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Willtek

1205

RF Probe 20 dB

user's guide

version 1.10



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Ordering information This guide is issued as part of the 1205 RF Probe 20 dB. The ordering number for the published guide is M 292 011. The ordering number for the 1205 RF Probe 20 dB is M 248 640.

Low Voltage Directive compliance This product was tested and conforms to the Low Voltage Directive, 73/23/EEC. A copy of the Declaration of Conformity is provided with this manual.

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About This Guide

This section contains the following basic information:

- "Purpose and scope" on page vi
- "Assumptions" on page vi
- "Technical assistance" on page vii
- "Conventions" on page viii

Purpose and scope

The purpose of this guide is to help you successfully use the 1205 RF Probe 20 dB. This guide includes task-based instructions that describe how to use the 1205 RF Probe 20 dB. Additionally, this guide provides a description of Willtek's warranty and repair information.

Assumptions

This guide is intended for novice users who want to use the 1205 RF Probe 20 dB effectively and efficiently.

Technical assistance

If you need assistance or have questions related to the use of this product, call or email one of Willtek's technical assistance centers.

Table 1 Technical assistance centers

Region	Phone Number	Fax number, email address
UK	+44 (0)20 8408 5720	+44 (0)20 8397 6286 support.uk@willtek.com
Europe, Middle East, Asia, Africa	+49 (0)89 99641 386 +49 (0)89 99641 227	+49 (0)89 99641 440 support.eu@willtek.com
Americas	+1 317 595 2021 +1 866 WILLTEK	+1 317 595 2023 support.us@willtek.com

Conventions

This guide uses symbols as described in the following tables.

Table 2 Symbol conventions



This symbol represents a general hazard.



This symbol represents a risk of electrical shock.

 NOTE

This symbol represents a Note indicating related information or tip.

Table 3 Safety definitions



WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

Safety Notes

This chapter provides the safety notes for the 1205 RF Probe 20 dB, including the Declaration of Conformity with European standards.

Safety warnings



Beware of high voltages

To reduce the risk of electric shock, avoid personal contact to the grounding barrel or ground clip of the 1205 if the unit being tested has power supply voltages of 40 V or higher.



CAUTION

The 1205 contact point and the flexible ground clip point are very sharp! They can easily puncture your skin. When storing the 1205 probe always put the vinyl shielding cap back on and the flexible ground clip back in the ground clip bag.



Risk of circuit damage

The 1205 ground barrel is a low impedance ground. Avoid contacting power supply lines with the grounding barrel or with the ground clip, this could damage the unit under test and/or the RF probe.



Risk of instrument damage

An external attenuator should be used between the probe and the instrument to prevent the possibility of instrument damage due to excessive peak power.

The 1205 RF Probe 20 dB shall be used only for its intended use as specified in section ["About the 1205 RF Probe 20 dB" on page 2](#). Willtek does not accept any liability for any other use.

Declaration of Conformity

The 1205 RF Probe 20 dB is an OEM product sold by Auburn Technology Corporation, USA as Model P20A 3 GHz RF Probe.

Auburn Technology Corporation

Model P-20A 3 GHz RF Probe


The Auburn Technology Corporation 3 GHz RF Probe Model P-20A has been tested to and conforms with the following:

Table 4 Application of Council Directives

Category	Directive	Standard
Safety	72/23/EEC	EN 61010-031:2002

Manufacturer: Auburn Technology Corporation
107 West 55th South
Wichita, Kansas 67217 USA
Telephone / Fax: +1-316-529-4520
www.AuburnTec.com

November 15 2002


Gary A Ward, R&D Director

Pay attention to safety instructions. This declaration is not a guarantee of features.

Safety Notes
Declaration of Conformity

1205 RF Probe 20 dB Overview



1

This chapter provides a general description of the 1205 RF Probe 20 dB. Topics discussed in this chapter include the following:

- "About the 1205 RF Probe 20 dB" on page 2
- "Features and capabilities" on page 2
- "Design" on page 2
- "Physical description" on page 3
- "Options" on page 4
- "Specifications" on page 5

About the 1205 RF Probe 20 dB

The 1205 RF Probe 20 dB is a passive 10:1 RF voltage probe with a 50 V_{DC} block built in. It has been designed to allow users of RF test equipment to use standard signal tracing techniques.

The 1205 RF Probe 20 dB has been designed for fault tracing in electric circuits, e.g. in opened devices. Trained personnel is required for such work.

The 1205 makes it possible to conveniently and accurately monitor or inject signals into RF circuits without significantly loading or detuning them. The 1205 comes with interchangeable ground clips and a center pin extender that adapt to a wide range of applications. An N to BNC adapter is also included to connect the RF probe to most RF testers.

Features and capabilities

- Bandwidth: 100 kHz to 4 GHz
- Low distortion, passive RF design
- Low RF loading characteristic
- Ergonomic design, lies gently in your hand
- Exchangeable ground connectors
- Includes center pin extender for measurements through holes
- Supplements Willtek instruments such as the 9100 Handheld Spectrum Analyzer Series and the 4032 STABLOCK.

Design

A frequency compensated 450 Ω resistive element is utilized in the probe's design to reduce circuit loading and to give the 1205 a 10:1 voltage ratio when connected to a 50 Ω instrument and probing a 50 Ω source. Special construction techniques of the 1205 produce

less than 1 pF of stray capacitance to minimize the capacitive loading effects on RF circuits. RF instruments require low inductance grounding to make consistent and accurate measurements. The 1205's interchangeable ground clips provide low inductance grounding and the ability to make contact with the circuit's active RF ground. To prevent false readings or damage to test equipment, an internal DC blocking capacitor (50 V_{DC} max.) is provided to decouple in-circuit supply voltages.

Physical description

The delivery of the 1205 RF Probe 20 dB includes:

- RF probe with BNC connector
- BNC to N adapter
- short pin ground clip
- extension cap
- flexible ground clip

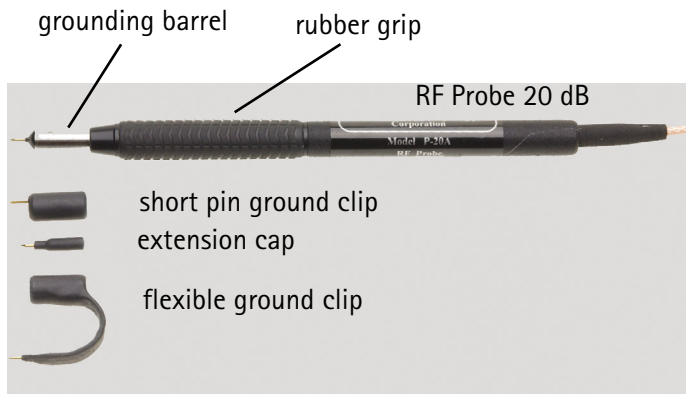


Figure 1 Willtek 1205 RF Probe 20 dB parts

Options

If you are using the 1205 with an instrument with an N-type connector, Willtek recommends the following accessory; this adapter is in the scope of supply for the RF probe:

Adapter N (male) to BNC (female), order number M 886 097

Specifications

Table 5 Specifications

Parameter	Specification
Frequency range	
– specified	100 kHz to 3 GHz
– usable	100 kHz to 4 GHz
Frequency response	± 3 dB
Power attenuation	20 dB (nominal) on 50 Ω terminated load For the attenuation on open sources, see page 14
Voltage attenuation	10:1 (nominal) for 50 Ω sources
RF loading effects	500 $\Omega \pm 10\%$ < 1 pF at 1 MHz
RF voltage range	7 V_{rms} (continuous) 35 V_{rms} (max. 1 second)
DC voltage block	50 V max.
Cable length	1 meter
Connector	BNC (male)

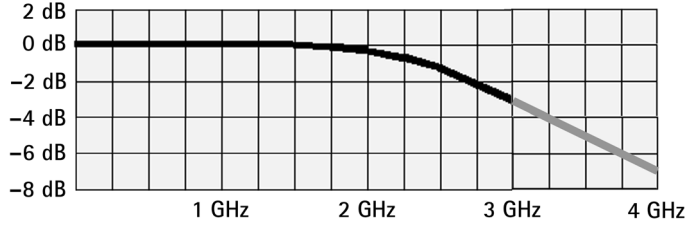


Figure 2 Typical frequency response with direct barrel grounding



Figure 3 Typical frequency response with short pin ground clip

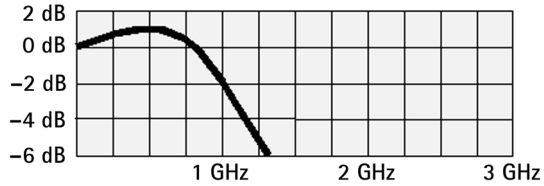


Figure 4 Typical frequency response with flexible ground clip

Operation

2

This chapter describes the functionality of the 1205 RF Probe 20 dB. Topics discussed in this chapter are as follows:

- "Grounding the 1205" on page 8
- "Measuring RF power" on page 11
- "Measuring RF voltage" on page 12
- "Inserting an RF signal to a circuit" on page 13
- "Measuring signals partly covered by RF shields" on page 14
- "Verifying the performance of the 1205 RF Probe 20 dB on an open source" on page 14

Connecting the 1205 RF Probe 20 dB to the test equipment

The RF probe includes a cable with a BNC connector, allowing you to connect the RF probe to a multitude of testers or RF generators.

If the test equipment is not equipped with a BNC connector (female) but with an N connector, screw the N to BNC adapter on the instrument and connect the RF probe to the adapter. An N to BNC adapter is delivered with the 1205 RF Probe 20 dB.

Grounding the 1205



CAUTION

The 1205's grounding barrel is a low impedance ground. Avoid contact with supply voltages! Avoid personal contact if 40 V or higher are present!

To obtain consistent and accurate RF amplitude measurements proper RF grounding is required.

- Measurements from 100 kHz to 1 GHz can be accurately measured by directly grounding the 1205's grounding barrel or by using the short pin or flexible ground clip.
- Frequencies from 1 to 2 GHz require direct grounding of the 1205's grounding barrel or the use of the short pin ground clip.
- Frequencies above 2 GHz require direct grounding of the 1205's grounding barrel.

See [Figure 2](#) through [Figure 4](#) for more information regarding the RF characteristics of different grounding methods.

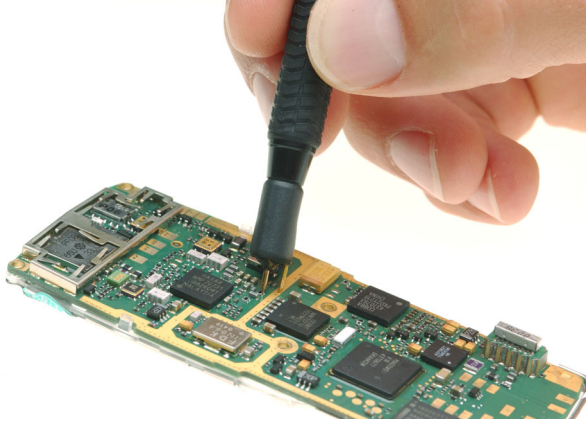


Figure 5 Short ground connection

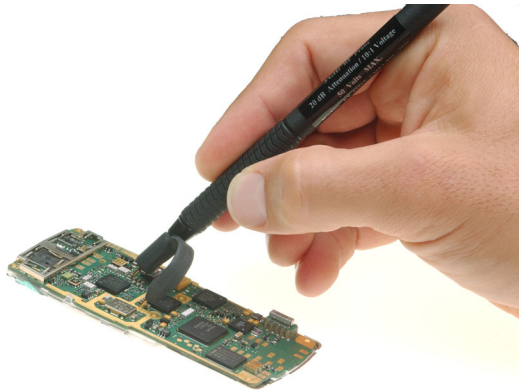


Figure 6 Flexible ground connection

Ground clips can be changed by grasping the ring portion of the clip and twisting it, while pulling to remove or pushing to assemble. Moderate force may be required.

Chapter 2 Operation

Grounding the 1205

If a good RF ground is out of reach, a 15 cm (6 inch) metal ruler or similar item can often be used to extend the ground to the probe. To minimize inductance, it is better to make direct contact with the grounding barrel of the probe.

Verification of a low inductance RF ground can be accomplished by slightly changing the 1205 ground contact position while observing that there are no significant changes in readings.

Measuring RF power

RF Power measurements from 100 kHz to 3 GHz at 50 Ω load can be made up to +30 dBm (1.0 W) continuously or +44 dBm (25 W) for one second.

The 1205 when used with a spectrum analyzer or RF power meter can effectively make in-circuit RF power measurements without the need for complex calculations. Add +20 dB to the instrument's reading if in dBm or multiply by 100 if using watts to get the power measurement for a 50 Ω source. RF circuits commonly have or nearly have a 50 Ω impedance and because of this, measurement errors will typically be insignificant for standard signal tracing techniques.



CAUTION WITH HIGH PEAK POWER

An external attenuator should be used between the probe and the instrument to prevent instrument damage due to excessive peak power.

When an RF source needs to be accurately measured, use the correction factor for loading effects according to [Table 6](#) and the power level conversion according to [Table 7](#) if the source has an impedance other than 50 Ω ($P = U^2/R$).

Table 6 Correction factors for loading effects

Circuit impedance (Ω)	Reading in watts: multiply by	Reading in dBm: add
25	1.05	0.2
50	1.10	0.4
75	1.16	0.6
100	1.2	0.8
200	1.4	1.6
To calculate loading effects for other impedances: Voltage ratio = $1 + (\text{impedance}/1000)$ Power ratio = voltage ratio squared		

Table 7 Power level conversion

Circuit impedance (Ω)	Reading in watts: multiply by	Reading in dBm: add
25	2.0	3
50	1.0	0
75	0.7	-1.8
100	0.5	-3
200	0.3	-6

Measuring RF voltage

With the 1205, RF voltage measurements from 100 kHz to 3 GHz can be made at up to $7 V_{rms}$ continuously.

The 1205 produces a 10:1 voltage ratio when used with instruments, such as RF volt meters and RF detectors while probing a 50 Ω source.

RF circuits commonly have or nearly have a 50 Ω impedance and because of this, measurement errors will typically be insignificant for standard signal tracing techniques.

Accurate RF voltage measurements can be obtained by multiplying the instrument's reading by 10.05. (The 0.05 is the correction factor for the 1205's loading characteristics for a 50 Ω source.)

When a source with an impedance other than 50 Ω needs to be accurately measured, use the following equation to obtain the correction factor:

$$\text{true voltage} = (\text{measurement voltage} \times 10) \times \text{L ratio}$$

$$\text{L ratio} = 1 + (\text{circuit impedance}/1000)$$

Inserting an RF signal to a circuit

The 1205 probe is a passive device. This means that RF signals can flow through the probe in either direction. Because of this characteristic and the 1205's 500 Ω impedance, RF signals can be injected without excessively loading the circuit being tested or the signal source.

The insertion loss of the 1205 probe is approximately 14.8 dB when connected to a 50 Ω source and injecting the signal into a 50 Ω circuit.

Variable insertion loss

The insertion loss will change depending on the impedance of the circuit being injected.

Chapter 2 Operation

Measuring signals partly covered by RF shields

- 1 Connect the BNC connector of the 1205 RF Probe 20 dB to the signal generator. Use the N to BNC adapter if the signal generator is equipped with an N-type connector.
- 2 Connect the signal ground of the 1205 to the ground of the PCB to which to insert the signal.
- 3 Connect the 1205 tip to the place in the circuit where to insert the signal.

Measuring signals partly covered by RF shields

A tip extension provides access through holes in RF shields. This allows you to check RF signals in locations that are hard to reach.

Verifying the performance of the 1205 RF Probe 20 dB on an open source

The performance of the 1205 can be verified by removing the ground clip and properly probing the output of a known RF source such as an RF signal generator.

Generator termination

RF signal generators are designed and calibrated to drive a $50\ \Omega$ load. If the generator's output is not terminated there will be a 5.2 dB increase in the generator's output voltage.

Measurements of a $50\ \Omega$ RF output terminated only with the 1205 will appear to have a +5.2 dB increase in power. This is due to the light loading characteristics of the 1205 probe, resulting in a measured insertion loss of 14.8 dB instead of the normal 20 dB.

Normalization of frequency response errors when using the 1205 probe with a spectrum analyzer and tracking generator can be done the same way as the above verification. Be aware that frequency response ripple is a function of the probe and analyzer

input impedance, and will be constant as long as the analyzer input attenuator is not changed. Be sure to allow for the +5.2 dB error if the signal source is not terminated into 50 Ω . If the signal source is terminated into 50 Ω the measurement error due to the 1205 loading is -0.2 dB.

Chapter 2 Operation

Verifying the performance of the 1205 RF Probe 20 dB on an open source

Warranty and Repair



This chapter describes the customer services available through Willtek. Topics discussed in this chapter include the following:

- ["Warranty information" on page 18](#)
- ["Equipment return instructions" on page 19](#)

Warranty information

Willtek warrants that all of its products conform to Willtek's published specifications and are free from defects in materials and workmanship for a period of one year from the date of delivery to the original buyer, when used under normal operating conditions and within the service conditions for which they were designed. This warranty is not transferable and does not apply to used or demonstration products.

In case of a warranty claim, Willtek's obligation shall be limited to repairing, or at its option, replacing without charge, any assembly or component (except batteries) which in Willtek's sole opinion proves to be defective within the scope of the warranty. In the event Willtek is not able to modify, repair or replace nonconforming defective parts or components to a condition as warranted within a reasonable time after receipt thereof, the buyer shall receive credit in the amount of the original invoiced price of the product.

It is the buyer's responsibility to notify Willtek in writing of the defect or nonconformity within the warranty period and to return the affected product to Willtek's factory, designated service provider, or authorized service center within thirty (30) days after discovery of such defect or nonconformity. The buyer shall prepay shipping charges and insurance for products returned to Willtek or its designated service provider for warranty service. Willtek or its designated service provider shall pay costs for return of products to the buyer.

Willtek's obligation and the customer's sole remedy under this hardware warranty is limited to the repair or replacement, at Willtek's option, of the defective product. Willtek shall have no obligation to remedy any such defect if it can be shown: (a) that the product was altered, repaired, or reworked by any party other than Willtek without Willtek's written consent; (b) that such defects were the result of customer's improper storage, mishandling, abuse, or misuse of the product; (c) that such defects were the result of customer's use of the product in conjunction with equipment electronically or mechanically incompatible or of an inferior quality; or (d) that the defect was the result of damage by fire, explosion, power failure, or any act of nature.

The warranty described above is the buyer's sole and exclusive remedy and no other warranty, whether written or oral, expressed or implied by statute or course of dealing shall apply. Willtek specifically disclaims the implied warranties of merchantability and fitness for a particular purpose. No statement, representation, agreement, or understanding, oral or written, made by an agent, distributor, or employee of Willtek, which is not contained in the foregoing warranty will be binding upon Willtek, unless made in writing and executed by an authorized representative of Willtek. Under no circumstances shall Willtek be liable for any direct, indirect, special, incidental, or consequential damages, expenses, or losses, including loss of profits, based on contract, tort, or any other legal theory.

Equipment return instructions

Please contact your local service center for Willtek products via telephone or web site for return or reference authorization to accompany your equipment. For each piece of equipment returned for repair, attach a tag that includes the following information:

- Owner's name, address, and telephone number.
- Serial number, product type, and model.
- Warranty status. (If you are unsure of the warranty status of your instrument, include a copy of the invoice or delivery note.)
- Detailed description of the problem or service requested.
- Name and telephone number of the person to contact regarding questions about the repair.
- Return authorization (RA) number (US customers), or reference number (European customers).

If possible, return the equipment using the original shipping container and material. Additional Willtek shipping containers are available from Willtek on request. If the original container is not available, the unit should be carefully packed so that it will not be damaged in transit. Willtek is not liable for any damage that may occur during

Appendix A Warranty and Repair
Equipment return instructions

shipping. The customer should clearly mark the Willtek-issued RA or reference number on the outside of the package and ship it prepaid and insured to Willtek.

Publication History

Revision	Changes
0212-100-A	First revision.
0304-110-A	Minor changes (more detailed description of delivery).

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