Calibration

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NCL CALIBRATION LABORATORIES

Calibration File No.: CP-422

Client.: APREL

CERTIFICATE OF CALIBRATION

It is certified that the equipment identified below has been calibrated in the **NCL CALIBRATION LABORATORIES** by qualified personnel following recognized procedures and using transfer standards traceable to NRC/NIST.

Equipment: Miniature Isotropic H-field RF Probe

Manufacturer: APREL Laboratories
Model No.: H-020
Serial No.: 101

IN AIR Calibration

Calibration Procedure: SSI/DRB-TP-D01-038
Project No: Internal

Calibrated: 2nd October 2004
Released on: 2nd October 2004

This Calibration Certificate is Incomplete Unless Accompanied with the Calibration Results Summary

Released By: _____

***NCL* CALIBRATION LABORATORIES**
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Division of APREL Lab.
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Introduction

This Calibration Report reproduces the results of the calibration performed in line with the SSI/DRB-TP-D01-038 H-Field Probe Calibration Procedure. The results contained within this report are for APREL H-Field Probe H-020 101.

References

SSI/DRB-TP-D01-038 H-Field Probe Calibration Procedure
IEEE Std 1309-2005 "Standard for Calibration of Electromagnetic Field Sensors and Probes, Excluding Antennas, from 9 kHz to 40GHz".

Conditions

Probe 101 was a new probe taken from stock prior to calibration.

Ambient Temperature of the Laboratory: 22 °C +/- 0.5°C

Sensor offset

Each probe is comprised of 3 magnetic sensors and positioned at 90 degree to each other in XYZ arrangement. Their electric center makes the calibrated center of the probe

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Calibration Results Summary

Probe Type: H-Field Probe H-020

Serial Number: 101

Frequencies: see the table "Sensitivity in Air" below

Sensor Offset: 3.0 mm

Sensor Diameter: 4.0 mm

Tip Enclosure: Polycarbonate

Tip Diameter: 8 mm

Total Length: 290 mm

Sensitivity in Air

Frequency	**Channel X**	**Channel Y**	**Channel Z**
824.2MHz	84.2mV/(A/m)^2	84.2mV/(A/m)^2	84.2mV/(A/m)^2
836.5MHz	86.7mV/(A/m)^2	86.7mV/(A/m)^2	86.7mV/(A/m)^2
848.8MHz	89.3mV/(A/m)^2	89.3mV/(A/m)^2	89.3mV/(A/m)^2
1850MHz	424.1mV/(A/m)^2	424.1mV/(A/m)^2	424.1mV/(A/m)^2
1880MHz	438.0mV/(A/m)^2	438.0mV/(A/m)^2	438.0mV/(A/m)^2
1910MHz	452.1mV/(A/m)^2	452.1mV/(A/m)^2	452.1mV/(A/m)^2

Diode Compression Point: 95 mV

Spatial Resolution:

The measured probe tip diameter is 5 mm (+/- 0.01 mm) and therefore meets the requirements of SSI/DRB-TP-D01-032 for spatial resolution.

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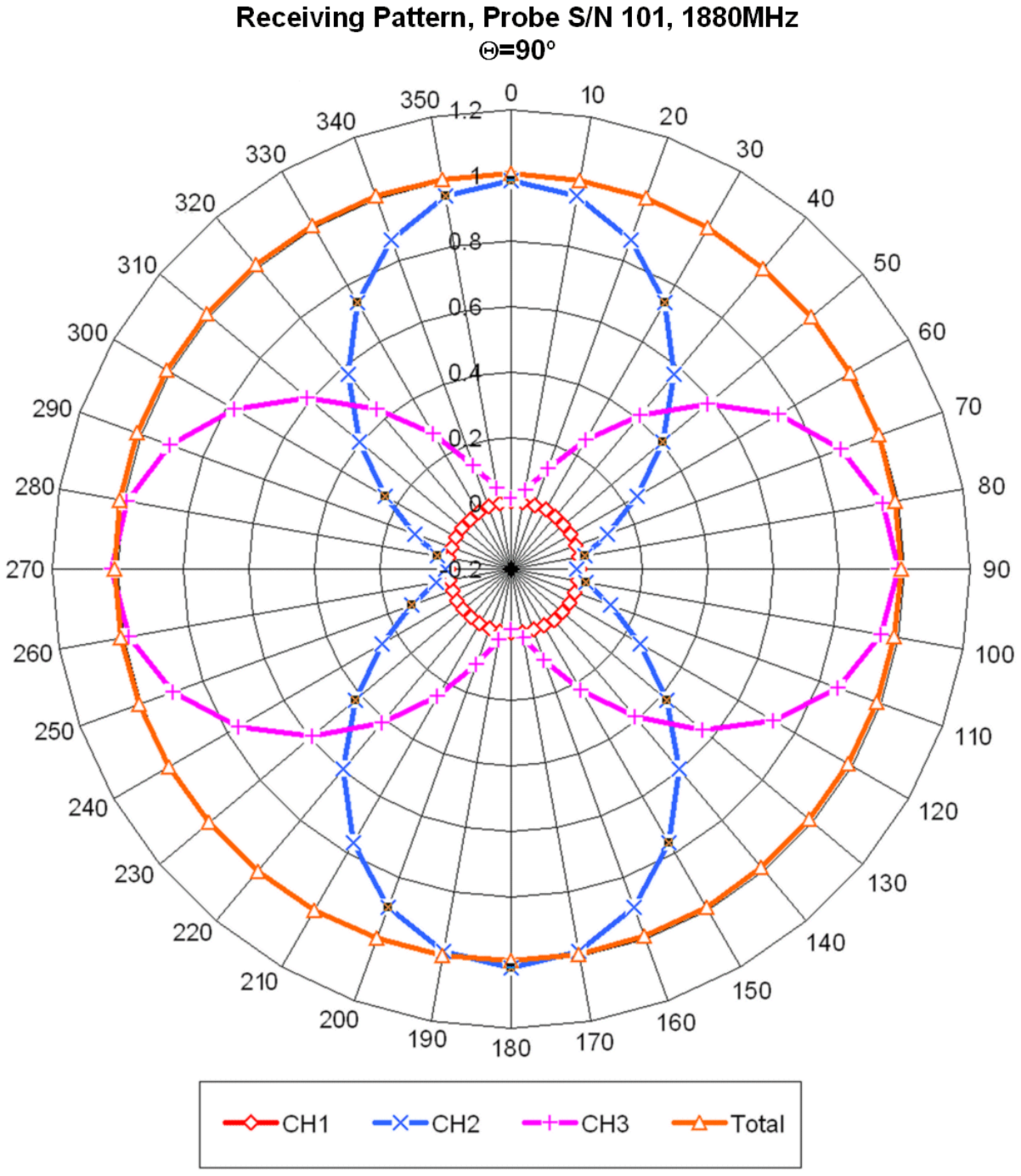
Receiving Pattern at 1880 MHz



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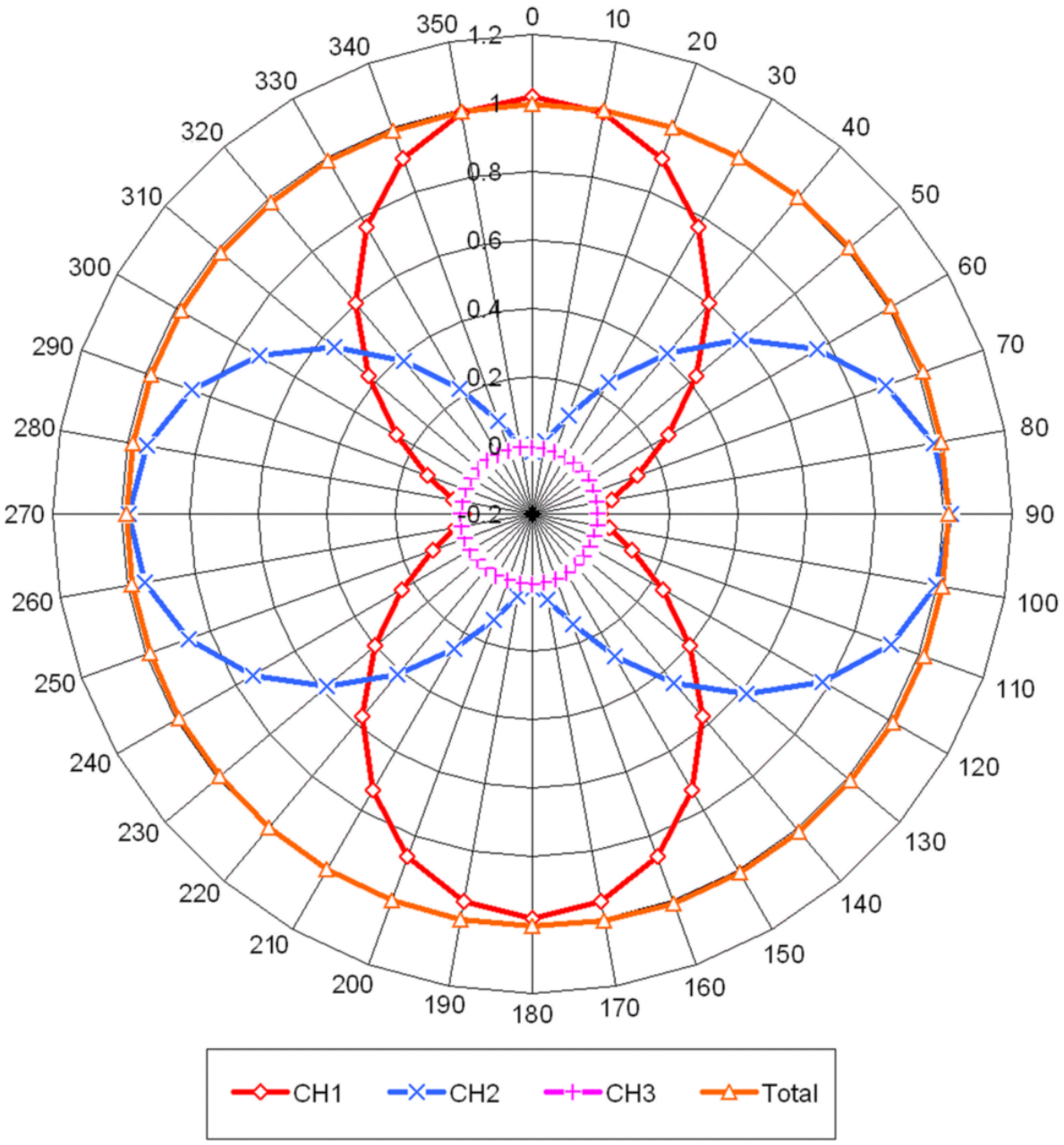
Receiving Pattern, Probe S/N 101, 1880MHz

Θ=0°



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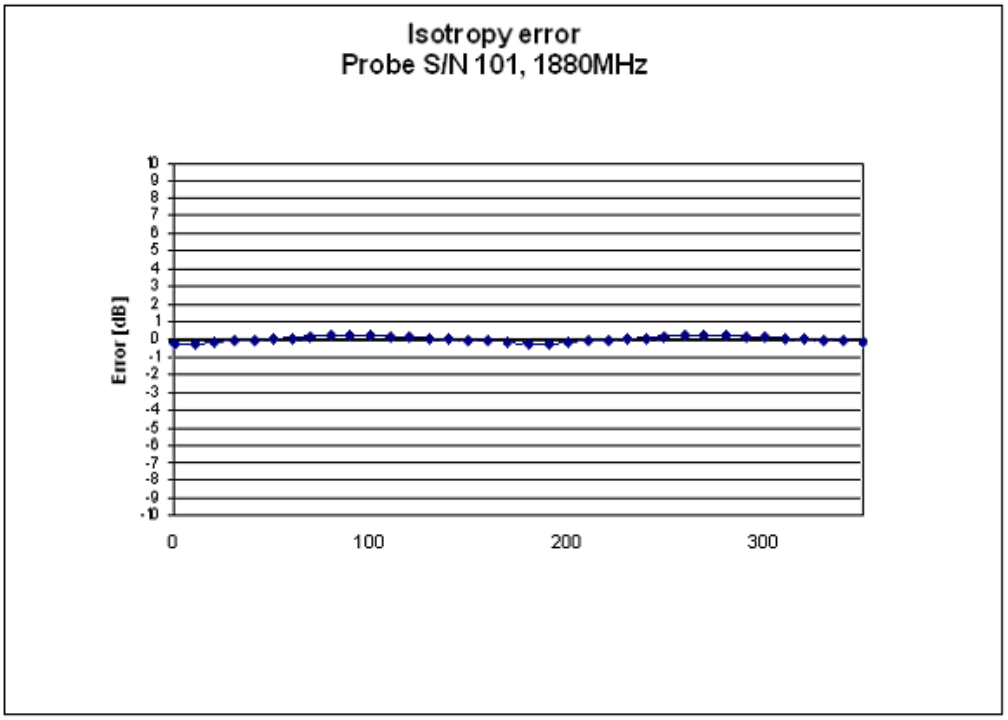
Isotropy Error 1880 MHz



Isotropicity: 0.10 dB

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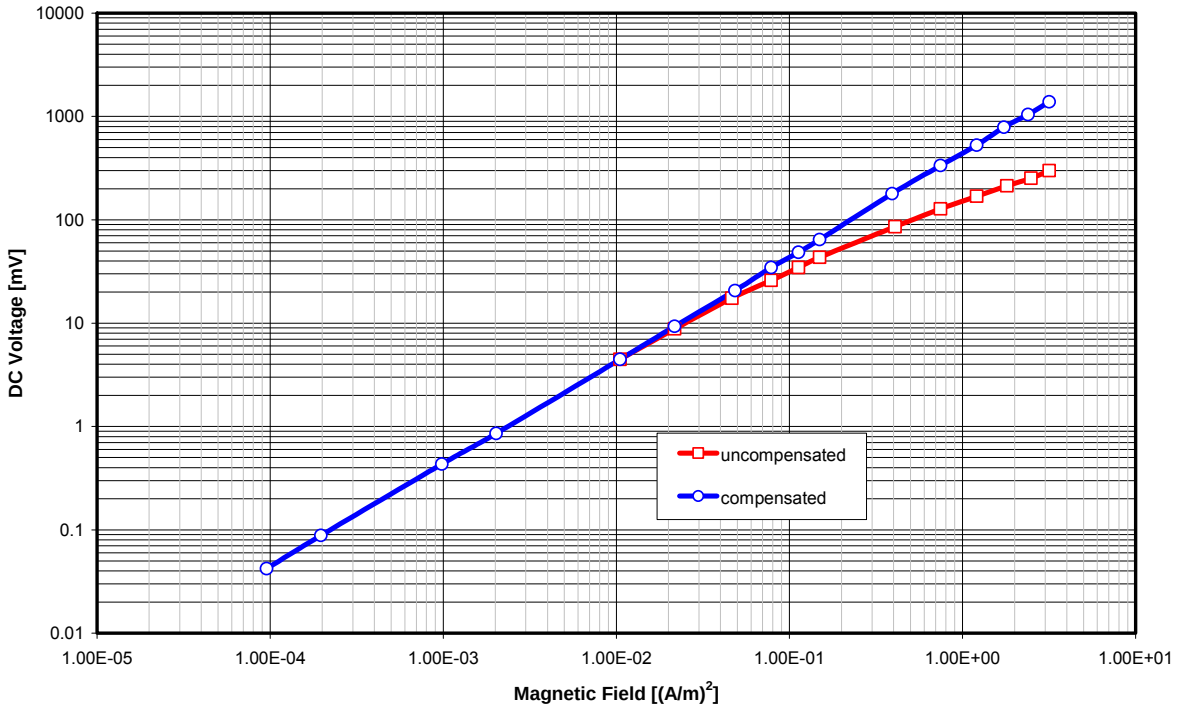
Dynamic Range



Test Equipment

The test equipment used during Probe Calibration, manufacturer, model number and, current calibration status are listed and located on the main APREL server R:\NCL\Calibration Equipment\Instrument List May 2005.

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Calibration File No.: CP-422

Client.: APREL

CERTIFICATE OF CALIBRATION

It is certified that the equipment identified below has been calibrated in the **NCL CALIBRATION LABORATORIES** by qualified personnel following recognized procedures and using transfer standards traceable to NRC/NIST.

Equipment: Miniature Isotropic E- Field RF Probe

Manufacturer: APREL Laboratories
Model No.: E-020
Serial No.: 269

IN AIR Calibration

Calibration Procedure: SSI/DRB-TP-D01-038
Project No: Internal

Calibrated: 21nd May 2005
Released on: 21nd May 2005

This Calibration Certificate is Incomplete Unless Accompanied with the Calibration Results Summary

Released By: _____

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Introduction

This Calibration Report reproduces the results of the calibration performed in line with the SSI/DRB-TP-D01-038 E-Field Probe Calibration Procedure. The results contained within this report are for APREL E-Field Probe E-020 269.

References

SSI/DRB-TP-D01-038 E-Field Probe Calibration Procedure
IEEE Std 1309-2005 "Standard for Calibration of Electromagnetic Field Sensors and Probes, Excluding Antennas, from 9 kHz to 40GHz".

Conditions

Probe 269 was a new probe taken from stock prior to calibration.

Ambient Temperature of the Laboratory: 22 °C +/- 0.5°C

Sensor offset

Each probe is comprised of 3 electric field sensors and positioned at 90 degree to each other in XYZ arrangement. Their electric center makes the calibrated center of the probe. The center is aligned with the main axis of the probe. For constructional reasons it is located a small distance, specified as the vertical offset, above the tip of the probe. The actual offset is specified in the probe's calibration certificate to allow for proper referencing to the probe's calibrated center when the probe's vertical position relative to the tested object is set by touching it with the probe's tip.

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Calibration Results Summary

Probe Type:	E-Field Probe E-020
Serial Number:	269
Frequency:	1880 MHz
Sensor Offset:	1.56 mm
Sensor Length:	2.5 mm
Tip Enclosure:	Ertalyte
Tip Diameter:	5 mm
Tip Length:	60 mm
Total Length:	290 mm

Sensitivity in Air

Channel X:	1.2 $\mu V/(V/m)^2$
Channel Y:	1.2 $\mu V/(V/m)^2$
Channel Z:	1.2 $\mu V/(V/m)^2$

Diode Compression Point:	95 mV

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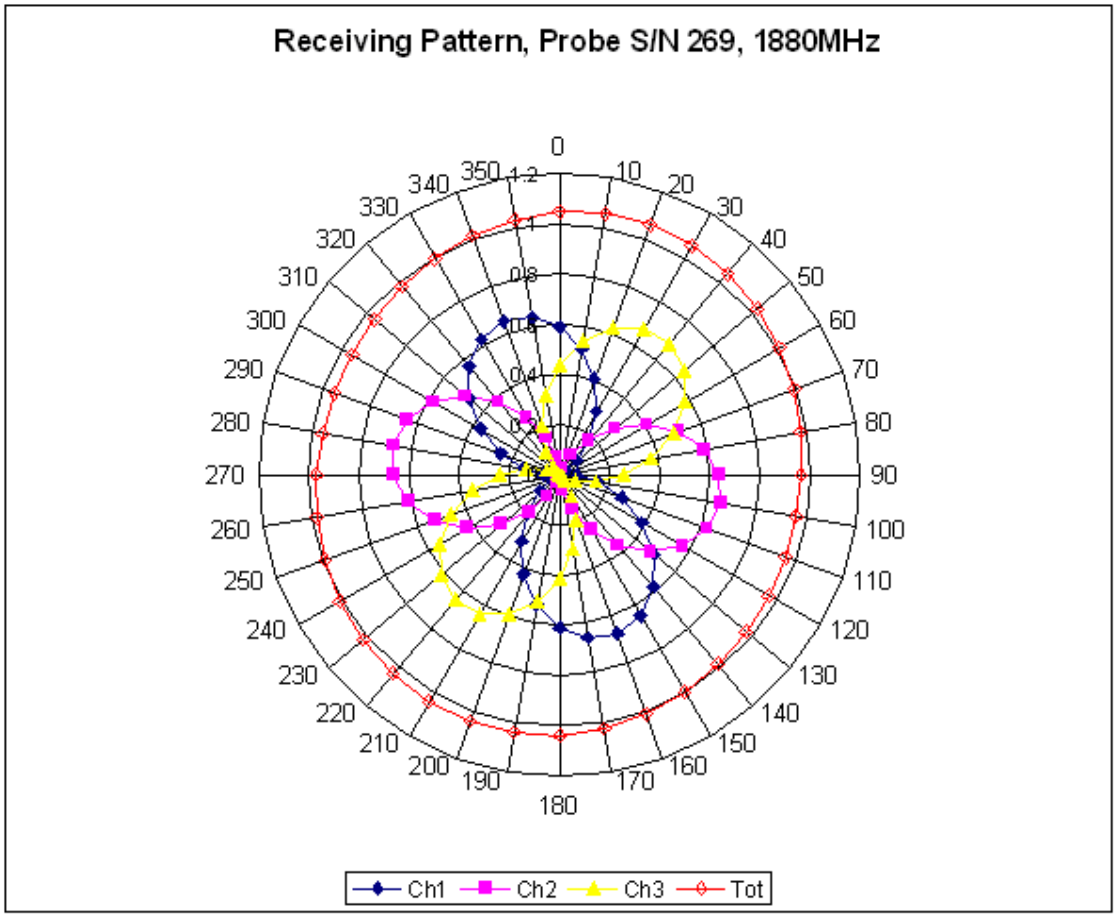
Spatial Resolution:

The measured probe tip diameter is 5 mm (+/- 0.01 mm) and therefore meets the requirements of SSI/DRB-TP-D01-032 for spatial resolution.

Receiving Pattern at 1880 MHz



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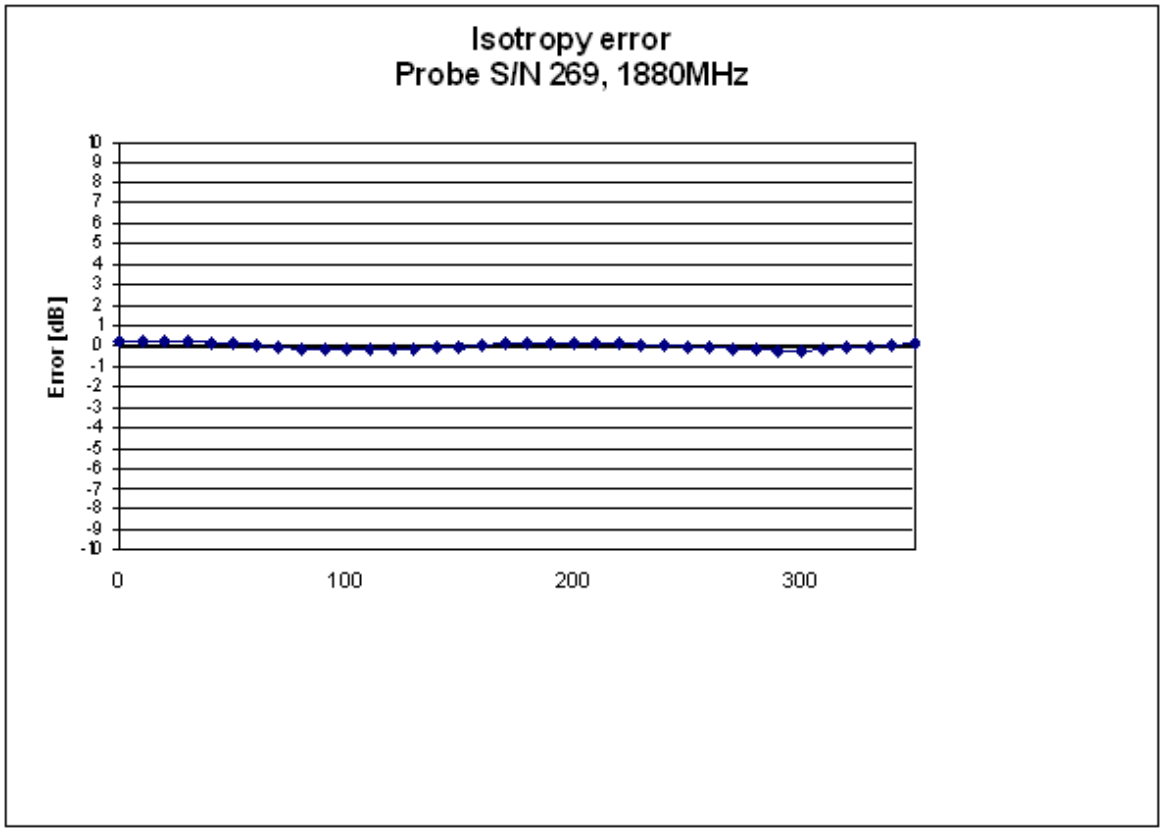
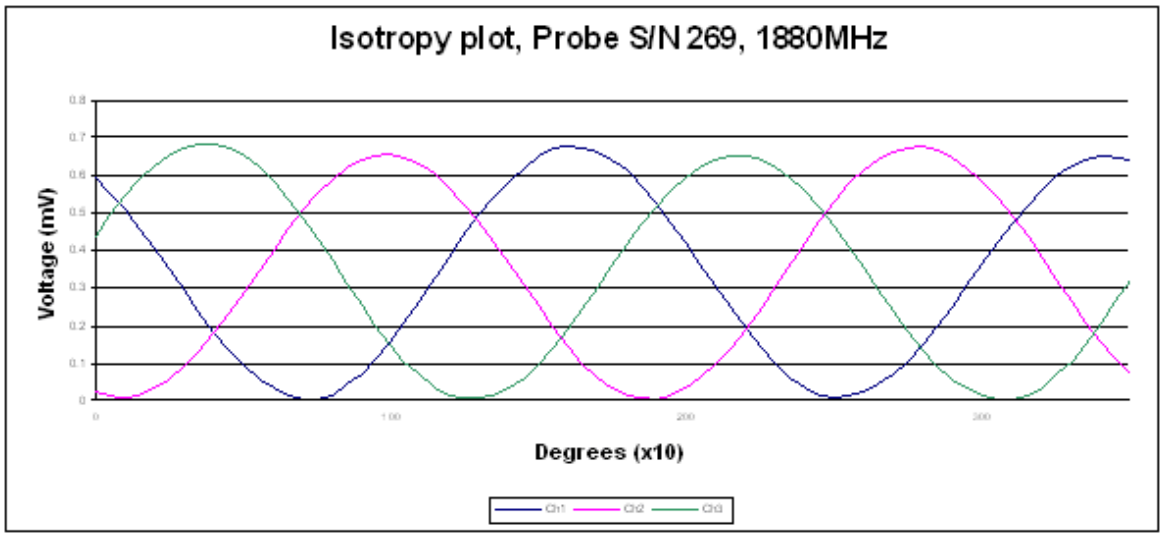
Isotropy Error 1880 MHz





Isotropicity: 0.10 dB

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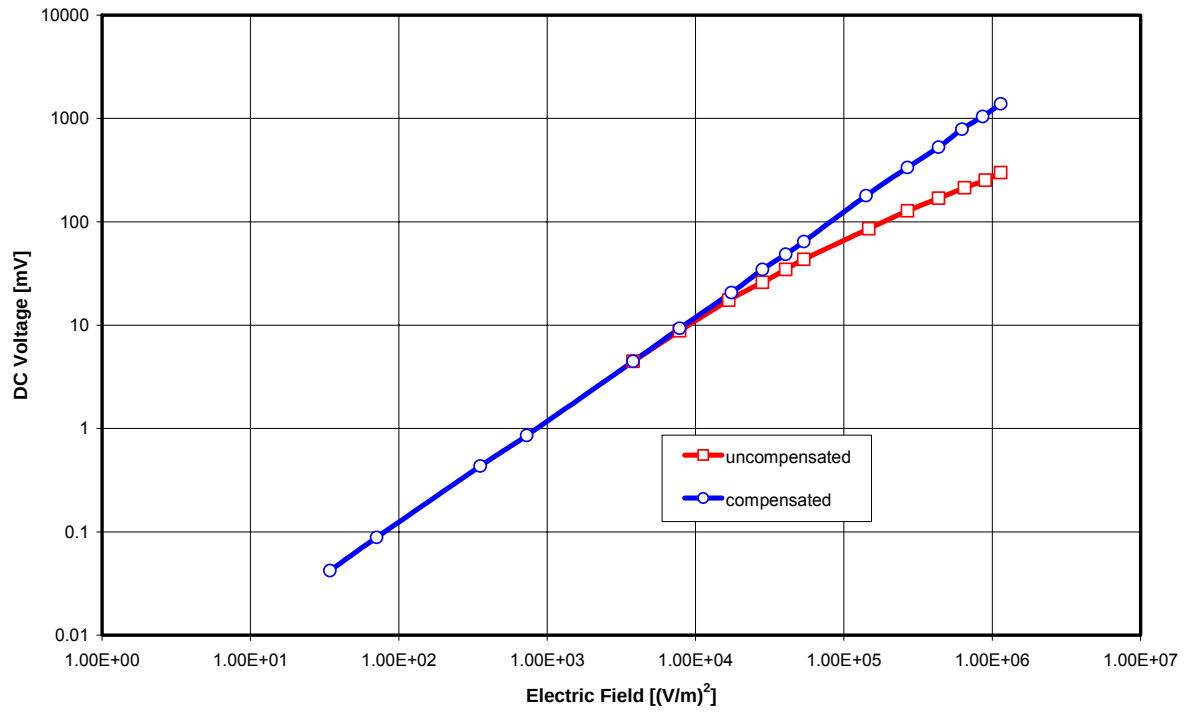
Dynamic Range



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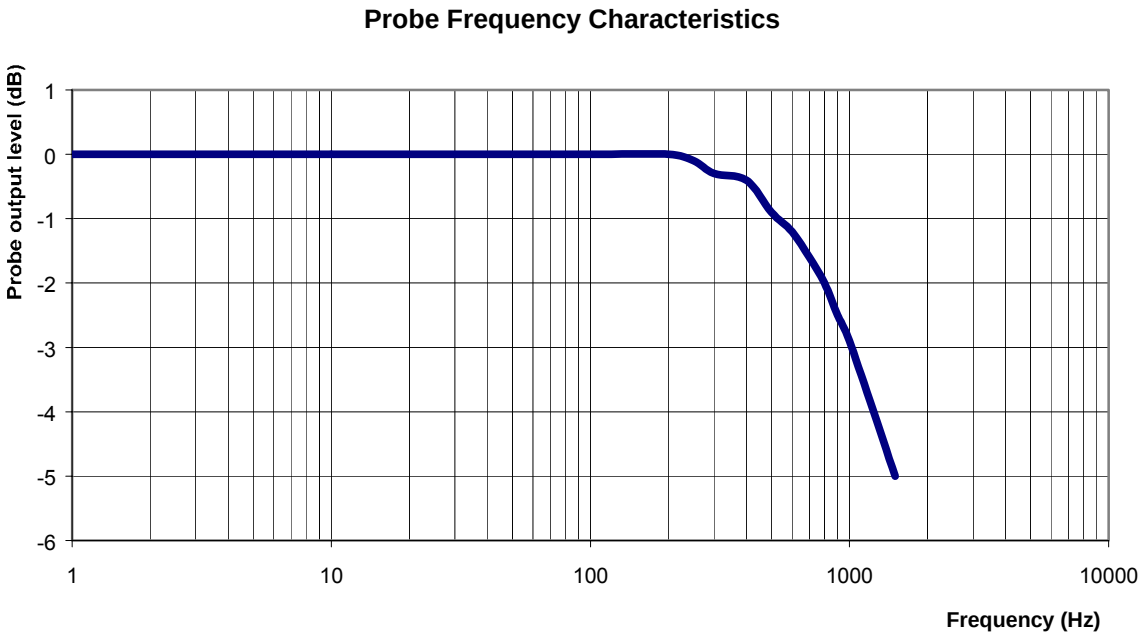
Video Bandwidth



Video Bandwidth at 500 Hz 1 dB
Video Bandwidth at 1.02 KHz: 3 dB

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Uncertainty Budget

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WD Near-Field Emissions Measurement Uncertainty Calculated

Contribution	Data (%)	Data Type	Probability Distribution	Divisor	Std. Uncertainty (%)	Std. Uncertainty (dB)
RF Reflections	3.0	Tolerance	rectangular	√3	1.7	
Probe Calibration	3.5	Standard Deviation	normal	1	3.5	
Field Probe Axial isotropy	3.7	Tolerance	rectangular	√3	1.5	
Field Probe Hemispherical Isotropy	10.9	Tolerance	rectangular	√3	4.4	
Probe Linearity	4.7	Tolerance	rectangular	√3	2.7	
Detection Limit	1.0	Tolerance	rectangular	√3	0.6	
Readout Electronics	1.0	Standard Deviation	normal	1	1.0	
Response Time	0.8	Tolerance	rectangular	√3	0.5	
Integration Time	1.7	Tolerance	rectangular	√3	1.0	
Probe Positioning Accuracy	0.4	Accuracy	rectangular	√3	0.2	
Device Holder Uncertainty	2.0	Standard Deviation	normal	1	2.0	
System Repeatability	3.0	Tolerance	rectangular	√3	1.7	
EUT Repeatability	2.0	Standard Deviation	normal	1	0.0	
Combined Standard Uncertainty u_c			normal		**7.6%**	**0.32**
Expanded Uncertainty (coverage factor = 2) U			Normal (K=2)		**15.2%**	**0.61**

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Measurement uncertainty reflects the quality and accuracy of a measured result as compared to the true value. Such statements are generally required when stating results of measurements so that it is clear to the user of these measurement results that the results may differ when reproduced by different laboratories. Measurement results vary due to the measurement uncertainty of the instrumentation, and measurement technique, even when using a standard for test setups and compliance measurements.

Most uncertainties are calculated using the tolerances of the instrumentation used in the measurement, the measurement setup variability, and the technique used in performing the test. While not generally included, the variability of the equipment under test also figures into the overall measurement uncertainty.

Another component of the overall uncertainty is based on the variability of repeated measurements (so-called Type A uncertainty). This may mean that the Hearing Aid immunity tests may have to be repeated by taking down the test setup and resetting it up so that there is a statistically significant number of repeat measurements to identify this very important aspect of measurement uncertainty.

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Equipment List

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Equipment Description	Asset / Serial Number	Calibration Due Date
ALSAS-10U	301571	Prior to Test
Anritsu MT8801C	301598	June 2006
Daq-Paq	301573	6 Jan 2006
Pentium 4 Workstation	301574	Not Required
Signal Generator	301468	September 2005
Gigatronics Power Meter	301393	October 2005
Gigatronics Broad Band Power Sensor	301394	October 2005
HP-Directional Coupler	100251	October 2005
APREL Laboratories 800-4200MHz 12W Amplifier	301577	Prior to Test
APREL Laboratories 835MHz Validation Dipole	180-00554	November 2006
APREL Laboratories 1900MHz Validation Dipole	210-00705	June 2006
APREL Laboratories E-020 E-Field Probe	212	October 2006
APREL Laboratories H-020 E-Field Probe	101	April 2006

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Zero Span & Wideband

Spectrum Analyzer plots

Mobile Service Tester Willtek 4300 was used to register the WD, make a call and then to control the WD, i.e. the WD was not used in the test mode.

In order to establish the call it was set to the appropriate SIN (System ID) and NID (Network ID) numbers. The instrument was equipped with the appropriate antenna to communicate with the WD over the air.

The instrument was used to set both, the uplink channels and output power level of the WD.

Three channels in each band, CDMA and PCS (low, middle and high) were tested. The channels were monitored with a Spectrum Analyzer to verify the correct type of modulation and channel frequencies were tested.

Plots follow.

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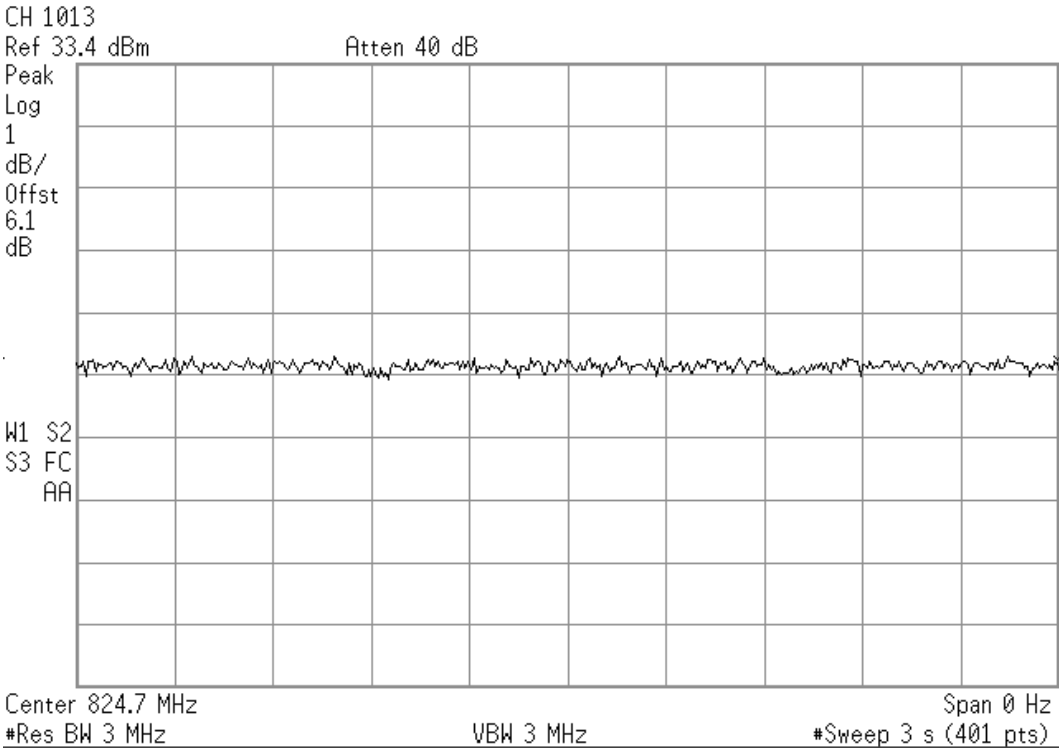
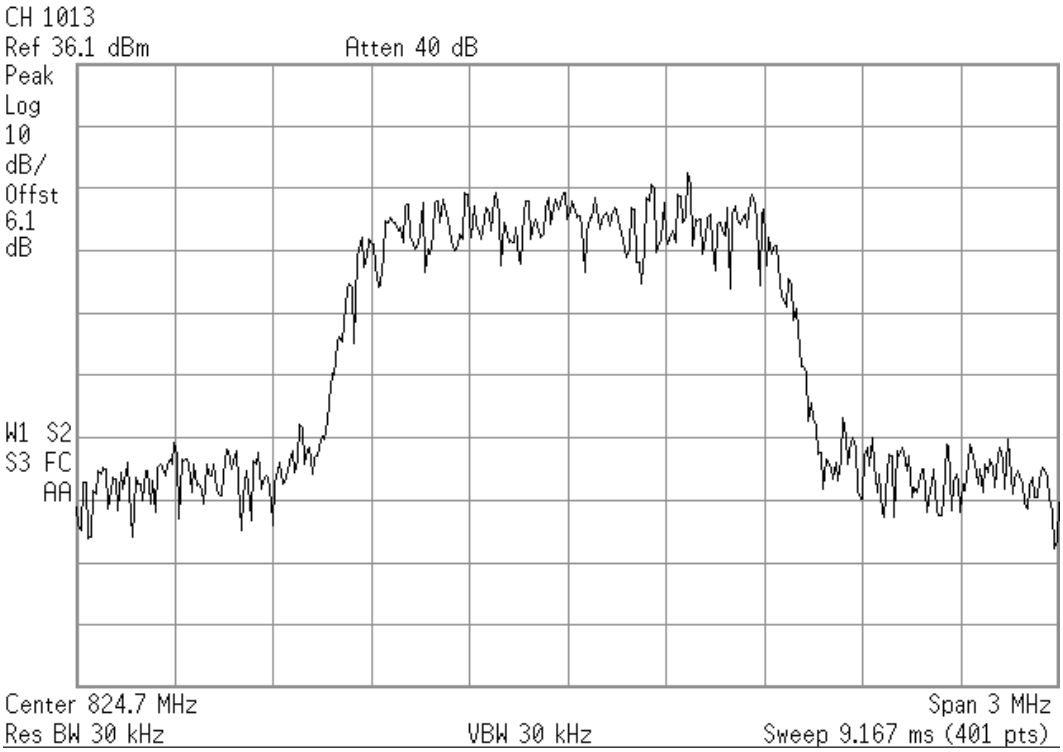


CDMA band, low channel, zero-span



CDMA band, low channel, wideband

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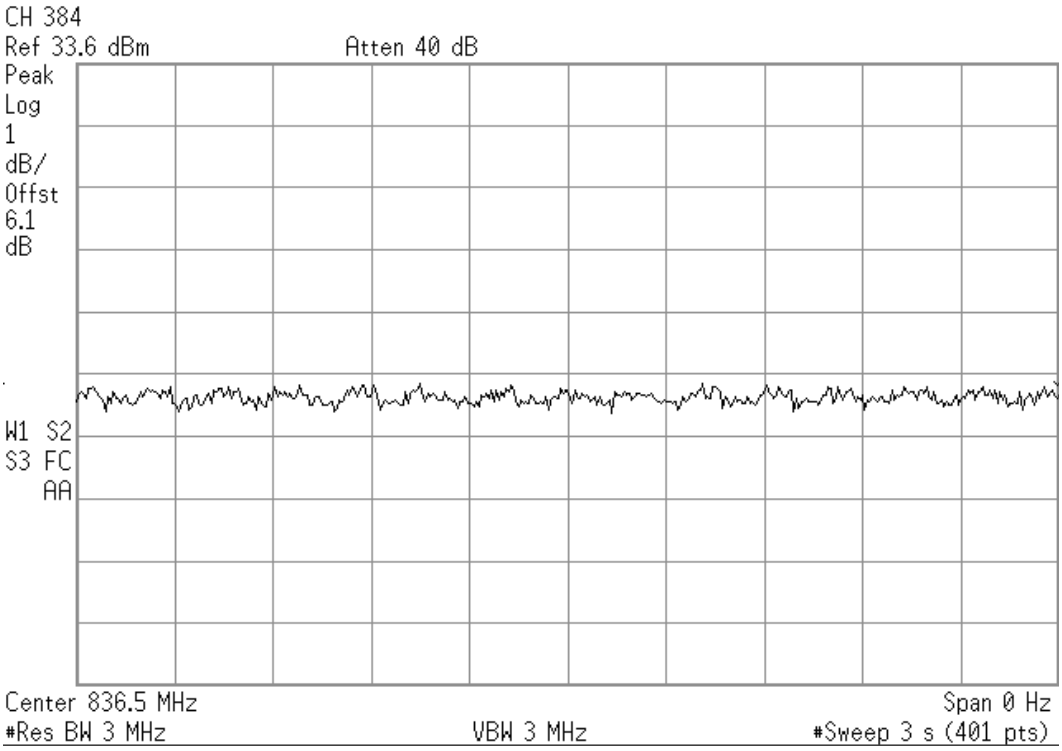
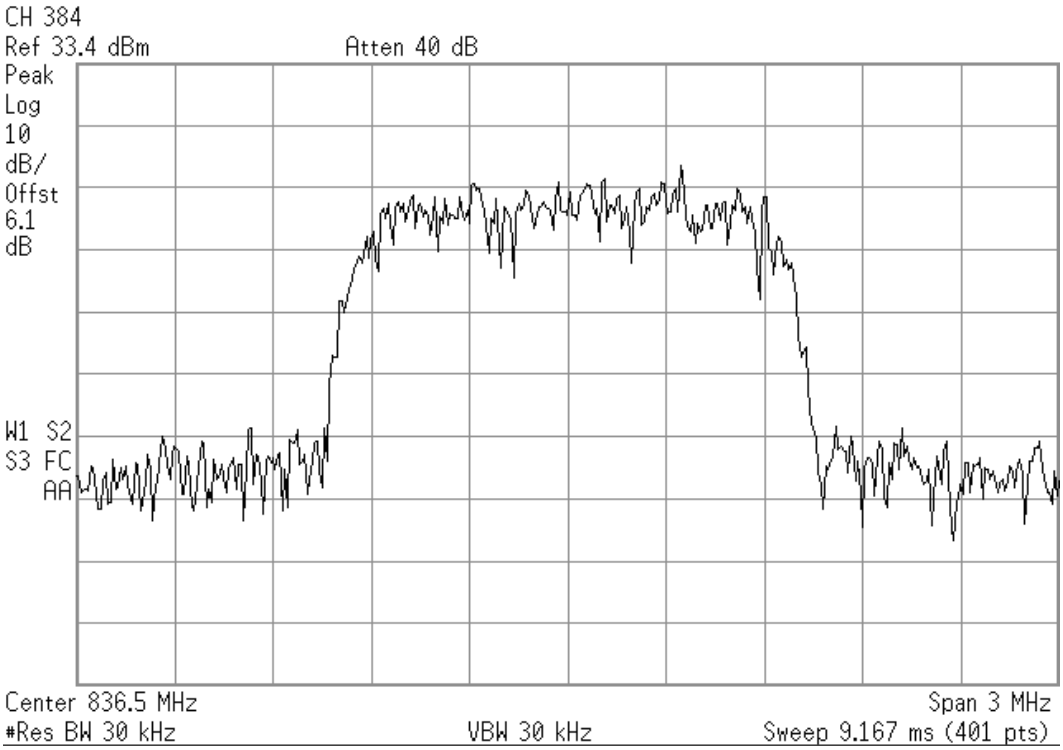


CDMA band, middle channel, zero-span



CDMA band, middle channel, wideband

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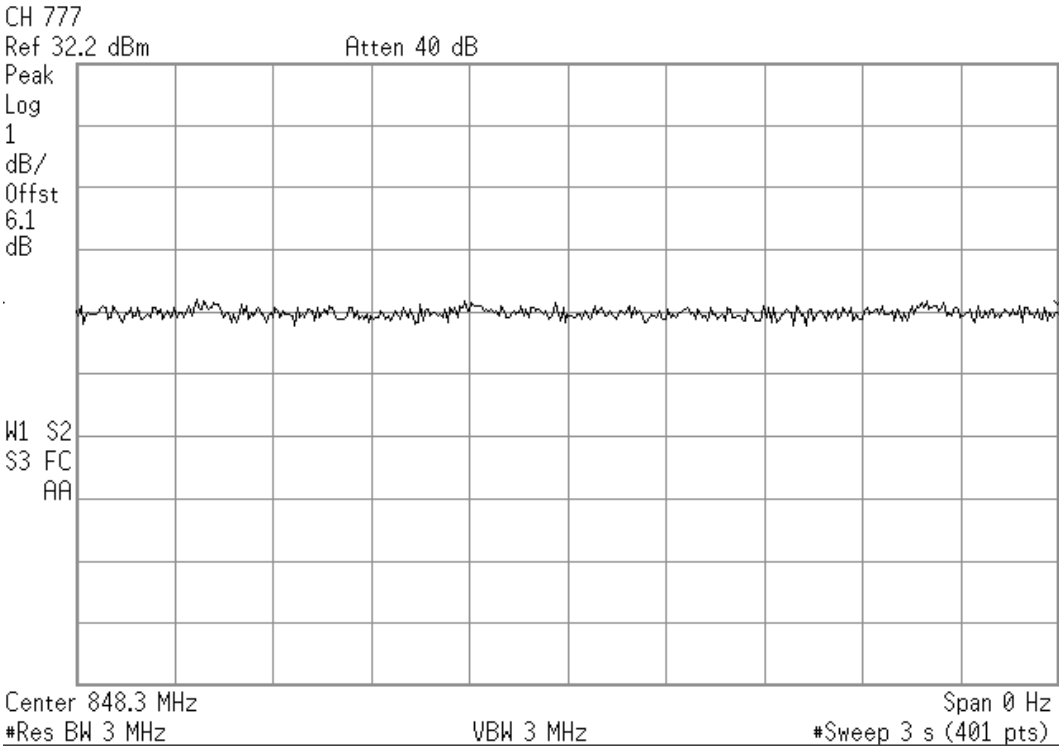
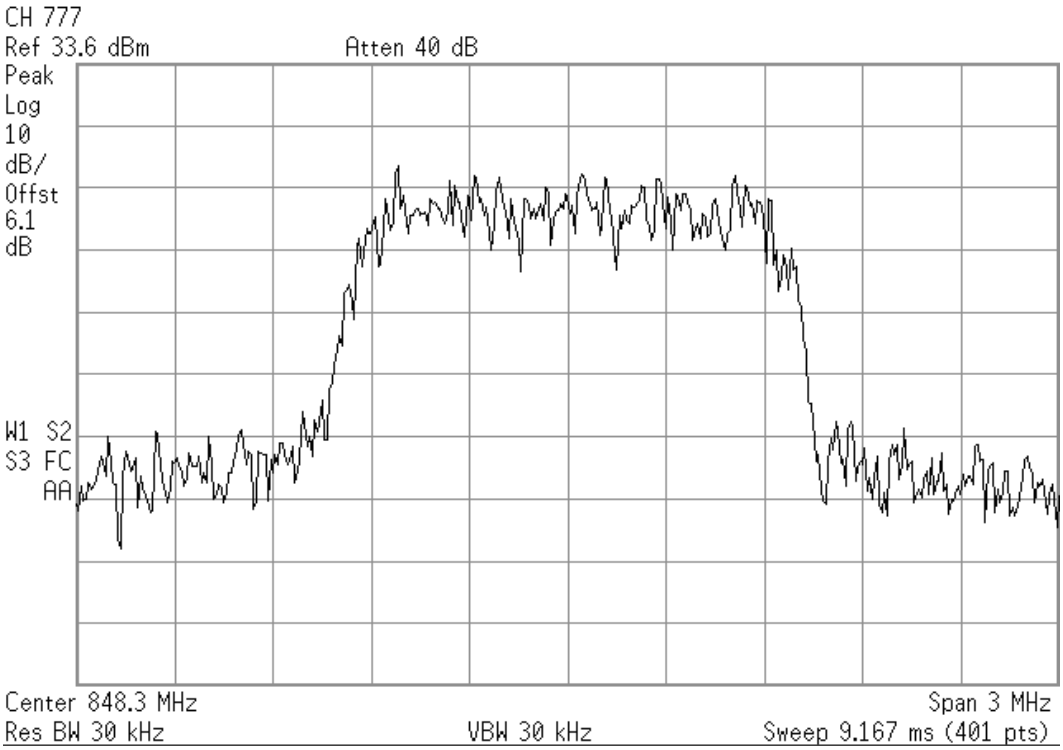


CDMA band, high channel, zero-span



CDMA band, high channel, wideband

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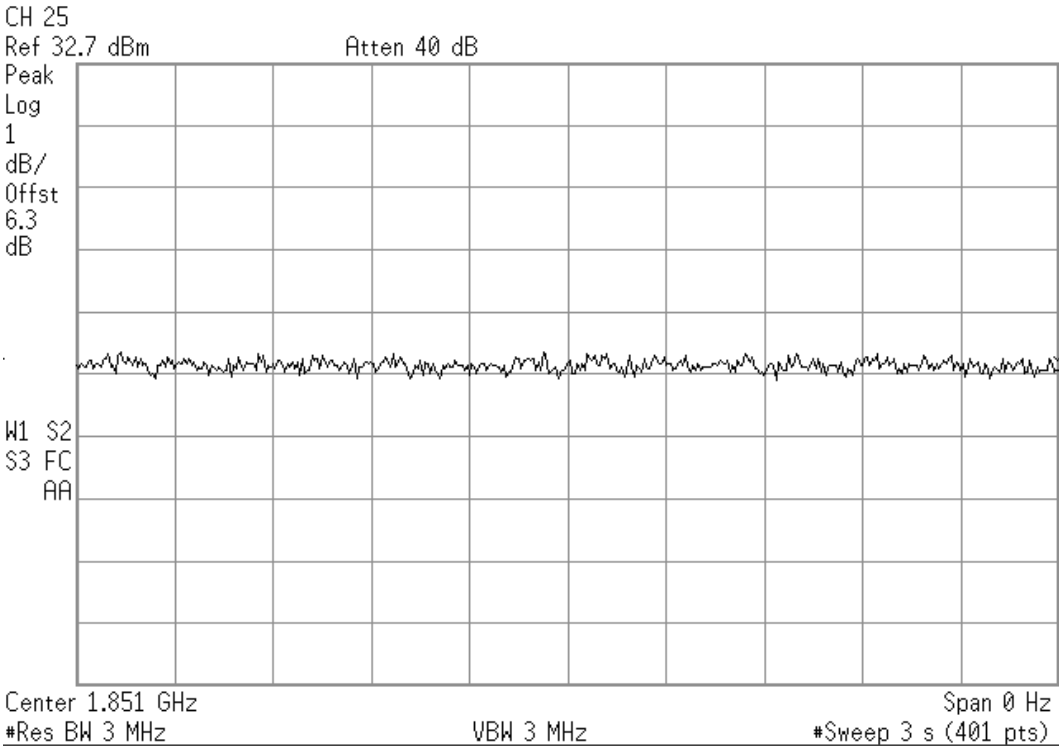
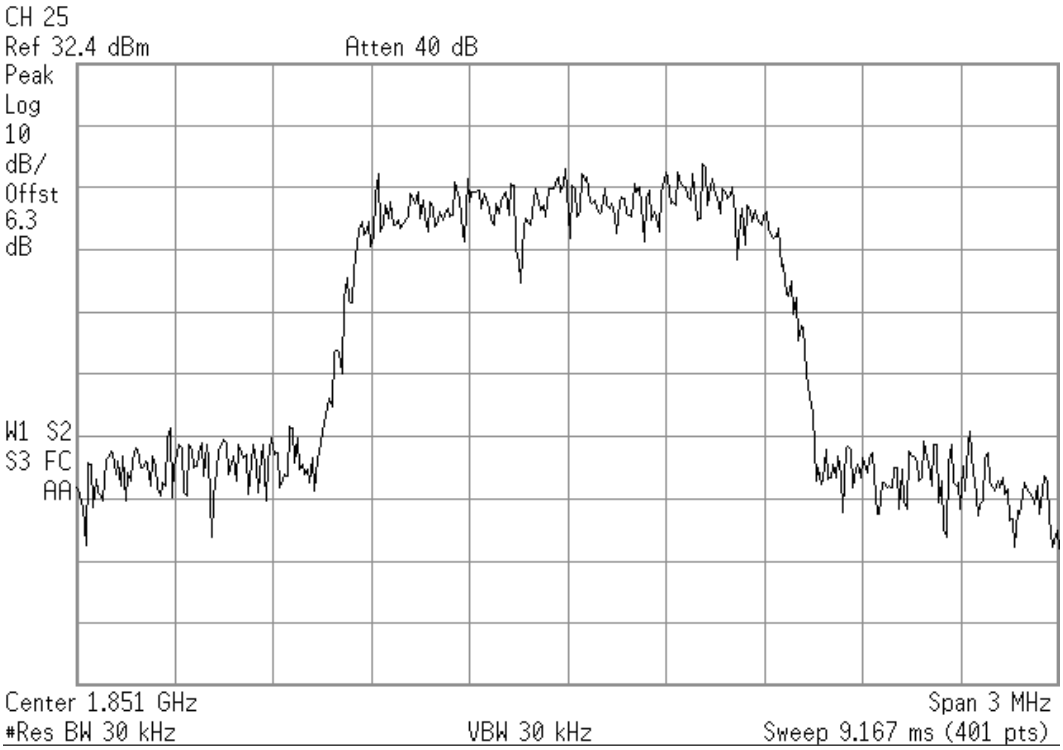


PCS band, low channel, zero-span



PCS band, low channel, wideband

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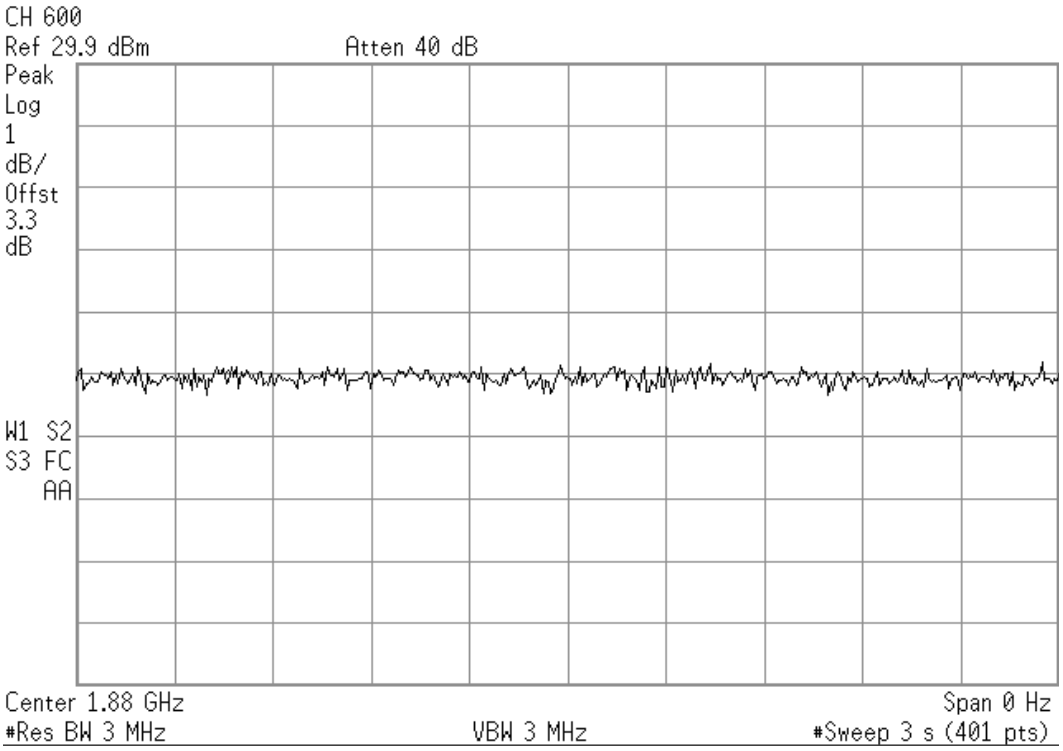
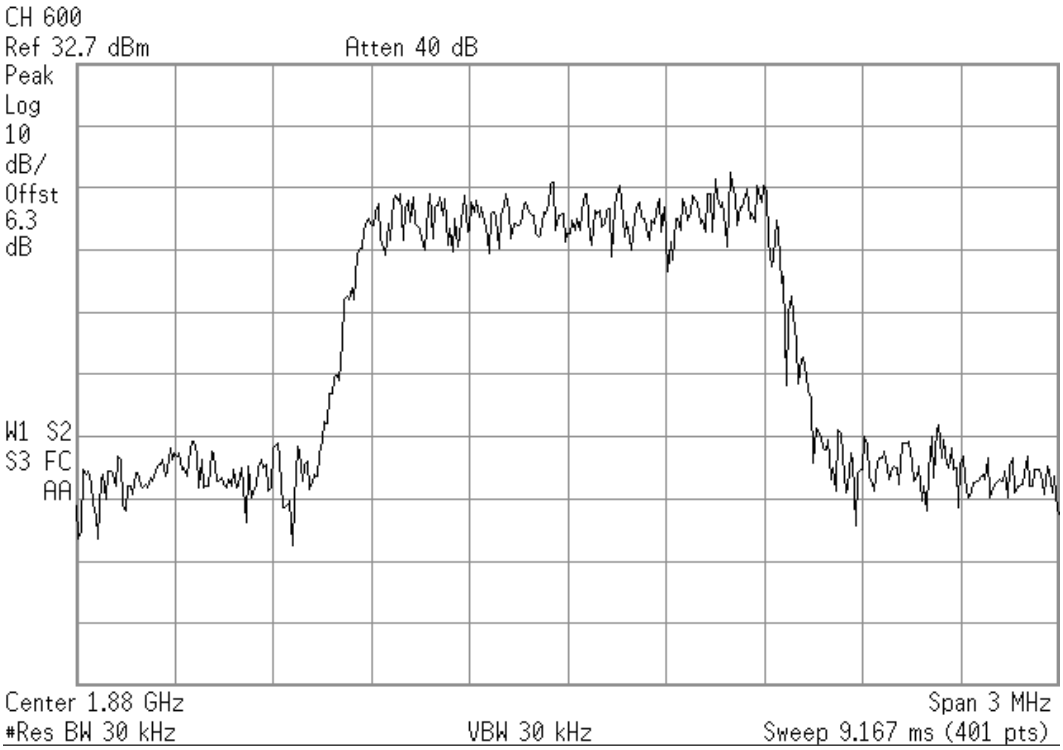


PCS band, middle channel, zero-span



PCS band, middle channel, wideband

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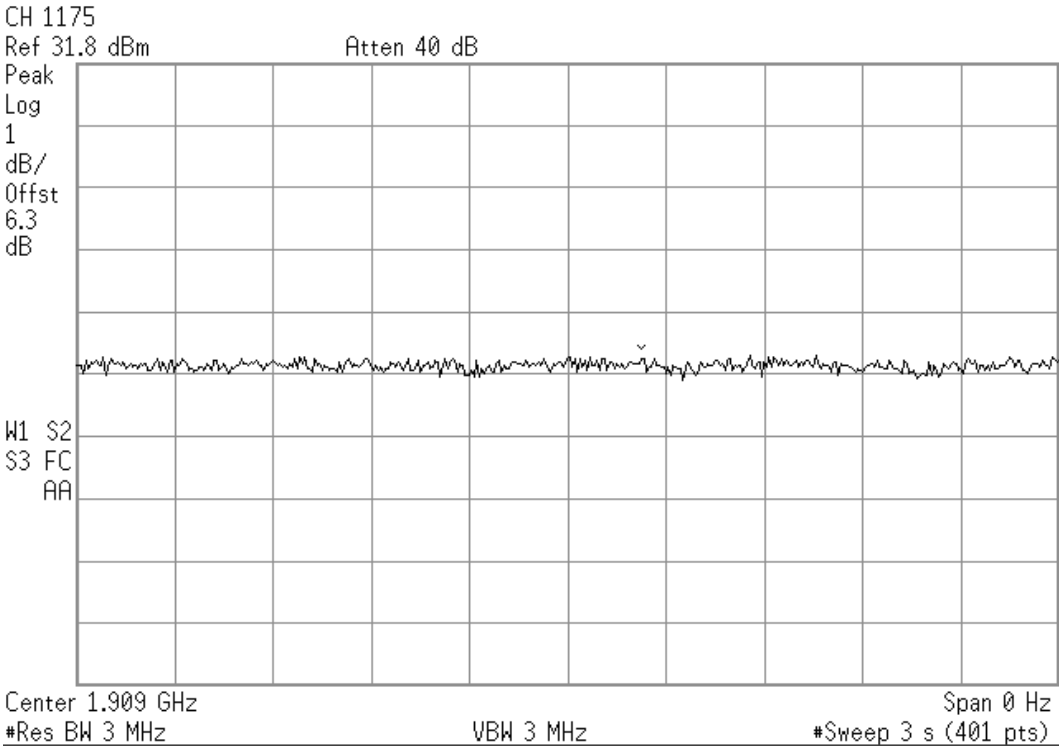
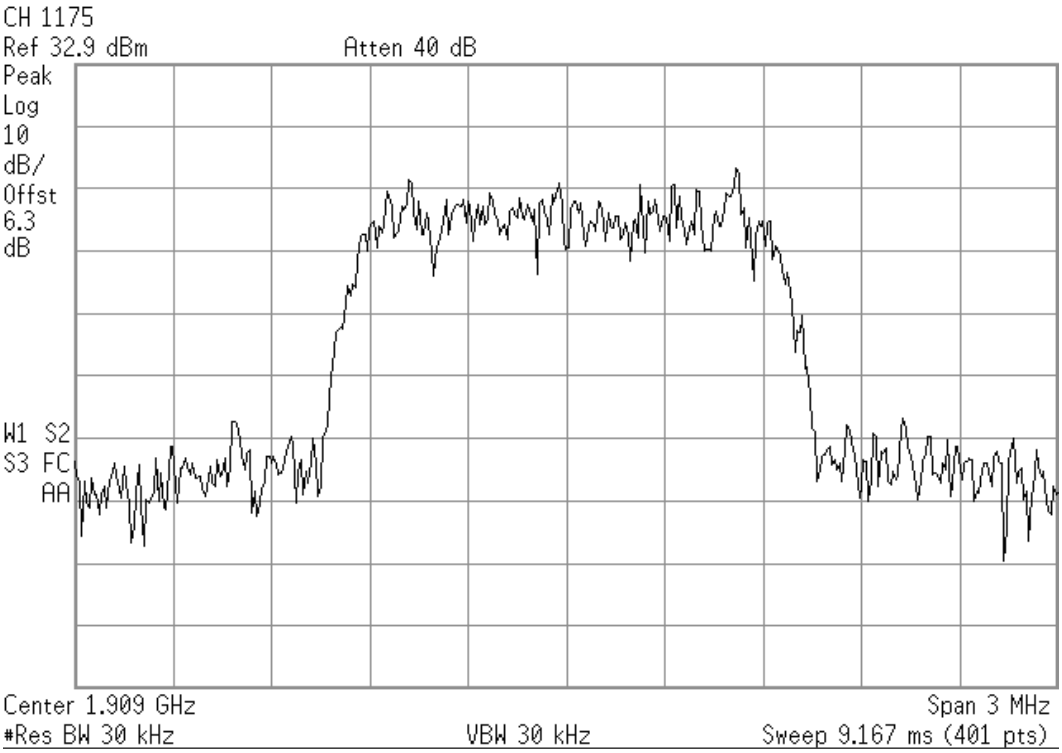


PCS band, high channel, zero-span



PCS band, high channel, wideband

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