



**91S16, 91S32,
AND P6464
OPERATOR'S MANUAL ADDENDUM**

**TO THE DAS 9100 SERIES OPERATOR'S MANUAL
(PART NUMBER 070-3624-00, 01, AND UP)**

This Tektronix Manual Addendum supports the following products:

**91S16 Pattern Generator Module
91S32 Pattern Generator Module
P6464 Pattern Generator Probe**

This addendum is designed to be inserted into *DAS 9100 Series Operator's Manuals*. The 062-5847-08 manual set is a package consisting of loose leaf binders with manuals and addenda. Each manual and addendum in the set has its own part number starting with the prefix 070. You can find your manual part number in the bottom left corner of the manual title page. (Note: Some manuals may already have this addendum inserted in the back of their binders. Check your manual to see if this addendum is a duplicate.)

This addendum contains operator's information specific to the 91S16 and 91S32 Pattern Generator Modules and the P6464 Pattern Generator Probe. It replaces information pertaining to the 91P16 and 91P32 Pattern Generator Modules in the *DAS 9100 Series Operator's Manual*.

Refer to the *DAS 9100 Series Operator's Manual* for information on other products, including mainframes, instrument modules, probes, and options.

How To Use This Addendum. This addendum is organized similarly to the *DAS 9100 Series Operator's Manual*. Information within the addendum corresponds to sections within the operator's manual.

This addendum affects only some of the operator's manuals sections; it does not affect all of them.

NOTE: You can order extra operator's manual binders by requesting P/N 016-0778-00.

**PLEASE CHECK FOR CHANGE INFORMATION
AT THE REAR OF THIS MANUAL**



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SAFETY SUMMARY

The general information in this summary is for both operator and service personnel. Specific warnings and cautions will be found throughout the manual where they apply, but may not appear in this summary.

TERMS IN THIS MANUAL

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 AS MARKED 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 THIS MANUAL

 This symbol indicates where applicable cautionary or other information is to be found.

SYMBOLS AS MARKED 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 does not apply more than 250 volts rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

GROUNDING THE PRODUCT

This product is grounded through the grounding conductor of the power cord. To avoid electrical shock, plug the power cord into a properly wired receptacle before connecting to the product input or output terminals. A protective-ground connection by way of the grounding conductor in the power cord is essential for safe operation.

DANGER ARISING FROM LOSS OF GROUND

Upon loss of the protective-ground connection, all accessible conductive parts (including knobs and controls that may appear to be insulated) can render an electric shock.

USE THE PROPER POWER CORD

Use only the power cord and connector specified for your product. Use only a power cord that is in good condition.

USE THE PROPER FUSE

To avoid fire hazard, use only the fuse of correct type, voltage rating and current rating as specified in the parts list in the *DAS 9100 Series Service Manual*.

Refer fuse replacement to qualified service personnel.

DO NOT OPERATE IN EXPLOSIVE ATMOSPHERES

To avoid explosion, do not operate this product in an explosive atmosphere unless it has been specifically certified for such operation.

DO NOT OPERATE WITHOUT COVERS

To avoid personal injury, do not operate this product without covers or panels installed.

GENERAL INFORMATION

DESCRIPTION

The 91S16 and 91S32 Pattern Generator modules are second generation pattern generator cards. Each module can be used alone, and each has specialized features that make it particularly suited to a field of applications. However, the 91S16 can also be used to control the operation of up to five 91S32s, giving you the advantage of both cards' feature sets.

NOTE

The 91S16 and 91S32 replace the first generation 91P16/32 pattern generator modules. You cannot operate a 91S16 or 91S32s if a 91P16 is installed in the DAS.

91S16 ALGORITHMIC PATTERN GENERATOR

The 91S16 is an algorithmic pattern generator. The 91S16 differs from stored-pattern (all vectors stored in RAM) pattern generators in that loops, conditional branches, and a wide variety of interactions with the circuit under test are allowed. A large pattern generator memory is not necessary with algorithmic pattern generators since the capability to branch and loop within the program allows you to keep the system under test stimulated without writing lengthy programs.

The 91S16 also allows you to have a great deal of real-time interaction with the circuit under test via the 91S16's optional P6460 External Control probe (Data Acquisition probe). This probe can be used to acquire the following external signals: External Jump, Interrupt Request, Interrupt Request Qualifier, Pause, and External Inhibit signals. You can also use this probe to acquire an external clock signal.

There are two phono connectors on the back of the 91S16 module; one accepts an external start signal, and the other provides an external trigger signal.

The 91S16 provides two 8-bit data registers (or one internal 16-bit data register) which can be used as counters or as an alternate source for pattern output. The 91S16 instruction set includes nine instructions ranging from simple *JUMP to label* commands to *IF Register = 0 JUMP to label*. Fifteen different labels can be programmed. You can also program a special interrupt service routine.

The 91S16 Pattern Generator module provides 16 data output channels, 2 clock, and 2 strobe lines. Strokes can be used as additional data channels. The master clock can be supplied either from the DAS internal clock or from an external device. Maximum clock speed is 50 MHz. Data output is normally synchronous with the master clock, but individual data and strobe lines can be programmed ± 10 ns relative to the master clock (± 5 ns relative to pod clock). Pattern memory is 1024 sequence lines (vectors) deep.

Only one 91S16 can be installed in the DAS, however the 91S16 can be used as a controller for up to five 91S32s.

91S32 STORED-PATTERN PATTERN GENERATOR

The 91S32 is a stored-pattern (all vectors stored in RAM) pattern generator. Not all pattern generator applications require as much interaction with the system under test as is provided by the 91S16. Instead, many applications require straightforward test patterns that are often quite lengthy, and frequently require wide data patterns. The 91S32 is designed to serve these "wide and deep" applications.

The 91S32 is traditionally programmed to execute its program in a sequential beginning-to-end fashion. However, if you use the 91S32 in conjunction with a P6452 probe attached to the DAS Trigger/Time Base module, you can use inputs from that module to supply External Clock, External Start, External Inhibit, and Pause signals. Data output is normally synchronous with the master clock's rising edge, but individual pods can be adjusted ± 5 ns and individual channels have an additional ± 5 ns range.

Each 91S32 provides 32 channels of data, four strobes, and four clock lines. You can install up to six 91S32s in a single DAS for a total of 192 data channels, 24 strobes, and 24 clock lines. In addition, the strobe lines can be used as extra data channels. Maximum clock speed is 50 MHz. Pattern depth for all channels is 2048 sequence lines (vectors), however there are features available that allow you to split the memory into two 1024-line pages and reload alternate pages of memory while the pattern generator is outputting data (this requires a 91S16). The 91S32 can also be programmed to execute its program repeatedly.

91S16 AS CONTROLLER FOR 91S32s

One 91S16 can serve as a controller for up to five 91S32s. In this configuration, you can supply up to 16 data channels with a memory depth of 1024 lines, plus 160 data channels with a memory depth of 2048 lines (two 1024-line pages). There are also 22 clock lines and 22 strobe lines available.

In addition, this configuration provides all the branching instructions and interactive features available with the 91S16 along with the large numbers of data channels and pattern depth afforded by the 91S32s.

There are two different operating modes available when the 91S16 and 91S32 are used together: Sequential mode and Follows 91S16 mode.

Sequential Mode. This operating mode allows the 91S16 and 91S32 to operate simultaneously. The 91S16 will supply the clock signal to the 91S32, however each card will execute its program independently. In other words, the 91S16 can perform branching operations while the 91S32s execute their program in a sequential line-by-line manner. When the 91S32 reaches the end of its memory, it can be set to automatically restart from the beginning. This will keep all data channels active for as long as is desired.

In this mode, the 91S32's memory is configured as a single 2048-line program.

Follows 91S16 Mode. This operating mode allows the 91S16 to have much more active control over the output of the 91S32s. The 91S32 will follow instructions governing sequence line execution programmed in the 91S16.

In Follows 91S16 mode, the vector memory address register of the 91S16 becomes the vector address register for the 91S32s via an interconnect cable. This means that if the 91S16 executes a loop, the 91S32s will also loop. For example, if 91S16 SEQ 10 (sequence line 10) contained an instruction transferring pattern execution to SEQ 5, the 91S32s would also jump to SEQ 5 and continue outputting data sequentially from that line.

The 91S16 also supplies the master clock to the 91S32 modules. Usually, you would want the 91S16 and 91S32 to output data according to the same clock, but you can program the 91S32 to execute its program at one-half or one-fourth the clock rate supplied by the 91S16 module.

In Follows 91S16 mode, the memory of the 91S32 is divided into two 1024-line pages called Page A and Page B. The size of these pages matches the memory depth of the 91S16. The 91S16 has control over which memory page the 91S32 will execute. As an example, you can program two different programs in the 91S32 (one in each page) and use the 91S16 to switch between the programs based on some signal sensed by the 91S16's optional P6460 External Control probe.

Pattern Download From Host

One major feature provided by Follows 91S16 mode is the automatic Pattern Download From Host feature. There are two versions of Pattern Download From Host. The Pattern Download For Static Devices version can be used with any legal combination of 91S16 and 91S32s installed. It can be implemented using either Option 02 or Option 06 GPIB interface commands. The Pattern Download For Dynamic Devices version uses the Keep-Alive feature programmed into the 91S16. This version is only available when you have a 91S16 and at least one 91S32 installed; you must use the Option 06 GPIB interface commands.

Pattern Download For Static Devices. If your pattern generator program is very large, or if you have developed the program on a host computer, the entire program may be too large to fit into the 91S32's memory. You can output 2047-lines of vectors, reload the pattern generator's memory from a host computer, output the new block of vectors, and continue this process until the entire program has been executed. The Pattern Download From Host feature uses either DAS Option 02 GPIB, the RS-232 master/slave interface using GPIB commands, or DAS Option 06 GPIB (high speed GPIB).

Pattern Download For Dynamic Devices (Keep-Alive) When using the Pattern Download For Static Devices feature, the pattern generator alternates between outputting patterns and sitting idle while the next block of vectors is downloaded from the host computer. This can cause a problem with dynamic circuit elements that require constant clock and vector inputs. The 91S16/32 combination provides a Keep-Alive function to supply clock and a few vectors to keep the circuit under test active until the 91S32 memory has been reloaded. Keep-Alive is essentially a subroutine you program into the 91S16; static devices being tested won't require this feature. Keep-Alive is only available when you are using DAS 9100 Option 06: I/O Communication Interface (with HSPAT GPIB command).

SIGNAL CHARACTERISTICS

The purpose of the pattern generator is to exercise a system under test. The pattern generator outputs clock and data signals which can be used to simulate circuit bus activity, or to directly stimulate circuit elements. At the same time, it interacts with the system under test by responding to a variety of external signals. The external signals available depend on whether you are using a 91S16 module, a 91S32 module, or a combination of the two modules.

Figure 1 illustrates the basic functions of the pattern generator and its input and output signals. The characteristics of these signals are set up and enabled via the Pattern Generator menus.

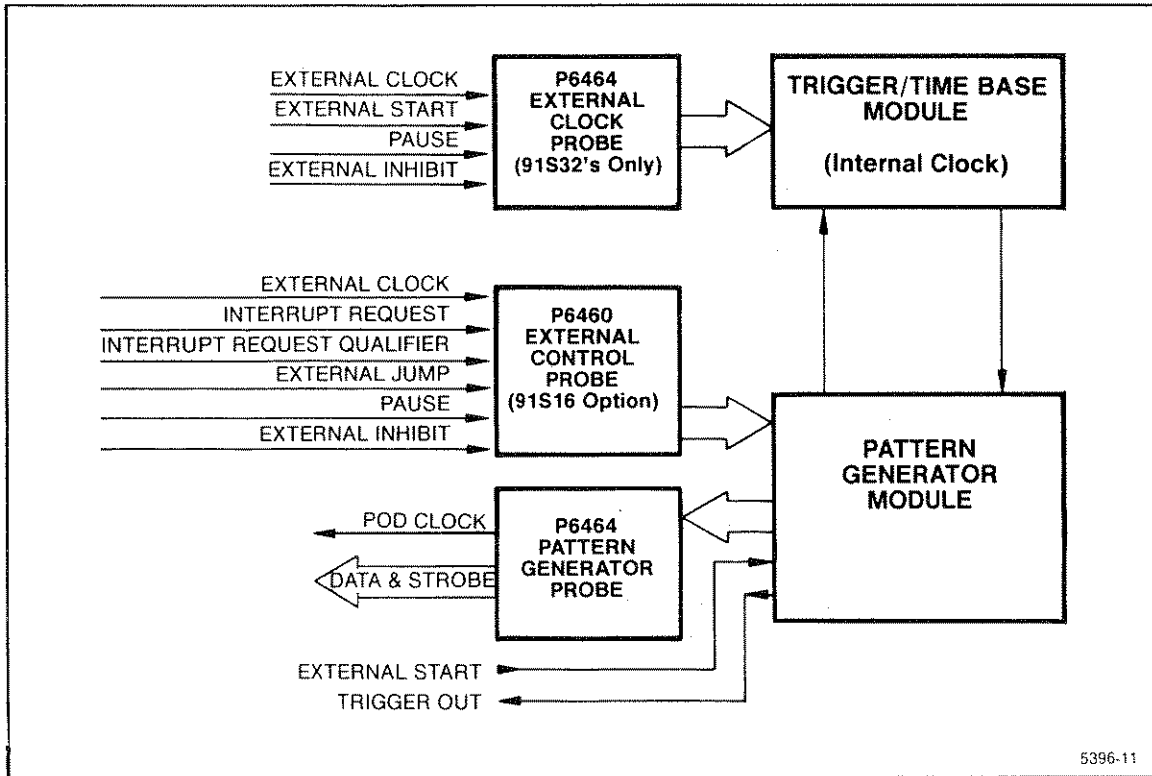


Figure 1. 91S16/32 block diagram.

Refer to the specification tables later in this section for technical parameters related to these signals.

CLOCKING

The pattern generator is associated with two types of clocks: the master input clock and the output clocks.

The pattern generator's master input clock controls the rate of the output clock and data. The master clock may be the DAS internal clock or the rising or falling edge of an external clock source. The external clock is supplied via the optional P6460 probe for the 91S16, or via the P6452 external control probe attached to the DAS Trigger/Time Base module for stand-alone 91S32s. The maximum clock rate is 50 MHz for the 91S16 with either internal or external clock source. 91S32s operating without a 91S16 controller can run at 50 MHz. using an internal clock source, or at 25 MHz. using an external clock source. A 91S16 operating with 91S32s can operate at up to 50 MHz., but there are some restrictions on the pod clock delay settings.

Here is a summary of the timing restrictions:

91S16	Up to 50 MHz with internal or external clock; no pod clock restrictions.
91S32 Stand-Alone	Up to 50 MHz. with internal clock if all pod clocks are set to 0 ns delay. Up to 25 MHz. with either an internal or external clock with no pod clock restrictions.
91S16 with 91S32s	Up to 50 MHz. with internal clock if all pod clock delays are set to -5 ns.

The output clock (pod clock) signals are derived from the master input clock. The output clock's rising edge is synchronized with the selected master clock edge, whether rising or falling.

Each P6464 Pattern Generator probe supplies one output clock line, labeled CLK. Each P6464 probe also supplies eight data channels and one strobe line. Each probe connects to a specific pod connector on the back of the pattern generator module. Pod connectors are assigned letters to help with identification. The 91S16 accepts two P6464 probes and one optional P6460 External Control Probe; the P6464s attach to pods A and B, and the P6460 probe attaches to Pod C. Each 91S32 has four P6464 probes and which attach to pods labeled Pod A through Pod D.

In addition to the simple relationship of the pattern generator master clock to the rising or falling edge of the input clock, each pod has a clock line that can be adjusted relative to the master clock. Pod clocks can be skewed ± 5 ns relative to the master clock, and data and strobe outputs can be skewed an additional ± 5 ns, allowing a maximum skew between data outputs (from two different pods) of 20 ns. All pod timing adjustments are made relative to the master clock. Data and strobe timing adjustments are made relative to the pod clocks.

When a 91S16 controls one or more 91S32s in Follows 91S16 mode, the 91S16 supplies the master clock to the 91S32s. You can program the 91S32's clock rate to be one-half, one-fourth, or the same as the 91S16's clock.

DATA OUTPUT

Data output from the pattern generator is normally parallel on all channels. Each channel's timing is adjustable up to ± 5 ns relative to its pod clock via the Setup: Timing sub-menu. Each pod clock is adjustable an additional ± 5 ns relative to the master clock.

Each pattern generator probe provides eight data channels labeled 0 through 7. Each probe also provides one strobe line which can be used as an additional data channel.

STROBES

Strobes provide either an additional data channel or an additional clock channel for each pod. If a strobe is used as a clock signal, its clock rate cannot be faster than one-half the rate of the master clock. Strobe width is tied to the width of the data channels (set by the master clock rate). The strobe channel's timing, like the data channels, is adjustable up to ± 5 ns relative to the pod clock.

INTERRUPT REQUEST

The 91S16 provides an Interrupt Request (IRQ) line via its optional P6460 External Control (Data Acquisition) probe. The 91S16 can be programmed to perform a special interrupt service routine every time the IRQ line is asserted. The 91S16 can also be programmed to ignore an interrupt call during certain segments of program memory.

There is also an interrupt request qualifier line provided by the 91S16's optional P6460 probe. This line allows you to qualify when the IRQ line is valid.

PAUSE

Both the 91S16 and the 91S32 have the capability to respond to an external pause signal. Pause causes the pattern generator to stop executing program lines but still hold the P6464 outputs at their current levels. The 91S16 PAUSE signal is supplied via its optional P6460 External Control probe. The stand-alone 91S32 PAUSE signal must be supplied via the P6452 External Clock Probe attached to the DAS Trigger/Time Base module.

INHIBIT

There are two kinds of inhibit signals used by the 91S16 and the 91S32: internally programmed inhibits and external inhibits. Either kind of inhibit signal causes some or all of the P6464 data lines to be tri-stated.

The 91S16 can have internal inhibits programmed in its Program: Run sub-menu. External inhibit signals are provided via its optional P6460 External Control probe. The 91S32 can also have internal inhibits programmed in its Program: Run sub-menu, and external inhibit signals are provided either by the 91S16's P6460 probe, or, if no 91S16 is installed, via a P6452 External Clock probe attached to the DAS Trigger/Time Base module.

The 91S16 and 91S32 Configuration sub-menus provide fields that allow you to select the polarity of the internal and external inhibit signals. They also allow you to use logical operators to combine these inhibit signals.

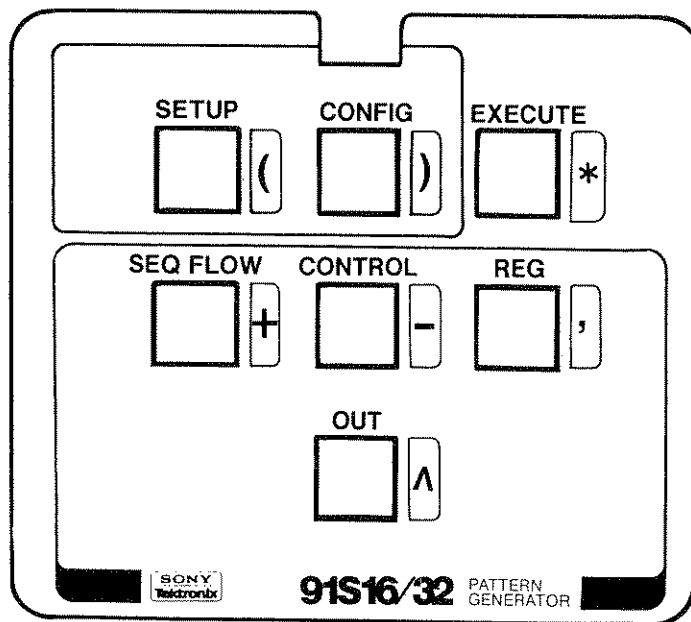
Both 91S16 and 91S32 modules provide bit-selectable inhibit masks for data channels in their program sub-menus. Inhibit masks for clock and strobes lines appear in the Configuration sub-menus.

EXTERNAL START

Both the 91S16 and the 91S32 can respond to External Start signals. These signals are supplied via a phono connector for the 91S16, and via the P6452 probe (attached to the DAS Trigger/Time Base module) for stand-alone 91S32s.

KEYBOARD CONTROLS

Figure 2 illustrates the keyboard overlay supplied with each 91S16 and 91S32. Apply this overlay over the existing Pattern Generator keys in the lower left corner of the DAS keyboard.



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Figure 2. 91S16/32 keyboard overlay.

The 91S16/32 Pattern Generator keys are arranged in three major groups. Group one consists of keys used to call up the various sub-menus on the display. This group includes the PATTERN GENERATOR key, the SETUP key, and the CONFIG key. Group two contains only the EXECUTE key. The third group consists of the SEQ FLOW, CONTROL, REG, and OUT keys. Key groups are outlined on the 91S16/32 keyboard overlay.

NOTE

The SETUP and CONFIG keys will not operate unless you have already entered the patten generator Program Run sub-menu. To enter the Setup and Configuration sub-menus, press the PATTERN GENERATOR key first, and then press either the SETUP or CONFIG key.

PATTERN GENERATOR This is the first key you will press when you want to call up any pattern generator sub-menu from the DAS power-up menu. After pressing the PATTERN GENERATOR key, the DAS will display the 91S16 Run sub-menu if a 91S16 is installed, otherwise it will display the 91S32 Run sub-menu.

SETUP This key causes the SETUP sub-menu to be displayed. There are two different setup sub-menus for each pattern generator module: PROBE and TIMING. See the *Introduction to 91S16 and 91S32 Sub-menus* section later in this manual for a description of these sub-menus. The 91S16 SETUP sub-menu will be displayed if a 91S16 is installed, otherwise the 91S32 SETUP sub-menu will be displayed.

CONFIG This key causes the Configuration sub-menu to be displayed. See the *Introduction to 91S16 and 91S32 Sub-menus* section for a description of this sub-menu. The 91S16 Configuration sub-menu will be displayed first whenever a 91S16 is installed in the DAS.

EXECUTE This key marks the end of data entry during an edit operation. Pressing this key tells the DAS you have finished making entries in an edit command and starts the operation.

SEQ FLOW This key is only used when programming branch instructions for the 91S16. SEQ FLOW stands for Sequence Flow, the order in which sequence lines are executed. See the 91S16 Program Run sub-menu for details.

CONTROL This key is used when programming the 91S16 to control the operation of one or more 91S32s operating in FOLLOWS 91S16 mode. This key also selects the TRIGGER instructions which issues a trigger signal via a phono connector on the back of the 91S16.

REG This is another 91S16 programming key used to control the function of the 91S16 internal register. REG instructions can include load, increment, or decrement the contents of the internal register.

OUT This key instructs the 91S16 to output the contents of its internal data register as data in place of the regular vector programmed for that sequence line. This key also provides an instruction that causes the pattern generator to ignore both the current Pod A pattern and register values and instead output the previous Pod A vector again.

INTRODUCTION TO 91S16 AND 91S32 SUB-MENUS

The 91S16 and 91S32 Pattern Generator modules provide a number of different sub-menus tailored to particular tasks. Because the 91S16 and 91S32 can each operate independently, or with the 91S16 as a controller for up to five 91S32s, the two types of pattern generator modules have similar sub-menus. In other words, the 91S16 and the 91S32 both have Run, Trace, and Step sub-menus. However, because the 91S16 and the 91S32 have different features, sub-menus with the same name for each card may not operate in exactly the same way. Also, when the 91S16 is used to control one or more 91S32s, the function of both cards' sub-menus changes slightly.

This section of the manual is designed to familiarize you with the names and functions of each type of sub-menu; let you know what other sub-menus are available; and help you move from one sub-menu to another easily. Detailed descriptions for each sub-menu are provided later in this addendum.

MAJOR SUB-MENU TYPES

Both the 91S16 and the 91S32 provide three basic types of sub-menus. These sub-menus are the Configuration, Setup, and Programming sub-menus. Figure 3 illustrates the grouping of the sub-menus within their major headings.

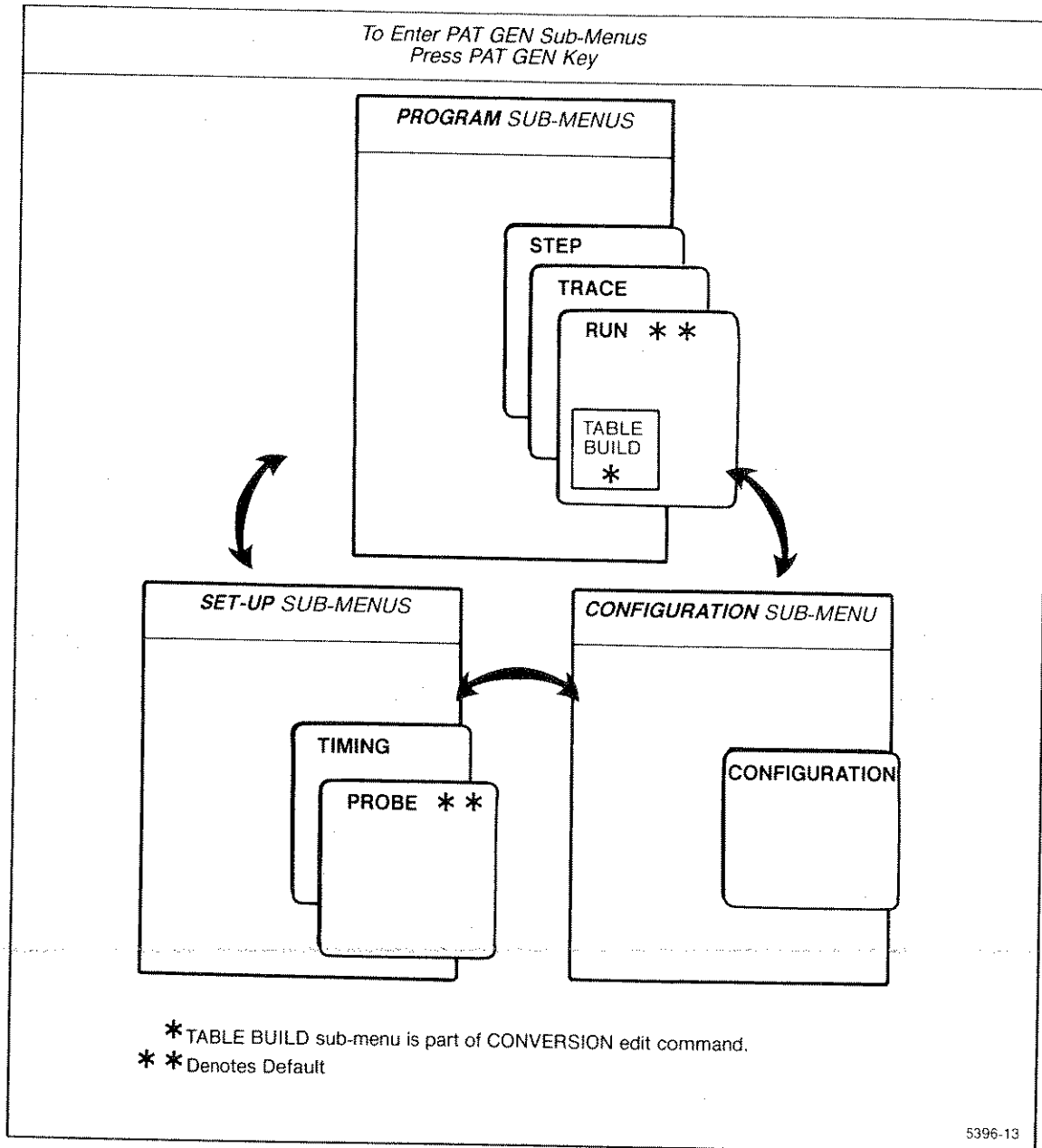
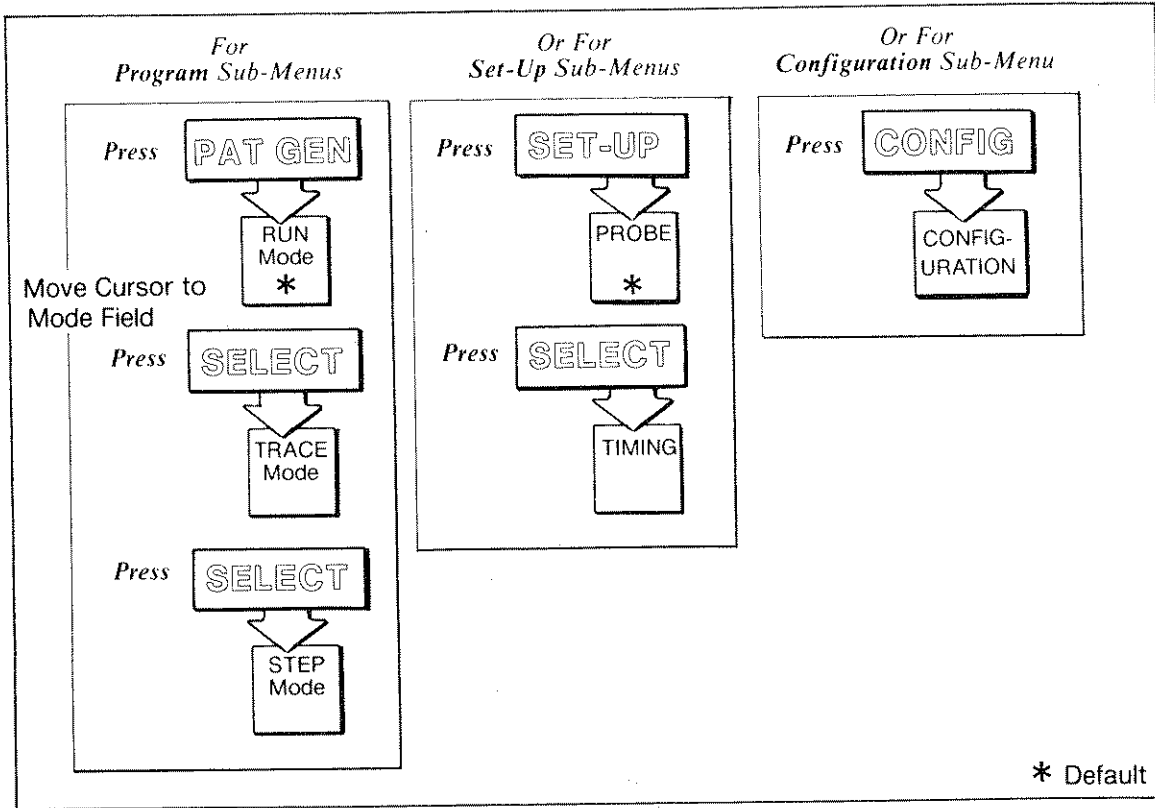


Figure 3. 91S16/32 sub-menu structure.

In order to access most of the pattern generator sub-menus, you must first press the PATTERN GENERATOR key. Once you have displayed a pattern generator sub-menu, you can easily move to and from the other sub-menus by pressing the appropriate key. Figure 4 illustrates how to use the DAS pattern generator keys to move between the various sub-menus.



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Figure 4. How to move between 91S16/32 Pattern Generator sub-menus.

CONFIGURATION SUB-MENUS

The 91S16 and 91S32 Configuration sub-menus are primarily used to set signal levels, signal polarities, pod delays, and various inhibit masks—the kinds of things you do once per test environment. They are also used to select major operating modes when 91S16 and 91S32 cards are used together.

Press the CONFIG key on the DAS keyboard to display the Configuration sub-menu. If you have a 91S16 installed in the DAS, the 91S16 Configuration sub-menu will be displayed first. Press the SELECT key to display the 91S32 sub-menu if you have both types of pattern generators installed.

NOTE

Some additional 91S32 Configuration sub-menu fields are available when the 91S32 is used in conjunction with a 91S16 module.

SETUP SUB-MENUS

There are two different Setup sub-menus: Probe, and Timing. Press the SETUP key to display the Probe sub-menu. If an 91S16 is installed in the DAS, the 91S16 Probe sub-menu will be displayed. If only 91S32s are installed, the 91S32 Probe sub-menu will be displayed. You cannot display the 91S32 Probe sub-menu if a 91S16 is installed in the DAS.

The Probe sub-menu allows you to enter parameters for external control signals. The 91S16 accepts external control signals through its optional P6460 External Control (Data Acquisition) Probe. The 91S16 also has two phono connectors on the back of the module; the top phono connector provides a trigger out signal (for an oscilloscope), and the bottom phono connector accepts an external start signal. The external start signal is enabled in this sub-menu. The 91S32, in stand-alone configuration, uses the P6452 External Clock (Data Acquisition) Probe connected to the DAS Trigger/Time Base module for its external control probe.

Because of the differences in these probes, the 91S16 and the 91S32 Probe sub-menus are quite different. The 91S16 Probe sub-menu will be the only Probe sub-menu available any time a 91S16 is installed in the DAS. If you are not using any external control signals with your pattern generator modules, you do not need to enter anything into these sub-menus.

The Timing sub-menu is exactly the same for both the 91S16 and the 91S32. To view the Timing sub-menu, move the screen cursor to the top-most field in the Probe sub-menu and press the SELECT key.

The Timing sub-menu adjusts the timing relationships between the clock, data, and strobe lines of a single P6464 Probe. You will use this sub-menu to select the master clock and adjust the timing relationships between various data and strobe lines.

This sub-menu allows you to adjust the time when each data channel outputs its signal relative to the master clock. You can use the fields in this sub-menu to move the clock (pod clock) supplied by a particular probe ± 5 ns relative to the master pattern generator clock. You can also individually program each of the data and strobe lines associated with that probe up to an additional ± 5 ns in 1 ns increments.

The Timing sub-menu also allows you to select the master pattern generator clock, either as a function of the clock supplied by the DAS, or in the case of the 91S16, as an external clock supplied by the P6460 External Control probe. 91S32s in stand-alone configuration can receive an external clock via a P6452 External Clock Probe attached to the DAS Trigger/Time Base module.

PROGRAMMING SUB-MENUS

The 91S16 and 91S32 Pattern Generator modules have three types of Programming sub-menus: Run, Trace, and Step. These sub-menu names reflect the three major pattern generator operating modes: Run mode, Trace mode, and Step mode. The Run sub-menu is the default sub-menu displayed when the PATTERN GENERATOR key pressed. It is also the most frequently used sub-menu. In addition, the Run sub-menu has a special sub-menu called TABLE BUILD used for editing existing data patterns.

You will use the Run sub-menu to enter the pattern used to stimulate your circuit under test, along with all associated programming instructions. Trace and Step sub-menus control features that help you monitor the pattern generator as it interacts with the system under test.

The Run sub-menu displays sequence lines that indicate the order of program execution. In the case of the 91S32, pattern generation will start with the lowest-numbered sequence line and progress sequentially until it reaches the highest-numbered sequence line. The 91S16 Run sub-menu allows loops and conditional branch instructions, but the same general order of execution holds true.

Each sequence line contains one or more fields in which you enter the data you want output via the P6464 pattern generation probes. Additional fields are provided for strobe and inhibit bits. The 91S16 provides additional fields for its specialized instructions.

Both the 91S16 and 91S32 Run sub-menus provide nine pattern editing instructions: CONVERT, COPY, DELETE, DISPLAY, FILL, INSERT, MODIFY, MOVE, and SEARCH. The CONVERT editing instruction displays the Table Build sub-menu. The Table Build sub-menu is used to convert an existing pattern generator program's data from one coding system to another (for example, from normal binary to the Gray code).

Trace and Step sub-menus simply display the number of clocks, sequence line being executed, and data vectors output so you can monitor program flow. Trace mode allows the pattern generator to execute its program automatically, but at a rate slow enough for you to see sequence jumps, loops, interrupt subroutines, and other structural demands on your pattern generator program. Step mode allows you to do exactly the same thing, but requires you to press the START PAT GEN key for each sequence line you want executed.

STANDARD AND OPTIONAL ACCESSORIES

91S16 PATTERN GENERATOR MODULE

The following lists include the standard and optional accessories for the 91S16 Pattern Generator Module.

Standard Accessories

- 2 010-6464-01 P6464 TTL/ECL Pattern Generator Probes
- 1 334-6094-00 91S16/32 Keyboard Overlay
- 1 070-5396-00 91S16, 91S32, and P6464 Operator's Addendum (English)
- 1 070-5398-00 91S16, 91S32 Operator's Reference Guide
- 1 334-6230-00 "EXTERNAL CONTROL PROBE" Label for optional P6460 Probe

Optional Accessories

- 010-6460-00 P6460 Data Acquisition Probe (External Control Probe)
- 020-1392-00 Controlled-Width Podlet
- 175-9676-00 Phono-to-Phono Cable (9-inch) For external start signal.
- 175-8165-00 Phono-to-BNC Cable (2-meters) For Trig Out signal.
- 070-5397-00 91S16, 91S32, and P6464 Service Addendum
- 003-1134-00 Delay Line Adjustment Tool

91S32 PATTERN GENERATOR MODULE

The following lists include the standard and optional accessories for the 91S32 Pattern Generator Module.

Standard Accessories

- 4 010-6464-01 P6464 TTL/ECL Pattern Generator Probes
- 1 175-9700-00 Interconnect Cable (six connector)
- 1 334-6094-00 91S16/32 Keyboard Overlay
- 1 070-5396-00 91SS16, 91S32, and P6464 Operator's Addendum (English)
- 1 070-5398-00 91S16, 91S32 Operator's Reference Guide

Optional Accessories

- 020-1392-00 Controlled-Width Podlet
- 003-1134-00 Delay Line Adjustment Tool
- 070-5397-00 91S16, 91S32, and P6464 Service Addendum
- 175-9782-00 Extender Interconnect Cable

P6464 TTL/ECL PATTERN GENERATOR PROBE

The following lists include the standard and optional accessories for the P6464 TTL/ECL Pattern Generator Probe.

Standard Accessories

- 1 070-5475-00 P6464 TTL/ECL Pattern Generator Probe Instruction Sheet
- 1 013-0217-00 Package of Grabber Tips (23 per probe)
- 1 334-6093-00 Package of Podlet Identification Labels
- 1 196-2963-00 Package of Lead-Sets (10 per probe)

SPECIFICATIONS

Table 1
ELECTRICAL SPECIFICATIONS: POWER REQUIREMENTS

Characteristic	Performance Requirement	Supplemental Information
Input Power Used by 91S16		+5 V \pm 3% at 8 A maximum +6 V \pm 5% at 43 mA maximum +12 V \pm 1.5% at 30 mA maximum -12 V \pm 10% at 30 mA maximum
Input Power Used by 91S32		+5 V \pm 3% at 8 A maximum +6 V \pm 5% at 36 mA maximum
Output Power from Mainframe to Each P6464		+5 V \pm 5% at 700 mA maximum
Output Power from Mainframe to P6460		+5 V \pm 3% at 600 mA maximum -5 V \pm 3% at 100 mA maximum

**Table 2
ELECTRICAL SPECIFICATIONS: 91S16 PATTERN PROCESSOR**

Characteristic	Performance Requirement	Supplemental Information
Sequence Number		0 to 1023, 1024 lines Multiple micro instructions can be programmed in the same sequence as long as instruction is different.
Internal Registers		2 8-bit registers: RA and RB RA and RB can be configured into one 16-bit register named R.
Sequence Flow Instructions		Program flow control: *(Advance to next line) IF RA=0 JUMP to label IF RB=0 JUMP to label IF R=0 JUMP to label IF EXT JUMP to label IF IRQ JUMP to label IF FULL JUMP to label IF END JUMP to label JUMP to label RETURN CALL RMT HALT Register Operation: *(Hold register value) INCR register value DECR register value LOAD register value Output Control: *Out data pattern OUT register value OUT REPEAT Note: * : Default Operation () : Displayed as Blank

Table 3
ELECTRICAL SPECIFICATIONS: 91S32 CONTROL

Characteristic	Performance Requirement	Supplemental Information
Operating Mode 91S32 with 91S16 Follows 91S16		91S32 receives the clock and high speed address (up to 1K range) from 91S16. 91S32 memory divided into two 1K pages, and changes between pages when 91S16 executes INCR PAGE.
Sequential		91S32 receives only the clock from 91S16. The 91S32 address and page counter are incremented automatically by the clock.
91S32 Stand-alone Repeat		Sequential operation only 1 to 65535 Free Run This field specifies the number of times the 91S32s will loop through their programs.
End Sequence		0 to 2047 This number specifies the last sequence line in the program; after executing the sequence line specified, the 91S32 restarts. The END SEQ field can be used when 91S32s are operating with a 91S16 in sequential mode or in 91S32 stand-alone mode.

**Table 4
ELECTRICAL SPECIFICATIONS: PATTERN DATA**

Characteristic	Performance Requirement	Supplemental Information
Number of Pattern Vectors 91S16		1024 maximum
91S32		2048 maximum
Pattern Width 91S16		16 parallel channels (2 strobos/91S16)
91S32		32 parallel channels (4 strobos/91S32) Expandable up to 176 channels with one 91S16 and five 91S32's. 16 + (32 × 5) Expandable up to 192 channels with six 91S32's. (32 × 6)
Data Channel Maximum Skew within Pod	1 ns at P6464 connector (no edge positioning)	Any data channels within a pod will be valid at P6464 connector within 1 ns of each other when Edge Positioning is not programmed.
Data Channel Maximum Relative Error within Pod	2 ns at P6464 connector (edge positioned)	Any data channels within a pod will be valid at P6464 connector within 2 ns + Edge Position of each other when Edge Positioning is programmed.
Data Channel Edge Positioning		Any data channel can be placed ±5 ns in 1 ns steps at P6464 probe tip centered on the Pod Clock. This is a function of the P6464 programmed via the Timing sub-menu.
Tri-State		Each data channel may be individually tri-stated (inhibited) by the pattern generator inhibit signal. The pattern generator inhibit signal sent to the P6464 is derived from microcode (Run sub-menu) and/or P6460 External Control Probe if 91S16 exists, or from P6452 External Clock Probe through Trigger/Timebase Module if only 91S32s installed.

Table 4 (cont.)
ELECTRICAL SPECIFICATIONS: PATTERN DATA

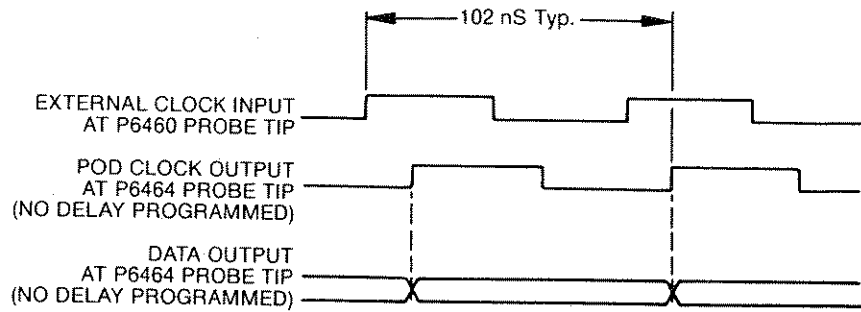
Characteristic	Performance Requirement	Supplemental Information
Vector Source for Pod A (91S16 only)		Data pattern, RA, RB, R (Low byte only) or Repeat previous Pod A value (OUT REP)
Vector Source for Pod B (91S16 only)		Data pattern or R (High byte only) <i>NOTE: Not RB, and not high byte of OUT REP</i>

**Table 5
ELECTRICAL SPECIFICATIONS: STROBE AND CLOCK OUTPUTS**

Characteristic	Performance Requirement	Supplemental Information
Strobe Output		1 strobe line per P6464
Number of Strobes		
91S16		2 strobes
91S32		4 strobes
Strobe Polarity		Strobe polarity can be programmed the same as pattern data.
Strobe Maximum Skew Relative to Data Channels Within Pod		
ECL	1 ns at P6464 connector (no edge positioning)	Strobe will be valid at P6464 connector within 1 ns (ECL) or 1.5 ns (TTL) with respect to other data channels in the same pod when Edge Positioning is not programmed.
TTL	1.5 ns at P6464 connector (one TTL load) (no edge positioning)	
Strobe Maximum Relative Error Within Pod	2 ns at P6464 connector (edge positioned)	Strobe will be valid at P6464 connector within 2 ns + Edge Position with respect to other data channels in the same pod when Edge Positioning is programmed.
Strobe Edge Positioning		Strobe can be positioned ± 5 ns in 1 ns steps at P6464 probe tip centered on the Pod Clock. This function is controlled in the Timing sub-menu.
Tri-State		Strobe may be tri-stated (inhibited) by the inhibit signal. The pattern generator inhibit signal sent to the P6464 is derived from microcode (Run-sub menu) and/or P6460 External Control Probe if 91S16 exists, or from P6452 External Clock Probe through Trigger/Time Base Module if only 91S32's used.
Pod Clock Output		1 clock line per P6464 probe can be used as a Pod Clock.
Number of Pod Clocks		
91S16		2 Pod Clocks
91S32		4 Pod Clocks
Pod Clock Polarity		Rising or Falling Edge, menu-selectable

Table 5 (cont.)
ELECTRICAL SPECIFICATIONS: STROBE AND CLOCK OUTPUTS

Characteristic	Performance Requirement	Supplemental Information
Pod Clock Pulse Width (at P6464 Connector) Internal Clock External Clock		≥ 8 ns Input pulse width ± 6 ns Clock pulse comes from P6460 External Control Probe if 91S16 exists, or from P6452 External Clock Probe through Trigger/Time Base Module if only 91S32's used.
Pod Clock Delay from External Clock Input		102 ns typical. Refer to Figure 5



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Figure 5. Pod Clock/Data Output Delay from External Clock Input.

**Table 5 (cont.)
ELECTRICAL SPECIFICATIONS: STROBE AND CLOCK OUTPUTS**

Characteristic	Performance Requirement	Supplemental Information
Pod Clock Maximum Skew Between Pods		Add 3 ns for maximum skew at P6464 probe tip if adjusted without probe.
Within 91S16 or 91S32	2 ns at P6464 connector (no edge positioning)	Edge of any Pod Clock within 91S16 or within 91S32 will occur at P6464 connector within 2 ns of each other when Edge Positioning is not programmed.
Between 91S16 and First 91S32	3 ns (adjusted as a set) 7ns (adjusted as a module) at P6464 connector (no edge positioning)	Edge of any Pod Clock within 91S16 and first 91S32 will occur at P6464 connector within 3 ns (adjusted as a set) or 7 ns (adjusted as a module) of each other when Edge Positioning is not programmed.
Between 91S32's	4 ns (adjusted as a set) 8 ns (adjusted as a module) at P6464 connector (no edge positioning)	Edge of any of 91S32 Pod Clock will occur at P6464 connector within 4 ns (adjusted as a set) or 8 ns (adjusted as a module) of each other when Edge Positioning is not programmed.
Pod Clock Maximum Relative Error between Pods		Add 3 ns for maximum relative error at P6464 probe tip if adjusted without probe.
Within 91S16 or 91S32	4 ns at P6464 connector (edge positioned)	Edge of any Pod Clock within 91S16 or within 91S32 will occur at P6464 connector within 4 ns + Edge Position of each other when Edge Positioning is programmed.
Between 91S16 and First 91S32	5 ns (adjusted as a set) 9 ns (adjusted as a module) at P6464 connector (edge positioned)	Edge of any Pod Clock and first 91S32 will occur at P6464 connector within 5 ns + Edge Position (adjusted as a set) or 9 ns + Edge Position (adjusted as a module) of each other when Edge Positioning is programmed.
Between 91S32's	6 ns (adjusted as a set) 10 ns (adjusted as a module) at P6464 connector (edge positioned)	Edge of any 91S32 Pod Clock will occur at P6464 connector within 6 ns + Edge Position (adjusted as a set) or 10 ns + Edge Position (adjusted as a module) of each other when Edge Positioning is programmed.

**Table 5 (cont.)
ELECTRICAL SPECIFICATIONS: STROBE AND CLOCK OUTPUTS**

Characteristic	Performance Requirement	Supplemental Information
Pod Clock Edge Positioning	± 5 ns in 5 ns steps	Pod Clock can be positioned in -5 ns to +5 ns range in 5 ns steps. Programmable.
Tri-State		<p>Pod Clock may be tri-stated (inhibited) by the inhibit signal.</p> <p>The pattern generator inhibit signal sent to the P6464 is derived from microcode (Run sub-menu) and/or P6460 External Control Probe if 91S16 exists, or from P6452 External Clock Probe through Trigger/Time Base Module if only 91S32's used.</p>

**Table 6
ELECTRICAL SPECIFICATIONS: CLOCK RATE**

Characteristic	Performance Requirement		Supplemental Information
Operating Rate, Run Mode	91S16		Up to 50 MHz (20 ns cycle time) internal clock or external clock
	91S32 With 91S16		Up to 50 MHz (20 ns cycle time) internal clock (Pod clock delay set to -5 ns) or 25 MHz (40 ns cycle time) external clock
Clock Source	Stand-Alone		Up to 50 MHz (20 ns cycle time) internal clock (Pod-clock delay set to 0 ns) Up to 25 MHz (40 ns cycle time) external clock
	Internal		Internal or external, selectable From Trigger/Time Base Module of the Mainframe
Polarity	External		From P6460 External Control Probe if 91S16 exists, or from P6452 External Clock Probe through Trigger/Timebase Module if only 91S32's used.
	Period		Rising or falling edge, selectable
	91S16	91S32 (Stand-Alone)	
Pulse High	20 ns min	20 ns int. ck. 40 ns ext. ck.	
Pulse Low	9 ns min	19 ns min	
	9 ns min	19 ns min	

Table 7
ELECTRICAL SPECIFICATIONS: 91S16 EXTERNAL CONTROL SIGNALS

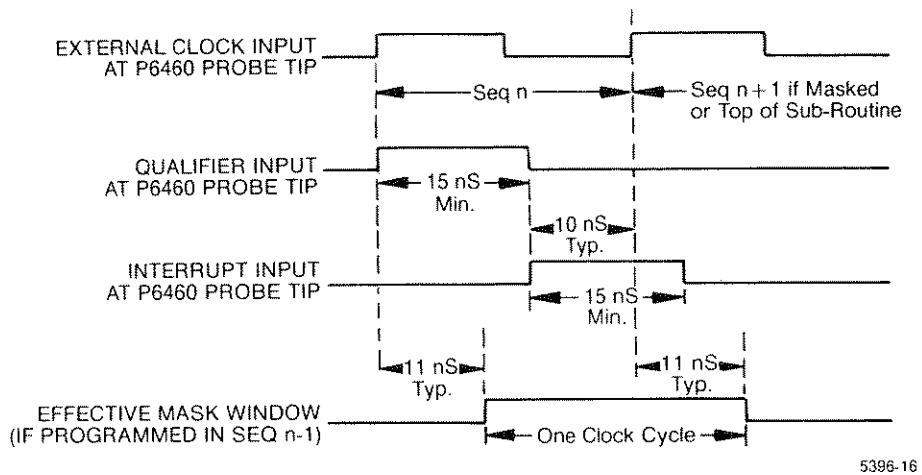
Characteristic	Performance Requirement	Supplemental Information
Using P6460 Probe		External control signals for 91S16 are obtained from P6460 External Control Probe.
Input Threshold Range	-6.40 V to +6.35 V in 50 mV steps	
Threshold Accuracy		Indicated value $\pm .5\% \pm 6.5$ mV
Minimum Logic Swing		0.5 V peak-to-peak, centered on the threshold
External Clock Input		1 external clock line (edge selectable) 9 ns minimum pulse width
Interrupt Input		1 interrupt line (edge selectable)
Interrupt Processing Cycle Delay		1 cycle When a valid interrupt request is logged in, the first interrupt vector appears at P6464 probe tip in the cycle where the interrupt has been sampled.
Interrupt Minimum Pulse Width		15 ns
Interrupt Input Timing Window Prior to External Clock Input		10 ns typical To be recognized in a certain cycle, assert the interrupt request in a range of 10 ns prior to the selected edge of the external clock, otherwise it will be recognized in the next cycle.
Interrupt Input Timing Window Prior to Pod Clock Output		104 ns typical To be recognized in a certain cycle, assert the interrupt request in a range of 104 ns prior to Pod clock selected edge output, otherwise recognized in the next cycle.
Interrupt Latency		1 cycle time Second interrupt can be latched in the next cycle after the first interrupt has been started.
Interrupt Service Call		1 level The stack used to save the return address for the interrupt service call has 1 level.

**Table 7 (cont.)
ELECTRICAL SPECIFICATIONS: 91S16 EXTERNAL CONTROL SIGNALS**

Characteristic	Performance Requirement	Supplemental Information
Interrupt Mask		Mask bit in microcode disables receipt of an interrupt as long as it is "1".
Interrupt Mask Timing Window		11 ns typical. Refer to Figure 6 11 ns typical after the rise/fall edge selected to 11 ns typical to the next rise/fall edge selected the external clock
Interrupt Qualifier Input		1 qualifier line (level selectable) An interrupt is recognized if the selected edge is detected on the interrupt line only when the qualifier line stays high or low as specified.
Interrupt Qualifier Input Minimum Pulse Width		15 ns
Interrupt Qualifier Input Setup Time Relative to Interrupt		15 ns minimum Maintain qualifier line high or low for 15 ns prior to the selected edge of the interrupt.
Interrupt Qualifier Input Hold Time Relative to Interrupt		0 ns maximum Maintain qualifier line high or low after the selected edge of the interrupt.
External Jump Input		1 external jump (level selectable) Pattern will branch on "IF EXT JUMP" instruction if the EXT JUMP line is activated when the instruction is tested.
External Jump Minimum Pulse Width		15 ns
External Jump Input Setup Time Relative to External Clock Input		15 ns minimum 10 ns typical Assert the external jump request 15 ns prior to the selected edge of the external clock.
External Jump Input Hold Time Relative to External Clock Input		0 ns maximum Assert the external jump request 0 ns after the selected edge of the external clock.
External Jump Input Setup Time Relative to Pod Clock Output		105 ns + 1 clock cycle typical Assert the external jump request 105 ns + 1 clock cycle prior to the Pod Clock selected edge output.

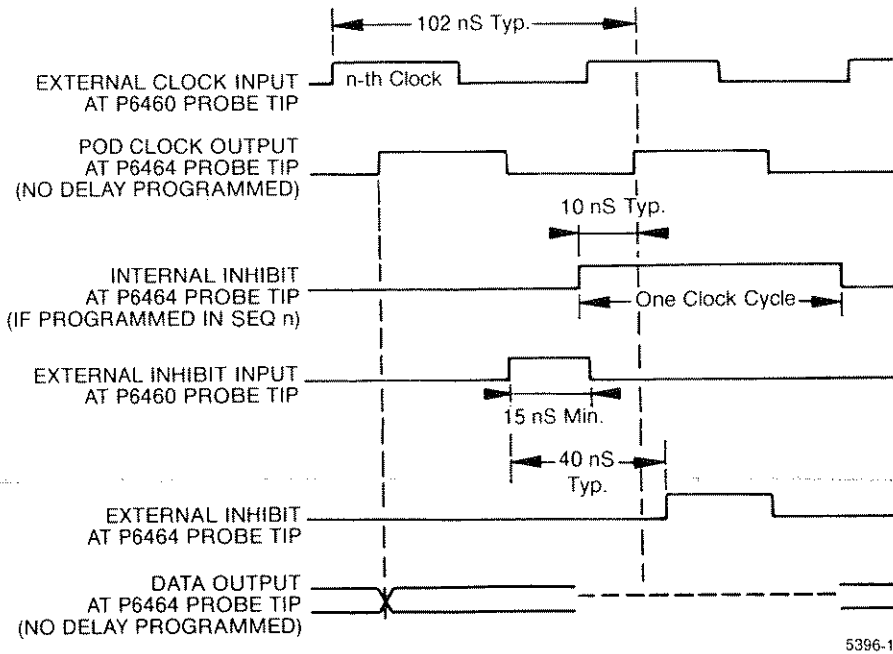
**Table 7 (cont.)
ELECTRICAL SPECIFICATIONS: 91S16 EXTERNAL CONTROL SIGNALS**

Characteristic	Performance Requirement	Supplemental Information
External Inhibit Input		1 external inhibit line (level selectable) External inhibit is ANDed/ORed with internal inhibit according to selection in Probe sub-menu.
External Inhibit Minimum Pulse Width		15 ns
External Inhibit Delay		40 ns typical. Refer to Figure 7
Pause Input		1 pause line (level selectable) Freezes the current data outputs while pause line remains true.
Pause Input Minimum Pulse Width		15 ns
Pause Input Setup Time Relative to External Clock Input		15 ns minimum 10 ns typical
Pause Input Hold Time Relative to External Clock Input		Assert the pause request 15 ns prior to the selected edge of the external clock. 0 ns
Pause Input Setup Time Relative to Pod Clock Output		59 ns typical Assert the pause request 59 ns prior to the selected edge of the Pod Clock output.



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Figure 6. Interrupt/Qualifier and Mask timing diagram.



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Figure 7. Internal and External Inhibit timing diagram.

Table 8
ELECTRICAL SPECIFICATIONS: 91S16 EXTERNAL START INPUT AND TRIGGER OUTPUT

Characteristic	Performance Requirement	Supplemental Information
External Start Input		TTL-level input (edge selectable); phono connector; 2 LS TTL fan-in
External Start Input Minimum Pulse Width		The pattern generator automatically starts when the external start signal is asserted after once pressing the START PAT GEN or START SYSTEM key on the keyboard.
Trigger Output		15 ns minimum
Trigger Output Timing Relative to Pod Clock Output		TTL-level output; phono connector; 5 STD TTL fan-out
Relative to External Clock Input		A TTL high-level signal occurs on the trigger output for 1 clock cycle when the 91S16 executes the TRIGGER instruction.
Trigger Output Timing Relative to Pod Clock Output		-46 ns
Relative to External Clock Input		Trigger signal occurs 46 ns prior to the selected edge of the pod clock output when no delay is programmed.
Relative to External Clock Input		56 ns
Relative to External Clock Input		Trigger signal occurs 56 ns after the selected edge of the external clock.

Table 9
ELECTRICAL SPECIFICATIONS: 91S32 EXTERNAL CONTROL SIGNALS

Characteristic	Performance Requirement	Supplemental Information
Using P6452 Probe		External control signals for 91S32 in stand-alone configuration are obtained from P6452 External Clock Probe attached to DAS Trigger/Time Base Module.
Input Threshold Range		-2.5 V to +5.00 V in 50 mV steps
Input Threshold Accuracy		Menu-selected value $\pm 2\% \pm 100$ mV
Minimum Logic Swing		0.5 V peak to peak centered on the threshold.
External Clock Input		1 external clock line (edge selectable) 19 ns minimum pulse width
External Inhibit Input		1 external inhibit line (level selectable) External inhibit is ANDed/ORed with internal inhibit according to menu selections in the Probe sub-menu.
External Inhibit Minimum Pulse Width		19 ns
External Inhibit Delay		76 ns minimum. When external inhibit line is asserted, the data outputs will be inhibited or tri-stated 76 ns after the external inhibit signal is asserted.

Table 9 (cont.)
ELECTRICAL SPECIFICATION: 91S32 EXTERNAL CONTROL SIGNALS

Characteristic	Performance Requirement	Supplemental Information
Pause Input		1 pause line (level selectable) Freezes the current data outputs while pause line remains true.
Pause Input Minimum Pulse Width		19 ns
Pause Input Setup Time Relative to External Clock Input		19 ns minimum Assert the pause request 19 ns prior to the selected edge of the external clock.
Pause Input Hold Time Relative to External Clock Input		0 ns max Assert the pause request 0 ns after the selected edge of the external clock.
Pause Input Setup Time Relative to Pod Clock Output		120 ns minimum 108 ns typical Assert the pause request 120 ns prior to Pod Clock selected edge output.
External Start Input		The pattern generator automatically starts when the external start signal is asserted after once pressing the START PAT GEN or START SYSTEM key on the keyboard.
External Start Input Minimum Pulse Width		19 ns minimum
External Start Input Setup Time Relative to External Clock Input		14 ns minimum 5 ns typical
External Start Input Hold Time Relative to External Clock Input		5 ns minimum 0 ns typical

Table 10
P6464 ELECTRICAL SPECIFICATIONS

Characteristic	Performance Requirement	Supplemental Information
Clock In, Maximum Frequency	50 MHz (20 ns)	
Power Required		Power required per channel from user's circuit. Voltages referenced to instrument ground.
V_H		-.5 V to +5.5 V at 85 mA + I load (user's more positive supply voltage)
V_L		+3 V to -5.5 V at 88 mA + I load (user's more negative supply voltage)
$V_H - V_L$		4.8 V to 5.2 V (within individual probes)
Pin Driver Outputs: Data, Clock, Strobe		
TTL Mode	$V_{L\ OUT} = V_L + .80\ V$ $V_{H\ OUT} = V_H - 1\ V$	
Drive Capability	sink or source > 20 mA	
Transition Time		3.5 ns maximum (20% to 80% of logic level), resistive load
ECL Mode	$V_{L\ OUT} = V_H - 1.65\ V$ $V_{H\ OUT} = V_H - 1\ V$	Nominal open emitters
Drive Capability	20 mA (50Ω to $V_H - 2\ V$)	50 pF maximum
Transition Time		2.5 ns maximum (20% to 80% of logic level), resistive load

Table 11
P6464 ENVIRONMENTAL SPECIFICATIONS

Characteristic	Description
Temperature	
Operating	0°C to +50°C
Storage	-55°C to +75°C
Humidity	90% to 95% relative humidity
Altitude	
Operating	4.5 km (15,000 ft.) maximum
Storage	15 km (50,000 ft.) maximum

Table 12
P6460 ELECTRICAL SPECIFICATIONS

Characteristic	Description
User's Ground Sense	<100 Ω to user's ground
Input Impedance	1 M Ω \pm 1%, 5 pF nominal; lead set adds approx. 5 pF
Max. Non-Destructive Input Voltage Range	\pm 40 V (DC + peak AC)
Max. Voltage Between Any Two Inputs	\pm 60 V (DC + peak AC)
Operating Input Voltage Range	From -40 V to input threshold's voltage + 10 V (+30 V for RS-232 only)
Threshold Offset and Accuracy	\pm 0.25% of threshold \pm 50 mV
Minimum Input Swing	0.5 V peak-to-peak, centered on the threshold
Minimum Pulse Width (with input 250 mV over the threshold from +0.5 V and -0.5 V)	4 ns at threshold

Table 13
P6460 ENVIRONMENTAL SPECIFICATIONS

Characteristic	Description
Temperature	
Operating	-15° C to +55° C
Storage	-62° C to +75° C
Humidity	95% to 97% relative humidity
Altitude	
Operating	4.5 km (15,000 ft.) maximum
Non-operating	15 km (50,000 ft.) maximum

OPERATING INSTRUCTIONS

This section describes installation requirements for the 91S16 and 91S32 Pattern Generator modules and their probes. It also provides a description of operator's checkout procedures for the modules and probes.

Repackaging Information. All 9100 Series products are shipped in specially designed transportation packaging. Keep this packaging for use whenever you ship DAS products. If the original packaging is no longer fit for use, contact your nearest Tektronix Field Office and obtain new DAS packaging.

If you need to ship any part of your 91S16 or 91S32 system to a Tektronix Service Center, please send in all parts of your system: the 91S16 and/or 91S32s and all of their probes.

When you ship a product to a Tektronix Service Center, be sure to attach an identifying tag to the product (inside the packaging). On this tag include your name, the name of your company, the name and serial number of the enclosed product, and a description of the service requested.

CONFIGURATION AND UPDATE REQUIREMENTS

CONFIGURATION REQUIREMENTS

The 91S16 module can be installed in any DAS slot supplied by the upgraded 22 ampere 5 volt power supply (p/n 620-0296-01). DAS 9100 instruments with the following serial numbers and greater will automatically have the upgraded power supply installed:

- Monochrome DAS 9109, serial numbers B050326 and higher
- Color DAS 9129, serial numbers B060100 and higher
- DAS 9119, serial numbers B010102 and higher

If your instrument has a lower serial number, have a qualified service technician verify that you have the 22 ampere supply installed. Refer the technician to the section at the back of this addendum (behind the goldenrod page) titled *Service Information: Verifying Installation of the Upgraded + 5 V Power Supply*.

Only one 91S16 module may be installed in the DAS system. If first generation 91P16/P32 Pattern Generator modules are installed in the DAS, you must remove them; you cannot have both 91S16/S32 and 91P16/P32 modules installed at the same time.

The 91S32 module can be used as a channel expander for the 91S16 or as discrete pattern generator. A maximum of five 91S32 modules can be installed with one 91S16 module, or a maximum of six 91S32s can be installed without a 91S16. 91S32s can be installed in any DAS slot supplied by the upgraded 22 ampere 5 volt power supply.

When more than one pattern generator module is installed in the DAS, the modules are connected by a ribbon cable which attaches to the top of each circuit board. This ribbon cable distributes clock signal to each module, and provides addresses and control signals to the 91S32s when used in FOLLOWS 91S16 mode.

As an expander, the first 91S32 module must be in the slot next to the 91S16. Additional 91S32 modules need to be in adjacent slots.

NOTE

91A04A and 91AE04A Data Acquisition Modules must be installed in slot numbers higher than the 91S16 and 91S32 modules.

91S32 TERMINATOR CONNECTORS. 91S32 modules contain a series of terminator connectors immediately below the interconnect cable card-edge connectors. These connectors are used to terminate the clock, address, and control signals passed over the interconnect cable. Only the 91S32s at the end of the signal path should have these terminators in place; you should remove the terminators from all intermediary boards.

When a 91S16 is used to control 91S32s, the 91S16 provides the clock and address signals. Hence, only the 91S32 farthest from the 91S16 should have its terminators installed (15 terminators). The following pin numbers should have terminators in place: J202, J204, J302, J304, J306, J308, J310, J312, J314, J316, J318, J320, J322, J324, and J102. J102 is located below and to the right of the other terminator connectors. The only pins that should not have terminators installed are J206 and J208.

Refer to Figure 8.

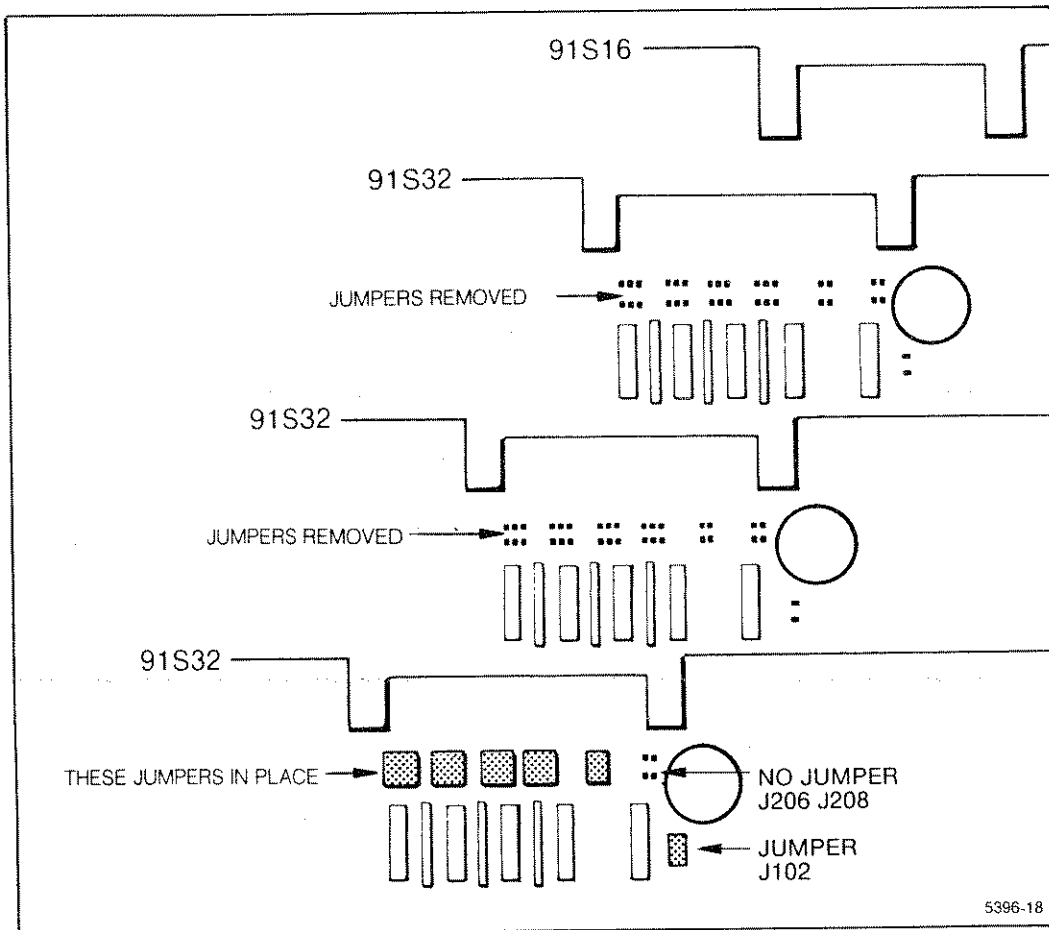


Figure 8. Terminator configuration for 91S32s with 91S16.

When 91S32s are used without a 91S16 module, the outermost 91S32 modules should have the following terminators in place: J206 and J208. Remove the rest of the terminators. Any intermediate 91S32 modules should have all their card-edge connector terminators removed. (No terminator on J102.)

Refer to Figure 9.

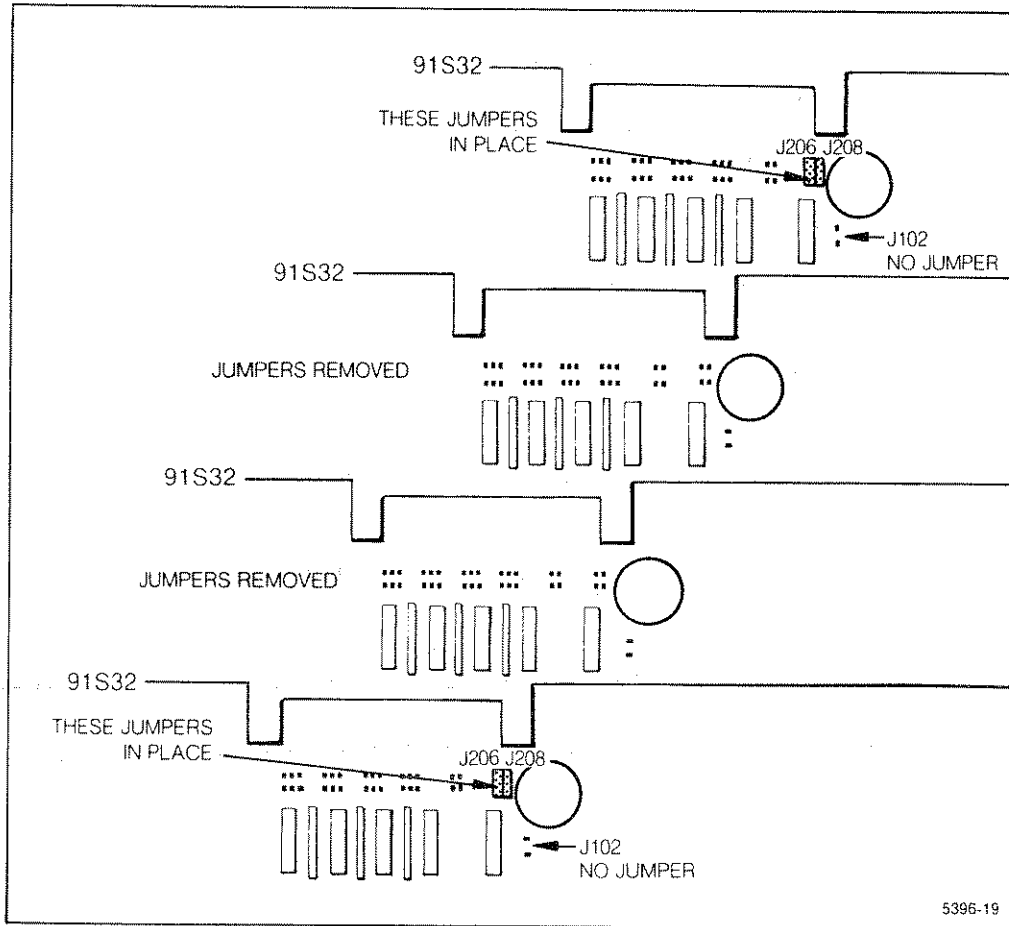


Figure 9. Terminator configuration for stand alone 91S32s.

MODULE INSTALLATION

The following paragraphs assume you are already familiar with the procedures for removing the mainframe top panel and cover, and with the procedures for installing modules into the mainframe bus slots. If you are not familiar with these procedures, refer to the *Operating Instructions* section of the *DAS 9100 Series Operator's Manual*.

Do not remove or install a 91S16 or 91S32 module until you have read the following warnings, cautions, and configuration requirements.

WARNING

When installing or removing instrument modules, the operator may gain access to the mainframe's module compartment only. Unless you are a qualified service technician, do not open any other compartments within the mainframe. Other compartments contain hazardous voltages.

CAUTION

When modules are being installed, the mainframe should be turned off and unplugged from its power source. Damage to the module's circuitry may occur if the module is installed while the mainframe is receiving power.

Installing a Module into the DAS

Figure 10 illustrates the location of a module in the mainframe. Refer to the figure while reading the following instructions.

CAUTION

If a 91S16 or 91S32 module is installed in a slot that is not supplied by the 22 amp 5 volt power supply, the module may not function correctly due to current overload.

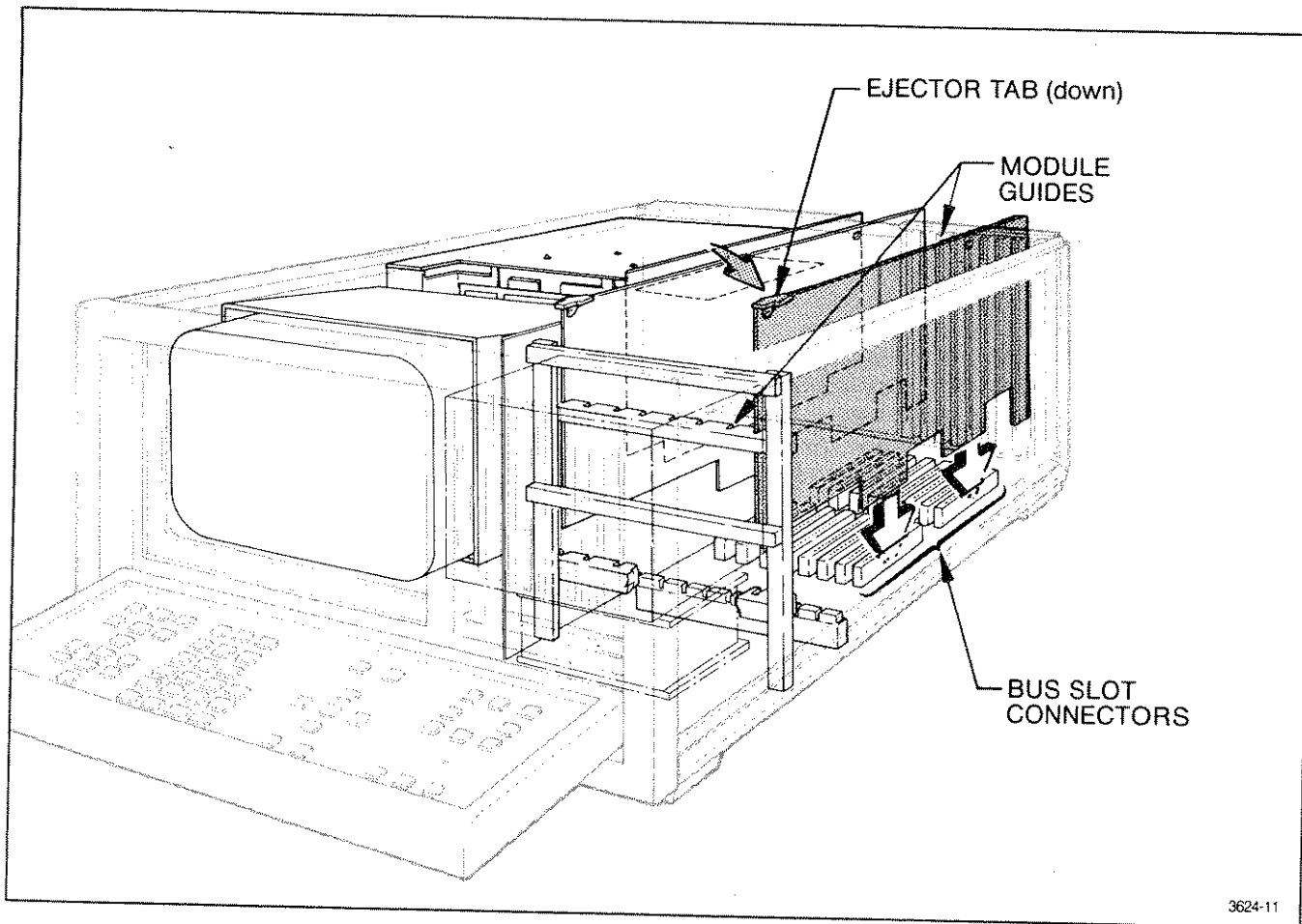
As long as all DAS bus slots are supplied by the 22 amp +5 V power supply, there are no power-related slot restrictions.

- Be sure power is off and the power cord is unplugged before attempting to install a module.
- Refer to *Section 2: Operating Instructions* in the *DAS 9100 Series Service Manual* (p/n 062-5848-00) for instructions on removing the mainframe top panel and module compartment cover.

CAUTION

The module may be damaged if it is installed or removed while the mainframe is receiving power.

1. Remove the mainframe top panel and module compartment cover. *Do not remove the power supply cover.*
2. Position the module over the selected bus slot, with the yellow ejector tab toward the front of the mainframe. Make sure this tab is parallel to the module.
3. Insert the module between the guide slots at the top of the mainframe. This procedure is easiest if you align the module with the rear guide first.
4. Slide the module down through the slots until its connectors rest on top of the bus slot connectors on the interconnect board.
5. Push the module down into the bus slot connectors. Press firmly on the board but do not press on components.



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Figure 10. Installing an instrument module in the mainframe.

Installing the Interconnect Cable

Each 91S32 is shipped with a six-connector interconnect cable. This cable distributes the clock signal from the 91S16, or from the 91S32 nearest the Trigger/Time Base module, to the rest of the 91S32s installed in the DAS. It also distributes the vector RAM address to the 91S32s when operating in Follows 91S16 mode.

You must cut any unnecessary connector blocks off of your interconnect cable or system performance will be degraded. Use a sharp razor blade to trim the unneeded cable and connector blocks off. Make your cut as close to the last needed connector block as possible. Do not leave any frayed ends.

To install the interconnect cable, simply align the connector blocks with the card edge connectors on the top of each 91S16 and 91S32 module, and press the connector blocks firmly in place. When seated, the top of the connector blocks should be roughly level with the top of the circuit boards. The red line on the interconnect cable should face toward the back of the DAS mainframe.

CONNECTING THE PATTERN GENERATOR PROBES

The 91S16 and 91S32 Pattern Generator modules use both pattern generator probes (to output signals) and an external control probe (to acquire external clock, inhibit, pause, etc.). The P6464 Pattern Generator probe supplies the pattern to the system under test for both 91S16 and 91S32 modules. The external control probe acquires external clock, interrupt, pause, (etc.) signals from an external device and provides them to the pattern generator. There are two different external control probes; one used when a 91S16 is installed in the DAS, and a different probe for when only 91S32s are present.

The 91S16 uses a P6460 Data Acquisition probe as an external control probe. This optional probe is referred to as the P6460 External Control Probe in this addendum. Any time a 91S16 module is installed in the DAS, the P6460 serves as the external control probe. The 91S16 also has two miniature phono connectors on the back of the module for EXT START (external start) and TRIG OUT (trigger-out) signals.

If only 91S32s are installed in the DAS, the P6452 Data Acquisition Probe attached to the DAS Trigger/Time Base module serves as the external control probe. This DAS standard accessory probe is referred to as the P6452 External Clock Probe in this addendum.

Specifications for the P6464 and P6460 probes can be found in the *Specifications* section of this addendum. Specifications for the P6452 probe can be found in the *DAS 9100 Series Operator's Manual*.

Connecting P6464 Pattern Generator Probes

The P6464 can be used with either 91S16 or 91S32 Pattern Generator modules. The 91S16 has three pod connector locations (from top to bottom: A, B, and C). The first two locations can accommodate one P6464 TTL/ECL Pattern Generator Probe each. The bottom connector is for the optional P6460 Data Acquisition Probe. The 91S32 has four pod connector locations (from top to bottom: A, B, C, and D). All four locations accommodate one P6464 each.

When connecting a probe to a module, first find the bus slot where that module is installed. Once you have identified the correct bus slot, look through the back-panel opening and locate the pod connectors.

WARNING

Refer to Figure 11 when connecting P6464 podlets. Podlets, when stacked close together, can heat-up and cause burns if touched by the operator. To prevent overheating, turn off the test circuit or disconnect the P6464 red sense lead when not in use.

Treat the podlets as high frequency components when connecting to the test circuit.

CAUTION

Turn the DAS power off before connecting or disconnecting a probe. Failure to power-down the DAS may result in damage to the pattern generator module.

NOTE

When connecting probes to a module with more than one pod connector, it is easiest to connect the first probe to the bottom connector and then work up.

NOTE

If you inadvertently connect an acquisition probe to a pattern generator pod (or vice versa) on the 91S16 or 91S32, the DAS will not notify you of this error. Damage will not occur to the probe.

Refer to Figure 11 when reading the following paragraphs.

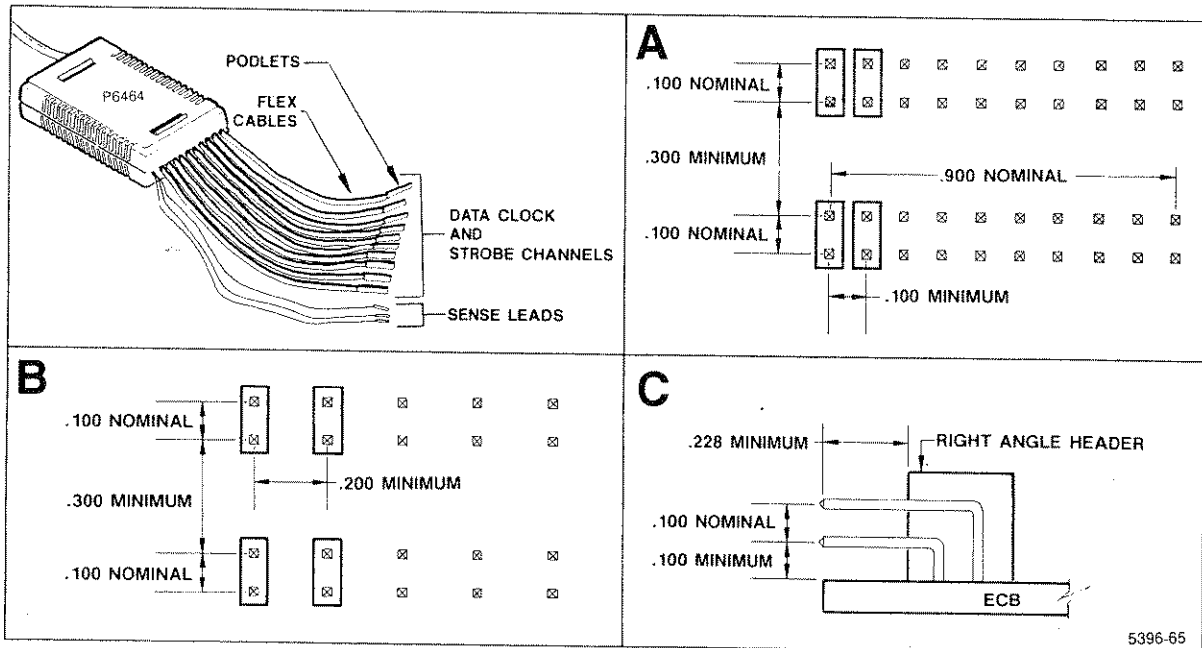


Figure 11. P6464 Pattern Generator Probe and Minimum Square-Pin Spacing. View A; With Fan. View B; Without Fan. View C; 90-Degree Square Pins.

The stimulus output of the P6464 probe consists of eight data channels, one clock line, and one strobe line. Each output consists of an active pin driver (podlet) at the end of an individual flex cable. The podlets are designed to slip over .025 inch square pins on your circuit. The square pins should be on 0.10 inch centers nominal. The square pins must be at least .228 inches long and the end the podlet slips over must be tapered. Use gold-plated pins to prevent corrosion within the podlet connectors.

Figure 11 shows minimum square-pin spacings for three different configurations.

- View A shows minimum square-pin spacing on a circuit *with a fan*. You can have up to ten (maximum) pairs of pins side-by-side in a group. The centers between pairs of square pins are 0.15 inch minimum between the sides of adjacent pairs and 0.30 inch minimum between the ends of adjacent pairs. The minimum recommended fan is 20 cubic feet per minute. The fan dissipates the heat generated by closely-stacked podlets and increases reliability.
- View B shows minimum square pin-spacing on a circuit *without a fan*. The centers between pairs of square pins are 0.20 inch minimum between the sides of adjacent pairs and 0.30 inch minimum between the ends of adjacent pairs.
- Use View C on a circuit *with 90-degree square pins* in conjunction with either of the other two view's spacings. The lower 90-degree square pin must be 0.10 inch minimum off the circuit board.

If your circuit does not have square pins, use the grabber tips and lead sets that are provided. One end of each lead set plugs into the podlet and the other ends slip inside the grabber tips.

The P6464 receives power from your circuit through three sense leads connected to the front on the probe. The red lead (VH) is connected to the higher voltage, the black (VL) lead is connected to the lower voltage, and the green lead is connected to ground. VH must be connected to a power source of -0.5 V to $+5.5$ V. VL must be connected to a power source of $+0.3$ V to -5.5 V. However, the difference between VH and VL must be 4.8 to 5.2 V.

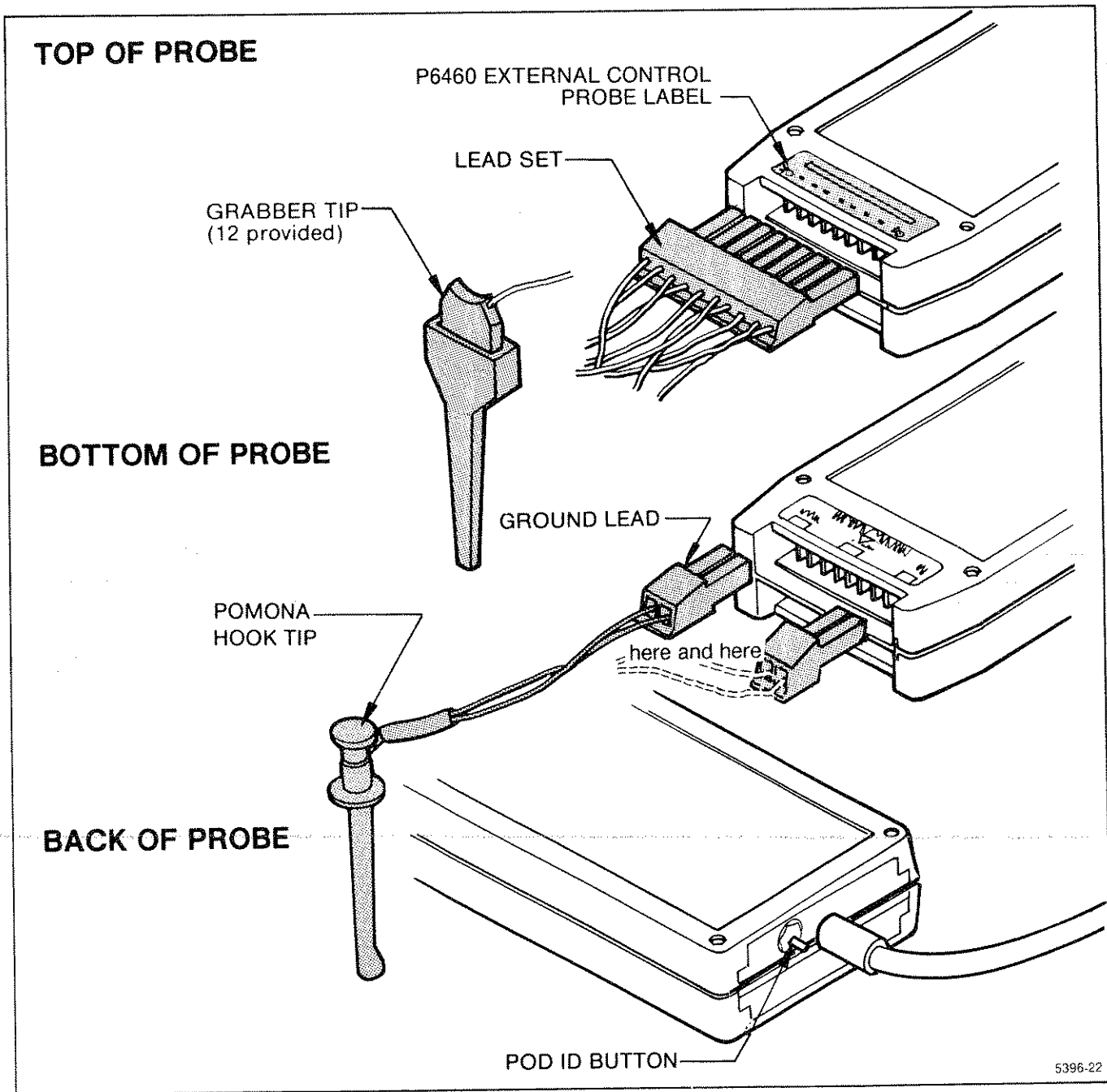


Figure 12. P6460 External Control Probe.

Connecting the P6460 External Control Probe to the 91S16

The P6460 External Control Probe should be connected to Pod C of the 91S16 Pattern Generator module. If you connect this probe to the wrong pod connector, the DAS will not indicate an error; however, no damage will occur.

The optional P6460 External Control Probe used with the 91S16 Pattern Generator module is the same probe labeled P6460 Data Acquisition Probe used with the 91A24 and 91AE24 Data Acquisition Modules. For our purposes, attach the self-adhesive "P6460 EXTERNAL CONTROL PROBE" label supplied with the 91S16 module. This label should be applied directly over the existing label on the top of the probe.

Figure 12 illustrates the various elements and features of the P6460 probe. Refer to this figure when reading the following paragraphs.

Probe Leads and Tips. Each P6460 probe is supplied with a 10-inch lead set and a package of 12 probe tips (grabber type). Figure 12 shows the connection of leads and tips.

Connect the lead set to the probe, making sure that the set's white lead is on the side of the probe housing labeled CK (clock). Push the lead set's connector into the probe housing. To disconnect the lead set, pull on its connector; do not pull on the leads.



Ground Lead Connections. Also provided with each P6460 are two 5-inch ground sense leads with Pomona Hook tips, and two alligator-clip lead tips. Plug both sets of ground leads into the probe housing's connectors labeled USERS GND as shown in Figure 12.

The middle GND connector, labeled Δ , should only be used when the diagnostic lead set is connected to the probe.

Maximum Non-Destructive Input Voltage. The maximum input voltage which may be used with the P6460 probe is ± 40 V peak.



Probe circuitry may be damaged if the P6460 is connected to a voltage source greater than ± 40 V peak.

Connecting the EXT START and TRIG OUT Phono Connectors to the 91S16

The 91S16 has two miniature phono connectors below the probe connectors on the back of the module. The top phono jack (J180) outputs the external trigger (TRIG OUT) signal to some external device (typically an oscilloscope). Use the optional 2-meter phono-to-BNC connector cable for this purpose.

The bottom miniature phono jack (J160) receives the external start signal. Typically, you will use the 9-inch phono-to-phono cable to connect the output of an acquisition module to this external start input jack.

Connecting the P6452 External Clock Probe to the Trigger/Time Base Module (91S32 Stand Alone)

Instructions for connecting the P6452 External Clock Probe to the DAS Trigger/Time Base module can be found in the *Operating Instructions* section of the *DAS 9100 Series Operator's Manual*. The P6452 probe can be used as the external signal source for the 91S32 Pattern Generator modules in stand alone configuration; the optional P6460 probe serves as the external control probe whenever a 91S16 is installed in the DAS.

To connect a probe to any DAS module:

1. Once you have identified the correct pod connector, grasp the probe's cable holder.
2. Align the cable connector with a square-pin pod connector. Be sure the raised tab on the cable holder is facing towards bus slot 0, and is aligned with the opening on the pod connector.
3. Gently push the cable connector onto the pod connector. Do not force the connection.

Figure 13 demonstrates probe connection procedures.

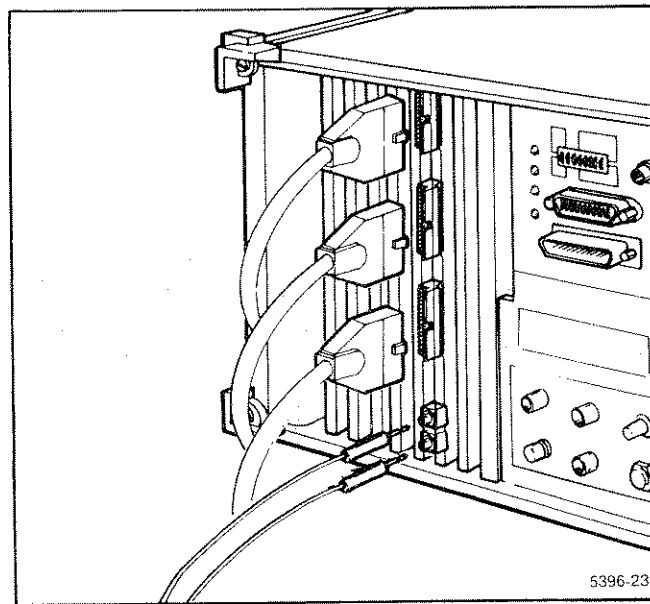


Figure 13. Installing a probe to a pod connector.

To remove a probe from a pod connector, firmly grasp the cable connector and gently pull straight out; do not pull on the cable itself.

OPERATOR'S CHECKOUT PROCEDURE

When the DAS mainframe is powered up, all installed 91S16 and 91S32 modules will appear on the power-up configuration display. PASS or FAIL notations appear next to each module to show the results of that module's power-up testing. Table 14 lists and defines the power-up error conditions for 91S16 and 91S32 modules.

Table 14
POWER-UP ERROR CONDITIONS

Error Condition	Definition
91S16 Pattern Generator Module FAIL	<p>The 91S16 module has failed the power-up test. The module will not operate properly. Refer the 91S16 module with probes to qualified service personnel.</p> <p>This failure does not affect the operation of any installed data acquisition module. If the 91S16 is being used to control 91S32s, the 91S32s may also be disabled by a failure in the 91S16.</p>
91S32 Pattern Generator Module FAIL	<p>The 91S32 module has failed the power-up test. The module will not operate properly. Refer the 91S32 module and its probes to qualified service personnel.</p> <p>Make sure the interconnect cable is attached before the DAS is turned on, otherwise the 91S32s will fail diagnostics.</p> <p>If multiple 91S32's fail on power-up, it is probably because:</p> <ol style="list-style-type: none"> 1. The interconnect cable is not properly attached. 2. There may be a broken line in the interconnect cable. 3. The terminating jumpers on the 91S32s have not been properly set. <p>If there is only one 91S32 failure when multiple 91S32s are installed, refer that 91S32 for service. Adjust the remaining modules so that there are no empty slots between modules.</p>

91S16 CONFIGURATION SUB-MENU FIELDS AND VALUES

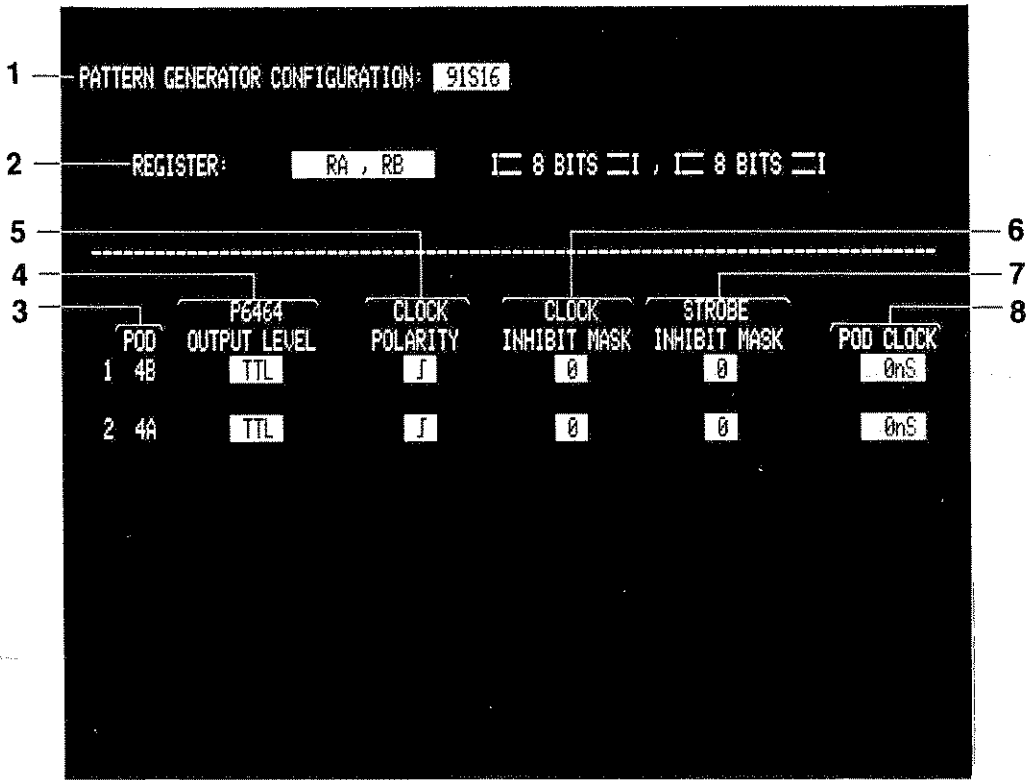
NOTE

The 91S16 Configuration sub-menu appears only when a 91S16 module is installed in the DAS.

The following paragraphs explain how to use the 91S16 Configuration sub-menu to set up the 91S16 Pattern Generator module. They discuss each menu field and explain the optional values.

Figure 14 illustrates the 91S16 Configuration sub-menu and its fields. The field names, which appear in reverse video on the screen, are bracketed [] throughout the text. Use the four directional cursor keys and the NEXT key to move the blinking screen cursor from one field to another.

Refer to the numbered callouts in Figure 14 when reading the following paragraphs. These numbers serve as visual references and do not imply sequence of use.



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Figure 14. 91S16 Configuration sub-menu.

Pattern Download From Host Feature. For information about downloading programs and vectors from a host computer to the 91S16 module, see the section of this addendum titled *GPIB Programming* . If you are using 91S16 and 91S32 modules together, also see the paragraphs titled *Pattern Download From Host* in the *91S32 Configuration Sub-Menu When Used With 91S16* section of this addendum.

1 PATTERN GENERATOR CONFIGURATION Field

The field directly to the right of the menu title is used to select either the 91S16 Configuration sub-menu or the 91S32 Configuration sub-menu.

NOTE

When a 91S16 is installed with one or more 91S32s, the 91S32 Configuration menu has some fields that are not displayed when only 91S32s are installed in the DAS. If you are using both 91S16 and 91S32 Pattern Generator modules, you will need to enter parameters in both the 91S16 Configuration sub-menu and the 91S32 Configuration sub-menu.

When a 91S16 is installed in the DAS, the 91S16 Configuration sub-menu will be displayed as the default menu. Press the SELECT key when the screen cursor is in this field in order to view the 91S32 Configuration sub-menu. (The 91S32 Configuration sub-menu is only available if there is at least one 91S32 installed in the DAS.)

2 REGISTER Field

The REGISTER field is used to select the configuration of the 91S16's internal register. This register can be used as an incrementing or decrementing counter for program loops or to supply an alternate source of pattern for some program line.

The 91S16 internal register at power-up is configured to be two 8-bit registers named RA and RB, however you can use the REGISTER field to select a single 16-bit register named R. When RA and RB are concatenated into register R, RB bits become the high-order bits of R, and RA bits become the low-order bits of R.

NOTE

If you have selected the register to be two 8-bit registers, only instructions relating to RB and RA will be displayed. If you have selected the internal register to be "R," a single 16-bit register, only instructions relating to R will be displayed in any of the 91S16 menus; no instructions relating to RB or RA will be displayed. If you have programmed any instructions that use the register in one configuration, you cannot select the other register configuration until you have deleted those instructions from the program.

To select the 91S16 internal register's configuration:

1. Move the screen cursor to the REGISTER field.
2. Press the SELECT key until the desired value appears in the field.

3 POD Heading

The POD heading is used to display the name of the pods associated with the 91S16's data probes. The DAS employs a numbering scheme using bus slot numbers to identify specific circuit boards and letters to identify specific probes attached to each circuit board.

Each P6464 Pattern Generator probe and P6460 External Control Probe is connected to a specific socket on the back of the 91S16 card referred to as a pod connector. The name of each pod connector is called the pod I.D. (pod identification).

A pod I.D. consists of a number and a letter. The number corresponds to the DAS slot number where the 91S16 card resides. The letter refers to the pod on that particular 91S16. For instance, a pod labeled 6B would correspond to the second pod on the 91S16 installed in DAS slot 6.

In the case of the 91S16, Pod A and Pod B are reserved for P6464 Pattern Generator Probes; Pod C is reserved for the optional P6460 External Control Probe.

4 P6464 OUTPUT LEVEL Field

The P6464 OUTPUT LEVEL field is used to select the output level for the P6464 Pattern Generator Probe. This probe outputs the data, strobe, and clock to a circuit/device under test. The P6464 Probe has two output levels, TTL and ECL. You can select the output levels for each pod independently.

To select the output level for the P6464 probe:

1. Move the screen cursor to the P6464 OUTPUT LEVEL field.

```
P6464
OUTPUT LEVEL
[TTL]
```

2. Press the SELECT key until the desired output level appears in the field.

```
[ECL]
```

5 CLOCK POLARITY Field

The CLOCK POLARITY field is used to specify whether the clock supplied to the device under test is a rising edge signal or a falling edge signal at the start of each cycle. Each pod has its own clock line, and you can set the clock edge for each pod independently. At power-up, all the clocks are set to rising edge signals.

To specify the clock's edge:

1. Move the screen cursor to the CLOCK POLARITY field.

```
CLOCK
POLARITY
[ ]
```

2. Press the SELECT key until the desired value appears in the field.

The DAS displays optional values in this order:

```
[ ]
[L ]
```

6 CLOCK INHIBIT MASK Field

The CLOCK INHIBIT MASK field is used to specify whether or not the clock output responds to the inhibit signal. If the CLOCK INHIBIT MASK field is set to 0 (unmasked), the clock signal for that data pod will be tri-stated whenever the inhibit signal is asserted. If the CLOCK INHIBIT MASK field is set to 1 (masked), the clock signal for that particular pod will continue to be output even if the inhibit signal is asserted. The default value for this field is 0 (unmasked).

To set the CLOCK INHIBIT MASK Field:

1. Move the screen cursor to the CLOCK INHIBIT MASK field:

CLOCK
INHIBIT MASK
[0]

2. Use the data entry keys to enter a 1 (masked).

CLOCK
INHIBIT MASK
[1]

7 STROBE INHIBIT MASK Field

The STROBE INHIBIT MASK field is used to specify whether or not the strobe output responds to the inhibit signal. If the STROBE INHIBIT MASK field is set to 0 (unmasked), that particular pod's strobe line will be tri-stated whenever the inhibit signal is asserted. If the STROBE INHIBIT MASK field is set to 1 (masked), that pod's strobe line will not be tri-stated, even if the inhibit signal is asserted. The default value for this field is 0 (unmasked).

To specify the strobe inhibit mask:

1. Move the screen cursor to the STROBE INHIBIT MASK field.

STROBE
INHIBIT MASK
[0]

2. Use the data entry keys to enter a 1 .

[1]

8 POD CLOCK Field

The POD CLOCK field is used to select the pod clock delay relative to the start of the pattern generator cycle. This feature allows you to adjust the timing of one pod relative to another. You could set one pod to output its data and clock signal 5 ns before the main clock edge, and set another pod to output data 5 ns after the main clock edge. The timing difference between the two pods would then be 10 ns.

Use the INCR or DECR keys to select a pod clock delay value. You can set each pod individually to output its data, strobe, and clock signals up to 5 ns before or 5 ns after the pattern generator clock edge. This field adjusts timing in 5 ns increments. The default value for this field is 0 ns.

Note: If you are running the 91S16 with 91S32s at 50 MHz, there are some restrictions on the pod clock delay value. Refer to the Timing sub-menu description for details.

To increase or decrease the POD CLOCK delay:

1. Move the screen cursor to the POD CLOCK field.

POD CLOCK
[0nS]

2. Use the INCR key to increase the delay value, or the DECR key to decrease it. The DAS displays the delay values in this order:

[-5nS]
[0nS]
[+5nS]

91S32 STAND ALONE CONFIGURATION SUB-MENU FIELDS AND VALUES

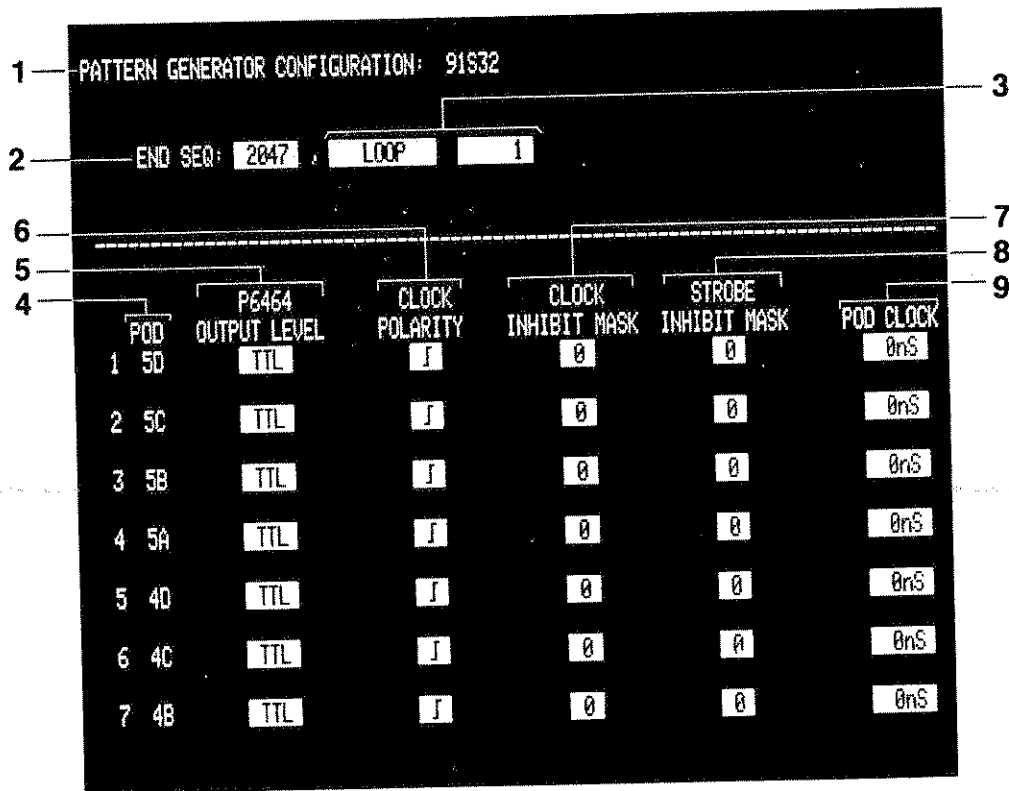
NOTE

The 91S32 Configuration menu is available only when 91S32 Modules are installed in the DAS. A slightly different version of the 91S32 Configuration sub-menu is displayed if both 91S16 and 91S32 Pattern Generator modules are installed in the DAS at the same time. See the section of this addendum titled 91S32 Configuration Sub-Menu When Used With 91S16 if you are using both types of pattern generator modules together.

The following paragraphs explain how you can use the 91S32 Configuration sub-menu to set up the pattern generator. Each sub-menu field is described and its optional values explained.

Figure 15 illustrates the 91S32 Configuration sub-menu and its fields. The fields, which appear in reverse video on the screen, are bracketed [] throughout the text. The four directional cursor keys and the NEXT key can be used to move the blinking screen cursor from one field to another.

Refer to the numbered callouts in Figure 15 when reading the following paragraphs. These numbers serve as visual references and do not imply sequence of use.



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Figure 15. 91S32 Stand Alone Configuration sub-menu.

Pattern Download From Host Feature. 91S32 modules can use the static device version of the Pattern Download From Host feature (91S16 optional). This feature allows you to download extensive programs into the pattern generator from a GPIB controller. Refer to the *GPIB Programming* section of this manual for details. You should also read the paragraphs titled *Pattern Download From Host* in the *91S32 Configuration Sub-Menu When Used With 91S16* section of this addendum.

1 PATTERN GENERATOR CONFIGURATION Field

This field (directly to the right of the menu title) indicates the title of the 91S32 Configuration sub-menu. The 91S32 Configuration sub-menu is the only option available when 91S32s are the only pattern generator modules installed in the DAS.

NOTE

If you are using a 91S16 with 91S32s, this field will default to the 91S16 Configuration sub-menu. See the section of this addendum titled 91S32 Configuration Sub-Menu When Used With 91S16.

2 END SEQ Field

The 91S32 pattern generator normally executes all the sequence lines in memory and then automatically restarts from the beginning. However, not all patterns require the full 2047 lines of available memory. This field allows you to specify some smaller number to reset pattern execution to the first sequence. This number can be any value between 0 and 2047 (ASEQ) or A 0 and B 1023 (RSEQ).

The 91S32 modules will repeatedly execute the program entered between the number in the START SEQ: field of the 91S32 Program: Run sub-menu (usually SEQ 0) and the sequence number specified in the END SEQ field.

The default value for the END SEQ field is END SEQ 2047. Note that this field will display END SEQ 2047 if you have set the SEQ field to ASEQ (absolute sequence) in the 91S32 Run sub-menu. If you have set the SEQ field to RSEQ (relative sequence), the allowable range will be Page A, 0 through 1023, and Page B, 0 through 1023. See the 91S32 Program: Run sub-menu section SEQ field description for details about the ASEQ and RSEQ options.

To specify the END SEQ:

1. Move the screen cursor to the END SEQ field.

END SEQ [2047]

2. Use the data entry keys to enter the END SEQ number. For example, to enter sequence number 500:

END SEQ [500]

3 LOOP Field

This field is used to specify the 91S32 operating mode. There are two possible selections for this field: LOOP and FREE RUN. The 91S32 normally executes all the sequence lines entered into memory starting with sequence 0 and running through to the sequence number specified in the END SEQ field, or until the end of memory if no END SEQ value has been specified. The pattern generator will execute this program repeatedly until you press the STOP key. This is called FREE RUN mode.

If you only want the pattern generator to loop through its program a certain number of times and then stop, select LOOP. Loop mode displays a special LOOP field where you can enter the number of times you want the pattern generator to execute its program. Maximum value for this field is 65535.

To select FREE RUN or LOOP mode:

1. Move the screen cursor to the field immediately to the right of the END SEQ field:

```
END SEQ [2047] [ LOOP ] [ 1]
```

2. Press the SELECT key until the desired value appears in the field.

```
END SEQ [2047] [ LOOP ] [ 1]
                [FREE RUN]
```

To enter a value for the [LOOP] field:

1. Move the screen cursor to the field immediately to the right of the LOOP field.
2. Use the data entry keys to enter the number of times you want the pattern generator to execute its program. For example, to run through the loop 1000 times, and then stop, enter 1000:

```
END SEQ [2047] [ LOOP ] [1000]
```

4 POD Heading

The POD heading is used to display the number of 91S32 boards installed in the DAS and the name of each data pod available. A POD refers to the specific connector on the back of the 91S32 where a P6464 probe is connected.

The name of each pod is referred to as pod I.D. (pod identification). A pod I.D. consists of a number and a letter. The number corresponds to the DAS slot number where that particular 91S32 card resides. The letter refers to the pod on that particular 91S32. For instance, a pod labeled 6C would correspond to the third pod on the 91S32 installed in DAS slot 6.

5 P6464 OUTPUT LEVEL Field

The P6464 OUTPUT LEVEL field is used to select the output level for the P6464 Pattern Generator Probe. This probe outputs the data, strobe, and clock to a circuit/device under test. The P6464 Probe has two output levels, TTL and ECL. You can select the output levels for each pod independently.

To select the output level for the P6464 Probe:

1. Move the screen cursor to the P6464 OUTPUT LEVEL field.

P6464
OUTPUT LEVEL
[TTL]

2. Press the SELECT key until the desired output level appears in the field.

[ECL]

6 CLOCK POLARITY Field

The CLOCK POLARITY field is used to specify whether the clock supplied to the device under test is a rising edge signal or a falling edge signal at the start of each cycle. Each pod has its own clock line, and you can set the clock edge for each pod individually. In default, all the clocks are set to rising edge signals.

To specify the clock's edge:

1. Move the screen cursor to the CLOCK POLARITY field.

CLOCK
POLARITY
[]

2. Press the SELECT key until the desired value appears in the field.

The DAS displays optional values in this order:

[]
[]

7 CLOCK INHIBIT MASK Field

The CLOCK INHIBIT MASK field is used to specify whether or not the clock output responds to the inhibit signal. If the CLOCK INHIBIT MASK field is set to 0 (unmasked), the clock signal for that data pod will be tri-stated whenever the inhibit signal is asserted. If the CLOCK INHIBIT MASK field is set to 1 (masked), the clock signal for that particular pod continues to be output even if the inhibit signal is asserted. The default value for this field is 0 (unmasked).

To set the CLOCK INHIBIT MASK Field:

1. Move the screen cursor to the CLOCK INHIBIT MASK field.

CLOCK
INHIBIT MASK
[0]

2. Use the data entry keys to enter a 1 (masked).

[1]

8 STROBE INHIBIT MASK Field

The STROBE INHIBIT MASK field is used to specify whether or not the strobe output responds to the inhibit signal. If the STROBE INHIBIT MASK field is set to 0 (unmasked), that particular pod's strobe line will be tri-stated whenever the inhibit signal is asserted. If the STROBE INHIBIT MASK field is set to 1 (masked), that pod's strobe line will never be tri-stated, even if the inhibit signal is asserted. The default value for this field is 0 (unmasked).

To specify the strobe inhibit mask:

1. Move the screen cursor to the STROBE INHIBIT MASK field.

```
STROBE
INHIBIT MASK
  [0]
```

2. Use the data entry keys to enter a 1 (masked).

```
[1]
```

9 POD CLOCK Field

The POD CLOCK field selects the pod clock delay value relative to the start of the pattern generator cycle. This feature allows you to adjust the timing of one pod relative to another. You could set one pod to output its data and clock signal 5 ns before the main clock edge, and set another pod to output data 5 ns after the main clock edge. The timing difference between the two pods would then be 10 ns.

Use the INCR or DECR keys to select a pod clock delay value. You can set each pod individually to output its data, strobe, and clock signals up to 5 ns before or 5 ns after the pattern generator clock edge. This field adjusts timing only in 5 ns increments. The default value for this field is 0 ns.

Note: If you have selected a clock rate of 50 MHz., all pod clock values must be set to 0 ns.

To increase or decrease the POD CLOCK delay:

1. Move the screen cursor to the POD CLOCK field.

```
POD CLOCK
  [ 0 nS]
```

2. Use the INCR key to increase the delay value, or the DECR key to decrease it. The DAS will display the delay values in the following order:

```
[-5 nS]
[ 0 nS]
[+5 nS]
```


91S32 CONFIGURATION SUB-MENU WHEN USED WITH 91S16

NOTE

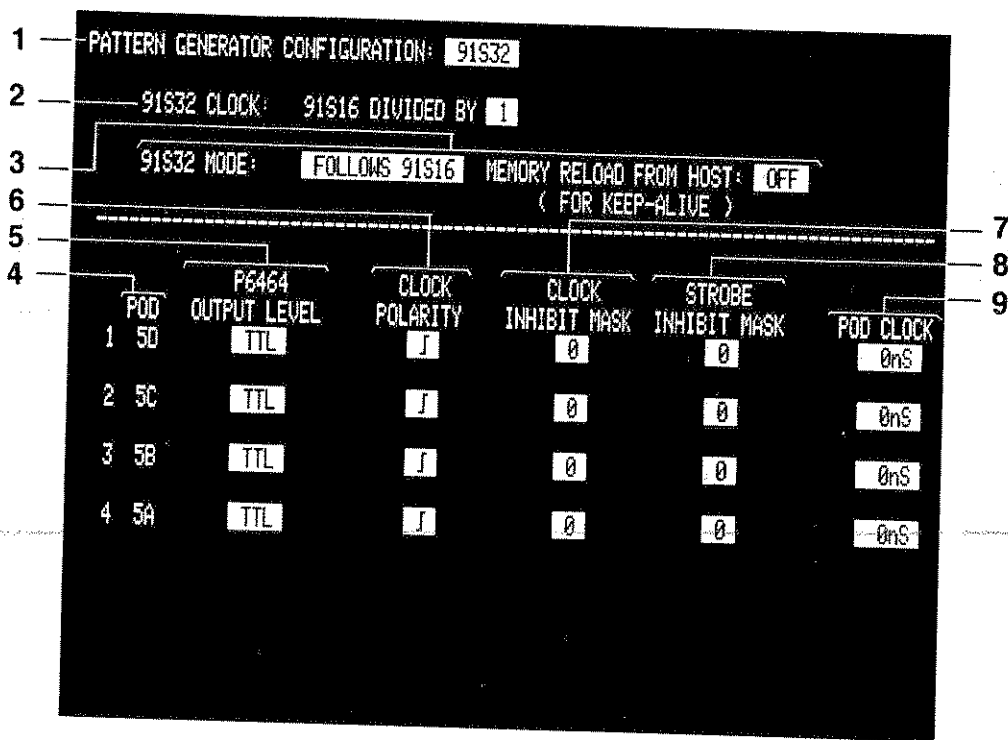
This version of the 91S32 Configuration sub-menu only appears when both 91S16 and 91S32 modules are installed in the DAS at the same time.

The following paragraphs explain how to use the 91S32 Configuration sub-menu when both 91S16 and 91S32 pattern generator modules are installed in the DAS. Refer to the preceding sub-section titled *91S32 Stand-Alone Configuration Sub-Menu* if you do not have a 91S16 installed.

Figure 16 illustrates the 91S32 Configuration sub-menu as it appears when both 91S16 and 91S32 modules are installed. There are several small differences between this sub-menu and the 91S32 Configuration sub-menu that appears when only 91S32s are installed; most of these differences are concerned with Follows 91S16 mode and the keep-alive feature.

Fields that appear in reverse video on the DAS screen are bracketed [] throughout the text. Use the four directional cursor keys and the NEXT key to move the blinking cursor from one field to another.

Refer to the numbered callouts in Figure 16 when reading the following paragraphs. These numbers are visual references only and do not imply sequence of use.



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Figure 16. 91S32 Configuration sub-menu when used with 91S16.

1 PATTERN GENERATOR CONFIGURATION Field

This field (directly to the right of the menu title) is used to select either the 91S16 or the 91S32 Configuration sub-menu display. If only 91S32s are installed, a slightly different version of the 91S32 Configuration sub-menu will be displayed; this version of the sub-menu is described in a separate section titled *91S32 Stand-Alone Configuration Sub-Menu*.

If both 91S16 and 91S32 modules are installed, the 91S16 Configuration sub-menu will be displayed first; the 91S32 Configuration sub-menu will only be displayed if you press the SELECT key when the screen cursor is in this field. Pressing SELECT repeatedly causes the DAS to alternately display the 91S16 and 91S32 Configuration sub-menus.

To alternately display the 91S16 or 91S32 Configuration sub-menus:

1. Move the screen cursor to the field directly to the right of the menu title.

PATTERN GENERATOR CONFIGURATION: [91S16]

2. Press the SELECT key until the 91S32 Configuration sub-menu appears in the field.

PATTERN GENERATOR CONFIGURATION: [91S32]

3. Press SELECT again if you want to return to the 91S16 Configuration sub-menu.

2 91S32 CLOCK Field

NOTE

The 91S32 CLOCK field will only appear if a 91S16 is installed in the DAS. If no 91S16 is installed, the 91S32's clock rate is set in the Timing sub-menu.

When 91S32 modules are used with a 91S16 module, the 91S32 modules receive their system clock from the 91S16 module. The 91S32 modules usually operate at the same clock rate as the 91S16 module, but they can be operated at one-half or one-fourth the clock rate of the 91S16.

For example, if you enter a 2 in the 91S32 CLOCK field, you can then program the 91S16 clock to run at 50 MHz (programmed in the Timing sub-menu) and the 91S32 modules will run at 25 MHz.

Even at slower clock rates, you may find it convenient to run the 91S16 faster than the 91S32s. The default divisor is 1.

Note: There are some pod clock delay restrictions when operating 91S16 and 91S32 modules at 50 MHz. Refer to the Timing sub-menu.

To change the clock divisor for the 91S32 modules:

1. Move the screen cursor to the 91S32 CLOCK field.

91S32 CLOCK: 91S16 CLOCK DIVIDED BY [1]

2. Press the INCR key to increase the divisor value or the DECR key to decrease the value. The DAS will display increasing divisor values in a 1-2-4 sequence. For example, to change the divisor to 2, press the INCR key once.

91S32 CLOCK: 91S16 CLOCK DIVIDED BY [2]

NOTE

The 91S16 and 91S32 combination can not run faster than 25 MHz (40 ns). If you program the 91S16 to run at 50 MHz and set the 91S32 CLOCK field to 91S16 DIVIDED BY 1, the 91S32 modules may not work properly.

3 91S32 MODE Field

The 91S32 module has two operating modes when used with a 91S16 module: Follows 91S16 mode and Sequential mode. Follows 91S16 mode is the default mode.

FOLLOWS 91S16 Mode and the MEMORY RELOAD FROM HOST Field

In Follows 91S16 mode, the 91S32s receive both its clock and vector-memory addresses from the 91S16 module via the interconnect cable. In this mode, when the 91S16 program executes a jump from SEQ 100 to SEQ 50, the 91S32s will also jump from SEQ 100 to SEQ 50. The 91S32s follow the sequence flow instructions programmed in the 91S16.

In Follows 91S16 mode the 91S32's memory is divided into two 1024-vector pages called Page A and Page B. Each memory page matches the 1024-vector depth of the 91S16's memory. When the pattern generator is started, the 91S16 outputs its 1024-vector pattern while the 91S32s output the pattern in Page A. When the 91S16 reaches an INCR PAGE (Increment Page) command, it instructs the 91S32s to switch to Page B. (Note: Pattern Download From Host does not use the INCR PAGE command to switch between Page A and Page B.)

Pattern Download From Host

Follows 91S16 mode also provides a Pattern Download From Host feature that allows you to reload the 91S32's vector memory from a host computer or mass storage device while the pattern generator is running. The Pattern Reload From Host feature allows you to use a pattern longer than 2047 lines. It also enables you to develop a pattern generator program on a host computer and enter it into the DAS remotely.

NOTE

In order to use the Pattern Download From Host feature, the DAS must be connected to a host computer using General Purpose Interface Bus (GPIB) connections and protocols. Instructions for making these connections and formatting the data to be downloaded to the pattern generator cards can be found in the section of this addendum titled GPIB Programming, the DAS Option 06: I/O Communication Interface Operator's Manual Addendum, and in Section 12: GPIB Programming in the DAS 9100 Series Operator's Manual.

There are two versions of Pattern Download From Host. Pattern Download For Static Devices can be used with either a 91S16, 91S32s, or a combination of the two. Pattern Download For Dynamic Devices (Keep-Alive) requires a 91S16 and at least one 91S32 module.

Pattern Download For Static Devices. This version of the Pattern Download feature can be implemented using DAS Option 02 or DAS Option 06 (GPIB commands via the GPIB or RS-232 interfaces). Using Pattern Download For Static Devices, the pattern generator outputs all its vectors, maintains the last vector at the probe tips while the next block of vectors is downloaded from the host computer, and then resumes outputting vectors. This process can be repeated until the entire program has been executed.

Pattern Download For Dynamic Devices (Keep-Alive). This version of the Pattern Download feature provides some clock and vector output during the interval when the 91S32's memory is being reloaded. Pattern Download For Dynamic Devices is only available when using the Option 06 HSPAT command over the GPIB interface. You must have a 91S16 and at least one 91S32 installed, and the pattern generator clock rate is limited to 25 MHz.

Some types of circuitry require constant clock and data inputs. Pattern Download For Static Devices, described above, does not provide any circuit stimulation while the host computer is downloading the next block of vectors. For static circuit elements this is not a problem; the device under test can just wait for the next block of vectors to finish being reloaded. But for dynamic circuit elements (such as dynamic RAMs), some clock and vector input is necessary to keep the device active while the reload process is being completed. The 91S16/32 Pattern Generator modules provide a feature called Keep-Alive to stimulate the circuit until the other page of memory is ready.

In order to use the Keep-Alive feature, you must set the MEMORY RELOAD FROM HOST (FOR KEEP-ALIVE) Field to ON.

NOTE

Selecting ON in the MEMORY RELOAD FROM HOST (FOR KEEP-ALIVE) field is only valid if you are using DAS 9100 Option 6: Fast GPIB Programming to perform memory reload. This field enables some instructions in the 91S16 Program: Run sub-menu that are only valid using Option 6 GPIB. See the GPIB of this addendum for detailed instructions about using Keep-Alive. Reloading the 91S32 memory from a host is possible via RS-232 or slow GPIB when this field is set to OFF, but the Keep-Alive feature will not be available.

Keep-Alive is basically a subroutine programmed into the 91S16 that outputs a limited number of vectors to the device under test while frequently testing to see if the memory reload operation has been completed:

Following 91S16 control, the 91S32s execute one 1024-line page of vectors while reloading the other page. However, it takes longer to reload a page of vectors than it does to execute a page of vectors. The Keep-Alive sub-routine programmed into the 91S16 provides some circuit stimulation while the 91S32 reload process is being completed. The 91S16 is programmed with instructions that test if the other page of memory has been reloaded. If the other page has been reloaded, the 91S16 instructs the 91S32s to switch execution to the newly refilled memory page; if the other page has not been reloaded, the 91S16 loops back through its sub-routine and the pattern generator continues to output some vectors.

An example of a Keep-Alive routine is provided in the GPIB section of this addendum.

SEQUENTIAL Mode and the END SEQ Field

When 91S32s are in Sequential mode with a 91S16, the two types of modules are clocked together but execute their programs independently. Pattern generation begins with the lowest numbered sequence line specified in the 91S32 Program: Run sub-menu (usually SEQ 0) and progresses sequentially until reaching the sequence number specified in the END SEQ field. Program execution in the 91S32 modules is not affected by branching instructions executed by the 91S16 program. For example, if the 91S16 is programmed to jump from SEQ 100 to SEQ 50, the 91S32s will not jump, but continue to execute their program sequentially at SEQ 101.

While 91S32s in Sequential mode are not affected by 91S16 branch instructions, they are affected by 91S16 halt and pause conditions since the 91S16 provides the clock to the 91S32 modules.

The END SEQ field allows you to specify a sequence line number smaller than Page B SEQ 1023 as the last line in your pattern generator program. The END SEQ field only appears when Sequential mode has been selected.

The advantage of Sequential mode is that you can program the 91S16 to perform conditional branching and loops while allowing the 91S32s to supply the usual sequential patterns. One example of this kind of application occurs when you are using the 91S16 to provide addresses to some memory device while the 91S32s supply the test vectors.

The default value for the END SEQ field is 2047. The numbering scheme for END SEQ field is dependent on whether you have selected ASEQ (absolute sequence) numbers or RSEQ (relative sequence) numbers in the 91S32 Program: Run sub-menu. If you have selected ASEQ in that sub-menu, the maximum allowable END SEQ field value is 2047. If you have selected RSEQ, the maximum allowable END SEQ field value is Page B 1023. The END SEQ field format will indicate which numbering scheme is being used.

To select either FOLLOWS 91S16 or SEQUENTIAL mode:

1. Move the screen cursor to the 91S32 MODE field.

91S32 MODE: [FOLLOWS 91S16] MEMORY RELOAD FROM HOST: [OFF]
(FOR KEEP-ALIVE)

2. Press the SELECT key until the desired mode appears in the field. The DAS will display the modes in this order:

[FOLLOWS 91S16]
[SEQUENTIAL]

NOTE

You cannot switch from FOLLOWS 91S16 mode to SEQUENTIAL mode if CALL RMT, IF FULL, or IF END instructions are programmed in the 91S16 Program: Run sub-menu, or if the MEMORY RELOAD FROM HOST (FOR KEEP-ALIVE) Field is set to ON.

To enable or disable the KEEP-ALIVE feature in FOLLOWS 91S16 mode:

1. Move the screen cursor to the 91S32 MODE field and select FOLLOWS 91S16 mode. Then move the cursor to the MEMORY RELOAD FROM HOST sub-field.

91S32 MODE: [FOLLOWS 91S16] MEMORY RELOAD FROM HOST: [OFF]
(FOR KEEP-ALIVE)

2. Press the SELECT key until the desired value appears in the field.

91S32 MODE: [FOLLOWS 91S16] MEMORY RELOAD FROM HOST: [ON]
(FOR KEEP-ALIVE)

To enter a value in the SEQUENTIAL mode END SEQ: sub-field:

1. Move the screen cursor to the 91S32 MODE field and select SEQUENTIAL mode. Then move the cursor to the END SEQ sub-field.

91S32 MODE: [SEQUENTIAL] END SEQ [2047]

2. Use the data entry keys to enter the END SEQ number. For example, enter 500:

91S32 MODE: [SEQUENTIAL] END SEQ [500]

4 POD Heading

The POD heading is used to display the number of 91S32 boards installed in the DAS and the names of each data pod available. A POD refers to the specific connector on the back of the 91S32 where a P6464 probe is connected.

The name of each pod is referred to as pod I.D. (pod identification). A pod I.D. consists of a number and a letter. The number corresponds to the DAS slot number where that particular 91S32 card resides. The letter refers to the pod on that particular 91S32. For instance, a pod labeled 6C would correspond to the third pod on the 91S32 installed in DAS slot 6.

5 P6464 OUTPUT LEVEL Field

The P6464 OUTPUT LEVEL Field is used to select the output level for the P6464 Pattern Generator Probe. This probe outputs the data, strobe, and clock to a circuit/device under test. The P6464 Probe has two output levels, TTL and ECL. You can select the output levels for each pod individually.

To select the output level for the P6464 Probe:

1. Move the screen cursor to the P6464 OUTPUT LEVEL field.

P6464
OUTPUT LEVEL
[TTL]

2. Press the SELECT key until the desired output level appears in the field.

[ECL]

6 CLOCK POLARITY Field

The CLOCK POLARITY field is used to specify whether the clock supplied to the device under test is a rising edge signal or a falling edge signal at the start of each cycle. Each pod has its own clock line, and you can set the clock edge for each pod individually. In default, all the clocks are set to rising edge signals.

To specify the clock's edge:

1. Move the screen cursor to the CLOCK POLARITY field.

```
CLOCK
POLARITY
[ ]
```

2. Press the SELECT key until the desired value appears in the field.

The DAS displays optional values in this order:

```
[ ]
[ ]
```

7 CLOCK INHIBIT MASK Field

The CLOCK INHIBIT MASK field is used to specify whether or not the clock output responds to the inhibit signal. If the CLOCK INHIBIT MASK field is set to 0 (unmasked), the clock signal for that data pod will be tri-stated whenever the inhibit signal is asserted. If the CLOCK INHIBIT MASK field is set to 1 (masked), the clock signal for that particular pod will continue to be output even if the inhibit signal is asserted. The default value for this field is 0 (unmasked).

To set the CLOCK INHIBIT MASK Field:

1. Move the screen cursor to the CLOCK INHIBIT MASK field:

```
CLOCK
INHIBIT MASK
[0]
```

2. Use the data entry keys to enter a 1 (masked).

```
CLOCK
INHIBIT MASK
[1]
```

8 STROBE INHIBIT MASK Field

The STROBE INHIBIT MASK field is used to specify whether or not the strobe output responds to the inhibit signal. If the STROBE INHIBIT MASK field is set to 0 (unmasked), that particular pod's strobe line will be tri-stated whenever the inhibit signal is asserted. If the STROBE INHIBIT MASK field is set to 1 (masked), that pod's strobe line will never be tri-stated, even if the inhibit signal is asserted. The default value for this field is 0 (unmasked).

To specify the strobe inhibit mask:

1. Move the screen cursor to the STROBE INHIBIT MASK field.

```
STROBE
INHIBIT MASK
[0]
```

2. Use the data entry keys to enter a 1 (masked).

```
STROBE
INHIBIT MASK
[1]
```

9 POD CLOCK Field

The POD CLOCK field is used to select the pod clock delay relative to the start of the pattern generator cycle. This feature allows you to adjust the timing of one pod relative to another. You could set one pod to output its data and clock signal 5 ns before the master clock edge, and set another pod to output data 5 ns after the master clock edge. The timing difference between the two pods would then be 10 ns.

Use the INCR or DECR keys to select a pod clock delay value. You can set each pod individually to output its data, strobe, and pod clock signals up to 5 ns before or 5 ns after the pattern generator master clock's selected edge. This field adjusts timing only in 5 ns increments. The default value for this field is 0 ns.

Note: When operating 91S16 and 91S32 modules together at 50 MHz, you must set all pod clock delay values to -5 ns.

To increase or decrease the POD CLOCK delay:

1. Move the screen cursor to the POD CLOCK field.

```
POD CLOCK
[ 0nS]
```

2. Use the INCR key to increase the delay value, or the DECR key to decrease it. The DAS displays the delay values in this order:

```
[-5nS]
[ 0nS ]
[+5nS]
```


91S16 PROBE SUB-MENU FIELDS AND VALUES

NOTE

The 91S16 Setup: Probe sub-menu appears only when the 91S16 Module is installed in the DAS.

The following paragraphs show how to use the 91S16 Setup: Probe sub-menu to set up the 91S16's P6460 External Control Probe. They discuss each menu field and explain all the optional values.

Figure 17 illustrates the 91S16 Setup: PROBE sub-menu and its fields. The fields, which appear in reverse video on the screen, are bracketed [] throughout the text. The four directional cursor keys and the NEXT key can be used to move the blinking screen cursor from one field to another.

Refer to the numbered callouts in Figure 17 when reading the following paragraphs. These numbers are intended to be a visual reference and do not imply sequence of use.

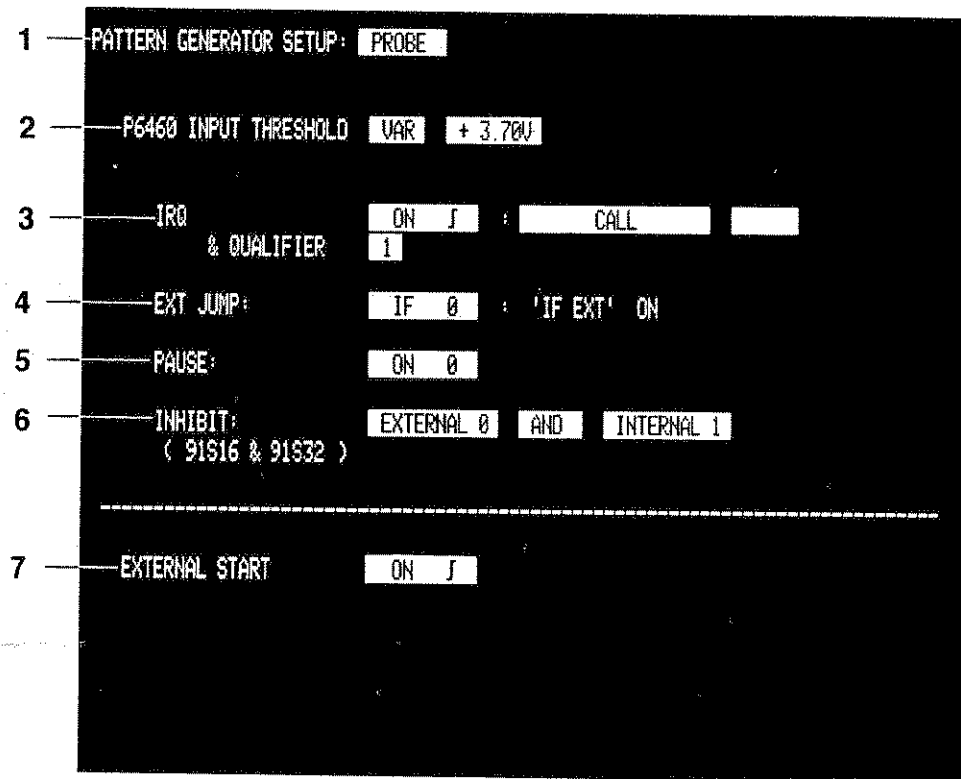


Figure 17. 91S16 Setup: Probe sub-menu.

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1 PATTERN GENERATOR SETUP Field

The field directly to the right of the menu title is used to select either the 91S16 Setup: PROBE or the 91S16 Setup: TIMING sub-menu display. In default, the 91S16 PROBE sub-menu is displayed whenever a 91S16 is installed in the DAS.

2 P6460 INPUT THRESHOLD Field

The P6460 INPUT THRESHOLD field is used to set the threshold level for the P6460 External Control Probe. This probe supplies the 91S16 pattern generator's external clock, interrupt request, interrupt request qualifier, external jump, pause, and external inhibit lines. In default, the INPUT THRESHOLD field is set to TTL + 1.40 V.

To change the INPUT THRESHOLD field from TTL to ECL or VAR (variable):

1. Move the screen cursor to the INPUT THRESHOLD field.
2. Press the SELECT key until the desired threshold level appears in the field. The DAS will display the optional values in this order:

```
[TTL] + 1.40 V
[VAR] [ + 3.70 V]
[ECL] - 1.30 V
```

When VAR has been selected, a new field appears to allow you to set the variable voltage level. The range for this field is between - 6.40 V and + 6.35 V in 50 mV increments. Use the INCR and DECR keys to set the value for this field.

3 IRQ Field AND QUALIFIER Field

The interrupt signal is supplied to the 91S16 module via the optional P6460 External Control Probe. This signal line must be connected to an external source. In order to use the interrupt signal to control the 91S16, you must abide by the following three rules:

1. For the internal interrupt to be true for a given clock cycle, the external interrupt signal must have a 15 ns set-up time relative to the selected edge of the external input clock. In other words, if you are running the 91S16 at 50 Mhz (20 ns clock cycles) the external interrupt signal must occur during the first 5 ns of the current clock cycle or else the interrupt will not be recognized until the next clock cycle.
2. The interrupt qualifier signal must stay true for 15 ns prior to the interrupt signal becoming active.
3. The interrupt mask must be set to 0 (unmasked).

The IRQ (Interrupt Request) field is divided into two parts. The first part specifies whether the interrupt is disabled or enabled. If it is enabled, another field appears which allows you to specify whether the interrupt will occur on the rising or falling edge of the external interrupt signal. The second part of the IRQ field specifies the mode the 91S16 uses to handle interrupts.

IRQ enabled, CALL <label> Mode and IF IRQ Mode

The 91S16 provides two modes for handling external interrupts. The options are CALL and IF IRQ. The first method uses a special interrupt servicing routine that suspends program execution when an interrupt is detected, executes a small subroutine, and then resumes program execution on the sequence line following the one where the interrupt was received. To use this method you will select CALL mode in the IRQ field.

The second method of handling interrupts allows you to program IF IRQ JUMP commands into specific program lines and transfer program flow without saving a return address. To use this method you will select IF IRQ mode in the IRQ field.

If you select CALL mode, you must enter the label for an interrupt service routine in the field next to CALL. You will then enter the same label name in a routine in the 91S16 Program: Run sub-menu. The last line of your servicing routine must contain the RETURN instruction to return program flow to the line following the one where the interrupt was detected.

The first sequence line of this routine must not contain a sequence flow instruction like JUMP or RETURN. If the first line does contain a sequence flow instruction, that instruction will be ignored.

If a second interrupt is detected while the pattern generator is performing an interrupt service routine, the second interrupt will be serviced after the first routine has been completed.

If you select IF IRQ mode, the IRQ line can be tested at convenient points in the pattern generator program by programming IF IRQ JUMP instructions in the 91S16 Program: Run sub-menu. In this mode, when an interrupt is detected, the pattern generator will automatically jump to another place in the program and continue executing sequence lines from that point. Different JUMP destinations can be programmed for each IF IRQ JUMP instruction programmed.

One advantage of the IF IRQ mode is that interrupts will only be serviced at convenient times. (Interrupt masking is possible with CALL mode too, by using the M column in the 91S16 Program: Run sub-menu. The disadvantage is that this method takes longer to program.)

NOTE

If you select CALL in the IRQ mode field, IF IRQ JUMP commands will not be available in the 91S16 Program: Run sub-menu. When in IF IRQ mode, the RETURN instruction will not be available in the Run sub-menu. If you have already programmed IF IRQ JUMP commands in the Run sub-menu, you can not change from IF IRQ to CALL mode in this menu. Similarly, if you have programmed the RETURN instruction in the Run sub-menu, you will not be able to change from CALL to IF IRQ mode in this menu. To change from one mode to the other, you will have to remove the mode-specific instructions from the 91S16 Program: Run sub-menu and then return to the Probe sub-menu to select the other mode.

NOTE

The 91S16 Pattern Generator Module automatically resets the interrupt line before beginning pattern execution. Therefore, if the IF IRQ instruction is programmed on the first line executed (usually SEQ 0) the interrupt-signal may not meet the required set-up and hold times necessary for the interrupt to be recognized for this clock cycle; the pattern generator may not jump from this sequence line.

NOTE

GPIB commands use hardware memory address, not labels, to control the pattern generator program flow. IRQ ENABLED CALL <label> mode reserves the first hardware memory location for the interrupt routine address, thereby shifting all program lines down one memory location. IRQ DISABLED and IRQ ENABLED IF IRQ mode do not reserve the first memory location. You must remember which IRQ mode is selected when programming jump addresses via GPIB. See the section of this addendum titled GPIB Programming for detailed information.

To enable an interrupt and select either the rising or falling edge:

1. Move the screen cursor to the IRQ field

IRQ [DISABLED]

2. Press the select key. The IRQ field will display a rising edge symbol.

[ON ⌋]

3. Press the SELECT key again to rotate through the list of optional values.

[DISABLED]
[ON ⌋]
[ON ⌌]

To specify either CALL or IF IRQ mode:

1. When the IRQ feature has been turned on, a new field appears to the right of the IRQ field. Move the screen cursor to this new field. The default value for this field is "IF IRQ" ENABLED".

IRQ [ON ⌋] ["IF IRQ" ENABLED]

2. Press the SELECT key until the desired mode appears in the field.

[ON ⌋] ["IF IRQ" ENABLED]
[CALL] []

CALL mode requires you to enter the label of the interrupt service routine in the new field to the right of CALL.

To enter the label value for CALL mode:

1. Move the screen cursor to the new field that appears to the right of CALL.
2. Use the data entry keys to enter the LABEL name. You must enter this same LABEL name in the 91S16 Program: Run sub-menu on the first line of the interrupt service routine. For example, you could call the interrupt service routine INTR.

IRQ [ON ⌋] [CALL] [INTR]

Interrupt Qualifier Field

When the IRQ field has been enabled, a new QUALIFIER field appears on the screen immediately below the IRQ field. This QUALIFIER field can be used to qualify whether or not the 91S16 responds to the interrupt request line.

The QUALIFIER signal is supplied via the P6460 External Control Probe. The interrupt qualifier signal must be connected to an external source for this feature to be available. You are not required to use the qualifier line in order to use the IRQ line. The QUALIFIER field defaults to DON'T CARE.

You can set the qualifier signal to be asserted for either high or low logic states. The QUALIFIER signal must have a 15 ns setup time relative to the selected edge of the IRQ signal. Hold time is 0 ns.

To set the QUALIFIER field's active state:

1. Move the screen cursor to the QUALIFIER field.

QUALIFIER [X]

2. Use the data entry keys to enter either a 1 (positive-true) or a 0 (negative-true) value into the field.

[1]

4 EXT JUMP Field

The EXT JUMP (External Jump) signal is tested by the IF EXT JUMP instruction which can be programmed in the 91S16 Program: Run sub-menu. The EXT JUMP field is used to select either positive-true (IF 1) or negative-true (IF 0) logic states for the external jump signal.

This signal is supplied via the optional P6460 External Control Probe. The EXT JUMP line must be connected to an external source. For the EXT JUMP signal to be asserted, it must have a 15 ns set-up time relative to the selected edge of the pattern generator clock. Hold time is 0 ns.

NOTE

The EXT JUMP field can not be disabled if you have programmed an IF EXT JUMP instruction in the 91S16 Program: Run sub-menu. To disable this field, you must first remove all IF EXT JUMP instructions.

To set the EXT JUMP active state:

1. Move the screen cursor to the EXT JUMP field.

EXT JUMP [DISABLED]

2. Press the SELECT key until the desired value appears in the field:

[IF 0]
[IF 1]

5 PAUSE Field

The PAUSE signal is used to freeze the output of the pattern generator in its present state. While the pause signal is active, all pattern generator data, clock and strobe lines maintain their current levels. The PAUSE field is used to specify whether a pause condition is asserted as either a positive-true or a negative-true input signal. In default, the PAUSE field is disabled.

The pause signal is supplied via the optional P6460 External Control Probe. This signal line must be connected to an external source. To be asserted, the pause signal must have a 15 ns setup time relative to the selected edge of the pattern generator clock. Hold time is 0 ns.

To set the PAUSE field to be either positive-true or negative-true:

1. Move the screen cursor to the PAUSE field.

PAUSE [DISABLED]

2. Press the SELECT key until the desired condition appears in the field:

[ON 0]
[ON 1]

6 INHIBIT (91S16 & 91S32) Field

The inhibit signal is used by both the 91S16 and 91S32 to selectively tri-state the outputs of the P6464 Pattern Generator probes. When the inhibit signal is asserted, any data line not masked by the INHIBIT MASK in the Program: Run sub-menu will be tri-stated.

The inhibit signal can be determined by logically combining the external inhibit line and the internal inhibit bit programmed in the Run sub-menu. You can choose to assert the inhibit signal as a simple reaction to either the internal inhibit bit, the external inhibit signal, or a combination of the two either ANDed or ORed together.

NOTE

The pattern generator will continue to execute its program even though an inhibit signal has been asserted. Some data may be output by the P6464 probes while an inhibit is asserted if those bits have been protected by the INHIBIT MASK in the Program: Run sub-menu.

The INHIBIT field is used to specify whether the internal and external inhibit signals are enabled on a positive-true (1) or negative-true (0) condition. Additional fields will appear when the INHIBIT field is enabled to allow you to combine the two inhibits using logical operators. In default, the INHIBIT field is disabled.

To set the asserted state for the internal and external inhibit signals:

1. Move the screen cursor to the INHIBIT field.

INHIBIT [DISABLED]

2. Press the SELECT key until the desired condition appears in the field:

[EXTERNAL 0] [ONLY]
 [EXTERNAL 1] [ONLY]
 [INTERNAL 0] [ONLY]
 [INTERNAL 1] [ONLY]

To select a logical relationship between the internal and external inhibits:

1. Move the screen cursor to the new field immediately to the right of the first condition field.
2. Press the SELECT key until the desired logical operator appears in the field.

INHIBIT [EXTERNAL 0] [ONLY]
 [AND] []
 [OR] []

3. A new field appears to the right of the logical operator field. This field allows you to set the asserted state for the other inhibit signal. Move the screen cursor to this new field and press select until the desired value you want appears in the field. For example:

[INTERNAL 0] [OR] [EXTERNAL 0]
 [EXTERNAL 1]

7 EXTERNAL START Field

The external start signal works like an external trigger. If the EXTERNAL START field has been set to ON and the START SYSTEM or START PAT GEN key has been pressed, the pattern generator will begin program execution when the external start signal is received.

The external start signal is supplied via the External Start Input phono connector located on the back of the 91S16 module. This is the bottom phono connector on the back of the circuit board. This connector must be connected to an external TTL-level signal source. To be asserted, the external start signal must have a 15 ns pulse width.

The EXTERNAL START field is used to enable the external start feature on either the rising or falling edge of the input signal. In default, the EXTERNAL START field is disabled.

To select either the rising or falling edge to enable the external start signal:

1. Move the screen cursor to the EXTERNAL START field.

EXTERNAL START [DISABLED]

2. Press the SELECT key until the desired value appears in the field.

[ON ⌋]
[ON ⌌]

91S32 PROBE SUB-MENU FIELDS AND VALUES

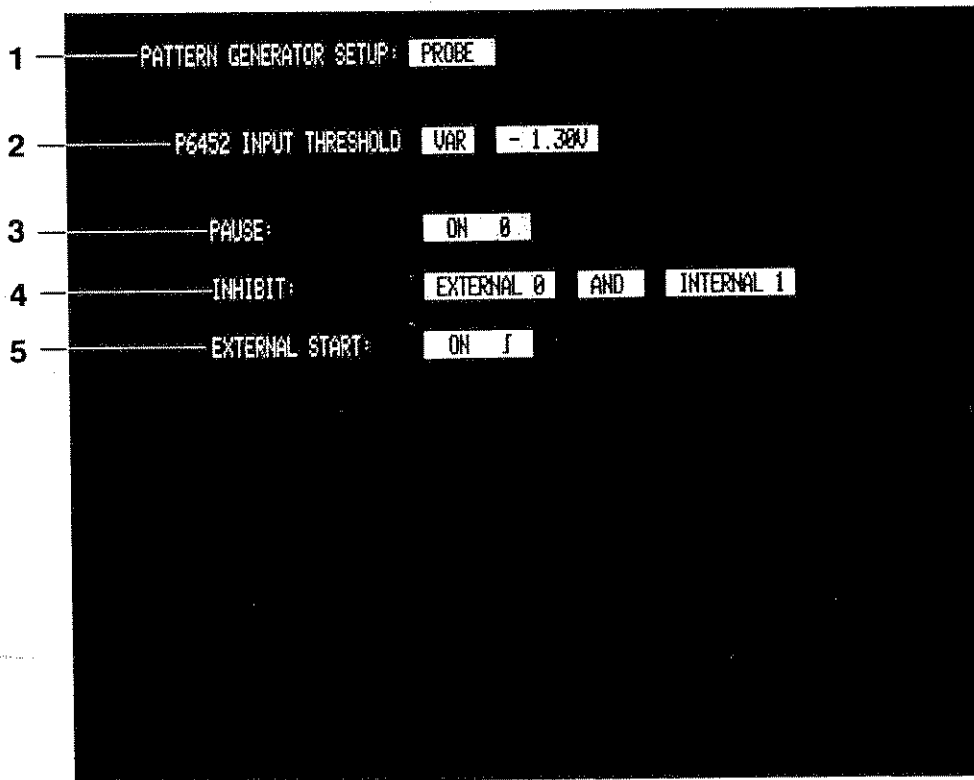
NOTE

The 91S32 Setup: Probe sub-menu will appear when 91S32 Modules are the only pattern generator cards installed. This menu will not appear if a 91S16 is installed.

The following paragraphs explain how you can use the Setup: Probe sub-menu to set up the P6452 External Clock (Data Acquisition) Probe when 91S32 modules are used without a 91S16 controller. (The P6452 probe connects to the DAS Trigger/Time Base module.) Each menu field is described and its optional values are explained.

Figure 18 illustrates the Probe sub-menu and its fields. The fields, which appear in reverse video on the screen, are bracketed [] throughout the text. The four directional cursor keys and the NEXT key can be used to move the blinking screen cursor from one field to another.

Refer to the numbered callouts in Figure 18 when reading the following paragraphs. These numbers serve as visual references and do not imply sequence of use.



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Figure 18. 91S32 Setup: Probe sub-menu.

1 PATTERN GENERATOR SETUP Field

Use this field (directly to the right of the menu title) to select either the Probe or the Timing sub-menu display. Refer to the description of sub-menu selections in the *Introduction to 91S16 and 91S32 Sub-Menus* section earlier in this addendum. The Probe sub-menu is the default display.

2 P6452 INPUT THRESHOLD Field

Use the P6452 INPUT THRESHOLD field to set the threshold level for the P6452 External Clock Probe. This probe supplies the pattern generator's external clock, pause, external inhibit, and external start signals.

NOTE

The P6452 External Clock Probe also supplies the external clock signal to the 91A32 Data Acquisition Modules. Therefore, any changes made to the probe's threshold in this menu will also affect the 91A32 external clock threshold. (Refer to the Trigger Specification Menu section of this manual.)

The P6452 External Clock Probe has a threshold-range switch. If this switch is set to NORM, the probe operates with a TTL/VAR threshold. If the switch is set to AUX, the probe operates with a MOS threshold. Once the probe switch has been set, the threshold field can be used to select the varying voltage levels for these thresholds.

If the probe is set to NORM, the threshold field defaults to TTL +1.40 V. This threshold can be changed to VAR (variable).

To change the P6452 INPUT THRESHOLD level field:

1. Move the screen cursor to the threshold field.

[TTL] +1.4 V

2. Press the SELECT key until the desired threshold level appears in the field.

The DAS displays optional threshold values in this order:

[TTL] +1.40 V
[VAR] [-1.30 V]

When VAR threshold is selected, a new field appears for setting the variable voltage level. The settings for this field range between +5.00 V and -2.50 V in 0.5 V increments. The voltage level may be changed by using the INCR and DECR keys.

If the P6452's threshold range switch has been set to AUX, the threshold field will show the MOS voltage range. This field may be set to a voltage level ranging between +20.00 V and -10.00 V in 0.20 V increments. Use the INCR and DECR keys to change the voltage level.

3 PAUSE Field

The pause signal is supplied via the P6452 External Clock Probe. This signal line must be connected to an external source. To be asserted, the pause signal must have a 19 ns set-up time and a 0 ns hold time (19 ns pulse width) relative to the selected edge of the clock.

The pause signal keeps the pattern generator outputs fixed at their last voltage states. While the pause line is enabled, all the pattern generator data and clock signals are held at their current levels.

The PAUSE field is used to specify whether a pause is enabled on a positive-true (1) or negative-true (0) condition. In default, the pause feature is disabled.

To set the PAUSE signal to be active-high (1) or active-low (0):

1. Move the screen cursor to the PAUSE field.

PAUSE [DISABLED]

2. Press the SELECT key until the desired condition appears in this field.

[DISABLED]

[ON 0]

[ON 1]

4 INHIBIT Field

The inhibit signal is generated by a logical operation of the internal and external inhibit signals. The internal inhibit signal can be programmed in the 91S32 Program Run sub-menu. The external inhibit signal line must be connected to an external source. Either inhibit signal can cause the pattern generator probes to be tri-stated.

NOTE

The pattern generator will continue to execute its program even though an inhibit signal has been asserted. Some data may be output by the P6464 probes while an inhibit is asserted if those bits have been protected by the INHIBIT MASK in the Program: Run sub-menu.

The INHIBIT field is used to specify whether the inhibit signals (internal and external) are enabled on a positive-true (1) or negative-true (0) transition. This field also allows you to select the logical operator combining the two inhibit signals. In default, the INHIBIT signal is disabled.

To set the INHIBIT field condition:

1. Move the screen cursor to the INHIBIT field.

INHIBIT [DISABLED]

2. Press the SELECT key until the desired condition appears in the field.

[EXTERNAL 0] [ONLY]

[EXTERNAL 1] [ONLY]

[INTERNAL 0] [ONLY]

[INTERNAL 1] [ONLY]

To select the logical operator:

1. Move the screen cursor to the field following the first inhibit selection.

```
[ EXTERNAL 0 ] [ONLY]
                [AND ] [   ]
                [ OR ] [   ]
```

2. Press the SELECT key until the desired logical operator appears in the field. For example, select OR:

```
[ INTERNAL 0 ] [OR] [EXTERNAL 0]
```

3. A new field appears to the right of the logical operator field. This field allows you to set the asserted state for the other inhibit signal. Move the screen cursor to this new field and press select until the desired value you want appears in the field. For example:

```
[ INTERNAL 0 ] [OR] [EXTERNAL 0]
                  [EXTERNAL 1]
```

5 EXTERNAL START Field

The external start signal is supplied by the P6452 External Clock Probe. This external start line must be connected to an external source. To be asserted, the external start signal must have a 19 ns minimum pulse width.

The external start signal works like an external trigger. If the EXTERNAL START field is set to enabled and the DAS START SYSTEM or START PAT GEN key has been pressed, the pattern generator will begin pattern execution when the external start signal is received.

The EXTERNAL START field is used to enable the external start feature on either the rising or falling edge of the input signal. In default, the EXTERNAL START feature is disabled.

To select either the rising or falling edge to enable the external start feature:

1. Move the screen cursor to the EXTERNAL START field.

```
EXTERNAL START: [DISABLED]
```

2. Press the SELECT key until the desired value appears in the field.

```
[ ON ⌈ ]
[ ON ⌋ ]
```

91S16 AND 91S32 TIMING SUB-MENU FIELDS AND VALUES

The following paragraphs explain how to use the Timing sub-menu to set up and adjust the 91S16 and 91S32 pattern generator pod and data channel timing relationships relative to the pattern generator master clock. Each menu field is described and all optional values are discussed.

Figure 19 illustrates the Timing sub-menu and its fields. The fields, which appear in reverse video on the screen, are bracketed [] throughout the text. The four directional cursor keys and the NEXT key can be used to move the blinking screen cursor from one field to another.

Refer to the numbered callouts in Figure 19 when reading the following paragraphs. These numbers serve as visual references and do not imply sequence of use.

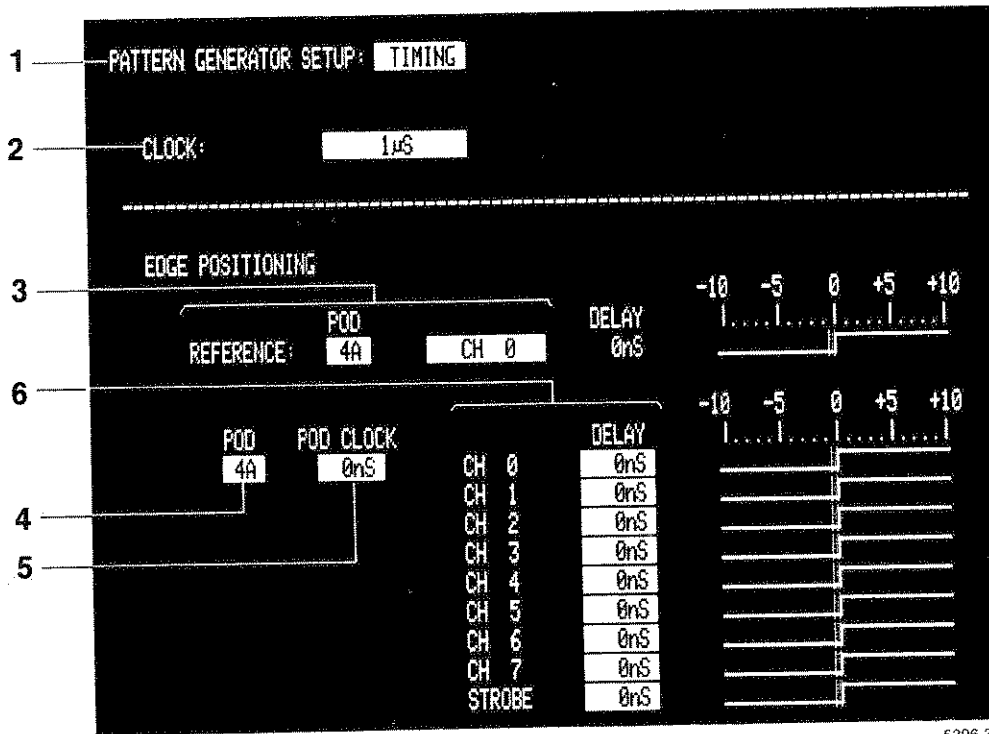


Figure 19. 91S16 and 91S32 Setup: Timing sub-menu.

1 PATTERN GENERATOR SETUP Field

The field directly to the right of the menu title is used to select either the Probe or the Timing sub-menu display. Refer to the *Introduction to 91S16 and 91S32 Sub-Menus* section earlier in this addendum. In default, the Probe sub-menu will be displayed.

To change the sub-menu to the TIMING sub-menu:

1. Move the screen cursor to the field directly to the right of the menu title.

PATTERN GENERATOR SETUP: [PROBE]

2. Press the SELECT key until the Timing sub-menu appears in the field:
[TIMING].

2 CLOCK Field

Use the CLOCK field to select the master input clock for the pattern generator. This clock is fed into the pattern generator (usually from the DAS Trigger/Time Base board) and is used to control the rate at which the pattern generator outputs clock and data signals to the circuit under test. The master clock can be supplied by an external clock source. In this case, the 91S16 External Clock signal is supplied via an optional P6460 External Control Probe. The External Clock signal, when only 91S32s are installed, is supplied via a P6452 External Clock Probe connected to the DAS Trigger/Time Base Module.

The CLOCK field optional settings depend on whether you are using just a 91S16, just 91S32s, or a combination of both. The optional values are as follows:

- 91S16 only
 - DAS internal clock, selections ranging from 5 ms through 20 ns
 - An external clock source: 50 MHz maximum (20 ns)
- 91S16 with 91S32s
 - DAS internal clock, selections ranging from 5 ms through 20 ns at 50 MHz. all pod clock delays must be set to -5 ns
 - An external clock source: 50 MHz. (20 ns)
- 91S32s only
 - DAS internal clock, selections ranging from 5 ms through 20 ns. at 50 MHz. all pod clock delays must be set to 0 ns
 - An external clock source can supply clocking signals between 5 ms and 40 ns.

NOTE

The DAS provides two internal clocks. These clocks are shared by the 91A32 and 91A08 data acquisition modules and the 91S16/32 pattern generator modules. Since it is possible to specify a different clock for each of these modules while only two are available, you must make sure that no more than two different clocks have been specified. Refer to the Start and Stop section of the DAS 9100 Series Operator's Manual for details.

The default CLOCK setting is the DAS internal clock, with an interval of $1 \mu\text{s}$. Use the INCR and DECR keys to increase or decrease the clock interval as needed.

To increase or decrease the internal clock rate:

1. Move the screen cursor to the CLOCK field.

CLOCK [1 μs]

2. Press the INCR key to increase the value or the DECR key to decrease the value.

The DAS will display increasing or decreasing clock values in a 1-2-5 sequence.

An external clock source can also be selected using this field. You can also specify either the rising or falling edge of the external clock signal. The external clock for the 91S16 is supplied via an optional P6460 External Control Probe connected to Pod C on the back of the 91S16 module. The external clock for 91S32s used without a 91S16 is supplied via the P6452 External Clock Probe attached to the DAS Trigger/Time Base Module.

When an external clock source is selected for the 91S16, the P6460 INPUT THRESHOLD level is displayed in the field following the CLOCK field for reference purposes.

To select an external clock source:

1. Move the screen cursor to the CLOCK field.

CLOCK [1 μ s]

2. Press the SELECT key until the desired clock value appears in the field.

The DAS will display the available clock values in this order:

[1 μ s]
 [EXTERNAL \uparrow]
 [EXTERNAL \downarrow]

3 REFERENCE Field

The REFERENCE field is used to select any data channel, strobe, or pod clock line you choose to use as a timing reference when programming the edge position of a particular pod's data and strobe channels.

The REFERENCE field is divided into two parts: POD, which specifies the pod I.D. for your reference channel; and the field following POD, which specifies a data channel, strobe, or pod clock line. The delay value of the reference signal relative to the pattern generator master clock is displayed in the DELAY field for your information; the value cannot be changed in this field. The delay value is also graphically represented as a positive-true signal for ease of comparison.

The default channel for the REFERENCE field is CH 0 of pod A anytime a 91S16 is installed. When only 91S32s are installed, the REFERENCE field default channel will be Channel 0 of pod A from the 91S32 installed in the highest-numbered DAS slot; for instance: CH 0, POD 6A.

To specify a different reference channel:

1. Move the screen cursor to the POD field.

POD
 REFERENCE [6A] [CH 0]

2. Use the data entry keys to enter any available pod I.D. For example, 5B.

[5B] [CH 0]

To select the data channel, strobe, or pod clock:

1. Move the screen cursor to the field following the POD field.

POD
 REFERENCE [6A] [CH 0]

2. Press the SELECT key until the desired reference channel appears in the field.

The DAS displays the data channels, strobe, and clock lines in this order:

```
[ CH 0 ]
[ CH 1 ]
[ CH 2 ]
[ CH 3 ]
[ CH 4 ]
[ CH 5 ]
[ CH 6 ]
[ CH 7 ]
[STROBE]
[POD CLOCK ]
```

4 POD Field

The POD field is used to specify the name of the pod you want displayed. Any available pod I.D. can be entered. The POD field defaults to either the 91S16 Pod A when a 91S16 is installed, or Pod A for the 91S32 in the highest-numbered DAS slot when only 91S32s are installed.

To select a pod for timing adjustment:

1. Move the screen cursor to the POD field.

```
POD
[6A]
```

2. Use the data entry keys to enter any available pod I.D. For example, enter 5B:

```
[5B]
```

5 POD CLOCK Field

The POD CLOCK field is used to adjust the timing of all the signals associated with this pod at one time. The adjustment is made in relation to the pattern generator's master clock. The master clock determines the start of each cycle.

Use the INCR or DECR keys to set the POD CLOCK delay value. The POD CLOCK delay value can be set ± 5 ns relative to the master clock. Each pod may have a different POD CLOCK delay value. In default, all the pod clocks have a delay value of 0 ns. The POD CLOCK delay values may also be changed in the Configuration sub-menu.

Remember that 91S32s operating at 50 MHz. with a 91S16 must have their pod clock delays set to -5 ns. 91S32s operating at 50 MHz. without a 91S16 must have their pod clock delays set to 0 ns.

To increase or decrease the POD CLOCK delay:

1. Move the screen cursor to the POD CLOCK field:

```
POD CLOCK
[ 0 nS ]
```

2. Use the INCR key to increase the delay value, or the DECR key to decrease it. The adjustment can be made in 5 ns intervals, displayed by the DAS in the following order:

```
[-5nS]
[ 0nS ]
[+5nS]
```

6 DELAY Field

The DELAY field is used to set the delay value for each of the data channels and the strobe lines relative to the pod clock. Each data channel and strobe line may have a different delay value. Use the INCR or DECR keys to adjust the delay value in 1 ns increments within a -5 ns to $+5$ ns range relative to the pod clock.

The DAS will display the total delay relative to the pattern generator's master clock for each channel (including the pod clock delay) in the DELAY field. The delay value for each data channel and the strobe line will be graphically represented as a rising edge in the timing diagram. In default, all the delay values are set to 0 ns.

NOTE

If you have used the Timing menu to adjust for pulse misalignment at the P6464 probe tips, the delay values and graphic representation of timing relationships shown in this menu will be misleading. You must remember to account for any data skew adjustments made via this menu. Alternatively, there is a deskew procedure using internal delay lines that will not affect the timing relationships shown in this menu; that procedure can be found in the DAS 9100 Series 91S16/32 Service Addendum (p/n 070-5397-00).

To increase or decrease the data channel and strobe delay:

1. Move the screen cursor to the DELAY field.

```
CH 0 [ 0nS]
CH 1 [ 0nS]
CH 2 [ 0nS]
CH 3 [ 0nS]
CH 4 [ 0nS]
CH 5 [ 0nS]
CH 6 [ 0nS]
CH 7 [ 0nS]
STROBE [ 0nS]
```

2. Use the INCR key to increase the delay value, or the DECR key to decrease it.

The delay value can be adjusted in 1 ns increments from -5 ns to $+5$ ns relative to the pod clock.

91S16 PROGRAM: RUN MODE SUB-MENU

NOTE

The 91S16 Program Run Mode sub-menu appears only when the 91S16 Module is installed.

The following paragraphs show how to use the 91S16 Program Run Mode sub-menu to enter instructions and patterns for the 91S16 Pattern Generator Module. They discuss each menu field and explain all optional values.

Figure 20 illustrates the 91S16 Pattern Generator Run Mode sub-menu and its fields. The fields, which appear in reverse video on the screen, are bracketed [] throughout the text. The four directional cursor keys and the NEXT key can be used to move the blinking screen cursor from one field to another.

Refer to the numbered callouts in figure 20 when reading the following paragraphs. These numbers serve as visual references and do not imply sequence of use.

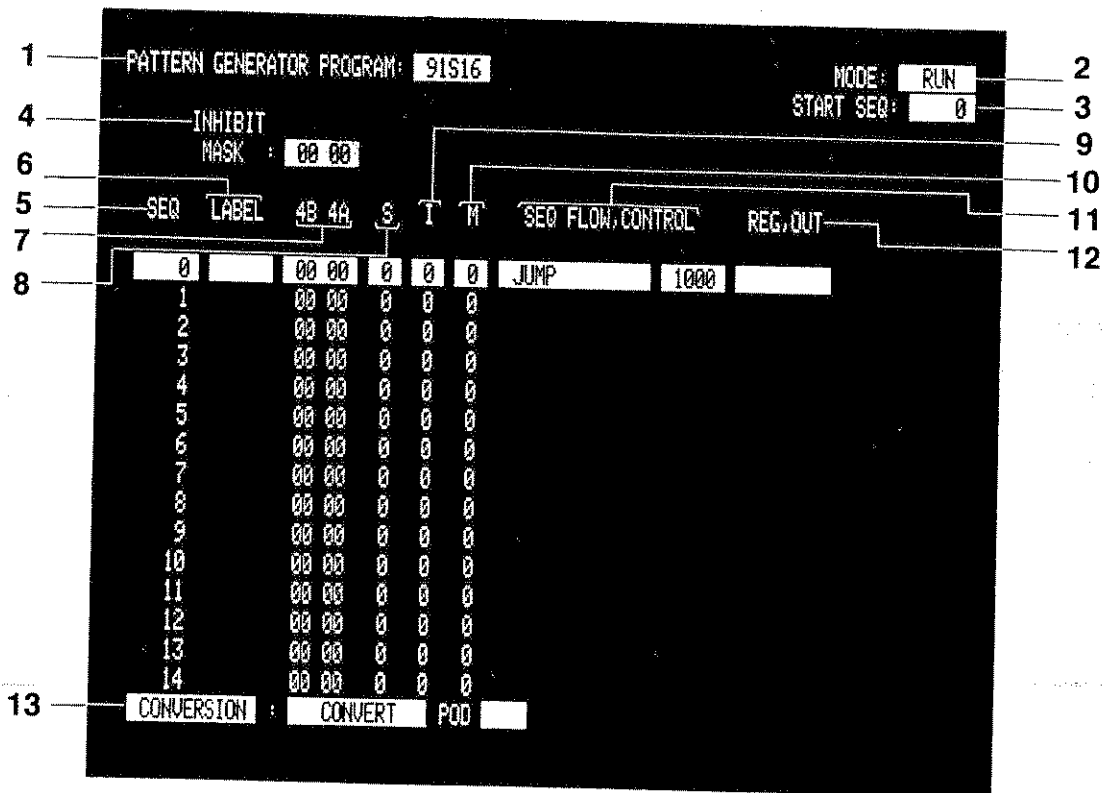


Figure 20. 91S16 Program: Run sub-menu.

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NOTE

In the following discussion, the 91S16 Module is assumed to reside in slot 4.

1 PATTERN GENERATOR PROGRAM Field

Use this field (directly to the right of the menu title) to select either the 91S16 or the 91S32 sub-menu display. Refer to the *Introduction to 91S16 and 91S32 Sub-Menus* section of this addendum. In default, the 91S16 Program: Run sub-menu is displayed whenever a 91S16 Module is installed in the DAS.

2 MODE Field

Use the MODE field to select the pattern generator's operating mode. The pattern generator normally outputs data in real-time, synchronously with the clock signal. This mode of operation is called Run mode, hence the name of this menu. For debugging purposes, the pattern generator can also output data at much slower rates, or even one step at a time. These modes of operation are called Trace and Step, and are described under the *Trace and Step Mode Sub-Menus* sections of this addendum. Descriptions of Trace and Step sub-menus are listed separately for the 91S16 and the 91S32.

Press the SELECT key while the screen cursor is in the MODE field to change between Run, Trace, and Step modes. The MODE field defaults to Run mode on power-up.

3 START SEQ Field

Use the START SEQ field to set the first sequence number the pattern generator will execute when the START PAT GEN key or the START SYSTEM key is pressed. The START SEQ field may be set to any number between 0 and 1023 as long as no interrupt service routine is programmed. If an interrupt service routine has been programmed, the START SEQ field can be set to any number between 0 and 1022.

To set the START SEQ field:

1. Move the screen cursor to the START SEQ field.

START SEQ: [0]

2. Use the data entry keys to enter the number of the sequence line where you want program execution to begin. For example, 500. The value you enter will appear in the field.

START SEQ: [500]

4 INHIBIT MASK Field

Use the INHIBIT MASK field to specify whether or not the data output channels respond to the inhibit (tri-state) signal. If the inhibit mask for a given data channel is set to 0 (unmasked), the data channel is tri-stated whenever the inhibit signal is asserted. If the inhibit mask is set to 1 (masked), then the inhibit signal is masked out and that data channel is not tri-stated, even though the inhibit signal has been asserted. The inhibit mask can be set for each individual data channel by specifying a value in the INHIBIT MASK field (default radix is hexadecimal). The default value for this field is 0, unmasked for all data channels.

To set the INHIBIT MASK field:

1. Move the screen cursor to the INHIBIT MASK field.

```
INHIBIT
  MASK : [00 00]
```

2. Use the data entry keys to specify the desired inhibit mask. The value you enter will appear in the field. The display radix of this field matches the radix you have selected for the data fields. This example shows hexadecimal values.

```
: [F0 A0]
```

5 SEQ (Sequence) Field

The SEQ field consists of a column of numbers on the left side of the display. Each number in this column corresponds to one program line. The program lines are displayed sequentially starting with SEQ 0. There is a total of 1024 sequence lines labeled 0-1023. Only a portion of these sequence lines are displayed at any given time.

Several methods are available to enable you to display different sequence lines. The first method is to use the scroll keys. These keys can be used at any time, and when the cursor is in any field.

To scroll through the sequence lines:

Press the up (↑) or down (↓) scroll key. Additional sequence lines will scroll up from the bottom or down from the top of the display.

The second method used to view different sequence lines is to enter the desired sequence number directly into the SEQ field. This method allows you to jump forward or backward and display specific blocks of sequence lines.

To move forward and display larger-numbered sequence lines:

1. Move the screen cursor to the sequence number you wish to change. For example, move the cursor to SEQ 11:

```
SEQ
[ 11]
```

2. Use the data entry keys to enter the first sequence number you wish to have displayed. For example, SEQ 200. The DAS will display [200] in place of [11], and then update the rest of the sequence lines following that position.

```
SEQ
  0
  1
  2
  3
  4
  5
  6
  7
  8
  9
 10
[ 200] SEQ 11 is changed to SEQ 200,
201    and the rest of the sequence
202    numbers are automatically updated
203    from that position through the
204    bottom line of the display.
205
```

NOTE

When using the above procedures, observe the following two rules. First, if the cursor is positioned below the top sequence number on the display, you cannot enter a number smaller than the number directly above the cursor location. Second, you cannot enter a number greater than 1023 (1022 if IRQ CALL is used).

To move backward to a smaller-numbered block of sequence lines:

1. Move the screen cursor to the SEQ field of the line where you want the smaller sequence number to be displayed. For example, SEQ 200.

```
SEQ
[ 200]
```

2. Press the DON'T CARE key.

The DAS will enter a 0 at this sequence number location.

NOTE

The number you enter must be larger than the number in the SEQ field immediately above the cursor location. Use the top field in the display if you want to view SEQ lines smaller than any currently displayed.

- Use the data entry keys to enter the sequence number you wish to display. For example, SEQ 15. The DAS will display 15 at that sequence number location, and then update the remaining sequence numbers on the screen from that position.

SEQ

0

1

2

3

4

5

6

7

8

9

10

[15] SEQ 200 is changed to SEQ 15

16 and the display is updated

17 from this position to the

18 bottom of the screen.

19

20

6 LABEL Field

Use the LABEL field for labeling specific program lines. These labels serve as destinations for three types of pattern generator instructions: JUMP, IF *<condition>* JUMP, and INTERRUPT CALL. (IF *<condition>* JUMP instructions include IF R=0, IF KEY, IF IRQ, etc.) All three of these instruction types transfer program flow to a line containing a specific label; they do not specify a destination according to a sequence line number.

You can assign a total of 15 labels in a 91S16 program. Each label may be up to four characters wide, and may include letters, numbers, and spaces.

To assign a label for a specific program line:

- Move the screen cursor to the LABEL field associated with that program line.

SEQ LABEL 4B 4A

[0] [] [00 00]

- Use the data entry keys to enter the label. For example, INIT. The DAS will display INIT in the LABEL field for that particular sequence line.

SEQ LABEL 4B 4A

[0] [INIT] [00 00]

To remove a label:

1. Move the screen cursor to the LABEL field you wish to remove.

```
SEQ LABEL 4B 4A
[ 0] [INIT] [00 00]
```

2. Press the DON'T CARE (X) key. The label will be deleted from the field.

```
SEQ LABEL 4B 4A
[ 0] [ ] [00 00]
```

7 #A and #B Pattern Fields

The A and B fields that appear on the menu are used to specify the data pattern you wish to output through the P6464 probes. The A field header designates the data pattern output through Pod A, and the B field header designates Pod B. The number that appears before the A and the B corresponds to the slot in the DAS where the 91S16 card resides.

Enter data patterns you wish to output line by line, one pod at a time. Use the DISPLAY editing command if you wish to change the radix of the data you are entering. The default radix is hexadecimal. Data patterns always default to 0.

See the *DISPLAY Editing Command* paragraphs later in this section for information about changing the display radix of the data columns and inhibit mask.

To enter data on any program line:

1. Move the screen cursor to the pattern field in the line you wish to program. Position the cursor under the label for the pod you wish to program.

```
SEQ LABEL 4B 4A
[ 0] [ ] [00 00]
```

2. Use the data entry keys to program the pattern you desire. The DAS will display the data values you have entered in the field and then shift the cursor one space to the right. For example, enter the value 30hex for Pod B.

```
SEQ LABEL 4B 4A
[ 0] [ ] [30 00]
```

3. Continue entering data values until both pods have been programmed. Then press the NEXT key to move the cursor to the first data field of the next line.

8 S (Strobe) Field

Use the S (Strobe) field to select whether or not the strobe channels associated with each pod will output signals when this particular program line is executed. Setting a 0 value for this field means that neither the Pod A nor the Pod B strobe will be output. Setting a 1hex means that only the Pod-A strobe is output. Setting a 2hex means only the Pod B strobe is output, while a 3hex means that both Pod A and Pod B strobes are output. You can program this field on a line-by-line basis, or you can use the FILL command to program whole blocks of sequence lines in one operation. See the *FILL Editing Command* paragraphs later in this section for details.

Strobe transitions are synchronous with the output clock. In default, the strobe field is set to 0 (no strobes).

To assert a strobe:

1. Move the screen cursor to the S field on the line you wish to program.

```

SEQ LABEL  4B 4A   S
[  0] [  ] [00 00] [0]

```

2. Use the data entry keys to enter the data value you desire. The 91S16 Strobe field contains 2 bits; the left bit corresponds to Pod B, and the right bit corresponds to Pod A. Default display radix is hexadecimal.

For example, to assert both the Pod A and Pod B strobes, enter a 3hex.

```

SEQ LABEL  4B 4A   S
[  0] [  ] [00 00] [3]

```

9 I (Inhibit) Field

Use the I (Inhibit) field to set the internal inhibit signal. It is used to temporarily tri-state the output of either Pod A or Pod B. (Tri-state is TTL-level high impedance, and ECL-level logical low.) The polarity of both the internal and external inhibit signals is programmable in the 91S16 Setup: Probe sub-menu. The probes can also be programmed to react to a logical combination of the internal and external inhibit signals. See the *91S16 Setup: Probe Sub-Menu* section in this manual.

For the following example, assume the following values have been set for the internal and external inhibits: External Inhibit 1 **OR** Internal Inhibit 1, positive-true signals.

Setting a 0 in the I (Inhibit) field means that neither pod is tri-stated and both pods will continue to output data, clock, and strobe lines. Setting a 1hex in this field will tri-state the outputs of Pod A. Setting a 2hex will tri-state the output of Pod B. Setting a 3hex will cause both Pod A and Pod B to be tri-stated.

Note that some data may still be output from a pod that has been tri-stated, because any value you set in the INHIBIT MASK field will cause specific data lines to ignore the inhibit signal.

You must set values for the I (Inhibit) field for every sequence line. The default value is 0 (no pods are tri-stated) and the default radix is hexadecimal. The internal inhibit signal becomes effective synchronously with the output clock.

To set an internal inhibit:

Move the screen cursor to the line you wish to program and position the cursor over the I field. Use the data entry keys to enter the appropriate value. For example, to assert the internal inhibits for both Pod A and Pod B, (with the Setup: Probe sub-menu INHIBIT field set to [INTERNAL 1]) enter a *3hex*.

```

SEQ LABEL  4B 4A      S   I
[  0] [  ] [00 00]  [0] [3]

```

10 M (Interrupt Mask) Field

Use the M (Interrupt Mask) field to mask out external interrupt signals received from the P6460 probe. Entering a 1 in the M field of a particular sequence line causes the pattern generator to ignore external interrupt signals during execution of that program line. This feature allows you to protect certain programming routines from being interrupted.

The M field must be set to 1 in each line you wish to protect. In default, the M field is set to 0 (unmasked).

To mask an interrupt:

Move the screen cursor to the M field in the line you wish to program. Use the data entry keys to enter a 1. The DAS will display a 1 in the M field.

```

SEQ LABEL  4B 4A      S   I   M
[  0] [  ] [00 00]  [0] [3] [1]

```

11 SEQ FLOW, CONTROL Fields

The SEQ FLOW and CONTROL fields displayed on the DAS screen correspond to the identically named keys grouped on the left-hand side of the DAS keyboard. SEQ FLOW (sequence flow) identifies a series of programming instructions that affect the order of sequence line execution (i.e., branching, conditional branching, and halt). Selecting a SEQ FLOW instruction may cause other fields to appear. The CONTROL key allows you to select instructions that control 91S32 pattern generator cards, or issue triggering cues to some external device. CONTROL instructions are optional and will appear in the same field as SEQ FLOW instructions.

There are five basic types of SEQ FLOW instructions and two CONTROL instructions. The default for both types of instruction is no operation, which means the SEQ FLOW, CONTROL field will be blank and the pattern generator will output its data and then advance to the next sequence line.

SEQ FLOW instructions include IF <condition> JUMP <label>, JUMP <label>, CALL RMT (call remote), RETURN, and HALT.

CONTROL instructions are INCR PAGE (increment page) and TRIGGER. INCR PAGE issues a command to 91S32s operating in Follows 91S16 mode (INCR PAGE is only available when the Memory Reload From Host field is set to OFF). TRIGGER causes a trigger signal to be output to some external device (e.g., an oscilloscope) via the trigger-out phono connector on the back of the 91S16 module.

NOTE

When entering SEQ FLOW and CONTROL instructions, position the screen cursor on any reverse-video field associated with the sequence line you wish to program.

To enter SEQ FLOW and CONTROL instructions on a sequence line:

1. Move the screen cursor to any field on the line you wish to program.
2. Press the SEQ FLOW or CONTROL key until the instruction you desire appears in the field. The DAS displays the SEQ FLOW instructions in the following order:

```
[HALT          ]
[JUMP          ][      ]
[IF RA=0 JUMP ][      ]
[IF RB=0 JUMP ][      ]
[IF R=0 JUMP  ][      ]
[IF IRQ JUMP   ][      ]
[IF EXT JUMP   ][      ]
[IF KEY JUMP   ][      ]
[IF FULL JUMP  ][      ]
[IF END JUMP   ][      ]
[RETURN        ]
[CALL RMT      ]
```

The DAS displays the optional CONTROL instructions in this order:

```
[TRIGGER      ]
[INCR PAGE    ]
```

To remove an instruction from a SEQ FLOW, CONTROL field:

Move the screen cursor to the SEQ FLOW, CONTROL field containing the instruction you wish to remove. For example, to remove the IF RA=0 instruction, place the screen cursor in the SEQ FLOW, CONTROL field and press the DON'T CARE key. The DAS will remove the instruction and leave the field blank.

To add a SEQ FLOW, CONTROL field to a sequence line:

1. Move the screen cursor to the SEQ FLOW, CONTROL field of the sequence line you wish to program.
2. Press the ADD LINE key on the DAS keyboard to add a new SEQ FLOW, CONTROL field. This will not add a new numbered sequence line; it simply creates space for you to program additional SEQ FLOW or CONTROL instructions affecting the current sequence line. The new SEQ FLOW, CONTROL field will appear in place of the field you already programmed and the original field will be displayed one line below.

You may add up to two additional CONTROL fields for each sequence line (only one SEQ, FLOW instruction per line allowed). For example, if you want to output the external trigger signal at this point and switch any 91S32s operating in Follows 91S16 mode from one page of memory to the other, you can program those instructions as follows:

SEQ	LABEL	4B	4A	S	I	M	SEQ FLOW, CONTROL	REG, OUT
100	[]	00	00	0	0	0	[INCR PAGE] [TRIGGER] [IF RB=0 JUMP]	[label]

The SEQ FLOW, CONTROL instructions may be entered in any order. When the instruction sequence is redisplayed, it is displayed in a pre-defined order that reflects the order of execution. All instructions programmed on a give sequence line will be executed.

To delete a SEQ FLOW, CONTROL field that has been added:

1. Move the cursor to the SEQ FLOW, CONTROL field you wish to delete.
2. Press the DELETE LINE key as many times as necessary. The DAS will delete a SEQ FLOW, CONTROL field each time the DELETE LINE key is pressed.

SEQ	LABEL	4B	4A	S	I	M	SEQ FLOW, CONTROL	REG, OUT
100	[]	00	00	0	0	0	[INCR PAGE] [label] [IF RB=0 JUMP] [label]	[]

NOTE

If you press the DELETE LINE key while the cursor is on a single line, all the instructions on that line will be removed.

Each SEQ FLOW and CONTROL instruction has individual performance characteristics. Several of these instructions require labels as additional parameters. The following paragraphs briefly describe each instruction and its capabilities.

HALT. Normally, the pattern generator runs through all 1024 sequence lines before stopping program output (assuming no loop or branch instructions are programmed). By using the HALT instruction, you may program the pattern generator to stop output on any sequence line.

When the pattern generator encounters a HALT instruction, it outputs the clock, data, and strobe values associated with that sequence line and then halts. If the HALT instruction is encountered on the first line the pattern generator executes, data and strobe signals are sent to the probe tips, but not the clock signal; no clock transition occurs.

When entered on a program line, the HALT instruction appears like this:

SEQ	LABEL	4B	4A	S	I	M	SEQ FLOW, CONTROL	REG, OUT
100	[]	00	00	0	0	0	[HALT]	

JUMP. Use the JUMP instruction to implement program jumps. Normally, the pattern generator outputs data in a straightforward line-by-line sequence. The JUMP instruction, however, alters this sequential flow by specifying a jump from one program line to another. Sequential program execution then resumes at that point.

When entered on a program line, the JUMP instruction appears like this:

```
SEQ LABEL 4B 4A S I M SEQ FLOW, CONTROL REG, OUT
100 [ ] 00 00 0 0 0 [ JUMP ] [ label ]
```

Use the empty field next to JUMP to enter the LABEL of the sequence line where you want program execution to resume. For instance:

```
SEQ LABEL 4B 4A S I M SEQ FLOW, CONTROL REG, OUT
98 [INIT] 00 00 0 0 0 [ ]
99 [ ] 00 00 0 0 0 [ ]
100 [ ] 00 00 0 0 0 [ JUMP ] [ INIT ]
```

INIT could be the name of a block of patterns used to test the initialization software in the device under test. In this case, you would type INIT in the LABEL field of the line you wished to jump to. Information about entering a name in the LABEL field is located in the *LABEL Field* paragraphs found later in this *91S16 Run Menu* section. Enter the label by using the data entry keys on the the DAS keyboard.

IF <conditional> JUMP. Use the IF <conditional> JUMP instruction to implement test and branch instructions. Normally, the pattern generator outputs data in a straightforward line-by-line sequence. The IF <conditional> JUMP instruction, however, alters this sequential flow when the conditions of the IF statement are satisfied. When the IF condition is satisfied, program flow is transferred to the line containing the label specified after JUMP.

For example:

```
SEQ LABEL 4B 4A S I M SEQ FLOW, CONTROL REG, OUT
98 [INIT] 00 00 0 0 0 [ ]
99 [ ] 00 00 0 0 0 [ ]
100 [ ] 00 00 0 0 0 [ IF R=0 JUMP ] [ INIT ]
```

When executed, this program line tests the pattern generator's register to see if it has the value 0. If R does equal 0, then program execution would resume at the sequence line that contained INIT in the LABEL field.

The DAS displays the conditional tests for the IF <conditional> JUMP instruction in this order:

```
RA=0
RB=0
R=0
IRQ
EXT
KEY
FULL
END
```

The following paragraphs briefly describe each conditional test.

IF RA=0 JUMP, IF RB=0 JUMP. The RA=0 and the RB=0 tests instruct the pattern generator to examine the contents of either register RA or register RB. IF RA=0 JUMP instructs the pattern generator to examine the contents of register RA and branch if the value in RA equals 0.

IF R=0 JUMP. The IF R=0 JUMP conditional test works the same as the IF RA=0 and IF RB=0 tests described above, only this test is performed on the combined 16-bit register named "R" (where $R = RA + RB$).

NOTE

The instruction for R=0 is not displayed in the list of possible instructions if you have configured the pattern generator register to be two 8-bit registers named RA and RB. Similarly, the conditional tests RA=0 and RB=0 are not included if you have configured the pattern generator register to be one 16-bit register called R. See the 91S16 Configuration Menu section for more information about using the 91S16 Pattern Generator's internal register.

IF IRQ JUMP. The IF IRQ JUMP conditional test instructs the pattern generator to examine the status of the P6460's IRQ (interrupt request) line. If the P6460 has detected a transition on this line prior to this clock cycle, the condition is considered to be true. When a transient on the IRQ line meets the following conditions, it can be recognized as an interrupt:

1. IRQ polarity and level as specified in the 91S16 Probe sub-menu have been satisfied.
2. The QUALIFIER line is driven to satisfy the level specified in the 91S16 Probe sub-menu.
3. The Interrupt Mask bit (M) is set to 0 (unmasked) in the 91S16 Program sub-menu.
4. The selected IRQ edge must occur 15 ns prior to the selected edge of the external clock (minimum pulse width is 15 ns).

NOTE

When the IRQ is disabled or the CALL is selected in the 91S16 Probe sub-menu, the IF IRQ JUMP instruction is not included in the list of conditional tests.

NOTE

Since the pattern generator resets all the lines from the P6460 External Control Probe at the start of execution, any external control signal test in the first sequence line executed will fail to meet its setup and hold time specifications. If the first line executed contains an IF IRQ JUMP instruction, the pattern generator will not jump even if an interrupt has been requested.

IF EXT JUMP. The IF EXT JUMP conditional test instructs the pattern generator to examine the status of the EXT JUMP (external jump) line of the P6460 External Control Probe. If the the EXT JUMP line meets the threshold level specified in the 91S16 Probe sub-menu, then the condition is considered to be true. Program execution will resume at the sequence line containing the label specified.

NOTE

When EXT JUMP is disabled in the 91S16 Probe sub-menu, the IF EXT JUMP conditional test is not displayed in the list of options.

NOTE

Since the pattern generator resets all the lines from the P6460 External Control Probe at the start of execution, the EXT JUMP signal will not meet its setup and hold time specifications for the first sequence line executed. If the first line executed contains an IF EXT JUMP instruction, the pattern generator will not jump even if the EXT JUMP line has been asserted.

IF KEY JUMP. The IF KEY JUMP conditional test instructs the pattern generator to determine whether the SHIFT START PAT GEN key on the DAS keyboard has been pressed. If the key was pressed before this sequence line was executed, the condition is considered to be true. This conditional test allows communication between the user and the pattern generator while the system is running. In this way, you can advance control of the pattern generator from one linked looping routine to another by pushing the SHIFT START PAT GEN KEY.

IF FULL JUMP and IF END JUMP. The IF FULL and IF END conditional tests are used to support the 91S16's Pattern Download From Host feature. In order to use these tests, you must be using a 91S16 to control the output of one or more 91S32s. Refer to the *91S32 Configuration Sub-Menu When Used With 91S16* section of this addendum for a description of the Pattern Download From Host feature.

Large patterns downloaded from a host computer often require more memory than the 2048-line maximum available with the 91S32. The Pattern Download From Host feature enables you to divide a larger pattern generator program into 1024-line blocks, output one block of program lines, download another block of sequence lines, output the new page of vectors, and continue the process until the entire program has been executed. The Pattern Download For Static Devices version does not output any vectors while a new block of vectors is being downloaded from the host.

The Pattern Download For Dynamic Devices (Keep-Alive) version does provide some 91S16 vectors to the system under test while the 91S32s are being reloaded. This mode of operation allows you to keep dynamic circuit elements active while the pattern generator is reloaded. Keep-Alive is only available with the Option 06 GPIB interface. IF FULL JUMP and IF FULL END are used to support the Keep-Alive subroutine. See the section of this addendum titled *GPIB Programming* for detailed instructions about Keep-Alive programming.

IF FULL tests to see if the GPIB controller has sent key code 47 to the DAS. Key code 47 indicates that the data transfer is complete. IF FULL then causes the 91S32s to switch program execution to the newly refilled memory page.

IF END tests to see if the GPIB controller has sent key code 46 to the DAS. Key code 46 indicates that all data transfers have been complete. IF END JUMP <label> then transfers program execution to some final sequence lines designated by the label.

NOTE

The IF FULL and IF END conditional tests are not displayed in the list of field options if the 91S32 Configuration sub-menu MEMORY RELOAD FROM HOST (FOR KEEP-ALIVE) field has not been set to ON.

RETURN. The RETURN instruction is used in conjunction with the IRQ enabled CALL <label> instruction programmed in the 91S16 Probe sub-menu. When the Probe sub-menu IRQ field has been set to CALL, a label field appears. You can then enter a label name in this field that corresponds to a set of sequence lines specifically designed to service the interrupt request. For example, call the label RSET.

```

PATTERN GENERATOR SETUP: [PROBE]

P6460 INPUT THRESHOLD    [TTL ] + 1.4V

  IRQ                      [ ON ] : [ CALL ] [RSET]
    & QUALIFIER           [ 1 ]

EXT JUMP:                 [DISABLED]

PAUSE:                   [DISABLED]

INHIBIT:                 [DISABLED]
(91S16 & 91S32)

-----

EXTERNAL START          [DISABLED]
    
```

When an interrupt request has been detected on the IRQ line from the P6460 External Control Probe, program execution transfers to the sequence line containing the label given in the Probe sub-menu. (It is possible to mask out the interrupt signal using the M field in the Program Run sub-menu.) In the example, suppose the pattern generator was executing sequence 100 at the time the interrupt request was detected. After executing line 100, the pattern generator would execute the sequence line containing RSET in the label field. Pattern execution will continue sequentially from that line until a RETURN instruction is encountered in the SEQ FLOW, CONTROL field. Pattern execution will then resume at sequence line 101.

NOTE

The RETURN instruction must only be used in conjunction with the IRQ CALL instruction. If a RETURN is executed before a IRQ CALL, the RETURN instruction acts like a call to itself, and the pattern generator will become caught in an endless loop.

SEQ	LABEL	4B	4A	S	I	M	SEQ FLOW, CONTROL	REG, OUT
100	[]	00	00	0	0	0		
10	[RSET]	FF	FF	0	0	0	[]	
11		AF	00	0	0	0	[]	
12		AA	1E	0	0	0	[RETURN]	
101		00	00	0	0	0	[]	

The RETURN instruction is programmed in the SEQ FLOW, CONTROL field in the last sequence line designed to service the interrupt request. Program flow continues on the sequence line following the one being executed when the interrupt request was detected.

NOTE

The RETURN instruction will not be displayed in the instruction list if the 91S16 Probe sub-menu's IRQ field is set to DISABLED or IF IRQ JUMP.

CALL RMT The CALL RMT (call remote device) instruction is part of the Pattern Download for Dynamic Devices (Keep-Alive) feature that allows the pattern generator to reload its memory from an external device. The other instructions associated with the Keep-Alive feature are IF FULL JUMP, and IF END JUMP.

CALL RMT is enabled when you set the MEMEORY RELOAD FROM HOST (FOR KEEP-ALIVE) field to ON in the 91S32 Configuration sub-menu.

NOTE

CALL RMT is only available when you are using DAS Option 06 GPIB. All restrictions that apply to Keep-Alive also apply to the CALL RMT instruction. Refer to the GPIB Programming section of this addendum.

The CALL RMT instruction issues an SRQ on the GPIB bus. This command is normally programmed to signal a host computer or external memory device that one page of the 91S32's pattern memory is ready to be reloaded. This signal can also be used in other situations, such as in automated test equipment (ATE), when you want to signal any external device when the pattern generator executes a certain program line.

NOTE

The CALL RMT instruction is not a subroutine. It is a control instruction which asserts an SRQ on the GPIB bus. When the controller performs a serial poll of the DAS, status byte 197 is returned to the controller. This instruction does not save a return address on the stack.

NOTE

Another CALL RMT instruction is valid only after the IF FULL JUMP instruction has been executed.

NOTE

If no 91S32 module is installed, or the MEMORY RELOAD FROM HOST (FOR KEEP-ALIVE) field is set to OFF in the 91S32 Configuration sub-menu, the CALL RMT instruction is not included in the instruction selection list.

TRIGGER. Use the TRIGGER instruction to generate an external device trigger signal. The trigger signal appears at the trigger output phono connector located near the probe connectors on the back of the 91S16. Use the optional 79-inch phono-to-BNC cable to connect the trigger output connector to an external device (such as an oscilloscope). This trigger signal is a positive-true, TTL-level, NRZ (non-return-to-zero) signal. It stays TTL-high for one cycle each time it is programmed.

NOTE

If the TRIGGER instruction is programmed for several consecutive sequence lines, the pulse width of the TRIGGER signal will widen in proportion to the number of TRIGGER instructions. For example, if you program the TRIGGER instruction in line 100 and line 101, the TRIGGER output signal will stay high for two clock cycles.

INCR PAGE The INCR PAGE (increment page) instruction is used when 91S32s are used in Follows 91S16 mode and the 91S32 Configuration sub-menu Memory Reload From Host field is set to OFF. Because the 91S32s have twice as much memory as the 91S16, it is often convenient to divide that memory into two 1024-line pages. These pages are called Page A and Page B. You may want to repeat the program loaded into Page A until a certain event occurs, and then switch to Page B. The INCR PAGE command switches 91S32 execution from one page of memory to the other.

12 REG, OUT Fields

The REG, OUT column heading designates the fields used to control operation of the two 8-bit, or one 16-bit, pattern generator registers. (Designating the pattern generator register as either two 8-bit registers or one 16-bit register is accomplished in the 91S16 Configuration sub-menu.) REG stands for register, and OUT is a reminder that the instructions in this field control when the contents of the register are output as pattern via the P6464 probes.

The REG key on the DAS keyboard corresponds to the REG instructions. REG instructions include LOAD R, INCR R (increment R), and DECR R (decrement R). If you configure the pattern generator register to be two 8-bit registers, you can select LOAD RA and LOAD RB, instead of LOAD R. If you don't program any REG instruction, the register will simply maintain its previous value.

The OUT key on the DAS keyboard corresponds to the OUT field and instructions. OUT instructions include OUT R (output the contents of register R as data), and OUT REP. OUT REP instructs the pattern generator to repeat whatever Pod A pattern it output on the previous sequence line. This could be a data value or a register value.

Program any REG or OUT instruction by pressing the corresponding instruction selection key. The instruction selected will be displayed under the REG, OUT field heading. Sometimes both REG and OUT instructions are programmed on the same line. If you want to program more than one REG or OUT instruction for a sequence line, you must press the ADD LINE key on the DAS keyboard. This will cause another REG, OUT field to appear. You can add up to two additional REG, OUT fields for each sequence line.

NOTE

When entering REG and OUT instructions, position the screen cursor on any reverse-video field associated with the sequence line you wish to program.

NOTE

Before attempting to use the LOAD command, carefully read the paragraph titled Load for instructions on loading the register(s) from the data field later in this section.

To enter a REG or OUT instruction on a sequence line:

1. Move the screen cursor to any field on the line where the instruction is to be programmed.
2. Press the REG or OUT key until the desired instruction appears in the field.

The DAS will display the REG instructions in this order:

```
[LOAD RA ]
[INCR RA ]
[DECR RA ]
[LOAD RB ]
[INCR RB ]
[DECR RB ]
```

OR

```
[LOAD R  ]
[INCR R  ]
[DECR R  ]
```

If you have configured the 91S16 internal register to be two 8-bit registers, only RA and RB instructions will be displayed; if you have configured the register to be one 16-bit register, only R instructions will be displayed.

The DAS will display the OUT instructions in this order:

```
[OUT RA ]
[OUT RB ]
```

OR

```
[OUT R  ]
```

AND

```
[OUT REP ]
```

To return REG and OUT instructions to their default values:

1. Move the screen cursor to the REG, OUT field you wish to default.

```
SEQ LABEL 4B 4A S I M SEQ FLOW, CONTROL REG, OUT
100 [ ] 00 00 0 0 0 [ ] [ OUT RA ]
```

2. Press the DON'T CARE key.

```
SEQ LABEL 4B 4A S I M SEQ FLOW, CONTROL REG, OUT
100 [ ] 00 00 0 0 0 [ ] [ ]
```

To add an additional REG or OUT field:

1. Move the screen cursor to a field on the line where the additional REG or OUT instruction needs to be added.

```
SEQ LABEL 4B 4A S I M SEQ FLOW, CONTROL REG, OUT
100 [ ] 00 00 0 0 0 [ ] [ INCR RA ]
```

2. Press the ADD LINE key on the DAS keyboard up to two times.

The DAS will create an additional reverse-video REG, OUT field each time you press the ADD LINE key; note that this does not create additional sequence lines, just extensions to the existing sequence line.

SEQ	LABEL	4B	4A	S	I	M	SEQ FLOW, CONTROL	REG, OUT
100	[]	00	00	0	0	0	[]	[]
							[]	[INCR RA]

REG and OUT Instructions

Read this section carefully; REG and OUT instructions depend on the configuration of the 91S16 internal register; most operations affect the output of Pod A only. Do not assume that a REG or OUT instruction also affects the data supplied to Pod B unless the following paragraphs specifically state that Pod B is affected.

Each REG (register control) and OUT (output register contents as data) instruction has individual performance characteristics. These characteristics are dependent on how you have configured the 91S16's internal register in the 91S16 Configuration sub-menu.

NOTE

You must select the configuration for the 91S16 internal register in the 91S16 Configuration sub-menu. You may select either two 8-bit registers named RB and RA, or one 16-bit register named R. The default configuration is RB and RA.

Keep in mind the following rules when using REG and OUT instructions:

1. When the 91S16's internal register is configured as two 8-bit registers called RA and RB, the initial value loaded into either register is loaded from the Pod A data field; the Pod B data field is not used to load either register. (Two sequence lines are required to load both registers.)

The most significant bit for each data register corresponds to the most significant bit of the Pod A data field.

When data is output from either RA or RB, it is delivered to the Pod A pattern generator probe; the Pod B probe receives its pattern (as usual) from the Pod B data column in the Run sub-menu. When either RA or RB is output, the data value specified for Pod A is ignored.

2. When the 91S16's internal register is configured as a single 16-bit register called R, the initial value is loaded from both the Pod B and the Pod A data fields.

When data is output from 16-bit register R, it is delivered to both Pod B and Pod A probes. The most significant bit of the register is delivered to the most significant data channel of the pattern generator probe attached to Pod B, while the least significant bit of the register is delivered to the least significant channel of Pod A.

When register R is output, the data values for Pod B and Pod A are ignored for that sequence line.

3. If you have programmed a SEQ FLOW or OUT instruction on the same line as a REG instruction, the SEQ FLOW or OUT instruction will be performed first. For example, if you program IF R=0 JUMP <label> instruction on the same line as a LOAD R instruction, the pattern generator will test to see if R=0 before loading R with some new value. Both instructions will be executed, but the conditional test will use the old value for R.

LOAD Instructions

The LOAD register commands are used to load the register with some initial value. LOAD uses either RA, RB, or R as an operand. The register names displayed will depend on whether you have selected two 8-bit registers or one 16-bit register.

LOAD RA, LOAD RB. Initial values for either RA or RB are loaded from the Pod A data field in the sequence line containing the LOAD instruction.

To load RA, move the screen cursor to the Pod A data field and use the data entry keys to specify the value you want loaded into the register. Move the screen cursor to the REG, OUT field and press SELECT until LOAD RA appears on the screen. LOAD RB works exactly the same way.

```

SEQ LABEL 4B 4A S I M SEQ FLOW, CONTROL REG, OUT
100 [ ] 00 01 0 0 0 [ ] [ LOAD RA ]

```

After executing sequence line 100, register RA will contain the value 00000001_{bin}.

LOAD R. The initial value of register R is loaded from the Pod B and Pod A data fields. The most significant bit of register R is taken from the most significant bit of Pod B, and the least significant bit of R is taken from the least significant bit of Pod A.

```

SEQ LABEL 4B 4A S I M SEQ FLOW, CONTROL REG, OUT
100 [ ] 01 02 0 0 0 [ ] [ LOAD R ]

```

After executing sequence line 100, register R contains the value 0000000100000010_{bin}.

INCR (Increment Register) Instructions

The INCR (Increment Register) instructions are used to increase the count of the specified register by one. There are INCR RA, INCR RB, and INCR R versions of this command. The options displayed depend on whether you have configured the internal register to be two 8-bit registers named RA and RB, or one 16-bit register named R.

INCR RA, INCR RB. These commands increment the values of their respective registers by 1 each time the sequence line containing the instruction is executed. The range of the counters is between 0 and FF. The next INCR command following FF resets the register to 0; no carry signal is generated.

INCR R. This command increments the value of register R each time the sequence line containing the instruction is executed. The range for the counter is between 0 and FFFF. The next INCR command following FFFF resets the register to 0; no carry signal is generated.

Here is an example of an INCR R instruction programmed into a sequence line; data fields are not affected by this command.

```

SEQ LABEL 4B 4A S I M SEQ FLOW, CONTROL REG, OUT
100 [ ] 00 00 0 0 0 [ ] [ INCR R ]

```

DECR (Decrement Register) Instructions

The DECR (Decrement Register) instructions are used to decrease the value of the specified register by one. There are DECR RA, DECR RB, and DECR R versions of this command. The options displayed depend on whether you have configured the internal register to be two 8-bit registers named RA and RB, or one 16-bit register named R.

DECR RA, DECR RB. These commands decrement the values of their respective registers by 1 each time the sequence line containing the instruction is executed. The range of the counters is between FF and 0. The next DECR command following 0 sets the register to FF; no borrow signal is generated.

DECR R. This command decrements the value of register R each time the sequence line containing the instruction is executed. The range for the counter is between FFFF and 0. The next DECR command following 0 sets the register to FFFF; no borrow signal is generated.

Here is an example of a DECR R instruction programmed into a sequence line; data fields are not affected by this command.

```

SEQ LABEL 4B 4A S I M SEQ FLOW, CONTROL REG, OUT
100 [ ] 00 00 0 0 0 [ ] [ DECR R ]
    
```

OUT (Output Register Contents) Instructions

The OUT (Output Register Contents) instruction allows you to output the contents of the 91S16's internal register as data in place of the value programmed in that sequence line's data field. There are OUT RA, OUT RB, and OUT R versions of this instruction. The options displayed depend on whether you have configured the internal register to be two 8-bit registers named RA and RB, or one 16-bit register named R. OUT instructions do not change the value in a register.

NOTE

OUT RA and OUT RB both provide data to the pattern generator probe attached to Pod A; neither outputs data to Pod B. OUT R outputs data to both Pod B and Pod A.

OUT RA, OUT RB. The value in the specified register is sent as data to the pattern generator probe connected to Pod A. Both register RA and register RB send data to the same pattern generator probe. You cannot have OUT RA and OUT RB instructions on the same sequence line.

OUT R. The value in register R is sent as data to the pattern generator probes connected to both Pod B and Pod A. The most significant register bit is sent to the Pod B channel 7 data line and the least significant register bit is sent to the Pod A channel 0 data line.

Here is an example of the OUT R instruction programmed into a sequence line. The data values programmed into the 4B and 4A fields for this line will not be sent to the pattern generator probe tips; these data values will be ignored by the pattern generator. (Note: the contents of data Pod B would be output if the instruction were OUT RB or OUT RA.)

```

SEQ LABEL 4B 4A S I M SEQ FLOW, CONTROL REG, OUT
100 [ ] 00 00 0 0 0 [ ] [ OUT R ]
    
```

NOTE

STEP and TRACE modes allow you to see the data output as each sequence line is executed and view the contents of the 91S16's internal register for that sequence line. Read the section of this addendum titled 91S16 Step and Trace Mode Sub-Menus for instructions on using these operating modes.

OUT REP (Out Repeat) Instruction

The OUT REP (Out Repeat) instruction causes the pattern generator to ignore its current data source for Pod A and repeat whatever vector it output for Pod A in the previous sequence line. It does not matter if the previous sequence line's vector originated as data, a register value, or even another OUT REP instruction.

NOTE

OUT REP only repeats the output of Pod A; it does not repeat the previous vector supplied to Pod B. If the previous data vector was a 16-bit value from register R, OUT REP will only repeat the 8 least significant bits (those originally supplied to Pod A); Pod B data will be supplied by the Pod B data field.

Here is an example of the OUT REP instruction programmed into a sequence line. When sequence line 101 is executed, it will output AA via the probe attached to Pod A, and 00 via the probe attached to Pod B.

SEQ	LABEL	4B	4A	S	I	M	SEQ FLOW, CONTROL	REG, OUT
99	[]	AA	AA	0	0	0	[]	
100	[]	00	00	0	0	0	[]	[OUT REP]

13 EDIT Fields

The 91S16 Module provides nine edit commands to manipulate labels, patterns, and instructions on program lines. These commands are designed to simplify programming.

To select an edit command:

1. Move the screen cursor to the edit field at the bottom of the screen:
2. Press the SELECT key until the desired command appears in the field. You can also use the INCR and DECR keys to select from the edit commands.

The DAS displays the list of possible edit commands in this alphabetical sequence:

```
[CONVERSION]
[ COPY ]
[ DELETE ]
[ DISPLAY ]
[ FILL ]
[ INSERT ]
[ MODIFY ]
[ MOVE ]
[ SEARCH ]
```

Each edit command has a specialized function. The CONVERSION command has a sub-menu used to make and check a conversion table. Several commands have sub-fields you will use to specify starting and ending sequence lines, or to select among additional sub-commands. Some of the commands have fields that require you to enter setup and editing parameters.

3. After entering the changes you wish to make for any of the edit operations, press the EXECUTE key. Some of the fields, such as those pertaining to sequence numbers, will be blanked after the edit operation has been completed. This is to prevent you from accidentally pressing EXECUTE again and damaging your corrected program.

The following paragraphs briefly describe each of the edit commands.

CONVERSION. The CONVERSION command allows you to search for and replace all pattern data values with corresponding different values in one operation. For instance, if you knew you wanted to replace all FFs *hex* in your program with AAs, and replace all 1Es *hex* with 00s, you could use the CONVERSION command to do that in one operation.

This feature is most commonly used when you are converting data from one coding system to another, such as from a normal binary counting method to that of the Gray code where only one bit changes as numbers are incremented.

The CONVERSION command has two sub-commands: CONVERT, which designates which pod's data is to be converted, and TABLE BUILD. The TABLE BUILD command displays a special menu called the TABLE BUILD sub-menu that allows you to specify which bit patterns to change. Instructions for using this menu are included in the following paragraphs.

CONVERT. This sub-command instructs the pattern generator to apply the conversion rules outlined in the TABLE BUILD sub-menu to the data in a particular pod. The way in which the TABLE BUILD sub-menu performs conversions will become clear as you read this section. If you had a 91S16 in DAS slot 1 and you wanted to modify the data programmed for Pod B according to the changes given in the TABLE BUILD sub-menu, you would type:

```
[CONVERSION] : [ CONVERT ] POD [1B]
```

Press the EXECUTE key to initiate the conversion.

The TABLE BUILD sub-menu only operates on one pod of data at a time. Therefore, if you wanted to convert all data patterns for a 91S16 in DAS slot 1 from one code to another, you would have to CONVERT POD 1A, and then CONVERT POD 1B. If you are using 91S32s along with your 91S16, you would have to run the conversion program four more times for each 91S32 to convert all the data from one code to another. However, you will often be using the different pods for different purposes, and you may only want to convert one pod's data and leave the rest of the data unchanged.

To specify which pod's data will be converted:

1. Move the screen cursor to the POD field.
[CONVERSION] : [CONVERT] POD []
2. Use the data entry keys to enter a pod I.D. For example, pod 4B. The DAS will display the pod I.D. in the POD field.
[CONVERSION] : [CONVERT] POD [4B]
3. Press the EXECUTE key to start the conversion. The DAS will display "CONVERTED POD 4B" on the second line of the screen when the conversion has been completed. The DAS will also blank the POD field to prevent accidental conversions later.

TABLE BUILD. Use the TABLE BUILD sub-menu to convert an existing data pattern into some modified data pattern. The menu provides two columns of 8-digit binary numbers from 00000000 to 11111111. Modifying the bit pattern in the CODE column and executing the CONVERT command on some pod's data will cause all instances of the pattern in the right-hand DATA field to be converted to the pattern in the CODE field.

For example, moving the screen cursor to 00000000 in the left-hand column, typing in 00000001, and then executing CONVERT POD 1A, will cause all instances of 00000000 stored as data in POD-1A to be changed to 00000001.

It may be useful for you to think of the bit-patterns in the left-hand column as sequence numbers. The bit-patterns in the left-hand DATA column represent all possible bit-patterns. Typing some pattern in a left-hand field is a way of moving your editing window from one bit-pattern to another; it will not change any data.

To invoke the TABLE BUILD sub-menu:

1. Move the screen cursor to the field containing CONVERT.

[CONVERSION] : [CONVERT] POD []

2. Press the SELECT key until TABLE BUILD appears in the field. The TABLE BUILD sub-menu will automatically appear on the screen.

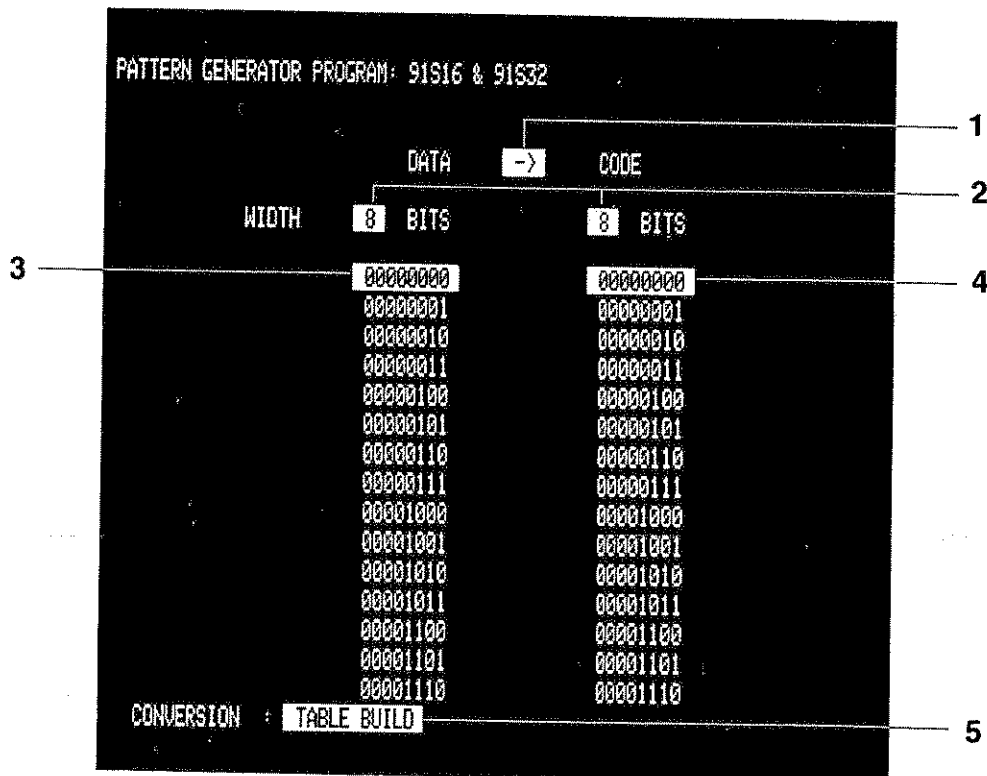


Figure 21. Table Build sub-menu.

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1 → Field

The → field indicates the direction for converting data. If the arrow is pointing to the right, data in the right-hand column will replace the data pattern indicated in the left-hand column. If the arrow is pointing to the left, the pattern in the left-hand column will replace the pattern in the right hand column.

When the arrow is pointing to the right, you can enter the same bit pattern in the right column for any number of bit patterns in the left column. However, when the arrow is pointing to the left, each pattern in the left column must convert to a unique pattern in the right column.

As long as you are mapping a unique pattern in the right column to a unique pattern in the left column, this feature allows you to change the data pattern, and then change back easily if you don't like the results of your first conversion.

This field defaults with the arrow pointing to the right.

To change the direction of the conversion arrow:

1. Move the screen cursor to the arrow field.
DATA [→] CODE
2. Press the SELECT key until the desired direction appears in the field.
DATA [←] CODE

2 WIDTH Fields

Use the WIDTH fields to select the bit width of the data and code columns. For both columns, you can select bit widths ranging from 1 to 8 bits. The default field width is 4 bits for each column.

You will usually want to set both column widths to the same value. The bit width you select will determine the depth of the corresponding DATA and CODE fields. However, if you select a width of 4 bits for the DATA column and 5 bits for the CODE column, both selection fields will be 16 lines deep (16 possible patterns from 4 bits); the field depth always truncates to match the shorter column. Selecting 8-bit field widths for both columns will generate a TABLE BUILD sub-menu with 256 lines of bit patterns.

If you shorten the width CODE field after having entered some longer value into one of the fields, the display will change to show the shorter pattern, but the DAS will retain the longer value in memory until the DAS is turned off.

To enter the DATA and CODE fields column widths:

1. Move the screen cursor to the WIDTH field over the column you wish to change.

	DATA	CODE
WIDTH	[4] BITS	[4] BITS

2. Use the data entry keys to enter the desired column width. For example, 8.

	DATA	CODE
WIDTH	[8] BITS	[4] BITS

Remember that no data conversion actually takes place until you EXECUTE the CONVERSION: CONVERT POD [##] command. Depending on how you configure your replacement

data patterns in the TABLE BUILD menu, it is possible that the CONVERT command will attempt to replace an 8-bit pattern with a smaller, say 4-bit, pattern. In this case, only the lowest 4 bits of the original pattern would be converted to the new pattern, and the data in the four most significant bits would not be changed. For example, if the original pattern was 11111111_{bin}, and the replacement pattern from the TABLE BUILD menu was 0000_{bin}, the resulting data would be 11110000_{bin}.

3 DATA Column

The DATA column automatically appears whenever the TABLE BUILD sub-menu is selected. The DATA column contains all possible bit patterns for data entered in the PROGRAM: Run sub-menu. Bit patterns in the DATA column represent existing data, while bit patterns in the CODE column represent planned changes to the data. (The only exception is when the direction field has the arrow pointing to the left.)

The depth of the DATA column is dependent on the value entered in the WIDTH field. Since all possible bit patterns for a particular width are shown, most TABLE BUILD sub-menus are too long to be displayed on one screen.

There are several ways of displaying different parts of the TABLE BUILD sub-menu. The first method is to use the scroll keys on the DAS keyboard.

To scroll through the DATA column sequences:

Press the ↑ or the ↓ key on the keyboard. The DAS will scroll the display up or down.

The second method used to display different DATA bit patterns is to enter the desired new pattern into a field within the DATA column. Just as in moving through sequence lines in the Program Run sub-menu, the DAS will display the DATA line you have entered and fill the rest of the page with DATA lines incrementing from that point.

To move forward to a larger block of DATA lines:

1. Move the screen cursor to the data field you wish to change. For example, line 1010.

```

DATA
00000101
00000110
00000111
00001000
00001001
[00001010]
00001011
00001100
00001101

```

- Use the data entry keys to enter the first DATA line you wish to display. For example, 11001000.

```

DATA
00000101
00000110
00000111
00001000
00001001
[11001000] DATA pattern 00001010 is
11001001   changed to 11001000 and
11001010   the remaining DATA patterns
11001011   increment from that line.
    
```

The DAS will display DATA line 11001000 in place of line 00001010, and then update the rest of the DATA lines following that position.

NOTE

Entering a value in one of the DATA column fields is a method of displaying different portions of this sub-menu; it will not change the data programmed for a pod in the Run sub-menu.

To display a block of DATA patterns with smaller values:

- Move the screen cursor to the first DATA line displayed in the TABLE BUILD menu.
- Use the data entry keys to enter the bit pattern you want to display. The display will fill with data lines starting with the pattern you have entered.

NOTE

Values in the DATA column are displayed in ascending order. If you wish to display a value smaller than any currently displayed, you must enter the new value in the topmost DATA column field.

4 CODE Column

Use the CODE column fields to enter the pattern you want to end up with after the conversion. Bit patterns in the CODE field will replace the bit patterns in the DATA field immediately to their left. More than one data pattern may be converted to the same CODE pattern. To do this, enter the same CODE pattern next to two or more DATA patterns.

To enter a pattern into the CODE field:

- Move the screen cursor to the desired CODE field:

```

DATA          CODE
[00000000]    [00000000]
    
```

- Use the data entry keys to enter the desired pattern. The DAS will display the value you enter in the CODE field:

```

DATA          CODE
[00000000]    [00001111]
    
```

- Repeat this procedure for each line until all the desired patterns are entered in the CODE fields to the right of the existing patterns.

NOTE

If more than one DATA pattern is converted to the same CODE pattern, the conversion of DATA to CODE can not be reversed by switching the → field to ←.

5 CONVERSION Field

Use the CONVERSION field to exit the TABLE BUILD sub-menu.

To exit the TABLE BUILD sub-menu:

- Move the screen cursor to the CONVERSION field:

[CONVERSION] : [TABLE BUILD]

- Press the SELECT key. The DAS will display the 91S16 Program Run sub-menu.

[CONVERSION] : [CONVERT] POD []

COPY Use the COPY command to duplicate sequence lines programmed in the 91S16 Run sub-menu, or to copy the data programmed for one pod to another. The command has a field that allows you to select either SEQ (sequences within the Run sub-menu) or POD (copy one pod's data to another pod).

To change the COPY command mode between SEQ and POD:

- Move the screen cursor to the field next to COPY:

[COPY] : [SEQ] [] THROUGH [] BEFORE SEQ []

- Press the SELECT key until the desired mode appears in the field.

[COPY] : [POD] [] TO []

SEQ Use the SEQ sub-command to duplicate sequence lines of program within the 91S16 Run sub-menu. When the COPY SEQ command is executed, all sequence lines specified are duplicated and placed immediately before the given destination. The sequence numbers for the menu are then updated; labels are retained in the duplicated lines.

NOTE

Using the COPY command when all 1024 sequence lines have been programmed may cause some high-numbered sequence lines to be lost from memory. (Only 1023 sequence lines are available when IRQ CALL is enabled.) The number of sequence lines lost will correspond to the number of new lines inserted. If you must add new sequence lines to a lengthy pattern, use the DELETE command first to remove unnecessary lines and make room for the additions.

To copy sequence lines:

1. Move the screen cursor to the SEQ/THROUGH fields.

SEQ	LABEL	4B	4A	S	I	M	SEQ FLOW, CONTROL	REG, OUT
0		FF	FF	0	0	0		LOAD R
1	LOOP	01	00	0	0	0	IF R=0 JUMP	END
2		02	00	0	0	0	JUMP	LOOP DECR R
3		03	00	0	0	0		OUT R
4	END	04	00	0	0	0		OUT R
5		05	00	0	0	0		
6		06	00	0	0	0		
7		07	00	0	0	0		
8		08	00	0	0	0		
9		09	00	0	0	0		

[COPY] : SEQ [] THROUGH [] BEFORE SEQ []

2. Use the data entry keys to enter the starting and ending sequences as well as a destination sequence. For example, to make a copy of sequence lines 0 through 4 and to place them before sequence line 5:

[COPY] : SEQ [0] THROUGH [4] BEFORE SEQ [5]

3. Press the EXECUTE key to initiate the COPY SEQ command.

SEQ	LABEL	4B	4A	S	I	M	SEQ FLOW, CONTROL	REG, OUT
0		FF	FF	0	0	0		LOAD R
1	LOOP	01	00	0	0	0	IF R=0 JUMP	END
2		02	00	0	0	0	JUMP	LOOP DECR R
3		03	00	0	0	0		OUT R
4	END	04	00	0	0	0		OUT R
5		FF	FF	0	0	0		LOAD R
6	LOOP	01	00	0	0	0	IF R=0 JUMP	END
7		02	00	0	0	0	JUMP	LOOP DECR R
8		03	00	0	0	0		OUT R
9	END	04	00	0	0	0		OUT R
10		05	00	0	0	0		
11		06	00	0	0	0		
12		07	00	0	0	0		
13		08	00	0	0	0		
14		09	00	0	0	0		

[COPY] : SEQ [] THROUGH [] BEFORE SEQ []

The DAS will display the message "COPIED SEQ 0 THROUGH 4 BEFORE SEQ 5" in the message field at the top of the display when the operation is complete. The DAS will also blank the SEQ and THROUGH fields to prevent accidental operation.

NOTE

When sequence lines with labels are copied, these labels are duplicated in the new lines. Before you start the pattern generator, or exit the Pattern Generator menus, you must remove these duplicate labels.

POD Use the POD sub-command to duplicate a pattern entered into memory for one pod and put a copy of the same pattern into memory for another pod. If there is already data in the destination pod, it will be discarded when the new pattern is copied into that pod's memory.

To copy a data pattern from one pod to another:

1. Move the screen cursor to the COPY: POD field.

SEQ	LABEL	4B 4A	S	I	M	SEQ FLOW, CONTROL	REG, OUT
0		FF FF	0	0	0		LOAD R
1	LOOP	01 00	0	0	0	IF R=0 JUMP	END
2		02 00	0	0	0	JUMP	LOOP DECR R
3		03 00	0	0	0		OUT R
4	END	04 00	0	0	0		OUT R
5		05 00	0	0	0		
6		06 00	0	0	0		
7		07 00	0	0	0		
8		08 00	0	0	0		
9		09 00	0	0	0		

[COPY] : POD [] TO []

2. Use the data entry keys to enter a pod I.D. For example, to make a copy of POD 4B and send it to POD 4A:

[COPY] : POD [4B] TO [4A]

3. Press the EXECUTE key to start the COPY POD operation.

The DAS will display the message "COPIED POD 4B to 4A" in the message field on the second line of the display when the COPY POD operation has been completed. The DAS will also blank the source and destination fields to prevent accidental operation.

SEQ	LABEL	4B 4A	S	I	M	SEQ FLOW, CONTROL	REG, OUT
0		FF FF	0	0	0		LOAD R
1	LOOP	01 01	0	0	0	IF R=0 JUMP	END
2		02 02	0	0	0	JUMP	LOOP DECR R
3		03 03	0	0	0		OUT R
4	END	04 04	0	0	0		OUT R
5		05 05	0	0	0		
6		06 06	0	0	0		
7		07 07	0	0	0		
8		08 08	0	0	0		
9		09 09	0	0	0		

[COPY] : POD [] TO []

DELETE Use the DELETE command to erase sequence lines within the Program Run sub-menu. When the DELETE command is executed, all sequence lines between the given starting and ending sequence lines (inclusive) are deleted. The remaining sequence line numbers are automatically updated.

NOTE

When sequence lines are removed by the DELETE command, a corresponding number of new sequence lines containing default values are created at the end of the pattern generator's memory. These new sequence lines will be inserted after the last sequence line that contains programming data in order to maintain a total of 1023 sequence lines (IRQ CALL enabled) or 1024 lines (IRQ CALL disabled).

To delete one or more sequence lines:

1. Move the screen cursor to the edit command field at the bottom of the Run sub-menu screen. Press the SELECT key until DELETE appears in the field.
2. Move the screen cursor to the SEQ field.

SEQ	LABEL	4B	4A	S	I	M	SEQ FLOW, CONTROL	REG, OUT
0		FF	FF	0	0	0		LOAD R
1	LOOP	01	00	0	0	0	IF R=0 JUMP	END
2		02	00	0	0	0	JUMP	LOOP DECR R
3		03	00	0	0	0		OUT R
4	END	04	00	0	0	0		OUT R
5		05	00	0	0	0		
6		06	00	0	0	0		
7		07	00	0	0	0		
8		08	00	0	0	0		
9		09	00	0	0	0		

[DELETE] : SEQ [] THROUGH []

3. Use the data entry keys to enter the sequence numbers of the first and last lines you wish to delete. If you only wish to delete one line, enter that sequence number in both fields.

[DELETE] : SEQ [3] THROUGH [5]

4. Press the EXECUTE key to start the DELETE operation. The DAS will display the message "DELETED SEQ 3 THROUGH 5" when the DELETE operation has been completed. The DAS will also update the remaining sequence line numbers, and blank the SEQ and THROUGH fields to prevent accidental operation.

SEQ	LABEL	4B	4A	S	I	M	SEQ FLOW, CONTROL	REG, OUT
0		FF	FF	0	0	0		LOAD R
1	LOOP	01	00	0	0	0	IF R=0 JUMP	END
2		02	00	0	0	0	JUMP	LOOP DECR R
3		06	00	0	0	0		
4		07	00	0	0	0		
5		08	00	0	0	0		
6		09	00	0	0	0		
7		10	00	0	0	0		
8		11	00	0	0	0		
9		12	00	0	0	0		

[DELETE] : SEQ [] THROUGH []

DISPLAY Use the DISPLAY command to select the display radix for the pod data, S (Strobe), I (Internal Inhibit), and M (Interrupt Mask) fields. This command makes it easier for you to read the values programmed into these fields, or to remove them from the display if they are not being used.

To remove or change the radix of the pod data, S, I, and M, fields:

1. Move the screen cursor to the edit command field and press select until DISPLAY appears.

SEQ	LABEL	4B	4A	S	I	M	SEQ FLOW, CONTROL	REG, OUT
0		FF	FF	0	0	0		LOAD R
1	LOOP	01	00	0	0	0	IF R=0 JUMP	END
2		02	00	0	0	0	JUMP	LOOP
3		03	00	0	0	0		DECR R
4	END	04	00	0	0	0		OUT R
5		05	00	0	0	0		OUT R
6		06	00	0	0	0		
7		07	00	0	0	0		
8		08	00	0	0	0		
9		09	00	0	0	0		

[DISPLAY] : 4B [HEX] 4A [HEX] S [HEX] I [HEX] M [HEX]

2. Move the screen cursor to the DISPLAY command field you want to change and press the SELECT key to change the radix or to turn off the field. For example, to change the radix for the S and I fields to BIN (binary), and to turn off the M field:

[DISPLAY] : 4B [HEX] 4A [HEX] S [BIN] I [BIN] M [OFF]

The DAS will then change the display of the S, I, and M fields as follows:

SEQ	LABEL	4B	4A	S	I	M	SEQ FLOW, CONTROL	REG, OUT
0		FF	FF	00	00			LOAD R
1	LOOP	01	00	00	00		IF R=0 JUMP	END
2		02	00	00	00		JUMP	LOOP
3		03	00	00	00			DECR R
4	END	04	00	00	00			OUT R
5		05	00	00	00			OUT R
6		06	00	00	00			
7		07	00	00	00			
8		08	00	00	00			
9		09	00	00	00			

[DISPLAY] : 4B [HEX] 4A [HEX] S [BIN] I [BIN] M [OFF]

FILL Use the FILL command to automatically fill in the values of the #B (POD-B data), #A (POD-A data), S (Strobe), I (Internal Inhibit), and M (Interrupt Mask) fields with some constant values. For instance, if you knew you wanted all the sequence lines from line 20 through line 30 to have the same data value for POD-A, you could use the FILL command to automatically enter that value in each data field instead of having to enter the value for each line individually.

You might use this command to change all the default values in the S (Strobe) field from 0s to 1s, or you might want to protect a block of sequence lines from external interrupts by programming a 1 into the M (Interrupt Mask) field for each line.

The FILL command displays its own fields which are used to modify each of the Run sub-menu's data, S, I, and M columns simultaneously. You can use this command to modify all of the columns in a single operation, or you can choose to modify just one or two columns at a time. Entering a DON'T CARE (X) into a FILL command field means that column's data will not be affected by the editing operation. For example, entering a DON'T CARE into the FILL command's S field means that values entered into the Run sub-menu's strobe column will not be affected by a FILL operation.

To use the FILL command:

1. Select the FILL command by pressing the SELECT key while the cursor is in the edit command field at the bottom of the DAS display.
2. Move the screen cursor to the SEQ field:

SEQ	LABEL	4B	4A	S	I	M	SEQ FLOW, CONTROL	REG, OUT
0		FF	FF	0	0	0		LOAD R
1	LOOP	01	00	0	0	0	IF R=0 JUMP	END
2		02	00	0	0	0	JUMP	LOOP DEC R
3		03	00	0	0	0		OUT R
4	END	04	00	0	0	0		OUT R
5		05	00	0	0	0		
6		06	00	0	0	0		
7		07	00	0	0	0		
8		08	00	0	0	0		
9		09	00	0	0	0		

[FILL] : SEQ [] THROUGH []
 --- [XX XX] [X] [X] [X] -----

2. Use the data entry keys to enter the starting and ending sequence numbers. Then move the cursor to the appropriate field and enter the pattern you wish to place in all the corresponding fields within that sequence range. For example, to fill SEQ lines 1 through 4 with "XX AA X 0 1":

[FILL] : SEQ [1] THROUGH [4]
 --- [XX AA] [X] [0] [1] -----

3. Press the EXECUTE key to start the FILL operation. The DAS will display the message "FILLED SEQ 1 THROUGH 4" on the second line of the display when the FILL operation has been completed. The DAS will also blank the SEQ and THROUGH fields, but not the pattern fields.

SEQ	LABEL	4B	4A	S	I	M	SEQ FLOW, CONTROL	REG, OUT
0		FF	FF	0	0	0		LOAD R
1	LOOP	01	AA	0	0	1	IF R=0 JUMP	END
2		02	AA	0	0	1	JUMP	LOOP DEC R
3		03	AA	0	0	1		OUT R
4	END	04	AA	0	0	1		OUT R
5		05	00	0	0	0		
6		06	00	0	0	0		
7		07	00	0	0	0		
8		08	00	0	0	0		
9		09	00	0	0	0		

[FILL] : SEQ [] THROUGH []
 --- [XX AA] [X] [0] [1] -----

INSERT Use the INSERT command to insert additional sequence lines into the Program Run sub-menu. The number of additional lines specified in the LINE(S) field are inserted just before the destination sequence line. The SEQ numbers for all the sequence lines are then updated. Newly inserted sequence lines always contain default values.

NOTE

If you are adding sequence lines to a program already containing 1023 lines (IRQ CALL enabled) or 1024 lines (IRQ CALL disabled), you will force the last lines in your program out of memory. The number of lines lost will correspond to the number of new lines inserted. If you must add new sequence lines to a lengthy pattern, use the DELETE command first to remove unnecessary lines and make room for the new lines.

To insert sequence lines:

1. Select the INSERT command by pressing the SELECT key while the cursor is in the edit command field at the bottom of the Program Run sub-menu.
2. Move the screen cursor to the LINE(S) field.

SEQ	LABEL	4B	4A	S	I	M	SEQ FLOW, CONTROL	REG, OUT
0		FF	FF	0	0	0		LOAD R
1	LOOP	01	00	0	0	0	IF R=0 JUMP	END
2		02	00	0	0	0	JUMP	LOOP
3		03	00	0	0	0		DECR R
4	END	04	00	0	0	0		OUT R
5		05	00	0	0	0		OUT R
6		06	00	0	0	0		
7		07	00	0	0	0		
8		08	00	0	0	0		
9		09	00	0	0	0		

[INSERT] : [] LINE(S) BEFORE SEQ []

2. Use the data entry keys to specify the number of lines you wish to add, and the sequence line where they are to be inserted. For example, to insert 3 lines before SEQ 2:

[INSERT] : [3] LINE(S) BEFORE SEQ [2]

- Press the EXECUTE key to start the INSERT operation. The DAS will display the message "INSERTED 3 LINE(S) BEFORE SEQ 2" in the message field when the insert operation has been completed. The DAS will also update the remaining sequence numbers, and blank the LINE(S) and SEQ fields to prevent accidental insertions.

SEQ	LABEL	4B	4A	S	I	M	SEQ FLOW, CONTROL	REG, OUT
0		FF	FF	0	0	0		LOAD R
1	LOOP	01	00	0	0	0	IF R=0 JUMP	END
2		00	00	0	0	0		
3		00	00	0	0	0		
4		00	00	0	0	0		
5		02	00	0	0	0	JUMP	LOOP
6		03	00	0	0	0		DECR R
7	END	04	00	0	0	0		OUT R
8		05	00	0	0	0		OUT R
9		06	00	0	0	0		
10		07	00	0	0	0		
11		08	00	0	0	0		
12		09	00	0	0	0		

[INSERT] : [] LINE(S) BEFORE SEQ []

MODIFY The MODIFY command uses logical operators to manipulate data already entered into the Program Run sub-menu. Three logical operators are available: AND, OR, and XOR (exclusive OR). Any programmable numeric column in the Run sub-menu can be modified by using these operators. For instance, you can modify one or both of the data fields, and the S (strobe), I (internal inhibit), and M (interrupt mask) fields, or any combination of the above. You can also limit the modification to a range of sequence numbers.

By ANDing a particular column with 0, you can modify all the data in that column to 0s. (Any number ANDed with 0 equals 0.) By ORing a column with a 1, you can set all the bits in that column to 1. (Any number ORed with a 1 equals 1.) By XORing any pattern with a 1, the bit pattern in that field is inverted. (In other words, all FFs *hex* would be changed to 00s, and all 11s *hex* become EEs.)

Here are reminder truth tables for the AND, OR, and XOR operations:

A AND B

A	B	A AND B
0	0	0
0	1	0
1	0	0
1	1	1

A OR B

A	B	A OR B
0	0	0
0	1	1
1	0	1
1	1	1

A XOR B

A	B	A XOR B
0	0	0
0	1	1
1	0	1
1	1	0

To MODIFY a column's data:

1. When the screen cursor is in the edit command field, press the SELECT key until the MODIFY command is displayed.
2. Move the screen cursor to the field immediately to the right of MODIFY and press the SELECT key until the desired logical operator is displayed. Logical operators are displayed in this order: AND, OR, XOR.

SEQ	LABEL	4B 4A	S	I	M	SEQ FLOW, CONTROL	REG, OUT
0		FF FF	0	0	0		LOAD R
1	LOOP	01 00	0	0	0	IF R=0 JUMP	END
2		02 00	0	0	0	JUMP	LOOP
3		03 00	0	0	0		DECR R
4	END	04 00	0	0	0		OUT R
5		05 00	0	0	0		OUT R
6		06 00	0	0	0		
7		07 00	0	0	0		
8		08 00	0	0	0		
9		09 00	0	0	0		

[MODIFY] : LOGICAL [AND] SEQ [] THROUGH []
 --- [XX XX] [X] [X] [X] -----

3. Move the screen cursor to the SEQ and THROUGH fields. Use the data entry keys to enter the number of the first and last sequence line you want to modify. For example, to modify sequence lines 1 through 9, enter:

[MODIFY] : LOGICAL [XOR] SEQ [1] THROUGH [9]
 --- [XX XX] [X] [X] [X] -----

4. Move the screen cursor down to the pattern line and enter the pattern you wish to use as a modifier. For example, to invert all the column B data pattern, select XOR as the logical operator and enter FFhex in the column B field. (Fields containing X are not affected by the MODIFY command.)

[MODIFY] : LOGICAL [XOR] SEQ [1] THROUGH [9]
 --- [FF XX] [X] [X] [X] -----

5. Press the EXECUTE key to start the MODIFY operation. The DAS will display the message "MODIFIED SEQ 1 THROUGH 9" in the message field at the top left-hand corner of the display. The DAS will also blank the SEQ and THROUGH fields to prevent accidental operation.

SEQ	LABEL	4B 4A	S	I	M	SEQ FLOW, CONTROL	REG, OUT
0		FF FF	0	0	0		LOAD R
1	LOOP	FE 00	0	0	0	IF R=0 JUMP	END
2		FD 00	0	0	0	JUMP	LOOP
3		FC 00	0	0	0		DECR R
4	END	FB 00	0	0	0		OUT R
5		FA 00	0	0	0		OUT R
6		F9 00	0	0	0		
7		F8 00	0	0	0		
8		F7 00	0	0	0		
9		F6 00	0	0	0		

[MODIFY] : LOGICAL [XOR] SEQ [] THROUGH []
 --- [FF XX] [X] [X] [X] -----

MOVE Use the MOVE command to move a block of sequence lines within a program to another location within that same program. When MOVE is executed, all the specified sequence lines are moved to a location just before the given destination sequence line. The sequence numbers are then automatically updated. Labels, data, and instructions are retained when sequence lines are moved.

Using the MOVE command will not destroy high-numbered program lines even if all 1024 lines have been programmed.

To MOVE a block of sequence lines from one location to another:

1. Select the MOVE command by pressing the SELECT key when the screen cursor is in the edit command field at the bottom of the 91S16 Program Run sub-menu.
2. Move the screen cursor to the SEQ field.

SEQ	LABEL	4B	4A	S	I	M	SEQ FLOW, CONTROL	REG, OUT
0		FF	FF	0	0	0		LOAD R
1	LOOP	01	00	0	0	0	IF R=0 JUMP	END
2		02	00	0	0	0	JUMP	LOOP DECR R
3		03	00	0	0	0		OUT R
4	END	04	00	0	0	0		OUT R
5		05	00	0	0	0		
6		06	00	0	0	0		
7		07	00	0	0	0		
8		08	00	0	0	0		
9		09	00	0	0	0		

[MOVE] : [SEQ] [] THROUGH [] BEFORE SEQ []

3. Use the data entry keys to enter the starting, ending, and destination sequence numbers. For example, to move sequence lines 1 through 3 and place them before sequence line 7:

[MOVE] : [SEQ] [1] THROUGH [2] BEFORE SEQ [7]

4. Press the EXECUTE key to start the MOVE operation. The DAS will display the message "MOVED SEQ 1 THROUGH 2 BEFORE SEQ 7" on the message line. The DAS will also update all the sequence lines and blank the SEQ, THROUGH, and BEFORE fields to prevent accidental move operations.

SEQ	LABEL	4B	4A	S	I	M	SEQ FLOW, CONTROL	REG, OUT
0		FF	FF	0	0	0		LOAD R
1		03	00	0	0	0		OUT R
2	END	04	00	0	0	0		OUT R
3		05	00	0	0	0		
4		06	00	0	0	0		
5	LOOP	01	00	0	0	0	IF R=0 JUMP	END
6		02	00	0	0	0	JUMP	LOOP DECR R
7		07	00	0	0	0		
8		08	00	0	0	0		
9		09	00	0	0	0		

[MOVE] : [SEQ] [] THROUGH [] BEFORE SEQ []

SEARCH Use the SEARCH command to locate some specific entry within the body of the Program Run sub-menu. The entry may be a label, a particular data pattern, or an instruction.

The SEARCH command allows you to specify the type of entry you are going to search for, and to specify a sequence range for the search. When executed, the SEARCH command compares all entries of the same type against the target string within the range of sequence lines you have specified. It will then place the screen cursor on the first sequence line containing that string, and display the total number of lines within the specified range that contain the target string. (The line total appears in the bottom right-hand corner of the display.)

The data entry keys can be used to select the second, or third, etc. sequence line containing the target string when the screen cursor is in the [] / # : SEARCHED field. (Instructions for using this field are included in the following paragraphs.)

To use the SEARCH command:

1. Select the SEARCH command by moving the screen cursor to the edit command field at the bottom of the Program Run sub-menu and pressing the SELECT key.
2. Select the type of pattern you are going to search for by moving the screen cursor to the field immediately to the right of the SEARCH: command.

[SEARCH] : [LABEL] SEQ [] THROUGH []
 [] - - - - -

3. Press the SELECT key until the desired target group appears in the field.

The DAS will display the target groups in this order:

- [LABEL]
- [PATTERN]
- [SEQ FLOW]
- [JUMP LABEL]
- [CONTROL]
- [REG]
- [OUT]

To SEARCH for a data pattern:

1. Move the screen cursor to the field immediately to the right of SEARCH:

SEQ	LABEL	4B	4A	S	I	M	SEQ FLOW, CONTROL	REG, OUT
0		FF	FF	0	0	0		LOAD R
1	LOOP	01	00	0	0	0	IF R=0 JUMP	END
2		02	00	0	0	0	JUMP	LOOP
3		03	00	0	0	0		OUT R
4	END	04	00	0	0	0		OUT R
5		05	00	0	0	0		
6		06	00	0	0	0		
7		07	00	0	0	0		
8		08	00	0	0	0		
9		09	00	0	0	0		

[SEARCH] : [LABEL] SEQ [] THROUGH []
 [] - - - - -

2. Press the SELECT key until the target group PATTERN appears in the field.

```
[ SEARCH ] : [ PATTERN ] SEQ [   ] THROUGH [   ]
----- [XX XX] [X] [X] [X] -----
```

3. Move the screen cursor to the SEQ and THROUGH fields and enter the starting and ending sequence numbers for the block of program you wish to search. For example, enter SEQ 0 THROUGH 10 to search for a pattern programmed in lines 0 through 10 inclusive. Note: The larger the search range you specify, the longer it takes for the edit operation to be completed. This also increases the likelihood you will locate data you are not interested in.
4. Move the screen cursor to the PATTERN sub-fields and use the data entry keys to enter the pattern you wish to search for. For example, enter:

```
[ SEARCH ] : [ PATTERN ] SEQ [ 0 ] THROUGH [ 10]
----- [10 00] [X] [X] [X] -----
```

DON'T CAREs (X's) will match any pattern.

5. Press the EXECUTE key to start the SEARCH operation. The DAS will display the message, "<[1]/ 1 : SEARCHED>" in the bottom right-hand corner of the display. The first number in this message indicates that the screen cursor has been placed on the line containing the first occurrence of the target pattern. The number following the slash tells you how many lines contain the target pattern within the range you specified for the search.

For example, if you had searched for 00 in a block of text where 15 lines contained the pattern 00, the message would read, "<[1]/ 15 : SEARCHED>". To see the 14th occurrence of the target pattern, you would move the screen cursor to the highlighted field in the first part of this message and type in 14. When you press the EXECUTE key, the screen cursor will be placed on the line containing the 14th occurrence of the target pattern, and the message field will read, "<[14]/ 15 : SEARCHED>".

To SEARCH for an instruction:

1. To SEARCH for an instruction (for example: R OUT) move the screen cursor to the field immediately to the right of SEARCH: and press the SELECT key until the appropriate instruction type appears in the field. In the case of R OUT, we want the OUT (output register) instruction type to be displayed in this field.

```
[ SEARCH ] : [ OUT ] SEQ [   ] THROUGH [   ]
----- [OUT R]
```

2. Move the screen cursor to the SEQ and THROUGH fields and use the data entry keys to enter the starting and ending sequence line numbers for the block of program you wish to search. For example, to search for some target pattern between sequence lines 3 and 10, enter SEQ 3 THROUGH 10.
3. Move the screen cursor to the OUT sub-field in the lower right-hand corner of the display. Press the SELECT key until the desired OUT instruction appears in the field. Note that in this case [OUT R] appears as the default choice. If you had configured the 91S16 register to be two 8-bit registers, you would have to move the screen cursor to this field and press the SELECT key until the desired instruction appeared. (OUT RA and OUT RB would be the choices in this case.)

```
[ SEARCH ] : [ OUT ] SEQ [ 3 ] THROUGH [ 10]
----- [OUT R]
```

4. Press the EXECUTE key to start the SEARCH operation. The DAS will display the message "<[1]/ 2 : SEARCHED>" on the last line of the display to indicate that the SEARCH operation has been completed. The DAS will also blank the SEQ and THROUGH fields, and position the screen cursor on the first sequence line containing the target pattern.

SEQ	LABEL	4B 4A	S	I	M	SEQ FLOW, CONTROL	REG, OUT
0		FF FF	0	0	0		LOAD R
1	LOOP	01 00	0	0	0	IF R=0 JUMP	END
2		02 00	0	0	0	JUMP	LOOP DECR R
3		03 00	0	0	0		OUT R
4	END	04 00	0	0	0		OUT R
5		05 00	0	0	0		
6		06 00	0	0	0		
7		07 00	0	0	0		
8		08 00	0	0	0		
9		09 00	0	0	0		

```
[ SEARCH ] : [OUT      ] SEQ [ 3] THROUGH [ 10]
-----
                    [OUT R]
```

NOTE

In the above display sample, the range specified for the SEARCH operation was from SEQ 3 through SEQ 10. That is why the first OUT R instruction found was on line 3, rather than on line 2.

5. Use the data entry keys to enter a value in the "<[1]/ 2 : SEARCHED>" message field if you wish to see a different sequence line containing the target pattern. For instance, if you wanted to see the second sequence line containing OUT R, you would move the screen cursor to the inverse-video field within the message and type a 2:

```
<[ 2]/ 2 : SEARCHED>
```

When you push the EXECUTE key the DAS will display:

SEQ	LABEL	4B 4A	S	I	M	SEQ FLOW, CONTROL	REG, OUT
0		FF FF	0	0	0		LOAD R
1	LOOP	01 00	0	0	0	IF R=0 JUMP	END
2		02 00	0	0	0	JUMP	LOOP DECR R
3		03 00	0	0	0		OUT R
4	END	04 00	0	0	0		OUT R
5		05 00	0	0	0		
6		06 00	0	0	0		
7		07 00	0	0	0		
8		08 00	0	0	0		
9		09 00	0	0	0		

```
[ SEARCH ] : [OUT      ] SEQ [ 3] THROUGH [ 10]
-----
                    [OUT R]
```

The message would then display, "<[2]/ 2 : SEARCHED>". Of course, this feature is more dramatic when the sequence lines containing the target pattern are farther apart.

91S32 PROGRAM: RUN MODE SUB-MENU FIELDS AND VALUES

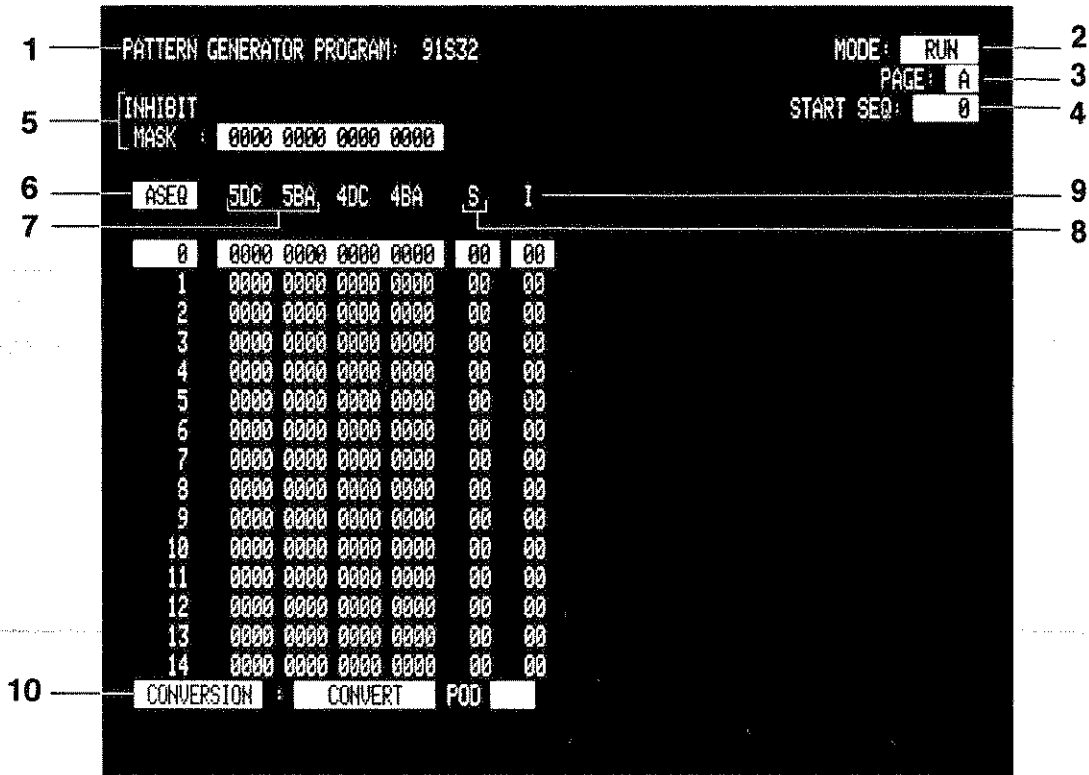
NOTE

The 91S32 Program Run Mode sub-menu appears only when the 91S32 Module is installed.

The following paragraphs describe how to use the 91S32 Program Run Mode sub-menu to enter patterns for the 91S32 Pattern Generator Module. They discuss each sub-menu field and list all optional values.

Figure 22 illustrates the 91S32 Pattern Generator Run Mode sub-menu and its fields. The fields, which appear in reverse video on the screen, are bracketed [] throughout the text. The four directional cursor keys and the NEXT key can be used to move the blinking screen cursor from one field to another.

Refer to the numbered callouts in Figure 22 when reading the following paragraphs. These numbers serve as visual references and do not imply sequence of use.



5396-28

Figure 22. 91S32 Program: Run sub-menu.

NOTE

In the following discussion, the three 91S32 Modules are assumed to reside in DAS slots 3, 4, and 5.

1 PATTERN GENERATOR PROGRAM Field

Use this field (directly to the right of the menu title) to select either the 91S16 or the 91S32 sub-menu display. Refer to the description of the Sub-Menu Selections in the *Menu Overview* section of this addendum. If the 91S16 Module is installed, the 91S16 sub-menu is displayed as the default sub-menu. Otherwise, the 91S32 sub-menu is displayed.

To change the display to show the 91S32 sub-menu:

1. Move the screen cursor to the field directly to the right of the menu title.
PATTERN GENERATOR PROGRAM: [91S16]
2. Press the SELECT key until 91S32 appears in the field.

The DAS displays the sub-menu titles in this order:

[91S16]

[91S32]

2 MODE Field

Use the MODE field to select the Pattern Generator's operating mode.

The pattern generator normally outputs data in real-time fashion synchronously with the clock signal. This is called Run mode, hence the name of this sub-menu. The pattern generator can also output data at much slower rates, or even one step at a time, for debugging purposes. These modes of operation are called Trace and Step modes, and are described in the *Trace Mode and Step Mode* section of this manual.

Press the SELECT key when the screen cursor is in the MODE field to change between Run, Trace, and Step modes. The MODE field defaults to Run mode on power-up.

3 PAGE Field

The 91S16 sequential pattern generator can act as a controller for one or more 91S32s. However, the 91S16 has only 1024 lines of pattern memory, compared to the 91S32 which has 2048 lines of pattern memory. You can divide the 91S32's memory into two 1024-line pages and use the 91S16 INCR PAGE command to switch between the two pages. This approach has several programming advantages which are explained under the SEQUENTIAL and FOLLOWS modes descriptions in the *91S32 Configuration Menu* section. The PAGE field indicates which PAGE of memory (A or B) is being displayed.

Note that there are two possible sequence numbering schemes for the 91S32. The SEQ field has two possible values: ASEQ and RSEQ. Instructions for changing between these values are given later in this section, but the numbering scheme selected affects the PAGE field. When ASEQ (Absolute Sequence) is selected, the 91S32's program lines are numbered from 0 through 2047; page B will start with sequence 1024. RSEQ stands for Relative Sequence (relative to page A or page B). When RSEQ is selected, the 91S32's program lines are numbered from 0 through 1023 for page A, and from 0 through 1023 for page B. Use the numbering scheme that is most convenient to you.

If you are using the 91S32 with its memory divided into two pages, you can select which page of data appears on the display. The default value for the PAGE field is A.

To display the other memory page:

1. Move the screen cursor to the PAGE field.

PAGE: [A]

2. Press the SELECT, INCR, or DECR key until the desired value appears in this field. For example, select page B:

[B]

4 START SEQ Field

Use the START SEQ field to designate the first sequence line the pattern generator will execute when you press the START PAT GEN key or the START SYSTEM key.

If the 91S32 is being used without a 91S16, or if the 91S32 is being used with a 91S16 in the SEQUENTIAL mode, the number you enter in the START SEQ field will determine the first sequence line executed. If the 91S32 is being used with a 91S16 in the FOLLOWS mode, you cannot set a value in this field, since the starting sequence will be set by the 91S16. For an explanation of SEQUENTIAL and FOLLOWS modes, see the *91S32 Configuration Menu* section of this manual.

The START SEQ number you enter will depend on how you have configured your SEQ field: either ASEQ (absolute sequence numbers) or RSEQ (relative sequence numbers). If the sequence number field is set to ASEQ, you can enter a START SEQ value between 0 and 2047. (IRQ enabled CALL <label> mode reduces the number of available sequence lines by one.) If you have set the sequence number field to RSEQ, you must set the memory page (A or B) and enter a sequence number between 0 and 1023. See the *SEQ Field* description later in this section for information on selecting ASEQ or RSEQ.

This field defaults to page A and sequence 0.

To specify the page and the sequence number for the START SEQ:

1. Move the screen cursor to the START SEQ field.

START SEQ: [A] [0]

2. Press the SELECT, INCR, or DECR key to change the page. For example, to select page B:

[B] [0]

3. Use the data entry keys to enter the starting sequence number. For example, to start the pattern generator at line 500:

[B] [500]

5 INHIBIT MASK Field

Use the INHIBIT MASK field to specify whether or not the data output channels respond to the inhibit signal. If the inhibit mask for a given data channel is set to 0 (unmasked), then that data channel is tri-stated whenever the inhibit signal is asserted. If the inhibit mask is set to 1 (masked), then the inhibit signal is masked out and that data channel is not tri-stated, even though the inhibit signal has been asserted. You can set the inhibit mask for each individual data channel in a pod by specifying a hexadecimal value in the INHIBIT MASK field. The default value for this field is 0 (unmasked for all data channels).

To specify the inhibit mask for a data pod:

1. Move the screen cursor to the INHIBIT MASK field:

```
INHIBIT
  MASK : [0000 0000 0000 0000 0000 0000]
```

2. Use the data entry keys to specify (in hexadecimal) the inhibit mask for each data pod. The DAS will automatically move the screen cursor one space to the right after you have entered a value.

```
INHIBIT
  MASK : [F000 0E00 00D0 000C B000 0A00]
```

6 SEQ (Sequence) Field

The SEQ field consists of a column of numbers running down the left side of the display. Each number in this column corresponds to one sequence line. The program lines are displayed sequentially starting with page A, sequence 0. There are 2048 total sequence lines, but they can be numbered either of two ways. When the SEQ field is set to ASEQ (absolute sequence numbers), the sequence lines are numbered from 0 through 2047. When the SEQ field is set to RSEQ (relative sequence numbers), the sequence lines are divided into two pages of data, page A and page B. The sequence lines are numbered page A, 0 through 1023, and page B, 0 through 1023. Dividing the memory into two pages has certain programming advantages explained under the *91S32 Configuration Menu* description. The PAGE field description in this section explains how to switch from one page to the other. Only a portion of the sequence lines are displayed at any given time.

To select either ASEQ or RSEQ:

1. Move the screen cursor to the SEQ field.

```
[ASEQ] 5DC 5BA 4DC 4BA 3DC 3BA S I
```

2. Press the SELECT key until the desired value appears in this field. For example, RSEQ.

The DAS displays optional values in this order.

```
[ASEQ]
[RSEQ]
```

You can display different sequence lines several different ways. The first method is to use the scroll keys. You can use these keys at any time and with the cursor in any field.

To scroll through the sequences:

1. Press the up (↑) or down (↓) scroll key. Additional sequence lines will scroll up from the bottom or down from the top of the display.

The second method for viewing more program lines requires you to enter a new number over an existing number displayed in the SEQ field. This method allows you to jump forward or backward and display specific blocks of sequence lines.

To move forward and display larger-numbered sequence lines:

1. Move the screen cursor to the sequence number you wish to change. For example, move the cursor to SEQ 11:

```
[ASEQ]
[ 11]
```

2. Use the data entry keys to enter the first sequence number you wish to have displayed. For example, SEQ 200. The DAS will display [200] in place of [11], and then update the rest of the sequence lines following that position.

```
[ASEQ]
0
1
2
3
4
5
6
7
8
9
10
[ 200]
201
202
203
```

SEQ 11 is changed to SEQ 200
and the rest of the sequence
numbers are updated from that
position to the bottom of the display.

To move backward to a smaller-numbered block of program lines:

NOTE

The preceding sequence number on the display must always be smaller than the number you enter. If you want to display a number smaller than any currently displayed, you must enter that number in the top-most SEQ field on the display.

1. Move the screen cursor to the sequence number you wish to replace with a lower number. For example, SEQ 200.

```
[ASEQ]
[200]
```

2. Press the DON'T CARE key.

The DAS enters a 0 at the cursor location.

3. Use the data entry keys to enter the sequence number to be displayed. For example, 15.

The DAS displays SEQ 15 at the cursor location, then updates the rest of the sequences from that position.

[ASEQ]

0

1

2

3

4

5

6

7

8

9

10

[15] SEQ 200 is changed to SEQ 15,

16 and the rest of the sequence

17 numbers are updated from

18 that position.

NOTE

When using the above procedures, observe the following two rules: 1) if the cursor is positioned below the top sequence number on the display, you cannot enter a number smaller than the number directly above the cursor location. 2) you cannot enter a number greater than 2047 for ASEQ and 1023 for RSEQ.

7 #DC and #BA Pattern Field

The pattern fields that appear on the sub-menu are used to specify the data pattern you wish to output through the P6464 probes. Data channels are grouped into pods of eight channels that correspond to a particular P6464 probe. A data pod is identified by a letter-number scheme called pod I.D. The pod I.D. number references the slot in the DAS where the 91S32 Module resides. The letters identify the connectors on the back of the 91S32 where the probes are attached. For example, a 91S32 installed in DAS slot 5 would have data column headings named 5DC and 5BA.

Data values are normally entered in hexadecimal, one pod at a time, card by card, and one line at a time. In other words, you would program the pattern for Pod D, and then Pod C, Pod B, and finally Pod A. If you had another 91S32, you would repeat this procedure until all pods had been programmed, and then move to the next sequence line. When the pattern generator is running, all pods output data synchronously with the output clock.

See the *DISPLAY Command* description later in this section for information about changing the display radix of the data columns. Data channels default to 0 for all cards and pods.

To enter data on any program line:

1. Move the screen cursor to the pattern field in the line you wish to program. Position the cursor over the pod to be programmed.

6DC	6BA	5DC	5BA	4DC	4BA
[0000	0000	0000	0000	0000	0000]

2. Use the data entry keys to enter the pattern you desire. The DAS will display the data values you have entered in the field and then shift the cursor one space to the right. For example, enter the value *3hex* for the 91S32 in DAS slot 6, pod D:

6DC	6BA	5DC	5BA	4DC	4BA
[3000	0000	0000	0000	0000	0000]

3. Continue entering data values until all the pods have been programmed. Then press the NEXT key and the cursor will move to the first data field of the next line.

8 S (Strobe) Field

Use the S field to select whether or not the strobe lines associated with each pod will be output when this particular program line is executed. This field allows you to individually assert the strobe signals for pods D, C, B, and A. Data pods are grouped into pairs, and each pair is represented by a column in the Strobe field. Strobe values are entered according to the display radix.

When more than one 91S32 is installed, the Strobe field width will expand. Strobe field columns will correspond to the order of data-field columns. In other words, the data column displayed at the left of the screen will correspond to the two high-order bits in the strobe field.

Strobes function just like additional data lines. The strobe transitions are synchronous with the output clock. The strobes are asserted by entering a 1 *binary* into the sequence line's associated S bit. (Note: Pay attention to the display radix.) In default, the strobes are set to 0s. See the *DISPLAY Command* description later in this section for instructions on changing the strobe field display radix.

To assert a strobe:

1. Move the screen cursor to the S field on the line you wish to program.

S
[000]

2. Use the data entry keys to enter the data value. For example, to assert the strobes of both pod 5A and 3D in hex, enter 108.

[108]

9 I (Inhibit) Field

Use the I (Inhibit) field to set the internal inhibit signal. The internal inhibit signal temporarily tri-states the output of one or all of the pods. Data pods are grouped into pairs, and each pair is represented by a column in the Inhibit field. Pods displayed on the left will be represented by the left-most column in the Inhibit field. Inhibit field values are entered for two pods at a time, usually in hexadecimal.

When more than one 91S32 is installed, the Inhibit field width will expand. Inhibit field columns will correspond to the order of the data-field columns. In other words, the data column displayed at the left of the screen will correspond to the two high-order bits in the Inhibit field.

The 91S32 provides two kinds of inhibit signals: Internal inhibits programmed in the 91S32 Program Run sub-menu, and External inhibits, delivered to the 91S32 via the P6452 External Clock (Data Acquisition) probe attached to the DAS Trigger/Time Base module. The 91S32 Configuration sub-menu allows you to select the polarity of each inhibit signal, and combine the two signals using logical operators.

For the following example, assume that the inhibit signals have been set to the following values: INHIBIT [INTERNAL 1] ONLY. (See the *91S32 Configuration Sub-Menu* description earlier in this addendum.)

Setting a *0hex* in the I (Inhibit) field means that neither pod in the pair is tri-stated and both pods will continue to output data, clock, and strobe lines. Setting a *1hex* in this field will tri-state the outputs of Pod A. Setting a *3hex* in this field will cause pods A and B to be tri-stated.

Note that some data may still be output from a pod that has been tri-stated, because any value you set in the INHIBIT MASK field will cause certain data lines to ignore the inhibit signal. Inhibit mask fields for the strobe and clock lines appear in the Configuration sub-menu.

Values for the I (Inhibit) field must be set for every sequence line. The default value is 0 and the default radix is hexadecimal. See the DISPLAY command description under the *91S32 RUN Sub-Menu* section for instructions on selecting a different display radix. The internal inhibit signal becomes effective in sync with the output clock.

If you are logically combining the internal and external inhibit signals in the Setup: Probe sub-menu, it is wise to check the inhibit interaction by viewing a portion of your program while in Step mode.

To assert an internal inhibit:

1. Move the screen cursor to the line you wish to program and position the cursor over the appropriate I field. In this example, there are 91S32s in DAS slots 6, 5, and 4.

```

      I
      [000]
  
```

2. Use the data entry keys to enter the data value. For example, to assert the internal inhibits for pods 5A, 4D and 4C in hex, enter 1CO.

The DAS will display the value you enter in the I field:

```

      I
      [1CO]
  
```

10 EDIT Fields

The 91S32 Module provides nine edit commands to manipulate data patterns on program lines. These commands are designed to simplify programming.

To select the edit command:

1. Move the screen cursor to the edit field at the bottom of the screen:

```
[CONVERSION] : [CONVERT  ] POD [  ]
```

2. Press the SELECT key until the desired command appears in the field. In addition to the SELECT key, the INCR and DECR keys may also be used to select from the edit commands. The INCR key selects the next command given in the list below, and the DECR key selects the previous command. Pressing any one of these keys will cause the DAS to scroll through the list of options.

The DAS will display the list of possible edit commands in this alphabetical sequence:

```
[CONVERSION ]
[COPY        ]
[DELETE     ]
[DISPLAY    ]
[FILL       ]
[INSERT     ]
[MODIFY     ]
[MOVE       ]
[SEARCH     ]
```

Each edit command has a specialized function. The CONVERSION command has a sub-menu used to make and check a conversion table. Several commands have sub-fields you will use to specify starting and ending sequence lines, or select among additional sub-commands. Some of the commands will have fields that require you to enter setup and editing parameters.

3. After entering the changes you wish to make for any of the edit operations, press the EXECUTE key. Some of the fields, such as those pertaining to sequence numbers, will be blanked after the edit operation has been completed. This is to prevent you from accidentally pressing EXECUTE again and damaging your corrected program.

The following paragraphs briefly describe what each of the edit commands does, and how to use them.

CONVERSION The CONVERSION command allows you to search for and replace all pattern data values with corresponding different values in one operation. For instance, if you knew you wanted to replace all FFs in your program with AAs, and replace all 1Es with 00s, you could use the CONVERSION command to do that in one operation.

This feature is most commonly used when you are converting data from one coding system to another, such as from a normal binary counting method to Gray code where only one bit changes as numbers are incremented.

The CONVERSION command has two sub-commands: CONVERT, which designates which pod's data is to be converted, and TABLE BUILD. The TABLE BUILD command displays a special sub-menu called the TABLE BUILD sub-menu that allows you to specify which bit patterns are to change. Instructions for using this sub-menu are included in the following paragraphs.

CONVERT This sub-command instructs the pattern generator to apply the conversion rules outlined in the TABLE BUILD sub-menu to the data in a particular pod. The way in which the TABLE BUILD sub-menu performs conversions will become clear as you read this section. If you had a 91S32 in DAS slot 1 and you wanted to modify the data programmed for Pod B according to the changes given in the TABLE BUILD sub-menu, you would type:

```
[CONVERSION] : [ CONVERT ] POD [1B]
```

Press the EXECUTE key to initiate the conversion.

The TABLE BUILD sub-menu only operates on one pod of data at a time, so if you wanted to convert all data patterns for a 91S32 in DAS slot 1 from one code to another, you would have to CONVERT POD 1A, and then CONVERT POD 1B, 1C and 1D. You will have to run the conversion program four more times for each additional 91S32 to convert all the data from one code to another. However, you will often use the different pods for different purposes, and you may only want to convert one pod's data and leave the rest unchanged.

To specify which pod's data will be converted:

1. Move the screen cursor to the POD field.

```
[CONVERSION] : [ CONVERT ] POD [ ]
```

2. Use the data entry keys to enter a pod I.D. For example, pod 6B. The DAS will display the pod I.D. in the POD field.

```
[CONVERSION] : [ CONVERT ] POD [6B]
```

3. Press the EXECUTE key to start the conversion. The DAS will display "CONVERTED POD 6B" on the second line of the screen when the conversion has been completed. The DAS will also blank the POD field to prevent accidental conversions later.

TABLE BUILD The TABLE BUILD sub-menu is used to convert an existing data pattern into some modified data pattern. The sub-menu provides two columns of 4-digit binary numbers from 0000 to 1111. However, you can set the column widths to be up to 8-digits wide. The following examples show 8-digit columns to demonstrate the TABLE BUILD's maximum capabilities.

Modifying the bit pattern in the CODE column and executing the CONVERT command on some pod's data will cause all occurrences of the pattern in the DATA field to be converted to the pattern in the CODE field.

For example: When you enter this sub-menu, both the DATA and CODE columns will contain the same bit pattern. Moving the screen cursor to 00000000 in the CODE column, typing in 00000001, and then executing CONVERT POD 1A will cause all occurrences of 00000000 stored as data in Pod-1A to be changed to 00000001.

It may help you to think of the bit patterns in the DATA column as sequence numbers. The bit patterns in the DATA column represent all possible bit patterns. Typing some pattern in a DATA field is one way to move your editing window from one bit pattern to another; it will not change any data.

To invoke the TABLE BUILD sub-menu:

1. Move the screen cursor to the field containing CONVERT.

[CONVERSION] : [CONVERT] POD []

2. Press the SELECT key until TABLE BUILD appears in the field. The TABLE BUILD sub-menu will automatically appear on the screen.

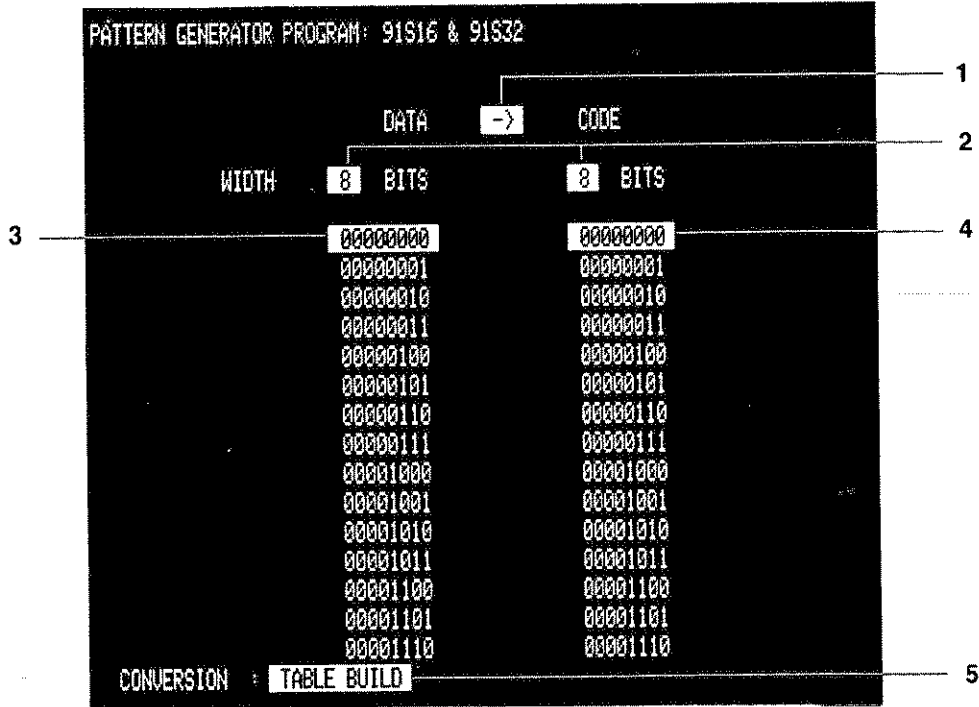


Figure 23. Table Build sub-menu.

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1 → Field

The → field indicates the direction for converting data. If the arrow is pointing to the right, data in the right-hand column will replace the data pattern indicated in the left-hand column. If the arrow is pointing to the left, the pattern in the left-hand column will replace the pattern in the right hand column.

When the arrow is pointing to the right, you can enter the same bit pattern in the right column for any number of bit patterns in the left column. However, when the arrow is pointing to the left, each pattern in the left column must convert to a unique pattern in the right column.

As long as you are mapping a unique pattern in the right column to a unique pattern in the left column, this feature allows you to change the data pattern, and then change back easily if you don't like the results of your first conversion.

This field defaults with the arrow pointing to the right.

To change the direction of the conversion arrow:

1. Move the screen cursor to the arrow field.

DATA [→] CODE

2. Press the SELECT key until the desired arrow appears in the field.

DATA [←] CODE

2 WIDTH Fields

The WIDTH fields are used to select the bit width of the data and code columns. For both columns, you can select bit widths ranging from 1 to 8 bits.

Usually, you will want to set both column widths to the same value. The bit width you select will determine the depth of the corresponding DATA and CODE fields. However, if you select a width of 4-bits for the DATA column and 5-bits for the CODE column, both selection fields will be 16 lines deep (16 possible patterns from 4 bits); the field depth always truncates to match the shorter column. Selecting 8-bit field widths for both columns will generate a TABLE BUILD sub-menu with 256 lines of bit-patterns.

If you shorten the width of either the DATA or CODE fields after entering some longer value into one of the fields, the display will change to show the shorter pattern, but the DAS will retain the longer value in memory until it is turned off. The default width for both fields is 4 bits.

To enter the DATA and CODE fields column widths:

1. Move the screen cursor to the WIDTH field over the column you wish to change.

	DATA	CODE
WIDTH	[4] BITS	[4] BITS

2. Use the data entry keys to enter the desired column width. For example, 8.

	DATA	CODE
WIDTH	[8] BITS	[4] BITS

Remember that no data conversion actually takes place until you EXECUTE the CONVERSION: CONVERT POD [# #] command. Depending on how you configure your replacement data patterns in the TABLE BUILD sub-menu, it is possible that the CONVERT command will try to replace an 8-bit pattern with a smaller, say 4-bit, pattern. In this case, only the lowest four bits of the original pattern would be converted to the new pattern, and the data in the four most significant bits would not be changed. For example, if the original pattern was 11111111_{bin}, and the replacement pattern from the TABLE BUILD sub-menu was 0000_{bin}, the resulting data would be 11110000_{bin}.

3 DATA Column

The DATA column automatically appears whenever the TABLE BUILD sub-menu is selected. The DATA column contains all possible bit-patterns for data entered in the PROGRAM: Run sub-menu. Bit patterns in the DATA column represent existing data, where bit patterns in the CODE column represent planned changes to the data. (The only exception to this is when the direction field has the arrow pointing to the left.)

The depth of the DATA column is dependent on the value entered in the WIDTH field. Since all possible bit patterns for a particular width are shown, most TABLE BUILD sub-menus will be too long to be displayed on one screen.

There are several ways of displaying different parts of the TABLE BUILD sub-menu. The first method is to use the scroll keys on the DAS keyboard.

To scroll through the DATA column sequences:

Press the ↑ or the ↓ scroll key on the keyboard. The DAS will scroll the display up or down.

Another method more suited to big jumps is to enter the desired new pattern in a DATA column field. Just as in moving through sequence lines in the Program Run sub-menu, the DAS will display the DATA line you have entered and fill the rest of the page with DATA lines incrementing from that point.

To move forward through a large block of DATA lines:

1. Move the screen cursor to the data field you wish to change. For example, line 1010.

```

DATA
[0000101]
[0000110]
[0000111]
[00001000]
[00001001]
[00001010]
[00001011]
[00001100]
[00001101]

```

2. Use the data entry keys to enter the first DATA line you wish to display. For example, 11001000.

```

DATA
[0000101]
[0000110]
[0000111]
[00001000]
[00001001]
[11001000] DATA pattern 00001010 is
[11001001] changed to 11001000 and
[11001010] the remaining DATA patterns
[11001011] increase from that line.

```

The DAS will display DATA line 11001000 in place of line 00001010, and then update the rest of the DATA lines following that position.

NOTE

Entering a value in one of the DATA column fields is one way of displaying a different portion of this sub-menu; it will not change the data programmed for a pod in the Run sub-menu.

To display a block of DATA patterns with smaller values:

1. Move the screen cursor to the first DATA line displayed in the TABLE BUILD sub-menu.
2. Use the data entry keys to enter the bit pattern you want to display. The display will fill with data lines starting with the pattern you have entered.

NOTE

The DAS displays DATA patterns in ascending order. To display a DATA value smaller than any currently displayed, enter the new DATA value in the topmost DATA column field.

4 CODE Field

The CODE field is used to enter the pattern you want to end up with after the conversion; the DATA field is the pattern you start with. More than one data pattern may be converted to the same CODE pattern. To do this, enter the same CODE pattern next to two or more DATA patterns.

To enter a pattern into the CODE field:

1. Move the screen cursor to the desired CODE field:

```

          DATA          CODE
    [00000000]    [00000000]
  
```

2. Use the data entry keys to enter the desired pattern. The DAS will display the value you enter in the CODE field:

```

          DATA          CODE
    [00000000]    [00011111]
  
```

3. Repeat this procedure for each line until all the desired patterns are entered in the CODE fields to the right of the existing patterns.

NOTE

If more than one DATA pattern is converted to the same CODE pattern, the conversion from DATA to CODE can not be reversed by switching the [-] field to [+].

5 CONVERSION Field

The CONVERSION field is used to exit the TABLE BUILD sub-menu.

To exit the TABLE BUILD sub-menu:

1. Move the screen cursor to the CONVERSION field:

```

CONVERSION : [TABLE BUILD]
  
```

2. Press the SELECT key. The DAS will display the Run sub-menu.

```

[CONVERSION] : [ CONVERT ] POD [ ]
  
```

COPY The COPY command is used to duplicate sequence lines programmed in the 91S32 Run sub-menu, or to copy the data programmed for one pod to another. This instruction displays a field that allows you to select either SEQ (copy sequences within the Run sub-menu) or POD (copy one pod's data to another pod).

To change the COPY command mode between SEQ and POD:

1. Move the screen cursor to the field to the right of COPY:

```

[ COPY ] : [SEQ] [ ] THROUGH [ ] BEFORE SEQ [ ]
  
```

2. Press the SELECT key until the desired mode appears in the field.

[COPY] : [POD] [] TO []

SEQ Use the SEQ sub-command to duplicate sequence lines of program within the 91S32 Run sub-menu. When the COPY SEQ command is executed, all sequence lines specified are duplicated and placed immediately before the given destination. The sequence numbers for the sub-menu are then updated; labels are retained in the duplicated lines.

NOTE

Using the COPY command when all 2047 ASEQ sequence lines, or all 1023 RSEQ (page A or B) sequence lines have been programmed may cause some high-numbered sequence lines to be lost from memory. The number of sequence lines lost will correspond to the number of new lines inserted. If you must add new sequence lines to a lengthy pattern, use the DELETE command first to remove unnecessary lines and make room for the additions.

To copy sequence lines:

1. Move the screen cursor to the SEQ and THROUGH fields.

[ASEQ]	5DC	5BA	4DC	4BA	3DC	3BA	S	I
0	0123	4567	89AB	CDEF	0123	4567	89A	BCD
1	1234	5678	9ABC	DEF0	1234	5678	9AB	CDE
2	2345	6789	ABCD	EF01	2345	6789	ABC	DEF
3	3456	789A	BCDE	F012	3456	789A	BCD	EF0
4	4567	89AB	CDEF	0123	4567	89AB	CDE	F01
5	5678	9ABC	DEF0	1234	5678	9ABC	DEF	012
6	6789	ABCD	EF01	2345	6789	ABCD	EF0	123
7	789A	BCDE	F012	3456	789A	BCDE	F01	234
8	89AB	CDEF	0123	4567	89AB	CDEF	012	345
9	9ABC	DEF0	1234	5678	9ABC	DEF0	123	456
10	ABCD	EF01	2345	6789	ABCD	EF01	234	567
11	BCDE	F012	3456	789A	BCDE	F012	345	678
12	CDEF	0123	4567	89AB	CDEF	0123	456	789
13	DEF0	1234	5678	9ABC	DEF0	1234	567	89A
14	EF01	2345	6789	ABCD	EF01	2345	678	9AB

[COPY]:[SEQ][] THROUGH [] BEFORE SEQ []

2. Use the data entry keys to enter the starting and ending sequences as well as a destination sequence. For example, to make a copy of sequence lines 0 through 4 and to place them before sequence line 5:

[COPY] : [SEQ] [0] THROUGH [4] BEFORE SEQ [5]

- Press the EXECUTE key to initiate the COPY SEQ command.

The DAS will display the message "COPIED SEQ 0 THROUGH 4 BEFORE SEQ 5" in the message field at the top of the display when the operation is complete. The DAS will also blank the SEQ and THROUGH fields to prevent accidental operation.

[ASEQ]	5DC	5BA	4DC	4BA	3DC	3BA	S	I
0	0123	4567	89AB	CDEF	0123	4567	89A	BCD
1	1234	5678	9ABC	DEF0	1234	5678	9AB	CDE
2	2345	6789	ABCD	EF01	2345	6789	ABC	DEF
3	3456	789A	BCDE	F012	3456	789A	BCD	EF0
4	4567	89AB	CDEF	0123	4567	89AB	CDE	F01
5	0123	4567	89AB	CDEF	0123	4567	89A	BCD
6	1234	5678	9ABC	DEF0	1234	5678	9AB	CDE
7	2345	6789	ABCD	EF01	2345	6789	ABC	DEF
8	3456	789A	BCDE	F012	3456	789A	BCD	EF0
9	4567	89AB	CDEF	0123	4567	89AB	CDE	F01
10	5678	9ABC	DEF0	1234	5678	9ABC	DEF	012
11	6789	ABCD	EF01	2345	6789	ABCD	EF0	123
12	789A	BCDE	F012	3456	789A	BCDE	F01	234
13	89AB	CDEF	0123	4567	89AB	CDEF	012	345
14	9ABC	DEF0	1234	5678	9ABC	DEF0	123	456

[COPY]:[SEQ] [] THROUGH [] BEFORE SEQ []

POD The POD sub-command is used to duplicate a pattern entered into memory for one pod and put a copy of the same pattern into memory for another pod. If there is already data in the destination pod, it will be discarded when the new pattern is copied into that pod's memory.

To copy a data pattern from one pod to another:

- Move the screen cursor to the COPY: POD field.

[ASEQ]	5DC	5BA	4DC	4BA	3DC	3BA	S	I
0	0123	4567	89AB	CDEF	0123	4567	89A	BCD
1	1234	5678	9ABC	DEF0	1234	5678	9AB	CDE
2	2345	6789	ABCD	EF01	2345	6789	ABC	DEF
3	3456	789A	BCDE	F012	3456	789A	BCD	EF0
4	4567	89AB	CDEF	0123	4567	89AB	CDE	F01
5	5678	9ABC	DEF0	1234	5678	9ABC	DEF	012
6	6789	ABCD	EF01	2345	6789	ABCD	EF0	123
7	789A	BCDE	F012	3456	789A	BCDE	F01	234
8	89AB	CDEF	0123	4567	89AB	CDEF	012	345
9	9ABC	DEF0	1234	5678	9ABC	DEF0	123	456
10	ABCD	EF01	2345	6789	ABCD	EF01	234	567
11	BCDE	F012	3456	789A	BCDE	F012	345	678
12	CDEF	0123	4567	89AB	CDEF	0123	456	789
13	DEF0	1234	5678	9ABC	DEF0	1234	567	89A
14	EF01	2345	6789	ABCD	EF01	2345	678	9AB

[COPY] : [POD] [] TO []

- Use the data entry keys to enter a pod I.D. For example, to make a copy of pod 5B and send it to pod 3D.

[COPY]: [POD] [5B] TO [3D]

3. Press the EXECUTE key to start COPY POD operation.

The DAS will display the message "COPIED POD 5B TO 3D" in the message field on the second line of the display when the COPY POD operation has been completed. The DAS will also blank the source and destination fields to prevent accidental operation.

[ASEQ]	5DC	5BA	4DC	4BA	3DC	3BA	S	I
0	0123	4567	89AB	CDEF	4523	4567	89A	BCD
1	1234	5678	9ABC	DEF0	5634	5678	9AB	CDE
2	2345	6789	ABCD	EF01	6745	6789	ABC	DEF
3	3456	789A	BCDE	F012	7856	789A	BCD	EF0
4	4567	89AB	CDEF	0123	8967	89AB	CDE	F01
5	5678	9ABC	DEF0	1234	9A78	9ABC	DEF	012
6	6789	ABCD	EF01	2345	AB89	ABCD	EF0	123
7	789A	BCDE	F012	3456	BC9A	BCDE	F01	234
8	89AB	CDEF	0123	4567	CDAB	CDEF	012	345
9	9ABC	DEF0	1234	5678	DEBC	DEF0	123	456
10	ABCD	EF01	2345	6789	EFCD	EF01	234	567
11	BCDE	F012	3456	789A	F0DE	F012	345	678
12	CDEF	0123	4567	89AB	01EF	0123	456	789
13	DEF0	1234	5678	9ABC	12F0	1234	567	89A
14	EF01	2345	6789	ABCD	2301	2345	678	9AB

[COPY] : [POD] [] TO []

DELETE Use the DELETE command to erase sequence lines within the Program Run sub-menu. When the DELETE command is executed, all sequence lines between the given starting and ending sequence lines (inclusive) are deleted. The remaining sequence line numbers are automatically updated.

NOTE

When sequence lines are removed by the DELETE command, a corresponding number of new sequence lines containing default values are created at the end of the pattern generator's memory. These new sequence lines will be inserted after the last sequence line that contains programming data in order to maintain a total of 2048 sequence lines (ASEQ) or 1023 lines (RSEQ) for both Page A and Page B.

NOTE

If you attempt to use the DELETE function across page boundaries when the 91S32s are set to FOLLOWS 91S16 mode, only the lines within the current page will be deleted; you will have to change to the other page and repeat the DELETE operation to remove the rest of the sequence lines.

To delete one or more sequence lines:

1. Move the screen cursor to the edit command field at the bottom of the Run sub-menu screen. Press the SELECT key until DELETE appears in the field.

2. Move the screen cursor to the SEQ field.

[ASEQ]	5DC	5BA	4DC	4BA	3DC	3BA	S	I
0	0123	4567	89AB	CDEF	0123	4567	89A	BCD
1	1234	5678	9ABC	DEF0	1234	5678	9AB	CDE
2	2345	6789	ABCD	EF01	2345	6789	ABC	DEF
3	3456	789A	BCDE	F012	3456	789A	BCD	EF0
4	4567	89AB	CDEF	0123	4567	89AB	CDE	F01
5	5678	9ABC	DEF0	1234	5678	9ABC	DEF	012
6	6789	ABCD	EF01	2345	6789	ABCD	EF0	123
7	789A	BCDE	F012	3456	789A	BCDE	F01	234
8	89AB	CDEF	0123	4567	89AB	CDEF	012	345
9	9ABC	DEF0	1234	5678	9ABC	DEF0	123	456
10	ABCD	EF01	2345	6789	ABCD	EF01	234	567
11	BCDE	F012	3456	789A	BCDE	F012	345	678
12	CDEF	0123	4567	89AB	CDEF	0123	456	789
13	DEF0	1234	5678	9ABC	DEF0	1234	567	89A
14	EF01	2345	6789	ABCD	EF01	2345	678	9AB

[DELETE] : [SEQ] [] THROUGH []

3. Use the data entry keys to enter the sequence numbers of the first and last lines you wish to delete. If you only wish to delete one line, enter that sequence number in both fields. For example, to erase sequence lines between SEQ 3 and 5.

[DELETE]: SEQ [3] THROUGH [5]

4. Press the EXECUTE key to start the DELETE operation. The DAS will display the message "DELETED SEQ 3 THROUGH 5" when the DELETE operation has been completed. The DAS will also update the remaining sequence line numbers, and blank the SEQ and THROUGH fields to prevent accidental operations.

[ASEQ]	5DC	5BA	4DC	4BA	3DC	3BA	S	I
0	0123	4567	89AB	CDEF	0123	4567	89A	BCD
1	1234	5678	9ABC	DEF0	1234	5678	9AB	CDE
2	2345	6789	ABCD	EF01	2345	6789	ABC	DEF
3	6789	ABCD	EF01	2345	6789	ABCD	EF0	123
4	789A	BCDE	F012	3456	789A	BCDE	F01	234
5	89AB	CDEF	0123	4567	89AB	CDEF	012	345
6	9ABC	DEF0	1234	5678	9ABC	DEF0	123	456
7	ABCD	EF01	2345	6789	ABCD	EF01	234	567
8	BCDE	F012	3456	789A	BCDE	F012	345	678
9	CDEF	0123	4567	89AB	CDEF	0123	456	789
10	DEF0	1234	5678	9ABC	DEF0	1234	567	89A
11	EF01	2345	6789	ABCD	EF01	2345	678	9AB
12	F012	3456	789A	BCDE	F012	3456	789	ABC
13	0123	4567	89AB	CDEF	0123	4567	89A	BCD
14	1234	5678	9ABC	DEF0	1234	5678	9AB	CDE

[DELETE] : [SEQ] [] THROUGH []

DISPLAY Use the DISPLAY command to select the display radix for the vector data, S (Strobe), and I (Internal Inhibit) fields. This command is designed to make it easier for you to read the values programmed into these fields, or to remove them from the display if they are not being used.

NOTE

Changing the radix of several fields when there are several 91S32s installed may cause some data columns to disappear from the display. These data columns can still be viewed by using the right arrow (-) scroll key to shift the display to the right.

To remove or change the radix of the DATA, S, and I fields:

1. Move the screen cursor to the field you wish to change.

[ASEQ]	5DC	5BA	4DC	4BA	3DC	3BA	S	I
0	0123	4567	89AB	CDEF	0123	4567	89A	BCD
1	1234	5678	9ABC	DEF0	1234	5678	9AB	CDE
2	2345	6789	ABCD	EF01	2345	6789	ABC	DEF
3	3456	789A	BCDE	F012	3456	789A	BCD	EF0
4	4567	89AB	CDEF	0123	4567	89AB	CDE	F01
5	5678	9ABC	DEF0	1234	5678	9ABC	DEF	012
6	6789	ABCD	EF01	2345	6789	ABCD	EF0	123
7	789A	BCDE	F012	3456	789A	BCDE	F01	234
8	89AB	CDEF	0123	4567	89AB	CDEF	012	345
9	9ABC	DEF0	1234	5678	9ABC	DEF0	123	456
10	ABCD	EF01	2345	6789	ABCD	EF01	234	567
11	BCDE	F012	3456	789A	BCDE	F012	345	678
12	CDEF	0123	4567	89AB	CDEF	0123	456	789
13	DEF0	1234	5678	9ABC	DEF0	1234	567	89A
14	EF01	2345	6789	ABCD	EF01	2345	678	9AB

[DISPLAY] : 5DC [HEX] 5BA [HEX] 4DC [HEX] 4BA [HEX] 3DC [HEX] 3BA [HEX]
S [HEX] I [HEX]

2. Press the SELECT key to change the radix or to turn off the field. For example, to change the radix for the 4DC column to OCT (Octal) and to change the I (Internal Inhibit) field to BIN (Binary) and to turn off the S (Strobe) field:

[DISPLAY] : 5DC [HEX] 5BA [HEX] 4DC [OCT] 4BA [HEX] 3DC [HEX] 3BA [HEX]
S [OFF] I [BIN]

The DAS will then change the display of the 4DC, I, and S fields as follows:

[ASEQ]	5DC	5BA	4DC	4BA	3DC	3BA	I
0	0123	4567	89AB	CDEF	0123	4567	101111001101
1	1234	5678	9ABC	DEF0	1234	5678	110011011110
2	2345	6789	ABCD	EF01	2345	6789	110111101111
3	3456	789A	BCDE	F012	3456	789A	111011110000
4	4567	89AB	CDEF	0123	4567	89AB	111100000001
5	5678	9ABC	DEF0	1234	5678	9ABC	000000010010
6	6789	ABCD	EF01	2345	6789	ABCD	000100100011
7	789A	BCDE	F012	3456	789A	BCDE	001000110100
8	89AB	CDEF	0123	4567	89AB	CDEF	0011010000101
9	9ABC	DEF0	1234	5678	9ABC	DEF0	010001010110
10	ABCD	EF01	2345	6789	ABCD	EF01	010101100111
11	BCDE	F012	3456	789A	BCDE	F012	011001111000
12	CDEF	0123	4567	89AB	CDEF	0123	011110001001
13	DEF0	1234	5678	9ABC	DEF0	1234	100010011010
14	EF01	2345	6789	ABCD	EF01	2345	100110101011

[DISPLAY] : 5DC [HEX] 5BA [HEX] 4DC [OCT] 4BA [HEXC] 3DC [HEX] 3BA [HEX]
S [OFF] I [BIN]

FILL The FILL command is used to automatically fill in the values of the #DC (PODs D and C data), #BA (PODs B and A data), S (Strobe), and I (Internal Inhibit) fields with some constant values. For instance, if you knew you wanted all the sequence lines from line 20 through line 30 to have the same data value for POD A, you could use the FILL command to automatically enter that value in each data field instead of having to enter the value for each line individually.

You might use this command to change all the default values in the S (Strobe) field from 0s to 1s. For large scale data value changes, see the CONVERSION: CONVERT Table Build sub-menu description earlier in this section.

The FILL command provides editing fields to modify each of the data, S, and I columns in the Program: Run sub-menu. The replacement value for each column can be specified individually. You can choose to modify the value in all columns in one operation, or choose to modify just one or two columns at a time. Enter a DON'T CARE (X) into the FILL command fields for the columns you do not want to modify.

To use the FILL command:

1. Select the FILL command by pressing the SELECT key while the cursor is in the edit command field at the bottom of the DAS display.
2. Move the screen cursor to the SEQ field:

[ASEQ]	5DC	5BA	4DC	4BA	3DC	3BA	S	I
0	0123	4567	89AB	CDEF	0123	4567	89A	BCD
1	1234	5678	9ABC	DEF0	1234	5678	9AB	CDE
2	2345	6789	ABCD	EF01	2345	6789	ABC	DEF
3	3456	789A	BCDE	F012	3456	789A	BCD	EF0
4	4567	89AB	CDEF	0123	4567	89AB	CDE	F01
5	5678	9ABC	DEF0	1234	5678	9ABC	DEF	012
6	6789	ABCD	EF01	2345	6789	ABCD	EF0	123
7	789A	BCDE	F012	3456	789A	BCDE	F01	234
8	89AB	CDEF	0123	4567	89AB	CDEF	012	345
9	9ABC	DEF0	1234	5678	9ABC	DEF0	123	456
10	ABCD	EF01	2345	6789	ABCD	EF01	234	567
11	BCDE	F012	3456	789A	BCDE	F012	345	678
12	CDEF	0123	4567	89AB	CDEF	0123	456	789
13	DEF0	1234	5678	9ABC	DEF0	1234	567	89A
14	EF01	2345	6789	ABCD	EF01	2345	678	9AB

[FILL] : SEQ [] THROUGH []

[XXXX XXXX XXXX XXXX XXXX XXXX] [XXX] [XXX]

3. Use the data entry keys to enter the starting and ending sequence numbers. Then move the cursor to the appropriate field and enter the pattern you wish to place in all the corresponding fields within that sequence range. For example, to fill SEQ lines 1 through 4 with "XXXX 0A0A XXXX XXXX XXXX XXXX 0C0 111".

[FILL] : SEQ [1] THROUGH [4]

[XXXX 0A0A XXXX XXXX XXXX XXXX] [0C0] [111]

4. Press the EXECUTE key to start the FILL operation. The DAS will display the message "FILLED SEQ 1 THROUGH 4" on the second line of the display when the FILL operation has been completed. The DAS will also blank the SEQ and THROUGH fields, but not the pattern fields.

[ASEQ]	5DC	5BA	4DC	4BA	3DC	3BA	S	I
0	0123	4567	89AB	CDEF	0123	4567	89A	BCD
1	1234	0A0A	9ABC	DEF0	1234	5678	0C0	111
2	2345	0A0A	ABCD	EF01	2345	6789	0C0	111
3	3456	0A0A	BCDE	F012	3456	789A	0C0	111
4	4567	0A0A	CDEF	0123	4567	89AB	0C0	111
5	5678	9ABC	DEF0	1234	5678	9ABC	DEF	012
6	6789	ABCD	EF01	2345	6789	ABCD	EF0	123
7	789A	BCDE	F012	3456	789A	BCDE	F01	234
8	89AB	CDEF	0123	4567	89AB	CDEF	012	345
9	9ABC	DEF0	1234	5678	9ABC	DEF0	123	456
10	ABCD	EF01	2345	6789	ABCD	EF01	234	567
11	BCDE	F012	3456	789A	BCDE	F012	345	678
12	CDEF	0123	4567	89AB	CDEF	0123	456	789
13	DEF0	1234	5678	9ABC	DEF0	1234	567	89A
14	EF01	2345	6789	ABCD	EF01	2345	678	9AB

[FILL] : SEQ [] THROUGH []
 [XXXX 0A0A XXXX XXXX XXXX XXXX] [0C0] [111]

INSERT Use the INSERT command to insert additional sequence lines into the Program: Run sub-menu. The number of additional lines specified in the LINE(S) field is inserted just before the destination sequence line. The SEQ numbers for all the sequence lines are then updated. Newly inserted sequence lines always contain default values.

NOTE

Adding sequence lines to a full memory page can cause existing sequence lines to be lost at the page boundaries. If you add sequence lines between SEQ 0 and 1023, you may lose sequence lines at SEQ 1023. If you add sequence lines between SEQ 1024 and 2047, you may lose sequence lines at SEQ 2047. The number of sequence lines lost will correspond to the number of new lines inserted. If you must add new sequence lines to a lengthy pattern, use the DELETE command first to remove unnecessary lines and make room for the new lines.

To insert sequence lines:

1. Select the INSERT command by pressing the SELECT key while the cursor is in the edit command field at the bottom of the Program Run sub-menu.

2. Move the screen cursor to the LINE(S) field.

[ASEQ]	5DC	5BA	4DC	4BA	3DC	3BA	S	I
0	0123	4567	89AB	CDEF	0123	4567	89A	BCD
1	1234	5678	9ABC	DEF0	1234	5678	9AB	CDE
2	2345	6789	ABCD	EF01	2345	6789	ABC	DEF
3	3456	789A	BCDE	F012	3456	789A	BCD	EF0
4	4567	89AB	CDEF	0123	4567	89AB	CDE	F01
5	5678	9ABC	DEF0	1234	5678	9ABC	DEF	012
6	6789	ABCD	EF01	2345	6789	ABCD	EF0	123
7	789A	BCDE	F012	3456	789A	BCDE	F01	234
8	89AB	CDEF	0123	4567	89AB	CDEF	012	345
9	9ABC	DEF0	1234	5678	9ABC	DEF0	123	456
10	ABCD	EF01	2345	6789	ABCD	EF01	234	567
11	BCDE	F012	3456	789A	BCDE	F012	345	678
12	CDEF	0123	4567	89AB	CDEF	0123	456	789
13	DEF0	1234	5678	9ABC	DEF0	1234	567	89A
14	EF01	2345	6789	ABCD	EF01	2345	678	9AB

[INSERT] : [] LINE(S) BEFORE SEQ []

Use the data entry keys to enter the number of lines you wish to add. Enter the sequence number where you want them to be inserted. For example, to insert 3 lines before SEQ 2:

[INSERT] : [3] LINE(S) BEFORE SEQ [2]

3. Press the EXECUTE key to start the INSERT operation.

The DAS will display the message "INSERTED 3 LINE(S) BEFORE SEQ 2" in the message field when the insert operation has been completed. The DAS will also update the remaining sequence numbers, and blank the LINE(S) and SEQ fields to prevent accidental insertions.

[ASEQ]	5DC	5BA	4DC	4BA	3DC	3BA	S	I
0	0123	4567	89AB	CDEF	0123	4567	89A	BCD
1	1234	5678	9ABC	DEF0	1234	5678	9AB	CDE
2	0000	0000	0000	0000	0000	0000	000	000
3	0000	0000	0000	0000	0000	0000	000	000
4	0000	0000	0000	0000	0000	0000	000	000
5	2345	6789	ABCD	EF01	2345	6789	ABC	DEF
6	3456	789A	BCDE	F012	3456	789A	BCD	EF0
7	4567	89AB	CDEF	0123	4567	89AB	CDE	F01
8	5678	9ABC	DEF0	1234	5678	9ABC	DEF	012
9	6789	ABCD	EF01	2345	6789	ABCD	EF0	123
10	789A	BCDE	F012	3456	789A	BCDE	F01	234
11	89AB	CDEF	0123	4567	89AB	CDEF	012	345
12	9ABC	DEF0	1234	5678	9ABC	DEF0	123	456
13	ABCD	EF01	2345	6789	ABCD	EF01	234	567
14	BCDE	F012	3456	789A	BCDE	F012	345	678

[INSERT] : [] LINE(S) BEFORE SEQ []

MODIFY The MODIFY command uses logical operators to manipulate data already programmed in the Program Run sub-menu. Three logical operators are available: AND, OR, and XOR (exclusive OR). Any programmable numeric column in the Run sub-menu can be modified by using these operators. For example, you can modify one or both of the data fields, the S (Strobe), and the I (Internal Inhibit) field, or any combination of the above. You can also limit the modification to a range of sequence numbers.

By ANDing a particular column with 0, you can modify all the data in that column to 0's. (Any number ANDed with 0 equals 0.) By ORing a column with a 1, you can set all the bits in that column to 1. (Any number ORed with a 1 equals 1.) By XORing (exclusive OR) any pattern with a 1, the bit pattern in that field is inverted. (In other words, all FF_{hex} would be changed to 00s, and all 11_{s hex} become EEs.)

Here are reminder truth tables for the AND, OR, and XOR operations:

A	B	A AND B
0	0	0
0	1	0
1	0	0
1	1	1

A	B	A OR B
0	0	0
0	1	1
1	0	1
1	1	1

A	B	A XOR B
0	0	0
0	1	1
1	0	1
1	1	0

To modify the pattern fields.

1. Press the SELECT key when the screen cursor is in the edit command field at the bottom of the Run sub-menu until the MODIFY command is displayed.
2. Move the screen cursor to the field immediately to the right of MODIFY and press the SELECT key until the desired logical operator is displayed. Logical operators are displayed in this order: AND, OR, XOR.

[ASEQ]	5DC	5BA	4DC	4BA	3DC	3BA	S	I
0	0123	4567	89AB	CDEF	0123	4567	89A	BCD
1	1234	5678	9ABC	DEF0	1234	5678	9AB	CDE
2	2345	6789	ABCD	EF01	2345	6789	ABC	DEF
3	3456	789A	BCDE	F012	3456	789A	BCD	EF0
4	4567	89AB	CDEF	0123	4567	89AB	CDE	F01
5	5678	9ABC	DEF0	1234	5678	9ABC	DEF	012
6	6789	ABCD	EF01	2345	6789	ABCD	EF0	123
7	789A	BCDE	F012	3456	789A	BCDE	F01	234
8	89AB	CDEF	0123	4567	89AB	CDEF	012	345
9	9ABC	DEF0	1234	5678	9ABC	DEF0	123	456
10	ABCD	EF01	2345	6789	ABCD	EF01	234	567
11	BCDE	F012	3456	789A	BCDE	F012	345	678
12	CDEF	0123	4567	89AB	CDEF	0123	456	789
13	DEF0	1234	5678	9ABC	DEF0	1234	567	89A
14	EF01	2345	6789	ABCD	EF01	2345	678	9AB

[MODIFY] : LOGICAL [AND] SEQ [] THROUGH [] BEFORE SEQ []
 [XXXX XXXX XXXX XXXX XXXX XXXX] [XXXX] [XXX]

- Press the SELECT key until the desired operator appears in the field. For example, XOR.

```
[MODIFY ] : LOGICAL [XOR] SEQ [ ] THROUGH [ ]
[XXXX XXXX XXXX XXXX XXXX XXXX] [XXX] [XXX]
```

- Move the screen cursor to the SEQ and THROUGH fields. Use the data entry keys to enter the number of the first and last sequence lines you want to modify. For example, to modify sequence lines 1 through 9, enter:

```
[MODIFY ] : LOGICAL [XOR] SEQ [ 1] THROUGH [ 9]
[XXXX XXXX XXXX XXXX XXXX XXXX] [XXX] [XXX]
```

- Move the screen cursor down to the pattern line and enter the pattern you wish to use as a modifier. For example, to invert all the Pod 3B and 3A data patterns, select XOR as the logical operator and enter FFFF_{hex} in the column A field. (Fields containing X are not affected by the MODIFY command.)

```
[MODIFY ] : LOGICAL [XOR] SEQ [ 1] THROUGH [ 9]
[XXXX XXXX XXXX XXXX XXXX FFFF] [XXX] [XXX]
```

- Press the EXECUTE key to start the MODIFY operation. The DAS will display the message "MODIFIED SEQ 1 THROUGH 9" in the message field at the top left-hand corner of the display. The DAS will also blank the SEQ and THROUGH fields to prevent accidental operation.

[ASEQ]	5DC	5BA	4DC	4BA	3DC	3BA	S	I
0	0123	4567	89AB	CDEF	0123	4567	89A	BCD
1	1234	5678	9ABC	DEF0	1234	A987	9AB	CDE
2	2345	6789	ABCD	EF01	2345	9876	ABC	DEF
3	3456	789A	BCDE	F012	3456	8765	BCD	EF0
4	4567	89AB	CDEF	0123	4567	7654	CDE	F01
5	5678	9ABC	DEF0	1234	5678	6543	DEF	012
6	6789	ABCD	EF01	2345	6789	5432	EF0	123
7	789A	BCDE	F012	3456	789A	4321	F01	234
8	89AB	CDEF	0123	4567	89AB	3210	012	345
9	9ABC	DEF0	1234	5678	9ABC	210F	123	456
10	ABCD	EF01	2345	6789	ABCD	EF01	234	567
11	BCDE	F012	3456	789A	BCDE	F012	345	678
12	CDEF	0123	4567	89AB	CDEF	0123	456	789
13	DEF0	1234	5678	9ABC	DEF0	1234	567	89A
14	EF01	2345	6789	ABCD	EF01	2345	678	9AB

```
[MODIFY ] : LOGICAL [XOR] SEQ [ ] THROUGH [ ]
[XXXX XXXX XXXX XXXX XXXX FFFF] [XXX] [XXX]
```

MOVE Use the MOVE command to move some block of sequence lines within a program to another location within that same program. When MOVE is executed, all the sequence lines specified are moved to a location just before the given destination sequence. The sequence numbers are then automatically updated. Labels, data, and instructions are retained when sequence lines are moved.

Using the MOVE command does not cause high-numbered program lines to be lost even if all 1022 sequence lines have been programmed.

NOTE

When 91S32 Modules are used in FOLLOWS 91S16 mode, you cannot move sequence lines from one page of memory to the other (e.g., Page A to Page B).

To MOVE a block of sequence lines from one location to another:

1. Select the MOVE command by pressing the SELECT key when the screen cursor is in the edit command field at the bottom of the 91S32 Program: Run sub-menu.
2. Move the screen cursor to the SEQ field.

[ASEQ]	5DC	5BA	4DC	4BA	3DC	3BA	S	I
0	0123	4567	89AB	CDEF	0123	4567	89A	BCD
1	1234	5678	9ABC	DEF0	1234	5678	9AB	CDE
2	2345	6789	ABCD	EF01	2345	6789	ABC	DEF
3	3456	789A	BCDE	F012	3456	789A	BCD	EF0
4	4567	89AB	CDEF	0123	4567	89AB	CDE	F01
5	5678	9ABC	DEF0	1234	5678	9ABC	DEF	012
6	6789	ABCD	EF01	2345	6789	ABCD	EF0	123
7	789A	BCDE	F012	3456	789A	BCDE	F01	234
8	89AB	CDEF	0123	4567	89AB	CDEF	012	345
9	9ABC	DEF0	1234	5678	9ABC	DEF0	123	456
10	ABCD	EF01	2345	6789	ABCD	EF01	234	567
11	BCDE	F012	3456	789A	BCDE	F012	345	678
12	CDEF	0123	4567	89AB	CDEF	0123	456	789
13	DEF0	1234	5678	9ABC	DEF0	1234	567	89A
14	EF01	2345	6789	ABCD	EF01	2345	678	9AB

[MOVE] : SEQ [] THROUGH [] BEFORE SEQ []

3. Use the data entry keys to enter the starting, ending, and destination sequence numbers. For example, to move sequence lines 1 through 3 and place them before sequence line 7:

[MOVE] : SEQ [1] THROUGH [3] BEFORE SEQ [7]

4. Press the EXECUTE key to start the MOVE operation. The DAS will display the message "MOVED SEQ 1 THROUGH 3 BEFORE SEQ 7" on the message line. The DAS will also update all the sequence lines and blank the SEQ, THROUGH and, BEFORE fields to prevent accidental move operations.

[ASEQ]	5DC	5BA	4DC	4BA	3DC	3BA	S	I
0	0123	4567	89AB	CDEF	0123	4567	89A	BCD
1	4567	89AB	CDEF	0123	4567	89AB	CDE	F01
2	5678	9ABC	DEF0	1234	5678	9ABC	DEF	012
3	6789	ABCD	EF01	2345	6789	ABCD	EF0	123
4	1234	5678	9ABC	DEF0	1234	5678	9AB	CDE
5	2345	6789	ABCD	EF01	2345	6789	ABC	DEF
6	3456	789A	BCDE	F012	3456	789A	BCD	EF0
7	789A	BCDE	F012	3456	789A	BCDE	F01	234
8	89AB	CDEF	0123	4567	89AB	CDEF	012	345
9	9ABC	DEF0	1234	5678	9ABC	DEF0	123	456
10	ABCD	EF01	2345	6789	ABCD	EF01	234	567
11	BCDE	F012	3456	789A	BCDE	F012	345	678
12	CDEF	0123	4567	89AB	CDEF	0123	456	789
13	DEF0	1234	5678	9ABC	DEF0	1234	567	89A
14	EF01	2345	6789	ABCD	EF01	2345	678	9AB

[MOVE] : SEQ [] THROUGH [] BEFORE SEQ []

SEARCH Use the SEARCH command to locate some specific entry within the body of the Program Run sub-menu. The entry may be a particular data pattern, a strobe value, or a internal inhibit value.

The SEARCH command allows you to specify the type of entry you are going to search for, and specify a sequence range for the search. When executed, the SEARCH command compares all entries of the same type against the target string within the range of sequence lines you have specified. It will then place the screen cursor on the first sequence line containing that string, and display the total number of lines within the specified range that contain the target string. (The number of occurrences appears in the bottom right-hand corner of the display.)

The data entry keys can be used to select the second, or third, etc. sequence line containing the target string when the screen cursor is in the []/ # : SEARCHED field. (Instructions for using this field are included in the following paragraphs.)

The SEARCH command has a sub-field used to specify the pattern you want to search for. Fields containing X's (Don't Cares) match all data patterns.

To search a pattern:

1. Select the SEARCH command by moving the screen cursor to the edit command field at the bottom of the Program Run sub-menu and pressing the SELECT key.
2. Select the type of pattern you are going to search for by moving the screen cursor to the field immediately to the right of the SEARCH command.

[ASEQ]	5DC	5BA	4DC	4BA	3DC	3BA	S	I
0	0123	4567	89AB	CDEF	0123	4567	89A	BCD
1	1234	5678	9ABC	DEF0	1234	5678	9AB	CDE
2	2345	6789	ABCD	EF01	2345	6789	ABC	DEF
3	3456	789A	BCDE	F012	3456	789A	BCD	EF0
4	4567	89AB	CDEF	0123	4567	89AB	CDE	F01
5	5678	9ABC	DEF0	1234	5678	9ABC	DEF	012
6	6789	ABCD	EF01	2345	6789	ABCD	EF0	123
7	789A	BCDE	F012	3456	789A	BCDE	F01	234
8	89AB	CDEF	0123	4567	89AB	CDEF	012	345
9	9ABC	DEF0	1234	5678	9ABC	DEF0	123	456
10	ABCD	EF01	2345	6789	ABCD	EF01	234	567
11	BCDE	F012	3456	789A	BCDE	F012	345	678
12	CDEF	0123	4567	89AB	CDEF	0123	456	789
13	DEF0	1234	5678	9ABC	DEF0	1234	567	89A
14	EF01	2345	6789	ABCD	EF01	2345	678	9AB

[SEARCH] : SEQ [.] THROUGH [.]
 [XXXX XXXX XXXX XXXX XXXX XXXX] [XXX] [XXX]

3. Move the screen cursor to the SEQ and THROUGH fields and enter the starting and ending sequence numbers for the block of program you wish to search. For example, enter SEQ 0 and THROUGH 10, to search for a pattern programmed in lines 0 through 10, inclusive. Note: the larger the search range you specify, the longer it takes for the edit operation to be completed, and the greater the likelihood you will locate data you are not interested in.
4. Move the screen cursor to the PATTERN sub-fields and use the data entry keys to enter the pattern you wish to find. For example, to search for a pattern between SEQ 0 and 10:

[SEARCH] : SEQ [0] THROUGH [10]
 [XXXX XXXX 1234 XXXX XXXX XXXX] [123] [XXX]

5. Press the EXECUTE key to start the SEARCH operation. The DAS will display the message, "<[1]/ 1 : SEARCHED>" in the bottom right-hand corner of the display. The first number in this message indicates that the screen cursor has been placed on the line containing the first instance of the target pattern. The number following the slash tells you how many lines contain the target pattern within the range you specified for the search.

[ASEQ]	5DC	5BA	4DC	4BA	3DC	3BA	S	I
5	5678	9ABC	DEF0	1234	5678	9ABC	DEF	012
6	6789	ABCD	EF01	2345	6789	ABCD	EF0	123
7	789A	BCDE	F012	3456	789A	BCDE	F01	234
8	89AB	CDEF	0123	4567	89AB	CDEF	012	345
[9]	[9ABC	DEF0	1234	5678	9ABC	DEF0]	[123]	[456]
10	ABCD	EF01	2345	6789	ABCD	EF01	234	567
11	BCDE	F012	3456	789A	BCDE	F012	345	678
12	CDEF	0123	4567	89AB	CDEF	0123	456	789
13	DEF0	1234	5678	9ABC	DEF0	1234	567	89A
14	EF01	2345	6789	ABCD	EF01	2345	678	9AB

[SEARCH] : SEQ [0] THROUGH [10]
 [XXXX XXXX 1234 XXXX XXXX XXXX] [123] [XXX]

For instance, if you had searched for 0000 in a block of text where 15 lines contained the pattern 0000, the message would read: "<[1]/ 15 : SEARCHED>". If you wanted to see the 14th occurrence of the target pattern, you could move the screen cursor to the highlighted field in the first part of this message and type in 14. When you pressed the EXECUTE key, the screen cursor would be placed on the line containing the 14th occurrence of the target pattern, and the message field would read: "<[14]/ 15 : SEARCHED>".

91S16 PROGRAM: TRACE AND STEP MODE SUB-MENUS

NOTE

The 91S16 Program Trace and Step sub-menus appear only when there is a 91S16 installed in the DAS.

The following paragraphs describe how you can use the 91S16 Trace and Step modes to monitor program execution and pattern output. Both Step and Trace modes cause the pattern generator to output data much more slowly than during normal operation. Trace mode causes the pattern generator to output data at a rate slow enough for you to monitor key parameters, while Step executes a single line of program each time you press the START PAT GEN key.

Both the Trace and Step sub-menus display CLOCK (the number of sequence lines executed since you pressed START), SEQ (the sequence line currently being executed), #B and #A (data output from pods B and A), S (strobe), register and control information.

Two features distinguish Trace mode from Step mode. Trace mode outputs the test vectors as fast as the DAS can put the corresponding data on the screen. Trace mode also allows you to set a breakpoint to automatically stop program execution after executing some specified program line. In Step mode, a test vector is output every time the START PAT GEN key is pressed; no breakpoint is needed since you control every output manually.

Figures 24 and 25 illustrate the 91S16 Pattern Generator Trace and Step Mode sub-menus. Refer to the numbered callouts when reading the following paragraphs. These numbers serve as visual references and do not imply sequence of use.

NOTE

In the following discussion, the 91S16 is assumed to be installed in DAS slot 6.

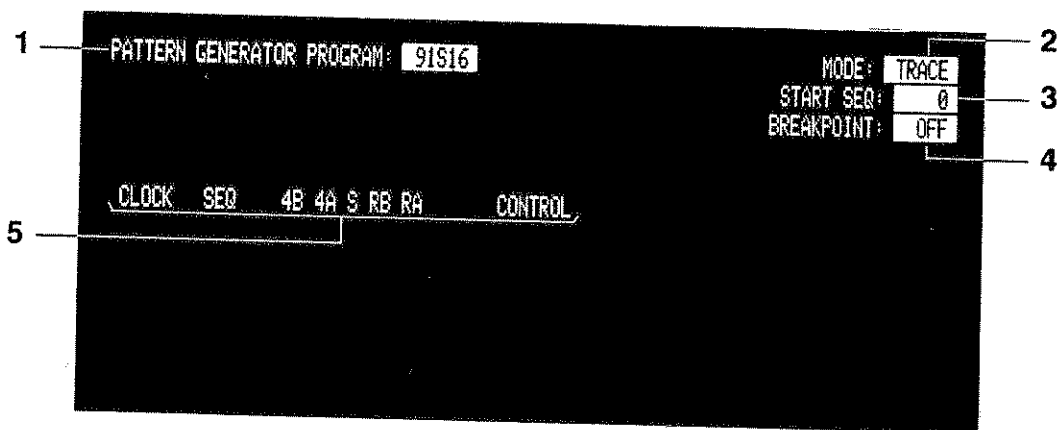
1 PATTERN GENERATOR PROGRAM Field

Use this field (directly to the right of the menu title) to select either the 91S16 or the 91S32 sub-menu display. The 91S16 sub-menu is the default menu.

2 MODE Field

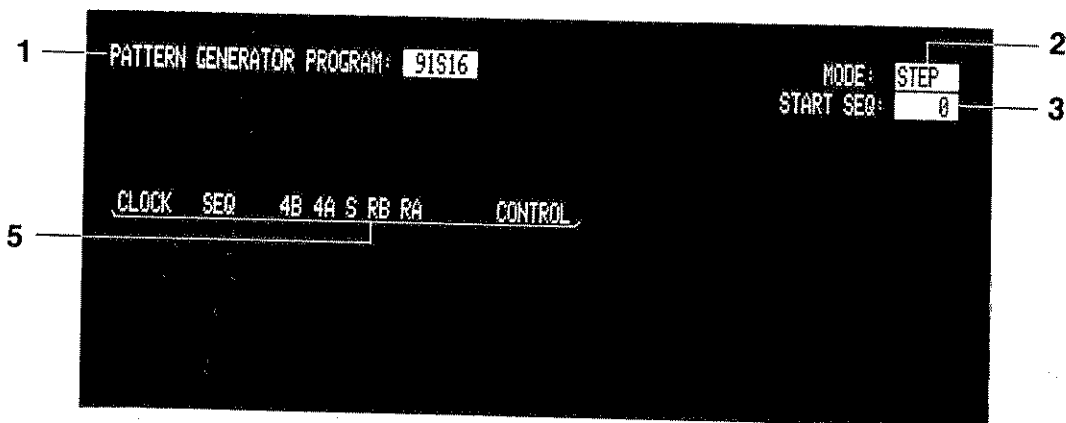
Use the MODE field to select the pattern generator's operating mode. The 91S16 has three modes of operation: Run, Trace, and Step. When operating in the Run mode, the pattern generator outputs data at the clock rate selected in the CONFIGURATION sub-menu. When in Trace mode, the pattern generator runs on a much slower clock of several hundred milliseconds, slow enough for you to see key trends in program execution. In Step mode, pattern execution is clocked each time you press the START PAT GEN key. Trace and Step modes assist you in debugging your pattern generation programs.

The MODE field defaults to Run mode.



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Figure 24. 91S16 Program: Trace sub-menu.



5396-49

Figure 25. 91S16 Program: Step sub-menu.

TRACE The Trace mode allows continuous execution of the pattern generator program while allowing you to monitor the execution on the Trace sub-menu display. Program execution is monitored by a readback function in the 91S16. This function allows you to see how often interrupt servicing routines are called, how many times certain loops are executed, where interrupt routines are activated, and the general branching structure of your program.

Use the START PAT GEN key to start Trace mode pattern execution. Execution stops when any key other than the <SHIFT> START PAT GEN key is pressed, when the pattern generator encounters a HALT in a program sequence line, or when it reaches sequence line 1023. When the pattern generator has been stopped for any reason, the DAS will display "PATTERN GENERATOR STOPPED" in the message field at the top left-hand corner of the display. If you press the START PAT GEN key after execution has been stopped, execution will resume at the sequence line specified in the START SEQ field of the Trace sub-menu.

NOTE

If any key other than the <SHIFT> PAT GEN key is pressed during Trace operation, the normal function of that key will be ignored and the pattern generator will stop outputting data.

The pattern generator also stops execution when it encounters a breakpoint specified in the Trace sub-menu BREAKPOINT field. The breakpoint is specified as a sequence line number. The pattern generator will output data and perform any instruction listed in the breakpoint line before stopping.

This feature allows you to output only a narrow range of program lines by specifying the starting sequence in the START SEQ field, and specifying the ending sequence with the BREAKPOINT field. Following a breakpoint, you can resume pattern output on the next sequence line by pressing the START PAT GEN key. Detailed instructions for using this field are given later in this section.

STEP The Step mode sub-menu performs the same functions as the Trace mode sub-menu but it allows you to have more control over data execution. Program execution proceeds only as fast as you press the START PAT GEN key. There is no breakpoint field for the Step sub-menu because you control every step of program execution manually. When the pattern generator executes a line containing the HALT instruction, or when it reaches the end of the pattern generator memory, the DAS will display the message "PATTERN GENERATOR STOPPED" in the upper-left corner of the display. If you press the START PAT GEN key again, the pattern generator will start execution at the first sequence line listed in the START SEQ: field.

NOTE

Use the INCR and DECR keys instead of the SELECT key to change between Step and Trace modes; otherwise you will lose the current display.

To change the 91S16 MODE of operation:

1. Move the screen cursor to the MODE field in the upper right-hand corner of the display.

MODE: [RUN]

2. Press the SELECT, INCR, or DECR key until the desired mode appears in this field. The DAS will the display the MODE field values in this order:

[RUN]
[TRACE]
[STEP]

3 START SEQ Field

Use the START SEQ field to set the first sequence number to be executed when the pattern generator begins operation. (You can start the pattern generator by pressing either the START PAT GEN key or the START SYSTEM key.) The START SEQ value may be any number between 0 and 1023 if no service interrupt call has been programmed, and between 0 and 1022 if the service interrupt call has been programmed.

To enter a beginning sequence number in the START SEQ field:

1. Move the screen cursor to the START SEQ field.

START SEQ: [0]

2. Use the data entry keys to enter the sequence number. For example:

START SEQ: [500]

NOTE

If the IRQ CALL instruction has been selected in the CONFIGURATION sub-menu after you have programmed the START SEQ field to 1023, the START SEQ field will be reset to 0. (Valid SEQ numbers are 0-1022 when IRQ CALL is programmed.)

4 BREAKPOINT Field

NOTE

The BREAKPOINT field is only available in the Trace mode sub-menu. Step mode is always manually controlled and thus does not need a breakpoint.

Use this field to set a breakpoint at any sequence line where pattern generator execution needs to be suspended. You can only set one breakpoint at a time. When a breakpoint sequence number has been set in the BREAKPOINT field, the pattern generator will execute all preceding sequences, including the sequence line containing the breakpoint, and then stop. The BREAKPOINT field default value is OFF.

To set a BREAKPOINT:

1. Select the Trace Mode sub-menu. Move the screen cursor to the BREAKPOINT field in the upper right-hand corner of the display.

MODE: [TRACE]
START SEQ: [0]
BREAKPOINT: [OFF]

2. Press the SELECT key to turn on the BREAKPOINT function. The sequence number field will appear below the BREAKPOINT field.

MODE: [TRACE]
START SEQ: [0]
BREAKPOINT: [ON]
 [1023]

3. Move the screen cursor to the sequence number field and use the data entry keys to enter the number of the sequence line where you want the breakpoint to occur. For example, enter sequence line 500:

```

MODE: [TRACE]
START SEQ: [ 0]
BREAKPOINT: [ ON ]
           [ 500]

```

5 Program Display Column Headings

The Trace and Step mode sub-menus have six types of headings under which data is tabulated as program execution is being traced. The number of clocks (sequence lines executed since START was pressed), data patterns output, strobes, the contents of the pattern generator register(s), and instructions programmed for each sequence line are displayed below these headings as each program line is executed.

For example, if sequence line 100 was executed as the 115th sequence (some loop accounted for the other 15 clock cycles), the Trace sub-menu might show this display:

CLOCK	SEQ	6B	6A	S	RB	RA	CONTROL
115	100	FF	1A	1	00	04	INCR PAGE

Data is displayed line by line, and scrolls up from the bottom of the display when the screen is full.

CLOCK This heading shows the number of clocks generated since the pattern generator was started. The clock begins counting at 0 and is reset when it reaches 9999. Because of loops, jumps, and subroutine calls, the clock cycle does not necessarily correspond to the sequence line being executed.

SEQ This heading shows the sequence number of the program line that has just been executed. It is the same sequence number that appears in the Run sub-menu. By tracking this number, program flow can be thoroughly monitored.

#B and #A These headings display the pattern delivered to the P6464 probe tips. The number relates to the slot in the DAS where the 91S16 is installed, and the letter denotes the pod. A DON'T CARE (X) in this field indicates that at least one of the channels in that pod has been tri-stated (assuming display in Hex). The radix for this field can be changed by using the DISPLAY command in the 91S16 Run sub-menu.

S The S (strobe) heading displays the status of the strobe lines. A DON'T CARE (X) in this field indicates that at least one of the strobe lines has been tri-stated. The radix for this field can be changed by using the DISPLAY command in the 91S16 Run sub-menu.

RB, RA These headings display the contents of the 91S16 pattern generator's registers. RB displays the contents of 8-bit register RB. RA displays the contents of register RA. If you have selected just one 16-bit register instead of two 8-bit registers in the 91S16 Configuration sub-menu, the heading changes to R. The radices for these fields are set by the radices of the #B and #A data pattern fields. If the pattern generator register has been set to a single 16-bit register, the 8 most significant bits of this display column follow the radix set for #B, and the 8 least significant bits of this display column follow the radix set for #A.

CONTROL This heading covers the display of all CONTROL instructions when they are executed. The two CONTROL instructions are TRIGGER and INCR PAGE (increment page). See the explanation for these commands in the 91S16 Run Menu section of this manual. In brief, TRIGGER causes a TTL-level signal to be output via a phono jack on the back of the 91S16. This signal can be used to trigger an external test device, such as an oscilloscope. INCR PAGE is used by the 91S16 to control 91S32s when a long pattern is being downloaded from a host computer or mass storage device.

91S32 PROGRAM: TRACE AND STEP MODE SUB-MENUS

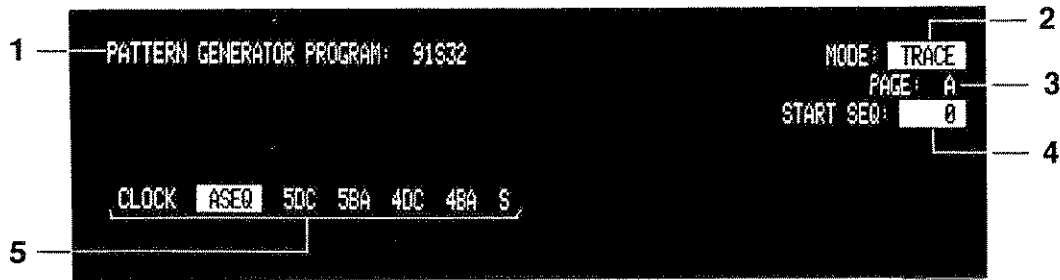
NOTE

The 91S32 Program Trace and Step sub-menus appear only when there is a 91S32 installed in the DAS.

The following paragraphs describe how you can use the 91S32 Trace and Step modes to monitor program execution and pattern output. Both Step and Trace modes cause the pattern generator to output data much more slowly than during normal operation. Trace mode causes the pattern generator to output data at a rate slow enough for you to monitor sequence flow, while Step executes only one line of program each time you press the START PAT GEN key.

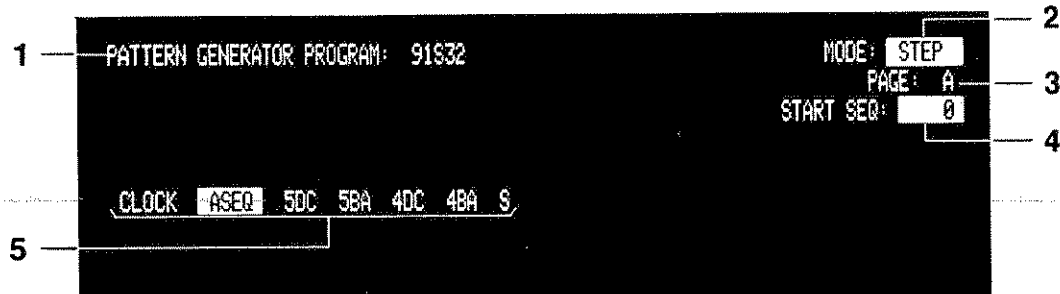
Both the Trace and Step sub-menus display CLOCK (the number of sequence lines executed since you pressed START), SEQ (the sequence line currently being executed), #DC and #BA (data output from pods grouped in pairs), and S (strobe).

Figures 26 and 27 illustrate the 91S32 Pattern Generator Trace and Step Mode sub-menus. Refer to the numbered callouts when reading the following paragraphs. The numbers serve as visual references and do not imply sequence of use.



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Figure 26. 91S32 Trace sub-menu.



5396-51

Figure 27. 91S32 Step sub-menu.

NOTE

In the following discussion, 91S32s are assumed to be installed in DAS slots 3, 4, and 5.

1 PATTERN GENERATOR PROGRAM Field

Use this field (directly to the right of the menu title) to select either the 91S16 or the 91S32 sub-menu display. The 91S16 sub-menu is the default menu.

To display the 91S32 Program sub-menus, position the screen cursor in this field and press the SELECT key. To change back to the 91S16 sub-menu, press the SELECT key again.

2 MODE Field

Use the MODE field to select the pattern generator's operating mode. The 91S32 has three modes of operation: Run, Trace, and Step. When operating in the Run mode, the pattern generator outputs data at the clock rate selected in the CONFIGURATION sub-menu. When in Trace mode, the pattern generator runs on a much slower clock of several hundred milliseconds, slow enough for you to see key trends in program execution. In Step mode, pattern execution is clocked each time you press the START PAT GEN key. Trace and Step modes are designed to assist you in debugging your pattern generation programs.

The MODE field defaults to Run mode.

TRACE The Trace mode allows continuous execution of the pattern generator program while allowing you to monitor the execution on the Trace sub-menu display. Program execution is monitored via a readback function in the 91S32. This will allow you to see how often subroutines are called, how many times certain loops are executed, where interrupt routines are activated, and the general branching structure of your program.

Use the START PAT GEN key to start Trace mode pattern execution. Execution will stop when any key is pressed, or when the pattern generator reaches sequence line 2047. When the pattern generator has been stopped for any reason, the DAS will display "PATTERN GENERATOR STOPPED" in the message field at the top left-hand corner of the display. If you press the START PAT GEN key after execution has been stopped, execution will resume at the sequence line specified in the START SEQ field of the Trace sub-menu.

STEP The Step mode sub-menu performs the same functions as Trace mode, except that only one program line is executed for each time you press the START PAT GEN key. When the pattern generator reaches the end of the pattern generator memory, the DAS will display the message "PATTERN GENERATOR STOPPED" in the upper-left corner of the display. Pressing the START PAT GEN key again will cause the pattern generator to start execution at the first sequence line listed in the START SEQ: field.

NOTE

When you change the mode field from Trace to Step, or to Run, the current display is lost. To change between Trace and Step mode without losing the current display, use the INCR and DECR keys instead of the SELECT key.

To change the 91S32 MODE of operation:

1. Move the screen cursor to the MODE field in the upper-right corner of the display.

MODE: [RUN]

2. Press the SELECT, INCR, or DECR key until the desired mode appears in this field. The DAS will the display the MODE field values in this order:

MODE: [RUN]

MODE: [TRACE]

MODE: [STEP]

3 PAGE: Heading

The page field indicates which page of the 91S32's memory is being executed. In this sub-menu the page value cannot be set; it is displayed here for reference purposes.

4 START SEQ Field

Use the START SEQ field to set the first sequence number to be executed when the pattern generator begins operation. (You can start the pattern generator by pressing either the START PAT GEN key or the START SYSTEM key.) The START SEQ value may be any number between 0 and 2047 if you are programming in absolute sequence numbers (ASEQ). If you are using relative sequence numbers (RSEQ), the range is Page A, 0 through 1023, or Page B, 0 through 1023. See the *91S32 Program: Run Sub-Menu* description for details concerning ASEQ and RSEQ numbers.

To enter a beginning sequence number in the START SEQ field:

1. Move the screen cursor to the START SEQ field.

START SEQ: [0]

2. Use the data entry keys to enter the sequence number. For example:

START SEQ: [500]

5 Program Display Column Headings

The Trace and Step mode sub-menus have four types of headings under which data is tabulated as program execution is being traced. The number of clocks (sequence lines executed since START was pressed), the number of the sequence line currently being executed, the data patterns being output via the P6464 probes, and the values programmed for each strobe are displayed below these headings as each program line is executed.

For example, if sequence line 100 was executed as the 115th sequence (some loop controlled by a 91S16 accounted for the other 15 clock cycles), the Trace sub-menu might show this display:

CLOCK	SEQ	6DC	6BA	S
115	100	01FF	1AEE	0

Data is shown line by line, and scrolls up from the bottom of the display when the screen is full.

CLOCK This heading shows the number of clocks generated since the pattern generator was started. The clock begins counting at 0 and is reset when it reaches 9999. If you are using a 91S16 with your 91S32s, the clock cycle will not necessarily correspond to the sequence line being executed because of loops, jumps, and subroutine calls. Starting the pattern generator at some mid-point in the pattern will also cause a discrepancy between the CLOCK count and the SEQ line being displayed.

SEQ This heading shows the sequence number of the program line that has just been executed. It is the same sequence number that appears in the Run sub-menu. The SEQ heading may be ASEQ or RSEQ depending on how you set the SEQ field in the 91S32 Run sub-menu. By tracking the SEQ numbers, you can thoroughly monitor program flow.

#DC and #BA These headings display the pattern delivered to the P6464 probe tips. The number relates to the slot in the DAS where the 91S16 is installed, and the letter denotes the pod. An X (DON'T CARE) in this field indicates that at least one of the channels in that pod has been tri-stated (assuming display in Hex). The radix for this field can be changed by using the DISPLAY command while in the 91S32 Run sub-menu.

S The S (strobe) heading displays the status of the strobe lines. An X (DON'T CARE) in this field indicates that at least one of the strobe lines has been tri-stated. The radix for this field can be changed by using the DISPLAY command in the 91S32 Run sub-menu.

GPIB PROGRAMMING

In this section you will find:

- general information on using the GPIB to remotely load and run the 91S16 and 91S32 pattern generator modules.
- a brief description of the capabilities and limitations of using GPIB commands with the Option 02 GPIB and RS-232 interfaces, and with the Option 06 GPIB interface.
- information on how to use the Option 06 GPIB interface to stimulate static devices (Pattern Download For Static Devices).
- information on how to use the Option 06 GPIB interface to stimulate dynamic devices (Pattern Download For Dynamic Devices {Keep-Alive}).

GENERAL INFORMATION

The General Purpose Interface Bus (GPIB) interface provided with DAS 9100 Series Options 02 and 06 conforms to the specifications contained in the IEEE 488-1978, *Standard Digital Interface for Programmable Instrumentation*. This section describes GPIB operational elements only in relation to 91S16 and 91S32 Pattern Generator modules installed in the DAS.

You can operate 91S16 and 91S32 pattern generator modules in the DAS from a remote controller by using the IEEE 488 General Purpose Interface Bus (GPIB) or the RS-232 master/slave interface (using GPIB commands).

Remote operation requires that you write a program for your controller to operate the DAS. To write such a program, you need to be familiar with your controller before you attempt to use the information in this section. The DAS can operate as a talker or a listener, but not as a controller in a GPIB system.

This section assumes that you are familiar with the GPIB as implemented in DAS 9100 Series Logic Analyzers. Refer to the *Option 06: I/O Communication Interface Operator's Manual Addendum* (part of the *DAS 9100 Series Operator's Manual package*). The following documents may also be useful to you:

- *GPIB Application Support* (Tektronix Part Number 070-2307-00)
- *Standard Digital Interface for Programmable Instrumentation* (IEEE 488-1978 standard). This document is published by The Institute of Electrical and Electronics Engineers, Inc. 345 East 47 Street, New York, New York 10017.

CAPABILITIES AND LIMITATIONS WHEN USING GPIB TO CONTROL THE 91S16 AND 91S32

There are three methods of implementing remote operation of the 91S16 and 91S32 pattern generator modules using GPIB commands. All three methods allow you to use a controller to load the pattern generator's memory and start operation. However, the method of implementing the Pattern Download From Host feature (described in the *91S32 Configuration Sub-Menu When Used With 91S16* section of this addendum) depends on whether you are using the Option 02 GPIB interface, the Option 06 GPIB interface, or the RS-232 interface.

All three methods use GPIB commands, but only Option 06 GPIB has the HSPAT (High-Speed PATtern download) command which allows you to use the Keep-Alive feature. Keep-Alive allows you to reload one page of the 91S32's memory while the 91S16 continues to output vectors; without this feature, the pattern generator briefly stops outputting vectors while the 91S32 completes its reload operation. (When the pattern generator stops, the last vectors are frozen at the probe tips.)

GPIB PROGRAMMING USING THE OPTION 02 GBIP AND RS-232 INTERFACES

Instructions for using the Option 02 GPIB and RS-232 interfaces are provided in the *DAS 9100 Series Operator's Manual*. Refer to that manual for more information.

GPIB PROGRAMMING USING THE OPTION 06 GPIB INTERFACE

This section only describes the Option 06 HSPAT command for the 91S16 and 91S32 pattern generator modules. Refer to the *Option 06 I/O Communication Interface Addendum* to the *DAS 9100 Series Operator's Manual* for an explanation of the GPIB system and description of other GPIB commands.

HSPAT (High-Speed Pattern Generator) Command

(Option 06 only, GPIB only)

The HSPAT command loads the pattern generator's program and pattern directly into the 91S16 and 91S32 memory. This command is supported only by the GPIB interface.

NOTE

The HSPAT command used with the 91S16 and 91S32 Pattern Generator modules is not the same HSPAT command used with the 91P16/32 Pattern Generator modules.

HSPAT Command Format

The HSPAT command has two parts. The first part consists of the command header (HSPAT) and its arguments. This part of the command is discussed under the paragraphs titled *Command Header Structure*.

The second part of the HSPAT command consists of the binary end block containing the data to be loaded into the pattern generator. This part of the command is discussed under the paragraphs titled *Data Block Structure*.

The command format is:

```
HSPAT <slot>,<start seq>,<total lines>(EOM)
@<data bytes>BC16
```

The DAS screen is turned off during data transfer. The pattern generator will stop when the HSPAT command is executed, unless the pattern generator is running in Keep-Alive mode.

Command Header Structure

The command header and its arguments tell the DAS which slot should receive the data, the sequence line where the data should start, and the total number of sequence lines in this transfer. The command header format is:

HSPAT <slot>,<start seq>,<total lines>(EOM)

<slot> is an ASCII integer representing the slot number of the pattern generator module you wish to reload.

<start> is an ASCII integer representing the hardware address where your program begins loading. For the 91S16, this number must be between 1 and 1024; for the 91S32, this number must be between 1 and 2048.

<total lines> is an ASCII integer representing the total number of lines being downloaded in this transfer. For the 91S16, this number must be between 0 and 1023; for the 91S32, this number must be between 0 and 2047.

(EOM) is the end of message indicator. (EOM) is the EOI line asserted on the last byte of the command header if the terminator switch is set to EOI. Otherwise, (EOM) is the LF (line feed) character if the terminator switch is set to LF/EOI.

Data Block Structure

The second part of the HSPAT command specifies the data you are downloading into the pattern generator. Data is transferred using the end block format:

@<data bytes>BC₁₆

<data bytes> are a continuous stream of 8 Bit bytes representing the pattern generator program microcode and patterns. The modules installed determine which data bytes are sent and their order.

NOTE

The symbol @ is 8 Bit ASCII. The second part of the program, <data bytes>BC₁₆, is 8 Bit Binary.

The byte order is described below:

For the 91S16:	1st byte	vector for Pod A
	2nd byte	vector for Pod B
	3rd byte	microcode (byte 0)
	4th byte	microcode (byte 1)
	5th byte	microcode (byte 2)
	6th byte	microcode (byte 3)

For the 91S32:	1st byte	vector for Pod A
	2nd byte	vector for Pod B
	3rd byte	vector for Pod C
	4th byte	vector for Pod D
	5th byte	inhibit/strobe

The BC₁₆ is always the last byte in the data byte sequence. The BC₁₆ can be followed by a semicolon (;) and any formatting character (LF, CR, or SP).

Cautions and Restrictions when using the HSPAT command

When you view a program downloaded into your pattern generator, data vectors, instructions, strobes, and inhibit data will be properly displayed in the pattern generator Program: Run sub-menu, but labels will not be correctly displayed. HSPAT uses hardware addresses instead of labels.

Programming the Interrupt Mode. Absolute memory addresses used by the GPIB command are affected by the interrupt handling mode you have selected in the 91S16 Setup: Probe sub-menu. You must select the desired interrupt mode using the DAS keyboard before beginning GPIB operation.

If you select "IRQ enabled, CALL <label> mode," you must structure your controller program to enter the first line of the interrupt service routine in hardware location 0. (When an interrupt arrives, the DAS will automatically look in the first memory location for the address of the service routine.) This means that the first sequence line of your program (SEQ 0) should be addressed to memory location 1, and each subsequent program line is addressed to the memory location one greater than the SEQ number.

If you have selected "IRQ disabled," or "IRQ enabled, IF IRQ mode," you should address the first sequence line of your program (SEQ 0) to memory location 0; the memory location and the SEQ number should match. See the Tables 15 and 16 for assistance in determining the proper memory address for the interrupt mode you have selected.

Programming the 91S16 Register Configuration. Instructions that use the 91S16 internal register are dependant on how you have configured the register in the 91S16 Configuration sub-menu. You must select the 91S16 internal register to be either two 8-bit registers named RA and RB, or one 16-bit register named R, before beginning GPIB operation.

Do not program LOAD R, OUT R, INCR R, or DECR R instructions unless you have selected the 91S16 internal register to be one 16-bit register called R. Conversely, do not program RA and RB instructions if the 91S16 register is configured to be R.

Programming the RETURN Instruction. Do not program the RETURN instruction unless you have set the 91S16 Setup: Probe sub-menu's IRQ field to CALL <label> mode.

Since HSPAT uses hardware addresses as Jump destinations, you can program any number of Jump instructions (without HSPAT, you are limited to 15 labels).

Correlating Menu Sequences and Hardware Locations

Since the HSPAT command loads your program directly into the 91S16/32 memory, you must use hardware locations to program memory. Tables 15, 16, and 17 show the relationship between menu sequence and hardware location. Be aware that the 91S16 hardware address is affected by the interrupt mode you select in the Probe sub-menu. In Sequential mode (with 91S16) and 91S32 Stand-Alone configuration (no 91S16) the 91S32 hardware address is affected by the number of vectors you download and the END SEQ field value you specify in the 91S32 Run sub-menu.

Table 15
MENU SEQUENCE AND HARDWARE LOCATION FOR 91S16

Menu Sequence		Hardware Location
IRQ enabled CALL <label>	IRQ disabled or IF IRQ	
reserved	0	0
0	1	1
1	2	2
2	3	3
3	4	4
.	.	.
.	.	.
1022	1023	1023

91S32 Sequence Number to Hardware Location Adjustments

When designing the files your controller will use to download data into the 91S32, you must take two factors into account. First, the 91S32 loads its memory from the bottom up, and the last sequence line is loaded into the very first memory location used. This factor becomes important when you are designating the hardware location for 91S32 data; especially if you downloading files shorter than 2047 sequence lines to 91S32s operating in Sequential mode, or 91S32s operating without a 91S16. Second, in Sequential and 91S32 Stand-Alone modes, certain combinations of the internal and external inhibit signals (programmed in the 91S16 Probe sub-menu) require you to invert the inhibit bit value you download.

Table 16 shows the relationship between sequence line and hardware location for 91S32s in both versions of Follows 91S16 mode, and when you are downloading a full block of 2047 sequence lines to 91S32s in Stand-Alone or Sequential modes.

If you are downloading fewer than 2047 sequence lines to 91S32s in Stand-Alone or Sequential modes, designating the correct hardware location for each sequence line is less intuitive. See the following paragraph, titled *Partial 91S32 Memory Reloads*, and Table 17.

Table 16
MENU SEQUENCE AND HARDWARE LOCATION FOR EACH 91S32

Menu Sequence			Hardware Location	
FOLLOWS 91S16 Mode		SEQUENTIAL		
IRQ enabled CALL <label>	IRQ disabled or IF IRQ			
Page A	reserved	0	2047	0
	0	1	0	1
	1	2	1	2
	2	3	2	3
	3	4	3	4

	1022	1023	1022	1023
	Page B	reserved	1024 (0)	1023
1023 (0)		1025 (1)	1024	1025
1024 (1)		1026 (2)	1025	1026
1025 (2)		1027 (3)	1026	1027
1026 (3)		1028 (4)	1027	1028
.		.	.	.
.		.	.	.
.		.	.	.
2045 (1022)		2047 (1023)	2046 (END SEQ - 1)	2047

Note: This example shows SEQUENTIAL mode when the END SEQ field is set to 2047.

Partial 91S32 Memory Reloads. When 91S32s in Stand-Alone or Sequential mode are reloaded with fewer than 2047 sequence lines, the hardware address for each sequence line is dependent on the value entered into the END SEQ field. You will need to enter the END SEQ value either by using key codes via the GPIB, or else by using the DAS keyboard while in the Program: Run sub-menu prior to downloading the vectors.

The 91S32 loads its memory in decending order from the bottom up, starting with hardware location 2047. In other words, the highest-numbered memory locations are always filled, but the lowest-numbered memory locations will only be filled if you are reloading the entire memory. See Table 17 for examples of how the sequence numbers are loaded into hardware for various sizes of partial reloads. Notice that the sequence line specified in the END SEQ field is loaded into the first available memory location.

Table 17
91S32s in Sequential and Stand Alone Modes
Menu Sequence to Hardware Location Map

END SEQ 2047		END SEQ 1999		END SEQ 7	
ASEQ	Hardware Location	ASEQ	Hardware Location	ASEQ	Hardware Location
2047	0	1999	48	7	2040
0	1	0	49	0	2041
1	2	1	50	1	2042
2	3	2	51	2	2043
3	4	3	52	3	2044
.	.	.	.	4	2045
.	.	.	.	5	2046
.	.	.	.	6	2047
2045	2046	1997	2046		
2046	2047	1998	2047		

The following equation shows you how to determine the hardware location for most sequence lines relative to any given END SEQ value. The equation for finding the correct hardware location for the sequence line specified in the END SEQ field follows. Note: This equation only applies if you are using 91S32s in Stand-Alone or Sequential modes.

$$\text{Absolute hardware address} = 2048 - \text{END SEQ value} + \text{ASEQ address.}$$

For example, to find the hardware address for sequence line 25 when you are downloading 100 sequence lines, you would first set the END SEQ field to 99 (100 sequences). Then, using the formula:

$$X = 2048 - 99 + 25$$

$$X = 1974$$

To find the hardware location for the sequence line designated in the END SEQ field, use the following formula:

$$\text{END SEQ line hardware address} = 2047 - \text{END SEQ field value.}$$

Note: You cannot change the END SEQ field value after you have downloaded the HSPAT command.

91S32 Sequential and Stand-Alone Mode Inhibit Bit Inversion. Certain combinations of the internal and external Inhibit bits (selected in the Probe sub-menu) require you to invert the downloaded internal inhibit value (i.e., program a binary 0 where you would otherwise program a binary 1). The following combinations of internal and external inhibit bits do **not** require any change:

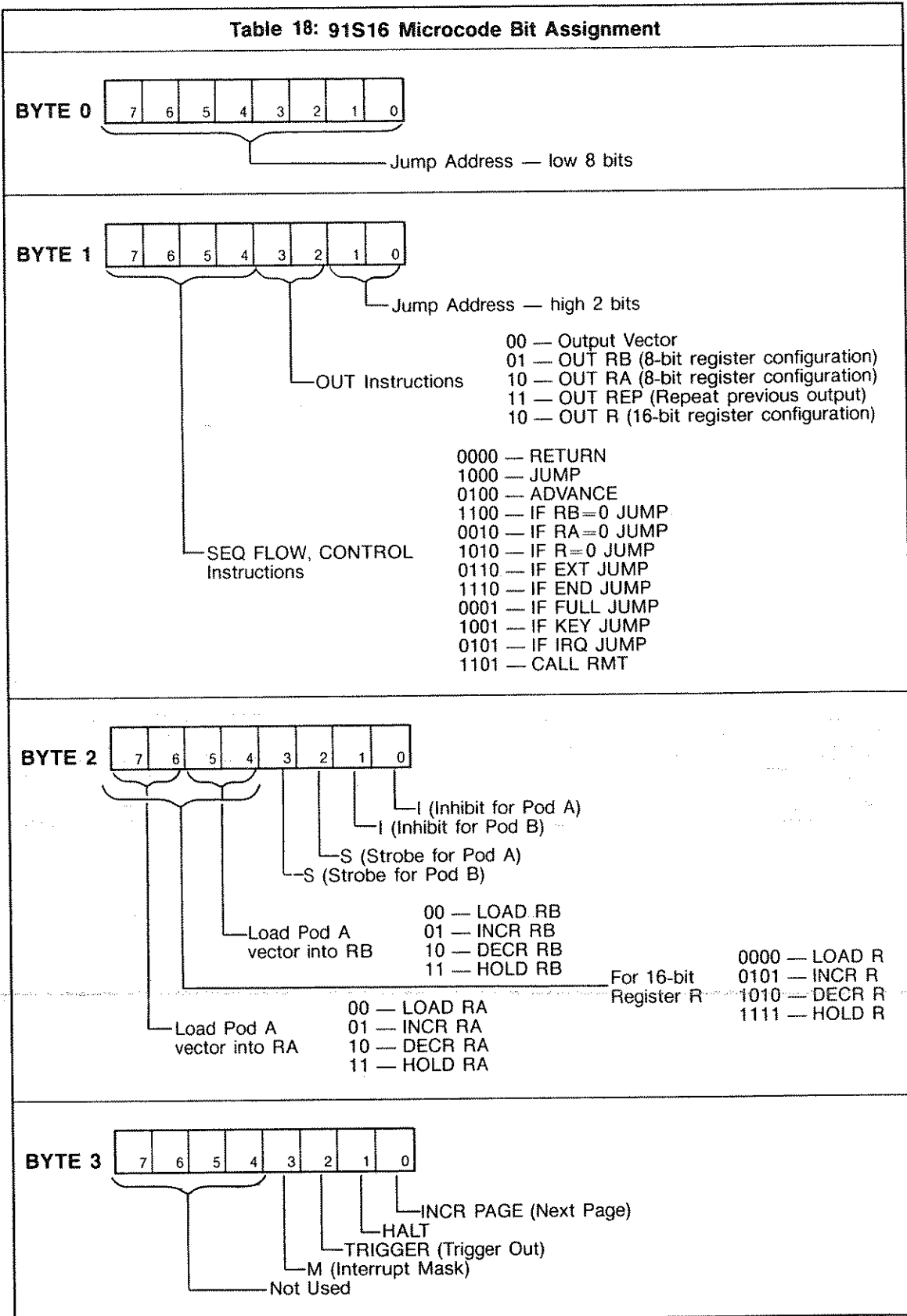
DISABLE
 INT 1 ONLY
 EXT 0 ONLY
 EXT 1 ONLY
 INT 1 OR EXT 0
 INT 1 OR EXT 1
 INT 0 AND EXT 0
 INT 0 AND EXT 1

The following combinations of internal and external inhibits require you to invert the internal inhibit value in order to obtain the expected results:

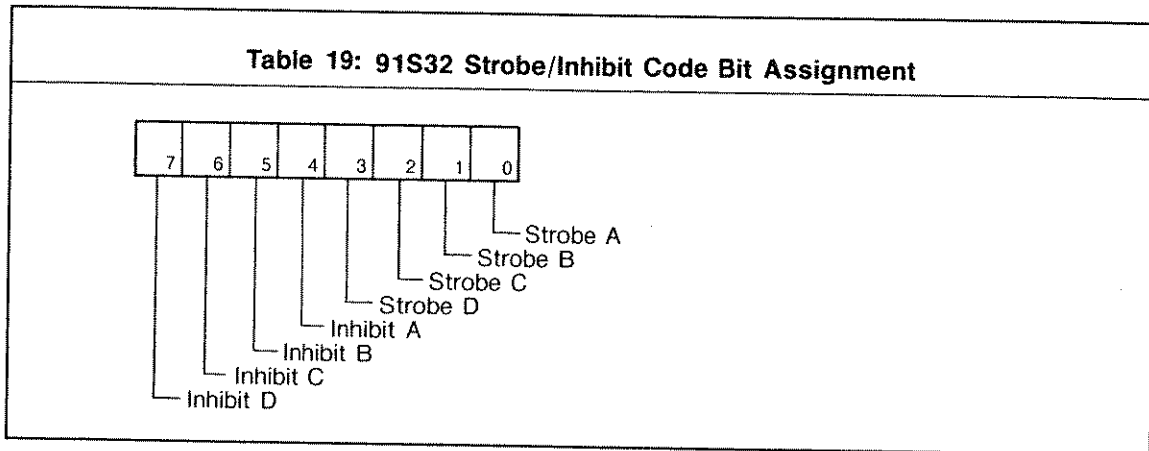
INT 0 ONLY
 INT 0 OR EXT 0
 INT 0 OR EXT 1
 INT 1 AND EXT 0
 INT 1 AND EXT 1

91S16 Microcode Bit Assignments. The 91S16 microcode bits are assigned as shown in Table 17.

NOTE All bit values are given in binary.



91S32 Microcode Bit Assignments. Multiple 91S32s are addressed according to their bus slot location. Table 18 shows the 91S32 strobe and inhibit bit assignments.



Using the HSPAT Command

The HSPAT command loads the DAS hardware directly; it does not set up the Pattern Generator sub-menus. As a result, HSPAT does not show labels programmed in the 91S16 Program: Run sub-menu.

NOTE

Instructions containing labels in the 91S16 Program: Run sub-menu may contain invalid data after the HSPAT command has been executed.

You can use HSPAT when the 91S16 Setup: Probe sub-menu interrupt request (IRQ) field is set to either "CALL <label>" or "IF IRQ" mode, but you must remember that "CALL <label>" mode requires that you enter the first line of the interrupt service routine into the first hardware memory location.

PROGRAMMING THE PATTERN DOWNLOAD FROM HOST FEATURE

There are two versions of the Pattern Download From Host Feature: The version that stimulates static devices can be run with any standard combination of 91S16 and 91S32 modules. This version is called Pattern Download For Static Devices, and it does not support the Keep-Alive feature. Dynamic circuits that require constant clock and vector inputs even while the pattern generator module is being reloaded from the host computer require the Pattern Download For Dynamic Devices (Keep-Alive) version. A description of that version appears later in this section.

Pattern Download For Static Devices

When using Pattern Download For Static Devices, the pattern generator will alternately output a block of vectors, fix the last vector at the probe tips while it reloads the next block of vectors from the host computer, and then output the next block of vectors. No special fields need to be enabled in order to use Pattern Download For Static Devices.

If a 91S16 is used, you must program the HALT instruction on the last line of each 91S16 vector download.

HALT Instruction. When the 91S16 executes a HALT instruction, or the 91S32 completes its specified number of LOOPS, SRQ is asserted. The DAS then responds with status byte 66 (operation complete) when polled by the controller. Status byte 66 indicates that the pattern generator has halted with the last vector asserted at the probe tip. Execution may be resumed by downloading a new setup to the pattern generator and then sending a start command. New setups may be downloaded by using either the PATGEN binary restore command or the HSPAT command.

NOTE

When using both acquisition and pattern generator modules, it is possible for status byte 66 to be generated twice (once for completion of acquisition and once for completion of pattern generation). If the controller polls the DAS after both of these operations have been completed, only one status byte 66 will be received.

Example of Binary File that establishes 91S16 Run sub-menu.

When downloaded, the following file results in the 91S16 Run sub-menu displayed at the right. The HSPAT command and its arguments are listed in the first line of the file. Note: The selected IRQ mode is CALL <label>; memory location 0 is loaded with the first line of the interrupt servicing routine.

Table 20. Binary file for Pattern Download For Static Devices.

SEQ	Hardware Location	Pattern Generator Program
		HSPAT 4,0,12 (EOM)
-1	0	@ 00 07 0A 80 F0 00
0	1	34 12 00 40 F0 08
1	2	FF 01 00 40 3C 08
2	3	00 02 00 48 F0 08
3	4	00 03 00 48 F0 08
4	5	00 84 07 28 B8 08
5	6	00 05 03 88 FC 00
6	7	00 06 00 40 FC 02
7	8	00 07 00 40 F0 00
8	9	00 08 00 40 FC 00
9	10	00 09 00 40 FC 00
10	11	00 0A 00 00 FC 00
		BC

Begin, End Block
91S16 Data (Pod A)
91S16 Data (Pod B)
91S16 μ Code (byte 0)
91S16 μ Code (byte 1)
91S16 μ Code (byte 2)
91S16 μ Code (byte 3)

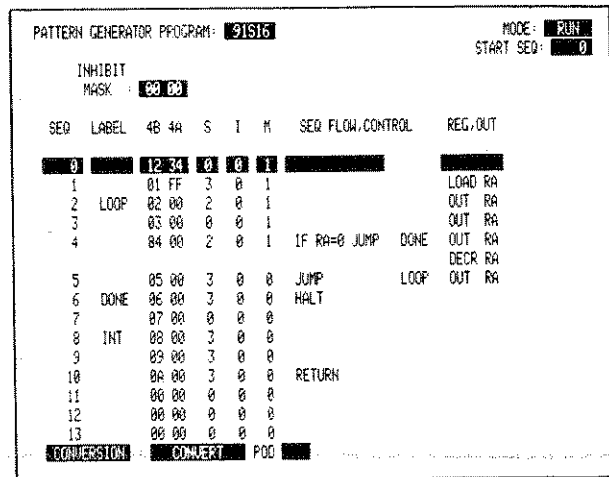


Figure 28. 91S16 Program: Run sub-menu display after binary download.

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Pattern Download For Dynamic Devices (Keep-Alive)

Pattern Download For Dynamic Devices (Keep-Alive) is only available if you are using DAS Option 06: I/O Interface (High Speed GPIB Programming). You must use a GPIB controller and the DAS GPIB interface. You must have a 91S16 and at least one 91S32 installed in the DAS.

When using Pattern Download For Dynamic Devices (Keep-Alive), the pattern generator outputs a page of vectors from both the 91S16 and the 91S32s. When the 91S16 reaches the bottom of its page, it enters a Keep-Alive subroutine that: 1) asserts the DAS SRQ line and informs the GPIB controller it is ready to receive a download (CALL RMT instruction), 2) executes the sequence lines contained within the Keep-Alive subroutine, thus continuing to output pattern to the circuit under test, and, 3) loops within the Keep-Alive subroutine until the controller sends a message that either the next page of vectors has been downloaded, or there are no more vectors to be downloaded. Upon receiving either of these instructions, the pattern generator exits the Keep-Alive routine and either instructs the 91S32s to begin executing the newly refilled memory page (implied INCR PAGE from IF FULL instruction), or else jumps to a specified shut-down routine (IF END instruction).

Description of Instructions:

CALL RMT When the CALL RMT (Call Remote device) instruction is executed, the DAS asserts the SRQ (service request) line and responds with status byte 197 when polled over the GPIB. Status byte 197 informs the controller that the pattern generator is ready for a download.

IF FULL JUMP When the 91S16 executes the IF FULL JUMP instruction it tests to see if the DAS has received KEY 46 from the controller. If KEY 46 has been received, the 91S16 instructs the 91S32s to change execution to the other memory page (implicit INCR PAGE), and begin execution on the sequence line containing the specified label. Initially, the pattern execution begins with Page A; the first successful IF FULL JUMP instruction transfers execution to Page B.

When constructing your controller program, you must send KEY 46 at the end of each complete download. If you are loading two 91S32 modules, the KEY 46 command should be sent only after both 91S32s have been loaded by HSPAT commands.

IF END JUMP When the 91S16 executes the IF END JUMP instruction it tests to see if the DAS has received KEY 47 from the controller. KEY 47 indicates that the controller has no more vectors to download to the 91S32s. Usually, the IF END JUMP instruction gives control to a routine that completes the pattern generation.

Example of a Binary File that establishes 91S16 Run sub-menu and Keep-Alive routine.

When downloaded, the following file results in the 91S16 Run sub-menu displayed at the right. Note: The selected IRQ mode is DISABLED so memory location 0 is loaded with SEQ 0 of the pattern generator program routine.

Table 21. Binary file for Pattern Download For Dynamic Devices.

SEQ	Hardware Location	Pattern Generator Program
HSPAT 4,0,15 (EOM)		
0	0	@ 00 00 00 40 F0 00
1	1	11 11 00 40 F0 00
2	2	22 22 00 40 F0 00
3	3	33 33 00 40 F0 00
4	4	44 44 00 40 F0 00
5	5	55 55 00 40 F0 00
6	6	66 66 00 40 F0 00
7	7	77 77 00 40 F0 00
8	8	88 88 00 40 F0 00
9	9	99 99 00 40 F0 00
10	10	AA AA 00 D0 F0 00
11	11	BB BB 00 10 F0 00
12	12	CC CC 0E E0 F0 00
13	13	DD DD 0A 80 F0 00
14	14	EE EE 00 40 F0 02

BC

Begin, End Block
91S16 Data (Pod A)
91S16 Data (Pod B)
91S16 μ Code (byte 0)
91S16 μ Code (byte 1)
91S16 μ Code (byte 2)
91S16 μ Code (byte 3)

```

PATTERN GENERATOR PROGRAM: 91S16
MODE: RUN
START SEQ: 0

INHIBIT
MASK: 00 00

SEQ LABEL 4B 4A S I M SEQ FLOW CONTROL REG OUT
0 START 00 00 0 0 0
1 11 11 0 0 0
2 22 22 0 0 0
3 33 33 0 0 0
4 44 44 0 0 0
5 55 55 0 0 0
6 66 66 0 0 0
7 77 77 0 0 0
8 88 88 0 0 0
9 99 99 0 0 0
10 AA AA 0 0 0 CALL RMT
11 KA BB BB 0 0 0 IF FULL JUMP STRT
12 CC CC 0 0 0 IF END JUMP STOP
13 DD DD 0 0 0 JUMP KA
14 STOP EE EE 0 0 0 HALT

CONVERSION: CONVERT POD
    
```

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Figure 29. 91S16 Program: Run sub-menu display after binary download.

Debugging HSPAT Programs

There are two methods you can use to debug your HSPAT programs. The first is based on the Pattern Generator TRACE and STEP modes, and the second is based on acquiring the program into acquisition memory. TRACE mode is basically an automatic version of STEP mode, so the STEP mode description applies to both.

STEP Mode Method: The STEP mode method uses the Pattern Generator STEP mode to show you the vector sequences as they have been processed by your program. For example, if your program contains a loop, the STEP mode method allows you to single-step through the repeated sequences. To use the STEP mode method:

1. Press the PATTERN GENERATOR key to enter the Program: Run sub-menu. Move the screen cursor to the MODE field and press SELECT until STEP appears.
2. Download the HSPAT command and your program.
3. Press the START PAT GEN key to single-step through the vector sequences.

Acquisition Method: The acquisition method allows you to look at your vector data in the State Table display. As with STEP mode, the acquisition method shows you the vector data sequences as they have been processed by your program. Unlike STEP mode, the acquisition method allows you to see the vector data as a whole (not one sequence line at a time).

To use the acquisition method:

1. Connect your pattern generator module to an acquisition module with probes. Each pod used on the pattern generator must be connected to a pod on the acquisition module.
2. Download the HSPAT command and your program.
3. Acquire the data with the acquisition module.
4. View the data in the State Table display.

SAMPLE GPIB CONTROLLER PROGRAMS

The following sample programs were written using a Tektronix 4050 Series graphic system as the GPIB system controller. Other controllers may require some program modification to work properly.

The sample programs use variable D1 as the talker/listener address for the DAS. You will need to enter this variable when you run the program. This variable needs to correspond to the setting you selected on the DAS address switch. The selected address is displayed at the top right corner of the Input Output menu.

Each program has a subroutine for handling Service Requests (SRQs). The program interrupts to this subroutine whenever SRQ is asserted.

NOTE

Some controllers can inadvertently Untalk the DAS by asynchronously responding to an SRQ from the DAS. For a discussion of this situation, see the Status Bytes, Error Codes, and Service Requests section of the Option 06 I/O Interface Operator's Addendum (Part of the DAS 9100 Series Operator's Manual package).

Modifying the Programs. If you need to modify these sample programs to run on your controller, not the following:

- The 4050 Series controller automatically asserts Remote Enable (REN) when these programs are run. You will need to include a statement that asserts REN in your program if your controller does not automatically do so.
- Table 12-42 of the Option 06 Operator's Addendum shows the traffic associated with the BASIC commands listed in the programming examples. This information may be useful to you if your controller functions differently from the 4050.

Sample Controller Program For Pattern Download For Static Devices

The example Pattern Download From Host for Static Devices program discussed in this section presupposes the following:

- A 91S16 (or 91S32) module is installed in slot 4.
- A properly formatted tape is currently mounted in the controller tape drive.
- If a 91S16 is used, the tape contains one or more files in binary end block format that specify vector data with a HALT instruction on the last sequence for the 91S16 module.
- If a 91S32 is used, the tape contains one or more files in binary end block format that specify vector data for a 91S32 module.

The following steps must be taken to program the example Pattern Download For Static Devices program:

1. Enter the 91S16 Setup: Probe sub-menu and set the IRQ field to IRQ enabled, CALL <1000>.
2. Enter the Setup: Timing sub-menu and set the clock rate.
3. Adapt the following controller program program to suit your needs. An example of a binary file that establishes the 91S16 Run sub-menu follows the program listing.

Overview of GPIB Controller Operation. The GPIB controller prompts the user for the DAS GPIB address, then waits for the DAS to assert an SRQ. When the proper SRQ is detected, the controller prompts the user for the number of the file containing data to be loaded into the first 91S32, issues the appropriate HSPAT command, and downloads that file. The controller continues to wait for SRQs (when the pattern generator executes a HALT instruction) and then performs file download routines until all files have been downloaded.

In order to use this feature, you must establish a GPIB controller program similar to that in Table 21. No special settings are required in the 91S16 or 91S32 sub-menus, but you must remember that hardware addresses are affected by the interrupt request mode selected. When using GPIB commands, the DAS cannot check for invalid entries.

Table 21
Sample Pattern Download From Host Controller Program for Static Devices

Main Program

<pre> 100 PRINT "Enter DAS address: "; 110 INPUT D1 </pre>	<p>1. Prompt the user for the DAS talker/listener address</p>
<pre> 120 ON SRQ THEN 2000 </pre>	<p>2. Establish the SRQ interrupt routine</p>
<pre> 130 GOSUB 1000 </pre>	<p>3. Load the pattern generator module</p>
<pre> 140 PRINT @D1:"START PGN" </pre>	<p>4. Start the pattern generator</p>
<pre> 150 B1=0 </pre>	<p>5. Wait for the pattern generator to halt (operation complete: SRQ 66 or 82)</p>
<pre> 160 IF B1<>66 AND B1<>82 THEN 160 </pre>	
<pre> 170 PRINT "Downlad more vectors? (Y or N): "; 180 INPUT Z\$ </pre>	<p>6. Prompt the user for more vectors to download.</p>
<pre> 190 IF Z\$<>"Y" THEN 220 200 GO TO 130 </pre>	<p>7. If the response is "Y," perform another download.</p>
<pre> 210 IF Z\$<>"N" THEN 170 220 PRINT "DONE" 230 END </pre>	<p>8. If the response is "N," report that the downloads are finished.</p>

Table 21 (cont.)
Sample Pattern Download From Host Controller Program for Static Devices

Pattern Generator Load Routine

1000 PRINT "Loading vectors, enter file number: ";	1. Prompt use for tape file containing binary end block.
1010 INPUT F1	
1020 FIND F1	2. Find file.
1030 PRINT @D1:"HSPAT 4,0,16"	3. Send HSPAT command header.
1040 WBYTE @D1+32:64	4. Designate the DAS as a listener.
1050 READ @33:B	5. Read binary data off tape byte-by-byte.
1060 WBYTE B	6. Relay it to the DAS.
1070 IF B=>0 THEN 1050	7. Final EOI sets 4050 Series sign bit negative.
1080 WBYTE @63:	8. Unlisten the DAS.
1090 RETURN	9. Return to load routine.

SRQ Handler Routine

2000 POLL A1,B1;D1	1. Poll the DAS
2010 IF B1=66 OR B1=82 THEN 2050	2. If the SRQ is an "operation complete" (a halt occurred), let it pass through and be handled by the main program.
2020 PRINT @D1:"ERRMSG?"	3. Otherwise, query the DAS for an error message.
2030 INPUT @D1:E\$	4. Receive the error message from the DAS.
2040 PRINT "Status =",B1,E\$	5. Print the status and error messages.
2050 RETURN	6. Return to main program.

Sample Controller Program for Pattern Download For Dynamic Devices (Keep-Alive)

The example Pattern Download For Dynamic Devices (Keep-Alive) program listed here presupposes the following:

- A 91S16 is installed in slot 4 and a 91S32 is installed in slot 5.
- A Properly formatted tape is currently mounted in the controller tape drive.
- The tape contains a file in binary end block format that specifies the vector data and Keep-Alive routine for the 91S16 module.
- The tape contains one or more files in binary end block format that specify vector data for a 91S32 module.

The following steps must be taken to enter the example Keep-Alive program listed below:

1. Enter the 91S32 Configuration sub-menu and select FOLLOW 91S16 mode. Set the MEMORY RELOAD FROM HOST (FOR KEEP-ALIVE) field to ON.
2. Enter the 91S16 Setup: Probe sub-menu and set the IRQ field to DISABLED.
3. Enter the Setup: Timing sub-menu and set to clock rate to 40 ns or greater.
4. Adapt the following controller program to suit your needs. A sample binary file that establishes the 91S16 Run sub-menu, including the Keep-Alive routine, follows the controller program.

Overview of GPIB Controller Operation. The GPIB controller prompts the user for the DAS GPIB address, then waits for the DAS to assert an SRQ. When the proper SRQ is detected, the controller prompts the user for the number of the file containing data to be loaded into the 91S16. The controller then issues the HSPAT command and downloads the contents of the file. It then prompts the user for the number of the file containing data for the first 91S32, issues the appropriate HSPAT command, and downloads that file. The controller continues to wait for SRQs and then perform file download routines until all files have been downloaded.

In order to use this feature you must establish a GPIB controller program similar to that in Table 22. No special settings are required in the 91S16 or 91S32 sub-menus, but you must remember that hardware addresses are affected by the interrupt request mode selected. When using GPIB commands, the DAS cannot check for invalid entries; you must not program instructions that have been disabled.

Table 22
Sample Pattern Download For Dynamic Devices Controller Program (Keep-Alive)

Main Controller Program

100 PRINT "Enter DAS address: "; 110 INPUT D1	1. Prompt user for DAS talker/listener address
120 ON SRQ THEN 4000	2. Establishes SRQ interrupt routine
130 GOSUB 1000	3. Load 91S16
140 GOSUB 2000	4. Load 91S32
150 PRINT @D1:"START PGN" 160 B1=0	5. Start Pattern Generator
170 IF B1<>197 AND B1<>213 THEN 170	6. Wait for CALL RMT to occur
180 PRINT "Download more vectors? (Y or N): "; 190 INPUT Z\$	7. Prompt the user for continuation of Keep-Alive
200 IF Z\$<>"Y" THEN 270	8. If the response is "Y," send another page to the 91S32, issue "KEY 46" to indicate "FULL," wait for another "CALL RMT."
210 GOSUB 2000 220 PRINT @D1:"KEY 46" 230 GO TO 160	
240 IF Z\$<>"N" THEN 180	9. If the response is "N," issue "KEY 47" to indicate "END."
250 PRINT @D1:"KEY47"	
260 PRINT "DONE" 270 END	10. Report when finished

91S16 Load Routine

1000 PRINT "Loading 91S16, enter file number: "; 1010 INPUT F1	1. Prompt user for tape file containing binary end block
1020 FIND F1	2. Find file
1030 PRINT @D1:"HSPAT 4,0,16"	3. Send HSPAT command header
1040 GOSUB 3000	4. Send binary end block to 91S16
1050 RETURN	5. Return to main program

Table 22 (cont.)
Sample Pattern Download For Dynamic Devices Controller Program (Keep-Alive)

91S32 Load Routine

2000 PRINT "Loading 91S32, enter file number: "; 2010 INPUT F1	1. Prompt for tape file containing binary end block
2020 FIND F1	2. Find file
2030 PRINT @D1:"HSPAT 5,0,16"	3. Send HSPAT command header
2040 GOSUB 3000	4. Send binary end block to 91S32
2050 RETURN	5. Return to either main program or to SRQ handler routine

Binary Transfer Routine

3000 WBYTE @D1+32:64	1. Designate the DAS as listener
3010 READ @33:B	2. Read binary data off tape byte-by-byte
3020 WBYTE B	3. Relay it to the DAS
3030 IF B=>0 THEN 3010	4. Final EOI sets 4050 Series' sign bit negative
3040 WBYTE @63:	5. "Unlisten" the DAS
3050 RETURN	6. Return to either 91S16 or 91S32 load routine

SRQ Handler Routine

4000 POLL A1,B1;D1	1. Poll the DAS for status
4010 IF B1=197 OR B1=213 THEN 4050	2. If the SRQ is a "CALL RMT," let it pass through and be handled by the main program.
4020 PRINT @D1:"ERMSG?"	3. Otherwise, query the DAS for the error message.
4030 INPUT @D1:E\$	4. Receive error message from the DAS.
4040 PRINT "Status = ",B1,E\$	5. Print status and error message
4050 RETURN	6. Return to main program.



ERROR AND PROMPTER MESSAGES: Additions with the 91S16 and 91S32 Pattern Generator Modules

NOT A 91S16 POD	Appears in the 91S16 Program: Run sub-menu when you enter an invalid pod I.D. in the CONVERSION: CONVERT POD editing command. Check to see which DAS slot the 91S16 is installed in and enter the appropriate pod I.D.
NOT A 91S32 POD	Appears in the 91S32 Program: Run sub-menu when you enter an invalid pod I.D. in the CONVERSION: CONVERT POD editing command. Check to see which DAS slot the 91S16 is installed in and enter the appropriate pod I.D.
CALL UNAVAILABLE: "IF IRQ" USED IN PROGRAM	Appears in the 91S16 Setup: Probe sub-menu when you attempt to change the interrupt request (IRQ) mode. You must remove any IF IRQ JUMP <label> instructions from the Program: Run sub-menu before changing modes.
CALL UNAVAILABLE: SEQ FLOW USED AT SEQ 1023	Appears in the 91S16 Setup: Probe sub-menu when you attempt to change the interrupt request (IRQ) mode. CALL mode reserves the first memory location for the interrupt routine jump address; this reduces the number of available sequence lines from 1023 to 1022. You must remove any sequence flow (SEQ FLOW) instructions programmed in SEQ 1023 before selecting CALL mode.
"IF IRQ" UNAVAILABLE: "RETURN" USED IN PROGRAM	Appears in the 91S16 Setup: Probe sub-menu when you attempt to change the interrupt request (IRQ) mode. You must remove the RETURN instruction programmed in the 91S16 Program: Run sub-menu before selecting IF IRQ mode.
PROCESSING IRQ SETUP	Appears when you attempt to exit the Setup: Probe sub-menu after changing IRQ modes. This message will disappear when the processing is complete. No action is required.
"R" USED IN PROGRAM	Appears in the 91S16 Configuration sub-menu when you attempt to select two 8-bit internal registers named RA and RB. Remove any instructions pertaining to the 16-bit internal register named R from the Program: Run sub-menu before changing the configuration of the 91S16 internal register.

"RA" OR "RB" USED IN PROGRAM

Appears in the 91S16 Configuration sub-menu when you attempt to select a single 16-bit internal register named R. Reemove any instructions pertaining to the 8-bit registers named RA and RB from the Program: Run sub-menu before changing the configuration of the 91S16 internal register.

**"IF FULL", "IF END", or
"CALL RMT" USED IN PROGRAM**

Appears in the 91S32 Configuration sub-menu when you select OFF in the MEMORY RELOAD FROM HOST (FOR KEEP-ALIVE) field. Remove any IF FULL, IF END, and CALL RMT instructions from the 91S16 Program: Run sub-menu before selecting OFF in this field.

PROCESSING END ASEQ SETUP

DAS is processing setup changes. No action required.

EDIT IN PROGRESS: <<<<<<<

Appears in the Program: Run sub-menu whenever lengthy edit operations are in progress. Chevrons will disappear as the process continues. No action required.

WARNING

THE FOLLOWING SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID PERSONAL INJURY, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO. REFER TO OPERATORS SAFETY SUMMARY AND SERVICE SAFETY SUMMARY PRIOR TO PERFORMING ANY SERVICE.



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6

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SERVICE INFORMATION

VERIFYING INSTALLATION OF THE UPGRADED + 5 V POWER SUPPLY

DAS 9100 mainframes can be configured using either an upgraded or an original-design + 5 V power supply. The original + 5 V power supplies provide up to 18 amps current, while the upgraded + 5 V power supplies provide up to 22 amps. 91S16 and 91S32 Pattern Generator modules require power from the upgraded + 5 V power supply. Therefore, it may be necessary to determine which + 5 V supplies are installed in your DAS.

A fully configured DAS contains three + 5 V power supplies; each supply provides power to two module slots. 91S16 and 91S32 Pattern Generator modules must be installed in slots supplied by the upgraded high-current +5 V power supply. Other DAS modules may not require this supply. You may want to install only enough upgraded + 5 V power supplies to satisfy your 91S16 and 91S32 modules, and then restrict module placement accordingly.

DAS 9100 instruments with the following serial numbers and greater will automatically have the upgraded power supply installed:

- Monochrome DAS 9109, serial numbers B050326 and higher
- Color DAS 9129, serial numbers B060100 and higher
- DAS 9119, serial numbers B010102 and higher

To identify the + 5 V power supply models in your mainframe, proceed as follows:

Remove Top Panel and Covers

Figure 1 illustrates how to remove the top panel and the module compartment cover.

1. Loosen the two large slotted screws in the upper corners of the back panel. Rotate the brackets behind these screws until they no longer block the edge of the top panel.
2. Press backward on the ridges at the front of the top panel. Simultaneously, pull on the rear edge until the front disengages.
3. Lift the panel up and off the mainframe.

NOTE

Step 4 is not necessary if you do not need to determine the position of the 91S16 and 91S32 modules.

4. Loosen the slotted-head screws that secure the module compartment cover until approximately 1/4 inch of each screw is exposed. Grasp the front edge of the cover and lift it off the mainframe.

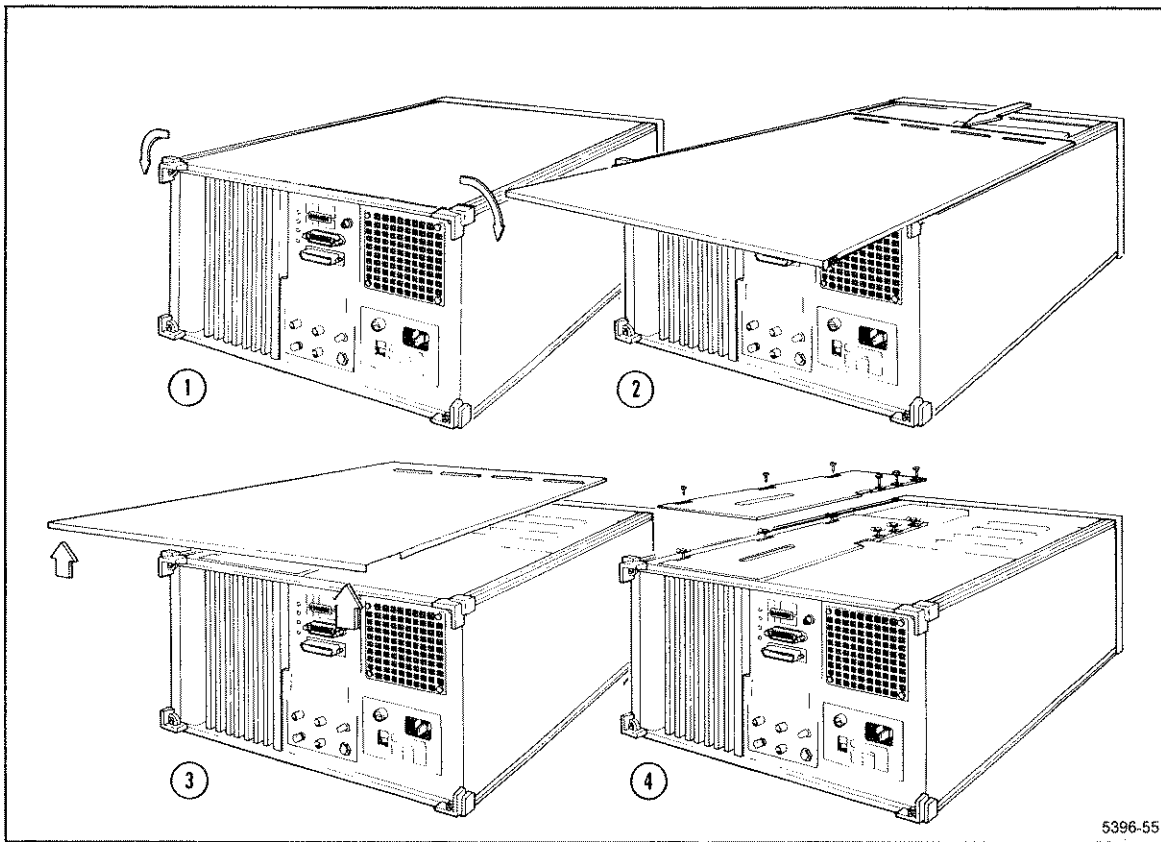


Figure B-1. Removing the top panel and the module compartment cover

WARNING

The power supply cover should be removed only by qualified service personnel. Hazardous voltages may be present; use extreme caution. Be sure power is off and the power cord is disconnected before removing the cover.

There are three holes located in the power supply cover. Chrome pins show through these holes to indicate the position of the + 5 V power supplies already installed. Locate these pins without removing the power supply cover; if all three pins are present, the DAS contains three + 5 V power supplies; this does not necessarily mean that upgraded + 5 V power supplies are installed.

- The + 5 V power supply module in the left position (adjacent to the main power supply) provides power to bus slots 1 and 2; this power supply is provided as a part of the basic DAS mainframe.
- The + 5 V power supply module in the center position provides power to bus slots 5 and 6.
- The + 5 V power supply in the right position (closest to the instrument modules) provides power to bus slots 3 and 4.

Remove Power Supply Cover

WARNING

DANGEROUS VOLTAGES ARE PRESENT ON THE CAPACITOR BRACKET BOARD DURING OPERATION AND FOR FIVE MINUTES AFTER POWER-DOWN. Each filtering capacitor can hold a 160 V charge. Wait at least five minutes for the capacitors to discharge before accessing the power supplies or related assemblies.

1. Remove the flat-head, POZIDRIVE screws that secure the power supply cover.
2. Lift the cover up and off.

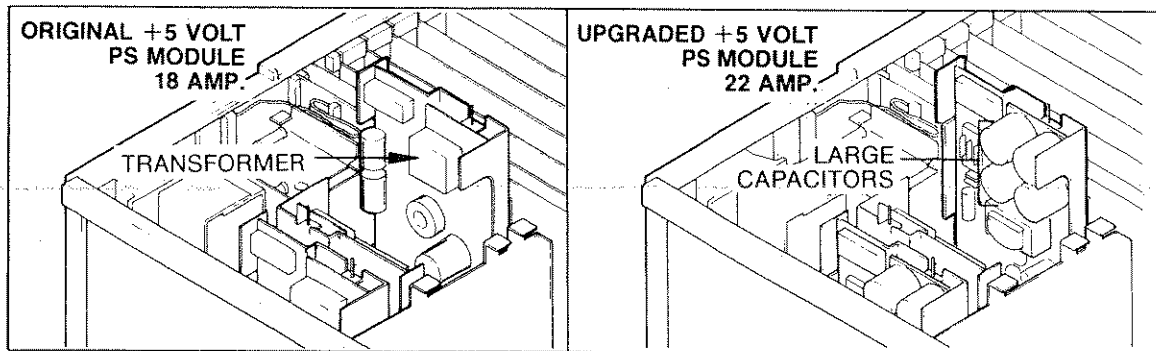
Identify Power Supply Models

Refer to Figure 2 and identify the + 5 V power supplies that serve the DAS bus slots where 91S16 and 91S32 modules reside. If original 18 amp + 5 V power supplies are installed, contact your Tektronix sales representative to obtain an upgraded 22 amp + 5 V power supply.

NOTE

If you have a color DAS, and you need to obtain upgraded 22-amp +5 V power supplies, you must also obtain the accompanying EMI kit. The EMI kit contains a shield that is placed between the color CRT gun and the +5 V module compartment. The EMI kit is not necessary for monochrome DAS's.

Part-number tags are fastened to the back of the chassis on each + 5 V power supply. Part numbers 620-0296-00 are for the original-design 18 amp models. Part numbers 620-0296-01 and up are for the upgraded 22 amp models.



5396-52

Figure B-2. Identifying the + 5 V power supply.

6

6

6

SERVICE INFORMATION

ADJUSTMENTS FOR MINIMUM SKEW BETWEEN MODULES

The procedures contained in this appendix allow a qualified service technician to verify the skew between 91S16 and 91S32 module outputs, and to make any necessary adjustments. If the adjustments described in this section do not achieve the skew specifications listed in the *General Information* section of this manual, contact your Tektronix Service representative to arrange repair.

WARNING

Open only the mainframe's module compartment. Other compartments within the mainframe contain hazardous voltages.

Do not place your fingers on components while the mainframe is turned on. DAS circuit boards and components can become very hot during operation.

Do not allow metal jewelry to come in contact with circuit components. A short between components could cause the jewelry to become very hot.

CAUTION

Instrument modules can be damaged if removed or installed while the mainframe is receiving power. To avoid damage, turn off the mainframe whenever you are moving a module.

Remove loose objects from the mainframe. During installation procedures, screws or other small objects may fall to the bottom of the mainframe. To avoid shorting out the primary power supply, do not power up the instrument until such objects have been removed.

NOTE

Tektronix Service Centers have the necessary equipment and personnel to perform any of the adjustments described in this appendix. If you desire, a service center can perform any of these adjustments for you.

If you send a module to a service center for adjustment, be sure to include all parts necessary for the adjustment. These may include other modules, the mainframe, probes, and cables.

The procedures in this appendix assume that the operator is already familiar with the steps necessary to access the DAS module compartment and install a circuit module on the Main Extender Board. Refer to the *DAS 9100 Series Service Manual*, (p/n 062-5848-00).

LIMITS AND TOLERANCES

All limits and tolerances given in this procedure are adjustment guides; they should not be interpreted as instrument specifications.

Tolerances given are for the instrument under test and do not include test instrument error.

EQUIPMENT

A list of the equipment required to adjust each module is provided in a table below. The specifications given in this table are the minimum necessary to produce accurate results. Therefore, any substituted equipment must meet or exceed the listed specifications. Refer to the manual for the specific test instrument if more information is required.

When equipment other than recommended test equipment is substituted, control settings or adjustment setups may need to be altered. If the equipment listed in the table is not available, carefully check the specifications listed in the table to make sure your substitute equipment is adequate.

Table C-1
Equipment Needed For The Adjustment Procedure

Equipment	Specifications	Equivalent Tektronix Instrument
DAS 9100 mainframe DAS 9100 Service Maintenance Kit Oscilloscope with 2 probes +5 V Power supply Delay line adjustment tool	No substitute allowed No substitute allowed 350 MHz bandpass PS503A No substitute allowed	2465 (w/P6230 probes) Tektronix Part number 003-1134-00

ABOUT THIS PROCEDURE

This adjustment procedure allows you to install 91S16 and 91S32 modules in any legal combination. However, the modules must be installed in consecutive slots powered by 22 amp +5 V power supplies. Refer to the *Operating Instructions* section of this manual for configuration rules. If you are unsure if you are using the correct +5 V power supply, refer to Appendix B (preceding).

The procedures contained in this appendix are grouped into four sections. The first section pertains only to 91S16 internal delay adjustments. The second section pertains to 91S32 internal adjustments. Sections 3 and 4 provide instructions for adjusting the skew between modules in either 91S16 with 91S32s, or 91S32 stand-alone configurations.

You must perform the individual module adjustments before adjusting skew between modules.

Tight Specification: The adjustment procedures contain several alternative steps with the procedure number enclosed in parentheses, followed by the words "Tight specification". Skew measurements made using these procedural steps are measured at the tip of the P6464 probe, and are therefore the most accurate adjustments possible. However, there are slight internal delay differences between P6464 probes. If you choose to use the tight specification procedural steps instead of the regular steps, you should dedicate each P6464 probe to a specific board and pod connector; connecting a P6464 other than the one used during the adjustment procedure may not provide the best performance.

Test Point Locations: Partial circuit board dollies for the 91S16 and the 91S32 are provided at the back of this appendix (Figures C-13 and C-14). Use these diagrams to help locate the delay lines and test points called out in the adjustment procedures.

SECTION 1: 91S16 INTERNAL ADJUSTMENTS

Adjusting 91S16 Delay Lines and Clock Control

The 91S16 has a total of six different variable delay lines in three different circuitry areas. There is one adjustment in the register timing circuitry, three in the Pod clock positioning circuitry, and two in the deskew circuitry between the Pod clocks.

Setup: Install the 91S16 on the main extender board.

NOTE

The same menu setup and equipment used to adjust these delay lines is used for subsequent procedures.



Use only the alignment tool p/n 003-1134-00 or damage to components may result.

Do not install or remove a module from the DAS mainframe with the power turned on. Doing so can damage the module.

Do not install or remove P6464 probes when the pattern generator is outputting data or damage to the probe or module may result.

1. Ensure power is off, then remove covers from all delay lines on the extended 91S16.
2. Connect one P6464 probe to Pod connector A and another P6464 to Pod connector B.
3. Power up the DAS.
4. Enter the Pattern Generator menu by pressing the PATTERN GENERATOR key.
5. Select the Pattern Generator Program sub-menu and enter the following program.

SEQ	LABEL	A	B	S	I	M	SEQ FLOW, CONTROL	REG, OUT
0	A	FF	FF	0	0	0		
1		00	00	0	0	0	JUMP A	

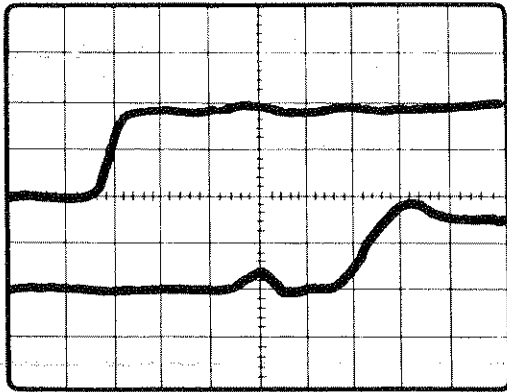
6. Enter the Probe sub-menu by pressing the SETUP key, then press SELECT to enter the Timing sub-menu.
7. Set the pattern generator clock to 200 ns.

Delay Line Adjustment for the First Latch's Clock in the Clock Line

1. Attach the probe for channel 1 of the oscilloscope to TP280-2 (located on middle of board near bottom), and connect probe ground leads to convenient GND test points. (TP280 is the reference point for the system clock.)
2. Attach the probe for channel 2 of the oscilloscope to TP610-2, and connect probe ground leads to convenient GND test points.
3. Set the oscilloscope to trigger on channel 1.
4. Press START PAT GEN. Adjust the oscilloscope for a display like Figure C-1.
5. Adjust delay line DL800 so that the rising edge on channel 2 is 25.5 ns \pm 1.0 ns after the rising edge on channel 1.
6. Move the position of all remaining variable delay lines except DL800 to approximate center.

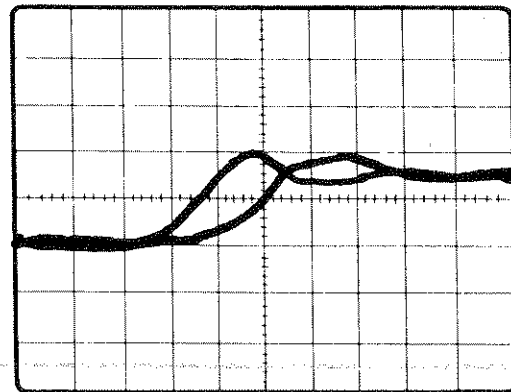
Adjusting Delay Lines for the Clock Line in the P6464 Probe

1. Attach the probe for channel 1 of the oscilloscope to TP720-2, and attach the probe for channel 2 to TP780-2. Connect probe grounds to GND test points.
2. Press START PAT GEN. Adjust delay line DL720 so that the rising edge of channel 1 is 3 ns \pm 0.5 ns after the rising edge of channel 2. (Channel 1 is clock, channel 2 is data.) See Figure C-2. Replace cover on DL720.
3. Move the probe for channel 2 to TP760-2. Adjust delay line DL740 so that the rising edge in channel 2 is 0 ns \pm 0.5 ns after the rising edge in channel 1. Replace cover on DL740.



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Figure C-1. First-latch clock line delay.



3072-39

Figure C-2. P6464 clock line delay.

Adjusting Delay Lines for the Pod Clock in Clock Positioning

1. Enter the Timing sub-menu, then set the Pod B clock delay to -5 ns. Set Pod A clock delay to 0 ns (default for Pod A). See Figure C-3.

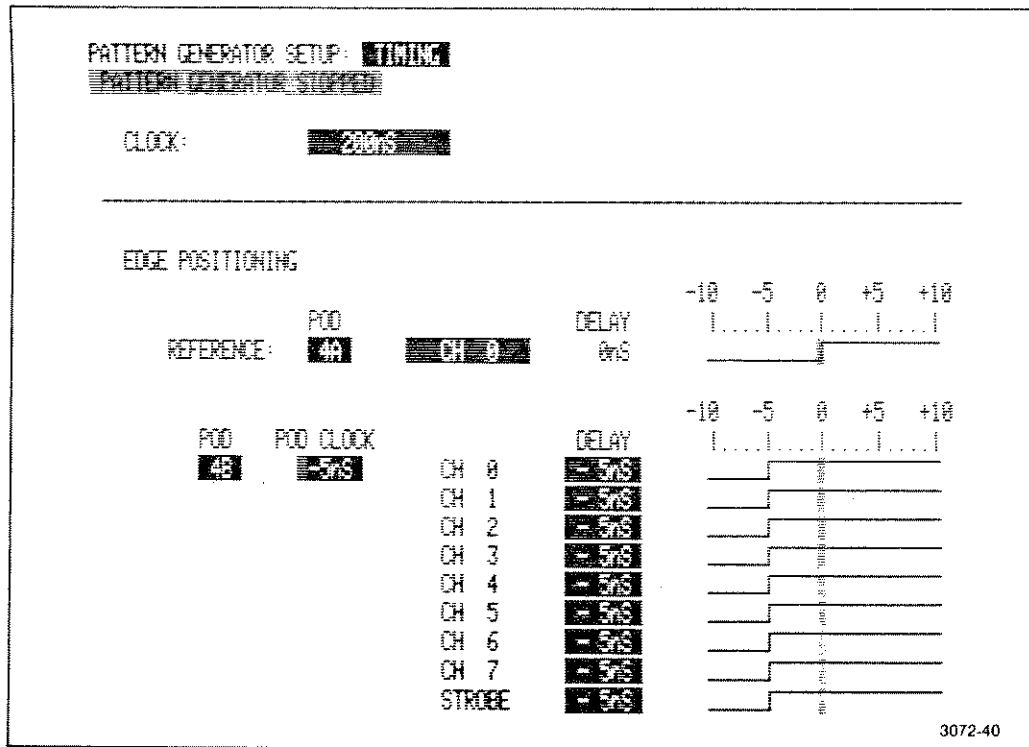
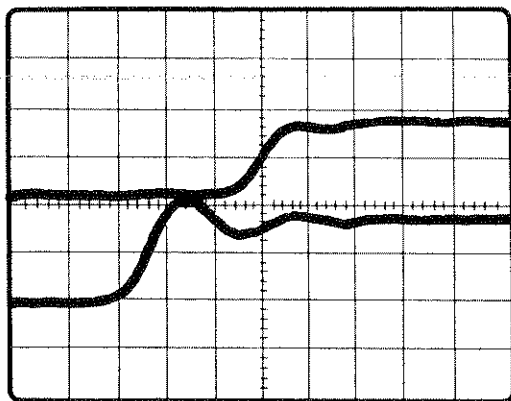


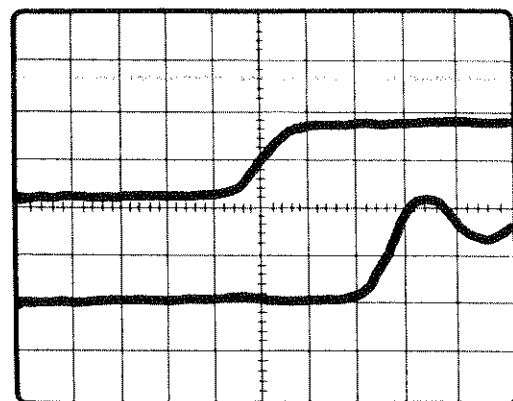
Figure C-3. Pod clock line delay line setup.

2. Press START PAT GEN.
3. Adjust delay line DL760 so that the rising edge in channel 1 is 5.0 ns \pm 0.25 ns after the rising edge in channel 2. See Figure C-4. Re-install cover on DL760.
4. Set Pod B clock delay to +5 ns in the sub-menu and press START PAT GEN. Adjust delay line DL780 so that the rising edge of channel 1 occurs 5.0 ns \pm 0.25 ns before the rising edge of channel 2. See Figure C-5.



3072-41

Figure C-4. Clock line delay for delay line DL760.



3072-42

Figure C-5. Clock line delay for delay line DL780.

Delay Line Adjustment for the Last Latch Clock

1. Move the oscilloscope channel 1 probe to test point TP280-2, and the probe for channel 2 to test point TP700-2.
- (1) (Tight Specification): Move the channel 1 oscilloscope probe to the CLK podlet for Pod A. Move channel 2 to the CLK podlet for Pod B.
2. Select the Timing sub-menu, then set the Pod A clock delay to -5 ns. Press START PAT GEN. (Leave the Pod B clock delay as it is.)
3. Adjust delay line DL700 so that the rising edge of channel 2 occurs 35.0 ± 0.25 ns after the rising edge of channel 1. See Figure C-6.

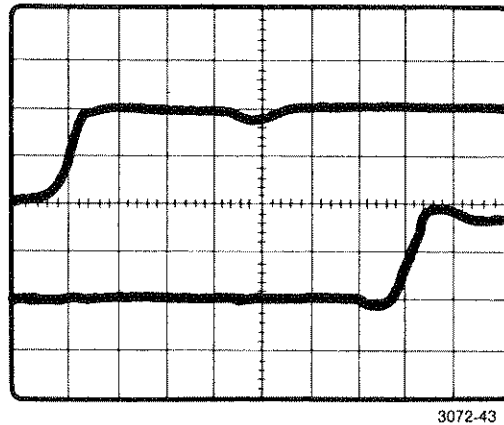


Figure C-6. Last latch clock adjustment.

- (3) (Tight specification): Adjust DL700 for zero skew.
4. Re-install the cover on DL700.

SECTION 2: 91S32 INTERNAL ADJUSTMENT PROCEDURE

Refer to Figure C-14 at the end of this appendix for help in locating test points and delay lines.

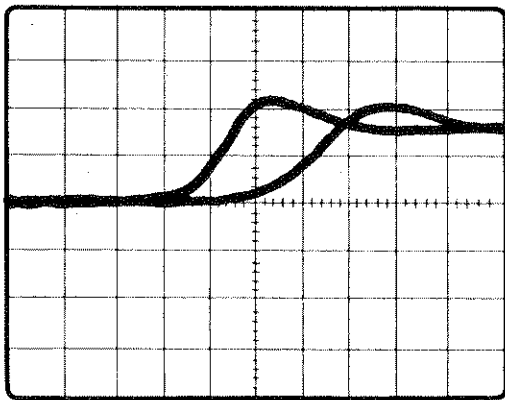
Delay Timing Adjustment

CAUTION

Do not install or remove any electrical module or sub-assembly in a DAS mainframe while power is on. Doing so can damage the module or sub-assembly.

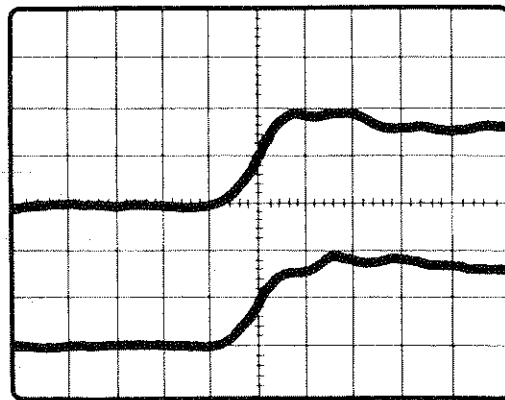
1. Turn off the DAS mainframe.
2. Remove all 91S32 or 91S16 Pattern Generator Modules from the mainframe.
3. Adjust the square-pin shorting jumpers on the Main Extender Board to accept a 91S32 module.
4. Insert the Main Extender Board in the slot where the 91S32 was removed. Install the 91S32 to be tested on the extender. Remove the covers from all delay lines on the 91S32.

5. Attach square-pin shorting jumpers J206 and J208 of the 91S32.
6. Connect the four P6464 Pattern Generator Probes to the 91S32.
7. Turn on the DAS. After the power-up sequence is successfully completed, press the PATTERN GENERATOR key.
8. Enter the Pattern Generator Timing sub-menu and set the clock to 200 ns.
9. Enter the Configuration sub-menu and select END SEQUENCE 2047, FREE RUN.
10. Check the menu fields for Pods A through D to ensure delays are set to 0 ns (default).
11. Connect oscilloscope probes and set up the oscilloscope as follows:
 - a. Channel 1 to TP500.
 - b. Channel 2 to TP580.
 - c. Connect probe grounds to GND test points near TP500 and TP580.
 - d. Trigger on a rising edge in channel 1.
12. Press START PAT GEN and adjust the oscilloscope to show a display like Figure C-7.



3072-44

Figure C-7. 91S32 pre-adjustment setup.



3072-45

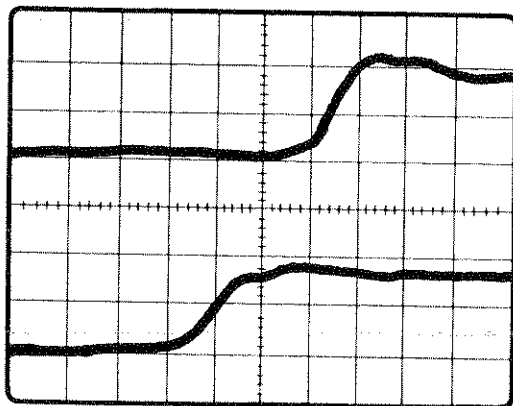
Figure C-8. 91S32 timing delay for DL260.

13. Adjust DL240 so that the pulse delay between channel 1 and channel 2 is 4 ns (± 0.25 ns). Re-install the cover on DL240.
14. Connect the channel 1 probe to TP580 and the channel 2 probe to TP600. Set the oscilloscope to trigger on a rising edge in channel 1.
- (14)(Tight specification): Connect the channel 1 probe to the P6464 probe clock output of Pod A. Connect the channel 2 probe to the P6464 clock output of Pod B. Attach the ground leads of the oscilloscope probes to the grounds of the P6464s. Trigger the oscilloscope on the rising edge of channel 1.
15. Adjust DL260 so the pulse delay between channel 1 and channel 2 is 0 ns (± 0.25 ns). See Figure C-8. Re-install the cover on DL260.

16. Move the channel 2 probe to TP620.
- (16)(Tight Specification): Move the channel 2 probe to the P6464 clock output of Pod C. Attach the ground lead of the channel 2 probe to the ground of the P6464 clock probe.
17. Adjust DL280 so that the pulse delay between channel 1 and channel 2 is 0 ns (± 0.25 ns). Reinstall the cover on DL280.
18. Move the channel 2 probe to TP640.
- (18)(Tight Specification): Move the channel 2 probe to the P6464 probe clock output of Pod D. Attach channel 2 probe ground to the ground of the P6464 clock probe.
19. Adjust DL300 so that the pulse delay between channel 1 and channel 2 is 0 ns (± 0.25 ns). Reinstall the cover on DL300.

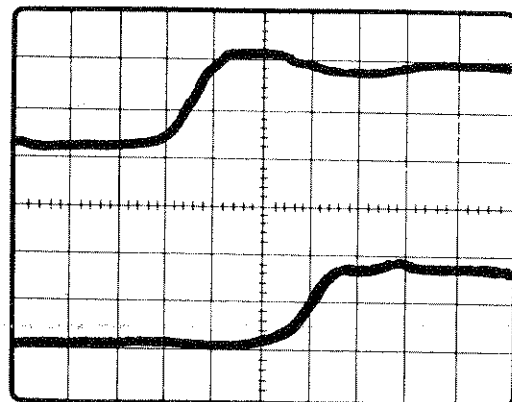
Adjusting 5 ns Pod-to-Pod Delay

20. Connect the channel 1 oscilloscope probe to TP580 and the channel 2 probe to TP600. Connect the probe ground leads to the grounds associated with those test points. Set the oscilloscope to trigger on a rising edge in channel 2.
- (20)(Tight Specification): Attach the channel 1 oscilloscope probe to the P6464 probe clock output of Pod A. Attach the channel 2 probe to the P6464 probe clock output of Pod B. Attach the ground leads of the oscilloscope probes to the grounds of the P6464 clock probes. Trigger the oscilloscope on a rising edge in channel 2.
21. Select the Timing sub-menu and set Pod A delay value to 0 ns, and set Pod B delay value to -5 ns.
22. Press START PAT GEN, then adjust the oscilloscope for a display like Figure C-9.



3072-46

Figure C-9. Setup for -5 ns Pod-to-Pod delay adjustment.

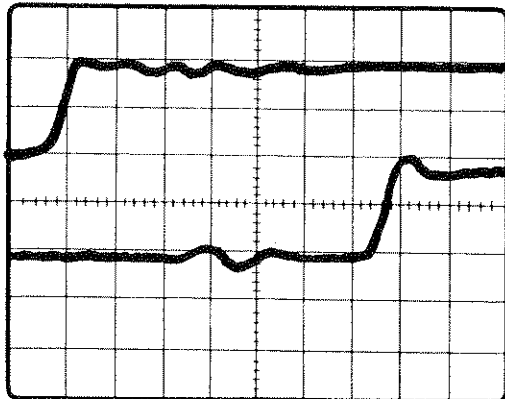


3072-47

Figure C-10. Setup for $+5$ ns Pod-to-Pod delay adjustment.

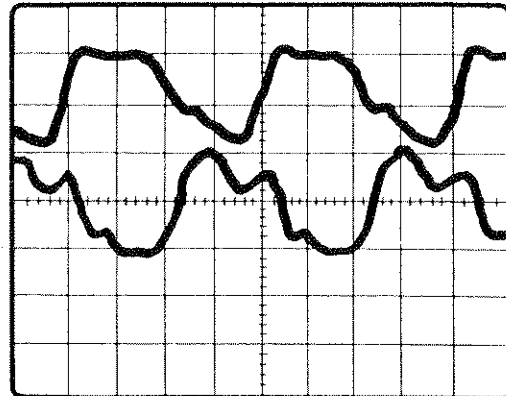
23. Adjust DL200 so that the pulse delay between channel 1 and channel 2 is 5 ns (± 0.25 ns). Reinstall the cover on DL200.
24. Set the Pod A delay to 0 ns and Pod B delay to $+5$ ns. Trigger the oscilloscope on a rising edge from channel 1.
25. Press START PAT GEN and adjust the oscilloscope for a display like Figure C-10.

26. Adjust DL220 so that the pulse delay between channel 1 and channel 2 is 5 ns (± 0.25 ns). Reinstall the cover on DL220.
27. Connect the channel 1 oscilloscope probe to TP200 and the channel 2 probe to TP500.
28. Adjust DL140 so that the pulse delay between rising edges of channel 1 and channel 2 is 33 ns (± 0.5 ns). See Figure C-11. Re-install the cover on DL140.



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Figure C-11. Oscilloscope display for DL140 adjustment.



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Figure C-12. Oscilloscope display for DL160 adjustment.

29. Set the clock in the Timing sub-menu to 20 ns and press START PAT GEN.
30. Adjust DL160 so that the pulse delay between the rising edge of channel 1 and the second rising edge of channel 2 is 31 ns (± 0.5 ns). See Figure C-12. Re-install the cover on DL160.
31. Repeat the procedure for each 91S32 in your system.
32. Disconnect the oscilloscope. Turn off the DAS mainframe, remove the 91S32 from the Main Extender Board, then remove the Main Extender Board. Finally, re-install the 91S32 in its slot.

This completes the 91S32 delay timing adjustment procedure.

SECTION 3: MULTIPLE 91S32 SKEW ADJUSTMENT (NO 91S16)

The same equipment used to adjust the 91S32 clock delay is used in this procedure. This procedure assumes the clock delay adjustment has been performed.

1. Install jumpers on J206 and J208 of the first and last 91S32 in the system. (This is the standard jumper configuration when no 91S16 is present.) Refer to the *Operating Instruction* section of this manual if necessary.
2. Remove covers from DL140 and DL160 on a 91S32.
3. Remove the Main Extender board and install two or more 91S32s in slots powered by a 22 A +5 V power supply.
4. Connect P6464 probes to the 91S32 Pod A connectors.
5. Connect the channel 1 oscilloscope probe to TP580 of the 91S32 in the slot closest to slot 7 (this becomes the master 91S32). Connect the channel 2 probe to TP580 of the 91S32 to be adjusted.

- (5) (Tight specification): Connect the channel 1 oscilloscope probe to the P6464 Pod A clock output of the 91S32 in the maximum slot. Connect the channel 2 probe to the P6464 Pod A clock output of the 91S32 to be adjusted. Ground the oscilloscope probes to the V-ref of the P6464 clock podlets.
6. Select the Timing sub-menu and set the clock to 200 ns.
7. Enter the Configuration sub-menu and select END SEQUENCE 2047, FREE RUN.
8. Press START PAT GEN, then adjust the oscilloscope for a display like Figure C-8.
9. Adjust DL140 so that the pulse delay between channel 1 and channel 2 is 0 ns (± 0.5 ns). Re-install the cover on DL140.
10. Select the Timing sub-menu, set the clock to 20 ns, and press START PAT GEN.
11. Adjust DL160 so that the pulse delay between channel 1 and channel 2 is 0 ns (± 0.5 ns). Re-install the cover on DL160.
12. If another 91S32 is present, repeat the procedure for that module. (Work from first to third, first to fourth, etc.)
13. Turn off DAS power and remove the 91S32 modules.

SECTION 4: 91S32 SKEW ADJUSTMENT WITH A 91S16

Equipment required for this procedure is the same as for previous procedures. This procedure assumes the clock delay adjustment has been performed on the 91S16 and 91S32 modules.

1. Install square-pin shorting jumpers on J102, J302, J304, J308, J310, J312, J314, J316, J318, J320, J322, J324, J202, J204, J206, and J208 of the 91S32. Refer to the *Operating Instructions* section of this manual if necessary.

NOTE

If multiple 91S32s are installed, position the 91S32 with the jumpers furthest from the 91S16.

2. Connect the channel 1 oscilloscope probe to test point TP720 on the 91S16. Connect the channel 2 probe to TP580 on the 91S32 to be adjusted.
- (2) (Tight specification): Connect the oscilloscope channel 1 probe to the P6464 Pod A probe clock output of the 91S16. Attach the channel 2 probe to the P6464 Pod A probe clock output of the 91S32 to be adjusted. Connect oscilloscope probe grounds to the P6464 grounds and podlet V-refs.
3. Select the 91S16 Program sub-menu and enter the following program:

SEQ	LABEL	A	B	S	I	M	SEQ FLOW, CONTROL	REG, OUT
0	A	00	00	0	0	0		
1		00	00	0	0	0	JUMP A	
4. Select the Timing sub-menu and set the clock to 200 ns.
5. Press START PAT GEN and adjust the oscilloscope for a display like Figure C-8.
6. Adjust DL140 on the 91S32 so that the pulse delay between channel 1 and channel 2 is 0 ns (± 0.5 ns).

This completes all 91S16 and 91S32 adjustment procedures. Disconnect the test equipment and restore the DAS to the standard operating configuration.

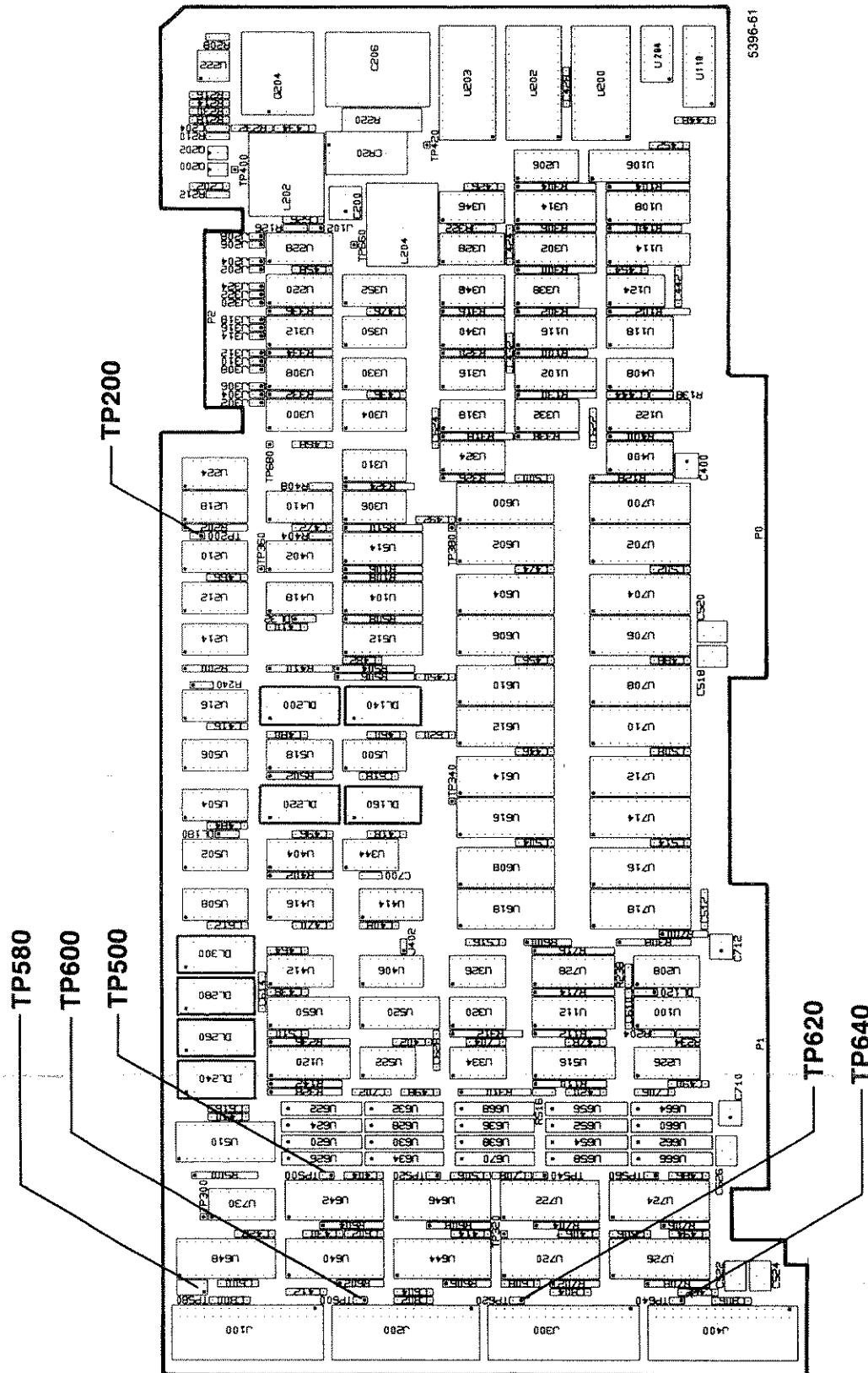


Figure C-14. 91S32 dolly and test point locator.

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