MKR 5416

CERTIFICATION TEST REPORT

FOR THE

RADIO FREQUENCY IDENTIFICATION SYSTEM TRANSCEIVER, MKR S416

FCC PART 15.247

COMPLIANCE

DATE OF ISSUE: FEBRUARY 4, 1999

PREPARED FOR:

SCS Corporation
10905 Technology Place
San Diego, CA 92127

P.O. No: 021521-00
W.O. No: 70529

Report No: **FC99-005**

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Date of test: January 5, 6, 20, 25, 28, 1999 &
February 1, 1999

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ADMINISTRATIVE INFORMATION

DATE OF TEST:	January 5, 6, 20, 25, 28, 1999 & February 1, 1999
PURPOSE OF TEST:	To demonstrate the compliance of the Radio Frequency Identification System Transceiver, MKR S416, with the FCC requirements for Part 15.247 devices
MANUFACTURER:	SCS Corporation 10905 Technology Place San Diego, CA 92127
REPRESENTATIVE:	Eric Mikuteit
TEST LOCATION:	CKC Laboratories, Inc. 5473A Clouds Rest Mariposa, CA 95338
TEST PERSONNEL:	Craig Mullis & Wes Norris
TEST METHOD:	ANSI C63.4 1992
FREQUENCY RANGE TESTED:	30 MHz – 24 GHz

EQUIPMENT UNDER TEST:

Antenna (2)

Manuf:	M/A-Com
Model:	ANP-C-116
Serial:	N/A
FCC ID:	

Antenna (4)

Manuf:	Huber Suhner
Model:	1324.19.000X
Serial:	N/A
FCC ID:	

Transceiver

Manuf:	Single Chip
Model:	MKR S416
Serial:	4100001
FCC ID:	MKR S416

SUMMARY OF RESULTS

The SCS Corporation Radio Frequency Identification System Transceiver, MKR S416, was tested in accordance with FCC Part 15.247 for compliance with the transmitter characteristics requirements of the FCC Rules.

As received, the above equipment was found to be fully compliant with the limits of FCC Part 15.247. The results in this report apply only to the items tested, as identified herein.

EQUIPMENT UNDER TEST (EUT) DESCRIPTION

The EUT is a 2.400 to 2.475 GHz Transceiver used to communicate with passive labels.

MEASUREMENT UNCERTAINTY

Associated with data in this report is a ±4dB measurement uncertainty.

EUT OPERATING FREQUENCY

The EUT was operating at 2.400 – 2.475 GHz.

TEMPERATURE AND HUMIDITY DURING TESTING

The temperature during testing was within +15°C and + 35°C.
The relative humidity was between 20% and 75%.

PERIPHERAL DEVICES

The EUT was tested with the following peripheral device:

Laptop
Manuf: Compaq
Model: Presario
Serial: V730BQH23748
FCC ID: CNTTA-24639-TT-E

REPORT OF MEASUREMENTS

The following Tables report the highest worst case levels reported during the tests performed on the Radio Frequency Identification System Transceiver, MKR S416. The data sheets from which these tables were compiled are contained in Appendix B.

Table 1: Highest Radiated Emission Levels

FREQUENCY MHz	METER READING dBμV	CORRECTION FACTORS Ant dB	Amp dB	Cable dB	Dist dB	CORRECTED READING dBμV/m	SPEC LIMIT dBμV/m	MARGIN dB	NOTES
36.036	43.0	12.1	-27.2	1.1		29.0	40.0	-11.0	V
40.066	41.0	11.2	-27.2	1.1		26.1	40.0	-13.9	V
63.320	41.0	9.1	-27.2	1.3		24.2	40.0	-15.8	V
80.032	39.7	7.6	-27.1	1.6		21.8	40.0	-18.2	V
220.177	35.5	17.1	-26.7	2.9		28.8	46.0	-17.2	V
248.934	32.3	16.1	-26.6	3.0		24.8	46.0	-21.2	V

Test Method: ANSI C63.4 1992
Spec Limit : 15.209
Test Distance: 3 Meters

NOTES:
H = Horizontal Polarization
V = Vertical Polarization
N = No Polarization
D = Dipole Reading
Q = Quasi Peak Reading
A = Average Reading

COMMENTS: Four Huber Suhner Antennas, Model 1324.19.000X, are connected to the Transceiver via 6' cables and two M/A-Com antennas, Model ANP-C-116 are connected via 6' cables filling all 6 antenna ports. The support device (Compaq Presario laptop) is used only to initiate normal operation of the EUT and then removed. The unterminated I/O cable is still connected to the RS232 9pin Dsub port of the transceiver. The EUT (transceiver and antennas) is in the normal transmit/receive mode of operation. The EUT is not a table-top mounted equipment, but would be installed in a cabinet or rack.

Table 2: Highest Radiated Emission Levels - Above 1GHz									
	METER	CORRECTION FACTORS				CORRECTED	SPEC		
FREQUENCY MHz	READING dBμV	Ant dB	Amp dB	Cable dB	Dist dB	READING dBμV/m	LIMIT dBμV/m	MARGIN dB	NOTES
4806.709	34.8	28.4	-32.5	14.5		45.2	54.0	-8.8	HA
4806.735	32.4	28.4	-32.5	14.5		42.8	54.0	-11.2	VA
4878.794	36.7	28.7	-32.4	14.7		47.7	54.0	-6.3	HA
4878.798	30.8	28.7	-32.4	14.7		41.8	54.0	-12.2	VA
4954.784	32.9	28.9	-32.2	14.9		44.5	54.0	-9.5	HA
4954.802	31.6	28.9	-32.2	14.9		43.2	54.0	-10.8	VA

Test Method: ANSI C63.4 1992
Spec Limit : 15.209
Test Distance: 3 Meters

NOTES: H = Horizontal Polarization
V = Vertical Polarization
N = No Polarization
D = Dipole Reading
Q = Quasi Peak Reading
A = Average Reading

COMMENTS: Four Huber Suhner Antennas, Model 1324.19.000X, are connected to the Transceiver via 6' cables and two M/A-Com antennas, Model ANP-C-116 are connected via 6' cables filling all 6 antenna ports. The support device (Compaq Presario laptop) is used only to initiate normal operation of the EUT and then removed. The unterminated I/O cable is still connected to the RS232 9pin Dsub port of the transceiver. The transceiver has all 6 antenna ports active. The EUT (transceiver and antenna) is in the normal transmit/receive mode of operation. The EUT is not a table-top mounted equipment, but would be installed in a cabinet or rack.

Table 3: Six Highest Conducted Emission Levels

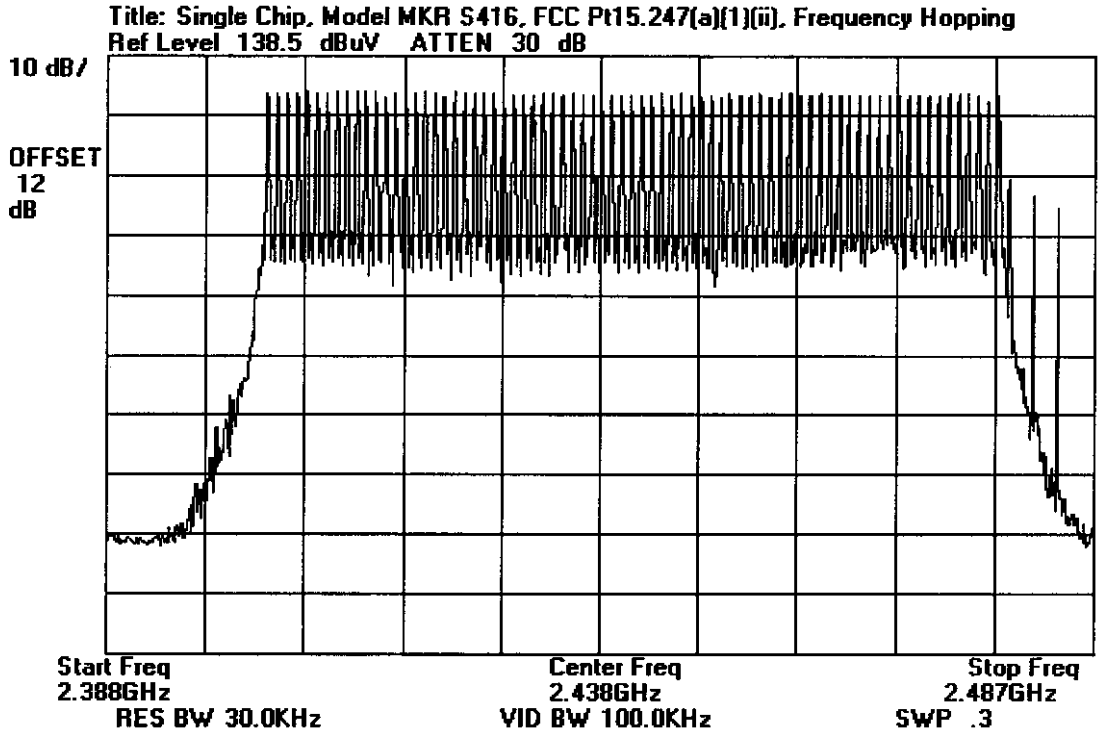
FREQUENCY MHz	METER READING dBµV	CORRECTION FACTORS Lisn dB	dB	dB	dB	CORRECTED READING dBµV	SPEC LIMIT dBµV	MARGIN dB	NOTES
0.784408	35.1	0.0				35.1	48.0	-12.9	B
7.585050	35.3	0.0				35.3	48.0	-12.7	B
8.418201	35.7	0.0				35.7	48.0	-12.3	W
8.614493	35.0	0.0				35.0	48.0	-13.0	B
13.615960	39.5	0.0				39.5	48.0	-8.5	W
13.808770	39.0	0.0				39.0	48.0	-9.0	W

Test Method: ANSI C63.4 1992
Spec Limit : 15.207
Test Distance: No Distance

NOTES: Q = Quasi Peak Reading
A = Average Reading
B = Black Lead
W = White Lead

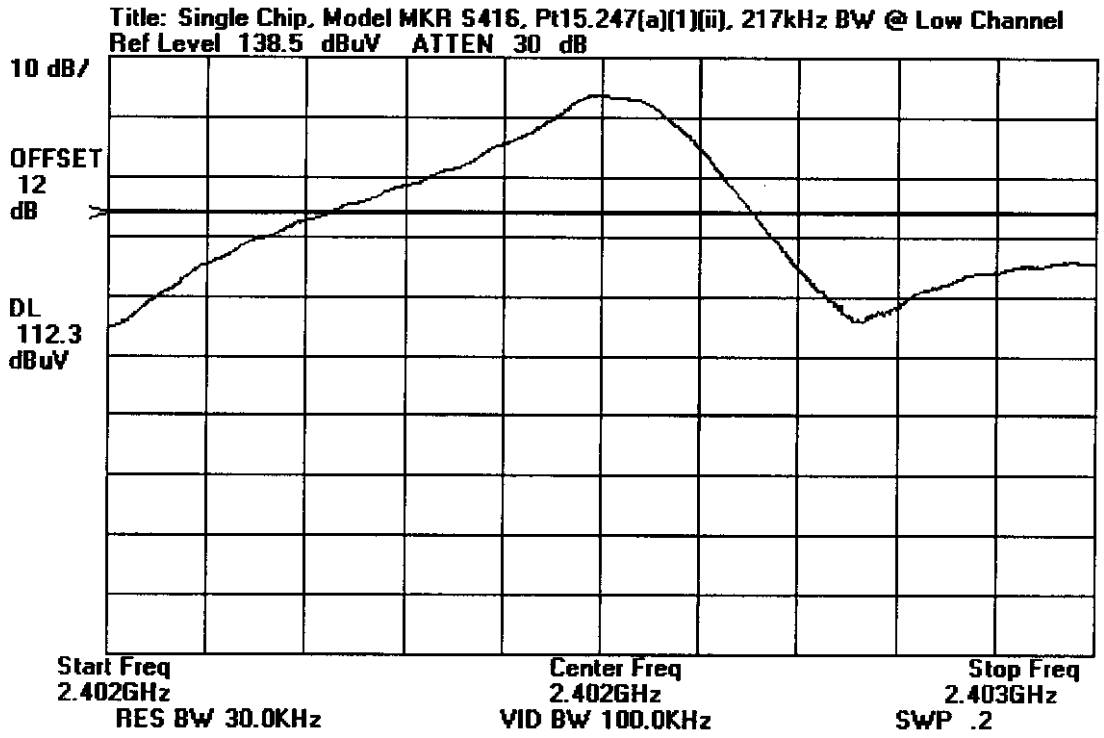
COMMENTS: Four Huber Suhner Antennas, Model 1324.19.000X, are connected to the Transceiver via 6' cables and two M/A-Com antennas, Model ANP-C-116 are connected via 6' cables filling all 6 antenna ports. The support device (Compaq Presario laptop) is used only to initiate normal operation of the EUT and then removed. The unterminated I/O cable is still connected to the RS232 9pin Dsub port of the transceiver. The EUT (transceiver and antennas) is in the normal transmit/receive mode of operation. The EUT is not a table-top mounted equipment, but would be installed in a cabinet or rack.

FCC Part 15.247(a)(1)(ii)Occupied Bandwidth Plot



FCC Part 15.247(a)(1)(ii)Occupied Bandwidth Plot

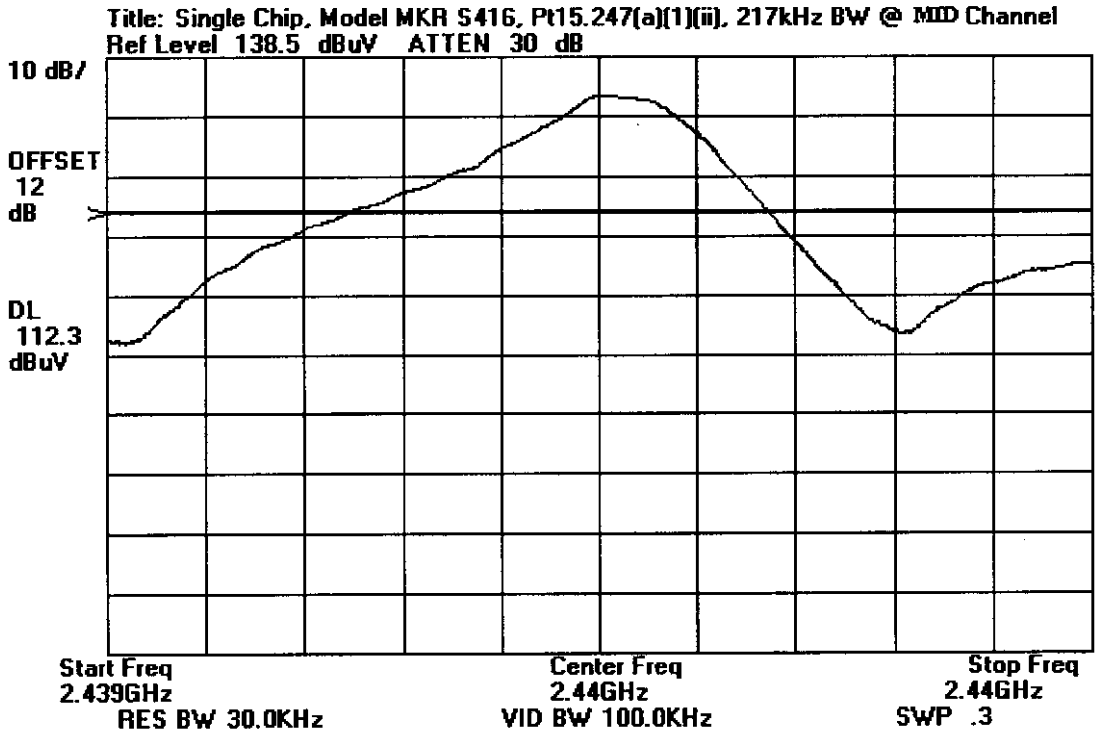
Bandwidth Characteristics



Note: The display line on the plot is 20dBc.

FCC Part 15.247(a)(1)(ii)Occupied Bandwidth Plot

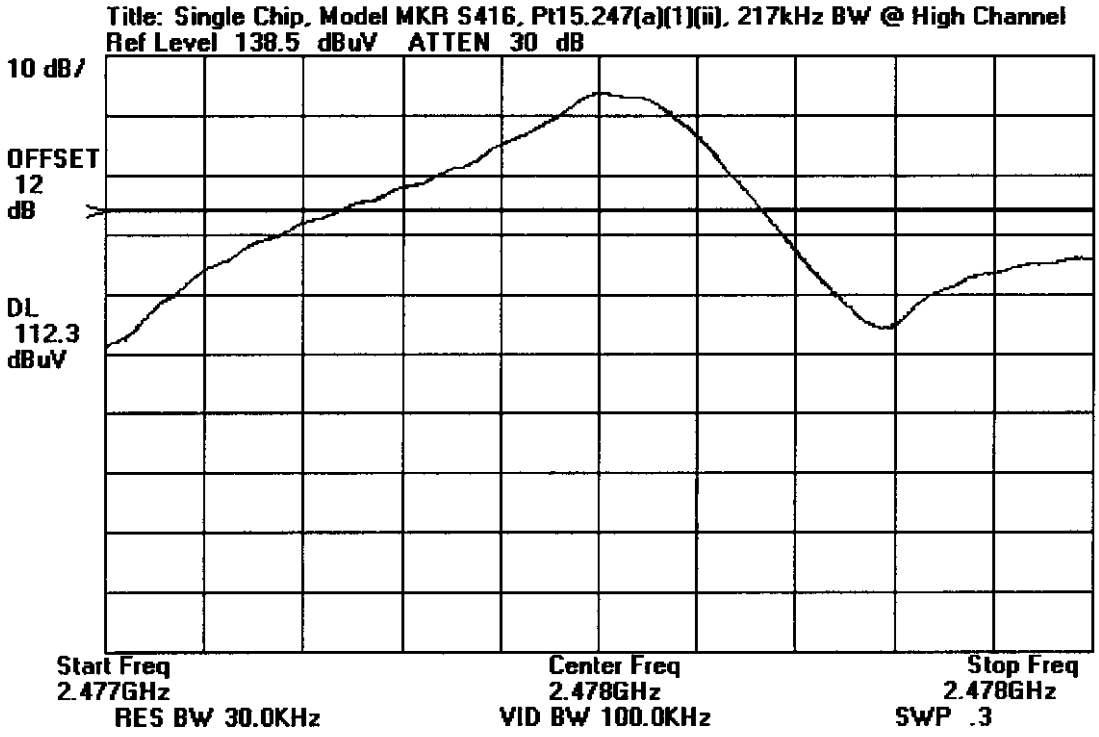
Bandwidth Characteristics



Note: The display line on the plot is 20dBc.

FCC Part 15.247(a)(1)(ii)Occupied Bandwidth Plot

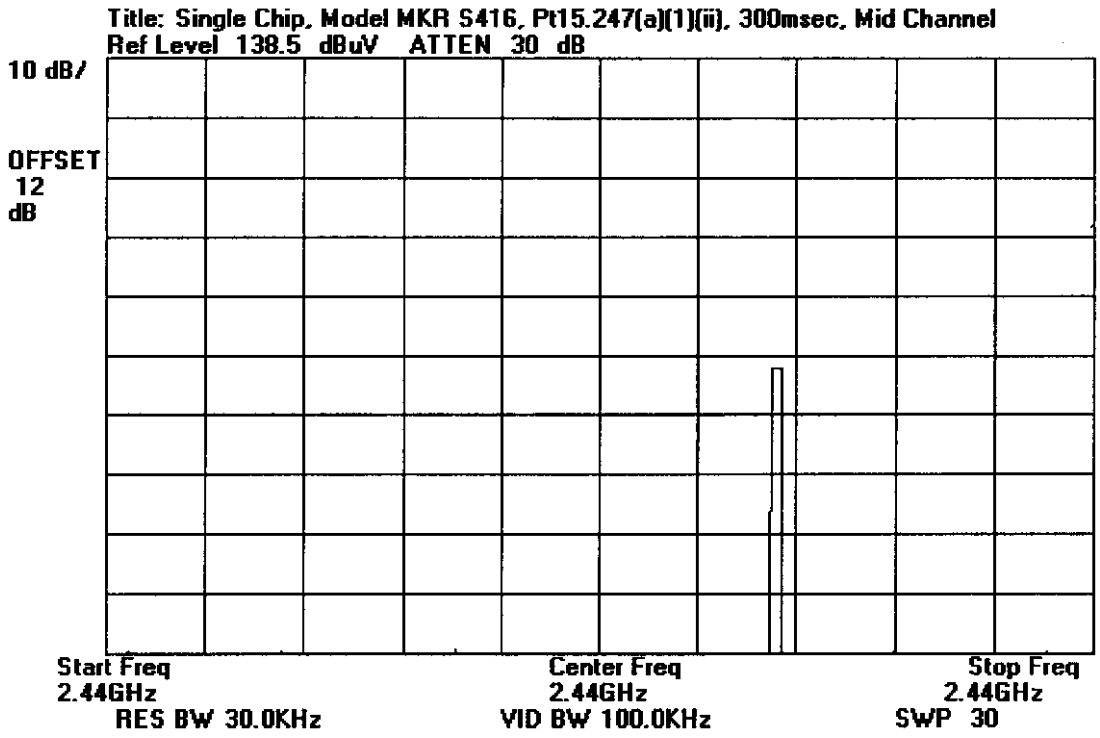
Bandwidth Characteristics



Note: The display line on the plot is 20dBc.

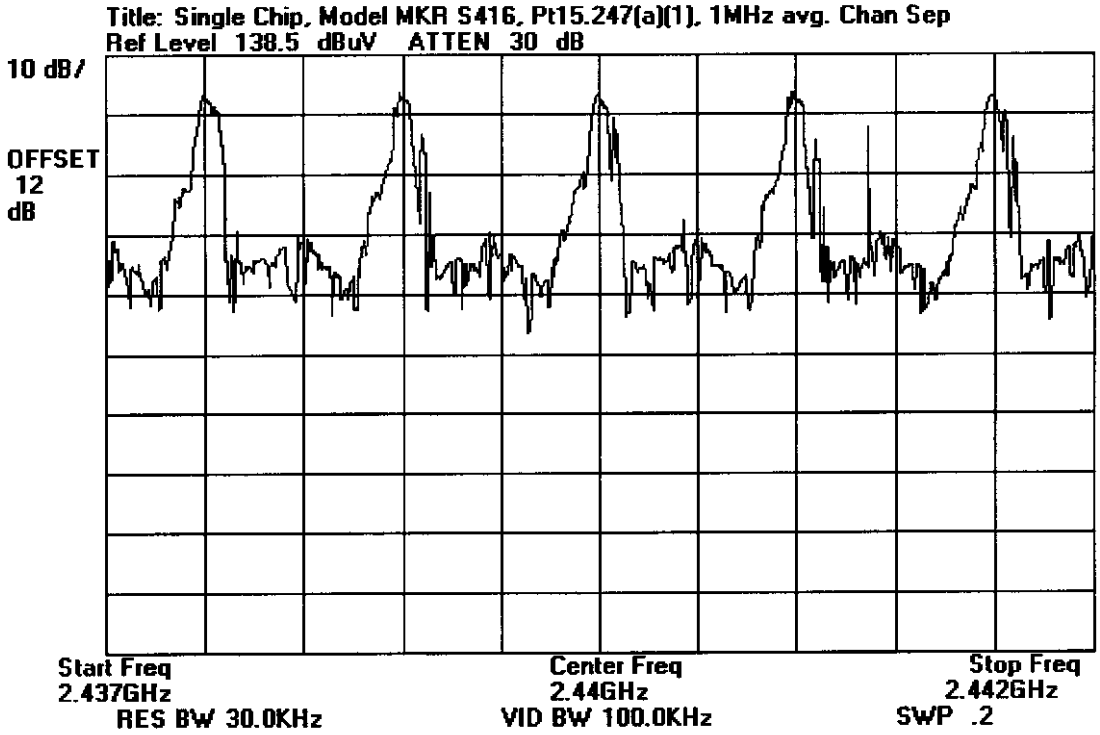
FCC Part 15.247(a)(1)(ii)Occupied Bandwidth Plot

Averaging Time of Channel Occupancy

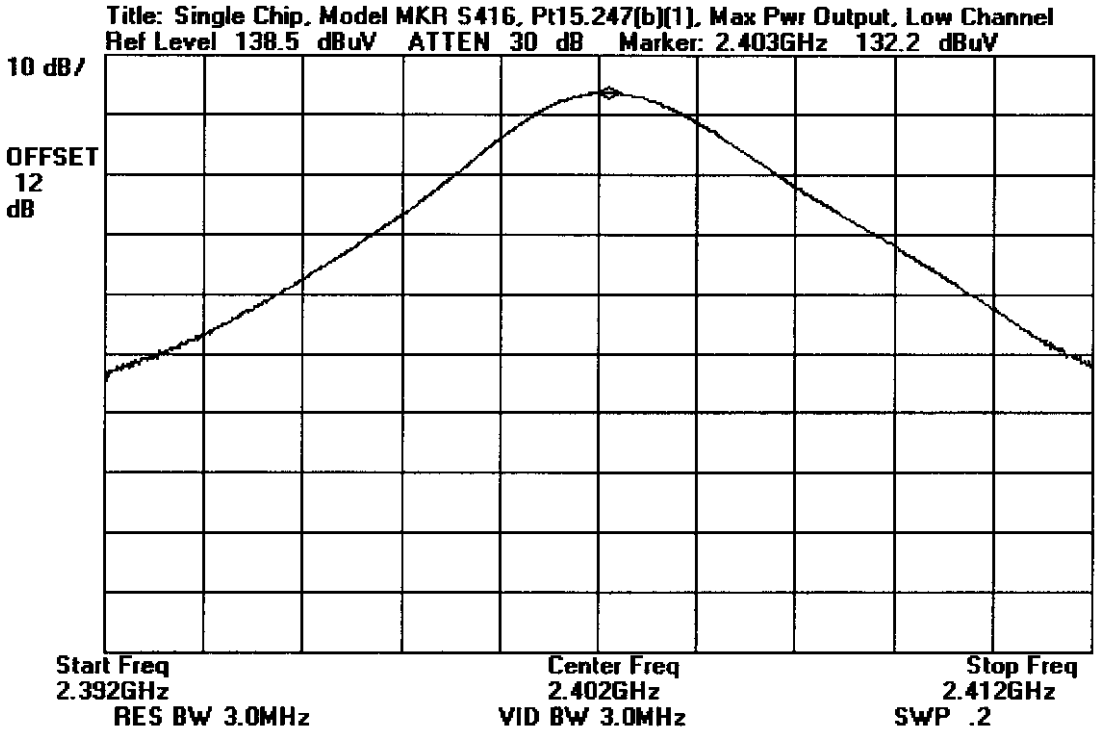


Note: This test per LP042006 using 10 different 30 sec. Sweeps.

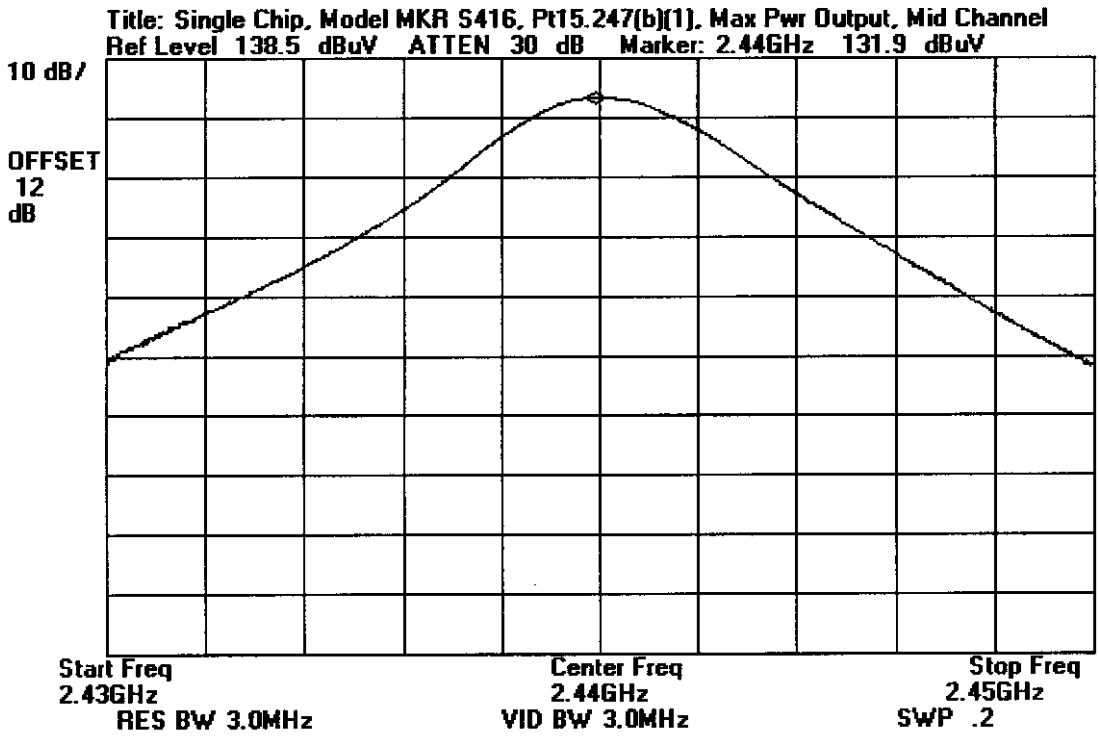
FCC Part 15.247(a)(1)Channel Separtaion



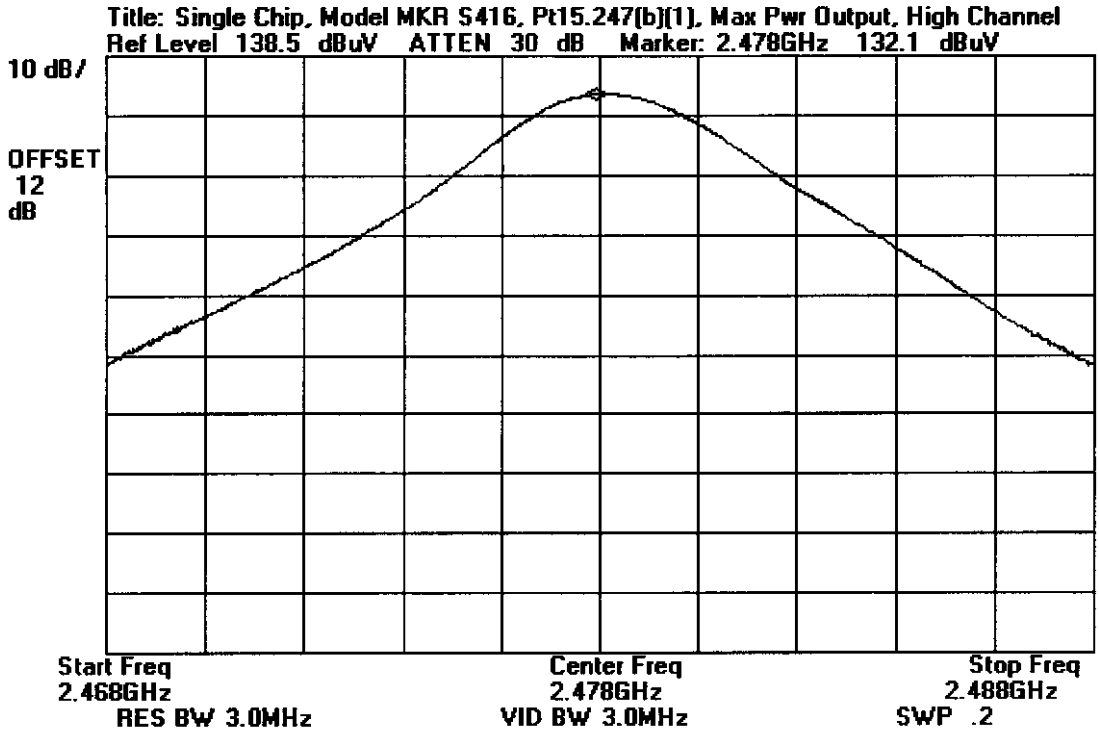
FCC Part 15.247(b)Maximum Output Power



FCC Part 15.247(b)(1)Maximum Output Power

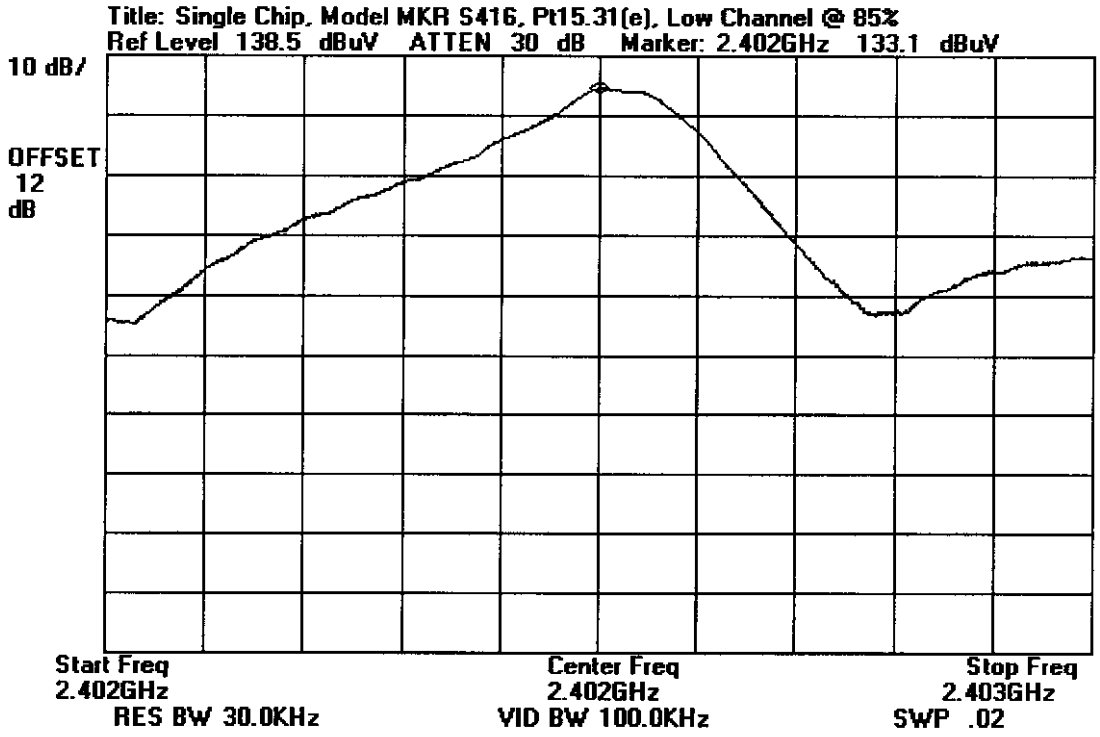


FCC Part 15.247(b)(1)Maximum Output Power



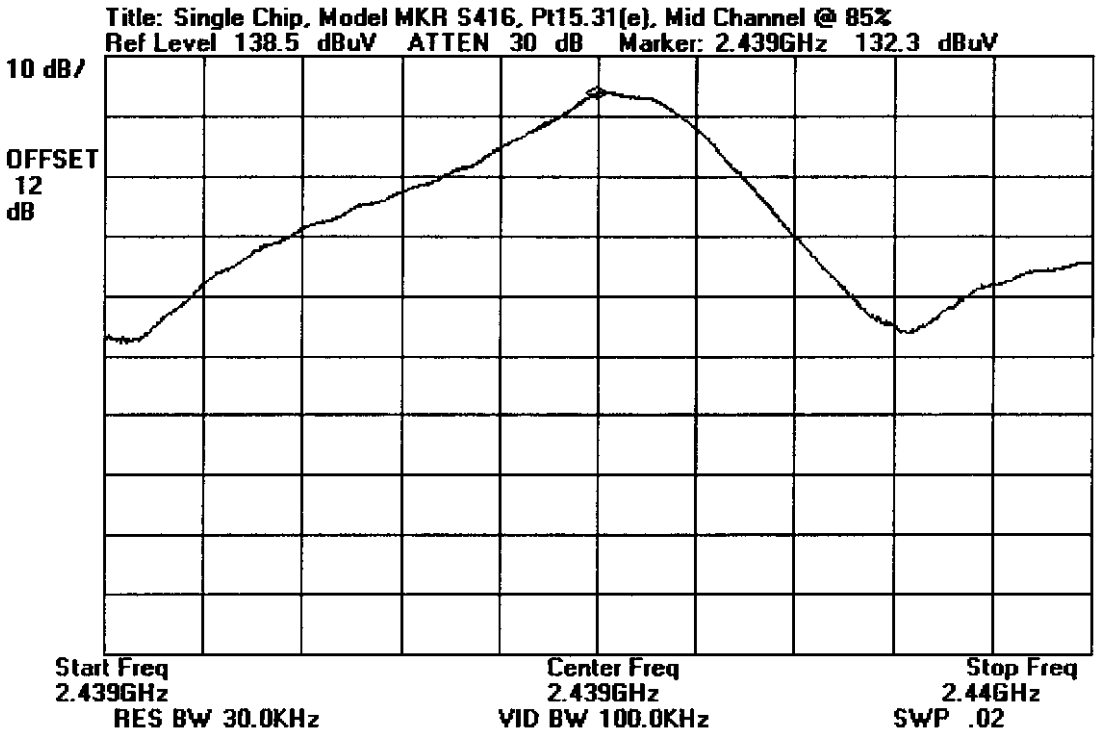
FCC Part 15.31(e)Voltage Variation of Input Power, 85% to 115%

85% of Input Voltage = 102 VAC



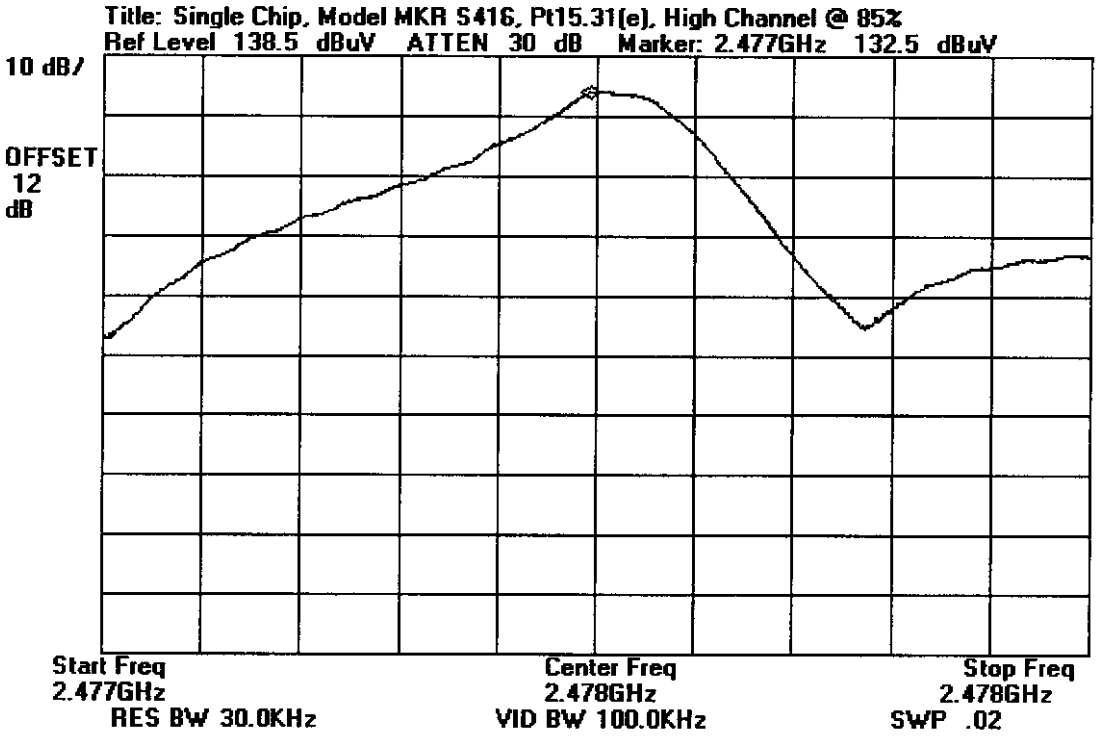
FCC Part 15.31(e)Voltage Variation of Input Power, 85% to 115%

85% of Input Voltage = 102 VAC



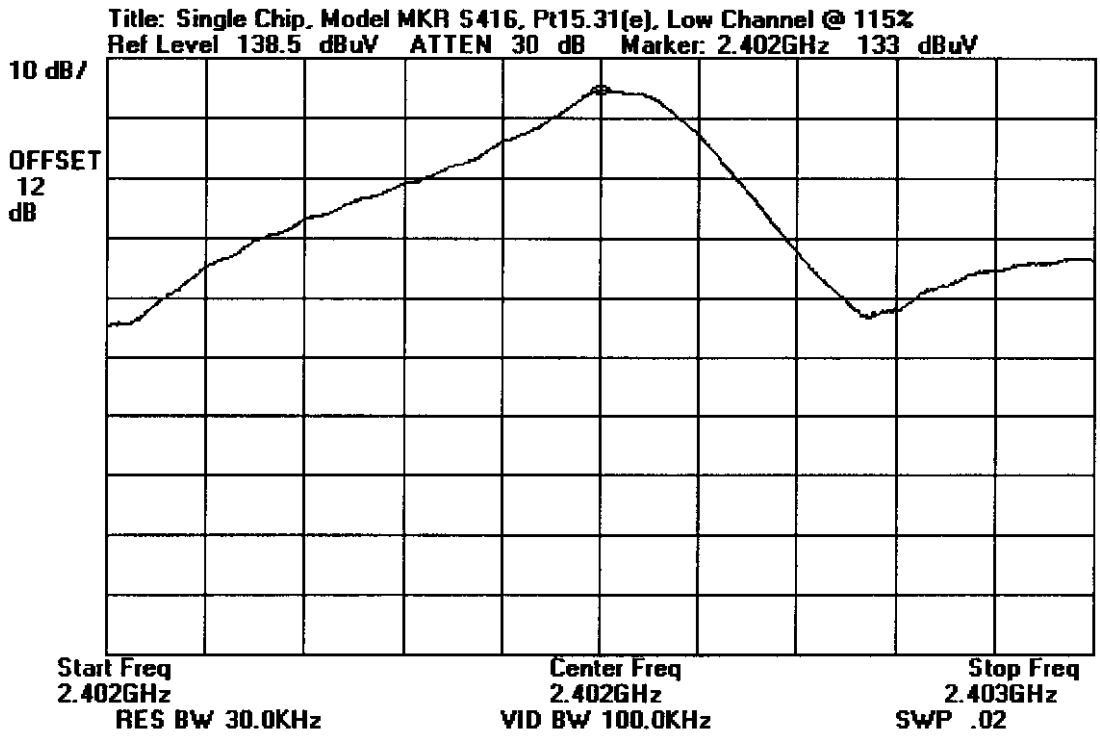
FCC Part 15.31(e)Voltage Variation of Input Power, 85% to 115%

85% of Input Voltage = 102 VAC



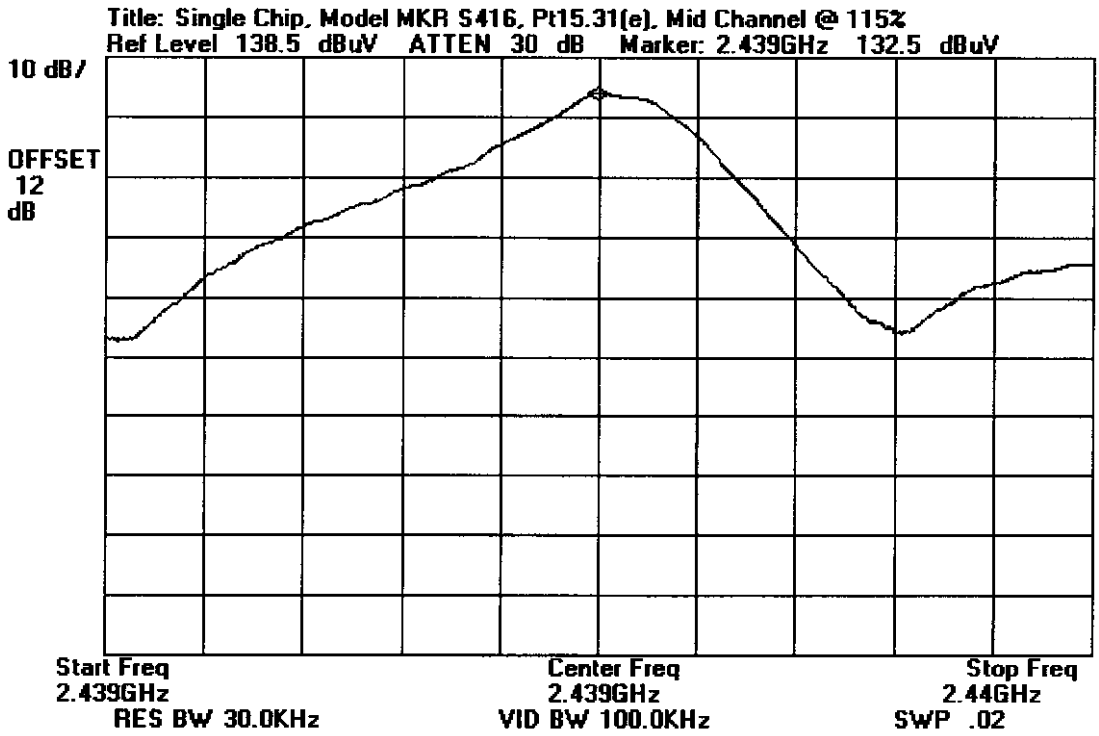
FCC Part 15.31(e)Voltage Variation of Input Power, 85% to 115%

115% of Input Voltage = 138 VAC



FCC Part 15.31(e)Voltage Variation of Input Power, 85% to 115%

115% of Input Voltage = 138 VAC



FCC Part 15.31(e)Voltage Variation of Input Power, 85% to 115%

115% of Input Voltage = 138 VAC

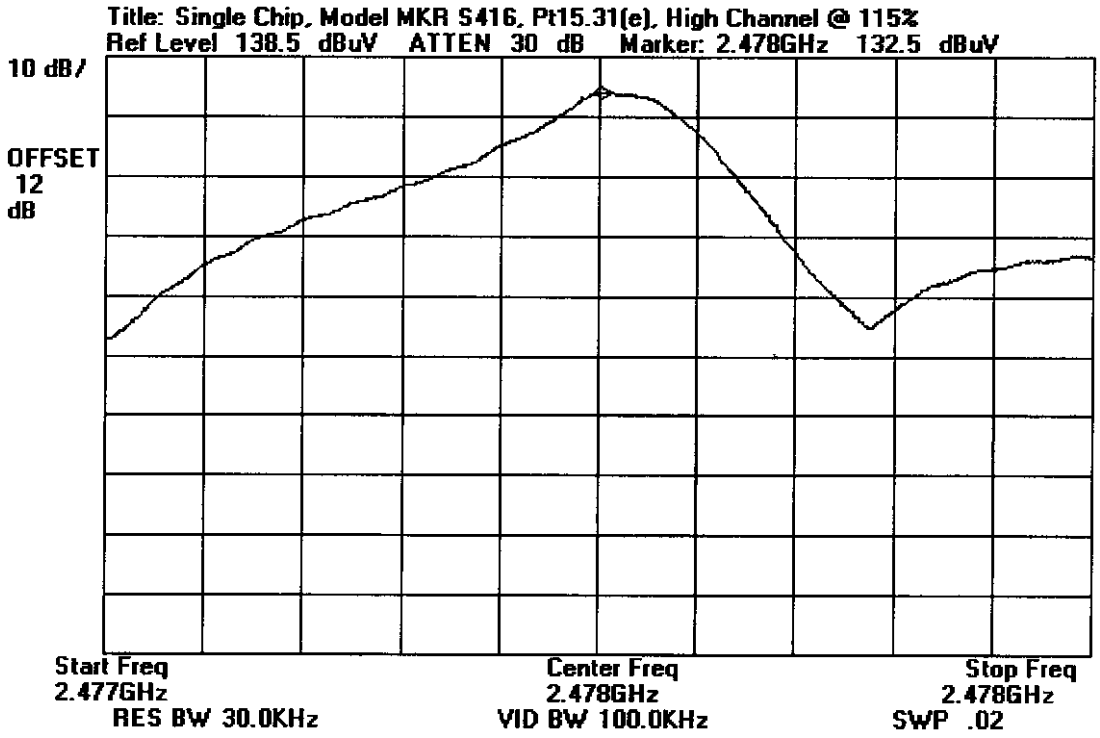


TABLE A

LIST OF TEST EQUIPMENT

1. Voltage Variac, Model PowerStat, S/N 1256D, Calibration date: August 12, 1998. Calibration due date: August 12, 1999.

2. Spectrum Analyzer, Hewlett Packard, Model No. 8566B, S/N 2209A01404. Calibration date: June 12, 1998. Calibration due date: June 12, 1999.

3. Preamp, Hewlett Packard, Model No. 8449B, S/N 3008A00301. Calibration date: October 15, 1998. Calibration due date: October 15, 1999.

4. Quasi-Peak Adapter, Hewlett Packard, Model No. 85650A, S/N 2811A01267. Calibration date: June 12, 1998. Calibration due date: June 12, 1999.

5. Biconical Antenna, A & H Systems, Model No. SAS-200/542, S/N 156. Calibration date: June 9, 1998. Calibration due date: June 9, 1999.

6. Log Periodic Antenna, A & H Systems, Model No. SAS-200/512, S/N 154. Calibration date: June 9, 1998. Calibration due date: June 9, 1999.

7. Magnetic Loop Antenna, EMCO, Model No. 6502, S/N 1074. Calibration date: May 11, 1998. Calibration due date: May 11, 1999.

8. Horn Antenna, EMCO, Model No. 3115, S/N 4683. Calibration date: March 3, 1998. Calibration due date: March 3, 1999.

9. LISN (FCC), Solar Electronics, S/N 855996, 992. Calibration date: May 28, 1998. Calibration due date: May 28, 1999.

10. LISN, Solar Electronics, S/N 8144793, 474. Calibration date: May 20, 1998. Calibration due date: May 20, 1999.

11. Site B (Barn) Calibration date: June 18, 1998. Site B (Barn) Calibration due date: June 18 1999.

12. Test software, EMI Test 2.91.

EUT SETUP

The equipment under test (EUT) and the peripheral listed were setup in a manner that represented their normal use. Any special conditions required for the EUT to operate normally are identified in the comments that accompany Tables 1 - 3 for radiated and conducted emissions. Additionally, a complete description of all the ports and I/O cables is included on the information sheets contained in Appendix A.

During radiated emissions testing, the EUT was mounted on a nonconductive, rotating table 80 cm above the conductive grid. The nonconductive table dimensions were 1 meter by 1.5 meters. This configuration is typical for radiated emissions testing of table top devices.

I/O cables were connected to the EUT and peripheral in the manner required for normal operation of the system.

During conducted emissions testing, the EUT was located on a wooden table measuring approximately 80 cm high, 1 meter deep, and 1.5 meters in length. One wall of the room where the EUT is located, has a minimum 2 meter by 2 meter conductive plane. The EUT was mounted on the wooden table 40 cm away from the conductive plane, and 80 cm from any other conductive surface.

The vertical metal plane used for conducted emissions was grounded to the earth. Power to the EUT was provided through a LISN. The LISN was grounded to the ground plane. All other objects were kept a minimum of 80 cm away from the EUT during the conducted test. Conducted emissions tests required the use of the LISN's listed in Table A.

TEST INSTRUMENTATION AND ANALYZER SETTINGS

The test instrumentation and equipment listed in Table A were used to collect both the radiated and conducted emissions data for the Radio Frequency Identification System Transceiver, MKR S416. For radiated measurements below 300 MHz, the biconical antenna was used. For frequencies from 300 to 1000 MHz, the log periodic antenna was used. The horn antenna was used to scan for frequencies above 1000 MHz. All antennas were located at a distance of 3 meters from the edge of the EUT. Conducted emissions tests required the use of the FCC type LISN's.

The HP spectrum analyzer was used for all measurements. Table B shows the analyzer bandwidth settings that were used in designated frequency bands. For conducted emissions, a reference level of 100 dBμV and a vertical scale size of 10 dB per division were used. A 10 dB external attenuator was also used during conducted tests, with internal offset correction in the analyzer. During radiated testing, the measurements were made with 0 dB of attenuation, a reference level of 97 dBμV, and a vertical scale of 10 dB per division.

TABLE B : ANALYZER BANDWIDTH SETTINGS PER FREQUENCY RANGE

TEST	BEGINNING FREQUENCY	ENDING FREQUENCY	BANDWIDTH SETTING
CONDUCTED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	30 MHz	1000 MHz	120 kHz
RADIATED EMISSIONS	1000 MHz	24 GHz	1 MHz

SPECTRUM ANALYZER DETECTOR FUNCTIONS

The notes that accompany the measurements contained in Tables 1 - 3 indicate the type of detector function used to obtain the given readings. Unless otherwise noted, all readings were made in the "Peak" mode. Whenever a "Quasi-Peak" or "Average" reading is listed as one of the six highest readings, this is indicated as a "Q" or an "A" in Table 1 - 3. The following paragraphs describe in more detail the detector functions and when they were used to obtain the emissions data for the Radio Frequency Identification System Transceiver, MKR S416.

Peak

In this mode, the Spectrum Analyzer or test engineer recorded all emissions at their peak value as the frequency band selected was scanned. By combining this function with another feature of the analyzer called "peak hold," the analyzer had the ability to measure transients or low duty cycle transient emission peak levels. In this mode the analyzer made a slow scan across the frequency band selected and measured the peak emission value found at each frequency across the band.

Quasi-Peak

When the true peak values exceeded or were within 2 dB of the specification limit, quasi-peak measurements were taken using the HP Quasi-Peak Adapter for the HP Spectrum Analyzer. The detailed procedure for making quasi peak measurements contained in the HP Quasi-Peak Adapter manual were followed.

Average

When the frequencies exceed 1 GHz, average measurements may be made using the spectrum analyzer. To make these measurements, the test engineer reduces the video bandwidth on the analyzer until the modulation of the signal is filtered out. At this point the analyzer is set into the linear mode and the scan time is reduced.

TEST METHODS

The radiated and conducted emissions data of the Radio Frequency Identification System Transceiver, MKR S416, was taken with the HP Spectrum Analyzer. Incorporating the applicable correction factors for distance, antenna, cable loss and amplifier gain, the data was reduced as shown in the "Sample Calculations". The corrected data was then compared to the FCC Part 15.247 emissions limits to determine compliance.

Preliminary and final measurements were taken in order to better ensure that all emissions from the EUT were found and maximized.

Radiated Emissions Testing

During the preliminary radiated scan, the EUT was powered up and operating in its defined FCC test mode with the I/O cables and line cords facing the antenna. The frequency range of 30 MHz - 88 MHz was then scanned with the biconical antenna located about 1.5 meter above the ground plane in the vertical configuration. During this scan, the turntable was rotated and all peaks, which were at or near the limit, were recorded. The frequency range of 100 - 300 MHz was scanned with the biconical antenna in the same manner, and the peaks recorded. Lastly, a scan of the FM band from 88 - 110 MHz was made, using a reduced resolution bandwidth and a reduced frequency span. The biconical antenna was changed to the horizontal polarity and the above steps were repeated. After changing to the log periodic antenna in the horizontal configuration, the frequency range of 300 - 1000 MHz was scanned. The log periodic antenna was changed to the vertical polarity and the frequency range of 300 - 1000 MHz was again scanned. . The horn antenna was used to scan for frequencies above 1000 MHz. Care was taken to ensure that no frequencies were missed within the FM and TV bands. An analysis was performed to determine if the signals that were at or near the limit were caused by an ambient transmission. If unable to determine by analysis, the equipment was powered down to make the final determination if the EUT was the source of the emission.

For the final radiated scan, the equipment was again positioned with its I/O and power cables facing the antenna. A thorough scan of all frequencies was manually made using a small frequency span, rotating the turntable as needed. Comparison with the previously recorded measurements was then made.

Using the peak readings from both scans as a guide, the test engineer then maximized the readings with respect to the table rotation, antenna height and configuration of the peripheral and cables. Maximizing of the cables was achieved by monitoring the spectrum analyzer on a closed circuit television monitor while the EUT cables were being moved and rearranged on the EUT table for maximum emissions. Photographs showing the final worst case configuration of the EUT are contained in Appendix A.

Conducted Emissions Testing

For conducted emissions testing, a 30 to 50 second sweep time was used for automated measurements in the frequency bands of 450 kHz to 1.705 MHz, 1.705 MHz to 3 MHz, and 3 MHz to 30 MHz. All readings within 20 dB of the limit were recorded. At frequencies where the recorded emissions were close to the limit, further investigation was performed manually at a slower sweep rate.

TRANSMITTER CHARACTERISTICS

Occupied Bandwidth Measurements

The fundamental frequency was kept within the permitted band 2400-2483.5 MHz.

Power Output

Frequency of Transmitter: 2.4 GHz

The RF conducted test, was measured using a direct connection between the antenna port of the transmitter and the spectrum analyzer, through suitable attenuation. The resolution bandwidth was adjusted to greater than the 6 dB bandwidth of the emissions.

Frequency	Measurement in dBm	Measurement in mW
2.4 GHz	25.9	389.05

The limit used was determined by the method stated in FCC Part 15.247(b).

SAMPLE CALCULATIONS

The basic spectrum analyzer reading was converted using correction factors as shown in the worst case emissions readings in Tables 1 - 3. For radiated emissions in dBμV/m, the spectrum analyzer reading in dBμV was corrected by using the following formula:

Meter reading (dBμV)
+ Antenna Factor (dB)
+ Cable Loss (dB)
- Distance Correction (dB)
- Pre-amplifier Gain (dB)

= Corrected Reading(dBμV/m)

This reading was then compared to the applicable specification limit to determine compliance. A typical data sheet will display the following in column format:

#	Freq MHz	Rdng dBuV	Barn	8449B	Horn	High	Dist	Corr dBuV/m	Spec	Margin	Polar

means reading number
Freq MHz is the frequency in MHz of the obtained reading.
Rdng dBuV is the reading obtained on the spectrum analyzer in dBμV.
8449B is short for the preamplifier factor or gain in dB.
High pass filter factor in dB.
Horn is the horn antenna factor in dB.
Barn is the cable loss in dB of the coaxial cable on the OATS.
Dist is the distance factor (in dB). It is used when testing at a different test distance than the one stated in the spec.
Corr dBμV/m is the corrected reading which is now in dBμV/m (field strength).
Spec is the specification limit (dB) stated in the agency's regulations.
Margin is the closeness to the specified limit in dB; + is over and - is under the limit.
Polar is the Polarity of the antenna with respect to earth.

APPENDIX A

INFORMATION ABOUT THE EQUIPMENT UNDER TEST

INFORMATION ABOUT THE EQUIPMENT UNDER TEST	
Test Software/Firmware:	**Diagrdid.exe/40.23**
CRT was displaying:	**Diagrdid.exe**
Power Supply Manufacturer:	**Phihong**
Power Supply Part Number:	**PSA-25-305**
AC Line Filter Manufacturer:	**Corcom**
AC Line Filter Part Number:	**3ED1**
Line voltage used during testing:	**115 V, 60Hz**

I/O PORTS	
Type	#
RS-232	1
AC Input	1
RF Ouput	6

CRYSTAL OSCILLATORS	
Type	Freq In MHz
ECS-200-20-7	20.000

PRINTED CIRCUIT BOARDS				
Function	Model & Rev	Clocks, MHz	Layers	Location
Main Transceiver	4 Rev. E	20	4	Rear
Power Supply	29203-125 Rev. A	Load dependant	2	Front
Interconnect	Rev. A	N/A	2	Middle

CABLE INFORMATION

Cable #:	1	Cable(s) of this type:	1
Cable Type:	Serial	Shield Type:	N/A
Construction:	Twisted, jacketed	Length In Meters:	2
Connected To End (1):	PC	Connected To End (2):	Transceiver
Connector At End (1):	DB-9 female	Connector At End (2):	DB-9 male
Shield Grounded At (1):	N/A	Shield Grounded At (2):	N/A
Part Number:	AE1020-ND	Number of Conductors:	9
Notes:	Standard 6 foot PC serial cable		

Cable #:	2	Cable(s) of this type:	1
Cable Type:	AC Line cord	Shield Type:	N/A
Construction:	Twisted, jacketed	Length In Meters:	2
Connected To End (1):	Wall plug	Connected To End (2):	Transceiver
Connector At End (1):	Standard 3 prong	Connector At End (2):	AC receptacle
Shield Grounded At (1):	N/A	Shield Grounded At (2):	N/A
Part Number:	Q102-ND	Number of Conductors:	3
Notes:	Standard 6 foot AC line cord		

Cable #:	3	Cable(s) of this type:	6
Cable Type:	Coaxial	Shield Type:	Braided
Construction:	Flexible coax	Length In Meters:	2
Connected To End (1):	Transceiver	Connected To End (2):	Antenna
Connector At End (1):	SMA male	Connector At End (2):	SMA male
Shield Grounded At (1):	Coaxial ground	Shield Grounded At (2):	Coaxial ground
Part Number:	P-3636-603-5272	Number of Conductors:	2
Notes:	Low loss coaxial cable		

APPENDIX B

MEASUREMENT DATA SHEETS

Test Location:	CKC Laboratories, Inc. • 5473A Clouds Rest Rd, Barn • Mariposa, CA 95338 • (800)-500-4EMC		
Customer:	**Single Chip**	Date:	Feb-05-99
Specification:	**FCC 15.209**	Time:	10:44
Test Type:	**Maximized Emissions**	Sequence#:	1
Equipment:	**RF Identification Transceiver**		
Manufacturer:	Single Chip Sytems	Tested By:	Craig Mullis
Model:	MKR S416		
S/N:	4100001		

Equipment Under Test **(* = EUT):**

Function	Manufacturer	Model #	S/N
Antenna (2)	M/A-Com	ANP-C-116	N/A
Antenna (4)	Huber Suhner	1324.19.000X	N/A
Transceiver	Single Chip	MKR S416	4100001

Support Devices:

Function	Manufacturer	Model #	S/N
Laptop	Compaq	Presario	V730BQH23748

Test Conditions / Notes:

Four Huber Suhner Antennas, Model 1324.19.000X, are connected to the Transceiver via 6' cables and two M/A-Com antennas, Model ANP-C-116 are connected via 6' cables filling all 6 antenna ports. The support device (Compaq Presario laptop) is used only to initiate normal operation of the EUT and then removed. The unterminated I/O cable is still connected to the RS232 9pin Dsub port of the transceiver. The EUT (transceiver and antennas) is in the normal transmit/receive mode of operation. The EUT is not a table-top mounted equipment, but would be installed in a cabinet or rack.

Measurement Data: Sorted by Margin Test Distance: 3 Meters

#	Freq MHz	Rdng dBµV	Barn dB	Bicon dB	dB	Pream dB	Dist dB	Corr dBµV/m	Spec dBµV/m	Margin dB	Polar
1	36.036	43.0	+1.1	+12.1		-27.2	+0.0	29.0	40.0	-11.0	Vert
2	36.005	42.9	+1.1	+12.1		-27.2	+0.0	28.9	40.0	-11.1	Vert
3	40.066	41.0	+1.1	+11.2		-27.2	+0.0	26.1	40.0	-13.9	Vert
4	63.320	41.0	+1.3	+9.1		-27.2	+0.0	24.2	40.0	-15.8	Vert
5	220.177	35.5	+2.9	+17.1		-26.7	+0.0	28.8	46.0	-17.2	Vert
6	80.032	39.7	+1.6	+7.6		-27.1	+0.0	21.8	40.0	-18.2	Vert
7	248.934	32.3	+3.0	+16.1		-26.6	+0.0	24.8	46.0	-21.2	Vert
8	160.031	31.2	+2.3	+14.1		-27.0	+0.0	20.6	43.5	-22.9	Vert

Test Location: CKC Laboratories, Inc. • 5473A Clouds Rest Rd, Barn • Mariposa, CA 95338 • (800)-500-4EMC

Customer:	**Single Chip**	Date:	Feb-01-99
Specification:	**FCC 15.209**	Time:	11:59
Test Type:	**Maximized Emissions**	Sequence#:	2
Equipment:	**RF Identification Transceiver**		
Manufacturer:	Single Chip Sytems	Tested By:	Craig Mullis
Model:	MKR S416		
S/N:	4100001		

Equipment Under Test **(* = EUT):**

Function	Manufacturer	Model #	S/N
Antenna (2)	M/A-Com	ANP-C-116	N/A
Antenna (4)	Huber Suhner	1324.19.000X	N/A
Transceiver	Single Chip	MKR S416	4100001

Support Devices:

Function	Manufacturer	Model #	S/N
Laptop	Compaq	Presario	V730BQH23748

Test Conditions / Notes:

Four Huber Suhner Antennas, Model 1324.19.000X, are connected to the Transceiver via 6' cables and two M/A-Com antennas, Model ANP-C-116 are connected via 6' cables filling all 6 antenna ports. The support device (Compaq Presario laptop) is used only to initiate normal operation of the EUT and then removed. The unterminated I/O cable is still connected to the RS232 9pin Dsub port of the transceiver. The transceiver has all 6 antenna ports active. The EUT (transceiver and antenna) is in the normal transmit/receive mode of operation. The EUT is not a table-top mounted equipment, but would be installed in a cabinet or rack.

Measurement Data: Sorted by Margin Test Distance: 3 Meters

#	Freq MHz	Rdng dBµV	8449B dB	Horn dB	Barn dB	High dB	Dist DB	Corr dBµV/m	Spec dBµV/m	Margin dB	Polar
1	4878.794	36.7	-32.4	+28.2	+14.7	+0.5	+0.0	47.7	54.0	-6.3	Horiz
	Average										
^	4878.794	42.9	-32.4	+28.2	+14.7	+0.5	+0.0	53.9	54.0	-0.1	Horiz
3	4806.709	34.8	-32.5	+27.9	+14.5	+0.5	+0.0	45.2	54.0	-8.8	Horiz
	Average										
^	4806.709	43.4	-32.5	+27.9	+14.5	+0.5	+0.0	53.8	54.0	-0.2	Horiz
5	4954.784	32.9	-32.2	+28.4	+14.9	+0.5	+0.0	44.5	54.0	-9.5	Horiz
	Average										
^	4954.784	44.2	-32.2	+28.4	+14.9	+0.5	+0.0	55.8	54.0	+1.8	Horiz
7	4954.802	31.6	-32.2	+28.4	+14.9	+0.5	+0.0	43.2	54.0	-10.8	Vert
	Average										
^	4954.802	46.0	-32.2	+28.4	+14.9	+0.5	+0.0	57.6	54.0	+3.6	Vert

Test Location: CKC Laboratories, Inc. • 5473A Clouds Rest Rd, Barn • Mariposa, CA 95338 • (800)-500-4EMC

Customer:	**Single Chip**	Date:	Jan-05-99
Specification:	**FCC pt 15.207**	Time:	14:38
Test Type:	**Conducted Emissions**	Sequence#:	2
Equipment:	**RF Identification Transceiver**		
Manufacturer:	Single Chip Sytems	Tested By:	Craig Mullis
Model:	MKR S416		
S/N:	4100001		

Equipment Under Test **(* = EUT):**

Function	Manufacturer	Model #	S/N
Antenna (2)	M/A-Com	ANP-C-116	N/A
Antenna (4)	Huber Suhner	1324.19.000X	N/A
Transceiver	Single Chip	MKR S416	4100001

Support Devices:

Function	Manufacturer	Model #	S/N
Laptop	Compaq	Presario	V730BQH23748

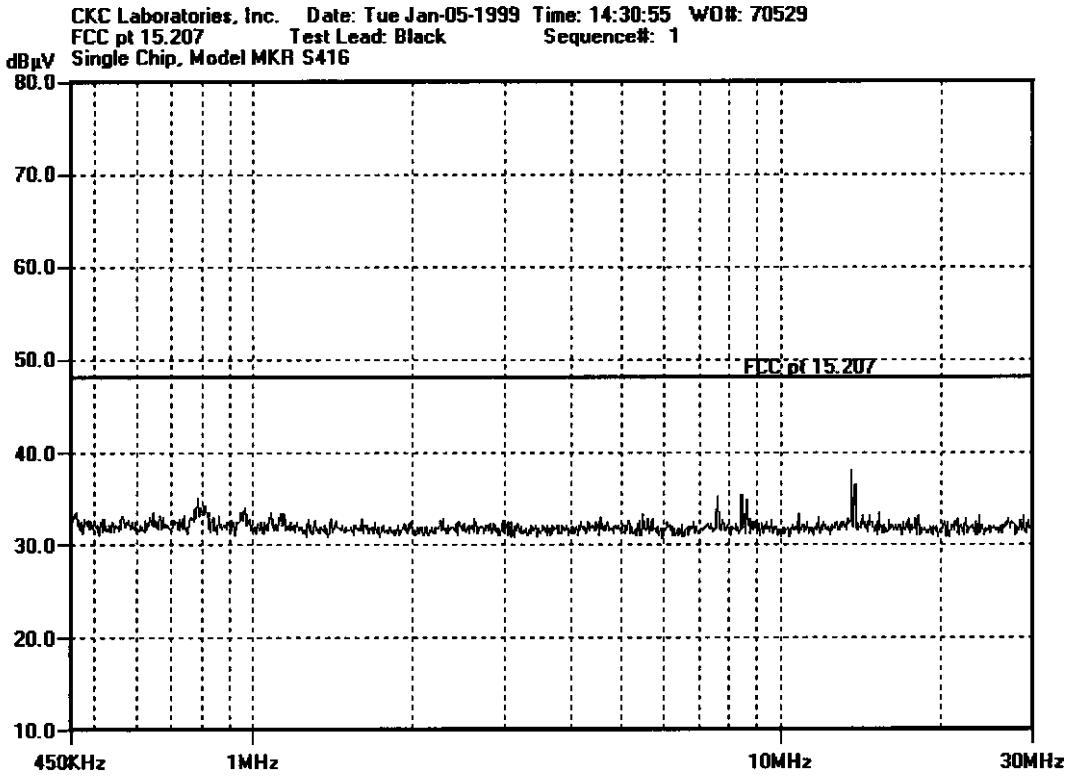
Test Conditions / Notes:

Four Huber Suhner Antennas, Model 1324.19.000X, are connected to the Transceiver via 6' cables and two M/A-Com antennas, Model ANP-C-116 are connected via 6' cables filling all 6 antenna ports. The support device (Compaq Presario laptop) is used only to initiate normal operation of the EUT and then removed. The unterminated I/O cable is still connected to the RS232 9pin Dsub port of the transceiver. The EUT (transceiver and antennas) is in the normal transmit/receive mode of operation. The EUT is not a table-top mounted equipment, but would be installed in a cabinet or rack.

Measurement Data: Sorted by Margin Test Lead: Black

#	Freq	Rdng dBµV	dB	dB	dB	dB	Dist dB	Corr dBµV	Spec	Margin dB	Polar
1	13.632M	38.0					+0.0	38.0	48.0	-10.0	Black
2	13.817M	36.5					+0.0	36.5	48.0	-11.5	Black
3	8.418M	35.4					+0.0	35.4	48.0	-12.6	Black
4	7.585M	35.3					+0.0	35.3	48.0	-12.7	Black
5	784.408k	35.1					+0.0	35.1	48.0	-12.9	Black
6	8.614M	35.0					+0.0	35.0	48.0	-13.0	Black
7	807.915k	34.3					+0.0	34.3	48.0	-13.7	Black
8	792.749k	34.1					+0.0	34.1	48.0	-13.9	Black

9	962.838k	34.0	+0.0	34.0	48.0	-14.0	Black
10	772.275k	33.8	+0.0	33.8	48.0	-14.2	Black
11	943.984k	33.6	+0.0	33.6	48.0	-14.4	Black
12	820.048k	33.6	+0.0	33.6	48.0	-14.4	Black
13	461.374k	33.6	+0.0	33.6	48.0	-14.4	Black
14	15.303M	33.5	+0.0	33.5	48.0	-14.5	Black
15	1.077M	33.5	+0.0	33.5	48.0	-14.5	Black
16	648.673k	33.5	+0.0	33.5	48.0	-14.5	Black
17	1.123M	33.4	+0.0	33.4	48.0	-14.6	Black
18	451.517k	33.4	+0.0	33.4	48.0	-14.6	Black
19	5.491M	33.3	+0.0	33.3	48.0	-14.7	Black
20	1.136M	33.3	+0.0	33.3	48.0	-14.7	Black


CKC Laboratories, Inc. Date: Tue Jan-05-1999 Time: 14:30:55 WO#: 70529
FCC pt 15.207 Test Lead: Black Sequence#: 1
dBµV Single Chip, Model MKR S416
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
FCC pt 15.207
450KHz
1MHz
10MHz
30MHz

Test Location: CKC Laboratories, Inc. • 5473A Clouds Rest Rd, Barn • Mariposa, CA 95338 • (800)-500-4EMC

Customer:	**Single Chip**	Date:	Jan-05-99
Specification:	**FCC pt 15.207**	Time:	14:45
Test Type:	**Conducted Emissions**	Sequence#:	2
Equipment:	**RF Identification Transceiver**		
Manufacturer:	Single Chip Sytems	Tested By:	Craig Mullis
Model:	MKR S416		
S/N:	4100001		

Equipment Under Test **(* = EUT):**

Function	Manufacturer	Model #	S/N
Antenna (2)	M/A-Com	ANP-C-116	N/A
Antenna (4)	Huber Suhner	1324.19.000X	N/A
Transceiver	Single Chip	MKR S416	4100001

Support Devices:

Function	Manufacturer	Model #	S/N
Laptop	Compaq	Presario	V730BQH23748

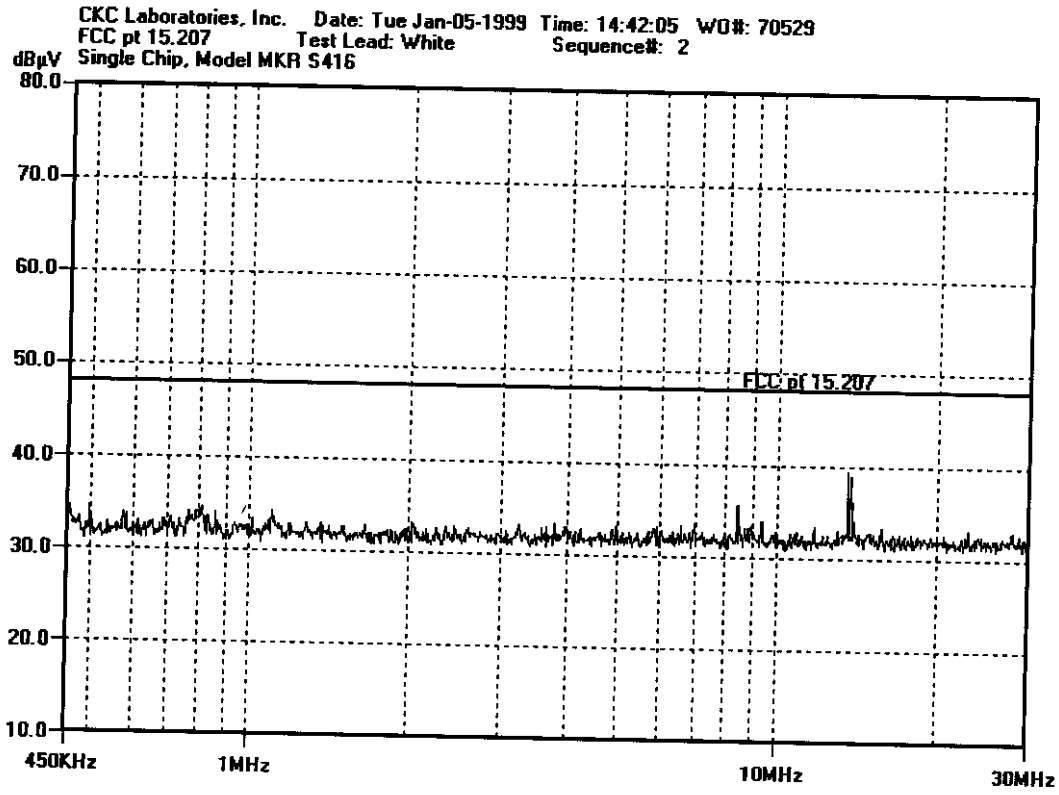
Test Conditions / Notes:

Four Huber Suhner Antennas, Model 1324.19.000X, are connected to the Transceiver via 6' cables and two M/A-Com antennas, Model ANP-C-116 are connected via 6' cables filling all 6 antenna ports. The support device (Compaq Presario laptop) is used only to initiate normal operation of the EUT and then removed. The unterminated I/O cable is still connected to the RS232 9pin Dsub port of the transceiver. The EUT (transceiver and antennas) is in the normal transmit/receive mode of operation. The EUT is not a table-top mounted equipment, but would be installed in a cabinet or rack.

Measurement Data: Sorted by Margin Test Lead: White

#	Freq	Rdng dBµV	dB	dB	dB	dB	Dist dB	Corr dBµV	Spec	Margin dB	Polar
1	13.616M	39.5					+0.0	39.5	48.0	-8.5	White
2	13.809M	39.0					+0.0	39.0	48.0	-9.0	White
3	8.418M	35.7					+0.0	35.7	48.0	-12.3	White
4	813.223k	34.6					+0.0	34.6	48.0	-13.4	White
5	498.531k	34.6					+0.0	34.6	48.0	-13.4	White
6	457.583k	34.6					+0.0	34.6	48.0	-13.4	White
7	1.102M	34.3					+0.0	34.3	48.0	-13.7	White
8	799.574k	34.1					+0.0	34.1	48.0	-13.9	White

9	13.953M	34.0	+0.0	34.0	48.0	-14.0	White
10	860.889k	34.0	+0.0	34.0	48.0	-14.0	White
11	764.692k	34.0	+0.0	34.0	48.0	-14.0	White
12	9.352M	33.9	+0.0	33.9	48.0	-14.1	White
13	577.393k	33.8	+0.0	33.8	48.0	-14.2	White
14	584.218k	33.7	+0.0	33.7	48.0	-14.3	White
15	6.970M	33.6	+0.0	33.6	48.0	-14.4	White
16	832.260k	33.6	+0.0	33.6	48.0	-14.4	White
17	776.825k	33.5	+0.0	33.5	48.0	-14.5	White
18	15.801M	33.4	+0.0	33.4	48.0	-14.6	White
19	8.519M	33.4	+0.0	33.4	48.0	-14.6	White
20	1.009M	33.4	+0.0	33.4	48.0	-14.6	White


CKC Laboratories, Inc. Date: Tue Jan-05-1999 Time: 14:42:05 WO#: 70529
FCC pt 15.207 Test Lead: White Sequence#: 2
Single Chip, Model MKR S416
dBµV
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
FCC pt 15.207
450KHz
1MHz
10MHz
30MHz