Intertek Testing Services

TestMark Laboratories

Evaluation For: TELEX COMMUNICATIONS Product: Liberation SPECTRE (Wireless Base)

3/4/99

TEST EQUIPMENT SUMMARY

List of Test Equipment:

ТҮРЕ	MANUFACTURER	MODEL	SERIAL NUMBER
LISN Quasi-Peak Adapter Spectrum Analyzer Spectrum Analyzer Display Electromagnetic Shielded Enclosure Preamplifier RF Preselector 12" Active Loop Antenna	Solar Hewlett Packard Hewlett Packard Hewlett Packard Rantec Hewlett Packard Hewlett Packard A.H. Systems	FCC 8012-50-R 24BNC 85650A 8568B 85662A SpaceSaver Model 25 8447D 85685A SAS-200/563B	814068 2043A00311 2338A03026 2344A05922 None 1937A01821 2510A00191

Project: 99-0241-AR-002 10 of 32 Final Report

Intertek Testing Services

TestMark Laboratories

Evaluation For: TELEX COMMUNICATIONS Product: Liberation SPECTRE (Wireless Base)

3/4/99

CONDUCTED EMISSIONS

Test Engineer:

Bryan Tucker

Test Date:

2/24/99

Test Location:

ITS-Lexington, Kentucky

Test Criteria:

Frequency	Section 15.107(a)		
(MHz)	Class B		
	(μV)	(dBµV)	
0.45 to 1.705	250	48.0	
1.705 to 30.000	250	48.0	

Note: The following sets of units are commonly used for EMI measurement:

- Decibels below one milliwatt (-dBm)
- . Decibels above one microvolt $(dB\mu V)$
- . Microvolt (μ V)

To convert between these units, use the following formulas:

- $20 \log_{10}(\mu V) = dB\mu V$
- $. \qquad \mathsf{dBm} = \mathsf{dB}\mu\mathsf{V-}\mathsf{107}$

Intertek Testing Services TestMark Laboratories

Evaluation For: TELEX COMMUNICATIONS Product: Liberation SPECTRE (Wireless Base)

3/4/99

CONDUCTED EMISSIONS, Continued

Test Procedure:

The conducted RF measurements were performed as follows:

- The EUT was connected to a 120 VAC source through a line impedance stabilization network (LISN). Test connections are shown in **Figure 1** at the end of this report.
- The position of each cable was varied to find the configuration that maximized each emission.

Test Configuration & Conditions:

FCC Part 15 Conducted tests were performed on the Liberation SPECTRE (Wireless Base) configured as follows as shown in **Figure 3**. A phone call was made using the wireless headset. During all testing this phone call was active with ambient noise.

Project: 99-0241-AR-002 4 of 32 Final Report

Evaluation For: TELEX COMMUNICATIONS

Product: Liberation SPECTRE (Wireless Base)

3/4/99

CONDUCTED EMISSIONS, Continued

Test Results:

All EUT measured emissions were less than the required limits. No configuration could be found that resulted in the limit being exceeded.

Six Highest Conducted Peaks					
Frequency (MHz)	Peak Amplitude (dB μ V)	Class B Limit (dBµV)	Limit Delta (dB)	Line Phase/ Neutral	Results
0.45	34.3	48.0	-13.7	Phase	Compliant
0.45	33.1	48.0	-14.9	Neutral	Compliant
0.50	32.8	48.0	-15.2	Phase	Compliant
14.3	31.7	48.0	-16.3	Neutral	Compliant
7.34	31.1	48.0	-16.9	Phase	Compliant
0.50	30.0	48.0	-18.0	Neutral	Compliant

Evaluation For: TELEX COMMUNICATIONS

Product: Liberation SPECTRE (Wireless Base)

3/4/99

RADIATED EMISSIONS

Test Engineer: Brian Tucker

Test Date: 3/4/99

Test Location: ITS-Lexington, Kentucky

Test Criteria:

Frequency (MHz)	Field Strength (uV/meter)	Field Strength (dBuV/meter)	Measurement distance (meters)
0.009 - 0.490	2400/F(kHz)	20Log[2400/F(kHz)]	300
0.490 – 1.705	24000/F(kHz)	20Log[42000/F(kHz)]	30
1.705 – 30.0	30.0	29.5	30
30.0 – 88.0	100.0	40.0	3
88.0 - 216.0	150.0	43.5	3
216.0 - 960.0	200.0	46.0	3
Above 960.0	500.0	54.0	3

Note: The following sets of units are commonly used for EMI measurement:

- Decibels below one milliwatt (-dBm)
- . Decibels above one microvolt (dB μ V)
- . Microvolt (μV)

To convert between these units, use the following formulas:

- $20 \log_{10}(\mu V) = dB\mu V$
- $. \qquad \mathsf{dBm} = \mathsf{dB}\mu\mathsf{V}\text{-}\mathsf{107}$

All measurements were performed at 1 meter. In order to extrapolate the appropriate limit at 1 meter the following calculation was performed (Note that this example calculation is performed at 1.82 MHz):

Limit at 1 meter = $40 \log_{10} (30 \text{m}/1 \text{m}) + 20 \log_{10} (30) = 88.6 \text{ dB}\mu\text{V/m}$

Evaluation For: TELEX COMMUNICATIONS

Product: Liberation SPECTRE (Wireless Base)

3/4/99

RADIATED EMISSIONS, Continued

Test Criteria, Continued:

Example of Field Strength Calculation Method

The measured field strength is calculated by summing the readings taken from the spectrum analyzer with the appropriate correction factors associated with the antenna losses and cable losses. The calculation formula and sample calculation are listed below.

Formula:

FS = RA + AF + CF

 $FS = Field Strength in dB_{\mu}V/m$

 $RA = Receiver Amplitude (Quasi-Peak) in dB_{<math>\mu$}V

AF = Antenna Factor in dB

CF = Cable Attenuation Factor in dB

Sample From Measurement Table:

 $RA = 39.1 dB_{\mu}V$ (The Worst-Case Emission Frequency)

AF = 33.5 dB

CF = 0.2 dB

$$FS \,=\, 39.1 \,+\, 33.5 \,+\, 0.2 \,=\, 72.8 \; dB_{\mu}V/m$$

Level in $\mu V/m$ = Common Antilogarithm [(72.8 dB $_{\mu}V/m$)/20] = 4365.1 $_{\mu}V/m$

Measurement Uncertainty Data for TestMark Laboratories

Conducted Emissions:

± 2.5 dB, 9 kHz to 150 kHz ± 2.8 dB, 150 kHz to 30 kHz

Radiated Emissions:

 \pm 4.8 dB, at 3 and 10 meters, 30 MHz to 200 MHz

+5.3 dB, -3.9 dB at 3 meters, 200 MHz to 1 GHz

 \pm 3.8 dB, at 10 meters, 200 MHz to 1 GHz

Evaluation For: TELEX COMMUNICATIONS
Product: Liberation SPECTRE (Wireless Base)

3/4/99

RADIATED EMISSIONS, Continued

Test Procedure:

A "footprint" emissions scan of the EUT was performed in a shielded enclosure. Radiated measurements were made on a 3-meter open field test site as follows:

- The EUT and the associated cables and peripherals were assembled and placed on the open field test site. Figure 1 details the arrangement of equipment on the test site.
- The EUT was powered and its functions and features were exercised during the testing process.
- The position of each connecting cable was varied to find the configuration that maximized each emission.
- An ambient emissions scan was performed over the required frequency range prior to energizing the EUT.
- This scan was compared to the composite EUT scan (EUT energized) to help identify and separate emitted RF from local ambient emissions.
- A loop antenna was used to scan from 1.5 MHz to 21.0 MHz. This frequency range was selected so as to encompass the fundamental (1.82 MHz) and the tenth harmonic of the fundamental (20.02 MHz).
- Each frequency range was measured with the receiving antenna polarized horizontally and again with it polarized vertically.
- Suspect peaks were monitored using the quasi peak detector and the EUT power cycled to verify the source of the emissions.

Test Configuration & Conditions:

FCC Part 15 Radiated tests were performed on the Liberation SPECTRE (Wireless Base) configured as follows:

The Liberation SPECTRE was connected as shown in **Figure 3**. A phone call was made using the wireless headset. During all testing this phone call was active with ambient noise .

Project: 99-0241-AR-002 8 of 32 Final Report

Evaluation For: TELEX COMMUNICATIONS Product: Liberation SPECTRE (Wireless Base)

3/4/99

RADIATED EMISSIONS, Continued

Test Results:

All EUT measured emissions were less than the required limits. No configuration could be found that resulted in the limit being exceeded.

	Six Highest Radiated Peaks (Measured at 3 meters)				
Frequency (MHz)	Peak Amplitude (dB <i>µ</i> V/m)	Class B Limit (dBµV/m)	Limit Delta (dB)	Polarization (H/V) and Axis	Results
1.82	72.8	88.6	-15.8	V	Compliant
*	*	*	*	*	Compliant
*	*	*	*	*	Compliant
*	*	*	*	*	Compliant
*	*	*	*	*	Compliant
*	*	*	*	*	Compliant

^{*} All other emissions were below the ambient noise floor.

Project: 99-0241-AR-002 9 of 32 Final Report

Evaluation For: TELEX COMMUNICATIONS Product: Liberation SPECTRE (Wireless Base)

3/4/99

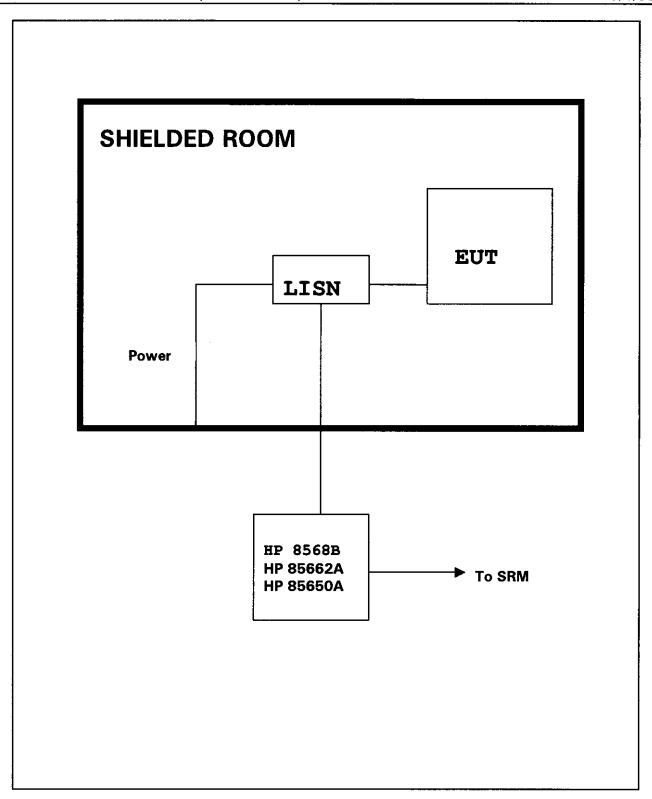
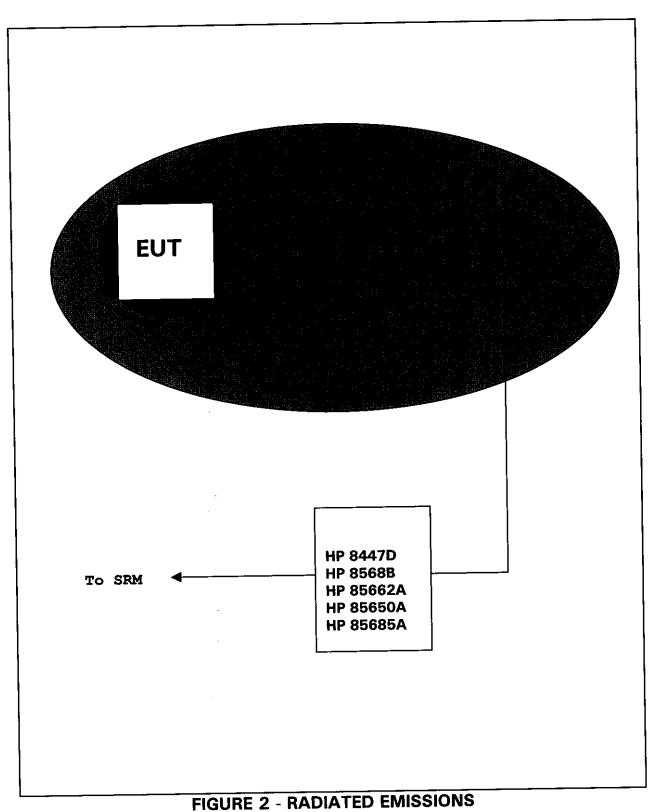


FIGURE 1 - CONDUCTED EMISSIONS

Project: 99-0241-AR-002 24 of 32 Final Report

3/4/99 Product: Liberation SPECTRE (Wireless Base)



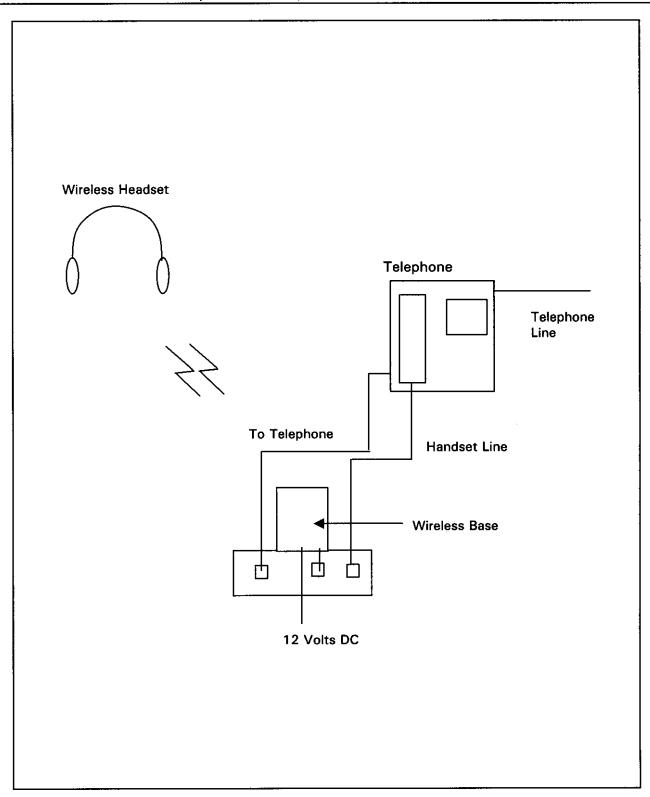


FIGURE 3 - EQUIPMENT CONFIGURATION

Project: 99-0241-AR-002 26 of 32 Final Report