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HEWLETT PACKARD

Operation Manual

HP 70205A and HP 70206A GRAPHICS DISPLAY

SERIAL NUMBERS

This manual applies directly to HP 70205A and HP 70206A graphics display with serial numbers prefixed 2731A and below.

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Safety Symbols

The following safety symbols are used throughout this manual. Familiarize yourself with each of the symbols and its meaning before operating this instrument.

Caution



The CAUTION sign denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in damage to or destruction of the instrument. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

Warning



The WARNING sign denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

General Safety Considerations

Warning



BEFORE THIS INSTRUMENT IS SWITCHED ON, make sure it has been properly grounded through the protective conductor of the ac power cable to a socket outlet provided with protective earth contact. Any interruption of the protective (grounding) conductor, inside or outside the instrument, or disconnection of the protective earth terminal can result in personal injury.

Warning



There are voltages at many points in the instrument which can, if contacted, cause personal injury. Be extremely careful. Any adjustments or service procedures that require operation of the instrument with protective covers removed should be performed only by trained service personnel.

Caution



BEFORE THIS INSTRUMENT IS SWITCHED ON, make sure its primary power circuitry has been adapted to the voltage of the ac power source. Failure to set the ac power input to the correct voltage could cause damage to the instrument when the ac power cable is plugged in.

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HP 70000 Modular Measurement System Documentation Outline

Instruments and modules of the HP 70000 Modular Measurement System are documented to varying levels of detail. Modules that serve as masters of an instrument require operation information in addition to installation and verification instructions. Modules that function as slaves in a system require only a subset of installation and verification information.

Manuals Supplied with Module

Installation and Verification Manual

Topics covered by this manual include installation, specifications, verification of module operation, and some troubleshooting techniques. Manuals for modules that serve as instrument masters will supply information in all these areas; manuals for slave modules will contain only information needed for slave module installation and verification. Master module documentation may also include some system-level information.

Operation Manual

Operation Manuals usually pertain to multiple- and single-module instrument systems. Topics include preparation for module use, module functions, and softkey definitions.

Programming Manual

Programming Manuals also pertain to multiple- and single-module instrument systems. Programming Manual topics include programming fundamentals and definitions for remote programming commands.

Service Manual, Available Separately

This manual provides service information for a module, including module verification tests, adjustments, troubleshooting, replaceable parts lists, and replacement procedures. For ordering information, contact a Hewlett-Packard Sales and Service Office. This manual is not always immediately available for new products. (NOTE: Some earlier service manuals are titled *Technical Reference*.)

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1

Display Overview

Introduction

This chapter covers the operation and capabilities of the HP 70205A Graphics Display and the HP 70206A System Graphics Display.

An HP 70000 Series measuring instrument consists of a mainframe and a set of modules (for example, a spectrum analyzer composed of a local oscillator, an IF section, and an RF section). However, such an instrument has neither a keyboard nor a display (CRT): the measuring instrument itself is separate from the display. An HP 70000 Series display is an essential part of a manually operated system and a powerful addition to a remotely operated system.

A display provides such capabilities as:

- A screen for one or several instruments to write on.
- A keyboard to control one instrument at a time.
- System-wide error reporting.
- Hardcopy output capability without the need for an external controller.

For a more complete description of the display features, see Chapter 2, "Softkey Reference."

Front-Panel Concept

The graphics displays serve as the "front panel" for instruments in the HP 70000 Modular Measurement System. It is possible to use one display with multiple measurement systems, one display for a single system, or even multiple displays for the same system.

The compact HP 70205A Graphics Display and the larger HP 70206A System Graphics Display each have one display with 14 unlabeled menu keys next to it. See Figure 1-3. These keys are labeled on the screen by whichever instrument owns the keyboard. Menu keys are used for all manual instrument-control functions.

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Notation Conventions

Throughout this manual, menu-key labels are denoted as TEXT. Fixed-label keys are denoted as [TEXT]. Fixed-label keys on the HP 70205A differ slightly from fixed-label keys on the larger HP 70206A. For example, on the HP 70206A the display key is denoted by [DISPLAY], while on the HP 70205A the same key is abbreviated [DSP]. The key functions are identical, but the HP 70206A key labels (unless noted otherwise) are used throughout this operating manual.

Fixed-label Keys:

For data entry, each display has a single knob and 15 labeled keys (0 through 9, decimal point, minus sign, back-space, step-up, and step-down). In most cases, data can be entered with either the numeric keypad (0—9), the display knob, or the step keys. In addition there are seven other keys (five on the HP 70205A):

[I/P] (Instrument Preset) When an instrument (such as the spectrum analyzer) owns the keyboard, pressing [I/P] will cause that instrument to preset many of its own operating parameters. This returns the instrument menu to the screen if the Display menu is in use, but does *not* affect operation of the display.

[USER] ([USR] on the HP 70205A) This key brings up the 14 menu keys most commonly needed by the user for instrument control. These keys are also available under the [MENU] key, although more than one keystroke is required to reach them. For more information on the [USER] key, including instructions for modifying the [USER] keys, refer to the operation manual for the master module in your system.

[MENU] ([MNU] on the HP 70205A) This key brings up a more general menu of menu keys for instrument control. This provides access to all menu keys for the instrument you are currently using. For most operations, this key accesses more functions than the [USER] key, but is less convenient. For more information, refer to the operation manual for the master module in your system.

[DISPLAY] ([DSP] on the HP 70205A) This key calls up a set of menu keys used to control the operations of the display itself. For more information about the individual menu keys under [DISPLAY] key, refer to Chapter 2, "Softkey Reference."

[LOCAL] ([LCL] on the HP 70205A) This key returns all modules in the system to local control from HP-IB remote.

[PRINT] (HP 70206A Only) This key starts a raster print output of the present display screen over HP-IB (the same as the PRINT menu key).

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(PLOT) (HP 70206A Only) This key starts a vector plot output of the present display screen over HP-IB (the same as the PLOT menu key).

A section in this chapter entitled "Display Capabilities" gives some examples of how to use the different menu key levels found under the (DISPLAY) key.

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HP 70205A Graphics Display

The graphics display is a 3/8-width module with 5-inch raster display screen which provides the human interface and manual control capability of the HP 70000 Modular Measurement System. It displays instrument status and measurement output, and it has graphics, trace, text, and marker capability. Controls include 14 user-definable menu keys, 10 data keys (numbered 0 through 9), 10 control keys, and a control knob. Instrument control is accomplished using menu keys to establish an interactive front-panel for your instrument.

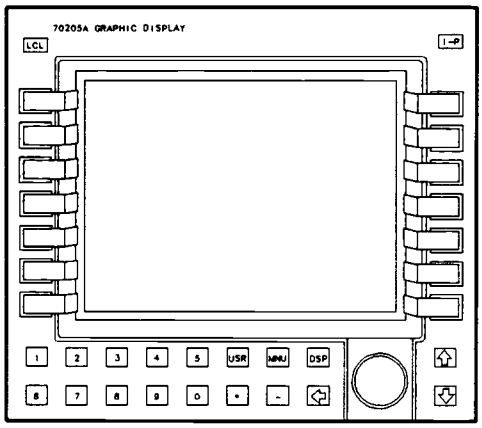


Figure 1-1. HP 70205A Graphics Display

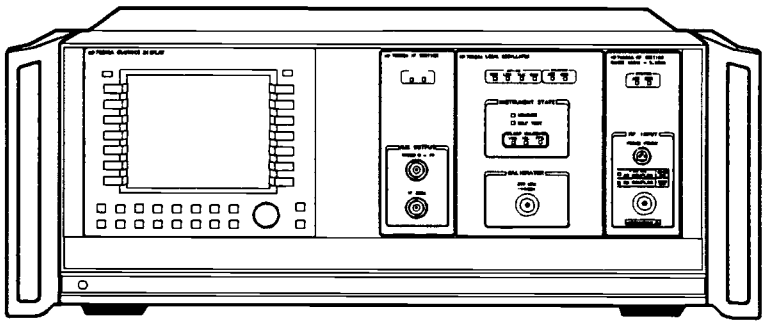


Figure 1-2.
HP 71100A Spectrum Analyzer Including HP 70205A Graphics Display

There are 14 menu keys, 7 on each side of the CRT display. Three keys (USR), (MNU), and(DSP)), are located underneath the CRT, each providing access to a different set of menu keys. Pressing any one of these keys brings up a menu of menu keys on the screen. Some of

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these menu keys provide further access to other menus. If the display is used as a stand-alone display, the [USER] and [MENU] keys will *not* bring up a menu or menu keys.

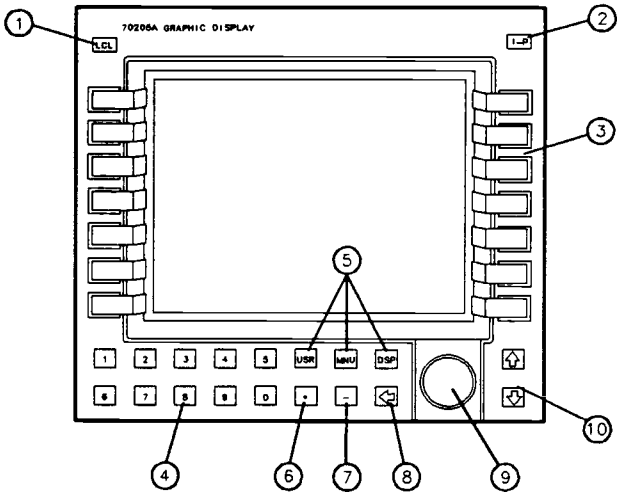


Figure 1-3. HP 70205A Graphics Display

1. [LCL] This key returns the instrument from HP-IB remote to local control.
2. [I/P] This key activates all the preset conditions of the instrument presently controlled by the keyboard.
3. **Menu Keys** These keys are used for most instrument and system control operations.
4. **Numeric Keypad** (0 through 9) This keypad enters numeric values.
5. [USR], [MNU], [DSP] keys, These keys are used to access three different top-level menu key menus.
6. [.] This key enters a decimal point.
7. [−] This key is used for entering negative numbers.
8. [←] This key is used to move from a lower level of menu keys to the next higher level. It is also used in data entry to move the cursor.
9. **Display Knob** This knob is used to change parameter values and to select alpha characters.
10. [↑] [↓] These two keys are used to change parameters up or down.

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HP 70206A System Graphics Display

The system graphics display is a stand-alone, large, easy-to-read screen display for the HP 70000 Modular Measurement System. It has a 9-inch raster CRT, System II frame and is stack-compatible with the HP 70001A Mainframe and other System II instruments. It supplies the same display and manual control capability as the HP 70205A Graphics Display.

The primary advantages of the HP 70206A are its large display size and the fact that when it is used in place of the HP 70205A, three-eighths of the mainframe capacity is released for use by other modules.

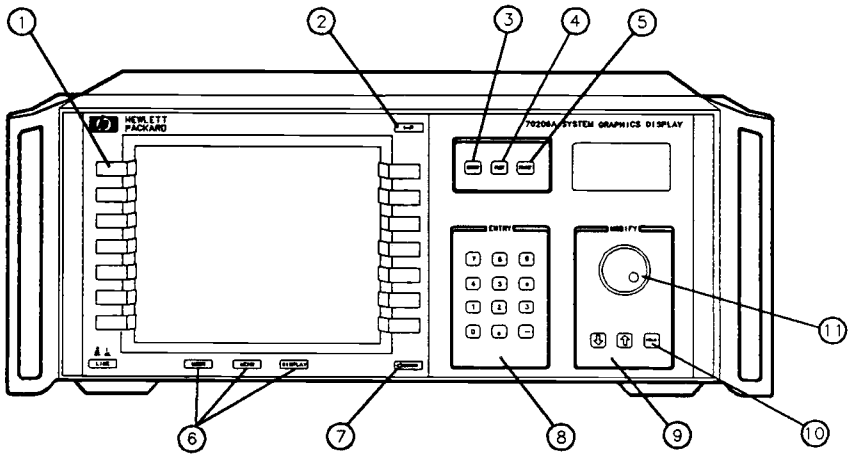


Figure 1-4. HP 70206A System Graphics Display

1. **Menu Keys** These keys are used for most instrument and system control operations.
2. (I/P) This key activates all the preset conditions of the instrument presently controlled by the keyboard.
3. (LOCAL) This key returns the instrument from HP-IB remote control to local control.
4. (PLOT) This key starts a vector plot output of the present display screen over HP-IB (the same as the PLOT menu key).
5. (PRINT) This key starts a raster print output of the present display screen over HP-IB (the same as the PRINT menu key).
6. (USER) (MENU) (DISPLAY) These keys call the top level menu key menus to the screen.
7. (←) This key is used to move from a lower level of menu keys to the next higher level. It is also used in text entry to move the cursor.

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8. **Numeric Keypad** This keypad enters numeric values.
9. ⇧ ⇩ These two keys are used to change parameters up or down.
10. HOLD This key deactivates the function displayed in the active function area; the readout is blanked from the screen.
11. **Display Knob** This knob is used to change parameter values, and to select alpha characters.

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Display Capabilities

The following section is a brief overview of what the HP 70205A and HP 70206A graphics displays can do. The display's capabilities are discussed in detail in Chapter 2, "Softkey Reference."

The display serves as the central user interface for all instruments on the HP 70000 Series instrument bus, HP-MSIB (Hewlett-Packard Modular System Interface Bus). It provides a screen on which the instruments write information and a keyboard used for manual instrument control.

To manually operate a single spectrum analyzer, the display can be used as a conventional keyboard and screen.

To achieve the display in Figure 1-5:

1. Press the (DISPLAY) key.
2. Press the SELECT INSTR key.
3. Press the (MENU) key.

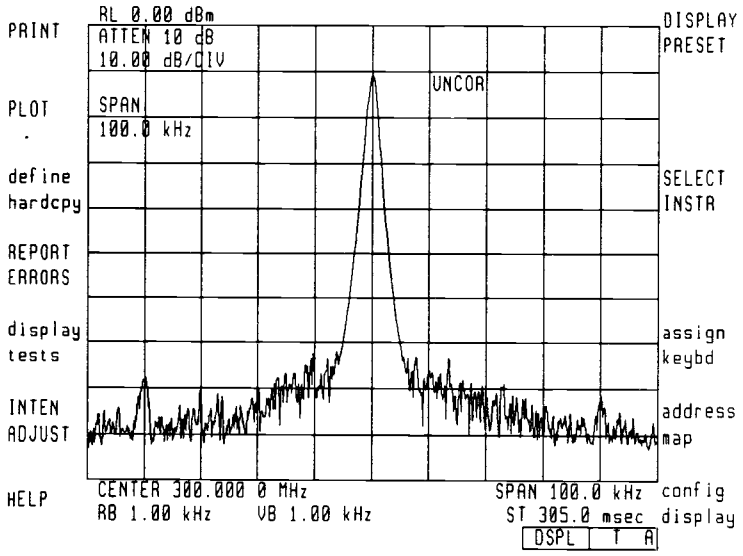


Figure 1-5. Display Capabilities

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Select Instrument

SELECT INSTR establishes contact between the display and the instruments currently configured in the HP 70000 system. For more information, see the SELECT INSTR menu key description in Chapter 2.

To achieve the display in Figure 1-6:

1. Press the DISPLAY key.
2. Press the SELECT INSTR key.

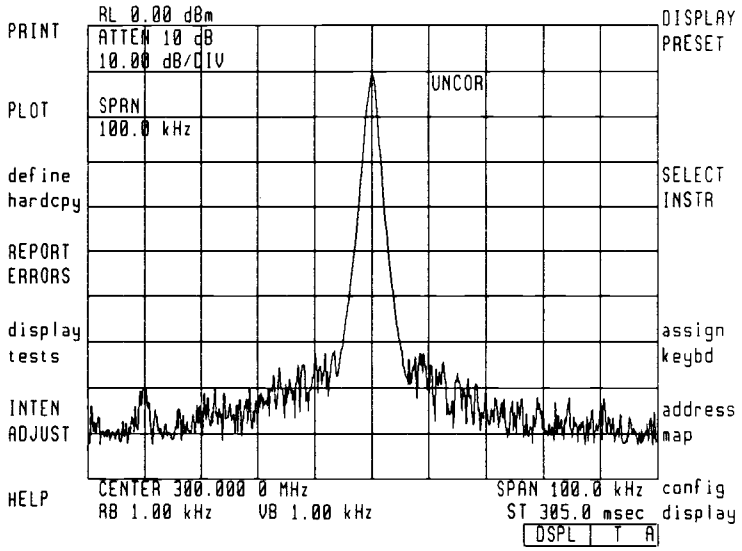


Figure 1-6. Select Instrument

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Hardcopy Outputs

The display helps the user obtain hardcopy output without the need of an external controller. For more information, see the menu key descriptions in Chapter 2 for `PRINT`, `PLOT`, and `define hardcopy`.

To achieve the display in Figure 1-7:

1. Press the DISPLAY key.
2. Press the `define hardcopy` key.

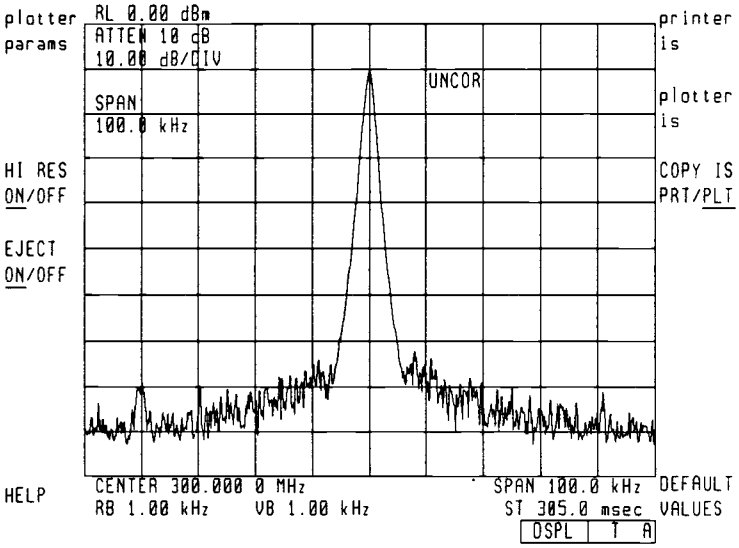


Figure 1-7. Print, Plot Capabilities

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Multiple Instrument Output Capabilities

The display allows users to view output from multiple instruments simultaneously. See the **config display** menu key description in Chapter 2 for further instructions.

To achieve the display in Figure 1-8:

1. Press the DISPLAY key.
2. Press the **config display** key.
3. Press the **build windows** key.
4. Press the **BUILD 2 WINDOWS** key.
5. Use **assign window**. Refer to Chapter 2 for a description of the **assign window** key.

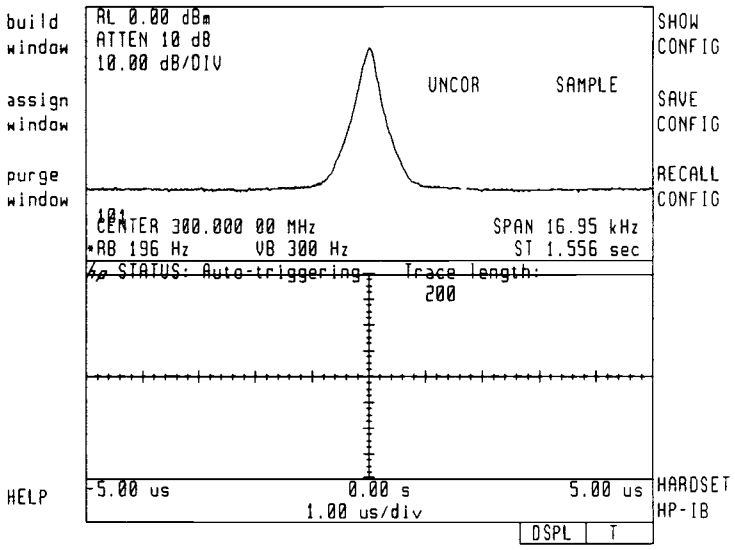


Figure 1-8. Multiple Instrument Output Capabilities

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HP-IB, HP-MSIB Addressing

By means of the display, users can examine the addresses of modules on HP-IB and HP-MSIB and can change the HP-IB addresses of certain modules. (See the **address map** menu key description in Chapter 2 for instructions and a description of the HP-MSIB addressing scheme).

To achieve the display in Figure 1-9:

1. Press the DISPLAY key.
2. Press the **address map** key.

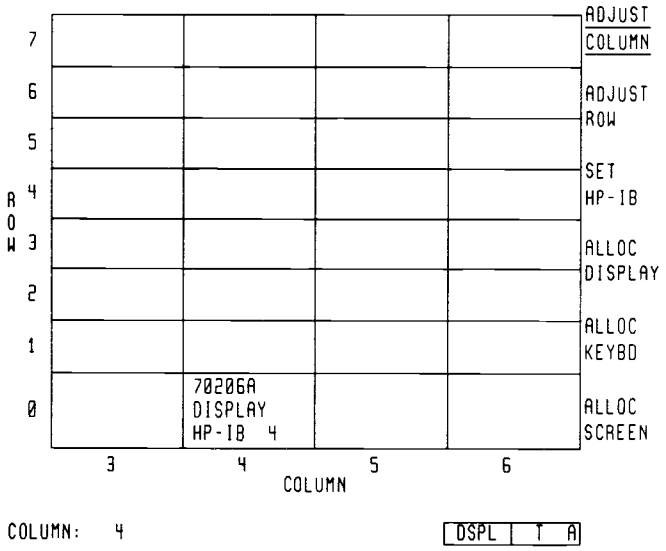


Figure 1-9. HP-IB, HP-MSIB Addressing

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Reporting Errors

The display reports any errors detected on HP-MSIB to the user. (See the REPORT ERRORS menu key description in Chapter 2 for more information.)

To achieve the display in Figure 1-10:

1. Press the DISPLAY key.
2. Press the REPORT ERRORS key.

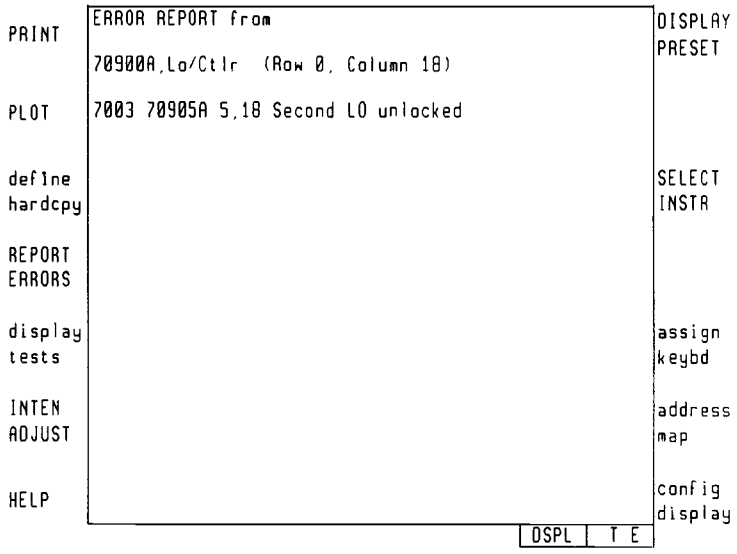


Figure 1-10. Report Errors

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Help Screens

The display explains its own operation with information available under the various **HELP** menu keys.

To achieve the configuration in Figures 1-11 and 1-12:

1. Press the (DISPLAY) key.
2. Press the **HELP** menu key.

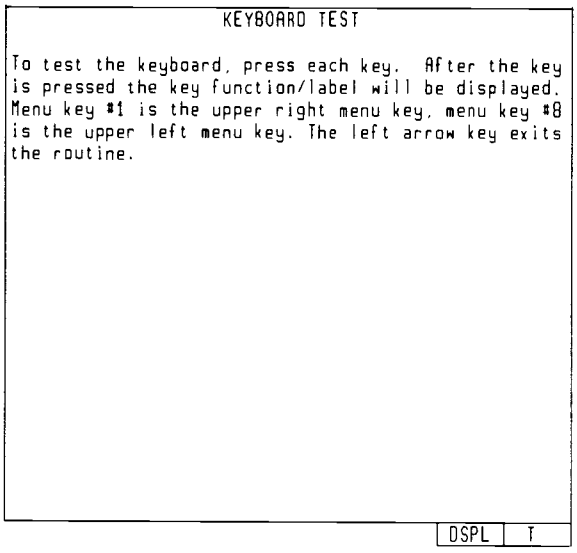


Figure 1-11. Help Screen: Page One

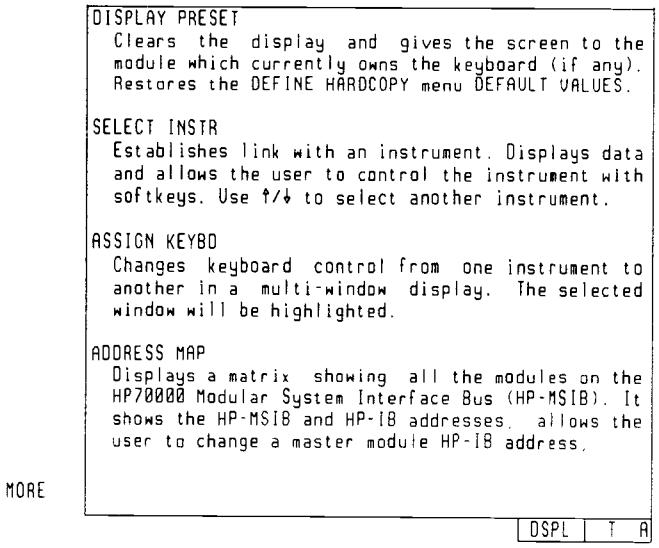


Figure 1-12. Help Screen: Page Two

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2

Softkey Reference

How to Use this Chapter

This chapter describes in detail the manual operation of the HP 70205A and HP 70206A graphics displays. All manually-available functions are accessed through keys by pressing the DISPLAY key. Note that the HP 70206A also makes the PRINT and PLOT functions available on keys. This chapter contains the following information:

Softkey Index Table 2-1 lists the menu keys alphabetically, gives the keystrokes to access them, and tells where to find more information.

Menu Tree Map Figure 2-2 shows a graphical representation of the display's menu keys.

Softkey Functions All menu keys are described in detail, including examples and sample outputs.

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Table 2-1. Softkey Index, Alphabetical Order

Key	Description	Path			Page
address map	Activates the address-map menu.	address map			2-14
ADJUST COLUMN	Horizontally adjusts the position of a highlighted box/window on the address map/display.	address map.	ADJUST COLUMN		2-18
ADJUST ROW	Vertically adjusts the position of a highlighted box/window on the address map/display	address map.	ADJUSTS ROW		2-18
ALLOC DISPLAY	Establishes contact between the screen and keyboard, and a specific module.	address map	ALLOC DISPLAY		2-21
ALLOC KEYBD	Establishes contact between the keyboard and a specific module.	address map	ALLOC KEYBD		2-24
ALLOC SCREEN	Assigns the entire screen to a particular module.	address map	ALLOC SCREEN		2-25
ASSIGN KEYBD	Enables keyboard control over any instrument currently writing information to a window on the screen.	ASSIGN KEYBD			2-13
assign window	Activates the assign-window menu.	config display	assign window		2-30
BALL	Activates a rotating 3-D ball on the display that can have its size and speed of rotation changed by the user.	display tests	tumble figures	BALL	2-70
build window	Activates the build-window menu.	config display	build window		2-26
BUILD 2 WINDOWS	Constructs two factory-defined windows on the display.	config display	build window	BUILD 2 WINDOWS	2-27
BUILD 4 WINDOWS	Constructs four factory-defined windows on the display.	config display	build window	BUILD 4 WINDOWS	2-27
CONFID TEST	Activates a display test in which roughly 90% of the operation of the display is checked.	display tests	CONFID TEST		2-69
config display	Activates the config-display menu.	config display			2-25
CUBE	Activates a rotating 3-D cube on the display that can have its size and speed of rotation changed by the user.	display tests	tumble figures	CUBE	2-70
DEFAULT WINDOW	Specifies the default window size (same as created by select instr command).	config display	build window	DEFAULT WINDOW	2-29

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Table 2-1. Softkey Index, Alphabetical Order (continued)

Key	Description	Path			Page
define hardcpy	Activates the define hardcopy menu	define hardcpy			2-49
DISPLAY ID	Activates ID screen that reports vers of disp op, dsp model #, ROM date, HP-MSIB addr, HP-IB addr, & dot gen relse code.	display tests	DISPLAY ID		2-67
display tests	Activates the display test menu.	display tests			2-67
EXECUTE	Redefines the window to the coordinates specified by the Xmin, Ymin, Xmax, and Ymax commands.	config display	build window	EXECUTE	2-28
EXECUTE	Redefines the assignment of or purges a window that was specified by select window, adjust column, or row commands.	config display	assign window	EXECUTE	2-30
HI RES ON/OFF	Enables/disables high resolution hardcopy on certain printers. Not available for plotter operations.	define hardcpy	EXPAND ON/OFF		2-59
HALF	Activates a rotating 3-D cone on the display that can have its size and speed of rotation changed by the user.	display tests	tumble figures	HALF	2-70
HARDSET HP-IB	Specifies the HP-IB address that the display will have when the system is turned on. Toggles with the softset HP-IB.	config display	HARDSET HP-IB	SOFTSET HP-IB	2-37
HELP	Activates a screen that contains brief descriptions of several config-display/define-hardcopy keys.	config display	HELP		2-70
HELP	Provides three pages of information about the operation of the other top-level keys directly accessible under DISPLAY key.	HELP			2-41
HP-IB	Assigns a single window to the HP-IB address of the display.	config display	assign window	HP-IB	2-30
HP-IB L ONLY	Sets the display to expect the printer or plotter to be in listen-only status on the HP-IB.	define hardcpy	printer is	HP-IB L ONLY	2-51
HP-IB TLK/LSN	Sets the display to expect the printer or plotter to be in talk/listen status at the HP-IB address input by the user.	define hardcpy	printer is	HP-IB TLK/LSN	2-51
HP-MSIB COLUMN	Specifies the printer-is/plotter-is column in the address map.	define hardcpy	printer-is\plotter is	ADJUST COLUMN	2-30

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Table 2-1. Softkey Index, Alphabetical Order (continued)

Key	Description	Path			Page
HP-MSIB ROW	Specifies the printer-is/plotter-is row in the address map.	define hardcpy	printer-is\plotter is	ADJUST ROW	2-52
INTEN ADJUST	Specifies or changes the intensity of the display.	INTEN ADJUST			2-70
KEY TEST	Tests the mechanical and electrical operation of every front-panel key on the display.	display tests	KEY TEST		2-69
KEYCOPY ON/OFF	Enables or disables printing or plotting of key labels, status box, and display line.	define hardcpy	KEYCOPY ON/OFF		2-56
KNOB TEST	Activates a test pattern and mode that will verify mechanical and electrical operation of the knob.	display test	KNOB TEST		2-68
MORE	Displays the next page of help information.	HELP	MORE		2-70
PLOT	Activates an HPGL plot of the display as specified by the define-hardcopy command.	PLOT			2-49
plotter is	Activates the plotter menu.	define hardcpy	plotter is		2-52
plotter params	Activates the plotter-parameters menu.	define hardcpy	plotter params		2-53
PRINT	Activates a raster-print output of the display as specified by the define-hardcpy command.	PRINT			2-48
printer is	Activates the printer-is menu.	define hardcpy	printer is		2-50
purge window	Activates the purge-window menu.	config display	purge window		2-35
RECALL CONFIG	Reconfigures the display to one of four configurations that were stored by using the save-configuration command.	RECALL CONFIG			2-45
REPORT ERRORS	Displays a report that gives a brief description of any error that has been detected by an element on the HP-MSIB.	REPORT ERRORS			2-62
ROD	Activates a rotating 3-D rod on the display that can have its size and speed of rotation changed by the user	display tests	tumble figures	ROD	2-70
SAVE CONFIG	Saves the complete configuration of the screen windows in one of four non-volatile memory registers.	SAVE CONFIG			2-45

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Table 2-1. Softkey Index, Alphabetical Order (continued)

Key	Description	Path			Page
SELECT INSTR	Establishes contact between the display and an instrument currently configured in the HP 70000 system.	SELECT INSTR			2-11
SELECT WINDOW	Selects one of up to four separate windows on the display.	config display	build window	SELECT WINDOW	2-27
SELECT WINDOW	Specifies the number of the window that will be assigned or purged when the execute key is pressed.	config display	assign window	SELECT WINDOW	2-30
SET HP-IB	Soft-changes the HP-IB address of an element currently on the HP-IB if that element will permit it.	address map	SET HP-IB		2-19
SHOW CONFIG	Reports windows defined, dimensions of windows, instrument and modules to which windows and keyboard are allocated.	SHOW CONFIG			2-42
SLAB	Activates a rotating 3-D slab on the display that can have its size and speed of rotation changed by the user	display tests	tumble figures	SLAB	2-70
SOFTSET HP-IB	Specifies the HP-IB address that the display will have when the system is turned on. Toggles with hardset HP-IB.	config display	SOFTSET HP-IB	HARDSET HP-IB	2-37
test pattern	Activates test patterns in the display.	display tests	test pattern	#1 - 5	2-70
TUMBLE FIGURES	Activates the tumble-figure menu.	display tests	TUMBLE FIGURES		2-70
Xmax	Specifies the right side of window or plot when building windows/plotting.	config display	build window	Xmax	2-26
Xmin	Specifies the left side of the window or plot when building windows or plotting.	config display	build window	Xmin	2-26
Ymax	Specifies the top side of the window or plot when building windows or plotting.	config display	build window	Ymax	2-26
Ymin	Specifies the bottom side of window or plot when building windows or plotting.	config display	build window	Ymin	2-26

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Softkey Functions

Introduction

This section describes in detail all the keys, including examples. All functions are accessed through keys by pressing the DISPLAY key. Note that the HP 70206A also makes functions available on keys. In addition, a brief discussion is included on the addressing of modules on (Hewlett-Packard Interface Bus) HP-IB and (Hewlett-Packard Modular System Interface Bus)HP-MSIB.

DISPLAY is a top-level key that allows the user access to the entire menu of display keys. Keys in the display menu enable the user to format and obtain hardcopy output (`PRINT`, `PLOT`, and `define hardcpy`), to configure the display screen into individually assignable windows (`config display`), and to access any of several instruments in the HP 70000 Modular Measurement System quickly (via `SELECT INSTR` and `assign keybd`). Furthermore, system-wide error reporting is available through the display (`REPORT ERRORS`), as well as several display self-test features (under `display tests`). A display preset (`DISPLAY PRESET`) is available that clears the display and gives the screen to the module which last owned the keyboard (if any).

In addition, all addressing on the HP-MSIB can be examined via the `address map` key. The display screen's intensity can be changed (`INTENS ADJUST`), and some brief key descriptions are available under `HELP`.

Top Level Softkeys

Figure 2-1 is a graphical representation of the keys accessed at various levels under DISPLAY. The 14 boxes at the top of Figure 2-2 represent the keys shown in Figure 2-1. This chapter describes the operation of all keys shown in the menu tree diagram.

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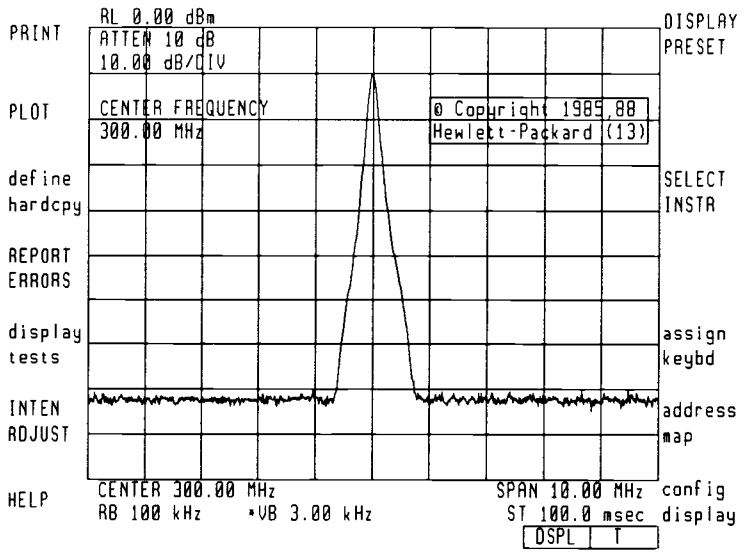


Figure 2-1. Top Level Menu for the DISPLAY Key

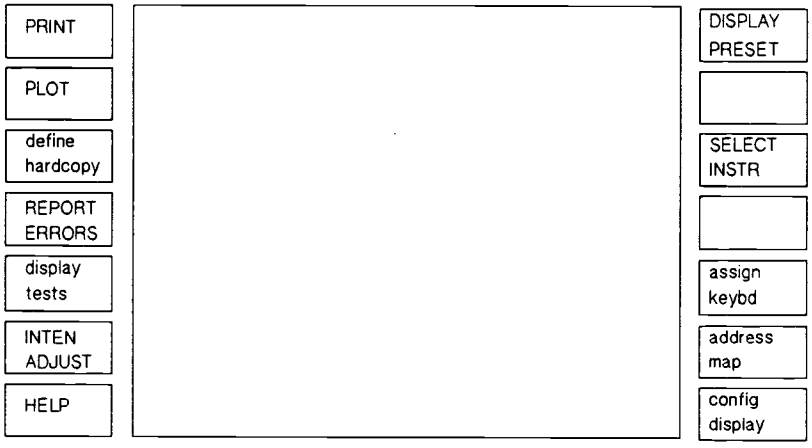


Figure 2-2. Key Menu Tree

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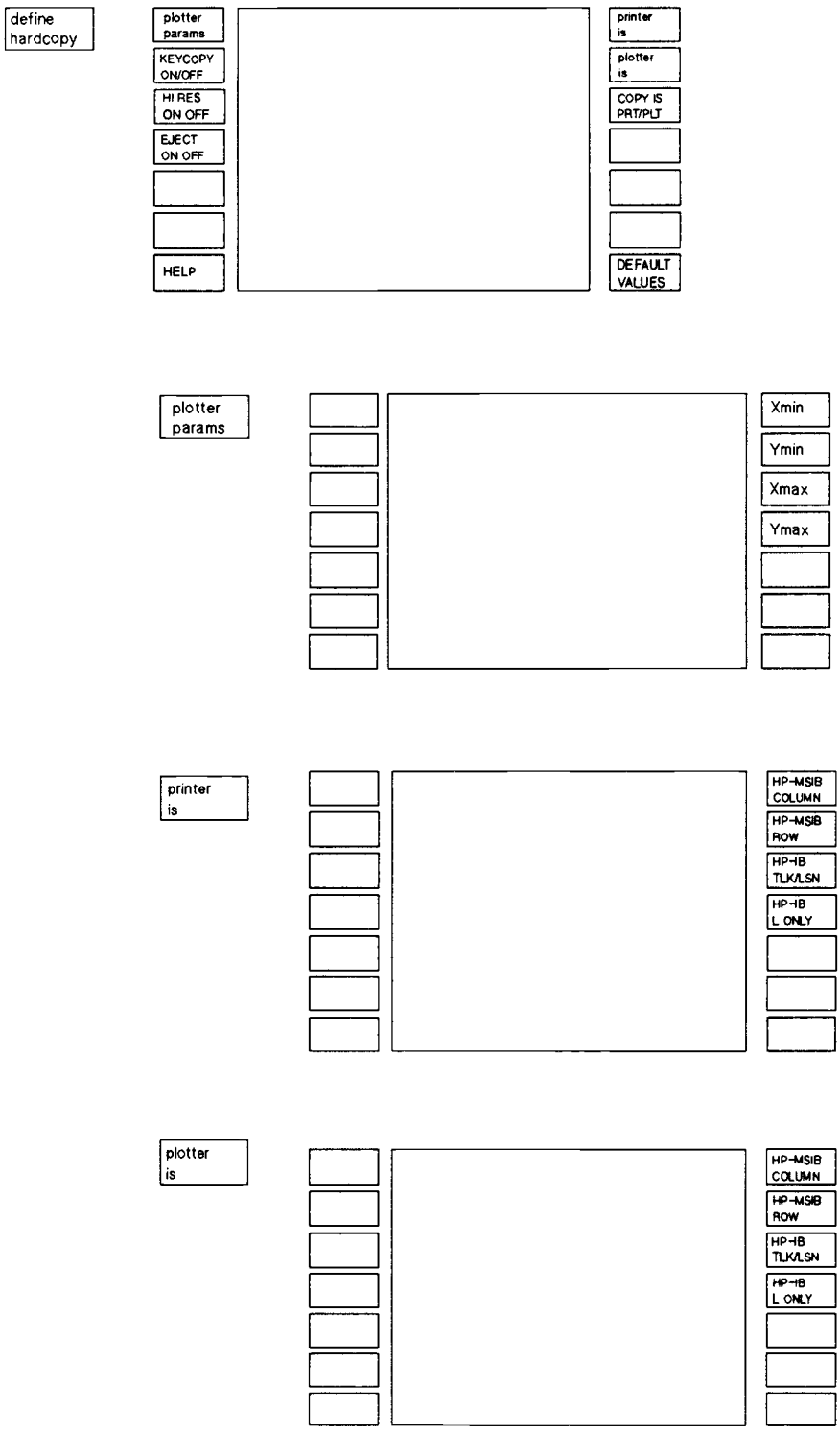


Figure 2-2. Key Menu Tree (continued)

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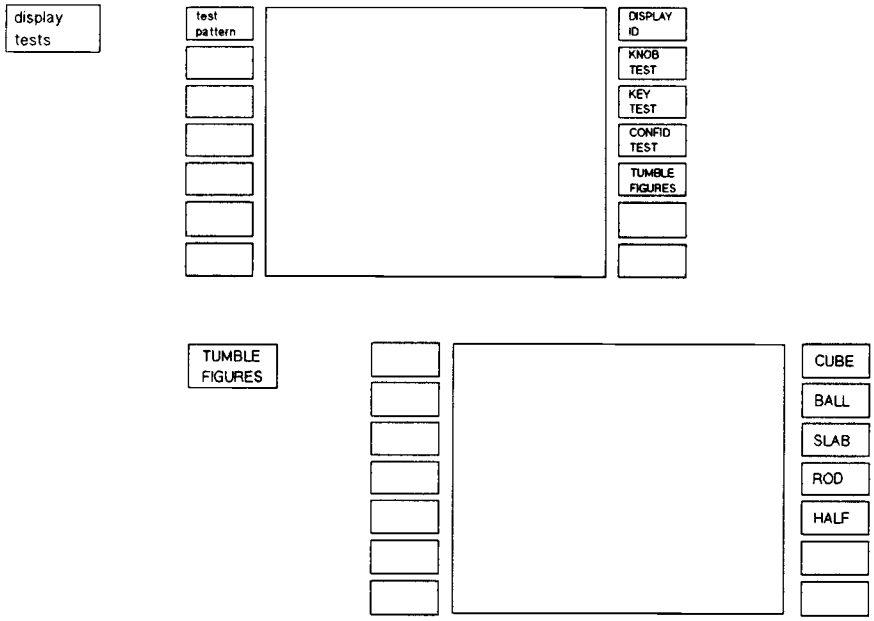


Figure 2-2. Key Menu Tree (continued)

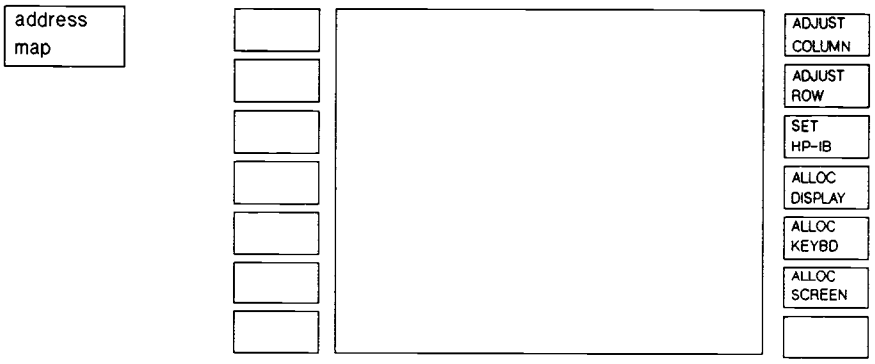


Figure 2-2. Key Menu Tree (continued)

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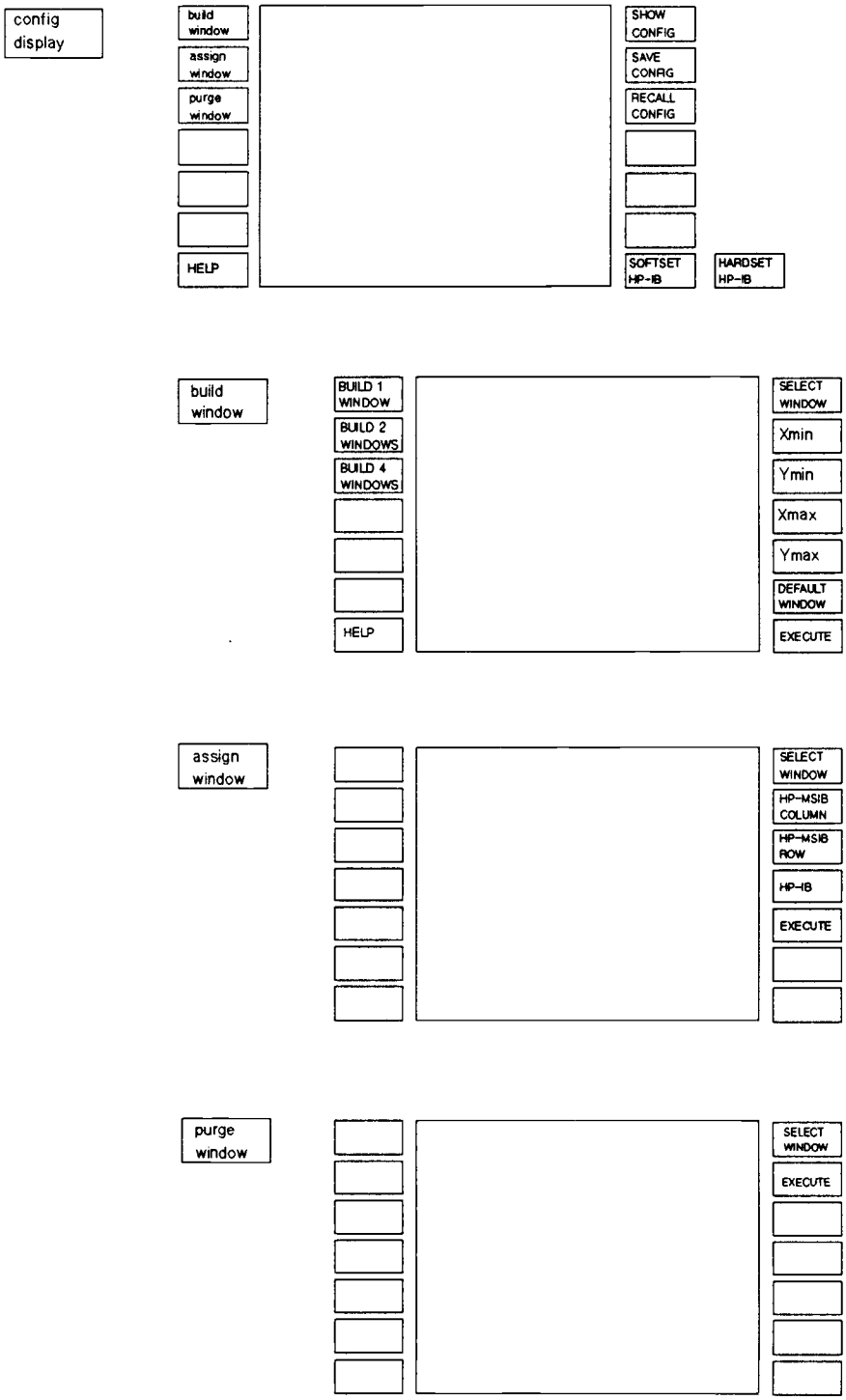


Figure 2-2. Key Menu Tree (continued)

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Display Preset

The DISPLAY PRESET key clears the screen, resets all HP-IB and window parameters to an initial state, and assigns the entire screen to the last module to own the keyboard (if none own the keyboard, the screen is left blank). It also resets the hardcopy parameters to their default values. See **define hardcopy**.

Select Instrument

The display works by establishing links to instruments. For example, in the spectrum analyzer, the display tries to establish a link with the local oscillator. The SELECT INSTR key establishes a link between the display and one instrument in the currently configured HP 70000 Modular Measurement System (for example, any of several spectrum analyzers). These links are required for data display and manual control of an instrument, since the display serves as the interface between that instrument and the user.

At power-on, the user is prompted to press SELECT INSTR. If, during a previous session, SELECT INSTR had been pressed and the screen assigned to an instrument, the display will automatically attempt to reestablish a link to that instrument. In that case, as soon as the link is established, the power-up prompt will go away. In most cases, this will happen so soon after the link is offered that the prompt will flash on the screen and be gone.

To establish (or reestablish) a link to an instrument, press DISPLAY and SELECT INSTR. If the display does not have a link to an instrument, it will look for the instrument with 0 row address, with the lowest column address on the HP-MSIB and allocate the entire screen and the 14 keys to that instrument. If a link already exists, the display will select the instrument with the next-highest address (for which the sequence goes.... 28, 30, 0, 1, 2....). Then the ⇧ (or SELECT INSTR again) and ⇩ keys can be used to select the instrument with the next highest or next lowest address.

The information displayed depends on the specific instrument selected. Since this key only establishes communication links between the display and the instrument, most instrument settings are unaffected when an instrument is selected. However, any previously defined display windows are erased.

The SELECT INSTRUMENT key is useful for establishing initial contact with a single instrument. To preserve existing windows, use the **assign window** key instead, available under **config display**. (These keys are described in detail in the CONFIG display subsection of this chapter.)

EXAMPLE: Obtain spectrum analyzer display and keyboard control.

This example describes how the user can quickly obtain a spectrum analyzer display on the screen regardless of the current screen configuration.

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It begins by breaking contact with the instrument, then reestablishes contact using the SELECT INSTR keys.

1. Press (DISPLAY).
2. Press DISPLAY PRESET
3. Press config display.
4. Press purge window.
5. Press EXECUTE.
6. Press (DISPLAY). This should result in a screen similar to Figure 2-3.



Figure 2-3.
Obtaining Spectrum Analyzer Display and Keyboard Control

If you press (USER), even the key labels disappear. No key other than (DISPLAY), (PRINT), or (PLOT) will give a response.

(USER) does not call up any keys because an instrument is not currently linked to the display. All keys under (USER) and (MENU) are created by and responded to by an instrument (such as the spectrum analyzer), while all keys under (DISPLAY) are generated by the display itself.

To obtain an instrument display on the screen, press (DISPLAY), and then SELECT INSTR. If using a spectrum analyzer, this should result in a display similar to Figure 2-4. To use the instrument now, simply press (USER) or (MENU) and use the appropriate keys.

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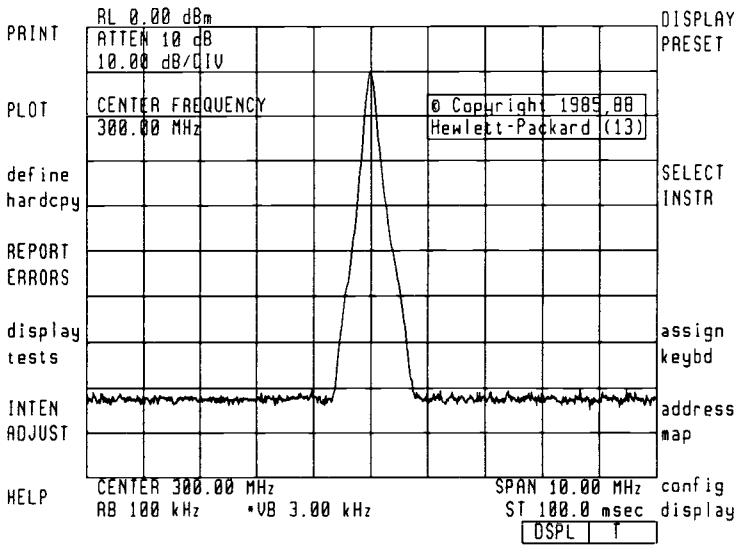


Figure 2-4. Instrument Display

Assign Keyboard

This key gives the user keyboard control over any instrument currently writing information to a window on the screen.

To use this key, press (DISPLAY) and **assign keybd**, then use the step keys, the display knob, or the numeric keypad to select the window desired (for example, the window written to by the instrument you wish to control). If it is defined, the window corresponding to the number chosen (1 through 4) will be highlighted on the screen. Next press (MENU) or (USER), and the specified instrument will respond with the appropriate key menu. A communication link between the keyboard and the module is established when the user leaves the (DISPLAY) function (for instance, by pressing (MENU) or (USER)).

EXAMPLE: Build two windows, one atop the other.

Use **assign keybd** to control separate instruments, both simultaneously writing to the display. (If you have already read **assign window** and **BUILD 2 WINDOWS**, and if you have two instruments in your system, try this example. If not, refer to the "Configure Display" section in this chapter.)

1. Press **config display**.
2. Press **build window**.
3. Press **BUILD 2 WINDOWS**.
4. Assign each window to a different instrument in the system, so that the display screen is similar to Figure 2-5.
5. Press (DISPLAY), **assign keybd**.
6. Use the step keys until the bottom window is highlighted on the screen.

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7. Press (MENU) or (USER).

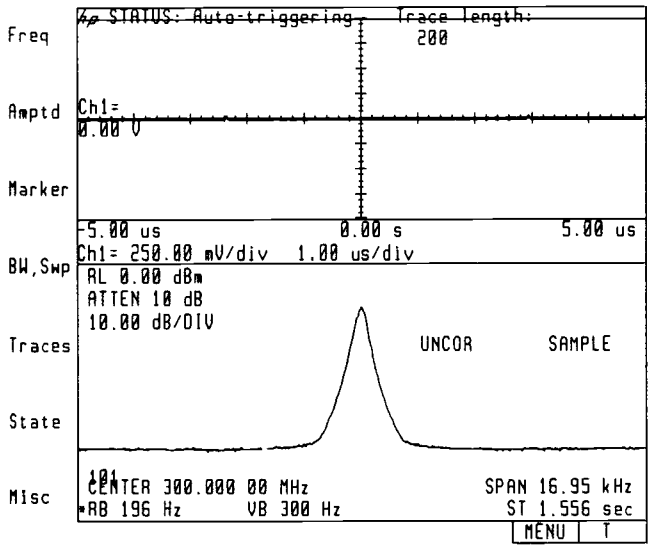


Figure 2-5. Assigning the Keyboard

You now have access to the basic instrument control keys of the instrument writing to the bottom window. In this figure, the user pressed (MENU), (FREQ), then **SPAN**. Note that SPAN 100 kHz is denoted as the active function.

assign keybd and **ALLOC KEYBD** (under **address map**) both link the keyboard with an instrument or module. They differ in the method by which the instrument to be controlled is selected. Both link the keyboard to a module: **assign keybd** by selection of a window in the display, **ALLOC KEYBD** by moving the cursor in the address map.

Address Map

The **address map** key allows you access to the address map. The address map is a real-time graphical representation of the HP 70000 system elements, modules and graphics displays, that are on HP-MSIB.

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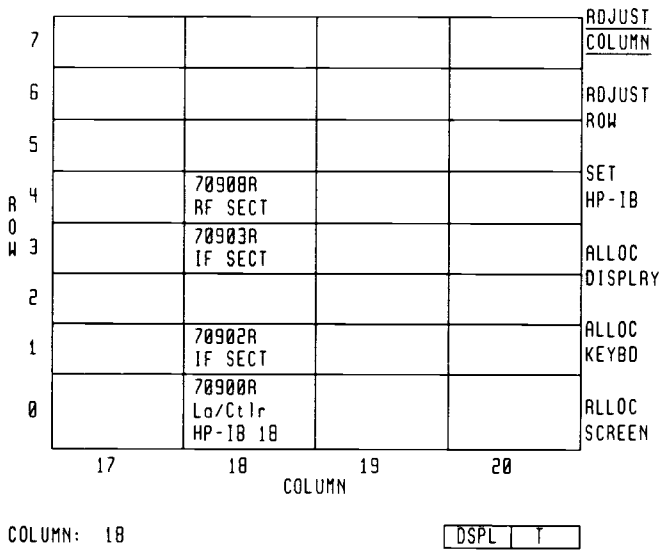


Figure 2-6. Typical HP 70000 Address Map Detail

The operation of individual keys under **address map** is described in the following pages. In this subsection we will briefly discuss the concept of the HP 70000 Modular Measurement System address map, HP-MSIB, and the capabilities accessible via the **address map** key. More information about HP-MSIB is available in the Installation and Verification Manual for your instrument, which is the primary user reference for addressing modules.

HP-MSIB has a two-dimensional addressing scheme. Each system element, such as the HP 70900B Local Oscillator module or the HP 70206A System Graphics Display, has a two-part bus address. The address consists of a row number and a column number (for example, row 0, column 18). This unique address serves as an identifier so that any element can talk with any other element on HP-MSIB, regardless of physical proximity or other bus traffic.

The address map is designed so that each element can be located by its unique address. The row address (first number) specifies the horizontal row of the grid where the element is located, and the column address specifies the vertical column. Rows have numbers 0 through 7 (0 is at the bottom of the screen) and columns are numbered 0 through 31 (0 is at the left edge of the map). The address 0, 31 is not available for use; hence, there are 255 available addresses.

Each modular measuring instrument (composed of several modules) will typically occupy all or part of a single column. The exception to this is multi-column instruments. See the Installation and Verification Manual for your instrument. Note that the display elements (HP 70205A and the larger HP 70206A) are *not* part of any measuring instrument. Each display serves as a general-purpose human-machine interface, providing a screen for the instruments and

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keys that enable the user to control the system. Since the displays are not part of any particular instrument, each will occupy its own column in the address map. The display must be located in a column other than the instrument that it is linked to. See the figures below.

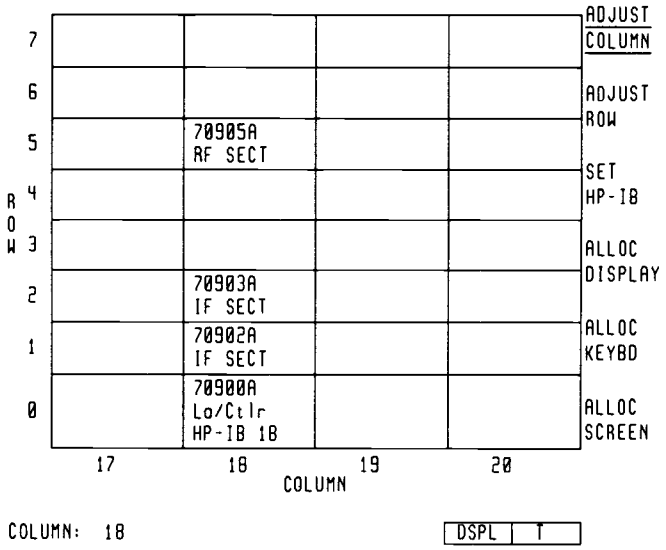


Figure 2-7. Addressing Conventions for Individual Elements

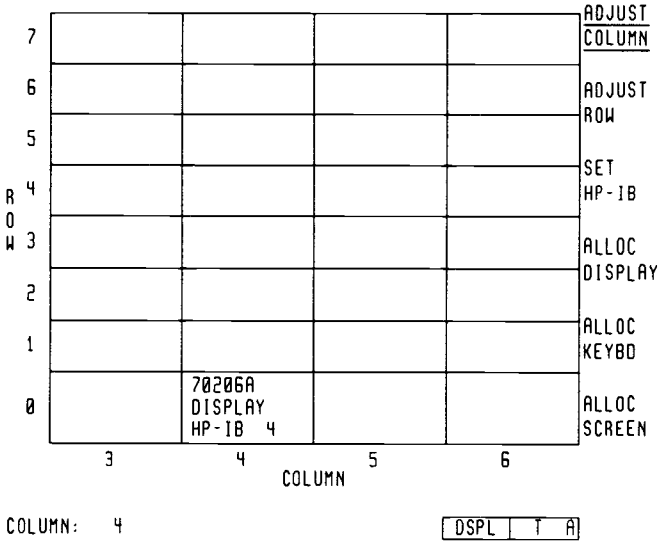


Figure 2-8. Addressing Conventions for the Display

HP-MSIB addresses are set only by switches located on each module or display. All elements (modules and HP 70206A displays) have

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adjustable column addresses. All elements except the displays have adjustable row addresses. (The displays are confined to row 0.) An appropriate element, when located in row 0, acts as a **master** to all modules above and to the right of it; this master has control as far as the column of the next master. The master module is able to control another module by ordering it to perform tasks and by controlling the flow of information to and from that module. For example, an error detected in an IF section will be reported to the master module, which will in turn report it to the user via the display. (In a spectrum analyzer, the master module is the local oscillator.)

The modules controlled by a master are referred to as slaves. Slave modules are addressed above the master; that is, slaves have higher row addresses than their master. A measuring instrument such as a spectrum analyzer will typically consist of one master (local oscillator module) and several slaves (IF sections, RF front-end sections, tracking generators, and so on). While a master module must be located in row 0, slave modules can be addressed in any of several rows.

HP-MSIB addresses must be unique. Setting two HP 70000 elements to the same address will create an error and make the HP-MSIB inoperative. If the cursor cannot be moved about within the address map after a module has been readdressed, check to see if two modules have the same row and column address. If so, removal of the modules is required. See the Installation and Verification Manual for your instrument for instructions. If HP-MSIB is inoperative at power-up, all modules will indicate this by blinking their error LED (the display blinks its **E** annunciator). To test for an inoperative HP-MSIB, cycle power and check the **E** annunciator.

HP-IB, HP-MSIB, and the Address Map

Although HP-IB and HP-MSIB are different buses, some elements on HP-MSIB are accessible via HP-IB. Specifically, certain elements that have an the HP-MSIB row address of 0 may be addressed over HP-IB with the proper configuration.

A brief discussion of HP-IB usage with HP 70000 systems will be presented here, but a more detailed coverage is given in the Installation and Verification Manual for your instrument.

Between mainframes (HP 70001A), HP-IB and HP-MSIB are completely separate and are carried on separate cables. HP-IB is a parallel-connected single cable bus; HP-MSIB is a series-connected dual-cable bus. Two HP 70000 Series mainframes are connected to the same HP-IB network only if each is connected to it individually, or if there is an HP-IB cable linking the two. HP 70206A also is connected to the system over separate HP-IB and HP-MSIB cables.

Within a single mainframe, HP-IB and HP-MSIB connections are carried along the backplane bus and are provided at the back of each 1/8-width module slot. A mainframe has exactly one HP-IB port (one connector) and one HP-MSIB port (two connectors: one IN and

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one OUT). Hence, all modules in a particular mainframe have access to both HP-IB lines and HP-MSIB lines.

All modules can communicate over HP-MSIB, but, as previously mentioned, only certain modules or elements can talk over HP-IB. Therefore, while every HP 70000 Series element takes up an HP-MSIB address, only the row 0 modules can occupy HP-IB addresses. Among HP 70000 series elements that can use HP-IB are HP 70900B Local Oscillator and HP 70205A and HP 70206A graphics displays.

Each system element that can talk over HP-IB can also be removed from HP-IB by positioning the HP-IB ON/OFF switch in the OFF position (Some modules indicate by this putting a NO in the address map in place of their HP-IB address). On the displays, this switch is readily accessible from the back panel. On the HP 70900B Local Oscillator, the switch is located on the top of the module, along with the other HP-IB and HP-MSIB switches. Changing any of these switches on the local oscillator requires removal of the module from the mainframe. See the Installation and Verification Manual for your instrument for more information.

Note



HP-IB address and HP-MSIB address of a system element are not necessarily related.

HP-MSIB address is determined solely by the setting of the address switches on the module (refer to the Installation and Verification Manual for your instrument). When applicable, HP-IB address of each module defaults to the HP-MSIB column address. For example, HP-MSIB address 0, 18 has a default HP-IB address of 18. Note, however, that HP-IB address of the local oscillator and of both displays may be set to any valid address using the `SET HP-IB` key, which is available through the `address map` key. See the `SET HP-IB` key description in this chapter for instructions.

Adjust Column and Adjust Row

The `ADJUST COLUMN` and `ADJUST ROW` keys, available directly under `address map`, allow you to move the cursor (the highlighted box) within the address map.

EXAMPLE: Adjust the column and row.

1. Press (DISPLAY).
2. Press `address map`.
3. Press `ADJUST COLUMN`.
4. Turn the display knob until the cursor rests on the local oscillator module.
5. Press `ADJUST ROW`.

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6. Use the ↑ key to place the cursor on the RF section as in Figure 2-9.

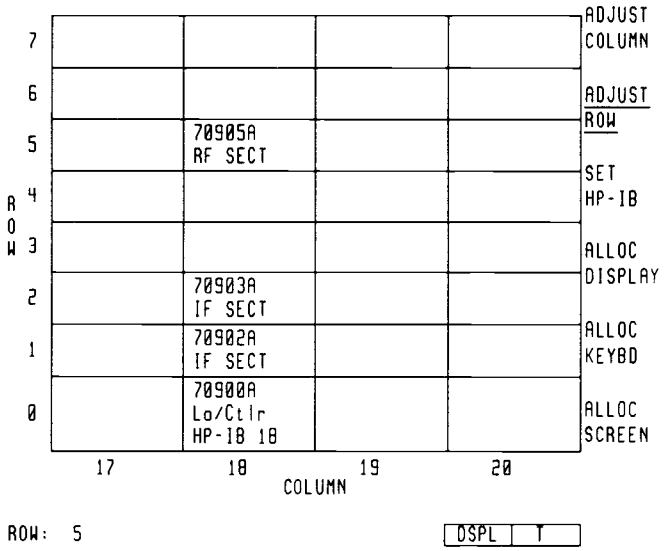


Figure 2-9. Adjusting Column and Row

The ADJUST COLUMN and ADJUST ROW keys accept data entry from the display knob, from the ↑ and ↓ keys, and from the numeric key pad.

The module currently highlighted in the address map will have a green "ACT" light on its front panel. (The displays show an A in the lower right-hand status box on the screen.) This light enables you to correlate the specific physical HP 70000 Series elements to their locations in the address map.

Set HP-IB

The SET HP-IB key allows you to change HP-IB address of any element currently on HP-IB if that element will permit it. The specific conditions are discussed earlier in this section.

EXAMPLE: Change HP-IB address of the display.

1. Press DISPLAY.
2. Press address map.
3. Press ADJUST COLUMN.
4. Turn the display knob so that the cursor box stops on the display as in Figure 2-10.

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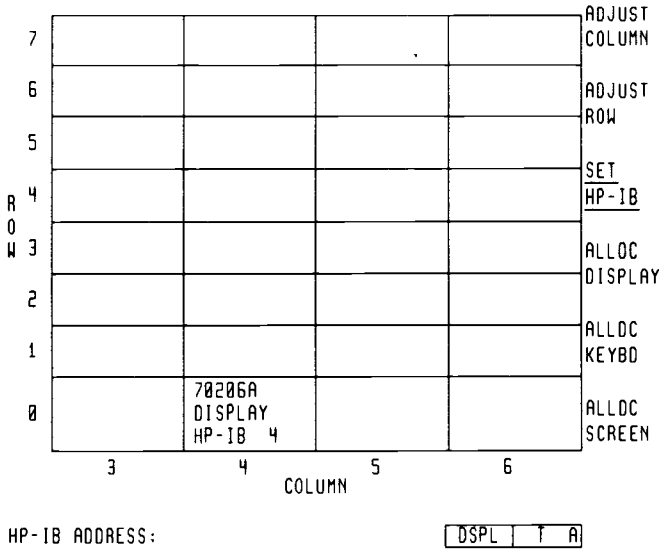


Figure 2-10. Adjust Column

5. Press **SET HP-IB**.
6. Press (2).
7. Press (0).
8. Press **ENTER**. HP-IB address of the display should immediately change to 20 as in Figure 2-11.

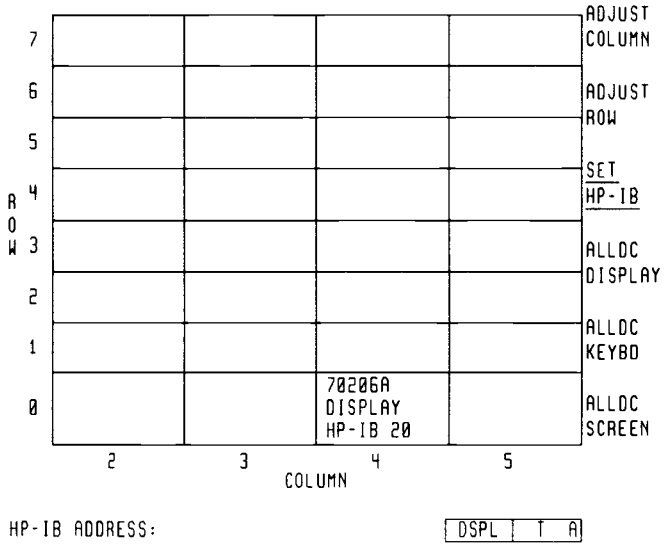


Figure 2-11. Setting HP-IB

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An HP 70000 Series element can show an HP-IB address on the address map even though the element is disabled (by HP-IB switch) and cannot communicate on HP-IB. See HP-MSIB earlier description in this section, or see the Installation and Verification Manual for your instrument. Some modules show that they are disabled by replacing their HP-IB address with the word "NO" in the address map.

HP 70900B Local Oscillator module has the ability to lock its HP-IB address so it will not respond to the `SET HP-IB` key. To do this set the "SW1/MEM" switch on the LO to the "SW1" position. With this switch set to "SW1", HP-IB address of the LO will remain identical to the HP-MSIB column address.

Upon power-up, HP-IB addressing is handled differently by different elements. Displays can be configured to have a power-up HP-IB address of either the HP-MSIB column address or the most recent HP-IB address given to the display with the `SET HP-IB` key. This option (for displays only) is discussed in the `HARDSET/SOFTSET HP-IB` section of this chapter. The local oscillator module, however, always has a power-up HP-IB address identical to its HP-MSIB column address.

Allocate Display

The key `ALLOC DISPLAY` is used to establish contact between the display and a specific module. `ALLOC DISPLAY` allocates the screen and keys to the module currently highlighted by the cursor in the address map.

EXAMPLE: Allocate the display to a particular instrument.

First, break contact with the spectrum analyzer.

1. Press (DISPLAY).
2. Press `address map`.
3. Press `ADJUST COLUMN`.
4. Use the display knob to place the cursor on an empty address, as in Figure 2-12. (On the display screen the cursor is the highlighted box.)

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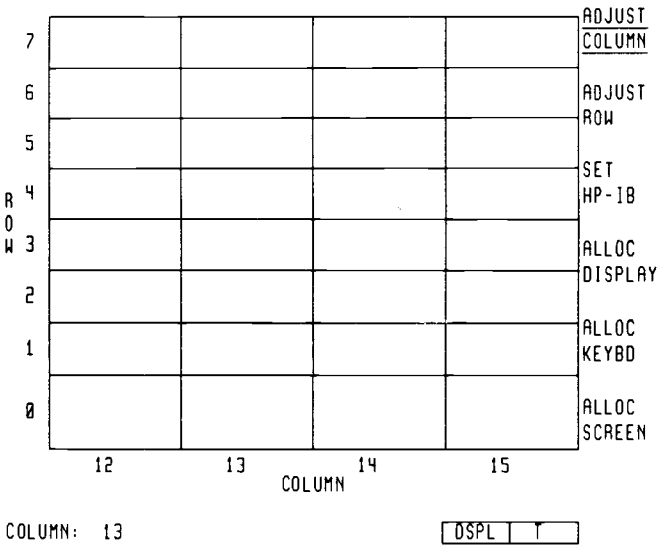


Figure 2-12. Allocating the Display to an Instrument

5. Press **ALLOC DISPLAY**.

This breaks all links with the existing instrument and attempts to establish a link between the display and a nonexistent instrument. This results in a blank screen, as in Figure 2-13.

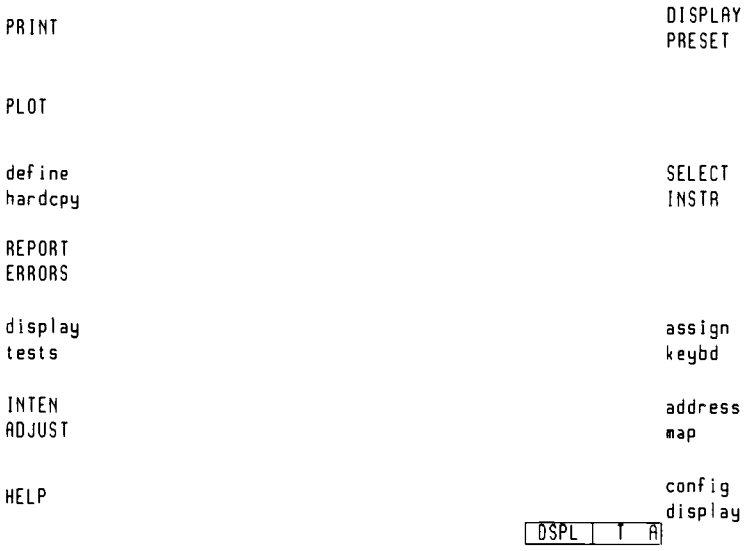


Figure 2-13. Blank Screen

Reestablish contact with the spectrum analyzer.

1. Press **address map**.

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2. Press ADJUST COLUMN.

3. Turn the knob to position the cursor on the local oscillator module.

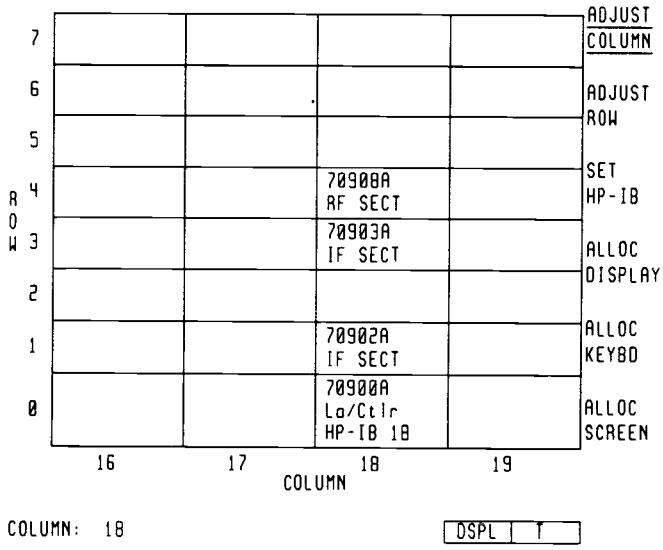


Figure 2-14. Cursor on Local Oscillator Module

4. Press ALLOC DISPLAY.

5. Press MENU to see the module's keys.

This should result in a screen similar to that shown in Figure 2-15, depending on the previous settings of the spectrum analyzer being used.

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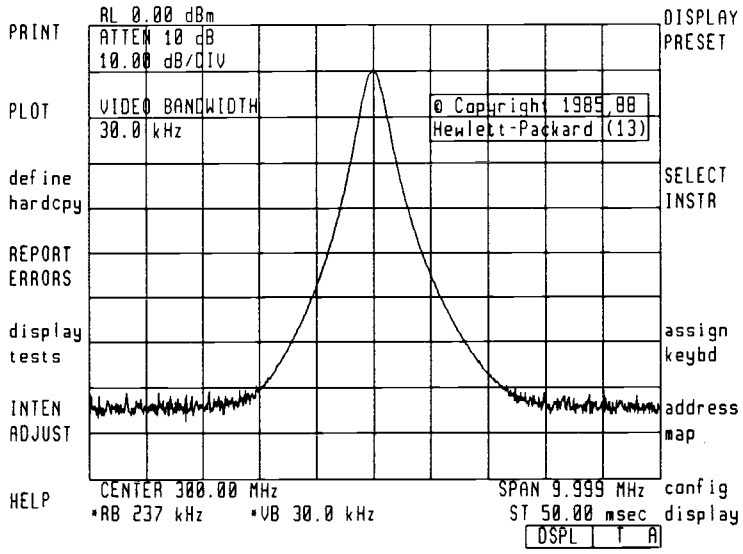


Figure 2-15. Allocated Display

In summary, `ALLOC DISPLAY` establishes contact between the display (the user interface) and an HP 70000 module, but differs from `SELECT INSTR`. `ALLOC DISPLAY`, used in the address map, requires that a particular module (element) be specified. `SELECT INSTR` selects an instrument on its own. Both, however, destroy any links between the display and any other instruments. Both destroy any existing windows in the display.

Allocate Keyboard

The `ALLOC KEYBD` key is used to allocate the keyboard to a specific module. The keyboard can then be used to control the instrument settings of a spectrum analyzer, such as center frequency and span.

1. Press (DISPLAY).
2. Press `address map`.
3. Move the cursor to the module desired.
4. Press `ALLOC KEYBD` and (MENU) to se the module's keys.

The keyboard will be linked to that module.

The keyboard and the screen can be allocated separately. `ALLOC KEYBD` links the keyboard with an instrument, but does not necessarily display any trace data from that instrument. Hence, the keys may not correspond to the instrument display shown.

Only a master module, such as HP 70900B Local Oscillator, can establish a link with the keyboard. Attempts to allocate the keyboard to slave modules will result in an error.

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`ALLOC KEYBD` lets the user link the keyboard with any master module by way of the address map. Another key, `assign keyboard`, which is available directly under [DISPLAY], is generally quicker and easier to use.

Allocate Screen

The two resources of the display, the keyboard and the screen, can be allocated separately. `ALLOC SCREEN` assigns the whole screen to a particular module, even though the keyboard may be assigned elsewhere. This allows the user to view the trace output from one instrument (on the screen) while controlling a different instrument (with the keyboard).

To use the `ALLOC SCREEN` key:

1. Press `address map`.
2. Move the cursor box to the module or instrument desired.
3. Press `ALLOC SCREEN` and the screen will be immediately allocated to that module. If the module is ready to put out trace information, the information will be immediately displayed.

Note

Only master modules can be linked to the display. Therefore, use `ALLOC SCREEN` only for master modules, such as the HP 70900B Local Oscillator module. Attempting to allocate the screen to a slave module will result in an error.

Configure Display

`config display` gives the user access to a submenu of keys that configure the various features of the display. See Figure 2-16. These features and capabilities consist of building windows on the screen, selecting the instruments that may write to those windows, saving and recalling display configurations, and viewing stored and current configurations.

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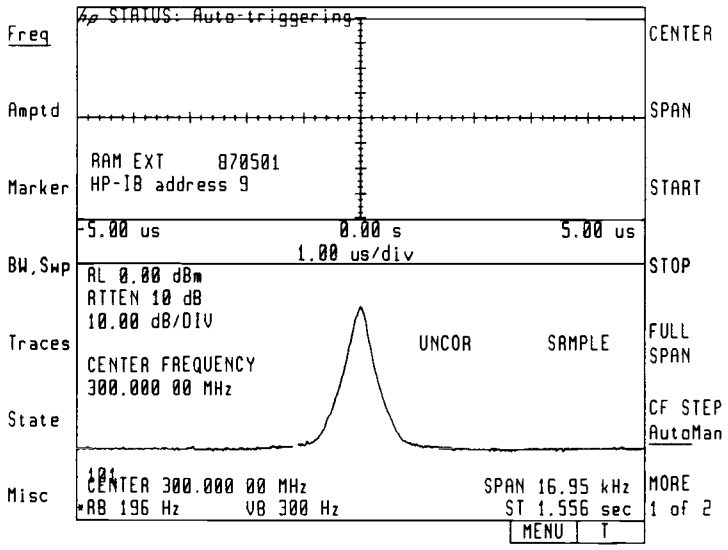


Figure 2-16. Configuring Display

The keys accessed by pressing **config display** include **build window**, **assign window**, **purge window**, **HELP**, **SHOW CONFIG**, **SAVE CONFIG**, **RECALL CONFIG**, and **HARDSET/SOFTSET HP-IB**. The following pages contain descriptions and examples of these keys. A listing and brief description of each follows:

- **build window** allows the user to construct up to four separate windows on the screen.
- **assign window** links windows with modules so that trace information can be displayed.
- **purge window** removes a previously built window.
- **HELP** calls up some brief descriptions of the keys available under **config display**.
- **SHOW CONFIG** displays a summary of the current and stored display screen configurations.
- **SAVE CONFIG**, **RECALL CONFIG** save and recall a screen configuration to or from one of the four screen configuration registers.
- **HARDSET/SOFTSET HP-IB** allows the user to determine the power-up HP-IB address of the display.

Build Window

The **build window** key allows the user to construct up to four separate windows on the screen. A window is a user-defined portion

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of the screen that is set aside for a single instrument to display information.

EXAMPLE: Build two windows.

Note

The BUILD 1 WINDOW, BUILD 2 WINDOWS, and BUILD 4 WINDOWS keys perform a similar function.

1. Press DISPLAY.
2. Press config display.
3. Press build window.

The build window submenu appears with SELECT WINDOW automatically underlined as in Figure 2-17. The underline indicates that this function is active. Select a window, numbered 1 through 4, by using any data entry method (step keys, display knob, numeric keypad, or key). If the key pad is used to enter the window number, the user must press ENTER to finish the entry.

For this example, build window #1.

Note

The window selected, if currently defined, is highlighted.

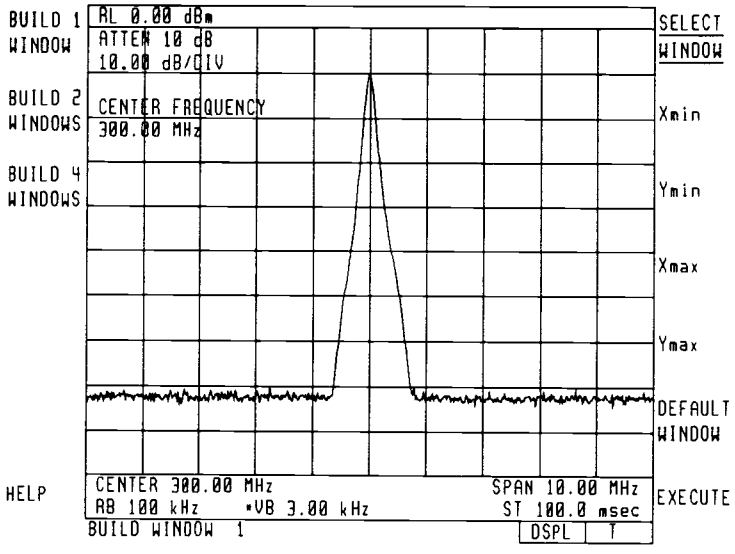


Figure 2-17. Build Window #1

Press Ymax, then turn the knob counterclockwise to bring the top line to a point just below the middle of the screen. At the bottom of the screen a Ymax value will be displayed and will change as

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the display knob is turned. Set Ymax to approximately 195. Press **EXECUTE**. Window #1 has now been redefined as in Figure 2-18.

1. Press the **assign window** key.
2. Press the **HP-MSIB** key.
3. Press the **EXECUTE** key.

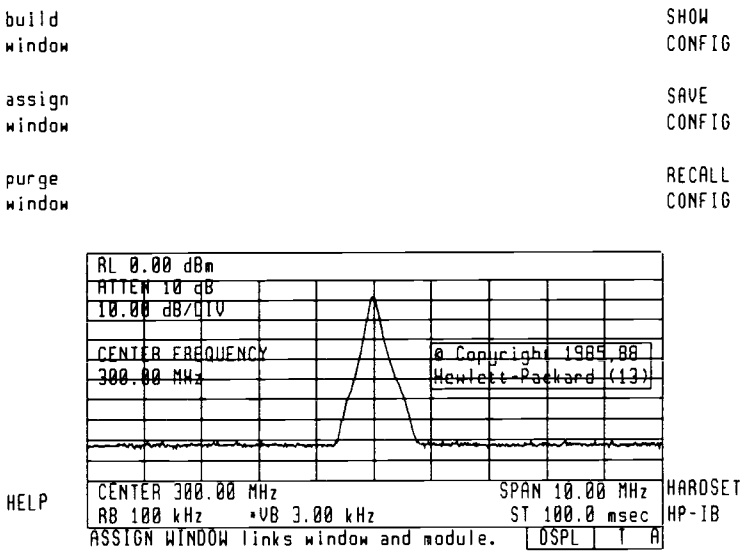


Figure 2-18. Build Window #2

1. Press **build window**.
2. Press **SELECT WINDOW**.
3. Press 1.
4. Press **ENTER**.
5. Press **Ymin**.
6. Using the display knob, move the bottom line to a position just above the other window (Ymin=205).
7. Press **EXECUTE**.

Two windows are now defined as in Figure 2-19. Each window could be assigned to different instruments if desired. See **assign window** description. See the **purge window** description to remove the windows.

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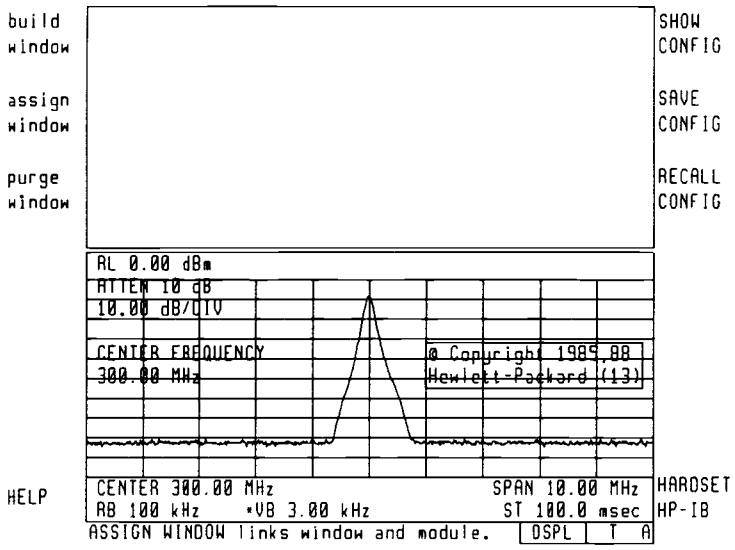


Figure 2-19. Windows #1 (top) and #2 (bottom)

The values of Xmin, Ymin, Xmax, Ymax represent the distances of the lines from the origin. The origin (X = 0, Y = 0) is located at the lower left corner of the screen. The top right corner of the screen is X = 1023, Y = 383. These dimensions are in display units (units of dots on the screen).

The standard-size window, available via `DEFAULT WINDOW`, has the following dimensions:

Xmin = 112

Ymin = 16

Xmax = 911

Ymax = 383

The default window is the window which is created by `SELECT INSTR`, `ALLOC DISPLAY`, `ALLOC SCREEN`, `DISPLAY PRESET`, and `BUILD 1 WINDOW`.

1. Any window can be changed in size or shape by rebuilding. Up to four windows may be defined and written to simultaneously by different instruments; thus, four different instruments can "talk" to the display simultaneously. The screen annotation usually present with one or two large windows may not appear on smaller windows.
2. The keys `BUILD 1 WINDOW`, `BUILD 2 WINDOWS`, and `BUILD 4 WINDOWS` can be used to construct multiple windows with a single keystroke.
3. The `DISPLAY PRESET` or `SELECT INSTR` keys will return the display to a single full-screen window.

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Assign Window

A window on the screen can be written to by any HP-MSIB master module (for example, the HP 70900B Local Oscillator) or by an HP-IB controller. **assign window** lets the user select the instrument that will write to a chosen window. The user can select a module on HP-MSIB by using **HP-MSIB COLUMN**, **HP-MSIB ROW**, and **EXECUTE**. See the following example.

Alternatively, a window may be accessed over HP-IB. To do this, press **assign window**, select the window, then press **HP-IB** and **EXECUTE**. The window will then have HP-IB address of the display. See **address map** to determine HP-IB address of the display. Only one display window at a time can be assigned to HP-IB. HP-IB can also operate without an explicitly defined window, since it automatically receives the default window at power-up (if HP-IB is not assigned a window, one does not show up in **SHOW CONFIG**).

EXAMPLE: Build two windows and assigning one to an instrument.

1. Clear the screen of all windows. See **purge window**.
2. Build two windows as in the **build window** example, leaving the screen with two blank, unassigned windows as in Figure 2-20. The lower window should be number 1 and the upper window should be number 2.

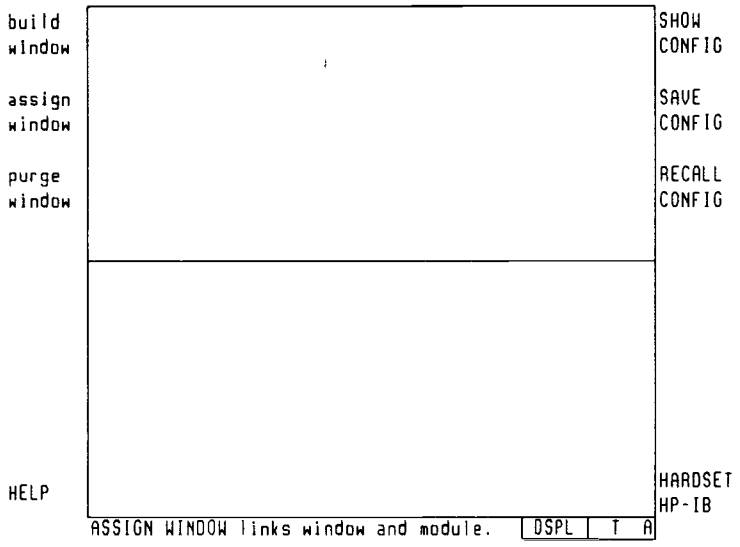


Figure 2-20. Building Two Windows

1. Press **assign window**, **SELECT WINDOW**, (1), and **ENTER**. The lower window should be highlighted.

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2. Press **HP-MSIB COLUMN** and turn the knob until the bottom line on the screen shows that an HP 70900B Local Oscillator module has been found, as in Figure 2-21 (the factory default address is 0,18).

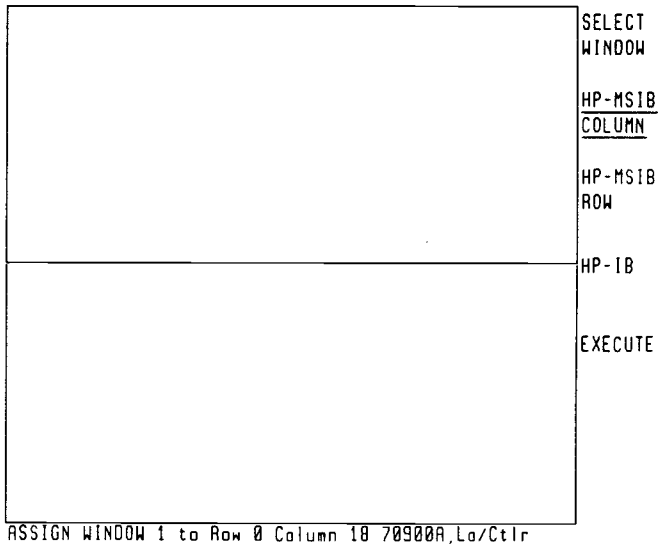


Figure 2-21. Building the First Window

1. Press **EXECUTE**. The trace output from that measurement instrument should appear in the window as in Figure 2-22.

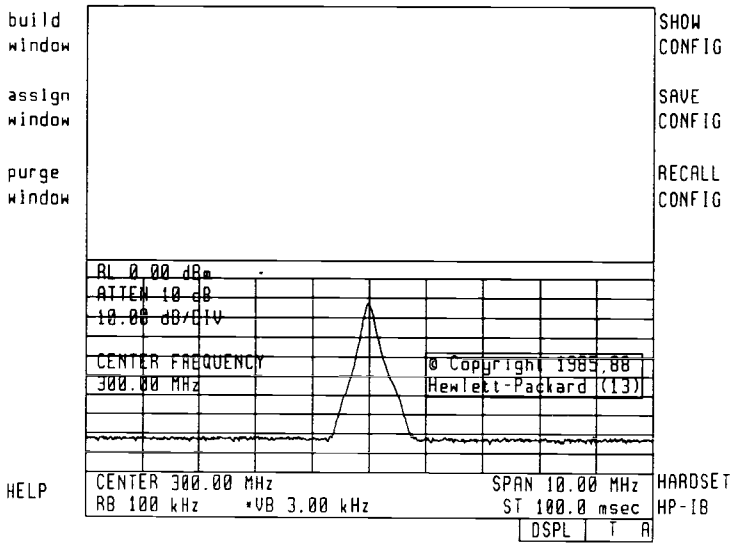


Figure 2-22. Assigning the First Window

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The keys appearing now are those of the display.

To access the key menu for control of the measurement instrument, press (MENU) or (USER).

To control a different instrument, use **assign keybd** to link the keys with a master module that has a window. **assign keybd** is available directly under the (DISPLAY) key.

EXAMPLE: Assign the other window to an instrument.

If your system contains only one instrument, then the second window can be assigned to it. This will result in the instrument's trace information shifting to the second window, which demonstrates the flexibility of the windowing capabilities. This also demonstrates that an instrument can be reassigned to another window from the front panel without changing any instrument settings or interrupting the sweep sequence. Note that the instrument only writes to one window at a time.

1. Press **assign window**
2. Press **SELECT WINDOW**
3. Use the step keys to select the other window (the window that is presently blank).
4. Press **HP-MSIB COLUMN**.
5. Turn the knob until the HP 70900B Local Oscillator module is indicated at the bottom of the screen.
6. Press **EXECUTE**, and the display should shift to the other window, as in Figure 2-23.

With only one instrument writing to the display, the instrument keys will be immediately available by pressing (USER) or (MENU)

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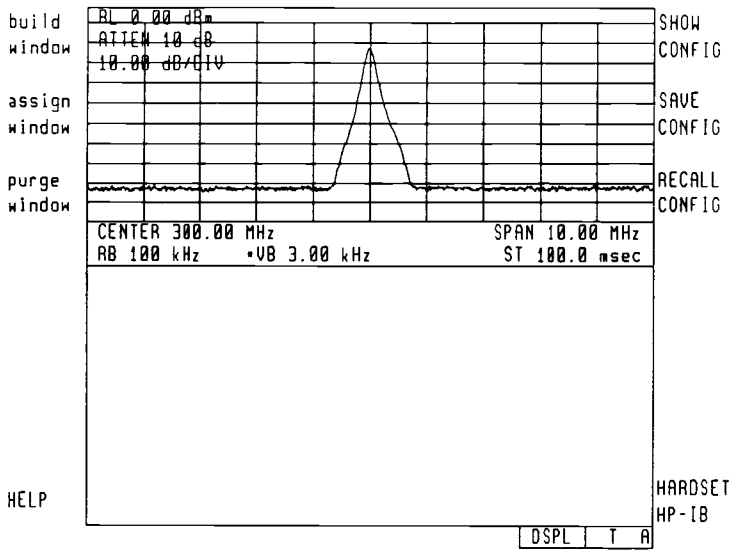


Figure 2-23. Assigning the Other Window

EXAMPLE: Assign two windows to different measuring instruments.

If your system contains more than one instrument, assign the second window to the second instrument. This will result in each instrument writing to a separate window. The two separate traces need not be restricted to sequential updating, as with a single-instrument display. The traces are both being taken in real time by separate instruments. Only the display element is common.

Start with a two-window, one-instrument display similar to Figure 2-24. See the first example in this section.

1. Press **assign window**
2. Press **SELECT WINDOW**.
3. Use the step keys to select the window that is defined but not written to.
4. Press **HP-MSIB COLUMN**.
5. Turn the knob until the other instrument is indicated at the bottom of the screen.

On the front panel of each master module (on row 0) is an "ACT," or active, LED light. The two local oscillators can be distinguished by the ACT LED the module indicated by the bottom line on the display screen will light its ACT LED.

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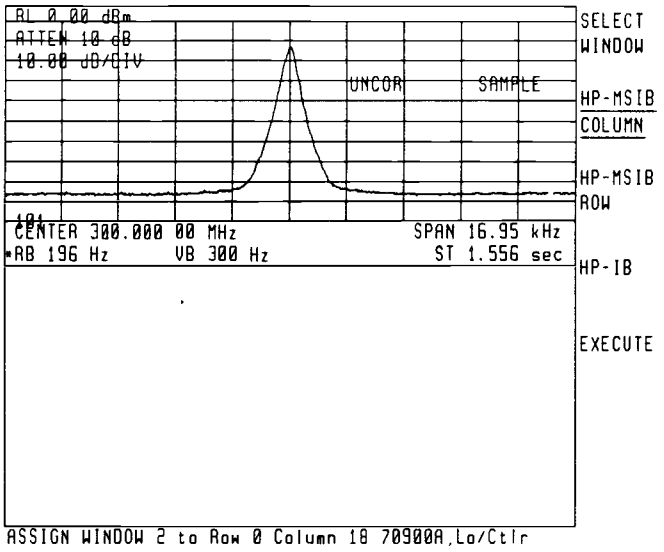


Figure 2-24. Building the Second Window

Once the other instrument has been indicated, press **EXECUTE** and the second instrument's trace information should appear in the other window as in Figure 2-25.

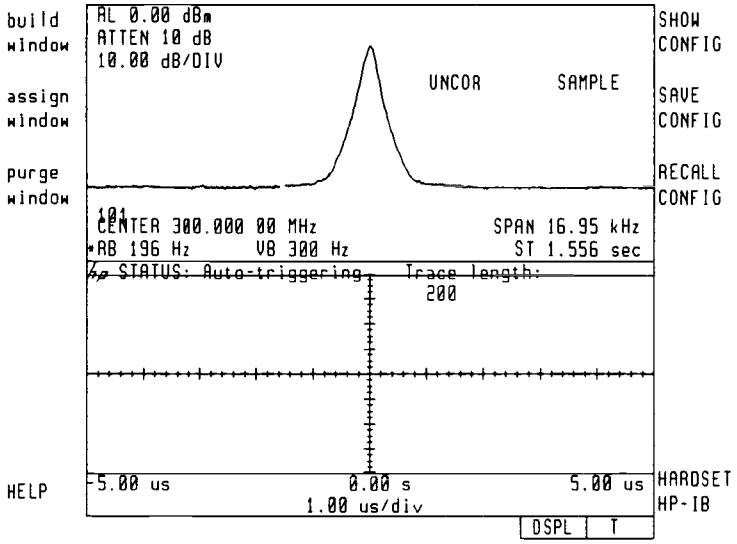


Figure 2-25. Assigning the Second Window

The keys now displayed are those of the display. By pressing USER or MENU, keys for one of the instruments will be obtained.

To control the other instrument, press **assign keybd**, use step keys to select a window, and press USER or MENU. See the

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assign keybd description in this chapter. **assign window** shifts the instrument's output back and forth between windows. **assign window**, however, does not disturb the link between the keyboard and an instrument. Whichever instrument has the keyboard before **assign window** is used will have it afterward.

Purge Window

purge window removes a previously defined window from the screen. Upon pressing **EXECUTE**, the window is destroyed, and any link with an instrument or module is broken. Trace information displayed in the window disappears from the screen, but is not destroyed: it resides in the spectrum analyzer and may be accessed again by assigning a different window to the analyzer See **build window** and **assign window**.

EXAMPLE: Purge two windows.

Start by building two windows, as in the **build window** example (#1 on the bottom, #2 on the top). Assign window #1 to a spectrum analyzer. The resulting screen should be similar to Figure 2-26.

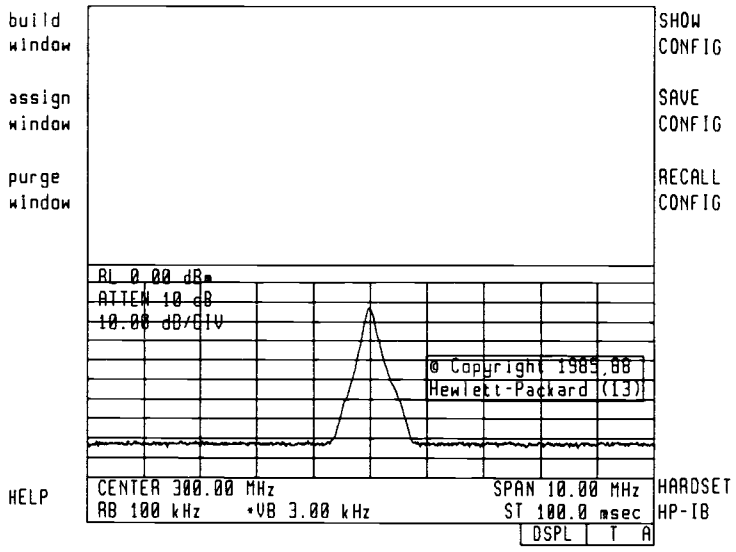


Figure 2-26. Building Two Windows

1. Press **purge window**.
2. Press **SELECT WINDOW**.
3. Use the step keys, knob, or keypad (plus **ENTER**) to select window #1 (the window with the trace displayed).

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4. Press **EXECUTE**. The entire window should disappear as in Figure 2-27.

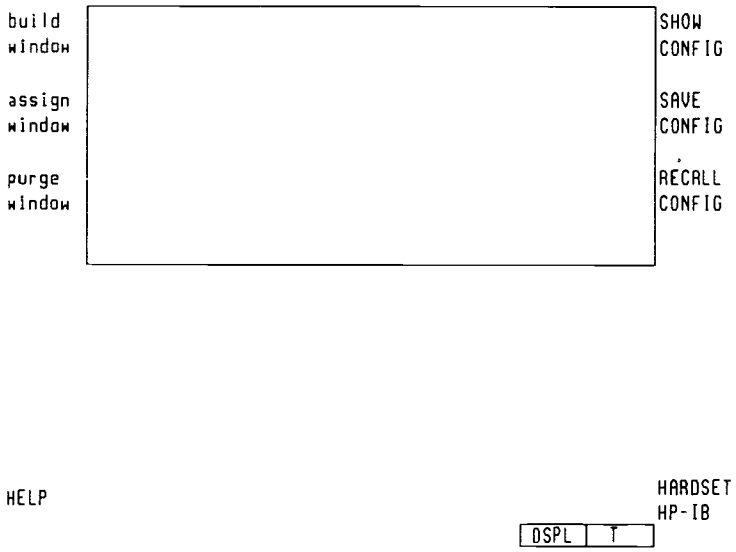


Figure 2-27. Select Window #1

To remove the second window:

1. Press **purge window**.
2. Press **SELECT WINDOW**.
3. Use the step keys to select window #2.
4. Press **EXECUTE** and the remaining window should disappear. See Figure 2-28.

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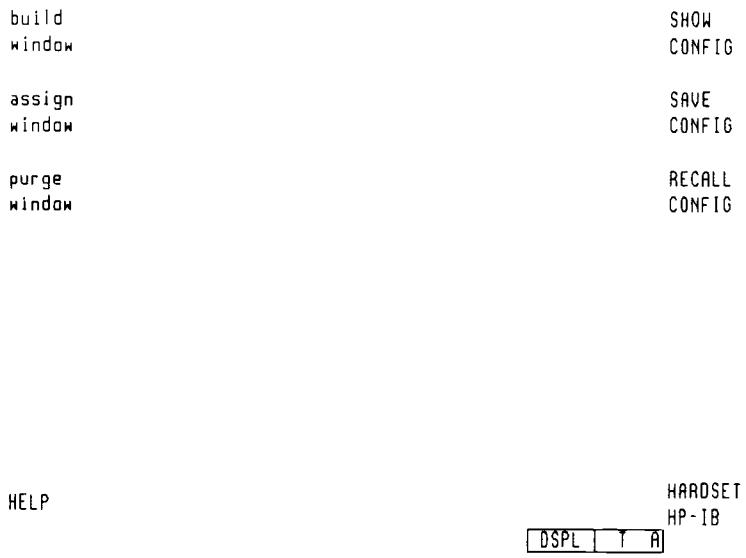


Figure 2-28. Removing the Second Window

Note

Windows need not be purged and rebuilt in order to change size. An existing window can be modified simply by using **build window**.

Hardset/Softset HP-IB

HARDSET/SOFTSET HP-IB helps select HP-IB address that the display will have when HP 70000 Series is next turned on. Switch the modes back and forth between HARDSET and SOFTSET by pressing the **HARDSET/SOFTSET HP-IB** key.

Note

In the HARDSET mode, the display will power-up with an HP-IB address identical to HP-MSIB address. See the "Address Map" description.

EXAMPLE: Demonstration of HARDSET HP-IB action.

Change HP-IB address of the display by using **SET HP-IB**. **SET HP-IB** is available via the keystroke sequence (DISPLAY) and **address map**. See "Address Map" in this chapter. Make sure that HP-IB address does not match the HP-MSIB address. See Figure 2-29.

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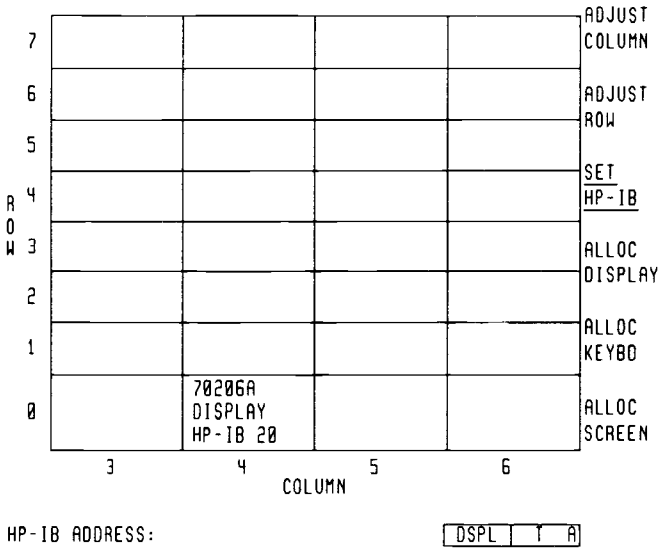


Figure 2-29. Changing the HP-IB Address

1. Press DISPLAY.
2. Press `config display`
3. Press `HARDSET/SOFTSET HP-IB` so that the display is left in the HARDSET mode, as in Figure 2-30.

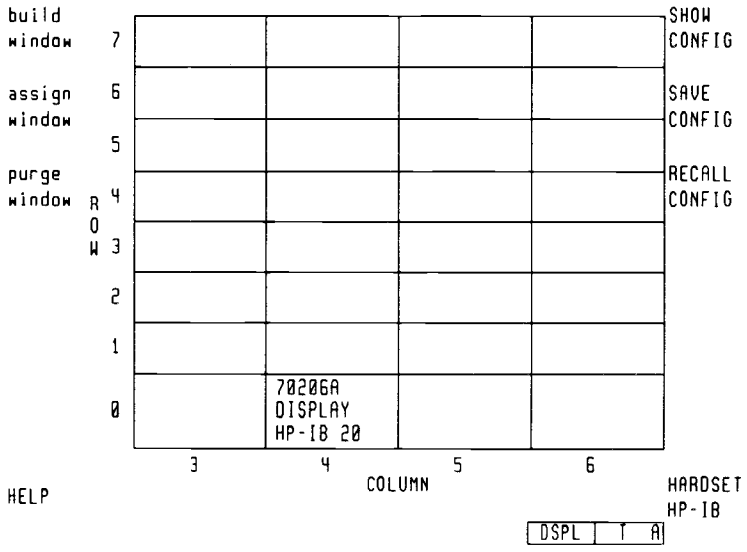


Figure 2-30. Hardset HP-IB

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Turn the system off and then on. Look at the display in the address map by pressing (DISPLAY), ADDRESS MAP, and using the knob to move the cursor to the display.

Note that HP-IB address is now the same as the HP-MSIB column address, as in Figure 2-31.

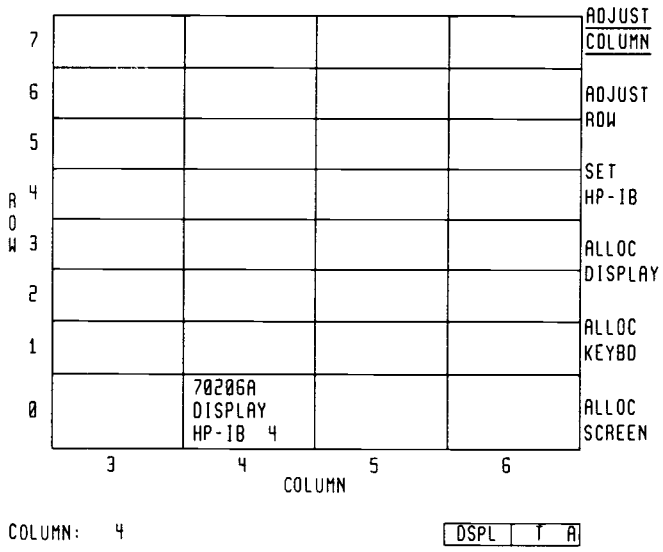


Figure 2-31. Hardset HP-IB Unchanged

Note

In the SOFTSET HP-IB mode, HP-IB address of the display, upon power-up, will be the same as it was before the power was turned off. In fact, that address will be retained even if the instrument is disconnected from the power source and transported.

EXAMPLE: Demonstrate SOFTSET HP-IB action.

As in the last example, set HP-IB address of the display to something other than its the HP-MSIB row address.

Select SOFTSET mode by pressing (DISPLAY), CONFIG display, and HARDSET HP-IB. This will toggle the options back and forth between HARDSET and SOFTSET. Leave the display in the SOFTSET mode, as in Figure 2-32.

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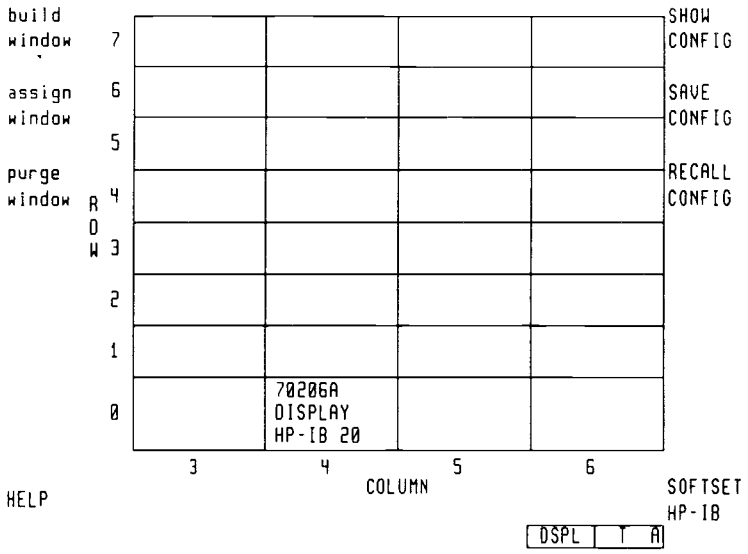


Figure 2-32. Setting Softset HP-IB

Turn the instrument off and then on.

Look at the display in the address map by pressing (DISPLAY), `address map`, and turning the knob to place the cursor on the display.

Note that HP-IB address is the same as it was before the power was turned off, as in Figure 2-33.

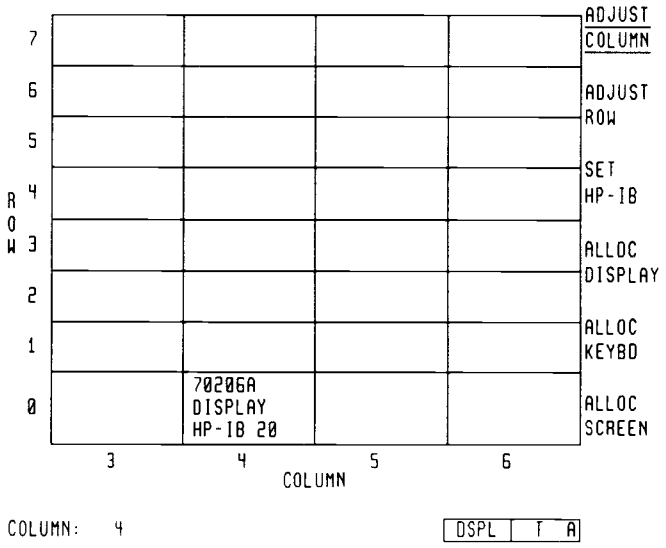


Figure 2-33. HP-IB Address Changes at Power Up

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Note

`HARDSET/SOFTSET HP-IB` affects HP-IB address of the only the display, not the spectrum analyzer master module. Also, this key affects the address only after the instrument has been shut off and then turned on again, and does not keep the user from changing HP-IB address of the display or the local oscillator (by means of the `SET HP-IB` key).

Help

The `HELP` key brings up a screen that contains brief descriptions of several `config display` keys. See Figures 2-34 and 2-35, below.

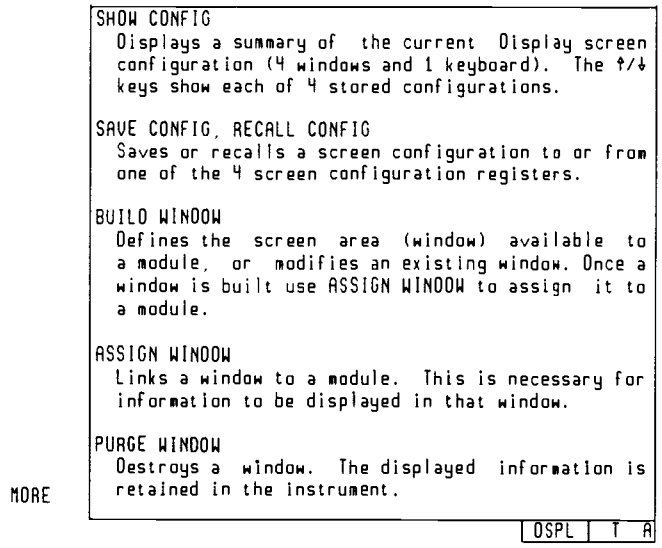


Figure 2-34. `config display` Help Screen, Page #1

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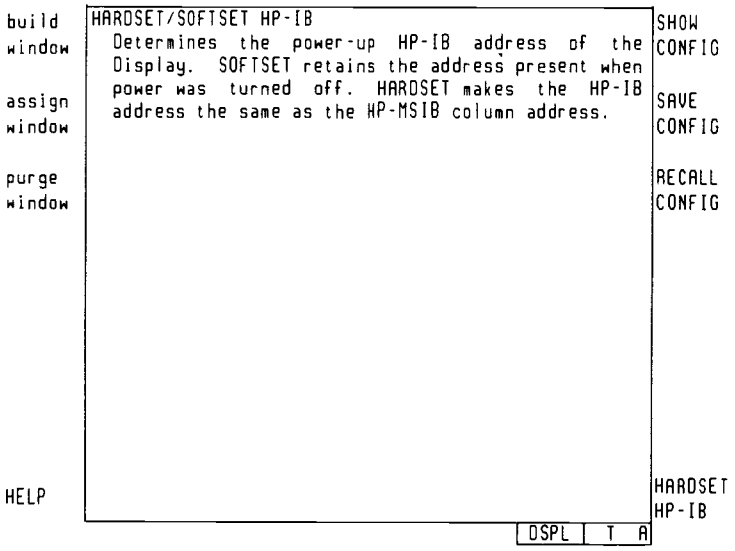


Figure 2-35. `config display` Help Screen, Page #2

Show Configuration

The display has six resources that it can allocate or assign to any of several HP 70000 series elements: these resources consist of a screen composed of up to four windows, plus a fifth window reserved for a controller on HP-IB, and one keyboard. The fifth window is "invisible" in that it does not show up in **`SHOW CONFIG`**. Press **`config display`**, **`SHOW CONFIG`**, to show the following:

- Which windows are defined (1 through 4).
- The dimensions of each window.
- The instrument or module each window is allocated to (that is, which module can write to a given window).
- Which module the keyboard is assigned to.

`SHOW CONFIG` not only brings up the current configuration of the display but also shows four other complete display configurations. These configurations reside in continuous-memory registers, so they will be recalled even if the power had been turned off.

See the sections in this chapter on **`SAVE CONFIG`** and **`RECALL CONFIG`** for more information.

EXAMPLE: View the current configuration.

1. Press DISPLAY.
2. Press **`config display`**.

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3. Press SHOW CONFIG.

In the figure below, only one window is defined, and it is assigned to an HP 70900B Local Oscillator module at HP-MSIB address 0, 18. The keyboard is also assigned to that module. This is the standard configuration obtained by pressing SELECT INSTR.

The window is of standard size; namely, it is 800 pixels wide (911 − 112 + 1) and 368 pixels high (383 − 16 + 1), which leaves room for keys. Windows 2, 3, and 4 are undefined.

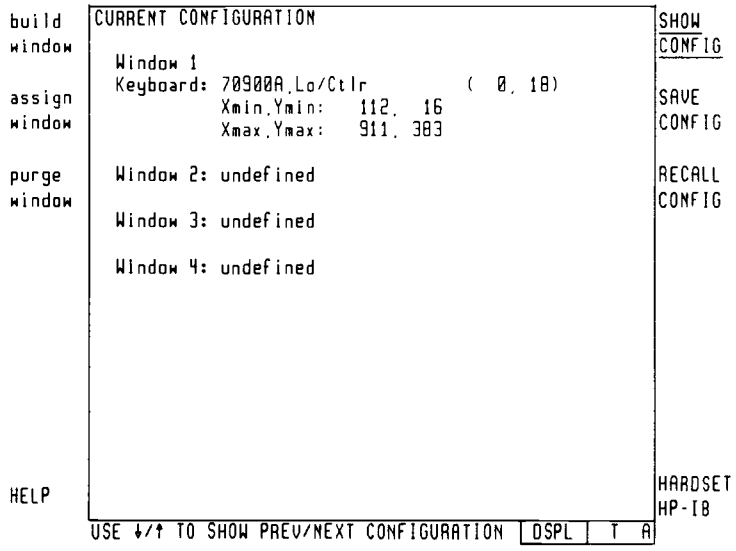


Figure 2-36. Show Current Configuration

EXAMPLE: View Configuration Registers 1 through 4.

There are four continuous-memory registers that store display configurations. To view these, perform the following step.

1. Press DISPLAY.
2. Press config display
3. Press SHOW CONFIG (which will display the current configuration).
4. Press the ↑ key. Configuration Register 1 should appear.
5. Press the ↑ key three more times to view Configuration Registers 2, 3, and 4. See Figure 2-37.

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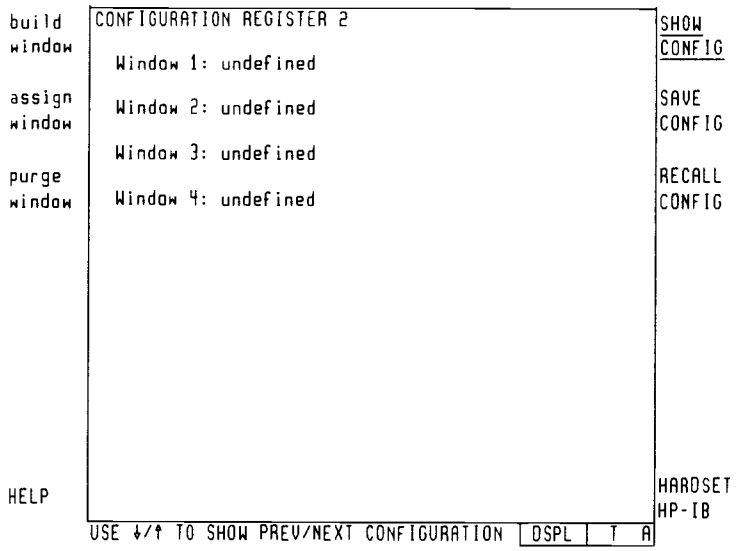


Figure 2-37. Configuration Register #4

If the current configuration or any of the registers contain only undefined (and unassigned) windows, try using **build window** and **assign window** to reconfigure the display. Then use **SAVE CONFIG** to store the new configuration. Observe how the changes are shown on the Current Configuration and Configuration Register screens by using the **SHOW CONFIG** key. If multiple instruments are available on HP-MSIB, try using **assign keybd**.

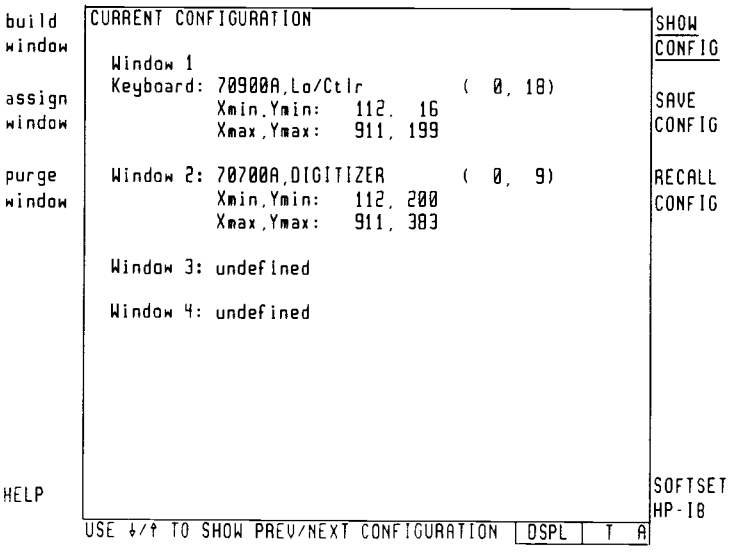


Figure 2-38. Current Configuration

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For example, Configuration Register 1 shown in the above figure describes the layout of the screen shown in Figure 2-39, below. The keys shown are for the analyzer writing to the bottom window (window #1). This can be inferred from "Keyboard" appearing below "Window 1" in Figure 2-38. Users can determine whether window #1 is the bottom window by comparing the Ymin and Ymax values for the two windows. See **build window**.

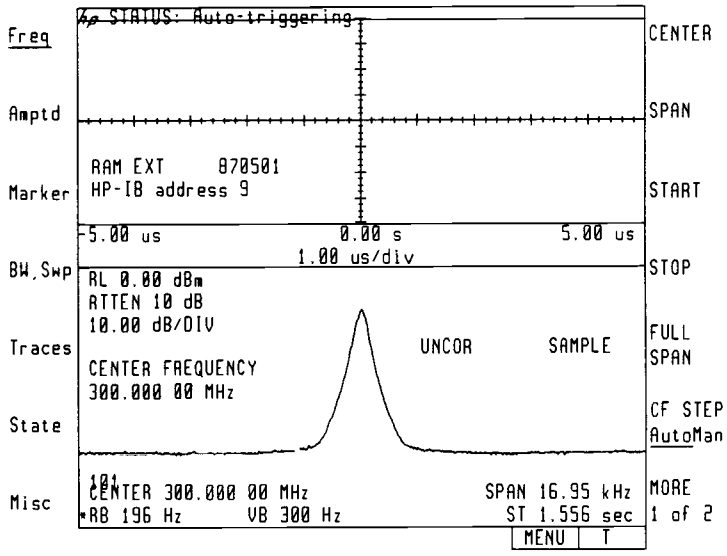


Figure 2-39. Configuration Register #1

Save Config/Recall Config

SAVE CONFIG stores the complete configuration of the screen windows in a continuous-memory register. Four registers are available, 1 through 4. See **SHOW CONFIG**.

Note

The Current Configuration will be retained if the power is turned off, but will be lost if a different configuration is recalled from one of the four registers.

RECALL CONFIG lets the user reconfigure the screen to a previously saved state with only a few keystrokes.

EXAMPLE: Save a screen configuration and recall it.

1. Configure a screen with multiple windows, as in Figure 2-40. See the **build window** example.
2. Assign an instrument (for example, a spectrum analyzer) to one window. See the **assign window** section of this chapter.

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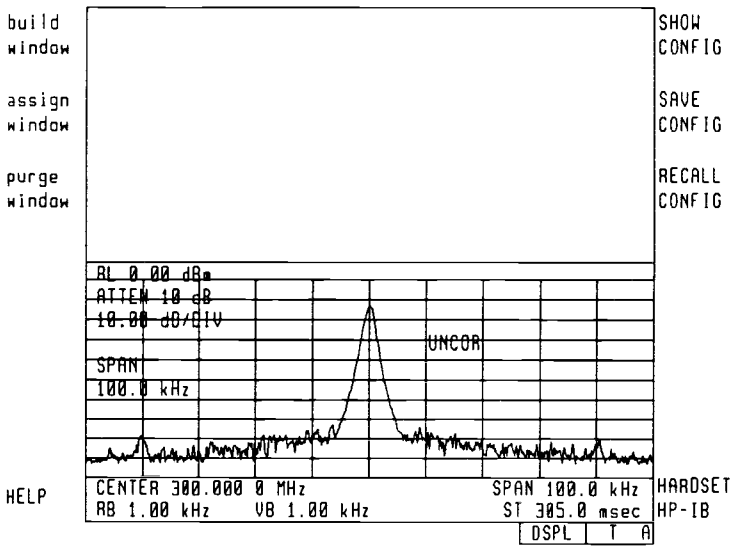


Figure 2-40. Recall Configuration

To save the configuration:

1. Press DISPLAY.
2. Press **config display**.
3. Press **SAVE CONFIG**.
4. Press 1.
5. Press **ENTER**

To change the current configuration by purging the lower window:

1. Press **config display**.
2. Press **purge window**.
3. Press 1.
4. Press **ENTER**.
5. Press **EXECUTE**.

The screen should resemble Figure 2-41.

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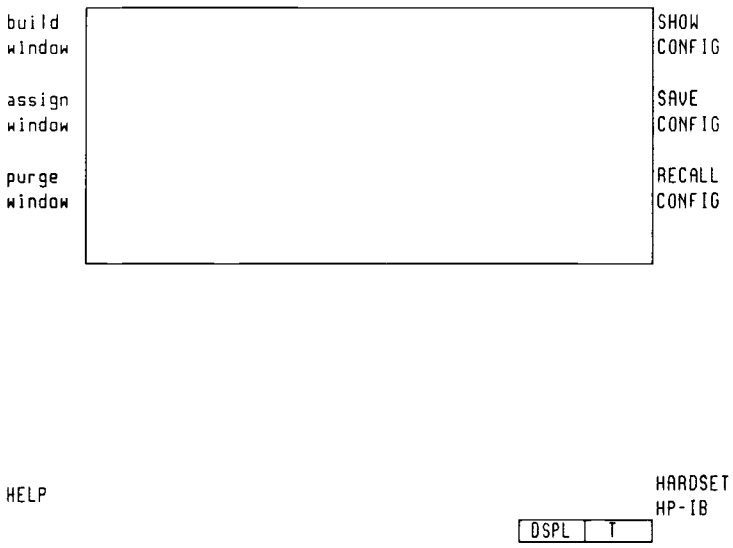


Figure 2-41. Save Configuration

To recover the original screen:

1. Press (DISPLAY).
2. Press `config display`.
3. Press `RECALL CONFIG`.
4. Press (1).
5. Press `ENTER`.

The recovered configuration should look the same as the configuration that was saved.

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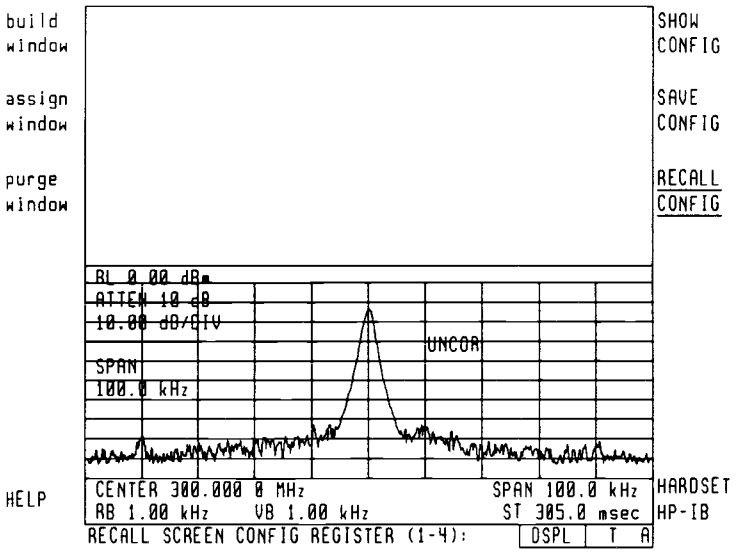


Figure 2-42. Recover the Original Configuration

Print

The **PRINT** key (or PRINT key on HP 70206A System Graphics display) initiates a raster print dump of the screen (and of the instrument's keys if configured to do so).

EXAMPLE: Print a copy of the instrument display.

Note

To follow this example, you may need to enter the address of your printer into the HP 70000 system and specify whether the keys are to be printed. Refer to the **printer is** and **KEYCOPY ON/OFF** keys in the **define hardcpy** section of this manual.

1. Enter the address of your HP-IB printer via the **printer is** key, available under **define hardcpy**. Select **KEYCOPY ON/ OFF** if desired.
2. Obtain the instrument display you want to print by using the keys in the USER menu.
3. Press DISPLAY.
4. Press **PRINT** (or the PRINT key on HP 70206A System Graphics Display). The printing process will begin immediately. It can be halted by pressing any front-panel key on the display during the print sequence. The screen will be frozen until the data transfer to the printer is complete.

When **PRINT** is pressed, the screen displayed will be printed.

The keys printed if **KEYCOPY ON/ OFF** is selected are the last ones displayed that were associated with the *instrument*, not the display element. Keys available under DISPLAY are referred to as "display utility keys" and are not normally shown on hardcopy output.

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The raster print dump process works with HP raster-format printers (dot-matrix) that can accept printer dumps of at least 384 lines by 512 points; for example, HP 2673A printer and HP 2225A Thinkjet Printer have this capability. (The `HI RES ON/OFF` function, described in `define hardcpy`, requires capability of 384 lines by 1024 points.) Most of the printers that work with HP 9000 Series 200/300 computers will work with HP 70000 system.

Direct hardcopy output from HP 70000 system without a controller requires a display element, either HP 70205A or HP 70206A.

Plot

Pressing `PLOT` initiates a vector plot dump over HP-IB to the plotter specified under `define hardcpy`. The operation of this key is almost identical to the operation of `PRINT`, but HP-IB output address of the plotter is set using `plotter is` rather than `printer is`.

Refer to the `PRINT` command for instructions on using this command when a computer is on HP-IB.

Note



HP 70205A and HP 70206A displays require that the plotter implement HP-GL, Hewlett-Packard Graphics Language. These displays work with plotters such as HP 7470A, HP 7475A, HP 7090A, and HP ColorPro.

See the `plotter is` key description to set the plotter parameters, including HP-IB address.

Define Hardcopy

The `define hardcpy` key allows the user access to several keys which are used to define parameters for hardcopy output. See Figure 2-43 below. These parameters include:

- `COPY IS PRT/PLT` determines whether the printer or plotter will be the destination when a CY (copy) command is sent.
- `DEFAULT VALUES` sets the standard default values for the printer and plotter:
  - `printer is`: HP-IB TLK/LSN 1
  - `plotter is`: HP-IB TLK/LSN 5
  - `COPY IS PRT/PLT`: PRINTER
  - `HI RES ON/OFF`: OFF
  - `EJECT ON/OFF`: ON
  - `KEYCOPY ON/OFF`: OFF (not shown), between `plotter params` and `HI RES ON/OFF`.

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- **plotter params** defines the limits used for plotter dumps when the display cannot ask the plotter what limits to use (for example, listen-only plotters).
- **KEYCOPY ON/OFF**. When ON, the printer and plotter outputs will copy the key labels, title line, and status box. When OFF, these items will be blanked.
- **HI RES ON/OFF**. When ON, the printer is set to high-resolution and all 1024 display points are dumped on each line (dumps normally are 512 points per line).
- **EJECT ON/OFF**. When ON, page ejects are sent at the end of dumps.

Note

Older plotters, such as HP 9872B, will show an error when they receive the page eject command. Use **EJECT OFF** to keep this from occurring.

See subsequent key descriptions for further instructions.

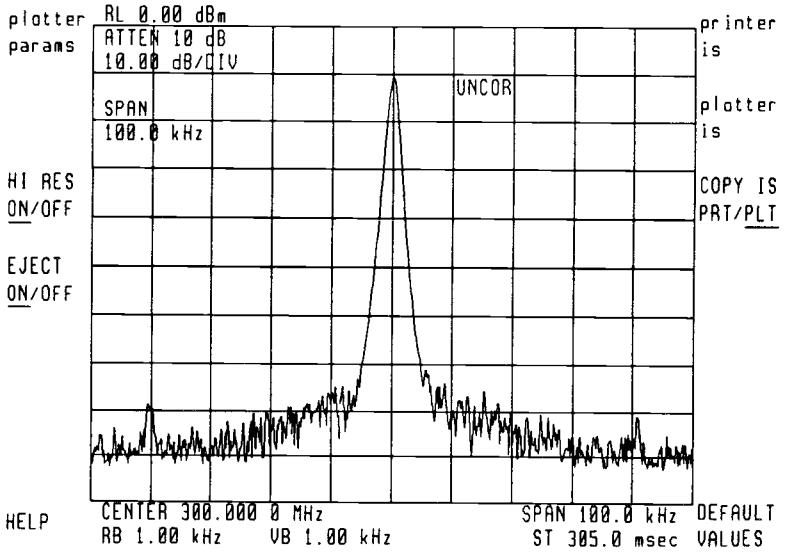


Figure 2-43. Define Hardcopy Menu

Printer Is

printer is defines HP-IB address and status of the output printer. The printer's address can be entered as:

- TLK/LSN, or talk/listen. (For example, TLK/LSN 1 means that the display expects the printer to be in talk/listen status at HP-IB address1.)

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- L ONLY, or listen only (sometimes called "listen always"). In this mode the printer is expected to be set to listen only on HP-IB. (For instructions, consult the operating documentation for the specific printer to be used.)

EXAMPLE: Set the expected printer address to HP-IB talk/listen 01.

1. Press (DISPLAY).
2. Press **define hardcpy**.
3. Press **printer is**.
4. Press **HP-IB TLK/LSN**.
5. Enter the address 1 (printers are typically addressed at 01).
6. Press **ENTER**. The address should change immediately, as in the lower-left corner of Figure 2-44.

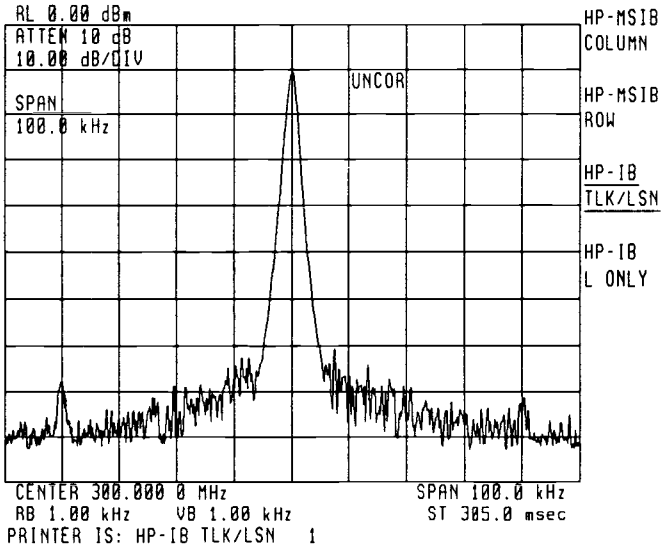


Figure 2-44. HP-IB TLK/LSN

To select listen-only, press the key so that **HP-IB L ONLY** is underlined and **PRINTER IS HP-IB L ONLY** is shown in the lower-left corner as in Figure 2-45.

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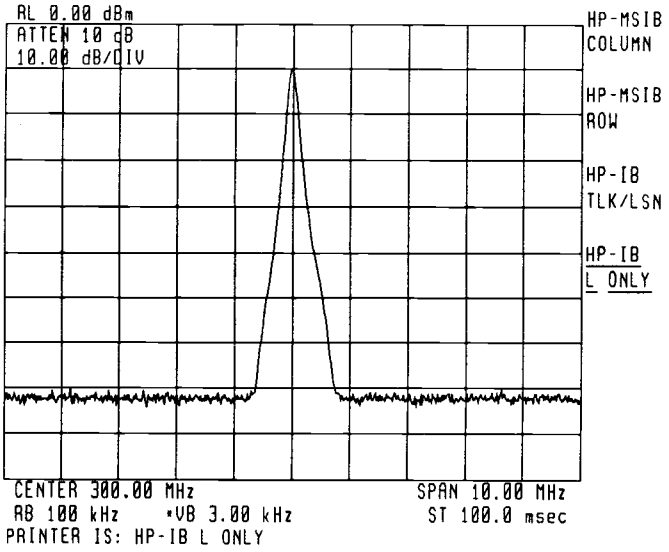


Figure 2-45. HP-IB L ONLY

Switching from **HP-IB L ONLY** back to **HP-IB TLK/LSN** will change HP-IB TLK/LSN address to 1. Check the address before you leave the **printer is** submenu.

HP-MSIB COLUMN and **HP-MSIB ROW** are used if an HP-MSIB print device is configured.

For a discussion of printer compatibility, see the **PRINT** key description.

Plotter Is

plotter is is used to specify HP-IB address of the hardcopy output plotter. The operation of **plotter is** is similar to that of **printer is**. (Plotters, however, usually have an HP-IB address of 5.)

Note that a listen-only plotter cannot tell the display what its corner points (P1, P2) are. With a listen-only plotter, the display will always use the P1, P2 corner points stored under **plotter params** (refer to **plotter params**), overriding the P1, P2 set-up on the plotter.

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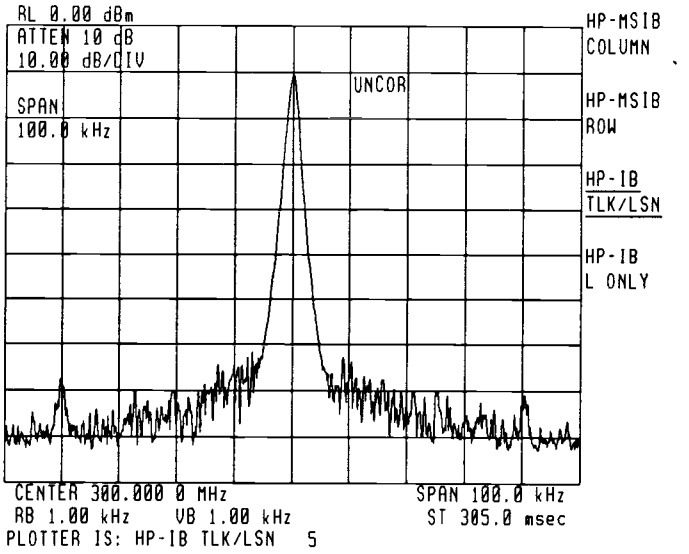


Figure 2-46. Plotter Is

Note

For a discussion on plotter compatibility see the **PLOT** key description.

Plotter Parameters

plotter params is a key that allows the user to alter the physical size of hardcopy output plots to listen-only plotters (or to TLK/LSN plotters if the output is initiated by remote control using the command CY 1).

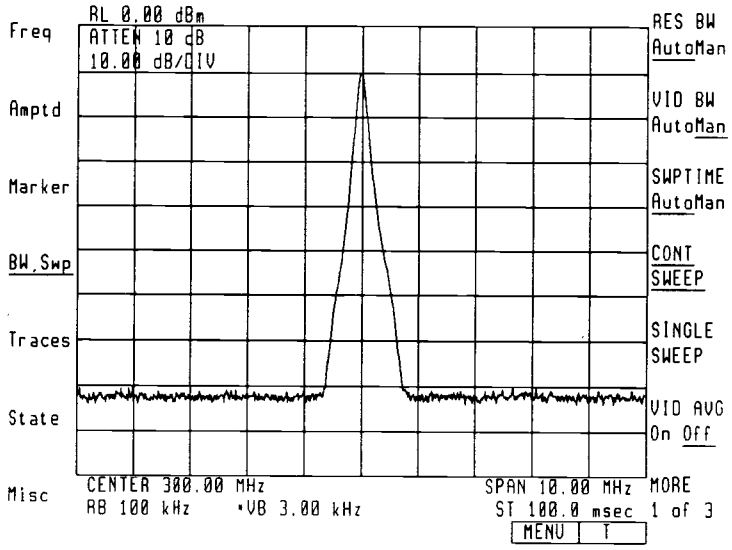


Figure 2-47. Standard Plot

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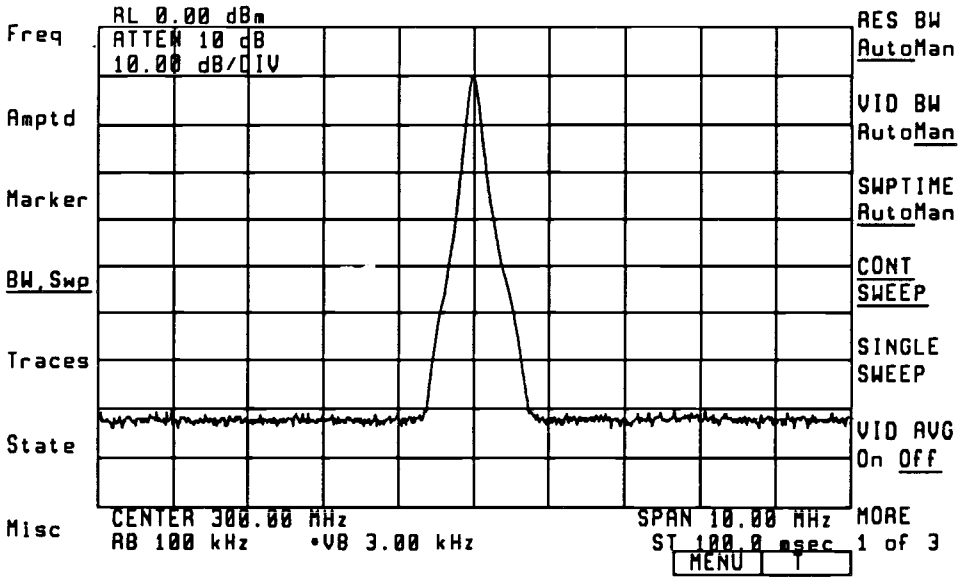


Figure 2-48. Wider Plot

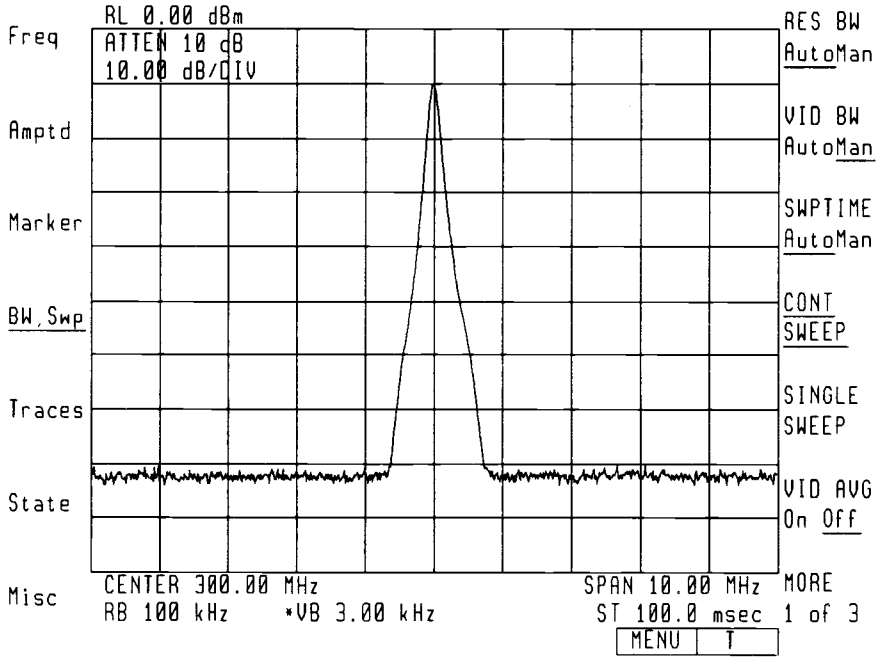


Figure 2-49. Plot Increased in Height

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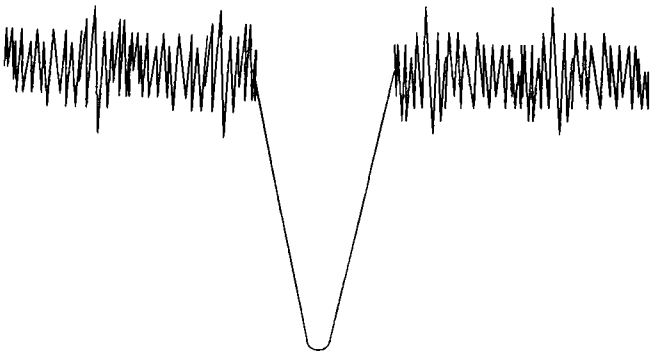


Figure 2-50. Inverted Plot

On HP plotters, the physical size and shape of output plots are determined by the locations of the "Scaling Points, P1 and P2." These locations are given in Cartesian coordinates: for example, P1 = 100, 100 and P2 = 10100, 7600. The actual size of these units depends on the specific plotter used. Typical unit size is 0.025 mm, or about 0.001 inch. The units are relative to the lower-left corner of the available plotting surface.

In Figure 2-51, the default plotting area for HP 7475A 6-Pen Graphics Plotter is outlined. P1 is the lower-left corner, P2 is the upper-right corner.

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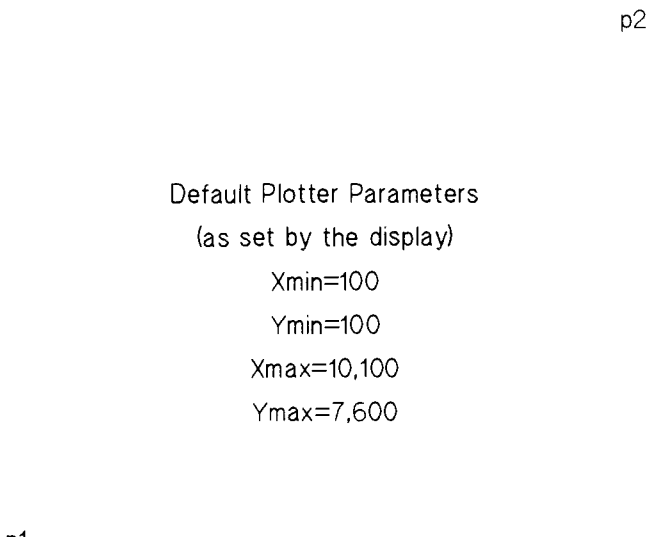


Figure 2-51.
Plotter Parameters as Set by HP 70205A and HP 70206A Displays

To set plotter parameters to their standard default values, press (DISPLAY), `define hardcpy`, and `DEFAULT VALUES` See `DEFAULT VALUES` description in this chapter. Xmin, Xmax, Ymin, and Ymax will be set to the values shown in the figure above (Figure 2-51). These values will allow 0.5-inch margins on 8.5-by-11 inch paper.

The plotter parameters are stored in a continuous-memory register; they will be retained even after the power has been turned off. Turning the system off and then on will not set the plotter parameters to their default values. The default values can only be reset by using the sequence in 1 above, or by pressing `DISPLAY PRESET`.

Instrument Preset (I/P) does not affect the plotter parameters or any other display features.

Plotters may operate differently as a listener (for example, L ONLY) or as a talker/listener (TLK/LSN). Consult the operating instructions for your particular plotter.

Keycopy On/Off

`KEYCOPY ON/OFF` enables the spectrum analyzer's key labels, status box, and data line to be copied as part of the hardcopy output to either a printer or plotter.

EXAMPLE: Delete keys from an analyzer plot.

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1. With **KEYCOPY ON** and a plotter connected to the display via HP-IB, arrange an analyzer screen to be plotted.
2. Press (DISPLAY).
3. Press **PLOT** on HP 70205A display (or the (PLOT) key on HP 70206A display). An output plot should appear as in Figure 2-52.

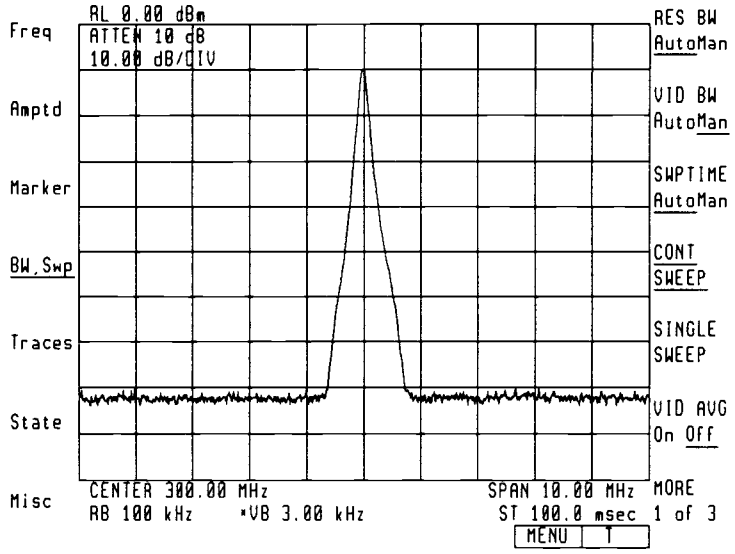


Figure 2-52. Plot Output

To delete the keys from the hardcopy output:

1. Press (DISPLAY).
2. Press **define hardcpy**.
3. Press **KEYCOPY OFF**.

This should result in KEYCOPY "OFF", indicating that key labels will not be plotted.

4. Press (USER) or (DISPLAY).
5. Press **SELECT INSTR** and arrange an instrument display for the plot.
6. Press (DISPLAY).
7. Press **PLOT** (or the (PLOT) key on HP 70206A).

The resulting plotter output, as in Figure 2-53, should contain no key labels.

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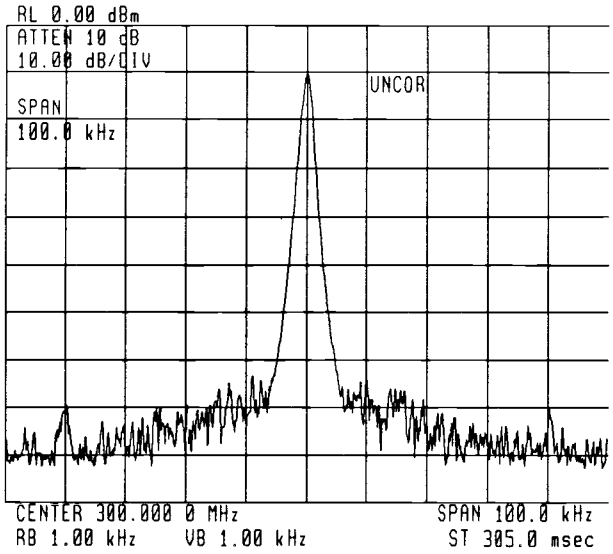


Figure 2-53. No Key Labels

KEYCOPY affects key labels only on hardcopy output. It does not remove key labels from the screen except during the output.

Key labels accessible under DISPLAY are normally not available for hardcopy output. The key labels that are printed or plotted are the most recent ones displayed by the instrument, or loaded by the ML command.

Annotation other than keys can be deleted also, but this is done by the instrument, not the display. Refer to your instrument's Operation Manual for information.

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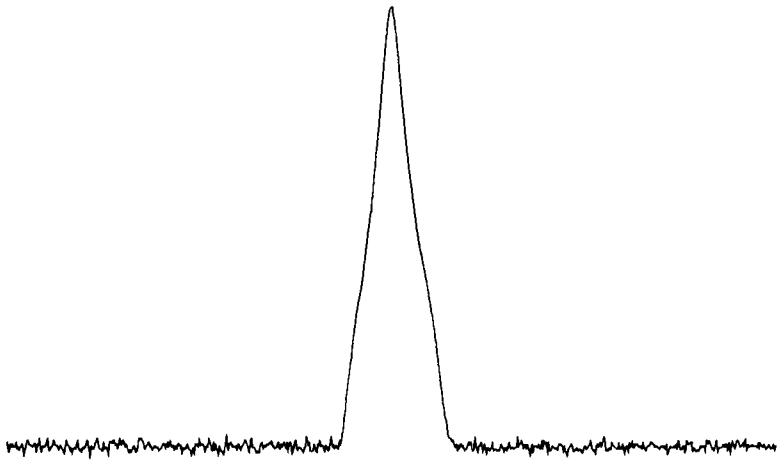


Figure 2-54.
Instrument output with ANNOT OFF, KEYCOPY OFF, and GRAT OFF

Hi Res On/Off

The HI RES option allows the user to obtain higher resolution printouts on certain printers.

To use the HI RES option, press `HI RES ON/OFF` so that the key appears as `HI RES ON`, then execute a print operation. See `PRINT` key description.

Using the HI RES option in a raster print dump, HP 70205A and HP 70206A displays will put out 384 lines with 1024 points per line.

When the HI RES option is not being used, the displays will output 384 lines of 512 points per line.

The higher resolution obtainable with HI RES is available only on raster PRINT operations. HI RES does not affect PLOT operations.

Although HP 2225A Thinkjet printer can accommodate 1024 lines per line, not all raster printer can. Some printers, like HP 2673A, have a line width of less than 1024 points. *Do not* use `HI RES` with these printers.

When making high-resolution prints with the HP Thinkjet, the printing operation will be slower than usual. This is because the printer must place more dots on each line.

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HI RES reprograms the printer to hold more dots per line. When done, it leaves the printer in this mode, since it has no way of knowing what mode the printer was in to begin with.

Note

HI RES does not work with the HP PaintJet printer.

Eject On/Off

When the EJECT ON/OFF key is ON a page is ejected at the end of both plotter and printer outputs.

To use the EJECT ON/OFF option press (DISPLAY), define hardcopy, then EJECT ON/OFF.

Note

Many plotters do not implement a page eject feature.

Copy is Prt/Plt

COPY IS PRT/PLT determines whether the printer or the plotter will be the destination when a CY (copy) command is received.

To use the COPY IS press (DISPLAY), define hardcopy, then COPY IS PRT/PLT.

Default Values

DEFAULT VALUES automatically sets the value of several user-definable parameters for hardcopy output. These parameters and their default values are listed in Table 2-2.

Table 2-2. Default Values

PRINTER IS:	HP-IB Talk/Listen at address 1.
PLOTTER IS:	HP-IB Talk/Listen at address 5.
COPY IS:	PRINTER
PLOTTER PARAMS:	Plot limits of Xmin, Ymin = 100, 100
	Plot limits of Xmax, Ymax = 10100, 7600
HI RES:	OFF
KEYCOPY:	OFF
EJECT:	ON

Note

The default plotter limits are those of HP 70470A and HP 7475A plotters. These allow 0.5-inch margins on standard A-size paper (8.5-by-11 inches).

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Help

The **HELP** key under **define hardcpy** presents a screen of brief descriptions explaining the functions available with other keys in the **define hardcpy** menu. See Figures 2-55 and 2-56 below.

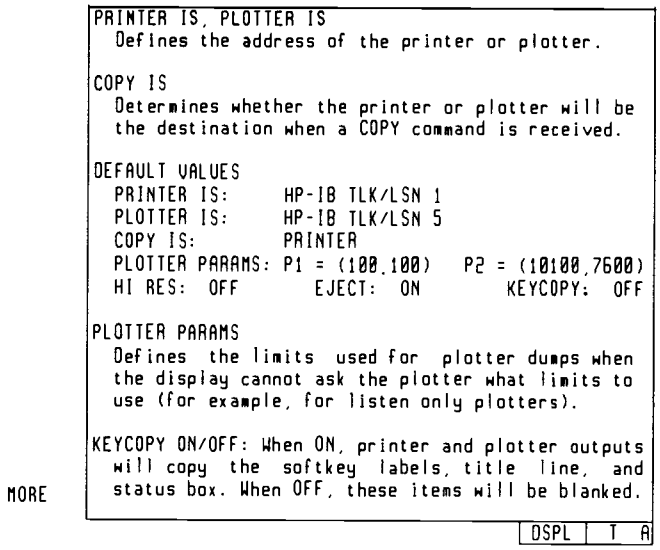


Figure 2-55. Help Screen, Page #1

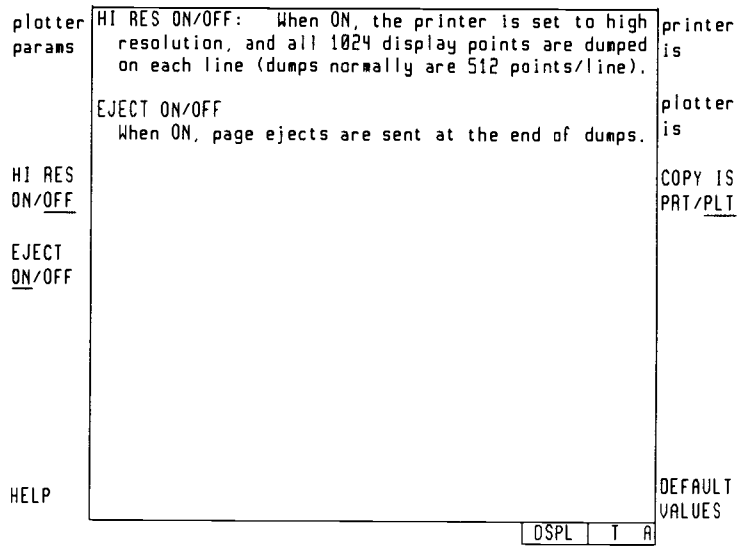


Figure 2-56. Help Screen, Page #2

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Report Errors

The REPORT ERRORS key gives the user a brief description of any error that has been detected by an element on HP-MSIB.

EXAMPLE: Detect an illegal command sent by HP-IB.

Begin by causing an error. Do this by connecting a computer or controller to HP 70000 system by HP-IB and sending an illegal command.

Example: `OUTPUT 718; "XX"`

If the local oscillator (the master module of the spectrum analyzer) has an HP-IB address of 18, it will detect an illegal command. An **E** will appear in the Status Box at the lower right-hand corner of the screen, as in Figure 2-57. Also, an error message may appear in the upper right-hand portion of the screen.

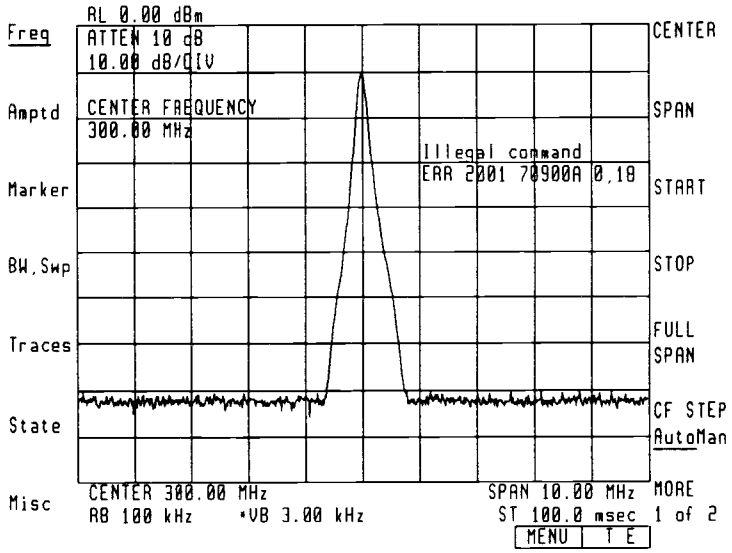


Figure 2-57. Status Box

The user can receive the error report by pressing DISPLAY, then REPORT ERRORS. A figure similar to Figure 2-58 appears, and provides the following information:

- Which module reported the error (in this case, HP 70900B Local Oscillator module).
- What the HP-MSIB address of that module is (for example, 0, 18).
- An error identification number (for example, 2001).
- A brief description of the error (for example, illegal command).

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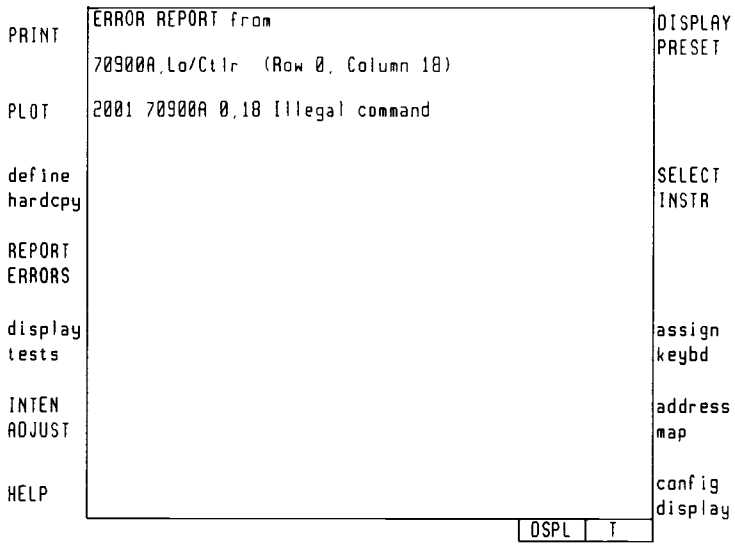


Figure 2-58. Reporting Errors

Most errors reported on HP-MSIB are transient errors such as those caused by illegal commands over HP-IB. These errors, once reported via `REPORT ERRORS`, are cleared from memory. Hence they cannot be reported or viewed a second time.

Other errors reported can be "hard" errors. These are caused by hardware problems such as unconnected rear-panel cables (see the following example) or the failure of an internal component. These problems can affect operation of the instrument, and cannot be cleared from memory until corrected.

EXAMPLE: Report and correct a hardware error.

If the rear-panel connection (labeled "300 MHz") between the local oscillator module and the RF section (for example, the HP 70904A) is removed, an error is detected by the RF section and shown on the screen. See Figure 2-59.

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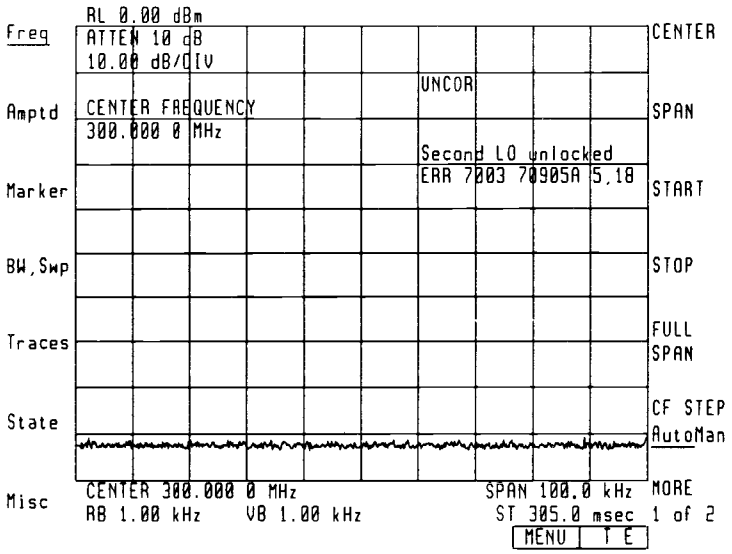


Figure 2-59. Error Screen

If (DISPLAY) and **REPORT ERRORS** are pressed, the error screen is shown but the error is not cleared from memory, as indicated by the presence of the **E** in the status box. See Figure 2-60.

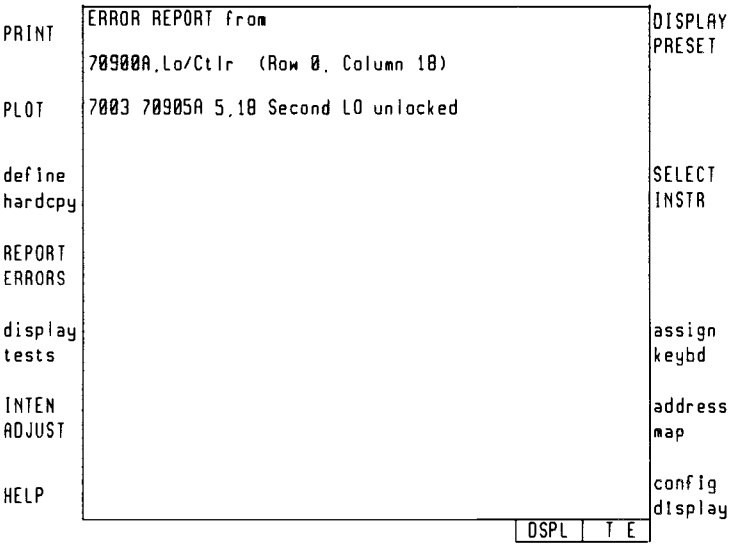


Figure 2-60. Error Not Cleared

Note that even if the hardware-related error is corrected at this point, it must be reported again to clear the system. Thus, press **REPORT ERRORS** to clear the system and remove the **E** from the status box.

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Hardware-related errors must be reported after they have been corrected in order to clear them from memory. This has been done for the following figure.

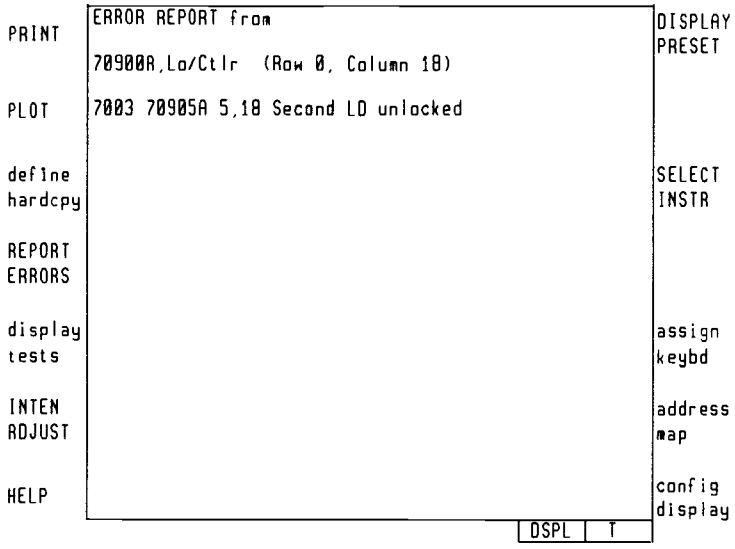


Figure 2-61. Cleared Errors

EXAMPLE: Clear error reports from multiple instruments.

If a system contains multiple instruments, each instrument will independently report the errors it detects.

For example, send an illegal command via HP-IB both to the display and the spectrum analyzer via a computer.

```
OUTPUT 704; "XX"

OUTPUT 718; "XX"
```

This results in an **E** in the status box, just as with a single error.

After pressing (DISPLAY) and **REPORT ERRORS**, the error detected by the module with the lowest column address is reported first (and cleared from memory if it is only a transient error).

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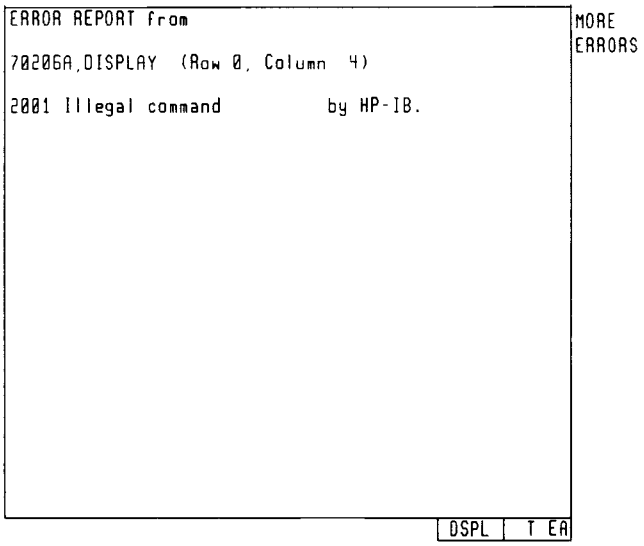


Figure 2-62. Multi-Instrument Errors

Notice that instead of the usual key menu under (DISPLAY), **MORE ERRORS** appears on the screen and the **E** remains in the status box. See Figure 2-63. The second error has not been reported yet.

Press **MORE ERRORS**, and the last error is reported (and cleared if it is only a transient error).

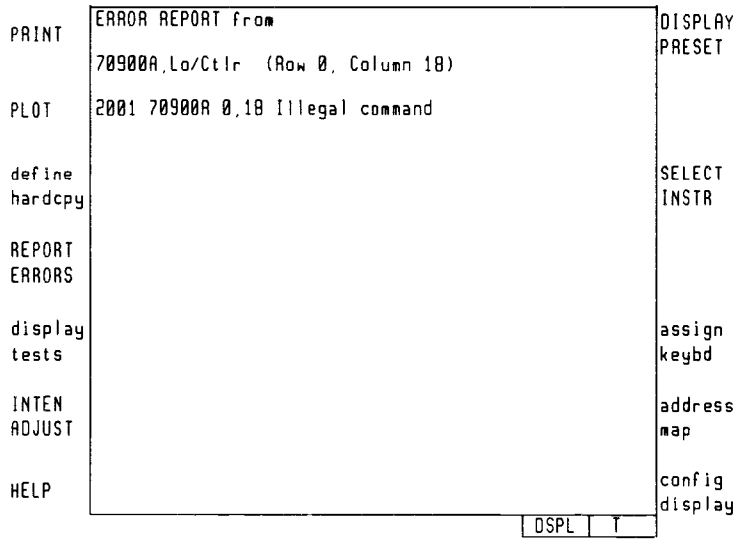


Figure 2-63. Clearing Multi-Instrument Errors

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Note

Some transient errors can be cleared by pressing (USER), (MENU), or by pressing (DISPLAY) and REPORT ERRORS.

Display Tests

The **display tests** key gives the user access to a menu of keys that provide operational tests of HP 70205A or HP 70206A displays themselves, their internal operation, and the keypad and knob.

Figure 2-64 shows the key submenu that appears when **display tests** is pressed.

See the following pages for a description of each **display tests** subkey and its operation.

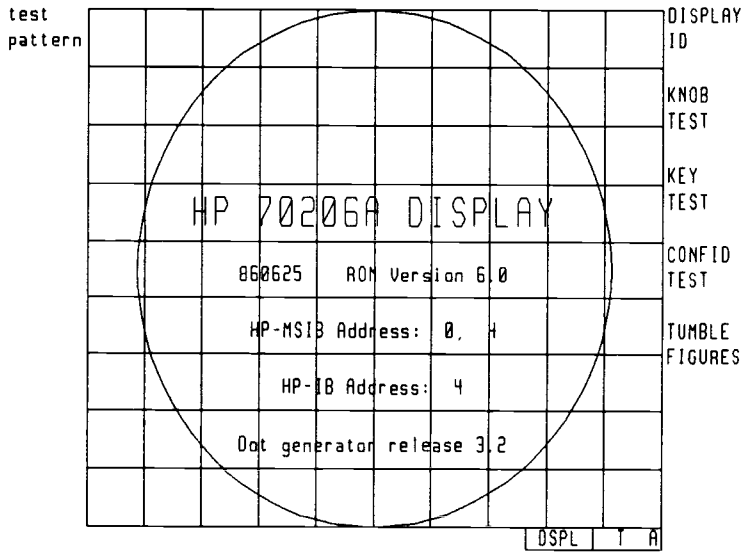


Figure 2-64. Display Tests Menu

Display Id

The **DISPLAY ID** key brings up an identification screen similar to the figure above. This provides:

- Basic verification of display operation.
- Display model number (for example, the HP 70205A).
- ROM firmware version of the display.
- HP-MSIB address (row, column) of the display.
- HP-IB address of display.
- Dot Generator Release code (for example, 3.1). (This is provided for firmware updating purposes.)

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Note This display screen does not provide the ROM version of other modules. For that information, see the appropriate section of the operating instructions for that module. For instance, the local oscillator's ROM version is available by pressing (MENU), **CONFIG**, and **ROM VERSION**.

Note Both displays can only have a row address of zero. The default address is row 0, column 4 (0,4).

Note The HP-IB address does not necessarily correspond to the HP-MSIB column address. To change the address of any HP-IB enabled module, see the operating instructions in this chapter for the **SET HP-IB** key, which is available under **address map**.

Knob Test

The **KNOB TEST** key brings up a test pattern similar to the one shown in Figure 2-65.

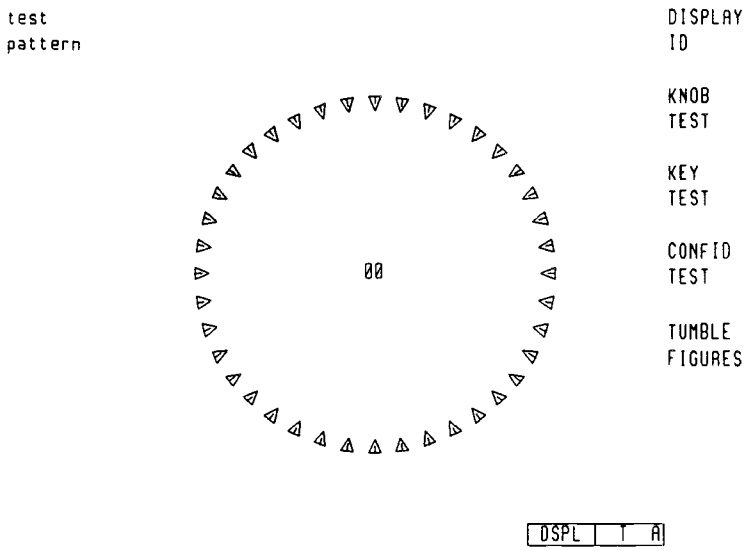


Figure 2-65. Knob Test

As the knob is turned, the test pattern rotates. This provides a test of the mechanical and electrical operation of the display knob. Note that the step keys will rotate the pattern but the numeric entry keypad will not.

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Key Test

The **KEY TEST** key allows the user to check the mechanical and electrical operation of every front-panel key on the display.

EXAMPLE: Use **KEY TEST**.

1. Press (DISPLAY).
2. Press **display tests**.
3. Press **KEY TEST**.
4. Press any key on the display's front panel and it will be echoed on the screen if it is working properly.
5. Press the (←) (back space) key to exit this function.

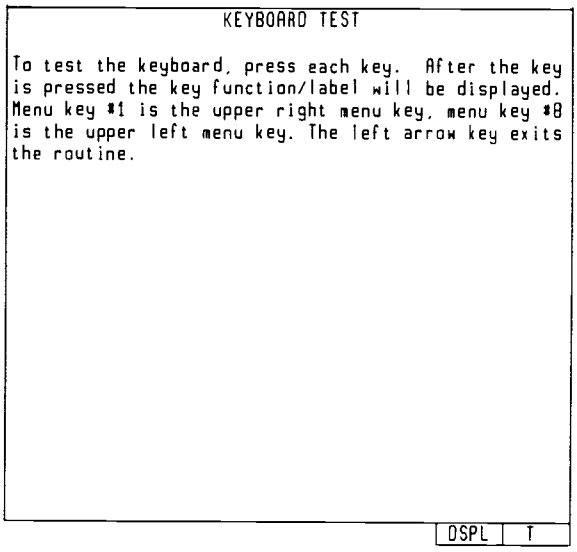


Figure 2-66. Key Test

Confidence Test

The display Confidence Test, initiated by pressing the **CONFID TEST** key, checks the operation of roughly 90% of the display unit. If no fault is found, **6001 confidence test passed** appears in the lower-left corner of the screen. If a fault is found, **6008 confidence test failed** is shown. In either case, the character set remains on the display.

If an error is detected, refer to the Installation and Verification Manual for your instrument.

Note

In display ROM Version 5.0 the character set is not left on the screen after the confidence test.

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Tumble Figures

`TUMBLE FIGURES` provides a menu of several keys that show rotating three-dimensional figures: `BALL`, `CUBE`, `HALF`, `ROD`, and `SLAB`.

- To change the size of the figures, turn the display knob.
- To change the speed of rotation about the three spatial axes, press three consecutive numeric keys; for example, press "999" for rapid rotation and "000" to halt rotation.
- To exit this function, press the (←) (back space) key.

Test Pattern

The key `test pattern` produces five test patterns used in screen alignment procedures. They are selected by pressing (DISPLAY), `display tests`, `test pattern`, entering a number 1 to 5 on the keypad, then pressing `ENTER`.

Note

In display ROM Version 5.0 there were four test patterns, with a key for each pattern (for example, PATTERN 1).

Intensity Adjust

`INTEN ADJUST` allows the user to change the intensity amplitude of the picture on the screen. Intensity is incrementally adjustable from 0 to 19 in steps of 1.

Note

Zero is not necessarily fully off.

When a display is turned on, it will use the most recent intensity adjustment unless it was set to less than 9. In this case the intensity will default to 9.

Help

The `HELP` key under (DISPLAY) provides two pages of information about the operation of the other top-level keys directly accessible under (DISPLAY). See Figure 2-67 for the first of the two pages. Press `MORE` for the second page.

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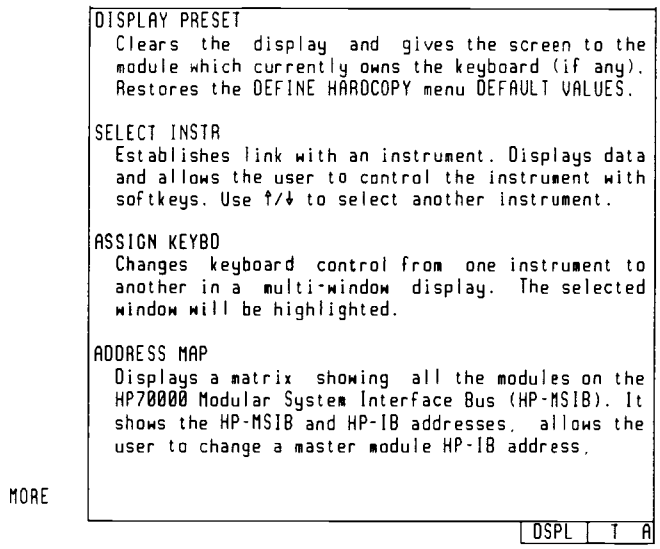


Figure 2-67. Display Help, Page #1

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CHAPTER 3
REMOTE DISPLAY OPERATION

This chapter discusses the remote operation of the HP 70205A Graphics Display and the HP 70206A System Graphics Display by remote computer control over HP-IB.

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INTRODUCTION

Chapter 3 covers remote operation of the HP 70000 series displays. For general information on the two display models, see Chapter 1, Introduction, in this part of the Operating Manual. For instructions on manual operation see Chapter 2, DSP Hardkey (Manual Display Operation). All capabilities and commands covered in this chapter are accessible with a computing controller over HP-IB. From the point of view of remote operation, both displays (HP 70205A and HP 70206A) are essentially identical. Any differences will be described in the text.

This chapter discusses different capabilities of the display accessed through remote operation. Capabilities are accessed by one or more two-letter commands, some of which require alphanumeric parameters: e.g. "PD" (Pen Down), or "RC 4" (Recall Screen Configuration from Register #4). The complete set of these commands comprises the HP 70000 Series Graphics Language, which contains some commands from HP-GL, the Hewlett-Packard Graphics Language. HP-GL commands are identified as such in the Graphics Command Listing later in this chapter.

NOTE

Programming techniques for the HP 71000 Series spectrum analyzers are discussed in Part II, Remote Operation. The second chapter of Part II, Programming Fundamentals, contains instructions for imitating manual operation. Chapter 3, Advanced Programming, describes techniques for making computations, measurements, and graphics.

Below is a list of the sections found in this chapter (Chapter 3, of Part III) and a brief description of each:

1. **Display Configuration**: Discusses remote techniques for building and assigning windows on the screen, saving and recalling screen configurations, and interrogating the display about its present configuration. For a more detailed description of the windowing concepts, see Chapters 1 and 2 in this part of the Operating Manual.

2. **Simple Graphics**: Shows how to use the screen of the display like a plotter. Covers pen control, line-type selection, plotting, graphing, scaling of the screen or window, and drawing of axes and graticules. (HP-GL type commands)

3. **Labeling the Screen**: Demonstrates the labeling of any type of display and the manipulation of the label, including rotation, relocation, enhancement, and enlargement.

4. **Hardcopy Output**: Shows how to obtain hardcopy output of the display screen with an external device such as an HP 7470A or 7075A Plotter, or an HP 2225A Thinkjet Printer. Covers the initiation of an output operation, selection of the output device on HP-IB, and the option of including the softkey labels in the output.

5. **Markers**: Demonstrates the selection and placement of a character on the screen as a marker, either for annotation or prompting.

6. **Character Sets**: Covers the use of either the standard character set or a set of the user's creation. This capability can be used to create one or more customized characters such as special markers or logos.

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7. **Referenced Graphics:** Discusses the concept and use of a new graphics capability called Referenced Graphics. With this capability, items on the screen such as axes, figures, and labels can be logically grouped together and manipulated as a single entity. The group as a whole can, for example, be moved, turned on or off, deleted, or made to blink.

8. **Informational Displays:** Discusses some of the informational screens that can be displayed, such as the Address Map, the Screen Configuration, and the Error Screen. See Chapter 2 for a further explanation of these features from the point of view of manual operation.

9. **Error Handling:** Discusses how the display can be used by a computer to report errors over HP-IB or on the screen for direct operator viewing. Modules in the HP 70000 system on HP-MSIB row 0 report all detected errors to the display.

10. **Utility Commands:** Contains examples, descriptions, and demonstrations of other capabilities of the HP 70000 Series Displays. These include direct and system-wide features such as Page Clearing, Learn Strings, and Beeping.

11. **Remotely-Controlled Display:** This section shows how softkey labels can be loaded in a computer window, how alphanumeric entries can be received, and how user operation can be simulated, all by remote control.

NOTE

This document uses brackets [XXX] to represent hardkeys and *XXX* to represent softkeys. It uses the HP 9000 Series 200/300 BASIC Language in all examples.

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HP-IB ADDRESS

The Display is accessed remotely over HP-IB at its own address, separate from that of any instrument in the HP 70000 system. See the Address Map section in Chapter 2 for more general information on HP-IB and the display.

To find the HP-IB address of the display, press the following keys: **[LCL]**, **[DSP]**, and *address map*.

Turn the knob until an "A" appears in the Status Box as shown in figure 1.

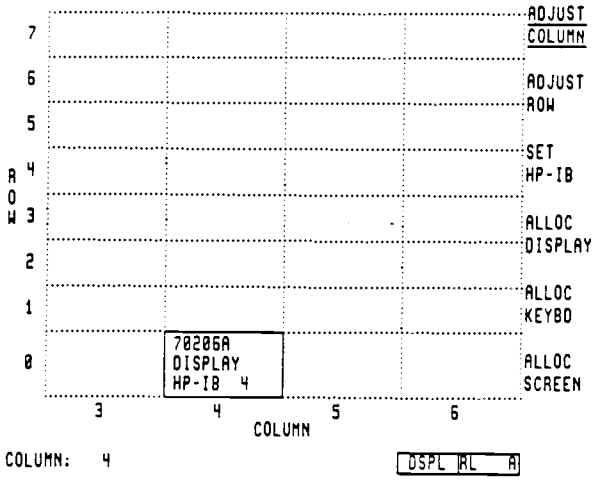


Fig 1. Address Map

This display shows an HP-IB address of 4.

The HP-IB address (also known as the device selector code) is formed by combining the HP-IB interface select code (7) from the computer with the Display HP-IB address (4 in this case) yielding 704. The display's factory-shipped HP-IB address in the example, 704, will be used throughout this chapter. If the HP-IB address of your display is different, substitute the appropriate value.

NOTE

The HP-IB Address can be determined only through manual operation.

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Section 1: DISPLAY CONFIGURATION

The resources of the display can be configured either manually or remotely by the user to meet various testing needs. These resources and capabilities are discussed in general in Chapter 2, DSP Hardkey (Manual Operation of Display), under the *config display* softkey description. In brief, the resources of the display include one keyboard and up to four separate windows (numbered 1-4) on the screen. Any window can be assigned to any instrument on HP-MSIB or to a controller on HP-IB. The keyboard is typically associated with one window, although it can be independent. A fifth window, which does not appear in the *SHOW CONFIG* screen, is automatically assigned to HP-IB unless one of the windows, one to four, is already assigned to HP-IB.

The HP 70000 Series Graphics Language commands that pertain to Display Configuration are listed and described below and demonstrated in the following example. Some command descriptions assume prior definition of other commands or concepts. These other commands are described elsewhere in this chapter (see the Display Command Summary in Chapter 4 for the location) and general concepts of display operation are covered in Chapters 1 and 2.

Assign Keyboard: AK window #

The AK command allows the controller to allocate the keyboard of the display to one of the four existing windows. If an instrument such as a modular spectrum analyzer is writing to that window, the keyboard can be used to control instrument settings such as Center Frequency and Span.

window # = 1 through 4

Build Window: BW Window#, X1,Y1,X2,Y2, Bus, Row, Col, Keyboard Control

BW constructs a window on the screen, assigns the window to an HP-MSIB element or to HP-IB, and determines whether the keyboard is similarly assigned or not.

Window # = 1 through 4

X1,Y1 X2,Y2: coordinates of window vertices. The smallest window allowed is 100 high by 200 wide (this appears square due to the extra horizontal resolution of the display).

Bus = 0: HP-IB (Window to be used by HP-IB controller)
Bus = 1: HP-MSIB (Window assigned to modular instrument)

Row, Col: HP-MSIB address of controlling module if window is assigned to one. These two parameters are ignored if window is used for HP-IB.

Keyboard Control = 0: Keyboard control unaffected, keyboard not necessarily associated with window.
Keyboard Control = 1: Keyboard linked with window, and can be used to control the modular instrument the window is assigned to.

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Select Instrument: CI address #

CI establishes a link with an instrument. It displays data and allows the user to control the instrument with softkeys. The CI command accepts a parameter from 0 to 30 or none. It invokes a SELECT INSTRUMENT starting at that address. If a parameter is not sent, the current address plus 1 (0 if the current address is 30) is used. If there is no current address, the search starts at 0.

Address # = 0 through 30

NOTE

While the CI is proceeding, no other HP-IB traffic should take place. The computer should wait until a module is found to proceed. A sample program which does this is:

```
10 Dsp=704
20 OUTPUT Dsp;"CI;";
30 REPEAT
40 UNTIL BIT (SPOLL(Dsp),4)
50 END
```

Note that CI resets all HP-IB parameters and assigns the entire screen to the module it finds.

Delete Entire Screen: DE (no parameters sent)

DE clears the entire screen of all writing, softkeys, windows, and keyboard assignments. All displayed data and current configuration information is lost. DE is useful for clearing the display before building windows.

Default Values: DF (no parameters sent)

DF sets certain display parameters to their default values. These parameters and their values are shown below. If the sender (either an HP 70900A LO Control Module or an HP-IB controller) does not have a window assigned, only the Input Mask value, the character sets, the label terminator, and preprocess mode are reset.

HP-GL Parameters: Line Type—Solid Line; Pen 1; Pen Up; Delta X=1; Standard character size; Standard and alternate character sets both 0; Input Mask (IM)=255,32,0. Label terminator: CHR$(3); Character rotation and lettering direction: normal.

Non-HP-GL Parameters: Group 0; Item 0; Blink Off; View On; Mapping Method (MP) Anisotropic. Preprocess mode: off.

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Initialize: IN (no parameters sent)

IN sets the Display to an initial power-on state. It clears data from the windows and sets default values as described by the DF command. IN does not alter window configuration, or clear errors. It does clear SRQ and the serial poll status byte.

Output P1,P2: OP (no parameters required, but response sent by display)

OP interrogates the display for the vertices, in display units, of the window that is currently assigned to HP-IB. The display responds over HP-IB with the values of X1, Y1, X2, and Y2, respectively. See the example in this section and the description of windowing in Chapter 2 under *config display*.

Output Graphics Link: OG (no parameters required, but response sent by display)

OG causes the display to output the row and column of the first module in the memory of the display which owns a window. The output consists of two integers separated by a comma. Both are −1 if no module has a window.

Recall Screen Configuration: RC register #

RC recalls the screen configuration (window sizes and assignment, and keyboard assignment) from the specified register (1 − 4). Operates similarly to the *RECALL CONFIG* softkey described in Chapter 2.

Show Configuration: SN register #

SN shows a summary of the display screen stored in registers 1 − 4, or in the current configuration (with register number = 0). A value of −1 exits the mode. SN works similarly to the *SHOW CONFIG* softkey described in Chapter 2.

NOTE

The configuration summary will remain on the screen until cleared by sending SN without an argument or by sending "SN −1."

Save Configuration: SV register #

SV saves the current screen configuration in one of four registers (1 − 4). SV works similarly to the *SAVE CONFIG* softkey described in Chapter 2.

Example: Building a Window and Finding P1,P2

Type in and run the following demonstration program on an HP-IB computing controller.

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NOTE

This example, like most others in this chapter, uses the HP BASIC language and assumes an HP-IB address of 704 for the Display and 718 for an HP 71000 series Modular Spectrum Analyzer (HP-MSIB address 0,18 for the Local Oscillator/Control Module).

```
10  REMOTE 7
20  ASSIGN @Dsp TO 704
                (DISPLAY'S HP-IB ADDRESS)
30  ASSIGN @Sa TO 718
                (ANALYZER'S HP-IB ADDRESS)
40  OUTPUT @Dsp;"DE;"
                (CLEAR THE SCREEN)
50  OUTPUT @Dsp;"BW 1,112,16,911,195,0,0,0,1;"
                (BUILD WINDOW #1 IN BOTTOM HALF OF SCREEN,
                 ASSIGN TO HP-IB)
60  OUTPUT @Dsp;"OP;"
                (INTERROGATE FOR X1,Y1,X2,Y2)
70  ENTER @Dsp;X1,Y1,X2,Y2
                (RECEIVE COORDINATES)
80  DISP X1,Y1,X2,Y2
                (CONTROLLER SHOWS 112,16,911,195)
90  PAUSE
                (PRESS "CONTINUE" ON CONTROLLER)
100 OUTPUT @Dsp;"SN0;"
                (SHOW CURRENT CONFIGURATION ON SCREEN)
110 PAUSE
                (PRESS "CONTINUE" ON CONTROLLER)
120 OUTPUT @Dsp;"SN;"
                (CLEAR SCREEN OF CONFIGURATION SUMMARY)
130 OUTPUT @Dsp;"BW2,112,205,911,383,1,0,18,1;"
                (BUILD WINDOW #2 IN TOP HALF OF SCREEN,
                 ASSIGN TO ANALYZER AT HP-MSIB ADDRESS 0,18
                 WITH KEYBOARD)
140 OUTPUT @Sa;"IP;TS;"
                (PRESET INSTRUMENT, TAKE SWEEP.
                 TRACE DATA WILL BE DISPLAYED IN WINDOW)
150 PAUSE
                (PRESS "CONTINUE" ON CONTROLLER)
160 OUTPUT @Dsp;"SN0;"
                (SHOW NEW SCREEN CONFIGURATION)
170 END
```


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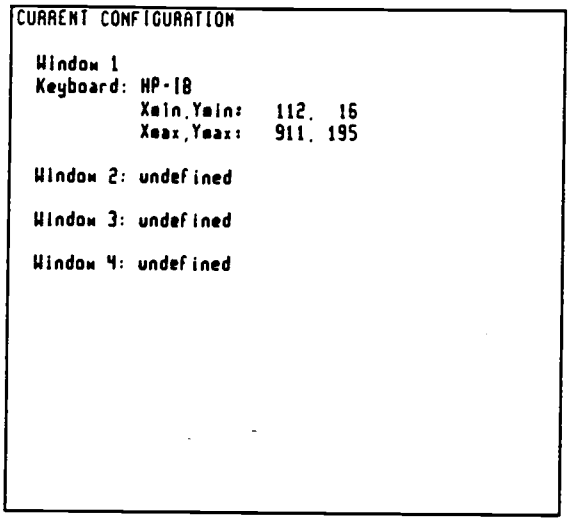


Fig. 2. Result of SN0

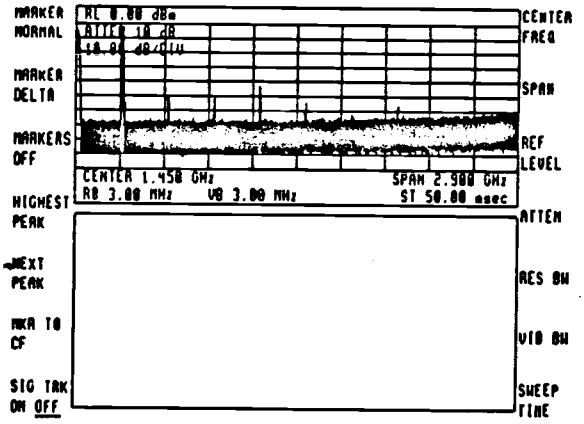


Fig. 3. Two-window screen.

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Section 2: SIMPLE GRAPHICS

The HP 70000 Series Displays can be used like an HP-GL plotter by a remote controller. The user can:

- Draw simple figures on the screen using various line types.
- Plot points by their X,Y coordinates.
- Graph sequential values such as those from an array.
- Change the shape and scale of drawings.
- Draw graticules or axes with a single command.
- Initialize the window to a preset condition.

This section is divided into the following subsections that deal with various simple graphics capabilities:

Pen Control: Covers commands PD (Pen Down), PU (Pen Up), SP (Select Pen), and LT (Line Type).

Plotting: Covers commands PA (Plot Absolute) and PR (Plot Relative).

Graphing: Covers commands GA (Graph Absolute), GR (Graph Relative), and DX (Set Delta – X).

Scaling and Shape: Covers commands SC (Scale to user units) and MP (Mapping Shape).

Axes and Graticules: Covers commands AX (Create Axis) and GT (Create Graticule).

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PEN CONTROL

Although the actual lines on the display screen are "drawn" by an electron beam, the term "pen" is used for graphics in two separate contexts. First, terms like "Pen Up" and "Pen Down" mean "draw with beam off" or "draw with beam on". Second, the "Select Pen" command (SP), while not affecting the lines drawn on the screen, indicates which of a plotter's ink pens is to be used for drawing, in anticipation of display-to-plotter output operations.

The pen control commands are described below and shown in the example.

Pen Up: PU (no parameters needed)

Suspends line drawing regardless of pen movement until the PD command is sent or the pen status is otherwise reset. The pen can move around but lines will not be drawn.

Pen Down: PD (no parameters needed)

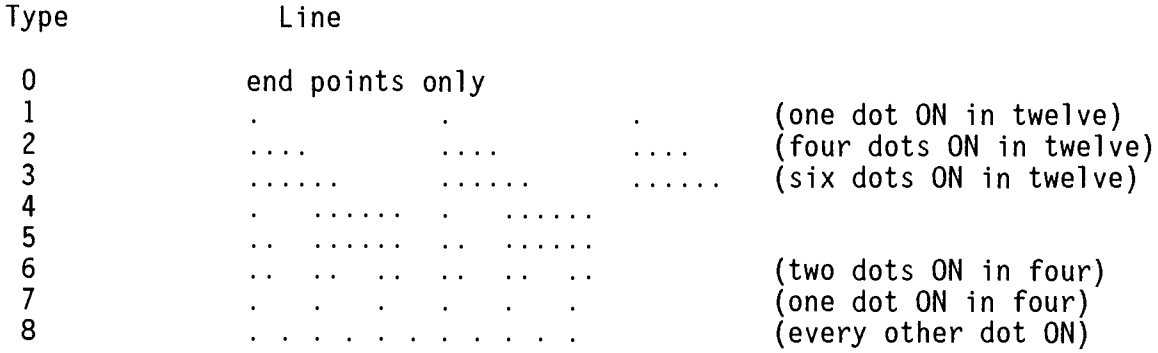
Restarts the line drawing following a PU command. In non-referenced graphics, this must be done before any lines will be seen (the pen starts UP).

Select Pen: SP pen #

On a monochromatic display such as the HP 70205A or HP 70206A Graphics Displays, SP affects operation only when the display performs a plotter output operation. The actual pen selected will depend on the plotter used. "Pen #" can range from 0 to 255, with 0 as the default value.

Line Type: LT type

LT selects the type of line used for on-screen graphics. The line types are shown below. Note that some plotters may not support all line types so they may appear different when dumped to a plotter. The line-type default is a solid line.



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NOTE

Because the display "stretches" each dot horizontally to take up two dot positions , line type 8 appears solid for horizontal lines. This phenomenon also affects the other line types to some degree.

A second parameter "length" is ignored if sent, but is included for HP-GL compatiblity. The LT command allows the user to create any desired line type within a 12-dot template. These are formed by passing a "type" parameter, other than 0-8. The display will take the bottom 12 bits of the parameter and repeat them over and over as the line type.

Example

"Type" Parameter = 2048 (In binary is 100000000000, so line type will be one dot on in every 12, same as type 1.)

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PLOTTING

Plotting can be thought of as moving a pen from its present position to another specified position. If the pen was down before the plot operation, a line will be drawn from the starting point to an endpoint specified in the PA or PR command. If the pen is up, no line will be drawn, but the pen will be located at the new endpoint. When a window is intialized the pen starts at coordinates X=0, Y=0, the lower-left corner of the screen. Scaling operations, described later in this chapter, do not move the pen.

NOTE

A controller writing on the screen over HP-IB may plot anywhere on the screen, and is not necessarily restricted by window size.

Plot Absolute: PA X1, Y1, ... Xn, Yn

The PA command moves the pen to a specific point on the screen, specified in the current user units (see SC command description later in this chapter), then moves it to the next specified point, and so on until it runs out of X, Y pairs.

The screen is considered to be a grid of points, any of which can be the endpoint of a PA command. Each point has an X and Y value. In the standard display units, the lower left corner of the display screen has coordinates X = 0, Y = 0, and the upper right corner has coordinates X = 1023, Y = 383. The screen can also be scaled to set the corner points to any chosen X, Y.

Example: Using the PA command to draw a box.

Execute the following program from an HP-IB controller:

```
10  ASSIGN @Dsp TO 704
                (DISPLAY'S HP-IB ADDRESS)
20  CLEAR @Dsp
30  OUTPUT @Dsp;"IN;"
40  OUTPUT @Dsp;"DE;"
                (CLEAR THE SCREEN)
50  OUTPUT @Dsp;"SC;"
                (SELECT DEFAULT DISPLAY UNITS,i.e.1023x383 UNITS)
60  OUTPUT @Dsp;"PU;PA 100,100;"
                (MOVE PEN TO LOWER LEFT CORNER)
70  OUTPUT @Dsp;"PD;"
                (PREPARE TO DRAW A BOX)
80  OUTPUT @Dsp;"PA 900,100,900,300;"
                (PLOT BOTTOM AND RIGHT SIDES OF BOX)
90  OUTPUT @Dsp;"PA 100,300,100,100;"
                (PLOT TOP AND LEFT SIDES)
```


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```
100 OUTPUT @Dsp;"PA 500,200;"
                (DRAW LINE TO CENTER OF BOX)
110 OUTPUT @Dsp;"PU;PA 700,250;PD;PA 900,300;"
                (DRAW BROKEN LINE TO TOP RIGHT CORNER OF BOX)
120 END
```

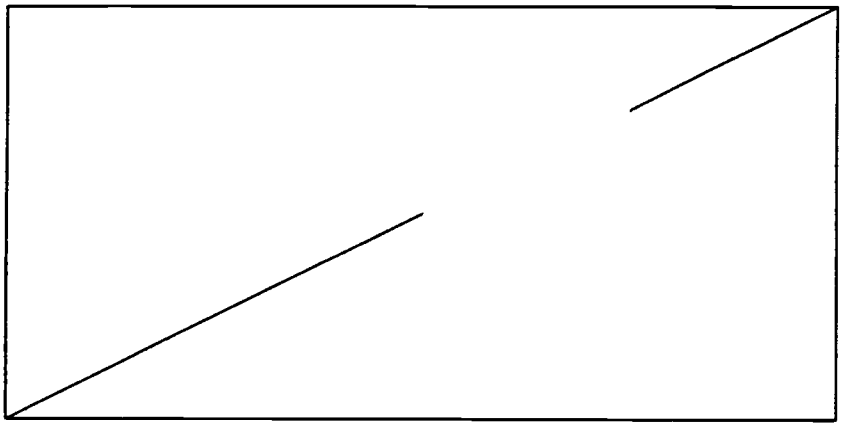


Fig. 4. Result of PA example program.

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Plot Relative: PR Xincrement1, Yincrement1...Xincrementn,Yincrementn

The Plot Relative command moves the pen Xincrement units to the right and Yincrement units up from its starting position. The currently defined user units are used. See the following example for a demonstration.

Example: Relative Plotting

```
10  ASSIGN @Dsp TO 704
                (DISPLAY'S HP-IB ADDRESS)
20  CLEAR @Dsp
30  OUTPUT @Dsp;"IN;"
                (INITIALIZE DISPLAY)
40  OUTPUT @Dsp;"DE;"
                (CLEAR THE SCREEN)
50  OUTPUT @Dsp;"SC;"
                (SELECT DEFAULT DISPLAY UNITS,
                 i.e.1023x383 UNITS)
60  OUTPUT @Dsp;"PU;PA 0,0;"
                (MOVE PEN TO LOWER LEFT CORNER)
70  OUTPUT @Dsp;"PD;"
                (PREPARE TO DRAW A LINE)
80  OUTPUT @Dsp;"PA 500,200;"
                (MOVE PEN TO APPROX CENTER OF SCREEN)
90  OUTPUT @Dsp;"PR 100,0;"
                (PR  DRAWS A LINE 100 UNITS TO THE RIGHT)
100 OUTPUT @Dsp;"PD;PA 100,0;"
                (NOTE HOW PA COMMAND OPERATES WITH THE SAME
                 COORDINATES AS PR ABOVE)
110 END
```

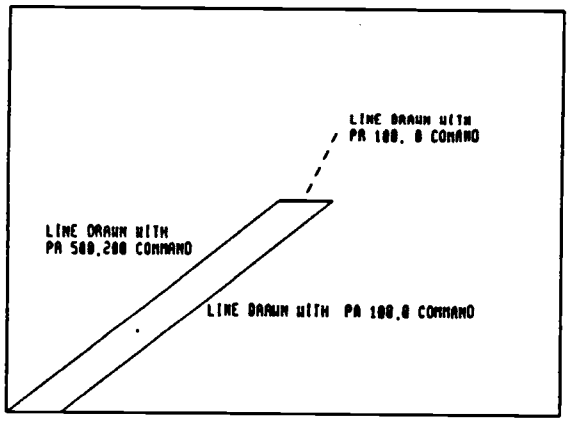


Fig. 5 Relative Plotting

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GRAPHING

Graphing differs from plotting in that only one parameter is specified, namely, the ordinate or y-value, and that graphing is usually faster. The x-value (abscissa) is adjusted automatically by the display according to the DX (Set Delta-X) command.

Graph Absolute: GA Y1, Y2, . . . Yn

GA moves the pen to a new point on the screen. The X-coordinate of that point will be the present X-coordinate plus the value set by the DX command. The Y-coordinate of that point will be the Y value. Consecutive Y values can be used with a single GA command.

Set Delta-X: DX Xincrement

The DX command is used for graphing with the GA and GR commands. Each time the GA or GR command is sent, or with each successive Y value, the X-coordinate of the pen is adjusted by Xincrement units. The DX command operates with whatever units (user or display) are presently being used. See the following example.

Example: Graphing Array Contents

```
10  DIM Array(2000)
20  ASSIGN @Dsp TO 704
                (DISPLAY'S HP-IB ADDRESS)
30  CLEAR @Dsp
40  OUTPUT @Dsp;"DE;IN;"
                (CLEAR SCREEN AND INITIALIZE DISPLAY)
50  DEG
60  FOR I=0 TO 1023
70    Array(I)=200+100*SIN(4*I)
                (FILL ARRAY TO GRAPH LATER)
80  NEXT I
90  OUTPUT @Dsp;"SC;"
                (SELECT DEFAULT DISPLAY UNITS,i.e.1023x383 UNITS)
100 OUTPUT @Dsp;"PU;PA 0,0;"
                (MOVE PEN TO LOWER LEFT CORNER)
110 OUTPUT @Dsp;"PD;"
                (PREPARE TO GRAPH ARRAY CONTENTS)
120 OUTPUT @Dsp;"DX1;"
                (SET Xincrement TO 1)
130 FOR J=0 TO 511
140   OUTPUT @Dsp;"GA";ARRAY(J);";"
                (GRAPH ARRAY CONTENTS)
150 NEXT J
```


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```
160 OUTPUT @Dsp;"DX2;"
                (EXPAND THE GRAPH HORIZONTALLY)
170 FOR K=512 TO 768
180    OUTPUT @Dsp;"GA";Array(K);";"
                (PLOT THE EXPANDED PORTION)
190 NEXT K
200 END
```

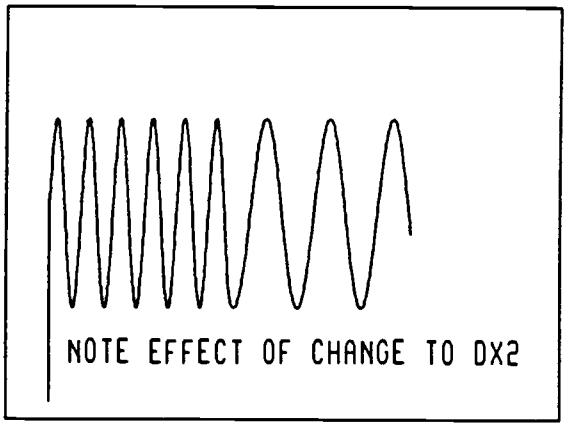


Fig 6.

Graph Relative: GR Yincrement1 . . . Yincrementn

GR uses one or several parameters to successively move the pen up or down from its present position. Yincrement is the number of units, positive or negative, that the pen will be moved vertically. The DX command sets the number of units the X coordinate will be incremented.

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SCALING

Any individual window on the screen can be given arbitrary dimensions for the convenience of the user. There are two kinds of units (dimensions) used: display units and user units.

Display units are the individual physical locations that can be addressed by the display. The display screen is 1024 units wide (x = 0 to 1023) and 384 units high (Y = 0 to 383), as discussed in the *build window* softkey description in Chapter 2. Display units can be specified at any time by sending the SC command with no parameter; e.g., OUTPUT 704;"SC;".

User units are specified by the user with the SC command. These units pertain to the currently active window only, and will not affect graphics operations in other windows, even those on the same screen.

Scale to User Units: SC Xmin, Xmax, Ymin, Ymax

The SC command is used to give the window dimensions that are useful from the user's point of view. Regardless of the physical size of the window, it will subsequently have a "width" in user units of Xmax minus Xmin and a "height" of Ymax minus Ymin. Any parameters can be negative, as long as Xmax is greater than Xmin and Ymax is greater than Ymin. See the following example.

NOTE

If no window is currently being used, the SC command will apply to the entire screen

Example: Scaling to User Units (SC command).

```
10  ASSIGN @Dsp TO 704
                (DISPLAY'S HP-IB ADDRESS)
20  CLEAR @Dsp
30  OUTPUT @Dsp;"DE;IN;"
                (CLEAR THE SCREEN, INITIALIZE WINDOW)
40  OUTPUT @Dsp;"BW 1,112,16,911,383,0,0,0,1;"
                (BUILD HP-IB WINDOW)
50  OUTPUT @Dsp;"SC;"
                (USE STANDARD DISPLAY UNITS FIRST)
60  OUTPUT @Dsp;"PU;PA 0,0;PD;PA 1023,0, 1023,383, 0,383, 0,0;"
                (FRAME THE WHOLE SCREEN IN DISPLAY UNITS)
70  I=0
80  Loop:  I=I+1
90  OUTPUT @Dsp;"PU;PA 112,16;PD;PA 911,16, 911,383, 112,383, 112,16;"
                (FRAME THE STANDARD WINDOW
                 NOTE SPACE LEFT ON SCREEN FOR SOFTKEYS)
100 OUTPUT @Dsp;"SC 0,1000, 0,1000;"
                (SCALE THE WINDOW TO 1000 BY 1000)
110 IF I=1 THEN GOTO Loop
                (GO BACK AND FRAME THE AREA WITH VERTICES P1,P2
                 OF 112,16 AND 911,383 IN THE NEW USER UNITS)
```


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```
120 OUTPUT @Dsp;"PU;PA0,0;PD;PA1000,1000;"
                (SHOW THE "1000 BY 1000" WINDOW BY DRAWING
                 DIAGONAL LINE)
130 END
```

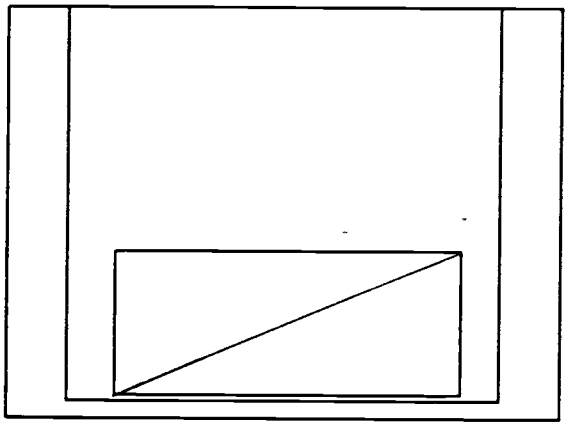


Fig. 7

Mapping Shape: MP shape

The MP command determines whether the shape of squares drawn in the active window will be square or rectangular.

Shape = 0: Squares take on aspect ratio of window
Shape = 1: Square are square shaped

See the following example.

Example: Using Mapping Shape (MP command).

```
10  ASSIGN @Dsp TO 704
                (DISPLAY'S HP-IB ADDRESS)
20  CLEAR @Dsp
30  OUTPUT @Dsp;"DE;IN;"
                (CLEAR THE SCREEN, INITIALIZE)
40  OUTPUT @Dsp;"BW 1,112,16,911,383,0,0,0,1;"
                (BUILD HP-IB WINDOW)
50  OUTPUT @Dsp;"SC 0,1000, 0,1000;"
                (SCALE THE WINDOW TO 1000 BY 1000)
60  OUTPUT @Dsp;"PU;PA0,0;PD;PA1000,0, 1000,1000, 0,1000, 0,0;"
                (FRAME WINDOW)
70  OUTPUT @Dsp;"MP0;"
                (DEFAULT MAPPING SHAPE, i.e. oblong)
80  OUTPUT @Dsp;"GP1;IT1;OR 0,0;GT 100,100,4,4;"
                (DRAW RECTANGULAR GRATICULE)
90  OUTPUT @Dsp;"MP1;"
```


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```
                (OTHER MAPPING SHAPE, i.e. square)
100 OUTPUT @Dsp;"IT2;OR 0,500;GT 100,100,4,4;"
                (DRAW SQUARE GRATICULE)
110 END
```

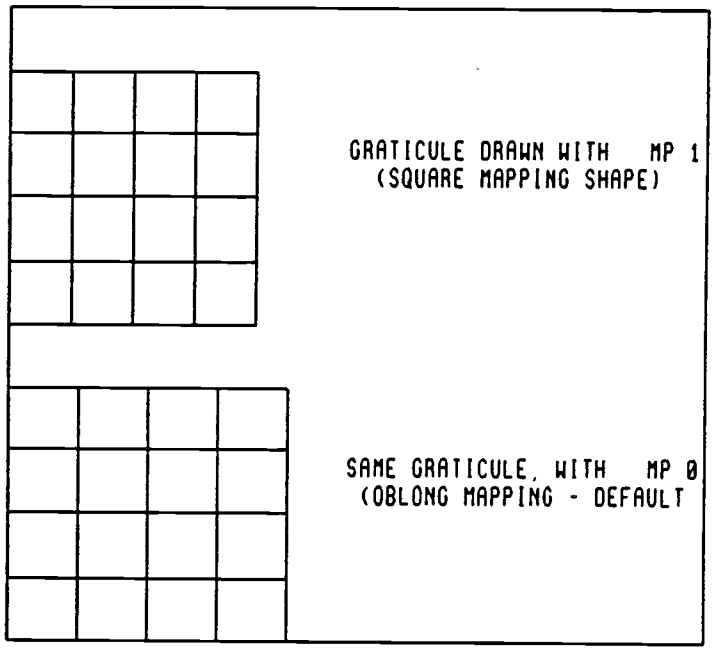


Fig. 8.

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AXES AND GRATICULES

Axes or graticules can be drawn with a single command. For usage see the example below. For annotation of axes, see the section in this chapter titled "Labeling the Screen."

AX Xlength, Ylength, Xint, Yint, Xtic, Ytic, Xmaj, Ymaj, Tsize. The Axis command draws a set of axes on the screen. All parameters are optional.

Xlength, Ylength: The length of each axis in current units. (Default 800,320)

Xint, Yint: The point on each axis that is intersected by the other axis Default = 0,0).

Xtic, Ytic: The distance, in current units, between minor tic marks on each axis. The default condition displays no tic marks.

Xmaj, Ymaj: The number of minor tic spaces between each major tic mark.

Tsize: The length of a major tic mark (Default 16). Minor tic marks are half as long. The tics on both axis are the same size even if the scaling factor in X and Y are different. The X scale factor is used to calculate their size.

NOTE

When using referenced graphics (see later section), the intersection of the two axes is the point that is "referenced."

Example: Drawing a set of axes.

```
10  ASSIGN @Dsp TO 704
                (DISPLAY'S HP-IB ADDRESS)
20  CLEAR @Dsp
30  OUTPUT @Dsp;"DE;IN;"
                (CLEAR THE SCREEN, INITIALIZE)
40  OUTPUT @Dsp;"BW 1,112,16,911,383,0,0,0.1;"
                (BUILD A WINDOW FOR HP-IB)
50  OUTPUT @Dsp;"SC 0,1000,0,1000;"
                (SCALE TO 1000 USER UNITS IN X AND Y)
60  OUTPUT @Dsp;"PD;"
70  OUTPUT @Dsp;"GP1;IT1;OR200,200;"
                (REFER TO REFERENCED GRAPHICS SECTION)
80  OUTPUT @Dsp;"AX1000,1000,200,200,10,10,2,2,20;"
                (DRAW AXIS)
90  END
```


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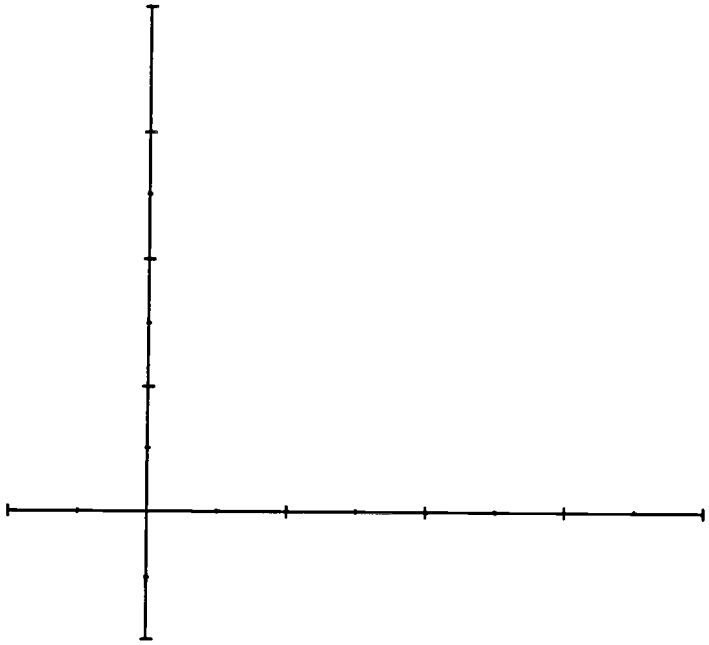


Fig. 9

Graticule: GT Boxwidth, Boxheight, #X boxes, #Y boxes

The GT command draws a graticule on the screen (see the following example). The point on a graticule referenced by the OR command (see Referenced Graphics section) is the lower left-hand corner of the graticule.

Boxwidth, Boxheight: The width and height of each box in current units.

#X boxes, #Y boxes: The number of boxes along each axis.

Example: Drawing a graticule.

```
10  ASSIGN @Dsp TO 704
20  CLEAR @Dsp
30  OUTPUT @Dsp;"DE;IN;"
40  OUTPUT @Dsp;"BW 1,112,16,911,383,0,0,0,1;"
                (BUILD A WINDOW FOR HP-IB)
50  OUTPUT @Dsp;"SC 0,1000,0,1000;"
                (SCALE TO 1000 USER UNITS IN X AND Y)
60  OUTPUT @Dsp;"PD;"
70  OUTPUT @Dsp;"GT100,100,10,10;"
                (DRAW GRATICULE, 10 BOXES BY 10 BOXES,
                 EACH BOX 100 UNITS SQUARE)
80  END
```


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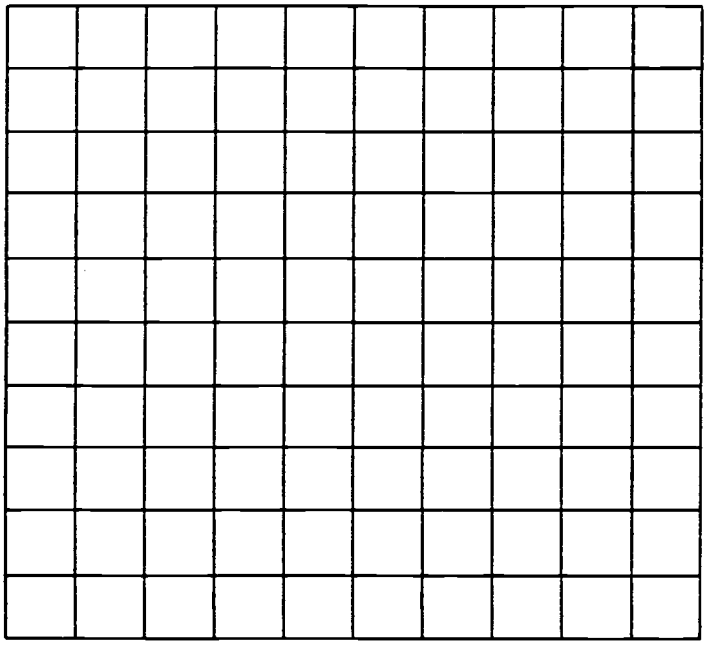


Fig. 10

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Section 3: LABELING THE SCREEN

The HP 70000 Series Displays have the capability to place text labels anywhere on the screen. Labels can be used by an HP 70000 series modular instrument (e.g., the local oscillator module of a spectrum analyzer) or by an HP-IB controller.

The example below uses Referenced Graphics. Although Referenced Graphics will be covered in a later section of this chapter, notice that labels can be used either in a referenced or non-referenced mode.

The location of a non-referenced label is determined by the location of the pen. To move the pen to a specified location prior to placing the label, use the Plot Absolute (PA) command. Use the Origin (OR) command to shift the location of a referenced label.

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MAKING A LABEL

Three commands are used to make a label. Configure Label (CL) defines the shape of the label (number of characters and lines), Define Terminator (DT) allows the user to define the end of a label, and Label (LB) actually places the label on the screen.

Configure Label: CL lines (24 max), characters, (68 max)

CL specifies the number of lines in the label ("lines") and the number of characters per line ("characters"). Default condition (when CL is sent with no parameters) is 1 line of 35 characters. No more than 68 characters will fit on any single line of the display.

NOTE

The CL command affects only those labels used in a referenced mode. Non-referenced labels can be written on multiple lines by sending the text in multiple OUTPUT statements, leaving out the semicolon, as in lines 140 through 160 of the following labeling example.

Define Terminator: DT Character

The DT command is used to define a character (any ASCII character) that will be used to signal the end of a label. A space cannot be sent between the DT and the Character.

Example: Correct = DT& Incorrect = DT &

The label terminator thus defined is used to terminate text in the LB, FC, and ML commands

Label: LB text <terminator>

The LB command causes the display to start placing text on the screen, according to the last CL command, until the label terminator character is received (See DT). A text string that is longer than the CL command allows will be scrolled off the display (see example).

NOTE

The defined terminator character must be sent at the end of each label. Anything received over HP-IB by the Display between the LB command and the defined terminator will be considered part of the label. See the example below for multi-line labels.

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Example: Making Labels.

```
10  ASSIGN @Dsp TO 704
20  CLEAR @Dsp
30  OUTPUT @Dsp;"DE;IN;"
40  OUTPUT @Dsp;"BW 1,112,16,911,383,0,0,0,1;"
                (BUILD STANDARD WINDOW #1)
50  OUTPUT @Dsp;"SC 0,1000,0,1000;"
                (SCALE TO 1000 USER UNITS IN X AND Y)
60  OUTPUT @Dsp;"DT#;"
                (DEFINE LABEL TERMINATOR TO BE #)
70  OUTPUT @Dsp;"PU;PA700,700;"
                (MOVE PEN TO TOP RIGHT QUADRANT)
80  OUTPUT @Dsp;"LBUNREFERENCED LABEL#;"
                (DRAW AN UNREFERENCED LABEL)
90  OUTPUT @Dsp;"GP1;IT1;CL2,10;"
                (CONFIGURE A REFERENCED LABEL)
100 OUTPUT @Dsp;"OR 100,700;"
                (SHIFT ORIGIN TO TOP LEFT QUADRANT)
110 OUTPUT @Dsp;"LBREFERENCED LABEL#;"
                (DRAW THE REFERENCED, CONFIGURED LABEL)
120 OUTPUT @Dsp;"GP1;IT2;CL3,10;"
                (CONFIGURE LABEL, 3 LINES OF 10 CHARACTERS)
130 OUTPUT @Dsp;"OR 100, 300;"
                (PLACE LABEL IN LOWER LEFT QUADRANT)
140 OUTPUT @Dsp;"LBLINE 1"
150 OUTPUT @Dsp;"LINE 2"
160 OUTPUT @Dsp;"LINE 3#;"
                (DRAW A MULTI-LINE LABEL BY SENDING THE
                 LINES SEPARATELY, AND ONLY USING THE TERMINATOR
                 CHARACTER AT THE END)
170 OUTPUT @Dsp;"GP1;IT3;CL2,5;"
                (CONFIGURE LABEL, 2 LINES OF 5 CHARACTERS)
180 OUTPUT @Dsp;"OR 700,300;"
                (PLACE LABEL IN LOWER RIGHT QUADRANT)
190 OUTPUT @Dsp;"LBTHIS LABEL IS BY FAR TOO LONG#;"
                (NOTE HOW LABEL GETS SCROLLED ACCORDING TO CL
                 COMMAND)
200 END
```


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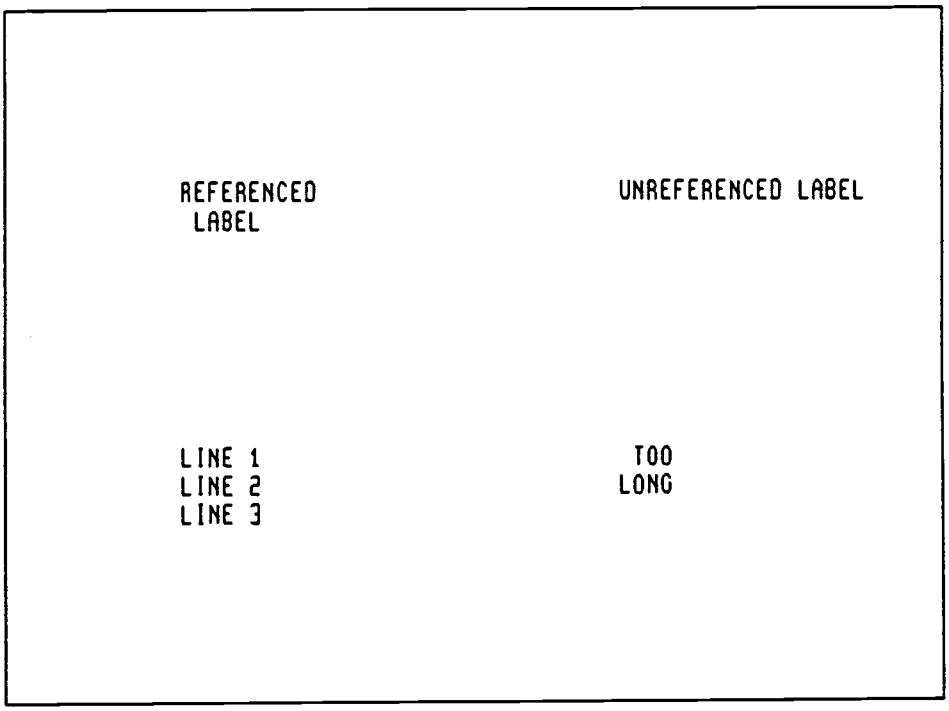


Fig. 11

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ENHANCING A LABEL

Labels, uniquely among figures on the display, can be enhanced by changing the size and angle of the characters that comprise them. Four commands are used to do this: DI (Set Character Direction Absolute), SI (Set Character Size Absolute), SR (Set Character Size Relative), DR (Set Character Direction Relative).

Set Character Direction Absolute: DI run, rise

The DI command specifies the direction of all text that appears until the direction is changed or reset, or until another referenced group or item is specified.

Set Character Direction Relative: DR run, rise

The DR command specifies the direction in which characters are lettered relative to width and length of a window. Run and rise are integers and specify a percentage of the algebraic distance between P1 and P2. P1 and P2 are the lower left and upper right vertex points of the window. Run is the desired percentage of P2x − P1x and the rise is the desired percentage of P2y − P1y. (See the DI command for lettering not affected by the choice of P1 or P2.) A DR command with a run parameter of 0 will produce vertical labeling.

Limits:

Run × (P2x − P1x)<32768
Rise × (P2y − P1y)<32768

Example:

```
Output@Dsp; "IN;IT1;DT#;OR 400,200;DR 10,10;LBTEST#;IT2;DT#;OR 400,100;DR 10,30;LBTEST#"
```

Set Character Size Absolute: SI width

The SI command sets the absolute size of characters used in labels. Width is in display units and specifies width of a cell. There are 16 discrete widths available, in multiples of 15 dots (15 is the smallest, 240 the largest).

Set Character Size Relative: SR percent

The SR command sets the size of the characters as a fixed percentage of the present window width so that character size remains proportional when P1 and P2 are changed. The same restrictions hold as for SI.

NOTE

The HP-GL commands SR and SI have another parameter for height, which the HP 70205A and HP 70206A will ignore.

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CHARACTER ENHANCEMENTS

The display supports character enhancements of underlining, blinking, and inverse video. These enhancements are enabled and disabled by sending an escape sequence and an enhancement character. The escape sequence is:

<ESC> & d <enhancement character>

FUNCTION	ENHANCEMENT						
	@	A	B	C	D	E	F	G
Enhance Character		X		X		X		X
Blinking			X	X			X	X
Inverse Video					X	X	X	X
Underline								
End Enhancements	X							

NOTE

These character engancements are ONLY available for referenced graphics (See Section 7 in this Chapter).

Example: Character Enhancement

```
10 Dsp = 704
20 OUTPUT Dsp;"IT 1;";
25 OUTPUT Dsp;"DT#;";
30 OUTPUT Dsp;"LB";CHR$(27);"&dB";
40 OUTPUT Dsp;"Inverse Video";
50 OUTPUT Dsp;"CHR$(27);"&d@#;";
60 END
```

This example shows how the size and direction of labels can be altered using the DI, SI, and SR commands. The window has been scaled to X = 0 to 1000, Y = 0 to 1000.

NOTE

Each of these enhancements, when used with referenced graphics, must be specified for each item individually.

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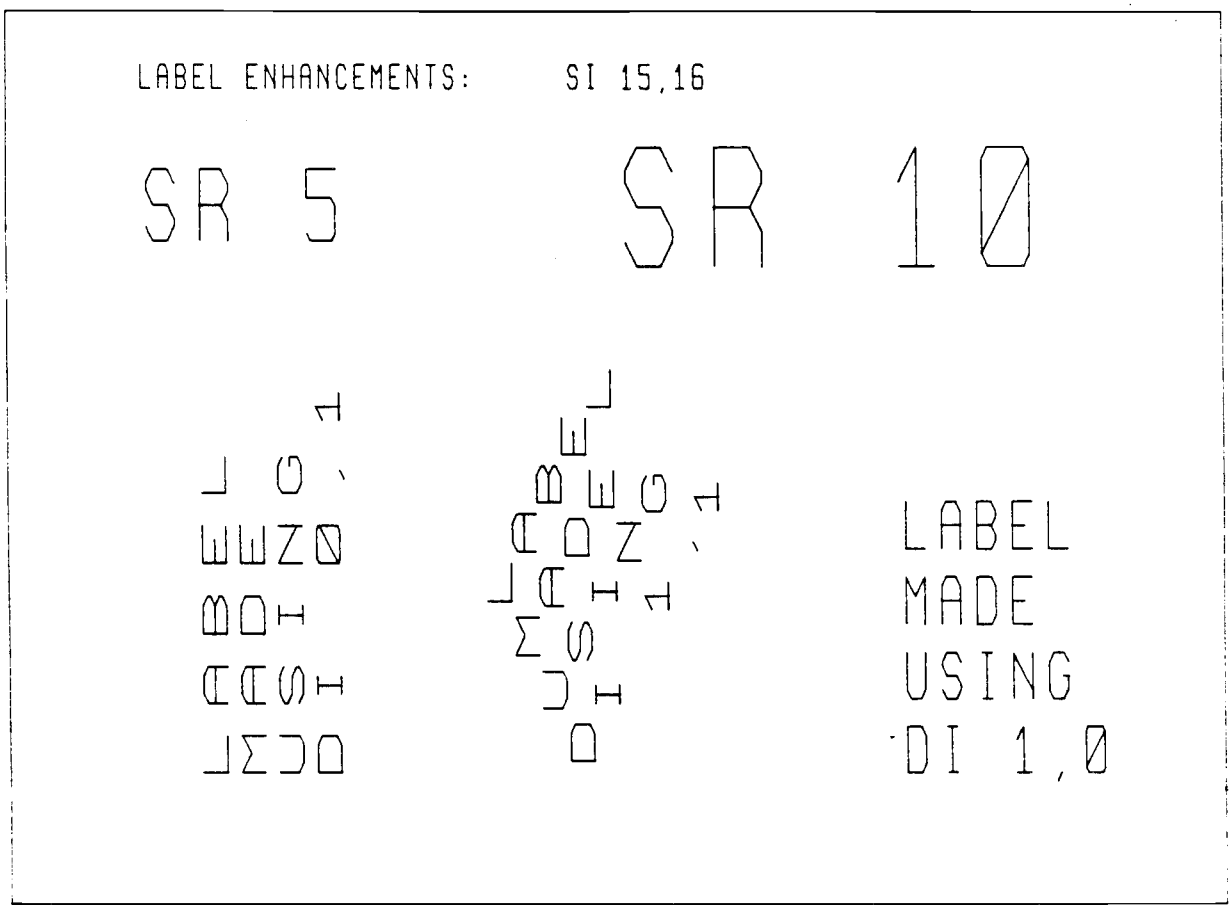


Fig. 12

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Section 4: Hardcopy Output

Both of the HP 70000 Graphics Displays have the ability to provide hardcopy output directly to a printer or plotter over HP-IB without the need for an external controller or computer. Plotter operations are performed using a vector graphics plotter that is HP-GL compatible to yield high-quality output. Printer operations are performed using an HP-IB compatible raster-format graphics printer, and usually take less time than plotter outputs. For more information on output device compatibility and manual operation for obtaining output, see the notes following the *PRINT* and *PLOT* softkey descriptions in Chapter 2.

Copy: CY (parameter option)

The CY command initiates a hardcopy output operation over HP-IB to the device specified by the PI (Printer/Plotter Is) command described below, or by the *COPY IS PRT/PLT* key in "Parameter option" is used to select the scaling points (P1 and P2) for plotting the *define hardcopy* menu.

Parameter option = 0: Use P1 and P2 as set by the plotter (for TLK/LSN plotters only). If the plotter is defined as L ONLY in the menu, use P1,P2 as stored in the display via the PL command or the *plotter params* softkey.

Parameter option = 1: Use P1,P2 as stored in the display.

Compatablility with Display ROM version 5.0: Software, using the CY or the PLOT command in the Local Oscillator Module, which worked with Display ROM version 5.0 when the System Controller on the Display switch was NOT set should work with version 6.0 when the System Controller switch IS set. (In version 5.0 when the System Controller was set, printer/plotter dumps did not work.) Refer to the CY command example.

Eject: EJ eject #

Parameter 1 = send a form feed at the end of printer dumps and PG at the end of plotter dumps. The *EJECT ON/OFF* softkey performs the same function. (PG causes the 7550 Plotter to eject a page, but turns on the error light on older plotters.) The parameters and their values are listed below.

Page Eject = 1
Page does not Eject = 0
Default = 1

High Resolution: HR resolution #

HR sets the printer dump resolution to either high resolution (1024 dots) or low resolution (512 dots). The *HI RES ON/OFF* softkey performs the same function. The parameters and their values are shown below.

High Resolution = 1
Low Resolution = 0

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KeyCopy On/Off: KC option #

The KC command allows the user to select whether or not the softkey labels will be included in the next hardcopy output. The *KEYCOPY ON/OFF* softkey performs the same function.

option # = 0: Off — do not include softkey labels (Default)
option # = 1: On — include softkey labels

Printer/Plotter Is: PI device type, row, col, bus

The PI command is used to specify the HP-IB address of the hardcopy output device used by CY. The device can be a printer or a plotter at any address.

device type = 0: Printer (default)
device type = 1: Plotter
row, col : These specify the address of the output device. For HP-IB devices, set row = 0 and col = HP-IB address (e.g., 1 or 5, not 701 or 705).
bus = 0: HP-IB
bus = 1: HP-MSIB

Plotter Parameters: PL X1, Y1, X2, Y2

The PL command sets the parameters (P1 and P2 coordinates) of the output plotter for Listen Only (L ONLY) plotters and for all plotters when the output is initiated with the command "CY1." Physical size of the output is dependent on the output device.

Default values: X1,Y1 = 100,100
Default values: X2,Y2 = 10500,7500

NOTE

The display will not perform an output operation over HP-IB if there is also an active controller on the bus. See the last part of the following examples.

Example: Obtaining Hardcopy Output with the System Controller switch set to 0 (OFF). (Note: Do not attempt to change the position of this switch with the Display ON.) Assumes data to be dumped is already on screen.

```
100  Dsp=704
105  Plt=705
110  CLEAR Dsp
```


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```
120  OUTPUT Dsp;"PI 1;";
             (THIS COMMAND TELLS THE DISPLAY THAT IT IS TO
             PERFORM A PLOTTER DUMP WHEN THE "CY" COMMAND
             IS ISSUED. "PI 0;" WOULD RESULT IN A PRINTER
             DUMP BEING PERFORMED)
130  OUTPUT Dsp;"CY0;";
             (THE DISPLAY IS INSTRUCTED TO DO A HARDCOPY DUMP.
             WITH THE SYSTEM CONTROLLER SWITCH SET TO 0 (OFF),
             THE DISPLAY WILL WAIT TO BE INSTRUCTED TO TALK
             BEFORE DOING THE OUTPUT. EVEN THOUGH WE HAVE TOLD
             IT TO ASK THE PLOTTER FOR P1,P2, IT WILL NOT BECAUSE
             IT IS NOT THE SYSTEM CONTROLLER. HENCE IT WILL USE
             THE STORED PLOTTER PARAMS)
140  SEND 7;UNL TALK (Dsp-700) LISTEN (Plt-700) DATA
             (THIS LINE INSTRUCTS THE DISPLAY TO
             TALK AND THE DEVICE AT ADDRESS 705 TO LISTEN.
             "DATA" CAUSES THE CONTROLLER UNASSERT THE ATN
             (ATTENTION) LINE ON THE HP-IB)
150  END
```

Example: Obtaining Hardcopy Output with Controller switch set to 1 (ON). (Note: Do not attempt to change the position of this switch with the Display ON.)

```
100  Dsp=704
120  CLEAR Dsp
130  OUTPUT Dsp;"PI 1;";
160  OUTPUT Dsp;"CY0;";
             (THE DISPLAY IS INSTRUCTED TO DO A HARDCOPY DUMP.
             WITH THE SYSTEM CONTROLLER SWITCH SET TO 1 (ON),
             THE DISPLAY LOOKS AT THE STATUS OF THE ATN AND
             REN LINES, PERFORMING THE DUMP ONLY WHEN BOTH GO
             FALSE)
210  SEND 7;UNT DATA
             (THIS LINE INSTRUCTS ALL DEVICES ON HP-IB TO
             UNTALK AND SETS ATN FALSE. NOW IT WILL USE THE
             PLOTTERS P1, P2.)
230  LOCAL 7
             (THIS COMMAND SETS REN FALSE — CLEARS THE
             COMPUTER FROM HP-IB AT WHICH POINT THE DISPLAY
             STARTS THE DUMP)
250  END
```


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Section 5: Markers

Multiple single-character fixed-size markers can be placed on the display screen using the commands MA (Marker Attributes) and MK (Place Marker). Markers can be used in either the referenced or non-referenced modes (see "Referenced Graphics" section of this chapter).

Intensity Setting: IS

IS sets the intensity of up to a maximum of two markers. Only **referenced** markers can be intensified (see Section 7).

IS 0 = normal (0 thru 127)
IS-1 = intensified (-128 thru −1)

Example: Output 704;"IN;IT1;MK400,200;IS0;IT2;MK500,200;IS-1;"

Marker Attributes: MA character, position (no space between MA and the character).

The MA command is used to specify the character to be used as a marker.

character = any character in the currently active character set (no default value). This character will be used as the marker.

position = (0 — 4). This specifies the position on the character that serves as the reference point for the marker. (See figure below.)

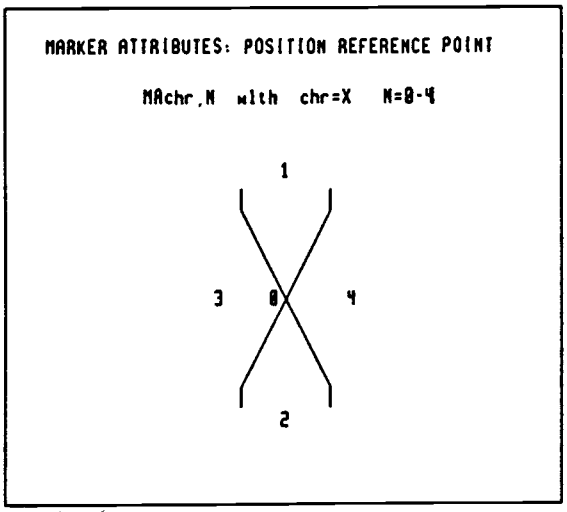


Fig. 13. Marker Reference Positions

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Place Marker: MK X, Y

The MK command is used to place a marker on the screen. The coordinates X and Y give the distance from the current location (or from the origin) that the marker will be placed.

For NON-REFERENCED graphics, the marker will be placed X units to the right and Y units above the current pen position.

NOTE

Placing a marker at a point other than the current pen position (neither X nor Y at 0) does NOT affect pen position after the marker has been drawn.

For REFERENCED graphics, the marker will be placed X units to the right and Y units above the current item origin. (See section on referenced graphics.)

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Section 6: Character Sets

The HP 70205A and HP 70206A Graphics Displays have the capacity to store multiple character sets. At present, two are available:

Character Set 0: US ASCII
Character Set 30: Saved User-Defined Set

The user can create a single new character for special uses (such as a logo or marker), or create a whole new character set in a different font. Once the other character set has been defined, it can be called up at any time by the controller or instrument.

There are six commands which pertain to character sets:

CA – Designate Character Set Alternate
CS – Designate Character Set Standard
SA – Select Alternate Character Set
SS – Select Standard Character Set
SU – Save User-Defined Character
UC – Draw User-Defined Character

Typically two Character Sets sets are available at any time, with one being used.

To choose which of the available character sets is used, either the SS (Select Standard) or SA (Select Alternate) command is used. When either of these commands is issued, the character set associated with the command (Standard or Alternate), is used when labeling (See section 3).

If a character set other than those currently associated with SS and SA is desired, then CA or CS must be used. CA associates a character set (0 or 30) with the SA command, and CS does the same for the SS command.

For Example: CS0; SS; will cause labels to use character set 0.

CS0; SS; CS30; will also cause labels to use character set 0 because no SS follows the CS30.

CS0; SS; CS30; SS will cause labels to use character set 30.

See below for details.

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Designate Character Set Alternate: CA set#

The CA command specifies which character set will be used for labeling when the SA command has been sent: CA designates the set, and SA calls it into action.

set # = 0: US ASCII (Standard and default)
set # = 30: User-Defined Character Set (see SU command)

Designate Character Set Standard: CS set#

The CS command specifies which character set will be used for labeling whin the SS command has been sent. The standard set is used when default conditions exist (power-on, DF, IN, *DISPLAY PRESET*, *SELECT INSTR*, DEVICE CLEAR) or when the SS (Select Standard Character Set) command is received. Set# designations are the same as for CA.

Select Alternate Character Set: SA (no parameters sent)

The SA command causes the display to begin writing labels and markers using the alternate character set specified by the CA command. It will continue to use this set until the power is turned off, the Display is initialized (*DISPLAY PRESET*, *SELECT INSTR*, Device clear, DF, IN), or the Select Standard Character Set (SS) command is used. Note that the alternate character set is used only to create labels and markers, and all commands (including the label terminator) must still be sent in the standard US ASCII character set.

Select Standard Character Set: SS (no parameters sent)

The SS command causes the display to activate the standard character set designated by the CS command. The standard character set is also activated upon power-on and by the DF,IN, *DISPLAY PRESET*, *SELECT INST*, and Device Clear commands.

Save User Defined Character: SU Char, pen control, xincrement, yincrement, (pen control), xincrement, yincrement, . . .

The SU command is used to save characters of your own design in character set 30. It can be used to create symbols not included in the character set of the display, to store logos, or to create your own character fonts. The ASCII name "char" denotes which position of the character set 30 the character will be saved in, and the parameters following (pen control, and x and y increments) define its shape (note no space should be sent between SU and Char).

SU defines the shape of the special character, as shown in the figure below.

The SU command does not draw the character on the screen. To do this, create a label using Character Set #30. (See descriptions of the LB, CA, and SA commands for instructions on how to do this.) The physical size of the character is determined by the SI or SR command in effect at the time it is actually drawn on the screen.

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Char: The ASCII name that the newly created character is stored under in character set 30.

Pen control:

99 = pen down
−99 = pen up (parameter is optional: pen is initially up)

Xincrement, Yincrement: the number of display units to move the pen in order to create the character (14 max). Very much like parameters in the PR command, these must be in successive pairs, all separated by commas and optional pen control commands. The stroke defined by a X,Y pair must be at a multiple of 45 degrees. To achieve this, the Display uses the following algorithm:

1. Either stroke = 0: stroke length that of nonzero stroke.

2. Both strokes non-zero: stroke length=X increment, stroke direction determined by sign of X and Y increment. Both positive, 45°, X>0, Y<0, −45°, both negative, −135°; X<0, Y>0, 135°

NOTE

Because of the doubled horizontal resolution, characters will actually appear shortened horizontally, and 45° angles will appear to be 63° angles.

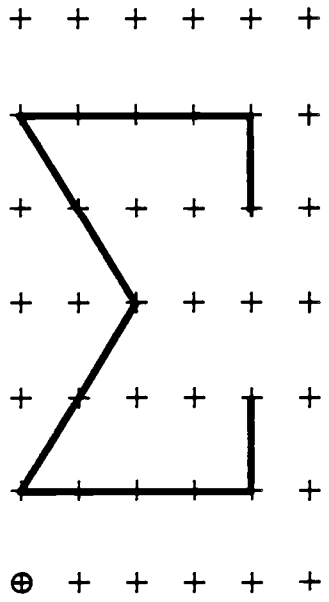


Fig. 14. Character Cell drawn by SU in example below

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Draw User-Defined Character: UC pen control, xincrement, yincrement, (pen control), xincrement, yincrement, . . .

The UC command draws a character immediately but does not save it. No limits are placed on the parameters and the strokes can be at any angle (just like using PR). A pen control parameter can come between any pair of X and Y increments (+99 = pen down, −99 = pen up).

NOTE

The UC command immediately draws a user-defined character (UDC); it does not deal with a stored character set.

Example: Character Set Usage

```
10  ASSIGN @Dsp TO 704
20  CLEAR @Dsp
30  OUTPUT @Dsp;"DE;IN;"
40  OUTPUT @Dsp;"BW1,112,16,911,383,0,0,0,1;"
                (BUILD HP-IB WINDOW)
50  OUTPUT @Dsp;"SC0,1000,0,1000;"
60  OUTPUT @Dsp;"PU;PA0,0;PD;PA1000,0,1000,1000,0,1000,0,0;"
70  OUTPUT @Dsp;"CS0;"
                (DESIGNATE STANDARD CHARACTER SET TO BE 0,
                 i.e., US ASCII − DEFAULT CONDITION)
80  OUTPUT @Dsp;"CA30;"
                (DESIGNATE ALTERNATE CHARACTER SET TO BE 30
                 i.e., USER-CREATED SET)
90  OUTPUT @Dsp;"SS;"
                (SELECT STANDARD CHARACTER SET; START USING IT)
100 OUTPUT @Dsp;"PU;PA400,500;DT#;"
                (MOVE PEN, DEFINE TERMINATOR)
110 OUTPUT @Dsp;"LBXXXXX#;"
                (PLACE LABEL OF Xs)
120 OUTPUT @Dsp;"SUX,4,1,+99,0,1,-4,0,2,-1,-2,-1,4,0,0,1;"
                (SAVE THE USER-DEFINED CHARACTER GREEK SIGMA UNDER
                 THE NAME OF "X" IN SET 30. NOTE: PLACE
                 "char" DIRECTLY AFTER THE SU COMMAND WITHOUT
                 A SPACE, OTHERWISE THE UDC WILL BE STORED UNDER
                 THE NAME)
130 OUTPUT @Dsp;"SA;"
                (SELECT-START USING-ALTERNATE CHARACTER SET)
140 OUTPUT @Dsp;"PU;PA400,400;LBXXXXX#;"
                (PLACE USER-DEFINED CHARACTERS)
150 OUTPUT @Dsp;"PU;PA400,300;SR10;LBXXXXX#;"
                (PLACE LARGER UDCs)
```


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```
160 OUTPUT @Dsp;"SR10,UC0,0,=99,6,0,0,16,-6,0,0,-16;"
                (DRAW A 6X16 BOX USING THE UC COMMAND.  NOTE THAT
                 THE PEN MOVEMENT PARAMETERS ARE INCREMENTAL,
                 IN A 6X16 CELL.  NOTE SIZE OF CELL RELATIVE TO
                 THE UDCs TO THE LEFT, WHICH WERE DRAWN WITH THE
                 SAME SR COMMAND.
170 OUTPUT @Dsp;"SS;"
                (RE-SELECT THE STANDARD CHARACTER SET )
180 END
```

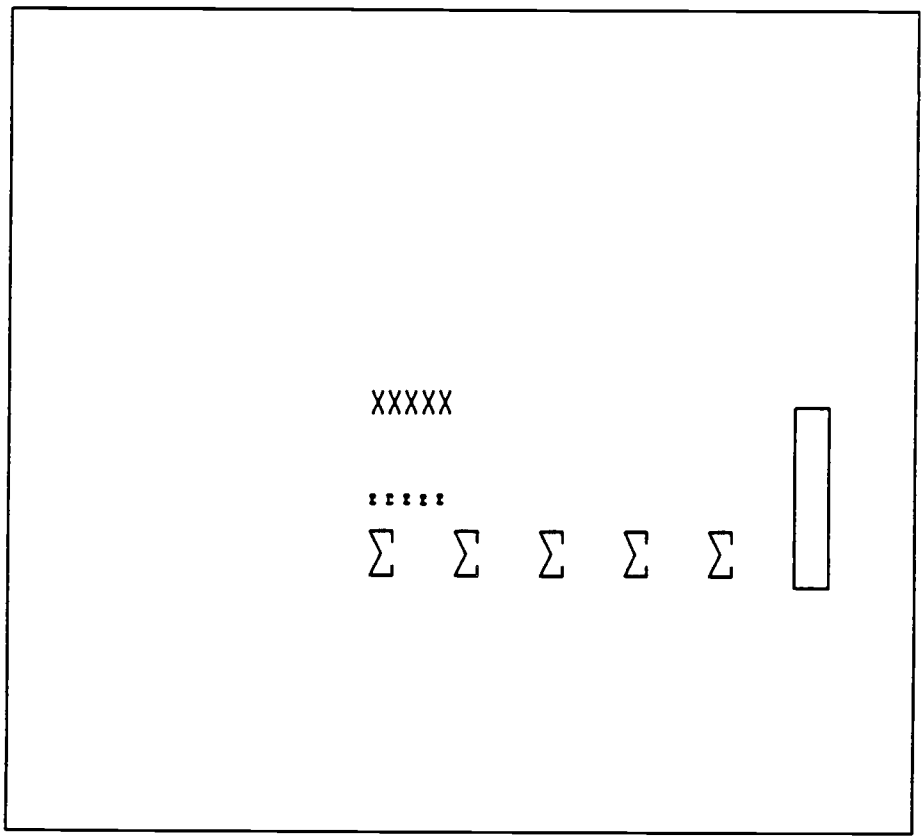


Fig. 15. Display Screen for Sample Program

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Section 7: REFERENCED GRAPHICS

Many of the capabilities discussed earlier in this chapter are contained in HP-GL, the Hewlett-Packard Graphics Language. One powerful set of capabilities not included in HP-GL but available with the HP 70205A and HP 70206A Graphics Displays are those of Referenced Graphics. Referenced Graphics allow the user greater flexibility in drawing figures and labeling the screen than would be possible with a regular plotter, printer, or instrument display.

Referenced Graphics allow the user to control and manipulate an item on the screen even after it has been drawn. The object can be moved, enlarged, blanked (turned off), viewed (turned on), deleted entirely, or made to blink. Furthermore, objects can be logically grouped with other objects, and attributes can be applied to each object individually or to the group collectively.

Virtually anything that can be drawn on the screen can be used as a referenced object. All types of objects can be included in the same logical group. Examples include lines, figures, labels, graphs, axes, graticules, and markers.

Each object drawn on the screen can be used in either a referenced or a non-referenced mode. If created in non-referenced mode, the object cannot be changed after being drawn. If drawn in a referenced mode, the object is known as an "item" and has a specific number associated with it (e.g., Item 3). When multiple items must be referred to at the same time, they may be defined as belonging to a single "group." Each item, however, retains its identity by having a unique reference number (e.g., Group 2, Item 3).

The following attributes can be assigned to **Referenced Items**:

- Blinking — See BL command description in this section.
- Blanking — See VW command description in this section.
- Pen Type — See SP command description in section 2.
- Origin — See OR command description in this section.
- Character size and Direction (labels only) — See the DI, DR, SI and SR command descriptions in section 3.
- Marker Character — See section 5.
- Line Type (plots and graphs only) — See LT command descriptions in section 2.
- Intensity (markers only) — See IS command
- Delta-X (graphs only) — See DX command descriptions in section 2.

To determine whether an object will be drawn as referenced or non-referenced, and to refer to a referenced item once it has been drawn, use the commands Identify Item (IT) and Identify Group (GP). If

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GP or IT commands are not received by the display, all objects drawn will be non-referenced. If the last IT command received was IT0 or the last GP command received was GP0, the next object drawn will be non-referenced. As previously mentioned, objects can be drawn in referenced mode (but without a group designation) simply by not sending any GP commands, causing each item's group number to default to 1. In this case, the whole concept of groups can be ignored for purposes of remote operation. The display will automatically be put in the non-referenced mode upon power-up or upon receipt of either DF or IN command (*DISPLAY PRESET* or *SELECT INSTR*). Once an IT# has been assigned an object and that object has been defined as a GRAPH, PLOT, LABEL, AXIS, MARKER, or GRATICULE, the item must be deleted with a DL command for it to be assigned to a different type of object, or an invalid parameter error will result.

Blank Ahead: BA <number of segments>

BA sets the number of line segments in a trace which will be blanked to the right of the current trace pointer. Traces are referenced plots or graphs drawn with GA, GR, PA, or PR commands. (see IT and GP) The blanking action occurs when a point is actually plotted or graphed.

Example

```
OUTPUT 704;"IN;IT1;OR 150,100;DX50;GA0,40,20,60,50,150,40,60,30,20,50,40,70,0;"
                (DRAW A GRAPH)
OUTPUT 704;"BA3;"
                (SET BLANK AHEAD TO 3)
OUTPUT 704;"TP5;GA150;"
                (REGRAPH POINT 5, NOW NEXT THREE SEGMENTS WILL BLANK)
```

Identify Item: IT item#

The most recently received IT command for the current window determines whether the next object to be drawn or modified will be referenced or non-referenced, and, if referenced, what its item number will be. The item will be in the most recently referenced GROUP (see GP below), or GP1 if no group has been referenced.

item# = 0: activates non-referenced mode
item# = 0 — 50: referenced item number 1 — 50.

Identify Group: GP group#

The most recently received GP command determines the group number of all referenced items (item# not 0) drawn or referred to. Attributes that may apply to an entire group include blinking, blanking (view command), and origin.

group# = 0: activates non-referenced mode (can be reversed by subsequent GP or IT commands)

group# = 1: referenced group number 1 — 16

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Set Origin: OR Xposition, Yposition

The OR command specifies the origin of the current entity. Both groups and items have an origin (location on the screen): the origin of a group is relative to the 0,0 point of the window (see SC command) and the origin of an item is relative to the origin of the group that contains the item.

NOTE

The physical location of a group's reference point on the screen (its origin) is determined by the OR command according to the units (scale) in effect at the time the group's origin is specified (that is, when the group or item is defined or the OR command is received). This means that the scale of the screen can be changed after the group's origin has been specified and the physical location of that origin will not be affected, that is, GP1, IT1;SC0,100,0,100 is NOT equivalent to SC0,100,0,100; GP1; IT1. Only in the latter case will the placement of the items reflect the scale factor 0,100,0,100.

If no group has been specified or if GP0 has been most recently received, the origin of the item will be located with respect to the 0,0 point of the window in current units. The origin of a group or item is implicitly set to 0,0 when the GP or IT command is sent.

NOTE

The OR command requires that parameters be sent. No default values exist for Xposition and Yposition.

The command sequence:

```
SC 0,1000,0,1000;
GP1;OR 500,500;
IT1;OR 0,0;
```

would place both the group's origin and the item's origin at the center of the window (not necessarily the center of the screen), while the sequence:

```
SC 0,1000,0,1000;
GP1;OR 500,500;
IT1;OR 500,500;
```

would place the group's origin in the center of the window (500,500) but the item's origin at the top right corner of the window (1000,1000).

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NOTE

Once the origin of a group or item has been specified, it can be changed at any time. The effect of changing the origin is to immediately shift the position of the group or item on the screen.

```
GP1;OR 500,500;
IT1;OR 500,500;
: :
GP1;IT1;OR 0,0;    (Resets item's origin)
GP1;OR 0,0;        (Resets group's origin)
```

Blink On/Off: BL mode

The BL command causes the currently active entity (group or item) to blink on and off.

mode = 0: off
mode = 1: on

Delete All Ref./Non-Ref. Objects: DA #

The DA command allows the user to delete (not just blank) all referenced or all non-referenced objects.

= 0: Delete all non-referenced objects.
= 1: Delete all referenced items and groups.

Delete Active Item or Group: DL (no parameter)

The DL command deletes (removes entirely) only the active entity (i.e., the last object or group of objects referred to by an IT or GP command).

NOTE

Be sure that the proper entity is active (e.g., send GP1;IT2;DL;, to delete only item 2 of group 1).

Pan: PN offset

The PN command is used to move an entire trace (plot or graph) horizontally in the current window. "Offset" gives the number of endpoints to shift the trace to the right (positive offset) or to the left (negative offset). Endpoints are just X-axis points or values on a plot or graph: the physical distance between endpoints depends on the scale being used (SC command) and, in the case of a graph, on the Delta-X value in force (DX command).

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Trace Pointer: TP endpoint

The TP command is used to specify the next point on a trace (graph or plot) that is to be referenced. This capability can be used to only re-draw a specific portion of a trace, as shown in the figure below.

"Endpoint" is the number of x-values from the beginning of a trace that the trace pointer will point to; i.e., the next graph command will begin at that x position.

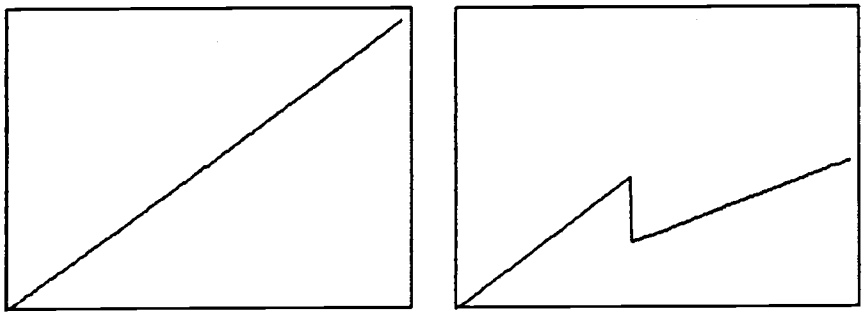
NOTE

The TP command can only be used with referenced graphics.

Example: Re-Drawing a Trace Using Trace Pointer.

```
10  ASSIGN @Dsp TO 704
20  CLEAR @Dsp
30  OUTPUT @Dsp;"DE;IN;"
40  OUTPUT @Dsp;"SC0,1000,0,1000;"
                (SCALE SCREEN TO 1000X1000)
50  OUTPUT @Dsp;"PU;PA0,0;"
60  OUTPUT @Dsp;"DX1;"
                (SET Xincrement TO 1)
70  OUTPUT @Dsp;"GP1;IT1;"
                (TRACE POINTER MAY ONLY BE USED WITH
                 REFERENCED ITEMS)
80  OUTPUT @Dsp;"PD;"
90  FOR J=0 TO 900
100    OUTPUT @Dsp;"GA";J";"
                (GRAPH DIAGONAL LINE)
110 NEXT J
120 OUTPUT @Dsp;"TP450;"
                (SET TRACE POINTER TO CENTER OF LINE)
130 FOR K=450 TO 900
140    OUTPUT @Dsp;"GA";K/2;";"
                (START RE-GRAPHING POINTS WITH NEW VALUES,
                 STARTING WITH THE POINT SPECIFIED BY THE
                 TP COMMAND)
```


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INITIAL GRAPH BEFORE TRACE POINTER WAS USED

GRAPH AFTER LAST HALF WAS RE-DRAWN USING TRACE POINTER TO REFERENCE CENTER

Fig. 16

View On/Off: VW mode

The VW command allows the user to view (turn on) or blank (turn off) the currently active entity (group or item). If no group or item has been specified (i.e., the window is in non-referenced mode), then all non-referenced objects are blanked.

mode = 0: blank active entity
mode = 1: view (unblank) active entity

For Example:

GP1; IT1; VW0 blanks Item 1 in Group 1
GP1; VW0; blanks all items in Group 1
GP0, IT0; VW0 blanks all non-referenced objects

Example: Using Referenced Graphics.

```
10 ASSIGN @Dsp TO 704
20 CLEAR @Dsp
30 OUTPUT @Dsp;"DE;IN;"
40 OUTPUT @Dsp;"BW 1,112,16,911,383,0,0,0,1;"
50 OUTPUT @Dsp;"SC0,1000,0,1000;"
60 OUTPUT @Dsp;"GP1;OR0,0;
                (GROUP 1 HAS ORIGIN AT LOWER LEFT CORNER)
70 OUTPUT @Dsp;"IT1;OR250,250;"
                (ITEM 1 IN GROUP 1 HAS ORIGIN 250,250 RELATIVE TO
                 ORIGIN OF GROUP 1. THAT IS, ITEM 1 HAS ORIGIN
                 250,250)
80 OUTPUT @Dsp;"MAX,0;MK0,0;"
```


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```
                (PLACE A MARKER (X) AT ORIGIN OF ITEM 1, GROUP 1)
90  OUTPUT @Dsp;"GP2;OR500,500;"
                (ORIGIN OF GROUP 2 IS AT MIDDLE OF SCREEN)
100 OUTPUT @Dsp;"IT1;MAX,0;MK0,0;"
                (PLACE A MARKER (X) AT ORIGIN OF GROUP 2)
110 OUTPUT @Dsp;"IT2;OR 250,250;"
                (ITEM 2 IN GROUP 2 HAS ORIGIN 250,250 RELATIVE TO
                 ORIGIN OF GROUP 2, WHICH IS AT 500,500.  HENCE
                 GP2,IT2 HAS ABSOLUTE ORIGIN 750,750 ON SCREEN)
120 OUTPUT @Dsp;"MAX,0;MK0,0;"
                (PLACE MARKER AT ORIGIN OF ITEM 2 IN GROUP 2)
130 OUTPUT @Dsp;"IT3,OR250,250;MAX,0;MK0,100;"
                (ITEM 3 HAS SAME ORIGIN AS ITEM 2, BUT DATA
                 (X=0,Y=100) PLACES IT ABOVE ITS ORIGIN)
140 END
```

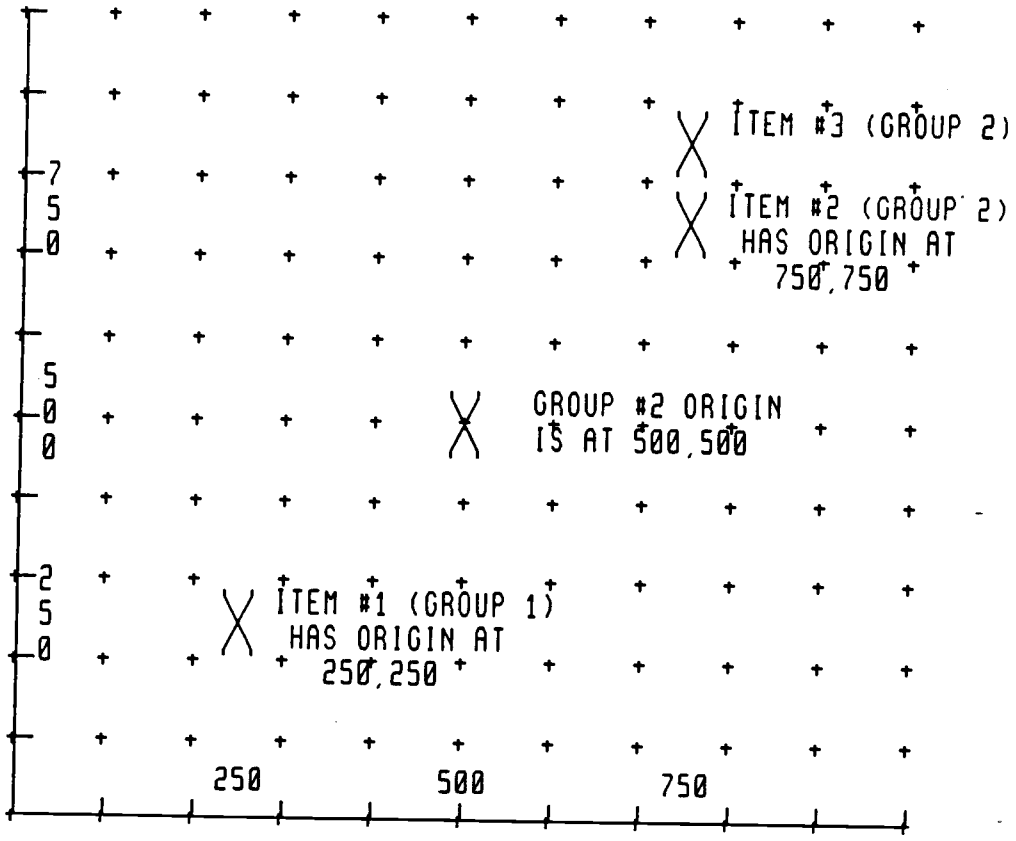


Fig. 17. Output From the Referenced Graphics Example.

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Section 8: INFORMATIONAL DISPLAYS

The HP 70205A and HP 70206A Graphics Displays have the capability to provide various types of system-level information, both on the screen for viewing by the user and over HP-IB for receipt by a controller. The informational screens include the Address Map, the Error Screen, and the Screen Configuration. Each of these is described in detail in Chapter 2 of this part, "DSP Hardkey (Manual Display Operation)," and the remote commands used to access them will be covered here.

Address Map: AM row, col

This command displays the Address Map screen, with the cursor (the highlighted box) resting in the space given by "row, col." The map is removed if either "row" or "col" is −1.

Example: Checking for Spectrum Analyzer in Address Map:

```
OUTPUT @Dsp;"AM0,18;"
```

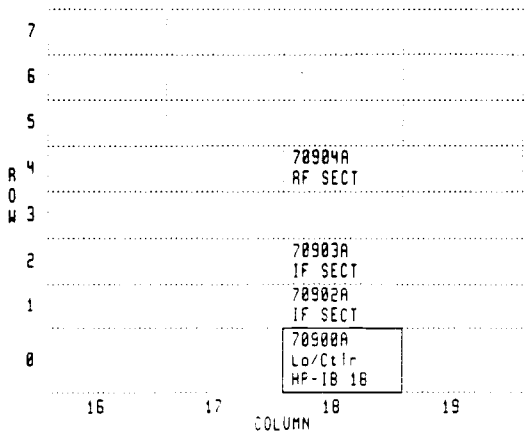


Fig. 18.

Display Status On/Off: DS statusbox, dataline

The DS command allows the user to selectively blank either or both of the two display status items: the status box and the data line box.

statusbox = 0: blank status box
statusbox = 1: show status box

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dataline = 0: blank data line box
dataline = 1: show data line box

DS; gives statusbox on dataline box off.

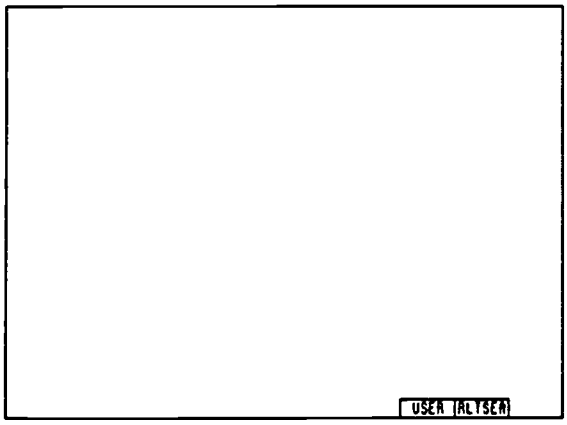


Fig. 19. Display Status Box

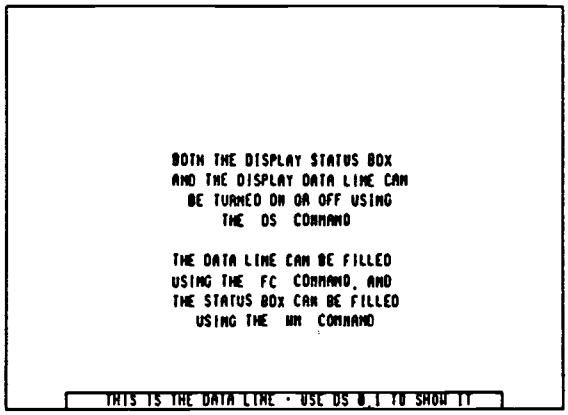


Fig. 20. Display Data Line Box

The display status box, shown in figure 20, gives status indications to the user for several aspects of the display's current operating mode. The left half of the box shows one of three indicators:

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- USER — the softkey labels shown are those sent to the display by the master module of an instrument (e.g. HP 70900A) in response to pressing the **[USER]** or **[USR]** hardkey.

- MENU — the softkey labels shown are those found in the main menu of the modular instrument that has control of the keyboard. MENU appears in the status box after the **[MENU]** or **[MNU]** hardkey is pressed.

- DSPL — the softkey labels shown are those of the display itself. DSPL shows in the status box after the **[DISPLAY]** or **[DSP]**hardkey has been pressed.

The right half of the display status box gives any of six single-letter indicators:

- R — Display is in remote mode on HP-IB. The keyboard is not accessible to the user until the **[LOCAL]** key on the display is pressed.

- L — Display is in listen mode on HP-IB.

- T — Display is in talk mode on HP-IB.

- S — Display is asserting SRQ (Service Request) on HP-IB.

- E — Display has detected a display error on HP-IB or over HP-MSIB. (see REPORT ERRORS softkey description in chapter 2).

- A — Display is addressed on HP-MSIB. This means either that its address is being interrogated (e.g., the cursor box in the address map is resting on the display) or that the display itself has control of the softkeys.

Error Screen: ES column#

The ES command forces the display to show the error screen, which lists any errors currently reported on the HP-MSIB column specified. Just like the REPORT ERRORS softkey (described in Chapter 2), the ES command clears non-hardware-related errors from the memory after they have been reported.

The errors are reported from one master module at a time. Hence, if more than one master module has errors to report, multiple ES commands must be sent. Also, only as many errors as can fit on the screen at once may be reported with a single ES command.

column# : Show error report screen from module with column # specified.

column# = −1: Turn off error reporting mode (default value)

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Output Identification: OI (no parameter sent, but response is generated)

The OI command causes the display to output, over HP-IB, an ASCII string that identifies the display as either an HP 70205A or HP 70206A.

Example: Interrogating Display for Identification.

```
10 OUTPUT @Dsp; "OI"
20 ENTER @Dsp;A$
30 DISP A$
40 END
```

The screen of the computer should show either "70205A" or "70206A."

Output Options: OO (no parameter sent, but response is generated)

OO is used to determine which plotter options are available. The display outputs: 0,1,0,0,0,0,0,0. The (1) in the second position indicates the display has pen select capability.

Output Version: OV (no parameters sent, but response is generated)

The OV command causes the display to respond over HP-IB with an ASCII string that gives the firmware version (for the display ROMs only).

Example: Finding Display Firmware Version

```
10 DIM A$[30]
20 ASSIGN @Dsp TO 704
30 OUTPUT @ Dsp;"OV;"
40 ENTER @Dsp;A$
50 DISP A$
60 END
```

The computer should display something similar to "860625 ROM Version 6.0."

Show Current Configuration: SN register#

The SN command shows a summary of the screen configuration, very much as the *SHOW CONFIG* softkey does (see Chapter 2). It lists all windows, their sizes and instrument assignments, and the allocation of the keyboard.

```
register # 0:   show current screen configurations
        1 – 4:  show configuration from registers 1 through 4
           –1:  exit the Show Configuration function.
```


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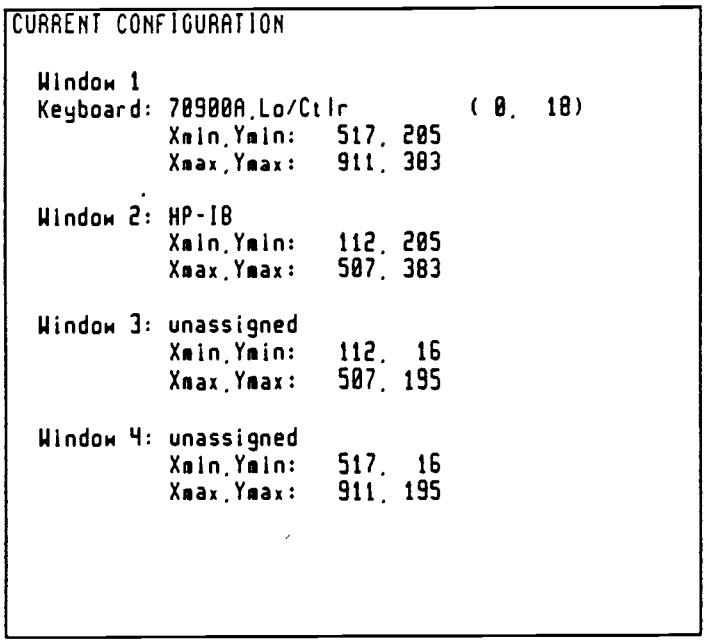


Fig. 21

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Section 9: ERROR HANDLING

Both the HP 70205A and the HP 70206A Graphics Displays can detect and report errors that occur on either HP-IB or HP-MSIB. The general procedure for reporting errors is discussed in Chapter 2 under the *REPORT ERRORS* softkey description.

Output Error String: EG (no parameters sent, but response generated)

The EG command causes the display to output an ASCII string over HP-IB describing any detected error pertains to the currently active window.

Notes:

1. EG responds only to errors detected at the display. Errors detected elsewhere but reported to the display by another master module (such as the HP 70900A) will not be indicated by the EG command.

2. EG clears errors from memory. Compatibility Note: In Display ROM version 5.0, EG did not clear errors.

3. EG only reports usage errors, not hardware errors.

Example: Receiving Error Report from Illegal Command

```
10  DIM A$ [30]
20  ASSIGN @Dsp to 704
30  OUTPUT @Dsp;"DE;IN;XX;"
                (SEND ILLEGAL COMMAND "XX" TO THE DISPLAY)
40  OUTPUT @Dsp;"EG;"
                (ASK FOR REPORT)
50  ENTER @Dsp;A$
60  DISP A$
70  END
```

This program should result in the following message on the screen of the computer (see the System Support Manual for error numbers):

2001,Illegal command

More than one error may be sent, separated by CR (Carriage Return) LF (Line Feed).

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Error Screen: ES column

See the description in Section 8, Informational Displays.

NOTE

The ES command clears some errors from memory.

Output Error Number: OE (no parameter sent, but response generated)

The OE command causes the display to send ASCII numbers over HP-IB describing the errors detected that pertains to the currently active window. The error numbers sent in response are described in the System Support Manual.

Notes:

1. OE responds only to errors detected at the display. (see EG description above) The errors described by both OE and EG pertain to the currently active window; e.g., the window assigned to HP-IB.

2. OE clears reported errors from memory.

3. OE only reports usage errors, not hardware errors.

Example: Detecting a parameter out of range using OE command.

```
10  ASSIGN @Dsp TO 704
20  OUTPUT @Dsp;"DE;"
30  OUTPUT $Dsp;"KC5;"
40  OUTPUT @Dsp;"OE;"
50  ENTER @Dsp;A$
60  DISP A$
70  END
```

This should result in an error number of 2006, which indicates "Parameter Out of Range". If more than one error, the output will be numbers separated by commas. If no errors, 0 will be sent.

Output Status: OS (no parameter sent, but response generated)

Upon receipt of the OS command, the display makes available over HP-IB a status byte, which is an unsigned ASCII integer, terminated by (CR) and (LF). The status byte provides information about the active window (values 1 and 8), the keyboard (values 2, 4 and 128) and the display as a whole (value 32). This is the same status byte sent when a Serial Poll is done. After OS is received, the Status Byte and SRQ are cleared.

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The display maintains a separate status byte for each window. Hence, if an HP-IB controller sends OS, the status byte pertains to the window assigned to HP-IB; if an HP-MSIB module sends OS, the status byte refers to the window assigned to that module.

Compatability note: In ROM version 5.0 OS did not clear SRQ or the Status byte.

The decimal value of the status byte is the sum of eight different quantities:

Quantity	Meaning
1	Pen down
2	I/P key pressed
4	Knob count available
8	Window initialized
16	Ready/Not Busy (cleared during CI and CY, set at end.)
32	Error detected by the display (not by another module on HP-MSIB)
64	not used
128	Keyboard data available after OS status byte is cleared.

Example: Receiving Status Byte

```
10 ASSIGN @Dsp TO 704
20 OUTPUT @Dsp;"IN;"
                (INITIALIZE WINDOW)
30 OUTPUT @Dsp;"OS;"
                (REQUEST STATUS BYTE)
40 ENTER @Dsp;A$
                (READ STATUS BYTE – EXPECTED VALUE OF 8)
50 OUTPUT @Dsp;PD;OS;"
                (PEN DOWN, REQUEST STATUS BYTE)
60 ENTER @Dsp;B$
                (READ STATUS BYTE – EXPECTED VALUE OF 1)
70 DISP A$,B$
                (DISPLAY BOTH STATUS BYTES, VALUES 8 AND 1)
80 END
```


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Input Mask: IM Emask, Smask, Pmask

The IM command allows the user to specify the conditions under which the display will:

- Set the Error Detected value in the status byte (see the OS command description)
- Assert SRQ (Service Request) on HP-IB

The parameters Emask and Smask, sent along with the IM command, are each 8-bit numbers given in decimal notation: their value will determine under what conditions the above actions are taken. The specific value of either parameter should be the sum the values (given below) corresponding to all conditions the user determines as prerequisite to setting the Error Detected bit in the status byte, or to asserting SRQ. See the OS command description for a discussion of the status byte.

NOTE

The Pmask parameter is included for consistency with HP-GL, where it is used to determine the response to an HP-IB Parallel Poll. The HP 70205A and HP 70206A Displays, however, do not have Parallel Poll response capability, so the parameter Pmask will be accepted by display, but then ignored.

Emask parameter composition values and meanings:

If the value of Emask contains:	Then the Error Detected bit in the status byte will be set if:
1	2001 – Illegal command
2	2006 – Parm out of range
4	2002 – Illegal parameter
8	2011 – Memory overflowed
16	2005 – Illegal character set
32	2007 – Missing terminator
64	2009 – Protocol error
128	6008 – Confidence test failed

For instance, Emask = 159 (128+16+8+4+2+1) sets the error value in the status byte if any error condition other than "Missing Terminator" or "Protocol error" occurs. Emask = 255 (all bits) is the default value. It will be set to this value during the following conditions:

Power-up
Device Clear
DISPLAY PRESET
SELECT INST
DF
IN

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Smask parameter composition values and meanings:

If the value of Smask contains:	Then the Display will assert SRQ on HP-IB if:
1	Pen down (cleared on PU)
2	I/P key pressed (cleared upon receipt of KY)
4	Knob count available (cleared on RP)
8	Window initialized (cleared upon receipt of OS)
16	Ready/Not Busy (cleared at start of CY or CI, set at end)
32	Error detected in display
64	Require service (for HP-IB compatibility)
128	Keyboard data is available (cleared on KY)

NOTE

Defaults set as for Serial Mask.

Notes: See notes below for individual values.

1 Refers to current window only

2 SRQ will be asserted on HP-IB in response to keyboard action only if the display is in Remote and:

Pre-Process mode is **ON**, regardless of where the keyboard is assigned (see PP command description)

OR

Pre-Process mode is **OFF**, but the keyboard is assigned to HP-IB

4 See note for 2

8 See note for 1

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16 Refers to entire display. If the value 16 is included, SRQ will be asserted if:

A copy operation has been completed (see CY)

A *SELECT INSTR* has been completed (see CI).

NOTE

Since CI re-initializes most Display parameters, including this mask, the Display CANNOT be set to assert SRQ at the end of a CI. The READY bit can be polled however (see example in CI command).

32 SRQ will be asserted if an error is detected at the display. This does not pertain to errors reported by the spectrum analyzer (i.e., the HP 70900A Local Oscillator/Control module). The HP 70900A can be instructed to assert SRQ in response to its own errors using the RQS command.

64 This value is included for HP-GL compatibility only. Its inclusion in Smask will have no effect.

128 See note for 2

For instance, sending IM255,32 (Smask = 32) will assert SRQ if an error is detected at the display. This is the default condition.

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Section 10: REMOTELY-CONTROLLED DISPLAY

The HP 70205A and HP 70206A Graphics Displays can be used in a variety of ways as a user interface while being remotely controlled. The displays have the capability to accept alphanummeric entry from the user, to display messages, prompts, and softkeys, and to send all keyboard entries to a controller for processing before being sent to an instrument.

The commands covered in this section will be:

AE: Alpha Entry — Allows the user to directly enter general ASCII text.

FC: Fill Command Window — Allows controller to display prompts on screen.

KP: Simulate Key Pressed — Allows controller to simulate any keyboard entry.

KY: Send Keyboard Data — Allows controller to interrogate display for keyboard entry.

ML: Menu Load — Allows controller to load softkey labels.

PP: Pre-Process — Forces the display to send all keyboard entries to the controller for processing.

RG: Simulate Knob Turned — Allows controller to simulate rotating the knob.

RP: Send Knob count

Alpha entry: AE mode#

When AE is received, the display clears the data line and softkey labels, then shows a portion of the character set on the data line with one character underlined by the cursor. The user may select a character by turning the display knob to position the cursor, then pressing *ENTER*. As the knob is turned further, the remainder of the character set will scroll into the data line.

The data entered with this simulated keyboard is immediately sent to the element controlling the keyboard. To determine which element controls the keyboard, see the *SHOW CONFIG* softkey and the discussions of the BW (Build Window) and PP(Pre-Process) commands.

mode# = 0: Disable Alpha Entry mode, clear line (default condition).
mode# = 1: Enable Alpha Entry mode.

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Fill Command Window: FC text <terminator>

The FC command allows the user to place a message or prompt on the data line, as shown below.

NOTE

The "text" message sent must end with the previously defined label terminator (see the DT command description).

Example:

OUTPUT @Dsp;"DS0,1;DT#;FCThis Is The Data Line#;"

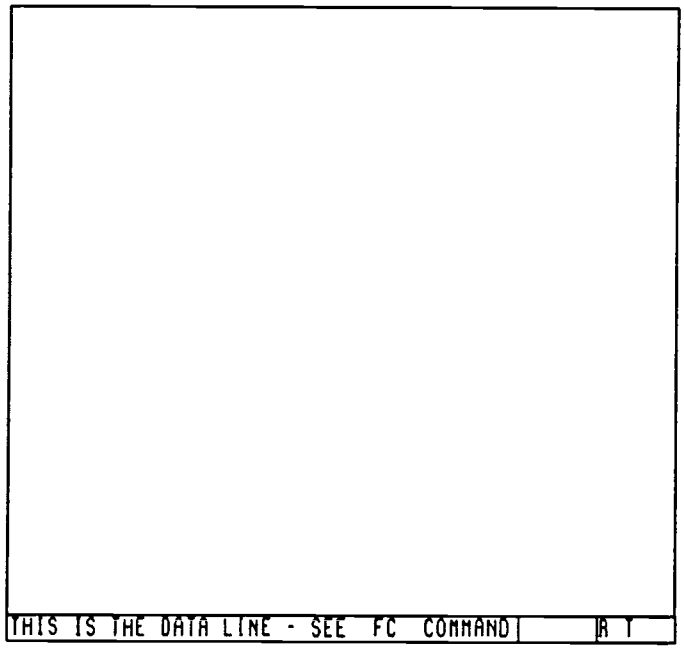


Fig. 22.

Simulate Key Pressed: KP keycode

The KP command allows the computing controller to simulate any sequence of key closures exactly as if a user had pressed the keys manually. The phantom key closure will be sent to the element controlling the keyboard. This capability works in conjunction with the PP, RG, KY, and RP commands for flexibile semi-automatic operation.

The keycodes are given below. The default code is 64, the Null Key (simulates no key closure).

Note that to push keys in [DSP] menu, the display must be in LOCAL. For example to ask for the first HELP screen:

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```
10 LOCAL 7
20 OUTPUT @DSP;"KP42;"
        (PRESS DSP)
30 OUTPUT @DSP; "KP30;"
        (PRESS HELP)
40 END
```

Compatibility Note: In ROM Version 5.0 the Display did not obey HP-IB commands in LOCAL, so KP could not be used to push [DSP] keys.

Key Simulated	Keycode
Numeric 0	0
Numeric 1	1
Numeric 2	2
Numeric 3	3
Numeric 4	4
Numeric 5	5
Numeric 6	6
Numeric 7	7
Numeric 8	8
Numeric 9	9
Softkey 1	17
Softkey 2	18
Softkey 3	19
Softkey 4	20
Softkey 5	21
Softkey 6	22
Softkey 7	23
Softkey 8	24
Softkey 9	25
Softkey 10	26
Softkey 11	27
Softkey 12	28
Softkey 13	29
Softkey 14	30
Decimal Point	32
Minus Sign	33
Left Arrow	34
Down Key	35
Up Key	36
Menu **[MNU]**	37
User **[USR]**	39
Local	40
Hold	41
Print	42
Display **[DSP]**	43
Instrument Preset **[I/P]**	46
Plot	47
Null Key	64

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Keycodes for other ASCII characters are 256 + N, where "N" is the character's decimal value in ASCII.

NOTE

The HP 70000 element receiving the phantom key closures may not be able to process incoming key signals as quickly as a controller can send them. A WAIT statement or equivalent may be used by the controller if necessary.

Send Keyboard Data: KY responsemode

Upon receipt of the KY command, the display will output, over HP-IB, the code of the key that was last pressed. See the KP description for a listing of the keycodes.

responsemode = 0: Send keycode in ASCII (default mode).

responsemode = 1: Send keycode in binary. If no key is pressed, a 64 "null Key" will be sent.

Menu Load: ML key#, label <terminator>, key#, label <terminator>...

NOTE

Each "label" must end with the previously define label terminator (see the DT command description).

The ML command enables the controller to place softkey labels on the screen. These labels serve as prompts for the user but do not affect the value of the key when it is pressed.

The softkeys are numbered 1 thru 14, as shown in the figure below. The "label" can be one or two lines of up to seven characters: the lines are either separated by a line feed or simply scrolled over to fit the window. Note use of the label terminators.

NOTE

A LF in a menu label also performs a CR function.

Example: Loading Menu Key Labels.

```
10 ASSIGN @Dsp TO 704
20 OUTPUT @Dsp;"DE;IN;"
30 OUTPUT @Dsp;"DT%;"
                (NOTE THAT LABEL TERMINATOR MUST BE USED!)
40 OUTPUT @Dsp;"ML1,KEY  #1%,7,KEY  #7%;"
```


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```
                (LOAD KEYS #1 AND 7)
50 OUTPUT @Dsp;"ML8,KEY   #8%,14,KEY   #14%;"
                (LOAD KEYS #8 AND 14)
60 END
```

MLO; or ML; clears ALL menu keys.

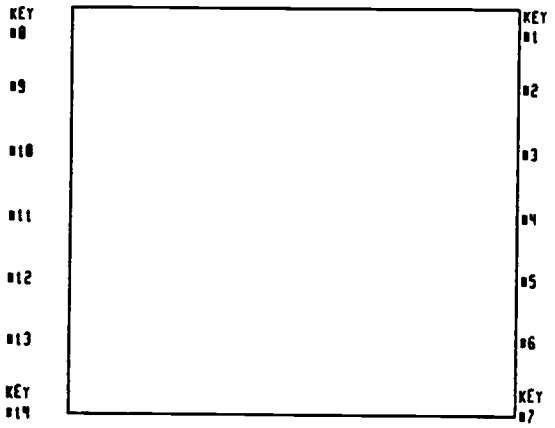


Fig. 23. Use of the Menu Load Command (ML)

Pre-Process: PP mode #

The PP command allows the user to direct that all key closures and knob data be reported directly to the controller, not to the active element (the modular instrument to which the keyboard is assigned). This allows the controller to process inputs intended for the instrument, and to send whatever key closure signals it determines are suitable using the commands KP (Simulate Key Pressed) and RG (Simulate Knob Turned).

mode # = 0: Turn off Pre-Process mode (default condition).

mode # = 1: Turn on Pre-Process mode; report keyboard entry to controller.

PP mode will only work if the Display is in Remote.

Simulate Knob Turned: RG count

The RG command, like the KP command, allows the controller to send phantom keyboard inputs to the instrument that the keyboard is assigned to. By sending either a positive or negative "count," the controller can simulate either a clockwise or counter-clockwise rotation of the knob.

Example: OUTPUT @Dsp;"RG 48;"

This simulates the clockwise rotation of the knob one full revolution.

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NOTE

Depending on the element receiving the knob count, the response may not be proportional to the size of the count; e.g., RG10 may result in a larger effect than RG5;RG5.

Send Knob Data: RP responsemode

The RP command causes the display to output, over HP-IB, the count of knob rotations accumulated since the last knob count reading. The response may be sent in either ASCII or binary format.

responsemode = 0: ASCII (default condition)
responsemode = 1: Binary

Example: OUTPUT @Dsp;"RP;" ENTER @Dsp;Count

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Section 11: UTILITY COMMANDS

The HP 70205A and HP 70206A Graphics Displays have several capabilities not mentioned in prior sections that deal with such things as self-testing of the display, automatically reconfiguring the screen, moving traces, and interrogating the display for available memory space. This section covers the following commands.

```
BP — Output audible "beep" tone
HF — Temporarily hold off on trace drawing
OL — Output learn string for reconfiguration
PG — Clear page (delete contents of only one window)
PN — Pan trace (graph or plot) across screen
RM — Interrogate display for remaining memory space
TE — Initiate self-test of display
TP — Specify trace pointer for graph updating
WM — Load label stating which menu is in use
```

Beep: BP frequency, duration

The BP command causes the display to put out an audible beep. The frequency and duration are independently adjustable to any of several discrete values, as shown below.

Frequency	Duration
444 (Hz)	.8 (mS)
500	15
571	31
666	61
800	123
1000	246
1333	492
2000	983

Hold Off: HF mode#

The HF command lets the user force the display to stop drawing new figures, although more data can still be sent. Once the HF command is received with "mode #" equal to 1, the display will finish drawing all figures in the input buffer, and then stop displaying new data until the "HF0" command is received. This command can be used to present only complete traces on the screen, but will affect speed of drawing, and may affect other windows in a multi-instrument system.

mode# = 1: Stop updating trace data.
mode# = 0: Resume updating trace data.

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Intensity Adjust: IA intensity #

IA sets the Display intensity. (in steps of 1). The parameters and their values are shown below.

Intensity # = 0 through 19
Default = 15

NOTE

An intensity setting of 0 is not guaranteed to result in a fully-off display.

Output Learn String: OL (no parameter sent but response generated)

The OL command can be used to obtain, over HP-IB, a string of ASCII characters describing the current configuration of the display screen (window definitions and assignments, but not trace data or stored configurations). This string can be stored in a controller or on a disc, and later sent back to the display, causing the display to reconfigure itself as it was prior to receiving the OL command.

Example: Reconfigure Display to Prior State.

```
10  ASSIGN @Dsp TO 704
20  DIM L$[100]
30  OUTPUT @Dsp;"DE;IN;"
40  OUTPUT @Dsp;"BW1,112,16,911,195,0,0,0,0;"
                (BUILD WINDOW #1, ASSIGN TO HP-IB)
50  OUTPUT @Dsp;"BW2,112,205,911,383,1,0,18,1;"
                (WINDOW #2,ASSIGN TO SPECTRUM ANALYZER AT 0,18)
60  OUTPUT @Dsp;"SNO;"
70  PAUSE
                (VIEW CONFIGURATION — PRESS CONTINUE)
80  OUTPUT @Dsp;"OL;"
                (ASK FOR LEARN STRING ON HP-IB)
90 ENTER @Dsp USING "%,K";L$
                (RECEIVE LEARN STRING)
100 OUTPUT @Dsp;"DE;"
                (DELETE SCREEN)
110 OUTPUT @Dsp;"SNO;"
                (SHOW BLANK CONFIGURATION ON SCREEN)
120 PAUSE
                (VIEW CONFIGURATION — PRESS "CONTINUE")
130 OUTPUT @Dsp USING "#,K";L$
                (SEND LEARN STRING — RECONFIGURE SCREEN)
140 SEND 7;DATA 0 END
150 OUTPUT @Dsp;"SN0;"
                (SHOW "NEW" CONFIGURATION)
160 END
```

Page: PG (no parameters sent, no response generated over HP-IB)

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The PG command erases all information displayed in the current window. While this does cause all trace data in that window to be lost, it does not alter the screen configuration as DE (Delete Screen) does, nor does it affect information contained within the other windows.

Remaining Memory: RM (no parameters sent, but response generated)

The RM command causes the display to output over HP-IB an ASCII string describing the amount of memory remaining for displayed information. The information is in the form: # blocks, block size (words).

Example: Interrogate Display for Remaining Memory.

```
10 ASSIGN @Dsp TO 704
20 OUTPUT @Dsp;"DE;IN;"
30 OUTPUT @Dsp;"RM;"
40 ENTER @Dsp;L$
50 DISP L$
60 END
```

The controller screen should respond with a number such as "96, 128" (96 blocks remaining, 128 words each).

Switch Sweep Circuits: SW sweep #

SW turns on and off the horizontal sweep of the display, which subsequently blanks the display. The sweep is turned back on if any key is pressed. The parameters and their values are shown below.

Sweep on = 0
Sweep off = 1
Default = 1

NOTE

It is not recommended that SW be used for blanking the Display due to the visible turn-on and turn-off transients.

Self Test: TE (no parameters)

The TE command initiates the self-test routine of the display. This is the same test described under the *CONFID TEST* softkey discussion in Chapter 2.

If the display fails the self test, error 6008 will be generated which will go out to OE or OG. If it passes, OE or OG will return 0.

Which Menu: WM menu

The WM command can be used to load a menu name into the left half of the display status box.

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NOTE

The menu name placed on the screen by the WM command does not necessarily relate to the actual softkeys displayed.

menu = 0: Blank the menu status box.
menu = 1: Load menu status box with "MENU."
menu = 2: Load menu status box with "USER."

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CHAPTER 4
APPENDICES

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APPENDIX A
DISPLAY COMMAND SUMMARY

The command summary below is a listing of HP 70205A and HP 70206A Display commands. The categories of commands correspond to section headings in Chapter 3, Remote Display Operation.

SECTION 1: DISPLAY CONFIGURATION

AK	ASSIGN KEYBOARD
BW	BUILD WINDOW
CI	SELECT INSTRUMENT
DE	DELETE ENTIRE SCREEN
DF	DEFAULT VALUES
IN	INITIALIZE
OG	OUTPUT GRAPHICS LINK
OP	OUTPUT P1, P2
RC	RECALL SCREEN CONFIGURATION
SN	SHOW CONFIGURATION
SV	SAVE CONFIGURATION

SECTION 2: SIMPLE GRAPHICS

AX	AXIS
DX	SET DELTA – X
GA	GRAPH ABSOLUTE
GR	GRAPH RELATIVE
GT	GRATICULE
LT	LINE TYPE
MP	MAPPING SHAPE
PA	PLOT ABSOLUTE
PD	PEN DOWN
PR	PLOT RELATIVE
PU	PEN UP
SC	SCALE TO USER UNITS
SP	SELECT PEN

SECTION 3: LABELING THE SCREEN

CL	CONFIGURE LABEL
DI	SET CHARACTER DIRECTION ABSOLUTE
DR	SET CHARACTER DIRECTION RELATIVE
DT	DEFINE TERMINATOR
LB	LABEL
SI	SET CHARACTER SIZE ABSOLUTE
SR	SET CHARACTER SIZE RELATIVE

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SECTION 4: HARDCOPY OUTPUT

CY	COPY
EJ	EJECT
HR	HIGH RESOLUTION
KC	KEYCOPY ON/OFF
PI	PRINTER/PLOTTER IS
PL	PLOTTER PARAMETERS

SECTION 5: MARKERS

IS	INTENSITY SETTING
MA	MARKER ATTRIBUTES
MK	PLACE MARKER

SECTION 6: CHARACTER SETS

CA	DESIGNATE CHARACTER SET ALTERNATE
CS	DESIGNATE CHARACTER SET STANDARD
SA	SELECT ALTERNATE CHARACTER SET
SS	SELECT STANDARD CHARACTER SET
SU	SAVE USER-DEFINED CHARACTER
UC	DRAW USER-DEFINED CHARACTER

SECTION 7: REFERENCED GRAPHICS

BA	BLANK AHEAD
BL	BLINK ON/OFF
DA	DELETE ALL REFERENCED/NON-REFERENCED OBJECTS
DL	DELETE ACTIVE ITEM OR GROUP
GP	IDENTIFY GROUP
IT	IDENTIFY ITEM
OR	SET ORIGIN
PN	PAN
TP	TRACE POINTER
VW	VIEW ON/OFF

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SECTION 8: INFORMATIONAL DISPLAYS

AM	ADDRESS MAP
DS	DISPLAY STATUS ON/OFF
ES	ERROR SCREEN
OI	OUTPUT IDENTIFICATION
OV	OUTPUT VERSION
SN	SHOW CONFIGURATION
OO	OUTPUT OPTIONS

SECTION 9: ERROR HANDLING

EG	OUTPUT ERROR STRING
ES	ERROR SCREEN
IM	INPUT MASK
OE	OUTPUT ERROR NUMBER
OS	OUTPUT STATUS

SECTION 10: REMOTELY-CONTROLLED DISPLAY

AE	ALPHA ENTRY
FC	FILL COMMAND WINDOW
KP	SIMULATE KEY PRESSED
KY	SEND KEYBOARD DATA
ML	MENU LOAD
PP	PRE-PROCESS
RG	SIMULATE KNOB TURNED
RP	SEND KNOB DATA

SECTION 11: UTILTITY COMMANDS

BP	BEEP
HF	HOLD OFF
IA	INTENSITY ADJUST
OL	OUTPUT LEARN STRING
PG	PAGE
RM	REMAINING MEMORY
SW	SWEEP CONTROL
TE	SELF TEST
WM	WHICH MENU

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APPENDIX B
HP-GL COMMANDS

Some non-HP-GL commands in the display have the same mnemonics as HP-GL commands not in the display (for example, GP).

BP	BEEP
CA	DESIGNATE ALTERNATE CHARACTER SET
CS	DESIGNATE STANDARD CHARACTER SET
DF	SET DEFAULT VALUES
DI	SET CHARACTER DIRECTION ABSOLUTE
DR	SET CHARACTER DIRECTION RELATIVE
DT	DEFINE TERMINATOR
GR	GRAPH RELATIVE
IM	INPUT MASK
IN	INITIALIZE
LB	LABEL
OE	OUTPUT ERROR
OH	OUTPUT HARD LIMITS
OI	OUTPUT IDENTIFICATION
OO	OUTPUT OPTIONS
OS	OUTPUT STATUS
PA	PLOT ABSOLUTE
PD	PEN DOWN
PG	PAGE
PR	PLOT RELATIVE
PU	PEN UP
SA	SELECT ALTERNATE CHARACTER SET
SC	SCALE TO USER UNITS
SI	SET ABSOLUTE CHARACTER SIZE
SP	SELECT PEN
SR	SET RELATIVE CHARACTER SIZE
SS	SET STANDARD CHARACTER SET
UC	USER-DEFINED CHARACTER

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