Intertek Testing Services

APPLICATION FOR FCC CERTIFICATION

GVC Corporation

900 MHz DSSS Cordless Telephone

Model: MH9082

FCC ID: DK4MH9082

Job # J99016614

Number of Pages: 17

Date of Report: July 24, 1999

NVLAP®

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1.0 Summary of Tests

GVC Corporation - Model No.: MH9082
FCC ID: DK4MH9082

TEST	REFERENCE	RESULTS
Max. Output power	15.247(b)	Pass
6 dB Bandwidth	15.247(a)(2)	Pass
Max. Power Density	15.247(d)	Pass
Out of Band Antenna Conducted Emission	15.247(c)	Pass
Out of Band Radiated Emission	15.247(c)	N/A
Radiated Emission in Restricted Bands	15.35(b)(c)	Pass
AC Conducted Emission	15.207	Pass
Radiated Emission from Digital Part	15.109	Pass
Radiated Emission from Receiver L.O.	15.109	Not Applicable
Processing Gain Measurements	15.247(e)	Provided by applicant
Antenna Requirement	15.203	Pass*

* EUT has non-detachable antenna.

Test Engineer: Xi-Ming Yang
Xing-ming Yang
Date: July 24, 1999

Telco Manager:
C.K. Li
Date: July 25, 1999

2.0 General Description

2.1 Product Description

The GVC Model No.: MH9082 is a 900 MHz DSSS digital cordless telephone.

A pre-production version of the sample was received on June 15, 1999 in good condition.

Overview of **900 MHz DSSS Cordless Telephone**

Applicant	**GVC Corporation**
Trade Name & Model No.	**GVC Corporation, MH9082**
FCC Identifier	**DK4MH9082**
Use of Product	Cordless Telephone
Manufacturer & Model of Spread Spectrum Module	GVC Corporation
Type of Transmission	Direct Sequence
Rated RF Output (mW)	100
Frequency Range (MHz)	903.6 - 926.44
Number of Channel(s)	20
Antenna(s) & Gain, dBi	0
Processing Gain Measurements	[X] Will be provided to ITS for submission with the application [ ] Will be provided directly to the FCC reviewing engineer by the client or manufacturer of the spread spectrum module
Antenna Requirement	[X] The EUT uses a permanently connected antenna. [ ] The antenna is affixed to the EUT using a unique connector which allows for replacement of a broken antenna, but DOES NOT use a standard antenna jack or electrical connector. [ ] The EUT requires professional installation (attach supporting documentation if using this option).
Manufacturer name & address	GVC Corporation 4F, No. 6, Lane 359, Sec. 2, Chung-shan Rd., Chung-Ho, Taipei, Taiwan, R.O.C.

2.2 Related Submittal(s) Grants

None.

2.3 Test Methodology

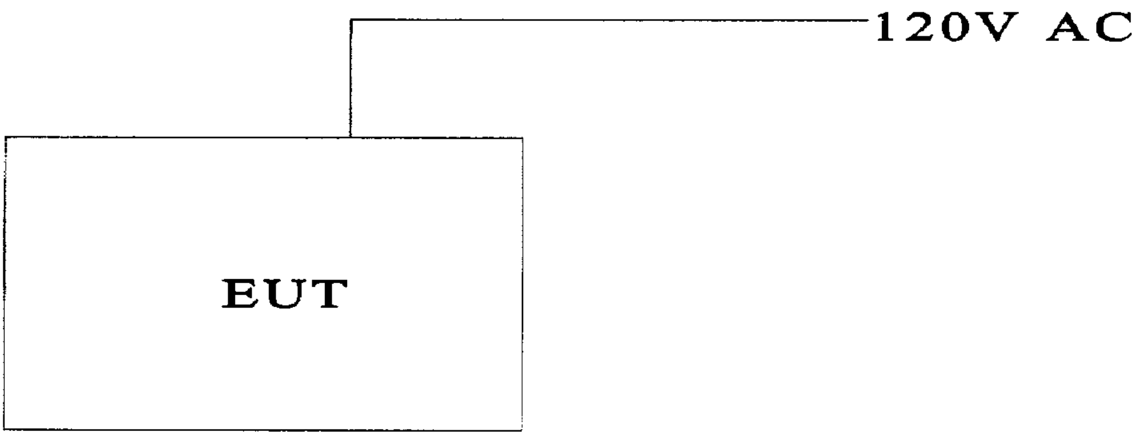
Both AC mains line-conducted and radiated emissions measurements were performed according to the procedures in ANSI C63.4 (1992). Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "**Data Sheet**" of this Application. All other measurements were made in accordance with the procedures in part 2 of CFR 47.

2.4 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is site 1. This test facility and site measurement data have been fully placed on file with the FCC and NVLAP accredited.

3.0 System Test Configuration

3.1 Support Equipment and description



None, the EUT is a standalone device.

3.2 Block Diagram of Test Setup

3.3 Justification

For emission testing, the equipment under test (EUT) was configured for testing in a typical fashion (as a customer would normally use it). During testing, all cables were manipulated to produce worst case emissions.

For radiated emission measurements, the EUT is attached to a cardboard box (if necessary) and placed on the wooden turntable. If the EUT attaches to peripherals, they are connected and operational (as typical as possible). The EUT is wired to transmit full power without modulation.

The signal is maximized through rotation and placement in the three orthogonal axes. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters. Detector function is in peak mode. Radiated emissions are taken at three meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance.

All readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance.

3.4 Software Exercise Program

The EUT exercise program used during radiated and conducted testing was designed to exercise the various system components in a manner similar to a typical use. For emissions testing, the units were setup to transmit continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing.

3.5 Mode of Operation During Test

The EUT was running in a transmitting mode.

3.6 Modifications Required for Compliance

The following modifications were installed during compliance testing in order to bring the product into compliance (Please note that this list does not include changes made specifically by GVC Corporation prior to compliance testing):

No modifications were made to the EUT by Intertek Testing Services.

3.7 Additions, deviations and exclusions from standards

No additions, deviations or exclusion have been made from standard.

4.0 Measurement Results

4.1 Maximum Conducted Output Power at Antenna Terminals, FCC Rules 15.247(b):

[ ] The antenna port of the EUT was connected to the input of a power meter. Power was read directly and cable loss correction was added to the reading to obtain power at the EUT antenna terminals.

[X] The antenna port of the EUT was connected to the input of a spectrum analyzer. The analyzer was set for maximun RES BW and power was read directly in dBm. External attenuation and cable loss were compensated for using the OFFSET function of the analyzer.

For antennas with gains of 6 dBi or less , maximum allowed transmitter output is 1 watt (+30 dBm).

For antennas with gains greater than 6 dBi, transmitter output level must be decreased by an amount equal to (GAIN - 6) dBm.

(Base Unit)		
Frequency (MHz)	Output in dBm	Output in mWatt
Low Channel: 904.2	13.8	24.0
Middle Channel: 914.4	12.3	17.0
High Channel: 925.7	13.0	20.0

Cable loss: 1.5 dB External Attenuation: 0 dB

Cable loss, external attenuation: [X] included in OFFSET function
[ ]added to SA raw reading

EUT Transmit Antenna Gain(dBi) + dBm max. output level = 16.3 dBm (36 dBm or less)

Please refer to Appendix A for the plots:

Plot B1a: Low Channel Output Power
Plot B1b: Middle Channel Output Power
Plot B1c: High Channel Output Power

(Handset Unit)		
Frequency (MHz)	Output in dBm	Output in mWatt
Low Channel: 904.2	10.1	10.2
Middle Channel: 914.4	10.3	10.7
High Channel: 925.7	9.8	9.5

Cable loss: 0 dB External Attenuation: 0 dB

Cable loss, external attenuation: [X] included in OFFSET function
[ ]added to SA raw reading

EUT Transmit Antenna Gain(dBi) + dBm max. output level = 17.2 dBm (36 dBm or less)

Please refer to Appendix A for the plots:

Plot H1a: Low Channel Output Power
Plot H1b: Middle Channel Output Power
Plot H1c: High Channel Output Power

4.2 Minimum 6 dB RF Bandwidth, FCC Rule 15.247(a)(2):

The antenna port of the EUT was connected to the input of a spectrum analyzer. Analyzer RES BW was set to 100 kHz. For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier. A PEAK output reading was taken, a DISPLAY line was drawn 6 dB lower than PEAK level. The 6 dB bandwidth was determined from where the channel output spectrum intersected the display line.

(Base Unit)	
Frequency (MHz)	Max. 6 dB Bandwidth (kHz)
914.34	1497

(Handset Unit)	
Frequency (MHz)	Max. 6 dB Bandwidth (kHz)
925.78	1494

Refer to Appendix B for the following plots:

Plot B2a: Low Channel 6 dB RF Bandwidth
Plot B2b: Middle Channel 6 dB RF Bandwidth
Plot B2c: High Channel 6 dB RF Bandwidth
Plot H2a: Low Channel 6 dB RF Bandwidth
Plot H2b: Middle Channel 6 dB RF Bandwidth
Plot H2c: High Channel 6 dB RF Bandwidth

4.3 Maximum Power Density Reading, FCC Rule 15.247(d):

The spectrum analyzer RES BW was set to 3 kHz. The START and STOP frequencies were set to the band edges of the maximum output passband. If there is no clear maximum amplitude in any given portion of the band, it may be necessary to make measurements at a number of bands defined by several START and STOP frequency pairs. The specification calls for a 1 second interval at each 3 kHz bandwidth; total SWEEP TIME is calculated as follows:

SWEEP TIME (SEC) = (Fstop, kHz - Fstart, kHz)/3 kHz

Antenna output of the EUT was coupled directly to spectrum analyzer; if an external attenuator and/or cable was used, these losses are compensated for with the analyzer OFFSET function.

(Base Unit)	
Frequency (MHz)	Power Density (dBm)
904.7	1.7

(Handset Unit)	
Frequency (MHz)	Power Density (dBm)
903.9	3.2

Frequency Span = 600 kHz

Sweep Time = 600 Frequency Span/3 kHz
= 200 seconds

Refer to Appendix C for the following plots:

Plot B3a.1 - B3a.2 Low Channel Power Density
Plot B3b.1 - B3b.2 Middle Channel Power Density
Plot B3c.1 - B3c.2: High Channel Power Density
Plot H3a.1 - H3a.2 Low Channel Power Density
Plot H3b.1 - H3b.2 Middle Channel Power Density
Plot H3c.1 - H3c.2: High Channel Power Density

4.4 Out of Band Conducted Emissions, FCC Rule 15.247(c):

In any 100 kHz bandwidth outside the EUT passband, the RF power produced by the modulation products of the spreading sequence, the information sequence, and the carrier frequency shall be at least 20 dB below that of the maximum in-band 100 kHz emission, or else shall meet the general limits for radiated emissions at frequencies outside the passband, whichever results in lower attenuation.

All other types of emissions from the EUT shall meet the general limits for radiated frequencies outside the passband.

Refer to Exhibit 6d for the following plots:

Plot B4a.1 - B4a.3: Low Channel Emissions
Plot B4b.1 - B4b.3: Middle Channel Emissions
Plot B4c.1 - B4c.4: High Channel Emissions
Plot H4a.1 - H4a.3: Low Channel Emissions
Plot H4b.1 - H4b.3: Middle Channel Emissions
Plot H4c.1 - H4c.4: High Channel Emissions

4.5 Out of Band Radiated Emissions (for emissions in 4. above that are less than 26 dB below carrier), FCC Rule 15.247(c):

For out of band emissions that are close to or that exceed the 20 dB attenuation requirement described in the specification, radiated measurements were performed at a 3 m separation distance to determine whether these emissions complied with the general radiated emission requirement.

[x] Not required
[ ] See attached data sheet

4.6 Transmitter Radiated Emissions in Restricted Bands, FCC Rule 15.35(b), (c):

Radiated emission measurements were performed from 30 MHz to <10000> MHz. Analyzer resolution is 100 kHz or greater for 30 MHz to 1000 MHz, 1 MHz for >1000 MHz.

Data is included of the worst case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs and data tables of the emissions are included. All measurements were performed with peak detection unless otherwise specified.

Refer to Exhibit E for the data on the significant emission frequencies, the limit and the margin of compliance.

4.7 AC Line Conducted Emission, FCC Rule 15.207:

[ ] Not required; battery operation only

[x] Appendix F for the test data.

4.10 Radiated Emissions from Digital Section of Transceiver (Transmitter), FCC Ref: 15.109

[ ] Not required - No digital part

[X] Refer to Appendix G for the test results.

[ ] Included in the separate DOC report.

4.11 Radiated Emissions from Receiver Section of Transceiver (L.O. Radiation), FCC Ref: 15.109, 15.111

[X] Not required - EUT operation above 960 MHz only

[ ] Not required - EUT is transmitter only

[ ] Not performed; exempt until June 1999

[ ] Test results are attached

4.12 Processing Gain Measurements, FCC Rule 15.247(e)

The processing gain shall be determined from the ratio in dB of the signal to noise ratio with the system spreading code turned OFF, to the signal to noise ratio with the system spreading code turned ON, as measured at the demodulated output of the receiver. The processing gain shall be at least 10 dB for a direct sequence spread spectrum system.

	Refer to attached test procedure and data sheets.
X	Refer to circuit analysis and processing gain calculations provided by manufacturer.

4.13 Transmitter Duty Cycle Calculation and Measurements, FCC Rule 15.35(b), (c)

The EUT antenna output port was connected to the input of the spectrum analyzer. The analyzer center frequency was set to EUT RF channel carrier. The SWEEP function on the analyzer was set to ZERO SPAN. The transmitter ON time was determined from the resultant time-amplitude display:

Duty cycle = Maximum ON time in 100 msec/100

Duty cycle correction, dB = 20 * log(DC)

	See attached spectrum analyzer chart(s) for transmitter timing
	See transmitter timing diagram provided by manufacturer
X	Not applicable, duty cycle was not used.

Processing Gain Measurements for MH-9082 DCT TEST report

1.Introduction

1.1 Scope

This document is a GVC Engineering test report for MH-9082 DCT answering cordless phone.

This document details the results of measurement of the processing gain of a DCT phone.

1.2 Reference Documents

This section lists documents that are referenced within or are materially relevant to this document.

Code of Federal Regulations, Title 47, Chapter 1, Part 15 Radio Frequency Devices (FCC)

1.3 Definitions

FCC	Federal Communications Commission
SNR	Signal to Noise Ratio
JSR	Jammer to Signal Ratio
CW	Continuous wave (jammer)
HS	Handset
BS	Base station
DBPSK	Differential Binary Phase Shift Keying

Table 1: Definitions and Abbreviations

2.An Overview of the FCC Method for measuring Processing Gain

Two methods are specified for measuring processing gain by the FCC in 15.247 (e). The first method simply involves calculating the signal to ratio noise (SNR) with the spreading code switched on with the SNR when the spreading code is switched off. The difference between the two is the processing gain. The SNR is measured at the demodulated output of the receiver. In principle this an acceptable method to measure the processing gain of any direct sequence spread spectrum communication system, however, it does not take into consideration that the non-spread spectrum portion of the system may operate under the assumption that the signal being transmitted is a spread spectrum signal and when the spreading code is switched off the system may fail to operate or operate at greatly reduced efficiency. In either case the measurement of processing gain will be meaningless.

The second method specified by the FCC to measure processing gain is detailed in 15.247 (e)(1). This involves transmitting a CW jammer in the RF passband of the system and measuring the jammer to signal ratio (JSR) required to achieve a certain bit error rate. The choice of the actual value of the bit error rate is left up to the tester. The jammer is stepped in 50 kHz increments across the entire passband and in each case the JSR to achieve the desired bit error rate is measured. The JSR is measured at the RF input to the system under test. The lowest 20% of the JSR data (in dB) is discarded. The processing gain can then be calculated as follows:

$$G_p = \left(\frac{S}{N}\right)_{theory} + \left(\frac{J}{S}\right)_{measured} + L_{system}$$

where G_p is the processing gain, the SNR is that theoretically predicted for the system under the test to achieve the desired bit error rate, the JSR is the lowest value (in dB) in the remaining data set and L_{sys} adjusts for non-ideal system losses. L_{sys} can not be greater than 2 dB.

3. Processing Gain Measurement Results

The following parameters were used in the test setup.

HS Tx power (dBm)	-3.6	
BS LNA gain (dB)	0	
Testsystem losses (signal) (dB)	-14.5	-4.0 dB (system), -3.0 dB (signal combiner) -7.5 dB (cables Loss)
Test system losses (jammer) (dB)	-5.6	-3 dB (signal combiner), -2.6 dB (cable Loss)

Table 2: Test Setup Parameters

The following measurement results were taken at the basestation.

The desired bit error rate was set at 10^{-3}.

Jammer Frequency (MHz)	BER (BS)	Received jammer power (dBm)	Received signal power (dBm)	Jammer/Signal ratio (dB)
903.60	1.15×10^{-3}	-16.4	-18.2	1.8
904.80	9.76×10^{-4}	-16.3	-18.2	1.9
906.00	1.12×10^{-3}	-16.7	-18.4	1.7
907.20	1.23×10^{-3}	-16.1	-18.0	1.9
908.40	9.87×10^{-4}	-16.5	-18.8	2.3
909.60	9.94×10^{-4}	-16.2	-18.3	2.1
910.80	1.17×10^{-3}	-16.7	-18.7	2.0
912.00	9.69×10^{-4}	-16.8	-19.0	2.2
913.20	1.08×10^{-3}	-16.6	-18.4	1.8
914.40	1.25×10^{-3}	-17.0	-19.1	2.1
915.60	1.13×10^{-3}	-16.7	-19.0	2.3
916.80	9.91×10^{-4}	-17.5	-19.7	2.2
918.00	1.22×10^{-3}	-17.2	-18.9	1.7
919.20	9.88×10^{-4}	-17.5	-19.6	2.1
920.40	9.67×10^{-4}	-16.8	-19.2	2.4
921.60	1.38×10^{-3}	-17.6	-19.4	1.8
922.80	9.76×10^{-4}	-17.3	-19.5	2.2
924.00	1.43×10^{-3}	-17.0	-18.7	1.7
925.20	9.54×10^{-4}	-17.5	-19.6	2.1
926.40	1.36×10^{-3}	-17.7	-19.5	1.8

Table 3: Test Results

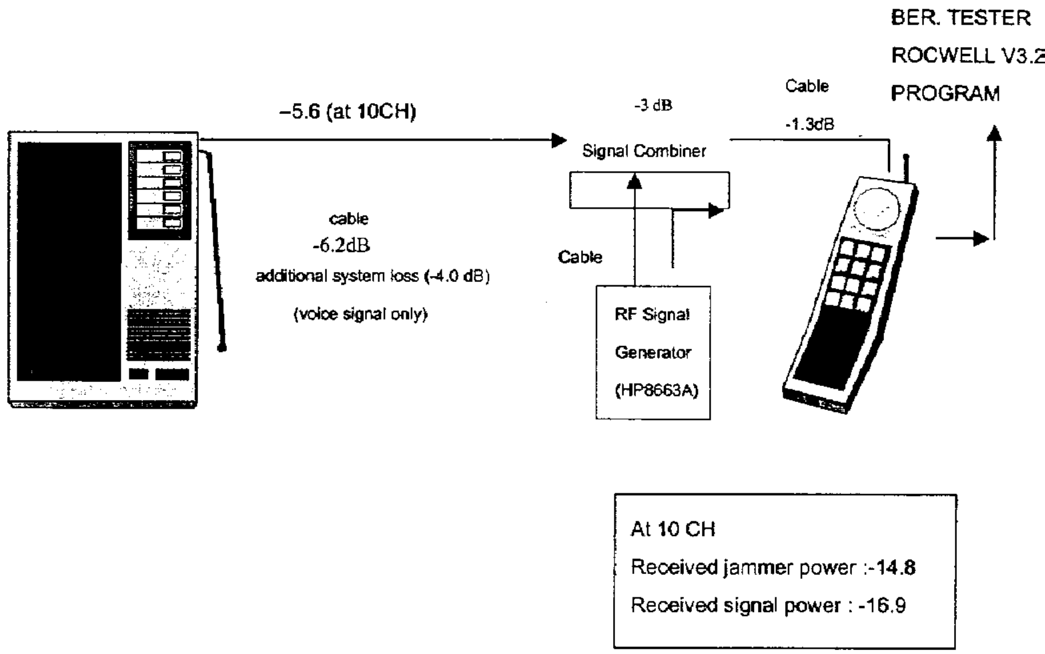


Figure 1: Test Setup

For DBPSK at 10^{-3} bit error rate the required SNR is 8.0 dB. Using the results above and the data in the table below the processing gain is calculated to be 12.1 dB.

required SNR (dB)	8.0
system losses (dB)	2.0
J/S ratio at 80% point (dB)	2.1
FCC Processing gain (dB)	12.1

Table 4: Processing Gain Calculation data

4. Conclusions

The result measured for processing gain of 12.1 dB is close to the actual processing gain due to a 12 chip spreading code of

$$10 \times \log_{10}(12) = 10.8\ dB$$

Appendices

List of Exhibits