

Annex Jammetest 2024

Important:

Time in the notes is local time, which is UTC +2, time in the log is UTC

Notes in bold and italic are editors notes for the reader

1 Site 2: Grunnvatn

1.1 Wednesday 11.9.2024

1.1.1 09:00 – 10:00 Leonardo testing with jammers: H.1.1(Position A), S.2.4(Position B), H.4.1 (Position C)

- 09:25:00 - Turned on H.1.1 with settings: Low power L1 WB
- 09:32:00 - H.1.1 still on with settings Low power L1 WB and turned on S2.4
- 09:35:10 - H.1.1 still on with settings Low power L1 WB, S2.4 still on, and turned on H.4.1
- 09:41:52 - H.1.1 changed to High power
- 09:49:15 - Turned off H.4.1
- 09:52:05 - Turned off S.2.4
- 09:54:05 - H.1.1 changed to Low power
- 09:55:20 - Turned off H.1.1

1.1.2 10:00 – 11:00 Technical University of Denmark testing with jammers H.1.1 (Position C 100m) and H.3.1(Position C 100m). Testcase: Flying drone in an area around the jammer

- 10:07:35 - Turned on H.1.1 with settings High power, L1 WB
- 10:08:55 - Log started approximately 20sek later than the test/jammer
- 10:12:10 - Turned off H.1.1
- 10:13:16 - Turned on H1.1 with same settings
- 10:17:55 - Turned off H.1.1
- 10:28:10 - Turned on H.3.1
- 10:36:25 - Turned off H.3.1
- 10:57:10 - Turned on H.1.1 with settings High power L1 WB
- 11:02:05 - Turned off H.1.1

1.1.3 11:00 – 12:00 Teledyne testing with jammers H.2.1, H.3.3, H.6.3, H.8.1 in origo. Testcase: flying drone while jamming

- 11:35:00 - Log started
- 11:33:25 - Turned on H.6.3
- 11:34:07 - Turned off H.6.3
- 11:35:18 - Turned on H.6.3
- 11:40:03 - Turned off H.6.3

- 11:45:02 – Turned on H.3.3
- 11:49:04 – Turned off H.3.3
- 11:51:43 – Turned on H.8.1
- 11:57:18 – Turned off H.8.1

1.1.4 12:00 – 13:00 Swedish Defense Material Administration testing with jammers H.1.4 (Position A), H.1.5 (Position B), H.1.1 (Position C) in different distances

- 12:32:40 - Log started
- 12:32:05 – Turned on H.1.4
- 12:32:15 – Turned on H.1.5 while H.1.4 is still on
- 12:32:30 – Turned on H.1.1 with settings High Pwr, L1 Chirp while H.1.4 and H.1.5 is still on
- 12:37:14 - Settings on H.1.1 changed to L1 NB
- 12:48:05 – Settings on H.1.1 changed to L1 WB
- 12:52:10 – Stopped H.1.1, H.1.4, H.1.5

1.1.5 14:00 – 15:00 University of Colorado testing with jammer H.1.1.

Testcase: Placed mobile phones around the field. Wants to walk with the jammer around, turning on and off jammer

- H.1.1 with settings: High power, L1WB, L2 WB
- 14:28:28 - Turned on H.1.1
- 14:32:11 – Turned off H.1.1
- 14:32:25 – Turned on H.1.1 (at position C100m and walking)
- 14:36:25 – Turned off H.1.1
- 14:36:20 – Turned on H.1.1 (at position C150m and walking)
- 14:40:10 – Turned off H.1.1
- 14:40:30 – Turned on H.1.1 (walking with jammer on)
- 14:43:36 – Turned off H.1.1
- 14:45:18 – Turned on H.1.1 (walking with jammer on)
- 14:48:56 – Turned off H.1.1
- 14:50:30 – Turned on H.1.1 (walking towards C50m with jammer on)
- 14:56:00 Turned off H.1.1

1.1.6 16:00 – 18:00 Novatel/Hexagon testing with jammer H.3.3 (Position A), H.1.4 (Position A), H.1.5 (Position B), F.6.1 with full power on every port(Position C)

Not recorded in the automated log – entered manually in the automated log

- 16:04:30 – Turned on H.1.5 with settings High power, L1CW, L2CW
- 16:10:40 – Changed settings on H.1.5 to L1NB, L2 NB

- 16:20:14 - Changed settings on H.1.5 to L1 WB, L2 WB
- 16:30:17 – Turned off H.1.5
- 16:31:57 – Turned on H.3.3
- 16:45:11 – Turned off H.3.3
- 16:48:02 – Turned on F.6.1
- 17:00:12 - Turned off F.6.1
- 17:02:55 – Turned on H.3.3 and F.6.1
- 17:12:25 – Turned off H.3.3 and F.6.1
- 17:15:05 - Turned on H.3.3 and H.1.5 with settings High power, L1WB, L2WB
- 17:24:00 – Turned off H.3.3 and H.1.5
- 17:26:16 – Turned on H.3.3 and H.1.5 with settings High power, L1WB, L2WB
- 17:27:41 - Turned off H.3.3 and H.1.5
- 17:28:44 - Turned on H.1.5 with settings High power, L1WB, L2WB and F.6.1
- 17:39:16 – Turned off H.1.5 and F.6.1
- 17:41:53 – Turned on H.1.4 and H.1.5 with settings High power, L1CW, L2CW
- 17:47:22 - Turned off H.1.4 and H.1.5
- 17:49:22 - Turned on H.3.3, H.1.5 with settings High power, L1WB, L2WB and F.6.1
- 17:53:34 - Turned off H.3.3, H.1.5 and F.6.1
- 17:55:19 – Turned on H.3.3 and F.6.1
- 18:02:19 – Turned off H.3.3
- 18:03:14 - Turned off F.6.1

2 Site 3: Stavne

2.1 Monday 9.9.2024

2.1.1 First round – from Stave to Nordmela:

Something went wrong with the logging; it disappeared when the start button was pressed. The jammer was turned on at 15:25 (at Stave) and turned off at 15:39 (Nordmela).

Manually edited in the automated log, start and stop was recorded with a few seconds between them

It was test 1.11.7 that was conducted. Jammer inside the car. Jammer H6.5.

2.1.2 Second round – from Nordmela to Stave

The logging looked correct. Test 1.11.8 was conducted, and with the jammer inside the car. Jammer H6.5.

2.1.3 Third round – from Stave to Nordmela

Correct log, more info: ad hoc test – the car with the jammer drove in the middle of the convoy. The jammer was moved to a box on the roof of the car instead of inside. Stopped and let three cars pass – all the cars were almost stationary at one point. Same jammer used – H6.5.

2.1.4 Fourth round – from Nordmela to Stave

Correct log, more info: ad hoc test – the car with the jammer drove in the middle of the convoy. Jammer placed in a box on the roof of the car. Jammer H6.5.

2.1.5 Fifth round – from Stave to Nordmela

The log says 1.11.7, this is incorrect, we conducted an ad hoc test – the car with the jammer drove in the middle of the convoy. Jammer placed in a box on the roof of the car. Logged the correct time. Jammer H6.5.

Automated log updated manually

2.1.6 Sixth round – from Nordmela to Stave

Correct log, more info: ad hoc test – the car with the jammer drove in the middle of the convoy. Jammer placed in a box on the roof of the car. Jammer H6.5.

2.2 Tuesday 10.9.2024

2.2.1 Test 1.10.6 - Towards Nordmela

All three jammers were placed with antennas pointing upward on the car roof towards the stationary test car. Jammer number 2 did not work during this test. Turned around at

2.2.2 Nordmela Test 1.10.6 - Towards Stave

All three jammers were placed with antennas pointing upward on the car roof towards the stationary test car. All three were confirmed during the test by Nkom.

2.2.3 Test 1.10.6 - Towards Nordmela

Adjustment from the previous two tests: the antennas were laid flat (pointing down toward the road) on the roof of the test cars at all three locations.

2.2.4 Test 1.10.6 - Towards Stave

The antennas were laid flat (pointing down toward the road) on the roof of the test cars at all three locations

2.2.5 Test 1.10.6 - Towards Nordmela

Adjustment from the previous two tests: the antennas were laid flat (pointing down toward the road) on the roof of the test cars at all three locations.

2.2.6 Test 1.10.6 - Towards Stave

Adjustment from the previous tests again: The antennas pointed upward from the car on the roof of the test cars at all three locations.

Positions of the three stationary test cars with jammers:

- Position 1: Latitude: 69.194605, Longitude: 15.840136 (jammer:)
- Position 2: Latitude: 69.169424, Longitude: 15.818470 (jammer:)
- Position 3: Latitude: 69.154570, Longitude: 15.794791 (jammer:)

Commented [KS1]: Er det noe som skulle ha stått her?

2.2.7 Test 1.10.3 - Towards Nordsanden

Error in log – it says test 1.10.4, but it should have been 1.10.3. Test car with jammer inside was placed right outside "the House" and all the test cars drove to the next turnaround point. The test cars could drive as many rounds as they wanted within 30 minutes.

Correct in the automated log

2.2.8 Test 1.10.4 - Towards Nordsanden

Test car with jammer inside was placed right outside "the House" and all the test cars drove to the next turnaround point. The test cars could drive as many rounds as they wanted within 30 minutes.

2.2.9 Test 1.10.3 - Towards Nordsanden

Test car with jammer inside was placed right outside "the House" and all the test cars drove to the next turnaround point. The test cars could drive as many rounds as they wanted within 30 minutes.

2.2.10 Test 1.10.4 - Towards Nordsanden

Test car with jammer inside was placed right outside "the House" and all the test cars drove to the next turnaround point. The test cars could drive as many rounds as they wanted within 30 minutes.

2.2.11 Ad hoc tests x2 (first towards Nordmela and the second back to Stave)

3 overtakes towards Nordmela – all test vehicles overtook the car with the jammer, then the jammer car overtook the whole line of cars (except the lead vehicle).

The cigarette jammer S2.4 was used.

A lead vehicle was first, followed by the car with the jammer.

The jammer was turned on for the entire trip.

When we arrived at Nordmela, we were informed that several of the test users could not reset their systems during the drive. Therefore, we decided that on the return, when we were going to use the stronger jammer (H6.5), the car with the jammer would wait until we received confirmation from Nkom that they were not picking up any more signals – before the car with the jammer overtook the entire convoy again.

We did this twice on the return to Stave.

2.3 Wednesday 11.9.2024

2.3.1 Planned Test 2.6.1 at 10:00 AM

- At the start of the test, we are 30m from the spoof position.
- Test start at 10:06. The spoofing only lasted for about a minute, as a small amplifier was broken. The test was not conducted because we were waiting for a new amplifier to be brought down from the mountain. Instead, we moved on to the next test.

2.3.2 Test 2.6.2 at 11:00

- 10 minutes at a stationary position, 30m from the spoof position.
- Started driving at 11:10:10.
- Speed: 50 km/h, though the test catalog states 40 km/h.
- The map in the car shows the car jumping back and forth in the same place. The position on the map is several kilometers behind the actual position on the road. The position on the map suddenly jumps back to Stave and shows the car driving in the opposite direction. The map indicates that the car is on the road the entire time. The car's position remains fixed at Stave and jumps back and forth towards the north. The car searches for a GPS signal. It's possible the car's wheels are indicating it's moving either forward or backward but not in which direction.
- The car's clock was also affected, showing one hour earlier than the actual time.
- Test end at 11:22.
- Duration: 22 minutes and 18 seconds.

After the spoofer was turned off, the car's GPS could not find the correct position and continued searching for a signal. Even 23 minutes after the test ended, the car still had not found a GPS signal. The car never regained the signal before the next test.

2.3.3 Test 2.6.3 ("Sea Spoofing") at 11:50

- Speed: 50 km/h, though the test catalog states 40 km/h.
- The car's clock jumped to a new time, showing two hours earlier than the actual time. It is suspected this happened because the position jumped to a different time zone.
- The car's GPS position was several miles out to sea. It appears the position is stationary on the water, but it is difficult to tell on the map. Note: At the start of the test, the GPS did not show the correct position at Stave, as it was still spoofed from the previous test. The position moved to the sea when the new spoofer for this test was activated.
- Began driving at 11:55, 5 minutes into the test due to the reorganization of cars in the convoy.
- Test stop at 12:07.
- Duration: 16 minutes and 14 seconds.
- After the spoofer was turned off, the GPS still could not find a signal and continued searching.

2.3.4 Test 2.6.1 - Attempted to start test at 12:30, actual test start at 12:31

- This test was conducted instead of test 2.6.4 due to limited time before lunch, and this test is stationary.
- Attempted test start at 12:30.
- Actual test start at 12:31.
- The position began in the sea from the previous test. At 12:31, the car's map found the correct position, but the clock was still 2.5 hours behind the actual time. The direction changed several times. In the last minutes of the test, the position moved further down the road.
- Test end at 12:51.
- Duration: 20 minutes.
- When the spoofer was turned off during this test, the car was stationary, and the signal returned immediately. In previous tests, the spoofer was turned off while the car was moving, and the signal did not return when the spoofing was stopped.
- Test 2.6.4 - Was not conducted, see the explanation in the previous test 2.6.1

2.3.5 Ad Hoc Test start at 14:47

Driving from Stave to Nordmela. Jammer: H3.2. Driving in convoy. Lead car in front, test car, jammer car, two test cars, SVV car at the back. Jammer is upright in the box on the roof. 50 km/h.

2.3.6 Ad Hoc Test

Driving from Nordmela to Stave. Jammer: H6.5. Driving in convoy from Nordmela to Stave. Lead car in front, test car, jammer car, test car, and SVV car at the back. 50 km/h. Upon arrival at Stave House, the jammer remained on for 2 minutes while stationary before the test ended.

2.3.7 Ad Hoc Test

Visited by the management group, conducted various tests with H6.5 and H6.6 to demonstrate what we are doing at Site 3. Jammer: H3.2. Demonstration for the management group. Short test. Stationary. Can see on the car's map that the signals are being jammed.

2.3.8 Ad Hoc Test started at 16:48

Testing at speed where the test car passes the jammer at varying speeds. An SVV car at each end controls the speed. The test cars drive back and forth along a stretch outside the Stave House. Jammer H3.2.

2.3.9 Ad Hoc Test

Testing at speed where the test car passes the jammer at varying speeds. An SVW car at each end controls the speed. The test cars drive back and forth along a stretch outside the Stave House. Jammer H6.5. Jammer not on L1 (switch 5 flipped up. Turned off L5 halfway through the test due to harmonics.

2.3.10 Ad Hoc Test

Three jammers are fixed along the driving route:

- H6.6 in the north, roundabout at the end.
- H6.5 minus L1 in the middle, at Stave House.
- H3.2 in the south, at the intersection, exit to the main road to Stave.

2.4 Thursday 12.9.2024

2.4.1 Test 2.6.1

- During spoofing, the GPS location of the car is far up in the marsh, in motion. When the spoofer is turned off, the GPS jumps down to the road, but several kilometers from where the car is, and the GPS remains stationary on the road.

2.4.2 Test 2.6.2

- From Stave to Nordmela
- Before the test starts, the GPS location jumps back to Stave where the car is located. Therefore, this test began at the correct GPS location, compared to the other tests that did not.
- During the spoofing, the map is at the correct position but in the wrong direction on the road. After 10 minutes, when we start driving, the car jumps back and forth at the same spot. It jumps in sync with the GPS signal update.
- Lost communication with Volvo during the test/convoy.
- Duration: 20 minutes

2.4.3 Test 2.6.4

- From Stave to Nordmela
- This test is conducted before 2.6.3 because 2.6.3 is a "sea test" and therefore does not matter where the test starts. To save time, this test was done before 2.6.3 so that 2.6.3 could be taken on the return from this test.
- The GPS location on the map in the car oscillates between being on the road and off the road, for example, on the beach or in the mountains/forest. Eventually, it jumps onto the road but remains at an exact point completely still, though in the correct direction.
- When the spoofer is turned off, the car does not find its position again until the next test. It just stays searching for the GPS signal.
- Drove at 35 km/h.
- Duration: 20 minutes

2.4.4 Test 2.6.3

- From Nordmela to Stave
- This test begins at the first intersection after the exit from Nordmela. At the intersection by Dverberg. This is because we want to use the same geographical test stretch on the road in all tests. We stopped for 2 minutes along the road at the intersection in Dverberg to start the test. The car is stationary when the test starts.
- At the start of the test, the GPS signal is not found again after the previous test. So, when the test starts, the car is at the wrong location on the map.
- The clock in the car was also spoofed. Real time: 12:20, clock in the car: 09:01.
- Drove at 35 km/h.

- During the test, the GPS location is out at sea.
- When the spoofer was turned off, the GPS location of the car jumped back to Nordmela, at a stationary point. It does not recover.

2.4.5 Test 2.6.1

- Test start at 14:10.
- The clock in the car was spoofed. Real time: 14:11, clock in the car: 14:01.
- The car is facing the wrong direction on the map before it starts driving up towards the mountain. Then it jumps back onto the roads, and then it remains stationary in the wrong direction.
- When the spoofer is turned off, the position jumps back to Stave, but it is facing the wrong direction on the road.

2.4.6 Test 2.6.2

- From Stave to Nordmela
- The car is stationary for 10 minutes before we drive.
- Drove at 35 km/h.
- The position on the map when the test starts is spoofed from the previous test: the position on the map in the car is correct but points in the wrong direction on the road.
- Generally more accurate spoofing in this test.
- After spoofing ends, the GPS signal returns to the correct position immediately. This is the first test where this happens. Usually, the GPS position is incorrect for a good while after spoofing ends.

2.4.7 Test 2.6.3

- From Nordmela to Stave
- The test begins at the first intersection after the exit from Nordmela. At the intersection by Dverberg. This is because we want to use the same geographical test stretch on the road in all tests.
- When the test begins, the GPS location on the map is in the correct place.
- After the spoofer is turned on, we remain stationary for 1 minute at the intersection before we begin to drive.
- After the spoofer is turned on, it takes less than 1 minute before the car detects the spoofer and sends the GPS location out to sea.
- Drove at 35 km/h.

2.4.8 Test 2.6.4

- From Stave to Nordmela
- At the start of the test, the GPS location on the map in the car is at the correct position.

- Started driving 12 minutes after the test start, which is 2 minutes later than planned. Therefore, the test only had 8 minutes in motion.
- When the spoofer was turned off, the map position of the car jumped back to the correct place.