

Calibration Accuracy

S31xD, S33xD

Site Master

MT8212B

Cell Master

Introduction

The ICN50 InstaCal module provides field users with a convenient and fast way to perform the calibration as it eliminates the need to change the connection to measure the Open, Short, and Load. When comparing the ICN50 InstaCal module with Anritsu's precision calibration components, it is important to understand the trade offs and the impact this could have on the overall measurement accuracy. The intent of this paper is to explain in simple terms the performance differences between the precision cal component and the InstaCal module. To aid the reader, this paper includes three graphs, one that gives users an easy way to estimate the error based on the measured return loss. The other two graphs compares the return loss measurement of a 3 dB pad and a 20 dB offset using both the InstaCal and OSLN50-1 precision cal components.

Directivity

Today when you look up the instrument accuracy or the accuracy of the InstaCal or precision Cal tee, you will find that the accuracy is specified in terms of directivity. It is useful to have a good understanding of directivity as it is usually the largest contributor to measurement uncertainty. It can therefore be used to estimate the measurement uncertainties associated with these two different calibration techniques.

The directivity can be seen as an extra leakage component added to the measurement vector as a result of deviations from the ideal. A directivity of 42 dB will add less measurement uncertainty than a directivity component of 35 dB. From this we can conclude that the better the directivity, the better the overall accuracy. A good rule of thumb for field use is to make sure that the measured return loss is at least 10 dB greater than the directivity. For instance, if you use a poor calibration component with a directivity specification of 30 dB and you try to measure a system with 25 dB Return Loss, your signal is only 5 dB greater than the leakage component and large errors will be introduced to this measurement.

The directivity of the ICN50 is 38 dB. If we use the InstaCal to make a return loss measurement of a cable and antenna system with a RL of 18 dB, then the signal will be 20 dB greater than the directivity of the device. With the help of math or an RF measurement chart, we can then figure out what the resulting measurement uncertainty is as a result of directivity components changing the amplitude and phase of the desired signal.

Similarly, the directivity of the precision load is 42 dB. If we use this to make the same 18 dB return loss measurement, the signal would be 24 dB greater than the directivity of the device.

Derive the Accuracy Using Graphs

Ideally it would be nice if the accuracy could be summarized with a single number for all measurements. Unfortunately it is not that simple because the estimated uncertainties will be different depending on the measured return loss. Instead of getting out the calculator for every scenario, a graph can be helpful here to estimate the uncertainty for different return loss levels.

Looking at the graph, we can see that the worst case error would be a about -1 dB and +1.1 dB error for a 20 dB InstaCal measurement and about ± 0.6 dB for a 20 dB measurement using the precision cal tee.

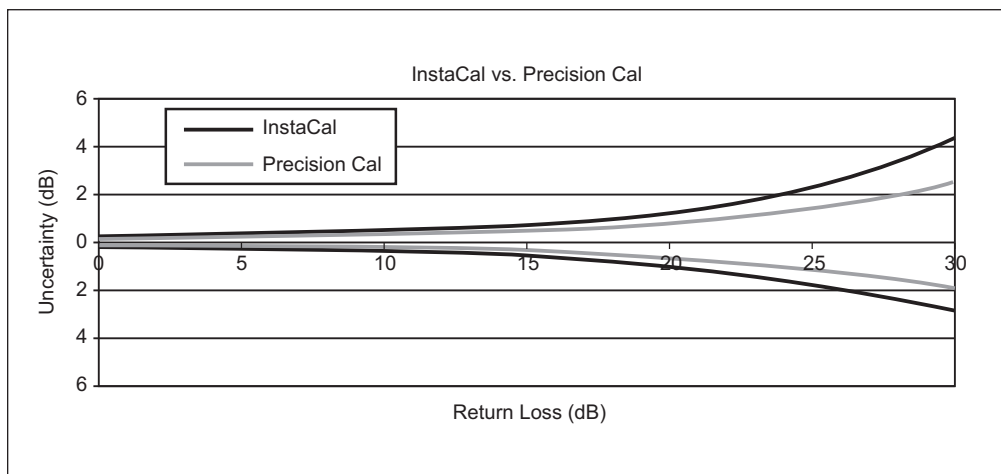


Figure 1: Estimated InstaCal Uncertainties vs. Precision Cal Uncertainties.

Comparing Traces

While the curves in Figure 1 can be helpful, a practical measurement can be more helpful to compare the data. Figure 2 shows a 20 dB offset measured with both the OSLN50-1 and InstaCal module. The small difference correlates with Figure 1.

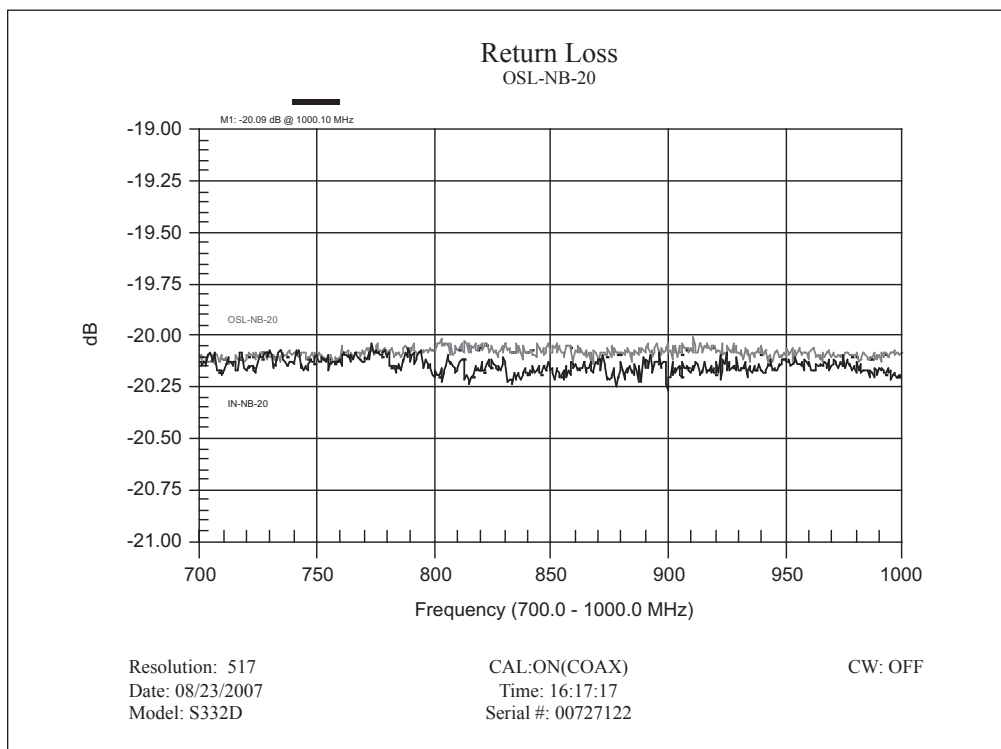


Figure 2: Comparing Two 20 dB Offset Measurements.

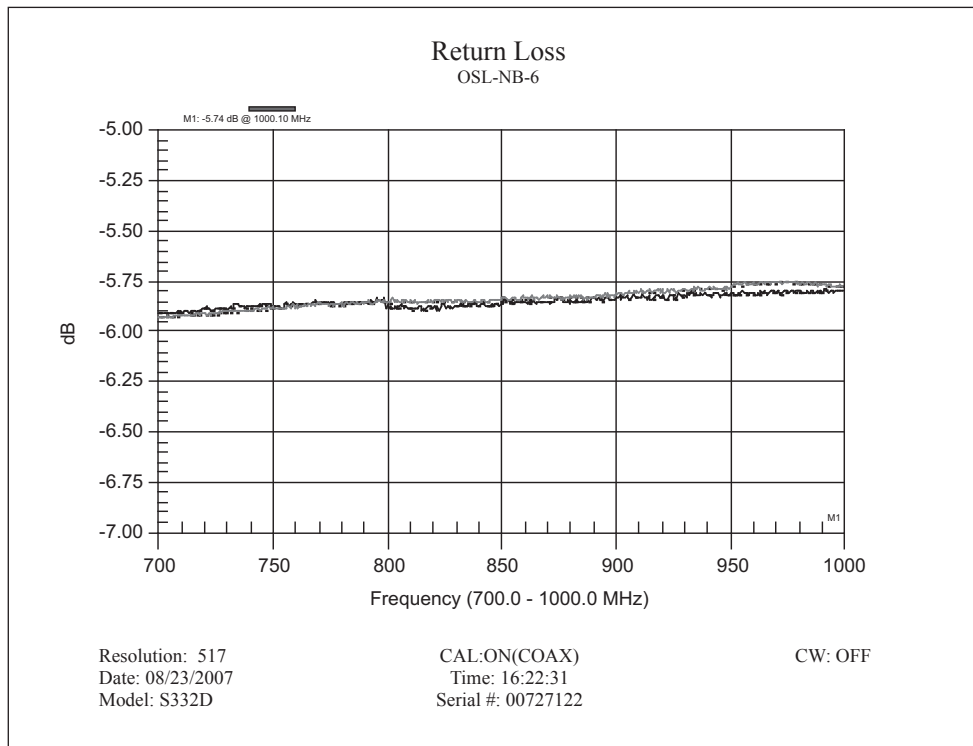


Figure 3: Comparing Two 3 dB Pad Measurements.

Figure 3 shows the same comparison but with a 3 dB pad. As expected, the graphs show less deviation because the errors are smaller since the measured signal is significantly greater than the specified directivity. The slope is a result of the pad performance.

Summary

Both the InstaCal and OSLN50-1 precision Cal components provide users with accurate calibrations. The InstaCal has the benefit of providing quick and easy calibrations and can result in significant time savings when troubleshooting cable and antenna systems in the field.

Anritsu

Anritsu Corporation

5-1-1 Onna, Atsugi-shi, Kanagawa, 243-8555 Japan
Phone: +81-46-223-1111
Fax: +81-46-296-1264

• U.S.A.

Anritsu Company

1155 East Collins Boulevard, Suite 100,
Richardson, Texas 75081 U.S.A.
Toll Free: 1-800-ANRITSU (267-4878)
Phone: +1-972-644-1777
Fax: +1-972-671-1877

• Canada

Anritsu Electronics Ltd.

700 Silver Seven Road, Suite 120, Kanata,
Ontario K2V 1C3, Canada
Phone: +1-613-591-2003
Fax: +1-613-591-1006

• Brazil

Anritsu Eletrônica Ltda.

Praca Amadeu Amaral, 27-1 Andar
01327-010 - Paraiso, São Paulo, Brazil
Phone: +55-11-3283-2511
Fax: +55-11-3886940

• Mexico

Anritsu Company, S.A. de C.V.
Av. Ejército Nacional No. 579 Piso 9, Col. Granada
11520 México, D.F., México
Phone: +52-55-1101-2370
Fax: +52-55-5254-3147

• U.K.

Anritsu EMEA Ltd.

200 Capability Green, Luton, Bedfordshire LU1 3LU, U.K.
Phone: +44-1582-433280
Fax: +44-1582-731303

• France

Anritsu S.A.

16/18 Avenue du Québec-SILIC 720
91961 COURTABOEUF CEDEX, France
Phone: +33-1-60-92-15-50
Fax: +33-1-64-46-10-65

• Germany

Anritsu GmbH

Nemetschek Haus, Konrad-Zuse-Platz 1
81829 München, Germany
Phone: +49 (0) 89 442308-0
Fax: +49 (0) 89 442308-55

• Italy

Anritsu S.p.A.

Via Elio Vittorini, 129, 00144 Roma, Italy
Phone: +39-06-509-9711
Fax: +39-06-502-2425

• Sweden

Anritsu AB

Borgafjordsgatan 13, 164 40 Kista, Sweden
Phone: +46-8-534-707-00
Fax: +46-8-534-707-30

• Finland

Anritsu AB

Teknobulevardi 3-5, FI-01530 Vantaa, Finland
Phone: +358-20-741-8100
Fax: +358-20-741-8111

• Denmark

Anritsu A/S

Kirkebjerg Allé 90 DK-2605 Brøndby, Denmark
Phone: +45-72112200
Fax: +45-72112210

• Spain

Anritsu EMEA Ltd.

Oficina de Representación en España

Edificio Veganova
Avda de la Vega, nº 1 (edf 8, pl1, of 8)
28108 ALCOBENDAS - Madrid, Spain
Phone: +34-914905761
Fax: +34-914905762

• Russia

Anritsu EMEA Ltd.

Representation Office in Russia

Tverskaya str. 16/2, bld. 1, 7th floor.
Russia, 125009, Moscow
Phone: +7-495-363-1694
Fax: +7-495-935-8962

• United Arab Emirates

Anritsu EMEA Ltd.

Dubai Liaison Office

P O Box 500413 - Dubai Internet City
Al Thuraya Building, Tower 1, Suite 701, 7th Floor
Dubai, United Arab Emirates
Phone: +971-4-3670352
Fax: +971-4-3688460

• Singapore

Anritsu Pte. Ltd.

60 Alexandra Terrace, #02-08, The Comtech (Lobby A)
Singapore 118502
Phone: +65-6282-2400
Fax: +65-6282-2533

• India

Anritsu Pte. Ltd.

India Branch Office

3rd Floor, Shri Lakshminarayan Niwas, #2726,
HAL 3rd Stage, Bangalore - 560 038, India
Phone: +91-80-4058-1300
Fax: +91-80-4058-1301

• P. R. China (Hong Kong)

Anritsu Company Ltd.

Units 4 & 5, 28th Floor, Greenfield Tower, Concordia Plaza,
No. 1 Science Museum Road, Tsim Sha Tsui East,
Kowloon, Hong Kong, P.R. China
Phone: +852-2301-4980
Fax: +852-2301-3545

• P. R. China (Beijing)

Anritsu Company Ltd.

Beijing Representative Office

Room 1515, Beijing Fortune Building,
No. 5, Dong-San-Huan Bei Road,
Chao-Yang District, Beijing 100004, P.R. China
Phone: +86-10-6590-9230
Fax: +82-10-6590-9235

• Korea

Anritsu Corporation, Ltd.

8F Hyunjuk Bldg. 832-41, Yeoksam-Dong,
Kangnam-ku, Seoul, 135-080, Korea
Phone: +82-2-553-6603
Fax: +82-2-553-6604

• Australia

Anritsu Pty Ltd.

Unit 21/270 Ferntree Gully Road, Notting Hill
Victoria, 3168, Australia
Phone: +61-3-9558-8177
Fax: +61-3-9558-8255

• Taiwan

Anritsu Company Inc.

7F, No. 316, Sec. 1, Neihu Rd., Taipei 114, Taiwan
Phone: +886-2-8751-1816
Fax: +886-2-8751-1817

