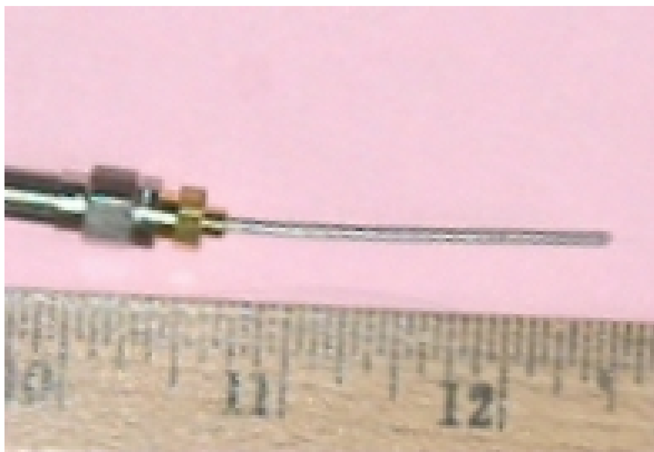
FemtoFarad Probes by

L. Forbes and Associates LLC*

introduces a new concept in low capacitance probes, patents granted[1]. Traditional high impedance and low capacitance probes employ resistive dividers. Here the input is not a resistor but rather a very small value capacitor as small as 5fF. This technique works well with large amplitude, 1 Volt or so, signals with small, nanosecond or sub-nanosecond, switching times. The value of the input capacitor can be tailored to the specific application, larger capacitances being used at lower frequencies.[2-4] Software is used to reconstruct the signal under test. Since this is a new type of probe some time may be require to become accustomed to the probe; however simple interpretations of sampling scope displays will yield approximate rise times and jitter by direct observation, more exact results are obtained from the software displays.



The tungsten whisker probe(not visible) is capacitively coupled to the mini-coaxial center conductor(barely visible(at 12.5 inches).

FREQUENCY RANGES

Optimum results are obtained by tailoring the probe capacitance to the frequency range or more particularly the rise and fall times of the signals to be tested. Probes are available over a very wide range of input capacitances. Assuming a 1 Volt input signal the optimum values are:

C=	**10fF**	**40fF**	**100fF**	**1pF**
trise	**8ps-50ps**	**20ps-200ps**	**50ps-0.5ns**	**0.5ns-50ns**
probe BW	**40GHz**	**16GHz**	**6GHz**	**600MHz**

without the use of additional optional amplifiers. The probes/amplifiers drive a 50 ohm scope input.

OUR TEST FACILITIES/PERSONNEL

At our lab in Corvallis, Oregon we have facilities for testing both the time and frequency response of probes up to 40GHz. One of the principals, L. Forbes, has 40 years experience in the semiconductor industry and is one of the top ten inventors in the USA ,c.f. Technology, USA Today Wed.Dec. 14th 2005

0ne setup for 16 GHz(20 ps rise times) includes probe, software and support; extra setups at the same location at a reduced cost ; repairs to tungsten probe tips are easily made.
For 40 GHz probes, call with your requirements and for an estimate.
ou need a high speed oscilloscope capable of running software or one with a GPIB connection to a PC and a license for LabView and MatLab., or we can recommend and/or provide an estimate for a complete system.

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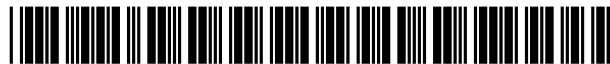
References

[1] United States Patents 7,728,607 June 1, 2010, and 7,924,040, April 12, 2011
Forbes "Electrical probe"
[2] M.E. Jacob, D.A. Miller and L. Forbes, "Low Capacitance High Speed Probe," Proc.IEEE Workshop on Microelectronics and Electron Devices, Boise, 18 April 2008, pp. 32-33.
[3] Michael Jacob, Drake Miller, and Leonard Forbes, "Ultra low capacitance high frequency IC probe," Proc. SPIE, Vol. 7042, No. 704203, 9 pages, 2008.
[4] Leonard Forbes , Drake A. Miller and Michael E. Jacob, "Low Capacitance Electrical Probe for Nanoscale Devices and Circuits," Open Nanoscience Journal, vol. 2, pp.39-42, 2008.



(12) **United States Patent**
Forbes

(10) **Patent No.: US 7,728,607 B2**
(45) **Date of Patent: Jun. 1, 2010**

(54) **ELECTRICAL PROBE**

(76) Inventor: **Leonard Forbes**, 7340 NW. Mountain View Dr., Corvallis, OR (US) 97330

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 255 days.

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(22) Filed: **Dec. 28, 2007**

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G01R 31/02 (2006.01)

(52) **U.S. Cl.** **324/754**

(58) **Field of Classification Search** .... None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,740,746 A * 4/1988 Pollock et al. 324/761
5,045,781 A 9/1991 Gleason et al.
5,172,051 A 12/1992 Zamborelli
5,274,336 A 12/1993 Crook et al.
5,506,515 A 4/1996 Godshalk et al.
5,512,838 A 4/1996 Roach
5,565,788 A 10/1996 Burr et al.
6,252,391 B1 6/2001 McAllister et al.

OTHER PUBLICATIONS

Sevick, Jerry. "A Simplified Analysis of the Broadband Transmission Line Transformer." High Frequency Electronics, pp. 48-53, Feb. 2004.
"Setting Up." https//www.cs.tcd.ie/courses/baict/bac/jf/labs/scope/setting.html.
Tektronix. "Choosing a probe for your tektronix scope." http://www.reprise.com/host/tektronix/reference/choosing_a_probe.asp. Jan. 24, 2004.

* cited by examiner

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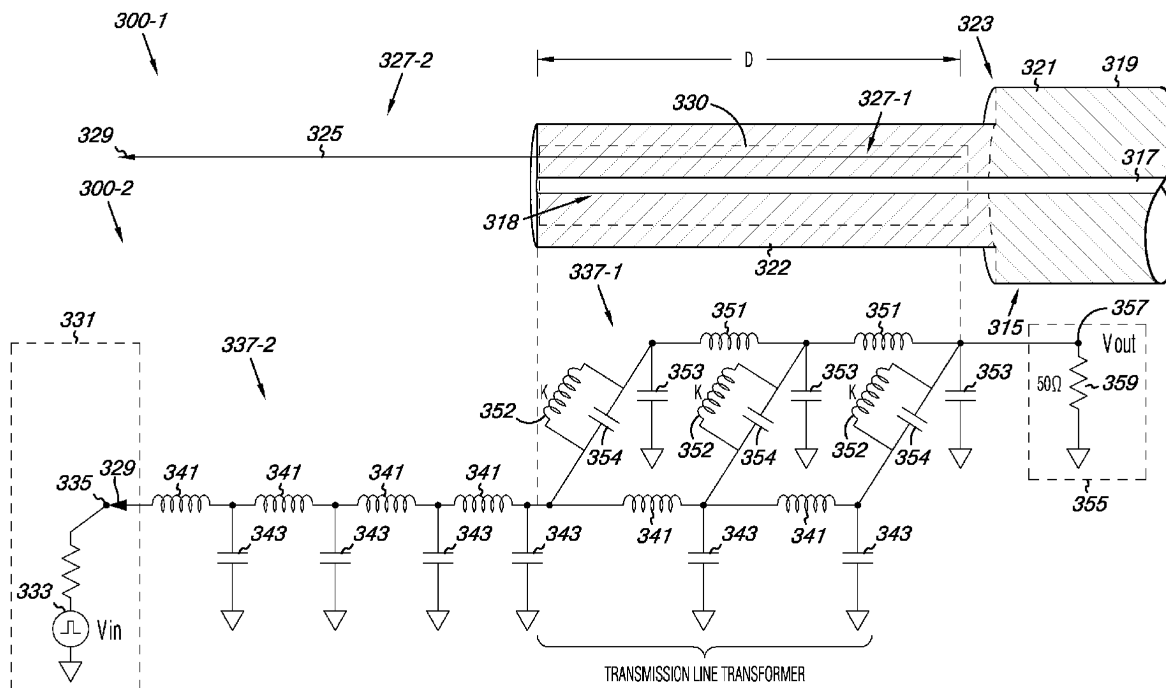
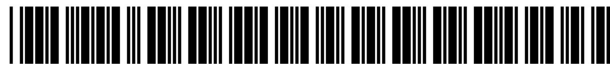
(57) **ABSTRACT**

Methods, devices, and systems for probing electrical circuits without loading the circuits are described herein. One embodiment of an electrical probe includes a coaxial cable having an inner conductor and an outer conductor, an extension portion of the inner conductor extending beyond the outer conductor at a probe end of the cable. The electrical probe includes a conductive whisker having a first portion separated from and extending a distance along the extension portion such that the first portion and the extension portion form a first capacitor and a second portion having a probe tip for receiving an input test signal from a circuit node under test.

22 Claims, 7 Drawing Sheets





(12) **United States Patent**
Forbes

(10) **Patent No.: US 7,924,040 B2**
(45) **Date of Patent: *Apr. 12, 2011**

(54) **ELECTRICAL PROBE HAVING A CONDUCTIVE WHISKER**

(76) Inventor: **Leonard Forbes**, Corvallis, OR (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

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(65) **Prior Publication Data**

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Related U.S. Application Data

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G01R 31/00 (2006.01)
G01R 1/067 (2006.01)
G01R 31/20 (2006.01)

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(58) **Field of Classification Search** .... None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,740,746 A * 4/1988 Pollock et al. 324/761
5,045,781 A 9/1991 Gleason et al.
5,172,051 A * 12/1992 Zamborelli 324/72.5
5,274,336 A 12/1993 Crook et al.
5,373,231 A * 12/1994 Boll et al. 324/158.1
5,506,515 A 4/1996 Godshalk et al.
5,512,838 A 4/1996 Roach
5,565,788 A 10/1996 Burr et al.
5,982,187 A * 11/1999 Tarzwell 324/755.05
6,252,391 B1 6/2001 McAllister et al.

OTHER PUBLICATIONS

Sevick, Jerry. "A Simplified Analysis of the Broadband Transmission Line Transformer." High Frequency Electronics, pp. 48-53, Feb. 2004.

"Setting Up." https://www.cs.tcd.ie/courses/baict/bac/jf/labs/scope/setting.html. 6 pgs.

Tektronix. "Choosing a probe for your tektronix scope." http://www.reprise.com/host/tektronix/reference/choosing_a_probe.asp. Jan. 24, 2004. 3 pgs.

* cited by examiner

Primary Examiner — Roberto Velez

(74) *Attorney, Agent, or Firm* — Brooks, Cameron & Huebsch, PLLC

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