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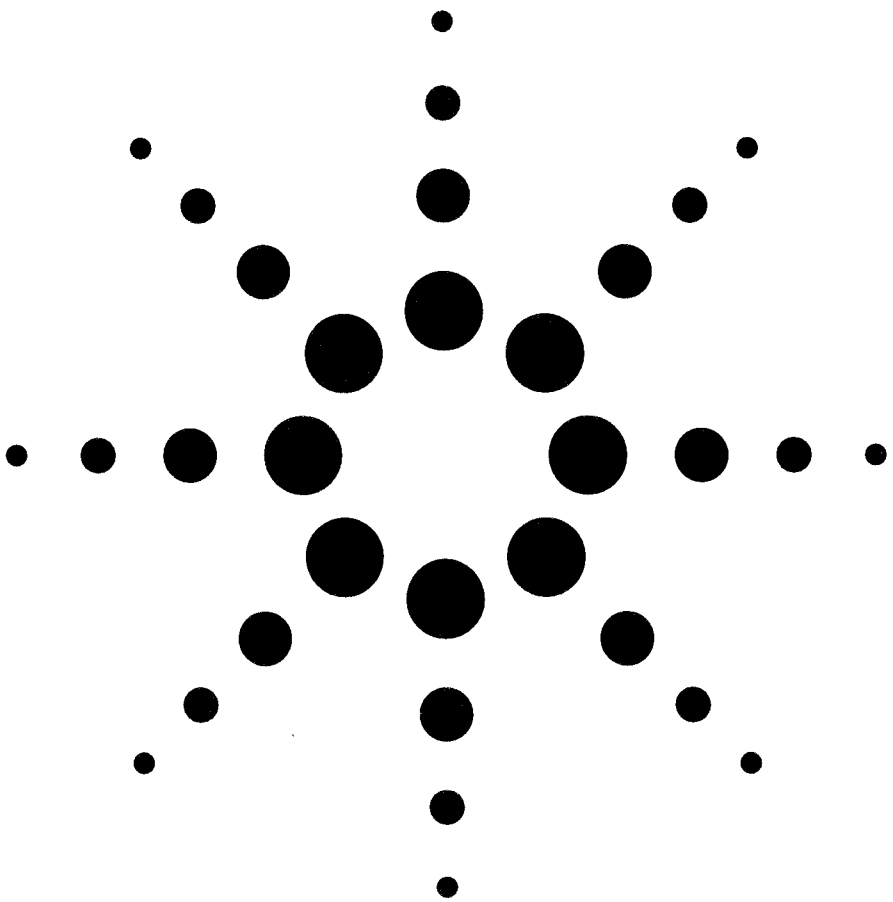
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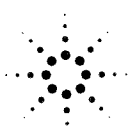
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HP E1440A
Synthesized Function/Sweep Generator
Service Manual





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Errata

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マニュアル・チェンジ

変更

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Service Manual

HP E1440A Synthesized Function/Sweep Generator

SERIAL NUMBERS

This manual applies to all instruments.

HEWLETT PACKARD

HP Part No. E1440-90001

Printed in USA October 1990

Edition 1
E1090

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Printing History

New editions are complete revisions of the manual. Update packages, which are issued between editions, contain additional and replacement pages to be merged into the manual by the customer. The date on the title page and back cover of the manual only changes when a new edition is published. When an edition is reprinted, all the prior updates to the edition are incorporated. No information is incorporated into a new edition unless it appears in a prior update.

Edition 1 October 1990 E1440-90001 E1090

Safety

This product has been designed and tested according to International Safety Requirements. To ensure safe operation and to keep the product safe, heed the symbols, warnings and cautions contained in this section.

Operational Safety

The following general safety precautions must be observed during all phases of operation, service, and repair of this product. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the product. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements.

DO NOT operate the product in an explosive atmosphere or in the presence of flammable gases or fumes.

Keep away from live circuits: Operating personnel must not remove equipment covers or shields. Procedures involving the removal of covers or shields are for use by service-trained personnel only. Under certain conditions, dangerous voltages may exist even with the equipment switched off.

To avoid dangerous electrical shock, DO NOT perform procedures involving cover or shield removal unless you are qualified to do so.

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DO NOT operate damaged equipment: Whenever it is possible that the safety protection features built into this product have been impaired, either through physical damage, excessive moisture, or any other reason, REMOVE POWER and do not use the product until safe operation can be verified by service-trained personnel. If necessary, return the product to a Hewlett-Packard Sales and Service Office for service and repair to ensure that safety features are maintained.

DO NOT service or adjust alone: Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT substitute parts or modify equipment: Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the product. Return the product to a Hewlett-Packard Sales and Service Office for service and repair to ensure that safety features are maintained.

Safety Symbols



The apparatus will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect the apparatus against damage.



Indicates dangerous voltages.



Earth terminal.



Protective earth.



Affixed to a product containing static sensitive devices - use anti-static handling procedures to prevent electrostatic discharge damage to components.

Warning



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

Caution



The CAUTION sign 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 or destruction of part or all of the equipment. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

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How to Use this Manual

Manual Overview

This manual shows how to service the HP E1440A. Brief operation and configuration information is provided where necessary, but you should refer to the "Operating and Programming Manual" for more specific information.

What is in this manual?

Chapter 1: *General Information*
Gives a brief description of the instrument, its features and how to use them (including a Quick Reference to the SCPI programming commands). It lists available options and accessories, and also provides specification details.

Chapter 2: *Installation*
Contains information and procedures required to install the HP E1440A instrument and it's options. Preparation for use with storing and shipping requirements are also described.

Chapter 3: *Adjustments*
Describes procedures for setting up the instrument to meet performance requirements after repair. A table of required test equipment is given.

Chapter 4: *Replaceable Parts*
Lists the part numbers for all user replaceble parts in the instrument. The chapter also contains ordering information for exchange items.

Chapter 5: *Service*
Contains procedures to help isolate module faults, and instructions on how to dis-assemble and assemble the module.

Appendix A: *Manual Changes*
Contains information required to correct or update this manual.

Appendix B: *Component Level Information Package*
A list of the additional component-level reference documentation contained in the CLIP. Insert the CLIP here if you order it.

Appendix C: *Performance Tests*
Describes performance tests and the recommended test equipment for testing and servicing the HP E1440A.

Appendix D: *Backdating Changes*
Contains information required to adapt the manual for instruments with a serial number lower than that shown on the title page.

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HP warrants that its software and firmware designated by HP for use with an instrument will execute its programming instructions when properly installed on that instrument. HP does not warrant that the operation of the instrument, software, or firmware will be uninterrupted or error free.

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1

General Information

Introduction

The HP E1440A Synthesized Function/Sweep Generator is a multi-task signal generator, built as a C-size (double slot) plug-in VXI module, for use with other similar modules in a VXI mainframe. It can be used as:

a reference source
Produces a sine wave of a specified frequency, amplitude, DC offset and phase.
a function generator
Produces various waveforms at a specified frequency, amplitude, DC offset and phase.
a sweep generator
Produces logarithmic and linear frequency sweeps.

Key Features

Key features of the HP E1440A are:

- 5 different output waveforms.
- Variable offsets and amplitudes.
- Can be used as a DC source.
- Multi-interval or multi-marker sweep capabilities.
- Sweep sequencing.
- Combined linear and logarithmic sweeps.
- Phase-continuous sweep.
- Message based module (responds to high level ASCII SCPI commands).
- Save/recall instrument settings.
- Compatible with VXIbus mainframe unit and associated modules.

Operation and Programming

The synthesizer is operated from a computer, using Standard Commands for Programmable Instruments (SCPI) . There are no manual controls on the HP E1440A, only external connectors and indicator lamps.

Programming information in this section is restricted to HP E1440A specifics. If you require information about VXIbus or VMEbus intrinsics then refer to industry standard publications about the VMEbus and the following VXI publications:

- The "VXIbus System Specification" published by The VXIbus Consortium, Inc.
- ANSI/IEEE-488.2-1987, "Digital Interface for Programmable Instrumentation" published by the Institute of Electrical and Electronic Engineers.

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Command Quick Reference

This section gives only brief general information on how to control the HP E1440A using a controller module. The following two tables, summarize the commands available for the HP E1440A. A complete syntax list of the HP E1440A programming commands can be found in Chapter 5 *Command Syntax Reference* of the User Manual.

Table 1-1. SCPI Command Quick Reference

Command	Sub-command & Parameter	Description
ABORt		Aborts current sweep
CALibration	[:ALL?]	Checks instrument calibration
INITiate	:CONTinuous ON|OFF	Enables/disables continuous sweeps
	[:IMMediate]	Starts a sweep cycle
OUTPut	[:STATe] ON|OFF	Switches/disconnects signal at output connector
	:AMPLify	Specifies the Output Amplifier
	[:STATe] ON|OFF	Switches Post Amplifier
	:TTLTrg <n>	Controls TTL trigger line outputs
	:SOURce	Selects source for TTL trigger
	:AOFF	Switches off all trigger lines
[SOURce]	:VOLTage|:POWer|CURRent	
	[:LEVel]	
	[:IMMediate]	
	[:AMPLitude]	Sets amplitude of unswept signal
	:VOLT:OFFSet	Specifies signal offset
	UNIT V|DBM|VRMS	Defines unit of amplitude
[SOURce]	:AM	Specifies Amplitude Modulated signal
	:STATe ON|OFF	AM Signal enabled or disabled
[SOURce]	:FREQuency [:CW|:FIXed]	Defines signal frequency characteristics, constant wave or fixed
	:MODE CW|FIXed|SWEep|LIST	Determine which **SET** of frequency commands
	:STARt	Specifies sweep start frequency
	:STOP	Specifies sweep stop frequency
	:CENTer	Specifies sweep center frequency
	:SPAN	Specifies overall frequency span
	:HOLD	Maintains span frequency as set
	:LINK CENTer|STARt|STOP	Links span to start, stop or center frequency
	:FULL	Specifies sweep equal to full range of instrument
[SOURce]	:FUNCtion	Controls shape and attributes of output signal
	[:SHAPe] DC|SINusoidal|SQUare |TRIangle|RUP|RDOWn|TTL	Specify shape of output waveform

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Table 1-1. SCPI Command Quick Reference (continued)

Command	Sub-command & Parameter	Description
[SOURce]	:LIST	Output signal sweeps to a set of accompanying lists
	:FREQUENCY	Specifies frequency points for list
	:STARt <num>[,<num]..	List of sweep start frequencies
	:POINts?	Returns no. of entries in start list
	:STOP	List of sweep stop frequencies
	:POINts?	Returns no. of entries in stop list
	:MARKer	List of sweep markers
	:POINts?	Returns no. of markers in list
	:STATe	Sets markers on/off
	:POINts?	Returns no. of entries in state list
	:SPACing	List of sweep type, linear or logarithmic
	:POINts?	Returns no. of entries in spacing list
	:DWELl	Specifies dwell time occurances for lists
	:POINts?	Returns no. of entries in dwell list
	:SEQuence	Defines a sequence for stepping through a list
	:POINts?	Returns no. of entries in sequence list
	:LENGth?	Returns no. of entries in sweep sequence array
[SOURce]	:MARKer [<n>]	Selects between different markers
	[:STATe] ON|OFF	Sets marker on or off
	:FREQuency	Controls frequency at which marker appears
	:AOFF	Turns all markers off
[SOURce]	:PHASe	Allows control of output signal phase against a reference
	[:ADJust]	Controls phase offset value relative to reference
	:STEP	Controls step size in radians (can specify DEG or RAD)
	:REFerence	An event that allocates current phase as future ref. phase
	:UNIT RADian|DEGree	Specifies unit for query returns and default
[SOURce]	:PM	Specifies Phase Modulated signal
	:STATe ON|OFF	PM Signal enabled or disabled
[SOURce]	:ROSCillator	Controls reference oscillator
	:SOURce INTernal|EXTernal|CLK 10	Selects reference oscillator to lock to
	:AUTO ON|OFF|ONCE	Allows instrument to "decide" INT or EXT
[SOURce]	:SWEep	Controls generation of a sweep signal
	:TIME	Sets duration of sweep
	:RETRace	Sets duration of sweep retrace time
	:AUTO ON|OFF|ONCE	Couples or isolates RETRace time to/from TIME
		ONCE = AUTO:ON, AUTO:OFF
STATus	:OPERation	Allows access to operation status register
	[:EVENt?]	Returns content of associated event register
	:CONDition?	Returns content of associated condition register
	:ENABle <integer no.> or ?	Allows event register to be pre-loaded/read
	:PTRansition <integer no.> or ?	Specifies a positive transition filter
	:NTRansition <integer no.> or ?	Specifies a negative transition filter
STATus	:QUEStionable	Same as Operation but on Ques. status register
	:FREQ	Allows operations on assoc. Ques. Frequency register
STATus	:PREset	Loads status register with preset pattern
SYSTem	:ERROR?	Returns error number to controller
	:PREset	Presets instrument to known state
	:VERSion	Returns SCPI version compatible with instrument

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Table 1-2. Common Command Reference

Command	Function
*CLS	Clears instrument status, leaves it Idle
*ESE	Sets Standard Event Status ENABLE register
*ESE?	Returns content of Standard Event Status ENABLE register
*ESR?	Returns content of Standard Event Status register
*IDN?	Identification Query, instrument identifies itself
*OPC	Operation Complete, ensures input queue is parsed, sweep is no longer running, then sets "completed" bit in event register
*OPC?	Operation Complete Query
*RST	Reset, resets instrument to known state. See Table 1-3.
*SRE	Service Request Enable, presets bits in SRE register
*SRE?	Service Request Enable Query, returns content of SRE register
*STB?	Read Status Byte Query, returns value of status register content
*TST?	Self Test Query, commands instrument to self test and output result
*WAI	Wait to Continue, causes instrument to halt until sweep is no longer running

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Reset/Startup conditions

The module has a default set of parameter settings which is set up when the module is switched on or a reset command (*RST) is received.

Table 1-3. Instrument Reset State

Parameter	Reset State
INITiate:CONTinuous	OFF
Amplitude	1 mV (p-p)
DC Offset	0 V
Units	Volts
Frequency	0 Hz
Freq. Mode	FIXed
Start Frequency	0 Hz
Stop Frequency	21 MHz
Frequency Span - Hold	OFF
Frequency Span - Link	CENTer
Marker (n)	OFF (n is 1 to 9)
Marker Frequency (n)	0 Hz (n is 1 to 9)
Sweep Time	1 s
Automatic Sweep Trace	ON
Sweep Direction	UP
ROscillator Source	INTernal
ROscillator Automatic	ON
Function	SINe
AM State	OFF
PM State	OFF
Output	OFF
Post amplifier	OFF
TTL Trigger Output(n)	OFF (n is 0 to 7)
TTL Trigger Output, Source(n)	SYNC (n is 0 to 7)
Phase	0 Deg
Phase Step	1 Deg
Phase Units	Radians
*SAV(n)	(n is 0 to 9)

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Specifications

All specifications apply after a 30 minute warm-up period, and are valid from 0°C to 55°C ambient temperature. All specifications describe the warranted performance, except for:

- Main Signal Output
- Squarewave Characteristics (also in Option 002)
- Auxiliary Inputs
- Auxiliary Outputs
- HP-IB Control
- General Characteristics

which describe the typical performance.

Waveforms

Sine, square, triangle, negative and positive ramps, DC and TTL clock.

Frequency

Range

Sine:	1 μHz - 21 MHz
Square:	1 μHz - 11 MHz
Triangle:	1 μHz - 11 kHz
Ramps:	1 μHz - 11 kHz
TTL clock:	1 μHz - 60 MHz

Resolution:
1 μHz, upto 100 kHz
1 mHz at 100kHz and greater frequencies

Accuracy:
$\pm$5 ppm of selected value, from 20°C to 30°C, at time of calibration with standard frequency reference.

Stability:
$\pm$5 ppm/year, from 20°C to 30°C

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Main Signal Output (Typical)

Impedance:
50Ω±1Ω, 0–10 kHz

Return Loss:
> 20 dB, 10 kHz to 20 MHz, except > 10 dB for
> 3 V, 5 MHz to 20 MHz.

Floating:
Chassis ground to circuit ground: Max. 42 V peak (AC + DC)
Max. external voltage, circuit ground to signal output: ±10 V

Connector:
BNC

Amplitude into 50Ω

(All waveforms without DC offset, except TTL clock).

Range:
1 mV to 10 V(p-p), amplitude can also be set up in **rms** and **dBm.**

Function	peak-to-peak	rms	dBm (50Ω)
Sine			
min.	1.000 mV	0.354 mV	−56.02
max.	10.00 V	3.536 V	+23.98
Square			
min.	1.000 mV	0.500 mV	−53.01
max.	10.00 V	5.000 V	+26.99
Triangle/ Ramps			
min.	1.000 mV	0.289 mV	−57.78
max.	10.00 V	2.887 V	+22.22

Resolution:
4 digits (0.03% of full range).

Accuracy: Accuracy specifications are given for 0 V DC offset. With DC offset, increase all sinewave tolerances by 0.2 dB and all function tolerances by 2%.

Sinewave:

	0.001 Hz to 100 KHz	>100 KHz to 10 MHz	>10 MHz to 20 MHz
+23.98 to 13.52 dBm	±0.2 dB	±0.4 dB	±0.4 dB
<+13.52 to −16.02 dBm	±0.2 dB	±0.6 dB	±0.6 dB
<−16.02 to −56.02 dBm	±0.2 dB	±0.6 dB	±0.9 dB

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Squarewave:

	0.001 Hz to 100 KHz	>100 KHz to 10 MHz
10 V(p-p) to 3 V(p-p)	±1.5%	±5%
<3 V(p-p) to 1 mV(p-p)	±2.2%	±10%

Triangle:

	0.001 Hz to 2 KHz	>2 KHz to 10 KHz
10 V(p-p) to 3 V(p-p)	±1.5%	±5.0%
<3 V(p-p) to 1 mV(p-p)	±2.7%	±6.2%

Ramps:

	0.001 Hz to 500 Hz	>500 Hz to 10 KHz
10 V(p-p) to 3 V(p-p)	±1.5%	±10.0%
<3 V(p-p) to 1 mV(p-p)	±2.7%	±11.2%

Supplementary Range Information: The 1 mV to 10 V (p-p) output range of the HP 3324A consists of 8 internal output ranges:

AC Function Only	DC Offset Only	AC Function and DC Offset		
Amplitude Range (p-p)	DC Level (+ or -)	Amplitude Range (p-p)	Max. DC (+ or -)	Min. DC (+ or -)
1.000 mV to 2.999 mV	1.000 mV to 1.499 mV			
3.000 mV to 9.999 mV	1.500 mV to 4.999 mV	1.000 mV to 3.333 mV	4.500 mV 3.333 mV	0.001 mV 0.001 mV
10.00 mV to 29.99 mV	5.000 mV to 14.99 mV	3.334 mV to 9.999 mV	14.99 mV 11.66 mV	0.001 mV 0.001 mV
30.00 mV to 99.99 mV	15.00 mV to 49.99 mV	10.00 mV to 33.33 mV	45.00 mV 33.33 mV	0.010 mV 0.010 mV
100.0 mV to 299.9 mV	50.00 mV to 149.99 mV	33.34 mV to 99.99 mV	149.9 mV 116.6 mV	0.010 mV 0.010 mV
300.0 mV to 999.9 mV	150.00 mV to 499.9 mV	100 mV to 333.3 mV	450.0 mV 333.3 mV	0.100 mV 0.100 mV
1.000 V to 2.999 V	500.0 mV to 1.499 V	333.4 mV to 999.9 mV	1.499 V 1.166 V	0.100 mV 0.100 mV
3.000 V to 10.00 V	1.500 V to 5.000 V	1.000 V to 9.998 V	4.500 V 1.000 mV	1.000 mV 1.000 mV

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Sinewave Spectral Purity

Phase Noise:
−55 dB for a 30 kHz band centered on a 20 MHz carrier (excluding ±1 Hz about the carrier).

Spurious:
All non-harmonically related output signals will be more than 60 dB below the carrier, (−55 dBc with DC offset), or less than −85 dBm, whichever is greater.

Sinewave Harmonic Distortion:
Harmonically related signals will be less than the following levels relative to the fundamental:

Frequency Range	Harmonic Level
0.1 Hz – 199 kHz	−60 dBc
200 kHz – 1.99 MHz	−40 dBc
2 MHz – 14.9 MHz	−30 dBc
15 MHz – 20 MHz	−25 dBc

Squarewave Characteristics (Typical)

Rise/Fall Time:
(10% to 90% of p-p output voltage): ≤20 ns

Overshoot:
5% of peak-to-peak amplitude at full output.

Symmetry:
≤0.02% of period +3 ns.

Triangle/Ramp Characteristics

Linearity:
(10% to 90%, 10 kHz): ±0.05% of full peak-to-peak output voltage for each range.

Ramp Retrace Time (typical):
(10% to 90%): ≤3 μs

Period Variation for Alternate Ramp Cycles (typical):
≤1% of period.

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DC Offset

Range:
DC only (no AC signal): 0 to ±5 V / 50Ω
DC + AC: Maximum DC offset ±4.5 V on highest range; decreasing to ±4.5 mV on lowest range.

Resolution:
4 digits

Accuracy:
DC only: ±0.015 mV to ±50 mV, depends on offset chosen, ±0.02 mV.
DC + AC, upto 1 MHz: ±0.06 mV to ±60 mV, depends on AC output level; ±0.2 mV to ±120 mV for triangle and ramps to 10 kHz.
DC + AC, from 1 MHz to 20 MHz: ±15 mV to ±150 mV, depends on AC output level.

Phase Offset

Range:
719.9° with respect to arbitrary starting phase or assigned zero phase. For squarewave frequencies below 25 kHz, phase changes greater than 25° may result in a phase shift of ±180° from the desired amount.

Resolution:
0.1°

Increment Accuracy:
±0.5°

Stability:
±1.0° of phase/°C

Sinewave Amplitude Modulation (Typical)

Modulation Depth (at full output for each range):
0 - 98%

Modulation Frequency Range:
DC to 350 kHz (1μHz-21 MHz carrier frequency)

Envelope Distortion:
−30 dB for modulation to 80% at 1 kHz, 0 Vdc offset

Sensitivity:
±5 V peak for maximum modulation

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Phase Modulation (Typical)

Sinewave Range
±900°, ±5 V input

Sinewave Linearity
±0.5%, best fit straight line upto ±720° of modulation range
±1%, best fit straight line >±720°

Squarewave Range
±450°

Triangle Range
±45°

Positive and Negative Ramps Range
±90°

Modulation Frequency Range
DC - 5 kHz

Frequency Sweep

Sweep Sequence Modes:
Single, continuous.

Sweep Function Modes: Multi-Interval:
Upto 50 **different** intervals can be sequenced and repeated in any order in a sequence which can contain upto 100 intervals.
Frequency-switching-time between intervals (to within 1 Hz):
≤12 ms for a 100 KHz step.
≤27 ms for a 1 MHz step.
≤72 ms for a 20 MHz step.

Multi-Marker:
Upto 9 marker frequencies can be set if a standard sweep (no Multi-Interval) is performed. Reaching a marker frequency generates a high-to-low transition at the marker output. Time between start- and marker-frequencies, succeeding marker frequencies, and marker- and stop-frequencies are ≤1.5 ms.

Linear Sweep (settable for each interval):
Sweep time: 0.01 s to 10^5 s
Maximum sweep width: full frequency range of the main output for the waveform in use.
Minimum sweep width: 0 Hz
One marker frequency can be set in each interval.

Logarithmic Sweep (settable for each interval):
Sweep time: 0.1 s to 10^5 s
Maximum sweep width: full frequency range of the main output for the waveform in use.
Minimum start frequency: 1 Hz
Minimum sweep width: 1 decade

Phase Continuity:
Sweep is phase continuous over the full frequency range of the main output for all modes.

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Auxiliary Inputs (Typical)

External REF IN 1/10 MHz
For phase locking the HP E1440A to an external frequency reference.
Signal from 0 dBm to 20 dBm into 50Ω
Reference signal must be a sub-harmonic of 10 MHz from 1 MHz to 10 MHz.
Connector: BNC or VXI-system clock
Max. external voltage: ±15 V

AM:
Input Impedance: 10 kΩ
Connector: BNC
Max. external voltage: ±15 V

PM:
Input Impedance: >40 kΩ
Connector: BNC
Max. external voltage: ±15 V

Auxiliary Outputs (Typical)

Floating:
Chassis ground to circuit ground: May be floated upto 42 V peak (AC & DC).

SYNC-OUT TTL:
1 μHz to 21 MHz phase synchronous squarewave with the same frequency as the main signal output,
or 1 μHz to 60 MHz TTL Clock (main signal output switched off).
Output impedance: 50Ω
Output levels: high level > 2 V, low level < 0.2 V
Connector: BNC and trigger bus.
Note: Level doubles into open input.
Max. external voltage: 0 V to +5 V, circuit ground to output signal.

X DRIVE 0–10V:
(0 - 100 s sweeps only).
The ramp is proportional to the entire sweep time, including each individual interval sweep time and the switching times between intervals.
Output impedance: 650 Ω
Output level: 0 to +10 V (into open circuit)
Connector: BNC.
Max. external voltage: ±10 V, circuit ground to output signal.

PEN LIFT:
TTL compatible voltage levels capable of sinking current from a positive source. Current 200 mA, voltage 45 V
Connector: BNC.
Max. external voltage: 0 V to +45 V, circuit ground to output signal.

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MARKER TTL:
High to low transitions at selected marker frequencies. TTL and CMOS compatible output levels.
Pulsewidth in Multi-Marker mode: 1 ms.
Connector: BNC and trigger bus.
Fan out: 4
Max. external voltage: 0 V to +5 V, circuit ground to output signal.

REF OUT 10 MHz
10 MHz squarewave for phase locking additional instruments to the HP E1440A.
Output impedance: 50Ω
Output levels (into 50Ω): high level > 2V, low level <0.2V
AC-coupled output levels: 10 dBm
Connector: BNC.
Max. external voltage: 0 V to +5 V, circuit ground to output signal.

VXIbus Interface Capabilities

Message based servant:
A16/A24 D16 Master
A16 D16 Slave

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Option 001 High-Voltage Output

Frequency range:
1 μHz to 1 MHz

Amplitude:
4 mV to 40 V(p-p) in 8 ranges, 4–12–40 sequence into 500Ω, < 500 pF load. Ranges are four times the standard instrument ranges, without DC offset.
Accuracy: ±2% of full output for each range at 2 kHz.
Flatness: ±10% relative to programmed amplitude.

Sinewave Harmonic Distortion:
Harmonically related signals will be less than the following levels (relative to the fundamental full output into 500Ω, 500 pF load):

Frequency Range	Harmonic Level
10 Hz – 199 kHz	–60 dBc
200 kHz – 1 MHz	–40 dBc

Squarewave Rise/Fall Time (typical):
≤125 ns, 10% to 90% of peak-to-peak output voltage with 500Ω, 500 pF load.

Squarewave Overshoot (typical):
≤10% of peak-to-peak output voltage with 500Ω, 500 pF load.

Output Impedance:
< 3Ω at DC, < 10Ω at 1 MHz.

DC Offset:
Range: 4 times the specified range of the standard instrument.
Accuracy: ±(1% of full output voltage for each range + 25 mV).

Maximum Output Current:
±40 mA peak.

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General (Typical refer to VXI System Specification)

Module Size: C

Number of Slots: two (2)

Connectors Used: P1, P2

Device Type: Message-based

Watts/Slot: 18 W

Cooling/Slot
Air flow: 2.0 litres/second, pressure 0.4 mm H_2O

Operating Environment:

Relative humidity: 65%, 0°C to 40°C
Operating temperature: 0°C to 55°C
Storage temperature: −40°C to +75°C

EMC:
Module meets FTZ 1046/1984, IEC 348 (safety class III)

Weight: 4 kg net, 6.5 kg shipping.

Power Requirements:

DC Volts	DC Current	Dynamic Current
+5 V	1 A	10 mA
+24 V	0.55 A	50 mA
−24 V	0.6 A	50 mA
−5.2 V	0.14 A	30 mA

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2

Installation

Introduction

This chapter provides information for inspecting, configuring and installing the HP E1440A module, and for installing the High Voltage Output Option 001. It also includes information about damage claims, packaging, storage and shipment.

Initial Inspection

Warning  **To avoid hazardous electrical shock, do not perform electrical tests when there are signs of shipping damage to any portion of the outer enclosure (covers, panels, etc.).**

Inspect the shipping container for damage. If the container or cushioning is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been verified both mechanically and electrically.

Procedures for checking the operation of the instrument are given in Appendix C *Performance Tests.*

Storage and Shipment

The instrument can be stored or shipped at temperatures between −40°C and +75°C. The instrument should be protected from temperature extremes which may cause condensation within it.

Return Shipments to HP

If the instrument or one of it's boards is to be shipped to a Hewlett-Packard Sales/Service Office (see Chapter 4), attach a tag showing owner, return address, model number and full serial number and the type of service required.

The original shipping carton and packing material may be re-usable, but the Hewlett-Packard Sales/Service Office will also provide information and recommendations on materials to be used if the original packing is no longer available or reusable. General instructions for repacking are as follows:

1. Wrap the instrument/board in an anti-static bag
2. Wrap this package in heavy paper or plastic.
3. Use strong shipping container. A double wall carton is adequate.

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4. Use enough shock-absorbing material (3 to 4 inch layer) around all sides of the instrument to provide a firm cushion and prevent movement inside container.
5. Seal shipping container securely.
6. Mark shipping container **FRAGILE** to encourage careful handling.
7. In any correspondence, refer to instrument by model number and serial number.

Configuring the Generator

ATTENTION
Static Sensitive

ATTENTION STATIC SENSITIVE DEVICES Handle the module only at 'Static Safe' work stations.

Setting the Logical Address

As described in the VXIbus Mainframe *System Installation Guide*, each plug-in module has a row of switches which are used to set the logical address of the module. The logical address distinguishes the module from other modules in the system.

Figure 2-1 shows the location of the HP E1440A logical address switch. Access to alter the switch settings may be gained through a cutout in the module cover.

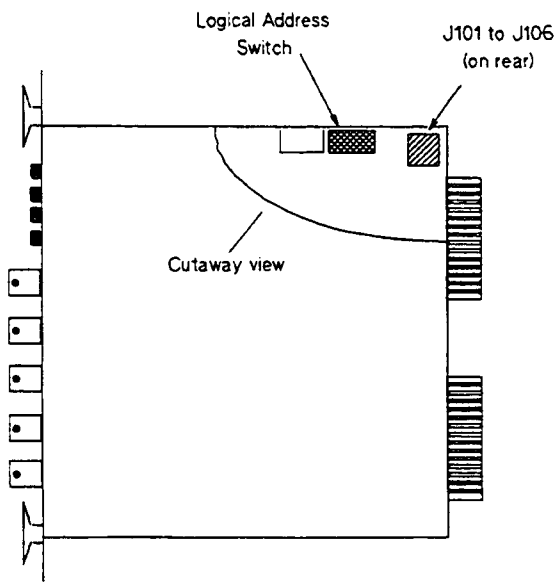


Figure 2-1. Address Switch and Jumper Location

The Logical Address switch has a factory setting of 88 which is equivalent to a secondary address of 11.

Figure 2-2 shows how a primary address setting of 88, transposes to a secondary address of 11 by shifting three places (ignoring the first three switches). Make sure you apply this rule when altering the switch setting to a number of your choice. Remember, the module secondary address must be the one present in all control programs for this module.

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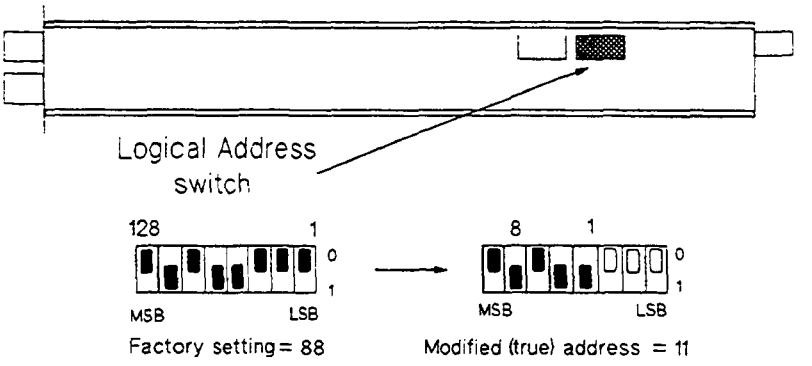


Figure 2-2. Address Switch Settings

This view of the switch settings is the one you will see when looking directly into the top of the module. The switch positions are shown from the same viewpoint.

Note

If there is no other identical HP E1440A module in the mainframe with this address, and this factory set address does not conflict with one of the other modules, then the factory setting may be left as it is.

The service switch beside the logical address switch is factory set as shown and is for use during Performance Tests only. It must not be altered during configuration!

Setting the Bus Request/Bus Grant Level

On the left hand side, close to the VXIbus connectors, mounted on the circuit land side of the control printed circuit board, there are several connecting links which you can change to alter the module configuration for control interrupt priority. The location of the links is shown in Figure 2-1 and the configurations are shown in Figure 2-3. Access is through a cutout in the cover.

Jumpers J101 to J106 can be used to alter the interrupt priority setting of the HP E1440A module. Usually this does not need to be altered from the factory setting of BG/BR3. However, if the HP E1440A is being used in a mainframe with other non-HP instruments, or in a specialized test equipment set-up, there may be a requirement to alter the controller interrupt priority of the module. Proceed as follows:

Caution

When altering the BG/BR level you will touch electronic components. **ESD precautions,** such as a wristlet connector to ground, must be used. Do NOT use BNC outer shields as they are not ground.

1. Place the module on a bench with the jumper-access cutout facing upwards.
2. Refer to figure 2-3 and remove the single jumper from the column where you want the full column of jumpers to be for the BG/BR level you require.
3. Move the three jumpers that are together across to the column you have just emptied.

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4. Place the single jumper in the now empty column, in line with the other two single jumpers.
5. Check that the final jumper positions are correct for the BG/BR level you require and that all jumpers are secure on their pins.

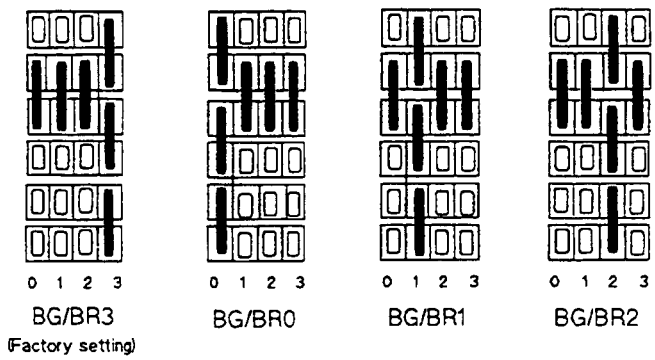


Figure 2-3. Jumper J101 Links Settings

The Jumper positions are factory set as shown for BG/BR3. Do not alter unless absolutely necessary.

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Installing the Generator

In addition to C-Size modules, the mainframe also accepts A- and B-Size modules. If you intend using the HP E1440A with these smaller size modules, it is better to install them first. Refer to the mainframe manual for details.

Warning



SHOCK HAZARD. Remove all sources of power from the mainframe before removing or installing the HP E1440A module.



ATTENTION STATIC SENSITIVE DEVICES Handle the module only at 'Static Safe' work stations.

Procedure

1. Choose the mainframe location for the module and place the module card edges into the mainframe guides (top and bottom).
2. Slide the module towards the rear of the mainframe until the connectors approach the backplane.
3. Check that the module connectors align with the backplane receptacles.

Caution



There are DIL switches on the backplane beside the connector receptacles, which could be damaged or altered, if the module connectors are pushed against them.

4. Carefully push the module home so that:
   - the connectors mate solidly with the back plane receptacles,
   - the screening fingers rest comfortably against the adjacent module,
   - and the front panel is flush against the front bar of the mainframe.
5. Secure the module using the captive screws in the front panel to lock the module into the mainframe

Power can now be restored to the mainframe.

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Installing the High Voltage Output, Option 001

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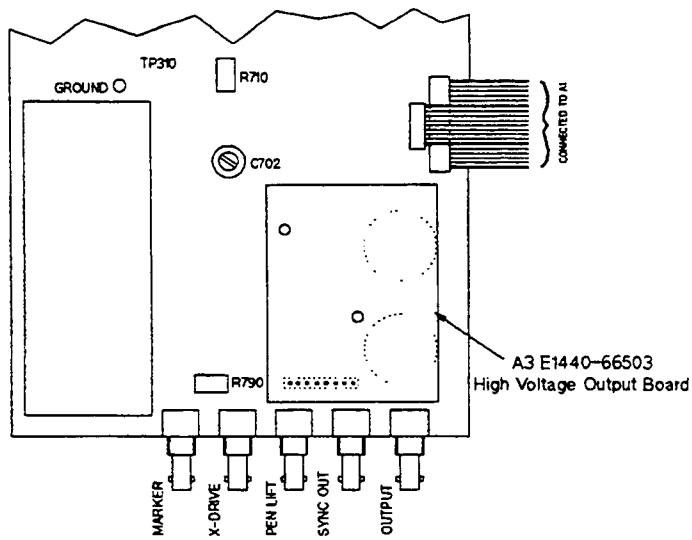


Figure 2-4. Locating the High Voltage Output Board

The High Voltage Output Board has to be mounted on the control board A2, as shown in Figure 2-4.

1. Dis-assemble the HP E1440A, as described at the beginning of Chapter 5, but do not disconnect all the cables.
2. Lay out the module as shown in Figure 5-4 with the component side of the boards facing upwards and the BNC connectors towards you.
3. Turn the High Voltage board so that the component side faces downwards and the 8-pin connector is towards you.
4. Carefully push the 8-pin connector into the socket behind the PEN LIFT and SYNC OUT BNC connectors on the control board A2.
5. Secure the board to its supporting posts using the two screws (HP Part No. 0515-0886).
6. Re-assemble the HP E1440A, as described in Chapter 5.

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3

Adjustment Procedures

Introduction

This chapter contains the adjustment procedures which you must carry out after repairing the HP E1440A. The replacement board assemblies, supplied on an exchange basis, are calibrated at the factory to minimise the adjustments you need to make.

All programming statements used in the procedures assume:

- an HP 9000 Series 200 or 300 computer as controller,
- that BASIC 5.0/5.1 is the programming language,
- that the HP E1440A is set to VXI secondary address 11,
- and that the VXI command module is set to VXI primary/HP-IB address 9.

Note The HP E1440A must be allowed to warm up for at least 30 minutes before carrying out any adjustments.

Equipment Required

The equipment required for the adjustment procedures is listed below. Any equipment which satisfies the critical specifications given in the table, may be substituted for recommended models.

Table 3-1. Recommended Test Equipment (Adjustments)

Instrument	Critical Specifications	Recommended Model
Power Meter	Accuracy: ±0.02 dBm	HP 436A
Power Sensor	Frequency Range: 100 kHz to 100 MHz Maximum Power: ≥100 mW	HP 8482A
VXI Mainframe (Development)	Must allow access to the adjusters on the right side of the HP E1440A.	HP E1400T
Command Module		HP E1405A
Controller		HP 9000 Series 200/300

Note All test equipment used must be allowed to warm up before carrying out any adjustment of the HP E1440A. Refer to the user manual for each item of equipment to find the minimum warm up time required.

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Amplitude Accuracy Adjustment

After replacing either of the board assemblies, you must carry out the following adjustment to ensure that the amplitude flatness specifications are met.

Equipment

- Power Meter HP 436A
- Power Sensor HP 8482A
- VXI Development Mainframe HP E1400T with command module HP E1405A

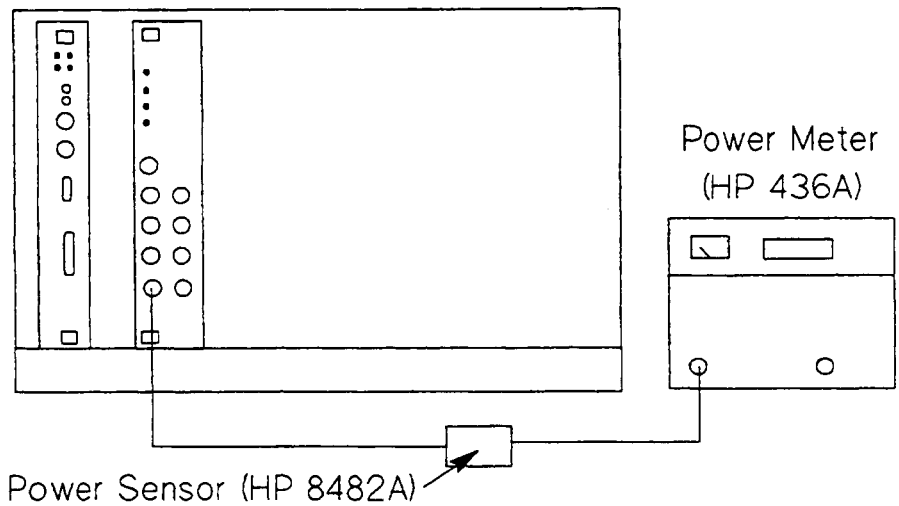


Figure 3-1. Test set-up for Amplitude Accuracy Adjustment

Procedure

1. Calibrate the power meter for the sensor using the 50 MHz, 1.00 mW power-reference output on the meter.
2. Connect the output of the HP E1440A to the power meter via the power sensor, as shown in Figure 3-1.
3. Set up the HP E1440A as follows:

```
OUTPUT 70911; "*RST;*CLS"          Reset and clear status
OUTPUT 70911; ":VOLT:AMPL 6.0 V"   Set amplitude to 6 V
OUTPUT 70911; ":OUTP ON"           Turn on the output
```

4. Switch the power meter to read dBm.
5. Set the HP E1440A frequency to 10 MHz:

```
OUTPUT 70911; ":FREQ 10 MHZ"    Set frequency to 10 MHz
```

6. Check that the indicated power level is 19.54 dBm ±0.04 dB.

   If not, adjust the level using the 10 MHz amplitude adjuster through the hole on the right side of the HP E1440A's case.

7. Change the frequency to 20.5 MHz:

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```
OUTPUT 70911; ":FREQ 20.5 MHZ"    Set frequency to 20.5 MHz
```

8. Check that the indicated power level is 19.54 dBm ±0.04 dB.

   If not, adjust the level using the 20 MHz amplitude adjuster through the hole on the right side of the HP E1440A's case and go back to step 5.

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4

Replaceable Parts

Introduction

This section contains parts and ordering information for the HP E1440A Synthesized Function/Sweep Generator.

Table 4-1 identifies those parts that can be returned to Hewlett-Packard as exchange items.

Those components that are easily accessible for replacement are listed in Table 4-2.

Figure 4-1 identifies the mechanical parts of the instrument which are listed in Table 4-2.

Repair philosophy is to board level, therefore individual components for sub-assemblies are not listed. However Appendix A to this manual contains details of an information pack which contains a full parts listing for those customers who require it.

Replaceable Parts List

The organization of table 4-2, which lists replaceable parts, is as follows:

- Chassis mounted parts in alphanumeric order by reference designator.
- Electrical assemblies and their replaceable parts in alphanumeric order by reference designator.

Note An electrical assembly is a cable or a printed circuit board and its components.

The information given for each part consists of the following:

- Reference designator
- Description of part
- Hewlett-Packard part number

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Reference Designators

Reference designators are alphanumeric names for parts.

1. A1 = electrical assembly number 1
2. MP1 = mechanical part number 1
3. A5F2 = fuse 2 on electrical assembly number 5

Ordering Information

To order a part listed in the tables, quote the Hewlett-Packard part number, quantity required, and address the order to your nearest Hewlett-Packard office as listed.

You may want to order a part that is not listed as replaceable. In this case, Include the instrument model number, instrument serial number (very important), with a description and function of the part.

Exchange Assemblies

Exchange assemblies are listed in a separate table; table 4-1. These exchange assemblies have a part number in the form xxxxx-695xx, whereas new part numbers are xxxxx665xx. Before ordering an exchange part, it is advisable to contact your local office or repair organization for current procedures and availability.

Note Exchange orders require return of the defective part



Direct Mail Order System

Within the USA, Hewlett-Packard can supply parts through direct mail order. The advantages are as follows:

- Direct ordering and shipment from Hewlett-Packard Parts Center in Mountain View, California.
- No maximum or minimum on any mail order (there is a minimum order for parts ordered through local Hewlett-Packard offices when orders require billing and invoicing).
- Prepaid transportation (there is a small handling charge for each order).
- No invoices - to provide these advantages, check or money order must accompany each order. Mail order forms and specific ordering information are available through your local Hewlett-Packard offices.

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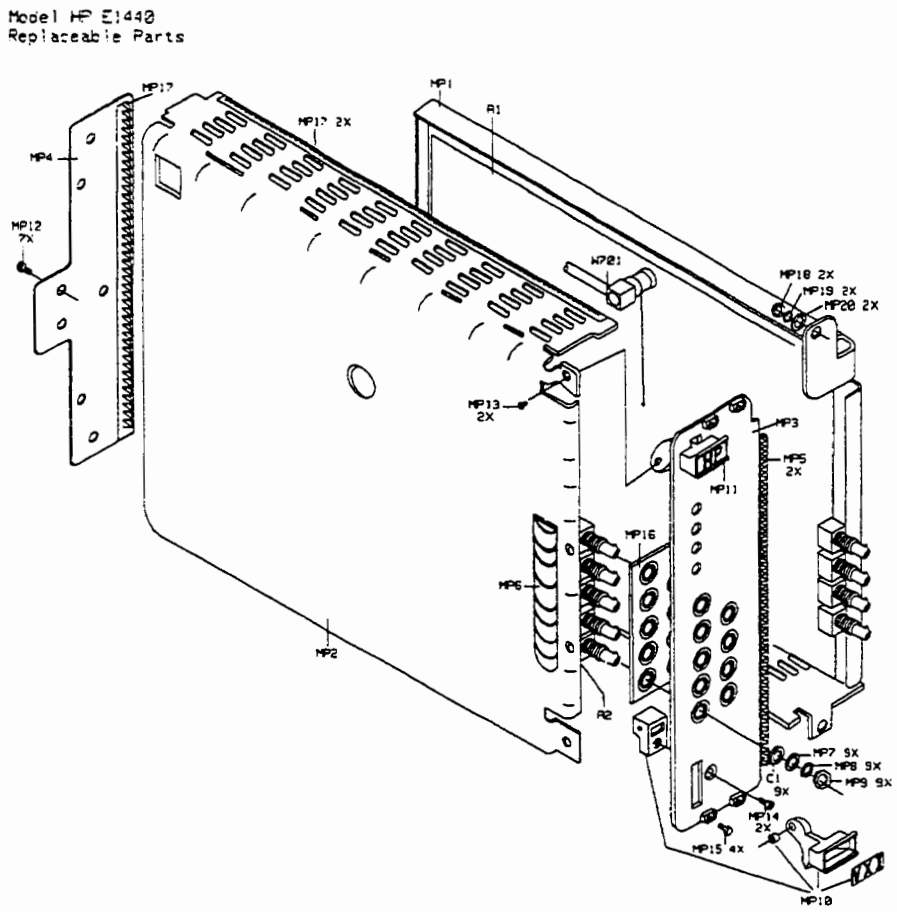


Figure 4-1. Mechanical Parts

HP E1440A Exchangeable parts

Table 4-1. Exchangeable Items

Part Number	Description	Includes	
E1440-69501	**Replacement Source Board Assy A1**	A1 Source Board	E1440-66501
	Fully calibrated and ready to install	C1 Capacitor washers	0160-6777
E1440-69502	**Replacement Control Board Assy A2**	A2 Control Board	E1440-66502
	Fully calibrated and ready to install	C1 capacitor washers	0160-6777

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Table 4-2. Replaceable Parts

Ref Designator	Description	Part Number
MP1	Chassis, right	E1440-00101
MP2	Chassis, left	E1440-00102
MP3	Front Panel	E1440-00201
MP4	Rear Shield Flat	E1440-00605
MP5	RFI Round Strip	8160-0428
MP6	RFI Strip Fingers	8160-0686
MP7	Washer FL MTLC	3050-0604
MP8	Washer lock INT1/2	2190-0054
MP9	Nut Hex Double Cham.	2950-0154
MP10	Ext Handle Kit Btm.	E1400-84105
MP11	Ext Handle Kit Top	E1400-84106
MP12	Screw Mach. M3X6MM	0515-0886
MP13	Screw M. M2.5C0.45	0515-1108
MP14	Screw	0515-1121
MP15	Captive Screw M2.5	0515-1968
MP16	Insulator	E1440-45401
MP17	Contact Fingers	0363-0125
MP18	Nut Hex M3X0.5	0535-0025
MP19	Washer Lock M3	2190-0584
MP20	Washer FL M3	3050-0891
MP21	Nut Hex 318-32T	2950-0001
C1	Capacitor Washer	0160-6777
A1	Signal Source Board	See Table 4-1
A2	Control Board	See Table 4-1
	Shield bottom	E1440-00602
	Shield top	E1440-00603
A3	High Voltage Board (Option 001)	E1440-66503
W701	Cable, Amplifier	E1440-61606

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5

Service

Introduction

This chapter contains information to assist you in locating faults in the HP E1440A. If the module hardware is faulty you need to identify which board has failed in order to return it to Hewlett-Packard for repair. If this is impossible, return the whole module.



ATTENTION STATIC SENSITIVE DEVICES Handle the module only at 'Static Safe' work stations.

The *Failed* Indicator is ON

If the HP E1440A "Failed" indicator remains on, the synthesizer is not able to communicate with the controller.

1. Check that the HP E1440A is correctly configured, and that all modules in the VXI mainframe have unique addresses.
2. Check if the HP E1440A works when you:
   a. use a different VXI controller module.
   b. use a different VXI mainframe.

If the HP E1440A still fails to communicate then the A2 Control Board is probably faulty. Return the Control Board to Hewlett-Packard for repair/exchange. Instructions for dis-assembling the HP E1440A follow in this chapter.

The *Failed* Indicator is OFF

If the HP E1440A "Failed" indicator is off, you should be able to communicate with the module. Therefore run the module self-test as described in "Functional Verification Tests" in Appendix C. Table C-2 indicates which board is likely to be faulty for each fault reported by the self-test.

To confirm which board is faulty, or if the self-test fails to detect the problem, carry out the "Identifying a Faulty Board" procedure.

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Identifying a Faulty Board

Recommended Test Equipment

Table 5-1. Recommended Test Equipment for Troubleshooting

Instrument	Critical Specifications	Recommended Model
AC/DC Digital Voltmeter	AC Function (True RMS) Ranges: 10 mV to 1000 V Bandwidth: 1 Hz to 1 kHz Resolution: 4.5 digits minimum DC Functions Ranges: 10 mV to 1000 V	HP 3458A
Digitizing Oscilloscope	Vertical Bandwidth: 1 GHz with random repetitive sampling technique Timebase accuracy:0.002%	HP 54111D
VXI Mainframe (Development)	Must allow access to the HP E1440A while it is partially dis-assembled.	HP E1400T

Block Diagram

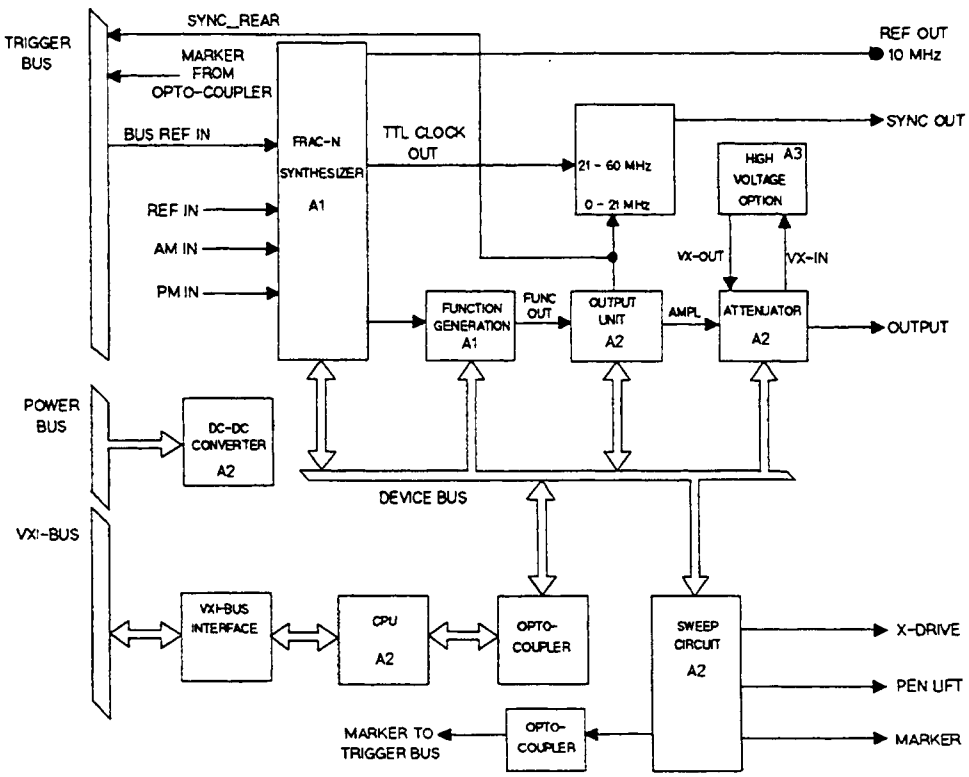
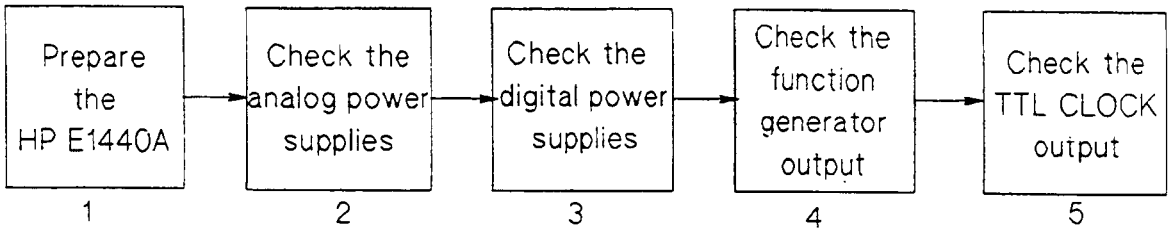


Figure 5-1. HP E1440A Block diagram

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Procedures

Check the module in the order shown.



1. Preparing the HP E1440A for troubleshooting

1. Dis-assemble the HP E1440A as far as step 8 in the dis-assembly procedure given in this chapter.*Do not remove the black co-axial cable.*
2. Carefully plug the open HP E1440A into the development mainframe, and switch it on.

2. Checking the Analog Power Supplies

Use a digital voltmeter to check that voltage supplies from the DC-DC converter on the control board A2 at the following testpoints:

Table 5-2. DC-DC converter voltages

Test Point	Voltage
TP318	Analog Ground
TP310	+5 V
TP311	+15 V
TP312	-15 V

The positions of the testpoints are shown in Figure 5-2.

Note



If the DC-DC converter is faulty, return the control board A2 to Hewlett-Packard for repair/exchange.

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3. Checking the Digital Power Supplies

Use a digital voltmeter to check the voltage supplies to the microprocessor circuits on the control board A2. The voltages can be measured at the fuses listed here:

Table 5-3. Digital power supplies

Test Point	Voltage
TP141	Digital Ground
F106	-5.2 V
F104	+24 V
F105	-24 V
F103	+5 V

The positions of the testpoint and fuses are shown in Figure 5-2.

Note

If the microprocessor's power supplies are faulty, return the control board A2 to Hewlett-Packard for repair/exchange.

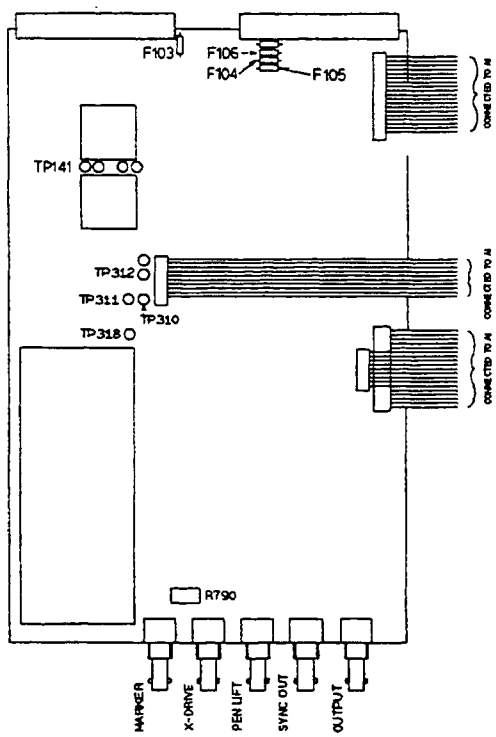


Figure 5-2. Control Board A2 - Location of Test Points

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4. Checking the Function Generator Output

If the main signal output is faulty, check if the output stages on the control board A2 are receiving the correct signal from the function generator on the signal source board A1 (See Figure 5-1):

1. Use the controller to set the waveform, frequency and amplitude as follows:

```
OUTPUT 70911; ":FUNC SIN"          Set waveform to sine
OUTPUT 70911; ":FREQ 1 KHZ"        Set frequency to 1 KHz
OUTPUT 70911; ":VOLT:AMPL 10.0 V"  Set amplitude to 10 V
OUTPUT 70911; ":OUTP ON"           Turn on the output
```

2. Disconnect the black co-axial cable joining the boards at the signal source board A1 end.
3. Move jumper A1J401 from it's normal position to it's test position. See Figure 5-3.
4. Use the oscilloscope to check the function generator's output signal at A1J401:

Parameter	Value
Waveform:	Sine
Amplitude:	400 mV p-p
Offset:	+5 V

5. If the sine output is good, use the controller to repeat the check for SQUare and TRIangle. Only the shape should change, the amplitude and offset should be the same.
6. Move jumper A1J401 back to it's normal position.

Note

If the function generator output is faulty in one or more waveforms, return the signal source board A1 to Hewlett-Packard for repair/exchange.

If the function generator output is good, then the output fault is on the control board A1. Return it to Hewlett-Packard for repair/exchange.

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5. Checking the TTL CLOCK output

If the main output works but the SYNC OUT is faulty at frequencies > 21 MHz, you must check if the SYNC OUT circuits on the control board A2 are receiving the correct input signal from the TTL CLOCK on the signal source board A1:

1. Use the controller to set the waveform and frequency as follows:

```
OUTPUT 70911; ":FUNC TTL"        Set waveform to TTL
OUTPUT 70911; ":FREQ 60 MHZ"     Set frequency to 60 MHz
```

2. Disconnect the cable from A1J203 (See Figure 5-4) and use the oscilloscope to check that there is a 60 MHz TTL CLOCK signal available at the connector.

Note

If the TTL CLOCK signal is faulty, return the signal source board A1 to Hewlett-Packard for repair/exchange.

If the TTL CLOCK signal is good, then the SYNC OUT fault must be on the control board A2. Return it to Hewlett-Packard for repair/exchange.

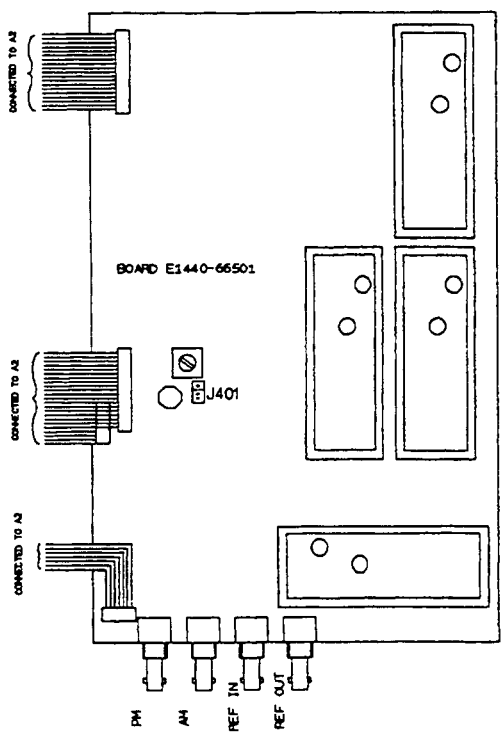


Figure 5-3. Signal Source Board A1 - Location of Test Points

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Dis-assembly and Assembly Instructions

Tools

The following tools are required

- Medium to small posidrive screwdriver (not Philips type).
- 5.5mm flat wrench.
- 5/8inch (15.875mm) box wrench.
- Loctite adhesive.
- Container to hold small, loose parts.
- Sheet of ESD protective foam, larger in area than the HP E1440A unit.

Dis-assembly



ATTENTION STATIC SENSITIVE DEVICES Handle the module only at 'Static Safe' work stations.

Dismantle the E1440A as follows:

1. Remove the small pivot screws from the latch handles.

Caution 

There is a small brass bush which will fall out from the center pivot hole of each latch as it is removed.

2. Remove the two latch handles.
3. Remove nut, lockwasher, plain washer and capacitive washer from each BNC connector.
4. Remove the small nut, lock washer and plain washer from each of the two front panel studs, which attach the front panel to the body of the HP E1440A module at the rear of the front panel.

Caution 

The front panel has two RFI strips attached to the back which provide electrical bonding to the main module chassis.

The adhesive may have spread slightly when the front panel was last tightened to the chassis, causing the strip to stick partly to the front panel and partly to the chassis.

If this happens when you perform the next step, carefully detatch the strips from the chassis and re-attach them to the rear of the front panel with a *little* Loctite adhesive.

5. Carefully lift the front panel away from the module.

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6. Remove the spacer panel from the BNC connectors.
7. Remove the seven (7) screws from the module rear panel.

Caution



A short, black, co-axial cable (W701) connects the two boards (See Figure 5-4). Until this is disconnected, the halves cannot be fully opened up and separated.

8. Prise the two halves of the module apart as far as possible without damaging the black co-axial cable.
9. Disconnect the black co-axial cable at both ends.
10. Open the module up completely.
11. Unplug the remaining connecting cables at the appropriate end.
12. If necessary, each board assembly can be removed from its chassis by removing the mounting screws.

Note



If you return a faulty board for repair or replacement, do not return the black co-axial cable W701 with the board. It is not supplied as part of either replacement board.

If you return the control board A2, remove and keep the top and bottom shields. They are not supplied as part of the replacement board.

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Re-assembly

Re-assembly of a module is the reverse of dis-assembly, except that attention must be paid to careful alignment of parts so that when it is fully bolted together, the module is not distorted. Proceed as follows:

1. If necessary, fit the replacement board to it's chassis.
2. Connect all the cables between the two boards, except the seperate black co-axial cable W701.

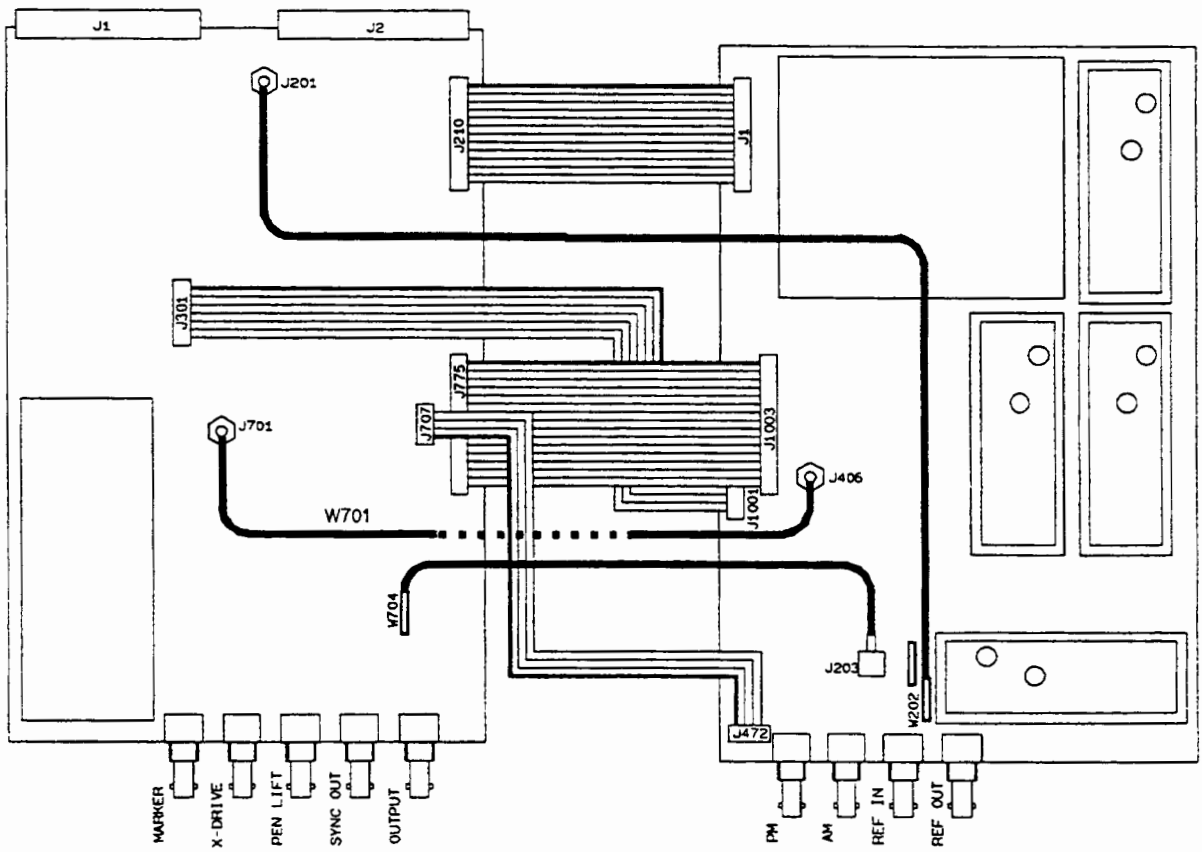


Figure 5-4. E1440A cable connections

3. Clip the two halves of the module together at the bottom.
4. Hinge the two halves towards each other until you can connect the short black co-axial cable.
5. Clip the tops of the module halves together.
6. Inspect the edge seams all around the module to check that the module halves are well aligned.
7. Fit and tighten the seven rear panel screws.
8. Place the spacer board over the BNC connectors.
9. Place the front panel taking care that the RFI strips are correctly seated.

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10. Fit the two stud nuts and washers (plain washer first, then the lock washer and finally the nut), *but only tighten the nuts by hand (finger-tight) at this stage.*
11. Fit the washers and nuts to the two center (PEN LIFT and REF IN) BNC connectors and tighten *by hand.* Refer to Figure 5-5.

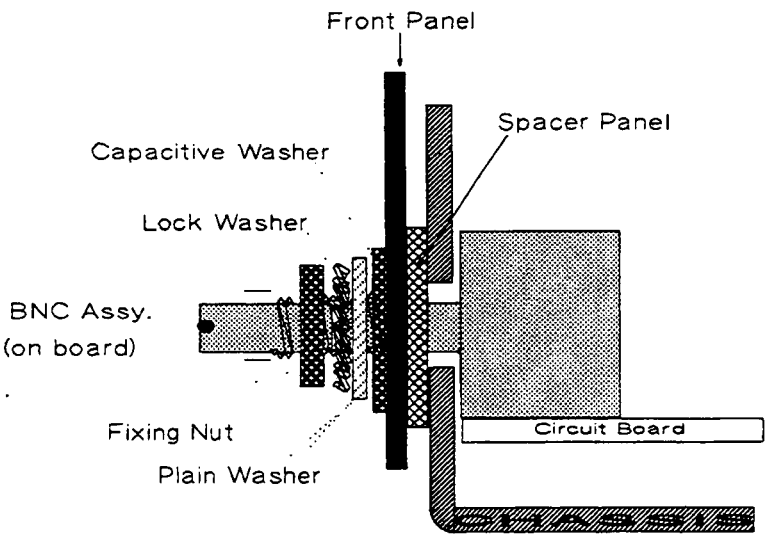


Figure 5-5. BNC Assembly Order

12. Align the front panel so that it's outside edges are flush with the module sides and the panel is square with the module chassis. This can be checked by running a straight edge such as a ruler over the side panels to check that it does not foul the edges of the front panel.

Caution The capacitive washers can be damaged by overtightening the nuts on the BNC connectors.

13. Tighten the two BNC nuts.
14. Tighten the two stud nuts.
15. Fit and tighten the BNC washers and nuts to the remaining BNC connectors.
16. Check the front panel to module alignment again.
17. Fit the two latch handles - the HP logo at the top, and the VXI logo at the bottom.

Caution If the front panel is not correctly aligned to the module, it can overlap with adjacent front panels in the mainframe and prevent the module from seating properly.

If necessary, loosen the BNC nuts and stud nuts to re-align the frontpanel, and then re-tighten.

18. If a board has been replaced, carry out the Adjustment Procedures given in Chapter 3.

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A

Manual Changes

Introduction

This appendix contains information for correcting errors and updating this manual.

At the time of print there are no changes.

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B

Component Level Information Package

Introduction

The component level information package (CLIP) contains:

1. Circuit schematics for each electrical assembly.
2. Parts list for each electrical assembly.
3. Component layout and locator table for each electrical assembly.

The CLIP for the HP E1440A must be ordered seperately.

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C

Performance tests

introduction

The performance of the HP E1440A can be tested at three levels:

- **Functional Verification Tests** - These check that the instrument functions are working. Use these tests when you want to check that the module is connected properly and responding to basic commands. No access to the interior of the module is necessary.
- **Operational Verification Tests** - These check that the instrument meets critical specifications. Use these tests after a repair, or as an aid to troubleshooting. These tests can be carried out *without* a controller.
- **Performance Verification Tests** - These test that the instrument meets all published specifications. Use these tests as an instrument calibration check, or after repair or as an aid to troubleshooting.

Note



The HP E1440A specifications, given in Chapter 1, are valid after a 30 minute warm up period.

All test equipment used must also be allowed to warm up before testing the HP E1440A. Refer to the equipment specifications to find the warm up time required.

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Recommended Test Equipment

The equipment required for the tests is listed in Table C-1. Any equipment which satisfies the critical specifications given in the table, may be substituted for recommended models.

Table C-1. Recommended Test Equipment for Performance Tests

Instrument	Critical Specifications	Recommended Model
Digitizing Oscilloscope	Vertical Bandwidth: 1 GHz with random repetitive sampling technique Timebase accuracy:0.002%	HP 54111D
Electronic Counter	Frequency measurement Time Interval Average A to B Frequency Range: to 100 MHz Resolution: 11 digits	HP 5370B
50Ω Feedthru Termination	Accuracy: ±1% Power Rating: 2 W	HP 10100C
VXI Mainframe (Development)	Must allow access to the Service switch on top of the HP E1440A.	HP E1400T

Functional Verification Tests

The best method of checking that the module is functioning is to:

1. Configure and install the module in a VXI mainframe, as described in Chapter 2.
2. Use the controller to carry out a module self-test and check the results. An example program is given in this section.
3. Check the instrument output with an oscilloscope. An example program is given in this section.

If a controller is not available, carry out the Operational Verification Tests described in a later section. These can be performed with or without a controller, but do not include the instrument self-test.

Note



The HP E1440A has a "Failed" indicator that remains on if the synthesizer is not able to communicate with the controller.

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Performing a Self-test

Starting the test

The instrument's self-test routine can be executed by sending it the command: *TST?

Sending the self test command is an easy way to check that you are correctly addressing the synthesizer module, and is also useful in locating intermittent problems which might occur during operation.

The result of the self-test is returned as a number where a value of zero indicates that no errors occurred. If one or more errors occur, they are added to the instrument error queue and a bit is set in the self-test result to indicate the error types:

Table C-2. Self-test result bits

Bit	Meaning	Module
Bit 0 (1)	ROM test failed	A2
Bit 1 (2)	RAM test failed	A2
Bit 2 (4)	Device bus test failed	A2
Bit 3 (8)	Software timer test failed	A2
Bit 4 (16)	Sweep timer test failed	A1
Bit 5 (32)	Amplitude calibration failed	A1 or A2
Bit 6 (64)	Fractional-N IC test failed	A1
Bit 7 (128)	VCO test failed	A1
Bit 8 (256)	Self-test was called when SWEEP or LIST was in progress. No test was carried out.	–

Refer also to the *TST? entry in Chapter 5 Command Reference in the User Manual.

Reading the Error Queue

When errors occur as a result of self-test or during operation, error codes and messages are added to the synthesizer error queue. The error queue can store up to 30 codes and messages on a 'first in first out' (FIFO) basis.

These errors can be read out using the command: SYS:ERR?

A returned value of 0 (zero) means there are no more errors.

Refer to the SYS:ERR? entry in Chapter 5 Command Reference in the User Manual.

Error numbers and messages are listed in Appendix E of the User's Manual.

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Example program

The following BASIC 5.0/5.1 program executes a self-test. The program assumes the mainframe is at a primary interface address of 09 and the synthesizer is at a secondary address of 11. The program also assumes that an HP 9000 Series 200/300 computer is used.

```
10  !Send the self-test command to the synthesizer
20  !
30  OUTPUT 70911;"*TST?"
40  !
50  !Enter and display the self test code
60  !
70  ENTER 70911;A
80  PRINT A
90  !
100  !Add code here to interrogate the error queue
110  if A is non-zero.
```

Checking the Instrument Output

After self-test, a simple test with an oscilloscope will check that the module output is functional. Connect an oscilloscope to the output BNC and then send the following short program:

```
10  !Reset the synthesizer
20  !
30  OUTPUT 70911;"*RST"
40  END
50  ! Set frequency value
60  !
70  OUTPUT 70911;"FREQ 1E3"
80  !
90  ! Set function to sinewave
100  OUTPUT 70911;"FUNC SIN"
110  !
120  ! Set output level to 1 V
130  !
140 OUTPUT 70911;"VOLT 1"
150 !
160 Switch on the output
170 !
180 OUTPUT 70911;"OUTP ON"
190 END
```


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Without a Controller

A DIL switch called the **Service Switch,** situated beside the address switch (see Figure C-1 and Figure C-2), can be used to force different startup values for the waveform, frequency and amplitude, as detailed in Table C-3.

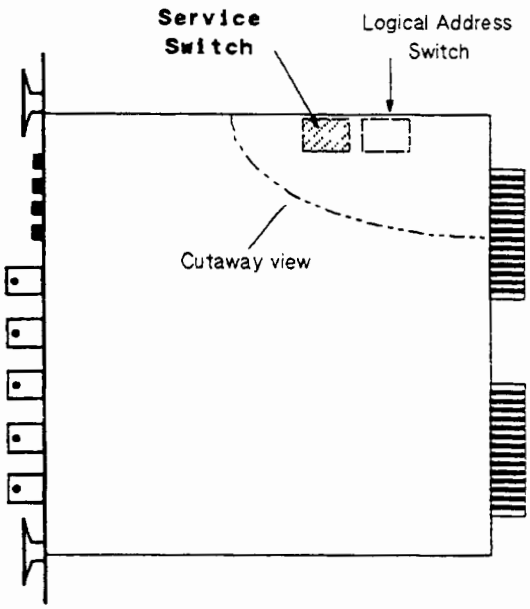


Figure C-1. Service Switch

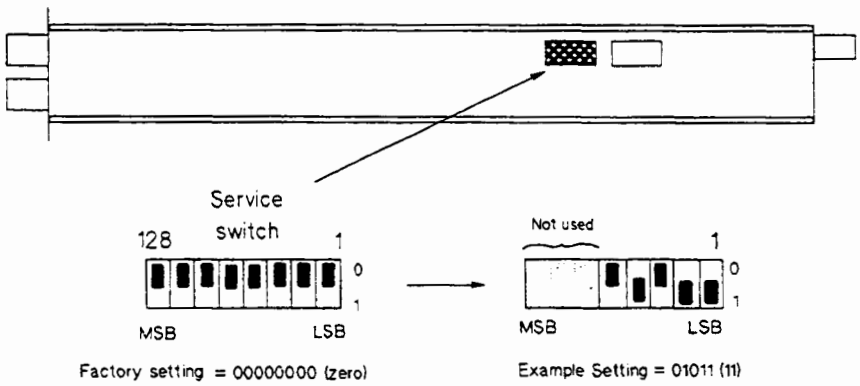


Figure C-2. Example Service Switch Setting

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1. Configure and install the module in a VXI mainframe, as described in Chapter 2.
2. For each of the switch settings in Table C-3:
   a. Switch off the mainframe.
   b. Set up the Service Switch.

Caution



If you are not using a Development mainframe, you have to remove the HP E1440A to access the Service Switch. *The mainframe must be switched off when removing or inserting the HP E1440A.*

   c. Switch on the mainframe.
   d. Using a timer and oscilloscope check that the output's frequency and amplitude are as given in Table C-3 and within specification.
3. Set the Service Switch back to 00000.

With a Controller

1. Configure and install the module in a VXI mainframe, as described in Chapter 2.
2. For each of the settings in Table C-3:
   a. Use the controller to set the waveform, frequency and amplitude to the values in the table, for example:

```
OUTPUT 70911; ":FUNC SIN"          Set waveform to sine
OUTPUT 70911; ":FREQ 10 MHZ"       Set frequency to 10 MHz
OUTPUT 70911; ":VOLT:AMPL 10.0 V"  Set amplitude to 10 V
OUTPUT 70911; ":OUTP ON"           Turn on the output
```

   b. Using a timer and oscilloscope check that the output's frequency and amplitude are as given in Table C-3 and within specification.

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Table C-3. Service Switch Parameter Settings

Switch	Dec equiv	Waveform	Freq (MHz)	Ampl (V_{pp})	Other
[1]00000	0	sin	0.0	0.001	
00001	1	sin	0.001	10.0	
00010	2	sin	8.0	10.0	
00011	3	sin	10.0	10.0	
00100	4	sin	13.0	10.0	
00101	5	sin	20.0	10.0	
00110	6	sin	21.0	10.0	
00111	7	squ	0.001	10.0	
01000	8	squ	10.0	10.0	
01001	9	squ	11.0	10.0	
01010	10	tri	0.01	10.0	
01011	11	rup	0.01	10.0	
01100	12	ttl	25.0	——	
01101	13	ttl	30.0	——	
01110	14	ttl	35.0	——	
01111	15	ttl	40.0	——	
10000	16	ttl	45.0	——	
10001	17	ttl	50.0	——	
10010	18	ttl	55.0	——	
10011	19	ttl	60.0	——	
10100	20	sin	0.0	10.0	
10101	21	squ	0.0	10.0	
10110	22	tri	0.0	10.0	
10111	23	rup	0.0	10.0	
11000	24	rdow	0.00	10.0	
[2]11001	25	dc	——	——	3V offset

Notes

1 Standard reset values

2 Values over 25 are treated as 25

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Performance Verification Tests

There are currently no Performance Verification Tests for the HP E1440A. Use the Functional and Operational Verification Tests to check the module after repair. The Performance Verification Tests will be part of a future manual update.

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D

Backdating Changes

Introduction

This appendix contains backdating information to adapt this manual for instruments with a lower serial number than that shown on the title page.

There are currently no backdating changes.

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3

Adjustments

Introduction

This chapter describes adjustment procedures for the HP E1440A instrument. Adjustment should only be required when the instrument fails one or more performance tests carried out after major repair or as certified calibration checks. In these cases, the appropriate adjustment may be made in isolation. Replacement board assemblies, supplied on an exchange basis, are calibrated at the factory to minimize the adjustments you need to make.

Note



After minor repair, correct functioning can be checked by carrying out the Overshoot and Amplitude Accuracy Tests at the end of this chapter. These tests are conducted with the module fully assembled.

Most adjustments can only be made with the HP E1440A case opened up for access. This requires a special test set-up and equipment as detailed below.

All setting up commands for the HP E1440A are sent to the instrument using a computer, operating over the VXI-bus interface. A computer capable of communicating in this way is an essential pre-requisite for these adjustment procedures.

Programming statements used in the procedures assume:

- an HP 9000 Series 200 or 300 computer as controller,
- that BASIC 5.0/5.1 is the programming language.

Module Identity

Before starting the adjustment procedures, check the VXI-bus address of the command module and the secondary address of the HP E1440A.

The HP E1440A commands in the following performance test procedures, use the variable **Vxi=71611** (case sensitive) to represent the full address of the module. Set this variable to the correct address for your test system.

For example:

VXI-bus interface number: 7

VXI command module address: 16

HP E1440A secondary address: 11

Set the variable **Vxi=71611** or replace **Vxi** with the number 71611 (or your own address) wherever it is used in the command strings.

Part of:

E1440-90001

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Note



The HP E1440A must be allowed to warm up for at least 60 minutes before commencing any adjustments.

Equipment Required

The equipment required for the adjustment procedures is listed below. Any equipment which satisfies the critical specifications given in the table, may be substituted for recommended models.

Table 3-1. Recommended Test Equipment (Adjustments)

Instrument	Critical Specifications	Recommended	Alternative
Digitizing Oscilloscope	Vertical Bandwidth:1 GHz	HP 5412xT	HP 54503A
Electronic Counter	Frequency measurement Time Interval Average A to B Frequency Range: to 100 MHz Resolution: 11 digits	HP 5370B	HP 5335A
Digital Voltmeter	AC Function (True RMS) Ranges: 10 mV to 1000 V Bandwidth: 1 Hz to 1 MHz Resolution: 4.5 digits minimum DC Functions Ranges: 10 mV to 1000 V	HP 3458A	HP 3456A
Power Meter	Accuracy:±0.02 dBm		HP 436A
Power Sensor	Frequency Range: 100 kHz to 100 MHz Maximum Power:≥100 mW		HP 8482A
Spectrum Analyzer	Frequency Range: 20 Hz to 40.1 MHz Spurious Responses: 100 dB below reference	HP 3585B	
DC Source	DC 2.5 V ±0.001 V adjustable	HP 6632A	HP 3324A
VXI Mainframe (Development)	Must allow access to front and right hand side of the HP E1440A.	HP E1400T	
Command Module		HP E1405A	
Controller		HP 9000 Series 200/300	
Attenuator 20 dB	Two required	HP 33340C	
Adapter	BNC female to dual Banana plug	HP 1251-2277	
Adapter	BNC Tee piece	HP 1250-0781	
Cable Assembly	SMA female to SMA female 30cm long	E1440-61616	

Note



All test equipment used must be allowed to warm up before carrying out any adjustment of the HP E1440A. Refer to the user manual for each item of equipment to find the minimum warm up time required.

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Programming Command Strings

The HP E1440A Users Manual (Part No. E1440-90011) contains details of the SCPI programming language used by the HP E1440A. All necessary command strings in BASIC, are included in the following adjustment procedures and they must be sent exactly as shown.

Example `OUTPUT␣Vxi;":FREQ␣1E6;:VOLT:AMPL␣5;:OUTP␣ON"`



Where ␣ represents a significant space between characters.

Default setting

To avoid actual or stored values having an effect on test settings, it is good practice to set the instrument to a known state before each test. This known state is achieved by sending the following command string:

```
OUTPUT␣Vxi;"*RST;*CLS"
```

Equipment Set-up

VXIbus Development Mainframe HP E1400T

The primary function of this mainframe is to provide greater access for development engineers, it is a laboratory tool. This means that it is likely to have been used with non standard slot configuration settings etc. last time it was used and you must first check that the module will operate within it before commencing any adjustment procedures.

1. Install the HP E1440A in the extreme right hand position in the mainframe.
2. Switch ON the mainframe and check that the *FAILED* indicator on the HP E1440A extinguishes. This indicates that the instrument is communicating correctly with the command module via the backplane and that self test has been sucessfull.
3. If the *FAILED* indicator remains ON, switch OFF the mainframe, remove the instrument and check the backplane DIL switches and/or software as detailed in the VXIbus Mainframe User Manual, to ensure that the chosen slot is usable and not switched out of circuit.
4. If the mainframe set up is correct but the *FAILED* indicator stays on, then a fault in the HP E1440A has been detected. This fault must be investigated before continuing the test set-up and adjustment procedures.

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Test Set-up

The HP E1440A is connected to test control equipment as shown below, and as test set-up figures at appropriate places in the text.

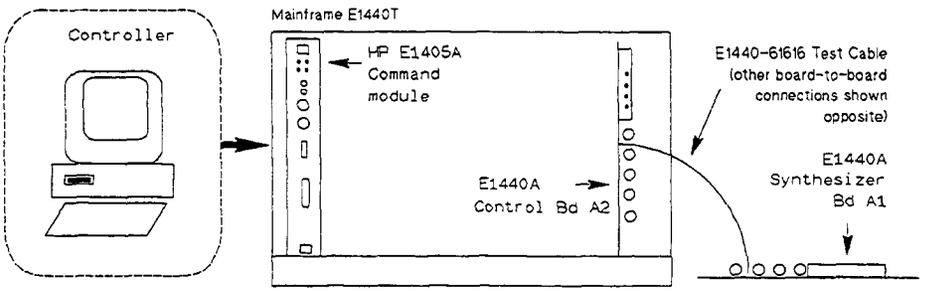


Figure 3-1. Basic Test Configuration

Test Preparation
HP E1440A

Prepare the HP E1440A for test as follows:



ATTENTION STATIC SENSITIVE DEVICES, Handle module only at 'Static Safe' work stations.

1. Ensure the mainframe power is switched OFF.
2. Open the HP E1440A case. Instructions on how to gain access to the HP E1440A are given in Chapter 5 *Service*.

Note



As the HP E1440A is dismantled, you may find that capacitive washers have been broken due to over tightening during previous assembly. These washers - Part Number HP 0160-6777 - **must** be replaced when the instrument is re-assembled.

---

3. Separate the two halves of the module as instructed but only disconnect, the short black cable W701 linking the boards. All other board connectors are long enough to leave connected
4. Lay the right hand side of the module, circuit board upwards on an anti static pad beside the development mainframe.

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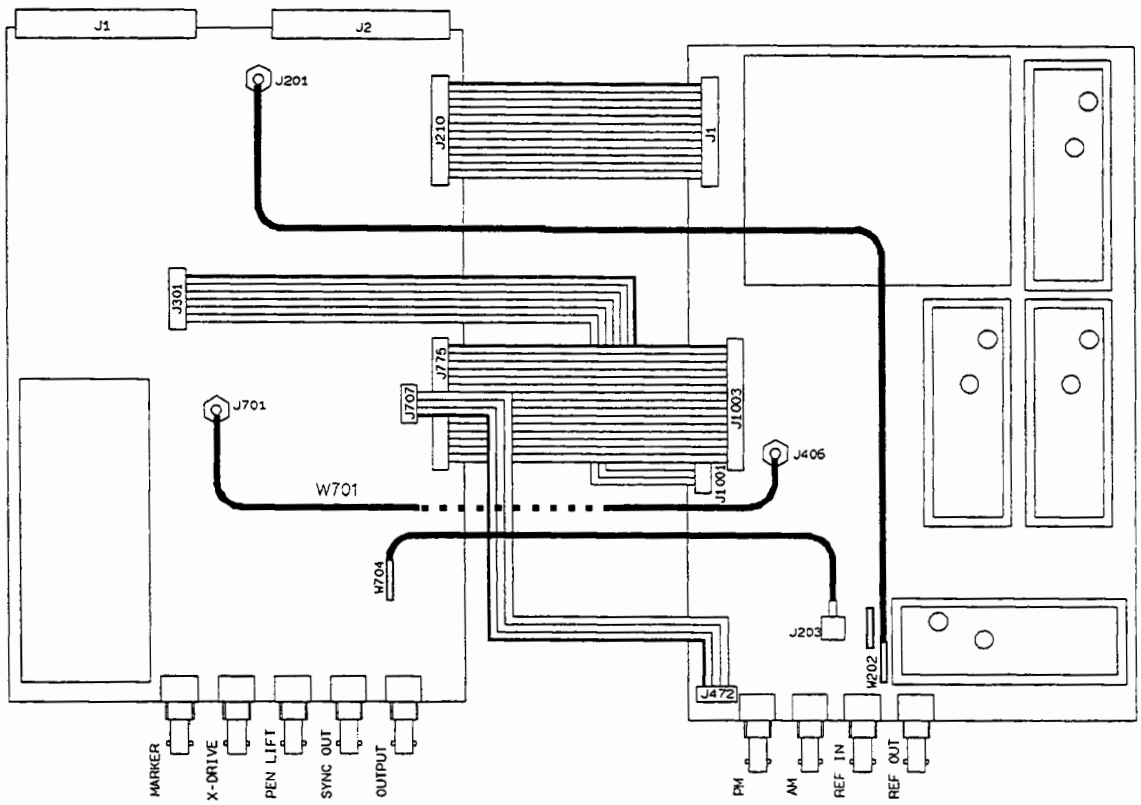


Figure 3-2. Cable Connections Between Boards

5. Remove the four fixing screws of the metal shield on the synthesizer board A1 and set the shield aside (access is required to components below this shield).
6. Carefully insert the left hand half of the module into the extreme right hand guide slot of the mainframe so that it connects into the back plane.
7. Use the test cable, Part Number E1440-61616 in place of the short black cable W701 to re-connect the module halves.
8. Switch ON the mainframe.
9. The "Failed" indicator should NOT be lit and you can now check communication with the HP E1440A by running the Self test described in Appendix C *Performance Tests - Functional Verification*.

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Adjustment Procedures

The adjustment procedures described below for the HP E1440A, are as follows:

- Power supplies
- Frequency
- VCO
- Amplitude level
- Gain
- Spurious measurements
- Mixer
- Harmonics
- Jitter
- X-drive
- Overshoot
- Amplitude Accuracy
- High voltage amplifier (Option 001)

Most adjustments given in this chapter refer to the synthesizer board A1 which is laid flat on the bench. To help you identify the component to be adjusted, the area where adjustments are to be made and where monitor points are located, is illustrated close to the instruction, within an outline of the appropriate board.

Power Supplies

1. Set DEFAULT state by issuing command string:

```
OUTPUT␣Vxi;"*RST;*CLS"
```

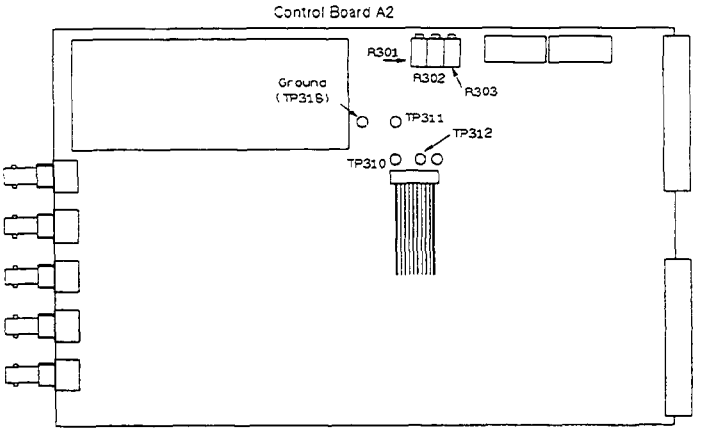


Figure 3-3. Power supplies adjustments

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+5V Power supply

2. Connect DVM to Test Point **TP310** and ground clip to **TP318**.
3. Refering to Figure 3-3, adjust **RV301** to obtain a reading of 5.02 V. Specification requirement is +5.02 ±0.01V.

+15V Power supply

4. Connect DVM to Test Point **TP311** and ground clip to **TP318**.
5. Refering to Figure 3-3, adjust **RV302** to obtain a reading of 15.00 V. Specification requirement is +15.0 ±0.02V.

−15V Power supply

6. Connect DVM to Test Point **TP312** and ground clip to **TP318**.
7. Refering to Figure 3-3, adjust **RV303** to obtain a reading of −15.00 V. Specification requirement is −15.00 ±0.02V.

Frequency

Frequency amplitude

Note



Frequency amplitude is set at factory. Check that there is a signal output and only adjust if there is no signal.

1. Issue the following command strings:

```
OUTPUT␣Vxi;"*RST;*CLS"
OUTPUT␣Vxi;":FREQ␣1E6;:VOLT:AMPL␣5;:OUTP␣ON"
```


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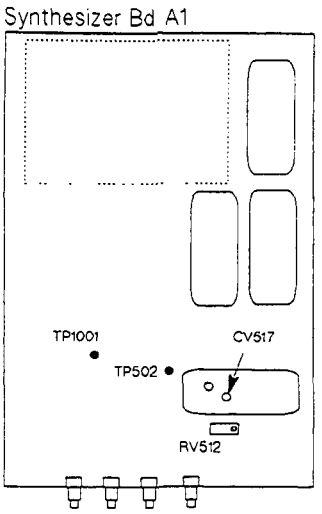


Figure 3-4. Frequency adjustments

2. Connect DVM to Test Point **TP502** and ground clip to **TP1001**.
3. A typical reading should be > 5.15 V.
4. If there is no reading, refer to Figure 3-4 and adjust **CV517** to achieve a maximum reading. The range of adjustment is approximately 120mV.

Frequency accuracy

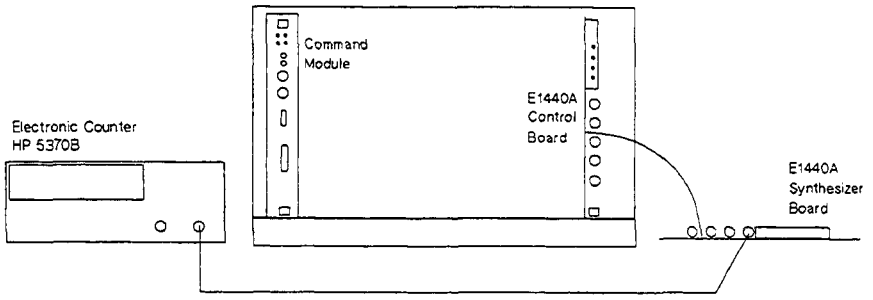


Figure 3-5. Test set-up for Frequency Accuracy

1. Connect the counter to Ref.OUT 10 MHz of the HP E1440A, as shown in Figure 3-5.
2. Set DEFAULT state by issuing command string:

```
OUTPUT␣Vxi;"*RST;*CLS"
```

3. Set the counter to AC Input.
4. Refering to Figure 3-4, adjust **RV512** to obtain a frequency reading of 10 MHz. Specification requirement is 10 MHz ±30 Hz.

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VCO Adjustment

1. Issue the following command strings:

```
OUTPUT␣Vxi;"*RST;*CLS"
OUTPUT␣Vxi;":FUNC␣TTL;:FREQ␣6E7"
```

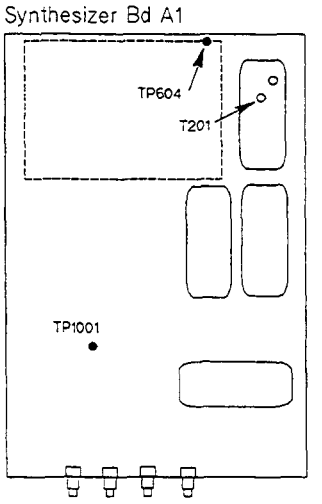


Figure 3-6. VCO adjustment

2. Connect DVM to Test Point **TP604** and ground clip to **TP1001**.
3. Refering to Figure 3-6, adjust **T201** to obtain −6.0 V. Specification requirement is −6.0 ±0.1V.

Note

The screwdriver used to adjust T201 will have a slight affect on the adjustment. Re-check the reading after screwdriver is removed.

Amplitude Level

The amplitude adjustment is done in three stages; negative and positive amplitude settings, followed by a mid-point (zero) check.

Negative setting

1. Issue the following command strings:

```
OUTPUT␣Vxi;"*RST;*CLS"
OUTPUT␣Vxi;"DIAG:DAC␣0,00000"
```


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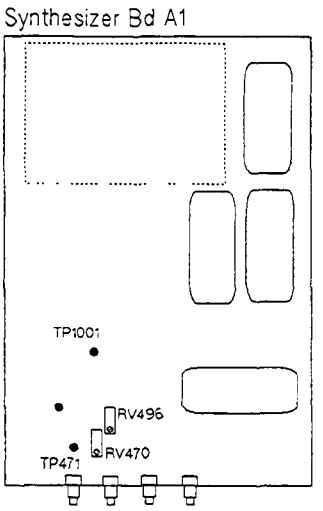


Figure 3-7. Amplitude adjustment

2. Connect DVM to **TP471** and ground clip to **TP1001**.
3. Refering to Figure 3-6, adjust **RV496** to obtain a reading of −10.04 V. Specification requirement is −10 ±0.002 V.
4. Leave DVM connected.

Positive setting

5. Issue the following command string:

```
OUTPUT␣Vxi;"DIAG:DAC␣Ø,1ØØØØ"
```

6. Refering to Figure 3-7, adjust **RV470** to obtain a reading of +10.04 V. Specification requirement is +10 ±0.002 V.
7. Leave DVM connected.

Amplitude check

8. Issue the following command string:

```
OUTPUT␣Vxi;"DIAG:DAC␣Ø,Ø5ØØØ"
```

9. Check that DVM reads zero ±0.005 V.
10. If the DVM does not read zero, repeat the positive and negative settings.

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Gain

There are three adjustments to make and they **must** be done in the order given. If any adjustment is made, all three adjustments must be repeated in order until no further adjustment is required. Issue the following command strings:

```
OUTPUT␣Vxi;"*RST;*CLS"
OUTPUT␣Vxi;":FUNC␣SIN;:FREQ␣1E3;:VOLT:AMPL␣10;:OUTP␣ON"
```

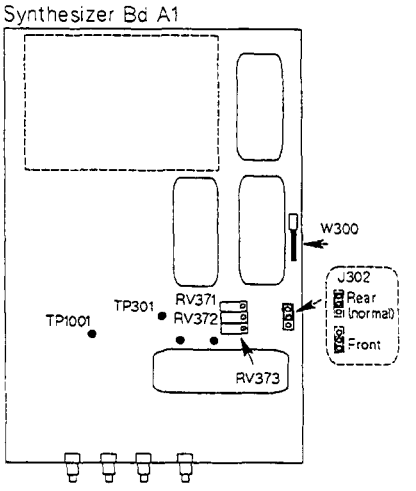


Figure 3-8. Gain adjustment

Gain adjustment 1

1. Move jumper **J302** to its front position as shown on Figure 3-8.
2. Issue the following command string:

   ```
   OUTPUT␣Vxi;":DIAG:DAC␣Ø,1ØØØØ"
   ```

3. Connect DVM to **TP301** and ground clip to **TP1001**.
4. Refering to Figure 3-8, adjust **RV373** to obtain a reading of zero volts. Specification requirement is 00 ±0.005 V.

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Gain adjustment 2

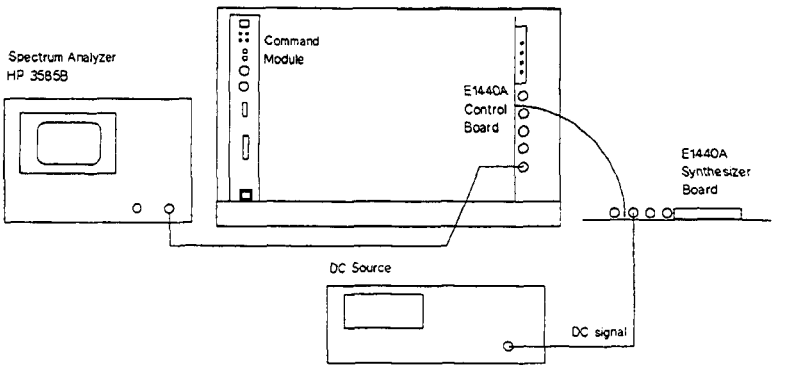


Figure 3-9. Test set-up for Gain

5. Issue the following command string:

```
OUTPUT␣Vxi;":AM:STAT␣ON"
```

6. Move the jumper on **J302** to its rear position.
7. Connect the HP E1440A SIGNAL OUT connector to the spectrum analyzer as shown in Figure 3-9.
8. Adjust the spectrum analyzer to reference the fundamental to the top display graticule (Center frequency 1 kHz, Span 1 kHz).
9. Ensure that the spectrum analyzer (Ref Levl Track) key is OFF (unlit).
10. Apply 2.5 Vdc to the HP E1440A AM INPUT connector.
11. Check for 5 V at W300 point.
12. Confirm that the new fundamental displayed on the spectrum analyzer is 37 dB lower than the previous reference.
13. Refering to Figure 3-8, adjust **RV372** if necessary to obtain the correct result.

Gain adjustment 3

14. Issue the following command strings:

```
OUTPUT␣Vxi;":AM:STAT␣OFF"
OUTPUT␣Vxi;":FUNC␣SQU"
```

15. Connect the DVM to **TP301**, ground clip to **TP1001**.
16. Refering to Figure 3-8, adjust **RV371** to obtain a reading of 6.525 V. Specification requirement is 6.525 ±0.025 V.
17. Leave jumper **J302** in it's rear (normal) position.
18. Disconnect the test equipment.

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Spurious adjustments

There are five adjustments to make. The readings are made using a spectrum analyzer.

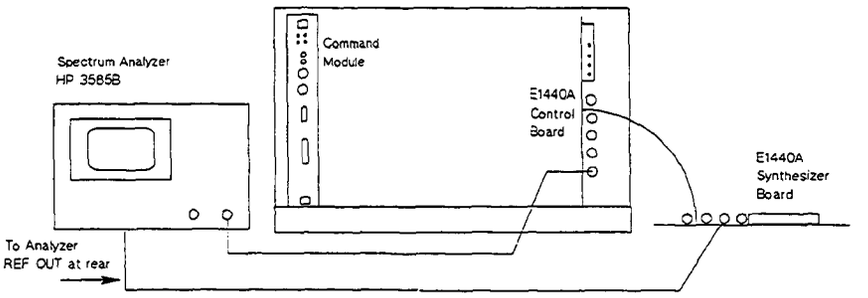


Figure 3-10. Test set-up for Spurious Measurements

Setting the reference

1. Issue the following command strings:

```
OUTPUT␣Vxi;"*RST;*CLS"
OUTPUT␣Vxi;":FREQ␣1E6;:VOLT:AMPL 10;:OUTP␣ON"
```

2. Connect the spectrum analyzer to the HP E1440A as shown in Figure 3-10.
3. Set up the spectrum analyzer as follows:

Sweep mode	Manual
Bandwidth	3 Hz Resolution
Center frequency	1 MHz
Span	10 kHz
Marker	Reference level

4. Press (Clear trace A) on the HP 3585B spectrum analyzer.
5. Measure the 1 MHz carrier amplitude on the spectrum analyzer with a 3Hz bandwidth as reference.

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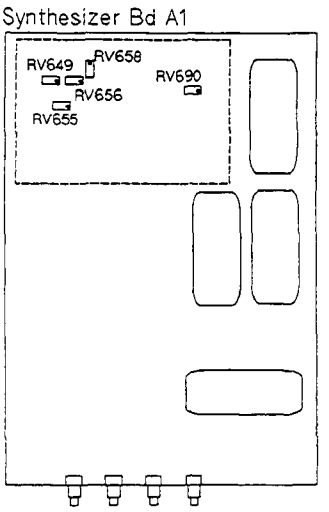


Figure 3-11. Spurious adjustments

Spurious 100 kHz

1. Issue the following command string:

   `OUTPUT␣Vxi;":FREQ␣1.1E6"`

2. Set spectrum analyzer center frequency to 0.9 MHz.
3. Measure the spurious trace at 0.900 000 MHz.
4. Refering to Figure 3-11, adjust **RV690** to obtain a minimum reading, typically a level of −85 dBc below the carrier. Specification limit is −70 dBc.

Spurious 10 kHz

1. Issue the following command string:

   `OUTPUT␣Vxi;":FREQ␣1.Ø1E6"`

2. Set the spectrum analyzer center frequency to 1 MHz.
3. Measure the spurious at 1.000 000 MHz.
4. Refering to Figure 3-11, adjust **RV658** to obtain a minimum reading, typically a level of −75 dBc below the carrier. Specification limit is −60 dBc.

Spurious 1 kHz

1. Issue the following command string:

   `OUTPUT␣Vxi;":FREQ␣1.ØØ1E6"`

2. Set the spectrum analyzer center frequency to 0.991 MHz.
3. Measure the spurious at 0.991 000 MHz.
4. Refering to Figure 3-11, adjust **RV656** to obtain a minimum reading, typically a level of −75 dBc below the carrier. Specification limit is −60 dBc.

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Spurious 100 Hz

1. Issue the following command string:

   ```
   OUTPUT␣Vxi;":FREQ␣1.000␣1E6"
   ```

2. Set the spectrum analyzer center frequency to 0.9901 MHz.
3. Measure the spurious at 0.990 100 MHz.
4. Refering to Figure 3-11, adjust **RV655** to obtain a minimum reading, typically a level of −80 dBc below the carrier. Specification limit is −60 dBc.

Spurious 10 Hz

1. Issue the following command string:

   ```
   OUTPUT␣Vxi;":FREQ␣1.0000␣1E6"
   ```

2. Set the spectrum analyzer center frequency to 0.99001 MHz.
3. Measure the spurious at 0.990 010 MHz.
4. Refering to Figure 3-11, adjust **RV649** to obtain a minimum reading, typically a level of −90 dBc below the carrier. Specification limit is −70 dBc.

Mixer

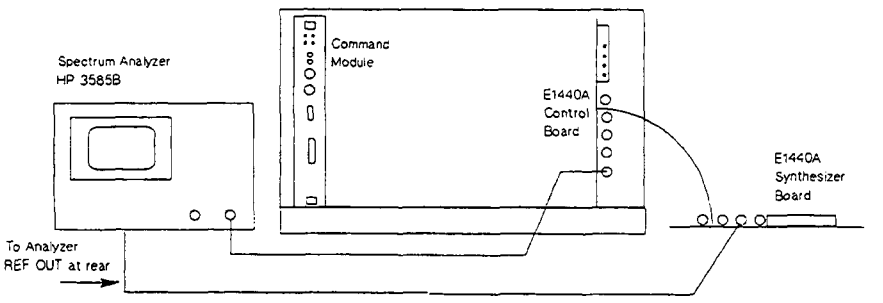


Figure 3-12. Test set-up for Mixer Adjustments

1. Issue the following command strings:

   ```
   OUTPUT␣Vxi;"*RST;*CLS"
   OUTPUT␣Vxi;":FREQ␣1.35E7;:VOLT:AMPL␣10;:OUTP␣ON"
   ```

2. Connect the spectrum analyzer to the HP E1440A as shown in Figure 3-12.
3. Measure the DUT carrier amplitude with the spectrum analyzer bandwidth of 10 Hz at 13.5 MHz.
4. Set up the spectrum analyzer as follows:

   Sweep mode Manual

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Bandwidth	10 Hz Resolution
Center frequency	13.5 MHz
Span	10 kHz
Marker	Reference level

5. Press [Clear trace A] on the HP 3585B spectrum analyzer.
6. Measure the mixer spurious trace with the spectrum analyzer set at 16.5 MHz.

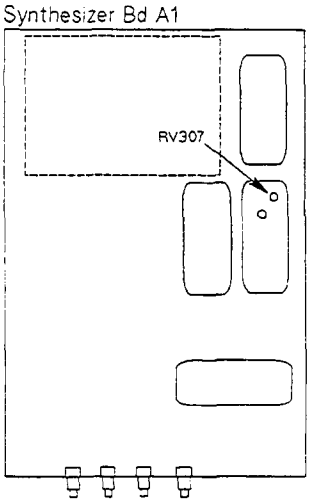


Figure 3-13. Mixer adjustment

7. Refering to Figure 3-13, adjust **RV307** to obtain a minimum reading, typically a level of −70 dBc to −80 dBc below the carrier. Specification limit is −70 dBc.

Note The adjustment on **RV307** is flat and may be clockwise or counter clockwise.

Harmonics

There are two adjustments to make and they are mutually dependent. This means you should loop back to the first adjustment and ensure that, if any further adjustment is necessary, the adjustments are repeated in order until no further adjustment is required.

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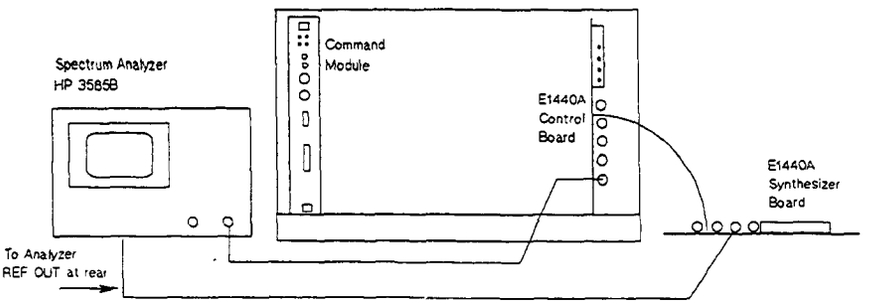


Figure 3-14. Test set-up for Harmonics Adjustments

Harmonics adjust

1. Issue the following command strings:

```
OUTPUT Vxi;"*RST;*CLS"
OUTPUT Vxi;":FREQ␣2E6;:VOLT:AMPL␣10;:OUTP␣ON"
```

2. Connect the spectrum analyzer to the HP E1440A as shown in Figure 3-14.
3. Measure the DUT carrier with the spectrum analyzer at 2 MHz.
4. Press the (Mkr → Ref Lvl) key on the spectrum analyzer.
5. Measure the Harmonics at 4 MHz.
6. Set the spectrum analyzer center frequency to 4 MHz.

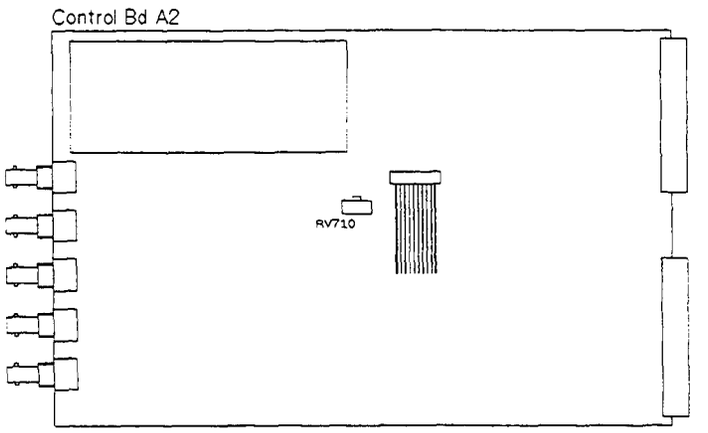


Figure 3-15. Harmonics adjustment

7. Refering to Figure 3-15, adjust **RV710** to obtain minimum harmonics level, typically a level of −55 dBc below the carrier. Specification limit is −42 dBc.

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Harmonics re-adjust

1. Issue the following command string:

   ```
   OUTPUT␣Vxi;":FREQ␣1.5E7;"
   ```

2. Measure the DUT carrier with the spectrum analyzer at 15 MHz.
3. Press the [Mkr → Ref Lvl] key on the spectrum analyzer.
4. Set the spectrum analyzer center frequency to 30 MHz.
5. Measure the Harmonics at 30 MHz.
6. Re-adjust **RV710** if necessary, to obtain a minimum reading, typically −37 dBc below the carrier. Specification limit is −30 dBc

Jitter

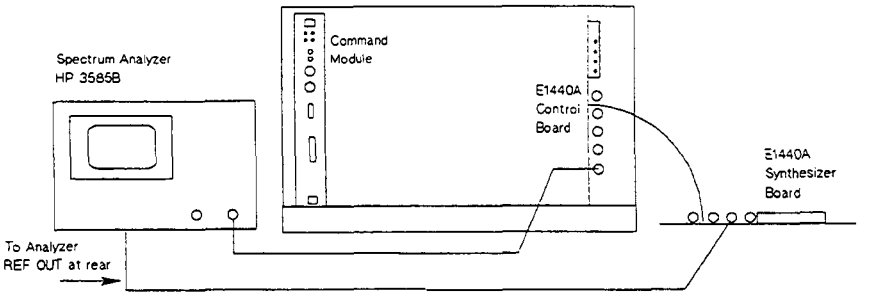


Figure 3-16. Test set-up for Jitter

1. Issue the following command strings:

   ```
   OUTPUT␣Vxi;"*RST;*CLS"
   OUTPUT␣Vxi;":FUNC␣RUP;:FREQ␣98;:VOLT:AMPL␣10;:OUTP␣ON"
   ```

2. Connect the spectrum analyzer to the HP E1440A as shown in Figure 3-16.
3. Set up the spectrum analyzer as follows:

Sweep mode	Manual
Bandwidth	3 Hz Resolution
Center frequency	98 Hz
Span	100 Hz
Marker	Reference level

4. Press [Clear trace A] on the HP 3585B spectrum analyzer.
5. Observing the spectrum analyzer, measure the fundamental wave at 98 Hz using the 3 Hz bandwidth.
6. Change the spectrum analyzer center frequency to 147 Hz.
7. Observing the spectrum analyzer, measure the wave at 147 Hz.

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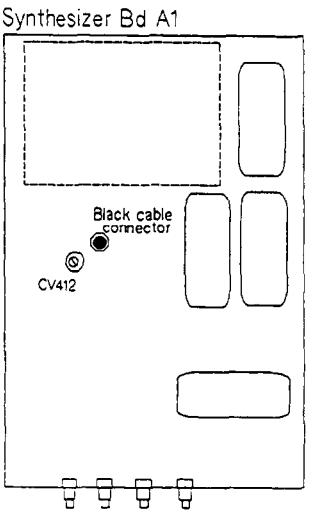


Figure 3-17. Jitter adjustment

8. Refering to Figure 3-17, adjust **CV412** for a minimum value, typically −62 dBc. Specification limit is −55 dBc.

X-drive

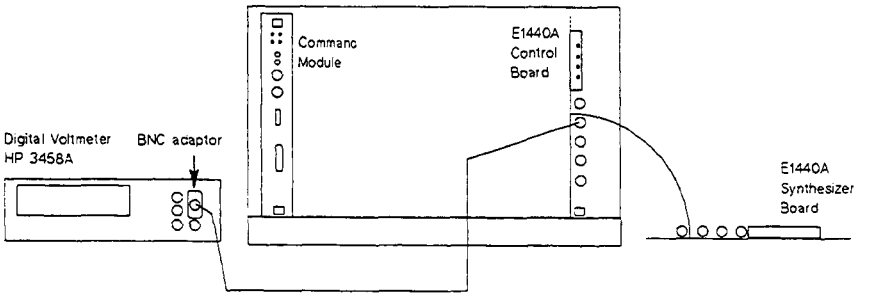


Figure 3-18. Test set-up for X-drive

1. Issue the following command strings:

```
OUTPUT␣Vxi;"*RST;*CLS"
OUTPUT␣Vxi;":FREQ:STAR␣1E6;STOP␣2E7"
OUTPUT␣Vxi;":SWE:TIME␣999E-3"
OUTPUT␣Vxi;":FREQ:MODE␣SWE"
OUTPUT␣Vxi;":INIT"
```

2. Connect the DVM to the HP E1440A as shown in Figure 3-18.
3. Measure the X-drive output.

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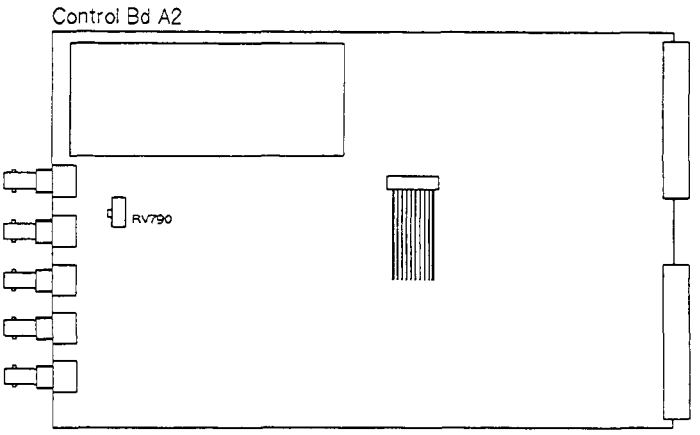


Figure 3-19. X-drive adjustment

4. Refering to Figure 3-19, adjust **RV 790** to provide an output of 10.8 ±0.1 V.

Note

Turning **RV 790** clockwise, increases output level and turning counter clockwise reduces output level.

Whilst adjusting there will be no response on the DVM. You will see the result of adjustment on the next sweep run.

5. If the specification is not met repeat as follows:
   a. Issue the following command string:

      `OUTPUT␣Vxi;":INIT"`

   b. Measure the X-drive output.
   c. Refering to Figure 3-19, adjust **RV 790** to provide an output of 10.8 ±0.1 V.

Overshoot

Before the overshoot and amplitude accuracy tests are carried out, the HP E1440A module must be re-assembled. There are two access holes in the right hand side cover to enable adjustments to be made.

Re-assembly

Re-assembly of a module is the reverse of dis-assembly, except that attention must be paid to careful alignment of parts so that when it is fully bolted together, the module is not distorted. Proceed as follows:

1. Switch OFF the mainframe.
2. Fit the square metal shield back onto the synthesizer board A1.
3. Withdraw the control board half of the module from the mainframe.
4. Disconnect the test cable and refit one end of the small black standard cable W701.

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5. Clip the two halves of the module together at the bottom.
6. Hinge the two halves towards each other until you can connect the free end of the short black co-axial cable W701.
7. Clip the tops of the module halves together.
8. Inspect the edge seams all around the module to check that the module halves are well aligned.
9. Fit and tighten the seven rear panel screws.
10. Place the spacer board over the BNC connectors.
11. Place the front panel taking care that the RFI strips are correctly seated.
12. Fit the two stud nuts and washers (plain washer first, then the lock washer and finally the nut), *but only tighten the nuts by hand (finger-tight) at this stage*.
13. Fit the washers and nuts to the two center (PEN LIFT and REF IN) BNC connectors and tighten *by hand*. Refer to Figure 3-20.

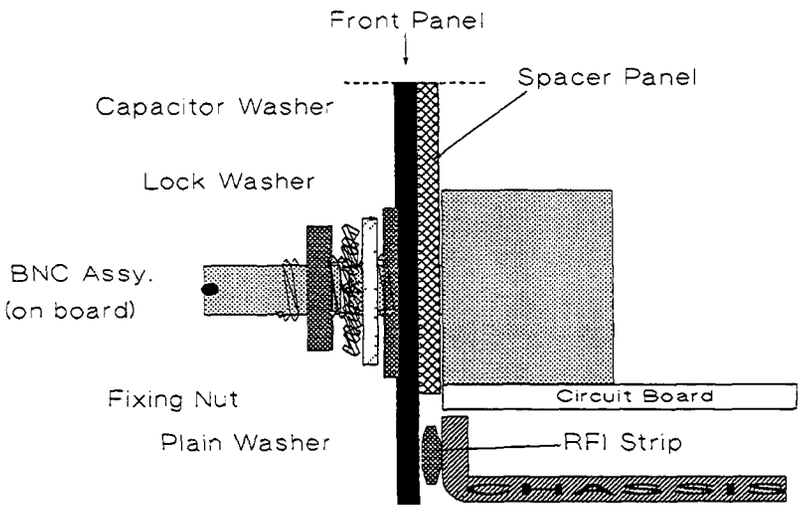


Figure 3-20. BNC Assembly Order

14. Align the front panel so that it's outside edges are flush with the module sides and the panel is square with the module chassis. This can be checked by running a straight edge such as a ruler over the side panels to check that it does not foul the edges of the front panel.

Caution The capacitive washers can be damaged by over tightening the nuts on the BNC connectors.

15. Tighten the two BNC nuts.
16. Tighten the two stud nuts.
17. Fit and tighten the BNC washers and nuts to the remaining BNC connectors.

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18. Check the front panel to module alignment again.

19. Fit the two latch handles - the HP logo at the top, and the VXI logo at the bottom.

Caution



If the front panel is not correctly aligned to the module, it can overlap with adjacent front panels in the mainframe and prevent the module from seating properly.

If necessary, loosen the BNC nuts and stud nuts to re-align the front panel, and then re-tighten.

20. Switch the Mainframe ON and allow 60 minutes warm up time before carrying out the Overshoot and Amplitude Accuracy adjustments.

Procedure

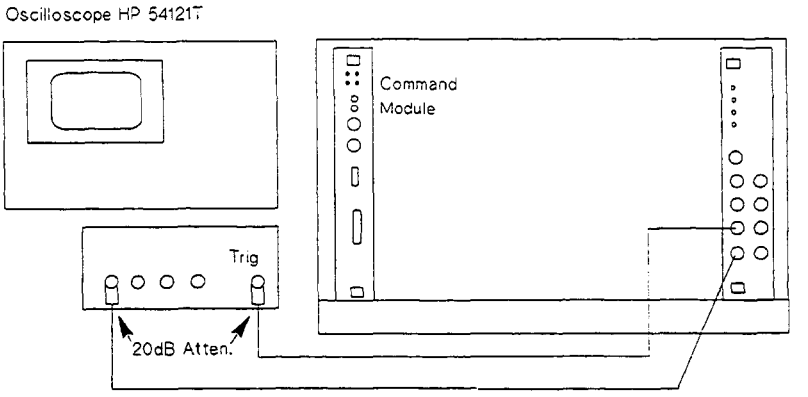


Figure 3-21. Test set-up for Overshoot

1. Connect oscilloscope to the HP E1440A SIGNAL O/P as shown in Figure 3-21.

2. Issue the following command strings:

```
OUTPUT␣Vxi;"*RST;*CLS"
OUTPUT␣Vxi;":FUNC␣SQU;:FREQ␣1.2E6;:VOLT:AMPL␣2.99;:OUTP␣ON"
```

3. Look on the oscilloscope for a smooth pulse response.

4. Adjust **CV702** (access hole identified on side cover) to reduce overshoot to minimum if necessary.

Note



This check is not an adjustment, but a preliminary setting for the amplitude accuracy adjustment which follows.

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Amplitude Accuracy Adjustment

There are two adjustments to make and they are mutually dependent. This means you should return to the first adjustment after a test sequence and ensure that, if any further adjustment is necessary, the adjustments are repeated in order until no further adjustment is required.

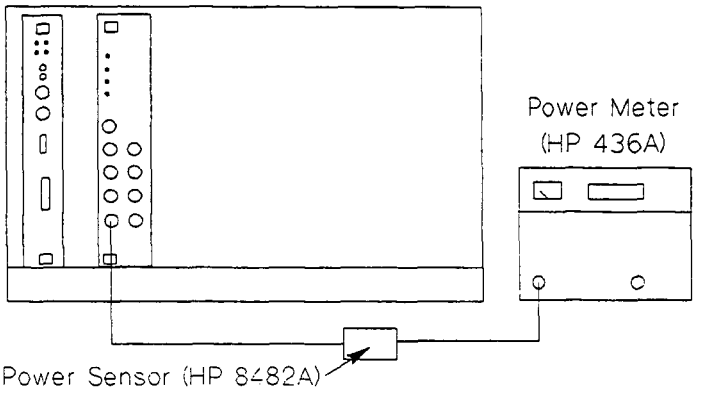


Figure 3-22. Test set-up for Amplitude Accuracy Adjustment

1. Calibrate the power meter for the sensor using the 50 MHz, 1.00 mW power-reference output on the meter.
2. Connect the output of the HP E1440A to the power meter via the power sensor, as shown in Figure 3-22.
3. Switch the power meter to read dBm.
4. Issue the following command strings:

```
OUTPUT␣Vxi; "*RST;*CLS"
OUTPUT␣Vxi; ":VOLT:AMPL 6.0 V"
OUTPUT␣Vxi; ":OUTP ON"
OUTPUT␣Vxi; ":FREQ 10 MHZ"
```

5. Check that the indicated power level is 19.54 dBm ±0.04 dB.
6. Adjust the level using the 10 MHz amplitude adjuster (R405) through the hole on the right side of the HP E1440A case, only if necessary.
7. Issue the following command string

```
OUTPUT␣Vxi; ":FREQ 20.5 MHZ"
```

8. Check that the indicated power level is 19.54 dBm ±0.04 dB.
9. Adjust the level using the 20 MHz amplitude adjuster (CV702) through the hole on the right side of the HP E1440A case, only if necessary.

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Note



Use care in adjusting **CV702**, otherwise you may affect the Overshoot Adjustment.

10. Check that overshoot is still acceptable. If it is not, repeat amplitude adjustments at 10 MHz and 20.5 MHz until no further adjustment is needed.

High Voltage Amplifier (Option 001)

There are no adjustments to make.

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3

Adjustments

Introduction

This chapter describes adjustment procedures for the HP E1440A instrument. Adjustment should only be required when the instrument fails one or more performance tests carried out after major repair or as certified calibration checks. In these cases, the appropriate adjustment may be made in isolation. Replacement board assemblies, supplied on an exchange basis, are calibrated at the factory to minimize the adjustments you need to make.

Note



After minor repair, correct functioning can be checked by carrying out the Overshoot and Amplitude Accuracy Tests at the end of this chapter. These tests are conducted with the module fully assembled.

Most adjustments can only be made with the HP E1440A case opened up for access. This requires a special test set-up and equipment as detailed below.

All setting up commands for the HP E1440A are sent to the instrument using a computer, operating over the VXI-bus interface. A computer capable of communicating in this way is an essential pre-requisite for these adjustment procedures.

Programming statements used in the procedures assume:

- an HP 9000 Series 200 or 300 computer as controller,
- that BASIC 5.0/5.1 is the programming language.

Module Identity

Before starting the adjustment procedures, check the VXI-bus address of the command module and the secondary address of the HP E1440A.

The HP E1440A commands in the following performance test procedures, use the variable **Vxi=71611** (case sensitive) to represent the full address of the module. Set this variable to the correct address for your test system.

For example:

VXI-bus interface number: 7

VXI command module address: 16

HP E1440A secondary address: 11

Set the variable **Vxi=71611** or replace **Vxi** with the number 71611 (or your own address) wherever it is used in the command strings.

Part of:

E1440-90001

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Note



The HP E1440A must be allowed to warm up for at least 60 minutes before commencing any adjustments.

Equipment Required

The equipment required for the adjustment procedures is listed below. Any equipment which satisfies the critical specifications given in the table, may be substituted for recommended models.

Table 3-1. Recommended Test Equipment (Adjustments)

Instrument	Critical Specifications	Recommended	Alternative
Digitizing Oscilloscope	Vertical Bandwidth:1 GHz	HP 5412xT	HP 54503A
Electronic Counter	Frequency measurement Time Interval Average A to B Frequency Range: to 100 MHz Resolution: 11 digits	HP 5370B	HP 5335A
Digital Voltmeter	AC Function (True RMS) Ranges: 10 mV to 1000 V Bandwidth: 1 Hz to 1 MHz Resolution: 4 5 digits minimum DC Functions Ranges: 10 mV to 1000 V	HP 3458A	HP 3456A
Power Meter	Accuracy:±0.02 dBm		HP 436A
Power Sensor	Frequency Range: 100 kHz to 100 MHz Maximum Power:≥100 mW		HP 8482A
Spectrum Analyzer	Frequency Range: 20 Hz to 40.1 MHz Spurious Responses: 100 dB below reference	HP 3585B	
DC Source	DC 2 5 V ±0 001 V adjustable	HP 6632A	HP 3324A
VXI Mainframe (Development)	Must allow access to front and right hand side of the HP E1440A	HP E1400T	
Command Module		HP E1405A	
Controller		HP 9000 Series 200/300	
Attenuator 20 dB	Two required	HP 33340C	
Adapter	BNC female to dual Banana plug	HP 1251-2277	
Adapter	BNC Tee piece	HP 1250-0781	
Cable Assembly	SMA female to SMA female 30cm long	E1440-61616	

Note



All test equipment used must be allowed to warm up before carrying out any adjustment of the HP E1440A. Refer to the user manual for each item of equipment to find the minimum warm up time required.

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Programming Command Strings

The HP E1440A Users Manual (Part No. E1440-90011) contains details of the SCPI programming language used by the HP E1440A. All necessary command strings in BASIC, are included in the following adjustment procedures and they must be sent exactly as shown.

Example

```
OUTPUT␣Vxi;":FREQ␣1E6;:VOLT:AMPL␣5;:OUTP␣ON"
```



Where ␣ represents a significant space between characters.

Default setting

To avoid actual or stored values having an effect on test settings, it is good practice to set the instrument to a known state before each test. This known state is achieved by sending the following command string:

```
OUTPUT␣Vxi;"*RST;*CLS"
```

Equipment Set-up

VXIbus Development Mainframe HP E1400T

The primary function of this mainframe is to provide greater access for development engineers, it is a laboratory tool. This means that it is likely to have been used with non standard slot configuration settings etc. last time it was used and you must first check that the module will operate within it before commencing any adjustment procedures.

1. Install the HP E1440A in the extreme right hand position in the mainframe.
2. Switch ON the mainframe and check that the *FAILED* indicator on the HP E1440A extinguishes. This indicates that the instrument is communicating correctly with the command module via the backplane and that self test has been sucessfull.
3. If the *FAILED* indicator remains ON, switch OFF the mainframe, remove the instrument and check the backplane DIL switches and/or software as detailed in the VXIbus Mainframe User Manual, to ensure that the chosen slot is usable and not switched out of circuit.
4. If the mainframe set up is correct but the *FAILED* indicator stays on, then a fault in the HP E1440A has been detected. This fault must be investigated before continuing the test set-up and adjustment procedures.

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Test Set-up

The HP E1440A is connected to test control equipment as shown below, and as test set-up figures at appropriate places in the text.

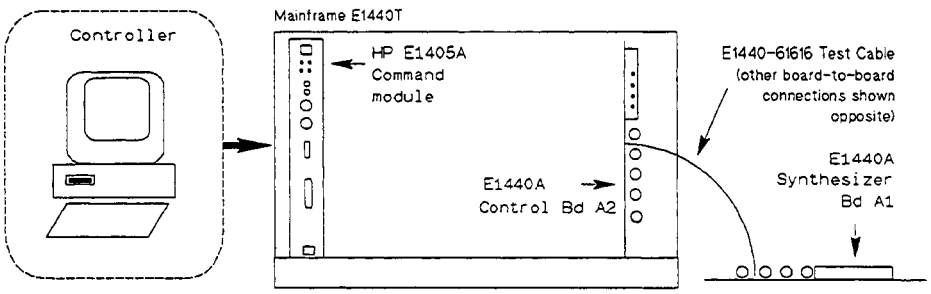


Figure 3-1. Basic Test Configuration

Test Preparation
HP E1440A

Prepare the HP E1440A for test as follows:



ATTENTION STATIC SENSITIVE DEVICES, Handle module only at 'Static Safe' work stations.

1. Ensure the mainframe power is switched OFF
2. Open the HP E1440A case. Instructions on how to gain access to the HP E1440A are given in Chapter 5 *Service*.

Note



As the HP E1440A is dismantled, you may find that capacitive washers have been broken due to over tightening during previous assembly. These washers - Part Number HP 0160-6777 - **must** be replaced when the instrument is re-assembled.

3. Separate the two halves of the module as instructed but only disconnect, the short black cable W701 linking the boards. All other board connectors are long enough to leave connected
4. Lay the right hand side of the module, circuit board upwards on an anti static pad beside the development mainframe.

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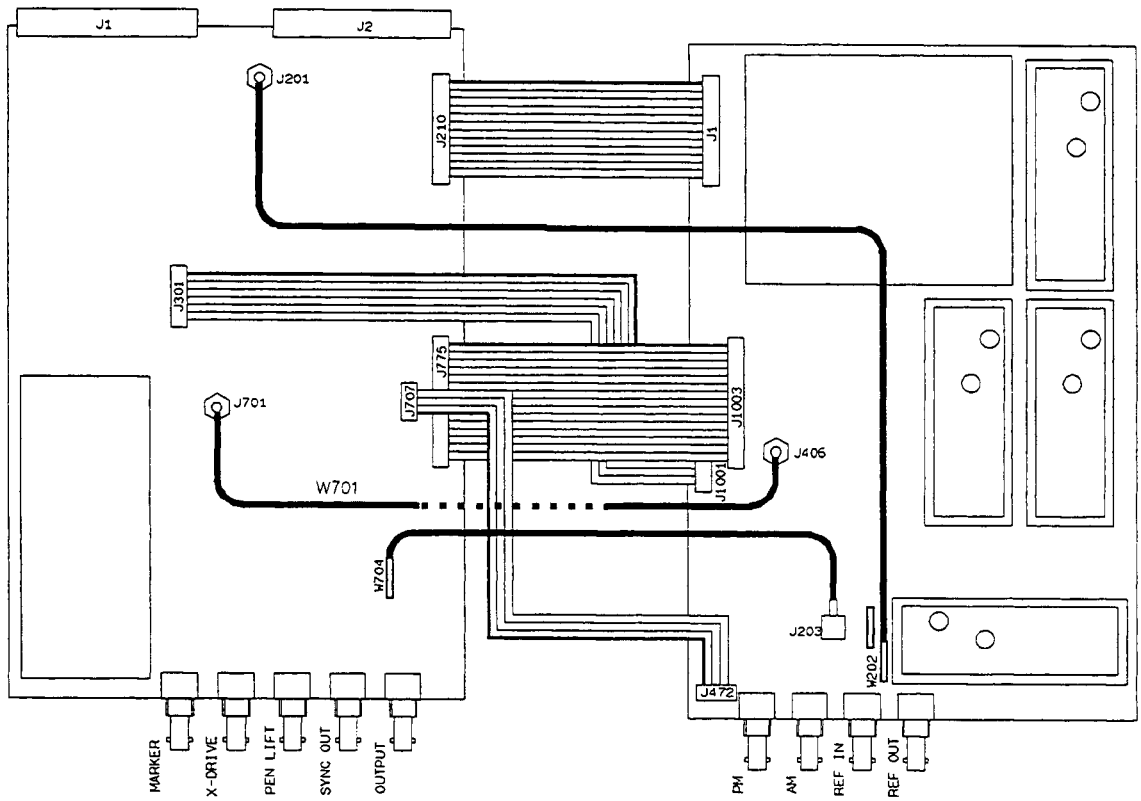


Figure 3-2. Cable Connections Between Boards

5. Remove the four fixing screws of the metal shield on the synthesizer board A1 and set the shield aside (access is required to components below this shield).
6. Carefully insert the left hand half of the module into the extreme right hand guide slot of the mainframe so that it connects into the back plane.
7. Use the test cable, Part Number E1440-61616 in place of the short black cable W701 to re-connect the module halves.
8. Switch ON the mainframe.
9. The "Failed" indicator should NOT be lit and you can now check communication with the HP E1440A by running the Self test described in Appendix C *Performance Tests - Functional Verification*.

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Adjustment Procedures

The adjustment procedures described below for the HP E1440A, are as follows:

- Power supplies
- Frequency
- VCO
- Amplitude level
- Gain
- Spurious measurements
- Mixer
- Harmonics
- Jitter
- X-drive
- Overshoot
- Amplitude Accuracy
- High voltage amplifier (Option 001)

Most adjustments given in this chapter refer to the synthesizer board A1 which is laid flat on the bench. To help you identify the component to be adjusted, the area where adjustments are to be made and where monitor points are located, is illustrated close to the instruction, within an outline of the appropriate board.

Power Supplies

1. Set DEFAULT state by issuing command string:

```
OUTPUT␣Vxi;"*RST;*CLS"
```

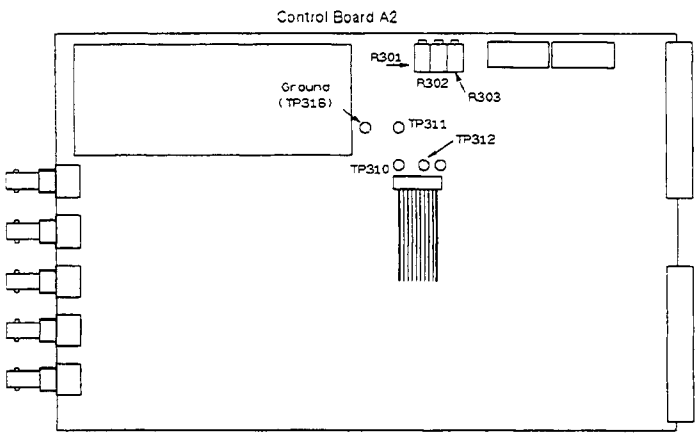


Figure 3-3. Power supplies adjustments

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+5V Power supply

2. Connect DVM to Test Point **TP310** and ground clip to **TP318**.
3. Refering to Figure 3-3, adjust **RV301** to obtain a reading of 5.02 V. Specification requirement is +5.02 ±0.01V.

+15V Power supply

4. Connect DVM to Test Point **TP311** and ground clip to **TP318**.
5. Refering to Figure 3-3, adjust **RV302** to obtain a reading of 15.00 V. Specification requirement is +15.0 ±0.02V.

−15V Power supply

6. Connect DVM to Test Point **TP312** and ground clip to **TP318**.
7. Refering to Figure 3-3, adjust **RV303** to obtain a reading of −15.00 V. Specification requirement is −15.00 ±0.02V.

Frequency

Frequency amplitude

Note



Frequency amplitude is set at factory. Check that there is a signal output and only adjust if there is no signal

1. Issue the following command strings:

```
OUTPUT␣Vxi;"*RST;*CLS"
OUTPUT␣Vxi;":FREQ␣1E6;:VOLT:AMPL␣5;:OUTP␣ON"
```


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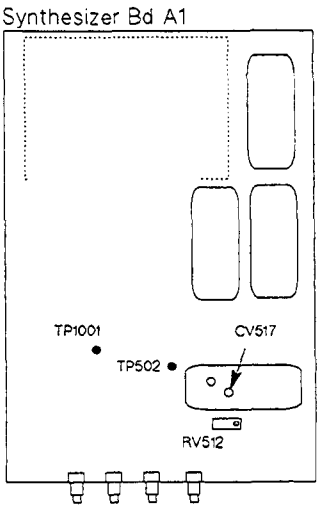


Figure 3-4. Frequency adjustments

2. Connect DVM to Test Point **TP502** and ground clip to **TP1001**.
3. A typical reading should be > 5.15 V.
4. If there is no reading, refer to Figure 3-4 and adjust **CV517** to achieve a maximum reading. The range of adjustment is approximately 120mV.

Frequency accuracy

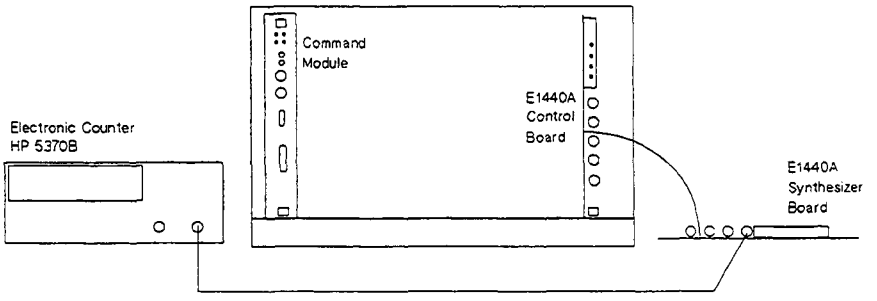


Figure 3-5. Test set-up for Frequency Accuracy

1. Connect the counter to Ref.OUT 10 MHz of the HP E1440A, as shown in Figure 3-5.
2. Set DEFAULT state by issuing command string:

```
OUTPUT␣Vxi;"*RST;*CLS"
```

3. Set the counter to AC Input.
4. Refering to Figure 3-4, adjust **RV512** to obtain a frequency reading of 10 MHz. Specification requirement is 10 MHz ±30 Hz.

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VCO Adjustment

1. Issue the following command strings:

```
OUTPUT␣Vxi;"*RST;*CLS"
OUTPUT␣Vxi;":FUNC␣TTL;:FREQ␣6E7"
```

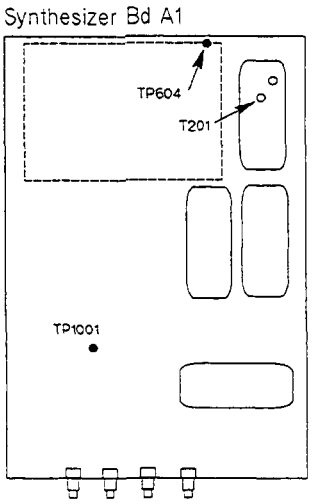


Figure 3-6. VCO adjustment

2. Connect DVM to Test Point **TP604** and ground clip to **TP1001**.
3. Refering to Figure 3-6, adjust **T201** to obtain −6.0 V. Specification requirement is −6.0 ±0.1V.

Note

The screwdriver used to adjust T201 will have a slight affect on the adjustment. Re-check the reading after screwdriver is removed.

Amplitude Level

The amplitude adjustment is done in three stages; negative and positive amplitude settings, followed by a mid-point (zero) check.

Negative setting

1. Issue the following command strings:

```
OUTPUT␣Vxi;"*RST;*CLS"
OUTPUT␣Vxi;"DIAG:DAC␣Ø,ØØØØØ"
```


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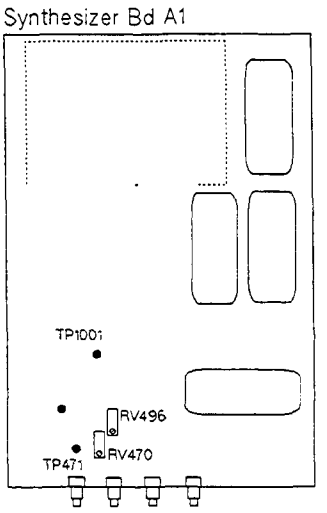


Figure 3-7. Amplitude adjustment

2. Connect DVM to **TP471** and ground clip to **TP1001**.
3. Refering to Figure 3-6, adjust **RV496** to obtain a reading of −10.04 V. Specification requirement is −10 ±0.002 V.
4. Leave DVM connected.

Positive setting

5. Issue the following command string:

   ```
   OUTPUT␣Vxi;"DIAG:DAC␣0,10000"
   ```

6. Refering to Figure 3-7, adjust **RV470** to obtain a reading of +10.04 V. Specification requirement is +10 ±0.002 V.
7. Leave DVM connected.

Amplitude check

8. Issue the following command string:

   ```
   OUTPUT␣Vxi;"DIAG:DAC␣0,05000"
   ```

9. Check that DVM reads zero ±0.005 V.
10. If the DVM does not read zero, repeat the positive and negative settings.

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Gain

There are three adjustments to make and they **must** be done in the order given. If any adjustment is made, all three adjustments must be repeated in order until no further adjustment is required. Issue the following command strings:

```
OUTPUT␣Vxi;"*RST;*CLS"
OUTPUT␣Vxi;":FUNC␣SIN;:FREQ␣1E3;:VOLT:AMPL␣10;:OUTP␣ON"
```

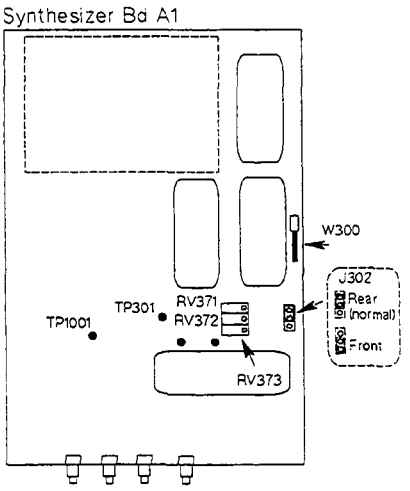


Figure 3-8. Gain adjustment

Gain adjustment 1

1. Move jumper **J302** to its front position as shown on Figure 3-8.
2. Issue the following command string:

   ```
   OUTPUT␣Vxi;":DIAG:DAC␣0,10000"
   ```

3. Connect DVM to **TP301** and ground clip to **TP1001**.
4. Refering to Figure 3-8, adjust **RV373** to obtain a reading of zero volts. Specification requirement is 00 ±0.005 V.

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Gain adjustment 2

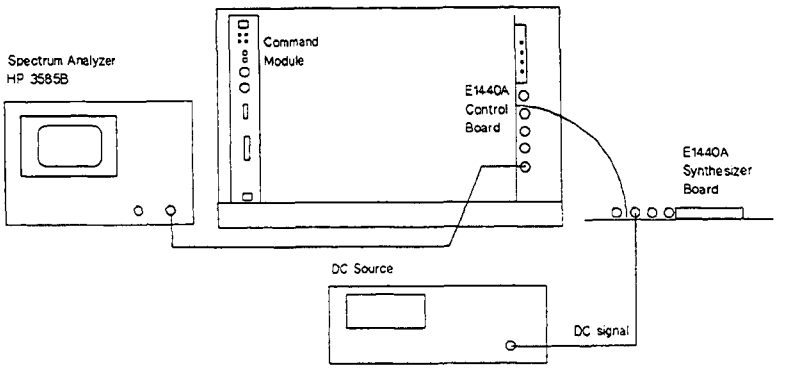


Figure 3-9. Test set-up for Gain

5. Issue the following command string:

   ```
   OUTPUT␣Vxi;":AM:STAT␣ON"
   ```

6. Move the jumper on **J302** to its rear position.
7. Connect the HP E1440A SIGNAL OUT connector to the spectrum analyzer as shown in Figure 3-9.
8. Adjust the spectrum analyzer to reference the fundamental to the top display graticule (Center frequency 1 kHz, Span 1 kHz).
9. Ensure that the spectrum analyzer (Ref Levl Track) key is OFF (unlit).
10. Apply 2.5 Vdc to the HP E1440A AM INPUT connector.
11. Check for 5 V at W300 point.
12. Confirm that the new fundamental displayed on the spectrum analyzer is 37 dB lower than the previous reference.
13. Refering to Figure 3-8, adjust **RV372** if necessary to obtain the correct result.

Gain adjustment 3

14. Issue the following command strings:

    ```
    OUTPUT␣Vxi;":AM:STAT␣OFF"
    OUTPUT␣Vxi;":FUNC␣SQU"
    ```

15. Connect the DVM to **TP301**, ground clip to **TP1001**.
16. Refering to Figure 3-8, adjust **RV371** to obtain a reading of 6.525 V. Specification requirement is 6.525 ±0.025 V.
17. Leave jumper **J302** in it's rear (normal) position.
18. Disconnect the test equipment.

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Spurious adjustments

There are five adjustments to make. The readings are made using a spectrum analyzer.

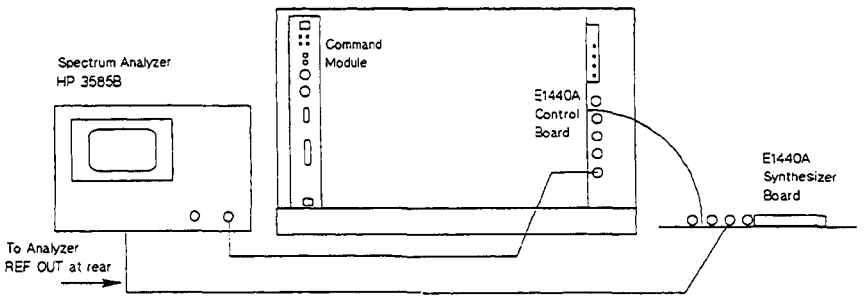


Figure 3-10. Test set-up for Spurious Measurements

Setting the reference

1. Issue the following command strings:

```
OUTPUT␣Vxi;"*RST;*CLS"
OUTPUT␣Vxi;":FREQ␣1E6;:VOLT:AMPL 10;:OUTP␣ON"
```

2. Connect the spectrum analyzer to the HP E1440A as shown in Figure 3-10.
3. Set up the spectrum analyzer as follows:

Sweep mode	Manual
Bandwidth	3 Hz Resolution
Center frequency	1 MHz
Span	10 kHz
Marker	Reference level

4. Press (Clear trace A) on the HP 3585B spectrum analyzer.
5. Measure the 1 MHz carrier amplitude on the spectrum analyzer with a 3Hz bandwidth as reference.

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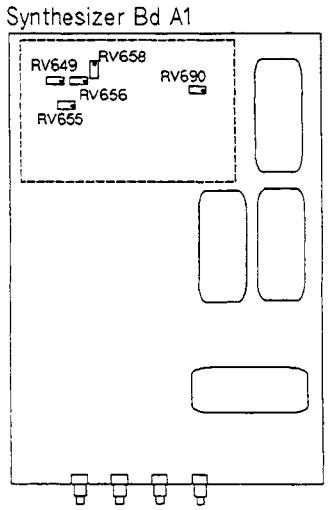


Figure 3-11. Spurious adjustments

Spurious 100 kHz

1. Issue the following command string:

   `OUTPUT␣Vxi;":FREQ␣1.1E6"`

2. Set spectrum analyzer center frequency to 0.9 MHz.
3. Measure the spurious trace at 0.900 000 MHz.
4. Refering to Figure 3-11, adjust **RV690** to obtain a minimum reading, typically a level of −85 dBc below the carrier. Specification limit is −70 dBc.

Spurious 10 kHz

1. Issue the following command string:

   `OUTPUT␣Vxi;":FREQ␣1.Ø1E6"`

2. Set the spectrum analyzer center frequency to 1 MHz.
3. Measure the spurious at 1.000 000 MHz.
4. Refering to Figure 3-11, adjust **RV658** to obtain a minimum reading, typically a level of −75 dBc below the carrier. Specification limit is −60 dBc.

Spurious 1 kHz

1. Issue the following command string:

   `OUTPUT␣Vxi;":FREQ␣1.ØØ1E6"`

2. Set the spectrum analyzer center frequency to 0.991 MHz.
3. Measure the spurious at 0.991 000 MHz.
4. Refering to Figure 3-11, adjust **RV656** to obtain a minimum reading, typically a level of −75 dBc below the carrier. Specification limit is −60 dBc.

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Spurious 100 Hz

1. Issue the following command string:

   ```
   OUTPUT␣Vxi;":FREQ␣1.0001E6"
   ```

2. Set the spectrum analyzer center frequency to 0.9901 MHz.
3. Measure the spurious at 0.990 100 MHz.
4. Refering to Figure 3-11, adjust **RV655** to obtain a minimum reading, typically a level of −80 dBc below the carrier. Specification limit is −60 dBc.

Spurious 10 Hz

1. Issue the following command string:

   ```
   OUTPUT␣Vxi;":FREQ␣1.00001E6"
   ```

2. Set the spectrum analyzer center frequency to 0.99001 MHz.
3. Measure the spurious at 0.990 010 MHz.
4. Refering to Figure 3-11, adjust **RV649** to obtain a minimum reading, typically a level of −90 dBc below the carrier. Specification limit is −70 dBc.

Mixer

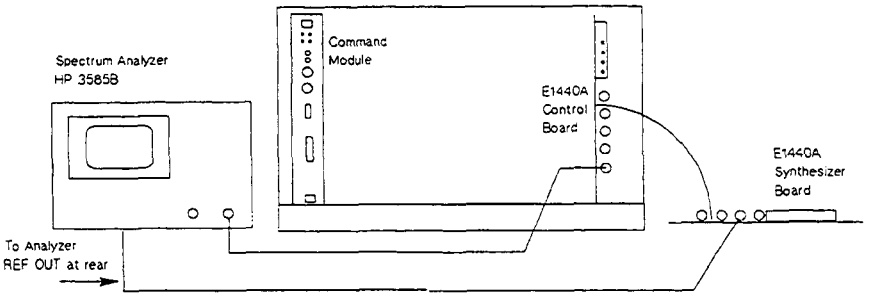


Figure 3-12. Test set-up for Mixer Adjustments

1. Issue the following command strings:

   ```
   OUTPUT␣Vxi;"*RST;*CLS"
   OUTPUT␣Vxi;":FREQ␣1.35E7;:VOLT:AMPL␣10;:OUTP␣ON"
   ```

2. Connect the spectrum analyzer to the HP E1440A as shown in Figure 3-12.
3. Measure the DUT carrier amplitude with the spectrum analyzer bandwidth of 10 Hz at 13.5 MHz.
4. Set up the spectrum analyzer as follows:

   Sweep mode Manual

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Bandwidth	10 Hz Resolution
Center frequency	13.5 MHz
Span	10 kHz
Marker	Reference level

5. Press (Clear trace A) on the HP 3585B spectrum analyzer.
6. Measure the mixer spurious trace with the spectrum analyzer set at 16.5 MHz.

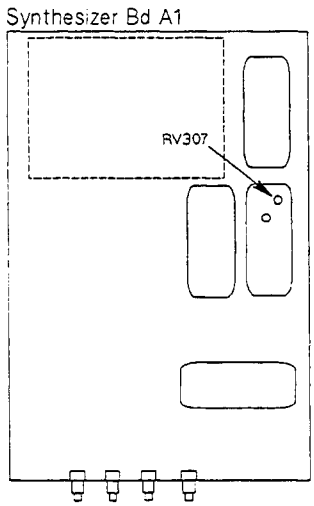


Figure 3-13. Mixer adjustment

7. Refering to Figure 3-13, adjust **RV307** to obtain a minimum reading, typically a level of −70 dBc to −80 dBc below the carrier. Specification limit is −70 dBc.

Note The adjustment on **RV307** is flat and may be clockwise or counter clockwise.

Harmonics

There are two adjustments to make and they are mutually dependent. This means you should loop back to the first adjustment and ensure that, if any further adjustment is necessary, the adjustments are repeated in order until no further adjustment is required.

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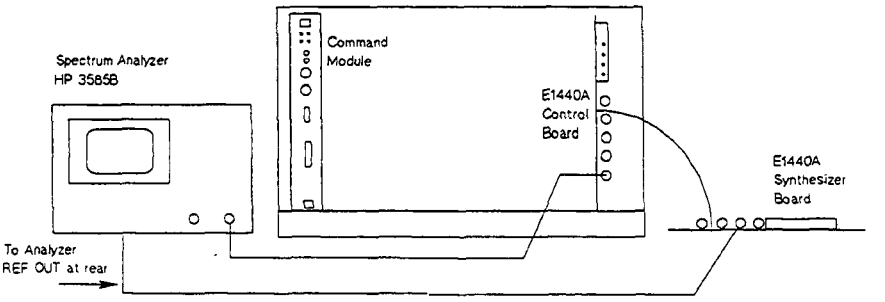


Figure 3-14. Test set-up for Harmonics Adjustments

Harmonics adjust

1. Issue the following command strings:

```
OUTPUT Vxi;"*RST;*CLS"
OUTPUT Vxi;":FREQ␣2E6;:VOLT:AMPL␣10;:OUTP␣ON"
```

2. Connect the spectrum analyzer to the HP E1440A as shown in Figure 3-14.
3. Measure the DUT carrier with the spectrum analyzer at 2 MHz.
4. Press the (Mkr → Ref Lvl) key on the spectrum analyzer.
5. Measure the Harmonics at 4 MHz.
6. Set the spectrum analyzer center frequency to 4 MHz.

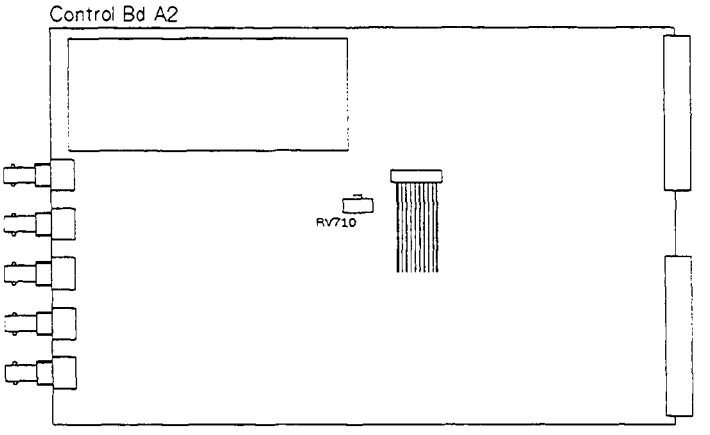


Figure 3-15. Harmonics adjustment

7. Refering to Figure 3-15, adjust **RV710** to obtain minimum harmonics level, typically a level of −55 dBc below the carrier. Specification limit is −42 dBc.

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Harmonics re-adjust

1. Issue the following command string:

   ```
   OUTPUT␣Vxi;":FREQ␣1.5E7;"
   ```

2. Measure the DUT carrier with the spectrum analyzer at 15 MHz.
3. Press the [Mkr → Ref Lvl] key on the spectrum analyzer.
4. Set the spectrum analyzer center frequency to 30 MHz.
5. Measure the Harmonics at 30 MHz.
6. Re-adjust **RV710** if necessary, to obtain a minimum reading, typically −37 dBc below the carrier. Specification limit is −30 dBc

Jitter

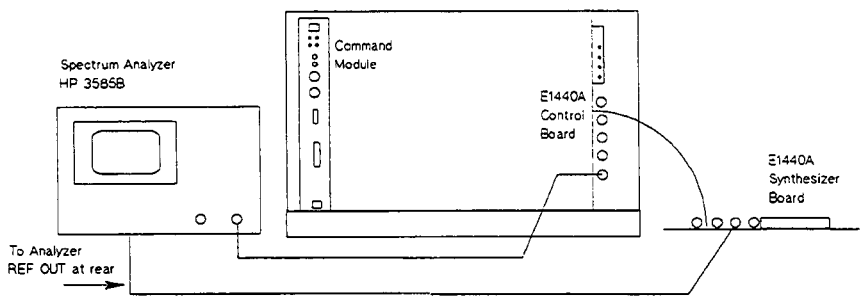


Figure 3-16. Test set-up for Jitter

1. Issue the following command strings:

   ```
   OUTPUT␣Vxi;"*RST;*CLS"
   OUTPUT␣Vxi;":FUNC␣RUP;:FREQ␣98;:VOLT:AMPL␣10;:OUTP␣ON"
   ```

2. Connect the spectrum analyzer to the HP E1440A as shown in Figure 3-16.
3. Set up the spectrum analyzer as follows:

Sweep mode	Manual
Bandwidth	3 Hz Resolution
Center frequency	98 Hz
Span	100 Hz
Marker	Reference level

4. Press [Clear trace A] on the HP 3585B spectrum analyzer.
5. Observing the spectrum analyzer, measure the fundamental wave at 98 Hz using the 3 Hz bandwidth.
6. Change the spectrum analyzer center frequency to 147 Hz.
7. Observing the spectrum analyzer, measure the wave at 147 Hz.

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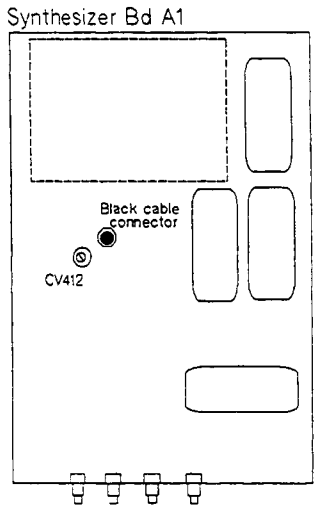


Figure 3-17. Jitter adjustment

8. Refering to Figure 3-17, adjust **CV412** for a minimum value, typically −62 dBc. Specification limit is −55 dBc.

X-drive

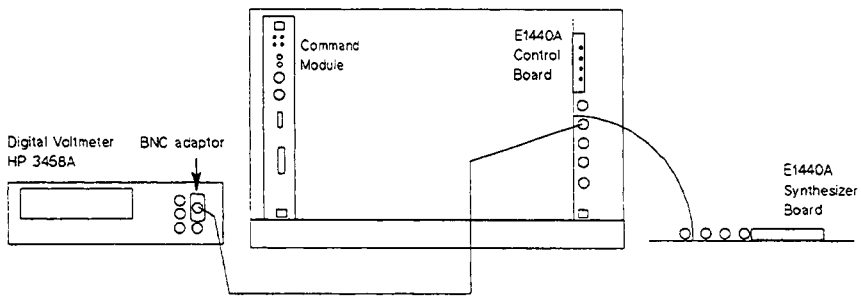


Figure 3-18. Test set-up for X-drive

1. Issue the following command strings:

```
OUTPUT␣Vxi;"*RST;*CLS"
OUTPUT␣Vxi;":FREQ:STAR␣1E6;STOP␣2E7"
OUTPUT␣Vxi;":SWE:TIME␣999E-3"
OUTPUT␣Vxi;":FREQ:MODE␣SWE"
OUTPUT␣Vxi;":INIT"
```

2. Connect the DVM to the HP E1440A as shown in Figure 3-18.
3. Measure the X-drive output.

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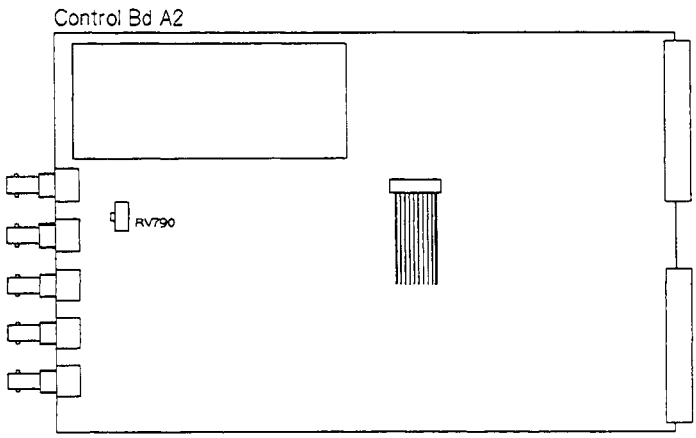


Figure 3-19. X-drive adjustment

4. Refering to Figure 3-19, adjust **RV 790** to provide an output of 10.8 ±0.1 V.

Note

Turning **RV 790** clockwise, increases output level and turning counter clockwise reduces output level.

Whilst adjusting there will be no response on the DVM. You will see the result of adjustment on the next sweep run.

5. If the specification is not met repeat as follows:
   a. Issue the following command string:

      ```
      OUTPUT␣Vxi;":INIT"
      ```

   b. Measure the X-drive output.
   c. Refering to Figure 3-19, adjust **RV 790** to provide an output of 10.8 ±0.1 V.

Overshoot

Before the overshoot and amplitude accuracy tests are carried out, the HP E1440A module must be re-assembled. There are two access holes in the right hand side cover to enable adjustments to be made.

Re-assembly

Re-assembly of a module is the reverse of dis-assembly, except that attention must be paid to careful alignment of parts so that when it is fully bolted together, the module is not distorted. Proceed as follows:

1. Switch OFF the mainframe.
2. Fit the square metal shield back onto the synthesizer board A1.
3. Withdraw the control board half of the module from the mainframe.
4. Disconnect the test cable and refit one end of the small black standard cable W701.

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5. Clip the two halves of the module together at the bottom.
6. Hinge the two halves towards each other until you can connect the free end of the short black co-axial cable W701.
7. Clip the tops of the module halves together.
8. Inspect the edge seams all around the module to check that the module halves are well aligned.
9. Fit and tighten the seven rear panel screws.
10. Place the spacer board over the BNC connectors.
11. Place the front panel taking care that the RFI strips are correctly seated.
12. Fit the two stud nuts and washers (plain washer first, then the lock washer and finally the nut), *but only tighten the nuts by hand (finger-tight) at this stage.*
13. Fit the washers and nuts to the two center (PEN LIFT and REF IN) BNC connectors and tighten *by hand*. Refer to Figure 3-20.

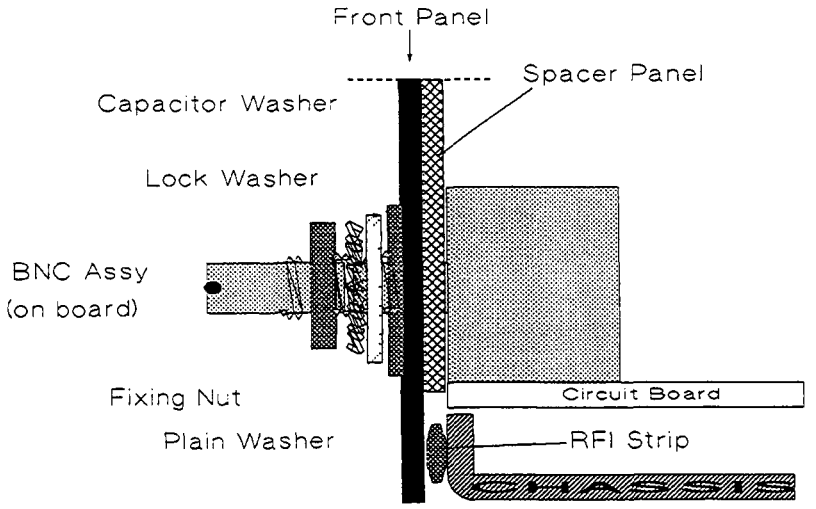


Figure 3-20. BNC Assembly Order

14. Align the front panel so that it's outside edges are flush with the module sides and the panel is square with the module chassis. This can be checked by running a straight edge such as a ruler over the side panels to check that it does not foul the edges of the front panel.

Caution The capacitive washers can be damaged by over tightening the nuts on the BNC connectors.

15. Tighten the two BNC nuts.
16. Tighten the two stud nuts.
17. Fit and tighten the BNC washers and nuts to the remaining BNC connectors.

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18. Check the front panel to module alignment again.

19. Fit the two latch handles - the HP logo at the top, and the VXI logo at the bottom.

Caution

If the front panel is not correctly aligned to the module, it can overlap with adjacent front panels in the mainframe and prevent the module from seating properly.

If necessary, loosen the BNC nuts and stud nuts to re-align the front panel, and then re-tighten.

20. Switch the Mainframe ON and allow 60 minutes warm up time before carrying out the Overshoot and Amplitude Accuracy adjustments.

Procedure

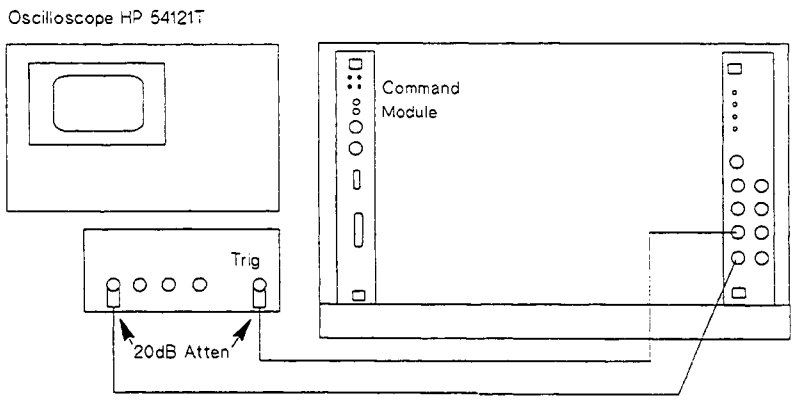


Figure 3-21. Test set-up for Overshoot

1. Connect oscilloscope to the HP E1440A SIGNAL O/P as shown in Figure 3-21.

2. Issue the following command strings:

```
OUTPUT␣Vxi;"*RST;*CLS"
OUTPUT␣Vxi;":FUNC␣SQU;:FREQ␣1.2E6;:VOLT:AMPL␣2.99;:OUTP␣ON"
```

3. Look on the oscilloscope for a smooth pulse response.

4. Adjust **CV702** (access hole identified on side cover) to reduce overshoot to minimum if necessary.

Note

This check is not an adjustment, but a preliminary setting for the amplitude accuracy adjustment which follows.

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Amplitude Accuracy Adjustment

There are two adjustments to make and they are mutually dependent. This means you should return to the first adjustment after a test sequence and ensure that, if any further adjustment is necessary, the adjustments are repeated in order until no further adjustment is required.

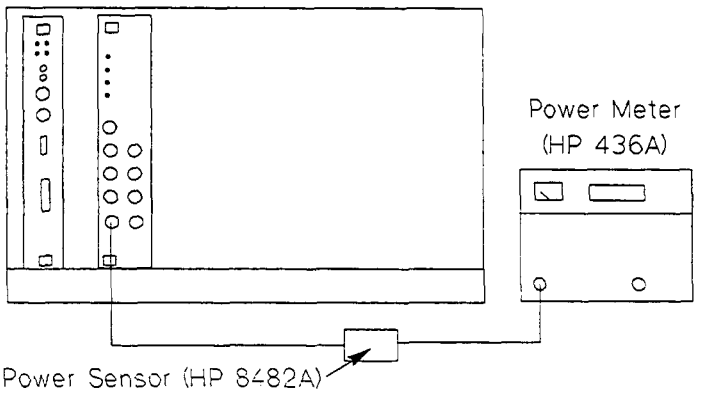


Figure 3-22. Test set-up for Amplitude Accuracy Adjustment

1. Calibrate the power meter for the sensor using the 50 MHz, 1.00 mW power-reference output on the meter.
2. Connect the output of the HP E1440A to the power meter via the power sensor, as shown in Figure 3-22.
3. Switch the power meter to read dBm.
4. Issue the following command strings:

```
OUTPUT␣Vxi; "*RST;*CLS"
OUTPUT␣Vxi; ":VOLT:AMPL 6.0 V"
OUTPUT␣Vxi; ":OUTP ON"
OUTPUT␣Vxi; ":FREQ 10 MHZ"
```

5. Check that the indicated power level is 19.54 dBm ±0.04 dB.
6. Adjust the level using the 10 MHz amplitude adjuster (R405) through the hole on the right side of the HP E1440A case, only if necessary.
7. Issue the following command string

```
OUTPUT␣Vxi; ":FREQ 20.5 MHZ"
```

8. Check that the indicated power level is 19.54 dBm ±0.04 dB.
9. Adjust the level using the 20 MHz amplitude adjuster (CV702) through the hole on the right side of the HP E1440A case, only if necessary.

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Note



Use care in adjusting **CV702**, otherwise you may affect the Overshoot Adjustment.

10. Check that overshoot is still acceptable. If it is not, repeat amplitude adjustments at 10 MHz and 20.5 MHz until no further adjustment is needed.

High Voltage Amplifier (Option 001)

There are no adjustments to make.

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