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Application Note Index 1989

Index of application information on Instruments, Systems, and Computers for Electronic Measurements, Including Solid State Components. Includes Application, Product, and Programming Notes.

Fifty Years of Looking to the Future

INTRODUCTION

This is an index to a collection of no-charge publications from Hewlett-Packard that can help you find solutions to measurement and design problems. These publications include application notes, application and technical briefs, application bulletins, product notes, and programming notes. Please use them to help you to get the most from your HP solid state components and electronic instruments and systems, or to help you choose HP products that best fill your needs.

Application notes help you use HP instruments, computers, and software to solve measurement problems. They are application-specific and typically include generic techniques with families of products. Product Notes are measurement techniques which are product-specific and often show extensions of performance outside normal lab environments, including performance data and explanations of specifications. Application Bulletins and Briefs cover the use of components products.

Programming notes cover various aspects of instrument control in a systems environment. There are two types of programming notes: introductory operating guides, and quick reference guides. An introductory operating guide shows novices how to program an instrument with a specific controller. A quick reference guide gives experienced users a short but complete description of an instrument's HP-IB operating characteristics.

How to find the information you need

The index is organized by industry, subject, and HP model number. At the back of this book are abstracts of all notes listed in the index, organized by application, product, and programming notes.

How to get the publication you want

All application publications listed in the index are available through your local HP Sales and Service Office or the Customer Information Center (800) 752-0900 (U.S. only). The locations and phone numbers of HP offices are listed on the back pages of this book. There is no charge for application publications but because they cover specific topics, they are supplied only on request.

To receive the publication you want as quickly as possible, please quote the ordering number included with each abstract.

How to obtain information about an application not covered in this index.

To obtain application information for HP products not listed in this index just call your nearest HP office, and ask for instrument, computer, or component sales, as appropriate. HP Sales Representatives are highly trained measurement specialists who have access to a worldwide information network that includes experts in a broad range of application areas.

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ABSTRACTS — APPLICATION NOTES

AB 1
Construction and Performance of High Efficiency Red, Yellow and Green LED Materials

The high luminous efficiency of Hewlett-Packard's High Efficiency Red, Yellow and Green lamps and displays is made possible by a new kind of light emitting material utilizing a GaP transparent substrate. This application bulletin discusses the construction and performance of this material as compared to the standard red GaAsP and red GaP materials.
Ordering Number: 5953-8378

AB 4
Detection and Indication of Segment Failures in Seven Segment LED Displays

The occurrence of a segment failure in certain applications of seven segment displays can have serious consequences if a resultant erroneous message is read by the viewer. This application bulletin discusses three techniques for detecting open segment lines and presenting this information to the viewer.
Ordering Number: 5952-8381

AB 5
Current Source for Diode Testing

Describes a constant current source designed primarily for ease of use in laboratory measurements. Easily programmable by thumb-wheel switches in 10μA steps from 10μA to 700 mA, its accuracy exceeds most commercially available current sources.
Ordering Number: 5952-9854

AB 6
PIN Diode RF Resistance Measurement

The use of the HP 4815 Vector Impedance Meter in conjunction with a tunable test fixture provides an efficient and reliable means for measuring the RF resistance of a PIN diode.
Ordering Number: 5952-8433

AB 9
Derivation, Definition and Application of Noise Measure

The associated gain at optimum noise figure bias becomes an important parameter at microwave frequencies. The noise measure of a device is a term including both noise figure and associated gain.
Ordering Number: 5952-9810

AB 13
Transistor Speed Up Using Schottky Diodes

Significant reduction in transistor switching delay time can be achieved by adding a Schottky diode and a PIN diode to the transistor switching circuit. This improvement in switching performance also extends the oscillator capability of the transistor to higher frequencies.
Ordering Number: 5954-2113

AB 14
Waveform Clipping with Schottky Diodes

Consideration is given in this application bulletin to the design requirements of clipping circuits which are used to limit the transmission of signals above or below specified levels. The characteristics of Schottky diodes needed to achieve the required performance in these circuits are discussed and recommendations made.
Ordering Number: 5952-9816

AB 15
Waveform Clamping with Schottky Diodes

Discussed in this application bulletin are the circuit design and diode performance requirements for a clamping circuit, which is used as a DC restorer or level shifter. Schottky diodes having the required characteristics for this type of circuit are recommended.
Ordering Number: 5952-9817

AB 16
Waveform Sampling with Schottky Diodes

Discusses the design considerations for a sampling circuit used to sample high frequency repetitive signals and reproduce them at lower frequencies for ease of monitoring. Schottky diode performance requirements important in the realization of a sampling circuit are considered.
Ordering Number: 5952-9818

AB 17
Noise Parameters and Noise Circles for the HXTR-6101, -6102,-6103, -6104, and – 6105 Low Noise Transistors

Noise figures as a function of source reflection coefficient ($r\Gamma_s$) can be expressed using three parameters – F_{min}, R_n, and Γ_o – known as noise parameters. These parameters are presented for five microwave transistors. The method of generating noise circles is given in a step-by-step fashion.
Ordering Number: 5952-9819

AB 18
The Performance of the HXTR-6101 at Submilliampere Bias Levels

Describes the performance of a low noise microwave transistor at bias conditions of $V_{CE} \pm 3V$ and $I_C \pm 1.0$ mA, 0.5 mA, 0.25 mA and frequencies 1.0, 1.5, 2.0 and 3.0 GHz.
Ordering Number: 5952-9820

AB 25
Characteristics of Zero Bias Detectors

The effects of temperature, frequency, and bias on the tangential sensitivity and voltage sensitivity of zero bias Schottky diodes is described.
Ordering Number: 5953-4414

AB 59
HP 16800A/16801A Bar Code Reader Configuration Guide for a DEC VT-100 or Lear Siegler ADM-31 to a DEC PDP-11 Computer

This application bulletin provides information to aid in configuring the HP 1680 0A/16801A bar code reader with a DEC-PDP-11 computer, and either a DEC-VT-100 terminal or a Lear Siegler ADM-31 terminal.
Ordering Number: 5953-9365

AB 60
Application Circuits For HCPL-3700 And HCPL-2601

Simple circuit illustrations are given for use of the HCPL- 3700 threshold detection optocoupler for ac or dc sensing requirements. Programmable threshold levels are given for the HCPL-3700. Also, a basic LSTTL to LSTTL isolation interface circuit for 10 MBd operation is given which uses the high common mode transient immunity HCPL-2601 optocoupler.
Ordering Number: 5953-9347

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ABSTRACTS — APPLICATION NOTES

AB 61
HP 16800A/16801A Bar Code Reader Configuration Guide for an IBM 3276/3278 Terminal

This application bulletin provides information to aid in configuring the HP 16800A/16801A bar code reader with an IBM 3276/3278 terminal to an IBM 3272/3274 Remote Communications Controller. In this configuration the IBM 3273/3274 is connected to an IBM mainframe computer.
Ordering Number: 5953-9361

AB 62
HP 16800A/16801A Bar Code Reader Configuration Guide for an IBM 4955F Series I Process Control CPU/ Protocol Converter and an IBM 3101 Terminal

This application bulletin provides information to aid in configuring the HP 16800A/16801A bar code reader in an eavesdrop configuration with an IBM 3101 terminal and an IBM Series 1 Process Control CPU/Protocol Converter. In this configuration the IBM Series is connected to an IBM mainframe computer.
Ordering Number: 5953-9362

AB 63
HP 16800A/16801A Bar Code Reader Configuration Guide for an IBM 5101 Personal Computer

This application bulletin provides information to aid in configuring the HP 16800A/16801A Bar Code Reader with an IBM 5101 Personal Computer.
Ordering Number: 5953-9363

AB 64
Mechanical and Optical Considerations for the 0.3" Microbright 7-Segment Display

The need to conserve space in electronic instruments has increased drastically in the drive to design more compact, more portable equipment. Hewlett-Packard has facilitated the saving of space in the design of front panels with the introduction of Hewlett-Packard's new HPSP-7300/-7400/-7500/-7800 series compact 0.3" seven segment displays. This application bulletin deals with several issues in the use of these displays. Optical filtering is covered, with recommendations on filters to use over the devices. Methods of adjusting the package height and recommended sockets are also presented, followed by a discussion on the brightness of the display.
Ordering Number: 5953-9366

AB 65
Using 50/125μm Optical Fiber with Hewlett-Packard Components

In some applications, 50/125 μm size optical fiber may be more advantageous to use than 100/140 μm size optical fiber. This bulletin describes advantages and applications of the 50/125 μm optical fiber.
Ordering Number: 5953-9370

AB 68
HP 16800A/16801A Bar Code Reader Configuration Guide for a MICOM Micro280 Message Concentrator

In some applications, multiple bar code readers may be required to input data to a logging terminal or a central processing unit. However, connecting each unit to a CPU may utilize more input/output ports than desired. A port concentrator will allow several devices to be connected using only one port to the CPU. This application bulletin provides information to aid in configuring the HP 16800A/ 16801A Bar Code Reader with a MICOM Micro280 Message Concentrator.
Ordering Number: 5953-9382

AB 69
CMOS Circuit Design Using Hewlett-Packard Optocouplers

This bulletin provides the CMOS designer with a set of useful interface circuits incorporating HP's optocouplers.
Ordering Number: 5953-9384

AB 71
200 μm PCS Fiber With Hewlett-Packard Fiber Optic Transmitters And Receivers

A description of the properties of 200 μm PCS fiber is given and the performance when used with Hewlett-Packard fiber optic components is described in the form of graphs and tables.
Ordering Number: 5954-1021

AB 73
Low-Cost Fiber Optic Transmitter And Receiver Interface Circuits

This bulletin provides assistance in designing circuits to interface Hewlett-Packard HFBR-0400 low-cost miniature fiber optic components with TTL I/O for applications at data rates up to 35 MBd. The TTL T_x/R_x circuits presented in this applications bulletin have been designed, built, and tested. They are suitable for a wide range of applications. The HFBR-0400 fiber optic components are compatible with either SMA or ST Style connectors. The concepts illustrated in this bulletin are applicable to both types.
Ordering Number: 5954-8415

AB 74
Option 002 Tape And Reel LED Lamps

Hewlett-Packard Option 002 tape and reel LED lamps have straight leads on standard 2.54 mm (0.100 inch) center spacing. These lamps may be auto-inserted into printed circuit boards with most radial auto-insertion equipment. However, it is important to have the proper plated through hole size and spacing in the printed circuit to assure high insertion yields. This application bulletin details the specific information on the printed board plated through hole size, spacing and tolerances necessary to assure high insertion yields of Option 002 LED lamps with 0.46 mm (0.018 inch) square leads.
Ordering Number: 5984-8402

AB 75
ESD Control In Portable Bar Code Readers

This application bulletin provides information to help the designer of portable bar code decoders to harden their system to ESD (Electrostatic discharge).
Ordering Number: 5954-2170

AB 76
Use Of LED Lamps And Displays In Night Vision Goggle Secure Lighting Applications

NVG secure lighting is concerned with the detectability of a light source on the ground by GEN II night vision goggles at some distance. The U.S. Army CECOM has issued a Secure Lighting Statement of Work, SOW which details the lighting modification guidelines that may be incorporated to make various light sources NVG secure. The objective of the Secure Lighting Program (paraphrased) is "to render all combat no-

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menclatural items designated for use at Corps level and below less detectable to threat image intensifier night observation as far as is practical." The application bulletin discusses the particulars of the U.S. Army NVG Secure Lighting SOW. High-performance green and yellow LED/NVG filter combinations that satisfy secure lighting requirements are discussed. Predicted performance values are presented in tabular format.
Ordering Number: 5954-8427

AB 77
Interfacing The Hewlett-Packard SmartWand

This application bulletin describes circuits that allow the user to interface the HP SmartWand to true RS232 connections.
Ordering Number: 5954-2176

AB 78
Low-Cost Fiber-Optic Links For Digital Applications Up To 150 MBd

The HFBR-2406 and HFBR-2416 are high-speed, low-cost, linear light-to-voltage converters with typical bandwidths of 125 MHz. All devices in the HFBR-0400 family are available with optical ports that are compatible with the industry stand SMA and ST fiber-optic connectors. The addition of the HFBR-24X6 products to the low-cost 0400 component family opens new avenues for designers. This Applications Bulletin will show you how these nine-piece plastic transmitters and receivers can be used to design fiber-optic links that meet tough cost and performance objectives for both analog and digital applications.
Ordering Number: 5954-8478

AN 52-4
Contribution Of HP Clocks To The BIH's International Atomic Time Scale

HP Cesium beam frequency standards are a major contributor to the international atomic time scale maintained by the BIH. Clock weighing and performance is evaluated with appropriate charts and graphs.
Ordering Number: 5952-7855

AN 57-1
Fundamentals of RF And Microwave Noise Figure Measurement

Comprehensive review of fundamentals of noise characteristics of two port networks. Defines the numerous terms used in noise figure measurements and surveys the methods used today.
Ordering Number: 5952-8255

AN 57-2
Noise Figure Measurement Accuracy

Considerable attention to measurement detail is still needed when characterizing RF/Microwave noise figure, in spite of advances on instruments, single-sideband down-converters, etc. This 32-page note examines contributors to error, EMI, double vs single-sideband, source impedance changes, DUT SWR, system noise figure, etc. It uses a series of nomographs to predict uncertainties based on various system parameters such as gain, SWR, and noise figure.
Ordering Number: 5952-3706

AN 62
TDR Fundamentals For Use With HP 54120T Digitizing Oscilloscope And TDR

Hewlett-Packards' popular Application Note 62 is back again. This new version is revised to reflect the advances in measurements that are possible with HP 54120T 20 GHz digitizing oscilloscope.
Ordering Number: 5954-2681

AN 62-1
Improving Time Domain Network Analysis Measurements

With the introduction of TDR in a digitizing oscilloscope, the microprocessor is now at the heart of the TDR measurement. This note presents the improved accuracy and resolution that the 5412OT digitizing oscilloscope brings to the TDR measurements.
Ordering Number: 5954-2682

AN 64-1
Fundamentals of RF and Microwave Power Measurement

Describes the general principles of power measurement including basic standards and traceability. Explores in detail the three most popular power sensors: thermocouples, thermistors, and diodes. Provides a comprehensive error analysis with particular emphasis on mismatch error. Compares advantages and disadvantages of the methods mentioned as related to various applications. Also treats pulse power measurement.
Ordering Number: 5952-8178

AN 64-2
Extended Applications of Automatic Power Meters

Describes a microwave mini-system for comparing calibration factor of power sensors against a sensor which has NBS traceability. Also discusses use of the system for accurate measurement of attenuation. Includes theory, error analysis, annotated program listings, and step-by-step procedures. Covers software routines for the HP 9825, 9830, and 1000 computers.
Ordering Number: 5952-8197

AN 64-4
Four Steps To Buying An RF/Microwave Power Meter

This note outlines major considerations for choosing an RF/MW power meter and sensors. It discusses an understanding of signal characteristics and how they affect accuracy, sources of measuring uncertainty, power sensor alternatives, and other applications concerns. For example, it is shown that multiple-tone signals or modulated carriers can cause as much as 10% uncertainty if measured with shaped diode sensors in the quasi-square-law range of -20 to +10 dBm.
Ordering Number: 5954-7363

AN 77-3
Measurement of Complex Impedance, 1 – 1000 MHz

Presents techniques for accurate determination of the magnitude and phase angle of impedance through use of the HP 8405A Vector Voltmeter. One of the techniques discussed involves use of precision wideband, high-directivity directional couplers to measure reflection coefficient. Another reflection method employs an accurate power splitter and precision terminations. Offers practical measurement examples and discusses accuracy considerations.
Ordering Number: 5952-0991

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ABSTRACTS — APPLICATION NOTES

AN 90B
DC Power Supply Handbook

The full benefits of modern regulated power supplies cannot be realized unless the user recognizes their versatility and high performance features and understands how to apply these capabilities. This handbook is designed to aid using power supplies by providing complete information on their operation, performance and connection. The handbook is divided into six main sections: Definitions, Principles of Operation, AC and Load Connections, Remote Programming, Output Voltage and Current Ratings, and Performance Measurements. The note is written for regulated power supply application problems.
Ordering Number: 5952-4020

AN 91
How Vector Measurements Expand Design Capabilities – 1 to 1,000 MHz

Many voltage, or amplitude, ratio measurements are in reality vector quantities. That is, they have both magnitude and phase angle associated with the measurements. These vector measurements can speed up engineering design efforts by providing useful phase information that is normally inconvenient to measure. This note describes just a few of the many ways to effectively use a vector voltmeter that operates over a 1 to 1,000 MHz frequency band.
Ordering Number: 5952-0917

AN 95-1
S-Parameter Techniques for Faster, More Accurate Network Design

Describes s-parameters, their measurement, and their use in circuit design. Also relates s-parameters to other familiar concepts, including h, y, and z parameters.
Ordering Number: 5952-1130

AN 123
Floating Measurements and Guarding

Guarded instruments will solve most common-mode problems if the guard terminal is connected properly. This application note explains the advantages of the guard in floating measurements and how to make the proper guard connections. It also tells what causes common-mode voltages and how guarding increases the accuracy of floating measurements.
Ordering Number: 5952-2153

AN 150
Spectrum Analyzer Basics

Describes the theory and operation of spectrum analyzers and their application. Includes information on the fundamentals, harmonic mixing, preselection, and tracking generators. Also included is a glossary of spectrum analyzer terms.
Ordering Number: 5954-9130

AN 154
S-Parameter Design

This note is the illustrated script for HP's four-part video tape presentation, "S-Parameter Design Seminar" a contemporary approach to the design of high-frequency solid-state circuits. After reviewing such concepts as s-parameters, the Smith Chart, signal flowgraphs, and stability considerations, the note discusses s-parameter characterization of microwave transistors and the application of constant gain and constant noise figure circles in the design of the high-frequency amplifiers.
Ordering Number: 5952-1087

AN 163-2
New Techniques of Digital Troubleshooting

Explains how to troubleshoot digital integrated circuits quickly and easily with inexpensive, handheld digital instruments. Emphasis is placed on troubleshooting "beyond the node" using current tracing techniques.
Ordering Number: 5952-7558

AN 164-4
Digital Phase Modulation (PSK) and Wideband FM

Discusses methods for generating biphase shift keyed (BPSK) and quadraphase shift keyed (QPSK) using the phase modulation capability of the 8660A/C Synthesized Signal Generator. This capability allows great versatility in varying modulation parameters which is ideal for investigating unique modulation formats. Also the ability to simulate high-rate FM using ϕM is discussed. Actual performance results are shown.
Ordering Number: 5952-8143

AN 170-1
HP 8640A/B Signal Generator Output Level Accuracy

Deals mainly with output level accuracy considerations in the HP 8640A/B signal generators (450 kHz to 550 MHz). It covers level accuracy specifications; shows how to operate these signal generators for best level accuracy; and compares the typical level accuracy of the 8640A/B and the 608 series signal generators. Step attenuators and waveguide-beyond-cutoff attenuators are discussed briefly. The effects of each type attenuator on level accuracy are presented.
Ordering Number: 5952-1218

AN 170-2
The 8640A/B Third Order Intermodulation Product Characteristics

Certain radio receiver test procedures require two or three signals applied at the input. When several signal generators are summed together for these tests, careful consideration must be given to the third order intermodulation products caused by the interconnection. This note shows typical third order IM characteristics of the 8640A/B, and recommends ways to reduce the levels of intermodulation products.
Ordering Number: 5952-8129

AN 171-1
Crystal Testing with the 8640A/B and 8405A

Describes a procedure to measure amplitude and phase characteristics of crystals using the HP 8640A/B Signal Generator (450 kHz to 550 MHz) and HP 8405A Vector Voltmeter. Primary emphasis is on measuring the crystal resonant frequency, which is defined as the frequency at which the crystal phase response goes through zero degrees. Series and par-

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allel resonances of a typical crystal filter are measured and identified, and a complete phase response is plotted.
Ordering Number: 5952-8117

AN 174-0
Index to the AN-174 Application Note Series

The 174 series of application notes describe HP Interface Bus systems using the HP 5345A electronic counter with the HP 9820, 9821 or HP 9830 calculator. Each note describes the measurement set-up, discusses important measurement considerations, and provides a complete listing of both the 9820/21 and 9830 programs.
Ordering Number: 5952-7348

AN 174-1
Measuring the Transfer Characteristic of a Voltage Controlled Oscillator

An HP 5345A counter, D-to-A converter, calculator, and plotter are used to automatically measure and plot the transfer characteristic (frequency out versus voltage in) of a VCO.
Ordering Number: 5952-0878

AN 174-2
Measuring Differential Nonlinearity of a Voltage Controlled Oscillator

The HP 5345A Counter is used in conjunction with a D-to-A converter, an HP 9820 Calculator, and a plotter to approximate the derivative of the VCO transfer characteristic and plot the modulation sensitivity of a VCO over a user specified range of input voltage.
Ordering Number: 5952-0879

AN 174-3
Measuring Integral Nonlinearity of a Voltage Controlled Oscillator

The Integral nonlinearity is defined in terms of the maximum departure of the actual VCO transfer characteristic from a first order least squares approximation of the data. An HP 5345A counter, calculator, and D-to-A converter are used to compute this parameter for a user's VCO.
Ordering Number: 5952-0880

AN 174-4
Measuring Dual VCO Tracking Error

In a fraction of the time required to perform the measurements and computations manually, the described set-up measures and plots the transfer characteristic of two VCOs and the corresponding percentage tracking error.
Ordering Number: 5952-0881

AN 174-5
Determining Probability Densities (Histograms) with the HP 5345A Electronic Counter

Automatically plots a histogram of any quantity (e.g., time interval, period, etc.) measurable with the HP 5345A Counter. The system has been successfully used to characterize frame-to-frame jitter in digital communications networks and time delay jitter through digital receivers as a function of S/N.
Ordering Number: 5952-7564

AN 174-7
Measuring Fractional Frequency Standard Deviation (Sigma) Versus Averaging Time (TAU)

Automatically characterizes the short-term stability of oscillators with a "sigma vs. tau" plot. Averaging time from 100 ns to 10 s may be selected by the user.
Ordering Number: 5952-7344

AN 174-8
Measuring FM Peak-to-Peak Deviation

The peak-to-peak deviation of FM signals with carriers in the range of 100 MHz to 500 MHz is automatically measured.
Ordering Number: 5952-0885

AN 174-9
Making Automatic Phase Measurements with the HP 5345A Electronic Counter

Phase angle between two signals is automatically measured with .01 degrees resolution for phase angles from 0 to 360 degrees.
Ordering Number: 5952-7325

AN 174-10
Measuring Electrical Length Delay of Cables

Measures delay through cables with resolution up to ps (05 cm). Useful for trimming two cables to the same electrical length.
Ordering Number: 5952-7326

AN 174-11
Measuring Warm-Up Characteristics and Aging Rates of Oscillators

Automatically plots the logarithm of $\Delta f/f$ vs. time with user-selected resolution.
Ordering Number: 5952-7327

AN 174-12
Measuring Frequency Sweep Linearity of Sweep Generators

Automatically plots the frequency vs. time characteristic of a sweep generator and also the differential nonlinearity curve.
Ordering Number: 5952-7328

AN 174-13
Measuring the Tuning Step Transient Response of VCOs to 18 GHz

Automatically plots VCO output frequency vs. time after application of a voltage step to the VCO. Time increments as small as 1 μs make the system useful to users and designers of VCOs used in frequency agile systems, ECM, and frequency control systems.
Ordering Number: 5952-7329

AN 174-14
Radar System Characterization And Testing using HP 5345A/55A/56A,B,C,D Counter

Describes Radar systems and operational test requirements of basic and modern radars. Emphasizes how signal characterization measurements with the HP 5345A/55A/56A,B,C,D can lead to improved radar performance. Actual test data from the AN/SPS10E, AN/SPS40A and AN/SPS65 (V)1 radar systems (average frequency, pulse width, pulse repetition period/frequency and frequency profiles) is presented. Measurement results of simulated pulsed IF signals encoded with phase modulation are described and presented.
Ordering Number: 5952-7892

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ABSTRACTS — APPLICATION NOTES

AN 181-1
Measuring Linearity of VCOs from 10 Hz to 23 GHz

The HP 5340A Frequency Counter is used in three different calculator-based HP Interface Bus (HP-IB) systems to measure and plot the transfer characteristics (frequency out vs. voltage in), the differential nonlinearity, and the integral nonlinearity of voltage-controlled oscillators in the frequency range of 10 Hz to 18 GHz (or 23 GHz when using an option).
Ordering Number: 5952-7321

AN 181-2
Voltage Controlled Oscillators Characterization Using The HP 5350B/5351B/5352B CW Microwave Frequency Counter

This application note describes how to use an HP 5350B, 5351B, or 5352B Microwave Frequency Counter in a completely automated computer-based test system for voltage controlled oscillator (VCOs). Two specific measurements are discussed and made-transfer characteristics and modulation sensitivity. To make system integration easy for you, a listing of the program is included in the note.
Ordering Number: 5952-7852

AN 183
High Frequency Swept Measurements

Describes "magnitude only" swept network measurements at microwave frequencies. The basic elements of a swept measurement system – oscillators, directional devices (couplers and bridges), detectors and displays – are discussed. Measurements of SWR, p (rho) and return loss using both reflectometers and swept slotted lines are presented in the section on impedance measurement. Measurements of gain and attenuation using directional couplers and power splitters are described in the section on transmission. Accuracy considerations are discussed extensively for measurements in coax and waveguide.
Ordering Number: 5952-9200

AN 187-6
Performance of the HP 8620C Sweep Oscillator Under Remote Programming

Documents the performance of the HP 86200-Series plug-ins in remote programming operation. Techniques for increasing precision, reducing errors, and source calibration are described to provide the system designer with enhanced measurement solutions through plug-in performance optimization.
Ordering Number: 5952-9271

AN 191-1
Automatic Zero Calibration of the HP 5359A Time Synthesizer at a Designated Remote Location

In this note the HP 5363A Time Interval Probes and the HP 5359A Time Synthesizer are used to precisely calibrate time at an external location. With this technique other instruments, for example high powered pulse generators, may be given increased timing resolution.
Ordering Number: 5952-7487

AN 191-2
Determining Digital Circuit Timing Tolerance to Optimize Adjustment or Design

For the circuit designer optimizing logic circuit design, this note describes how the HP 5359A Time Synthesizer may be used to establish timing operating margins. Optimum timing can readily be established for a single integrated circuit but may be obscure in a complex gating system. The precise, digitally positioned, jitter free, output pulse of the 5359A may be shifted in steps as small as 100 ps to determine circuit operating limits.
Ordering Number: 5952-7488

AN 191-3
Precision Time Interval Measurements in Radar Applications

The use of the HP 5370B Universal Time Interval Counter is discussed for making precise time interval measurements required to design, produce, and maintain radar equipment. The statistical functions of the 5370B allow pulse jitter to be conveniently characterized.
Ordering Number: 5952-7491

AN 191-4
Using the HP 5370B Universal Time Interval Counter to Characterize Pulse Width, Repetition Rate, and Jitter

The statistical capability of the HP 5370B is used to provide mean, maximum, minimum, and standard deviation of the time intervals measured.
Ordering Number: 5952-7505

AN 191-5
Measurement of Propagation Delays Using the HP 5370B Time Interval Counter and HP 5363B Time Interval Probes

Propagation delays of integrated circuits are measured using the HP 5370B Time Interval Counter and HP 5363B Time Interval Probes. The measurement system can not only measure propagation delays of integrated circuits, but also of any other digital device. Both manual measurement procedures and an HP-IB automatic technique using a desktop computer are discussed.
Ordering Number: 5952-7563

AN 191-6
Precise Cable Length and Matching Measurements Using the HP 5370B Universal Time Interval Counter and HP 5363B Time Interval Probes

Describes two techniques to make absolute cable length measurements to within 0.01% accuracy. Relative measurements for cable matching can be made with millimeter resolution. The measurement technique employs the injection of a pulse into a transmission line. A time interval measurement is then made between incident and reflected pulse which can easily be converted to a precise length by using a prescribed mathematical relationship.
Ordering Number: 5952-7568

AN 191-7
High-Speed Timing Acquisition And Statistical Jitter Analysis Using The HP 5370B Universal Time Interval Counter

This document describes how to use the HP 5370B Universal Time Interval Counter along with the HP 5370B High-Speed Histogram Software to characterize timing jitter in a Pulse Code Modulated System. The software, which runs in BASIC on an HP 9000 Series 200/300 controller, can fill a timing histogram at a rate of up to 4200 measurements/second. Analysis includes standard deviation, mean, peak-to-peak jitter, chi-square test for Normality, Probability Distribution, and

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more. All of the analysis features can be performed on the entire data sample or on selected portions. The software is available for free upon return of the enclosed business reply card.
Ordering Number: 5952-7908

AN 200-1
Fundamentals of Microwave Frequency Counters

Discusses the four principal down-conversion techniques for extending the frequency range of counters into the microwave region: prescaling, heterodyne (with emphasis on the HP 5342A). Compares the major performance specifications between the techniques to allow the users to choose a counter appropriate for their applications.
Ordering Number: 5952-7484

AN 200-2
Fundamentals of Quartz Oscillators

Describes the quartz crystal fundamentals, such as structure, crystal cuts, and vibration modes. It includes environmental influences on the crystal and causes of oscillator frequency changes. Typical performance of various oscillator compensation techniques are also discussed.
Ordering Number: 5952-7507

AN 200-3
Time Interval Measurement Using an Electronic Counter

Time interval measurement is discussed from the theoretical side to point up factors that have a great influence on measurement accuracy as well as from the practical side by way of examples, showing application of an electronic counter to specific measurements including pulse width and spacing on a complex pulse train and phase measurement. The HP 5363A Time Interval Probes box, which eliminates the major uncertainties in time interval measurements with an electronic counter, is discussed in detail. Other ways of making time interval measurements are also discussed.
Ordering Number: 5952-7561

AN 200-4
Understanding Frequency Counter Specifications

Describes frequency counter measurement errors and how these errors are specified. Defines least significant digit displayed, resolution, and accuracy.
Ordering Number: 5952-7522

AN 200
The Fundamentals of Electronic Frequency Counters

A 44-page introduction to the methods and techniques of frequency and time measurement. The characteristics of the fundamental frequency counter are discussed in detail, along with a chapter devoted to the special properties of the period measuring frequency counter. The time interval meter and the techniques for precise timing measurements are considered. The basic methods by which microwave frequency measurements are performed and the advantages of each method are also discussed.
Ordering Number: 5952-7506

AN 205-2
Sonar Transducer Calibration Measurement and Computation with the HP 3042A Automatic Network Analyzer System

This application note describes how Sonar Transducers are calibrated by the U.S. Navy using HP's Model 3042A Automatic Network Analyzer. One of the greatest benefits realized by the Navy was the ability to perform impedance and transmitting response measurements of underwater transducers at high power levels. The operation of the entire system is under direct control of an HP 9825A Desktop Computer. The computer's ability to configure and calibrate the test set has shortened data recording time and reduced operator errors. Describes HP's system in detail, giving a clear example of how HP instrumentation combined with HP computer technology has revolutionized this measurement process.
Ordering Number: 5952-8813

AN 218-2
Obtaining Millihertz Resolution from the 8671A and 8672A

Some microwave applications of microwave synthesizers require finer resolution steps than the 1, 2, and 3 kHz available in the HP 8671/2 models. By combining the 8672 with an HP 3330B or HP 3335A synthesizer, programmable resolutions down to 1 or 3 millihertz can be obtained. Software subroutines are furnished.
Ordering Number: 5952-8184

AN 218-5
Obtaining Leveled Pulse-Modulated Microwave Signals from the HP 8672A

Describes how an external pulse modulator can be used with a 2-18 GHz synthesized signal generator to achieve fast rise/fall time pulsed RF with 80 dB on/off ratio and constant peak power.
Ordering Number: 5952-8251

AN 222-0
An Index to Signature Analysis Publications

Lists all other application notes currently available in the AN 222 series about signature analysis. They cover a wide range of interests from how to design or retrofit signature analysis into digital systems to the cost reductions that can be expected in production test and field service by doing so. It also lists all data sheets for the complete line of Hewlett-Packard signature analysis products, plus other related publications about digital troubleshooting.
Ordering Number: 5952-7625

AN 222-2
Application Articles on Signature Analysis

This is a collection of eight technical articles on signature analysis. It is intended to assist in the design or retrofit of digital products for SA troubleshooting. The annotated table of contents guides the reader to articles on background, SA technique, design case histories, design guidelines, retrofit, and cost savings.
Ordering Number: 5952-7542

AN 222-3
A Manager's Guide to Signature Analysis

Shows how to calculate the cost reductions that can be expected in production test and field service by implementing signature analysis. It suggests simplified rules of thumb for estimating the costs, savings, and feasibility of SA. Concludes with ROI calculations for a sample product.
Ordering Number: 5952-7592

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ABSTRACTS — APPLICATION NOTES

AN 222-4
Guidelines for Signature Analysis: Understanding the Signature Measurement

Shows how Hewlett-Packard signature analyzers take signature measurements. Contains guidelines for controlling the gate through the start, stop, and clock inputs. It shows how measurements of three-state nodes are treated, and more. This information applies to both design and retrofit situations.
Ordering Number: 5952-7595

AN 222-6
Troubleshooting with Composite Signatures

Explains how composite signature and the backtracing algorithm can be used to implement a structured troubleshooting procedure without a computer-aided system, resulting in time savings for the logic troubleshooter.
Ordering Number: 5952-7684

AN 222-12
A Signature Analysis Based Test System for ECL Logic

Describes how signature analysis testing was implemented in various circuit assemblies of the HP Series 64 Computer, using the HP 5005B Signature Multimeter. Discusses the HP 5005B implementation, the method of generating vectors, how backtracing to component level faults was accomplished, and the resulting test reports.
Ordering Number: 5952-7667

AN 229-6
RS-232C/CCITT V.24 Interfacing and Handshaking Guide

The procedure required to interface a peripheral device to a computer is a multistep process. This application note thoroughly explains the underlying concepts as well as the instructions used in this process and supplements the material contained in the operating and programming manuals for HP's EIA RS-232-C/CCITT V.24 plotters. This note emphasizes how to determine and set up communication and handshake protocol. It should prove useful to new owners of HP plotters as well as more experienced users.
Ordering Number: 5953-9770

AN 229-11
Protocol Converters: Linking HP Graphics Peripherals with IBM Networks/Systems

This application note provides information about how graphics peripherals — particularly the HP 7550A graphics plotter — fit into IBM systems. It discusses the function of protocol converters, two different types of protocol converters and considerations for choosing a converter.
Ordering Number: 5953-9874

AN 229-14
Connecting a DEC VAX to an HP Plotter or Film Recorder

This note explains how to connect an HP plotter or film recorder to a DEC VAX computer. It outlines configurations and cabling for the HP Colorpro, 7220, 7221, 7470, 7475, 7550, 7580, 7585, 7586, and Draftpro plotters, and the HP 7510 color film recorder. At the end of this note are two appendices which contain connection diagrams and show pin-outs for each cable mentioned in the text.
Ordering Number: 5954-7133

AN 231-3
Making Telecommunication Measurements in Complex Impedances

A digital switch "subscriber's line card" must have an impedance which matches that of the subscriber's line – otherwise poor transhybrid loss and poor frequency response can result. Telecommunications measurements on these circuits are only meaningful if carried out under matched conditions, with the correct interpretation of results. This application note answers many of the questions commonly asked about measurements in complex impedances and suggests a practical measurement solution using the HP 3779C/D Primary Multiplex Analyzer (PMA).
Ordering Number: 5953-5484

AN 238
Semiconductor Measurements with the HP 4140B Picoammeter/DC Voltage Source

This application note describes how to easily make very low current measurements (down to 10^{-15}A) and quasi-static capacitance-voltage measurements of semiconductor devices/patterns on wafers with the HP 4140B pA Meter/DC Voltage Source. Contents include MOS device characterization, such as I-V measurements of MOS FETs and gated diodes of test wafers, and quasi-static C-V measurement of MOS structures and photo diode characterization.
Ordering Number: 5952-8840

AN 238-1
Ultra Low Current Semiconductor DC Parameter Measurement System Using HP 4140B

This application note describes two applications for the Model 4140B pA Meter/DC Voltage Source configured into an automatic measurement system. The first application describes the measurement of the $h_{FE} - I_c$ characteristics of a bipolar transistor; the second is of a field effect transistor's (FET) transconductance, gm. In both applications, measurement is made down to the 10^{-15} range. This application note will satisfy process engineers and process design engineers who have long wanted an inexpensive, easy-to-use, automatic measuring system capable of quick and accurate characterization of semiconductor devices.
Ordering Number: 5952-8873

AN 243
The Fundamentals of Signal Analysis

A primer for those who are unfamiliar with the advantages of analysis in the frequency and model domains and with the class of analyzers we call Dynamic Signal Analyzers. Major sections of this 60-page publication include: Time, frequency and modal domains: a matter of perspective; Understanding Dynamic Signal Analysis; and Using Dynamic Signal Analyzers. The note avoids the use of rigorous mathematics in discussions to allow a broader understanding of the material. The note includes 120 figures and photographs.
Ordering Number: 5952-8898

AN 243-1
Effective Machinery Maintenance Using Vibration Analysis

Vibration analysis is a proven technique for increasing the availability and reducing maintenance expense of rotating machinery. Dynamic Signal Analyzers use digital signal processing techniques to provide insight into machinery vibration – removing much of the guesswork from analysis. This note

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provides information on the four key steps in analysis: 1) converting vibration to an electrical signal with transducers, 2) using the frequency domain to reduce the signal to simple components, 3) identifying the defect causing abnormal components, and 4) implementing necessary repairs and documenting results. 60 pages, 103 illustrations.
Ordering Number: 5953-5113

AN 243-2
Control System Development using Dynamic Signal Analyzers

This note is intended for engineers who make measurements on feedback control loops. After reading this note, the reader should understand how a dynamic signal analyzer can be used to make quality measurements that describe the performance parameters of a feedback loop circuit. The note has two parts. The first part provides a quick review of control theory for linear systems. This section is optional and is intended as general reference information. The second part describes how to use a dynamic signal analyzer to make measurements on a feedback loop circuit. It also discusses analysis techniques that can be applied to the measurement results so that the engineer can determine special parameters that describe the performance of the feedback loop circuit.
Ordering Number: 5953-5136

AN 243-3
The Fundamentals of Modal Testing

This application note provides a development of measurement theory and practical information on measurement techniques used to perform modal analysis. Modal analysis is an experimental process used to determine the dynamic behavior of a mechanical structure. Typically, Fourier analyzers are used to measure vibration signals from special transducers mounted on the mechanical structure. This note will help the reader improve the quality of measurements made with the analyzer.
Ordering Number: 5954-7957

AN 243-4
PC Control of the HP 35660A and 3562A Spectrum Analyzers via HP-IB

This Ap Note describes control of the HP 35660A and 3562A Spectrum Analyzers via HP-IB, using BASIC or C programming languages and IBM compatible computers. Includes program examples
Ordering Number: 5952-0002

AN 245-1
Signal Averaging with the HP 3582A Spectrum Analyzer

The purpose of this application note is to develop an understanding, by theory and example, of two kinds of signal averaging used by the HP 3582A: power spectrum averaging and time averaging. These types of averaging are commonly used in digital signal analysis. The HP 3582A and other HP Fourier analyzers use digital signal analysis as opposed to swept analyzer techniques.
Ordering Number: 5952-8767

AN 245-2
Measuring the Coherence Function with the HP 3582A Spectrum Analyzer

Provides a theoretical and practical introduction to the coherence function. The specific topics covered include the use of the coherence function as an indicator of the statistical quality of a transfer function measurement, the use of the coherence function as an indicator of quality, the theoretical details of the coherence function and its calculation. Examples of the uses of the coherence function are included to help clarify the theory involved.
Ordering Number: 5952-8768

AN 245-3
Third Octave Analysis with the HP 3582A Spectrum Analyzer

Provides a means for making 1/3 octave measurements with an HP 3582A controller by an HP 9835A desktop computer. Discusses traditional 1/3 octave analysis techniques and how to adapt an FFT analyzer for the job. Compliance of results with ANSI standard is described. A program listing and flow diagrams are included. Also, an appendix lists the same program written in HP 9825A computer language.
Ordering Number: 5952-8800

AN 245-4
Accessing the HP 3582A Memory with HP-IB

The internal memory structure of the HP 3582A Spectrum Analyzer is clearly spelled out, along with descriptions of the various kinds of data to be found there. Equipped with this information and an HP-IB compatible computer, a user may speed up data transfers, obtain normally inaccessible data or modify some routines. The note is 16 pages, with 12 figures, including example program listings.
Ordering Number: 5952-8804

AN 245-5
Log Sweep with the HP 3582A Spectrum Analyzer

This note provides a means of modifying the HP 3582A Spectrum Analyzer operation so that it produces a 256-point log display covering the range of 10 Hz to 25 kHz. The key to this modification is the use of an external controller whose communication path with the 3582A is the HP interface bus (HP-IB). The required program is given in both BASIC and HPL languages. The 12-page note includes several figures, as well as two program listings.
Ordering Number: 5952-8805

AN 246
Using the HP 3585A Spectrum Analyzer with the HP 9825A Computing Controller

A brief description of the HP-IB programmability of the HP 3585A is followed by examples of subroutines with flowcharts and listings. These subroutines are useful for automated spectral analysis on the bench or in production to reduce measurement time and provide new capability such as CRT limit tests and logarithmic sweeps.
Ordering Number: 5952-8765

AN 246-1
Optimizing the Dynamic Range of the HP 3585A Spectrum Analyzer

This application note describes dynamic range in general and illustrates how to optimize the dynamic range of the HP 3585A Spectrum Analyzer for different measurement conditions. Topics discussed include reducing analyzer noise and distortion, and the effects on swept frequency response measurements. The 8-page note includes 11 figures and photographs.
Ordering Number: 5952-8815

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ABSTRACTS — APPLICATION NOTES

AN 246-2
Measuring Phase Noise with the HP 3585A Spectrum Analyzer

Detecting and measuring phase noise is the subject of this application note. The 16-page note includes discussions of: understanding phase noise, effects of phase noise on real systems, relating phase noise to frequency stability, and practical methods of measuring phase noise. The note includes a BASIC program listing for use with HP desktop computers and the HP 3585A.
Ordering Number: 5952-8838

AN 250-2
Battery Charging/Discharging

General information on battery charging/discharging with three examples: Constant Current Charging, Taper Charging and Constant Current Discharging.
Ordering Number: 5952-4033

AN 283-2
External Frequency Doubling of the 8662A Synthesized Signal Generator

Explains the effects of a passive external frequency doubler on the output level, modulation, spectral purity, and sweep of the HP 8662A Synthesized Signal Generator. Includes a brief tutorial on doubler operation, typical performance of the HP 11721A frequency doubler, and software for an HP 9825A controlled HP-IB system for convenient control of a frequency doubled 8662A.
Ordering Number: 5952-8217

AN 283-3
Low Phase Noise Applications of the HP 8662A and 8663A Synthesized Signal Generators

Describes the use of the 8662A and 8663A Synthesized Signal Generators in applications requiring extremely low SSB phase noise. Includes a brief tutorial on the nature and specification of phase noise and phase noise considerations in transceiver test. Typical 8662A/8663A phase noise performance is discussed and methods are described for using the 8662A/8663A to measure phase noise of RF and microwave sources. Both manual measurements, and automated measurements using the HP 3048A Phase Noise Measurement System are discussed. The fast frequency switching mode of the HP 8662A/8663A is also described.
Ordering Number: 5953-8435

AN 286-1
Applications and Operation of the 8901A Modulation Analyzer

Describes general operation of the HP 8901A Modulation Analyzer. Includes information and procedures needed for applications such as signal generator calibration, broadcast monitoring, mobile radio transmitter testing, measuring VCO differential nonlinearity, and accurately measuring peak modulation transients. Discusses the theory and operation of the optional modulation calibrator. Describes rem HP-IB operation and includes detailed software examples and application subroutines with annotated listings for various computing controllers.
Ordering Number: 5952-8208

AN 286-2
Accurate Mixer/Amplifier Compression Measurement Using the 8901A Modulation Analyzer

This application note focuses on measuring mixer and amplifier compression and describes a novel measurement technique using the HP 8901A modulation analyzer. Other presently available techniques for measuring compression have been cumbersome at best, mainly because of inaccuracies in determining the compression point in a mixer or an amplifier. The 8901A Modulation Analyzer allows measurement of the compression point conveniently and with great precision, thereby virtually eliminating guess work and making it possible to use the linear dynamic range to its maximum.
Ordering Number: 5952-8245

AN 287-2
Frequency Profile Using an HP 5345A Time Synthesizer

Frequency Profile is the time variation of frequency within a signal. This application note describes the use of an HP 5345A Electronic Counter, an HP 5359A Time Synthesizer together with an HP 9825A Calculator to obtain the frequency profile of an unknown signal. Two measurement techniques are used; the time approach, in which an external gate pulse moves inside an input signal stream to obtain its frequency profile and the events approach in which the External Gate can capture any one particular event.
Ordering Number: 5952-7530

AN 287-3
Frequency Profile Using an HP 5370A Universal Time Interval Counter and an HP 5359A Time Synthesizer

Frequency Profile is the time variation of frequency within a signal. This application note describes the use of an HP 5370A/B Universal Time Interval Counter, an HP 5359A Time Synthesizer together with an HP 9825A Desktop Computer to obtain the frequency profile of an unknown signal. Two measurement techniques are used: the time approach in which an external gate pulse moves inside an input signal stream to obtain its frequency profile and the events approach in which the external gate can capture any one particular event.
Ordering Number: 5952-7549

AN 290
Practical Temperature Measurements

This application note describes the fundamentals of thermocouple, RTD, thermistor and integrated circuit temperature sensors. It covers practical precautions to be observed both in physical installation and in electrical measurement.
Ordering Number: 5952-8801

AN 290-1
Practical Strain Gauge Measurements

Considers various aspects of strain measurements using bonded resistance strain gauges including those that affect accuracy and methods to improve it.
Ordering Number: 5952-8880

AN 290-2
Using the HP 3497A to Control Industrial Wastewater Treatment

This application note gives a detailed description of the operation of a purification plant to treat industrial wastewater. An HP 3497A and HP-85 are used to monitor and control the facility. A description is given of the system hardware and

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control software. PID theory and implementation are explained.
Ordering Number: 5953-6921

AN 291-1
User's Guide to the 5355/56 Automatic Frequency Converter

Operation and application of the HP 5355A Automatic Frequency Converter Plug-in to the HP 5345A Counter and HP 5356A/B Frequency Converter Heads. Measurement of radar parameters such as average frequency in the burst, PRF, and pulse width is explained.
Ordering Number: 5952-7541

AN 297-2
Automated Reverse Recovery Time Measurements of Diodes

The technique described in this application note makes automated measurements of reverse recovery time possible. It uses the HP 8161A Programmable Pulse Generator, the HP 5370A Universal Counter and the HP 5363B Time Interval Probe. This automated solution saves the time of skilled operators and eliminates human errors.
Ordering Number: 5952-9542

AN 298-4
HP 64000 Logic Development System Microassemblers for Bit-Slice Processors

Creating microcode for hardware control in bit-slice processors is simplified by using the HP 64851A User Definable Assembler to implement microassemblers and linkers for the target processor. A detailed example of a microassembler and linker design illustrates this useful implementation of the user-definable assembler.
Ordering Number: 5953-2746

AN 302-1
Direct Radio Frequency Impedance Measurements Using the 4191A RF Impedance Analyzer

Describes HP 4191A RF Impedance Analyzer applications in the 1 MHz to 1000 MHz frequency range. Applications include MOS semiconductor measurements, cable characterization, crystal testing, varactor diode characterization and measuring input/output impedance of entire circuits. Special calibration techniques for improving impedance measurement accuracy are described.
Ordering Number: 5952-8853

AN 302-2
Impedance Characterization of High Q Devices from 1 MHz to 1000 MHz with 1 Hz Resolution

This application note describes how high Q devices, such as crystals, having Q values up to 10^6 can be stably characterized using an HP-IB system consisting of the HP 4191A RF Impedance Analyzer, the HP 8660C Synthesized Signal Generator, and the HP 9845B Desktop Computer. Software for the system is included in the application note so that measurements can be made immediately. This application note provides a description of the system and instructions on how to make certain 4191A hardware modifications.
Ordering Number: 5952-8872

AN 312-1
Configuration of a Two-tone Sweeping Generator

Describes methods for configuring a source that will generate both a "local oscillator" signal and a "receiver" signal that are offset by a desired intermediate frequency (IF). The system described uses the HP 8350A Sweep Oscillators in either a simple tracking configuration or in a phase-locked configuration for a more stable IF. Many swept measurements on mixers, receiver front ends, and other translators may be made with this source, which can operate over a 10 MHz to 26.5 GHz frequency range. (A phase-locked configuration is also described for the HP 8620C Sweep Oscillators for 2 to 18.6 GHz coverage).
Ordering Number: 5952-9316

AN 313-1
Troubleshooting Microprocessor-based Systems Using the HP 5180A Waveform Recording (Using the HP 9825 Controller)

Describes how the HP 5180A can team up with a logic analyzer to capture elusive signals in microprocessor-based systems.
Ordering Number: 5952-7634

AN 313-2
Using the HP 5180A Waveform Recorder with a Spectrum Analyzer for New Time-Domain Measurement Capability

Describes numerous measurement possibilities produced by combining an HP 5180A with a spectrum analyzer used as a fixed tuned receiver (zero span mode). For example, by digitizing the video output, pulse to pulse amplitude variations in MTI radar may be studied. Software listings for pattern recognition studies and amplitude probability distributions (APD) are included.
Ordering Number: 5952-7635

AN 313-3
Using the HP 5180A Waveform Recorder to Measure Microwave VCO Settling Time and Post Tuning Drift

Shows how to measure, on a single-shot basis, microwave VCO settling time and post tuning drift over time spans from 50 nanoseconds to over 10 seconds.
Ordering Number: 5952-7636

AN 313-4
Extending the Frequency Range and Increasing the Effective Sample Rate of the HP 5180A Waveform Recorder

Describes an automated system for repetitive inputs to 100 MHz. Based on equivalent time sampling, the system uses a programmable delay generator to provide effective sampling at rates as high as 20 GHz. Annotated HP 9826 software listings are provided.
Ordering Number: 5952-7637

AN 313-5
Power Supply Testing with the HP 5180A Waveform Recorder

Shows how to use the HP 5180A to make difficult single-shot measurements in power supply testing such as step load recovery, turn-on/turn-off, and ripple/noise measurements.
Ordering Number: 5952-7647

AN 313-6
Recording Sonar and Other Signals Using the HP 5180A's Toggle Mode

Describes how to use the HP 5180A's toggle timebase mode

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to measure signals, such as sonar bursts, which are separated by relatively long dead times.
Ordering Number: 5952-7641

AN 313-7
Interconnecting Two or More HP 5180A Waveform Recorders to Obtain Multiple Input Channels

Describes techniques for obtaining simultaneous sampling with multiple HP 5180A Waveform Recorders.
Ordering Number: 5952-7670

AN 313-8
Using the Direct Memory Access Capability of the HP 5180A Waveform Recorder with the HP 9826 Desktop Computer

Gives detailed instructions on using the DMA I/O port on the HP 5180A Waveform Recorder. Example subroutines and a demonstration program with the HP 9826A Desktop Computer are given.
Ordering Number: 5952-7710

AN 313-9
Using the 5180A Waveform Recorder to Evaluate Floppy Disc Media and Drive Electronics

Techniques for measuring computer disc media and drives are described. Measurements on media include defect mapping, amplitude variation measurements, and frequency domain overwrite measurements. Drive measurements include time margin and timing analysis on various parts of the read recovery chain.
Ordering Number: 5952-7701

AN 313-10
Radar System Characterization And Testing

"Radar System Characterization and Testing Using the HP 5185A/T" describes how to use the HP 5185A Waveform Recorder or HP 5185T Digitizing Oscilloscope to capture and analyze single-shot or repetitive radar system signals. Topics include: Automatic, objective analysis of individual radar pulses using IEEE Standard 181-1977 based firmware resident in the HP 5185T. Simultaneous dual-channel capture of radar IF signals. Frequency and phase profiling. Threshold crossing estimation techniques are demonstrated which result in single-shot timing resolution better than 100 picoseconds. Single-shot spectrum analysis of radar signals at IF. Single-shot I & Q measurements. A special sampling mode is described that can provide orders of magnitude more consecutive radar bursts in a single measurement than could be obtained with conventional sampling.
Ordering Number: 5952-7905

AN 313-11
Using Digital Filtering Techniques To Improve Analog-To-Digital Converter Measurements

This document discusses the benefits and practical considerations of using a digital filtering technique known as SINC interpolation to improve the timing resolution of a digitized signal. This effectively improves hardware performance, time domain measurements, and analysis results. Items discussed include proper digitizing techniques, how to use SINC interpolation, digital filter accuracy as it pertains to digitizer accuracy, reconstruction of AM and FM signals, and a complete description of the HP BASIC software available free of charge from Hewlett-Packard.
Ordering Number: 5952-7945

AN 314-1
Receiver Testing with the HP 8770S Arbitrary Waveform Synthesizer System

RF and microwave receiver testing requires signal simulation at the RF frequency, intermediate frequency, and video or baseband. The fully-arbitrary (dc to 50 MHz) waveforms from the HP 8770A/S Arbitrary Waveform Synthesizer can now create "real-life" test signals which can include not only the ideal signal but also add noise, distortions, jitter, and other signals which stress the circuits and check for marginal performance. Application programs are reviewed and example programs presented.
Ordering Number: 5954-6358

AN 314-2
Synthesizing Magnetic Disc Read and Servo Signals with the HP 8770S Arbitrary Waveform Synthesizer System

Comprehensive testing of magnetic disc read and servo signals requires not only the ideal digital signals, but should include jitter, noise, missing bit and extra bit, and other interfering distortions to press the circuitry to the edge of its performance limits. The HP 8770A/S Arbitrary Waveform Synthesizer with its dc to 50 MHz complex waveforms can do all of that and more. This application note presents the technical background and shows how the required waveforms can be created.
Ordering Number: 5954-6357

AN 314-4
Exceptionally-Complex Signal Simulation For Multi-Signal Environments In Radar/EW Test

This prospectus describes an instrument setup of commercial equipment which provides very complex signals and modulations such as radar chirps, antenna scans, multi-path fades, staggered pulse trains, multiple lobing and much more from 10 to 3000 MHz. It features complete control over the carrier signal phase plane with dc to 50 MHz bandwidth for both in-phase and quadrature.
Ordering Number: 5952-3702

AN 314
Variable Persistence Aids Signal Display

Provides a look at variable persistence theory and measurement applications. Also, it puts the variable persistence technique into perspective with other storage methods.
Ordering Number: 5953-3898

AN 314-5
A Guide to Microwave Upconversion

Most microwave systems use frequency translation as an inherent part of their architecture. This note starts with considerations of basic mixer theory, spurious and intermodulation products and their relation to LO drive levels. Band selection and filtering are directed toward minimizing crossing spurious. Selection of mixer components and LO requirements are also examined, and recommendations of typical filter model numbers are given.
Ordering Number: 5953-2342

AN 316-0
Introduction to Computer Aided Test

The terminology and most fundamental concepts encountered in the world of computer-aided testing are introduced. The material is directed to individuals who have had experi-

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ence with manual test processes, but who have little or no experience with computers. This document should provide the novice with enough information to make an intelligent decision on whether or not to proceed in earnest into the world of computer-aided test.
Ordering Number: 5952-4102

AN 316-4
Power Supply Programming with the HP 6942A Multiprogrammer

The output voltage and current of most power supplies are controlled via the front panel. Programmable supplies can be controlled by the front panels or by an analog signal from a remote programming system. The system generally consists of a computer with a digital-to-analog interface, so the digital output of the computer can control the analog input of the supply. Hewlett-Packard makes a variety of computers and interface systems which can control programmable supplies. This note describes how to design, build, and program an automated testing system using the HP 6012A and 6024A Programmable Power Supplies and the HP 6942A Multiprogrammer system.
Ordering Number: 5952-4075

AN 316-5
Data Capture with the HP 6942A/6944A Multiprogrammers

The A/D is the central piece to any waveform digitizer. This application note shows how to get the most out of the advanced capabilities of the HP 69759A 500 kHz A/D in the HP 6942A and HP 6944A Multiprogrammers. It documents the three modes of operation for buffered A/Ds. These are burst acquisition event-triggered acquisition, and continuous data acquisition to disc. Also described are the techniques for monitoring more than one analog input. These are parallel buffered A/Ds, the scanning buffered A/D, and multiplexed A/Ds.
Ordering Number: 5952-4116

AN 317
Practical Design and Evaluation of High Frequency Circuits Using the HP 4193A Vector Impedance Meter

Mainly explains in-circuit impedance measurements in the frequency range of 400 kHz to 110 MHz. How to obtain useful information on RF circuit design is discussed, showing practical applications which include (1) input/output impedance measurements, (2) crystal oscillator design and evaluation, (3) printed circuit pattern impedance measurements, as well as (4) RF component measurements. Several measuring techniques convenient for in-circuit measurements are also provided. A sample program is given in the appendix to assist understanding of how HP-IB programming is done.
Ordering Number: 5953-6910

AN 318-1
The Benefits of P/AR

Describes what the peak-to-average ratio (P/AR) is and how effectively it can be used to simplify voice band data (modem) circuit qualification and troubleshooting.
Ordering Number: 5952-4996D

AN 319
Parametric Characterization of Digital Circuits up to 50 MHz

Describes parametric characterization of digital circuits up to 50 MHz with the HP 8180A/8182A stimulus/response system. Also describes the representative parameters and tests in various applications and gives a detailed example of an ac-parametric test of a complex IC.
Ordering Number: 5952-9549

AN 322
Analysis of Semiconductor Capacitance Characteristics Using the HP 4280A 1 MHz C Meter/C-V Plotter

Describes methods of semiconductor material evaluations by using the HP 4280A. Chiefly, methods of physical parameter measurements by performing C-V (Capacitance-Bias Voltage) or C-t (C-time) characteristics measurements are described.
Ordering Number: 5953-6939

AN 323
Detection of High Level Signals in FDM Networks

Quality of service is of major importance to telecommunications network operators and customers. Unfortunately, as the density and sophistication of traffic increases, so do customer expectations. As a result, it is increasingly difficult to maintain networks at quality levels which are perceived as acceptable by their users. One important contributor to transmission degradation and loss of quality is the presence of high-level signals in Frequency Division Multiplexed (FDM) traffic. This application note considers the origins, effect on traffic and methods of detection of these signals.
Ordering Number: 5953-5411

AN 324-1
Understanding Your Bed-of-Nails Test Fixtures

A tutorial on bed-of-nails test fixture for board test systems. Specific topics include: probe and socket selection and operation, vacuum requirements and vacuum pump selection, wiring the test fixture, drilling the fixture plates, fixture plate materials, and test fixture verification.
Ordering Number: 5953-6951

AN 325-2
Machine Tool Calibration

Discusses the significance of positioning accuracy and geometry measurements on CNC machining centers and presents "before and after" examples of problems uncovered through using the HP 5528A Laser Measurement System and its many dimensional measurement capabilities.
Ordering Number: 5952-7708

AN 325-10
Sub-Micron Positioning With The HP 5527A Laser Position Transducer System

This application note discusses using the HP 10936A servo-axis board in an HP 5527A Laser Position Transducer System to control position with sub-micron accuracies. Both hardware and software examples illustrate how to easily implement this type of closed-loop servo positioning system.
Ordering Number: 5952-7942

AN 325-11
Disk Drive Servo-Track Writing with Laser Interferometers

Describes the benefits and techniques of incorporating laser interferometers into disk drive servo-track writers. Integration of a laser interferometer system into a servo-track writer is

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discussed with emphasis on the optical layout and servo electronics.
Ordering Number: 5952-7984

AN 326
Principles of Microwave Connector Care (for Higher Reliability and Better Measurements)

The significance of coaxial connectors in determining the accuracy and repeatability of microwave measurements cannot be overstated. This note describes recommended practices for making connections, maintaining and cleaning connectors, and verifying their suitability. Connector types addressed are precision 3.5mm, 2.4mm and 7mm as well as Type-N. A summary chart showing "DOs" and "DO NOTs" of microwave connector care is included.
Ordering Number: 5954-1566

AN 327-1
Extended Dynamic Range of Scalar Transmission Measurements Using the HP 8757A, 8756A or 8755C Scalar Network Analyzers

Describes two configurations of conventional scalar network measurement equipment that achieve up to 100 dB of dynamic range. One configuration exploits the high output power of a microwave source, while the other capitalizes on the gain and output power of a microwave amplifier. Both configurations use the external crystal leveling power control of the microwave source to combine the calibrated dynamic range of the reference detector (R) with that of the transmission detector (B) in a ratioed measurement (B/R). Theory of operation, useful limits and measurement accuracy are also discussed.
Ordering Number: 5953-8882

AN 328-1
Practical Test System Signal Switching

A brief examination of system configurations, switch topologies, and noise reduction in system switching. Aimed at the system designer who needs to understand the concepts of system switching, shielding, and grounding.
Ordering Number: 5953-6962

AN 329
Spectral Purity Characteristics Of HP Microwave Signal Sources

Compares the major specifications of the various types of microwave sources offered by Hewlett Packard (e.g., sweepers, signal sources, synthesizers). Emphasis is placed on a discussion of the spectral purity of each source (in particular, phase noise), since spectral purity is often a critical yet subtle specification.
Ordering Number: 5954-8349

AN 332
Microwave Switching from SPDT to Full Access Matrix

This application note reviews RF & Microwave coaxial switching configurations (dc – 26.5 GHz), from the simplest SPDT through signal transfer, to full-access matrix switches. Operating characteristics such as insertion loss, SWR, and signal isolation are considered. Finally, several novel self-test configurations are proposed for automatically testing signal path condition through the matrix.
Ordering Number: 5953-6466

AN 332-1
Novel Combinations Of Microwave Switches And Step Attenuators For Programming Applications

Describes nine custom modifications of the HP coaxial step-attenuator family for operation from dc to 26.5 GHz. Included are multiport switches from SP3T on either end. Other combinations include various attenuator pads such as a 70 dB stepper with SPDT or a 20 dB step with transfer switch plus SPDT. The custom modules feature 5-million cycle life.
Ordering Number: 5954-8892

AN 334
Automation of Semiconductor Parameter Analysis

Describes a method of automatic parameter characterization of semiconductor devices such as MOS FETs, Bipolar transistors, MOS diodes and Schottky diodes. Measurements and analysis are easily done by application programs and easy-to-use programming tools. This application note also explains how to make low current measurements on wafer stage devices and how to make DLTS measurements.
Ordering Number: 5952-7765

AN 335
Return Loss and the HP 4937A

This application note discusses the return loss measurement: the cause of poor return loss, what the measurement is about and the technique the HP 4937A uses to make the measurement.
Ordering Number: 5952-5033

AN 336
An Introduction to Signaling

This application note discusses the basics of signaling with emphasis on supervisory signaling. The types of supervisory signaling includes: loop start, ground start, loop reverse battery wink response and E/M type I, II. This application note is intended for readers with no previous knowledge in signaling.
Ordering Number: 5952-5034

AN 339
Parametric Analysis for Electronic Components and Circuit Evaluation Using the HP 4194A

This application note describes a method of determining the various parameters of materials, electronic components, and circuits by impedance and gain-phase measurement. The parameter is equivalent circuit constants of electronic components, such as inductors, capacitors, resonators, and bandwidth of bandpass filters, and so on. This application note also explains how to make the filter's Go/No Go testing in production lines.
Ordering Number: 5950-2856

AN 339-3
Crosstalk And Impedance Measurements Of PC Board Pattern

Describes how to use the HP 4194A to measure impedance parameters crosstalk and the dielectric constant of PC Boards. This will be useful to PC board and circuit designers, PC board end users and material suppliers.
Ordering Number: 5952-7863

AN 339-6
Static Head Testing for Disk Drives

This application note describes how to use the HP 4194A to perform static disc drive magnetic head testing. This will be

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useful to Magnetic Head manufacturers (lab, QA, production) and disc drive manufacturers (lab, QA).
Ordering Number: 5952-7871

AN 339-11
Filter Test For Production And Incoming Inspection

This application note covers filter test applications using the HP 4194A Impedance/Gain-Phase Analyzer. It shows how to use the analyzer's auto-sequence programming capability to quickly perform GO/NO-GO filter testing. In addition, this document describes how to derive key filter parameters using the 4194's analysis functions.
Ordering Number: 5952-7887

AN 339-20
Role Of DC Parametric Test In High Speed Digital And Microwave Component Manufacturing

This note describes the purpose and benefits fulfilled by DC parametric test instruments and system (HP4145B, HP4062B/C, HP4280A, HP4142B, etc.) in microwave and high speed digital semiconductor component manufacturing. This article is useful for engineers wishing to obtain a fundamental understanding of how this equipment contributes to the success of the semiconductor component manufacturer.
Ordering Number: 5952-7936

AN 340-1
Using the HP 5183T To Characterize Sonar Transducers And Systems

A major contribution of the HP 5183T in this application is that it allows testing with short tone-burst signals (less than 1msec). This is important when the test environment is a small tank. By digitizing transducer test signals and using built-in processing functions such as RMS and FFT, the HP 5183T makes the measurements of hydrophone sensitivity, projector response, complex impedance, and directivity pattern. The large memory-up to 512K samples-of the HP 5183T greatly increases throughput by capturing data as parameters are varied.
Ordering Number: 5952-7805

AN 340-1
Reducing Fixture-induced Test Failures

Most users of Surface Mount Technology (SMT) adjust their PC board layout processes to provide access for test, but many forget that standard fixture technology may not have the accuracy required for probing these smaller targets. This application note examines the tolerances of fixturing and the effect of these tolerances on probing accuracy.
Ordering Number: 5954-8672

AN 341-1
Testing a Complex LSI/VLSI IC with a Low-Cost Measurement Set-up

This application note gives an example of how to test an 8 bit Microprocessing unit (MPU) using the HP 8175A Digital Signal Generator and the HP 1630G Logic Analyzer. There are three different tests described: Test of normal operation, test of interrupt timing and the measurement of write data hold time. The device under test is the HP 6809E MPU.
Ordering Number: 5952-9572

AN 341-2
Simulating Sensor Signals

Describes how the HP 8175A Digital/Analog Signal Generator helps to calibrate and test an Infrared (IR) Detecting System. The HP 8175A's versatility and performance makes it the ideal instrument to satisfy application requirements in the field of Sensor Systems, where analog signals are dominant, but the signal processing is done digitally.
Ordering Number: 5952-9651

AN 343-1
Measurements Applications For Digital Microwave Radio

This 36-page note outlines measurements and techniques for analog signals in digital radios. It reviews DMR fundamentals, covers various radio alignment techniques, BER testing, compares vector vs. constellation displays, phase noise, filter and AGC testing and other simulations. Specific results are shown on the HP 8980A Vector Analyzer, a dual-channel dc to 350 MHz sampling signal analyzer.
Ordering Number: 5954-6365

AN 343-2
Dynamic Component Test Using Vector Modulation Analysis

Design of pulsed components for systems using scattering parameters and traditional network analyzers has limits, since the components cannot operate in CW, and the measuring bandwidth yields average phase of the pulse tops. For rise/fall time transient analysis of gain/phase characteristics, the HP 8981A Vector Modulation Analyzer with 100 MHz measurement bandwidth is used so that phase trajectories of the rise/fall period as well as pulsetop may be analyzed.
Ordering Number: 5954-6367

AN 343-3
Coherent Pulsed Tests Of Radar And EW Systems

Almost all modern radar and EW equipment now coherently transmit and detect signals. This 36-page note describes new methods for testing the MW and IF portions using vector-modulation equipment and principles. Topics include AM-PM and AM-AM considerations, demodulator alignments, amplitude monopulse as well as IFM and compressive types of pulses.
Ordering Number: 5954-6366

AN 343-4
Measuring Demodulator Image Rejection Using The HP 8980A Vector Analyzer

Modern MW systems depend on a critical component called a vector demodulator, and the image rejection parameter has always been difficult to characterize. By measuring gain imbalance and quadrature error with the HP 8980A, the image rejection may be easily calculated using the procedures described in this note.
Ordering Number: 5952-3703

AN 343-5
A Calibrated Signal Simulation System Utilizing I/Q Modulation Techniques

VAWS is the HP-coined title for Vector/Arbitrary Waveform Synthesizer, a 10 to 3000 MHz generator with fully arbitrary control of the in-phase and quadrature of the carrier phase plane using two dc to 50 MHz HP 87708 digital synthesizers from modulation sources. This note details the calibration routines for improving performance on SSB image rejection, carrier leakage, amplitude ripple, and phase match between I and Q.
Ordering Number: 5952-6471

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ABSTRACTS — APPLICATION NOTES

AN 344
Bandwidth And Sampling Rate In Digitizing Oscilloscopes

This Application Note explores the theoretical basis for understanding the impact of sampling rate, using comparison to bandwidth as the starting point. There is no single, simple relationship of bandwidth to sampling rate; both are important and each must be considered independently.
Ordering Number: 5954-2631

AN 345-1
Amplifier Measurements Using The Scalar Network Analyzer

This note describes how scalar network analysis can be used to measure several important amplifier parameters as a function of both frequency and input power. Specific techniques using the HP 8757 scalar network analyzer and HP 8350 sweep oscillator are shown to measure gain, gain compression, return loss, and SWR.
Ordering Number: 5954-1599

AN 345-2
Mixer Measurements Using The Scalar Network Analyzer

This note describes how scalar network analysis can be used to measure several important mixer parameters as a function of both frequency and input RF power. Specific techniques using the HP 8757 scalar network analyzer and HP 8350 sweep oscillator are shown to measure conversion loss, conversion compression, isolation, return loss, and SWR.
Ordering Number: 5954-8369

AN 348
Voltage And Time Resolution In Digitizing Oscilloscopes

Explains the effects of voltage and time resolution on oscilloscope measurements, including a discussion of A-to-D converter error and effective bits.
Ordering Number: 5954-2652

AN 350-1
Using Your HP Plotter With An IBM Mainframe – For ISSCO Software Users

This note will help you use your HP plotter with an IBM mainframe and will help you configure your ISSCO software for use with your HP plotter. This note is divided into three sections: 1) choosing a protocol converter, 2) adding a printer emulator protocol converter, and 3) adding a cluster controller protocol converter. This note also contains troubleshooting information, a summary of cable information, and a summary of recommended protocol converters.
Ordering Number: 5954-7174

AN 350-3
Using Your HP Plotter With An IBM Mainframe – For SAS/GRAPH Software Users

This note will help you use your HP plotter with an IBM mainframe computer and will help you configure your SAS/GRAPH software for use with your HP plotter. The note is divided into three sections: 1) choosing a solution, 2) using a printer emulator protocol converter, and 3) using a cluster controller protocol converter. It also contains troubleshooting information, a summary of cable information, and a summary of recommended protocol converters.
Ordering Number: 5954-8748

AN 350-4
Line Quality And Accuracy – What They Are And How To Achieve Them

This application note defines the terms "line quality" and "accuracy." It tells you how to find out your plotter's capacity for precision, and suggests ways for achieving the best plots possible. This note is for users who need the most accurate plots possible, and for those who wish to learn more about getting the best looking plots possible.
Ordering Number: 5954-7132

AN 350-5
Using Your Plotter With Buffers And Spoolers

This note is intended as an educational piece about external plotter buffers. It will present an overview of the functions of external buffers and will tell you how to determine if a buffer will be an advantage to your system. The note will also list things that you should consider when making purchase decisions.
Ordering Number: 5959-9713

AN 351
Characterization Of High-Speed Optical Components With An RF Network Analyzer

This note describes how to make measurements on electrical and optical components using the HP 8753A Network Analyzer and a set of external optical converters.
Ordering Number: 5954-8352

AN 355
Digital Radio Theory And Measurements

Explains the principles of digital line-of-sight microwave radio systems using modulation schemes from 2-PSK to 256 QAM. Describes the practical impairments that occur in microwave radios due to propagation and equipment imperfections, and refers to international standards. Finally the application note describes how the various measurements are made on a digital radio.
Ordering Number: 5954-9554

AN 356
High Speed DC Characterization Of Semiconductor Devices from sub-pA to 1A

Introduces GaAs MOSFET and bipolar transistor characterizations to increase understanding of optimized HP 4142B use. Comprehensive application information will help readers understand device characterization and the latest pulsed measurement and Analog Feedback Unit (AFU) measurement techniques.
Ordering Number: 5950-2930

AN 356-1
High Throughput and Stabilizations Know-how And Practical Application

This note describes many application examples and useful know-how for high throughput and stability using the HP 4142B DC Source Monitor.
Ordering Number: 5950-2954

AN 358-1
Characterization Of Frequency – Agile Sources With The HP 5371A Frequency And Time Interval Analyzer

This application note, using a frequency-hopping radio transmitter as an example, illustrates how the HP 5371A's unique

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measurement technology contributes to frequency-agile measurements. Switching transient analysis, settling time verification, hopping frequency distribution and FM or FSK modulation analysis are discussed in detail. Also included is an explanation of mixer down-conversion and prescaling to extend the HP 5371A's capabilities to RF and microwave frequencies.
Ordering Number: 5952-7924

AN 358-2
Jitter And Wander Analysis In Digital Communications With The HP 5371A Frequency And Time Interval Analyzer

Jitter and wander timing error phenomena in digital communications networks are easily captured and analyzed with the HP 5371A. This application note demonstrates the flexibility and precision of continuous time-interval measurements with the HP 5371A when analyzing jitter and wander. Instrument operation and results analysis are indicated. Specific measurements include: histogram and statistical analysis of data-to-clock jitter, jitter and wander spectrum and Allan Variance for the characterization of wander.
Ordering Number: 5952-7925

AN 358-3
Time Domain Characterization of Magnetic Disc Drives

Time-interval measurements are useful to understand various phenomena that reduce a disk drive's timing window margin. This note describes techniques to measure read noise, write noise, timing asymmetry, and peak shift of magnetic disk drives using the HP 5371A Frequency and Time Interval Analyzer. The unique continuous measurement capability and flexible arming of the HP 5371A give the read/write engineer the ability to identify these effects and gain better insight for improvements of the drive's timing performance.
Ordering Number: 5952-7928

AN 359
Selecting A Jitter Test Set

This application note shows how to select a dedicated test set to measure timing jitter in digital telecommunications transmission terminal and link equipment. The measurement method and key specifications are described and matched with the test requirements for the main types of jitter measurements.
Ordering Number: 5954-9563

AN 360
Jitter Tolerance Testing Using External Phase/ Frequency Modulated Sources And Bit Error Rate Test Sets

Jitter tolerance of digital transmission equipment is measured by checking the output of the equipment under test for binary errors while stressing the input with a suitably jittered test pattern. Bit Error Rate Test Sets (BERTS) are used for pattern generation and error detection but generally do not have the built-in jitter modulation capability required to provide the jittered test signal. This application note shows how to obtain a suitably jittered test signal from a BERTS using a frequency or phase modulated frequency synthesizer.
Ordering Number: 5954-9564

AN 361
Traceability of Optical Power Measurements

In this paper, a traceability model is established which describes equipment, procedures and parameters effecting calibration accuracy of optical power meters at HP.
Ordering Number: 5952-9652

AN 362
Bit Error Rate Measurements On Optical Fiber System

The BER (Bit Error Ratio) is the main quality criterion for a Transmission System. This Application Note describes the most important limiting parameters of long-haul Fiber Optic Systems and how to make Bit Error measurements in general. It provides a detailed example of Optical Margin testing, on an end-to-end Optical Transmission System, using an HP 8158/57 Optical Attenuator and an HP Digital Transmission Analyzer. The essential improvements offered by the described set-up, are high programming speed, excellent accuracy and repeatability, extremely low back-reflections and validity for all wavelengths from 600 nm to 1650 nm.
Ordering Number: 5952-9650

AN 364-1
Quality Gains In Telecom Australia's Digital Microwave Network

Discusses application of the HP 3708A Noise and Interference Test Set and HP 3709B Constellation Analyzer in Telecom Australia's Digital Microwave Radio Network. Details of their radio system and maintenance philosophy are given, and the note describes how they use the instruments to test their network. The note then goes on to describe the benefits of both instruments, with examples of their direct application in solving Telecom Australia's testing problems.
Ordering Number: 5954-9572

AN 365-1
Mixed Signal Transmission Tests Using The HP 3065AT Telecomtest

HP Telecomtest is software which optimizes the HP 3065AT Combinational Board Test System to address telecom test needs. The features provided by HP Telecomtest allow a test engineer to achieve higher fault coverage for the mixed signal and serial-interfaces boards which are common in the telecommunications industry. In this note, a codec is used as an example to describe the problems of telecom testing and the features offered by HP Telecomtest to solve these problems. Guidelines are offered so that a test engineer can develop tests for his or her own mixed-signal and serial-interface boards.
Ordering Number: 5954-8697

AN 366-1
How To Measure Insertion Loss Of Optical Components

Insertion Loss is one of the main parameters used to describe the performance of an optical component. Insertion Loss reduces the power budget of any optical system and hence its performance. This paper in particular, describes test methods for connnectorized optical components. Implications of the test set-up conditions on the test accuracy are examined to get a feeling for the critical points of the measurement. Examples of IL measurements on connectorized components and of IL measurements in parallel beam show the versatility of Hewlett-Packard's Lightwave test equipment.
Ordering Number: 5952-9660

AN 366-2
How To Measure Return Loss Of Optical Components

Reflections at fiber coupling devices in fiber optic transmis-

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sion lines must be avoided, since they deteriorate the stability of the transmitting laser. In this application note, different return loss test methods are described and compared. The most precise and cost efficient method using general lightwave test equipment such as HP 8155A Laser Source, HP 8152A Optical Power Meter, and HP 11890/91A Lightwave Coupler, is then discussed in detail.
Ordering Number: 5952-9661

An 366-3
How to Measure Return Loss in Optical Links

The last years have seen a steady movement to higher data rates and longer transmission distances in fiber-optic links. Unfortunately the transmitting devices for higher data rates are more sensitive to back-reflections, causing increased error rates. Therefore more care has to be taken to avoid or suppress back-reflections in optical links to achieve good system performance. This application note describes how to measure the return loss of optical components installed in a fiber link with the HP 8145A OTDR, a tool that has been used for years in fault location and fiber characterization.
Ordering Number: 5952-9662

AN 369-1
Using Impedance Measurement to Evaluate Electronic Components and Materials

This application note provides several practical examples for testing electronic components and materials such as ceramic capacitors, film capacitors, cored coil, and magnetic heads.
Ordering Number: 5950-2949

AN 369-2
Tantalum Capacitor Measurement

This note gives a measurement example for tantalum electrolytic capacitor featuring LIST SWEEP function.
Ordering Number: 5950-2950

AN 369-3
Magnetic Head Measurement Using a Constant Test Current

This note gives an inductance measurement example for magnetic head featuring constant test signal function. In addition, an application for scanning measurements is covered.
Ordering Number: 5950-2951

AN 369-4
Impedance Measurement for Incoming Inspection

This note describes problems and solutions on impedance measurements at incoming inspection.
Ordering Number: 5950-2952

AN 369-5
Multi-frequency C-V Measurement of Semiconductors

This note gives a C-V measurement example for a MOS device. Included are a measurement program, and a discussion of measurement error.
Ordering Number: 5950-2953

AN 369-6
Impedance Testing Using the HP 4284A Scanner

This application note provides information on measuring impedance with HP 4284A and a scanner. When the scanning measurement is made, it is common to meet with correction problem. This application note introduces new techniques used in the HP 4284A to solve the problem. The note also covers how to design a scanning system.
Ordering Number: 5950-2975

AN 369-7
Measurement of Capacitance Characteristics of a Liquid Crystal Cell with the HP 4284A Precision LCR Meter

This application note describes capacitance vs. AC test signal voltage measurement using the HP 4284A with Option 001 which extends the test signal voltage up to 20 Vrms.
Ordering Number: 5950-2994

AN 369-8
Wide Range DC Current Biased Inductance Measurement Using the HP 4284A Precision LCR Meter/ HP 42841A Bias Current Source

This application note describes DC current biased inductance measurements that are more accurate and made over a wider frequency range than was previously possible.
Ordering Number: 5950-2367

AN 371
Lightwave Measurement with the HP 71400A Lightwave Signal Analyzer

This application note describes the HP 71400A lightwave signal analyzer and how it can be used to measure modulated lightwave carriers with wavelengths between 1,200 and 1,600 nanometers. Among the measurements that can be made on Fabry-Perot and DFB lasers are frequency response, intensity modulation, frequency modulation, intensity noise, optical power, linewidth, and chirp. Examples demonstrate many lightwave measurement procedures.
Ordering Number:

AN 372-1
Power Supply Testing

This application note examines the electronic load as it is used in power supply test applications. Considerations involving equipment configuration, measurement accuracy, resolution, and electronic load settings are discussed.
Ordering Number: 5952-4190

AN 372-2
Battery Testing

This application note discusses how an electronic load is used to test batteries. An overview of different battery types and chemistries is provided with a focused examination of secondary batteries.
Ordering Number: 5952-4191

AN 372-3
Power Component Testing

This application note discusses how an electronic load is used to test power components. In this application, an electronic load generates low duty cycle, high current pulses. These pulses are required to prevent heating effects encountered when testing power transistors at high currents.
Ordering Number: 5952-4192

AN 373
Rotation Simulation and ADC Testing with Synthesized Signals

Synthesized Function/Sweep Generators, such as the HP

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3324A, are used in a wide range of applications. This application note describes two applications:
- Synthesizers in ADC Testing
- Simulation of Rotating Signals

These applications are explained from the viewpoint of the function generator, and what should be considered when performing the tests and measurements described.
Ordering Number: 5952-9693

AN 374-1
Antenna Pattern Measurements Using the HP 8510B

Describes systems based on the HP 8510B network analyzer for making radiation pattern measurements of antennas. Included are system block diagrams, operating procedures, measurement considerations, and example pattern measurements.
Ordering Number: 5952-6675

AN 376-1
Biasing Three-Terminal Devices for Test

Measuring the operating characteristics of a wide variety of three-terminal devices can be accomplished with a single biasing configuration. This eliminates the need to rewire or change instrumentation. This application note explains a number of biasing methods for two and three terminal devices, and develops a flexible method which solves the problems which can be encountered when using the more common methods.
Ordering Number: 5952-4193

AN 377-1
Automatic Frequency Profiling of Chirped Radar Pulses Using the HP 5361A Pulse/CW Microwave Counter

This note describes an automated technique for profiling chirped radar pulses using the HP 5361A 20GHz Pulse/CW Microwave Counter. Included is a description of the profiling process, the recommended measurement set-up, and the sample HP BASIC program which automates the measurements. A free software disk is available upon returning the supplied Business Reply Card.
Ordering Number: 5952-7987

AN 377-2
Automated Characterization of Microwave Voltage Controlled Oscillators Using the HP 5361A 20GHz Pulse/CW Microwave Counter

This note describes an automated technique for characterizing frequency tuning linearity, modulation sensitivity, step response and post-tuning drift of VCO's. Included is a description of the profiling process, the recommended measurement set-up, and the sample HP BASIC program which automates the measurements. A free software disk is available upon returning the supplied Business Reply Card.
Ordering Number: 5952-7988

AN 401-15
HP 8672A Synthesized Signal Generator – HP 1000 HP-IB Programming

Ordering Number: 5953-2814

AN 416
Powered Paper Stackers for the HP2565A, HP 2566A/B, and HP 2567B Printers

This application note discusses the testing procedures a customer would use to select a powered paper stacker for use with the HP 2565A, HP 2566A/B, and HP 2567B printers. It also lists recommended powered paper stacker supplies and their stacker models for use with these HP printers.
Ordering Number: 5954-7293

AN 421-1 through AN 421-32
Data Acquisition and Computer Aided Test Application Summary Series

The AN 421 Application Summary Series consists of a set of one-page application notes on 32 different industries. Each note details the problem, the types of measurements, and a Hewlett-Packard solution. Each note also includes a typical configuration of an entire data acquisition or computer-aided test system, including price.
Ordering Number: 5954-9631 through 5954-9662

AN 422
X.25 COMM

Tells how to connect HP 9000 Series 800 Computers to X.25 Packet Switching Networks via an HP 1000 A400 Computer that functions as a gateway for the HP 9000 Series 800 Computer.
Ordering Number: 5954-8579

AN 424
Keeping Your Big Blue Network In The Pink

IBM and compatible network installations are growing at a fast rate. New installations consist almost exclusively of SNA networks, but old installations are both SNA and BSC. Networks of these two technologies are very complex and can cause serious problems for network managers when they go down. Network control is the goal because it will result in minimum downtime and maximum customer satisfaction. Procedures for network maintenance, including troubleshooting, are discussed. Tools for troubleshooting are explained for data center personnel. This paper is designed for data center/EDP personnel including the data center technician and network manager for both SNA and BSC IBM and compatible networks.
Ordering Number: 5952-5131

AN 425
The Care And Feeding Of Your X.25 Network

The use of X.25 packet switching networks (PSN), and especially private packet networks (PPN), is escalating as an efficient form of data communications. Managing an X.25 packet switching network is critical because of increasing reliance on X.25 networks. Network control is the goal because it will result in minimum downtime and maximum customer satisfaction. Procedures for network maintenance, including troubleshooting, will be discussed. One of these steps is troubleshooting problems. Tools for troubleshooting will be explained for data center personnel. This paper is designed for data center/EDP personnel including the data center technician and network manager for both private and public PSNs.
Ordering Number: 5952-5132

AN 426
File Sharing Between HP BASIC/WS, HP BASIC/UX and HP-UX for HP 9000 Series 300 Computers

HP BASIC 5.0 allows HP 9000 Series 300 computers to have HP BASIC/WS and HP-UX operating systems on the same disk and to share datafiles between BASIC and HP-UX applications. Application note 426 provides various examples of

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how to access an HP-UX text file from BASIC and HP-UX.
Ordering Number: 5952-6353

AN
SNA Development Testing System

Hewlett-Packard's SNA development testing system, consisting of three software products and the HP 4954A protocol analyzer, is the ideal tool for testing SNA-compatible component designs. It provides a standalone test system, giving engineers complete control of their test environment.

This product note briefly discusses the three products which make up the SNA development testing system: the SNA programming language, the 3270 device exerciser, and the LU6.2 node exerciser. Common questions and answers about the LU6.2 node exerciser are included for your convenience. Appendices provide detailed information on the SNA emulation language and 3270 device exerciser test descriptions.
Ordering Number: 5952-5122

AN 915
Threshold Detection of Visible and Infrared Radiation with PIN Photodiodes

Fundamental explanation of PIN photodiode detectors is given in this application note. Advantage of using photodiodes versus photomultiplier tubes are explored. Explanation is given about the PIN photodiode construction, its mode of operation, equivalent circuit configuration and performance with respect to noise equivalent power and signal-to-noise ratio. Guidance is given for critical amplifier design considerations to maintain low noise, high sensitivity, and fast response for optimum circuit performance. Two simple amplifier circuits are included for either low-noise application (NEP of -95dBm) or for high-speed response application (bandwidth of 9.5 MHz).
Ordering Number: 5953-0431

AN 918
Pulse and Waveform Generation with Step Recovery Diodes

Step Recovery Diode characteristics are described for application to high speed (PS range) pulse and waveform generating circuits. Design details and example circuits are presented for applications such as pulse sharpness, impulse generators, and square wave generators.
Ordering Number: 5954-2080

AN 922
Application of PIN Diodes

Discusses how the PIN diode can be applied to a variety of RF control circuits. Such applications as attenuating, leveling, amplitude and pulse modulating, switching, and phase shifting are discussed in detail. Also examines some of the important properties of the PIN diode and how they affect its application.
Ordering Number: 5954-2094

AN 923
Schottky Barrier Diode Video Detectors

Describes the characteristics of HP Schottky barrier diodes intended for use in video detector or video receiver circuits, and discusses some design features of such circuits. Though less sensitive than the heterodyne receiver, the many advantages of the video receiver make it extremely useful. The Schottky diode can be used to advantage in applications such as beacon missile-guidance, fuse-activating, and countermeasure receivers, and as power-leveling and signal-monitoring detectors.
Ordering Number: 5954-2079

AN 928
Ku-Band Step Recovery Multipliers

Discusses the use of step-recovery diodes in a times-eight single stage frequency multiplier which, at 16 GHz, has a typical maximum output of 75 mW. The note also provides design modifications, together with references, for meeting other performance requirements.
Ordering Number: 5954-2107

AN 944-1
Microwave Transistor Bias Considerations

A practical discussion of the temperature dependent variables in a microwave transistor that cause RF performance degradation due to changes in quiescent point. Passive circuit networks that minimize quiescent point drift with temperature are analyzed, and the general equations for dc stability factors are given. Emphasis on practical circuit design is highlighted by typical circuit examples.
Ordering Number: 5952-8376

AN 945
Photometry of Red LEDs

Nearly all LEDs are used either as discrete indicator lamps, or as elements of a segmented or dot-matrix display. As such they are viewed deirectly by human viewers, so the primary criteria for determining their performance is the judgement of the viewer. Equipment for measuring LED light output should, therefore, simulate human vision. This note provides answers to these questions: 1) what to measure (definition of terms)? 2) how to measure it (apparatus arrangement)? and 3) whose equipment to use?
Ordering Number: 5952-0420

AN 947
Digital Data Transmission Using Optically Coupled Isolators

This note describes design considerations and circuit techniques of optically coupled isolators with special emphasis on selection of line drivers, transmission lines, and line receiver termination for optimum data rate and common mode rejection. Both resistive and active terminations are described for multiplexing applications, and for common mode rejection and data rate enhancement.
Ordering Number: 5953-7759

AN 948
Performance of the 6N135, 6N136, and 6N137 Optocouplers in Short to Moderate Length Digital Data Transmission Systems

This note describes the basic design elements of a data transmission link and presents several examples of total systems that will be useful to system designers at distances that range from 1 foot to 30 feet and have moderate overall cost.
Ordering Number: 5953-7716

AN 951-1
Applications for Low-Input Current, High-Gain Optocouplers

Applications where large common mode signals are encountered are discussed in this note. Examples of line receivers,

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logic isolation, power lines, medical equipment and telephone lines are presented.
Ordering Number: 5953-7794

AN 951-2
Linear Applications of Optocouplers

Optocouplers can be used to transfer an analog signal between two optocouplers, can replace expensive transformers, instrumentation amplifiers, and A/D conversion techniques by which 6N135/6N136 and HCPL-2530 series optocouplers can be used to transmit analog information. The operation of each circuit is explained in detail and typical circuit performance is given.
Ordering Number: 5954-8430

AN 956-1
The Criterion for the Tangential Sensitivity Measurement

Discusses the meaning of Tangential Sensitivity and a recommended measurement technique.
Ordering Number: 5952-0423

AN 956-3
Flicker Noise in Schottky Diodes

Treats the subject of flicker (1/f) noise in Schottky diodes, comparing four different types.
Ordering Number: 5952-0487

AN 956-4
Schottky Diode Voltage Doubler

Explains how Schottky detectors can be combined to achieve higher output voltages than would be produced by a single diode.
Ordering Number: 5952-0495

AN 956-5
Dynamic Range Extension of Schottky Detectors

Discusses operation of two types of detectors: the small signal type, also known as square-law detectors; and the large signal type, also known as linear or peak detectors. Techniques for raising the compression level are presented. An example is given illustrating the effect of bias current level on an HP 5082-2751 detector.
Ordering Number: 5952-8335

AN 956-6
Temperature Dependence of Schottky Detector Voltage Sensitivity

A discussion of the effects that temperature changes have on Schottky barrier diodes. Performance improves at lower temperatures in a predictable manner. Data presented were obtained using HP 5082-2750 detector diodes.
Ordering Number: 5952-8341

AN 957-1
Broadbanding the Shunt PIN Diode SPDT Switch

Covers an impedance matching technique which improves the bandwidth of shunt PIN diode switches.
Ordering Number: 5954-2082

AN 957-2
Reducing the Insertion Loss of a Shunt PIN Diode

Examines a simple filter design which includes the shunt PIN diode capacitance in a low-pass filter, thereby extending the upper frequency limit.
Ordering Number: 5952-0491

AN 957-3
Rectification Effects in PIN Attenuators

Attenuation levels of PIN diodes are changed by high incident power. Variation in attenuation may be minimized by proper choice of bias resistance. Performance of a PIN diode is limited by both carrier level and frequency because of rectification effects. This note presents the effects of frequency, power level, and bias supply for three types of HP diodes: 5082-3170, 3140 and 3141.
Ordering Number: 5952-8429

AN 963
Impedance Matching Techniques for Mixers and Detectors

Presents a methodical technique for matching complex loads, such as Schottky diodes, to transmission line. Direct application to broadband mixers and detectors is illustrated.
Ordering Number: 5952-0496

AN 967
A Low Noise 4 GHz Amplifier Using the HXTR-6101 Silicon Bipolar Transistor

Describes in detail the design of a single-stage state-of-the-art low noise amplifier at 4 GHz using the HXTR-6101 silicon bipolar transistor. Both the input and output matching networks are described.
Ordering Number: 5952-9800

AN 972
Two Telecommunications Power Amplifiers for 2 and 4 GHz Using the HXTR-5102 Silicon Bipolar Power Transistor

Describes in detail the design of two linear power amplifiers using the HXTR-510 2. In each case, small signal S-parameters, and power contours are used in the characterization.
Ordering Number: 5952-9876

AN 974
Die Attach and Bonding Techniques for Diodes and Transistors

Several package styles are available for use with hybrid integrated circuits. This application note gives detailed instructions for attaching and bonding these devices. A brief description of an impedance matching technique for mixer diodes is also included.
Ordering Number: 5953-4406

AN 975
A 4.3 GHz Oscillator Using the HXTR-4101 Bipolar Transistor

A general technique for transistor oscillator design is illustrated with the details of a 4.3 GHz bipolar oscillator. Small signal S-parameters are used for a preliminary non-oscillating circuit. Measurements of this circuit yield the information needed to complete the circuit design.
Ordering Number: 5953-4411

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ABSTRACTS — APPLICATION NOTES

AN 976
Broadband Microstrip Mixer Design – the Butterfly Mixer

One of the big problems in broadband microstrip designs is the realization of low impedance shunt lines. Low impedance means wide lines with lots of parasitics difficult to account for in the design. This application note shows how to solve this problem by using radial lines (the butterfly wings) illustrated with a mixer using a C-2 diode for the frequency range of 8 to 12 GHz.
Ordering Number: 5954-2076

AN 979
The Handling and Bonding of Beam Lead Devices Made Easy

Beam Lead devices are particularly attractive for hybrid circuits because of their low parasitics and small size. The availability of equipment and techniques specifically designed for their small size has facilitated the handling and bonding of these devices. This note describes some of this equipment and techniques, and outlines suggestions for the proper handling and bonding of Beam Lead devices.
Ordering Number: 5953-4435

AN 980
A Cost-Effective Amplifier Design Approach at 425 MHz Using the HXTR-3101 Silicon Bipolar Transistor

The HP HXTR-3101, simplified matching networks, and off-the-shelf components are used in an amplifier design which achieves a gain of 13.5 dB at 425 MHz. Construction details include the circuit board layout and component placement.
Ordering Number: 5953-4436

AN 982
A 900 MHz Driver Amplifier Stage Using the HXTR-3102

A modified version of the "load-pull" technique is used in the design of a power driver amplifier stage at 900 MHz. The final output power is 21.5 dBm at 900 MHz. Design and construction details are provided.
Ordering Number: 5953-4440

AN 983
Comb Generator Simplifies Multiplier Design

A filter is added to a comb generator to produce higher output power over a narrow band of frequencies. Results are presented for a 1 GHz input comb generator with X-Band output.
Ordering Number: 5953-4441

AN 984
How to Get More Output Power from a Comb Generator Module with the Right Bias Resistance

The output power of a comb generator is coupled by optimizing the external bias resistance.
Ordering Number: 5953-4442

AN 985
Achieve High Isolation in Series Applications with the Low Capacitance HPND-4005 Beam Lead PIN

Low capacitance is required for a diode to achieve high isolation in the series configuration. On the other hand, low resistance is needed for low insertion loss. This combination of characteristics in the HPND-4005 Beam Lead PIN diode makes it well suited for series switching applications. The performance of this diode in a SPST switch and a SPDT switch is described in this note. The equivalent circuits derived in this note would be useful in the design of circuits for switching and other signal control applications.
Ordering Number: 5953-4443

AN 986
Square Law and Linear Detection

Frequency, diode capacitance, breakdown voltage, and load resistance all have an effect on the slope of a microwave detector. At high input levels the linearity may be controlled by proper tuning.
Ordering Number: 5953-4444

AN 987
Is Bias Current Necessary?

Bias current is often necessary to reduce the impedance of detector diodes to a reasonable level. However, when the signal level is high, rectified current may reduce the impedance without the need for bias current. Measurements with the 5082-2755 diode are used to illustrate this effect.
Ordering Number: 5953-4446

AN 988
All Schottky Diodes are Zero Bias Detectors

Diodes which are normally biased make excellent detectors when the bias is eliminated. It is necessary to use a load with an impedance comparable to the diode impedance. This is shown with an HP 5082-2755 diode used with an HP 3469B multimeter as the load.
Ordering Number: 5953-4449

AN 989
Step Recovery Diode Doubler

A straightforward multiplier design technique is illustrated by a doubler to 4 GHz using an HP 5082-0805 step recovery diode. The multiplier is capable of delivering 4 watts of output power over a 10% bandwidth.
Ordering Number: 5953-4454

AN 990
A 500 MHz Oscillator with the HXTR-3102 Bipolar Transistor

The design and performance of a 500 MHz oscillator using the HXTR-3102 silicon bipolar transistor is described.
Ordering Number: 5953-4462

AN 991
Harmonic Mixing with the HSCH-5530 Series Dual Diode

The dual diode on coplanar waveguide forms an anti-parallel pair. This arrangement is excellent for mixers with subharmonic local oscillators. A mixer for 34 GHz was designed and built. Conversion loss was measured as a function of frequency and local oscillator power level.
Ordering Number: 5953-4492

AN 992
Beam Lead Attachment Methods

This application bulletin gives a general description of various methods of attaching beam lead components to both hard and soft substrates. A table summarizes the most common attachment methods with advantages, disadvantages, and equipment costs.
Ordering Number: 5953-4496

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ABSTRACTS — APPLICATION NOTES

AN 993
Beam Lead Diode Bonding to Soft Substrate

The hard gold surface on standard pc boards with soft substrate material makes it almost impossible to successfully bond beam lead diodes onto the boards with normally recommended thermocompression bonding. Described in this application note is a new method of resistive spot welding or modified gap welding, which uses a single electrode to weld the beam while the conductor is contacted separately. This method allows tight pressure to be used on the weld probe, resulting in an effective bond without damaging the beam lead device.

Ordering Number: 5953-4497

AN 994
A 2 GHz Power Oscillator Using the HXTR-4103 Bipolar Transistor

Describes the design of a 1 watt 2.0 GHz microstrip oscillator using the common collector HXTR-4103 transistor. The artwork layout for the printed circuit board and construction details are included in this application note.

Ordering Number: 5953-4495

AN 995
The Schottky Diode Mixer

A major application of the schottky diode is the production of the difference frequency when the two frequencies are combined or mixed in the diode. Mixing efficiency is measured by the conversion loss, the ration of signal input power to intermediate frequency output power. This application note studies the effect on mixing efficiency of diode parasitics, local oscillator power level, DC bias, barrier voltage, and local resistance. The advantage of multiple diode mixers are considered. Distortion products are also discussed.

Ordering Number: 5954-2073

AN 996
Designing with HAMP-1001, 1002, 1003 and 1004 TO-8 Amplifiers

The four amplifiers discussed in this applications note are cascadable gain block amplifiers housed in TO-8 packages with guaranteed RF specifications across the entire 10 to 1500 MHz band. Maximum input and output VSWR is 2:1 into 50 ohms. Included in the note is RF data for both single stages and cascades of 2, 3 and 4 stages of TO-8 amplifiers. Printed circuit board artwork for single stage amplifiers and cascades of up to four TO-8 amplifiers are also included.

Ordering Number: 5954-2068

AN 997
A 2 GHz Balanced Mixer Using SOT-23 Surface Mount Schottky Diodes

The HSMS-2822 is a series diode pair in the SOT-23 package – ideal for use in a balanced mixer. The microstrip matching circuit consists of open stubs between the diodes and the I.F. port.

Ordering Number: 5954-2090

AN 998
A 75 Ohm 470-800 MHz Low Noise Amplifier Using The HXTR-3121 Bipolar Translator

This application note describes the design and construction of a two stage 470 MHz to 806 MHz LNA using the 100 mill plastic package HXTR-3121 transistor. The amplifier has a typical gain of 29 dB, a noise figure of less than 3.2 dB and an input and output VSWR less than 2:1 into 75 ohms. A computer program is used to synthesize the input, interstage and output impedance matching networks. Complete construction details are given.

Ordering Number: 5954-2088

AN 1002
Consideration of CTR Variations in Optically Coupled Isolator Circuit Designs

A persistent, and sometimes crucial, concern of designers using optocouplers is that of the current transfer ratio, CTR, changing with time. The change, or CTR degradation, must be accounted for if long, functional lifetime of a system is to be guaranteed. This application note discusses a number of different sources for this degradation.

Ordering Number: 5953-7799

AN 1004
Threshold Sensing for Industrial Control Systems with the HCPL-3700 Interface Optocoupler

Applications of the HCPL-3700 interface optocoupler are addressed, specifically isolation and threshold detection capability in industrial control systems.

Ordering Number: 5953-0406

AN 1005
Operational Considerations for LED Lamps and Display Devices

In the design of a display system, which incorporates LED lamps and display devices, the objective is to achieve an optimum between light ouput, power dissipation, reliability, and operating life. The performance characteristics and capabilities of each LED device must be known and understood so that an optimum design can be achieved. The primary source for this information is the LED device data sheet. This application note describes the use of the electrical and optical information contained within a data sheet. Two designs using this information in the form of numerical examples are presented, one for dc operation and one for pulsed (strobed) operation.

Ordering Number: 5953-0419

AN 1006
Seven Segment LED Display Applications

LED seven segment displays provide a low-cost solution a wide variety of display applications. Hewlett-Packard LED seven segment displays are available in a wide variety of sizes, colors, and package outlines. These products are matched for intensity and color to provide a uniform light emitting display. This application note describes the types of products available, and discusses both dc and strobed drive techniques. Drive circuits for typical applications are shown and tables of available seven segment decoder/drivers, digit drivers, and LSI circuits are included. Finally, information concerning display mounting, soldering, cleaning, and filtering is included.

Ordering Number: 5953-0439

AN 1007
Bar Graph Array Applications

Bargraph displays offer the designer an alternative to numeric displays for providing a visual readout of an analog signal. Hewlett-Packard bargraph displays are available in a variety of display colors and can be mounted in arrays to provide a variety of different resolutions. This application note describes

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the package configuration, shows typical analog input or digital input drive circuits and provides several microprocessor interfaces. Summarized at the end of the application note are tables of integrated circuits designed to interface to bargraph displays.
Ordering Number: 5953-0452

AN 1008
The HBCS-1100 High Resolution Optical Sensor

This application note gives the basic optical flux coupling design for discrete emitters and detectors and presents the concepts of modulation transfer function, depth of field, and reflective sensor design. It also discusses the optical and electrical operation of the HBCS-1100 High Resolution optical sensor. Finally, it presents electrical design techniques which allow the HBCS-1100 to interface with popular logic families.
Ordering Number: 5954-0460

AN 1011
Design and Operational Considerations for the HEDS-5000 Incremental Shaft Encoder

This application note is directed toward the system designer using the HEDS-5000 and HEDS-6000 modular incremental shaft encoders. First the note briefly analyzes the theory of design and operation of these products. A practical approach to design considerations and an error analysis provide an in-depth treatment of the relationship between motor mechanical parameters and encoding error accumulation. Operation considerations for assembly, test, troubleshooting and repair are presented. Finally some circuits and software concepts are introduced which will be useful in interfacing the shaft encoder to a digital or microprocessor-based system.
Ordering Number: 5953-9393

AN 1012
Methods of Legend Fabrication

Hewlett-Packard LED light bar modules inscribed with fixed messages or symbols can be used as economical annunciators. Annunciators are often used in front panels to convey the status of a system, to indicate a selected mode of operation or to indicate the next step in a sequence. This application note discusses alternative ways the message or symbols (legends) can be designed. A selection matrix is provided to assist in the selection of the most appropriate method of legend fabrication. Each fabrication method is explained in detail along with mounting and attachment techniques. Finally, prevention of cross-talk is discussed for legend areas of a multi-segmented light bar.
Ordering Number: 5953-0478

AN 1013
Elements of a Bar Code System

This application note describes in detail the elements that make up most bar code systems. Included is a discussion of the fundamental system design, detailed discussion of seven popular code symbologies, a section of symbol generation, and methods of data entry. A glossary of terms and a reference section are also included. This is an excellent publication for people who are just learning about bar code, or for those who need a more comprehensive understanding of the subject.
Ordering Number: 5953-9387

AN 1015
Contrast Enhancement Techniques for LED Displays

Contrast enhancement is essential to assure readability of LED displays in a variety of indoor and outdoor ambients. Plastic filters are typically used for contrast enhancement with indoor lighting, and glass circular polarized filters are typically used to achieve readability in sunlight ambients. This application note discusses contrast enhancement technology for both indoor and outdoor ambients, the theory of Discrimination Index, and provides a list of tested contrast enhancement filters and filter manufacturers.
Ordering Number: 5953-7788

AN 1016
Using the HDSP-2000 Alphanumeric Display Family

The HDSP-2000 family of alphanumeric display products provides the designer with a variety of easy-to-use display modules with on-board integrated circuit drivers. The HDSP-2000 family is available in a variety of character heights and display colors. These displays can be arranged to create both single line and multiple line alphanumeric panels. This note is intended to serve as a design and application guide for users of the HDSP-2000 family of alphanumeric display devices. It covers the theory of the device design and operation, considerations for specific circuit designs, thermal management, power derating and heat sinking, and intensity modulation techniques.
Ordering Number: 5953-7787

AN 1017
LED Solid State Reliability

Light emitting diode display technology offers many attractive features to the designer. One of the most common reasons that LED displays are designed into an application, however, is the high level of reliability of the LED display. Hewlett-Packard has taken a leadership role in setting reliability standards for LED displays and documenting reliability performance. This note explains how to use the reliability data sheets published for HP LED indicators and displays. It describes the LED indicators and display packages, defines device failures, and discusses parameters affecting useful life, failure rates and mechanical test performance.
Ordering Number: 5953-7784

AN 1018
Designing with the HCPL-4100 and HCPL-4200 Current Loop Optocouplers

This application note will assist the circuit design engineer on the proper use of and performance that can be expected from Hewlett-Packard 20 mA current loop optocouplers. Practical applications for interfacing to and from a current loop are shown. In addition, overall current loop system aspects are discussed. Current loop configurations, current sources, and fundamental information are also presented.
Ordering Number: 5953-9359

AN 1019
Using the HLMP-4700/-1700/-7000 Series Low Current Lamps

Hewlett-Packard manufactures a series of LED lamps that are designed for operation at 2 mA DC. These lamps are available in high-efficiency red, yellow, and high-performance green in a variety of package styles. These lamps allow the designer to reduce system power dissipation, and drive circuit costs. This application note contrasts electrical characteristics of the

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low-current lamp with HP's conventional lamp. Costs of implementing lamp drive circuits are discussed, as in power conservation in TTL and circuits involving higher voltages. Finally, telecommunications and battery information are presented.
Ordering Number: 5953-9369

AN 1021
Utilizing LED Lamps Packaged on Tape and Reel

This application note describes the use of automatic insertion equipment used for tape and reel of LED Lamps.
Ordering Number: 5954-0861

AN 1022
100 MBaud Fiber Optic Link Design with Discrete Components

As the technology of fiber optic communication matures, design considerations for large volume applications focus as much on cost and reliability, as bandwidth and bit-error-rate. This application note describes a 100 MBd fiber optic communication link which was implemented with low-cost, non-exotic technology, including LED transmitter, PIN photodiode detector, off-the-shelf ICs and discrete components, laid out on epoxy-glass circuit boards.
Ordering Number: 5954-0979

AN 1023
Radiation Immunity Of Hewlett Packard Optocouplers

Opening with a quotation from MIL-HDBK-279 describing optocouplers containing photodiodes as superior to optocouplers containing phototransistors, this note describes the properties of ionizing radiation (particles and photons) and how it affects the performance of optocouplers. Graphs show degradation of CTR (Current Transfer Ratio) in the 6N140 as a function of gamma total dose (up to 1000 rad [Si]) and as a function of total neutron fluence (up to $6 \times 10^{12} n/cm^2$). A table gives radiation hardness requirements for various military requirements.
Ordering Number: 5954-1003

AN 1025
Applications and Circuit Design for the HEDS-7000 Series Digital Potentiometer

This application note demonstrates some of the uses for the Hewlett-Packard HEDS-7500 series digital potentiometer, explains how a digital potentiometer works, and explains some of the advantages of a digital potentiometer over a standard resistive potentiometer. In addition, this application note provides some examples of circuitry which will interface the digital potentiometer to a microprocessor, and provides mechanical design considerations and available options for the HEDS-7500 series digital potentiometer.
Ordering Number: 5954-8485

AN 1026
Designing with Hewlett-Packard's HDPL-2416 Smart Display

The trend in LED Alphanumeric displays is to simplify a designer's job as much as possible by incorporating on-board character storage. ASCII character generation, and multiplexing within the display. The HPDL-2416 is a four-character alphanumeric display which incorporates a 64-character ASCII decoder and an on-board CMOS IC to perform these functions. This application note is intended to serve as a design and application guide for users of the HPDL-2416. The information presented will cover electrical description, electrical design considerations, interfacing to micro-processors, preprogrammed message systems, mechanical and electrical handling, and contrast enhancement.
Ordering Number: 5954-0886

AN 1027
Soldering LED Components

The modern printed circuit board is assembled with a wide variety of semiconductor components including LED lamps and displays. The quantity of solder connections will be many times the component count. It is important for display system designers and PC board assembly engineers to understand the aspects of the soldering process and how they relate to LED components to assure high yields. This application note provides an in-depth discussion on the aspects of the soldering process and how they relate to LED lamps and display components, with the objective of being able to serve as a guide towards achieving high yields for solder connections.
Ordering Number: 5954-0893

AN 1028
Surface Mount Subminiature LED Lamps

Modern printed circuit boards are being assembled with surface mounted components, replacing through hole mounted components in many traditional applications. Hewlett-Packard has surface mounted options for its HLMP-6000/7000 series of subminiature LED lamps, Options 011 and 013 for "gull wing" leads and Option 021 for "yoke" leads for inverted mounting. This application note provides information on how to surface mount and vapor phase reflow solder these surface mount subminiature LED lamps.
Ordering Number: 5954-0902

AN 1029
Luminous Contrast and Sunlight Readability of the HDSP-238X Series LED Alphanumeric Displays for Military Applications

Military specifications for avionics and other kinds of electronics that require readability in sunlight use specific definitions for luminous contrast. The concept of chrominance contrast and the theory of Discrimination Index (see Hewlett-Packard Application Note 1015) are not used by the military as a means of determining readability in sunlight. Thus, the military requirements for readability in sunlight are based solely on luminous contrast measurements. This application note discusses the luminous contrasts used by military specifications, and describes anti-reflection/circular polarized filters designed for use with the HDSP-238X series sunlight viewable LED displays and presents
Ordering Number: 5954-0923

AN 1031
Front Panel Design

In many applications designers are faced with the problem of how to match the perceived brightness of an assortment of seven segment displays, light bars, linear arrays and lamps on the same front panel. To simplify this problem Hewlett-Packard has introduced S02 option selected parts. S02 option selected parts provide a restricted range of luminous intensity for a given part number. This application note is written as a design guide to matching the perceived brightness of LED displays and lamps on a front panel. The procedure shown in the application note will enable the designer to calculate the needed display drive currents for a given ambient light level and filter.
Ordering Number: 5954-0933

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ABSTRACTS — APPLICATION NOTES

AN 1032
Design of the HCTL-1000's Digital Filter Parameters by the Combination Method

Digital closed loop motion control systems employing a dedicated IC as a controller are becoming increasingly popular as a solution to the need for controlled velocity and positioning systems. Hewlett-Packard's HCTL-1000 is a general-purpose motion control IC which has been designed for these type of closed loop systems. A digital compensator has been designed into the HCTL-1000 to provide a stable response to an input command. This application note explains how the combination method can be used for calculation of the HCTL-1000's digital compensation filter parameters to provide a stable, closed loop position control system.

Ordering Number: 5954-8455

AN 1033
Designing With The HDSP-211X Smart Display Family

Hewlett-Packard's smart alphanumeric display, the HDSP-211X, is built to simplify the user's display design. Each HDSP- 211X has an on-board CMOS IC which displays eight characters. All of the IC features are software driven. These features include 128 character ASCII decoder, 16 user-defined symbols, seven brightness levels, flashing characters, a self test, and all of the circuitry needed to decode, drive, and refresh eight 5 x 7 dot matrix characters. This application note discusses how to interface the HDSP- 211X display to either a Motorola 6808 or an Intel 8085 microprocessor. A 32 character display interface is explained for each microprocessor. The note includes a detailed description of the hardware and software. The software illustrates how the user-defined symbols and a string of ASCII characters are loaded into the display.

Ordering Number: 5954-8424

AN 1034
How to Make Accurate Fiber Optic Power Measurements

The most important fiber optic test instrument is the power meter. No engineering lab, production floor or maintenance facility in the fiber optics field can operate without power meters. Most optical engineers learn about the limitations and uncertainties of this measurement after discovering inconsistencies. These problems may be caused by the meter. But they maybe also originated from effects outside of the meter, such as reflections, interferences and laser sensitivity to back-reflections. The application note describes how the measurement uncertainty is reduced to a minimum with the HP 8152A optical power meter and how to reduce uncertainties resulting from the measurement set-up.

Ordering Number: 5952-9646

AN 1035
Versatile Link Application Note

The Versatile Link Application Note describes how fiber optics can be used to solve different types of application problems, introduces Hewlett-Packard's Versatile Link plastic fiber-optic components, and shows how to design a working fiber-optic link using the Versatile Link. It also includes several additional application circuits to help the designer obtain maximum performance from the Versatile Link.

Ordering Number: 5954-2191

AN 1036
Solid State Relay Introduction and Applications

A brief opening describes SSRs (Solid State Relays), their advantages relative to EMRs (Electro Magnetic Relays), and their classification according to contact characteristics. There follows a description of HSSR-8200 "control" and "contact" properties. Arrangement of the contacts for signal switching, multiplexing, gain switching, and low-level sensing are discussed. Circuit suggestions and design rules are given for operation of the "control" LED. Schematics and design rules for overvoltage protection of the open contacts are presented.

Ordering Number: 5954-2200

Logistics Data Book

Commercial instruments purchased by the US Government for measurement applications are assigned National Stock Numbers (NSN), and sometimes military nomenclature, relating to usage, e.g., AN/USM-323, a VHF Signal Generator. This 150-page document cross-references HP model numbers vs. NSNs, nomenclatures, JETD references, contract numbers, and recommended replacements for obsoleted instruments.

Ordering Number: 5954-7744

HP 4954A
X.25 Network Performance Analysis

With X.25 becoming a popular means of transporting data, the need for efficient and effective data communications test equipment has increased. In the past, users were the first to detect network problems, and reported such problems to the network manager. With the tools available today, this role can be reversed. Network managers now are placed in a proactive situation and can find and solve problems BEFORE they reach the customers.

This product note explains how the HP 18370A X.25 network performance analyzer can help a network manager fulfill these responsibilities. A sample X.25 network is used to illustrate the various network management techniques.

Real life problems are introduced and then solved using the X.25 network performance analyzer.

This product note is designed to help network managers attain their primary goal — customer satisfaction.

Ordering Number: 5952-5120

HP 4972A
LAN Performance Analysis

The HP 4972A LAN protocol analyzer and the HP LAN performance analysis and application software is designed to provide unbiased information about network activities because it functions independently of any vendors' hardware and software. The analyzer derives network performance information by observing the actual network traffic.

This product note discusses performance analysis of Ethernet and IEEE 802.3 networks. It proposes a five step methodology for analyzing and managing network performance. In particular, it discusses how the HP 4972A LAN protocol analyzer and the HP LAN performance analysis system can be used to take those five easy steps to network bliss.

Ordering Number: 5952-5103

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ABSTRACTS — APPLICATION NOTES

TB 101
Fiber Optic SMA Connector Technology

TB 101 discusses trade offs between various SMA connector techniques and provides a contact matrix of manufacturers versus SMA connector type.
Ordering Number: 5954-1004

TB 102
Fiber/Cable Selection For LED Based Local Communications Systems

TB 102 is intended to assist the first-time user of fiber optics with the selection of a fiber cable that best meets desired system requirements. Issues discussed in TB 102 include: Trade offs between various fiber types, the effect of LED emitters on fiber performance, coupled power versus numerical aperture and factors that influence cable selection. A contact matrix that lists fiber cable manufacturers versus cable type is also included.
Ordering Number: 5954-1011

TB 103
High-Speed Optocouplers vs. Pulse Transformers

For high speed signaling with ground loop isolation, pulse transformers are often used. Here are summarized briefly the difficulties encountered in the use of pulse transformers, such as rise-time, sag, and interwinding capacitance. A table summarizes the parameter of Hewlett-Packard optocouplers designed for high speed signaling. A second table summarizes the advantages of using these optocouplers instead instead of pulse transformers.
Ordering Number: 5954-1017

TB 104
Baseband Video Transmission With Low Cost Fiber Optic Components

The transmission of video signals over fiber optic links offers several advantages relative to comparable wire distribution systems. TB 104 describes simple T_x/R_x circuits providing 20 MHz, 3 dB bandwidth for high resolution analog video transmission.
Ordering Number: 5954-1025

TB 105
ST® Connector/Cable Guide

A fairly recent development from AT&T is the ST Connector, and its rapid acceptance by users of fiber optic components is an indication that it may soon become a standard connector. TB 105 provides a quick comparison between the SMA and the ST style connector. A table at the end lists some suppliers of the ST style connectored cables.
Ordering Number: 5954-8436

ST is a registered trademark of AT&T Light guide Cable Connectors.

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ABSTRACTS — PRODUCT NOTES

1631A/D-1
A Guide to Cross-Domain Analysis

Solve complex digital design problems with the HP 1631A/D's interactive measurement capabilities. Topics include: analog waveform analysis, timing analysis, timing and analog post-processing, interactive timing and analog, state analysis, interactive analysis, system performance analysis.
Ordering Number: 5954-2618

1631A/D-2
Measurement Reference Guide

Details on how to use the digitizing oscilloscope, timing analyzer, and state analyzer within the HP 1631A/D. Also included is a discussion of the HP 1631A/D's cross-triggering capabilities, as well as an introduction to DRAMs.
Ordering Number: 5954-2622

3065-2
Safeguard In-circuit

Ordering Number: 5954-5971

3065-3
Adding Remote Fixturing Capability to the HP 3065

Ordering Number: 5954-5979

3065-4
Fixturing for High-speed Integrity on the HP 3065 at Combinational Test System

Ordering Number: 5954-8670

3235-1
Programming Guide to the HP 3235A Switch/Test Unit and the HP System 1000

Explains how to communicate various commands to the HP 3235A and to return results using both ASCII and binary formats and the IEEE-728 Block A header. Describes the use of subroutines inside the HP 3235A that permit multitasking and stand-alone operation. Interrupt handling techniques for the HP 3235A in the RTE A environment are also discussed. Many of these topics are merged together to form a complete program example.
Ordering Number: 5953-7023

3314A-1
Operator's Introduction to the HP 3314A

Ordering Number: 5953-5102

3324A
Rotation Simulation and ADC Testing With Synthesized Signals Using the HP 3324A

Synthesized function/sweep generators, such as the HP3324A, are used in a wide range of applications. This application note describes just two of these applications: rotation simulation and ADC testing. The applications are explained from the viewpoint of the function generator and what should be considered when performing the tests and measurements described.
Ordering Number: 5952-9693

3325B-1
Remote Operation of the HP 3325B via RS-232

This note describes the configuration and settings necessary for remote operation of the HP 3325B via a modem and telephone line.
Ordering Number: 5954-7987

3326A-1
Introductory Operating Guide to the HP 3326A Two-channel Synthesizer

An overview of applications requiring two or more test signals that can be supplied by the HP 3326A. Topics covered are third-order IMD, two-tone signalling, multiphase, and dual stimulus general purpose measurements. This note describes the applications, measurement considerations, and the solution provided using the HP 3326A.
Ordering Number: 5953-5134

3421A-2
The 3421A Data Acquisition/Control Unit

This product note is a primer for programming the HP 3421A Data Acquisition/Control Unit with either the HP 71B or HP 75D Handheld Computers over the Hewlett-Packard Interface Loop (HP-IL). Printers (HP 2225B and HP 82162A), and mass storage devices (HP 9114A/B and HP 82161A) are also discussed for recording and storing data in a system application.
Ordering Number: 5953-6987

3458-1
Optimizing Throughput and Reading Rate

Illustrates how you can use the revolutionary speed and accuracy of the HP 3458A Multimeter to achieve the best possible test throughput and reading rates for your application. Explains the trade-offs offered by the instrument, and its optimal use with the HP 9000 series 200/300 computers.
Ordering Number: 5953-7058

3458-2
High Resolution Digitizing With the HP 3458A

The HP 3458A Multimeter solves many needs for high-resolution digitizing (more than 12 bits). Application-oriented examples demonstrate the advantages of using the HP 3458A Multimeter. This product note also discusses errors in measurements when digitizing waveforms and how the HP 3458A reduces these errors. Also talks about the HP 3458A Option 005 Waveform Analysis Library.
Ordering Number: 5953-7059

3458-3
Electronic Calibration of the HP 3458A

Demonstrates the validity of electronic adjustments made automatically in the HP 3458A Multimeter. Demonstrates HP knowledge of metrology fundamentals.
Ordering Number: 5953-7060

3468A-1
Using the HP 3468A

Describes how to operate the HP 3468A (or HP 3468B) DMM for measurements from the front panel. Includes programming examples and completely bar coded programs for the HP 41 handheld computer.
Ordering Number: 5953-6902

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ABSTRACTS — PRODUCT NOTES

3478A-1
Using the HP 3478A

Describes how to operate the HP 3478A DMM for measurements from the front panel. Includes examples for remote programming using a BASIC language computer.
Ordering Number: 5953-6901

3488A-1
Using the HP 3488A

Brief description of how to operate and program the HP 3488A switch/control unit from the front panel and via HP-IB. Also covers connections to the HP 3488A and configurations of the cards.
Ordering Number: 5953-6959

3561A
HP-IB Programming commands for the HP 3561A Dynamic Signal Analyzer

Ordering Number: 5953-5186

3561A-1
Using the HP 3561A Dynamic Signal Analyzer

The HP 3561A is a 100 kHz Dynamic Signal Analyzer with powerful analysis capabilities for applications in electronics, vibration and acoustics. This product note provides an introduction to operation and detailed front panel key sequences for measurements in each application area. Information on remote operation via HP-IB, with specific programming commands for each of the measurements described above, is also included.
Ordering Number: 5953-5114

3561A-2
Acoustic Measurements with the HP 3561A

This product note defines basic terms and measurements used in acoustic and noise testing and goes on to explain how to use the HP 3561A spectrum analyzer to make these measurements.
Ordering Number: 5952-4819

3562
Programming Guide for the HP 3562A Dynamic Signal Analyzer with the HP 9000 Basic Workstation

This note is intended to be an introductory guide to programming the HP 3562A over the HP-IB using an HP series 200 or 300 computer using the HP Basic Language. The note includes simple real life programs, that accomplish useful tasks. For each example there is a tutorial that describes what each line of code does.

More programming information can be found in the HP 3562A Programming Manual, PN 03562-90031.
Ordering Number: 5953-5183

3562A-1
Operator's Introduction to the HP 3562A Dynamic Signal Analyzer

This note describes the HP 3562A's capabilities, functions, and features, and provides examples of typical measurements.
Ordering Number: 5954-7973

3562A-2
Signal Switching and Multi-channel Measurements with the HP 3562A Dynamic Signal Analyzer

The HP 3562A is a two-channel dynamic signal analyzer. This note shows how the HP 3562A can measure more than two signals by automatically controlling a switch. The analyzer can set the switch for two signals, make measurements, and then set the switch for a different pair of signals. This is done without the aid of a separate computer since the HP 3562A can act as the controller over the Hewlett-Packard Interface Bus (HP-IB). Included are examples of how to do this with the HP 3488A switch controller and HP 44472A VHF switches. Information on how to do this with other switches is also provided.
Ordering Number: 5953-5191

3577A-1
User's Guide to the HP 3577A Network Analyzer

This product note will aid in understanding the measurement concepts behind the HP 3577A (5 Hz – 200 MHz) Network Analyzer. Besides giving an introduction to actual instrument operation, it provides background material on network analysis fundamentals such as measurement hookup, performance optimization and error correction. A further chapter demonstrates remote operation of the 3577A via HP-IB.
Ordering Number: 5953-5119

3577A-2
Loop Gain Measurements with the HP 3577A Network Analyzer

A brief description of vector loop gain transfer function measurements with the HP 3577A. Topics covered include signal injection techniques with the loop closed, as well as measurements with the loop opened.
Ordering Number: 5953-5131

3585A
Understanding the HP 3585A Spectrum Analyzer

An excellent overview of the important measurement capabilities of the HP 3585A. This note includes a review of Spectrum analysis basics and discusses operational features of the HP 3585A for making frequency responsive measurements. It also covers modulation, non-linear circuit analysis, and surveillance measurements.
Ordering Number: 5952-8764

3708-1
Noise and Interference Effects in Microwave Radio Systems

This product note introduces the concepts of microwave radio noise, Carrier-to-Noise ratio, and interference. The effects of flat-fading and interference conditions on BER performance of digital radios is also discussed, contrasting with the Signal-to-Noise ratio performance for analog radio systems. Finally, a comparison between the traditional and HP 3708A methods of C/N testing is presented along with guidance on how to obtain the same results from both methods.
Ordering Number: 5953-5487

3708-2
Using the HP 3708A on Microwave Radio Testing

This product note introduces new users of the HP 3708A Noise and Interference Test Set to general operation of the instrument in microwave testing. Three basic tests are described using the HP 3708A; Carrier to Noise ratio, Carrier-to-Noise ratio with auxiliary interference, and Carrier-to-In-

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terference ratio vs. BER. This note then highlights the differences in performing the measurements on both digital and analog radio systems.
Ordering Number: 5953-5489

3708-3
Determination of Residual Bit-Error Ratio in Digital Microwave Systems

Residual error is a phenomenon that is present within every digital radio system, and its determination is of great importance both for initial installation, and routine system maintenance. Current methods for determining residual error ratio are time-consuming and cumbersome, and this product note describes a method of measuring this residual error ratio in a very short time using the HP 3708A Noise and Interference Test Set.
Ordering Number: 5953-5490

3708-4
Demonstration Guide: How to Win with the HP 3708A

This Demonstration Guide shows you in simple terms how to use the HP 3708A Noise and Interference Test Set to perform C/N versus BER testing. Used with or without software, the Guide shows specific demonstrations for development labs, manufacturers, and digital radio operators. It then shows in detail how to use the new demonstration software to improve speed and accuracy of the C/N vesus BER tests, and boasts many features which permit unattended measurements and results printing/plotting. This Demonstration Guide is essential reading for those who want to get the most out of the HP 3708A.
Ordering Number: 5954-9551

3708-5
Testing Satellite Systems With The HP 3708A

Describes the need for testing satellite systems and the different categories of performance testing. Includes a detailed description of satellite system testing with the HP 3708A to simulate the effects of noise and inference. Also included are practical tips to show how the HP 3708A is used for low bit rate applications, and what to do to increase noise power from the instrument.
Ordering Number: 5954-9555

3730-1
High Accuracy RF Measurements Using the HP 3730B

This product note is intended to illustrate some of the most important benefits of the HP 3730B and to help customers obtain better use of their MLA test systems. The HP 3730B is a flexible RF-to-IF Down Converter which combines the convenience of multi-band frequency coverage with excellent residual performance. When used to extend the interface capabilities of 70 or 140 MHz IF Microwave Link Analyzers (MLAs), the HP 3730B enables the RF performance of microwave radio systems to be optimized.
Ordering Number: 5953-5468

3776-1
Measurement Principles

The HP 3776A/B PCM Terminal Test Set can perform a wide range of measurements on 4 kHz analog voice and data channels in a mixed analog and digital network. This note explains these measurements and help the user to interpret the measurement results and identify the nature and source of a problem or impairment on the channel under test.
Ordering Number: 5953-5440

3776-2
Getting the Most Out of Your Versatile "LEVEL" Measurement

This note shows how the HP 3776A/B PCM Terminal Test Set can be used for "LEVEL" measurement to explore voice channels for fault-finding and diagnosis in the mixed analog and digital network. By generating a stimulus and measuring via one of a number of filters an additional range of measurements can be made: signal level, harmonic distortion, spurious inband tones, discrimination against outband tones, spurious outband outputs and 50/60 Hz rejection.
Ordering Number: 5953-5460

3776-3
Getting the Most Out of Your Group Delay/Envelope Delay Measurement

Describes the implementation and operation of Envelope Delay Distortion and Group Delay Distortion measurements in the HP 3776A/B PCM Terminal Test Set. The two measurement techniques are described and their significance to data traffic is explained. A complete example program for an HP 200 series computer with BASIC is included for both measurements.
Ordering Number: 5953-5461

3776-4
Getting the Most Out of Your End-to-end Measurements

This note explains how two HP 3776A/B PCM Terminal Test Sets can be used in making end-to-end measurements over telephone circuits in both the digital and analog domains. The various measurement capabilities of the HP 3776A/B in the end-to-end configuration are discussed and appropriate operation sequences illustrated with flow diagrams.
Ordering Number: 5953-5462

3776-5
Simulation of Line Signaling and Dialing with the HP 3776A

Describes how various signaling functions can be simulated using the HP 3776A PCM Terminal Test Set. By simulating signaling sequences the user can conveniently access different routes through CEPT networks from analog or digital access points.
Ordering Number: 5953-5463

3776-6
Simulation of Line Signaling and Dialing with the HP 3776B

Describes how various signaling functions can be simulated using the HP 3776B PCM Terminal Test Set. By simulating signaling sequences the user can conveniently access different routes through the North American network from analog or digital access points.
Ordering Number: 5953-5464

3785-1
Practical Jitter Measurements

Describes demonstration software that in conjunction with HP Telecommunications Test equipment performs three of the measurement techniques currently being used in this investigative work. The techniques utilize computer-controlled in-

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strumentation to quickly and accurately obtain results data at any of the three CCITT standard bit rates of 2, 8, and 34 Mbit/s. A sample program, to perform these measurements at the 2 Mbit/s level, and written in BASIC for HP Series 80 Personal Computers is listed.
Ordering Number: 5953-5429

3800
SNA Network Performance Analysis

SNA networks are complex and the burden of managing day-to-day operations of the network falls to a network manager. Performance information about the network is needed to make sound decisions on both a short-term and long-term basis. Decisions affecting topology, resources and users must be made. Software tools available from IBM and others run on installed equipment and the network devices themselves. These solutions take up valuable CPU time and memory space, and are limited in their ability to pinpoint and solve problems. The need for standalone dedicated hardware to help monitor, maintain and manage an SNA network is becoming increasingly obvious to the savvy network manager. A protocol analyzer is an ideal solution to help meet this need.

This product note addresses SNA/BSC network management within the above framework. By using true-to-life examples of problems and situations, features of the SNA/BSC network performance analysis software are applied in the solution of practical problems.
Ordering Number: 5952-5138

3852-1
Programming Guide To The HP 3852A And The HP 1000

This programming guide describes the preparation and programming of an HP 1000 computer system when used with the HP 3852A data acquisition and control instrument. It describes the error handling, time-outs, data formats, interrupts, and triggering of the instrument. Special attention is paid to high speed data transfers from the instrument's voltmeter.
Ordering Number: 5953-7011

3852-3
Multitasking On The HP 3852A Data Acquisition/Control Unit

This multitasking product note contains seven practical examples of programming the HP 3852A data acquisition and control instrument to utilize its multitasking operating system. The examples demonstrate time-slicing, queuing, priorities, interrupts, interactive programming, and logging data. It is designed to simplify the task of learning a powerful operating system.
Ordering Number: 5953-7043

3585A
Understanding the HP 3585A Spectrum Analyzer

An excellent overview of the important measurement capabilities of the HP 3585A. This note includes a review of spectrum analysis basics and discusses operational features of the HP 3585A for making frequency, amplitude, noise level and frequency response measurements. It also covers modulation, non-linear circuit analysis, and surveillance measurements.
Ordering Number: 5952-8764

4935A-1
Datacom Channel Testing with an HP 4935A

Describes how to test a datacom channel with the HP 4935A Transmission Impairment Measuring Set (TIMS). In addition to measurement procedures, this note explains what each measurement is, why it is important, how it is measured, and what the results mean.
Ordering Number: 5952-4988

4937S
HP 4937S Product Note

The HP 4937S Network Access Transmission Set can solve some of the problems created by the AT&T divestiture. Discusses how the HP 4937S provides solutions for telephone companies, equipment providers and communication service users.
Ordering Number: 5952-5032

4945A
HP 4945A Master/Slave Product Note

This product note discusses testing problems, explains what master/slave is, and discusses master/slave capabilities. Breaking master/slave down into two phases, link-up and operation, it explains how the technique works. It gives step-by-step directions on how to operate the HP 4945A under master/slave, with several screen shots to illustrate the process.
Ordering Number: 5952-5025

4948A-1
Measurement Principles

On voice-frequency circuits, data-impairing effects, such as noise, jitter and transients, are traditionally measured using Transmission Impairment Measuring Sets (TIMS). These instruments require that the circuit to be tested is removed from service. The HP 4948A In-Service TIMS, on the other hand, uses a completely new method to measure the same impairing effects. It does not require the circuit to be removed from service, because it uses the "live" modem signal as the line stimulus, not an artificially generated signal.
Ordering Number: 5954-7913

4948A-2
Network Monitoring System Demonstration Software For The HP 4948A

The HP 4948A In-service TIMS, or ITIMS, is a useful network monitoring tool, and the demonstration system software described in this product note gives a working example of a low-cost network monitoring system which is virtually modem-independent. The system runs on a color HP Vectra, IBM PC, XT or AT computer or compatible. The software can control one ITIMS and several HP 3777A Channel Selector switches to monitor voice-grade leased data lines. The status of the network being monitored can be seen at a glance on a network status display. This display is always on view and is updated using color as results are returned to the PC.
Ordering Number: 5954-9552

4954A-1
SNA Network Performance Analysis

SNA networks are complex and the burden of managing day-to-day operations of the network falls to a network manager. Performance information about the network is needed to make sound decisions on both a short-term and long-term basis. Decisions affecting topology, resources and users must be made. Software tools available from IBM and others run on installed equipment and the network devices themselves. These solutions take up valuable CPU time and memory space, and are limited in their ability to pinpoint and solve

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problems. The need for standalone dedicated hardware to help monitor, maintain and manage an SNA network is becoming increasingly obvious to the savvy network manager. A protocol analyzer is an ideal solution to help meet this need.

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4954A-2
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4972A-1
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Ordering Number: 5952-5103

5180A-2
Dynamic Performance Testing of A-to-D Converters

Provides a detailed description of the tests used to specify the dynamic performance of the HP 5180A's A-to-D converter. Beat frequency testing, histogram testing, discrete finite Fourier transform testing, and sine-wave curve fitting are among the tests covered. Annotated software listings which can be adopted to a variety of waveform recorders are provided.
Ordering Number: 5952-7629

5180A-3
General Purpose Subroutines for the HP 5180A Waveform Recorders

An advanced programming guide to the HP 5180A covering rules and formats, command types, data I/O (in binary, ASCII, and using DMA), teach/learn programming, data storage and retrieval techniques, and other topics. Numerous software listings in subroutine form are included.
Ordering Number: 5952-7643

5182A-1
Understanding the HP 5182A Waveform Recorder/ Generator

The operation of the HP 5182A is described in detail. There are four main sections: 1) Recording Waveforms into Memory, 2) Viewing Memory Records, 3) Generating a Waveform from Memory, 4) Interfacing to a Computer System. Each section includes figures to help explain the typical operations that are discussed.
Ordering Number: 5952-7733

5334A-1
Remote and Front Panel Operation of the HP 5334A Universal Counter

Describes remote and front panel operation of the HP 5334A Universal Counter. Program examples are in BASIC for the Series 200 Desktop Computers. High speed output, SRQ interrupt, and applications programs are included.
Ordering Number: 5952-7699

5335A
HP 5335A Universal Counter User's Introduction

Describes the many unique features and measurements possible with the 5335A Counter. Application examples are also given.
Ordering Number: 5952-7604

5370B-2
Better than 100ps Accuracy in HP 5370B Time Interval Measurements

Through Bias Error ReductionThis note describes how to minimize systematic (bias) errors from a time interval measurement to yield better than 100ps accuracy. Applications include ATE/IC Tester calibration, characterization or test of ICs, and disc drive testing.
Ordering Number: 5952-7834

5370B-3
High Throughput Picosecond Characterization of Pulse Parameters

Describes how, by virtue of its 20ps single short resolution and great measurement speed, the HP 5370B can be used in pulse characterization applications. A BASIC program listing is included which exemplifies techniques for statistical and graphical presentation of data such as histograms and frequency versus time plots. These capabilities are useful in applications such as Disc Testing, IC Characterization, and Data Communications Testing.
Ordering Number: 5952-7769

5371A
HP 5371A Frequency and Time Interval Analyzer

This brochure provides detailed information on HP 5371A measurement capabilities. Continuous measurement technology is explained in depth. Special arming features of the HP 5371A are examined. Time interval, frequency, period, phase, rise and fall time, pulse width, duty cycle, totalize and peak amplitude measurements are discussed. This product note also examines the HP 5371A's built-in analysis features such as time variation, histogram, statistics and event timing. Detailed product specifications are provided.
Ordering Number: 5952-7927

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ABSTRACTS — PRODUCT NOTES

HP 5384A/5385A-1
5384A and 5385A Frequency Counter User's Guide

Describes front and rear panel operation of the HP 5384A and HP 5385A frequency counters. Remote operation is also covered. Sample application programs for an HP-IL system with the HP 41C/CY handheld calculators and for an HP-IB system with the HP series 80 Desktop Computers are included.
Ordering Number: 5952-7700

5527A-1
Rapid Data Collection With The HP 5527A Laser Position Transducer System

This product note presents the hardware and software required to collect position data measured by the HP 5527A Laser Position Transducer System at uniform data rates up to 300 kHz
Ordering Number: 5952-7946

5527A-2
Achieving Maximum Accuracy and Repeatability with the HP 5527A Laser Position Transducer System

This product note introduces the basic concepts, techniques and principles that determine the overall performance of the HP 5527A Laser Position Transducer System. Details are given on how to determine a laser system's accuracy and repeatability for a given application.
Ordering Number: 5952-7973

6031A/32A/33A/38A
Quick Reference Guide HP Systems Power Supplies Models 6031A, 6032A, 6033A and 6038A

Ordering Number: 5952-4118

6940B-1
Scanning with the 6940B

This product note provides installation and programming information for the Model 6940B and several of its I/O cards in scanning applications. Also provided, is a section on the theory of operation of the scanning system.
Ordering Number: 5952-4076

6940B-2
Power Supply Control

This system-level document provides all the information needed to program the HP 6012A and HP 6024A power supplies from the HP desktop computer or controller via the HP 69502A power supply programming card.
Ordering Number: 69520-90003

6940B-3
Subassembly Testing

An HP 6940B multiprogrammer is used as the core of an automatic test system by Ford Motor Company's Electrical and Electronics Division. The automatic test system provides Ford with an increase in the quality of their electronic subassemblies while increasing productivity. The HP 6940B multiprogrammer allows Ford's test engineers to design an automatic test system quickly and with the needed flexibility.
Ordering Number: 5952-4086

6940B-4
Automating Manual Equipment

A Hewlett-Packard 6940B Multiprogrammer is used as the core of a Radiation Monitoring System developed by Yankee Atomic Electric Company's Nuclear Services Division. The HP 6940B is used in conjunction with radiation measurement equipment to automate a radiation monitoring system utilizing the Thermoluminescent Dosimetry technique (TLD). The HP 6940B Multiprogrammer is used to digitize the glow curves and control the TLD reader.
Ordering Number: 5952-4094

6940B-5
Basic Research

The study of submicron device characteristics comprises a portion of the research efforts of the microelectronics research group at Colorado State University (CSU). The HP 6940B multiprogrammer is used to interface an HP 9845A desktop computer to a Scanning Electron Microscope (SEM). These components are the basis of an Electron-Beam-Lithography (EBL) system. This EBL system gives the CSU research group the capability of sub-tenth micron pattern generation.
Ordering Number: 5952-4098

6940B-6
Product Evaluation

The development of tire and tread designs at BF Goodrich requires doing evaluations of their performance characteristics. Tire engineers use the HP 6940B multiprogrammer to test tire effectiveness under varying surface and load conditions. The multiprogrammer based test system provides a flexibility which allows tire engineers to quickly and easily implement changes in test procedures. This flexibility allows many experiments to be performed during a field test. Results are available almost immediately, and thus more timely product decisions can be made.
Ordering Number: 5952-4097

6942A-1
A Multiprogrammer Application Story in Production Line Testing

An HP 6942A multiprogrammer controlled from an HP 9825A Desktop Computer is used in a versatile system designed by Solitron Devices Inc. to test digital and linear hybrid microcircuits during their assembly. These hybrid devices include power amplifiers and custom digital LSI CMOS circuits. Further system capabilities include testing of integrated circuits, printed circuit boards, and other electronic subassemblies and products. The test system, which operates with both analog and digital signals, can be produced, set up, and completely operational for less than $30,000. The system increased productivity more than tenfold by reducing the average test time per device.
Ordering Number: 5952-4080

6942A-2
A Multiprogrammer Application Story in Heavy Industry

An HP 6442A multiprogrammer controlled by an HP 9915A Modular computer is used to control the manufacture of helically corrugated metal pipe. Northwest Culver Co. designed a patented system to set up the pipe mill, continuously measure the pipe diameter and lengths being produced, adjust the mill accordingly, and transfer resulting data to a real-time inventory system. Virtually all measurements and control outputs are done directly by multiprogrammer I/O cards thus avoiding any custom circuitry. The combination of the HP 9915A computer and HP 6942A multiprogrammer.
Ordering Number: 5952-4095

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6942A-3
A Multiprogrammer Application Story in Instrument Control

An HP 6942A multiprogrammer, controlled by an HP 9835A desktop computer, is used in an automatic modem test system developed by Harris Government Information Systems Division. The Harris Integrated Test System (HITS) is a computerized test system which automatically tests, aligns, and troubleshoots complex ground and airborne modems, either by themselves or within terminals. Within the HITS system, the HP 6942A functions as an instrument controller for five separate pieces of Harris designed interface emulation equipment. As a dedicated hardware controller, the multiprogrammer provides an excellent, cost-effective solution which easily met performance criteria.
Ordering Number: 5952-4096

8340-2
Generating Phase-Coherent Microwave Signals with the HP 8340 and 8341 Synthesized Sweepers

This note describes how to configure two HP 8340 or 8341 synthesized sweepers to achieve two microwave signals that are phase coherent. This configuration also allows the user to vary the phase between the two signals. This is useful in testing phased array antennas or other phase sensitive devices or systems.
Ordering Number: 5954-1595

8340-3
Typical Performance of the 8340 and 8341 Synthesized Sweepers

Describes the typical (defined as 85% of units pass) and mean performance of the HP 8340 and 8341 synthesized Sweepers as documented by actual production test data. Key specification such as power, level accuracy, and spurious are included.
Ordering Number: 5954-8389

8340A-1
Increasing the Frequency Switching Speed on the HP 8340A Synthesized Sweeper

This product note addresses the HP 8340A Synthesized Sweeper's definition of specified switching time, and explains the techniques available to improve its switching times with sample programs written for the HP 200 series (HP 9816A, 9826A, 9836A) computers.
Ordering Number: 5953-8870

8340A-6
Reduced Harmonic Distortion Using the Integra TMF-1800H Tracking Filter with the HP 8340A Synthesized Sweeper

This product note describes the source harmonic performance, the equipment setup, and the operation associated with using the Integra TMF-1800H Tunable Microwave Filter with the HP 8304 Synthesized Sweeper.
Ordering Number: 5952-9343

8340A-7
Microwave Noise Figure Measurements Using the HP 8340A Synthesized Sweeper with the HP 8970A Noise Figure Meter

This note describes the operation of the HP 8340A Synthesized Sweeper as an external LO for the HP 8970A Noise Figure Meter.
Ordering Number: 5953-8879

8349-1
Achieving Calibrated Output Power with the HP 8350 Sweep Oscillator/8349 Broadband Amplifier Combination

Describes how to calibrate the ALC reference of the HP 8350B Sweep Oscillator using the LED power output display in the HP 8349B Microwave Amplifier, allowing the sweep oscillator to control the level of output power at the amplifier. Included are an example of equipment set-up and typical results.
Ordering Number: 5954-1516

8350-3
A Penlift Dwell Circuit for the HP 8350 Sweep Oscillator

This product note details a circuit which attaches to the programming connector of the HP 8350 Sweep Oscillator and creates an extended penlift command. This is useful in systems that involve the HP 8350 with a multiband plug-in, a power meter, and an HP X-Y recorder.
Ordering Number: 5953-8859

8350-4
Pulse Modulation Characteristics of the HP 83500 Series Sweep Oscillator RF Plug-ins

Describes the new pulse modulation performance available in the new HP 83500 series RF plug-ins. Includes improved typical performance in the areas of repetition rate, minimum pulse width, and delay time. Also included is a list of the serial numbers of the RF plug-ins that have this capability as well as a list of appropriate retrofit kits for those units that do not.
Ordering Number: 5954-1505

8350-6
Reduced Harmonic Distortion Using the Integra TMF-1800H Tracking Filter with the 8350 Sweep Oscillator

This product note describes the source harmonic performance, the equipment set-up, and the operation associated with using the Integra TMF-1800H Tunable Microwave Filter with an HP 8350 Sweep Oscillator mainframe and any HP 83590 series Plug-in.
Ordering Number: 5952-9345

8350-8
Leveling the HP 8350B Sweep Oscillator with an HP 430 Series Power Meter

This product note describes how to set up a power meter leveling system using the HP 8350B Sweep Oscillator and the HP 438A, 436A, or 432A/B Power Meters. These systems provide improved output power flatness and source match. Examples of equipment set-ups and typical performance are given.
Ordering Number: 5954-1507

8350-9
Improving the Output Power Flatness from the HP 8350B Sweep Oscillator

Obtain improved output power variation and effective source match from the HP 8350B sweep oscillator by using the technique described in this product note. This very simple technique incorporates external leveling along with the power slope compensation feature of the HP 83500 Series RF plug-ins to provide up to ± 0.2 dB (typical) output power flatness from 50 MHz to 18 GHz.
Ordering Number: 5954-8344

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ABSTRACTS — PRODUCT NOTES

8350A-1
Using the HP 8350A Sweep Oscillator with the Wiltron-560 Scalar Network Analyzer

This note describes the necessary connections to make the HP 8350A work with the Wiltron 560 Scalar Network Analyzer.
Ordering Number: 5952-9328

8350A-2
Improved Frequency Accuracy by Calibrating HP 83590 Series RF Plug-ins to HP 8350A Sweep Oscillator Mainframe

Describes how to improve the frequency accuracy of an HP 83590 series plug-in using the built-in diagnostic and calibration firmware and any frequency counter with an upper frequency range of 7 GHz or 13.5 GHz.
Ordering Number: 5952-9330

8350A-7
Microwave Noise Figure Measurements Using the HP 8350A Sweep Oscillator with the HP 8970A Noise Figure Meter

This note describes the operation of the HP 8350 sweeper as an external LO for the HP 8970A Noise Figure Meter.
Ordering Number: 5952-9344

8408B-1
Building Your Own HP 8408B Automatic Network Analyzer

Describes how to configure a 500 MHz to 18 GHz Automatic Vector (magnitude and phase) RF and Microwave Network Analyzer using standard instruments. Topics include required hardware, system assembly, and system checkout. Also see AN 221A for a discussion of sources of error and ambiguity, measurement calibration techniques, and correction of errors.
Ordering Number: 5953-8851

8510-1A
Millimeter-wave Vector Measurements Using the HP 8510A Network Analyzer and HP Millimeter-wave Test Sets.

Describes a millimeter-wave network measurement system that can be configured using the HP 8510A Network Analyzer and other components available from HP. The block diagram, theory and configuration procedures, and functional tests for systems covering the 26.5 GHz, 33 to 50 GHz, and 40 to 60 GHz waveguide bands are shown. Typical measurement results and expected performance levels are also discussed.
Ordering Number: 5954-1523

8510-2
Radar Cross-Section Measurements with the HP 8510 Network Analyzer

Describes a system based on the HP 8510A Network Analyzer for making Radar Cross-Section (RCS) measurements. The block diagram, theory of operation, and typical results are discussed. A sample program for measurement calibration is also included.
Ordering Number: 5954-1522

8510-3
Measuring Dielectric Constant with the HP 8510 Network Analyzer

Describes a measurement technique for deriving complex permeability and permitivity from S-parameter measurements of a material sample. Basic theory, sample fixturing, measurement procedures, and typical results are discussed. Accuracy consideration and time domain enhancements are also developed.
Ordering Number: 5954-1535

8510-5A
Specifying Calibration Standards for the HP 8510B Network Analyzer

Describes criteria for specifying calibration standard definitions and classes for the HP 8510B Network Analyzer. Includes an example of specifying standards for a waveguide calibration kit.
Ordering Number: 5956-4352

8510-6
On-wafer Measurements Using The HP 8510 Network Analyzer

Describes a system based on the HP 8510 network analyzer and Cascade Microtech wafer probes for making measurements of microwave devices and circuits (MMICs) on-wafer. Included are a system block diagram, calibration procedures, and example measurements.
Ordering Number: 5954-1579

8510-7
Amplitude and Phase Measurements of Frequency Translation Devices with the HP 8510B

Describes a system based on the HP 8510B network analyzer for making amplitude and phase matching and tracking measurements on frequency translation components such as mixers and receivers. Included are a system block diagram, procedures for matching mixers and receiver channels, and typical results.
Ordering Number: 5954-8379

8510-8
Applying the HP 8510B TRL Calibration for Non-coaxial Measurements

Describes the Thru-Reflect-Line (TRL) calibration procedure for the HP 8510B network analyzer. Included are specifying calibration standards, calibration procedures, and an example calibration with a microstrip fixture.
Ordering Number: 5954-8382

8510-9
Pulsed RF Network Measurements Using the HP 8510B

Describes a system based on the HP 8510B network analyzer for making magnitude and phase measurements on components that have a pulsed-RF input signal. Included are system block diagrams, measurement considerations, and example measurements.
Ordering Number: 5956-4333

8510-10
An Introduction to Operating the HP 8510B Network Analyzer

Describes operating procedures for the HP 8510B network analyzer. An overview of the front panel, system setup, calibration, transmission and reflection measurements and time domain measurements are given.
Ordering Number: 5954-8367

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8510-12
Millimeter-wave Measurements Using the HP 8510B Network Analyzer

Describes a system based on the HP 8510B network analyzer for making magnitude and phase measurements on devices and components in the 26.5 GHz to 100 GHZ frequency range. System block diagrams, operating procedures, and example measurements are given.
Ordering Number: 5956-4331

8510-13
Measuring Noninsertable Devices

This note describes several calibration techniques for dealing with the noninsertable device measurement problem. The techniques include "switched adapters," "modelled thru," and the new "adapter removal" methods. Measurment procedures and examples are shown.
Ordering Number: 5956-4373

8510-14
Using Multiple Test Sets with the HP 8510B

This note describes how a single HP 8510B can alternately control up to four test sets. In many applications this results in reduced setup times and increased productivity. A description of how a multiple test set system works and detailed operating instructions are included.
Ordering Number: 5952-6674

8566A-2
Using the HP 8566A Spectrum Analyzer for Signal Analysis Above 22 GHz with External Mixers

Describes how to use the HP 11970 series of external waveguide mixers for signal analysis above 22 GHz with the HP 8566A Spectrum Analyzer. This note explains how to use the automatic signal identification routine built into the 8566A firmware and the algorithm used to perform this function. Also included are procedures for calculating frequency and amplitude accuracies and techniques for making amplitude corrected measurements.
Ordering Number: 5952-9384

8566B/68B-1
Third-Order Intermodulation Distortion Measurements

This note contains a complete program that measures the third-order IMD products of two input signals in the range of 10 MHz to 500 MHz. The program can be downloaded into an HP 8566B or HP 8568B Spectrum Analyzer and executed from the analyzer front panel, or run from a computer.
Ordering Number: 5954-2701

8620C-1
Using the HP 8620C Sweep Oscillator with the Wiltron 560 Scalar Network Analyzer

This note describes the necessary connections to make the HP 8620C Sweep Oscillator work with the Wiltron 560 Scalar Network Analyzer.
Ordering Number: 5952-9327

8642A/B-1
The Benefits and Use of the HP 8642A/B

This product note explores the HP 8642A/B features by discussing their benefits for various applications. An application matrix shows the benefits of the HP 8642A/B advanced features for common RF application areas. Where an application is simplified with the HP 8642A/B, a checker and benefit are positioned. After the matrix, a familiarization guide walks you through the front panel describing HP 8642A/B features and demonstrating their use to help you become acquainted with the HP 8642A/B and its operation.
Ordering Number: 5953-8453

8642A/B-2
Using Sweep Functions on the HP 8642A/B

The HP 8642A/B includes features such as sweep that make it versatile for many applications. Although the HP 8642A/B is not a dedicated sweep generator, three useful sweep functions (digitally-stepped frequency sweep, linear phase-continuous frequency sweep, and log/linear amplitude sweep) are provided. This product note focuses on the advantages and limitations of these sweep functions, and the HP 8642A/B's compatibility with the HP 8756A and HP 8757A Scalar Network Analyzers.
Ordering Number: 5953-8452

8644A
Series 200/300 HP-SL Programming Guide

Ordering Number: 5951-6727

8645-1
Agile operation Of The HP 8645A

Manual operation of the new frequency agile capabilities of the HP 8645A Agile Signal Generator are explained in detail in this product note. Specific topics include entering channel and sequence tables, setting hop rate and dwell time, establishing hop synchronization with external equipment and controlling amplitude changes. Numerous timing waveforms are given for different modes of agile operation.
Ordering Number: 5951-6711

8645-2
A Catalog Of HP 8645A Information

Extensive information on various performance and operational aspects of the HP 8645A Agile Signal Generator are explained in this product note. Among the thirty topics covered are descriptions of many unspecified signal characteristics and special operating capabilities that are built-in to the generator. This information should provide assistance in evaluating the capabilities of the generator for a particular application and in optimizing its operation for various signal simulations.
Ordering Number: 5951-6712

8665A
Series 200/300 HP-SL Programming Guide

Ordering Number: 5951-6727

8673A-1
Reducing HP 8673A Signal Generator Harmonically Related Spurious with Integra TMF-1800K Tunable Microwave Filter

Describes how a tracking YIG filter can be used to suppress unwanted harmonics and sub-harmonics of a 2-26 GHz signal generator. Includes typical performance data.
Ordering Number: 5952-8290

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ABSTRACTS — PRODUCT NOTES

8673A-2
Synthesized Signals from 2 to 60 GHz

Describes how an active doubler can be used with a 2-26 GHz signal generator to extend operation to 60 GHz. Includes typical performance data.
Ordering Number: 5952-8284

8683/4-1
Applications and Performance of the 8683A/B and 8684A/B Microwave Signal Generators

Describes the typical performance of a family of cavity tuned signal generators with AM, FM, and pulse modulation. Also discusses tests these generators are well suited to make. Includes some theory of operation and built-in test capability.
Ordering Number: 5952-8260

8683/4-2
Performance and Applications of the HP 8683/4D Microwave Signal Generators

This note shows how these 2.3 to 18.0 GHz cavity-tuned generators with internal frequency-doublers perform in typical measurement situations. It covers the special considerations needed when using passive doublers. Other applications such as satellite video (wide-band FM) are described.
Ordering Number: 5952-8298

8753-1
Amplifier Measurements Using the HP 8753 Network Analyzer

Measure commonly specified amplifier parameters such as gain, gain compression, isolation, SWR, deviation from linear phase, group delay, and complex impedance. Harmonic measurement capability in the HP 8753B quickly determines swept-frequency amplifier harmonica over a broad range.
Ordering Number: 5956-4361

8753-2
Mixer Measurements Using the HP 8753B Network Analyzer

Provides description and explanation for the measurement of mixers using the HP 8753B network analyzer. Measurements include conversion loss, conversion compression, amplitude and phase tracking, third-order IMD, isolation and SWR. Also covered are filtering, attenuation, and frequency selection considerations necessary for making accurate measurements on a frequency translating device.
Ordering Number: 5956-4362

8756-2
Using the HP 11664C Detector Adapter to Make Millimeter-wave Scalar Measurements

This note includes a discussion of a scalar millimeter-wave measurement system based on the HP 8756A, a detailed procedure for calibrating the HP 11664C Detector Adapter, two measurement examples, and a listing of some known millimeter-wave equipment vendors.
Ordering Number: 5954-1506

8756-4
How to Automate the HP 5344S Source Synchronizer, the HP 8350B Sweep Oscillator, and the HP 8756 Scalar Analyzer with an HP Series 200 Computer

This note describes how to configure an automatic scalar network measurement system using the HP 5344S Source Synchronizer for applications requiring better frequency accuracy. Included are connection instructions, a sample program using the HP Series 200 BASIC language, and a complete description of the program.
Ordering Number: 5953-8894

8756A-1
Automating the HP 8756A Scalar Network Analyzer

This note describes an economical computer-controlled scalar network analyzer. Using the HP 8756A Scalar Network Analyzer, and 8350B Sweep Oscillator with appropriate RF plug-in, and an HP 85 computer, this system can make automatic insertion and/or return loss measurements over a 10 MHz to 26.5 GHz frequency range. The data may be displayed or printed as a graphical plot or table of values. Topics included are equipment description, system operation, software overview, and program listing.
Ordering Number: 5953-8869

8757-1
Using AC detection with the HP 8756/8757 Scalar Network Analyzers to Make More Accurate Measurements

This note describes the benefits and applications of using AC detection instead of DC detection with a scalar network analyzer. Included is a brief review of AC and DC detection, and the affects on measurements of amplifiers, mixers, switches, filters, and antenna.
Ordering Number: 5954-8386

8757-2
V and W Band Millimeter Scalar Measurements Using the HP 8757 Scalar Network Analyzer

This note describes a scalar network analyzer system that is capable of making measurements over the critical portions of the V(50 to 75 GHz) and W (75 to 110 GHz) millimeter-wave bands. Included are the theory of operation, hardware requirement, and setup, calibration procedure, and measurement capabilities. The systems described cover 55 to 65 GHz, and 90 to 100 GHz.
Ordering Number: 5954-8380

8757-5
Measuring Voltage-Controlled Devices with the HP 8757A Scalar Network Analyzer

Describes measurements of voltage controlled oscillators and voltage controlled attenuators using the non-standard sweep mode of the HP 8757A Scalar Network Analyzer. In this mode the scalar analyzer accepts any sweep ramp in the 0-10 V.H range to drive the X-axis of the display. VCO power or VCA attenuation are then displayed directly as a function of tuning voltage.
Ordering Number: 5954-1537

8757-6
Automated Amplifier Measurements Using the HP 8756/8757 Scalar Network Analyzers

This note describes a method for automating common amplifier measurements as described in AN 345-1 (which describes the theory behind amplifier measurements and example measurement sequences). Included is a program listing, description of operation, various descriptions for those interested in modifying the program, and the required equipment. The program operates on most HP 9000 Series 200 and 300 computers using BASIC.
Ordering Number: 5954-8347

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ABSTRACTS — PRODUCT NOTES

8770S-2
Effective Use Of The HP 8770S Signal Simulator System

This 64-page note provides detailed programming considerations for the HP 11776A Waveform Generation Software and the 50 MHz Arbitrary Waveform Synthesizer. It covers waveforms from sine waves to frequency-hopped to multiple tone carriers, pulsed wave forms, phase-tagging, and pulse train with AM and scan characteristics. Seven appendices review technical details such as truncation noise.
Ordering Number: 5954-6360

8780A-1
Introductory Operating Guide To The HP 8780A Vector Signal Generator

This 32-page note gives performance data for the 10 to 3000 MHz signal generator for such parameters as modulation, digital PSK/QAM, FM amplitude/scalar and combinations of simultaneous modulation. TDMA, bit-error- rates, and pulse-coded radar are considered as well as dynamic wideband component testing for phase transients.
Ordering Number: 5954-6368

8791-1
Using Dynamic Data with the Frequency Agile Signal Simulator

The HP 8791 is a state-of-the-art signal generator (10 to 3000 MHz) capable of wideband and complex modulation needed in modern system test. Certain systems such as secure communications require dynamic data to be entered on a real-time basis for AM, FM, Phase modulation and carrier frequency or pulse characteristics. This note provides instructions for accessing the dynamic memories with data up to 33 MHz rates.
Ordering Number: 5953-2343

8901A-1
Extending the Frequency Range of the 8901A Modulation Analyzer

Ordering Number: 5952-8248

8902A-2
Accurate Singal Characterization at Millimeter-Wave Frequencies

The HP 8902A Measuring Receiver can be configured to accurately characterize signals and calibrate attenuators at millimeter-wave frequencies. This product note describes how measurements are made from 26.5 to 110 GHz using the HP 8902A, and typical uncertainties which can be expected when making these measurements.
Ordering Number: 5953-8436

8903A-1
Operating the 8903A Audio Analyzer Below 20 Hz

Ordering Number: 5952-8246

8904A
A Book Of Ideas For Creating Waveforms With The HP 8904A

This waveform catalog contains listings for a number of complex waveforms which can be created by the HP 8904A. Over 70 complex wave forms are listed, each with an actual digitized plot of the waveform, complete setting details for the HP 8904A, and application information. Also included are hints and tips for modifying the waveforms to match specific requirements.
Ordering Number: 5951-6715

8904A-1
Using the HP 8904A Multifunction Synthesizer As A Communications Signaling Source

This note explains how the HP 8904A can be used as signaling source for various communication systems. Three major types of signaling are covered: Tone signaling, DTMF (telephone touch tone), and digital signaling. Examples of how to set up the HP 8904A for various standard formats are presented. These examples include CTCSS, CCIR, CCITT Euro and Motorola 5/6 tone for tone signaling and DCS, RPCI and GSC formats for digital pocket paging.
Ordering Number: 5953-8489

8904A-2
Using The HP 8904A Multifunction Synthesizer As An FM Stereo Composite Generator

Explains how the 8904A can be used in conjunction with a signal generator and audio analyzer to test FM stereo receivers. Topics covered include: system basics of FM stereo, what test signals the HP 8904A can generate, pre-emphasis with the HP 8904A, and SCA and ARI applications. Also included are measurement systems setups and programming examples. Advanced topics explain how the HP 8904A can be used to improve stereo separation of RF signal generators.
Ordering Number: 5953-8487

8904A-3
Using The HP 8904A Multifunction Synthesizer As A Modulation Source For Navigation Applications

This product note explains the basic principles of the VOR and ILS systems and how the HP 8904A can be used to generate them. Detailed instrument settings for the 8904A are included as well as discussions of predicting accuracies when generating VOR and ILS signals. Information concerning complete automatic test systems for VOR/ILS application is also presented.
Ordering Number: 5953-8488

8904A-4
Using the HOP RAM Sequence Mode Special Option H-O8 for the HP 8904A Multifunction Synthesizer

This product note explains the operating of the HOP RAM sequence mode of the HP 8904A. This mode is available for the HP 8904A with special option H-O8. Included are example instrument screen, HP-IB codes and example programming techniques.
Ordering Number: 5951-6731

8970A-1
Applications and Operation of the 8970A Noise Figure Meter

Outlines step-by-step procedures for making noise figure measurements on a variety of devices using a modern, computer aided noise figure meter. Describes how to configure systems for amplifiers or mixer measurements, 10 MHz to 18 GHz. Also includes a brief theory of operation section.
Ordering Number: 5952-8254

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ABSTRACTS — PRODUCT NOTES

8970B/S-2
Applications And Operation Of The HP 8970B Noise Figure Meter And HP 8970S MW Noise Figure Measurement System

This 70-page note gives detailed NF measurement procedures for the range from 10 to 18,000 MHz, with step-by-step guides to the many different modes. With the new HP 8971B Noise Figure Test Set, the somewhat intimidating down-conversion setups are considerably simplified, and required mixer, amplifiers, filters and switching are all contained in the system.
Ordering Number: 5954-8896

8970B/S-3
Noise Parameter Measurement Using the HP 8970B Noise Figure Meter and the ATN Model NP4 Noise Parameter Test Set

Designers of RF and microwave amplifiers and integrated-circuit modules need to make optimization decisions between gain and noise figure when designing matching networks for transistors. Gain and noise figure circles plotted on a Smith Chart is the method for determining the optimum source impedance for a device. The ATN Model NP4 Test Set provides the programmable source impedance and the HP 8970T NF Measurement System provides the noise figure capability. This note details the theory and practice of setting up the equipment and making the measurements.
Ordering Number: 5952-6639

8980A-1
Introductory Operating Guide To The HP 8980A Vector Analyzer

Covers extended performance data and special measurement routines for complex modulation formats such as 64QAM, offset QPSK, TDMA burst measurements, constellation closure, quadrature error and chirped radar signals. Appendices include theory on a build-it-yourself vector demodulator.
Ordering Number: 5954-6369

8980A-2
Dynamic Range Considerations Of The HP 8980A Vector Analyzer

This note considers how system noise, gain settings, and timing jitter affect the effective dynamic range of this dual-channel baseband analyzer (dc to 350 MHz). It looks at various operating conditions and control settings.
Ordering Number: 5952-3704

11729B-1
Phase Noise Characterization of Microwave Oscillators (Phase Detector Method)

Covers the basic theory of unwanted phase modulation and the phase detector method of measurement. Also describes a system based on the 11729B Carrier Noise Test Set for measurements on free running and synthesized sources, 5 MHz to 18 GHz. Includes an estimate of overall measurement accuracy.
Ordering Number: 5952-8286

11729C-2
Phase Noise Characterization of Microwave Oscillators (Frequency Discriminator Method)

Discusses RF and microwave single-sideband phase noise measurements based on the HP 11729C Carrier Noise Test Set for signals from 10 MHz to 18 GHz. Focuses on the frequency-discriminator method which is most useful for measurements on free-running oscillators. Since no external low-noise reference synthesizer is required by the discriminator method, costs are lower. Detailed measurement procedures are given along with complete calibration and accuracy considerations. Five appendices round out the technical material.
Ordering Number: 5953-6497

11970-71
HP 11970-71 Series Harmonic Mixers

This product notes describes how to use HP Spectrum Analyzer models 8566A/B, 71300A, 8569B and 8562A/B with HP 11970/71 series harmonic mixers (18 to 110 GHz).
Ordering Number: 5954-9100

34800-1
Programming and Demo Guide to the HP FTM/300 Functional Test Manager Software Package

This programming guide is a software interactive document that shows how easy it is to use the framework of HP FTM/300 to enhance your development of production test software. It describes the foremost features of HP FTM/300. The guide leads you through a developed test that simulates the final testing of a HP 3325A function generator.
Ordering Number: 5953-7028

35650
Introduction to Programming the HP 35650 Series Hardware

This Product Note conceptually describes the HP 3565S Hardware. It introduces the commands and syntax needed to program the hardware via HP-IB and the Basic operating system for HP 9000 Series 200 & 300 computers. The Product Note describes the HP 35651A HP-IB/Signal Processor Module, HP 35652A 50 KHz Input module and the HP 35653A Source Module. A sample program is described to obtain frequency spectrums from a single input module.
Ordering Number: 5954-7965

35651A-1
Introduction To Programming The HP 35650 Series Hardware

This product note introduces the commands and syntax needed to program the HP 35650 via HP-IB and the Basic operating system for HP 9000 Series 200 and 300 computers. It describes the HP 35651A HP-IB/Signal Processor Module, HP 35652A 50 kHz Input module and the HP 35653A Source Module. Includes a sample program which obtains frequency spectrums from a single input module.
Ordering Number: 5954-7965

35660A-1
Production Testing with the HP 35660A Dynamic Signal Analyzer

This note discusses how the HP 35660A low frequency analyzer and its internal progrmming language (HP Instrument BASIC) can automate production testing without an external computer. An example program is included show how acts as a system controller while testing a group of filters.
Ordering Number: 5954-7996

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ABSTRACTS — PRODUCT NOTES

35660A-2
Single-plane Balancing with the HP 35660A Dynamic Signal Analyzer

The advantages of balancing rotating machinery include longer equipment life, less machinery noise, and reduced energy consumption. This note describes how the HP 35660A low frequency spectrum analyzer can make precision balancing measurements using a technique called single-plane balancing.

Ordering Number: 5954-7997

44458A
Using HP DACQ/300 Programming Guide

This programming guide outlines the basic functions that the HP DACQ/300 software can perform. It contains 17 programming examples to show how the software can save programming time. Graphs and printouts are included to show the results of each example. The appendix contains typical execution speeds of the software on several HP Series 200 and 300 computers.

Ordering Number: 5953-7022

54110 A/D
Precision Time-Interval Measurements with the HP 54100/110 Digitizing Oscilloscope

The new generation of digitizing oscilloscopes have exceptionally accurate and stable time bases. How accurate are real world time-interval measurements made with these oscilloscopes? This product note examines all the attributes of the measurements that influence the overall measurement accuracy

Ordering Number: 5954-2644

54110D
Dual Delayed Sweep Versus Random Repetitive Sampling

Many analog oscilloscopes offer dual sweep display; most digitizing oscilloscopes have a singe time base. This product note shows how the single time base in the digitizing oscilloscope solves each of the problems that are addressed by dual sweep, only better.

Ordering Number: 5954-2643

54111D
Sub-nanosecond Single-Shot Digitizing Using the HP 5411D

This note presents a measurement process that doubles the single-shot bandwidth of HP's 54111D digitizing oscilloscope. Included are example programs for all popular instrument controller.

Ordering Number: 5954-2680

54120-1
Histograms and Statistical Analysis of Signals For Use With the HP 54120T Digitizing Oscilloscope

The HP 54120T Digitizing Oscilloscope features a histogram function that allows the user to quantify measurements via statistics. As a result, signal characteristics may be measured in ways previously impossible. Two of the most common applications are measuring jitter and noise on a signal. With the advent of infinite persistence in conjunction with the histogram function, traditional eye diagrams may be quantified like never before.

Ordering Number: 5954-2693

54200A/D-1
Hybrid Instruments Forge an Alliance Between Analog and Digital Worlds

This article discusses both the HP 54200A/D Digitizing Oscilloscope and the HP 1631A/D Logic Analyzer. Both use the same A/D converter that samples at 200 megasamples/second, and both are hybrid instruments. The many features of both products are outlined, and the design and applications are featured.

Ordering Number: 5954-2623

54201A/D
Solving Measurement Problems in the Communications Industry

Advances in analog design, multiplexing schemes, digital designs, and switching speeds are essential to meeting the goals of communications equipment manufacturers. The HP 54201 digitizing oscilloscope provides a cost-effective, general purpose solution to problems encountered during the development of future communications products, as well as in the verification of equipment presently being manufactured.

Ordering Number: 5954-2642

70000-1
HP 70000 System Design Overview

This product note is an introduction to the HP 70000 system architecture and its components. It provides an overview of the considerations that a systems designer should take into account and presents a basis for determining HP 70000 system-instrument and module-design strategies. This information helps system designers scope the extent of these projects and identifies tools available that assist in completing projects.

Ordering Number: 5954-9135

81800S/A-1
Performing Measurements with the HP 81800A Software Pac

This note describes how the HP 81800A Software Pac can be used to considerably reduce the time necessary to create programs for the HP81800S Digital Circuit Test System.

Ordering Number: 5952-9571D

81800S/A-2
Add DC Characterization Capability to the HP 81800S

Describes how the capabilities of the HP 81800S Digital IC Test system can be expanded to include dc measurements. For this purpose the HP 6942A Multiprogrammer or the HP 4145A Semiconductor Parameter Analyzer are used. This note includes theoretical aspects as well as wiring and program examples.

Ordering Number: 5952-9573

81800S/A-3
Testing Microprocessors with the HP 81800S

Describes how microprocessors can be tested with the HP 81800S Digital Circuit Test System. This note covers the hardware which is required as well as the test philosophy, the pattern generation and the test program generation.

Ordering Number: 5952-9589

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85016-1
Making Measurements and Configuring Run-only Tests Using the HP 8328A/85016B

This note describes the HP 85016B Transmission Line Test Software and/or HP 8328A Test System. Provided are guided operation for fault location measurements in Basic Mode, and run-only pass/fail testing of fault location and insertion loss measurements using the Advanced mode of operation. Included are the hardware setup, step-by-step instructions, and sample output.

Ordering Number: 5954-1600

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PROGRAM NOTES

Model	Controller	Note Type	Ordering Number
438A	9826A	Quick Reference Guide	5952-8297
438A		Introductory Operating Guide	5953-6483
1650A	HP Vectra/IBM PC	Introductory Operating Guide	5952-4241
3065C		Introductory Operating Guide	5953-6963
3326A		Introductory Operating Guide	5953-5135
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3561A		HP-IB Programming	5953-5186
3562A	Series 200/300	Programming Guide	5953-5183
3708A		Quick Reference Guide	5953-5482
3708A	Series 200	Introductory Operating Guide	5953-5436
3709B		Quick Reference Guide	5954-9548
3717A		Quick Reference Guide	5953-6661
3746A		Quick Reference Guide	5953-6689
3764A		Quick Reference Guide	5953-5445
3776A/B		Quick Reference Guide	5953-5453
3776A/B	Series 200	Introductory Operating Guide	5953-5443
3781A		Quick Reference Guide	5953-6652
3781B		Quick Reference Guide	5952-3283
3782A		Quick Reference Guide	5953-6652
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3785A		Quick Reference Guide	5953-6669
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4955		Miscellaneous Programming Note	5950-5065
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6130A	Series 200	Quick Reference Guide	5952-4130
6130C	9826/9836	Introductory Operating Guide	5950-1937
6131A	Series 200	Quick Reference Guide	5952-4130
6131C	9826/9836	Introductory Operating Guide	5950-1937
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6133A	Series 200	Quick Reference Guide	5952-4130
6138A	Series 200	Quick Reference Guide	5952-4130
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8341A		Quick Reference Guide	5953-8877

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8566B		Miscellaneous Programming Note	5952-9392
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8644A	Series 200/300	HP-SL Programming Guide	5951-6727
8645A	Series 200/300	Introductory Programming Guide	5951-6727
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8665A	Series 200/300	HP-SL Programming Guide	5951-6727
8673B/C/D	Series 200	Introductory Operating Guide	5953-6457
8720A		Quick Reference Guide	08720-90014
8720A		Compatibility Guide	08720-90054
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8756A	Series 200	Introductory Operating Guide	5953-8858
8756A	HP-85A	Introductory Operating Guide	5953-8878
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8757A	Series 200	Introductory Operating Guide	5954-1561
8757C/E		Quick Reference Guide	08757-90077
8757C/E	Series 200/300	Introductory Programming Guide	08757-90076
8757C/E	Vectra DOS/Quick Basic	Introductory Programming Guide	08757-90075
11970/71		Programming Note	5954-9100
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