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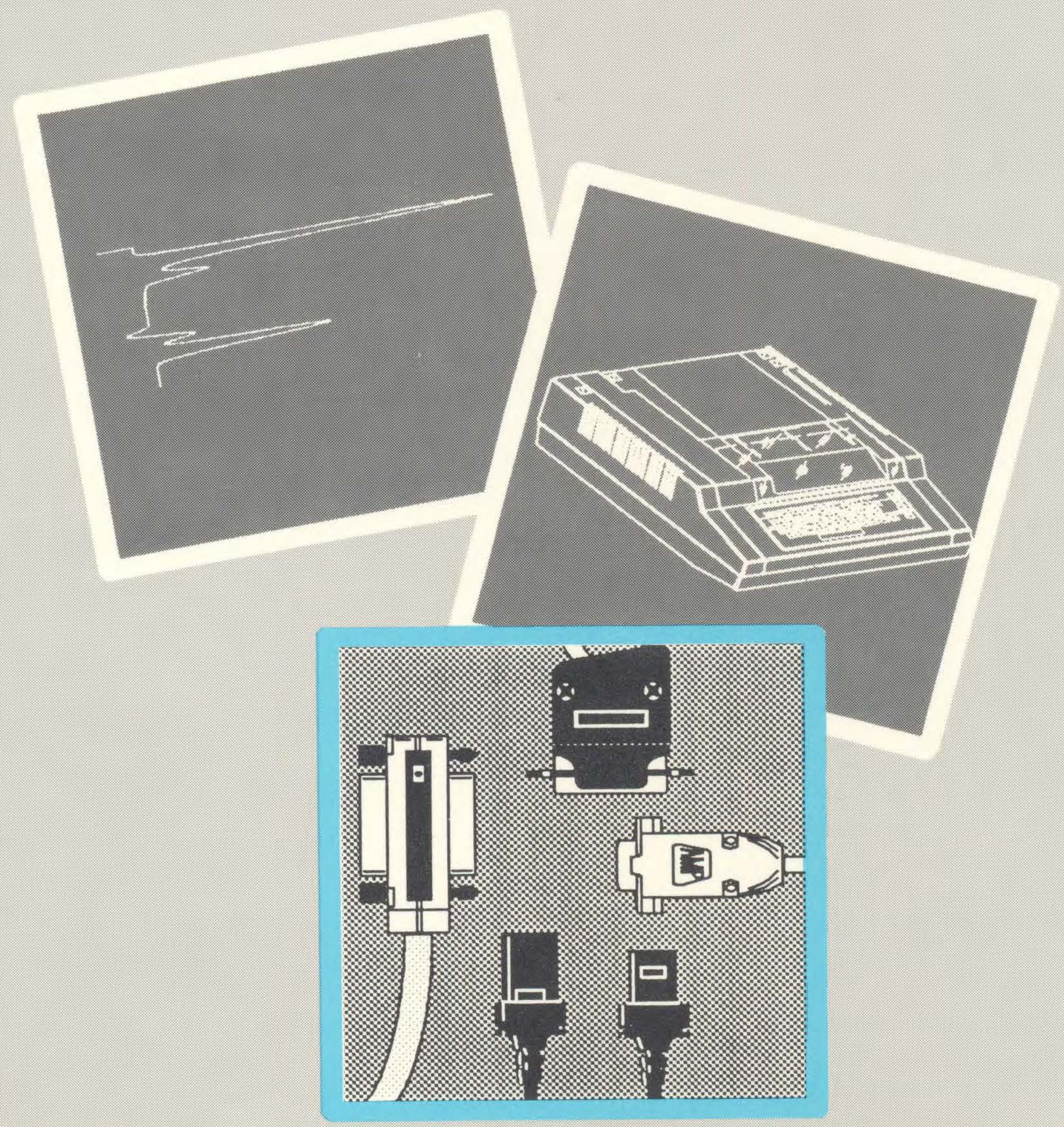

HP 3396 Series II Integrator
Networking Guide

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HP 3396 Series II Networking Guide

Part Number 03396-90255

What is your major application of the product described in this manual?

_____

_____

How long have you been using this product?

☐ Just received ☐ 1-3 months ☐ 3-6 months ☐ 6-12 months ☐ Over 1 year

How often do you refer to this manual?

☐ Daily ☐ Weekly ☐ Monthly ☐ Seldom ☐ Never

What was your level of integrator knowledge before you began using this manual?

☐ None ☐ Just beginning ☐ Some experience ☐ Experienced ☐ Expert

Please indicate your agreement (or disagreement) with these statements:	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
• The manual contains the information I need.	☐	☐	☐	☐	☐
• The information is easy to find.	☐	☐	☐	☐	☐
• The information is accurate.	☐	☐	☐	☐	☐
• The instructions are easy to understand.	☐	☐	☐	☐	☐
• The manual contains enough examples.	☐	☐	☐	☐	☐
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_____

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Networking Guide
HP 3396 Series II Integrator

Manual Part No.
03396-90255

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Printing History

The information contained in this document may be revised without notice.

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First edition—June 1990
Printed In U.S.A.

Safety Information

The HP 3396 Series II is an IEC (International Electrotechnical Commission) Safety Class 1 instrument. This unit has been designed and tested in accordance with recognized safety standards.

Whenever the safety protection of the HP 3396 Series II has been compromised, disconnect the unit from all power sources and secure the unit against unintended operation.

WARNING

A WARNING CALLS ATTENTION TO A CONDITION OR POSSIBLE SITUATION THAT COULD CAUSE YOU OR OTHERS INJURY.

CAUTION

A Caution calls attention to a condition or possible situation that could damage or destroy the product or your work.

Important User Information for In Vitro Diagnostic Applications

This is a multipurpose product that may be used for qualitative or quantitative analyses in many applications. If used in conjunction with proven procedures (methodology) by a qualified operator, one of these applications may be In Vitro Diagnostic Procedures.

General instrument performance characteristics and instructions are included in this manual. Specific In Vitro Diagnostic procedures and methodology remain the choice and the responsibility of the user and are not included.

RFI Certification for the Federal Republic of Germany

Manufacturer's Declaration

This is to certify that the equipment **HP 3396 Series II** is in accordance with the Radio Interference Requirements of Directive FTZ 1046/1984. The German Bundespost was notified that this equipment was put into circulation and the right to check the series for compliance with the requirements was granted.

Herstellerbescheinigung

Hiermit wird bescheinigt, daß das Gerät/System

HP 3396 Series II

in Übereinstimmung mit den Bestimmungen von Postverfügung 1046/84 funkentstört ist.

Der Deutschen Bundespost wurde das Inverkehrbringen dieses Gerätes/Systems angezeigt und die Berechtigung zur Überprüfung der Serie auf Einhaltung der Bestimmungen eingeräumt.

How to Use this Guide

This book is part of the HP 3396 Series II manual set and addresses how to use the HP 3396 as part of a system of instruments.

Installation instructions for the devices mentioned in this book (except for RS-232-C devices) are located in the *Installation and Serivce Manual.* Specific cable and troubleshooting information is also located there.

You'll find information in the first chapter about using the HP 3396 Series II integrator with older Hewlett-Packard instruments and other manufacturer's analytical instruments.

Consult chapter 2 for information about Hewlett-Packard's analytical instrument network, INET.

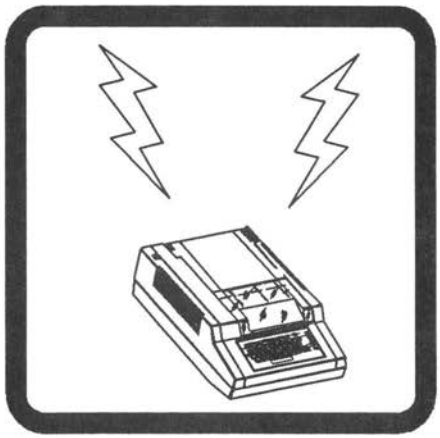
Chapter 3 discusses how to use printers and disk drives with the HP 3396.

Information about using the RS-232-C capabilities of the HP 3396 is located in chapter 4. The HP Peak-96 Information Manager connects the HP 3393/96 integrator to your HP Vectra or equivalent Personal Computer. In-depth programming information for other RS-232-C applications can be found in the HP 3396 Series II *RS-232-C Programmer's Guide,* which may be ordered separately (part number 03396-90335).

Contents

1

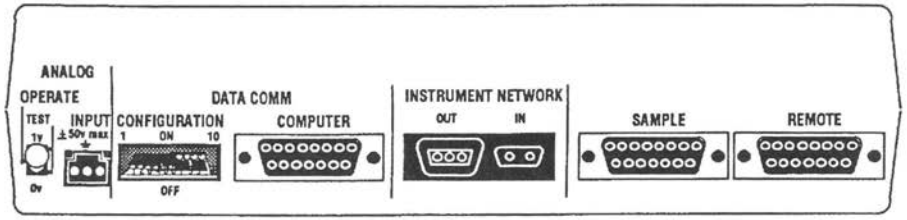
Communicating with Other Devices



In this chapter...

What Devices Communicate with the Integrator?

The HP 3396 Series II integrator communicates with a variety of devices through its back panel receptacles.



Device Type	Interface Type	Back Panel Receptacle	See Chp
HP networking analytical instruments	INET	INSTRUMENT NETWORK	3
Non–INET analytical instruments	Analog	ANALOG INPUT	1
	TTL	REMOTE	1
	BCD	SAMPLE	1
Printers	HP-IL and HP-IB*	INSTRUMENT NETWORK	2
	RS-232-C	COMPUTER	4
Disk drives	HP-IL and HP-IB*	INSTRUMENT NETWORK	2
HP-IL/HP-IB Interface (HP 82169A)	HP-IL	INSTRUMENT NETWORK	2
Host computer	RS-232-C	COMPUTER	4
Modem	RS-232-C	COMPUTER	4

**Requires HP 82169A HP-IL/HP-IB Interface*

Using Non-INET Analytical Instruments

The HP 3396 Series II integrates analog input between –10 mV and +1000 mV.

Use the appropriate Analog Signal cable to connect an analytical instrument not part of Hewlett-Packard's instrument network to the analog input receptacle of the HP 3396 Series II. See the *Installation and Service* Manual for installation information.

NonINET analytical instruments must be started and stopped manually unless the Remote Control cable is used. Sample numbers are transmitted from nonINET instruments through the Sample Number cable.

Using the Remote Control Cable

A Remote Control cable allows the integrator

- to start other instruments
- to be started and stopped by other instruments
- to provide readiness status to other instruments.

Since remote control signals are exchanged over the Instrument Network (INET), a Remote Control cable is not usually needed when INET is installed.

NOTE: Since both INET and the Remote Control cable supply readiness status, any instrument connected to the HP 3396 via INET should not directly or indirectly connect its READY output to the HP 3396's READY input via the Remote Control cable.

The Remote Control cable start output is connected to the start input of an analytical instrument such as a gas chromatograph (GC). The READY line in the cable may be connected to a signal from the GC that indicates oven readiness. In this case, when you press **[START]** on the HP 3396, the integrator is started, and so is the oven program on the GC. If the oven or the integrator is not ready, the message "`not ready`" is printed at the start of the run. The integrator processes the signal anyway; the message serves only to caution you that something is not ready.

See the HP 3396 Series II *Installation and Service* Manual for related information.

Using the Sample Number Cable

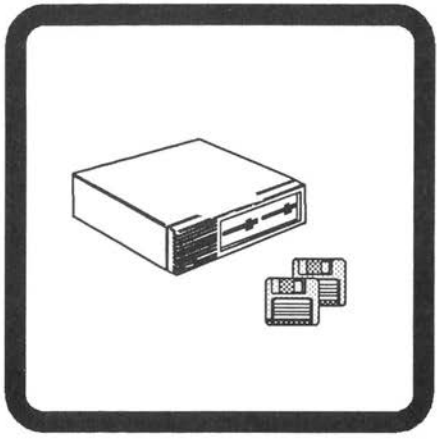
The Sample Number cable allows the HP 3396 Series II to accept binary coded decimal (BCD) sample (bottle) number data from an automatic sampler or sequencer. Since sample number data are exchanged over INET, a sample number cable is usually not needed when INET is installed. See chapter 3, *Using the Instrument Network* for a more detailed explanation.

Further information about how to automate a series of analyses using the Sample Number cable can be found in the *Automating Analyses* chapter of the HP 3396 Series II *Operating Manual*.

See the HP 3396 Series II *Installation and Service Manual* for related information.

2

Using the Instrument Network



In this chapter...

What Is the Instrument Network?

Hewlett-Packard's analytical Instrument Network (INET) provides a data, parameter, and command path for analytical instruments to communicate with each other. The Hewlett-Packard Interface Loop (HP-IL) provides a path for this communication. The following table lists the INET instruments that are compatible with the HP 3396 at the time of this printing.

INET Instruments Compatible with the HP 3396

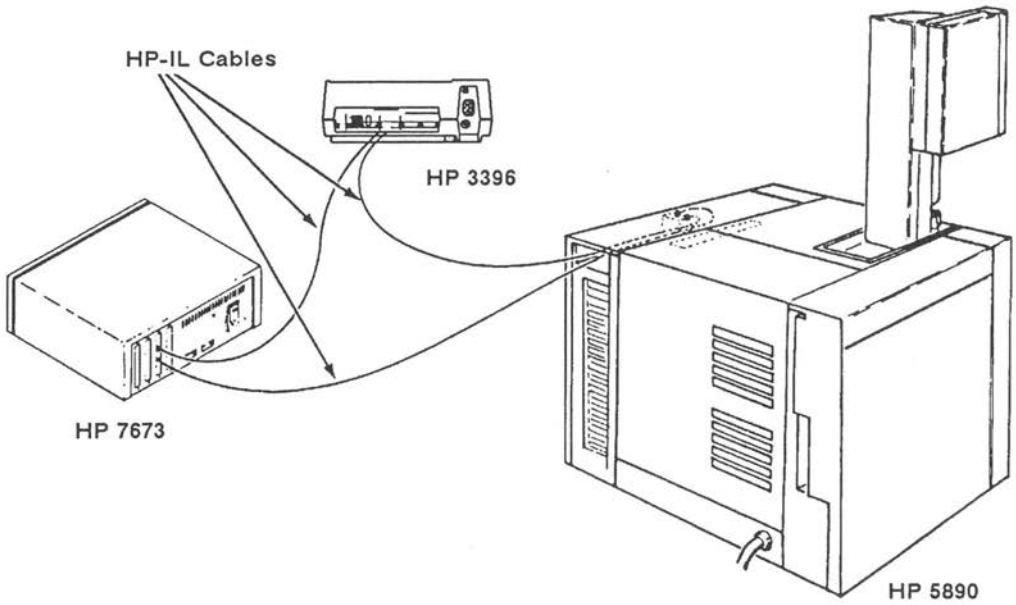
Device Type	Model Number	Comments
INET GC	HP 5890A	Rev C or later software.
INET GC	HP 5890 Series II	
INET LC	HP 1090L	Rev B2616 or later software is compatible with the HP 3396.
INET Sampler	HP 7673	Automatic sampler.
INET Sampler/Event Control Module (S/ECM)	HP 19405A	Used with nonINET samplers, HP 7670/71/72A and to control automated GC valving.

Starting and Stopping INET

When INET is enabled, runs may be started from any INET instrument by pressing **[START]**. All INET instruments will start at the same time, coordinated by communication over the network. When starting sequences on INET, the HP 7673 will begin its pre-run activity before starting the HP 5890 and its associated integrator.

See chapter 9 of the HP 3396 *Operating Manual* for related information.

Hewlett-Packard's Instrument Network (INET)



Checking for Instrument Readiness

All INET instruments, the HP-IL disk drives, and instruments that use the READY line in the Remote Control cable can be checked for readiness by the HP 3396.

The green READY indicator on the keyboard indicates local HP 3396 readiness only.

1. **Type [R] [E] [A] and press [ENTER] to check system readiness.**

   If the HP-IL loop is "UP" (all cables connected, all instruments switched on), and if all INET instruments and HP-IL disk drives are ready, the HP 3396 prints `SYSTEM IS READY`. (The HP 3396 checks the readiness of the disk drives only when file storage is enabled via option 2 or option 5.)

   The Remote Control cable ready line must be in its ready state, as well, if it is being used.

   If the HP-IL loop is "DOWN" (a broken connection, or instruments powered OFF), the HP 3396 assumes you are not using it, and reports that all is ready as above. To avoid being misled if you don't know whether the loop is down, use the **SYSTEM** command **[S] [Y] [ENTER]**. The HP 3396 will print `Loop is down` instead of the `LOOP CONFIGURATION TABLE` if the loop is not active.

   During sequence operation the readiness check is performed automatically, and the HP 3396 waits for system readiness before starting each run in the sequence. However, when you start a run manually, the HP 3396 will not automatically check readiness. When the system is not ready and a run is started manually, the run will proceed after warning you that the system is not ready by printing `START; not ready`.

Listing INET Devices

With the HP 3396 in system command mode, a user can get a listing of the INET Configuration Table. This command can be abbreviated by its first two characters.

1. **Type [I] [N] and press [ENTER] to get a listing of the INET Configuration Table.**

The routing of INET data from producers to consumer is referred to as a *data path* in the table. Data paths are automatically configured when the instrument is switched on, but may also be changed manually from the HP 3396 keyboard.

Example

INET CONFIGURATION

ENTRY	MODEL	ADDR	DATA PATH	STATUS
1	3396A	0	BO CONS CH 0	IDLE
2	7673A	9	BO PROD CH 0	IDLE
3	7673A	9	BO PROD CH1	IDLE
4	3396A	0	C1 CONS CH 0	ACTIVE
5	5890A	10	C1 PROD CH 0	ACTIVE
6	5890A	10	C1 PROD CH 1	IDLE
7	3396A	0	KO PROD CH 0	ACTIVE
8	7673A	9	KO CONS CH 0	ACTIVE
9	5890A	10	KO CONS CH 0	ACTIVE
10	3396A	0	SO CONS CH 0	ACTIVE
11	7673A	9	SO PROD CH 0	ACTIVE
12	7673A	9	SO PROD CH 1	IDLE

NOTE: The HP 3396A and the HP 3396 Series II are both listed as 3396A on the INET configuration listing.

Controlling INET Devices

The HP 5890 and HP 7673 have the ability to execute unique sets of commands sent from the HP 3396 using K0 data path transactions. Each of these instruments also has a set of response messages that are returned to the HP 3396 as a result of executing a command.

The HP 5890 has a keycode corresponding to each key on its keypad. (See table on the next page.) By combining keycodes, command strings can be formed to implement a sequence of keystrokes as if they had been entered directly at the keypad.

Example

To enter an oven temperature of 250°C at the HP 5890's keypad, you would press **[OVEN] [TEMP] 250 [ENTER]**

The command string for this set of key sequences is **KEY:G250@** where **KEY:** is the command for keypad entries.

1. **Press [OP( )] [6] [ENTER] to send a K0 command string.**

   This dialog may also be accessed through section 8 of the **[EDIT] [METH]** dialog. Whichever way the dialog is accessed, the syntax for entering commands remains the same and the HP 3396 responds with

   ```
   DEVICE ADDRESS:
   ```

2. **Press [10] [ENTER] to enter the loop address of the HP 5890.**

   This address is printed in the INET Configuration Table which is accessed by pressing **[I] [N] [ENTER]**. After entering the address of the intended consumer, the HP 3396 will prompt for a command string with

   ```
   COMMAND STRING:
   ```

3. **Type KEY:G250@ to set the oven temperature on the HP 5890 to 250°C.**

   The command string entered at this point depends on the instrument receiving the command and your purpose. A partial list of commands, which represent set points for the HP 7673, can be found on the next two pages.

   See *Understanding INET* later in this chapter for related information.

INET_I/O Commands for HP 5890A and HP 5890 Series II

HP 5890 Key	Keycode	HP 5890 Key	Keycode
STOP	=	CLEAR	?
START	^	0	0
OVEN TEMP	G	1	1
INIT TEMP	H	2	2
INIT TIME	I	3	3
RATE	J	4	4
FINAL TEMP	K	5	5
FINAL TIME	L	6	6
INJ A TEMP	M	7	7
INJ B TEMP	N	8	8
DET A TEMP	O	9	9
DET B TEMP	P	.	.
OVEN MAX	Q	-	-
EQUIB TIME	R	gold key	/
SIG 1	V	TABLE	/H
SIG 2	W	ADD	/I
RANGE	X	DELETE	/J
ZERO	Z	PREVIOUS	/K
ATTN	Y	NEXT	/L
DET	>	INJ A PRES	/M
ON	E	INJ B PRES	/N
OFF	F	OVEN TRACK	/O
A	A	AUX TEMP	/P
B	B	FLOW PARAM	/S
COL COMP 1	C	CRYO PARAM	/S
COL COMP 2	D	STORE	/V
FLOW	S	LOAD	/W
PURGE	U	TCD SENS	/>
TIME	T	to check ROM version	;
ENTER	@	super clear	:

HP 7673 INET_I/O Commands

HP 7673 Command	Command Abbreviation
INJECTIONS/BOTTLE	INJ
FIRST BOTTLE	FIRST
LAST BOTTLE	LAST
SAMPLE WASHES	WASH
PUMPS	PUMP
VISCOSITY	VIS
INJECTION VOLUME	VOL
A WASHES	AWASH
B WASHES	BWASH
PRIORITY SAMPLE	PRI
ON-COLUMN	ONCOL

The following BASIC program uses the **INET_IO** command and the command string listed above to set the oven temperature to 250°C at the HP 5890 located at INET address 8. For this program to execute properly, the HP 3396 must be configured as a K0 producer and the HP 5890 as a K0 consumer. See *Understanding INET* later in this chapter for instructions on how to change the INET Configuration Table.

```
 10 !This program sets HP 5890 GC OVEN TEMP to 250
 20 !First dimension a command string (GCOP$) for the appropriate
 30 !keystrokes and a response string (GCRESP$) for the GC's response
 40 DIM GCOP$(22), GCRESP$(80)
 50 !Enter the command string
 60 GCOP$ = "KEY:G250@"
 70 !Transmit the command to device address via INET
 80 INET_IO 8, GCOP$, GCRESP$
 90 PRINT GCRESP$
100 END
```

This program directs the HP 3396 to print the instrument's response to the command sent to it. The response printed by the HP 3396 might look like this:

```
AOVEN     TEMP      50        250
```

In this case, the "A" indicates that the HP 5890 has acknowledged the new oven temperature set point. The current value of the oven temperature is listed next, followed by the new set point. Attempting to set the oven temperature to 500° C, however, elicits the following response:

```
OVEN LIMIT = 400
```

Any combination of keys that is valid on the keyboard can be replicated using the INET_IO command. When an invalid key sequence is entered, the CLEAR keycode must be sent to clear the error and go on, just as it is done at the instrument keypad. Refer to the Operator's Quick Reference Card and the HP 5890 *Reference Manual* for a list of valid key sequences for the HP 5890.

Controlling the HP 7673 through BASIC

Commands are sent via INET to control the HP 7673 in the same way they are sent to the HP 5890. However, since the HP 7673 does not have a keypad, the sampler commands duplicate all the set points accessible through the HP 3396 sequence dialog. Unlike the HP 5890, the HP 7673's message strings are composed of a set point keyword and a value for either or both the front and rear injectors. A complete list of keycodes for the HP 7673's sampler parameters are located earlier in this section. The syntax for each sampler command is the same. The table below uses the INJECTIONS/BOTTLE command to illustrate the sampler command syntax.

Command String Syntax for the HP 7673

Command String Syntax	Action Taken by HP 7673
INJ	Returns current set points
INJ2,3	Injector 1 will do 2 injections per bottle. Injector 2 will do 3 injections per bottle.
INJ,1	Injector 1 will use its current setting. Injector 2 will do 1 injection per bottle.
INJ3,	Injector 1 will do 3 injections per bottle. Injector 2 will use its current setting.

When the HP 7673 acknowledges a set point, the HP 3396 prints the current set point values separated by a comma, for the front and rear injectors. If only one injector is installed, the set point will be repeated twice. If only one injector's set point is changed, the previous set point value for the other injector is retained and printed. When the sampler command string causes an error, then the sampler will print "N" and an error message. If a keycode is sent to a different instrument at the wrong address, the HP 3396 may print:

```
ADDRESS IS NOT ON LOOP OR DOES
NOT SUPPORT KO DATA PATH
```

Example

The BASIC program below illustrates how to send commands to a dual injector HP 7673 to control the number of pumps done by the front and rear injectors. The HP 3396 must be configured as a K0 producer and the HP 7673 as a K0 consumer. See *Understanding INET* later in this chapter for instructions on how to change the INET Configuration table. The HP 7673 in this example is at INET address 9.

```
 10  !Set HP 7673A front injector to do 5 pumps per sample and
 20  !the rear injector to do 2 pumps per sample
 30  !SAMPOP$ = command string
 40  !SAMPRESP$ = response string
 50  DIM SAMPOP$(22), SAMPRESP$(80)
 60  !Enter the command string
 70  SAMPOP$ = "PUMPS5,2"
 80  INET_IO 9, SAMPOP$, SAMPRESP$
 90  PRINT SAMPRESP$
100  END
```

This program directs the HP 3396 to print the INET sampler's response to the PUMP command string. If the sampler accepts the new set point, it might respond with:

```
A  5,  2
```

If, however, the command is rejected by the sampler, it responds with:

```
N error message
```

Understanding INET

HP-IL, the Hewlett-Packard Interface Loop, is a serial two-wire connection and a software protocol that allows printers, storage devices, and analytical instruments to communicate with each other. INET instruments are Hewlett-Packard samplers and gas chromatographs that operate with the HP 3396 on the HP-IL. INET devices use HP-IL protocol to exchange information.

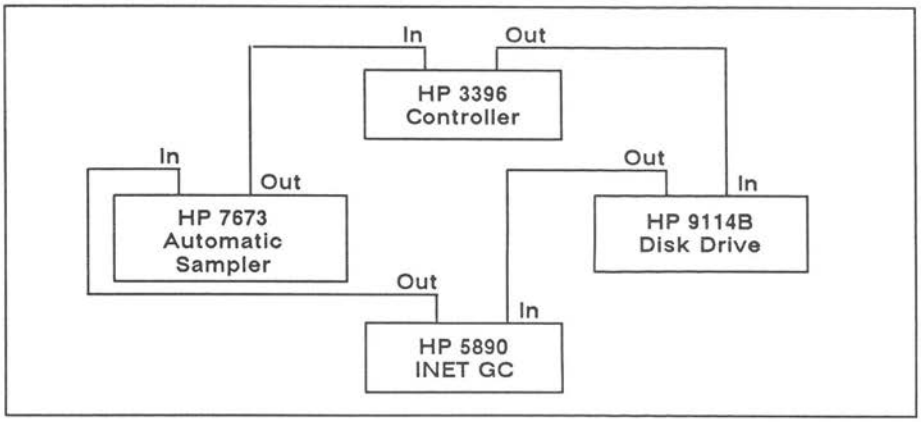
INET is a communications application of HP-IL that controls analytical instrumentation. Where HP-IL protocol allows printers and disk drives to communicate with the HP 3396A, INET provides a data and command path for analytical instruments to operate effectively together. Implicit in the network are protocol and data structures that allow a group of instruments comprising a controller, data producers, and data consumers to function as a single system. Each INET device is an HP-IL device with an extra layer of software for more sophisticated operation. INET is controlled locally by the HP 3396 or remotely controlled by a host computer when an integrator is not used.

Since INET instruments use the HP-IL interface, much of the physical operation is also the same as HP-IL. The HP-IL-based network has one controller and a number of talkers and listeners. The HP 3396 is the HP-IL controller. Producers send messages over the loop and consumers receive messages. INET's producers and consumers are divided further into "objects" (or instrument functions) that produce and consume different types of chromatographically meaningful data.

Each INET instrument stores its own set points and parameters and also makes them available to the HP 3396, for listing and remote storage. The collection of these storage areas is the active workspace of the HP 3396 system. The active workspace will expand and contract as instruments are added or removed from the network. However, while the HP 3396 is being operated, the active workspace always appears to be a single, contiguous, yet distributed piece of information.

A typical INET system is illustrated below.

INET System



As stated before, INET adds another layer of software protocol to HP-IL so that analytical instruments can communicate with each other as well as with other HP-IL devices. Since INET devices must conform to HP-IL standards, both types of instruments are compatible on the same loop with one HP 3396 acting as controller for both analytical and HP-IL devices.

Controlling INET Devices

The HP-IL interface and INET protocol allow the HP 3396 to receive and control INET instrument set points. The set points are encoded ASCII character strings and are grouped in blocks in the active workspace with the INET (loop) address of the instrument to which they belong. These strings are transmitted to the HP 3396 over the HP-IL/INET link during configuration. The HP 3396 can also pass set points between INET instruments (including itself) and local or computer storage. For example, the **[STORE] [METH]** key sequence initiates the passing of set point blocks from the network instruments to the HP 3396. Once these keys are pressed at the HP 3396 keyboard, all set point traffic is automatic.

If the network is broken and then reconnected in a different order, the address of a particular instrument may change. However, since the HP 3396 tries to load set points to the loop using model numbers as addresses, each instrument will still get the correct set point block as long as there are no other instruments with the same model number on the loop.

The HP 3396 only discriminates between instruments with the same model number by their physical location. Set points from a method saved prior to the break may be sent to the wrong instrument. If two instruments with identical model numbers are on the same loop and their positions are switched *after* a method has been stored, each will receive the set points intended for the other when the method is reloaded into the active workspace. However, INET instruments will not accept set points with parameter value errors (e.g. an HP 19405A will reject HP 5890 parameters).

In addition to accepting keyboard entry for its own set points, in certain cases the HP 3396 provides keyboard entry of set points for other INET devices. The **[PREP] [SEQ]** dialog allows set points to be chosen for the HP 7673 sampler or the HP 19405A S/ECM sampler controller. The HP 7673 sampler and HP 5890 GC set points may be entered via option 6, the **[PREP] [METH]** dialog, or through INET_IO statements in a BASIC program. The HP 3396 may alter set points before or after a run but not while a run is in progress. Specific instructions for how to enter set points for INET instruments from the HP 3396 are described in earlier in this chapter.

INET Operating States

As the instruments exchange commands under the direction of the HP 3396, INET moves through its five distinct operating states.

INET Operating States

Network State	Typical HP 3396 Mode or Activity
Inactive	Waiting for commands
Prerun	Waiting for sampler to find bottle, doing pumps, washes, etc.
Run	Integration mode
Postrun	Calculation and report generation
"Run may not begin"	Plot mode, BASIC mode, during an **ANALYZE**, an open dialog, or threshold measurement. Also if the host computer explicitly requests the "run may not begin" state, or during a column compensation run on the HP 5890.

INET states are characterized by the type of HP 3396 activity as well as the kinds of data transmissions that are taking place. The steps outlined below illustrate how an HP 3396 and an active sampler would typically proceed through different network states as they carry out a sequence of runs.

1. Inactive state: The network instruments are ready; the user then presses **[SEQ] [START]** on the HP 3396 keyboard. The HP 3396 issues a command to change the network state to the Prerun state.

2. Prerun state: The sampler begins searching in its sample tray for the bottle specified in its sequence. When it finds the bottle, it makes an injection and issues a command for INET to enter the Run state.

3. Run state: The HP 3396 enters INTEGRATION mode. When the run ends (for example, when a Timetable STOP command occurs), the HP 3396 sends a message on the network to change the network to the Postrun state.

4. Postrun state: During this state, the HP 3396 calculates the result of the previous run and prints its report. It calls for any report annotations other instruments wish to add, and it appends them to the end of the report. (The report may be printed or written to a file.)

5. The next state change depends on the sampler. If the sampler is finished, it directs the network to the Inactive state (1). If it is not finished with its sequence, it directs the network to the Prerun state (2). The sampler advances to the next sample to be injected and INET operation continues from there.

Automatic Network Configuration

Data paths connect data producers to data consumers of matching type and format. INET automatically configures data paths among all of the instruments on the loop. Certain objects allow only one consumer or producer, while other data types may allow multiple consumers and producers.

When an active data producer puts data out on the loop, the active consumers of that type of data accept it automatically. For example, an active INET sampler (e.g. HP 7673) produces sample numbers on the loop. The HP 3396 is an active consumer of sample numbers. It prints the sample number from the sampler in the upper right hand corner of the report for that run and also searches its sample table for a match to the sample number.

Before the configuration process is begun, the HP 3396 determines whether to initiate a cold- or warm-start configuration. The HP 3396 initiates a cold-start configuration when

- the HP 3396 is switched off and switched back on,
- a **RECONFIGURE** command is executed from system command mode,
- a power failure occurs for a length of time greater than the battery life or memory backup time of any INET instrument on the loop,
- INET instruments are added to the HP 3396 after it has been operating in a stand-alone condition only since cold-start,

The HP 3396 initiates a warm-start configuration, reverting back to its last active state, when

- the loop is broken and reconnected in the same place,
- an HP-IB instrument is added or removed,
- an HP-IL instrument is added to the INET loop in such a way that no INET instrument addresses are changed,
- INET or HP-IL instruments are added to or removed from a working INET loop in a way that changes the address of one or more INET instruments.

- a RECONFIGURE statement is executed from a BASIC program.
- power failure occurs for a length of time shorter than the battery life or memory backup time of any one of the INET instruments,
- the power fails on the HP 19405A,
- a method or sequence file is loaded into the active workspace.

The last case does not occur as part of the HP-IL reconfiguration, as do the other cases. The "Configuring, Wait ..." message does not appear and INET addresses on the loop do not change. The HP 3396 reconciles the INET data path information in the INET Configuration Table with the current hardware and configuration, linking producers and consumers as required by the method or sequence. If the file contains set points for instruments that are not on the network, those set points will not be used, and an error message will be printed. However, the loop will generally still function for devices that do have a set point match; missing devices will be ignored.

The configuration process proceeds as follows:

1. The HP 3396 first determines if the configuration is a cold–start or warm–start. When the configuration is a cold-start, the HP 3396 instructs INET instruments to set their configuration parameters to the cold (power-up) status. Otherwise, under warm-start conditions, configuration parameters remain active and unchanged.
2. The HP 3396 uploads configuration parameters from the INET devices in loop-address order to determine the current state of the devices and data paths.
3. The HP 3396 then modifies the configuration parameters it has received based on whether the configuration is a cold- or warm-start and on the configuration constraints listed earlier in this chapter.
4. The HP 3396 then downloads the modified parameters back to the INET devices and checks to see that the modified parameters are accepted by each device on the loop.

Establishing and Changing INET Data Paths

INET protocol allows INET instruments to exchange a number of different types of data. Because each instrument on INET is actually a collection of functions housed together, INET addresses these functions separately as "objects". Objects are instrument functions that act as producers or consumers of particular data types. Producers generate one data type and transmit it onto the loop for a corresponding consumer or consumers to use. The HP 3396, acting as an INET controller, routes data from producers to matching consumers. The data route from producer to consumer is defined as a "data path". The HP 3396 controller keeps track of

- the model numbers of all producers and consumers,
- the types of data being exchanged,
- the number of data-producing sources, or channels, in use with each data path,
- the status of each data path.

All of this information is listed in the INET Configuration Table; see *Listing INET Devices* earlier in this chapter.

INET Data Types

Various types of data are transmitted between INET instruments. The data types are qualified by a format #, a digit from 0 to 9. Format numbers allow instruments to choose among formats for expressing the standard data types, preventing erroneous automatic configuration with instruments using different formats.

Common data types in use with the HP 3396 are listed in the table below.

INET Data Types

Data Type	Name	Description
A0	Run Annotation (Format 0)	Data records of printable ASCII strings with a maximum of 42 characters for annotating the plot during a run.
B0	B0 (Format 0)	Reserved.
C1	Chromatographic Signal (Format 1)	20 Hz signal points cover the full HP 5890 FID dynamic range and are represented by a 32-bit binary signed number.
I0	Immediate Data (Format 0)	Sampler parameter data.
I1	Immediate Data (Format 1)	External events timetable data.
K0	Device Dependent Commands (Format 0)	Analytical instrument set point data or keyboard dialogs.
R0	Report Annotation (Format 0)	Printable ASCII data appended to reports.
S0	Sample Number (Format 0)	Three digit ASCII sample numbers ranging from 0 to 999 used in postrun report calculations.

INET Data-Type Configuration Constraints

Data Type	Constraints	INET State(s) During Data Transmission
A0	Multiple active producers and active consumers allowed.	Run or Plot
B0	Reserved; status cannot be changed.	Not applicable
C1	Multiple active consumers, one active producer allowed.	All
I0	One active producer and one active consumer allowed. HP 3396 activates the I0 consumer in the instrument that is the active S0 producer.	All
I1	One active producer and one active consumer allowed.	All
K0	One active producer and multiple active consumers allowed.	All, except for Run
R0	Multiple active consumers and active producers allowed.	Postrun, Idle, and "Run may not begin"
S0	One active S0 producer, multiple active S0 consumers allowed.	Immediately after Postrun

In general during INET configurations, instruments with lower addresses have priority in getting their objects activated. This is not true, however, when the HP 19405A and another INET sampler (e.g., the HP 7673) coexist on the same INET loop. In this case the HP 7673 will take priority as the active sampler (S0 producer) irrespective of its address.

The configuration process generates an INET Configuration Table, which has at least one entry for each INET device on the network. For simple devices, that entry may contain only the address and model number of the device. For more complex instruments, the table has an entry for each object or separate data-consuming function within the instrument.

With the HP 3396 in system command mode, a user can get a listing of the INET Configuration Table. This command can be abbreviated by its first two characters

[I] [N] [ENTER]

The routing of INET data from producers to consumer is referred to as a *data path* in the table. Data paths are automatically configured at power-on, but may also be changed manually from the HP 3396 keyboard. A typical INET Configuration Table is illustrated below.

INET Configuration Table

INET CONFIGURATION

ENTRY	MODEL	ADDR	DATA PATH	STATUS
1	3396A	0	B0 CONS CH 0	IDLE
2	7673A	9	B0 PROD CH 0	IDLE
3	7673A	9	B0 PROD CH1	IDLE
4	3396A	0	C1 CONS CH 0	ACTIVE
5	5890A	10	C1 PROD CH 0	ACTIVE
6	5890A	10	C1 PROD CH 1	IDLE
7	3396A	0	K0 PROD CH 0	ACTIVE
8	7673A	9	K0 CONS CH 0	ACTIVE
9	5890A	10	K0 CONS CH 0	ACTIVE
10	3396A	0	S0 CONS CH 0	ACTIVE
11	7673A	9	S0 PROD CH 0	ACTIVE
12	7673A	9	S0 PROD CH 1	IDLE

NOTE: The HP 3396A and the HP 3396 Series II are both listed as 3396A on the INET configuration listing.

Changing the INET Configuration Table

INET Configuration Table setpoints are stored in a method or sequence file when the **[STORE] [METH]** or **[STORE] [SEQ]** functions are executed. All HP 5890 Gas Chromatograph data paths are stored in the method file. All HP 7673 Automatic Sampler data paths are stored in the sequence file. Other instruments on the network have their paths divided between the method and sequence files. When method and sequence files are loaded, the system automatically tries to implement the INET configuration implied by these files.

For typical INET systems comprising an HP 3396, an HP 7673, and an HP 5890, the automatic configuration will be acceptable in most cases. However, it is possible to make configuration changes manually using the **INET_CONFIGURATION** command. This command provides a way to alter the loop configuration through an interactive dialog at the HP 3396 keyboard. To enter this dialog, press

[I] [N] [ENTER]

After the INET configuration is listed (see previous page), the HP 3396 prompts

```
EXIT, CHANGE, OR HELP [E*/C/H]:
```

Press **[ENTER]** to exit the dialog and return to the system command mode. **[H] [ENTER]** will explain the abbreviations used in the INET Configuration Table and list some precautions to take when manually changing the status of an entry manually. Entering **[C] [ENTER]** allows one to alter the configuration of the loop manually. When **[C] [ENTER]** is pressed, the HP 3396 responds

```
CHANGE ENTRY NUMBER:
```

The only information listed in the INET Configuration Table that may be changed through this dialog is the status of a data path. Active producers and consumers can be deactivated, and inactive ones can be activated. The configuration of a particular data type is subject to the constraints listed earlier in this chapter.

If an INET data path is listed as IDLE and you wish to activate it, enter the number of the entry to be activated. To deactivate an entry number, enter its number with a [–] key before it. For example, to use the analog input for the HP 5890 instead of INET data, the C1 data path in the listing above must be deactivated. Entering [–][**4**] and [–][**5**] accomplishes this. When the INET configuration is listed again, this path is shown as IDLE. See the figure below.

Changes to INET Configuration Table

```
EXIT, CHANGE, OR HELP [E*/C/H]: C

CHANGE ENTRY NUMBER: -4

CHANGE ENTRY NUMBER: -5

CHANGE ENTRY NUMBER:

*IN

                    INET CONFIGURATION
ENTRY   MODEL       ADDR    DATA PATH          STATUS
-----   ------      ----    ----------         ------
  1     3396A         0     BO CONS CH 0       IDLE
  2     7673A         9     BO PROD CH 0       IDLE
  3     7673A         9     BO PROD CH1        IDLE

  4     3396A         0     C1 CONS CH 0       IDLE
  5     5890A        10     C1 PROD CH 0       IDLE
  6     5890A        10     C1 PROD CH 1       IDLE

  7     3396A         0     KO PROD CH 0       ACTIVE
  8     7673A         9     KO CONS CH 0       ACTIVE
  9     5890A        10     KO CONS CH 0       ACTIVE

 10     3396A         0     SO CONS CH 0       ACTIVE
 11     7673A         9     SO PROD CH 0       ACTIVE
 12     7673A         9     SO PROD CH 1       IDLE
```

When making Configuration Table changes, be sure that each data path has at least one active producer and one active consumer. The HP 3396 will deactivate data paths configured incorrectly e.g., where there are too many or too few producers or consumers. Some INET instruments may also reject a configuration change themselves, e.g., if an option is not installed. After making changes, it is a good idea to list the INET Configuration Table again to verify them.

The table on the next page lists all the INET data types used in the HP 3396 and the INET instruments that produce and consume these data types.

INET Instruments as Data-Type Producers and Consumers

INET Instruments	Data Types							
	A0	B0[1]	C1	I0[2]	I1	K0	R0	S0
HP 3396	C	C	C	P	P	P	C	C
HP 5890	--	--	P	--	--	C	--	--
HP 7673	--	P	--	C	--	C	--	P
HP 19405A	P	--	--	C	C	--	--	P
HP 1090L	--	--	--	--	--	--	P	P

C = CONSUMER P =PRODUCER

[1] B0 data path is not in use.

[2] I0 data is coupled to S0 data and is not listed separately in the INET Configuration Table.

More detailed information follows about how and why to make configuration changes for each INET data type.

Run and Report Annotation Data (A0 AND R0)

Run annotation is performed by the HP 3396 in response to its internal demands, such as retention time printing and to demands from Run annotation producers on the Instrument Network. The HP 3396 consumes Format 0 Run Annotation data which consists of printable ASCII characters sent by a producer during the Run or Plot states. The HP 19405A is a Format 0 Run Annotation Data Producer. This instrument sends the characters "EX" to the HP 3396 whenever any of their contacts or triacs switch due to an External Events Timetable entry. Because multiple A0-producers are permitted, the HP 3396 may overprint simultaneous annotations.

Normally active, the A0-producer may be deactivated to prevent cluttering of the plot with annotations. For example, an annotation might overprint an important retention time, making it unreadable. To deactivate an A0-producer, first list the INET Configuration Table. Find the HP 3396 A0-consumer and deactivate it (the last consumer of a particular data type must be deactivated before the last producer may be deactivated). Then deactivate the A0 producer.

After the A0-producer is deactivated, the External Events Timetable entries will still be executed by the sampler during runs, but "EX" is no longer printed on the plot. When all consumers on one data path are deactivated, the HP 3396 automatically deactivates the resulting unmatched producers, printing the message

```
UNMATCHED PRODUCERS DEACTIVATED
```

In the example above, the A0-producer is explicitly deleted. The HP 3396 finds no unmatched producers, and so no automatic deactivation is necessary. Either deactivation method is acceptable, but the former saves a few keystrokes in cases when all objects of a particular data path are to be deactivated. Of course, if you want to deactivate just some but not all of the producers on a data path, each must be deleted explicitly. If there are multiple active producers of a particular data type and format #, you need not deactivate the consumers before deactivating a producer. However, before deactivating the last active producer on a data path, you must deactivate all the consumers on that data path.

Report annotation is similar to run annotation in that, once the data path is activated, the printing occurs automatically. R0-producers, however, send their ASCII strings during the Postrun state to be printed on the HP 3396 and/or stored with the result file as part of the report for each run. R0-producers are polled in order of descending INET/HP-IL address, starting with the highest device address. An R0-producer may also request permission from the the HP 3396 to use its printer to print set points, for example, during the "Idle" and "Run may not begin" states.

Producers and consumers of the report annotation data are activated and deactivated as described above for run annotation data consumers and producers.

B0 Data (B0)

When an HP 7673 is part of INET, the INET Configuration Table will list the sampler as a producer of B0 data and the HP 3396 as its consumer. However, this data path is not in use and cannot be activated from the HP 3396 keyboard.

Chromatographic Data (C1)

The HP 3396 is a consumer of Format 1 chromatographic data. Instruments such as the HP 5890 Gas Chromatograph, with INET compatibility, may send their digitized output signals to the HP 3396 using INET rather than the analog signal lines. The active C-producer continuously sends data to the active consumer, so one can list the signal level ([**LIST**] [**ZERO**] [**ENTER**]) or do an automatic threshold determination ([**THRESH**] [**ENTER**]) at any time. The HP 3396 can either plot the data ([**PLOT**]) or integrate the data and produce a report ([**START**]), just as with the analog voltage signal from the rear panel input. If it is an active C1 consumer, the HP 3396 plot of C1 data will automatically start when an HP 5890 column compensation run begins.

Only one Format 1 chromatographic data producer may be active at any time. When more than one HP 5890 is on the INET system, C1-producers can be deactivated as shown in *Changing the INET Configuration Table* above. Just deactivating the C1 consumer will shut off the Format 1 Chromatographic data producer. The HP 3396 will then use the signal applied to its analog voltage input as the signal to integrate. To activate a desired C1-producer, enter its entry number, and then reactivate the C1-consumer.

Immediate Data (I0 AND I1)

The immediate data formats supported by the HP 3396 are Format 0 for a portion of the **[PREP] [SEQ]** entries and Format 1 for **[EXT0]** key entries which may be entered directly via the SET EXT statements in BASIC, the external events timetable dialog, or through the **[PREP] [METH]** dialog. The HP 7673 sampler or HP 19405A sampler controller uses the I0 data path to send prompts to the HP 3396 printer and to get response messages from the HP 3396 keyboard. When the HP 19405A is used as an external event controller, it uses the I1 data path to send prompts and get responses in the same way. In any network with only one S/ECM or INET sampler, it will be automatically configured at power-on as a consumer of one or both formats of Immediate data. The HP 3396 configures itself as the producer of the two data formats, thus establishing control over the sampler or sampler controller.

Note that the sample data type (S0) described below and the immediate data format, I0, are coupled in the HP 3396. The I0 data path is automatically activated when the S0 data type is activated, but the I0 data

path is not listed separately in the INET Configuration Table. Immediate data formats may be transmitted during any INET state.

To depart from the power-on network configuration for I1 data, use the **[I] [N] [ENTER]** key sequence. The constraints for immediate data are given in the table above. Even in a single sampler system there may be reasons to deactivate the I1 data path. For example, deactivating the path prevents casual users from inadvertently changing the External Event Timetable, perhaps causing an undesired external event. If more than four external events are needed, another HP 19405A can be added to the system. In this case the **[I] [N]** dialog selects which HP 19405A is online to the EXT() commands via the I1 path.

Device Dependent Commands (K0)

The HP 5890 and the HP 7673 are consumers of K0 commands. The K0 data path allows the HP 3396 as a K0 producer to send command strings changing the set points of these instruments, or cause certain other actions to be taken, as long as a run is not in progress. Fundamentally, a single K0 transaction consists of the HP 3396 sending a message to an INET device and the INET device sending a response back to the HP 3396. To enter these commands from the HP 3396 keyboard, option 6, the **[PREP] [METH]** dialog, or the **INET_IO** command in BASIC, may be used. Entering commands is explained in the section called *Controlling INET Instruments through BASIC* earlier in this chapter.

The K0 data path producer (the HP 3396) and all consumers are automatically configured as ACTIVE when power is switched on. Although K0 consumers can be deactivated, there is no reason to deactivate them since the indicated device address determines which instrument is the active consumer of a particular command string.

Sample Data (S0)

At power-on configuration, the HP 3396 is configured as an active S0-consumer and the INET sampler is the active producer of sample data. S0 data describes the sample most recently analyzed and may represent bottle numbers or an ID code. Typically the S0 data is the bottle number of the most recently injected vial. Since I0 data is coupled to S0 data, the HP 3396 is configured as an active I0–producer and the INET sampler is the active consumer of I0-data at power-on.

As an S0 consumer, the HP 3396 uses the sample number (bottle number) as an index into the sample table for calibrated reports (ESTD, ISTD, and NORM). The HP 3396 also prints the sample number in the upper right hand corner of the report. If the Sample Number cable is used as the source of this information, the HP 3396 S0 consumer object should be IDLE.

To deactivate the active S0-producer, you must first deactivate all active S0-consumers (typically only the HP 3396). When the S0-consumers are deactivated, the HP 3396 automatically deactivates the matching S0-producers. At this point, no sample data will be transmitted to the HP 3396.

To switch from one active producer to another (if several of one type are connected to INET), enter "C" for the change dialog after listing the INET Configuration Table. Deactivate all the matching consumers, then deactivate the current producer and activate the desired one. Finally, reactivate the desired consumer(s). See the configuration constraints listed above

HP 3396 Background Tasks

As the INET controller, the HP 3396 manages the interactions of analytical equipment as described in the preceding subsections. In addition to the operation and data structures described, INET performs several functions that are apparent only by their indirect effects on the instruments.

Among these functions are readiness, status polling, and error detection. The HP 3396 continuously polls each of the following:

- HP-IL addresses (INET only) in address order for readiness and status.
- HP 3396 keyboard.

After each status poll cycle the INET controller conducts an INET "readiness to begin a run" poll if in the Idle or Postrun state. In addition, pressing **[R] [E] [A] [ENTER]** causes an immediate poll of INET devices, including the most recent host computer readiness return, and prints the results on the printer/plotter.

The network state determines the response to [**START**] key presses from INET instruments and the host computer. The status indicators (LEDs) on the HP 3396 keyboard are set to reflect the state of the network (READY, RUN, KEYBD) and the host computer (COMM), if one is connected. Unless a sequence of runs is being started, any start message or keystroke starts a run immediately, with the HP 3396 printing

```
START; not ready
```

if it is not ready to start a run. If a sequence of runs is being started from a program or if the [**SEQ**] [**START**] keys were pressed, the network will wait for all instruments to become ready before starting any run. The HP 3396 will print the message

```
Waiting for System Readiness
```

and hold off the actual start of the run.

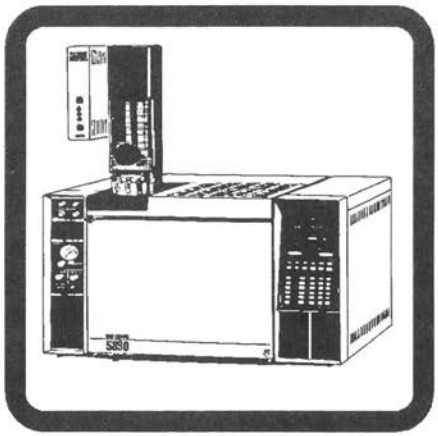
During the Prerun, Run, and "Run may not begin" INET states, the ready polling is suspended. If the Instrument Network is in any of these states, it has already accepted a start signal or intentionally ignored a start signal, so by definition, it is not ready. No polling is necessary until the network proceeds to the Postrun state.

The HP-IL status polling also allows instruments on INET to print warning and error messages on the HP 3396 printer/plotter. For example, the HP 19405A S/ECM, upon finding the sample tray won't move, responds to the status poll by having the HP 3396 print

```
19405A SAMPLER/EVENT CONTROL MODULE
LOOP ADDRESS: 1
CANNOT GET CORRECT BOTTLE
CHECK AIR PRESSURE AND CABLES
S/ECM ABORTED
```

3

Using Disk Drives and Printers



In this chapter...

Compatible Disk Drives and Printers

You can elect to save certain types of HP 3396 files, data, and BASIC programs externally on disk drives or in a host computer system.

The HP 9153A/C Disk Drive contains a hard or fixed disk. The other drives listed use flexible or ,"floppy", disks.

Disk Drives Compatible with the HP 3396 Series II.

Disk Drive Model Number	Notes
HP 9114A[1]/B	HP-IL, battery-operated, dual floppy drive
HP 9122C/D[1]	HP-IB device[2]
HP 9153A[1]/C[3]	10 Megabyte Winchester, HP-IB device[2]

Note: The HP 3396 is only compatible with double-sided *subset 80* command set disk drives.

[1]This disk drive is no longer available.

[2]Requires use of an HP 82169A HP-IL/HP-IB Interface.

[3]When used with the HP 3396 Series II, the HP 9153C 10 megabyte disk drive should be divided into the maximum number of volumes. This will keep disk directory listings on the HP 3396 to a reasonable length. See the HP 9153C *Getting Started* manual for instruction on setting the configuration switch to determine the number and size of volumes.

Hewlett-Packard's Peak-96 Information Manager allows easy storage of integrator files at a host computer.

Printers Compatible with the HP 3396 SERIES II

Printer Model Number	Notes
HP 2225A	"ThinkJet" HP-IB device
HP 2225B	"ThinkJet" HP-IL device

Listing Devices on the Loop

Compatible printers and disk drives use the Hewlett-Packard Interface Loop or Hewlett-Packard Interface Bus.

1. **Press [S] [Y] [ENTER]to list all the devices currently active on the loop.**

This is a typical listing for the system with an HP 9122 HP-IB disk drive.

Example

```
*SY

        LOOP CONFIGURATION
ADDRESS    DEVICE ID    ACCESSORY ID & CLASS
-------    ---------    --------------------
   8        HP82169A    43H  Interface

  1-7      (Reserved for HPIB devices)

DISC NAME  ADDRESS    DRIVE #    VOLUME  #
---------  -------    -------    ---------
   A          1          0          0
   B          1          1          0

RS-232-C SWITCH SETTINGS
Baud                 9600
Timeout              15 sec
Handshake Delay      Off
Hardware Handshake   Disabled

INTERNAL SERIAL NUMBER:  22390
```

2. **Press [R] [E] [A] [ENTER] to check system readiness.**

Autoconfiguration and Reconfiguration

After the cables are connected and all instruments are switched on, the HP 3396, as controller, configures the loop. Configuring includes

- recognizing the types and internal functions of the devices in the network,
- assigning addresses.

When assigning addresses, the HP 3396 always assigns address 0 to itself. Addresses 1 to 7 are reserved for HP-IB devices and are set by switches on the HP-IB devices themselves. Addresses 8 to 31 are assigned in order around the loop starting with the device connnected to the controller's HP-IL output receptacle. Data or commands destined for a device on the loop often include the address of that instrument. When the order of instruments in the loop is changed, the system must be reconfigured so that the HP 3396 is aware of the new address for each device. The HP 3396 cannot detect the removal of an HP-IB device unless the system is reconfigured by

- breaking the loop,
- resetting the HP-IB interface (by pressing the reset button),
- executing a RECONFIGURE command in BASIC or system command mode.

At the direction of the controller, the loop automatically reconfigures under the following circumstances:

- recovery from a power failure,
- recovery from a break in the loop (e.g., breaking the loop to add a device, or a power failure at a remote device),
- executing a RECONFIGURE command from BASIC or system command mode.

1. **Press [R] [E] [C] [ENTER] to reconfigure the system when instruments are added or moved on the loop.**

   If there are more than 31 devices on the loop, the HP 3396 prints `TOO MANY HP-IL OR HP-IB DEVICES.`

   When the loop is broken, the HP 3396 prints

   ```
   LOOP DOWN:  TIMEOUT
   ```

   When the loop is restored, the HP 3396 will configure again as described above.

   Once the configuration is done, the **SYSTEM** command may be used to list the addresses of the devices on the loop. For example, it is necessary to know a printer's address when using option 5 (postrun report option) or when sending a listing of a Method file to an external printer via the **XADDRESS** command. **[S] [Y] [ENTER]** will list HP-IL and INET devices on the loop and their addresses. The current settings for the RS-232-C switches are also printed below the device listings. HP-IB printers are not identified in this table.

   On HP-IL, after devices have transmitted data to the HP 3396 as the system controller, the integrator sends the data it received back around the loop. When there is a discrepancy between data sent out by the transmitting device and the data sent back by the HP 3396, the device will send the controller an End of Transmission Error message. When this message is received, the integrator prints

   ```
   "ETE" ERROR
   ```

   This error could be due to faulty electronics in one or more devices on the HP-IL loop or heavy electrical/radio interference preventing data from successfully traveling the HP-IL loop.

Using Disk Drives

See the HP 3396 Series II *Installation and Service Manual* for instruction about how to install disk drives with the HP 3396.

Accessing Disk Drives

Commands and key sequences that access disk drives are listed below. All commands listed below are discussed in the HP 3396 Operating Manual unless otherwise indicated.

Listing files on disk:	Operating Manual chapter...
[LIST] [CALIB] *filespec* [ENTER]	5
[LIST] [METH] *filespec* [ENTER]	8
[LIST] [SEQ] *filespec* [ENTER]	9

Listing files on disk to an external printer: this chapter

NOTE: The XADDRESS (external address) must be set to successfully list files to an external printer.

[CTRL][LIST] [CALIB] *filespec* [ENTER]
[CTRL][LIST] [METH] *filespec* [ENTER]
[CTRL][LIST] [SEQ] *filespec* [ENTER]

Storing files on disk:	Operating Manual chapter...
[STORE] [CALIB] *filespec* [ENTER]	5
[STORE] [METH] *filespec* [ENTER]	8
[STORE] [SEQ] *filespec* [ENTER]	9

Loading files from disk:

[LOAD] [CALIB] *filespec* [ENTER]	5
[LOAD] [METH] *filespec* [ENTER]	8
[LOAD] [SEQ] *filespec* [ENTER]	9

Deleting files from disk:

[DEL] [CALIB] *filespec* **[ENTER]**	5
[DEL] [METH] *filespec* **[ENTER]**	8
[DEL] [SEQ] *filespec* **[ENTER]**	9

System commands: This chapter

READY
RECONFIGURE
SYSTEM

File and disk commands: Operating Manual chapter...

COPY *filespec,filespec*	7
CREATE *filespec,size*	BASIC User's Manual
DIRECTORY *diskspec* or *filespec*	7
FORMAT *diskspec,volume,max files*	7
PACK *diskspec*	7
PURGE *filespec*	7
Option 2: Storing data from runs	7
Option 5: Listing post-run data	6

Refer to the HP 3396 *BASIC Language User's Manual* for information about file storage and retrieval from BASIC.

File System Commands

The table below lists the commands that control disk drives. More detailed descriptions of the system commands may be found in the HP 3396 Series II *Operating Manual*. BASIC commands and statements are described in more detail in the *BASIC Language User's* and *BASIC Language Reference* Manuals.

File System Commands (M:disk or external disk drives)

System Command	Abbr	Syntax	Valid File Extensions
ANALYZE,I	--	ANALYZE *filespec*,I	.RAW, .BNC, .BNA
ASSIGN	AS	ASSIGN *keynumber*,*filespec*	.BAS
COPY	CO	COPY *filespec1*,*filespec2*	all
CREATE	CR	CREATE *filespec*,*size*	all
[CTRL] [LIST]	^[LIST]	[CTRL] [LIST] [CALIB] *filespec* [METH] [SEQ]	.CAL, .MET, .SEQ
[DELETE]	--	[DEL] [CALIB] *filespec* [METH] [SEQ]	.CAL, .MET, .SEQ
DIRECTORY	DI	DIRECTORY *diskspec* or *filespec*	all
FORMAT	--	FORMAT *diskspec*,*volume*,*numberfiles*	n/a
[LIST]	--	[LIST] [CALIB] *filespec* [METH] [SEQ]	CAL, .MET, .SEQ
[LOAD]	--	[LOAD] [CALIB] *filespec* [METH] [SEQ]	.CAL, .MET, .SEQ
PACK	PA	PACK *diskspec*	n/a
PURGE	PU	PURGE *filespec*	all
READY	REA	READY	n/a
RECONFIGURE	REC	RECONFIGURE	n/a
RENAME	REN	RENAME *filespec1*,*filespec2*	all
[STORE]	--	[STORE] [CALIB] *filespec* [METH] [SEQ]	.CAL, .MET, .SEQ
SYSTEM	SY	SYSTEM	n/a

n/a = not applicable

continued on next page

File System Commands (cont'd)

BASIC Command or Statement	Abbr	Syntax	Valid File Extensions
ASK # DATUM	--	ASK # *channel*:DATUM *string variable*	all
ASK # LENGTH	--	ASK # *channel*:LENGTH *numeric variable*	all
ASK # LIFTYPE	--	ASK # *channel*:LIFTYPE *numeric variable*	all
ASK # RECORD	--	ASK # *channel*:RECORD *numeric variable*	all
COPY	CO	COPY *filespec1*, *filespec2*	all
CREATE	CR	CREATE *filespec*, *filesize*	all
DEVICE$	--	DEVICE$(*HP-IL device address*)	n/a
DIRECTORY	DI	DIRECTORY *diskspec* or *filespec*	n/a
FORMAT	--	FORMAT *diskspec*, *volume*, *numberfiles*	n/a
GET	G	GET *filespec*	.BAA *or* .BAS
GETCALIB	--	GETCALIB "*filespec*"	.CAL
GETMETH	--	GETMETH "*filespec*"	.MET
GETSEQ	--	GETSEQ "*filespec*"	.SEQ
JOIN	JO	JOIN *filespec*	.BAA
LOAD	LO	LOAD *filespec*	.BAA
PACK	PA	PACK *diskspec*	n/a
PURGE	PU	PURGE *filespec*	all
READ #	--	READ # *channel*:*variable list*	all
RELEASE REST	--	RELEASE REST # *channel*	n/a
RENAME	REN	RENAME *filespec1*, *filespec2*	all
RUN	R	RUN *filespec*	.BAA and .BAS
SAVE	SA	SAVE *filespec*	.BAA and .BAS
SET # MARGIN	--	SET # *channel*:MARGIN *column number*	all
SET # RECORD	--	SET # *channel*:RECORD *numeric expression*	all
SYSTEM	SY	SYSTEM	n/a

[1] BASIC is installed with Option 100.
n/a = not applicable

Using Printers

See the HP 3396 Series II *Installation and Service Manual* for instruction about how to install disk drives with the HP 3396.

HP 3396 Printer Commands

System or BASIC Command	Syntax	Description
[CTRL] [LIST]	[CTRL] [LIST] [CALIB] *filespec* [METH] [SEQ]	Uses address of printer specified in XADDRESS command to list a CALIB, METH, or SEQ file.
[OP()] 5	[OP()] 5	Specifies printer address for postrun report.
XADDRESS	XADDRESS *device address*	Specifies printer address for external listings.
PRINTER IS	PRINTER IS *#channel*	Defines output device for PRINT statements.
PRINT USING	PRINT *#channel* USING {*string* | *line number* | *label*}: *expression list*	Evaluates expression(s) and sends the formatted output to the printer.
XADDRESS	XADDRESS *device address*	Specifies address of an external printer for XLIST and XMARGIN commands.
XLIST	XLIST *range,range*	Prints workspace program between the lines specified on external printer defined by XADDRESS. To list a program on the HP 3396 from a BX terminal session, set XADDRESS to –2.
XMARGIN	XMARGIN *column number*	Sets right margin of printer defined by XADDRESS command.

Understanding HP-IL and HP-IB

The HP 3396 is compatible with various types of Hewlett-Packard Interface Loop, Hewlett-Packard Interface Bus, and Instrument Network devices.

HP-IL is a serial two–wire connection and a software protocol that allows printers, storage devices, and analytical instruments to communicate with each other. All INET devices are HP-IL–compatible.

HP-IB is a parallel bus link with its own protocol, equivalent to IEEE-488.

HP-IL supports up to 31 devices on the "loop", reserving seven of these for HP-IB devices such as printers and disk drives. HP-IB is an entirely different type of instrument interface that connects devices in parallel and uses a different message protocol. HP-IB devices are integrated into the HP-IL through the HP 82169A HP-IL/HP-IB Interface.

More in-depth information about HP-IL may be found in the book *The HP-IL System: An Introductory Guide to the Hewlett-Packard Interface Loop* written by Kane, Harper, and Ushijima and published by OSBORNE/McGraw Hill.

HP-IL devices play one of three different roles: *controller*, *talker*, or *listener*. Each loop has one device that acts as a controller and devices that talk and listen. As the HP-IL controller, the HP 3396

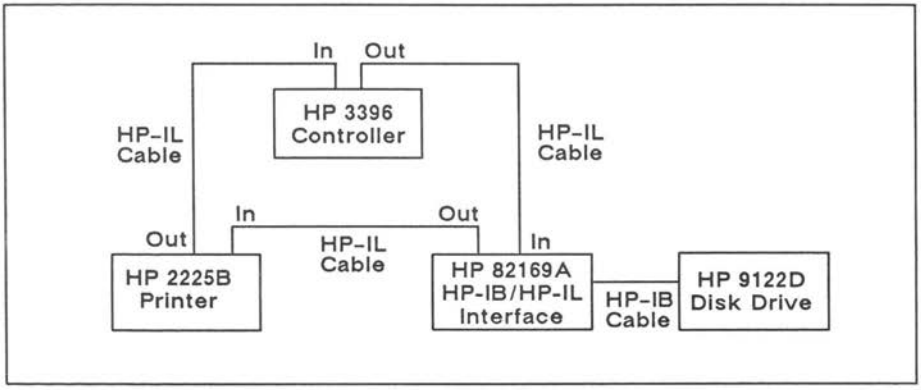
- assigns addresses and talking and listening roles to each device,
- services device requests, and
- initiates the transfer of data from talkers to listeners.

The HP 3396 is capable of initiating actions at a remote device on the loop. For example, a command from the HP 3396 loads a method file from a disk drive and specifies that the method listing be sent to a particular printer.

On the loop talkers are message senders and listeners are message receivers. Some devices, such as disk drives, function as both talkers and listeners, while printers are primarily listeners.

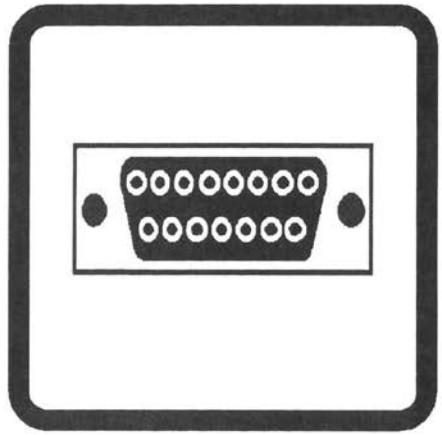
An illustration of a loop with HP-IL and an HP-IB device is shown below.

HP-IL System



4

Using RS-232-C Devices



In this chapter...

What Is the RS-232-C Interface?

The RS-232-C link is a single-cable, bidirectional interface that conforms to Electronic Industries Association (EIA) standards. The HP 3396 can be connected via RS-232-C link to a computer and other external devices to send and receive data and commands.

An external terminal may be connected to the HP 3396 via RS-232-C for the purpose of writing and executing BASIC programs. Instructions on how to use the external BASIC capability are included in this chapter.

Communications between an HP 3396 and an external computing device require programs to be running on the host computer to operate the RS-232-C link. HP Peak-96 is the Hewlett-Packard product that allows an IBM-compatible personal computer to control the HP 3396. This chapter does not provide detailed operating and programming instructions for the range of other possible host computers. This information is contained in the *RS-232-C Programmer's Guide* (03396–90335).

Installing RS-232-C Devices

The RS-232-C hardware includes the "COMPUTER" connector and configuration switches on the rear panel, and the choice of the DTE (male) cable, or the DCE (female) cable. The HP 3396 can be configured to be Data Terminal Equipment (DTE), the terminal end of the RS-232-C interface, or Data Communication Equipment (DCE), the modem end of the interface, whichever is appropriate. The cable determines the mode of operation.

CAUTION

The HP 3396 cannot function as a general purpose terminal.

RS-232-C Interface installation involves

1. Choosing the proper cable.
2. Connecting the cable.
3. Setting the configuration switches.
4. Matching RS-232-C protocol.

Choosing the Proper Cable

The physical connection for the RS-232-C link is made by a cable with a 15–pin male connector to the COMPUTER receptacle on the rear panel of the HP 3396. Since the HP 3396 can be configured as either Data Terminal Equipment (DTE) or Data Communications Equipment (DCE), two different cables may be used.

RS-232-C Cables

Cable Option # (Part Number)	Description	HP 3396 Mode
301 (03396–60520)	15-pin connector to 25-pin female "D" RS-232-C connector	DCE
302 (03396–60510)	15-pin connector to 25-pin male "D" RS-232-C connector	DTE
303 (03396–60530)	15-pin connector to 9-pin female "D" RS-232-C connector	DCE
304 (03396–60520) (HP 92224M)	15-pin connector to 25-pin female "D" RS-232-C male-to-male converter	DCE

The most straightforward way to connect two devices is to determine which device transmits its data on which connector pin. Then make sure the other device receives data on that pin. (In most cases only pins 2, 3, and 7 are used.)

The HP 3396 implements the RS-232-C functions shown below.

RS-232-C Functions Implemented on the HP 3396

Connector					
25-pin (DTE)	25-Pin (DCE)	9-Pin (DCE)	Mnemonic	Description	Direction
1	1	–	AA	Protective Ground (Shield)	--
2	3	2	BA	Transmitted Data	DTE → DCE
3	2	3	BB	Received Data	DCE → DTE
4	4	7	CA	Request to Send	DTE → DCE
5	5	8	CB	Clear to Send	DCE → DTE
–	6	6	CC	Data Set Ready	DCE → DTE
7	7	5	AB	Signal Common	--
–	8	1	CF	Received Line Signal Detector	DCE → DTE
–	20	4	CD	Data Terminal Ready	DTE → DCE

CAUTION

Voltages applied to any RS-232-C connection must not exceed 25V peak with respect to signal common, or damage to the HP 3396 may result.

DTE or DCE?

The needs of the RS-232-C device being connected to the HP 3396 determine which cable and configuration are used. When a DCE device, such as a modem, is being connected, the HP 3396 is configured as DTE and uses the DTE cable. When the DCE cable is used, the HP 3396 looks like a modem to DTE devices.

The HP 3396 DTE cable has a male 25-pin "D" connector. When the HP 3396 has the DTE cable connected, it behaves as a DTE device. The connected device must be a DCE device, transmitting on pin 3 (BA) and receiving on pin 2 (BB).

There are two DCE cables for the HP 3396. One (03396–60520) has a female 25-pin "D" connector. Use this cable to connect the HP 3396 to a DTE device, transmitting data on pin 2 (BB) and receiving on pin 3 (BA). The other DCE cable (03396–60530) has a female 9-pin "D" connector. Use this cable to connect the HP 3396 to a DTE device, transmitting data on pin 3 (BA) and receiving on pin 2 (BB).

By RS-232-C convention, all DCE devices should have a FEMALE 25-pin "D" connector associated with them, and all DTE devices should have a MALE 25-pin "D" connector associated with them. However, many manufacturers use custom connectors or, to avoid male bulkhead fittings, use female connectors on their DTE devices and provide a male-to-male cable. Therefore, just looking at the connector on the RS-232-C device is not a reliable way to determine which cable you should use. In addition not all RS-232-C devices clearly show whether they are DTE or DCE. Some may be switchable as well (such as the HP 3396).

Consult the reference material provided with your RS-232-C device to be sure that the HP 3396 cable you received is the appropriate one. The signals shown in the table on the previous page should match so that an output from the HP 3396 is connected to the appropriate input on the RS-232-C device and vice versa. The connectors should be of opposite gender. The HP 3396 and the RS-232-C device should operate properly if these two conditions are met.

If these conditions are not met and the output and input signals do not match or the connectors are not opposite in gender, customized cables, or adapters are required.

Customizing Cables

You may find that the signals with the same mnemonics in both instruments are matched input to output, but the connector gender is the same in both instruments (both male or both female); then you need a gender-changing adapter. Gender-changing adapters are either male-to-male or female-to-female adapters with the pins connected straight through (#1 to #1, etc.).

On the other hand, you may find that the signals with the same mnemonic in both devices are the same, i.e., both inputs or both outputs. You will need an adapter to cross-connect the devices. Such adapters for DTE devices (both devices transmitting data on Pin 2, both with male connectors) are called modem-eliminator or null-modem adapters. They cross-connect the commonly used DTE signals so that the needs of two DTE devices may be satisfied.

With the following set of adapters, you should be able to conquer almost any RS-232-C situation:

- male-to-male straight through (HP 92224M), to change gender,
- female-to-female straight through (HP 92224F), also to change gender,
- modem-eliminator or null-modem, usually female-to-female, to allow two DTE devices to be connected together.

It is also possible that you may need a combination of cross-connecting and gender-changing adapters. Similar adapters can be constructed or purchased for other combinations of connectors and device types.

Connecting the Cable

CAUTION

Connecting the HP 3396 RS-232-C cable to incompatible instruments may damage either the HP 3396, the external device, or both. Be sure that your computer or peripheral conforms to EIA Standard RS-232-C.

After you have determined that your external device meets EIA Standards for RS-232-C, follow the steps below to connect your cable.

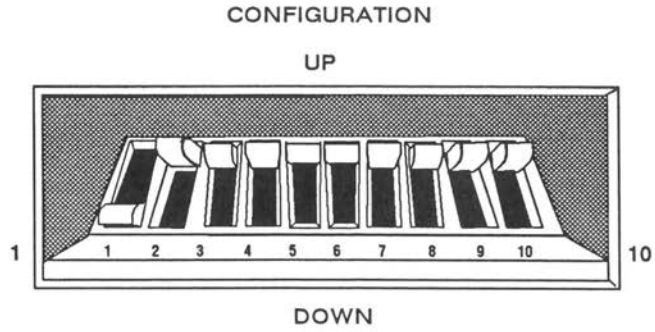
1. **Choose the appropriate DCE or DTE RS-232-C interface cable.**
2. **Plug the DTE or DCE cable into the connector labeled "COMPUTER" on the rear panel of the HP 3396.**
3. **Plug the opposite end of the cable which has a 9- or 25-pin "D" connector into the RS-232-C input jack on the external device.**

Setting the Configuration Switches

A bank of ten switches located on the rear panel allows selection of the following configuration parameters:

- data rate (from 150 to 19,200 baud),
- hardware handshaking CA/CB (Request to Send, Clear to Send), and
- duration of handshake timeouts (short—15 seconds, or long—3 minutes).

The figure below shows the switches as they are set at the factory.



RS-232-C Switch Settings

Switch	UP	DOWN	Function
1.	———		Data Rate (see table)
2.	———		Data Rate (see table)
3.	———		Data Rate (see table)
4.	Disable	Enable	Hardware Handshake (CA/CB)
5.			Not Used
6.			Not Used
7.			Not Used
8.			Not Used
9.	Off	30 msec	Handshake Delay
10.	15 sec	3 m in	Timeout

Data Rate Table

Rates	Switch		
(BAUD)	1	2	3
19200	UP	UP	UP
9600	DOWN	UP	UP
4800	UP	DOWN	UP
2400	DOWN	DOWN	UP
1200	UP	UP	DOWN
600	DOWN	UP	DOWN
300	UP	DOWN	DOWN
150	DOWN	DOWN	DOWN

1. **Set the switches to indicate the desired data rate, to enable or disable CA/CB hardware handshaking, and to select a timeout duration as shown above.**

2. **Press the [CTRL] and [BREAK] keys simultaneously to allow the integrator to recognize the new settings.**

Listing the Switch Settings

You may list the current setting of the RS-232-C configuration switches by pressing

[S] [Y] [ENTER]

After printing the status of the INET loop, the HP 3396 will print the current values of these switches. Shown below is the HP 3396 listing of factory-set values for the RS-232-C switches.

```
RS-232-C            SWITCH SETTINGS
Baud                9600
Timeout             15 sec
Handshake Delay     Off
Hardware Handshake  Disabled
```

Use the descriptions below and the manual for your RS-232-C device to decide if any configuration switches need to be set.

Data Rate Switches 1,2,3

The data rate is the number of bits per second (or baud) transmitted by the link. Switches 1 to 3 allow you select the rate your equipment can handle. For RS-232-C, the available rates are 150, 300, 600, 1200, 2400, 4800, 9600, and 19200 baud. The HP 3396 rate must be set equal to the rate that the external device is using. For applications in which only reports, processed peak data, setpoints, methods, sequences, and calibrations are to be transmitted, any transmission rate from 150 to 19200 baud is acceptable.

If you plan to transmit raw (unbunched) data directly from the HP 3396 to the external device, you must select a rate greater than or equal to 2400 baud.

Hardware Handshake Switch 4

Switch 4 enables or disables the hardware handshake—Request to Send/Clear to Send (CA/CB) for DTE operation of the HP 3396. Handshaking is a timing feature provided to allow external devices to hold off HP 3396 transmissions in conversation mode with signals on the CB line. Handshaking does not apply to BX (external BASIC) mode, DCE mode, or to I/O commands initiated from a BASIC program via the READ # and PRINT # statements.

If hardware handshaking is enabled, the HP 3396 turns CA ON before each buffer of data is to be transmitted. It then checks CB. If CB is ON, the HP 3396 transmits the data; otherwise it waits for the external device to turn CB ON before transmitting the data. The HP 3396 will wait only until the end of the timeout period, which is determined by switch 10, for the external device to turn CB ON. If the external device does not turn CB ON, the HP 3396 will timeout and revert to default protocol. However, the HP 3396 cannot itself disable hardware handshaking, so if the remote device continues to be unresponsive, the HP 3396 will time out repeatedly. If the external device responds to the hardware handshake before the end of the timeout period, the HP 3396 turns off CA at the end of a data transmission and the process starts again.

If you wish to use this feature, you MUST use the DTE cable regardless of the device type of the external instrument. You may have to make an

adapter to use the DTE cable and connect the correct RS-232-C signals together. (See *Customizing Cables* above.) Whenever the DTE cable is used, either the external device must implement the CA/CB handshake or you must disable the handshake or, again, the HP 3396 will timeout repeatedly when host communication is attempted.

Switches 5, 6, 7, and 8 are not used

Handshake Delay Switch 9

Switch 9 may be set to force the HP 3396 to wait 30 milliseconds after receiving each handshake response before actually transmitting. This provides for host computers which may acknowledge a handshake quickly but are not immediately ready to receive. This delay applies to all handshakes.

Timeout Duration Switch 10

Switch 10 may be set for short (15-second) or long (3-minute) timeouts, depending upon the response time of the computer to be connected. The HP 3396 aborts unfinished communications and returns to the default protocol if it receives no handshake response from the computer before the timeout period ends. One or more of the handshake options—hardware RS-232-C CA/CB (Request to Send/Clear to Send), Remote (ENQ/ACK), or Read Sequence—must be active for the timeout to be in effect.

The timeout only applies if a handshake response is expected in conversation mode and does not arrive within the timeout window. The HP 3396 will wait indefinitely for the host computer to send messages if the pause occurs when no handshake response is expected. Timeouts do not apply to BX (External BASIC) mode or to I/O commands initiated from a BASIC program via the READ # and PRINT # statements.

Matching RS-232-C Protocol

For RS-232-C communications to be completed successfully, the protocol for the remote device must match the HP 3396 protocol. Protocol is the set of conventions that determines the format and relative timing of the message exchange between the remote device and the HP 3396. When using the DTE cable, set up your remote RS-232-C device to match the HP 3396 default protocol. The default protocol is listed below:

Default RS-232-C Protocol

Default Parameter	Setting	Meaning
Parity	OFF	The parity bit in the character frame is set to zero for transmitted characters, and is not checked for received characters.
Echo	OFF	Characters received by the HP 3396 are not returned (echoed) back to the sender.
Local Handshake	ON	When the HP 3396 receives an Enquire (ENQ) character, it transmits an Acknowledge (ACK) character.
Remote Handshake	OFF	The HP 3396 sends no Enquire and expects no Acknowledge character. Data are sent with no handshake, one line at a time.
Maximum Buffer Size	80	The maximum number of characters the HP 3396 can send or receive in a single transmission, excluding the conversation and stage mnemonics, checksum, handshake characters, and termination sequence.
Remote Device Capabilities	MUTE	The HP 3396 does not expect the remote device to respond to messages. The remote device may send configuration commands if it is able.
Local Termination Sequence		Messages from the HP 3396 will be terminated by a Carriage Return character followed by a Line Feed character. (CR LF)
Remote Termination Sequence		The HP 3396 expects messages from the host to be terminated by a Carriage Return character followed by a Line Feed character. (CR LF)
Read Sequence	NONE	The HP 3396 does not wait for a special character sequence during a read operation before transmitting.
Checksum	NONE	The HP 3396 will not include a checksum between the text and the termination sequence.

Using External BASIC

External BASIC allows the BASIC capabilities of the HP 3396 to be accessed from a remote terminal via RS-232-C.

To use external BASIC:

1. **Choose the appropriate DCE cable and connect your terminal to the HP 3396 using the instructions earlier in this chapter.**

2. **Type "BX" on the HP 3396 keyboard.**

3. **Enter programs from the remote terminal.**

   These programs may be listed on the HP 3396 printer via the XLIST command while the XADDRESS is set to –2.

4. **Enter "EX" from remote terminal to return to HP 3396 keyboard entry.**

   In "BX" mode any characters normally printed on the HP 3396 will be directed to the terminal display.

   For more information about external BASIC see the HP 3396 Series II ***BASIC Language User's Manual.***

Using RS-232-C in Remote Mode

In REMOTE mode control of communications and of the HP 3396 have been acquired by a host computer. While in REMOTE mode, the prompt changes to a # and the computer has access to all key sequences available to the user in LOCAL mode.

Operation in REMOTE mode gives the host potentially full control of the HP 3396. A host device may acquire control of the HP 3396 any time except when the HP 3396 is

- executing a command
- in the midst of a run
- printing
- in BASIC or external BASIC.

Once the HP 3396 is in REMOTE mode, the HP 3396 keyboard is locked except for the **[START]**, **[STOP]**, **[SEQ]**, **[CTRL]**, and **[BREAK]** keys. The amber COMM indicator will turn on and stay on to let you know the communication link is established.

The operation and programming requirements of remote RS-232-C devices vary. Because of the range of possible host computers, it is beyond the scope of this networking guide to give detailed operating or programming instructions for REMOTE mode. See the *HP 3396 RS-232-C Programmer's Guide* (03396–90335).

Index

A

B

C

D

E

F

G

H

I

J

K

L

N

O

P

R

S

T

X

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