

SAILOR MARINE PRODUCTS

Improved safety at sea

User Manual

SAILOR SART

9GHz search and rescue transponder



SAILOR

When safety counts

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TECHNICAL CHARACTERISTICS

1. FREQUENCY: 9.2GHz - 9.5GHz
2. POLARIZATION: Horizontal
3. SWEEP RATE: 5 μ s per 200MHz nominal
4. RESPONSE SIGNAL: 12 sweeps
5. FORM OF SWEEP: Forward: 7 μ s \pm 1 μ s
Reverse: 0.4 μ s \pm 0.1 μ s
6. PULSE EMISSION: 100 μ s nominal
7. EIRP: >400mW (+26dBm)
8. RX SENSITIVITY: Better than -50dBm (0.1 mW/m²) (Note 1)
9. DURATION: 96 hours in standby condition followed by a minimum 8 hours of transmission while being continuously interrogated with a pulse repetition frequency of 1KHz.
10. TEMP RANGE: Operating: -20⁰C to +55⁰C
Storage: -30⁰C to +65⁰C
11. RECOVERY TIME: Following excitation: 10 μ s or less
12. ANTENNA HEIGHT: Greater or equal to 1m (Note 2)
13. RESPONSE DELAY: 0.5 μ s or less
14. ANTENNA BEAM: Vertical: +/-12.5 degrees
Azimuth: Omnidirectional to +/-2dB
15. WEIGHT: 1kg
16. DIMENSIONS: 300mm long x 62mm diameter.

Note

1. Effective receiver sensitivity includes antenna gain.
2. The effective antenna height applies to equipment required by Regulation 6.2.2 of Chapter III and 7.1.3 and 8.3.1 of Chapter IV of the 1988 Amendments to the 1974 SOLAS Convention.

GENERAL DESCRIPTION

The SAILOR SART is designed for survivor location during search and rescue operations.

CARRY-OFF SART

Supplied as one integral unit. This is normally mounted in a bulkhead bracket (supplied) which is used to stow the unit on the mother vessel. On abandoning to a survival craft the SART can be carried in one hand and mounted through a port in the canopy using the attached telescopic mast mount.

The main external components of the SART are of high visibility orange thermoplastic, joined by stainless steel screws and sealed against water ingress by O-rings.

Operation is by a push button switch after a security label has been broken.

A press-to-test feature is provided to check that the unit is operational.

The Lithium battery is fitted with fuse protection to prevent overload and it has a five year storage life. A latching connector is provided to link the battery assembly to the circuit and facilitate battery replacement.

Each SAILOR SART carries a serial number on the centre label.

SART PRINCIPLE OF OPERATION

Fitting of a SART enables a survival craft to show up on a search vessel's radar display as an easily recognised series of dots.

RADAR (radio detection and ranging) is a device carried by most ships which is used to determine the presence and location of an object by measuring the time for the echo of a radio wave to return from it, and the direction from which it returns.

A typical ship's radar will transmit a stream of high power pulses on a fixed frequency anywhere between 9.2GHz and 9.5GHz. It will collect the echoes received on the same frequency using a display known as a Plan Position Indicator (PPI), which shows the ship itself at the centre of the screen, with the echoes dotted around it. Echoes further from the centre of the screen are thus further from the ship and the relative or true bearing of each echo can be easily seen.

The SART operates by receiving a pulse from the search radar and sending back a series of pulses in response, which the radar will then display as if they were normal echoes. The first return pulse, if it sent back immediately, will appear in the same place on the PPI as a normal echo would have done. Subsequent pulses, being slightly delayed, appear to the radar like echoes from objects further away. A series of dots is therefore shown, leading away from the position of the SART. This distinctive pattern is much easier to spot than a single echo such as from a radar reflector. Moreover, the fact that the SART is actually a transmitter means that the return pulses can be as strong as echoes received from much larger objects.

A complication arises from the need for the SART to respond to radars which may be operating at any frequency within the 9GHz band. The method chosen for the SART is to use a wideband receiver (which will pick up any radar pulses in the band), in conjunction with a swept frequency transmitter. Each radar pulse received by the SART results in a transmission consisting of 12 forward and return sweeps through the range 9.2GHz to 9.5GHz. The radar will only respond to returns close to its own frequency of operation (ie. within its receive bandwidth), so a "pulse" is produced at the radar input each time the sweep passes through the correct frequency.

A slow sweep would give the radar a stronger echo to deal with as the sweep would be inside the operating bandwidth for a longer period. The delay for the sweep to reach the operating frequency may however lead to an unacceptable range error, as delayed echoes appear to be coming from more distant objects.

To minimise this problem, the SART uses a "sawtooth" response, sweeping quickly, then slowly for each of its twelve forward and return sweeps. At long range, only the slow sweeps, giving the strongest returns, are picked up. At close range, where errors are more important, the fast sweeps are also detected. As the first sweep is a fast one, then the range error is minimised and should be less than 150 metres.

The timescale over which all this occurs is very short. Each "fast" sweep takes about $0.4\mu\text{s}$, each "slow" sweep about $7.5\mu\text{s}$. The complete series of twelve forward and return sweeps is therefore complete within $100\mu\text{s}$. Displayed on the PPI, the spacing between each pair of dots will be 0.6 nautical miles.

On a long range setting, a typical radar will be triggering the SART every millisecond - but only during the period that the rotating radar scanner is pointing in the correct direction. Most modern radars use sophisticated noise rejection techniques, which prevent the display of echoes which are not synchronized with the radar's own transmissions, so one radar will not normally be confused by a SART's response to a neighbouring radar.

If no radar pulses are detected for a period exceeding 15 seconds, the SART reverts to "standby" mode.

INSTALLATION

The preferred mounting location is inside the vessel, and protected from the elements.

Do not install the SART within the ship's radar beam.

Fix the mounting bracket to a bulkhead in a convenient location. Drop the SART, dome uppermost, into the bracket and push down into place.

Release by pulling outwards on bracket tab and lifting the SART up.

NOTE: Safe compass distance 1.5m.

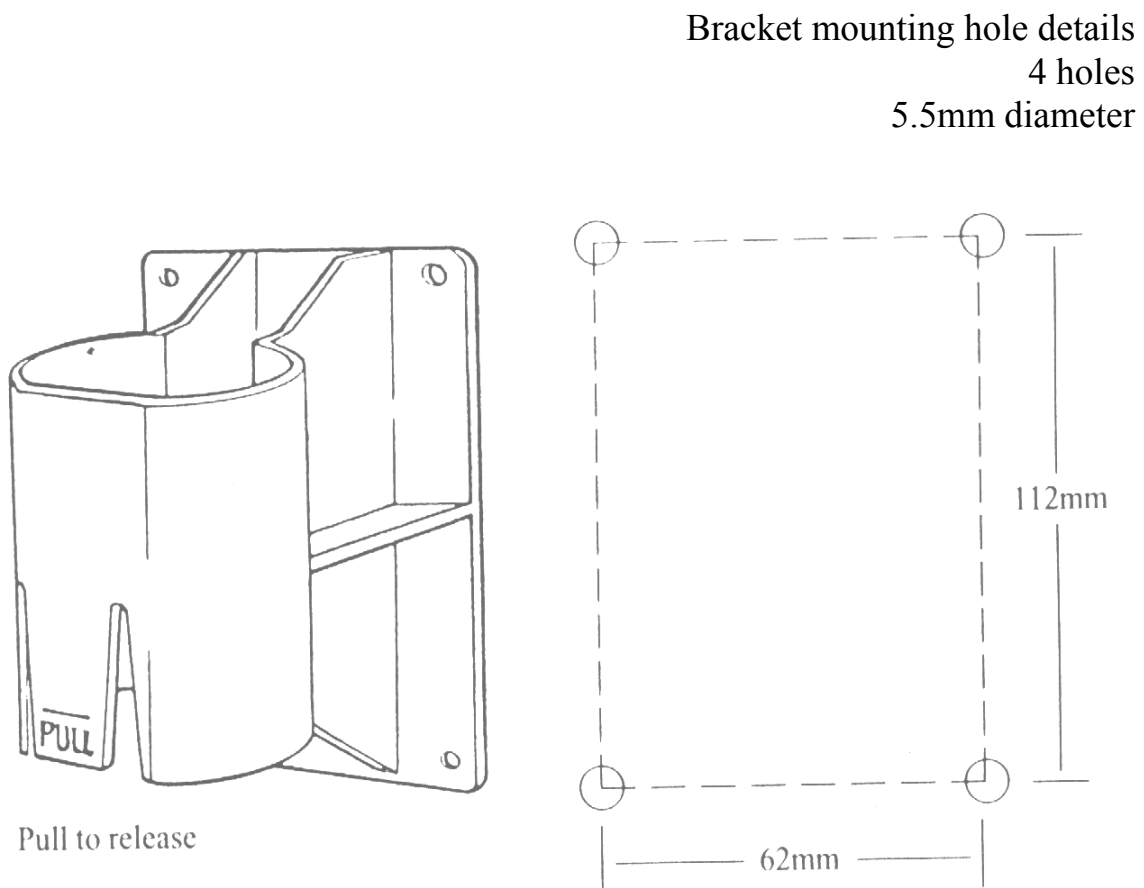


Figure 1

OPERATING INSTRUCTIONS

1. Activate according to instructions on unit.
2. Pull mast section firmly away from SART.
3. Remove black top from mast.
4. Extend mast and twist to lock.
5. Push firmly into hole in base of SART.
6. Insert through observation port (A) of survival craft and position bottom of mast into antennae pocket (B) (see figure 2).
7. Secure to canopy support (C).

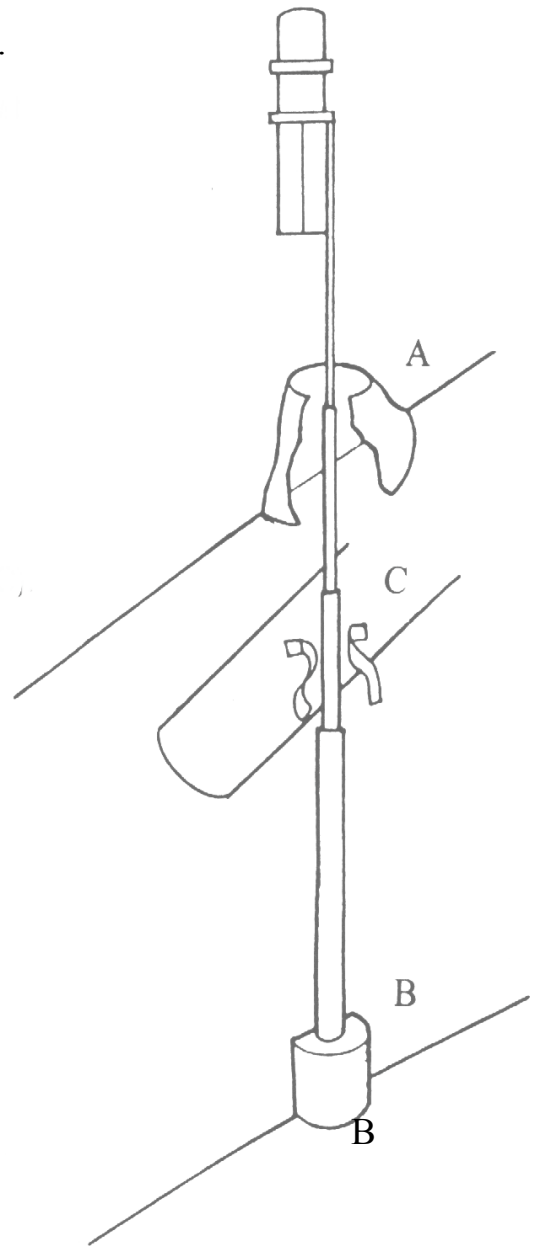


Figure 2

OPERATING INSTRUCTIONS FOR LOOP MOUNTING

1. Remove and discard mast section.
2. Suspend SART by the loop from the highest point of the survival craft.

SELF-TEST FACILITY

Regular testing of the SART is advised

Locate the SART within the line of sight of an operating approved marine Radar. Insert the test probe *carefully* into the hole in the centre of the activation switch, taking care not to damage the security label. Pushing the test probe into the hole, activates the test cycle, the red LED will be "on" continuously and the buzzer will sound once every two seconds. The SART will signal on the radar. To switch off the SART, insert probe through small hole at rear of switch and push firmly until the switch clicks off.

WARNING

Only test for a number of seconds as a live distress call may be received by other vessels in range.

TO REPLACE BATTERY

1. The battery should be changed 5 years from manufacture date shown on the label and routine test procedures should be carried out. Always advise serial number of SART when ordering replacement batteries.
2. Release three screws at base of SART. Remove baseplate, lanyard and mast and retain safely.
3. Remove six screws in flange between transponder assembly and cell housing assembly (see figure 3). Do not attempt to remove radome.
4. Carefully unlatch and separate the connector using a special separator tool to avoid damaging the latch mechanism. Discard the O-ring.
5. Apply grease to the replacement O-ring and fit into internal recess. Connect new battery, reassemble unit and tighten screws.
6. Replace base plate, mast and lanyard and tighten three screws
7. Return old battery to an approved dealer for safe disposal.

TECHNICAL DESCRIPTION

A single switched antenna is used for both receive and transmit functions. The switch normally connects the antenna to the receiver circuit. In the "standby" state, only the receiver portion of the SART is powered, to reduce battery consumption to a minimum. In this condition, the indicator circuit causes the LED to flash once every two seconds.

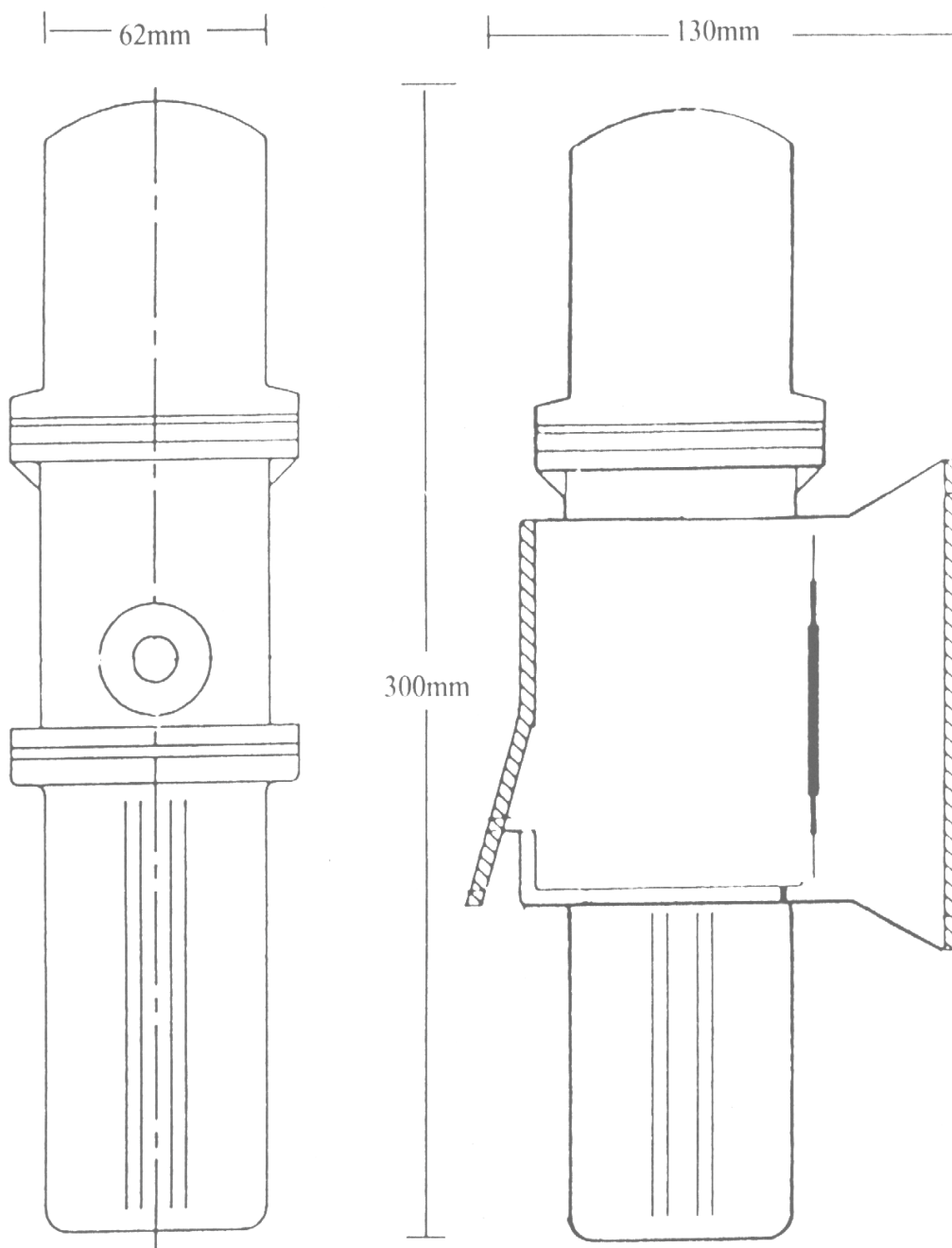
On receipt of a radar pulse, the video amplifier and detector circuit causes the rest of the circuitry to become active, and the unit switches to "transmit mode". In this condition, the indicator circuit causes the LED to remain steady and the bleeper to sound every two seconds.

The detection of a radar pulse causes the switch to connect the antenna to the transmitter circuit. The output stage is fed by a Voltage Controlled Oscillator (VCO), whose frequency is determined by a sweep generator. On triggering by the detector, the sweep generator turns on the VCO and causes it to produce exactly 12 forward and reverse frequency sweeps, before shutting down again.

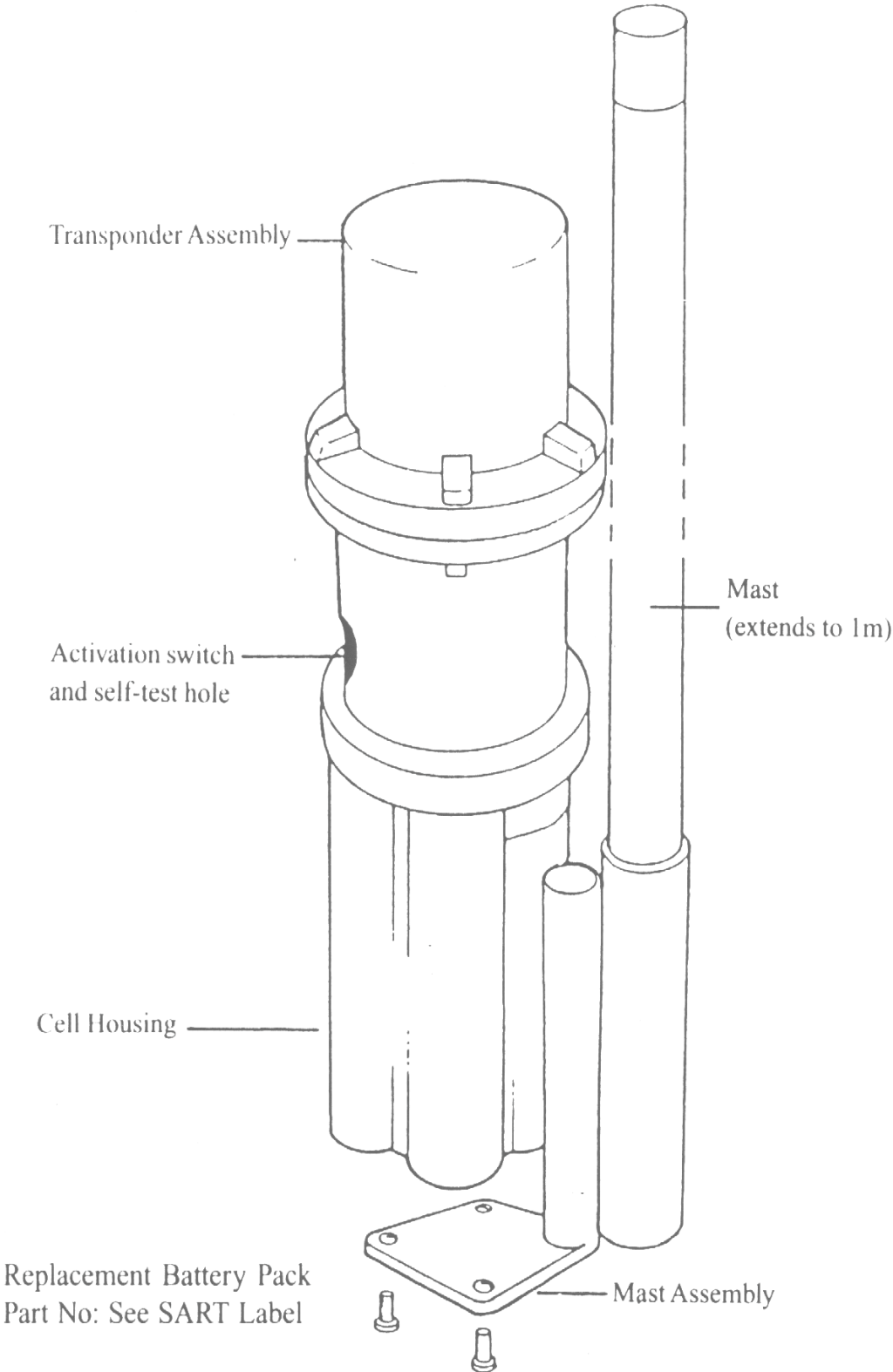
If no radar pulses are detected for a period exceeding 15 seconds, the unit reverts to "standby mode".

FUNCTION CHART

RED LED	BLEEPER	SART STATUS
OFF	OFF	OFF
FLASHING EVERY 2 SECONDS	OFF	TEST BUTTON OPERATED OR STANDBY MODE
ON	ON EVERY 2 SECONDS	ACTIVELY TRANSPONDING



Only remove mast section in an emergency situation



Replacement Battery Pack
Part No: See SART Label

Mounting Bracket
Part No: 760-00A-A001

Figure 3

OPERATION OF MARINE RADAR FOR SART DETECTION

Radar Range Scale

When looking for a SART it is preferable to use a range scale between 6 and 12 nautical miles. This is because the spacing between the SART responses is about 0.6 nautical miles (1125 metres) and it is necessary to see a number of responses to distinguish the SART from other responses.

SART Range Errors

There are inherent delays in the SART responses and the SART has a trigger delay and may also have to sweep through the whole radar band before reaching the frequency of the search radar. At medium ranges of about 6 nautical miles the range delay may be between about 150 metres and 0.6 nautical miles beyond the SART position. As the SART is approached the radar delay of the first dot should be no more than 150 metres beyond the SART position.

Radar Bandwidth

This is normally matched to the radar pulse length and is usually switched with the range scale and the associated pulse length. Narrow bandwidths of 3.5MHz are used with long pulses on long range and wide bandwidths of 10-25MHz with short pulses on short ranges. Any radar bandwidth of less than 5MHz will attenuate the SART signal slightly so it is preferable to use a medium bandwidth to ensure optimum detection of the SART. The Radar operating manual should be consulted about the particular radar parameters and bandwidth selection.

Radar Side Lobes

As the SART is approached side lobes from the antenna may show the SART responses as a series of arcs or concentric rings. These can be removed by the use of the anti-clutter sea control although it may be operationally useful to observe the side lobes as these will confirm that the SART is near to the ship.

Detuning the Radar

To increase the visibility of the SART in clutter conditions the radar may be detuned to reduce the clutter without reducing the SART response. Radar with automatic frequency control may not permit manual detune of the equipment. Care should be taken in operating the radar detuned, as other wanted navigational and anti-collision information may be removed. the tuning should be returned to normal operation as soon as possible.

Gain

For maximum range SART detection the normal maximum gain should be used.

Anti-Clutter Sea Control

For optimum range SART detection this control should be set to the minimum. Care should be exercised as target in sea clutter may be obscured. Some sets have automatic/manual anti sea-clutter control facilities in which case the operator should switch to manual.

Anti-Clutter Rain Control

This should not be used when trying to detect SARTs as the SART responses may be removed by this control. Some sets have automatic/manual anti-clutter rain control facilities in which case the operator should switch to manual.

LIMITED WARRANTY

This product is covered by the General Terms of Sales and Delivery for S.P. Radio A/S.

Where any valid claim in respect of any of the products which is based on any defect in the quality or condition of the products or their failure to meet specification is notified to S.P. Radio A/S within the Warranty period in accordance with this Warranty, S.P. Radio A/S shall be entitled to replace the products (or the part in question) free of charge or, at S.P. Radio A/S' sole discretion, refund to the Buyer the price of the products (or a proportionate part of the price), but S.P. Radio A/S shall have no further liability to the Buyer.

S.P. Radio A/S shall be under no liability in respect of any defect arising from fair wear and tear, wilful damage, negligence, abnormal working conditions, failure to follow the manufacturer's instructions (whether oral or in writing), misuse or alteration or repair of the product S.P. Radio A/S' approval.

The above Warranty does not extend to parts, materials or equipment not manufactured by S.P. Radio A/S, in respect of which the Buyer shall only be entitled to the benefit of any such warranty or guarantee as is given by the manufacturer to S.P. Radio A/S. The battery storage life is specifically excluded from this Warranty.

The benefit of this Warranty shall extend to subsequent purchasers of the products provided that such transfer in ownership is notified in writing to S.P. Radio A/S within fourteen (14) days of such transfer.

EXCEPT IN RESPECT OF DEATH OR PERSONAL INJURY CAUSED BY S.P. RADIO A/S NEGLIGENCE, S.P. RADIO A/S SHALL NOT BE LIABLE TO THE BUYER BY REASON OF ANY REPRESENTATION, OR ANY IMPLIED WARRANTY, CONDITION OR OTHER TERM, OR ANY DUTY AT COMMON LAW OR UNDER THE EXPRESS TERMS OF THE CONTRACT FOR ANY CONSEQUENTIAL LOSS OR DAMAGE (WHETHER FOR LOSS OF PROFIT OR OTHERWISE), COSTS, EXPENSES OR OTHER CLAIMS FOR CONSEQUENTIAL COMPENSATION WHATSOEVER (AND WHETHER CAUSED BY THE NEGLIGENCE OF S.P. RADIO A/S, ITS EMPLOYEES OR AGENTS OR OTHERWISE) WHICH ARISE OUT OF OR IN CONNECTION WITH THE SUPPLY OF THE PRODUCTS OR THEIR USE OR RESALE BY THE BUYER, EXCEPT AS EXPRESSLY PROVIDED IN THIS WARRANTY.

S.P. Radio A/S shall be under no liability under the above Warranty (or any other warranty, condition or guarantee) if the total price for the products has not been paid by the due date for payment.

Any claim by the Buyer which is based on any defect in the quality or condition of the products or their failure to correspond with specification shall be notified to S.P. Radio A/S in writing within a reasonable time after discovery of the defect or failure, and in any event during the Warranty period. The product shall be returned at the Buyer's expense S.P. Radio A/S' address as below or an authorised repair facility as determined S.P. Radio A/S following notification.

Any enquiries regarding service under this Warranty should be directed to S.P. Radio A/S at the following address:

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80-7040M issue 1