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ROYAL CANADIAN MARINE
SEARCH & RESCUE
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CHIRP Solid State vs. Closed Radome Radar Tests

Station 1 & Station 6 – May 2021

Executive Summary

In March 2014 Station 1 performed a series of radar tests triggered by concerns around the performance of 4kW 24” closed radome units commonly used on RCM-SAR vessels. The main conclusion of these tests was a clear superiority of 12 kW 48” open array radars for SAR operations. In March 2018 Stations 1 and 20 were asked by the Region to compare the 48” open array radar to the new Quantum CHIRP solid state radars appearing on the market. In August 2019 the same tests were performed by Stations 1 and 25 with a Quantum 2 CHIRP radar with Doppler. Since large open array radars are not practical on delta configuration RHIBs, Stations 1 and 6 were asked by the Region in May 2021 to compare the newer 4kW 24” HD closed radome to the solid state Quantum CHIRP radar as possible options for such open RHIBs.

This last series of tests was performed at the same location and with a similar inconspicuous target vessel as the original 2014 tests. The 4kW radome and CHIRP were both mounted on SAR-6, a delta configuration RHIB. The target vessel was a 19’ ex-Coast Guard RHIB.

SAR-6

Target vessel

We also performed limited tests with a 12kW open array radar mounted on SAR-1 to calibrate this new series of test results to the 2014 tests. The results were nearly identical in 2014 and 2021. We therefore added the Open Array test results to all tables – they are a combination of results from 2014 and 2021.

As highlighted in prior tests neither the radome nor the CHIRP radar come close to the open array in image resolution or detection range. The radome unit did perform slightly better than in the 2014 tests and did not present any fatal flaws (e.g. total lack of detection). The CHIRP performed significantly worse than the radome and than in prior tests with a larger target. It repeatedly failed to detect the target on a direct collision course, did not trigger the RACON until a cable away, showed very poor discrimination of targets and created more ghost images.

Based on these tests the CHIRP radar is not suitable for SAR operations at high speed and close to shore. The radome is far from perfect but could be an acceptable substitute for an open array on vessels where the latter would be impossible to install, i.e. delta RHIBs with no cabin or roof.

Full conclusions and recommendations can be found on page 21.

Tested Configurations

The following configurations were tested (see section 8 for more details):

1) 24” closed HD radome, 4kW, factory tuned, mounted on SAR-6 (called “Radome” in the test results)

2) CHIRP Quantum solid state radar, 20 W, factory tuned, mounted on SAR-6 (called “CHIRP” in the test results).

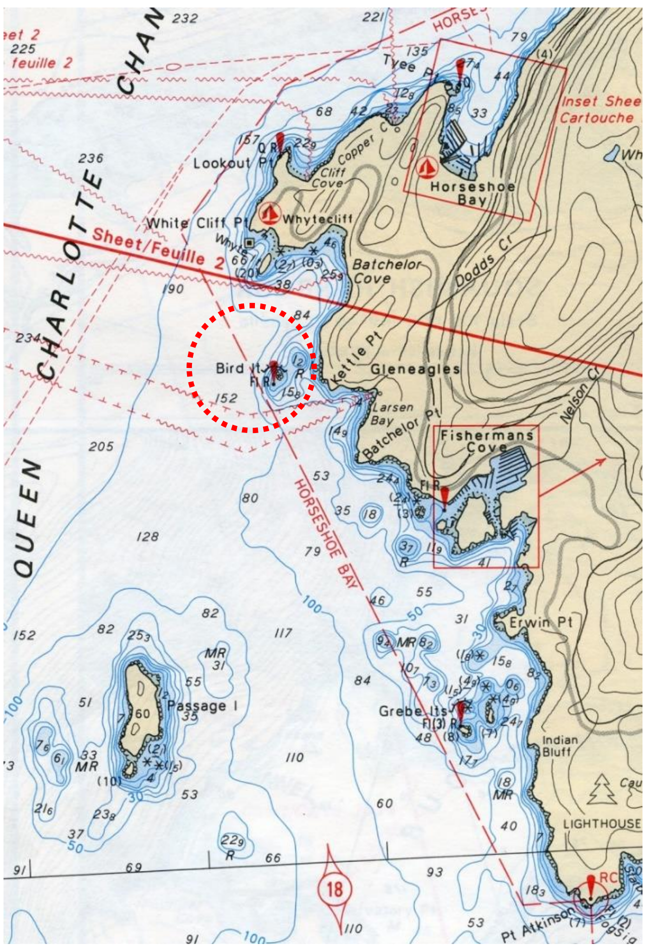
3) 48” open array, 12 kW, factory tuned, mounted on SAR-1 (called “Open Array” in the test results) for test calibration purposes only.

Test Environment

The moving target was an ex-Coast Guard 19’ Zodiac Hurricane RHIB with fibreglass hull and no radar deflector or other large metallic objects on board other than the outboard engine. Its radar unit was disabled. Special thanks to Simon Pearce of Station 6 for providing us with this vessel for the tests and spending a long day driving his RHIB back and forth.

The fixed target was a standard navigational aid with an effective echoing area of roughly $10m^2$. The tests used Bird Islet’s red beacon, which is situated approximately 60 meters off Bird Islet and 320 meters or 0.18 nm off the mainland (see the red dotted circle on the chart). We used QB as a RACON target.

Weather for all test runs was clear skies, light winds, calm seas or a 1’ chop, and good to perfect visibility.



Note that this is the same location and target vessel type as the original 2014 tests. The 2018 and 2019 tests were performed at a different location (Thrasher Rocks) and with a larger target vessel (Type 1).

Radar Setup

All tests were conducted with the radars set to Harbour Mode, automatic gain, automatic sea state, rain filter off. Enhanced Echo mode was turned off on both units. Only the radar range setting was changed during the tests.

Test Protocol and Results

Both stationary (fixed) and moving targets were detected, at various vessel speeds. Additionally, the discrimination resolution of the radars was tested by verifying their ability to distinguish two close-by targets. We tested the ability of the radars to trigger a RACON beacon. Our intention was to also test the radars' ability to detect a SART beacon but none could be sourced in time.

The goal of the tests was to emulate situations that are most common and critical for coastal SAR vessels. We therefore focussed on the detection of small inconspicuous vessels (the 19' RHIB) and small land features, both at slow and high speeds, at distances under 3nm. The various tests and results are listed below.

In some cases there was a significant difference between the intermittent detection of a target (target detected every 2nd or 3rd scan) and continuous detection (target detected every scan). In such cases both measurements are listed, with an "i" for the intermittent detection and a "c" for the continuous detection. If there was little difference between the two measurements, a single data point is listed.

At closer ranges, targets were sometimes immediately and continuously detectable (i.e. at the outer edge of the screen). In such case the measurement is printed in *italics*.

If a target was not detectable at a defined range, the cell is marked with a "-". If a range was not used during the test the cell is marked "NT". An arrow > or < in a column for intermittent readings indicates the reading was always constant at that range.

Note that the CHIRP solid state radar has intermediate range settings (1/16, 3/8, 1, 2 and 4nm) not available on the conventional radome units. We did not use these intermediate ranges for our tests.

All tests were performed with a primary tester at the master Axiom Pro screen on the vessel, with a secondary tester at the second Axiom Pro screen confirming the readings of the primary tester.

1. Slow/stationary detection

Starting at 3 nm from the fixed target the SAR vessel is driven at 25 kn towards the fixed target (light by Bird Islet). The table shows the distance at which the combined light+islet target detaches from the mainland, and then the distance at which the light detaches from the islet.

Speed (kn)	Range (nm)	Target separates from mainland at (nm)			Target separates from islet at (nm)		
		Radome	CHIRP	Open Array	Radome	CHIRP	Open Array
25	3.0	2.2i 1.8c	2.0i 1.5c	*3.0*	1.4i 1.0c	0.7	NT
25	1.5	*1.5*	1.5i 1.2c	*1.5*	1.0	0.7i 0.6c	0.85i 0.5c
25	0.75	*0.75*	*0.75*	*0.75*	*0.75*	0.6	*0.75*
25	0.5	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*

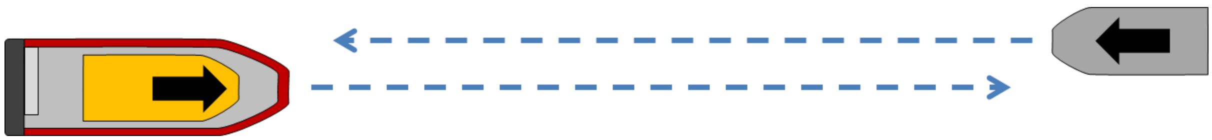
2. Moving target detection

Starting 2 nm away from the target vessel the SAR vessel is driven at 25 kn towards the target vessel. The moving target vessel crosses the bow of the SAR vessel at a constant 15 kn speed. The table shows at which distance of the target vessel detection is achieved under standard radar settings – both approaching the target and driving away from the target.

Speed (kn)	Range (nm)	Target detected at (nm) forward			Target detected at (nm) aft		
		Radome	CHIRP	Open Array	Radome	CHIRP	Open Array
25	6.0	NT	NT	NT	NT	NT	NT
25	3.0	0.4i 0.15c	-*	1.3	NT	0.9i 0.7c*	1.0
25	1.5	0.5i 0.3c	0.5*	1.4	0.6	0.7i 0.3c*	*1.5*
25	0.75	0.5i 0.35c	0.6i 0.4c*	*0.75*	0.6i 0.3c	0.75i 0.6c*	*0.75*
25	0. 5	0.5i 0.35c	NT	*0.5*	0.5i 0.3c	NT	*0.5*

*) Note that on the CHIRP unit the target only showed up on the 3 nm range for 2 scans at 0.6 nm then disappeared until the target was 0.2 nm aft of SAR-6. On the 1.5 nm and 0.75 nm range the target disappeared at 0.2 nm and reappeared when the target was 0.1 nm aft of SAR-6.

3. Moving target detection at speed



Starting 3 nm apart the target vessel and the SAR vessel drive towards each other. The target vessel proceeds straight toward the SAR vessel at various speeds then continues past the SAR vessel holding course. The SAR vessel drives at the same speed. The table shows the distances at which the target is first detected, and the distance at which the target disappears after the vessels have past each other and continue on their respective courses.

Speed (kn)	Range (nm)	Target detected forward at (nm)			Target vanishes aft at (nm)		
		Radome	CHIRP	Open Array	Radome	CHIRP	Open Array
15	3.0	1.2i 0.6c	-*	1.3	NT	0.8i 0.4c*	1.4
15	1.5	0.6i 0.4c	-*	1.5	0.5i 0.4c	0.7i 0.5c*	1.3
15	0.75	0.6i 0.4c*	0.3*	.75	0.6i 0.3c	0.5i 0.4c*	0.75
15	0.5	0.5	NT	0.5	0.5	NT	0.5
25	3.0	NT	NT	1.5	NT	NT	1.5
25	1.5	0.7i 0.5c	0.4i 0.25c*	1.5	0.7i 0.3c	0.7i 0.5c*	1.5
25	0.75	0.75	0.25*	0.75	0.6	0.65i 0.4c*	0.75
25	0.5	0.5	0.3i*	0.5	0.5	0.5*	0.5

*) Notes: Radome – at 0.75 range the target becomes tiny when closer than 0.3 nm, hard to detect.
CHIRP notes below:

Speed (kn)	Range (nm)	CHIRP Notes
15	3.0	Only briefly showed up a 1.0, then disappeared until 0.25 aft
15	1.5	Only briefly showed up a 0.3, then disappeared until 0.15 aft
15	0.75	Disappeared at 0.2 until reappeared 0.1 aft
25	1.5	Disappeared at 0.2 until reappeared 0.15 aft
25	0.75	Disappeared at 0.2 until reappeared 0.1 aft
25	0.5	Disappeared at 0.2 until reappeared 0.1 aft

4. Target resolution – side by side

The target vessel is positioned 35 meters to the side of the fixed target. The SAR vessel starts 1.5 nm from the target and drives at 25 kn towards the fixed target. The table shows the distances at which the target vessel first detaches from the light, the distances at which the separation becomes constant, and the same measurements with the SAR vessel driving away from the targets.

Speed (kn)	Range (nm)	Target intermittently separated (nm) forward			Target constantly separated (nm) forward		
		Radome	CHIRP	Open Array	Radome	CHIRP	Open Array
25	1.5	0.6	0.2	1.0	0.4	-	0.5
25	0.75	*0.75*	0.3	0.65	0.7	0.2	0.5
25	0.5	>	>	>	*0.5*	*0.5*	*0.5*

Speed (kn)	Range (nm)	Target constantly separated until (nm) aft			Target intermittently separated until (nm) aft		
		Radome	CHIRP	Open Array	Radome	CHIRP	Open Array
25	1.5	0.4	0.4	0.4	0.7	0.5	0.7
25	0.75	0.6	0.6	0.5	0.7	0.7	0.7
25	0.5	*0.5*	*0.5*	*0.5*	<	<	<

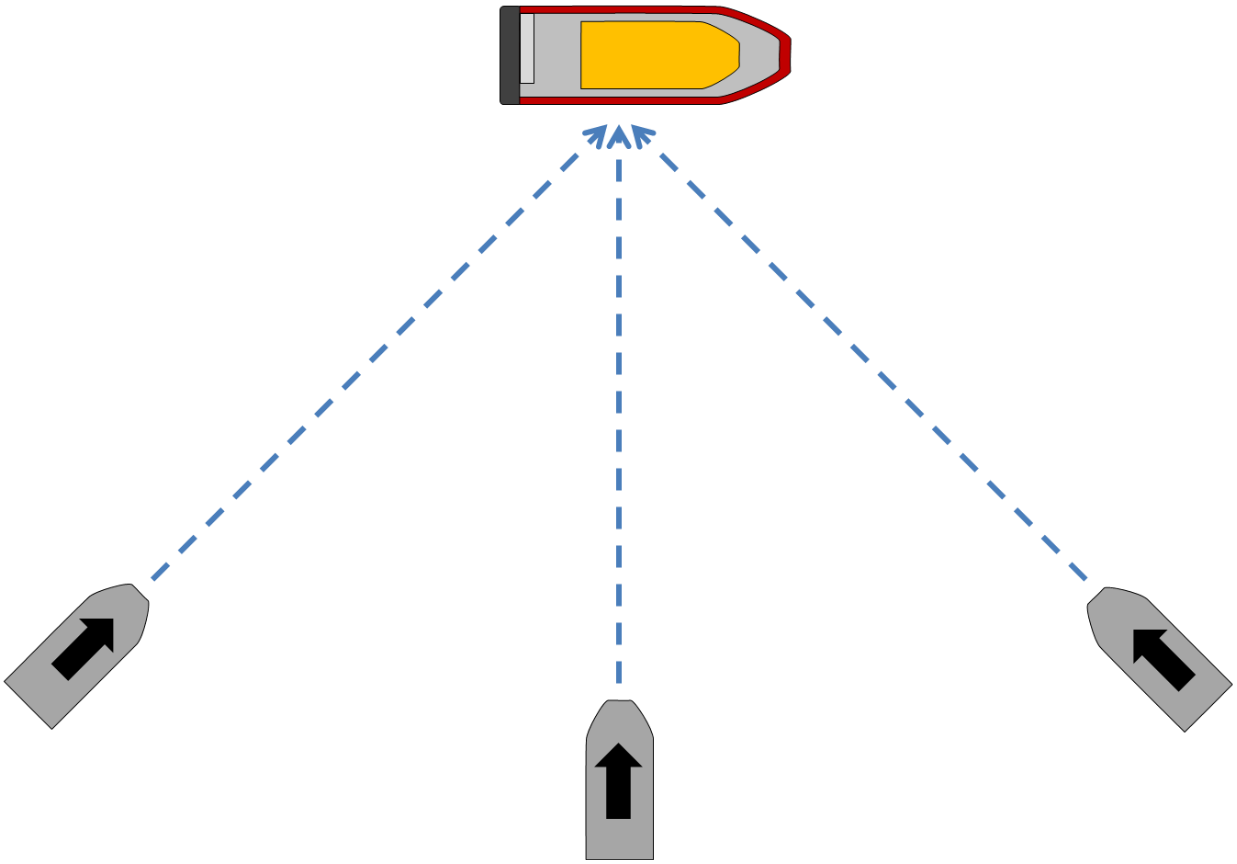
5. Target resolution – in front of each other

The target vessel is positioned 50 meters in front of the fixed target. The SAR vessel starts 2 nm from the target and drives at 25 kn towards the fixed target. The table shows the distances at which the target vessel first detached from the light, the distances at which the separation becomes constant, and the same measurements with the SAR vessel driving away from the targets.

Speed (kn)	Range (nm)	Target intermittently separated (nm) forward			Target constantly separated (nm) forward		
		Radome	CHIRP	Open Array	Radome	CHIRP	Open Array
25	1.5	0.8	0.25	>	0.5	-	*1.5*
25	0.75	*0.75*	0.25	>	0.5	-	*0.75*
25	0.5	>	*0.5*	>	*0.5*	0.25	*0.5*

Speed (kn)	Range (nm)	Target constantly separated until (nm) aft			Target intermittently separated until (nm) aft		
		Radome	CHIRP	Open Array	Radome	CHIRP	Open Array
25	1.5	0.5	-	0.7	0.5	0.5	0.8
25	0.75	0.5	0.25	*0.75*	*0.75*	0.35	<
25	0.5	*0.5*	*0.5*	*0.5*	<	<	<

6. Target detection – side angles



The SAR vessel is stationary in open water. The target vessel drives at 15 kn at 45°, 90° and 135° towards the stationary SAR vessel, starting 2 nm away. The table shows the distances at which the target is first detected, and then the distance at which the signal becomes constant. These tests we only performed with the CHIRP units since the 2014 showed no angular variation for open array units and the latter detected the target at 1.5 nm under all angles.

4.1 – at 45° from the bow

Speed (kn)	Range (nm)	Target detected intermittently at (nm)		Target detected constantly at (nm)	
		Radome	CHIRP	Radome	CHIRP
15	1.5	0.4	0.8	0.35	0.6
15	0.75	0.7	0.6	0.3	0.35
15	0.5	*0.5*	*0.5*	0.4	0.35

4.2 – at 90° abeam

Speed (kn)	Range (nm)	Target detected intermittently at (nm)		Target detected constantly at (nm)	
		Radome	CHIRP	Radome	CHIRP
15	1.5	0.6	0.7*	0.4	0.6
15	0.75	0.7	0.7	0.3	0.6
15	0.5	*0.5*	*0.5*	0.3	0.35

*) Note: CHIRP at 1.5 nm range – target intermittent when under 0.3 nm and closer.

4.3 – at 135° from the bow (or 45° from the stern)

Speed (kn)	Range (nm)	Target detected intermittently at (nm)		Target detected constantly at (nm)	
		Radome	CHIRP	Radome	CHIRP
15	1.5	0.5	0.75	0.4	0.6
15	0.75	0.7	*0.75*	0.3	0.6
15	0.5	*0.5*	>	0.4	*0.5*

7. RACON activation/detection

Starting 3 nm away from a RACON buoy the SAR vessel drives at 25 kn towards the fixed target. The distances at which the radar detects the target and triggers the RACON response is marked below.

Speed (kn)	Range (nm)	Radar detects target forward			Radar triggers RACON response fwd		
		Radome	CHIRP	Open Array	Radome	CHIRP	Open Array
25	3.0	1.3	1.3i 0.8c*	NT	1.2	-	NT
25	1.5	1.3	1.1i 0.8c*	NT	1.2	-	NT
25	0.75	*0.75*	0.75i 0.5c	NT	0.5	-	NT
25	0.5	*0.5*	*0.5*	NT	*0.5*	0.1	NT

*) Note for CHIRP: at 3.0 and 1.5 range, target disappears when closer than 0.2 nm.

Speed (kn)	Range (nm)	Radar triggers RACON response aft			Radar detects target aft		
		Radome	CHIRP	Open Array	Radome	CHIRP	Open Array
25	3.0	1.3	-	NT	1.4	1.2c 1.6i	NT
25	1.5	0.8	-	NT	1.4	1.0	NT
25	0.75	*0.75*	-	NT	*0.75*	*0.75*	NT
25	0.5	*0.5*	0.2	NT	*0.5*	*0.5*	NT

8. Test details

8.1 – SAR-6 with 4kW 24" HD closed radome radar ("Radome")

Date of test	8-May-2021
Start time	10:00
End time	12:30
Vessel	SAR-6
Height of radar above WL (m)	2.5m
Forward tilt	5°
Radar type	Raymarine 24" HD Radome 4kW E92143 s/n 0772023
Radar firmware level	-
Display type	Raymarine Axiom 12 Pro (2x)
Display software level	3.12.217
Coxswain	Paul Sawyer
Tester	Boudewijn Neijens
Sea state (ft)	1 ft
Wind speed (kn)	5 kn
Visibility (nm)	Unlimited
Rain	None

8.2 – SAR-6 with Quantum 20W CHIRP solid state radar ("CHIRP")

Date of test	8-May-2021
Start time	13:30
End time	16:30
Vessel	SAR-6
Height of radar above WL (m)	2.5m
Forward tilt	5°
Radar type	Raymarine Quantum 20W E70210 s/n 0900175, wired connection
Radar firmware level	2.44
Display type	Raymarine Axiom 12 Pro (2x)
Display software level	3.12.217
Coxswain	Paul Sawyer
Tester	Boudewijn Neijens
Sea state (ft)	Calm to 1 ft
Wind speed (kn)	Calm to 5 kn
Visibility (nm)	Unlimited
Rain	None

8.3 – SAR-1 with 12kW 48" open array radar ("Open Array")

Date of test	8-May-2021
Start time	13:00
End time	14:00
Vessel	SAR-1
Height of radar above WL (m)	3.5m
Forward tilt	7°
Radar type	Raymarine Open Array 12kW E52082 s/n 0130056
Radar firmware level	-
Display type	Raymarine Axiom 12 Pro (3x)
Display software level	3.13.103
Coxswain	Bruce Falkins
Tester	Roger Wagstaff
Sea state (ft)	1 ft
Wind speed (kn)	5 kn
Visibility (nm)	Unlimited
Rain	None

Observations

Signal filtering: On the CHIRP unit we observed a significant signal strength reduction for the moving target at distances between 0.3 nm forward and 0.1 nm aft, to the point that the target would often disappear altogether. The radome unit did better but close-by targets were at times hard to detect due to their tiny size on screen. This seems to be related to excessive automatic filtering applied when the target signal becomes too large/close on screen. The open array unit did not present the same issue.

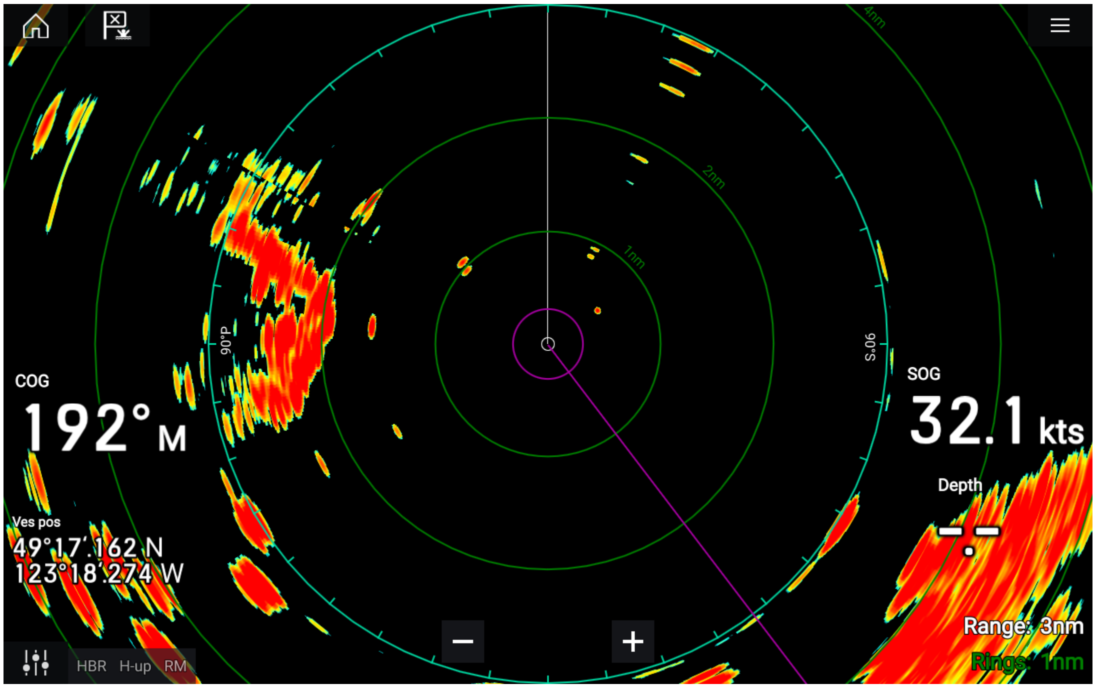
Missed targets: During test 3 (vessels moving towards each other on a collision course) the CHIRP did not detect the target on the 3 nm and 1.5 nm ranges.

Image resolution and accuracy: the radome tends to "smudge" targets significantly. The CHIRP does slightly better but often reduces the size of targets to only a few pixels (see images below). The open array does much better on both counts, showing much better delineated coastal features and well defined targets.

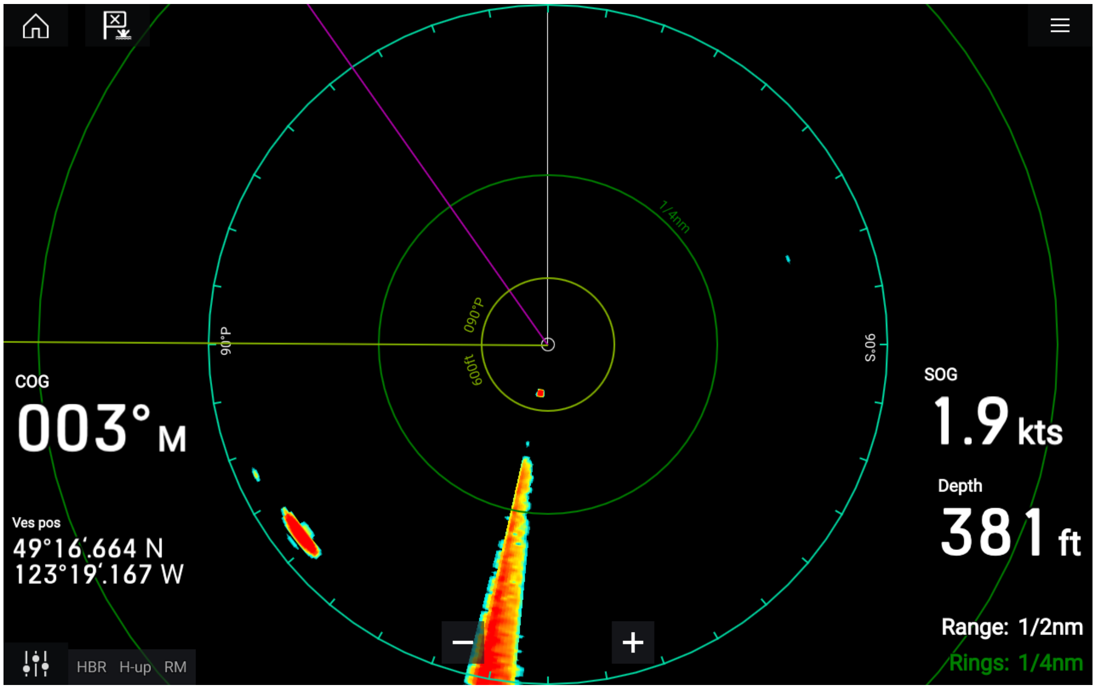
Vessel speed: we found that detection was somewhat better at 25 knots compared to lower speeds. Above 25 kn the improvement was marginal.

RACON detection: The radome showed a weak return signal on screen (see images below). The CHIRP showed a strong return signal but only at very close range. We did not test the open array but know from experience that SAR-1 will trigger QB at 5 nm with a strong signal on screen.

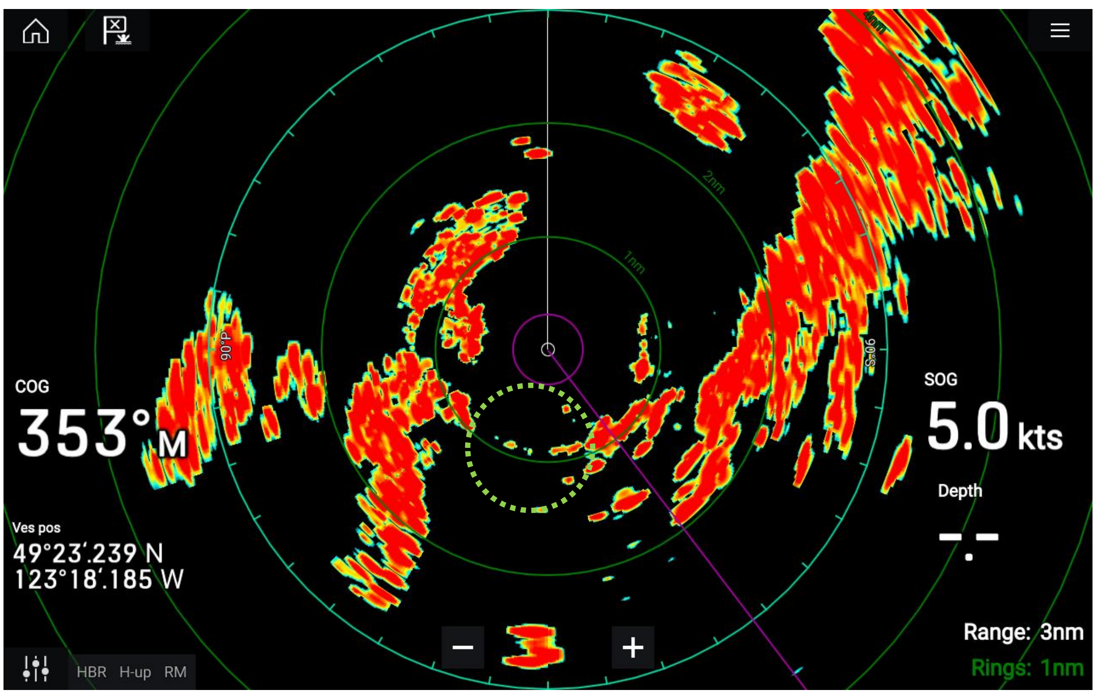
SAR-6 with Radome radar: The display “smudges” targets. The RACON response is shown at 25° - it is at times hard to detect but was triggered at distances in excess of 1 nm.



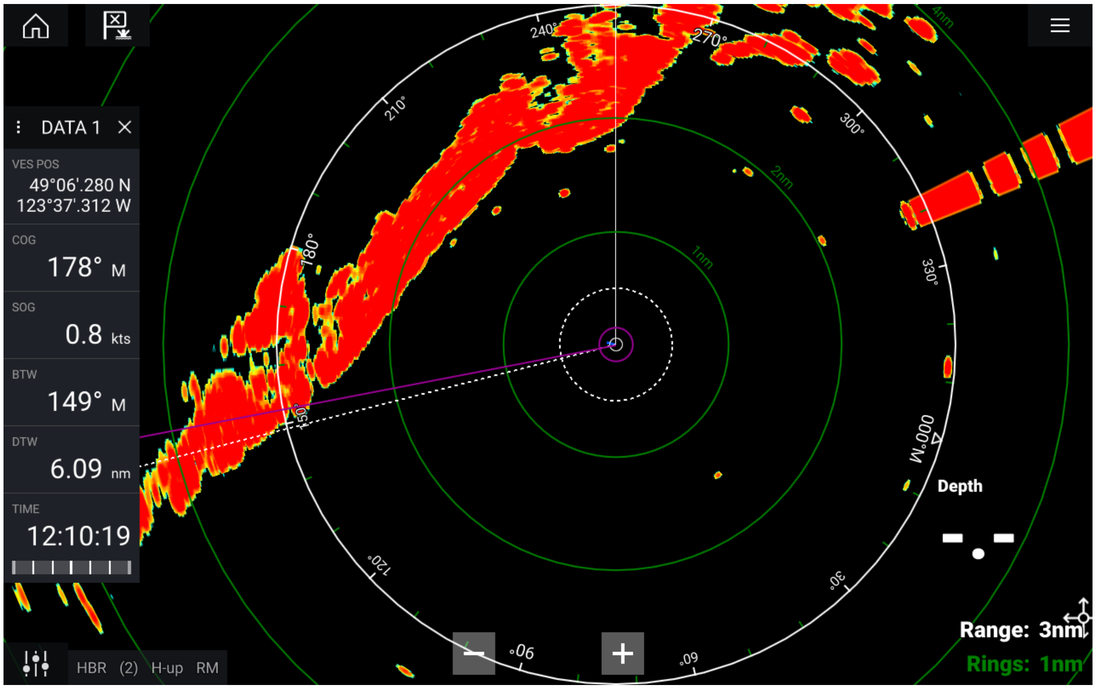
SAR-6 with CHIRP radar: The RACON response is shown at 190° - the signal is very clear but was only triggered at distances under 2 cables making it useless.



The typical target signatures are a bit less smudgy than on the Radome, but were often tiny (a few pixels) and hard to detect especially with adverse lighting. The unit frequently "invented" ghost targets making it difficult to distinguish real targets – see the dots between Whytecliff and Bowen Island circled in green.



SAR-1 with Open Array radar: For reference, here is the image of an Open Array: clear RACON signal detected roughly 3nm away at 60°, and much better detail of the shoreline and on-the-water targets.



Ranges: With the exception of detecting prominent shoreline features and large vessels, the 6 nm range is of little use on SAR vessels. The 6 nm range proved useless in most tests.

The CHIRP solid state units feature additional intermediate range settings (1/16, 3/8, 1, 2 and 4 nm) which might be useful in specific circumstances, although we have had no complaints from users of units not supporting these extra ranges.

When changing ranges on the CHIRP the display goes blank for 2 seconds.

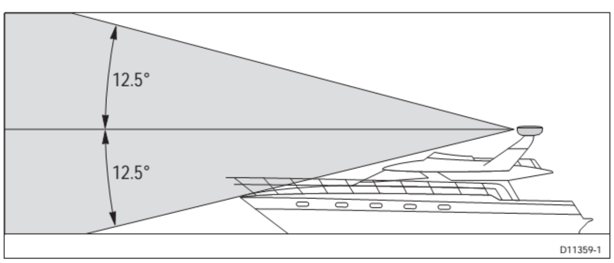
Configuration: Both the radome and the CHIRP often showed better detection of targets astern of SAR-6. Both radars were mounted on an angled wedge (approx. 5°) which ensures the radar is well within its vertical beam width under any operating conditions. Moreover SAR-6 rides very flat on the water at all speeds. One possible explanation is the bulk of the self-righting bag mounted directly ahead of the radar and partly obscuring the radar. Another possible explanation is that the signature of the target vessel might be stronger on its stern due to its vertical transom and the metallic mass of the engine.

Manufacturer specifications: since the CHIRP solid state units are significantly different from "conventional" magnetron rotating radars, we felt it would be useful to list the key features as stated by the manufacturer.

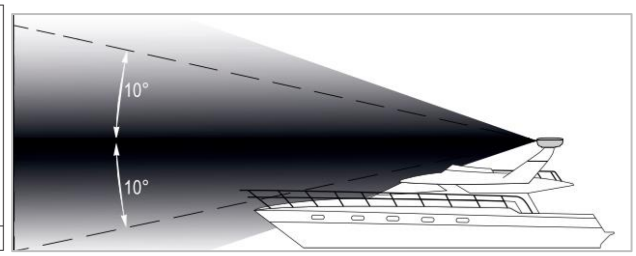
Unit	SAR-6: 24" HD Radome	SAR-6: CHIRP Solid State	SAR-1: 48" Open Array
Transmit Frequency	9405 MHz +/- 25 MHz	9354 – 9446 MHz	9405 MHz +/- 20 MHz
Peak Power	4 kW	20 W	12 kW
Horizontal Beam Width	3.9°	4.9°	1.85°
Vertical Beam Width	25°	20°	25°
Rotation Speed	24 rpm above 3 nm range 48 rpm at 3 nm or lower	Equivalent of 24 rpm	24 rpm above 3 nm range 48 rpm at 3 nm or lower
Receiver Noise	<5 db	<4 db	<5 db

Radiation: The CHIRP solid state radars operate at a lower power level than conventional magnetron radars, which in turn limits the amount of emitted radiation. According to the WHO: *"Marine radars can be found on small pleasure boats to large ocean-going vessels. Peak powers of these systems can reach up to 30 kW. Under normal operating conditions, with the antenna rotating, the average power density of the higher power systems within a metre of the antenna is usually less than 10 W/m^2. In accessible areas on most watercraft, these levels would fall to a few percent of present public RF exposure standards."* In other words: even the powerful 12 kW open array is perfectly safe, but crews might nevertheless be reassured by the lower emissions of the CHIRP radars.

Vertical beam width: As show in the table above, the CHIRP has a narrower vertical beam width. This was not a factor for the current tests as SAR-6 rides very flat, but during the 2019 tests with SAR-25 we witnessed a significant degradation of performance when driving with the bow up: detection of a target on an opposing course degraded by 33% at lower speeds, highlighting the sensitivity of CHIRP units to trim and radar mount angle.



Raymarine radome and open array units



Raymarine CHIRP solid state units

Test Interpretation

Tests 1 & 2 – target detection ahead: The detection distance and discrimination of fixed targets was largely independent of speed. The radome discriminated a fixed target at 2.2 nm and detected the moving target at 0.5 nm, whereas the CHIRP discriminated at 2.0 nm and detected the moving target at 0.5 nm but only using the 1.5 range or lower – it barely detected the target using the 3.0 range. For reference the open arrays discriminated fixed targets much further away (3 nm+) and detected the moving target at 1.3 nm, i.e. nearly 3x the distance. This means that at 35 kn an open array detects the moving target 134 seconds before collision, whereas the radome or CHIRP detect it 51 seconds before collision.

Test 3 – Collision course: these tests are most crucial because of the combined speed of both vessels and the limited time for the operator to determine if a risk of collision exists.

The CHIRP unit performed extremely poorly in these tests. The target vessel was barely detectable on both 3.0 and 1.5 ranges. It only showed with certainty at 0.4 nm using the 0.5 range, and disappeared again at 0.2 nm which would give the operator 10 seconds (or 4 radar sweeps) to call the target and initiate an avoidance manoeuvre. Since the radar showed better performance looking aft and there is some doubt about the reason for this, we used the better aft-looking results for the calculations in the table below.

The table shows the earliest confirmed detection (strong intermittent or continuous signal) of the target. We computed the time to collision at various speeds and show the number of radar sweeps the operator can use before collision. The CHIRP unit sweeps at the equivalent of 24 rpm, whereas both the radome and open array units sweep at 48 rpm at ranges of 3 nm and lower, giving the operator more information to work with.

Unit type	Combined speed (kn)	Detection at (nm)	Time to collision (sec)	Radar sweeps to collision
Radome	30	1.2	144	115
CHIRP	30	0.8*	96	38
Open Array	30	1.5	180	144
Radome	50	1.2	86	69
CHIRP	50	0.7*	50	20
Open Array	50	1.5	108	86
Radome	70	1.2	62	49
CHIRP	70	0.7*	36	14
Open Array	70	1.5	77	62

*) Note: CHIRP unit calculations based on aft-looking detection. Forward detection was 0.4 nm at best.

Tests 4&5 – Resolution: All units are better at detecting targets in front of a fixed target than targets side by side. The radome unit was significantly better than the CHIRP at the detecting the target, both in front to back and side by side configurations. The open array outperformed both units significantly at front to back discrimination.

Test 6 – Lateral detection: This is the only test where the CHIRP performed at times better than the radome, but still well short of the open array (which typically detected the target at 1.5 nm at all angles). The tests show all three units have relatively constant detection capabilities at all angles.

Test 7 – RACON detection: The radome triggered the RACON at 1.2 nm, the CHIRP around 0.1 nm. In other words: CHIRP radars are not powerful enough to trigger a RACON. We know from experience that SAR-1 will trigger QB at 5 nm.

Conclusions

The 4kW HD radome performed better than the CHIRP, but as expected is still significantly inferior to a 12 kW 48" open array unit. The CHIRP performed worse than in the 2018 and 2019 tests, likely due to the smaller size and radar signature of the target vessel (prior CHIRP tests had used a larger Type 1 vessel as a target). Highlights are:

- Poor image resolution for both radome and CHIRP compared to the open array. This makes it hard for the navigator to cross-reference the radar image with the chart plotter or paper charts; and to distinguish targets close to each other.
- On the CHIRP: lack of positive detection at 3.0 and 1.5 ranges, and dropped signals for close-by targets at all ranges. This means operators sometimes only have a few radar sweeps to detect and confirm a target before in disappears.
- On the CHIRP: long wait for the screen to refresh when changing ranges. This compounds the issue of detection confirmation as it reduces the time available to check on fast approaching targets.
- Limited detection distances on both radome and CHIRP compared to open arrays.
- Poor target discrimination. The CHIRP unit has a tendency to enlarge and blur target images above 3 cables, but often loses the target when closer than 3 cables. The CHIRP also tends to add ghost images extending off land features.
- The CHIRP solid state units operate at 24 rpm at all times whereas the radome and open array units accelerate to 48 rpm at ranges of 3 nm and lower – which are the ranges typically used by SAR vessels. In other words: the open array and radome units will refresh twice as frequently in close quarters, i.e. when it matters most.
- Inability to detect RACONs with CHIRP units despite operating at the same bandwidth as conventional radars.

In summary: as highlighted in prior tests neither the radome nor the CHIRP radar comes close to the open array in image resolution or detection range. The radome unit did perform slightly better than in the 2014 tests and did not present any fatal flaws (e.g. total lack of detection). The CHIRP performed significantly worse than the radome and than in prior tests with a larger target. It repeatedly failed to detect the target on a direct collision course, did not trigger the RACON until a cable away, showed very poor discrimination of targets and created more ghost images.

Recommendations

Based on these tests with an inconspicious target, the CHIRP radar is not suitable for SAR operations at high speed and close to shore. The radome is far from perfect but could be an acceptable substitute for an open array on vessels where an open array would be impossible to install, i.e. delta RHIBs with no cabin or roof.

Since many tests showed better results for detection aft of the vessel it would be prudent to raise the radome on SAR-6 by a few inches and verify if this improves forward detection.

B. Neijens – Station 1, May 2021

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