

# Test Equipment Solutions Datasheet

Test Equipment Solutions Ltd specialise in the second user sale, rental and distribution of quality test & measurement (T&M) equipment. We stock all major equipment types such as spectrum analyzers, signal generators, oscilloscopes, power meters, logic analysers etc from all the major suppliers such as Agilent, Tektronix, Anritsu and Rohde & Schwarz.

We are focused at the professional end of the marketplace, primarily working with customers for whom high performance, quality and service are key, whilst realising the cost savings that second user equipment offers. As such, we fully test & refurbish equipment in our in-house, traceable Lab. Items are supplied with manuals, accessories and typically a full no-quibble 2 year warranty. Our staff have extensive backgrounds in T&M, totalling over 150 years of combined experience, which enables us to deliver industry-leading service and support. We endeavour to be customer focused in every way right down to the detail, such as offering free delivery on sales, covering the cost of warranty returns BOTH ways (plus supplying a loan unit, if available) and supplying a free business tool with every order.

As well as the headline benefit of cost saving, second user offers shorter lead times, higher reliability and multivendor solutions. Rental, of course, is ideal for shorter term needs and offers fast delivery, flexibility, try-before-you-buy, zero capital expenditure, lower risk and off balance sheet accounting. Both second user and rental improve the key business measure of Return On Capital Employed.

We are based near Heathrow Airport in the UK from where we supply test equipment worldwide. Our facility incorporates Sales, Support, Admin, Logistics and our own in-house Lab.

All products supplied by Test Equipment Solutions include:

- No-quibble parts & labour warranty (we provide transport for UK mainland addresses).
- Free loan equipment during warranty repair, if available.
- Full electrical, mechanical and safety refurbishment in our in-house Lab.
- Certificate of Conformance (calibration available on request).
- Manuals and accessories required for normal operation.
- Free insured delivery to your UK mainland address (sales).
- Support from our team of seasoned Test & Measurement engineers.
- ISO9001 quality assurance.

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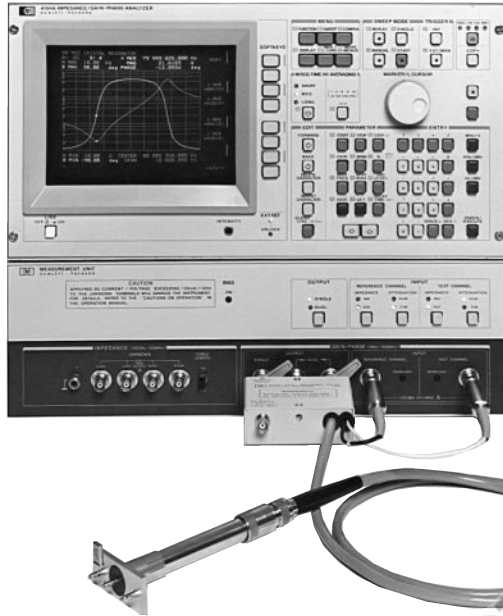
# Impedance Measuring Instruments

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## Impedance/Gain-Phase Analyzer

HP 4194A

- Wide range impedance measurement: 100 Hz to 40 MHz, 10 m $\Omega$  to 100 M $\Omega$
- Gain-phase measurement: 10 kHz to 100 MHz, 0.1  $\Omega$  to 1 M $\Omega$ , when used with the HP 41941A/B
- Flexible measurement, computation, and analysis capabilities on a color graphic display
- Fully programmable



HP 4194A with HP 41941A

### HP 4194A Impedance/Gain-Phase Analyzer

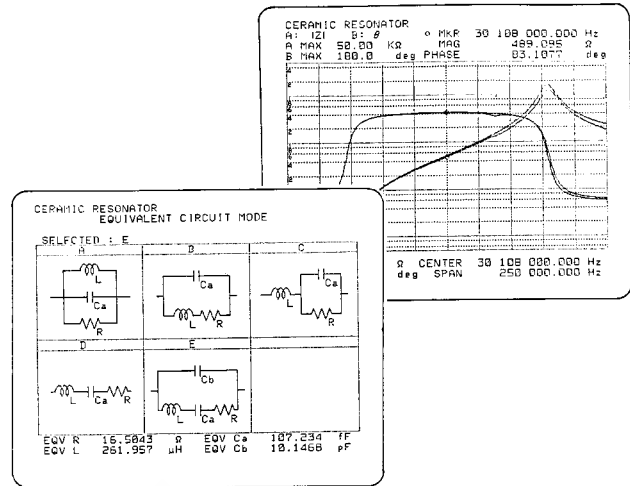
The HP 4194A impedance/gain-phase analyzer is an integrated solution for efficient measurement and analysis or go/no-go testing of components and circuits. Detailed impedance and transmission characteristics, including secondary parameter derivations, can be simply and quickly evaluated or tested. The HP 4194A can contribute to improving engineering productivity and reducing test cost. The analyzer is flexible and has wide measurement capabilities in both impedance and transmission measurements. It is also fully programmable using Auto Sequence Programming (ASP). Desired measurements and computations, including graphics analysis, can be programmed simply by storing front-panel key-stroke operations, allowing you to customize measurement, computation, and analysis functions. The HP 4194A also features high-accuracy and error elimination functions to ensure reliable measurements.

#### Wide-Range Accurate Measurement

Featuring a wide test frequency range—100 Hz to 40 MHz for impedance measurement (10 kHz to 100 MHz when using the HP 41941A/B Impedance Probe Kit) and 10 Hz to 100 MHz for gain-phase measurements—the HP 4194A satisfies a wide spectrum of needs. Realistic device characteristics can be analyzed under actual operating conditions by varying the test frequency, test signal level, and dc bias. The HP 4194A's high degree of measurement accuracy—0.17 percent for impedance measurements (1.5 percent when using the HP 41941A/B) with an amplitude ratio of 0.1 dB—ensures that you'll improve the quality of your test devices.

#### Quick Analysis

The HP 4194A makes high-speed measurements, (approximately 3.7 ms per point), displays results on a color CRT, and performs parameter analysis of components and circuits quickly and efficiently, substantially reducing development and evaluation time. The analysis function not only provides you with impedance and transmission characteristics, but also allows you to determine secondary parameters. Using the marker and line cursor functions, you can obtain the resonating frequency of resonators and the pass band width of band pass filters quickly.



### Equivalent Circuit Analysis Function

Using the HP 4194A's equivalent circuit analysis function, you can easily and quickly obtain those equivalent circuit constants that, until now, required a number of time-consuming, complicated calculations. By using measured values, this unique function can approximate the circuit constant values of five circuit models. For example, a resonator's equivalent circuit elements or a coil's self inductance, lead resistance, and stray capacitance can be easily obtained.

The equivalent circuit analysis function also simulates the frequency characteristics of components by using derived circuit values or values you specify. By using approximation and simulation, you can compare design values to measurement values, thereby improving component design efficiency.

### Auto Sequence Program (ASP)

The HP 4194A's ASP function, an internal programming feature, allows you to control all HP 4194A operations (measurement, display, and analysis) without the need for an external computer. By using ASP and actual measurement values, you can readily calculate many secondary parameters that you may need to evaluate. You can use the HP 4194A's powerful analysis functions to analyze these calculated parameters.

You can also use ASP to enhance such HP 4194A functions as alternate sweep, sweep timing control, and marker tracking. Because ASP eliminates the need for external controller, thereby eliminating data transfer time, the HP 4194A can quickly and efficiently perform production line go/no-go testing of components such as resonators and filters. All these features combine to increase your engineering and manufacturing productivity.

### Increased Capabilities with the HP 41941A/B Impedance Probe Kit

When using the HP 4194A with the HP 41941A/B impedance probe kit, you can perform reliable impedance evaluations up to 100 MHz. Measurement errors due to residual impedance and stray admittance are eliminated by using the calibration standards furnished with the HP 41941A/B and the HP 4194A's automatic calibration function. This makes it possible to make highly accurate measurements (basic measurement accuracy 1.5 to 3 percent) over a wide measurement range of 100 m $\Omega$  to 1 M $\Omega$ . Calibration accuracy is guaranteed to the tips of the HP 41941A (1.5 m) and HP 41941B (3 m) impedance probes.

The HP 41941A/B can be used as a grounded probe to evaluate the impedance of in-circuit components such as printed circuit patterns, and the input/output impedance of circuits. In addition, you can connect an external dc bias source directly to the HP 41941A/B to perform dc biased measurements up to  $\pm 150$  V/0.5 A, to measure the dc characteristics of inductors, capacitors, materials, and semiconductors. To perform swept dc bias measurements, use the HP 4194A's  $\pm 40$  V internal dc bias source.

### Specifications

#### Impedance Measurements

**Measurement Parameters:**  $|Z|$ ,  $|Y|$ ,  $\Theta$ , R, X, G, B, L, C, D, Q.

Twenty parameter combinations are available.

**Test Frequency:** 100 Hz to 40 MHz (cable length: 0m); 100 Hz to 15 MHz (cable length: 1 m), 1 mHz resolution.

**OSC Level:** 10 mV–1 V rms ( $\leq 10$  MHz), 10 mV–0.5 V rms ( $> 10$  MHz) (UNKNOWN terminal open), 3-digit resolution

**DC Bias:** 0 to  $\pm 40$  V, 10 mV resolution

**Measurement Terminal:** 4-terminal pair configuration

#### Measurement Range and Maximum Resolution:

Measurement parameter	Range	Max. resolution
$ Z $ , R, X	10 m $\Omega$ to 100 M $\Omega$	100 $\mu\Omega$
$ Y $ , G, B	10 nS to 100 S	1 nS
$\Theta$	$\pm 180^\circ$	0.01 $^\circ$
L	1 nH to 100 kH	10 pH
C	10 fF to 0.1 F	0.1 fF
D	0.001 to 10	0.0001
Q	0.1 to 1000	0.1

**Basic Measurement Accuracy:** 0.17%

**Level Monitor:** 1 mV to 1 V rms, 1  $\mu$ A–20 mA

#### Gain-Phase Measurements

**Measurement Parameters:** Tch/Rch (dB, Linear Ratio),

Tch, Rch (V, dBm, dBV),  $\Theta$  (degree, rad),  $\tau$

Tch=Test Channel, Rch=Reference Channel,  $\tau$ =Group Delay

**Measurement Frequency:** 10 Hz to 100 MHz, 1 mHz resolution

**Aperture Frequency Range** (Group Delay Measurements): 0.5% to 100% of frequency span

**OSC Level:** –65 dBm to +15 dBm, 0.1 dB resolution

#### Measurement Range

**Tch/Rch:** 0 to  $\pm 120$  dB, 0.001 dB resolution

**Tch, Rch:** –107 dBm to –5 dBm (0 dB attenuator); –87 dBm to +15 dBm (20 dB attenuator); 0.001 dB resolution

$\Theta$ :  $\pm 180^\circ$  (can display phase continuously with the phase scale expansion function), 0.01 $^\circ$  resolution

$\tau$ : 0.1 ns to 1 s, 0.1 ns resolution

#### Basic Measurement Accuracy

**Tch/Rch:** 0.1 dB, 0.5 $^\circ$

**Tch, Rch:** 0.35 dBm

**Level Monitor:** Monitor the input level of the reference and test channels in units of dBm, dBV and Volts

#### Impedance Measurements Using the HP 4194A/B

The specifications listed are for the HP 4194A when used with the HP 41941A/B.

**Frequency Range:** 10 kHz to 100 MHz, 1 mHz resolution

#### OSC Level

**Option 350:** 10 mV to 1.28 V rms

**Option 375:** 10 mV to 1.54 V rms

#### DC Bias

**Internal:**  $\pm 40$  V,  $\pm 20$  mA

**External:**  $\pm 150$  V,  $\pm 500$  mA, max. 25 W

**Measurement Range:** 100 m $\Omega$  to 1 M $\Omega$

**Basic Measurement Accuracy:**  $\pm 1.5\%$  to 3% ( $\geq 100$  kHz),  $\pm 3\%$  to 6% ( $< 100$  kHz)

**Cable Length:** HP 41941A: 1.5 m; HP 41941B: 3 m

#### Common Specifications

**Trigger Mode:** Internal, external, and manual

#### Sweep Capabilities

**Sweep Parameter:** Frequency, OSC level, dc bias (impedance measurements only)

**Entry:** START/STOP or CENTER/SPAN

**Sweep Type:** LIN, LOG, ZERO SPAN (dc Bias: LIN or ZERO SPAN only)

**Number of Measurement Points:** 2 to 401 points

**Sweep Functions:** Partial sweep, expand markers sweep, program points measurement

### Display

**CRT:** 7.5-inch color CRT

**Display Mode:** Rectangular (X- A & B), rectangular (A–B), table

**Display Control:** Autoscale, superimpose, and storage

### Analysis

**Marker:** Single, delta, double markers

**Line-Cursor:** Line-cursor, delta-line cursor

**Equivalent Circuit Function:** Approximation, simulation

#### Arithmetic Operation

**Data Register Manipulation:** Use arithmetic operations and functions to manipulate data registers

**Go/No-Go Limits**

### Programming

**Auto Sequence Program (ASP):** Control the HP 4194A's operation with an internal program language. ASP can be entered using the front-panel keys or downloaded from HP-IB

**Program Memory Size:** 20 kB of nonvolatile memory

**Copy:** Dump, plot, print mode

### General Specifications

**Operating Temperature and Humidity:** 0 to 40 $^\circ$  C

(HP 41941A/B: –20 to +65 $^\circ$  C),  $\leq 95\%$  RH at 40 $^\circ$  C

**Storage Temperature:** –30 $^\circ$  C to +60 $^\circ$  C (HP 41941A/B: –40 to +65 $^\circ$  C)

**Safety:** Based on IEC-348, UL-1244

**Power:** 100, 120, 220 V  $\pm 10\%$ , 240 V –10% + 5%, 48 to 66 Hz, 400 VA (max.)

**Size:** 425 mm W x 375 mm H x 620 mm D (16.73 in x 14.76 in x 24.41 in)

**Weight:** Net, approximately 37 kg (81.4 lb)

### Reference Data

#### Typical Measurement Speed

**Impedance:** Approximately 3.7 ms/point

**Gain-phase:** Approximately 3.5 ms/point

**Impedance when used with the HP 41941A/B:** Approximately 5.2 ms/point

### Accessories Furnished

**HP 16047D:** Direct Coupled Test Fixture

**HP 8120-1838:** 30-cm BNC Cable (2 ea.) (Option 350)

**HP 04194-61640:** 30-cm BNC Cable (2 ea.) (Option 375)

**HP 8120-1839:** 60-cm BNC Cable (Option 350)

**HP 04194-61641:** 60-cm BNC Cable (Option 375)

**HP 1250-0080:** BNC Adapter

### Key Literature

HP 4194A Impedance/Gain-Phase Analyzer Data Sheet, p/n 5952-7802

### Ordering Information

**HP 4194A** Impedance/Gain-Phase Analyzer

**Opt 350\*** 50  $\Omega$  System

**Opt 375\*** 75  $\Omega$  System

**Opt W30** Extended Repair Service

**Opt 001** High-Stability Frequency Reference

**HP 41941A\*** Impedance Probe Kit (1.5 m)

**HP 41941B\*** Impedance Probe Kit (3 m)

\*Must select either Option 350 or 375.