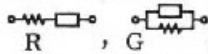


Table 1-1. Specifications (Sheet 1 of 5).

SPECIFICATIONS

Parameters Measured:

| | |
|------------|--|
| Z | θ (radian/degree) |
| Y | |
| Γ | |
| R | X |
| G | B |
| Γ_x | Γ_y |
| L C |  R, G, D, Q |

Δ (unit deviation) and $\Delta\%$ (percent deviation) for all parameters.

Test Signal (Internal): 1 to 1000 MHz

| Characteristics ¹ | 1–500 MHz | 500–1000 MHz |
|------------------------------|-----------------|-----------------|
| Level (50 Ω load) | -20 ± 3 dBm | -20 ± 3 dBm |
| Frequency Resolution | 100 kHz | 200 kHz |
| Frequency Accuracy at 23°C | 3 ppm | 3 ppm |

1. After 40 minute warm-up,
Temperature: 23°C \pm 5°C.

External Test Signal:

Frequency : 1 MHz to 1000 MHz
Input Level : 0 dBm typ., -3 to $+3$ dBm.
(Test level: -17 to -23 dBm at 50 Ω load)

Sweep Characteristics:

Sweep mode :

- Auto: Single sweep from programmed start to stop frequency (or in reverse direction). Sweep pause at desired frequency step is feasible.
- Manual: Bidirectional step shift (up-down) of frequency between start and stop frequencies.

Sweep span: Maximum 1 MHz to 1000 MHz, selectable in 100 kHz minimum frequency step intervals.

Frequency step:

Linear sweep: Selectable in 100 kHz minimum step frequency intervals (to 999 MHz).

Logarithmic sweep: A total of 50 step frequencies (51 spot frequencies) automatically selected at logarithmically regular intervals, minimum 100 kHz (rounds off fractional frequency to 100 kHz).

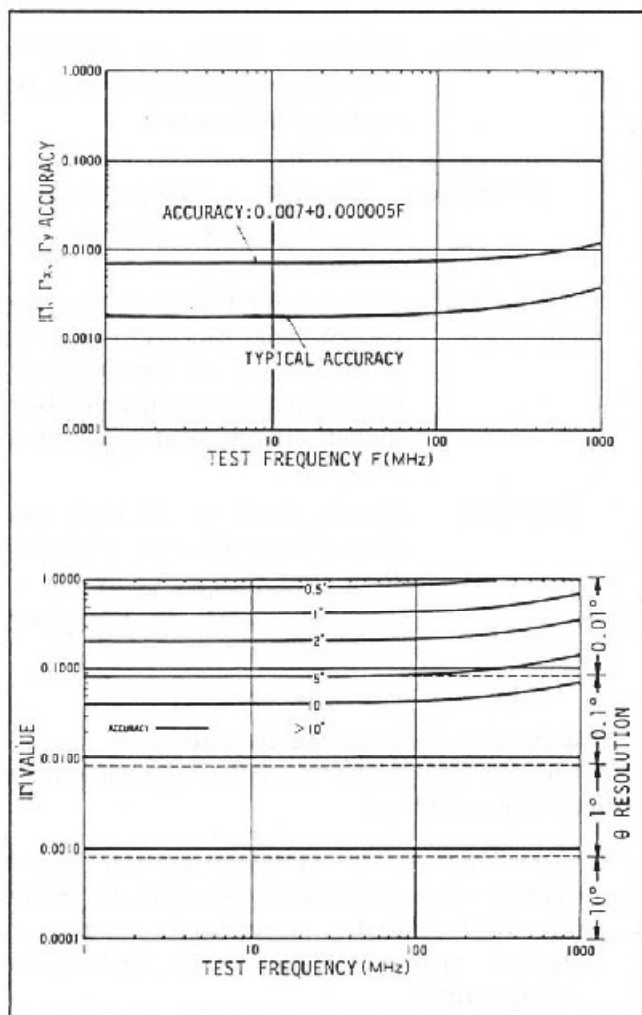
Fast sweep: Manual sweep by 10 times programmed step frequency intervals in linear sweep mode, or by 1/5 of frequency points in logarithmic sweep mode.

Measurement Accuracy and Resolution:

Accuracies apply under the following measurement operating conditions:

- 1) Specifies reflection coefficient accuracy ($|\Gamma|$ – θ and Γ_x – Γ_y measurement accuracies). Accuracies for other parameter measurements are given as typical values in Supplemental Performance Characteristics.
- 2) Warm-up time: at least 40 minutes.
- 3) Auto-calibration properly completed using standard reference terminations.
- 4) Measurement frequency identical to auto-calibration frequency points (51 spots).
- 5) Environmental temperature: 23°C \pm 5°C (allows temperature variation). 0°C ~ 55°C (at the constant temperature at which auto-calibration is completed).
- 6) Measurement taken at UNKNOWN connector (without using test port extension).

Table 1-1. Specifications (Sheet 2 of 5).



Measurement Range:

$|\Gamma|$, Γ_x , Γ_y : 0.0001 to 1.0000
 θ : 0.00 to $\pm 180.00^\circ$
 (0 to $\pm \pi$ radian)

Display: 4-1/2 digit maximum, simultaneous display of two parameter values, maximum display 19999. (Number of display digits changes depending on measurement frequency and range).

Digit Shift: Number of desired display digits (less than the maximum display digits) is selectable by control key.

Range Modes: Auto and Hold.

Measurement Terminal: Single test port, APC-7 connector terminal.

Deviation Measurement: A measurement display value or a desired value entered by DATA input keys can be stored as a reference value. Next, pressing Δ or $\Delta\%$ button enables the difference between the referenced value and subsequent result to be displayed. (Deviation spread in counts is -19999 to 19999 or from -1999.9% to 1999.9%).

Electrical Length Correction: The effects in phase of the reflection coefficient particular to the test fixture used can be automatically corrected by entering electrical length number of the test fixture with DATA input keys.

Input data range: 0 to 99.99 cm

Automatic Calibration: Memorizes measurement results of reference termination impedances and automatically performs corrections to optimize measurement accuracy in subsequent measurements.

Reference termination impedances: 0Ω , 50Ω and OS .

Calibration frequency: 51 spot frequencies automatically selected from within the frequency range of 1 MHz to 1000 MHz or of programmed start to stop frequencies.

Calibration data at frequencies other than the selected calibration frequency points are obtained by using cubic interpolation approximations.

Self Test: Performs cyclic operation of internal function tests and displays diagnostic code sets (when any abnormality is detected).

Internal Bias: Internal dc bias source manually or remotely controllable from 0V to $\pm 40V$ in 10mV (minimum) steps.

Bias control range and accuracy ($23^\circ C \pm 5^\circ C$):

| Bias Voltage Control Range | Accuracy |
|----------------------------|---|
| -40.00V — 40.00V | $\pm(0.1\% \text{ of setting} + 10\text{mV})^*$ |

* $\pm (0.4\% + 20\text{mV})$ at $0^\circ C$ to $55^\circ C$

Bias output characteristics:

$1390\Omega \pm 10\%$, 7.2 mA max. ($\pm 10\%$).

Table 1-1. Specifications (Sheet 3 of 5).

Control: Manual control by front panel keys or remote control by HP-IB controller. Bias voltage sweep is also feasible.

Sweep characteristics:

Sweep Mode:

Auto: Single sweep from programed start to stop voltages or in reverse direction. Sweep pause at desired voltage step is feasible.

Manual: Bidirectional step shift (up-down) of bias voltage between start and stop bias voltages.

Sweep span: Maximum -40 to +40V (linear sweep). Maximum +0.01 to +40V (logarithmic sweep). Selectable in 0.01V minimum voltage step intervals.

Voltage step:

Linear sweep: Selectable in 0.01V (minimum) step voltage intervals (to ± 40 V).

Logarithmic sweep: A total of 50 step voltages (51 spot voltages) automatically selected at logarithmically regular intervals, minimum 0.01V (rounds off fractional voltage to 0.01V).

Fast sweep: Manual sweep at 10 times programmed step voltage intervals in linear sweep mode, or by 1/5 of voltage points in logarithmic sweep mode.

DC bias monitor: Bias voltage monitor output (common to external dc bias input), BNC connector, output impedance $1k\Omega \pm 10\%$.

Save Function: Continuous memorization of one or two desired control settings states powered by stand-by battery. Memorized setting data is preserved in event that instrument loses operating power and can be restored as actual control setting anytime by pressing control keys. Memorizes the following data and control settings:

- 1) Front panel pushbutton control settings (except SELF TEST function).
- 2) Automatic calibration data (restored just after the instrument is turned on).
- 3) Reference values in deviation measurement.

External DC Bias: External DC bias input connector on rear panel (common to internal dc bias voltage monitor connector), maximum ± 40 V.

Bias input characteristics: $390\Omega \pm 10\%$, 100mA max.

Trigger: Internal, external and manual.

HP-IB INTERFACE: Remote control and data output via the HP-IB (based on IEEE-Std-488 and ANSI-MC1.1).

Remotely controllable functions:

- 1) DISPLAY A functions ($|Z|$, $|Y|$, $|\Gamma|$, R, G, Γ_x , L and C).
- 2) DISPLAY B functions (θ , X, B, Γ_y , R, G, D and Q).
- 3) Test signal frequency (SPOT).
- 4) Frequency sweep functions (START, STOP and STEP frequencies, LOG SWEEP, MANUAL STEP, AUTO START, PAUSE and SWEEP ABORT).
- 5) Deviation functions (Δ , $\Delta\%$, REF A, REF B, and STORE DSPL A/B).
- 6) High speed.
- 7) Range hold.
- 8) Digit shift (DSPL A and DSPL B).
- 9) Electrical length.
- 10) Open capacitance.
- 11) Automatic calibration.
- 12) Save functions (SAVE 1, SAVE 2, RCL 1 and RCL 2).
- 13) Self test.
- 14) Trigger.
- 15) DC bias voltage (SPOT).
- 16) Bias voltage sweep functions (START, STOP and STEP voltages, LOG SWEEP, MANUAL STEP, AUTO START, PAUSE and SWEEP ABORT).
- 17) X-Y recorder control functions (LL, UR and INTRPL) (option 004 only).

Data output:

- 1) $|Z|$, $|Y|$ or $|Γ|$ with $θ$; R with X; G with B; $Γ_x$ with $Γ_y$; L or C with R, G, D or Q.
- 2) Test frequency in swept frequency measurement.
- 3) Frequency in automatic calibration.
- 4) Bias voltage in swept bias voltage measurement.

Internal function allowable subsets:
SH1, AH1, T5, L4, SR1, RL1, DC1 and DT1.

Data output format: Either of two formats may be selected (switchable on rear panel).

Format A.

1. Stationary (fixed) frequency/bias measurement:

$$\frac{0}{1} \frac{XXX}{234} \pm \frac{NNN}{5} . \frac{NNE}{789} \pm \frac{NN}{10} \text{ (CR/LF)} \frac{11}{11}$$
2. Swept frequency/bias measurement or auto-calibration:

$$\frac{0}{1} \frac{X}{12} \pm \frac{NNNN}{13} . \frac{NNNN}{5234} \pm \frac{NNE}{5} \pm \frac{NN}{789} . \frac{XXX}{2} \pm \frac{NNN}{10} . \frac{NNE}{10} \pm \frac{NN}{11} \text{ (CR/LF)} \frac{11}{11}$$

Format B.

1. Stationary (fixed) frequency/bias measurement:

$$\frac{0}{1} \frac{XXX}{234} \pm \frac{NNN}{5} . \frac{NNE}{789} \pm \frac{NN}{10} \text{ (CR/LF)} \frac{11}{11}$$

$$\frac{XXX}{234} \pm \frac{NNN}{5} . \frac{NNE}{789} \pm \frac{NN}{10} \text{ (CR/LF)} \frac{11}{11}$$
2. Swept frequency/bias measurement or auto-calibration:

$$\frac{0}{1} \frac{X}{12} \pm \frac{NNNN}{13} . \frac{NNNN}{5234} \pm \frac{NNE}{5} \pm \frac{NN}{789} . \frac{XXX}{2} \pm \frac{NNN}{10} . \frac{NNE}{10} \pm \frac{NN}{11} \text{ (CR/LF)} \frac{11}{11}$$

$$\frac{XXX}{234} \pm \frac{NNN}{5} . \frac{NNE}{789} \pm \frac{NN}{10} \text{ (CR/LF)} \frac{11}{11}$$

$$\frac{XXX}{234} \pm \frac{NNN}{5} . \frac{NNE}{789} \pm \frac{NN}{10} \text{ (CR/LF)} \frac{11}{11}$$

(1) Space.
(2) Data status of DISPLAY A.
(3) Function of DISPLAY A or calibration condition.
(4) Deviation measurement mode of DISPLAY A.
(5) Value of DISPLAY A (decimal point position is coincident with display).
(6) Comma (data delimiter).
(7) Data status of DISPLAY B.
(8) Function of DISPLAY B or calibration condition.
(9) Deviation measurement mode of DISPLAY B.
(10) Value of DISPLAY B (decimal point position is coincident with display).
(11) Data terminator.
(12) Sweep parameter.
(13) Measurement frequency or bias voltage (decimal point position is coincident with display).

GENERAL

Operating Temperature and Humidity:
0°C to 55°C at 95% RH (to 40°C).

Power Requirements: 100/120/220V $\pm 10\%$, 240V $\pm 5\%$ - 10%, 48-66Hz.

Power Consumption: 150VA max with any option.

Dimensions:
425.5 (W) x 230 (H) x 574 (D) mm
(16-3/4" x 9-1/16" x 22-5/8")

Weight: Approximately 24 kg (Std).

Table 1-1. Specifications (Sheet 5 of 5).

| OPTIONS | ACCESSORIES |
|---|--|
| <p>Option 002: Provides test signal frequencies selectable at 100 Hz resolution to 500 MHz and at 200 Hz resolution to 1000 MHz.</p> <p>Option 004: Analog voltage outputs for graphically recording sweep measurement data on an X-Y recorder. Three channel BNC output connectors on rear panel.</p> <p>DISPLAY A connector: Outputs voltage proportional to three lesser significant digit numbers of DISPLAY A display outputs (1 mV/count).</p> <p>DISPLAY B connector: Outputs voltage proportional to DISPLAY B display outputs in the same manner as that for DISPLAY A connector outputs.</p> <p>FREQ/BIAS connector: Outputs voltage proportional to test frequency or bias voltage as: Start frequency/voltage : 0V Stop frequency/voltage : 1V</p> <p>Reference recorder voltages: Lower Left (LL) : 0, 0, 0 V Upper Right (UR) : +1, +1, +1V</p> <p>Voltage accuracy: $\pm (0.5\% + 2\text{ mV})$ at $23^\circ\text{C} \pm 5^\circ\text{C}$ $\pm (1\% + 5\text{ mV})$ at 0°C to 55°C</p> <p>Interpolation function: Smoothing of recorder outputs by arithmetic interpolation of measurement data, selectable by control key.</p> | <p>Accessories Supplied: Reference terminations for calibrating the 4191A. Three kinds of terminations are included:</p> <ul style="list-style-type: none"> 0 Ω reference termination (short), (HP P/N 04191-85300). 50 Ω reference termination, (HP P/N 04191-85301). 0S reference termination (open), (HP P/N 04191-85302). <p>Additionally, accessory box (HP P/N 04191-60200) which accommodates these terminations and all the available test fixtures is furnished.</p> <p>Operating booklet (HP P/N 04191-90100).</p> <p>Power Cord (HP P/N 8120-1378).</p> |
| <p>Option 907: Front handle kit, for front handle installation</p> <p>Option 908: Rack flange kit, for mounting in IEC standard rack.</p> <p>Option 909: Rack flange & handle kit, for rack mounting and handle installation.</p> <p>Option 910: Extra operating manual.</p> <p>Option 91S: Extra service manual.</p> | <p>Accessories Available: [Accessories, other than primary accessories, are outlined in Table 1-2.]</p> <p>16091A: Coaxial Fixture set, direct coupled, two types of sample holders, coaxial termination structure, with APC-7 connectors. For mounting cylindrical sample piece in inner cavity chamber. Usable on all 4191A ranges to 1000 MHz.</p> <p>16092A: Spring Clip Fixture, direct coupled, for holding axial or radial lead components or leadless chip elements. Either slide clip contact or twin clip contacts can be attached on the terminal deck with APC-7 connector. Usable on all ranges at frequencies below 500 MHz.</p> <p>16093A: Binding Post Fixture, direct coupled, two binding posts on terminal deck with APC-7 connector, for holding axial or radial lead components, 7 mm terminal post interval. Usable on all ranges at frequencies below 250 MHz.</p> <p>16093B: Binding Post Fixture, direct coupled, three binding posts (including a guard terminal) on terminal deck with APC-7 connector, 18 mm terminal post interval (15 mm to guard). Usable on all ranges at frequencies below 125 MHz.</p> <p>16094A: Probe fixture, two-needle probe adapter, compatible with APC-7 connector test cable, for in-circuit testing of components, variable needle span (15 mm max.). Usable on all ranges at frequencies below 125 MHz.</p> |