Errata

Title & Document Type: 70422A Microwave Downconverter User's Guide

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HP References in this Manual

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, semiconductor products and chemical analysis businesses are now part of Agilent Technologies. We have made no changes to this manual copy. The HP XXXX referred to in this document is now the Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A.

About this Manual

We've added this manual to the Agilent website in an effort to help you support your product. This manual provides the best information we could find. It may be incomplete or contain dated information, and the scan quality may not be ideal. If we find a better copy in the future, we will add it to the Agilent website.

Support for Your Product

Agilent no longer sells or supports this product. You will find any other available product information on the Agilent Test & Measurement website:

www.tm.agilent.com

Search for the model number of this product, and the resulting product page will guide you to any available information. Our service centers may be able to perform calibration if no repair parts are needed, but no other support from Agilent is available.

HEWLETT
PACKARD

HP 70422A
Microwave Downconverter

User's Guide

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Hewlett-Packard Company
Santa Rosa Systems Division
1400 Fountaingrove Parkway
Santa Rosa, CA 95403-1799, U.S.A.

What You'll Find in This Manual…

Chapter 1 • Introduction and Installation

Chapter 2 • Front and Rear Connectors and Indicators

Chapter 3 • Technical Data

Chapter 4 • Customer Support

Warranty

Certification

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology (NIST, formerly NBS), to the extent allowed by the Institute's calibration facility, and to the calibration facilities of other International Standards Organization members.

Warranty

This Hewlett-Packard system product is warranted against defects in materials and workmanship for a period corresponding to the individual warranty periods of its component products. Instruments are warranted for a period of one year. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products that prove to be defective.

Warranty service for products installed by HP and certain other products designated by HP will be performed at Buyer's facility at no charge within HP service travel areas. Outside HP service travel areas, warranty service will be performed at Buyer's facility only upon HP's prior agreement and Buyer shall pay HP's round trip travel expenses. In all other areas, products must be returned to a service facility designated by HP.

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CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT,
TORT, OR ANY OTHER LEGAL THEORY.

Assistance

Product maintenance agreements and other customer assistance agreements
are available for Hewlett-Packard products.

For assistance, call your local Hewlett-Packard Sales and Service Office
(refer to "Service and Support").

Service and Support

Any adjustment, maintenance, or repair of this product must be performed by qualified personnel. Contact your customer engineer through your local HP Service Center. You can find a list of HP Service Centers on the web at `http://www.hp.com/go/tmdir`.

If you do not have access to the Internet, one of these HP centers can direct you to your nearest HP representative:

United States:	Hewlett-Packard Company Test and Measurement Call Center PO Box 4026 Englewood, CO 80155-4026 (800) 452 4844 (toll-free in US)
Canada:	Hewlett-Packard Canada Ltd. 5150 Spectrum Way Mississauga, Ontario L4W 5G1 (905) 206 4725
Europe:	Hewlett-Packard European Marketing Centre Postbox 999 1180 AZ Amstelveen The Netherlands (31 20) 547 9900
Japan:	Yokogawa-Hewlett-Packard Ltd. Measurement Assistance Center 9-1, Takakura-Cho, Hachioji-Shi Tokyo 192, Japan (81) 426 56 7832 (81) 426 56 7840 (FAX)
Latin America:	Hewlett-Packard Latin American Region Headquarters 5200 Blue Lagoon Drive, 9th Floor Miami, Florida 33126, U.S.A. (305) 267 4245 (305) 267 4288 (FAX)
Australia/New Zealand:	Hewlett-Packard Australia Ltd. 31-41 Joseph Street Blackburn, Victoria 3130 Australia 1 800 629 485 (toll-free)
Asia-Pacific:	Hewlett-Packard Asia Pacific Ltd. 17-21/F Shell Tower, Times Square 1 Matheson Street, Causeway Bay Hong Kong (852) 2599 7777 (852) 2506 9285 (FAX)

Safety and Regulatory Information

Review this product and related documentation to familiarize yourself with safety markings and instructions before you operate the instrument. This product has been designed and tested in accordance with international standards.

WARNING
The WARNING notice denotes a hazard. It calls attention to a procedure, practice, or the like, that, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

CAUTION
The **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a **CAUTION** notice until the indicated conditions are fully understood and met.

Instrument Markings

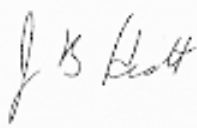| Symbol	Description
⚠ !	When you see this symbol on your instrument, you should refer to the instrument's instruction manual for important information.
⚡	This symbol indicates hazardous voltages.
☀	The laser radiation symbol is marked on products that have a laser output.
∼	This symbol indicates that the instrument requires alternating current (ac) input.
CE	The CE mark is a registered trademark of the European Community. If it is accompanied by a year, it indicates the year the design was proven.
CSA	The CSA mark is a registered trademark of the Canadian Standards Association.
1SM1-A	This text indicates that the instrument is an Industrial Scientific and Medical Group 1 Class A product (CISPER 11, Clause 4).
│	This symbol indicates that the power line switch is ON.
⏻	This symbol indicates that the power line switch is OFF or in STANDBY position.

Safety Earth Ground

This is a Safety Class I product (provided with a protective earthing terminal). An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set. Whenever it is likely that the protection has been impaired, the product must be made inoperative and secured against any unintended operation.

Before Applying Power

Verify that the product is configured to match the available main power source as described in the input power configuration instructions in this manual. If this product is to be powered by autotransformer, make sure the common terminal is connected to the neutral (grounded) side of the ac power supply.

Declaration of Conformity

DECLARATION OF CONFORMITY
according to ISO/IEC Guide 22 and EN 45014

Manufacturer's Name: Hewlett-Packard Co.

Manufacturer's Address: Microwave Instruments Division
1400 Fountaingrove Parkway
Santa Rosa, CA 95403-1799
USA

declares that the product

Product Name: Downconverter

Model Number: HP 70422A

Product Options: This declaration covers all options of the above product.

conforms to the following Product specifications:

Safety: IEC 1010-1:1990+A1 / EN 61010-1:1993
CAN/CSA-C22.2 No. 1010.1-92

EMC: CISPR 11:1990/EN 55011:1991 Group 1, Class A
IEC 801-2:1984/EN 50082-1:1992 4 kV CD, 8 kV AD
IEC 801-3:1984/EN 50082-1:1992 3 V/m, 27-500 MHz
IEC 801-4:1988/EN 50082-1:1992 0.5 kV Sig. Lines, 1 kV Power Lines

IEC 1000-3-2:1995/EN 61000-3-2:1995
IEC 1000-3-3:1994/EN 61000-3-2:1995

Supplementary Information:

The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carries the CE-marking accordingly.

Santa Rosa, California, USA   9 Sept. 1997

John Hiatt/Quality Engineering Manager

European Contact: Your local Hewlett-Packard Sales and Service Office or Hewlett-Packard GmbH, Department HQ-TRE, Herrenberger Strasse 130, D-71034 Böblingen, Germany (FAX +49-7031-14-3143)

Typeface Conventions

Italics
- Used to emphasize important information:
  Use this software *only* with the HP xxxxxX system.

- Used for the title of a publication:
  Refer to the *HP xxxxxX System-Level User's Guide*.

- Used to indicate a variable:
  Type LOAD BIN *filename*.

`Instrument Display`
- Used to show on-screen prompts and messages that you will see on the display of an instrument:
  The HP xxxxxX will display the message **`CAL1 SAVED`**.

[Keycap]
- Used for labeled keys on the front panel of an instrument or on a computer keyboard:
  Press **[Return]**.

{Softkey}
- Used for simulated keys that appear on an instrument display:
  Press **{Prior Menu}**.

`User Entry`
- Used to indicate text that you will enter using the computer keyboard; text shown in this typeface must be typed *exactly* as printed:
  Type LOAD PARMFILE

- Used for examples of programming code:
  ```
  #endif // ifndef NO_CLASS
  ```

Path Name
- Used for a subdirectory name or file path:
  Edit the file *usr/local/bin/sample.txt*

Computer Display
- Used to show messages, prompts, and window labels that appear on a computer monitor:
  The **Edit Parameters** window will appear on the screen.

- Used for menus, lists, dialog boxes, and button boxes on a computer monitor from which you make selections using the mouse or keyboard:
  Double-click **EXIT** to quit the program.

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3. System Specifications

4. Customer Support

1

Overview

The HP 70422A Microwave Downconverter Module is part of the 70000 modular measurement system (MMS). The microwave downconverter translates microwave signals to RF frequencies with minimal phase and AM noise contribution. State-of-the-art phase noise performance gives the user the capability to lower the microwave noise floor of the phase noise measurement system. The HP 70422A is a 4/8 wide module that accepts signals between 5 MHz and 18 GHz at levels between +5 dBm (+5 dBm minimum <12 GHz and +10 dBm <18 GHz) and +15 dBm.
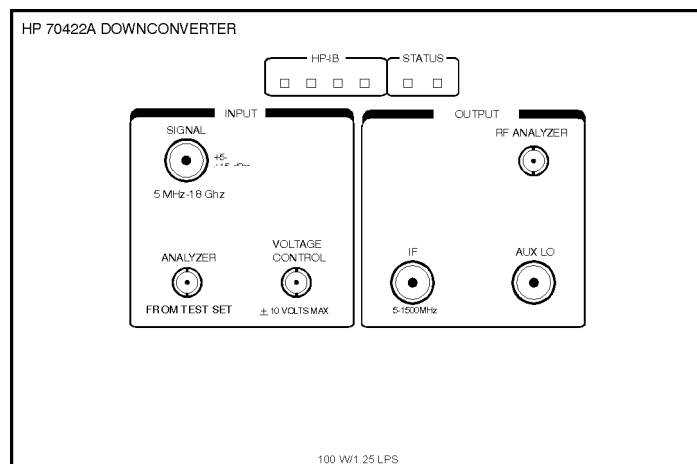
frontp.cdr

Figure 1-1   HP 70422A Microwave Downconverter

2

# Front-Panel Connectors and Indicators

Introduction

This chapter lists the HP 70422A's front and rear panel connectors and indicators. All connectors and indicators are listed alphabetically.

This chapter contains the following Information:

- **Front-Panel Connectors and Indicators**, page 2-2
- **Rear-Panel Connectors**, page 2-4

Front-Panel Connectors and Indicators
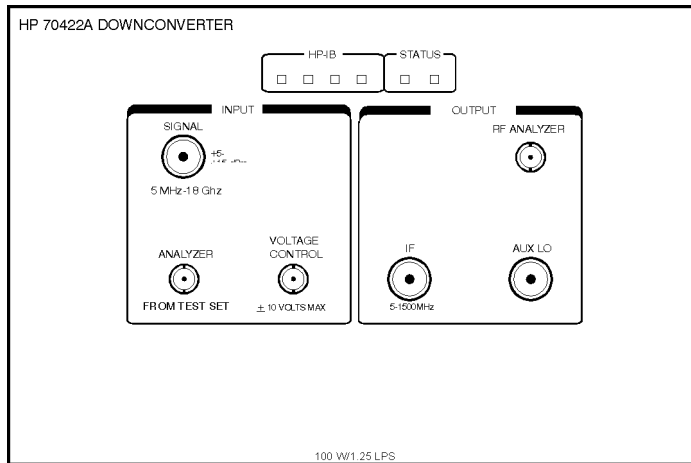
frontp.cdr

ACT indicator

The active module indicator shows when the module can be controlled from the MMS mainframe.

ERR indicator

The error message indicator shows when an error occurs and that an error message can be read.

Operating considerations

Messages can also be read over the HP-IB.

IF output

The signal at this connector is the downconverter's output.

Limits

- Nominal output level: 0 to +5 dBm (input signal ≥ -30 dBm)

- Maximum output level: +15 dBm

- Frequency: 5 to 1500 MHz

The IF amplifiers frequency response starts rolling off above 1200 MHz. It is best to avoid using an IF frequency between 1200 and 1500 MHz.

LSN indicator

The listen indicator shows when the module is addressed to listen over HP-IB.

RF ANALYZER Output

This connector provides a monitoring point for the downconverter's input or IF output.

Characteristics

- Output impedance: 50 Ω

Operating considerations

Terminating

Terminate the **IF** output in 50Ω when monitoring the input. Leaving it unterminated can cause frequency response ripples in the monitored input.

RMT indicator

The remote indicator shows when the module is enabled for HP-IB control (lit) or front-panel control (not lit).

SIGNAL input

This connector accepts the input signal for the downconverter.

Limits

- Maximum level: +15 dBm
- Frequency: 5 MHz to 18 GHz

SRQ indicator

The service request indicator shows when the module has requested service over HP-IB.

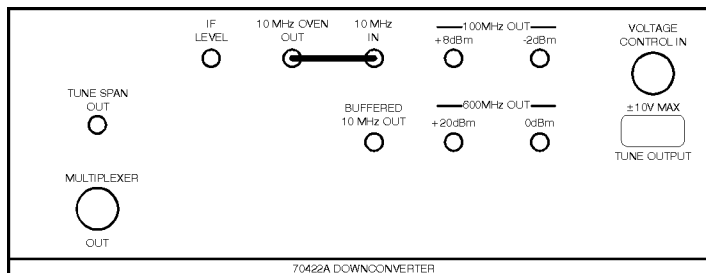**STATUS indicators**

See ACT and ERR.

TLK indicator

The talk indicator shows when the module is addressed to talk over HP-IB.

Aux LO output

The signal at this connector on the downconverter can drive the comb generator of an external mmWave harmonic mixer.

When the downconverter is in source mode this connector is the output.

Rear-Panel Connectors

rearpp.cdr

10 MHz IN

This connector accepts a 10 MHz reference signal for the module's phase-lock-loops. It is normally jumpered to the **10 MHz OVEN OUT** connector.

Limits

- Level range: +7 to +13 dBm

Characteristics

- Input impedance: 50 Ω

Operating considerations

Noise and other impurities on a signal applied to this input will show up on the output. The amount of noise and impurities passed through depends on the tuning sensitivity.

10 MHz OVEN OUT

The signal at this connector is the output of the 10 MHz reference oscillator. It is normally jumpered to the **10 MHz IN** connector.

Characteristics

- Typical output power: +13 dBm

- Output impedance: 50 Ω

Operating considerations

External tuning -This signal can be tuned by a voltage applied to the rear-panel **VOLTAGE CONTROL** connector.

100 MHz OUT
-2 dBm

The signal at this connector is an output of the 100 MHz reference oscillator.

Characteristics

- Output impedance: 50 Ω

- Typical output power: –2 dBm

Operating considerations

External tuning - This signal can be tuned by a voltage applied to the rear-panel VOLTAGE CONTROL connector.

100 MHz OUT
+8 dBm

The signal at this connector is an output of the 100 MHz oscillator.

Characteristics

- Output impedance: 50 Ω

- Typical output power: +8 dBm

Operating considerations

External tuning - This signal can be tuned by a voltage applied to the rear-panel **VOLTAGE CONTROL** connector.

600 MHz OUT
0 dBm

The signal at this connector is an output of the 600 MHz Output oscillator.

Characteristics

- Output impedance: 50 Ω

- Typical output power: 0 dBm

Operating considerations

External tuning - This frequency can be tuned by a voltage applied to the either the front or rear-panel **VOLTAGE CONTROL** connector.

600 MHz OUT
+20 dBm

The signal at this connector is an output of the 600 MHz oscillator.

Characteristics

- Output impedance: 50 Ω

- Typical output power: +20 dBm

Operating considerations

External tuning - This signal can be tuned by a voltage applied to the rear-panel **VOLTAGE CONTROL** connector.

IF LEVEL output

Not used.

MULTIPLEXER OUT

The signal at this connector is the voltage that is measured by the internal voltmeter.

Characteristics

- Output level range: +/-10 V

- Output impedance: 1 kΩ

- Bandwidth: 100 kHz

TUNE OUTPUT

Not used.

TUNE SPAN OUT

Not used.

VOLTAGE CONTROL input

This connector accepts an external tuning voltage for the 10 MHz, 100 MHz, or 600 MHz oscillators.

Limits

- Maximum voltage: ±+/-10 Volts

- Maximum frequency shift (10 MHz): ±0.25 ppm

- Maximum frequency shift (100 MHz): ±5 ppm

- Maximum frequency shift (600 MHz): ±100 ppm

Characteristics

- Input impedance: 100 kΩ

3

System Specifications

This chapter contains the following information:

- **Specifications**, page 3-2
- **General Considerations**, page 3-2
- **Downconverter Noise Floor Specifications**, page 3-3

Specifications

General Considerations

Warm up time: 1 hour.

Specifications: Apply over the operating conditions unless otherwise noted.

Operating Temperature Range: +0 deg C to +55 deg C.

NOTE

The HP 70422A has low susceptibility to RFI and mechanical vibration. Care must be exercised however in making measurements in high RFI or mechanical vibration environments as spurious signals may be induced in the module.

Table 3-1 **General Specifications**

RF Input	• 5 MHz to 18 GHz
	(18 to 20 GHz typical overrange)
Input Power	• + 15 dBm max
	• 5 dBm min to 12 GHz
	• 10 dBm min to 18 GHz
Noise Figure	• 15 dB (typical)
LO Resolution	• 600 MHz (1.8 to 18 GHz)
IF Output **IF Output Power** **IF Gain**	• 5 MHz to 1.2 GHz • 0 - +5 dBm (typical) • 0 - 45 dB (5 dB steps)
Mixing Spurious **< 6 GHz** **> 6 GHz**	• < -50 dBc (except below) • < -70 dBc

Table 3-2   *Mixing Spurious*

Carrier Frequency Range (GHz) Where a mixing spur will occur <100 MHz from the carrier	Typical Spurious (dBc)
1.566 - 1.634, 1.166 - 1.234	<-10
1.325 - 1.375, 1.060 - 1.200 1.775 - 1.825, 1.420 - 1.460 1.274 - 1.303	<-20
2.225 - 2.275, 1.250 - 1.270 1.013 - 1.043, 1.250 - 1.043	<-30
1.112 - 1.138, 2.380 - 2.420 ,2.975 - 3.025, 2.483 - 2.517 1.483 - 1.517, 1.983 - 2.017 3.583 - 3.617	<-40
3.071 - 3.101, 2.983 - 3.017 2.556 - 2.586	<-50
4.785 - 4.815, 4.183 - 4.217 3.580 - 3.620, 1.487 - 1.513 4.099 - 4.129, 3.483 - 3.517 2.042 - 2.072, 2.087 - 2.113 2.860 - 2.900	<-60
All others	<-50 to 6 GHz Above 6 GHz <-70

Downconverter Noise Floor Specifications

Table 3-3   *Downconverter Noise Floor Specifications - All Oscillators Locked*

Downconverter Noise Floor											
Input Frequency		Offset from Carrier (Hz)									Spurious (dBc)	
		1	10	100	1k	10k	100k	1M	10M	100M	<1k	>1k
1 to .30 GHz	Spec.	-45	-75	-92	-120	-132	-138	-140	-140	-140	-50	-65
	Typical	-50	-80	-97	-125	-137	-143	-145	-145	-145	-60	-75
3.0 to 6.0 GHz	Spec.	-39	-69	-86	-114	-126	-138	-140	-140	-140	-44	-70
	Typical	-44	-74	-91	-119	-131	-143	-145	-145	-145	-50	-80
6.0 to 12.0 GHz	Spec	-33	-63	-80	-108	-120	-135	-135	-135	-135	-40	-70
	Typical	-38	-68	-85	-113	-125	-140	-140	-140	-140	-50	-80
12.0 to 18.0 GHz	Spec	-29	-59	-76	-104	-116	-126	-126	-126	-126	-37	-60
	Typical	-34	-64	-81	-109	-121	-131	-131	-131	-131	-47	-70

4   Customer Support

This chapter contains the following information:

- **Introduction**, page 4-2

- **Returning Your Downconverter for Service**, page 4-3

- **Module Re-installation**, page 4-5

Introduction

Before calling Hewlett-Packard or returning your HP 70422A Phase Noise Downconverter module for service, please read your warranty information. Warranty information is printed at the front of this user's guide.

In any correspondence or telephone conversations, refer to the phase noise downconverter by its full model number (HP 70422A) and full serial number. With this information, the Hewlett-Packard representative can determine whether your unit is still within its warranty period.

Determining Your Module's Serial Number

When a module is manufactured by Hewlett-Packard, it is given a unique serial number. This serial number is attached to a label on the front frame or front panel of the module. (Refer to Figure 4-1.) A serial number label is in two parts. The first part makes up the serial number prefix and consists of four digits and a letter. The second part makes up the serial number suffix and consists of the last five digits on the serial number label. The serial number prefix is the same for all identical modules; it only changes when a change in the electrical or physical functionality is made. The serial number suffix, however, changes sequentially and is different for each module.
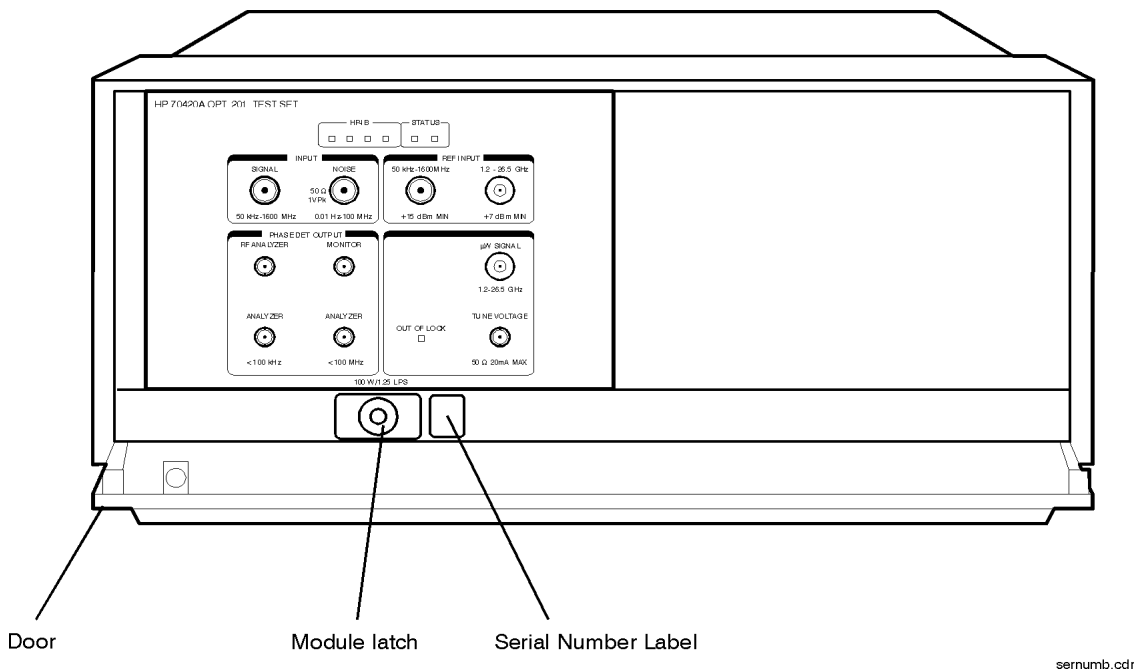

Figure 4-1   Serial Number Location

Returning Your Downconverter for Service

To return your downconverter for service, contact Hewlett-Packard at (800)403-0801 for instructions on where to send it. Please also have the model number (HP 70422A) and serial number handy.

Use the following procedure to return your phase noise downconverter to Hewlett-Packard for service:

1. Fill out a service tag (available at the end of this user's guide) and attach it to the instrument. Please be as specific as possible about the nature of the problem. Send a copy of any or all of the following information:

2. a completed description of the problem.

3. any other specific data on the performance of the phase noise subsystem

CAUTION

CAUTION Damage can result if the original packaging materials are not used. Packaging materials should be anti-static and should cushion the downconverter on all sides. **NEVER USE STYRENE PELLETS IN ANY SHAPE AS PACKAGING MATERIALS**. They do not adequately cushion the instrument or prevent it from moving in the shipping container. Styrene pellets can also cause equipment damage by generating static electricity or by lodging in fan motors.

4. Place the downconverter in its original packaging materials.

If the original packaging materials are not available, you can contact a Hewlett-Packard sales and service office to obtain information on packaging materials or you may use an alternative packing material referred to as "bubble-pack". One of the companies that makes bubble-pack is Sealed Air Corporation of Hayward, California, 94545.

5. Surround the phase noise downconverter with at least 3 to 4 inches of its original packing material or bubble-pack to prevent the downconverter from moving in its shipping container.

6. Place the phase noise downconverter, after wrapping it with packing material, in its original shipping container or a strong shipping container that is made of double-walled corrugated cardboard with 159 kg (350 lb) bursting strength.

The shipping container must be both large enough and strong enough to accommodate your downconverter and allow at least 3 to 4 inches on all sides for packing material.

7. Seal the shipping container securely with strong nylon adhesive tape.

8. Mark the shipping container "FRAGILE, HANDLE WITH CARE" to help ensure careful handling.

9. Retain copies of all shipping papers.

Module Re-installation

The installation procedure for the test set may include one or more of the following major steps:

1. Preliminary work: checking line voltage, verifying that HP 70001A Mainframe is already functioning properly, and setting MS-IB address (if needed).

2. Module installation: installing HP 70422A into an HP 70001A Mainframe, and connecting cables (if needed).

3. Verification: checking that the unit is working properly.

For MMS information beyond what is included in this manual, refer to the appropriate MMS manual.

Verify MMS is Functioning Properly

Before installing the test set, verify that the mainframe in which the downconverter is to be installed is working properly. There should be no errors present.

If the mainframe does not appear to be functioning properly, consult the MMS manual for troubleshooting before continuing with the installation procedure.

Setting HP-IB/MS-IB Address

This procedure requires a small flat-head screw driver or similar object for setting MS-IB address switches.

If your subsystem will be controlled via HP-IB, set the HP-IB address to a location that does not conflict with any other downconverter in your MMS system.

The MS-IB address comes from the factory with the default set to "28". This also represents the HP-IB default address. If this location does not conflict with any other instrument in your MMS, you do not need to change it.

Each instrument in the MMS system must have a unique HP-IB address. If you need to change the HP-IB address use the MS-IB address switches which will change the HP-IB default address.

The MS-IB row switches for the downconverter must be set to "zero" (because the downconverter is a master in the system).

Set the column address to an available HP-IB address location, using the binary weighted value switches.
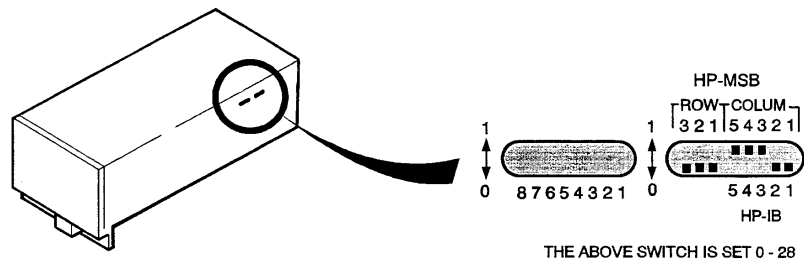
HP-MSB
ROW   COLUM
3 2 1   5 4 3 2 1

1   1
↕   ↕
0   8 7 6 5 4 3 2 1   0   5 4 3 2 1

HP-IB

THE ABOVE SWITCH IS SET 0 - 28

Figure 4-2   Module Addressing

Before you begin installation:

Verify that all parts are present and inspect for damage. If a part is missing or damaged contact your nearest Hewlett-Packard Sales or Service Office. Tools Required

Before installation, assemble these tools:

• 8mm Hex-ball driver, for locking the units into the mainframe.
• HP MMS Manual for your mainframe.

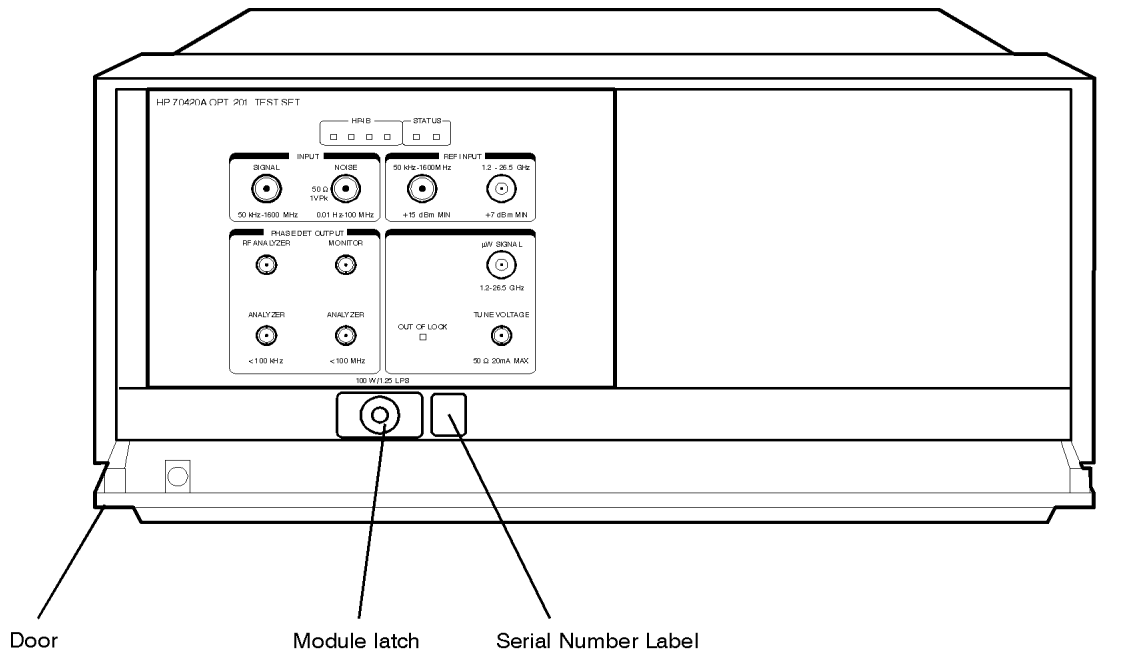1. Slide the downconverter module into the right-hand slot of the mainframe.

Door   Module latch   Serial Number Label

sernumb.cdr

Figure 4-3   Installing the Downconverter Module into a Mainframe

2. Tighten the downconverter's latch using the 8-mm hex ball driver. Close the door.

Powering up the Module

Verify that the downconverter is working:

• All front-panel LED's will illuminate for a few seconds, then blink off.

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