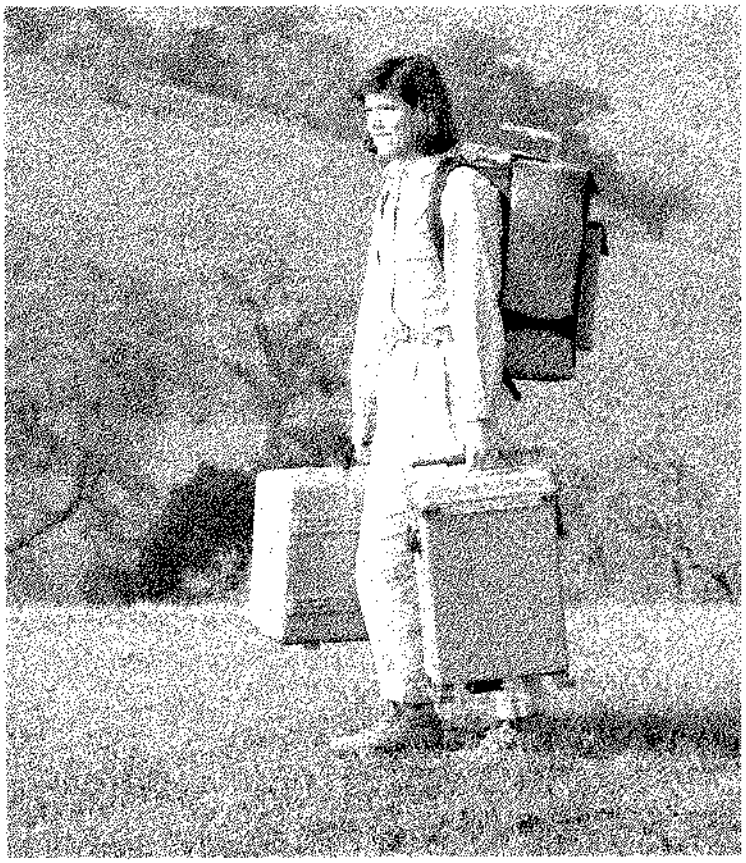
HP 11758V Digital Radio Test System

HEWLETT® PACKARD

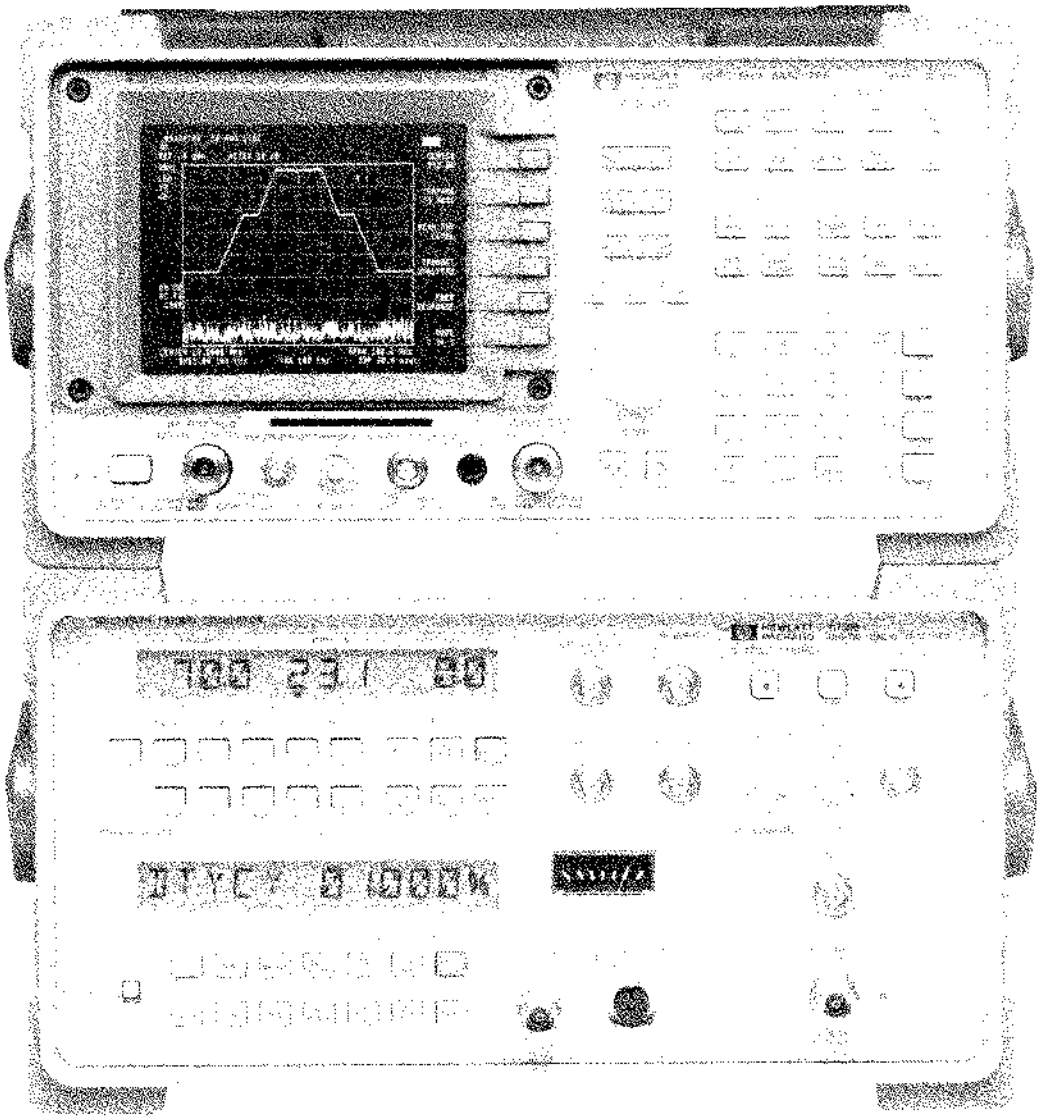
Technical Data

The hundreds of pounds of test equipment needed to install and service digital microwave radios presents users with a problem. This bulky equipment must be hauled out to a radio site during commissioning and back again each time routine maintenance is required. The logistical difficulties can be immense, but there is a solution — ***a Hewlett-Packard solution.***



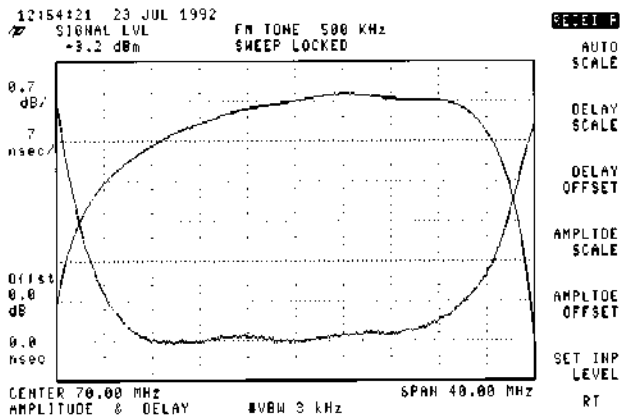
Hewlett-Packard has combined the most important pieces of test equipment into an integrated test solution for digital microwave radio — ***the HP 11758V Digital Radio Test System.***

HP 11758V Digital Radio Test System



- *Spectral Analysis at IF and RF*
- *Group Delay and Amplitude Flatness*
- *IF and RF Power Measurement*
- *IF and RF Frequency Measurement*
- *IF and RF Swept Signals*
- *Scalar Analysis*
- *IF and RF Return Loss*
- *Diversity Antenna Delay Equalization*
- *Upconvertor Flatness Measurement*
- *Intermodulation Distortion Measurement*
- *Multipath Fading Analysis*
- *Signature Measurement and Display*

The HP 11758V has many new exciting features. . .



Group Delay

Option 201 adds IF-IF, end-to-end group delay and amplitude flatness measurement capability to Digital Radio Test System. You no longer need a MLA for digital radio testing. Several accessories are also available to help you make other important tests like Diversity Antenna Delay Equalization (DADE) and IF return loss.

Improved User Interface

All the new capabilities in the HP 11758V have now been integrated under an improved user interface. It is now easier to switch between the various measurement programs. This allows you to learn the system more quickly and improves your efficiency when testing radios. It is even designed to let you more easily add your own measurement personalities into the DRTS system.

E-Series Spectrum Analyzer

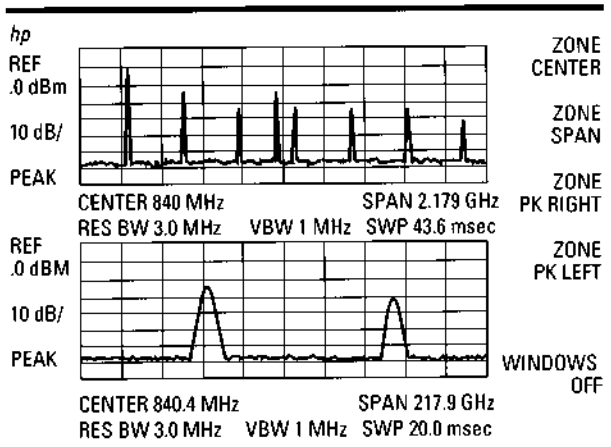
The HP 11758V now uses the HP 8953E Spectrum Analyzer so you get the benefits of all its new features and improved specifications. These new features include several built-in measurements like Adjacent Power Measurement, Third Order Intercept calculation and Occupied Bandwidth Power. Another new feature is Zoom Window which allows you to zoom-in on and view a portion of the display while simultaneously viewing the full sweep.

New Event Counter

The capability of the event counter has been enhanced. It now keeps track of the start and stop time of your measurement. It is now easier to make long term error measurements. When the measurement is halted you will see the start and stop time and date as well as the errors counted. It is then easier to compute the effective error rate.

New RF Source Options

New options extend the range of the RF source to 24 GHz. Now antenna return loss measurements can be made even on higher frequency radios.



. . . and the HP 11758V still has all the capability of the HP 11758U.

Spectral Occupancy

Digital radios operate with very well-defined and controlled spectral occupancy. It is a routine practice to measure the occupancy of radios against predefined limits or masks. HP DRTS makes this measurement automatically and quickly. The test system can even print out a record of the test for later reference.

Flatness

Digital radios produce high quality transmissions, but only if the channel response is well adjusted. HP DRTS contains the stimulus and response measuring capability to make channel flatness adjustments. With HP DRTS, you can even measure flatness across a frequency translation. This is important when checking your up-converter's flatness.

Return Loss

Antenna feed problems are another source of dispersion which can degrade signal quality. Antenna return loss is a good indicator of an antenna feed's "health". Using your external directional coupler, HP DRTS measures return loss at installation to verify correct antenna assembly. It is also a helpful tool to use whenever antenna feed damage is suspected.

Frequency

To align your local oscillators, HP DRTS contains a nine-digit frequency counter. The counter uses the same input as the spectrum analyzer and has an impressive sensitivity of –40 dBm.

Signature Measurements

The signature of a digital microwave radio indicates the radio's ability to cope with multipath fading. The HP DRTS measures and displays the radio's Static M-Curve, Hysteresis, Dynamic M-Curve, and Dynamic S-Curve. These measurements indicate radio equalizer performance when presented with a static or dynamic fading condition. Signatures can be used to compare radios or to monitor individual radio performance over time. The HP DRTS also measures radio dispersive fade margin and recovery time.

C/N vs. BER

HP DRTS enables you to bring computer power to remote radio sites with its downloadable programming (DLP) capability. One DLP that comes standard with HP DRTS controls an HP 3708A and a BERT to make C/N vs BER measurements. The C/N vs. BER measurement tests a radio's sensitivity to flat or non-frequency dependent fades. It is an excellent tool to characterize and compare different radios or to serve as a final performance check of the entire radio system.

Power

Power is one of the most basic, often needed measurements. The power meter in HP DRTS is invaluable for performance evaluation and troubleshooting. With the sensor, attenuators, and the 50- to 75-Ohm adapter included with HP DRTS, you can measure power over a wide range of frequencies and power levels.

Intermodulation

The tradeoff between transmitted power and quality degradations caused by intermodulation is an inherent aspect of digital microwave radio design. Intermodulation, caused by driving the output amplifiers too hard, places a limit on the signal quality. Therefore, an intermodulation test is used to check and adjust the output amplifiers. HP DRTS supplies a three-tone intermodulation test signal which is useful in testing intermodulation down to –60 dBc.

Specifications

All specifications apply over 0°C to +55°C. The Spectrum Analyzer, IF Tracking Generator, RF Source, Flatness Analyzer and Frequency Counter will meet their specifications when (1) they have been stored for 2 hours at a constant temperature within the specified range, (2) 30 minutes has elapsed after turn on, and (3) after CAL FREQ, CAL AMPTD and CAL YTF have been run. *Note: Supplemental Characteristics are not specifications. They provide useful, but nonwarranted, information about instrument performance.*

SPECTRUM ANALYZER SPECIFICATIONS

Frequency Specifications

Frequency Range: 9 kHz to 22 GHz

Band	LO Harmonic (N)	
0	1	9 kHz to 2.9 GHz
1	1	2.75 GHz to 6.5 GHz
2	2	6.0 GHz to 12.8 GHz
3	3	12.4 GHz to 19.4 GHz
4	4	19.1 GHz to 22 GHz

Frequency Accuracy:

Readout Accuracy (Start, Stop, Center, Marker):
±(frequency readout x frequency reference error* + 1.0% of span + 20% of RBW + 100 Hz x N)**

Stability:

Noise Sidebands: <= –105 dBc/Hz + 20 Log N** at >30 kHz offset from CW signal (1 kHz RBW, 30 Hz VBW, and sample detector)

Residual FM: <(250 x N**)Hz pk-pk in 100 ms (1 kHz RBW, 1 kHz VBW)

System Related Sidebands:
<–65 dBc + 20 log N** at >30 kHz offset from CW signal

Frequency Span:

Range: 0 Hz (zero span), (10 x N**) kHz to 19.25 GHz

Resolution: 4 digits

Accuracy: ±2% of span, span ≤10 MHz x N**
±3% of span, span >10 MHz x N**

Frequency Reference:

Aging: $\pm 1 \times 10^{-7}$/year

Initial Achievable Accuracy: $\pm 2.2 \times 10^{-8}$

Temperature Stability: $\pm 1 \times 10^{-8}$

Resolution Bandwidth: (–3 dB)

Range: 1 kHz to 3 MHz selectable in 1.3, 10 steps

Accuracy: ±20%

Video Bandwidth: (–3 dB)

Range: 1 Hz to 1 MHz selectable in 1.3, 10 steps

Accuracy: ±30%

*Frequency Reference Error = (Aging rate x period of time since adjustment + initial achievable accuracy + temperature stability)

**N = LO Harmonic

***Mixer Power Level (dBm) = Input Power (dBm) –Input Attenuator (dBm)

Amplitude Specifications

Amplitude Range: Displayed Average Noise Level to +30 dBm

Displayed Average Noise Level (Input terminated, 0-dB attenuation, 1 kHz RBW, 1 Hz VBW, sample detector):

400 kHz to 2.9 GHz	≤ –112 dBm
2.75 GHz to 6.4 GHz	≤ –114 dBm
6.0 GHz to 12.8 GHz	≤ –102 dBm
12.4 GHz to 19.4 GHz	≤ –98 dBm
19.1 GHz to 22 GHz	≤ –92 dBm

Spurious Responses:

Second Harmonic Distortion
<–70 dBc (for –40-dBm tone at input mixer,*** 10 MHz to 2.9 GHz)
<–100 dBc (for –10-dBm tone at input mixer,*** >2.75 GHz)
(or below displayed average noise level)

Third Order Intermodulation Distortion
>10 MHz: <–70 dBc for two –30-dBm tones at input mixer*** with >50 kHz separation

Other Input Related Spurious Responses:
<–20 dBm at input mixer***, >30 kHz offset)
<–65 dBc for applied frequencies ≤ 18 GHz
<–60 dBc for applied frequencies < 22 GHz

Reference Level:

Range: Same as Amplitude Range

Accuracy
±0.3 dB @ –20 dBm
±(0.3 dB + 0.01 x dB from –20 dBm) @ 0 dBm to –59.9 dBm

Sweep time Range: 20 ms to 100 s

IF TRACKING GENERATOR SPECIFICATIONS

Frequency Range:

Direct: 300 kHz to 2.9 GHz

Frequency Accuracy:
± (frequency readout x frequency reference error* + span accuracy + 1% of span + 20% of resolution BW + 2 kHz

Supplemental Characteristics

Output Level Resolution: *–1 to –66 dBm / 0.1 dB*

Harmonic Spurious: –25 dBc (300 kHz to 2.9- GHz)

Nonharmonic Spurious from 300 kHz to 2.9 GHz:
–27 dBc (TG Output 300 kHz to 2.0 GHz)
–23 dBc (TG Output 2.0 GHz to 2.9 GHz)

Specifications

All specifications apply over 0°C to +55°C. The Spectrum Analyzer, IF Tracking Generator, RF Source, Flatness Analyzer and Frequency Counter will meet their specifications when (1) they have been stored for 2 hours at a constant temperature within the specified range, (2) 30 minutes has elapsed after turn on, and (3) after CAL FREQ, CAL AMPTD and CAL YTF have been run. *Note: Supplemental Characteristics are not specifications. They provide useful, but nonwarranted, information about instrument performance.*

SPECTRUM ANALYZER SPECIFICATIONS

Frequency Specifications

Frequency Range: 9 kHz to 22 GHz

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0	1	9 kHz to 2.9 GHz
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2	2	6.0 GHz to 12.8 GHz
3	3	12.4 GHz to 19.4 GHz
4	4	19.1 GHz to 22 GHz

Frequency Accuracy:

Readout Accuracy (Start, Stop, Center, Marker):
±(frequency readout x frequency reference error* + 1.0% of span + 20% of RBW + 100 Hz x N)**

Stability:

Noise Sidebands: <= –105 dBc/Hz + 20 Log N** at >30 kHz offset from CW signal (1 kHz RBW, 30 Hz VBW, and sample detector)

Residual FM: <(250 x N**)Hz pk-pk in 100 ms (1 kHz RBW, 1 kHz VBW)

System Related Sidebands:
<–65 dBc + 20 log N** at >30 kHz offset from CW signal

Frequency Span:

Range: 0 Hz (zero span), (10 x N**) kHz to 19.25 GHz

Resolution: 4 digits

Accuracy: ±2% of span, span ≤10 MHz x N**
±3% of span, span >10 MHz x N**

Frequency Reference:

Aging: $\pm 1 \times 10^{-7}$/year

Initial Achievable Accuracy: $\pm 2.2 \times 10^{-8}$

Temperature Stability: $\pm 1 \times 10^{-8}$

Resolution Bandwidth: (–3 dB)

Range: 1 kHz to 3 MHz selectable in 1.3, 10 steps

Accuracy: ±20%

Video Bandwidth: (–3 dB)

Range: 1 Hz to 1 MHz selectable in 1.3, 10 steps

Accuracy: ±30%

*Frequency Reference Error = (Aging rate x period of time since adjustment + initial achievable accuracy + temperature stability)

**N = LO Harmonic

***Mixer Power Level (dBm) = Input Power (dBm) –Input Attenuator (dBm)

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Amplitude Range: Displayed Average Noise Level to +30 dBm

Displayed Average Noise Level (Input terminated, 0-dB attenuation, 1 kHz RBW, 1 Hz VBW, sample detector):

400 kHz to 2.9 GHz	≤ –112 dBm
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Spurious Responses:

Second Harmonic Distortion
<–70 dBc (for –40-dBm tone at input mixer,*** 10 MHz to 2.9 GHz)
<–100 dBc (for –10-dBm tone at input mixer,*** >2.75 GHz)
(or below displayed average noise level)

Third Order Intermodulation Distortion
>10 MHz: <–70 dBc for two –30-dBm tones at input mixer*** with >50 kHz separation

Other Input Related Spurious Responses:
<–20 dBm at input mixer***. >30 kHz offset)
<–65 dBc for applied frequencies ≤ 18 GHz
<–60 dBc for applied frequencies < 22 GHz

Reference Level:

Range: Same as Amplitude Range

Accuracy
±0.3 dB @ –20 dBm
±(0.3 dB + 0.01 x dB from –20 dBm) @ 0 dBm to –59.9 dBm

Sweep time Range: 20 ms to 100 s

IF TRACKING GENERATOR SPECIFICATIONS

Frequency Range:

Direct: 300 kHz to 2.9 GHz

Frequency Accuracy:
± (frequency readout x frequency reference error* + span accuracy + 1% of span + 20% of resolution BW + 2 kHz

Supplemental Characteristics

Output Level Resolution: *–1 to –66 dBm / 0.1 dB*

Harmonic Spurious: –25 dBc (300 kHz to 2.9- GHz)

Nonharmonic Spurious from 300 kHz to 2.9 GHz:
–27 dBc (TG Output 300 kHz to 2.0 GHz)
–23 dBc (TG Output 2.0 GHz to 2.9 GHz)

GROUP DELAY AND AMPLITUDE FLATNESS (OPT. 201) SPECIFICATIONS

End-to-End:

Amplitude:

Max. Range: 16 dB

Max. Sensitivity: 0.1 dB/div

Residual Flatness: ±0.1 dB (70/140 MHz ±20 MHz)

Delay:

Max. Range: ±200 ns

Max. Sensitivity: 0.1 ns/div

Residual Flatness: ±0.1 ns (70/140 MHz ±20 MHz)

Noise: <0.1 ns rms (250 kHz tone, 200 kHz dev)

Transmitter:

Center Frequency:

Range: 300 kHz-2.9 GHz
300 kHz-24 GHz (depends on RF source options)

Span:

Range: 0-2.9 GHz

Output:

Range: –1 to –66 dBm

FM Characteristics:

Rate: 55.56, 66.67 83.33, 92.59, 200, 250, 277.778, 500 and 555.56 kHz

Accuracy: ±10 ppm Typical

Deviation: 0 to 400 kHz but not exceeding 2.1 x Rate kHz rms

Harmonics: <=25 dBc

Sweep:

Time: 50 ms Fixed

Shape: Sawtooth

Receiver:

Center Frequency:

Range: Same as input range of spectrum analyzer

Accuracy: Same as transmitter

Span: Same as transmitter

Input Level: –50 to +30 dBm

FM Characteristics: Same as transmitter

Averaging of Traces: 1-16384 sweeps

Scale: 0.1 to 2 dB/div
0.1 to 50 dB/div

RF SOURCE SPECIFICATIONS

Frequency Range:
3.50 to 24 GHz (depending on option)

Output Level: +5 dBm to –15 dBm, 3.5 to 13 GHz
+0 dBm to –15 dBm, 13 to 24 GHz

Frequency Accuracy:
3.5 to 6.5 GHz ±(1 x 10^{-6} x center frequency +1.5% of span +2 kHz)
6.5 to 13 GHz ±(1 x 10^{-6} x center frequency +1.5% of span +4 kHz)
13 to 24 GHz ±(1 x 10^{-6} x center frequency +1.5% of span +8 kHz)

Sweep Range: 0 Hz, 8 kHz to 2.7 GHz

Residual FM: (CW mode)
3.5 to 6.5 GHz <30 kHz pk-pk
6.5 to 13 GHz <50 kHz pk-pk (typical)
13 to 24 GHz <100 kHz pk-pk (typical)

Harmonics and Sub-Harmonics: <–40 dBc

Spurious Signals: (<30 kHz from CW signal)
3.5 to 6.5 GHz <–64 dBc
6.5 to 13 GHz <–58 dBc
13 to 24 GHz <–40 dBc

FLATNESS ANALYZER SPECIFICATIONS

Frequency Range: Same as source range

Flatness: <±0.05 dB per 40 MHz (normalized)

Input Level: +20 dBm to –30 dBm

Amplitude Scale: 0.1, to 1.0 dB/division

Display Scale Fidelity:

Ref Level (dBm)	Log Incremental Accuracy (dB/2 dB step)	Log Maximum Cumulative (dB)
–30 to –20.1	0.7	0.7
–20 to –15.9	0.4	0.6
–16 to +20.0	0.8	1.2

FREQUENCY COUNTER SPECIFICATIONS

Frequency Range: 10 MHz to 22 GHz

Sensitivity: <–40 dBm

Accuracy: ±(Frequency readout x Frequency Reference Error* + Counter resolution + 100 Hz x N**)

Resolution: 5, 10, 100 1 k, 10 kHz

THREE TONE SOURCE SPECIFICATIONS

Center Frequencies (nominal): 67 MHz, 70 MHz, and 75 MHz
Option 143: 137 MHz, 140 MHz, and 145 MHz

Frequency Adjustment: ±2.5 MHz

Maximum Output Level: <–7 dBm per tone, –2 dBm total

Flatness: <0.5 dB

Spectral Purity: <–65 dBc at –8 dBm output level

EVENT COUNTER SPECIFICATIONS

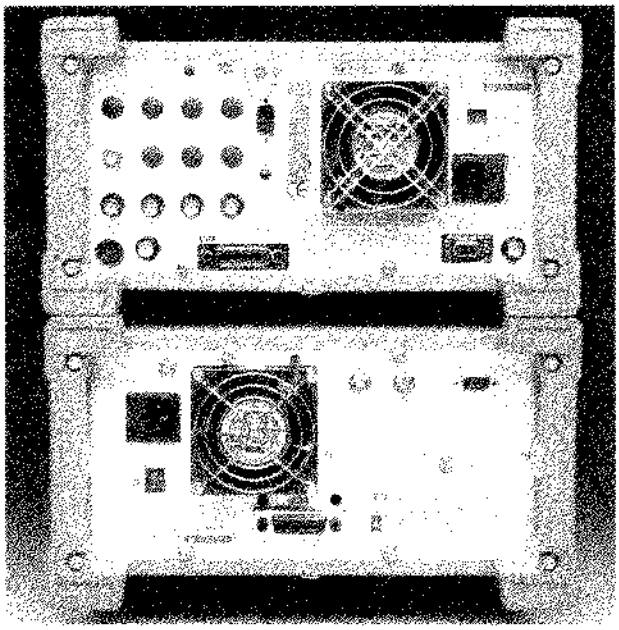
Supplemental Specifications

Input Level: TTL, HCMOS, open collector TTL
Maximum Pulse Rate: 1.6 MHz
(Driven from TL or HCMOS)
Minimum Pulse Width: 300 ns
(Driven from TTL or HCMOS)
Input Impedance:
AC 75 Ω
DC 2k Ω

OSCILLOSCOPE SPECIFICATIONS

Supplemental Specifications

Bandwidth: DC to 100 kHz
Input Level: ±5v displayed
±10v maximum input
Scale: ±2mv to ±5v full scale



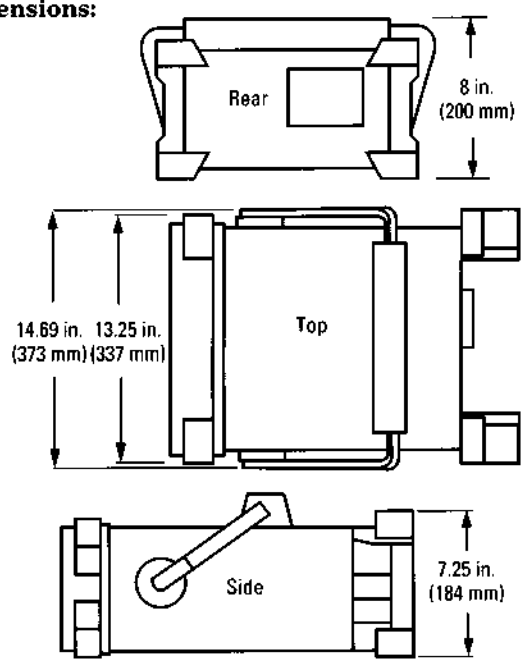
HP DRTS rear panel.

General Specifications

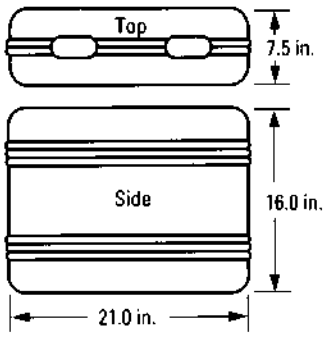
Net Weight:

Spectrum Analyzer/Counter	36 lbs. (16.4 kg)
Power Meter/RF Source	28 lbs.
Accessory Kit	20lbs.

Dimensions:



Accessory Kit:



Remote Programming:

HP-IB Interface Functions: SH1, AH1, T5, TEO, L3, LEO, SR1, RL1, PP1, DC1, DT0, CO, E2

EMI: Meets conducted and radiated emissions levels of Part 7 Mil Standard 461C and VDE 0871 Level B

Power Requirements:
100, 120, 220, 240 Vac +5% to –10%
48 Hz to 66 Hz
400 Hz for 115 Vac only

Operating Temperature: 0 to 55°C

Storage Temperature: –40 to +75°C

HP 11758V Digital Radio Test System
includes the following:

HP 8593E Spectrum Analyzer
configured with the following:

Tracking Generator
Flatness Analyzer Measurements Card and Personality
Frequency Measurement Personality
Digital Radio Measurement Personality (Masks)
Low-Frequency Oscilloscope Measurements Personality
Scalar Analyzer Measurements Personality
Signature Measurements Personality
Precision Frequency Reference
HP-IB

HP 11758B Digital Radio Test Set
which includes the following:

Power Meter
Multipath Fading Simulator
Intermodulation Test Source
HP 8470B Opt. 12 RF/IF Crystal Detector
HP 8481D Power Sensor
HP 11708A 30 dB Reference Attenuator
HP 11730B 3m Power Sensor Cable
HP 10833D 0.5m HP-IB Cable
11758-60022 75 Ω BNC Cable
8120-05343 Control Interconnect Cable
1250-0780 50 Ω N(m) to BNC(f) (2)

Option 270, 26.5 GHz Frequency Extension

This option extends the specified range of the spectrum analyzer to 26.5 GHz. The input connector to the spectrum analyzer remains type N (female). The power sensor normally supplied is replaced by the HP 8485D 26.5 GHz Power Sensor. Also included is an HP 1250-1744 APC-3.5(f) to N(m) Adapter.

Option 301 Accessory Kit

Includes the following:
HP 8491B Opt. 030 30 dB 18 GHz Attenuator
HP 8498A Opt. 030 30 dB High Power Attenuator
HP 8491B Opt. 020 20 dB 18 GHz Attenuator
HP 11852B 50/75 Ω Minimum Loss Pad (2)
HP 11766A DADE Switch
HP 1767A IF Amplifier
HP 1769A IF Return Loss Bridge
Adapters:
1250-2273 50 Ω N(f) to SMA(m) (2)
1250-0777 50 Ω N(f) to N(f)
1250-1287 75 Ω BNC(f) to BNC(f)
1250-2281 50 Ω N(m) to N(f) Right Angle
1250-0778 50 Ω N(m) to N(m)
9100-4859 75 Ω N(m) to BNC(f) Adapter
Cables:
HP 11500A 50 Ω N(m) to N(m) 6 ft
11758-60022 75 Ω double shielded BNC 6 ft (2)
11758-60023 75 Ω double shielded BNC 10 ft
11758-60024 75 Ω double shielded BNC 15 ft
11758-809012 Accessory Storage Box
8720-0015 SMA Wrench

Ordering Information

HP 11758V Digital Radio Test System

Opt. 007	3.5 to 6.5 GHz RF Source
Opt. 011	Add 10.7 to 11.7 GHz RF Source (requires Opt. 007)
Opt. 140	140 MHz Multipath Fading Simulator and Intermodulation Test Source (replaces 70 MHz)
Opt. 147	70 and 140 MHz Multipath Fading Simulator and 70 MHz Intermodulation Test Source
Opt. 201	Group Delay and Amplitude Flatness Measurements
Opt. 270	Spectrum Analyzer frequency extension to 26.5 GHz with type N(f) connector
Opt. 301	Accessory Kit
Opt. 908	Rack Mount Kits without handles
Opt. 909	Rack Mount Kits with handles
Opt. 915	Detailed Programming, Operation and Service Manuals
Opt. 916	Extra Operating Manual
K01	Soft Carrying Cases (2)
H04	Fader High Power Input/Output Capability
H07	Add 6.0 to 8.0 GHz RF Source (requires Opt. 007)
H08	Add 7.0 to 10 GHz RF Source (requires Opt. 007)
H10	Add 9.5 to 13.0 GHz RF Source (requires Opt. 007)
H13	Add 6.0 to 13.0 GHz RF Source (requires Opt. 007)

Other sources available. Contact your HP representative.

HEWLETT PACKARD

For more information, call your local HP sales office listed in the telephone directory white pages. Ask for the Test and Measurement Department, or write to Hewlett-Packard:

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(301) 670-4300

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