

akkreditiert durch die / *accredited by the***Deutsche Akkreditierungsstelle GmbH**als Kalibrierlaboratorium im / *as calibration laboratory in the*Deutsche
Akkreditierungsstelle
D-K-15195-01-00**Deutschen Kalibrierdienst****DKD**Kalibrierschein
*Calibration certificate*Kalibrierzeichen
Calibration mark

582505
D-K- 15195-01-00
2021-01

Gegenstand <i>Object</i>	FS-Z110 HARMONIC MIXER
Hersteller <i>Manufacturer</i>	ROHDE & SCHWARZ
Typ <i>Type</i>	FS-Z110
Fabrikat/Serien-Nr. <i>Serial number</i>	101467
Auftraggeber <i>Customer</i>	RISE Research Institutes of Sweden AB
	Brinellgatan 4 504 62 Borås SE
Auftragsnummer <i>Order No.</i>	4942001194 10, 1565-0
Anzahl der Seiten des Kalibrierscheines <i>Number of pages of the certificate</i>	3 Certificate 6 Outgoing Results 6 Incoming Results
Datum der Kalibrierung <i>Date of calibration</i>	2021-01-12

Dieser Kalibrierschein dokumentiert die Rückführung auf nationale Normale zur Darstellung der Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI).

Die DAkkS ist Unterzeichner der multilateralen Übereinkommen der European co-operation for Accreditation (EA) und der International Laboratory Accreditation Cooperation (ILAC) zur gegenseitigen Anerkennung der Kalibrierscheine.

Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.


This calibration certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI).

The DAkkS is signatory to the multilateral agreements of the European co-operation for Accreditation (EA) and of the International Laboratory Accreditation Cooperation (ILAC) for the mutual recognition of calibration certificates.

The user is obliged to have the object recalibrated at appropriate intervals.

Dieser Kalibrierschein darf nur vollständig und unverändert weiterverbreitet werden. Auszüge oder Änderungen bedürfen der Genehmigung des ausstellenden Kalibrierlaboratoriums. Kalibrierscheine sind bei Nennung des für die Freigabe Verantwortlichen in Klarschrift auch ohne Unterschrift gültig.

This calibration certificate may not be reproduced other than in full except with the permission of the issuing laboratory. Calibration certificates with the full name of the approval responsible person are valid without signature.

Datum der Ausstellung <i>Date of issue</i>	Freigabe des Kalibrierscheins durch <i>Approval of the calibration certificate by</i>
2021-01-13	 Dr. Gerhard Rösel Leiter des Kalibrierlaboratoriums <i>Head of the calibration laboratory</i>


Johannes Negele Bearbeiter <i>Person in charge</i>

Object FS-Z110 HARMONIC MIXER
Type FS-Z110 **Serial No.** 101467
Date 2021-01-13 **Material No.** 1048.0471.02
Page 2 / 3

582505
D-K- 15195-01-00
2021-01



Place of Calibration

87700 Memmingen, Rohde-und-Schwarz-Str. 1

Calibration Procedure

The measuring object is an RF harmonic mixer, which converts an RF signal at one frequency into a signal at another frequency (here: IF). The conversion loss was measured using a vector network analyzer. The RF output power as well as the IF input power of the corresponding ports of the VNA were traced back to a power sensor. The conversion loss is defined as the ratio of the power at the IF frequency to the power at the RF frequency with a given LO power. (IF: Intermediate frequency; LO: Local Oscillator)

The traceability is represented in the table Working Standards used.

Calibration Method **See first page of Outgoing Results**

Statement of Compliance

Incoming: All measured values are within the data sheet specifications.

Outgoing: All measured values are within the data sheet specifications.

Working Standards used

Item	Type	Serial Number	Calibration Certificate Number	Cal. Due
Therm.Power Sensor DC-44GHz	NRP-Z55	140170	0023 D-K-15195-01-00 2020-12	2022-02-28
Thermal Waveguide Power Sensor	NRP110TWG	910003	100024 D-K-15195-01-00 2020-10	2021-10-31
Vect. Netw. Analyzer 4PORT	ZVA67	101175	0042 D-K-15195-01-01 2020-03	2021-03-31

Object FS-Z110 HARMONIC MIXER
Type FS-Z110 **Serial No.** 101467
Date 2021-01-13 **Material No.** 1048.0471.02
Page 3 / 3

582505
D-K- 15195-01-00
2021-01



Measurement Uncertainty

The expanded measurement uncertainty corresponds to the measurement results from the standard measurement uncertainty multiplied by the coverage factor $k = 2$.
It was determined in accordance with EA-4/02 M:2013. The true value is located in the corresponding interval with a probability of 95 %.

Environmental Conditions

Ambient Temperature $(23 \pm 1) ^\circ\text{C}$ Relative Humidity 20%-60%

Ancillary Functional Measurements

In addition to the calibration results, the calibration certificate includes functional measurements that might have an influence on the measurement uncertainty of the calibration results. The functional measurement results are marked and are not intended to be used to support the further dissemination of metrological traceability. They are intended to verify the requirements on the measurement object according to manufacturer specifications and technical standards.

Comments on Measurement Results

The measurement results in the test report stated below have been tested for compliance with the given specifications and marked if necessary. The associated uncertainty of measurement has been taken into account. Measurement results that are not covered by the DAkkS accreditation are marked with ¹.

Ref.: ILAC G8:09/2019 'Guidelines on Decision Rules and Statements of Conformity'.

Outgoing Results

Designation: HARMONIC MIXER
Type: FS-Z110
Material No.: 1048.0471.02
Serial No.: 101467
Certificate No.: 582505 D-K-159195-01-00 2020-01
Referring to Test Documentation: 5038.8323.01-PB-01.04

Test Department: 3MME3
Name: Johannes Negele
Date: 2021-01-12

The following abbreviations may be used in this document

- {a} No measurement uncertainty stated because the errors always add together. So it is sure that a measurement result evaluated as "PASS" is pass.
 - {b} The measurement uncertainty depends on the measurement result. The stated measurement uncertainty is valid for the close area around the specification. Measurement results outside the close area have a higher measurement uncertainty but are within the specification.
 - {c} Functional test, therefore no measurement uncertainty is stated.
 - {d} Typical value, refer to performance test.
 - {e} The measurement uncertainty is taken into account when setting the measuring system.
 - {f} Verification of specified requirements. Technical operation that consist of the determination of one or more characteristics to a specified procedure.
- DL or DT Data Limit for symmetrical tolerance limits
 - DLL Datasheet Lower Limit
 - DUL Datasheet Upper Limit
 - MU Symmetrical Measurement Uncertainty
 - MLL or MLV Measurement Uncertainty Lower Value
 - MUL or MUV Measurement Uncertainty Upper Value
 - Nom. Nominal Value
 - Dev. Deviation
 - Act. Actual Value
 - UGB Uncertainty Guard Band: Measuring uncertainty violates the data (spec.) limit.
 - UGB1 A compliance statement may be possible where a confidence level of less than 95 % is acceptable.
 - UGB2 A non-compliance statement may be possible where a confidence level of less than 95 % is acceptable.
 - DU Datasheet Uncertainty

Explanation of charts

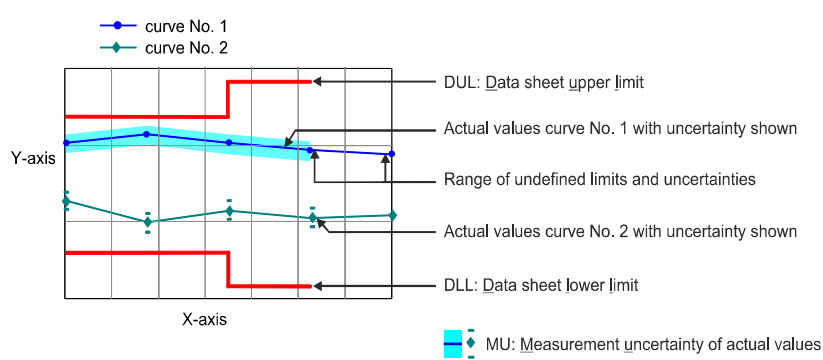


Table of contents

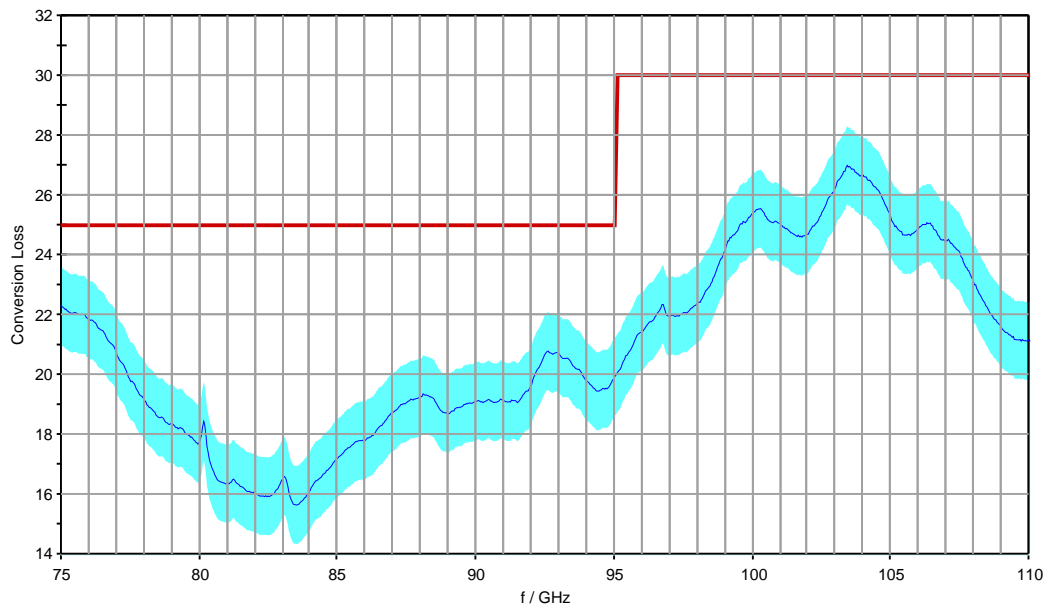
Software used for measurement	4
1. Conversion Loss (8. Harmonic)	5
1.1 Conversion Loss (IF = 404.4 MHz)	5
1.2 Conversion Loss (IF = 729 MHz)	5
1.3 Conversion Loss (IF = 1330 MHz)	6
1.4 Continuity response within 1 GHz	6

Software used for measurement			
Item	Type	Version	Remark
Suite	Setup	V12.10	Test Management Software G5
Test Program (7012.8706.00_)	Component	V01.05	

1. Conversion Loss (8. Harmonic)

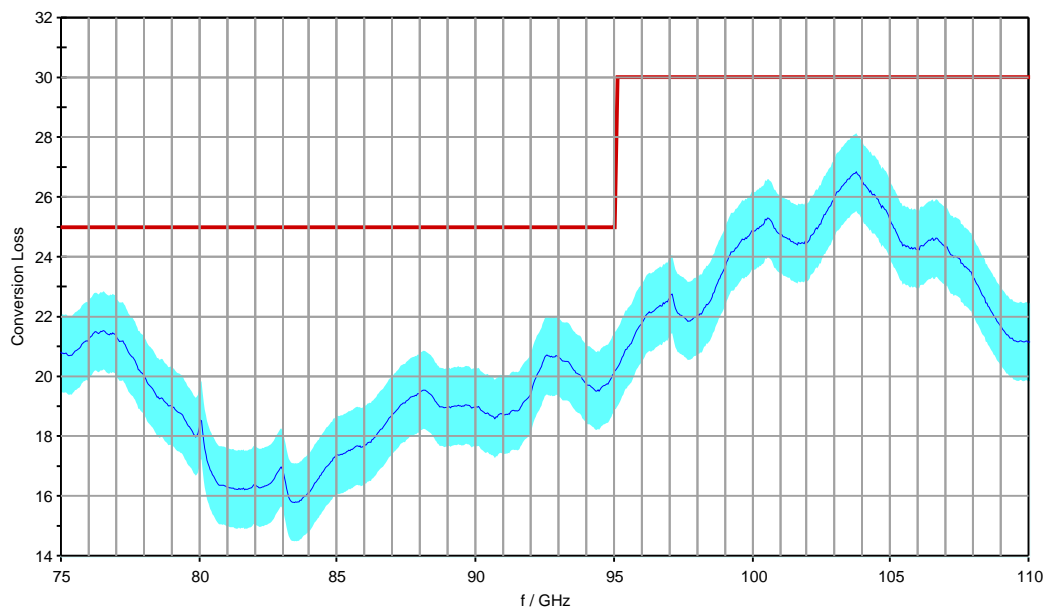
1.1 Conversion Loss (IF = 404.4 MHz)

IF = 404.4 MHz, 8. Harmonic



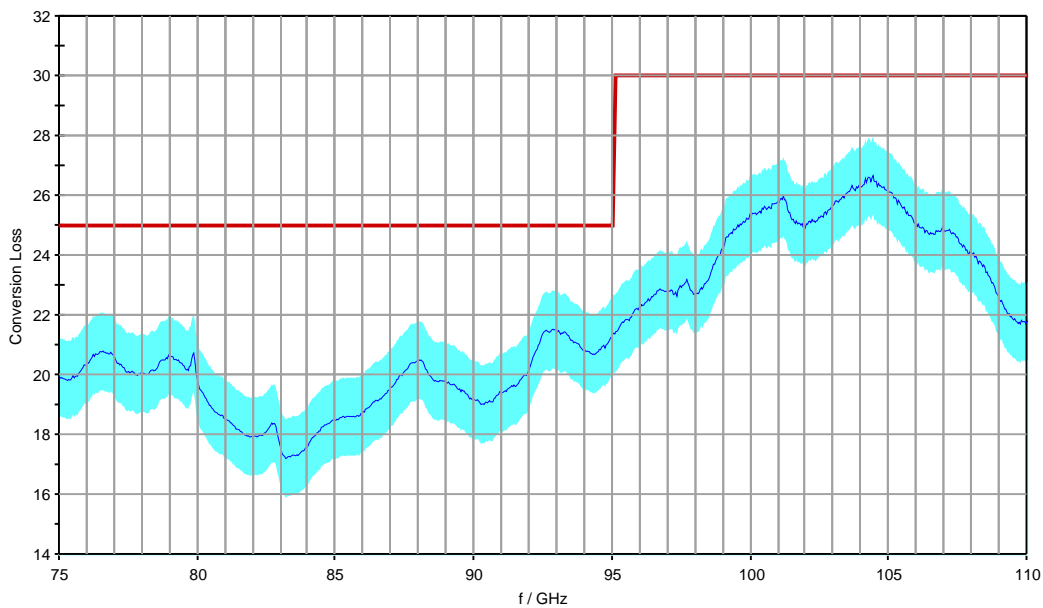
1.2 Conversion Loss (IF = 729 MHz)

IF = 729 MHz, 8. Harmonic



1.3 Conversion Loss (IF = 1330 MHz)

IF = 1330 MHz, 8. Harmonic



1.4 Continuity response within 1 GHz

Continuity response within any 1 GHz Band, 8. Harmonic

	DUL /dB	Continuity /dB
max. at IF = 404.4 MHz:	6.0	2.09
max. at IF = 729 MHz:	6.0	2.24
max. at IF = 1330 MHz:	6.0	2.08

Incoming Results

Designation: HARMONIC MIXER
Type: FS-Z110
Material No.: 1048.0471.02
Serial No.: 101467

Referring to Test Documentation: 5038.8323.01-PB-01.04

Test Department: 3MME3
Name: Johannes Negele
Date: 2021-01-12

The following abbreviations may be used in this document

- {a} No measurement uncertainty stated because the errors always add together. So it is sure that a measurement result evaluated as "PASS" is pass.
 - {b} The measurement uncertainty depends on the measurement result. The stated measurement uncertainty is valid for the close area around the specification. Measurement results outside the close area have a higher measurement uncertainty but are within the specification.
 - {c} Functional test, therefore no measurement uncertainty is stated.
 - {d} Typical value, refer to performance test.
 - {e} The measurement uncertainty is taken into account when setting the measuring system.
 - {f} Verification of specified requirements. Technical operation that consist of the determination of one or more characteristics to a specified procedure.
- DL or DT Data Limit for symmetrical tolerance limits
 DLL Datasheet Lower Limit
 DUL Datasheet Upper Limit
 MU Symmetrical Measurement Uncertainty
 MLL or MLV Measurement Uncertainty Lower Value
 MUL or MUV Measurement Uncertainty Upper Value
 Nom. Nominal Value
 Dev. Deviation
 Act. Actual Value
 UGB Uncertainty Guard Band: Measuring uncertainty violates the data (spec.) limit.
 UGB1 A compliance statement may be possible where a confidence level of less than 95 % is acceptable.
 UGB2 A non-compliance statement may be possible where a confidence level of less than 95 % is acceptable.
 DU Datasheet Uncertainty

Explanation of charts

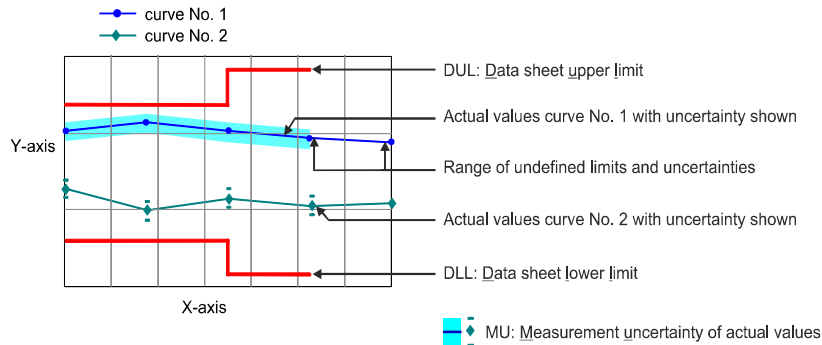


Table of contents

Software used for measurement	4
1. Conversion Loss (8. Harmonic)	5
1.1 Conversion Loss (IF = 404.4 MHz)	5
1.2 Conversion Loss (IF = 729 MHz)	5
1.3 Conversion Loss (IF = 1330 MHz)	6
1.4 Continuity response within 1 GHz	6

Type FS-Z110
Test System MP728001
Temperature (23 -3/+7)°C
File (Incoming) 1048.0471.02_101467_10M.MF
Page 4 / 6

Serial No. 101467
Material No. 1048.0471.02
Date 2021-01-12



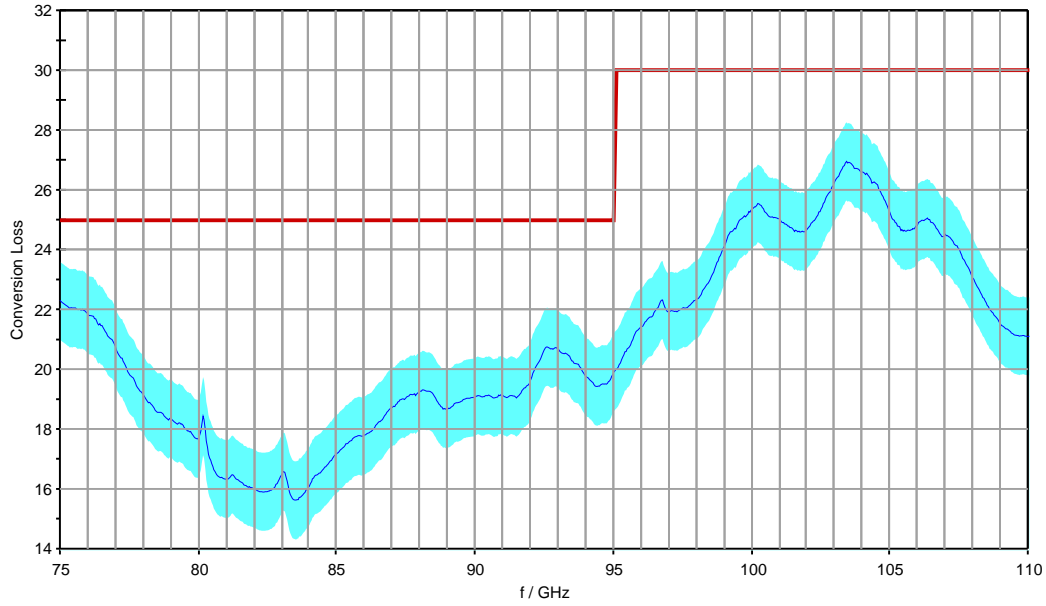
Software used for measurement			
Item	Type	Version	Remark
Suite	Setup	V12.10	Test Management Software G5
Test Program (7012.8706.00_)	Component	V01.05	

Incoming Results

1. Conversion Loss (8. Harmonic)

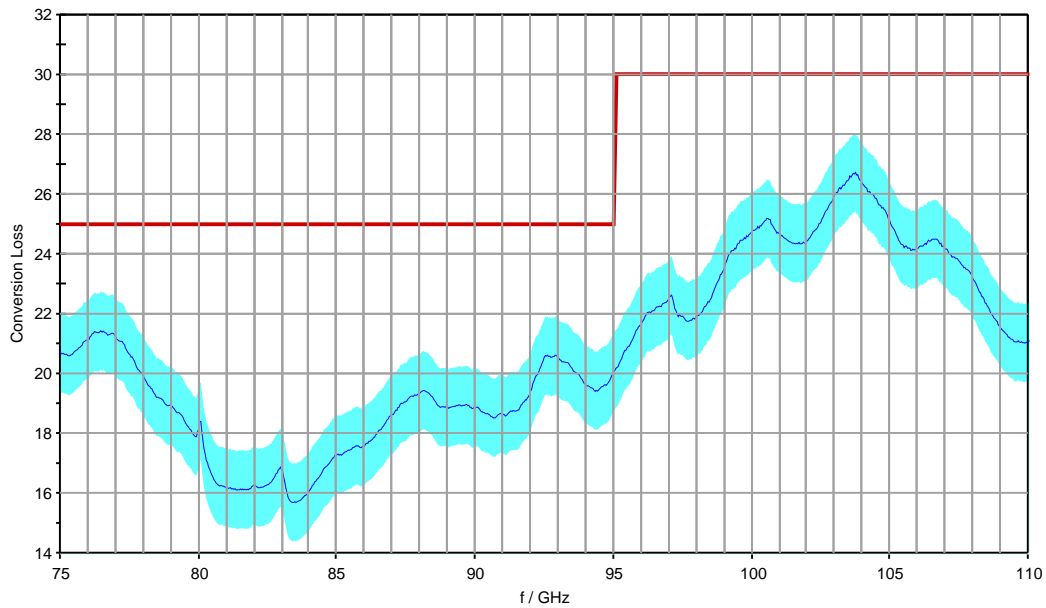
1.1 Conversion Loss (IF = 404.4 MHz)

IF = 404.4 MHz, 8. Harmonic



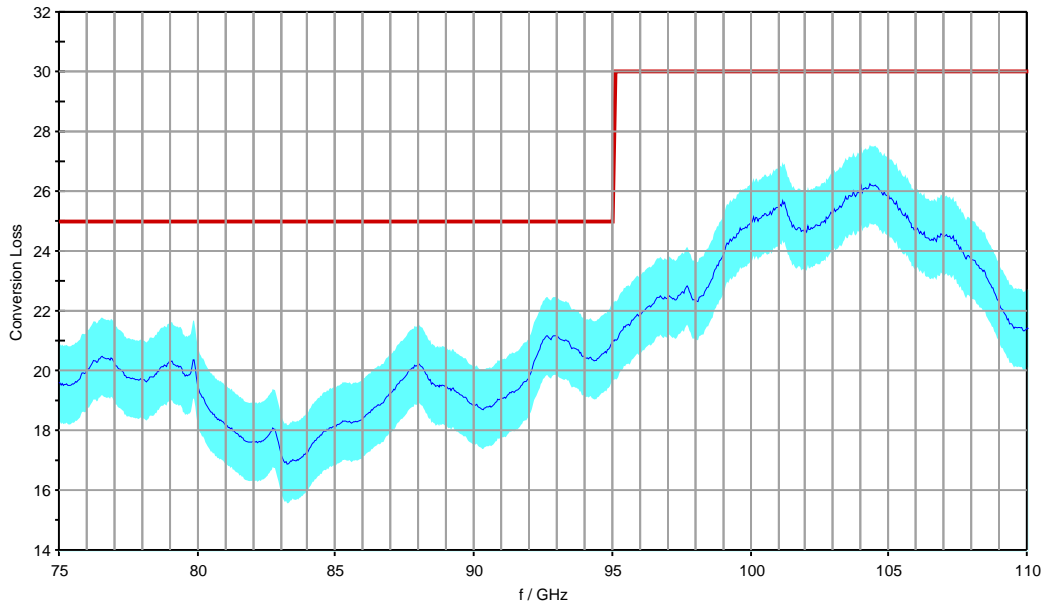
1.2 Conversion Loss (IF = 729 MHz)

IF = 729 MHz, 8. Harmonic



1.3 Conversion Loss (IF = 1330 MHz)

IF = 1330 MHz, 8. Harmonic



1.4 Continuity response within 1 GHz

Continuity response within any 1 GHz Band, 8. Harmonic

	DUL /dB	Continuity /dB
max. at IF = 404.4 MHz:	6.0	2.11
max. at IF = 729 MHz:	6.0	2.23
max. at IF = 1330 MHz:	6.0	2.05