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REPORT ON ELECTROMAGNETIC COMPATIBILITY TESTS

Performed at:
TWENTY PENCE TEST SITE

Twenty Pence Road,
Cottenham,
Cambridge
U.K.
CB4 4PS

on

BEWATOR-COTAG

SM500
Contactless SmartCard Reader

dated

14 March 2000

Equipment Under Test (EUT):	SM500
Test Commissioned by:	BEWATOR-COTAG Mercers Row Newmarket Road Cambridge CB5 8EX
Representative:	Martin Young
Test Started:	6 March 2000
Test Completed:	13 March 2000
Test Engineer:	Dave Smith
Date of Report:	14 March 2000
Report:	
Written by: _ _ _ _Dave Smith _ _ _ _ .	Checked by: _ _ _ Derek Barlow _ _ _ .
Date: _ _ _ _ _14 March 00 _ _ .	Date: _ _ _ 24 March 00 _ _ _ .

Test Standards Applied

CFR 47 : 1998	*Code of Federal Regulations: Part 15 Subpart C - Radio Frequency Devices - Intentional Radiators*	**PASS**

Emissions Test Results Summary

CFR 47 : 1998 PASS

Test	Port	Method	Limit	PASS/FAIL	*Notes*
Conducted Emissions	ac power	ANSI C63.4:1992	FCC pt 15 Subsection C	PASS	
Radiated Emissions		ANSI C63.4:1992	FCC pt 15 Subsection C	PASS	#1

#1 The limits of section 15.225 (13.553 - 13.567MHz) and section 15.229 (40.66 - 40.70 MHz) were applied, based on the manufacturer's declared operating frequencies.

Contents

1 EUT Details

1.1 General

The EUT was a SM500 Contactless SmartCard Reader.

The EUT is an intentional radiator operating in both of the following bands:

- o 13.553 - 13.567MHz (Section 15.225)
- o 40.66 - 40.70 MHz (Section 15.229)

The EUT contained no clocks or circuitry operating at or above 108MHz.

Details of the EUT and associated peripherals used during the tests are listed below. Figure 1 shows the interconnections between the EUT and peripherals.

Item	Manufacturer	Model	Description	Serial No:	FCC ID
1	Bewator-Cotag	SM500	EUT	0012	EZO5PQSM500
2	ARCHER	273-1652A	AC adaptor		
3	Bewator-Cotag	4000	Controller with PSU	1203	EZO5PQ4000

1.2 Modifications to EUT and Peripherals

Details of any modifications that were required to achieve compliance are listed below. The modification numbers are referred to in the results sections as appropriate.

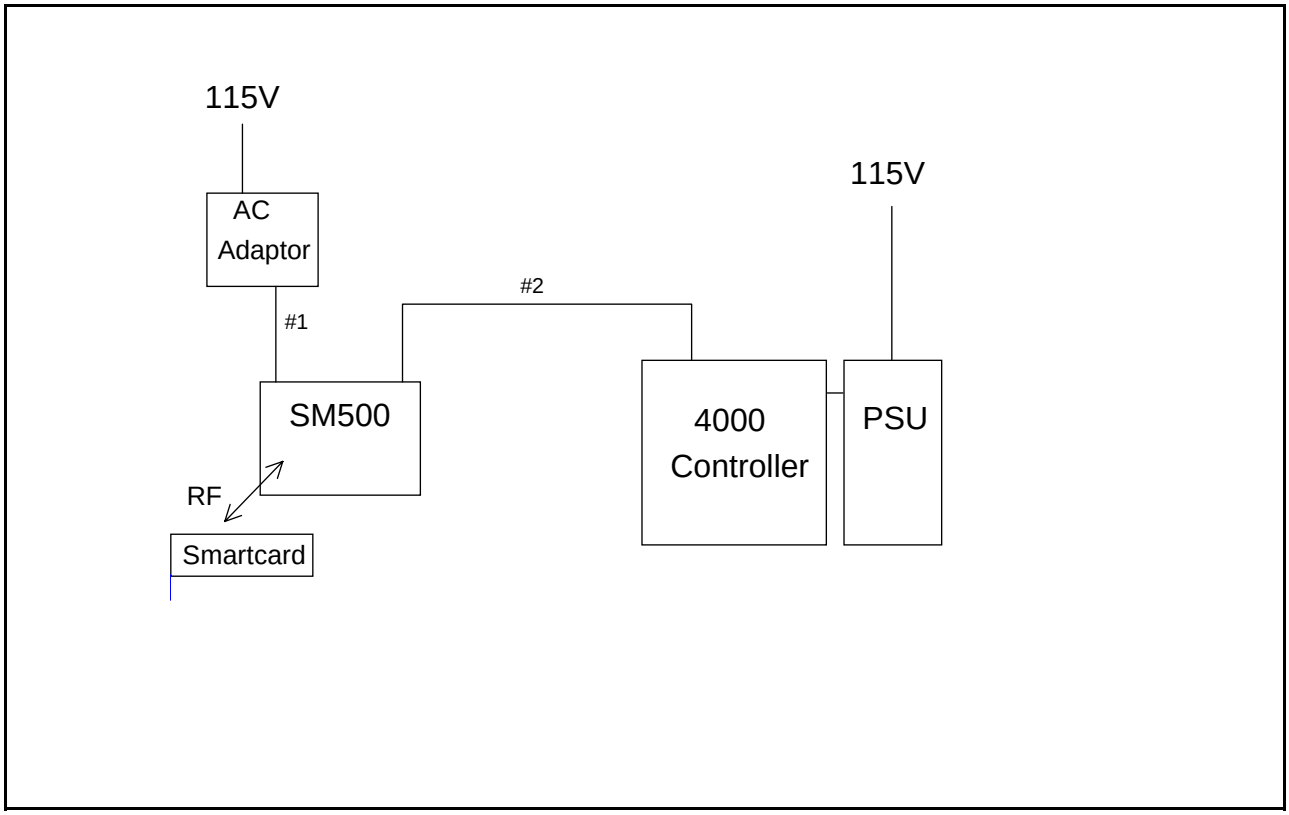
Mod No:	Details
0	Original unit with no modifications.

1.3 EUT Operating Modes

The EUT was tested in the following operating mode or modes. Generally, operating modes are chosen that will exercise the functions of the EUT as fully as possible and in a manner likely to produce maximum emission levels or susceptibility. Individual test result sheets reference the operating mode of the EUT.

Operating Mode	Details
1	SmartCard in Field - Sending data to controller.
2	SmartCard not in Field.

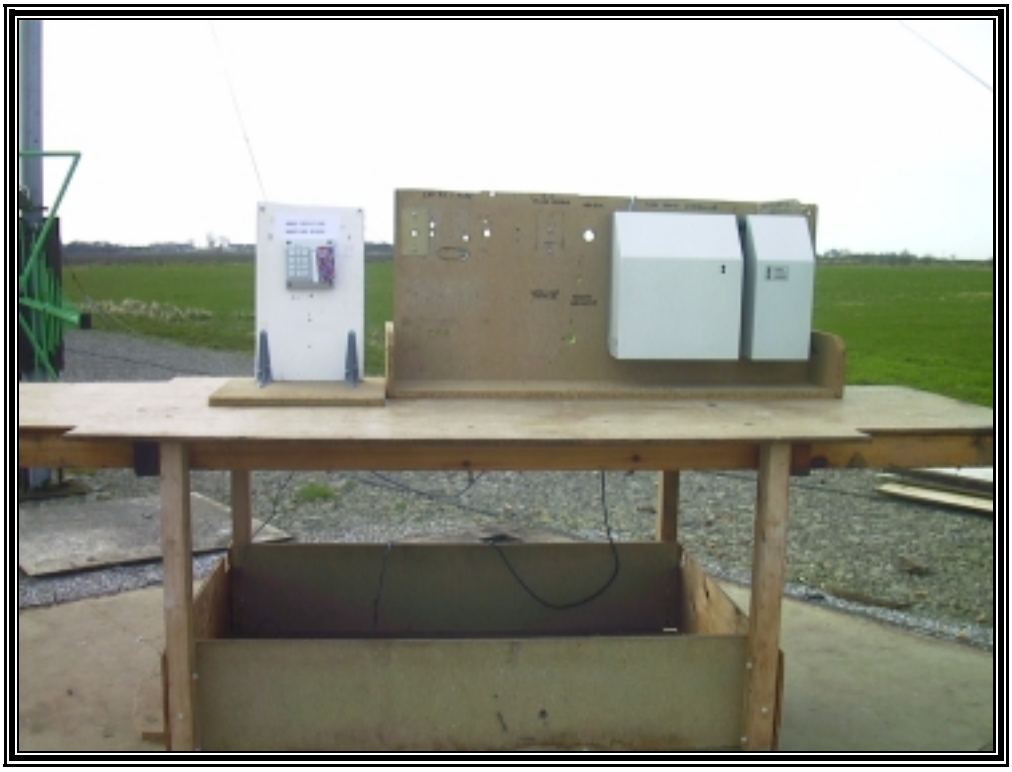
Figure 1 General Arrangement of EUT and Peripherals



#1 unscreened DC power cable - 1.5m
#2 screened communications cable - 2m

Photograph 1 Conducted Emissions - Back

Photograph 2 Conducted Emissions - Front



Photograph 3 Radiated Emissions - Front

Photograph 4 Radiated Emissions - Back

2 Test Equipment

The test equipment used during the tests was one or more of the items listed below. Individual test result sheets indicate which items were used.

Ref No:	Manufacturer	Model	Description	Serial	Cal Date
R1	Chase	LHR7000	RF Receiver 10kHz - 30MHz	1056	30 June 99
R3	Rohde and Schwarz	ESHS10	RF Receiver 9k - 30MHz	843743/010	22 June 99
R4	Rohde and Schwarz	ESVS10	RF Receiver 20MHz - 1GHz	843744/002	23 June 99
R5 R5B	Hewlett Packard Hewlett Packard	HP 8595E HP87405A	Spectrum Analyser Pre-amp	3412A00701 3207A00322	14 Dec 99
L1	EMCO	1912.5	LISN	1358	18 Mar 99
L2	Rohde and Schwarz	ESH3-Z5	LISN	843862/009	18 Mar 99
A2	EMCO	3146	Log Periodic Antenna 200MHz - 1GHz	2011	15 Jul 99
A4	Chase	CBL6112	Bilog Antenna 30MHz - 2GHz	2027	15 Jul 99
A5	Chase	CBL111A	Bilog Antenna 30MHz - 1GHz	1760	15 Jul 99
A7	EMCO	6502	Active Loop 9kHz - 30MHz	2139	1 Oct 99

3 Test Methods

3.1 Conducted Emissions - ac power

This section describes the general method of performing this test. The specific method used and any deviations from this general method are listed in the appropriate results section.

Bench top EUTs and peripheral equipment are normally placed on a 0.8m high non-conducting bench, positioned 0.4m from one of the metallic walls of a screened room. Floor standing EUTs are normally placed 0.1m above the metallic floor of the screened room. Mains leads are bundled so as not to exceed 1m.

The EUT is powered using a 50ohm/50uH Line Impedance Stabilisation Network (LISN). Peripherals are powered using a second a 50ohm/50uH LISN. These LISNs are bonded to the screened room floor.

With the correct supply voltage applied to the EUT scans are performed on both the live and neutral line outputs of the LISN using quasi-peak detection over the specified frequency range. The results of these scans are shown in the plots section at the end of the report.

Significant emissions identified by the scans are measured and the results tabulated. The table of results is shown in the conducted emissions results section.

3.2 Radiated Emissions below 30MHz

This section describes the general method of performing this test. The specific method used and any deviations from this general method are listed in the appropriate results section.

Initial scans are performed in a semi-anechoic screened room at a distance of 3m. Scans are performed over the frequency range specified in the test standard with a loop antenna both co-axially and orthogonally orientated with respect to the EUT. During these scans the EUT and peripherals are rotated through 360°. Bench top EUTs are placed on a non-conducting bench at a height of 0.8m above the ground plane. Floor standing EUTs are placed 0.1m above the ground plane. The results of the scans are shown in the plots included at the end of the report.

Significant emissions identified by the scans are measured on an open area test site at the appropriate test distance using a CISPR16 quasi-peak receiver. Maximised readings are obtained by rotating the EUT through 360° with the antenna at a height of 1m. Measurements are made with the antenna both co-axially and orthogonally orientated with respect to the EUT and the results tabulated.

3.3 Radiated Emissions above 30MHz

This section describes the general method of performing this test. The specific method used and any deviations from this general method are listed in the appropriate results section.

Initial scans are performed in a semi-anechoic screened room at a distance of 3m. Scans are performed over the frequency range specified in the test standard with the antenna both horizontally and vertically polarised. During these scans the EUT and peripherals are rotated through 360°. Bench top EUTs are placed on a non-conducting bench at a height of 0.8m above the ground plane. Floor standing EUTs are placed 0.1m above the ground plane. The results of the scans are shown in the plots included at the end of the report.

Significant emissions identified by the scans are measured on an open area test site at the appropriate test distance using a CISPR16 quasi-peak receiver. Maximised readings are obtained by rotating the EUT through 360° and adjusting the height of the antenna from 1m to 4m. Measurements are made with the antenna both horizontally and vertically polarised and the results tabulated.

4 Test Results

The following sections contain tabulated test results. Plots of various scans are included at the back of this section.

4.1 Conducted Emission Results

Test Equipment: Factor Set 1: EMLISN RG214 10 m cable

Conducted Emissions

Company: BEWATOR-COTAG *Product:* SM500

Date: 6 March 2000 *Test Eng:* Dave Smith

Ports: ac power

Test: ANSI C63.4:1992 using limits of FCC pt 15 Subsection C

Ports:

Test:

Test	Op Mode	Mod State	Line (L/N)	Fact Set	Freq. MHz	Det qp/ av	Rec. Level dBuV	Corr'n Factor dB	Total Level dBuV	Limit FCC(C) dBuV/m	Margin FCC(C) dBuV/m	Limit	Margin	Notes
	1	0	L	1	5.549	qp	34.1	0.2	34.3	48.0	13.7			
	1	0	L	1	13.562	qp	32.7	0.2	32.9	48.0	15.1			
	1	0	L	1	18.479	qp	41.2	0.3	41.5	48.0	6.5			
	1	0	L	1	22.175	qp	43.0	0.3	43.3	48.0	4.7			
	1	0	L	1	24.023	qp	41.8	0.3	42.1	48.0	5.9			
	2	0	L	1	13.561	qp	38.2	0.2	38.4	48.0	9.6			
	1	0	N	1	5.544	qp	33.3	0.2	33.5	48.0	14.5			
	1	0	N	1	13.562	qp	32.5	0.2	32.7	48.0	15.3			
	1	0	N	1	18.479	qp	40.0	0.3	40.3	48.0	7.7			
	1	0	N	1	20.372	qp	41.0	0.3	41.3	48.0	6.7			
	1	0	N	1	22.175	qp	40.6	0.3	40.9	48.0	7.1			
	1	0	N	1	29.566	qp	40.2	0.3	40.5	48.0	7.5			
	2	0	N	1	13.561	qp	37.8	0.2	38.0	48.0	10.0			

Results	**Minimum Margin**	**4.7 dB**	
	PASS/FAIL	**PASS**	

Notes	Comments and Observations
#1	Results of scans shown in plot 1 to plot 4.

4.2 Radiated Emissions Results - Intentional Emissions

Test Equipment:	Factor Set 1:	HFBilog	RG214	25 m cable
	Factor Set 2:	Loop	RG214	25 m cable

Radiated Emissions

Company: BEWATOR-COTAG *Product:* SM500

Date: 13 March 2000 *Test Eng:* Dave Smith

Test: using limits of FCC pt 15 Subsection C

Test:

Test	Op Mode	Mod State	Dist m	Fact Set	Freq. MHz	Ant Pol	Rec. Level dBuV	Corr'n Factor dB/m	Total Level dBuV/m	Limit FCC(C) dBuV/m	Margin FCC(C) dBuV/m	Limit	Margin	Notes
	1	0	3	1	40.670	V	26.7	13.6	40.3	60.0	19.7			#1
	1	0	3	1	40.670	H	28.2	13.6	41.8	60.0	18.2			#1
	1	0	3	2	13.561	C	49.6	10.6	60.2	80.0	19.8			#2
	1	0	3	2	13.561	P	42.2	10.6	52.8	80.0	27.2			#2

Results	Minimum Margin	18.2 dB	
	PASS/FAIL	PASS	

Notes	Comments and Observations
	Results of screened room scans shown in plots 5 to 10.
#1	Based on limit of section 15.229.
#2	Based on limit of section 15.225. Measurements made with loop antenna over ground plane at distance of 3m. Measurement was found to be almost 20dB below limit specified at 30m.

4.3 Radiated Emissions Results - Spurious Emissions

Test Equipment:	Factor Set 1:	HFBilog	RG214	25 m cable
	Factor Set 2:	Loop	RG214	25 m cable

Radiated Emissions

Company: BEWATOR-COTAG *Product:* SM500

Date: 13 March 2000 *Test Eng:* Dave Smith

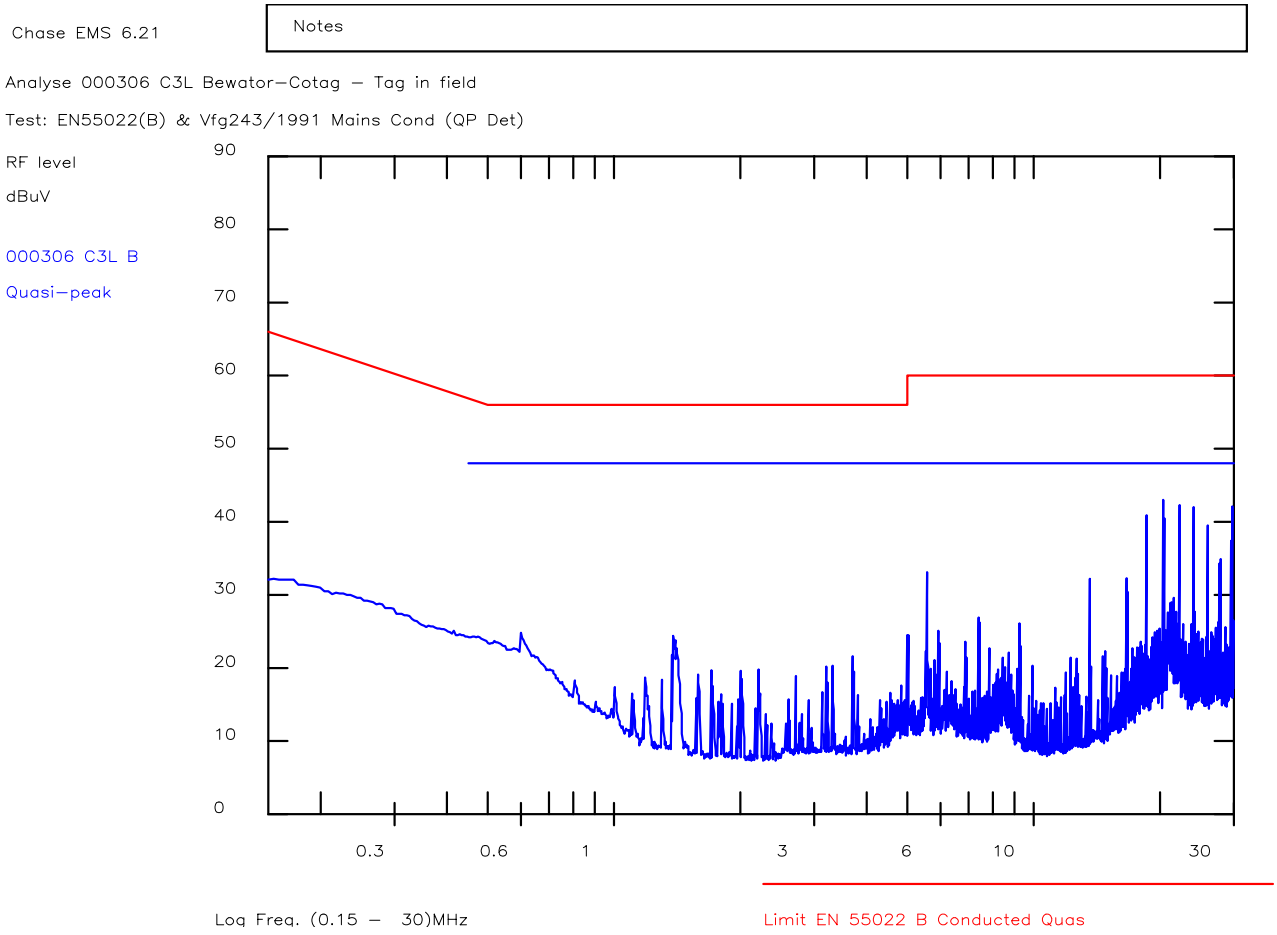
Test: ANSI C63.4:1992 using limits of FCC pt 15 Subsection C

Test:

Test	Op Mode	Mod State	Dist m	Fact Set	Freq. MHz	Ant Pol	Rec. Level dBuV	Corr'n Factor dB/m	Total Level dBuV/m	Limit FCC(C) dBuV/m	Margin FCC(C) dBuV/m	Limit	Margin	Notes
	1	0	3	1	32.029	V	7.6	18.5	26.1	40.0	13.9			
	1	0	3	1	32.029	H	2.9	18.5	21.4	40.0	18.6			
	1	0	3	1	68.387	V	29.7	7.7	37.4	40.0	2.6			
	1	0	3	1	68.387	H	24.7	7.7	32.4	40.0	7.6			
	1	0	3	1	90.547	V	17.8	10.8	28.6	43.5	14.9			
	1	0	3	1	90.547	H	17.2	10.8	28.0	43.5	15.5			
	1	0	3	1	94.240	V	24.6	11.5	36.1	43.5	7.4			
	1	0	3	1	94.240	H	23.5	11.5	35.0	43.5	8.5			
	1	0	3	1	136.737	V	23.6	13.3	36.9	43.5	6.6			
	1	0	3	1	136.737	H	16.3	13.3	29.6	43.5	13.9			
	1	0	3	1	140.450	V	26.0	13.1	39.1	43.5	4.4			
	1	0	3	1	140.450	H	21.3	13.1	34.4	43.5	9.1			
	1	0	3	1	144.130	V	24.3	13.0	37.3	43.5	6.2			
	1	0	3	1	144.130	H	20.8	13.0	33.8	43.5	9.7			
	1	0	3	1	171.844	V	14.7	12.2	26.9	43.5	16.6			
	1	0	3	1	171.844	H	17.3	12.2	29.5	43.5	14.0			
	1	0	3	1	179.274	V	21.6	11.9	33.5	43.5	10.0			
	1	0	3	1	179.274	H	19.5	11.9	31.4	43.5	12.1			
	1	0	3	1	188.493	V	22.0	11.8	33.8	43.5	9.7			
	1	0	3	1	188.493	V	23.5	11.8	35.3	43.5	8.2			

Results	Minimum Margin PASS/FAIL	2.6 dB PASS	

Notes	Comments and Observations
	Results of screened room scans shown in plots 7 to 10.



PLOT 1 Conducted Emissions (Live) - SmartCard in Field

Company:	Bewator-Cotag	Product:	SM500
Date:	06 Mar 00	Test Engineer:	DS
Test:	FCC pt 15	Limit:	FCC (C) QP

Notes:
TAG in Field.
Serial cable connected to 4000 series controller.

Line:	Live	Attenuator:	10dB PAD	Operating Mode:	1
Detector:	QuasiPeak			Mod. State:	0
LISN:	EMCO	Filename:	C0306581.plt		

Frequency List (MHz)

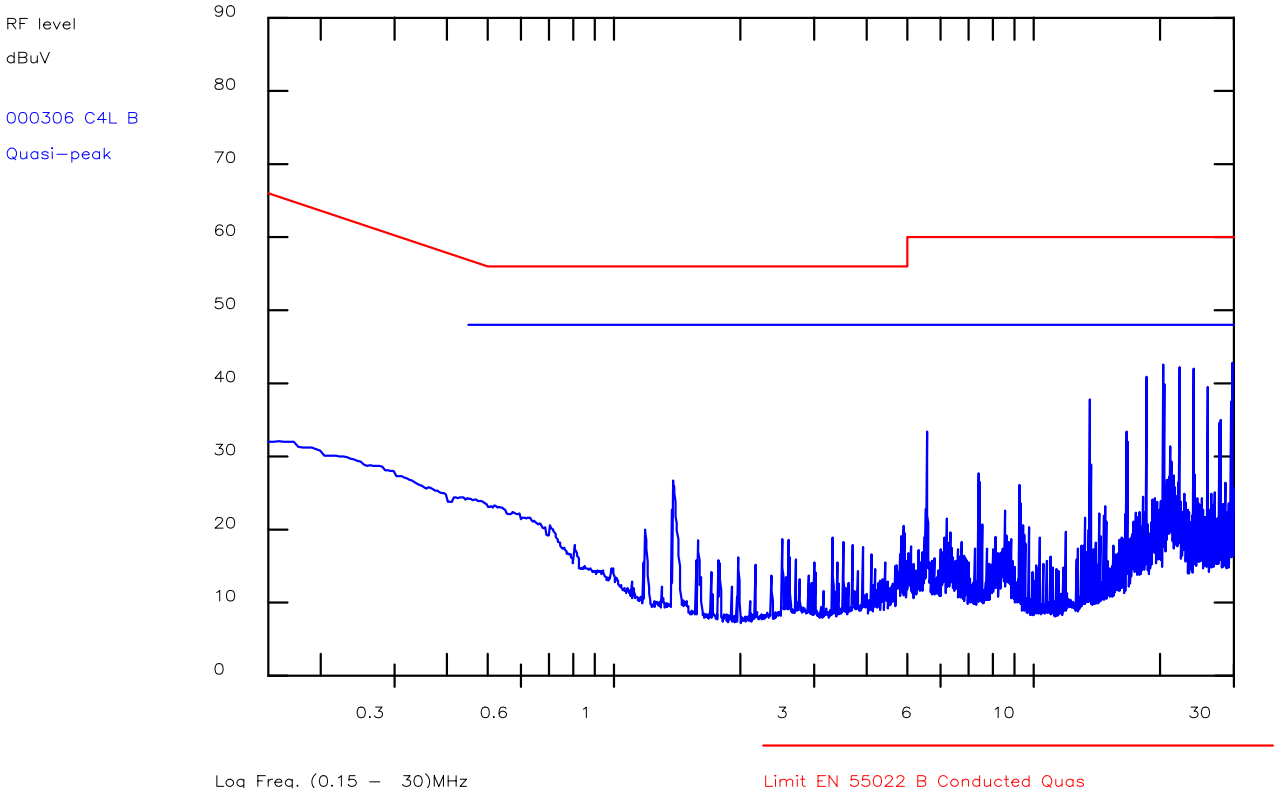
5.544	22.175					
13.562	24.023					
18.579						
20.326						

Chase EMS 6.21

Notes

Analyse 000306 C4L Bewator-Cotag - Tag not in field

Test: EN55022(B) & Vfg243/1991 Mains Cond (QP Det)



PLOT 2 Conducted Emissions (Live) - SmartCard not in Field

Company:	Bewator-Cotag	Product:	SM500
Date:	06 Mar 00	Test Engineer:	DS
Test:	FCC pt 15	Limit:	FCC (C) QP

Notes:
TAG not in Field.
Serial cable connected to 4000 series controller.

Line:	Live	Attenuator:	10dB PAD	Operating Mode:	2
Detector:	QuasiPeak			Mod. State:	1
LISN:	EMCO	Filename:	C0306599.plt		

Frequency List (MHz)

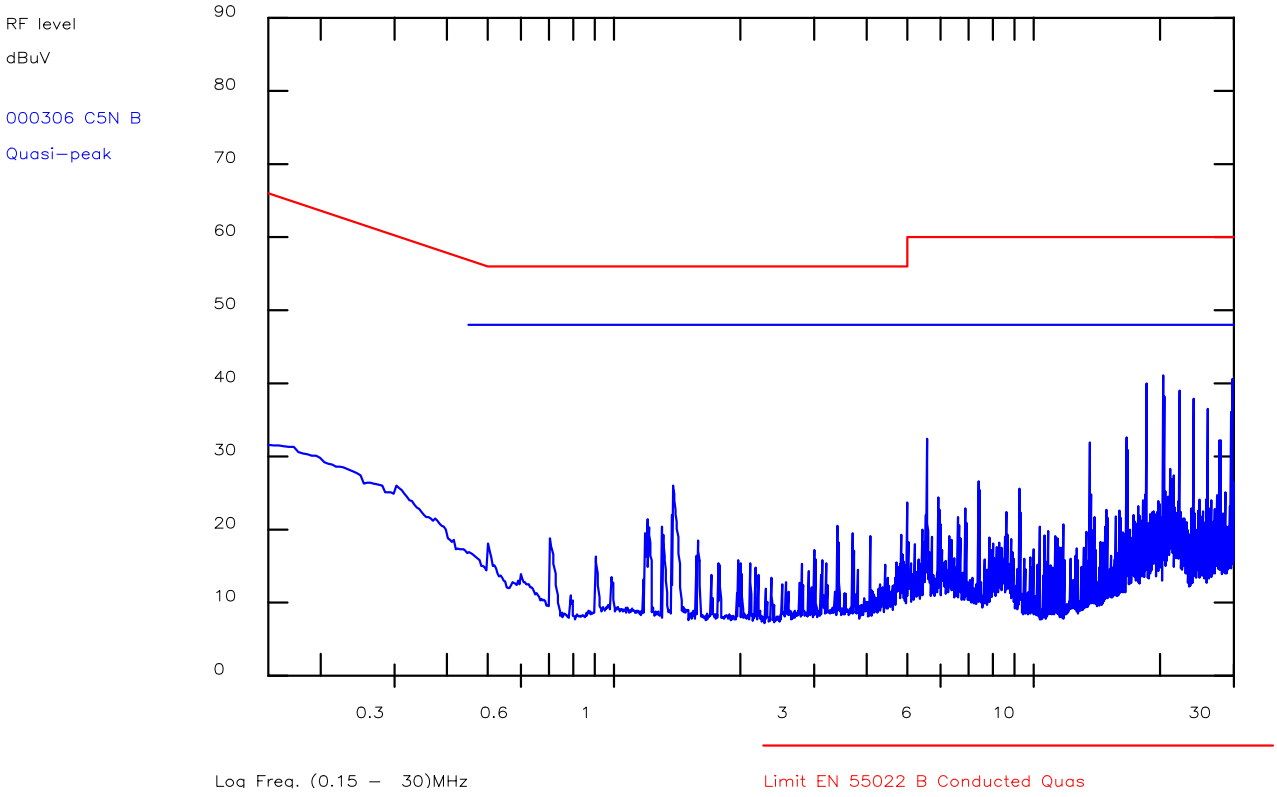
13.561						

Chase EMS 6.21

Notes

Analyse 000306 C5N Bewator–Cotag SM500 – Tag in field

Test: EN55022(B) & Vfg243/1991 Mains Cond (QP Det)



PLOT 3 Conducted Emissions (Neutral) - SmartCard in Field

Company:	Bewator-Cotag	Product:	SM500
Date:	06 Mar 00	Test Engineer:	DS
Test:	FCC pt 15	Limit:	FCC (C) QP

Notes:
TAG in Field.
Serial cable connected to 4000 series controller.

Line:	Neutral	Attenuator:	10dB PAD	Operating Mode:	1
Detector:	QuasiPeak			Mod. State:	0
LISN:	EMCO	Filename:	C03065B3.plt		

Frequency List (MHz)

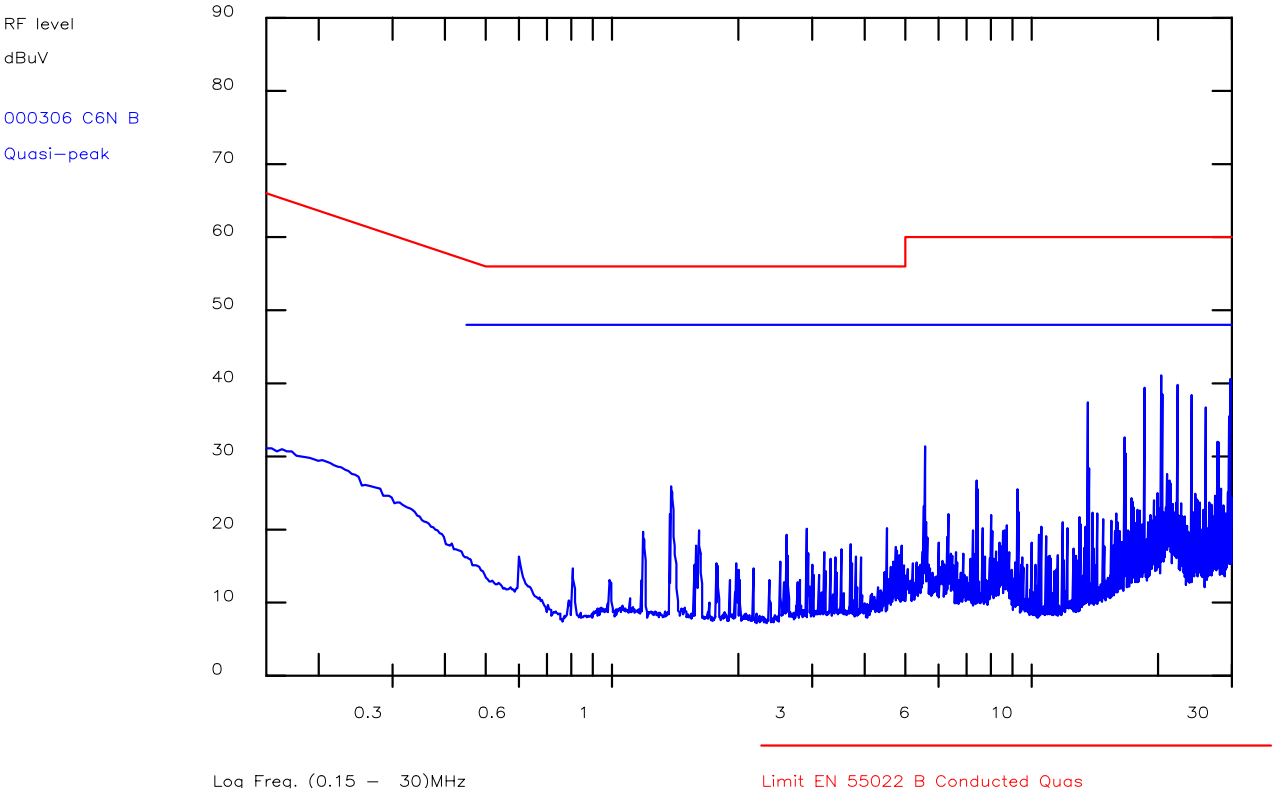
5.544	22.175					
13.562	29.566					
18.479						
20.327						

Chase EMS 6.21

Notes

Analyse 000306 C6N Bewator Cotag SM500 Tag not in Field

Test: EN55022(B) & Vfg243/1991 Mains Cond (QP Det)



PLOT 4 Conducted Emissions (Neutral) - SmartCard not in Field

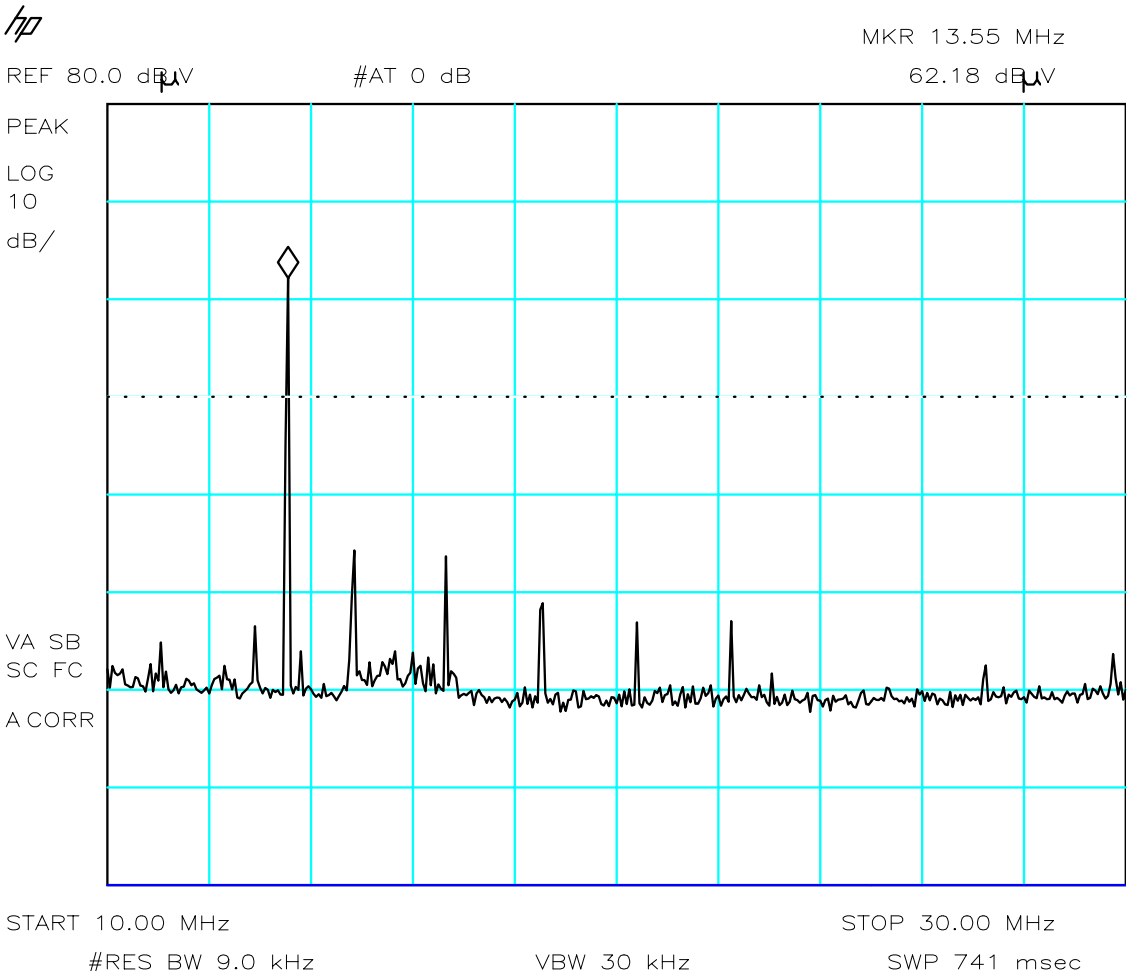
Company:	Bewator-Cotag	Product:	SM500
Date:	06 Mar 00	Test Engineer:	DS
Test:	FCC pt 15	Limit:	FCC (C) QP

Notes:
TAG not in Field.
Serial cable connected to 4000 series controller.

Line:	Neutral	Attenuator:	10dB PAD	Operating Mode:
Detector:	QuasiPeak			Mod. State:
LISN:	EMCO	Filename:	C03065C7.plt	

Frequency List (MHz)

13.561						



PLOT 5 Radiated Emissions below 30MHz - SmartCard in Field

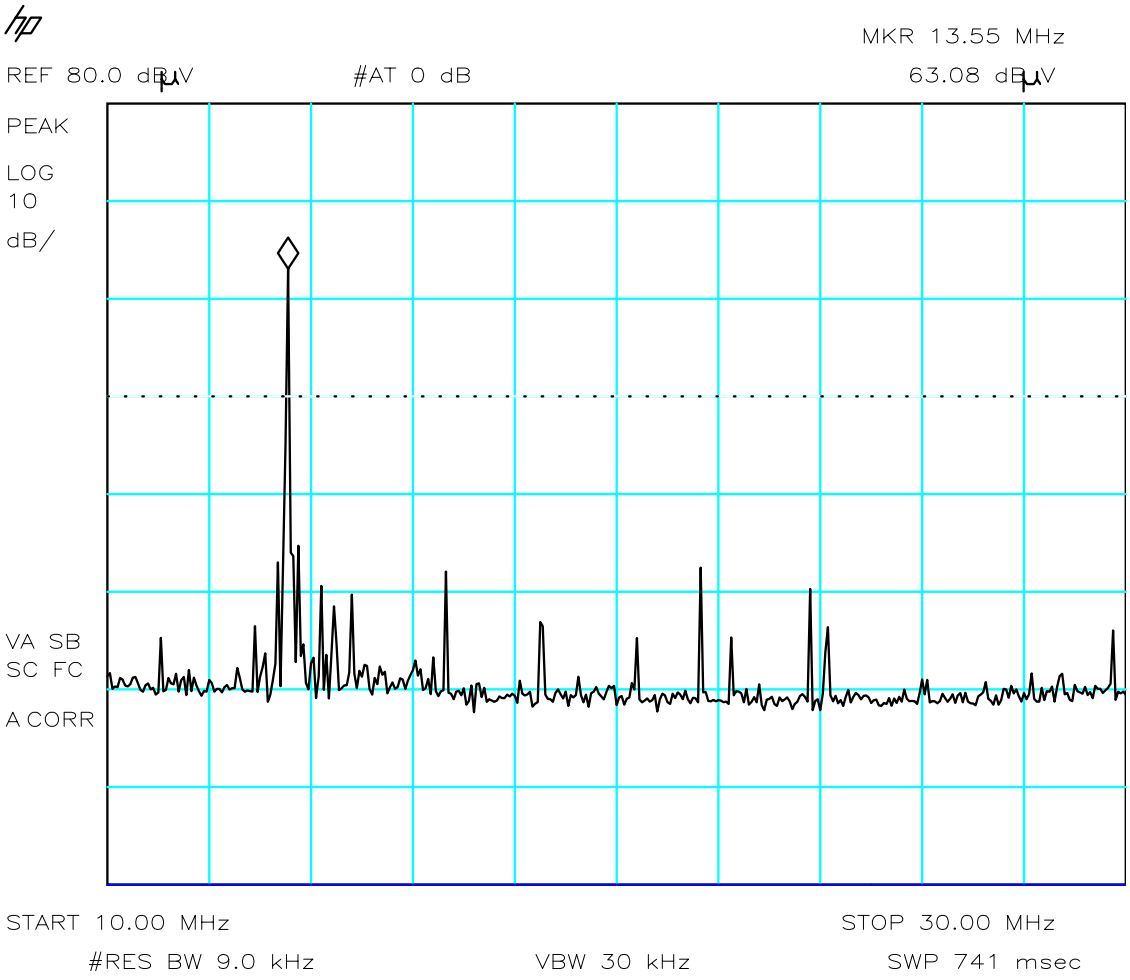
Company:	Bewator Cotag	Product:	SM500
Date:	06 Mar 00	Test Engineer:	DS
Test:	FCC pt 15	Limit:	FCC (C)

Notes:
Tag in field

Polarisation:	co-ax and orth	Orientation:	0 - 360°	Operating Mode:	1
Distance:	3m	Antenna:	Active Loop	Mod. State:	0
Height:	1m	Filename:	H0306666.plt		

Frequency List (MHz)

13.561						



PLOT 6 Radiated Emissions below 30MHz - SmartCard not in Field

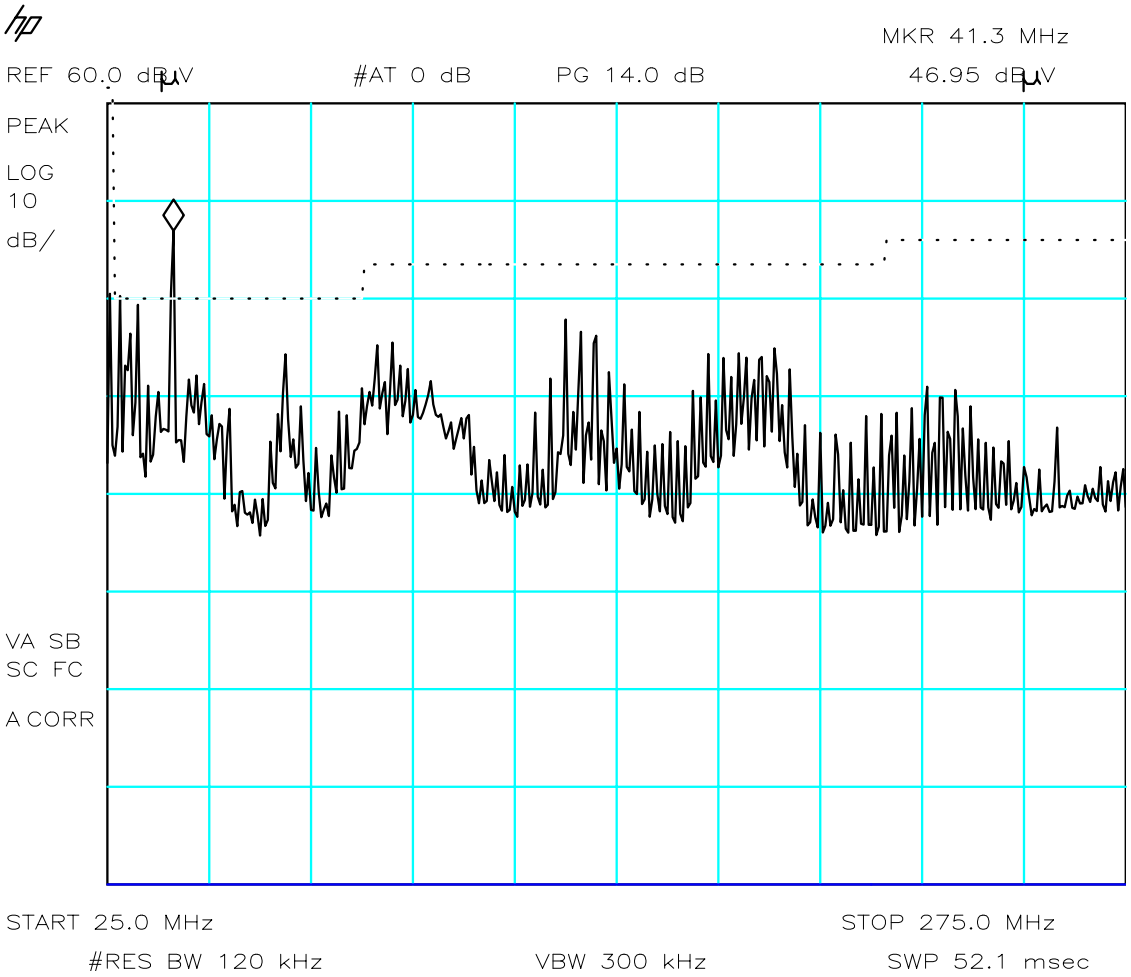
Company:	Bewator Cotag	Product:	SM500
Date:	06 Mar 00	Test Engineer:	DS
Test:	FCC pt 15	Limit:	FCC (C)

Notes:
Tag not in field

Polarisation:	co-ax and orth	Orientation:	0 - 360°	Operating Mode:	2
Distance:	3m	Antenna:	Active Loop	Mod. State:	0
Height:	1m	Filename:	H030666C.plt		

Frequency List (MHz)

13.561						



PLOT 7 Radiated Emissions 25MHz to 275MHz - SmartCard in Field

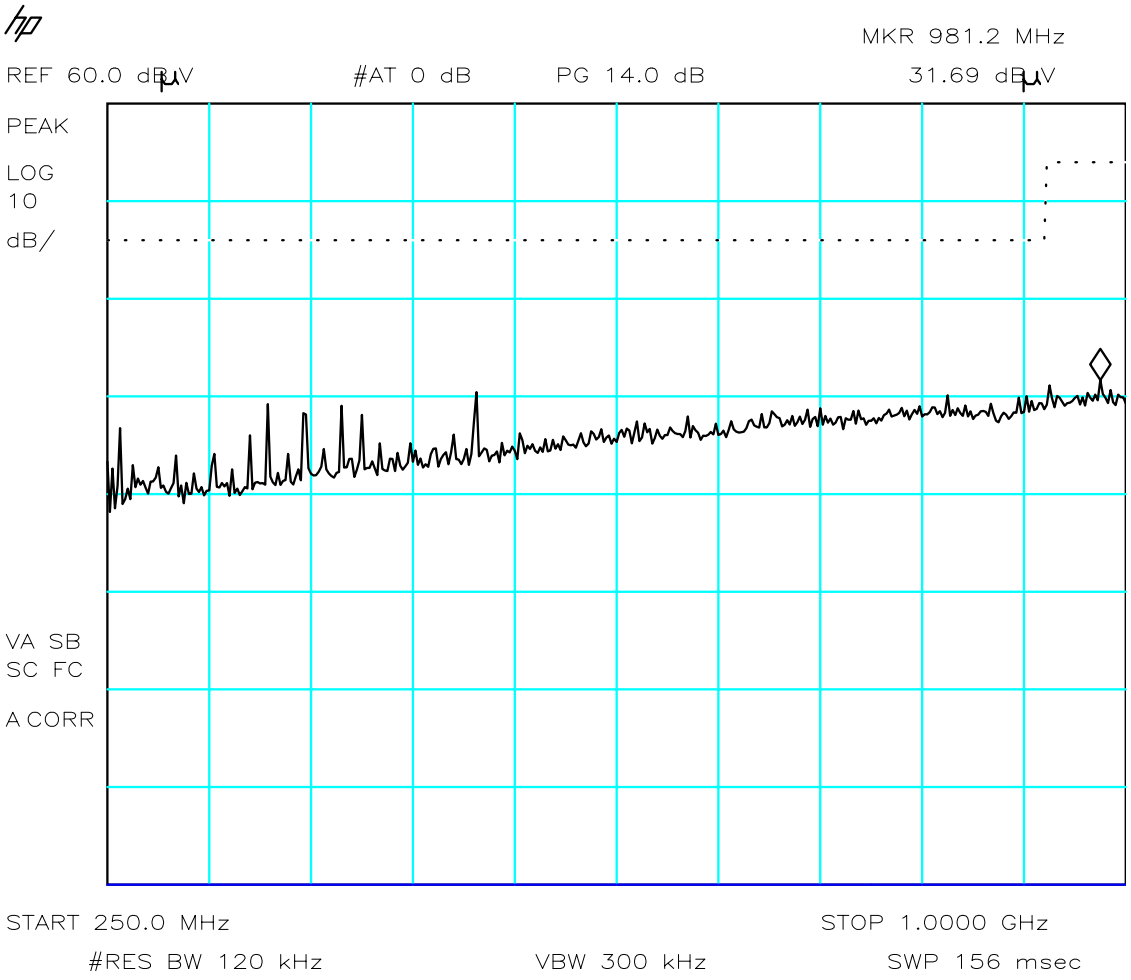
Company:	Bewator Cotag	Product:	SM500
Date:	06 Mar 00	Test Engineer:	DS
Test:	FCC pt 15	Limit:	FCC (C)

Notes:
Tag in field

Polarisation:	V + H	Orientation:	0 - 360°	Operating Mode:	1
Distance:	3m	Antenna:	Bilog	Mod. State:	0
Height:	1m	Filename:	H0306629.plt		

Frequency List (MHz)

32.000	94.300	171.845				
40.670	136.800	179.260				
68.388	140.450	188.475				
90.65	144.140	225.425				



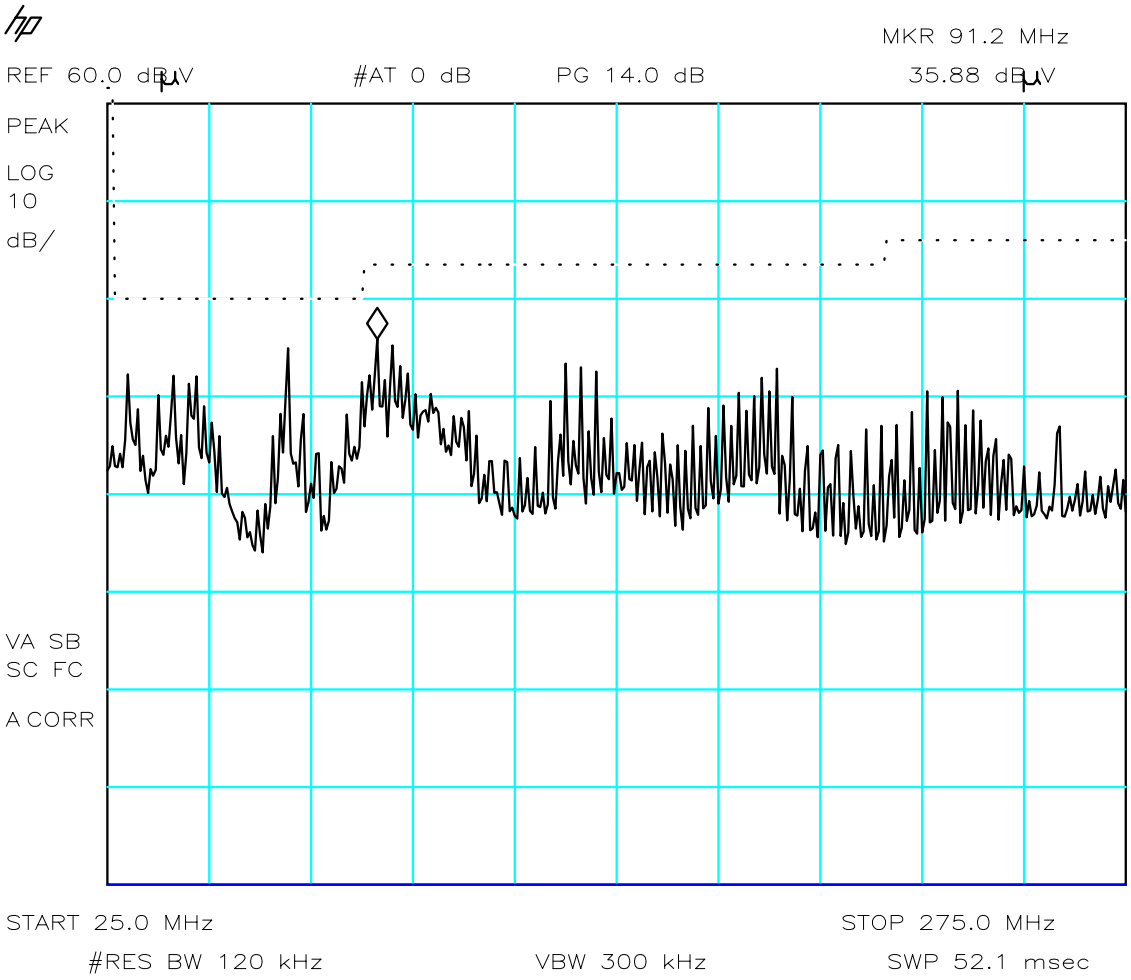
PLOT 8 Radiated Emissions 250MHz to 1GHz - SmartCard in Field

Company:	Bewator Cotag	Product:	SM500
Date:	06 Mar 00	Test Engineer:	DS
Test:	FCC pt 15	Limit:	FCC (C)

Notes:
Tag in field

Polarisation:	V + H	Orientation:	0 - 360°	Operating Mode:	1
Distance:	3m	Antenna:	Bilog	Mod. State:	0
Height:	1m	Filename:	H030663D.plt		

Frequency List (MHz)



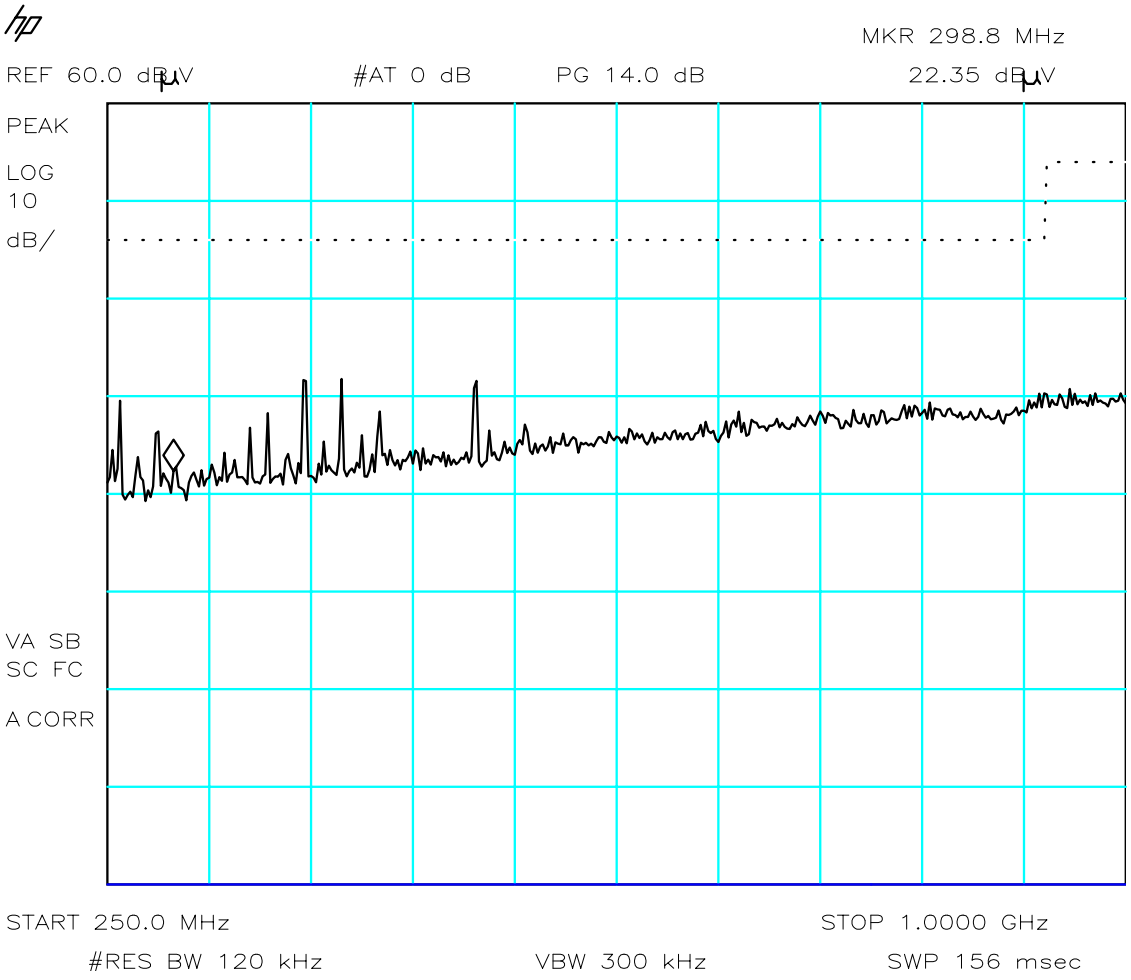
PLOT 9 Radiated Emissions 25MHz to 275MHz - SmartCard not in Field

Company:	Bewator_Cotag	Product:	SM500
Date:	06 Mar 00	Test Engineer:	DS
Test:	FCC pt 15	Limit:	FCC (C)

Notes:
Tag not in field

Polarisation:	V + H	Orientation:	0 - 360°	Operating Mode:	2
Distance:	3m	Antenna:	Bilog	Mod. State:	0
Height:	1m	Filename:	H0306683.plt		

Frequency List (MHz)



PLOT 10 Radiated Emissions 250MHz to 1GHz - SmartCard not in Field

Company:	Bewator_Cotag	Product:	SM500
Date:	06 Mar 00	Test Engineer:	DS
Test:	FCC pt 15	Limit:	FCC (C)

Notes:
Tag not in field

Polarisation:	V + H	Orientation:	0 - 360°	Operating Mode:	2
Distance:	3m	Antenna:	Bilog	Mod. State:	0
Height:	1m	Filename:	H03066A1.plt		

Frequency List (MHz)
