HEWLETT hp PACKARD

ARS-400

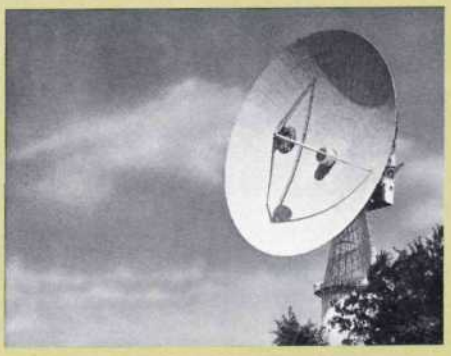
AUTOMATIC RECEIVER SYSTEM

100 kHz to 18 GHz

AN INTEGRATED PACKAGE . . .

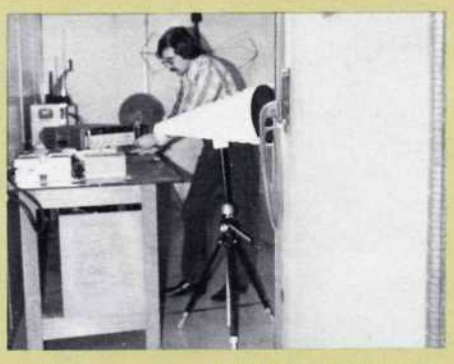
Ready to work in your application

Spectrum Management



System Monitoring

Electronic Intelligence



Electromagnetic Interference

Site Surveillance

THE ARS-400 AUTOMATIC

RECEIVER SYSTEM

An integrated system with . . .

- Fully Automatic Precision Receiver
- Data Analysis Capability
- Graphics Display Console
- Mass Storage Devices
- Powerful, Easy-To-Use Programming Language
- Reliable, Field-Proven, Commercial Equipment
- Capability To Be Part Of A Distributed Network Of Automatic Receiver Systems

In a ready-to-use configuration for . . .

- Fast Signal Location
- Accurate Signal Measurements
- Flexible Modulation Analysis

Delivers these benefits . . .

- Your System Quickly Becomes Operational
- You Get More Information That Is Easy To Retrieve
- You Have More Confidence In The Measured Data
- You Get More Productivity From Your Operators And Facilities

A cost-effective solution for your applications . . .

Spectrum Management

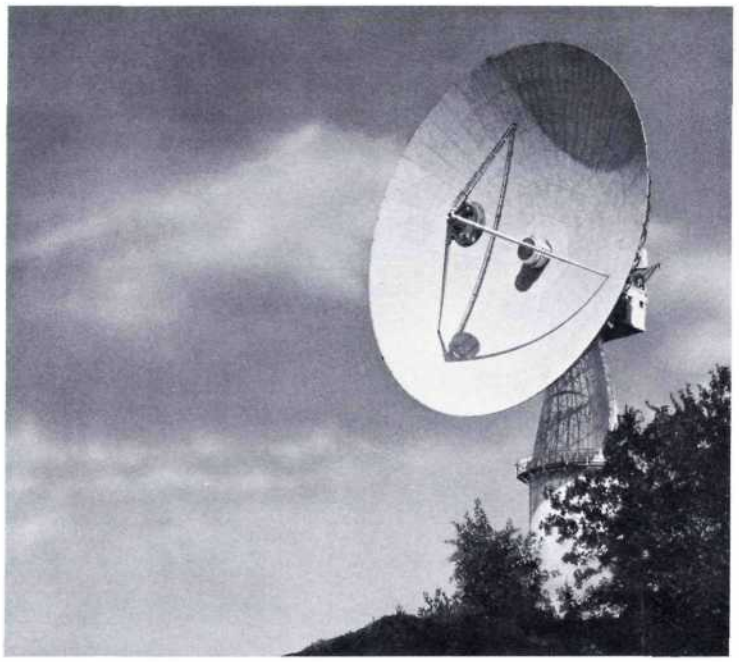
Spectrum managers, facing increasing demands for spectrum space, are finding the automatic receiver is a significant new tool in their work. The automatic receiver provides the spectrum manager with the data he needs to make well-informed decisions. Spectral data is gathered with a minimum of time, equipment, and skilled operator personnel.

The Hewlett-Packard ARS-400 Automatic Receiver System is particularly well suited for spectrum management applications. It is a high-speed monitoring system that can gather significant amounts of data with high accuracy, provide powerful data analysis and reduction, and present all information, including operator instructions, on a display that is continuously updated.

Consider the following ARS-400 features for spectrum management applications:

- Broad frequency coverage for both active and proposed bands.
- Tuning accuracy and selectivity for even the most crowded spectrum.
- On-line storage of measured data for quick and easy retrieval or transfer to another computer via IBM compatible magnetic tape.
- Data gathering at a very high rate of speed without operator interaction.
- Broad dynamic range to detect low level signals in the presence of large signals.
- Detectors for AM, FM, SSB and pulse-modulated signals.

The ARS-400 is ready to work for you. Consider a measurement site with the appropriate antenna arrays and the ARS-400 Automatic Receiver System. The antenna feeds are connected to the receiver's multiple inputs. The operator simply loads your measurement program to set up all the receiver's functions (input frequency, sensitivity, bandwidth and detector type), selects the desired antenna, and measures the RF signal strength. The receiver steps through the desired frequency band and measures and logs signal strength at each channel. It can do this task repetitively and gather the large amounts of data needed to characterize channel loading, modulation index, average signal strength, or other parameters of interest. With this data on magnetic tape, subsequent decisions can be based on actual data. The operator's data gathering responsibility is now reduced. One automatic receiver and its operator can do the work of several manual receiving stations.



System Monitoring

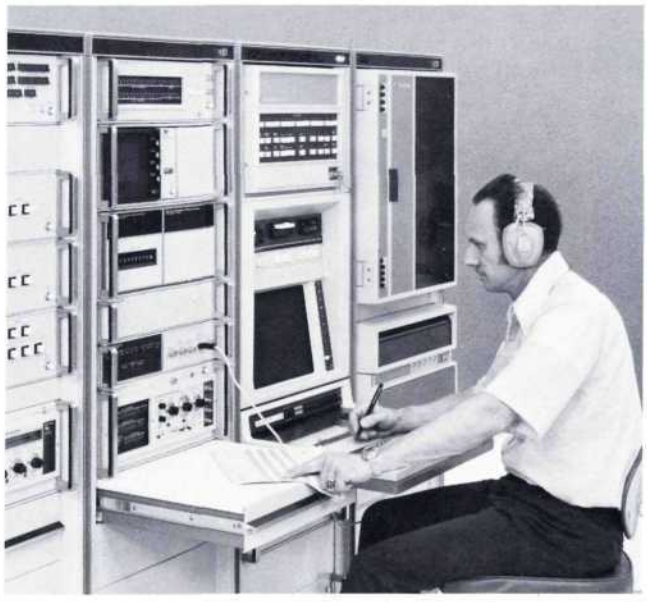
Many of today's complex communication systems require continuous monitoring to ensure optimum performance and reliability. Critical signal parameters such as power levels, modulation levels, signal bandwidth, carrier-to-noise ratio, etc., provide the communication system operator with a complete record of authorized traffic, as well as detection of unauthorized transmissions. An automatic receiver system performs rapid on-line performance analysis and provides feedback on system status. The data can be used to detect system performance degradation, thus minimizing expensive down-time and optimizing performance and reliability. Problems are predicted, isolated, and prevented before they interrupt system operations.

The ARS-400 Automatic Receiver System has the capability and flexibility to monitor nearly all communication systems. The user can actively monitor several critical points in the system. Growth needs can be met without the need for any additional "field add-on equipment" with extra costs. For system monitoring applications, the ARS-400 offers:

- Frequency coverage for baseband, IF, and carrier measurements.
- Wide range of bandwidths to match the signal of interest.
- Sensitivity to monitor without disturbing the communication system.
- Automatic limit checking to test signal parameters against specifications.

A major benefit of the ARS-400 is the minimizing of the operator's role in repetitive monitoring measurements. The system generally runs itself, reporting on an exception basis when signals being monitored drift out of specification. In a satellite communication system, for example, the ARS-400 can be programmed to look at and check the signals being relayed through the satellite against a schedule, insuring they are all authorized for the current time slot, and to compare signal strengths so no signal is penalized in signal/noise performance. These measurements require no operator action; he is free to do other tasks. But should one or more signals be out of specification, the system can alert the operator to the problem and give him the data he needs to correct it quickly.

Electronic Intelligence



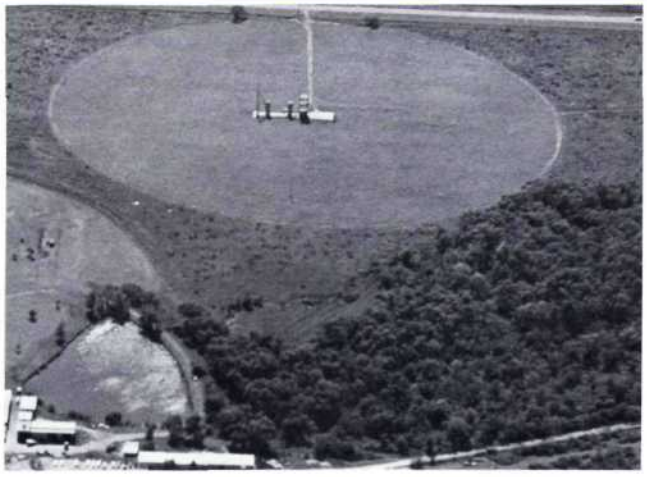
Signal acquisition, location, and analysis are important objectives of agencies responsible for national security. An automatic receiver system is a powerful tool for this application. It has the speed, detection and analysis capabilities to handle a wide range of intelligence applications. It can rapidly detect the presence of new signals, even when they appear in a portion of the spectrum crowded with known signals. Under program control, it can scan all or parts of specific bands and flag the unfamiliar signals for more detailed analysis. It can measure characteristics of RF (frequency, power and bandwidth) or post-detection signals (modulation indices and spectral content).

The ARS-400 Automatic Receiver System is a proven commercial system that is a cost-effective alternative to expensive, specialized equipment. Program control is facilitated by an easy-to-use instruc-

Electromagnetic Interference

Increasing compatibility requirements and environmental controls determine that the building blocks for today's sophisticated electronic systems be thoroughly tested for generation of and susceptibility to electromagnetic interference. Traditionally these tests have been performed using manual testing, an expensive method considering the many hours of test time required. With the ARS-400, EMI testing is faster and more accurate than with manual techniques. Automatic EMI testing means auto-selection of band, sensor, bandwidth, and test frequency; it means auto-correction for system frequency response (flatness), antenna or current probe factors, and RF losses in feed lines; it means auto-conversion of measurements to microvolts/meter or other desired units of measure. The result is more data, better data, and easily retrievable data. You bene-

Site Surveillance



When planning a radio communication link, an ARS-400 system provides the data needed to select transmission frequency, modulation type, and receiver location. Path loss data can also be measured and, hence, transmitter power may be specified for the desired fade margin (given antenna gains and receiver noise figure).

The ARS-400 Automatic Receiver System makes these measurements quickly and accurately under program control. The data can be analyzed on-line or logged on magnetic tape for convenient transfer to another computer for electromagnetic compatibility analysis. Because the data is gathered rapidly, more data can be taken and better overall system

tion set. Formal training for new personnel is minimized; personnel operating effectiveness can be achieved on the job without interrupting system operation. Operator dependence and human error are reduced and in some applications, unattended operation is feasible. Reduced operator dependence not only provides faster system response time, it cuts operating costs of your sites.

You can rely on the ARS-400 because:

- It covers almost all frequencies of interest to intelligence agencies.
- Good overall sensitivity provides wide geographic coverage from one site.
- Faster tuning rates are provided by wider bandwidths and streamlined software operating statements.
- A flexible peak hold detection scheme provides high intercept probability for low duty cycle signals.

In some applications, the ARS-400 may be programmed to step through a desired band or bands. At each step the system measures signal strength and compares the signal against a threshold. If it exceeds the threshold, it would dwell and make a more detailed analysis. The operator can listen to the demodulated output as the system switches from AM to SSB to FM detection. With the ARS-400, one operator can now scan more of the spectrum and significantly improve the probability of intercepting brief transmissions.

fit because now your system designers have the information they need to improve their designs, your quality assurance people have the documentation to support your contractual obligations, and your products have the back-up necessary to satisfy the concerned regulatory agencies.

Consider these features:

- Eight receiver input ports under automatic control to handle multiple antennas.
- System sensitivity as low as −130 dBm in a 1 kHz bandwidth for low level measurements.
- Peak and quasi-peak responding detection.
- Flexible graphic display with hardcopy output available.

In a typical electromagnetic compatibility application the ARS-400 would be installed near the shielded test chamber. Leads from the antennas and current probes would be brought outside and connected to the multiple system inputs. Your measurement routine containing preprogrammed acceptance test limits is loaded by the operator. The measurement routine is then executed while the device under test is operated in all modes. The ARS-400 automatically scans the entire test frequency range, selecting appropriate sensors, and records the measured RFI levels. The results are then displayed as a graph report showing RF emissions versus frequency with acceptance test limits superimposed.

performance will be assured at the chosen site. Measurement settings, location, time of day, month, and year can be logged with the data and recorded to prevent loss and confusion at a later date.

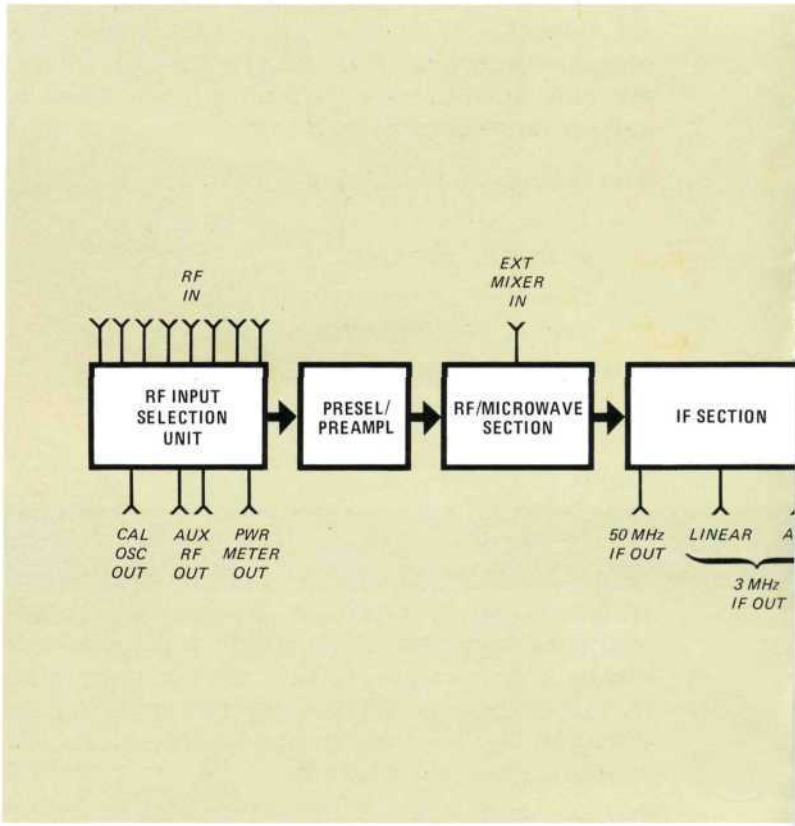
The ARS-400 has been designed with the performance characteristics needed for site surveillance applications. It offers:

- Calibrated signal strength measurements.
- Frequency coverage and accuracy for HF, troposcatter, and land line communication bands.
- Minimum operator interaction, making lengthy, unattended, measurement runs practical.

In a typical site survey, the ARS-400 (with appropriate antennas) would be located at the potential site. Measurements might be taken over several bands centered at the possible transmit frequencies. A complete history of ambient signal characteristics would be recorded on magnetic tape. The signals measured could include some from transmitters at the proposed frequencies and transmit sites to measure path loss. With all operations accomplished automatically, more data can be gathered in less time and at less cost than is possible with manual equipment.

The ARS-400 Automatic Receiver System is a versatile RF/microwave measurement system for automatic signal monitoring, detection, and analysis in the 100 kHz to 18 GHz frequency range. The system has capabilities that enable it to be used in a variety of surveillance and test applications – features such as synthesized high speed tuning, self-calibration of all receiver modes, flexible detection (AM, FM, SSB), broad dynamic range, exceptional frequency accuracy and resolution, automatically-tuned preselection for spurious-free response, and time-calibrated data collection.

The block diagram shows the functional signal flow path of the ARS-400 Automatic Receiver System. The ARS-400 consists of instruments that filter and detect RF signals, convert these signals to digital data, and process and output this data to display, hardcopy, and tape storage devices.



FULLY PROGRAMMED PRECISION RECEIVER

RF signals enter the ARS-400 through one of the eight available input ports on the RF Input Selection Unit. The RF Input Selection Unit is a versatile, broadband signal routing instrument operated under program control or manually for antenna (input port) selection and signal attenuation selection from 0 to 70 dB in 10 dB steps.

The Preselectors/Preamplifiers are inserted into the RF path to limit the mixer input to the frequency of interest, to provide increased sensitivity for low-level signals, and to attenuate unwanted signals for measurements in congested signal environments. There are three Preselectors/Preamplifiers, both covering two bands in the frequency range of 100 kHz to 18 GHz (preselection starts at 500 MHz). Control signals from the Data Processing Section automatically select the Preselector/Preamplifier. Additional control signals select the discrete tuned frequency within the selected band.

The RF/Microwave Section converts the input signal to a 50 MHz IF signal. Multiple frequency conversion techniques are utilized to achieve spurious-free response. The external mixer input port provides a phase-locked local oscillator signal and accepts the returning IF signal (550 MHz or 2050 MHz). This port can be used to extend the ARS-400's frequency coverage above 18 GHz if desirable.

The 50 MHz IF signal from the RF/Microwave Section is fed into the programmable IF Section. Programmable IF functions are IF bandwidth and IF gain. The 50 MHz IF signal is downconverted to 3 MHz which is amplified, filtered, and fed to the Multimode Detector Section. Output ports are available for both the 50 MHz and 3 MHz IF signals.

The Multimode Detector Section has log envelope, narrowband and wideband FM, AM, and SSB detectors. There is a video output port and an audio output headphone jack for monitoring purposes.

The Multimode Digitizer accepts the video signal from the Multimode Detector Section or an external source. The A/D conversion process is initiated by program control, digitizes at a controlled rate, and outputs the 12-bit data to the Data Processing Section. The A/D converter is preceded by sample hold, quasi-peak, or peak hold functions selected under program control. The peak hold circuit is optimized for interception of low duty cycle signals.

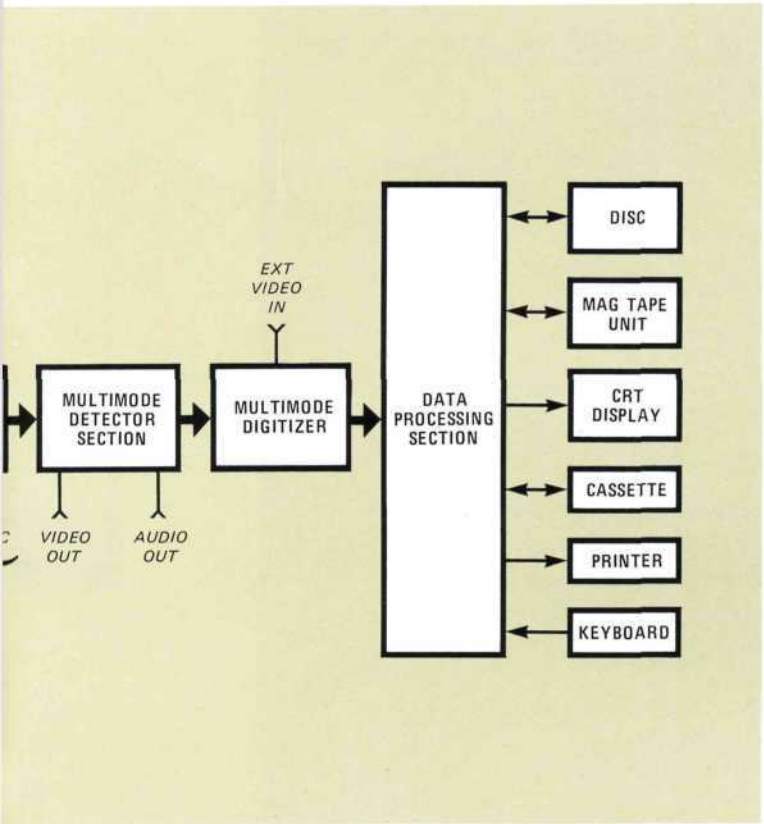
DATA ANALYSIS CAPABILITY

The Data Processing Section contains the instruments that provide program control of the ARS-400 measurement sections, operator interface, and processing of incoming digitized data to final measurement information for the CRT display, hardcopy printer and disc or magnetic tape storage. Within the Data Processing Section is a digital computer with 32K words of memory and 14 input/output channels to communicate with instruments and/or peripherals. The keyboard/printer has the full character set of the standard teleprinter plus special keys and switches that can be sensed by the computer during program execution. A cassette input/output unit provides a convenient means to input programs and output small amounts of data.

APPLICATION PROGRAMMING TOOLS

The ARS-400 is supplied with configured programming tools that are ready to run – right on each system. These tools

INTEGRATED SYSTEM . . .



are BASIC and FORTRAN language processors that transform English-like application programs into detailed instructions needed by the instruments and data processing equipment in the ARS-400. You prepare application programs for your specific measurement objectives right on the ARS-400 – every programming tool you need is supplied with the system. Learning to write application programs is easy, as you will see on the following pages that describe the ARS-400 programming capability.

INTERACTIVE GRAPHIC OUTPUT

The capabilities of the operator console enhance the performance of the ARS-400. The interactive CRT display has a large screen that displays alphanumeric characters and vectors. It enables interactive program editing and flexible system operation by presenting graphical displays mixed with text. Program preparation and editing can be done in FORTRAN or BASIC language. A control on the keyboard allows the operator to position an electronic cursor on the CRT to interact with the information displayed. Both programming and system operation are easy on the ARS-400 because the interactive display presents the data in the most meaningful form – whether graphical, text, or tabular.

MASS STORAGE AND HARD COPY

Mass storage capability for the measurement data of the ARS-400 can be provided by a magnetic tape unit or a disc. The magnetic tape unit uses IBM-compatible 9-track tape on reels up to 10½ inches in diameter that records data at 800 bits per inch. The storage capacity of the disc is 2.4 million words.

The hardcopy printer provides a permanent record of alphanumeric data. The unit operates on a thermal printing process which transfers heat from a dot print-head matrix to heat-sensitive paper. It prints 30 characters per second. A graphic hard copy can also be provided by a Versatec Matrix 200 Plotter; it reproduces on hard copy any graphic or tabular data displayed on the CRT in approximately 25 seconds.

DIAGNOSTIC PROGRAMS

The ARS-400 is provided with a set of diagnostic programs that will enable system level self-test and fault isolation. Your operators, with minimum training, can run a system level self-test periodically or if they suspect degraded performance. The system level self-test will either confirm system performance or indicate the suspected malfunction. Maintenance personnel, equipped with another set of ARS-400 diagnostic programs, can isolate the faulty module for repair.

DISTRIBUTED SYSTEMS CAPABILITY

The ARS-400 can be one part of a distributed system of automatic receivers tied together by a communications network. Used with an HP 9700 Real Time Executive System, a distributed system enables correlation of data from several stations, availability of measured data to/from all stations and additional mass storage of programs/data.

SPECIFIED SYSTEM PERFORMANCE

The performance of the ARS-400 is specified as a complete system. Receiver characteristics such as sensitivity, selectivity and tuning speed are characterized while the receiver is under program control – there is no need to extrapolate from manual mode specifications and computer parameters to predict overall system performance in your application. With the ARS-400, key system performance characteristics are verified and guaranteed so that you can rely upon them for your requirements.

SYSTEM OPTIONS

The ARS-400 Automatic Receiver System can be configured to meet the needs of your applications. *This means that you order what you need – and pay for no more.* The options for the ARS-400 Automatic Receiver System are contained in the ARS-400 Ordering Information data sheet, HP literature request number 5952-1478. Your local HP computer systems field engineer can help you determine the configuration that will satisfy your application requirements.

EASY PROGRAMMING . . .

Programming the ARS-400 generally requires only a few days of training. Measurement programs are developed using a conversational instruction set that is easily learned. The instruction set is an extension of the widely used BASIC language and provides a convenient means to control all programmable functions of the system, analyze the measurement data, and display and/or record the results.

To write a measurement program for the ARS-400, you simply type instructions much as you would turn controls to develop a procedure with manual equipment. The understanding applied to the measurement program is the same, only now the ARS-400's keyboard and instruction set make up the "front panel" controls. Error correction, scaling, data formatting, and other important functions are handled automatically by the computer – you do not have to be an expert in computers or other, more detailed, programming languages.

As an example, the channel scanning measurement program outlined below shows how easy it is to write programs for the ARS-400.

EASY-TO-WRITE PROGRAMS

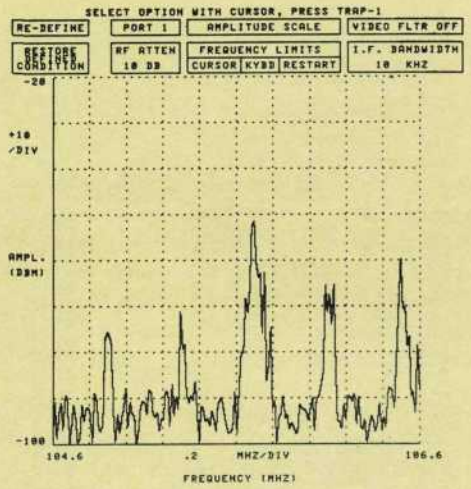
```
10  ARSET . . . . . Reset system
20  ATTEN(10) . . . . . Set attenuator to 10 dB
30  BWDTH(3) . . . . . Set bandwidth to 3 kHz
40  TUNE(150) . . . . . Tune analyzer to 150 MHz
50  FOR I=1 TO 10 . . . . . Define tune, measure loop
60  MEAS(A) . . . . . Measure signal strength
70  LET B=A+107 . . . . . Convert to dB above 1 microvolt
80  PRINT "CHAN ";I;":",150+(I-1)*.02;" MHZ",B;" DBUV"
90  STEP(20) . . . . . Increase analyzer tuning by 20 kHz
100  NEXT I
```

GIVE ACCURATE MEASUREMENT DATA

```
CHAN 1    :   150     MHZ      -4.02748     DBUV
CHAN 2    :   150.02  MHZ      12.2952      DBUV
CHAN 3    :   150.04  MHZ      5.46916      DBUV
CHAN 4    :   150.06  MHZ      1.50488      DBUV
CHAN 5    :   150.08  MHZ      5.78734      DBUV
CHAN 6    :   150.1   MHZ      48.4919      DBUV
CHAN 7    :   150.12  MHZ      -2.76418     DBUV
CHAN 8    :   150.14  MHZ      1.54059      DBUV
CHAN 9    :   150.16  MHZ      3.81764      DBUV
CHAN 10   :   150.18  MHZ      6.43582      DBUV
```

Programming the ARS-400 is easy – yet the powerful instruction set provides you with measurement capabilities for a wide variety of applications. The output data shown on pages 11, 12 and 13 illustrate the versatility and power of the ARS-400 in various measurement applications. This output data is displayed on the interactive graphics display console – but is also recorded on mass storage devices, easily retrievable for later data analysis.

Locate Signals

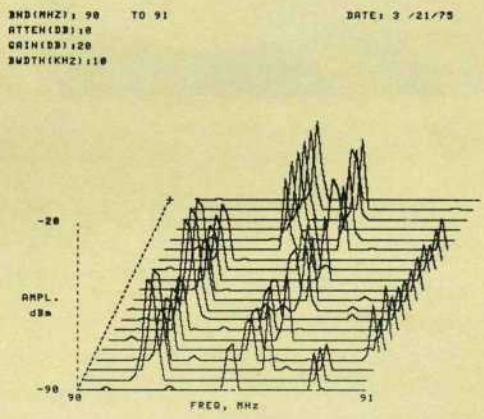


Signal Strength vs. Frequency

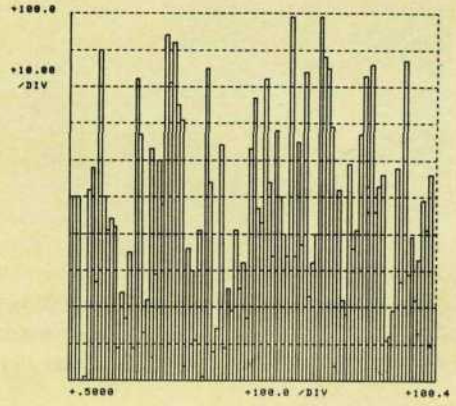
- Scan at rates up to 2 GHz per second
- Observe and record signals continuously
- Label CRT with display scales and operational state of system
- Use electronic cursor to select specific signals or bands for detailed analysis

Log Signal History

- Rapidly scan desired channels
- Display signal level at each channel
- Repeat scan, plotting new results alongside old ones
- Record complete picture of band activity over time



Falling Raster Scan



Occupancy Bar Graph

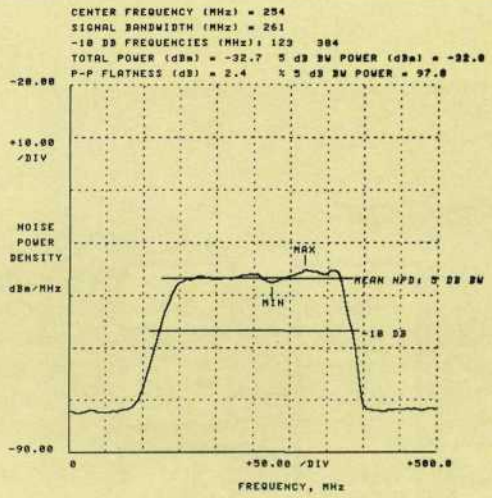
BAND NUMBER	CHANNEL FREQ MHZ	AMPLITUDE DBM	OCCUPANCY %
11	35.62	-51	50
11	35.64	-43	50
11	35.66	-101	0
11	35.68	-30	2
11	35.70	-90	52
11	35.72	-71	58
11	35.74	-51	26
11	35.76	-46	90
11	35.78	-83	50
11	35.80	-75	41
11	35.82	-71	44
11	35.84	-64	42
11	35.86	-55	09
11	35.88	-41	24
11	35.90	-68	18
11	35.92	-61	36
11	35.94	-51	09
11	35.96	-78	82
11	35.98	-62	67

Occupancy Data Table

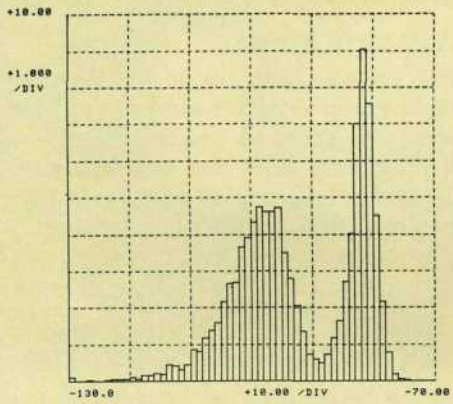
- Use bar graph or data table to display and record current or average signal strength or band occupancy over time

Analyze Signals

- Repetitively sample random signals versus frequency
- Automatically correct power density measurement for system equivalent noise bandwidth and adjust to desired reference bandwidth
- Analyze power density for:
  - average power density
  - peak power density
  - signal center frequency
  - signal bandwidth



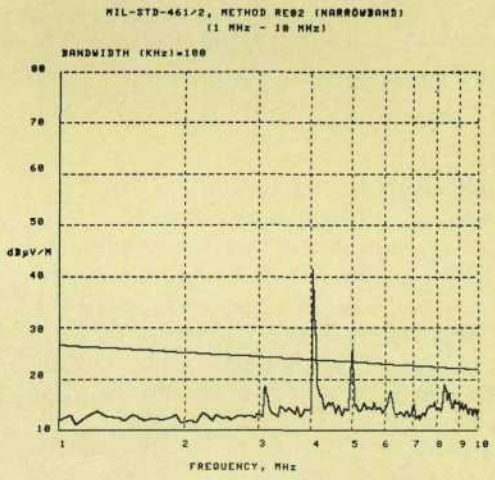
Noise Power Density



Probability Density Function

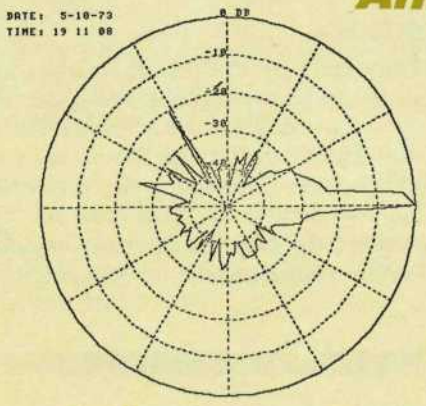
- Repetitively sample complex signal at specific frequency
- Analyze distribution of signal amplitudes
- Display probability density function to separate small signal from noise

- Quasi-peak response
- Measure signal amplitude versus frequency from standard sensor (antenna or probe)
- Correct for sensor transfer function
- Compare signal levels against test limits
- Display results in appropriate format



Radiated Signal Strength

Analyze Radiation Patterns

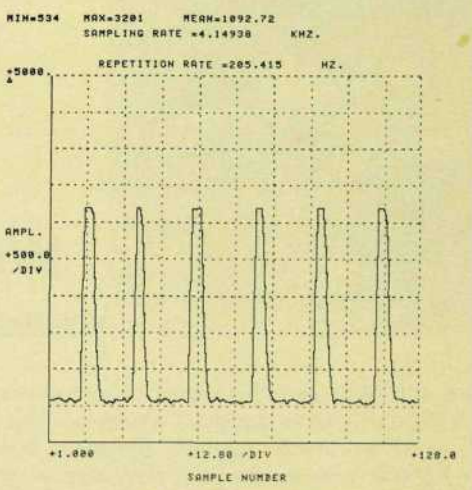


Signal Strength vs. Antenna Azimuth

- Characterize effective radiation patterns of rotational antennas from a single vantage point
- Characterize effective radiation patterns of fixed antennas by moving the receiver

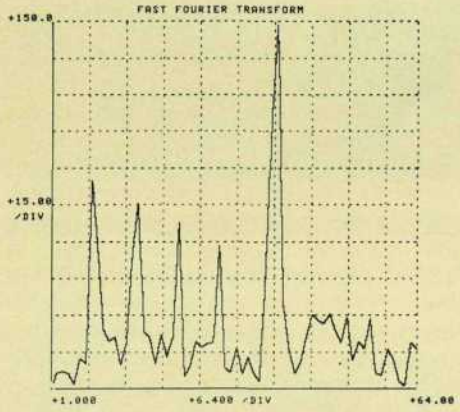
. . . FOR YOUR APPLICATIONS

Analyze Modulation



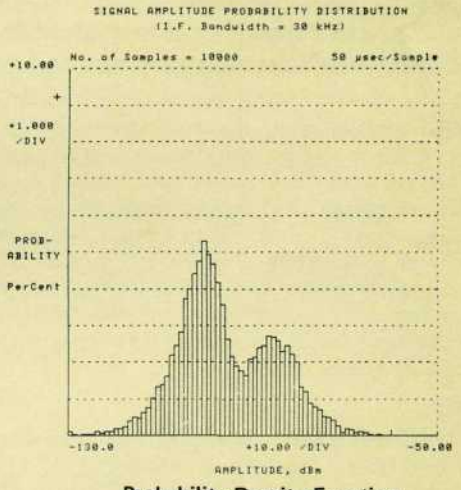
Modulation Signal

- Demodulate AM, FM, SSB, pulsed signals and display the detector output versus time



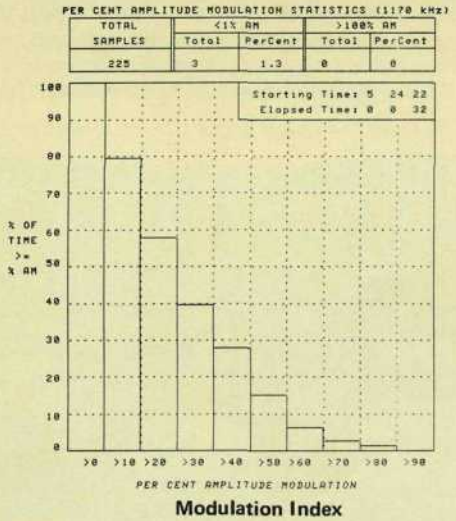
Frequency Spectrum

- Repetitively sample detector output and analyze modulation characteristics using Fourier transform
- Test for modulation excursions beyond limits and only present exceptions to operator



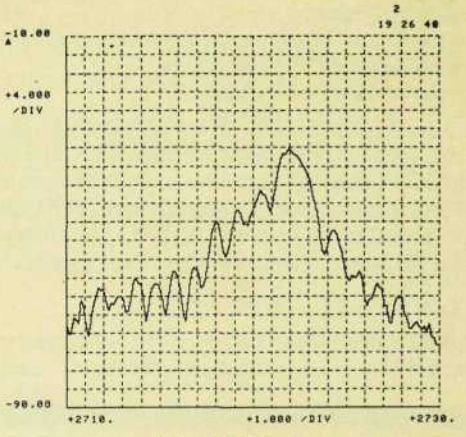
Probability Density Function

- Display probability density function of amplitude or frequency of demodulated signal



Modulation Index

- Compile modulation statistics



Pulse RF Spectrum

- Determine pulse width and pulse repetition rate for pulse modulated signals

WORLD-WIDE FIELD SUPPORT

The ARS-400 Automatic Receiver System follows the Hewlett-Packard tradition of technical excellence and quality – backed by HP worldwide support. When you take delivery of an ARS-400 system, the following support services are available to you.

PERFORMANCE VERIFICATION

Every ARS-400 receives a complete performance verification test at Hewlett-Packard's manufacturing facility. This test guarantees that the ARS-400 performs to specifications that are published in HP literature request number 5952-1479. The test results of all performance verification tests are furnished with each system.

INSTALLATION

At installation, a Hewlett-Packard customer engineer performs functional and diagnostic tests to ensure that the system is operating normally.

WARRANTY

A complete warranty program covers the ARS-400 system for 90 days beyond system installation date. This warranty provides two scheduled preventive maintenance service calls by your HP service representative and complete repair service during the warranty period. These services are provided at no extra charge if you are within 100 miles of an HP service office. A nominal charge to cover travel beyond the 100-mile radius extends this service to remote locations. Your HP field engineer can tell you how this warranty applies to your specific situation.

TRAINING

Each ARS-400 system purchased entitles one member of your staff to receive 5 days of user training at HP's technical training facilities. This training is designed to prepare you for:

- Operation of system hardware
- Interpretation and understanding of system characteristics and specifications
- Implementation of effective ATS-BASIC language measurement and display programs
- Routine preventive maintenance

For more advanced users HP offers advanced programming training. This training is designed for users who have mastered the ATS-BASIC Language and now wish to extend their system capabilities to include programming in HP FORTRAN and/or the reconfiguration of the ATS-BASIC Interpreter to add FORTRAN subroutines as BASIC Language statements.

SYSTEM DOCUMENTATION

Every ARS-400 user receives a complete set of service documentation. Service documentation consists of system level technical manuals for the operator and maintenance personnel. Additionally, individual operating and service manuals are provided for each standard HP instrument used in the ARS-400 system.

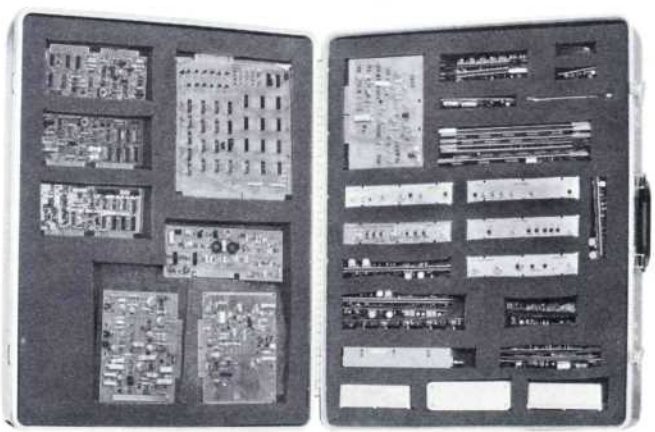
SERVICE CONTRACTS

For system support beyond the warranty period, a versatile maintenance agreement package is offered. With the exception of extremely remote areas, this program is available throughout HP's worldwide service organization. Service and Support agreements offer you:

- Convenient preventive maintenance service to maximize reliability and keep unscheduled interruptions to a minimum.
- Emergency repair service with guaranteed response time.
- Known service costs that eliminate unbudgeted expense.
- Reduced overhead costs by reducing the need to maintain trained personnel and capital equipment at your facility.

FIELD SUPPORT PACKAGES

For those ARS-400 users unable to take advantage of Hewlett-Packard service contracts due to system operation in remote locations, HP offers special field support packages. These support packages are designed to allow a user to fully support his systems. One kit is intended to stay with each operating ARS-400. The second kit equips the central support group with extra tools and skills to provide complete back-up support for several operating locations, each with its own on-site support package. For more information on these field support packages, contact your HP field engineer.



Typical On-Site Support Package

ARS-400 Performance Characteristics

This description summarizes the performance characteristics typically available with the ARS-400. It is intended to expand upon the performance verified system specifications presented in the ARS-400 Performance Verification Data Sheet (HP literature request number 5952-1479).

FREQUENCY CHARACTERISTICS

Calibrated Tuning Range: 100 kHz to 18.0 GHz

Tuning Bands:

Tuning Range	Harmonic Mixing Mode	First IF Frequency	Band Code Number
0.1 - 10 MHz	2-	50 MHz	1
0.01 - 2.55 GHz	1-	2050	3
1.5 - 3.55	1-	550	2
2.6 - 4.65	1+	550	4
3.55 - 7.65	2+	550	5
4.65 - 8.75	2+	550	6
5.6 - 11.75	3-	550	7
6.7 - 12.85	3+	550	8
7.65 - 15.85	4-	550	9
8.75 - 16.95	4+	550	10
9.7 - 18.0	5-	550	11

Preselector/Preamplifier Tuning Bands:

0.1 - 500 MHz
0.5 - 2 GHz
2 - 4 GHz
4 - 8 GHz
8 - 12 GHz
12 - 18 GHz

Tuning Accuracy:

Tuning accuracy is the summation of the following parameters:

(1) Setability of 10 MHz system reference oscillator to external frequency standard (typically ±2 Hz).

(2) Specified aging rate of system reference oscillator ($\pm 3 \times 10^{-9}$/day × number of days since calib. × tuned frequency (Hz)).

(3) Setability of IF offset adjustment to internal frequency standard (typically ±2 Hz).

(4) Aging rate of system IF offset adjustment after 4 hours warm-up (typically 1 Hz/day).

(5) IF offset error due to temperature change (typically 10 Hz/°C).

(6) IF Bandwidth filter center frequency error (±10% of selected IF bandwidth).

For optimum frequency accuracy, calibration of system reference oscillator to external frequency standard is recommended once every 30 days.

Spectral Resolution:

IF Bandwidths: 10 Hz to 300 kHz in 1 - 3 sequence and 2.4 kHz (SSB mode only) and 3 MHz.

IF Bandwidth Shape: Gaussian (except 2.4 kHz)

IF Bandwidth Accuracy:
Individual IF filter 3 dB points calibrated to ±20% (10 kHz bandwidth filter calibrated to ±5%).

IF Bandwidth Selectivity:

IF Bandwidth	60 dB/3 dB Bandwidth Ratio
10, 30, 100, 300 Hz	11:1
1, 3 kHz	11:1
2.4 kHz	2.5:1
10, 30, 100, 300 kHz	20:1
3 MHz	6.5:1

Tuning Resolution: 1 Hz × Harmonic Mixing Number

Tune/Measure Time:

Tune/measure time is characterized for:

(1) Amplitude response to within ±1 dB of steady state value.

(2) Tuning upward in frequency.

(3) Frequency step sizes ≤ 3 MHz within any band.*

Non Phase-Locked Tuning Mode: < 1.4 msec per step (IF BW = 3 MHz)

Phase-Locked Tuning Mode: < 4 msec per step (IF BW ≥ 3 kHz)**

** Band change requires 125 msec.*

*** For IF BW < 3 kHz, add 1/BW(Hz) to total tune/measure time.*

ARS-400 Performance Characteristics

AMPLITUDE CHARACTERISTICS

Amplitude characteristics are for log envelope detection mode and instantaneous response mode for the digitizer.

Average Internal Noise Level:

Tuning Range (GHz)	Avg. Noise Level (dBm) (BW = 1 kHz)	Nominal Noise Figure (dB)
0.0001 - 0.5	-135	9
0.5 - 2	-135	9
2 - 4	-130	14
4 - 8	-125	19
8 - 12	-120	24
12 - 18	-110	34

For bandwidths other than 1 kHz:

Nominal Avg. Noise Level (dBm) =
Nominal Avg. Level (dBm) @ 1 kHz BW +
10 log BW (kHz)

Peak noise typically 10 to 14 dB above average noise.

Residual Responses:

Frequency Range	Residual Response (dBm)
100 kHz - 4.65 GHz	-110
3.55 - 18.0 GHz	-105

Frequency Response:

Frequency Range	Frequency Response (dB)
0.1 - 500 MHz	±1.0
0.5 - 2 GHz	±3.0
2 - 8 GHz	±4.0
8 - 18 GHz	±5.0

Relative Amplitude Accuracy: ±1.0 dB

Instantaneous Distortion Free Dynamic Range

The dynamic range of the system is presented for operation with a 1 kHz IF bandwidth and with peak hold or quasi-peak detection unselected. It includes the limitations of the log IF Amplifier, the detector, and the digitizer (72 dB).

For a Single Signal Within the Preselector Bandwidth:

In the single signal condition, the distortion-free dynamic range is the difference between the 1 dB compression point and the nominal noise floor.

Frequency Range (GHz)	Dynamic Range (dB) (BW = 1 kHz)
.0001 - 12	⩾ 70
12 - 18	⩾ 60

For operation in bandwidths other than 1 kHz:

Dynamic Range = Dynamic Range @ BW = 1 kHz -
10 log BW (kHz)
(72 dB maximum)

For Two or More Signals Within the Preselector Bandwidth:

For multiple signals within the preselector bandwidth and for all signals separated by 1 MHz minimum, the distortion-free dynamic range is the difference between the system input level that produces third order IM products equal to the nominal noise floor and the noise floor itself.

Frequency Range (GHz)	Dynamic Range (dB) (BW = 1 kHz)
0.0001 - 4	⩾ 70
4 - 12	⩾ 60
12 - 18	⩾ 50

For operation in bandwidths other than 1 kHz:

Dynamic Range = Dynamic Range @ BW = 1 kHz -
7 log BW (kHz)
(72 dB maximum)

Preselector Selectivity

Preselector/Preamplifier Bandwidths:

20 MHz @ 0.5 GHz
25 MHz @ 2 GHz
40 MHz @ 8 GHz
50 MHz @ 18 GHz

Preselector/Preamplifier 60 dB/3 dB Bandwidth Ratio: ⩽ 6:1

ARS-400 Performance Characteristics

DETECTION CHARACTERISTICS

Log Envelope:

Video Bandwidth: 1.5 MHz (150 Hz video filter available for IF BW ≤300 kHz)

AM (with Automatic Gain Control):

Video Bandwidth: 100 Hz to 15 kHz
Distortion: 2% @ 1 kHz modulation rate, 30% modulation index

SSB (Upper or Lower Sideband):

Video Bandwidth: 300 Hz to 2.7 kHz
Distortion: 5% @ 1 kHz modulation rate
BFO: variable ±2 kHz or fixed

Wideband FM:

Deviation Limits: ±5 kHz to ±300 kHz
Distortion: 1% @ 1 kHz modulation rate, ±75 kHz deviation
Video Bandwidth: DC to 100 kHz

Narrowband FM:

Deviation Limits: ±50 Hz to ±15 kHz
Distortion: 2% @ 1 kHz modulation rate, ±5 kHz deviation
Video Bandwidth: DC to 3 kHz

DIGITIZER CHARACTERISTICS

Sample and Hold:

Aperture: 0.1 μsec
Throughput Rate: 30 kHz

Peak Hold (+):

Response Time: 0.2 μsec to within 3 dB
Hold Time: 1 second
Throughput Rate: 5 kHz

Peak Hold (-):

Response Time: 3 μsec to within 3 dB
Hold Time: 1 second
Throughput Rate: 5 kHz

Quasi-Peak Hold:

Response Time: 1 millisecond
Delay Time: 600 milliseconds
Throughput Rate: 30 kHz

INPUT PORT CHARACTERISTICS

RF Input: Eight type N input ports, all terminated in 50 ohms when not in use.

SWR:

Frequency	Unselected Port	Selected Port*
10 kHz - 2 GHz	<1.2	<1.5
2 - 8	<1.6	<1.8
8 - 12	<1.7	<2.0
12 - 18	<1.9	<2.3

**Applies to frequencies in selected preselector/preamplifier band.*

Isolation: > 90 dB between any two input ports

Maximum Input : +10 dBm

Switching Time: < 65 ms

External Mixer Input: compatible with HP 11517A waveguide mixer

External Video Input:

Impedance: 50 ohms

Bandwidth: 5 MHz

Input Level: 0 to +1 volt

OUTPUT PORT CHARACTERISTICS

RF Output: Five output ports. Two ports dedicated to receiver in signal analysis subsystem. Remaining three ports available for accessory instruments; one output normally used for power meter.

Isolation: > 90 dB between any two output ports

Switching Time: < 65 ms

50 MHz IF Output:

Load Impedance: 50 ohms nominal

Bandwidth: 3 MHz

Gain: with 0 dB input attenuation
100 kHz to 2 GHz, 20 dB
2 GHz to 18 GHz, > 25 dB

Output Level: -20 dBm maximum

ARS-400 Performance Characteristics

Output Port Characteristics (Cont.)

Linear 3 MHz IF Output:

Impedance: 50 ohms

Bandwidth: Same as selected IF bandwidth, 300 kHz maximum

Gain: with 0 dB input attenuation and 50 dB IF gain
100 kHz to 2 GHz, 60 dB
2 GHz to 18 GHz, 80 dB

Output Level: 0 dB maximum

AGC 3 MHz IF Output:

Impedance: 50 ohms

Bandwidth: same as selected IF bandwidth, 300 kHz maximum;
Lowest undistorted amplitude modulation sidebands,
100 Hz in slow mode
2 kHz in fast mode

AGC Range: 60 dB

Output Level: -34 dBm

Video Output :

Load Impedance: 50 ohms

Level: 0 to +1 volt

Bandwidth: same as selected detector

Audio Output :

Load Impedance: 8 ohms

Bandwidth: 2.4 kHz

Level: up to 0.5 watt (manual volume control)

CALIBRATION OSCILLATOR

Frequency: 30 MHz, harmonics present to ≈900 MHz

Amplitude: -30 dBm

GENERAL CHARACTERISTICS

Power Requirements: 3.5 kW from three 20A circuits (115V) or three 10A circuits (230V)

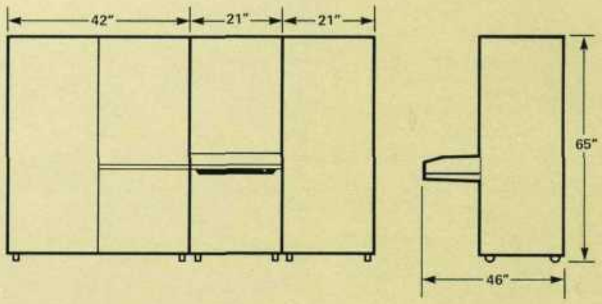
Weight: 1200 lbs.

Ambient Temperature Range:

Storage: -30 to +50°C

Operating: +5 to +35°C; for typical performance temperature must be held to within ±2°C.

Outline:



The above characteristics are subject to change without notice.

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For more information, call your local HP Sales Office or East (301) 948-6370 • Midwest (312) 677-0400 • South (404) 434-4000 • West (213) 877-1281. Or write: Hewlett-Packard, 1501 Page Mill Road, Palo Alto, CA 94304. In Canada: 275 Hymus Blvd., Point Claire, Quebec. In Europe: Hewlett-Packard, P.O. Box 85, CH-1217 Meyrin 2, Geneva, Switzerland. In Japan: Yokogawa-Hewlett-Packard, 1-59-1, Yoyogi, Shibuya-ku, Tokyo, 151.

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