Agilent
85070E Dielectric Probe Kit
200 MHz to 50 GHz

Technical Overview

New!

- Performance probe! Combines rugged, high temperature and frequency performance in a slim design. Perfect for your most demanding applications!

Features

- Measures complex permittivity over a broad frequency range
- Results can be viewed in a variety of formats: er', er", loss tangent, and Cole-Cole
- Software runs on a PC, or internally on the PNA Series of network analyzer and guides user through easy calibration and measurement
- Data is easily shared with other Windows® based programs or through the user programmable Component Object Model (COM) interface

Agilent Technologies

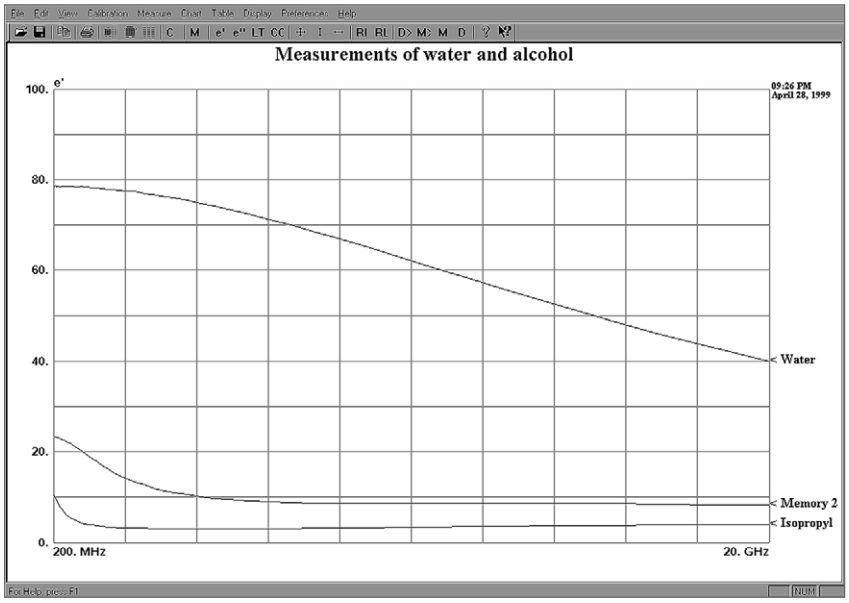
Swept High-Frequency Dielectric Measurements

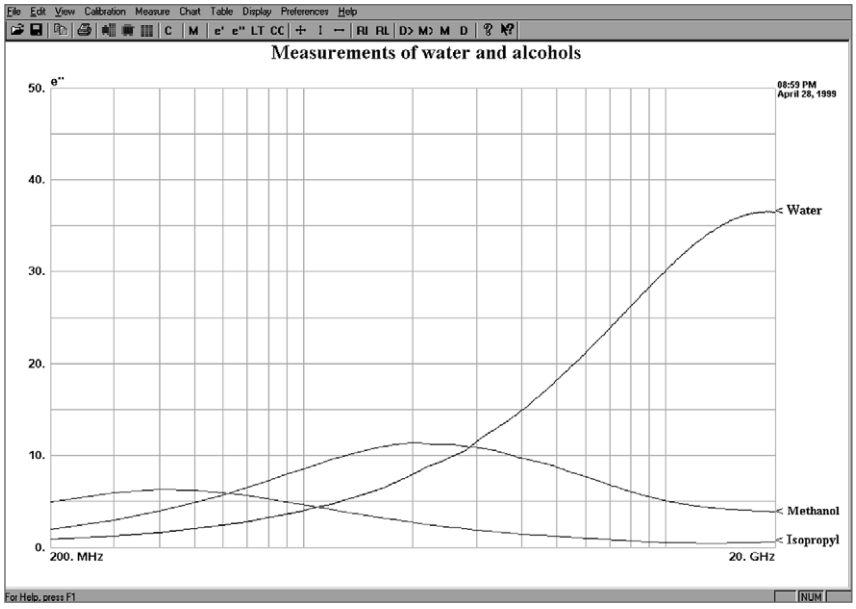
The Agilent Technologies 85070E Dielectric Probe Kit determines the dielectric properties, or complex permittivity, of many materials. Because a materials dielectric properties are determined by its molecular structure, if the molecular structure changes, so will the dielectric properties. Measuring them can indirectly measure other properties that are also correlated to the molecular structure, and can be a valuable alternative when the property of interest is difficult to measure directly.

Measurements are made by simply immersing the probe into liquids or semi-solids – no special fixtures or containers are required. Measurements are non-destructive and can be made in real time. These important features allow the Dielectric Probe Kit to be used in process analytic technologies.

The complete system is based on a network analyzer, which measures the material's response to RF or microwave energy. The probe transmits a signal into the material under test (MUT). Depending on the Agilent network analyzer and probe used, frequencies can extend from 200 MHz to 50 GHz.

The included software controls the network analyzer and guides the user through easy setup and measurement steps. In seconds, it calculates and displays complex permittivity in a variety of formats, including dielectric constant, dielectric loss factor, loss tangent or Cole-Cole.





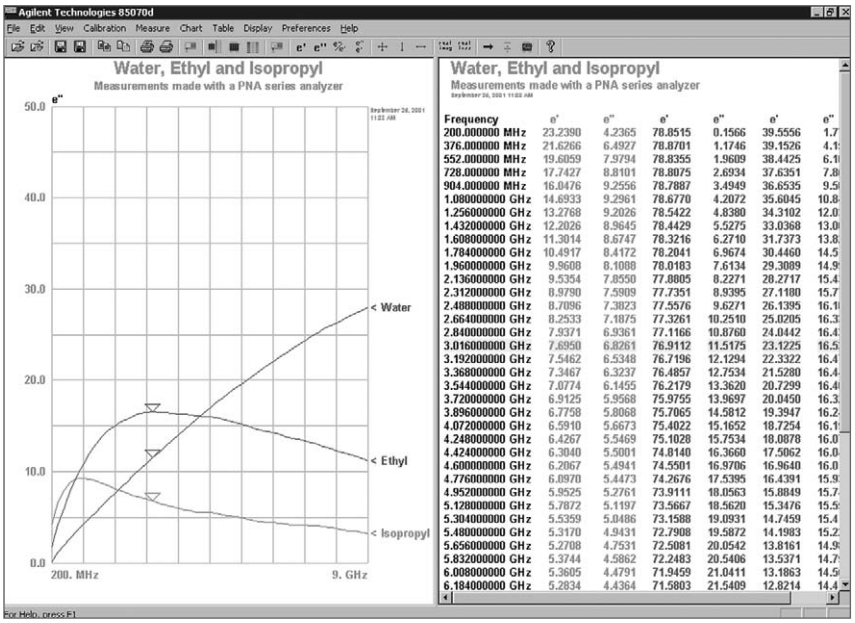
Software displays dielectric constant and loss factor as a function of frequency.

Easy Data Analysis Display

The split screen window and marker aids in data analysis. Simply click on a point on the chart or table to activate and move the marker.

Connect to other programs

Data charts and tables can easily be copied and pasted into any Windows-based application for further analysis or report generation. The component object model (COM) interface allows the measurement to be setup, triggered, and read from a user written program. This is valuable for analyzing material changes over time. Example Visual Basic® and C++ projects are included to aid program development.



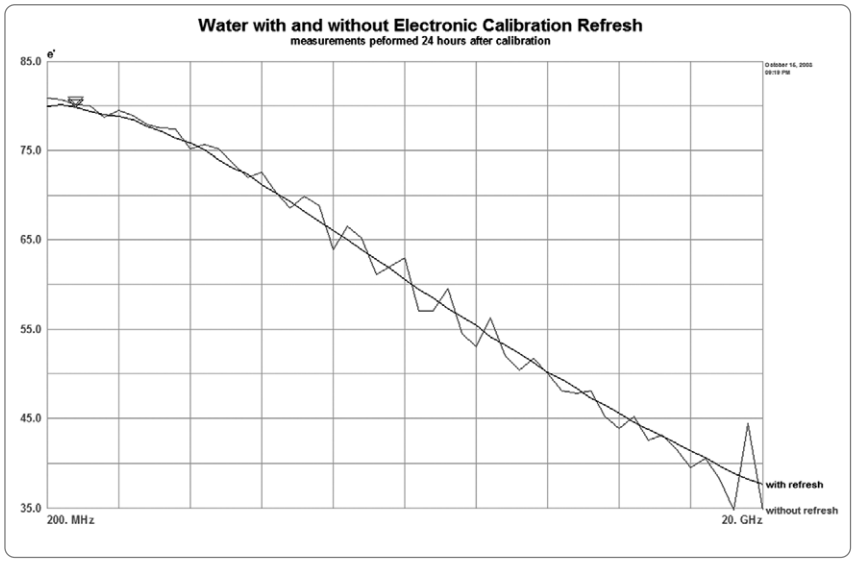
Display data in chart form, table form, or both.

Calibration Refresh Reduces Drift Errors

ECal module connected in line

The new automated Electronic Calibration Refresh feature recalibrates the system automatically, in seconds, just before each measurement is made. This virtually eliminates cable instability and system drift errors. Processes can now be monitored over long time periods, including tests that vary MUT temperature and pressure over time.

How it works:
The Agilent Electronic Calibration module (ECal) microwave ports are connected in line between the probe and the network analyzer test port cable. The ECal module communication port is connected either to the PC or PNA Series network analyzer running the 85070E software. The software guides the user through a normal "three standard" calibration, (usually open, short, water), performed at the end of the probe. This calibration is then transferred to the ECal module. The ECal module remains in line and a complete ECal calibration is automatically performed before each measurement. Errors due to test port cable movement are removed by the new calibration.



Water with and without Electronic Calibration Refresh

This measurement shows the effects of system drift and cable instability on a dielectric measurement of water and the improvement with Electronic calibration refresh. Both measurements were made 24 hours after the original calibration. The lighter colored, noisier, trace was made before the Electronic Calibration refresh was turned on. The darker, smoother, trace shows the improvement made after the Electronic Calibration refresh was turned on.

For systems without an ECal module, a simpler, "one standard" refresh calibration feature is also available, which can reduce the effects of system drift over time or temperature. After the initial "three standard" probe calibration is performed, the calibration can be refreshed at any time with the connection of a single standard. Any one of the three calibration standards can be defined as the refresh standard.

New Options Allow You to Configure Kit to Meet Your Needs

Now three probe designs to choose from

New! Performance Probe

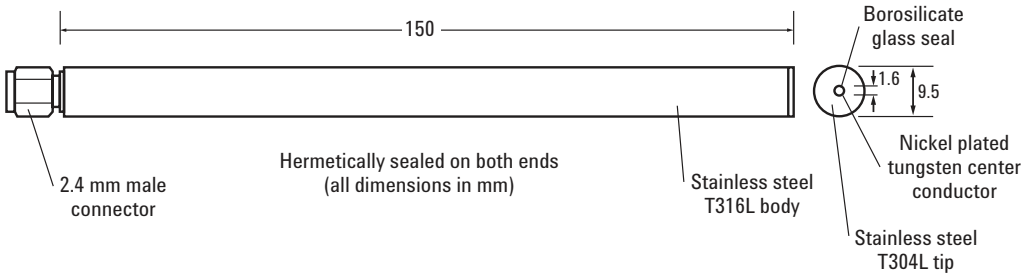
Combines rugged, high temperature, and frequency performance in a slim design.
This probe features rugged, high temperature and frequency performance in a slim design, perfect for your most demanding applications. The probe is sealed on both the probe tip and the connector end, which make it our most rugged probe. The probe withstands a wide –40 °C to +200 °C temperature range, which allows measurements versus frequency and temperature.

The probe can be autoclaved, so it is perfect for applications in the food, medical, and chemical industries where sterilization is a must. The slim design allows it to fit easily in fermentation tanks, chemical reaction chambers, or other equipment with small apertures.

The small diameter also allows it to be used with smallest sample sizes of all Agilent's probes. It is useful for measuring liquid, semi-solid, as well as flat surfaced solid materials. The Performance Form Probe Kit comes complete with a calibration short.

Frequency range 500 MHz to 50 GHz.
2.4mm male connector

Performance Probe Kit

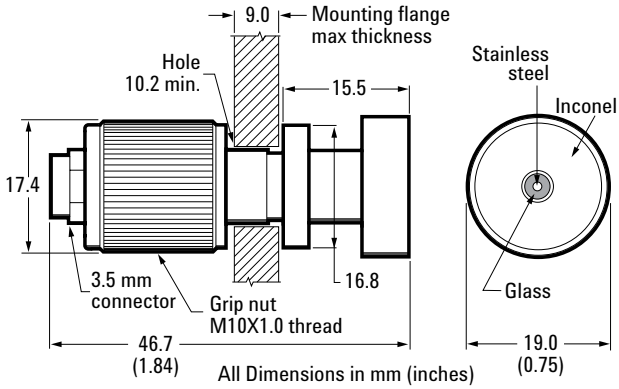


High temperature probe

Survives corrosive chemicals and high temperatures
Frequency range: 200 MHz to 20 GHz.
3.5 mm male connector.

Rugged in design, this probe features a hermetic glass-to-metal seal, which makes it resistant to corrosive or abrasive chemicals. The probe withstands a wide –40 °C to +200 °C temperature range, which allows measurements versus frequency and temperature. The large flange makes it easier to measure flat surfaced solid materials, in addition to liquids and semi-solids. The 3.5 mm aperture has a larger sensing volume than our other probes.

High Temperature Probe Kit

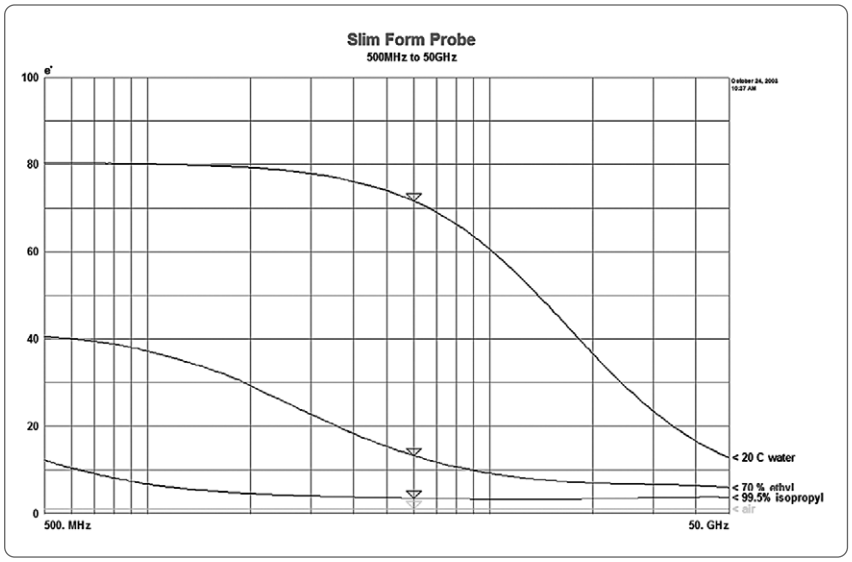


Slim Form Probe

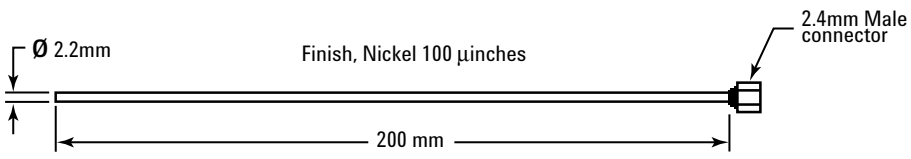
Smaller diameter fits into tight spaces.
Frequency range 500 MHz to 50 GHz.
2.4 mm male connector.

This probe features a slim design, which allows it to fit easily in fermentation tanks, chemical reaction chambers, or other equipment with small apertures. The slim design also allows it to be used with smaller sample sizes. Best used for liquids and soft semi-solids.

For castable solids, the probe is economical enough to be cast into the material and left in place. Because of the consumable nature of this design, these probes are offered in sets of three. The Slim Form probe kit comes with a sealed Slim Form holder that adapts 2.2 mm outer diameter to 10 mm inner diameter bracket included in the kit as well as commercially available "Midi" sized adapters and bushings.



Slim Form Probe measurement to 50 GHz



Three Cables to Choose From

20 GHz Flexible Cable
Cable to choose when tempertature performance is not critical. SMA female connectors connect to High Temperature probe. When connecting to Slim Form probe, an additional adapter may be needed (see configuration guide).

50 GHz Flexible Cable
Cable to choose for high frequency applications. 2.4 mm female connectors connect directly to Slim Form Performance probes.

20 GHz High Temperature Cable
Use with High Temperature or Performance probes for high temperature applications from –40 °C to +200 °C. SMA female connectors connect directly to High Temperature probe. Adapter included in kit connects High Temperature Cable to Performance probe.

Accessories

Probe Stand
The probe stand has a 13 x 7 inch porcelain base and 24 inch high by 0.5 inch diameter metal support. This stand works with mounting bracket and ECal holder included in the standard kit. It is highly recommended to stabilize measurement setup.

Software Menu Items

File
Save or recall measurement setups or previous measurement results. Print copies of the measurement results in a tabular or graphical format.

Edit
Copy the measurement results to the clipboard. Either graph or the tabular listing can be copied. This allows your measurement results to be pasted into other applications.

View
Select the section you want to view. Selections include the toolbar, status bar, table of the measurement data, and chart of the measurement data.

Calibration
Select the frequency range, number of points, linear or log sweep. Guided calibration sequence; choice of calibration materials or user-specified; refresh calibration for single standard or ECal; recalibration versus temperature; automatic refresh on or off.

Measure
Trigger a measurement.

Chart
Select the format to be displayed on the chart. Choices include er', er'', loss tangent, and Cole-Cole. Set Graticule scale factors or "autoscale". Select from linear, semi-log, or log-log representations.

Table
Choose between a tabular formatting of real and imaginary or real and loss tangent

Display
Display current measurement data; save/display up to 3 memory traces; compare data to reference trace with trace math. Turn the marker on or off.

Preferences
Select your preference of fonts, colors, and annotations used to plot and list the measurement data.

Help
On-line help including the product manual.

Toolbar
Provides single click access to the most important menu items.

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."

Probe Characteristics Table

	Performance Probe	Slim Form Probe	High Temperature Probe
Frequency Range (nominal)	500 MHz to 50 GHz Maximum limited by MUT properties $< \frac{(285\text{-}j125)\text{GHz}}{\sqrt{\lvert \varepsilon_r^* \rvert}}$	500 MHz to 50GHz Maximum limited by MUT properties $< \frac{(285\text{-}j125)\text{GHz}}{\sqrt{\lvert \varepsilon_r^* \rvert}}$	200 MHz to 20 GHz with network analyzer 10 MHz to 3 GHz with E4991A Impedance analyzer with option 10. Maximum limited by MUT properties $< \frac{110\text{GHz}}{\sqrt{\lvert \varepsilon_r^* \rvert}}$
Temperature Range	–40 to +200 °C	0 to +125 °C	–40 to +200 °C
Temperature Slew Rate	< 10 degrees/minute	< 10 degrees/minute	< 10 degrees/minute
Immersable length (approximate)	140 mm	200 mm	35 mm
Connector	2.4 mm male	2.4 mm male	3.5 mm male
Repeatability and resolution	Two to four times better than accuracy	Two to four times better than accuracy	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, flat[3] surface with gap-free contact at the probe face.	Liquid or soft semi-solid. Material is "infinite" in size, non-magnetic ($\mu_r^* = 1$), isotropic (uniform orientation), and homogeneous (uniform composition)[2].	Material is "infinite" in size, non-magnetic ($\mu_r^* = 1$), isotropic (uniform orientation), and homogeneous (uniform composition)[2]. Solids have a single, smooth, flat[3] surface with gap-free contact at the probe face.
Sample size requirements	Minimum 5 mm insertion and 1 mm around tip of probe	Minimum 5 mm insertion and 5 mm around tip of probe	Diameter: > 20 mm Thickness: $> \frac{20}{(\sqrt{\lvert \varepsilon_r^* \rvert})}$ mm Granule size[4]: < 0.3 mm
Expected Value requirements	Maximum recommended ε_r': < 100 Minimum recommended loss tangent > 0.05 Not recommended for low loss (loss tangent < 0.5) materials with $\varepsilon' > 5$	Maximum recommended ε_r': < 100 Minimum recommended loss tangent > 0.05 Not recommended for low loss (loss tangent < 0.5) materials with $\varepsilon' > 5$	Maximum recommended ε_r': < 100 Minimum recommended loss tangent > 0.05 Not recommended for low loss (loss tangent < 0.5) materials with $\varepsilon r' > 5$
Accuracy (typical)[1]	Dielectric constant, $\varepsilon_r' = \varepsilon_r' \pm 0.05\lvert \varepsilon_r^* \rvert$. $\varepsilon_r'' = \varepsilon_r'' \pm 0.05\lvert \varepsilon_r^* \rvert$	Dielectric constant, $\varepsilon_r' = \varepsilon_r' \pm 0.05\lvert \varepsilon_r^* \rvert$. $\varepsilon_r'' = \varepsilon_r'' \pm 0.05\lvert \varepsilon_r^* \rvert$	Dielectric constant, $\varepsilon_r' = \varepsilon_r' \pm 0.05\lvert \varepsilon_r^* \rvert$. $\varepsilon_r'' = \varepsilon_r'' \pm 0.05\lvert \varepsilon_r^* \rvert$

1. Practical frequency range, accuracy and resolution depend on properties of the MUT. Value indicates typical accuracy at 23 ±3 °C, not including effects of probe contact and cable flexure.
2. If 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.
3. Sample must be as flat as the probe face, which is lapped to ±100 µ inches.
4. Measurement repeatability for granular materials is dependent on density variation.

Configuration Guide

Choose one of our suggested configurations

High Temperature Configuration
85070E:
- Performance Probe Kit, Option 050, or High-Temperature Probe Kit, Option 020
- High Temperature Cable, Option 002
- Probe Stand, Option 001
- USB Security Key, Option UL8
- Recommend 20 GHz PNA Series network analyzer.

Rugged High Frequency Configuration
85070E:
- Performance Probe, Option 050
- Probe Stand, Option 001
- USB Security Key, Option UL8
- Recommend 50 GHz PNA Series network analyzer and 50 GHz ECal module

Economy Configuration
85070E
- Slim Form Probe Kit, Option 030
- 20 GHz Flexible Cable, Option 022
- USB Security Key, Option UL8
- Recommend ENA-L or PNA-L Series network analyzer

High Temperature Probe Kit (Option 020)

Slim Form Probe Kit (Option 030)

Performance Probe Kit (Option 050)

Configuration Guide -continued

Or, customize your own

Dielectric Probe Kit, 85070E
Includes:
- Dielectric Probe Software application on CD-Rom
- 1 mounting bracket to connect probes to Option 001 Probe Stand or similar stand
- 1 10 mm holder to connect performance probe or slim form holder to mounting bracket
- 1 3 mm hex key for 10 mm holder and Ecal holder screws
- 1 ECal holder to connect ECal module to mounting bracket
- 1 Type-N female to 3.5 mm male adapter, 1250-1743
- 1 3.5 mm male to 2.4 mm female adapter 11901D
- 1 foam lined walnut box.

Probes – Choose one or all

Performance Dielectric Probe Kit, Option 050
Includes:
- 1 Performance Dielectric Probe
- 1 Calibration Short

High-Temperature Dielectric Probe Kit, Option 020
Includes:
- 1 High Temperature Probe
- 1 Calibration Short

Slim Form Probe Kit, Option 030
Includes:
- 3 Slim Form probes
- 1 connector saver
- 1 Calibration short
- 1 10 mm dia sealed probe holder.
- 6 O-rings

Slim Form probe replenishment Kit, Option 033
Contains 3 extra Slim Form Probes

Cables - (Optional, choose any or all)

- High Temperature Cable, Option 002
- 20 GHz Flexible Cable, Option 022
- 50 GHz Flexible Cable, Option 032

Accessory - (Optional, highly recommended)

- Probe Stand, Option 001

Security Key - (Must choose one)

- Parallel Hardware Key, Option UL7 (required for Windows NT® 4.0)
- USB Hardware Key, Option UL8

Additional available parts

- 8710-2036 High-Temperature Dielectric Probe
- 85070-60003 Shorting block and clamp for high temperature probe
- 85070-60004 Short for Slim Form Probes
- 85070-60007 Slim Form Probe holder
- 85070-60008 ECal Holder
- 85070-60009 Set of three Slim Form Probes
- 85070-60010 Performance Probe
- 85070-60012 Short for Performance Probe
- 85070-60011 10mm Holder for Performance Probe and Slim Form probe
- 8120-6286 High Temperature Cable
- 8120-6192 20GHz Flexible Cable
- 8121-1290 50GHz Flexible Cable
- 9301-1298 Probe Stand

Adapter Selection Guide

Some configurations may need extra adapters. The Agilent adapter part numbers are charted below.

Network analzyer port to cable

Network analyzer port connector	High Temperature 20 GHz Cable	Flexible 20 GHz Cable	Flexible 50 GHz Cable
Type-N female	1250-1743 (included in kit)	1250-1743 (included in kit)	11903A
3.5 mm male	None needed	None needed	11901C
2.4 mm male	11901D (included in kit)	11901D (included in kit)	None needed

Probe to cable

Probe	High Temperature 20 GHz Cable	Flexible 20 GHz Cable	Flexible 50 GHz Cable
High Temperature Probe	None needed	None needed	11901C
Slim Form Probe	11901D (included in kit)	11901D (included in kit)	None needed

Adapters needed when using automated Electronic Calibration Refresh

Ecal module to cable

ECal Module Connector	High Temperature 20 GHz Cable (3.5 mm female)	Flexible 20 GHz Cable (3.5 mm female)	Flexible 50 GHz Cable (2.4 mm female)
Type-N male	1250-1750	1250-1750	11903C
Type-N female	1250-1743 (included in kit)	1250-1743 (included in kit)	11903A
3.5 mm male	None needed	None needed	11901C
3.5 mm female	1250-1748	1250-1748	11901A
2.4 mm male	11901D (included in kit)	11901D (included in kit)	None needed
2.4 mm female	11901C	11901C	11900A

Ecal module to probe

ECal Module Connector	High Temperature Probe	Performance and Slim Form Probe
Type-N male	1250-1745	11903B
Type-N female	1259-1744	11903D
3.5 mm male	83059B	11901B
3.5 mm female	None needed	11901D (included in kit)
2.4 mm male	11901B	11900B
2.4 mm female	11901C	None needed

Compatible ECal modules[1]

ECal module requires USB connection to PC or PNA Series network analyzer
N469xA series
8509xC series

Compatible network analyzers

8753ET/ES
8719ET/ES
8720ET/ES
8722ET/ES
8712ET/ES
8714ET/ES
8510C
All PNA Series
All ENA Series

Older Agilent network analyzers may be compatible. Please download free trial demo from our Web site to determine compatibility:
www.agilent.com/find/materials

PC requirements

- Windows® 98, 2000, ME, XP, or Windows NT® 4.0*
- CD-Rom drive to load software

Software can be run directly on PNA series network analyzers or interfaced over LAN

All other network analyzers require a GPIB interface card with a compatible driver (Agilent SICL or National Instruments 488.2M)

1 Optional, needed for Automated Electronic Calibration Refresh

* Windows NT® 4.0* requires Option UL7 Parallel Security Key

Web resources

Visit Agilent Web sites for additional product and literature information.

Materials test:
www.agilent.com/find/materials

PNA Series network analyzers:
www.agilent.com/find/pna

Electronic Calibration (ECal):
www.agilent.com/find/ecal

RF and microwave test accessories:
www.agilent.com/find/accessories

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Agilent Technologies' Test and Measurement Support, Services, and Assistance
Agilent Technologies aims to maximize the value you receive, while minimizing your risk and problems. We strive to ensure that you get the test and measurement capabilities you paid for and obtain the support you need. Our extensive support resources and services can help you choose the right Agilent products for your applications and apply them successfully. Every instrument and system we sell has a global warranty. Two concepts underlie Agilent's overall support policy: "Our Promise" and "Your Advantage."

Our Promise
Our Promise means your Agilent test and measurement equipment will meet its advertised performance and functionality. When you are choosing new equipment, we will help you with product information, including realistic performance specifications and practical recommendations from experienced test engineers. When you receive your new Agilent equipment, we can help verify that it works properly and help with initial product operation.

Your Advantage
Your Advantage means that Agilent offers a wide range of additional expert test and measurement services, which you can purchase according to your unique technical and business needs. Solve problems efficiently and gain a competitive edge by contracting with us for calibration, extra-cost upgrades, out-of-warranty repairs, and onsite education and training, as well as design, system integration, project management, and other professional engineering services. Experienced Agilent engineers and technicians worldwide can help you maximize your productivity, optimize the return on investment of your Agilent instruments and systems, and obtain dependable measurement accuracy for the life of those products.

For more information on Agilent Technologies' products, applications or services, please contact your local Agilent office.

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www.agilent.com/find/contactus

Product specifications and descriptions in this document subject to change without notice.

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