Option 3T provides 128K programmable word memory for the Pattern Generator only. This option is described in detail in the Programmers manual. Includes SONET/FDDI Pattern ROM.
- Option 3R, 128K Extended Pattern Memory. Option 3R provides 128K programmable word memory for the Error Detector only. This option is described in detail in the Programmers manual. Includes SONET/FDDI Pattern ROM.
- GPIB cable, one meter, double shielded, Tektronix part number 012–0991–01.
- GPIB cable, two meter, Tektronix part number 012–0991–00.

NOTE

The CSA 907A may not comply with VDE B emissions requirements when using the two meter cable.

- RS-232-C cable, ten foot, Tektronix part number 012–0911–00.
- Centronics cable, nine foot, DB-25 Male to 36 pin male Centronics, Tektronix part number 012–1250–00.

Power Cord Options

The following power cords are available for the CSA 907A.

- Option A1 Universal European 220 V/6A, 50 Hz, Tektronix part number 161–0066–09.
- Option A2 United Kingdom 240 V/6A, 50 Hz, Tektronix part number 161–0066–10.
- Option A3 Australian, 240V/6A, 50 Hz, Tektronix part number 161–0066–11.
- Option A4 North American 250 V/10A, 60 Hz, Tektronix part number 161–0066–12.
- Option A5 Switzerland, 240 V/6A, 50 Hz, Tektronix part number 161–0154–00 .

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Appendix B: Specifications

Table 4-1: CSA 907A Pattern Generator Specifications

Characteristic	Specification
Frequency Range	150 kHz to 700 MHz (Mbit/sec) with Internal or External Clock
Resolution	Crystal Locked at 1 kHz
Stability	10 ppm typical
Memory	10 Frequencies
External Clock In	0.5−1.4 V_{p-p} recommended, 2.0 V_{p-p} maximum, 50 Ω, DC Coupled, selectable termination to GND or −2 V, 0.5 V_{p-p} min. 1.4 V_{p-p} maximum centered on −1.31 V with −2 V termination 2.0 V_{p-p} maximum centered on Gnd with Gnd termination
Data Out Formats	NRZ-L, Normal and Complement; PRBS patterns or programmable word
PRBS pattern	2^n-1, n=7, 15, 17, 20, 23 PRBS Patterns are pseudo-random bit streams described in the CCITT Blue Book, Volume IV Fuscicle IV.4-Recommendation 0.151. The patterns for n=7 and n=17 are not specified in that document. n=7 uses type 6 & 7. n=17 uses type 14 & 17.
Word length maximum	16 bits (128K pattern memory with Option 3A/3T/3R)
Word order	Transmit LSBit or MSBit first
Word memories	10 × 16 bits (8 × 128K bits with Option 3A/3T/3R)

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Table 4-1: CSA 907A Pattern Generator Specifications (Cont.)

Characteristic	Specification
Data and Clock outputs	50 Ω True and Complement (75 Ω True and Complement with Option 2A/2T/2R)
Amplitude	500 mV_{p-p} to 2 V_{p-p} into 50 Ω (75 Ω with Option 2A/2T/2R) 50 mV steps
Baseline Offset	−2.0 V to +1.8 V into 50 Ω (75 Ω with Option 2A/2T/2R) to ground, 50 mV steps
Pulse top limit	+2.8 V into 50 Ω to Gnd. (75 Ω with Option 2A/2T/2R), +5.6 V open load, +4.3 V into 50 Ω to +3 V
Rise/Fall Times	200 ps, typical @ 1 V_{p-p}
Output Timing	CLOCK/DATA edge aligned (±100 ps)
Data Inhibit	Rear panel BNC, ECL (50 Ω to −2 V termination), 500 mVp-p to 1 V_{p-p} centered on −1.31 V Asynchronous, 1 bit + 500 ps minimum width
Error Injection	Single, or 10^{-n}, where n=3, 4, 5, 6, 7
External	1 error injected for each rising edge, ECL, 50 Ω to −2 V, 50 ns minimum pulse width, 500 mV_{p-p} to 1 V_{p-p} centered on −1.31 V
Auxiliary Outputs	Clock/4 and Pattern Sync, DC coupled, 200 mV_{p-p} (±100 mV ±20%) centered on Gnd into 50 Ω

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Table 4-2: CSA 907A Error Detector Specifications

Characteristic	Specifications
Frequency Range	150 kHz to 700.00 MHz (Mbit/sec), Clock Input. Displayed with 10 kHz resolution.
Memory	10 Frequencies
Synchronization	
Auto Set	Unit automatically selects PRBS mode, clock threshold data polarity, data threshold, and Clock/Data input timing phase delay, then synchronizes on the input data pattern.
Manual mode	User selects parameters, then unit attempts to synchronize on the input data pattern.
Disable mode	Sync circuitry disabled
Sync thresholds	PRBS mode 25% (1024 errors/4096 bits) WORD mode 3.1% (128 errors/4096 bits) Option 3A/3T/3R (128K Word) thresholds, programmable: **LEVEL BER RATIO (errors/bits)** 1 3.1E−2 256/8192 2 7.8E−3 256/32768 3 1.9E−3 256/131072 4 9.7E−4 256/262144 5 4.8E−4 256/524288 6 2.4E−4 256/1048576 7 1.2E−4 256/2097152 8 6.1E−5 256/4194304 9 3.0E−5 256/8388608
BER Measurements	Three simultaneous BER measurements (Totalize, Window, and Test) displayed as: BER: 9.9E−01 to <1.0E−16 TOTALIZE: 0 to 99999999, then 1.0E8 to 9.9E36
Totalize mode	BER since power-on or reset
Window mode	BER over sliding window, programmable in time (1 second−24 hours) or bits (1E8−1E16)
Test mode	BER over time of test, programmable in time (1 second−24 hours). Additional calculations include ES, EFS, TES, SES, DM, US, and LOS
History indicators	Sync loss, bit error, phase error, power

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Table 4-2: CSA 907A Error Detector Specifications (Cont.)

Characteristic	Specifications
Data and Ref Data Inputs	NRZ-L, RZ, True (or Inverted, Data only)
Input Threshold	Variable, depends on input termination: 50 Ω to Gnd: −2 to +4 V 50 Ω to −2 V: −3 to +3 V 50 Ω to +3 V: −1.5 to +4.5 V FLT: −2 to +2 V
Input Amplitude	0.5−6.0 V
Impedance	50 Ω (75 Ω with Option 2A/2T/2R), Gnd, +3 V, FLT, or −2.0 V Termination
Delay Range	0 to 4 ns, variable in 100 ps steps
Clock Input	Square wave for frequencies < 100 MHz, sine or square wave for frequencies ≥ 100 MHz. Amplitude is variable depending on input termination: 50 Ω to Gnd: −2 to +4 V 50 Ω to −2 V: −3 to +3 V 50 Ω to +3 V: −1.5 to +4.5 V FLT: −2 to +2 V
Monitor Outputs	Pattern Sync, Clock, Data, and Error 200 mV_{p-p} typical, DC coupled, 50 Ω, centered on ground
Data Monitor	Latched input data
Clock Monitor	Buffered Input clock
Pattern Sync	One bit-wide pulse per frame
Printer Interface	
Format	Parallel Centronics-type and redirectable to serial (RS-232-C) or GPIB ports.
Hardcopy	Front-panel key **F4** prints unit setup
Print on event	Print if BER threshold is exceeded; programmable rate (1E−02 to 1E−06)
Print on end-of-window	Print on End of Window, programmable in time (1 second−24 hours) or bits (1E8−1E16)
Print on end-of-test	Print on End of Test, programmable length (1 second−24 hours)

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Table 4-3: CSA 907A Pattern Generator and CSA 907A Error Detector Common Specifications

Characteristic	Specification
Front-Panel Connectors	SMA female
Physical Specifications	6″ H × 14.4″ W × 16.5″ D (152 mm × 366 mm × 420 mm)
Weight	24 lbs (11 kg)
Operating Temperature	0 to 40°C
Storage Temperature	−20° to 40° C
Humidity	90% RH at 30° C, 75% RH to 40° C, MIL-T-28800D Class 6, Test 4.5.5.1.2.2 modified to 90% at 30° C
Power Requirements	90−132 VAC, or 180−264 VAC, 47−63 Hz. 100 W maximum
RS-232-C and GPIB Interfaces	
Controlled functions	Remote control of all front-panel functions except power and panel lock.
Read back functions	See Programmer manual
GPIB EOS character	LF (line feed; $0A_{hex}$)
GPIB Address	Front-panel selected; 0−30 or OFF-BUS.

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Appendix C: Default Settings

To return the Pattern Generator or Error Detector to its factory default settings, power it down, then hold down the **CLEAR** key in the **PATTERN** section, the **MSB** (1) key, and the **VIEW ANGLE** key while powering up the instrument. You will see the message **Default Settings** briefly on the display.

Table 4-4: CSA 907A Pattern Generator Factory Default Settings

Parameter	Setting
Frequency	
External Clock Mode	INT, GND termination
Frequency	705.000 MHz
Frequency Memory (All 10)	705.000 MHz
Frequency Step Size	100.000 MHz
Data Pattern	
PRBS Pattern	PN7
WORD Memory (All 10)	AA 55
Programmable Data Pattern	AA 55
Current Pattern Setting	PRBS
Data Invert	OFF
Clock/Data Outputs	
Output Clock Amplitude	1.50 V
Clock Baseline Offset	−0.75 V
Output Data Amplitude	1.50 V
Data Baseline Offset	−0.75 V
Error Injection Rate	OFF
Miscellaneous	
View Angle	0
Panel Lock	OFF

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Table 4-4: CSA 907A Pattern Generator Factory Default Settings (Cont.)

Parameter	Setting
Remote Interfaces	
Remote Mode	LOCAL
GPIB Address	15
GPIB Terminator	EOI/LF
RS-232-C Prompt	CSA907AT
RS-232-C Baud Rate	9600
RS-232-C Parity	EVEN
RS-232-C Data Size	8 bits
RS-232-C EOL	CR/LF

Table 4-5: CSA 907A Error Detector Factory Default Settings

Parameter	Setting
Clock, Data and Ref Data Inputs	
Input Data Delay	0 ps[1]
Input Data Threshold	0.00 V[1]
Input Clock Threshold	0.00 V
Single/Diff	Single
Reference Data Delay	0 ps
Reference Data Threshold	−1.50 V
Input Data Termination	0 V
Input Clock Termination	0 V
Reference Data Termination	0 V
Data Pattern	
PRBS Pattern	PN7[1]
WORD Memory (All 10)	AA 55
Programmable Data Pattern	AA 55
Current Pattern setting	PRBS
Data Invert	OFF[1]
Reference Data Mode	OFF

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Table 4-5: CSA 907A Error Detector Factory Default Settings (Cont.)

Parameter	Setting
Auto/Status	
Auto Search Mode	ON
Synchronization Disable	OFF
Error Display Select Mode	TOTALIZE
Error Beeper	
Audio Volume	0 (OFF)
Error Rate Threshold	1E−3
Miscellaneous	
View Angle	0
Panel Lock	OFF
Remote Interfaces	
Remote Mode	LOCAL
GPIB Address	14
GPIB Terminator	EOI/LF
RS-232-C Prompt	CSA907AR
RS-232-C Baud Rate	9600
RS-232-C Parity	EVEN
RS-232-C Data Size	8 bits
RS-232-C EOL	CR/LF
Time Keeping	
Date	1−1−1990
Time	00:00:00.0
Printer	
Port	Parallel
Output (test report)	OFF
Current BER	
Mode	SECONDS
BITS	1.0E09
SECONDS	300

[1] **May be adjusted during AUTOSET process after power-up default settings have been made.**

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Appendix D: Performance Verification

The following tests verify that the CSA 907A Pattern Generator and CSA 907A Error Detector achieve their specified performance. These instruments are not user-adjustable. If your CSA 907A needs repair, return it to a Tektronix field office. (See Packaging for Shipment, on page 1-7.)

Recommended Test Equipment

The recommended test equipment needed to verify performance is listed below. Only the first three items are required to perform a functional test.

Table 4-6: Recommended Test Equipment

Description	Minimum Specification	Example	Comment
CSA 907A Pattern Generator			
CSA 907A Error Detector			
Coaxial SMA Cables	equal length		
Standard Instrument	six each 50 Ω	Tektronix part number: 174–1427–00	
75 Ω Option	four each 75 Ω, two each 50 Ω	Tektronix part number: 012–1338–00 (75 Ω) 012–0074–00 (50 Ω),	
SMA male to BNC female Adapter	eight each	Tektronix part number: 015–1018–00	
Digital Sampling Oscilloscope (DSO)	Tektronix 11800 Series or CSA 803 Communications Signal Analyzer	11801A or CSA 803	
Sampling Head, installed in DSO	Low-noise sampling head	Tektronix SD-22 Sampling Head, or SD-26 Sampling Head	
Signal Generator(s)	Signal generator(s) covering the range 150 kHz–705 MHz	Tektronix SG 503 (250 kHz–250 MHz) Tektronix SG 504 (245 MHz–1050 MHz)	
Square Wave Generator	0.1 Hz to 11 MHz, variable offset	Tektronix FG 502	
Power splitter	50 Ω, SMA female connectors	Tektronix part number: 015–0565–00	

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Table 4-6: Recommended Test Equipment (Cont.)

Description	Minimum Specification	Example	Comment
Attenuator (for signal connection to the DSO; not used for 75 Ω option)	2X or 5X attenuation, 50 Ω, SMA female connectors	2X attenuator, Tektronix part number: 015–1001–00 5X attenuator, Tektronix part number: 015–1002–00	
Impedance Match (for use with 75 Ω option only)	two each, 75 Ω to 50 Ω	Tektronix part number: 011–0057–01 (BNC: requires use of BNC to SMA adapter). See Figure 4-1.	Male end of BNC is 75 Ω. 75 Ω to 50 Ω ratio: 2.35. 50 Ω to 75 Ω ratio: 1.6
50 Ω BNC Terminator	Male connector	Tektronix part number: 011–0123–00	
RS-232-C Terminal	300 baud (faster is acceptable)	See the CSA 907A Programmer manual	
Torque Wrench (for SMA connectors)	Range of 7–10 in.-lb.		
Printer	Centronics compatible		

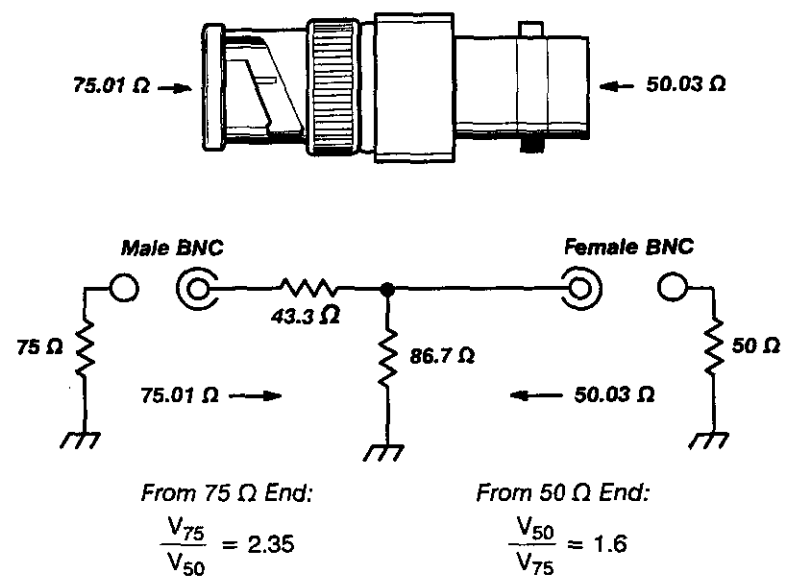


Figure 4-1: 75 Ω to 50 Ω Impedance Match

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Functional Test

To functionally test the CSA 907A, connect the Error Detector to the Pattern Generator and confirm their correct operation as described below.

NOTE

In these procedures, the Pattern Generator (Tx) and Error Detector (Rx) are returned to their default settings. The word memories will be reset. If you have entered word patterns that you do not want to lose, use a GPIB or RS-232-C controller to save them before beginning these procedures.

☐ **Step 1:** Make connections appropriate to the options installed as follows:

Table 4-7: Connections for Functional Test

Option	From	To	Comment
Standard Instrument	Tx Clock	Rx Clock	50 Ω, SMA Coax
	Tx Not Clock	Rx Not Clock	50 Ω, SMA Coax
	Tx Data	Rx Data	50 Ω, SMA Coax
	Tx Not Data	Rx Not Data	50 Ω, SMA Coax
75 Ω Option	Tx Clock	Rx Clock	75 Ω, SMA Coax[1]
	Tx Not Clock	Rx Not Clock	75 Ω, SMA Coax[1]
	Tx Data	Rx Data	75 Ω, SMA Coax[1]
	Tx Not Data	Rx Not Data	75 Ω, SMA Coax[1]

1 This may be accomplished by using SMA to BNC adapters and 75 Ω BNC Coaxial cables.

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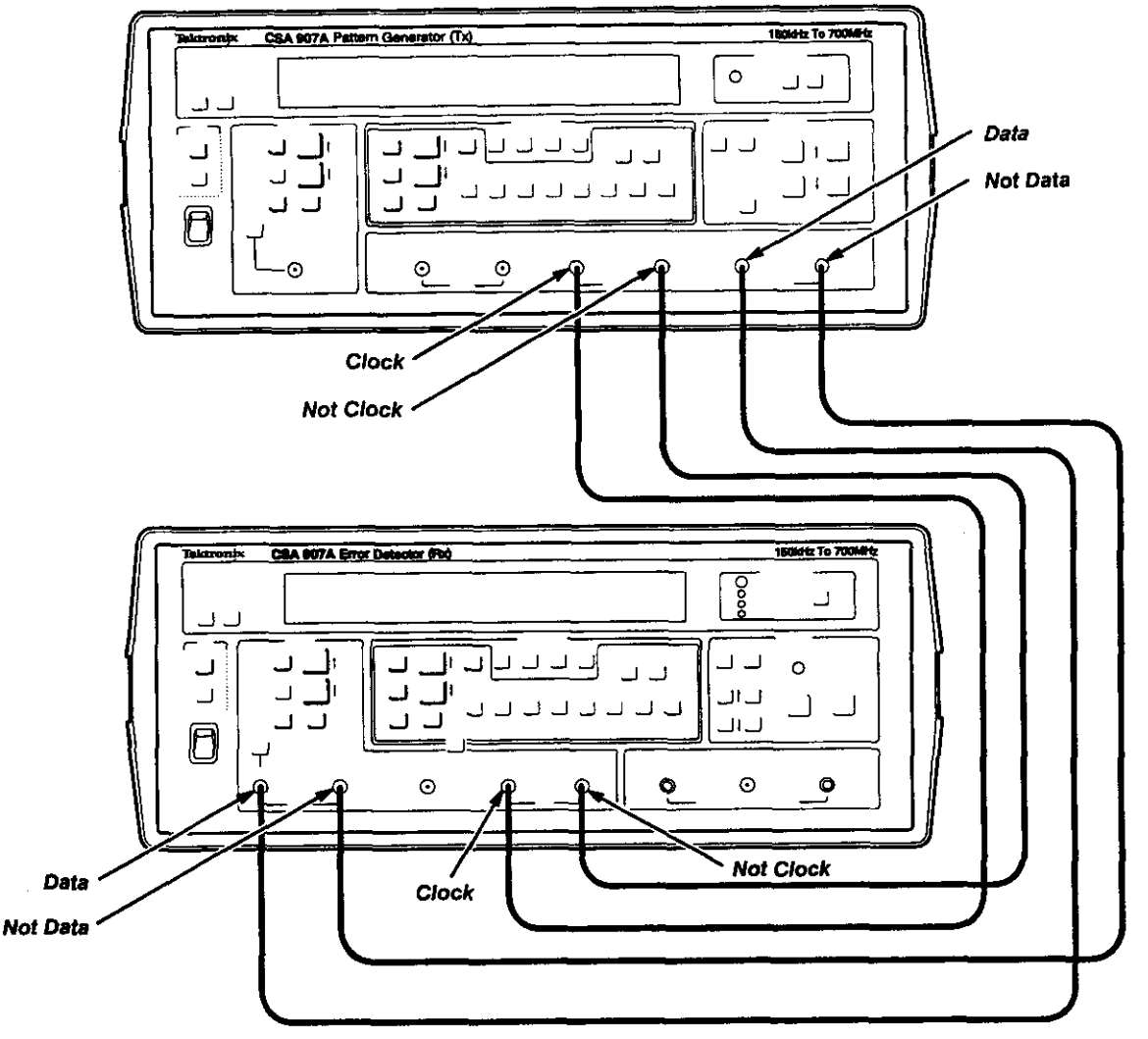


Figure 4-2: Setup for Functional Test of Standard Instrument

☐ **Step 2:** Reset both the Pattern Generator and the Error Detector to their factory default settings: Depress the **CLEAR** key in the **PATTERN** section, the **MSB** (1) key, and the **VIEW ANGLE** key, and hold down all three keys while cycling the power.

The message **Default Settings** should appear briefly on the display of each unit, followed by the CSA 907A logo, before the functional display appears.

☐ **Step 3:** At the Pattern Generator, verify that error injection is off (you should see **ERR OFF** on the display). If error injection is on, press the **SINGLE** key in the **ERROR INJECT** section to turn it off.

☐ **Step 4:** At the Pattern Generator, verify that PRBS is selected (the **PRBS** LED, in the **PATTERN** section, should be on). If not, press the **PRBS** key to select it.

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☐ **Step 5:** At the Error Detector, press the **START/STOP** key in the **ERROR DETECTION** section and the **CLEAR** key in the **ERROR HISTORY** section to clear the error display and the error history LEDs. All four history LEDs should be off.

Because the Error Detector defaults to Autoset mode, the Error Detector and Pattern Generator are now linked and synchronized. The following checks will confirm the functionality of the units.

Confirmation of Frequency Function

☐ **Step 6:** In the Pattern Generator **CLOCK** section, the **FREQUENCY** LED should be on; If it is not, press the **FREQUENCY** key to select it.

☐ **Step 7:** Use the Pattern Generator **CLOCK** up/down keys to change the output frequency.

☐ **Step 8:** Check that the frequency displayed by the Error Detector matches the Pattern Generator output to within ±0.1 MHz. (Note that the resolution of the Error Detector is 0.01 MHz and that the resolution of the Pattern Generator is 0.001 MHz.)

☐ **Step 9:** At the Pattern Generator use the **STEP** key to select another frequency step size (note the placement of the underscore on the Pattern Generator frequency display), and repeat steps 7 and 8 at this step size.

☐ **Step 10:** Repeat steps 7 through 9 for all step sizes.

Confirmation of Selectable Data Patterns

☐ **Step 11:** In the Pattern Generator **PATTERN** section verify that the **PRBS** LED is on. If not, press the **PRBS** key to select it.

☐ **Step 12:** Press the Pattern Generator **PATTERN** up/down keys to select PRBS pattern PN7.

☐ **Step 13:** Verify that the Error Detector displays the same PRBS pattern as the Pattern Generator.

☐ **Step 14:** At the Error Detector, press the **CLEAR** key in the **ERROR HISTORY** section.

☐ **Step 15:** Verify that the four **ERROR HISTORY** LEDs are off and stay off.

☐ **Step 16:** At the Pattern Generator, use the **PATTERN** up/down keys to select the next PRBS pattern.

☐ **Step 17:** Repeat steps 13 through 16 for each of the five PRBS patterns.

☐ **Step 18:** In the Pattern Generator **OUTPUT** section, press the **INVERT DATA** key. The **INVERT DATA** LED will light.

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☐ **Step 19:** Verify that the **INVERT DATA** LED in the Error Detector **INPUT** section is also on.

☐ **Step 20:** Repeat steps 12 through 17, noting that **INV** is displayed after the PRBS pattern on the Error Detector display.

Confirmation of Pattern Generator Output Data Level Change

In this part of the functional test procedure, you will verify that the Error Detector threshold responds correctly to the sample values of baseline offset and amplitude in the Pattern Generator output. The sample values and threshold limits are summarized in the following Data Levels table. Repeat steps 21 through 27 for each row of the Data Levels table.

NOTE

Values in the following table are repeated; the purpose of this test is to determine that the CSA 907A responds correctly to changes *in data level. You do not need to read the results except at Step 26.*

Table 4-8: Data Levels

Pattern Generator Baseline Offset	Pattern Generator Amplitude	Error Detector Threshold Limits
−1.00	1.00	−0.70 to −0.30
0.00	1.00	0.30 to 0.70
−1.00	2.00	−0.20 to 0.20

☐ **Step 21:** In the Pattern Generator **OUTPUT** section, the **DATA** LED *should be on. If not, press* the **DATA** key. The **INVERT DATA** LED should be off. If it is not, press the key to turn it off.

☐ **Step 22:** *Use the Pattern Generator* **BASELINE OFFSET** up/down keys to set the baseline offset value shown in the Pattern Generator Baseline Offset column of the Data Levels table.

☐ **Step 23:** Use the **AMPLITUDE** up/down keys to set the amplitude to the value shown in the Pattern Generator Amplitude column of the Data Levels table.

☐ **Step 24:** At the Pattern Generator select another PRBS pattern (using the **PATTERN** up/down keys) to initiate a resynchronization by the Error Detector.

☐ **Step 25:** Select PRBS pattern PN7.

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☐ **Step 26:** At the Error Detector verify that once the green **LOCK** LED in the SYNC section lights, the displayed threshold is between the limits shown in the Error Detector Threshold Limits column of the Data Levels table. Cycle through all five PRBS patterns (PN7, PN15, PN17, PN20, and PN23) and verify that the Error Detector synchronizes on each pattern.

☐ **Step 27:** At the Error Detector, press the **CLEAR** button in the **ERROR HISTORY** section to ensure that the **SYNC LOSS** LED is off.

Confirmation of Error Injection Rates

☐ **Step 28:** In the Error Detector **ERROR DETECTION** section, press the **DISPLAY SELECT** key until there is an ∞ (infinity) symbol on the display preceding the error rate.

☐ **Step 29:** At the Error Detector, press the **CLEAR** key in the **ERROR HISTORY** section, and press the START/STOP key in the ERROR DETECTION section to clear the history LEDs and error rate display.

☐ **Step 30:** In the Pattern Generator **ERROR INJECTION** section press the **SINGLE** key and confirm on the Error Detector the **BIT** LED (in the **ERROR HISTORY** section) lights and that the displayed error total increases by one each time you press the **SINGLE** key. Press this key at least 20 times.

NOTE

*Press the **SINGLE** key briefly. If you hold it down, the Pattern Generator injects errors repeatedly into the data stream.*

☐ **Step 31:** In the **ERROR HISTORY** section press the **CLEAR** key to clear the history LEDs.

☐ **Step 32:** In the Pattern Generator **ERROR INJECTION** section, press the **RATE** key. **ERR 1E−7** will appear on the display. The **ERROR INJECTION** LED should be on steadily.

☐ **Step 33:** In the Error Detector **ERROR DETECTION** section, press the **START/STOP** key to clear the totalize error display.

☐ **Step 34:** Wait 15 seconds; then confirm that the error rate displayed on the Error Detector matches the Pattern Generator injected error rate and that the Error Detector **BIT** LED in the **ERROR HISTORY** section is lighted.

☐ **Step 35:** In the Pattern Generator **ERROR INJECTION** section, press the **RATE** key once to select the next error rate.

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☐ **Step 36:** Repeat steps 33 through 35 until all Pattern Generator error rates have been verified and EXT appears on the Pattern Generator display. Press the Pattern Generator **ERROR RATE** key once more to turn off error injection.

☐ **Step 37:** Look straight at the Pattern Generator LCD panel. Depress the view angle button until you see the darkest digits. Change the vertical angle from which you view the display and adjust the clarity by depressing the view angle adjust button. This is to verify that the contrast of the display can be optimized for the user's viewing angle.

☐ **Step 38:** Repeat Step 37 for the Error Detector.

☐ **Step 39:** Set the Pattern Generator and Error Detector to Factory Default Settings. Verify that the Error Detector **SYNC LOCK** light illuminates. Push the **CLEAR** key in the **ERROR HISTORY** section. Record the delay value shown on the display (lower left display area) for later use. Deselect **AUTOSET** on the Error Detector. Press the **DELAY** key in the input section of the Error Detector. Vary the delay using the **UP** and **DOWN** arrow keys in the input section of the Error Detector until the **PHASE** light in the ERROR HISTORY section illuminates.Manually return the Error Detector delay setting to that recorded above. Verify that the **PHASE** light can be extinguished by the **CLEAR** key.

Confirmation of Selectable Error Detector Terminations

☐ **Step 40:** Set the Pattern Generator and Error Detector to Factory Default Settings. Confirm that the Error Detector **F2** LED is not lighted.

☐ **Step 41:** Push the Error Detector **TERM** button and confirm that the LCD displays GND.

☐ **Step 42:** Perform the following actions for each termination listed:

a. Select the Error Detector termination by using the **UP** and **DOWN** arrow keys in the INPUT section.

b. On the Pattern Generator, select PN15, wait for a few seconds, then select PN7. Use the **UP** and **DOWN** arrow keys to select the different PN values.

c. Wait for the Error Detector LOCK light to come on.

d. Confirm the the Error Detector threshold display falls within the limits shown in Table 4-9.

NOTE

The threshold limits listed in Table 4-9 assume that the Pattern Generator is set to default Amplitude and Baseline Offset.

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Table 4-9: Error Detector Termination Threshold Limits

Error Detector Termination	Error Detector Threshold Limits
50 Ω to GND	0 V ±300 mV
50 Ω to −2 V	−1.0 V ±300 mV
50 Ω to +3 V	1.5 V ±300 mV
FLT	0 V ±300 mV

e. Press **F2** on the Error Detector to select CLOCK inputs and confirm that the F2 LED is lighted, and repeat steps a through d.

Confirmation of Differential Operation

☐ **Step 43:** Set the Pattern Generator and Error Detector to Factory Default Settings.

☐ **Step 44:** Push the Error Detector **DIFF** button and confirm that the LED lights.

☐ **Step 45:** Push the Error Detector **F2** button and then the **DIFF** button. Verify that the Error Detector LOCK light illuminates.

Confirmation of Buttons and Indicators

☐ **Step 46:** Reset both the Pattern Generator and Error Detector by cycling the power.

☐ **Step 47:** Verify the following Pattern Generator LED's.

Section	ON	OFF
CLOCK	FREQUENCY	RECALL SAVE EXT
PATTERN	PRBS	WORD RECALL SAVE WORD LENGTH F1−F4 Bits 1−8
OUTPUT	DATA	CLOCK INVERT DATA
ERROR INJECT		RATE
Left Side		PANEL LOCK GPIB ADDR LOCAL

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☐ **Step 48:** Verify the Pattern Generator LEDs and buttons operate by toggling the following buttons and observing the LEDs turn ON and OFF.

Section	LED/Button	Indicator
Left Side	PANEL LOCK	ON–OFF
	GPIB ADDR	ON–OFF

☐ **Step 49:** Verify the Error Detector LEDs and buttons operate by toggling the following buttons and observing the LEDs turn ON and OFF

Section	LED/Button	Indicator
LEFT SIDE	PANEL LOCK	ON–OFF
	ADDR	ON–OFF

Pattern Generator Specification Checks

The following procedures verify the Pattern Generator internal clock source, external clock input, data patterns, data output, clock output, error injection, and Clock/4 output.

Internal Clock Source Check

This procedure will test the Pattern Generator internal clock as well as the Error Detector clock input.

☐ **Step 1:** Make connections appropriate to the options installed as follows:

Table 4-10: Connections for Internal Clock Source Check

Option	*From*	To	Comment
Standard Instrument	Tx Clock	Rx Clock	50 Ω, SMA Coax
	Tx Not Clock	Rx Not Clock	50 Ω, SMA Coax
	Tx Data	Rx Data	50 Ω, SMA Coax
	Tx Not Data	Rx Not Data	50 Ω, SMA Coax
	Rx Monitor Clock Out	DSO Input	50 Ω
	Tx PATTERN SYNC	DSO Trigger Input	50 Ω
75 Ω Option	Tx Clock	Rx Clock	75 Ω, SMA Coax[1]
	Tx Not Clock	Rx Not Clock	75 Ω, SMA Coax[1]
	Tx Data	Rx Data	75 Ω, SMA Coax[1]
	Tx Not Data	Rx Not Data	75 Ω, SMA Coax[1]
	Rx Monitor Clock Out	DSO Input	50 Ω
	Tx PATTERN SYNC	DSO Trigger Input	50 Ω

1 This may be accomplished by using SMA to BNC adapters and 75 Ω BNC Coaxial cables.

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☐ **Step 2:** Reset both the Pattern Generator and the Error Detector to their factory default settings: Depress the **CLEAR** key in the **PATTERN** section, the **MSB (1)** key, and the **VIEW ANGLE** key, and hold down all three keys while cycling the power. Press the **CLEAR** key in the **ERROR HISTORY** section of the Error Detector.

☐ **Step 3:** Set the DSO to display the clock signal.

☐ **Step 4:** For each row in the Pattern Generator Clock Frequency Limits table (following), set the Pattern Generator frequency controls in the **CLOCK** section to set the clock frequency to the value in the Frequency column and verify that the frequency displayed by the Error Detector is within the limits given in the Limits column. Use the DSO to measure the frequency and verify that it is also within the limits.

Table 4-11: Pattern Generator Clock Frequency Limits

Frequency	Limits
150.0 kHz	147.0 kHz to 153.0 kHz
1.00 MHz	0.98 MHz to 1.02 MHz
10.00 MHz	9.80 MHz to 10.20 MHz
100.00 MHz	98.00 MHz to 102.00 MHz
200.00 MHz	196.00 MHz to 204.00 MHz
400.00 MHz	392.00 MHz to 408.00 MHz
700.00 MHz	686.00 MHz to 714.00 MHz

☐ **Step 5:** Disconnect the cables between the DSO and the CSA 907A. Connect the Pattern Generator **Clock/4** output through a 50 Ω power splitter to the DSO input and trigger input.

☐ **Step 6:** Set the Pattern Generator Clock to 400 MHz.

☐ **Step 7:** Verify that the rate of the **Clock/4** output is 100 MHz ±2 MHz.

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External Clock Input Check

☐ **Step 1:** Make connections appropriate to the options installed as follows:

Table 4-12: Connections for External Clock Input Check

Option	From	To	Comment
Standard Instrument	Tx Clock	Rx Clock	50 Ω, SMA Coax
	Tx Not Clock	Rx Not Clock	50 Ω, SMA Coax
	Tx Data	Rx Data	50 Ω, SMA Coax
	Tx Not Data	Rx Not Data	50 Ω, SMA Coax
	Rx Monitor Clock Out	DSO Input	50 Ω
	Tx PATTERN SYNC	DSO Trigger Input	50 Ω
	Signal or Square Wave Generator	Tx External Clock Input	50 Ω, SMA Coax
75 Ω Option	Tx Clock	Rx Clock	75 Ω, SMA Coax[1]
	Tx Not Clock	Rx Not Clock	75 Ω, SMA Coax[1]
	Tx Data	Rx Data	75 Ω, SMA Coax[1]
	Tx Not Data	Rx Not Data	75 Ω, SMA Coax[1]
	Rx Monitor Clock Out	DSO Input	50 Ω
	Tx PATTERN SYNC	DSO Trigger Input	50 Ω
	Signal Generator	Tx External Clock Input	50 Ω, SMA Coax

1 This may be accomplished by using SMA to BNC adapters and 75 Ω BNC Coaxial cables.

☐ **Step 2:** Reset both the Pattern Generator and the Error Detector to their factory default settings: Depress the **CLEAR** key in the **PATTERN** section, the **MSB** (**1**) key, and the **VIEW ANGLE** key, and hold down all three keys while cycling the power. Press the **CLEAR** key in the **ERROR HISTORY** section of the Error Detector.

☐ **Step 3:** Set the DSO to display the clock signal.

☐ **Step 4:** Set the Signal or Square Wave Generator output voltage to be in the range 0.5 to 1.5 V peak-to-peak, centered around ground. The CSA 907 is designed to accept pulses and square waves, although sine waves will usually work except at lower frequencies.

☐ **Step 5:** Switch on the signal generator.

☐ **Step 6:** Press the **EXT** key in the Pattern Generator **CLOCK** section to enable the external clock input. The **EXT** LED should be lighted.

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☐ **Step 7:** For each row in the Pattern Generator Clock Frequency Limits table (following), set the Signal or Square Wave Generator to the frequency listed in the Frequency column and verify that the frequency displayed by the Error Detector and the frequency displayed by the DSO are within the defined limits after the Error Detector SYNC LOCK light turns on. If it does not SYNC, confirm that the Pattern Generator PRBS light is on. Push the button and turn on the PRBS light if it is off.

Table 4-13: Pattern Generator Clock Frequency Limits

Frequency	Limits
150.0 kHz	147.0 kHz to 153.0 kHz
1.00 MHz	0.98 MHz to 1.02 MHz
10.00 MHz	9.80 MHz to 10.20 MHz
100.00 MHz	98.00 MHz to 102.00 MHz
200.00 MHz	196.00 MHz to 204.00 MHz
400.00 MHz	392.00 MHz to 408.00 MHz
700.00 MHz	686.00 MHz to 714.00 MHz

Data Pattern Check

☐ **Step 1:** Make connections appropriate to the options installed as follows:

Table 4-14: Connections for Data Pattern Check

Option	From	To	Comment
Standard Instrument	Tx Clock	Rx Clock	50 Ω, SMA Coax
	Tx Not Clock	Rx Not Clock	50 Ω, SMA Coax
	Tx Data	Rx Data	50 Ω, SMA Coax
	Tx Not Data	Rx Not Data	50 Ω, SMA Coax
	Tx PATTERN SYNC	DSO Trigger Input	50 Ω
	Rx Monitor Data Out	DSO Input	50 Ω
75 Ω Option	Tx Clock	Rx Clock	75 Ω, SMA Coax[1]
	Tx Not Clock	Rx Not Clock	75 Ω, SMA Coax[1]
	Tx Data	Rx Data	75 Ω, SMA Coax[1]
	Tx Not Data	Rx Not Data	75 Ω, SMA Coax[1]
	Tx PATTERN SYNC	DSO Trigger Input	50 Ω

1 This may be accomplished by using SMA to BNC adapters and 75 Ω BNC Coaxial cables.

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☐ **Step 2:** Reset both the Pattern Generator and the Error Detector to their factory default settings: Depress the **CLEAR** key in the **PATTERN** section, the **MSB** (1) key, and the **VIEW ANGLE** key, and hold down all three keys while cycling the power. Press the **CLEAR** key in the **ERROR HISTORY** section of the Error Detector.

☐ **Step 3:** Set the DSO to display the data signal.

☐ **Step 4:** Use the **STEP** key and the **CLOCK** up/down keys at the Pattern Generator to set the clock frequency to 160 MHz.

☐ **Step 5:** Set the Pattern Generator and the Error Detector word length to two bytes (16 bits). The method to set the word length depends on whether the unit is equipped with extended memory, Option 3A/3T/3R (128K RAM Extended Memory).

To determine what options are installed in your unit, press the following sequence of keys:

Pattern Generator	
F1	to enter Menu Mode
F1	again to view the second page of the Main Menu
F3	to enter Utility Menu
F2	to view a list of the installed options
F1	repeatedly to exit the Menu system
Error Detector	
F1	to enter Menu Mode
F1	again to get to page 2
F1	again to get to page 3
F4	to enter Utility Menu
F2	to view a list of the installed options
F1	repeatedly to exit the Menu system

For units without Option 3A/3T/3R:

In the **PATTERN** section, press the **WORD** key, then press the **WORD LENGTH** key to select word length mode. The **WORD LENGTH** LED should light. Use the **PATTERN** up/down keys to select **16** (bits).

For units with Option 3A/3T/3R:

Press the **F1** key to enter menu mode. Select **WORD** (**F4**) from the main menu, then select **LENGTH** (**F3**) from the Word menu. Set the length to **0002 BYTES** (using the **PATTERN** up/down keys to change the digit). Press **F4** to set the selection.

To get back out of menu mode, press **F1** repeatedly.

Remember to do this for both the Error Detector and Pattern Generator.

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☐ **Step 6:** Perform the following sequence:

a. Press the Error Detector **AUTOSET** button to disable that function. The **AUTOSET** LED should go out.

b. In the **PATTERN** section of both the Pattern Generator and the Error Detector press the **WORD** key to select word pattern mode. The **WORD** LED should light. Press the **CLEAR** key in the **ERROR HISTORY** section of the Error Detector.

☐ **Step 7:** For each row of the Word Patterns and Frequency Values table (following), set the *Pattern Generator and Error Detector* Word data pattern as shown in the Pattern column. In the table, the two eight-bit LED sequences are shown below the hexadecimal value; load the first into location 00000 and the second into location 00001.

a. Use the PATTERN up/down keys to select location 00000.

b. Use the BIT keys to set the Byte 00000 pattern.

c. Use the PATTERN up/down keys to select location 00001.

d. Use the BIT keys to set the Byte 00001 pattern.

Verify that the Error Detector synchronizes on the input (the **LOCK** LED in the **SYNC** section should light). *Use the DSO* to measure the signal frequency, and verify that it is within the limits shown in the Frequency Limits column.

Table 4-15: Word Patterns and Frequency Values

Pattern (and BIT LED Sequence)	Frequency Limits (measured on DSO)
AAAA: MSB LSB Byte 00000 ☼ o ☼ o ☼ o ☼ o Byte 00001 ☼ o ☼ o ☼ o ☼ o	78.40 MHz to 81.60 MHz
CCCC: Byte 00000 ☼ ☼ o o ☼ ☼ o o Byte 00001 ☼ ☼ o o ☼ ☼ o o	39.20 MHz to 40.80 MHz
F0F0: Byte 00000 ☼ ☼ ☼ ☼ o o o o Byte 00001 ☼ ☼ ☼ ☼ o o o o	19.60 MHz to 20.40 MHz
FF00: Byte 00000 ☼ ☼ ☼ ☼ ☼ ☼ ☼ ☼ Byte 00001 o o o o o o o o	9.80 MHz to 10.20 MHz

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Data Output Amplitude and Baseline Offset Check

☐ **Step 1:** Make connections appropriate to the options installed as follows:

Table 4-16: Connections for Data Output Amplitude and Baseline Offset Check

Option	From	To	Comment
Standard Instrument	Tx Data	DSO Ch 1 Input	50 Ω, SMA Coax; Use 2X or 5X attenuator at Ch 1 Input
	Tx Not Data	DSO Ch 2 Input	50 Ω, SMA Coax; Use 2X or 5X attenuator at Ch 2 Input
	Tx PATTERN SYNC	DSO Trigger Input	50 Ω
75 Ω Option	Tx Data	DSO Ch 1 Input	75 Ω, SMA Coax[1]
	Tx Not Data	DSO Ch 2 Input	75 Ω, SMA Coax[1]
	Tx PATTERN SYNC	DSO Trigger Input	50 Ω[1]

1 This may be accomplished by using SMA to BNC adapters and 75 Ω BNC Coaxial cables. Use a 75 Ω Impedance Match at the DSO input end of the 75 Ω cable connecting the Data and Not Data lines. Attenuators are not required when the Impedance Match is used

☐ **Step 2:** Reset both the Pattern Generator and the Error Detector to their factory default settings: Depress the **CLEAR** key in the **PATTERN** section, the **MSB** (**1**) key, and the **VIEW ANGLE** key, and hold down all three keys while cycling the power.

☐ **Step 3:** At the Pattern Generator use the **STEP** key and the **CLOCK** up/down keys to set the clock frequency to 100 MHz.

☐ **Step 4:** Set the DSO to display the data and not data signals at a ground crossing point. (A time base setting of 75 ps/div will provide a reasonable display.)

☐ **Step 5:** Verify that the Data and Not Data signals are time matched at the ground crossing ±75 ps.

☐ **Step 6:** Set the DSO to display a wider time section of the waveforms (2 to 20 ns/div will provide a reasonable display).

☐ **Step 7:** Connect a 50 Ω BNC Terminator to the Data Inhibit input on the Pattern Generator rear panel and verify that the Data Output switches low and the Not Data Output switches high.

☐ **Step 8:** Remove the 50 Ω BNC Terminator that was connected in step 7.

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☐ **Step 9:** For each row in the Pattern Generator Data Amplitude table (below), set the Pattern Generator data amplitude to match the value in the Amplitude column, and verify that the amplitude as measured by the DSO is within the limits stated in the Limits column. Do this for both the Data and the Not Data signals.

(To set the Pattern Generator data amplitude, press the **DATA** key in the **OUTPUT** section, then use the **AMPLITUDE** up/down keys. You do not need to adjust the baseline offset for this part of the procedure.)

Table 4-17: Pattern Generator Data Amplitude

Amplitude	Limits
2.0 V	1.6 to 2.4 V
0.5 V	0.4 to 0.6 V

NOTE

Remember to account for the attenuator or the 75 Ω to 50 Ω adapter when measuring amplitude and baseline offset at the DSO. Refer to the illustration at the end of this section for the definition of amplitude and baseline offset.

☐ **Step 10:** For each row in the Pattern Generator Data Baseline Offset table (following), set the Pattern Generator data baseline offset to match the value in the Baseline Offset column and verify that the baseline offset as measured by the DSO is within the limits stated in the Limits column. Do this for both the Data and the Not Data signals. Leave the data amplitude set at 0.50 V.

(To set the Pattern Generator data baseline offset, press the **DATA** key in the **OUTPUT** section, then use the **BASELINE OFFSET** up/down keys.)

Table 4-18: Pattern Generator Data Baseline Offset

Baseline Offset	Limits
−2.0 V	−2.4 to −1.6 V
1.8 V	1.5 to 2.1 V

NOTE

Remember to account for the attenuator or the 75 Ω to 50 Ω adapter when measuring amplitude and baseline offset at the DSO. Refer to the illustration at the end of this section for the definition of amplitude and baseline offset. These parameters are to be measured at a point on the waveform after transients have settled.

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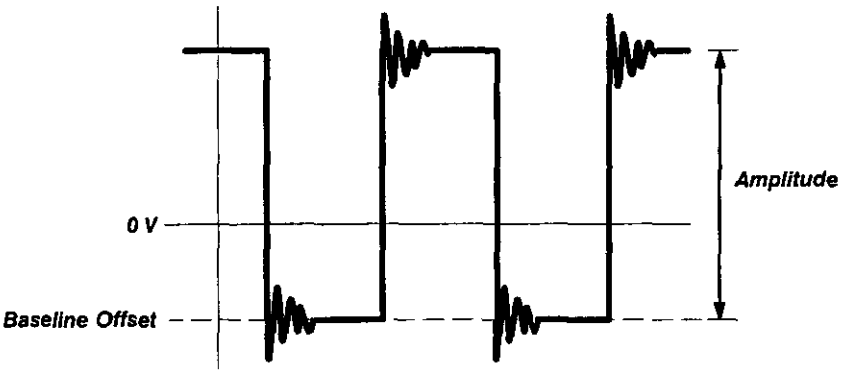


Figure 4-3: Definition of Amplitude and Baseline Offset

Clock Output Amplitude and Baseline Offset Check

☐ **Step 1:** Make connections appropriate to the options installed as follows:

Table 4-19: Connections for Clock Output Amplitude and Baseline Offset Check

Option	From	To	Comment
Standard Instrument	Tx Clock	DSO Ch 1 Input	50 Ω, SMA Coax; Use 2X or 5X attenuator at Ch 1 Input
	Tx Not Clock	DSO Ch 2 Input	50 Ω, SMA Coax; Use 2X or 5X attenuators at Ch 2 Input
	Tx PATTERN SYNC	DSO Trigger Input	50 Ω
75 Ω Option	Tx Clock	DSO Ch 1 Input	75 Ω, SMA Coax[1]
	Tx Not Clock	DSO Ch 2 Input	75 Ω, SMA Coax[1]
	Tx PATTERN SYNC	DSO Trigger Input	50 Ω

1 This may be accomplished by using SMA to BNC adapters and 75 Ω BNC Coaxial cables. Use a 75 Ω to 50 Ω Impedance Match at the *DSO input end of the 75 Ω cable connecting the Clock and Not Clock lines.* Attenuators are not required when the Impedance Match is used

☐ **Step 2:** Reset both the Pattern Generator and the Error Detector to their factory default settings: Depress the **CLEAR** key in the **PATTERN** section, the **MSB** (1) key, and the **VIEW ANGLE** key, and hold down all three keys while cycling the power. Press the **CLEAR** key in the **ERROR HISTORY** section of the Error Detector.

☐ **Step 3:** At the Pattern Generator use the **STEP** key and the **CLOCK** up/down keys to set the clock frequency to 100 MHz.

☐ **Step 4:** Set the DSO to display the clock and not clock signals at a ground crossing point. (A time base setting of 75 ps/div will provide a reasonable display.)

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☐ **Step 5:** Verify that the Clock and Not Clock signals are time matched at the ground crossing ±75 ps.

☐ **Step 6:** Set the DSO to display a wider time section of the waveforms (2 to 5 ns/div will provide a reasonable display).

☐ **Step 7:** For each row in the Pattern Generator Clock Amplitude table (below), set the Pattern Generator clock amplitude to match the value in the Amplitude column, and verify that the amplitude as measured by the DSO is within the limits stated in the Limits column. Do this for both the Clock and the Not Clock signals.

(To set the Pattern Generator clock amplitude, press the **CLOCK** key in the **OUTPUT** section, then use the **AMPLITUDE** up/down keys. You do not need to adjust the baseline offset for this part of the procedure.)

Table 4-20: Pattern Generator Clock Amplitude

Amplitude	Limits
2.0 V	1.6 to 2.4 V
0.5 V	0.4 to 0.6 V

NOTE

Remember to account for the attenuator or the 75 Ω to 50 Ω adapter when measuring amplitude and baseline offset at the DSO. Refer to the illustration at the end of the preceding section for the definition of amplitude and baseline offset. These parameters are to be measured at a point on the waveform after transients have settled.

☐ **Step 8:** For each row in the Pattern Generator Clock Baseline Offset table (below), set the Pattern Generator clock baseline offset to match the value in the Baseline Offset column, and verify that the Baseline Offset as measured by the DSO is within the limits stated in the limits column. Do this for both the Clock and the Not Clock signals. Leave the amplitude set at 0.50 V.

NOTE

When measuring baseline offset, be sure the amplitude is ≤ 1 V peak-to-peak.

(To set the Pattern Generator clock baseline offset, press the **CLOCK** key in the **OUTPUT** section, then use the **BASELINE OFFSET** up/down keys.)

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Table 4-21: Pattern Generator Clock Baseline Offset

Baseline Offset	Limits
−2.0 V	−2.4 to −1.6 V
1.0 V	0.8 to 1.2 V
1.8 V	1.5 to 2.1 V

NOTE

Remember to account for the attenuator or the 75 Ω to 50 Ω adapter when measuring amplitude and baseline offset at the DSO. Refer to the illustration at the end of the preceding section for the definition of amplitude and baseline offset. These parameters are to be measured at a point on the waveform after transients have settled.

External Error Injection Check

☐ **Step 1:** Make connections appropriate to the options installed as follows:

Table 4-22: Connections for External Error Injection Check

Option	From	To	Comment
Standard Instrument	Tx Clock	Rx Clock	50 Ω, SMA Coax
	Tx Not Clock	Rx Not Clock	50 Ω, SMA Coax
	Tx Data	Rx Data	50 Ω, SMA Coax
	Tx Not Data	Rx Not Data	50 Ω, SMA Coax
	Square Wave Generator	Tx Error Inject Input on Rear Panel	50 Ω, SMA Coax (Verify the signal voltages before making this connection [Step 2])
75 Ω Option	Tx Clock	Rx Clock	75 Ω, Interconnect Coax[1]
	Tx Not Clock	Rx Not Clock	75 Ω, Interconnect Coax[1]
	Tx Data	Rx Data	75 Ω, Interconnect Coax[1]
	Tx Not Data	Rx Not Data	75 Ω, Interconnect Coax[1]
	Square Wave Generator	Tx Error Inject Input on Rear Panel	50 Ω, Coax (Verify the signal voltages before making this connection [Step 2])

1 This may be accomplished by using SMA to BNC adapters and 75 Ω BNC Coaxial cables.

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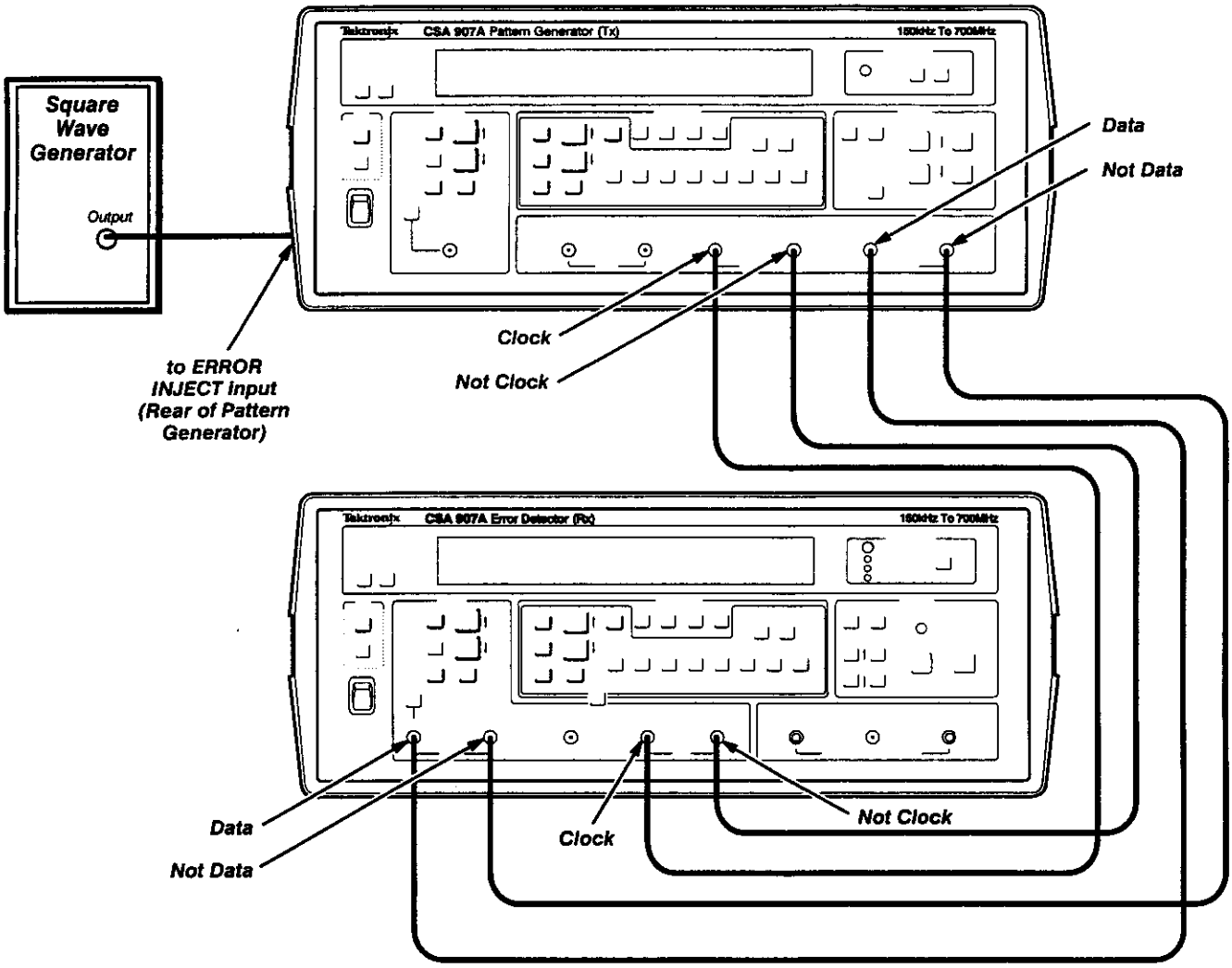


Figure 4-4: Setup for Pattern Generator External Error Injection Check for a Standard Instrument

☐ **Step 2:** Set the Square Wave Generator to produce a square wave of 1 kHz. Set the output amplitude to 1 V peak-to-peak when loaded by 50 Ω. Set the output offset for a readout of −0.3 V on the Square Wave Generator (into 50 Ω to ground). This will result in an ECL level signal when connected to the 50 Ω to −2 V termination at the Pattern Generator Error Inject Input.

CAUTION

Damage to the CSA 907A may occur if the signal limits are exceeded.

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☐ **Step 3:** Reset both the Pattern Generator and the Error Detector to their factory default settings: Depress the **CLEAR** key in the **PATTERN** section, the **MSB** (**1**) key, and the **VIEW ANGLE** key at one time while cycling the power. The message Default Settings should appear briefly on the display of each unit, followed by the CSA 907 logo before the functional display appears.

☐ **Step 4:** In the Pattern Generator **ERROR INJECT** section, press the **RATE** key repeatedly until the display shows **ERR EXT**.

Repeat steps 5 through 7 for each row in the Error Injection Rate table (following).

☐ **Step 5:** Set the Pattern Generator clock frequency to the value listed in the Frequency column (in the **CLOCK** section, press the **FREQUENCY** key, then use the **STEP** key and the **CLOCK** up/down keys to set the frequency).

☐ **Step 6:** Once the Error Detector has synchronized with the Pattern Generator (the **LOCK** LED in the **SYNC** section will light), press the **START/STOP** key in the Error Detector **ERROR DETECTION** section and the **CLEAR** key in the **ERROR HISTORY** section.

☐ **Step 7:** Verify that the error rate displayed by the Error Detector is within the limits in the Limits column of Table 4-23 and that the Error Detector **BIT** LED in the **ERROR HISTORY** section is lighted.

Table 4-23: Error Injection Rate

Frequency	Error Rate	Limits
1 MHz	1.0 E−3	9.9 E−4 to 1.1 E−3
10 MHz	1.0 E−4	9.9 E−5 to 1.1 E−4
50 MHz	2.0 E−5	1.9 E−5 to 2.1 E−5
100 MHz	1.0 E−5	9.9 E−6 to 1.1 E−5
200 MHz	5.0 E−6	4.9 E−6 to 5.1 E−6
400 MHz	2.5 E−6	2.4 E−6 to 2.6 E−6
700 MHz	1.4 E−6	1.3 E−6 to 1.5 E−6

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Error Detector Monitor Outputs

☐ **Step 1:** Make connections appropriate to the options installed as follows:

Table 4-24: Connections for Monitor Output Check

Option	From	To	Comment
Standard Instrument	Tx Clock	Rx Clock	50 Ω, SMA Coax
	Tx Not Clock	Rx Not Clock	50 Ω, SMA Coax
	Tx Data	Rx Data	50 Ω, SMA Coax
	Tx Not Data	Rx Not Data	50 Ω, SMA Coax
	Rx Monitor Output Clock	DSO Ch 1 Input	50 Ω, SMA Coax; Use 2X or 5X attenuator at Ch 1 Input
	Rx Monitor Output Data	DSO Ch 2 Input	50 Ω, SMA Coax; Use 2X or 5X attenuator at Ch 2 Input
	Rx Pattern Sync Output	DSO Trigger Input	50 Ω, SMA Coax
75 Ω Option	Tx Clock	Rx Clock	75 Ω, SMA Coax[1]
	Tx Not Clock	Rx Not Clock	75 Ω, SMA Coax[1]
	Tx Data	Rx Data	75 Ω, SMA Coax[1]
	Tx Not Data	Rx Not Data	75 Ω, SMA Coax[1]
	Rx Monitor Output Clock	DSO Ch 1 Input	50 Ω, SMA Coax[1] Use 2X or 5X attenuator at the Ch 1 input
	Rx Monitor Output Data	DSO Ch 2 Input	50 Ω, SMA Coax[1] Use 2X or 5X attenuator at the Ch 2 input
	Rx Pattern Sync Output	DSO Trigger Input	50 Ω, SMA Coax[1]

1 This may be accomplished by using SMA to BNC adapters and 75 Ω BNC Coaxial cables.

☐ **Step 2:** Reset the Pattern Generator and Error Detector to Factory Default Settings.

☐ **Step 3:** Verify that the Monitor Clock Out is between 691 and 719 MHz.

☐ **Step 4:** Verify that the Monitor Data Out has a waveform of 200 mV ±100 mV amplitude centered around ground ±100 mV.

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Error Detector Reference Data Inputs

☐ **Step 1:** Make connections appropriate to the options installed as follows:

Table 4-25: Connections for Reference Data Input Check

Option	From	To	Comment
Standard Instrument	Tx Clock	Rx Clock	50 Ω, SMA Coax
	Tx Not Clock	Rx Not Clock	50 Ω, SMA Coax
	Tx Data	Rx Data	50 Ω, SMA Coax
	Tx Not Data	Rx Reference Data Input	50 Ω, SMA Coax
75 Ω Option	Tx Clock	Rx Clock	75 Ω, SMA Coax[1]
	Tx Not Clock	Rx Not Clock	75 Ω, SMA Coax[1]
	Tx Data	Rx Data	75 Ω, SMA Coax[1]
	Tx Not Data	Rx Reference Data Input	75 Ω, SMA Coax[1]

1 This may be accomplished by using SMA to BNC adapters and 75 Ω BNC Coaxial cables.

☐ **Step 2:** Reset the Error Detector and Pattern Generator to Factory Default Condition.

☐ **Step 3:** Allow the Error Detector to sync lock.

☐ **Step 4:** Note the delay and threshold values on the display.

☐ **Step 5:** Depress **F3** on the Error Detector to select the Ref Data Input controls.

☐ **Step 6:** Set the delay and threshold to the values noted in step 4.

To set the delay, push **DELAY** key in the **THRESH** section (the key will light) and use the up/down keys to adjust.

To set the threshold, push the **THRESH** key in the **INPUT** section (the key will light) and use the up/down keys to set the level.

☐ **Step 7:** Select Ext Ref Data Input in the Error Detector by pressing the EXT key near the REF DATA INPUT connector and verify that it is measuring >10 E+09 errors.

☐ **Step 8:** Select Error Detector data invert. Press the **START/STOP** and **CLEAR** buttons in the **ERROR HISTORY** section of the Error Detector and verify that it is error free. (The lock light will not be lit).

☐ **Step 9:** Deselect Rx data invert, ext ref data input, and F3. Verify that the **SYNC** light is on.

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Error Detector Error Inhibit and Error Output

☐ **Step 1:** Make connections appropriate to the options installed as follows:

Table 4-26: Connections for Error Inhibit and Error Output Check

Option	From	To	Comment
Standard Instrument	Tx Clock	Rx Clock	50 Ω, SMA Coax
	Tx Not Clock	Rx Not Clock	50 Ω, SMA Coax
	Tx Data	Rx Data	50 Ω, SMA Coax
	Tx Not Data	Rx Not Data	50 Ω, SMA Coax
	Rx Error Output (Rear Panel)	DSO Input	50 Ω, SMA Coax; Use 2X or 5X attenuator at Input
	Rx Monitor Clock Output	DSO Trigger Input	50 Ω, SMA Coax
75 Ω Option	Tx Clock	Rx Clock	75 Ω, SMA Coax[1]
	Tx Not Clock	Rx Not Clock	75 Ω, SMA Coax[1]
	Tx Data	Rx Data	75 Ω, SMA Coax[1]
	Tx Not Data	Rx Not Data	75 Ω, SMA Coax[1]
	Rx Error Output (Rear Panel)	DSO Input	75 Ω, SMA Coax[1]
	Rx Monitor Clock Output	DSO Trigger Input	75 Ω, SMA Coax[1]

1 This may be accomplished by using SMA to BNC adapters and 75 Ω BNC Coaxial cables.

☐ **Step 2:** Reset to Factory Default settings.

☐ **Step 3:** Allow Error Detector to Sync.

☐ **Step 4:** Select Pattern Generator Error Injection to 1E−3 using the **RATE** key in the **ERROR INJECTION** section.

☐ **Step 5:** Verify that the Error Detector Error Out produces random pulses.

☐ **Step 6:** Connect a 50 Ω terminator to the Error Detector Error Inhibit. Verify that the Error Out pulses stop.

RS-232 Verification

☐ **Step 1:** Set the terminal, Pattern Generator, and Error Detector to compatible operating settings.

☐ **Step 2:** Switch the terminal, Pattern Generator, and Error Detector off.

☐ **Step 3:** Connect the terminal to the Pattern Generator.

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☐ **Step 4:** Switch the terminal on with Factory Default Settings.

☐ **Step 5:** Switch the Pattern Generator on. Verify that the terminal displays the Logo.

☐ **Step 6:** *Repeat Steps 2 through 5 for the Error Detector.*

Printer Port Verification

☐ **Step 1:** Switch off the Error Detector and the printer.

☐ **Step 2:** Connect the printer to the Error Detector.

☐ **Step 3:** *Switch the printer on.*

☐ **Step 4:** Switch the Error Detector on with the default settings.

☐ **Step 5:** Press **F4** and verify that the hardcopy of Error Detector status results.

Option 3A/3T/3R and SONET/FDDI Pattern ROM

The following procedure is used to verify performance of the SONET/FDDI Pattern ROM, included with Option 3A/3T/3R (128K RAM Extended Memory). If Option 3A/3T/3R is not installed on your instrument, you cannot perform this procedure.

Option 3A/3T/3R Verification Procedure — This procedure is to verify *Option 3A/3T/3R only. Verify the rest of the instrument* with procedure that begins at the front of this appendix.

☐ **Step 1:** *Make connections appropriate to the options installed as described in the following table.*

Table 4-27: Connections for Option 3A/3T/3R Verification Procedure

Option	From	To	*Comment*
Standard Instrument	Tx Clock	Rx Clock	50 Ω, SMA Coax
	Tx Not Clock	Rx Not Clock	50 Ω, SMA Coax
	Tx Data	Rx Data	50 Ω, SMA Coax
	Tx Not Data	Rx Not Data	50 Ω, SMA Coax
75 Ω Option	Tx Clock	Rx Clock	75 Ω, SMA Coax[1]
	Tx Not Clock	Rx Not Clock	75 Ω, SMA Coax[1]
	Tx Data	*Rx Data*	75 Ω, SMA Coax[1]
	Tx Not Data	Rx Not Data	75 Ω, SMA Coax[1]

1 This may be accomplished by using SMA to BNC adapters and 75 Ω BNC Coaxial cables.

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☐ **Step 2:** Reset both the Pattern Generator and the Error Detector to their factory default settings: Depress the **CLEAR** key in the **PATTERN** section, the **MSB** (1) key, and the **VIEW ANGLE** key, and hold down all three keys while cycling the power.

The message **Default Settings** should appear briefly on the display of each unit, followed by the CSA 907 logo, before the functional display appears.

☐ **Step 3:** Set the Word Synchronization Threshold of the Error Detector to 9 with the following steps

Press **F1** to select menus.
Press **F4** to select **WORD**.
Press **F1** to select **MORE**.
Press **F2** to select **SYNC**.
Press the **UP** key in the **PATTERN** section until the display reads **THRES LEVEL=9**.
Press **F4** to **SET** the selection.
Press **F1** repeatedly to exit the menu system.

☐ **Step 4:** Disable the Error Detector AUTOSET function by pressing the AUTOSET key.The LED in the key should dim.

☐ **Step 5:** Select Pattern P9 on both the Pattern Generator and the Error Detector by doing the following:

Press **WORD** on both instruments.
Press **RECALL** in the **PATTERN** of both instruments.
Press the **DOWN** key in the **PATTERN** section of both instruments to select pattern **P9**.

☐ **Step 6:** Verify that Pattern P9 is correct by doing the following:

Press the Error Detector **CLEAR** key in the **ERROR HISTORY** section.
Press Error Detector **START/STOP** key.
Verify that the Error Detector **SYNC LOCK** is lighted, the **ERROR HISTORY** lights are all out, and the **NUMBER OF ERRORS** count in the display is **0**.

☐ **Step 7:** Verify that patterns P8 through P0 are correct by doing the following:

Press the **DOWN** key in the **PATTERN** section of both instruments to select the next pattern.
Press the Error Detector **CLEAR** key in the **ERROR HISTORY** section.
Press the Error Detector **START/STOP** key.
Verify that the Error Detector **SYNC LOCK** is lighted, the **ERROR HISTORY** lights are all out, and the **NUMBER OF ERRORS** count in the display is **0**.
Repeat the above for each of the patterns.

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Appendix E: CSA 907A Block Diagrams

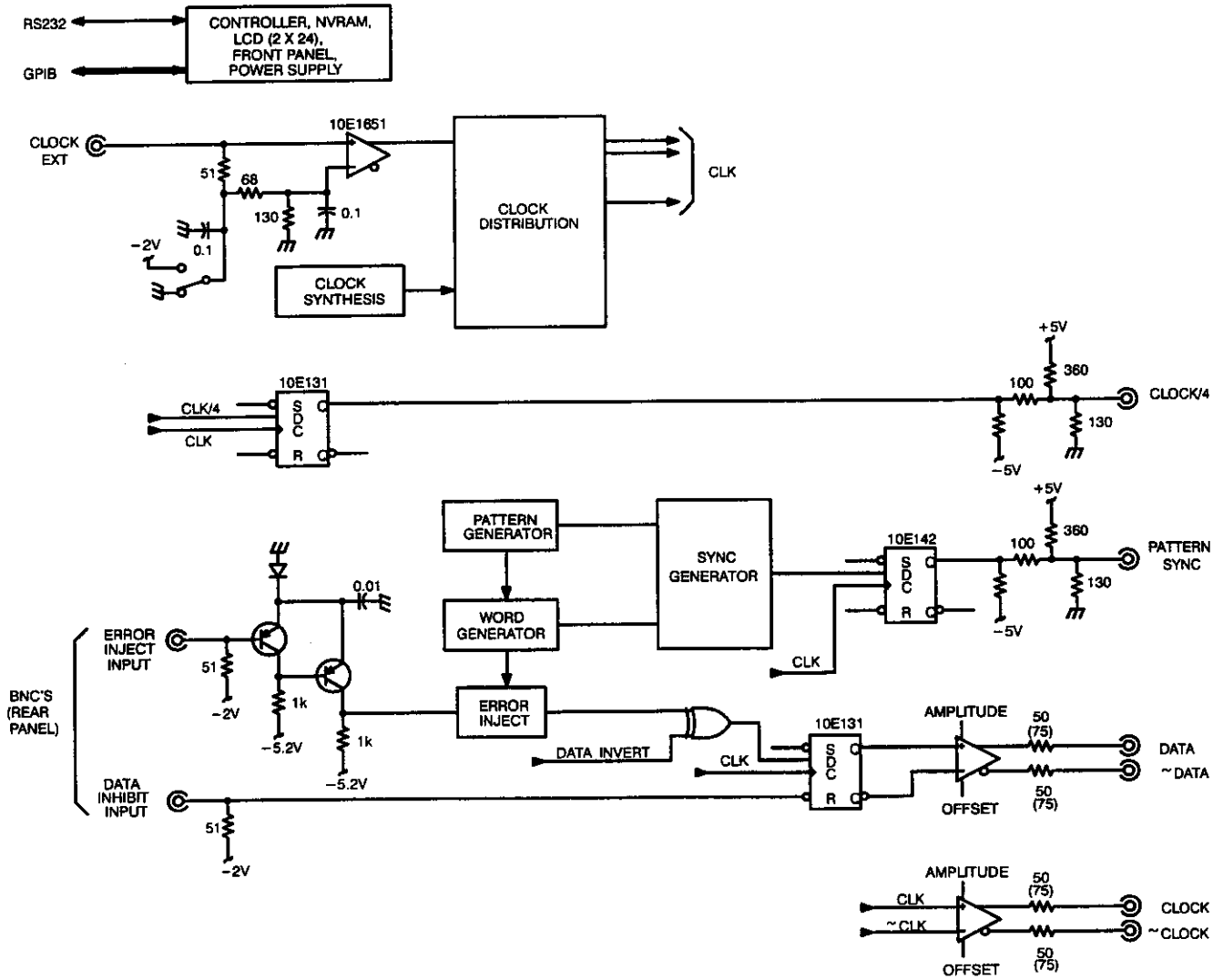


Figure 4-5: CSA 907A Pattern Generator Block Diagram

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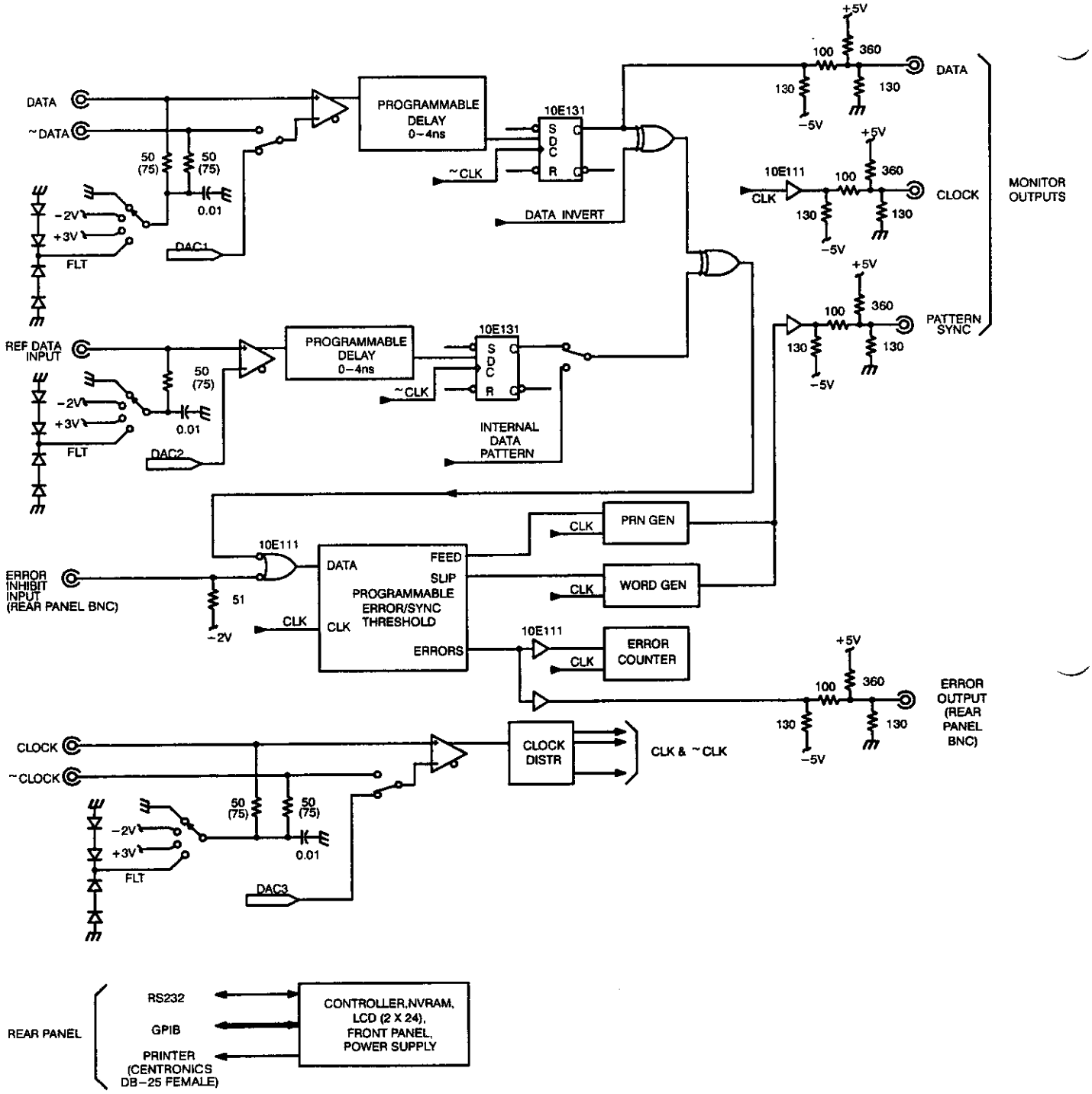


Figure 4-6: CSA 907A Error Detector Block Diagram

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Appendix F: Rackmount Installation

The following procedures describes how to install the rackmount kit on the CSA 907A.

NOTE

If a bale handle is attached to your instrument, use the first procedure to install the rackmount kit. If no bale handle is attached, use the second procedure.

Procedure with Bale Handles Attached

☐ **Step 1:** Remove the bale handle.

Pry off the handle detent buttons with a small, flat screwdriver inserted at a point on the horizontal axis of the instrument.

Remove the screws hidden by the buttons. Stretch the handle outward and remove it.

☐ **Step 2:** Remove the front and rear bezels.

☐ **Step 3:** Slide the side trim strips from the side rails.

☐ **Step 4:** Remove the four front-panel screws and the front panel. Add the square nut and plastic retainer to each side rail. Notice the three nuts that are already installed on each side as examples. Install the front panel.

☐ **Step 5:** Loosely screw the T-shaped panel bracket to the middle two square nuts in each side rail.

NOTE

The screws are metric.

☐ **Step 6:** Attach the rack mount panel to the panel brackets using four 8–32 nuts. Slide the bracket in the rails as necessary.

☐ **Step 7:** Replace the front bezel using two metric screws. sliding the rack mount panel and brackets in the side rails as necessary for alignment.

☐ **Step 8:** Tighten the four panel bracket screws previously attached to the side rails.

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☐ **Step 9:** Replace the rear bezel using two screws and keeping the top band bottom covers in place.

Installation without Bale Handles Attached

☐ **Step 1:** Remove the front and rear bezels.

☐ **Step 2:** Loosely screw the T-shaped panel bracket to the middle two square nuts in each side rail.

NOTE

The screws are metric.

☐ **Step 3:** Attach the rack mount panel to the panel brackets using four 8–32 nuts. Slide the bracket in the rails as necessary.

☐ **Step 4:** Replace the front bezel using two metric screws. sliding the rack mount panel and brackets in the side rails as necessary for alignment.

☐ **Step 5:** Tighten the four panel bracket screws previously attached to the side rails.

☐ **Step 6:** Replace the rear bezel using two screws and keeping the top band bottom covers in place.

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Glossary

Autoset
An operating mode of the CSA 907A Error Detector, in which it automatically searches for and sets its input parameters to synchronize with the input data.

BER
Bit Error Rate.

FDDI
Fiber Distributed Data Interface.

Pattern Sync
An output of the CSA 907A Pattern Generator that provides a signal suitable for oscilloscope trigger, with a trigger event occurring once per pattern frame.

PRBS
Pseudo-Random Binary Sequence. The CSA 907A provides five PRBS patterns.

SONET
Synchronous Optical NETwork.

Sync
Synchronization, or pattern alignment.

Test BER Mode
An operating mode of the CSA 907A Error Detector, in which it calculates errors over a programmable length of time. Test BER results may be Timed, Untimed, or Repeat, and are preceded by the T, U, or R symbol on the display.

Totalize BER Mode
An operating mode of the CSA 907A Error Detector, in which it averages errors over the total time of the test. Totalize BER results are preceded by the ∞ (infinity) symbol on the display.

Window
An operating mode of the CSA 907A Error Detector, in which it calculates errors over a programmable sliding window. Window BER results have no symbol preceding them on the display.

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