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# RHV-8 Frequency Stability Test Report

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Contents

## 1. Purpose

### 1.1 Document Purpose

This test is used to determine performance of RHV-8 to a variety of government frequency stability regulations for the EU, US and Canada.

### 1.2 Test Overview

The EUT is placed in a call at a variety of temperature and supply voltage conditions. Its frequency stability is then monitored to determine if it is within guidelines.

The test is carried out according to Nokia document DTY01510-EN, Frequency Stability Test Procedure, auth. Byron Holz, Nokia Test & Certification Center – Dallas, and the format of this report is heavily derivative of the above document.

### 1.3 Test Rationale

This test is essential to determining a handset's compliance with federal regulations.

## 2. LIST OF Abbreviations, Acronyms and Terms

### 2.1 Abbreviations

Hz – Hertz
MHz – Megahertz

### 2.2 Acronyms

| | |
|---|---|
| BSE | Base Station Emulator |
| C | Celsius |
| CFR | Code of Federal Regulations |
| DC | Direct Current |
| EGSM | Global System for Mobile communications - Extended |
| EUT | Equipment Under Test |
| FCC | Federal Communications Commission |
| GPS | Global Positioning System |
| PCS | Personal Communications System |
| ppm | parts per million |
| RF | Radio Frequency |
| TCC | Test and Certification Center |

### 2.3 Terms

*This section intentionally left blank.*

## 3. STANDARDS BASIS

FCC. 47 CFR, Part 2.1055, Frequency Stability.
FCC. 47 CFR, Part 24.235, Frequency Stability.
Industry Canada. RSS-133, Issue 2, Rev. 1. November 6, 1999. Section 7, Frequency Stability
Industry Canada. RSS-128, Issue 2, Rev. 1. November 6, 1999. Section 8, Frequency Stability

## 4. Test equipment, materials list and sample requirements

### 4.1 Test Equipment and Materials

Automated Transceiver Test stack used to carry out test procedure. This is the in house test system used for batch verification over environmental extremes. The relevant equipment used during the test is listed below.

| | | |
|---|---|---|
| Environmental Chamber<br>Thermotron 2800 | Serial no. 30913<br>Calibrated 4 Aug 05 | <br>Due 4 Aug 06 |
| Base Station Emulator<br>Rohde & Schwarz CMU200 | Serial no. 100715<br>Calibrated 25 Jan 06 | <br>Due 25 Jan 08 |
| Power Supply<br>Agilent 6632A | Serial no. US37479490<br>Calibrated 17 Aug 04 | <br>Due 17 Aug 06 |

### 4.2 Phone Sample

RHV-8 Serial no. 001063 Proto B4 IMEI 004400581757380

Conducted RF connection to test system, powered via dummy battery connected to power supply. FBUS via system connector for automated phone control. Test conducted in shielded room.

## 5. Location Information

All equipment needed to perform this test is available in the RHV-8 project area laboratory at the Vertu Ltd. Church Crookham site in the UK.

## 6. PASS/FAIL CRITERIA

FCC Part 24.135 specifies a maximum allowable frequency error of +/- 1 ppm.

GSM Frequency Error limits specify a maximum allowable error of +/- 0.1 ppm under ideal radio conditions (no fading). GSM limits, being worst case, are used in this test.

In GSM1900/GSM1800 this equates to a maximum allowable error of +/- 185 Hz.

In GSM900/GSM850 this equates to a maximum allowable error of +/- 89 Hz.

## 7. System Validation Instructions

The following was verified before proceeding:

- All calibrated equipment is marked with a calibration sticker and is still within its calibration interval.
- The ambient temperature and humidity of the lab is within the normal operating limits of all test equipment.
- The BSE should power on and pass any internal self-checks.
- The reference clock on the BSE is locked to the Vertu site distributed 10 MHz reference, which uses a GPS time standard.

## 8. Test Procedure

The testing described below is designed to cover all the requirements listed in Section 3. Since RSS-128 and RSS-133 only require a subset of 47 CFR 2.1055 measurements, the following changes can be made to the procedures below for those Industry Canada standards *only*:

- For RSS-128 and 133, perform temperature stability only at –30°C, +20°C, and +50°C. A longer settling time, minimum one hour, should be used when making these larger temperature changes.
- For RSS-128, perform battery stability test only at +/- 15%, +20°C.
- For RSS-133, perform battery stability test only at nominal and battery endpoint conditions, +20°C.

The test procedure described is performed for all operating modes and bands supported by the EUT. For RHV-8 this is GSM 850/900/1800/1900.

### 8.1 Temperature Stability

1) The temperature chamber and BSE are placed in an RF shielded environment.
2) The EUT is placed in the temperature chamber and connected via the conducted RF link to the BSE. The EUT's battery supply may be used for this test, but if the DC supply is being used, it must be set at the nominal battery voltage.
3) Set the chamber for –30°C and allow it to stabilize at that temperature. Once the chamber has ramped down, wait a minimum of 3 hours to allow the internal temperature of the EUT to stabilize.
4) Place a call between the BSE and EUT at the EUT's maximum output power, middle channel. Measure frequency error reported by the BSE for at least one minute (10,000 bursts used in test) and until the EUT no longer exhibits any significant drift in frequency. Record the worst-case frequency error observed. Repeat this on low and high channels, in each band, and record the results for these channels also.
5) Increase the chamber temperature by 10 degrees, and allow at least 30 minutes for the components in the EUT to stabilize once this temperature has been reached.
6) Measure the frequency error as described in step 4.
7) Repeat steps 5 and 6 for temperatures up to +50°C in 10 degree steps.

### 8.2 Voltage Stability

1) Place the EUT and BSE in an RF shielded environment at +20°C. The chamber used in 8.1 should be used to regulate this temperature if ambient conditions are not suitable.

2) Power the EUT directly from the DC power supply at the EUT's nominal battery voltage.

3) Place a call between the BSE and EUT at the EUT's maximum output power, middle channel. Observe the frequency error reported by the BSE for at least one minute and until the EUT no longer exhibits any significant drift in frequency (10,000 bursts used in test). Record the worst-case frequency error observed. Repeat this on low and high channels, in each band, and record the results for these channels also.

4) Repeat step 3 with the DC output at the following settings: 85% of nominal, 115% of nominal, and at the specified end point of the battery's operational voltage.

## 9. Results

Summary tables are provided below for generating reports:

**FCC Requirements: +/- 1ppm**

**GSM Requirements: +/- 0.1 ppm**

### 9.1 Frequency Error vs Temperature

| Temperature (°C) | GSM850 Frequency Error (Hz) Limit = +/- 89 Hz | | | GSM900 Frequency Error (Hz) Limit = +/- 185 Hz | | |
|---|---|---|---|---|---|---|
| | ch 128 | ch 192 | ch 251 | ch 512 | ch 700 | ch 885 |
| -30 | -39.2 | 15.37 | -17.82 | -14.79 | -16.92 | -36.22 |
| -20 | -43.91 | -22.34 | -16.14 | -15.82 | -22.73 | -38.74 |
| -10 | -47.91 | 17.05 | -27.25 | -21.37 | -20.53 | -46.94 |
| 0 | -31.9 | -18.02 | -17.11 | -17.37 | -18.34 | -28.61 |
| 10 | -26.99 | -21.31 | -14.59 | -18.85 | -23.44 | -26.67 |
| 20 | -26.47 | -16.01 | -20.15 | -24.86 | -22.73 | -27.18 |
| 30 | -32.93 | -21.7 | -13.43 | -20.73 | -20.02 | -27.77 |
| 40 | -28.09 | -18.98 | -15.56 | -20.08 | -21.95 | -23.25 |
| 50 | -24.86 | -18.92 | -21.63 | -24.99 | -19.44 | -23.44 |

| Temperature (°C) | GSM1800 Frequency Error (Hz) Limit = +/- 185 Hz | | | GSM1900 Frequency Error (Hz) Limit = +/- 185 Hz | | |
|---|---|---|---|---|---|---|
| | ch 512 | ch 700 | ch 885 | ch 512 | ch 661 | ch 810 |
| -30 | -32.87 | -30.61 | -31.25 | -53.72 | -49.59 | -52.43 |
| -20 | -30.22 | -30.87 | -32.48 | -54.89 | -52.82 | -51.4 |
| -10 | -26.09 | -29.57 | -31.83 | -55.98 | -50.75 | -49.27 |
| 0 | -30.09 | -29.7 | -29.9 | -55.73 | -50.56 | -51.66 |
| 10 | -31.77 | -30.35 | -29.51 | -56.56 | -52.24 | -50.5 |
| 20 | -30.67 | -27.77 | -31.12 | -56.11 | -49.46 | -51.79 |
| 30 | -27.44 | -31.77 | -29.12 | -65.35 | -48.11 | -49.59 |
| 40 | -28.8 | -29.25 | -33 | -58.24 | -47.52 | -53.08 |
| 50 | -29.57 | -31.06 | -29.32 | -55.08 | -51.21 | -48.43 |

### 9.2 Frequency Error vs Voltage

| Voltage (%) | Voltage (V) | GSM850 Frequency Error (Hz) Limit = +/- 89 Hz | | | GSM900 Frequency Error (Hz) Limit = +/- 185 Hz | | |
|---|---|---|---|---|---|---|---|
| | | ch 128 | ch 192 | ch 251 | ch 512 | ch 700 | ch 885 |
| End Point | <3.4 | Tx off | Tx off | Tx off | Tx off | Tx off | Tx off |
| Nominal | 4.0 | -20.21 | -25.96 | -21.63 | -24.54 | -18.53 | -27.83 |
| 115% Nominal | 4.6 | -26.09 | -17.89 | -26.35 | -18.47 | -21.76 | -19.11 |
| 85% Nominal | 3.4 | -20.28 | -25.31 | -17.63 | -24.73 | -16.4 | -30.61 |

| Voltage (%) | Voltage (V) | GSM1800 Frequency Error (Hz) Limit = +/- 185 Hz | | | GSM1900 Frequency Error (Hz) Limit = +/- 185 Hz | | |
|---|---|---|---|---|---|---|---|
| | | ch 512 | ch 700 | ch 885 | ch 512 | ch 661 | ch 810 |
| End Point | <3.4 | Tx off | Tx off | Tx off | Tx off | Tx off | Tx off |
| Nominal | 4.0 | -37.58 | -40.49 | -34.48 | -40.94 | -41.07 | -36.03 |
| 115% Nominal | 4.6 | -36.87 | -37.39 | -36.61 | -37.71 | -38.55 | -36.87 |
| 85% Nominal | 3.4 | -37.26 | -40.36 | -35.39 | -35.97 | -37.13 | -40.55 |

The transmit power amplifier supply is disabled below 3.3 V and phone powers off at 3.2 V.

## 10. Conclusions

No failures noted over temperature, worst case frequency error = -65.35Hz (GSM1900 CH512 @ 30° Celsius)

No failures noted over voltage, worst case frequency error = -41.07 Hz (GSM1900 CH661 @ Nominal Voltage)