

Intertek Testing Services**TestMark Laboratories**

Evaluation For: TELEX COMMUNICATIONS

Product: Liberation SPECTRE (Wireless Base)

3/4/99

TEST EQUIPMENT SUMMARY**List of Test Equipment:**

TYPE	MANUFACTURER	MODEL	SERIAL NUMBER
LISN	Solar	FCC 8012-50-R 24BNC	814068
Quasi-Peak Adapter	Hewlett Packard	85650A	2043A00311
Spectrum Analyzer	Hewlett Packard	8568B	2338A03026
Spectrum Analyzer Display	Hewlett Packard	85662A	2344A05922
Electromagnetic Shielded Enclosure	Rantec	SpaceSaver Model 25	None
Preamplifier	Hewlett Packard	8447D	1937A01821
RF Preselector	Hewlett Packard	85685A	2510A00191
12" Active Loop Antenna	A.H. Systems	SAS-200/563B	307

CONDUCTED EMISSIONS**Test Engineer:** Bryan Tucker**Test Date:** 2/24/99**Test Location:** ITS-Lexington, Kentucky**Test Criteria:**

Frequency (MHz)	Section 15.107(a) Class B	
	(μ V)	(dB μ V)
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 μ V)
- . Microvolt (μ V)

To convert between these units, use the following formulas:

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

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 .

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 (dB μ V)	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

RADIATED EMISSIONS**Test Engineer:** Brian Tucker**Test Date:** 3/4/99**Test Location:** ITS-Lexington, Kentucky**Test Criteria:**

Frequency (MHz)	Field Strength ($\mu\text{V}/\text{meter}$)	Field Strength ($\text{dB}\mu\text{V}/\text{meter}$)	Measurement distance (meters)
0.009 – 0.490	2400/F(kHz)	$20\text{Log}[2400/\text{F}(\text{kHz})]$	300
0.490 – 1.705	24000/F(kHz)	$20\text{Log}[42000/\text{F}(\text{kHz})]$	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 ($\text{dB}\mu\text{V}$)
- . Microvolt (μV)

To convert between these units, use the following formulas:

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

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):

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

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 $\text{dB}_{\mu}\text{V/m}$

RA = Receiver Amplitude (Quasi-Peak) in dB_{μ}V

AF = Antenna Factor in dB

CF = Cable Attenuation Factor in dB

Sample From Measurement Table:

RA = 39.1 dB_{μ}V (The Worst-Case Emission Frequency)

AF = 33.5 dB

CF = 0.2 dB

$$FS = 39.1 + 33.5 + 0.2 = 72.8 \text{ dB}_{\mu}\text{V/m}$$

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

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:

± 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

± 3.8 dB, at 10 meters, 200 MHz to 1 GHz

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 .

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 μ V/m)	Class B Limit (dB μ V/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.

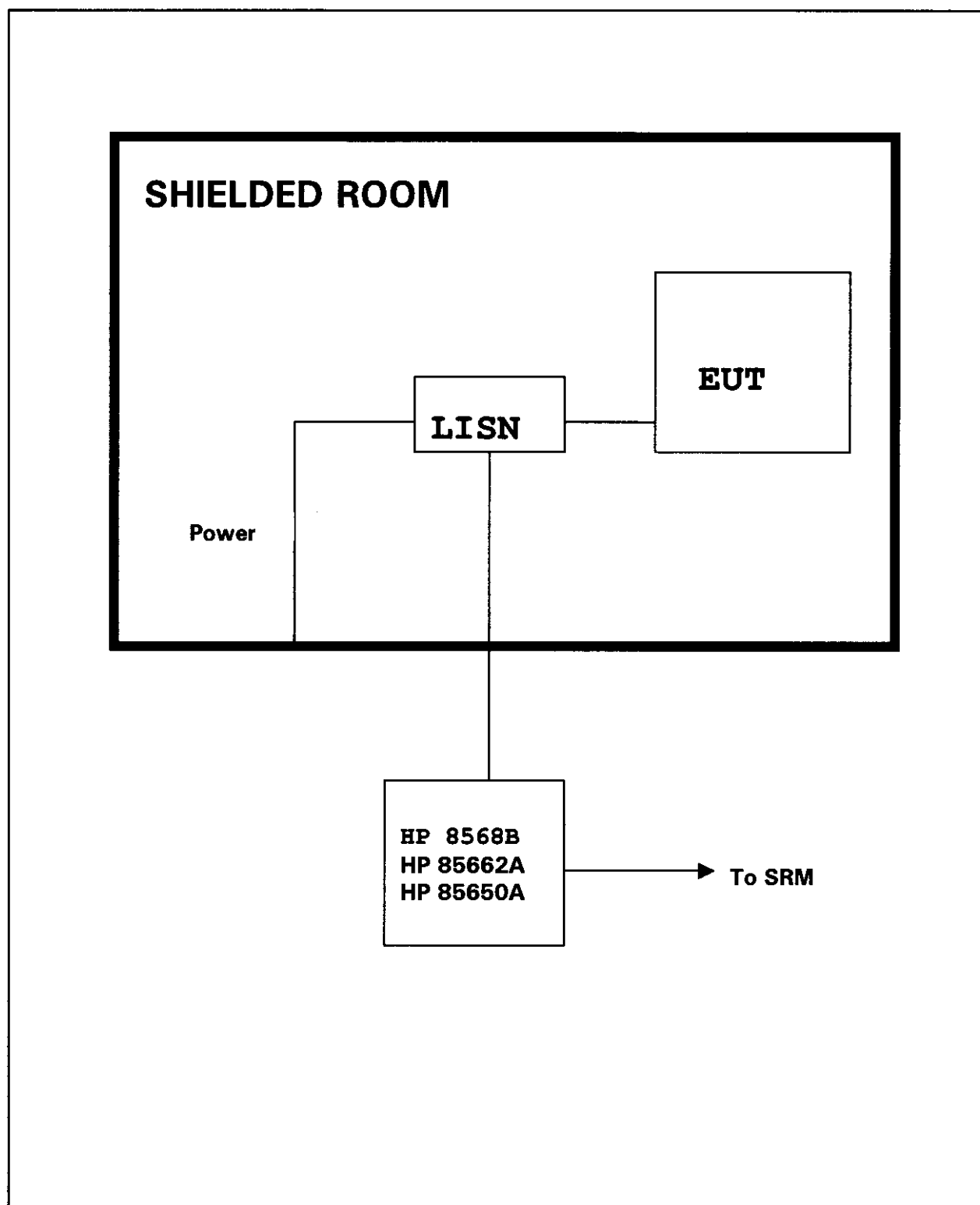


FIGURE 1 - CONDUCTED EMISSIONS

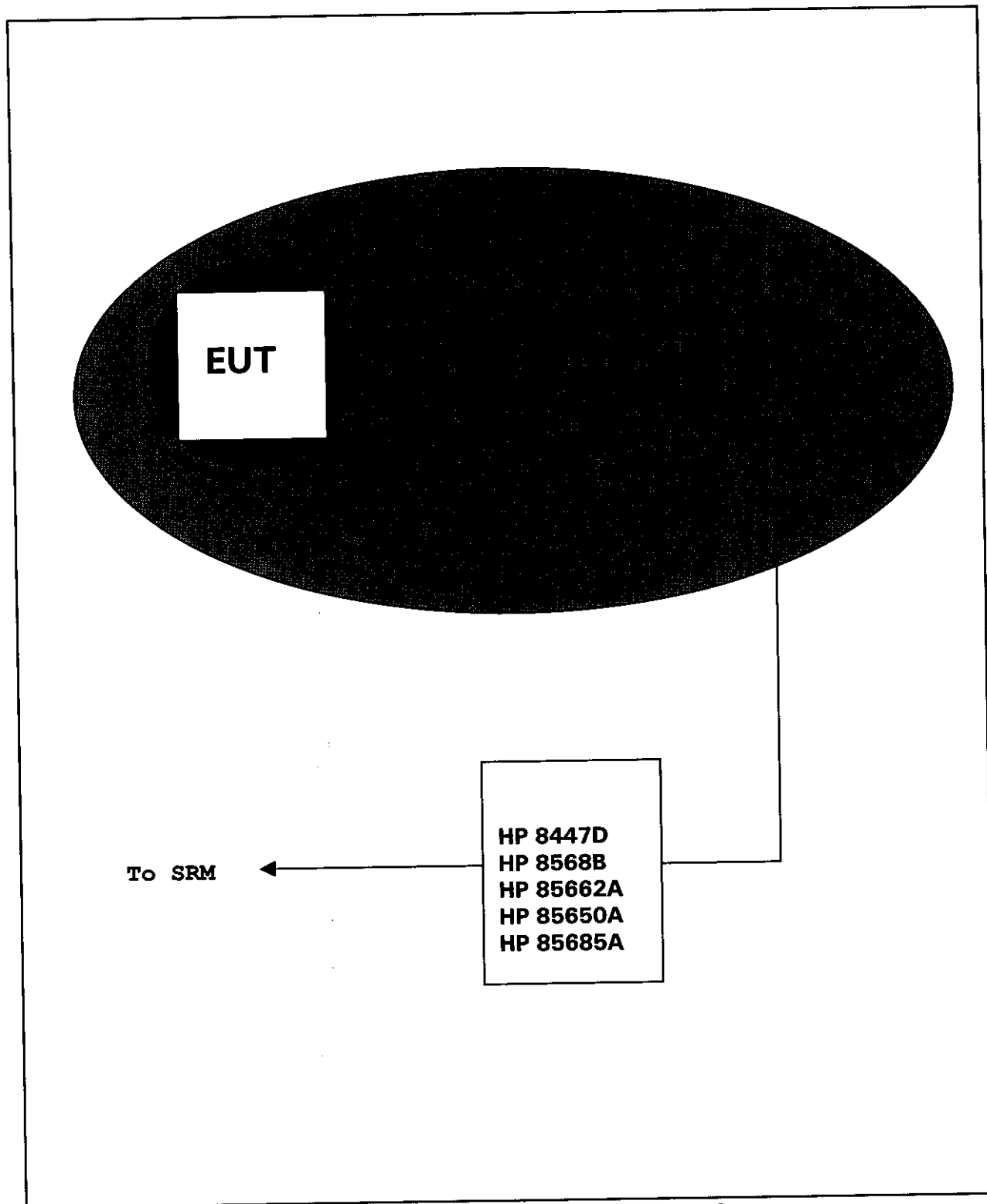


FIGURE 2 - RADIATED EMISSIONS

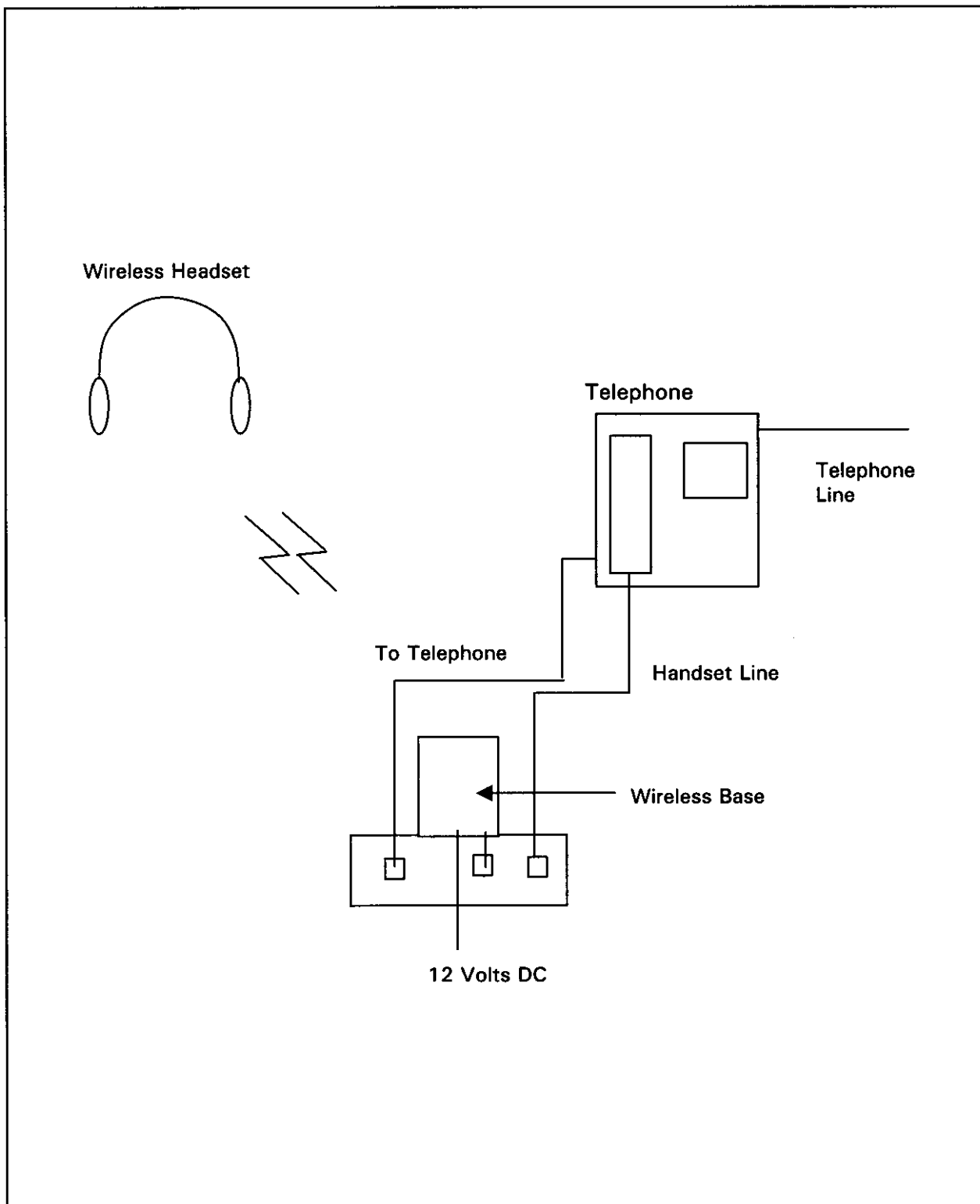


FIGURE 3 - EQUIPMENT CONFIGURATION