FCC Part 15.247
Transmitter Certification

Single Channel Direct Sequence Transmitter

Test Report

FCC ID: SK9C1A-2

FCC Rule Part: 15.247

ACS Report Number: 04-0396-15C-DTS

Manufacturer: Itron Electricity Metering, Inc.
Trade Name: CENTRON ™ ICARe
Model: C1A-2

Test Begin Date: January 13, 2004
Test End Date: January 15, 2004

Report Issue Date: January 3, 2005

FOR THE SCOPE OF ACCREDITATION UNDER LAB Code 200612

Prepared by:
J. Kirby Munroe
Manager Wireless Certifications
ACS, Inc.

Reviewed by:
R. Sam Wismer
Engineering Manager
ACS, Inc.

This report contains 15 pages

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1.0 GENERAL

1.1 Introduction
The purpose of this report is to demonstrate compliance with Part 15, Subpart C of the FCC's Code of Federal Regulations.

1.2 Product Description
The ICARe will be a transmit-only meter module that collects and transmits metering data over the 902 - 928 MHz Industrial, Scientific and Medical (ISM) RF band. The unit will contain both a Direct Sequence Spread Spectrum (DSSS) transmitter and a Frequency Hopping (FSK) transmitter.

The ICARe functions as a RF transmitter that is capable of supporting remote meter reading using mobile and fixed network protocols. The mobile network functions will be the R300 (ITRON™ protocol) or the R900 (SURF© protocol). The fixed network function will be the CellNet© electricity endpoint protocol (PID2) to maintain legacy functionality.

The endpoint will be installed in the CENTRON meter as the register board. The metrology board will provide power and energy data to the endpoint in the same manner as a normal register board.

The endpoint will provide the following data depending on configuration and firmware option:
- Cumulative energy readings using the ITRON protocol
- Cumulative energy readings using the Schlumberger SURF protocol
- Cumulative and interval readings using the CellNet by Atos Origin protocol

The endpoint will determine electrical energy data by counting pulses from the metrology board and then converting them to energy values for display and transmission. The endpoint will use a constant loaded during configuration to provide the correct energy values for the network being supported.

The endpoint will also use a serial protocol for configuration and testing using the register serial port.

It is also necessary for the endpoint to be able to be installed on previous meter bases with no modifications to the base to maintain the modularity requirement of the CENTRON meter.

Detailed photographs of the EUT are filed separately with this filing.

1.2.1 Intended Use

The CENTRON ™ ICARe is intended to be installed on a residential or commercial structure to record electricity usage and transmit the data to either utility personnel or to a nearby base station depending on which radio is active. Only one radio will ever be active at any given time.

If the meter is configured for remote meter data collection by a utility meter reader, the Frequency Hopping (FSK) transmitter radio will be activated.

If the meter is configured for base station data collection the Direct Sequence Spread Spectrum (DSSS) transmitter radio will be activated.

The radios are configured at the factory and cannot be activated by the end user or utility personnel.

2.0 LOCATION OF TEST FACILTY

All testing was performed by qualified ACS personnel located at the following address:

ACS, Inc.
5015 B.U. Bowman Drive
Buford, GA 30518

2.1 DESCRIPTION OF TEST FACILITY

Both the Open Area Test Site (OATS) and Conducted Emissions site have been fully described, submitted to, and accepted by the FCC, Industry Canada and the Japanese Voluntary Control Council for Interference by information technology equipment.

The following certification numbers have been issued in recognition of these accreditations and certifications:

FCC Registration Number: 89450
Industry Canada Lab Code: IC 4175
VCCI Member Number: 1831

- VCCI OATS Registration Number R-1526
- VCCI Conducted Emissions Site Registration Number: C-1608

2.1.1 Open Area Test Site

The open area test site consists of a 40’ x 66’ concrete pad covered with a perforated electro-plated galvanized sheet metal. The perforations in the sheet metal are 1/8” holes that are staggered every 3/16”. The individual sheets are placed to overlap each other by 1/4” and are riveted together to provide a continuous seam. Rivets are spaced every 3” in a 3 x 20 meter perimeter around the antenna mast and EUT area. Rivets in the remaining area are spaced as necessary to properly secure the ground plane and maintain the electrical continuity.

The entire ground plane extends 12’ beyond the turntable edge and 16’ beyond the antenna mast when set to a 10 meter measurement distance. The ground plane is grounded via 4 - 8’ copper ground rods, each installed at a corner of the ground plane and bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is an all aluminum 10’ flush mounted table installed in an all aluminum frame. The table is remotely operated from inside the control room located 40’ from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Adjacent to the turntable is a 7' x 7' square and 4' deep concrete pit used for support equipment if necessary. The pit is equipped with 5 - 4" PVC chases from the pit to the control room that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit. The pit is covered with 2 sheets of 1/4" diamond style re-enforced steel sheets. The sheets are painted to match the perforated steel ground plane, however the underside edges have been masked off to maintain the electrical continuity of the ground plane. All reflecting objects are located outside of the ellipse defined in ANSI C63.4.

A diagram of the Open Area Test Site is shown in Figure 2.1-1 below:

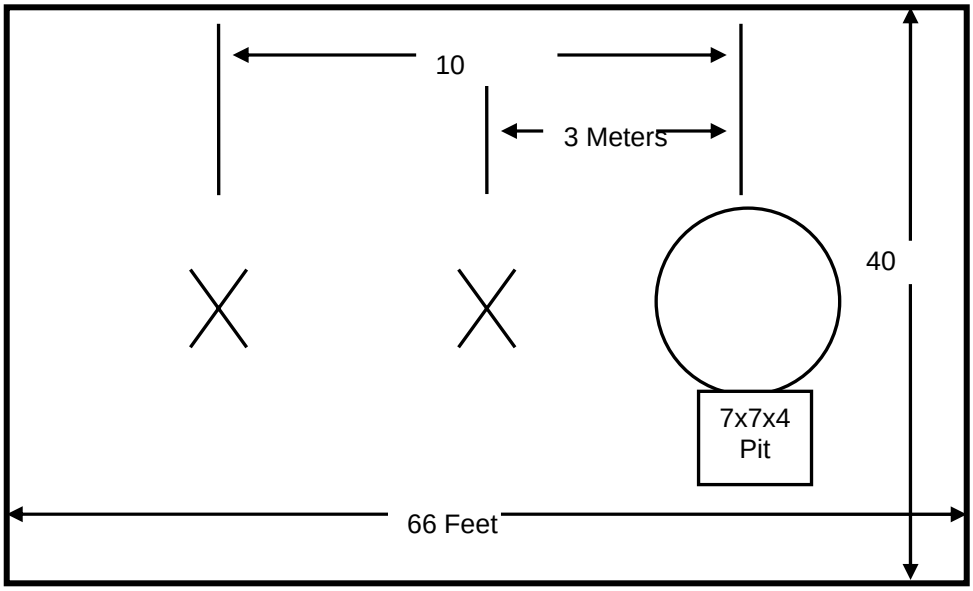

Figure 2.1-1: Open Area Test Site

2.1.2 Conducted Emissions Test Site Description
The AC mains conducted EMI site is a shielded room with the following dimensions:

- Height: 3.0 Meters
- Width: 3.6 Meters
- Length: 4.9 Meters

The room is manufactured by Rayproof Corporation and installed by Panashield, Inc. Earth ground is provided to the room via an 8' copper ground rod. Each panel of the room is connected electrically at intervals of 4".

Power to the room is filtered to prevent ambient noise from coupling to the EUT and measurement equipment. Filters are models 1B42-60P manufactured by Rayproof Corporation.

The room is of sufficient size to test table top and floor standing equipment in accordance with section 6.1.4 of ANSI C63.4.

A diagram of the room is shown below in figure 2.1.2-1:

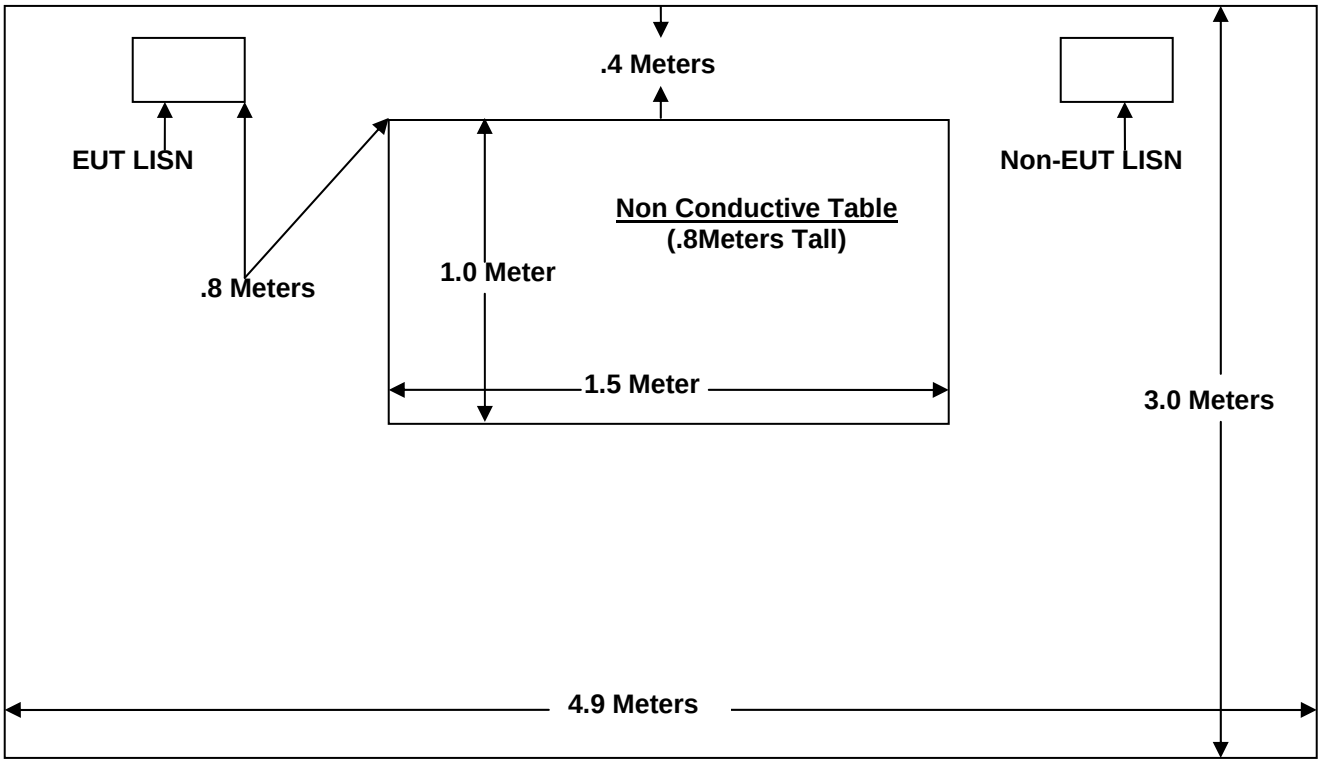

Figure 2.1.2-1: AC Mains Conducted EMI Site

3.0 APPLICABLE STANDARD REFERENCES
The following standards were used:

- ANSI C63.4-1992: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9KHz to 40GHz
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures (October 2002)
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators (October 2002)
- FCC OET Bulletin 65 Appendix C - Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields

4.0 LIST OF TEST EQUIPMENT

All test equipment used for regulatory testing is calibrated yearly or according to manufacturer's specifications.

Table 4.0-1: Test Equipment

Equipment Calibration Information					
ACS #	**Mfg.**	**Eq. type**	**Model**	**S/N**	**Cal. Due**
---	Agilent	Spectrum Analyzer	E7402A	US40240259	11/08/04
---	Agilent	Spectrum Analyzer	8563EC	4111A01283	10/10/04
26	Chase	Bi-Log Antenna	CBL6111	1044	10/14/04
152	EMCO	LISN	3825/2	9111-1905	1/08/05
153	EMCO	LISN	3825/2	9411-2268	12/11/04
193	ACS	OATS Cable Set	RG8	193	1/09/05
167	ACS	Conducted EMI Cable Set	RG8	167	1/09/05
24	ACS	Cable	Heliax	24	04/07/04
5	ACS	Cable	LL-335	None	8/20/04
6	ACS	Cable	LL-335	None	8/6/04
22	Agilent	Pre-Amplifier	8449B	3008A00526	9/18/04
73	Agilent	Pre-Amplifier	8447D	272A05624	04/15/04
30	Spectrum Technologies	Horn Antenna	DRH-0118	970102	5/8/04
105	Microwave Circuits	High Pass Filter	H1G810G1	2123-01 DC0225	6/17/04
40	EMCO	Biconical Antenna	3104	3211	9/19/04

5.0 SYSTEM BLOCK DIAGRAM

Table 5.0: System Block Diagram

Diagram Number	Manufacturer	Equipment Type	Model Number	Serial Number	FCC ID
1	EUT	Electricity Meter	C1A-2	None	SK9C1A-2

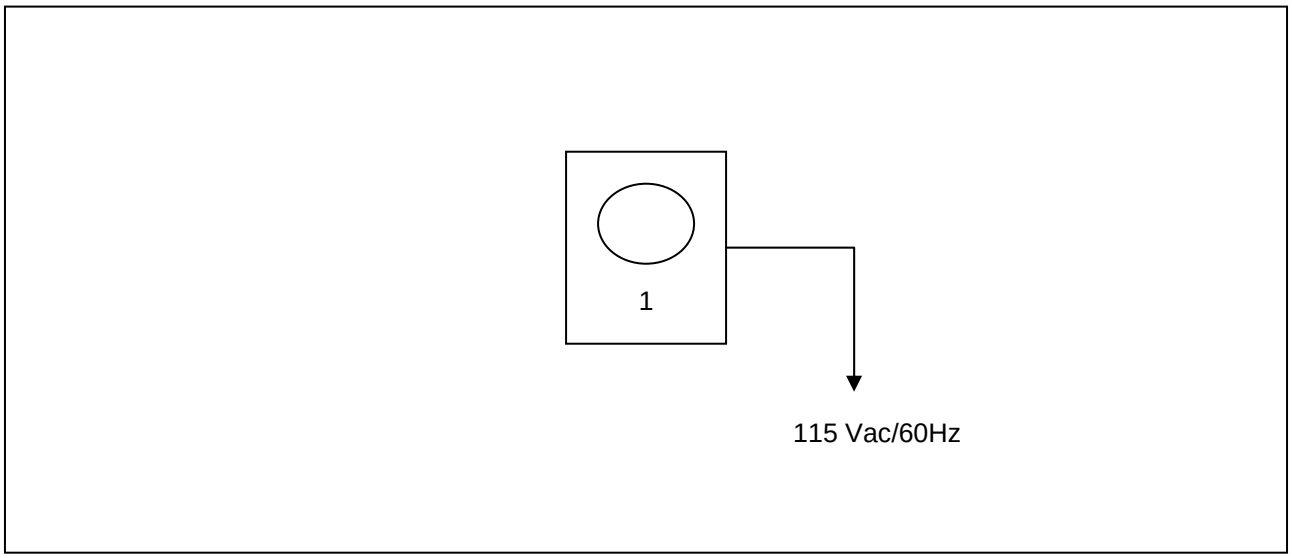

Figure 5.0-1: EUT Test Setup

6.0 SUMMARY OF TESTS

6.1 Antenna Requirement – FCC Section 15.203

The EUT employs an integrated antenna that cannot be modified without damaging the device.

6.2 Power Line Conducted Emissions - FCC Section 15.207

6.2.1 Test Methodology

ANSI C63.4 sections 6 and 7 were the guiding documents for this evaluation. Conducted emissions were performed from 150kHz to 30MHz with the spectrum analyzer's resolution bandwidth set to 9kHz and the video bandwidth set to 30kHz.

6.2.2 Test Results

Table 6.2.2-1: Conducted Emissions – Line 1

Frequency (MHz)	Uncorrected Reading (dBuV)	Detector (P/A)	Total Correction Factor (dB)	Corrected Reading (dBµV)	Limit (dBµV)	Margin (dB)
Peak Readings						
0.28299	16.79	P	24.13	40.92	62.20	21.3
0.34044	16.53	P	22.96	39.49	60.56	21.1
0.43224	16.72	P	21.09	37.81	57.94	20.1
0.5002	17.97	P	19.50	37.47	55.99	18.5
3.76	14.75	P	10.45	25.20	56.00	30.8
11.33	12.6	P	10.56	23.16	60.00	36.8
16.07	13.01	P	10.61	23.62	60.00	36.4
19.71	12.86	P	10.65	23.51	60.00	36.5
23.65	12.26	P	10.69	22.95	60.00	37.1
26.05	12.71	P	10.72	23.43	60.00	36.6
Average Readings						
0.28299	2.72	A	24.13	26.85	52.20	25.3
0.34044	2.61	A	22.96	25.57	50.56	25.0
0.43224	2.51	A	21.09	23.60	47.94	24.3
0.5002	2.48	A	19.50	21.98	45.99	24.0
3.76	0.8	A	10.45	11.25	46.00	34.8
11.33	-0.9	A	10.56	9.66	50.00	40.3
16.07	-1.03	A	10.61	9.58	50.00	40.4
19.71	-0.9	A	10.65	9.75	50.00	40.3
23.65	-1	A	10.69	9.69	50.00	40.3
26.05	-1.3	A	10.72	9.42	50.00	40.6

Table 6.2.2-1: Conducted Emissions – Line 2

Frequency (MHz)	Uncorrected Reading (dBuV)	Detector (P/A)	Total Correction Factor (dB)	Corrected Reading (dBµV)	Limit (dBµV)	Margin (dB)
Peak Readings						
0.1535	20.83	P	26.77	47.60	65.90	18.3
0.2589	15.43	P	24.62	40.05	62.89	22.8
0.36189	15.89	P	22.52	38.41	59.95	21.5
0.44545	17.63	P	20.82	38.45	57.56	19.1
0.8745	16.14	P	14.18	30.32	56.00	25.7
4.79	13.84	P	10.50	24.34	56.00	31.7
13.52	12.69	P	10.59	23.28	60.00	36.7
15.17	12.58	P	10.60	23.18	60.00	36.8
17.83	11.88	P	10.63	22.51	60.00	37.5
19.36	11.45	P	10.64	22.09	60.00	37.9
Average Readings						
0.1535	4.1	A	26.77	30.87	55.90	25.0
0.2589	3.13	A	24.62	27.75	52.89	25.1
0.36189	2.8	A	22.52	25.32	49.95	24.6
0.44545	2.759	A	20.82	23.58	47.56	24.0
0.8745	2.4	A	14.18	16.58	46.00	29.4
4.79	1	A	10.50	11.50	46.00	34.5
13.52	-0.59	A	10.59	10.00	50.00	40.0
15.17	-0.56	A	10.60	10.04	50.00	40.0
17.83	-0.6	A	10.63	10.03	50.00	40.0
19.36	-0.64	A	10.64	10.00	50.00	40.0

6.3 Radiated Emissions - FCC Section 15.209(Unintentional Radiation)

6.3.1 Test Methodology

ANSI C63.4 Sections 6 and 8 were the guiding documents for this evaluation. Radiated emissions tests were performed over the frequency range of 30MHz to 5000MHz. Measurements of the radiated field strength were made at a distance of 3m from the boundary of the equipment under test (EUT) and the receiving antenna. The antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. Radiated measurements were made with the Spectrum Analyzer's resolution bandwidth set to 120KHz for measurements above 30MHz.

The EUT was caused to go into a "Standby" mode of operation for this test.

6.3.2 Test Results

Results of the test are given in Table 6.3.2-1 below:

Table 6.3.2-1: Radiated Emissions Tabulated Data (Unintentional Radiators)

Frequency (MHz)	Uncorrected Reading (dBµV)	Antenna Polarity (H/V)	Antenna Height (cm)	Turntable Position (°)	Total Correction Factor (dB)	Corrected Reading (dBµV)	Limit (dBµV)	Margin (dB)	Results
35.388	9.93	V	100	0	17.29	27.22	40	12.8	**Pass**
42.933	16.24	H	100	0	13.57	29.81	40	10.2	**Pass**
84.96	20.14	V	100	0	9.21	29.35	40	10.6	**Pass**
117.3	22.19	V	100	0	12.79	34.98	43.5	8.5	**Pass**
125.92	12.35	V	100	280	13.22	25.57	43.5	17.9	**Pass**
205.69	17.88	H	100	0	11.35	29.23	43.5	14.3	**Pass**
306.196	34.01	H	100	0	-11.82	22.19	46	23.8	**Pass**
702.44	33.62	V	200	0	-1.35	32.27	46	13.7	**Pass**

No emissions within 20dB of the limit were detected above 702 MHz.

6.4 Peak Output Power – FCC Section 15.247(b)(3)

6.4.1 Test Methodology (Conducted Method)

The 6dB bandwidth of the EUT was within the resolution bandwidth of the Rohde & Schwarz spectrum analyzer, therefore the power measurement was made using the spectrum analyzer method. The resolution and video bandwidth were set to 3MHz. The EUT was caused to transmit a continuous signal at the low, center and high channels.

6.4.2 Test Results

Results are shown below in table 6.4.2-1 and in figure 6.4.2-1 below:

Table 6.4.2-1: RF Output Power

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
917.58MHz	25.33	30	4.67

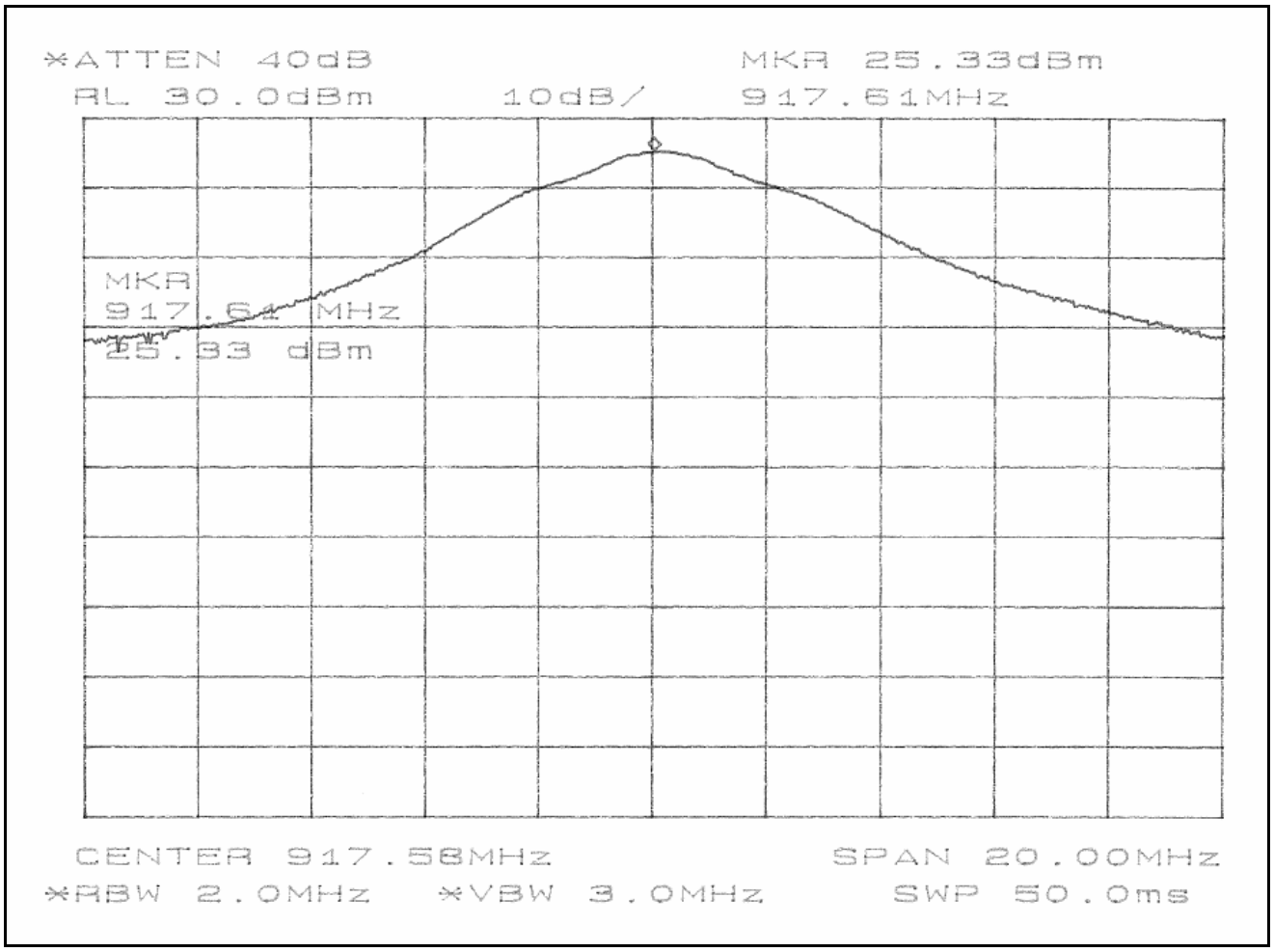

Figure 6.4.2-1: Peak Output Power

Result: PASS

6.5 6dB Bandwidth – FCC Section 15.247(a)(2)

6.5.1 Test Methodology

The 6dB bandwidth was measured in accordance with FCC 97-114 Appendix C. The EUT was caused to generate a continuous at the low, center and high channels.

6.5.2 Test Results

Results are shown below in table 6.5.2-1 and figure 6.5.2-1:

Table 6.5.2-1: 6dB Bandwidth

Frequency [MHz]	Bandwidth [MHz]	Limit [dBm]	Result
917.58MHz	1.39	>= 500kHz	Pass

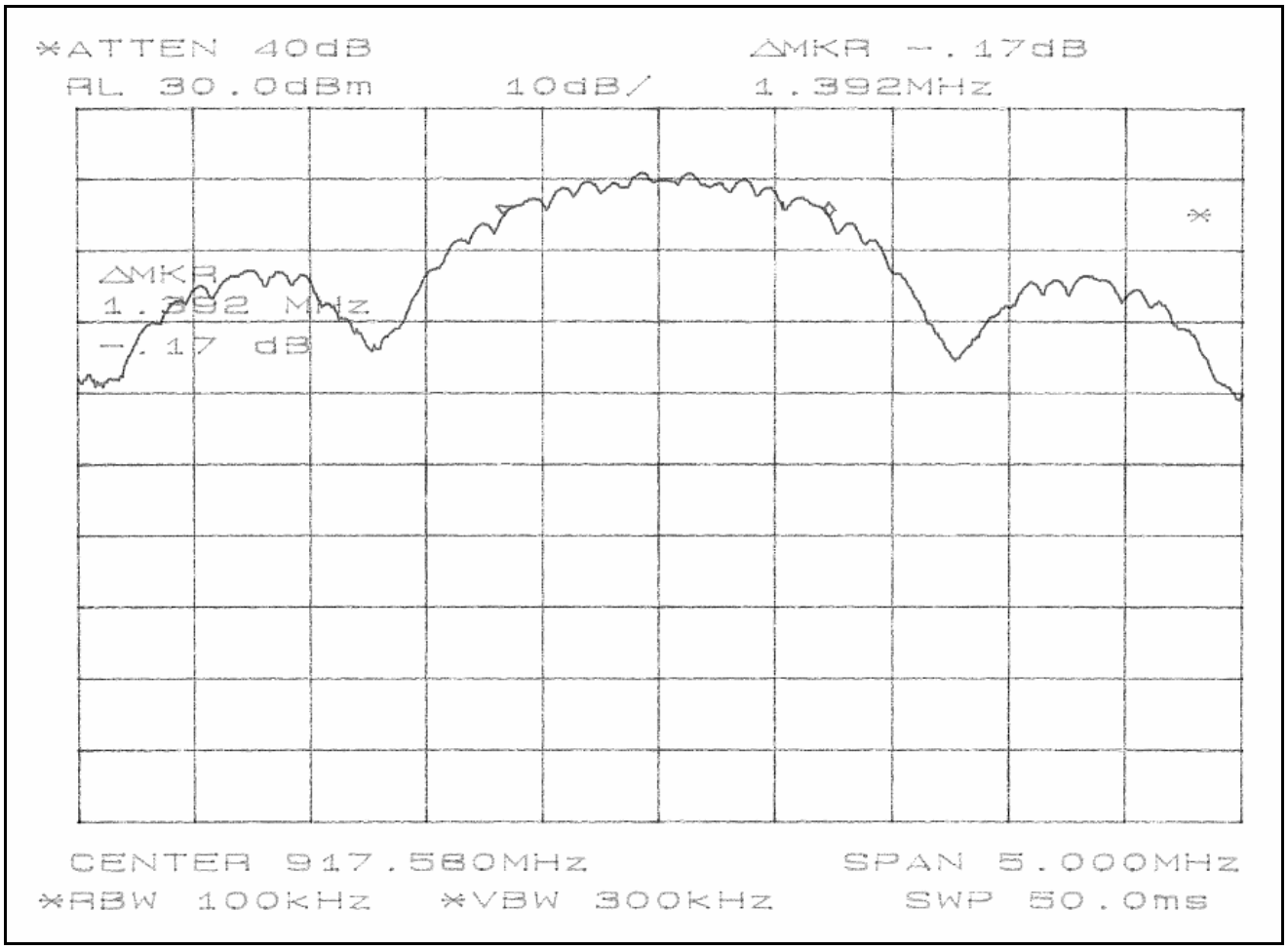

Figure 6.5.2-1: 6dB Bandwidth Plot

Result: PASS

6.6 Spurious Emissions – FCC Section 15.247(c)

6.6.1 Conducted Spurious Emissions

6.6.1.1 Test Methodology

The EUT was investigated for conducted spurious emissions from 30MHz to 60GHz, 10 times the highest fundamental frequency. Measurements were made at the low, center and high channels of the EUT. For each measurement, the spectrum analyzer's VBW was set to 100kHz and the RBW was set to 1MHz. No averaging factor was applied.

6.6.1.2 Test Results

All emission found were greater than 20dB down from the fundamental carrier. The RF conducted spurious emissions found in the band of 30MHz to 60GHz are reported graphically separately with this filing in a file titled "04-0396 Conducted Spurious Plots - DS.pdf".

6.6.2 Radiated Spurious Emissions

6.6.2.1 Test Methodology

Radiated emissions tests were made over the frequency range of 30MHz to 10GHz, 10 times the highest fundamental frequency.

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 1000MHz, quasi-peak measurements were made using a resolution bandwidth (RBW) of 120kHz and a video bandwidth (VBW) of 300kHz. For frequencies above 1000MHz, average measurements were made using an RBW of 1MHz and a VBW of 10Hz and peak measurements were made with RBW of 1MHz and a VBW of 1MHz.

The EUT was caused to generate a constant carrier signal for the test.

6.6.2.2 Test Results

Radiated spurious emissions found in the band of 30MHz to 60GHz are reported in Table 6.6.2.2-1. Each emission found to be in a restricted band as defined by section 15.205, was compared to the radiated emission limits for a class B device defined in section 15.209.

Table 6.6.2.2-1: Radiated Spurious Emissions

Frequency (MHz)	Level (dBuV)	Detector (P/A)	Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV)	Limit (dBuV)	Margin (dB)	Final Result (Pass/Fail)
2752.82	63	P	V	-3.41	59.59	74.00	14.41	**PASS**
2752.5	40.2	A	V	-3.41	36.79	54.00	17.21	**PASS**
3670.3	65.7	P	H	3.32	69.02	74.00	4.98	**PASS**
3670	42.5	A	H	3.32	45.82	54.00	8.18	**PASS**
4587.8	60	P	H	5.64	65.64	74.00	8.36	**PASS**
4587.5	38.7	A	V	5.63	44.33	54.00	9.67	**PASS**

Sample Calculations

$R_C = R_U + CF_T$

Where:

CF_T	=	Total Correction Factor (AF+CA+AG)-DC(Average Measurements Only)
R_U	=	Uncorrected Reading
R_C	=	Corrected Level
AF	=	Antenna Factor
CA	=	Cable Attenuation
AG	=	Amplifier Gain
DC	=	Duty Cycle Correction Factor (If applicable)

Example Calculation:

Corrected Level: 63 + (-3.41) = 59.59 dBuV

Margin: 74dBuV – 59.59 dBuV = 14.41 dB

6.7 Peak Power Spectral Density- FCC Section 15.247(d)

6.7.1 Test Methodology

The power spectral density was measured in accordance with OET bulletin 97-114, appendix C. The EUT was caused to generate a constant carrier on the low, middle and high fundamental channels. The hopping function was turned off for the measurement.

6.7.2 Test Results

Results are shown below in table 6.7.2-1 and figure 6.7.2-1.

Table 6.7.2-1: Peak Power Spectral Density

Frequency [MHz]	Level [dBm]	Cable Attenuation Factor [dB]	Corrected Level [dBm]	Limit [dBm]	Result
917.58MHz	7.33	.5	7.83	8	Pass

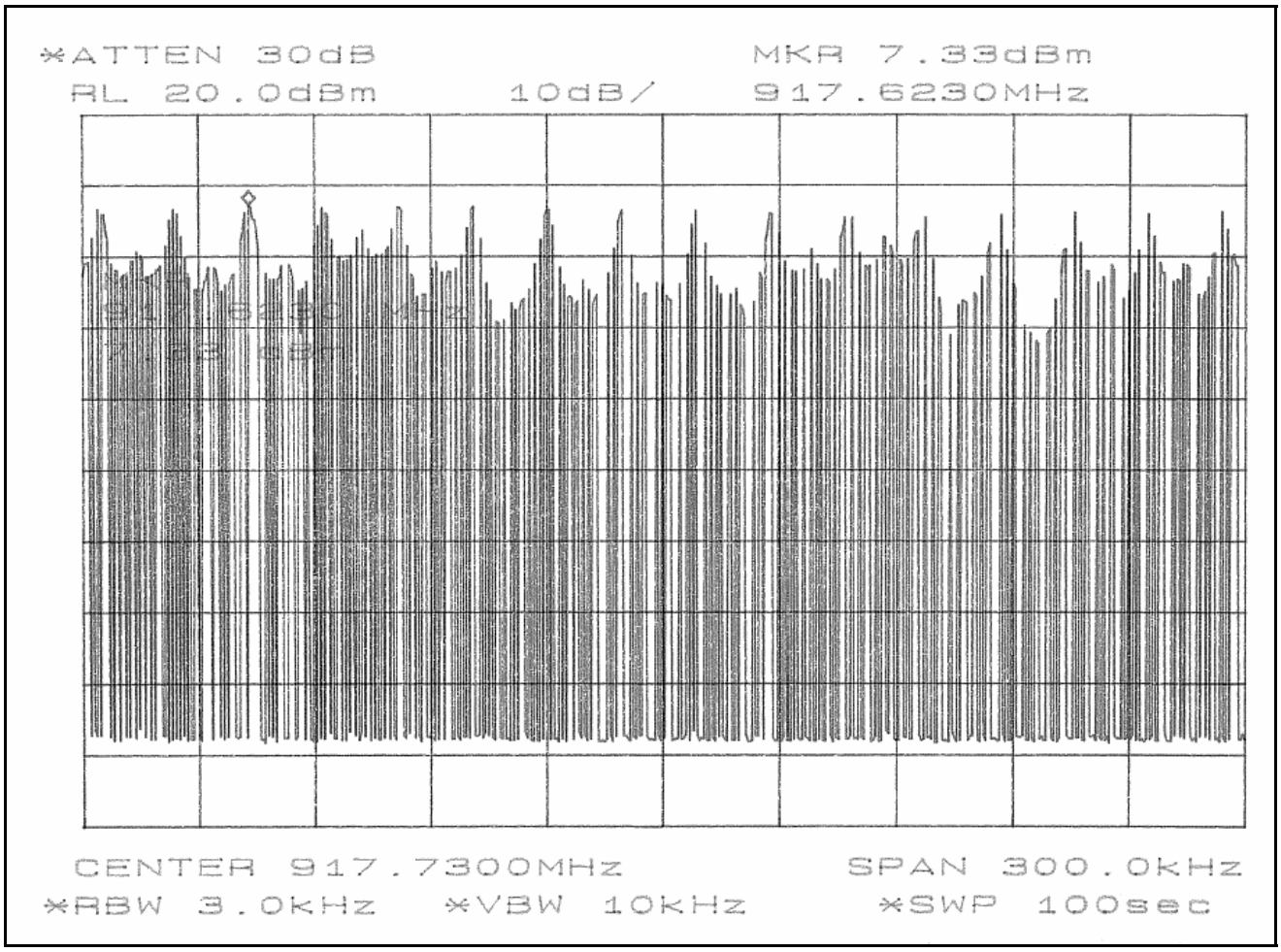

Figure 6.7.2-1: Peak Power Spectral Density

Result: PASS

7.0 MODIFICATIONS

No modifications were made to bring the EUT into compliance with the rules.

8.0 CONCLUSION

In the opinion of ACS, Inc. the CENTRON ™ ICARe C1A-2, manufactured by Itron Electricity Metering, Inc., meets the relevant requirements of FCC Parts 2 and 15, as required.