



## Jammertest 2022 - Transmission plan

Session	Transmissions	Comments
<b>Session 1</b>	<u>Tests of low effect jammers (1. l.j.a)</u>	Need a thorough log for different time stamps for each jammer
<b>Monday</b>	<u>Stationary jammers</u>	
<b>Part 1</b>	Single band jammers	
<b>(14.00-18.00)</b>	<ul style="list-style-type: none"><li>• 14:00-14:10 – Placement tests</li><li>• 14:10 – Jammer 1 (inside car)</li><li>• 14:11 – Jammer 2 (inside car)</li><li>• 14:12 – Jammer 3.1 (inside car)</li><li>• 14:13 – Jammer 3.2 (inside car)</li><li>• 14:14 – Jammer 6.1 (inside car)</li><li>• 14:15 – Jammer 6.2 (inside car)</li><li>• 14:16 – Jammer 7.1 (inside car)</li><li>• 14:17 – Jammer 7.2 (inside car)</li><li>• 14:18 – Jammer 8.1 (inside car)</li><li>• 14:19 – Jammer 8.2 (inside car)</li><li>• 14:20 – Jammer 8.3 (inside car)</li><li>• 14:21 – Jammer 8.4 (inside car)</li><li>• 14:22 – Jammer 10 (inside car)</li><li>• 14:23 – Jammer 11 (inside car)</li><li>• 14:24 – Jammer 12 (inside car)</li><li>• 14:25 – Jammer 13 (inside car)</li> <li>• 14:30 – Jammer 1 (outside car)</li><li>• 14:31 – Jammer 2 (outside car)</li><li>• 14:32 – Jammer 3.1 (outside car)</li><li>• 14:33 – Jammer 3.2 (outside car)</li><li>• 14:34 – Jammer 6.1 (outside car)</li><li>• 14:35 – Jammer 6.2 (outside car)</li><li>• 14:36 – Jammer 7.1 (outside car)</li><li>• 14:37 – Jammer 7.2 (outside car)</li><li>• 14:38 – Jammer 8.1 (outside car)</li><li>• 14:39 – Jammer 8.2 (outside car)</li><li>• 14:40 – Jammer 8.3 (outside car)</li><li>• 14:41 – Jammer 8.4 (outside car)</li></ul>	Use the same car and note down the position of the jammer and the type of car  For an overview of the different jammers, see 'Jammer overview – frequency bands and modulations'

	<ul style="list-style-type: none"> <li>• 14:42 – Jammer 10 (outside car)</li> <li>• 14:43 – Jammer 11 (outside car)</li> <li>• 14:44 – Jammer 12 (outside car)</li> <li>• 14:45 – Jammer 13 (outside car)</li> </ul> <p>Dual band jammers</p> <ul style="list-style-type: none"> <li>• 15:00 – Jammer 4.1 (inside car)</li> <li>• 15:01 – Jammer 4.2 (inside car)</li> <li>• 15:02 – Jammer 5.1 (inside car)</li> <li>• 15:03 – Jammer 5.2 (inside car)</li> </ul> <ul style="list-style-type: none"> <li>• 15:10 – Jammer 4.1 (outside car)</li> <li>• 15:11 – Jammer 4.2 (outside car)</li> <li>• 15:12 – Jammer 5.1 (outside car)</li> <li>• 15:13 – Jammer 5.2 (outside car)</li> </ul> <p>Multi band jammers</p> <ul style="list-style-type: none"> <li>• 15:20 – Jammer 9 (inside car)</li> <li>• 15:21 – Jammer 14 (inside car)</li> </ul> <ul style="list-style-type: none"> <li>• 15:25 – Jammer 9 (outside car)</li> <li>• 15:26 – Jammer 14 (outside car)</li> </ul> <hr/> <p><b><i>Half hour break – 15:30 to 16:00</i></b></p> <hr/> <table border="0" style="width: 100%;"> <tr> <td style="width: 70%;"><u>High effect jammer (Cemetery)</u></td> <td style="width: 30%; vertical-align: top;">Directional antenna (right hand circular polarization) at maximum output (20 W EIRP)</td> </tr> <tr> <td> <ul style="list-style-type: none"> <li>• 16:00 - L1 CW</li> <li>• 16:15 - L1 PRN</li> <li>• 16:30 - L1, G1 CW</li> <li>• 16:45 - L1, G1 PRN</li> <li>• 17:00 - L1, G1, L2 CW</li> <li>• 17:15 - L1, G1, L2 PRN</li> <li>• 17:30 - L1, G1, L2, L5 CW</li> <li>• 17:45 - L1, G1, L2, L5 PRN</li> </ul> </td> <td style="vertical-align: top;">10 minutes jamming sessions with 5 minutes breaks to change set-up(s)</td> </tr> </table>	<u>High effect jammer (Cemetery)</u>	Directional antenna (right hand circular polarization) at maximum output (20 W EIRP)	<ul style="list-style-type: none"> <li>• 16:00 - L1 CW</li> <li>• 16:15 - L1 PRN</li> <li>• 16:30 - L1, G1 CW</li> <li>• 16:45 - L1, G1 PRN</li> <li>• 17:00 - L1, G1, L2 CW</li> <li>• 17:15 - L1, G1, L2 PRN</li> <li>• 17:30 - L1, G1, L2, L5 CW</li> <li>• 17:45 - L1, G1, L2, L5 PRN</li> </ul>	10 minutes jamming sessions with 5 minutes breaks to change set-up(s)
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<p><b>Session 1</b></p> <p><b>Monday</b></p> <p><b>Part 2</b></p> <p><b>(16.00-17.30)</b></p>	<p><u>Long-time jamming with low effect jammer (2. l.j.a.)</u></p> <p>Jammer 9</p> <p>Driving and flying allowed in the vicinity of Grunnavatn.</p>				

<p><b>Session 2</b></p> <p><b>Tuesday</b></p> <p><b>(09.00-13.00)</b></p> <p><i>Driving Bleik community house ('Samfunnshuset') – Grunnvatnet allowed</i></p>	<p><u>Power ramp tests</u></p> <p>100 dB (reduction) – 10 seconds</p> <p>98 dB – 10 seconds</p> <p>...</p> <p>2 dB – 10 seconds</p> <p>0 dB – 10 seconds</p> <p>2 dB – 10 seconds</p> <p>...</p> <p>98 dB – 10 seconds</p> <p>100 dB – 10 seconds</p> <ul style="list-style-type: none"> <li>• 09:20 - Ramp 1: L1 CW</li> <li>• 09:50 – Ramp 2: L1 PRN</li> <li>• 10:20 – Ramp 3: L1, G1, L2, L5 CW</li> <li>• 10:50 – Ramp 4: L1, G1, L2, L5 PRN</li> </ul> <hr/> <p><b>Half hour break – 11:15 to 11:45</b></p> <hr/> <p><u>Power ramp tests</u></p> <ul style="list-style-type: none"> <li>• 11:45 - L1, L5, E5b CW</li> <li>• 12:15 - L2, L5, G2, E5b CW</li> <li>• 12:45 - L2, L5, G2, E5b PRN</li> </ul>	<p>2 nW to 20 W EIRP (100 dB dynamics)</p> <p>25 minutes in total with transmissions for each test. 10 seconds of stable and continues transmission, and a few moments to change (which can involve some instability).</p> <hr/> <p>25 minutes in total for each ramp test</p>
<p><b>Session 3</b></p> <p><b>Tuesday</b></p> <p><b>Part 1</b></p> <p><b>(14.00-18.00)</b></p> <p><i>Driving Bleik community house ('Samfunnshuset') – Grunnvatnet allowed</i></p>	<p><u>Long time, high effect jamming</u></p> <ul style="list-style-type: none"> <li>• 14:00 – L1 CW</li> <li>• 14:30 – L1 PRN</li> <li>• 15:00 – L1, G1, L2, L5 CW</li> <li>• 15:30 – L1, G1, L2, L5 PRN</li> </ul> <hr/> <p><b>Half hour break – 16:00 to 16:30</b></p> <hr/> <p><u>Pyramid</u></p> <p><i>Everything with PRN</i></p>	<p>20 W EIRP in 20 minutes sessions</p> <hr/> <p>3 minutes jamming sessions with 2</p>

	<p>Start 16:30</p> <ul style="list-style-type: none"> <li>• E5b</li> <li>• Eb5, L5</li> <li>• E5b, L5, G2</li> <li>• E5b, L5, G2, L2</li> <li>• E5b, L5, G2, L2, B1l</li> <li>• E5b, L5, G2, L2, B1l, G1</li> <li>• E5b, L5, G2, L2, B1l, G1, L1</li> <li>• E5b, L5, G2, L2, B1l, G1</li> <li>• E5b, L5, G2, L2, B1l</li> <li>• E5b, L5, G2, L2</li> <li>• E5b, L5, G2</li> <li>• E5b, L5</li> <li>• E5b</li> </ul>	<p>minutes breaks to change set-up(s)</p> <p>Effect:</p> <ul style="list-style-type: none"> <li>- 5 W FOR B1l, G1</li> <li>- 10 W for the rest</li> </ul>
<p><b>Session 3</b></p> <p><b>Tuesday</b></p> <p><b>Part 2</b></p> <p><b>(14.00-18.00)</b></p>	<p><u>“Jammer playground” at 2. l.j.a.</u></p> <p>Jammers not in use in part 1 are brought to Grunnvatn for a loose test session.</p> <p>Driving and flying allowed in the vicinity of Grunnvatn.</p>	
<p><b>Session 4</b></p> <p><b>Wednesday</b></p> <p><b>Part 1</b></p> <p><b>(09.00-13.00)</b></p> <p><i>Driving Bleik community house – Grunnvatnet allowed</i></p>	<p><u>Long time, high effect jamming</u></p> <ul style="list-style-type: none"> <li>• 09:10 – L1 CW</li> <li>• 09:30 – L1 PRN</li> <li>• 09:50 – L1, G1, L2, L5 CW</li> <li>• 10:10 – L1, G1, L2, L5 PRN</li> </ul>	<p>20 W EIRP in 15 minutes sessions</p> <p>Here the idea is to create an environment in which it is possible to move in and out of jammed areas</p>
<p><b>Half hour break – 10:30 to 11:00</b></p>		
	<p><u>Low-effect jammers</u></p> <p>11:00-11:30 - Preparation for vehicle test type 2 (inline jammer)</p> <p>11:30-11:55 – Driving from <i>cemetery</i> to Grunnvatnet</p>	<p>It is necessary to choose which single band jammer (SBJ) and dual band jammer (DBJ) to pick for these driving tests.</p>

	<ul style="list-style-type: none"> <li>• 11:30 – platoon 1 – SBJ (L1)</li> <li>• 11:35 – platoon 2 – DBJ (L1, L2)</li> <li>• 11:40 – platoon 3 – Jammer 9</li> </ul> <p>11:50-12:30</p> <p>Quick turn around and grace period (5 min to get systems to get position again)</p> <p>Change vehicle roles and do smaller and other changes based on experiences from first platoon</p> <p>12:30-12:50 – Driving from Bauktua to <i>cemetery</i></p> <ul style="list-style-type: none"> <li>• 12:30 – platoon 1 – Jammer 9</li> <li>• 12:35 – platoon 2 – SBJ (L1)</li> <li>• 12:40 – platoon 3 –DBJ (L1, L2)</li> </ul>	<p>Use experience from earlier in the week to decide this.</p> <p>It is necessary to keep a log from the driving tests to document when jammers where used, at to note done the results from each vehicle</p>
<p><b>Session 4</b></p> <p><b>Wednesday</b></p> <p><b>Part 2</b></p> <p><b>(09.00-13.00)</b></p>	<p><u>“Jammer playground” at 2. l.j.a.</u></p> <p>Jammers not in use in part 1 are brought to Grunnvatn for a loose test session.</p> <p>Driving and flying allowed in the vicinity of Grunnvatn.</p>	
<p><b>Session 5</b></p> <p><b>Wednesday</b></p> <p><b>Part 1</b></p> <p><b>(14.00-18.00)</b></p>	<p>14:15-14:40 – Driving from <i>cemetery</i> to Bauktua</p> <ul style="list-style-type: none"> <li>• 14:15 – platoon 1 – DBJ (L1, L2)</li> <li>• 14:20 – platoon 2 – Jammer 9</li> <li>• 14:25 – platoon 3 – SBJ (L1)</li> </ul> <p>14:50-15:05</p> <ul style="list-style-type: none"> <li>• Vehicle with jammer drives from Samfunnshuset to Bauktua and passes the platoon.</li> <li>• All other vehicles start from Bauktua towards Samfunnshuset.</li> </ul> <p>15:10 – 15:25</p> <ul style="list-style-type: none"> <li>• Vehicle with jammer drives from Bauktua to Samfunnshuset and passes the platoon.</li> <li>• All other vehicles start from Samfunnshuset towards Bauktua.</li> </ul> <p>15:30 – 16:30</p>	<p>Use experience from earlier driving tests to choose which jammer is most applicable for these driving tests</p>

<p><i>Driving allowed in the vicinity of Bleik community house ('Samfunnshuset').</i></p>	<ul style="list-style-type: none"> <li>Place one jammer in vehicle parked between Samfunnshuset and Bauktua and other vehicles pass it</li> </ul> <p>16:30-18:00 - Static testing of small jammers with vehicles at Samfunnshuset</p>
<p><b>Session 5</b> <b>Wednesday</b> <b>Part 2</b> <b>(14.00-18.00)</b></p>	<p><u>"Jammer playground" at 2. l.j.a.</u></p> <p>Jammers not in use in part 1 are brought to Grunnvatn for a loose test session.</p> <p>Driving and flying allowed in the vicinity of Grunnvatn.</p>
<p><b>Session 6</b> <b>Thursday</b> <b>(09.00-13.00)</b></p> <p><i>Driving allowed in the vicinity of Bleik community house ('Samfunnshuset')</i></p>	<p><u>Simple spoofing</u></p> <p>See Annex 1.</p>
<p><b>Session 7</b> <b>Thursday</b> <b>(14.00-18.00)</b></p> <p><i>Driving allowed in the vicinity of Bleik community house ('Samfunnshuset')</i></p>	<p><u>Advanced spoofing</u></p> <p>See Annex 2</p>



<p><b>Session 8</b></p> <p><b>Friday</b></p> <p><b>(09.00-13.00)</b></p> <p><i>Driving Bleik community house – Grunnvatnet allowed</i></p>	<p>Rest tests and new ideas.</p> <p>Demonstrations of tests which turned out to be demonstration worthy.</p> <p>Fill in during the test week</p> <p>Proposed tests:</p> <ul style="list-style-type: none"><li>- Satellite test: high effect jammer at full power (20 W), main direction 300°. Time: 09:56 to 10:07 (local time)</li><li>- Jammer location tests – jammers in different cars and testing if localisation equipment can identify correct car and where in the car we've hidden the jammer</li><li>- Standard jammers in car driving past receiving probes (Bauktuva, Grunvatn) and passing them several times</li><li>- Place three-four jammers (L1 and L2) in the terrain and test CERPA-antennas driving past them. Proposed place is by the road before the cemetery (road to the old cemetery), to do drive-by tests and turning tests</li><li>- Drive from Community house to Grunnvatnet and u-blox car will follow the car that has jammer inside. Returning so that we drive in front and jammer behind us in your car</li><li>- Redo a few coherent spoofing attacks by Samfunnshuset</li><li>- Static tests<ul style="list-style-type: none"><li>o No interference &gt; L1 interference &gt; I delete ALMANAC and GPSEPHMERIS on our receiver &gt; restart receiver &gt; Interference stops ~5mins after I want to observe tracking and ranges &gt; End</li><li>o No interference &gt; L1, L2 interference &gt; I delete ALMANAC and GPSEPHMERIS on our receiver &gt; restart receiver &gt; Interference stops ~5mins after I want to observe tracking and ranges &gt; End</li><li>o No interference &gt; L1, L2, L5 interference &gt; I delete ALMANAC and GPSEPHMERIS on our receiver &gt; restart receiver &gt; Interference stops ~5mins after I want to observe tracking and ranges &gt; End</li></ul></li><li>- Drive up and down the road from the cemetery to Samfunnshuset and back two times with a L1 jammer</li></ul>
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#	Scenario	Where	When	Which jammer
1	Satellite test: high effect jammer at 20 W in direction 300°.	From the cemetery	09:56 to 10:07 (local time)	High effect jammer
2	Jammers in cars driving by stationary receivers	Grunnvatn/ Bauktuva		2 L1 (different power levels), 1 L1&L2
3	Direction attacks: place several jammers spread out in the terrain (by the old cemetery road) and do drive by tests	Old cemetery road		3 L1&L2 jammers
4	Driving test with following cars, drive in front and in back of the jammer car	From Samfunnshuset to Buktuva		Jammer 9/Jammer 14
5	Redo some of the spoofing attacks <ul style="list-style-type: none"> <li>- Test 10, 11 (only upper L-band initial jamming), 12</li> </ul> <p>Only half of the driving</p>	Samfunnshuset	Before 11.30	Spoofing setup, jammer 9 & jammer 14
6	Drive up and down the road from the cemetery to	Road between cemetery and Samfunnshuset		L1 jammer





		Samfunnshuset a couple of times with a jammer in a car			
	<b>7</b>	Static tests with different jammers	Bauktuva		L1, L1&L2, L1&L2&L5
	<b>8</b>	Jammer inside truck	Grunnvatn		L1&L2



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Test 5 (9-11.30) and 6 (11.30) will be done at Samfunnshuset (need jammer 6.1, 6.2 and jammer 9).

Follow-up with test 7 (12)

Test 1 is done independently (10)

Test 2, 3, 4 and 8 (Grunnvatn, start 9.30 in the order that is most useful)

### Annex 1

Simple spoofing										
Initial conditions										
Signals	Eph	Pos	Time	Initial jamming	Continuous jamming	Scenario	Estimated start	Estimated duration	Comments	
GPS L1 C/A Galileo E1	Simulated	False	False	None	None	Static position	0900	~1 hour	Initial capability tests. Running continuous, change jamming during run.	
	Simulated	False	False	All bands/signals	All except L1/E1	Static position				
					G1	Static position				
	Simulated	True	False	False	All bands/signals	None	Static position	1000	~15 min	
						All except L1/E1	Jump in position			
	Simulated	True	True	False	All bands/signals	All except L1/E1	Static position (up to 15 min) + Motion	1020	20-30 min	
	Simulated	True	True (< 30 seconds off)	True (< 30 seconds off)	All bands/signals	All except L1/E1	Static position (up to 15 min) + Motion	1055	20-30 min	
	Simulated	False	False	True (< 30 seconds off)	All bands/signals	All except L1/E1	Static position, jump in time	1130	~15 min	
	Simulated	False	False	True (< 30 seconds off)	All bands/signals	All except L1/E1	Static position, drift in time (frequency step)	1145	20-30 min	
	Simulated	True	True	True (< 30 seconds off)	All bands/signals	All except L1/E1	Static position, jump in time	1215	~15 min	
	Simulated	True	True	True (< 30 seconds off)	All bands/signals	All except L1/E1	Static position, drift in time (frequency step)	1230	20-30 min	
										If time, repeat with variations in jamming conditions

## Annex 2

Advanced spoofing									
Initial conditions									
Signals	Eph	Pos	Time	Initial jamming	Continuous jamming	Scenario	Estimated start	Estimated duration	Comments
GPS L1 C/A Galileo E1	True	True	Synchronised	All bands/signals	All except L1/E1	Static position + motion	1400	20-30 min	
	True	True	Synchronised	All bands/signals	None	Static position + motion	1430	20-30 min	
	True	True	Synchronised	None	None	Static position + motion	1500	20-30 min	
	True	True	Synchronised	All bands/signals	All except L1/E1	Static position + drift in time (frequency step)	1530	20-30 min	
	True	True	Synchronised	All bands/signals	None	Static position + drift in time (frequency step)	1600	20-30 min	
	True	True	Synchronised	None	None	Static position + drift in time (frequency step)	1630	20-30 min	
	True	True	Synchronised	All bands/signals	All except L1/E1	Inject leap second	1700	15 min	
	True	True	Synchronised	All bands/signals	All except L1/E1	Remove leap second	1715	15 min	
	True	True	Synchronised	All bands/signals	All except L1/E1	Static position + time step (1-100 µs)	1730	30 min	Performed in several steps