Intertek ETL SEMKO

EMC TESTING DEPARTMENT

RADIO PERFORMANCE MEASUREMENTS ON THE CUBIC TRANSPORTATION SYSTEMS LTD HHU (HANDHELD UNIT)

D A Legge

Test Report 02008116_2

Report approved by:

K Newman
Manager
EMC Testing Department

9th October 2003
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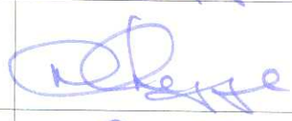
Applicant:	Cubic Transportation Systems Ltd 177 Nutfield Road Merstham Surrey RH1 3HR Tel: 01737646800 Fax: 01737643693
Applicant's Representative:	Mr John Siseman
Purchase Order No:	M/64269
Description of Equipment Under Test:	HHU Reader Assembly
Serial Number(s)	HHU7
Test Specification(s):	ANSI C63.4 - CFR: 47 part 15
Test Date(s):	22 to 23 July 2002
Results of Test(s):	Pass

Test Engineer(s):	D A Legge	
Report Written by:	D A Legge	
Checked by:	R Orchard	

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RADIO PERFORMANCE MEASUREMENTS ON THE CUBIC TRANSPORTATION SYSTEMS LTD HHU READER

1 INTRODUCTION

The Cubic Transportation Systems Ltd HHU reader has been tested by Intertek Testing & Certification Ltd on behalf of Cubic Transportation Systems Ltd. This report contains the results of these tests for type testing.

2 TEST PROCEDURE

2.1 Relevant Performance Specification

The relevant performance specification for the Cubic Transportation Systems Ltd HHU reader is ANSI C63.4 and CFR 47 part 15. All tests were undertaken in accordance with the procedures in this specification.

2.2 Test Environment

The tests were performed in the EMC Testing Department at the ITS laboratories in Leatherhead. The samples were subjected to the ambient conditions in the laboratory, except during tests at extremes of temperature and voltage. The temperature and relative humidity recorded during the period of each test are given in the results.

2.3 Configuration of Test Sample

The Cubic Transportation Systems Ltd HHU reader has a nominal radiated field of 36.1 dBμV/m at 30 m and was configured to operate on a nominal frequency of 13.56 MHz.

Prior to testing the samples were tested for maximum radiated field strength orientation. It was found that the horizontal plane gave the higher radiated field levels. Therefore testing was not carried out in the vertical plane.

2.4 Test Power Source

The applicant declared that the sample is intended to operate from an internal battery power supply. The declared test voltage was: -

Normal test voltage	3.7 V

3 TEST RESULTS

Ambient temperature 24°C Relative humidity 66%

3.1 E - Field Strength 13.56 MHz @ 10m

Signal Level = 25.6dBµV + (antenna factor + 19.9dB)+ (cables + 0.5dB) = 46dBµV/m

Limit field strength 10,000µV/m at 30 m

Test Conditions		Transmitter field strength (dBµV/m)
T_{nom}(24)°C	V_{nom}(3.7) V	36.0
Measurement uncertainty (dB)		± 3

Note: The amplitudes at the band edge limits were fl - 8dBc and fh – 4dBc.

Ambient temperature 21°C Relative humidity 51%

3.2 Permitted Range of Operating Frequencies for Wideband Equipment

Sub-clause 7.3

Operating frequency band: ISM band 13.553 - 13.567 MHz

Test conditions		Frequency MHz
T_{nom}(21)°C	V_{nom}(3.7) Vdc	13.5607
T_{min}(-20) °C	V_{min}(3.5) Vdc	13.5607
T_{max}(+55) °C	V_{min}(3.5) V	13.5607
Measurement uncertainty Hz	±100	

Test conditions		Frequency MHz
V_{nom}	3.7Vdc	13.5607
V_{min}	3.4Vdc	13.5607
V_{max}	4.1Vdc	13.5607
Measurement uncertainty Hz	±100	

Note(s): 3.4V DC is the cut off voltage for the unit

Note(s): The carrier signal remained within the ISM band at 13.5607 MHz under all extreme conditions.

3.3 Transmitter Spurious Emissions Radiated (<30 MHz)

3.4 Rated carrier output 36.0 dBμV/m

HHU reader searching for card (Transmitting)

Frequency (MHz)	Bandwidth**(kHz)	Level(dBμV/m)
27.99	120.0	26.8
Measurement uncertainty (dB)	± 3	

**Bandwidth = the measuring receiver bandwidth

HHU reader in standby

Frequency (MHz)	Bandwidth**(kHz)	Level (dBμV/m)
27.99	120.0	16.8
Measurement uncertainty (dB)	± 3	

**Bandwidth = the measuring receiver bandwidth

Ambient temperature 24°C Relative humidity 66%

3.5 Transmitter Spurious Emissions Radiated (>30 MHz to 1 GHz)

Rated carrier output 36.0dBμV/m

HHU reader searching for card (Transmitting)

F (MHz)	Level dBμV/m	Limit dBμV/m
30.5	25.8	30.0
41.6	23.5	30.0
44.1	20.6	30.0
63.9	20.8	30.0
144.4	26.7	33.5
193.9	30.8	33.5
228.0	35.3	36.0
350.0	33.5	36.0
Measurement uncertainty (dB)	± 3	

HHU in standby

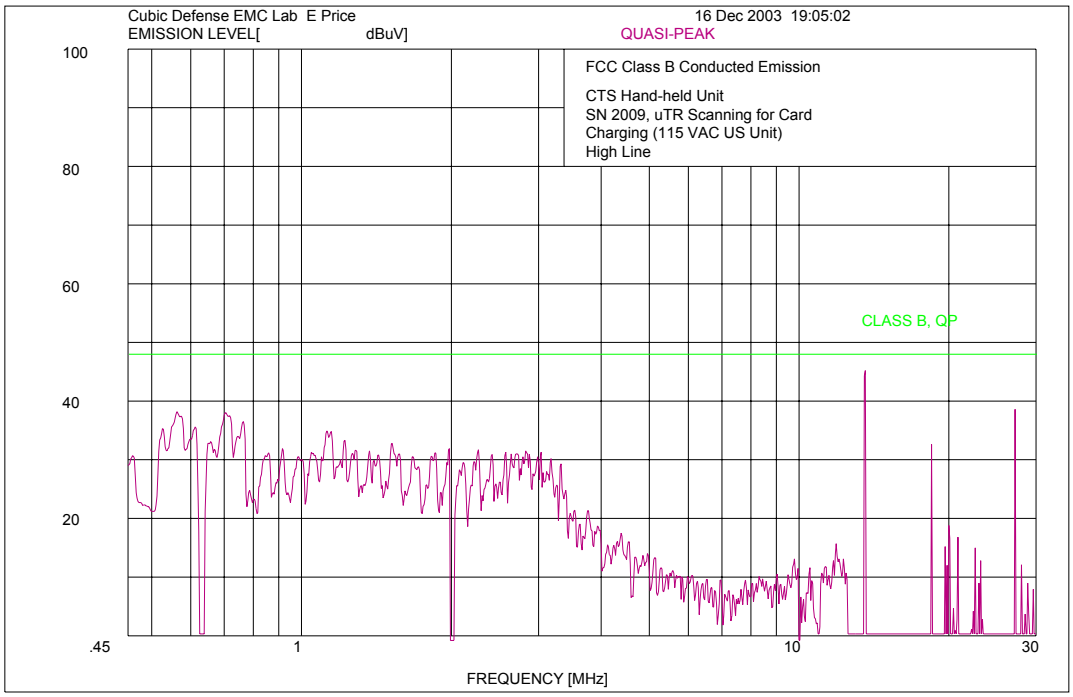
There were no emissions above measuring system noise.

3.6 HHU Conducted Emissions Tests

EUT: Hand Held Unit(HHU) Cubic P# 0001-1147 (S# 2009)
Charging in a Casio IT-760 IOE Charging Cradle
With a Casio DT-825ADP-U 120Vac Power Adapter

Test to: Title 47 Part 15.207a dated 10/01/2001
Conducted limit: 250uV from 450kHz to 30MHz, CISPR quasi-peak detector

Test Data:

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Cubic Defense EMC Lab  E Price   16 Dec 2003  19:05:02
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Quasi-Peaks above -50 dB of Limit Line #1
  peak criteria = 1 dB
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PEAK#	FREQ (MHz)	(dBuV)	DELTA
1	13.58	45.2	-2.8
2	27.13	38.6	-9.4
3	.5644	38.2	-9.8
4	.705	38	-10.0
5	.7667	36.5	-11.5
6	.6138	35.6	-12.4
7	.5278	35.3	-12.7
8	1.128	34.9	-13.1
9	1.227	33.3	-14.7
10	.6592	33.1	-14.9
11	1.526	32.8	-15.2
12	18.44	32.6	-15.4
13	.9183	31.9	-16.1
14	1.987	31.9	-16.1
15	2.273	31.7	-16.3

HHU Conducted Emissions Tests

PEAK#	FREQ (MHz)	(dBuV)	DELTA
16	1.285	31.6	-16.4
17	1.374	31.5	-16.5
18	2.827	31.5	-16.5
19	1.05	31.3	-16.7
20	2.578	31.3	-16.7
21	3.036	31.3	-16.7
22	.8623	31.2	-16.8
23	1.858	31.2	-16.8
24	1.268	31.1	-16.9
25	1.571	31	-17.0
26	2.643	31	-17.0
27	2.699	31	-17.0
28	2.42	30.9	-17.1
29	2.875	30.9	-17.1
30	1.427	30.8	-17.2
31	.4595	30.7	-17.3
32	.9861	30.5	-17.5
33	1.673	30.5	-17.5
34	2.791	30.5	-17.5
35	2.985	30.5	-17.5
36	3.179	30.2	-17.8
37	1.201	30	-18.0
38	2.225	29.7	-18.3
39	2.116	29.5	-18.5
40	3.329	29.3	-18.7
41	2.756	28.5	-19.5
42	3.113	28	-20.0
43	3.061	27.8	-20.2
44	1.481	26.4	-21.6
45	2.503	26.2	-21.8
46	2.461	25.9	-22.1
47	3.26	25.7	-22.3
48	1.323	25.6	-22.4
49	.7895	24.8	-23.2
50	3.4	24.8	-23.2
51	1.906	24.4	-23.6

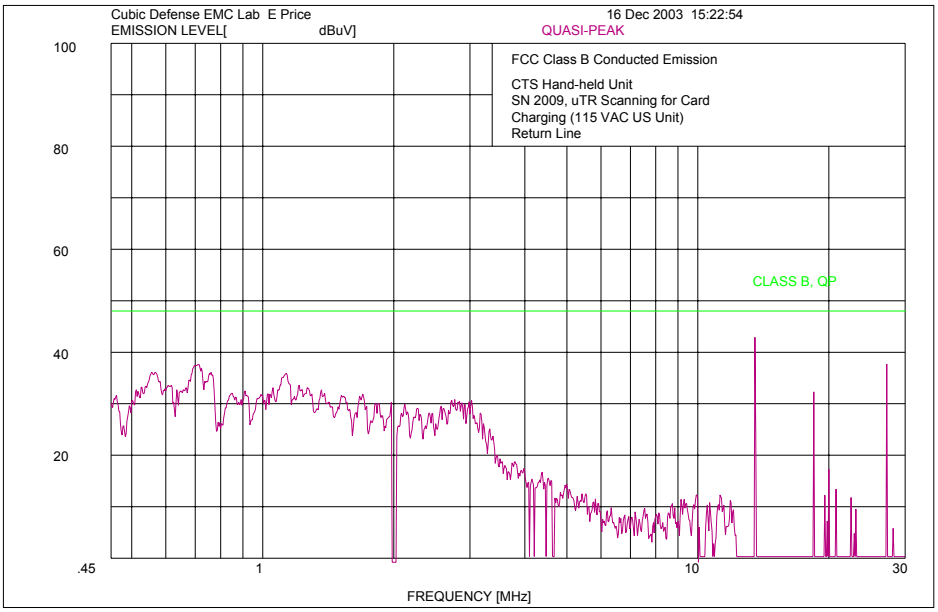
HHU Conducted Emissions Tests

PEAK#	FREQ (MHz)	(dBuV)	DELTA
52	3.546	21.4	-26.6
53	3.76	21.3	-26.7
54	3.472	20.9	-27.1
55	3.621	19	-29.0
56	19.97	18.8	-29.2
57	3.938	18.7	-29.3
58	4.391	17.5	-30.5
59	20.83	16.8	-31.2
60	4.541	16	-32.0
61	11.87	15.7	-32.3
62	4.124	15.5	-32.5
63	4.246	15.4	-32.6
64	19.64	15.2	-32.8
65	22.55	15	-33.0
66	4.96	14	-34.0
67	4.857	13.7	-34.3
68	4.677	13.4	-34.6
69	5.129	13.3	-34.7
70	9.786	13.1	-34.9
71	12.27	13.1	-34.9
72	11.72	12.8	-35.2
73	23.13	12.8	-35.2
74	27.93	12.1	-35.9
75	19.8	12	-36.0
76	11.29	11.8	-36.2
77	5.282	11.6	-36.4
78	10.51	11.6	-36.4
79	9.952	11.5	-36.5
80	5.578	11.1	-36.9
81	11.1	10.7	-37.3
82	12.43	10.7	-37.3
83	9.037	10.5	-37.5
84	5.416	10.4	-37.6
85	9.503	10.4	-37.6
86	5.672	10.3	-37.7
87	6.092	10.3	-37.7
88	11.48	10.3	-37.7
89	5.965	10.1	-37.9
90	8.309	10.1	-37.9
91	5.817	10	-38.0
92	8.45	9.7	-38.3
93	6.515	9.6	-38.4
94	6.938	9.5	-38.5
95	7.802	9.5	-38.5
96	10.6	9.4	-38.6
97	6.247	9.3	-38.7
98	8.593	9.3	-38.7
99	22.94	9	-39.0
100	28.77	9	-39.0
101	6.406	8.9	-39.1
102	8.035	8.9	-39.1
103	8.205	8.9	-39.1
104	8.924	8.8	-39.2
105	9.19	8.8	-39.2
106	8.775	8.5	-39.5
107	9.345	8.4	-39.6
108	6.653	8.2	-39.8

HHU Conducted Emissions Tests

PEAK#	FREQ (MHz)	(dBuV)	DELTA
109	7.64	7.9	-40.1
110	29.5	7.9	-40.1
111	7.901	7.8	-40.2
112	6.765	7.7	-40.3
113	7.235	7.7	-40.3
114	7.085	7.1	-40.9
115	7.357	7	-41.0
116	10.08	6.6	-41.4
117	10.21	6.2	-41.8
118	20.39	4.7	-43.3
119	22.37	4.2	-43.8
120	28.41	3.7	-44.3
121	23.32	2.8	-45.2

HHU Conducted Emissions Tests

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Quasi-Peaks above -50 dB of Limit Line #1
  peak criteria = 1 dB
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PEAK#	FREQ (MHz)	(dBuV)	DELTA
1	13.52	42.9	-5.1
2	27.13	37.7	-10.3
3	.7139	37.6	-10.4
4	.5574	36.1	-11.9
5	.7635	36.1	-11.9
6	1.137	35.9	-12.1
7	.6087	33.6	-14.4
8	1.216	33.6	-14.4
9	.5278	33.2	-14.8
10	1.059	33.1	-14.9
11	1.268	33.1	-14.9
12	.5147	32.7	-15.3
13	.6374	32.7	-15.3
14	1.368	32.7	-15.3
15	.9144	32.5	-15.5
16	18.44	32.3	-15.7
17	.8515	32	-16.0
18	1.028	31.9	-16.1
19	1.701	31.9	-16.1
20	.9945	31.8	-16.2
21	.4634	31.6	-16.4
22	1.519	31.6	-16.4
23	2.768	30.8	-17.2
24	2.722	30.7	-17.3

HHU Conducted Emissions Tests

PEAK#	FREQ (MHz)	(dBuV)	DELTA
25	3.023	30.6	-17.4
26	2.839	30.5	-17.5
27	2.985	30.4	-17.6
28	1.979	30.3	-17.7
29	2.875	30.2	-17.8
30	1.82	30.1	-17.9
31	1.85	30.1	-17.9
32	2.125	29.9	-18.1
33	2.911	29.9	-18.1
34	.4956	29.6	-18.4
35	2.578	29.5	-18.5
36	2.273	29.1	-18.9
37	2.61	29.1	-18.9
38	2.42	28.2	-19.8
39	3.166	28.2	-19.8
40	2.451	28.1	-19.9
41	2.301	27.9	-20.1
42	.7929	26.4	-21.6
43	2.503	26.1	-21.9
44	3.219	26.1	-21.9
45	.4812	25.7	-22.3
46	3.329	25.1	-22.9
47	3.457	20	-28.0
48	3.516	19.3	-28.7
49	3.792	18.7	-29.3
50	3.606	18	-30.0
51	3.987	17.4	-30.6
52	19.97	17.3	-30.7
53	3.667	16.8	-31.2
54	4.391	16.7	-31.3
55	4.522	15.5	-32.5
56	4.158	15.4	-32.6
57	4.447	14.7	-33.3
58	5.001	14.4	-33.6
59	5.065	13.4	-34.6
60	20.74	13.4	-34.6
61	4.836	12.8	-35.2
62	5.416	12.5	-35.5
63	5.531	12.5	-35.5
64	9.952	12.3	-35.7
65	11.24	12.3	-35.7
66	19.56	12.2	-35.8
67	5.282	12	-36.0
68	22.46	11.8	-36.2
69	4.696	11.7	-36.3
70	5.817	11.5	-36.5
71	9.151	11.4	-36.6
72	9.306	11.4	-36.6
73	11.87	11.2	-36.8
74	5.744	10.9	-37.1
75	10.64	10.8	-37.2
76	5.89	10.6	-37.4
77	8.738	10.6	-37.4
78	11.15	10.4	-37.6
79	10.51	10.3	-37.7
80	11.48	10.3	-37.7
81	5.601	10.1	-37.9
82	6.326	9.8	-38.2

HHU Conducted Emissions Tests

PEAK#	FREQ (MHz)	(dBuV)	DELTA
83	8.849	9.8	-38.2
84	7.545	9.7	-38.3
85	23.03	9.5	-38.5
86	12.07	9.4	-38.6
87	6.195	9.2	-38.8
88	7.174	9	-39.0
89	8.137	8.8	-39.2
90	8.557	8.8	-39.2
91	8.035	8.5	-39.5
92	6.794	8.4	-39.6
93	6.938	8.1	-39.9
94	7.055	8	-40.0
95	6.597	7.9	-40.1
96	6.041	7.6	-40.4
97	7.327	7.6	-40.4
98	8.999	7.2	-40.8
99	19.8	7.2	-40.8
100	7.901	6.9	-41.1
101	8.309	6.9	-41.1
102	10.08	6	-42.0
103	28.05	5.8	-42.2
104	22.84	4.8	-43.2
105	10.87	2.8	-45.2