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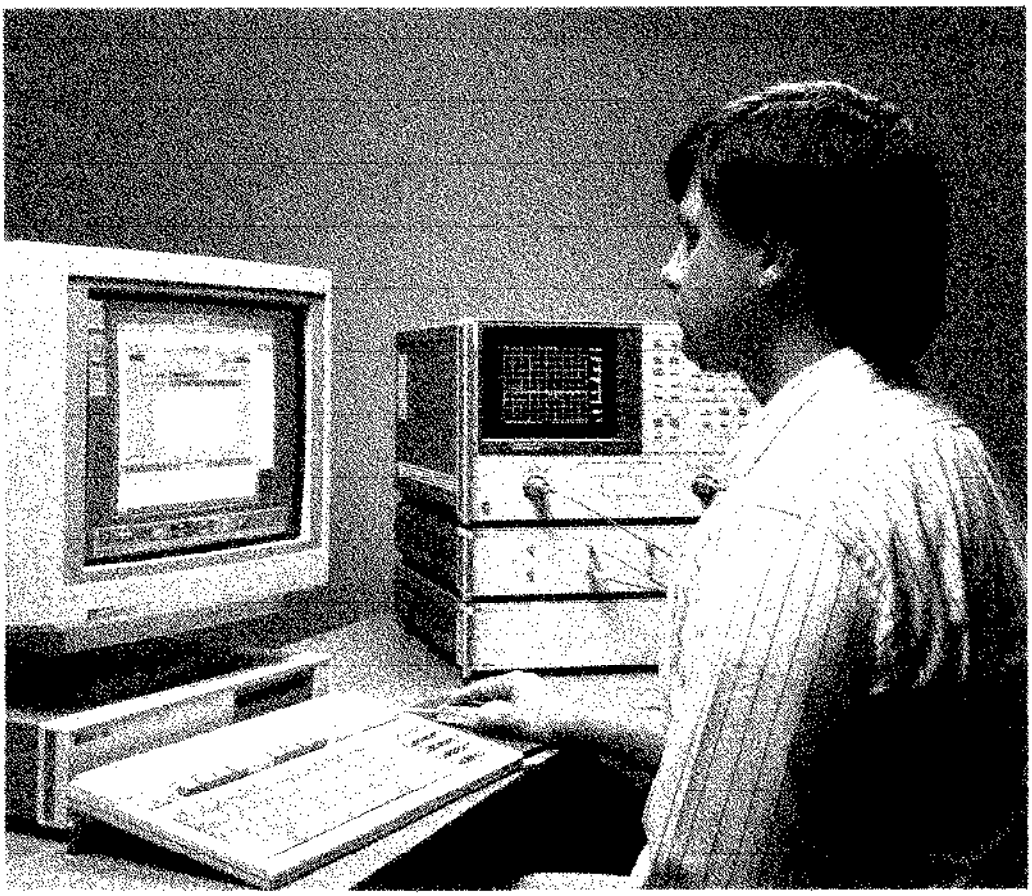
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HEWLETT PACKARD

# HP 87130A
# Attenuator/Switch Driver



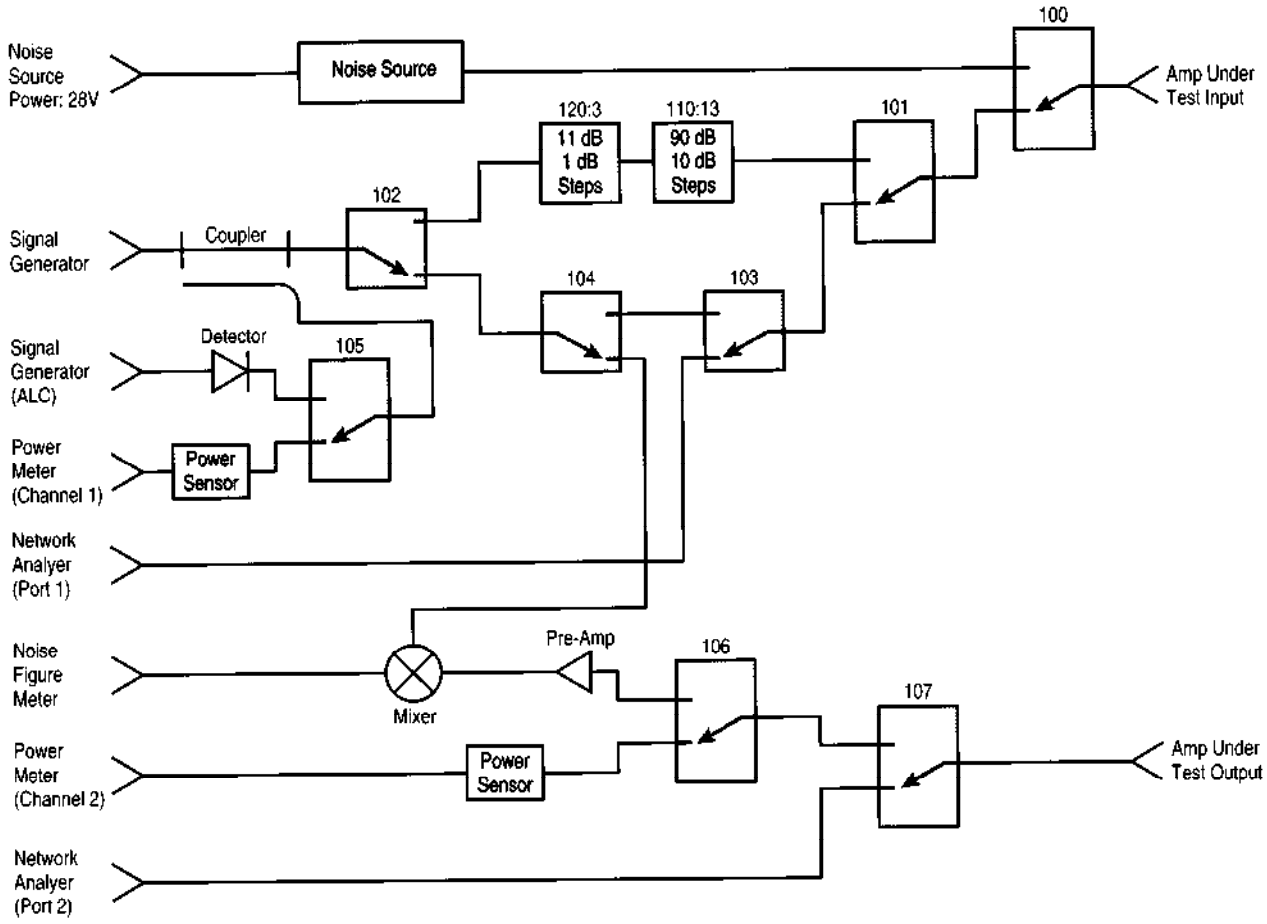


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# HP 87130A
# Attenuator/Switch Driver

- *Control 31 switches, expandable to 248*
- *Simple Programming through HP-ITG and HP-VEE*
- *Switch position sensing*
- *User defined and labeled switch paths*
- *SCPI compatible*

The HP 87130A Attenuator/ Switch Driver simplifies the task of controlling and integrating up to 248 switches and/or step attenuator sections into RF and microwave ATE systems. HP-ITG and HP-VEE software drivers speed system programming for the HP 87130A. Switch driver boards provide switching signals and verify switch positions. Additional driver boards, interconnect boards, and cables provide expanded capacity, remote switching and everything needed for simple device connection.




**Typical switching matrix- numbers indicate switch channels.**



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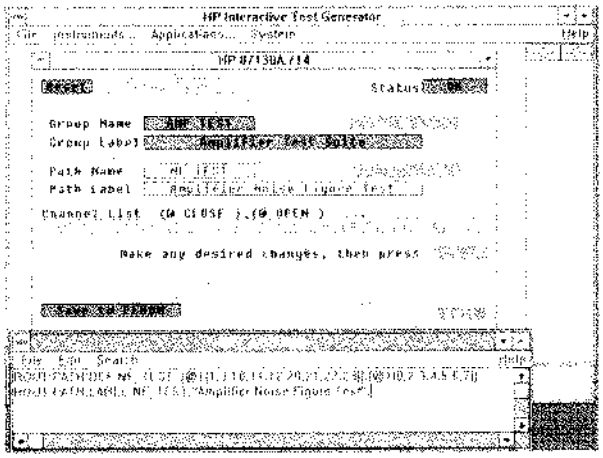


Figure 1.
Path command

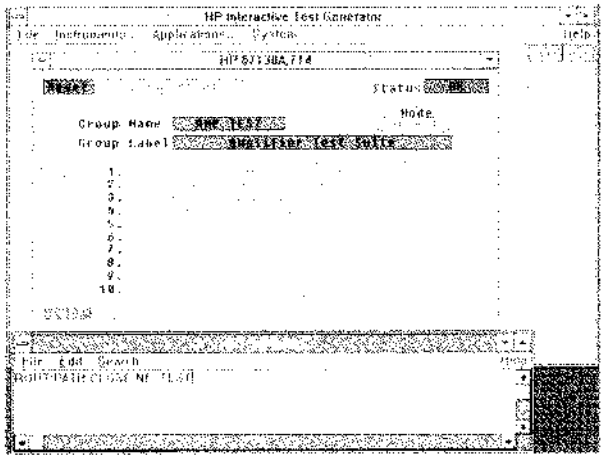


Figure 2.
Group command

## Efficient programming

Set and verify switch positions with the interactive ITG and VEE visual interfaces. Rapidly generate program instructions with the powerful HP-ITG driver. Use the PATH command to combine the switch settings and to give it a meaningful name such as "Amplifier Noise Figure Test" (figure 1). Organize PATHs into custom menus with the GROUP command (figure 2).

## Simple hardware

Quickly expand the drive capability from 31 to 248 switches by adding up to seven external switch driver boards. Connect switches and step attenuators easily with switch signal distribution boards, step attenuator cables and switch cable harnesses.

## Block diagram and expandability

The HP 87130A is a self contained switch and step attenuator driver built into a 3 1/2 inch high, full rack width cabinet. Its internal power supply is sufficient to control and drive up to 248 external switches, the HP-IB/SCPI controller board, and the electromechanical switch and step attenuator driver board (figure 3). The controller board provides the HP-IB link and protocol management in addition to SCPI command translation, storage for configuration information and translating and relaying QUERY results. The controller board communicates to the HP 84940A driver boards (one internal, up to 7 external) over a TTL level parallel data bus. The connection between the controller board and the driver boards provides both the power necessary to bias the driver board and the power required to drive the switches.

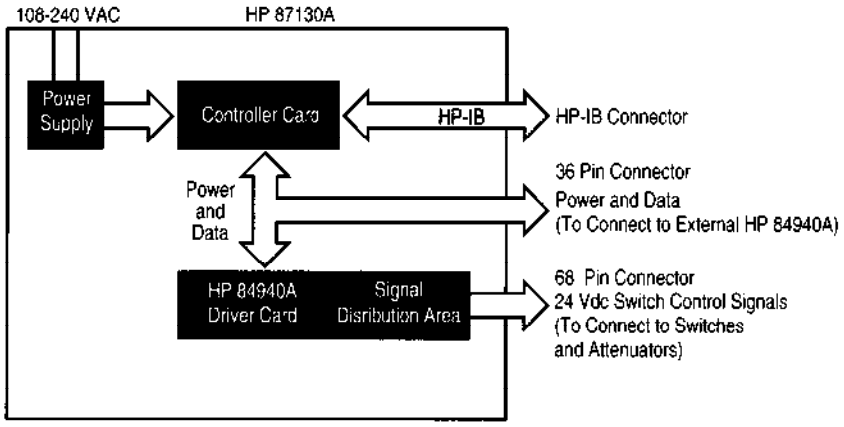



**Figure 3.**
**Block diagram**



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# Controlling the HP 87130A

**Reduce and preserve your software investment**

The HP 87130A insures that software investment is preserved for the long term with SCPI *(Standard Commands for Programmable Instruments)* compatibility and is designed to simplify and speed test system software development. SCPI compatibility means that a common set of instrument control commands are used for similar operations. As a result, software developed for the HP 87130A today will work with the HP 70611A Modular Measurement System Switch Attenuator Driver and with future versions of SCPI compatible instruments. Extensions to the SCPI command set, built in EEROM, and optional software drivers provide very powerful features to reduce code development cost, system trouble shooting, and provide for manual control of the switching interface.

The test engineer has many choices available for controlling the HP 87130A. Whether it is through user provided control programs written in Instrument Basic, Rocky Mountain Basic, C, or Pascal or through test development environments such as the HP Integrated Test Generator (HP-ITG) or the HP Visual Engineering Environment (HP-VEE), all the features of the HP 87130A simplify the task of programming and controlling the switching interface.

**Precise control, the basics**

Each switch or step attenuator section in the system is referred to as a CHANNEL. The HP 87130A has the capability to control up to 248 channels when it is fully expanded with eight HP 84940A driver cards. Each channel can be set to one of two possible states, either OPEN or CLOSE. Figure 4 shows how the channels are controlled. In HP-ITG the channel list shows all the driver cards and their channels which are available for switching. Each channel's state is indicated as being either open (inverse video) or closed (normal video). To change the state, the user simply uses the mouse pointer to click on the channel to toggle its state to either open or closed. When writing code, the open and close states are set via the:

"ROUTe:OPEN <channel list>"
and
"ROUTe:CLOSe <channel list>"

commands, where the channel list indicates the channels that will be set into the OPEN or CLOSE states. While controlling a switching interface in this manner may be quite simple, it is not efficient in particularly large switching systems, where signal paths may include many switches, and where several different paths may be specified for use at one time. The HP 87130A incorporates powerful PATH commands to simplify programming and controlling complicated paths.

**Take the right path**

Typically, in a switching system, signals are routed from one port to several other ports on a regular basis in order to perform a test or other function. In a large system, where there are many possible input to output port combinations, keeping the proper channel states straight and recalling them to achieve a particular routing can be a time-consuming job. In the HP 87130A the PATH command allows the test engineer to define often used channel lists, give short logical names to channel lists, self document channel lists, and recall channel lists.

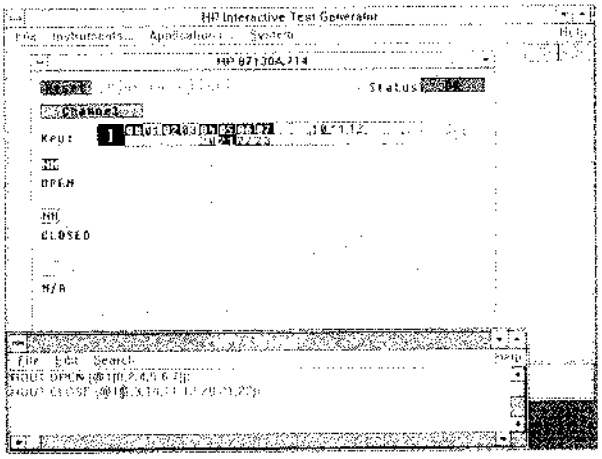



Figure 4.
Channel commands



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A Path is defined as a predetermined set of OPEN and CLOSED channels. While it is possible to just call this path "Path 1", it would be better to give it a meaningful name to make it easy to remember what it is for or what it does. Figure 1 is an example of how to define and name a path. The path definition includes channels lists for BOTH Closed and Open switches, along with a logical name assigned to this set of channels lists. In this example, the path is used for testing the noise figure of an amplifier, so the path has been given the name "NF_TEST". It is also possible to give the path a more complete description by giving it a LABEL. This label is a self documenting feature in the HP 87130A, providing a more detailed description of the purpose of the path. Names and labels are stored in the HP 87130A, saving programming time and code overhead because they do not need to be defined within the program.

Recalling a path (Figure 2) is simply a matter of clicking on the desired path or issuing a simple, logical statement. Once again, for those generating code, the path name provides some degree of self documentation, making it very easy to see, within the program, what path this command is selecting.

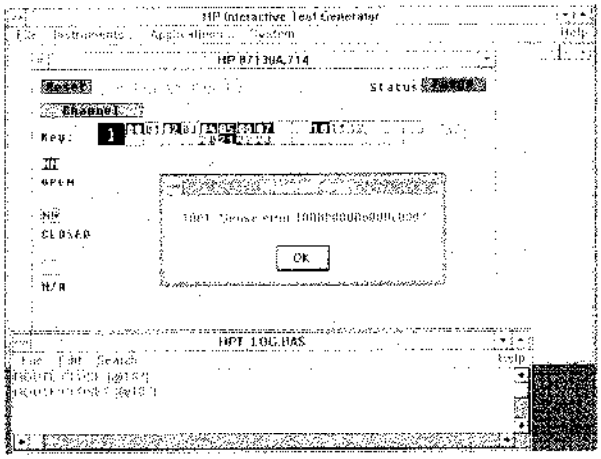



Figure 5.
Error sensing

It is occasionally necessary to troubleshoot a switching interface to isolate and correct problems in the system. It is also frequently desirable to verify that channels are properly set before proceeding with the test program. The HP 87130A can query switches to determine if each channel is in its commanded state. In this way the user can isolate any switches which are not operating properly.

When used in conjunction with the OPEN and CLOSE commands, it is very easy to determine where the problem may lie and take steps to remedy the situation. Figure 5 shows the query forms of the CLOSE command in detail. This feature utilizes the HP 84940A's built in sensing circuits to determine the state a switch is in. It relies on the characteristic of self-interrupting switches to cease drawing current from its control source once switching is completed. Switches that do not self-interrupt will not work with this feature (table 1).



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## Fresh start, everytime

In complex switching systems, it is sometimes important to assure that the system starts up in a predetermined state for system calibration, for manual control or to prevent the possibility of damaging measuring equipment. This is particularly important when delicate measuring equipment could possibly be destroyed if connected to a high power source. The HP 87130A includes a Power Fail command that allows the test engineer to define a starting state for all the channels in the system. With PFail (figure 6) the initial state of each channel is defined, so that when the HP 87130A is powered up, the switches are set to their start-up positions.

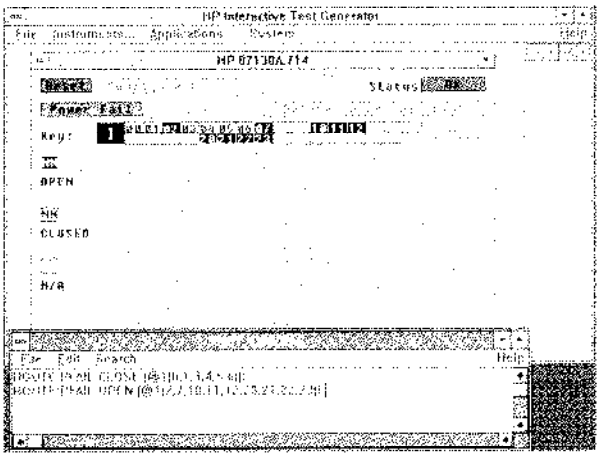


Figure 6.
Power fail commands

These features and others included in the HP 87130A make it an extremely flexible and easy to use switching system interface driver, whether it is controlled from one of HP's instrument control environments or from a user written program.

## Software drivers

Hewlett-Packard provides two software environments to aid engineers in developing complex test programs: HP-ITG and HP-VEE.

HP-ITG helps speed the task of developing an ATE program for production testing. When used with the automatic test program command generation feature of ITG, it is easy to quickly and accurately build programs to control the HP 87130A. ITG gives the user a virtual front panel to control the instrument. In the case of the HP 87130A, where no front panel control exists, ITG provides a simple, straightforward manual interface. HP-ITG runs on both personal computers and UNIX work stations, in addition to HP-Basic equipped PCs and workstations.

HP-VEE is a problem solving environment that lets you create complete engineering solutions without programming. VEE software drivers for the HP 87130A give the user a convenient interface for controlling the routing of signals within the test system. HP-VEE provides visual objects that aid in the collection, analysis and presentation of data. Further capabilities are provided for data storage, flow, modularity, debugging, documentation and the creation of custom user interfaces. By tying the capabilities of the HP 87130A's sophisticated signal routing interface and the visual interface capabilities of VEE, it is possible to create one-button measurement solutions that take care of signal routing, instrument set up, and signal analysis in one step.



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# Hardware

## Expansion

The basic HP 87130A contains a single HP 84940A Driver Card capable of powering and controlling 31 switches. When additional driver capability is required or when remotely switching from a centrally located system, up to 7 additional HP 84940A driver cards can be added externally, giving a total capacity of 248 switches (figure 7). The HP 84940A Driver Cards may be located up to 100 feet away from the HP 87130A. Typically these additional cards will be mounted inside the switching interface where the additional switching is required (figure 8).

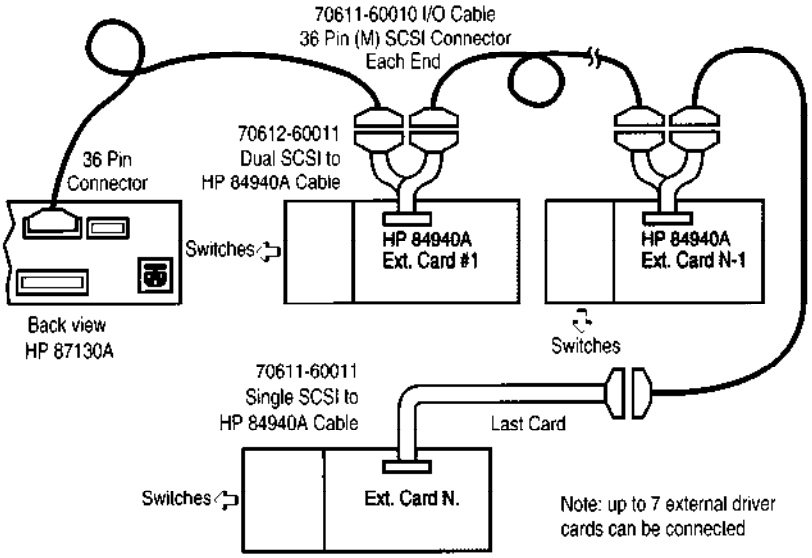



**Figure 7.**
**Expanding drive capability**

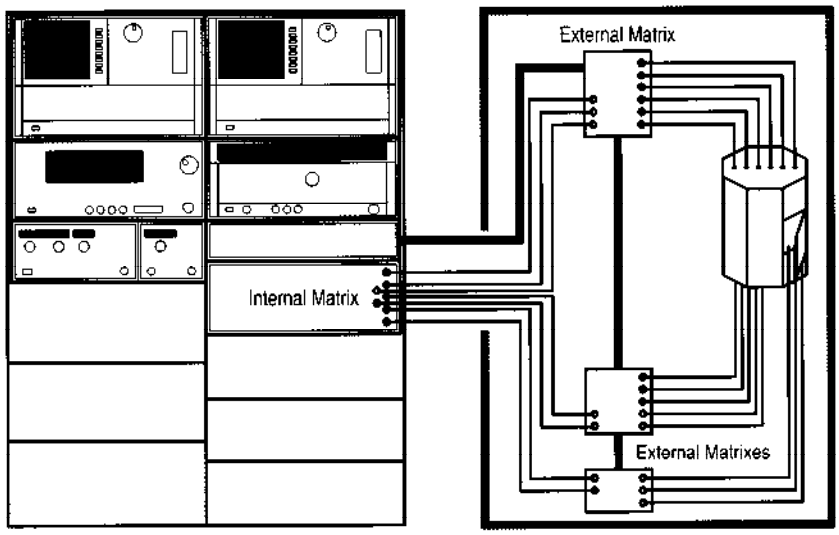



**Figure 8.**
**Satellite test**



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**Simple and quick hardware integration**

The HP 87130A can easily be integrated into any test system. In an application where the HP 87130A is directly controlling up to 31 switches, the recommended configuration is to use the HP 84941A Distribution Board with the HP 70611-60012 driver cable included with the HP 87130A (figure 9). The HP 84941A distributes the switch control signals to 31 4-pin connectors (figure 10). Each connector provides an OPEN and CLOSE signal and a common 24 Vdc supply. The connectors on the HP 84941A are polarized to prevent reversed connections. Miswiring the +24 V wire will cause catastrophic driver board failure.

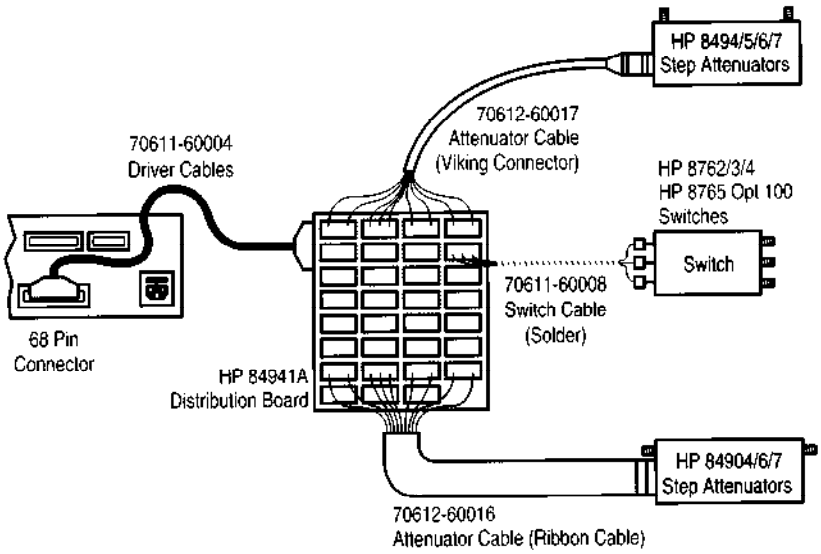



**Figure 9.**
**Connecting device**

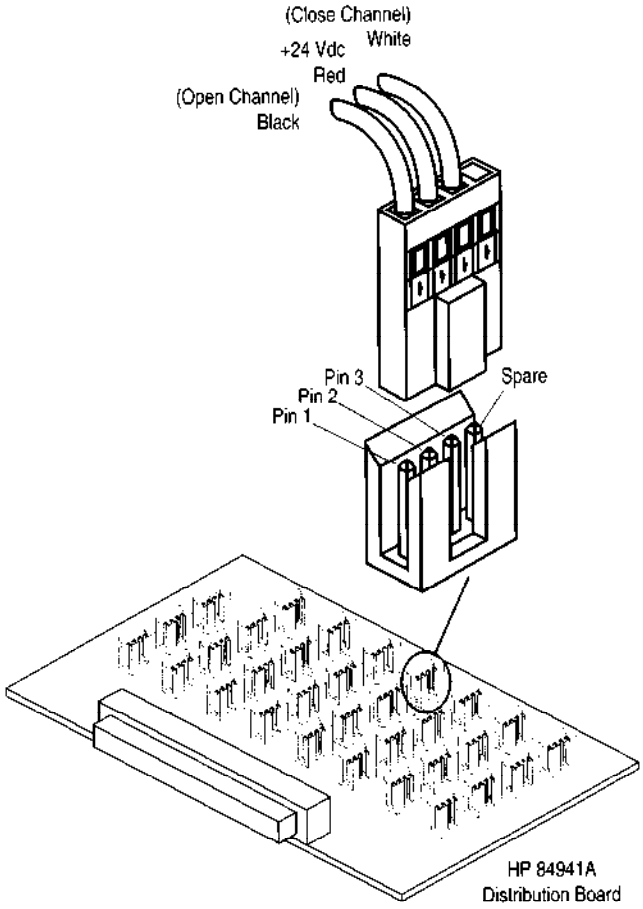



**Figure 10.**
**Single typical switch channel connector**



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The HP 84940A Driver Board (figure 11) simplifies integrating HP's broad family of microwave step attenuators and switches (table 1) into an ATE system with convenient drive cables and signal distribution accessories. It translates the commands from the controller board to provide control signals and check the position of switches.

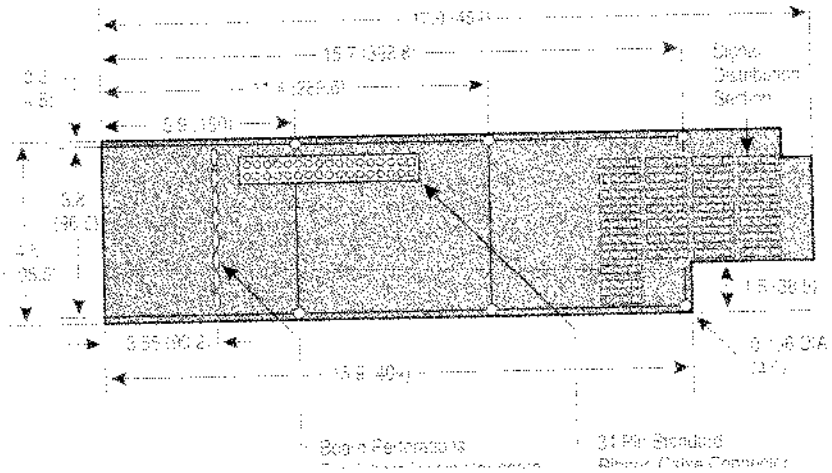
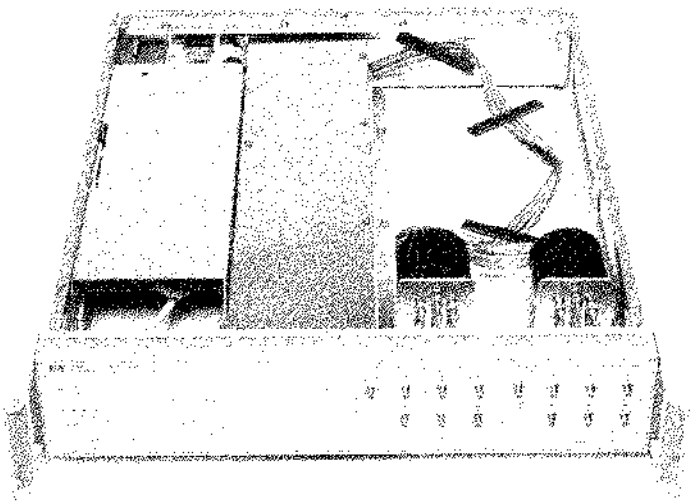


**Figure 11.**
**HP 84940A Driver Card**



**Custom switching configurations can be built into the HP 87130A. This shows the HP 87130A Option K01 which adds two HP 87106B 20 GHz SP6T switches. This configuration can be used as a test port expander with a vector network analyzer.**



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The board is designed to drive + 24 Vdc switches which are switched by sinking the control pins to ground. The HP 84940A has a 68 pin connector (figure 12a) for directly driving attached switches and a dual inline connector to communicate with the controller board. When using only a single external HP 84940A driver board, it should be connected to the HP 87130A using the HP 70611-60011 interface cable, which is terminated to a single 36 pin high density connector (figure 12b). When attaching multiple driver cards, the HP 70611-60013 interface cable provides the connections necessary to connect to the controller card and additional driver cards. The last external HP 84940A Driver Card should be connected via the HP 70611-60011 so that the low impedance TTL pulses carried on the data bus do not cause emission problems (figure 8). All the cables necessary for quickly connecting the HP 84940A driver board to the HP 87130A are included with the HP 84940A.

The HP 84941A Distribution Board includes 32 prewired cables that can be used to directly connect switches to the distribution board. Additional cables are available in sets of 30 as HP 11764H.

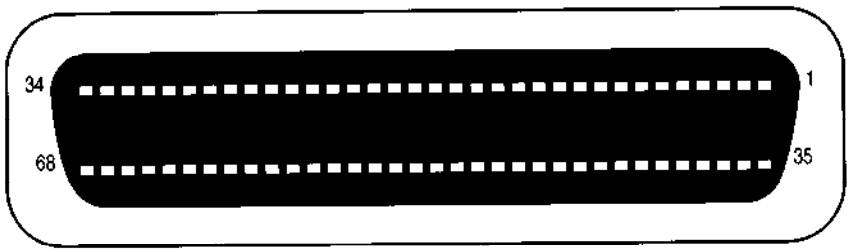



**Figure 12a. HP 70611-60004 Standard output cable is a six-foot cable with two male, 68-pin SCSI II type connectors.**

| Pin | Function | Pin | Function |
|---|---|---|---|
| 1 | Return | 35 | Return |
| 2 | Channel 0, Open | 36 | Channel 0, Closed |
| 3 | Channel 1, Open | 37 | Channel 1, Closed |
| 4 | Channel 2, Open | 38 | Channel 2, Closed |
| 5 | Channel 3, Open | 39 | Channel 3, Closed |
| 6 | Channel 4, Open | 40 | Channel 4, Closed |
| 7 | Channel 5, Open | 41 | Channel 5, Closed |
| 8 | Channel 6, Open | 42 | Channel 6, Closed |
| 9 | Channel 7, Open | 43 | Channel 7, Closed |
| 10 | Channel 8, Open | 44 | Channel 8, Closed |
| 11 | Channel 9, Open | 45 | Channel 9, Closed |
| 12 | Channel 10, Open | 46 | Channel 10, Closed |
| 13 | Channel 11, Open | 47 | Channel 11, Closed |
| 14 | Channel 12, Open | 48 | Channel 12, Closed |
| 15 | Channel 13, Open | 49 | Channel 13, Closed |
| 16 | Channel 14, Open | 50 | Channel 14, Closed |
| 17 | Channel 15, Open | 51 | Channel 15, Closed |
| 18 | Channel 16, Open | 52 | Channel 16, Closed |
| 19 | Channel 17, Open | 53 | Channel 17, Closed |
| 20 | Channel 18, Open | 54 | Channel 18, Closed |
| 21 | Channel 19, Open | 55 | Channel 19, Closed |
| 22 | Channel 20, Open | 56 | Channel 20, Closed |
| 23 | Channel 21, Open | 57 | Channel 21, Closed |
| 24 | Channel 22, Open | 58 | Channel 22, Closed |
| 25 | Channel 23, Open | 59 | Channel 23, Closed |
| 26 | Channel 24, Open | 60 | Channel 24, Closed |
| 27 | Channel 25, Open | 61 | Channel 25, Closed |
| 28 | Channel 26, Open | 62 | Channel 26, Closed |
| 29 | Channel 27, Open | 63 | Channel 27, Closed |
| 30 | Channel 28, Open | 64 | Channel 28, Closed |
| 31 | Channel 29, Open | 65 | Channel 29, Closed |
| 32 | Channel 30, Open | 66 | Channel 30, Closed |
| 33 | Channel 31, Open | 67 | +24 Vdc |
| 34 | Channel 32, Open | 68 | Return |



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For step attenuators, two types of cables are available. The HP 11764E is terminated to 4 four-position connectors and a Viking connector for use with the HP 8494/5/6/7 step attenuators and the HP 8766/7/8/9 multiport switches. The second cable, the HP 11764F, incorporates a 14 position dual inline connector in place of the Viking connector for use with step attenuators with ribbon cable connectors such as the HP 84904/6/7 family of high performance step attenuators (figure 9).

Connecting switches and step attenuators to remotely mounted HP 84940A Driver Cards is also straightforward. The HP 84940A has a distribution section similar in layout to the HP 84941A (figure 11). Switches and step attenuators are connected in a similar fashion to the method described above. Switches or step attenuators located remote from the internal HP 84940A may be driven with an HP 70611-60012 cable and another HP 84941A Distribution Card.

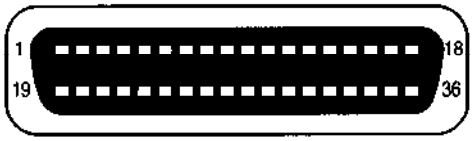



**Figure 12b. HP 70611-60010 The standard I/O data cable is a five-foot cable with two female, 36-pin SCSI II type connectors.**

| Pin | Function | Pin | Function |
|---|---|---|---|
| 1 | Return | 19 | D6, Data Line |
| 2 | Return | 20 | D7, Data Line |
| 3 | NC | 21 | D8, Data Line |
| 4 | NC | 22 | D9, Data Line |
| 5 | NC | 23 | D10, Data Line |
| 6 | NC | 24 | D11, Data Line |
| 7 | +5 Vdc | 25 | D12, Data Line |
| 8 | +5 Vdc | 26 | D13, Data Line |
| 9 | +24 Vdc | 27 | D14, Data Line |
| 10 | +24 Vdc | 28 | NC |
| 11 | Return | 29 | NC |
| 12 | Return | 30 | Register CLR |
| 13 | D0, Data Line | 31 | Store |
| 14 | D1, Data Line | 32 | I/O |
| 15 | D2, Data Line | 33 | Return |
| 16 | D3, Data Line | 34 | Return |
| 17 | D4, Data Line | 35 | NC |
| 18 | D5, Data Line | 36 | NC |

## Accessories

The HP 87130A is designed to translate commands delivered over an HP-IB link into switch controlling actions. It will operate with most PCs and workstations equipped with an HP-IB port and running HP-ITG, HP-VEE or a user written program. It is compatible with Hewlett-Packard's microwave switches and step attenuators (table 1) and many switches from other vendors. Since it drives a switch by providing a temporary current pulse, it will not work with non-latching or failsafe switches that require current to be applied constantly to hold a position.



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# Specifications

## Electrical

**Drive Capacity**
*Internal Driver* 31 relays. One HP 84940A driver card is installed within the instrument.

*External Drivers* 217 additional relays. Up to 7 additional HP 84940A driver cards can be daisy-chained external to the HP 87130A. Each HP 84940A can drive 31 relays.

**Voltage**
+24 volts ±3.0 Vdc

Miswiring the +24 V wire will cause catastrophic driver board failure.

**Current Pulses**
800 mA maximum per four relay group. 200 mA per relay. Default pulse width is 30 msec. Pulse width is adjustable from 5 ms to 1275 ms ±5 ms, in 5 ms steps.

**Load Inductance**
Typically <500 mH.

**Load Capacitance**
Typically < 0.01 uF.

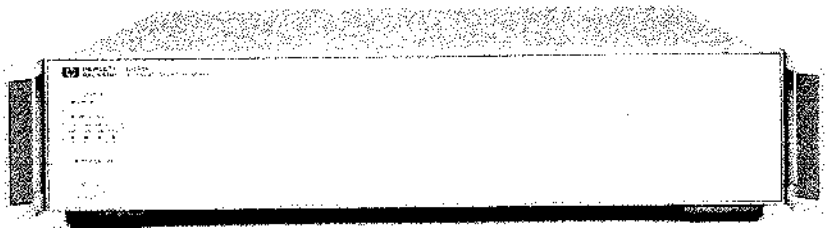
**Switching Speed**
Sensing delay is adjustable, per relay, from 5 to 1275 ms ±5 ms. Pulse width is also adjustable, per relay from 5 to 1275 ms ±5 ms. The final switching speed is a function of pulse widths, sensing delays, the sequence of relays driven, and the state of the chosen channels.

**Remote Programming**
All functions are HP-IB programmable except the line switch and bus address. All functions are programmable to conform with IEEE 488.2-1987 Standard Commands for Programmable Instruments (SCPI).The HP 87130A can output over the interface almost all settings, error/malfunction codes and operation status.

**Interface to External Drivers**
36-pin SCSI II type connector

**Interface to External Switches**
68-Pin SCSI II type connector

**Interface to Controller**
HP-IB IEEE-488 standard connector



## Environmental

**Temperature**
*Operating* -5° C to +60° C
*Survival* -40° C to +70° C

**Humidity**
95% relative humidity at 40°C max

**Altitude**
*Operating*
4,600 meters (15,000 feet)
*Non-Operating*
15,300 meters (50,000 feet)

**Vibration**
*Operating* 0.21 g (rms)
*Survival* 2.1 g (rms)
*Swept Sine* 0.5 g (pk)

**Shock**
*End use*
350 g (pk) for 3 ms duration
*Transportation*
100 g (pk) for 30 ms duration

**Electromagnetic Compatibility Military Specs**
Conducted and radiated interference is in compliance with CISPR, Pub 11 (1985) and Messempfaenger-Postferfuegung 526/527/79 (Kennzeichnung Mit F-Nummer/Funkschutzzeichen). Meets the requirements of MIL-STD-461B.

**Maximum Power Dissipation**
110 Watts

**Weight**
3.2 kg (7 lbs)

**Dimensions**
*Height*
102 mm (4 inches including feet)
*Width*
425.4 mm (16.75 inches)
*Depth*
502 mm (19.75 inches)
Allow 3 inches of clearance in back for cables.



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# Ordering and Configuration Information

**HP 87130A**
Attenuator/Switch Driver HP-IB/SCPI switch and step attenuator driver will drive up to 31 switches or step attenuator sections. Includes one HP 70611-60004 1.83 meter switch signal interface cable and a rack mount kit.

**HP 84940A**
Switch Driver Card will drive up to 31 switches. The card kit includes the HP 70611-60010 cable to connect to the HP 87130A and one each of the HP 70612-60011 and HP 70611-60013 interface cables for mounting the driver card into an external cabinet. (Each HP 87130A can control up to 7 HP 84940A Switch Driver Cards.)

**HP 84941A**
Switch Interface Kit includes a switch signal distribution card, which interfaces to the signal interface cable included with the HP 87130A, and 31 3-wire switch interface cables for building cable harnesses.

**Controller Hardware and Software**
The HP 87130A can be controlled by a wide variety of PC and Workstation based controllers.

As a minimum any 100% PC compatible computer may be used as a controller when used with an HP-IB interface card.

**PC Hardware and Software**
*HP 82335B*
HP-IB interface card and command library for MS-DOS and Windows 3.0. It works with all HP Vectra computers, in addition to IBM PC, PC/XT, PC/AT and all true IBM PC compatibles. The command library supports most popular programming languages.

*HP 82300D*
Measurement Coprocessor. Designed for an IBM-AT or compatible ISA or EISA bus. This 68000 based coprocessor provides its own operating system, processor, HP-IB port, and RAM. It provides HP BASIC control over instruments on the bus.

*HP 82324B*
High Performance Measurement Coprocessor. Provides much of the same functionality of the HP 82300D but with the power and speed of a 68030 processor.

*HP E2020A*
HP Interactive Test Generator for DOS. Provides virtual front panel, instrument drivers and interactive HP BASIC code generation. Options include:

335: Delete HP-IB Interface card
AA6: Media on 5.25 in 1.2 MB disk
AA8: Media on 3.5 in 1.44 MB disk

Hewlett-Packard's HP 9000 Series 300 Controllers offer powerful control options for the most demanding test and measurement needs. Depending upon your specific software and hardware needs, HP BASIC/WS,HP BASIC/UX and HP-VEE are available for developing test software and controlling test equipment. Consult with your HP sales representative for more information on available hardware and software for HP workstations.



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# Table 1

## HP Compatible Step Attenuators

| HP Model | Frequency | Description | Sense | HP OEM Equivalent | Order Option | Order Cable |
|---|---|---|---|---|---|---|
| 8494G | dc - 4 GHz | 0-11 dB,1 dB steps | yes | 33320G | Std | 11764E |
| 8494H | dc - 18 GHz | 0-11 dB, 1 dB steps | yes | 33320H | Std | 11764E |
| 8495G | dc - 4 GHz | 0-70 dB, 10 dB steps | yes | 33321H | Std | 11764E |
| 8495H | dc - 18 GHz | 0-70 dB, 10 dB steps | yes | 33321G | Std | 11764E |
| 8495K | dc - 26.5 GHz | 0 - 70 dB, 10 dB steps | yes | 33321K | Std | 11764E |
| 8496G | dc - 4 GHz | 0-110 dB, 10 dB steps | yes | 33322H | Std | 11764E |
| 8496H | dc - 18 GHz | 0-110 dB, 10 dB steps | yes | 33322G | Std | 11764E |
| 8497K | dc - 26.5 GHz | 0-90 dB, 10 dB steps | yes | 33323K | Std | 11764E |
| 84904K | dc - 26.5 GHz | 0-11 dB, 1 dB steps | yes | 33324K | Std | 11764F |
| 84904L | dc - 40 GHz | 0-11 dB, 1 dB steps | yes | 33324L | Std | 11764F |
| 84904M | dc - 50 GHz | 0-11 dB, 1 dB steps | yes | 33324M | Std | 11764F |
| 84906K | dc - 26.5 GHz | 0-90 dB, 10 dB steps | yes | 33326K | Std | 11764F |
| 84906L | dc - 40 GHz | 0-90 dB, 10 dB steps | yes | 33326L | Std | 11764F |
| 84906M | dc - 50 GHz | 0-90 dB, 10 dB steps | yes | 33326M | Std | 11764F |
| 84907K | dc - 26.5 GHz | 0-70 dB, 10 dB steps | yes | 33327K | Std | 11764F |
| 84907L | dc - 40 GHz | 0-70 dB, 10 dB steps | yes | 33327L | Std | 11764F |
| 84907M | dc - 50 GHz | 0-70 dB, 10 dB steps | yes | 33327M | Std | 11764F |

## HP Compatible Switches

| HP Model | Frequency | Description | Terminated | Sense | HP OEM Equivalent | Order Option | Order Cable |
|---|---|---|---|---|---|---|---|
| 8762A | dc - 4 GHz | SPDT | yes | yes | 33311A | Std | 11764H * |
| 8762B | dc - 18 GHz | SPDT | yes | yes | 33311B | Std | 11764H * |
| 8762C | dc - 26.5 GHz | SPDT | yes | yes | 33311C | Std | 11764H * |
| 8763A | dc - 4 GHz | Transfer | yes | yes | 33312A | Std | 11764H * |
| 8763B | dc - 18 GHz | Transfer | yes | yes | 33312B | Std | 11764H * |
| 8763C | dc - 26.5 GHz | Transfer | yes | yes | 33312C | Std | 11764H * |
| 8764A | dc - 4 GHz | 5 port | no | yes | 33313A | Std | 11764H * |
| 8764B | dc - 18 GHz | 5 port | no | yes | 33313B | Std | 11764H * |
| 8764C | dc - 26.5 GHz | 5 port | no | yes | 33313C | Std | 11764H * |
| 8765A | dc - 4 GHz | SPDT | no | no | 33314A | 024 & 100 | 11764H * |
| 8765B | dc - 20 GHz | SPDT | no | no | 33314B | 024 & 100 | 11764H * |
| 8765C | dc - 26.5 GHz | SPDT | no | no | 33314C | 024 & 100 | 11764H * |
| 8765D | dc - 40 GHz | SPDT | no | no | 33314D | 024 & 100 | 11764H * |
| 8765F | dc - 4 GHz | 75 ohm SPDT | no | no | | 024 & 100 | 11764H * |
| 87104A | dc - 4 GHz | SP4T | yes | yes | | Std | 11764G |
| 87104B | dc - 20 GHz | SP4T | yes | yes | | Std | 11764G |
| 87104C | dc - 26.5 GHz | SP4T | yes | yes | | Std | 11764G |
| 87106A | dc - 4 GHz | SP6T | yes | yes | | Std | 11764G |
| 87106B | dc - 20 GHz | SP6T | yes | yes | | Std | 11764G |
| 87106C | dc - 26.5 GHz | SP6T | yes | yes | | Std | 11764G |

* The HP 84941A Signal Distribution Board includes the HP 11764H cable set (enough cables to connect 31 switches).
For reordering switch and attenuator interface cables see next page.



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When additional integration accessories are required in order to complete a switching system, individual items may be ordered from a Hewlett-Packard Parts Center. The following accessories may be ordered individually:

**HP 11764E**
*Ribbon cable connector to Distribution Board*
Extra Viking cable connector to interface HP 8494/5/6/7 Step Attenuators to the HP 84941A Distribution Board or HP 84940A Driver Board signal distribution section. 1 cable.

**HP 11764F**
*Ribbon cable connector to Distribution Board*
Extra ribbon cable connector to interface HP 84904/6/7 Step Attenuators to the HP 84941A Distribution Board or HP 84940A Driver Board signal distribution section. 1 cable.

**HP 11764G**
*Ribbon cable to Distribution Board*
Extra ribbon cable connector to interface HP 87104/6 Multiport Switch to the HP 84941A Distribution Board or HP 84940A Driver Board signal distribution section. 1 cable.

**HP 11764H**
*Switch Interface Cable Kit*
Additional cables for use with the HP 84940A Driver Board or the HP 84941A Distribution Board for connecting switches. Package of 31 cables.

**HP 70611-60004**
*Switch Driver Cable*
Extra 68 pin female SCSI type connector (both ends) for connecting devices to the 68 pin male SCSI type switch driver connector on the HP 87130A. 1 cable.

**HP 70611-60010**
*Driver Control Cable*
Extra driver cable for connecting the HP 87130A to the HP 84940A. 1 cable.

**HP 70611-60011**
*HP 84940A Interface Cable*
Extra 34 pin PC board connector to 36 pin SCSI type male bulkhead connector for connecting an HP 84940A to the HP 70611-60010 Driver Control Cable. 1 cable.

**HP 70612-60011**
*HP 84940A Dual Interface Cable*
Extra 34 pin PC board connector to two 36 pin male SCSI type connectors for connecting an HP 84940A and daisy chaining additional HP 84940As. 1 cable.



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**For more information, call your local HP sales office listed in your telephone directory or an HP regional office listed below for the location of your nearest sales office.**

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(708) 255 9800

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Los Angeles, CA 90045
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Atlanta, GA 30339
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