LABOTECH

Test Report

For

Trade Name: FURUNO
Model: U-AIS Transponder
Type: FA-100

Report No.: FLI 12-02-001

Date of Issue: 10 May 2002

Furuno Labotech International Co., Ltd.

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TESTING LABORATORY STATUS

Furuno Labotech International Co., Ltd. (hereafter called FLI) has been holding the following status after having been assessed according to the provisions of ISO/IEC Guide 25 and/or EN 45001:

(1) KTL Listed Testing Laboratory:

- listed by KTL Certification, PO Box 60004, 6800 JA Arnhem, The Netherlands (Certificate No.: KCS/L116 dated 26 July 1999) for testing the following product categories/ standards:

- IEC 60945 Maritime navigation and radiocommunication equipment and systems - General requirements.

(Note: KTL Certification has been renamed Telefication bv.)

(2) TÜV Appointed EMC Test Laboratory:

- appointed by TÜV Rheinland, 19-5 Shin Yokohama 3-chome, Kohoku-ku, Yokohama 222-0033 Japan (Certificate of Appointment No. 9861943-0007 dated 07 July 2000)

Scope of appointment:

- EN 50081-1, EN 50082-1/-2, EN 61000-6-2, EN 55022, EN 61000-3-2/-3, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6, EN 61000-4-8, EN 61000-4-11, ENV 50204

1 PRINCIPAL INFORMATION

1.1 Introduction

This report contains the results of measurements and tests carried out by FLI for the purpose of the technical assessment on the durability and resistance to the environmental conditions, and EMC on the Equipment under Test (EUT).

The order for these tests and inspections has been placed by:

Company name	:	Furuno Electric Co., Ltd.
Address	:	9-52 Ashihara-cho
City	:	Nishinomiya City
Postcode	:	662-8580
Country	:	Japan

1.2 Equipment under test (EUT)

During the tests, the sample of the following equipment was submitted by Furuno Electric Co., Ltd. The tests were conducted for the EUT driven from 24 VDC power supply:

U-AIS Transponder

Manufacturer:	Furuno Electric Co., Ltd.
Trade name:	FURUNO
Type designation:	FA-100
Serial number:	3539-0001
Power supply:	12 - 24 VDC

Item	Type number	Unit serial number	Equipment category	Remarks
Transponder	FA-100	3539-0001	Protected	Test setup: Table-top
Junction box	CB-100	0001	Protected	
Distributor	DB-1	0001	Protected	
Combined antenna	GVA-1	0001	Exposed	

Softwares contained in the EUT:

	Program number (with Rev. number included)
MAIN :	245-0001-000
SUB :	245-0002-000
H8S1 :	245-0003-000
H8S2 :	245-0004-000
H8S3 :	245-0005-000

1.3 Test schedule

(1) Date of receipt of EUT: 22 November 2001

(2) Date(s) of tests performed: (Testing period: 30 November 2001 to 23 April 2002)
Tests were carried out in accordance with the specifications detailed in subclause 1.5 at the following locations and on the following dates:

EN 60945 Clause nr.	Item	Test site	Date
6	Operational check	FLI Nishinomiya Laboratory [2]	5 April 2002
7	Power supply		12 April 2002
	Climatic test		----
8.2.1	Dry heat - Storage test		15 February 2002
8.2.2	Dry heat - Function test		12 February 2002
8.3	Damp heat - Function test		13 February 2002
8.4	Low temperature - Functional test		14 February 2002
8.7	Vibration test	FLI Nishinomiya-Hama Laboratory [1]	27 to 29 December 2001
8.8	Rain test		25 December 2001
8.9	Immersion test		Not applicable.
8.12	Corrosion (salt mist) test		Not performed.
9	EMC emission test (Unwanted electromagnetic emission)	FLI Nishinomiya-Hama Laboratory [1]	24 December 2001
10	EMC immunity test (Immunity to electromagnetic environment)	Nishinomiya Laboratory [2]	30 November, 1, 3, 17 - 22 December 2001
11.1	Acoustic noise and signals test (Special purpose test)	Nishinomiya Laboratory [2]	13 March 2002
11.2	Compass safe distance measurement (Special purpose test)		7 March 2002
12.1	Access test to dangerous voltages (Safety precaution)		12 April 2002

EN 60945 Clause nr.	Item	Test site	Date
12.2	Electromagnetic radiofrequency radiation (Safety precaution)	Nishinomiya-Hama Laboratory [1)]	23 April 2002
12.3	Emission test from visual display unit (VDU) (Safety precaution)		23 April 2002
12.4	X-radiation measurement (Safety precaution)		Not applicable
13	Maintenance	Nishinomiya Laboratory [2)]	23 April 2002
14	Equipment manual		23 April 2002
15	Marking and identification		23 April 2002

[1)] 2-20 Nishinomiya Hama, Nishinomiya City, Hyogo Prefecture, 662-0934 Japan
[2)] 9-52 Ashihara-Cho, Nishinomiya City, Hyogo Prefecture, 662-8580 Japan

1.4 Observation and comments

(1) Corrosion (salt mist) test was not performed.
(See Furuno Electric Statement HIK-232 dated 19 February 2002.)

(2) Immunity tests to “Surges on a. c. power lines” and to “Power supply short-term variation” were not applicable, because the EUT was not powered by a. c. power supply.

(3) X-radiation test was not applicable, because the EUT had no devices, or functions that affect those tests results.

(4) For “Unwanted electromagnetic emission - Radiated emissions from enclosure port” test, measurements were voluntarily made for the frequencies of 1 GHz to 2 GHz according to the draft Standard EN 60945: 4th ed., in addition to 150 kHz to 1 GHz specified by the Standard EN 60945: 3rd ed.

1.5 Test specifications applied

The equipment are intended for use in the following application areas:

For Maritime Safety Navigation,

The sample was tested to the requirements of the following standards:

- EN 60945 Third edition: 1996-11, Maritime navigation and radiocommunication equipment and systems - General requirements - Methods of testing and required test results

  Clauses 6, 7, 8.2, 8.3, 8.4, 8.7, 8.8, 9, 10, 11, 12, 13, 14 and 15.

- IEC 61993-2: 2001-12, Maritime navigation and radiocommunication equipment and

systems - Automatic identification systems (AIS) - Part 2: Class A shipborne equipment of the universal automatic identification system (AIS) - Operational and performance requirements, methods of test and required test results.
Clauses 11, 12 and 13.

1.6 Performance test and check applied

The following performance test and check were applied to the EUT according to the Standard IEC 61993-2:

1.6.1 Performance test:

(1) For the Transmitter:

(a) Frequency error (IEC 61993-2 Clause 15.1.1)

(b) Carrier power (IEC 61993-2 Clause 15.1.2)

(c) Channel switching (IEC 61993-2 Clause 14.7)

(d) Transmitter attack time (IEC 61993-2 Clause 15.1.5)

(e) Transmitter release time (IEC 61993-2 Clause 15.1.6)

(2) For the Receiver (both TDMA and DSC):

(a) Sensitivity at 25 kHz and 12.5 kHz (IEC 61993-2 Clauses 15.3.1, 15.3.2, 15.4.1)

(b) Channel switching time (IEC 61993-2 Clause 14.7)

1.6.2 Performance check:

(1) Automonous mode (IEC 61993-2 Clause 14.1.1)

(a) Transmit Position reports (IEC 61993-2 Clause 14.1.1.1)

(b) Receive Position reports (IEC 61993-2 Clause 14.1.1.2)

1.7 Conclusions

The tests on the samples of the FURUNO FA-100 have been completed satisfactorily and showed NO NON-COMPLIANCES with the specifications stated in subclause 1.5 in this report:

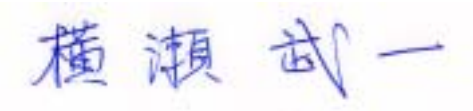
The test results of this report relate only to the items tested.

Total page number of this report is 89 including the front page.

Tested by:

Name: T. Yokose
Chief Engineer, Technical Section

Signature:



Verified by:

Name: T. Segawa
Manager/QA

Signature:

Approved by:
All data herein contained is true and correct to my best knowledge.

Date: 10 May 2002

Name: M. Komori
Manager, Technical Section

Signature:

2 TEST REPORT OVERVIEW

General requirements for marine navigational and radio communication equipment and systems
IEC 60945 Third edition: 1996-11

IEC 60945 Clause	Item	Test conditions	Satisfactory	Relevant clause number of this report
6	Operational check		yes	3.1
7	Power supply	Extreme power supply, Excessive conditions, Power supply short-term variation and Power supply failure.	yes	3.2
8	Durability and resistance to environmental conditions	----	----	----
8.1	General	----	----	----
8.2	Dry heat	----	----	----
8.2.1	- Storage test (portable, exposed & submerged equipment)	+70°C ± 3°C, 10 h to 16 h	yes	3.3.1
8.2.2	- Functional test (portable, protected & exposed equipment)	+55°C ± 3°C, 10 h to 16 h	yes	3.3.2
8.3	Damp heat	----	----	----
8.3.1	- Functional test (protected & exposed equipment)	+40 °C ± 2°C, 93% ± 3%RH, 10 h to 16 h	yes	3.3.3
8.4	Low temperature	----	----	----
8.4.1	- Storage test (portable equipment)	-30°C ± 3°C, 10 h to 16 h	n. a.	----
8.4.2	- Functional tests	-20°C ± 3°C, (portable) -15°C ± 3°C, (protected) -25°C ± 3°C, (exposed) 10 h to 16 h	yes	3.3.4
8.5	Thermal shock (portable equipment)	+70°C ± 3°C, 1 h, air +25°C ± 3°C, 1 h, under water	n. a.	----
8.6	Drop (portable equipment)		n. a.	----
8.6.1	Drop on hard surface	1000 mm ± 10 mm, 6 drops	n. a.	----
8.6.2	Drop into water	20 m ± 1 m, 3 drops	n. a.	----

IEC 60945 Clause	Item	Test conditions	Satisfactory	Relevant clause number of this report
8.7	Vibration	1. Resonance search: 2 to 5 Hz to 13.2 Hz, ± 1.0 mm, 13.2 Hz to 100 Hz, 7 ms^{-2} 2. Endurance test: - For Q ≧ 5, 2 h at each resonant freq. - For Q <5, 2 h at one single resonant freq. - If no resonance occurred, 2 h at 30 Hz.	yes	3.4
8.8	Rain (Exposed equipment)	IPX6 (IEC 60529)	yes	3.5
8.9	Immersion (Submerged and portable equipment)	600 kPa, 12 h	n. a.	----
8.10	Solar radiation (portable equipment)		n. a.	----
8.11	Oil resistance (portable equipment)		n. a.	----
8.12	Corrosion	4 spraying periods with a salt solution, each of duration 2 h, with a storage periods of 7 days after each.	n. p.	1.4
9	Unwanted electromagnetic emission		----	----
9.1	General		----	----
9.2	Conducted emissions	10 kHz to 30 MHz	yes	3.8.1
9.3	Radiated emissions from enclosure port	150 kHz to 30 MHz, 30 MHz to 1 GHz, 1 GHz to 2 GHz (voluntary)	yes	3.8.2
10	Immunity to electromagnetic environment		----	----
10.1	General		----	----
10.2	Immunity to conducted low-frequency interference (all equipment categories except portable)	For a.c. powered equipment: 10 % (50 Hz to 900 Hz) 10 % to 1 % (900 Hz to 6 kHz) 1 % (6 kHz to 10 kHz) For d. c. powered equipment: 10 % (50 Hz to 10 kHz) Performance criterion A	yes	3.9.1

IEC 60945 Clause	Item	Test conditions	Satisfactory	Relevant clause number of this report
10.3	Immunity to conducted radio frequency interference (all equipment except portable)	3 V (10 kHz to 80 MHz) 10 V at specified spot frequencies: Performance criterion A	yes	3.9.2
10.4	Immunity to radiated radio frequencies (all equipment categories except submerged)	10 V/m (80 MHz to 1 GHz) Performance criterion A	yes	3.9.3
10.5	Immunity to fast transients on a. c. power, signal and control lines (all equipment categories except portable)	2 kV differential, 1 kV common. Performance criterion B	yes	3.9.4
10.6	Immunity to surges on a. c. power lines (all equipment categories except portable)	1 kV line/earth, 0.5 kV line/line. Performance criterion B	n. a.	1.4
10.7	Immunity to power supply short-term variation (all equipment categories except portable)	a) Vn+ (20 ± 1) % (1.5 s ± 0.2 s) Fn + (10 ± 0.5) % (5 s ± 0.5 s) b) Vn - (20 ± 1) % (1.5 s ± 0.2 s) Fn - (10 ± 0.5) % (5 s ± 0.5 s) Performance criterion B	n. a.	1.4
10.8	Immunity to power supply failure (all equipment categories except portable)	60 s, 3 breaks Performance criterion C	yes	3.9.7
10.9	Immunity to electrostatic discharge (all equipment categories except submerged)	6 kV contact, 8 kV air. Performance criterion B	yes	3.9.8
11	Special purpose tests	----	----	3.10
11.1	Acoustic noise and signals (all equipment intended for installation in wheelhouse and bridge wings)	Acoustic noise power: ≦ 60 dB(A) Audible alarm: 75 to 85 dB(A)	yes	3.10.1
11.2	Compass safe distance measurement (all equipment categories except submerged)	a) In the magnetic condition, b) After magnetization, c) In the energized condition,	yes	3.10.2
12	Safety precautions	----	----	3.11
12.1	Protection against accidental access to dangerous voltages	IEC 60529, table I, first characteristic numeral 2	Yes	3.11.1
12.2	Electromagnetic radiofrequency radiation measurement	For above 30 MHz, maximum distance from the EUT at 100 W/m^2 , and also 10 W/m^2 below 1 GHz.	Yes	3.11.2

IEC 60945 Clause	Item	Test conditions	Satisfactory	Relevant clause number of this report
12.3	Emission from visual display unit (VDU)	- Magnetic flux density: ≦200 nT, (5 Hz to 2kHz) ≦25 nT, (2 kHz to 400 kHz) - Electromagnetic radiation: ≦10 V/m at 30 cm, (5 Hz to 2 kHz) ≦1 V/m at 30 cm, (2 kHz to 400 kHz) - Electrostatic field: ≦± 500 V	yes	3.11.3
12.4	X-radiation measurement	Dose rate > 5 μJ/kgh (0.5 mrem/h) at 50 mm	n. a.	1.4
13	Maintenance (all equipment categories)		yes	3.12
14	Equipment manual (all equipment categories)		yes	3.13
15	Marking and identification (all equipment categories)		yes	3.14

Note: n. a. - Not applicable, n. p. - Not performed.

3 TEST RESULTS

3.1 Operational checks

3.1.1 Operational check of modes required by the equipment standard

IEC 60945 Reference: 6.1
Minimum performance requirement reference: 4.2.1

Results observed:

Observation	Result
- All modes of operation required by the equipment standard are available, and controlled over the required range.	Passed

3.1.2 Operational check of design of control facilities

IEC 60945 Reference: 6.2
Minimum performance requirement reference: 4.2.2

Results observed:

Observation	Result
- The number of operational controls, their design and manner of function, location, arrangement and size provide for simple, quick and effective operation of the EUT.	Passed
- The shape and size of each control is appropriate to its mode of operation.	Passed
- All instruments are logically grouped according to their function.	Passed
- The information presentation is suited to the maximum expected rate of change of information. Data is shown on the display screen of the EUT.	Passed
- Rotating controls and indicators turn clockwise for increased function.	NA
- Linear controls and indicators move upwards or to the right for increased function.	Passed
- The equipment elements related to control are readily distinguishable from the control screen of the EUT.	Passed
- There is a time delay of at least 3 s between initial operation of a distress button and the alert being activated.	NA

Note: NA - Not applicable.

3.1.3 Operational check of use of controls

IEC 60945 Reference: 6.3
Minimum performance requirement reference: 4.2.3

Results observed:

Observation	Result
- All operational controls permit normal adjustments to be easily performed, and are arranged in a manner which minimizes the chance of inadvertent operation.	Passed
- All controls not required for normal operation are not readily accessible.	Passed
- The operational controls which could switch off the equipment or may lead to degradation of performance, or to false indications are specially protected against unintentional operation.	Passed
- All operational controls and indicators are easy of use and are correct and suitable related to their function and environment (expected ambient illumination and sound).	Passed
- A distress alert is only activated by means of a dedicated distress button, and that it is not a key of an ITU-T digital input panel, or of an ISO keyboard on the EUT.	NA
- The dedicated distress button is clearly identified and is protected against inadvertent operation.	NA
- The distress alert initiation requires at least two independent actions.	NA
- The EUT indicates the status of a distress alert transmission.	NA
- It is possible to interrupt and initiate distress alerts at any time.	NA
- There is a time delay of at least 3 s between initial operation of the distress button and an alert being activated.	NA

3.1.4 Operational check of identification

IEC 60945 Reference: 6.4

Minimum performance requirement reference: 4.2.4

Results observed:

Observation	Result
- All operational controls and indicators are easy to identify and read from the position where the equipment is normally operated.	Passed
- The instrument and indicator character type is simple and clear.	Passed
- All controls and indicators are identified in English.	Passed
- All controls for optional facilities which are not fitted are blocked off.	NA
- Where optional facilities are provided by software, via common control arrangements, such facilities are clearly indicated.	NA
- The indicators are satisfactorily positioned relative to the operator's line of sight, and are not obscured when operating associated controls under normal operating conditions.	Passed
- All instruments are clearly readable from 1 m.	Passed

3.1.5 Operational check of illumination

IEC 60945 Reference: 6.5
Minimum performance requirement reference: 4.2.5

Results observed:

Observation	Result
- The illumination provided in the EUT is adequate for operation of the equipment under all expected conditions.	Passed
- All light sources can be dimmed to prevent interference with the navigation.	Passed
- There is no external illumination required which should be identified in the equipment manual.	NA
- Warning and alarm indicators cannot be dimmed below reading intensity.	NA
- The illumination is dazzle-free and adjustable to extinction, except for those warning and alarm indicators which are illuminated in the warning/alarm condition, and indicators required for equipment reactivation or distress alerting, which are to be clearly visible in all appropriate conditions of ambient illumination.	Passed
- Controls which are not illuminated, such as tracker balls, are located easily and unambiguously by tactile means.	NA
- All information is presented on a LCD screen with high contrast on a low-reflectance background that emits negligible (adjustable) light at night.	Passed
- There are no transparent covers which cause reflections.	Passed
- The alarm indications are red or otherwise highlighted.	Passed
- The warning and alarm indications are not visible in the safe condition. Any indirect illumination is low enough to avoid false indications.	Passed
- All lamps are adjustable from full brightness for all conditions of varying ambient illumination.	Passed

3.1.6 Operational check of damage and safety

IEC 60945 Reference: 6.6
Minimum performance requirement reference: 4.2.6

Results observed:

Observation	Result
- Misuse of the controls for normal use which are accessible to the operator can not cause damage to the equipment or injury to personnel.	Passed

3.1.7 Operational check of inter-unit connection

IEC 60945 Reference: 6.7
Minimum performance requirement reference: 4.2.7

Results observed:

Observation	Result
- The manufacturer declares that software interfaces to other equipment are tested in a full possible configuration, so no special testsoftware was necessary.	Passed
- The EUT has the arrangements to achieve electrical separation and isolation between the EUT and the equipment to which it may be connected.	Passed

3.1.8 Operational check of digital panels

IEC 60945 Reference: 6.8
Minimum performance requirement reference: 4.2.8

Results observed:

Observation	Result
- The EUT has a digital input panel with the digits 0 to 9; the arrangement is according to ITU-T recommendation E.161 subclause 3.1.1.	Passed

3.1.9 Operational check of indicator

IEC 60945 Reference: 6.9
Minimum performance requirement reference: 4.2.9

Results observed:

Observation	Result
- The testing of all operational indicators, displays and audible devices is available on the EUT. Audible alarms meet the requirements of Clause 11.1 of IEC 60945.	NA
- The status of the distress alert transmission is indicated at the EUT.	NA

3.1.10 Operational check of software

IEC 60945 Reference: 6.10
Minimum performance requirement reference: 4.2.10

Results observed:

Observation	Result
- With the manufacturer is checked that any software required to facilitate operation in accordance with its equipment standard, including for its initial activation/reactivation, is permanently installed within the EUT, in such a way that it is not possible for the user to have access to that software.	Passed
- With the manufacturer is checked that it is not possible for the user to augment, amend or erase any software in the EUT required for operation in accordance with	Passed

its equipment standard.	
- With the manufacturer is checked that all means are provided to monitor the operational software of the EUT automatically at appropriate intervals, as indicated in the manufacturer's documentation and to activate an alarm in the event of non-automatically recoverable failure.	Passed

3.2 Power supply tests
3.2.1 Extreme Power supply tests

IEC 60945 reference: 7.1

Minimum performance requirement reference: 4.3.1

Extreme power supply conditions:

Power supply	Voltage variation (%)	Frequency variation (%)
AC	± 10	± 5
DC	+ 30 – 10	Not applicable.

Performance tests (PT) and performance checks (PC) which shall be applied:

Environment	Normal power supply	Extreme power supply
Dry heat	PT	PC
Damp heat	PC	---
Low temperature	PT	PC
Normal temperature	PT	PT

Results:

Power supply voltage applied:	- Nominal: 24 VDC - High voltage (24 VDC +30 %): 31.2 VDC, - Low voltage (24 VDC -10 %): 21.6 VDC,
Results obtained:	Performance tests and performance checks were done with successful results. See Clause 3.3 of this report for details.

3.2.2 Excessive conditions tests

IEC 60945 reference: 7.2 and 5.2.3

Minimum performance requirement reference: 4.3.2

Excessive conditions:
- Excessive current
- Excessive voltage
- Power supply misconnections

Results:

1 - Against Excessive current:	6.3 A Circuit Protector in the EUT was incorporated.
2 - Against Excessive voltage over 31.2 VDC (Max. nominal 24 VDC x 1.3):	Means were not provided for the EUT. The EUT operated satisfactorily as intended for the input voltage up to 35 VDC.
3 - When subjected to the input of 31.2 VDC of reversed polarity for 5 min.:	6.3 A Circuit Protector in the EUT was activated, and the EUT was protected from damage.

3.2.3 Power supply short-term variation tests (Not applicable)

IEC 60945 reference: 7.3

Minimum performance requirement reference: 4.3.3

Results:

Not applicable to d. c. powered equipment.

3.2.4 Power supply failure tests

IEC 60945 reference: 7.4

Minimum performance requirement reference: 4.3.3

Results:

See Clause 3.9.7 of this report.

3.3 Climatic Test
3.3.1 Dry heat - Storage test

IEC 60945 reference:	8.2.1
EUT category:	Portable, exposed and submerged equipment
Basic standards applied:	IEC 60068-2-2, IEC 60068-2-48

Limits/Test conditions:

Temperature:	+70°C ± 3°C,
Duration:	10 h to 16 h,
EUT operation:	Powered off during duration period,
Power supply variation:	Normal condition; - Nominal, 24 VDC Extreme conditions; - High voltage (+30 %): 31.2 VDC - Low voltage (-10 %): 21.6 VDC
Performance check:	After the test, Performance check shall be carried out under normal environmental conditions. See Clause 1.6 of this report.
EUT:	Combined antenna GVA-100
Measuring/Test instruments used:	See Clause 4.2 of this report.
Test arrangement:	See Clause 5.1 of this report.

Results:

Results obtained:	Performance check was done with successful results. The EUT operated as intended in accordance with the product standard.
Note:	

3.3.2 Dry heat - Function test

IEC 60945 reference:	8.2.2
EUT category:	Portable, protected and exposed equipment
Basic standard applied:	IEC 60068-2-2

Limits/Test conditions:

Temperature:	+55°C ± 3°C,
Duration:	10 h to 16 h,
EUT operation:	Powered on during duration period with nominal power supply voltages.
Power supply variation:	Normal condition; - Nominal, 24 VDC. Extreme conditions; - High voltage (+30%): 31.2 VDC, - Low voltage (–10%): 21.6 VDC.
Performance test/check:	At the end of duration period, Performance test/check shall be carried out under nominal and extreme power supply conditions. See Clause 1.6 of this report.
EUT:	Transponder FA-100, Junction box CB-100, Distributor DB-1, Combined antenna GVA-1.
Measuring/Test instruments used:	See Clause 4.2 of this report.
Test arrangement:	See Clause 5.1 of this report.

Results:

Results obtained:	Performance test/check were done with successful results. The EUT operated as intended in accordance with the product standard. See Clause 6 of this report for the test data taken during the test.

3.3.3 Damp heat – Function test

IEC 60945 reference:	8.3.1
EUT category:	Portable, protected and exposed equipment
Basic standard applied:	IEC 60068-2-30

Limits/Test conditions:

Temperature:	+40°C ± 2°C,
Relative humidity:	93% ± 3%,
Duration:	10 h to 16 h,
EUT operation:	Powered on at least 2 h during duration period.
Power supply:	Normal condition; - Nominal, 24 VDC.
Performance check:	During the period for which the EUTs are powered on, Performance check shall be carried out under normal power supply condition. See Clause 1.6 of this report.
EUT:	Transponder FA-100, Junction box CB-100, Distributor DB-1, Combined antenna GVA-1.
Measuring/Test instruments used:	See Clause 4.2 of this report.
Test arrangement:	See Clause 5.1 of this report.

Results:

Results obtained:	Performance check was done with successful results. The EUT operated as intended in accordance with the product standard.
Environmental conditions observed:	On 13 February 2002, 23°C, 46%RH.

3.3.4 Low temperature – Functional tests

IEC 60945 reference:	8.4.2
EUT category:	Portable, protected and exposed equipment.
Basic standard applied:	IEC 60068-2-1

Limits/Test conditions:

Temperature:	-20°C ± 3°C (for portable equipment) -15°C ± 3°C (for protected equipment), -25°C ± 3°C (for exposed equipment),
Duration:	10 h to 16 h,
EUT operation:	Powered on at least 2 h during duration period.
Power supply variation:	Normal condition; - Nominal, 24 VDC. Extreme conditions; - High voltage (+30%): 31.2 VDC, - Low voltage (–10%): 21.6 VDC.
Performance test/check:	During the period for which the EUTs are powered on, performance test/check shall be carried out under normal and extreme power supply conditions. See Clause 1.6 of this report.
EUT:	Transponder FA-100, Junction box CB-100 and Distributor DB-1 (protected equipment). Combined antenna GVA-1 (exposed equipment).
Measuring/Test instruments used:	See Clause 4.2 of this report.
Test arrangement:	See Clause 5.1 of this report.

Results:

Results obtained:	Performance test/check were done with successful results. The EUT operated as intended in accordance with the product standard. See Clause 6 of this report for the test data taken during the test.

3.4 Vibration Test

IEC 60945 reference:	8.7
EUT category:	All equipment
Basic standard applied:	IEC 60068-2-6

Limits/Test conditions:

Resonance search test:	
Frequency range, 2 to 5 Hz to 13.2 Hz:	Excursion: ± 1 mm
13.2 Hz to 100 Hz:	Acceleration: 7 ms^{-2}
Endurance test:	
(a) For Q ≧ 5,	2 h endurance at each resonant frequency,
(b) For Q < 5,	2 h endurance at one single resonant frequency,
(c) IF no resonance occurred,	2 h endurance at 30 Hz.
Performance check:	Performance check shall be carried out at least once during each endurance test period, and once before the end of each endurance test period.
	See Clause 1.6 of this report.
EUT:	Transponder FA-100, Junction box CB-100, Distributor DB-1, Combined antenna GVA-1.
Measuring/Test instruments used:	See Clause 4.3 of this report.
EUT arrangement for Performance check:	See Clause 5.1 of this report.

Results:

Resonance points detected:	See Clause 7 of this report for Vibration response plots taken during the test.
Endurance tests performed:	- Tests were performed at the resonance frequencies described in Clause 7 of this report. - Performance check was done with successful results after the test. - There was no damage, or degradation of performance after the test.
Note:	

3.5 Rain Test

IEC 60945 reference:	8.8
EUT category:	Exposed equipment.
Basic standard applied:	IEC 60529, IPX6

Limits/Test conditions:

- Internal diameter of nozzle:	12.5 mm;
- Delivery rate:	100 l/min ± 5%;
- Water pressure:	To be adjusted to achieve the specified delivery rate;
- Core of substantial stream:	Circle of approximately 120 mm at distance 2.5 m from nozzle;
- Test duration:	Approximately 30 min.
- Distance from nozzle to the EUT surface:	Approximately 3 m.
- EUT operation:	Powered on during the test.
- Performance check:	At the end of the tests, Performance check shall be carried out.

EUT:	Combined antenna GVA-1
Measuring/Test instruments used:	See Clause 4.4 of this report.
EUT arrangement for Performance check:	See Clause 5.1 of this report.

Results:

Results obtained:

- Performance check was done with successful results after the test.
- There was no damage, or unwanted ingress of water after the test.

Note:

3.6 Immersion Test (Not applicable)

IEC 60945 reference:	8.9.1
EUT category:	Submerged equipment.
Basic standard applied:	None

Limits/Test conditions:

- Hydraulic pressure:	600 kPa
- Duration period:	12 h
- Performance check:	At the end of the test, Performance check shall be carried out.

EUT:

Measuring/Test instruments used:

EUT arrangement for Performance check:

Results:

Results obtained:	Not applicable to protected and exposed equipment.

Note:

3.7 Corrosion (salt mist) Test (Not performed)

IEC 60945 reference:	8.12
EUT category:	All equipment
Basic standard applied:	IEC 60068-2-52

Limits/Test conditions:

- Salt solution:	5 % sodium chloride (NaCl) solution.
- Spraying period:	2 h
- Storage conditions:	+40°C ±2°C, 90 - 95 %RH, 7 days
- Severity of the test:	Severity (1): 4 spray periods, each of 2 h, with a humidity storage period of 7 days after each.
- Performance check:	At the conclusion of the test, Performance check shall be carried out.

EUT:

Measuring/Test instruments used:

EUT arrangement for performance checks:

Results:

Results obtained:	Not performed. See Clause 1.4 of this report.

Note:

3.8 EMC Emission Test

3.8.1 Conducted emissions

IEC 60945 reference:	9.2
EUT category:	All equipment except portable.
Basic standard applied:	CISPR 16-1

Limits:
In the frequency range 10 kHz to 30 MHz, the radio frequency voltage at the power supply terminals of the EUT shall not exceed the limits shown in figure 2 of IEC 60945 Third edition: 1996-11.

Frequency range	Limits
10 kHz to 150 kHz	63 mV to 0.3 mV (96 dBµV to 50 dBµV)
150 kHz to 350 kHz	1 mV to 0.3 mV (60 dBµV to 50 dBµV)
350 kHz to 30 MHz	0.3 mV (50 dBµV)

Test conditions:

EUT operating mode:	Autonomous mode with the test environment of 5 test targets.
Associated cables:	See Clause 5.2 of this report. Note: the EUT was connected to the artificial mains network (AMN) through the Power cable of 0.8 m.
Measuring/Test instruments used:	See Clause 4.6 of this report.
Test arrangement:	See Clause 5.2 of this report.
Ports tested:	Power (12 - 24 VDC)

Results:

Results obtained:	No conducted spurious voltage exceeds the specified limits. See Clause 8, EMC Emission measurement plots taken during the tests.
Note:	
Measurement uncertainty:	Has been taken into account when the limits have been set. (See also prEN 50222)
Environmental conditions observed:	On 24 December 2001, 23 - 23°C, 59 - 59%RH Power supply voltage measured: 24.2 - 24.2 VDC

3.8.2 Radiated emissions from enclosure port

IEC 60945 reference:	9.3
EUT category:	All equipment except submerged.
Basic standard applied:	CISPR 16-1

Limits:

The radiation limit at distance 3 m from the enclosure port over the frequency range 150 kHz to 1 GHz is shown in figure 4 of IEC 60945 Third edition: 1996-11.

Frequency range	Limits
150 kHz to 300 kHz	10 mV/m to 316 µV/m (80 dBµV/m to 52 dBµV/m)
300 kHz to 30 MHz	316 µV/m to 50 µV/m (52 dBµV/m to 34 dBµV/m)
30 MHz to 1 GHz except 156 MHz to165 MHz	500 µV/m (54 dBµV/m)
156 MHz to 165 MHz	16 µV/m (24 dBµV/m)
1 GHz to 2 GHz (voluntary)	500 µV/m (54 dBµV/m)

Test conditions:

EUT operating mode:	Autonomous mode with the test environment of 5 test targets.
Associated cables:	See Clause 5.2 of this report.
Measuring/Test instruments used:	See Clause 4.6 of this report.
Test arrangement:	See Clause 5.2 of this report.
Measuring distance:	3 m
Antenna used:	(1) Active screened loop for the frequency range of 150 kHz to 30 MHz, (2) Bilog for the frequency range of 30 MHz to 1000 MHz, (3) Double-ridged waveguide horn for the frequency range of 1 GHz to 2 GHz.

Results:

Results obtained:	No radiated emission components exceed the specified limits. See Clause 8, EMC Emission measurement plots taken during the tests.
Note:	Measurements were voluntarily made for the frequencies of 1 GHz to 2 GHz according to the draft Standard EN 60945: 4th ed., in addition to 150 kHz to 1 GHz specified by the Standard EN 60945: 3rd. ed.
Measurement uncertainty:	Has been taken into account when the limits have been set. (See also prEN 50222)
Environmental conditions observed:	On 24 December 2001, 23 - 23°C, 59 - 59%RH Power supply voltage measured: 24.2 - 24.2 VDC

3.9 EMC Immunity Test (Immunity to electromagnetic environment)
3.9.1 Immunity to conducted low-frequency interference

IEC 60945 reference:	10.2
EUT category:	All equipment except portable.
Basic standard applied:	None.

Test conditions:

The performance of the EUT shall be the criterion A as defined in IEC 60945 Third edition: 1996-11 when the following test voltages are superimposed on the power lines:

- For a.c. powered equipment:
  a sinusoidal rms voltage, of amplitude 10 % of the nominal supply voltage, swept in frequency from 50 Hz to 900 Hz, then reducing to 1% at 6 kHz, and maintain at 1% up to 10 kHz

- For d.c. powered equipment:
  a sinusoidal rms voltage, of amplitude 10 % of the nominal supply voltage, swept in frequency from 50 Hz to 10 kHz

Performance check:	See Clause 1.6 of this report.
Measuring/Test instruments used:	See Clause 4.7 of this report.
Test arrangement:	See Clause 5.2 of this report.
Ports tested:	Power (12 - 24 VDC)

Results:

Performance check results obtained:	The EUT continued to operate as intended during and after the test. No malfunction or degradation of performance, or loss of function was observed during and after the test.
Note:	
Measurement uncertainty:	Has been taken into account when the limits have been set. (See also prEN 50222)
Environmental conditions observed:	On 22 December, 20 - 20°C, 44 - 44%RH Power supply voltage measured: 24.1 - 24.1 VDC

3.9.2 Immunity to conducted radio frequency interference

IEC 60945 reference:	10.3
EUT category:	All equipment except portable.
Basic standard applied:	IEC 61000-4-6

Test conditions:
The performance of the EUT shall be the criterion A as defined in IEC 60945 Third edition: 1996-11 when the tests are carried out with the following test levels:

3 V rms amplitude swept over the frequency range 10 kHz to 80 MHz (Severity level 2);
10 V rms amplitude at spot frequencies of 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 MHz.

Performance check:	See Clause 1.6 of this report.
Dwell time and frequency step:	3 s (1) 1.5 kHz for the frequency range of 10 - 150 kHz, (2) 50 kHz for the frequency range of 150 kHz - 5 MHz, (3) 1 % for the frequency range of 5 MHz - 80 MHz.
Measuring/Test instruments used:	See Clause 4.7 of this report.
Test arrangement:	See Clause 5.2 of this report.
Ports tested:	Power ports: (a) FA-100: Power (12 - 24 VDC). Signal and control ports: (a) FA-100: LAN (10B-T), AD-10 IN, EXTRA I/O, to JUNCTION BOX. (b) CB-100: FA-100, SENSOR3, BEACON IN, L/R, PC I/O, ALARM OUT. (c) DB-1: (d) GVA-100: (e) GSC-001: (f) FAB-151D:
Coupling devices used:	CDN-M2 for Power ports, EM clamp for signal and control ports

Results:

Performance check results obtained:	The EUT continued to operate as intended during and after the test. No malfunction or degradation of performance, or loss of function was observed during and after the test.

Note:	(1) Cable length between “GPS ANT” and “VHF ANT” ports of FA-100 and DB-1 port was 1 m as stated in the manufacture’s specifications, and tests were not applicable. (2) Test frequencies of 45.0 MHz, 45.1 MHz (TDMA RX 1st IF) and 21.4 MHz (DSC RX 1st IF) were excluded for the tests, because those frequencies falls into the EUT narrow band responses (spurious responses). (3) Separate type antennas of GSC-001 for GPS RX and FAB-151D for VHF TX/RX were tested in addition to Combined antenna GVA-100.
Measurement uncertainty:	Has been taken into account when the limits have been set. (See also prEN 50222)
Environmental conditions observed:	On 30 November, 23 - 23 °C, 52 - 52 %RH Power supply voltage measured: 24.1 - 24.1 VDC On 1 December, 23 - 24 °C, 52 - 54 %RH Power supply voltage measured: 24.1 - 24.1 VDC On 19 December, 23 - 23 °C, 52 - 52 %RH Power supply voltage measured: 24.1 – 24.1 VDC On 20 December, 24 - 24 °C, 54 - 54 %RH Power supply voltage measured: 24.1 – 24.1 VDC

3.9.3 Immunity to radiated radio frequencies

IEC 60945 reference:	10.4
EUT category:	All equipment except submerged.
Basic standard applied:	IEC 61000-4-3

Test conditions:
The performance of the EUT shall be the criterion A as defined in IEC 60945 Third edition: 1996-11 when placed in a modulated electric field strength 10 V/m swept over the frequency range 80 MHz to 1 GHz. The modulation shall be at 400 Hz ± 10% to a depth of 80% ± 10%.

Performance check:	See Clause 1.6 of this report.
Dwell time and frequency step:	3 s 1 %
Measuring/Test instruments used:	See Clause 4.7 of this report.
Distance between test antenna and EUT:	3 m
Test arrangement:	See Clause 5.2 of this report.

Results:

Performance check results obtained:	The EUT continued to operate as intended during and after the test. No malfunction or degradation of performance, or loss of function was observed during and after the test.
Note:	(1) Following test frequencies were excluded for the tests, because those frequencies fall into the EUT RX frequencies and the EUT narrow band responses (spurious responses): for CH. A of TDMA RX: - 161.975 MHz (f(RX)), - 251.975 MHz (f(RX) + 2 x f(1st IF)), for CH. B of TDMA RX: - 162.025 MHz (f(RX)), - 252.225 MHz (f(RX) + 2 x f(1st IF)), for GPS RX: - 1/7, 1/4, 1/3, 1/2 of GPS RX frequency (1575.42 MHz) (2) Separate type antennas of GSC-001 for GPS RX and FAB-151D for VHF TX/RX were tested in addition to Combined type antenna GVA-100.
Measurement uncertainty:	Has been taken into account when the limits have been set. (See also prEN 50222)

Environmental conditions observed:	On 3 December, 23 - 23 °C, 52 - 52 %RH Power supply voltage measured: 24.1 - 24.1 VDC, On 17 December, 23 - 23 °C, 52 - 52 %RH Power supply voltage measured: 24.1 - 24.1 VDC On 18 December, 23 - 23 °C, 52 - 52 %RH Power supply voltage measured: 24.1 - 24.1 VDC

3.9.4 Immunity to fast transients on a. c. power, signal and control lines

IEC 60945 reference:	10.5
EUT category:	All equipment except submerged.
Basic standard applied:	IEC 61000-4-4

Test conditions:
The performance of the EUT shall be the criterion B as defined in IEC 60945 Third edition: 1996-11 when pulses of the following characteristics are applied to its power, control and signal lines:

rise time:	5 ns (values between 10% and 90%)
width:	50 ns (50% value)
amplitude:	2 kV differential on a. c. power lines 1 kV comon mode on signal and control lines
repetition rate:	5 kHz (1 kV), 2.5 kHz (2 kV)
application:	15 ms burst every 300 ms
duration:	3 min to 5 min for each of positive and negative polarity pulses

Performance check:	See Clause 1.6 of this report.
Measuring/Test instrument used:	See Clause 4.7 of this report.
Test arrangement:	See Clause 5.2 of this report.
Ports tested:	Power ports: None. (Not applicable to d. c. power port.) Signal and control ports: (a) FA-100: LAN (10B-T), AD-10 IN, EXTRA I/O, to JUNCTION BOX. (b) CB-100: FA-100, SENSOR3, BEACON IN, L/R, PC I/O, ALARM OUT. (c) DB-1: (d) GVA-100:
Coupling devices:	CDN for AC Power port, Capacitive clamp for signal and control ports.

Results:

Performance check results obtained:	The EUT continued to operate as intended after the test. No malfunction or degradation of performance, or loss of function was observed after the test.
Note:	
Measurement uncertainty:	Has been taken into account when the limits have been set. (See also prEN 50222)
Environmental conditions observed:	On 21 December, 23 - 23 °C, 54 - 52 %RH Power supply voltage measured: 24.0 - 24.0 VDC

3.9.5 Immunity to surges on a. c. power lines (Not applicable)

IEC 60945 reference:	10.6
EUT category:	All equipment except portable.
Basic standard applied:	IEC 61000-4-5

Test conditions:
The performance of the EUT shall be the criterion B as defined in IEC 60945 Third edition: 1996-11 when pulses of the following characteristics are applied to its power lines:

rise time:	1.2 µs (values between 10% and 90%)
width:	50 µs (50% value)
amplitude:	1 kV line/earth
	0.5 kV line/line
repetition rat:	1 pulse per min.
application:	continuous
duration:	5 min for each of positive and negative polarity pulses

Performance check:	
Measuring/Test instrument used:	
Test arrangement:	
Ports tested:	

Results:

Performance check results obtained:	Not applicable to d. c. powered equipment.
Note:	
Measurement uncertainty:	
Environmental conditions observed:	

3.9.6 Immunity to power supply short-term variation (Not applicable)

IEC 60945 reference:	10.7
EUT category:	All equipment except portable.
Basic standard applied:	IEC 61000-4-11

Test conditions:
The performance of the EUT shall be the criterion B as defined in IEC 60945 Third edition: 1996-11 when submitted to the following power supply variation relative to nominal value 1/min for 10 min:

a) Voltage: nominal + (20 ± 1)%, duration 1.5 s ± 0.2 s
Frequency: nominal + (10 ± 0.5)%, duration 5 s ± 0.5 s, superimposed

b) Voltage: nominal – (20 ± 1)%, duration 1.5 s ± 0.2 s
Frequency: nominal – (10 ± 0.5)%, duration 5 s ± 0.5 s, superimposed

c) Rise and decay times of voltage and frequency variation:
0.2 s ± 0,1 s (from 10% to 90%)

Performance check:	
Measuring/Test instrument used:	
Test arrangement:	
Port tested:	

Results:

Performance check results obtained:	Not applicable to d. c. powered equipment.
Note:	
Measurement uncertainty:	
Environmental conditions observed:	

3.9.7 Immunity to power supply failure

IEC 60945 reference:	10.8
EUT category:	All equipment except portable.
Basic standard applied:	IEC 61000-4-11

Test conditions:
The performance of the EUT shall be the criterion C as defined in IEC 60945 Third edition: 1996-11 after each of three breaks in power supply of duration 60 s. There shall be no corruption of operational software or loss of essential data.

Performance check:	See Clause 1.6 of this report.
Measuring/Test instrument used:	See Clause 4.7 of this report.
Test arrangement:	See Clause 5.2 of this report.
Port tested:	Power (12 - 24 VDC)

Results:

Performance check results obtained:	The EUT continued to operate as intended after the test. No malfunction or degradation of performance, or loss of function was observed after the test.
Note:	
Measurement uncertainty:	Has been taken into account when the limits have been set. (See also prEN 50222)
Environmental conditions observed:	On 22 December, 20 - 20 °C, 47 - 47 %RH Power supply voltage measured: 24.0 - 24.0 VDC

3.9.8 Immunity to electrostatic discharge

IEC 60945 reference:	10.9
EUT category:	All equipment except submerged.
Basic standard applied:	IEC 61000-4-2

Test conditions:
The performance of the EUT shall be the criterion B as defined in IEC 60945 Third edition: 1996-11 when the test levels are 6 kV (direct- and indirect-) contact and 8 kV air discharge.

Performance check:	See Clause 1.6 of this report.
Measuring instrument used:	See Clause 4.7 of this report.
Test arrangement:	See Clause 5.2 of this report.

Results:

Performance check results obtained:	The EUT continued to operate as intended after the test. No malfunction or degradation of performance, or loss of function was observed after the test.
Note:	(1) The EUT, Junction Box CB-100, Distributor DB-1 and Combined Antenna GVA-100 were not tested, because there was no part to be touched by crews after the installation and in normal operating conditions.
Measurement uncertainty:	Has been taken into account when the limits have been set. (See also prEN 50222)
Environmental conditions observed:	On 22 December, 20 - 20 °C, 47 - 47 %RH Power supply voltage measured: 24.0 - 24.0 VDC

3.10 Special purpose tests
3.10.1 Acoustic noise and signals Test

IEC 60945 reference:	11.1
EUT category:	All equipment intended for installation in wheelhouses and bridge wings
Basic standard applied:	IEC 60651

Limits/Test conditions:

- Distance from any part of EUT to microphone of sound-level meter: 1 m
- Sound-level meter: Complying with IEC 60651
- EUT operating condition: Gives the highest level of unwanted acoustic noise power.
- Acoustic noise power limit: ≦ 60 dB(A)
- Audible alarm power limit: 75 - 85 dB(A)

EUT: FA-100, DB-1, CB-100.

Measuring/Test instruments used: See Clause 4.8 of this report.

EUT/Test arrangement: - Powered on.

Results:

Results obtained: - The acoustic noise and the audible alarm power levels generated by the EUT were found within the specified limits. (see the table below for details.)

Name	Acoustic noise level measured (dB (A))		Audible alarm level measured (dB(A))	Remarks
	EUT powered off	EUT powered on		
Transponder FA-100	28	28	76 - 81	
Distributor DB-1		28	NA	
Junction box CB-100		28	NA	

Note: NA - Not applicable.

Environmental conditions observed: On 13 March 2002,
Temperature: 21°C, Humidity: 45%RH
Power supply voltage measured: 24.0 VDC

3.10.2 Compass safe distance measurement

IEC 60945 reference:	11.2
EUT category:	All equipment except submerged.
Basic standard applied:	ISO/R 694 (ISO 694: 2000)

Limits/Test conditions:

- Position and attitude of the EUT:	At which the error produced at the compass would be a maximum, provided the item can be fitted in this way.
- Compass safe distance (CSD) for the standard compass:	The distance between the nearest point of the EUT and the center of the compass at which it will not produce a deviation in the compass of more than 5.4 °/H.
- CSD for the steering compass:	The permitted deviation is 18°/H.
Test conditions:	a) in the magnetic condition, b) after magnetization, c) in the energized condition.
EUT:	
Measuring/Test instruments used:	See Clause 4.9 of this report.
EUT/Test arrangement:	Power off and on (receive mode).

Results:

Results obtained:

	CSD for STD compass (m)		CSD for STR compass (m)	
	Power off	Power on	Power off	Power on
Transponder FA-100	0.9	1.0	0.6	0.6
Max. value:	1.0		0.6	
Junction box CB-100	0.6	0.6	0.4	0.4
Max. value:	0.6		0.4	
Distributor DB-1	0.3	0.3	0.3	0.3
Max. value:	0.3		0.3	
Combined antenna GVA-1	0.3	0.3	0.3	0.3
Max. value:	0.3		0.3	

Environmental conditions observed: On 7 March 2002,
Temperature: 21°C, Humidity: 54%RH

3.11 Safety precautions
3.11.1 Protection against accidental access to dangerous voltages

IEC 60945 reference:	12.1
EUT category:	All equipment.
Basic standard applied:	IEC 60529

Limits/Test conditions:

- Degrees of protection:	IEC 60529, table I,
- Brief description:	First characteristic numeral 2. Protected against access to hazardous parts with a finger.
- Definition:	The joint test finger of 12 mm ϕ, 80 mm length, shall have adequate clearance from hazardous parts.
EUT:	FA-100, DB-1, CB-100, GVA-100.
Measuring/Test instruments used:	See Clause 4.10 of this report.

Results:

Results obtained:

(1) There were no openings of the enclosure of the EUT to allow access to hazardous parts with the test finger.
(2) Any further access to the interior of the EUT was only possible by means of a spanner or screwdriver after the installation according to the manufacturer's specifications.
(3) There were no dangerous voltages over 50 Vpeak in the EUT (except radio frequency voltages).

3.11.2 Electromagnetic radiofrequency radiation

IEC 60945 reference:	12.2
Basic standard applied:	None.

Limits/Test conditions:

- Equipment category:	Designed to radiate electromagnetic radio frequency energy,
- Frequency range:	Above 30 MHz,
- Operational state and condition:	Emitting the maximum radiation, (PN Pattern, TDMA Type 1 & 2, DSC 1, 2 & 3) TX power: nominal High (12.5 W).
EUT antenna:	GVA-100
Measuring/Test instruments used:	See Clause 4.11 of this report.

Results:

- Maximum distance from the EUT at which 100 W/m^2 was measured:	Not applicable.
- Maximum distance from the EUT at which 10 W/m^2 was measured for the EUT radiating at frequencies below 1 GHz:	Not applicable.
- Description in the equipment manual:	Not applicable.
- Results obtained:	At the EUT surface, maximum radiation power density measured was found 2.64 W/ m^2.
Environmental conditions observed:	On 23 April 2002, 20 - 20°C, 63 - 63%RH, Power supply voltage: 24.0 - 24.0 VDC.

3.11.3 Emission from visual display unit (VDU)

IEC 60945 reference:	12.3
Basic standard applied:	None.

Limits/Test conditions:

- Magnetic flux density:	5 Hz to 2 kHz:	≦ 200 nT,
	2 kHz to 400 kHz:	≦ 25 nT
- Electromagnetic radiation:	5 Hz to 2 kHz:	≦ 10 V/m at 30 cm,
	2 kHz to 400 kHz:	≦ 1 V/m at 30 cm
- Electrostatic field:	≦ ± 500 V	

EUT:	FA-100
Measuring/Test instruments used:	See Clause 4.12 of this report.
EUT arrangement:	Display Brilliance: center, Display Contrast: center.

Results:

Results obtained:	Passed.
- Magnetic flux density	
for 5 Hz to 2 kHz:	5.9 nT
for 2 kHz to 400 kHz:	0.8 nT
- Electromagnetic radiation	
for 5 Hz to 2 kHz:	0.4 V/m
for 2 kHz to 400 kHz:	0.05 V/m
- Electrostatic field:	28 V
Environmental conditions observed:	On 23 April, 20 - 20°C, 63 - 63%RH, Power supply voltage: 24.0 - 24.0 VDC.

3.11.4 X-radiation (Not applicable)

IEC 60945 reference: 12.4
Basic standard applied: None.

Limits/Test conditions:

- Dose rate: > 5 μJ/kgh (0.5 mrem/h)
- Distance: at 50 mm

EUT:

Measuring/Test instruments used:

EUT arrangement:

Results:

Results obtained: Not applicable.
The EUT display device was LCD, not CRT.

Environmental conditions observed:

3.12 Maintenance

IEC 60945 reference: 13
Minimum performance requirement reference: 4.9

Results observed

Observation	Result
- Main units of the EUT can be replaced readily without elaborate recalibration or readjustment.	Passed
- The EUT is readily accessible for inspection and maintenance purposes.	Passed

3.13 Equipment manual

IEC 60945 reference: 14
Minimum performance requirement reference: 4.10

Results observed

Observation	Result
- Adequate information is provided to enable the EUT to be properly operated and maintained.	Passed
- Operating and servicing manuals:	
a) are written in English.	Passed
b) identify the category of the equipment or units.	Passed
c) provide full circuit diagrams, component layouts and component parts list, where fault diagnosis and repair down to component level are practical,	NA
d) contain sufficient information to enable a defective complex module to be located, identified and replaced, where fault diagnosis and repair down to component level are not practical.	Passed

Note: NA - Not applicable.

3.14 Marking and identification

IEC 60945 reference: 15

Minimum performance requirement reference: 4.11

Results

Observation	Result
- Each unit of the EUT is marked externally with:	
a) identification of the manufacture,	Passed
b) equipment type number or model identification,	Passed
c) serial number of the unit.	Passed
- The title and version of each software element included in the installed software system are either marked or displayed on command on the EUT.	Passed
- When the marking and the title and version of the software are displayed only on the display, such information is also included in the EUT manual.	Passed

4 List of Measuring/Test Instruments

4.1 Measuring/Test Instruments for Operational checks:

C/N	Instrument	Type	S/N	Manufacturer	Calibration due date	Relevant clause no.
HT487	Dielectric withstand tester	TOS5051	FH000589	Kikusui	October 2002	3.1

4.2 Measuring/Test Instruments for Climatic Test:

C/N	Instrument	Type	S/N	Manufacturer	Calibration due date	Relevant clause no.
HT370	Climatic chamber (L)	TBE-3HW5GE2F	3013000995	Tabai Espec	July 2002	3.3
HT128	Temperature recorder (L)	437006/R1182	4370TB580	Yokogawa	July 2002	
HT415	Climatic chamber (S)	PL-4KP	14004204	Tabai Espec	May 2002	
HT416	Temperature recorder (S)	SRF-106	99400404	Tabai Espec	May 2002	

4.3 Measuring/Test Instruments for Vibration Test:

C/N	Instrument	Type	S/N	Manufacturer	Calibration due date	Relevant clause no.
HT367	Vibration test system (L)	VS-2000-20	S-4798	IMV	February 2004	3.4
HT373	Vibration test system (M)	VS-600-140	212540	IMV	November 2003	
HT396	Pickup sensor	VP-15	2344T	IMV	Every time	
HT397	Pickup sensor	VP-15	2341T	IMV	Every time	
HT399	Pickup sensor	V11-101S	S532	SHINKEN	Every time	
HT400	Pickup sensor	V11-101S	S533	SHINKEN	Every time	
HT438	Pickup sensor	VP-15	2327T	IMV	Every time	

4.4 Measuring/Test Instruments for Rain Test:

C/N	Instrument	Type	S/N	Manufacturer	Calibration due date	Relevant clause no.
HT194	Nozzle	IPX6	0004	Furuno	N. A.	3.5
HT197	Rain test set		D-005	Furuno	N. A.	
HT388	Rain test chamber	QBY-1002	D-006	Furuno	N. A.	
HT178	Pressure gauge	0.3 MPa	751419	TOKO	April 2002	

4.5 Measuring/Test Instruments for Corrosion Test:

C/N	Instrument	Type	S/N	Manufacturer	Calibration due date	Relevant clause no.
HT	Salt mist/Humidity chamber	CASS90	HJ299011	Suga		Not used.
HT	pH meter	HM-12P	64CY359W	Toa denpa		
HT	Hydrometer/ thermometer	Toyama	705070	Toa keiki		

4.6 Measuring/Test Instruments for EMC Emission Test:

C/N	Instrument	Type	S/N	Manufacturer	Calibration due date	Relevant clause no.
HT199	EMI receiver	ESCS30	826457/021	Rohde & Schwarz	December 2002	3.8.1/3.8.2
HT463	Spectrum analyzer	R3132	110401654	Advantest	August 2002	3.8.1/3.8.2
HT466	Transient limiter	11947A	3107A03364	Agilent	August 2002	3.8.1
HT328	Artificial mains network	MN425B	M13368	Anritsu	August 2002	3.8.1
HT468	Bilog antenna	CBL6141A	4200	Schaffner	August 2002	3.8.2
HT467	Double-ridged waveguide horn antenna	3115	6520	EMCO	August 2002	3.8.2
HT195	Active loop antenna	11966A (6502)	3202	HP/EMCO	August 2002	3.8.2
HT365	Semi-anechoic Chamber	3mSAC	D-002	Riken	September 2003	3.8.1/3.8.2

4.7 Measuring/Test Instruments for EMC Immunity Test:

C/N	Instrument	Type	S/N	Manufacturer	Calibration due date	Relevant clause no.
HT368	Anechoic chamber	3mAC	D-001	Riken	August 2002	3.9.2/3.9.3
HT131	Frequency generator	LFG-1300S	1607492	Leader electronics	October 2002	3.9.1
HT130	AC voltmeter	VP-9623A	545650E122	Panasonic	October 2002	3.9.1
HT338	Signal generator (10 kHz - 2.06 GHz)	SMY-02	839294/005 51400102	Rohde & Schwarz	August 2002	3.9.2/3.9.3
HT340	Power amplifier (10 kHz - 200 MHz)	M423/M5300	222-0595	IFI	August 2002	3.9.2/3.9.3
HT341	Power amplifier (200 MHz - 1 GHz)	SMCC-100	234-0395	IFI	August 2002	3.9.3

C/N	Instrument	Type	S/N	Manufacturer	Calibration due date	Relevant clause no.
HT347	RF millivoltmeter	URV5	51420006	Rohde & Schwarz	August 2002	3.9.2
HT349	100 V insertion unit	URV5Z4-01	51450089	Rohde & Schwarz	August 2002	3.9.2
HT148	CDN-M2	L801M2	259	LUTHI	January 2002	3.9.2
HT447	CDN-M2 (for 10 - 150 kHz)	TSCDN-M2-16A	2042	TSJ (FCC)	October 2002	3.9.2
HT302	EM injection clamp	TSIC-32	372	FCC	April 2002	3.9.2
HT213	Decoupling clamp	FTC101	4589	LUTHI	N. A.	3.9.2
HT395	E-field sensor (10 kHz - 1 GHz)	FP2000	25982	Amplifier Research	March 2002	3.9.3
HT342	E-field meter	FM2000	15912	Amplifier research	N. A.	3.9.3
HT344	Directional power sensor (25 MHz - 1 GHz)	NAP-Z6	839393/002	Rohde & Schwarz	August 2002	3.9.3
HT480	Power reflection meter (200 kHz - 4 GHz)	NRT	100162	Rohde & Schwarz	August 2002	3.9.3
HT345	Biconnical antenna	EM-6913	134	Electro-metrics	August 2002	3.9.3
HT346	Log-periodic antenna	EM-6950	610	Electro-metrics	August 2002	3.9.3
HT336	Burst generator	EFT500	0495-22	EM TEST	August 2002	3.9.4
HT183	Capacitive coupling clamp	HFK	0395-14	EM TEST	N. A.	3.9.4
HT182	Decoupling clamp	FTC101	4190	LUTHI	N. A.	3.9.4
HT219	3 Phase coupling network	CNI-503	0997-03	EM TEST	August 2002	3.9.4
HT335	ESD simulator	ESD-30	0495-05	EM Test	August 2002	3.9.8
HT173	DC power supply	GP035-30	1014397082	Takasago	N. A.	3.9.4/3.9.7/ 3.9.8

4.8 Measuring/Test Instruments for Acoustic noise and signals Test:

C/N	Instrument	Type	S/N	Manufacturer	Calibration due date	Relevant clause no.
HT453	Sound level meter	VS-3710A	66645	Panasonic	June 2002	3.10.1

4.9 Measuring/Test Instruments for Compass Safe Distance (CSD) measurements:

C/N	Instrument	Type	S/N	Manufacturer	Calibration due date	Relevant clause no.
HT433	3-axis Magnetic field meter	HM-310NR	003111	MTI	November 2002	3.10.2

4.10 Measuring/Test Instruments for Access Tests to Dangerous Voltages:

C/N	Instrument	Type	S/N	Manufacturer	Calibration due date	Relevant clause no.
HT435	Jointed test finger	P-10.09	d-008	EXCEL	N. A.	3.11.1

4.11 Measuring/Test Instruments for Electromagnetic RF radiation measurements:

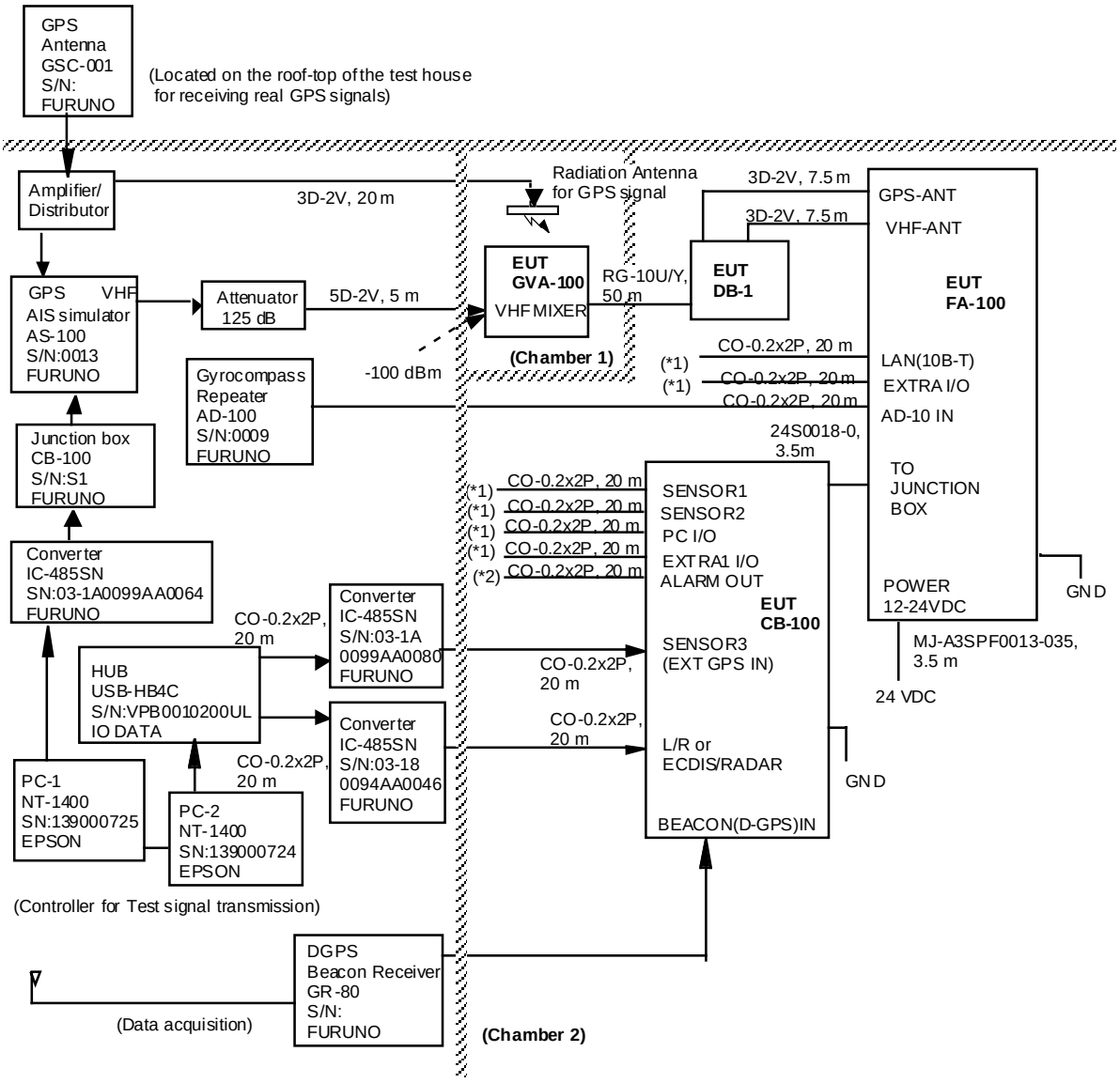
C/N	Instrument	Type	S/N	Manufacturer	Calibration due date	Relevant clause no.
HT330	Radiation hazard meter	Model 4C	211171	General Microwave	December 2002	3.11.2

4.12 Measuring/Test Instruments for Emission Measurement from VDU:

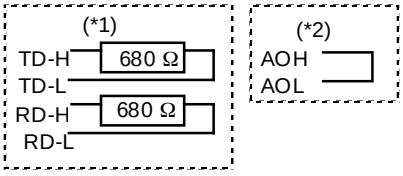
C/N	Instrument	Type	S/N	Manufacturer	Calibration due date	Relevant clause no.
HT196	Electrostatic voltmeter	Model 520-1	9830/007	Trek Japan	October 2002	3.11.3
HT184	Magnetic field meter (2 - 400 kHz)	BMM-5	5134	Enviromentor	June 2002	
HT185	Magnetic field meter (5 Hz - 2 kHz)	BMM-3000	36	Enviromentor	June 2002	
HT186	Electric field meter (5 Hz - 400 kHz)	EMM-4	4291	Enviromentor	June 2002	

5 EUT/ Test Arrangement

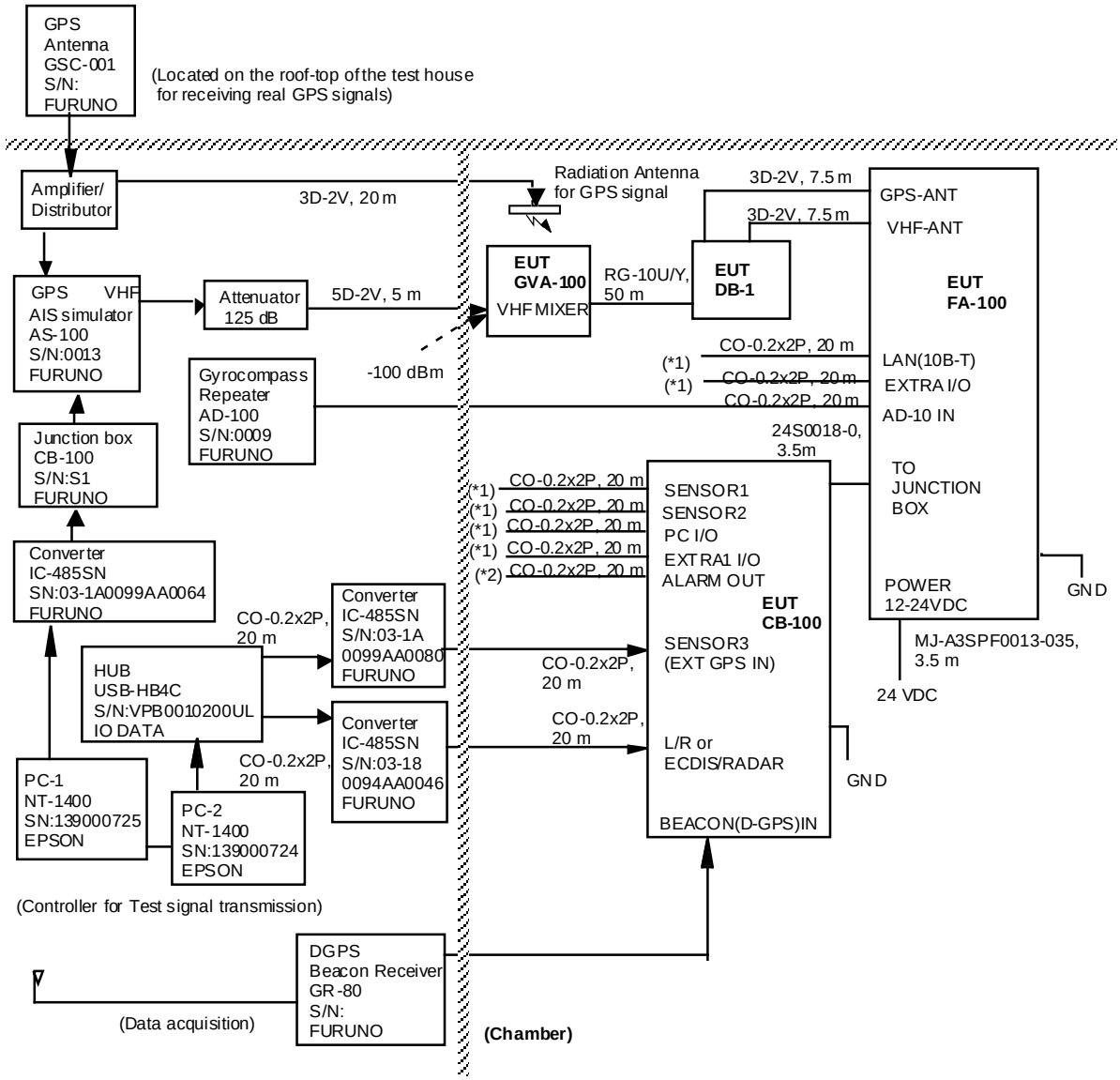
5.1 Climatic and Vibration tests,

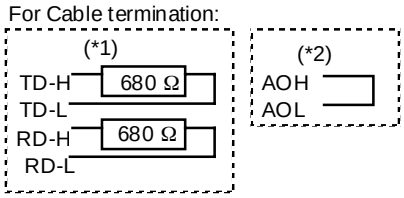


For Cable termination:



5.2 EMC tests,


GPS Antenna GSC-001 S/N: FURUNO
(Located on the roof-top of the test house for receiving real GPS signals)
Amplifier/ Distributor
3D-2V, 20 m
Radiation Antenna for GPS signal
3D-2V, 7.5 m
3D-2V, 7.5 m
GPS-ANT
VHF-ANT
EUT GVA-100
VHF MIXER
RG-10U/Y, 50 m
EUT DB-1
EUT FA-100
GPS VHF AIS simulator AS-100 S/N:0013 FURUNO
Attenuator 125 dB
5D-2V, 5 m
-100 dBm
CO-0.2x2P, 20 m
(*1)
LAN(10B-T)
EXTRA I/O
AD-10 IN
Gyrocompass Repeater AD-100 S/N:0009 FURUNO
Junction box CB-100 S/N:S1 FURUNO
24S0018-0, 3.5m
TO JUNCTION BOX
SENSOR1
SENSOR2
PC I/O
EXTRA1 I/O
ALARM OUT
EUT CB-100
SENSOR3 (EXT GPS IN)
POWER 12-24VDC
GND
MJ-A3SPF0013-035, 3.5 m
24 VDC
Converter IC-485SN SN:03-1A0099AA0064 FURUNO
CO-0.2x2P, 20 m
(*2)
Converter IC-485SN S/N:03-1A 0099AA0080 FURUNO
HUB USB-HB4C S/N:VPB0010200UL IO DATA
Converter IC-485SN S/N:03-18 0094AA0046 FURUNO
L/R or ECDIS/RADAR
BEACON(D-GPS)IN
PC-1 NT-1400 SN:139000725 EPSON
PC-2 NT-1400 SN:139000724 EPSON
(Controller for Test signal transmission)
DGPS Beacon Receiver GR-80 S/N: FURUNO
(Data acquisition)
(Chamber)


For Cable termination:
(*1)
TD-H
680 Ω
TD-L
RD-H
680 Ω
RD-L
(*2)
AOH
AOL

6 EUT Test Results taken during tests

This clause contains test results taken during the Climatic tests.

Table 6.1 - Cross-reference between EN 60945 and IEC 61993-2

EN 60945 Clause No. and Test item			IEC 61993-2 Clause No.			
			Transmitter		Receiver	
			Performance test	Performance check	Performance test	Performance check
8.2.1	Dry heat	- Storage tests	N. A.	14.1.1.1	N. A.	14.1.1.2
8.2.2	Dry heat	- Functional tests	15.1.1, 15.1.2, 14.7, 15.1.5, 15.1.6,	14.1.1.1	15.3.1, 15.3.2, 15.4.1, 14.7	14.1.1.2
8.3	Damp heat	- Functional tests	N. A.	14.1.1.1		14.1.1.2
8.4.2	Low temperature	- Functional tests	15.1.1, 15.1.2, 14.7, 15.1.5, 15.1.6,	14.1.1.1	15.3.1, 15.3.2, 15.4.1, 14.7	14.1.1.2

Table 6.2 - Test items of IEC 61993-2

IEC 61993-2 Clause No.	Test item
15.1.1	Frequency Error
15.1.2	Carrier Power
15.1.5	Transmitter Attack Time
15.1.6	Transmitter Release Time
15.3.1	Sensitivity – 25kHz Operation
15.3.2	Sensitivity – 12.5kHz Operation
15.4.1	Maximum Sensitivity
14.7	Channel selection
14.1.1	Operating mode / Capability - Autonomous mode

EUT:	Combined Antenna GVA-100	Transponder FA-100 Connection Box CB-100 Distributor DB-1
EUT category:	"Exposed"	"Protected"
Dry heat:	+70˚C --> +55˚C	+55˚C
Low temperature:	-25˚C	-15˚C

(1) TDMA Transmitter - Frequency Error (according to IEC 61993-2 Clause 15.1.1)

Date of test: 12 Feb. 2002 Ambient temp.: 23 °C R.H.: 41 %
Date of test: 14 Feb. 2002 Ambient temp.: 24 °C R.H.: 40 %

TEST CONDITIONS		FREQUENCY ERROR (Hz)							
		156.025 kHz		157.4125 kHz		160.6375 kHz		162.025 kHz	
Temperature	Voltage	H.P.	L.P.	H.P.	L.P.	H.P.	L.P.	H.P.	L.P.
Tmin (-15 °C)	*Vmin (21.6 V)*	- 658	- 568	- 665	- 568	- 645	- 561	- 632	- 560
	Vmax (31.2 V)	- 658	- 568	- 665	- 568	- 645	- 561	- 632	- 560
Tmax (+55 °C)	*Vmin (21.6 V)*	+ 507	+ 507	+ 507	+ 507	+ 513	+ 513	+ 517	+ 517
	Vmax (31.2 V)	+ 507	+ 507	+ 507	+ 507	+ 513	+ 513	+ 517	+ 517
Measurement uncertainty		±9 Hz							
Limits		≤ ±0.5 kHz under normal conditions, ≤ ±1 kHz under extreme conditions.							

H.P. = Output carrier power set at its nominal High: 12.5 W
L.P. = Output carrier power set at its nominal Low: 2 W

Measuring equipment used: 08, 12, 18

(2) TDMA Transmitter - Carrier Power (according to IEC 61993-2 Clause 15.1.2)

Date of test: 12 Feb. 2002 Ambient temp.: 23 °C R.H.: 41 %
Date of test: 14 Feb. 2002 Ambient temp.: 24 °C R.H.: 40 %

TEST CONDITIONS		CARRIER POWER (W)							
		156.025 kHz		157.41525 kHz		160.6375 kHz		162.025 kHz	
Temperature	Voltage	H.P.	L.P.	H.P.	L.P.	H.P.	L.P.	H.P.	L.P.
Tmin (-15 °C)	*Vmin (21.6 V)*	12.7	2.3	12.7	2.3	12.4	2.3	12.3	2.2
	Vmax (31.2 V)	12.7	2.3	12.7	2.3	12.4	2.3	12.3	2.2
Tmax (+55 °C)	*Vmin (21.6 V)*	9.9	1.8	9.1	1.8	9.6	1.7	9.1	1.7
	Vmax (31.2 V)	9.9	1.8	9.1	1.8	9.6	1.7	9.1	1.7
Measurement uncertainty		0.7 dB							
Limits		Normal test conditions: => H.P.: - between 8.8 and 17.7 W => L.P.: - between 1.4 and 2.8 W - within ± 1.5 dB of the rated carrier power Extreme test conditions: => H.P.: - between 6.3 and 19.8 W => L.P.: - between 1.0 and 3.2 W - within +2.0 & -3.0 dB of the rated carrier power							

H.P. = Output carrier power set at its nominal High: 12.5 W
L.P. = Output carrier power set at its nominal Low: 2 W

Measurement equipment used: 01, 12, 18

(3) TDMA Transmitter - Channel Switching (according to IEC 61993-2 Clause 14.7)

Date of test: 12 Feb. 2002 Ambient temp.: 23 °C R.H.: 41 %
Date of test: 14 Feb. 2002 Ambient temp.: 24 °C R.H.: 40 %

TEST CONDITIONS		Results	
Temperature	Voltage	156.025 kHz	160.6375 kHz
Tmin (-15 °C)	*Vmin (21.6 V)*	Passed	Passed
	Vmax (31.2 V)	Passed	Passed
Tmax (+55 °C)	*Vmin (21.6 V)*	Passed	Passed
	Vmax (31.2 V)	Passed	Passed
Required		- Confirm that the EUT switches to Channel / bandwidth and duplex / simplex channels accordingly. - Confirm that the EUT delivers a TXT - sentence with ID 036, followed by the ACA - sentences needed to inform of changes in the AIS use of regional operating settings.	
Measurement uncertainty		N. A.	

Measuring equipment used: 01, 02, 12, 18, 22

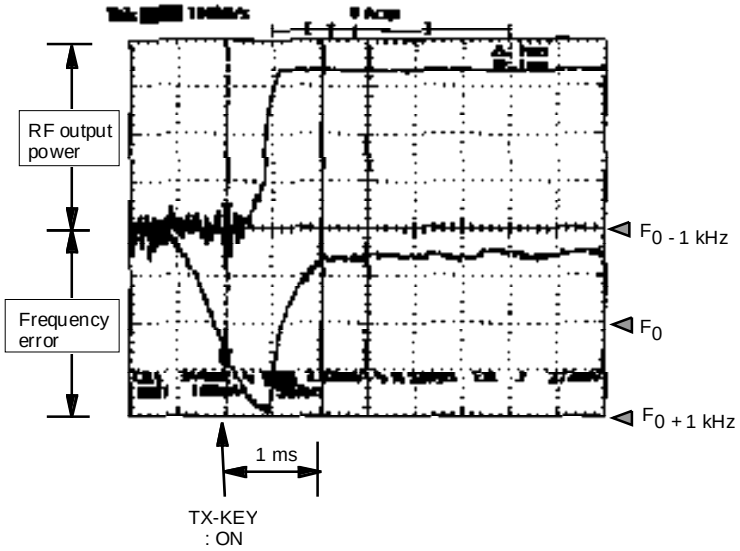
(4) TDMA Transmitter - Transmitter Attack Time (according to IEC 61993-2 Clause 15.1.5)

Date of test: 12 Feb. 2002 Ambient temp.: 23 °C R.H.: 41 %
Date of test: 14 Feb. 2002 Ambient temp.: 24 °C R.H.: 40 %

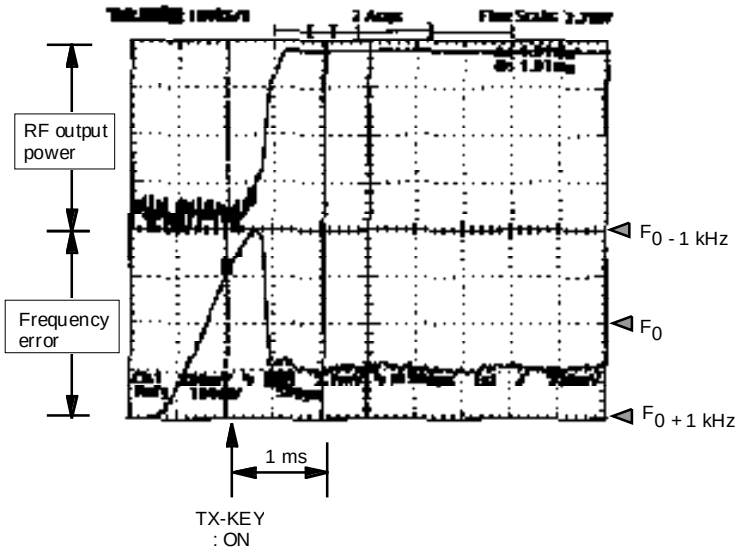
TX freq.: 156.025 MHz Carrier power: H. P.

PLOTS OF FREQUENCY DIFFERENCE/ OUT PUT POWER VERSUS TIME

At the Low-temperature cycle:



At the Dry heat cycle:



Measurement Uncertainty: ±2 %
Limit:
- Transmitter attack time T_0: within 1 ms,
- Transient power level: within +1.5 dB of its final value at any time,
- Carrier frequency Fc: within ± 1 kHz of its required value after 1 ms.

Measuring equipment used: 01, 05, 06, 10, 12, 15, 17, 18

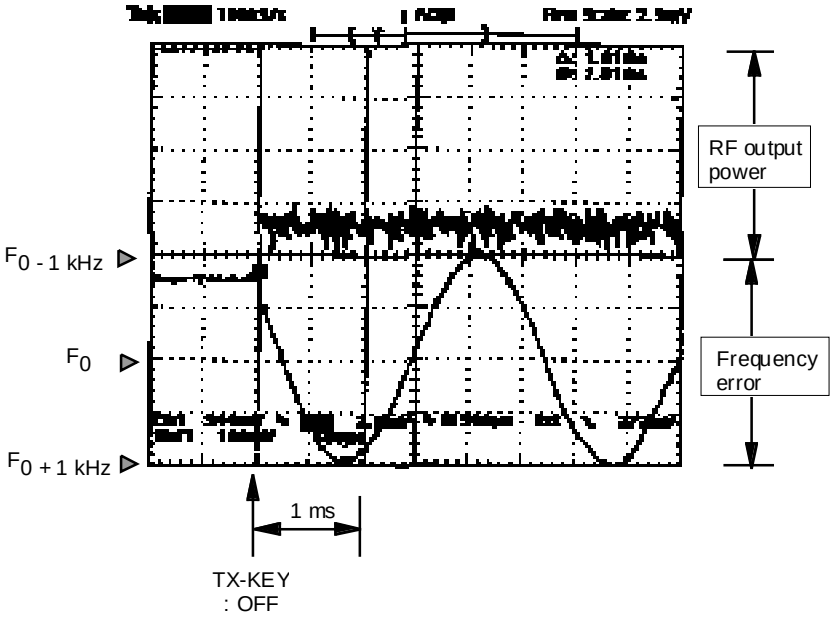
(5) TDMA Transmitter - Transmitter Release Time (according to IEC 61993-2 Clause 15.1.6)

Date of test: 12 Feb. 2002 Ambient temp.: 23 °C R.H.: 41 %
Date of test: 14 Feb. 2002 Ambient temp.: 24 °C R.H.: 40 %

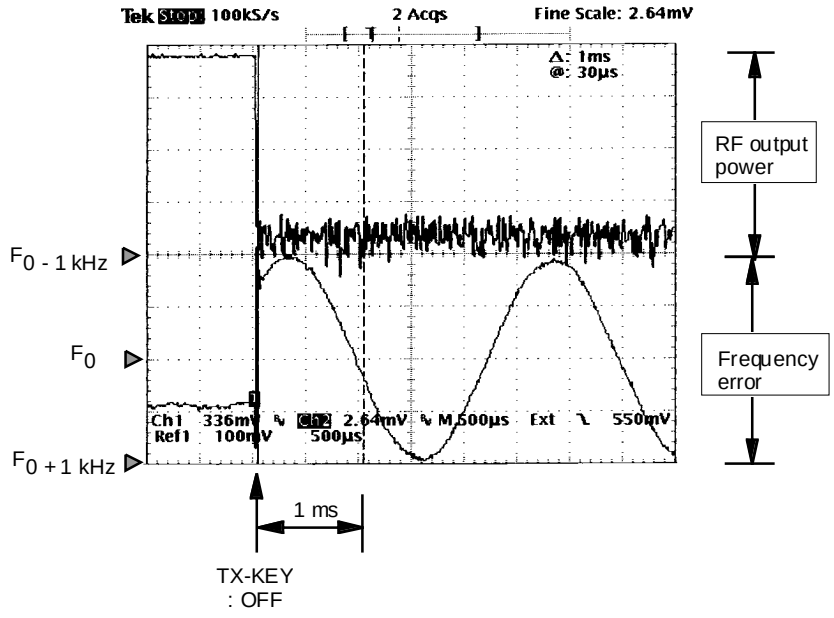
TX freq.: 156.025 MHz Carrier power: H. P.

PLOTS OF FREQUENCY DIFFERENCE/ OUT PUT POWER VERSUS TIME

At the Low-temperature cycle:



At the Dry heat cycle:



Measurement Uncertainty: ±2%.

Limit:- Transmitter release time T_r: within 1 ms,

Measuring equipment used: 01, 05, 06, 10, 12, 15, 17, 18

(6) Receiver
(6-1) TDMA Receiver - Sensitivity at 25 kHz (according to IEC 61993-2 Clause 15.3.1)

Date of test: 12 Feb. 2002 Ambient temp.: 23 °C R.H.: 41 %

Date of test: 14 Feb. 2002 Ambient temp.: 24 °C R.H.: 40 %

TEST CONDITIONS		SENSITIVITY LEVEL	
		Fn: 156.025 MHz	Fn: 162.025 MHz
Temperature	Voltage	RF level (dBm)	RF level (dBm)
Tmin (-15 °C)	*Vmin (21.6 V)*	- 110 dBm at 15% PER	- 111 dBm at 9% PER
	Vmax (31.2 V)	- 110 dBm at 15% PER	- 111 dBm at 9% PER
Tmax (+55 °C)	*Vmin (21.6 V)*	- 108 dBm at 12% PER	- 108 dBm at 10% PER
	Vmax (31.2 V)	- 108 dBm at 12% PER	- 108 dBm at 10% PER
Measurement uncertainty		±1 dB	
Limits		≤ - 107 dBm with a PER of 20% under normal test conditions, ≤ - 101 dBm with a PER of 20% under extreme test conditions,	

Measuring equipment used: 02, 18, 20, 21, 22

(6-2) TDMA Receiver - Sensitivity at 12.5 kHz (according to IEC 61993-2 Clause 15.3.2)

Date of test: 12 Feb. 2002 Ambient temp.: 23 °C R.H.: 41 %
Date of test: 14 Feb. 2002 Ambient temp.: 24 °C R.H.: 40 %

TEST CONDITIONS		SENSITIVITY LEVEL	
		Fn: 157.4125 MHz	Fn: 160.6375 MHz
Temperature	Voltage	RF level (dBm)	RF level (dBm)
Tmin (-15 °C)	*Vmin (21.6 V)*	- 109 dBm at 16% PER	- 109 dBm at 11% PER
	Vmax (31.2 V)	- 109 dBm at 16% PER	- 109 dBm at 11% PER
Tmax (+55 °C)	*Vmin (21.6 V)*	- 106 dBm at 18% PER	- 106 dBm at 17% PER
	Vmax (31.2 V)	- 106 dBm at 18% PER	- 106 dBm at 17% PER
Measurement uncertainty		±1 dB	
Limits		≤ - 98 dBm with a PER of 20% under normal test conditions, ≤ - 92 dBm with a PER of 20% under extreme test conditions,	

Measuring equipment used: 02, 18, 20, 21, 22

(6-3) DSC Receiver - Sensitivity (according to IEC 61993-2 Clause 15.4.1)

Date of test: 12 Feb. 2002 Ambient temp.: 23 °C R.H.: 41 %
Date of test: 14 Feb. 2002 Ambient temp.: 24 °C R.H.: 40 %

TEST CONDITIONS		SENSITIVITY LEVEL (dBm)		
		Fn: 156.525 MHz (CH 70)		
Temperature	Voltage	Fn	Fn - 1.5 kHz	Fn + 1.5 kHz
Tmin (-15 °C)	*Vmin (21.6 V)*	- 107 dBm at 0.4% BER	- 106 dBm at 0.1% BER	- 106 dBm at 0.1% BER
	Vmax (31.2 V)	- 107 dBm at 0.4% BER	- 106 dBm at 0.1% BER	- 106 dBm at 0.1% BER
Tmax (+55 °C)	*Vmin (21.6 V)*	- 105 dBm at 0.8% BER	- 104 dBm at 0.2% BER	- 102 dBm at 0% BER
	Vmax (31.2 V)	- 105 dBm at 0.8% BER	- 104 dBm at 0.2% BER	- 102 dBm at 0% BER
Measurement uncertainty		±1 dB		
Limits		≤ - 107 dBm with a BER of 1% under normal test conditions, ≤ - 101 dBm with a BER of 1% under extreme test conditions,		

Measuring equipment used: 03, 18, 19, 20

(6-4) Channel Switching Time (according to IEC 61993-2 Clause 14.7)

Date of test: 12 Feb. 2002 Ambient temp.: 23 °C R.H.: 41 %
Date of test: 14 Feb. 2002 Ambient temp.: 24 °C R.H.: 40 %

TEST CONDITIONS		Results	
Temperature	Voltage	156.025 kHz	160.6375 kHz
Tmin (-15 °C)	*Vmin (21.6 V)*	Passed	Passed
	Vmax (31.2 V)	Passed	Passed
Tmax (+55 °C)	*Vmin (21.6 V)*	Passed	Passed
	Vmax (31.2 V)	Passed	Passed
Required		- Confirm that the EUT switches to Channel / bandwidth and duplex / simplex channels accordingly. - Confirm that the EUT delivers a TXT - sentence with ID 036, followed by the ACA - sentences needed to inform of changes in the AIS use of regional operating settings.	
Measurement uncertainty		N. A.	

Measuring equipment used: 01, 02, 12, 18, 22

TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS:

No.	Instrument/Ancillary	Type	Serial No.	Manufacturer	Calibration Due date
01	Spectrum analyzer	R3273	101003561	ADVANTEST	02. 2003
02	Vector Signal generator	SMIQ03B	1125.5555.03	R& S	02. 2002
03	Signal generator	8664A	3744A02535	Agilent	02. 2003
04	Signal generator	8664A	3744A02527	Agilent	02. 2003
05	Signal generator	2041	119864/055	Marconi	07. 2002
06	Modulation analyzer	8901B	3028A03046	H P	08. 2002
07	Modulation analyzer	8901B	2718A01184	H P	08. 2002
08	Frequency counter	5385A	2730A05114	H P	08. 2002
09	Audio analyzer	8903B	2818A04215	H P	08. 2002
10	Oscilloscope	TDS380P	J300711	Tektronix	04. 2002
11	Digital Multimeter	E2377A	3651J18669	H P	03. 2003
12	Attenuator (30dB)	8498A	1801A04084	H P	08. 2002
13	Printer	PM-2000C	ANF0025191	EPSON	- - - -
14	RF combiner	ZFSC-3-1	09642	Mini-Circuit	- - - -
15	Hybrid	CB722S	- - - -	TDK	- - - -
16	RF combiner	ZFSC-4-1	09810	Mini-Circuit	- - - -
17	SWR bridge	60NF50	- - - -	WILLTRON	- - - -
18	Power supply	PAN55-20	AK003307	KIKUSUI	- - - -
19	DSC signal generator	FMJ-0201	- - - -	Furuno	- - - -
20	Personal Computer	Endevor NT-1400	139000724	EPSON DIRECT	- - - -
21	Personal Computer	Endevor NT-1400	139000725	EPSON DIRECT	- - - -
22	AIS Transponder	AS-100	- - - -	Furuno	- - - -
23	Freq. Converter & SSB modulator	- - - -	- - - -	Furuno	- - - -

7 Vibration response plots taken during the tests

This clause contains the vibration response plots taken during the tests and listed in the following table.

Item no.	EUT			Description / Direction of Vibration
	Name	Type	S/N	
7.1				Summary of Vibration test results
7.2	U-AIS Transponder	FA-100	3539-0001	X (Left/Right)
7.3				Y (Back/Forth)
7.4				Z (Up/Down)
7.5				Position of Accelerometer
7.6	Junction Box	CB-100	0001	X (Left/Right)
7.7				Y (Back/Forth)
7.8				Z (Up/Down)
7.9				Position of Accelerometer
7.10	Distributor	DB-1	0001	X (Left/Right)
7.11				Y (Back/Forth)
7.12				Z (Up/Down)
7.13				Position of Accelerometer
7.14	Combined Antenna	GVA-100	0001	X (Left/Right)
7.15				Y (Back/Forth)
7.16				Z (Up/Down)
7.17				Position of Accelerometer

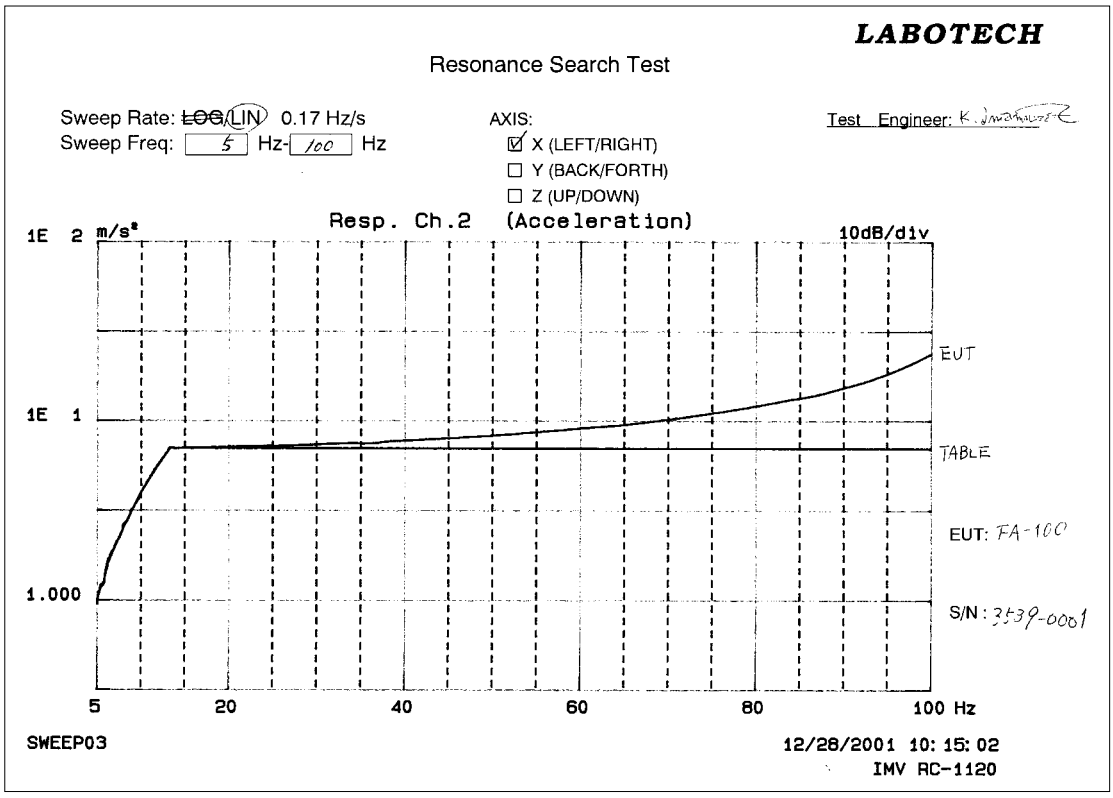
7.1 Summary of Vibration test results

EUT	Resonance points detected				Endurance test performed at freq. (Hz)	Remarks
	Vibration Direction	Freq. (Hz)	Acceleration (m/s^2)	Q		
U-AIS Transponder FA-100	X (left/right)	100.0	23.60	3.4	100.0	
	Y (back/forth)	51.20 100.0	20.75 15.40	3.0 2.2	51.20	
	Z (up/down)	64.20	12.55	1.8	64.20	
Junction Box CB-100	X (left/right)	(*)	(*)	(*)	30.0	
	Y (back/forth)	(*)	(*)	(*)	30.0	
	Z (up/down)	(*)	(*)	(*)	30.0	
Distributor DB-1	X (left/right)	(*)	(*)	(*)	30.0	
	Y (back/forth)	(*)	(*)	(*)	30.0	
	Z (up/down)	(*)	(*)	(*)	30.0	
Combined Antenna GVA-100	X (left/right)	50.62 99.87	217 55.4	31.0 7.9	50.62 99.87	
	Y (back/forth)	36.25	156.0	22.3	36.25	
	Z (up/down)	99.87	18.2	2.6	99.87	

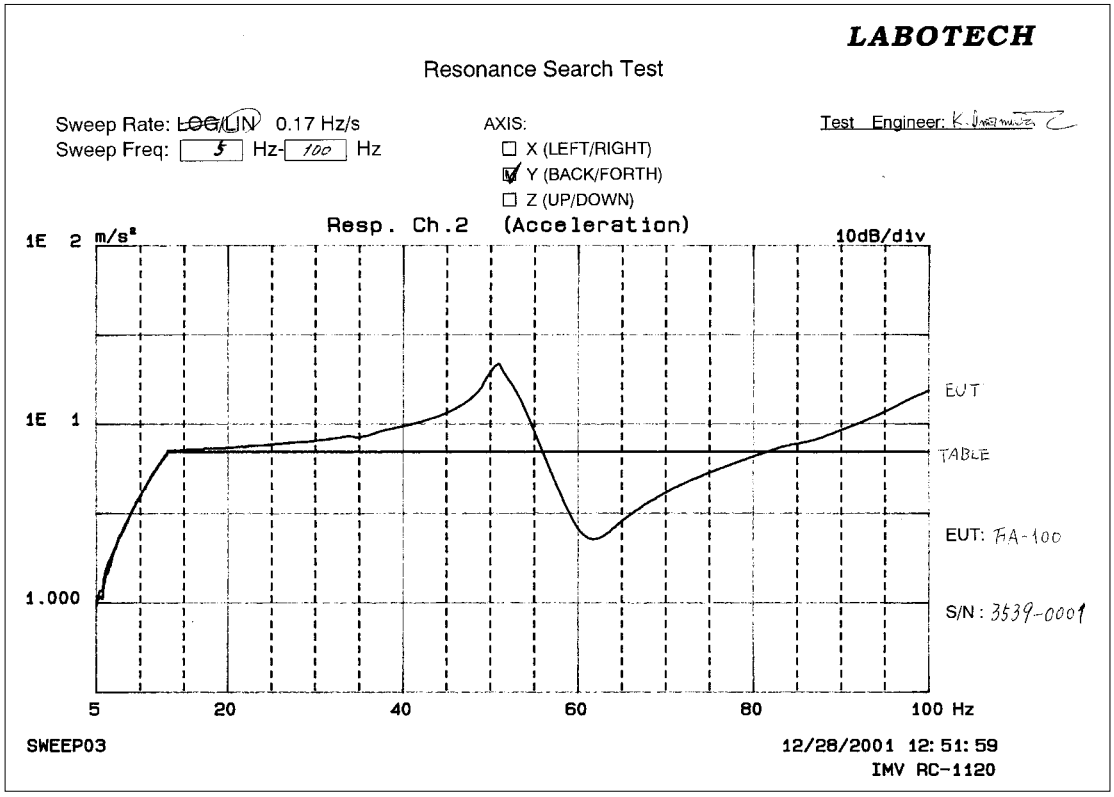
(Note: (*) – no resonance detected.)

Environmental conditions observed: On 27 December 2001, 23 - 26°C, 45 - 48%RH,
On 28 December 2001, 21 - 26°C, 42 - 49%RH,
On 29 December 2001, 18 - 21°C, 53 - 49%RH,

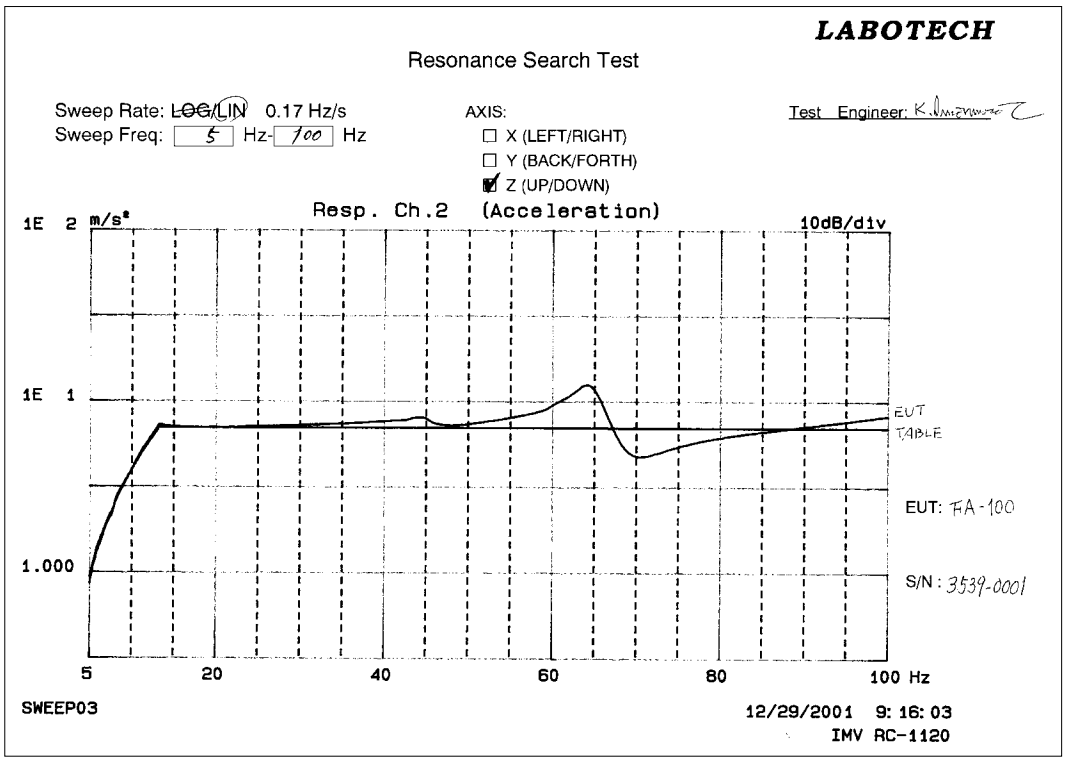
7.2 Vibration response plots for Transponder FA-100, X (Left/Right) Direction.



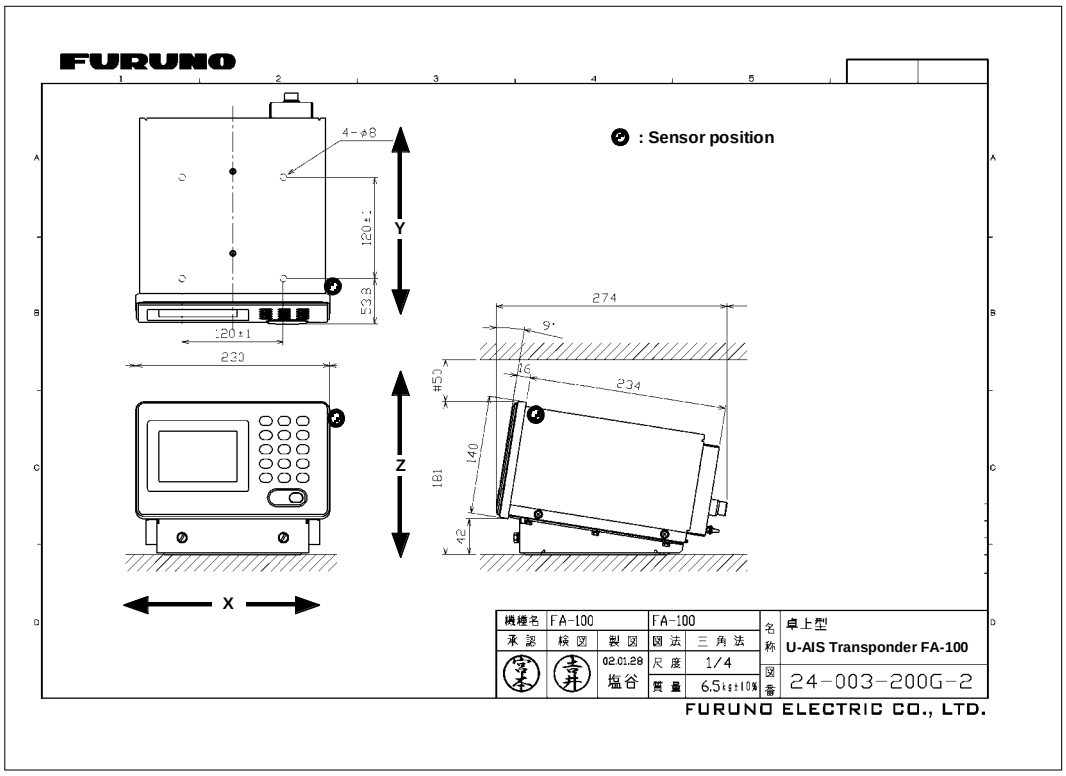
7.3 Vibration response plots for Transponder FA-100, Y (Back/Forth) Direction.



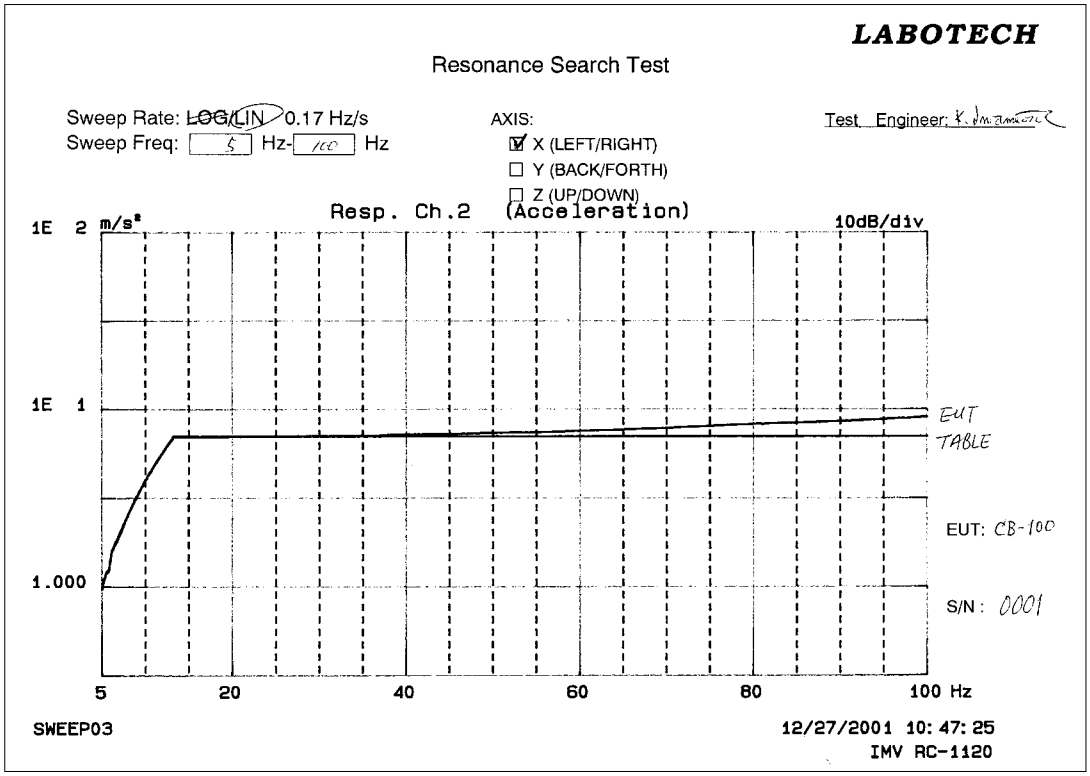
7.4 Vibration response plots for Transponder FA-100, Z (Up/Down) Direction.



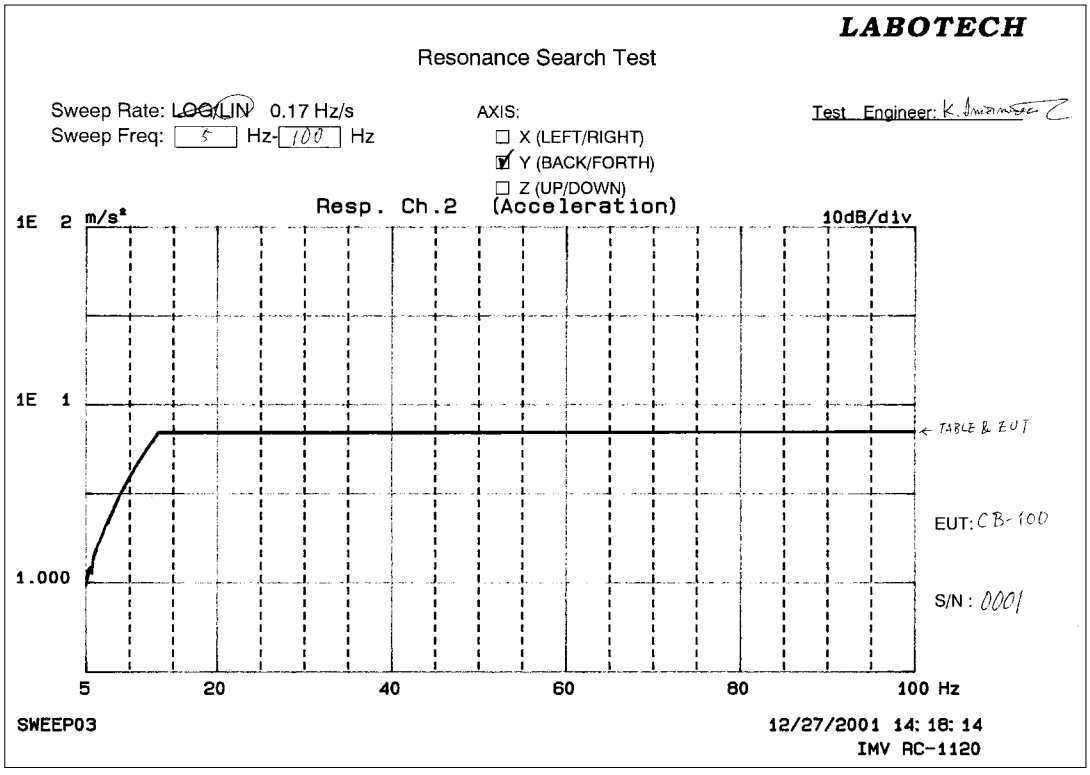
7.5 Position of Accelerometer for Transponder FA-100,



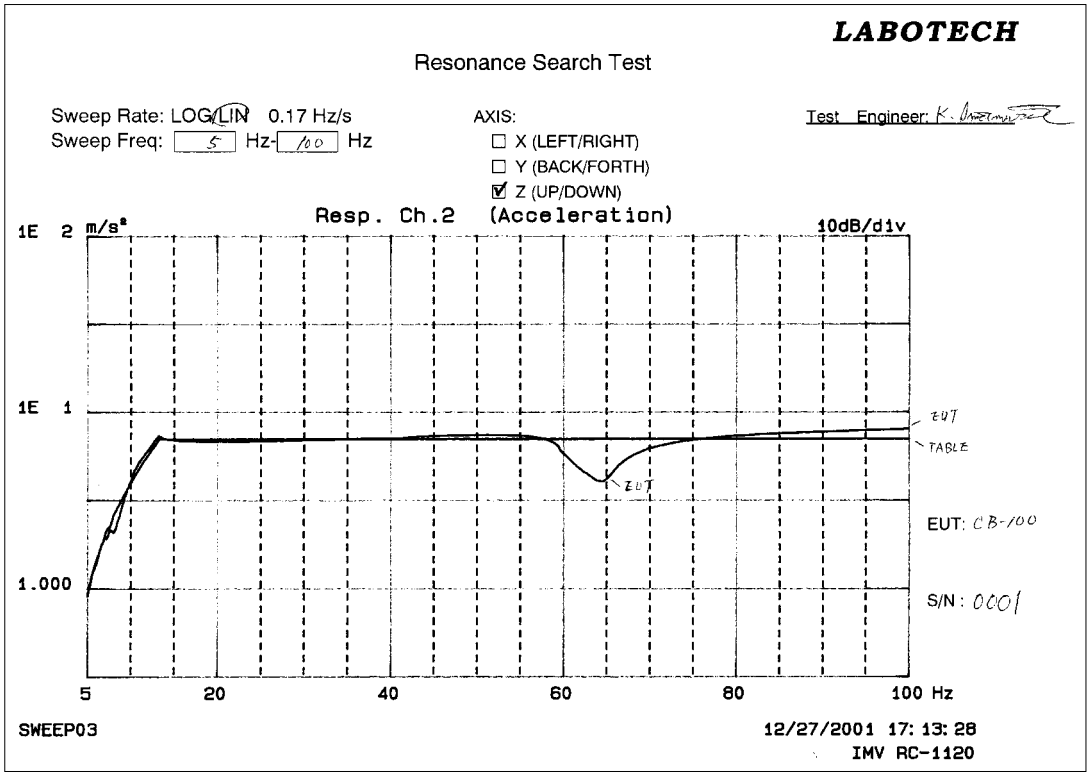
7.6 Vibration response plots for Junction Box CB-100, X (Left/Right) Direction.



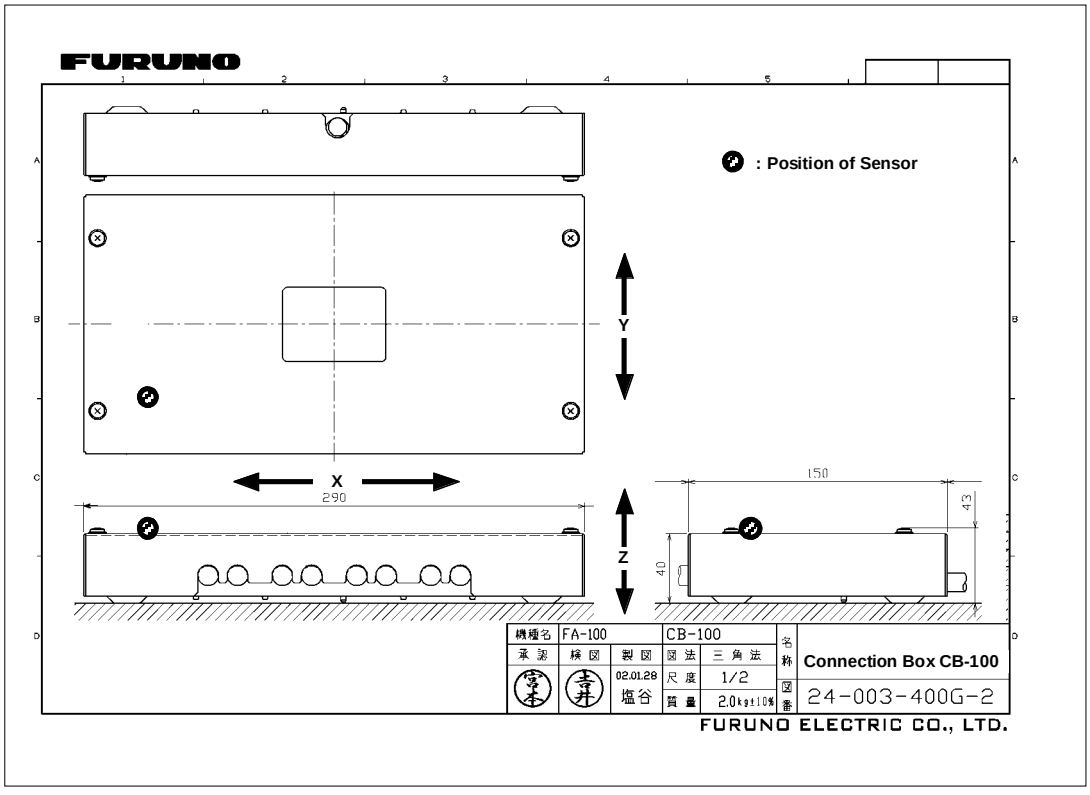
7.7 Vibration response plots for Junction Box CB-100, Y (Back/Forth) Direction



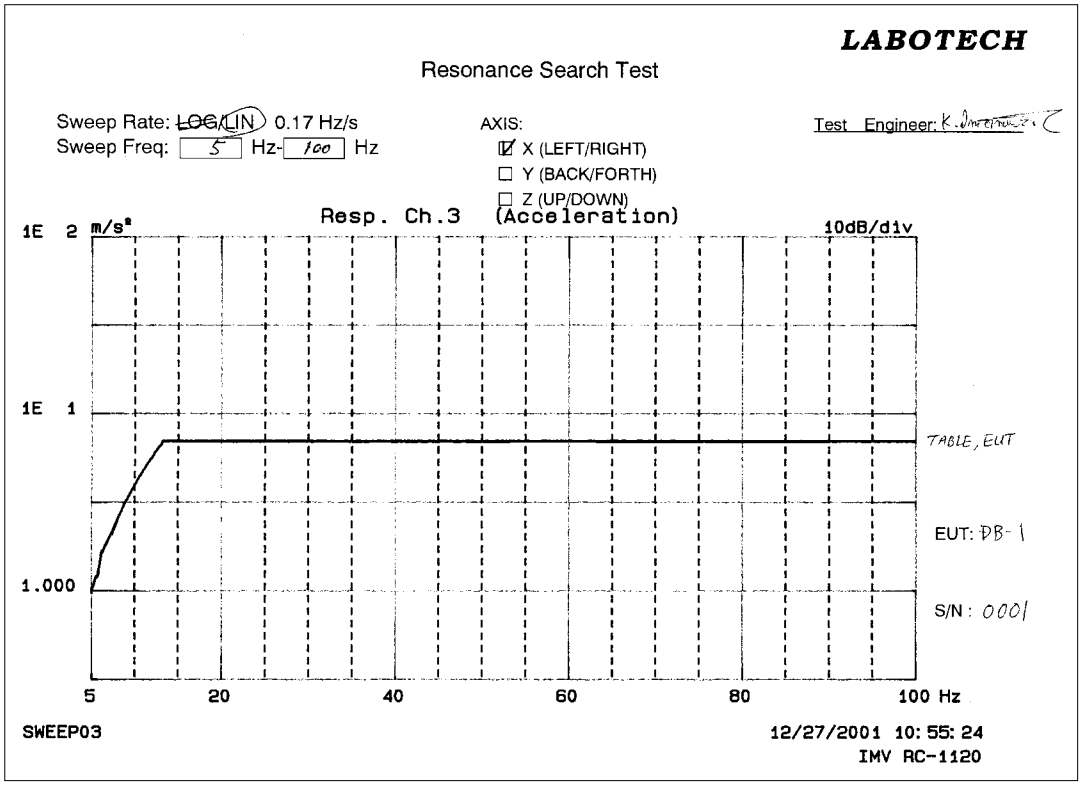
7.8 Vibration response plots for Junction Box CB-100, Z (Up/Down) Direction



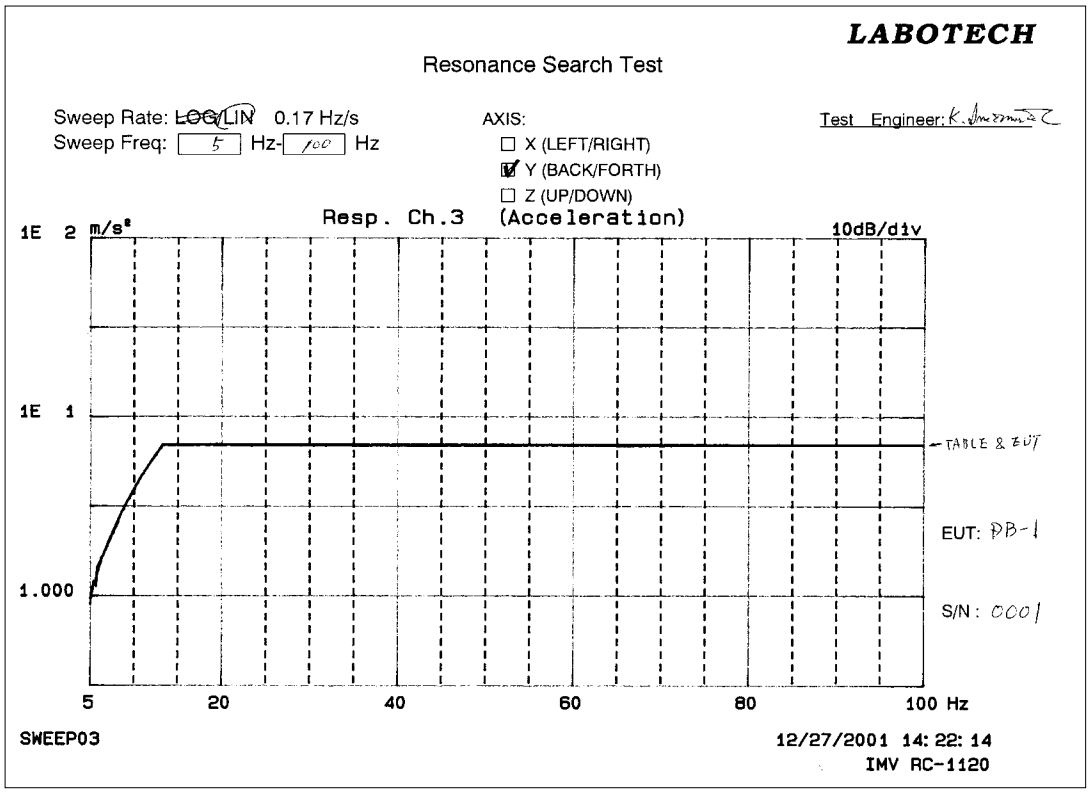
7.9 Position of Accelerometer for Junction Box CB-100



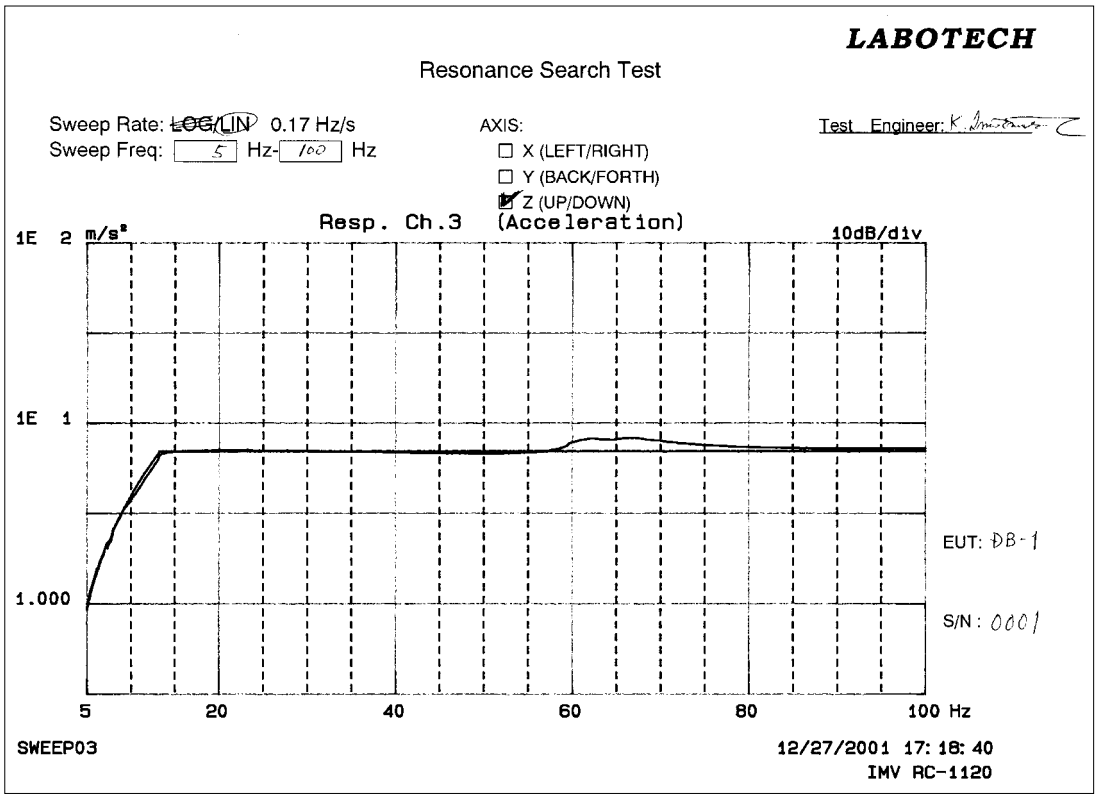
7.10 Vibration response plots for Distributor DB-1, X (Left/Right) Direction.



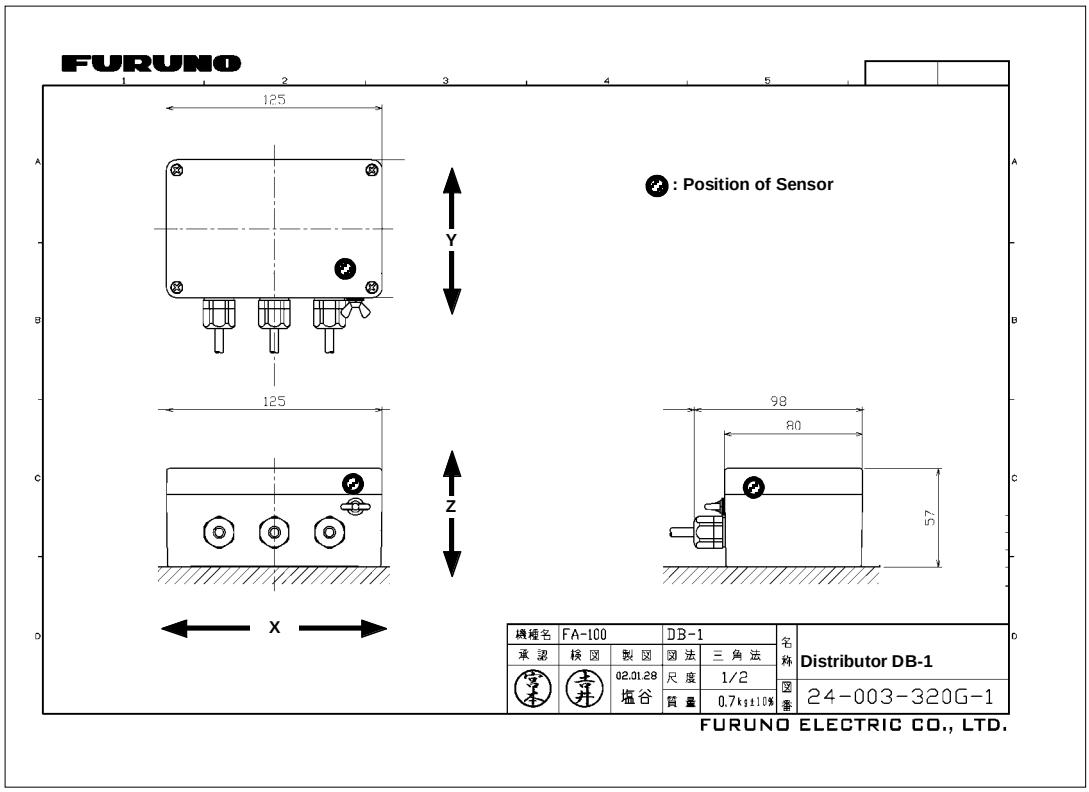
7.11 Vibration response plots for Distributor DB-1, Y (Back/Forth) Direction.



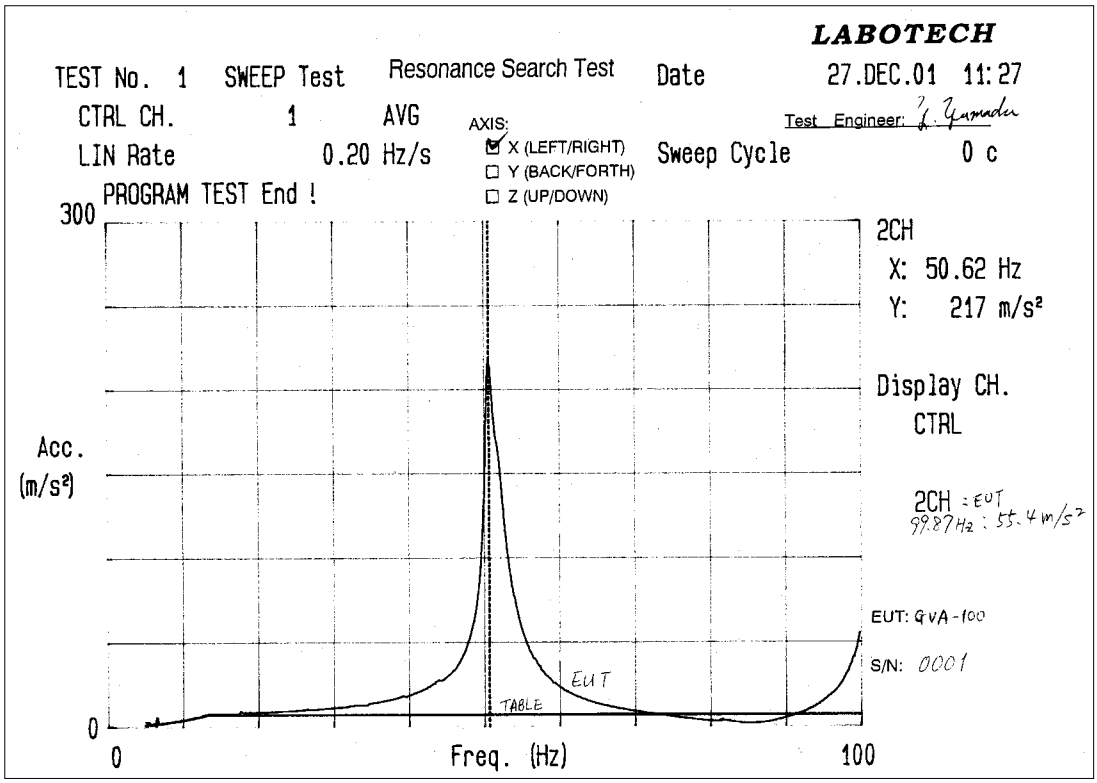
7.12 Vibration response plots for Distributor DB-1, Z (Up/Down) Direction.



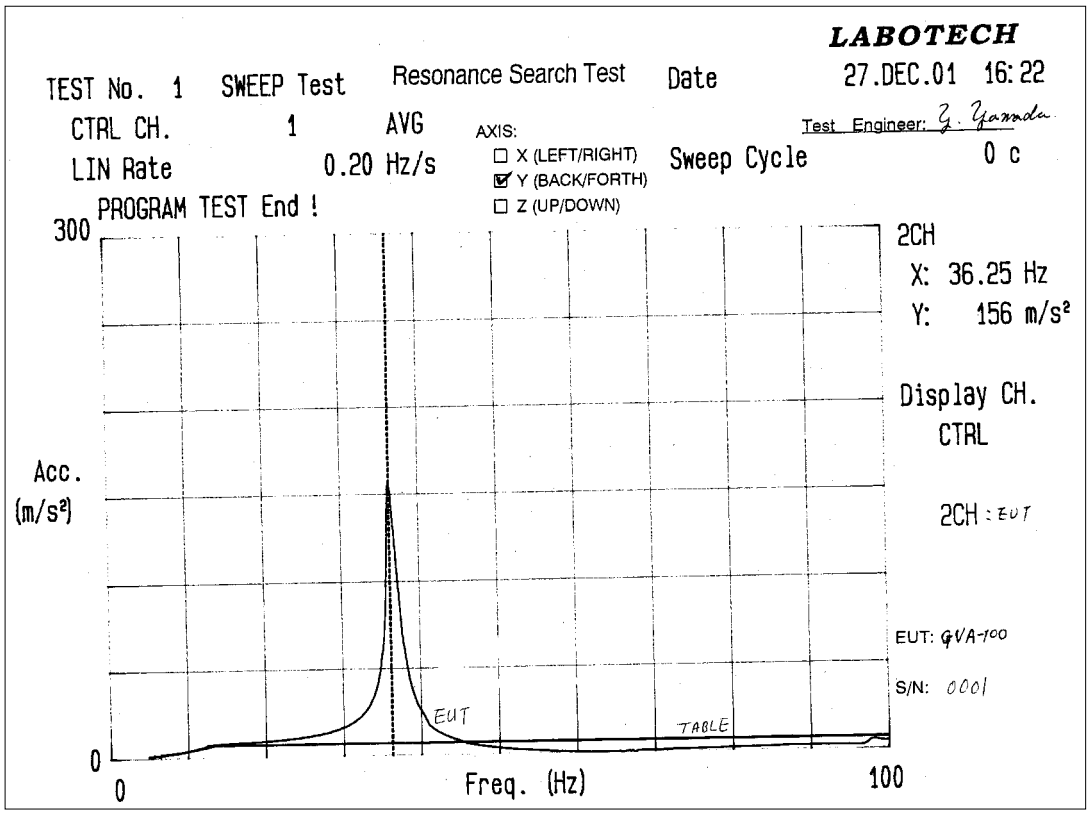
7.13 Position of Accelerometer for Distributor DB-1,



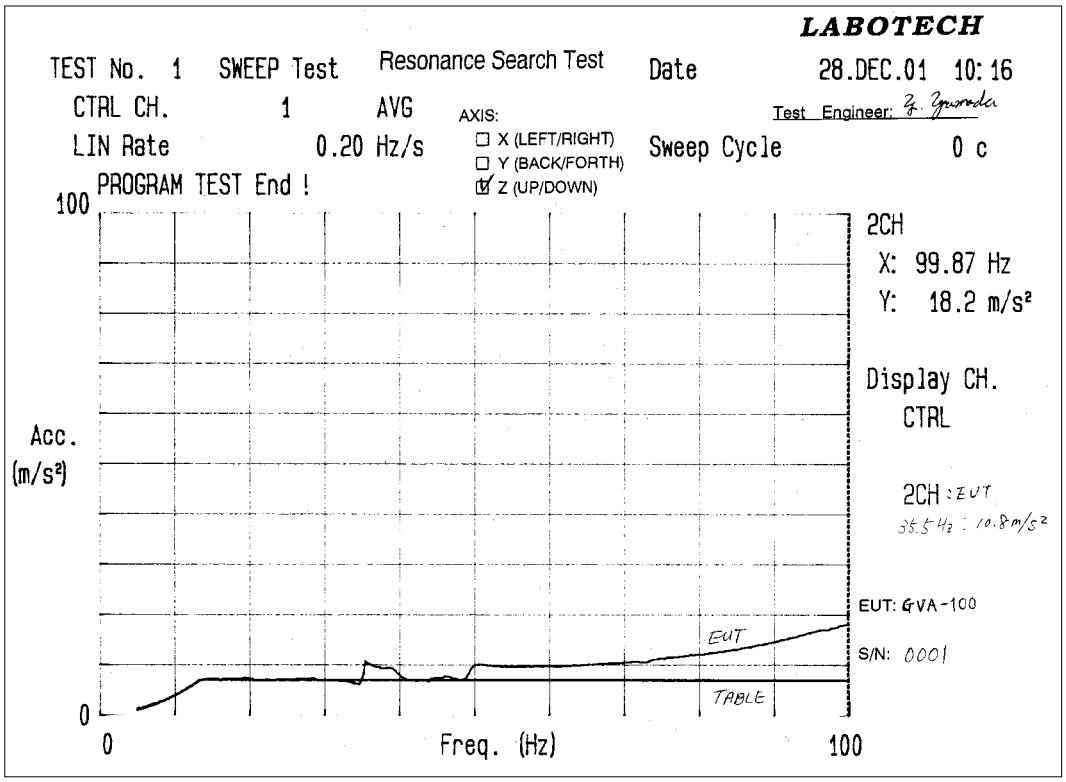
7.14 Vibration response plots for Combined Antenna GVA-100, X (Left/Right) Direction.



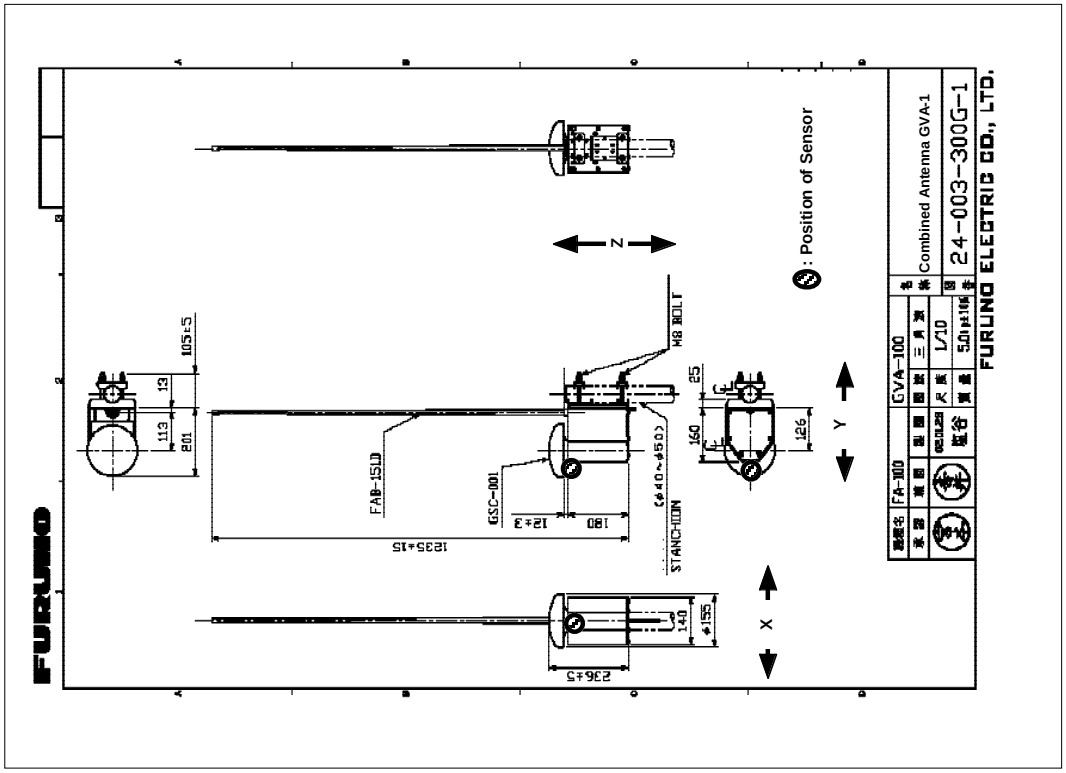
7.15 Vibration response plots for Combined Antenna GVA-100, Y (Back/Forth) Direction.



7.16 Vibration response plots for Combined Antenna GVA-100, Z (Up/Down) Direction.



7.17 Position of Accelerometer for Combined Antenna GVA-100,



8 EMC emission measurement plots taken during the tests

This clause contains the plots taken during the tests and listed in the following table.

Item No.	Relevant clause of this report	Description
8.1	3.6.1	Conducted emission: Plots in the frequency range of 10 kHz - 30 MHz for (L1) & (L2), 24VDC Power Port
8.2	3.6.1	Conducted emission: QP list in the frequency range of 10 kHz - 30 MHz for (L1) & (L2), 24 VDC Power Port
8.3	3.6.2	Radiated emission: Plots in the frequency range of 150 kHz - 30 MHz (0 & 90 degrees)
8.4	3.6.2	Radiated emission: QP list in the frequency range of 150 kHz - 30 MHz (0 & 90 degrees)
8.5	3.6.2	Radiated emission: Plots in the frequency range of 30 MHz - 2 GHz (Vertical & Horizontal)
8.6	3.6.2	Radiated emission: QP list in the frequency range of 30 MHz - 2 GHz (Vertical & Horizontal)

8.1 Conducted Emission: Plots in the frequency range of 10 kHz – 30 MHz (L1)+(L2), 24 VDC Power Port

Results of Conducted Emission

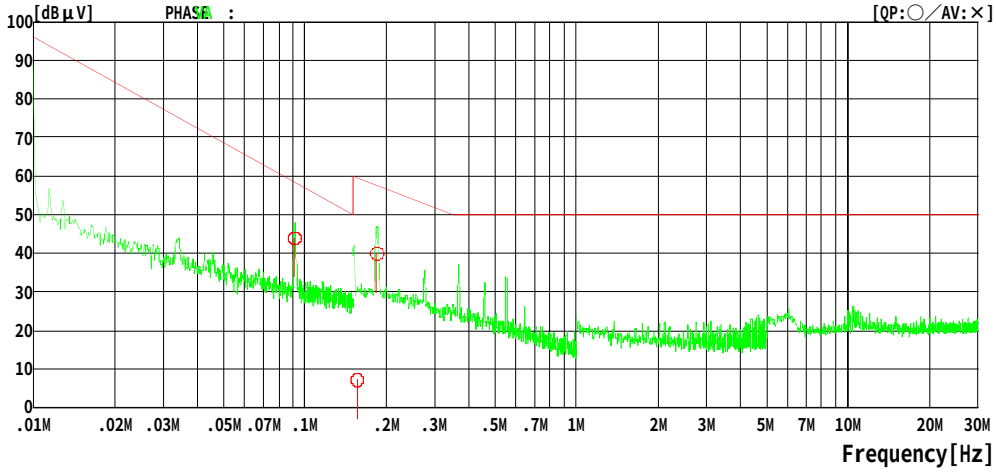
Furuno Labotech International CO., LTD.
Date : 2001/12/24 15:11

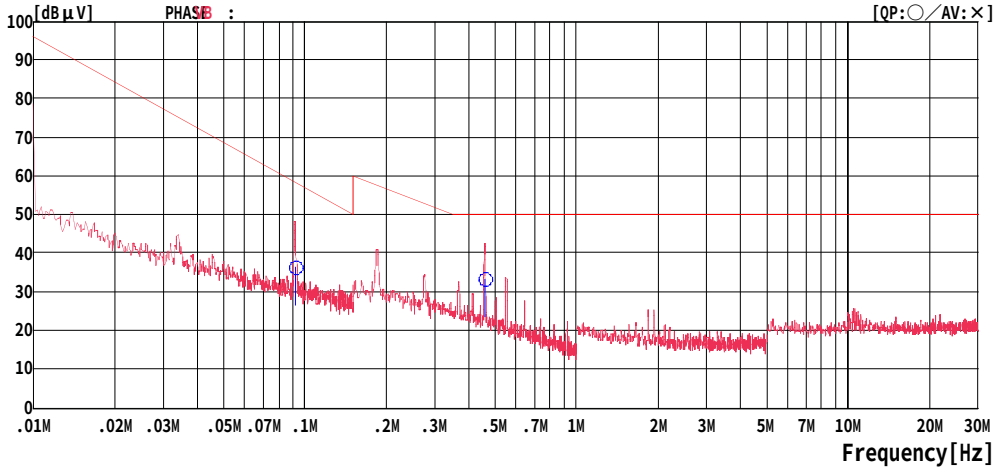
Model Name : UAIS Transponder
Type Name : FA-100
Serial No. : -0001
Test Mode : Automonus mode w/ 5 target

Test Site : Nishinomiya-Hama
Regulation : IEC 60945-3rd/1996-11
Power Supply : 24 VDC
Operator : T.Yokose

Memo :

LIMIT : IEC 60945 (QP)





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Comment: The spectrum represents peak values and the markers quasi-peak values.

8.2 Conducted Emission: QP list in the frequency range of 10 kHz – 30 MHz (L1)+(L2), 24 VDC Power Port

Results of Conducted Emission

Furuno Labotech International CO., LTD.
Date : 2001/12/24 15:11

Model Name : UAIS Transponder
Type Name : FA-100
Serial No. : -0001
Test Mode : Automonus mode w/ 5 target
Test Site : Nishinomiya-Hama
Regulation : IEC 60945-3rd/1996-11
Power Supply : 24 VDC
Operator : T.Yokose

Memo :

LIMIT : IEC 60945 (QP)

NO	FREQ [MHz]	READING QP [dBµV]	READING AV [dBµV]	C.F [dB]	IT [dB]	RESULT QP [dBµV]	RESULT AV [dBµV]	MARGIN QP [dB]	MARGIN AV [dB]	LIM QP/AV	PHASE
1	0.0917	30.3	----	13.8		44.1	----	14.3	58.4		VA
2	0.1552	-4.8	----	12.0		-7.2	----	52.4	59.6		VA
3	0.1833	28.3	----	11.6		39.9	----	17.7	57.6		VA
4	0.0920	22.7	----	13.8		36.5	----	21.8	58.3		VB
5	0.4599	22.8	----	10.6		33.4	----	16.6	50.0		VB

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8.3 Radiated Emission: Plots in the frequency range of 150 kHz – 30 MHz (0 & 90 degrees)

Results of Magnetic Field Emission

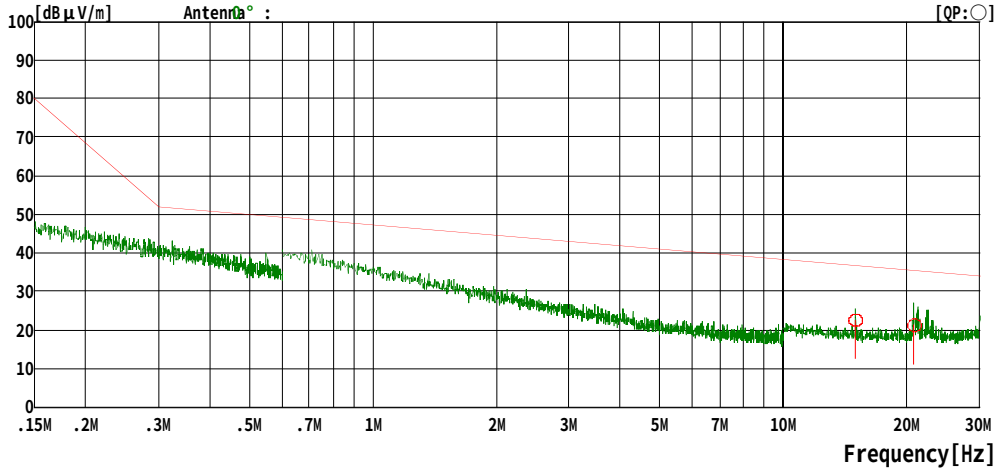
Furuno Labotech International CO., LTD.
Date : 2001/12/24 12:43

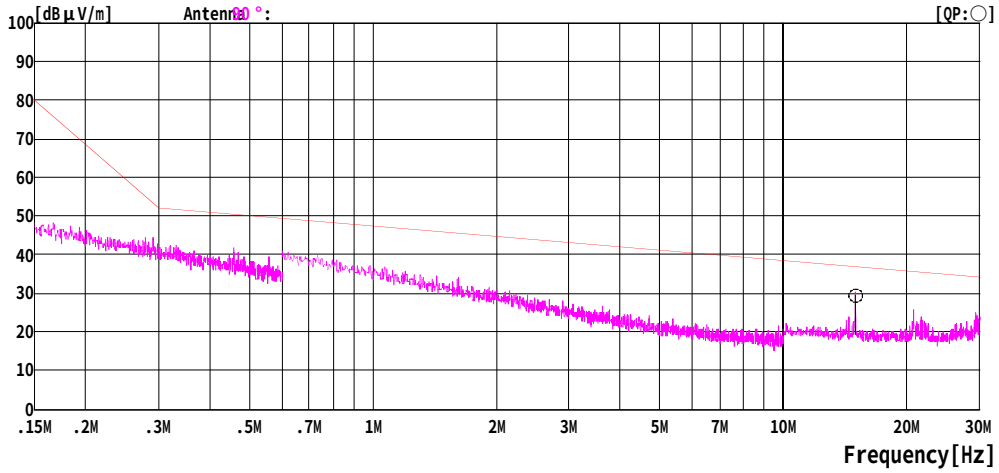
Model Name : UAIS Transponder
Type Name : FA-100
Serial No. : -0001
Test Mode : Automonus mode with 5 targ

Test Site : NISHINOMIYA-HAMA
Reguration : IEC 60945 3rd/1996-11
Power Supply : 24 VDC
Operator : T,Yokose

Memo :

LIMIT : IEC60945-3rd/1996-11 (3m)





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Comment: The spectrum represents peak values and the markers quasi-peak values.

8.4 Radiated Emission: QP list in the frequency range of 150 kHz – 30 MHz (0 & 90 degrees)

Results of Magnetic Field Emission

Furuno Labotech International CO., LTD.
Date : 2001/12/24 12:43

Model Name : UAIS Transponder
Type Name : FA-100
Serial No. : -0001
Test Mode : Automonus mode with 5 targ

Test Site : NISHINOMIYA-HAMA
Reguration : IEC 60945 3rd/1996-11
Power Supply : 24 VDC
Operator : T,Yokose

Memo :

LIMIT : IEC60945-3rd/1996-11 (3m)

No.	FREQ [MHz]	READING [dBμV]	ANT QP FACTOR [dB]	LOSS [dB]	ARGIN B]	RESULTANTENNA [dBμV/m]	LIMITTABLE M [dBμV/m]	[d	[DEG]
1	14.999	11.4	10.7	0.6	14.0	22.7	0 °	36.7	95
2	20.808	10.1	10.4	0.8	14.1	21.3	0 °	35.8	20
3	14.999	18.1	10.7	0.6	7.3	29.4	90 °	36.7	07

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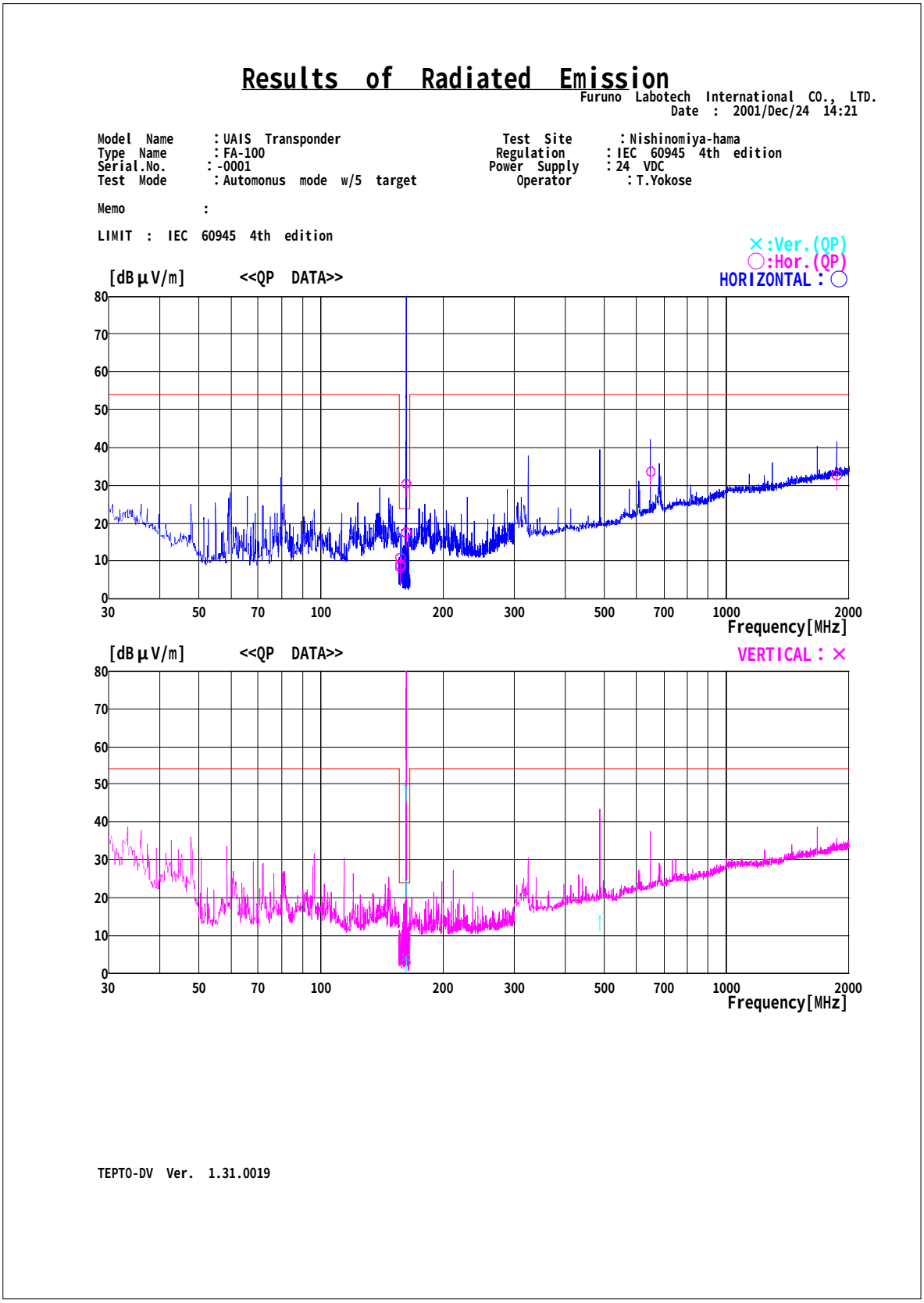
8.5 Radiated Emission: Plots in the frequency range of 30 MHz – 2 GHz



Comment: The spectrum represents peak values and the markers quasi-peak values.

8.6 Radiated Emission: QP list in the frequency range of 300 MHz – 2 GHz

Results of Radiated Emission

Furuno Labotech International CO., LTD.
Date : 2001/Dec/24 14:21

Model Name : UAIS Transponder
Type Name : FA-100
Serial.No. : -0001
Test Mode : Automonus mode w/5 target

Test Site : Nishinomiya-hama
Regulation : IEC 60945 4th edition
Power Supply : 24 VDC
Operator : T.Yokose

Memo :

LIMIT : IEC 60945 4th edition

No.	FREQ [MHz]	READING [dBµV]	ANT QP FACTOR [dB]	LOSS [dB]	GAIN [dB]	MARGIN [dB]	RESULT [dBµV/m]	ANTEN HEIGHT [cm]	TABLE [DEG]	
----- Horizontal ------										
1	156.757	17.3	12.4	2.1	23.3	15.5	8.5	209	24	333
2	156.757	19.8	12.4	2.1	23.3	13.0	11.0	191	24	255
3	156.757	17.8	12.4	2.1	23.3	15.0	9.0	105	24	298
4	162.191	26.7	12.1	2.2	23.4	6.4	17.6	133	24	9
5	162.025	39.5	12.2	2.2	23.4	-6.5	30.5	276	24	349
6	648.062	32.1	20.2	4.6	23.2	20.3	33.7	136	54	103
7	1862.776	21.8	27.0	8.1	24.1	21.2	32.8	100	54	106
----- Vertical ------										
8	162.147	13.2	12.2	2.2	23.4	19.8	4.2	321	24	254
9	162.028	58.2	12.2	2.2	23.4	-25.2	49.2	245	24	272
10	162.027	33.4	12.2	2.2	23.4	-0.4	24.4	237	24	5
11	485.919	17.1	17.5	3.8	23.4	39.0	15.0	395	54	145

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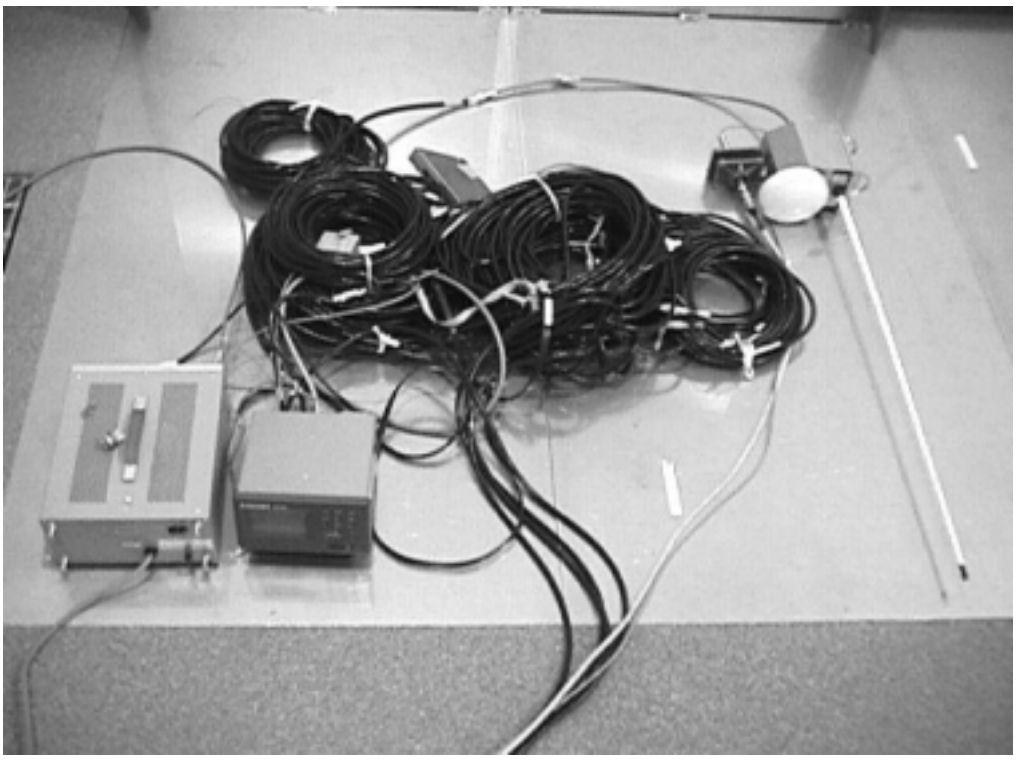
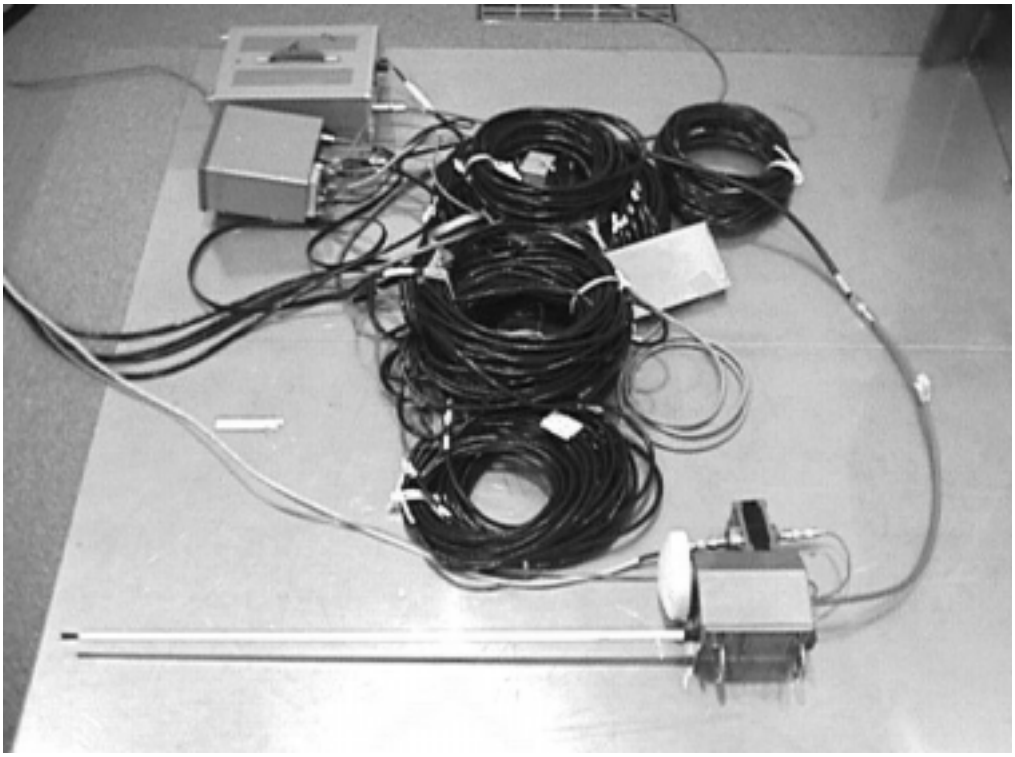
9 Photos of TEST Setup/Arrangement

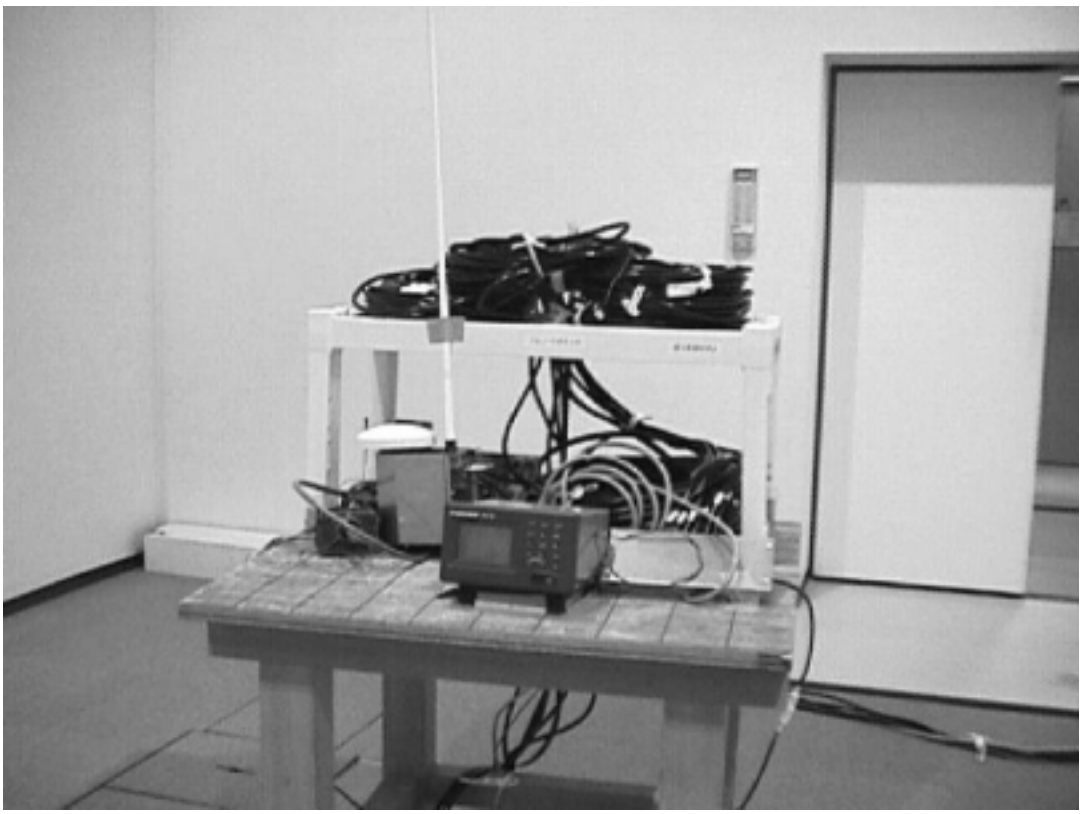
9.1 For EMC Emission – Conducted emission test



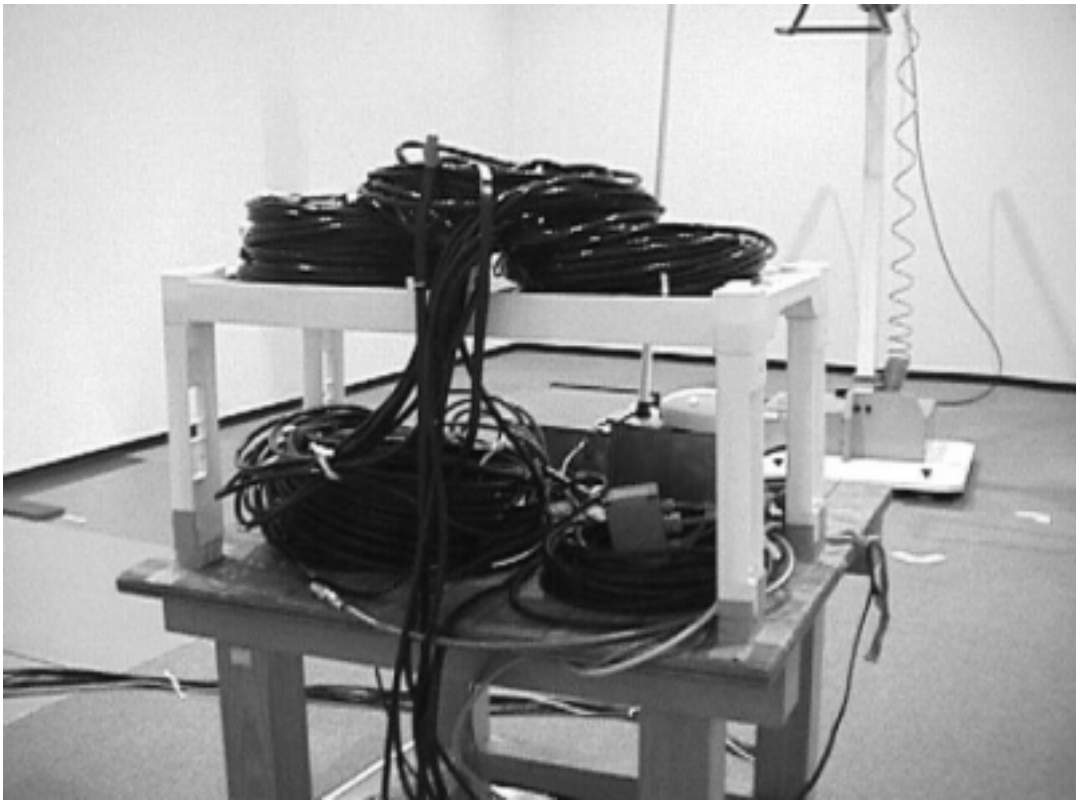
9.2 For EMC Emission – Conducted emission test



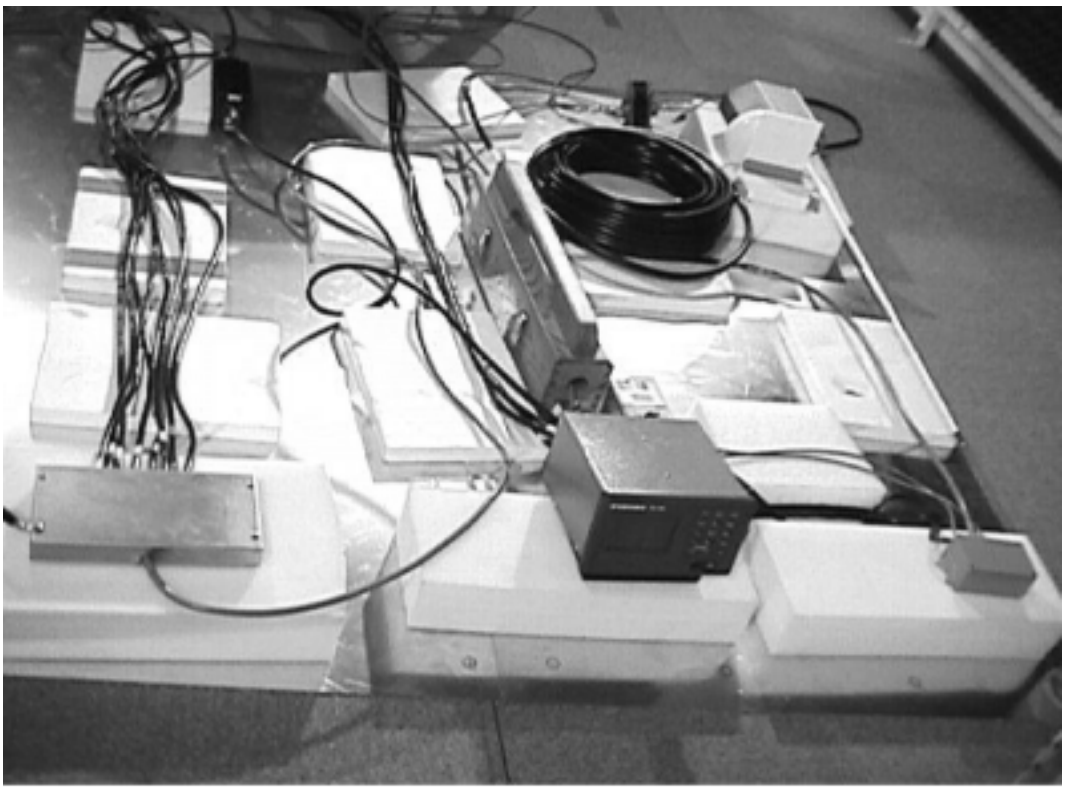
9.3 For EMC Emission – Radiated emission test



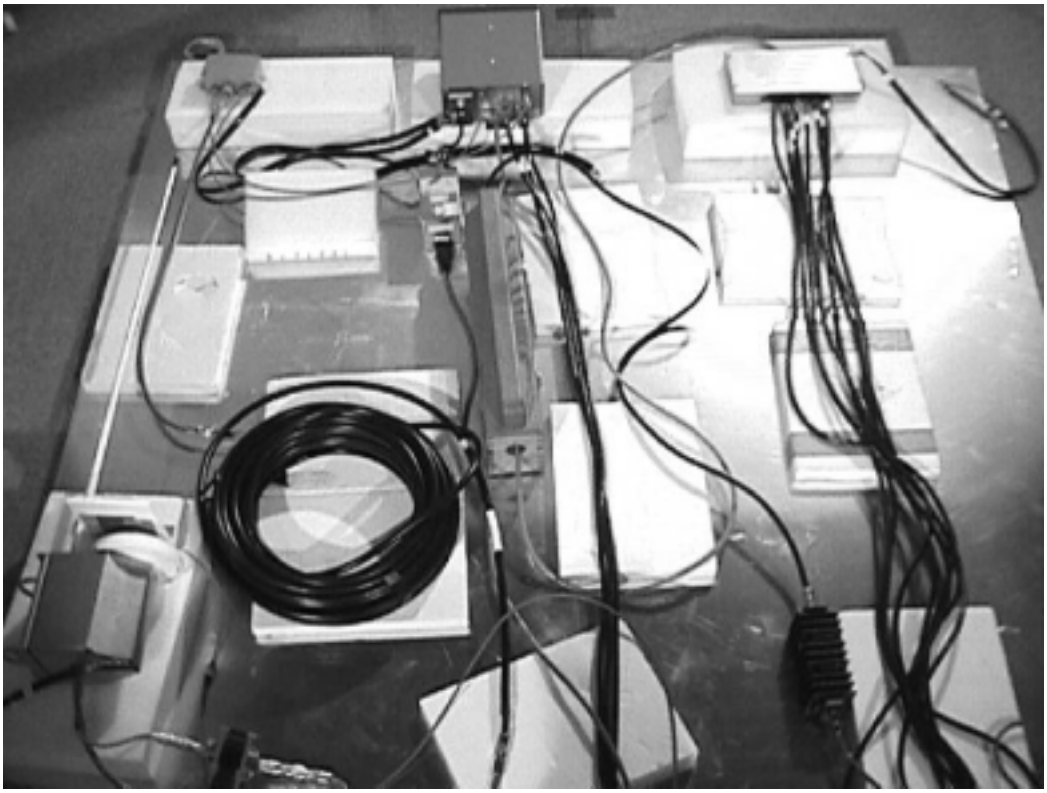
9.4 For EMC Emission – Radiated emission test



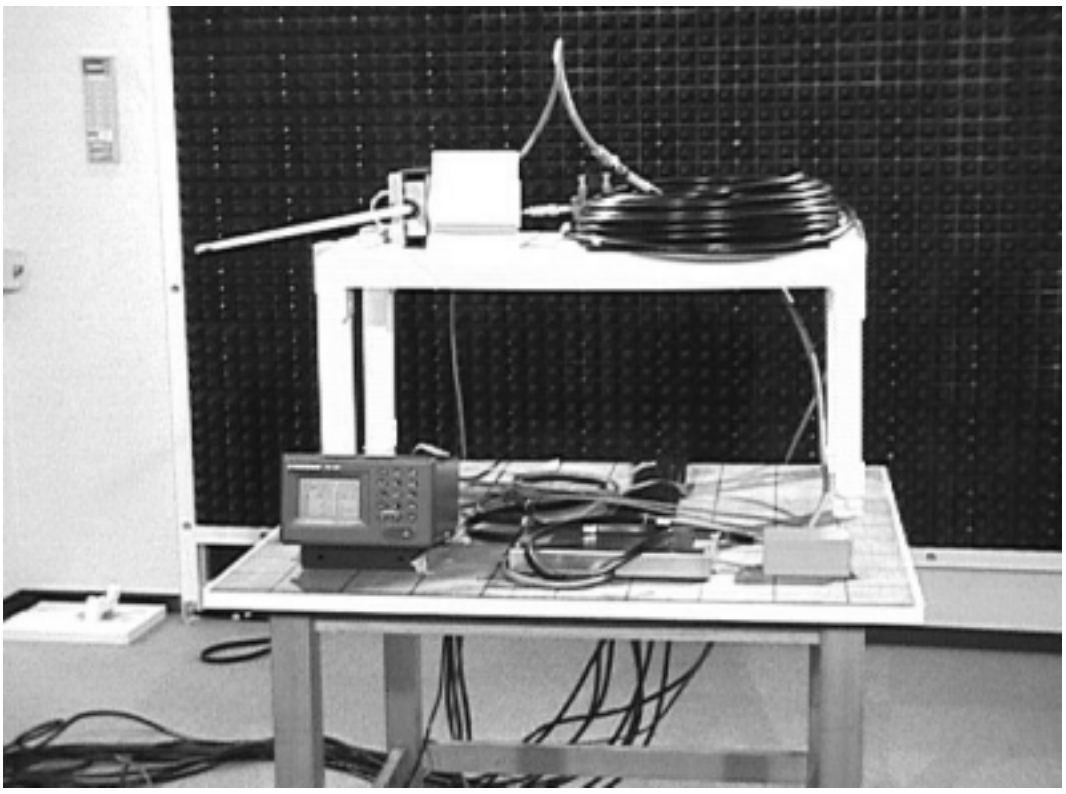
9.5 EMC Immunity - Conducted radio frequency interference test



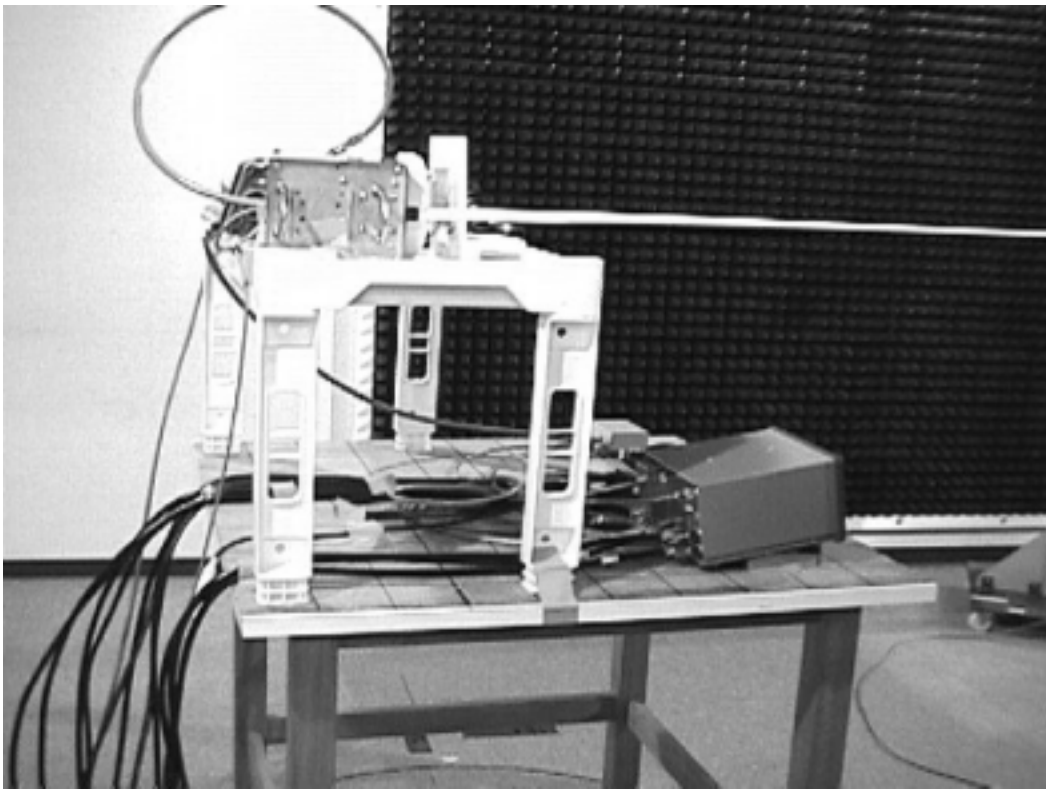
9.6 EMC Immunity - Conducted radio frequency interference test



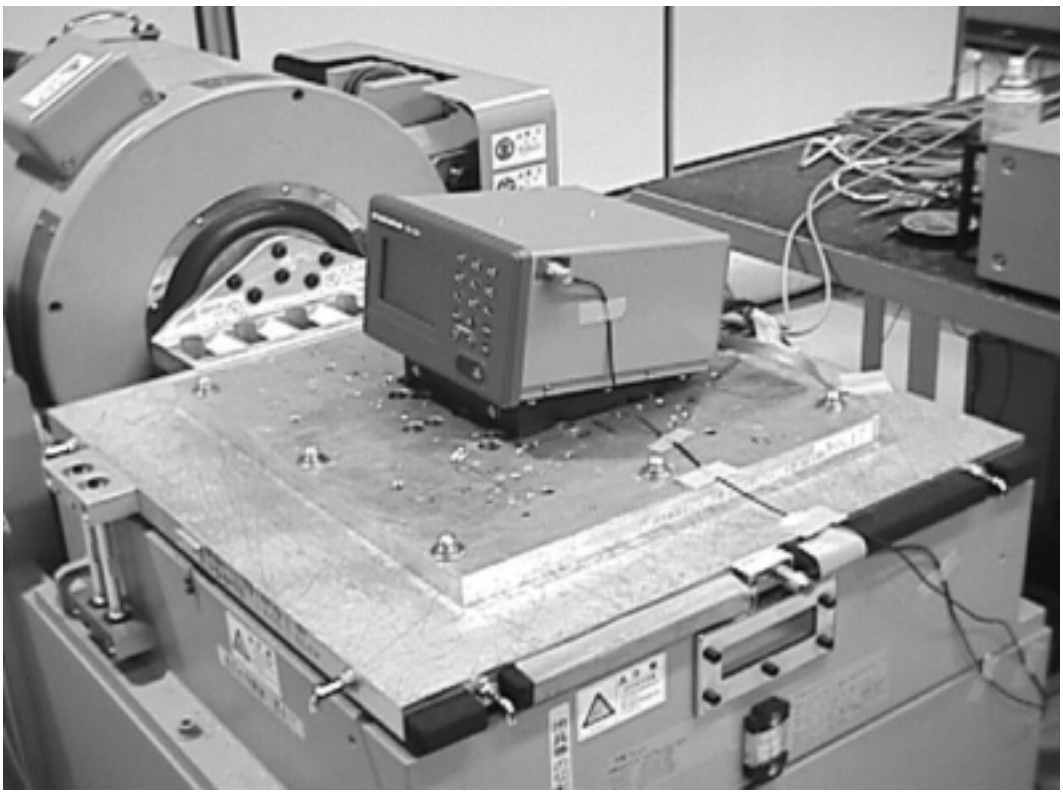
9.7 For EMC Immunity – Radiated radio frequencies test



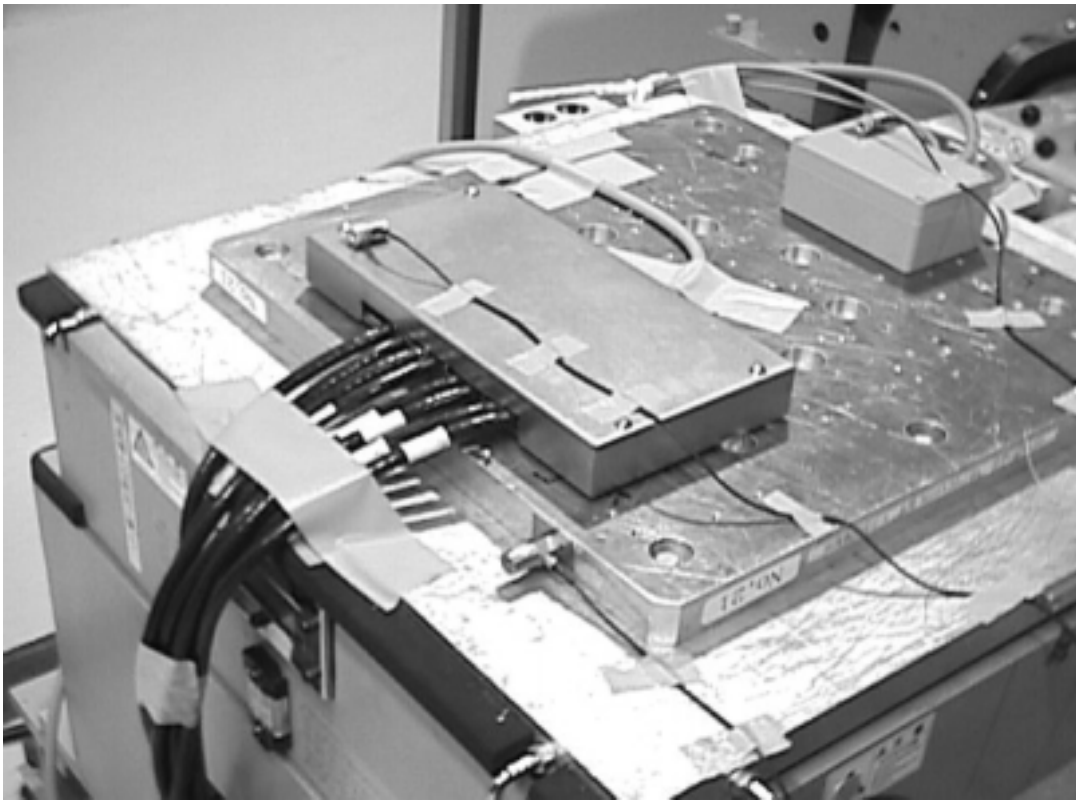
9.8 For EMC Immunity – Radiated radio frequencies test



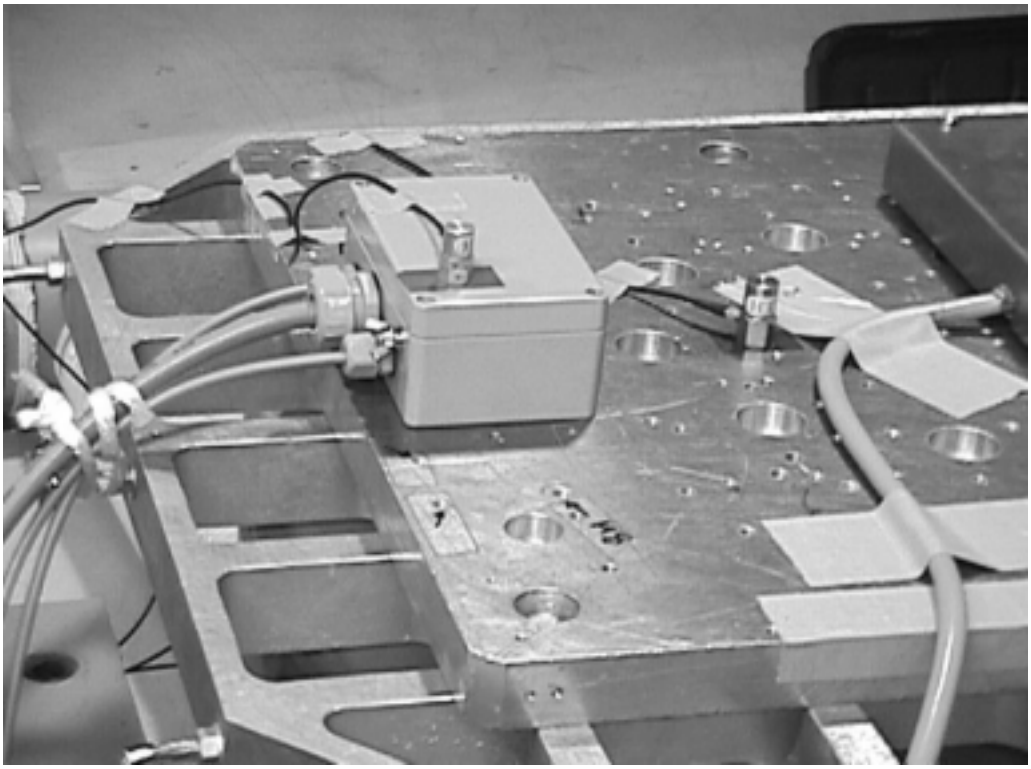
9.9 For Vibration test - Transponder FA-100



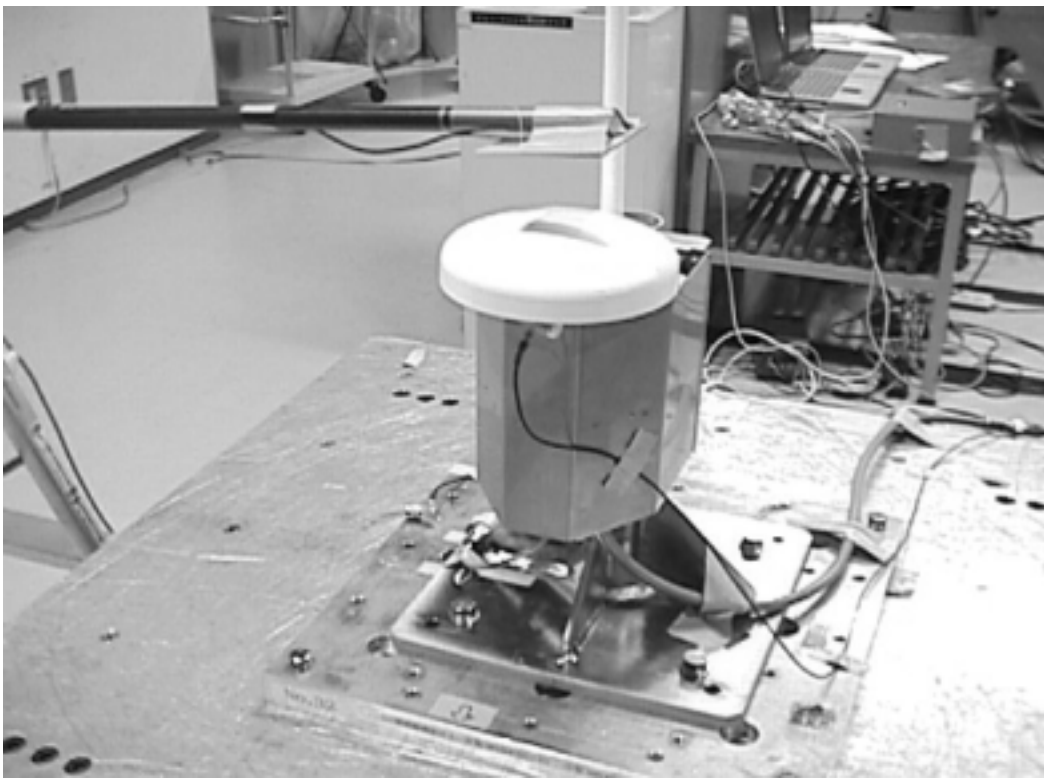
9.10 For Vibration test - Connection Box CB-100



9.11 For Vibration test - Distributor DB-1



9.12 For Vibration test - Combined Antenna GVA-100



9.13 For Rain test - Combined Antenna GVA-100,