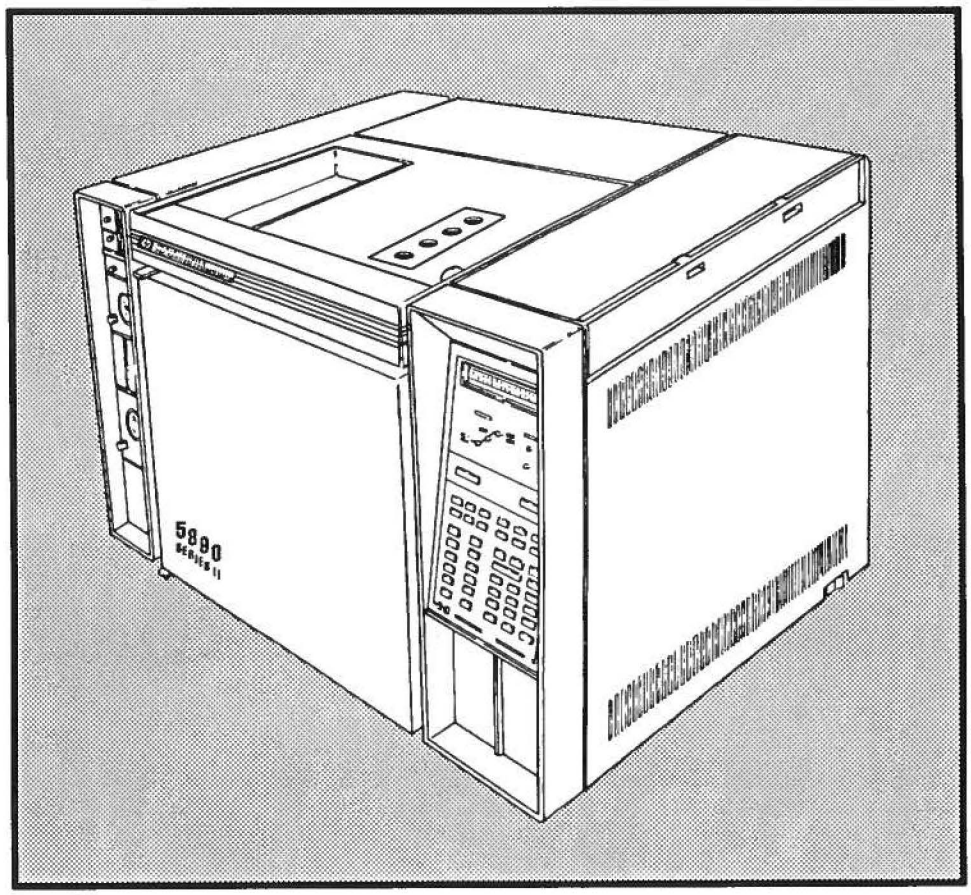
HEWLETT-PACKARD

HP 5890 SERIES
Gas Chromatographs
with RS-232-C Serial Interface



HP 5890 SERIES
Gas Chromatographs
with RS-232-C Serial Interface

HEWLETT PACKARD

© Copyright 1986, 1987, 1988, 1989, 1990 by Hewlett-Packard Company
All Rights Reserved

Manual Part No. 19242-90120

Edition 2, July 1990
Printed in USA

CONTENTS

HP 5890A GC with RS-232-C Serial Interface

INTRODUCTION ..... SECTION 1

How To Use This Manual 1-1

INSTALLATION & INITIAL OPERATION ..... SECTION 2

Installation 2-1
Field Installation of Interface Board 2-1
Installing the Interface Cable 2-3
Getting Started 2-4
Setting the Baud rate 2-4
Conversation Structures 2-4
Configuration Setup 2-5
Setpoint Conversations 2-6

USING THE HP 5890A GC RS-232-C SERIAL INTERFACE ..... SECTION 3

Capabilities 3-1
Conversation Summary 3-1
RS-232-C Interface Characteristics 3-2
Hardware 3-3
Software 3-3
DTE vs. DCE 3-3
Signal Definitions 3-5
The Data 3-6
HP 5890A Keyboard Settings 3-7

CONFIGURATION CONVERSATIONS ..... SECTION 4

Baud Rate 4-1
Parity 4-2
Handshakes 4-3
DF 4-3
E+ or E- 4-3
H+ or H- 4-3
N+ or N- 4-4
RS 4-4
TS 4-4
X+ or X- 4-4

SECTION 1

Introduction

All references to HP 5890A include both HP 5890A and HP 5890 SERIES II except where noted.
The HP 5890A RS-232-C Serial Interface option provides an implementation of the EIA Standard RS-232-C Serial Binary Data Interchange. The interface is supported in the HP 5890A by hardware and protocol-level firmware. A host computer to be connected to the HP 5890A must also have like support, that is, the hardware and low-level software must be present to operate the interface, and application-level programs capable of carrying out the high-level interpretive functions must also be running. The HP 5890A is not intended as a general-purpose computer terminal device; its functions are specific to the needs of analytical data.

The communication between the HP 5890A and a host computer is conversational, that is, to accomplish a particular operation, the HP 5890A and the host exchange messages in a particular pattern called a conversation. Note, however, that all conversations are initiated by the host computer.

HOW TO USE THIS MANUAL

Other than this brief introduction, this manual contains several other sections. The next section, Section 2: Installation & Initial Operation, contains detailed instructions about how to field install RS-232-C hardware. Moreover, it provides concise information about obtaining the first interaction between the HP 5890A GC and a host computer. Section 3: Using the HP 5890A GC RS-232-C Serial Interface, describes many of its capabilities and characteristics. Both of these sections are intended to aid the initial user. Once the unit is up and running, and the user more comfortable with the interaction between the GC and the host, Sections 4, 5, 6, and 7, will likel become the most used.

Sections 4 through 7 contain detailed information about conversations and commands. Each section is devoted to a specific functional conversation; and each of the appropriate commands (for that function) is included in alphabetical order for easy user access. Section 4 contains information about configuration. Section 5 covers status and setpoints. Section 6 includes run control. And Section 7 describes signal data.

Section 8: Service, is intended to aid the user in isolating a suspected problem. It also contains parts related information.

SECTION 2

Installation & Initial Operation

This section is intended to aid the user in adding the necessary hardware to the HP 5890A Gas Chromatograph and performing the initial transmission between the host and the GC.

INSTALLATION

This area explains how to add the RS-232-C Cable and the Interface Board to an HP 5890A Gas Chromatograph. If the Interface accessory is being added to an existing GC, both the Interface Board and cable must be installed. If the gas chromatograph has been ordered with the Interface option, the Interface Board will already have been installed; however, the cable must be added during the instrument's installation.

Position the HP 5890A Gas Chromatograph so that its right side panel and the top cover on the right are fully accessible.

In order to install either the RS-232-C cable or board, the first task is to access the area under the top right cover. Lift the rear edge of the top right cover and remove it from the instrument.

Field Installation of the RS-232-C Interface Board

CAUTION

ELECTRONIC COMPONENTS CAN BE DAMAGED BY STATIC ELECTRICITY. IN HANDLING COMPONENTS, AND/OR CIRCUIT BOARDS CONTAINING SUCH COMPONENTS, PROPER HANDLING IS REQUIRED. USE STATIC CONTROL WRIST STRAP (e.g.-Part No. 9300-0969, small 9300-0970, large) CONNECTED TO AN APPROPRIATE GROUND BEFORE HANDLING BOARDS AND/OR COMPONENTS. STORE BOARDS AND/OR COMPONENTS IN STATIC-PROTECTIVE BAGS OR ENCLOSURES, WHEN NOT INSTALLED IN THE INSTRUMENT.

If the HP 5890A Gas Chromatograph were ordered from the factory with the Interface Option, the board will already be installed. Skip this procedure and proceed with adding the Interface Cable.

Before attempting to field install the Interface Board:

1. Turn off all of the instrument's heated zones and allow enough time for them to cool.
2. Turn off all gas supplies at their sources.
3. Turn off instrument power and disconnect the line power cord from its receptacle.

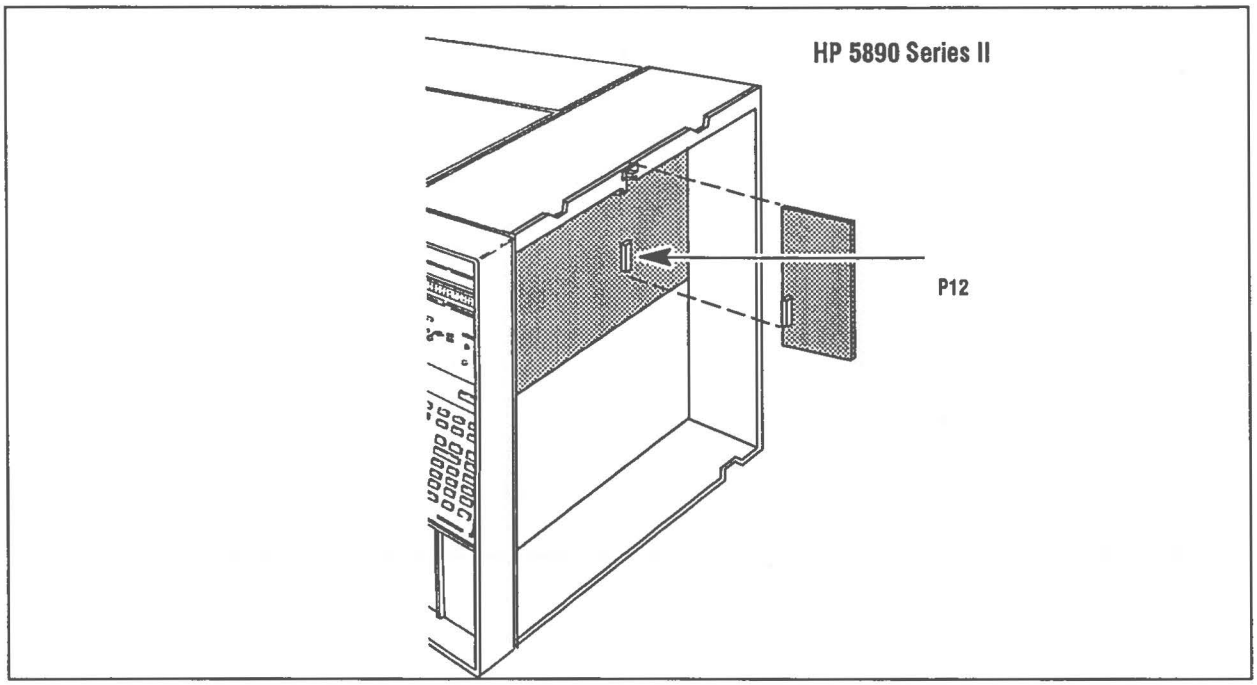


Figure 2-1. Board Mounting Location (HP 5890 SERIES II).

Position the RS-232-C Interface Board alongside the instrument. Its component side should be facing the front of the instrument.

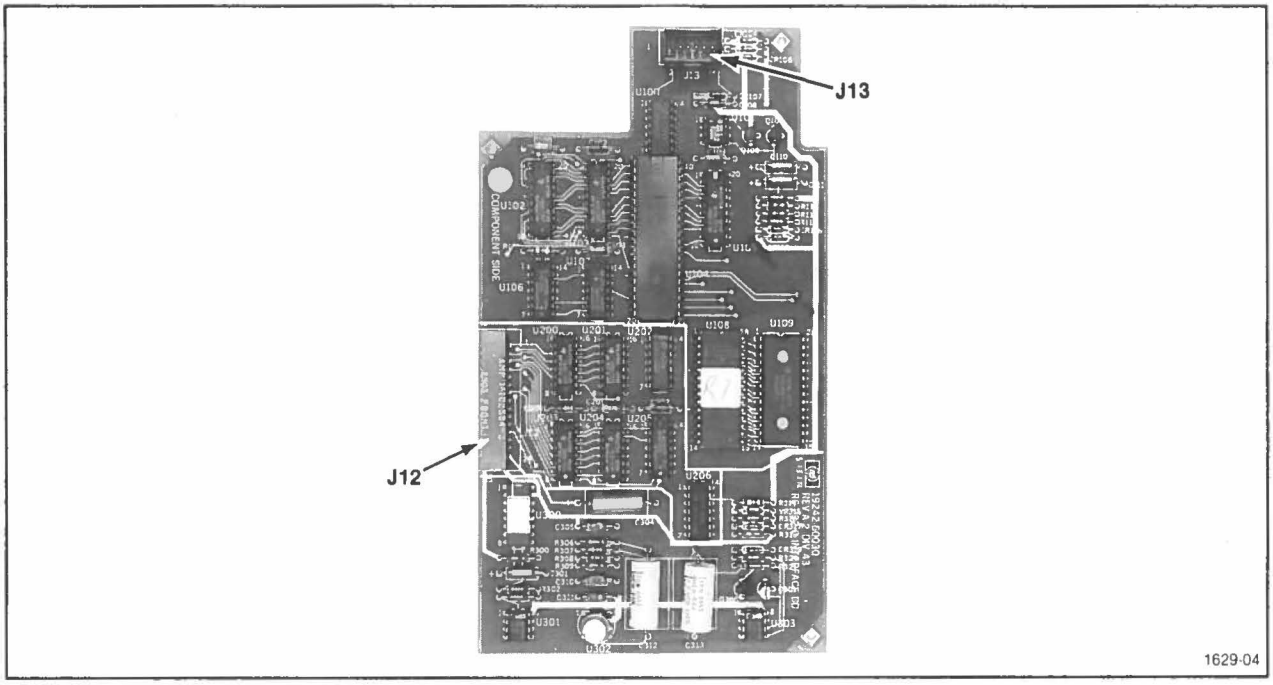


Figure 2-2. RS-232-C Interface Board

GETTING STARTED

This area provides information to successfully receive actual temperatures and flows from the HP 5890A to the host computer via the RS-232-C Serial Interface. Other commands use similar conversation structures and are explained in detail in Section 3 of this manual.

The HP 80 Series computer is used as the host in the examples in this section. Your computer may have different configuration or handshake requirements. These are discussed briefly in this section; and further described in Section 3. For more details, refer to the manual for your specific host computer.

SETTING THE BAUD RATE

The first operation is to set the interface baud rate at the HP 5890A to agree with the RS-232-C interface of your host machine. First press the [CLEAR] key on the HP 5890A, then press the [•] key. The display will be CALIB AND TEST [0-9]. Press the [3] key, then [ENTER] to display the default configuration selections for your GC. Press the [1] then [ENTER] keys to set the baud rate to 9600. Other baud rates may be selected from Table 1.

This procedure stores in the HP 5890A your baud rate selection and two other options that will be discussed later. The interface only reads this value when it does its self-test so to make the new baud rate take effect, either turn the HP 5890A off and back on, or press the keys: [CLEAR] [•] [5] [ENTER]. Then wait for the completion of the self test sequence (refer to HP 5890A Reference Manual, Section 13 for "CALIB and TEST" functions).

Table 2-1. HP 5890A Key Selection for Setting Baud Rate

Baud Rate	HP 5890A Key	Baud Rate	HP 5890A Key
19200	0	9600	1
4800	2	2400	3
1200	4	600	5
300	6	150	7

Now your commands to the HP 5890A will be properly received.

CONVERSATION STRUCTURES

All conversations are started and controlled by the host computer. Commands are sent to the GC from the host and replies come from the GC to the host. The GC has only one reply it generates on its own, the power on message, PREN HP5890 REV A. All other replies are part of conversations opened by the host. It is important to note that all commands from your host to the HP 5890A GC are introduced by an ESCAPE (Ec) character and an upper case C to give the GC a firm recognition point in each command.

A command is always used in the form shown below: (Note that items enclosed within brackets, [ ], are optional.)

EcC cc [ss] [*parameters, if needed*] [ts]

Where:

- EcC is the command introducer.
- cc is the command.
- ss is the stage.
- ts is the termination sequence.

SETPOINT CONVERSATIONS

There are several commands that can read and control setpoints, control timing of each run, and receive signal data from the GC (Refer to Section 3 for more information).

The following example has the host computer read the actual temperatures and flows of the HP 5890A GC. The host computer (a Hewlett-Packard Series 80 Personal Computer in this case) utilizes a program written in HP-86 BASIC.

The example program:

```
 10 RESET 10
 20 CONTROL 10,3 ; 15,26
 30 C$=CHR$(27)&"C" @ T$=CHR$(10)
 40 DIM A$[100]
 50 A$=""
 60 IOBUFFER A$
 70 OUTPUT 10 USING "#K"; C$&"DF                    "
 80 OUTPUT 10 USING "#K"; C$&"EP"&C$&"TS#"&T$&"#"&C$&"RS*?*"
 90 OUTPUT 10 USING "#K"; C$&"ATRQ"&T$
100 OUTPUT 10 USING "#K"; "?" @ ENTER 10 ; A$
110 DISP A$
120 END
```

This program listing may appear somewhat cryptic for personnel that are not familiar with HP-86 BASIC. The following is an explanation of what each line of the program actually does.

Line 10	*Reset the HP-86 IO card.*
Line 20	*Set HP-86 IO card to 9600 baud, even parity.*
	(All transmissions at this point are even parity.)
Line 30	*Define* C$ *string as* ⁴C.
	Define T$ *string as* ↳.
Line 40	*Define* A$ *as a string 100 characters long.*
Line 50	*Set* A$ *empty.*
Line 60	*Declare* A$ *as an I/O Buffer.*
Line 70	*Send* DF *command with 20 blanks for filler, to allow the HP 5890A to set defaults. (HP-86 "#K" format is a compact format with no inserted blanks).*
Line 80	*Send* EP *command (Enable Even Parity).*
	Send TS#↳# *command (Define* ↳ *as termination sequence).*
	Send RS*?* *command (Define ? as read sequence).*
Line 90	*Send* ATRQ *command (Request actual temperatures and flows) with* <ts>.
Line 100	*Send read sequence,* ? *in this case, to prompt for the reply.*
	Receive input from HP 5890A as A$ string.
	(This is done on one line due to the response time of the HP-86).
Line 110	*Display response from GC.*

The reply from the HP 5890A displayed on the HP-86 would look similar to:

```
ATEN 125.00, 200, 200, 200, 200, 29.6,  0.0↳
```

Obviously, the values obtained from the GC are based on the conditions established at the time of inquiry. However, the sequence of the listing of the temperatures and flows remains the same. The sequence of actual temperatures and flows are: oven temperature, injection port A temperature, injection port B temperature, detector A temperature, detector B temperature, flow A, then flow B.

SECTION 3

Using the HP 5890A GC RS-232-C Serial Interface

CAPABILITIES

The HP 5890A RS-232-C Interface option provides an implementation of the EIA Standard RS-232-C Serial Binary Data Interchange. The interface is supported in the HP 5890A by hardware and protocol-level firmware. A host computer to be connected to the HP 5890A must also have like support, that is, the hardware and low-level software must be present to operate the interface, and application-level programs capable of carrying out the high-level interpretive functions must also be running. The HP 5890A is not intended as a general-purpose computer terminal device; its functions are specific to the needs of analytical data.

One exception to the need for high-level software to communicate with the HP 5890A is that some peripheral devices can be used in limited ways to operate the communication links, and send and receive data from the HP 5890A. For example, using the RS-232-C interface, the HP 5890A can be connected to a Hewlett-Packard display terminal to perform limited data logging and display. Considerable operator attention is required for such connections due to the primitive computing capabilities of the terminal.

Conversation Summary

The communication between the HP 5890A and a host computer is conversational, that is, to accomplish a particular operation, the HP 5890A and the host exchange messages in a particular pattern called a conversation. Note, however, that all conversations are initiated by the host computer. A conversation is a series of commands and replies which direct the instruments through the necessary exchange of information. The conversations are categorized by their function in the following tables.

Configuration Conversations: Host sets parity and handshake requirements in the HP 5890A.

EP	Enable even parity
OP	Enable odd parity
ZP	Disable parity [DEFAULT]
DF	Set HP 5890A default configuration
E+	Enable Echo
E-	Disable Echo [DEFAULT]
H+	Enable host handshake - ENQ/ACK
H-	Disable host handshake [DEFAULT]
N+	Enable HP 5890A (node) handshake - ENQ/ACK [DEFAULT]
N-	Disable HP 5890A (node) handshake
RS	Define read sequence [DEFAULT (none)]
TS	Define termination sequence [DEFAULT CR]
X+	Enable XON/XOFF protocol
X-	Disable XON/XOFF protocol [DEFAULT]

Table 3-1. Configuration Conversation Codes

Hardware

The hardware comprises the circuitry in the HP 5890A, the connector under the electronic module top cover and the DTE (male) cable. The HP 5890A is configured to be Data Terminal Equipment (DTE), the terminal end of the RS-232-C interface.

CAUTION

Voltages applied to any RS-232-C Connection must not exceed +/- 25 V peak with respect to signal common or damage to the HP 5890A may result.

Throughout this manual when referring to RS-232-C signals, the term "high" implies a voltage between +3 V and +25 V with respect to the signal common; and "low" implies a voltage between -3 V and -25 V with respect to signal common.

The HP 5890A line driving circuits provide a nominal 12 V signal with respect to signal common. The driving capabilities are compatible with RS-232-C. Note that voltages between +3 V and -3 V with respect to signal common are not guaranteed to be recognized as either a high or a low by the HP 5890A or other RS-232-C compatible devices.

Software

The software in HP 5890A memory controls the operation of the hardware to effect communications in the conversational mode described later in this section. The character set used is the ASCII seven-bit code, with an eighth bit set aside for parity checking. Two additional bits are transmitted, one START bit and one STOP bit. The characters are transmitted serially.

In addition to the baud rate selection from the keyboard, the HP 5890A accepts configuration commands which select various handshake and communications options to complete the RS-232-C interface definition. The options include: parity (even, odd, or none), echo, $^{E}Q/^{A}K$ (enquire/acknowledge) handshake in both directions, $^{D}1/^{D}3$ (XON/XOFF) handshake from the host, choice of MUTE or VOCAL mode operation (whether the HP 5890A sends complete conversations or abridged ones), definition of termination sequence, definition of read (prompt) sequence, and selection of transmission buffer size.

Thus, by setting the baud rate from the keyboard and receiving configuration commands, the HP 5890A RS-232-C interface can be customized to meet the needs of many different devices. Computers, modems, and terminals are among the devices which can be connected to the HP 5890A. This area of the manual will proceed through installation and operation of some typical RS-232-C connections and explaining the aspects of computer communication unique to the RS-232-C interface.

DTE vs. DCE

RS-232-C systems were originally designed for connecting data processing equipment such as terminals and computers together over long distances, using, for example, telephone lines. The equipment was divided into two categories: Data Communications, and Data Terminal. Data Communication Equipment is the modem end of an RS-232-C system. It is the equipment used to communicate over distance to another Data Communication device by whatever means appropriate. For example, a modem for use with switched telephone lines uses audio frequency electronic signals to transmit the data. The RS-232-C interface is the connection between the Data Communication device and the producer or consumer of the data, the Data Terminal Equipment. Data Terminal Equipment is not limited to terminals in the sense of data entry devices. At one end of the system, the DTE device may be a terminal, while at the other end, the DTE device may be a computer. See Figure 3-1.

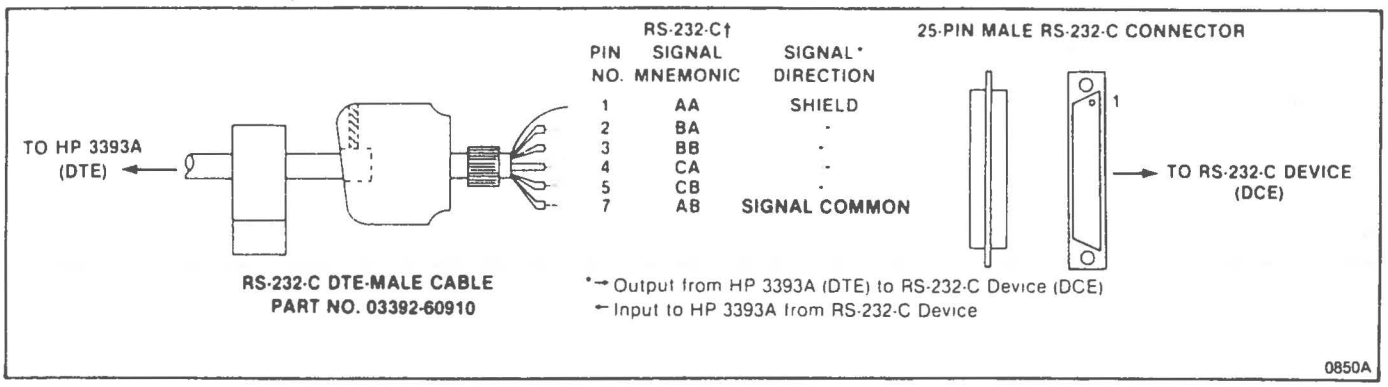


Figure 3-2. DTE Cable Diagram

A minimum set of signals for two-way RS-232-C communications comprises the signals BA (pin 2, transmitted data , DTE to DCE) and BB (pin 3, received data , DCE to DTE), and AB (pin 7, signal common). The HP 5890A works using just these three signals, provided the host computer is configured properly.

Signal Definitions

The definitions of the signals which the HP 5890A implements for DTE operation, and some recommendations about their use follow. These definitions are intended as a guide to which features are available and how to use them properly.

CAUTION

Connecting the protective ground to the chassis of the HP 5890A and the host computer can result in excessive current flow in the shield due to differences in ground potential between the two instruments. Connect the shield to either chassis, but not both.

AA Protective Ground (shield). Pin 1. Recommended for electrically noisy environments. Connected to earth ground through the HP 5890A chassis. It should be connected only at one end, that is, if you leave the shield on the cable connected to pin 1 of the RS-232-C connector, don't connect the other end of the shield to the host computer chassis.

BA Transmitted Data. Pin 2. This is the line on which the HP 5890A transmits its data to the other device (the DCE). The line is LOW for a binary 1 (-12V nominal) and HIGH for a binary 0 (+12V nominal), and its rest state (no data being transmitted) is the 1 state (LOW).

The HP 5890A Keyboard Settings

Some of the choices about how the RS-232-C interface behaves are made by setting an address using the HP 5890A keyboard. The baud rate is selectable (Refer to the Configuration Conversations area of this section for more details).

The HP 5890A supports baud rates from 150 to 19200.

NOTE

Baud means a "signaling unit" per second. In the RS-232-C ASCII interface, the signaling unit is one binary bit, so baud means bits per second.

Divide the baud rate by 10 to get characters per second. The rates of the HP 5890A and the device connected must match. In general, it is a good idea to use the highest rate which the device supports, but there are some exceptions to the advice. If no handshaking is possible and the other device has limited memory, then the rate chosen should be less than the average rate at which the device can handle data, to prevent overruns.

If the device has a large buffer (temporary memory to store incoming characters until they can be interpreted) then higher baud rates than the device's average may be used even without handshakes because the characters can be put into the buffer until the device catches up.

The buffer size on the HP 5890A Serial Interface Board requires minimum baud rates when using the SD (send signal data) conversation. For decimal data, a baud rate of 9600 or greater is recommended for two channels at 20 Hertz. For hexidecimal data, a baud rate of 2400 or greater is recommended for two channels at 20 Hertz.

Another factor in the selection of baud rates is the distance separating the HP 5890A from the other device. RS-232-C specifies baud rates less than 20000 baud at distances less than 50 feet. Longer distances require better cables, and careful attention to shielding. If distance is greater than 50 feet, lower baud rates are mandated. If a particular interconnection yields a high rate of incidence of transmission errors, try a lower rate.

Handshake protocols allow the HP 5890A to pace the reception and transmission of data to match the connected device's capability. Note that the conversational nature of the communications is also a kind of handshaking, and serves to pace the communications. The use of handshakes is recommended because often the handling of the data from the HP 5890A by the connected device will be dependent on the nature of the data. Thus a computer may not need much time to respond to a SM (status modified) conversation, but the response time to each record in a SD (send signal data) conversation may be considerably longer. Another example is the case where, if no data is to be transmitted during a run, the response to a local start notification conversation (ST) may be relatively trivial, but when actual temperatures (AT) and signal data (SD) are to be received and saved by the host computer, the start of a run may be a busy time, allocating memory space, and responding to several conversation requests which are interleaved.

SECTION 4

Configuration Conversations

The configuration commands are a special set of commands that are used to define the format that will be used by the host computer and the HP 5890A GC to exchange data.

Configuration Conversations: Host sets parity and handshake requirements in the HP 5890A.

EP	Enable even parity
OP	Enable odd parity
ZP	Disable parity [DEFAULT]
DF	Set HP 5890A default configuration
E+	Enable Echo
E-	Disable Echo [DEFAULT]
H+	Enable host handshake - ENQ/ACK
H-	Disable host handshake [DEFAULT]
N+	Enable HP 5890A (node) handshake - ENQ/ACK [DEFAULT]
N-	Disable HP 5890A (node) handshake
RS	Define read sequence [DEFAULT (none)]
TS	Define termination sequence [DEFAULT CR LF]
X+	Enable XON/XOFF protocol
X-	Disable XON/XOFF protocol [DEFAULT]

Table 4-1. Configuration Conversation Codes

These commands do not have any reply because the format may not be set up and device errors (parity or overrun) may cause the host interface to hang. These commands also do not require a <termination sequence> because it may not be defined yet. This is also where the read sequence or "throttle" is set, so that the GC only responds when the host is capable of receiving.

Baud Rate

The baud rate for the HP 5890A GC is set by using its keyboard. It must match the baud rate of the RS-232-C interface of the host computer before any commands can be recognized.

To establish or change the baud rate (and ST and HR bypasses) within the GC:

1. Press the [CLEAR] key on the HP 5890A, then press the [•] key.
   The HP 5890A will display CALIB AND TEST [0-9].

2. Press the [3] key,
   the GC will display CONFIGURE NETWORK .
   then press [ENTER] .
   GLOBAL ADDR: ##,## will be displayed.

Handshakes

All handshake commands are structured in the following form.

ᴱ₍Ccc[*parameters, if needed*]

Where cc is the handshake command.

DF SET DEFAULTS

Reset interface to default values, closes all open conversations, stops data collection, does not reconfigure signal producers, sets DF command bit in fault word.

Host must allow 100ms for command to complete; this can be provided by adding several null characters in the command transmitted to the HP 5890A.

Default is E-, H-, N+, X-, ZP, no read sequence, ᶜᴿ⁺termination sequence.

E+ or E- ENABLE or DISABLE ECHO

If enabled, each character that does not have a special meaning (see X commands in this section), is echoed to sender.

Used primarily as a test mode, when connected to a terminal.

Default is E-.

H+ or H- ENABLE or DISABLE HOST HANDSHAKE

If enabled, the GC will transmit an ᴱ₀ (ASCII character 5) before each reply and wait for an ⁽ˣ (ASCII character 6).

Default is H-.

SECTION 5

Status and Setpoint Conversations

The Status and Setpoint conversations command group allows the host machine to determine what is going on at the GC and to set up the GC operation.

Status & Setpoint Conversations: Host requests information about the HP 5890A status, parameter setpoints, and parameter actual values.

AR	Acquire or release remote control; locks HP 5890A keyboard
AT	Read actual temperatures and flows
CA	Change all; send a workfile to the HP 5890A
EV	Read HP 5890A environmental status
IC	Read HP 5890A instrument configuration
IF	Read HP 5890A instrument fault string
IK	Read last HP 5890A key pressed
LA	List all; receive a workfile from the HP 5890A
LU	Lock or unlock the START key on the HP 5890A
OT	Output text to the HP 5890A display
RF	Read HP 5890A serial interface fault word
RI	Read run and readiness information
RK	Perform remote keystrokes from the host
RT	Retransmit last message sent by the HP 5890A

Table 5-1. Status & Setpoint Conversation Codes

Most of these commands have only two stages, the host requests the conversation and the GC replies with an end stage and a reply string.

CA CHANGE ALL, THEN SEND ALL SETPOINTS TO GC

Send new workfile to the GC.

```
Host Command                                    HP 5890A Reply
EtCCARQ<ts> ---------------------------------> CACO<ts>
EtCCAPR<setpoint string 1><ts> <-----------------<
    >-------------------------------------> CACO<ts>
EtCCAPR<setpoint string 2><ts> <-----------------<
    >-------------------------------------> CACO<ts>
EtCCAPR<setpoint string 3><ts><------------------<
    >-------------------------------------> CACO<ts>
EtCCAPR<setpoint string 4><ts><------------------<
    >-------------------------------------> CACO<ts>
EtCCAPR<setpoint string 5><ts><------------------<
    >-------------------------------------> CACO<ts>
EtCCAPR<setpoint string 6><ts><------------------<
    >-------------------------------------> CACO<ts>
EtCCAPR<setpoint string 7><ts><------------------<
    >-------------------------------------> CACO<ts>
```

(Refer to the bottom of this page for setpoint string structures.)

After the setpoints are sent to the GC, the CK stage is used to tell the GC to check the setpoints for validity.

```
Host Command                                    HP 5890A Reply
EtCCACK<ts> <-------------------------------------<
```

If all of the setpoints are okay, then the setpoints are installed in the GC as the active setpoints.

```
Host Command                                    HP 5890A Reply
   >---------------------------------------> CAEN<ts> {setpoints OK}
```

However, if all of the setpoints are not okay, the GC returns with an abort stage.

```
Host Command                                    HP 5890A Reply
   >---------------------------------------> CAAB6<inet error message><ts>
```

The CA setpoint strings are structured as indicated below.

```
<setpoint string 1> = 5890A,aa,C0P0s,C0P1s,C1P0s,C1P1s,K0C0+,$
<setpoint string 2> = ,v,ooo,e,e,mmm,xxx.xx,ttt.tt
<setpoint string 3> = ,rr.r,ooo,ttt.tt,rr.r,ooo,ttt.tt,rr.r,ooo,ttt.tt
<setpoint string 4> = ,zzz,e,zzz,e,zzz,e,zzz,e
<setpoint string 5> = ,ppppp,rr,ccccccc,e,bb,e,ppppp,rr,ccccccc,e,bb,e
<setpoint string 6> = ,e,d,ttt.tt,e,d,ttt.tt
<setpoint string 7> = ,e,ttt.tt,ttt.tt,e,ttt.tt,ttt.tt,$
```

For more information about these strings, refer to Section 8 of the HP 5890A Reference Manual.

IC INSTRUMENT CONFIGURATION

Returns a string that describes the current GC configuration.

```
Host Command                                  HP 5890A Reply
ESCICRQ<ts> ---------------------------------> ICENabfwxyz<ts>
```

The first two parameters (ab) indicate the detector/s type, where:

```
0 = FID
1 = TCD
2 = NPD
3 = No detector installed
4 = ECD
5 = (for future use)
6 = (for future use)
```

The third parameter (f) indicates the presence of a flow sensor. A 1 means that a flow sensor is installed; a 0 indicates that no sensor exists.

The last 4 parameters (wxyz) are for heated zones. A 1 is indicated for an installed zone; or a 0, if not installed.

```
w = Injector A zone
x = Detector A zone
y = Injector B zone
z = Detector B zone
```

Keep in mind that a zone may be installed for other reasons than an injection port or detector (i.e. heated valve box). Regardless of the use, if it is installed, the parameter will be indicated with a 1 .

IK INSTRUMENT KEY

Returns the key code of the last key pressed on the GC. If no new key has been pressed since the last time the IK command was used, it returns the same code as the previous invocation.

Host Command	HP 5890A Reply
^[CIKRQ<ts> ---------->	IKEN<key code><ts>

Where the <key code> is a single digit as indicated below.

Host Key Code	HP 5890A Key	Host Key Code	HP 5890A Key
-	—	I	INIT TIME
.	•	J	RATE
0	0	K	FINAL TEMP
1	1	L	FINAL TIME
2	2	M	INJ A TEMP
3	3	N	INJ B TEMP
4	4	O	DET A TEMP
5	5	P	DET B TEMP
6	6	Q	OVEN MAX
7	7	R	EQUIB TIME
8	8	S	FLOW
9	9	T	TIME
>	DET	U	PURGE
?	CLEAR	V	SIG 1
A	A	W	SIG 2
B	B	X	RANGE 2↑( )
C	COL COMP1	Y	ATTN 2↑( )
D	COL COMP2	Z	ZERO
E	ON	^	START
F	OFF	=	STOP
G	OVEN TEMP	@	ENTER
H	INIT TEMP	:	SUPER CLEAR

OT OUTPUT TO HP 5890A DISPLAY

Sends an output message to the GC's visual display.

```
Host Command                                    HP 5890A Reply
EcOTRQ<ts> ------------------------------------> OTCO<ts>
EcOTPR<display string><ts><--------------------<
   >---------------------------------------> OTEN<ts>
```

Where:

<display string> = 20 spaces of presentation.

The display string must fit into the available 20 spaces of presentation on the HP 5890A visual display. If the requested string is less than 20 characters (including spaces) long, it will be left justified. If the string exceeds 20 spaces of presentation, an abort stage will be returned.

To display a character blinking, precede that character with a "\" (backslash). If every character were to be blinking, it would require that a backslash precede each character. Although this would create a 40 character string, it is permissible since it results in only 20 characters of presentation.

To completely clear the HP 5890A display send a single " " (blank space).

RF READ FAULT WORD

If there is a system error that causes loss of communication, use the Read Fault Word command to find out what went wrong.

The Serial Interface board has a 64 character command buffer. Any command that exceeds this length, from conversation ID to <ts> inclusive, will be discarded and the command lost flag will be set in the RF conversation.

The board also has an 80 character receive buffer, if this limit is exceeded, an overflow marker is put in the buffer and the extra characters are discarded. If this marker is detected in a command, that command is discarded and the command lost flag is set.

```
Host Command                                    HP 5890A Reply
EcRFRQ<ts> ------------------------------------> RFENpbcd0000<ts>
```

The RFEN reply's eight characters are:

- p = 1 means a parity error.
- b = 1 means an input buffer overflow (host sending too quickly, handshake lost).
- c = 1 means a command lost. Start new command before the end of current one (i.e. missing <ts>, or imbeded Ec).
- d = 1 means a defaults command was executed.
- 0000 is reserved for future use (always 0000).

A 1 indicates that a fault was detected; a 0 indicates that the fault is clear. All faults are cleared, when the RF command is executed.

RK REMOTE KEYSTROKE

```
Host Command                                    HP 5890A Reply
EcCRKRQ<ts> ------------------------------> RKC0<ts>
EcCRKPR<key string><ts> <------------------------<
```

Where:

<key string> is up to 20 keycodes.

If all keycodes are accepted, then the display contents are returned (the RK command with no keycodes will just return the display contents).

```
Host Command                                    HP 5890A Reply
   >---------------------------------------> RKEN<display contents><ts>
```

However, if any of the key codes cause an error, the command returns with an abort stage.

```
Host Command                                    HP 5890A Reply
   >---------------------------------------> RKAB6<ts>
```

When the command returns with an abort stage, part of the <key string> may or may not have been accepted.

Host Key Code	HP 5890A Key	Host Key Code	HP 5890A Key
-	—	I	INIT TIME
.	•	J	RATE
0	0	K	FINAL TEMP
1	1	L	FINAL TIME
2	2	M	INJ A TEMP
3	3	N	INJ B TEMP
4	4	O	DET A TEMP
5	5	P	DET B TEMP
6	6	Q	OVEN MAX
7	7	R	EQUIB TIME
8	8	S	FLOW
9	9	T	TIME
>	DET	U	PURGE
?	CLEAR	V	SIG 1
A	A	W	SIG 2
B	B	X	RANGE 2↑( )
C	COL COMP1	Y	ATTN 2↑( )
D	COL COMP2	Z	ZERO
E	ON	^	START
F	OFF	=	STOP
G	OVEN TEMP	@	ENTER
H	INIT TEMP	:	SUPER CLEAR

SECTION 6

Run Control Conversations

There are three run control commands: Host Ready Flag (HR), Status Modification Flag (SM), and Start Notification Request (ST). The host can use them in combination to control starting the HP 5890A run and to be notified when any change occurs to the GC. They may have delayed replies from the HP 5890A, and must be used carefully in application programs.

Run Control Conversations: Commands that allow the host to control the start of runs and monitor changes in the HP 5890A.

HR	Delays start until host is ready
SM	Requests that host be notified when HP 5890A status is modified
ST	Start analysis if HP 5890A is in pre-run and notify the host

Table 6-1. Run Control Conversation Codes

If read sequences are used to control replies, and the status modified or start notification conversations are used, care must be taken not to send two commands that produce replies without getting the replies.

For example:

```
Host Command                                    HP 5890A Reply
EcCSMRQ<ts> ------------------------------->          (delayed reply)
EcCRKRQ<ts> ------------------------------->
<rs> ------------------------------------> RKC0<ts>
   <-------------------------------------------<
EcCRKPRG200@<ts> ------------------------->
<rs> ------------------------------------> SMPR001  (delayed reply)
   <-------------------------------------------<
```

At this point, the RKEN reply is still waiting, sending the SMC0 command could cause the interface to hang, trying to complete the RK conversation (waiting for <rs>) when the input parser is waiting to get the next command (the SMC0).

To avoid this problem, if the SM process is received instead of an expected string, get that string before sending the next SM command.

```
Host Command                                    HP 5890A Reply
<rs> ------------------------------------> RKEN<display>
EcCSMC0 ---------------------------------->          (delayed reply)
   <-------------------------------------------<
```

ST START NOTIFICATION REQUEST

The STRQ command asks the HP 5890A to notify the host computer when the run begins. (To start the run from the host, a remote key stroke, RK , must be sent. Refer to Status and Setpoint Conversations previously discussed in this section.) The interface will not complete the conversation until it goes from prerun to run. The STRQ is necessary for the run to begin, unless ST was bypassed when setting the baud rate. The STEN will be sent to the host whenever a ST conversation is open (STRQ received) and the GC goes to the running state (even if the ST bypass is true).

```
Host Command                                    HP 5890A Reply
EcCSTRQ<ts> ------------------------------> STEN<ts>
```

Trying to open the ST conversation while the HP 5890A is in run mode will result in a wrong time abort stage.

STATE	Conditions necessary to go to:	Effect of going to:
READY:	Oven temp is at setpoint. Zone Temps are at setpoints. Host is ready (HRRQ received) or HR bypassed. External is ready.	External "Ready" switch is closed.
PRERUN:	Pressing [START]. Host sends RK start keycode. External "Start" received.	If STRQ already received or ST bypassed, then goes immediately to Running.
RUN:	STRQ received or ST bypassed. Ready conditions met.	If STRQ received, send STEN reply. Close external "Inject" switch. Insert start marker in data stream. Set "Host Not Ready".
POSTRUN:	Run completes (normal end). Pressing [STOP] (abort). Host sends RK stop keycode or other abort command.	Insert stop marker into data stream. If SMRQ or SMCO received, then send SMPRxyz with end or abort flag set.

Table 6-2. HP 5890A State Diagram

The HP 5890A response to ST and HR command request stages depends on the state of the GC when the command is received. The previous table generally describes that response. For more details about the various states, refer to Section 9 of the HP 5890A Reference Manual.

SECTION 7

Data Set-up and Control Conversations

Up to two signals can be received from the HP 5890A GC over the RS-232-C Serial Interface. Two host commands, CD and CP , are used to select the signal/s and establish the many parameters that define the format for the data transmission.

Signal data transfer will be the busiest time for communications between the host computer and the GC. The data buffer in the GC's Serial Interface requires the host to frequently ask for data. If the data buffer overflows, an abort occurs and all other data is lost.

Signal Data Conversations: Setting the signal transfer parameters and controlling the data transfer.

CD	Configure data transfer
CP	Configure signal producers
SD	Send signal data

Table 7-1. Signal Data Conversation Codes

CP CONFIGURE SIGNAL PRODUCERS

The HP 5890A has two signal "data producers", these may be either on or off and produce either full or ranged data. Ranged data is full-range data scaled by 2 to the "range" power.

```
Host Command                                  HP 5890A Reply
EcCCPRQ<ts> ------------------------------> CPC0<ts>
EcCCPPRsrsr<ts> <------------------------------<
   >--------------------------------------> CPEN<ts>
```

Where:

The first sr is for Signal 1 and the second sr is for Signal 2.

```
s = 0 sets signal off.
s = 1 sets signal on.
r = 0 turns that signal's ranging off (sets full-range).
r = 1 turns that signal's ranging on.
```

At least 1 signal must be configured to start a "Send Data" conversation.

One example of the srsr string might be 1000. This would configure Signal 1 ON as full-ranged data and Signal 2 OFF.

Data is produced by the HP 5890A as soon as a particular signal is configured. The Serial Interface board will not collect this data until a Send Data conversation is open. If the Configure Data conversation sets the "Start Immediate" flag, then data collection starts as soon as the SDRQ is received and SDPR replies are sent to the host as soon as they are ready. If the start immediate is not set, then the Serial Interface board will not collect data until the start of the run. The start and stop markers will be used no matter what the state of the "immediate" flag. If both signals are configured then the Send Data stages will alternate, sending whichever signal buffer has the most data. If the host falls behind the data to the extent that a data point is sent from the HP 5890A and its buffer is full, the SDAB2 reply is sent, data collection is stopped, and the Send Data conversation is closed.

Decimal - Conversational Example:

```
        ECCDRQ<ts> ----------------------------> CDC0<ts>
        ECCDPR1000D11 <----------------------------<
            >----------------------------------> CDEN07<ts>

    Host Buffer Size = 100      Data points per line = 07
    Bunch factor = 0 (20 Hz)
    Data Format = Decimal
    Conversational Mode = 1
    Data Immediate = 1

    <data string> = "SDPR1          0, ...              0<ts>" => 92 char

    Decimal format = sign + 10 digits + comma, Leading zero suppressed.
    HP5890A waits for "SDC0" command before sending more data.
```

Hexadecimal Conversational Example:

```
        ECCDRQ<ts> ----------------------------> CDC0<ts>
        ECCDPR1001H11 <----------------------------<
            > ---------------------------------> CDEN11<ts>

    Host Buffer Size = 100      Data points per line = 11
    Bunch factor = 1 (10 Hz)
    Data Format = Hexadecimal
    Conversational Mode = 1
    Data Immediate = 1

    <data string> = "SDPR1hhhhhhhhHHHHHHHH...HHHHHHHHhhhhhhhh<ts>" => 97 char

    Hexadecimal Format = 8 characters per point, no separator.
    HP5890A waits for "SDC0" command before sending more data.
```

SECTION 8

Service

TROUBLESHOOTING

test", suspect the cable to be at fault.

3. Using a short jumper wire, connect pins 2 and 3 together in the connector of the GC's cable (see the Figure below).

```
          ___
        /    |
      /   o1 |------- AA  protective ground (shield)
    /14o     |
    |     o2 |------- BA  transmitted data
    |  o     |                              \ jumper
    |     o3 |------- BB  received data     /  wire
    |  o     |
    |     o  |
    |  o     |
    |     o  |
    |  o     |
    |     o  |
    |  o     |
    |     o7 |------- AB  signal common
    |  o     |
    |     o  |
    |  o     |
    |     o  |
    |  o     |
    |     o  |
    |  o     |
    |     o  |
    |  o     |
    |     o  |
    |25o     |
     \    o13|
      \      |
       \___|
```

Figure 4-2. Interface Cable Connector with Pin 2 Jumpered to Pin 3

This connects the transmitted signal from the GC to the cable (pin 2), through the jumper to pin 3, and back through the cable to the GC. Press the key sequence of:

[CLEAR] [•] [7] [ENTER]

This sequence will initiate the GC's self-test sequence, which includes a testing of the RS-232-C Interface. The GC (with the jumper installed) should return a PASSED SELF TEST message. This verifies that continuity exists from the Interface Board through the cable and back to the board. In this case, suspect that the problem exists either in the host computer or its cable.

If the GC returns a FAILED SELF TEST message, the problem .... ? (Refer to Volume II, Section 19 (Electronic Troubleshooting) of the HP 5890A GC Reference Manual.)