ELECTROMAGNETIC COMPATIBILITY DEPARTMENT

EMC MEASUREMENTS ON THE IDENTEC ELC1A-3 READER WITH TC6 TAG

H R Mohammed

ITS Test Report No. 99000574
Issue No. 2
Commercial-in-confidence

Report approved by: J Bearpark
Manager
EMC Department

February, 2000
Ref. HRM/jt/99000574-1219

Test:	EMC Emissions
Standard(s):	FCC Rules, Part 15, Subpart C : 1998 Section 15.207 and 15.209
Equipment Under Test (EUT):	Tag Reader
Manufacturer:	Identec Ltd.
Model Name:	ELC1A-3 (Reader) TC6 Tag
Build State:	Production
Test Required By:	Identec Ltd. Mercantile Road Rainton Bridge Industrial Estate Houghton-le-Spring Co Durham DH4 5PH
Company Order No:	CRA 1881
Test commenced:	10th January 2000
Test completed:	12th January 2000

Test Engineer(s):	H R Mohammed	
Report Prepared By:	H R Mohammed	
Client's Representative:	Mr H Dodd	

Note: "Opinions and interpretations expressed herewith are outside the scope of UKAS accreditation".

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1) INTRODUCTION

The equipment described on page 2 has been tested to determine compliance with the standards noted. The measurements have been performed at ITS Testing and Certification Ltd. in accordance with the requirements of the standards using equipment and procedures which comply with UKAS requirements. The results of the tests are attached and are summarised below. Any deviations from standard test methods are noted in the test results, which are given on the following pages.
The test configuration is shown in Fig. 1.

2) SUMMARY OF RESULTS

Test Type	**Standard**	**Limit/Test Level**	**Result**
Mains Terminal Voltage Emissions	FCC Rules, Part 15 Subpart C : 1998	As Standard	Pass
Radiated Magnetic Field Intensity	FCC Rules, Part 15 Subpart C : 1998	As Standard	Pass
Radiated Field	FCC Rules, Part 15 Subpart C : 1998	As Standard	Pass

3) EMISSIONS MEASUREMENTS RESULTS SUMMARY (WORST CASE EMISSIONS)

For emissions tests, the EUT operating mode was on, with Tag.

Standard	Test	Configuration/ Operation	Results/Margin (dB) Freq. (MHz)	Fig. No.
FCC Rules, Part 15 Subpart C : 1998	Mains Terminal Voltage Emissions	On	Pass	2 and 3
FCC Rules, Part 15 Subpart C : 1998	Radiated Magnetic Field Intensity	On	Pass 8.15dB at 0.1536MHz	See Appen. A
FCC Rules, Part 15 Subpart C : 1998	Radiated Electric Field	On	Pass	See Appen. B

Deviations from Standard Test Method: None

Comments: No magnetic field emissions seen above 460.8kHz or below 153kHz measurement. No radiated electric field emissions seen at 3m above noise level on ITS open field test site.

4) CONFORMITY IN PRODUCTION

ITS Testing & Certification Ltd. has based this test report on results from the equipment sample provided.

The manufacturer is advised that he may have an obligation to demonstrate that production samples are in conformity with the Standards noted.

5) ITS EQUIPMENT LIST

5.1 Conducted Emissions

Equipment Used	Plant No	Cal Due
Rohde & Schwarz ESHS10 Receiver	825	20.4.2000
50Ω/50µH LISN	A690A	12.2.2000

5.2) Radiated Emissions

Equipment Used	Plant No	Cal Due
Rohde & Schwarz ESUS10 Receiver	824	8.2.2000
Chase Bilog	B933B	22.12.2000
15m Cable	B885B	4.11.2000
ITS Open Area Test Site	A754A	3.8.2000
Rohde & Schwarz ESHS10 Receiver	825	20.4.2000
Rohde & Schwarz HFH-2-Z2 loop antenna	A921A	8.3.2000

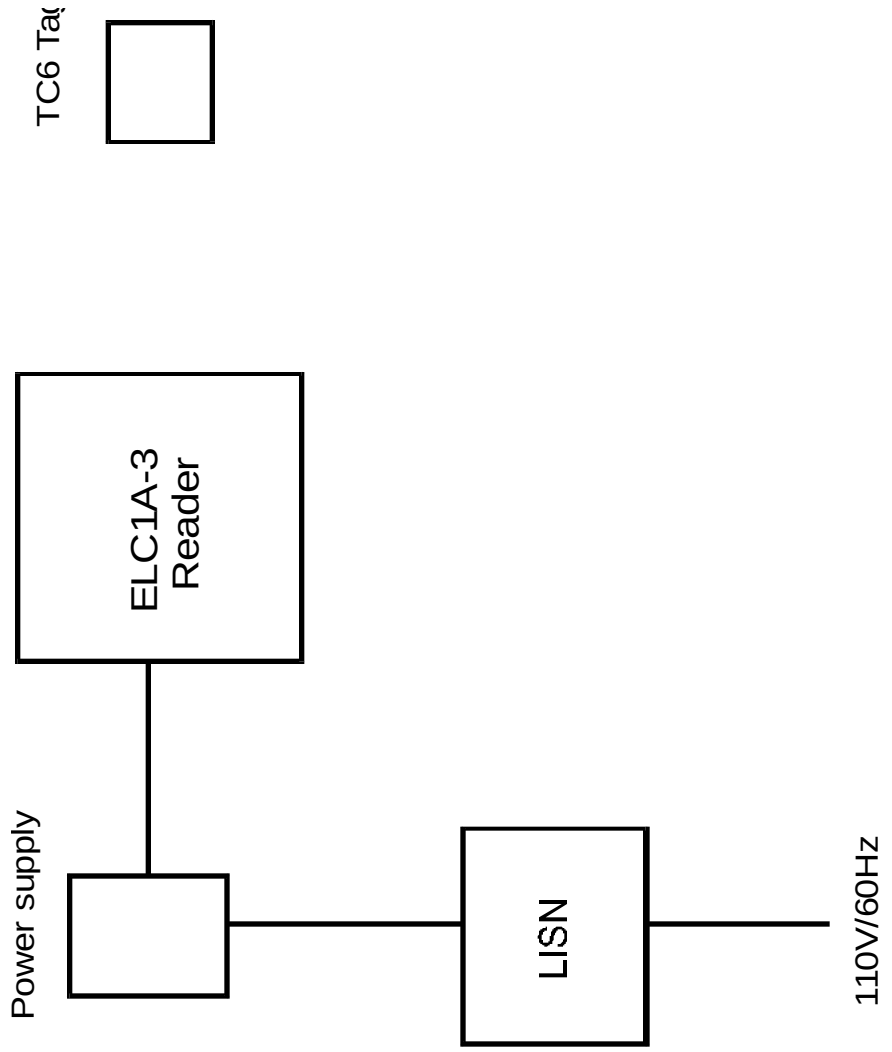

Figure 1: Configuration for measurements

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ITS Testing and Certification Ltd
Conducted Emissions

EUT	Cryptag Tag
Manuf	Identec Ltd
Op Cond	With Tag
Operator	Haroun Mohammed
Test spec	FCC Rules, Part 15, Subpart D, Section 15.207
Comment	Live Terminal

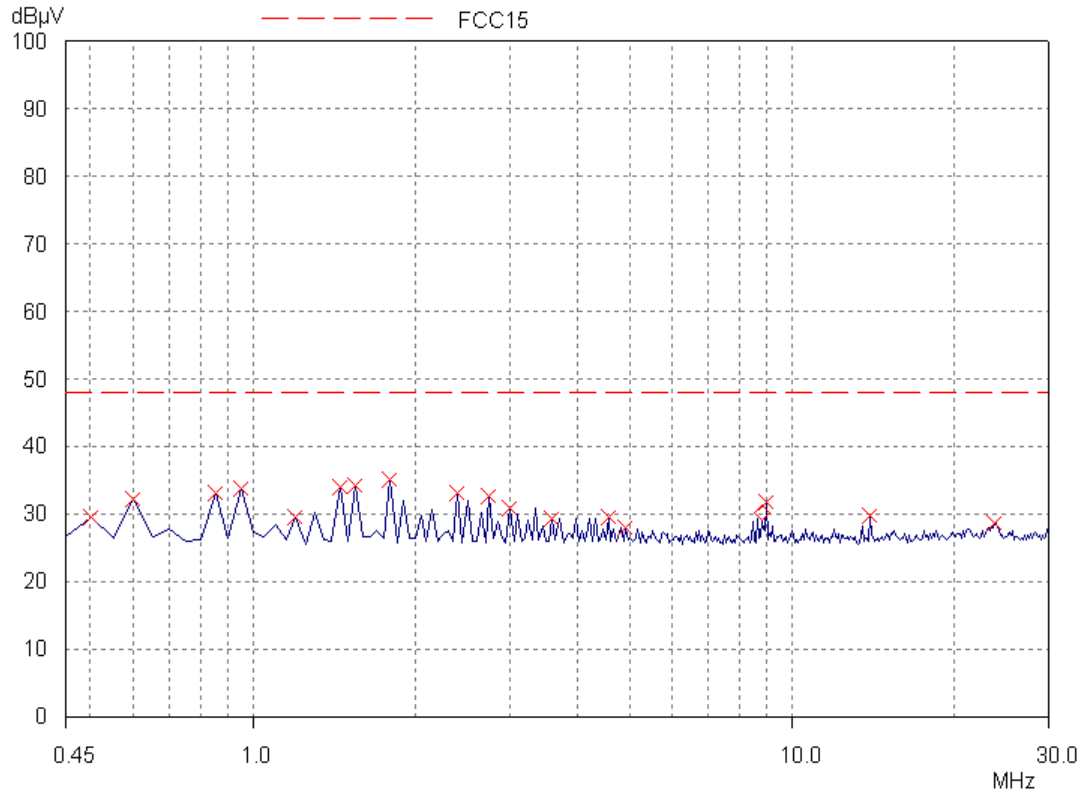
Result File identec4.dat: cond, with tag, live terminal

Scan settings (1 Range)

Frequencies			Receiver settings					
Start	*Stop*	*Step*	*IF BW*	*Detector*	*M-time*	*Atten*	*Preamp*	*Op Rge*
450kHz	30MHz	50kHz	10kHz	PK	200ms	Auto	OFF	60dB

Transmitter	No.	Start	Stop	Name
1	1	450kHz	30MHz	No9LISN

Prescan Measurement		
	Detector	X PK
	Meas time	see scan settings
	Subranges	25
	Acc. Margin	20 dB



ITS Testing and Certification Ltd
Conducted Emissions

EUT	Cryptag Tag
Manuf	Identec Ltd
Op Cond	With Tag
Operator	Haroun Mohammed
Test spec	FCC Rules, Part 15, Subpart D, Section 15.207
Comment	Live Terminal

Result File identec4.dat: cond, with tag, live terminal

Scan settings (1 Range)

Frequencies — Receiver settings

Start	*Stop*	*Step*	*IF BW*	*Detector*	*M-time*	*Atten*	*Preamp*	*Op Rge*
450kHz	30MHz	50kHz	10kHz	PK	200ms	Auto	OFF	60dB

Transmitter	No.	Start	Stop	Name
1	1	450kHz	30MHz	No9LISN

Prescan Measurement		
	Detector	X PK
	Meas time	see scan settings
	Subranges	25
	Acc. Margin	20 dB

Peak Search Results

Frequency MHz	PK Level dBµV	PK Limit dBµV	PK Delta dB
0.5	29.62	47.96	18.34
0.6	32.16	47.96	15.80
0.85	33.04	47.96	14.92
0.95	33.86	47.96	14.10
1.2	29.62	47.96	18.34
1.45	33.94	47.96	14.02
1.55	34.16	47.96	13.80
1.8	35.04	47.96	12.92
2.4	33.14	47.96	14.82
2.75	32.74	47.96	15.22
3.0	30.96	47.96	17.00
3.6	29.40	47.96	18.56
4.55	29.56	47.96	18.40
4.9	27.96	47.96	20.00
8.95	31.66	47.96	16.30
13.95	29.74	47.96	18.22
23.7	28.72	47.96	19.24

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ITS Testing and Certification Ltd
Conducted Emissions

EUT	Cryptag Tag
Manuf	Identec Ltd
Op Cond	With Tag
Operator	Haroun Mohammed
Test spec	FCC Rules, Part 15, Subpart D, Section 15.207
Comment	Neutral Terminal

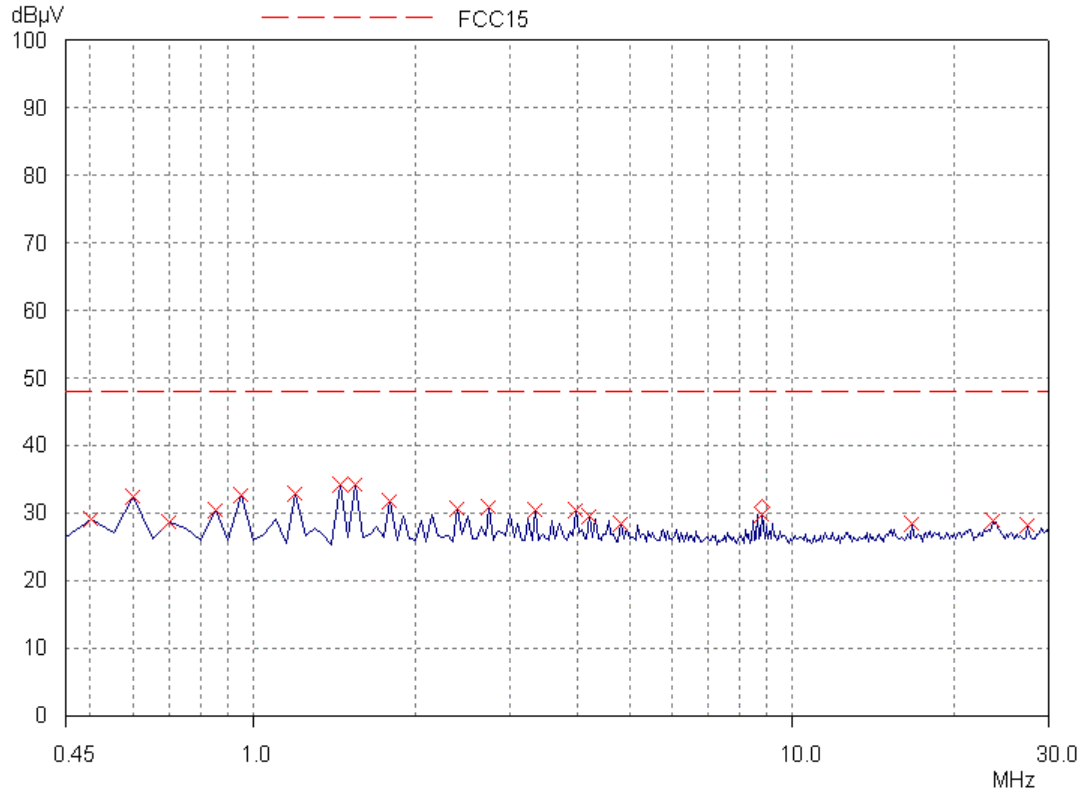
Result File identec3.dat: cond, with tag, neutral terminal

Scan settings (1 Range)

Frequencies			Receiver settings					
Start	*Stop*	*Step*	*IF BW*	*Detector*	*M-time*	*Atten*	*Preamp*	*Op Rge*
450kHz	30MHz	50kHz	10kHz	PK	200ms	Auto	OFF	60dB

Transmitter	No.	Start	Stop	Name
1	1	450kHz	30MHz	No9LISN

Prescan Measurement		
	Detector	X PK
	Meas time	see scan settings
	Subranges	25
	Acc. Margin	20 dB



ITS Testing and Certification Ltd
Conducted Emissions

EUT	Cryptag Tag
Manuf	Identec Ltd
Op Cond	With Tag
Operator	Haroun Mohammed
Test spec	FCC Rules, Part 15, Subpart D, Section 15.207
Comment	Neutral Terminal

Result File identec3.dat: cond, with tag, neutral terminal

Scan settings (1 Range)

Frequencies			Receiver settings					
Start	*Stop*	*Step*	*IF BW*	*Detector*	*M-time*	*Atten*	*Preamp*	*Op Rge*
450kHz	30MHz	50kHz	10kHz	PK	200ms	Auto	OFF	60dB

Transmitter	No.	Start	Stop	Name
1	1	450kHz	30MHz	No9LISN

Prescan Measurement	Detector	X PK
	Meas time	see scan settings
	Subranges	25
	Acc. Margin	20 dB

Frequency MHz	PK Level dBµV	PK Limit dBµV	PK Delta dB
0.5	29.16	47.96	18.80
0.6	32.48	47.96	15.48
0.7	28.72	47.96	19.24
0.85	30.50	47.96	17.46
0.95	32.72	47.96	15.24
1.2	32.80	47.96	15.16
1.45	34.10	47.96	13.86
1.55	34.22	47.96	13.74
1.8	31.82	47.96	16.14
2.4	30.58	47.96	17.38
2.75	30.88	47.96	17.08
3.35	30.44	47.96	17.52
3.95	30.34	47.96	17.62
4.2	29.62	47.96	18.34
4.8	28.34	47.96	19.62
8.75	29.84	47.96	18.12
16.64999	28.34	47.96	19.62
23.6	28.96	47.96	19.00
27.35	28.20	47.96	19.76

APPENDIX A

Extrapolation of Field Strength with Distance

The calculated field strength at the required distance was obtained using the following calculations:

In the near field region of a transmitting source
(distance ($\leq \lambda/2\pi$) the magnetic field strength, H is related to distance, d, by:

$H = \frac{k}{d^n}$ .....(1)

where k is a constant and n a power factor (usually between 2 and 3 on a test site).

If H_1 and H_2 are the magnetic fields in dB (μV/m) at d_1 and d_2, the path loss (L) between measurement distances d_1 and d_2 is given by:

$L = H_1 - H_2 = 20n \log_{10} (d_2/d_1)$ dB .....(2)

Therefore $n = \frac{H_1 - H_2}{20 \log(d_2/d_1)}$ .....(3)

The field strength H_3 at a greater distance d_3 from the EUT (less than or equal to $\lambda/2\pi$) is determined by calculation of a new path loss given by:

$L_3 = n \times 20 \log (d_3/d_1)$ dB .....(4)

The field at d_3 is then given by:

$H_3 = H_1 - L_3$ dB (μV/m) .....(5)

ELC1A-3 Magnetic Field Results

Frequency (kHz)	Receiver Indication dB(µV/m) at 3m	Receiver Indication dB(µV/m) at 10m	Receiver Indication dBµV/m at 20m	Distance Correction Factor dB	Field at 300/30m dB(µV/m)	Limit 300/30m dB(µV/m)
153.6	-	76.64	64.23	-48.44*	+15.76	23.91
307.2	-	42.00	29.00	-50.78*	-21.78	23.91

* Using n derived from (3).

Magnetic Field

Correction factors for the loop antenna and cable are built into the measuring receiver. Therefore the indicated value on the receiver is in dB (µV/m). This takes account of the conversion to equivalent plane wave electric field from magnetic field, and the characteristics of the loop antenna.

Measuring Receiver

Rohde & Schwarz ESVS10
Quasi Peak Detector
Bandwidth: < 150kHz, 200Hz
> 150kHz, 10kHz
No external amplifier is used in the measuring system.

Conducted Emissions

dB (µV) = Received signal dB (µV) + Insertion loss of LISN (dB).
Quasi-Peak Detector.*

Electric Field

Field Intensity, dB (µV/m) = Receiver Indicator, dB (µV) + Antenna correction (m^{-1}) + cable loss (dB).
*Measurements were made with a peak detector. The FCC requirement calls for a quasi-peak detector. Further measurements using a quasi-peak detector were not made since the peak measurements were well under the quasi-peak limit. (Figs. 2 and 3)

APPENDIX B

Results of radiated electric field measurements at 3m in ITS anechoic chamber.

Note: The following results show emission levels above the

FCC limit. This is due to receiver noise.

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ITS Testing and Certification Ltd
Radiated Emissions

EUT	Cryptag Tag
Manuf	Identec Ltd
Op Cond	With Tag
Operator	Haroun Mohammed
Test spec	FCC Rules, Part 15, Subpart D, Section 15.209
Comment	Pre scan at 3m. Height 1m, Vert Pol

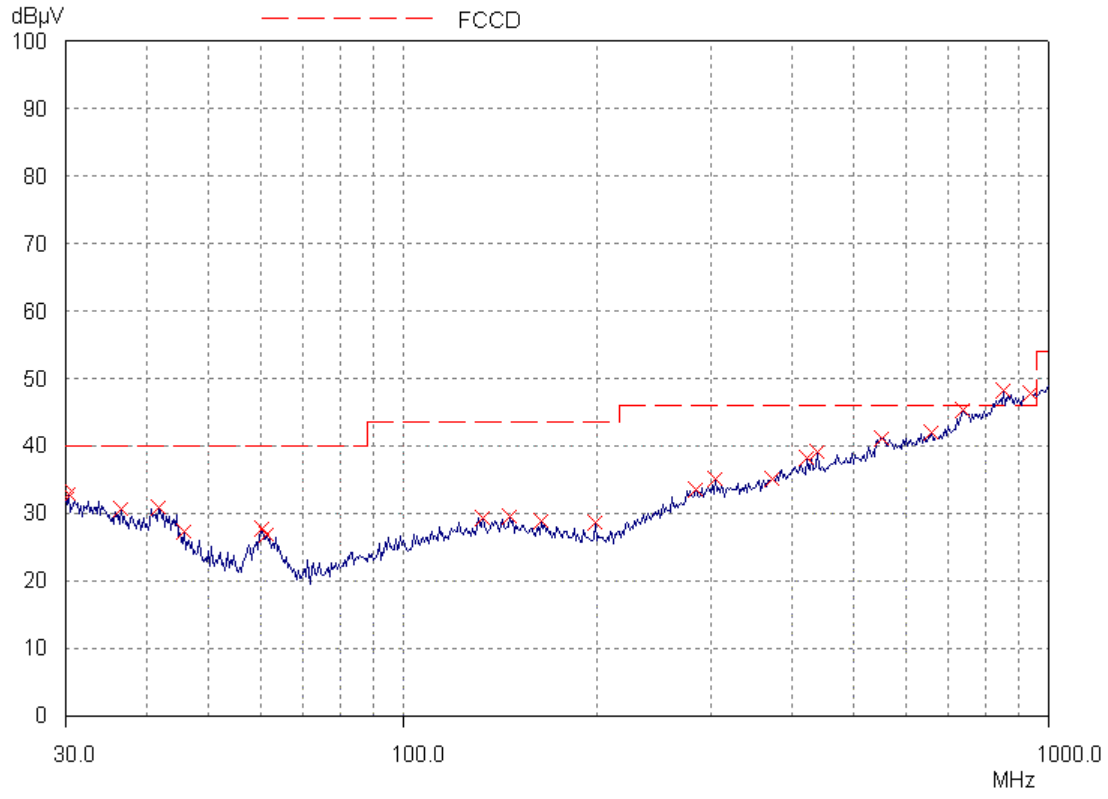
Result File identec5.dat: rad, vert pol, with tag, 3m

Scan settings (1 Range)

Frequencies			Receiver settings					
Start	*Stop*	*Step*	*IF BW*	*Detector*	*M-time*	*Atten*	*Preamp*	*Op Rge*
30MHz	1000MHz	50kHz	120kHz	PK	20ms	Auto	OFF	60dB

Transmitter	No.	Start	Stop	Name
1	20	30MHz	1000MHz	CableB885B
	21	30MHz	1000MHz	BilogB933B

Prescan Measurement	Detector	X PK
	Meas time	see scan settings
	Subranges	25
	Acc. Margin	15 dB



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ITS Testing and Certification Ltd
Radiated Emissions

EUT	Cryptag
Manuf	Identec Ltd
Op Cond	With Tag
Operator	Haroun Mohammed
Test spec	FCC Rules, Part 15, Subpart D, Section 15.209
Comment	Pre scan at 3m. Height 1m, Vert Pol

Result File identec5.dat: rad, vert pol, with tag, 3m

Scan settings (1 Range)

Frequencies			Receiver settings					
Start	*Stop*	*Step*	*IF BW*	*Detector*	*M-time*	*Atten*	*Preamp*	*Op Rge*
30MHz	1000MHz	50kHz	120kHz	PK	20ms	Auto	OFF	60dB

Transmitter	No.	Start	Stop	Name
1	20	30MHz	1000MHz	CableB885B
	21	30MHz	1000MHz	BilogB933B

Prescan Measurement	Detector	X PK
	Meas time	see scan settings
	Subranges	25
	Acc. Margin	15 dB

Peak Search results

Frequency MHz	PK Level dBµV	PK Limit dBµV	PK Delta dB
30.2	32.96	40.00	7.04
36.4	30.71	40.00	9.29
41.8	30.91	40.00	9.09
45.8	27.40	40.00	12.60
60.45	27.77	40.00	12.23
61.5	26.97	40.00	13.03
132.7	29.31	43.52	14.21
146.6	29.44	43.52	14.08
163.8	28.82	43.52	14.70
197.85	28.61	43.52	14.91
282.9	33.49	46.02	12.53
304.0	35.09	46.02	10.93
371.4	35.07	46.02	10.95
419.6	38.16	46.02	7.86
436.2	39.15	46.02	6.87
550.35	41.18	46.02	4.84
655.9	41.94	46.02	4.08
736.6	45.28	46.02	0.74
847.9	48.25	46.02	-2.23
934.6	47.74	46.02	-1.72

Peak Search results (continued)

Frequency MHz	PK Level dBµV/m	PK Limit dBµV/m	PK Delta dB
2.2	20.52		
3.25	20.63		
4.45	20.42		
5.75	20.44		
11.1	20.64		
11.5	20.71		
15.6	19.89		
28.0	18.80		

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ITS Testing and Certification Ltd
Radiated Emissions

EUT	Cryptag
Manuf	Identec Ltd
Op Cond	With Tag
Operator	Haroun Mohammed
Test spec	FCC Rules, Part 15, Subpart D, Section 15.209
Comment	Pre scan at 3m. Height 1m, Horiz Pol

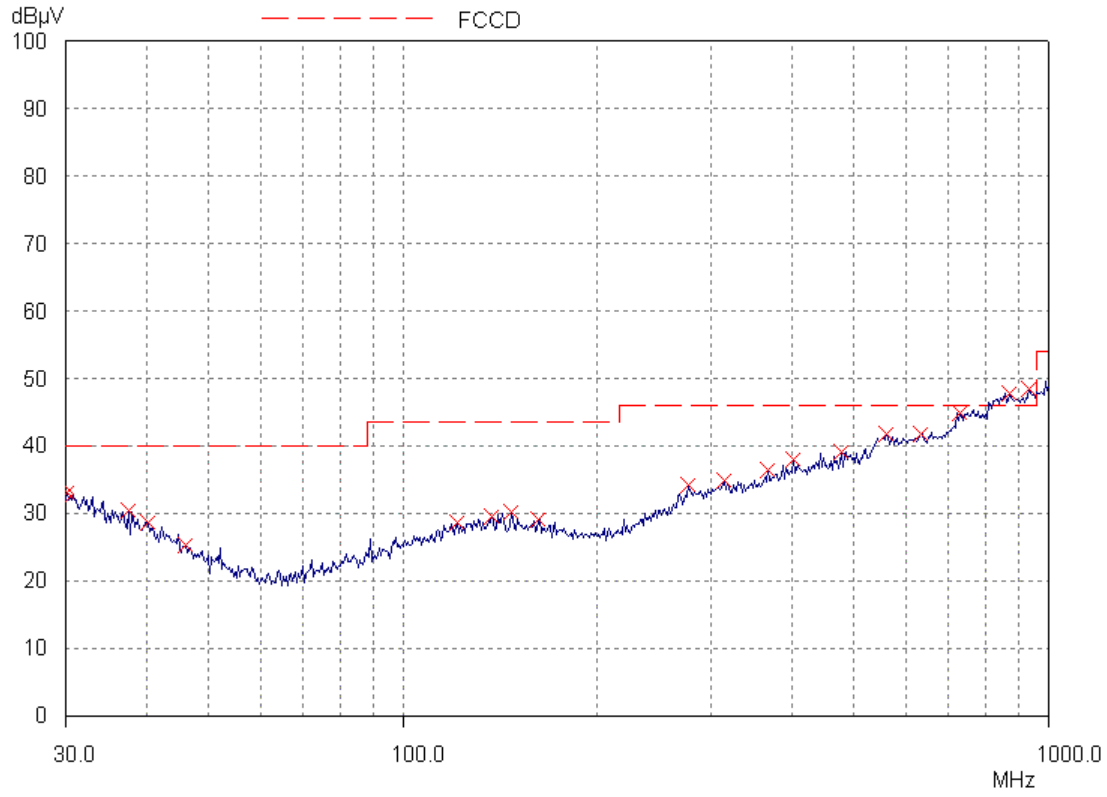
Result File identec6.dat: rad, vert pol, with tag, 3m

Scan settings (1 Range)

Frequencies			Receiver settings					
Start	*Stop*	*Step*	*IF BW*	*Detector*	*M-time*	*Atten*	*Preamp*	*Op Rge*
30MHz	1000MHz	50kHz	120kHz	PK	20ms	Auto	OFF	60dB

Transmitter	No.	Start	Stop	Name
1	20	30MHz	1000MHz	CableB885B
	21	30MHz	1000MHz	BilogB933B

Prescan Measurement	Detector	X PK
	Meas time	see scan settings
	Subranges	25
	Acc. Margin	15 dB



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ITS Testing and Certification Ltd
Radiated Emissions

EUT	Cryptag
Manuf	Identec Ltd
Op Cond	With Tag
Operator	Haroun Mohammed
Test spec	FCC Rules, Part 15, Subpart D, Section 15.209
Comment	Pre scan at 3m. Height 1m, Horiz Pol

Result File identec6.dat: rad, vert pol, with tag, 3m

Scan settings (1 Range)

Frequencies			Receiver settings					
Start	*Stop*	*Step*	*IF BW*	*Detector*	*M-time*	*Atten*	*Preamp*	*Op Rge*
30MHz	1000MHz	50kHz	120kHz	PK	20ms	Auto	OFF	60dB

Transmitter	No.	Start	Stop	Name
1	20	30MHz	1000MHz	CableB885B
	21	30MHz	1000MHz	BilogB933B

Prescan Measurement	Detector	X PK
	Meas time	see scan settings
	Subranges	25
	Acc. Margin	15 dB

Peak Search results

Frequency MHz	PK Level dBµV	PK Limit dBµV	PK Delta dB
30.05	33.08	40.00	6.92
37.45	30.45	40.00	9.55
40.25	28.64	40.00	11.36
45.85	25.32	40.00	14.68
121.0	28.56	43.52	14.96
137.15	29.47	43.52	14.05
146.7	30.16	43.52	13.36
161.95	29.09	43.52	14.43
275.2	34.25	46.02	11.77
313.1	34.78	46.02	11.24
366.45	36.40	46.02	9.62
400.55	37.91	46.02	8.11
474.8	39.16	46.02	6.86
559.7	41.78	46.02	4.24
630.8	41.78	46.02	4.24
727.9	44.95	46.02	1.07
868.65	47.78*	46.02	-1.76
928.45	48.55*	46.02	-2.53

APPENDIX C

Details of Equipment Under Test

Unit Title:	Tag Reader
Model No:	ELC1A-3
Serial No:	7,377
Description/Details:	Tag Reader
Power Supply: Switch Mode Type: Manufacturer: Model No: Switching Frequency:	Yes Advance NS055012 -
Power Supply: Linear Type: Manufacturer: Model No:	Yes No information supplied No information supplied
Input supply Configuration:	Two wire
Clock Oscillator Frequencies:	153.6kHz intentional emitter
Other Interference Sources:	No information supplied
Supply Filter (Manufacturer/Type/Model):	None
Cabinet Screening (Material/Construction):	None
Interface Cable(s) Screening (Method):	Metal Foil around cable
Interface Connector(s) Grounding (Method):	Pig-tail connection at supply end
Internal Grounding (Method):	No information supplied
Other Suppression (Filters, Ferrites, Screening etc):	No information supplied
Operating Mode(s) for Test:	Receive/Transmit