RC-01-40826/1/TC

E.M.C Test Report

According to the standard:
FCC PART 15 Edition 2002

Equipment under test:
TIA: TRANSPONDER INTERROGATOR
ANTENNA (ANBAL) TYPE 843630

Company:
SIEMENS TRANSPORTATION SYSTEMS

DISTRIBUTION: Mr. ESTIEVENART **(Company:** SIEMENS TRANSPORTATION SYSTEMS**)**

Number of pages: 18 + 2 annexes

Ed.	Date	Modified pages	Prepared By Name Signature	Reviewed By Name signature	Approved By Name signature
0	**25/06/02**	**Creation**	**T. COLARD**		

TEST CERTIFICATION FOR: FCC Certification

***NAME OF THE EQUIPMENT UNDER TEST*:** TIA: TRANSPONDER INTERROGATOR ANTENNA (ANBAL)

Type: 843630
Serial number: PNYL 003 (V2)

NAME OF THE MANUFACTURER: SIEMENS TRANSPORTATION SYSTEMS

ADDRESS OF THE COMPANY INTRODUCING THE EQUIPMENT:

Company: SIEMENS TRANSPORTATION SYSTEMS

Address: 48 à 56, rue Barbès
BP 531
92542 Montrouge Cedex
France

Person in charge: Mr. ESTIEVENART

Present person during the tests: Mr. N'GUYEN and Mr. ESTIEVENART

DATES OF TESTS: The 15th March, 15th April and 14th June 2002

TESTS LOCATION: EMITECH open area test site in Aunainville (28)

TESTS OPERATORS: T. COLARD / E. COEURET

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Annexes: *Customer's questionnaire.*
Antenna factors, insertion losses and amplifier values.

1. INTRODUCTION

This document submits the results of Electromagnetic Compatibility tests performed on the equipment "**TIA: TRANSPONDER INTERROGATOR ANTENNA (ANBAL) TYPE 843630**" here in referred to as the EUT, according to the document listed below.

2. REFERENCE DOCUMENT

FCC PART 15 Edition 2002

Code of Federal Regulations
Title 47- Telecommunication
Chapter 1- Federal Communication Commission
Part 15- Radio frequency devices
Subpart C- Intentional Radiators

3. EQUIPMENT UNDER TEST (EUT) CONFIGURATION

See photograph next page.

See customer's questionnaire in annex.

See antenna factors, insertion losses and amplifier values in annex.

Modification of the equipment during the tests: No

Photograph of the equipment under test (EUT)

4. SUMMARY OF TEST RESULTS

The following table summarizes test results of the EUT.

Designation of test	Test results				Comments
	Pass	Fail	N.A.	N.P.	
Intentional radiated emissions in the band 9 kHz – 0.49 MHz	✓				Section 15.209
Intentional radiated emissions in the band 1.705 MHz – 10 MHz	✓				Section 15.223
Unintentional radiated emissions in the band 9 kHz - 30 MHz	✓				Section 15.209
Unintentional radiated emissions in the band 30 MHz – 1 GHz	✓				Section 15.209
Conducted emissions on AC mains ports			✓		Section 15.207

N.A.: Not Applicable
N.P.: Not Performed

The tested sample "**TIA: TRANSPONDER INTERROGATOR ANTENNA (ANBAL) TYPE 843630**" complies with the requirements of the standard:

- FCC PART 15 Edition 2002

according to the limits specified in the present report.

5. INTENTIONAL RADIATED EMISSIONS IN THE BAND 9 KHZ – 0.49 MHZ

Standard: FCC PART 15 Edition 2002

Section: 15.209

Equipment under test arrangement

The equipment under test (EUT) is placed on a wooden table, at 0.8 m above the ground plane (turntable).
Antenna height is 1 m above the ground plane.
For each frequency corresponding to an emission, EUT carried out a rotation through 360° with the aid of the turntable, with the aim to find the maximum of signal.
The test antenna is oriented in two orientations (perpendicular or parallel). Only the highest level is recorded.

Test configuration photographs:

The equipment was studied to work below a train, so we simulate the train in placing a large plan of copper at 10 cm above the transponder.

The standard ANSI C63-4 authorizes to realize the measurement in an open site without ground plane under the antenna at the frequencies inferior to 30 MHz.

Frequency range: 9 kHz – 0.49 MHz.

Detection mode: Average

Resolution bandwidth: 200 Hz

Measurement distance: 10 meters.

Limit:

Frequency range (MHz)	Frequency field strength (µV/m)	Frequency measurement distance (meters)
0.009-0.490	2400/F (kHz)	300

Limits in dBµV/m can be extrapolated to 10 m using 40 dB / decade.

Operating mode during the test:

The transponder is detecting permanently the coil antenna.

Instrumentation test list:

Meter	Nr Emitech	Category	Mark	Type
187	3/16/12/004	OATS	Emitech	Site champ libre
315	3/24/18/049	Loop antenna	Rohde et Schwarz	HFH2-Z2
344	5/14/00/025	Power supply	Rohde et Schwarz	HZ-9
2205	1/02/18/068	Spectrum analyzer	Agilent	E7405A

Results:

FREQUENCY (MHz)	ANTENNA ORIENTATION	AZIMUTH (degrees)	MEASUREMENT (dBµV/m)	LIMIT (dBµV/m)	MARGIN (dB)
0.128	Perpendicular	270	59.4	85.5	26.1

Observation during the test:

The equipment complies with the requirements of the standard FCC PART 15.209 Edition 2002.

6. INTENTIONAL RADIATED EMISSIONS IN THE BAND 1.705 MHZ – 10 MHZ

Standard: FCC PART 15 Edition 2002

Section: 15.223

Equipment under test arrangement

The equipment under test (EUT) is placed on a wooden table, at 0.8 m above the ground plane (turntable).
Antenna height is 1 m above the ground plane.
For each frequency corresponding to an emission, EUT carried out a rotation through 360° with the aid of the turntable, with the aim to find the maximum of signal.
The test antenna is oriented in two orientations (perpendicular or parallel). Only the highest level is recorded.

Test configuration photographs: Same as chapter 5.

Frequency range: 1.705 MHz – 10 MHz.

Detection mode: Average

Resolution bandwidth: 9 kHz

Measurement distance: 10 meters

Limit:

100 µV/m at a distance of 30 meters if emission bandwidth at 6 dB is more than 10%.
Emission bandwidth at 6 dB is 11 kHz and is less than 10%. So the limit is the higher level between 15 µV/m at a distance of 30 meters and (the bandwidth in kHz)/(the center frequency in MHz): 11/9.984=1,11µV/m at 30 meters.

So the limit is 20log15=23.5 dBµV/m at 30 meters.

Limits in dBµV/m can be extrapolated to 10 m using 40 dB / decade.

Operating mode during the test:

The transponder is detecting permanently the coil antenna.

Instrumentation test list:

Meter	Nr Emitech	Category	Mark	type
187	3/16/12/004	OATS	Emitech	Site champ libre
315	3/24/18/049	Loop antenna	Rohde et Schwarz	HFH2-Z2
344	5/14/00/025	Power supply	Rohde et Schwarz	HZ-9
2205	1/02/18/068	Spectrum analyzer	Agilent	E7405A

Results:

FREQUENCY (MHz)	ANTENNA ORIENTATION	AZIMUTH (degrees)	MEASUREMENT (dBµV/m)	LIMIT (dBµV/m)	MARGIN (dB)
9.984	Perpendicular	240	40.5	43.5	3.0

Observation during the test:

The equipment complies with the requirements of the standard FCC PART 15.223 Edition 2002

7. UNINTENTIONAL RADIATED EMISSIONS IN THE BAND 9 KHZ – 30 MHZ

Standard: FCC PART 15 Edition 2002

Section: 15.209

Equipment under test arrangement

The equipment under test (EUT) is placed on a wooden table, at 0.8 m above the ground plane (turntable).
Antenna height is 1 m above the ground plane.
For each frequency corresponding to an emission, EUT carried out a rotation through 360° with the aid of the turntable, with the aim to find the maximum of signal.
The test antenna is oriented in two orientations (perpendicular or parallel). Only the highest level is recorded.

Test configuration photographs: Same as chapter 5.

Frequency range: 9 kHz - 30 MHz.

Detection mode: Quasi-peak except frequency bands 9-90 kHz and 110-490 kHz (average).

Resolution bandwidth: 200 Hz from 9 kHz to 150 kHz.
9 kHz from 150 kHz to 30 MHz

Measurement distance: 10 meters.

Limit:

Frequency range (MHz)	Frequency field strength (µV/m)	Frequency measurement distance (meters)
0.009-0.490	2400/F (kHz)	300
0.490-1.705	24000/F (kHz)	30
1.705-30.0	30	30

Limits in dBµV/m can be extrapolated to 10 m using 40 dB / decade.

Operating mode during the test:

The transponder is detecting permanently the coil antenna.

Instrumentation test list:

Meter	Nr Emitech	Category	Mark	Type
187	3/16/12/004	OATS	Emitech	Site champ libre
315	3/24/18/049	Loop antenna	Rohde et Schwarz	HFH2-Z2
344	5/14/00/025	Power supply	Rohde et Schwarz	HZ-9
2205	1/02/18/068	Spectrum analyzer	Agilent	E7405A

Results:

FREQUENCY (MHz)	ANTENNA ORIENTATION	AZIMUTH (degrees)	MEASUREMENT (dBµV/m)	LIMIT (dBµV/m)	MARGIN (dB)
0.383	Perpendicular	270	32.7	75.9	43.2
0.640	Perpendicular	270	41.8	51.5	9.7
0.896	Perpendicular	270	42.1	48.5	6.4
1.280	Perpendicular	270	36.2	45.5	9.3

Observation during the test:

The equipment complies with the requirements of the standard FCC PART 15.209 Edition 2002.

8. UNINTENTIONAL RADIATED EMISSIONS IN THE BAND 30 MHZ – 1 GHZ

Standard: FCC PART 15 Edition 2002

Section: 15.209

Equipment under test arrangement:

Category of equipment: Table-top equipment

The equipment under test (EUT) is placed on a non-conductive test table at 0.8 m above the horizontal metal ground plane.

For maximum meter reading at each frequency, the antenna height is adjusted between 1 m and 4 m above the ground plane. A 360 degrees rotation of the EUT is performed in vertical and horizontal polarization. The frequency azimuth and antenna height are presented in the tables on the next pages.

Test configuration photographs:

Frequency range: 30 MHz - 1 GHz

Detection mode: Quasi-peak

Resolution bandwidth: 120 kHz

Measurement distance: 10 meters

Limit: The EUT must satisfy emission requirements of the standard for class B as shown in table below.

Frequency range (MHz)	Limit for Class B Quasi-peak (dBµV/m)	Limit for Class A Quasi-peak (dBµV/m)
30 to 88	30.0	39.0
88 to 216	33.5	43.5
216 to 960	36.0	46.4
Above 960	44.0	49.5

Operating mode during the test:

The transponder is detecting permanently the coil antenna.

Instrumentation test list:

Meter	Nr Emitech	Category	Mark	Type
187	3/16/12/004	OATS	Emitech	Site champ libre
317	3/24/18/051	Biconical antenna	Schwarzbeck	30/300 MHz
1057	1/02/12/045	Receiver	Rohde & Schwarz	ESVP
1282	3/24/18/224	Log-periodic antenna	Schwarzbeck	UHALP 9107
2341	4/19/00/018	Antenna mast	HD GmbH	MA 240
2342	4/19/00/019	Mast controller	HD GmbH	HD 100

Results:

Table reference	Comments
Table 1	Measurement in vertical polarization
Table 2	Measurement in horizontal polarization

Observation during the test:

The equipment complies with the requirements of the standard FCC PART 15.209 Edition 2002.

TEST SITE: Open area test site **TABLE 1**

RADIATED EMISSION: Electric field

STANDARD: FCC Part 15.209 Edition 2002

TEST DISTANCE: 10 m

POLARIZATION: Vertical

MODEL: TRANSPONDER INTERROGATOR ANTENNA (ANBAL) TYPE 843630

FREQUENCY (MHz)	ANTENNA HEIGHT (cm)	AZIMUTH (degrees)	MEASUREMENT (dBµV/m)	LIMIT (dBµV/m)	MARGIN (dB)
139.775	100	90	22.1	33.5	11.4
149.756	100	90	23.7	33.5	9.8
179.705	100	300	19.5	33.5	14.0
199.680	100	270	23.5	33.5	10.0
229.631	100	240	33.1	36.0	2.9
239.611	400	120	26.9	36.0	9.1

No significant frequency has been found other than those given above between 30 MHz and 1 GHz.

TABLE 2

TEST SITE: Open area test site

RADIATED EMISSION: Electric field

STANDARD: FCC Part 15.209 Edition 2002

TEST DISTANCE: 10 m

POLARIZATION: Horizontal

MODEL: TRANSPONDER INTERROGATOR ANTENNA (ANBAL) TYPE 843630

FREQUENCY (MHz)	ANTENNA HEIGHT (cm)	AZIMUTH (degrees)	MEASUREMENT (dBµV/m)	LIMIT (dBµV/m)	MARGIN (dB)
209.662	300	30	25.7	33.5	7.8
249.592	200	200	31.4	36.0	4.6

No significant frequency has been found other than those given above between 30 MHz and 1 GHz.

ANNEX 1

Customer's questionnaire

(2 pages)

Section 1 - Equipment under test:

Designation : TIA : Transponder Interrogator Antenna (ANBAL) .....
.....

Type (or commercial reference): 843630 .....

Serial number : PNYL 003 (V 2) .....
.....

Manufacturer: Siemens Transportation Systems .....
Address: 48 à 56, rue Barbès BP 531 .....
92542 Montrouge Cedex .....

Company introducing the equipment: Siemens Transportation Systems .....
Address: 48 à 56, rue Barbès BP 531.....
92542 Montrouge Cedex.....
.....
Name of the Person in charge of the Product: D. Grimbert.....

State of development: ❑ prototype ■ pre-serial ❑ serial

Power Supply : (If several types , indicate each of them) : no power supply

❑ single phase Voltage: .....Vac
❑ three phases Voltage: .....Vac■ continuous Voltage: 110 Vdc
❑ AC/DC adapter Voltage: .....Vac / ..... Vdc

Power
❑ greater than 1kW
❑ less than 1kW

■ Equipment for professional use only
❑ Equipment other than lighting appliances with power < 75W

Dimensions : (height x length x width in cm) : 12,2 x 40,4 x 25,4 .....

Section 2 – Schematic of the configuration & Interconnection cables:

Please draw the product configuration with all cables that might be connected to it, and indicate cables length :
See figure 5-1 of "CC Transponder Interrogator Antenna hardware environmental qualification test procedure" (DRM/NYL/14.1549.01/JME/JME)

Please list all interconnection cables [(1)] and their characteristics (recommended max. length, type…) :

See § 4.5 of "CC Transponder Interrogator Antenna hardware environmental qualification test procedure" (DRM/NYL/14.1549.01/JME/JME).....

One cable, recommended max length : 10 m.....

.....*(1) Cables likely to be connected to the equipment (not only those provided by the manufacturer)*

Section 3 : Control procedure to be used during immunity tests

This section describes how it's possible to verify if the equipment is working correctly during the tests.

Procedure (description of the implementation of control means):

See § 5.4 of "CC Transponder Interrogator Antenna hardware environmental qualification test procedure" (DRM/NYL/14.1549.01/JME/JME)

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List of equipment used to realize the control according to the procedure above (except adverse information, equipments allowing to verify the acceptance criteria are dependent on the customer)

OTPB n°1 : outil de test portable de balise (transponder test tool) with software WINXL V 216.19 .....

Balise PNYL 017 (transponder) with programme ATR4.tek (Checksum 9991).....

1 Personal computer .....

.....

Important: During immunity tests, it might be necessary to protect the control equipments from the disturbances applied during the test. Accordingly, interconnection cables length should be at least 5 m. In case of impossibility, contact us about this.

Section 4 : Susceptibility criteria

In this section, please indicate which function(s) must not be damaged (or which is the maximum allowed level in terms of loss of performances) when the equipment is disturbed:

By a continuous disturbance (electrical field, radiated or conducted, for example)

See § 5.4 of "CC Transponder Interrogator Antenna hardware environmental qualification test procedure" (DRM/NYL/14.1549.01/JME/JME)

FER < 2/10 (FER : Frame Error Rate).....

.....

.....

By a transient disturbance (electrostatic discharge for example)

See § 5.4 of "CC Transponder Interrogator Antenna hardware environmental qualification test procedure" (DRM/NYL/14.1549.01/JME/JME)

FER < 2/10 (FER : Frame Error Rate).....

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ANNEX 2

Antenna factors, insertion losses and amplifier values

(3 pages)

BILL OF MATERIAL

The test antenna used for the radiated emission between 9 kHz and 30 MHz is the active loop antenna n°315 referenced 3/24/18/049. Antenna factors are given in table 1.

The test antenna used for the radiated emission between 30 MHz and 300 MHz is the biconical antenna n°317 referenced 3/24/18/051. Antenna factors are given in table 2.

The test antenna used for the radiated emission between 300 MHz and 1 GHz is the log-periodic antenna n°1282 referenced 3/24/18/224. Antenna factors are given in table 3.

The measuring receiver n°1057 referenced 1/02/12/045 used in the frequency range 30 MHz to 1 GHz has an integrated preamplifier.

The test cable used between 9 kHz and 1 GHz to connect the antennas to the receiver/analyzer for measurements at a distance of 10 meters has losses given in table 4.

The test antenna used for the radiated emission between 1 GHz and 12 GHz is the horn antenna n°941 referenced 3/24/18/149. Antenna factors are given in table 5.

The amplifier n°1960 referenced 3/01/12/092 and its cable used to connect the spectrum analyzer to the test cable has gain values given in the table 6.

The test cable used between 1 GHz and 12 GHz to connect the horn antenna to the amplifier for measurements at a distance of 3 meters has losses given in table 7.

Frequency (MHz)	Antenna factor (dB/m)	Frequency (MHz)	Antenna factor (dB/m)
0.01	21.5	1	20.4
0.015	20.9	1.5	20.7
0.02	20.4	2	20.5
0.03	20.7	3	20.2
0.05	20.1	5	19.9
0.075	19.8	8	19.9
0.1	19.9	10	19.6
0.15	19.7	15	19.1
0.2	20.3	20	20.1
0.3	20.8	25	20.8
0.5	20.8	30	22.3
0.75	20.3	/	/

TABLE 1 : ACTIVE LOOP ANTENNA

Frequency (MHz)	Antenna factor (dB/m)	Frequency (MHz)	Antenna factor (dB/m)
30	19.3	120	13.7
35	15.9	125	14.1
40	14.5	140	14.2
45	14.3	150	14.1
50	10.5	160	15.7
60	9.2	175	16.5
70	6.5	180	17.3
80	7.8	200	17.2
90	8.5	250	18.3
100	9.7	300	20.2

TABLE 2 : BICONICAL ANTENNA

Frequency (MHz)	Antenna factor (dB/m)	Frequency (MHz)	Antenna factor (dB/m)
300	16.0	700	21.9
400	16.8	800	21.9
500	19.1	900	23.2
600	21.6	1000	24.4

TABLE 3 : LOG-PERIODIC ANTENNA

Frequency (MHz)	loss (dB)	Frequency (MHz)	loss (dB)
0.01	0.2	125	1.3
0.1	0.4	140	1.3
1	0.5	150	1.2
10	0.6	160	1.6
30	0.7	180	1.6
35	0.8	200	1.6
40	0.8	250	1.8
45	0.9	300	2.1
50	0.8	400	2.4
60	1.0	500	2.7
70	1.0	600	3.1
80	1.1	700	3.5
90	1.2	800	3.7
100	1.3	900	3.9
120	1.2	1000	4.3

TABLE 4 : TEST CABLE FOR 10M MEASUREMENT

Frequency (GHz)	Antenna factor (dB/m)	Frequency (GHz)	Antenna factor (dB/m)
1.0	24.5	7.0	37.3
1.5	26.9	7.5	38.1
2.0	29.1	8.0	38.3
2.5	30.1	8.5	38.7
3.0	31.9	9.0	39.1
3.5	32.5	9.5	39.2
4.0	33.7	10.0	39.4
4.5	33.6	10.5	39.5
5.0	34.9	11.0	39.7
5.5	35.7	11.5	40.1
6.0	36.0	12.0	40.1
6.5	36.2	/	/

TABLE 5 : HORN ANTENNA

Frequency (GHz)	Gain value (dB)	Frequency (GHz)	Gain value (dB)
1.0	43.9	7.0	34.7
1.5	44.7	7.5	34.2
2.0	45.3	8.0	35.2
2.0	34.6	8.0	30.5
2.5	36.3	8.5	30.8
3.0	34.1	9.0	31.3
3.5	34.6	9.5	31.1
4.0	35.4	10.0	30.7
4.5	34.8	10.5	29.5
5.0	35.3	11.0	30.3
5.5	35.2	11.5	31.0
6.0	35.3	12.0	29.8
6.5	34.9	/	/

TABLE 6 : AMPLIFIER (1-2GHz/2-8GHz/8-12GHz) + 2M CABLE

Frequency (GHz)	loss (dB)	Frequency (GHz)	loss (dB)
1.0	5.3	4.5	11.2
1.5	6.4	5.0	12.0
2.0	7.4	6.0	12.8
2.5	8.3	8.0	15.8
3.0	9.0	10.0	17.6
3.5	9.2	12.0	18.9
4.0	10.5	/	/

TABLE 7 : TEST CABLE FOR 3M MEASUREMENT