Engineering and Testing for EMC and Safety Compliance

APPLICATION FOR FCC CERTIFICATION

DIRECT SEQUENCE SPREAD SPECTRUM TRANSMITTER

Samsung Electronics
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Model: SOLO 5350

FCC ID: A3L5350015318

July 30, 2001

STANDARDS REFERENCED FOR THIS REPORT	
PART 2: 1999	FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS
PART 15: 1999	RADIO FREQUENCY DEVICES

Frequency Range	Conducted Output Power (W)	Freq. Tolerance	Emission Designator

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Document Number: 2001201 / QRTL01-196

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1 INTRODUCTION

The following Application for FCC Certification and Industry Canada for a Direct Sequence Spread Spectrum transmitter is prepared on behalf of *Samsung Electronics* in accordance with Part 15.247 of the Federal Communications Commissions and RSS-210 for Industry Canada. The Equipment Under Test (EUT) was the Samsing SOLO 5350, *FCC ID:* A3L5350015318. The test results reported in this document relate only to the item that was tested.

All measurements contained in this Application were conducted in accordance with ANSI C63.4 Methods of Measurement of Radio Noise Emissions, 1992. The instrumentation utilized for the measurements conforms to the ANSI C63.4 standard for EMI and Field Strength Instrumentation. Some accessories are used to increase sensitivity and prevent overloading of the measuring instrument. These are explained in the appendix of this report. Calibration checks are performed regularly on the instruments, and all accessories including the high pass filter, preamplifier and cables.

All radiated and conducted emissions measurement were performed manually at Rhein Tech, Incorporated. The radiated emissions measurements required by the rules were performed on the three-meter, open field; test range maintained by Rhein Tech Laboratories, Inc., 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. Complete description and site attenuation measurement data have been placed on file with the Federal Communications Commission. The power line conducted emission measurements were performed in a shielded enclosure also located at the Herndon, Virginia facility. Rhein Tech, Labs, Inc. is on the FCC accepted lab list as a Facility available to do measurement work for others on a contract basis.

1.1 RELATED SUBMITTAL (S)/GRANT (S)

This is an original application for certification.

1.2 TEST METHODOLOGY

Final radiated emissions measurements between 30 and 960 MHz were made on the OATS at a distance of 3 meters. Any final radiated emissions over 960 MHz were made on the OATS at a distance of 3 meters using video averaging measuring detector. The EUT was placed on a nonconductive turntable 0.8 meters above the ground plane.

1.3 TEST FACILITY

The open area test site and conducted measurement facility used to collect the radiated data is located on the parking lot of Rhein Tech Laboratories, Inc. 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. This site has been fully described in a report dated March 3, 1994, submitted to and approved by the Federal Communication Commission to perform AC line conducted and radiated emissions testing (ANSI C63.4 1992).

2 SYSTEM TEST CONFIGURATION

2.1 JUSTIFICATION

The system was configured for testing in a typical fashion (as a customer would normally use it).

2.2 EUT EXERCISE SOFTWARE

The EUT exercise program used during radiated and conducted testing has been designed to exercise the various system components in a manner similar to typical use. The software, contained on the hard disk drive, sequentially exercises each system component; 1) an H prints on the monitor, 2) an H prints on the printer, 3) an H is sent to the serial ports, 4) a file is read from the floppy diskette, 5) a file is read from the hard drive and any other hard drive present, 6) a file is read from the CD-ROM drive. Systems that utilize network cards are connected to a server and are configured to transmit and receive packets of data. The complete cycle takes less than one second and is repeated continuously. As the keyboard and mouse are strictly input devices, no data was transmitted to them during the test. They are, however, continuously scanned for data input activity. Any other ports the EUT may utilize are loaded in a typical fashion.

2.3 SPECIAL ACCESSORIES

The end user is advised to use the same type cables as mentioned in Sections 2-1 and 2-2.

2.4 TEST SYSTEM DETAILS

The FCC Identifiers for all equipment, plus descriptions of all cables used in the tested system (including inserted cards, which have grants) are:

TABLE 2-1: EQUIPMENT UNDER TEST (EUT)

Part	Manufacturer	Model	Serial Number	FCC ID	Cable Description	RTL Bar Code
LAPTOP (EUT)	GATEWAY COMPANIES, INC.	SOLO 5350	SOLO5350PR102	A3L5350015318		013517

TABLE 2-2: EXTERNAL COMPONENTS USED IN TEST CONFIGURATION

Part	Manufacturer	Model	Serial Number	FCC ID	Cable Description	RTL Bar Code
MODEM	US ROBOTICS	0413	839032B86PA9L	DoC	SHIELDED I/O UNSHIELDED POWER	900698
VCR	JVC	HR-S5100U	15920318	ASIP5D024	SHIELDED I/O UNSHIELDED POWER	900161
AUDIO DEVICE	RADIO SHACK	SCP-18	N/A	N/A	SHIELDED I/O	900176
MICROPHONE	GATEWAY 2000, INC.	MODEM SPEAKERPHONE	N/A	N/A	SHIELDED I/O	010153
MICROPHONE	GATEWAY 2000, INC.	MODEM SPEAKERPHONE	N/A	N/A	SHIELDED I/O	010154
AUDIO DEVICE	RADIO SHACK	SCP-59	N/A	N/A	SHIELDED I/O	900691
MICROPHONE	GATEWAY 2000, INC.	MODEM SPEAKERPHONE	N/A	N/A	SHIELDED I/O	010155
SPEAKER	BOSTON ACOUSTICS	BA265	0000143	SAMPLE	UNSHIELDED I/O	011997
SPEAKER	BOSTON ACOUSTICS	BA265	0000143	N/A	UNSHIELDED I/O UNSHIELDED POWER	011996
JOYSTICK	JECO	1	N/A	CLASS A		901154
MOUSE	MICROSOFT CORPORATION	SHORT TAIL USB	N/A	SAMPLE	SHIELDED FERRITE ON CONNECTOR END I/O	012119
KEYBOARD	MAXI SWITCH	2196003-XX-XXX	06010464	D7J2196003-XX	SHIELDED I/O	900538
PRINTER	HEWLETT PACKARD	C6410A	MY9321B26W	DOC	SHIELDED I/O, UNSHIELDED POWER	012295
MONITOR	LG ELECTRONICS	EVF700 17"	N/A	SAMPLE	SHIELDED, FERRITE BOTH ENDS I/O UNSHIELDED POWER	011929

2.5 CONFIGURATION OF TESTED SYSTEM

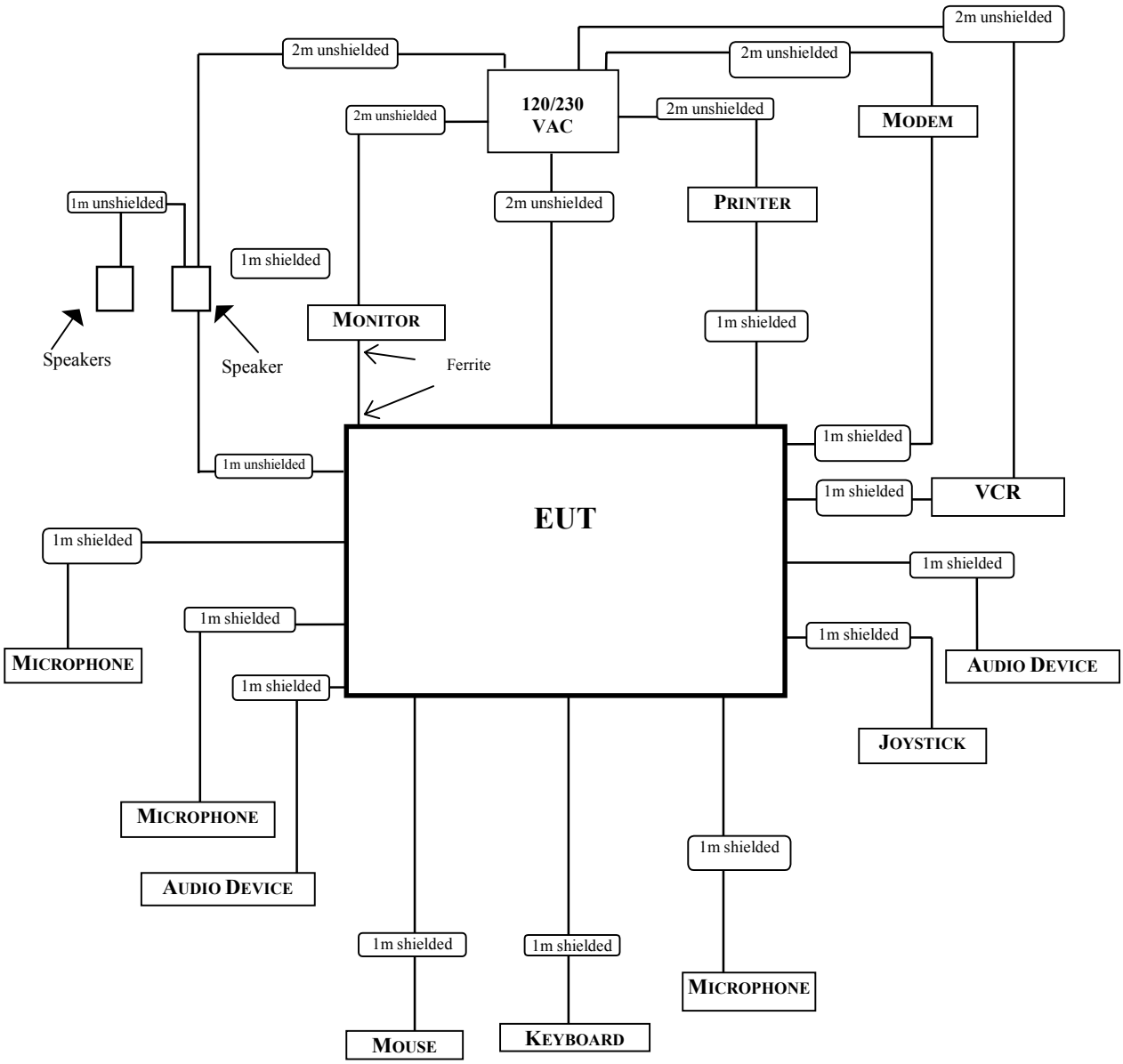

FIGURE 2-1: CONFIGURATION OF TESTED SYSTEM

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Suite 1400
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http://www.rheintech.com

3 CONFORMANCE STATEMENT

STANDARDS REFERENCED FOR THIS REPORT	
PART 2: 1999	FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS
PART 15: 1999	RADIO FREQUENCY DEVICES

Frequency Range	Conducted Output Power (W)	Freq. Tolerance	Emission Designator

I, the undersigned, hereby declare that the equipment tested and referenced in this report conforms to the identified standard(s) as described above. Modifications were not made during testing to the equipment in order to achieve compliance with these standards.

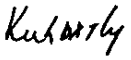
Furthermore, there was no deviation from, additions to or exclusions from the ANSI C63.4 test methodology.

Signature: 

Date: July 30, 2001

Typed/Printed Name: Bruno Clavier

Position: Vice President of Operation
(NVLAP Signatory)

Signature: 

Date: July 30, 2001

Typed/Printed Name: Kinh Ly

Position: Test Engineer / Technician

NVLAP *Accredited by the National Voluntary Accreditation Program for the specific scope of accreditation under Lab Code 20061-0.*

Note: This report may not be used by the client to claim product endorsement by NVLAP or any agency of the U.S. Government.

4 FIELD STRENGTH CALCULATION

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FI(dBuV/m) = SAR(dBuV) + SCF(dB/m)
FI = Field Intensity
SAR = Spectrum Analyzer Reading
SCF = Site Correction Factor

The Site Correction Factor (SCF) used in the above equation is determined empirically, and is expressed in the following equation:

SCF(dB/m) = - PG(dB) + AF(dB/m) + CL(dB)

SCF = Site Correction Factor
PG = Pre-amplifier Gain
AF = Antenna Factor
CL = Cable Loss

The field intensity in microvolts per meter can then be determined according to the following equation:

$$FI(uV/m) = 10^{FI(dBuV/m)/20}$$

For example, assume a signal at a frequency of 125 MHz has a received level measured as 49.3 dBuV. The total Site Correction Factor (antenna factor plus cable loss minus preamplifier gain) for 125 MHz is -11.5 dB/m. The actual radiated field strength is calculated as follows:

49.3 dBuV - 11.5 dB/m = 37.8 dBuV/m

$$10^{37.8/20} = 10^{1.89} = 77.6 \text{ uV/m}$$

EIRP calculation: Power from power meter in (dBm) + antenna gain in (dBi)

5 CONDUCTED EMISSIONS MEASUREMENTS

The power line conducted emission measurements were performed in a Series 81 type shielded enclosure manufactured by Rayproof. The EUT was assembled on a wooden table 80 centimeters high. Power was fed to the EUT through a 50 ohm / 50 microhenry Line Impedance Stabilization Network (EUT LISN). The EUT LISN was fed power through an A.C. filter box on the outside of the shielded enclosure. The filter box and EUT LISN housing are bonded to the ground plane of the shielded enclosure. A second LISN, the peripheral LISN, provides isolation for the EUT test peripherals. This peripheral LISN was also fed A.C. power. A metal power outlet box, which is bonded to the ground plane and electrically connected to the peripheral LISN, powers the EUT host peripherals.

The spectrum analyzer was connected to the A.C. line through an isolation transformer. The 50-ohm output of the EUT LISN was connected to the spectrum analyzer input through a Solar 7 kHz high-pass filter. The filter is used to prevent overload of the spectrum analyzer from noise below 7 kHz. Conducted emission levels were measured on each current-carrying line with the spectrum analyzer operating in the CISPR quasi-peak mode (or average mode if applicable). The analyzer's 6 dB bandwidth was set to 9 kHz. No video filter less than 10 times the resolution bandwidth was used. Average measurements are performed in linear mode using a 10 kHz resolution bandwidth, a 1 Hz video bandwidth, and by increasing the sweep time in order to obtain a calibrated measurement. The range of the frequency spectrum to be investigated is specified in FCC Part 15. The highest emission amplitudes relative to the appropriate limit were measured and have been recorded in this report.

5.1 CONDUCTED EMISSIONS TEST

The following table lists worst-case conducted emission date. Specifically: Emission Frequency, Test Detector, Analyzer Reading, Site Correction Factor, corrected Emission Level, Quasi Peak Limit and Margin, and the Average Limit and Margin.

The initial step in collecting conducted data is a spectrum analyzer peak scan of the measurement range. If the conducted emissions exceed the limit with the instrument set to the quasi-peak mode, then measurements are made in the average mode.

The conducted test was performed with the EUT exercise program loaded, and the emissions were scanned between 150 kHz to 30 MHz on the NEUTRAL SIDE and HOT SIDE, herein referred to as L1 and L2, respectively.

5.1.1 FCC PART 15 §15.107 CONDUCTED EMISSIONS TEST DATA

TABLE 5-1: FCC PART 15 §15.107 CONDUCTED EMISSIONS: NEUTRAL SIDE (LINE 1)

Temperature: 74°F Humidity: 41%								
Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV)	Site Correction Factor (dB)	Emission Level (dBuV)	CISPR B QP Limit (dBuV)	CISPR B QP Margin (dBuV)	CISPR B AV Limit (dBuV)	CISPR B AV Margin (dBuV)
0.150	Qp	47.6	2.0	49.6	66.0	-16.4	56.0	-6.4
0.356	Qp	42.6	0.9	43.5	58.8	-15.3	48.8	-5.3
0.475	Qp	41.1	0.8	41.9	56.4	-14.5	46.4	-4.5
2.252	Qp	34.1	1.3	35.4	56.0	-20.6	46.0	-10.6
6.000	Pk	40.6	1.9	42.5	60.0	-17.5	50.0	-7.5
29.225	Pk	38.4	4.1	42.5	60.0	-17.5	50.0	-7.5

Pk = Peak; QP = Quasi-Peak; Av = Average

TEST PERSONNEL:

KINH LY — TEST TECHNICIAN/ENGINEER

SIGNATURE

JULY 11, 2001 — DATE OF TEST

TABLE 5-2: FCC PART 15 §15.107 CONDUCTED EMISSIONS: HOT SIDE (LINE 2)

Temperature: 74°F Humidity: 41%								
Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV)	Site Correction Factor (dB)	Emission Level (dBuV)	CISPR B QP Limit (dBuV)	CISPR B QP Margin (dBuV)	CISPR B AV Limit (dBuV)	CISPR B AV Margin (dBuV)
0.156	Qp	47.8	2.2	50.0	65.7	-15.7	55.7	-5.7
0.190	Qp	44.2	3.1	47.3	64.0	-16.7	54.0	-6.7
0.400	Qp	35.5	0.9	36.4	57.9	-21.5	47.9	-11.5
6.385	Pk	39.6	2.0	41.6	60.0	-18.4	50.0	-8.4
10.330	Pk	33.9	2.3	36.2	60.0	-23.8	50.0	-13.8
20.160	Pk	29.0	3.3	32.3	60.0	-27.7	50.0	-17.7

Pk = Peak; QP = Quasi-Peak; Av = Average

TEST PERSONNEL:

KINH LY — TEST TECHNICIAN/ENGINEER

SIGNATURE

JULY 11, 2001 — DATE OF TEST

TABLE 5-3: TEST EQUIPMENT USED FOR TESTING (CONDUCTED EMISSIONS)

RTL Asset #	Manufacturer	Model	Part Type	Serial Number
900931	HP	8566B	Spectrum Analyzer (100 Hz - 22 GHz)	3138A07771
900070	Solar		LISN	
900339	Hewlett Packard	85650A	Quasi-Peak Adapter (30 Hz – 40 GHz)	2521A00743

6 FCC PART 15 §15.109 RADIATED EMISSIONS MEASUREMENTS

Before final measurements of radiated emissions were made on the open-field three/ten meter range; the EUT was scanned indoor at one and three meter distances. This was done in order to determine its emissions spectrum signature. The physical arrangement of the test system and associated cabling was varied in order to determine the effect on the EUT's emissions in amplitude, direction and frequency. This process was repeated during final radiated emissions measurements on the open-field range, at each frequency, in order to insure that maximum emission amplitudes were attained.

Final radiated emissions measurements were made on the three/ten-meter, open-field test site. The EUT was placed on a nonconductive turntable 0.8 meters above the ground plane.

At each frequency, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters in order to determine the maximum emission levels. Measurements were taken using both horizontal and vertical antenna polarizations. The spectrum analyzer's 6 dB bandwidth was set to 120 kHz, and the analyzer was operated in the CISPR quasi-peak detection mode. No video filter less than 10 times the resolution bandwidth was used. The range of the frequency spectrum to be investigated is specified in FCC Part 15. The highest emission amplitudes relative to the appropriate limit were measured and recorded in this report. . **For radiated measurements above 1 GHz, a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz are used.**

Note: Rhein Tech Laboratories, Inc. has implemented procedures to minimize errors that occur from test instruments, calibration, procedures, and test setups. Test instrument and calibration errors are documented from the manufacturer or calibration lab. Other errors have been defined and calculated within the Rhein Tech quality manual, section 6.1. Rhein Tech implements the following procedures to minimize errors that may occur: yearly as well as daily calibration methods, technician training, and emphasis to employees on avoiding error.

6.1 FCC PART 15 §15.109 RADIATED EMISSIONS TEST

The following data lists the significant emission frequencies, measured levels, correction factor (includes cable and antenna corrections), the corrected reading, plus the limit.

6.1.1 FCC PART 15 §15.109 RADIATED EMISSION

Temperature: 90°F Humidity: 25%									
Emission Frequency (MHz)	Test Detector	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
130.380	Qp	V	170	1.0	52.0	-17.1	34.9	43.5	-8.6
399.860	Qp	H	345	2.4	50.6	-11.4	39.2	46.0	-6.8
409.547	Qp	V	165	1.0	37.9	-11.1	26.8	46.0	-19.2
422.560	Qp	V	135	1.0	38.4	-10.6	27.8	46.0	-18.2
435.565	Qp	V	165	1.0	38.4	-10.6	27.8	46.0	-18.2
442.052	Qp	V	145	1.0	38.9	-10.7	28.2	46.0	-17.8
468.068	Qp	H	155	2.2	43.4	-9.8	33.6	46.0	-12.4
474.561	Qp	H	165	2.0	43.1	-9.5	33.6	46.0	-12.4
480.065	Qp	V	225	1.6	44.2	-9.8	34.4	46.0	-11.6
500.577	Qp	V	360	1.0	40.3	-9.6	30.7	46.0	-15.3
528.068	Qp	V	345	1.0	39.7	-8.7	31.0	46.0	-15.0
662.510	Qp	H	235	2.6	44.8	-5.7	39.1	46.0	-6.9
703.993	Qp	V	90	1.0	43.7	-5.9	37.8	46.0	-8.2
747.993	Qp	V	90	1.0	40.6	-5.0	35.6	46.0	-10.4

TEST PERSONNEL:

KINH LY		JULY 12, 2001
TEST TECHNICIAN/ENGINEER	SIGNATURE	DATE OF TEST

TABLE 6-1: TEST EQUIPMENT USED FOR TESTING (RADIATED EMISSIONS)

RTL Asset #	Manufacturer	Model	Part Type	Serial Number
900931	HP	8566B	Spectrum Analyzer (100Hz – 22 GHz)	3138A07771
900772	EMCO	3161-02	Horn ANTENNA (2-4 GHz)	900772
901053	Schaffner@Chase	CBL6112B	Bilog antenna (20 MHz - 2 GHz)	2648
900323	EMCO	3161-03	Horn Antenna (4-8,GHz)	9508-1020
900889	HP	85685A	RF Preselector for HP 8566B or 8568B (20Hz-2GHz)	3146A01309
900339	Hewlett Packard	85650A	Quasi-Peak Adapter (30 Hz – 1 GHz)	2521A00743