# ELECTROMAGNETIC EMISSIONS TEST REPORT

**according to Part 15, subpart C, §15.225 and subpart B**

**FOR**

## ON TRACK INNOVATIONS Ltd.

**EQUIPMENT UNDER TEST:**

Gasoline Management System**,** model GMS

**FCC ID:JNX-OTI-GMS-V1**

**Prepared by:** ______________
**Mrs. M. Cherniavsky, cert. engineer**
**Hermon Labs**

**Approved by:** ______________
**Mr. A. Usoskin, QA manager**
**Hermon Labs**

**Approved by:** ______________
**Dr. E. Usoskin, C.E.O.**
**Hermon Labs**

**Approved by:** ______________
**Mr. R. Gilboa, vice president (R&D)**
**On Track Innovations Ltd.**

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ACCREDITED
839.01

**Electrical**

## Description of equipment under test

| | |
|---|---|
| Test items | Automatic control system of vehicle refueling at the gas stations, FCC ID:JNX-OTI-GMS-V1 |
| Manufacturer | On Track Innovations Ltd. |
| Brand Marks | OTI |
| Types (Models) | GMS |
| Receipt date | April 8, 1999 |

## Applicant information

| | |
|---|---|
| Applicant's representative & responsible person | Mr. Ronnie Gilboa, vice president (R&D) |
| Company | On Track Innovations Ltd. |
| Address | Z.H.R. Industrial Zone |
| P.O. Box | 32 |
| Postal code | 12000 |
| City | Rosh Pina |
| Country | Israel |
| Telephone number | +972-6693 8884 |
| Telefax number | +972-6693 8887 |

## Test performance

| | |
|---|---|
| Project Number: | 13384 |
| Location | Hermon Laboratories |
| Test started | April 8, 1999 |
| Test completed | April 27, 1999 |
| Purpose of test | The EUT certification in accordance with CFR 47, part 2, §2.1033 |
| Test specification(s) | FCC part 15 subpart C §15.225, §15.207, §15.209<br>subpart B, §15.107, §15.109 |

The A2LA logo endorsement applies only to the test methods and the standards that are listed in the scope of Hermon Laboratories accreditation by A2LA.
Through this report a point is used as the decimal separator and the thousands are counted with a comma.
This report is in conformity with EN 45001 and ISO GUIDE 25.
The test results relate only to the items tested.

# Table of Contents

# 1 General Information

## 1.1 Abbreviations and Acronyms

The following abbreviations and acronyms are applicable to this test report:

| | |
|---|---|
| AVR | average |
| BW | bandwidth |
| cm | centimeter |
| dB | decibel |
| dB(μV) | decibel referred to one microvolt |
| dB(μV/m) | decibel referred to one microvolt per meter |
| EMC | electromagnetic compatibility |
| EUT | equipment under test |
| FM | frequency modulation |
| GHz | gigahertz |
| HL | Hermon Laboratories |
| Hz | hertz |
| IF | intermediate frequency |
| kHz | kilohertz |
| m | meter |
| MHz | megahertz |
| msec | millisecond |
| NA | not applicable |
| NARTE | National Association of Radio and Telecommunications Engineers, Inc. |
| Ω | ohm |
| ppm | part per million |
| RBW | resolution bandwidth |
| RE | radiated emission |
| RF | radio frequency |
| QP | quasi-peak (detector) |
| VBW | video bandwidth |
| V | volt |
| V/m | volt per meter |
| UHF | ultra high frequency |

## 1.2 Specification References

| | |
|---|---|
| CFR 47 part 15: October 1998 | Radio Frequency Devices. |
| ANSI C63.2:06/1987 | American National Standard for Instrumentation-Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz-Specifications. |
| ANSI C63.4:1992 | American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz. |

## 1.3 EUT Description

The Gasoline Management System (GMS) is designed to provide automatic control of vehicle refueling at the gas stations.
The system comprises reader system, installed in the gas station, and transponder tags, installed in the vehicles and / or carried by the drivers.
The reader system comprises the following:

1. Antenna controller, mounted inside the pumps housing. The antenna controller is a μP. controlled transceiver, operating at 13.56 MHz.
2. A loop antenna is mounted on each refueling nozzle or at the pump. The antenna is connected to the antenna controller via a 50 Ω coax cable which, part of the way in a case of using a refueling nozzle, runs inside the petrol hose. The loop antenna works in inductive close proximity coupling.
3. Site controller, located in the gas station office. The site controller supplies 12 V AC power to the antenna controller and the RS422 communication network. The site controller interfaces between the antenna controllers and the gas station main computer. It also provides protection required since the antenna is located in hazardous area.

The tags are passive transponders which exchange data with the reader by demodulating the carrier on off key, 100% amplitude modulation in one direction, and by varying their internal loading, thereby affecting small variations of the transmitted amplitude in the other direction. In this respect the tags do not transmit any active energy. Exchanging the data in both directions requires continuous transmission of the RF carrier by the reader. In an operative environments at an active gas station, the station main computer, which controls all the actions of the gas pumps, upon detecting a need to read a tag at a specific nozzle, activates a short interrogation sequence via the I.S. terminal and the corresponding antenna controller. The resultant mode of work is highly intermittent, where most of the time the individual transmitter in the antenna controller shut off and is only turned on for a short periods of time upon demand generated by the host computer.
In the EMC tests a continuous transmission mode of operation was enforced by specific settings of jumpers in the antenna controller.
The antenna controller is an inexpensive, compact radio frequency communications electronic interface with contactless read/write capability.
At the Host's command, the antenna controller generates and modulates a 13.56 MHz carrier signal for the transmission of power, commands and data to an in-range smart Tag.
The smart tag, acting as a passive transponder, utilizes variable load modulation on the transmitted carrier wave to transfer data to the antenna controller. Read and write operations have equal data rates and ranges.

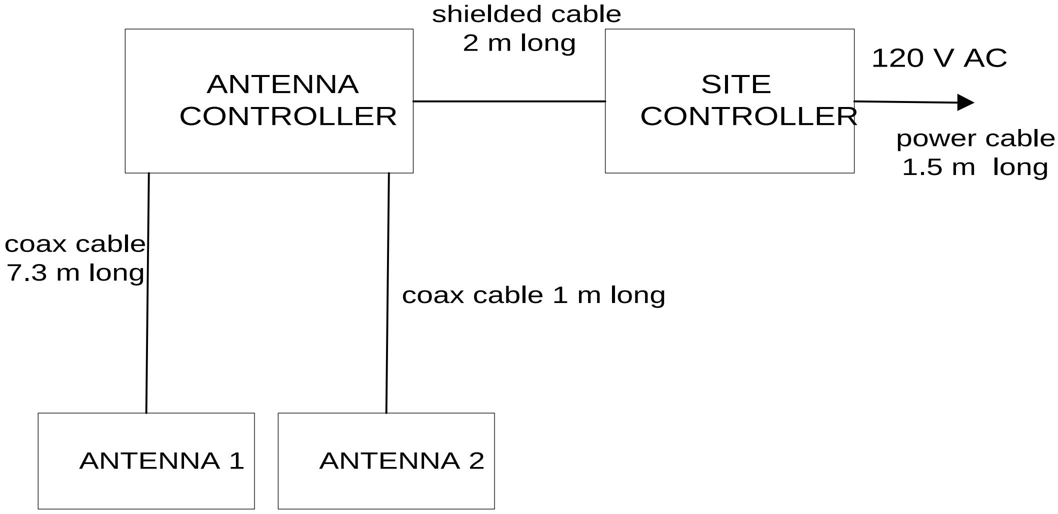
## 1.4 Changes Made in EUT

To withstand the FCC part 15 class B requirements the additional filter 1VK3 (F2578), manufactured by CORCOM, was installed at the EUT input.

## 1.5 EUT Test Configuration

The EUT configuration and operation during the tests were defined by the customer. Test configuration is given in Figure 1.1:
1) Antenna controller: S/N D-107C003, model N12-U1-RS485-CE
2) Site controller: S/N M-113E009, model SC-U1-110/12-40-D9F.

**Figure 1.1**
**EUT test configuration**



## 1.6 Statement of Manufacturer

I, Ronnie Gilboa, vice president (R&D) of On Track Innovations Ltd., declare that GMS was tested from April 8 to April 27, 1999 by Hermon Laboratories and which this test report applies to, is identical of the equipment that will be marketed.

The term identical means identical within the variations that can be expected to arise as a result of quantity production technique.

Mr. Ronnie Gilboa, vice president (R&D)
On Track Innovations Ltd

Signature:__ ___

Date:__May 23, 1999 ______

# 2 Test Facility Description

## 2.1 General

Tests were performed at Hermon Laboratories, which is a fully independent, private EMC, Safety and Telecommunication testing facility. Hermon Laboratories is listed by the Federal Communications Commission (USA) for all parts of Code of Federal Regulations 47 (CFR 47), listed by Industry Canada for radiated measurements (file numbers IC 2186-1 for OATS and IC 2186-2 for anechoic chamber), recognized by VDE (Germany) for witness test, certified by VCCI, Japan (the registration numbers are R-808 for OATS, R-809 for anechoic chamber, C-845 for conducted emissions site), assessed by NMi Certin B.V. (Netherlands) for a number of EMC, Telecommunications and Safety standards, recognized by TUV Sudwest (Germany) for Safety testing, and Accredited by AMTAC (UK) for safety of Medical Devices. The laboratory is accredited by American Association for Laboratory Accreditation (USA) according to ISO GUIDE 25/EN 45001 for EMC, Telecommunications and Product Safety Information Technology Equipment (Certificate No. 839.01).

| | |
|---|---|
| Address: | PO Box 23, Binyamina 30550, Israel. |
| Telephone: | +972 (0)6628 8001 |
| Fax: | +972 (0)6628 8277 |

Person for contact: Mr. Alex Usoskin, testing and QA manager.

## 2.2 Equipment calibration

The test equipment has been calibrated according to its recommended procedures and is within the manufacturer's published limit of error. The standards and instruments used in the calibration system conform to the present requirements of MIL-STD-45662A.
The laboratory standards are calibrated by the third party (traceable to NIST, USA) on a regular basis according to equipment manufacturer requirements.

### 2.2.1 Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements

| | |
|---|---|
| Conducted emissions with LISN | 9 kHz to 30 MHz: ± 2.1 dB |
| Radiated emissions in the open field test site at 10 m measuring distance | Biconilog antenna: ±3.2 dB<br>Log periodic antenna: ±3 dB<br>Biconical antenna: ±4 dB |
| Radiated emissions in the anechoic chamber at 3 m measuring distance | Biconilog antenna: ±3.2 dB |

## 2.3 Laboratory Personnel

The three people of Hermon Laboratories that have participated in measurements and documentation preparation are: Dr. Edward Usoskin - C.E.O., Mr. Michael Nikishin - test engineer and Mrs. Marina Cherniavsky - certification engineer.
Dr. E. Usoskin is an EMC specialist, M. Cherniavsky is a telecommunication engineer certified by the National Association of Radio and Telecommunications Engineers (NARTE, USA.).
The Hermon Laboratories' personnel that participated in this project have more than 90 years combined experience time in EMC measurements and electronic products design.

## 2.4 Statement of Qualification

The test measurement data supplied in this test measurement report having been received by me, is hereby duly certified. The following is a statement of my qualifications:
I am an engineer, graduated from university in 1996 with an MScEE degree, have obtained 2 years experience in EMC measurements and have been with Hermon Laboratories since 1998.

Name: Mr. Michael Nikishin Signature:_ ___________
Position: test engineer Date: May 19, 1999

I hereby certify that this test measurement report was prepared by me and is hereby duly certified. The following is a statement of my qualifications.
I am an engineer, graduated from university in 1971, with an MScEE degree, have obtained 26 years experience in electronic products design and development. Also, I am a Telecommunication Class II engineer certified by the National Association of Radio and Telecommunications Engineers, Inc. (USA.), the certificate no. is E2-03410 and have been with Hermon Labs since 1991.

Name: Mrs. Marina Cherniavsky Signature:_ _______
Position: certification engineer Date: May 19, 1999

I hereby certify that this test measurement report was prepared under my direction and that to the best of my knowledge and belief, the facts set in the report and accompanying technical data are true and correct.
The following is a statement of my qualifications.
I have a Ph.D. degree in electronics, have obtained more than 42 years of experience in EMC, Safety, Telecommunications measurements and electronic product design.
Also, I am an EMC engineer certified by the National Association of Radio and Telecommunications Engineers, Inc. (USA). The certificate no. is EMC-000623-NE, Senior Member, and have been with Hermon Labs since 1986.

Name: Dr. Edward Usoskin Signature:_ _____
Position: C.E.O. Date: May 19, 1999

# 3 Test Measurements

## 3.1 Field Strength of Emissions according to § 15.225 (a)

### 3.1.1 Specified limit

| Frequency, MHz | Field strength, microvolts/meter | Field strength, dB (µV/m) | Measurement distance, meters |
|---|---|---|---|
| 13.553 – 13.567 | 10,000 | 80 | 30 |
| Outside band | 30 | 29.5 | 30 |

### 3.1.2 Extrapolation (distance correction) factor

The test was performed at 10 meter test distance, i.e. the distance between measuring antenna and EUT boundary. The results were extrapolated by using the square of an inverse linear distance extrapolation factor DF:

$$DF = 40 \log (D_1/D_2) = 19.1 \text{ dB, where}$$

$D_1$ is the 30 meters specified measurement distance
$D_2$ is the 10 meters test measurement distance.
The DF=19.1 dB was applied for limit calculation at 10 m test distance measurements.

For 13.56 MHz frequency the calculated limit is:
$Limit_{10m} = Limit_{30\,m} + DF$ = 80 dB(µV/m) + 19.1 dB = 99.1 dB(µV/m).
For outside of band emissions the calculated limit is:
$Limit_{10m} = Limit_{30\,m} + DF$ = 29.5 dB(µV/m) + 19.1 dB = 48.6 dB(µV/m).

### 3.1.3 Test procedure and results

The test was performed at the Hermon Labs open field test site (OFTS) at 10 meters test distance, i.e. the distance between measuring antenna and EUT boundary. Limit for 10 meters test distance was calculated using a square of an inverse linear-distance extrapolation factor.
The EUT was placed on the wooden turntable, as shown in Figure 3.1.1, Photograph 3.1.1 and operated in continuous transmitting mode. The measurements were performed with loop antenna with its center positioned 1 – 4 m above the ground.

To find maximum radiation the turntable was rotated 360°, the antenna was rotated about its vertical axis and the antenna polarization was changed from vertical to horizontal.
The quasi peak detector was used. The test measurement results were recorded into Table 3.1.1. The edge frequencies at which the field strength drops below specified limit for out of band emissions were measured and found inside assigned frequency band 13.553 – 13.567 MHz.

**Reference numbers of test equipment used**

| | | | | | | |
|---|---|---|---|---|---|---|
| HL 0027 | HL 0028 | HL 0038 | HL 0275 | HL 0287 | HL 0446 | HL 0812 |
| HL 0813 | | | | | | |

Full description is given in Appendix A.

**Table 3.1**

**Radiated emission measurements - test results**
**Field strength of fundamental frequency**

TEST SPECIFICATION: FCC part 15 subpart C § 15.225
COMPANY: On Track Innovations Ltd.
EUT: GMS
DATE: April 18, 1999
RELATIVE HUMIDITY: 49%
AMBIENT TEMPERATURE: 22°C

MEASUREMENTS PERFORMED AT 10 METRES DISTANCE

| Frequency MHz | Measured Result dB (µV) | Correction Factor dB (1/m) | Radiated Emissions dB (µV/m) | Calculated Limit dB (µV/m) | Spec. Margin dB | Pass/ Fail |
|---|---|---|---|---|---|---|
| 13.563 | 45 | 10.4 | 55.4 | 99.1 | 43.7 | Pass |
| 13.565 | 38 | 10.4 | 48.4 | 48.6 | 0.2 | Pass |
| 13.557 | 38 | 10.4 | 48.4 | 48.6 | 0.2 | Pass |

**Notes to table:**

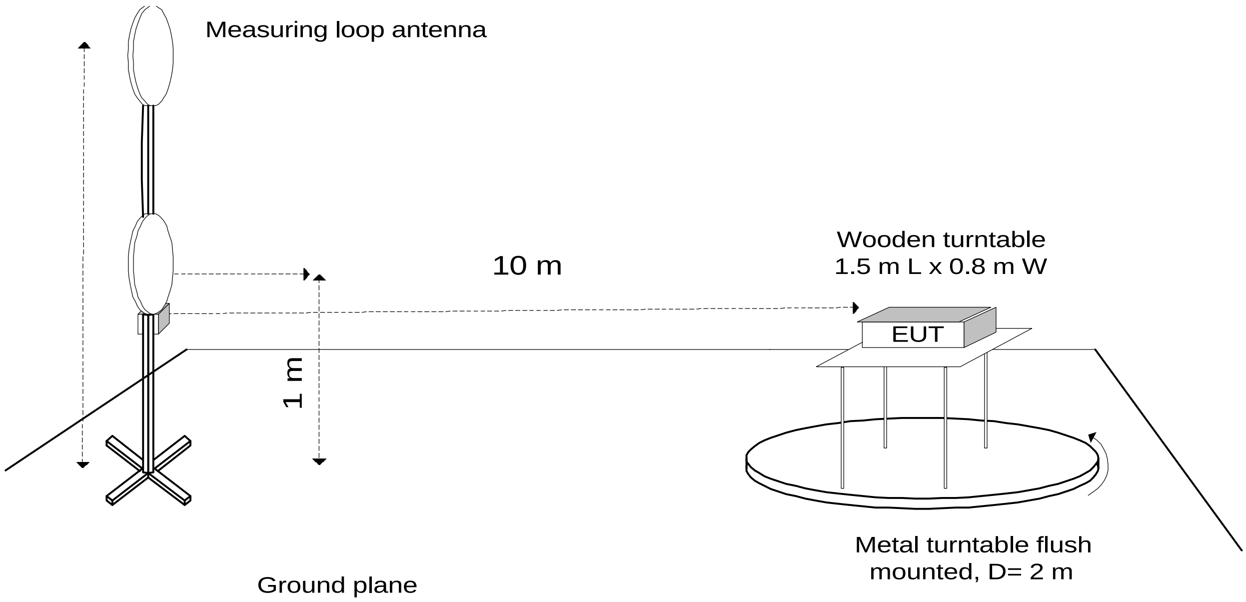
Quasi peak detector with resolution bandwidth = 9 kHz was used.
The test results listed in Table 3.1 were obtained during measurements with loop antenna in vertical polarization.
Radiated emission dB(µV/m) = measured result {dB(µV)} + correction factor {dB(1/m)}.
Correction factor = antenna factor + cable loss (for antenna factor and cable loss refer to Appendix B).
Calculated limit is in accordance with §15.225 (a), (b) and §15.209.

**Table abbreviations:**
Spec. Margin = Specification margins = dB below (negative if above) specification limit.

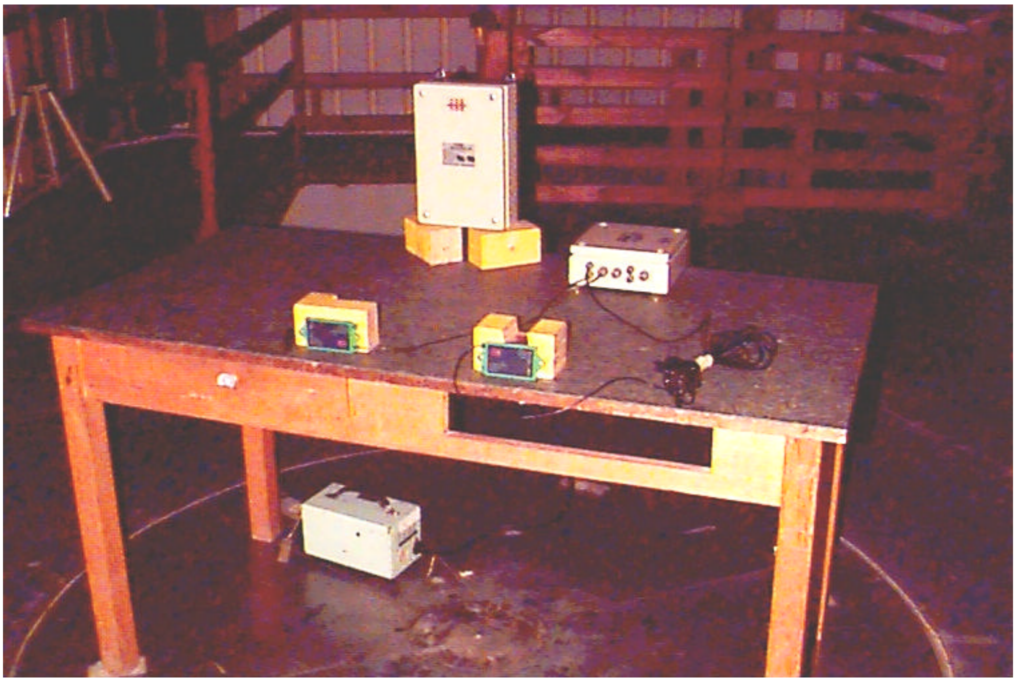
Test performed by:
Mr. Michael Nikishin, test engineer

Hermon Labs

**Figure 3.1.1**
**Radiated emission test setup**



**Photograph 3.1.1**
**Radiated emission measurements setup**



## 3.2 Emissions Radiated Outside of the Specified Frequency Band according to §15.225 (b)

### 3.2.1 Specified limits

The field strength of any emissions appearing outside of this band shall not exceed the general radiated emission limits of § 15.209.

### 3.2.2 Test procedure and results

The radiated emissions measurements were performed at the open field test site at 3 meters measuring distance The EUT was placed on the wooden table as shown in Photographs 3.2.1, 3.2.2. The frequency range from the lowest generated signal frequency 13.56 MHz up to 10$^{th}$ harmonic (140 MHz) was investigated. The loop and biconical antennas were used. To find maximum radiation the turntable was rotated 360$^{o}$, the measuring antenna height changed from 1 to 4 m, and the antennas polarization was changed from vertical to horizontal.
The measurements were performed with the following EMI receiver settings:
from 13.56 MHz to 30 MHz - quasi-peak detector, RBW = 9 kHz
from 30 MHz to 140 MHz - quasi-peak detector, RBW=120 kHz.
The test results are given in Tables 3.2 and 3.3.

**Reference numbers of test equipment used**

| | | | | | |
|---|---|---|---|---|---|
| HL 0027 | HL 0028 | HL 0032 | HL 0038 | HL 0275 | HL 0287 |
| HL 0446 | HL 0812 | HL 0813 | | | |

Full description is given in Appendix A.

**Radiated emission measurements - test results**
**frequency range 13 MHz - 140 MHz**

TEST SPECIFICATION: FCC part 15 subpart C § 15.225
COMPANY: On Track Innovations Ltd.
EUT: GMS
DATE: April 18, 1999
RELATIVE HUMIDITY: 49%
AMBIENT TEMPERATURE: 22°C

**Table 3.2**
MEASUREMENTS PERFORMED AT 3 METRES DISTANCE

| Frequency<br>MHz | Measured Result<br>dB (µV) | Correction Factor<br>dB (1/m) | Radiated Emissions<br>dB (µV/m) | Specified Limit @30 m distance<br>dB (µV/m) | Spec. Margin<br>dB | Pass/ Fail |
|---|---|---|---|---|---|---|
| 27.1166 | 13 | 9.8 | 22.8 | 29.5 | 6.7 | Pass |

**Notes:** The test result was found below limit specified for 30 m measuring distance.
Quasi peak detector with resolution bandwidth = 9 kHz was used.
The test result listed in Table 3.2 was obtained during measurements with loop antenna in vertical polarization.

**Table 3.3**
MEASUREMENTS PERFORMED AT 3 METRES DISTANCE

| Frequency<br>MHz | Ant. Hgt. | TT Pos.<br>(°) | Radiated Measured Result<br>dB (µV) | Correction Factor<br>dB (1/m) | Radiated Emissions<br>dB (µV/m) | Spec. Limit<br>dB (µV/m) | Spec. Margin<br>dB | Pass/ Fail |
|---|---|---|---|---|---|---|---|---|
| 54.240 | 1.13 | 181 | 13 | 11.9 | 24.9 | 40 | 15.1 | Pass |
| 67.805 | 1.0 | 139 | 21 | 9.5 | 30.5 | 40 | 9.5 | Pass |
| 81.330 | 1.49 | 127 | 23 | 9.0 | 31.0 | 40 | 9 | Pass |

**Notes:** Quasi peak detector with resolution bandwidth = 120 kHz was used.
The test result listed in Table 3.3 was obtained during measurements with biconical antenna in vertical polarization.

**Notes to tables 3.2, 3.3:**
Radiated emission dB(µV/m) = measured result {dB(µV)} + correction factor {dB(1/m)}.
Correction factor = antenna factor + cable loss (for antenna factor and cable loss refer to Appendix B).
Specified limit is in accordance with §15.225(b) and §15.209.
**Table abbreviations:**
Spec. Margin = Specification margins = dB below (negative if above) specification limit.

Test performed by:
Mr. Michael Nikishin, test engineer

Hermon Labs

## 3.3 Frequency stability test according to §15.225(c)

### 3.3.1 Definition of the test

This test was performed to measure the frequency stability versus ambient temperatures from -20°C to +50°C at normal supply voltage and versus supply voltage from 0.85 $U_{nom}$ to 1.15 $U_{nom}$ at a temperature of 20 degrees. The maximum allowed frequency tolerance is ±0.01%.

### 3.3.2 Test results

The test was performed at unmodulated carrier frequency 13.5605 MHz. The test results are given in the Tables 3.3.1, 3.3.2 and Plots 3.3.1 to 3.3.11. Test setup is shown in Photograph 3.3.1.

**Table 3.3.1**
**Frequency stability test results**

| Measured frequency tolerance, ±% vs temperature, ºC | | | | | | | | Pass/ Fail |
|---|---|---|---|---|---|---|---|---|
| -20 | -10 | 0 | 10 | 20 | 30 | 40 | 50 | |
| -0.0008 | -0.0005 | 0.0003 | 0.0001 | 0.0 | 0.0001 | 0.0001 | 0.0003 | Pass |

**Table 3.3.2**
**Frequency stability test results**

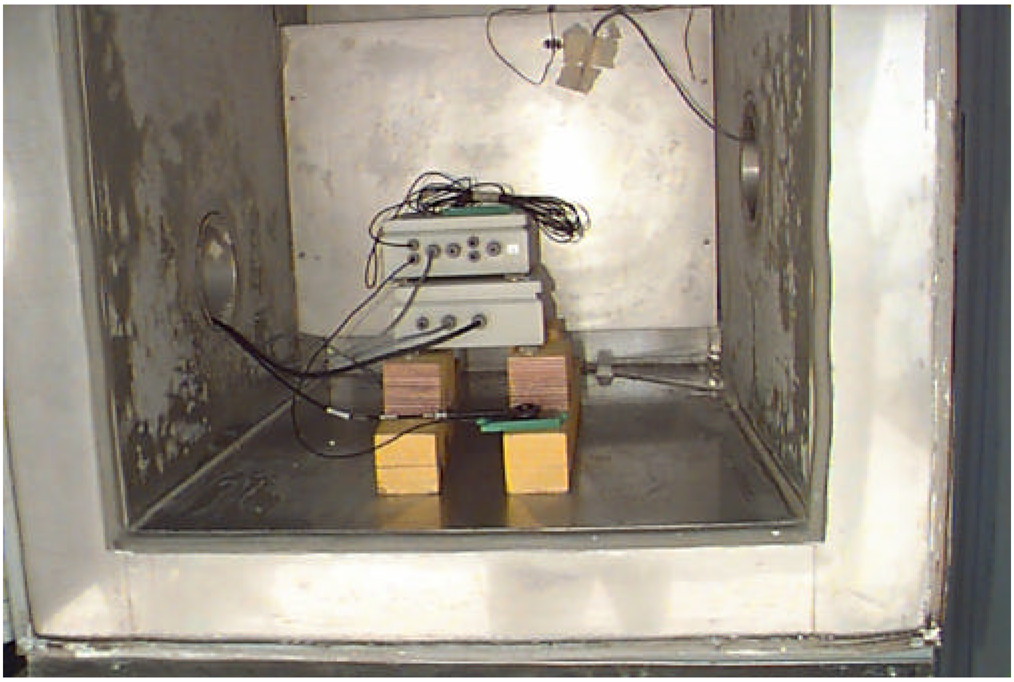
| Measured frequency tolerance, ±% vs primary supply voltage, V AC | | | Pass/ Fail |
|---|---|---|---|
| 102 | 120 | 138 | |
| 0 | 0 | 0 | Pass |

**Reference numbers of test equipment used**

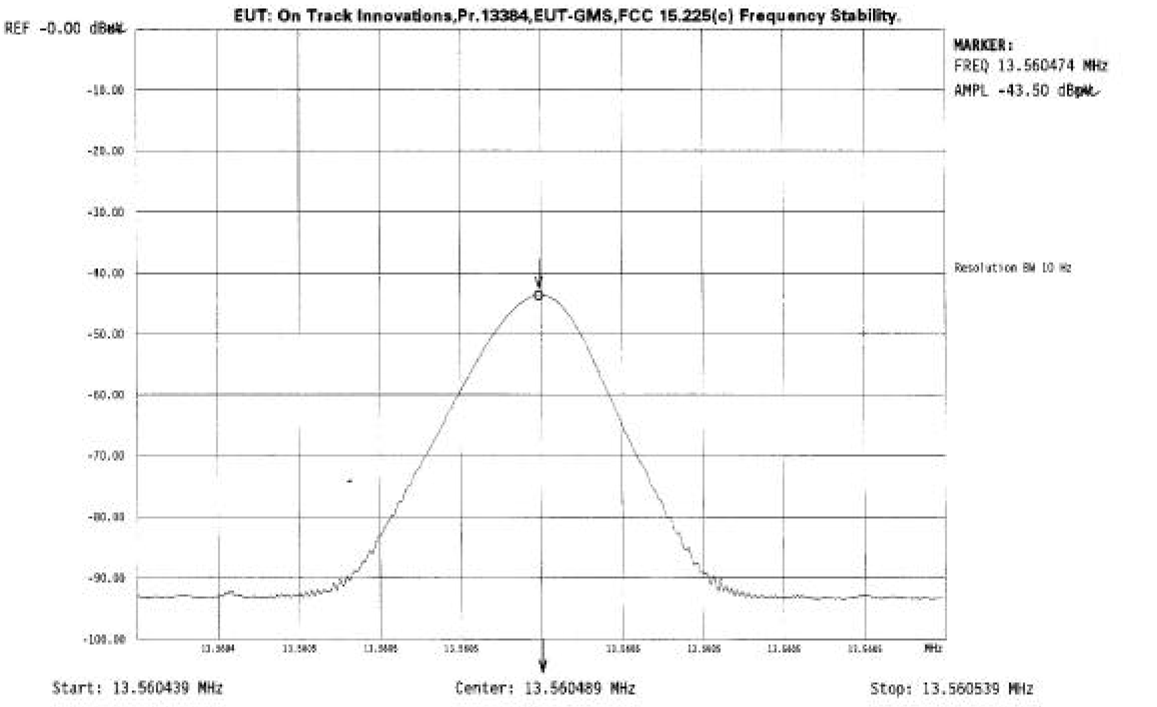
| | | | | | | |
|---|---|---|---|---|---|---|
| HL 0027 | HL 0500 | HL 0560 | HL 0679 | HL 1194 | | |

Full description is given in Appendix A.

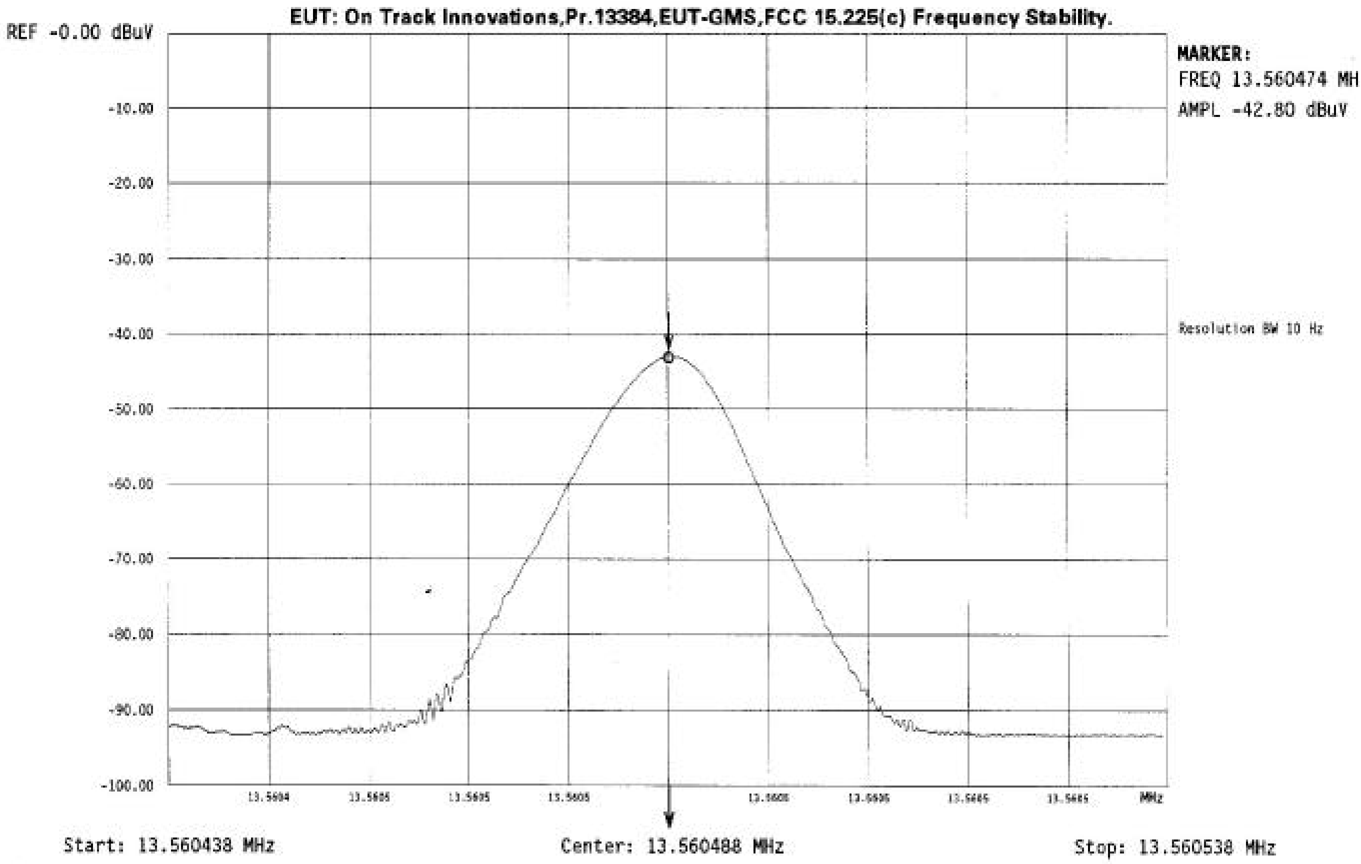
**Photograph 3.3.1.**
**Frequency stability measurement test setup**



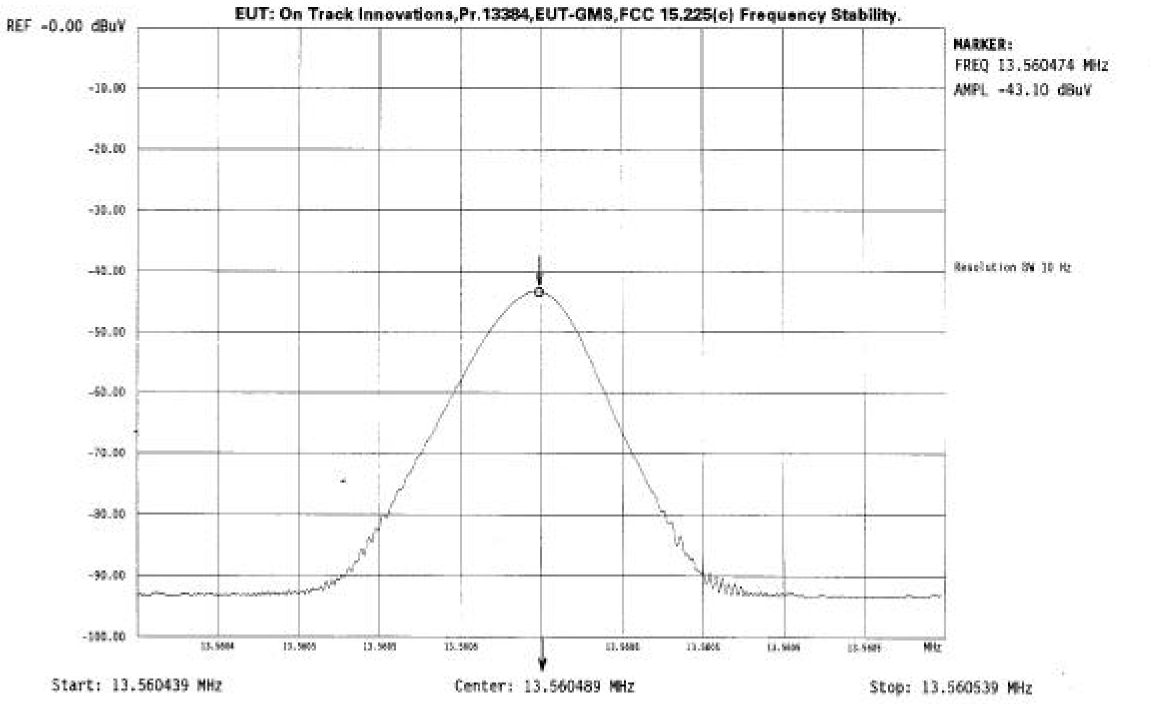
**Plot 3.3.1**
**Frequency stability vs primary supply voltage test**
**U=120 V AC**



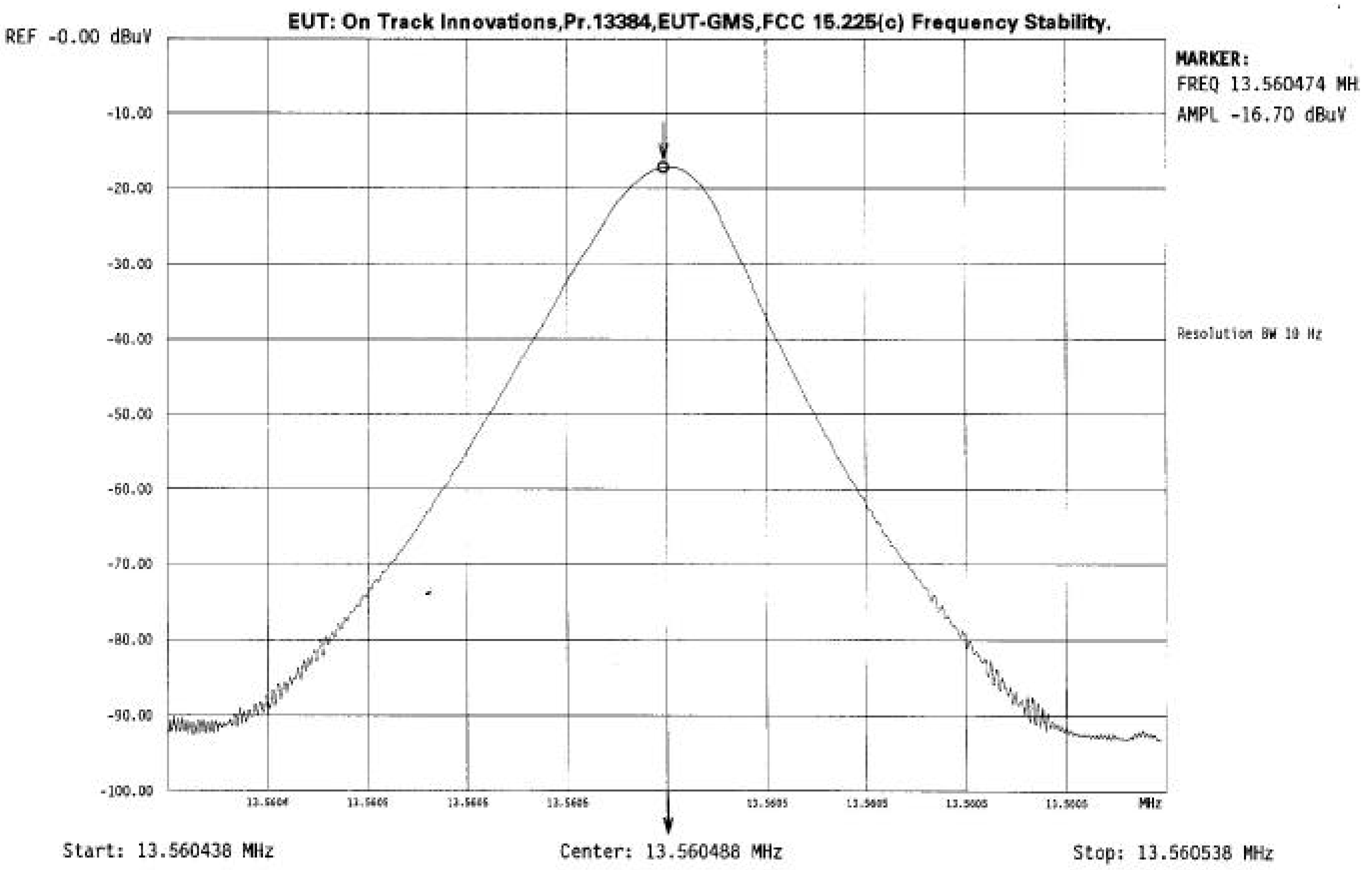
**Plot 3.3.2**
**Frequency stability vs primary supply voltage test**
**U=138 V AC**



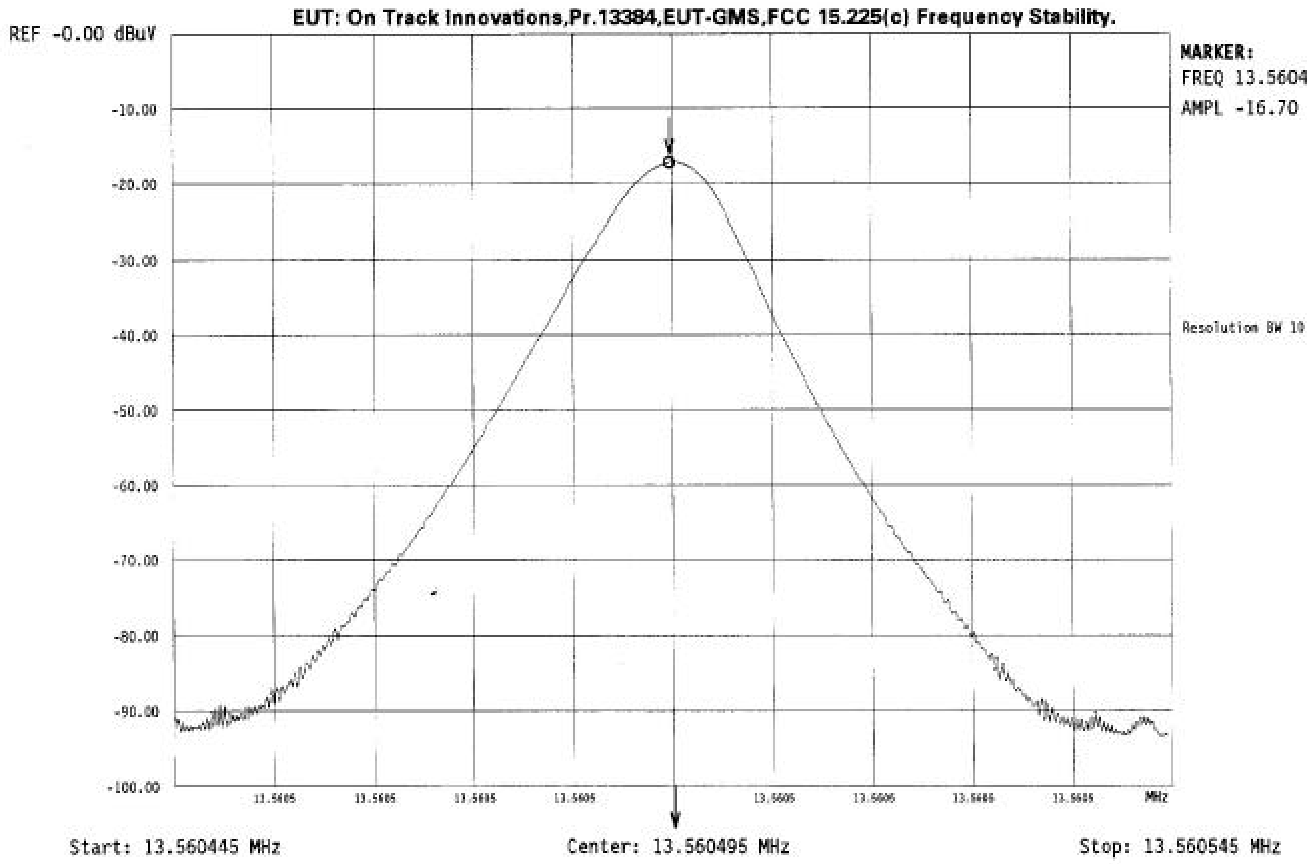
**Plot 3.3.3**
**Frequency stability vs primary supply voltage test**
**U=102 V AC**



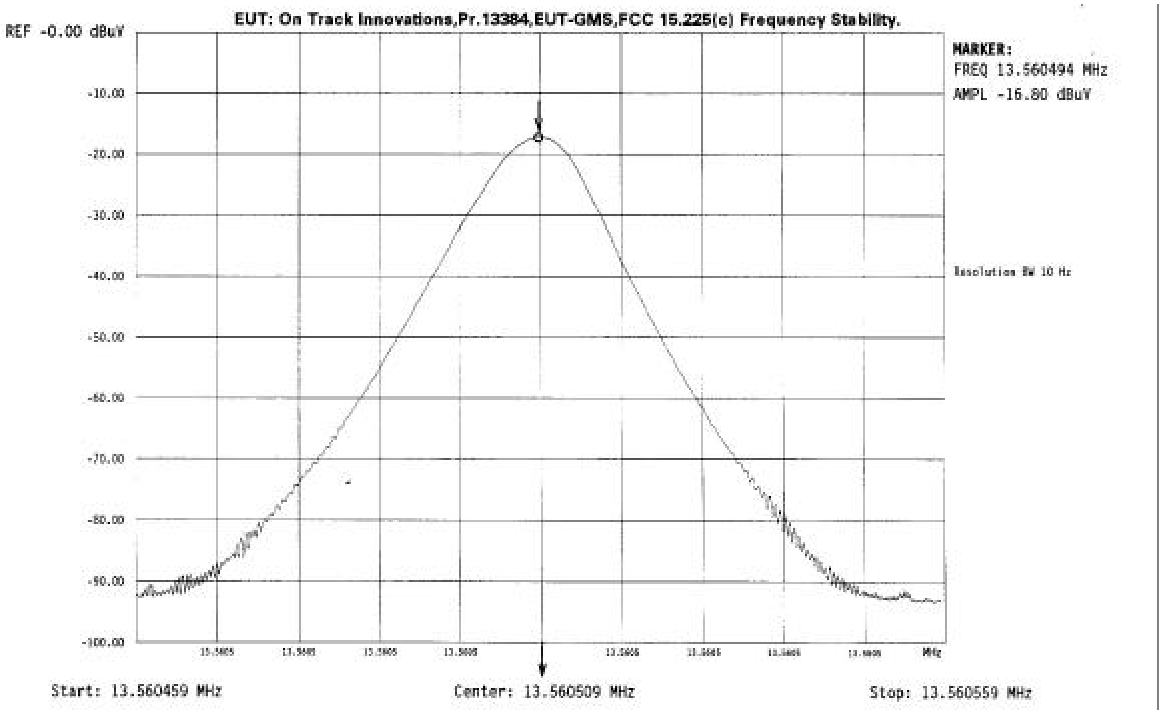
**Plot 3.3.4**
**Frequency stability vs temperature test**
**T = 20°C**



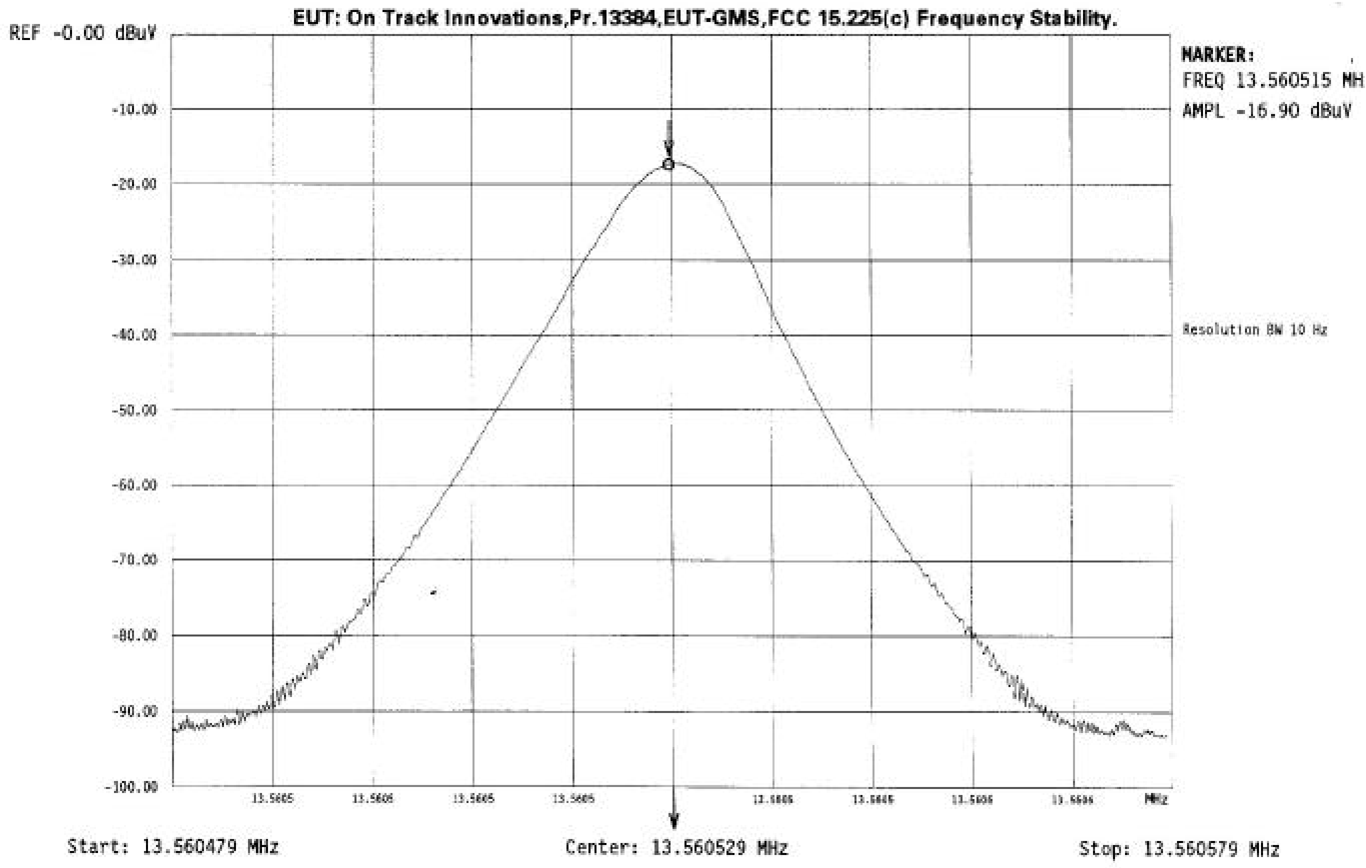
**Plot 3.3.5**
**Frequency stability vs temperature test**
**T = 30°C**



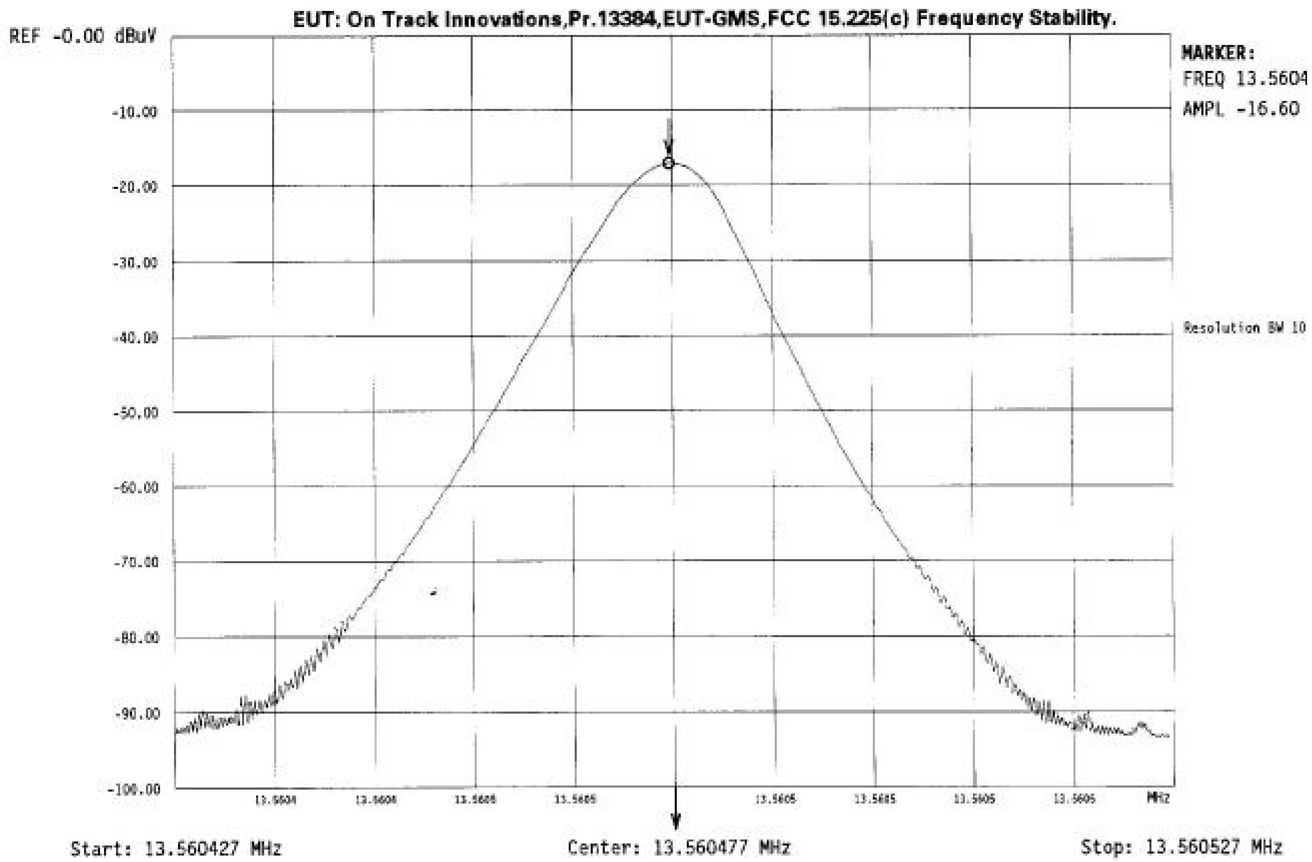
**Plot 3.3.6**
**Frequency stability vs temperature test**
**T = 40°C**



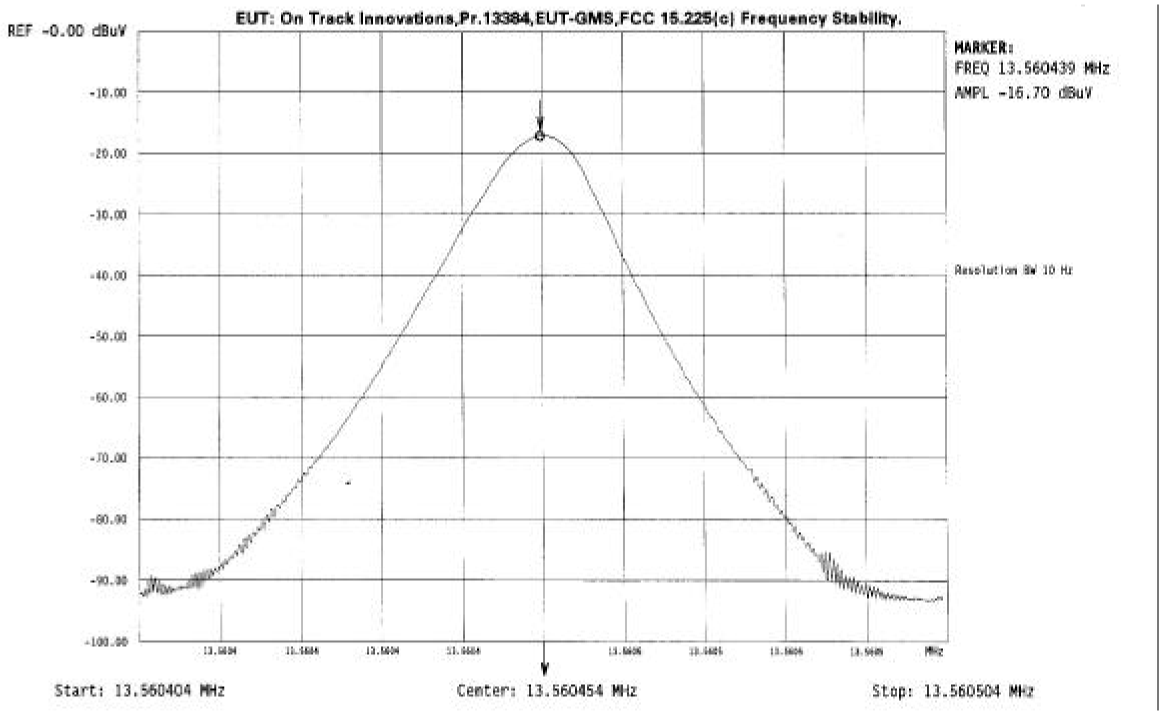
**Plot 3.3.7**
**Frequency stability vs temperature test**
**T = 50°C**



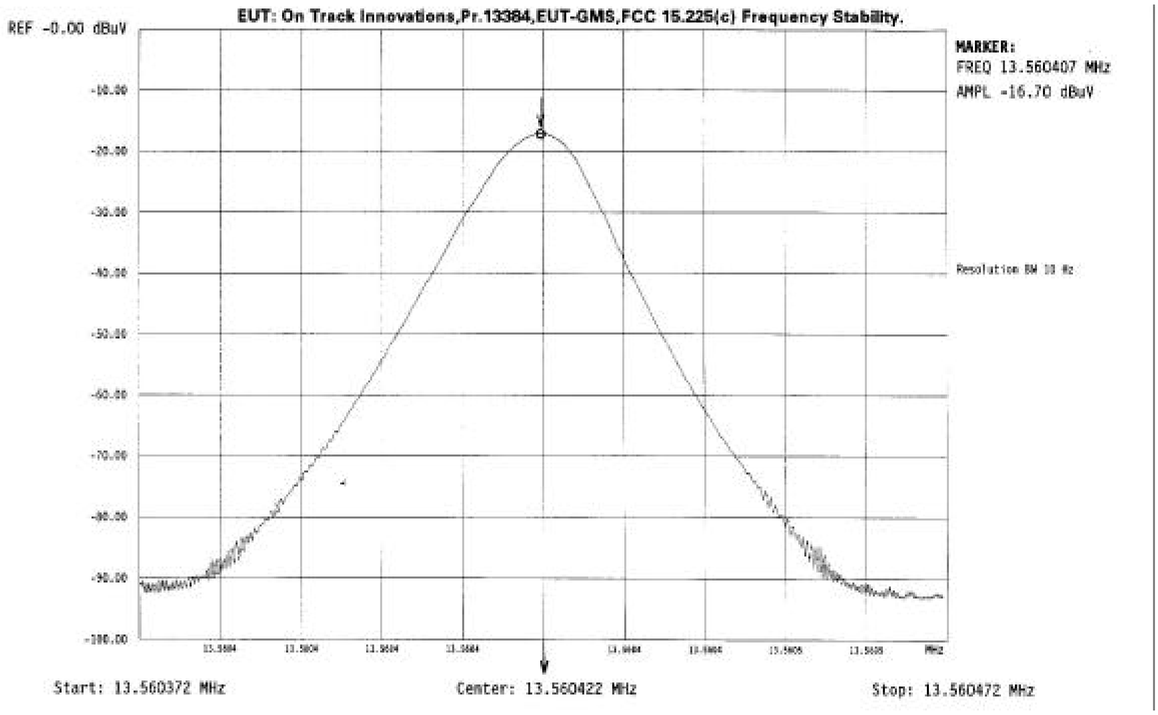
**Plot 3.3.8**
**Frequency stability vs temperature test**
**T = 10°C**



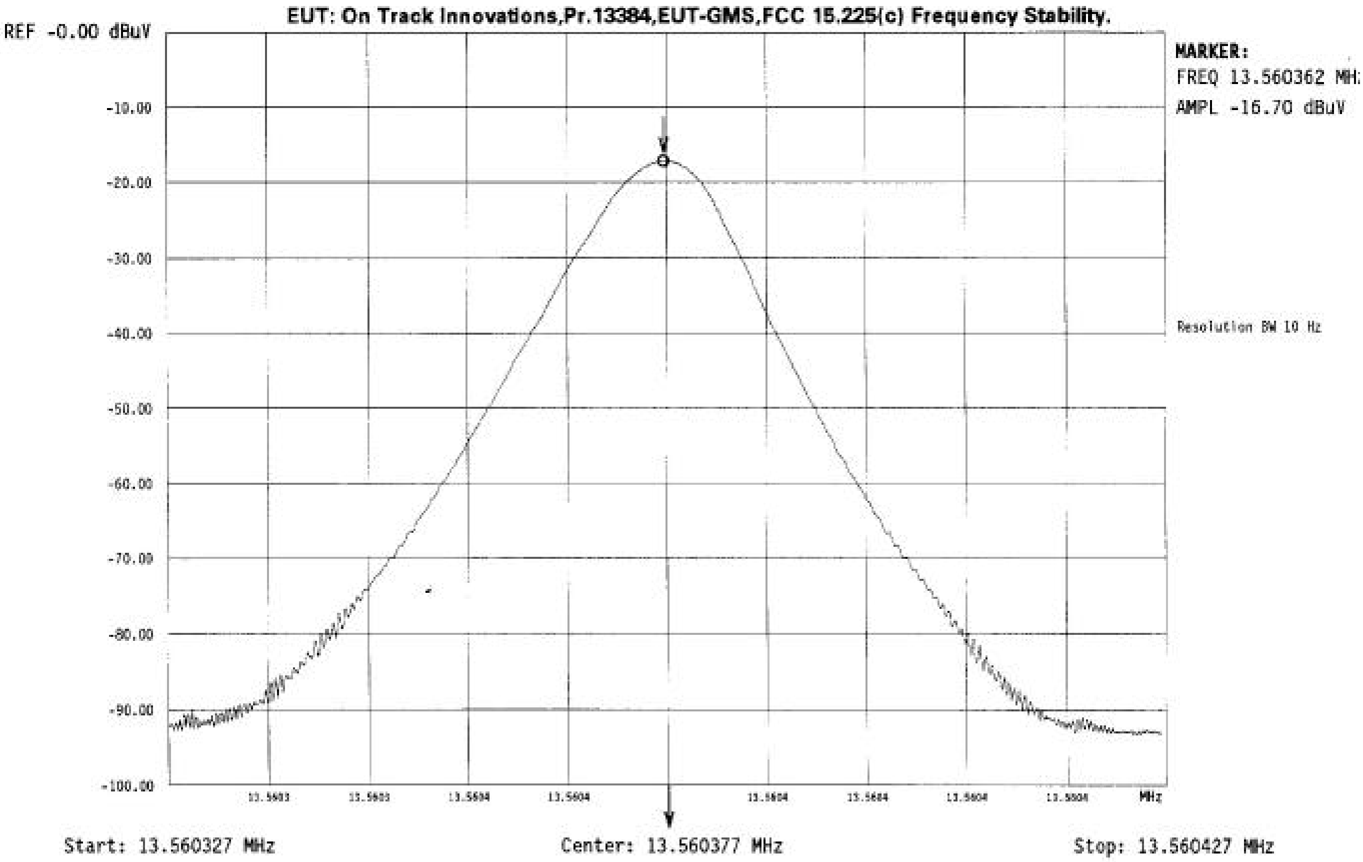
**Plot 3.3.9**
**Frequency stability vs temperature test**
**T = 0°C**



**Plot 3.3.10**
**Frequency stability vs temperature test**
**T = -10°C**



**Plot 3.3.11**
**Frequency stability vs temperature test**
**T = -20°C**



## 3.4 Unintentional radiated emissions (class B digital device) test according to Part 15, §15.109

### 3.4.1 Definition of the test

This test was performed to measure radiated emissions from the receiver and incorporated digital device of the EUT.

### 3.4.2 Test set-up

The radiated emissions measurements of the EUT receiver and incorporated digital device in the frequency range from 30 MHz to 1 GHz were performed at the open field test site at 3 meters measuring distance. The EUT was placed on the wooden table as shown in Figure 3.4.1.
The biconical and log periodic antennas were used. To find maximum radiation the turntable was rotated 360$^{o}$, the cables position was varied, the measuring antenna height changed from 1 to 4 m, and the antennas polarization was changed from vertical to horizontal. The measurements were performed with EMI receiver settings: RBW=120 kHz, quasi-peak detector.

The results of measurements were recorded into Table 3.4.1.

**Reference numbers of test equipment used**

| | | | | | | |
|---|---|---|---|---|---|---|
| HL 0027 | HL 0028 | HL 0032 | HL 0034 | HL 0038 | HL 0275 | HL 0287 |
| HL 0812 | HL 0813 | | | | | |

Full description is given in Appendix A.

**Table 3.4.1 Radiated emission measurements test results**
**(Electric field, frequency range 30 MHz - 1 GHz)**

TEST SPECIFICATION: FCC part 15 subpart B Class B
COMPANY: On Track Innovations Ltd.
EUT: GMS
DATE: April 18, 1999
RELATIVE HUMIDITY: 49%
AMBIENT TEMPERATURE: 22°C

MEASUREMENTS PERFORMED AT 3 METERS DISTANCE

| Frequency MHz | Ant. Type | Ant. Pol. | Ant. Hgt. | TT Pos. (°) | Radiated Measured Result dB (μV) | Correction Factor dB (1/m) | Radiated Emissions dB (μV/m) | Spec. Limit dB (μV/m) | Spec. Margin dB | Pass/ Fail |
|---|---|---|---|---|---|---|---|---|---|---|
| 52.023 | Bic | V | 1.0 | -259 | 17 | 12.2 | 29.2 | 40 | 10.8 | Pass |
| 72.022 | Bic | V | 1.0 | -314 | 19 | 8.9 | 27.9 | 40 | 12.1 | Pass |
| 154.04 | Bic | V | 1.0 | 16 | 17 | 16.9 | 33.9 | 43.5 | 9.4 | Pass |
| 230.62 | LP | H | 1.0 | -155 | 8 | 15.3 | 23.3 | 46 | 22.7 | Pass |

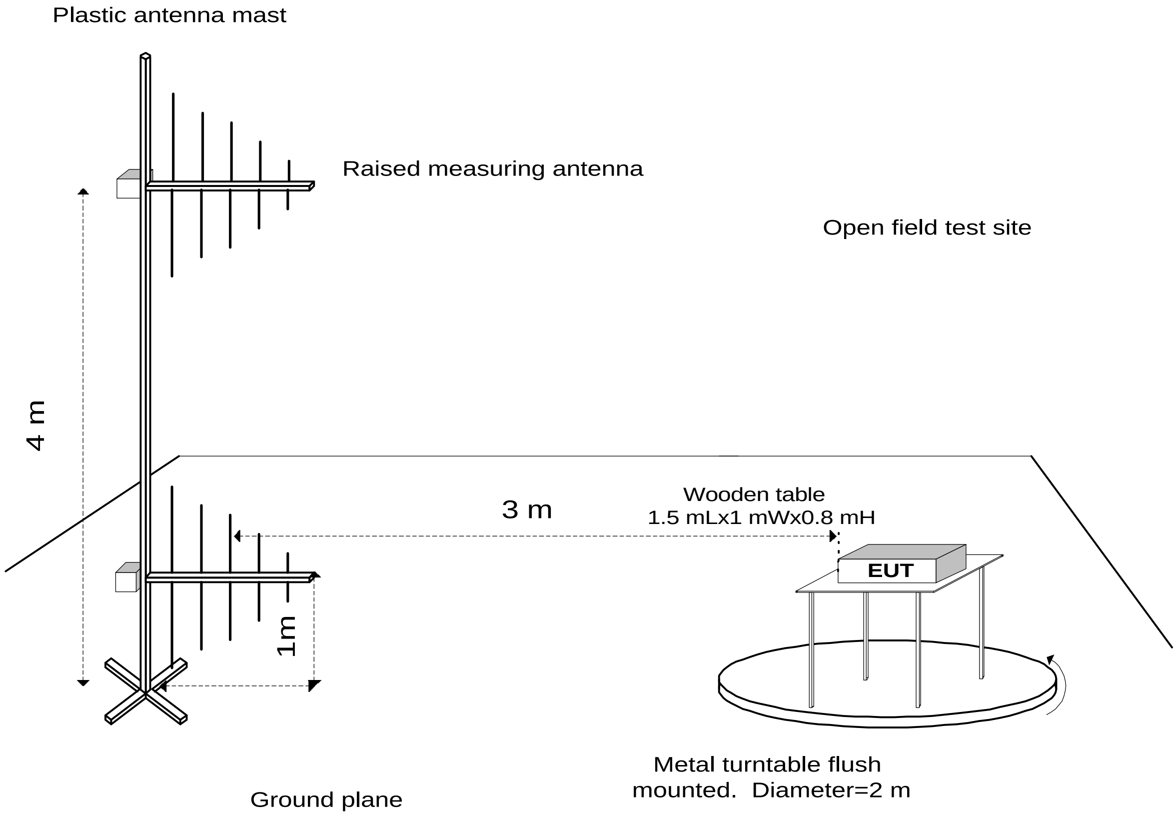
**Test parameters:**
Detector type = QP (quasi peak).
Resolution bandwidth = 120 kHz.

**Table calculations and abbreviations:**
Radiated emission dB (μV/m) = measured results dB(μV) + correction factor dB(1/m).
Correction factor = antenna factor + cable loss (for antenna factor and cable loss refer to Appendix B).
Ant. type = antenna type (Bic - biconical, LP - log periodic).
Ant. pol. = antenna polarization (V-vertical, H-horizontal).
Ant. hgt. = antenna height.
TT pos. = turntable position in degrees, (EUT front panel = $0^o$).
Spec. margin = specification margins = dB below (negative if above) specification limit.

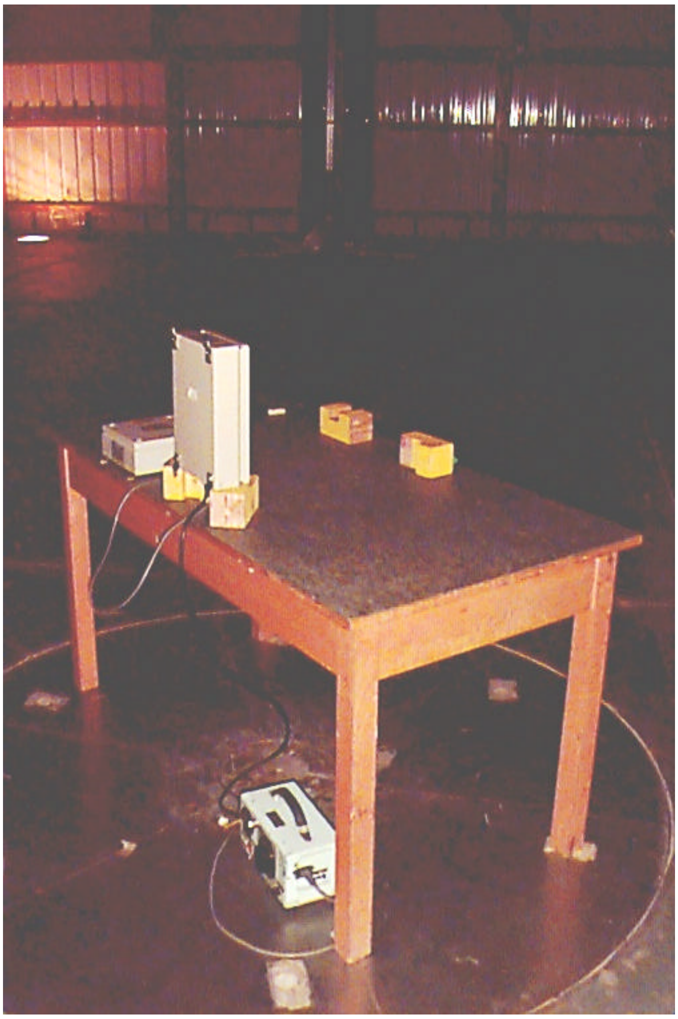
Test performed by:
Mr. Michael Nikishin, test engineer

Hermon Labs

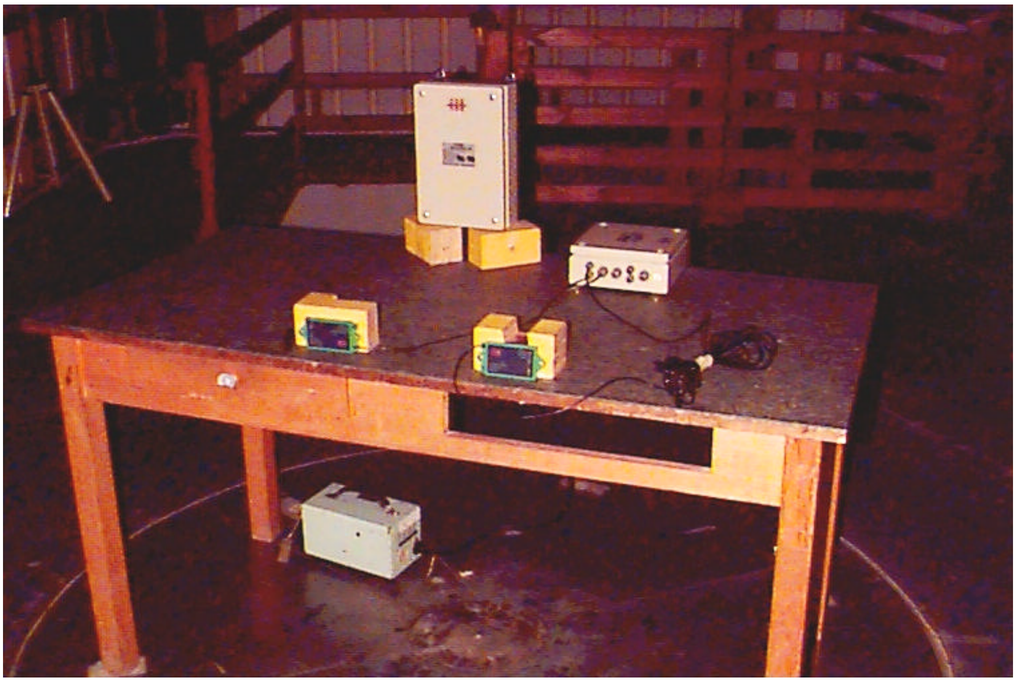
**Figure 3.4.1**
**Radiated emission test setup**



**Photograph 3.4.1**
**Radiated emission measurement test setup**



**Photograph 3.4.2**
**Radiated emission measurement test setup**



## 3.5 Conducted Emission Measurements according to Part 15, §15.107, §15.207

### 3.5.1 Definition of the test

This test was performed to measure conducted emissions.

### 3.5.2 Test set-up

The test was performed in the shielded room. The EUT was setup as shown in Figure 3.5.1 and Photograph 3.5.1.

The frequency range from 450 kHz to 30 MHz was investigated.

The measurements were performed at the adapter 120 V AC power lines (both neutral and phase) by means of the LISN, connected to the spectrum analyzer. The unused 50 Ω connector of the LISN was resistively terminated in 50 Ω when not connected to the measuring instrument. The quasi peak detector (resolution bandwidth = 9 kHz) was used. The measured test result was 36.74 dBμV @ 13.56 MHz frequency (11.26 dB below specified limit). The test results are shown in Plots 3.5.1, 3.5.2.

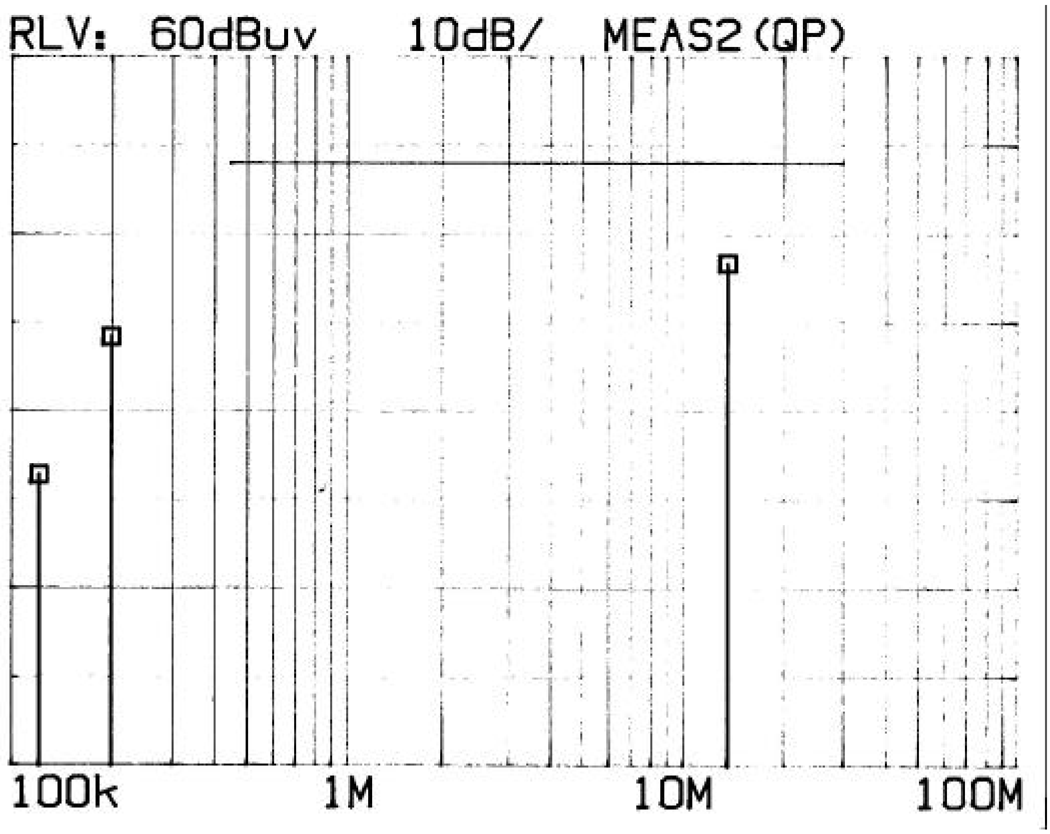
**Reference numbers of test equipment used**

| | | | | | | |
|---|---|---|---|---|---|---|
| HL 0026 | HL 0185 | HL 0447 | HL 0580 | HL 0591 | HL 0672 | HL 0817 |

Full description is given in Appendix A.

**Plot 3.5.1**

Test Specification: § 15.107, § 15.207, class B
Conducted Emission Measurements on power line
Frequency range: 450 kHz-30 MHz
Line: phase
Detector:quasi peak



**Plot 3.5.2**

Test Specification: § 15.107, § 15.207, class B
Conducted Emission Measurements on power line
Frequency range: 450 kHz-30 MHz
Line: neutral
Detector:quasi peak

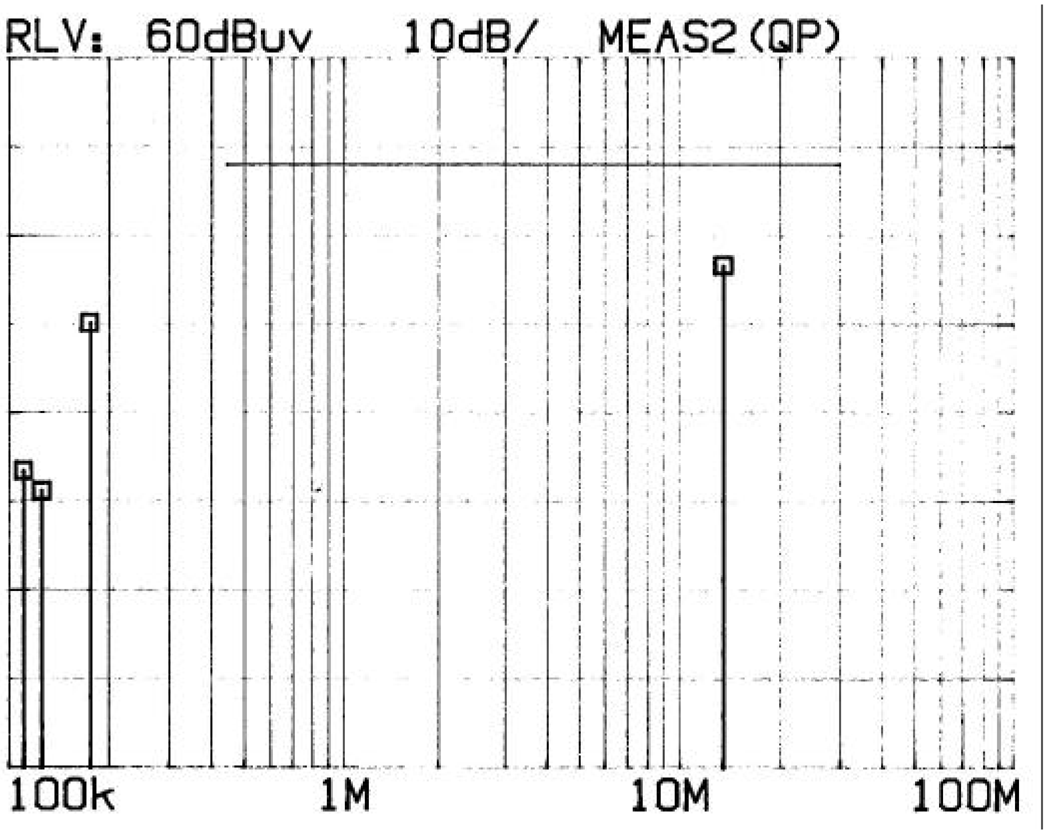
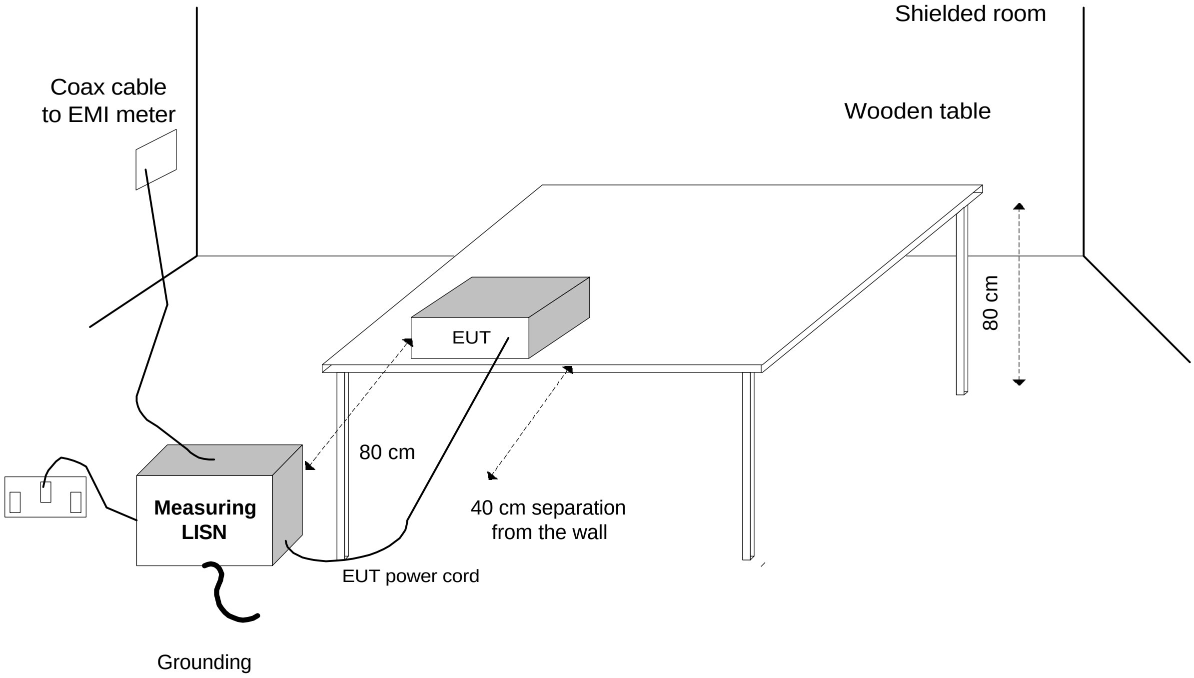
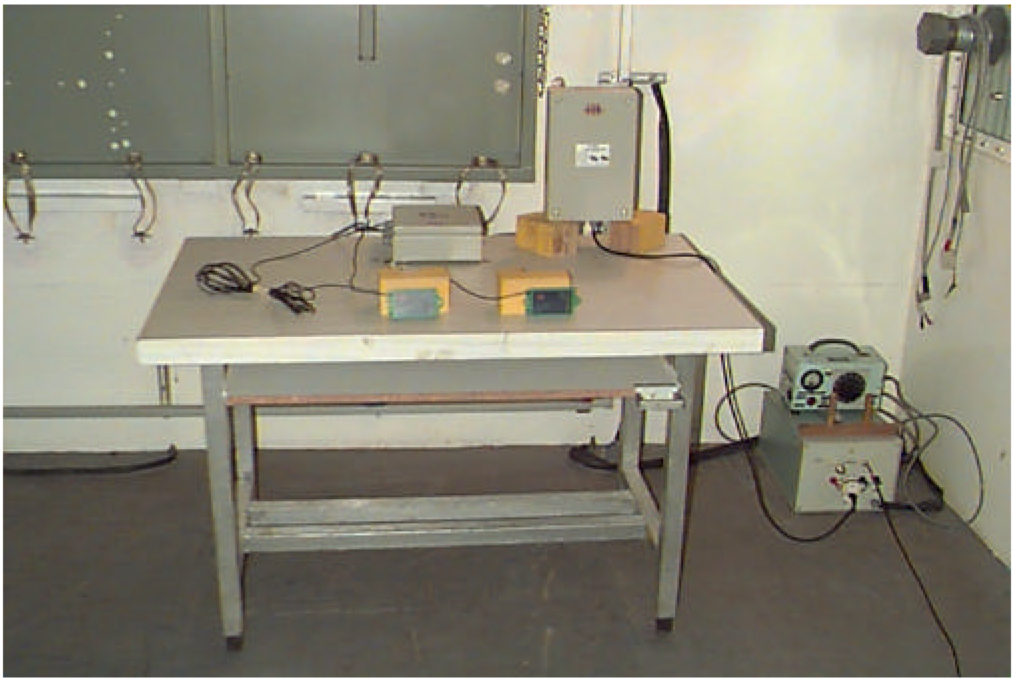


**Figure 3.5.1.**
**Conducted emission test setup**



**Photograph 3.5.1.**
**Conducted emission test setup**



# 4 Summary and Signatures

The EUT, Gasoline Management System, was found to be in compliance with the requirements of FCC Part 15, §§15.225, 15.209, 15.107, 15.109, 15.207 class B limits.

**Test performed by:**

Mr. Michael Nikishin, test engineer _______

**Approved by:**

Dr. Edward Usoskin, C.E.O. _______

**Responsible person from**
**On Track Innovation Ltd.**

Mr. Ronnie Gilboa, vice president (R&D) _______

# APPENDIX A - Test equipment and ancillaries used for tests

| HL Serial No. | Serial No. | Description | Manufacturer | Model No. | Due Calibr. |
|---|---|---|---|---|---|
| 0026 | 3460 | Spectrum Analyzer, 100 Hz-2.2 GHz | Anritsu | MS 2601A | 8/99 |
| 0027 | 4838 | Spectrum Analyzer, 50 Hz-2 GHz | Anritsu | MS-611A | 10/99 |
| 0028 | 44147 | Interference Analyzer, 9KHz-1GHz | Electro-Metrics | EMC 30MKIV | 7/99 |
| 0032 | 3577 | Biconical Antenna, 20-200 MHz | Electro-Metrics | BIA-25/30 | 4/00 |
| 0034 | 1988 | Log Periodic Antenna, 200 - 1000 MHz | Electro-Metrics | LPA 25/30 | 4/00 |
| 0038 | 028 | Antenna Mast, 1-4 m | Hermon Labs | AM-1 | 2/00 Check |
| 0127 | 15112-45 | Generator Tracking | Hewlett Packard | 8444A-60031 | 1/00 |
| 0185 | 1765 | Graphics Plotter | Hewlett Packard | 7475A | NA |
| 0275 | 040 | Table non-metallic, adjustable height, 1.5 x 1.0 x 0.8 m | Hermon Labs | TNM | 3/00 Check |
| 0287 | 042 | Turntable, Motorized Diameter, 2m | Hermon Labs | TMD-2 | 4/00 Check |
| 0446 | 2857 | Active Loop Antenna 10 kHz-30 MHz | Electro-Mechanics | 6502 | 11/99 |
| 0447 | 0447 | LISN, 16/2, 300 V RMS | Hermon Labs | LISN 16-1 | 12/99 |
| 0500 | 2893-05 | Oven temperature | Thermotron | S-16 Mini-Max | 11/99 |
| 0560 | 0071 | Multimeter Digital | Fluke | 87 | 7/99 |
| 0566 | 3566 | Antenna, Biconical, 20-200 MHz | Electro-Metrics | BIA 25/30 | 4/00 |
| 0580 | 580 | DC block adaptor 10 kHz-2.2 GHz | Anritsu | MA8601 A | 6/99 |
| 0591 | 3 | Attenuator 10 dB, 50 Ohm, N-type, 2W | Elisra Electronic Systems | MW2100-N-Type | 6/99 |
| 0672 | 027 | Shielded Room 4.6(L) x 4.2(W) x2.4(H) m | Hermon Labs | SR-3 | 5/99 Check |
| 0679 | 130 | Controller Temperature and Humidity with Adaptor RS232/RS485 | Hermon Labs | HTCL-1 | 10/99 |
| 0812 | 148 | Cable, coax, RG-214, 11.5 m, N-type connectors | Hermon Labs | C214-11 | 8/99 |
| 0813 | 149 | Cable, coax, RG-214, 12 m, N-type connectors | Hermon Labs | C214-12 | 8/99 |
| 0817 | 153 | Cable, coax, RG-58, 8 m, N-type connectors | Hermon Labs | C58-8 | 8/99 |
| 1194 | 2952 | Variac, 220 V/ 2.5 A | Hermon Labs | 2952 | 1/00 |

# APPENDIX B-Test Equipment Correction Factors

**Correction Factor**
**Line Impedance Stabilization Network**
**Model ANS-25/2**
**Electro-Metrics**

| Frequency, kHz | Correction Factor |
|---|---|
| 10 | 4.9 |
| 15 | 2.86 |
| 20 | 1.83 |
| 25 | 1.25 |
| 30 | 0.91 |
| 35 | 0.69 |
| 40 | 0.53 |
| 50 | 0.35 |
| 60 | 0.25 |
| 70 | 0.18 |
| 80 | 0.14 |
| 90 | 0.11 |
| 100 | 0.09 |
| 125 | 0.06 |
| 150 | 0.04 |

The correction factor dB is to be added to the meter readings (dB/µv) of the interference analyzer or spectrum analyzer.

## Antenna Factor
## Biconical Antenna Electro-Metrics Model BIA-25/30
## Ser.No.3577

| Frequency MHz | Antenna Factor dB(1/m) | Frequency MHz | Antenna Factor dB(1/m) |
|---|---|---|---|
| 30 | 14.6 | 120 | 16.0 |
| 35 | 12.8 | 125 | 15.1 |
| 40 | 12.5 | 130 | 15.0 |
| 45 | 12.8 | 135 | 15.0 |
| 50 | 12.6 | 140 | 14.8 |
| 55 | 11.7 | 145 | 14.7 |
| 60 | 11.6 | 150 | 16.5 |
| 65 | 10.3 | 155 | 17.0 |
| 70 | 9.0 | 160 | 17.0 |
| 75 | 8.0 | 165 | 17.4 |
| 80 | 8.9 | 170 | 18.0 |
| 85 | 9.4 | 175 | 18.9 |
| 90 | 11.1 | 180 | 19.1 |
| 95 | 12.3 | 185 | 19.8 |
| 100 | 13.6 | 190 | 20.4 |
| 105 | 14.3 | 195 | 20.1 |
| 110 | 15.5 | 200 | 20.4 |
| 115 | 18.6 | | |

Antenna factor is to be added to receiver meter reading in dB(µV) to convert to field intensity in dB(µV/meter).

## Antenna Factor
## Log Periodic Antenna Electro-Metrics Model LPA-25/30
## Ser.No.1988

| Frequency MHz | Antenna Factor dB(1/m) | Frequency MHz | Antenna Factor dB(1/m) |
|---|---|---|---|
| 200 | 15.1 | 625 | 25.3 |
| 225 | 15.0 | 650 | 25.9 |
| 250 | 16.3 | 675 | 27.2 |
| 275 | 17.3 | 700 | 27.5 |
| 300 | 18.5 | 725 | 28.1 |
| 325 | 19.1 | 750 | 28.0 |
| 350 | 19.4 | 775 | 28.3 |
| 375 | 20.0 | 800 | 28.5 |
| 400 | 20.8 | 825 | 29.1 |
| 425 | 21.3 | 850 | 29.5 |
| 450 | 22.0 | 875 | 29.9 |
| 475 | 22.8 | 900 | 30.3 |
| 500 | 23.4 | 925 | 30.3 |
| 525 | 23.8 | 950 | 30.6 |
| 550 | 24.2 | 975 | 31.2 |
| 575 | 24.6 | 1000 | 31.8 |
| 600 | 24.8 | | |

Antenna factor is to be added to receiver meter reading in dB(µV) to convert to field intensity in dB(µV/meter)

**Antenna factor**
**Electro-Mechanics active loop antenna**
**Model 6502, Ser.No.2857**

| Frequency, MHz | Antenna Factor, dB (1/m) |
|---|---|
| 0.009 | 18.7 |
| 0.010 | 17.7 |
| 0.020 | 13.2 |
| 0.050 | 10.4 |
| 0.075 | 10.2 |
| 0.10 | 9.9 |
| 0.15 | 9.8 |
| 0.25 | 9.9 |
| 0.50 | 9.8 |
| 0.75 | 9.7 |
| 1.0 | 10.1 |
| 2.0 | 10.0 |
| 3.0 | 10.2 |
| 4.0 | 10.1 |
| 5.0 | 10.1 |
| 10.0 | 9.6 |
| 15.0 | 9.6 |
| 20.0 | 9.3 |
| 25.0 | 8.7 |
| 30.0 | 7.5 |

Antenna factor dB(1/m) is to be added to receiver meter reading in dB(μV) to convert it into field intensity in dB(μV)/meter