



LS Research Inc.

GPT Mobitex MODEM

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Part 90 Type Acceptance, Conducted Measurements

prepared for

GPT



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Mobitex MODEM

I. Project Information

Project: Mobitex MODEM

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Proposal Date:
Revision:
Proposal #:
Proposal File:
Job Number:

Signatures:

Technical Approval



II. FCC Conducted Tests

A. Part 90 Subpart I

1. 90.207 (a) (1) Types of Emissions (Device Classification)

Classified as an ***F1D*** emitter (Frequency Modulation, Digital Modulation, telemetry data). Power levels: 2W.

2. 90.209 (a) (5) Bandwidth Limitations (Device Classification, Test Condition).

12.5 kHz Nominal Channel Bandwidth

3. Part 2.985 Output Power, Part 2.991 Spurious Emissions at Antenna terminals and Part 2.989 Occupied bandwidth using 90.210 (j), and 90.211 Emission Mask for F1D Transmitter.

a) Test Requirement:

(1) On any frequency from the center of the authorized bandwidth by a displacement frequency of more than 2.5 kHz, but no more than 6.25 kHz: At least $53\log(f_d/2.5)$ dB.

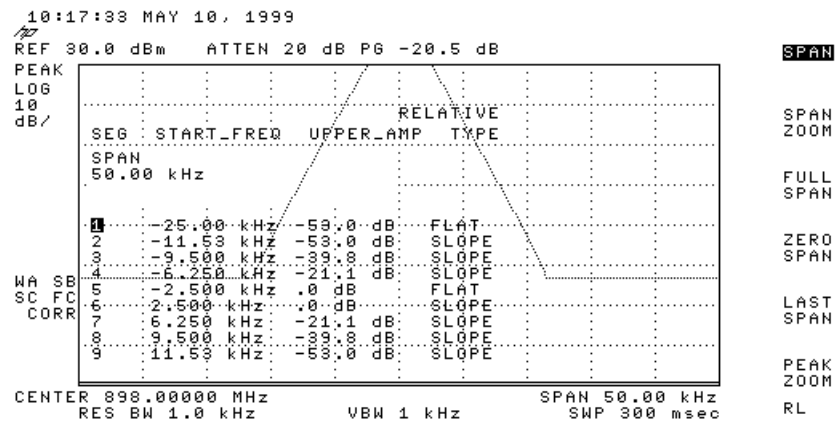
(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 6.25 kHz but no more than 9.5 kHz: At least $103\log(f_d/3.9)$ dB.

(3) On any frequency removed from the center of the authorized band by a displacement frequency (f_d in kHz) of more than 9.5 kHz : At least $157\log(f_d/5.3)$, or $50+10\log(P)$, dB or 70 dB, whichever is the lesser attenuation.

The test condition is presented in Tabular form below. The definition of the spectrum mask as indicated on the spectrum analyzer is also presented.

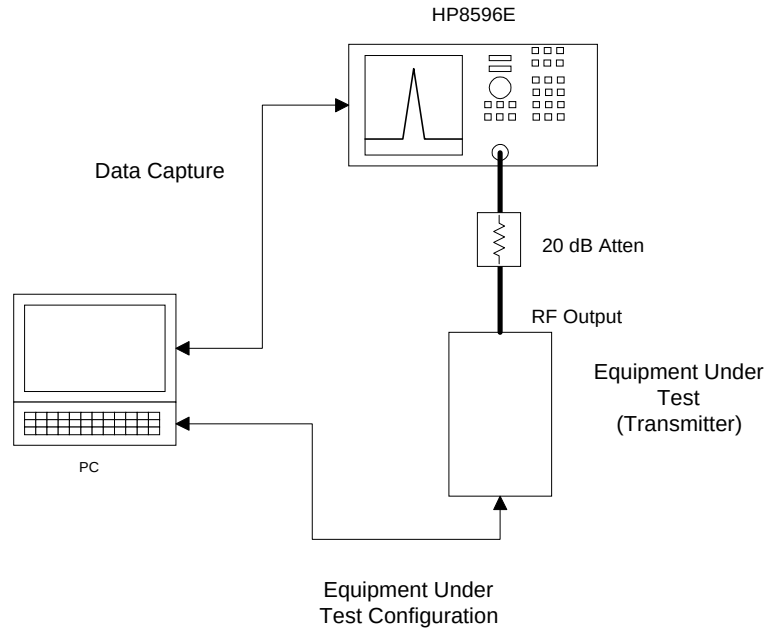


90.210 (j)	Absolute Frequency Offset Range (kHz): $ f_m $	Attenuation relative to Carrier power P.
(1)	2.5 to 6.25	$53\log(f_d/2.5)$ dB
(2)	6.25 to 9.5	$103\log(f_d/3.9)$ dB
(3)	> 9.5	Min ($157\log(f_d/5.3)$, $50 + 10 \log_{10}(P)$ dB ,70 dB)





b) Test Configuration



c) Test Conditions: Stimulus

Set transmitter for single frequency, +30 dBm output power, pseudorandom test data modulation.

Measure Spectrum Mask (j).

d) Equipment Under Test Conditions, Instrument Conditions and Indicated Numerical Data for Part 2.985 Output Power.

Presented below is a table that summarizes the equipment under test conditions, instrument conditions and numerical data. Numerical Data for the Transmitter Power under each of the test conditions is indicated in the Table. The source of the numerical data is presented in sub-sections(e),and (f), Test Indications. Demonstration of compliance is presented in sub-sections (e) and (f).



	Set Channel	Set f (MHz)	Desired Po (dBm)	Po (dBm)	Po (W)	Limit (dBm)	2nd (dBm)	3rd (dBm)	fcenter (MHz)	span (kHz)	RBW (kHz)	VBW (kHz)	filename (*.pcx)
Conducted Emission -	481	896.0125	+33	30.69	1.17				896.0129	50	1.0	1.0	187_1low
Harmonic Output						-20	-37.93		1792.0259	100	1.0	1.0	187_2low
						-20		-35.90	2688.0390	100	1.0	1.0	187_3low
	828	900.3500	+33	30.71	1.18				900.3504	50	1.0	1.0	187_1hi
						-20	-34.10		1800.7006	100	1.0	1.0	187_2hi
						-20		-32.47	2701.0509	100	1.0	1.0	187_3hi

NOTES: Po measured on HP8596E.

Internal modulation with PN data used for BW measurement.

Harmonic must be < -53 dBc for 2W output, < -50 dBc for 1W output. Computes to a constant -20 dBm level.

Set channel: E.U.T Carrier Channel Setting .

Set f: E.U.T Carrier Frequency Setting .

Desired Po: Nominal EUT Power Settings

Po: Measured Absolute Output Power (HP8596E)

Limit: Harmonic limit based on output power $50+10\log(P)$

2nd : Second Harmonic Level in dB relative to absolute Power

3rd : Third Harmonic Level in dB relative to absolute Power

fcenter: Spectrum Analyzer Center Frequency Setting

span: Spectrum Analyzer Frequency Span Setting.

RBW: Spectrum Analyzer Resolution Bandwidth.

VBW: Spectrum Analyzer Video Bandwidth.

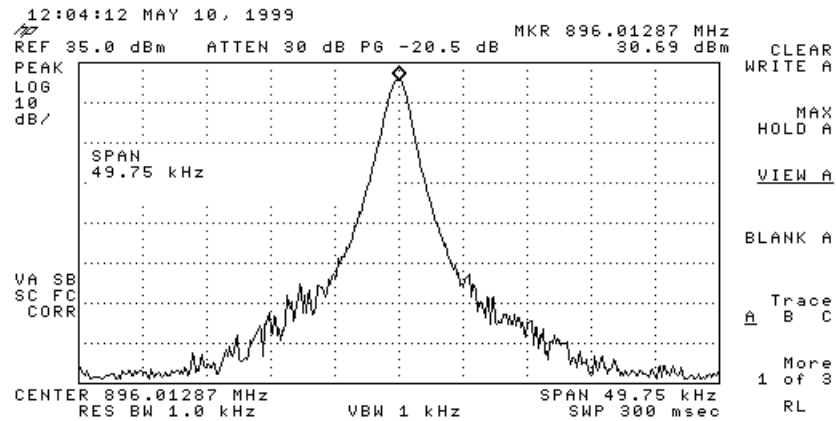
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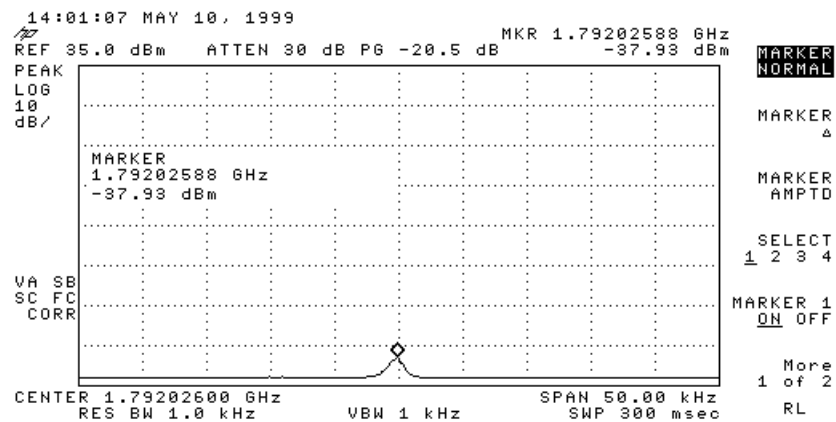
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e) Test Indications Part 2. 991 Conducted Spurious Emissions at Antenna Terminals



Test Condition: Channel 481, +33 dBm nominal output power, +30.6 dBm actual.



Test Condition: Channel 481, +30.6 dBm output power

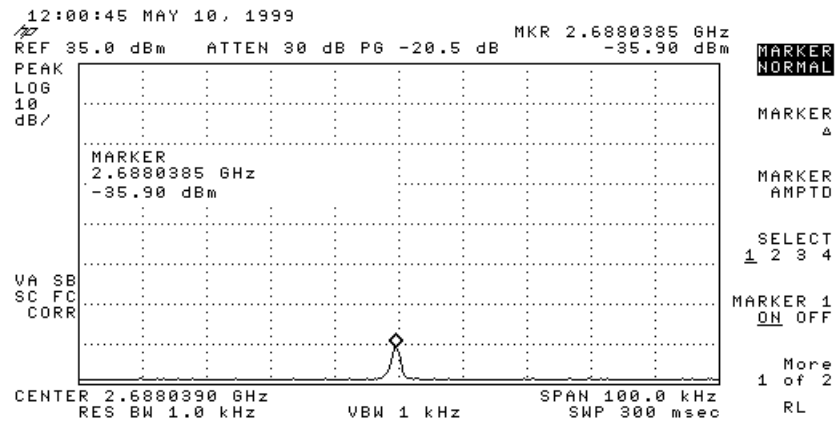
Test Limit: $50 + 10 \log(2W) = 53 \text{ dBc} = -20 \text{ dBm absolute}$

Test Indication: -37.9 dBm

Test Outcome: -37.9 dBm < -20 dBm → PASS

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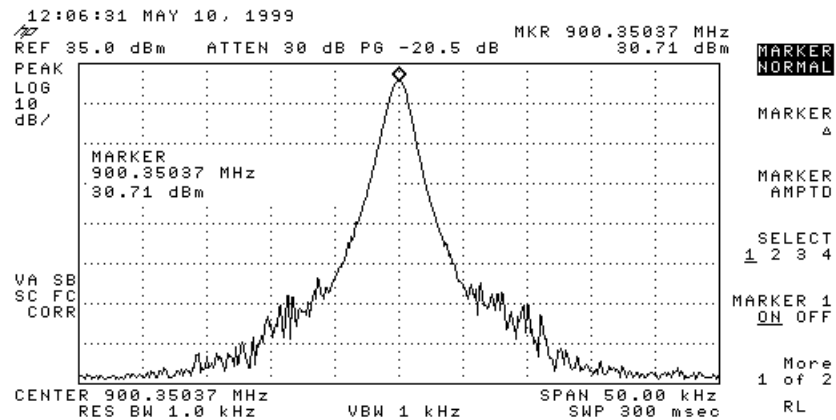
Test Condition: Channel 481, +30.6 dBm output power

Test Limit: $50 + 10 \log(2W) = 53 \text{ dBc} = -20 \text{ dBm absolute}$

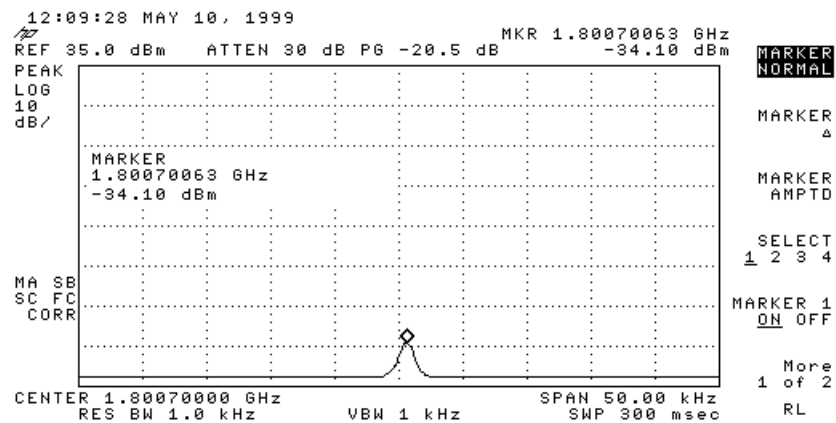
Test Indication: -35.9 dBm

Test Outcome: -35.9 dBm < -20 dBm → PASS

All other harmonics are < -40 dBm → PASS



Test Condition: Channel 828, +33 dBm nominal output power, +30.7 dBm actual.



Test Condition: Channel 828, +30.7 dBm output power

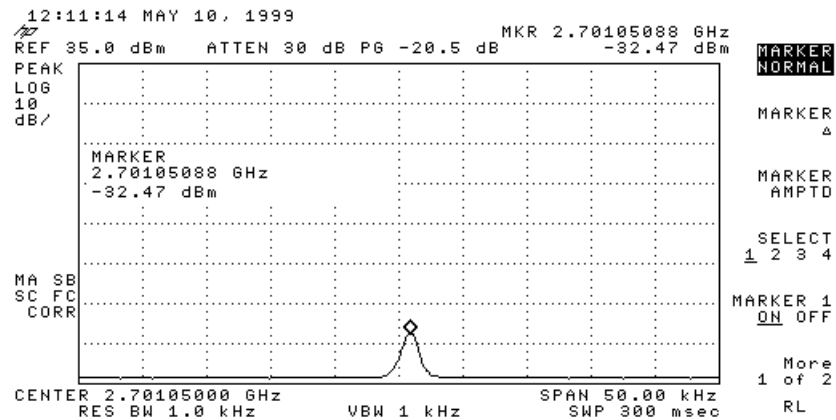
Test Limit: $50 + 10 \log(2W) = 53 \text{ dBc} = -20 \text{ dBm absolute}$

Test Indication: -34.1 dBm

Test Outcome: -34.1 dBm < -20 dBm → PASS

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Test Condition: Channel 828, +30.7 dBm output power

Test Limit: $50 + 10 \log(2W) = 53 \text{ dBc} = -20 \text{ dBm absolute}$

Test Indication: -32.5 dBm

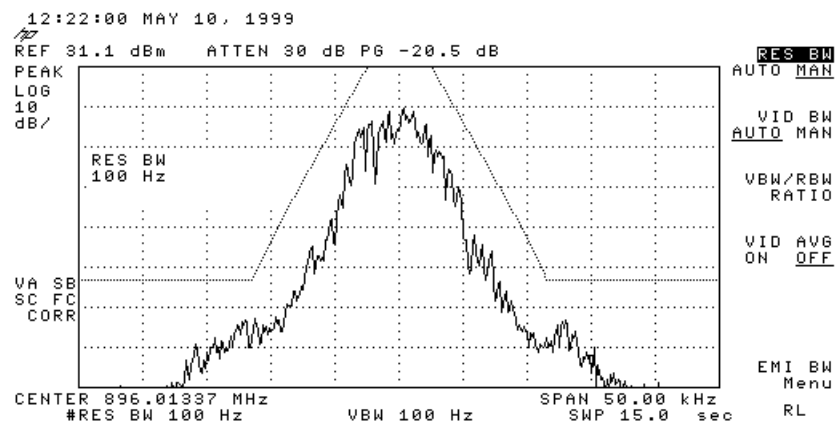
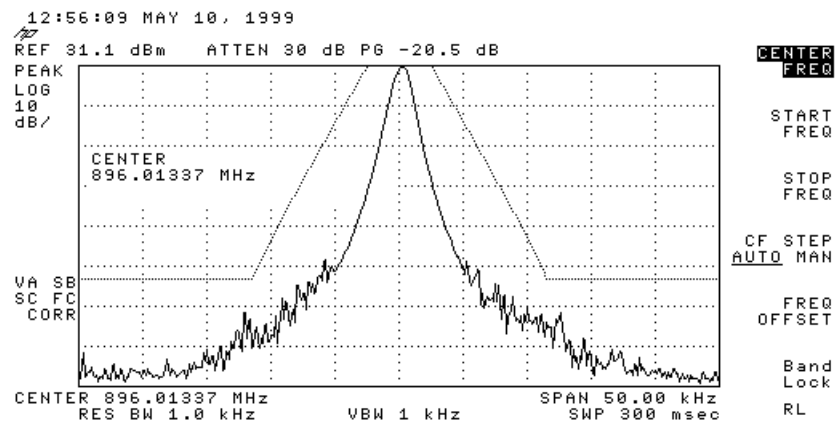
Test Outcome: -32.5 dBm < -20 dBm → PASS

All other harmonics are < -40 dBm → PASS



f) Test Indications Part 2. 989 Occupied Bandwidth

1. Deviation Set for normal operating conditions
2. Reference Level setting under these conditions:
 - (a) Span = 50 kHz.
 - (b) Resolution Bandwidth = 1 kHz.
 - (c) Video Bandwidth = 1 kHz.
 - (d) Peak hold and Display, Set Reference Level to Peak.
4. Measurement Indication under these conditions:
 - (a) Span = 50 kHz
 - (b) Resolution Bandwidth = 100 Hz.
 - (c) Video Bandwidth = 100 Hz.



Test Condition: 150 MHz, 125 mW
Test Limit: Indicated Mask 90.210(j)
Test Indication: Indicated Spectrum falls below Indicated Mask
Test Outcome: Spectrum falls below Indicated Mask → PASS

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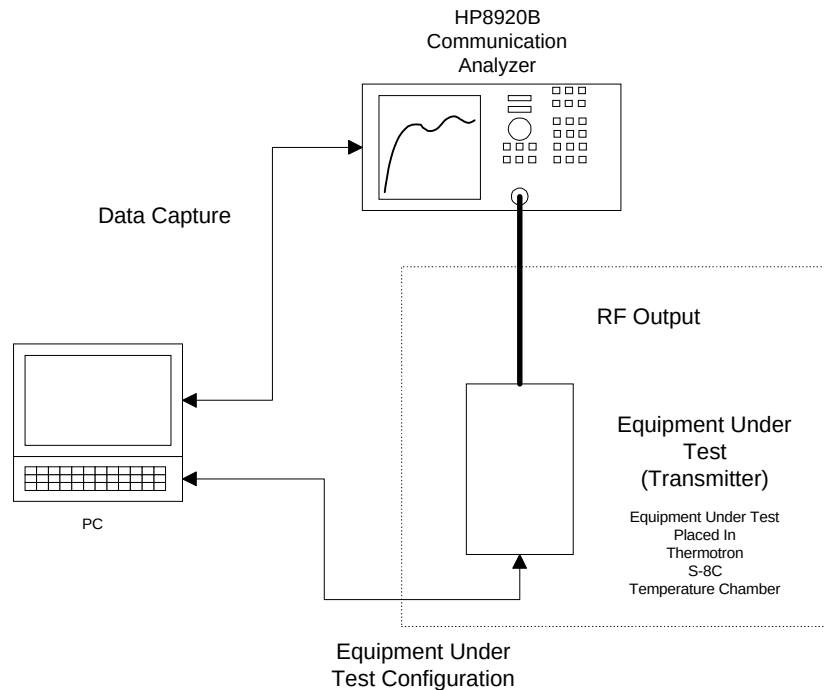
4. Part 2.995 and 90.213 (a) Frequency Stability

a) Test Requirement

Stations below 2W output power must have an absolute frequency stability of **1.5 ppm** when operating in the 896 to 901 MHz band.

Test in accordance to conditions called out in Part 2.995 (a) (1):
Frequency stability must be measured from **-30 to 50 degrees centigrade for (b) steps of 10 degrees** allowing for thermal equilibrium.

b) Test Configuration





c) Test Conditions, Numerical Test Indications

Nominal Frequency: 896.0125

Set T (deg C)	Actual T (Deg C)	f (MHz)	Error (kHz)	ppm w.r.t 23 deg C	ppm absolute
-30	-29.2	896.013808	1.31	1.00	1.46
-20	-20.6	896.013653	1.15	0.83	1.29
-10	-10.0	896.013211	0.71	0.33	0.79
0	-0.6	896.013131	0.63	0.25	0.70
10	11.6	896.013115	0.61	0.23	0.69
20	20.6	896.012976	0.48	0.07	0.53
23	22.8	896.012911	0.41	0.00	0.46
30	32.2	896.012670	0.17	-0.27	0.19
40	41.7	896.012433	-0.07	-0.53	-0.07
50	50.6	896.012386	-0.11	-0.59	-0.13

Test Condition: 896.0125 MHz, +20 dBm, (-30 deg. C to 50 deg C, 10 degree steps)

Test Limit: 1.5 ppm Maximum Frequency Offset

Test Indication:

Maximum Frequency Offset is 1.46 ppm absolute and 1.00 ppm relative to 25 deg C.

Test Outcome: 1.46 ppm < 1.5 ppm → PASS



III. Equipment List

Equipment	LSR Serial No.	Serial Number	Calibration
HP8596E Spectrum Analyzer	CC000130C	3205A00103	
HP8920B Communication Test Set	-	US36492280	3/25/99
HP53310 Modulation Domain Analyzer	CC000124C	On Record	12/12/95
Thermotron S-8C Temp Chamber	CC000210C	On Record	6/5/98
HP33120 Arb. Waveform Synthesizer	CC000181C	On Record	9/29/97

IV. Equipment Uncertainties

Specified Characteristic	Specified Probability Density	Specified Uncertainty
HP8596E Spectrum Analyzer		
Reference Level Accuracy	Uniform	+/-0.3 dB +0.01 X dB from -20 dbm
Calibrator Output	Uniform	+/-0.4 dB
Absolute Amplitude Calibration Uncertainty	Uniform	+/-0.15 dB
Gigatronics 86301A Sensor Calibration Factor	Uniform	1.33%
HP53310 Modulation Domain Analyzer CHAN A ,B		
Absolute Frequency Accuracy (OPT 010)		< 5 X 10 ⁻⁹
Frequency Resolution		
Time: 2 mS/div , Tsamp=100uS, f=200 MHz	Gaussian	100 Hz rms
Time: 20 mS/div , Tsamp=1 mS, f=200 MHz	Gaussian	2 Hz rms
Time Interval Error		
Tsamp=100 uS	Gaussian	100 ps rms
Tsamp=1 mS	Gaussian	1nS rms
HP8920B Communication Test Set		
Audio Output Frequency Accuracy	Uniform	0.025%
Audio Output Level Accuracy	Uniform	+/-2% Vset +/- 50 uV
Frequency Deviation Accuracy	Uniform	+/- 4% Reading + 7 Hz rms
Thermotron S-8C Temp. Chamber		
Temperature Accuracy	Uniform	+/- 0.3 deg C

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V. Uncertainty Analysis

HP Spectrum Analyzer Total Uncertainty (-60 dBm level):

Perform Root-Sum-Square of three uncertainties to find total uncertainty for a 95% confidence level:

Uniform uncertainties specify the probability density interval $\pm a$. The variance of the uniform density is $a^2/3$.

Sum the uncorrelated variances to find the total variance:

$$\text{Total variance} = [(0.3 \text{ dB} + 0.01 \bullet 40 \text{ dB})/3 + (0.4)/3 + (0.15)/3] = 1.25/3 = 0.416$$

The uncertainty for a 95% confidence interval is 1.96 times the standard deviation:

$$\text{Total Uncertainty} = \pm 1.96 \bullet \sqrt{0.416} = 1.96 \bullet 0.644 = \pm 1.26 \text{ dB}$$