Nemko Test Report:	3L0498RUS2
Applicant:	Andrew Corporation
Equipment Under Test: (E.U.T.)	Optical repeater
In Accordance With:	**FCC Part 22, Subpart H** Cellular Band Repeaters
Tested By:	Nemko USA Inc. 802 N. Kealy Lewisville, TX 75057-3136
Authorized By:	 Tom Tidwell, Frontline Manager
Date:	4/22/04
Total Number of Pages:	52

Table of Contents

Section 1. Summary of Test Results

Manufacturer:	Andrew Corporation	
Model No.:	MMR Optical Master Unit	MMR 8A/19
Serial No.:	30	14

General: **All measurements are traceable to national standards.**

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 22, Subpart H.

☒	New Submission	☐	Production Unit
☐	Class II Permissive Change	☒	Pre-Production Unit

THIS TEST REPORT RELATES ONLY TO THE ITEM(S) TESTED.

THE FOLLOWING DEVIATIONS FROM, ADDITIONS TO, OR EXCLUSIONS FROM THE TEST SPECIFICATIONS HAVE BEEN MADE.
See " Summary of Test Data".

Summary Of Test Data

NAME OF TEST	PARA. NO.	SPEC.	MEAS.	RESULT
RF Power Output	22.913(a)	500W	16.6W	Complies
Occupied Bandwidth	22.917(c)	Input/Output	Complies	Complies
Spurious Emissions at Antenna Terminals	22.917	-13 dBm	Complies	Complies
Field Strength of Spurious Emissions	22.917	-13 dBm E.I.R.P.	Complies	Complies
Frequency Stability	22.355	1.5 ppm		Complies

Footnotes:

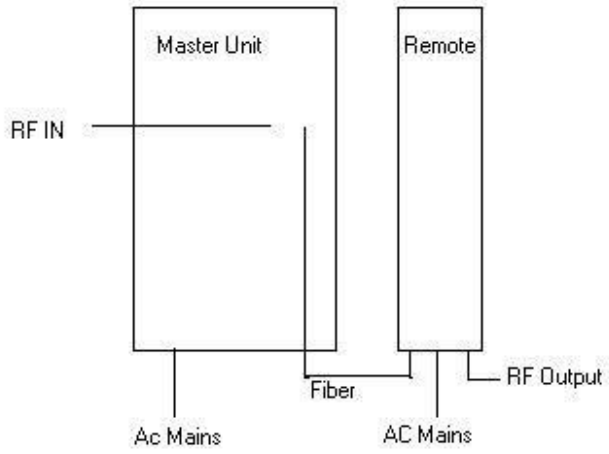
Measurement uncertainty for each test configuration is expressed to 95% probability.

.

Section 2. General Equipment Specification

Supply Voltage Input:		115V AC
Frequency Range:	**Downlink:**	869 – 894 MHz
Frequency Range:	**Uplink:**	NA
Type of Modulation and Designator:		**CDMA (F9W)** ☒ **GSM (GXW)** ☐ **NADC (DXW)** ☒ **CDPD (F9W)** ☐ **AMPS (F8W, F1D)** ☒
Output Impedance:		50 ohms
Max Input Power:		+20 dBm
RF Output (Rated): (Per Carrier)	**Downlink:**	CDMA 34 dBm (2 Carriers) NADC 36 dBm (2 Carriers) AMPS 39 dBm (2 Carriers)
	Uplink:	Per Channel: NA W Total: NA W
Frequency Translation:		**F1-F1** ☐ **F1-F2** ☐ **N/A** ☒
Band Selection:		**Software** ☐ **Duplexer Change** ☐ **Fullband Coverage** ☒

System Diagram



Section 3. RF Power Output

NAME OF TEST: RF Power Output	PARA. NO.: 2.1046
TESTED BY: Dustin Oaks	DATE: 12/17/2003

Test Results: Complies.

Test Data:

	Modulation Type	Power Output (dBm)	
Uplink	AMPS	NA	
Downlink	AMPS	39.99	
Uplink	CDMA	NA	
Downlink	CDMA	39.06	
Uplink	NADC	NA	
Downlink	NADC	42.21	

Equipment Used: 1036, 1625, 1629, 1604, 1474, 1053

Measurement Uncertainty: +/- 1.6 dB

Temperature: 21 ?C

Relative Humidity: 51 %

Section 4. Occupied Bandwidth

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 2.1049
TESTED BY: Dustin Oaks	DATE: 12/18/2003

Test Results: Complies.

Test Data: See attached plots

Equipment Used: 1036, 1625, 1629, 1604, 1474, 1053

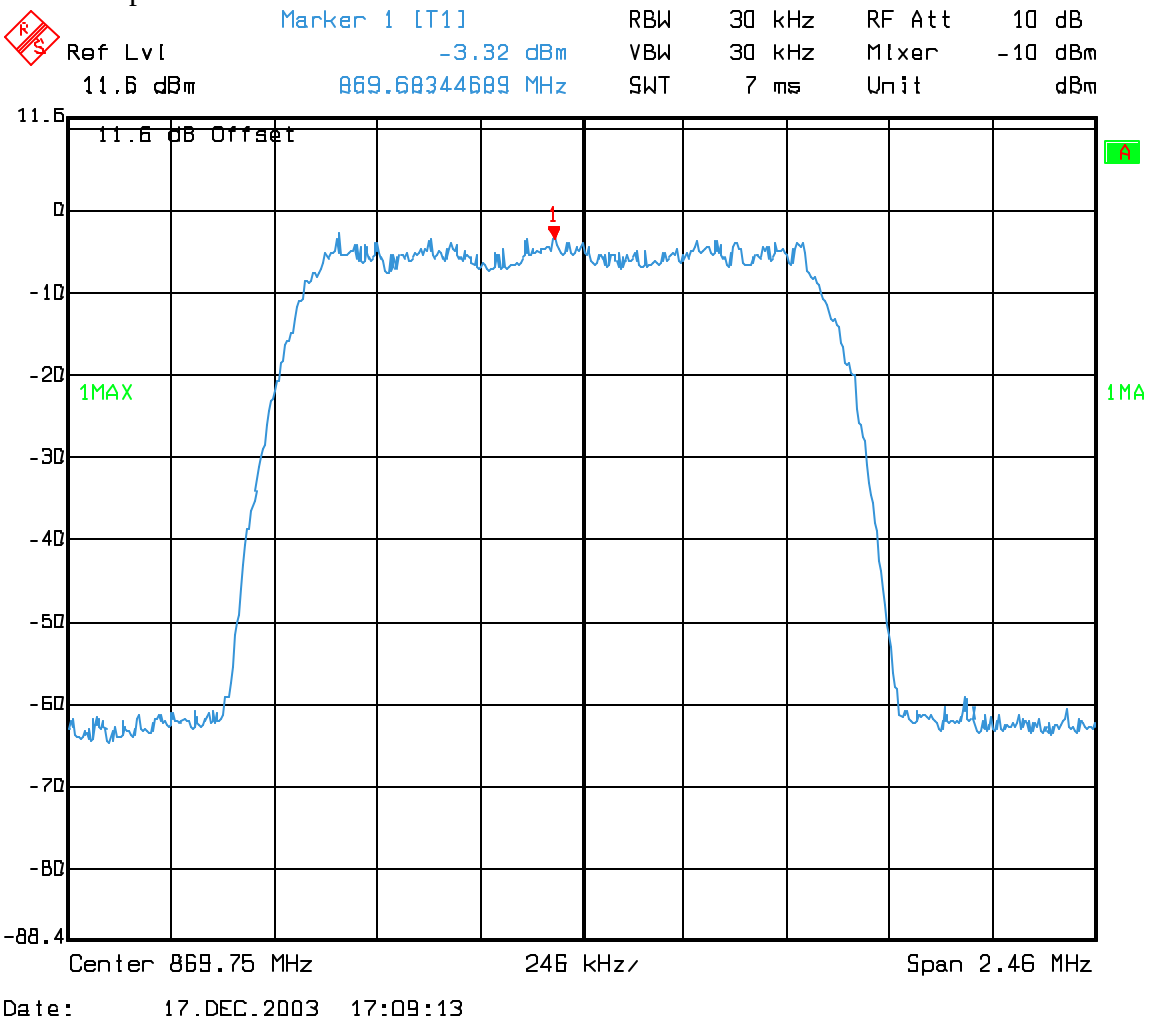
Measurement Uncertainty: +/- 1.6 dB

Temperature: 21 ?C

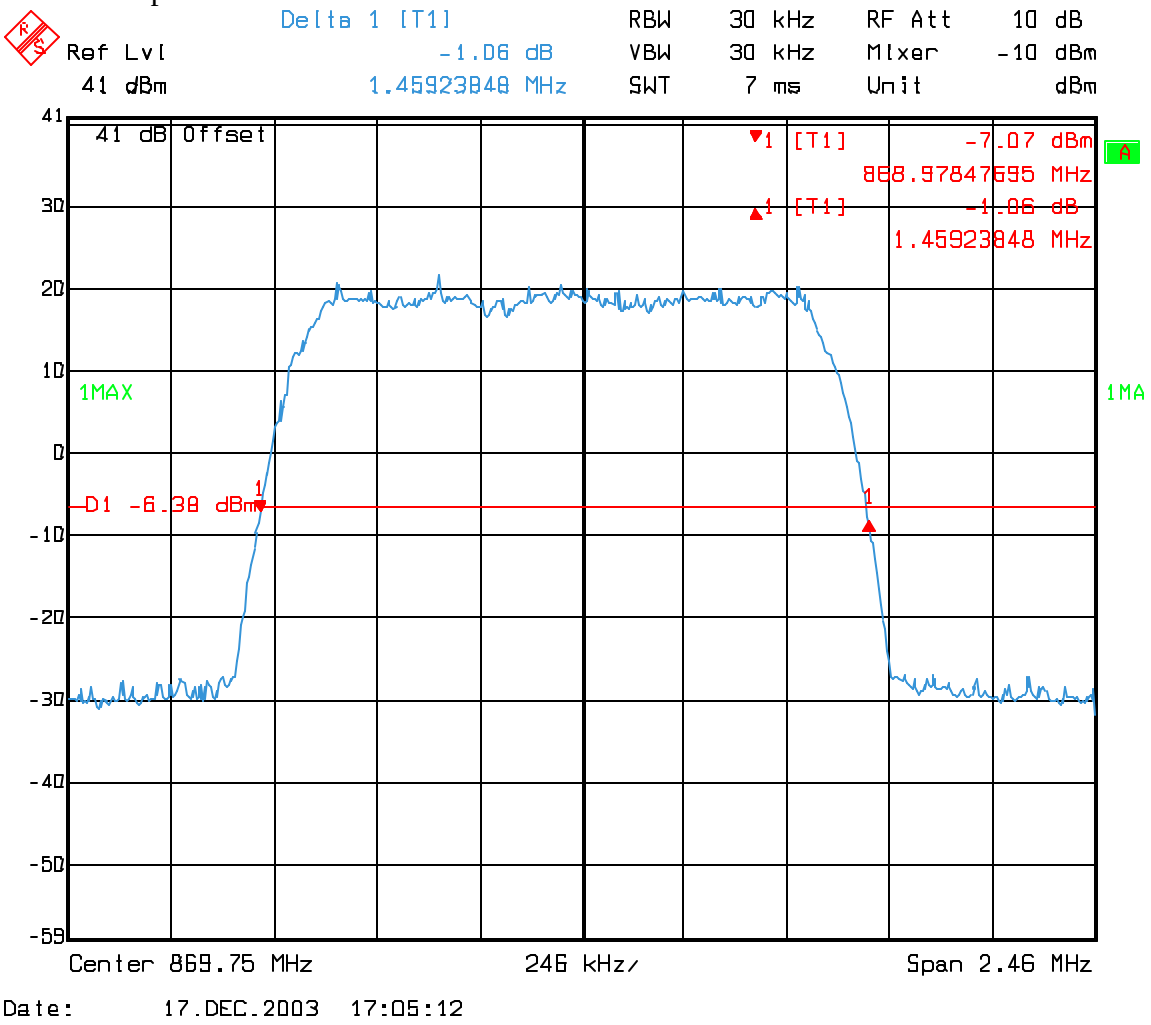
Relative Humidity: 51 %

Occupied Band Width / Input Output Plots

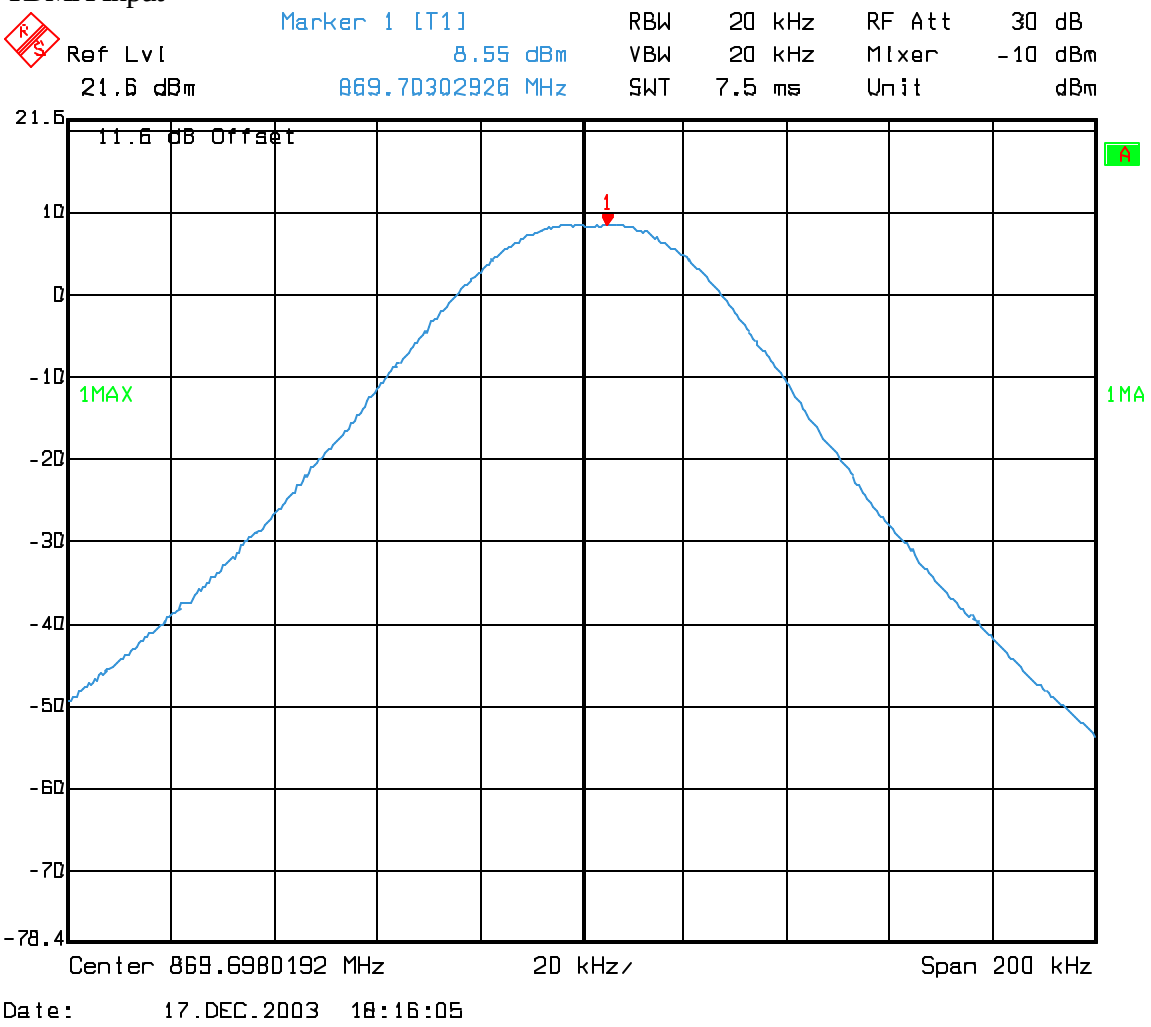
CDMA Input



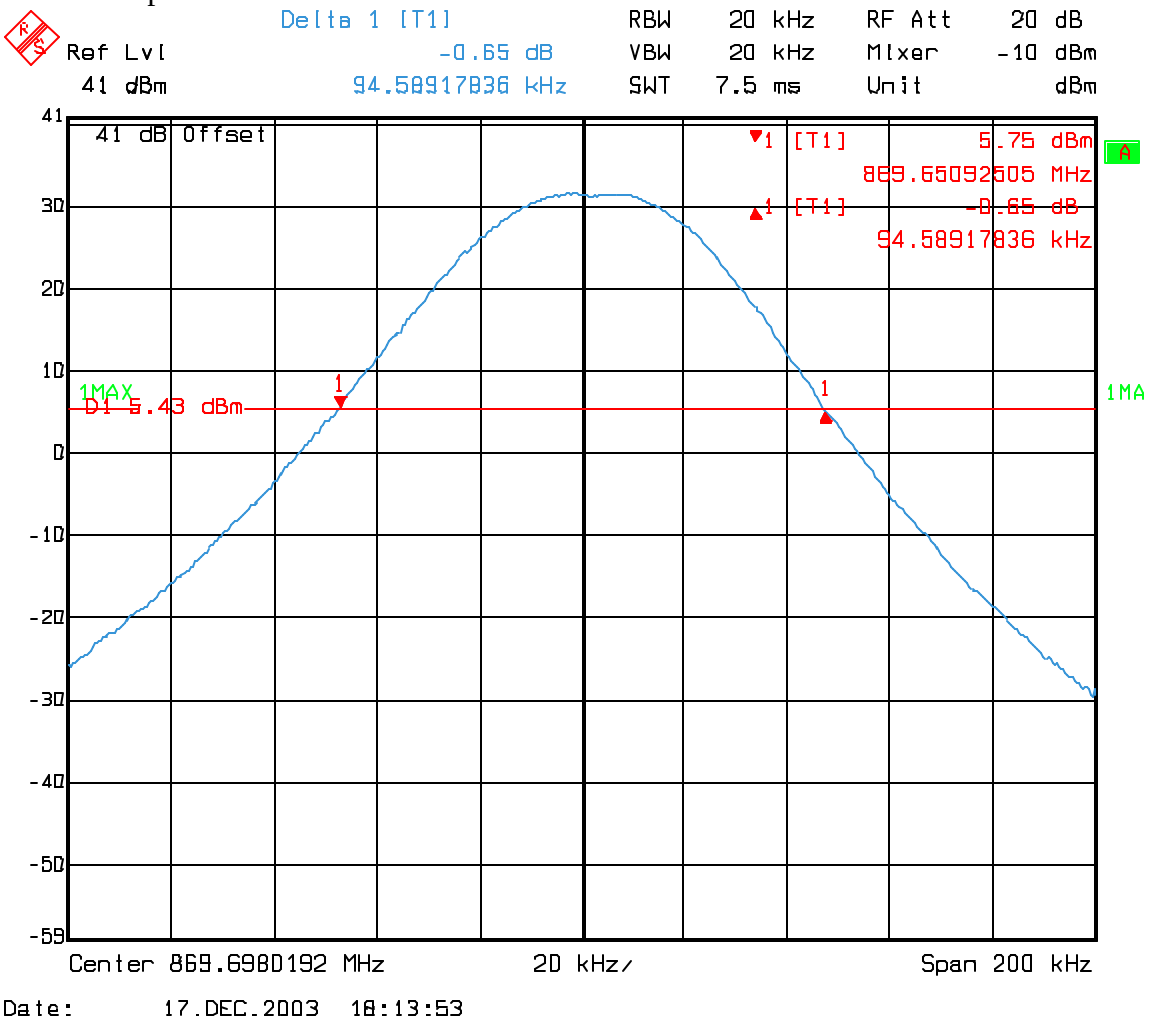
CDMA Output


Delta 1 [T1]
-1.06 dB
1.45923848 MHz
RBW 30 kHz
VBW 30 kHz
SWT 7 ms
RF Att 10 dB
Mixer -10 dBm
Unit dBm
Ref Lvl
41 dBm
41 dB Offset
1 [T1] -7.07 dBm
868.97847695 MHz
1 [T1] -1.06 dB
1.45923848 MHz
1MAX
1MA
D1 -6.38 dBm
41
30
20
10
0
-10
-20
-30
-40
-50
-59
Center 869.75 MHz
246 kHz/
Span 2.46 MHz
Date: 17.DEC.2003 17:05:12

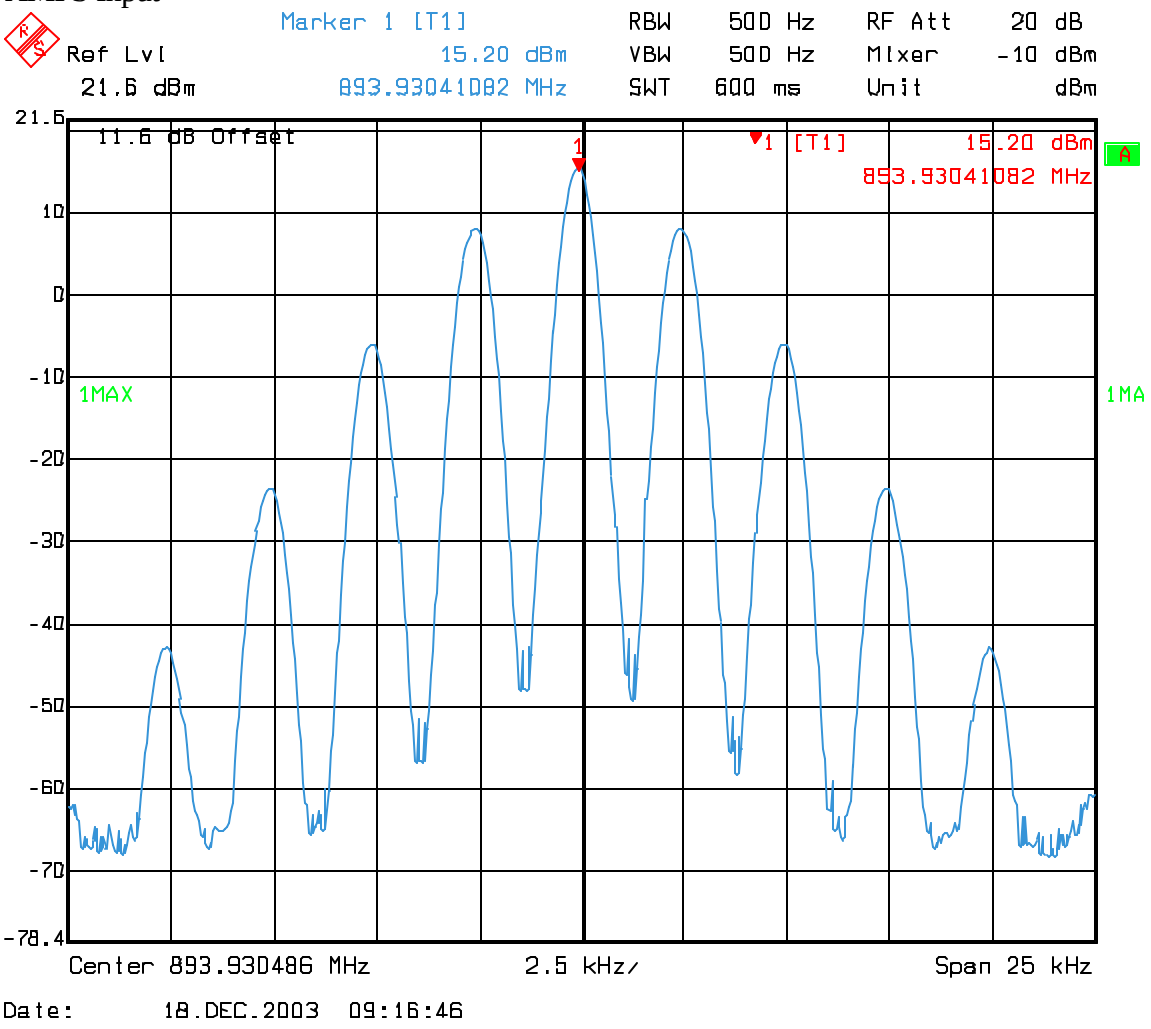
TDMA Input


Marker 1 [T1]
8.55 dBm
869.70302926 MHz
RBW 20 kHz
VBW 20 kHz
SWT 7.5 ms
RF Att 30 dB
Mixer -10 dBm
Unit dBm
Ref Lvl
21.6 dBm
11.6 dB Offset
21.6
10
0
-10
-20
-30
-40
-50
-60
-70
-78.4
1MAX
1MA
A
Center 869.6980192 MHz
20 kHz/
Span 200 kHz
Date: 17.DEC.2003 18:16:05

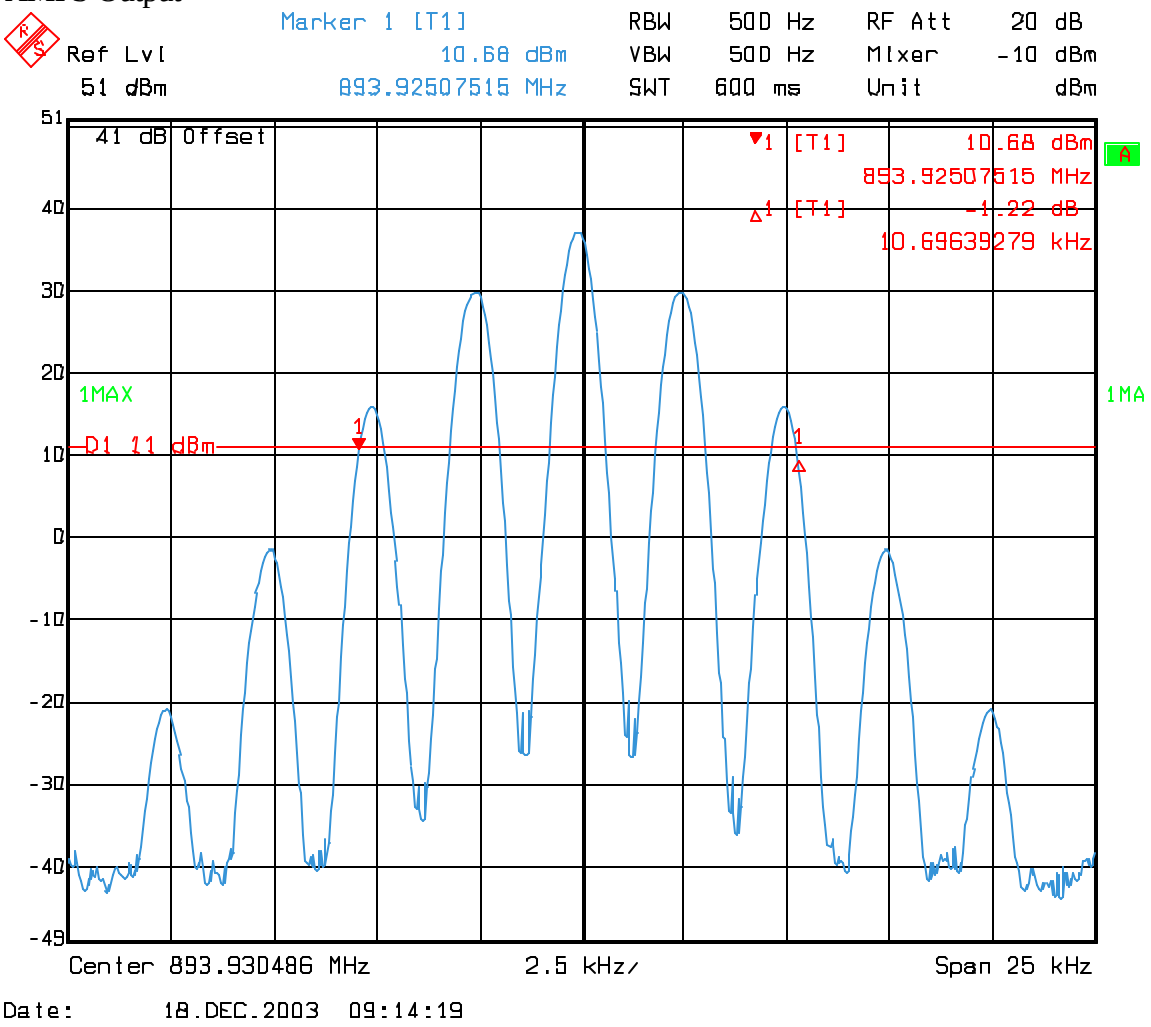
TDMA Output


Delta 1 [T1]
-0.65 dB
94.58917836 kHz
Ref Lvl
41 dBm
RBW 20 kHz
VBW 20 kHz
SWT 7.5 ms
RF Att 20 dB
Mixer -10 dBm
Unit dBm
41 dB Offset
1 [T1] 5.75 dBm
869.65092505 MHz
1 [T1] -0.65 dB
94.58917836 kHz
1MAX
D1 5.43 dBm
1MA
41
30
20
10
0
-10
-20
-30
-40
-50
-59
Center 869.6980192 MHz
20 kHz/
Span 200 kHz
Date: 17.DEC.2003 18:13:53

AMPS Input

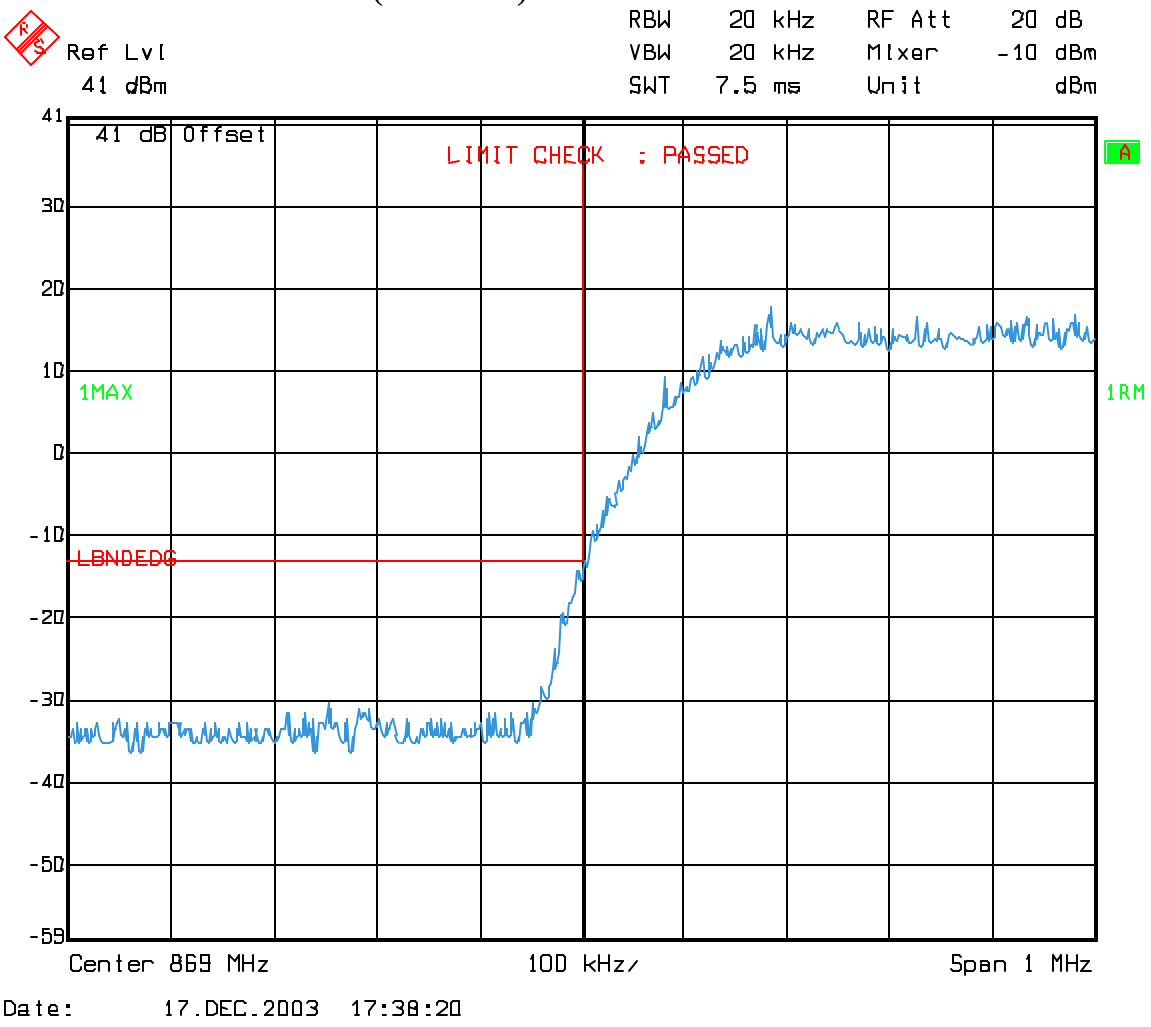

Marker 1 [T1]
Ref Lvl
21.6 dBm
15.20 dBm
893.93041082 MHz
RBW 500 Hz
VBW 500 Hz
SWT 600 ms
RF Att 20 dB
Mixer -10 dBm
Unit dBm
11.6 dB Offset
1 [T1] 15.20 dBm
893.93041082 MHz
1MAX
1MA
21.6
10
0
-10
-20
-30
-40
-50
-60
-70
-78.4
Center 893.930486 MHz
2.5 kHz/
Span 25 kHz
Date: 18.DEC.2003 09:16:46

AMPS Output

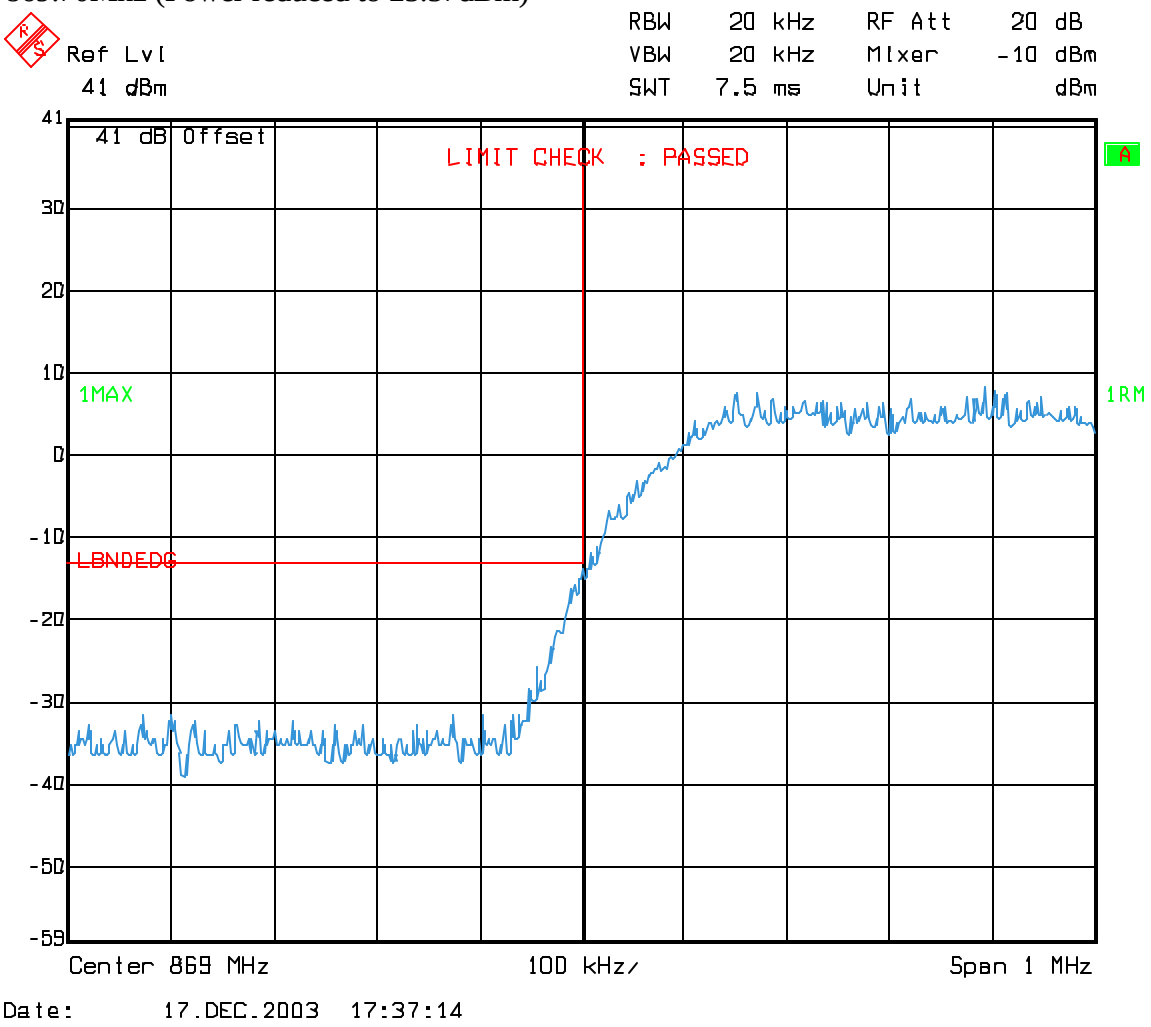

Marker 1 [T1]
Ref Lvl
51 dBm
10.68 dBm
893.92507515 MHz
RBW 500 Hz
VBW 500 Hz
SWT 600 ms
RF Att 20 dB
Mixer -10 dBm
Unit dBm
41 dB Offset
1 [T1] 10.68 dBm
853.92507515 MHz
Δ1 [T1] -1.22 dB
10.69639279 kHz
1MAX
D1 11 dBm
1MA
51
40
30
20
10
0
-10
-20
-30
-40
-45
Center 893.930486 MHz
2.5 kHz/
Span 25 kHz
Date: 18.DEC.2003 09:14:19

Band Edge

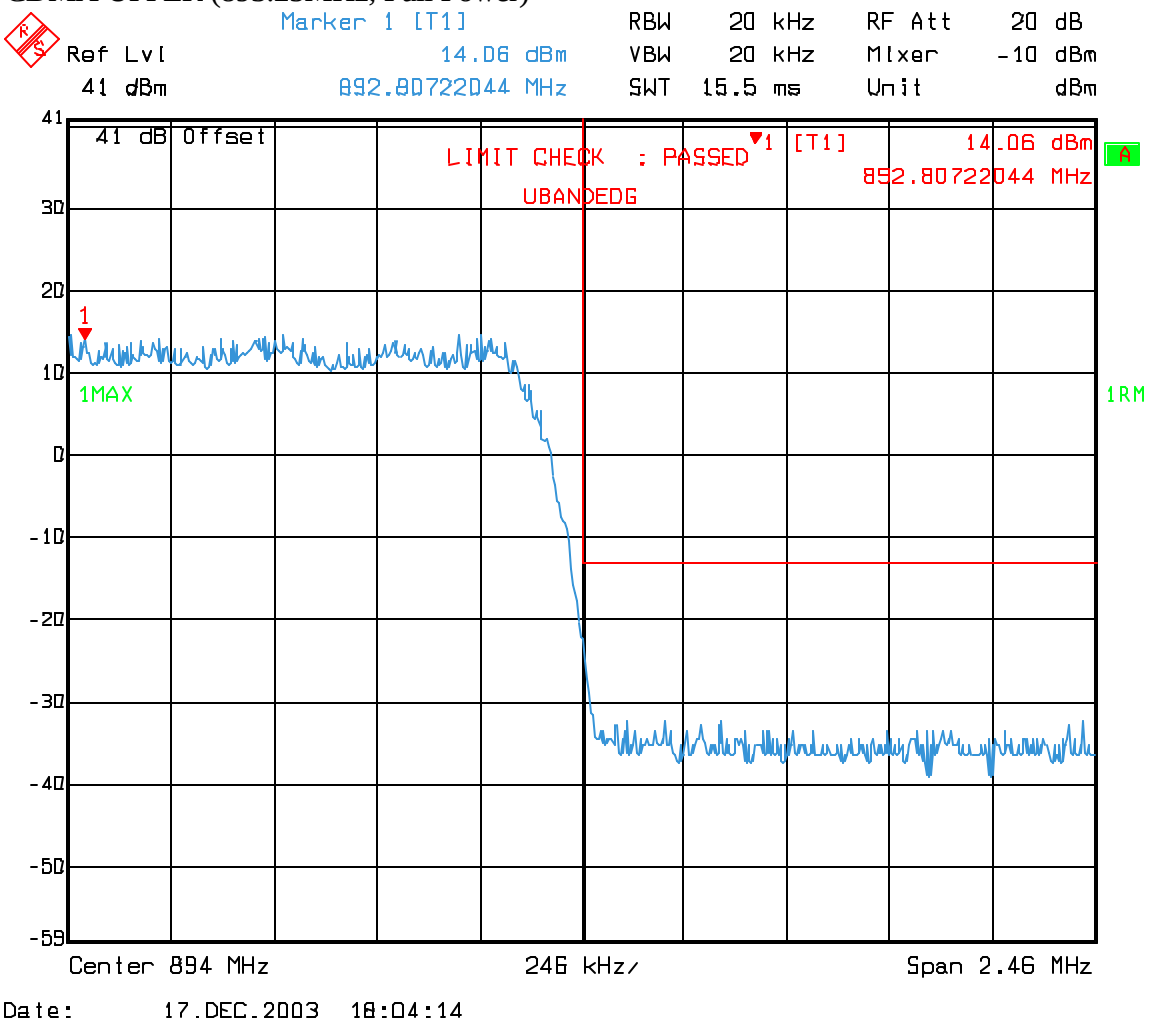
CDMA LOWER 869.73Mhz (Full Power)



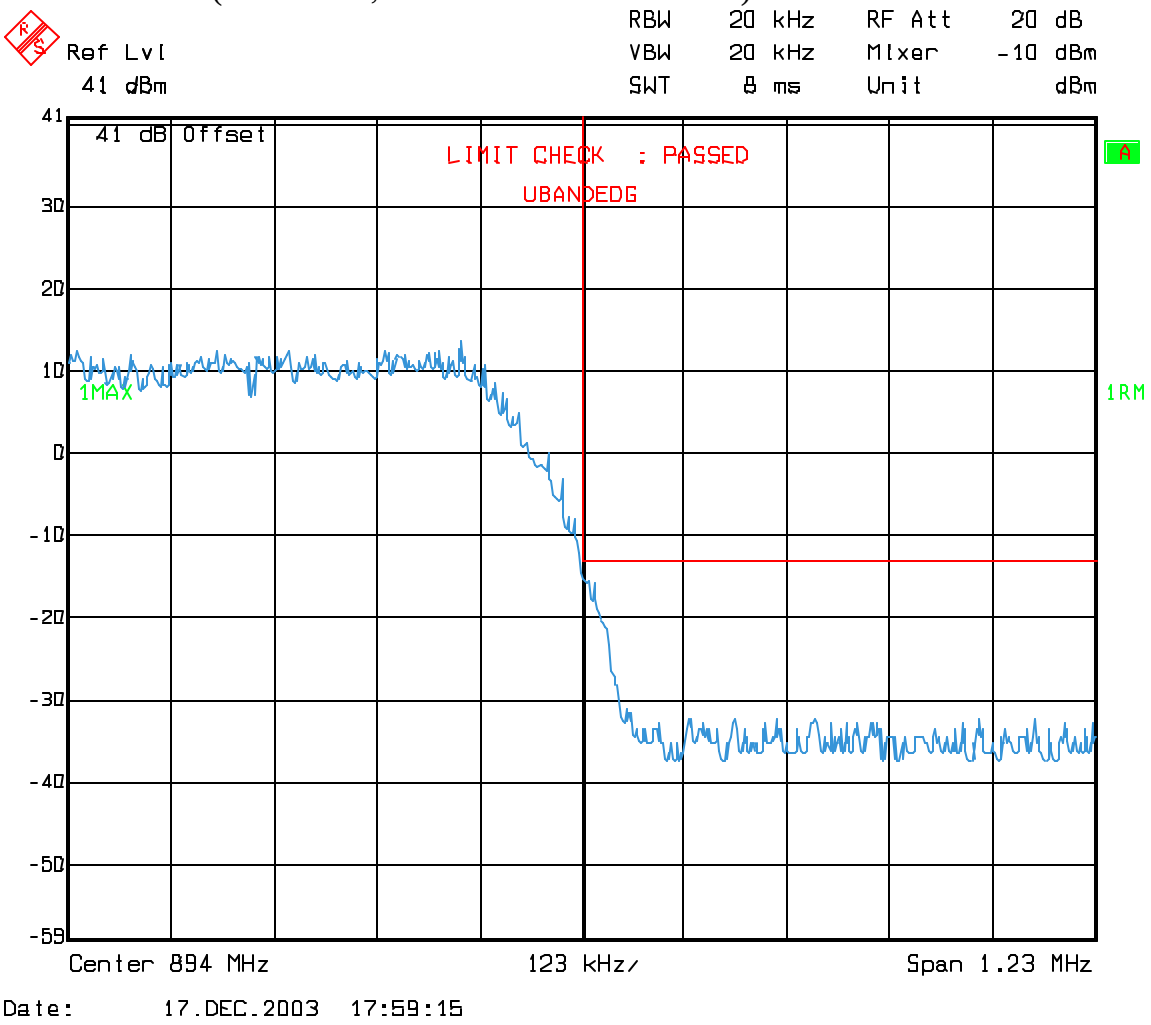
869.70Mhz (Power reduced to 25.57dBm)



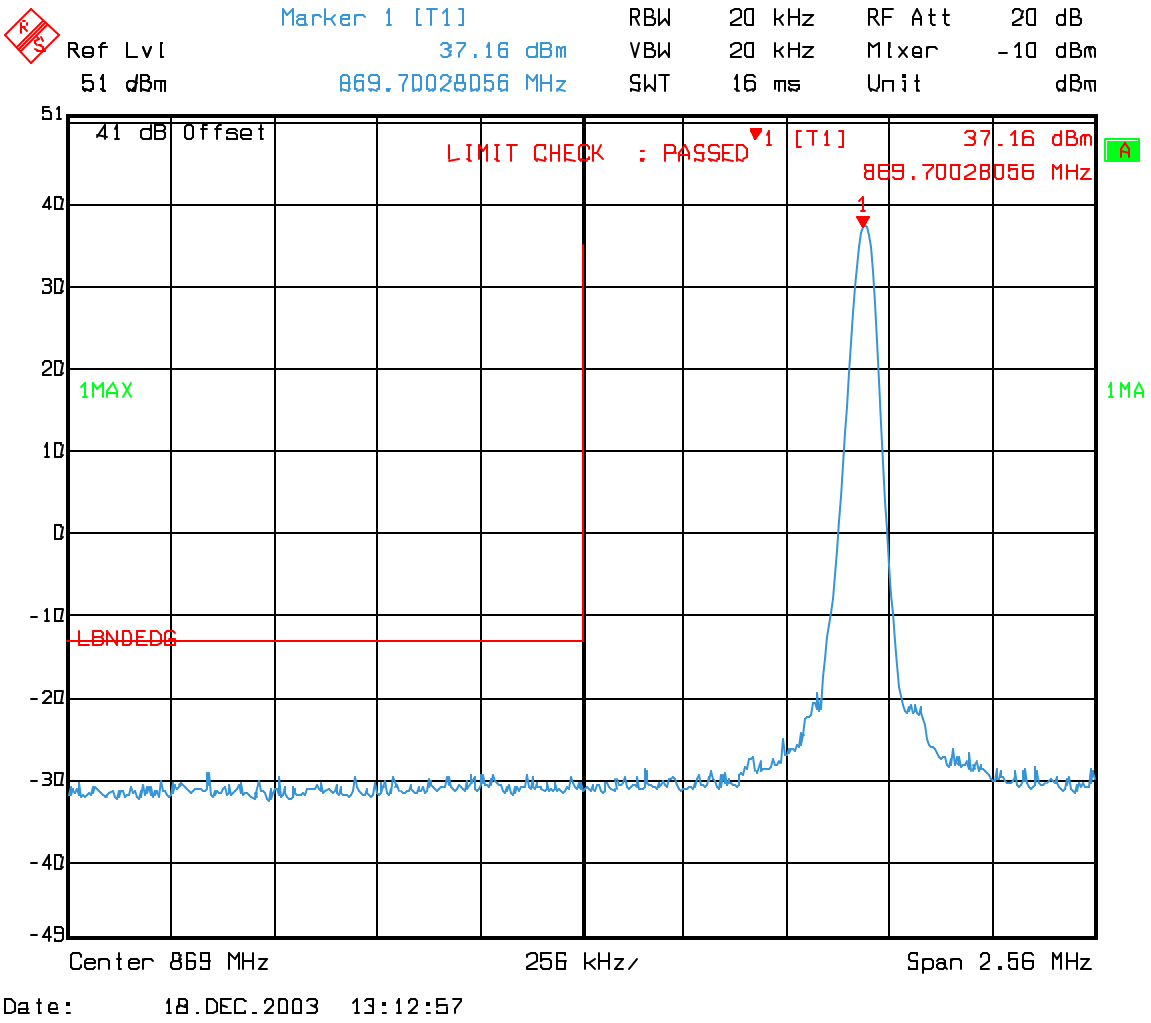
CDMA UPPER (893.25MHz, Full Power)



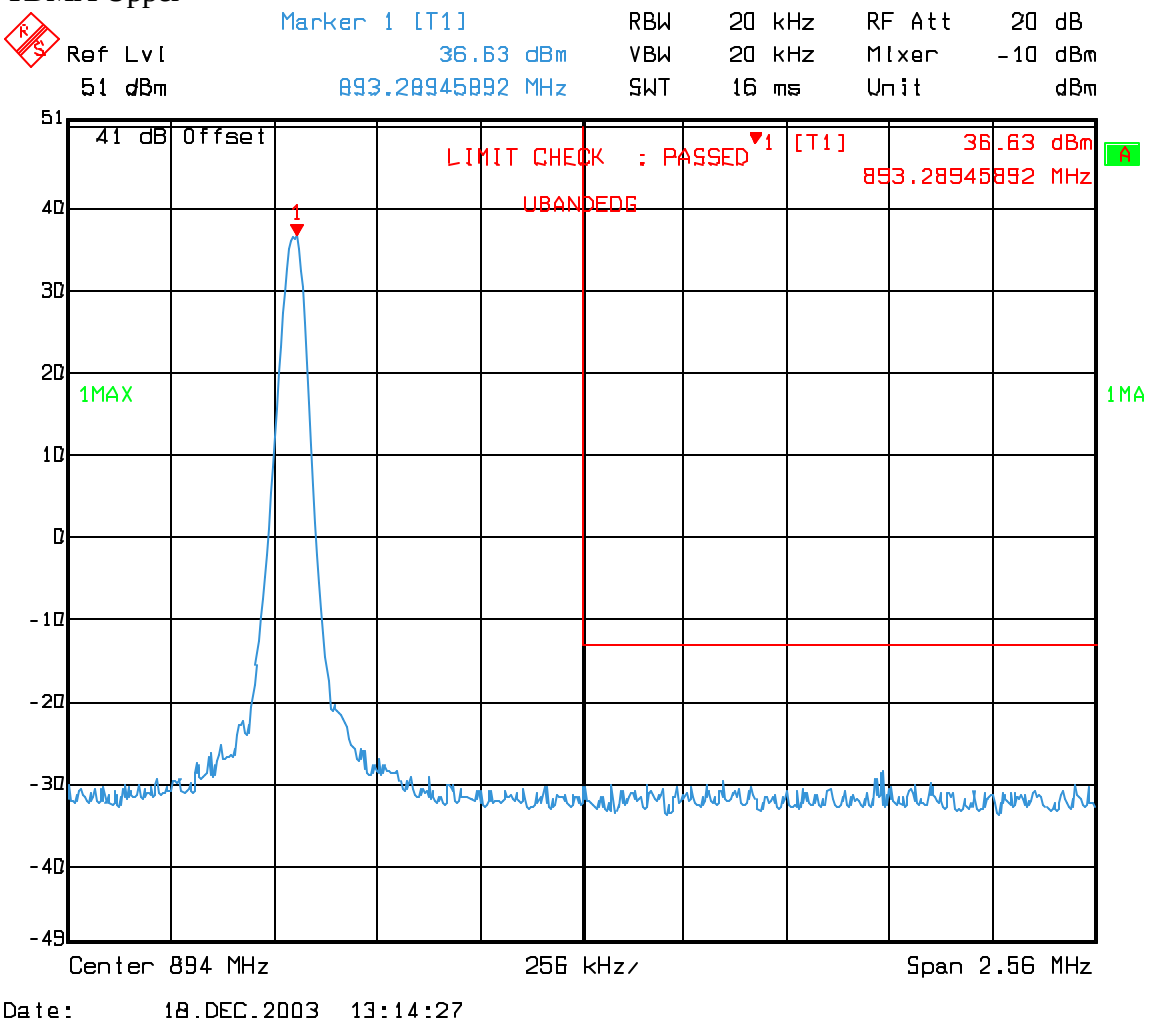
CDMA UPPER (893.28MHz, Power reduced to 30.64dBm)



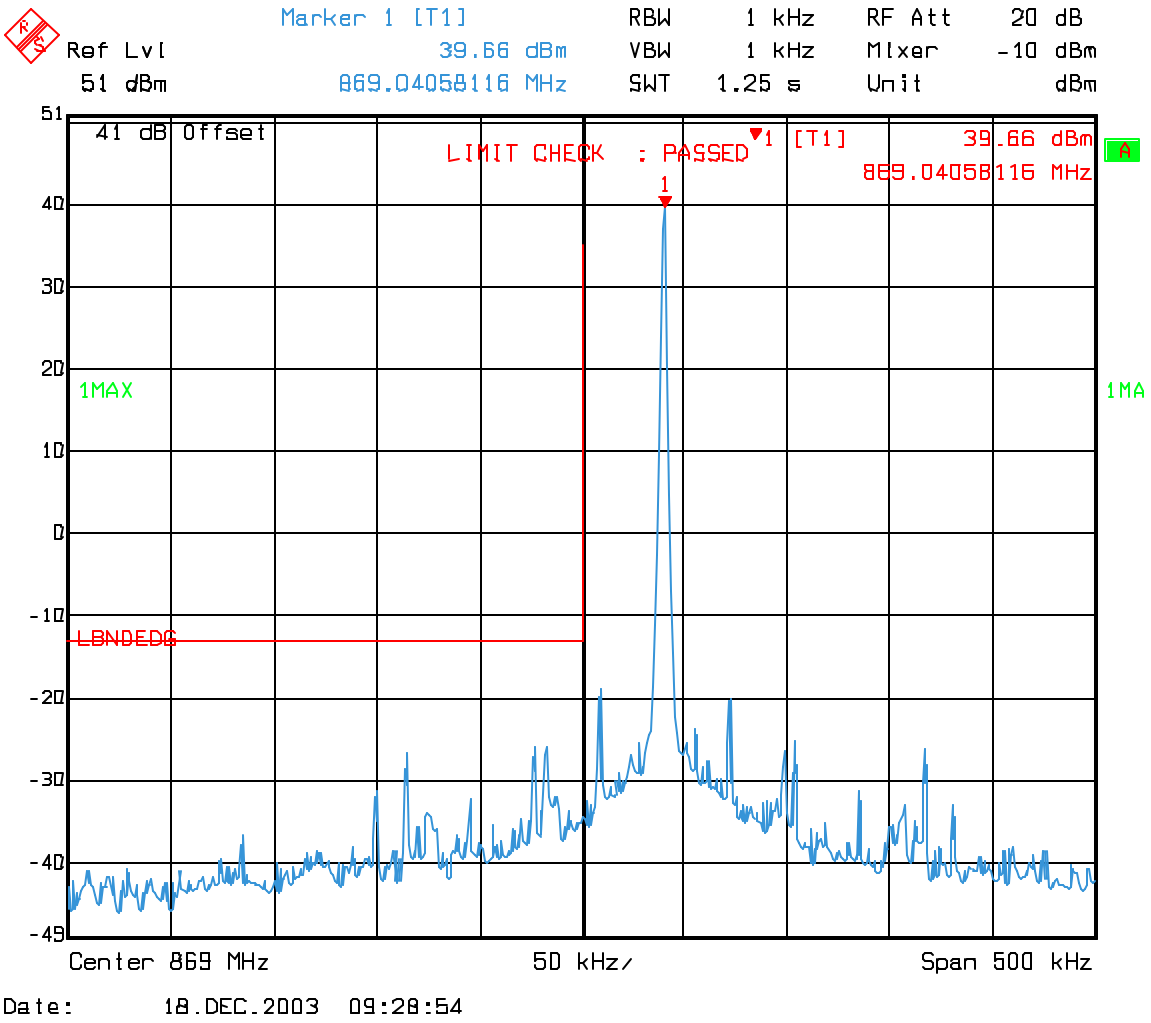
TDMA LOWER


Marker 1 [T1]
Ref Lvl
51 dBm
37.16 dBm
869.70028056 MHz
RBW 20 kHz
VBW 20 kHz
SWT 16 ms
RF Att 20 dB
Mixer -10 dBm
Unit dBm
41 dB Offset
LIMIT CHECK : PASSED
1 [T1]
37.16 dBm
869.70028056 MHz
1MAX
1MA
LBNDEDG
51
40
30
20
10
0
-10
-20
-30
-40
-45
Center 869 MHz
256 kHz/
Span 2.56 MHz
Date: 18.DEC.2003 13:12:57

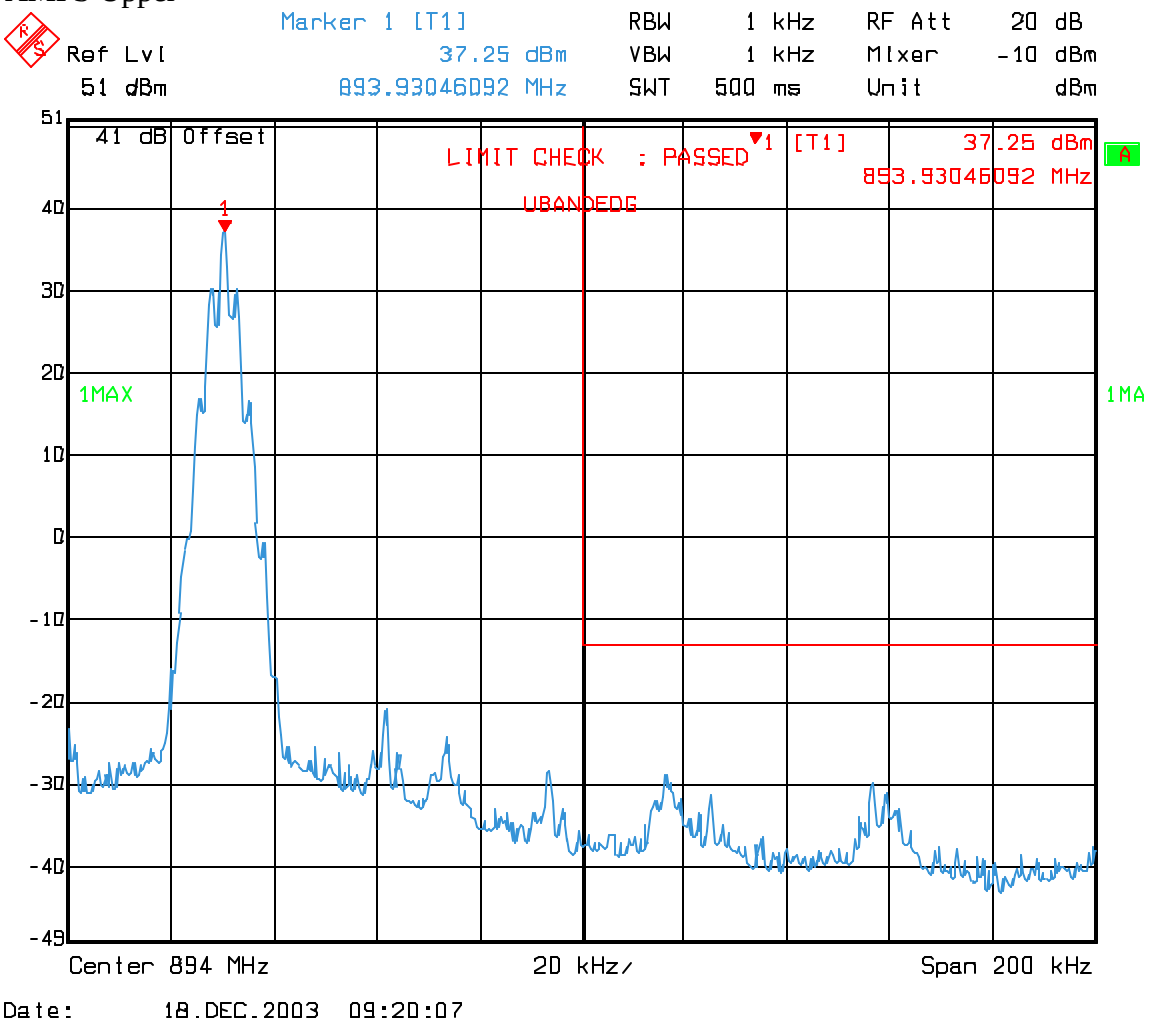
TDMA Upper


Marker 1 [T1]
Ref Lvl
51 dBm
36.63 dBm
893.28945892 MHz
RBW 20 kHz
VBW 20 kHz
SWT 16 ms
RF Att 20 dB
Mixer -10 dBm
Unit dBm
41 dB Offset
LIMIT CHECK : PASSED
UBANDEDG
1 [T1]
36.63 dBm
893.28945892 MHz
1MAX
1MA
51
40
30
20
10
0
-10
-20
-30
-40
-45
Center 894 MHz
256 kHz/
Span 2.56 MHz
Date: 18.DEC.2003 13:14:27

AMPS Lower

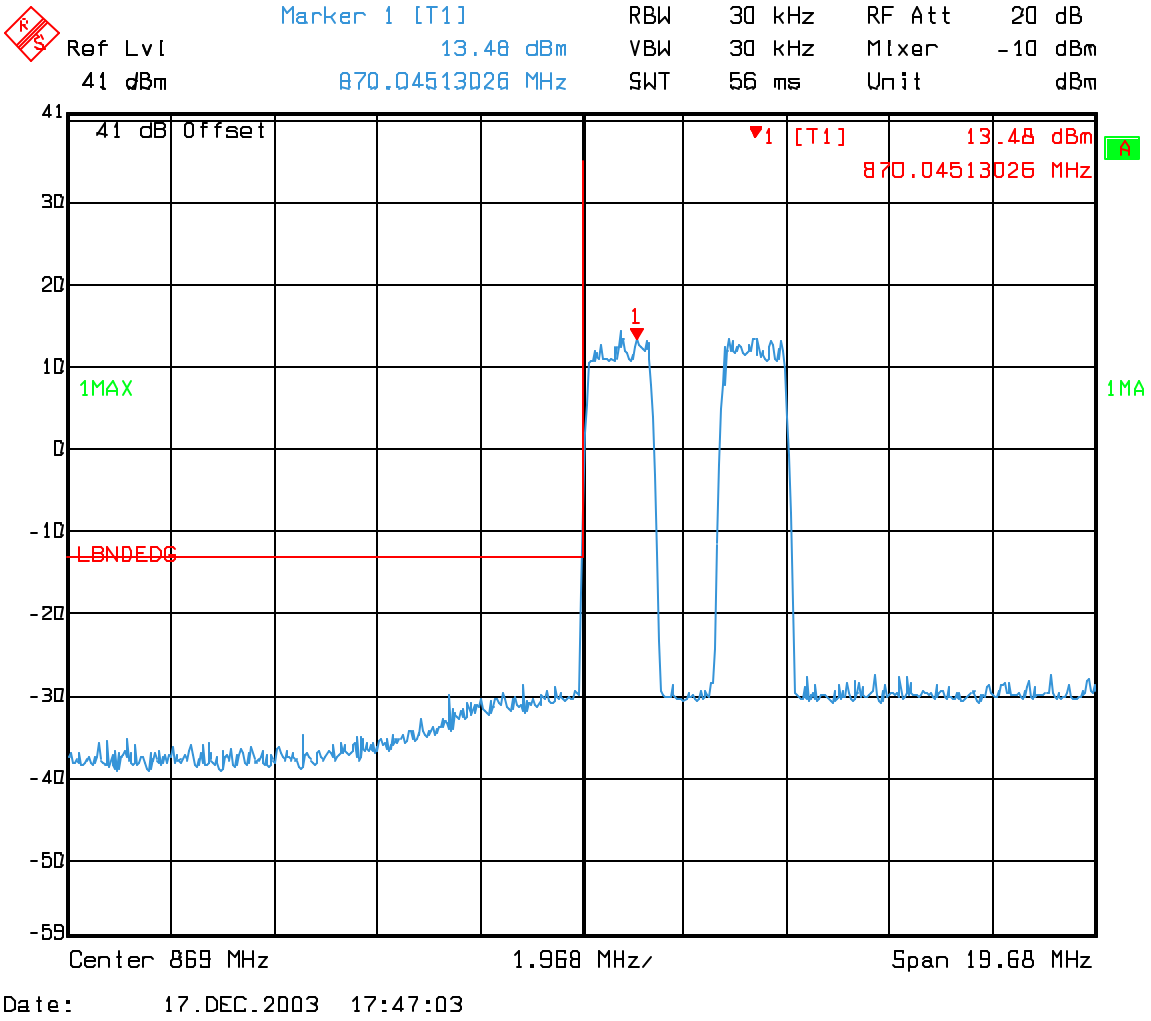

Marker 1 [T1]
39.66 dBm
869.04058116 MHz
RBW 1 kHz
VBW 1 kHz
SWT 1.25 s
RF Att 20 dB
Mixer -10 dBm
Unit dBm
Ref Lvl
51 dBm
41 dB Offset
LIMIT CHECK : PASSED
1 [T1]
39.66 dBm
869.04058116 MHz
1MAX
1MA
LBNDEDG
51
40
30
20
10
0
-10
-20
-30
-40
-45
Center 869 MHz
50 kHz/
Span 500 kHz
Date: 18.DEC.2003 09:28:54

AMPS Upper

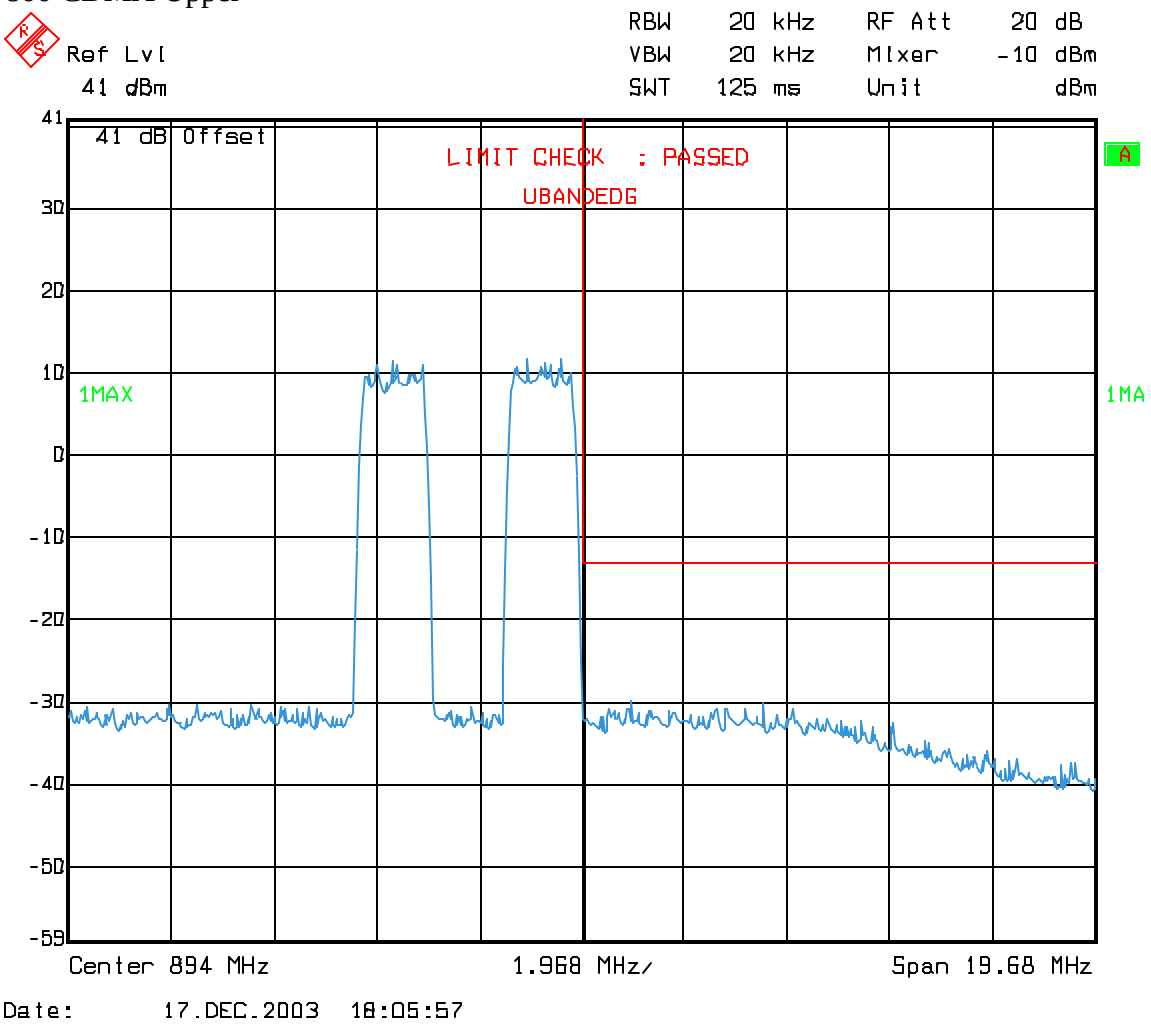

Marker 1 [T1]
Ref Lvl
51 dBm
37.25 dBm
893.93046092 MHz
RBW 1 kHz
VBW 1 kHz
SWT 500 ms
RF Att 20 dB
Mixer -10 dBm
Unit dBm
41 dB Offset
LIMIT CHECK : PASSED
UBANDEDG
1 [T1]
37.25 dBm
893.93046092 MHz
1MAX
1MA
51
40
30
20
10
0
-10
-20
-30
-40
-45
Center 894 MHz
20 kHz/
Span 200 kHz
Date: 18.DEC.2003 09:20:07

Intermodulation

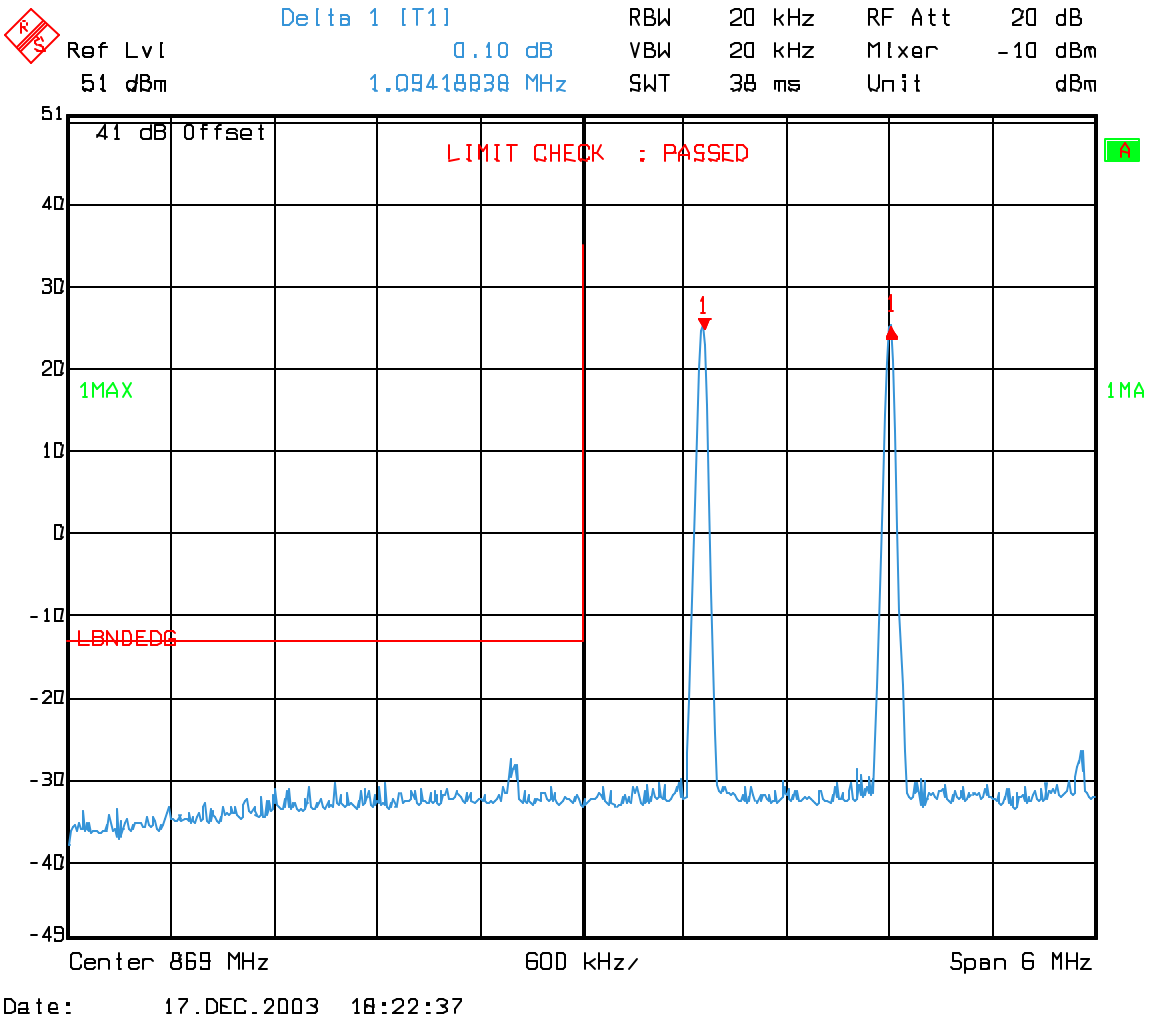
800 CDMA Lower



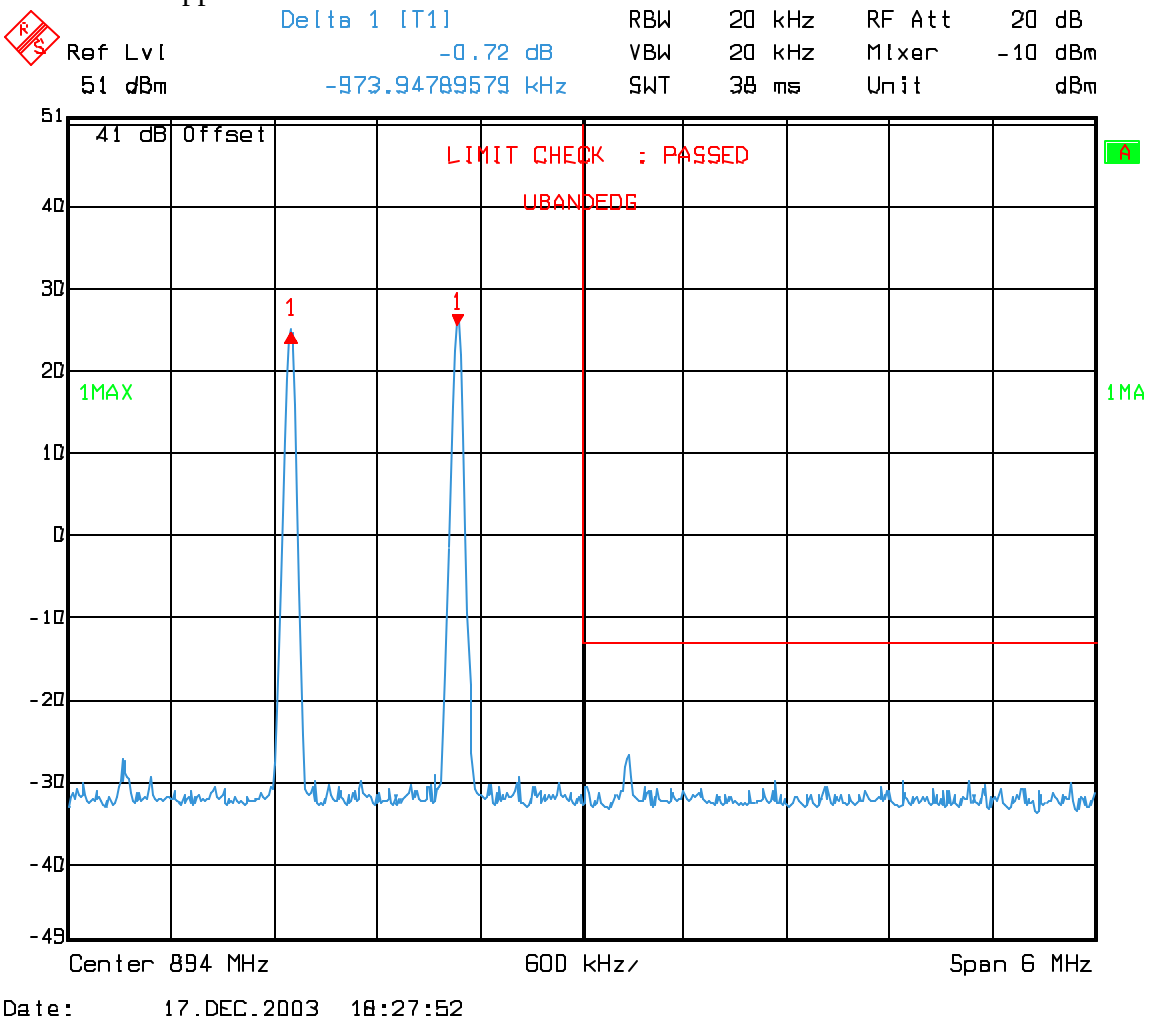
800 CDMA Upper



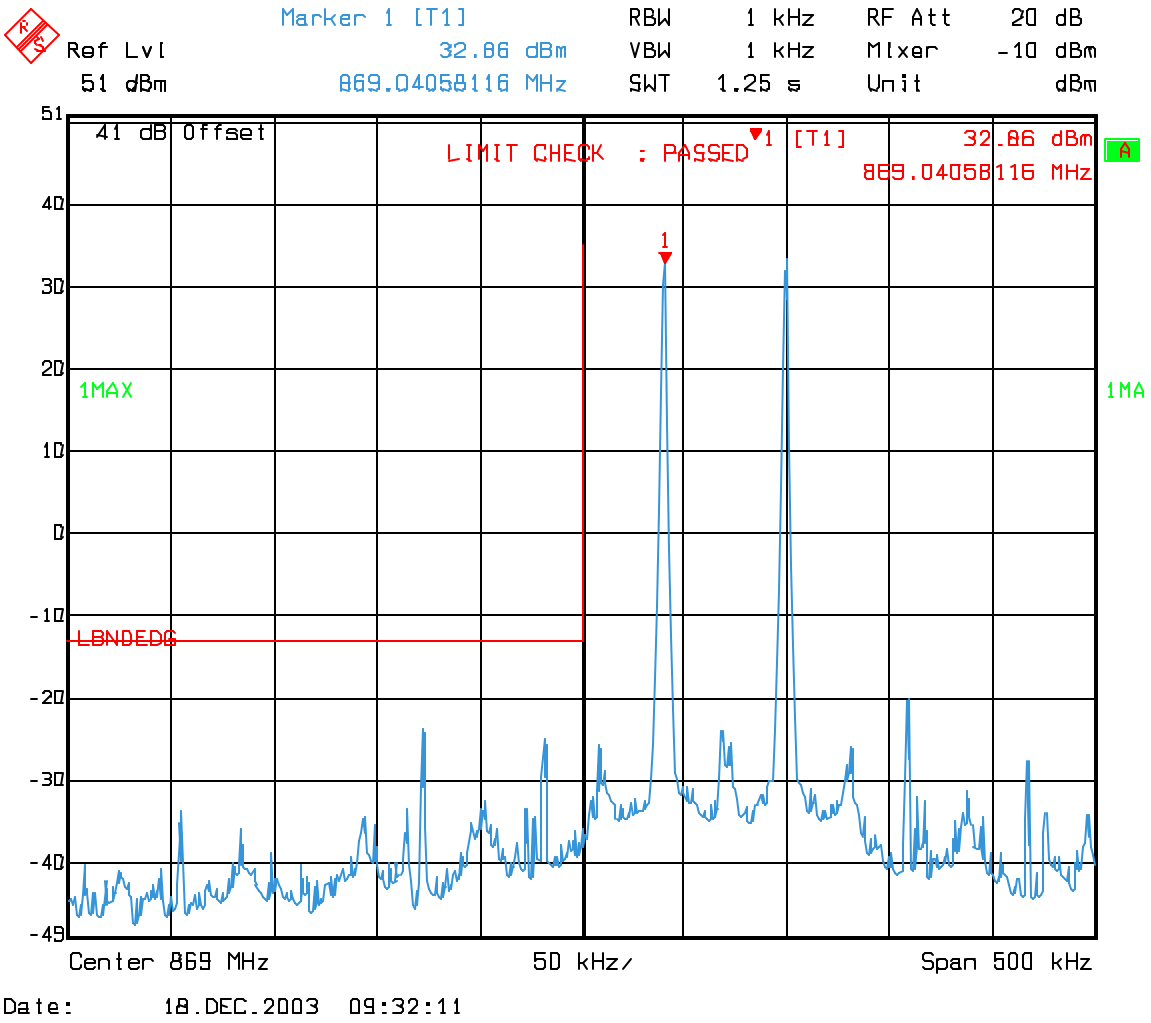
800 TDMA Lower



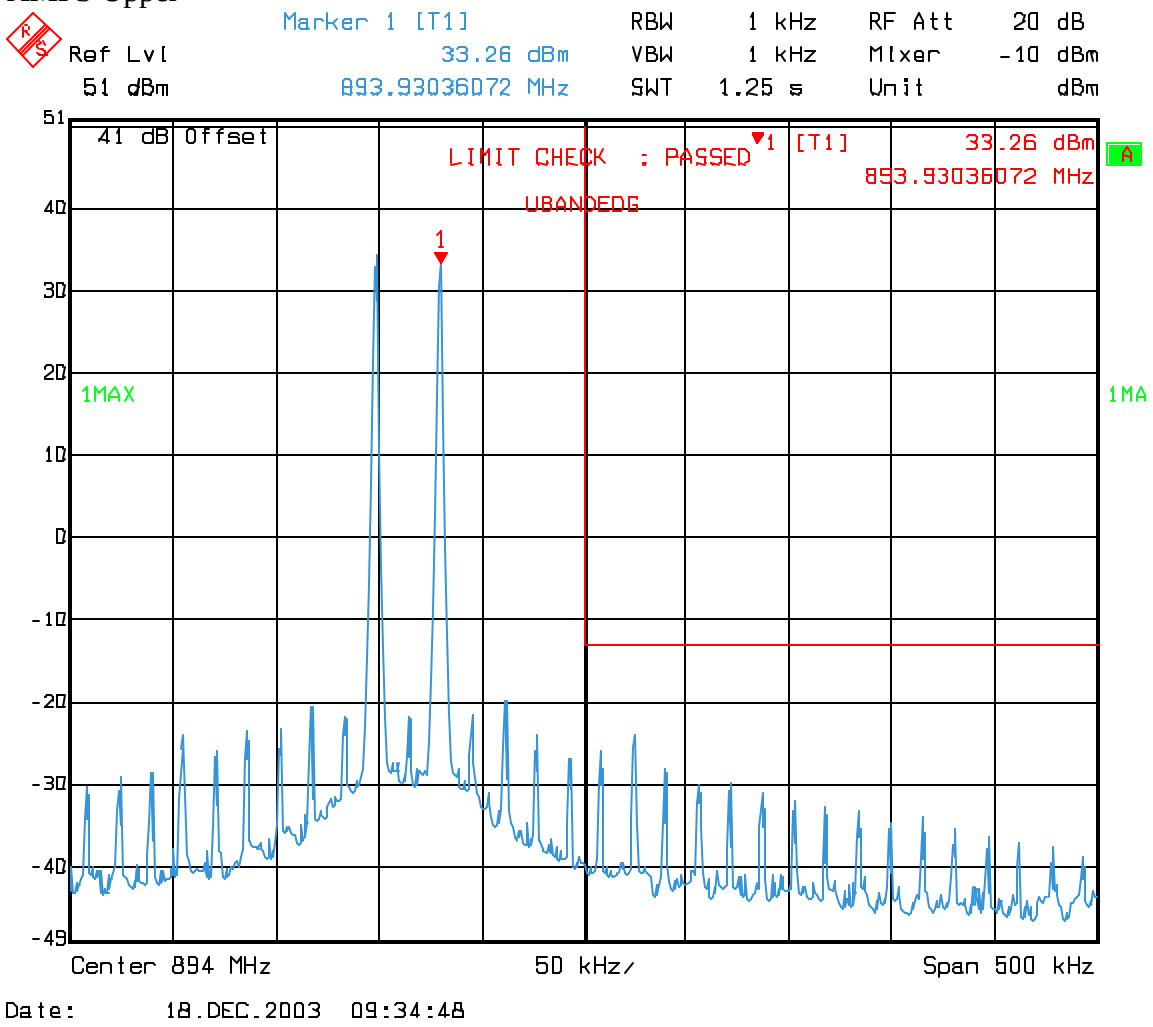
800 TDMA Upper



AMPS Lower


Marker 1 [T1]
Ref Lvl
51 dBm
32.86 dBm
869.04058116 MHz
RBW 1 kHz
VBW 1 kHz
SWT 1.25 s
RF Att 20 dB
Mixer -10 dBm
Unit dBm
41 dB Offset
LIMIT CHECK : PASSED
1 [T1]
32.86 dBm
869.04058116 MHz
1MAX
1MA
LBNDEDG
51
40
30
20
10
0
-10
-20
-30
-40
-45
Center 869 MHz
50 kHz/
Span 500 kHz
Date: 18.DEC.2003 09:32:11

AMPS Upper


Marker 1 [T1]
33.26 dBm
893.93036072 MHz
RBW 1 kHz
VBW 1 kHz
SWT 1.25 s
RF Att 20 dB
Mixer -10 dBm
Unit dBm
Ref Lvl
51 dBm
41 dB Offset
LIMIT CHECK : PASSED
UBANDEDG
1 [T1]
33.26 dBm
893.93036072 MHz
1MAX
1MA
51
40
30
20
10
0
-10
-20
-30
-40
-45
Center 894 MHz
50 kHz/
Span 500 kHz
Date: 18.DEC.2003 09:34:48

Section 5. Spurious Emissions at Antenna Terminals

NAME OF TEST: Spurious Emissions @ Antenna Terminals	PARA. NO.: 2.1051
TESTED BY: Dustin Oaks	DATE: 12/18/2003

Test Results: Complies.

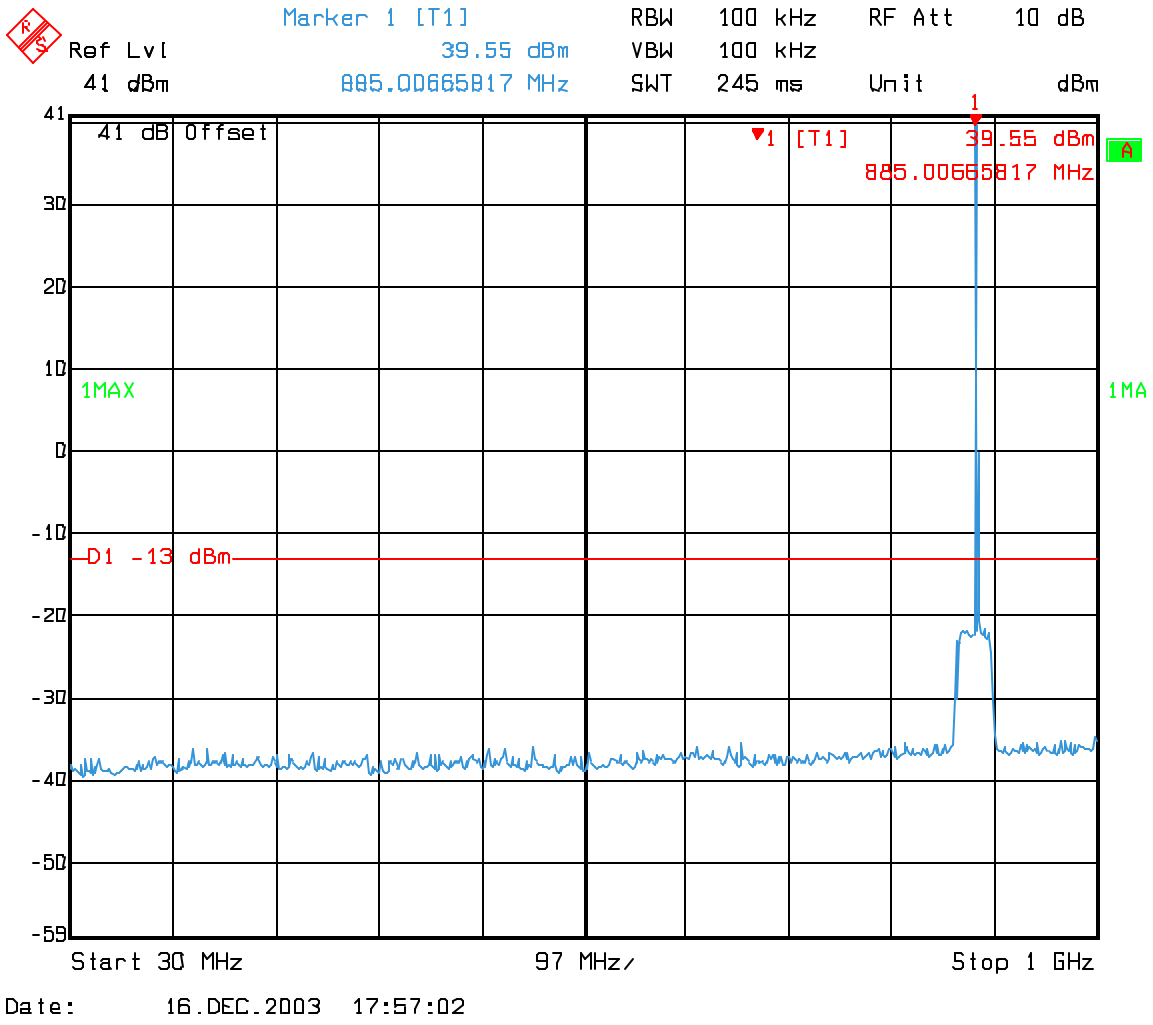
Test Data: See attached plots

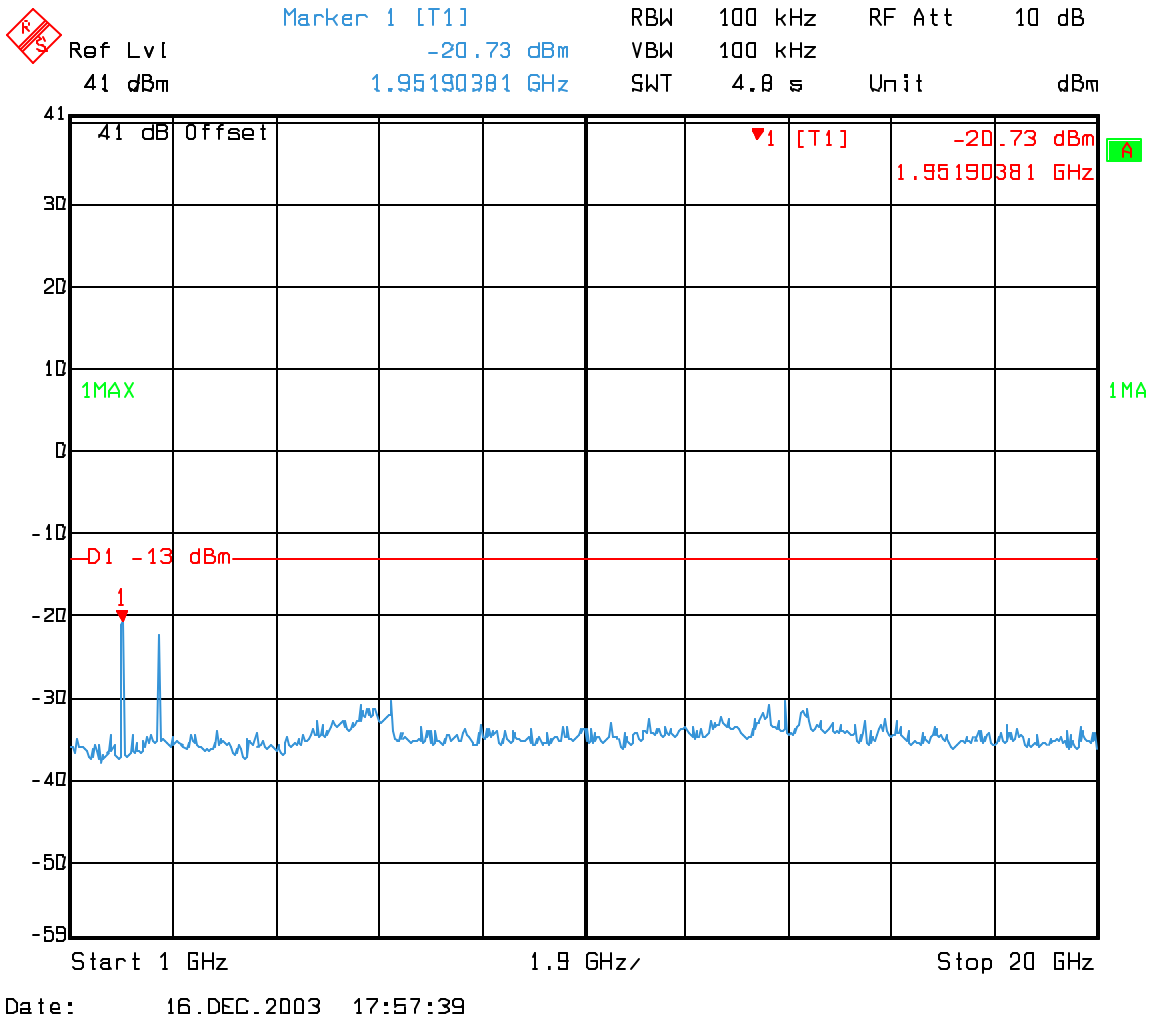
Equipment Used: 1036, 1625, 1629, 1604, 1474, 1053

Measurement Uncertainty: +/- 1.6 dB

Temperature: 21 ?C

Relative Humidity: 51 %


Marker 1 [T1]
Ref Lvl
41 dBm
39.55 dBm
885.00665817 MHz
RBW 100 kHz
VBW 100 kHz
SWT 245 ms
RF Att 10 dB
Unit dBm
41 dB Offset
1 [T1]
39.55 dBm
885.00665817 MHz
1MAX
1MA
D1 -13 dBm
41
30
20
10
0
-10
-20
-30
-40
-50
-59
Start 30 MHz
97 MHz/
Stop 1 GHz
Date: 16.DEC.2003 17:57:02


Marker 1 [T1]
Ref Lvl
41 dBm
-20.73 dBm
1.95190381 GHz
RBW 100 kHz
VBW 100 kHz
SWT 4.8 s
RF Att 10 dB
Unit dBm
41 dB Offset
1 [T1]
-20.73 dBm
1.95190381 GHz
1MAX
1MA
D1 -13 dBm
Start 1 GHz
1.9 GHz/
Stop 20 GHz
Date: 16.DEC.2003 17:57:39

Section 6. Field Strength of Spurious

NAME OF TEST: Field Strength of Spurious	PARA. NO.: 2.1053
TESTED BY: Dustin Oaks	DATE: 12/18/2003

Test Results: Complies.

Test Data: No Emissions found within 20dB of Limit. Noise from was greater than 20dB below limit. Frequency range scanned from 30MHz to 20GHz

Equipment Used: 1016, 1484, 1485, 1304, 791, 1480

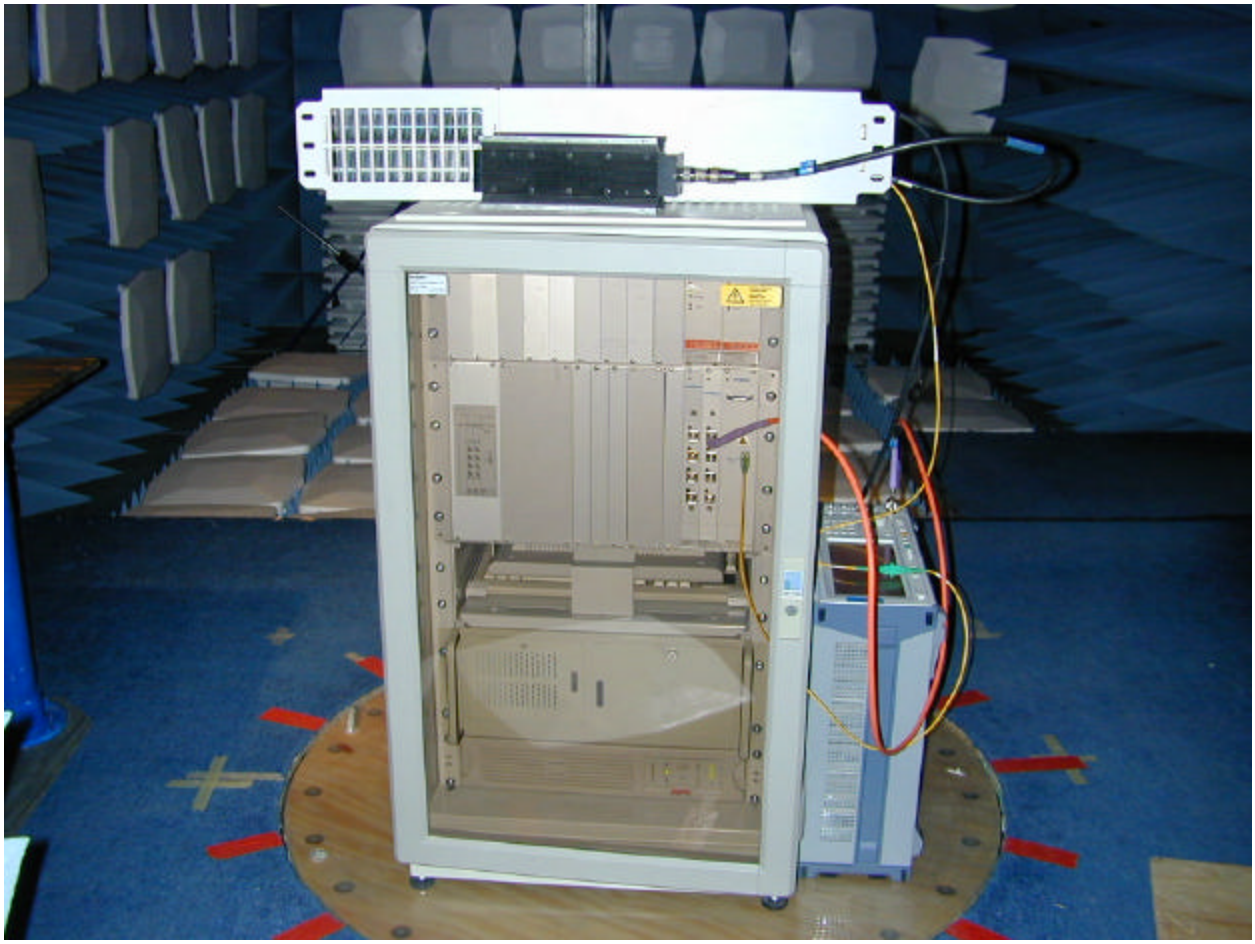
Measurement Uncertainty: +/- 3.6 dB

Temperature: 21 ?C

Relative Humidity: 51 %

Photographs of Test Setup

FRONT VIEW



REAR VIEW

Section 7. Frequency Stability

NAME OF TEST: Frequency Stability	PARA. NO.: 2.1055
TESTED BY:	DATE:

Test Results: Not Applicable

Test Data: See attached table.
Standard Test Frequency: MHz
Standard Test Voltage:

Equipment Used:

Measurement Uncertainty: +/- 1 x 10^{-7} ppm

Temperature: ?C

Relative Humidity: %

Nemko ID	Description	Manufacturer Model Number	Serial Number	Calibration Date	Calibration Due
1036	SPECTRUM ANALYZER	ROHDE & SCHWARZ FSEK30	830844/006	12/18/01	12/19/03
1464	Spectrum analyzer	Hewlett Packard 8563E	3551A04428	02/11/03	02/11/05
1625	CABLE, 18 ft	MEGAPHASE 10311 1GVT4	N/A	03/05/03	03/04/04
1629	CABLE, 6 ft	MEGAPHASE 10311 1GVT4	N/A	CBU	N/A
1604	ATTENUATOR	NARDA 776B-20	NONE	N/A	N/A
1474	20db Attenuator DC 18 Ghz	MCL Inc. BW-S20W2	NONE	CBU	N/A
1053	SIGNAL GENERATOR	ROHDE & SCHWARZ SMIQ 03	DE22081	06/10/03	06/09/04
1016	Pre-Amp	HEWLETT PACKARD 8449A	2749A00159	08/28/03	08/28/04
1484	Cable 2.0-18.0 Ghz	Storm PR90-010-072	N/A	07/24/03	07/23/04
1485	Cable 2.0-18.0 Ghz	Storm PR90-010-216	N/A	07/24/03	07/23/04
1304	HORN ANTENNA	ELECTRO METRICS RGA-60	6151	09/22/03	09/22/05
791	PREAMP, 25dB	ICC LNA25	398	10/27/03	10/26/04
1480	Bilog Antenna	Schaffner-Chase CBL6111C	2572	CalNotReq	N/A

Section 8. Test Equipment List

ANNEX A - TEST DETAILS

NAME OF TEST: RF Power Output	**PARA. NO.: 2.1046**

Minimum Standard: Para. No. 22.913(a). The maximum effective radiated power (ERP) of base transmitters and cellular repeaters must not exceed 500 watts.

Method Of Measurement:

Detachable Antenna:
The peak power at antenna terminals is measured using an in-line peak power meter. Power output is measured with the maximum rated input level.

Integral Antenna:
If the antenna is not detachable from the circuit then the Peak Power Output is derived from the peak radiated field strength of the fundamental emission by using the plane wave relation GP/4? $R^2 = E^2/120$? and proceeding as follows:

$$P ? \frac{E^2 R^2}{30G} ? \frac{E^2 3^2}{30G}$$

where,

P = the equivalent isotropic radiated power in watts
E = the maximum measured field strength in V/m
R = the measurement range (3 meters)
G = the numeric gain of the transmit antenna in relation to an isotropic radiator

NAME OF TEST: Occupied Bandwidth (Voice & SAT) PARA. NO.: 2.1049

Minimum Standard: 22.917(c) The mean power of any emission removed from the carrier frequency by a displacement frequency (f_d in kHz) must be attenuated below the mean power of the unmodulated carrier (P) as follows:

(i) On any frequency removed from the carrier frequency by more than 12 kHz but not more than 20 kHz:

at least 117 log (f_d/12)

(ii) On any frequency removed from the carrier frequency by more than 20 kHz, up to the first multiple of the carrier frequency:

at least 100 log (f_d/11) dB or 43 + 10 log (P) dB, whichever is the lesser attenuation.

Method Of Measurement:

Spectrum Analyzer Settings:

RBW: 300 Hz
VBW: ? RBW
Span: 100 kHz
Sweep: Auto

Input Signal Characteristics (F3E/F3D):

RF level: Maximum recommended by manufacturer
AF1 frequency: 6 kHz
AF1 level: sufficient to produce 2 kHz deviation
AF2 frequency: 2.5 kHz
AF2 level: sufficient to produce 12 kHz deviation.

NAME OF TEST: Occupied Bandwidth (WB Data)	**PARA. NO.: 2.1049**

Minimum Standard: 22.917(c) The mean power of any emission removed from the carrier frequency by a displacement frequency (f_d in kHz) must be attenuated below the mean power of the unmodulated carrier (P) as follows:

(1) On any frequency removed from the carrier frequency by more than 20 kHz but not more than 45 kHz:

at least 26 dB

(2) On any frequency removed from the carrier frequency by more than 45 kHz but not more than 90 kHz:

at least 45 dB

(3) On any frequency removed from the carrier frequency by more than 90 kHz, up to the first multiple of the carrier frequency:

at least 60 dB or 43 + 10 log (P) dB, whichever is the lesser attenuation.

Method Of Measurement:

Spectrum Analyzer Settings:
RBW: 300 Hz
VBW: ? RBW
Span: 200 kHz
Sweep: Auto

Input Signal Characteristics:
RF level: Maximum recommended by manufacturer
AF1 frequency: 10 kHz, random bit sequence
AF1 level: sufficient to produce 8 kHz deviation

NAME OF TEST: Occupied Bandwidth (ST)	**PARA. NO.: 2.1049**

Minimum Standard: 22.917(c) The mean power of any emission removed from the carrier frequency by a displacement frequency (f_d in kHz) must be attenuated below the mean power of the unmodulated carrier (P) as follows:

(1) On any frequency removed from the carrier frequency by more than 20 kHz but not more than 45 kHz:

at least 26 dB

(2) On any frequency removed from the carrier frequency by more than 45 kHz but not more than 90 kHz:

at least 45 dB

(3) On any frequency removed from the carrier frequency by more than 90 kHz, up to the first multiple of the carrier frequency:

at least 60 dB or 43 + 10 log (P) dB, whichever is the lesser attenuation.

Method Of Measurement:

Spectrum Analyzer Settings:
RBW: 300 Hz
VBW: ? RBW
Span: 200 kHz
Sweep: Auto

Input Signal Characteristics:
RF level: Maximum recommended by manufacturer
AF1 frequency: 10 kHz tone
AF1 level: sufficient to produce 8 kHz deviation

NAME OF TEST: Occupied Bandwidth (Digital Modulation) PARA. NO.: 2.1049

Minimum Standard: Not defined by FCC. Input vs. Output.

Method Of Measurement:

Spectrum Analyzer Settings:
RBW: CDMA (30 kHz), GSM (30 kHz), NADC (1 kHz) and CDPD (1 kHz)
VBW: ? RBW
Span: As required
Sweep: Auto

Input Signal Characteristics:
RF level: Maximum recommended by manufacturer

NAME OF TEST: Spurious Emission at Antenna Terminals	**PARA. NO.: 2.1051**

Minimum Standard: Para. No. 22.917(e). The mean power of emissions must be attenuated below the mean power of the unmodulated carrier on any frequency twice or more than twice the fundamental emission by at least 43 + 10 log P. This is equivalent to -13 dBm absolute power.

Method Of Measurement:

Spectrum Analyzer Settings:
RBW: 30 kHz (AMPS). As required for digital modulations.
VBW: ? RBW
Start Frequency: 0 MHz
Stop Frequency: 10 GHz
Sweep: Auto

NAME OF TEST: Field Strength of Spurious Radiation	**PARA. NO.: 2.1053**

Minimum Standard: Para. No. 22.917(e). The mean power of emissions must be attenuated below the mean power of the unmodulated carrier on any frequency twice or more than twice the fundamental emission by at least 43 + 10 log P. This is equivalent to -13 dBm absolute power.

Calculation Of Field Strength Limit:

An example of attenuation requirement of 43 + 10 Log P is equivalent to -13 dBm (5 x 10^{-5} Watts) at the antenna terminal. We determine the field strength limit by using the plane wave relation.

$GP/4?R^2 = E^2/120?$

For emissions ? 1 GHz:

G = 1.64 (Dipole Gain)
P = 10^{-5} Watts (Maximum spurious output power)
R = 3m (Measurement Distance)

$$E ? \frac{\sqrt{30GP}}{R}$$

$$E ? \frac{\sqrt{30 \text{ x } 1.64 \text{ x } 5 \text{ x } 10^{?5}}}{3} ? \ 0.016533 \text{ V / m} ? 84.4 \text{ dB?V / m}$$

For emissions > 1 GHz:

G = 1 (Isotropic Gain)
P = 1 x 10^{-5} Watts (Maximum spurious output power)
R = 3m (Measurement Distance)

$$E ? 84.4 ? 20Log\sqrt{1.64} ? 82.3dB?V / m@3m$$

The spectrum is searched to 10 GHz.

NAME OF TEST: Frequency Stability	**PARA. NO.: 2.1055**

Minimum Standard: Para. No. 22.355. The transmitter carrier frequency shall remain within the tolerances given in Table C-1.

Table C-1

Freq. Range (MHz)	Base, fixed	Mobile > 3 W	Mobile ? 3 W
821 to 896	1.5	2.5	2.5

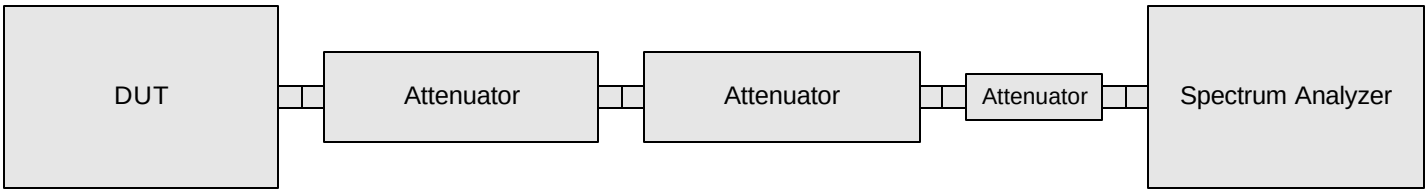
Method Of Measurement:

Frequency Stability With Voltage Variation:
The E.U.T. is placed in an environmental chamber and allowed to stabilize at +20 degrees Celsius for at least 15 minutes. The frequency counter and signal generator are phase locked with the same 10 MHz reference frequency by connecting the 10 MHz ref. out of the counter to the 10 MHz ref, in of the signal generator. With the voltage input to the E.U.T. set to 85% S.T.V., the frequency is measured in 30 second intervals for a period of 5 minutes. This procedure is repeated at 100% S.T.V. and 115% S.T.V.

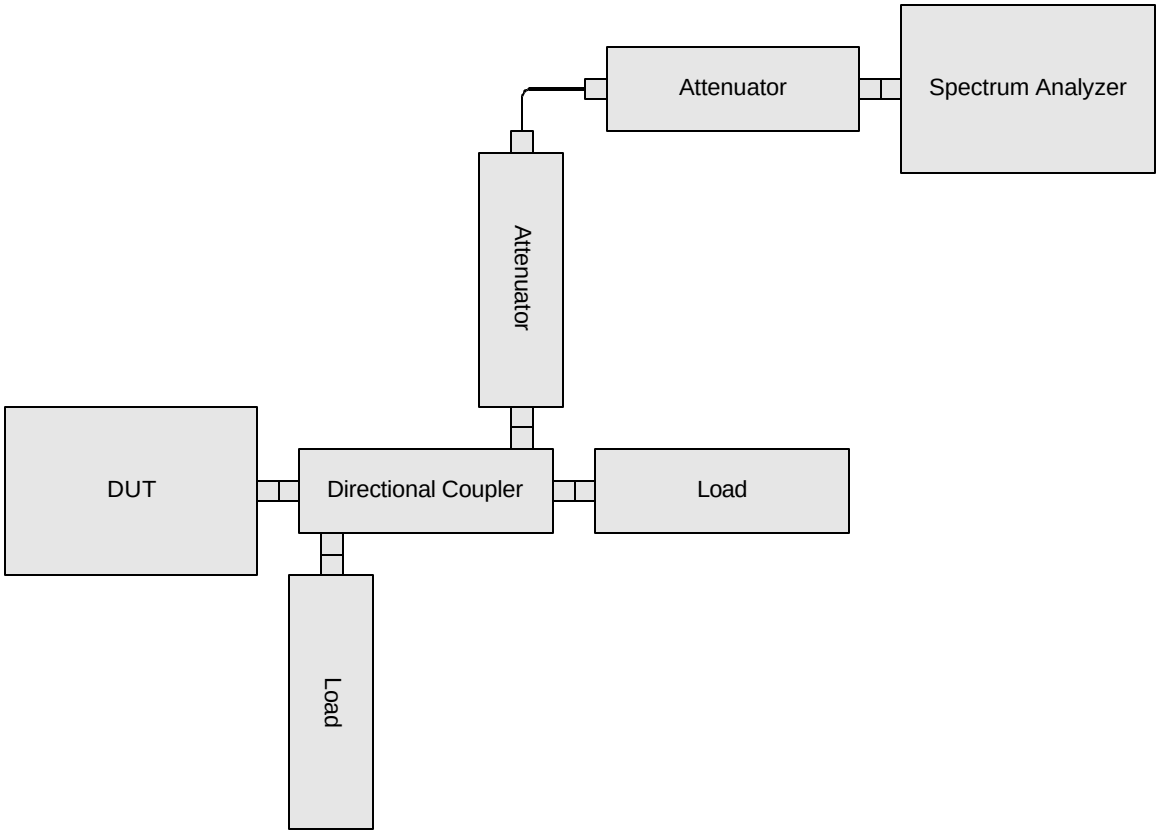
Frequency Stability With Temperature Variation:
The input voltage to the E.U.T. is set to S.T.V. and the temperature of the environmental chamber is varied in 10 degree steps from -30 degrees C to +50 degrees C. The E.U.T. is allowed to stabilize at each temperature and the frequency is measured in 30 second intervals for a period of 5 minutes.

ANNEX B - TEST DIAGRAMS

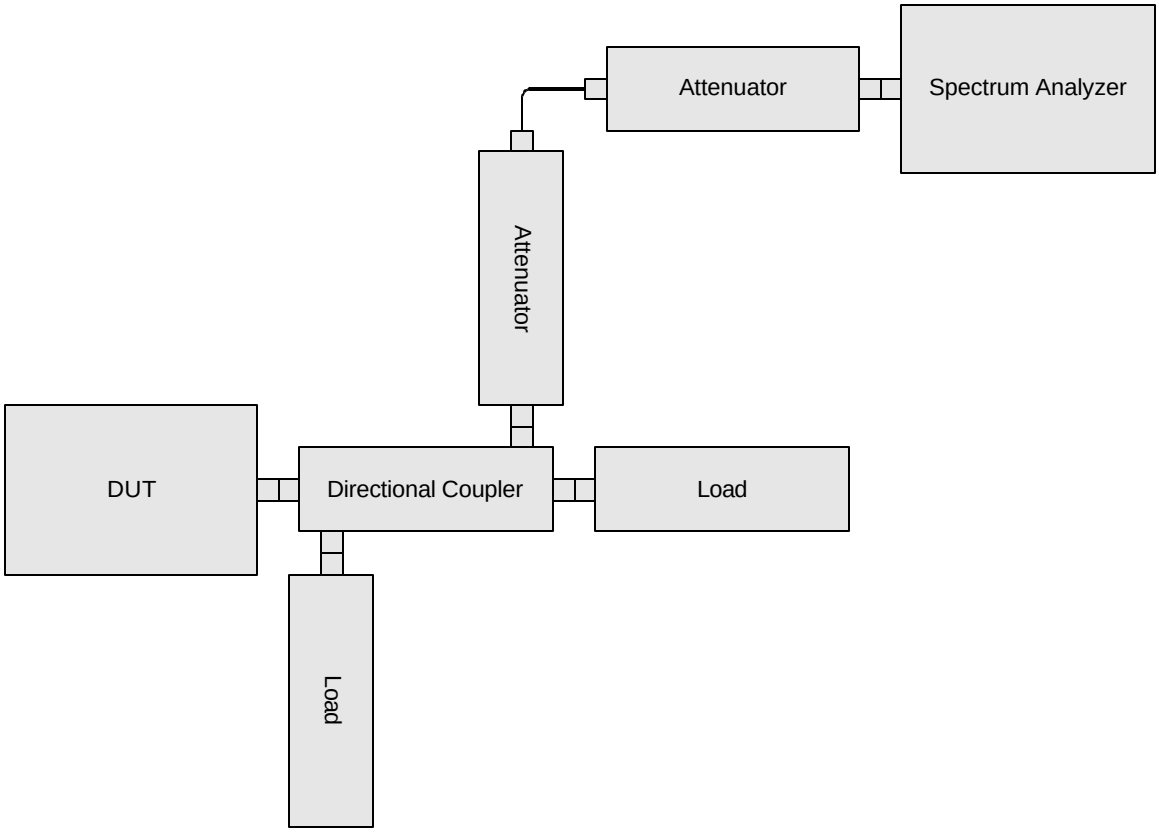
Para. No. 2.1046 - R.F. Power Output

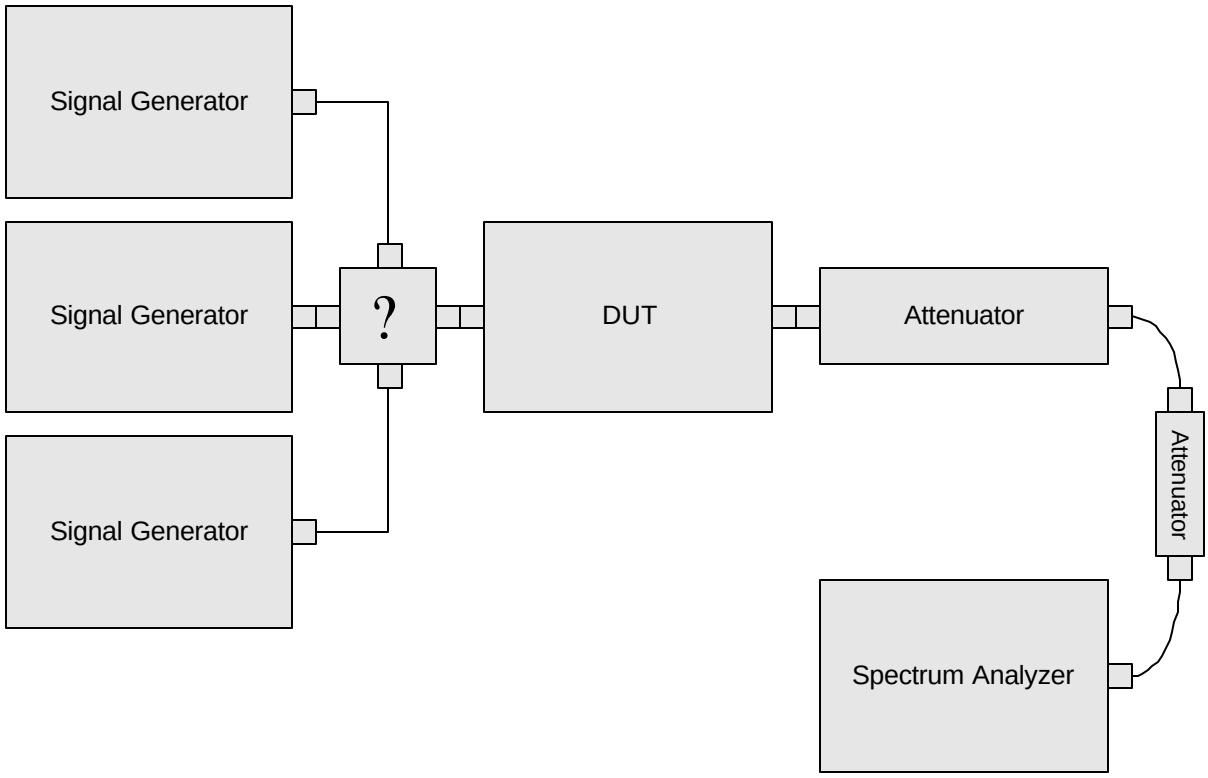


Para. No. 2.1049 - Occupied Bandwidth

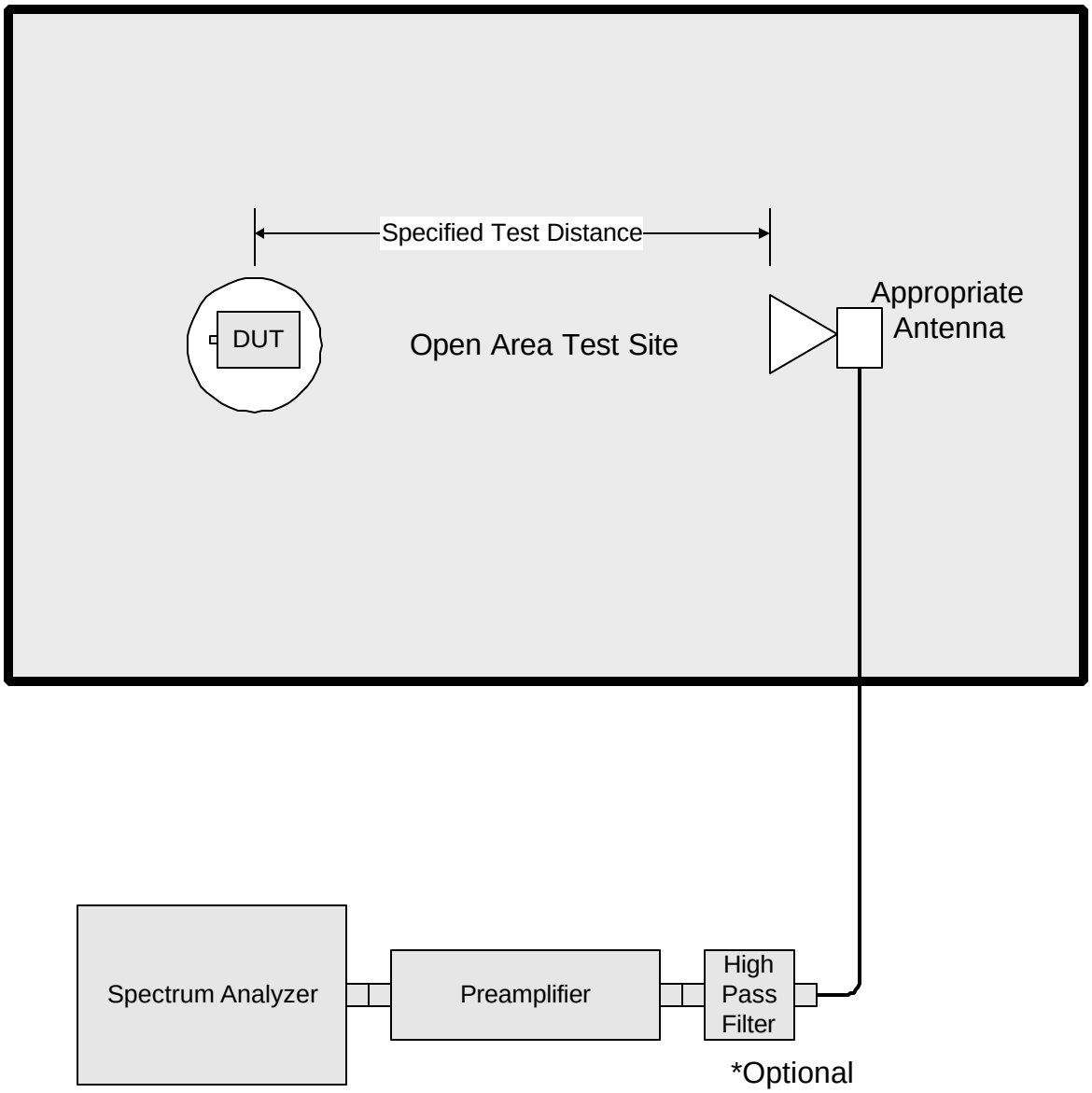


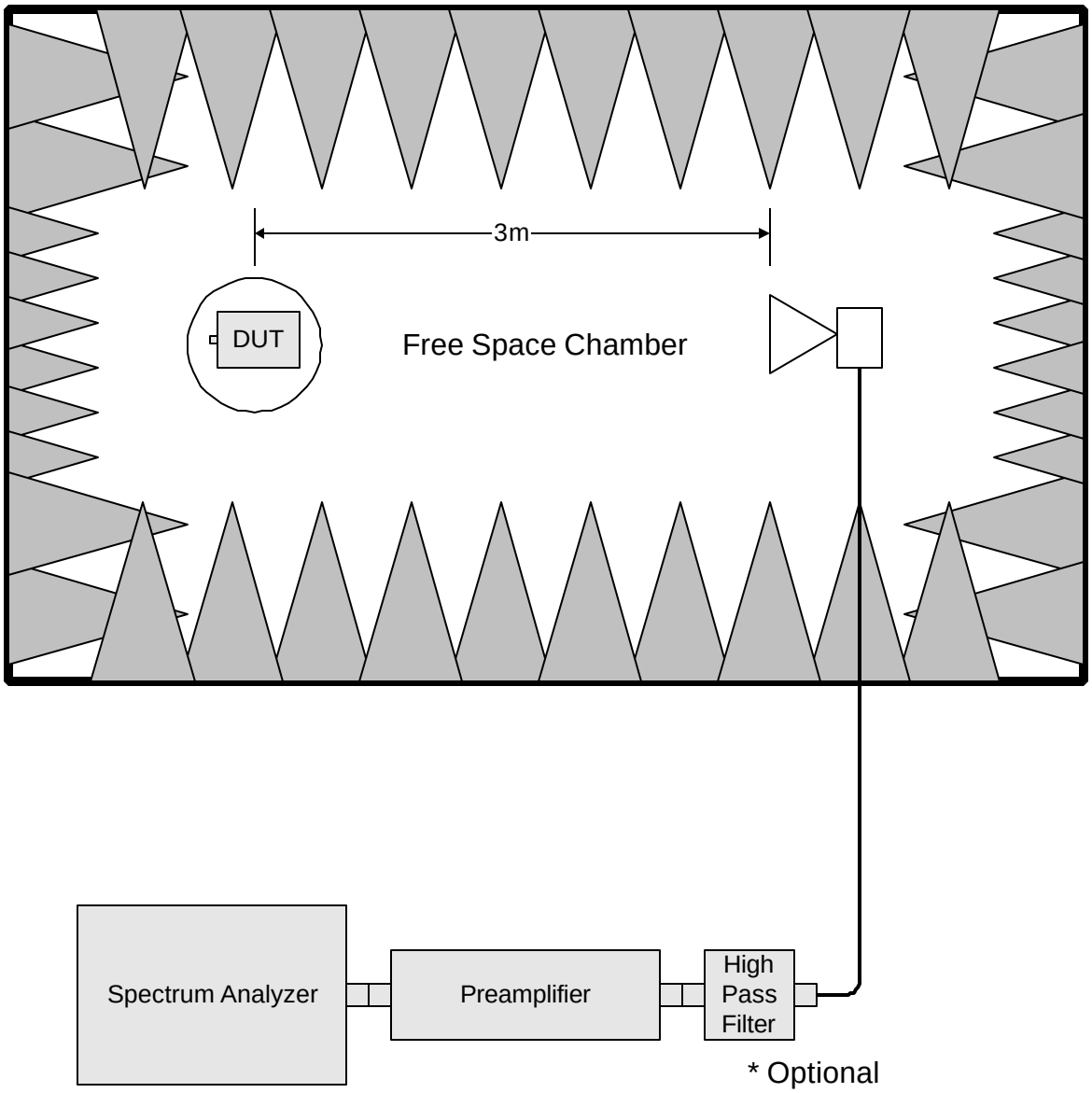
Para. No. 2.1051 Spurious Emissions at Antenna Terminals


Attenuator
Spectrum Analyzer
Attenuator
DUT
Directional Coupler
Load
Load


Signal Generator
Signal Generator
Signal Generator
?
DUT
Attenuator
Attenuator
Spectrum Analyzer

Para. No. 2.1053 - Field Strength of Spurious Radiation




3m
DUT
Free Space Chamber
Spectrum Analyzer
Preamplifier
High Pass Filter
* Optional

Para. No. 2.1055 - Frequency Stability