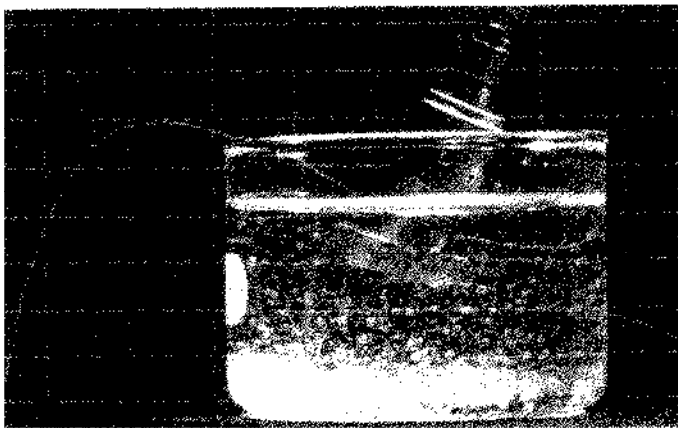


HP 85070M Dielectric Probe Measurement System

HP 85070B High-Temperature Dielectric Probe Kit

Technical Data



Swept high-frequency dielectric measurements

The HP 85070M is a dielectric probe measurement system that measures the intrinsic electrical properties of materials in the RF and microwave frequency bands. The system includes an HP 85070B high-temperature dielectric probe, RF or microwave network analyzer, computer, software and all necessary accessories to measure the complex dielectric constant (also called relative permittivity, ϵ_r^*) of liquids and semi-solids, including the dielectric loss factor or loss tangent.

The system displays dielectric properties over a wide 3 GHz (optionally 20 GHz) bandwidth, which means you get more information at the frequencies you need, rather than relying on single-point or low-frequency data.

Fast, convenient, and non-destructive tests

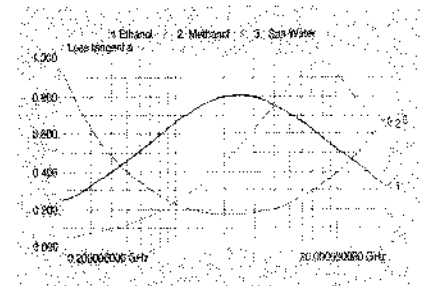
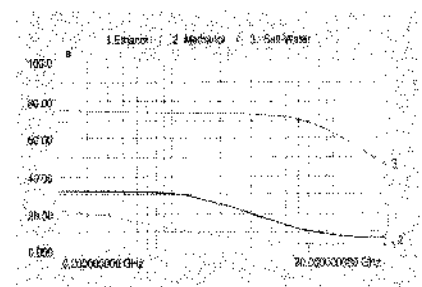
The HP 85070M system makes dielectric measurements quickly and easily. To obtain data at hundreds of frequencies in seconds simply immerse the probe into liquids or semi-solids - no special fixtures or containers are required. For pliable solids (such as plastics), just press the probe against a single flat surface.

Complete easy-to-use system

The HP 85070M system is based on a versatile network analyzer, which provides the high-frequency stimulus and measures the reflected response.

The probe transmits a signal into the material under test (MUT). The measured reflected response from the material is then related to its dielectric properties. A computer controls the system, and runs on software (included with the

200 MHz to 20 GHz



Software displays dielectric constant and loss tangent across a 200 MHz to 20 GHz frequency sweep.

HP 85070B) that guides the user through a measurement sequence. There is no need for microwave or network analyzer experience.

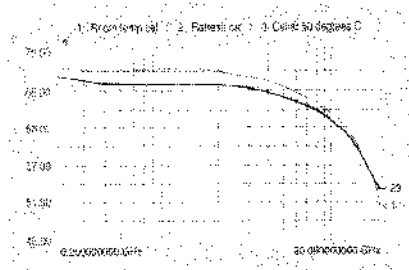
New HP 85070B features

- Rugged design withstands temperatures from -40° to $+200^{\circ}\text{C}$.
- Hermetic glass-to-metal seal resists corrosive chemicals.
- Refresh calibration simplifies measurements over temperature.
- New accessories (cable, short circuit, mounting bracket) improve measurement repeatability.

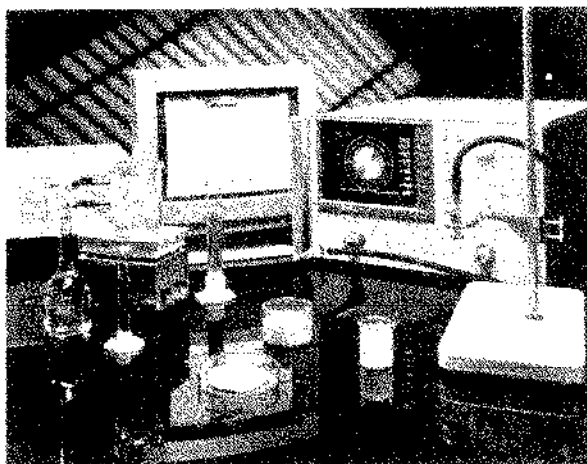
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Probe survives corrosive chemicals or high temperatures

The HP 85070B high-temperature dielectric probe kit is also available separately. However, a network analyzer and controller are required to complete the system. The probe features a hermetic glass-to-metal seal, which makes it resistant to corrosive or abrasive chemicals.



Refresh calibration simplifies this measurement of water made at 50°C.



The probe withstands a wide -40°C to $+200^{\circ}\text{C}$ temperature range, which allows measurements versus frequency and temperature. This is an important variable, since the dielectric constant of a material can vary significantly as a function of temperature.

A special refresh calibration feature provides corrected measurements over a wide temperature range. Rather than doing a full calibration at each temperature, a single standard can be used to update or refresh an existing calibration.

The HP 85070M dielectric measurement system

HP 85070B Option 001/002 high-temperature dielectric probe kit

Includes contents of probe kit (shown below), probe stand (Option 001) and high-temperature cable (Option 002).

HP D2623A Option ABA 486/33N Vectra PC with HP D1194A Option ABA super VGA display

Includes keyboard, mouse, mouse pad and HP 82335B HP-IB interface card (installed).

Pre-configured with MS-DOS®, Microsoft Windows® and the HP 85070B software.

HP 3630A Option 004 PaintJet color printer (with a 2 meter long centronics cable)

HP 8752A Option 003 3 GHz RF network analyzer (with a 2 meter long HP-IB cable)

HP 85070M Option 020 substitutes the HP 8720C 20 GHz microwave network analyzer.

Contents of HP 85070B high-temperature dielectric probe kit

High-temperature dielectric probe	3.5 mm (m) connector type.
Dielectric probe software	MS-DOS® version is standard Option 300 substitutes the HP BASIC version.
Flexible cable	Connects probe to network analyzer test port; 1 meter long with SMA (f) to SMA (f) connectors.
High-temperature cable (Option 002)	1 meter long semi-rigid high-temperature (-40° to $+200^{\circ}\text{C}$) cable with SMA (f) to SMA (f) connectors.
Adapters	Adapts network analyzer test port to flexible cable, when necessary; includes one 3.5 mm (m) to 7 mm adapter for 7 mm test ports and one 3.5 mm (m) to Type-N (m) adapter for Type-N (f) test ports.
50 Ω termination	Used for open/short/load calibrations; 3.5 mm (m) connector type.
Shorting block and clamp	Fits over probe face for a repeatable short circuit.
Remote trigger switch and cable	Allows hands-free or remote measurements; 2 meter long cable connects to HP 8752, 8753, 8719, 8720 and 8722 network analyzers.
Mounting bracket	Keeps probe in a fixed position to minimize cable movement for more repeatable measurements; bracket fits a 1/2-inch diameter support rod.
Probe stand (Option 001)	Probe stand consists of a 24-inch high, 1/2-inch diameter metal support rod with a 13x7-inch porcelain base.
Liquid vials (2) with stoppers and adapter	For measurements of liquids; 15 ml volume.

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Performance characteristics

Specifications describe the warranted performance over the temperature range 0° to 55°C. **Supplemental characteristics** are intended to provide information useful in applying the instrument, by giving typical but non-warranted performance parameters. These are denoted as "typical," "nominal," or "approximate."

Frequency range

Probe: 200 MHz to 20 GHz (nominal)

Maximum limited by MUT properties: $< \frac{110}{\sqrt{\epsilon_r^{*1}}} \text{ GHz}$

Temperature

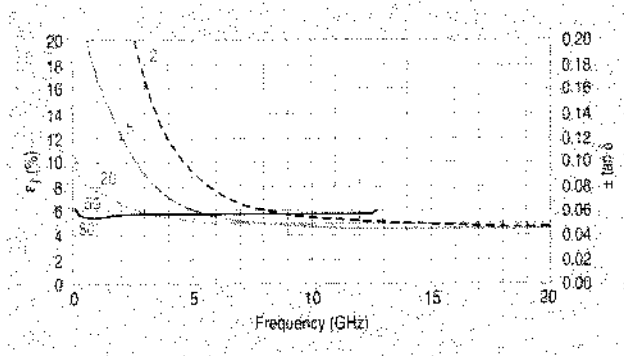
Range: -40°C to +200°C

Rate: <10°C per minute

Accuracy (typical)

Dielectric constant, ϵ_r' : $\pm 5\%$

Loss tangent, $\tan \delta$, ϵ_r''/ϵ_r' : ± 0.05



Typical accuracy¹ vs. frequency for $\epsilon_r^* = 2, 5, 20, 50, 80$

Repeatability and resolution (typical)

Two to four times better than accuracy.

Material under test assumptions

Material is "infinite" in size, non-magnetic ($\mu_r^* = 1$), isotropic (uniform orientation), and homogeneous (uniform composition)². Solids have a single, smooth, flat³ surface with gap-free contact at the probe face.

Sample requirements

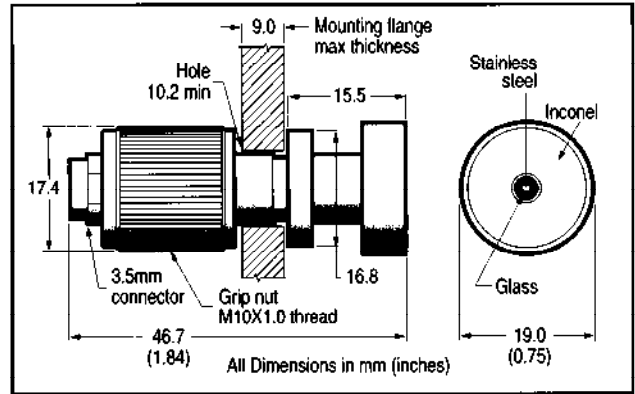
Diameter: > 20 mm

Thickness: $< \frac{20}{\sqrt{\epsilon_r^{*1}}} \text{ mm}$

Granule size⁴: < 0.3 mm

Maximum recommended ϵ_r' : < 100

Minimum recommended $\tan \delta$ ⁵: > 0.05



Software features

Setup

Select frequency range, number of points, linear or log sweep; save/recall test conditions and calibrations.

Calibration

Guided calibration sequence; choice of calibration materials or user-specified; refresh calibration for single standard recalibration versus temperature.

Measure

Trigger measurement; title measurement.

Format

ϵ_r' , ϵ_r'' , $\tan \delta$ or Cole-Cole plots; tabular listings of data.

Display

Display current measurement data; save/display up to 3 memory traces; compare data to reference trace with trace math.

Scaling

Set graticule scale factor or "autoscale."

Output

Hardcopy plots to plotters or graphics printers; tabular listings to printers; save/recall/export data via disk in MS-DOS® ASCII format or HP BASIC BDAT format (HP LIF binary).

¹Practical frequency range, accuracy and resolution depend on properties of the MUT. Graphs indicate typical accuracy at 23 ±3°C, not including effects of probe contact and cable flexure.

²If the material is not homogeneous, the result is an average value weighted by the intensity of the E-field which is highest at the center conductor of the probe tip.

³Sample must be as flat as the probe face which is lapped to ±100 μinches.

⁴Measurement repeatability for granular materials is dependent on density variation.

⁵Not recommended for low loss ($\tan \delta < 0.5$) materials with $\epsilon_r' > 5$.

Ordering information

		U.S. Price
HP 85070M dielectric probe measurement system		\$43,000
<i>Fully configured system includes HP 85070B dielectric probe kit, HP 8752A-003 3 GHz network analyzer, pre-configured computer with HP-IB interface and software, printer, probe stand, high-temperature cable and accessories.</i>		
Option 1FF	Deletes HP Vectra PC	delete \$1,000
Option 020	Substitutes HP 8720C 20 GHz network analyzer	add \$29,000
HP 85070B high-temperature dielectric probe kit		\$5,750
<i>Kit includes probe, MS-DOS® software (standard), cable, adapters, termination, shorting block, probe bracket, remote trigger and vials. Requires a controller and network analyzer to complete the system (see table of compatible components below).</i>		
Option 001	Adds probe stand (highly recommended)	add \$150
Option 002	Adds high-temperature cable	add \$1,800
Option 300	Substitutes HP BASIC software	add \$0

Compatible components

	HP 85070B standard software (MS-DOS® version)	HP 85070B Option 300 software (HP BASIC version)
	Program is compiled and not modifiable 3.5-inch disk format (MS-DOS®)	Program is 90% modifiable. 3.5-inch disk format (HP LIF)
Controller	HP Vectra 386 or 486 with 3.5-inch floppy disk drive, >20 MByte hard drive, >4 MByte RAM, coprocessor (recommended), IEEE-488 interface card/library (HP 82335B HP-IB interface or National Instruments AT-GPIB, GPIB-II or GPIB-IIA interface). Requires MS-DOS® version 3.20 or higher and Microsoft Windows® 3.0 or 3.1.	HP 9000 Series 300 or 9816 or 9836 with >700 kByte 3.5-inch floppy disk drive, >2 MByte RAM. Requires HP BASIC operating system 5.0 or higher.
Network analyzer	HP 8752A (300 kHz to 1.3 or 3 GHz) HP 8753A/B/C (300 kHz to 3 or 6 GHz) HP 8719A/C, 8720A/B/C or 8722A (50 or 130 MHz to 13.5, 20 or 40 GHz) <i>Adapters for the 2.4 mm test ports of the HP 8722A are not supplied in the HP 85070B kit (the HP 85130F adapter set adapts 2.4 mm test ports to 3.5 mm).</i> HP 8510B/C (45 MHz to 20, 26.5 or 50 GHz, depending on source and test set) <i>Compatible with synthesized source-based HP 8510B/C systems with firmware revision 5.0 or higher. Not compatible with HP 8350 sweeper-based systems. Adapters for the 2.4 mm test ports of the HP 8517A test set are not supplied in the HP 85070B kit (the HP 85130F adapter set adapts 2.4 mm test ports to 3.5 mm). Upgrade HP 8510A systems using HP 85103C performance upgrade package.</i>	

HP 85075B extra dielectric probe		\$1,400
<i>Additional probe for back up or replacement. Software and accessories from the HP 85070B kit are still required to make measurements.</i>		
HP 85078A upgrade kit		\$0
<i>Upgrades the HP 85070A to the full capabilities of the HP 85070B. Options 070 and 370 include a new probe, software, shorting block, cable, adapters and mounting bracket.</i>		
Option 001	Adds probe stand (highly recommended)	add \$150
Option 002	Adds high-temperature cable	add \$1,800
Option 070	Upgrade kit for HP 85070A to HP 85070B standard (MS-DOS®)	add \$3,000
Option 370	Upgrade kit for HP 85070A to HP 85070B Option 300 (HP BASIC)	add \$3,000
HP 85079B software update		\$0
<i>Updates the HP 85070B software to the most current version. Contact HP for details.</i>		
Option 070	Updates HP 85070B standard (MS-DOS®) software	add \$0
Option 370	Updates HP 85070B Option 300 (HP BASIC) software	add \$0

For more information, call your local HP sales office listed in your telephone directory.

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