

RESEARCH REPORT

# Test Report for the Alarms in IST Vivago Wristcare® home system

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## Abstract

The objective of this study was to evaluate technically whether the IST Vivago Home System alarms function as stated in the alarm specifications. The tests were carried out in laboratory conditions with one single home unit in simulated situations. The system successfully passed all the tests as specified in the alarm specifications. This suggests that the system performs as specified in the alarm specifications. However, it should be noted that this test was based on one single home system and simulated conditions in laboratory environments. Extrapolations to other conditions, or statistics about different units, are beyond the scope of the present study.

Tampere, 03.06.2002

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# 1 Introduction

## 1.1 Objectives of the test

This report describes tests and their results performed on behalf of IST Oy on their Vivago WristCare® system. This report focusses only on the *home edition* of that system.

The WristCare system is used for monitoring the wellbeing of elderly people (automatic alarms) and allow them to call for aid by pressing a button on a wristwatch-like *WristCare* unit (manual alarm). The system contains the following elements:

- *WristCare* unit
- *Base Unit*
- *Receiving station using Vista software*

The wristcare unit is worn like a wristwatch and monitors movements, temperature and skin conductivity. It sends radiofrequency (RF) messages to the base station to inform it of movements or 'alarm' situations.

The base unit receives and analyzes the RF messages from its associated wristcare. In case of alarm situations, the base unit uses an analog phone line connection to inform a receiving station of the situation.

The receiving station comprises a modem and a PC running *IST Vista* software. The receiving station is set up in a care station where alarms are received and handled by care personnel

This report tests the functionality of the alarms built into the system against the specifications (Appendix A).

## 1.2 Limitations

The tests concentrate on the *main* features of the *whole system*. The tests do not aim to cover all the specifications separately for the wrist unit, base station, and the whole Vista system. The features and conditions tested are defined in this test plan. No extrapolations to other conditions and/or features are made. Especially, for the test design:

- Testing is done in simulated conditions. The test conditions are made as repeatable as possible.
- Alarm logic is dependent on correct detection of whether the unit is worn on wrist or not. The alarms dependent on this detection are tested with an assumption that the detection of wrist unit usage works correctly.
- Detection whether the wrist unit is on wrist or not is tested by some cases where manufacturer's instructions on using the unit are followed. The results of this test may not be extrapolated to other conditions, e.g. different wrist properties (skin conductivity, anatomy, etc.) and dirtyness of the wrist unit.
- The tests are only done for one wrist unit.

## 2 Test equipment

### 2.1 Wrist unit

A Vivago 3001 wrist unit, with the Serial number: 200477, ID: 5255, Type: 3001

### 2.2 Base station

Type ML4012-1, serial #BBDADB1, id #41032

### 2.3 Software

- IST Vista v1.15 modules 1,2&3
- Custom software for controlling the movement generator.

### 2.4 Accessories:

- Janke-Kunkel IKA-VIBRAX-VXR test tube shaker. This was used for long term simulation of movements.
- X10 based switch and controller to switch the shaker on and off.
- A 'wrist simulator' - a cable connecting the electrodes of the wristcare unit, simulating the situation where it is 'on wrist'.



*The shaker used for simulating wrist movements, shown with several WristCare units on it. The 'wrist simulator' cables are clearly visible too.*

## 3 Tests and results

For manufacturer's definition for the specifications of different alarms, see Appendix A. In the following, different tests are shortly described, and their results reported.

### 3.1 Manual Alarms

#### 3.1.1 Manual alarm

Definition: the alarm is generated when the user has pressed the wrist unit button for 2 seconds.

#### Objective:

To test that the manual alarm is always generated in different conditions when the wrist unit is within the radio transmission range.

#### Test plan:

- A1. Wrist unit is on the wrist. The alarm button is pressed for >2secs. The alarm should be received immediately. Success of receiving alarm is reported.
- A2. Wrist unit is off the wrist. The alarm button is pressed for >2secs. The alarm should be received immediately. Success of receiving alarm is reported.
- A3. Wrist unit is out of range (out of range alarm in Vista is received or there is a flashing light in the home unit). The unit is brought back to range but the Vista (home base station) has not yet detected the return of the unit (home unit light is still flashing). A manual alarm button is pressed. An alarm should be received.

#### Result:

- A1: OK  
A2: OK  
A3: OK

### 3.2 Automatic Physiological Alarms

#### 3.2.1 Passivity alarm

Test equipment: computer-controlled force generator, to which the wrist unit is attached to simulate movements in predefined pattern.

#### Test plan:

- B1. **Objective:** to generate a passivity alarm without a deterioration alarm (04) being generated in daytime (10-20).  
The wrist unit is moved for 2 seconds every 10 minutes within a 4-hour period. A passivity alarm should be generated. The delay from the test start to generation of the alarm is reported.
- B2. **Objective:** to test that no passivity alarm is generated in nighttime (20-10).  
The same pattern as in test B1 is applied. A passivity alarm should not be generated.

**B3. Objective:** to exceed the threshold where a passivity alarm is generated in daytime.  
The wrist unit is moved for 2 seconds every 20 seconds within a 5-hour period. No passivity alarm should be generated.

**Results:**

B1: OK, delay was 4h8min

B2: OK

B3: OK

### 3.2.2 Deterioration alarm

Test equipment: computer-controlled force generator, to which the wrist unit is attached to simulate movements in predefined pattern.

Adaptation: the base unit is tested with the adaptation time set to the default maximum values (2h30min for day time, 3h30min for night time).

**Objectives:**

- To test that the deterioration alarm is triggered when the unit is not moved during the specified maximum limits, both during daytime and nighttime.
- To test that the deterioration alarm limits (day and night) will adapt both to a shorter time if the unit is moving, and to a longer time after a triggered alarm.

**Test plan:**

- C1. Alarm limit is set to the default, at daytime. For the home unit this is done by powering it down, powering it up again and reregistering the wrist unit. The wrist unit is on hand (simulated). The wrist is kept still (no movements). Delay to a *deterioration alarm* is reported. The test is repeated at nighttime.
- C2. Like C1, but a single movement within the time is generated at the mid-time of the test period. No alarm should be generated. Follow-up time 3h.
- C3. Adaptation test. The base unit is in the day time mode. The alarm limit is reset, like in test C1. The wrist unit is on hand (simulated). During 24 hours, the wrist unit is activated once per 5 minutes. Next, the wrist unit is kept still. The alarm should come 30 minutes sooner than in test C1. Delay is reported. Next, the wrist unit is activated again once per 5 minutes, during one hour. After keeping the wrist unit still for a while another alarm should be generated, now at the same interval as in test C1. Delay is reported.
- C4. Like C3, but at nighttime.

**Results:**

C1: OK, daytime: delay was 2h38min.

C1: OK, nighttime: delay was 3h36min.

C2: OK

C3: OK, first part: delay was 2h10min.

C3: OK, second part: delay again was 2h37min.

C4: OK, first part: delay was 3h08min.

C4: OK, second part: delay was 3h37min.



### 3.3 Automatic Access Control

#### 3.3.1 WristCare out of range *and* WristCare back in range

**Objective:**

To test that the system recognizes a situation where the wrist unit is moved out of transmission range and brought back to the range.

**Test plan:**

E2. A wrist unit is on the wrist (simulated) and next to base station. The unit is taken out of range. Truly being out of range is tested by pressing the manual alarm button – no alarm should be received. After a delay the base station led should start flashing indicating out of range and also an alarm should be received in Vista (delay is reported). Then, the unit is brought back in range (next to base station). Back in range alarm should be received. A delay is reported.

**Results**

E2: OK, Out of range delay: 1h8min.

E2: OK, Back in range delay: 9 min.

### 3.4 Automatic Technical Alarms

#### 3.4.1 WristCare off wrist and WristCare back on wrist

**Objective:**

To test that the wrist unit on and off detection functions in normal conditions.

**Test plan:**

F1. A clean wrist unit is on table. Then the wrist unit is put on the wrist of a test user (*not simulated, this time*) and tightened according to manufacturer's instructions. The *Back on wrist* alarm should be received (delay recorded). Then, the unit is taken off wrist and put back on table. A delay to the *off wrist* alarm is recorded (wait time >50min is considered as no alarm).

**Disclaimer:**

this is more like a test case than a proof of specifications. Affecting factors to the detection include wrist and skin properties, skin-electrode contact, tightening of the unit and cleanliness of the unit and skin. These factors are not tested nor systematically controlled in this test.

**Results**

F1: OK, first part, delay to *back on wrist*: 9min

F1: OK, second part, delay to *off wrist*: 43min

### 3.4.2 Battery empty

**Objective:**

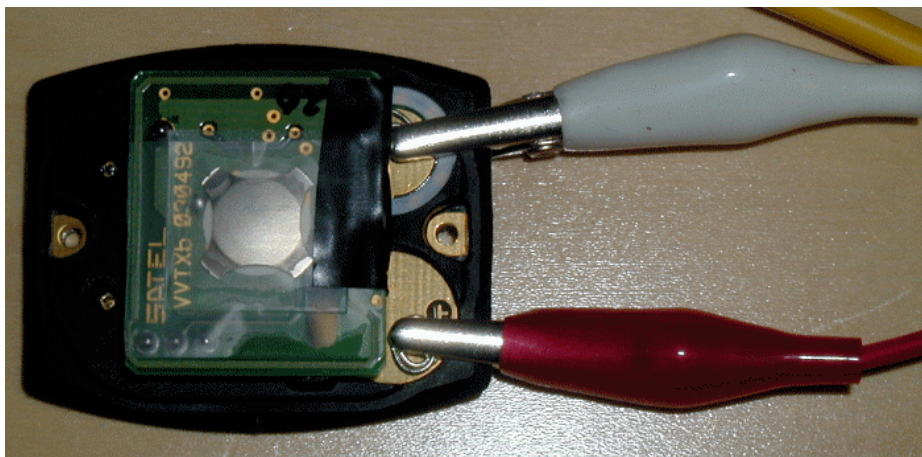
To test that the system recognizes an empty battery.

**Test plan:**

G1. The wrist unit is opened. The battery is removed and a laboratory power supply is connected to the battery bins. The operating voltage is set at 3.15VDC. Manual alarm is generated to make sure that the unit is working and in range. The voltage is then gradually dropped (steps 0.05V) and after each drop a manual alarm is activated. The battery alarm should be received when the voltage is dropped too low (<2.9V). The operation is continued until battery alarm is received.

**Result**

G1: The alarm was sent when pressing the button for manual alarm when the supply voltage was 2.90 Volts.



*An opened WristCare unit during the battery test.*

## 4 Conclusions

The tests for one home system were carried out. The system passed all the tests successfully. This suggests that the system performs as specified in the alarm specifications. However, it should be noted that this test was based on one single home system and simulated conditions in laboratory environments. Extrapolations to other conditions, or statistics about different units, are beyond the scope of the present study.

## Appendix A: Alarm descriptions



### WRISTCARE® - HOME ALARMS

This briefly describes the VIVAGO WristCare home system alarms: how they occur, and how to proceed with them.

#### **Manual alarm (01)**

The alarm is sent when the user presses the button on the wrist unit for 2 seconds. This alarm is sent even if the wrist unit is not worn on wrist. The user's condition must be checked immediately.

#### **Passivity notification (02)**

This notification will be given when the user has been passive, which is defined as the user moving very little. In the home system, the notification is triggered in 4-5 hours. The notification is a sign of an unusually long period of low activity. The activity level that triggers the notification is empirically fixed. For some users this can be triggered occasionally, if the user's activity level remains below the empirically tested fixed level. The level of passivity is analysed during the daytime, between the hours of 10 a.m. - 8 p.m. When this notification is sent, the user's condition should be checked.

#### **Deterioration alarm (03)**

The alarm is sent when the user has become inactive. The length of inactivity that triggers the alarm depends on the user's inactive periods. The system is continuously studying the user's activity level and adapts the alarm limit to be typically 30min longer than the longest recent inactive period. The total variation in the alarm limit is based on empirical studies and the natural difference in the activity level of users during the day and night. Therefore, the total variation in the alarm limit is 30min – 2h30min during the day and 60min – 3h30min during the night.

A considerable change in the sleep rhythm, compared to the adaptation level, can trigger unnecessary alarms. This can be due to a change in medication, for example. If using the home system and this alarm is triggered, the base unit will stimulate the user and will beep for a period of 10 minutes. The user may cancel the alarm by pressing the button on the base unit to acknowledge it (see Alarm acknowledgement, 17), or by simply reacting to the stimulation in order to generate measurable movements. If the user does not react to the beeping, the alarm will be sent after the 10 minutes of stimulation. When the alarm has been received, the user's condition must be checked immediately.

Note for home users: For a complete and more reliable adaptation level, the user should be advised to stay within radio signal range to the base unit during the first 4 day period.

**WristCare off wrist (04)**

This alarm is sent after the user has removed the wrist unit from wrist. In home system the alarm is sent when the wrist unit has been removed from the wrist for over 30 minutes

If an alarm is triggered even though the WristCare is attached to the user's wrist, the strap must be tightened. Unnecessary alarms can be triggered if the user's wrist is very slender and/or extremely dry or the wrist unit is simply too loose.

At home, the user will be able to press the button on the base unit and get an hour before the alarm will be sent. This can be used if a longer bathing time is needed. Each pressing of the button will give an extra hour from the time the button was pressed.

**WristCare back in range (22)**

This notification is triggered when the user re-enters radio signal range of the base unit. It is triggered within 5-10 minutes for wrist unit 3001. For the device interface it is triggered in 2 hours, or immediately if the manual button is pressed twice.

**WristCare back on wrist (23)**

This notification is given when the user re-attaches the wrist unit to his/her wrist. It is given within 5-10 minutes for wrist unit 3001.

**WristCare out of range (24)**

In home system the notification is given when the base unit has not received any radio signals from the wrist unit in 60 minutes. Notification is not given if the "User gone out" notification has already been sent. During the time the wrist unit is out of transmission range the indicator light of the home base unit is flashing slowly.

Technical note: This may also indicate a damaged wrist unit or device interface. Construction material, such as steel and thick walls can affect the radio signal transmission between the wrist unit and base unit.

**WristCare battery empty (28)**

This notification is triggered when the wrist unit battery is nearly empty. The wrist unit battery should be replaced immediately, as the wrist unit's operation is no longer reliable at this point.