



Consilium

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Rev. C
October 2008

SRT X-BAND TRANSCEIVER

RADAR SYSTEMS

TECHNICAL MANUAL

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304202P003
REV. C
October 2008
SRT X-BAND
TRANSCIEVER
RADAR SYSTEMS

TECHNICAL
MANUAL

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APPLICATION FOR MANUAL REVISIONS

Upon receipt of this manual, please fill in the necessary data. It is important that the addressee be the end user so that the operating personnel will receive all revisions to the manual

EQUIPMENT NAME

SERIAL No..... MODEL

MANUAL TITLE

..... MANUAL PART NUMBER.....

ISSUED INDEX..... REVISION INDEX.....

PURCHASING AGENCY

NAME OF USER.....

ADDRESS OF USER.....

.....

.....

ATTN:.....

RECORD OF CHANGES

RCS CODE/REV. INDEX	DATE	PURPOSE OF THE CHANGE	CHANGE REQUESTED BY
Revision A	NOV 2007	First Emission	
Revision B	April 2008	Add the EC CERTIFICATE	Request for Changes 014/08
Revision C	October 2008	Replace the EC CERTIFICATE	Request for Changes 044/08



Bundesrepublik Deutschland

Federal Republic of Germany

Bundesamt für Seeschifffahrt und Hydrographie
Federal Maritime and Hydrographic Agency



BUNDESAMT FÜR
SEESCHIFFFAHRT
UND
HYDROGRAPHIE

EC TYPE EXAMINATION (MODULE B) CERTIFICATE

This is to certify that:

Bundesamt für Seeschifffahrt und Hydrographie, specified as a "notified body" under the terms of „Schifffahrtsgesetz“ of 9. September 1998 (BGBl. I, p. 2860) modified last 8. April 2008 (BGBl. I, p. 706), did undertake the relevant type approval procedures for the equipment identified below which was found to be in compliance with the Navigation requirements of Marine Equipment Directive (MED) 96/98/EC and the last modification by Directive 2008/67/EC.

Manufacturer **Consilium Selesmar S.r.l.**
Address **Via Romita 26, 50025 Montagnana V.P., Florence, ITALY**
Applicant **Consilium Selesmar S.r.l.**
Address **Via Romita 26, 50025 Montagnana V.P., Florence, ITALY**
Annex A.1 Item (No & item designation) **4.34 Radar equipment with automatic radar plotting aid (ARPA)**
4.37 Radar equipment with automatic radar plotting aid (ARPA) for high-speed craft
Product Name **SELUX ST**
Trade Name(s) **SELUX ST-250 DISPLAY, SELUX ST-340 DISPLAY**

Specified Standard(s)

IMO-Resolution A.694 (17)	IMO-Resolution MSC.64 (67) Annex 4 ¹	IEC 60872-1 Ed.1.0, 1998 ²	IEC 61993-2 Ed.1.0, 2001 ⁴
IMO-Resolution A.813 (19)	IMO-Resolution MSC 191(79)	IEC 60936-1 Ed.1.1, 2002 ²	IEC 61162-1 Ed.3.0, 2007
IMO-Resolution A.820 (19) ¹	IMO-Resolution MSC 192(79)	IEC 60936-2 Ed.1.0, 1998 ²	IEC 61162-2 Ed.1.0, 1998
IMO-Resolution A.823 (19) ¹	ITU-R M. 1177-3 / ITU-R. M. 683-3 ³	IEC 60945 Ed.4.0, 2002	IEC 62388 Ed.1.0, 2007

¹ superseded by MSC. 192(79), ² superseded by IEC 62388 ³ Limited to the detection of SART

⁴ Limited to required data content to display and process other AIS information as defined in IEC 61162-1 Ed. 3

Applied version of Annex A.1 (MED): Directive 2008/67/EC

This certificate remains valid unless cancelled, expired or revoked.

Date of issue: **2008-09-23**

Issued by: **Bundesamt für Seeschifffahrt und Hydrographie
Bernhard-Nocht-Str. 78, 20359 Hamburg, Germany
Notified body 0735**

Expiry date: **2013-09-22**

Certificate No.: **BSH/4612/4340779/08**

USCG-Module-B No.: **165.120/EC0735** Unique Identifier: **- 4340779**

This certificate consists of 6 pages.



by order

Schulz-Reifer
Schulz-Reifer



This certificate is issued under the authority of the „Bundesministerium für Verkehr, Bau und Stadtentwicklung“.
V2008-09-03

Components necessary for operation:

See Annex 1 to EC Type Examination Module B Certificate BSH/4612/4340779/08

Approval Documentation:

See Annex 2 to EC Type Examination Module B Certificate BSH/4612/4340779/08

Places of production:

Consilium Selesmar S.r.l.
Via Romita 26, 50020 Montagnana V.P.
Florence, Italy

Limitations on the acceptance or use of the product:

Notes:

The manufacturer shall inform Bundesamt für Seeschifffahrt und Hydrographie, as the notified body, of any modifications to the type-tested product(s) that may affect compliance with the requirements or conditions laid down for use of the product(s).

In case the specified regulations or standards are amended during the validity of this certificate, the product(s) must be re-certified before being placed on board vessels to which such amended regulations or standards apply.

The Mark of Conformity (wheelmark) may only be affixed to the type approved equipment, and a Manufacturer's Declaration of Conformity may only be issued, if the product quality system fully complies with the Marine Equipment Directive and is certified by a notified body against ANNEX B module D, E, or F of the Directive.

U.S. Coast Guard Approval

This product has been assigned a U.S. Coast Guard Module B number (165.xxx/EC0735/Unique Identifier [if other than EC 0735: /Number of the notified body which certifies the quality assurance system]) to note type approval to Module B only as it pertains to obtaining U.S. Coast Guard approval as allowed by the "Agreement between the European Community and the United States of America on Mutual Recognition of Certificates of Conformity for Maritime Equipment" signed February 27th, 2004. Note: U.S. Coast Guard Approval covers only the APRA Tracker. A separate FCC approval for the Radar system is required before placed on the market

Notice on legal remedies available:

Objection to this document may be filed within one month after notification. The objection must be filed in writing to, or put on record at, Federal Maritime and Hydrographic Agency, Bernhard-Nocht-Str. 78, 20359 Hamburg, Germany

SRT X-BAND RADAR SYSTEMS
FOREWORD

**ANNEX 1 TO
EC TYPE EXAMINATION (MODULE B) CERTIFICATE**

No.: BSH/4612/4340779/08

List of Components:

No.	Designation	Type designation
1.1	X-Band Scanner (for Up Mast Transceiver)	a) 6 ft Array, type 02R-052 b) 9 ft Array, type 02R-053
1.2	X-Band Scanner (for Down Mast Transceiver)	a) 6 ft Array, type 02R-006 b) 9 ft Array, type 02R-007/C
1.3	X-Band Scanner (for SRT)	a) ANT6X-001 b) ANT9X-001
2.1	X-Band Transceiver (Up Mast)	a) 12.5 kW, type 39X-002 b) 25 kW, type 39X-003
2.2	X-Band Transceiver (Down Mast)	a) 25 kW, type 09N-009
2.3	X-Band Transceiver (SRT)	a) SRT/12-002 b) SRT/25-002
2.4	X-Band Transceiver (SRT) HSC	a) SRT/12-003 b) SRT/25-003
3.1	X-Band Turning Unit (Down Mast)	a) Pedestal, type 03R-034
3.2	X-Band Turning Unit (Down Mast) HSC	a) Pedestal, type 03R-038 (HSC)
3.3	X-Band Turning Unit (SRT)	a) SRT/PED-001
3.4	X-Band Turning Unit (SRT) HSC	a) SRT/PED-002
4.	S-Band Scanner	a) 12 ft Array, type 02R-039/B
5.1	S-Band Transceiver (Up Mast)	a) 30 kW, type 09N-011
5.2	S-Band Transceiver (Down Mast)	a) 30 kW, type 09N-010
6.1	S-Band Turning Unit	a) Pedestal, type 03R-039
7.1	Display Unit 250 mm PPI	a) 10CM-004, 19" TFT
7.2	Display Unit 340 mm PPI	a) 10CM-005, 23.1" TFT b) 10CM-006, 23.1" TFT
8.	Control Unit	a) Control Panel, type 10KB-009 b) Control Panel, type 10KB-010
9.	Processor Unit	a) Display Core, type DCORE-001
10.	Other mandatory equipment	
10.1	Power Supply Unit for S-Band Turning Unit	a) Power Supply, type 16PS-003
11.	Additional Navigational Equipment	a) Video Splitter, type VS-104 b) SRT Adapter Box, type SRTAB-001

SRT X-BAND RADAR SYSTEMS FOREWORD

Table of Combinations

Designation	Type of RADAR							
	1.1	1.2	1.3	1.4	2.1	2.2	2.3	2.4
Category of Radar	Type of RADAR							
	1.1	1.2	1.3	1.4	2.1	2.2	2.3	2.4
1.1 X-Band Scanner (for Up Mast Transceiver)	U1				U1			
1.2 X-Band Scanner (for Down Mast Transceiver)		D1				D1		D3
1.3 X-Band Scanner (for SRT)	U2		D2		U2		D2	
2.1 X-Band Transceiver (Up Mast)	U1				U1			
2.2 X-Band Transceiver (Down Mast)		X				X		
2.3 X-Band Transceiver (SRT)	U2				U2			
2.4 X-Band Transceiver (SRT) HSC								X
3.1 X-Band Turning Unit (Down Mast)			D1			D1		
3.2 X-Band Turning Unit (Down Mast) HSC								D3
3.3 X-Band Turning Unit (SRT)			D2			D2		
3.4 X-Band Turning Unit (SRT) HSC								D4
4 S-Band Scanner		X		X		X		X
5.1 S-Band Transceiver (Up Mast)		X				X		
5.2 S-Band Transceiver (Down Mast)				X			X	
6.1 S-Band Turning Unit		X		X		X		X
7.1 Display Unit 250 mm PPI	X	X	X	X				X
7.2 Display Unit 340 mm PPI					X	X	X	X
8. Control Unit	X	X	X	X	X	X	X	X
9. Processor Unit	X	X	X	X	X	X	X	X
10.1 Power Supply Unit for S-Band Turning Unit	X			X	X			X

- Note:
- X = Mandatory equipment.
 - O = Optional equipment.
 - Dn = Identification of option for down mast configuration
 - Un = Identification of option for Up mast configuration
 - D = One out of noted possibilities in relevant section is mandatory.
 - a).z) = Reference to relevant section within list of components.

Example: Upmast version may consist out of 1.1, 2.1, 7.1, 8, 9 or 1.3, 2.3, 7.1, 8, 9

**SUPPLEMENT TO ANNEX 1
EC TYPE EXAMINATION (MODULE B) CERTIFICATE**

No.: BSH/4612/4340779/08

**Statement concerning Spurious Emissions, Out of Band
Emissions and the Boundary between both**

The following Radar Transceivers, which form part of the systems noted in this certificate, have been subject to a measurement procedure as detailed in IEC 60936-1, Ed. 1.1 (2002), Annex D, as contained in Amendment 1 and the guidelines contained in ITU-R Recommendation RM.1177. This standard defines the test method and requirements that ship-borne radar have to meet in order to comply with Appendix 3 of the Radio Regulations and ITU-R Recommendations SM.1539 and SM.1541. The results of the measurement procedure were satisfactory and provide sufficient evidence that these Radar Transceivers are compliant with the criteria contained in the standards mentioned above and fulfil the requirements of Maritime Equipment Directive 96/98/EC as amended by 2001/53/EC and 2002/75/EC.

Table of measured Transceivers:

Type	Model No.	Magnetron
X-Band, Up Mast	Type 39X-002 / 12.5 kW	JRC MSF 1425A
X-Band, Up Mast	Type 39X-003 / 25 kW	JRC M1475A
S-Band, Up Mast	Type 09N-011 / 30 kW	JRC M1302L/M5020
X-Band, Up Mast	Type SRT/12-002, 12.5 kW	JRC MSF1425A, E2V MG4010
X-Band, Up Mast	Type SRT/25-002, 25 kW	JRC M1475A, E2V MG5424*

The test reports detailing the tests and test results provided by the applicant are:

**CETECOM: 2-3052-01-01/02 (X-Band)
CETECOM: 2-3052-01-02/02 (S-Band)
CETECOM: 2-3985-01-01/05 (X-Band)
CETECOM: 4-2638-01-04/07 (X-Band)**

The Transceiver Modules contained in the above Transceiver/Turning units are also found in the following Down Mast units. Since the applicable electronic circuitry and component parts are comparable and the addition of the wave-guide is known to have band limiting properties, a presumption of conformity can be applied by analogy.

Down Mast Unit
25 kW, X-Band, Down Mast Transceiver, Type 09N-009
30 kW, S-Band, Down Mast Transceiver, Type 09N-010

The following X-Band Transceiver units (Up Mast) for HSC are covered by the above documented test reports:

Up Mast Unit
12.5 kW, X-Band, Up Mast Transceiver (HSC), Type SRT/12-003
25 kW, X-Band, Up Mast Transceiver (HSC), Type SRT/25-003

* Note: Both 25 kW magnetrons for the SRT transceivers are only permitted in combination with the 9.4 GHz band rejection filter.

ANNEX 2 TO
EC TYPE EXAMINATION (MODULE B) CERTIFICATE
No.: BSH/4612/4340779/08

Approval Documentation

I. System Documentation

Technical Manual	304610P001 Rev. A, September 2008	SELUX ST-250 Display SELUX ST-340 Display
Technical Manual	304202P003 Rev. A, November 2007	SRT X-Band Transceiver, Radar Systems

Annex to
EC QUALITY SYSTEM (MODULE D) CERTIFICATE
No. BSH/4613/03101/0804/08



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	Item	Module B Certificate data			
		Registration number	date of issue	date of expiry	Notified Body
		USCG Approval No.			
A.1/4.34	Radar equipment with automatic radar plotting aid (ARPA)				
	SELUX ST	BSH/4612/4340779/08	2008-09-23	2013-09-22	0735
		165.120/EC0735/4340779	2008-09-23	2013-09-22	0735
	SELUX T250-C ARPA, SELUX T340-C ARPA	BSH/4612/4340031/05	2005-05-20	2010-05-19	0735
		165.120/EC0735/4340031	2005-05-20	2010-05-19	0735
	SELUX T250-C ARPA, SELUX T340-C ARPA	6522/1118/1/2005	2005-01-03	2010-01-02	0735
		165.120/EC0735/1118/1	2005-01-03	2010-01-02	0735
MM 950/A NAVBAT	6522/1106/2003	2003-12-15	----	----	
		----	----	----	
A.1/4.37	Radar equipment with automatic radar plotting aid (ARPA) for high-speed craft				
	SELUX ST	BSH/4612/4340779/08	2008-09-23	2013-09-22	0735
		----	----	----	----
	SELUX T250-C ARPA, SELUX T340-C ARPA	BSH/4612/4340031/05	2005-01-03	2010-01-02	0735
		----	----	----	----
	MM 950/A NAVBAT	6522/1106/2003	2003-12-15	----	----
		----	----	----	----

Hamburg, 2008-09-23



Notice on legal remedies available:

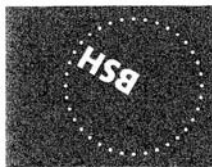
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BUNDESAMT FÜR SEESCHIFFFAHRT UND HYDROGRAPHIE
FEDERAL MARITIME AND HYDROGRAPHIC AGENCY

BUNDESAMT FÜR
SEESCHIFFFAHRT
UND
HYDROGRAPHIE

Bescheinigung Nr. 538
Certificate No.

über die Messung der Schutzabstände vom Magnet-Regel- und Magnet-Steuerkompaß gemäß ISO R 694 und DIN EN 60945 Absatz 11.2
(about the measurement of the safe distances to the Standard-Magnetic- and Steering-Magnetic-compass in accordance with ISO R 694 and IEC 60945 Section 11.2)

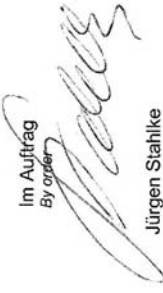
SRT X Band Transceiver / Pedestal

Gerät bzw. Anlageteil <i>Equipment or part of equipment</i>	Display Core Unit	SRT Adapter Box Unit	SRT X-Band Transceiver
Hersteller <i>Manufacturer</i>	Consilium Selesmar, Italy	Consilium Selesmar, Italy	Consilium Selesmar, Italy
Nr. der Baumusterprüfbescheinigung <i>No. of type approval certificate</i>	---	---	---
Typbezeichnung <i>Type</i>	10 DC - 004	SRT AB - 001	SRT / 25 - 002
Serien - Nr. <i>Part - No.</i>	AH 285	AH 100	AH 508
Schutzabstand vom <i>Safe distance to the</i> Magnet-Regelkompaß <i>Standard-Magnetic-compass</i> Magnet-Steuerkompaß <i>Steering-Magnetic-compass</i>	0,80 m 0,50 m	1,20 m 0,50 m	1,35 m 0,85 m
Reduzierter Schutzabstand vom <i>Reduced safe distance to the</i> Magnet-Regelkompaß <i>Standard-Magnetic-compass</i> Magnet-Steuerkompaß <i>Steering-Magnetic-compass</i>	0,50 m 0,30 m	0,75 m 0,30 m	0,85 m 0,55 m
Bemerkungen <i>Remarks</i>			

SRT X-BAND RADAR SYSTEMS
FOREWORD

Gerät bzw. Anlageteil <i>Equipment or part of equipment</i>			
Hersteller <i>Manufacturer</i>			
Nr. der Baumusterprüfbescheinigung <i>No. of the type approval certificate</i>			
Typbezeichnung <i>Type</i>			
Einzelnummer <i>Partnumber</i>			
Schutzabstand vom Magnet-Regelkompaß Standard-Magnetic-compass Magnet-Steuerkompaß Steering-Magnetic-compass			
Reduzierter Schutzabstand vom Magnet-Regelkompaß Standard-Magnetic-compass Magnet-Steuerkompaß Steering-Magnetic-compass			
Bemerkungen <i>Remarks</i>			

Die gemessenen Schutzabstände gelten ausschließlich für die vorgestellte Ausführung. Bei Änderung der Konstruktion und / oder der Betriebsdaten verliert die Bescheinigung ihre Gültigkeit.
The measured safe distances apply only to the represented design. If the construction and / or operating data are changed this certificate will lose its validity.

Im Auftrag
 By order

 Jürgen Stahlke

Hamburg, den 4. Dezember 2007

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WARNINGS

IMPORTANT NOTE

For correct operation, please, read this instruction manual carefully, before operating the equipment.

HIGH VOLTAGE

Radar equipment requires the use of high voltages. This can cause injury, or loss of life. Danger exists only when the units are opened, exposing internal circuits, as when servicing the equipment. You do not face any danger during normal operation. The SRT X-Band Radar System has been carefully designed to protect personnel from possible injury from high voltages at normal operation.

When inspecting or servicing the equipment, nevertheless, it is recommended that the Line Switch to left open, as an added protection.

Although every effort has been made to eliminate danger to personnel, no responsibility is accepted for any injury or loss of life suffered in connection with the equipment.

RADIO-FREQUENCY RADIATION

Harmful effects (particularly to the eyes) may be caused by exposure of any part of the human body to radio-frequency mean power densities. Hazard distances at which power densities of 100 W/ m², 50 W/ m² and 10 W/m² exist, are given in the following table

Configuration	Distance to 100 W/ m ² point [m]	Distance to 50 W/ m ² point [m]	Distance to 10 W/ m ² point [m]
12 kW Transceiver + 6'X Band Antenna (ANT6X-001)	-	0,15	0,6
12 kW Transceiver + 9'X Band Antenna (ANT9X-001)	-	-	0,5
12 kW Transceiver + 12'X Band Antenna (ANT12X-001)	-	-	0,35
25 kW Transceiver + 6'X Band Antenna (ANT6X-001)	0,1	0,2	1,3
25 kW Transceiver + 9'X Band Antenna (ANT9X-001)	-	0,1	1,0
25 kW Transceiver + 12'X Band Antenna (ANT12X-001)	-	0,05	0,9

Note :

12 KW transceiver: SRT/12-002 - SRT/12-003.

25 KW transceiver: SRT/25-002 - SRT/25-003 or SRT/PED-001 / SRT/PED-002 with 25KW Dowmast transceiver,

The system is however designed too always disable the microwave radiation when the antenna is not rotating.

The pedestals have also been prepared for the installation of an external safety switch, which can be mounted on, or near the platform. This switch removes the power from the Pedestal eliminating the possibility of accidental operation during servicing and also causes disabling of transmission.

Whenever it is necessary to disconnect the waveguide system from a radar transmitter for maintenance purpose, the transmitter output should be terminated in a matched load, when possible. If this is not possible, care should be taken to avoid standing in front of an open-ended waveguide from which power is being radiated.

NEVER look down a waveguide from which power is being radiated.

X-RAY RADIATION

This unit does not generate X-RAY radiation.

SAFETY SWITCH

The Radar Unit is provided with a safety switch, which disable the Antenna movement during maintenance operations and avoids high voltage damage. Always turn the safety switch off, whenever advised in this manual (for instance, before performing any maintenance or installation procedure.). Ignoring safety switch operation may produce hazard of electrocution as well as other severe injures.

SAFETY PRECAUTIONS

Purpose

Safety precautions described in this paragraph are applicable to the SRT X-Band Radar System. Depending upon the type of advice, the following attention sings are used in the technical manual:

DANGER

IF THIS OPERATING PROCEDURE, MAINTENANCE PROCEDURE, PRACTICE, CONDITION OR STATEMENT IS NOT STRICTLY FOLLOWED, COULD RESULT IN SEVERE INJURY OR DEATH OF PERSONNEL

WARNING

IF THIS IS OPERATING PROCEDURE, MAINTENANCE PROCEDURE, PRACTICE, CONDITION OR STATEMENT IS NOT STRICTLY FOLLOWED, COULD RESULT IN DAMAGE, OR DESTRUCTION OF UNIT, OR LOSS OF EMISSION EFFECTIVENESS.

CAUTION

IF THIS IS OPERATING PROCEDURE, MAINTENANCE PROCEDURE, PRACTICE, CONDITION OR STATEMENT IS NOT STRICTLY FOLLOWED, COULD RESULT IN INJURY OF PERSONNEL OR PROPERTY DAMAGE .

NOTE

Advice of an essential operating procedure, maintenance procedure, condition or statement which must be followed.

Whenever a precaution, relating specific part of the technical manual is needed, precaution information is given in the relevant part of the manual. Warnings and Cautions Signs precede applicable text.

Safety Operations

During normal operation (front cover closed), the unit can be quickly disconnected from the main power line, setting to OFF the main circuit breaker located on the electric switchboard.

During maintenance (front cover opened), it is possible to turn on the unit, by linking P1 on SRT Power Board (Chapter 9, Figure 9.1.10, pos. 5). This link forces the unit main power to be ON. During normal operation P1 on SRT Power Board must be set OPEN.

NOTE

The main power line is always present on the terminal board

Safety Summary

The following are general safety precautions that are not related to any specific procedure and therefore do not appear elsewhere in this technical manual. These are recommended precautions that all personnel must understand and apply during all phases of operation and maintenance.

KEEP AWAY FROM ANY LIVE CIRCUITS !
(Do not touch any circuits under operation!)

Operating personnel must at all times observe all safety regulations.

Do not replace components or make adjustments inside the unit with the high voltage supply turned ON. Under certain conditions, dangerous potentials may exist also, when the power breaker is in the OFF position, due to charges

retained on capacitors. To avoid danger and casualties, always remove power and discharge to ground a high voltage circuit before touching it!

DO NOT SERVICE OR ADJUST ALONE !

Under no circumstances should any person initiate servicing or adjusting the unit except in the presence of someone capable of helping.

RESUSCITATION

Personnel working with or near high voltage should be familiar with modern methods of resuscitation. Such information may be obtained from the Bureau of Medicine and Surgery or equivalent.

Warning Information

The following warnings signs appear in this technical manual, and to point out their importance, they are repeated also here for emphasis:

WARNING

USE EXTREME CARE WHEN WORKING ON THE UNIT ONCE THE COVER HAS BEEN OPENED. THE MAGNETRON ASSEMBLY OPERATES AT HIGH VOLTAGES THAT MAY CAUSE FATAL INJURIES

WARNING

BE AWARE OF HIGH VOLTAGE CAPACITORS ! IT IS NECESSARY TO SHORT-CIRCUIT THEIR LEADS BEFORE PERFORMING ANY MAINTENANCE ACTION ON THEM.

WARNING

ON THE ELECTRIC SWITCHBOARD, SET TO "OFF" THE POWER BREAKER DEDICATED TO THE PRESENT EQUIPMENT AND HANG TO IT A SIGN, READING: "WORK IN PROGRESS ! DO NOT SWITCH ON!"

WARNING

USE EXTREME CARE, WHEN WORKING ON THE EQUIPMENT, ONCE THE FRONT COVER HAS BEEN OPENED. THE MAGNETRON ASSEMBLY OPERATES AT HIGH VOLTAGES THAT MAY CAUSE FATAL INJURIES!

WARNING

SET MAIN LINE BREAKER TO OFF BEFORE REPLACING ANY FUSE. FUSES ARE UNDER VOLTAGE LEVELS WHICH MAY CAUSE FATAL INJURIES!

CHAPTER 1

DESCRIPTION AND MAIN CHARACTERISTICS

1.1 Introduction

1.1.1 Manual Applicability

The present technical manual provides information, data, and procedures relevant to general description, operation, functional description, scheduled maintenance, troubleshooting, corrective maintenance and replaceable parts list of the SRT X-Band RADAR SYSTEMS consisting of 12 kW or 25 kW pedestal and 6, 9, or 12 feet antennas.

For brevity of description, reference to the equipment in this manual, can also be made by means of the Manufacturer code name:

SRT X-Band RADAR SYSTEMS with 12 or 25 kW Pedestal with 6, 9, or 12 Feet Antennas (Chapter 9,.Figure 9.1.4 pos. 8).

The contents of the present technical manual are arranged in 10 Chapters as follows:

Warnings

Chapter 1	DESCRIPTION AND MAIN CHARACTERISTICS
Chapter 2	OPERATION
Chapter 3	FUNCTIONAL DESCRIPTION
Chapter 4	PREVENTIVE MAINTENANCE
Chapter 5	TROUBLESHOOTING
Chapter 6	CORRECTIVE MAINTENANCE
Chapter 7	PART LIST
Chapter 8	INSTALLATION
Chapter 9	FIGURES

1.1.2 The purpose of the equipment

The SRT X-Band Radar System, when connected to a Display Unit (not described in this manual), performs the following functions:

- It receives the radar controls from the Display Unit connected to the equipment.
- It generates and receives the RF pulses.
- It processes the RF pulses.
- It sends the radar data and controls to the Display Unit.

The equipment's power supply, 48 VDC is given by the Display Unit or from the SRT Adapter Box from the Ship Main Line.

1.1.3 List of Abbreviations

All measurement abbreviations are according to the MIL STD-12. Other terms and abbreviations, used in the manual are listed in Table 1.1.1 - List of abbreviations.

Table 1.1.1 - List of abbreviations

ABBREVIATION	MEANINGS
AC	Alternating Current
AZ	Antenna Azimuth Pulse
DC	Direct Current
dB	Decibel
dBm	Decibel referred to 1 milli-Watt
HL	Heading Line
HV	High Voltage
IF	Intermediate Frequency
LED	Light Emitting Diode
LO	Local Oscillator
LNFE	Low Noise Front End
LV	Low Voltage
MDS	Minimum Detectable Signal
MTBF	Mean Time Between Failures
PRF	Pulse Repetition Frequency
RC	Resistor - Capacitor
RF	Radio Frequency
RPM	Revolution per Minute
TXRX	Radar Transceiver
STC	Sensitivity Time Control
TTL	Transistor-Transistor Logic
VCO	Voltage Controlled Oscillator
WG	Waveguide

1.2 Configuration Table

Pedestal	Antenna	Transceiver	Output Power	Rotational Speed
SRT/12-002	ANT6X-001	Included in Pedestal	12 KW	Standard
SRT/12-002	ANT9X-001	Included in Pedestal	12 KW	Standard
SRT/25-002	ANT6X-001	Included in Pedestal	25 KW	Standard
SRT/25-002	ANT9X-001	Included in Pedestal	25 KW	Standard
SRT/12-003	ANT6X-001	Included in Pedestal	12 KW	HSC
SRT/12-003	ANT9X-001	Included in Pedestal	12 KW	HSC
SRT/25-003	ANT6X-001	Included in Pedestal	25 KW	HSC
SRT/25-003	ANT9X-001	Included in Pedestal	25 KW	HSC
SRT/PED-001	ANT6X-001	09N-009	25 KW	Standard
SRT/PED-001	ANT9X-001	09N-009	25 KW	Standard
SRT/PED-002	ANT6X-001	09N-009	25 KW	HSC
SRT/PED-002	ANT9X-001	09N-009	25 KW	HSC

1.3 Physical Description

The SRT 12 and 25 kW X-Band Radar System is composed of (Chapter 9, Figure 9.1.2):

- The Antenna: 6, 9, or 12 feet (pos. 3)
- The Pedestal (pos. 2)
- Optional equipments: Heater, Encoder, SRT Adapter Box

All Units are designed for maximum resistance to the severe environmental conditions in which they have to operate.

Table 1.3.1- Equipment, Accessories and Documents Supplied

Pos.	Description	Code	Width (mm)	Height (mm)	Depth (mm)	Weight (Kg)
1	12.5 or 25 kW X-Band Receiver Transmitter Modulator and Antenna	Unit type: SRTX				
		SRTX/12-002 / SRT/12-003	364*	391*	534	35*
		or	1800**	466**		40**
		SRT/25-002 / SRT/25-003 with	2650***	466**		44***
ANT6X-001 (**) or ANT12X-001 (***) or ANT12X-001 (****)	3618'''	466'''	49''''			
2	Technical manual	304202P003	N.A.	N.A.	N.A.	N.A.

(*) Without Antenna

- (**) With 6' Antenna
- (***) With 9' Antenna
- (****) With 12' Antenna

1.3.1 Antenna

The Antennas available are:

- 6 feet: ANT6X-001
- 9 feet: ANT9X-001
- 12 feet: ANT12X-001 (only IEC 60945 tested)

The Antenna (Chapter 9, Figure 9.1.2 pos. 3) is fixed to the Pedestal Support (pos. 1) by means of four (4) screw (pos. 1)

The antenna consists of

- a side feeded slotted waveguide of 6, 9, or 12 feet lengths,
- a waveguide feeding the slotted waveguide from the rotary joint including a turnaround part. The connection to the rotary joint is through a choke flange without screws.
- a polarisator to radiate only in horizontal polarization.
- an antenna horn consisting of upper and lower side to form the vertical beam.
- A plastic external cover for weather protection.

The antenna is mounted on the pedestal by the antenna support structure with 4 screws. This support structure makes the antenna more rigid against wind and vibration.

1.3.2 Pedestal

The Pedestal is composed of a metal cabinet (Chapter 9 Figure 9.1.3 pos. 1), made of Aluminum, treated with anticorrosive paint in order to be saline atmosphere resistant. The cabinet is provided with a cover (Chapter 9 Figure 9.1.4 pos. 2) fixed to the cabinet by four screw (pos. 1); the cover can be opened to allow an easy access to the internal components.

In that part of the cabinet, which is on the same side as the cover hinge (Chapter 9 Figure 9.1.3 pos. 2), the following items are located:

- the screw for the grounding connection of the Unit to the ship structure (pos. 4)
- the main connector (pos. 3) for the connecting cable with the Display Unit used also for the power supply.

When the cover is open, it is possible to access the following internal units (Chapter 9, Figure 9.1.4):

- Connecting Terminal Board
- Electronics Rack (pos. 4)
- Brushless Motor Controller (pos. 5)
- Motor Unit (pos. 6)
- RF Head (pos. 7)

1.3.2.1 Main Connector

The Main Connector (Chapter 9, Figure 9.1.3 pos. 3), is mounted at the bottom of the Pedestal cabinet (pos. 1). This main connector allows the connection between the Display Unit (or the optional SRT Adapter Box), and the Pedestal Unit (including the Motor Unit and Electronics Rack).

On the Main Connector the following signals can be located:

- Combined Video,
- Power supply,
- Safety Switch.

1.3.2.2 SRT Electronics parts

The SRT X-BAND RADAR Pedestal contains high speed electronic circuits, which allow to the RF HEAD, transmission, reception and processing the RF echoes.

Table 1.3.2 – SRT X-Band 12 and 25kW Composition lists the main assemblies composing the unit and their position inside the unit.

Table 1.3.2 – SRT X-Band 12 and 25kW Composition

DESCRIPTION	POSITION
RF HEAD	Chapter 9, Figure 9.1.4, pos. 7
Electronic Rack	Chapter 9, Figure 9.1.4, pos. 4
Bearing Reader Board	Chapter 9, Figure 9.1.30, pos. 2
Brushless motor controller Board	Chapter 9, Figure 9.1.4, pos. 5
Brushless motor	Chapter 9, Figure 9.1.4, pos. 6

Table 1.3.3 - RF HEAD

DESCRIPTION	POSITION
Magnetron	Chapter 9, Figure 9.1.27, pos. 2
Circulator	Chapter 9, Figure 9.1.27, pos. 3
Limitier	Chapter 9, Figure 9.1.27, pos. 4
RF_Amplifier Assy	Chapter 9, Figure 9.1.27, pos. 5

Table 1.3.4 - Electronics Rack

DESCRIPTION	POSITION
SRT_Control	Chapter 9, Figure 9.1.6, pos. 6
SRT_MOS	Chapter 9, Figure 9.1.6, pos. 7
SRT_Power	Chapter 9, Figure 9.1.6, pos. 8

The Electronics Rack is connected to:

- the Bearing Reader Board Read-out by a connector (Chapter 9, Figure 9.1.17 pos. 2) on the SRT Control Board.
- the Brushless Motor Controller Board (Chapter 9, Figure 9.1.17 pos. 3).
- the RF HEAD (Chapter 9, Figure 9.1.17 pos. 4 and Chapter 9, Figure 9.1.15 pos. 1)
- the Display Unit, through the Main Connector (Chapter 9, Figure 9.1.3 pos. 3).

1.3.2.3 Motor Unit

The Motor Unit is composed of (Chapter 9, Figure 9.1.5):

- the Motor (pos. 1) whose function is to provide the necessary power to produce the Antenna rotation,
- the Gear Reduction Box (pos. 2) whose function is to reduce the motor angular speed,
- the final gear (pos. 3) whose function is to transmit, through the rotating wheel, the motion, provided by the Gear Reduction, to the Antenna,
- the Optical Read-out (Chapter 9, Figure 9.1.30, pos. 1) whose function is to generate the Heading Line (HL) pulse and the pulses indicating the Antenna position (AZ).
- the Rotary Joint (Chapter 9, Figure 9.1.31, pos. 1) whose function is to connect the Waveguide of the Antenna to the internal one; this part is connected to the Waveguide (Chapter 9, Figure 9.1.2 pos. 4) from the RF HEAD
- The Motor Group is connected to the Brushless Controller by means of a cables provided with connectors for the Electric Motor supply and a cable provided with connector for the Optical Read-Out signals.

1.3.2.4 Pedestal for Downmast Configuration

In the case of a Downmast Configuration the Pedestal contains only the Motor Unit as described in 1.2.2.3. and one interface PCB.

The link between the rotary joint and the external waveguide is made with a special 90° joint (Figure 9.1.34/45 – 2) with a flange choke at one of the extremities.

In this way a mechanically locked connection is not needed and the transceiver lid can be easily opened.

The microwave signals are connected from the Downmast RF unit by a flexible waveguide. The pedestal casting has an separate opening for the flexible waveguide to enter (Chapter 9, Figure 9.1.33. Downmast pedestal Dimensional Drawing).

The mechanical assembly is mounted similarly to Up- mast configuration, according to Figure 9.1.34.

The whole assembled SRT pedestal with open top is shown in Figure 9.1.35.

The interface PCB (Figure 9.1.34/45 - 1) functions are:

- Bearing signal conditioning with a +15V high level in output
- Antenna soft –start circuit and rotation protection via the external safety switch.
- Coaxial cable interface for the Performance Monitor Arm signal.
- Terminal board for the Multicore cable.

The Multicore cable is connected trough a cable gland to the interface PCB and the brushless motor controller during the installation. The cable gland is not only IP protected but has an optional ring tenure for EMC.

1.4 Functional Description

The SRT 12 KW and 25 kW X-BAND Radar System is divided mainly into Receiver and Transmitter sections, both connected to a solid state controlled modular R.F. HEAD.

The Transmitter generates the R.F. energy in the X-Band range and pulses modulated with a peak power of 12 or 25 kW. The length and PRF of the pulses are in accordance with the range scale selected on the Display Unit. The transmission pulses can be: Short, Medium and Long.

The Receiver enables reception of echoes and subsequent amplification in the RF_Amplifier Assy.

The Electronics Rack unit also includes the circuits to generate the voltage required for its operation.

The function of the Antenna unit is to:

- 1) Transmit the R.F: pulses within the specified (se b1.4.1) vertical and horizontal lobes with horizontal polarization.
- 2) Receive the reflected R.F. echo signals and forward them towards the RF HEAD.

1.5 Technical Characteristics

In Table 1.4.1. the Technical Data Sheet of the SRT X-Band Radar System with 12 and 25 kW pedestal and 6, 9, and 12 feet antennas are given:

Table 1.4.1. SRT X-Band Radar System technical Data Sheet:

1	1 General Description
<p>In this configuration a sturdy and splash proof antenna pedestal houses the following sub-assemblies:</p> <ul style="list-style-type: none"> • Built-in, X band, solid state controlled Transceiver; • Transceiver DC Power Supply and external AC/DC converter box; • Antenna motor & reducer; • High performance plastic gear wheel • RF rotary joint; • Proximity switch for antenna data transmission (azimuth and heading line) or encoder with 1024 pulses. • The antenna is an End Fed Slotted Waveguide type. • Selectable antenna rotation speed. <p>The above compact arrangement allows a direct coupling between Transceiver and rotary joint, thus simplifying the installation work and significantly reducing the RF losses normally accepted when the Transceiver is installed into a separate cabinet in "down-mast" position. The interface with the radar console is through a single connector and it is not necessary to open the transceiver casting during installation. Every analog adjustment is made remotely from the Selux console.</p> <p>The pedestal with built-in 12kW or 25 kW transceiver supports 6' / 9' / 12' antennas.</p> <p>Both Transceiver and motor driver are fed by a 48 VDC supply, an external transformer is required for 115/220 VAC 50/60 Hz power supply.</p> <p>The Transceiver has new compact electronics with a high integration level derived from a well-tested design.</p> <p>Main features:</p> <ul style="list-style-type: none"> • Modular and solid state construction; • Electronic Modulator based on MOSFET technology; • Long life 3rd/4th generation magnetron (10/12 KW and 25 KW); • Low Noise Amplifier providing a reduced overall Noise Figure (4.0 dB nominal); • Microcomputer controlled operations; • Serial link with telemetry and remote control for adjustments; • Built-in test facilities for power supply and modulator parameters; • PRF jittering removing any possible ambiguity due to multiple-time-around echoes; 	
<ul style="list-style-type: none"> • Two different Sectors Blanking to be set at time of installation; 	

SRT X-BAND RADAR SYSTEMS
DESCRIPTION AND MAIN CHARACTERISTICS

1	1 General Description
<ul style="list-style-type: none"> • Performance Monitor; • Rotation: 20 and 40 RPM selectable; 	

2. Antenna & Driver - Technical Specifications			
Antenna model	6X	9X	12X
Antenna Unit Type I/N	ANT6X-001	ANT9X-001	ANT12X-001
Driver & Transceiver I/N:	SRT/12-002 SRT/25-002 SRT/12-003 SRT/25-003	SRT/12-002 SRT/25-002 SRT/12-003 SRT/25-003	SRT/12-002 SRT/25-002
Antenna type	End-fed-slotted wave guide		
Antenna length (inch / mm.)	6' / 1800	9' / 2650	12' / 3618
Antenna swing circle (/ mm.)	1800	2650	3618
Frequency (MHz)	9325 - 9425		
Polarization	Horizontal		
Gain (dB)	29	31	32,5
Horizontal beam width at -3 dB	1,35°	0,9°	0,7°
Vertical beam width at -3 dB	22°	22°	22°
Horizontal side lobes ('dB):			
- within 10°	- 27	- 26	- 26
- outside 10°	- 30	-_30	-_30
VSWR	Better than 1.20		
PPR	128 / 1024 with encoder		
Nominal Rotation speed (RPM)	> 40		> 20
Nominal Wind resistance (KT)	100		

SRT X-BAND RADAR SYSTEMS
DESCRIPTION AND MAIN CHARACTERISTICS

3. X Band Transceiver - Technical Specifications		
Nominal peak power (KW):	12/10 (*)	25
Transceiver I/N:	SRT/12-002 SRT/12-003	SRT/25-002 SRT/25-003
Operating frequency (MHz):	9375 ± 30 or 9410 ± 30 (X Band)	
Pulse length (nsec.):	60 - 250 - 800	
PRF (Hz):	3000-1500-750	
Modulator:	MOSFET Solid state	
IF amplifier:	Logarithmic	
IF dynamic (dB)	100 (+30 pre STC)	
IF center frequency (MHz)	60	
IF bandwidth (MHz): - short pulse - medium pulse - long pulse	20 4,8 1,5	
Overall noise figure (nominal dB)	≤ 5	
MDS on long pulse (dBm)	≤ -110	
- Overall at receiver level	≤ -100	
- At IF level	≤ -110	

(*) EEV 4th generation magnetron is 10.5 KW, NJRC is 12 KW

4. Environmental features	
Operating temperature	-25°C / +55°C As in IEC 60945
Storage temperature	-25°C / +70°C As in IEC 60945
Relative humidity	Up to 95% at +40° As for IEC 60945
Vibrations	As for IEC 60945
Water proof according to	IP 66
Wind resistance (KT)	100

SRT X-BAND RADAR SYSTEMS
DESCRIPTION AND MAIN CHARACTERISTICS

5. Dimensions (mm)	
Width	364
Depth	534
Height	391

6. Weights (Kg)			
Antennas (6X / 9X / 12X)	5	9	14
Pedestal with Transceiver	35		

7. Required Power Supply	
Standard configuration	24 VDC or 115/220 VAC
Power consumption:	Ca 350 W Peak at maximum wind load

8. Options	
Different PRF set	Upon Customer request
Heaters	For very cold environments (< -25° C)
Encoder 1024 pulses	Upon Customer request

CHAPTER 2 OPERATION

2.1 Introduction

2.1.1 Purpose

The present chapter provides the operating instructions, information and procedures required in order to enable operating personnel to efficiently and effectively operate the SRT X-BAND Radar System, for it to accomplish its designated tasks.

The Chapter is divided in:

Paragraph 2.2 Controls and Indicators

Paragraph 2.3 Semi-operative Controls

The Unit does not require personnel on steady watch conditions, but requires general monitoring during normal operating situations. Since, the Unit has no operating controls, paragraph 2.2 is not applicable. All semi-operative controls are located inside the unit.

2.2 Controls and Indicators

Since the Unit has no operating controls, this paragraph is not applicable.

2.3 Semi-operative Controls

The unit is fitted with some semi-operative controls, which are accessible, when the front cover is open.

Table 2.3.1 - Semi-Operative Controls Location of TXRX Cabinet

Fig.	Pos.	Code (Ref. Assy)	Type	Function
Figure 9.1.4	9	S1 (Electronics Rack)	Interlock	TXRX cover interlock switch for disabling the High Voltage generation

Table 2.3.2 - Semi-Operative Controls Location of Electronic Rack

Fig.	Pos.	Code (Ref. Assy)	Type	Function																
Figure 9.1.17	6	S1	10 position rotary switch	It selects the TXRX unit operation mode as follow: <table style="margin-left: 20px; border: none;"> <tr> <td>Pos.</td> <td>Function</td> </tr> <tr> <td>0</td> <td>SRT under external control 1</td> </tr> <tr> <td>1</td> <td>SRT under external control 2</td> </tr> <tr> <td>2</td> <td>SRT in local stand-by</td> </tr> <tr> <td>3</td> <td>SRT in local with short pulse</td> </tr> <tr> <td>4</td> <td>SRT in local with medium pulse</td> </tr> <tr> <td>5</td> <td>SRT in local with long pulse</td> </tr> <tr> <td>9</td> <td>SRT in local with long pulse and performance monitor with auto tuning and antenna rotation</td> </tr> </table>	Pos.	Function	0	SRT under external control 1	1	SRT under external control 2	2	SRT in local stand-by	3	SRT in local with short pulse	4	SRT in local with medium pulse	5	SRT in local with long pulse	9	SRT in local with long pulse and performance monitor with auto tuning and antenna rotation
Pos.	Function																			
0	SRT under external control 1																			
1	SRT under external control 2																			
2	SRT in local stand-by																			
3	SRT in local with short pulse																			
4	SRT in local with medium pulse																			
5	SRT in local with long pulse																			
9	SRT in local with long pulse and performance monitor with auto tuning and antenna rotation																			
Figure 9.1.10	2	DL1	LED green	It indicates the presence of the +24VDC power supply																
Figure 9.1.10	3	DL2	LED green	It indicates the presence of the +5V																
Figure 9.1.10	4	DL3	LED red	It indicates the presence of High Voltage																
Figure 9.1.10	6	DL4	Red and Green	Green indicates when Line Voltage is ON Red indicates that the PCB is in operation.																

Table 2.3.3 - Semi-Operative Controls Location of Brushless Motor Controller

Fig.	Pos.	Code (Ref. Assy)	Type	Function
Figure 9.1.32	1	DL1	LED green	It indicates the presence of the +50 VDC power supply
Figure 9.1.32	2	DL2	LED red	It indicates the status of the controller: Light on = motor in OFF or controller in protection Light off = motor in rotation

2.4 NMEA Transfer Protocol

2.4.1 Abbreviations

RDC	Radar Display Console
TXRX	Transceiver (TX/RX)
CRC	Checksum Field

Field Type

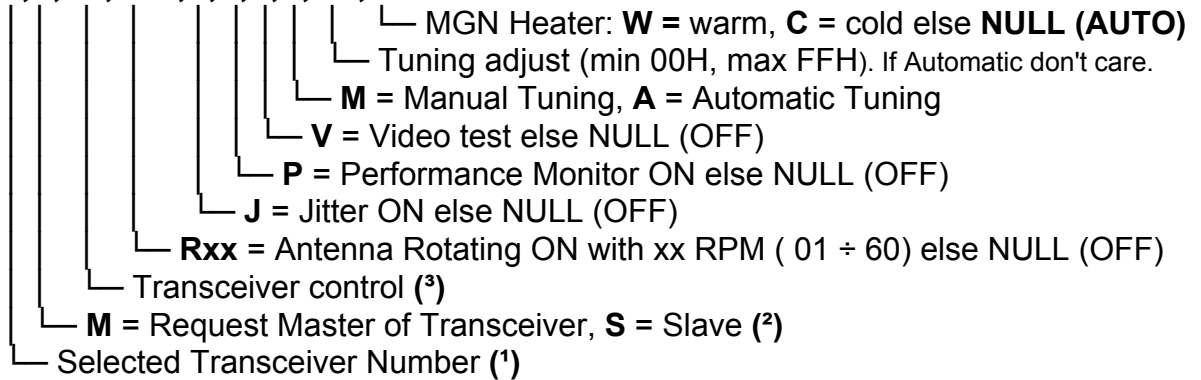
<i>Field type</i>	<i>Symbol</i>	<i>Definition</i>
Status	A	A = Yes, data valid, warning flag clear. V = No, data invalid, warning flag set.
Variable Numbers	x.x	Variable length integer or floating numeric field. Optional leading and trailing zeros. The decimal point and associated decimal fraction are optional if full resolution is not required (example: 73.10 = 73.1 = 073.1 = 73).
Fixed HEX field	hh-	Fixed length HEX number only, MSB on the left.
Variable text	c—c	Variable length valid character field.
Fixed alpha field	aa-	Fixed length field of upper-case or lower-case alpha characters.
Fixed number field	xx-	Fixed length field of numeric characters.
Fixed text field	cc-	Fixed length of valid characters.

- NOTE ¹ Spaces shall only be used in variable text fields.
- NOTE ² A negative SIGN “-“ (HEX 2D) is the first character in a field if the value is negative. When used, this increases the specified size of fixed length fields by one. The sign is omitted if the value is positive.

2.4.2 DATA TRANSMISSION FROM RDC TO TXRX (OR INTERFACES)

2.4.2.1 OPERATIONAL CONTROL SENTENCE 2

\$PCO2,x,a,aa,aaa,a,a,a,a,hh,a*hh<CR><LF>



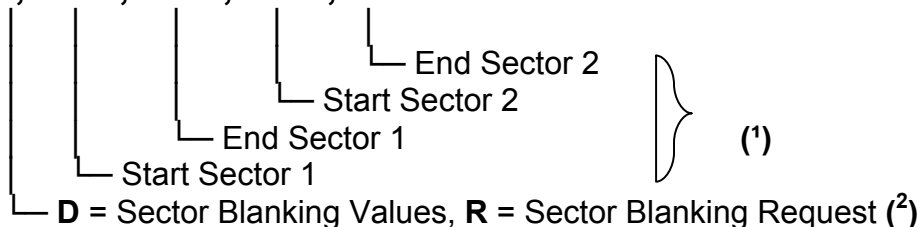
Notes:

- ⁽¹⁾ Transceiver Number: 1, 2, 3, 4 (**SPARE in stand alone TXRX**)
- ⁽²⁾ Master/Slave request (**SPARE in stand alone TXRX and single equipments**)
- ⁽³⁾ Transceiver control:

<i>Field type</i>	<i>Field Descriptions</i>
SB	Stand By
SH	Short pulse, High frequency
SM	Short pulse, Medium frequency
SL	Short pulse, Low frequency
MM	Medium pulse, Medium frequency
ML	Medium pulse, Low frequency
LL	Long pulse, Low frequency

2.4.2.2 SECTOR BLANKING SENTENCE

\$PSE2,a,xxx.x,xxx.x,xxx.x,xxx.x*hh<CR><LF>

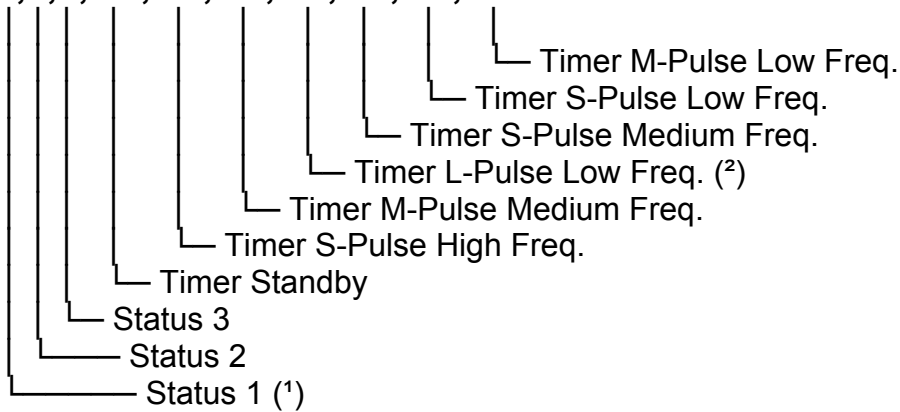


Notes:

- ⁽¹⁾ Start & End Sector units are degree. Es: 90.6.
This value will be rounded depending from the position sensor used
- ⁽²⁾ If Sector Blanking Request, don't care

2.4.2.3 TIMERS INITIALIZATION

\$PTIM,x,x,x,x.x,x.x,x.x,x.x,x.x,x.x,x.x*hh<CR><LF>



Notes:

- (1) Command 1: 1 = Request for transmission of actual values
2 = Initialization of values .
3 = Reset of values.

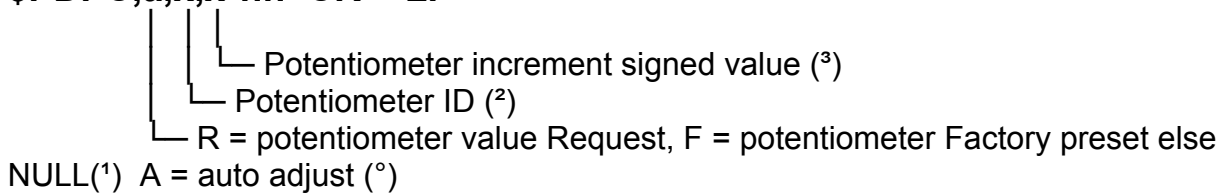
Command 2: Spare
Command 3: Spare

(2) Timers : Integer value to pre-set the operated time. LSB is equal to 1 hour.

If Command 1 = 1 or Command 1 = 3 don't care.

2.4.2.4 DIGITAL POTENTIOMETERS

\$PDPC,a,x,x*hh<CR><LF>



Notes:

- (1) Factory preset is available for latest TX/RX versions.
(2) Pot. ID

#Potentiometer to be upgraded:
0 PRE-STC AMPLITUDE
1 PRE-STC SLOPE
2 P.M. OPEN
3 P.M. DISTANCE (Power Level)
4 TUNING INTICATION
5 TUNE OFFSET

6 NOISE DIODE CURRENT

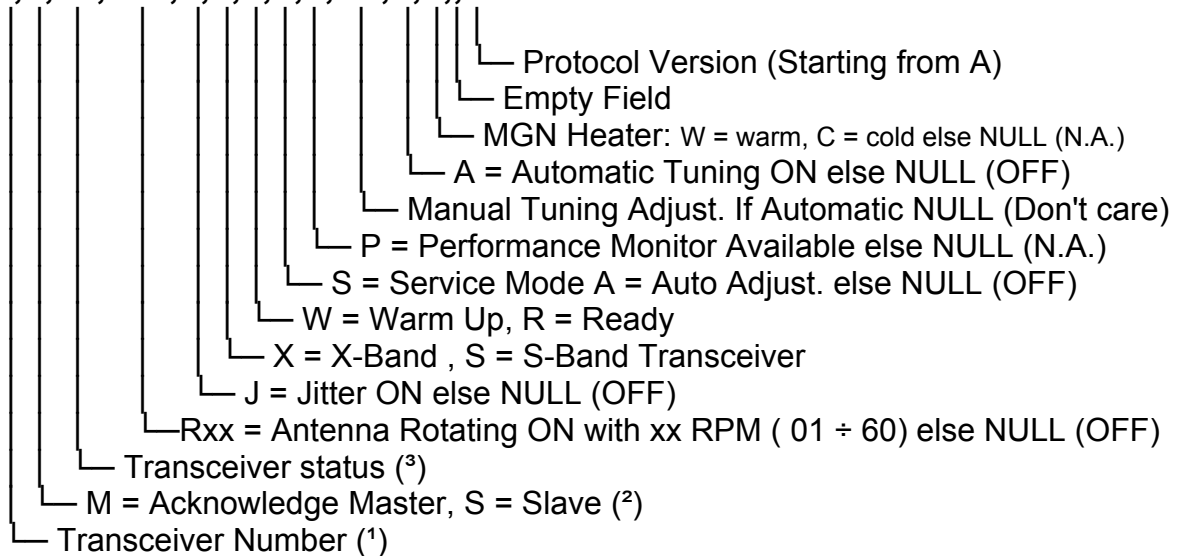
- (³) Increment or decrement to apply (range ± 7). (NEVER SEND 0)
 (°) If "A" with pot id, adjust only the correspondent Pot. (not yet).
 If "A" without pot id (.,), adjust all the auto adjustable (Tune offset for now).

Sentence should be sent under operator request only. Application of value is immediate but storage of this one (not volatile memory) will take place after 20 seconds from last change i.e. from last DPC sentence reception.

2.4.3 DATA TRANSMISSION FROM TXRX TO RDC

2.4.3.1 STATUS SENTENCE 2

\$PST2,x,a,aa,aaa,a,a,a,a,hh,a,a,,a*hh<CR><LF>



Notes:

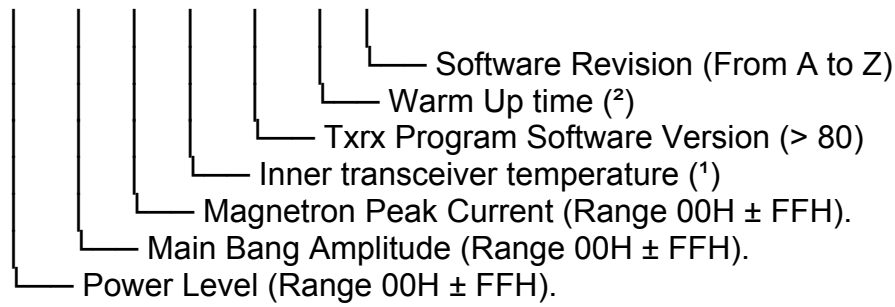
- (¹) Transceiver Number: 1, 2, 3, 4 (**NULL in stand alone TXRX**)
 (²) Master/Slave acknowledge (**NULL in stand alone TXRX**)
 (³) Transceiver status:

Field type	Field Descriptions
SB	Stand By
SH	Short pulse, High frequency
SM	Short pulse, Medium frequency
SL	Short pulse, Low frequency
MM	Medium pulse, Medium frequency
ML	Medium pulse, Low frequency
LL	Long pulse, Low frequency

2.4.3.2 DATA SENTENCE

\$PDAT,hh,hh,hh,xxx,xx,xxx,x*hh<CR><LF>





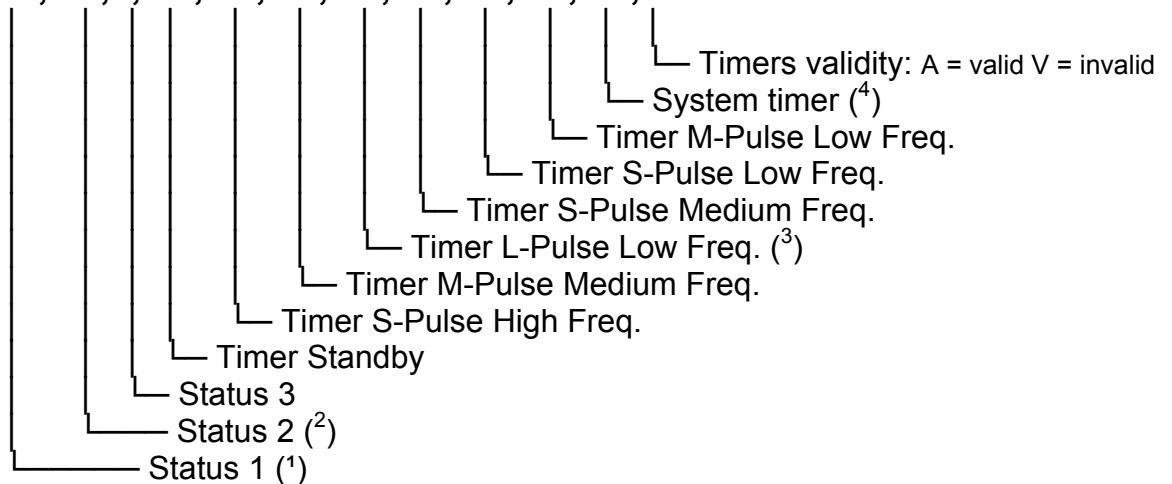
Notes:

- (1) Transceiver temperature: From -99 to 99 Celsius degree (signed value).
- (2) Warm Up time: calculated in seconds, when null becomes TXRX READY.

Value of power level, main bang and magnetron peak current during sector blanking are frozen.

2.4.3.3 TIMERS INFORMATION

\$PTIM,c--c,x.x,x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,a*hh<CR><LF>



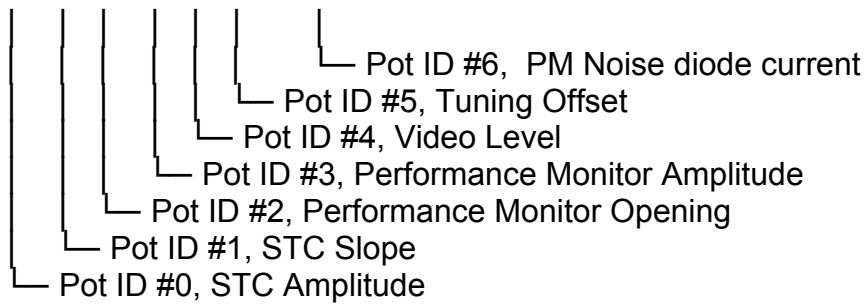
Notes:

- Status 1 (1) : Magnetron Type label
- Status 2 (2) : Integer value indicating the magnetron end of life, from 0 to 999, > 100 mean end of life.
- Status 3 : Spare

- (3)Timers : Integer value indicating the operated time. LSB is equal to 1 hour.
- (4)System : Integer value indicating lifetime of transceiver LSB is equal to 1 hour

2.4.3.4 DIGITAL POT. INFORMATION

\$PDPI,xx,xx,xx,xx,xx,xx,xx*hh<CR><LF>

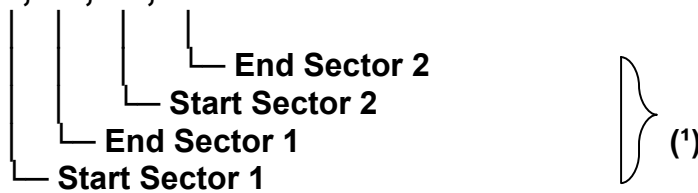


Notes:

Potentiometer decimal Value : Range 0 ÷ 99.

2.4.3.5 SECTOR BLANKING SENTENCE

\$PSE2,,x.x,x.x,x.x,x.x*hh<CR><LF>

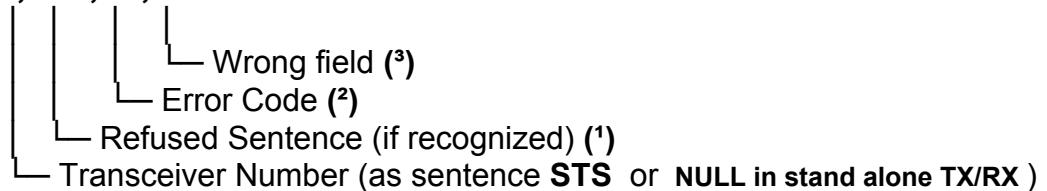


Notes:

(1) Start & End Sector units are degree. Es: 90.6.

2.4.3.6 WRONG COMMAND RETURN (NACK)

\$PNAC,x,aaa,xx,xx*hh<CR><LF>



Notes:

- (1) See list of accepted sentences
- (2) Numeric value, from 0 to 99, command dependent (see list below)
- (3) Field number. Incremental from 1 after sentence code.

Es. 1: **\$PNAC,2,COP,01,05*hh<CR><LF>**

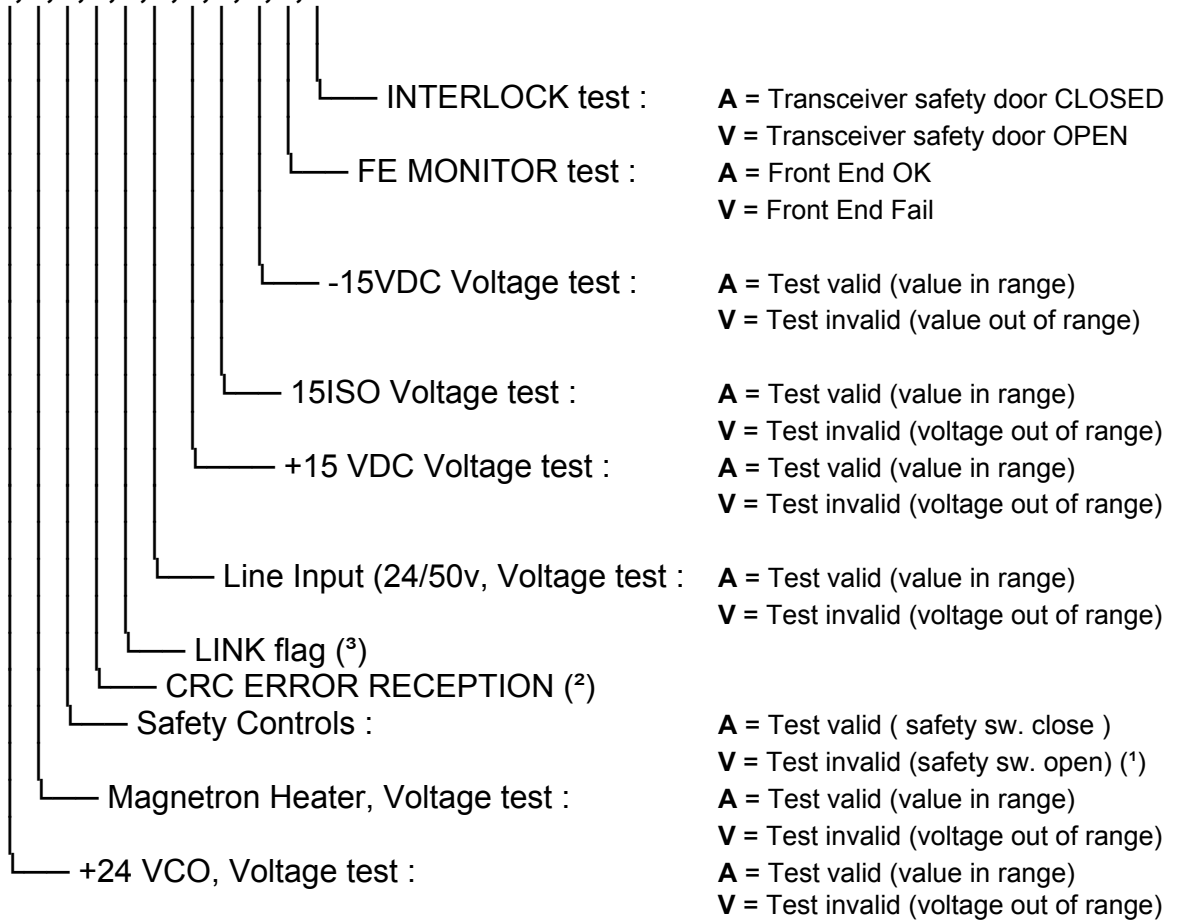
Meaning: feedback on error inside COP command for transceiver 2 through TXRX Interface, error type #01, field #05 (wrong JITTER field)

Es. 2: **\$PNAC,,COP,01,37*hh<CR><LF>**

Meaning: same feedback error directly from TXRX

2.4.3.7 HEALTH SENTENCE 2

\$PHT2,a,a,a,a,a,a,a,a,a,a,a*hh<CR><LF>



Notes:

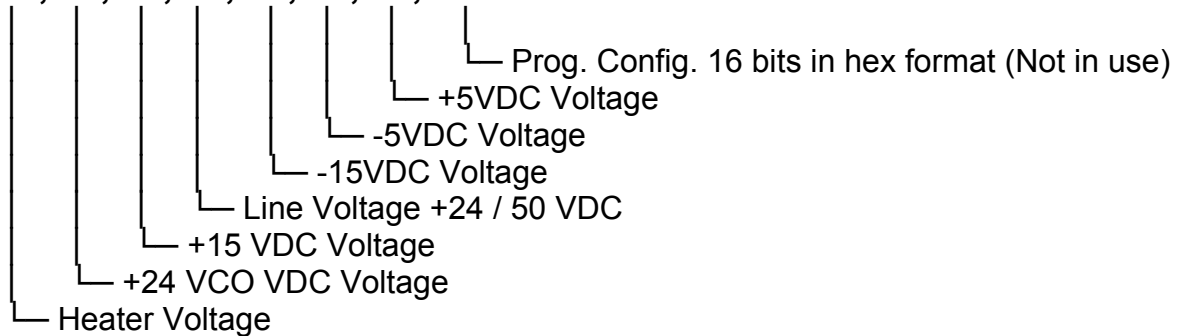
LINK flag: Valid if Rx data are received.

Invalid if Rx data are NOT received. (time-out)

CRC ER: Invalid each time a crc error in Rx data will be found.

2.4.3.8 DATA SENTENCE 3

\$PDT3,x.x,x.x,x.x,x.x,x.x,x.x,x.x,hhhh*hh<CR><LF>



Each value of voltage is integer and millivolt.

2.4.4 GENERAL NOTES

1) Rates:

Data transmission rate to **TXRX** should be:

Sentence **CO2** 1 Hz normally, or when is necessary

Sentence **SE2** when is necessary upgrade Sector Blanking

Sentence **TIM** every time is necessary timers information or reset values

Sentence **DPC** every time is necessary digital potentiometer information or value upgrade

Sentence **CFG** only for first setup

Sentence **SPD** only for first setup and when the motor controller is changed

Rate shall be not faster than 50ms between two consecutive sentences.

Data transmission rate from **TXRX** are:

Sentence **ST2** 1 Hz normally

Sentence **DAT** connection depending : 1 Hz (Interfaces) or 150ms (TXRX).

Sentences **DPI, SE2** on request

Sentences **TIM**, on request and each 30 minutes of interval after power on.

Sentence **NAC** when necessary

Sentences **HT2** 1 Hz normally

Sentences **DT3** 1 Hz normally

Sentences **CFG** on request.

Sentences **SPD** on request.

2) Error Code:

MESSAGE	ERROR CODE	MEANING
CO2	00	CRC ERROR
	01	Field not in compliance with specification
	02	Missing transceiver control
SEC	00	CRC ERROR
	01	Field not in compliance with specification
	02	Wrong sector value
TIM	00	CRC ERROR
	01	Field not in compliance with specification
	02	Missing command type
	03	Initialization value outside limits
DPC	00	CRC ERROR
	01	Field not in compliance with specification
	02	Wrong potentiometer ID
	03	Potentiometer value outside limits
CFG	00	CRC ERROR
	01	Field not in compliance with specification

CHAPTER 3

FUNCTIONAL DESCRIPTION

3.1 Introduction

The present chapter provides the functional and detailed description of the main functions and operations performed by the SRT X-BAND RADAR SYSTEM.

Functional diagrams are used to depict signal processing whilst the text is used to support diagrams as necessary for explanation purposes.

The descriptions are structured in paragraphs as described in what follows:

Paragraph 3.2 - Functional Description, provides a general functional description, functional areas identification and main interconnections among them. This allows highlighting the main functions relationship and unit performance. As a functional area it is intended a group of circuits, or other devices, which operate together to accomplish a well defined function. Each of the major functions of the unit shown in the functional block diagram (Chapter 9, Figure 9.1.7 and Figure 9.1.8) is described in details on separate functional block diagrams whose description is given as follows:

Paragraph 3.2.1 Electronics Rack

Paragraph 3.2.2 RF HEAD

Paragraph 3.2.3 Brushless Motor Controller

Paragraph 3.2.4 Motor Unit

Paragraph 3.2.5. Optional Unit: SRT Adapter Box

Paragraph 3.2.6. Optional Unit: Heater

Paragraph 3.2.7. Optional Unit: Encoder

Functional block diagrams show the development of a function from input to output in detail. Main assemblies and subassemblies (modules and cards) are shown and identified by code name and part number (P/N).

Hardware blocks are used in the signal paths to describe the processing functions performed. For a better understanding, the signal functions on circuit blocks are tagged by letters whose meanings are described in the list of abbreviations Table 1.1.1 - List of abbreviations.

Signal flows are mainly laid down from left to right and from top to bottom therefore subassemblies can be illustrated more than once to ensure logical signal flow. Signals, on functional block diagram, appear with their official code name as indicated on the manufacturer electric schematic diagrams and tabular interconnection lists.

Comments for explanation purpose on signal paths are within parenthesis; this sometimes identifies their operational accomplishment. Timing diagrams and word-code bit structure figures are also given as necessary for a better understanding of the described function. Logic terms and principles used in this technical manual comply with standard engineering practices.

Logic symbols (gates) are used, if they represent more appropriately, in a simplified form, the logic function performed even by complex parts of hardware.

Where necessary, functional description of power supplies and minor assemblies are referred to schematic diagrams.

NOTE

The schematic block diagrams of Chapter 3 show all the functions that the boards' hardware could potentially support, while the related functional description refers only to the functions implemented in the present customized configuration.

3.2 Functional Description

On the basis of the SRT X-BAND RADAR SYSTEM functional block diagram shown in Chapter 9, Figure 9.1.7, the equipment can be subdivided into the following main assemblies:

- Electronics Rack
- RF Head
- Brushless Motor Controller
- Motor Unit

There are also a number of optional functions which are also described below, as:

- The SRT Adapter Box
- Heaters
- Encoder

3.2.1 Electronics Rack

The Electronics Rack block diagram is shown in Chapter 9, Figure 9.1.7 and Figure 9.1.8. Each block represents a functional area which is described in detail in the following function of the present chapter (paragraphs 3.3 through 3.7). The blocks indicated by dotted lines represent circuits assembled on the equipment chassis.

This is concerning all the blocks diagrams of this chapter.

Basically, the unit performs the following functions:

- it generates the power supply voltages required for the unit's functioning
- it generates the R.F. pulses which will be radiated by the Antenna; the pulses, in X-band wave length (9375 \pm 30 MHz for NJRC or 9410 \pm 30 MHz for EEV Magnetrons) and with 12 (10 for EEV Magnetrons) or 25 kW peak nominal power, can be selected among the following:

Pulse Type	Duration	PRF
SHORT PULSE	nominal 60 ns	3000 Hz
MEDIUM PULSE	nominal 250 ns	1500 Hz
LONG PULSE	nominal 800 ns	750 Hz

- it receives the echoes reflected from targets and it converts and amplifies them
- it monitors the unit's correct operations

3.2.1.1 SRT Power Board

The SRT Power (Chapter 9, Figure 9.1.11) is divided into 2 units, LVPS and HVPS; it generates all the voltage sources needed by the electronics rack from the original 50 VDC (40÷60).

The SRT Power unit is equipped with protection circuits to avoid wrong polarity connection, over current and over voltage spikes. A voltage sensor is connected with microprocessor interrupt request input to provide save state function in case of voltage fall under 40 VDC and to safely perform system shut down without data loss.

3.2.1.2 SRT Power - Low Voltage Power Supply

The LVPS's function (Chapter 9, Figure 9.1.13) is to generate the low DC voltages, necessary to supply the SRT electronic circuits. As input, the circuit receives the 50 VDC voltage. This voltage filtered and stabilized by suitable solid state components in order to get as output:

- +5 V, -5 V, +15 V, - 15 V, +15V Iso, +24V to supply all the other electronic circuits
- VFIL, Magnetron Heater in accordance with selected Pulse and magnetron type.

3.2.1.3 SRT_Power - High Voltage Power Supply

The H.V.P.S. Generator Circuit's function (Chapter 9, Figure 9.1.14) is to generate the high voltage (700 V) necessary to pulse transformer and to the Magnetron for the transmission pulse generation. The signals used in this circuit are:

- 50 VDC (VMOD)
- HVON from Gate Array of SRT Control Board
- LPA (Long Pulse Adjustment), MPA (Medium Pulse Adjustment) and SPA (Short Pulse Adjustment) from Gate Array of SRT Control Board
- HVSTOP from SRT MOS board.

The H.V.P.S. starts functioning when the signal, output from the COMPARATOR, is active; the signal is active when:

- the signal HVON, from the Gate Array of SRT Control Board, is LOW; this signal is forced to high, inactive, when:
 - 3 min. period isn't yet passed since TXRX has been turned on
 - TXRX is in standby mode
 - safety switch or interlock is open.
 - +15V is $\leq 14V$ or $\geq 16V$
 - VFil (6.3V) is $\leq 5V$ or $\geq 7V$
- input voltage supply is over 40 VDC
- the signal HVSTOP is Low, which disables the functioning of the circuit when the +15 ISO voltage is absent.
- the HVPS Generator Circuit generates the correct high voltage value.

When the high voltage is generated, the COMPARATOR sends to the Gate Array of the SRT_Control board the signal HVOK and the red LED DL3 (HVOK), mounted on the SRT_Power lights-up.

The VMOD is applied to the primary of the HVPS TRANSFORMER which, driven by the MOSFET, generates as output the required high voltage (700 V).

The Mosfet enabling is controlled by a circuit, which, also protects the MOSFET, itself.

The circuit is composed by the blocks COMPARATOR, POTENTIOMETER and FLYBACK CONTROLLER. When the COMPARATOR recognizes HVON signal to be low, enables the FLYBACK CONTROLLER that in turn enables transformer Mosfet output; in the feedback loop another comparator assures that high voltage value is stable and correct. This action is performed by potentiometers and LPA, MPA and SPA signals. In this way, it is possible to control the Magnetron output power.

HVPS unit generates an additional 150 V voltage for a neon lamp performance monitor, for future use.

3.2.1.4 SRT_Mos Board

Two configurations are available one for 12 KW and one for 25 KW, the number of MOSFET transistor switched differ in these two versions.

Basically the SRT_Mos board (Chapter 9, Figure 9.1.16) performs the following main function: High Voltage Pulses generation for Magnetron.

The Pulse Circuit Generator's function is to generate the necessary high voltage supplying the Magnetron, according to the previous selections.

The Input Pushing Trigger is TRPUSH and the input Pulling Trigger is TRPULL; both from SRT_CONTROL Board. To the Pulse Circuit Generator is applied as well the 700 V from the HVPS Generator Circuit.

To one terminal of the primary windings of the PULSE TRANSFORMER is applied the 700V whilst the second terminal is connected to the MOSFET (push and pull).

The pulse is generated in accordance with TRPULL and will be pushed in accordance with TRPUSH; in fact there is current only when the Transformer is grounded with the TRPULL. Every time there is 700 V on the primary, there is, as well, 6 kV on the secondary windings of the PULSE TRANSFORMER. According with this configuration the R.F. is sent to the antenna from the Magnetron.

In order to get the best operating conditions for the Magnetron, there is also a need to energize magnetron filament with a 6.3 V Filament Voltage (voltage changes slightly depending from the magnetron installed, EEV or NJRC and 12 and 25 kW), named VFIL which is applied to a section of the secondary windings of the PULSE TRANSFORMER. As result, the signal FIL. sent to the Magnetron, has always a potential 6.3 V greater than the K potential.

While the SRT is Transmitting, the CURRENT TRANSFORMER generates the signal MCUR which:

- is used in this circuit to block high voltage to magnetron when current absorbed by magnetron is too high.
- is sent to the Gate Array of the SRT_Control Board
- is sent to the Microprocessor of the SRT_Control Board

3.2.1.5 SRT_Control Board

The SRT_CONTROL Board (Chapter 9, Figure 9.1.18) is located in the Electronic assy, and his function is to control all SRT operations.

The SRT_CONTROL Board is divided in the following main circuits

- Microprocessor and Gate Array
- System monitor
- Performance Monitor
- Input and Output Interface

3.2.1.6 Microprocessor and Gate Array

3.2.1.6.1 General Description

PCB

The heart of SRT_Control Board, is an advanced 32 Bit MCU (Micro-controller Unit) (Chapter 9, Figure 9.1.18), with highly sophisticated, on chip, peripheral capabilities and performing the function of:

- managing all functions of the SRT unit on the basis of commands/data from the Display Unit
- preparing the feed-back signals to be sent out to the Indicator unit
- executing all internal processing to assure the SRT units control and monitoring

The Microprocessor used in the board is the MCF5211 with these characteristics:

- 16 KB SRAM,
- 128 KB Flash Memory,
- Two UARTs,
- Queued serial peripheral interface (QSPI) with four peripheral chip selects,
- Four 32-bit timer channels with DMA capability,
- Four 16-bit timer channels for capture, compare and pulse width modulation (PWM),
- Four - channel 16-bit/8-channel 8-bit PWM generator,
- Two periodic interrupt timers (PITs) for alarm and countdown timing,
- Eight - channel 12-bit ADC
- System integration (PLL, SW watchdog)
- Up to 33 general-purpose I/O

The SRT unit management is performed by the Microprocessor that does not require any external PROM or RAM elements. Its own memory, in fact, has sufficient capacity to store the Operative Program. It is using an external U30 EEPROM, (Chapter 9, Figure 9.1.17 pos.7) for store transmitting parameters. The necessary clock pulse of 50 MHz generated by the crystal oscillator.

In Chapter 9, Figure 9.1.19 are displayed the Microprocessor and Gate Array general configuration, the main sub-systems and how they relate to the pins of the MCU.

3.2.1.6.2 Functions Performed

The main functions performed by the Microprocessor with the Gate Array (Chapter 9, Figure 9.1.20 and Figure 9.1.21), on the basis of commands and selections, Remote, (from Display Unit) or Local, (Through the Selector), are:

- to initialize the TXRX operations
- to generate the trigger pulse for SRT MOS Board and the trigger (TR) pulse for the Display Unit and the P.M. function
- to generate the PRESTC waveform for the RF Detector Assy (STC) and the selection commands for band-width of Receiver
- to generate:
 - . the VCO forwarded to Mixer
 - . the control signals forwarded to SRT MOS and SRT Power Boards
- to receive the signals producing the Antenna rotation
- to perform the processing on various sensor signals in order to monitor the correct operations of the TXRX unit

3.2.1.6.3 Microprocessor Output Signals

PCB

TR	Transmission Trigger.
CS0, CS1, SCK, SO	Serial Gate Array and EEprom management signals
TX	Asynchronous serial transmission
/RES	Asynchronous Reset

3.2.1.6.4 Microprocessor Input Signals

PCB

VDLEVEL	Main bang Video signal level the value is send, in serial mode, to the Display Unit
PWLEVEL	Information about the Power Level; the value is send, in serial mode, to the Display Unit
MCUR	Magnetron cathode current pulse sample the value is send, in serial mode, to the Display Unit
VFIL M	VFil Voltage value
24 VCO M	+24Vco Voltage value.
12 VT	40 to 60VDC Main Power Voltage value
15 M	+15V Voltage value.

TEMP	Temperature value; the value is send, in serial mode, to the Display Unit
+5V M	+ 5V Voltage value.
- 5V M	- 5V Voltage value.
- 15V M	- 15V Voltage value.
Monitor M	Information about the L.N.F.E. status.
AZ	Antenna azimuth pulse
HL	Antenna ship reset pulse
RX	Asynchronous serial receive
IRQ	Video data Reception/Transmission Interrupt.
NMI	Power supply line absence.
CK10	50 MHz clock
SCK, SI	Serial Gate Array management signals

3.2.1.6.5 Gate Array Input Signal

PCB

CK50	Input for the 50 MHz clock.
ANTBLK	High voltage generation and antenna rotation disabling from the Safety Switch.
SLK	High voltage generation and antenna rotation disabling from the interlock.
LINE	Main power supply voltage
HV OK	High voltage supply feedback
HV Stop	Feedback from SRT MOS board for +15Iso presence
MPLC	Magnetron transmission current.
P1 and P2	Links for the board configuration.
S1 selector	4 bit for the selector position.
TR	Transmission Trigger.
CS1, SCK, SO	Serial Gate Array management signals
TRSTC	Pre-trigger for the STC generation.
RXCOMB	Serial reception of the combined video.

3.2.1.6.6 Gate Array Output Signal

PCB

DATA BUS	Bit DB0-DB7 of the Data Bus.
NMI	Power supply line absence.
IRQ	Video data Reception/Transmission Interrupt.
CK10	10 MHz clock
CS0-CS7	Digital potentiometer chip select.
U/D, INC	Digital potentiometer control signals.
SWFIL1-2-3	Magnetron filament voltage control signals.
ANTS	Antenna switch on signal.
SPA, MPA, LPA	HVPS circuit control signals.
HVON	HVPS circuit switch on signals.
SWB1-SWB2	Signals for the control of the NIFB bands.
TRPS	Trigger PUSH for the transmission pulse generation.
TRPL	Trigger PULL for the transmission pulse generation.
/TR Out	Trigger for the display
/GSTC	Gate for the STC signal generation.
TXCOMB	Serial transmission of the combined video.
DIS TX	Disabling for the combined transmission on the video.
TUNEN and /TUNEN	Tuning detectors at transmission frequency
PM Out	
SCK, SO	Serial Gate Array management signals

3.2.1.6.7 Gate Array Pulse Length Generator

The Pulse Length Generator Function (Chapter 9, Figure 9.1.21) provides the length of the generated pulse in accordance with the previous selections.

This function is performed by the Gate Array, which generates the signals TRPS and TRPL when:

- the signal TR is active
- the signal HVOK is low
- the 50 MHz clock is present
- the signal RESET is high
- the signal LINE is true
- the signal SLK is high
- the signal ANTBLK is high
- Main Line \geq 40VDC

The signals TRPS and TRPL are applied to the DRIVER which generates the signals TRPUSH and TRPULL for the Pulse Generator circuit of the SRT_Mos Board.

3.2.1.7 System Monitor Functions

System state monitor (Chapter 9, Figure 9.1.22) is performed by this unit. Unit is composed of :

- Voltage Monitor
- Temperature Monitor
- SLK
- Safety switch

Voltage monitor performs monitoring of power supply voltage level. It receives its inputs from the Voltage sensor of the SRT_Power Board.

Temperature monitor detects temperature value to be processed by the microprocessor. In case of high value the microprocessor generates the signals for switching the fan on through the Gate Array.

SLK is a signal from switch that disables transmission and antenna rotation when the apparatus cover is open.

Safety switch disables the radar unit from hazardous power supply. The safety switch must be operated when radar unit is under maintenance to prevent high voltage hazard for operators.

3.2.1.8 Performance Monitor Functions

The Performance Monitor's function is to monitor Transmission Power, Tuning and Noise Figure in order to result in a Noise Ring presentation on PPI and for to have the peak power value on TXRX DATA.

In the related circuit there is a diode, put inside the RF Head, operating as a revelator when the magnetron send the power in output or as noise generator when the signal PM_Out is available.

When the diode is operating as revelator, it is synchronized with the transmission and the revelator circuit can detect the power present at the diode; this circuit is always activated, the measurement is made every trigger and the measured value is available on TXRX data.

When the command PMON, Performance Monitor ON, is inserted, the power value and the tuning value are arranged to change PM_Out signal parameters. The scope of this circuit is to introduce a noise ring on PPI. This noise ring change its distance by the variation of the transmitting power and its thickness by the variation of the tuning.

A neon lamp, placed in front of the Antenna, on a monitor arm extending from the antenna pedestal, powered by 150 Voltage forwarded by POWER MOS

Board, is excited at each antenna scan by the radiated RF pulse energy, any time the RF beam crosses over.

The result is, that when the Performance Monitor is switched on and the neon lamp is radiated by the Magnetron RF, the RF energy causes a current variation on neon lamp and on RM signal. A revelator circuit provides to detect this variation that interrupts the Noise Ring

This function supplies to a general verification of the output power sent out.

3.2.1.9 Input and Output interface

The Input interface of the SRT_Control board receives input signals from SRT Power, SRT MOS, RF Detector, Safety Switch, interlock and forwards them to the microprocessor and to the gate array. Signal conditioning and level shifting operation is accomplished by buffers, level translators and peak hold devices.

Azimuth (AZ-in) and Heading Line (HL-in) input signals are processed as well and forwarded to the microprocessor and the gate array (AZ, HL)

The Output interface forwards processed signals from Gate Array, RF Detector, Safety Switch and from the TX pin of the microprocessor to the Display, the RF detector and the brushless motor controller.

3.2.1.10 Azimuth (AZ) and Heading Line (HL) Signal Circuit Generator

The Antenna Unit must constantly forward its Azimuth position and Heading Line to the Display Unit. The function of this circuit (Chapter 9, Figure 9.1.30) is to process the incoming signals AZIN and HLIN and forward them to the Microprocessor the signal AZ and HL for the blanking function.

The output signal AZOUT and HLOUT are used on the Display Unit.

3.2.2 RF HEAD

The RF Head (Chapter 9, Figure 9.1.23) is composed of a solid state controlled MAGNETRON stage connected to a CIRCULATOR and ending with a flange to be connected to a waveguide in order to transfer the RF PULSE to the Antenna for it to be radiated. In the 25 kW system, there is also a Band Pass FILTER included between the magnetron and the circulator to filter out spurious frequency emissions.

The opposite end of the CIRCULATOR is fitted with the LIMITER, the RF_Amplifier (L.N.F.E + RF_Detector). L.N.F.E (Low Noise and Front End) is composed of: the IMAGE REJECTION FILTER, the LOW NOISE AMPLIFIER,

two-BALANCED MIXER and the LOCAL OSCILLATOR; RF_Detector is the final amplification stage and it is of the logarithmic kind.

The RF Head is designed to generate RF pulses in the X-Band range up to 12 or 25 kW and to receive echo from targets.

During transmission time, the MAGNETRON receives a high voltage trigger pulse, whose length (short / medium / long) is determined by the operator settings on Display, and generates high power RF pulses in the X-Band range until the high voltage pulse is applied to its cathode.

The RF energy generated is sent to the CIRCULATOR, and from this to the waveguide which delivers the energy for the radiating Antenna.

The CIRCULATOR is a 3-way microwave device used either as a RF switch or to send the transmission pulses to the Antenna or to apply the received echoes to the Receiver.

The second function carried out by the RF HEAD unit is to convert, the receiving R.F. energy, reflected from targets, into intermediate frequency, (I.F.) and amplify it. This is provided by the R.F. HEAD block mainly consisting of:

- Limiter
- Integrated RF Amplifier composed of:
 - . Low Noise Front End (Low Noise Amplifier, Mixer, LO)
 - . RF Detector

The echo signal received by the Antenna arrives, through the Limiter and the Low Noise Amplifier, to the Mixer where it is mixed with the signal forwarded by the Local Oscillator. The resulting beat is the 60 MHz IF signal which is forwarded to the RF_Detector. The Limiter is used to avoid an output above a scheduled value. A higher output would cause a short-circuit.

The Low Noise Amplifier and the Image Rejection Filter are used to amplify the echo signal in order to improve the noise figure of the receiver. The Local Oscillator is integrated directly into the LNFE. It can be tuned up to the Magnetron transmission frequency through the VCO voltage level.

The RF Detector Assy's function (Chapter 9, Figure 9.1.24 and Figure 9.1.25) is to amplify the echo signals delivered by the RF HEAD Assy. It is composed of a Group Amplifier stages, cascade connected, with specific components so to obtain a logarithmic dynamic characteristic. The central frequency is 60 MHz and the bandwidth is 1.8 MHz for Long Pulse, 4.5 MHz for Medium Pulse, 24 MHz for Short Pulse.

To maintain the target echo signals free from any possible external induction that can degrade the performance of the Unit, the DC power supply voltages and the band switching commands are applied to the module by means of a FILTER.

3.2.3 Brushless Motor Controller

Speed controller board sets brushless motor rotation speed by means of variable voltage signal VEL coming from SRT_Control Board. An enable control 5V signal is produced as well (start), for safety purpose. Turning the safety switch off results in preventing motor from rotating (Chapter 9, Figure 9.1.26).

3.2.4 Motor Unit

The Motor Unit, on which 6' and 9' and 12 'X-Band Antennas can be mounted, is equipped with an Electric Motor powered by the Brushless Motor Controller board in the casting (Chapter 9, Figure 9.1.5).

The motion is transferred to the X-BAND ANTENNA through 2 GEAR REDUCTION GROUPS, with a total reduction ratio of 60:1. Note only for 6 and 9 feet per 12 feet is 120:1. The ANTENNA nominal angular speed can be ≥ 40 rpm.

On the Antenna shaft is mounted the OPTICAL READ-OUT group that generates the pulses used to determine the Antenna position (Azimuth) and the Heading Line.

The OPTICAL READ-OUT group is composed of a disk rotating with the Antenna shaft and an optical sensor composed of two slotted optical switches. When in front of the optical sensor passes a hole of the disk, a pulse is generated by the Photo-transistor. The pulse is sent to the INTERFACE block of the Electronics Rack through the SIGNAL CONDITIONER circuit, which adapts the amplitude of the pulses from the Optical Read-out

The Heading Line pulses are obtained by means of another optical sensor, equal to the previous one, which generates a pulse when a deeper hole passes through the sensor.

On the SRT_Control board, it is applied a SAFETY SWITCH. This switch positioned outside the equipment, when open, disables, in the SRT, the power supply for the MOTOR and inhibits RF emission, thus achieving a safety condition when personnel have to operate on the equipment both for maintenance and for repairing. The wiring from the switch enters in the equipment through the smaller stuffing tube. The installation is compulsory and it is recommended to install the switch at the bottom of the mast stairs giving access to the Unit.

NOTE

Before performing any service on the Antenna, SWITCH OFF the Safety Switch.

3.2.5 Optional Equipment: SRT Adapter Box

It is possible to connect TRTX units to the Radar Display with lengths of 300 m between.

To ensure adequate signal levels at this distances the SRT Adapter Box has been introduced.

The SRT Adapter Box has the following functions:

- Ensure adequate Power supply level (of 50 V) for the TRTX even at long cable lengths. A 480W AC/DC power supply with universal input from 85VDC to 250 VDC is located on the right part of the box.
- Safety switch location to interrupt the antenna rotation during maintenance.
- The Adapter PCB within the adapter box ensures correct signal buffering and adjustment of signal levels (amplification) compensating for cable losses.
- Decode the combined video and if needed convert older types of protocol (as Mastermate) to new combined video protocol standards. The decoding logic extracts the serial data packets, the trigger and bearing signals from the combined video and translated them in standard levels (for example 232/422 for serial lines)

Figure 9.1.36 shows the SRT Adapter Box PCB layout.

LED D9 is a dual red / green LED. When red the board receives from the display unit. When green transmitting to the display unit.

LED D10 is also a dual red/ green LED . When green, there is a proper signal decoding is going on. When red, there is a parity error at decoding.

This latter LED works when the decoding function is enabled.

3.2.6 Optional Equipment: Heaters

Heaters are introduced for extreme cold environments, when the SRT Radar System is expected to operate down to -40° C. The heater system consists of cylindrical heater resistors mounted inside two cavities on the top part of the transceiver. The heaters warm the inside electronics and the gearbox.

A controller PCB stops the heating when temperature is going over 0° C and switches all the available power that is not used by the antenna rotation to the heaters.

3.2.7 Optional Equipment: Encoder

The function of the Encoder is to increase the angular resolution of the azimuth and heading signal to 1024 pulses for revolution.

CHAPTER 4 PREVENTIVE MAINTENANCE

4.1 Introduction

This chapter provides the necessary information to execute the preventive maintenance operations which must be carried out in order to ensure the SRT X-BAND Radar System's full efficiency.

The maintenance procedures are described in tabular form (Card); each card lists the operations which must be performed, their periodicity, the personnel required, the materials and the time required for their performance.

4.2 Preventive Maintenance Procedure

The preventive Maintenance procedures are given by means of cards. Each card, besides indicating the operations to be performed during the maintenance execution, lists the following indications:

- PERIODICITY: it is an alphanumeric code to identifying the maintenance action described. The following periodicity symbols, as appropriate, are used in the order of increasing periodicity interval as listed in the following:
 - . M: Monthly
 - . S: Semi-annual
 - . A: Annually
 - . WR: When Required
- PERSONNEL: it indicates the number and the typology of the personnel able to perform the maintenance operations; by making the assumption that the qualification, knowledge, experience and skill needed to fulfill the task assigned are proportional to the ranks. The following abbreviations are used:
 - . ST: is a qualified persons with not less than ten years of experience on the job
 - . JT: is a qualified person with more than four years of experience on the job
 - . R: is a young technician with less than four years of experience on the job, he can be either qualified or undergoing qualification
- REQUIRED INSTRUMENTS: it indicates the tools or the instruments which are used in the card operations; Table 4.2.1 - List of Recommended Tools and Instruments lists the tools, the instruments and the material required to perform the Preventive Maintenance operations.
- REQUIRED TIME: it indicates the total time required to perform the card operations

- SAFETY PRECAUTIONS: it indicates the precaution to be followed in order to ensure a safe Preventive Maintenance operation execution

Table 4.2.2 - List of the Preventive Maintenance Cards, for each of them, indicates the periodicity and the required time.

Table 4.2.1 - List of Recommended Tools and Instruments

Pr.	Description	Type	Note
1	Set of screwdrivers	USAG	Insulated handle or equivalent
2	Set of open wrenches	USAG	
3	Set of socket wrenches	USAG	
4	Set of socket hexagonal	USAG	
5	Set of communication tools	-	
6	30 W welders	-	
7	Electric Solder Iron		
8	Desoldering tool	SILVERSTAT	
9	Vacuum cleaner		
10	Digital multimeter	CHAUVIN ARNOUX CPA 9651 (3:5)	
11	Oscilloscope	Tektronix	

Table 4.2.2 - List of the Preventive Maintenance Cards

Card	Operation	Periodicity	Required Time
1	Check of the External Preservation Status	S1	15'
2	Internal Inspection and General Cleaning	S2	15'
3	Replacement of the Magnetron	WR1-8000 h	30'

WARNING

HIGH VOLTAGE IS PRESENT INSIDE THE UNIT. DO NOT OPEN THE CABINET COVER BEFORE THE MAIN LINE BREAKER HAS BEEN TURNED TO OFF POSITION. ALL WORK PERFORMED ON THE TXRX MUST BE RECORDED IN THE UNIT LOG BOOK.

WARNING

BEFORE STARTING ANY MAINTENANCE WORK, IT IS MANDATORY THAT, FOR THE SAFETY OF PERSONNEL, ALL HIGH-VOLTAGE CAPACITORS BE SHORT-CIRCUITED BY MEANS OF A WELL INSULATED SCREWDRIVER OR OTHER SUITABLE TOOL. BEFORE CONNECTING INSTRUMENTATION USED FOR PERFORMING MEASUREMENTS INSIDE THE UNIT, IT IS ADVISABLE TO SWITCH OFF THE POWER SUPPLY. DO NOT ALTER THE SETTING OF THE SEMIOPERATIVE CONTROLS UNLESS A SPECIFIC ADJUSTMENT IS REQUIRED AND THE NECESSARY TEST EQUIPMENT IS AVAILABLE

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CARD 1

UNIT SRT 12 KW X-BAND	OPERATION Check of external preservation status	PERIODICITY S1
PERSONNEL 1R	REQUIRED INSTRUMENTS None	REQUIRED TIME 15 minutes
<p>SAFETY PRECAUTIONS On the electric switchboard, set to OFF the Main Line Breaker relevant to the unit and hang to it a placard reading "WORK IN PROGRESS - DO NOT SWITCH ON"</p>		
STEP	SEQUENCE OF OPERATIONS	
1.	Check that no parts of the plastic covering the Antenna have been painted.	
2.	Check the casing preservation state.	
3.	Unscrew and grease the 4 fastening screws of the cover (Chapter 9, Figure 9.1.4, pos. 1) to avoid corrosion and facilitate future inspections.	
4.	If paint has been scratched off at any point, proceed as follows: <ul style="list-style-type: none"> - Carefully degrease the part to be painted - Smooth lightly with emery paper - Clean with dry brush - Apply a coat of anticorrosive - When the applied anticorrosive is dry, paint with a brush or, better still, by spraying 	
5.	On the electric switchboard, set to ON the power breaker relevant to the unit and remove the warning placard.	

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CARD 2

UNIT SRT 12 KW X-BAND	OPERATION Internal inspection and general cleaning	PERIODICITY S2
PERSONNEL 1R	REQUIRED INSTRUMENTS Set of screwdrivers, Electro Contact Cleaner, Soft brush, Primer, Paint, Emery paper, Soft cloth	REQUIRED TIME 15 minutes
SAFETY PRECAUTIONS On the electric switchboard, set to OFF the Main Line Breaker relevant to the unit and hang to it a placard reading "WORK IN PROGRESS - DO NOT SWITCH ON"		
STEP	SEQUENCE OF OPERATIONS	
1.	<u>Preliminary Operations</u> Position the Antenna as shown in Chapter 9, Figure 9.1.1.	
2.	Unscrew and remove the four screws (Chapter 9, Figure 9.1.4, pos. 1) locking the cover (pos. 2) and open the former.	
3.	<u>Internal Multipin Connectors and Cables Inspection</u> Check the conditions of each connector electric contacts (pins and plugs), connector packing and of its cable. Clean contacts by using Electro Contact Cleaner. Repair or replace, if necessary, any defective part.	
4.	<u>Mechanical Checks</u> Check the gear integrity. Add grease if the gear shows lack of lubrication.	
5.	Check, carefully, that all cabinet internal screws are not loose.	
6.	Replace or tighten firmly as necessary.	
7.	<u>General Cleaning</u> Cleaning is necessary only when layers, often dark layers, can be clearly seen on some areas. If these layers are visible, they must be removed with a dry cloth. Only if really necessary, repeat the procedure with cloth dampened in carbon tetrachloride. A special brush for cleaning, of appropriate size, may also be used. If and when necessary use an air-brush to remove dust from inside the pedestal.	
8.	By using a soft brush and alcohol, remove dust, ash and grease from the internal components.	
9.	Dry the surfaces by using a soft cloth.	
10.	By using a soft brush and alcohol, remove dust, ash and grease from the external surfaces of the cabinet.	
11.	Dry the surfaces by using a soft cloth.	
12.	<u>Final Operations</u> Close the equipment cover by following the reverse procedure.	
13.	Grease the fastening screws to avoid corrosion and facilitate future inspections and fix the cover.	
14.	On the electric switchboard, set to ON the power breaker relevant to the unit and remove the warning placard.	

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CARD 3

UNIT SRT 12 KW X-BAND	OPERATION Replacement of the Magnetron	PERIODICITY WR1 (8000 hours)
PERSONNEL 1JT	REQUIRED INSTRUMENTS Set of screwdrivers, Electric Soldering Iron, Silicone grease compound 340	REQUIRED TIME 30 minutes
SAFETY PRECAUTIONS On the electric switchboard, set to OFF the Main Line Breaker relevant to the unit and hang to it a placard reading "WORK IN PROGRESS - DO NOT SWITCH ON"		
STEP	SEQUENCE OF OPERATIONS	
	<p><u>Preliminary Operations</u></p> <p>1. Position the Antenna as shown in Chapter 9, Figure 9.1.1.</p> <p>2. Unscrew and remove the four screws (Chapter 9, Figure 9.1.4, pos. 1) locking the cover (pos. 2) and open the former.</p> <p><u>Removal</u></p> <p>3. Unscrew the 4 screws holding protection shield (Chapter 9, Figure 9.1.6, pos. 9)</p> <p>4. By means of the proper screwdriver, remove the Magnetron wires from the terminal (Chapter 9, Figure 9.1.15 pos.1) tacking note of their disposition:</p> <ul style="list-style-type: none"> • Unplug yellow and green cables loosing the 2 bolts • Unplug the yellow-green earth cable <p>5. By means of the proper screwdriver, unscrew the screws (Chapter 9, Figure 9.1.27 pos. 1 and pos. 6) fixing the Magnetron (pos. 2).</p> <p>6. Remove the Magnetron.</p> <p><u>Installation</u></p> <p>7. Before fastening the Magnetron to the proper seat, spread a layer of silicone grease on Magnetron surface which is in contact with the alloy in order to increase the Magnetron heating surface dissipation.</p> <p>8. In order to install the new Magnetron, perform the removal operations in reverse order.</p> <p><u>Calibration</u></p> <div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>WARNING</p> <p>IN ORDER TO PREVENT ANY ACCIDENTAL ROTATION OF THE ANTENNA, DISCONNECT THE MOTOR FROM THE BRUSHLESS CONTROLLER BOARD AND UNPLUG THE 5 PIN CONNECTOR.</p> </div> <p>9. On the electric switchboard, set to ON the Main Line Break relevant to the unit and remove the warning placard.</p> <p>10. Position the selector S1 of SRT_Control Board (Chapter 9, Figure 9.1.17 pos. 6) on position 2.</p> <p>11. Perform the following operations:</p> <ul style="list-style-type: none"> - on the SRT_Power board, made a link P1 (Chapter 9, Figure 9.1.10, pos. 5), - before switching on, wait for 30 minutes. <p>12. By following the procedures of display manual, perform the VCO calibration.</p> <p><u>Final Operations</u></p> <p>13. Perform the following operations:</p> <ul style="list-style-type: none"> - on the SRT_Power remove the link P1 (Chapter 9, Figure 9.1.10, pos. 5), - on SRT_Control Board, position S1 (Chapter 9, Figure 9.1.17 pos. 6) on 0 (zero). <p>14. Unlock and close the equipment cover by following the reverse procedure.</p>	

CHAPTER 5 TROUBLESHOOTING

5.1 Introduction

5.1.1 General

This chapter provides the procedures to be followed in order to locate the faulty component when a trouble arises in the SRT X-BAND RADAR SYSTEM.

5.1.2 Organization

The troubleshooting procedures are described by means of flow charts. When the faulty component is located, refer to Chapter 6 for its replacement.

5.1.3 Personnel

The personnel involved in the troubleshooting procedures must be of a skilled technician type and must have a good knowledge of the equipment.

5.1.4 Tools and Instruments

For the execution of the troubleshooting procedures, besides usual tools (screwdrivers, pliers, etc.), the following instruments are required:

Table 5.1.1- List of Recommended Instruments

Pos.	Description	Type	Note
1	Digital Multimeter	CHAUVIN ARNOUX CPA 9651 (3:5)	or equivalent
2	Oscilloscope	Tektronix	or equivalent

5.2 Troubleshooting Procedures

5.2.1 Safety Precautions

WARNING

SET THE SAFETY SWITCH TO OFF AND HANG TO IT A PLACARD READING "WORK IN PROGRESS DO NOT SWITCH ON

WARNING

OPERATE WITH CARE ON THE TXRX UNIT BECAUSE OF HIGH VOLTAGES AND HIGH POWER

5.2.2 Troubleshooting Operations

Table 5.2.1 - List Of Main Possible Failures, describes the failures that can be met during the equipment functioning. If the failure occurred is not listed, call the Manufacturer Service.

Table 5.2.1 - List Of Main Possible Failures)

TXRX does not turn on	Transmitter can't be controlled	Antenna data can't be controlled	Transmitter performance is low	Sector Blanking is not working	Antenna does not rotate	There is no current to magnetron	Transmitter does not generate RF	Antenna rotates, but rotation speed cannot be controlled	Potential Cause	Check	Remedy
x									Power supply is missing or polarity is inverted	Check DL1 Led status and measure voltage on TB2 of PCB SRT_Power	Connect the 24VDC voltage to the transmitter properly
x									Power_ON signal is missing	Close P1 link on PCB SRT_Power and make sure the Led DL2 lights on properly	Replace SRT_Control Board
x									Voltage supply is too low	Check DL1 Led Status and measure voltage on TB2 of SRT_Power Board	Connect the 24VDC voltage to the transmitter properly
x	x	x			x				BNC video cable is interrupted	Check electrical continuity and insulation from GND	
	x	x							Video signal is low	Check video signal and data signal amplitude on TP1 (VD Out) of REI 2K Board	Adjust amplitude properly
			x			x			Magnetron exhausted	Check magnetron transmission hours and current Need check on console	Replace magnetron
					x		x		The safety switch is open	Check switch position and continuity	Close the safety switch or replace it
						x	x		High voltage generator is damaged	Disconnect 700V cable from TB3 of SRT_Power Board, disconnect motor cables, turn S1 of the SRT_Control Board on position 3 and make sure DL3 is off.	Replace SRT_Power Board
		x		x					Cable between Bearing Reader and SRT_Control boards is interrupted	Check electrical continuity of the cables	Replace cable

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TXRX does not turn on	Transmitter can't be controlled	Antenna data can't be controlled	Transmitter performance is low	Sector Blanking is not working	Antenna does not rotate	There is no current to magnetron	Transmitter does not generate RF	Antenna rotates, but rotation speed cannot be controlled	Potential Cause	Check	Remedy
		x		x					Circuits are damaged	Check input and output azimuth signals on SRT_Control board	Replace the damaged board
			x						High voltage is too low	Check magnetron current and 700VDC voltage value	Adjust high voltage values on SRT_Power Board
					x				Motor power supply is missing	Check if 24VDC voltage value on Brushless Motor Controller ends is low or missing	Connect the 24VDC voltage to the controller properly
					x				Motor power supply is missing	Check Brushless if Motor Controller enable signals are missing	Replace SRT_Control Board
					x				Motor power supply is missing	Check Brushless if Motor Controller enable signals are present	Replace the Brushless Motor Controller
						x	x		Modulator is damaged	Disconnect 700V cable from TB3 of SRT_Power Board, disconnect motor cables, turn S1 of the SRT_Control Board on position 3 and make sure DL3 is off.	Replace SRT_Mos Board
								x	Brushless Motor Controller is not enabled properly	Check Brushless Motor Controller Signals	Replace SRT_Control Board

CHAPTER 6

CORRECTIVE MAINTENANCE

6.1 General

6.1.1 Introduction

This chapter provides the procedure, which must be followed in order to replace a faulty component of the SRT X-BAND transceiver according to the troubleshooting procedures of Chapter 5.

6.1.2 Safety Precautions

If not otherwise specified in the procedures, during the corrective maintenance operations, the following safety rules must be followed:

- each maintenance operation must be carried out only after the equipment switching off
- before removing any component, be sure the spare part is available
- verify the integrity of the spare part and, if possible, perform a functional test

WARNING

SET TO OFF THE MAIN BREAKER OF THE EQUIPMENT
AND HANG TO IT A PLACARD READING

<<WORK IN PROGRESS DO NOT SWITCH ON>>

6.1.3 Personnel

The replacement operations must be carried out exclusively by skilled personnel with a good knowledge of the equipment.

6.1.4 Required Tools and Instruments

To carry out the replacement operations described in this chapter, only normal workshop tools (as screwdrivers, wrenches etc.) are required.

The tools required to perform the troubleshooting operations are:

- set of screwdrivers;
- set of open wrenches;

- set of socket wrenches;
- set of hexagonal wrenches.

6.2 Corrective Maintenance Procedures

6.2.1 General

This paragraph provides a detailed description of the operations to be carried out in order to replace a damaged component Table 6.2.1 - List of Corrective Maintenance Procedures.

Table 6.2.1 - List of Corrective Maintenance Procedures

Paragraph	Component to be replaced
6.2.2	Antenna Replacement
6.2.4	Replacement of Motoreducer Assy
6.2.5	Replacement of the Brushless Motor Controller
6.2.6	Replacement of the Magnetron
6.2.7	Replacement of the RF_Amplifier Assy
6.2.8	Removal / Installation of Electronics Assy
6.2.9	Replacement of the Bearing Reader Board

6.2.2 Antenna Replacement

a) Required Tools

- Set of open wrenches
- Set of screwdrivers

b) Removal

1. By means of the proper open wrench, loose and remove the screws (Chapter 9, Figure 9.1.2, pos. 6) fixing the external Waveguide of the Antenna (pos. 3) to the Pedestal
2. Using the proper open wrench, loose and remove the bolts (pos. 1) fixing the Antenna (pos. 3) to the Pedestal (pos. 2)
3. Remove the Antenna from the Pedestal, paying attention not to damage the Antenna Waveguide

c) Installation

1. Check for the integrity of the new Antenna
2. In order to install the Antenna, perform the removal operations in reverse order

6.2.3 Opening/Closing of the TXRX Cover

a) Required Tools

- Set of hexagonal wrenches

b) Opening

1. On the electric switch board, set to OFF the Main Line Breaker relevant to the unit and hang to it a placard reading "WORK IN PROGRESS - DO NOT SWITCH ON"
2. By hands, rotate the Antenna (Chapter 9, Figure 9.1.2 pos. 3) orthogonally with respect to the cover opening direction as shown in Chapter 9, Figure 9.1.1
3. Unscrew the four screws (Chapter 9, Figure 9.1.4 pos. 1) locking the cover (pos. 2) and open the former

c) Closing

1. Check for the integrity of the cover seal (pos. 3) and eventually replace it
2. Unlock the cover by releasing the locking device and close the cover
3. Grease the fastening screws and fix the cover
4. On the electric switchboard, set to ON the power breaker relevant to the unit and remove the warning placard

6.2.4 Replacement of the Motoreducer Assy

a) Required Tools

- set of hexagonal wrenches

b) Removal

1. By following the procedures of paragraph 6.2.3, open the TXRX the Cover. Take note of connections displacement in order to be able to reconnect the cables in the proper positions. Unscrew contacts and power supply from brushless motor driver.
2. Holding the Motor with the Gear Reduction Group, remove the 4 screws (Chapter 9, Figure 9.1.5, pos. 4) fixing the group (pos.1 + pos. 2) to the support and remove the group

c) Installation

1. Check for the integrity of the new Motor Group with the Gear Reduction Group
2. In order to install the Motor Group with the Gear Reduction Group, perform the removal operations in

reverse order

6.2.5 Replacement of the Brushless Motor Controller

a) Required Tools

- Set of screwdrivers;
- Set of hexagonal wrenches.

b) Removal

1. By following the procedures of paragraph 6.2.3, open the TXRX Cover
2. Disconnect the Brushless Motor Controller (Chapter 9, Figure 9.1.4 pos. 5) cables, taking note of their disposition
3. By means of the proper socket wrench, unscrew the 4 screws (pos. 10) fixing the Brushless Motor Controller to the mechanical frame
4. Remove the Brushless Motor Controller.

c) Installation

1. Check for the integrity of the new Brushless Motor Controller
2. In order to install the Brushless Motor Controller, perform the removal operations in reverse order without closing the cover
4. Close the cover following the procedures of paragraph 6.2.3

6.2.6 Replacement of the Magnetron

a) Required Tools

- Set of screwdrivers,
- Set of open wrenches,
- Set of hexagonal wrenches,
- Silicone grease compound 340.

b) Removal

1. By following the procedures of paragraph 6.2.3, open the TXRX Cover
2. Unscrew the 4 screws holding protection shield (Chapter 9, Figure 9.1.6, pos. 9)
3. Unplug yellow and green cables loosing the 2 bolts
4. Unplug the yellow-green earth cable

5. By means of the proper screwdriver, unscrew the screws (Chapter 9, Figure 9.1.27 pos. 1 and pos. 6) and remove the Magnetron (pos. 2).

c) Installation

6. Before fastening the Magnetron to the proper seat, spread a layer of silicone grease on Magnetron surface which is in contact with the alloy in order to increase the Magnetron heating surface dissipation.
7. In order to install the new Magnetron, perform the removal operations in reverse order
8. IN ORDER TO PREVENT ANY ACCIDENTAL ROTATION OF THE ANTENNA, DISCONNECT THE MOTOR FROM THE BRUSHLESS CONTROLLER BOARD AND UNPLUG THE 5 PIN CONNECTOR.
9. On the electric switchboard, set to ON the Main Line Break relevant to the unit and remove the warning placard.
10. Position the selector S1 of SRT_Control Board (Chapter 9, Figure 9.1.17 pos. 6) on position 2.
11. On the SRT_Power board, made a link P1 (Chapter 9, Figure 9.1.10, pos. 5)

before switching on, wait for 30 minutes.

12. By following the procedures of display manual, perform the VCO calibration.
13. Perform the following operations:
 - on the SRT_Power remove the link P1 (Chapter 9, Figure 9.1.10, pos. 5),
 - on SRT_Control Board, position S1 (Chapter 9, Figure 9.1.17 pos. 6) on 0 (zero).
14. Unlock and close the equipment cover by following the reverse procedure.

6.2.7 Replacement of the RF Front End Assy

a) Required Tools

- Set of screwdrivers,
- Set of open wrenches,
- Set of hexagonal wrenches,

b) Removal

1. By following the procedures of paragraph 6.2.3, open the TXRX Cover
2. Disconnect the RF_Amplifier Assy (Chapter 9, Figure 9.1.28, pos. 1) cabling, taking note of its disposition.
3. By means of the proper screwdrivers, unscrew the 4 screws (pos. 2)

c) Installation

1. Check for the integrity of the new RF_Detector Assy
2. In order to install the RF_Detector Assy, perform the removal operations in reverse order without closing the Pedestal cover
3. By following the procedures of display manual, perform the VCO calibration
4. Close the Pedestal cover following the procedures of paragraph 6.2.3

6.2.8 Removal/Installation of the Electronics Assy

a) Required Tools

- Set of screwdrivers,
- Set of open wrenches,
- Set of hexagonal wrenches,

b) Removal

1. By performing the operations of paragraph 6.2.3, open the SRT cover
2. Unscrew the 4 screws holding protection shield (Chapter 9, Figure 9.1.6, pos. 9)
3. Remove the Electronics Rack cabling connectors, taking note of their position. Table 6.2.2 - Connectors of the Electronics Rack describes connectors to be removed and their position in the Pedestal Unit.
4. By means of the proper screwdriver, unscrew the four screws (Chapter 9, Figure 9.1.29, pos. 1) fixing the Electronics Rack to the SRT cover.
5. Extract the Electronics Rack from the cover paying attention to the cables and to the Waveguide joint Chapter 9, Figure 9.1.31, pos. 1)

c) Installation

1. Before installing the new electronics assy, remove the EEPROM U30 from the SRT_Control Board of the old Electronics Rack and replace it in the SRT_Control Board of the new one. If this operation is skipped, then the unit must be set up manually from blank to recover values and settings stored in the old board EEPROM.
2. In order to install the Electronics Rack, perform the Removal operations in reverse order

Table 6.2.2 - Connectors of the Electronics Rack

Board	Connector	Purpose
SRT_Control	J4	BNC, Video Signal output
SRT_Control	P2	Terminal board for the signal to/from the Display Unit
SRT_Control	TB1	Safety Switch input
SRT_Control	J12	Cable for the Optical Read-Out connection
SRT_Control	J1	Small BNC, Video Signal input
SRT_Control	J2	Small BNC, Tune Signal input
SRT_Control	P1	RF_Amplifier controls
SRT_Control	TB3	Terminal Board for the Brushless Motor Controller
SRT_Power	TB2	Main Power input
SRT_Mos	A – K – Fil	Magnetron terminals

WARNING

WHEN THE ELECTRONICS RACK IS INSERTED ON THE FIXING BOLTS PAY A LOT OF ATTENTION NOT TO DAMAGE THE WAVEGUIDE JOINT (Chapter 9, Figure 9.1.31, pos. 1)

6.2.9 Replacement of the Bearing Reader Board

a) Required Tools

- Set of screwdrivers,
- Set of open wrenches,
- Set of hexagonal wrenches,

b) Removal

1. By following the procedures of paragraph 6.2.3, open the TXRX the Cover
2. Disconnect the Bearing Reader Board cables (Chapter 9, Figure 9.1.30, pos. 2).
3. By means of the proper screwdriver, unscrew the 2 screws (pos. 1) fixing the Bearing Reader mechanical frame
4. Remove the Bearing Reader Board

c) Installation

1. Check for the integrity of the new Bearing Reader Board
2. In order to install the Bearing Reader Board, perform the removal operations in reverse order

CHAPTER 7

PART LIST

7.1 Introduction

This chapter provides the list of the SRT 12/25 KW X-BAND replaceable parts.

7.1.1 Part List

The parts' list is divided into major assemblies. All parts attached to the assemblies are listed in Part List Tables. The Parts' List Tables consist of eight columns as follows:

- Column 1: POS. (Position): the column reports the replaceable parts position in the reference figure
- Column 2: DESCRIPTION: the column includes the descriptive identification data of the replaceable part
- Column 3: SPECIFICATION NUMBER OR TYPE: the column reports the specification number or the type of the replaceable part assigned by the supplier
- Column 4: REQUIRED QUANTITY (N): the column indicates, for each replaceable part, how many of them are assembled on the equipment

7.1.2 Part Location Illustration

Figures of Chapter 9 provide the location of the components. The position numbers of the items shown in the figure are referenced in the related Part List Tables.

7.2 Part List Tables

Table 7.2.1- List Of Items Of Chapter 9

FIG./POS.	Description	Drawing Specification Number or Type	Required Quantity (N)
Figure 9.1.2	6' Antenna X-Band	304465G1	1
"	9' Antenna X-Band	304465G2	1
"	12' Antenna X-Band	304465G3	1
Figure 9.1.5	Motoreducer assy for 6/9' antennas	304280A2	1
Figure 9.1.5	Motoreducer assy for 12 antenna	TBD	1
Figure 9.1.4, pos.5	Brushless motor driver	304427A1	1
Figure 9.1.27, pos.2	X Band Magnetron 12 KW	89A504P024	1
"	X Band Magnetron 25 KW	89A504P023	1
Figure 9.1.28	RF Amplifier assy	304214A1	1
Figure 9.1.6	Main electronics assy 12 KW	304212A2	1
"	Main electronics assy 25 KW	304212A3	1
Figure 9.1.2	Performance Monitor Arm	304316A1	1

CHAPTER 8 INSTALLATION

X-Band Antenna Group including 6 or 9 12 feet Antenna and Pedestal with 12 / 25 kW Transceiver up-mast

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8.1 Introduction

This chapter of the Technical manual can be used as a self-contained Installation Manual for the SRT X-Band Radar System including 6 or 9 12 feet Antenna and Pedestal with 12kW or 25 kW Transceiver up-mast. It contains necessary information, pictures and drawings to handle, assemble and install this unit as a part of the complete Radar Equipment. Actions how to prepare this unit for the Radar Equipment Setup Procedure are also described.

8.1.1 Shipping

Following general rules apply:

- Inspection for damage during transport
- When the unit(s) arrives at destination, inspection should be performed immediately to register any damage that may have occurred during transfer
- The customer is normally responsible for insurance during the transportation. If any damage is found, both the insurance company and the shipping agent must be informed immediately

8.1.2 Unpacking

The unit parts are placed in cardboard boxes covered with a plastic sheet. Each box includes a protecting polyurethane box shaped for the contained parts.

- The following rules should be observed:
- Units must be transferred on board still packed into their boxes

When the units are removed from their boxes they must be left in their protective plastic cover until installation

It is advisable to keep the packing material for possible future use the plastic sheet in which the unit is wrapped can be used to protect it during installation and maintenance procedures.

In addition to the various main parts forming the unit (see par. 8.3.2 below) there is further material included in the delivery. Those additional things are:

- Technical Manual with Installation Manual included
- Installation Kit (Terminals, clamps, connectors etc.)
- Standard Spare Part Kit (Fuses etc.)

The Installation Kit and the Spare Part Kit is necessary for the installation and operation of the equipment, and must be kept by them who perform the installation work. Contents of the Kits should be checked immediately after unpacking, using the materials list contained in the box. The manufacturer will not accept claims for missing items unless presented immediately after unpacking.

8.1.3 Storage

After the material contained in the boxes has been inspected in the presence of customer and it has been verified that no damage has occurred, the unit shall be stored in its original packing until the time of installation. The storage premises must be dry and well protected.

If the units must be kept in storage for more than one month, it is advisable to insert hygroscope substances, such as silicon gel salts, in the crates. See par. 8.2 Specification, (Environmental Conditions)

8.1.4 Handling

The antenna and the pedestal must be run up the mast separately and then assembled.

The pedestal is lifted by crane. Use slings attached to the eyebolts fitted on top of the pedestal.

Minimum angle at the base is 60°. See Figure 1 (Lifting by crane)

The pedestal contains delicate electronic components - handle accordingly.

The antenna surface is sensitive to impacts and pressure. Any deformation of the antenna surface can reduce the radar performance. Lift the antenna in slings, carefully preventing it from slipping.

8.2 Specifications

8.2.1 Dimensions and weights (Also See Out-line Drawings)

Length	534 mm
Width	364 mm
Height	391 mm
Weight with 6 ft antenna	35 + 5 kg
Weight with 9 ft antenna	35 + 9 kg
Weight with 12 ft antenna	35 + 14 kg
Swing circle with 6 ft antenna	1800 mm
Swing circle with 9 ft antenna	2650 mm
Swing circle with 12 ft antenna	3620 mm

8.2.2 Required power

Standard configuration	115-220 V / 50-60 HZ
Peak Power consumption 12 kW /25 kW under 100 KN winds	250 W / 380 W
Medium Power consumption (from minimum configuration 12KW / 6X to 25KW / 9X HSC	75 W /130 W

8.2.3 Environmental Data

Operating temperature	-25°C / +55°C Note: With Heater -40°C
Storage temperature	-25°C / +70°C
Relative humidity	Up to 95% at +40°C
Water resistance, Salt spray, Vibrations etc	As per IEC 60945

8.3 Installation

8.3.1 Installation Principles

In order to obtain the best radar performance and accessibility, the following precautions should be used:

- Space for the antenna to swing freely. See par.8.2 (Specifications; Antenna type)
- Safety and easy access for maintenance purposes. It is preferable to use a platform on the ship mast.
- Figure 2 (Suggested Masthead Antenna mounting)
- The antenna to be accessible in all directions
- Avoid exposure to exhaust fumes from the funnel
- Avoid strong vibrations
- Avoid interference between two antennas
- Avoid obstacles in the radar beam, especially ahead of athwart ships directions

If two radar sets are installed, their antennas should be installed on different levels.

The antennas can be mounted, either on a single mast construction, so they are on top of each-other, as illustrated in Figure 2 (Suggested Masthead Antenna mounting) or the antennas can be mounted on a platform, Figure 3 (Suggested Antenna mounting), one on portside and one on starboard side.

The following formula and drawing, as illustrated in Figure 4 (Antenna Positions), will help you to determine the correct distance and height between the two radar antennas. The 45° angle on the drawing is the actual vertical beam-width with a safety margin included.

Example:

“ $H = L$ ”,

H = height between the two antennas

L = the distance between the two antennas

If the distance L is 6m, then the height should be = 6m.

Blind sectors towards the bow and within a few degrees on port and/or starboard side caused by the structure of the ship must be avoided with great care. In case of a blind sector at the bow in mid-ships' position, it is advisable to mount the antennas on the starboard side of the ships' keel-line.

When obstacles are sufficiently far from the antenna, they will result in a blind sector on the radar display with approximately the same amplitude as observed by the human eye, but these obstacles can produce false echoes. An echo produced by an obstacle close to the antenna, can be suppressed by reflecting the antenna-beam skywards by mounting a reflector made of metal, as also illustrated in Figure 2 (Suggested Masthead Antenna mounting). This solution

however does not eliminate the blind sector, but will reduce false echoes produced by the obstacle. The best position for the reflector can be found by testing out different positions.

It is highly recommended that the shipyard submit the drawings of the radar antenna position(s) to the manufacturer for approval.

The Installation consists of following basic steps:

- Mount the Unit without the Antenna on the mast
- Make relevant connector
- Install and connect the Performance Monitor (optional) arm
- Install the Safety Switch
- Mount the Antenna on the Unit

NOTE

The transceiver should be installed in such way that the performance monitor arm is not facing funnels or other big ships obstruction. Sector blanking is enabled to prevent false echoes caused by funnels and/or big ships construction (see above). If performance monitor arm is positioned, within this blanking area, the pedestal must be turned because the radar performance monitor is not working where there is no transmission in the sector of its sensor

Installation of Safety Switch CHANGE: IT IS ON THE DC CORE OR ADAPTER BOX OR OPTIONAL FOR THE ADAPTER BOX EXTERNAL is compulsory. It is recommended to be installed at the bottom of the stairs giving access to the Antenna Pedestal. The waterproof switch is supplied by manufacturer, but a connection cable (2x2,5mm²) should be provided by the shipyard.

The Antenna Group must be covered by plastic sheet during any painting performed after the installation.

NOTE

In no case, the Antenna shall be used to hoist the Pedestal up the mast

8.3.2 Mechanical installation

The SRT consists of following units and type designations:

Pedestal with 12/25 kW transceiver	SRT/xx
6 feet antenna	ANT6X-001
9 feet antenna	ANT9X-001
12 feet antenna	ANT12X-001
Safety switch (optional, always included in DC-CORE or SRT ADAPTER BOX)	

8.3.2.1 Unit (pedestal + transceiver)

Prepare the platform for mounting of the pedestal, with its built in transceiver. Hole diameters and distances is evident from Figure 5 (Dimensions Drawing).

The pedestal should be mounted with its lid hinges pointed forward and cable glands pointed astern. However the antenna swinging plane must be horizontal in all directions when ship is upright on even keel. Consider giving ample space for service, especially astern of the antenna group. If such space can not be achieved, contact manufacturer for installation alternatives.

NOTE

The protection waveguide covers on the antenna and pedestal must not be removed until when mounting the antenna. Anyhow the waveguide joints may not be uncovered when the antenna is not mounted.

NOTE

The fixing materials to fasten the antenna pedestal to the ship's platform are not provided by the manufacturer. Assuming a platform plate thickness of 20 mm, four M10 stainless steel bolts of 65 mm length, with relative nuts grooves and washers, must be used. The tightening couple is 44 Nm.

8.3.2.2 Antenna

The antenna and the unit must be run up the mast separately and then assembled. The TXRX should not be lifted with the antenna already mounted.

The mounting procedure of the antenna to the pedestal consists of following steps:

- Remove the waveguide protections on the antenna and pedestal.
- Mount the antenna over its support, check that the waveguide connections are on the same side. The antenna assumes the right position following two reference plugs.
- Rest the antenna on the pedestal and tighten the 4 bolts holding the antenna (Chapter 9, Figure 9.1.2 pos. 1). The tightening couple is 22 Nm

8.3.2.3 Safety Switch (External is optional)

Usually the safety switch is located on the Radar Display DCORE or the optional SRT adapter Box.

Installation of safety switch is compulsory. The optional safety switch can be supplied by the manufacturer.

It is recommended to place the safety switch at the bottom of the stairs that are giving access to the radar mast. The switch must be mounted with the cable glands pointing down. Connect the cable as described in 8.3.3 Electrical installation.

8.3.2.4 Performance Monitor Arm

To install the P.M. Arm proceed as follows:

- Connect the P.M. Arm for the radiation monitor on the SRT. The arm shall be angled upwards

8.3.3 Electrical installation

The electrical installation of the SRT consists of cabling and connection to terminals, Figure 6 (SRT schematic blocks), as described below:

8.3.3.1 Multicore Cable

Also see par. 8.5 (Multicore Cabling and Termination Principles)

NOTE

Use the installation materials for the Multicore cable which are delivered by the manufacturer to ensure proper connection

Normally the cable (4 twisted pair + 2 Coax + 8 wire), P/N 55X456P001, is delivered to a length of 30m. The Multicore cable includes wires for Power, Video, Trigger and Antenna data. It is therefore required to handle these cables with particular care.

The SRT unit end of the multi-core cable shall be connected to the Main Connector see Figure 7 and Figure 8.

8.3.3.2 Safety Switch

The safety switch is supplied by the manufacturer. Cable from the safety switch to the Core is not included.

- Check the Safety Switch is placed as described in par. 8.3.2 Mechanical Installation
- Connect the two poles of the safety switch, on TB1 of SELUX display Core
- The cable gland not used must be properly sealed
- Carefully make sure that the switch is closed in “1” (On) position and open in “0” (Off) position

8.3.3.3 Grounding

Connect a tinned braided copper wire (>25mm²) between the GROUND TERMINAL on the SRT and the radar mast.

8.3.4 Pre Setup Procedures

This paragraph provides information concerning the preliminary controls and procedures to be done as a completion of the electrical installation and before supplying the unit with power and before performing the System Setup

Procedure:

NOTE

Powering the Radar System is not included in the Pre Setup Procedure

- Carry out a careful visual inspection of the installed components referring to the layouts of the unit and to the interconnection drawings
- Carefully check the integrity of the fuses

NOTE

Powering the Radar System is not included in the Pre Setup Procedure

8.3.4.1 Ship power Voltage

- The unit must be connected to ship main voltage through the Radar display console DC-CORE or through the SRT adapter box.
- Cable section shall be $\geq 4\text{mm}$ to support a 15A current.

8.3.4.2 Compass Safe Distance

Every unit should be located outside the minimum magnetic compass safe distance according to the following table:

Unit	Unit type	Safe distance to the standard magnetic compass (m)	Safe distance to the steering magnetic compass (m)	Reduced Safe distance to the standard magnetic compass (m)	Reduced Safe distance to the steering magnetic compass (m)
12.5 or 25 kW X-Band SRT Transceiver	SRTX/12-002 SRT/12-003 or SRTX/25-002 SRT/25-003	1.35	0.85	0.85	0.55
SRT Adapter Box	SRTAB-001	1.20	0.50	0.75	0.30

8.4 Installation figures and Drawings

The following figures and drawings are included after this page:

Figure 1 (Lifting by crane)

Figure 2 (Suggested Masthead Antenna mounting)

Figure 3 (Suggested Antenna mounting)

Figure 4 (Antenna Positions)

Figure 5 (Dimensions Drawing)

Figure 6 (SRT schematic blocks)

Figure 7 (Main Connector Drawing)

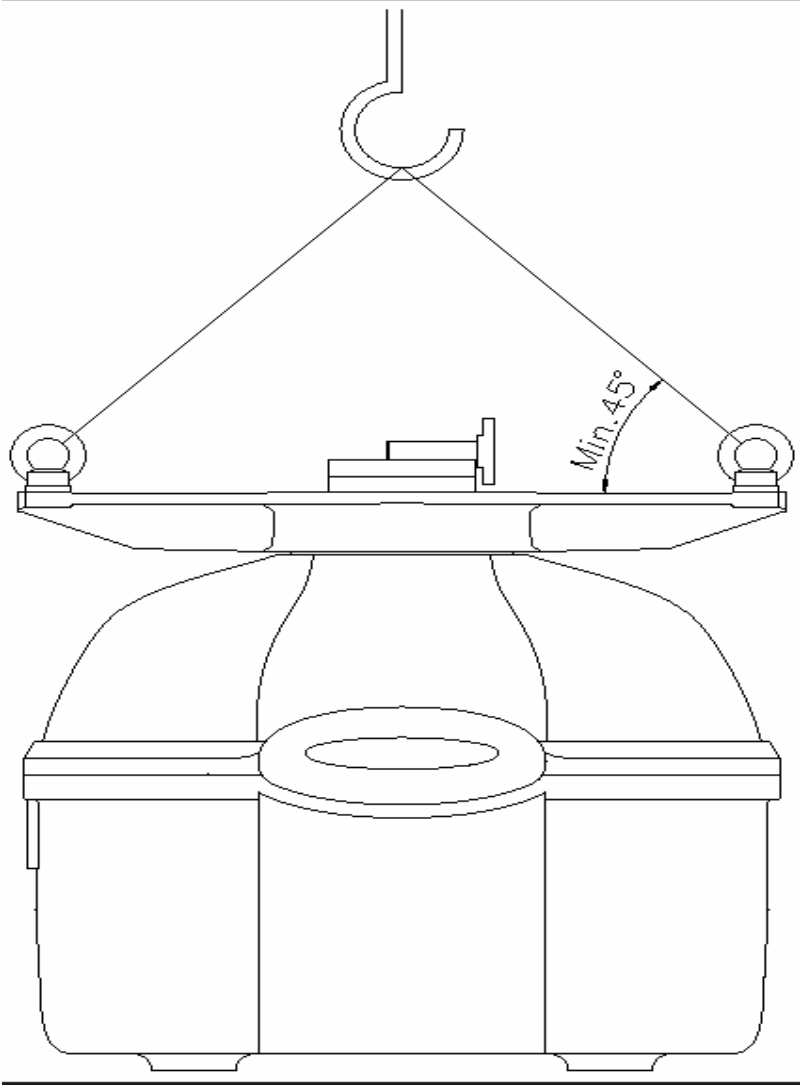
Figure 8 (Cable termination)

Figure 9 (SRT Control boards Drawing)

Figure 10 (SRT Control board - service switch)

Figure 11 (Safety Switch Drawing)

Fig 1 Lifting by crane



WARNING Never pass or stay under any lifted object.

Fig 2 Suggested Masthead Antenna mounting

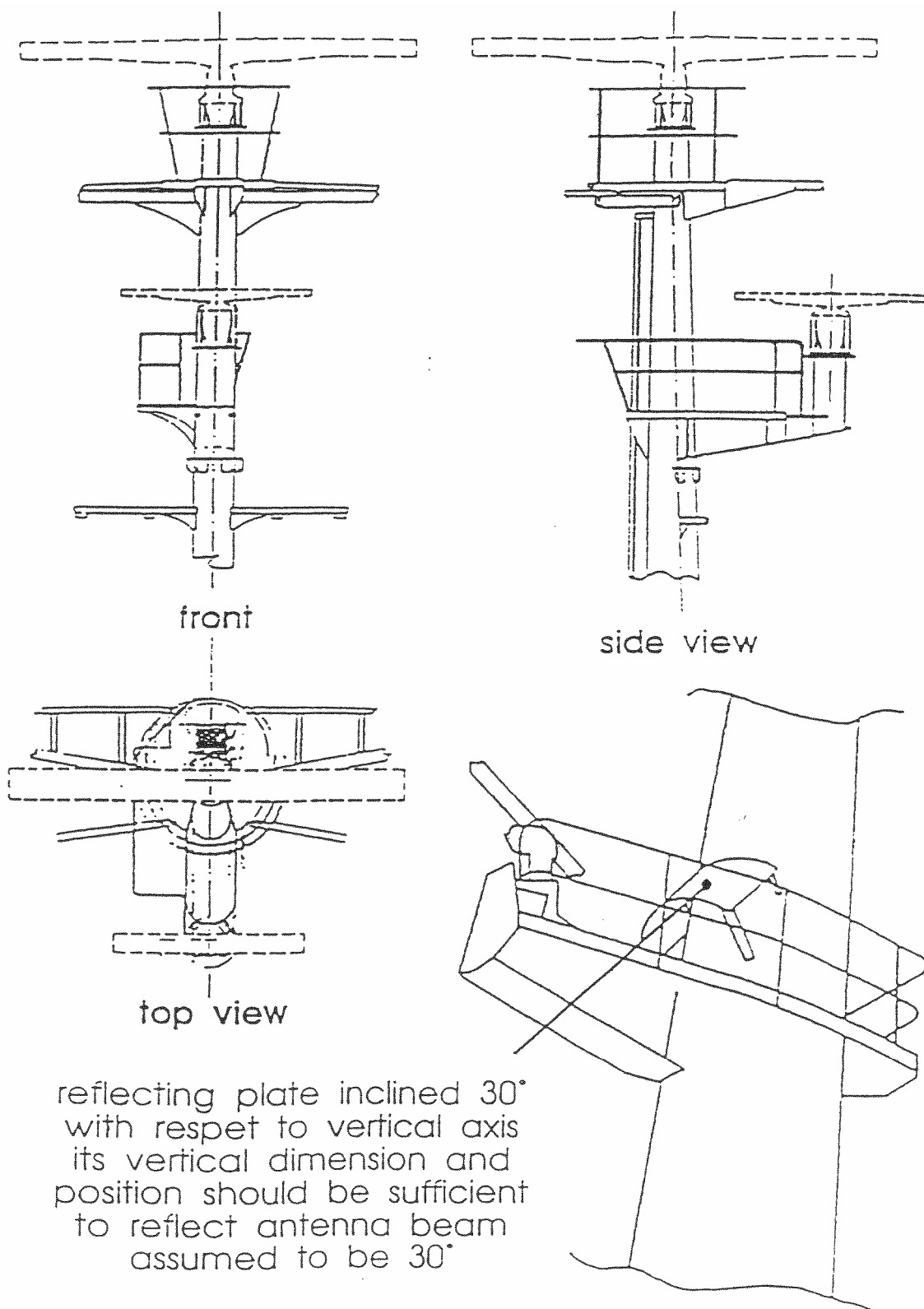
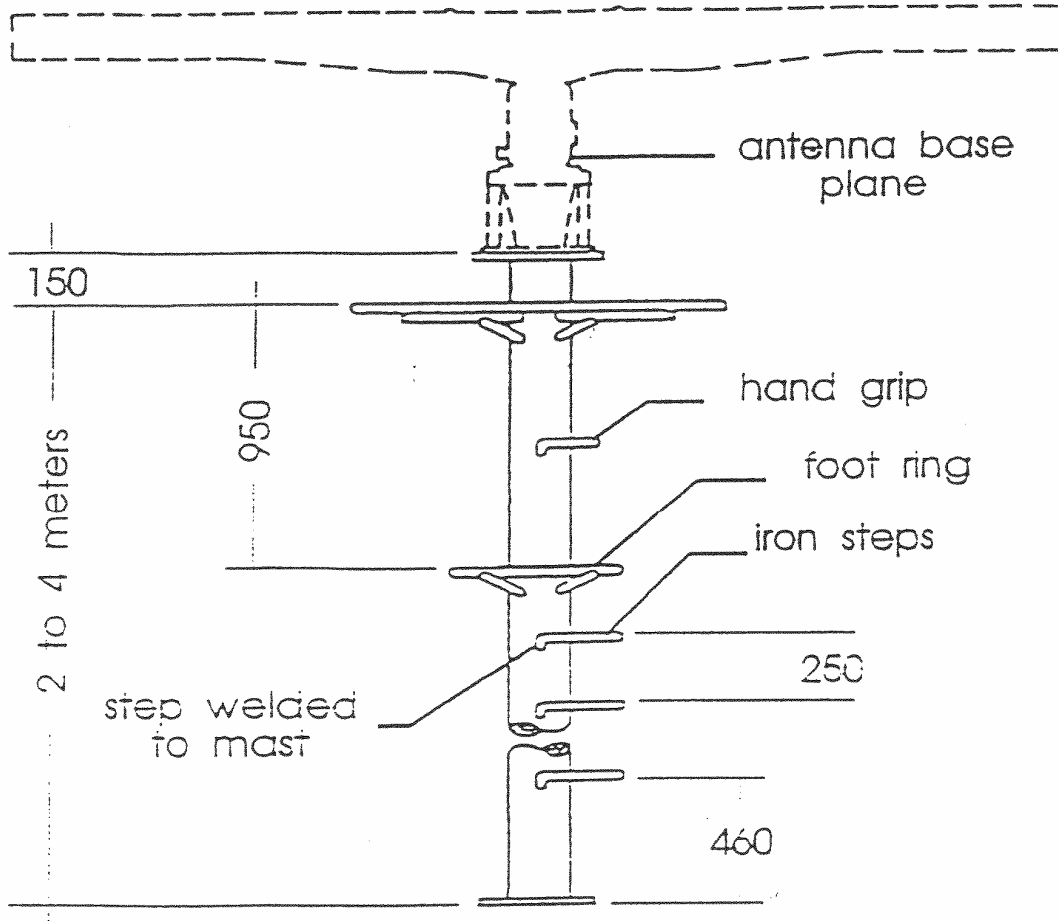
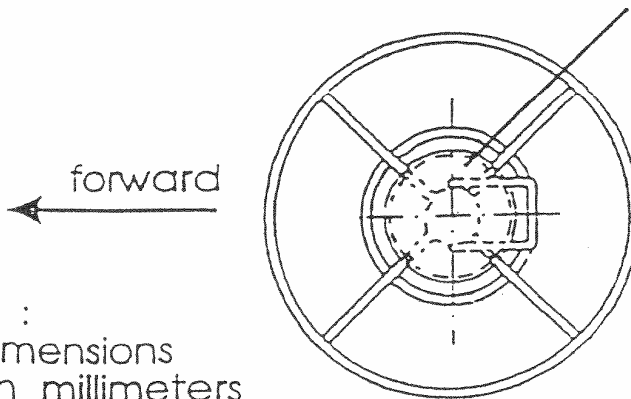


Fig 3 Suggested Antenna mounting

SUGGESTED ANTENNA MOUNTING :



for location of holes see
outline drawing relative
to each antenna unit



NOTE :
all dimensions
are in millimeters

NOTE :
this type of pole
mast with safety
rings should only
be used for
heights up to
4 meters

Fig 4 Antenna Positions

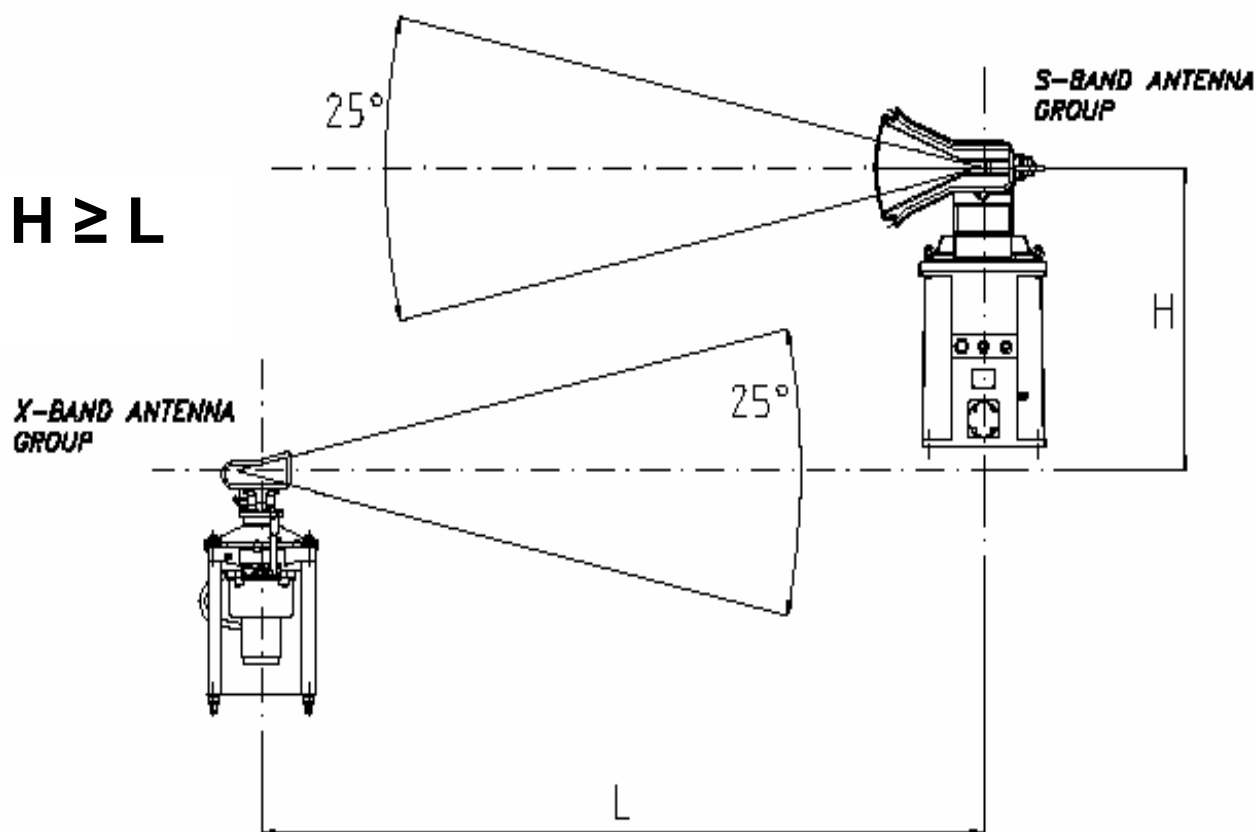
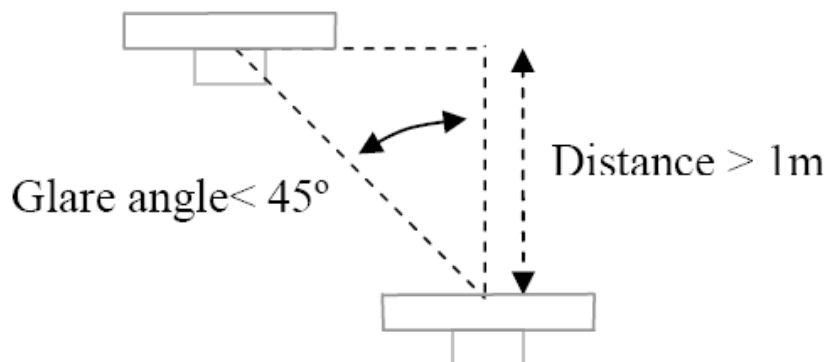


Fig 5 Dimension drawing

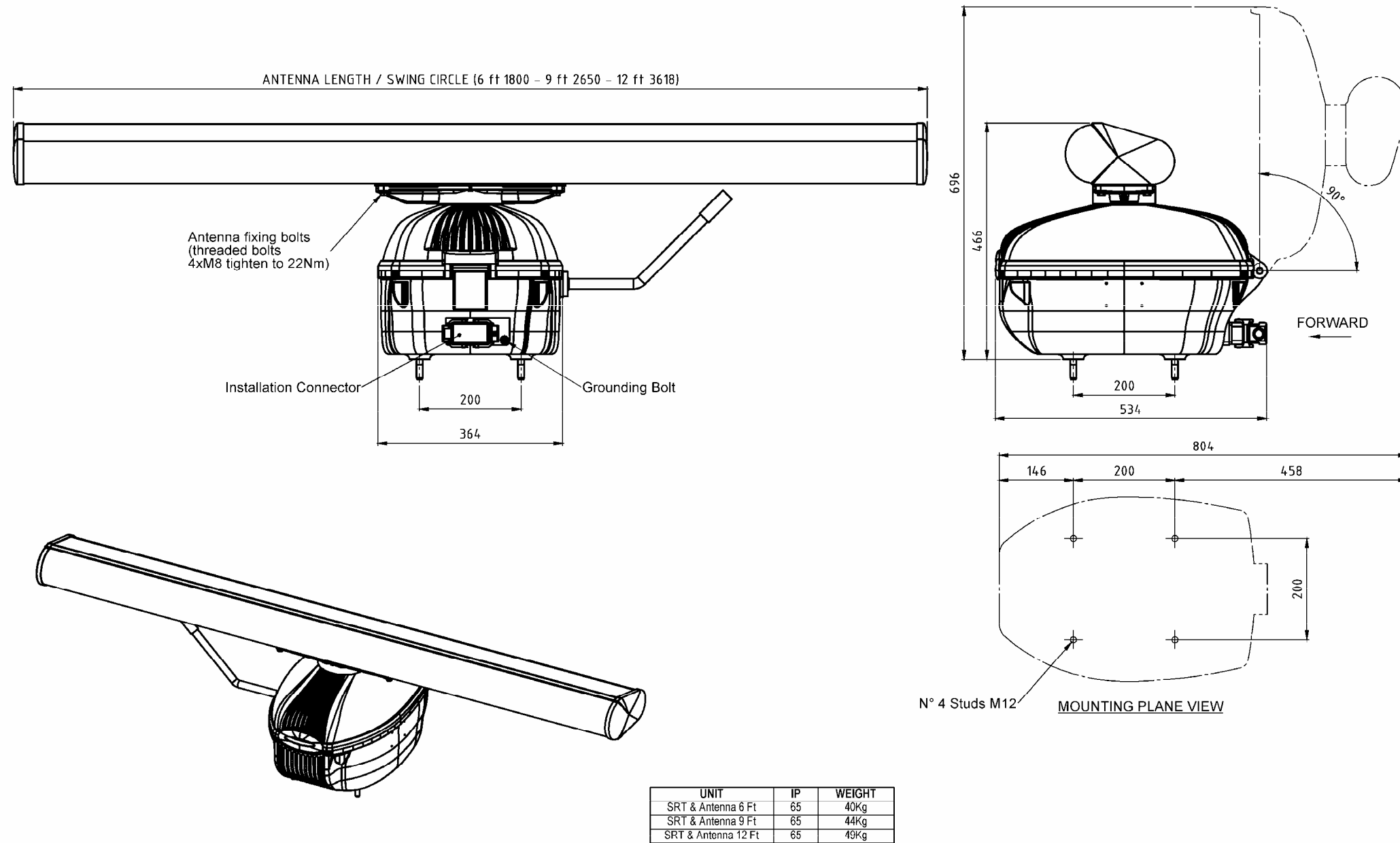


Fig 6 SRT Schematic blocks

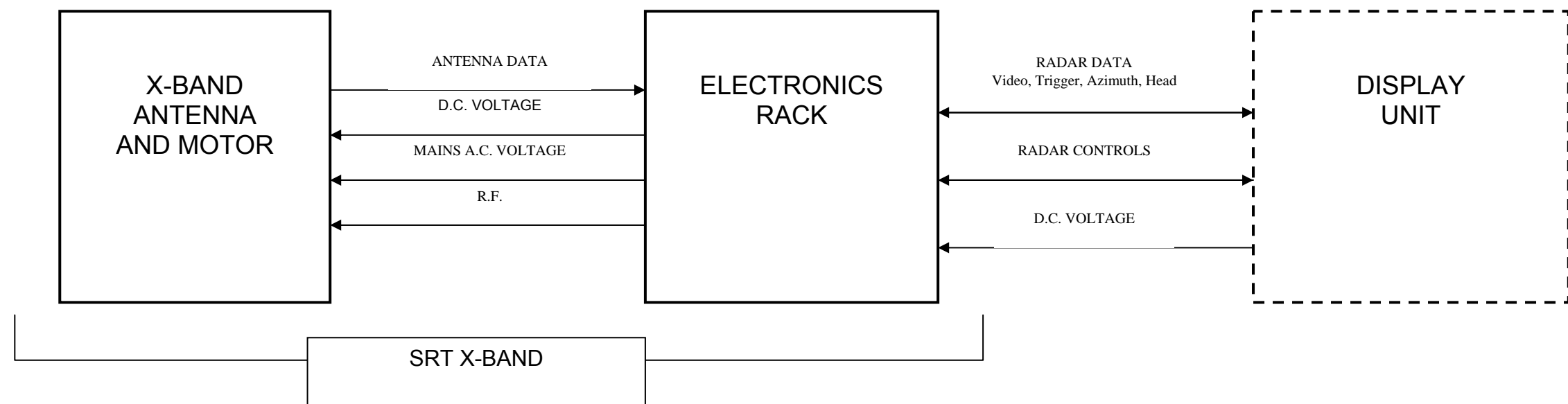


Fig 7 Main Connector Drawing

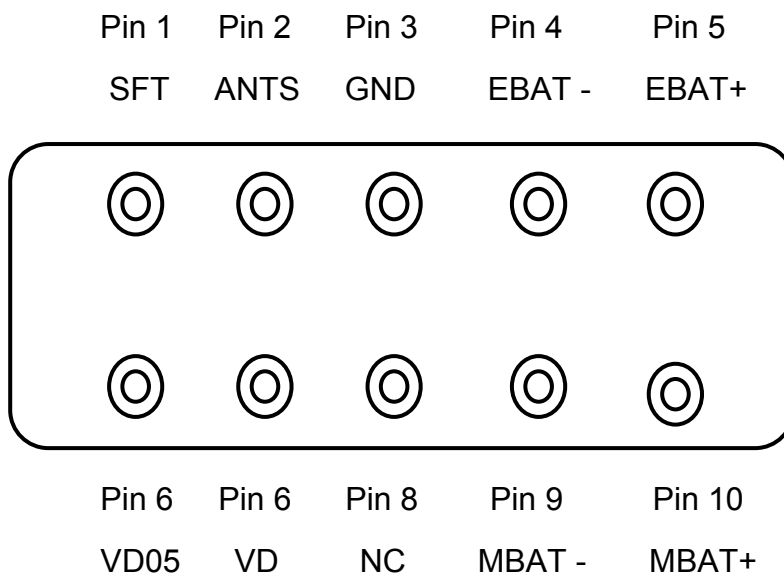
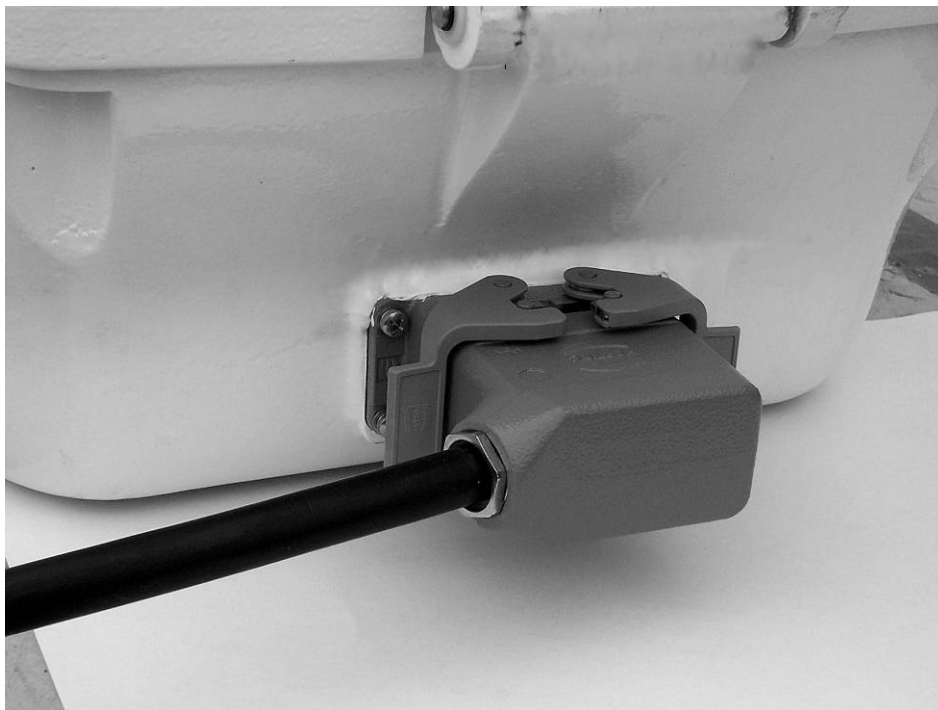


Fig 8 Cable termination

Cable connector in 12/25kW X-band Up-mast transceiver



1

Fig 9 SRT Control Board

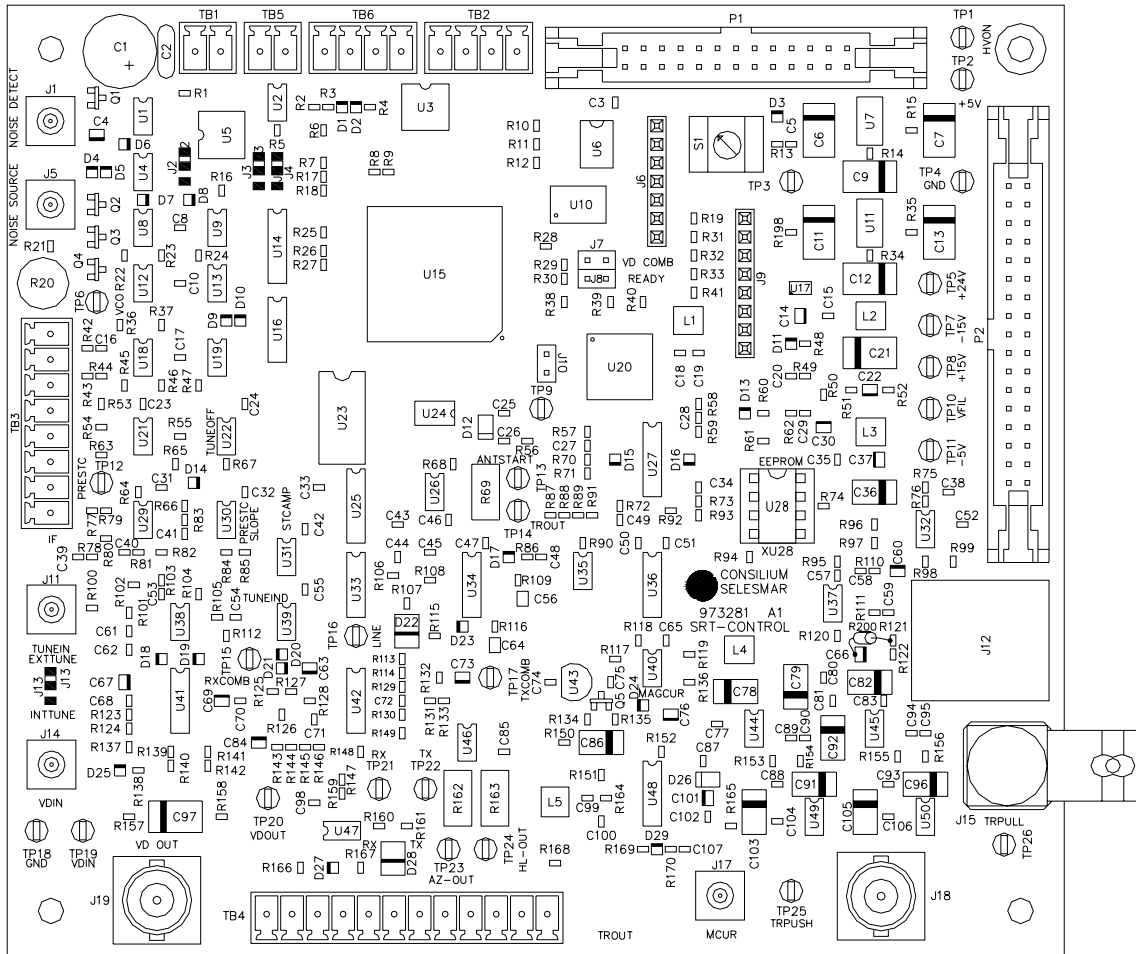


Fig 10 SRT Control board - Service switch

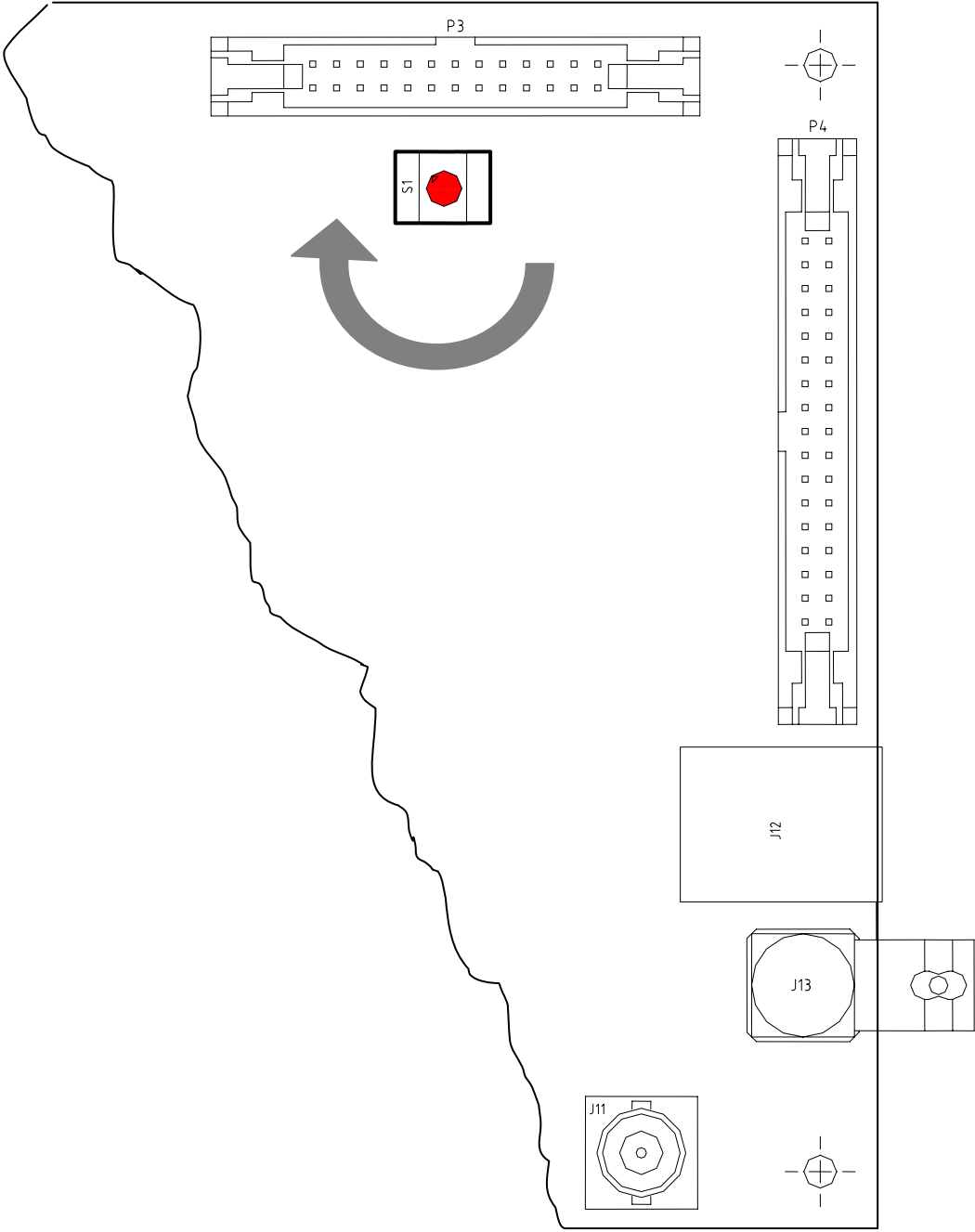
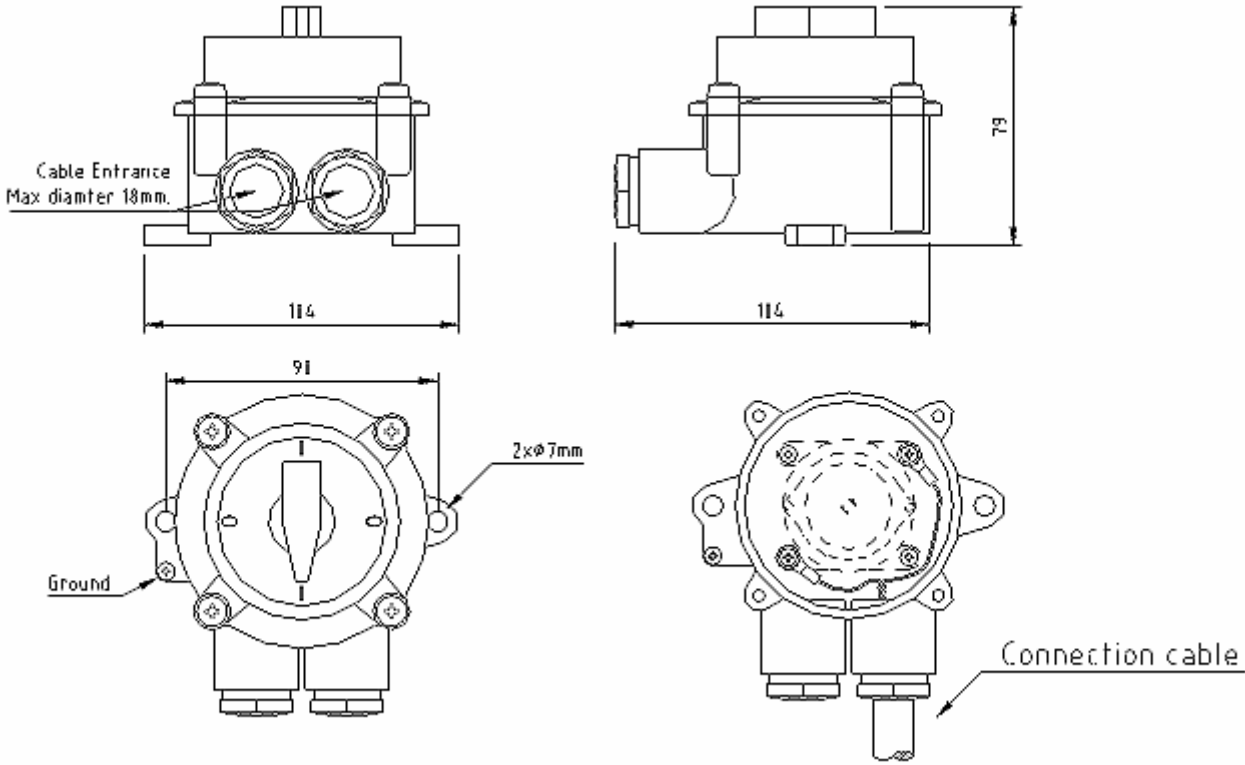


Fig. 11 Safety Switch



8.5 Annex

Special extensive illustrated instructions are included in this paragraph

8.5.1 Multicore Cabling and Termination Principle

55X456P001

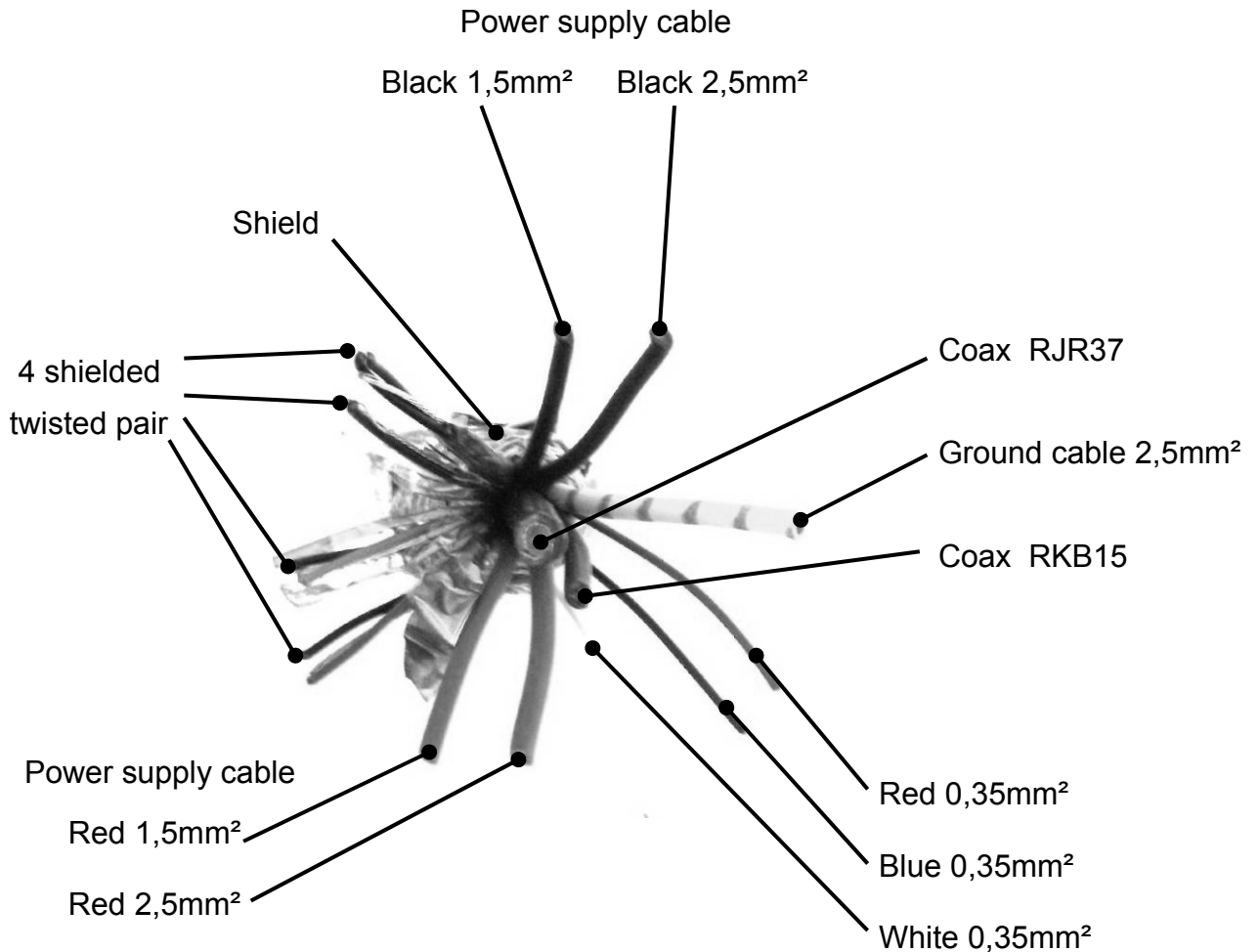
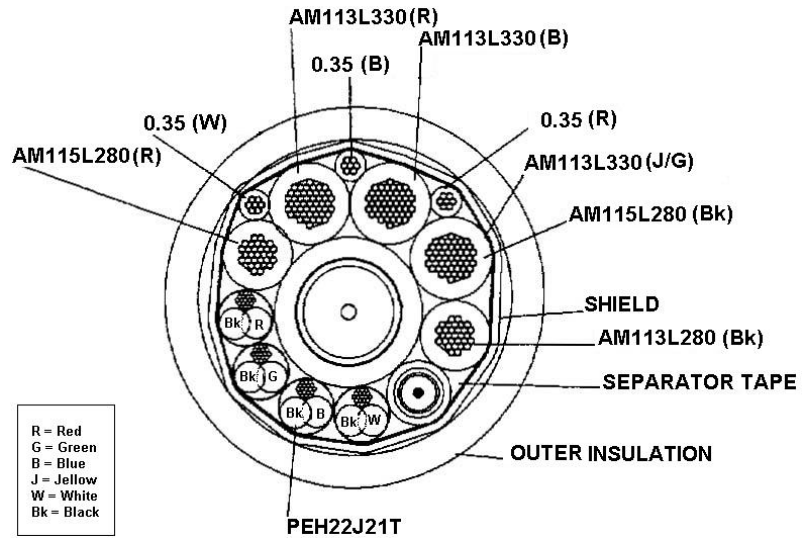
MULTI CORE CABLING AND TERMINATION PRINCIPLES FOR

- SRT X-Band Antenna Group including 6, 9 or 12 feet Antenna and Pedestal with 12 kW Transceiver Upmast
- SRT X-Band Antenna Group including 6, 9 or 12 feet Antenna and Pedestal with 25 kW Transceiver Upmast
- SRT X-Band Antenna Group including 6, 9 or 12 feet Antenna and Pedestal with 25 kW Transceiver Downmast
- Interconnection from Display to Display

Installation Instructions

Multicore Cable Technical Specification

Core overview of Multicore Cable:



Cable handling

- Dismantle the outer insulation of the cable for 60 cm.



- Remove most of the shield, let it be 5 cm with shield perceptible to vision:

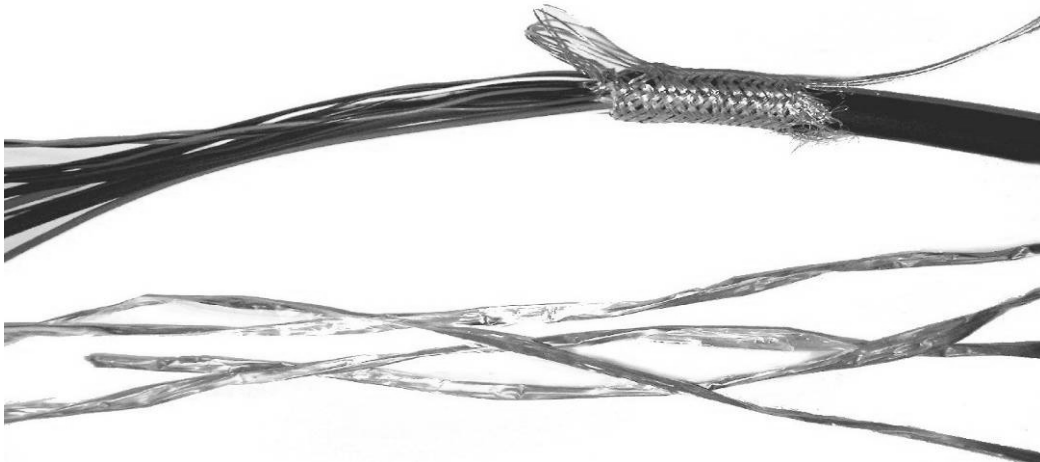


- Remove the main protective film and turn, as in the picture, the shield over the cable outer isolation.



Main Shield and inner shields handling

- Remove the metallic film from each twisted pair cables and pass the 4 ground wires through the turned shield.



0.35 mm² cores

- Cut the core to the wanted length and dismantle the core for 10mm:



- Insert and crimp the blue-end terminal:



Note: End terminal should always be used.

- Double connection in one terminal (yellow terminal):



- Triple connection in one terminal (grey terminal):



1,5 and 2,5 mm² cores

- Cut the core to the wanted length and dismantle the core for 10mm:



Note: End terminal should always be used.

RG coaxial cables

Mechanical details of BNC connector:



Cut the cable to the wanted length.

Dismantle the outer isolation of the RG coaxial cable without damaging the shield, and put the related part of the BNC connector as below:



Details related to the ring of the BNC connector.



Take back the shield on the ring and trim exceeding shield:



Dismantle the outer isolation of the centre core without damaging the centre core and be sure that the shield is not shorted with the centre core:



Solder the centre core with the BNC pin.

Be careful not damage the isolation (i.e. burned) during the solder process:



Mount the BNC connector as below:



ELLIPTICAL WAVEGUIDE KIT

20 Mt. P/N 304615A1

30 Mt. P/N 304615A2

INSTALLATION INSTRUCTIONS

Type EW85



**Flexibility and
High Strength**

ELLIPTICAL WAVEGUIDE KIT

20 Mt. P/N 304615A1

30 Mt. P/N 304615A2

INSTALLATION INSTRUCTIONS

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1 Introduction

The installation, maintenance, or removal of waveguide parts requires qualified, experienced personnel. Manufacturer installation instructions have been written for such installation personnel. Antenna systems should be inspected once a year by qualified personnel to verify proper installation, maintenance and condition of equipment.

The manufacturer disclaims any liability or responsibility for the results of improper or unsafe installation practices.

1. Check that contents are complete as per Table in Chapter 2 or Chapter 3 in accordance with the length of waveguide supplied.
2. The false base may be removed from the box with all components.
3. Assemble all items in accordance with the instruction in Chapter 5
4. Figure 5.3.2. is a full scale template and may be used to prepare for fitting the wall/roof feed thru supplied.
5. Particular attention should be taken of the minimum bend radius when routing the waveguide.
6. Finally fit sleeve and connector (as per Paragraph 5.2) shrink sleeve in place over connector/waveguide using a hot air blower. (e.g. a domestic hair drier.)

Elliptical waveguide is supplied pressurised. An air inlet valve is included with each pressurised length. Gaskets, silicone grease, connecting hardware and assembly instructions are packed with unattached connectors.

READ INSTRUCTIONS THOROUGHLY BEFORE ASSEMBLY

2 20Mt. Elliptical Waveguide Kit composition

The Elliptical Waveguide Kit P/N TBD composed of:

Pos	Q.ty	Part Number	Description
1	1	302826A1	20 Mt. Andrew Waveguide Kit, including
1.1	20Mt.	86X201P002	- EW85 Waveguide
1.2	2	86X202P002	- Connector for EW85 Waveguide
1.3	1	86X203P002	- Wall/Roof Feed-thru
1.4	20	69F104P001	- Hanger for EW85 Waveguide
1.5	1	86X206P001	- Pressure Window
2	1	86X131G801	WR90 Bend

3 30Mt. Elliptical Waveguide Kit composition

The Elliptical Waveguide Kit P/N TBD composed of:

Pos	Q.ty	Part Number	Description
1	1	302826A2	30 Mt. Andrew Waveguide Kit, including
1.1	30Mt.	86X201P002	- EW85 Waveguide
1.2	2	86X202P002	- Connector for EW85 Waveguide
1.3	1	86X203P002	- Wall/Roof Feed-thru
1.4	30	69F104P001	- Hanger for EW85 Waveguide
1.5	1	86X206P001	- Pressure Window
2	1	86X131G801	WR90 Bend

4 Installation Instructions

4.1 Elliptical Waveguide

Elliptical waveguide is supplied pressurised. An air inlet valve is included with each pressurised length. Gaskets, silicone grease, connecting hardware and assembly instructions are packed with unattached connectors.

ELLIPTICAL WAVEGUIDE TYPE NUMBER	DIMENSIONS OVER JACKET IN INCHES (MILLIMETRES)	VOLUME PER 100 FEET (30 M) IN CUBIC FEET (LITRES)	RADIUS OF MINIMUM BEND IN INCHES (MILLIMETRES) E-PLANE - H-PLANE	RECOMMENDED TWIST LIMIT IN DEGREES PER FOOT (METRES)	WAVEGUIDE WEIGHT LB/FT (KG/M)
EW(85)	1.32 x 0.90 (33.5 x 22.9)	0.42 (11.9)	8 (200) - 19 (480)	1 (3)	0.36 (0.54)

4.1.1 Preparation and Inspection

Inspect waveguide for possible shipping damage and pressure loss. Waveguide and connector assemblies have been pressure tested at factory before shipping.

Maximum allowable pressure drop for assembly over 20 Ft. (6.1.m) is 1lb/in² (7 kPa) in 24 hours from initial pressure of 10lb/in² (70 kPa). Each assembly is pressurized with dry air to 10 lb/in² prior to shipping and result of factory pressure test is recorded on inspection tag tied to assembly. Tire gauge can be used to check pressure. If waveguide has pressure loss, check all joints for possible leaks especially at pipe threads. Refer to paragraph 5.4. for pressure information.

Factory attached connector is shipped with blank flange attached to maintain pressure during shipment. Do not remove flange until after waveguide is installed.

Field attachment of connector at Transceiver end must be completed before hoisting. Attach connector to end of waveguide in accordance with instructions in paragraph 5.2.

Pressure test assembly prior to hoisting.

4.1.2 Hoisting

Obtain suitable hoist line to support weight of waveguide. Refer to table above for weights per foot (metre). Place protective covering over connector to prevent damage during hoisting. Attach robe sling or cable grip near end of waveguide allowing sufficient length to reach Antenna Group input from hoisted line to keep from dangling. Rope sling may be used in lieu of cable grip for every short lengths. Use cable grips in accordance with instructions received.

Additional tying is done above and below cable grips to keep weight on hoist line and not on waveguide. Make certain to allow slack in waveguide when tying and that slack is maintained during hoisting. tying is accomplished with strong fiber-reinforced tape or similar material applied generously at 15 or 20 Ft. (4.6 or 6.1 m) intervals as waveguide is raised.

Hoist waveguide slowly. Careless handling can cause kinks, dents, and scrapes. Waveguide may be bent in both E and H planes. Do not make bends

smaller than minimum bending radius shown in table. Note that H plane minimum bending radius is considerably larger than E plane radius. Waveguide bend can be formed by hand.

An improvised mandrel that will provide curved forming surface of equivalent radius may be used. waveguide may be twisted slightly for flange alignment. Use cable grip as temporary anchor to support waveguide until connector has been properly mated with Antenna Group input. Provide sufficient slack to permit easy flange alignment.

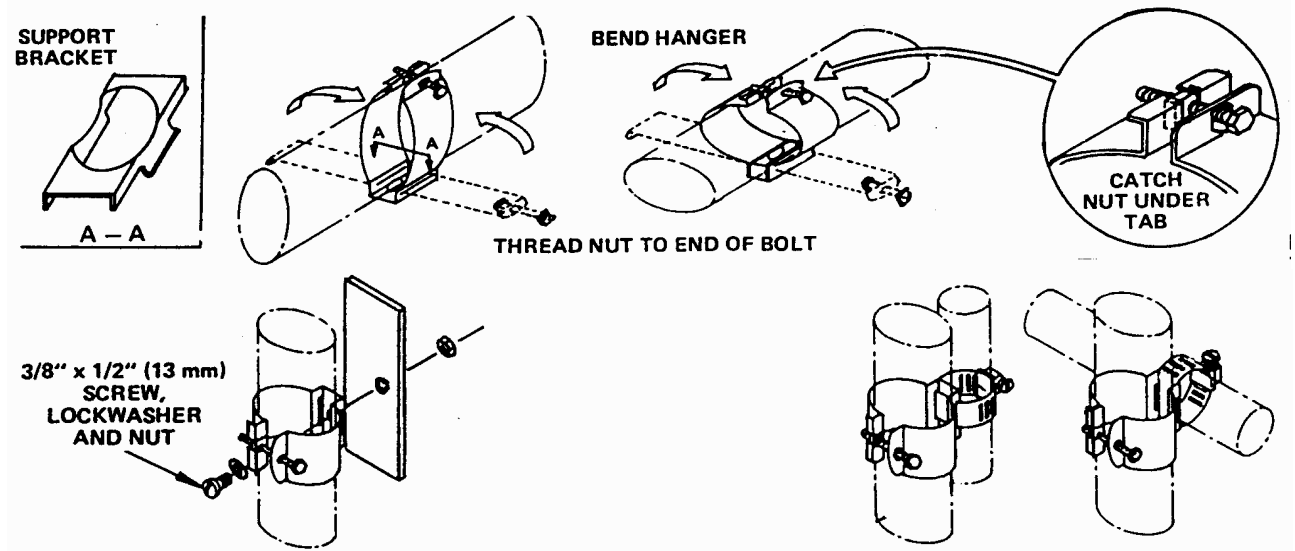
4.1.3 Anchoring

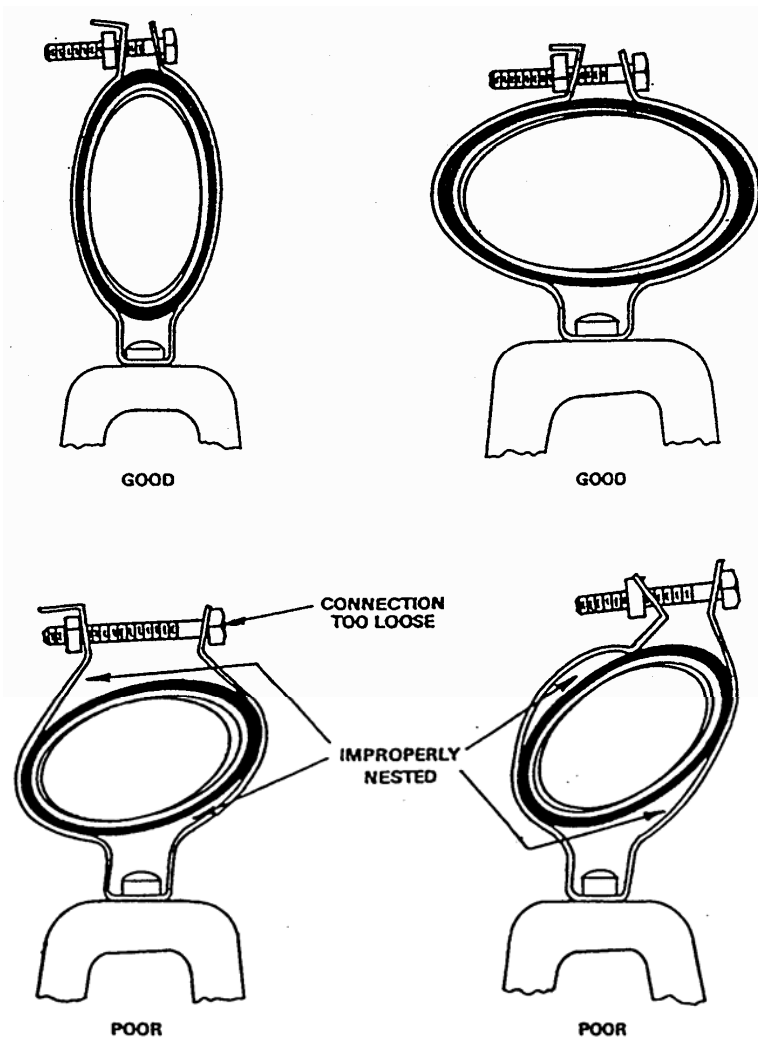
Maintain hoist line tension until anchoring is completed. Attachment to lighting conduit or vertical angle irons runs is recommended in installations where antenna mast do not provide adequate or convenient hanger support.

Waveguide subject to vibration or wind must not be left unsupported.

Space hangers approximately 1 Ft. (0.3m) apart for first three at top of vertical run and 4 Ft. (1.2m) apart thereafter. If distance from feed termination to 1st hanger is more than 4 Ft., waveguide must be supported. Position hangers to hold waveguide away from antenna mast. rubbing against edges can cause damage. Do not tighten hangers excessively as dents or deformations can cause degradation in electrical performance.

Hangers kit contain support brackets which snaps into slots on each side of hanger base. See detail A-A. After each hanger is attached and support bracket is snapped in, thread captivated nut to end of bolt as shown. Place waveguide into hanger, bend hanger around waveguide and slip bolt into slot of bent tab, catching nut under tab. Tighten bolt until hanger grips firmly. Excessive tightening may damage waveguide. If jacket has been cut, apply vinyl tape to damaged area. Top and bottom of waveguide should be grounded by low impedance conductors. Antenna Group input connection cannot serve as top ground.





4.1.4 Horizontal Runs

Route waveguide from base of mast to feed-thru flange and from feed-thru flange to Transceiver.

It can be supported above or below roof. Attach waveguide to horizontal support member using same type hangers and 4Ft. intervals as in vertical run. Exposed horizontal runs must be protected from weight of accumulated ice and damage from falling ice other objects.

4.1.5 Waveguide Connections

Where is possible connect end of waveguide directly to Transceiver and to Antenna Group input without any short interconnection. (only the adapter must be used).

Otherwise, assemble rigid waveguide parts in accordance with the typical installation drawing.

See that gasket and mating surface of flanges are clean. Use comothene, vythene or other non-flammable fluid for cleaning. Do not apply silicone grease to flange gaskets. Join flanges making certain gasket is in position. Add connecting hardware and fasten flanges together, tightening screws evenly. If factory prepared length of waveguide must changed, cut the waveguide to appropriate length and attach connector to waveguide after required length of run has been determined. Attach elliptical waveguide connector to E-bend elbow through the adapter.