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Rapport d'essai / *Test report*

JDE : 60046678 N° 200605-3111CR-R1-E

DELIVRE A / *ISSUED TO* : **GEMPLUS**
ZI AThelia III
Voie Antiope
13705 LA CIOTAT - FRANCE

Objet / *Subject* **:** Essais de compatibilité électromagnétique conformément aux normes FCC CFR 47 Part 15, Subpart C.
Electromagnetic compatibility tests according to the standards FCC CFR 47 Part 15, Subpart C.

Matériel testé / *Apparatus under test* :

- Produit / *Product* : Lecteur Carte à Puce Sans Contact / *Contactless Smartcard Reader*
- Marque / *Trade mark* : GEMPLUS
- Constructeur / *Manufacturer* : GEMPLUS
- Type / *Model* : GEMPROX PU
- N°de série / *serial number* * : Proto n°V2
- FCC ID : MESPROXU

* : information donnée par le client / *information given by the customer*

Date des essais / *Test date* **:** 6 au 8 juin 2006 / *June from 6th to 8th, 2006*

Lieu d'essai / *Test location* **:** **LCIE**
ZI des Blanchisseries
38500 VOIRON - France

Test réalisé par / Test p*erformed by* **:** Laurent CHAPUS

Ce document comporte /*Composition of document :* 25 pages.

VOIRON, LE 7 AOUT 2006 / AUGUST 7TH, 2006

Ecrit par / *Written by*
Laurent CHAPUS

Approuvé par / *Approved by,*
Jacques LORQUIN

1. TEST PROGRAM

Standard : FCC CFR 47, PART 15, Subpart C
ANSI C63-4 (2003)
Requirements for intentional radiator. Chapter 15.225 (Operation within the band 13.110-14.010MHz)

2. SYSTEM TEST CONFIGURATION

2.1. Justification

The system was configured for testing in a typical fashion (as a customer would normally use it).
USB and RS232 data transmission modes are evaluated.
The GEMPROX-CU is used for the compliance evaluation. (GEMPROX-PU without plastic enclosure)

2.2. HARDWARE IDENTIFICATION

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

GEMPROX-PU **Sn: Proto n°V2**
P/N: HWP113580A

*** Configuration:**

- **RF transmitter Input/Output:**
  USB port
  RS232+DC input power (RJ45 connector)
  (Only one used for normal operation)
- **Carrier frequency:** 13.56MHz
- **Power supply:**
  USB port: 5V dc from USB
  RS232 mode: 5V dc from power adapter FRIWO FW7650/05 (5V/1A)
  Primary rated power source: 110Vac/60Hz (RS232 mode)

2.3. Auxiliaries

The FCC IDs for all equipment, more description of all cables used in the tested system are:

Trade Mark – Model Number (Serial number)	FCC ID	Description	Cable description
GEMPROX-PU * Sn : PROTO N°V2	MESPROXU	Contactless smartcard reader	Power cord unshielded, USB cable shielded, RS232 cable shielded
FRIWO Type: FW7650/05 (sn: none)	None	AC/DC Power supply Out 5Vdc/1A	DC power cord unshielded.
Hewlett Packard VECTRA VL420 DT pn: P5755-60201 (sn: FR14122957)	DOC	Personal computer	Power cord unshielded. All other cable shielded.
Hewlett Packard pn:D2846 (sn: JP74001000)	DOC	Monitor	Power cord unshielded. Video cable shielded
Hewlett Packard pn:C4736A (sn: LZA4000061)	DZL211092	MOUSE	PS2 cable
Hewlett Packard pn:C4774 (sn: M990814763)	GYUR73SK	Keyboard	PS2 cable
GEMPLUS GEM COMBI CD Lite	None	Smartcard ISO 14443	None

*** : Equipment under test.**

2.4. Equipment modifications

No equipment modification has been necessary during testing.

2.5. EUT Exercise software

The EUT exercise program used during radiated and conducted testing was exercised the GEMPROX-PU in a manner similar to a typical use, with smartcard data readings.
PC Software used: GEMPROX UTILITY

2.6. Special accessories

The USB or RS232 interface cables used for compliance testing are shielded.
Cables are used with ferrites clamps :

- USB cable: ferrite WURTH ELEKTRONIK 742 7114
- RS232 cable: ferrite WURTH ELEKTRONIK 742 7113

All these cables with ferrites are normally supplied with the product.

2.7. I/O cables

Cables used for the test of the GEMPROX-CU:
- 1x USB cable, shielded: 1.2m
- 1x RS232 cable, shielded (RJ45 connectors)

3. RADIATED EMISSION DATA

3.1. TEST SETUP

The EUT is placed on a non-conducting table of 80cm height.

Radiated emission test setup

Equipment configuration and running mode:
A contactless smartcard is placed on the top side of the reader.

The installation of EUT is identical for pre-characterization measurement in a 3 meters full anechoic chamber and for measures on a 3 meters Open site.
Mains: 230Vac/50Hz

3.2. TEST SEQUENCE AND RESULTS

3.2.1. Pre-characterization at 3 meters [9kHz-30MHz]

A pre-scan of all the setup has been performed in a 3 meters full anechoic chamber.
The distance between EUT and antenna is 3 meters. Pre-characterization is performed in vertical (V) polarization and the loop antenna position was rotated during the test for maximized the emission measurement.
Frequency band investigated is 9kHz to 30MHz. (No frequency observed between 9kHz to 150KHz)
The pre-characterization graphs are obtained in PEAK detection.

See graphs examples:

USB mode:	graph **m#1**	(see page 11/25)
RS232 mode:	graph **m#2**	(see page 12/25)

3.2.2. Pre-characterization at 3 meters [30MHz-1GHz]

A pre-scan of all the setup has been performed in a 3 meters full anechoic chamber.
The distance between EUT and antenna is 3 meters. Test is performed in horizontal (H) and vertical (V) polarization with a log-periodic antenna Chase CBL6111A and on 4 faces of the EUT.

See graphs examples:

USB mode:	H polarization	graph **m#3**	(see page 13/25)
	V polarization	graph **m#4**	(see page 14/25)

RS232 mode:	H polarization	graph **m#5**	(see page 15/25)
	V polarization	graph **m#6**	(see page 16/25)

3.2.3. Characterization on 10 meters open site below 30 MHz

The product has been tested according to ANSI C63.4(2003), FCC part 15 subpart C. Radiated Emission were measured on an open area test site. A description of the facility is on file with the FCC.

The product has been tested at a distance of **10 meters** from the antenna and compared to the FCC part 15 subpart C §15.225 limits in the frequency range 13.553MHz 13.567MHz. Measurement bandwidth was 9kHz.
Antenna height was 1m for both horizontal and vertical polarization.
Antenna was rotated around its vertical axis.
Continuous linear turntable azimuth search was performed with 360 degrees range.
No other frequency than the carrier at 13.56MHz was found and measured on the 10 meters open site.
Equipment was moved (3 axis measurement) to position that maximized emission. A summary of the worst case emissions found in all test configurations and modes is shown on clauses 3.2.1.

Frequency (MHz)	QPeak Limit (dBµV/m) @ 30m	QPeak (dBµV/m)	QPeak-Lmt (Margin dB)	Turntable Angle (deg)	Ant. Pol./ Angle (deg)	Tot Corr (dB)
13.56*[1]	84.0	47.8*[2]	-36.2	270°	V / 90°	35.3

*[1]: Fundamental – 15.225 limits. Measure have been done at 10m distance and corrected according to requirements of 15.209.e) (M@30m = M@10m-19.1dB)
*[2]: Q-Peak measurement, worst case for USB or RS232 mode (Found with RS232 cable)

Limits Subclause §15.225

Frequency (MHz)	Field strength (µV/m)	Measurement distance (m)
13.553-13.567	15 848 84 dBµV/m	30
13.410-13.553 13.567-13.710	334 50.5 dBµV/m	30
13.110-13.410 13.710-14.010	106 40.5 dBµV/m	30

3.2.4. Characterization on 3 meters open site from 30MHz to 1GHz

The product has been tested according to ANSI C63.4(2003), FCC part 15 subpart C. Radiated Emission were measured on an open area test site. A description of the facility is on file with the FCC.

The product has been tested at a distance of **3 meters** from the antenna and compared to the FCC part 15 subpart C §15.209 limits. Measurement bandwidth was 120kHz from 30 MHz to 1GHz.
Antenna height search was performed from 1m to 4m for both horizontal and vertical polarization. Continuous linear turntable azimuth search was performed with 360 degrees range.
Equipment was moved (3 axis measurement) to position that maximized emission. A summary of the worst case emissions found in all test configurations and modes is shown on clause 3.2.2.

Results for USB mode:

No	Frequency (MHz)	QPeak Limit (dBµV/m)	Qpeak (dBµV/m)	Qpeak-Limit (Margin, dB)	Angle (deg)	Pol	Hgt (cm)	Tot Corr (dB)	Comments
1	40.671	40.0	36.9	**-3.1**	185	V	100	11.1	
2	135.604	43.5	37.6	**-5.9**	260	H	230	14.7	
3	149.151	43.5	34.7	**-8.8**	50	V	100	14.8	
4	162.742	43.5	39.1	**-4.4**	295	V	100	17.3	
5	176.302	43.5	31.1	**-12.4**	325	V	100	17.9	
6	189.862	43.5	37.5	**-6.0**	185	H	100	18.9	
7	203.391	43.5	38.3	**-5.2**	180	V	100	15.8	
8	216.981	46.0	40.6	**-5.4**	300	V	100	15.6	
9	244.093	46.0	38.6	**-7.4**	320	V	100	15.3	
10	298.316	46.0	27.1	**-18.9**	335	V	100	17.7	

Results for RS232 mode:

No	Frequency (MHz)	QPeak Limit (dBµV/m)	Qpeak (dBµV/m)	Qpeak-Limit (Margin, dB)	Angle (deg)	Pol	Hgt (cm)	Tot Corr (dB)	Comments
1	40.687	40.0	32.1	**-7.9**	320	V	100	11.1	
2	135.604	43.5	37.6	**-5.9**	205	V	100	14.7	
3	149.171	43.5	29.4	**-14.1**	285	V	100	14.8	
4	162.730	43.5	35.7	**-7.8**	210	H	190	17.3	
5	176.289	43.5	39.9	**-3.6**	205	V	100	17.9	
6	189.852	43.5	38.0	**-5.5**	105	H	160	18.9	
7	203.408	43.5	37.6	**-5.9**	70	H	140	15.8	
8	216.980	46.0	38.4	**-7.6**	155	V	100	15.6	
9	230.537	46.0	35.2	**-10.8**	160	V	100	15.5	
10	244.106	46.0	37.8	**-8.2**	155	V	100	15.3	

RESULTS : PASS

3.3. Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follow :

FS = RA + AF + CF – AG

Where FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Factor
AG = Amplifier Gain

Assume a receiver reading of 52.5dBµV is obtained. The antenna factor of 7.4 and a cable factor of 1.1 is added. The amplifier gain of 29dB is subtracted, giving a field strength of 32 dBµV/m.
FS = 52.5 + 7.4 + 1.1 – 29 = 32 dBµV/m
The 32 dBµV/m value can be mathematically converted to its corresponding level in µV/m.
Level in µV/m = Common Antilogarithm [(32dBµV/m)/20] = 39.8 µV/m.

4. CONDUCTED EMISSION DATA

The product has been tested according to ANSI C63.4-(2003) and FCC Part 15 subpart C.

The product has been tested with 110V/60Hz power line voltage and compared to the FCC Part 15 subpart C §15.207 limits. Measurement bandwidth was 9kHz from 150 kHz to 30 MHz.

Measurement was initially made with an HP-8591EM Spectrum Analyzer in peak mode. This was followed by a Quasi-Peak, i.e. CISPR measurement with the Rohde & Schwarz ESH3 receiver for any strong signal. If the average limit is met when using a Quasi-Peak detector, the EUT shall be deemed to meet both limits and measurement with the average detector is unnecessary. The LISN (measure) is 50Ω / 50µH.

The Peak data are shown on the following plots. Quasi-Peak and Average measurements are detailed in a table with frequencies and levels measured.

Interconnecting cables and equipment's were moved to position that maximized emission. A summary of the worst case emissions found in all test configurations and modes is shown on the following page.

4.1. TEST SETUP

The EUT is placed on a table at 0.8m height. The cable of the power adapter has been shorted to 1meter length. The EUT is powered trough the LISN (measure). The peripheral equipment (monitor) is connected to a separate LISN.

USB mode: the EUT is connected to the PC with the USB cable. EUT is powered from the 5V of the USB port. The PC is connected to the LISM (Measure);

RS232 mode: the EUT is connected to the PC with the RS232 cable. EUT is powered from the 5V of the power adapter. The power adapter is connected to the LISM (Measure).

4.2. TEST SEQUENCE AND RESULTS

Measurements are performed on the phase (L1) and neutral (N) of power lines of the PC (110Vac/60Hz) or power adapter.
A measurement is also performed with a 50Ω dummy load replacing the transmitter antenna in order to demonstrate that some 13.56MHz may be cross-coupled to AC line connection.

Graphs are obtained in PEAK detection.
Measures are also performed in Quasi-Peak and Average for any strong signal.

USB mode (EUT powered by PC)

Measure on L1:	graph c#1	(see page 17/25)
Measure on N:	graph c#2	(see page 18/25)

RS232 mode (EUT powered by power adapter FRIWO FW7650/05)

Measure on L1:	graph c#3	(see page 19/25)
Measure on N:	graph c#4	(see page 20/25)

Dummy load (50Ω) (EUT powered by PC)

Measure on L1:	graph c#5	(see page 21/25)
Measure on N:	graph c#6	(see page 22/25)

5. FUNDAMENTAL FREQUENCY TOLERANCE (15.225E)

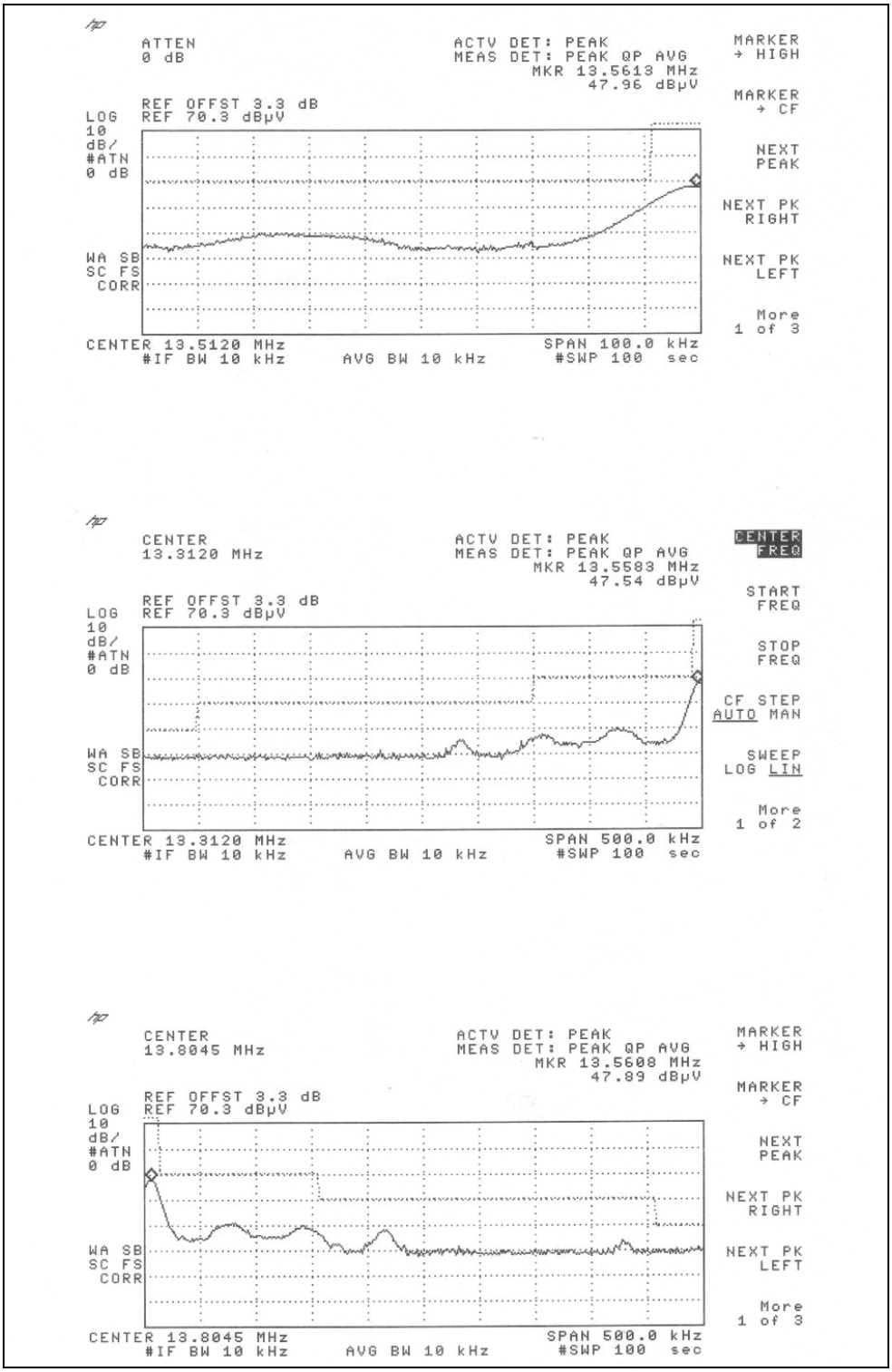
The frequency tolerance of the carrier signal shall be maintained within +/-0.01% of the operating frequency when the temperature is varied from -20℃ to +50℃ and prima ry voltage is varied from 85% to 115% of the rated supply voltage.

5.1. Temperature and voltage fluctuation

Temperature has been set at +20℃, –20℃ and +50℃.
Mains voltage is 110V/60Hz, 93.5V or 126.5V
Frequency of carrier: 13.56 MHz
Upper limit: 13.561356 MHz
Lower limit: 13.558644 MHz
Equipment's configuration: RS232 mode (EUT is powered by power adapter)

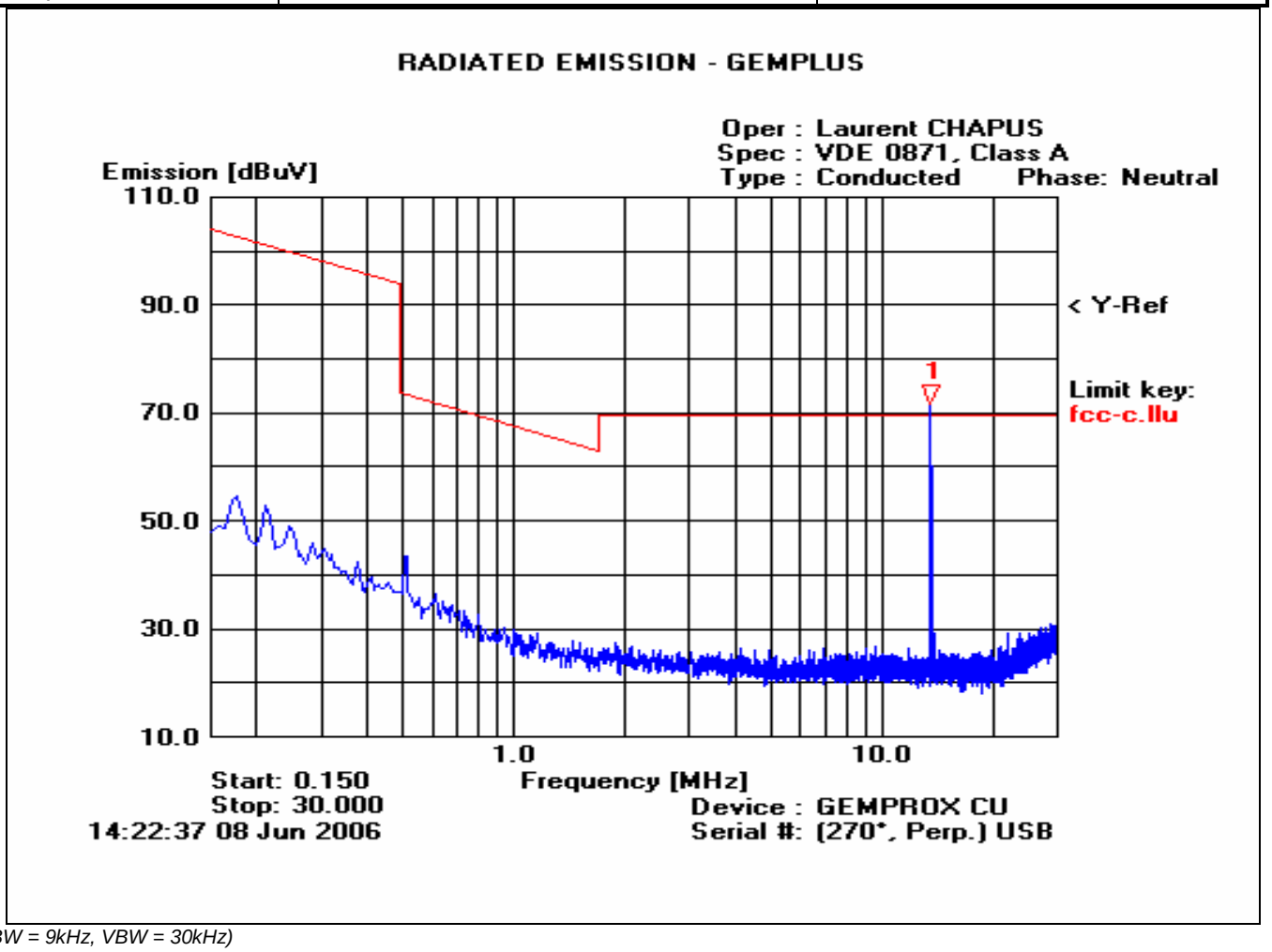
Temperature	**-20℃**	**20℃**	**+50℃**
Power voltage: 110V Frequency (MHz) Carrier level	 13.559838 +1.3dBc	 13.559963 REF	 13.559988 -0.7dBc
Power voltage: 93.5V Frequency (MHz) Carrier level	 13.559838 +1.1dBc	 13.559963 -0.2dBc	 13.559988 -0.8dBc
Power voltage: 126.5V Frequency (MHz) Carrier level	 13.559838 +2.1dBc	 13.559963 +0.7dBc	 13.559988 +0.2dBc
Result	Pass	-	Pass

6. BAND-EDGE COMPLIANCE §15.209



RBW = 10kHz, VBW = 10kHz (Peak measurement)

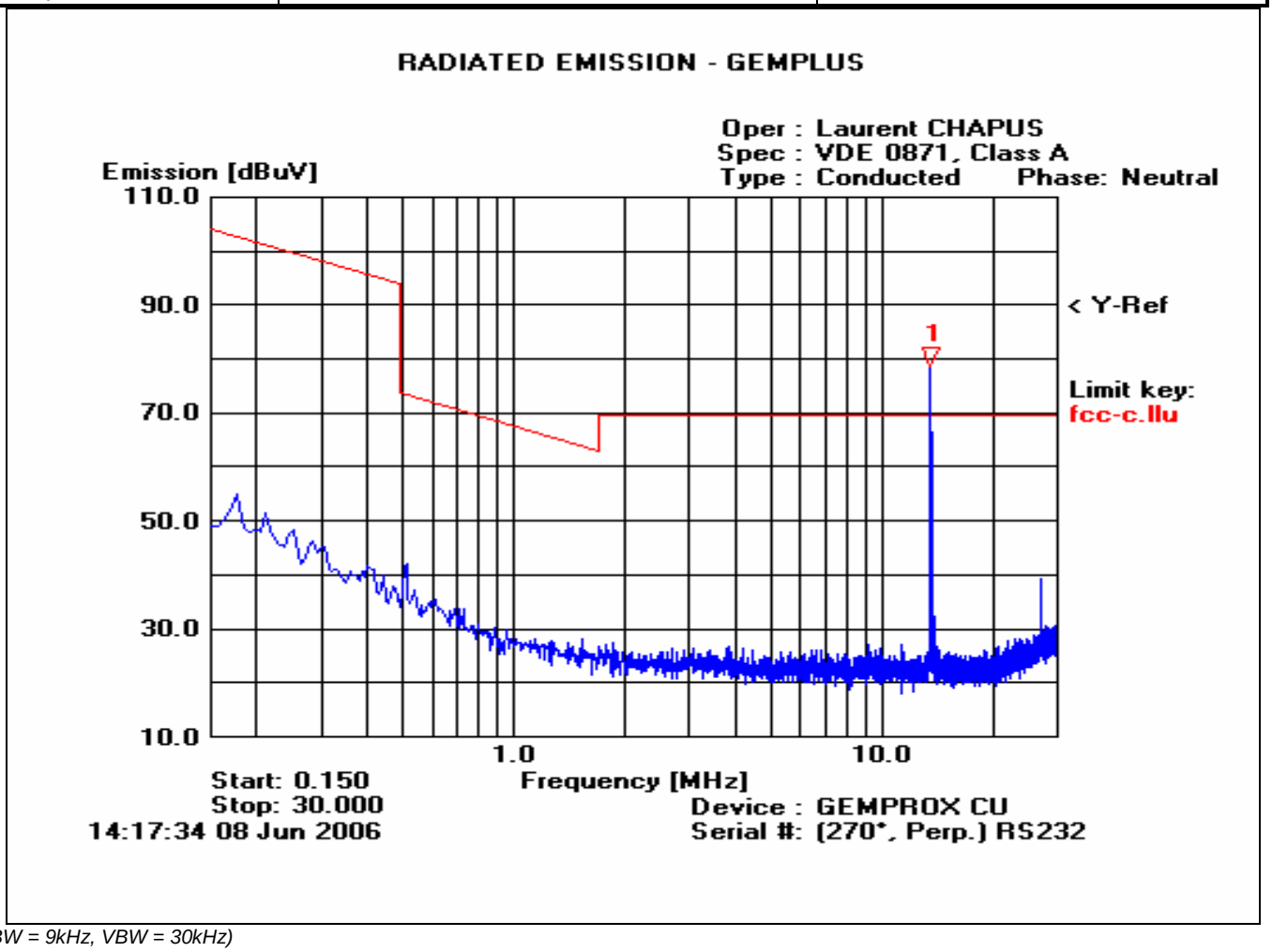
RADIATED EMISSION		**Test configuration:**
Graph name:	**m#1**	**USB mode**
Antenna position:	**Perpendicular**	
Azimuth:	**270°**	
Freq Band:	**150kHz-30MHz**	



(RBW = 9kHz, VBW = 30kHz)

Marker	Freq. [MHz]	Peak [dBuV]	Q-Peak [dBuV]	Average [dBuV]	Limit [dBuV]
1	13.58	71.78 *	-	-	69.50 (Carrier frequency)

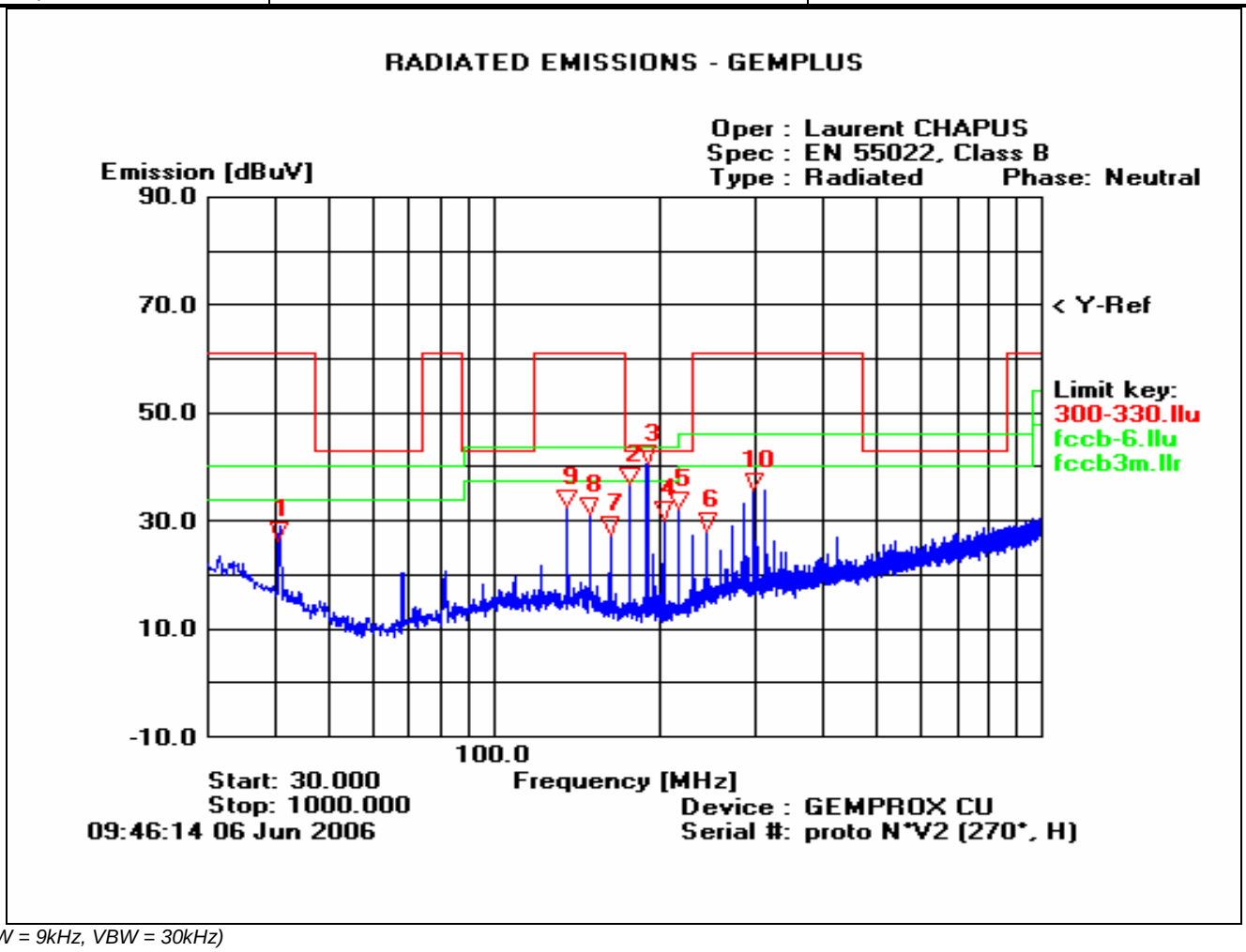
RADIATED EMISSION		**Test configuration:**
Graph name:	**m#2**	**USB mode**
Antenna position:	**Perpendicular**	
Azimuth:	**270°**	
Freq Band:	**150kHz-30MHz**	



(RBW = 9kHz, VBW = 30kHz)

Marker	Freq. [MHz]	Peak [dBuV]	Q-Peak [dBuV]	Average [dBuV]	Limit [dBuV]	
1	13.58	78.68 *	-	-	69.50	(Carrier frequency)

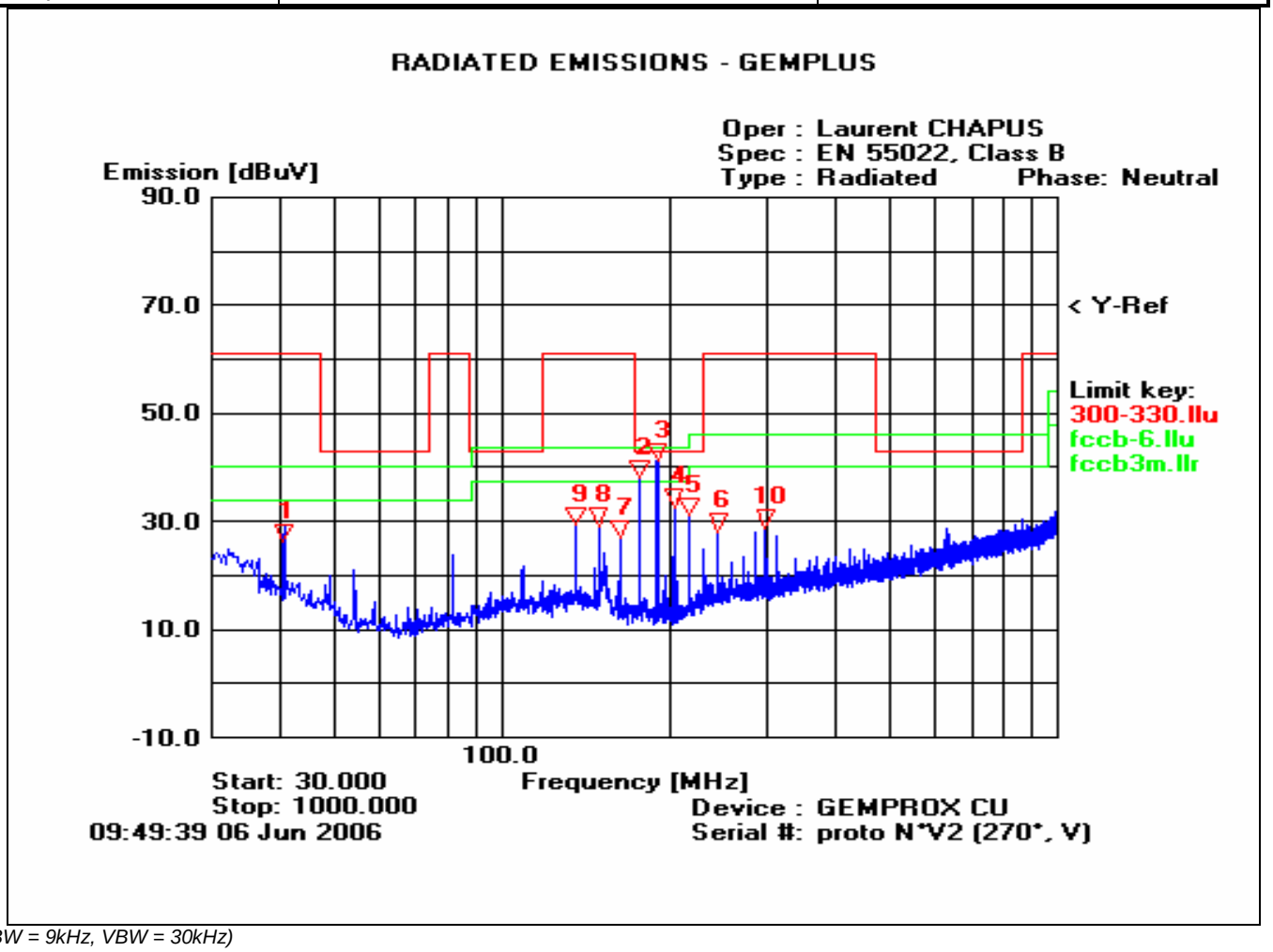
RADIATED EMISSION		**Test configuration:**
Graph name:	**m#3**	**USB mode**
Antenna position:	**Horizontal**	
Azimuth:	**270°**	
Freq Band:	**30MHz-1GHz**	



(RBW = 9kHz, VBW = 30kHz)

Marker	Freq. [MHz]	Peak [dBuV]	Q-Peak [dBuV]	Average [dBuV]	Limit [dBuV]
1	40.36	26.33	-	-	61.00
2	176.6	36.68	-	-	43.00
3	190.3	40.57	-	-	43.00
4	203.7	30.25	-	-	43.00
5	216.9	32.18	-	-	43.00
6	244.3	28.17	-	-	61.00
7	162.9	27.38	-	-	61.00
8	149.3	31.09	-	-	61.00
9	135.6	32.38	-	-	61.00
10	298.1	35.65	-	-	61.00

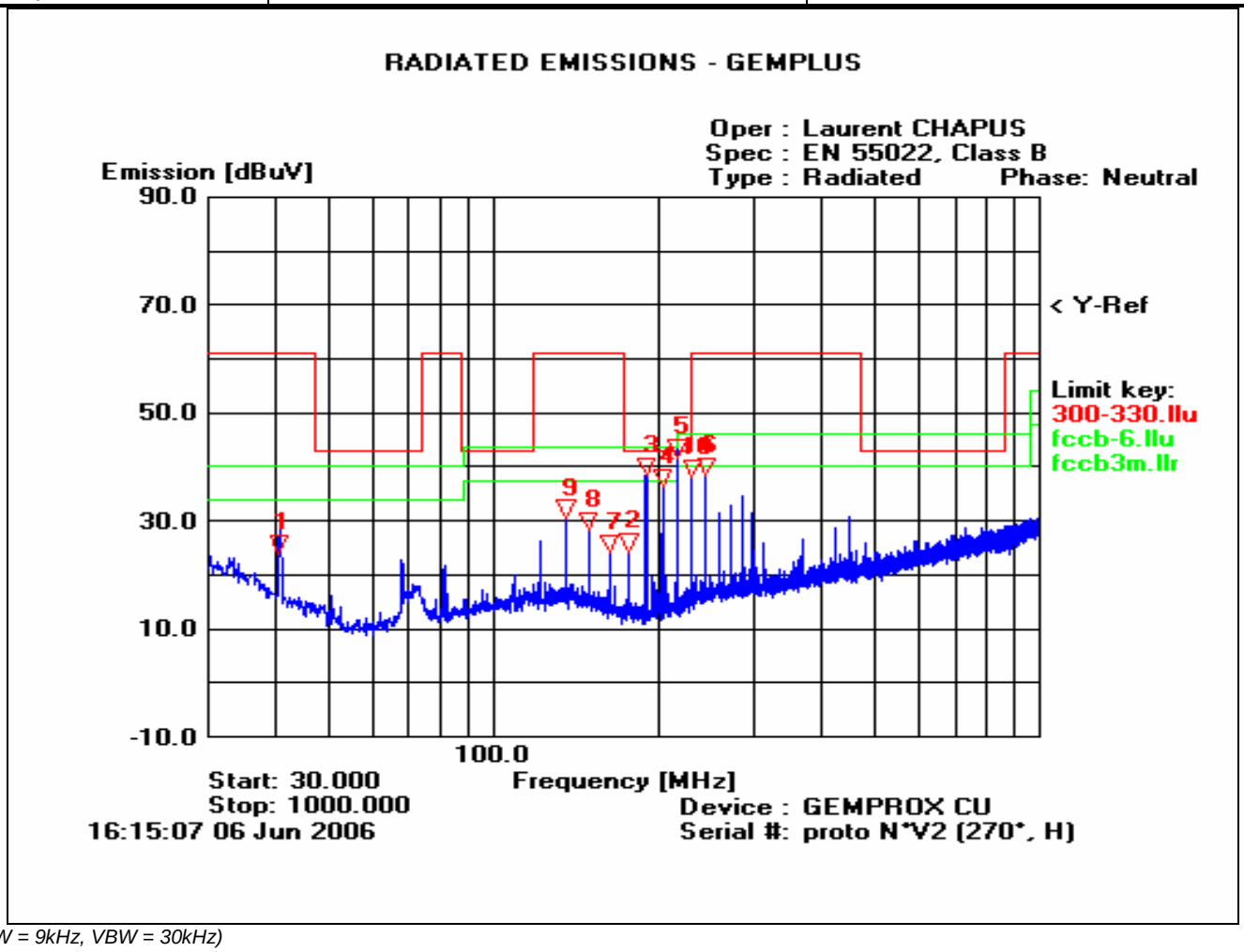
RADIATED EMISSION		**Test configuration:**
Graph name:	**m#4**	**USB mode**
Antenna position:	**vertical**	
Azimuth:	**270°**	
Freq Band:	**30MHz-1GHz**	



(RBW = 9kHz, VBW = 30kHz)

Marker	Freq. [MHz]	Peak [dBuV]	Q-Peak [dBuV]	Average [dBuV]	Limit [dBuV]
1	40.36	26.21	-	-	61.00
2	176.6	37.95	-	-	43.00
3	190.3	41.05	-	-	43.00
4	203.7	32.61	-	-	43.00
5	216.9	30.97	-	-	43.00
6	244.3	28.15	-	-	61.00
7	162.9	26.93	-	-	61.00
8	149.3	29.10	-	-	61.00
9	135.6	29.38	-	-	61.00
10	298.1	28.83	-	-	61.00

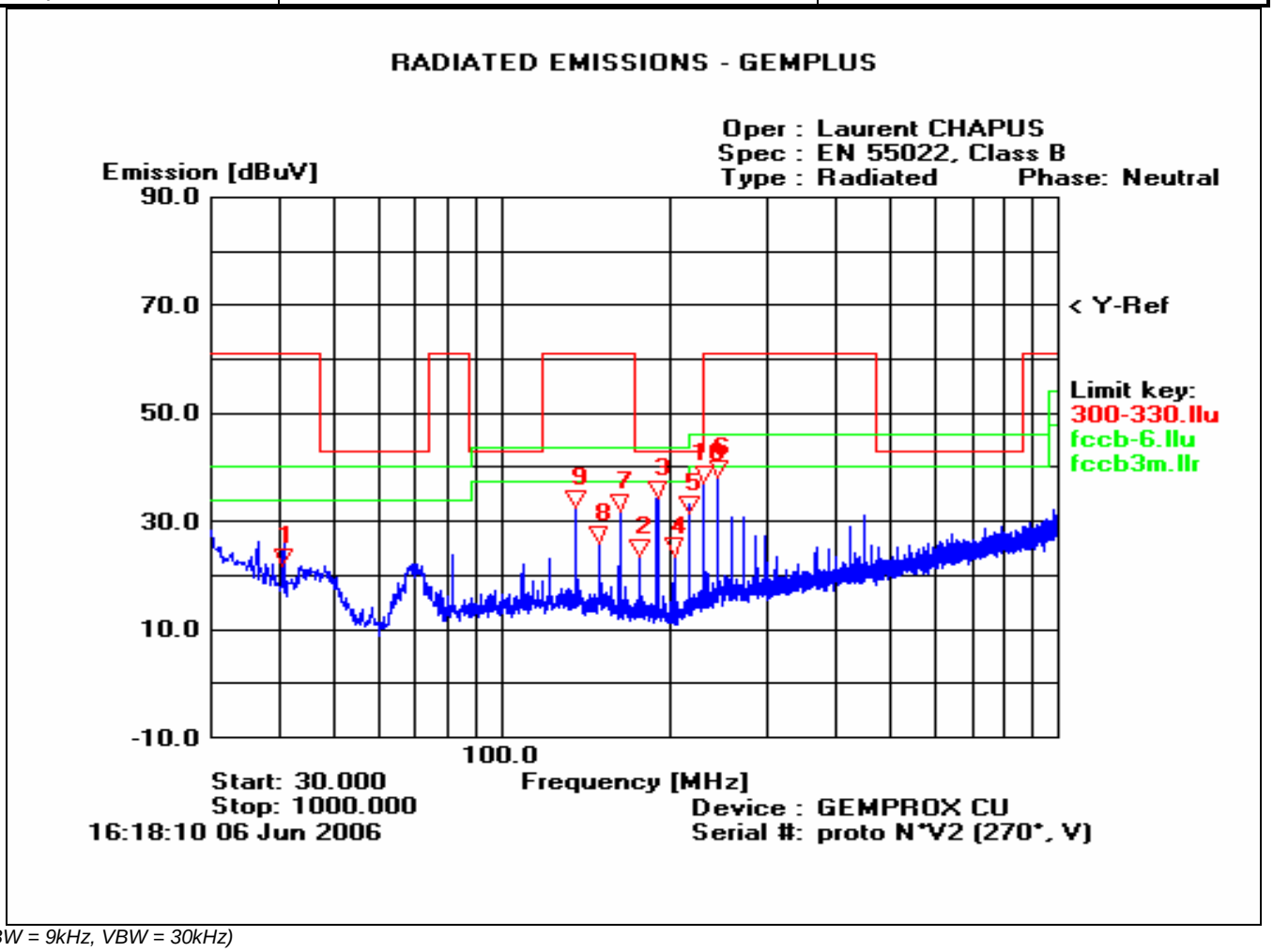
RADIATED EMISSION		**Test configuration:**
Graph name:	**m#5**	**RS232 mode**
Antenna position:	**Horizontal**	
Azimuth:	**270°**	
Freq Band:	**30MHz-1GHz**	



(RBW = 9kHz, VBW = 30kHz)

Marker	Freq. [MHz]	Peak [dBuV]	Q-Peak [dBuV]	Average [dBuV]	Limit [dBuV]
1	40.36	23.91	-	-	61.00
2	176.6	24.33	-	-	43.00
3	190.3	38.27	-	-	43.00
4	203.7	36.35	-	-	43.00
5	216.9	41.65	-	-	43.00
6	244.3	38.35	-	-	61.00
7	162.9	24.05	-	-	61.00
8	149.3	28.26	-	-	61.00
9	135.6	30.48	-	-	61.00
10	230.6	38.01	-	-	61.00

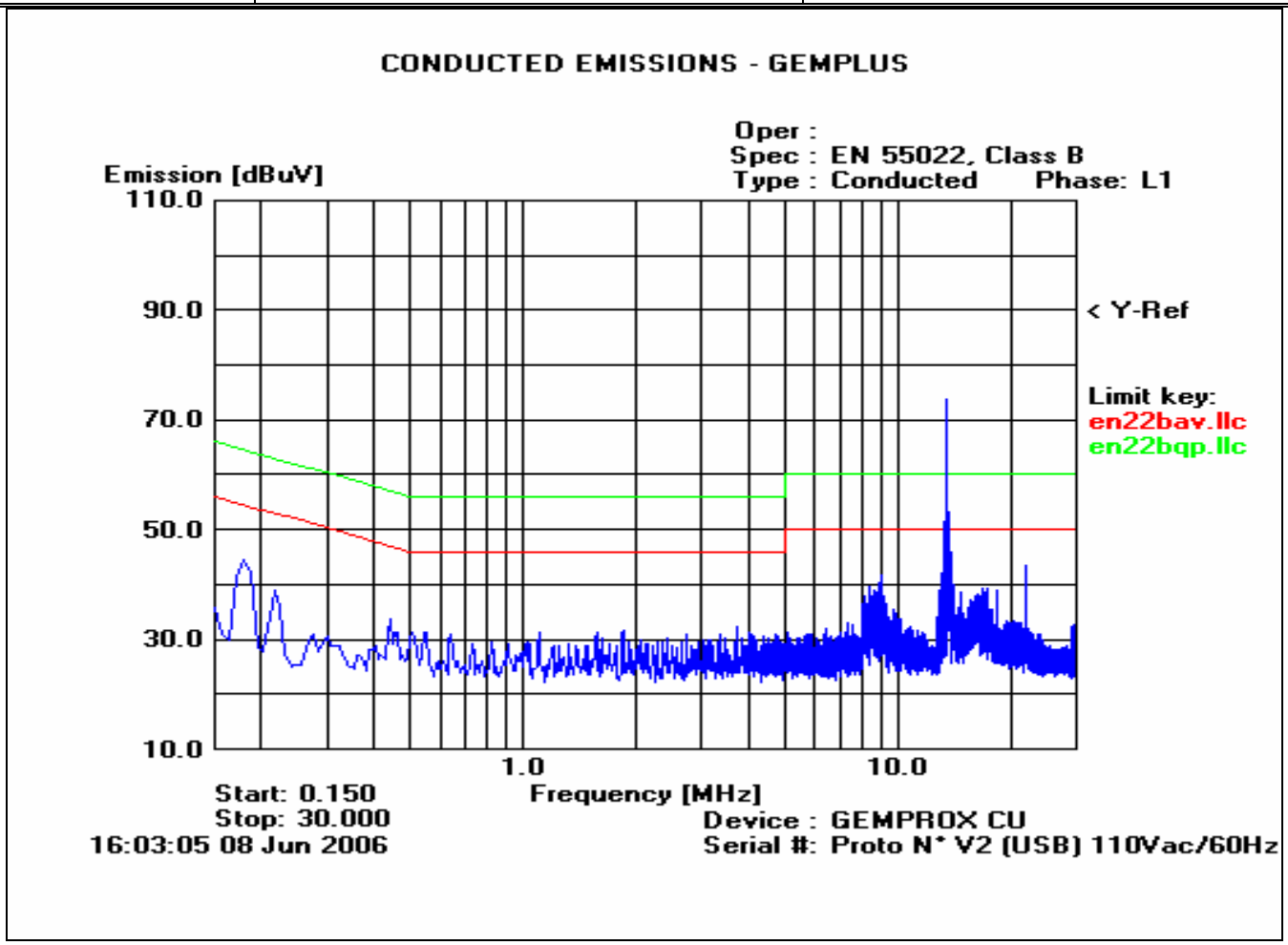
RADIATED EMISSION		**Test configuration:**
Graph name:	**m#6**	**RS232 mode**
Antenna position:	**vertical**	
Azimuth:	**270°**	
Freq Band:	**30MHz-1GHz**	



(RBW = 9kHz, VBW = 30kHz)

Marker	Freq. [MHz]	Peak [dBuV]	Q-Peak [dBuV]	Average [dBuV]	Limit [dBuV]
1	40.36	21.70	-	-	61.00
2	176.6	23.43	-	-	43.00
3	190.3	34.14	-	-	43.00
4	203.7	23.52	-	-	43.00
5	216.9	31.43	-	-	43.00
6	244.3	38.12	-	-	61.00
7	162.9	31.68	-	-	61.00
8	149.3	25.90	-	-	61.00
9	135.6	32.40	-	-	61.00
10	230.6	36.95	-	-	61.00

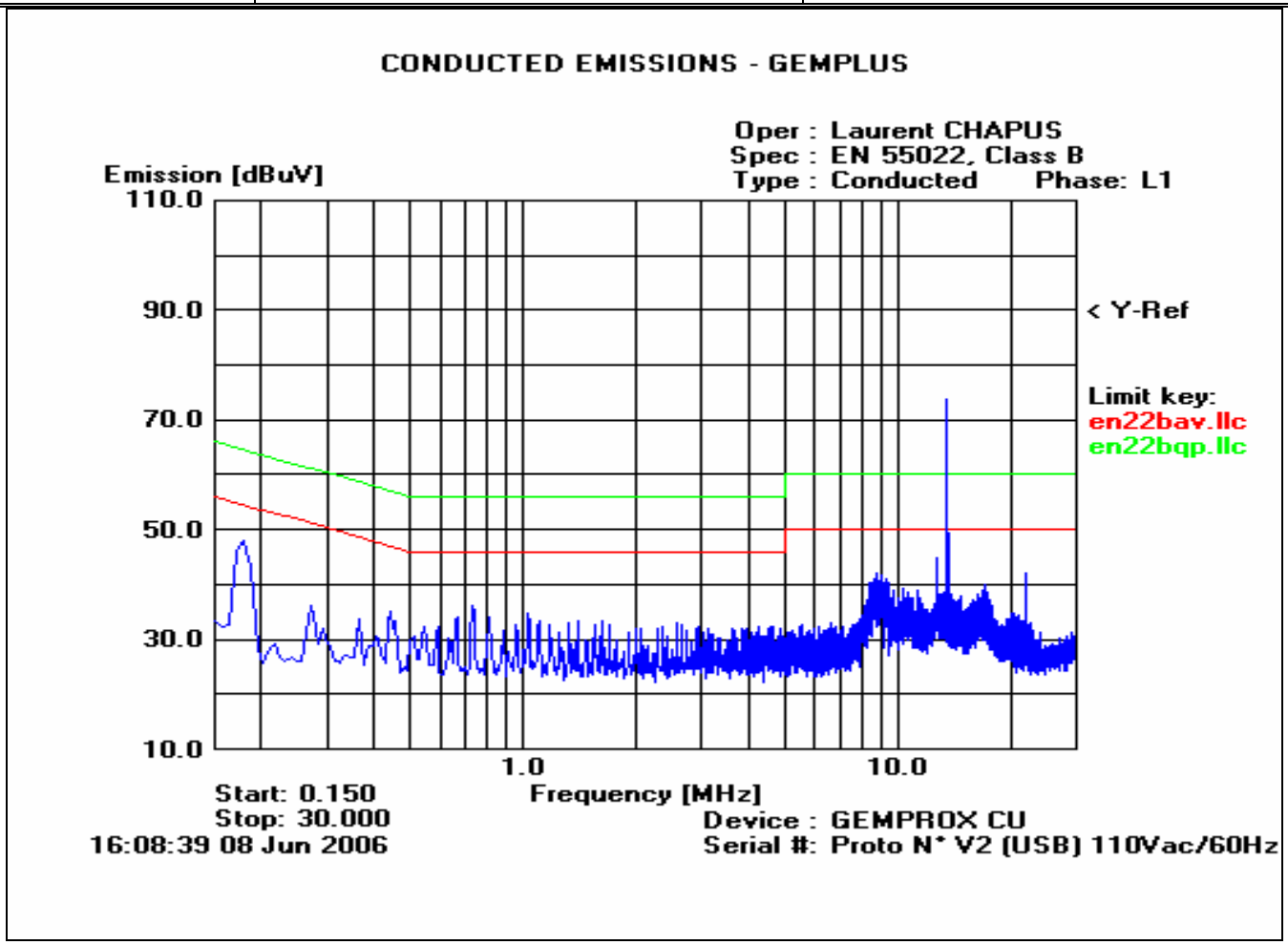
CONDUCTED EMISSION		**Test configuration:**
Graph name:	**c#1**	**USB Mode**
Voltage/Frequency:	**110V/60Hz**	
Phase	**L1**	



(RBW = 9kHz, VBW = 30kHz)

Marker	Freq. [MHz]	Peak [dBuV]	Q-Peak [dBuV]	Average [dBuV]	Limit [dBuV]	
1	13.57	73.75 *	73.67 *	73.63 *	50.00	(Carrier frequency)
2	0.180	44.38	43.33	42.62	54.00	
3	0.220	38.92	37.69	36.74	52.00	

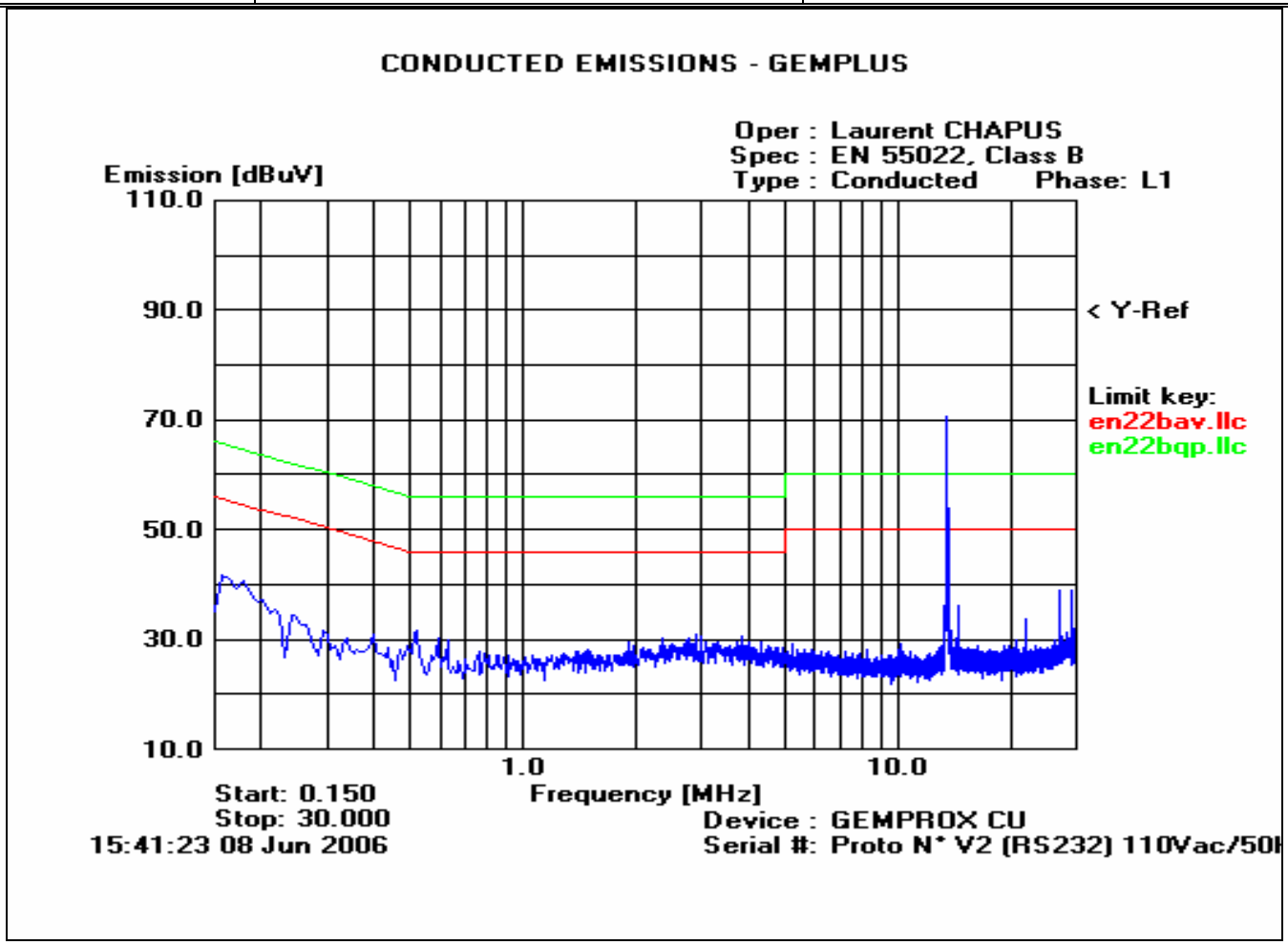
CONDUCTED EMISSION		**Test configuration:**
Graph name:	**c#2**	**USB Mode**
Voltage/Frequency:	**110V/60Hz**	
Phase	**N**	



(RBW = 9kHz, VBW = 30kHz)

Marker	Freq. [MHz]	Peak [dBuV]	Q-Peak [dBuV]	Average [dBuV]	Limit [dBuV]	
1	13.57	73.75 *	73.65 *	73.54 *	50.00	(Carrier frequency)
2	0.180	48.23	47.30	46.66	54.00	

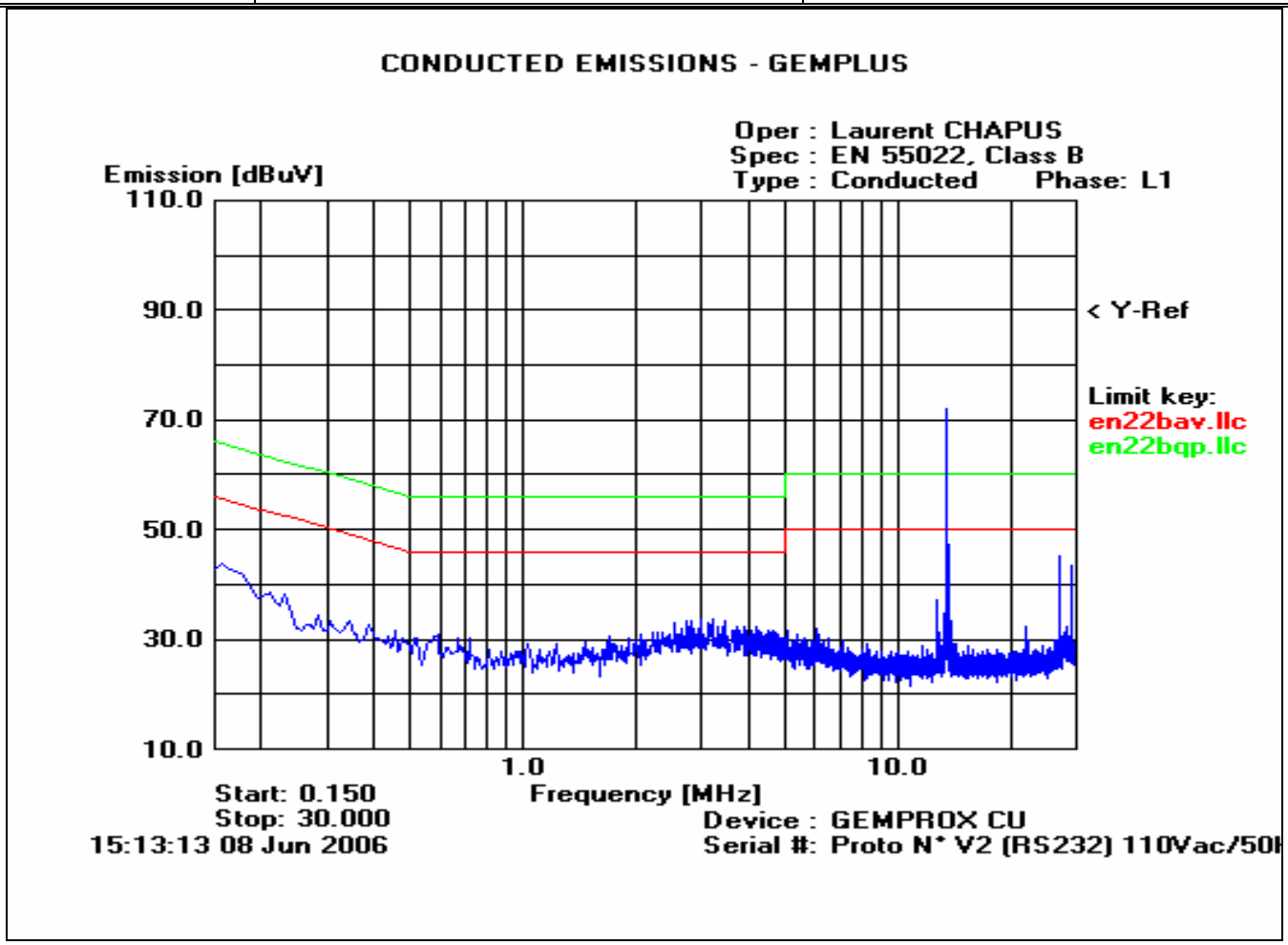
CONDUCTED EMISSION		**Test configuration:**
Graph name:	**c#3**	**RS232 mode**
Voltage/Frequency:	**110V/60Hz**	
Phase	**L1**	



(RBW = 9kHz, VBW = 30kHz)

Marker	Freq. [MHz]	Peak [dBuV]	Q-Peak [dBuV]	Average [dBuV]	Limit [dBuV]	
1	13.57	70.36 *	-	-	50.00	(Carrier frequency)
2	29.28	36.92	-	-	50.00	
3	27.12	38.98	-	-	50.00	

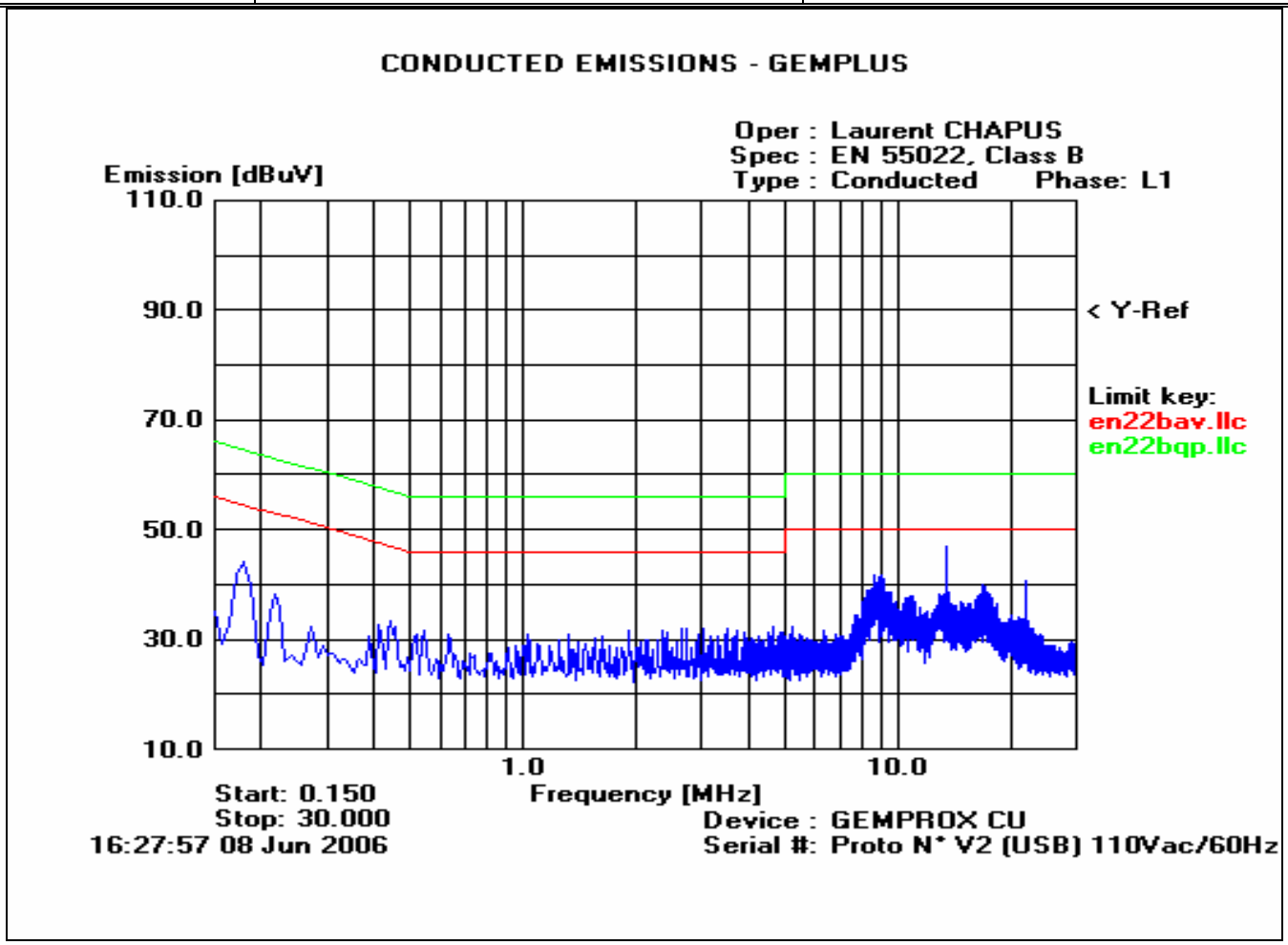
CONDUCTED EMISSION		**Test configuration:**
Graph name:	**c#4**	**RS232 mode**
Voltage/Frequency:	**110V/60Hz**	
Phase	**N**	



(RBW = 9kHz, VBW = 30kHz)

Marker	Freq. [MHz]	Peak [dBuV]	Q-Peak [dBuV]	Average [dBuV]	Limit [dBuV]	
1	13.57	72.65 *	71.82 *	67.69 *	50.00	(Carrier frequency)
2	29.28	35.17	-	-	50.00	
3	27.12	45.32	-	-	50.00	

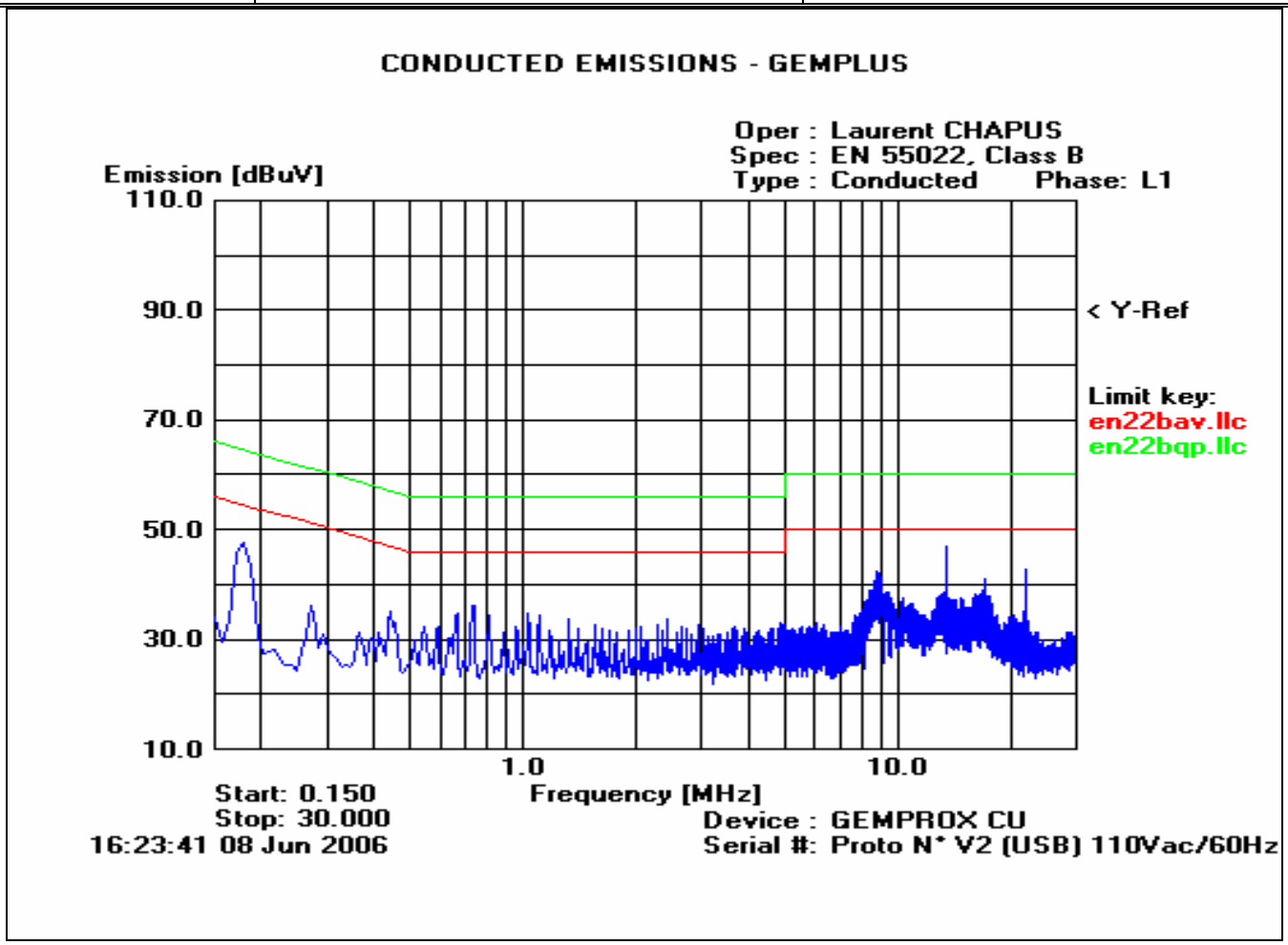
CONDUCTED EMISSION		**Test configuration:**
Graph name:	**c#5**	**Dummy load (50Ω) replacing the antenna**
Voltage/Frequency:	**110V/60Hz**	
Phase	**L1**	



(RBW = 9kHz, VBW = 30kHz)

Marker	Freq. [MHz]	Peak [dBuV]	Q-Peak [dBuV]	Average [dBuV]	Limit [dBuV]
1	13.57	47.17	45.43	44.47	50.00
2	0.180	44.50	43.54	42.73	54.00
3	21.97	42.64	37.69	24.13	50.00

CONDUCTED EMISSION		**Test configuration:**
Graph name:	**c#6**	**Dummy load (50Ω) replacing the antenna**
Voltage/Frequency:	**110V/60Hz**	
Phase	**N**	



(RBW = 9kHz, VBW = 30kHz)

Marker	Freq. [MHz]	Peak [dBuV]	Q-Peak [dBuV]	Average [dBuV]	Limit [dBuV]
1	13.57	47.44	45.55	44.83	50.00
2	0.180	48.07	47.28	46.54	54.00
3	21.97	42.71	-	-	50.00

LISTE DE MATERIEL / *LIST OF EQUIPMENT*

	N°LCIE	GENRE	MARQUE	TYPE	SERIE
	A1481006VO	RF Voltmeter	BOOTON	9200C	339301AA
	A1240169VO	Multimeter	WAVETEK	DM15XL	40417876
	C2320056VO	Coupling Decoupling Network	FCC	FCC 801 M1 25	28
	C2320057VO	Coupling Decoupling Network	FCC	FCC 801 M2 25	38
	C2320058VO	Coupling Decoupling Network	FCC	FCC 801 M3 25	96
	A4083040VO	Oscilloscope 100 MHz 500Ms/s	TEKTRONIX	TDS30-25	H712103
EMC	A2640011VO	Measurement receiver 9kHz–30MHz	ROHDE ET SCHWARZ	ESH3	972079/117
EMC	A4049061VO	Transient limiter	HEWLETT PACKARD	11947A	3107A01596
EMR	A7102019VO	Amplifier 9 KHz – 1300 MHz	HEWLETT PACKARD	8447F Opt 64	3113A06394
EMC	A3169049VO	Conducted emission comb generator	BARDET		CGPR12
	A2320059VO	LISN	EMCO	3810/2SH	9511/1182
EMR	A3169050VO	Radiated emission comb generator	BARDET		PR17B
EMR	A4060016VO	Spectrum analyzer 9kHz –1.8MHz	HEWLETT PACKARD	8591E	3536A00384
EMR	C2040051VO	Bi-log antenna	CHASE	CBL6111A	1628
	A5160028VO	Burst generator	SCHAFFNER	NSG2025-1	1109
	C1127003VO	Surge generator	SCHAFFNER	NSG650	269
	A2249072VO	Coupling clamp	SCHAFFNER	CDN 126	194
	A7130044VO	Surge Coupler	SCHAFFNER	CDN 110	294
	C2320060VO	Surge coupling network	SCHAFFNER	CDN116	166
	A2249019VO	Field probe 30-1000 MHz	HEWLETT PACKARD	11940A	2650A05962
	A2249023VO	Field probe 9kHz – 30 MHz	HEWLETT PACKARD	11941A	2807A04302
	A5322008VO	Pistol DES 15 KV	SCHAFFNER	NSG 435	1354
	A5322009VO	Pistol DES 25 KV	SCHAFFNER	NSG 432	1226
FST	A2120003VO	Harmonic/Flickermeter (Power supply)	HEWLETT PACKARD	6842A	3531A00109
	A7156005VO	Adaptor 50-150 ohms	FCC	FCC-150-50	378
	A7156006VO	Adaptor 50-150 ohms	FCC	FCC-150-50	379
	B2163022VO	Frequency generator	MARCONI	2023	112158027
	A2249021VO	Field probe	HOLADAY	HI-4422	90264
	A7102020VO	Amplifier 0.01-1000 MHz	KALMUS	757LC	122297-7
	A7132005VO	Coupler bi-directional 40 dB	KALMUS	DC100RHH	7330A-1
	A7122008VO	Attenuator 6 dB	BIRD	8343-060	2038
	B4204052VO	Thermo-hygrometer	HUGER		
EMR	D3044009VO	Anechoic chamber	EUROSHIELD	RDF-F-60-060	1213
EMC	D3044010VO	Faraday Cage	RAY PROOF		4854
	A5329032VO	Absorption clamp	LUTHI	MDS21	2826
	A5329033VO	Injection EM clamp	LUTHI	EM101	35430
	A5329042VO	Ferrite Tube	LUTHI	FTC 101	4485
	A5322010VO	Test station ESD			
	A5329043VO	Shielded cable « IMR&EMR »	AIRCOM		
	A7122009VO	Attenuator 10 dB	HEWLETT PACKARD	8491A	2708A53166
	A5329034VO	Shielded cable injection IMC			
	A5329035VO	Shielded cable calibration IMC	AIRCOM		
	A5329036VO	Direct Injection Module 100 Ohms		MID01-100 ohms	
EMR	C2040050VO	Antenna biconic	EMCO	3104C	9401-4636
EMR	C2040056VO	Antenna log-periodic	EMCO	3146	2178
EMR	F2000286VO	Controller table	EMCO	1060-10	1217
EMR	F2000287VO	Controller antenna mast	EMCO	1050	8811-1295
	A4049059VO	Adaptor quasi-peak	HEWLETT PACKARD	HP85650	2811A01136
	A4060017VO	Spectrum analyzer	HEWLETT PACKARD	HP8568B	2732A04140
	A4060019VO	Spectrum analyzer display	HEWLETT PACKARD	HP85662A	2816A16561
	A4060027VO	RF pre-selector	HEWLETT PACKARD	HP85685A	2833A00773
EMR	F2000288VO	Antenna mast	EMCO	1050	
EMR	F2000289VO	Turntable	EMCO	1060	
EMR	C4040009VO	Air Compressor	ATLAS COPCO	LX111	0615-038
	C1207122VO	Dipole precision	SCHWARZBECK	VHAP	211
	C1207123VO	Dipole precision	SCHWARZBECK	UHAP	205
	C2040054VO	Antenna log-periodic	SCHWARZBECK	UHALP 9107	910
	C2040047VO	Antenna biconic	SCHWARZBECK	VHA 910	911
	C2040048VO	Antenna biconic	EMCO	3104	3767
	C2040049VO	Antenna biconic	EMCO	3110	1245
	C2040055VO	Antenna log-periodic	EMCO	3146A	9011-1151
EMC	C2320061VO	LISN	TELEMETER ELECTRONIC	NNB-2/16Z	98010

	N°LCIE	GENRE	MARQUE	TYPE	SERIE
	C2320062VO	LISN tri-phase ESH2-Z5	RHODE ET SCHWARZ	33852.19.53	841223/008
	C2320063VO	LISN tri-phase ESH2-Z5	RHODE ET SCHWARZ	33852.19.53	841223/007
FST	A1240170VO	Multimeter	FLUKE	87	75250745
	C2320064VO	Coupling Decoupling Network	EM TEST	CDN-M3	6219C
	C2320065VO	Coupling Decoupling Network	EM TEST	CDN-T8/RJ45	9011C
	C2040057VO	Antenna monopole	AH SYSTEM	SAS-551	181
	A1290017VO	Current probe	SCHAFFNER	CSP9160	1097
	C2320066VO	RSI 4 wires	RHODE ET SCHWARZ	ENY41	838119/023
	C2320067VO	RSI 2 x 2 wires	RHODE ET SCHWARZ	ENY22	836727/015
	A5329034VO	Current injection probe	SCHAFFNER	CIP8213	52
	C2042027VO	Antenna horn	EMCO	3115	6382
	A4060018VO	Spectrum Analyzer 9KHz – 26.5GHz	HEWLETT PACKARD	8593E	3409u00537
	A4024018VO	Oscilloscope 500 MHz	HEWLETT PACKARD	54542C	US36040602
	A5442021VO	Generator HF 100 KHz – 3200 MHz	HEWLETT PACKARD	8648C	3443U00509
	A4024019VO	Oscilloscope	HEWLETT PACKARD	54720A	0007426600
	A4089115VO	Active probe 2.5 GHz	HEWLETT PACKARD	54701A	3220A 00325
	A4089116VO	Active probe 2.5 GHz	HEWLETT PACKARD	54701A	3220A 00329
	C2040058VO	Close field probe 30 MHz – 1 GHz	HEWLETT PACKARD	HP11940A	
	C2040059VO	Close field probe 9 KHz – 30 MHz	HEWLETT PACKARD	HP11941A	
	A4069007VO	High frequency probe	HEWLETT PACKARD	85024A	280 1A 04205
	A5329044VO	Absorption clamp	RHODE ET SCHWARZ	85024A	194.0100.50
	A3169048VO	Field site source	EMCO	4610	9012-1161
	A7102022VO	Amplifier 0.5-1000 MHz	KALMUS	706FC	7359-1
	A7122010VO	Attenuator 70 dB	HEWLETT PACKARD	8495B	3308A17069
	A7122011VO	Attenuator 20 dB - 0.1 GHz	ROLS ESH	ESH 2Z11	349.7518.52
	A1290018VO	Current probe	HF STROMWANDLER	ESH2-Z1	872 545/24
	A2240015VO	Field probe	EMCO	7405	9301-2355
	A7132006VO	Coupler bi-directional	HEWLETT PACKARD	778D	1144A07705
	A7102023VO	Amplifier 2.5 GHz	MINI-CIRCUITS	ZFL-2500VH AS	
	A7102024VO	Amplifier 8 GHz	HEROTEK	A1080304A	222033
FST	D1022117VO	Climatic chamber	BIA CLIMATIC	CL 6-25	200 105 6
EMR	A5329045VO	Cable IMR&EMR (Anechoic chamber)	SMEE	KX13	
	A5329046VO	Cable EMR FCC	RADIALL	9542 gd câb. vert	
	A5329047VO	Cable EMR FCC	RADIALL	960603 pt câb. vert	
EMR	C2040052VO	Loop Antenna	ELECTRO-METRICS	EM-6879	690234
	C2040053VO	Loop Antenna	TELEC	CT2A	140
	A2322003VO	Leakage current tool	SMEE	61010A3&A4	
EMR	A5329048VO	Cable EMR OATS	SUCOFLEX	106G	553
	A1500016VO	Wattmeter RF	ANRITSU	ML1437A	03050003
	A7132007VO	Coupler bi-directional 20 dB	MCLI	C36-20	0D2LS 0148
	A5329038VO	Cable coaxial 3.5 m	SUHNER	SUCOFLEX 106	26732/6
	A2249024VO	Field E probe 5GHz	HOLADAY	HI-6005	107884
	A7102025VO	Amplifier 0.8-3GHz	PRANA	AP32 SV125A	0310-0573
EMR	A4049060VO	Adapter quasi-peak	HEWLETT PACKARD	HP85650A	2811A01134
EMR	A4060028VO	Spectrum analyzer display	HEWLETT PACKARD	HP85662A	2816A16603
EMR	A4060029VO	Spectrum analyzer	HEWLETT PACKARD	HP8568B	2732A04155
EMR	A4060030VO	Pre-selector RF	HEWLETT PACKARD	HP85685A	2837A00784
	C2042028VO	Antenna horn	SCHWARZBECK	BBHA 9170	BBHA9170232
	A7043036VO	Power supply DC 300W / 150V-6A	SODILEC	7SDLIN/GB AUTO 300	493711
	A5320017VO	BEST EMC	SCHAFFNER		200040-023SC
	A5322011VO	Pistol de DES	SCHAFFNER	BEST ESD	1033
	C2320073VO	Coupling clamp TRS	SCHAFFNER	CDN8014	074
	C2320068VO	Line impedance stabilization network	EMCO	3825/2	9309/2122
	C2320069VO	Coupling Decoupling Network	LUTHI	CDN L-801 M2	2076
	C2320070VO	Coupling Decoupling Network	LUTHI	CDN L-801 M2	2075
	A7102026VO	Amplifier	ALDETEC	ALS01452	001
	A5442022VO	Frequency generator 2GHz – 18GHz	HEWLETT PACKARD	8672A	2104A01703
	A7122013VO	Burst verification coupler	SCHAFFNER	INA 265 A	20935/1
	A7122014VO	Burst verification coupler	SCHAFFNER	INA 266	20935/2
	A5329040VO	Cable coaxial		RG58	
	A2249022VO	HV PROBE (E6N CVH1-100/1)	SCHAFFNER	MD200	037005
	A1092039VO	Amperemeter clamp	CHAUVIN ARNOUX	P01120040A	100044CAV
	A1091249VO	Shunt coaxial	LEM	ISM 5P/5	4502
	A5329041VO	Cable coaxial 45cm			
EMR	A7043037VO	Power supply DC 30V 10A	ELC	AL924	95/00600

	N°LCIE	GENRE	MARQUE	TYPE	SERIE
	A4089117VO	Voltage probe	SMEE		
	A7156004VO	Adaptation 100ohms	LUTHI	CR100A	221
	A1240171VO	Multimeter	FLUKE	189	89770115
	C2320071VO	Coupling Decoupling Network	LUTHI	L 801 M4 PE	2088
	A7122012VO	Attenuator	WEINSCHEL	48-40-43	BT2126
	A1092041VO	Electromagnetic Injection Clamp	LUTHI	EM101	35758
	A1092042VO	Ferrite tube	LUTHI	FTC101	4763

EMR: *Radiated emission*
EMC: Conducted emission
FST: Frequency stability

TABLE DES INCERTITUDES / *UNCERTAINTIES CHART*

Type de mesure / *Kind of measurement*	**Incertitude élargie laboratoire / *Wide uncertainty laboratory* (k=2) ±x(dB)**	**Incertitude limite du CISPR / *CISPR uncertainty limit* ±y(dB)**
Emission Rayonnée / *Radiated emission*		
Loop antenna (9kHz - 30MHz)	±4.70 dB	-
Double ridged waveguide horn antenna (1GHz - 18GHz)	±5.20 dB	-
Biconic antenna (30MHz - 200MHz) – Horizontal polarization	±4.46 dB	±5.2
Biconic antenna (30MHz - 200MHz) - Vertical polarization	±5.15 dB	±5.2
Log-périodic antenna (200MHz - 1GHz) - Horizontal polarization	±4.48 dB	±5.2
Log-périodic antenna (200MHz - 1GHz) - Vertical polarization	±5.04 dB	±5.2
Emission conduite RSIL / *Conducted emission LISN*		
Estimation of uncertainties for measurement from 150kHz to 30MHz	±3.40 dB	±3.6
Emission conduite RSI / *Conducted emission LIS*		
Estimation of uncertainties for measurement from 150kHz to 30MHz	±3.20 dB	±3.6
Emission conduite sonde de courant / *Conducted emission current probe*		
Estimation of uncertainties for measurement from 150kHz to 30MHz	±2.68 dB	±3.6

Les valeurs d'incertitudes calculées du laboratoire étant inférieures aux valeurs d'incertitudes limites établies par le CISPR, la conformité de l'échantillon est établie directement par les niveaux limites applicables. / *The uncertainty values calculated by the laboratory are lower than limit uncertainty values defined by the CISPR. The conformity of the sample is directly established by the applicable limits values.*