



Plot 13. TDMA Downlink Input Low CH



Plot 14.TDMA Downlink Output Low CH





Plot 15.TDMA Downlink Input Mid CH









Plot 17.TDMA Downlink Input Hi CH









Plot 19.TDMA Uplink Input Low CH







Electromagnetic Compatibility Occupied Bandwidth CFR Title 47 Part 24 Subpart E



Plot 21.TDMA Uplink Input Mid CH



Plot 22.TDMA Uplink Output Mid CH



Electromagnetic Compatibility Occupied Bandwidth CFR Title 47 Part 24 Subpart E



Plot 23.TDMA Uplink Input Hi CH



Plot 24.TDMA Uplink Output Hi CH





Plot 25. GSM Downlink Input Low CH



Plot 26.GSM Downlink Output Low CH





Plot 27.GSM Downlink Input Mid CH



Plot 28.GSM Downlink Output Mid CH





Plot 29.GSM Downlink Input Hi CH









Plot 31.GSM Uplink Input Low CH



Plot 32.GSM Uplink Output Low CH





Plot 33.GSM Uplink Input Mid CH



Plot 34.GSM Uplink Output Mid CH





Plot 35.GSM Uplink Input Hi CH



Plot 36.GSM Uplink Output Hi CH



Electromagnetic Compatibility Criteria for Intentional Radiators

§ 2.1053 Radiated Spurious Emissions

Test Requirement(s): § 2.1053 Measurements required: Field strength of spurious radiation.

§ 2.1053 (a): Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of § 2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from half-wave dipole antennas.

§ 2.1053 (b): The measurements specified in paragraph (a) of this section shall be made for the following equipment:

(1) Those in which the spurious emissions are required to be 60 dB or more below the mean power of the transmitter.

(2) All equipment operating on frequencies higher than 25 MHz.

(3) All equipment where the antenna is an integral part of, and attached directly to the transmitter.

(4) Other types of equipment as required, when deemed necessary by the Commission.

§ 24.238 Emission limitations for Broadband PCS equipment: The rules in this section govern the spectral characteristics of emissions in the Broadband Personal Communications Service.

§ 24.238 (a): Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$.



LGC Wireless	Electromagnetic Compatibility
FSN-1-MH-1 Main Hub, FSN-EH-1 Expansion Hub	Radiated Spurious Emissions
and FSN 809019-1 RAU	CFR Title 47 Part 24 Subpart E

Test Procedures:	As required by 47 CFR 2.1053, field strength of radiated spurious measurements was made accordance with the procedures of TIA/EIA-603-A-2001 "Land Mobile FM or F Communications Equipment Measurement and Performance Standards." Radiated emission measurements were performed inside a 10 meter semi-anechoic chamb The EUT was set at a distance of 3m from the receiving antenna. The EUT's RF ports we terminated to 500hm load. The EUT was set to transmit at the low, mid and high channels the transmitter frequency range at its maximum power level. The EUT was rotated about 36 and the receiving antenna scanned from 1-4m in order to capture the maximum emission. calibrated antenna source was positioned in place of the EUT and the previously record signal was duplicated. The maximum EIRP of the emission was calculated by adding the forward power to the calibrated source plus its appropriate gain value. These steps were carried out with the receiving antenna in both vertical and horizontal polarization. Harmonic emission up to the 10 th or 40GHz, which ever was the lesser, were investigated.			
Test Results:	The EUT complies with the requirements of this section.			
Test Engineer:	Shawn McMillen			
Test Date(s):	June 14, 2006			



Electromagnetic Compatibility Criteria for Intentional Radiators

§ 2.1053 Measurements required: Field strength of spurious radiation.

Downlink								
Frequency (MHz)	Antenna Polarity (H/V)	Field Strength of Spurious Harmonics (dBm)	Substitution Antenna Gain (dBi)	Power into Substitution Antenna(dBm)	EIRP (dBm)	Limit (dBm)	Margin	Detector Type
3860.0	V	-56.3	9.6	-44.2	-34.6	-13.0	21.6	Peak
3860.0	Н	-57.2	9.6	-46.2	-36.6	-13.0	23.6	Peak
5790.0	V	-60.3	11.4	-47.9	-36.5	-13.0	23.5	Peak
5790.0	Н	-61.1	11.4	-47.0	-35.6	-13.0	22.6	Peak
			Low	Channel				
3925.0	V	-55.3	9.6	-44.2	-34.6	-13.0	21.6	Peak
3925.0	Н	-57.3	9.6	-46.8	-37.2	-13.0	24.2	Peak
5887.5	V	-60.2	11.4	-48.8	-37.4	-13.0	24.4	Peak
5887.5	Н	-62.2	11.4	-49.2	-37.8	-13.0	24.8	Peak
Mid Channel								
3990.0	V	-57.9	9.6	-47.6	-38.0	-13.0	25.0	Peak
3990.0	Н	-59.6	9.6	-43.5	-33.9	-13.0	20.9	Peak
5985.0	V	-60.1	11.4	-50.2	-38.8	-13.0	25.8	Peak
5985.0	Н	-60.5	11.4	-49.8	-38.4	-13.0	25.4	Peak
High Channel								

Table 13. Radiated Harmonics, Downlink

Note: All other emissions were measured at the noise floor of the spectrum analyzer

Electromagnetic Compatibility Radiated Spurious Emissions CFR Title 47 Part 24 Subpart E

Electromagnetic Compatibility Criteria for Intentional Radiators

Photograph 8. Test Equipment and setup for various Radiated Measurements

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 2.1051 Spurious Emissions at Antenna Terminals

Test Requirement(s):	§ 2.1051 Measurements required: Spurious emissions at antenna terminals: The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in § 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.
	§ 24.238 Emission limitations for Broadband PCS equipment: The rules in this section govern the spectral characteristics of emissions in the Broadband Personal Communications Service.
	§ 24.238 (a): Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P) dB$.
Test Procedures:	A modulated carrier generated by the signal generator carrier was connected to either the Uplink or Downlink RF port at a maximum level as determined by the OEM A spectrum analyzer was connected to either the Uplink or Downlink port depending on the circuitry being measured. The spectrum analyzer was set to 1MHz RBW and 3MHz VBW. The spectrum was investigated from 30MHz to the 10 th harmonic of the carrier.
	The inter-modulation requirements were performed in a similar manner as described above. The spectrum analyzer was set to 100KHz RBW and 300KHz VBW. Two modulated carriers were injected into the EUT. One carrier was set at the band edge of either the Uplink or Downlink band and the other at carrier set at 6MHz deviation from the first carrier. The in band spurious emissions were investigated.
Test Results:	The EUT complies with the requirements of this section.
Test Engineer(s):	Shawn McMillen
Test Date(s):	June 9, 2006

Plot 37. CDMA Downlink Conducted Emissions Low CH

Plot 38. CDMA Uplink Conducted Emissions Low CH

Electromagnetic Compatibility Spurious Emissions at Antenna Terminals CFR Title 47 Part 24 Subpart E

Plot 39. CDMA Downlink Conducted Emissions Mid CH

Plot 40. CDMA Uplink Conducted Emissions Mid CH

Plot 41. CDMA Downlink Conducted Emissions Hi CH

Plot 42. CDMA Uplink Conducted Emissions Hi CH

Plot 43. TDMA Downlink Conducted Emissions Low CH

Plot 45. TDMA Downlink Conducted Emissions Mid CH

Electromagnetic Compatibility Spurious Emissions at Antenna Terminals CFR Title 47 Part 24 Subpart E

Plot 47. TDMA Downlink Conducted Emissions Hi CH

Plot 49. GSM Downlink Conducted Emissions Low CH

Plot 50. GSM Uplink Conducted Emissions Low CH

Electromagnetic Compatibility Spurious Emissions at Antenna Terminals CFR Title 47 Part 24 Subpart E

Plot 51. GSM Downlink Conducted Emissions Mid CH

Electromagnetic Compatibility Spurious Emissions at Antenna Terminals CFR Title 47 Part 24 Subpart E

Plot 53. GSM Downlink Conducted Emissions Hi CH

Plot 55. CDMA Downlink Low End Intermodulation

Plot 56. CDMA Uplink Low End Intermodulation

Plot 57. CDMA Downlink Hi End Intermodulation

Plot 58. CDMA Uplink Hi End Intermodulation

Plot 59. TDMA Downlink Low End Intermodulation

Plot 60. TDMA Uplink Low End Intermodulation

Plot 61. TDMA Downlink Hi End Intermodulation

Plot 62. TDMA Uplink Hi End Intermodulation

Plot 63. GSM Downlink Low End Intermodulation

Plot 64. GSM Uplink Low End Intermodulation

Plot 65. GSM Downlink Hi End Intermodulation

Plot 66. GSM Uplink Hi End Intermodulation

Electromagnetic Compatibility Criteria for Intentional Radiators

2-11-04/EAB/RF Out of Band Rejection

Plot 67. Out of Band Rejection Downlink

Plot 68. Out of Band Rejection Uplink

Electromagnetic Compatibility Criteria for Intentional Radiators

§2.1055 Frequency Stability over Ten	nperature and Voltage Variations
--------------------------------------	----------------------------------

Test Requirement(s):	§2.1055(a)(1) §24.235
Test Procedures:	As required by 47 CFR 2.1055, <i>Frequency Stability measurements</i> were made at the RF output terminals using a Directional Coupler through a Spectrum Analyzer and Power Meter.
	The EUT was placed in the Environmental Chamber and support equipments are outside the chamber on a table. A CW signal was injected into the EUT at the appropriate RF level. The frequency counter option on the Spectrum Analyzer was used to measure frequency deviations. The frequency drift was investigated for every 10^{C} increment until the unit is stabilized then recorded the reading in tabular format with the temperature range of -30 to 50^{C} .
	Voltage supplied to EUT is 120 VAC reference temperature was done at 20 ^{°C} . The voltage was varied by \pm 15 % of nominal.
Test Results:	Equipment complies with Section 2.1055 and 24.235.
Test Engineer(s):	Shawn McMillen
Test Date(s):	June 13, 2006

Electromagnetic Compatibility Frequency Stability CFR Title 47 Part 24 Subpart E

Frequency Stability Test Results

Temperature	Measured	Drift
(Celsius)	Freq (MHz)	ppm
50	1962.498210	0.041
40	1962.498191	0.050
30	1962.498186	0.053
20	Refe	rence
10	1962.498187	0.052
0	1962.498220	0.036
-10	1962.498226	0.033
-20	1962.498244	0.023
-30	1962.498280	0.005

Reference Freq. = 1962.498290MHz at $20^{\circ C}$

Reference:	120Vac at 20° ^C Freq	• = 1962.498290MHz
	120100000000000000000000000000000000000	• • • • • • • • • • • • • • • • • • • •

Measured Voltage(dc)	Measured	Drift	
+/-15% of nominal	Freq (MHz)	(Hz)	
102	1962.498289	0.001	
138	1962.498290	0.000	

Electromagnetic Compatibility Test Equipment CFR Title 47 Part 24 Subpart E

V. Test Equipment

Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ANSI/NCSL Z540-1-1994 and ANSI/ISO/IEC 17025:2000.

MET Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
182034	COUPLER, DIRECTIONAL 1-20 GHz	KRYTAR	101020020	SEE NOTE	
182034	COUPLER, DIRECTIONAL 1-20 GHz	KRYTAR	101020020	SEE 1	NOTE
182041	COUPLER, BI DIRECTIONALCOAXIAL	NARDA	N/A	SEE 1	NOTE
182041	COUPLER, BI DIRECTIONALCOAXIAL	NARDA	N/A	SEE 1	NOTE
182121	PRE-AMPLIFIER	HEWLETT PACKARD	8449B	10/14/2005	10/14/2006
182128	Harmonic Mixer	Hewlett Packard	11970A	10/03/2003	10/03/2006
182129	Harmonic Mixer	Hewlett Packard	11970K	10/03/2003	10/03/2006
1S2184	BILOG ANTENNA	CHASE	CBL6112A	1/12/2006	1/12/2007
1S2198	ANTENNA, HORN	EMCO	3115	7/14/2005	7/14/2006
182202	ANTENNA, HORN, 1 METER	EMCO	3116	3/23/2004	3/23/2007
182263	CHAMBER, 10 METER	RANTEC	N2-14	7/25/2005	7/25/2006
182421	EMI RECEIVER	ROHDE&SCHWARZ	ESIB 7	2/9/2006	2/9/2007
182430	WIDEBAND POWER METER	ANRITSU COMPANY	ML2488A	1/12/2006	1/12/2007
182430	WIDEBAND POWER METER	ANRITSU COMPANY	ML2488A	1/12/2006	1/12/2007
182432	WIDEBAND POWER SENSOR	ANRITSU COMPANY	MA2491A	1/12/2006	1/12/2007
182432	WIDEBAND POWER SENSOR	ANRITSU COMPANY	MA2491A	1/12/2006	1/12/2007
182460	Analyzer, Spectrum 9 kHz-40GHz	Agilent	E4407B	07/06/2005	07/06/2008
N/A	HIGH PASS FILTER	MICRO-TRONICS	HPM13146	SEE NOTE	

Note: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.

Electromagnetic Compatibility Certification & User's Manual Information CFR Title 47 Part 24 Subpart E

VI. Certification & User's Manual Information

Certification & User's Manual Information

A. Certification Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart I — Marketing of Radio frequency devices:

§ 2.801 Radio-frequency device defined.

As used in this part, a radio-frequency device is any device which in its operation is capable of Emitting radio-frequency energy by radiation, conduction, or other means. Radio- frequency devices include, but are not limited to:

- (a) The various types of radio communication transmitting devices described throughout this chapter.
- (b) The incidental, unintentional and intentional radiators defined in Part 15 of this chapter.
- (c) The industrial, scientific, and medical equipment described in Part 18 of this chapter.
- (d) Any part or component thereof which in use emits radio-frequency energy by radiation, conduction, or other means.

§ 2.803 Marketing of radio frequency devices prior to equipment authorization.

- (a) Except as provided elsewhere in this chapter, no person shall sell or lease, or offer for sale or lease (including advertising for sale or lease), or import, ship or distribute for the purpose of selling or leasing or offering for sale or lease, any radio frequency device unless:
 - (1) In the case of a device subject to certification, such device has been authorized by the Commission in accordance with the rules in this chapter and is properly identified and labeled as required by §2.925 and other relevant sections in this chapter; or
 - (2) In the case of a device that is not required to have a grant of equipment authorization issued by the Commission, but which must comply with the specified technical standards prior to use, such device also complies with all applicable administrative (including verification of the equipment or authorization under a Declaration of Conformity, where required), technical, labeling and identification requirements specified in this chapter.
- (d) Notwithstanding the provisions of paragraph (a) of this section, the offer for sale solely to business, commercial, industrial, scientific or medical users (but not an offer for sale to other parties or to end users located in a residential environment) of a radio frequency device that is in the conceptual, developmental, design or preproduction stage is permitted prior to equipment authorization or, for devices not subject to the equipment authorization requirements, prior to a determination of compliance with the applicable technical requirements *provided* that the prospective buyer is advised in writing at the time of the offer for sale that the equipment is subject to the FCC rules and that the equipment will comply with the appropriate rules before delivery to the buyer or to centers of distribution.

- (e)(1) Notwithstanding the provisions of paragraph (a) of this section, prior to equipment authorization or determination of compliance with the applicable technical requirements any radio frequency device may be operated, but not marketed, for the following purposes and under the following conditions:
 - (*i*) *Compliance testing;*
 - (ii) Demonstrations at a trade show provided the notice contained in paragraph (c) of this section is displayed in a conspicuous location on, or immediately adjacent to, the device;
 - (iii) Demonstrations at an exhibition conducted at a business, commercial, industrial, scientific or medical location, but excluding locations in a residential environment, provided the notice contained in paragraphs (c) or (d) of this section, as appropriate, is displayed in a conspicuous location on, or immediately adjacent to, the device;
 - (iv) Evaluation of product performance and determination of customer acceptability, provided such operation takes place at the manufacturer's facilities during developmental, design or pre-production states; or
 - (v) Evaluation of product performance and determination of customer acceptability where customer acceptability of a radio frequency device cannot be determined at the manufacturer's facilities because of size or unique capability of the device, provided the device is operated at a business, commercial, industrial, scientific or medical user's site, but not at a residential site, during the development, design or pre-production stages.
- (e)(2) For the purpose of paragraphs (e)(1)(iv) and (e)(1)(v) of this section, the term *manufacturer's facilities* includes the facilities of the party responsible for compliance with the regulations and the manufacturer's premises, as well as the facilities of other entities working under the authorization of the responsible party in connection with the development and manufacture, but not the marketing, of the equipment.
- (f) For radio frequency devices subject to verification and sold solely to business, commercial, industrial, scientific and medical users (excluding products sold to other parties or for operation in a residential environment), parties responsible for verification of the devices shall have the option of ensuring compliance with the applicable technical specifications of this chapter at each end user's location after installation, provided that the purchase or lease agreement includes a proviso that such a determination of compliance be made and is the responsibility of the party responsible for verification of the equipment.

Certification & User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart J — Equipment Authorization Procedures:

§ 2.901 Basis and Purpose

- (a) In order to carry out its responsibilities under the Communications Act and the various treaties and international regulations, and in order to promote efficient use of the radio spectrum, the Commission has developed technical standards for radio frequency equipment and parts or components thereof. The technical standards applicable to individual types of equipment are found in that part of the rules governing the service wherein the equipment is to be operated.¹ In addition to the technical standards provided, the rules governing the service may require that such equipment be verified by the manufacturer or importer, be authorized under a Declaration of Conformity, or receive an equipment authorization from the Commission by one of the following procedures: certification or registration.
- (b) The following sections describe the verification procedure, the procedure for a Declaration of Conformity, and the procedures to be followed in obtaining certification from the Commission and the conditions attendant to such a grant.

§ 2.907 Certification.

- (a) Certification is an equipment authorization issued by the Commission, based on representation and test data submitted by the applicant.
- (b) Certification attaches to all units subsequently marketed by the grantee which are identical (see Section 2.908) to the sample tested except for permissive changes or other variations authorized by the Commission pursuant to Section 2.1043.

¹ In this case, the equipment is subject to the rules of Part 15. More specifically, the equipment falls under Subpart B (of Part 15), which deals with unintentional radiators.

Certification & User's Manual Information

§ 2.948 Description of measurement facilities.

(a) Each party making measurements of equipment that is subject to an equipment authorization under Part 15 or Part 18 of this chapter, regardless of whether the measurements are filed with the Commission or kept on file by the party responsible for compliance of equipment marketed within the U.S. or its possessions, shall compile a description of the measurement facilities employed.

(1) If the measured equipment is subject to the verification procedure, the description of the measurement facilities shall be retained by the party responsible for verification of the equipment.

- (i) If the equipment is verified through measurements performed by an independent laboratory, it is acceptable for the party responsible for verification of the equipment to rely upon the description of the measurement facilities retained by or placed on file with the Commission by that laboratory. In this situation, the party responsible for the verification of the equipment is not required to retain a duplicate copy of the description of the measurement facilities.
- (ii) If the equipment is verified based on measurements performed at the installation site of the equipment, no specific site calibration data is required. It is acceptable to retain the description of the measurement facilities at the site at which the measurements were performed.
- (2) If the equipment is to be authorized by the Commission under the certification procedure, the description of the measurement facilities shall be filed with the Commission's Laboratory in Columbia, Maryland. The data describing the measurement facilities need only be filed once but must be updated as changes are made to the measurement facilities or as otherwise described in this section. At least every three years, the organization responsible for filing the data with the Commission shall certify that the data on file is current.

Certification & User's Manual Information

B. Label and User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart A — General:

§ 15.19 Labeling requirements.

- (a) In addition to the requirements in Part 2 of this chapter, a device subject to certification or verification shall be labeled as follows:
 - (1) Receivers associated with the operation of a licensed radio service, e.g., FM broadcast under Part 73 of this chapter, land mobile operation under Part 90, etc., shall bear the following statement in a conspicuous location on the device:

This device complies with Part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference.

(2) A stand-alone cable input selector switch, shall bear the following statement in a conspicuous location on the device:

This device is verified to comply with Part 15 of the FCC Rules for use with cable television service.

(3) All other devices shall bear the following statement in a conspicuous location on the device:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

- (4) Where a device is constructed in two or more sections connected by wires and marketed together, the statement specified under paragraph (a) of this section is required to be affixed only to the main control unit.
- (5) When the device is so small or for such use that it is not practicable to place the statement specified under paragraph (a) of this section on it, the information required by this paragraph shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed. However, the FCC identifier or the unique identifier, as appropriate, must be displayed on the device.

§ 15.21 Information to user.

The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Verification & User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart B — Unintentional Radiators:

§ 15.105 Information to the user.

(a) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

ı.

LGC Wireless FSN-1-MH-1 Main Hub, FSN-EH-1 Expansion Hub and FSN 809019-1 RAU Electromagnetic Compatibility End of Report CFR Title 47 Part 24 Subpart E

End of Report