VISIONMASTER FT®

Ship's Manual
Volume 1

(Installation, Servicing & Maintenance)

Northrop Grumman Sperry Marine B.V.

118 Burlington Road, New Malden, Surrey, KT3 4NR England
Tel: +44 (0) 20 8329 2000 Fax: +44 (0) 20 8329 2415

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Warnings and Cautions



WARNING! – LETHAL VOLTAGE HAZARD

Lethal voltages may be exposed when access covers are removed. Some capacitors take several minutes to discharge their stored voltages after the equipment is switched OFF: this is a lethal voltage hazard. Always set the supply switch-fuse to OFF and remove the fuses before removing the access covers of the equipment.



WARNING! – HEALTH HAZARD

When cleaning the inside of the equipment, take care not to inhale dust. The dust is a temporary health hazard, depending on individual allergies.



WARNING! – RADIATION HAZARD

Keep outside the hazard zone around an antenna or open waveguide radiating power. Refer to the table below for hazard zones. When you need to work on the Scanner Unit, make sure the radar is switched OFF, and that both the Mains Isolator and the Scanner Control Unit are turned to the OFF position.
Never look directly into an open waveguide.



WARNING! – X-RAY RADIATION

X - Rays may be produced by high voltage equipment such as magnetrons in radar transmitters.
Tests have shown that levels of ionising radiation (X-Rays) emitted from NGSM S and X Band radars are no higher than normal background levels.
Observe all warning signs on equipment and in supplied documentation..

Radar and other forms of RF radiation can cause Cardiac Pacemakers to malfunction. If you use a Cardiac Pacemaker and suspect a malfunction, leave the vicinity of the radar system immediately and seek medical advice.

Most countries accept that there is no significant radiation hazard at RF power density levels of up to 10 mW/cm2

.

Table 1: Hazard Zones

Antenna Length	10 mW/cm2	1 mW/cm2
1.2m X-band	1.7m	17m
1.8m X-band	1.05m	10.5m
2.4m X-band	0.75m	7.5m
2.7m S-band	0.73m	7.3m
3.7m S-band	0.55m	5.5m



CAUTION! – ELECTROSTATIC SENSITIVE DEVICES (ESSDS)

The equipment contains ESSDs. Take care not to damage these devices by discharge of electrostatic voltages.

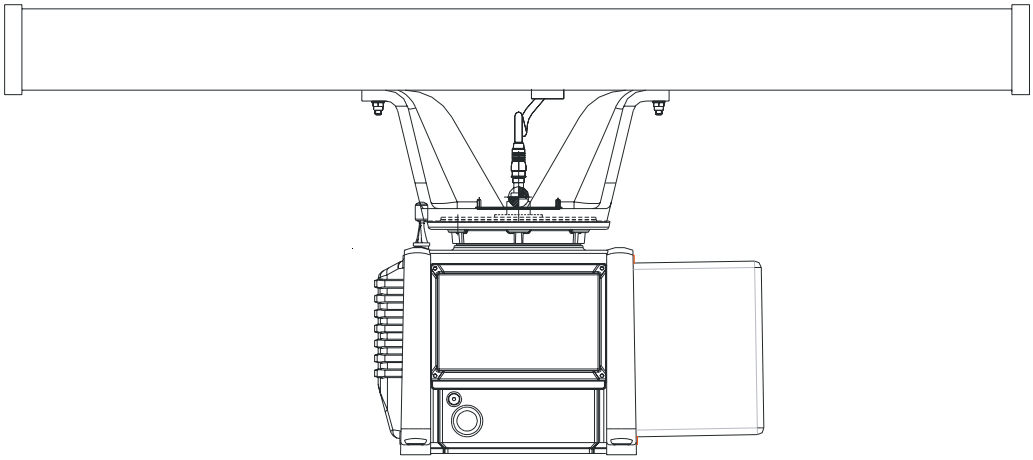
Revision Record

Table 2: Revision Record

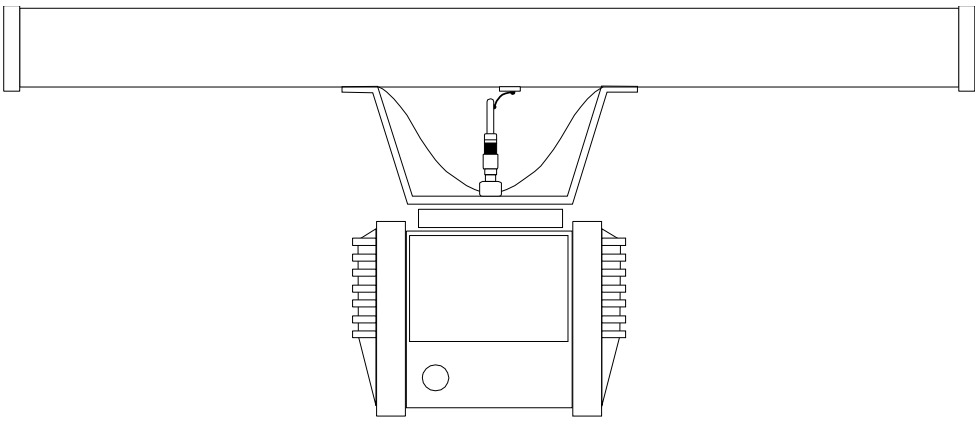
Revision No	Issue Date	Date Incorporated	Incorporated By
Issue 1	November 2006		
Issue 2	December 2006		
Issue 3	April 2008		
Issue 4	July 2008		

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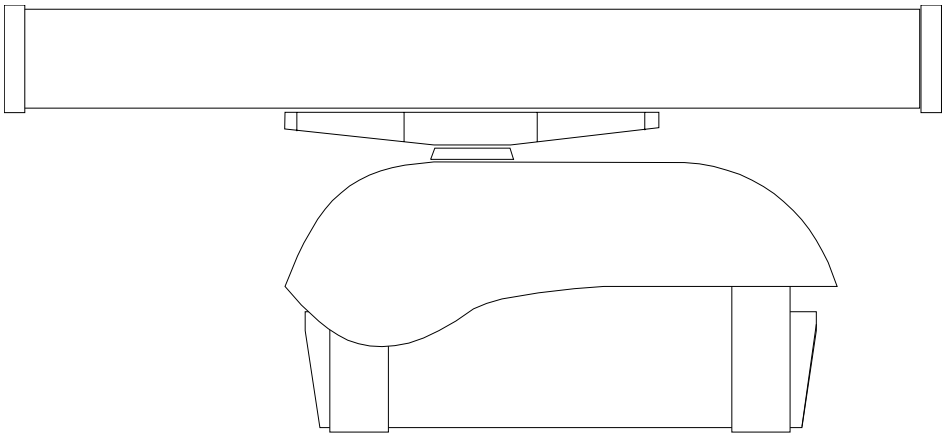
Modules and Assemblies



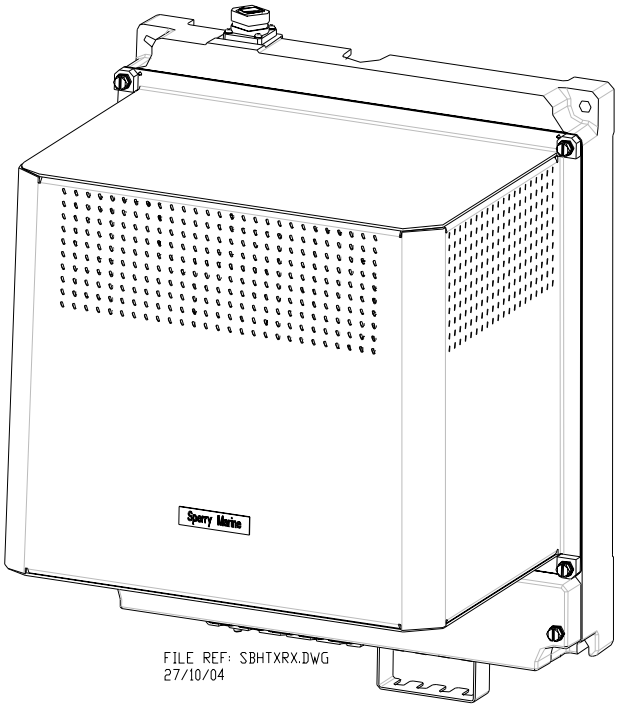
VisionMaster - S-band Scanner Unit (with integral Transceiver)



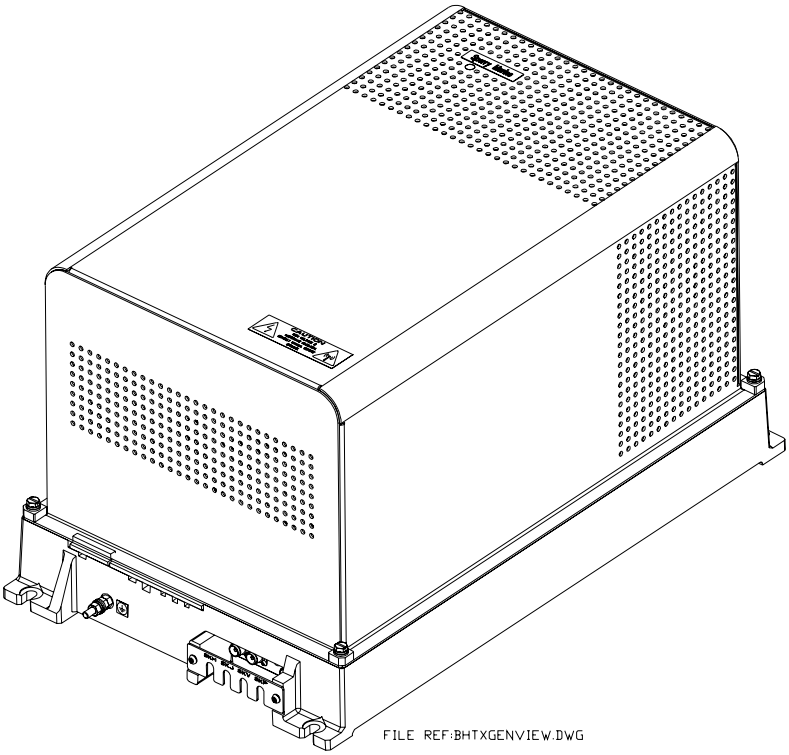
VisionMaster - S-band Scanner Unit (for use with bulkhead Transceiver)



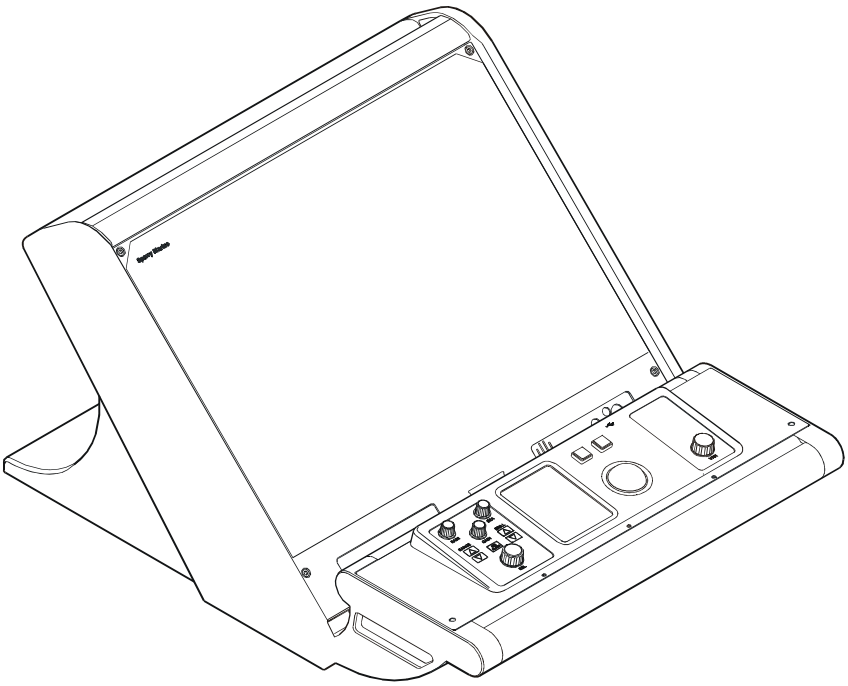
VisionMaster - X-band Scanner Unit (with integral or bulkhead Transceiver)



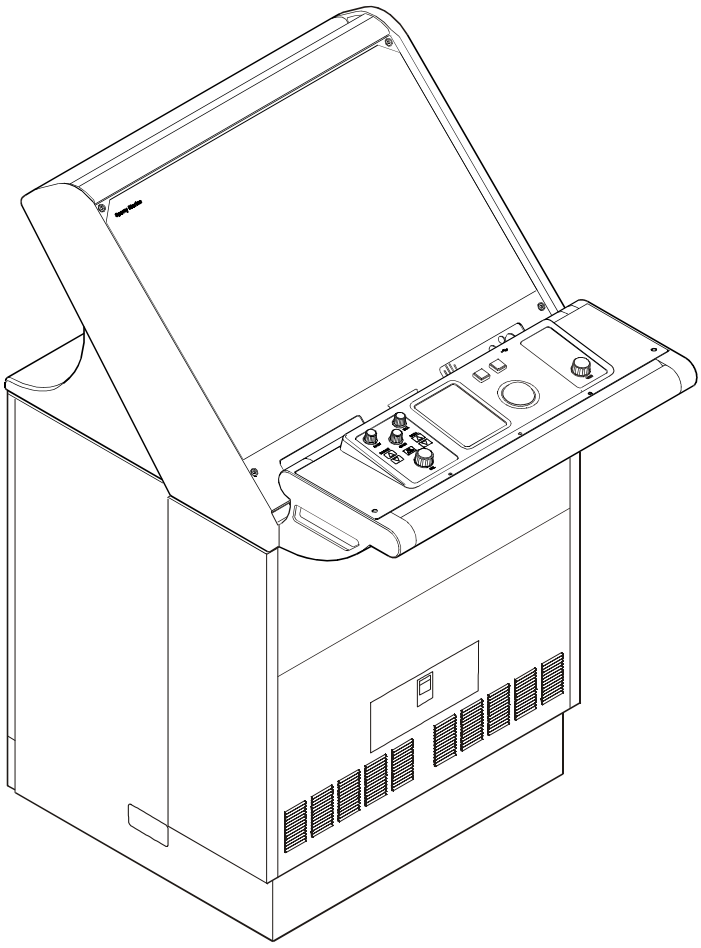
VisionMaster - S-Band Bulkhead Transceiver



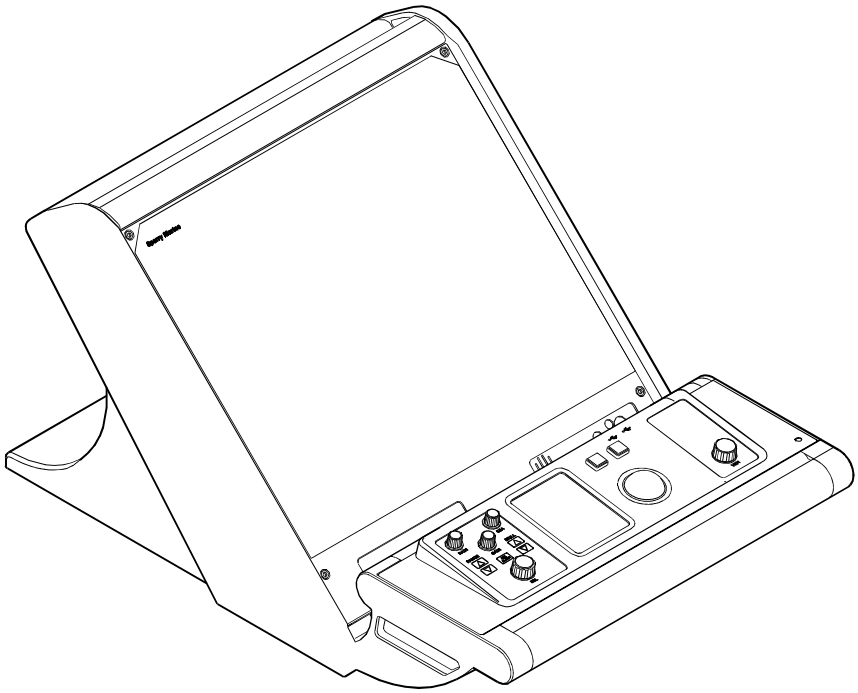
VisionMaster - X-Band Bulkhead Transceiver



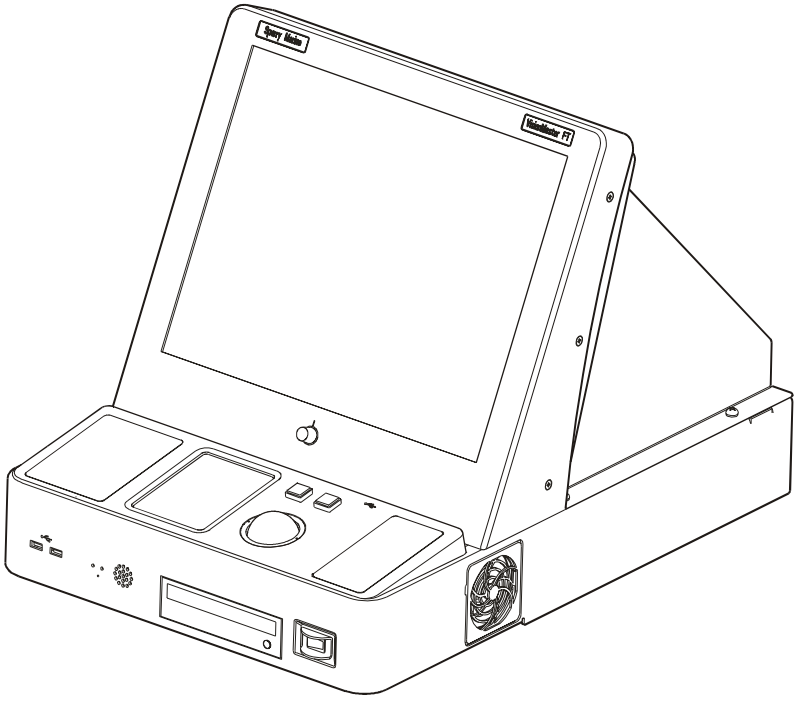
VisionMaster - 340 Table Mounted Console



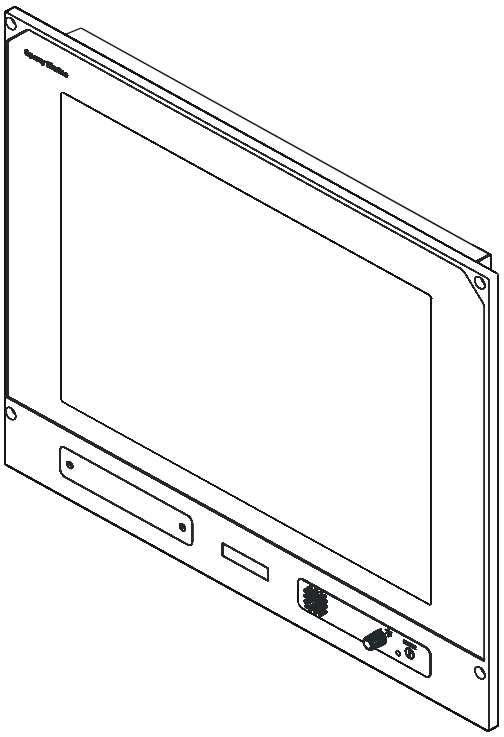
VisionMaster - 340 Pedestal Console



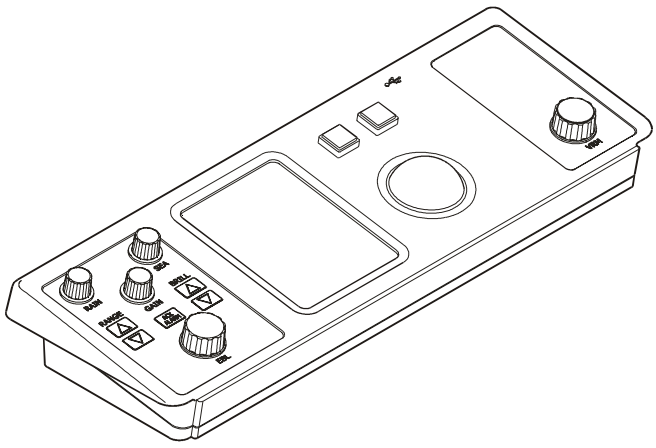
VisionMaster - 250 Table Mounted Console



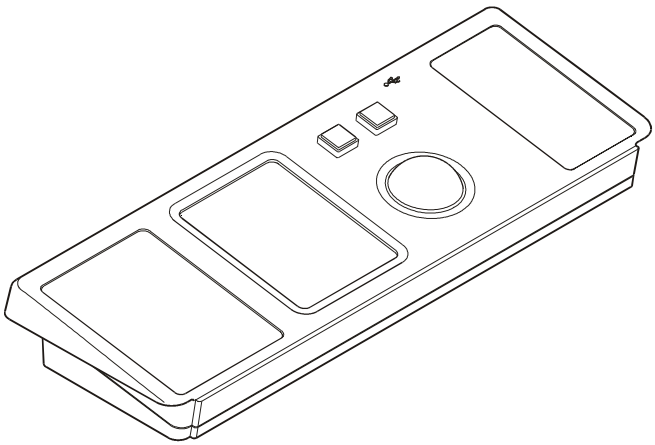
VisionMaster - 19" Integrated Tabletop Display



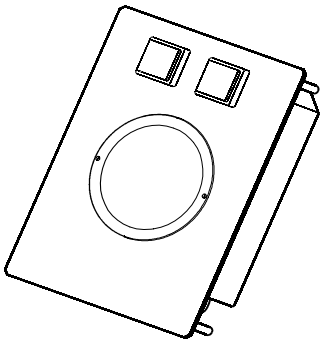
Flat Panel Monitor



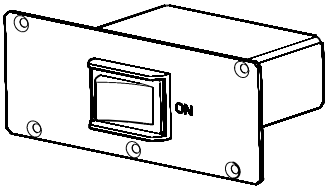
Control Panel



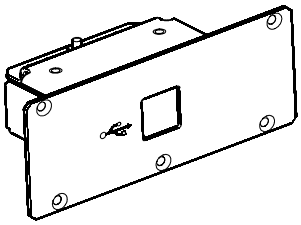
Basic Control Panel



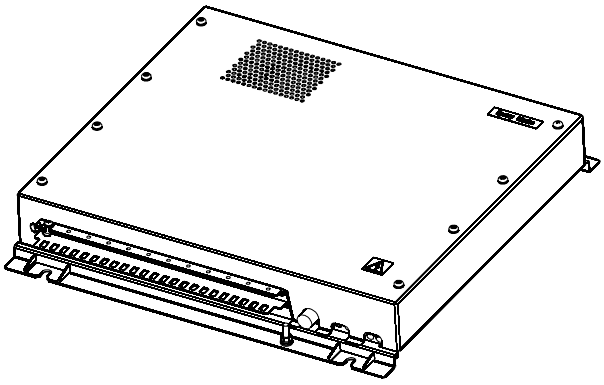
Trackball



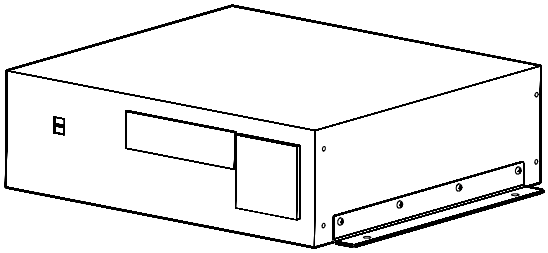
On/Off Switch



USB Connector



PCI/O Unit



Processor Unit

Preface

HOW TO USE THIS MANUAL

The VisionMaster Ship’s Manual is divided into two volumes.

Volume 1 (this manual) is intended for use by installation and service engineers.

Volume 2 includes service functions carried out at the VisionMaster display, including configuration, diagnostics & commissioning and chart installation.

The structure and design of the manual should help you to quickly find the information that you need. Consistent presentation techniques are used throughout the manual.

Volume 1 is divided into the following chapters:

- **Chapter 1 - Technical Specification**. Includes a full specification of the VisionMaster FT Series, both operational and technical.
- **Chapter 2 - System Identification**. Details the system’s identity labels and unit type numbers.
- **Chapter 3 - Installation**. Includes descriptions of cable types and system component installations, including installation diagrams and inter-unit cabling information. Appendix A details the ECDIS display calibration procedure. Appendix B describes the installation of a PCI Serial Card.
- **Chapter 4 - Fault Reporting and First Line Servicing**. Describes the procedures for fault identification and details all first line servicing permitted.
- **Chapter 5 - Routine Maintenance**. Describes the procedures for routine maintenance.
- **Chapter 6 - Modifications**. Used for recording system and equipment modifications after release of publication.
- **Chapter 7 - Interswitch Units**. Describes 2-way and 6-way Interswitch units.
- **Chapter 8 - Additional Features**. Details the special options for transceivers and turning units, covering the specification, installation, commissioning and servicing.

NOTICE

Northrop Grumman Sperry Marine B.V. have a policy of continuous development. This may lead to the equipment described in this manual being at variance with equipment manufactured after its publication.

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Related Documents

Other publications in the VisionMaster FT series are listed in Table 3 below:

Table 3: Related Documents

Document Title	Document Number
VisionMaster Ship’s Manual - Volume 2	65900011V2
ECDIS Bridge Card	65900008
Radar/Chart Radar Bridge Card	65900009
Radar/Chart Radar User’s Guide	65900010
ECDIS User’s Guide	65900012

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Declaration of Conformity

NORTHROP GRUMMAN

Sperry Marine

Marine Equipment Directive Declaration of Conformity

Manufacturer: Northrop Grumman Sperry Marine B.V.
118 Burlington Road, New Malden
Surrey, KT3 4NR United Kingdom

Declaration:
It is hereby certified that the Equipment listed conforms with the Council Directive for Marine Equipment 96/98/EC, as amended by Commission Directives 2008/67/EC, 2002/75/EC and 2002/84/EC, and has been Type examined by Notified Body No 0191 as shown on Certificates of Type Examination No QQ-MED-14/08-01i, QQ-MED-14/08-02i, QQ-MED-14/08-03i, QQ-MED-14/08-04i, QQ-MED-01/08-01R and QQ-MED-02/08-01i.

Equipment: VisionMaster FT (ECDIS & Radar)

Type Number	Description	Type Number	Description
65901AN	Processor - ECDIS (no overlay)	65801BAR or CA◈	Turning Unit
65901AT	Processor – Radar/Chart Radar	65830B*R or C*◈	Turning Unit
65920ATAF, AG, BF or BG	19" Integrated Radar Display	65837A♣	Scanner Control Unit
65900AA or AB	VMFT PCIO Interface Unit	65604A	X-Band Antenna 4ft
65903KF or KG	Control Panel (Kit Form)	65606A	X-Band Antenna 6ft
65903AF or AG	Control Panel (Deck Console)	65608A	X-Band Antenna 8ft
65909AF or AG	Control Panel (250 Desktop)	65612A	S-Band Antenna 12ft
65817G	250 LCD Monitor (Kit Form)	65842A	2 Way Interswitch Unit
65919C or T	250 LCD Monitor	65846A	6 Way Interswitch Unit
65823A	340 LCD Monitor (Kit Form)	65849A	Slave Junction Box
65923C or E	340 LCD Monitor	32SDV001 to 006/008	Security Device
65923605 or 65919605	Monitor Chassis		
65923200, 201 or 202	Plinth		
65923665 or 675	Pedestal		
65810◉A◈ or 65910◉A◈	Transceiver/Turning Unit (10kW)		
65825◉A◈ or 65925◉A◈	Transceiver/Turning Unit (25kW)		
65830 M*R or N*◈	Transceiver/Turning Unit (30kW)		
65810 E,F,G,H, or L	Transceiver (10kW)		
65825 E,F,G,H, or L	Transceiver (25kW)		
65831A or B	Transceiver (30kW)		

Option Codes: * E, F, G, H, J, K, L, M, P, Q, R or S ◉ M, N, P, T or W ◈ R, T or U ♣ B, C, E, F or H

Standards Applied:-

EN 62388:2008	Marine Shipborne Radar Equipment
EN 60945: 2002	General Requirements for Marine Navigation Equipment
EN 61162-1: 2000	Digital Interfaces
EN 61162-2: 2001	Digital Interfaces
EN 61174:2002	Electronic Chart Display and Information Systems
EN 62065:2002	Track Control Systems

Mike Pope, Technical Director - Europe

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Chapter 1

Technical Specification

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1 Radar System Performance

Table 1: Radar System Performance

Parameter	Detail
Minimum Range	Less than 35m using $10m^2$ target, measured with short pulse, 4.5m antenna height, on 0.25 and 0.5nm range scales.
Range Discrimination	Better than 35m on 0.75nm range.
Bearing Discrimination (typical figures)	2.5° with 4 ft antenna (X-Band). 1.7° with 6 ft antenna (X-Band). 1.3° with 8 ft antenna (X-Band). 4.0° with 9 ft antenna (S-Band). 2.4° with 12 ft antenna (S-Band) on 1.5 nm range using 10 m^2 reflector at a range of 1.0 nm.
Range Ring Accuracy	1% of the maximum range of the scale in use or 25m whichever is the greater.
Variable Range Marker Accuracy	1% of the maximum range of the scale in use or 25m whichever is the greater.
Radar System Bearing Accuracy	Better than ± 1º

1.1 Radar Performance in Defined Climatic and Sea Conditions

The maximum distance in service may differ from the values calculated below, depending on climatic and sea conditions, efficiency of the radar and the target's reflecting ability. The following tables are provided to illustrate that the detectable distances and the sea clutter extent increase when the height of the antenna is increased.

The pulse width used to define the following data is the one best suited for the relevant conditions, this is typically Long Pulse (LP), unless otherwise stated.

1.1.1 **Masthead Installation** (Transceiver up-mast)

Table 2: X band radar performance in clear conditions (no rain, sea state1)

Parameters		Radar Height above the sea level (metres)			
		10	15	30	50
Maximum range of detection (n.miles)	Navigation Buoy without radar reflector	4.3	5.1	6.9	8.5
	SOLAS vessel greater than 500GT	7.6	8.7	11.3	13.9
Sea clutter maximum extent (n.miles)		0.6	0.7	1.1	1.4

Table 3: X band radar performance in sea state 5 (no rain)

Parameters		Radar Height above the sea level (metres)			
		10	15	30	50
Maximum range of detection (n.miles)	Navigation Buoy without radar reflector	4.2	5.0	1.3*	0.5*
	SOLAS vessel greater than 500GT	7.6	8.7	11.3	13.9
Sea clutter maximum extent (n.miles)		4.0	5.0	3.3*	3.6*

* Short Pulse

Table 4: S band radar performance in clear conditions (no rain, sea state1)

Parameters		Radar Height above the sea level (metres)			
		10	15	30	50
Maximum range of detection (n.miles)	Navigation Buoy without radar reflector	3.1	3.7	5.1	6.5
	SOLAS vessel greater than 500GT	7.6	8.6	11.1	13.6
Sea clutter maximum extent (n.miles)		0.4	0.6	0.8	1.1

Table 5: S band radar performance in sea state 5 (no rain)

Parameters		Radar Height above the sea level (metres)			
		10	15	30	50
Maximum range of detection (n.miles)	Navigation Buoy without radar reflector	2.9	3.3	4.0 †	4.4*
	SOLAS vessel greater than 500GT	7.6	8.6	11.1	13.6
Sea clutter maximum extent (n.miles)		3.0	3.8	4.2 †	3.9*

* Short Pulse

† Medium Pulse

1.1.2 **Bulkhead Installation** (Transceiver down-mast)

The following values are based on a 20 metre length waveguide cable for X band radar and a 20 metre length coax cable for S band radar.

Table 6: X band radar performance in clear conditions (no rain, sea state1)

Parameters		**Radar Height above the sea level (metres)**			
		10	**15**	**30**	**50**
Maximum range of detection (n.miles)	Navigation Buoy without radar reflector	4.0	4.7	6.2	4.1
	SOLAS vessel greater than 500GT	7.1	8.2	10.7	13.3
Sea clutter maximum extent (n.miles)		0.5	0.6	0.9	1.3

Table 7: X band radar performance in sea state 5 (no rain)

Parameters		**Radar Height above the sea level (metres)**			
		10	**15**	**30**	**50**
Maximum range of detection (n.miles)	Navigation Buoy without radar reflector	3.8	4.4	0.9*	0.5*
	SOLAS vessel greater than 500GT	7.1	8.2	10.7	13.3
Sea clutter maximum extent (n.miles)		3.7	4.5	2.5*	2.7*

* Short Pulse

Table 8: S band radar performance in clear conditions (no rain, sea state1)

Parameters		**Radar Height above the sea level (metres)**			
		10	**15**	**30**	**50**
Maximum range of detection (n.miles)	Navigation Buoy without radar reflector	2.7	3.3	4.6	5.8
	SOLAS vessel greater than 500GT	7.0	8.0	10.3	12.7
Sea clutter maximum extent (n.miles)		0.4	0.5	0.7	1.0

Table 9: S band radar performance in sea state 5 (no rain)

Parameters		Radar Height above the sea level (metres)			
		10	15	30	50
Maximum range of detection (n.miles)	Navigation Buoy without radar reflector	2.6	3.0	3.5†	3.6*
	SOLAS vessel greater than 500GT	7.0	8.0	10.3	12.8
Sea clutter maximum extent (n.miles)		2.7	3.5	3.7†	3.2*

* Short Pulse

† Medium Pulse

1.1.3 Effect of Transmission-line Length

Values based on Radar at 30 metres above sea level.

Table 10: X band radar performance in clear conditions (no rain, sea state1)

Waveguide length (metres)	Range of 1st detection (n.miles)	
	SOLAS vessel greater than 500GT	Navigation Buoy without radar reflector
30	10.4	5.9
20	10.7	6.2
10	11.0	6.6

Table 11: S band radar performance in clear conditions (no rain, sea state1)

Waveguide length (metres)	Range of 1st detection (n.miles)	
	SOLAS vessel greater than 500GT	Navigation Buoy without radar reflector
30	10.0	4.3
20	10.3	4.6
10	10.7	4.9

1.2 Degradation of Radar Performance in Clutter Conditions

1.2.1 Rain Clutter

Rain clutter creates a high return of noise-like reflections that effectively decreases the signal-to-noise levels within the radar receiver. In addition, it creates an attenuation of the radar signal, which also decreases the signal-to-noise levels. Both these effects reduce the target detection capability of a radar system.

1.2.2 Sea Clutter

The presence of sea clutter degrades the detection performance of radar. Three main effects cause this degradation:

a) Large waves which can obscure targets.

b) Waves reflecting radar energy that compete with the reflection from the target. This increases the noise levels that the target is embedded within.

c) Waves which can exist over several scans and during this time exhibit a target-like behaviour. This causes sea 'spikes' that can obscure or be confused with real targets. Appropriate anti-clutter processing can sometimes reduce this effect, but not consistently.

At longer distances, typically over a mile or two (depending for example on antenna height), the effect of b) above is greatly lessened. At shorter distances, this effect becomes very marked, anti-clutter processing should be used in order to improve the detection performance of the radar caused by this effect.

Signal processing, for example scan-to-scan correlation can reduce the effects of c).

1.2.3 Sea State, Wind and Wave Height

Sea Clutter is generally defined in terms of a sea state. Establishing the sea state is important for assessing the visibility of radar targets in sea clutter. Sea state is a term used as a measure of wave height and can be defined by the Douglas scale, the Hydrographic Office scale and the Beaufort scale, which is a wind speed scale. Guidance for the sea state and wind speed is provided in the following Douglas Sea State Parameter table.

The sea state describes the roughness of the sea, but is not a full indication of the strength of sea clutter. Wind speed is often a better indication of sea clutter, though this does depend on the duration (time blowing over sea) and the fetch (the maximum length of open water over which wind can blow). When wind begins to blow, the sea requires a finite time to reach a condition known as a fully developed sea.

Sea states in the table below are approximately equated to wind speeds. Sea swell will make accurate assessment of wave observations very difficult and the table is only applicable to waves formed by local wind conditions.

Cross winds relative to the line of sight to the target produce less clutter than head winds and in terms of clutter returns, this represents approximately half a numerical sea state less clutter signal return than detecting a target in head wind.

Table 12: Douglas Sea State Parameters.

Douglass sea state	Mean wind speed (kn)	Significant wave height (m)	Sea state description
0	<4	<0,2	Flat, very calm
1	5-7	0,6	Smooth
2	7-11	0,9	Slight
3	12-16	1,2	Moderate
4	17-19	2,0	Rough
5	20-25	3,0	Very rough
6	26-33	4,0	High

Note 1: *This table only applies to waves formed by local wind. Significant wave height is defined as the crest to trough height of the highest 1/3 waves. Individual waves and/or swell can combine to significantly increase the wave height and may result in obscuration of the target.*

Note 2: *The table values are approximate due to the subjective nature of the sea state assessment. Sea swell will make assessment of wave height very difficult.*

1.2.4 Range of First Detection

The following tables show estimated ranges of first detection in various weather conditions. These figures are provided as an approximate guide; there are many other factors that can influence detection range.

For moving targets, the video build up process will be most effective when the range scale is increased, and with longer pulse lengths.

All small vessel radar reflectors are to meet IMO performance standards.

Table 13: X band radar performance in sea state 2

Target Description	Max. detection range in clear conditions (NM)	Max. detection range in sea state 2 (NM)
Shorelines rising to 60m	20.0	20.0
Shorelines rising to 6m	8.7	8.7
Shorelines rising to 3m	6.9	6.9
SOLAS ships (>5000 gross tonnage)	11.7	11.7
SOLAS ships (>500 gross tonnage)	8.2	8.2
Small vessel with radar reflector	5.1	5.1
Navigation buoy with corner reflector	5.0	5.0
Typical Navigation buoy	4.7	4.7
Small vessel of length 10 m with no radar reflector	3.6	3.6
Channel markers	2.4	2.4

Table 14: X band radar performance in sea state 5

Target Description	Max. detection range in clear conditions (NM)	Max. detection range in sea state 5 (NM)
Shorelines rising to 60m	20.0	20.0
Shorelines rising to 6m	8.7	8.7
Shorelines rising to 3m	6.9	6.9
SOLAS ships (>5000 gross tonnage)	11.7	11.7
SOLAS ships (>500 gross tonnage)	8.2	8.2
Small vessel with radar reflector	5.1	5.0*
Navigation buoy with corner reflector	5.0	4.9*
Typical Navigation buoy	4.7	4.4*
Small vessel of length 10 m with no radar reflector	3.6	Target not visible
Channel markers	2.4	Target not visible

* In smooth swell the target may be visible up to the stated range. In the presence of strong winds (>20 knots) and breaking waves, detection of the target is likely to be reduced, or may not be visible.

Table 15: X band radar performance in 4mm rain

Target description	Max. detection range in clear conditions (NM)	Max detection range in 4mm rain (NM)	
		Long Pulse	Short Pulse
Shorelines rising to 60m	20.0	19.3	17.9
Shorelines rising to 6m	8.7	7.7	7.3
Shorelines rising to 3m	6.9	5.6	5.6
SOLAS ships (>5000 gross tonnage)	11.7	11.0	10.1
SOLAS ships (>500 gross tonnage)	8.2	7.1	6.8
Small vessel with radar reflector	5.1	1.4	3.5
Navigation buoy with corner reflector	5.0	1.3	3.6
Typical Navigation buoy	4.7	1.2	3.2
Small vessel of length 10 m with no radar reflector	3.6	0.7	2.3
Channel markers	2.4	0.4	1.5

Table 16: X band radar performance in 16mm rain

Target description	Max. detection range in clear conditions (NM)	Max detection range in 16mm rain (NM)	
		Long Pulse	Short Pulse
Shorelines rising to 60m	20.0	17.0	11.6
Shorelines rising to 6m	8.7	6.4	6.5
Shorelines rising to 3m	6.9	4.3	5.0
SOLAS ships (>5000 gross tonnage)	11.7	9.7	9.0
SOLAS ships (>500 gross tonnage)	8.2	5.7	6.0
Small vessel with radar reflector	5.1	0.5	1.4
Navigation buoy with corner reflector	5.0	0.6	1.3
Typical Navigation buoy	4.7	0.5	1.2
Small vessel of length 10 m with no radar reflector	3.6	0.4	0.7
Channel markers	2.4	0.2	1.0

Table 17: X band radar performance in 4mm rain, sea state 5

Target Description	Max. detection range in clear conditions (NM)	Max. detection range in 4mm rain, sea state 5 (NM)
Shorelines rising to 60m	20.0	19.3
Shorelines rising to 6m	8.7	7.7
Shorelines rising to 3m	6.9	5.8 *
SOLAS ships (>5000 gross tonnage)	11.7	11.0
SOLAS ships (>500 gross tonnage)	8.2	7.1*
Small vessel with radar reflector	5.1	3.1 †
Navigation buoy with corner reflector	5.0	3.3 †
Typical Navigation buoy	4.7	1.2 †
Small vessel of length 10 m with no radar reflector	3.6	Target not visible
Channel markers	2.4	Target not visible

* Medium Pulse

† Short Pulse. In smooth swell the target may be visible up to the stated range. In the presence of strong winds (>20 knots) and breaking waves, detection of the target is likely to be reduced, or may not be visible.

Table 18: S band radar performance in sea state 2

Target Description	Max. detection range in clear conditions (NM)	Max. detection range in sea state 2 (NM)
Shorelines rising to 60m	20.0	20.0
Shorelines rising to 6m	8.8	8.8
Shorelines rising to 3m	6.8	6.8
SOLAS ships (>5000 gross tonnage)	12.0	12.0
SOLAS ships (>500 gross tonnage)	8.0	8.0
Small vessel with radar reflector	3.7	3.7
Navigation buoy with corner reflector	3.6	3.6
Typical Navigation buoy	3.3	3.3
Small vessel of length 10 m with no radar reflector	3.0	3.0
Channel markers	1.5	1.5

Table 19: S band radar performance in sea state 5

Target Description	Max. detection range in clear conditions (NM)	Max. detection range in sea state 5 (NM)
Shorelines rising to 60m	20.0	20.0
Shorelines rising to 6m	8.8	8.8
Shorelines rising to 3m	6.8	6.8
SOLAS ships (>5000 gross tonnage)	12.0	12.0
SOLAS ships (>500 gross tonnage)	8.0	8.0
Small vessel with radar reflector	3.7	3.5 *
Navigation buoy with corner reflector	3.6	3.4 *
Typical Navigation buoy	3.3	3.0 *
Small vessel of length 10 m with no radar reflector	3.0	Target not visible
Channel markers	1.5	Target not visible

* In smooth swell the target may be visible up to the stated range. In the presence of strong winds (>20 knots) and breaking waves, detection of the target is likely to be reduced, or may not be visible.

Table 20: S band radar performance in 4mm rain

Target description	Max. detection range in clear conditions (NM)	Max detection range in 4mm rain (NM)	
		Long Pulse	Short Pulse
Shorelines rising to 60m	20.0	19.9	17.8
Shorelines rising to 6m	8.8	8.3	7.1
Shorelines rising to 3m	6.8	5.9	5.2
SOLAS ships (>5000 gross tonnage)	12.0	11.8	10.2
SOLAS ships (>500 gross tonnage)	8.0	7.3	6.4
Small vessel with radar reflector	3.7	2.3	2.7
Navigation buoy with corner reflector	3.6	2.3	2.6
Typical Navigation buoy	3.3	2.1	2.4
Small vessel of length 10 m with no radar reflector	3.0	1.8	2.2
Channel markers	1.5	0.7	1.1

Table 21: S band radar performance in 16mm rain

Target description	Max. detection range in clear conditions (NM)	Max detection range in 16mm rain (NM)	
		Long Pulse	Short Pulse
Shorelines rising to 60m	20.0	19.4	17.7
Shorelines rising to 6m	8.8	6.9	7.1
Shorelines rising to 3m	6.8	4.5	5.1
SOLAS ships (>5000 gross tonnage)	12.0	10.7	10.1
SOLAS ships (>500 gross tonnage)	8.0	5.9	6.3
Small vessel with radar reflector	3.7	1.4	2.4
Navigation buoy with corner reflector	3.6	1.5	2.3
Typical Navigation buoy	3.3	1.3	2.1
Small vessel of length 10 m with no radar reflector	3.0	1.2	1.9
Channel markers	1.5	0.5	0.8

Table 22: S band radar performance in 4mm rain, sea state 5

Target Description	Max. detection range in clear conditions (NM)	Max. detection range in 4mm rain, sea state 5 (NM)
Shorelines rising to 60m	20.0	19.9
Shorelines rising to 6m	8.8	8.3
Shorelines rising to 3m	6.8	5.9
SOLAS ships (>5000 gross tonnage)	12.0	11.8
SOLAS ships (>500 gross tonnage)	8.0	7.3
Small vessel with radar reflector	3.7	2.7 *
Navigation buoy with corner reflector	3.6	2.6 *
Typical Navigation buoy	3.3	2.3 *
Small vessel of length 10 m with no radar reflector	3.0	Target not visible
Channel markers	1.5	Target not visible

* Short Pulse. In smooth swell the target may be visible up to the stated range. In the presence of strong winds (>20 knots) and breaking waves, detection of the target is likely to be reduced, or may not be visible.

2 Antenna Specification (X-band)

Operating frequency: 9410MHz ± 30MHz

Table 23: Antenna Specification – X-band

Parameter	Aperture Size		
	1.2m (4ft)	1.8m (6ft)	2.4m (8ft)
Horizontal Beam Width, -3dB (maximum)	2.0°	1.3°	1.0°
Vertical Beam Width, -3dB (nominal)	24°	24°	24°
Sidelobes within 10° of Beam (minimum)	-23dB	-23dB	-23dB
Sidelobes outside 10° of Beam (minimum)	-30dB	-30dB	-30dB
Gain (nominal)	29dB	30dB	31dB
Polarisation	Horizontal	Horizontal	Horizontal
Limiting Relative Wind Speed	100kt	100kt	100kt

The rotational speeds shown in Table 24 apply to all sizes of X-band antenna.

Table 24: Rotational Speeds – X-band

Rotational Speed	rpm
Standard	28rpm
High	45rpm

3 Antenna Specification (S-band)

Operating frequency: 3050MHz ± 10MHz

Table 25: Antenna Specification – S-band

Parameter	Aperture Size	
	2.7m (9ft)*	3.7m (12ft)
Horizontal Beam Width, -3dB (maximum)	2.8°	2.0°
Vertical Beam Width, -3dB (nominal)	30°	30°
Sidelobes within 10° of Beam (minimum)	—	-23dB
Sidelobes within 15° of Beam (minimum)	-23dB	—
Sidelobes outside 10° of Beam (minimum)	—	-30dB
Sidelobes outside 15° of Beam (minimum)	-28dB	—
Gain (nominal)	25dB	26dB
Polarisation	Horizontal	Horizontal
Limiting Relative Wind Speed	100kt	100kt

* The 2.7m (9ft) antenna is not type approved to IEC 62388 specification.

The rotational speeds shown in Table 26 apply to all sizes of S-band antenna.

Table 26: Rotational Speeds – S-band

Rotation Speed	Mains Supply Frequency	
	50Hz	60Hz
Standard	25rpm	30rpm
High	48rpm	48rpm

4 Transceiver Specification

The following specification applies equally to X-band and S-band Transceivers (except where shown).

4.1 Mounting Arrangements

The transceiver can be mounted inside the Antenna Turning Unit or it can be a separate module inside the ship's bulkhead.

Table 27: Mounting Arrangements

Option	X-band	S-band
Masthead	Aloft within Turning Unit	
Bulkhead	Waveguide feed to Turning Unit	Co-axial feed to Turning Unit

4.2 Transmitter

Table 28: Transmitter Specifications

Parameter	X-band	S-band
Magnetron Frequency	9410MHz ± 30MHz	3050MHz ± 10MHz
Magnetron Peak Power (nominal)	10kW or 25kW	30kW
Pulse Length/PRF (nominal)	0.05µs/1800Hz (Short Pulse) 0.05µs/3000Hz (Short Pulse optional X-band only) 0.25µs/1800Hz (Medium Pulse) 0.75µs/785Hz (Long Pulse)	
Pulse Generator	Solid-state with Pulse Forming Network driving the Magnetron.	

4.3 Receiver

Table 29: Receiver Specifications

Parameter	Detail
Type	Logarithmic, with Low Noise Front End (LNFE)
Tuning	AFC/Manual
IF (Intermediate Frequency)	Centred at 60MHz
IF Bandwidth (nominal)	20MHz on short and medium pulses 3MHz on long pulse
Noise Factor (nominal)	5.0dB
Dynamic Range (nominal)	80dB

4.4 Performance Monitor

Type Approved systems require a Performance Monitor to be present in the system.

Table 30: Performance Monitor Specifications

Parameter	Detail
Monitored Performance	Radar Receiver and entire Radar System
Type	Transponder
Presentation	Four concentric arcs on the Display Unit. The arcs are of reducing brightness outwards. They show degradation in performance (including the antenna) in 5dB increments relative to the inner arc.

4.5 Display to Transceiver Interface

Table 31: Display to Transceiver Interface

Parameter	Detail
Radar Video Output	Peak amplitude -2.0V to -5.0V
	Shoulder Noise -0.25V minimum
	Input Impedance 75Ω ± 10%
Trigger Output	RS422 differential signals
Display to Transceiver Data	RS422 differential signals

4.6 Options

4.6.1 High Pulse Repetition Frequency

This option, available on 10kW and 25kW X-band Transceivers, increases the short pulse repetition frequency to 3kHz. This can be combined with the 'additional-features' option listed below.

4.6.2 Antenna Rotation in Standby

This isolated closing-contact input is used to make the antenna rotate when the Transceiver is in standby.

This option cannot be used with the Speed Select Input option, see Section 4.6.3.6 '*Speed Select Input (X-band systems only)*'.

4.6.3 Additional Features

The 'additional features' versions of the Tuning Units and Transceivers give the extra Input and output capabilities listed below.

The Synchro or Resolver Output is only available as an option on Scanner Units with 'additional features'.

4.6.3.1 Heading Marker Output

Output 1

Output 1 is an uncommitted contact output from a solid-state relay.

Output 2

Output 2 is an RS422 output, used to drive a differential line.

Both outputs share a common adjustment to correct for small errors in Heading Marker alignment.

4.6.3.2 Azimuth Data Output

4096 Pulse Bearing Output

This incremental output is available either in RS422 format (to drive a differential line), or as an open drain output (to drive a single-ended input).

Synchro or Resolver Bearing Data Output

The Scanner Unit can be fitted with a size 11 Synchro or Resolver. This is not aligned: any alignment must be given externally.

The synchro may be a Control Transmitter (CX) or a Control Differential Transmitter (CDX).

4.6.3.3 External Trigger Input

This 75ohm coaxial input lets the Transmitter synchronise with other equipment on the ship.

When there is a signal at the external trigger input, external trigger will be automatically chosen as the mode of operation.

Transmission occurs approximately 11µs after the leading edge of the pulse.

4.6.3.4 Radar Silence Input

On receipt of this input, the transmitter is switched to standby within one pulse-repetition interval. The transmitter remains on standby as long as the signal occurs.

The input signal format can be selected to be: RS422, RS423 or uncommitted contact.

The sense of the signal can be selected to be active high or active low.

4.6.3.5 Pre-trigger Output

This 75ohm coaxial output lets other equipment on the ship synchronise with the Transmitter.

The leading edge of the positive output pulse occurs approximately 11µs before the magnetron output.

4.6.3.6 Speed Select Input (X-band systems only)

This isolated closing-contact input lets you remotely select between high and low antenna rotation speed.

This option cannot be used with the Antenna Rotation in Standby option, see Section 4.6.2 '*Antenna Rotation in Standby*'.

5 Interswitch Units

The basic single radar system may be expanded by the addition of up to six transceivers and consoles, connected via an Interswitch unit. The two types of interswitch units are:

- 2-Way Interswitch - allows one or two transceivers to be connected to up to four consoles.
- 6-Way Interswitch - allows up to six transceivers to be connected to up to six consoles.

For details on the Interswitch, refer to *Chapter 11 'Interswitch Units'*.

6 Description of VisionMaster Consoles

6.1 250 Tabletop and 340 Tabletop/Deckstand Versions

The 250 tabletop and 340 tabletop/deckstand versions of the VisionMaster FT comprise the following:

- PC Input/Output (PCIO) Unit
- Processor Unit
- Display Unit
- Control Panel assembly

Console assemblies are supplied as a standalone pedestal version (i.e. deck mounted) or a kit version (i.e. without pedestal for installation into an existing console suite).

The deckstand console version is supplied with display side cheeks and pedestal side panels.

6.1.1 PCIO Unit

The PCIO unit is the interface to the external sensors and the connection interface to the top unit assembly.

On a multi-node system all PCIO boards must have the same heading sensors configured.

There are two PCIO Unit variants; one fitted with a standard compass board and one fitted with a special compass board.

The following inputs are provided:

- analogue compass data (stepper or synchro)
- analogue log (pulse) data
- nine serial data inputs, (one being a dedicated serial compass input).

The following outputs are provided:

- six serial data outputs
- three relay outputs for vigilance alarm, remote alarm and system operational
- one buzzer output to monitor.

Note: *Two of the serial input/outputs are used for Interswitch and Monitor Control.*

6.1.2 Processor Unit

The Processor unit is based on an Intel Pentium Processor running Windows XP at 1280 x 1024 resolution, 32 bit colour at 60Hz. It contains the Scan Converter (SC) PCB that processes data from the top unit.

The Processor unit has the following inputs and ports:

- two PS2 inputs, one of which is used by the trackball
- one serial input
- one parallel input
- six USB ports (two ports go to the control panel, two are used for USB security devices, one is used for the PCIO and one is spare).

6.1.3 Display Unit

The display unit is supplied with one of the following flat panel monitors:

Table 32: Monitors Specification

Radar Circle Diameter (mm)	Screen Diagonal (inches)	Aspect Ratio	Pixels Resolution	Pixels Ratio
250	19.0	5:4	1280x1024	5:4
340	23.1	4:3	1280x1024	5:4

The monitor has a power switch, which controls the monitor only, and a brightness adjustment control. The brightness adjustment control has an indexed position, marked as a white line. This indexed position sets the default brightness and calibrated operation.

The monitor supports a minimum of 64 colours.

The display unit provides buffered video and sync output for a VDR. The output is at the same frequency and resolution as the output of the processor unit.

The display unit is designed for a nominal viewing distance of 1 metre.

In CID watch mode the instrumentation text should be readable from at least two metres.

The display unit should be installed in accordance with IMO resolution MSC/Circ.982 'Guidelines on Ergonomic Criteria for Bridge Equipment and Layout'.

6.1.4 Control Panel Assembly

The Control Panel Assembly includes the following variants:

- Control Panel or Trackball
- Power On/Off switch
- USB connector (supplied when the assembly includes a trackball)

The control panel includes the following group of controls:

- Trackball, with left and right keys
- Rotary controls
- Adjustment and Acknowledgement buttons

The control panel is connected to the Processor Unit by a USB cable. The USB cable also provides power to the control panel.

The trackball is connected separately to the Processor Unit by a PS2 cable. This ensures that should the control panel USB fail the trackball can still be operated.

6.2 19" Integrated Tabletop

The 19" integrated tabletop is a unit where the LCD, Processor assembly, PCIO, Control Panel and security device are all contained in a single mechanical housing.

The external controls include a brightness control for the LCD and a power On/ Off switch.

6.2.1 PCIO PCB

The PCIO PCB is the same board as used on the 250/340 Tabletop displays. The PCIO is attached to the base enclosure of the unit.

6.2.2 Processor Assembly

The Processor assembly includes the following modules:

- DVD Rewriter
- Fan with filter

The following inputs and ports are provided:

- two PS2 inputs, for the trackball and a standard PC keyboard for commissioning only
- one serial input
- one network port (10/100/1000 Base-T)
- ten USB ports (two can be used for security devices, two ports are at the front of the unit, one is used for the control panel, one is used for the PCIO and four are spare).

6.2.3 Monitor

The monitor for the 19" Integrated includes a brightness control only.

7 Total Watch

If a node is configured as a Total Watch workstation the following presentation modes will be available:

- Chart Radar
- ECDIS
- Conning Information Display

The operator may switch between presentation modes using the Watch Mode button.

The availability of the watch modes listed above is dependent on the product type and security device installed at initialisation.

8 Radar Specification

8.1 Range Scales & Range Rings

Table 33: Range Scales and Range Rings

Range Scales	Range Rings	Available Pulse Lengths		
NM	NM	Short	Medium	Long
0.125	0.025	✔		
0.25	0.05	✔		
0.5	0.1	✔	✔	
0.75	0.25	✔	✔	
1.5	0.25	✔	✔	
3	0.5	✔	✔	✔
6	1		✔	✔
12	2		✔	✔
24	4		✔	✔
48	8			✔
96	16			✔

8.2 Range Rings and Bearing Scale

Table 34: Range Ring and Bearing Scale Parameters

Parameter	Detail
Fixed Range Ring accuracy	1% of maximum of scale in use, or 25m, whichever is the greater.
Fixed Bearing Scale	Electronically generated scale markers at 1°, 5° and 10° with bearing annotation every 10°.

8.3 Own Ship

There are two types of symbol used to display own ship’s position and heading, defined as follows:

- True Scaled Outline: This symbol is drawn such that its length and width represent the configured length and beam of the ship. True scaled outline is displayed in addition to own ship minimised symbol (heading line and beam line).
- Minimised Symbol: The minimised symbol is drawn where the scaled outline symbol cannot be resolved at the given range scale. The minimised symbol may be drawn in one of two ways, as described below:.
  - Circle Symbol: The circle symbol is drawn if the presentation mode is Chart Radar and the chart display is enabled. The symbol is displayed in addition to the heading line and beam line.
  - Heading and Beam Line Symbol: This symbol appears when the system is in Radar Maps or Charts Off view. The symbol consists of the heading line and beam line only.

If the position data becomes invalid, ship's outline or circle symbol are shown in red and the system switches to water stabilised mode. The heading line and beam line remain in green.

If the heading data becomes invalid, ship's outline and circle symbol are not displayed and heading line/beam line is shown in red. After a short period of time the presentation mode reverts to Head Up. In Head Up the ship's outline or circle symbol re-appear and are then shown in green.

8.3.1 Heading Line

The ship's heading line (HL) is shown as a single line starting from own ship’s CCRP and drawn to the edge of the radar video display.

The bearing of the HL is dependent on the presentation mode.

- In head up (H UP) mode the heading line is always drawn vertically.
- In course up (C UP) mode the heading line is initially drawn vertically and then changes dependent on the heading bearing.
- In north up (N UP) mode the heading line is drawn at the correct compass heading.

The HL may be shown as a stern line (SL) drawn behind own ship. The type of marker (HL or SL) can be selected for one or more transceivers during top unit configuration, *see Chapter 4, Configuration*.

8.3.2 Beam Line

The Beam Line is a line displayed at right angles to the Heading line and extends each side of own ship’s CCRP. The beam line length can be increased from the default length.

8.3.3 Own Ship Vector

A vector of own ship is drawn with a length corresponding to the distance on the video display that own ship will cover, given its current speed, in the current vector time.

Own ship vector is shown in True Vectors only, with a double arrowhead when in ground stabilisation mode, and a single arrowhead when in water stabilisation mode.

8.4 Centring

If the screen has been off centred or panned it can be redrawn with own ship's CCRP at the centre of the video display. All chart data and target positions are also moved in accordance.

8.5 Max View

Max View off-centres the video display at approximately 70% of the range scale radius so that a line drawn from it in the direction of the current course passes through the centre of the video circle.

Max View is not available at a range scale of 96 NM.

In unstabilised presentation mode (Head Up), the direction is reciprocal to the heading marker.

In stabilised presentation mode (North Up or Course Up), the direction is reciprocal to the course over ground (COG), or heading marker if COG is unavailable.

8.6 Off Centring, Panning and GoTo

8.6.1 Off Centring

Own ship's CCRP can be moved anywhere within approximately 70% of the range scale radius. Also a selected screen position (chart marker or object) can be positioned at the centre of the display with own ships position and all other chart and target positions moved in accordance.

Off Centring is not available at a range scale of 96 NM.

8.6.2 Panning

Panning moves a selected chart position or object to the centre of the display. Own ship's position, chart data and target positions are all moved in accordance.

Panning is only available in Standby mode.

8.6.3 GoTo

GoTo moves the centre of the video display to a specific LAT/LON position or a location name specified by the operator.

GoTo is only available in Standby mode.

8.7 Video Processing

Table 35: Video Processing

Function	Detail
Manual Control	Variable controls for gain, anti-clutter sea and anti-clutter rain.
Anti-clutter Auto	Advanced adaptive rain and sea clutter suppression circuits, applied without manual adjustment.
Enhance	Operation available on range scales of 0.75nm and above. Target enhancement is shown over entire video circle, except for a small area around the radar origin. Special circuitry for identifying weak/fading targets.
Scan Filtering	Scan integration for the reduction of noise and radar interference.
Peak Intensification	High level video which by-passes filtering process.
Video Build Up	Scan integration build up of persistent targets.
Video Fade and Trails Decay	Fast fade of video levels and slow decay of trails over the whole image.

8.8 Cursor Readout

The position of the cursor is used to provide the positional coordinates of targets located within the display. The cursor position is displayed as either True or Relative bearing to own ship in Latitude and Longitude.

Table 36: Cursor Readout

Parameter	Detail
Range	Defined as the distance between the CCRP and cursor position as measured in nautical miles.
Bearing	Angle from the CCRP to the cursor position, displayed as true or relative.
Reciprocal Bearing	Defined as bearing from the cursor position to the CCRP, displayed true or relative.
Latitude/Longitude	Corresponding to the current cursor position.
Time To Go	Estimated from the geographical distance between the CCRP and the cursor position divided by speed over ground (in ground stabilised mode) or speed through water (in water stabilised mode).

LAT/LON readings are not available if the following happen:

- own ship's position is lost when in Transmit
- the compass is unaligned
- there is a compass error

8.9 Presentation Modes

Table 37: Presentation Modes

Parameter	Detail
Head-Up (unstabilised)	Maintained relative to the ship's fore/aft axis. Only Relative Motion mode is available.
North-Up	Maintained relative to a fixed true bearing. Only available with a valid compass input. Relative Motion and True Motion modes available.
Course-Up	

8.10 Motion Modes

8.10.1 Relative Motion

Own ship is shown at a selected point or fixed point on the radar screen. The advantage of RM is that a constant range ahead of own ship is maintained making it not necessary to reset the display as in TM.

RM is available in all presentation modes (Head Up, North Up and Course Up) and at all range scales.

If the display is unstabilised (i.e. Head Up) only RM is available.

8.10.2 True Motion

Own ship moves across the radar screen at the selected ground or water stabilised velocity.

TM is available on range scales 0.5 NM to 48 NM. If the range scale is outside these limits, the motion mode will temporarily revert to RM.

TM is available with North Up or Course Up stabilised presentation modes only.

A disadvantage of the TM presentation mode is that the radar display range ahead of own ship decreases as own ship moves across the display. The display has to be reset, automatically either when own ship reaches approximately 70% of display radius, or manually as required.

8.10.2.1 True Motion – Water Stabilised

Own ship moves across the radar picture according to the input of heading (derived from the compass) and speed through water (STW) (derived from the waterlocked log).

With water stabilisation, stationary targets will appear to move due to tide/ leeway and effects of current.

8.10.2.2 True Motion – Ground Stabilised

Own ship moves across the radar picture according to the inputs derived either from tracking a fixed echo (echo reference) target, or from a fixed position sensor. The fixed position sensor must be approved in accordance with the requirements of IMO in resolution MSC.112(73).

A ground stabilisation presentation is provided using course over ground (COG) and speed over ground (SOG) inputs, obtained when a position sensor such as GPS is providing data, or locked to an echo fixed with respect to ground.

With ground stabilisation, the ship will show its true movement over the ground. Tide, leeway and effects of current are removed.

8.11 Trails Modes

Video trails may be displayed in True or Relative mode.

The Trails mode selection is reflected in the vector mode, i.e. if the mode is True Trails then True Vectors will automatically be selected.

If a range scale lower than 0.5 NM is selected in True Trails then the trail mode will change to Relative. If the display becomes 'unstabilised' only Relative Trails are available.

Long, Short and Permanent trails are selectable. Trails can be removed from the display by selecting Off, or the trails time reset to zero by selecting Reset. The long and short trail lengths are shown on the display, and are dependent on the selected range as follows:

Table 38: Trails Parameters

Range Scale NM	Short Time	Long Time
0.125	10 seconds	30 seconds
0.25	10 seconds	30 seconds
0.5	15 seconds	45 seconds
0.75	15 seconds	45 seconds
1.5	30 seconds	90 seconds
3	30 seconds	90 seconds
6 and above	1 minute	3 minutes

Permanent trails are timed for up to 60 minutes, and can be displayed until manually reset.

8.11.1 Relative Trails

In unstabilised mode (Head Up), relative trails will represent the exact motion of objects relative to own ship.

In stabilised mode, the trails are generated from the azimuth stabilised position of own ship. Stationary objects will produce trails if own ship moves its position relative to the objects, whether by tide or leeway effects on own ship, or by own ship's actual motion.

The ground stabilisation or water stabilisation reference has no effect on relative trails.

8.11.2 True Trails

In True Trails mode the trails are generated using the water or ground stabilisation of own ship.

8.11.2.1 True Trails – Water Stabilised

Own ship moves across the radar picture according to the input of heading (derived from the compass) and speed through water (STW) (derived from the log).

With water stabilisation, trails attached to fixed targets give a direct indication of tide or current set and rate experienced by own ship. Leeway effects, if significant, will produce trails on stationary targets.

Moving targets generate trails, representing their true heading and speed, but modified by the tide or current effects referred to above.

8.11.2.2 True Trails – Ground Stabilised

Own ship moves across the radar picture according to the course over ground (COG) and speed over ground (SOG) inputs, obtained when a position sensor such as GPS is providing data; or locked to an echo fixed with respect to ground.

Moving targets generate trails, representing their own COG and SOG. Stationary targets do not produce trails.

8.12 Colour Management

The Colour Management feature utilises common colour sets comprised of RGB values that are calibrated for the monitor in use by the system.

On a multi-node system all nodes, by default, are affected by a global colour set change The operator may change the colour set from any node.

Table 39: Colour Sets

Colour Set	Inside Radar Circle	Outside Radar Circle
Day Bright	Blue background, yellow radar video	White text on light grey background
Day Black	Black background, yellow radar video	Off white text on darker grey background
Dusk	Black background, yellow radar video	Light grey text on dark grey background
Night	Black background, yellow radar video	Grey text on black background
Night Red	Black background, red radar video	Red text on black background

8.12.1 Brilliance Groups

The brilliance groups feature initially provides predefined brilliance groups, which can be independently adjusted by the operator.

8.12.2 SENC Data

The SENC feature ensures adjustments made to the brightness and contrast settings on the monitor will enable SENC data such as coastlines, safety contour and other objects to be adequately displayed.

8.13 Synthetics Control

The Synthetics control suppresses all synthetics other than the radar video.

8.13.1 Synthetics Colours

- Readout Data is invalid and unusable : Red
- Readout Data is degraded : Amber
- Readout Data is valid : Green
- Own Ship Invalid Synthetics : Red

8.14 EBLs, VRMs & ERBLs

8.14.1 Variable Range Marker (VRM)

Two independent VRMs are available. Each VRM is a ring of long dashes, the first and second VRMs having different mark/space ratio of line dashes.

VRMs can be offset or dropped to a LAT/LON referenced position. If the VRM is offset from the CCRP, the centre of the VRM is indicated by a dot. If the VRM is activated and the range scale is changed the VRM maintains its range.

8.14.2 Electronic Bearing Line (EBL)

There are two EBLs, variable from 0° to 359.9° in 0.1° increments. Each EBL is a line of dashes, the first and second EBLs having different mark/space ratio of dashes.

When an EBL is turned on the value of its associated VRM is also shown.

The origin of an EBL can be offset or dropped to a LAT/LON referenced position. If the EBL is offset from the CCRP, its origin is indicated by a dot.

8.14.3 Electronic Range and Bearing Line (ERBL)

When a VRM is turned off, the VRM function is merged with the EBL to form an ERBL. There is a marker on the ERBL where the VRM intersects to indicate the range setting of the VRM.

8.15 Trial Manoeuvre

A Trial Manoeuvre is based on speed, rate of turn and course through water values entered for own ship. The following parameters are used to define the manoeuvre:

- A true course to follow after the manoeuvre.
- A true speed to be maintained during and after the manoeuvre.
- A delay time before the manoeuvre is to start.
- A rate of turn for the manoeuvre.

Table 40: Trial Manoeuvre

Parameter	Detail	Power on default
Final True Course	0 to 359.9°, in 0.1° increments.	000.0°
Manoeuvre Speed	0 to 75kts.	15kt
Delay Time	0 to 30 minutes, in 0.1 minute increments.	0.0 min
Rate of Turn	1°/min to maximum set rate of turn in initialisation	Ownship's commissioned standard rate of turn
Alarm raised	30 seconds before manoeuvre starts.	

The manoeuvre course and speed is either STW or SOG, depending on the currently selected stabilised mode (ground or water).

8.16 Alarms and Warnings

All alarms and warnings are indicated by both audible and visual means.

Alarms are initially displayed on the Alarm Status Indicator, from where they can be acknowledged. Some alarms are automatically cleared by the system. A list of all currently active and unacknowledged alarms and warnings is shown in the Alarms Display.

There are two types of announcement sources: internal and external. Internal announcements are generated by the VisionMaster FT system. External announcements are those relayed to the alarm management system from other equipment.

Table 41: Alarms and Warnings

Type	Indication	Display Area
Unacknowledged Active Alarm	Flashing red	Indicator and Display
Unacknowledged Active Warning	Flashing orange	Indicator and Display
Unacknowledged Inactive Alarm or Warning	Flashing grey	Indicator and Display
Acknowledged Active Alarm	Steady red	Display only
Acknowledged Active Warning	Steady orange	Display only
Acknowledged Inactive Alarm or Warning	No indication	Removed from both areas

8.16.1 Alarms and Warnings on a Multi-Node System

On a multi-node system generated alarms and warnings are designated as 'system' or 'local'. System alarms or warning are always displayed and audibly announced on all nodes in the system. Local alarms or warnings are always displayed and audibly announced on the node that generated the local announcement. An alarm or warning that is designated as local may optionally be displayed and audibly announced on any node in the system other than the one upon which it was generated.

Acknowledgement of a system alarm or warning at one node acknowledges that alarm or warning at all nodes on the system.

8.16.2 Prompts

Prompts appear directly underneath the Alarms and Warnings field and can be either temporary or permanent.

Permanent prompts denote a state or mode of operation, provide instruction to the operator, or may display settings.

Temporary prompts are general system responses to a user interaction and are displayed briefly for a commissioned time period.

8.16.3 Alarm Buzzer

The alarm buzzer is located in the monitor and controlled by the PCIO Unit.

The alarm buzzer may be temporarily muted for a configurable period of time. The mute alarm buzzer is a global mute across all nodes.

8.17 Sensors

8.17.1 Serial Interfacing

The system supports acquisition of sensor data via serial interfaces having 1000V optical isolation, connected to the PCIO board.

The sensor data must comply with international specifications IEC 61162-1 and IEC 61162-2.

On a multi-node system all nodes use the same sensor for each type of sensor data, for example, GPS1 for position data.

All serial inputs can accept RS232 or RS422 format.

The system can accept the following sentences (defined at system configuration) to obtain the types of data listed in Table 42.

Table 42: Sentences and Sensor Data

Sentence	Data
ACK, ALR	Alarms
DBT, DPT	Depth
DTM	Datum Offset
GGA, GLL, GNS	Geodetic Position
HDG	Magnetic Heading, Deviation and Variation
HDT	True Heading
MWV	Wind Speed and Angle
RMC	Position, Ground Speed, Course over Ground
ROT	Rate of Turn
RTE	Routes
THS	True Heading and Status
TLB	Target Label
VBW	Ground Speed and Water Speed
VDM	AIS data
VDO	AIS data (own ship)
VHW	Water Speed
VTG	Ground Speed and Course Over Ground
WPL	Waypoints for Routes
ZDA	Date and Time, Local Time Offset

The following table lists the PCIO unit serial inputs available and configurable for IEC 61162-1 and IEC 61162-2 sensor data.

Table 43: PCIO unit serial inputs

IEC Type	Baud Rate	Serial Input
IEC 61162-1	4800	All IEC 61162-1 sensors via serial inputs TSCD, TSCE, TSCF, TSCG TSCH and TSCJ of PCIO.
IEC 61162-2	38400	HDG, HDT and ROT sentences via serial input TSCA of the PCIO. All other IEC 61162-2 sensors via serial inputs TSCB and TSCC. TSCB and TSCC may be configured to accept 4800 and 9600 baud.

Serial inputs TSCF, TSCG TSCH and TSCJ can be configured to operate at 9600 baud, although these serial inputs cannot be configured as a heading source.

If a serial input is used for tracking, then the serial form must conform to IEC61162-2, i.e. 38400 baud and a message rate of approximately 50Hz.

All serial outputs are available in RS232 and RS422 format (on different terminal positions).

8.17.2 Azimuth Stabilisation

A standard compass board allows interfacing to most stepper and 360:1 ratio synchro compass types. A special compass board provides interfacing to 180:1, 90:1, 36:1 and 1:1 ratio synchros. This interface board is mounted in the PCIO unit.

Interfacing with compasses that have a serial output is also available. However, the preferred interface is a stepper or synchro compass.

- Maximum Rate of Turn 1200°/m
- Course Accuracy within 0.5° of input source.

See Chapter 3 '*Installation*', Section 7.2 '*Compass Cabling and Link Settings*' for details of compass types and cabling details.

8.17.3 Pulse Log Input

The system supports acquisition of single axis water speed data via a pulse log interface, complaint to IMO resolution A 824 (19). The pulses can be TTL or 'closed contact' type. The open circuit potential for the Pulse Log input is approximately 5V.

The following interface options can be selected:

- Whether or not a pulse log is connected, default is `not connected'.
- The polarity of the pulses (positive or negative).
- The pulse log rate, 100 to 2560 pulses per nautical mile.

Table 44: Pulse Log Input

Parameter	Detail
Speed Range and Input	0 to 75Kt
Steady State Speed Accuracy	±5% or ±0.25Kt, whichever is the greater, ignoring errors defined from the input source.

8.17.4 Manual Sensor Data

Sensor data can be manually entered by the operator to the following criteria.

Table 45: Sensor Data Manual Entry

Data Type	Manual Entry Requirements
Course Over Ground Vessel Set	A range of 0.0º to 359.9º, and resolution of 0.1º.
Geodetic Position	A range of 89°48.000' south to north latitude and 180°00.000' east to west longitude, and resolution of 0.001 minute, in latitude and in longitude.
Speed Over Ground (single axis only) Vessel Drift Speed Through Water (single axis only)	A range of 0.0 to 99.9 knots, and resolution of 0.1 knots.

8.17.5 Computed Data

The term "computed data" is used to indicate the source of data when the system itself is responsible for computing this data, usually based on other types of sensor data received conventionally via an interface.

8.17.5.1 Radar Target Based Data

The system provides the following target based data:

- echo referenced velocity
- echo referenced position

The values of both target based data is determined by the operator selecting a fixed-position radar target, for an echo referenced position a geographic position is also assigned. The system then determines the ship's ground velocity or position based on changes in the range and true bearing to the target.

8.17.5.2 Other Computed Data

The system provides the following additional computed data:

- Set and Drift
- Ground Velocity (including ground speed and course over ground)
- Water Speed
- Rate of Turn (calculated on selected Heading source).

8.17.6 Dead Reckoning of Position

Where valid position data for own ship is not received the system establishes a computed position by dead reckoning from the last valid position received using own ship's direction and speed.

The timeout limit applied to valid dead reckoning values defaults to 30 seconds.

The system considers position data to be invalid if the most recent usable sample data received from a position sensor is older than the timeout limit.

8.18 Target Data

8.18.1 Tracked Targets

The Tracker allows targets to be acquired manually by the operator or automatically by the auto-acquisition zones. The tracker parameters are shown below.

Table 46: Tracker Parameters

Parameter	Value
Tracking range	0.25 to 40.0 nm
Acquisition range	0.25 to 40.0 nm
Cancellation range	0.0 to 40.0 nm
Max number of tracked targets in a single node system	100
Max number of tracked targets in a CAT 2 single node system	60
Max number of tracked targets in a multi node system	200
Max tracking velocity	150 knots true
Time to display motion trend vector	After 12 good plots from acquisition
Vector Length	1 to 60 minutes in 0.1 minute increments
CPA/BCR Alarm Settings	0.1 to 20 nm in 0.1 nm increments
TCPA/BCT Alarm Settings	1 to 99 minutes in 1 minute increments

All tracked targets are monitored for Lost Target. Only established tracked targets are monitored for CPA/TCPA and bow crossing infringements.

All distances and times are relative to the own ship’s physical location.

The velocity of the tracked target is through the water if own ship's selected speed is water stabilised, or over the ground if own ship's selected speed is ground stabilised.

When a tracked target's predicted range is less than the minimum tracking range the tracked target is dead reckoned using a constant velocity without any Lost Target alarms being raised.

Any VisionMaster FT console required to meet the target accuracy scenarios of IEC60872-1 or IEC60872-2 must be supplied with compass information in analogue form, or in serial form conforming to IEC61162-2.

8.18.1.1 Tracking Targets on a Multi-Node System

Whenever the limits for CPA/TCPA or BCR/BCT are changed, they are distributed to all other nodes. This ensures that all nodes are evaluating the alarm condition using the same values. Each node evaluates the alarm conditions on the targets processed by that node.

Whenever a target alarm (CPA, BCR, lost target) is acknowledged on a node, all targets of the same number on other nodes have their alarm condition acknowledged. If other nodes have alarms for targets not present on the acknowledging node, the alarm condition for these targets remains unchanged.

8.18.1.2 Automatic Dropping of Targets

An auto-drop mode can be enabled in which individual AIS or tracked targets, deemed not to be a threat to own ship, are automatically dropped by the tracker without an alarm being raised.

8.18.2 Target Vectors

Vectors indicate the velocity (speed and direction) of own ship and moving targets. All vectors are shown as a dashed line beginning at own ship CCRP or the target origin. The length of the vector indicates speed and its bearing indicates direction.

The vector mode determines whether the vectors represent the true velocity of targets or their velocity relative to own ship. The vector mode is either True (T) or Relative (R) and is aligned with the Trails mode (relative or true).

8.18.3 AIS Targets

AIS targets are displayed in a Sleeping or Activated state. AIS targets can become activated either manually or automatically. An activated AIS target can be manually changed to Sleeping.

An activated AIS target is displayed with heading and speed/course vector, if heading data is invalid the course vector is shown in place of the heading line.

Sleeping targets will become automatically activated:

- when selected by the operator
- when the target infringes the CPA/TCPA limits
- when the target enters an auto-acquisition zone

The following alarm states apply to all AIS targets:

- Infringe bow crossing limits (range and time)
- Dangerous target (CPA/TCPA infringement)
- Enter acquisition zone
- Lost (sleeping targets do not raise a Lost alarm)

The system uses ship categories and intervals to define when a target is shown as lost.

AIS targets are prioritised as Class A or Class B, according to importance. The system can display class A targets only, class B targets only, or class A and B.

Table 47: Ship Categories and Lost Target Intervals

Ship Category	Lost Target Interval (Class A)	Lost Target Interval (Class B)
anchored or moored and speed <= 3 knots (class A), <= 2 knots (class B)	18 minutes	18 minutes
anchored or moored and speed > 3 knots	60 seconds	18 minutes
0 <= speed <= 14 knots (class A), 2 to 24 knots (class B)	60 seconds	180 seconds
0 <= speed <= 14 knots and changing course	60 seconds	180 seconds
14 < speed <= 23 knots	36 seconds	180 seconds
14 < speed <= 23 knots and changing course	36 seconds	180 seconds
speed > 23 knots	30 seconds	180 seconds
speed > 23 knots and changing course	30 seconds	180 seconds

When an AIS target is activated the system displays alphanumeric information on the target.

In addition to the tracker parameters shown in Table 46, for AIS targets the system displays the additional information of the target's current heading.

Up to 200 AIS targets can be displayed in the video circle at any one time. The targets closest to the CCRP will be displayed.

When AIS targets are not displayed, received AIS transmissions continue to be processed so that the targets will be displayed if they move into the closest 200 to the CCRP.

8.18.4 Multi-Node Targets

Targets are distributed to all other nodes to allow correlation. Only one node is responsible for correlating targets at any one time. The correlation information is distributed to ensure target numbering across all nodes is identical.

On an Radar/Chart Radar only local tracked targets, acquired by the operator on that node, are displayed. These tracked targets will not appear on other Radar nodes unless the operator manually acquires the same target. In the same way AIS targets may be activated and set to sleeping on an individual node without appearing on other nodes.

8.18.5 Auto-acquisition Zones

Two annular auto-acquisition zones can be defined by the operator. Any target that enters these areas is automatically acquired and tracked by the system. Each acquisition zone can be turned on or off. Auto acquisition zones are relative to own ship's heading and are disabled after the heading data becomes unusable.

The default auto-acquisition zones are two sections of an annulus. The zone annulus is defined from the start bearing clockwise to the end bearing, i.e. the arcs will extend clockwise from the start position. The ranges and depths are the same, irrespective of whether a metric, NM, or SM display has been selected.

If an attempt is made to define a zone with a subtended angle of >354º, the result will be a 360º zone.

Table 48: Auto Acquisition Zone Parameters

Limits on Annulus		
Parameter	**Min**	**Max**
Range	1.0 NM	40.0 NM
Depth	0.4 NM	2.0 NM
Bearing (when not a full annulus)	6°	354°

The initial auto-acquisition zone definitions (i.e. the first time the system is run) are shown below.

Table 49: Auto Acquisition Default Zone Definitions

Default Zone Definitions	
Zone 1	
Range	4 to 5 NM
Bearing	270° to 90°
Zone 2	
Range	12 to 14 NM
Bearing	270° to 90°

8.18.6 Cancel All Targets

When this option is selected tracked targets are dropped and AIS targets set to a sleeping state if they meet the following criteria:

- It is not the echo reference target
- The target is an AIS target that does not infringe the CPA/TCPA or Bow Crossing alarm criteria
- The target is an AIS target and is not in an auto-acquisition zone.

8.18.7 Past Position Dots

It is possible to display up to four past position dots indicating the past positions of all tracked targets, depending on how long the target has been tracked.

Table 50: Past Position Dots Intervals

Parameter	Detail
Dot time intervals	15 sec
	30 sec
	1 min
	2 min
	4 min
	8 min
	16 min

The position of the dots will match the trails, i.e. they will be true position dots when the trails are true, and relative dots when the trails are relative.

8.18.8 Test Targets

Test Targets include a fixed test target pattern which is stationary relative to own ship, and a number of user defined movable test targets (the number is defined by the radar interface board). Test targets' video is mixed with the radar video so that they can be displayed and tracked in exactly the same manner as live targets.

Both fixed and moveable test targets are displayed on the screen as flashing crosses.

When either test target is on, a letter 'X' is displayed at the bottom of the presentation area.

When test targets are displayed on a simulated radar video the letters XX are displayed.

8.18.9 Track Table Output

Track table transmits data for own ship, system information and all system target data. This data includes course, speed, position, type (e.g. tracked, AIS etc.) and source of target (e.g. tracker).

The CCRP is used as the data reference point.

The system provides RS232 and RS422 serial output of the track table data with the following options:

- No output (default)
- Output as IEC 61162-1 (i.e. serial interface operating at 4800 Baud)
- Output as IEC 61162-2 (i.e. serial interface operating at 38400 Baud)

The track table output contains the following message types, output every two seconds:

- Own ship data (OSD)
- Radar system data (RSD)
- Tracked target message (TTM) - maximum of ten every two seconds.

8.19 Navigation Tools

8.19.1 Navigation Marks

Navigation marks can be defined anywhere within the video circle by the operator. Each Nav mark corresponds to a LAT/LON position.

8.19.2 Parallel Index Lines

Up to five parallel index (PI) lines can be displayed simultaneously, on range scales of 0.25 NM and above. Multiple sets of PI lines can be defined and stored on the system. Each PI Line spans the video circle.

Sets of PI lines can be imported or exported between consoles.

Saved PI lines are distributed among system nodes.

8.19.3 Mapping Objects

A selection of pre-defined mapping objects (lines, danger points, areas, buoys, nav marks and beacons) can be defined by the operator.

Mapping objects can be saved as groups. Grouped objects and geographic mark-up areas can be saved, or saved and retrieved from a shared database and imported and exported to or from other nodes or external drives.

8.19.4 Parallel Cursor

A rotating parallel cursor, centred on the CCRP, can be displayed. The parallel cursor consists of two orthogonal lines (axes) extending to the edge of the video circle with their axis crossing point at CCRP. A series of equally spaced parallel lines, spaced at the currently set range ring interval, are shown on either both sides of the CCRP (full mode) or one side of the CCRP (half mode).

The parallel cursor bearing can be true or relative. In True Bearing the parallel cursor is azimuth stabilised (i.e. maintains a constant orientation with respect to north). In Relative Bearing the parallel cursor is unstabilised (i.e. maintains a constant orientation with respect to ship's heading).

8.19.5 History Tracks

History tracks are lines indicating the past locations of position sources. Two history track lines can be displayed simultaneously; primary and secondary.

The primary history track indicates the past location of own ship from data provided by the selected position source. Secondary history tracks indicate the past locations using other selected position sources.

Time marks show the time of day that own ship was at specific position, and may be displayed regularly along the history track.

Event marks may be added to the primary history track, with each event mark time-stamped adjacent to the event symbol.

The displayed track length is variable from 0.0 minutes to 8.0 hours. The default period is the maximum history track length of 8 hours.

8.19.6 Display Settings

8.19.6.1 Ownship

The display of the following own ship synthetics data may be controlled:

- Beam Line length adjustment.
- Display of the following:
  - True Scale Outline
  - Stern Line
  - Antenna position
  - Predicted ship position
- Own ship vector settings
- Predicted Vector/Path

8.19.7 Next Turn EBL

Next Turn EBL is data transferred from an external Voyage Management System (VMS), which can then be represented graphically in the video circle.

8.19.8 Grid

A LAT/LON grid can be displayed. The grid values are taken from the latest valid position of the CCRP, as reported by the position sensor.

The grid can display between two and four LAT/LON lines, based on the scale of the display.

The LAT/LON grid will not be displayed when the chart orientation is 45° to 135° and from 225° to 315°.

8.20 Routes

Route plans may be created, stored and exported. A route is made up from a number of user defined waypoints. A route can contain up to 200 waypoints.

When a route is monitored, the system tracks own ship's movement in relation to the route plan, and provides notification of wheel-over points, dangerous objects in the area, and other required information.

Up to a 100 route plans may be saved to a database, which are then editable from any node on the system. If the same route plan is being edited on more than one node at the same time, the operators at the other editing nodes are notified when the plan is saved.

8.20.1 External Route Plans

External Route Plans (ERPs) are route plans that were created and stored on a GPS unit, a legacy VMS unit, or some other device external to VisionMaster FT. These route plans may be displayed if they are sent using IEC 61162 RTE and WPL sentences over a serial connection.

Only basic monitoring (cross-track distance, distance to waypoint, and estimated time to waypoint) is provided for ERPs. Track control, return-to-plans, alarms, and the ability to save are not provided for ERPs.

8.21 Charts

Chart information uses the same reference and coordinate criteria as the radar and AIS, including datum, scale orientation, CCRP and azimuth stabilisation mode.

Radar information has priority over chart information. Chart data is displayed such that the radar is not substantially masked, obscured or degraded.

All chart information may be temporarily removed from the video circle by a single operator action (Synthetics Off).

All chart information, with the exception of coastlines, may be temporarily removed from the video circle by a single operator action.

A Chart Radar node allows vector charts only to be displayed. The system supports both C-MAP and SevenCs vector chart engines.

8.21.1 C-MAP Chart Formats

The C-MAP chart engine supports the following chart formats:

- C-MAP Professional (unofficial chart format*)
- ENC (official S-57 encypted charts converted to C-MAP's proprietary chart database format)
- Professional + (extended version of CM93v3 charts supplied on DVD)

C-MAP presentation libraries are supported.

8.21.2 SevenCs Chart Formats

The SevenCs chart engine supports the following chart formats:

- S-57 (unencrypted official chart format†, implementation based on IHO S57 standard)
- S-63 (encrypted S-57 official chart format, implementation based on IMO S63 standard).
- VPF (unofficial chart format. The content, format, and structure of VPF are specified by the MIL-STD-2407).
- DirectENC (ChartWorld).

SevenCs presentation libraries are supported.

* Unofficial chart format is data which does not comply with the S-57 Edition 3 format (document published by National Hydrographic Offices).

† Official chart format data which complies with the S-57 Edition 3 format.

8.21.3 Chart Display Mode

Charts can be displayed in the following modes:

- Chart Filled - the land colour fill shows as a different colour than the water and chart objects are filled with the applicable colours.
- Chart Unfilled - the land and sea are the same colour and coastlines, safety contours and other objects are shown in outline only.
- Charts/Maps Off - no chart information is displayed.

The display of charts is suppressed if the presentation mode is in Head Up, i.e. unstabilised.

8.21.4 Chart Feature Sets

The following types of chart feature sets can be selected: Base (default), Standard and Other.

Base is the bare minimum allowable feature set. Standard is a superset of Base that includes additional information. Other is also a superset of Base, but may contain information not available in Standard.

Some features are common across chart formats, while others are particular to a specific format. A chart feature set can be customised by applying specifically selected features.

The selection of chart feature sets and the application of custom features is governed by the current range scale. All feature sets are available and custom features can be applied at range scales of 12 NM and below.

At higher range scales the following feature sets can be applied.

- at 96 NM Base chart set only is available;
- at 48 NM Base and Standard chart sets are available;
- at 24 NM Base, Standard and Other chart sets are available.

8.21.5 Chart Match

Chart Match allows the operator to correct any discrepancy between the radar video and the chart display. By selecting the radar object and the chart object to be matched, an offset can be created that is applied to the chart display. This offset persists until the chart match is cancelled, or until the chart cells displayed on the screen at the time of the selection are no longer on the screen.

Chart Match includes the capability to specify a range and bearing adjustment to be applied to any loaded chart in order to alter the chart's relative position to the own ship's CCRP plotted position.

8.21.6 Chart Updates

All chart updates made by the operator are logged in the chart engines. A record of C-MAP updates is kept in the C-MAP database; the SevenCs engine keeps a record of updates in a log file.

If an update is not properly applied or the update is out of sequence the update is terminated, an update rejection is logged by the system and a warning of this action is given.

8.21.7 Chart Installation

Chart Installation enables the loading of charts onto the system hard drive from a chart installer utility. If the chart type supports network installation, chart installation can be made from any node on the system.

Charts can be installed using a USB key. Where C-MAP charts are being installed the key used will be pre-assigned with a unique user ID.

Where S-57 charts are being installed the key used will include information such as the S-57 user permit.

For information on the chart installer see Volume 2, Chapter 3 '*Chart Installation*'.

8.21.8 Chart Permissions

Information on chart license and permit expiration can be viewed via a secondary window. When a chart license or permit is about to expire a warning is generated. If the C-MAP license has expired the system stops displaying the respective charts.

8.21.9 Chart Depths/Heights

The following depth and height safety threshold values may be applied:

Table 51: Chart depth/height threshold values

Depth	Default	Min	Max
Safety Depth	30 metres	Distance from water surface to bottom of ship's keel, plus own ship's safety buffer (usually half ship's beam)	N/A
Safety Height	30 metres	Distance from ship's highest point to lowest point of the overhead obstruction.	N/A
Shallow Contour	2 metres	0 metres	30 metres (default safety depth)
Deep Contour	30 metres	30 metres (default safety depth)	N/A

8.21.10 Chart Query

The chart query facility enables detailed information on geographic objects and specific chart areas to be made.

The following query options can be selected:

- Filter - search by geographic type (points, lines, areas, arcs and/or 3D and cluster points)
- Area Size - search area as a factor of scale (small, medium, large)

8.21.11 Chart Dangers

Safety checking continuously searches the chart database and mariner objects database for objects that could endanger the safety of own ship.

Contours, prohibited areas, and areas with special conditions are considered dangerous if their depth is less than own ship's safety depth or no depth is defined for that object.

All objects above the water are considered dangerous if their clearance is less than own ship safety height. When safety checking detects a dangerous object, a Chart Dangers alarm appears and a Dangers icon is displayed with a red background.

Own ship's safety region is indicated by a lined area following own ship's course over ground, as own ship moves across the screen the line is redrawn every 30 seconds. The time length of the safety region line may be changed.

8.22 Safety Checking

Depth, height and look-ahead time safety checking parameters may be specified on any node and then synchronized between all nodes.

Each node only lists the objects of concern detected by own ship safety checking the charts on that node. The viewed state of objects of concern is node independent and not distributed. The periodic own ship safety checking is triggered on all nodes at the same time. Only one alarm is raised for all chart dangers and cautions found on all nodes during the safety checking operation.

8.23 Time Management

Time management is controlled by the selected sensor source, for example GPS. The selected time sensor is used by the system to synchronize the time for all nodes.

Time Management provides the operator with the option of entering a local date and time offset from GMT in hours and minutes. The time zone offset may then used by the system to display local time.

8.24 Data Logging

The system logs the following voyage data to XML files:

- Sensor
- Own ship/CCRS
- Routes
- Targets
- Charts

Node state information for all nodes in the system is logged to XML files at a periodic default rate of 5 seconds (configurable between 1 and 60 seconds).

8.25 Autopilot

If compliance with international standards for Track Control * is required, the VisionMaster system is interfaced with a Sperry NAVIPILOT 4000, this device is known as an Autopilot.

The Autopilot interface enables operator selection of three heading control modes, or the system may automatically switch the heading control mode under certain failure scenarios. The Autopilot control modes are:

- Autopilot Heading Mode
- VisionMaster Heading Control
- Track Control

8.25.1 Autopilot Heading Control

Autopilot heading control enables the Autopilot to have full control of ship's heading. In this mode the heading order and turn rate is set at the Autopilot.

8.25.2 VisionMaster Heading Control

VisionMaster Heading Control is the default steering mode when NAV Mode (external heading control) is selected from the Autopilot. In this mode the heading order and turn rate is set at the VisionMaster console.

8.25.3 Track Control

Track Control mode allows the VisionMaster system to automatically adjust the heading order and the rate order to steer own ship along the track of a monitored route.

* Track control is intended to keep own ship automatically on a monitored route, under various conditions and within the limits related to the ship's manoeuvrability.

9 ECDIS Specification

The following ECDIS specification sub-sections are included where there are differences between the ECDIS and Radar specification, or where the ECDIS specification includes features additional to radar. For information on common features, refer to Section 8 '*Radar Specification*'.

If a workstation is to be used as an ECDIS, either configured as a standalone or as a Total Watch, then the system requires an Uninterruptible Power Supply (UPS) to be fitted.

See *Chapter 3 'Installation'* for further information on connecting a UPS.

9.1 Scale Ratio

Scale Ratio includes two selection modes: Automatic and Manual.

- Auto Scale - the current scale ratio of the display area for ownship is regularly checked against the compilation scale of the largest chart cell. If the scales differ, the scale ratio is changed to match the compilation scale of the chart.
- Manual Scale - the scale ratio that may be selected manually is between 1:500 and 1:8,000,000.

Table 52: Scale Ratio, Range Rings and Pulse Lengths

		Available Pulse Lengths		
Scale Ratio	**Range Rings (NM)**	Short	Medium	Long
1:4,000	0.05	✔		
1:5,000	0.05	✔		
1:8,000	0.1	✔	✔	
1:10,000	0.25	✔	✔	
1:15,000	0.25	✔	✔	
1:20,000	0.25	✔	✔	
1:30,000	0.25	✔	✔	
1:40,000	0.5	✔	✔	
1:50,000	0.5		✔	✔
1:80,000	1		✔	✔
1:100,000	1		✔	✔
1:150,000	2		✔	✔
1:200,000	2		✔	✔
1:300,000	4		✔	✔

Note: *Only the scale ratios where radar video is present are listed in Table 52.*

9.2 Own Ship

There are two types of symbol used to display own ship’s position and heading, defined as follows:

- Outline Symbol: This symbol is drawn such that its length and width represent the configured length and beam of the ship.
- Circle Symbol: The circle symbol is displayed if the outline symbol cannot be resolved at the given scale.

Either symbol is shown in red if the position data is invalid. If heading data is invalid the outline symbol is not displayed, although the circle symbol remains in the system colour.

9.2.1 Heading Line

The ship's heading line (HL) is shown as a single line starting from own ship’s CCRP and drawn to the edge of the chart display.

The bearing of the HL is dependent on the presentation mode.

- In Course Up (C UP) mode the heading line is initially drawn vertically and then changes dependant on the current heading bearing.
- In North Up (N UP) mode the heading line is drawn at the current compass heading.

The HL may be shown as a stern line (SL) drawn behind own ship. The type of marker (HL or SL) can be selected for one or more transceivers during top unit configuration, *see Chapter 4, Configuration*.

9.3 Presentation Modes

There are two presentation modes available: North Up and Course Up.

- **North Up** - power on default mode. True north is at the top of the chart window with the North arrow pointing vertically and ship’s heading marker shown at the appropriate bearing. North Up is selected when a valid compass input is unavailable.
- **Course Up** - the ship’s bearing is shown pointing north with the North arrow pointing in the direction of true north. A valid compass input is required for Course Up mode.

9.4 Motion Modes

The only motion mode currently available for ECDIS is True Motion (TM).

In TM mode the movement of own ship is confined to a TM limits box, the size of which may be defined by the user. When own ship reaches the edge of the TM limits box, and true motion reset limits are enabled, the display is reset automatically, or reset manually as required.

9.5 Trails

Long, Short and Permanent trails are selectable. Trails can be removed from the display by selecting Off, or the trails time reset to zero by selecting Reset. The long and short trail lengths are shown on the display, and are dependent on the selected scale ratio as shown below.

Table 53: Trails Parameters

Scale Ratio	Short Time	Long Time
1:4,000 to 1:10,000	15 seconds	30 seconds
1:15,000 to 1:40,000	30 seconds	60 seconds
1:50,000 and above	60 seconds	120 seconds

True Trails are selected by default, and represent either ground stabilised or water stabilised motion. Relative trails can also be selected.

Permanent trails are timed for up to 60 minutes, and can be displayed until manually reset. > 60 minutes is displayed when above 60 minutes.

9.6 Video Transparency Levels

If the ECDIS has radar overlay, the radar video can be turned on or off in ECDIS presentation mode.

The video shall not obscure chart information and be clearly distinguishable from the chart information within appropriate tolerances in:

- Scale
- Orientation
- Projection

Radar video is removed from the chart window if the scale ratio is 1:500,000 or more, or 1:3,000 or less.

The transparency level of the radar video may be set from 20%, 40%, 60%, 80% or 100% (opaque).

9.7 Primary and Secondary Presentations

The ECDIS may be viewed as a primary display (where one chart covers the whole display area), or a primary and secondary presentation.

The chart presentation options available are:

- Primary (secondary presentation off)
- Primary and Secondary (vertical split screen)
- Primary and Secondary (horizontal split screen)
- Primary, with secondary screen as popup window (picture in picture mode)

9.7.1 Picture in Picture Mode

When the system is first switched into picture-in-picture mode, the secondary chart window is shown as a popup window over the primary chart window. The secondary chart window can be moved and resized within the maximum and minimum limits.

9.7.2 Split Screen Mode

When the system is first switched into a split screen mode (vertical or horizontal), the primary and secondary chart windows occupy an equal amount of area on the display. The secondary chart window can be resized within the maximum and minimum limits.

9.8 Chart Formats

In addition to the C-MAP and SevenCs vector chart formats listed in Section 8.21 '*Charts*', the ECDIS also includes the ability to display charts in raster format (ARCS).

9.9 Multi-Node Targets

An ECDIS in a multi-node system will display all tracked targets from other nodes and all AIS targets in the system.

The following apply for an ECDIS with radar overlay:

1. Targets may be acquired and AIS targets activated.
2. Targets may be cancelled, providing they are not being tracked on other radar nodes, or selected on other ECDIS nodes.
3. AIS targets may be set to sleeping providing they are not selected on other nodes.

The following apply for an ECDIS without radar overlay:

1. Targets may not be acquired or cancelled.
2. AIS targets may be activated and set to sleeping providing they are not selected on other nodes.

Radar and Chart Radar nodes on a multi-node system are not affected by actions taken on ECDIS nodes.

9.10 Conning Information Display

The Conning Information Display (CID) may be configured as an Optional Feature in the configuration tool, see *Chapter 4 'Configuration'*. CID pages are available on ECDIS nodes, or on standalone CID nodes.

CID pages may display a variety of read-only information, including engine automation data, heading, position, route and steering status, weather data, etc.

The layout and mix of readouts on the CID pages may be customised and edited from the CID Designer, which is in the Config tool.

10 Transceiver Interface

10.1 Standby/Transmit

The display and the transceiver are in one of two operational modes, standby or transmit. In addition, when the transceiver is in standby it may also be warming up.

Note: *The operational mode of the display is considered separate from the operational mode of the transceiver to which it is connected.*

In the event of a Transceiver error the display switches from Transmit to Standby.

When a display is powered on in an Interswitch system the interswitch allocates a transceiver for the display to be connected to.

10.1.1 Warm Up

Upon power-on of a "cold" transceiver, a warm up period is required to prevent damage to the magnetron before it can start transmitting.

Note: *The power-on of a display will not necessarily mean the connected transceiver will start in warm up, as an interswitch in the system may maintain power to the transceiver even if no displays are currently connected to it.*

Note: *BME transceivers give an indication of warm up in the serial messages transmitted to the display. For use with non-BME transceivers a transceiver compatibility unit (TCU) must be used. If a TCU is not used then the interfacing equipment must conform to the protocols detailed in 65800/HIS/001 Display – Transceiver Interface.*

When a display is connected to a transceiver that is in warm up, either because of interswitching or from power-on, a count for the warm up period is displayed, starting at 0 and incrementing each second up to a maximum of 999. When the warm up period has ended the count is removed and the display is in Standby.

10.1.2 Master/Slave Control

The method of selecting Master or Slave Display operation is dependent on whether an interswitch is fitted.

1. Where no interswitch is fitted the system defaults to Master. The Master/ Slave Display selection is done as part of Commissioning and the transceiver identification is fixed at A.
2. Where an Interswitch is fitted the Master/Slave selection and Transceiver identification (A to F) is determined by the Interswitch.

When operating as a Slave Display on power-on the display defaults to standby but the connected transceiver does not change its operational mode.

10.2 Pulse Length

Three pulse length options are available:

- Short Pulse
- Medium Pulse
- Long Pulse.

Pulse lengths can only be selected on a Master Display, when the display is in Transmit.

The pulse lengths available depend on the selected range scale.

Where a change of range scale results in the pulse length having to change then the pulse length closest to the existing range scale is automatically selected. If the display's requested pulse length does not match the pulse length of its connected transceiver a pulse length error alarm is raised.

10.3 Transceiver Tuning

Two transceiver tuning modes are available, Automatic Frequency Control (AFC) and Manual. The current level of tuning is indicated by a shaded bar adjacent to the caption.

For a Master Display there are three tuning controls:

- AFC On/Off (power on default)
- Coarse Tune
- Manual Fine Tune

For a Slave Display the tuning mode and tune level are not controlled by the display but mirror the values of the connected transceiver.

The coarse tune level control allows the centre tune frequency to be set up for the transceiver to which a display is connected This control is typically done at Commissioning with the system default set to the centre value of the AFC tune range. A different level is stored for each transceiver and restored both at power on and when the transceiver is selected.

During the coarse tuning process any configured Sector Blanking is suppressed, when coarse tuning is complete the Sector Blanking is restored to its original setting.

When AFC is turned off manual fine tune is available for the operator to tune the connected transceiver.

10.4 Sector Blanking

Two blanking sectors can be set up for each Transceiver during Commissioning. These sectors inhibit radar transmission over an angular width of up to 180°, with a combined maximum blanking of 340°. Each sector is aligned and maintained with respect to own ship's head in all presentation modes for both centred and off-centred video displays.

Sector blanking is suppressed when:

- Coarse tuning the transceiver
- Performance monitor is on
- Video level is being adjusted.

10.5 Transceiver Interface in a Multi-Node System

The following settings are distributed and used among the system nodes:

- Coarse and fine tune levels
- Transceiver settings (i.e. Heading Marker Offset, Sample Pulse Start, Sample Pulse Width, Trigger Delay, AC Law and AC Spike)
- Performance monitor tune and XR/XT attenuator values

11 Power Requirements

11.1 Power Requirements and Unit Characteristics

The main power source must have a voltage between 92 and 276V rms at a frequency between 47 and 64Hz.

For high-voltage multiphase supplies, a step-down transformer is available.

Table 54: Power Requirements

Unit	Maximum Input Power
Consoles (Including Monitor, PCIO and Processor Units)	
250 Console (with 19" LCD)	310VA
340 Console (with 23" LCD)	310VA
19" Integrated Tabletop	250VA
19" LCD	100VA
23" LCD	100VA
Processor Unit	150VA
PCIO Unit	60VA
X-band Scanner Motor and Transceiver	
Standard Speed Unit	250VA
High-Speed Unit	370VA
S-band Transceiver	
S-band Transceiver Unit	120VA
S-band Scanner Motor	
Standard Speed Unit - single phase	750VA
High-Speed Unit - single phase	750VA
Standard Speed Unit - 3 phase (per phase)	500VA
High Speed Unit - 3 phase (per phase)	600VA

Table 55: Unit Characteristics

Parameter	All Units except S-band Scanner Motor Unit
Power Factor Correction	Better than 0.9
Transient protection	Over-voltage transient of up to 40% above nominal input voltage with maximum duration of one second. Pulse transient of up to ± 1200V peak, with a rise time of 2 to 10µs and duration up to 20µs.
Protection facilities	Output short circuit. High and low input voltage. Output over-voltage. Slow start.

12 Mechanical Specification

12.1 Weights and Dimensions

Table 56: Weights and Dimensions

Console Assembly (including modules)	Height (mm)	Depth (mm)	Width (mm)	Weight (kg)
250 Console deck mounted	1102(1223*)	843	680	131.5
340 Console deck mounted	1102(1223*)	843	680	136.5
19" Integrated Tabletop	480 (484#)	650	460 (517#)	26
Desktop Assembly (not including modules)				
340 Console desktop	450(585*)	843	680	47.5
250 Console desktop	450(585*)	843	530	34
Console Modules				
250 Monitor (19" LCD) kit version	444	82	483	11.2
340 Monitor (23" LCD)	534	86	632	19
250 Monitor (19" LCD) in 340 console	534	86	632	14
Processor Unit (including mounts)	172.5	382	518.5	14
PCIO Unit	84	452	457	8.5
X-band Units				
Scanner Unit with 1.2m Antenna	440	586	1305†	49 42‡
Scanner Unit with 1.8m Antenna	440	586	1914†	52 44‡
Scanner Unit with 2.4m Antenna	440	586	2550†	55 47‡
Bulkhead Transceiver (658xxA, B, P, T, W)	607	327	370	23
Bulkhead Transceiver (658xxE, F, G, H, L)	607	330	370	19
S-band Units				
Scanner Unit + 2.7m Antenna + integral Transceiver	800	718	2800†	163.5
Scanner Unit + 2.7m Antenna. No integral Transceiver	800	675	2800†	150.5
Scanner Unit + 3.7m Antenna + integral Transceiver	800	718	3700†	176.5
Scanner Unit + 3.7m Antenna. No integral Transceiver	800	675	3700†	163.5
Bulkhead Transceiver Unit	515	318	402	25

* When monitor is in service position
\# When mounting straps are fitted.
† Antenna Turning Circle
‡ Excluding Transceiver

Refer to individual drawings in Chapter 3 '*Installation*' for dimensions and weights of smaller components, such as the Control Panel Modules.

12.2 Console Mounting Options

The console components are supplied either as integrated unit (deck mounting) or as a kit for fitting into customer specified consoles. See Chapter 3 '*Installation*' for installation details.

13 Compass Safe Distance

Table 57: Compass Safe Distance

Console Assembly	Standard	Steering
250 Console deck mounted	2.4 m	1.6 m
340 Console desktop	2.4 m	1.6 m
250 Console desktop	2.4 m	1.6 m
340 Console deck mounted	2.4 m	1.6 m
19" Integrated Tabletop	1.3 m	1 m
Console Modules		
250 Monitor (19" FPD)	1.8 m	1.8 m
340 Monitor (23.1" FPD)	2.6 m	2.6 m
Processor Unit	2.0 m	1.3 m
PCIO Unit	2.2 m	1.5 m
On-Off Switch Module	0.3 m	0.3 m
Trackball Module	0.3 m	0.3 m
USB connector	0.3 m	0.3 m
Control Panel Keyboard Module	0.4 m	0.3 m
X-band Units		
Scanner Unit 10kW	1.4 m	0.8 m
Scanner Unit 25kW	3.3 m	2.0 m
Scanner Unit (without Transceiver)	0.4 m	0.3 m
Bulkhead Transceiver 10kW	1.3 m	0.7 m
Bulkhead Transceiver 25kW	3.3 m	2.0 m
S-band Units		
Scanner Unit 30kW	4.1 m	2.4 m
Scanner Unit (without Transceiver)	0.8 m	0.5 m
Bulkhead Transceiver 30kW	4.3 m	2.6 m
Scanner Control Unit	0.8 m	0.4 m

14 International Specifications

This equipment meets the requirements of the following International Standards for maritime navigation equipment:

Table 58: International Specifications

Number	Version	Title
IEC 60872-1*	1998	Maritime Navigation and Radiocommunication Equipment and Systems - Radar Plotting Aids - Automatic Radar Plotting Aids (ARPA) - Methods of Testing and Required Test Results
IEC 60936-1*	2002	Maritime Navigation and Radiocommunication Equipment and Systems - Radar - Part 1: Shipborne Radar - Performance Requirements - Methods of Testing and Required Test Results
IEC 60936-2*	1998	Maritime Navigation and Radiocommunication Equipment and Systems - Shipborne Radar For High-Speed Craft (HSC) - Methods of Testing and Required Test Results
IEC 60936-3*	2002	Maritime Navigation and Radiocommunication Equipment and Systems - Radar - Part 3: Radar with chart facilities. Performance requirements - Methods of testing and required test results
IEC 60936-5*	2003	Maritime Navigation and Radiocommunication Equipment and Systems - Radar - Part 5: Guidelines for the use and display of AIS information on radar
IEC 60945	2002	Maritime Navigation and Radiocommunication Equipment and Systems - General Requirements - Methods of Testing and Required Test Results
IEC 61162-1	2000	Maritime Navigation and Radiocommunication Equipment and Systems - Digital Interfaces - Part 1: Single Talker and Multiple Listeners
IEC 61162-2	1998	Maritime Navigation and Radiocommunication Equipment and Systems - Digital Interfaces - Part 2: Single Talker and Multiple Listeners, high-speed Transmission
IEC 61174-2	2001	Maritime Navigation and Radiocommunication Equipment and Systems - Electronic Chart Display and Information System (ECDIS). Operation and performance requirements - Methods of testing and required test results.
IEC 62065-1	2002	Maritime Navigation and Radiocommunication Equipment and Systems - Track Control systems. Operation and performance requirements - Methods of testing and required test results.
IEC 62388-1	2007	Maritime navigation and radio-communication equipment and systems - Shipborne radar - Performance requirements, methods of testing and required test results

* These IEC documents are superseded by IEC 62388-1

CHAPTER 2

SYSTEM IDENTIFICATION

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1 Introduction

The alphanumeric System Number allocated to the VisionMaster FT Series details the various units of the particular system to which the number refers. Each System Number may consist of up to seven identifying labels.

1.1 Radar System Identification

The description below covers all CAT 1 and CAT 2 Radar/Chart Radar variants.

The various labels (from 1 to 7) of VisionMaster FT Radar Series Part Numbers, shown below, are explained in more detail in Section 2 '*Radar System Identification Labels*'.

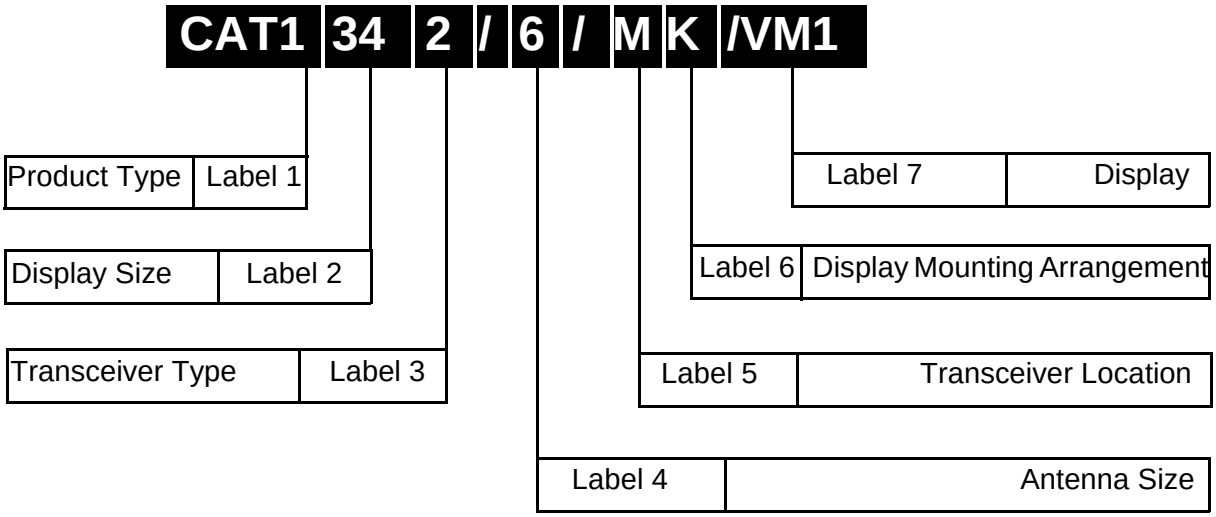


Figure 2.1 VisionMaster FT Radar Series Part Numbers

1.2 ECDIS System Identification

The various labels for a VisionMaster FT ECDIS (Electronic Chart Display and Information System) are shown in Figure 2.2, and are explained in more detail in Section 3 '*ECDIS System Identification Labels*'.

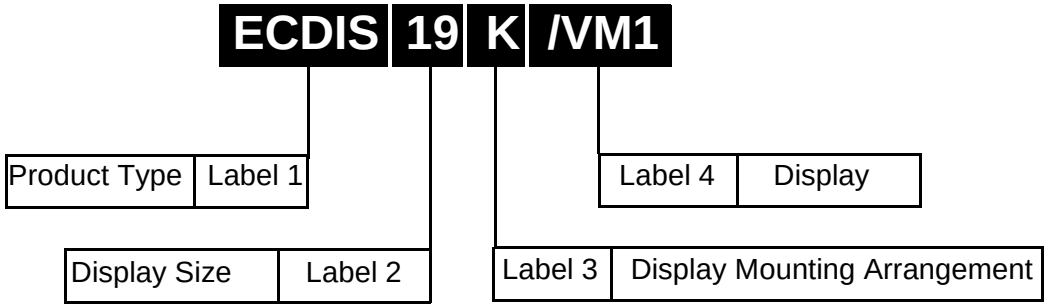


Figure 2.2 VisionMaster FT ECDIS Series Part Numbers

2 Radar System Identification Labels

2.1 Label 1 Radar Type

Label	Radar Type
CAT1	CAT 1 Radar
CAT1C	CAT 1 Chart Radar
CAT1H	CAT 1 HSC* Radar
CAT1HC	CAT 1 HSC Chart Radar
CAT2	CAT 2 Radar
ECAT2	Enhanced CAT 2 Radar
ECAT2C	Enhanced CAT 2 Chart Radar
CAT2H	CAT 2 HSC Radar
ECAT2H	Enhanced CAT 2 HSC Radar
ECAT2HC	Enhanced CAT 2 HSC Chart Radar

*. High Speed Craft

2.2 Label 2 Display Size

Label	Display Size
25	250mm Display PPI "12 inch"
34	340mm Display PPI "16 inch"

2.3 Label 3 Transceiver Type

Label	Transceiver Type
1	10kW X-band AC Ship's Mains
2	25kW X-band AC Ship's Mains
3	30kW S-band AC Ship's Mains

2.4 Label 4 Antenna Type

Label	Antenna Size
4	4ft (X-band)
6	6ft (X-band)
8	8ft (X-band)
9	9ft (S-band)*
12	12ft (S-band)

*. For non type approved systems

2.5 Label 5 Transceiver Location

Label	Transceiver Location
M	Masthead Transceiver
B	Bulkhead Transceiver

2.6 Label 6 Display Mounting Arrangement

Label	Display Mounting Arrangement
K	Kit format for mounting in console
T	Tabletop mounted
Blank or D	Deck Standing

2.7 Label 7 Display Technology

Label	Monitor Type
VM1	VisionMaster (for IEC 60936 & IEC 60872)
VM2	VisionMaster (for IEC 62388)

3 ECDIS System Identification Labels

3.1 Label 1 Product Type

Label	Product Type
ECDIS	ECDIS
ECDISRO	ECDIS with Radar Overlay

3.2 Label 2 Display Size

Label	Display Size
19	19 inch Display
23	23 inch Display
27	27 inch Display (widescreen)

3.3 Label 3 Display Mounting Arrangement

Label	Display Mounting Arrangement
K	Kit format for mounting in console
T	Tabletop mounted
Blank or D	Deck Standing

3.4 Label 4 Display Technology

Label	Monitor Type
VM1	VisionMaster (1st Generation)
VM2	VisionMaster (2nd Generation)

4 Unit Type Numbers

A VisionMaster FT Radar System is configured from among the following unit types:

- Monitor Unit
- Processor Unit
- Security Block
- PCIO Unit
- Control Panel Assembly
- 19" Integrated Tabletop (self contained console assembly)
- Antenna Unit
- Turning Unit (with or without Integral Transceiver)
- Bulkhead Transceiver Unit
- Scanner Control Unit (S-Band)
- Interswitch Unit

A VisionMaster FT ECDIS (without radar overlay) is configured from among the following unit types:

- Monitor Unit
- Processor Unit
- Security Block
- PCIO Unit
- Control Panel Assembly
- Interswitch Unit

4.1 Monitor Unit

The Monitor Unit type number consists of a five-figure number (e.g. 65923) followed by a single letter suffix (e.g. C). A typical complete Monitor Unit Type Number may therefore be 65923C. A further breakdown of the number is as follows:

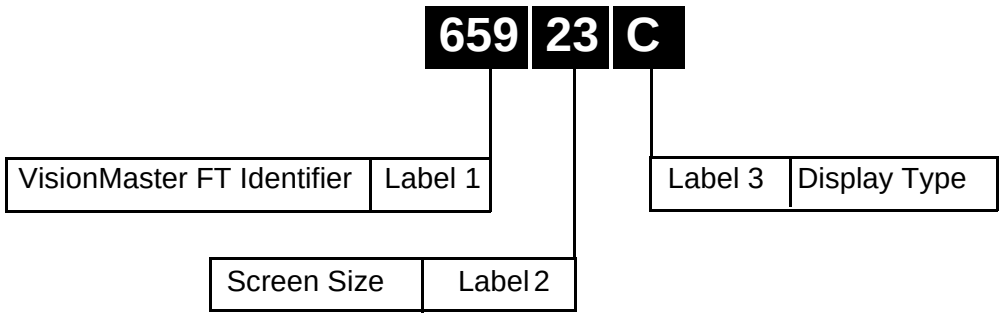


Figure 2.3 Monitor Unit Label

4.1.1 Label 1 Identifier

Label	Monitor Type
659	Visionmaster FT (glass fronted)
658	Kit format only (black bezel)

4.1.2 Label 2 Screen Size

Label	Diagonal
17	19" FST (250mm radar circle) Kit only
19	19" FST (250mm radar circle)
23	23" FST (340mm radar circle)
27	27" FST (340mm radar circle)

Note: *The 23" and 19" BridgeMaster E monitors (type 65823A and 65817G respectively) may be used in kit systems.*

4.1.3 Label 3 Monitor Type

Label	Monitor Series	Variant and Size
A	340	340 kit (Hatteland) black bezel
C	250/340	340 console/desktop (Hatteland)
E	340	340 console (Melford)
G	250	250 kit (Hatteland) black bezel
M	340	340 console (Melford) - Radar only
T	250	250 desktop (Hatteland)

Note: *There is an independent On/Off switch for all monitors.*

Note: *All monitors have a buffered video output.*

4.2 Processor Unit

The type numbers for the Processor Unit are as follows:

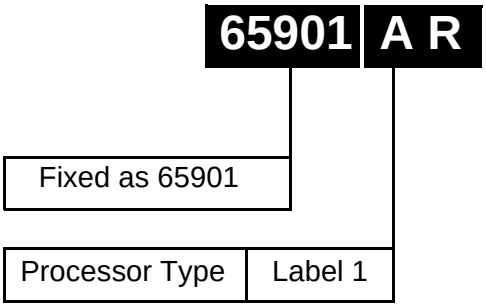


Figure 2.4 Processor Electronics Unit label

4.2.1 Label 1 Processor Type

Label	Processor Type
AR	Radar/Chart Radar and ECDIS with Radar Overlay (60936 and 60872 standards only)
AN	ECDIS only
AT	CAT 1 and CAT2 versions of Radar/Chart Radar and ECDIS with Radar Overlay (62388 standard only)

4.3 Security Device

The types of security device (product type identifier) are as follows:

- 32SDV001 for CAT 1 Radar
- 32SDV002 for CAT 1 Chart Radar
- 32SDV003 for ECDIS
- 32SDV004 for ECDIS with Radar Overlay
- 32SDV005 for Multi-node workstation
- 32SDV006 for Total Watch (CAT 1 Chart Radar and ECDIS)
- 32SDV008 for CAT 2 Radar

The security devices listed above are for individual workstations, with the configured product type for each workstation matching the security device fitted. The exception being 32SDV005 (multi-node workstation) where the product type selected in the configuration determines the mode of operation.

4.4 PCIO Unit

There are two types PCIO unit:

- 65900AA for Standard Compass (stepper & 360:1 synchro)
- 65900AB for Special Compass (1:1, 36:1, 90:1 & 180:1 synchro)

The standard compass PCIO unit will be supplied for all serial compass input systems.

4.5 Control Panel Assembly

The Control Panel Assembly includes Control Panel, On/Off switch and USB sub assemblies.

The control panel sub assembly includes a trackball (with integral keys), rotary controls, adjustment and acknowledgement buttons.

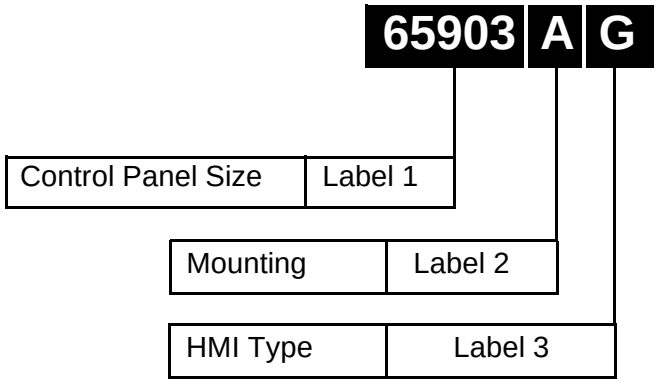


Figure 2.5 Control Panel Assemblies

4.5.1 Label 1 Control Panel Size

Label	Size
65903	23" FST
65909	19" FST

4.5.2 Label 2 Mounting

Label	Mounting
A	Integral
K	Kit

4.5.3 Label 3 HMI Type

Label	HMI Type
F	Trackball only
G	Control Panel with integral trackball

4.6 19" Integrated Tabletop

The 19" integrated tabletop display is a unit where the LCD, Processor, PCIO, Control Panel and security device (see Section 4.3 '*Security Device*') are all contained in a single mechanical housing.

The 19" Integrated Tabletop type numbers are as follows:

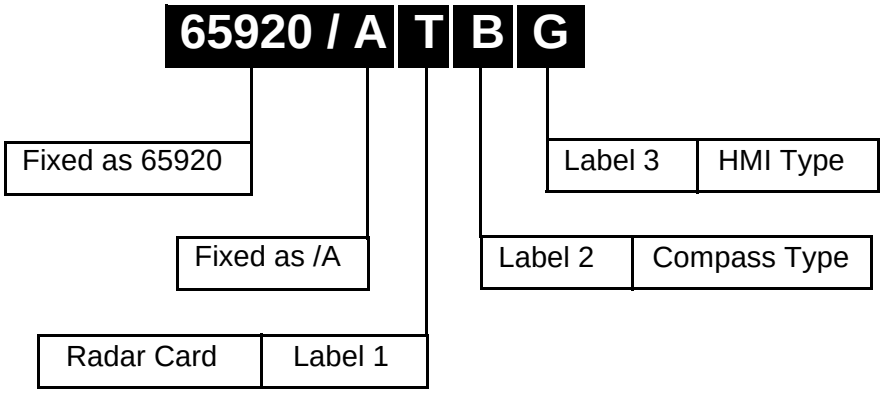


Figure 2.6 19" Integrated Tabletop Label

4.6.1 Label 1 Radar Card Type

Label	Radar Type
N	ECDIS (no radar fitted)
T	SC3 card fitted

4.6.2 Label 2 Compass Type

Label	Compass
A	Standard Compass
B	Special Compass

4.6.3 Label 3 HMI Type

Label	HMI Type
F	Trackball only
G	Control Panel with integral trackball

4.7 Antenna Unit

The Antenna unit type numbers are as follows:

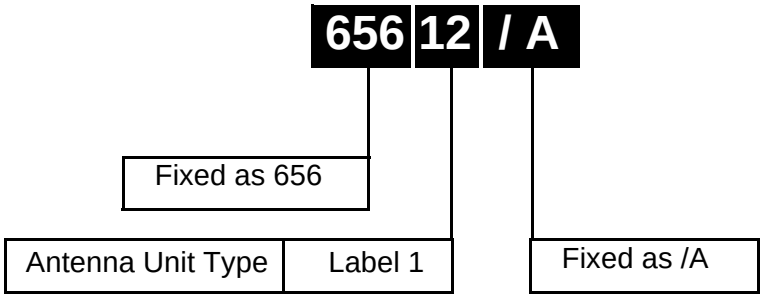


Figure 2.7 Antenna Unit Label

4.7.1 Label 1 Antenna Type

Label	Radar Type
04	4ft (X-band)
06	6ft (X-band)
08	8ft (X-band)
09	9ft (S-band)
12	12ft (S-band)

4.8 Turning Units and Integral Transceivers

The type numbers for Turning Units and Integral Transceivers are as follows:

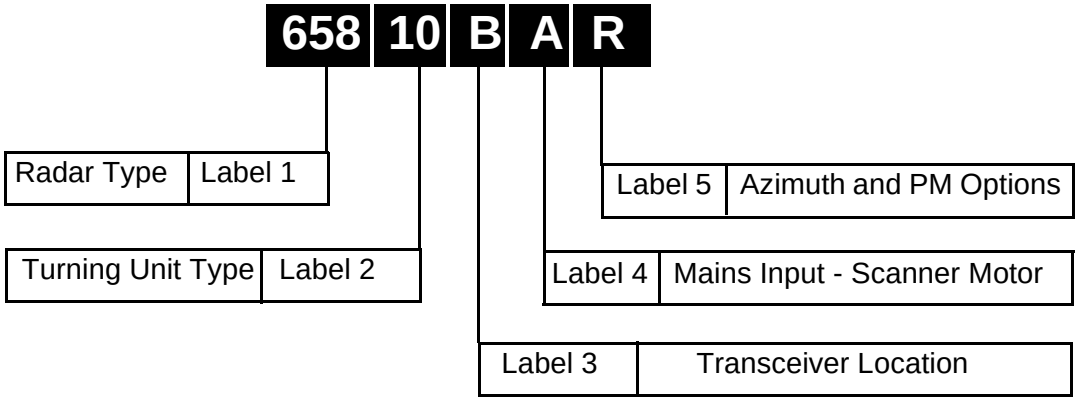


Figure 2.8 Turning Unit and Integral Transceiver label

4.8.1 Label 1 BridgeMaster E Identifier

Fixed as 658

4.8.2 Label 2 Turning Unit Type

Label	Turning Unit Type
01	X-band without Transceiver
10	X-band with 10kW Transceiver
25	X-band with 25kW Transceiver
30	S-band with 30kW Transceiver

X-band Turning Units are supplied set to 'Standard Speed'. Speed changes are effected by link changes within the unit. S-band Turning Units are correctly set for their turning speed.

4.8.3 Label 3 Transceiver Location and Type

Label	Transceiver Location
B	Bulkhead
C	Bulkhead with additional facilities
M	Masthead with biased Limiter
N	Masthead with additional facilities
P	Masthead, 3kHz short pulse variant
T	Masthead, 3kHz with additional facilities
W	Masthead with non-biased Limiter

4.8.4 Label 4 Mains Input – Scanner Motor

Label	Phases	Voltages (V)	Frequency (Hz)	Speed	Band*
A	1	110/240	50/60	S/H	X
E	1	110 – 120	50/60	S	S
F	1	220 – 240	50/60	S	S
G	3	110 – 120	50/60	S	S
H	3	220 – 240/380 – 440	50/60	S	S
J	1	110 – 120	50	H	S
K	1	220 – 240	50	H	S
L	3	110 – 120	50	H	S
M	3	220 – 240/380 – 440	50	H	S
P	1	110 – 120	60	H	S
Q	1	220 – 240	60	H	S
R	3	110 – 120	60	H	S
S	3	220 – 240/380 – 440	60	H	S

*. For **X-band** Turning Units the motor is powered from the transceiver. This supply matches the Processor Electronics Unit supply.
For **S-band** Turning Units the motor is fed from its own supply via a Scanner Control Unit and can differ from the Transceiver/Processor Electronics Unit supply.

4.8.5 Label 5 Azimuth and Performance Monitor Options

Label	Performance Monitor	Synchro/ Resolver	Synchro Type
P	No	No	N/A
R	Yes	No	N/A
S	No	Synchro	CX
T	Yes	Synchro	CX
U	Yes	Synchro	CDX
V	No	Synchro	CDX

4.9 Bulkhead Transceiver Unit

The type numbers for the Bulkhead Transceiver Unit are as follows:

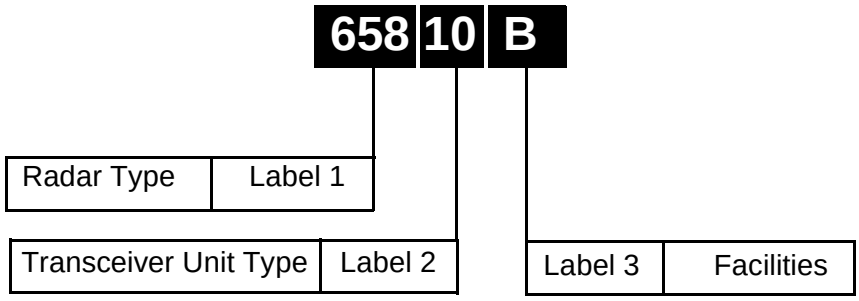


Figure 2.9 Bulkhead Transceiver Unit label

4.9.1 Label 1 BridgeMaster E Identifier

Fixed as **658**

4.9.2 Label 2 Transceiver Type

Label	Transceiver Type
10	10kW X-band
25	25kW X-band
31	30kW S-band

4.9.3 Label 3 Facilities

Label	Facilities
S-Band Units	
A	Standard with biased limiter
B	With Additional Facilities
X-Band Units	
E	Standard with biased limiter
F	With Additional Facilities
G	3kHz short pulse variant
L	3kHz short pulse with additional facilities
H	Standard non-biased limiter

4.10 Scanner Control Unit

The type numbers for the Scanner Control Unit are as follows:

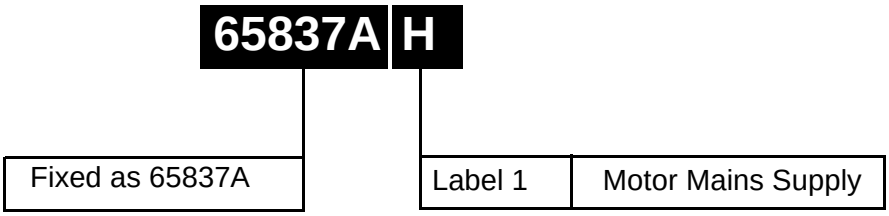


Figure 2.10 Scanner Control Unit label

4.10.1 Label 1 Motor Main Supply

Label	Phases	AC Voltage	Antenna Speed
B	3	380/440	Standard
C	3	220/240	Standard
	3	380/440	High
E	1	220/240	Either
	3	110/120	Standard
	3	220/240	High
F	3	110/120	High
H	1	110/120	Either

Scanner Control Units (SCU) are adjusted internally for thermal trip current and the number of phases (1 or 3).

4.11 Interswitch Unit

Interswitch Type	System Configuration
65842A	Up to 4 Displays and 2 Top Units
65846A	Up to 6 Displays and 6 Top Units

5 Configuring a Typical System

The following shows how a typical system is configured using the information above. The requirement is for an S-band CAT 1 Chart Radar with the following characteristics:

1.	Display Unit	Deck mounted 23" (340mm) flat panel monitor.
2.	Processor Unit	Standard
3.	Security Block	CAT 1 Chart Radar
4.	PCIO Unit	Standard Compass
5.	Tray Assembly	Control Panel
6.	Antenna	12ft S-band, standard speed
7.	Transceiver	30kW Masthead mounted with Performance Monitor
8.	Ship's Mains Supply	220/240V AC, 50Hz, 1 Phase

The System Identification number for the system specified above would be:

CAT1C	34	3	/	12	/	M	/	VM1

The individual Type Numbers for the specified units would be:

Monitor Unit	659 | 23 | C
Processor Unit	65901 | AT
Security Device	32SDV002
PCIO Unit	65900 | AA
Tray Assembly	65903A | G
Antenna	656 | 12 | /A
Turning Unit (including Transceiver)	658 | 30 | M | F | R
Scanner Control Unit	65837A | E

Note: *The modular method for configuring VisionMaster FT systems results in a large number of possible combinations, not all of which are commercially available. Consult NORTHROP GRUMMAN SPERRY MARINE for full details.*

6 Options and Kits

9640454	Step down transformer for use with 380-440V 50/60Hz 3-phase mains.
65800700	Isolation Switch

Various kits with different lengths of installation cable are available.

Consult NORTHROP GRUMMAN SPERRY MARINE for full details.

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1 General Information

The Installation Engineer is responsible for providing the work needed for the installation and making sure the Contractor completes the work.

1.1 Preparation

The preparation required for installation is as follows:

1. If necessary, the structure of the ship should be strengthened to support the system components. For data on system components, *see Chapter 1, Technical Specification*.
2. The supplying and fitting of mounting facilities for the system components.
3. The supplying of power supplies terminated by a switch-fuse box. The Installation Engineer will specify the voltage level and current rating of the supplies.
4. The supplying and installation of cable trays, battens and/or conduits for the interconnecting cables of the system.
5. When a mast is to be mounted on a wooden deck, earth leads or strips must be supplied for connection to the mast.

1.2 Installation Procedure

Installation includes the following operations:

1. The Contractor will install the mast. If required, the Contractor will supply and install adjustable stays for the mast, and take suitable precautions to minimise vibration.
2. Unpacking and external inspection of the system components.
3. Installation of the Scanner Unit.
4. If required, installation of waveguide brackets and/or deck glands.
5. Installation of the other system components. If a bulkhead transceiver is to be installed a mounting pad must be supplied.
6. Planning and laying of cables.
7. Installation of Console Assembly.
8. Interconnection of system components.

2 Cable Details

Refer to the Cabling Schedules section below for details of cables and related terminations. Inter-unit cabling diagrams are given in Section 7.1. For details of the X-band RF waveguide, RF termination and installation see Section 6. Details of the S-band coaxial RF Feeder are given in Section 6.5.3.

2.1 Supply Cables

The following points should be considered when you decide which size of cable to use to connect the ship's supply to the radar:

a. The voltage drop from the supply to the radar must not exceed 2% of the supply voltage.

b. The current required by the radar must not exceed the current rating of the cable.

If the radar system is to be supplied by a three-phase supply, the radar system must be connected between two of the three phase lines. If it is a high-voltage supply, an isolating transformer must be supplied to reduce the voltage to 220/240V at the system input.

Note: *S-band Turning Unit motors are fed directly from the AC supply via the appropriate Scanner Control Unit (SCU); see Section 6.6 for details of the SCU.*

2.2 Power Consumption

The power consumption of the radar is given in Chapter 1 *'Technical Specification'*.

2.3 Switch Fuses

The radar is connected to the power supply of the ship by two Switch Fuses. The Switch Fuses are not supplied with the radar, and are therefore of local manufacture. The fuse ratings of the Switch Fuses are given in Section 7.5 '*System Fuses*' page 171.

2.4 Control Cables

The control cables detailed on the Inter-unit Cabling diagrams may be used up to a maximum length of 180m, unless otherwise stated. Special cable kits are available for cable lengths up to 300m.

The DATA cable (Service Code MA00007419) conforms to UL Type CL2, AWM 2919 and CSA PCC FT4.

The other multicore cables conform to IEC 92/3 and DEF STAN 61-12 Part 5.

The LSZH (low smoke zero halogen) cables follow the construction of DEF STAN 61-12 Part 5 but have polyethylene insulation over the cores instead of PVC.

The cables are multicore stranded or bunched, and have tinned copper wire conductors.

Each conductor is insulated with PVC to form cores. The cores are screened with braided tinned copper wire, and the complete cable is sheathed with PVC. The temperature range of the cables is -25°C to +70°C.

Table 1: Standard Cable details

Ref.	Service Code	Cable Diameter mm	Number of Cores	Core Strands/ Diameter mm	Resistance per 1000m (at 20°C) W	Current Rating A	Voltage (RMS) V	Min Bend Radius mm
16-2-2C	3218376	6.9	2	16/0.2	40.1	2.5	440	50
16-2-4C	3209342	7.7	4	16/0.2	40.1	2.5	440	60
16-2-6C	3211274	8.7	6	16/0.2	40.1	2.5	440	65
16-2-12C	3211266	11.0	12	16/0.2	40.1	2.5	440	85
37-3-2R	3228207	10.3	2	37/0.32	6.79	13	440	80
37-3-4R	3214044	11.8	4	37/0.32	6.79	13	440	90
—	MA00007419	8.4	4 pairs	7/0.2	—	—	30	80
PT1YM	3236862	6	1	1X0.6	95	—	—	36
FSJ1-75	MA00012534	7.4	1		49.2	—	—	25
FSJ4-75A	MA00012880	13.2	1	1X3	4.9	—	—	32

Note: *PT1YM characteristic impedance is 75Ω, and is double screened; each screen provides 95% coverage.*

Table 2: Low Smoke Zero Halogen (LSZH) Alternatives to Standard Cables

Reference	Service Code	Cable Diameter mm	Number of Cores	Core Strands/ Diameter mm	Resistance per 1000m W	Current Rating A	Voltage (RMS) V	Min Bend Radius mm
16-2-2C	MA00014100	6.9	2	16/0.2	40.1	2.5	440	50
16-2-4C	MA00014167	7.7	4	16/0.2	40.1	2.5	440	60
16-2-6C	MA00014175	8.7	6	16/0.2	40.1	2.5	440	65
16-2-12C	MA00014183	11.0	12	16/0.2	40.1	2.5	440	85
37-3-2R	MA00014191	10.3	2	37/0.32	6.79	13	440	80
37-3-4R	MA00014209	11.8	4	37/0.32	6.79	13	440	90
—	MA00014126	7.8	4 pairs	7/0.2	—	—	30	80
PT1YM	91005248	6	1	1X0.6	95	—	—	36
FSJ1RN-75A	MA00014142	7.4	1	—	49.2	—	—	25
FSJ4RN-75A	MA00016089	13.2	1	1X3	4.9	—	—	32

Note: *91005248 characteristic impedance is 75Ω, and is double screened; each screen provides 95% coverage.*

2.5 Cable Core Colour Coding

2.5.1 Multicore Cables

R	Red	BN	Brown
B	Blue	V	Violet
G	Green	O	Orange
Y	Yellow	P	Pink
W	White	L/G	Light Green
BK	Black	GY	Grey

2.5.2 Data Cables

Data Cable (four twisted pairs)				Data Cable (four twisted pairs) Low Smoke Zero Halogen alternative			
B/W		Blue/ White	Twisted Pair	B		Blue	Twisted Pair
W/B		White/ Blue		BK		Black	
G/W		Green/ White	Twisted Pair	G		Green	Twisted Pair
W/G		White/ Green		BK		Black	
BN/W		Brown/ White	Twisted Pair	W		White	Twisted Pair
W/BN		White/ Brown		BK		Black	
O/W		Orange /White	Twisted Pair	R		Red	Twisted Pair
W/O		White/ Orange		BK		Black	

2.6 Coaxial Cables

2.6.1 Signal Coaxial Cables

The coaxial signal cables detailed on the Inter-unit Cabling diagrams can be used up to a maximum length of 300m depending on the type of cable chosen. These cables are double screened, and have a nominal impedance of 75Ω. Braiding is made from tinned copper to reduce corrosion problems

Table 3: Signal Coaxial Cable Details

Service Code	Cable Diameter mm	Nominal Impedance Ω	Attenuation at 10MHz dB/100m	Comments
3236862 91005248	6.0	75	3.9	Double screened, Mylar insulation between screen (PT1YM), use with cable runs <67m
MA00012534 MA00014142	7.4	75	1.87	Low-loss, copper-clad steel inner, solid copper screen, use with cable runs <180m
MA00012880 MA00016089	13.2	75	0.96	Ultra-low-loss, solid-copper inner and screen, use with cable runs <300m.

2.6.2 S-band Coaxial Cable

This is a 7/8" foam dielectric RF feeder cable. The cable has a minimum bend radius of 250mm (10"), and may be used up to a maximum recommended length of 30m. Longer lengths may be used at the owner's discretion, but performance will be significantly degraded for lengths over 30m.

Table 4: S-band Coaxial Cable Details

Service Code	Cable Diameter mm	Nominal Impedance Ω	Attenuation at 3GHz dB/100m	Comments
9648577	28	50	8.31	Andrew Type LDF-50A

2.7 X-band Elliptical Waveguide

This is a 33.5 x 22.9mm corrugated elliptical waveguide. The waveguide has a minimum bend radius of 200mm in the 'H' plane and 480mm in the 'E' plane. It can be used to a maximum recommended length of 30m. Longer lengths may be used at the owner's discretion, but performance will be significantly degraded for lengths over 30m.

Table 5: Waveguide Details

Service Code	Waveguide Size mm	Attenuation at 9.4GHz dB/100m	Comments
RA00000109	33.5 x 22.9	9.96	Andrew Type EW85
RA00000075	33.5 x 22.9	9.96	RFS Type EP100

3 Safety Earthing

All company equipment with internal voltages greater than 50V AC (rms) and contained in a protective metal chassis must have the chassis connected directly to earth. This is to stop the chassis becoming live under fault conditions. The earth link is made by connecting a low resistance conductor between the equipment's 6mm stainless steel safety earth stud (marked with ) and the main ship's earth.

Particular care must be taken when protecting the connections from environmental and electro-chemical corrosion. Before assembly, you must make sure the contact areas are oxide-free and that they are coated with a thin layer of conducting paste to seal the joints. The most suitable materials for making connections between the equipment's earthing bolt and the ship's earth are aluminium or tinned copper straps that give a large contact area.

If an aluminium strap is connected to a ship's stainless steel earth a zinc-plated washer must be used between the strap and the ship's earth.

If a tinned copper strap is connected to a ship's aluminium earth an aluminium washer (rather than steel) must be used between the strap and the ship's earth.



CAUTION

The connecting of the bonding straps must be made from each piece of equipment to the ship's earth. You must not loop from unit to unit. To ensure this is a non-current-carrying connection no other connection must be made to the earth bolt.

The safety earth must never be removed during normal use or servicing. It is only safe to remove it once the equipment has been isolated from all external power sources.

4 Electromagnetic Continuity Screening

The purpose of EMC screening is to:

- restrict the emission of electro-magnetic energy from the equipment; and
- reduce its susceptibility to external electro-magnetic influence.

Individual items of equipment are EMC screened by their protective chassis. However, the screening should be extended to cover both input and output connections and cabling. This will maintain overall electro-magnetic efficiency.

Care must be taken when bonding the braids of interconnecting cables where indicated in the appropriate cable schedules.

5 Siting

5.1 General considerations

The performance of the system depends on the correct siting of the system Scanner Unit (Turning Unit and Antenna). When siting the Scanner Unit you should consider the following:

1. Compass safe distance.
2. Satisfactory short-range and long-range performance of the radar.
3. Protection of the equipment (cables and waveguide if applicable) from damage.
4. Ease of access for safe servicing.
5. Minimum practical length of waveguide or S-band coaxial cable, if applicable.
6. Freedom from blind arcs and false echoes, particularly on the starboard side of the vessel as own ship usually has to give way to vessels approaching from this direction. Port side visibility is also extremely important for monitoring approaching vessels, as these normally pass own ship on the port side. This is particularly important for vessels that navigate in narrow channels or canals.

   Ship features which commonly obstruct the radar beam are funnels, masts, Samson posts and crosstrees. A funnel usually throws a shadow aft, which may or may not be considered serious. However, it is a probable source of false echoes aft. Shadows thrown by Samson posts and masts will vary in extent with their size and proximity to the scanner.

   If there are obstacles around the selected site, it may be necessary to position the scanner towards the starboard side of the vessel (Figure 3.1 identifies this as position B). In this example, position B gives the antenna an unobstructed area for direction of traffic on own ship's starboard side. In practice, in the direction of the ship's bow, a mast or crane can often reflect or suppress signals transmitted from the antenna.

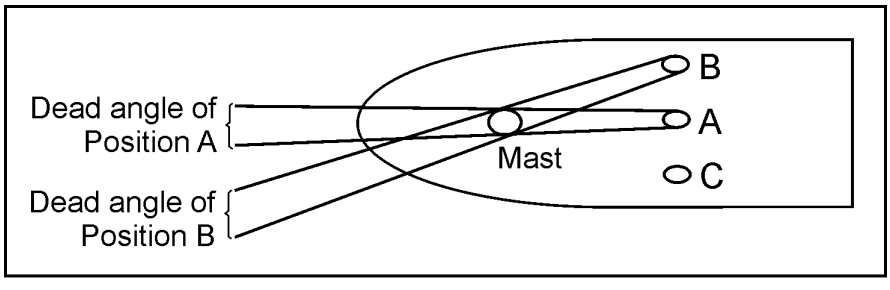
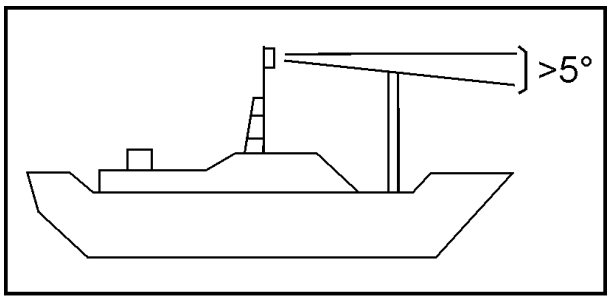


Figure 3.1 Scanner Siting

This type of obstruction can cause the system to show large false returns on the Display and/or fail to detect target returns within a certain dead angle. On AIS systems this may also cause the radar to lose automatically-tracked targets that move into the dead area. If the obstacle forms a significant obstruction, the scanner height may have to be changed to make sure the angle of depression is a minimum of 5 degrees (see Figure 3.2)

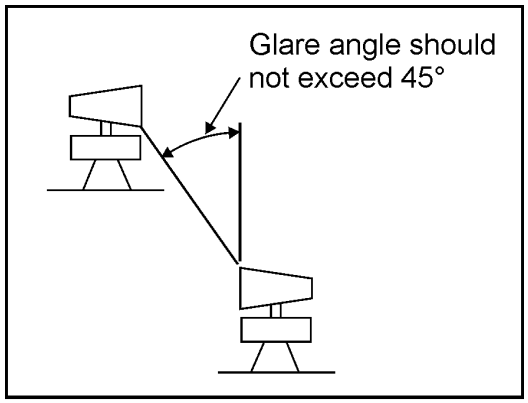
The scanner must be installed only as high as is necessary to clear major objects. It must also be remembered that when the scanner height is minimised the short-range performance is improved along with the effects of sea clutter. Therefore, position the scanner high enough to secure 5 degrees or greater angle of depression. The angle is measured between the horizontal line drawn from the antenna and the top of the mast or obstacle.



Siting-2.gif

Figure 3.2 Minimum angle of Depression

7. To avoid interference from an adjacent radar antenna the vertical separation between antennas should be as large as practicable. As a minimum, the glare angle between antennas should be less than 45° (see Figure 3.3).



Siting-3.gif

Figure 3.3 Dual Scanner Positioning (glare angle)

8. Local wind effect due to ship's structure.
9. Local vibration environment.

5.2 Bulkhead Specific Considerations

The site and method of mounting the below-decks equipment should be chosen to comply, as far as possible, with the wishes of the owner or master of the vessel. The following points should also be considered:

1. Compass safe distance.
2. Ease of access for servicing.
3. Positioning to avoid the ingress of moisture.
4. Positioning away from doors or ports that are used frequently.
5. Positioning to minimise accidental damage.
6. Environmental considerations such as adequate ventilation, dust, dirt and clean air.
7. Position the Workstation assembly away from strong magnetic fields.
8. Position the Display Screen away from direct sunlight.
9. Local vibration environment.

6 Securing of System Components

6.1 Mains Isolator (Optional Fit)

It is good practice to include Mains Isolator Switches Type 65800700 in the system wiring of AC powered systems. Their function is to let the Scanner Unit (with the exception of the Motor Supply in S-band systems), the PCIO unit, the Processor Unit, and Display be isolated from the ship's mains supply.

The Scanner Unit Motor supply in S-band systems is isolated separately by the Scanner Control Unit. For safety reasons, the Mains Isolator must be mounted next to the SCU so that the S-band system can be isolated from a single location.

If needed, the Mains Isolator can be locked in the **OFF** position using a suitable padlock.

In multiple radar systems more than one isolating switch may be needed.

Note: *Refer to Section 7 'System Component Interconnections' for connection details.*

6.1.1 Uninterruptible Power Supply (Optional Fit)

If a workstation is to be used as an ECDIS, then the system requires an Uninterruptible Power Supply (UPS) to be fitted.

The UPS is usually connected between the ship's mains supply and the mains isolator switch.

The system monitors the UPS via relays. An alarm is raised when there is a reduction in power causing the UPS to be on battery backup or a power failure to a UPS.

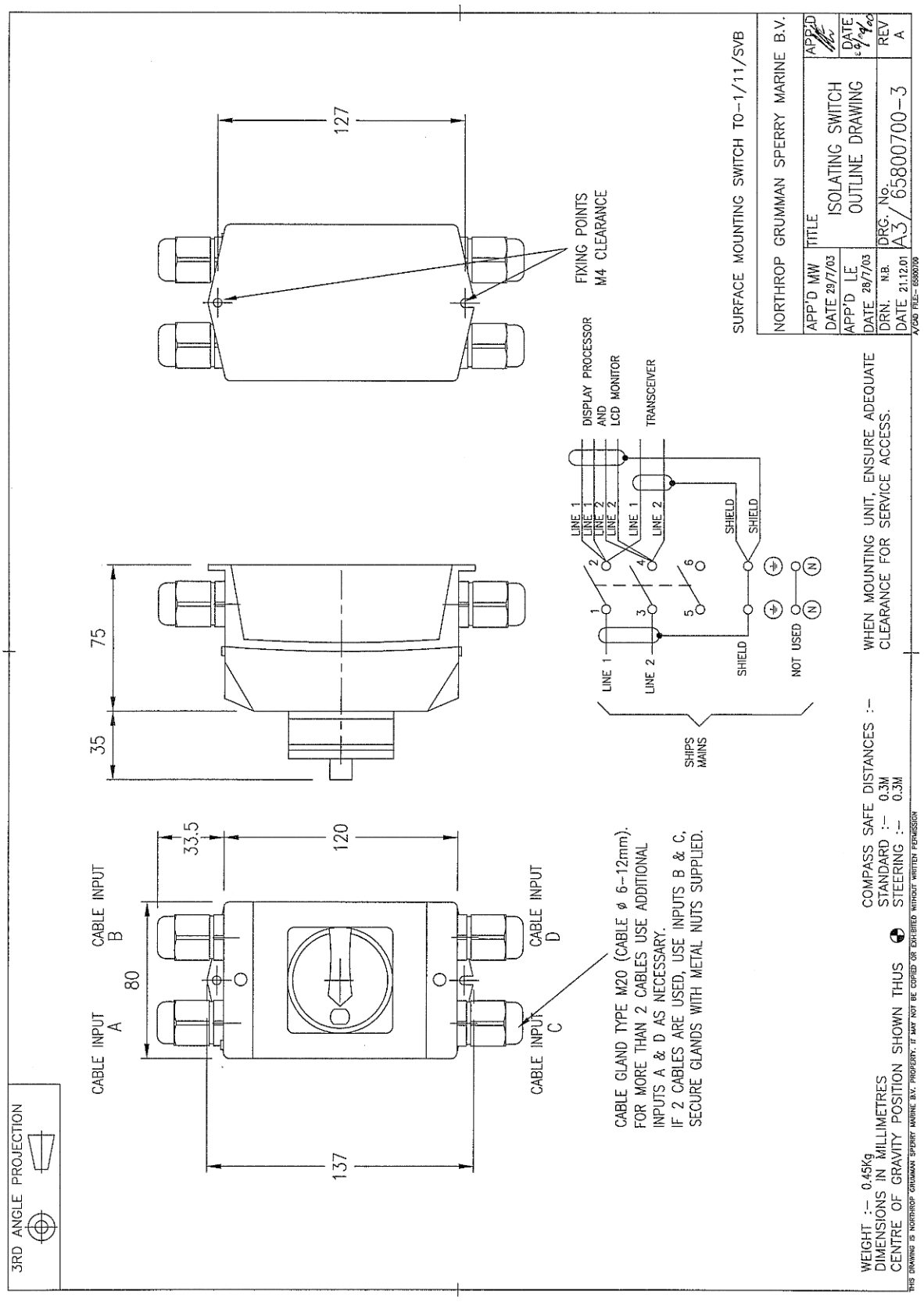


Figure 3.4 Isolation Switch Installation

6.2 X-band Scanner Assembly

The X-band Scanner assembly is made up of the following sub-assemblies. Each of these is supplied in its own packing, with relevant installation drawings:

Turning Unit With/without Masthead Transceiver (10 or 25kW)

Despatch Kit 65801660

(Installation Drawing 65801050)

Note: *A Bulkhead system would also be supplied with the following:*

Bulkhead Transceiver (10 or 25kW)

Despatch Kit 65825660

(Installation Drawing 65825050 OR 65825055)

Turning Units or Turning Units with integral Transceivers fitted with the 'additional features' option are supplied with a supplementary despatch kit 65825661 in addition to the above.

Antenna 4ft, 6ft or 8ft

Despatch Kit is supplied in Antenna carton.

(Installation Drawing 65601275)

To install the X-band Scanner assembly carry out the following operations, preferably in the sequence outlined below:

1. Prepare the site (refer to Section 5 '*Siting*').
2. Bolt the Turning Unit to the mounting platform (ship's structure) as shown in Installation Drawing 65801050 supplied with the Turning Unit, and in Figure 3.5.
3. Bolt the Antenna to the Support Casting as shown in Installation Drawing 65601275 supplied with the Antenna, and in Figure 3.12.
4. Lay in and install the cables for the Turning Unit following the Cabling Schedules in Section 6.2.6 '*Cabling Information*'.
5. Make sure the Turning Unit, the Motor Drive Board and the Pulse Bearing Board are correctly set for the required high or low-speed option, set using their relevant jumper links, see Section 6.2.5 '*Turning Unit Link Settings*'.

Figures 3.6 to 3.11 shows X-band Scanner outline drawings that are intended to duplicate those provided with the equipment. However, as changes may occur to the details that may not be reflected in this manual, the installation drawings supplied with the equipment take precedence in the event of differences arising.

6.2.1 Turning Unit

WARNING

The Turning Unit must be lifted using the four fixing holes at the base of the unit. The weight and spread of the Antenna can cause a freestanding Turning Unit to topple over. The Turning Unit must therefore be bolted onto its mounting platform before attaching the Antenna to the Turning Unit. When working on the X-band Turning Unit with the top casting raised, always make sure the locking bolt or latch on the stay is in the locked position.

The Turning Unit is bolted to the mounting platform with four Neoprene isolating pads (65601251) between the Turning Unit casting and the mounting platform, to prevent galvanic corrosion.

Additional washers or pads may be added to level the mounting so that the Turning Unit casting does not twist when the bolts are tightened. M10 washers can be used as shims, or purpose made parts, produced locally, may be used.

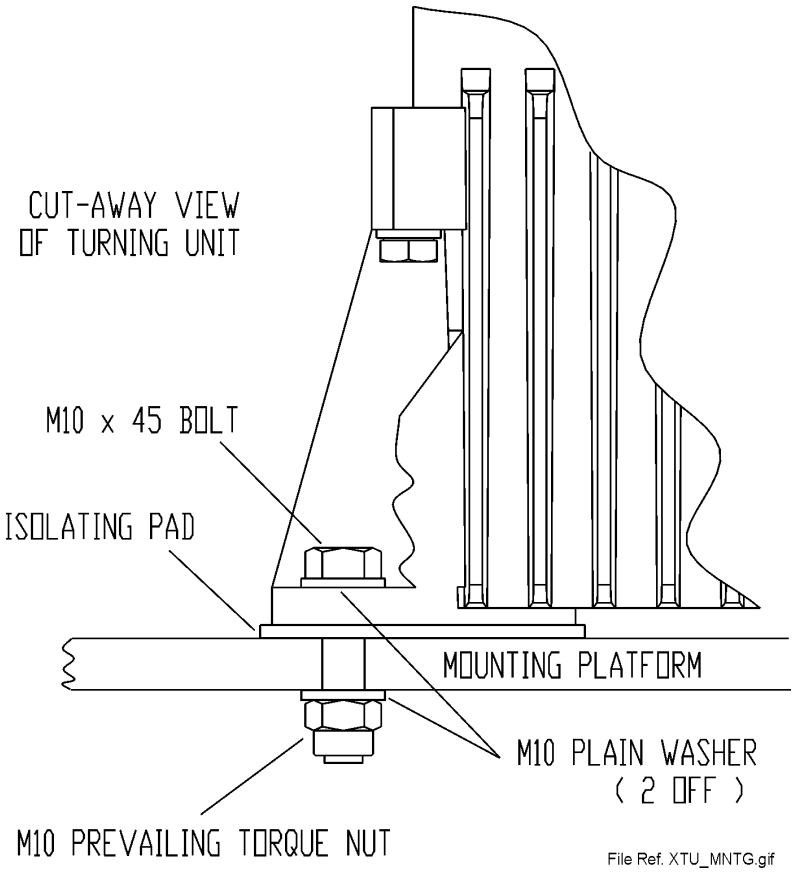


Figure 3.5 Fixing the Turning Unit to the Mounting Platform

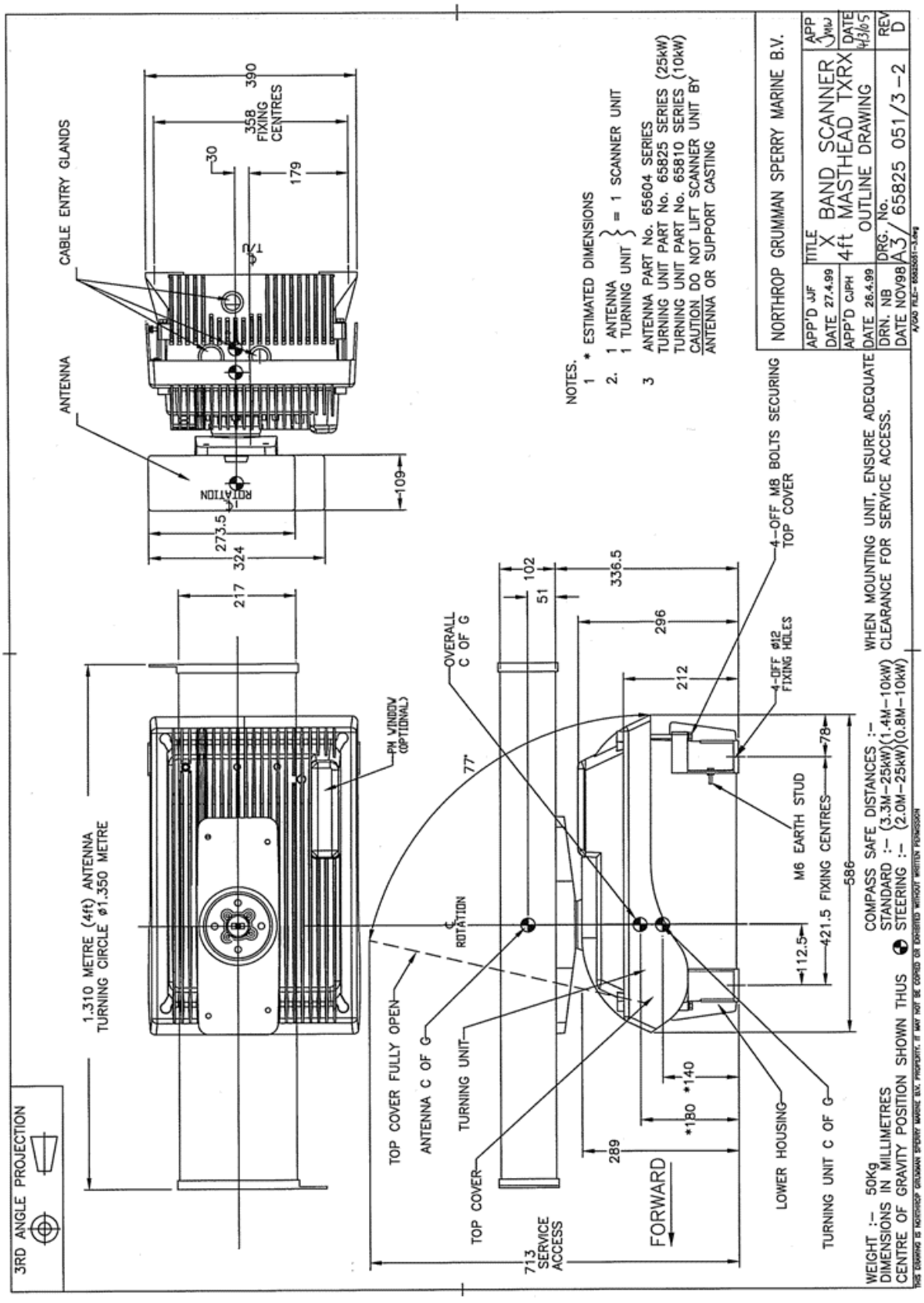


Figure 3.6 X-band Scanner 4ft Masthead Tx/Rx Installation

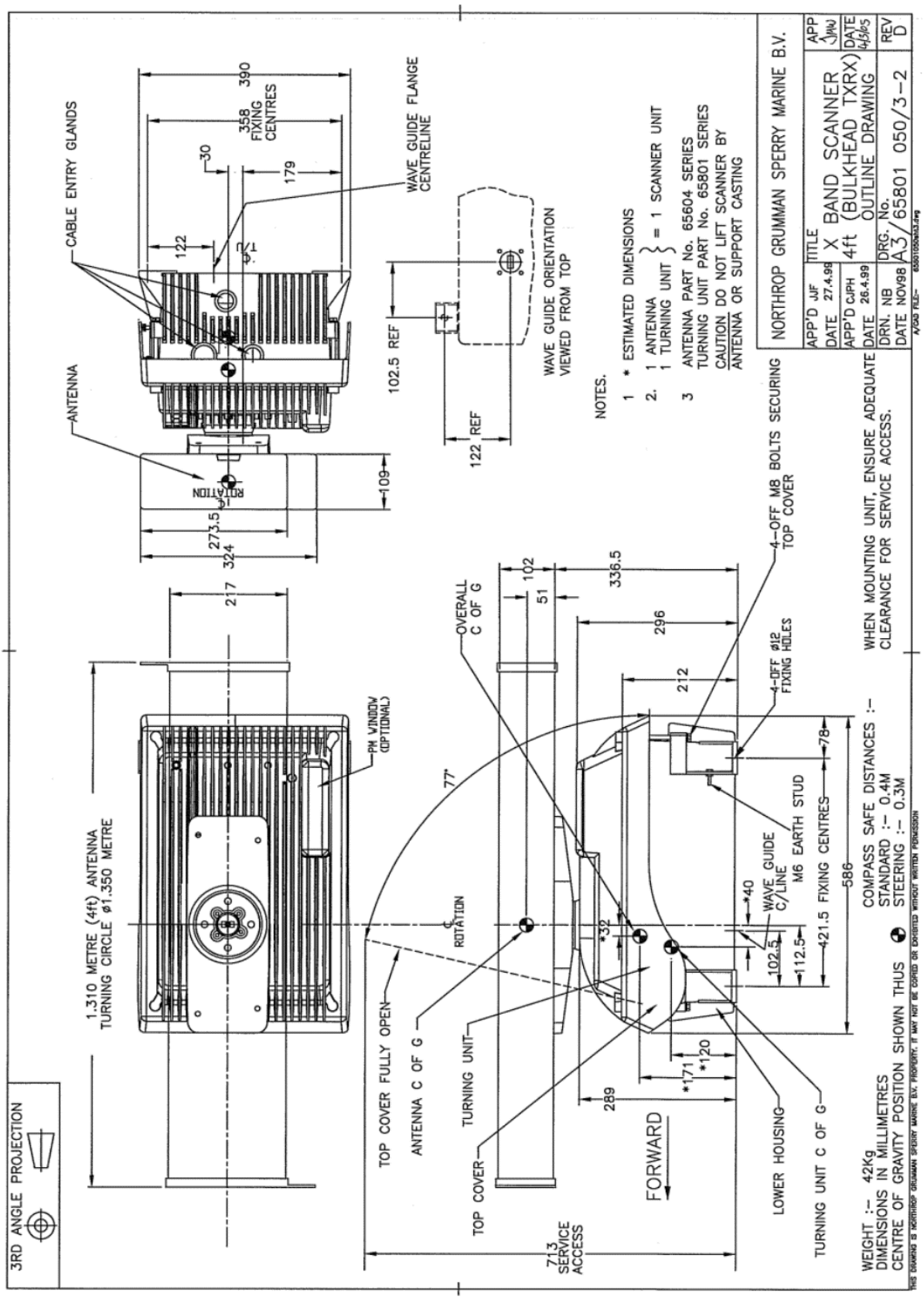


Figure 3.7 X-band Scanner 4ft Bulkhead Tx/Rx Installation

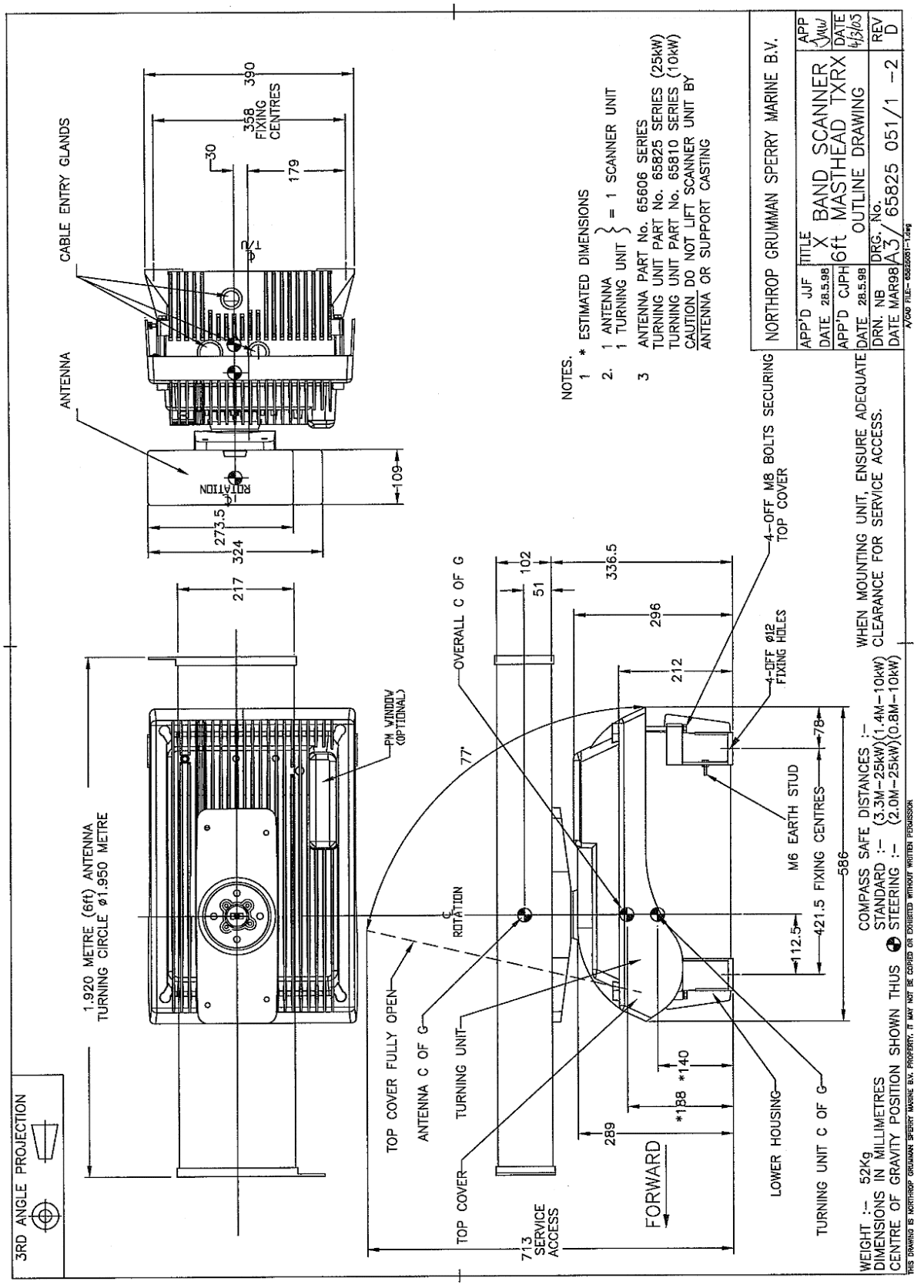


Figure 3.8 X-band Scanner 6ft Masthead Tx/Rx Installation

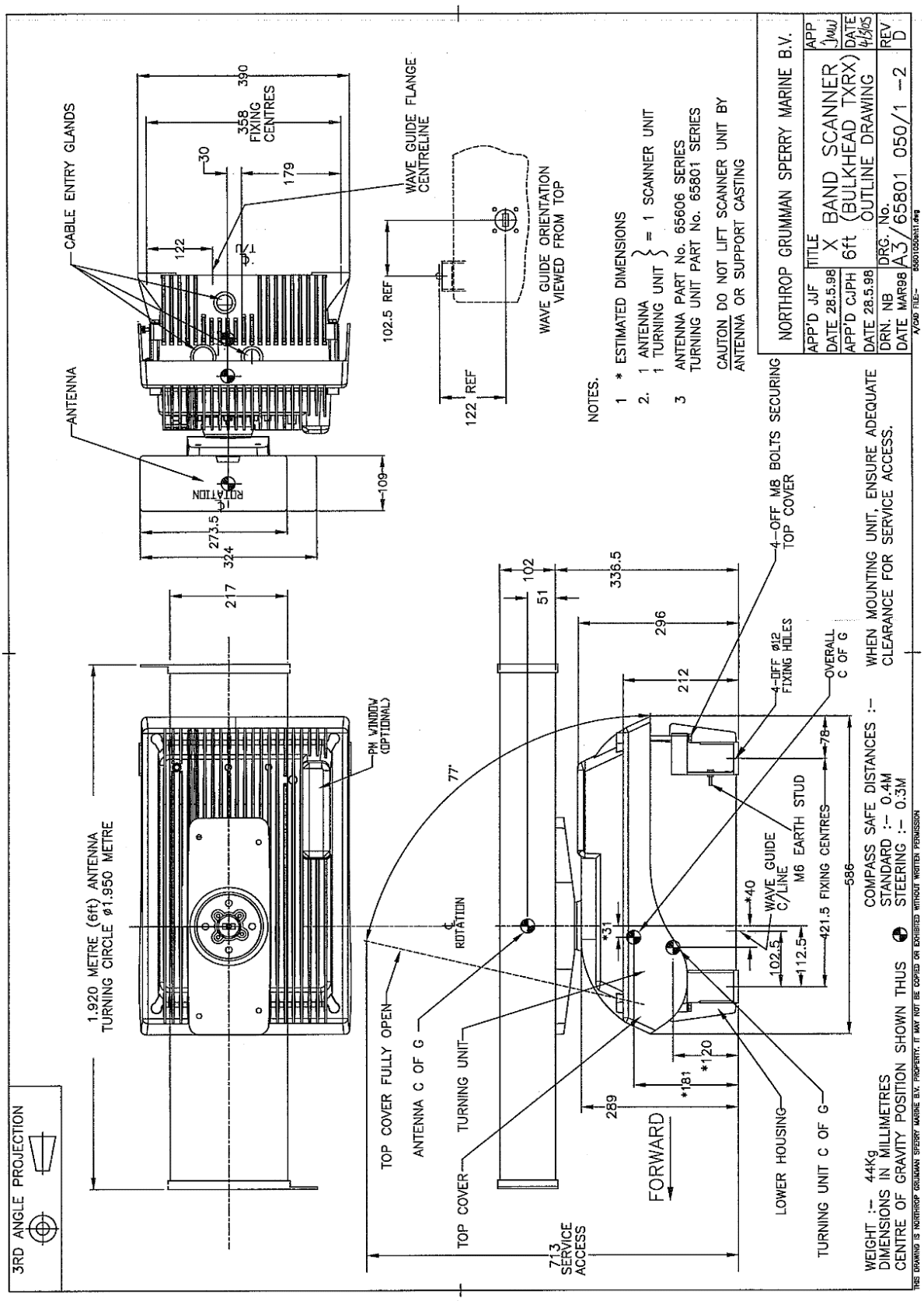


Figure 3.9 X-band Scanner 6ft Bulkhead Tx/Rx Installation

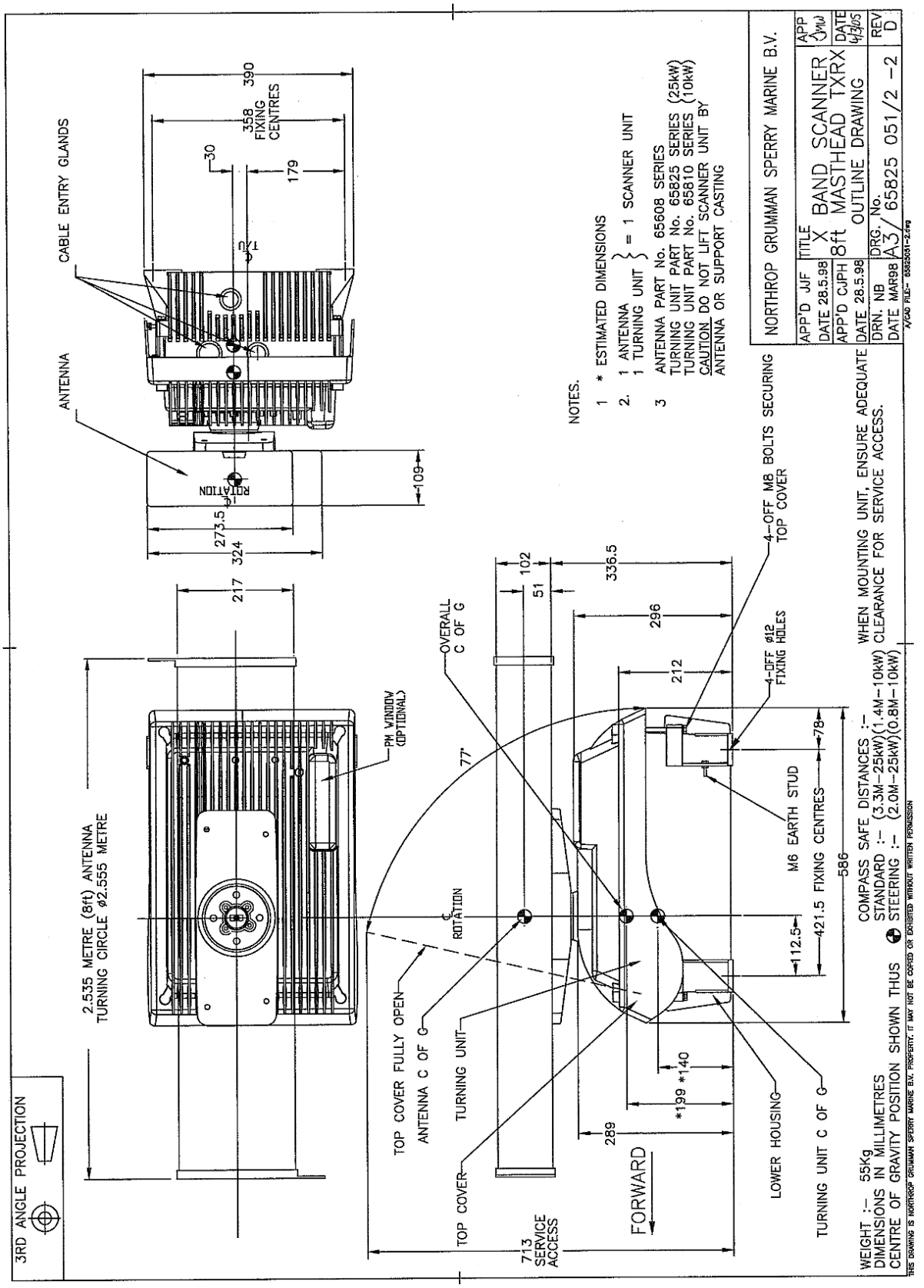


Figure 3.10 X-band Scanner 8ft Masthead Tx/Rx Installation

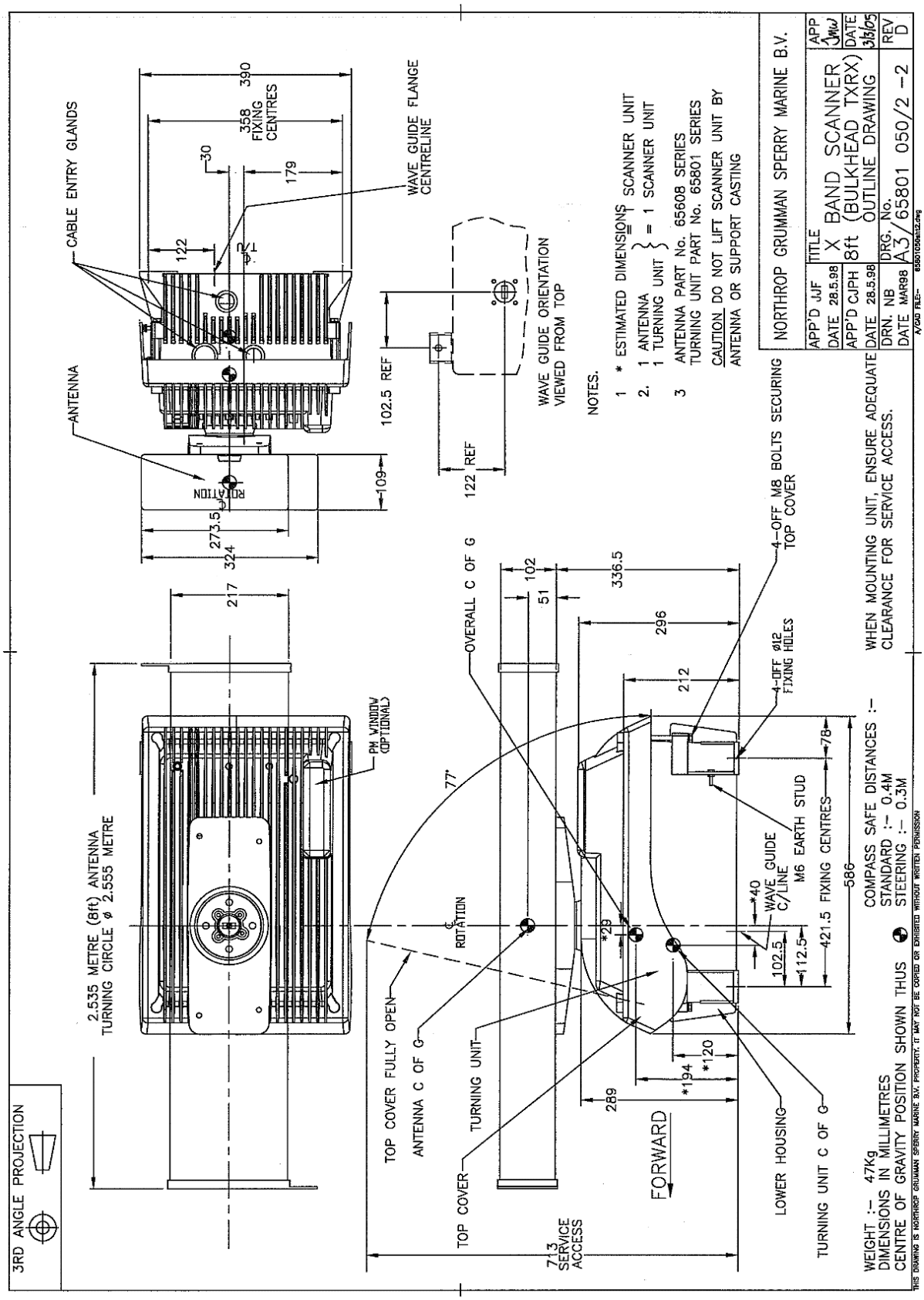


Figure 3.11 X-band Scanner 8ft Bulkhead Tx/Rx Installation

6.2.2 Support Casting

The Support Casting is factory fitted to the Turning Unit and needs no further assembly during installation.

6.2.3 Performance Monitor

The Performance Monitor consists of the Performance Monitor module and a control cable. The equipment is normally factory fitted.

6.2.4 Antenna

The Antenna is fitted to the Support Casting using the parts listed below (supplied with the antenna).

4 x M8 Stainless Steel Plain Nut (grade 316S16)	4411544
2 x Washer with locking tab	65602122

The holes in the support casting are asymmetrically placed to prevent the antenna being fitted backwards. The support casting has the word 'FRONT' visible from above to help with initial antenna location.

Figure 3.12 shows how these are fitted.

Make sure the four Antenna fixing bolts are well coated with Denso Paste before securing to the turning unit.

Note: *The lock tab ends must be bent as shown in Figure 3.12 to prevent rotation of the nuts.*

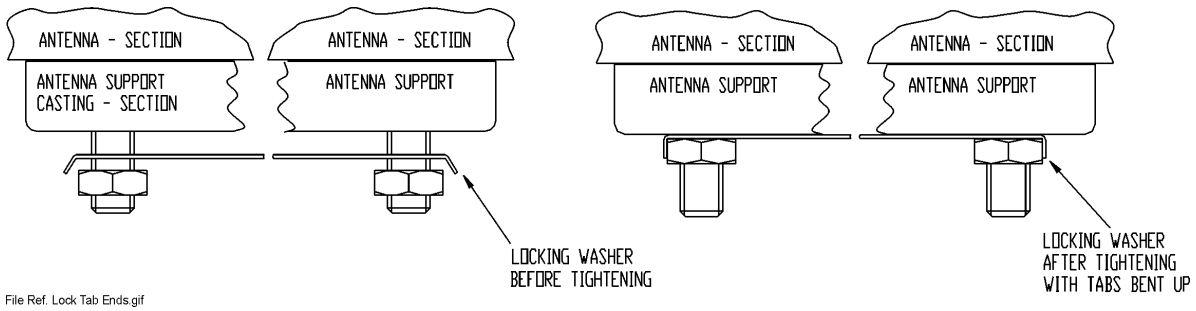


Figure 3.12 Fixing the Antenna to the Support Casting

After assembling and securing the Antenna to the turning unit apply a bead of sealant around the joint between the Antenna and support casting. Smooth the sealant finish with a damp cloth.

6.2.5 Turning Unit Link Settings

To access the PCBs housed in the Turning Unit loosen the four bolts securing the top casting to the bottom casting. Lever the top casting up and secure in position with the stay locking bracket, see Figure 3.41, page 56.

Standard Turning Units include the following types:

65801Bxx

65810Mxx, 65810Pxx, 65810Sxx, 65810Wxx

65825Lxx, 65825Mxx, 65825Pxx, 65825Wxx

For link settings on 'additional features' turning units, see Section 3 '*Installation and Interconnections*' in Chapter 12 *'Additional Features*'.

'Additional features' turning units include the following types:

65801Cxx

65810Nxx, 65810Txx

65825Nxx, 65825Txx

For the standard turning units, two scanner speed settings are available: 'LOW' and 'HIGH', depending on the following settings of the Motor Drive Board and the Pulse Bearing PCB Assembly.

For the 'additional features' turning units fitted with Motor Drive Board 65801827 and Pulse Bearing Board 65801826, there is a third option that lets you remotely select between the two scanner speed settings.

6.2.5.1 Motor Drive PCB Assembly (65801811)

For Motor Drive PCB Assembly 65801827 (fitted to 'additional features' turning units) see Section 3.3.5 in Chapter 12 *'Additional Features'*.

Setting link LK1 on the Motor Drive Board 65801811

This link is set during installation and commissioning, and requires no tools to change it.

The factory default setting is 'NORMAL' speed. If no jumper is fitted, the rotational speed defaults to high-speed.



CAUTION

Under no circumstances should the link position be moved whilst the motor is running.

With the jumper in the position marked 'LO' (pins 1 and 2 – left hand pair), the nominal scanner speed is 28 rpm, see Figure 3.13.

With the jumper in the position marked 'HI' (pins 2 and 3 – right hand pair), the nominal scanner speed is 45 rpm.

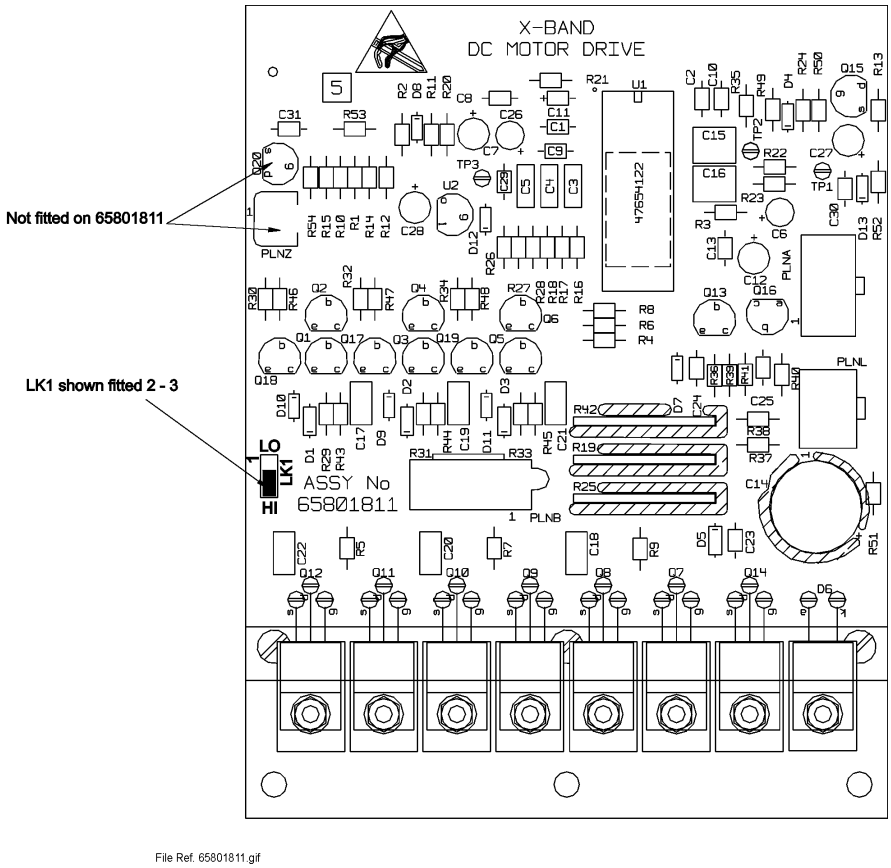


Figure 3.13 Motor Drive Board 65801811 – Showing Link Position

6.2.5.2 Pulse Bearing PCB Assembly (65801805)

For Pulse Bearing PCB Assembly 65801826 (fitted to 'additional features' Turning Units) see Section 3.3.4 in Chapter 12 *'Additional Features'*.

Setting link LK1 on the Pulse Bearing PCB Assembly 65801805

This link does not change the rotational speed of the scanner, but does alter the ability of the phase-locked loop within the board to track the scanner rotational speed. The factory default setting is optimised for 'LOW' speed. If no jumper is fitted, the Pulse Bearing PCB Assembly is optimised for high-speed.

CAUTION

Under no circumstances should the link position be moved whilst the motor is running.

1. Set the jumper in the position marked '1' (pins 1 and 2 – the lower pair) when the nominal scanner speed is 28 RPM ('LOW'), see Figure 3.14.

2. Set the jumper in the upper pair position (pins 2 and 3) when the nominal scanner speed is 45 RPM ('HIGH').

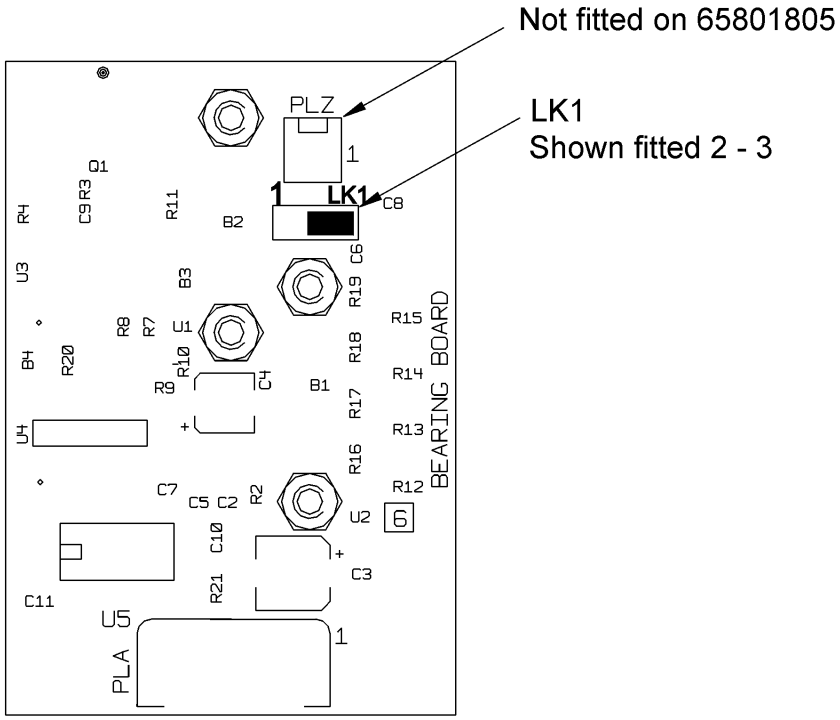
The link is set during installation and commissioning. The link can be moved with the PCB in place using long nose pliers. This is not easy because the PCB mounting bracket obscures the position of the link.

The recommended method is:

1. Loosen the two Pozidriv screws that hold the mounting bracket in place.
2. Slide the whole assembly to the right using the slotted screw holes in the mounting bracket.
3. Move the assembly forward into a more accessible position for the link to be moved.

During removal and refitting of the mounting bracket, take care not to damage the teeth on the pulse disc assembly that run between opto-couplers mounted on the rear of the Pulse Bearing PCB. Before re-tightening the two Pozidriv screws, check that both pairs of plain and single coil washers are above the top surface of the mounting bracket and not trapped beneath it.

For an easier installation, it is recommended that you complete this operation, if it is required, before mounting the Turning Unit aloft.



File ref: 65801805.gif

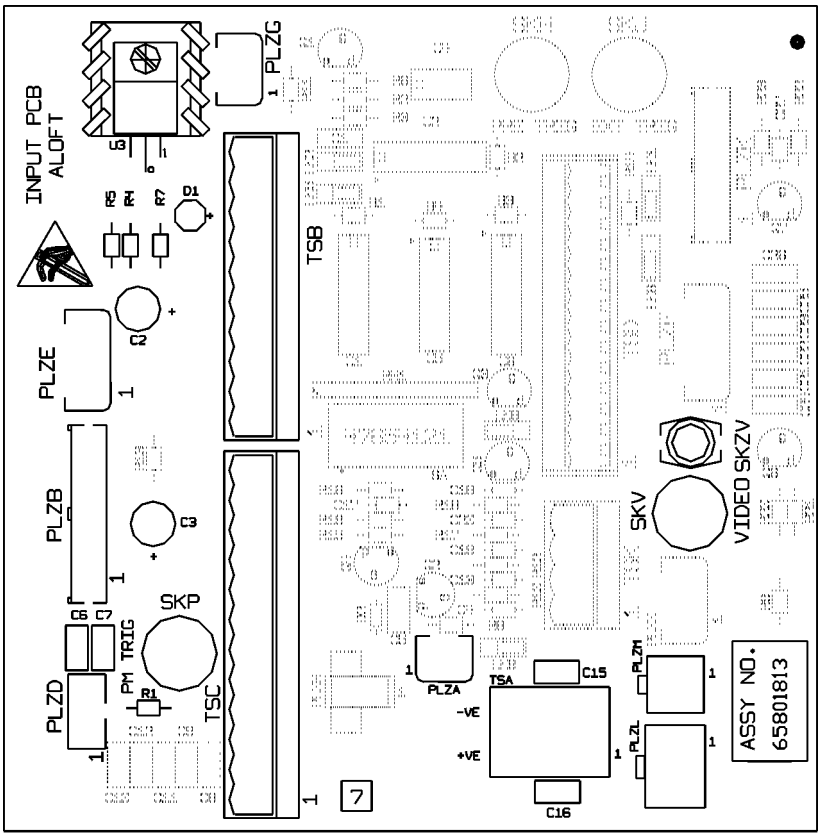
Figure 3.14 Pulse Bearing Board 65801805 - Showing Link Position

6.2.5.3 Turning Unit Input PCB Assembly 65801813 (fitted to standard Turning Units)

For Input PCB Assembly 65801819 (fitted to 'additional features' Turning Units), see Section 3.3.2 in Chapter 12 *'Additional Features'.*

The diagram below shows details of the Turning Unit Input Board 65801813. To access the board:

1. Release the four retaining bolts (see Figures 3.6 to 3.11).
2. Lift up the upper casting cover on its hinges.
3. Remove the screening cover.



File Ref. 65801813.gif

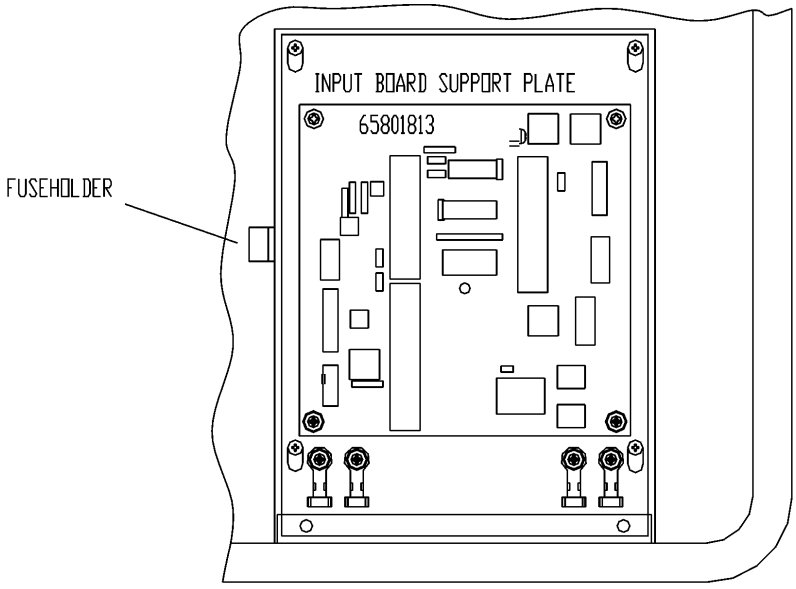
Figure 3.15 Turning Unit – Input Board Details

Note: *The video cable does not plug into the Input Board, but goes directly to the Receiver. Refer to Section 6.2.7 'Fitting the Cable Glands' for further details.*

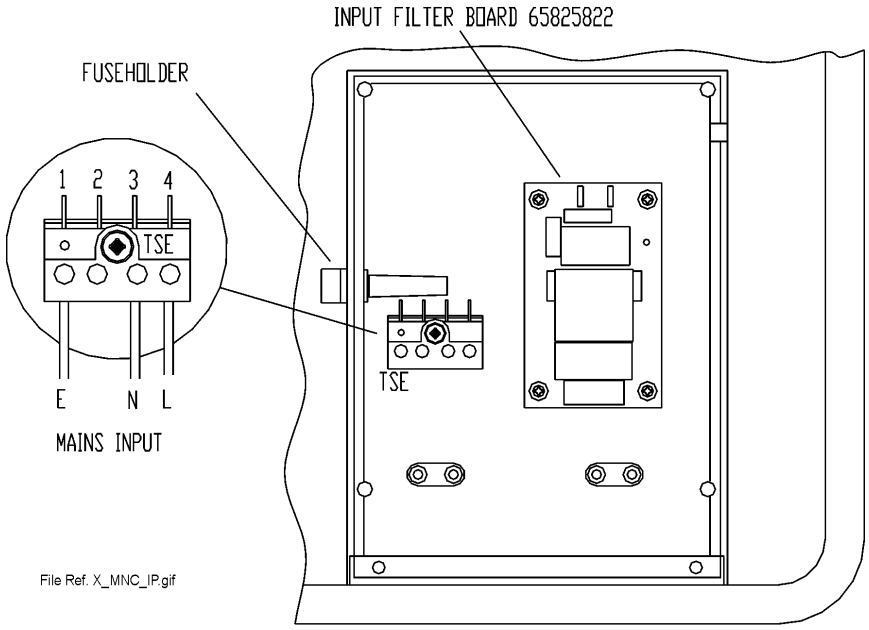
6.2.5.4 Turning Unit Mains Input Connector (Aloft Transceiver)

Figure 3.16 shows details of the Mains Input Connector TSE (Integral Transceiver only). These are accessed by removing the support plate that is held by four fixing screws (see below).

Note: *The screws only need to be partially undone to let the plate slide out.*



VIEW OF INPUT BOARD WITH SCREEN COVER REMOVED



VIEW OF MAINS INPUT WITH INPUT BOARD SUPPORT PLATE REMOVED

Figure 3.16 Turning Unit – Mains Input Details

6.2.6 Cabling Information

Before fitting the cables in the Turning Unit loosen the four bolts securing the top casting to the bottom casting. Lever the top casting up and secure in position with the stay locking bracket, see Figure 3.41.

Table 6 shows the route each cable uses to enter the turning unit (with or without an integral transceiver). Figure 3.17 shows the cable entry points; three of these are via cable glands labelled 1, 2 and 3.

Note: *For cable entry details for turning units with 'additional features', see Section 3.2 'Interconnections' in Chapter 12 'Additional Features'.*

The RF feeder (waveguide) input is only needed when the transceiver is mounted below decks (bulkhead). The bulkhead lower casting is different from the masthead variant because the X-band waveguide flange is mounted on the underside face. See Figure 3.7, Figure 3.9 or Figure 3.11 for details.

A 6mm bolt is fitted so that the unit can be connected to the ship's structure. This **must not** be used for any other connection.

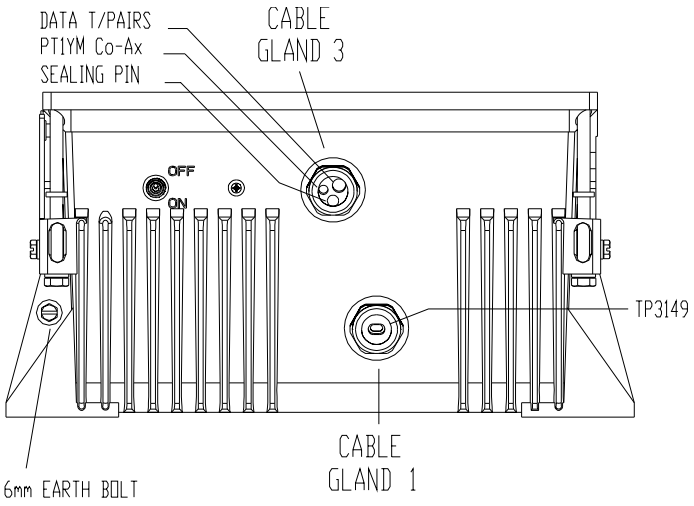
For details of how to terminate the cables into their connector blocks, see the Interconnection Diagrams and Cabling Schedules in Section 7 '*System Component Interconnections*'.

Each cable gland has a waterproof seal and a separate EMC seal. These must be installed as shown in Figure 3.19.

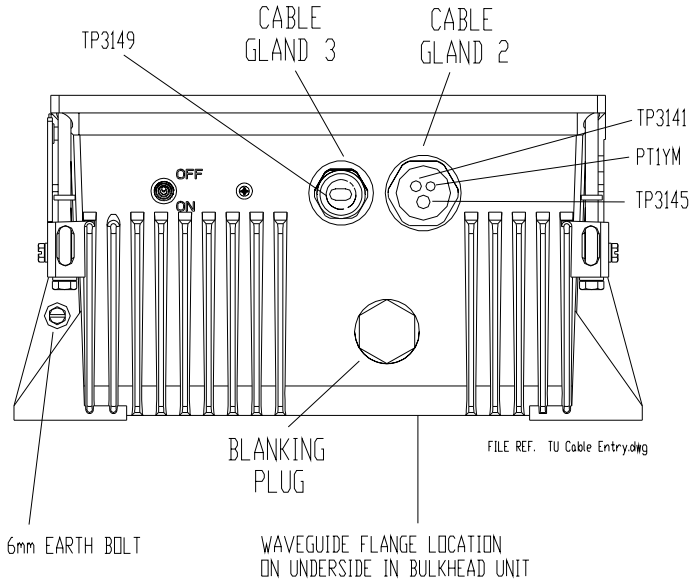
Details for terminating the RF feeder (waveguide) are given in Section 2.7 '*X-band Elliptical Waveguide*'.

Table 6: X-band Cable Gland Details

Cable Gland	Turning Unit without Integral Transceiver		Turning Unit with Integral Transceiver	
	Description	**Cable Type**	**Description**	**Cable Type**
Cable Gland 1	Blanking Plug	—	Mains Input AC	37-3-2R
Cable Gland 2	PM/Bearing	16-2-12C	Blanking Plug	—
Cable Gland 2	PM Trigger	75Ω co-ax	—	—
Cable Gland 2	TU Enable	16-2-2C		
Cable Gland 3	Motor 50V	37-3-2R	Radar Video	75Ω co-ax
Cable Gland 3	—	—	Data	T/Pairs
RF Connector	RF Feed	X-band Waveguide	—	—



Turning Unit for use with Aloft Transceiver



Turning Unit for use with Bulkhead Transceiver

FILE REF. TU cable entry

Figure 3.17 Turning Unit - Cable Entry Positions

6.2.7 Fitting the Cable Glands

The installation cables are connected into the turning unit via the correct cable glands (see Table 6). The body of the gland fits through a hole in the casting and is held in position by the Top Nut. An 'O' ring seal is fitted below the casting surface (input side).

A waterproof seal and an EMC gasket are provided with each gland as shown in Figure 3.18 and Figure 3.19. Some glands are designed for a single cable; others are intended or several cables. Unused glands are fitted with a blanking plug. Unused cable entries are fitted with a sealing pin to maintain the seal integrity.

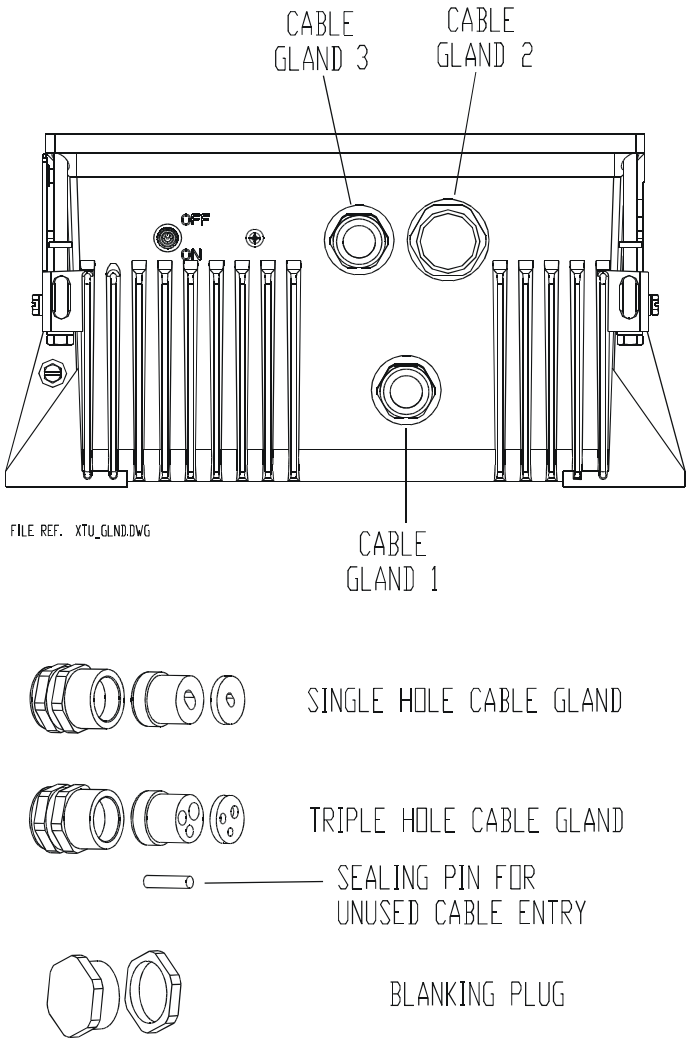


Figure 3.18 Turning Unit (Bulkhead Transceiver) – Cable Entry Positions

Note: *Cable Glands and Blanking Plugs are normally factory fitted to the Turning Unit. Turning Units for aloft transceivers do not have cable gland holes.*

6.2.8 Cable Installation: X-band Scanner Unit

The waterproof seal works by clamping onto the cable PVC sheath. The EMC gasket clamps onto the cable braid.

Note: *Do not to force the outer sheath through the EMC gasket as the gasket can split.*

The braid is also formed into a tail that is grounded by means of an adjacent earth tag. The fitting procedure is shown in Figure 3.19.

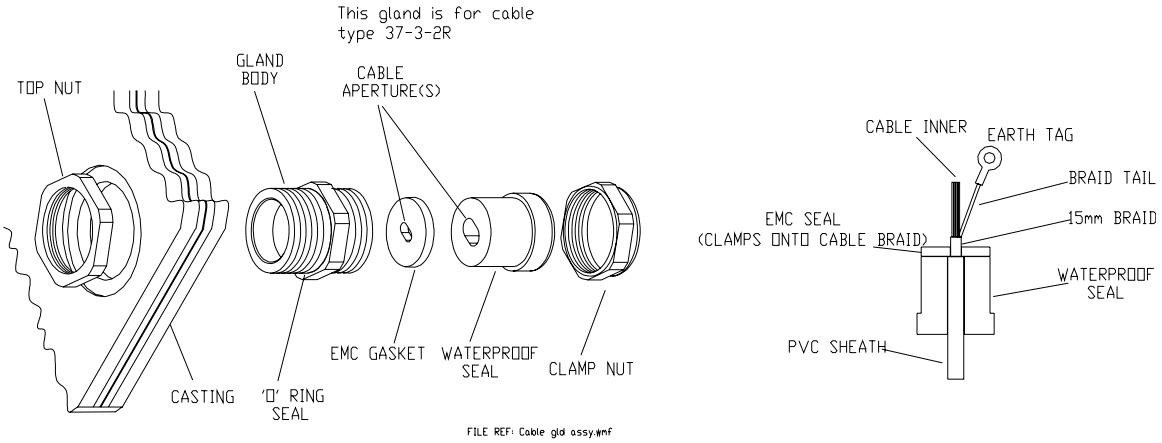


Figure 3.19 Detailed view of Cable Gland Assembly

To Install the Cables:

1. Unscrew the gland nut.
2. Remove the waterproof seal and the EMC gasket.
3. Feed the cables through the gland nut and waterproof seal.
4. Strip the outer sheath to expose approximately:
   300mm of braid for the multicore cables.
   1200mm of braid for the video coaxial cable.
5. Push the braid back to expose approximately 50mm of the inner cores.
6. Trim 50mm off the inner cores.
7. Pull the braid back and twist into a point.
8. Feed the cable through the EMC gasket until it is positioned as shown in Figure 3.19.
9. For the Multicore Cable: flare the braid out to within approximately 15mm of the EMC gasket and form a tail.
10. For the Coaxial Cable: do not fit the connector at this time.

6.2.8.1 Cable Assembly into Scanner Unit:

To assemble the cables into the scanner unit:

1. Feed the assembled cables and seals into the gland body.
2. Tighten the gland nut to compress the waterproof seal.
3. Crimp the earth tags to the braids of the multicore cables, keeping them as short as possible.
4. Attach the earth tags with the screws provided.
5. Trim and attach the cable inners to the appropriate connectors.
6. The video coaxial cable does not plug into SKV on the Input PCB, but is connected to SKV on the Receiver Assembly.
7. Sleeve the braid of the coaxial cable with the 6mm sleeving supplied.
8. Route the cable through the slot at the end of the filter box cover, along the cable loom on the right hand side of the scanner unit.
9. Use cable ties to clip it to the loom.
10. Trim to length and fit the coaxial plug.
11. For systems using below-decks transceivers the Performance Monitor Trigger coaxial cable is terminated in the same way, but only needs to be stripped back 200mm, as it is plugged into SKP on the Input PCB.

6.2.8.2 Cable Assembly into Turning Unit

To assemble the cables into the turning unit:

1. Feed the assembled cables and seals into the gland body.
2. Tighten the gland nut until the EMC seal is compressed.
3. Crimp the earth tags provided to the braids of the multicore cables
4. Attach them to the earth studs adjacent to the cables. The tails should be as short as is practicable.
5. Trim and make off the cable inners to the appropriate terminal blocks.
6. Trim the coaxial cables to length.
7. Slide the plastic sleeve supplied in the despatch kit over the exposed braid.
8. Fit the coaxial connectors.
9. Plug them into the appropriate sockets.

6.3 X-band Bulkhead Transceiver

The Bulkhead Transceiver, type 65810A to 65810W (10kW) or 65825A to 65825W (25kW), is installed below decks in a suitable location such as the ship's equipment room.

The installation should consider accessibility for maintenance and servicing, and the distance between the Transceiver and the Scanner Unit. For maximum performance, this should be kept as short as practicable: the loss per metre of the X-band waveguide is typically 10dB per 100 metres (2dB for 20 metres). This loss applies to both the transmitted RF pulse and the received signals.

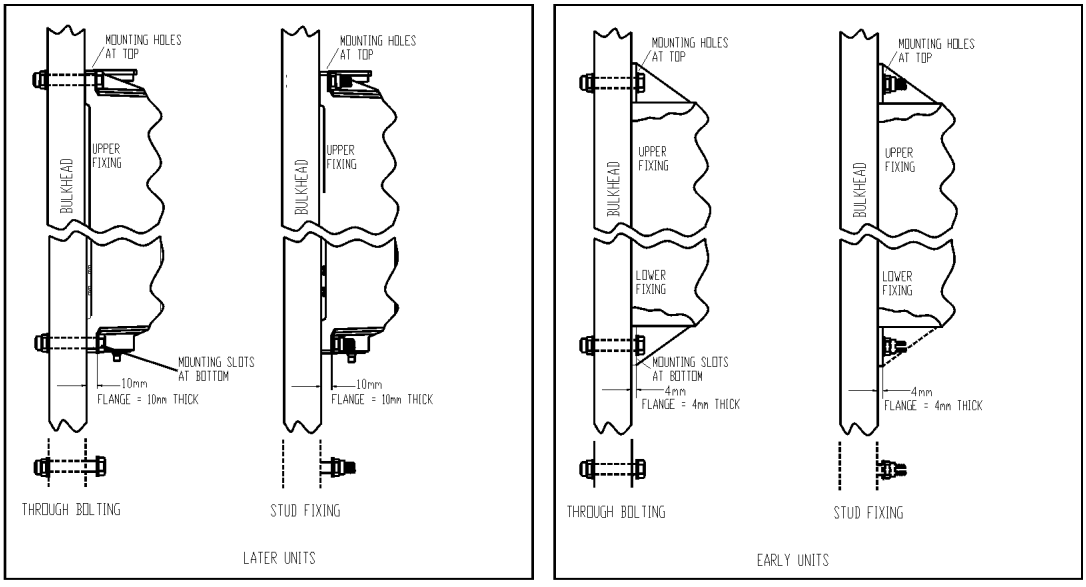
The maximum recommended cable length using standard coaxial cable (PT1YM) is:

- 30 metres between the Turning Unit and the Transceiver Unit; and
- 67 metres between the Transceiver and Display.

Greater separation is possible by using a lower loss cable. Contact Northrop Grumman Sperry Marine B.V. if greater separation is required.

When choosing the installation location for the Transceiver, routing of the RF Feeder (waveguide) should be carefully considered.

The Transceiver may be attached to the bulkhead by several methods. The actual method chosen will depend on individual circumstances, with due regard given to the likely vibration and shock loading which may be experienced. The available methods include through bolting to the bulkhead, or mounting on studs supplied by the shipyard. Slotted mounts are supplied at the bottom for ease of installation.



File Ref. Xbd BT_mounting.gif

Figure 3.20 X-band Bulkhead Transceiver – Mounting Alternatives

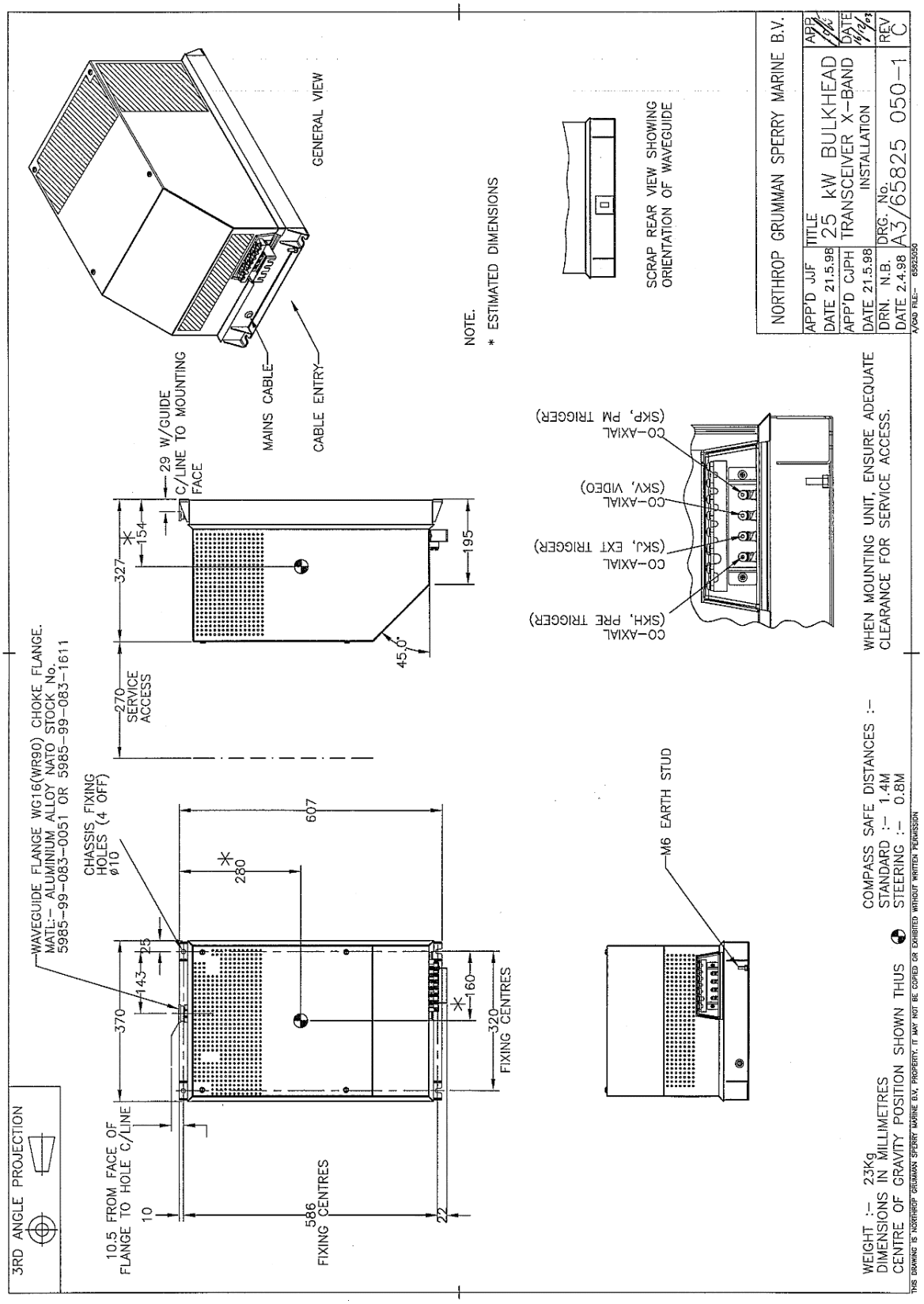


Figure 3.21 X-band Bulkhead Transceiver 25kW Installation

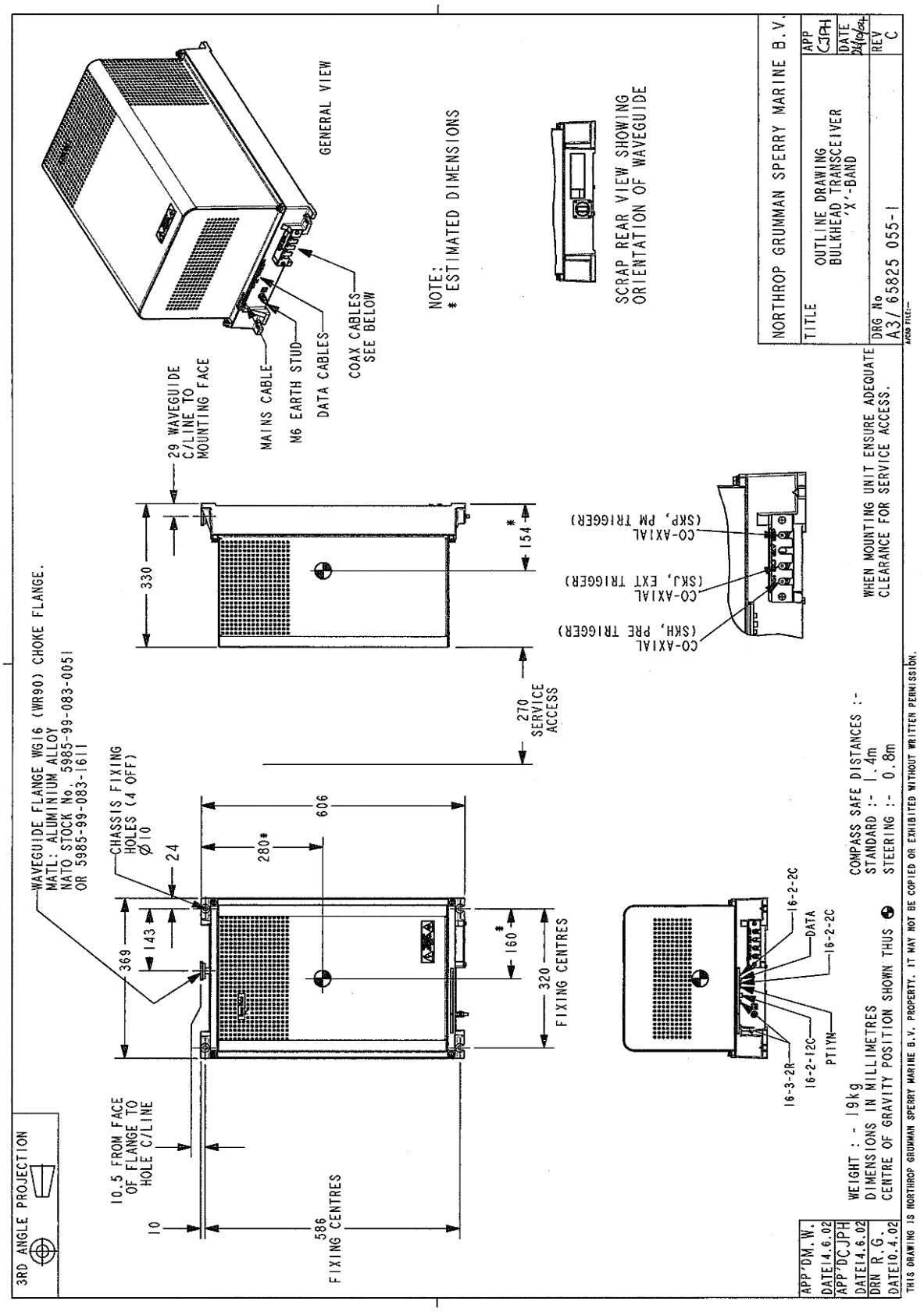


Figure 3.22 X-band Bulkhead Transceiver 25kW (later version) Installation

6.3.1 Bulkhead Transceiver Cabling Information

Figure 3.24 shows details of the cable input. The Transceiver cover, which is secured by four fixing screws, is shown removed. A cable-retainer holds the coaxial cables in place. The cables must be fitted to the retainer after the cables are in place.

All other cables, with the exception of the X-band RF feeder (waveguide), are individually clamped on their cable braids to provide EMC shielding. The braids are also made off as tails and connected to earth tags supplied.

The AC mains input is connected to TSE located underneath the cover plate as shown in Figure 3.24.

6.3.1.1 Bulkhead Transceiver Input PCB Details

Figure 3.23 shows details of the Input PCB Assembly 65801814.

Access to the board is made by removing the main Transceiver cover and the Filter Box cover. Refer to the cabling schedules in Section 7 '*System Component Interconnections*' for details of the connections, which are made by using the two-part connectors supplied.

For 'additional features' transceivers fitted with PCB 65801815 or 65801821, see Section 3.3 *'Configuring Printed Circuit Boards'* in *Chapter 12 'Additional Features'.*

Configuration for normal operation is by link settings as follows:

LK2 Link pins 2 and 3

LK3 Link pins 2 and 3

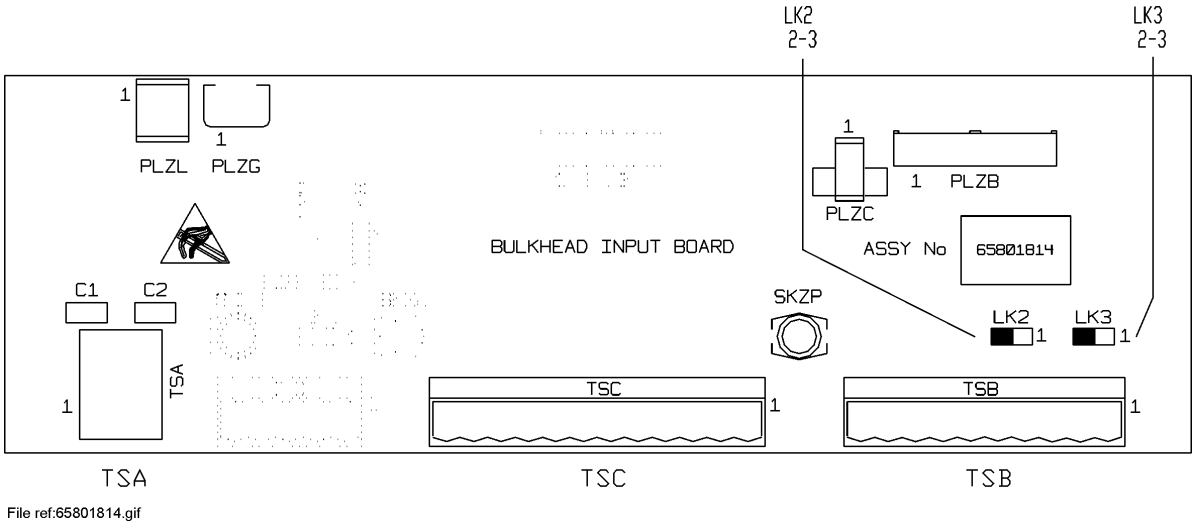


Figure 3.23 X-band Bulkhead Transceiver - Input Board Details

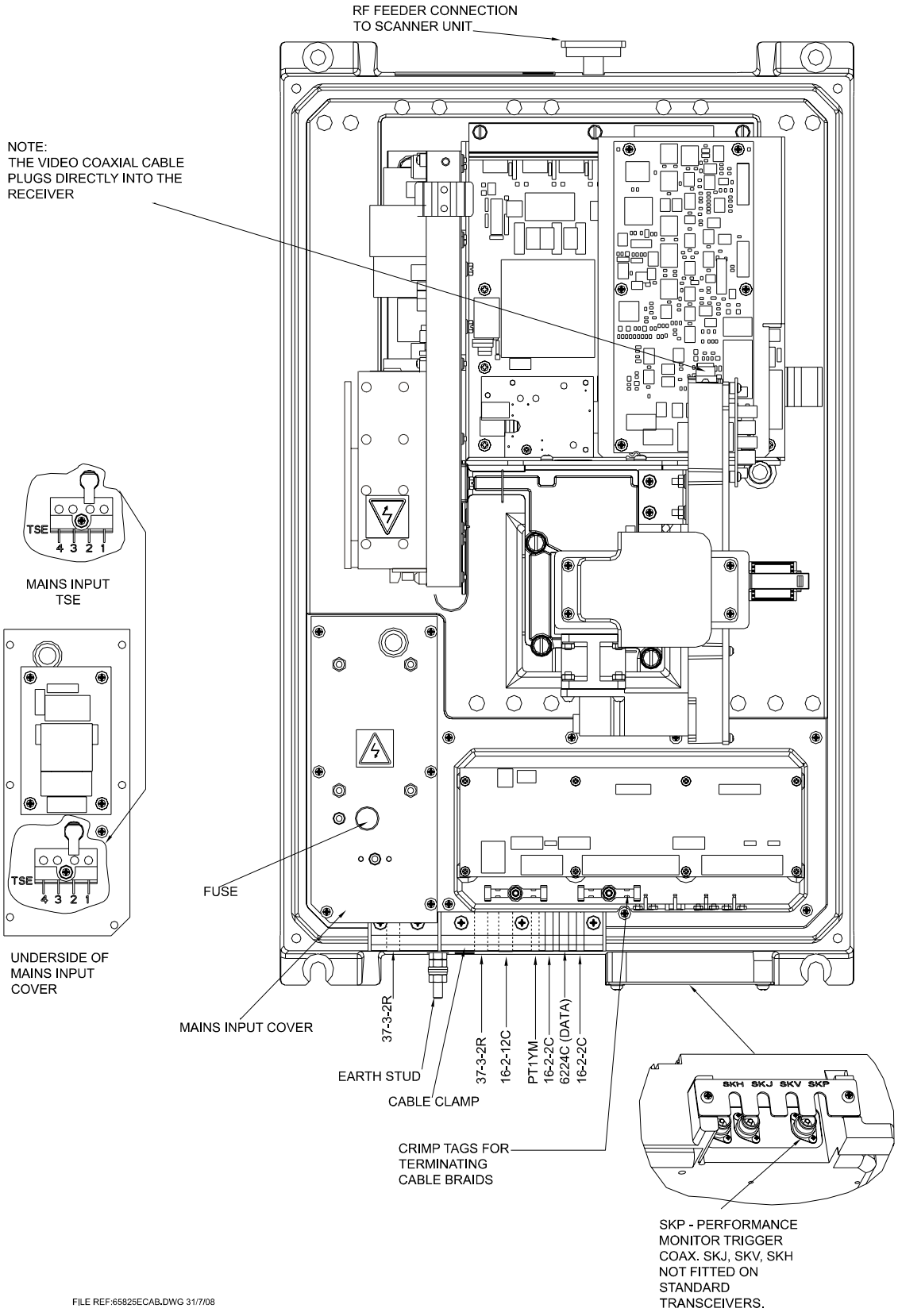


Figure 3.24 X-band Bulkhead Transceiver – Cable Input Details

6.3.2 Fitting the RF Elliptical Waveguide (X-band)

For X-band radars a 33.5mm x 22.9mm corrugated elliptical waveguide is used for the run between the Bulkhead Transceiver Unit and the Turning Unit. The waveguide used is Andrew Antennas Type EW85.

A 12" flexible waveguide (Part No 1189.z, supplied) must be fitted between the elliptical waveguide and the turning unit.

Although apparently robust, the waveguide must be protected against strain and kinking, and must be treated with great care. The ends of the waveguide must be kept sealed against the ingress of moisture before the connectors are assembled. The maximum permissible twist is 3°/metre (39").

Bends should have the largest bending radius practicable. A single bend may be made when necessary with a minimum bending radius (measured from the axis of the waveguide) of 203mm (8in) in the 'E' plane, and 482mm (19in) in the 'H' plane.

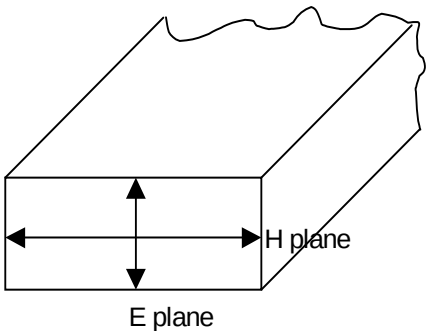


Figure 3.25 Waveguide Planes

For convenience, the upper (Turning Unit) connector can be fitted before installation of the waveguide (waveguide kits supplied by Sperry Marine have one connector fitted) but the following precautions must be taken:

1. Any bend required within 1m (3ft) of the waveguide end must be formed before carrying out the cutting and assembly procedure described in subsequent paragraphs. No bend may be nearer than 250mm (10in) from the end of the waveguide.
2. Whenever possible, to allow for movement between the Turning Unit and mast, a double bend should be formed in the waveguide to produce an offset immediately below the Turning Unit.
3. The waveguide sealer plugs must be removed and discarded from the waveguide apertures in the scanner and turning units.
4. The waveguide and assembled connector should be fitted to the Turning Unit so that a minimum amount of distortion of the waveguide occurs between the connector and the pre-formed bend.

5. The waveguide should be installed and secured in position (using the waveguide supports shown in Figure 3.40) as far as is practicable before the lower Transceiver Unit connector is fitted to the waveguide. The precautions given in paragraph 1. above must be observed if a bend is required adjacent to the Transceiver Unit.

6.3.2.1 Assembling the Connectors to the Waveguide

When assembling the connectors to an Andrew Antennas waveguide kit, refer to section 6.3.2.1a). When assembling the connectors to an RFS waveguide kit, refer to section 6.3.2.1b).

6.3.2.1a) Assembling the Connectors using Andrew Antenna Waveguide kit

Figures 3.26 to 3.31 are reproduced by permission of Andrew Antennas.

General

A straight connector (Type 185BC) is used to terminate the waveguide at each end.

Tools required

You will need a hacksaw (with a fine-toothed blade) and 1-15/16" open-ended spanner to fit the connectors to the waveguide.

Procedure

The procedure that follows applies to the straight connectors at each end of the waveguide. It is very important that swarf and other foreign matter is prevented from entering the waveguide.

Prepare the waveguide end and assemble the connector as follows:

1. Make sure the end of the waveguide is straight for at least 250mm (10in). The ends of the waveguide must be cut squarely, to ensure this wrap a straight edged piece of paper around the waveguide. Tilt the waveguide downwards to prevent copper swarf entering. Remove a 24mm (15/16in) length of the polyethylene jacket. Clean the external copper with Comothene (or Ultraclean) solvent and the interior with a bottlebrush, *see* Figure 3.26.

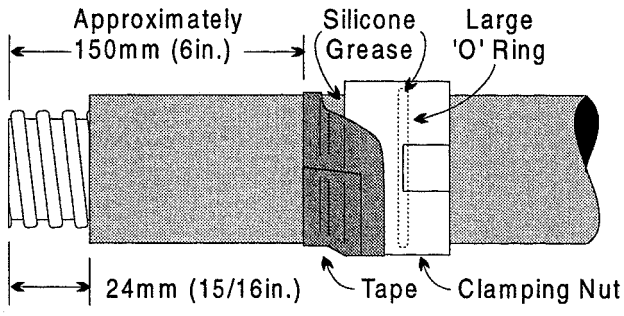


Figure 3.26 Cut Jacket

2. Apply a thin film of silicone grease (MS4 or similar) to the large 'O'-ring and insert it in the internal groove of the clamping nut. Apply a thin film of grease to the smooth internal surface of the clamping nut and slip the nut over the end of the waveguide, as shown in Figure 3.26. Wrap several turns of tape around the clamping nut and jacket to prevent foreign matter from entering.
3. Grease the cut edge of the jacket. Slip the chamfered end of the compression ring over until the recessed edge bottoms against the jacket (align the pin in holes facing away from the jacket), as shown in Figure 3.27 and Figure 3.28.

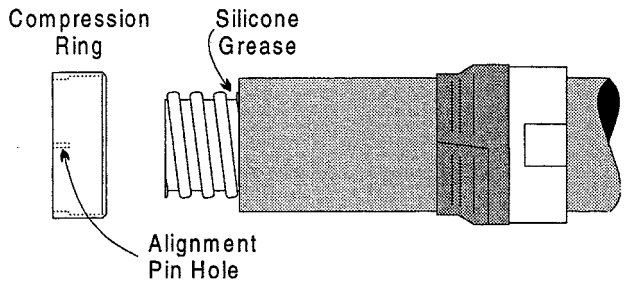


Figure 3.27 Fit Compression Ring

4. Turn the gasket inside out and fit it on to the end of the waveguide. Apply a thin film of silicone grease to the gasket threads. Roll the gasket over to the correct position and against the compression ring, *see* Figure 3.28, and apply a thin film of grease to the outside surface of the gasket. Clean any grease from the exposed copper with solvent.

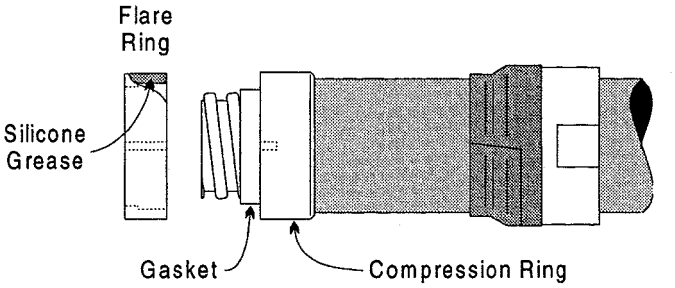


Figure 3.28 Fit Flare Ring

5. Fit the recessed side of the flare ring over the gasket, with alignment holes of the flare ring and compression ring corresponding. Push the flare ring firmly against the compression ring.

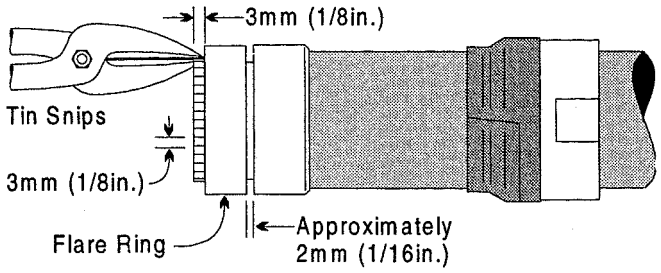


Figure 3.29 Cut Tabs

6. With tin-snips, cut the bared end of the waveguide into tabs 1/8in wide and 1/8in deep – as close to the flange as possible, *see* Figure 3.29. Flatten the tabs against the flare ring with a mallet using minimum force. Heavy blows will reduce the thickness of the copper, *see* Figure 3.30. Trim off any tab protruding beyond the edge of the flare ring. Clean the tabs with solvent to remove any silicone grease.

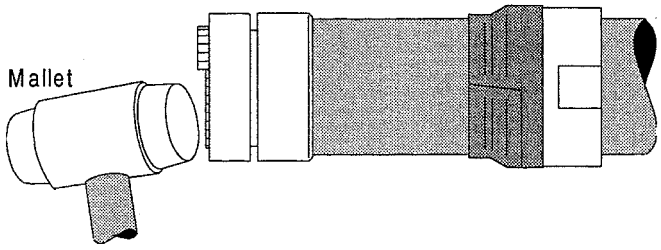


Figure 3.30 Flare End

7. Make sure the mating RF contact face of the Type 185AC connector body is clean and thoroughly grease-free. Clean the inside of the waveguide with a bottlebrush.
8. Fit the smaller 'O'-ring to the external groove on the connector body without any grease, *see* Figure 3.31. Apply a thin film of grease to the rear outer surface of the compression ring (so that the large 'O'-ring in the clamping nut will slide over the compression ring and seat in the recess).

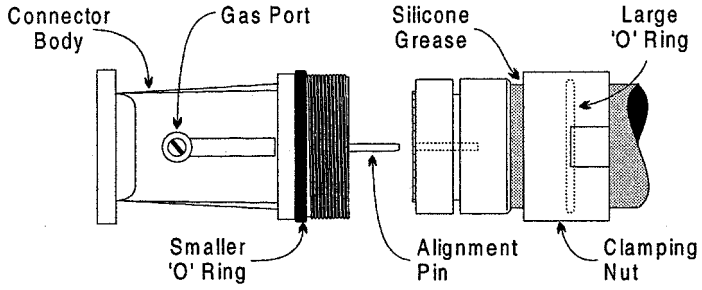


Figure 3.31 Fit Connector

9. Place the connector body against the flare ring. Insert the alignment pin in the holes of the flare ring and compression ring. Remove the tape from the clamping nut. Slide it over the rings and screw it to the thread on the connector body.
10. Hold the rectangular part of the connector body with an adjustable spanner and tighten the clamping nut with 1-15/16in set spanner across the flats. DO NOT turn the connector body.

6.3.2.1b) Assembling the Connectors using RFS Waveguide Kit

The following instructions and figures 3.32 to 3.37 are reproduced by permission of RFS (Radio Frequency Systems).

Tools and Materials Required

The following tools and materials are required.

- Tape measure, hammer, pliers, finetoothed saw, brush, half-round file (fine), solid small tin shears, knife, open-ended spanners 12 mm set of allen wrenches, cloth, Plast 2000 20 ccm, adhesive tape.

Termination Disassembly

Refer to Figure 3.32 and list below for components in mounting of terminations.

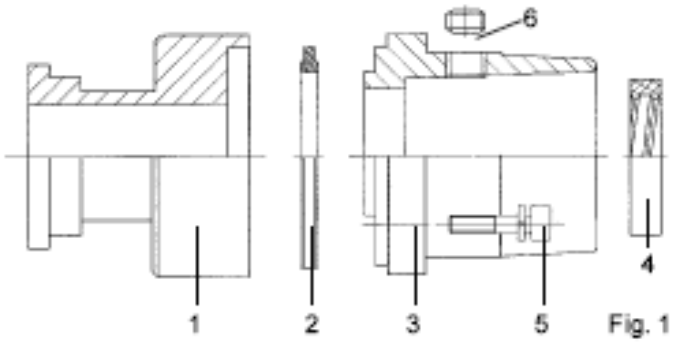


Figure 3.32 Termination Disassembly

1 Adapter section
2. Sealing ring
3. Back end
4. Sealing profile
5. Screw set with lock washers
6. Plastic screw (filling port for Plast 2000)

Waveguide Trimming

1. Cut waveguide at right angle to axis. Tilt the waveguide downwards to prevent swarf from entering the centre of the waveguide, or block off the waveguide centre using a cloth. Remove 35 mm length of polyethylene jacket as shown in Figure 3.33. Remove burrs and swarf.

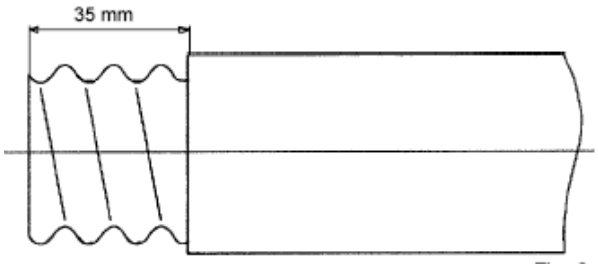


Figure 3.33 Waveguide Trimming

Waveguide Flanging

2. Slide the sealing profile (4) onto the corrugated tube, as shown in Figure 3.34.
3. Slide back end (3) onto waveguide up to sealing profile.

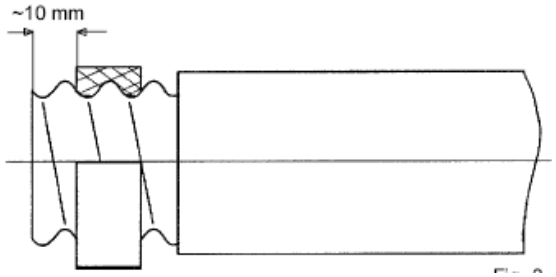


Figure 3.34 Waveguide Flanging

4. Cut in the corrugated copper tube circumferential up to the back end using tin shears. The distance between the copper tube end and the back end should be aproximately 4 mm. Cut evenly with a space of aproximately 3 mm, with spacing smaller than 2 mm at ends of larger elliptical axis, see Figure 3.35.

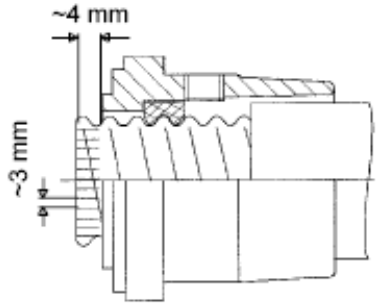


Figure 3.35 Cutting Copper Tube

5. Bend the feathered ends of the copper tube out and flange to the back end using a hammer, see Figure 3.36. Do not deform the inner bending area. If necessary, flatten the contact surface with a file. Remove cloth and any swarf from the inside of the waveguide.

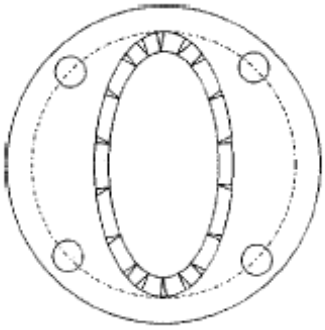


Figure 3.36 Treating the Copper Tube End

Assembly of Adapter Section

6. Screw together the back end (3) with sealing ring (2) and adapter section (1). Tighten allen screws rigidly alternating crosswise.
7. Wrap up the gap between the back end and the waveguide jacket with adhesive tape.
8. Screw Plast tube into the M9 filling port, tilt the assembly downwards and slowly fill up with the Past 2000, see Figure 3.37. The back end is filled completely when the tape swells all around.
9. Remove the tube and close the port with the plastic screw (6). Clean surplus Plast from the area.

Note: *The curing time for Plast 2000 is at least 24 hours. The waveguide* ***must not*** *be pressurized before this period.*

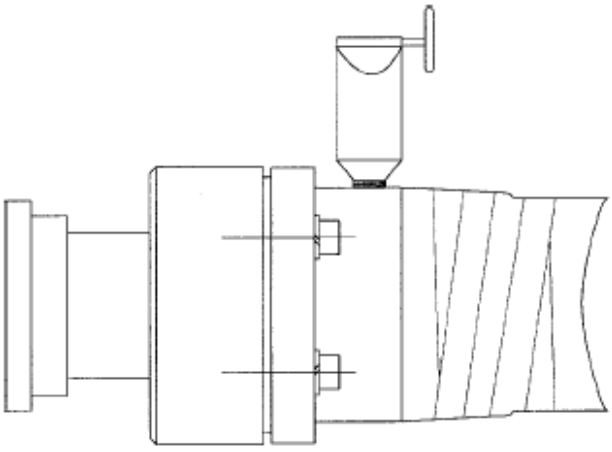


Figure 3.37 Injection of Plast 2000

6.3.2.2 Fitting the Deck Gland

The EW85 waveguide passes through its own separate deck gland (part number 9391991 (sks86347/a), positioned near the foot of the mast. The kit consists of a deck gland, gasket, upper and lower pressure plates, four m6 x25 screws and four split gaskets.

To fit the deck gland:

1. Cut the deck and fit the flange using suitable fixings (not supplied – *see* Figure 3.38).
2. Assemble the deck flange split gaskets (refer to note below) loosely around the waveguide section from below.
3. Slide the assembly upwards into the deck gland, *see* Figure 3.39.
4. Secure the waveguide down the mast.
5. Tighten the four split gasket screws carefully. Do **not** over-tighten the screws. This avoids possible distortion of the waveguide.
6. Fill the space between the waveguide and deck gland with hermastic oil-proof compound.

Note: *Split gaskets must be fitted in alternative positions to make sure the split does not line up with the split of an adjacent gasket.*

Initially, assemble the gaskets loosely before inserting them into the deck flange, see Figure 3.39. The assembly may be inverted to give you better access to the screws.

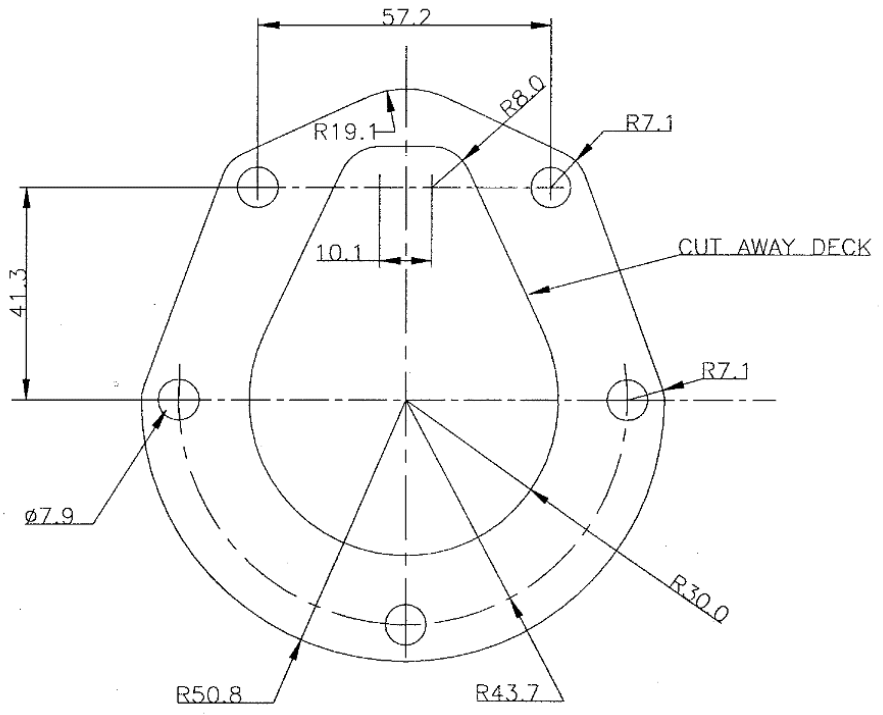


Figure 3.38 Deck Gland Fixing

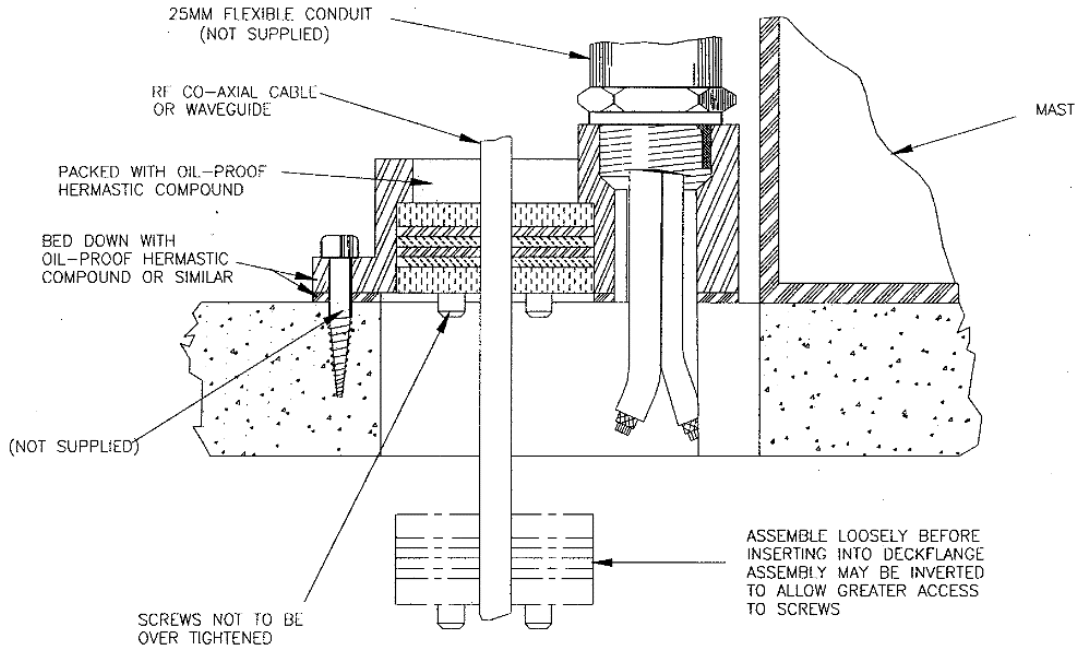


Figure 3.39 Deck Gland Details

Note: *If cables are not routed via conduit into a deck gland, make sure the cable entry hole is fully sealed using a suitable silicone sealant.*

6.3.2.3 Installing the Waveguide

Waveguide hangers are supplied (Andrew hanger kit type 42396a-5) for supporting the waveguide along its run between the scanner unit and the bulkhead transceiver. Each kit contains 10 hangers.

Their associated support assembly (Andrew type 1116.b) and fixing kit (Andrew type 31769-1) are included as part of the installation kit.

Normally, a hanger is attached to a cable entry tray using suitable bolts at the recommended spacing of 0.9 metres (3ft). The support brackets must be fitted to the hangers to prevent distortion when the hanger is wrapped around the waveguide, as show in Figure 3.40.

Figure 3.40 also shows additional hardware (not supplied in the installation kit) that can be used for special mounting arrangements. If required, these can be purchased from Andrew Corporation.

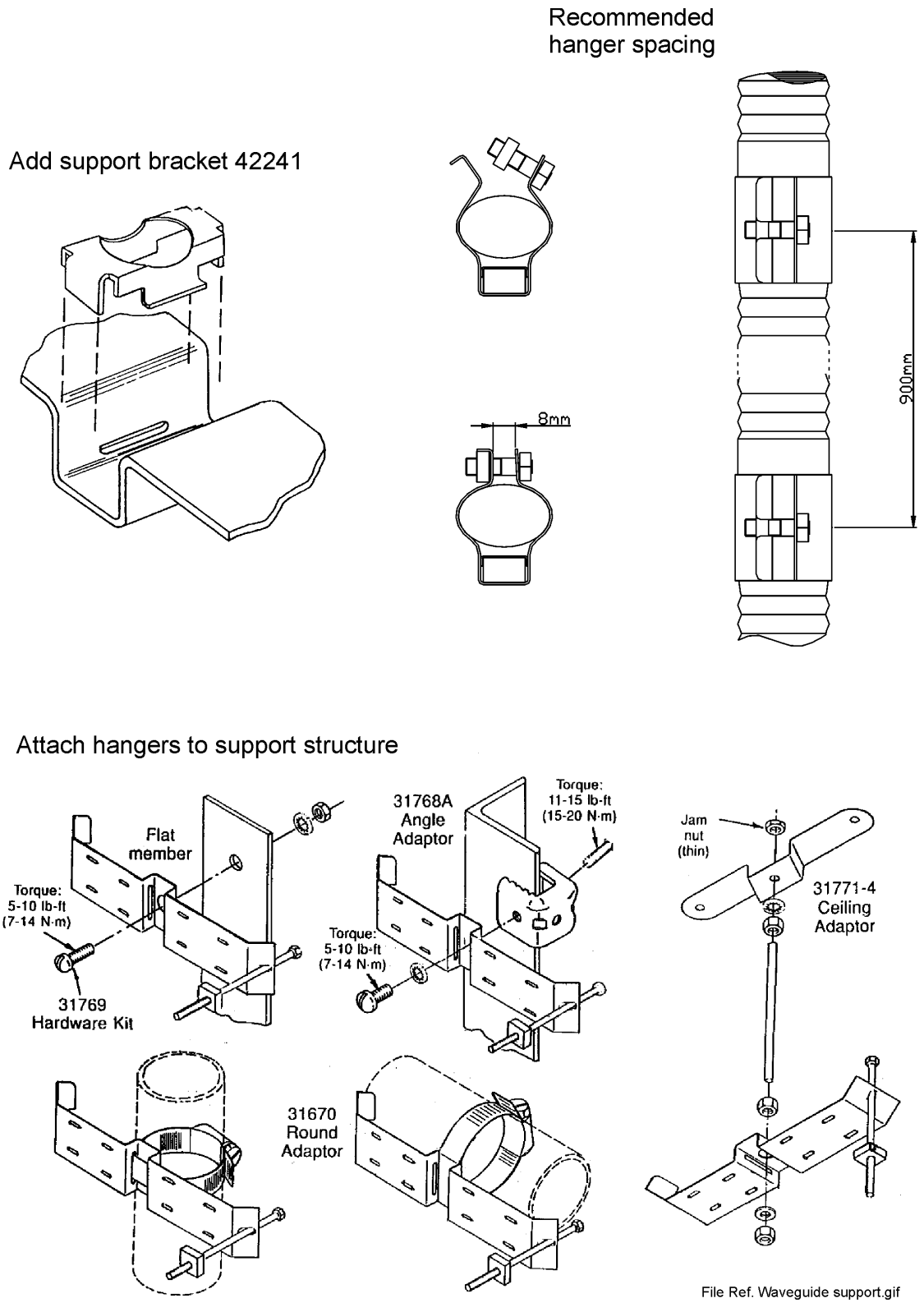


Figure 3.40 Waveguide Support Details

6.3.3 Sealing the Turning Unit

Before securing the top casting and bottom casting of the Turning Unit ensure the seal groove in the top casting and the mating faces of the top casting and lower casting are liberally coated with the petroleum jelly supplied (MA00013789).

Apply denso paste (9037446) to the four top casting retaining bolts.

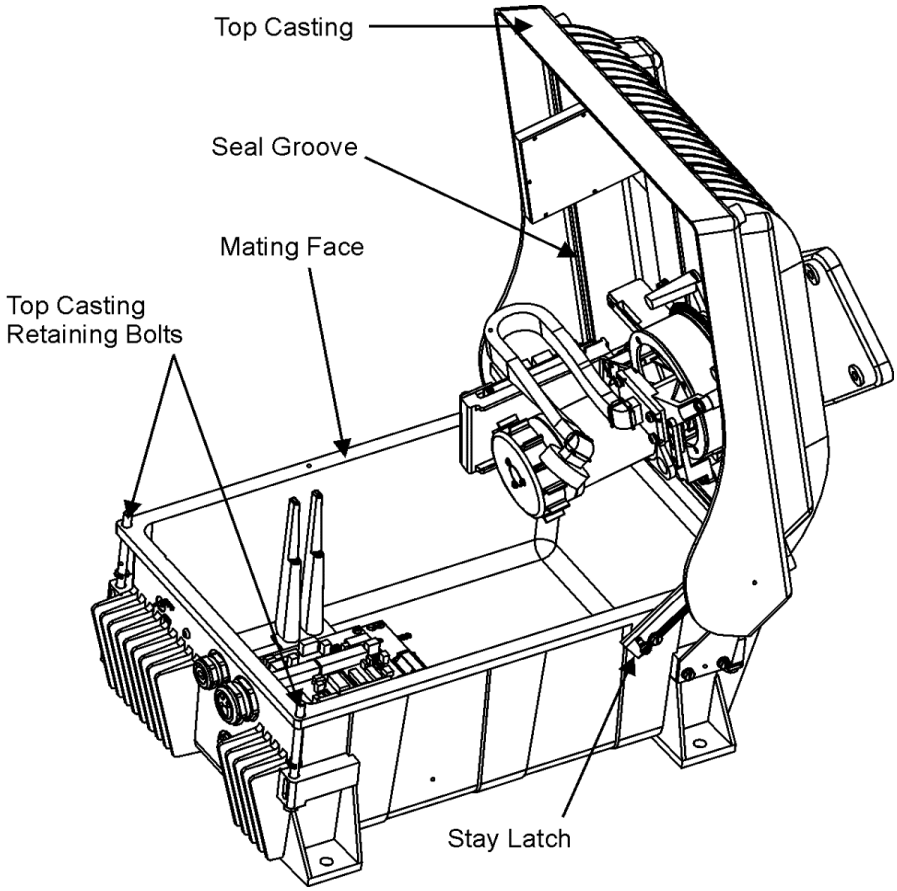


Figure 3.41 Sealing the Turning Unit

6.4 S-band Scanner Assembly

The S-band Scanner assembly is made up of the following sub-assemblies. Each component is supplied in its own packing, together with relevant installation drawings:

Turning Unit	With/without Integral Transceiver (30kW) Despatch Kit 65830660 (Installation Drawing 65830050)
Note: a Bulkhead system would also be supplied with the following:	
Bulkhead transceiver	(30kW) Despatch Kit 65831660 (Installation Drawing 65831050)
Antenna	12ft or 9ft
Antenna Despatch Kit	65612610 (Installation Drawing 65612050-054)

To install the S-band Scanner assembly carry out the following operations, preferably in the sequence outlined below:

1. Preparation of the site (refer to Section 5 '*Siting*').
2. Bolting the Turning Unit to the mounting platform (ship's structure) as detailed in Installation Drawing 65830050 supplied with the Turning Unit, and in Figure 3.48.
3. Bolting the Support Casting to the Turning Unit as detailed in Installation Drawing 65612050-054 supplied with the Antenna Despatch Kit, and in Figure 3.49.
4. Bolting the Antenna to the Support Casting as detailed in Installation Drawing 65612050-054 supplied with the Antenna Despatch Kit, and in Figure 3.50.
5. Laying in and installing the cables for the motor and the Turning Unit in Section 6.4.6 '*Cabling Connections*'.

Figures 3.42 to 3.46 show S-band Scanner outline drawings that are intended to duplicate those provided with the equipment. However, as changes may occur to the details that may not be reflected in this manual, the installation drawings supplied with the equipment take precedence in the event of any differences.

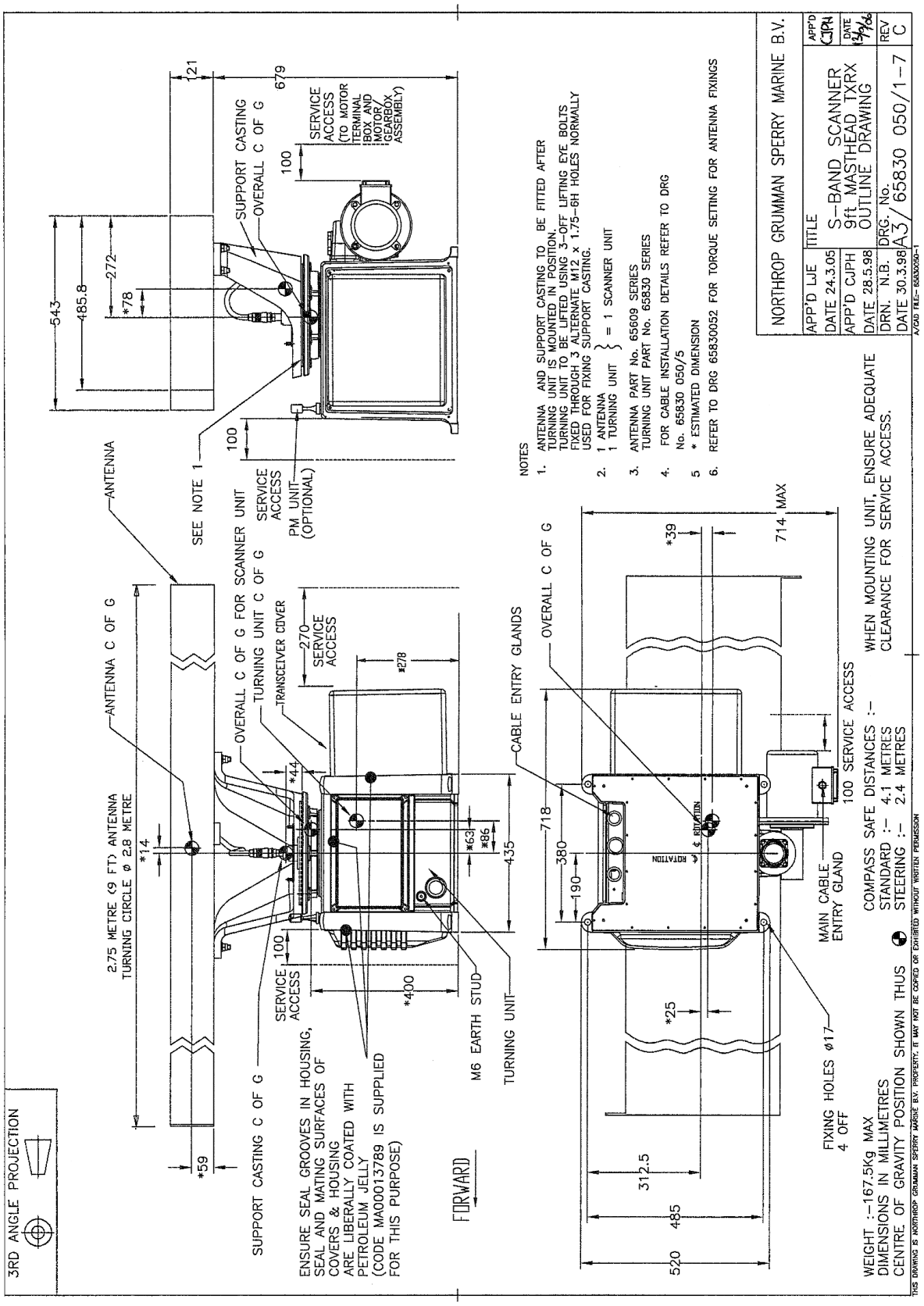


Figure 3.42 S-band Scanner 9ft Masthead Tx/Rx 30kW Installation

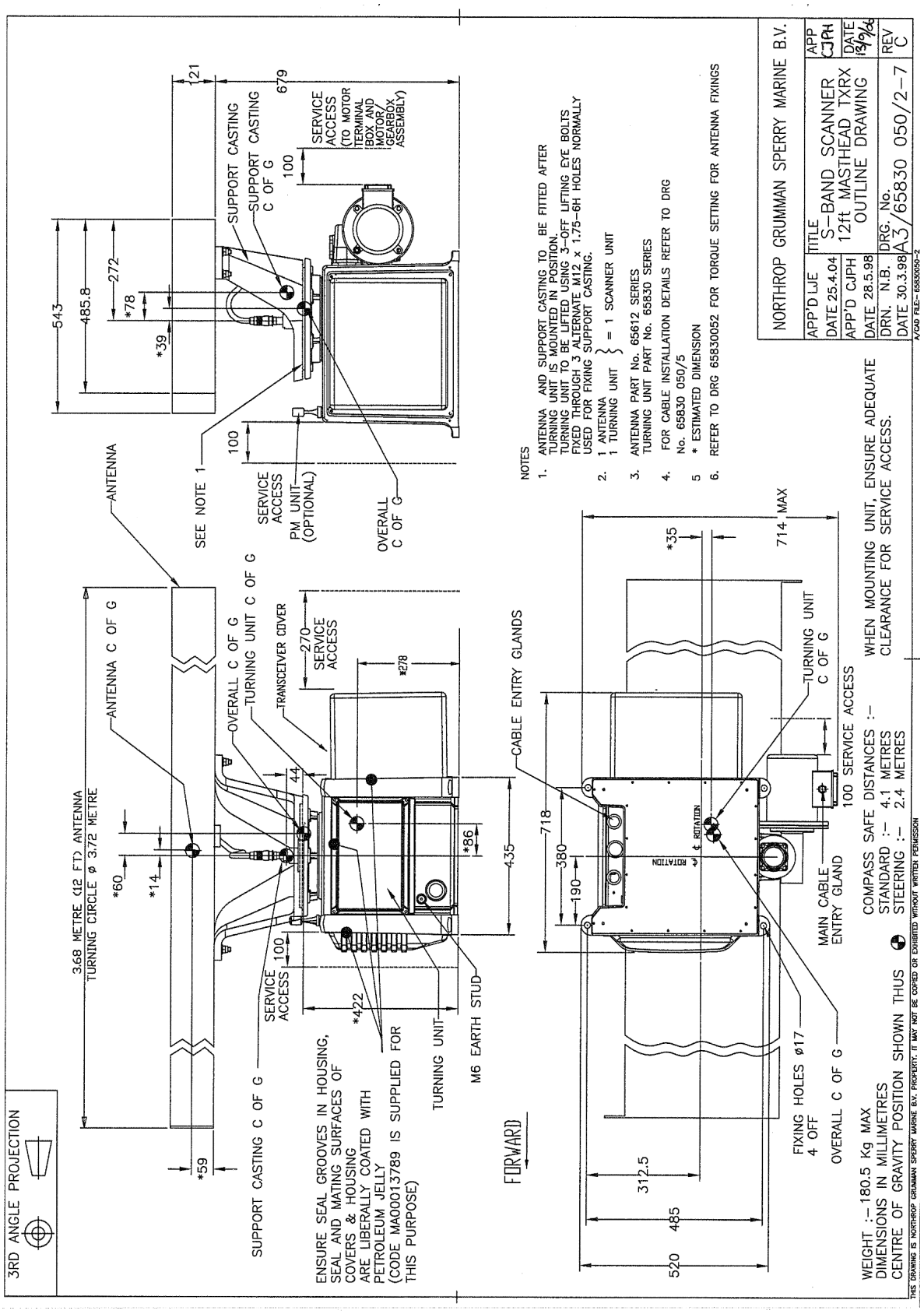


Figure 3.43 S-band Scanner 12ft Masthead Tx/Rx 30kW Installation

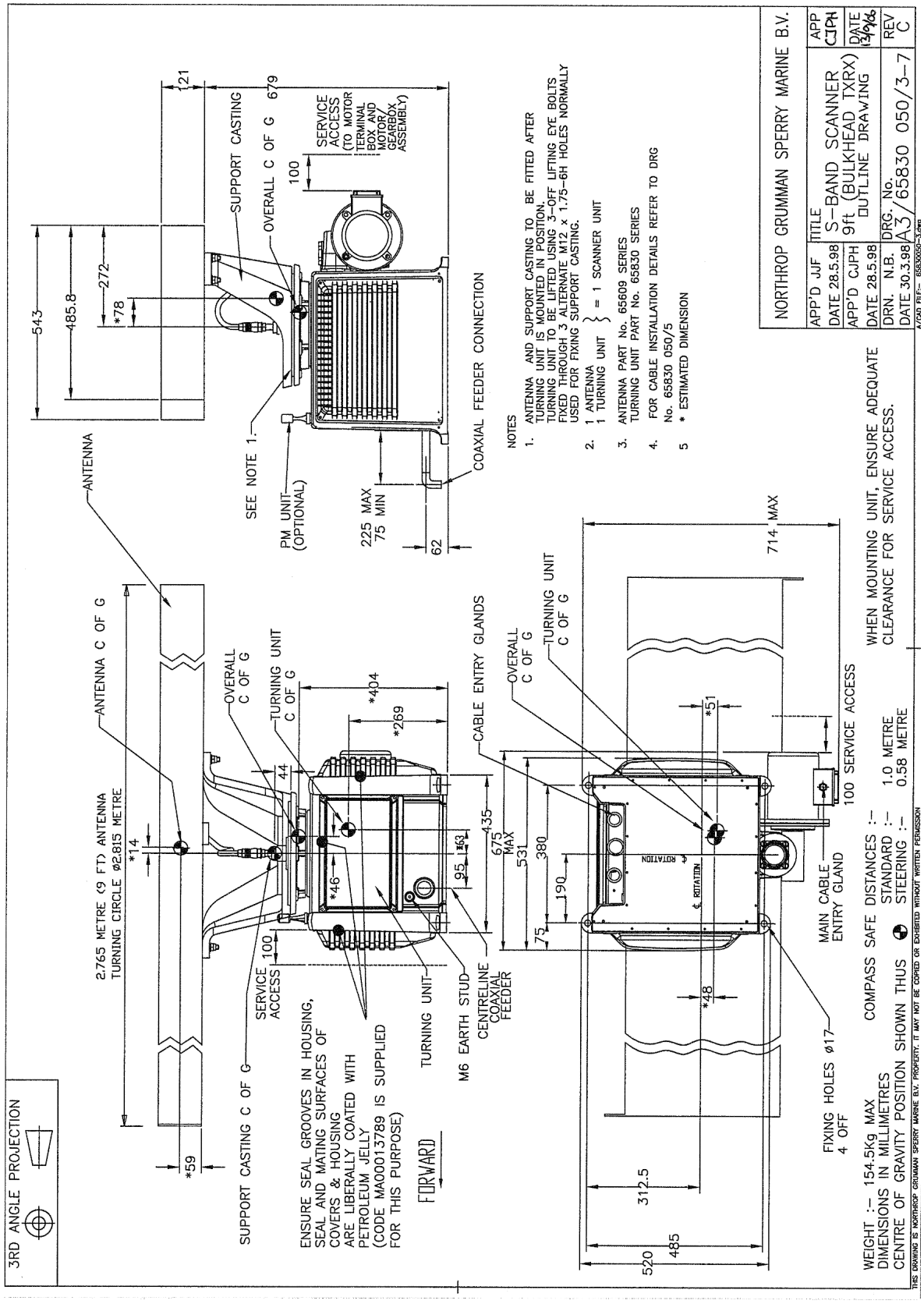


Figure 3.44 S-band 9ft Bulkhead Tx/Rx Installation

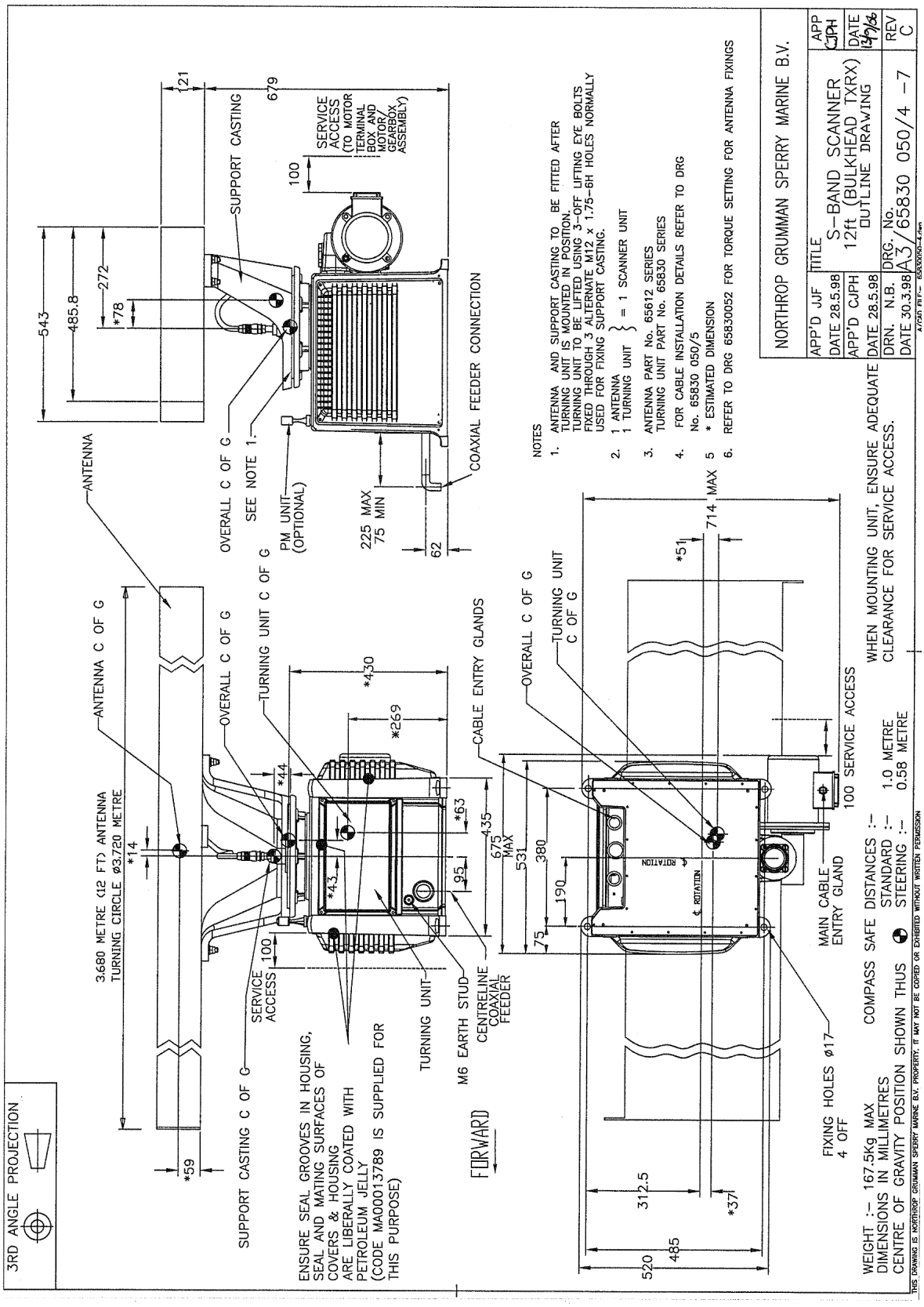


Figure 3.45 S-band Scanner 12ft Tx/Rx Installation

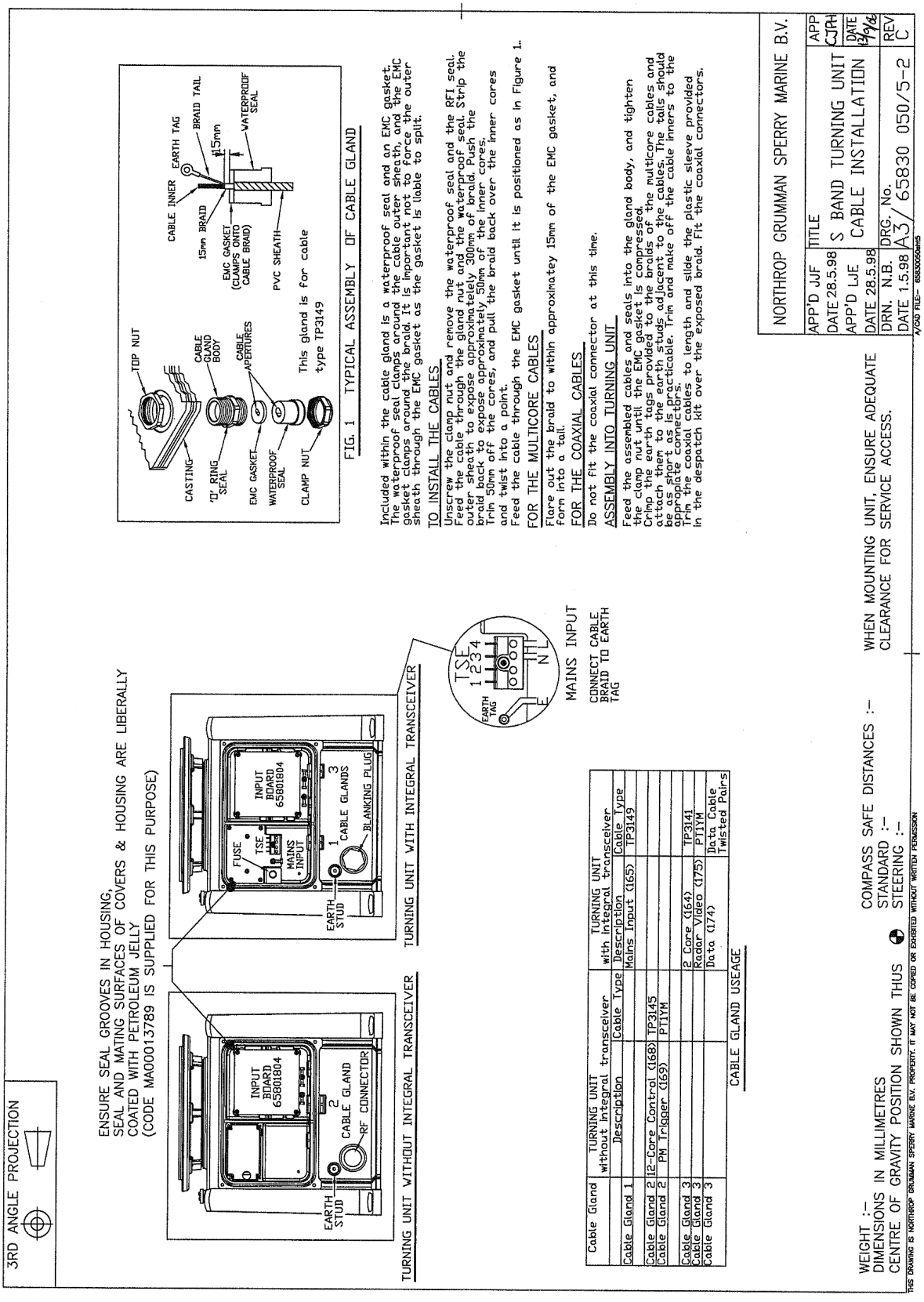


Figure 3.46 S-band Turning Unit Cable Installation

6.4.1 Turning Unit

WARNING! HEAVY WEIGHT

The Turning Unit must be lifted by crane, do not attempt to lift the Turning Unit by hand.
Never lift a combined Turning Unit and Antenna Unit by the Antenna Unit. This is dangerous and would cause damage to the Antenna Unit.

CAUTION

The weight and spread of the Antenna can cause a freestanding Turning Unit to topple over. The Turning Unit should be bolted down onto its mounting platform before attaching the Antenna and Support Casting to the Turning Unit..

To lift the turning Unit onto the mounting platform:

1. Screw the three M12 lifting eyebolts, type MA00010272 (part of Lifting Kit 65830701) into the torque tube in the three positions shown in Figure 3.47. The eyebolts are fitted in a symmetrical pattern in three of the six holes normally used for attaching the Support Casting to the Turning Unit; only three of the holes are tapped.
2. Remove the eyebolts after the Turning Unit has been bolted to the mounting platform. Refer to "BS4278 Eyebolts for Lifting Purposes" and the safe use of lifting equipment in accordance with the Health and Safety Work Act, Part 1, Section 6.

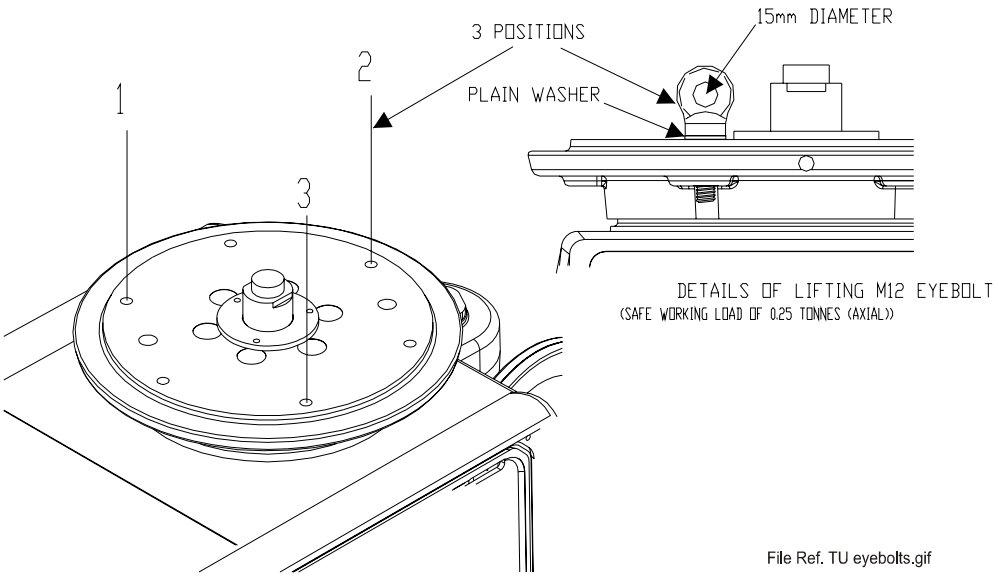


Figure 3.47 Attachment of Lifting Eyebolts

The Turning Unit is attached to the mounting platform using the fixings supplied in the Turning Unit Despatch Kit 65830660.

Figure 3.48 shows how these are fitted. Before assembly make sure all threads and bushes are coated with Denso Paste.

Note: *The Turning Unit is bolted directly to the mounting platform. No intervening washer or pad is used, except for the purpose of levelling the mounting. This stops the Turning Unit casting from twisting when the bolts are tightened. M16 washers may be used as shims, or purpose made parts, produced locally, may be used.*

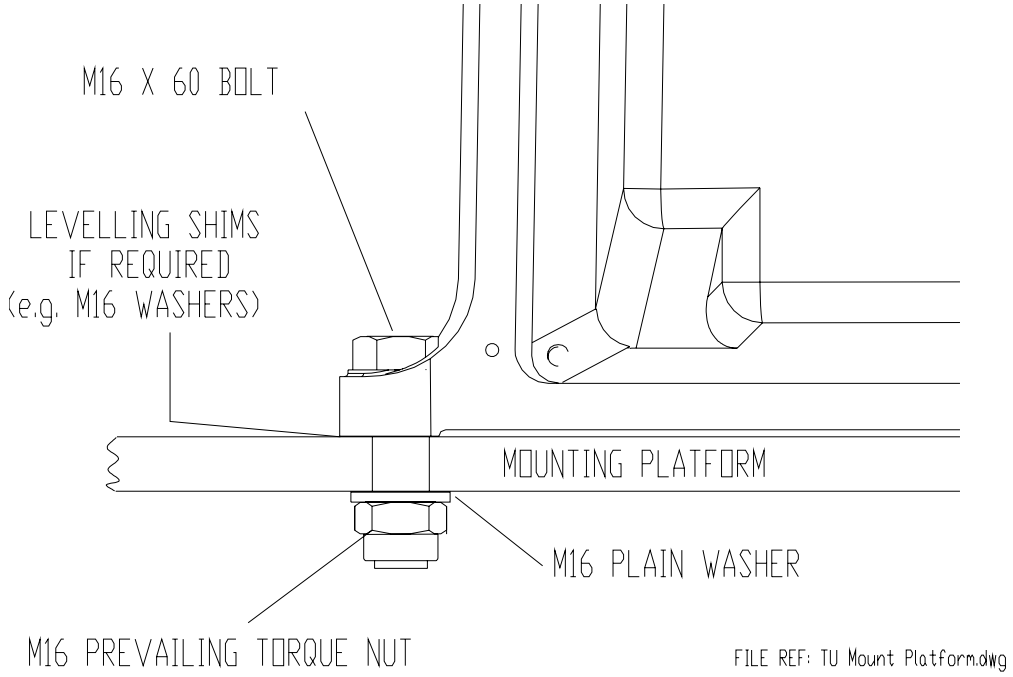


Figure 3.48 Fixing the Turning Unit to the Mounting Platform

6.4.2 Support Casting

The Support Casting is fitted to the Turning Unit torque tube using Fixing Kit 65612611, which is part of the Antenna Despatch Kit 65612610.

Figure 3.49 shows how these are fitted. Ensure that all threads and bushes are coated with Denso paste.

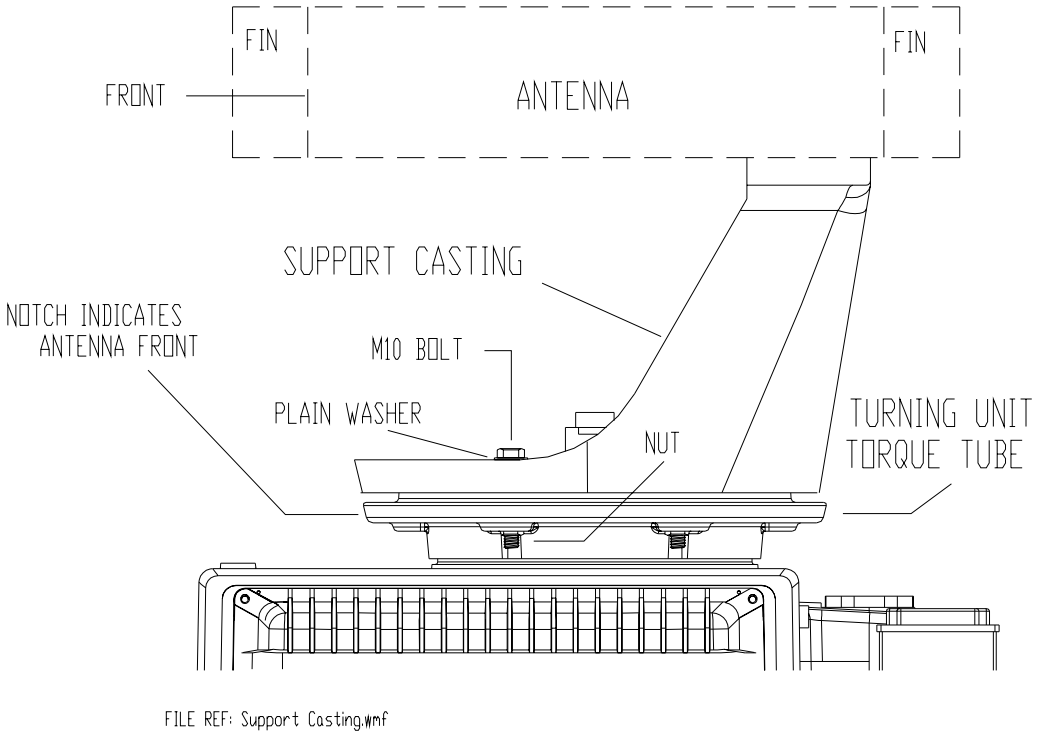


Figure 3.49 Fixing the Support Casting to the Torque Tube

6.4.3 Performance Monitor

The Performance Monitor consists of the Antenna, the Performance Monitor module and an associated cable. The equipment is normally factory fitted.

6.4.4 Antenna

The Antenna is fitted to the Support Casting using the parts listed below which are supplied with the antenna:

4 x M12 Plain Nuts

6 x Spacers

2 x Lock Tabs

Figure 3.50 shows where these are fitted. Make sure all threads and bushes are coated with Denso Paste. For full fitting instructions see drawing 65830052 supplied with the equipment.

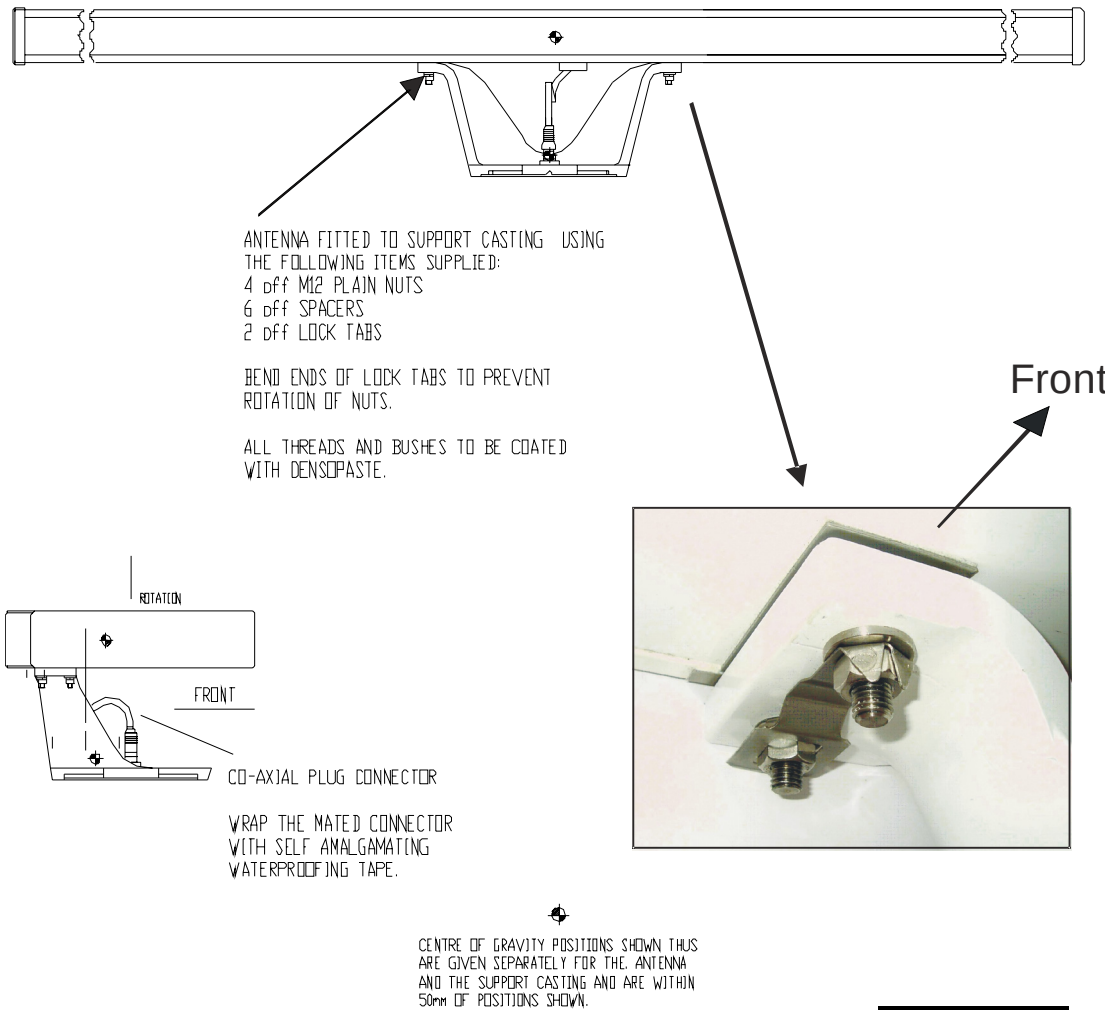


Figure 3.50 Fixing the Antenna to the Support Casting

Note: *The lock tab ends must be bent as shown in Figure 3.50 to stop the nuts rotating.*

The next step is to connect the S-band coaxial cable from the Antenna to the Turning Unit RF connector as shown in Figure 3.50. The mated connector must then be wrapped with self-amalgamating tape as an additional precaution against water ingress.

6.4.5 Motor Connections

Various motor types are available for different mains supplies and standard/ high-speed antenna rotation rate variants.

The following table gives the motor types that are available:

Table 7: Motor Types

Mains Supply Characteristics	Motor Type for Standard Speed Antenna	Motor Type for High-Speed Antenna
110/120/220/240 Volts, 1ϕ (50/60 Hz)	91003757	91003759
110/120 Volts, 3ϕ(50/60 Hz)	91003752	91003754
220/240/380/440 Volts, 3ϕ (50/60 Hz)	91003751	91003753

CAUTION



As referenced in Table 7, dual voltage motors are used for both single and 3 phase supplies. 110-120/220-240Volts for single phase; 220-240/380-440Volts for 3 phase. In addition to the wiring of the mains supply to these motors, the windings must also be correctly configured for the appropriate voltage. Incorrect configuration will adversely affect the unit's performance – refer to connection details below.

For all motor types:

1. First, feed the mains cable through the cable gland on the motor termination box housing.
2. Connect the cable braid to the motor chassis.
3. Connect the individual insulated conductors to the appropriate terminals as detailed for each motor type in the following section.
4. Make sure the cable is not under strain in the termination box area, and sufficient slack is available to remake the connection, should this ever be necessary, for example, if a motor is changed in service.
5. Make sure the insulated conductors are terminated appropriately:
   - using ring crimp terminals on threaded studs; or
   - stripping insulation back by 5mm for screw compression pillars.
6. Ensure that any gasket fitted for sealing the terminal box cover is correctly seated when the cover is re-secured.

6.4.5.1 Single Phase Motor Connections

Make connections according to the label on the inside of the termination box cover. Ensure that the rated motor volts are matched to the supply. If the radar antenna rotates in the wrong direction, re-configure the connections on the motor according to the diagram on the motor housing (the radar antenna should rotate anti-clockwise when viewed from below).

For dual voltage single phase motors connection details are shown in Figure 3.51.

There are 6 wires from the motor housing to the terminal block, numbered 1, 2, 3, 4, 5 and 8. Connect the wires to the terminal block as detailed in Figure 3.51 for the required motor supply voltage.

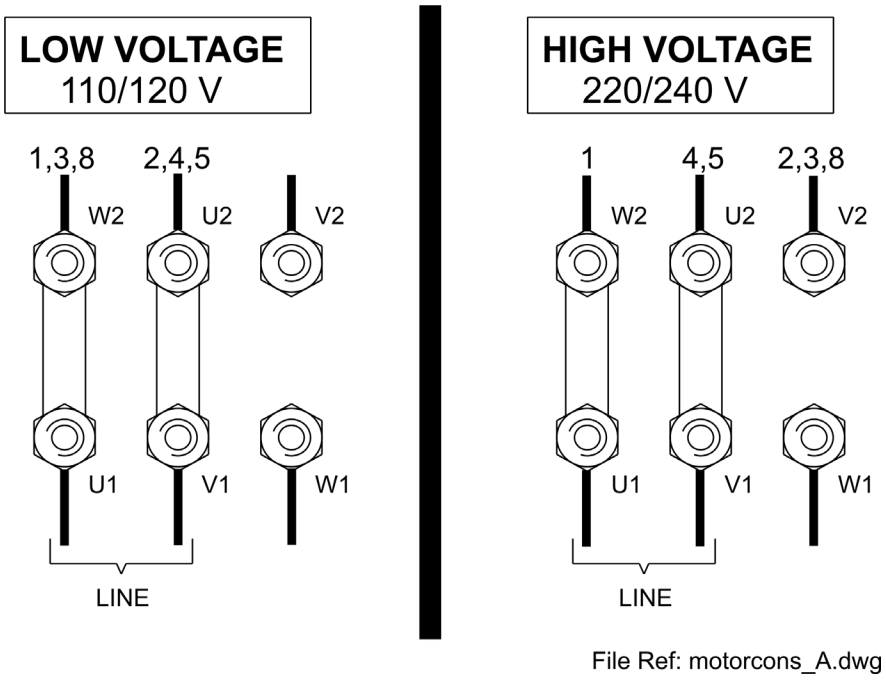


Figure 3.51 Dual Voltage Single Phase Motor Connections

Table 8: Single Phase Motor Cable Data

Wiring Diagrams 65900061 or 65900062	Description	Motor Label Reference
TSH1	AC LINE	L, L1 or U1
TSH2	AC NEUTRAL	N, L2, U2 or V1

6.4.5.2 Three Phase Motor Connections

For dual voltage three phase motors, ensure that windings are configured for the appropriate voltage, see Figure 3.52. Delta (triangle) connected windings are for low voltage operation, Star (Y) for high voltage.

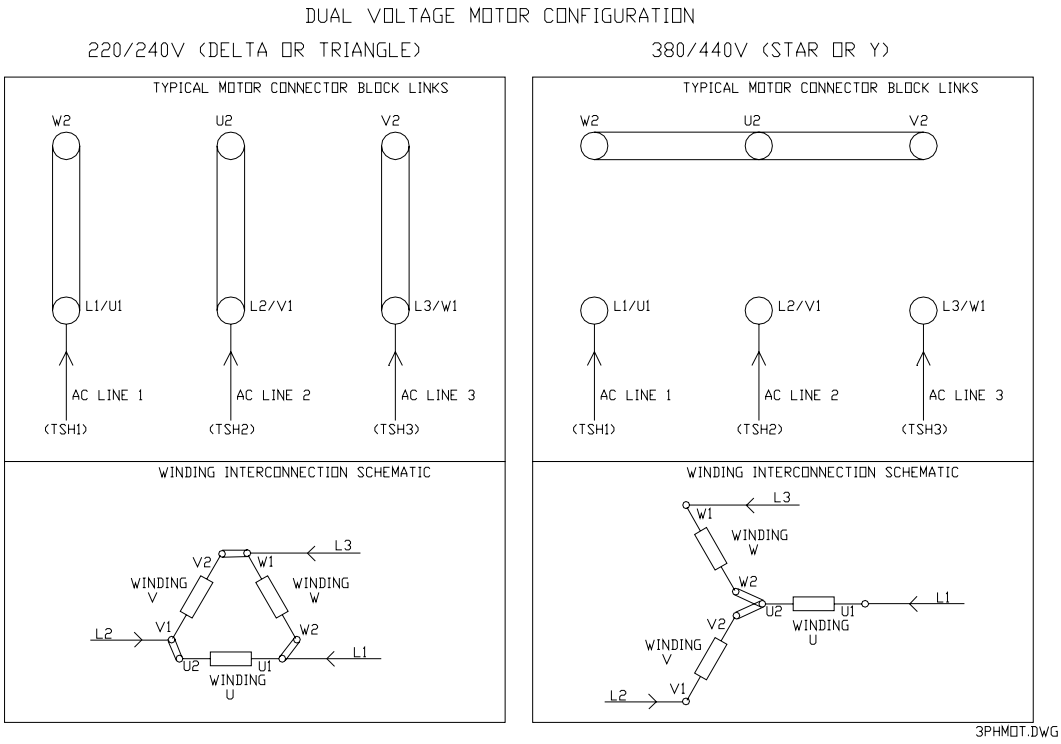


Figure 3.52 Dual Voltage 3 Phase Motor Configuration

The label on the inside of the termination box cover gives details of mains supply connections, and of the winding re-configuration details for alternate voltages if appropriate.

Ensure that the rated motor volts are matched to the supply. If the radar antenna rotates in the wrong direction, reversal of any two phases will correct this (the radar antenna should rotate anti-clockwise when viewed from below).

Table 9: Three Phase Motor Cable Data

Wiring Diagrams 65900061 or 65900062	Description	Motor Label Reference
TSH1	AC LINE 1	L1 or U1
TSH2	AC LINE 2	L2 or V1
TSH3	AC LINE 3	L3 or W1

6.4.6 Cabling Connections

Figure 3.53 shows the cable entry points. Three of these are via cable glands labelled 1, 2 and 3. Details of these cable glands are given in Table 10.

The RF cable input is only needed when the Transceiver is mounted below decks (Bulkhead).

The motor supply cable is connected directly to the motor termination blocks mounted in the box on the side of the motor.

A 6mm stud is fitted to let the unit bond to the ship's structure: this must **not** be used for any other connection.

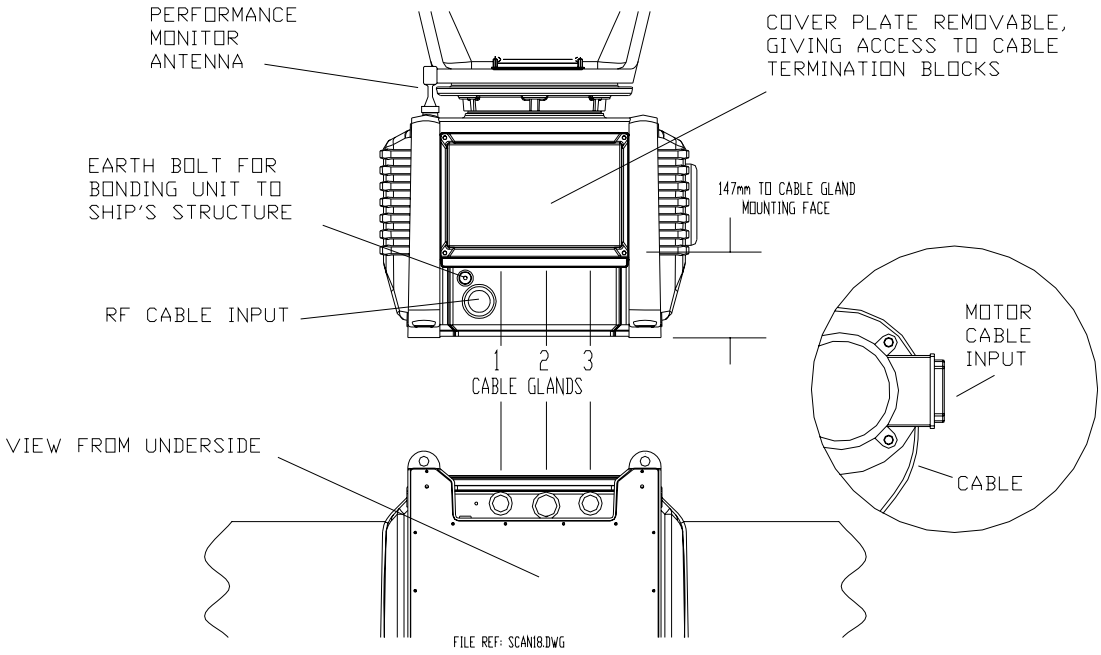


Figure 3.53 Turning Unit – Cable Entry Locations*

* This drawing is for a turning unit without integral Transceiver. Refer to the Table 10 for details of cable fitted for different variants.

Figure 3.54 shows details of the Input Board 65801813 (or 65801819) and the Mains Input connector (integral transceiver only) TSE.

The input board is accessed by removing the cover plate, which is held by four fixing screws (see Figure 3.53). Links LK3 and LK4 on the Input Board should be set as shown in Figure 3.54. Link LK5 is fitted.

For information on input board 65801819 see Section 3.3.2 in Chapter 12 *'Additional Features'.*

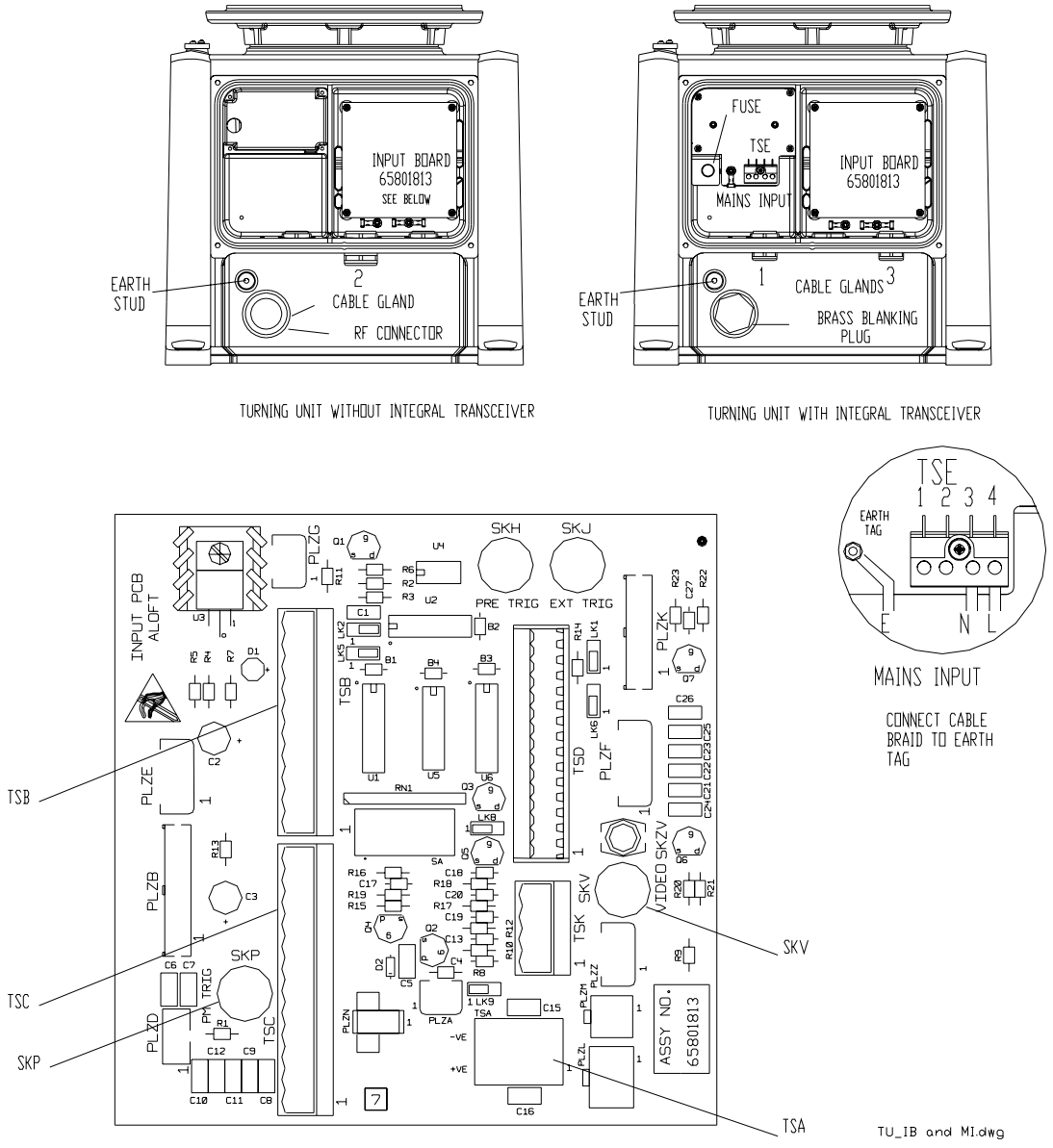


Figure 3.54 Turning Unit – Input Board and Mains Input Details

6.4.7 Fitting the Cable Glands

The installation cables are connected into the Turning Unit (with or without an Integral Transceiver) via the appropriate cable glands, see Table 10 below.

For systems with 'additional features' see the relevant figures in Chapter 12 *'Additional Features'*.

Table 10: S-band Cable Gland Details

Cable Gland	Turning Unit without Integral Transceiver		Turning Unit with Integral Transceiver	
	Description	**Cable Type**	**Description**	**Cable Type**
Cable Gland 1	—	—	Mains Input	37-3-2R
Cable Gland 2	12-Core	16-2-12C	—	—
Cable Gland 2	PM Trigger	75Ω co-ax	—	—
Cable Gland 3	—	—	2-Core	16-2-2C
Cable Gland 3	—	—	Radar Video	75 Ω co-ax
Cable Gland 3	—	—	Data	T/Pairs
RF Connector	RF Feed	S-Band co-ax	—	—

The body of the gland fits through a hole in the casting and is held in position by the Top Nut. An 'O' ring seal is fitted below the casting surface (input side), see Figure 3.55.

A waterproof seal and an EMC gasket are supplied with each gland as shown in Figure 3.56. Some glands are designed for a single cable; other glands are used for several cables.

Note: *Cable Glands and Blanking Plates are normally factory fitted to the Turning Unit.*

Information about fitting and terminating the RF feeder cable (S-band coaxial) are in Section 6.5.3.

For information on how to terminate the cables into their connector blocks, see Section 7.1 '*Cabling and Interconnection Diagrams*'.

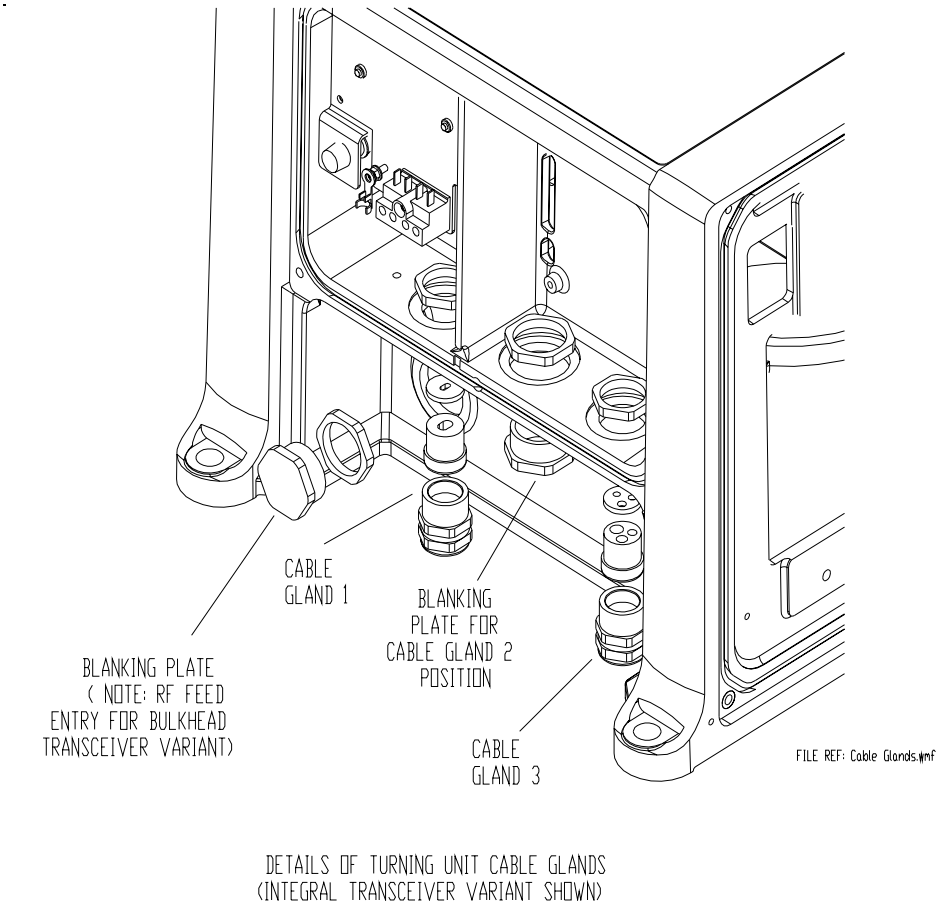


Figure 3.55 General View of the Cable Glands

The waterproof seal works by clamping onto the cable PVC sheath. The EMC seal clamps onto the cable braid.

Note: *Do not force the outer sheath through the EMC gasket; the gasket can split.*

The braid is also formed into a tail that is grounded by means of an adjacent earth tag. The fitting procedure is detailed in Figure 3.57.

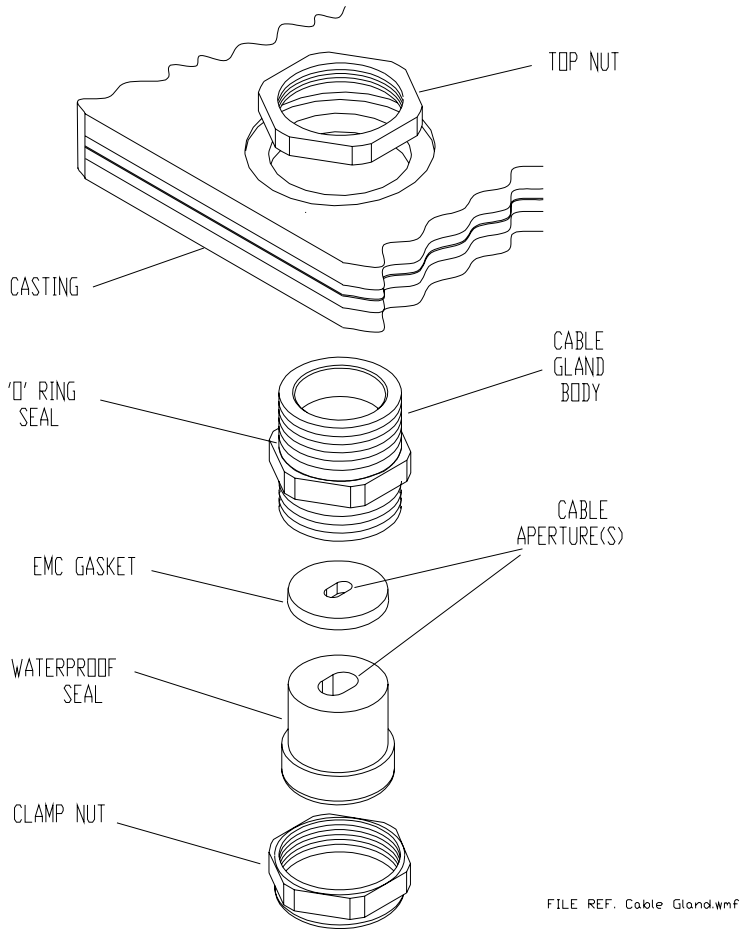


Figure 3.56 Detailed view of a Cable Gland

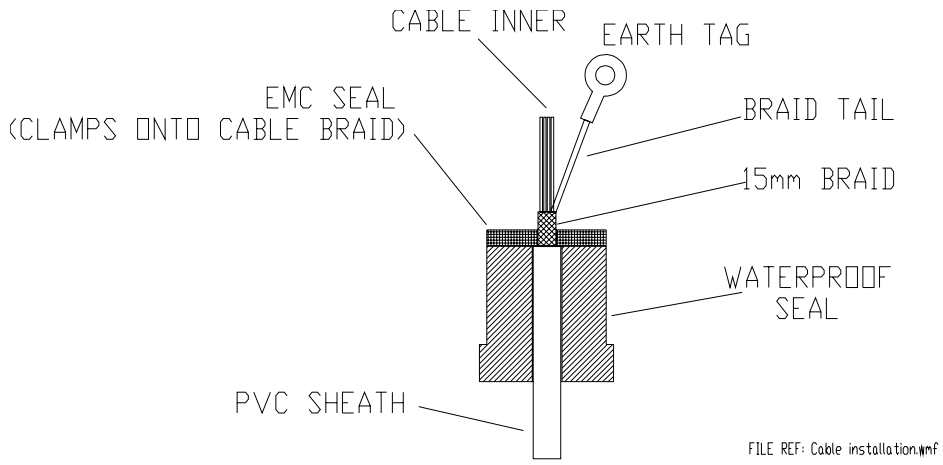


Figure 3.57 Cable Installation Details

6.4.8 Installing the Cables

To install the cables:

1. Unscrew the gland nut.
2. Remove the waterproof seal and the EMC seal.
3. Feed the cable through the gland nut and the waterproof seal.
4. Strip the outer sheath to expose approximately 300mm of braid.
5. Push the braid back to expose approximately 50mm of the inner cores.
6. Trim 50mm off the inner cores.
7. Pull the braid back over the inner cores and twist into a point.
8. Feed the braid through the EMC seal until the cable is positioned as in Figure 3.57.

For the multicore cables:

Flare out the braid to within approximately 15mm of the EMC seal, and form it into a tail.

For the coaxial cables:

Do not fit the coaxial connector at this time.

6.4.8.1 Assembling cables into Turning Unit

To assemble the cables into the turning unit:

1. Feed the assembled cables and seals into the gland body.
2. Tighten the gland nut until the EMC seal is compressed.
3. Crimp the earth tags provided to the braids of the multicore cables
4. Attach them to the earth studs adjacent to the cables: the tails should be as short as is practicable.
5. Trim and make off the cable inners to the appropriate terminal blocks.
6. Trim the coaxial cables to length.
7. Slide the plastic sleeve supplied in the despatch kit over the exposed braid.
8. Fit the coaxial connectors.
9. Plug them into the appropriate sockets.

6.5 S-band Bulkhead Transceiver

The S-band Bulkhead Transceiver, 65831A, is installed below decks in a suitable location such as the ship’s equipment room. The installation should consider accessibility for maintenance and servicing, and the distance between the Transceiver and the Scanner Unit.

For maximum performance, this should be kept as short as practicable as the loss per metre of the S-band coaxial cable is typically 8.31dB per 100 metres (1.7dB for 20m). This loss applies to both the transmitted RF pulse and the received signals.

The maximum recommended cable length using standard coaxial cable (PT1YM) is:

- 30 metres between the Turning Unit and the Transceiver Unit; and
- 67 metres between the Transceiver and Display.

Greater separation is possible by using a lower loss cable. Contact Northrop Grumman Sperry Marine B.V. if greater separation is needed.

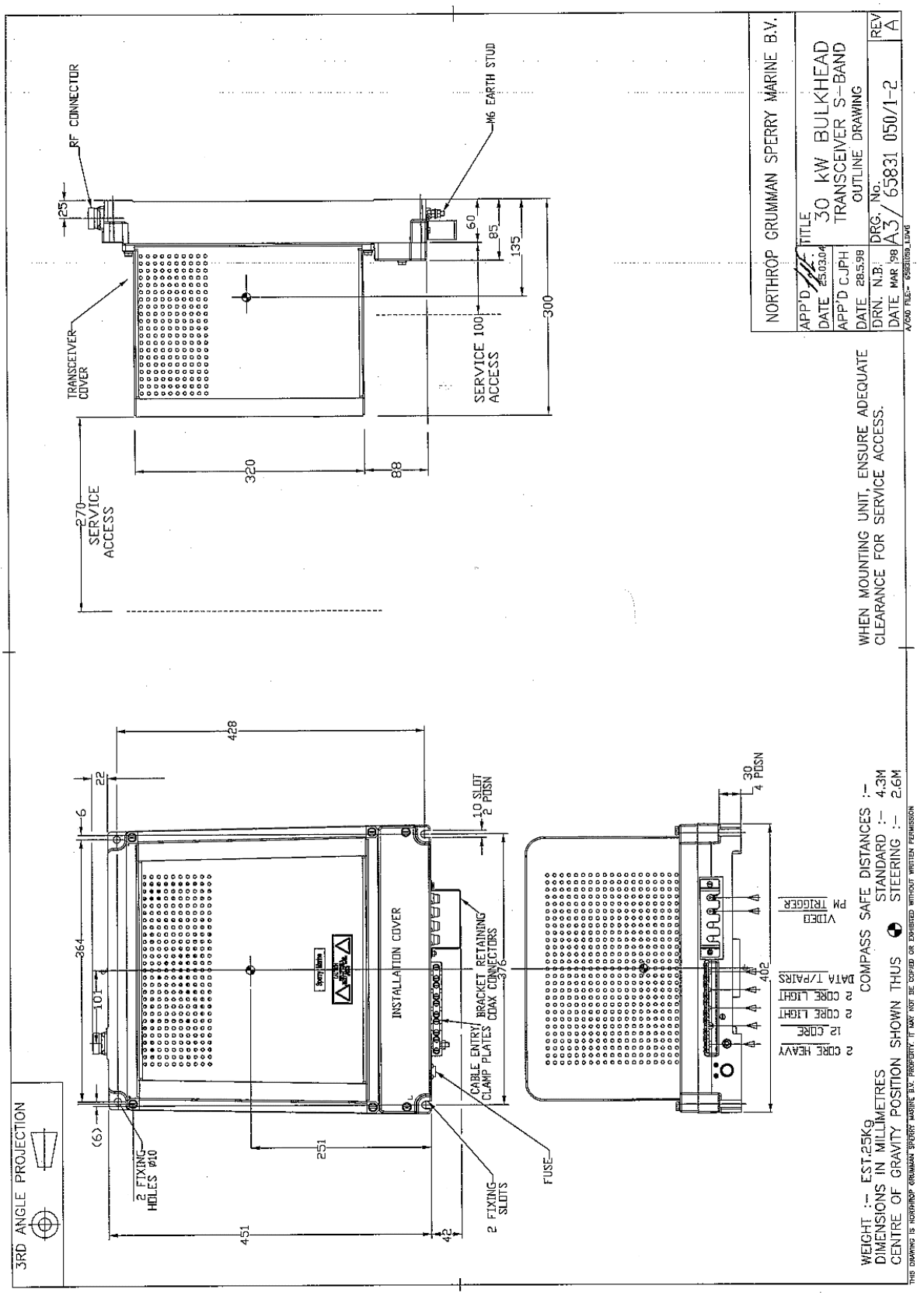


Figure 3.58 S-Band Bulkhead Transceiver 30kW Installation

6.5.1 Assembling the Bulkhead Transceiver

The Transceiver may be attached to the bulkhead by several methods. The actual method chosen will depend on individual circumstances: consider the likely vibration and shock loading which may be experienced. The available methods include through bolting to the bulkhead, or mounting on studs supplied by the shipyard, see Figure 3.59 below. Slotted mounts are supplied at the bottom for ease of installation.

Note: *The positions of the four fixings for the unit are not on a rectangle. The horizontal spacing of the top fixings is 364mm compared with 376mm for the lower fixings. When choosing the installation location for the Transceiver, consider how the RF feeder coaxial cable is to be routed.*

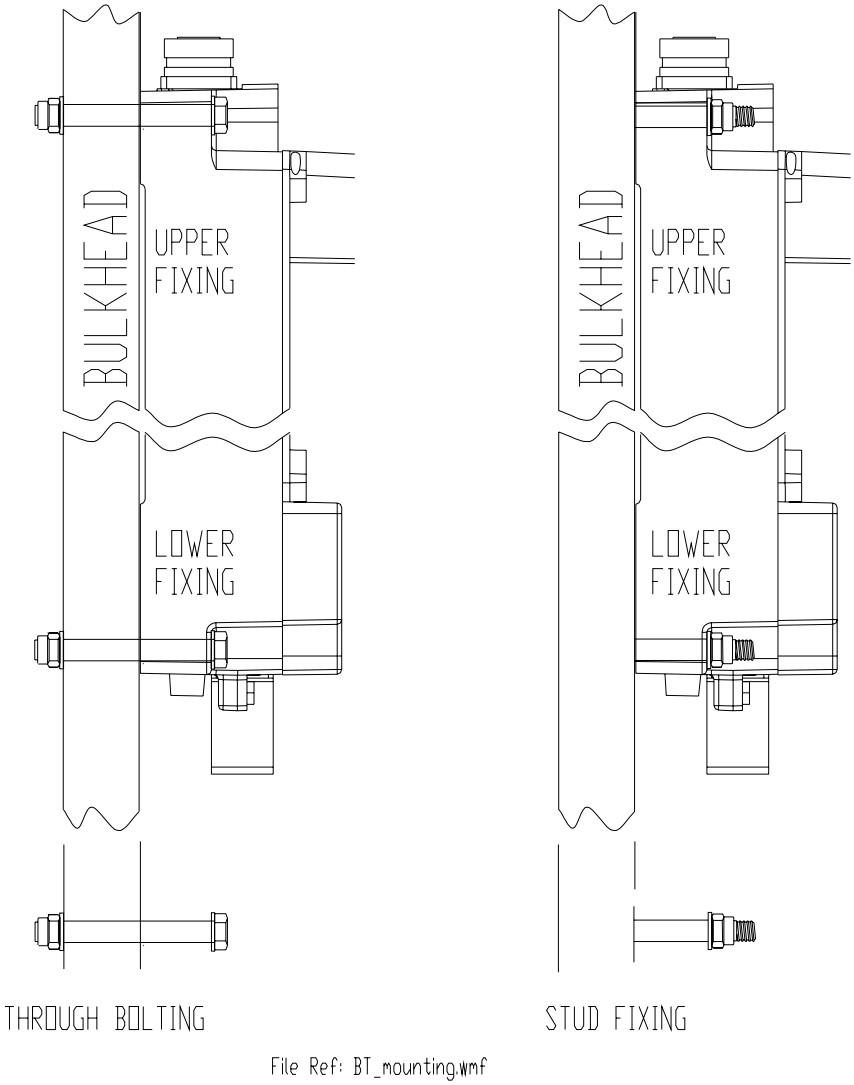


Figure 3.59 Bulkhead Transceiver – Mounting Alternatives

6.5.2 Cabling Information

Figure 3.60 below shows details of the cable inputs. The cable cover plate, which is secured by two fixing screws, is shown removed.

Note: *A cable retainer holds the coaxial cables. This must be fitted after the cables are in place.*

All other cables, with the exception of the RF feeder S-band coaxial cable, are individually clamped on their cable braids to provide EMC shielding. The braids are also made off as tails and connected to earth tags provided. The AC mains input is connected to TSE as shown.

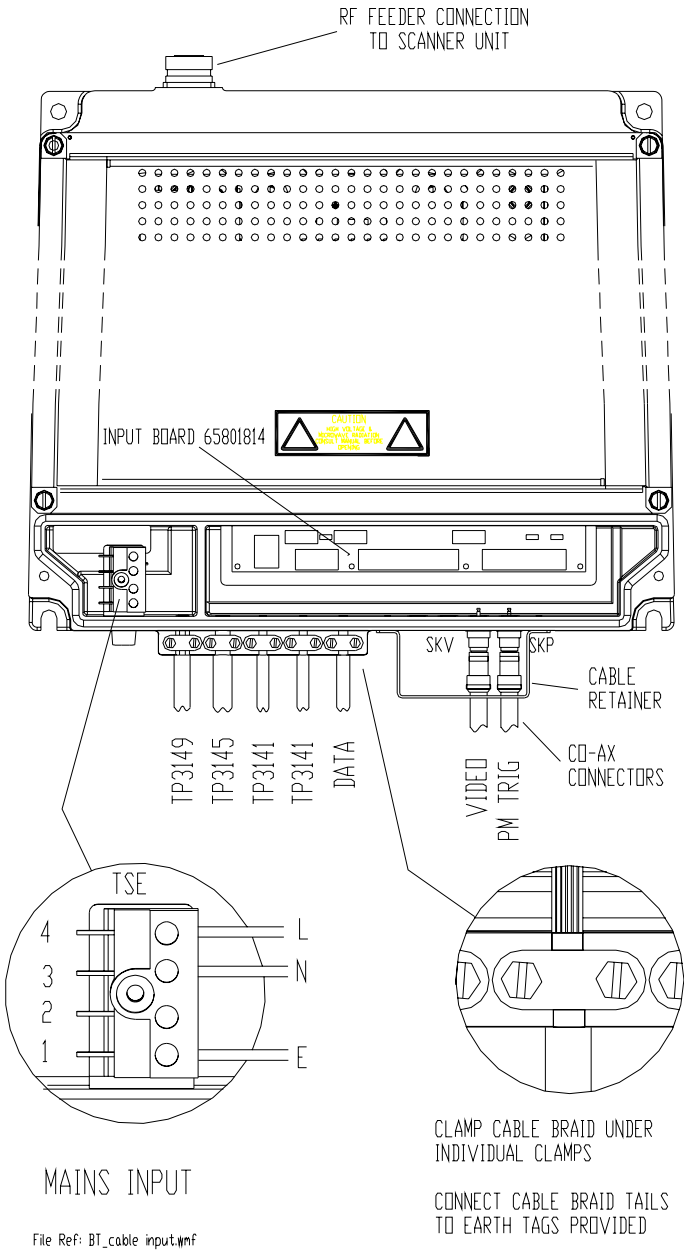


Figure 3.60 Bulkhead Transceiver – Cable Input Details

Figure 3.61 shows details of the Input Board, 65801814. Refer to the cabling schedules for details of the connections, which are made via the two part connectors provided. Links LK2 and LK3 on the Input Board should be set as shown. Link LK1 is not fitted.

Refer to Section 3.3.1 in Chapter 12 *'Additional Features'* for details of PCB 65801815 fitted to 'additional features' Transceivers.

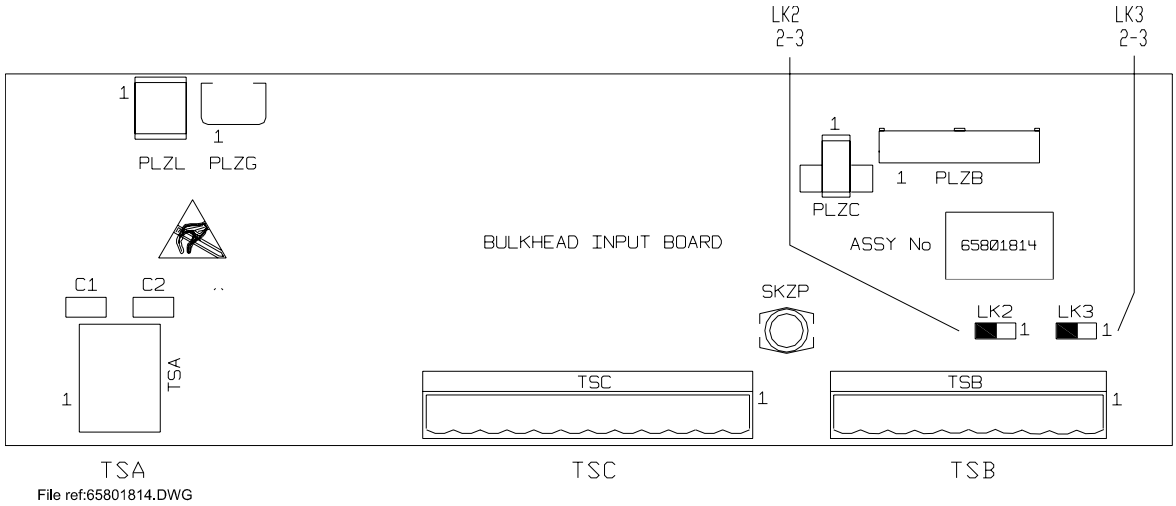


Figure 3.61 Bulkhead Transceiver – Input Board Details

6.5.3 Fitting the RF Feeder Cable (S-band Coaxial Cable)

6.5.3.1 General Information

A RF coaxial cable is used for the run between the Bulkhead Transceiver Unit and the Turning Unit with S-band radars. The cable used is Andrew Antennas Heliax LDF5-50A 7/8in 50 ohm – overall diameter 28mm (1.1in).

Although robust, the cable must be protected against strain and kinking, and must be treated with the greatest care at all times. The ends of the cable must be kept sealed against the ingress of moisture before the connectors are assembled.

Wherever possible, bends should have as great a bending radius as practicable. A single bend may be made when necessary with a minimum bending radius (measured from the axis of the cable) of 250mm (10in).

For convenience, the upper (Turning Unit) connector can be fitted before you install the cable. Because of the possibility of movement of the inner conductor relative to the outer conductor the following precautions must be taken:

1. Any bend required within 1m (3ft) of the cable end must be formed before carrying out the cutting and assembly procedure detailed in subsequent paragraphs. No bend may be closer that 250mm (10in) from the end of the cable.

2. To allow for movement between the Turning Unit and mast, whenever possible, a double bend should be formed in the cable to produce an offset immediately below the Turning Unit.
3. The cable and assembled connector should be fitted to the Turning Unit so that a minimum amount of distortion of the cable occurs between the connector and the pre-formed bend.
4. The cable should be installed and secured in position (using the waveguide supports) as far as is practicable before the lower (Transceiver Unit) connector is fitted to the cable. The precautions given in paragraph 1 above must be observed if a bend is required adjacent to the Transceiver Unit.

6.5.3.2 Assembling the Connectors

Figures 3.62 to 3.70 are reproduced by permission of Andrew Antenna.

General

A straight connector assembly (Type L45DM) is used to terminate the feeder cable at each end. The assembly comprises a clamping nut, spring ring, outer connector, cable cutting guide and compression cap.

Tools required

A fine-toothed blade hacksaw, a 1¼in open-ended spanner and a $1^{3}/_{8}$in open-ended spanner will be sufficient for fitting the connectors to the cable.

Procedure

The procedure that follows applies to the straight connectors at each end of the feeder cable. It is very important that swarf and other foreign matter is prevented from entering the cable.

Prepare the cable end and assemble the connector as follows:

1. Using a knife, remove approximately 2in (50mm) from the end of the jacket.

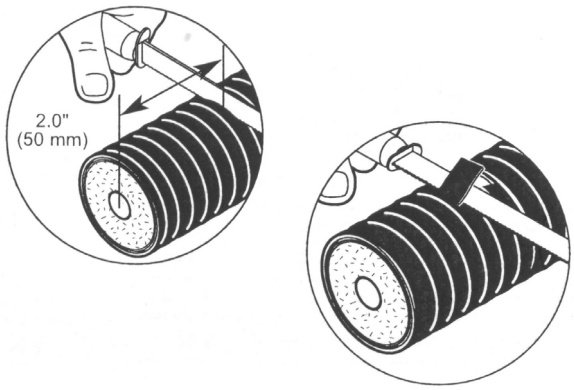


Figure 3.62 Removing Cable Jacket

2. Make sure the end of the cable is straight by attaching the cable cutting guide approximately 1 1/2 in (38mm) from the jacket and cutting the end of the cable using a hacksaw, see Figure 3.63.

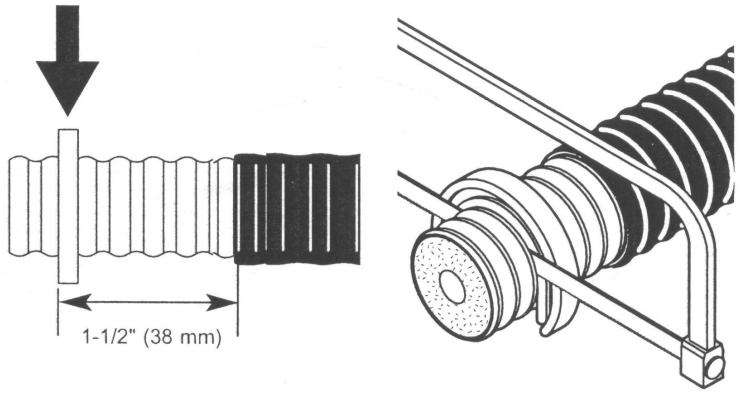


Figure 3.63 Cutting the Cable End

3. Deburr the inside edge of the inner conductor and the inside edge of the outer conductor, see Figure 3.64.

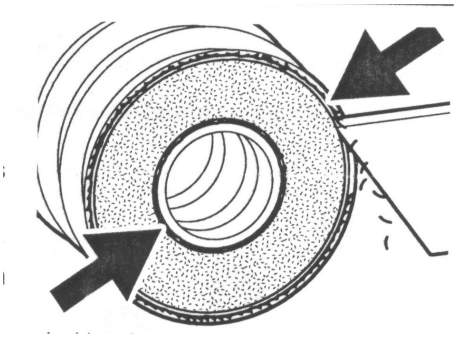


Figure 3.64 Deburring inside edges of conductor

4. Deburr the outside edge of the outer conductor, see Figure 3.65. Be sure outer conductor is round and undistorted.

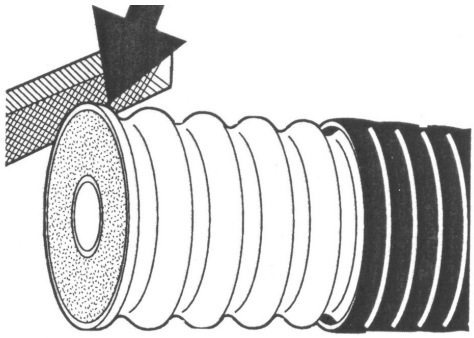


Figure 3.65 Deburring outside edge of conductor

5. Using a wire brush carefully remove debris from the end of the cable.
6. Add the clamping nut to the end of the cable, push the nut up the cable until it covers the jacket end, see Figure 3.66.

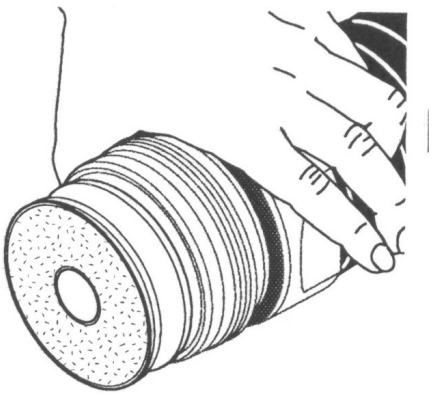


Figure 3.66 Adding Clamping Nut to Cable

7. Add the spring ring to the cable end, see Figure 3.67.

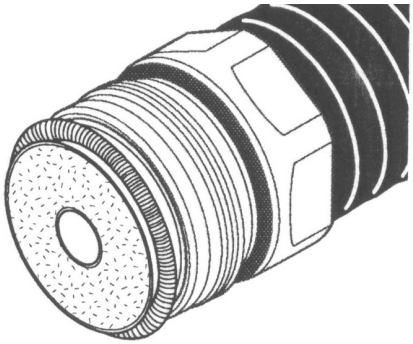


Figure 3.67 Adding the Spring Ring

8. Attach the compression cap to the cable end and using a twisting motion compress the cable foam against the clamping nut, see Figure 3.68.

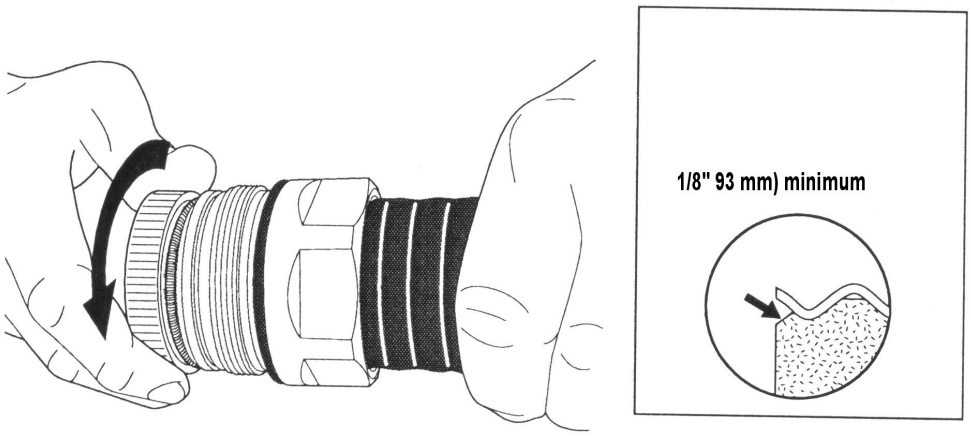


Figure 3.68 Attaching end cap and compressing foam

9. Attach the outer connector to cable end and screw onto the clamping nut, see Figure 3.69.

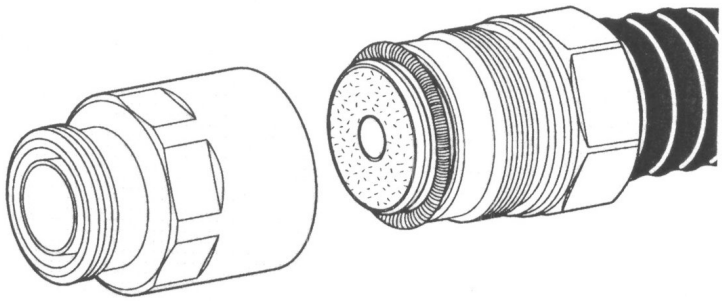


Figure 3.69 Attaching Connector to Body

10. Tighten the outer connector using the 1¼in and 1 3/8in spanners. Hold the outer connector with one spanner and turn the clamping nut; do **not** turn the outer connector. Make sure there is good metal to metal contact between the clamping nut and outer connector, see Figure 3.70.

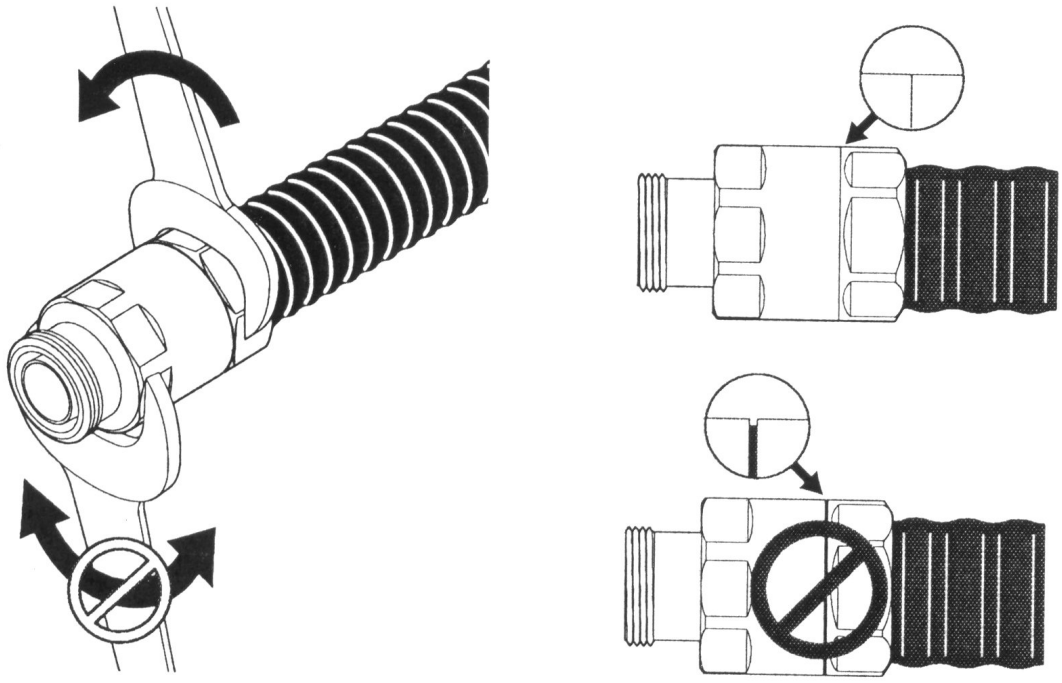


Figure 3.70 Screwing the Connector to the Clamping Nut

6.5.3.3 Fitting the Deck Gland

The 7/8in RF feeder cable passes through its own separate deck gland, positioned near the foot of the mast. The gland kit consists of:

- a rubber boot
- adjustable tension clamp (with screws)
- gland half plates
- six sealing washers
- butyl sealing tape.

In addition you will need the following (obtained locally) (see Figure 3.71):

- six M6 bolts (of suitable length)
- six M6 flat washers
- six M6 lock washers
- six M6 nuts.

To fit the deck gland do the following:

1. Cut a 40 mm diameter entrance hole in the deck, having installed and secured the cable from the Turning Unit down the mast; pass the Transceiver Unit end through the entrance hole.
2. Remove the paper from the Butyl tape.
   Cover the cable in the area of the Deck Gland with the butyl tape.
3. Place the boot around the feeder, position the boot over the butyl tape, and fit the tension clamp.
   Offer the boot up to the entrance hole in the deck and mark the location of the six holes for the fixing bolts.
4. Withdraw the boot from the hole and drill six 7mm mounting holes through the deck.
5. Slide the boot back over the entrance hole in the deck and tighten the tension clamp. Apply sealant to the face of the gland boot.
6. Align the holes in the gland half plates with the holes in the boot and the holes in the deck. Secure the assembly in position with six M6 bolts, flat washers, lock washers and nuts, together with the sealing washers provided in the kit.
   The bolts are inserted downwards and the sealing washers only go under the bolt heads, see Figure 3.71 for location details.

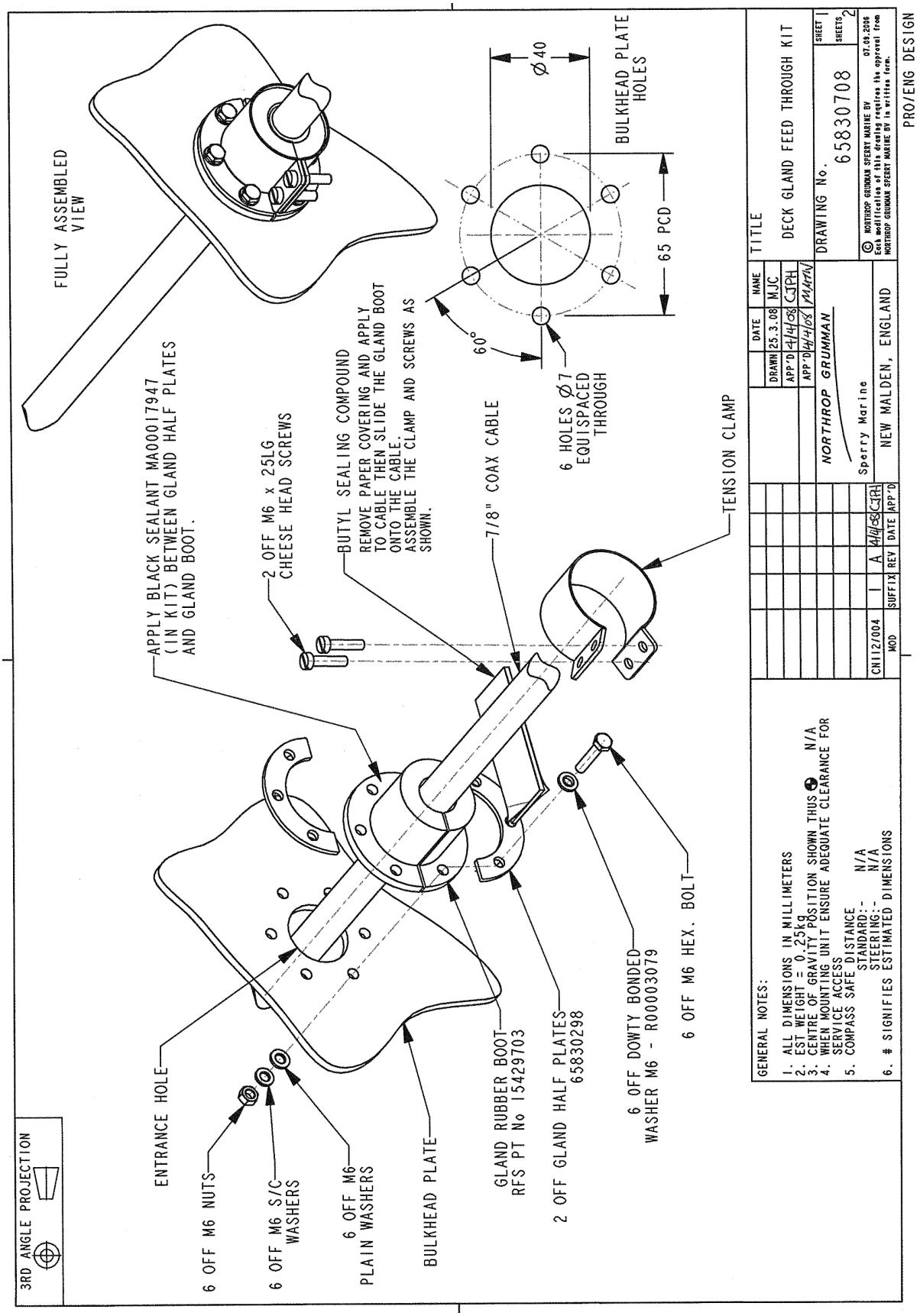


Figure 3.71 Deck Gland Feed Through Kit

6.5.3.4 Installing the Cable

Cable Hangers are supplied (Andrew Hanger Kit Type 42396A-5) to support the cable along the cable run between the Scanner Unit and the Bulkhead Transceiver. Each kit contains 10 Hangers. Their associated Fixing Kit (Andrew Type 31769-1) is included as part of the Installation Kit.

Normally, a hanger is attached to a cable tray, using suitable bolts, at a recommended spacing of 0.9 metres (3 feet). The support brackets must be fitted to the hangers to prevent distortion when the hanger is wrapped around the coaxial cable as shown in Figure 3.72.

Figure 3.72 also shows additional hardware (not supplied in the Installation Kit) that helps with special mounting arrangements. If required, these can be purchased from Andrew Corporation.

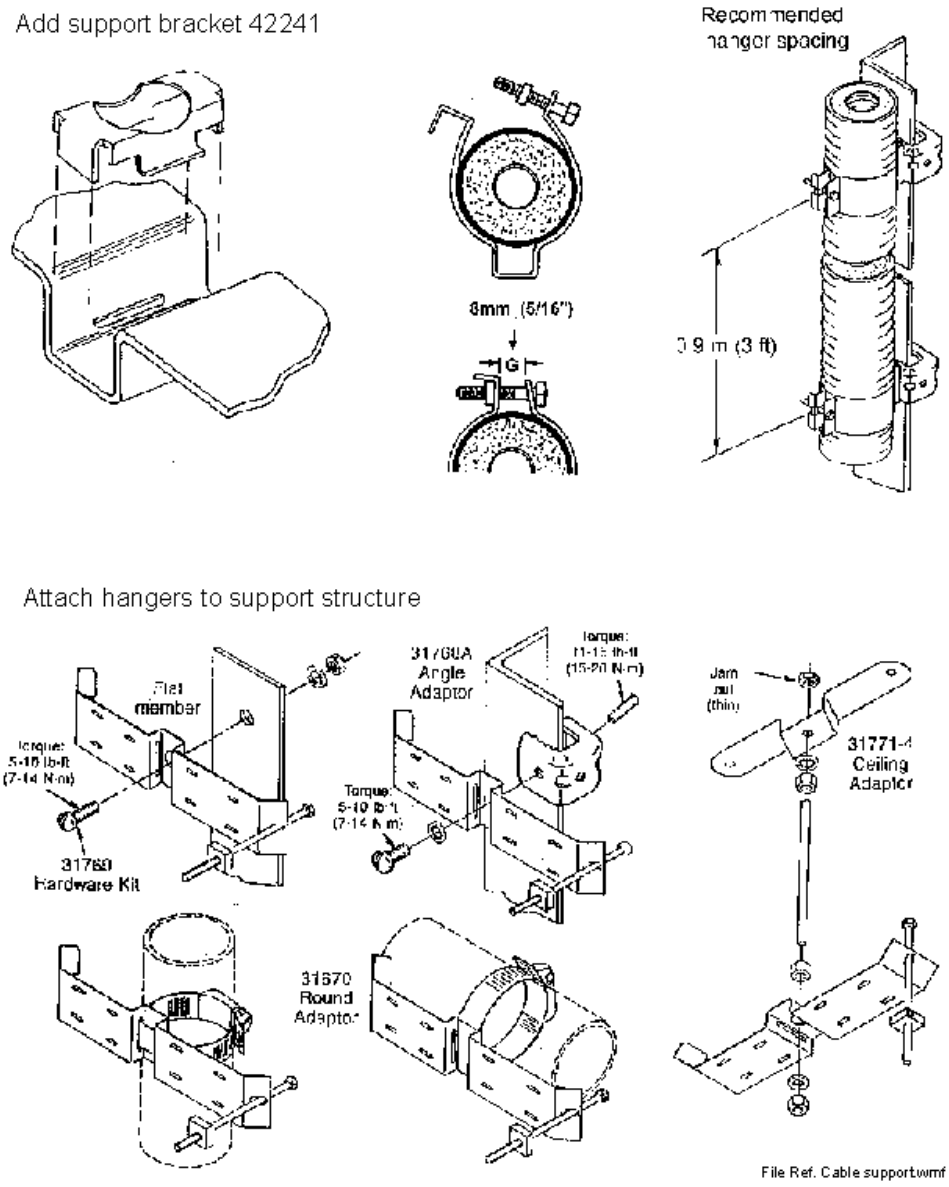


Figure 3.72 Cable Support Details

6.6 Scanner Control Unit

6.6.1 Mounting Position

Normally, the Scanner Control Unit (SCU) is mounted so that it is accessible to the radar operator. Also it must be mounted so that a service engineer can get access to the isolator for the mains supply to the Turning Unit motor. Therefore, it is preferable to mount the SCU close to the Mains Isolator, see Figure 3.74 for the SCU Installation drawing.

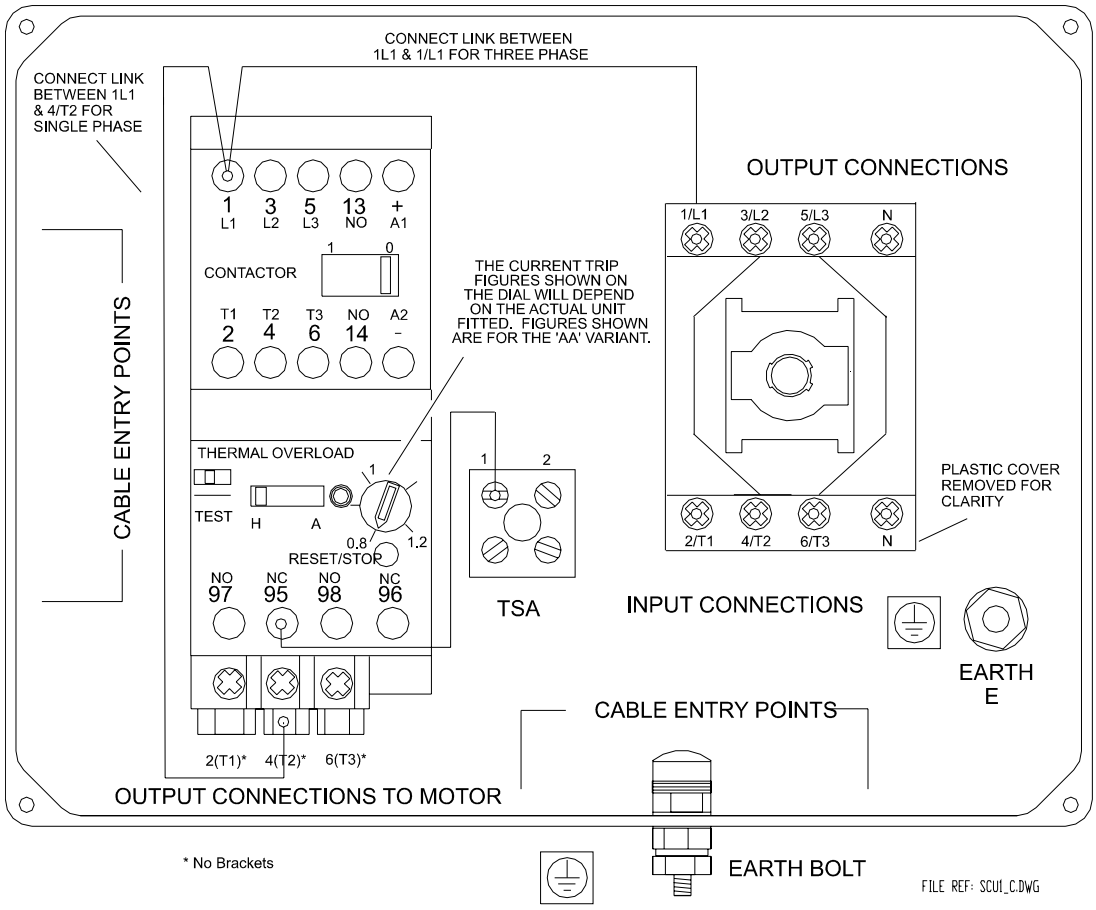


Figure 3.73 Scanner Control Unit - Internal Layout

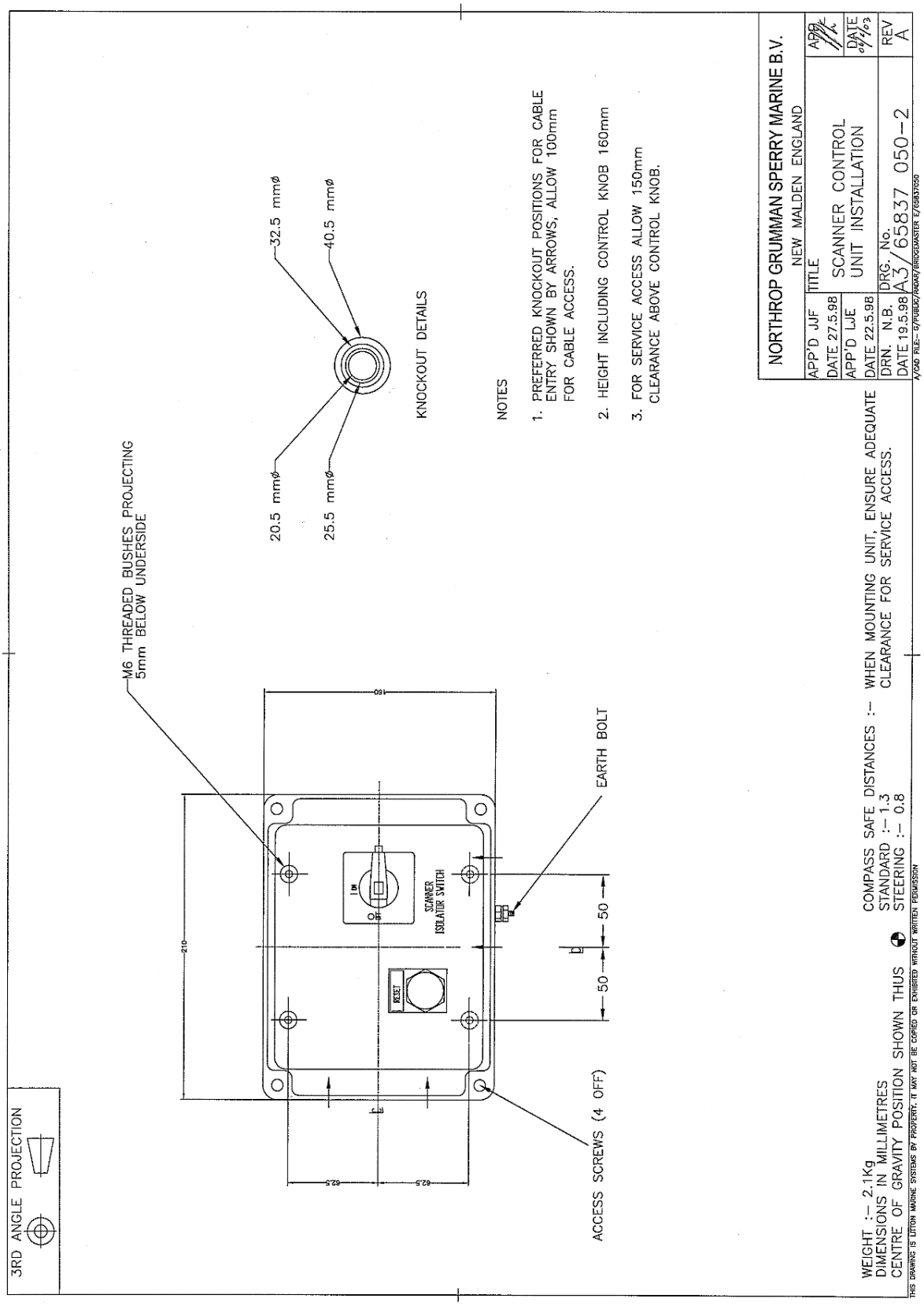


Figure 3.74 Scanner Control Unit Installation

6.6.2 Single Phase or Three Phase Mains Supply Voltage

The connection details and relevant cabling schedules for a single-phase supply (1ϕ) SCU and three-phase supply (3ϕ) SCU are shown in Figure 3.75 and Figure 3.76 respectively.

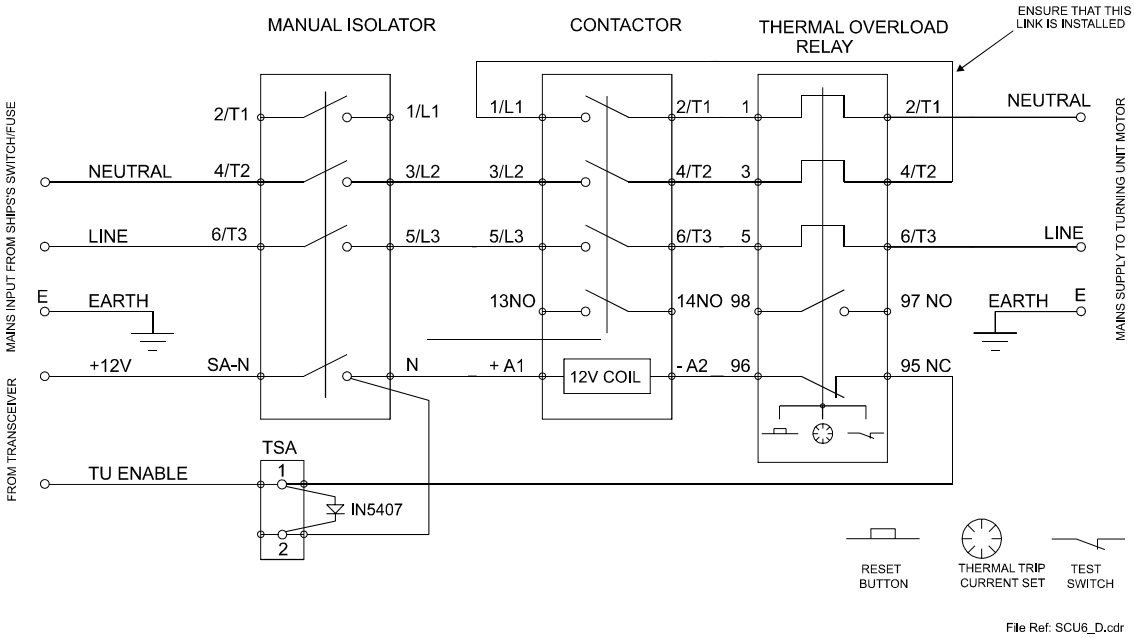


Figure 3.75 Scanner Control Unit – Single Phase Supply Arrangement*

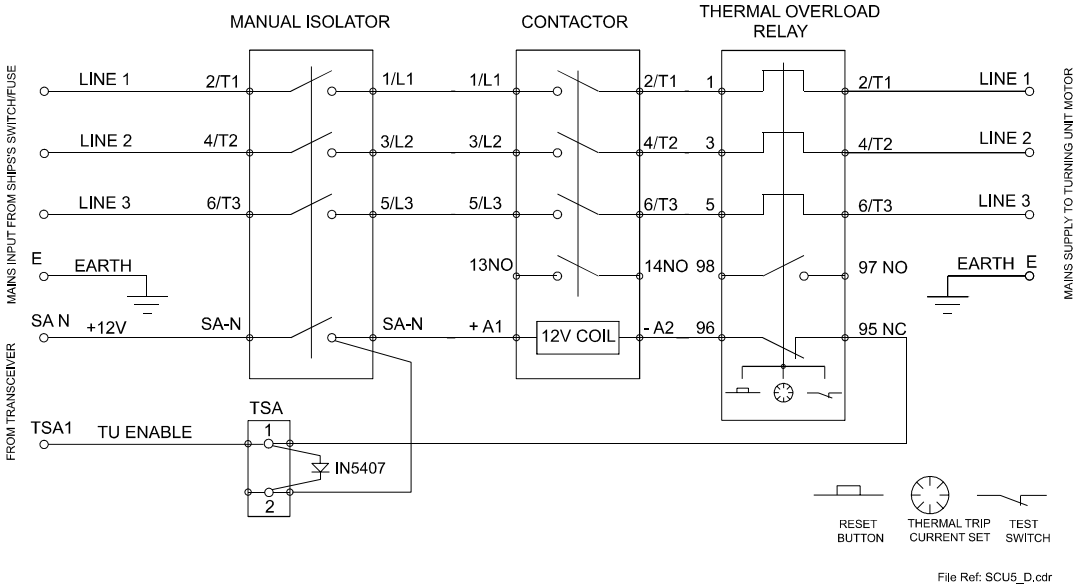


Figure 3.76 Scanner Control Unit – Three-Phase Supply Arrangement*

* Refer to Cable Schedules for details of connections to the ship's supply and the Turning Unit motor.
For Thermal Trip current settings, refer to Table 11 in Section 6.6.3.
Cable type 37-3-2R may be used for 220/240V supplies.

6.6.3 Scanner Speed Option

Two scanner speed options, 'Standard' and 'High', are available, depending on the type of scanner motor. Motor types 91003751, 52, 57 and 58 are standard speed; 91003753, 54, 59 and 60 are high-speed.

See Section 6.5.3.4 '*Installing the Cable*' for connection details.

Table 11 below defines the Thermal Current Trip settings for each variant. These settings must be set during installation.

Table 11: Thermal Current Trip Settings

Mains Supply Voltage	Standard Speed Scanner		High-Speed Scanner	
	50Hz	60Hz	50Hz	60Hz
110/120 Volts 1ϕ	8.0A	8.0A	8.0A	8.0A
	65837AH	65837AH	65837AH	65837AH
220/240 Volts 1ϕ	4.0A	4.0A	4.0A	4.0A
	65837AE	65837AE	65837AE	65837AE
110/120 Volts 3ϕ	5.2A	5.2A	6.4A	6.4A
	65837AE	65837AE	65837AF	65837AF
220/240 Volts 3ϕ	2.2A	2.2A	4.0A	4.0A
	65837AC	65837AC	65837AE	65837AE
380/440 Volts 3ϕ	1.3A	1.3A	1.8A	1.8A
	65837AB	65837AB	65837AC	65837AC

6.7 Isolation Transformer Unit

Refer to Figure 3.77 for the installation of this unit.

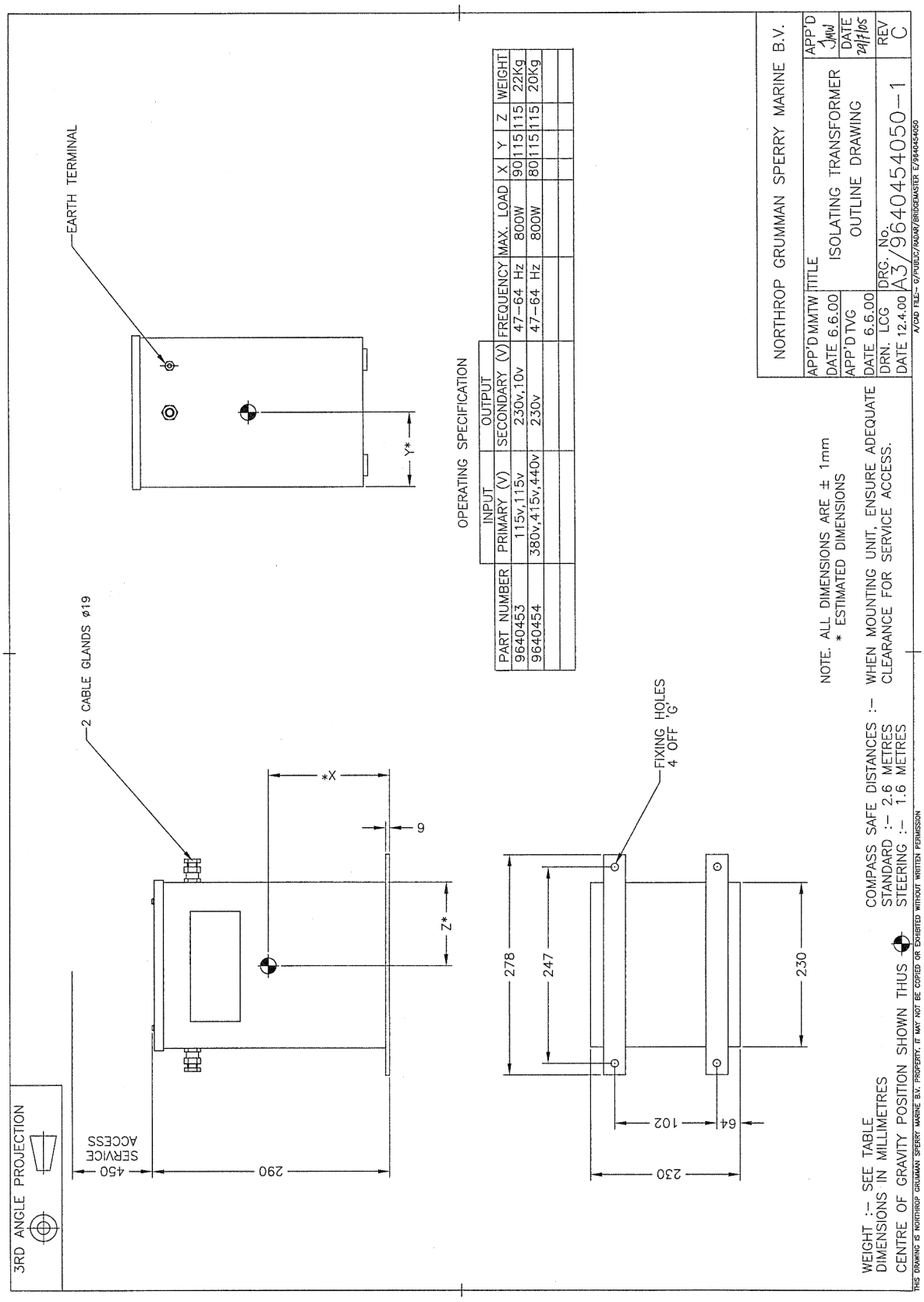


Figure 3.77 Isolation Transformer Unit Installation

6.8 19" Integrated Tabletop Display

The 19" integrated tabletop display is a combined monitor, processor, PCIO, and control panel (basic or trackball only).

The integrated tabletop display comprises the following sub-assemblies and modules:

- 19" LCD Monitor
- PC sub unit - comprises a processor, hard disk, SC3 card and graphics card.
- PCI/O PCB
- Control Panel
- DVD drive
- Security Device
- 24V Power Supply
- DC/DC Converter
- On/Off switch
- Two USB ports
- Buzzer PCB
- 5 Amp Fuse

All sub-assemblies and modules are housed in an enclosure chassis, monitor bezel and rear cover.

For the 19" Integrated Tabletop outline drawings refer to the following:

- Figure 3.78 and Figure 3.79 (sheets 1 and 2).

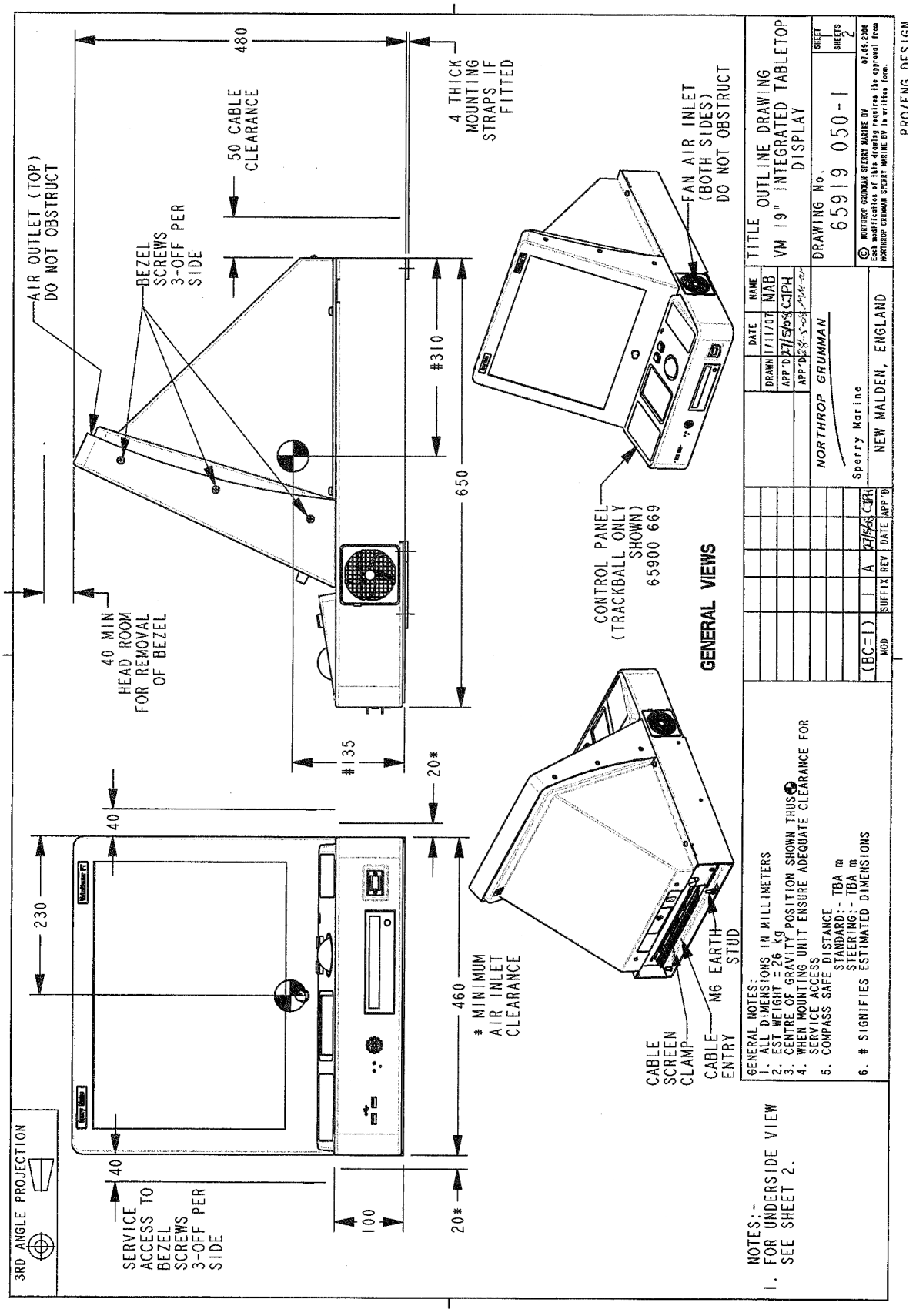


Figure 3.78 19" Integrated Tabletop Outline Drawing - Sheet 1

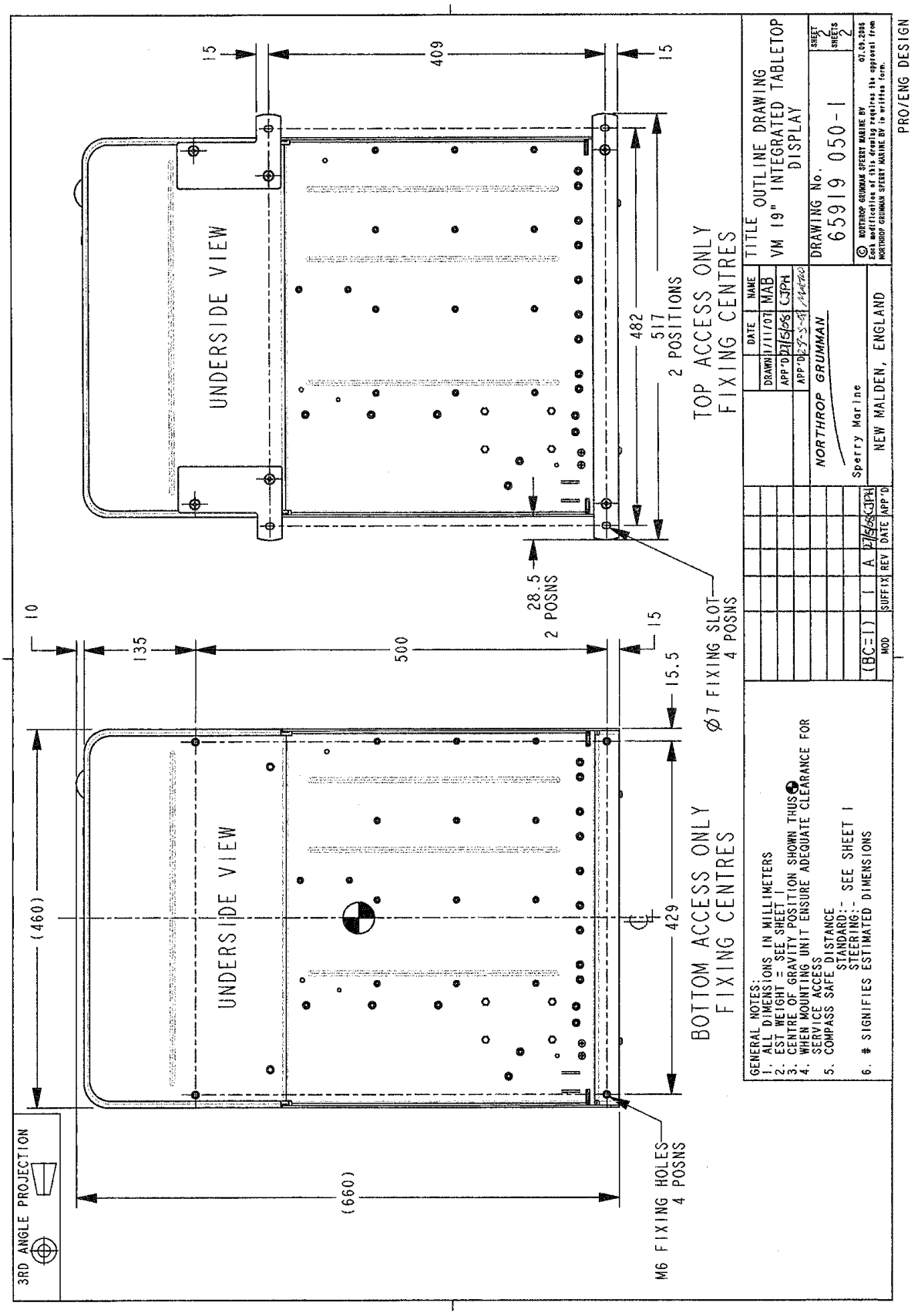


Figure 3.79 19" Integrated Tabletop Outline Drawing - Sheet 2

6.8.1 Installing the 19" Integrated Display to a Tabletop

There are two methods of securing the Integrated display to a tabletop:

- Top Access, where the display is fixed from the top of the table. When using this method, the left and right hand mounting bracket and mounting strap listed below must be attached to the underside of the enclosure.
- Bottom Access, where the display is fixed from the underside of the table top.

6.8.1.1 Top Access Installation

To secure the integrated display from the top of the table you will need the following parts, supplied with Installation Kit 65919607:

- four wood screws (4107624)
- four large M6 washers (4711203)
- Mounting Bracket - RH (65919165)
- Mounting Bracket - LH (65919166)
- Mounting Strap (65919114)
- six M6 x 10 locking screws (65800258)

To install the display to the tabletop:

1. Attach the two mounting brackets and mounting strap to the underside of the enclosure using the six M6 locking screws.
2. Mark and drill the four M6 fixing holes on the table top to the dimensions shown in 65919050, sheet 2 (Figure 3.79) top access.
3. Attach the display assembly to the table top using the four wood screws and M6 washers. Or, use suitable length M6 bolts to secure.

6.8.1.2 Bottom Access Installation

If you are fixing the display from the underside, mark and drill the four M6 fixing holes on the table as shown in 65919050, sheet 2 (Figure 3.79) bottom access. Use suitable length M6 bolts to secure.

6.8.2 Removing 19" Integrated Display Modules

To install the input cables to the 19" integrated display the following modules must be removed from the main assembly:

- LCD Bezel
- Rear Cover
- Rear Panel
- Cable Clamp

Refer to Figure 3.81 for an illustration of the 19" Integrated Display with the modules removed.

6.8.2.1 Removing the Bezel and Rear Cover

1. Remove the six bezel retaining screws (three each side).
2. Remove the four M6 screws, M6 plain washers and M6 spring washers (two either side) from the rear cover. Remove the two M4 screws, M4 plain washers and M4 spring washers from the rear of the cover.
3. Pull the bezel forward from the top to disengage the bezel from the rear cover spring clips.
4. Remove the two M4 screws, M4 plain washers and M4 spring washers from the top of the rear cover. Slide the rear cover backwards, remove the cover earth strap and then remove the cover from the enclosure assembly.
5. To remove the bezel, disconnect the bezel earth strap from the display chassis.

6.8.2.2 Removing the Rear Panel

1. Remove the three M6 screws and M6 spring washers retaining rear panel. The left and right hand screws attach the panel directly to the enclosure chassis; the centre screw attaches the display chassis to the rear panel.
2. After the Processor and LCD assembly have been pivoted upwards, (see Section 6.8.2.3 '*Pivoting the Processor and LCD Assembly*') pull and manuvour the rear panel up and backwards to remove it from the enclosure chassis.

Note: *Removing the fuse holder may help in the removal of the rear panel.*

6.8.2.3 Pivoting the Processor and LCD Assembly

When the LCD bezel, rear cover and the rear panel's centre screw have been removed, the combined Processor plate assembly and the LCD assembly may be pivoted up from the main enclosure assembly.

1. To open the Processor/LCD assembly, lift up the assembly from the rear of the display chassis. The assembly hinges on two brackets attached to the enclosure chassis.
2. To secure the assembly in the open position, push the Stay forward, which is attached to the underside of the display chassis and the side of the enclosure chassis, see Figure 3.80 below.

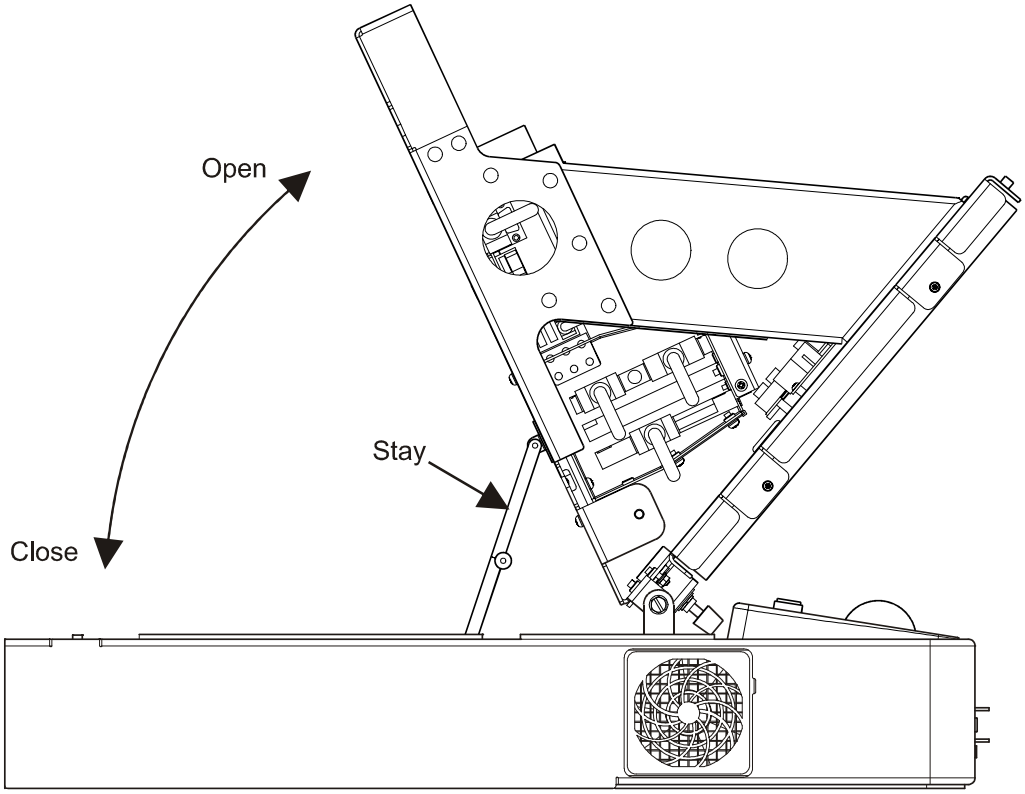


Figure 3.80 Pivoting the Processor and LCD Assembly

6.8.2.4 Removing the Cable Clamp Top Plate

1. Remove the five M4 countersunk screws securing the cable clamp top plate to the cable clamp bottom plate.

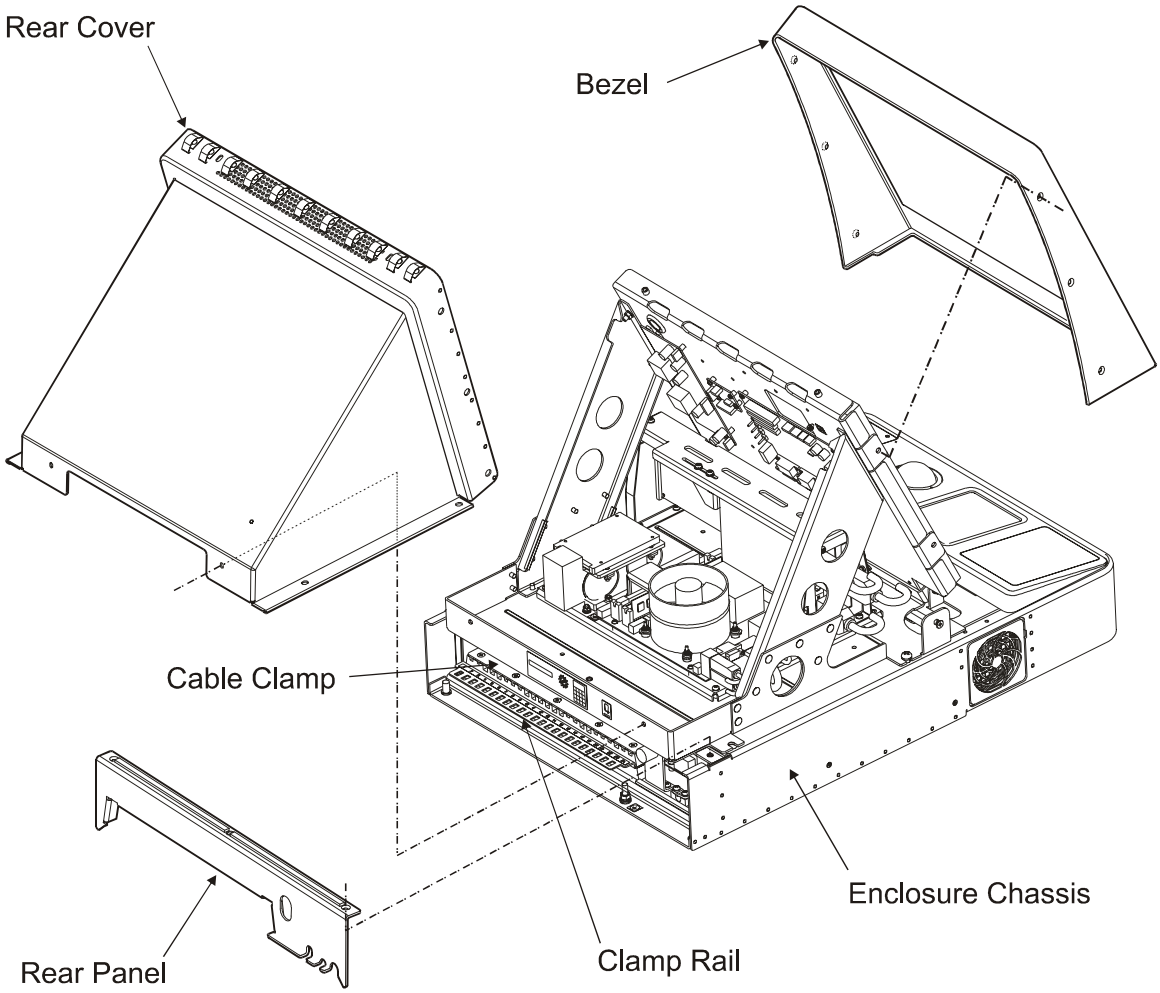


Figure 3.81 19" Integrated Display - Covers & Panel Removal

6.9 Console Assemblies (deck mounted and tabletop kit versions)

The VisionMaster console assembly can be supplied in one of the following variants:

- a 340 mm (23.1" LCD) deck mounted modular unit
- a 340 mm (23.1" LCD) table top kit version
- a 250 mm (19.0" LCD) table top kit version
- a 250 mm (19.0" LCD) deck mounted modular kit (same physical size as the 340mm kit)

Each console assembly comprises the following sub assemblies and modules:

- Display Unit - comprises a flat panel monitor (FPM) held in a chassis.
- Control Panel Assembly - a housing that contains a control panel (or trackball), a power On/Off switch. A USB connector is included when only the trackball is supplied.
- PCIO Unit.
- Processor Unit.

The deck mounted unit also includes a Pedestal, which includes shelves for the PCIO unit and Processor unit.

The deck mounted unit can be supplied either as a standalone console, or installed in an existing console suite. A standalone version comes with the addition of display side cheeks and pedestal side panels.

For 340 mm outline drawings refer to the following:

- Figure 3.82 and Figure 3.83 (sheets 1 and 2) for the 340 mm deck mounted console, standalone version.
- Figure 3.84, Figure 3.85 and Figure 3.86 (sheets 1 to 3) for the 340 mm deck mounted console assembly for installation into an existing console suite.
- Figure 3.87 for the 340 mm table top console assembly.

For 250 mm outline drawing refer to the following:

- Figure 3.88 for the 250 mm table top console assembly.

The assembly instructions are given in the order they should be done. To assemble the console units from their supplied parts, refer to the documentation supplied with the parts and the following sub-sections:

- Section 6.10.1 '*Installing a Standalone Pedestal to the Deck*'.
- Section 6.10.1.1 '*Installing the Control Panel to the Display Chassis*'.
- Section 6.10.1.2 '*Installing the Control Panel/Display Chassis to the Pedestal*'.
- Section 6.10.5 '*Installing the Monitor to the Display Chassis*'.

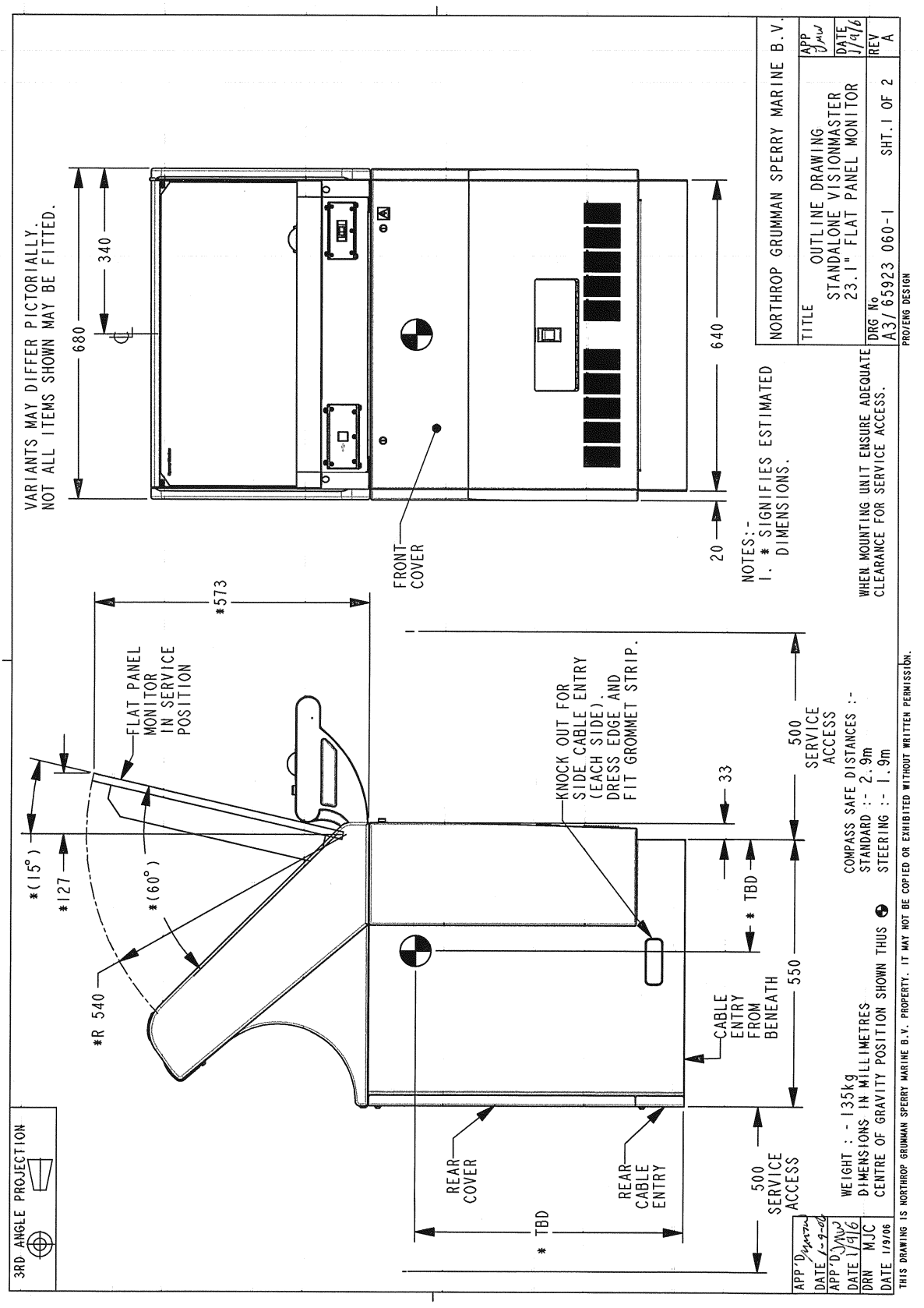


Figure 3.82 Deck Mounted 340 mm Console Assembly Outline Drawing Standalone Version - Sheet 1

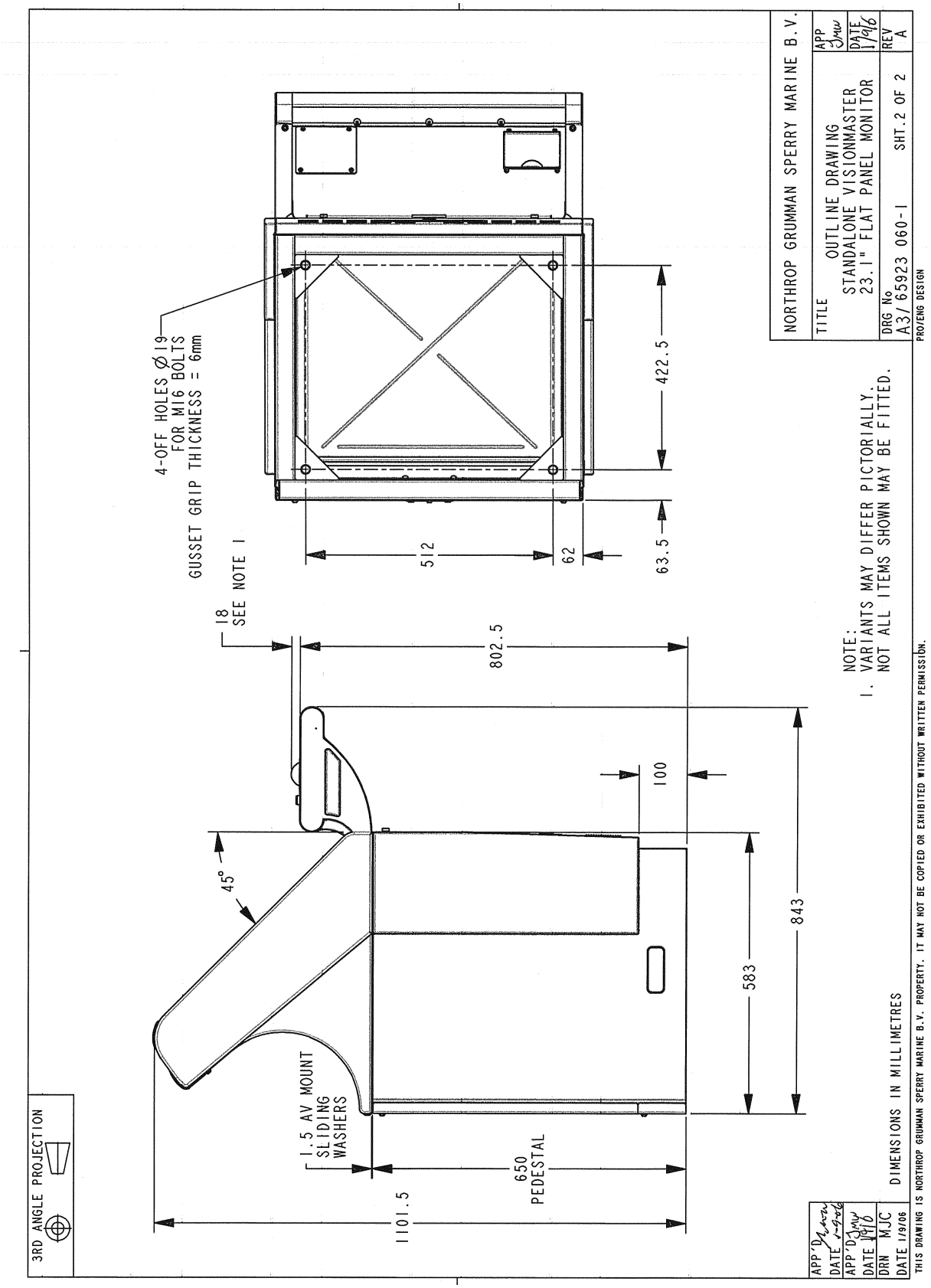


Figure 3.83 Deck Mounted 340 mm Console Assembly Outline Drawing Standalone Version - Sheet 2

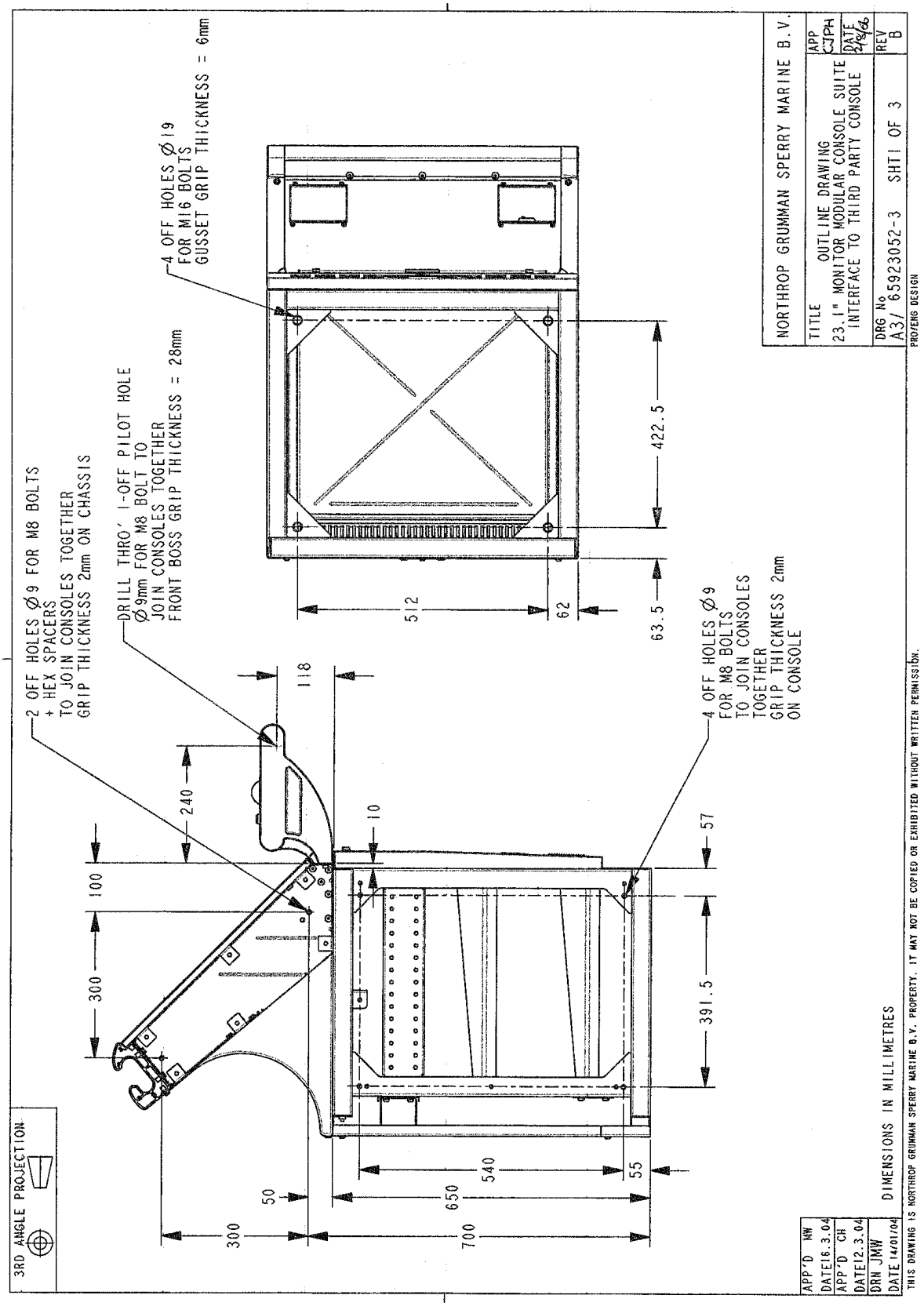


Figure 3.84 Deck Mounted 340 mm Console Assembly Outline Drawing for installation into a Console Suite - Sheet 1

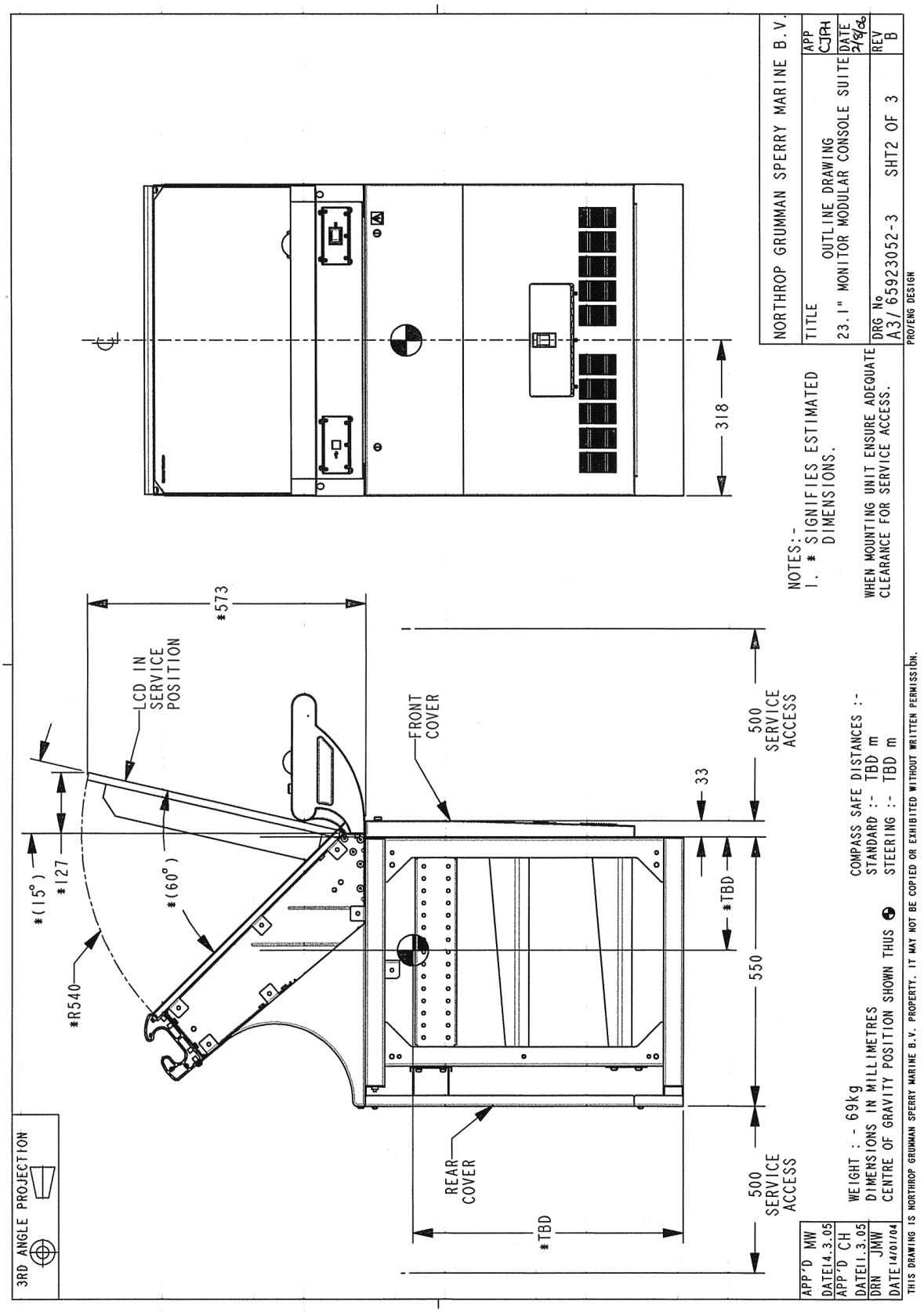


Figure 3.85 Deck Mounted 340 mm Console Assembly Outline Drawing for installation into a Console Suite - Sheet 2

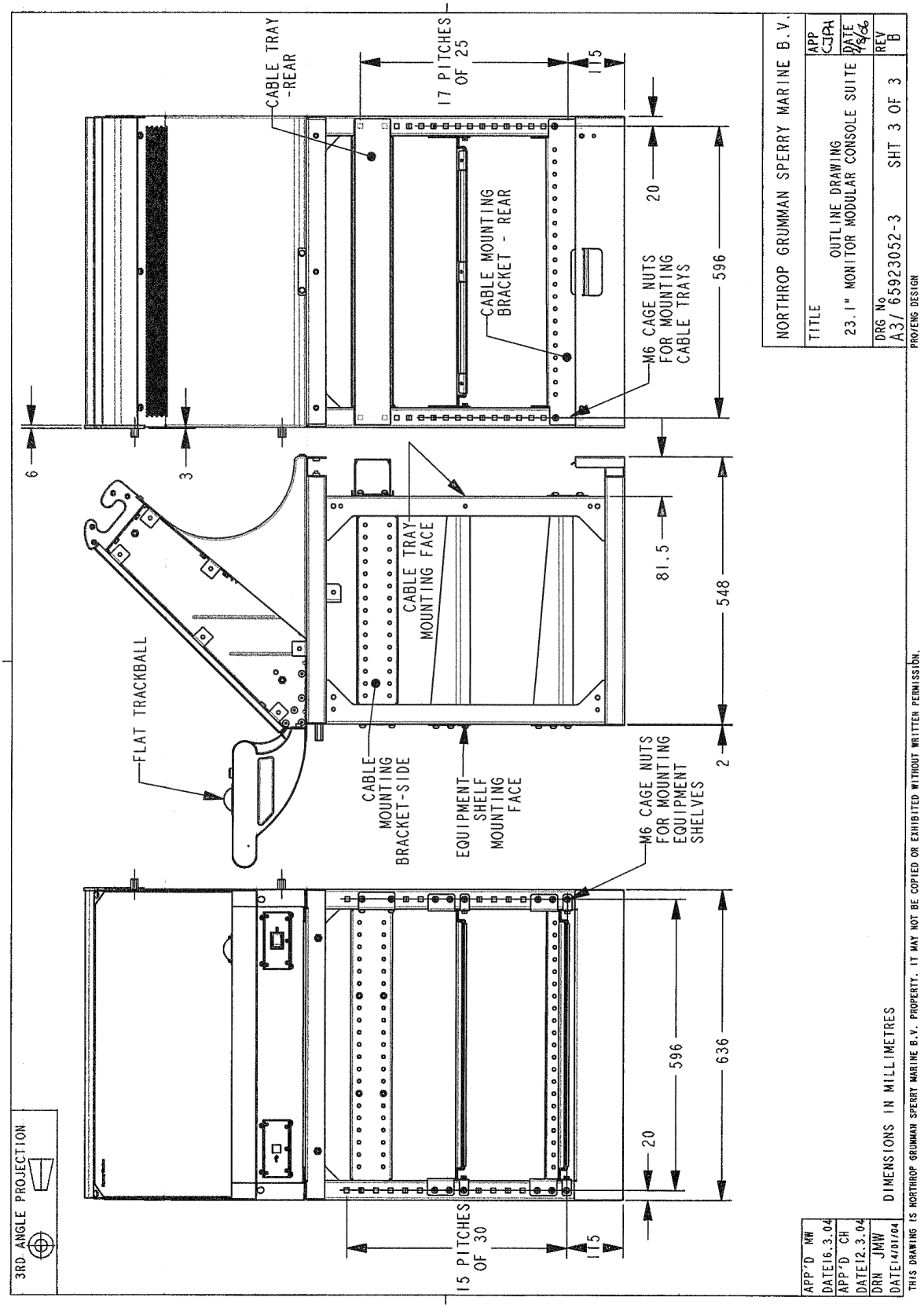


Figure 3.86 Deck Mounted 340 mm Console Assembly Outline Drawing for installation into a Console Suite - Sheet 3

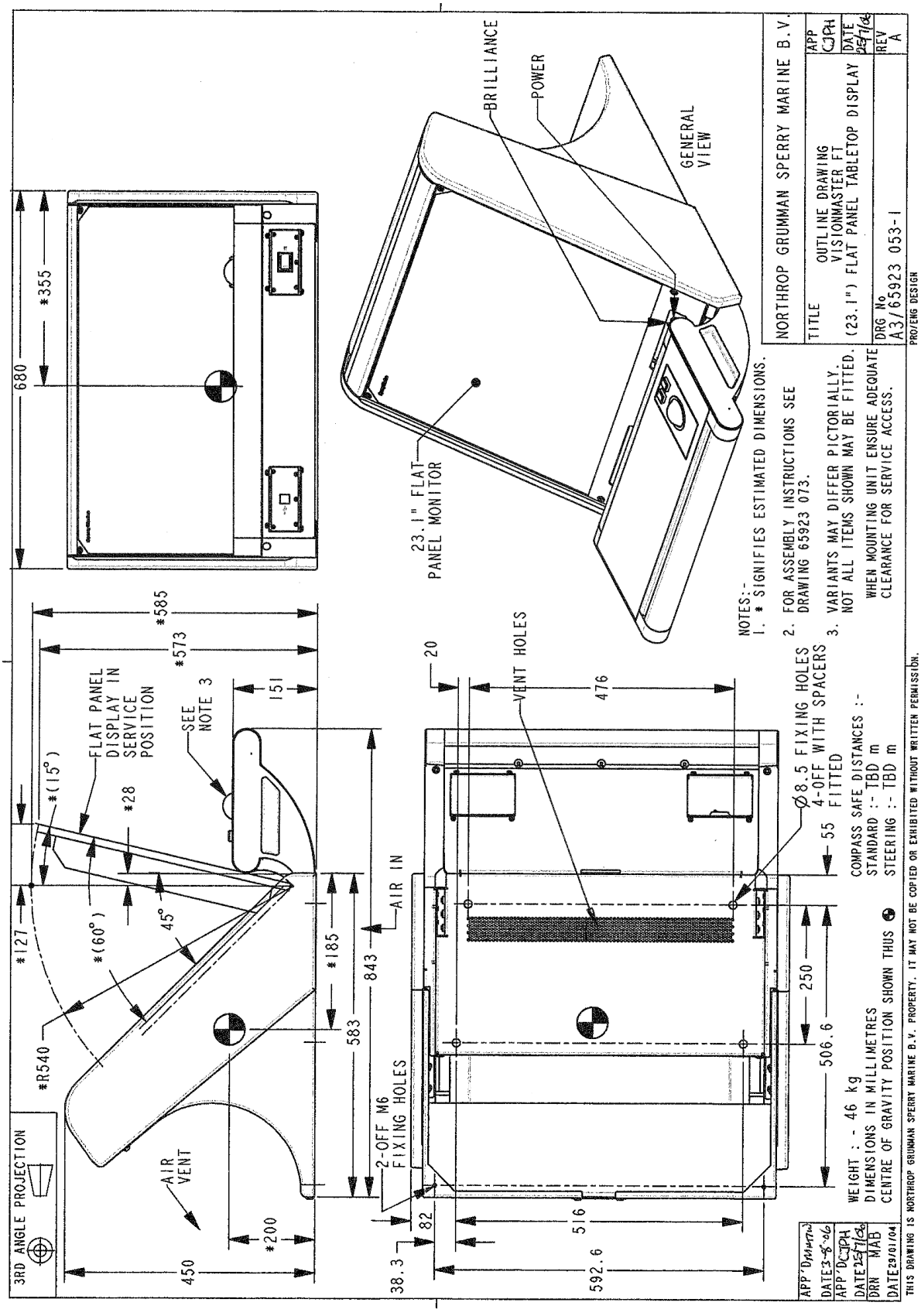


Figure 3.87 Console Assembly 340 mm Table Top Version Outline Drawing

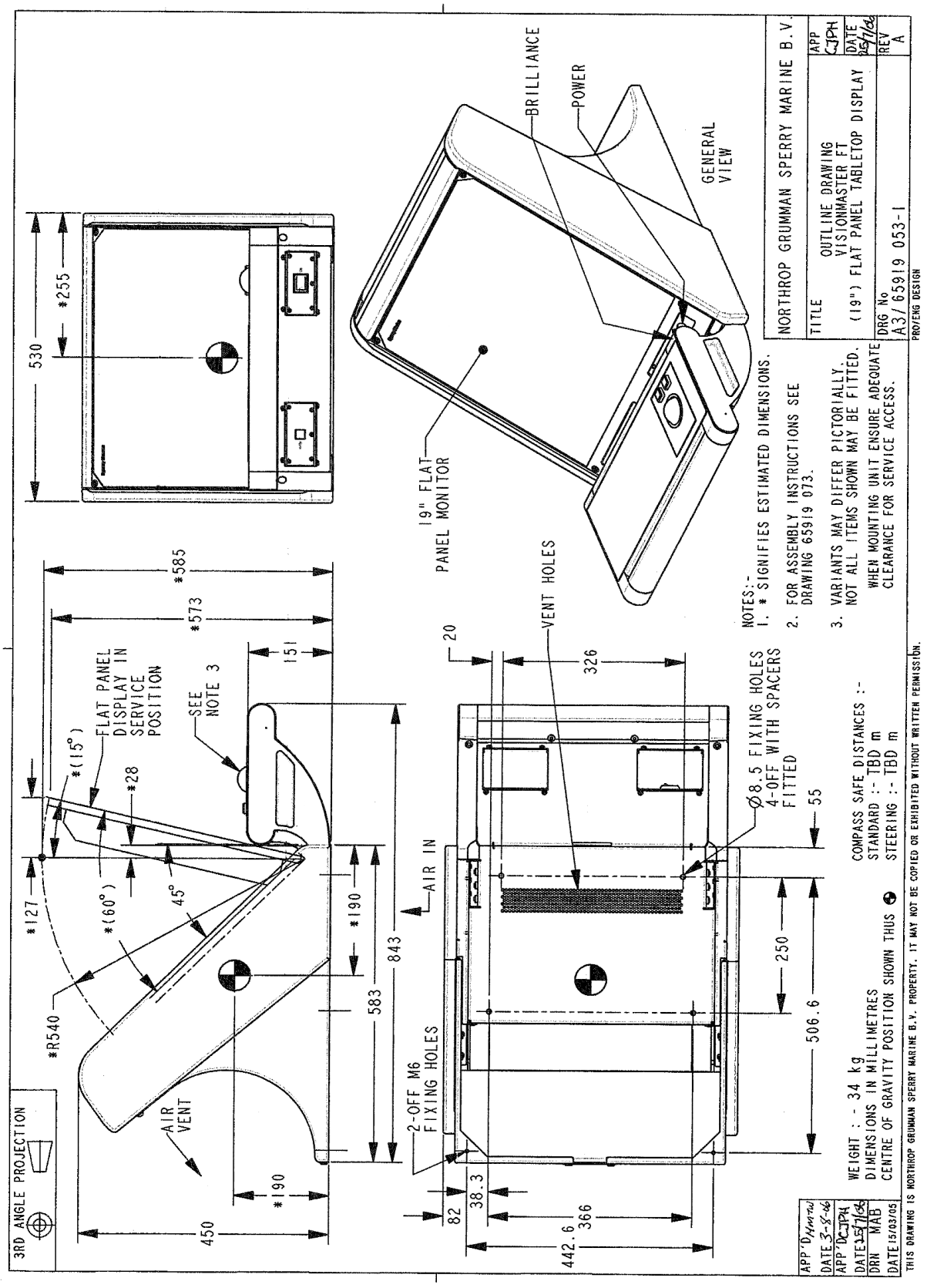


Figure 3.88 Console Assembly 250 mm Table Top Version Outline Drawing

6.9.1 Display Unit

The Display Unit assembly includes a 19" (250mm) or 23.1" (340mm) flat panel monitor (FPM) for use with a 110/220 V AC power supply.

A 19" FPM with a 23.1" metalwork frame can also be housed in a 340mm display unit.

The FPM includes an independent On/Off switch and brilliance control.

The FPM includes a buffered video and sync output for a VDR, at the same frequency and resolution as the output of the processor unit, see Cabling diagrams, Figure 3.121 to Figure 3.127. The VDR output is connected to the RGB OUT terminal at the rear of the FPM.

The FPM is housed in a metal chassis. On the deck mounted console version the chassis is attached to a pedestal; on the table top version the chassis is mounted to the table top.

In the standalone console version the chassis is supplied with left and right hand side cheeks.

Refer to the following figures for general information on the display unit.

- Figure 3.89 for the 23.1" Hatteland FPM outline drawing.
- Figure 3.90 for the 19" FPM outline drawing.
- Figure 3.91 for the 19" FPM in a 23.1" frame outline drawing.
- Figure 3.92 for the 23.1" Melford FPM outline drawing
- Figure 3.93 for the 340 mm Display Unit chassis with side cheeks removed (for an existing console suite).

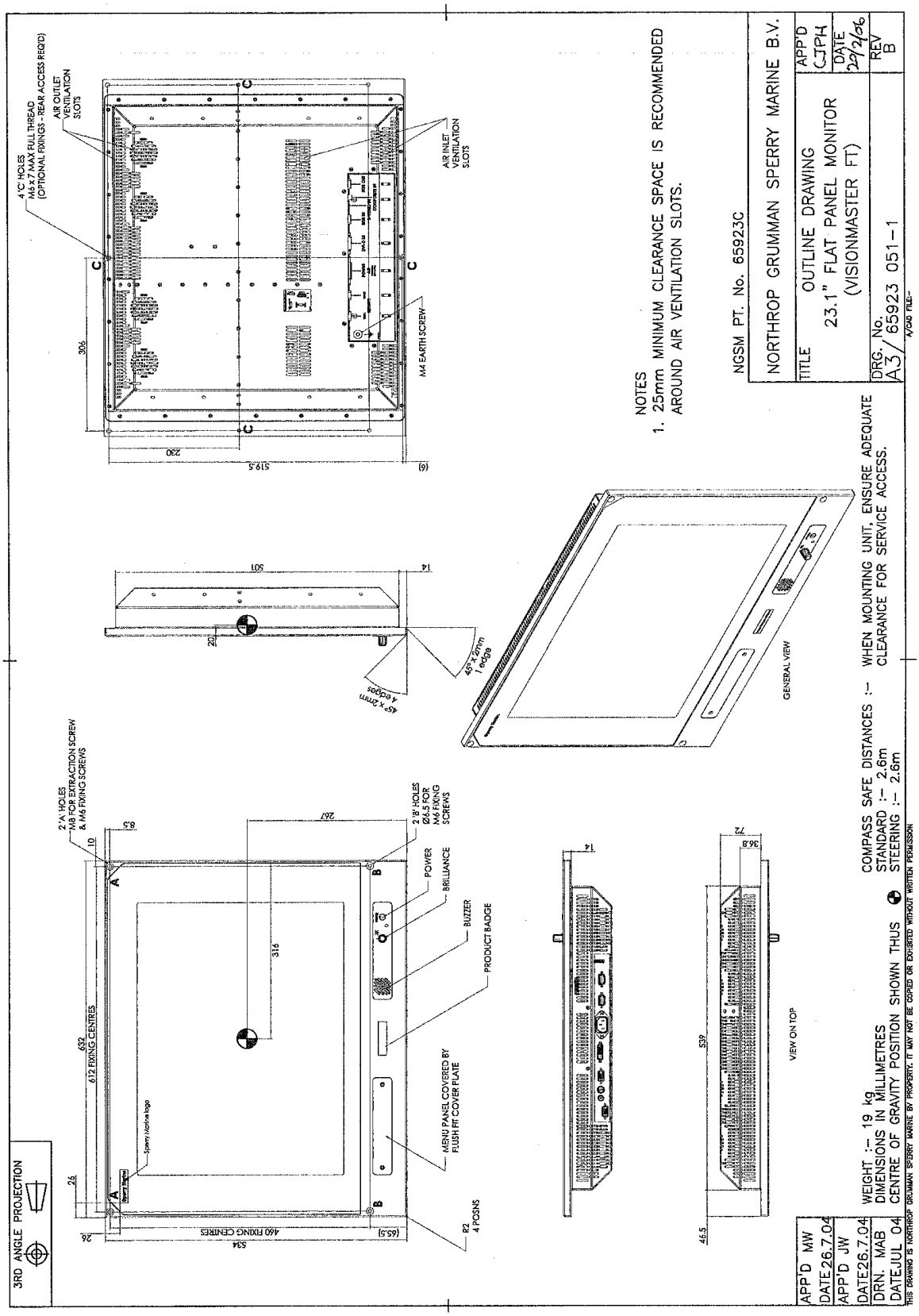


Figure 3.89 23.1" Hatteland Flat Panel Monitor - Outline Drawing

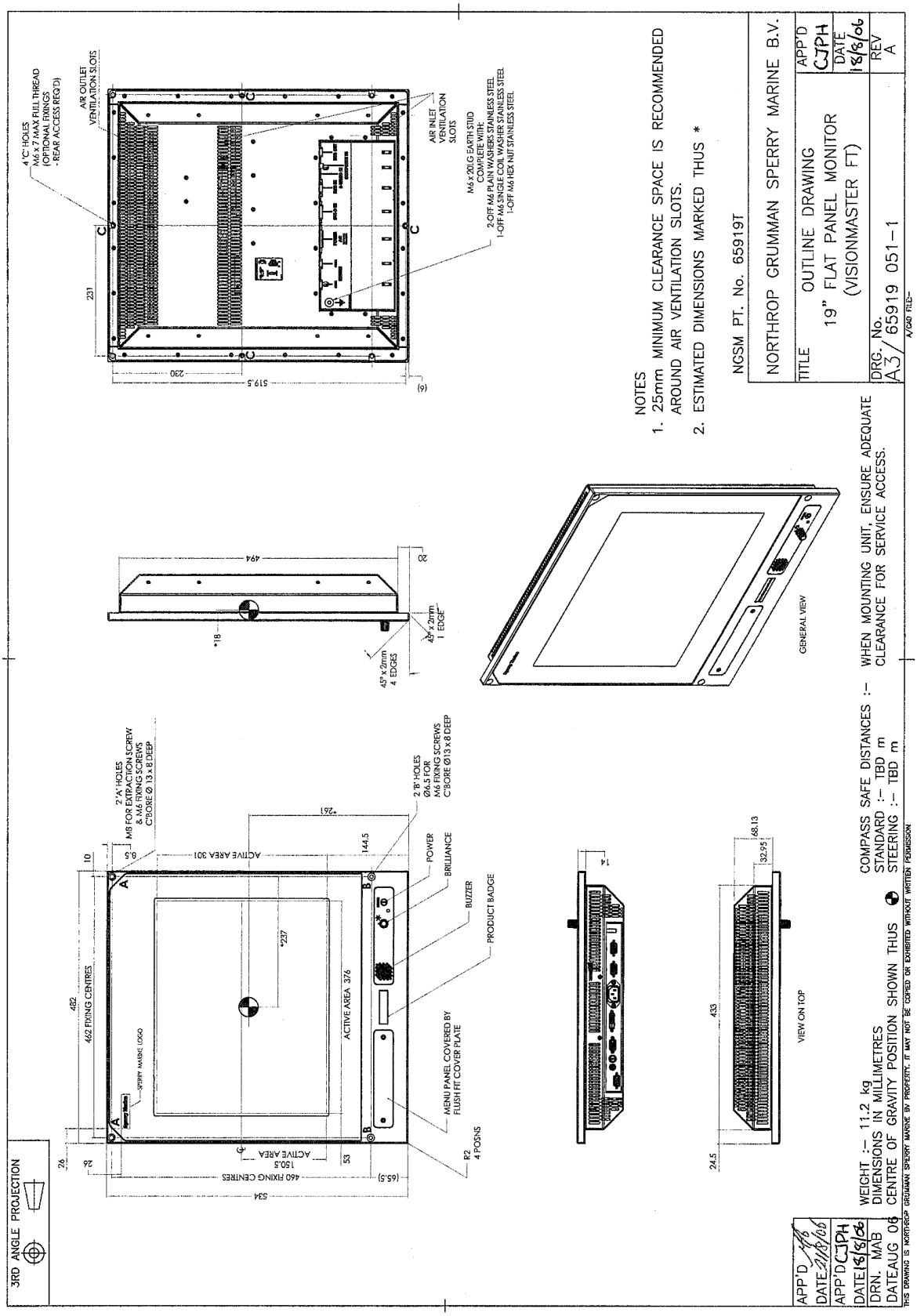


Figure 3.90 19" Hatteland Flat Panel Monitor - Outline Drawing

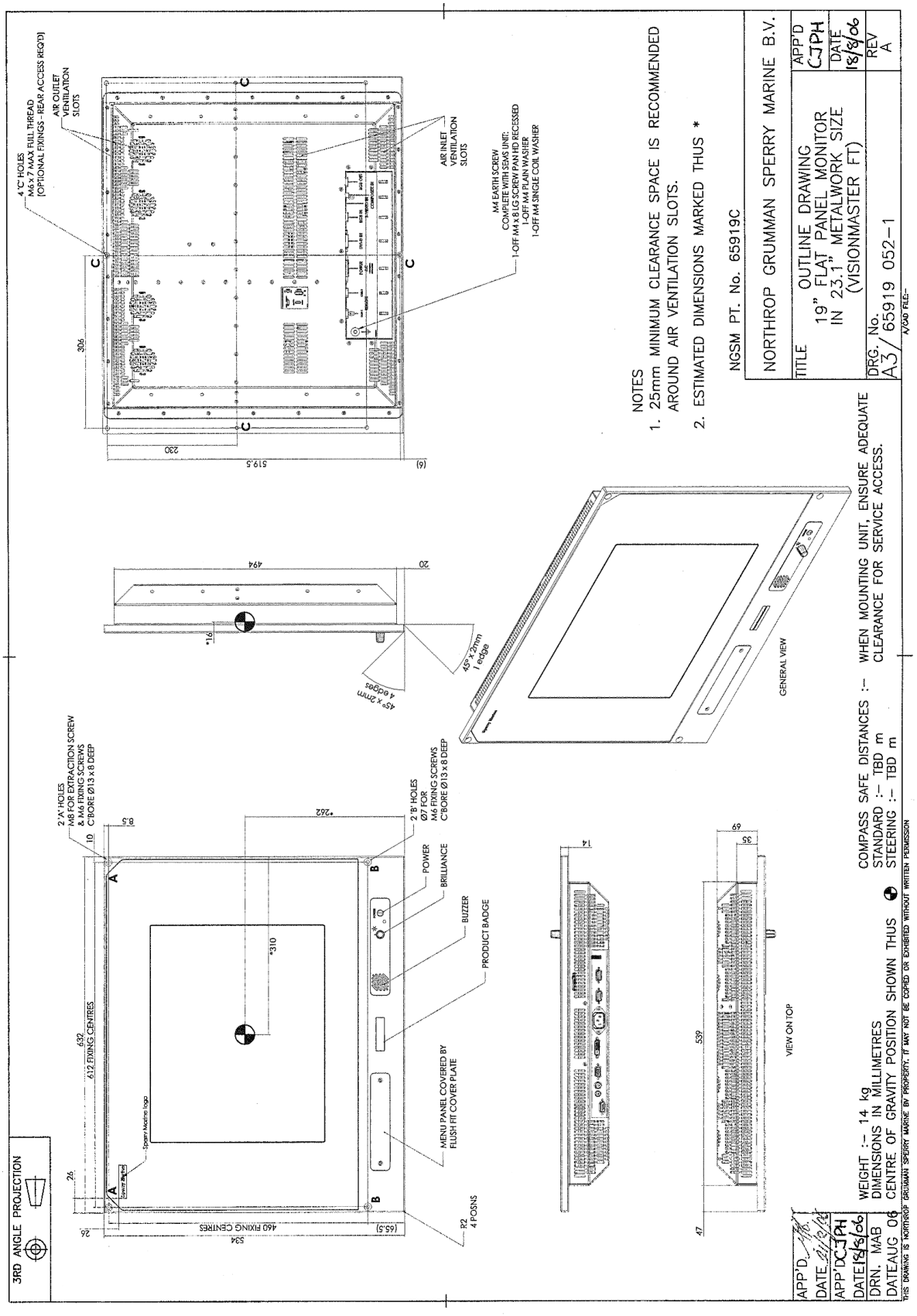


Figure 3.91 19" Hatteland Flat Panel Monitor in 23.1" Frame - Outline Drawing

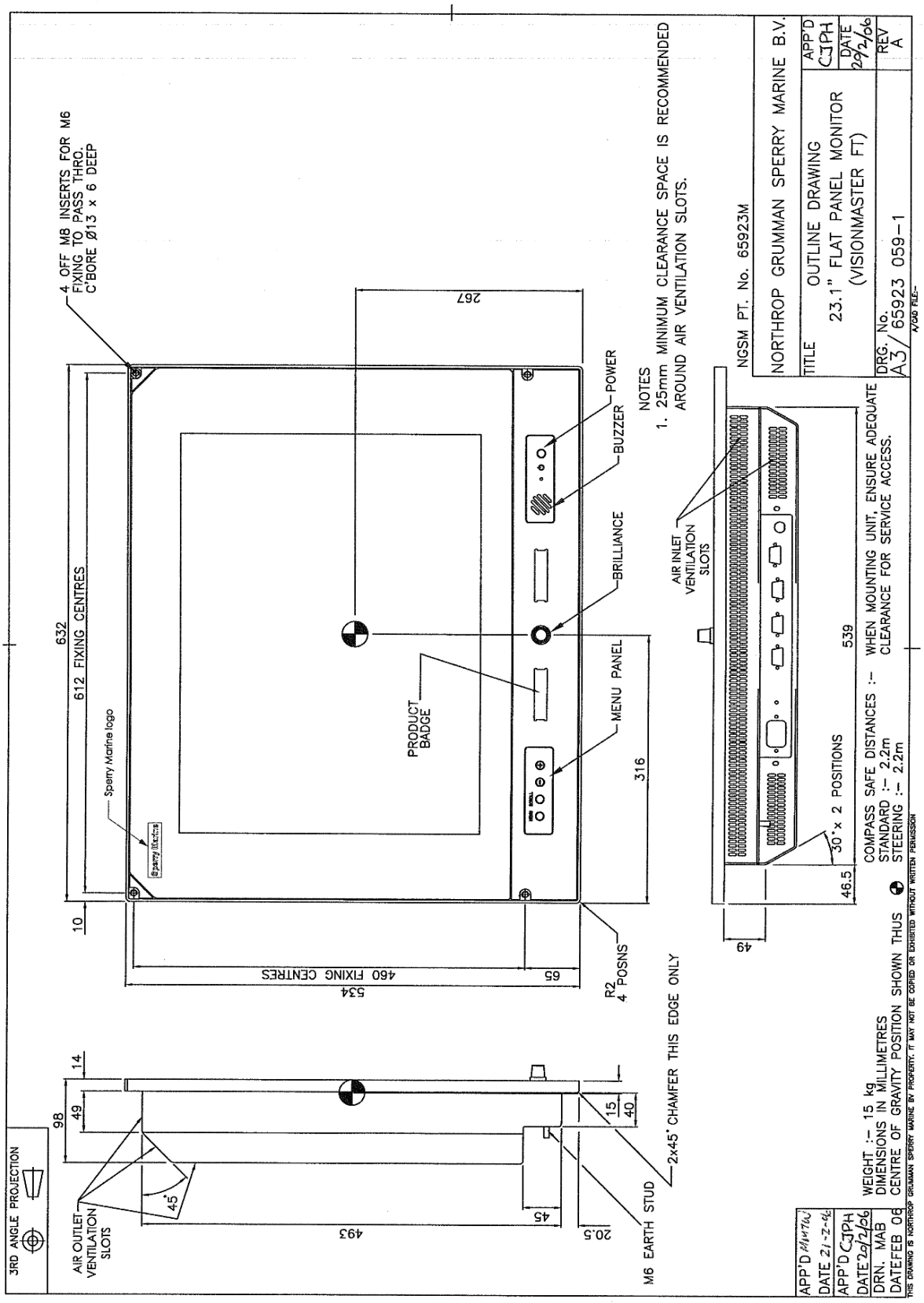


Figure 3.92 23.1" Melford Flat Panel Monitor - Outline Drawing

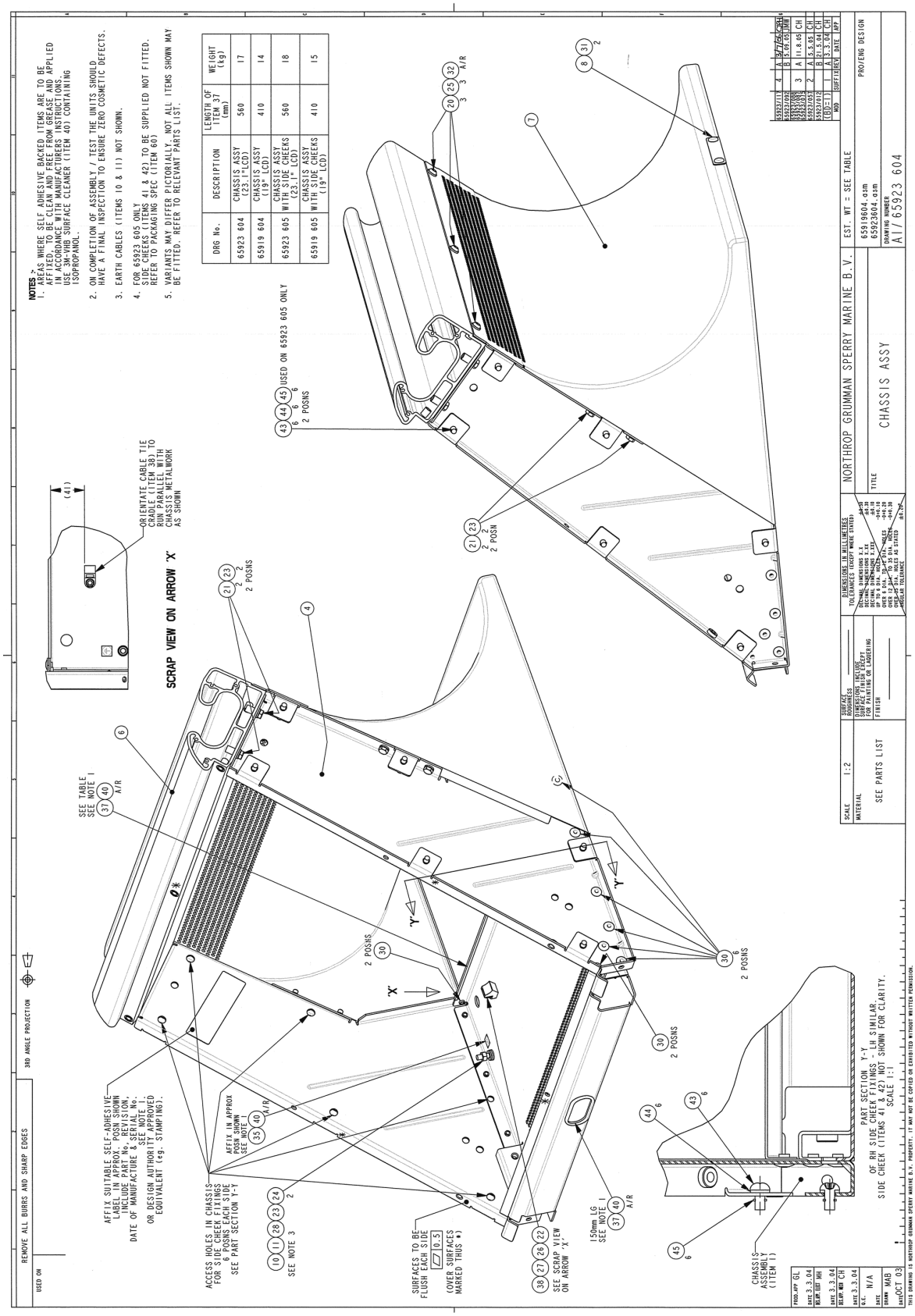


Figure 3.93 340 mm Chassis Assembly with side cheeks removed

6.9.2 Control Panel Assembly

The Control Panel assembly houses the following modules:

- Control Panel or Trackball
- On/Off switch

A USB connector is included if the control panel assembly houses only a trackball.

6.9.2.1 Removing the Mounting Plate

In order to install any of the control panel modules the module mounting plate must first be removed from the control panel assembly. To remove the mounting plate, refer to steps 1) to 5) below and Figure 3.94.

1. Remove two cap head screws and single coil washers from the underside of the control panel tray, using a hex key. Retain fixings for later use.
2. Remove the three torque prevailing nuts. Retain fixings for later use.
3. Dislodge the mounting plate from the control panel tray by inserting the hex key through the holes that the cap head screws came out of and pushing the plate up.
4. Pull the mounting plate forward to unclip from the back of the control panel tray.
5. Disconnect any cables running from the modules attached to the module mounting plate at the processor end, remove any cable restraints and pull the cables through and remove the plate and modules.

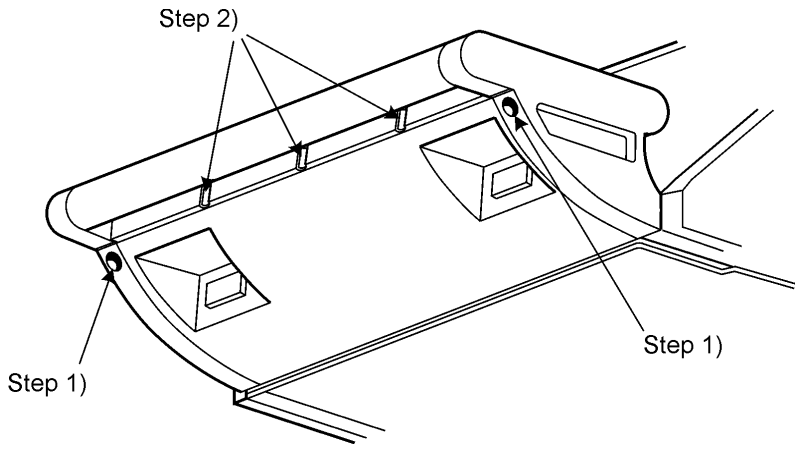


Figure 3.94 Removing control panel mounting plate

The following outline drawings are provided for control panel module kit versions only:

- Figure 3.96 for Control Panel outline drawing.
- Figure 3.97 for Trackball outline drawing.

- Figure 3.98 for USB connector kit outline drawing.
- Figure 3.99 and Figure 3.100 for On/Off switch kit outline drawings.

For instructions on assembling the modules into the control panel assembly see:

- Section 6.9.2.2 '*Installing the Control Panel*'
- Section 6.9.2.3 '*Installing the Trackball*'
- Section 6.9.2.5 '*Installing the USB Connector*'
- Section 6.9.2.6 '*Installing the On/Off Switch*'

6.9.2.2 Installing the Control Panel

The control panel consists of a trackball (with left and right keys), rotary controls, and adjustment and acknowledgement buttons.

The control panel is supplied and installed as one unit. To install the control panel in the housing, refer to steps 1) to 4) below and Figure 3.95.

1. Assemble control panel (65900667) to mounting plate (65923659) by dropping the control panel through the aperture in the mounting plate and securing with two M5 pan screws (4012623) and two washers (4709195).
2. Attach mounting strap (65900239) to control panel with two M5 pan head screws, M5 washers and M5 single coil washers using fixings already attached to the control panel.
3. Attach mounting strap to mounting plate with two M5 torque prevailing nuts (4415388). Do not over tighten and bend strap, there should be a gap between the plate and the strap.
4. Feed cables through aperture in control panel tray, connect to processor unit as shown on Figure 3.120.

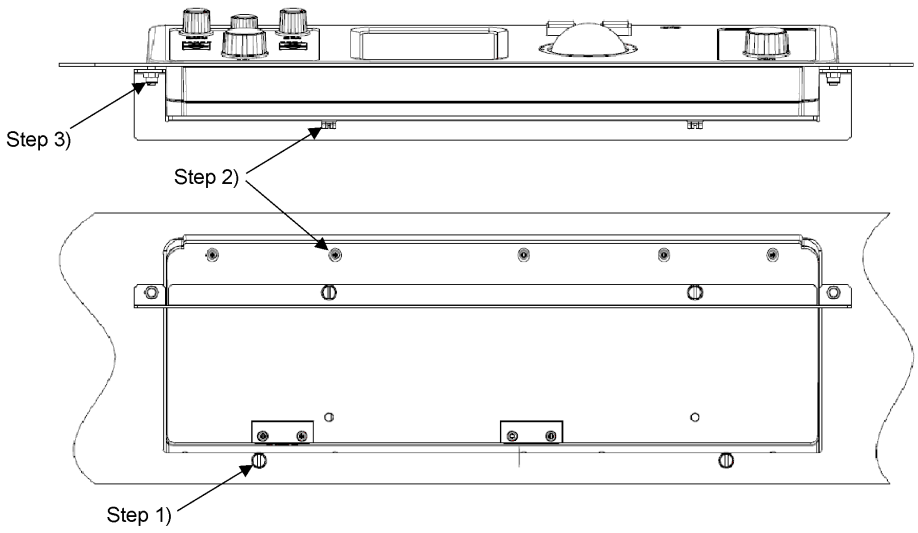


Figure 3.95 Installing Control Panel

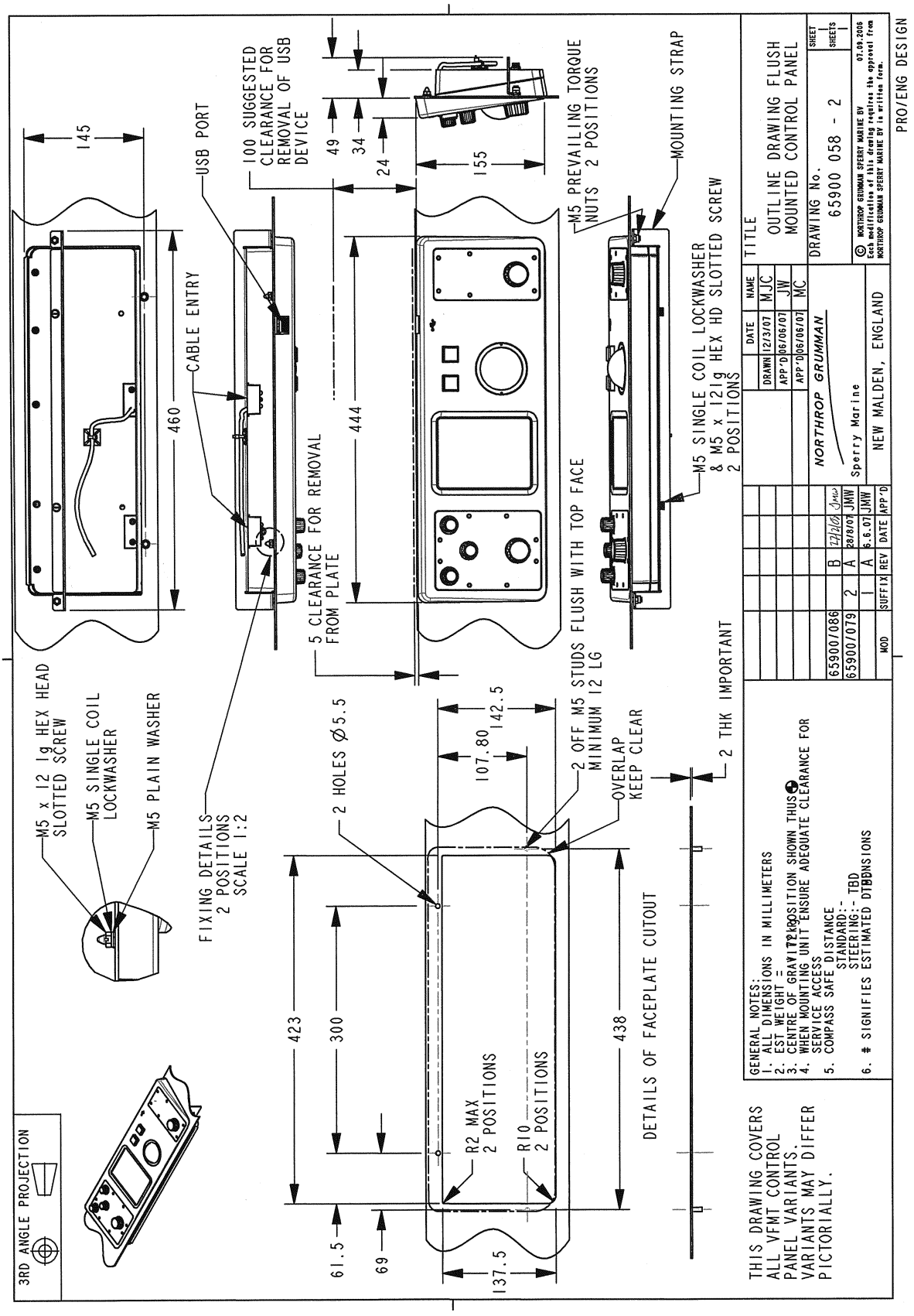


Figure 3.96 Control Panel Outline Drawing

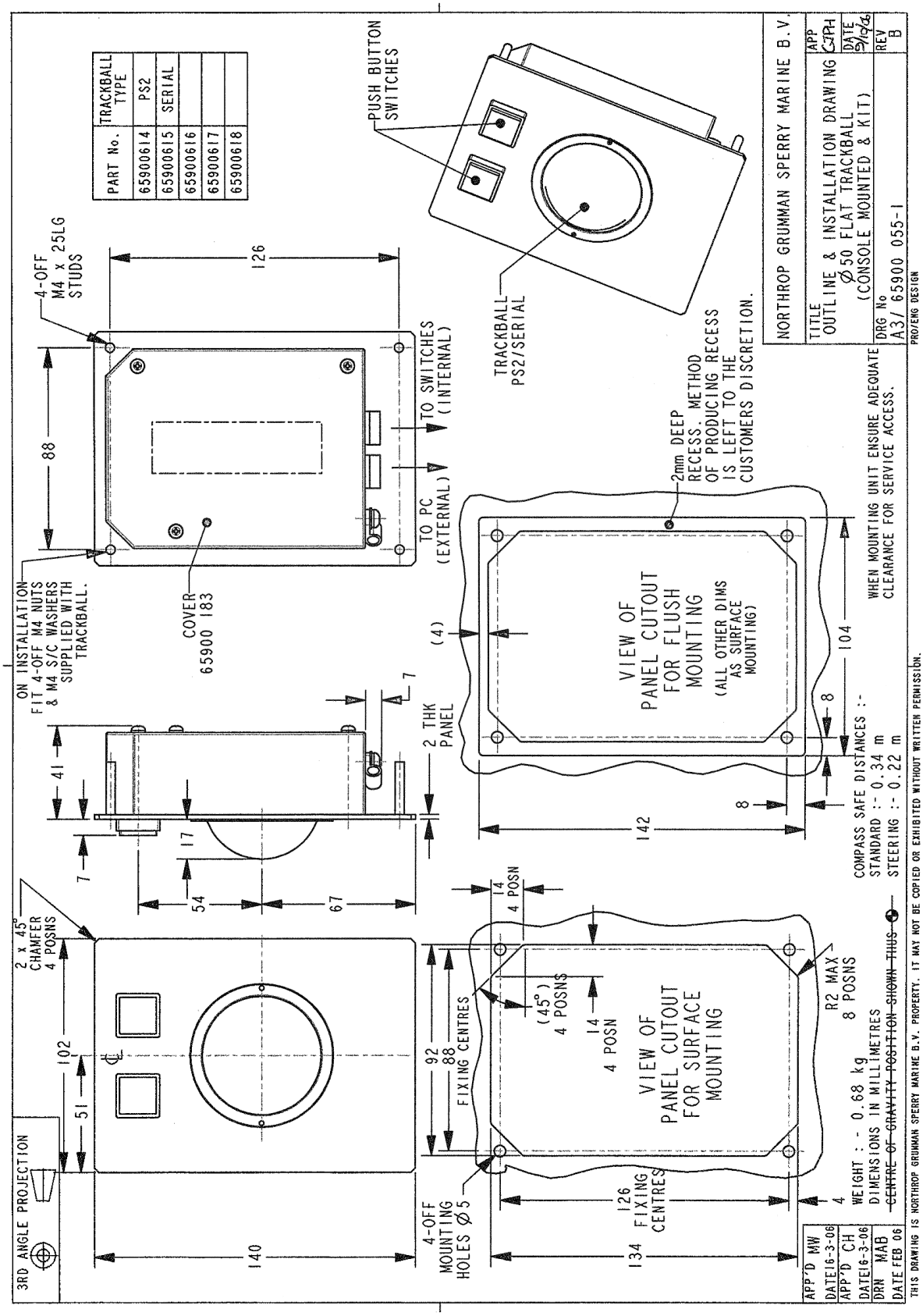


Figure 3.97 Flat Trackball Outline Drawing

6.9.2.3 Installing the Trackball

To fit the trackball to the Control Panel assembly do the following:

a. Install the trackball into the connecting holes of the module mounting plate and secure with four M4 nuts and four S/C washers supplied with the trackball kit.

b. Connect the trackball cable from Plug P2 to the PS2 socket on the Processor unit as shown Figure 3.120.

c. Install the trackball and mounting plate to the control panel as described below.

6.9.2.4 Installing the Mounting Plate

When the modules have been installed secure the mounting plate by doing the following:

1. Place the mounting plate into the recess at top of the control panel housing.
2. From the underside of the control panel secure the mounting plate at the left and right front ends with two cap head screws (4006224) and two washers (4709195).
3. Between the two screws secure the mounting plate with three insert nuts (4415787).

6.9.2.5 Installing the USB Connector

To fit the USB connector to the Control Panel assembly do the following:

a. Install the USB connector into the underside of the Control Panel housing (see Figure 3.94) and secure with four M4 countersunk screws.

b. Plug the USB connector cables to the front USB connector on the processor unit, as shown on Figure 3.120.

6.9.2.6 Installing the On/Off Switch

To fit the On/Off switch to the Control Panel assembly do the following:

a. Install the On/Off switch into the underside of the Control Panel housing (see Figure 3.94) and secure with four M4 countersunk screws.

b. Connect the On/Off switch cable to the PCIO unit, as shown on Figure 3.120.

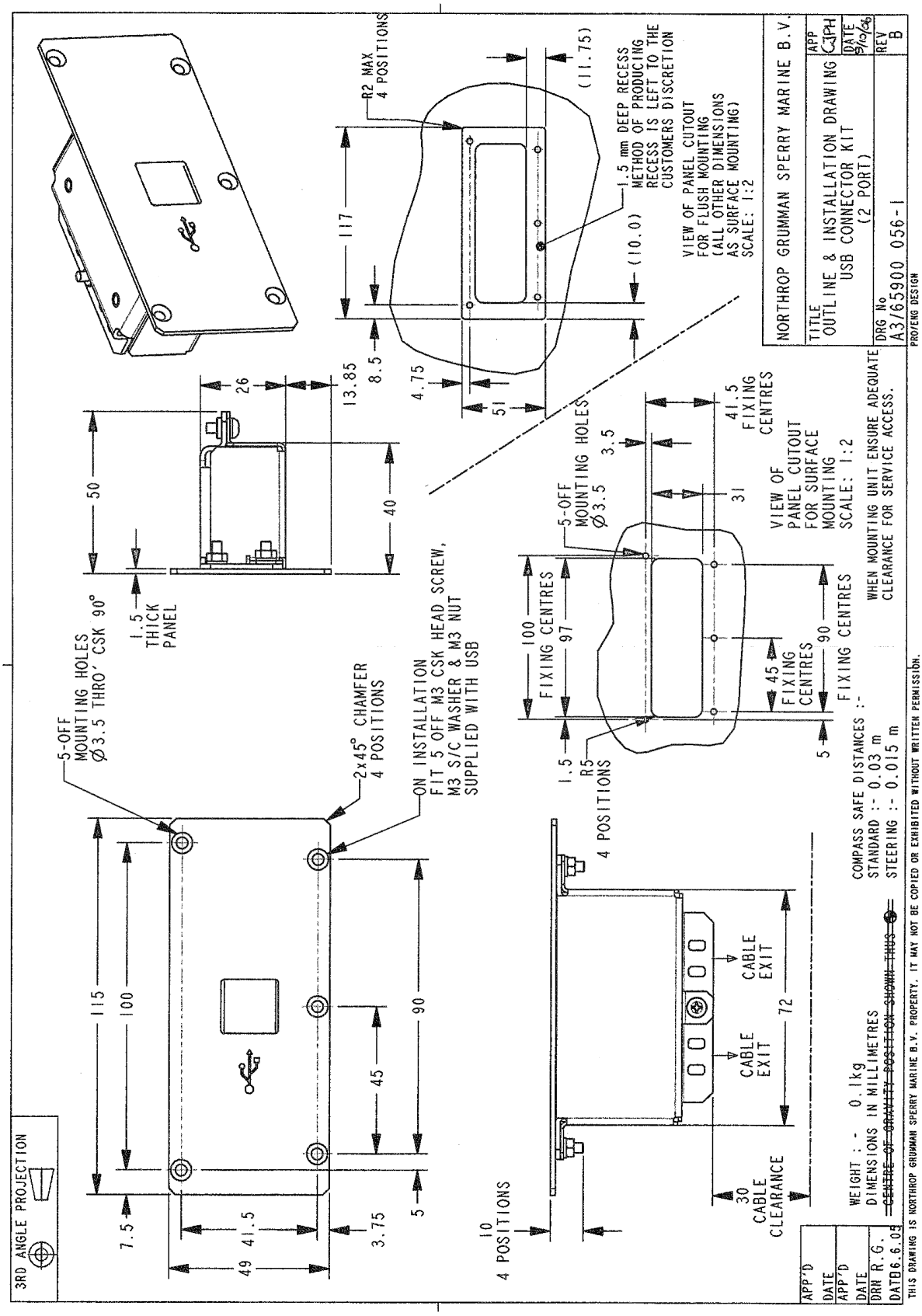


Figure 3.98 USB Connector Kit Outline Drawing

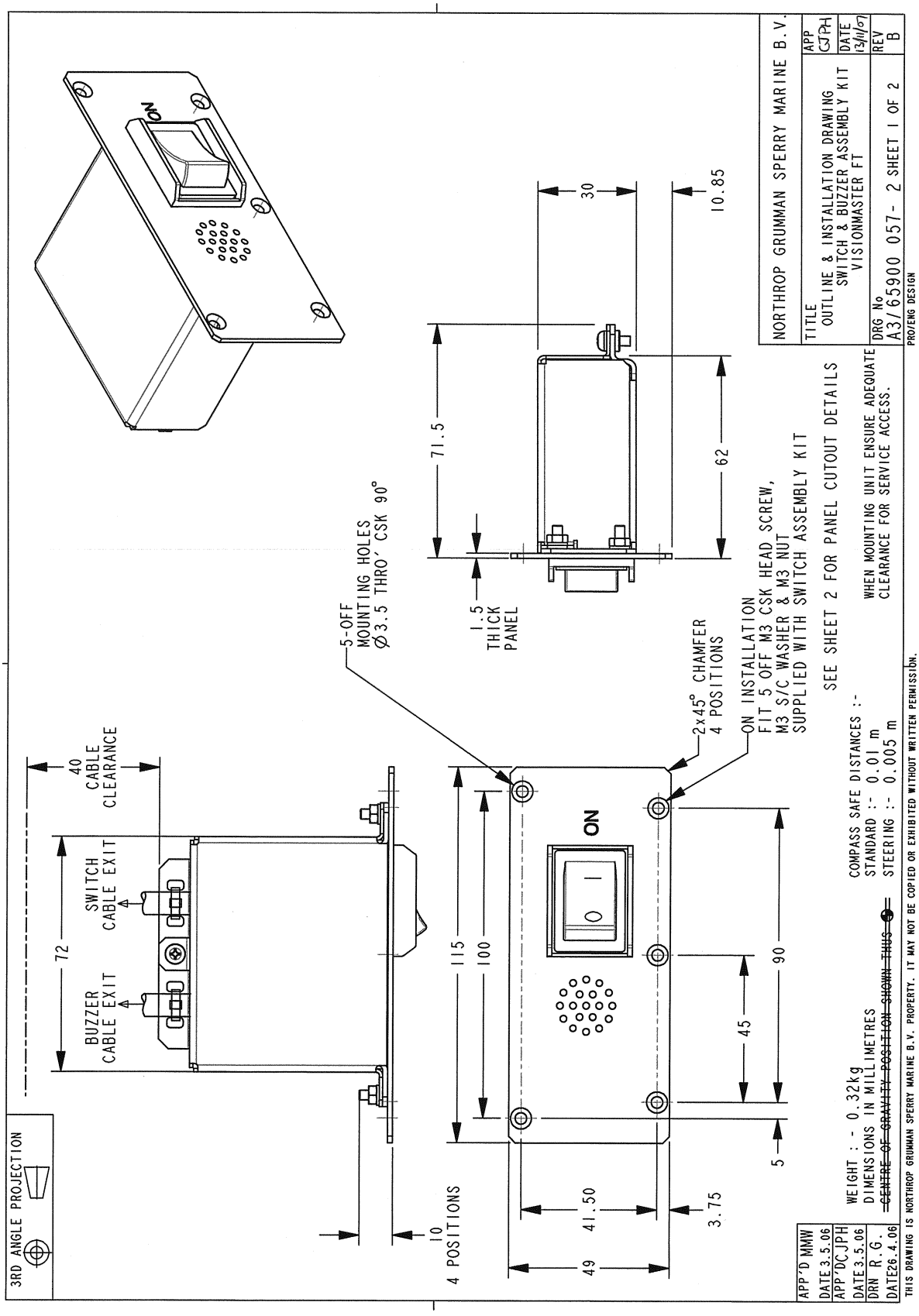


Figure 3.99 On/Off Switch & Buzzer Kit Outline Drawing - Sheet 1

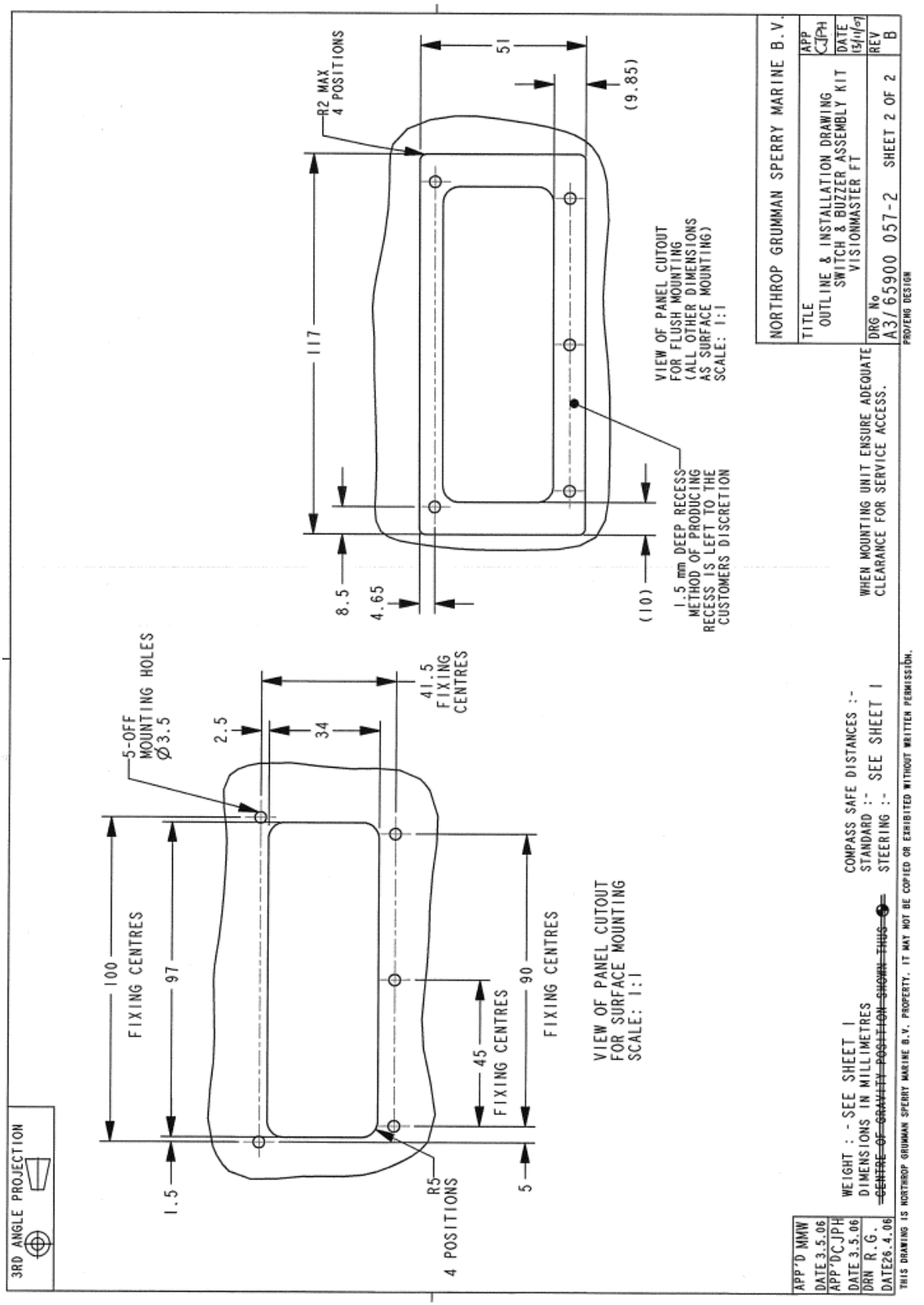


Figure 3.100 On/Off Switch & Buzzer Kit Outline Drawing - Sheet 2

6.9.3 Processor Unit and PC/IO Unit

The Processor Unit and PC/IO unit are secured to removable trays in the pedestal.

To assemble the Processor Unit and PCIO Unit, refer to Section 6.10.7 '*Installing the Processor and PCIO Unit to the Console*'.

For information on the connecting cables between the Processor unit and the I/O unit, see Section 6.10.8 '*Installing Processor and PCIO connector cables*'.

Refer to the following figures for general information on the Processor Unit and I/O Unit.

- Figure 3.101 for an outline drawing of the PCIO Unit
- Figure 3.102 for an outline drawing of the Processor Unit.

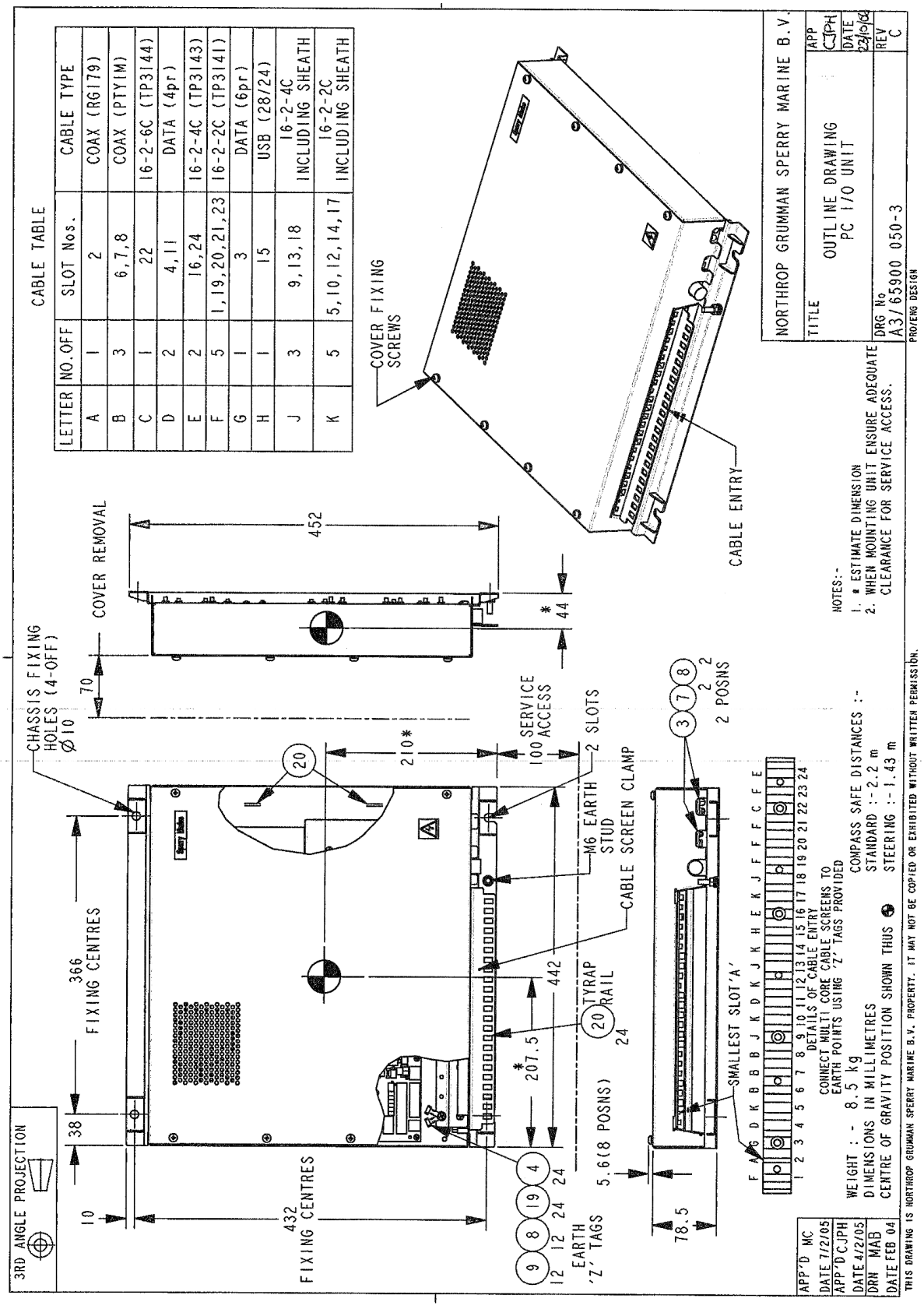


Figure 3.101 PCIO Unit - Outline Drawing

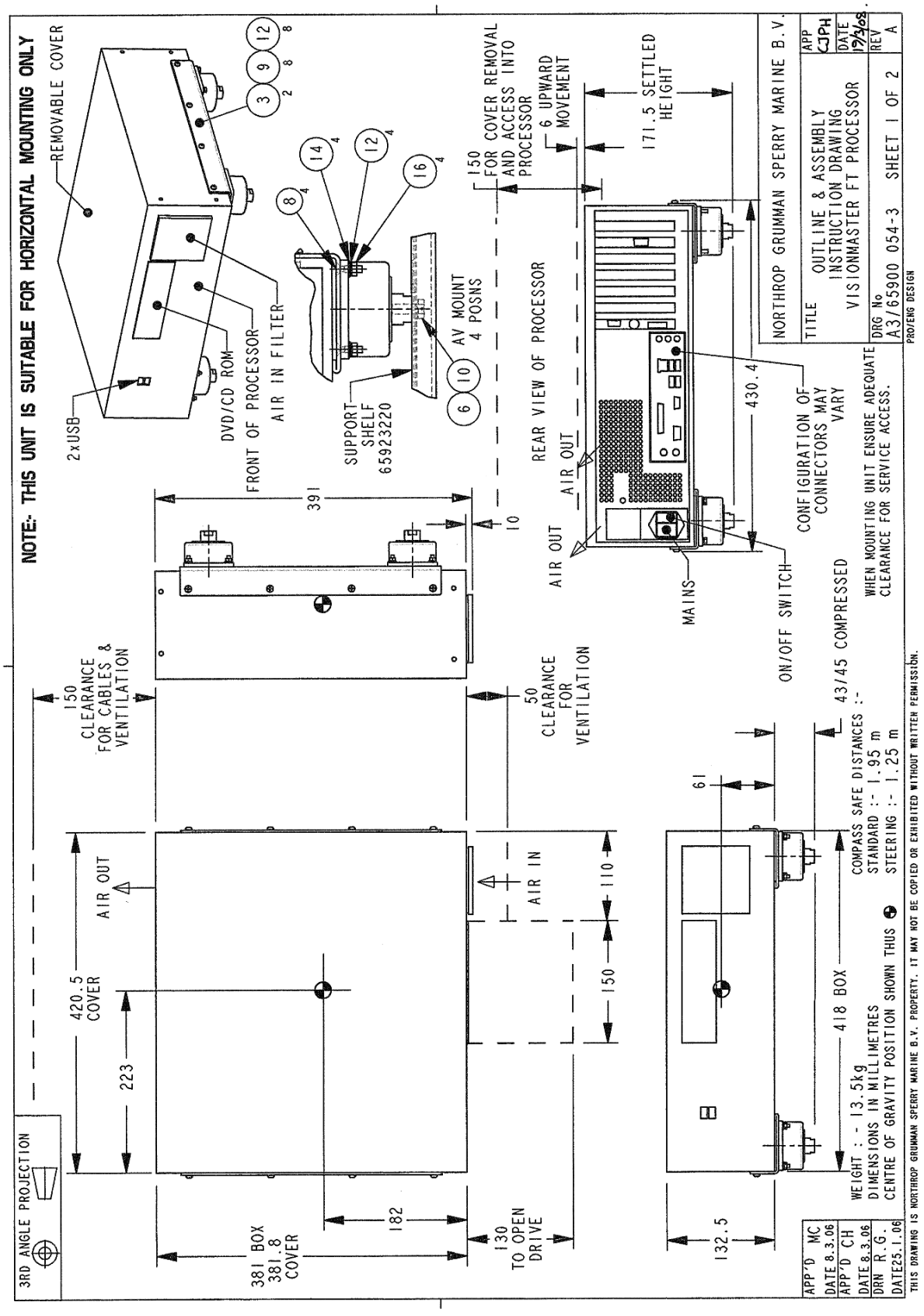


Figure 3.102 Processor Outline Drawing - Sheet 1

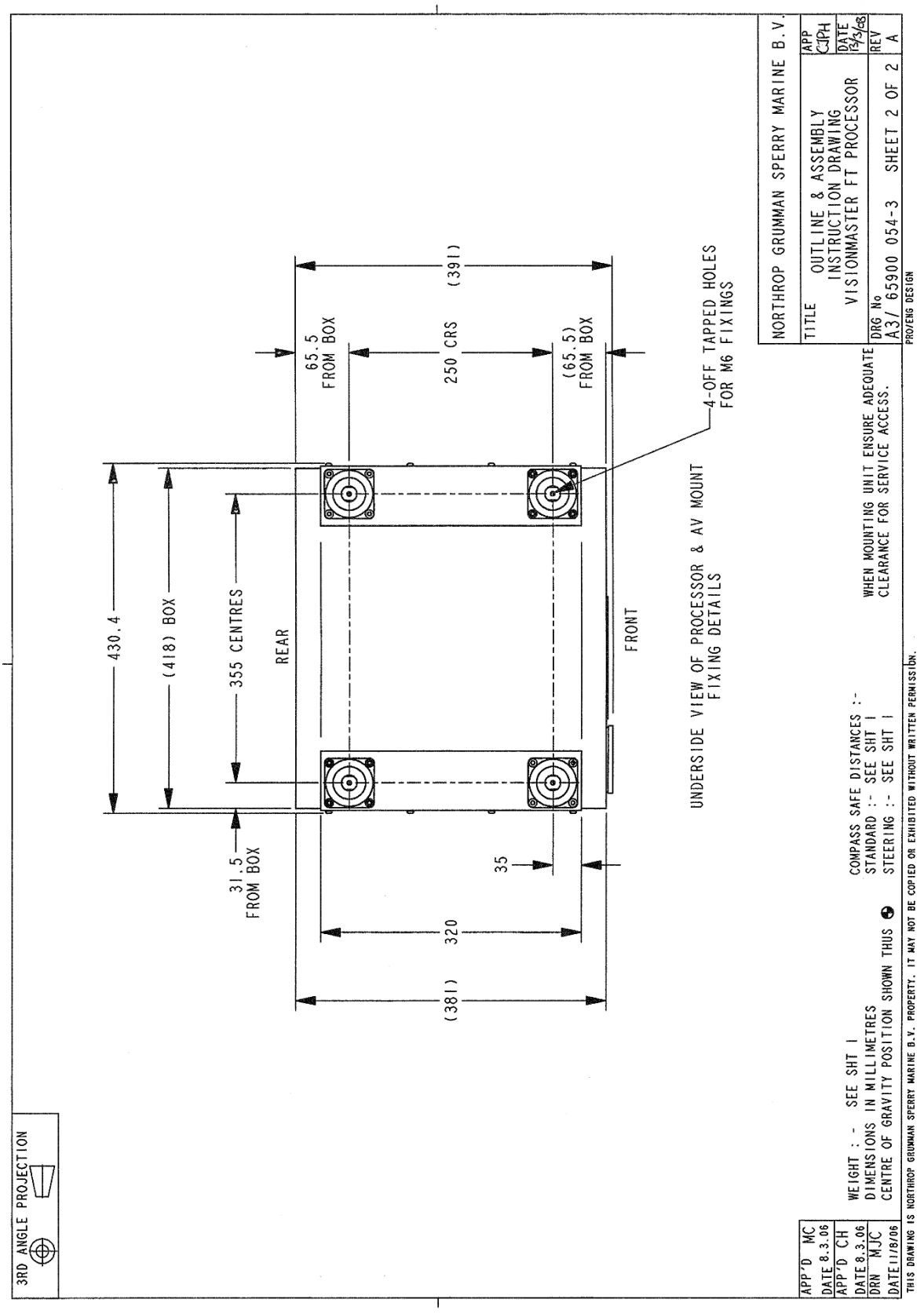


Figure 3.103 Processor Outline Drawing - Sheet 2

6.10 Installing the Console Assembly

6.10.1 Installing a Standalone Pedestal to the Deck

The pedestal assembly is secured to the ship's deck or foundation by four hex head bolts, supplied by the shipyard.

Note: *To enable ease of position it is advisable to install the pedestal to the deck before the control panel and display chassis are attached to the pedestal.*

To assemble a standalone pedestal you will need the following parts, supplied with Despatch Kit 65923 610:

- four M16 hex head steel bolts, A2 or A4-70 (length to suit foundation/ deck)
- eight M16 plain steel washers (4709322)
- four M16 S/C steel washers (4709241)
- four M16 hex head steel nuts (4411579).

To assemble the pedestal do the following:

1. Drill four 19mm holes in the foundation /deck to the dimensions shown in the plan view of Figure 3.84.
2. Undo the two captive screws at the top of the front cover panel and remover the front cover.
3. Remove the five screws attaching the rear cover to the pedestal and remove the rear cover.
4. Remove the four screws attaching the lower cable support shelf to the pedestal (two at the front and two each side) and remove the shelf.
5. Remove 'knockout' panels from either the lower side panel (for side cable entry) or lower rear panel (for rear cable entry). Fit grommet strip (MA00010173) to the edges where the panel has been removed.
6. Bolt down the pedestal to the foundation/deck using the bolts, washers and nuts, as shown in Figure 3.104.
7. Refit front cover, rear cover and cable support shelf to pedestal.

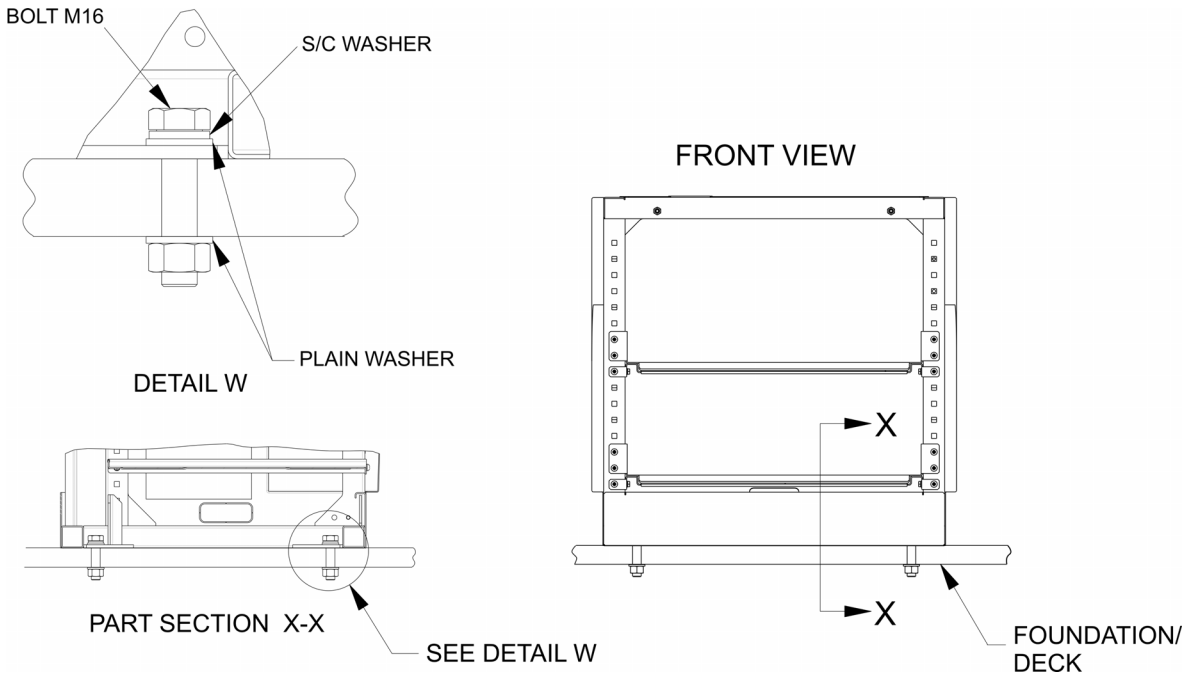


Figure 3.104 Installing a Standalone Pedestal to Foundation/Deck

6.10.1.1 Installing the Control Panel to the Display Chassis

To assemble you will need the following parts, supplied with Despatch Kit 65923 611:

- six M6 x 20 cap head screws (4006267)
- two M6 x 16 cap head screws (4006259)
- eight M6 S/C washers (4709209)
- two shims (65900145)

To assemble the control panel to the display chassis do the following:

1. Attach the control panel to the chassis using six M6 x 20 screws and six S/C washers (three either side). Do not fully tighten the screws.
2. If required, fit shims between arm of control panel and chassis, left and right side.
3. Attach control panel to the bottom of the chassis using two M6 x 16 screws and M6 S/C washers.
4. Fully tighten all eight screws.

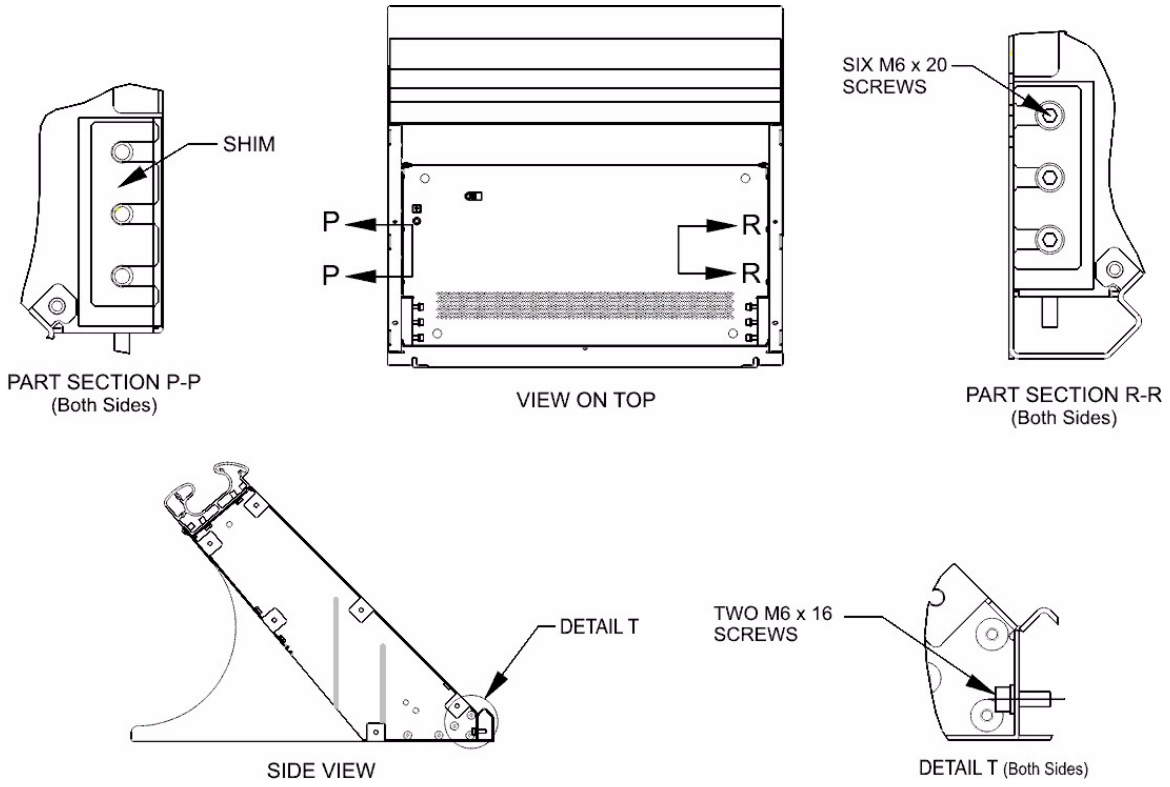


Figure 3.105 Installing Control Panel to Display Chassis

6.10.1.2 Installing the Control Panel/Display Chassis to the Pedestal

To assemble you will need the following parts, supplied with Despatch Kit 65923 609:

- two M6 studs (65900 131)
- six sliding washers (65900 137)
- four M8 studs (65900 130)
- six 'O' rings (MA00015271)
- six isolator assemblies (65900 640)
- twelve M6 x 12 cap head screws (4012690)
- twelve M6 S/C washers (4709209)
- twelve M6 retaining washers (MA00006650)

To assemble the Control Panel/Display Chassis to the Pedestal do the following:

1. Fit two M6 studs to the underside of rear cover chassis, remove backing from sliding washers and affix around studs.
2. Fit four M8 studs to pedestal frame, remove backing from sliding washers and affix around studs.
3. Fit four 'O' rings to the four M8 studs.
4. Place the control panel/chassis assembly onto the M8 pedestal studs and ensure that the two rear cover chassis M6 studs fit in the corresponding pedestal holes.
5. From the chassis side attach four isolator assemblies to the four M8 studs. Do not fully tighten the isolators.
6. Fit two 'O' rings to the two isolators, from the underside of the pedestal attach the two isolator assemblies to the chassis studs.
7. Fully tighten all six isolator assemblies.

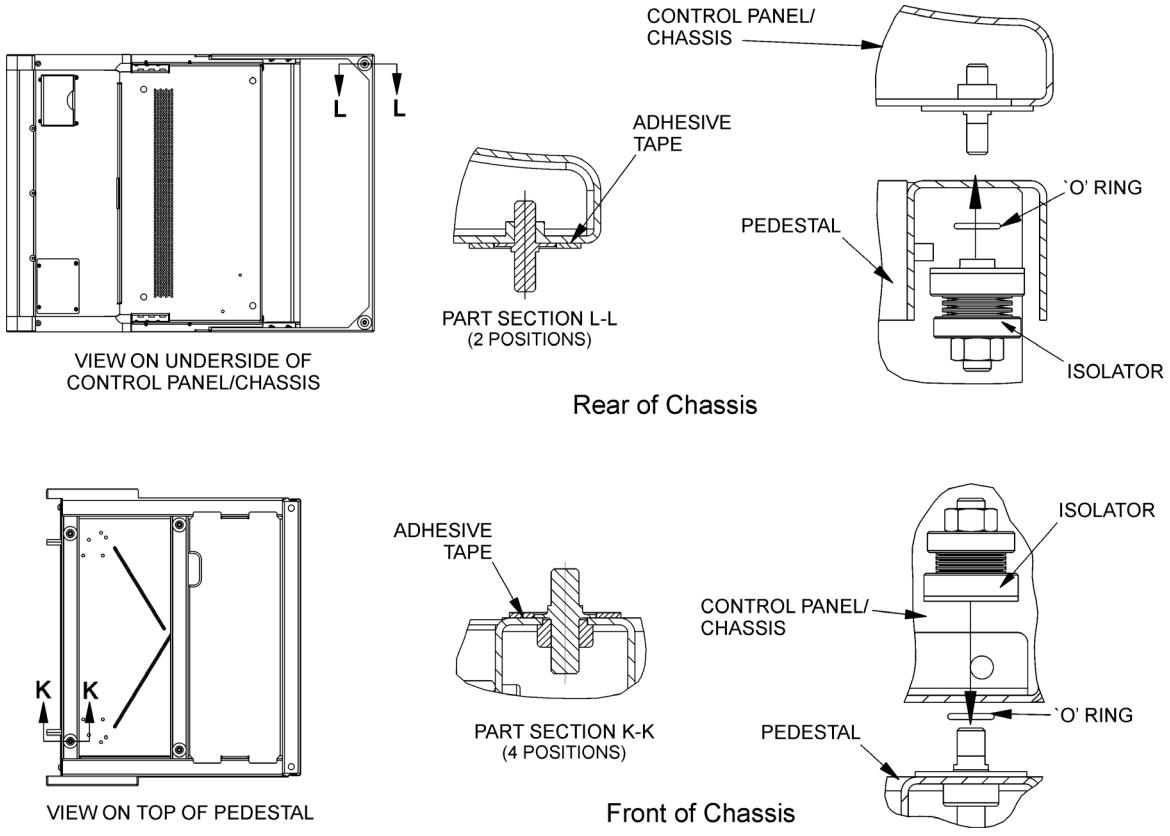


Figure 3.106 Installing Control Panel and Display Chassis to Pedestal

6.10.2 Installing a Pedestal Assembly to a Console Suite

The pedestal assembly is secured to the ship's deck or foundation by four hex head bolts, supplied by the shipyard.

To assemble a pedestal to the ship's deck or foundation you will need the following parts, supplied with Despatch Kit 65923 609:

- four M16 hex head steel bolts, A2 or A4-70 (length to suit foundation/ deck)
- eight M16 plain steel washers (4709322)
- four M16 S/C steel washers (4709241)
- four M16 hex head steel nuts (4411579)

To assemble a pedestal assembly to an existing console suite you will need the following parts, supplied with Despatch Kit 65923 610:

- ten hex head M8 x 16 screws (3610462)
- one hex head M8 x 75 screw (3610594)
- four csk M4 x 16 thread forming screws (4080416)
- two hex head M6 x 12 screws (4009088)
- thirteen M8 single coil washers (4709217)
- two M6 single coil washers (4709209)
- seven M8 nuts (4411544)
- one spacer - handrail (65923120)
- two hex spacers (MA00014787)
- four M8 spacers (65900138)
- two M6 spacers (65900139)

To fit the pedestal to the ship's deck, do the following:

1. Drill four 19mm holes in the foundation /deck to the dimensions shown in the plan view of Figure 3.84.
2. Undo the two captive screws at the top of the front cover panel and remover the front cover.
3. Remove the five screws attaching the rear cover to the pedestal and remove the rear cover.
4. From the front of the pedestal remove the four screws attaching the shelf to the pedestal and remove the shelf.
5. Bolt down the pedestal to the foundation/deck using the bolts, washers and nuts, as shown in Figure 3.107.

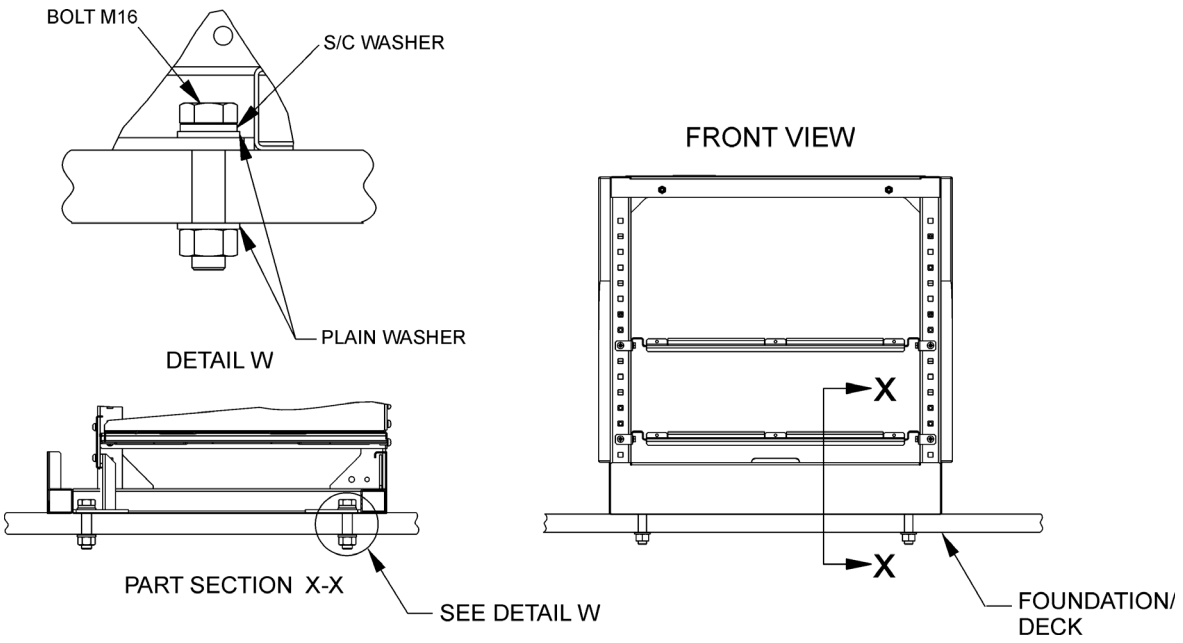


Figure 3.107 Installing a Console Suite Pedestal to Foundation/Deck

To fit the pedestal to an existing console suite do the following:

1. Using the four M8 x 16 screws, washers and nuts attach each side of the pedestal to the adjoining pedestal as shown in Figure 3.108.
2. Repeat step 1 for each additional pedestal added to the console suite.

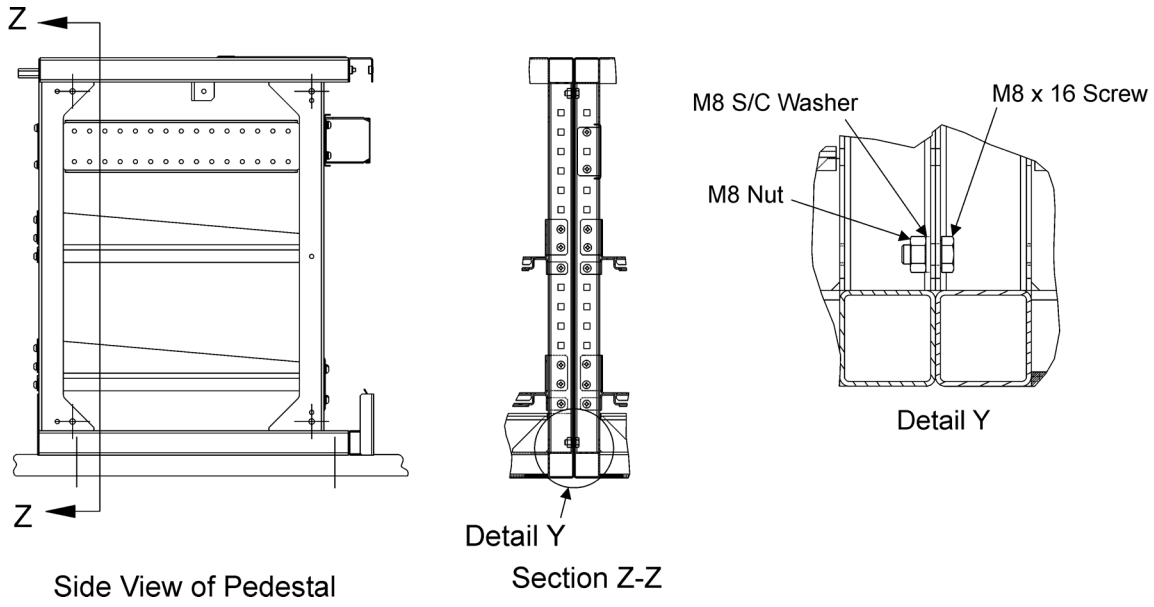


Figure 3.108 Attaching the pedestal to the existing consoles

6.10.2.1 Preparing the Control Panel for installation into a Console Suite

Before fixing the control panel assembly to the display chassis do the following:

1. Drill a 9mm diameter hole through the 1mm diameter front pilot hole on both sides of the control panel casting, see Figure 3.109.

Note: *Do NOT drill a hole in the final left hand or right hand end control panel of the console suite.*

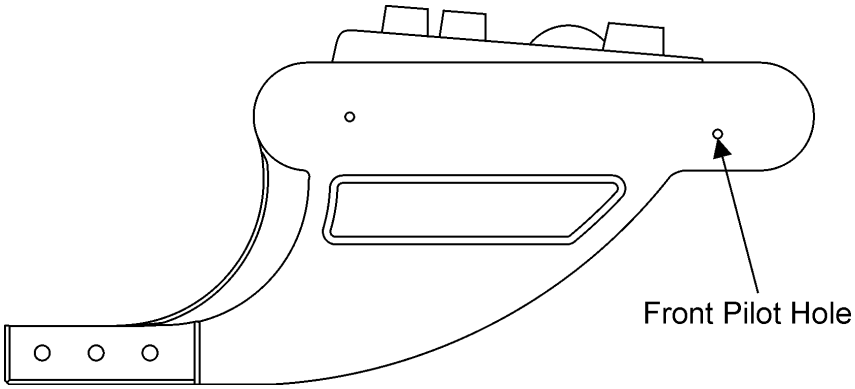


Figure 3.109 Front Pilot Hole on side of Control Panel

For information on fitting the Control Panel assembly to the console chassis, see Section 6.10.1.1 '*Installing the Control Panel to the Display Chassis*'.

6.10.2.2 Fitting Spacers to the Display Chassis

With reference to Figure 3.110 below, attach the display chassis/control panel assembly to the pedestal using the spacers and fixings.

1. To fill the gap between each chassis handrail fit the handrail spacer (65923120) to the right hand side of the display chassis using the four M4 x 16 csk screws.
2. Attach the two M8 hex spacers (MA00014787) to the right side of display chassis using M8 S/C washers and M8 nuts. Fully tighten nuts.

Note: *Do NOT fit the handrail spacer or the M8 hex spacers to the final right hand end display chassis.*

3. From the top of the display chassis fit the four M8 spacers (65900138) using M8 x 16 screws and M8 S/C washers.
4. From underneath the pedestal at the display rear attach the two M6 spacers (65900139) using M6 x 12 screws and M6 S/C washers.

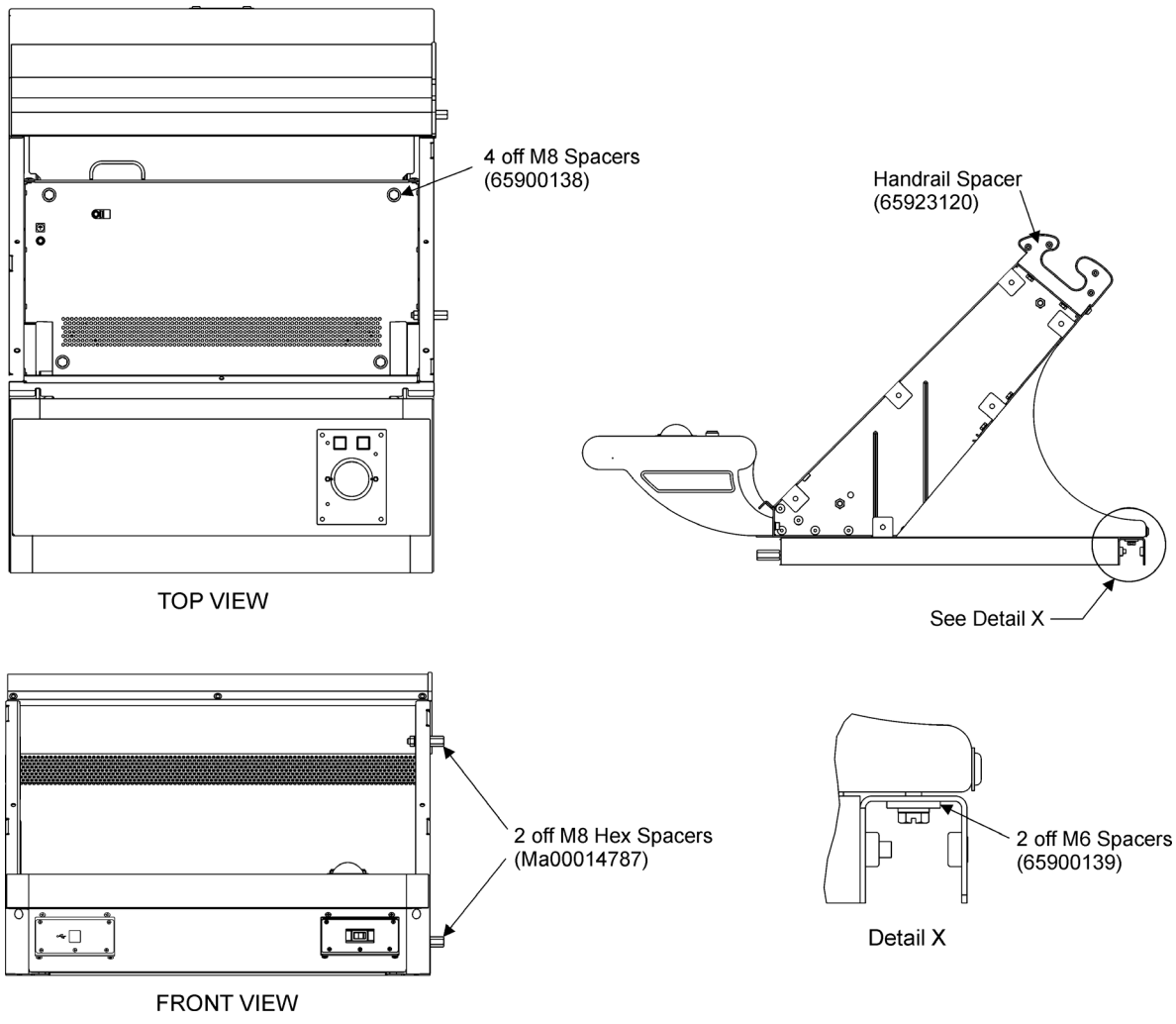


Figure 3.110 Location of Spacers on Display Chassis Assembly

6.10.2.3 Attaching Console Assemblies together

With reference to Figure 3.111, attach the control panel assemblies and display chassis assemblies together as described below:

1. Attach each control panel assembly together using one M8 x 75 bolt (3610594), M8 S/C washer and M8 nut, inserted through the 9 mm hole in the side of the control panel.
2. Attach each display chassis assembly together using two M8 x 16 hex head screws (3610462) and M8 S/C washers. See Figure 3.84 for location of the two holes in side of display chassis.

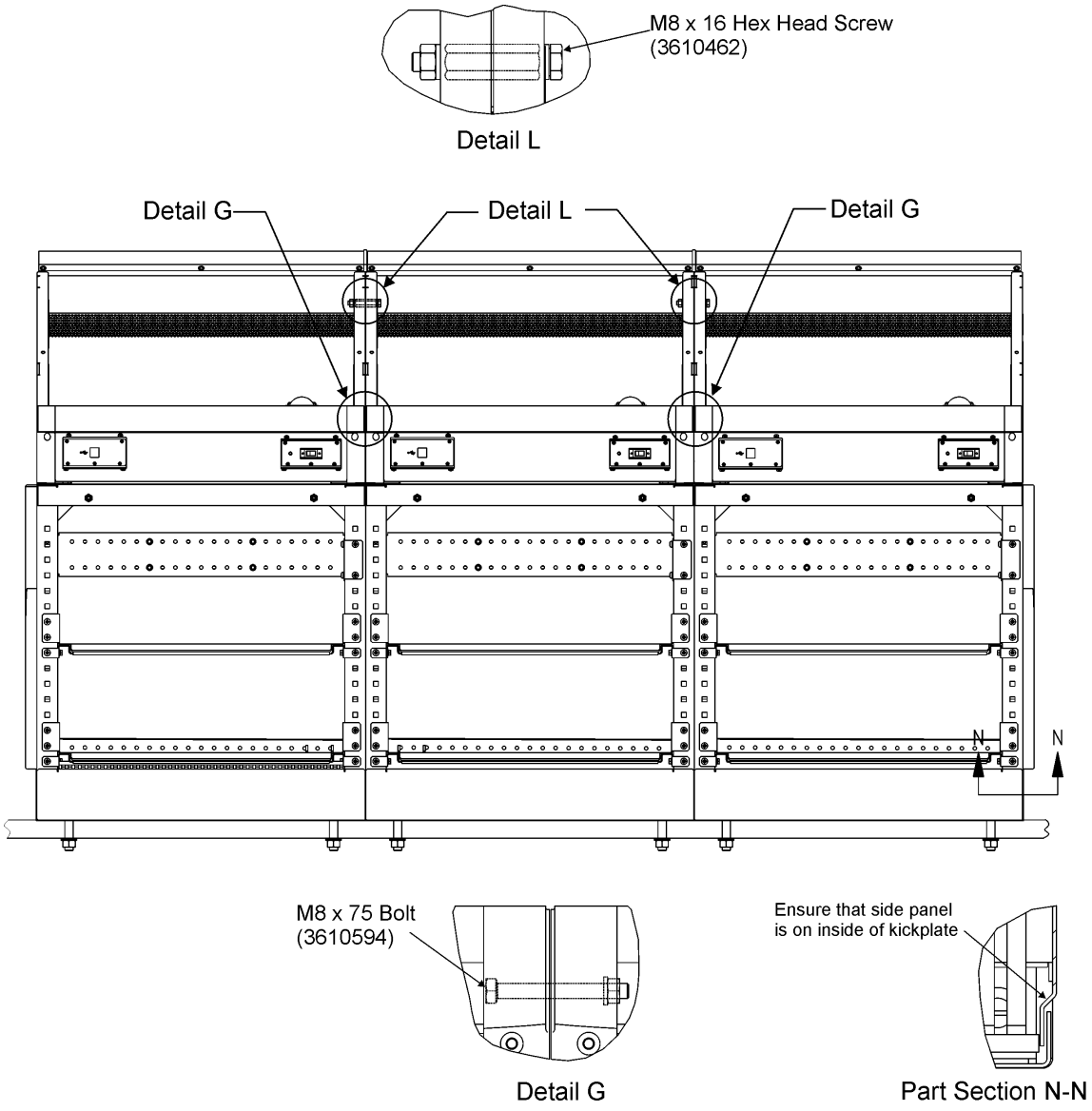


Figure 3.111 Attaching Console Assemblies together

6.10.3 Installing the Cable Tray and Mounting Plates

The cable mounting plates are attached to the pedestal framework and can fitted at any convenient height and on either side of the framework. The data cable tray is attached to the top rear mounting plate and pedestal framework.

To assemble the mounting plates and data cable tray you will need the following parts, supplied with Despatch Kit 65923 681 (for cable tray) and Despatch Kit 65923 682 (mounting plate):

- twelve M6 x 16 pan head screws (4012704)
- twelve M6 single coil washers (4709209)
- four M6 plain washers (4709284)
- four M6 nuts (4411536)
- twelve M6 cage nuts (MA00014738)

With reference to Figure 3.112, attach the rear mounting plate, side mounting plate and cable tray to the required position as described below:

1. Attach the lower mounting plate and side mounting plate using four M6 x 16 screws, single coil washers and cage nuts.
2. Remove the lid from the cable tray and attach each end of the tray to the upper mounting plate and pedestal framework using four M6 x 16 screws, single coil washers and cage nuts.
3. Secure the cable tray to the upper mounting plate using four M6 x 16 screws, plain washers and M6 nuts.
4. Re-install the cable tray lid.

Additional mounting plates and/or cable trays can be fixed to the pedestal by using the fixings supplied in despatch kits 65923 681 (cable tray) and 65923 682 (mounting plates).

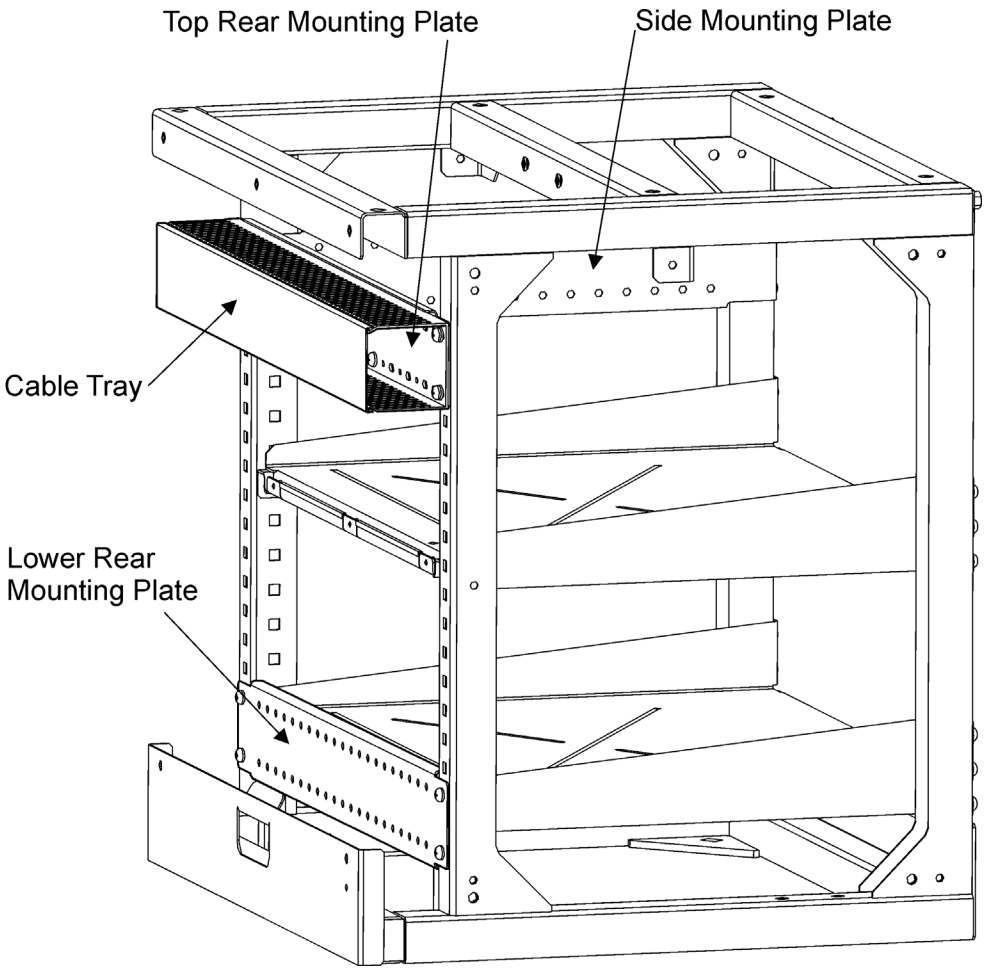


Figure 3.112 Mounting Plates and Cable Tray Location

6.10.4 Attaching Side Panels and Side Cheeks

The left hand and right hand side cheeks (65923110 and 111) are attached to each side of the console, or each end of a console suite.

The left hand and right hand side panels (65923197 and 198) are attached to to each side of the pedestal, or each end of a console suite.

To assemble the side panels you will need the following parts, supplied with Despatch Kit 65923 683:

- twelve (six each side) M6 grounding washers (MA00016477)
- twelve (six each side) M6 nuts (4411536)

To assemble the side cheeks you will need the following parts, supplied with Despatch Kit 65923 683:

- twelve (six each side) M6 x 12 pan head screws (4012690)
- twelve (six each side) M6 single coil washers (4709209)
- twelve (six each side) M6 retaining washer (MA00006650)

6.10.4.1 Attaching the Side Panels

1. Insert the six threaded studs attached to each side panel through the corresponding holes on the pedestal framework.
2. From inside the pedestal assembly place the six grounding washers over the side panel bolts, ensuring the cutting edges of the washers are against the pedestal framework.
3. Attach the M6 nuts to the side panel studs and secure each panel by fully tightening the nuts.

6.10.4.2 Attaching the Side Cheeks

1. Position the left hand and right hand side cheeks on each end of the display chassis.
2. From the access holes of the display chassis (see Figure 3.113) attach the side cheeks using the M6 screws, S/C washers and retaining washers, six positions each side. Fully tighten the screws gradually in rotation.

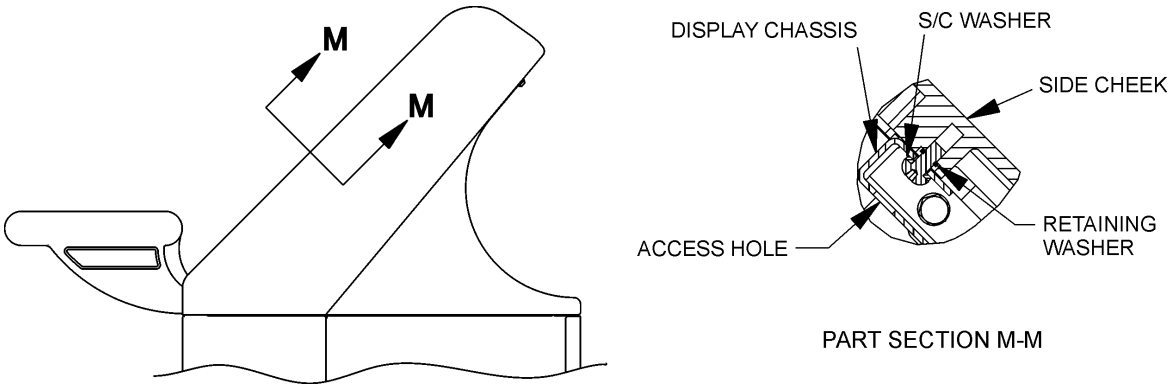


Figure 3.113 Installing side cheeks to console chassis

6.10.5 Installing the Monitor to the Display Chassis

To assemble you will need the following parts, supplied with Despatch Kit 65923 608:

- two M8 x 40 hex head screws (4008553)
- four M6 x 20 cap head screws (65923125)

To fit the Monitor to the display chassis do the following:

1. Attach the two M8 screws to the upper set of holes in the monitor and use these to lower the monitor into the chassis aperture, allowing the lower edge of the monitor to sit along the chassis.
2. When the monitor is correctly positioned in the chassis remove the M8 screws, which can then be discarded or retained for service applications.
3. Attach the Monitor to the chassis using the four M6 screws. Fully tighten the screws.
4. Fit cables to the Monitor as shown in Table 12 below.
5. Tywrap cables together and clip through the cable restraint attached to chassis.

Table 12: Cable Installation

Part No.	Description	From	To
65823512	Cable assy. - Video	Video In (monitor)	Processor unit
65900531	Cable assy. - Earth	Earth Tag (monitor chassis)	Earth Tag (pedestal)
65900532	Cable assy. - Earth	Earth Tag (monitor Chassis)	Earth Tag (monitor)
Power Cable	Cable - Mains	Mains In (IEC)	PCIO unit

6.10.6 Installing the Display Assembly to a Table Top

To install the Display assembly (with control panel and monitor assembled) you will need the following parts, supplied with Despatch Kit 65923 608:

- four M8 x 40 hex head screws (4008553)
- four M8 Washers (4709217)
- four M8 Nuts (4411544)
- four M8 Spacers (65900138) - for 23.1" display only.
- four Woodscrews (4107624)
- M6 Washers (4711203).

To prepare a table top do the following:

1. Mark four holes for the M8 screws. Fefer to Figure 3.87 for the 340mm display version, and Figure 3.88 for the 250mm display version for fixing hole dimensions.
2. If the display is to be attached to a wooden top, drill four blind holes to a dimension smaller that the M8 screws.

To fit the Display to the table top do the following:

1. Attach the display using the four M8 screws, nuts and washers. If the display is a 23.1" console suite use the additional M8 spacers.
2. Or, use the four woodscrews and M6 washers, if the Display is to be attached to a wooden table top.

6.10.7 Installing the Processor and PCIO Unit to the Console

To assemble the Processor unit you will need the following parts, supplied with Despatch Kit 65900 637:

- four AV mounts (MA00018036)
- four M6 x 16 Hex head slotted screws (4009053)
- four M6 S/C washers (4709209)
- sixteen M4 x 16 Csk screws (4013026)
- sixteen M4 plain washers (4707699)
- sixteen M4 SC washers (4709187)
- sixteen M4 nuts (4410149).

To assemble the PCIO unit you will need the following parts, supplied with Despatch Kit 65900 600:

- four M8 x 16 Hex head bolts (3610462)
- four M8 S/C washers (4709217)
- two M8 plain washers (4709292)
- four M8 nuts (4411544).

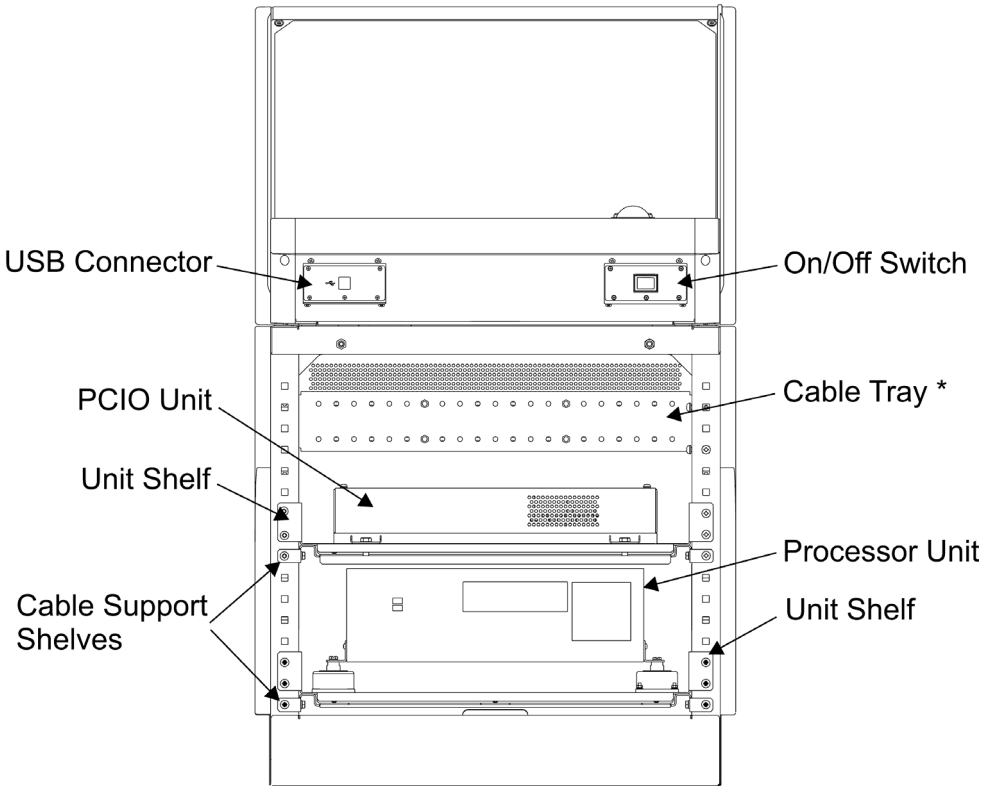


Figure 3.114 Front View of Console showing PC and PCIO Units installed*

* The cable tray assembly is only fitted in the Console suite, see drawing 65923 072 for details.

6.10.7.1 Installing the Processor Unit to the Console

To install the Processor unit into the console assembly do the following:

1. Attach the four AV mounts to the Processor unit shelf using the sixteen M4 screws, M4 SC washers, M4 plain washers and M4 nuts, see Figure 3.102 and Figure 3.103. The AV mount fixing holes are marked on the shelf as 'C', see Figure 3.115.
2. Attach the Processor unit to the AV mounts using the four M6 x 16 screws (4009053) and M6 washers (4709209), as shown in Figure 3.102.
3. Fit the assembled Processor unit and shelf to the pedestal, directly above the lower cable support shelf using the four screws and washers. Ensure the unit shelf rear locators are properly engaged in the cable support shelf.

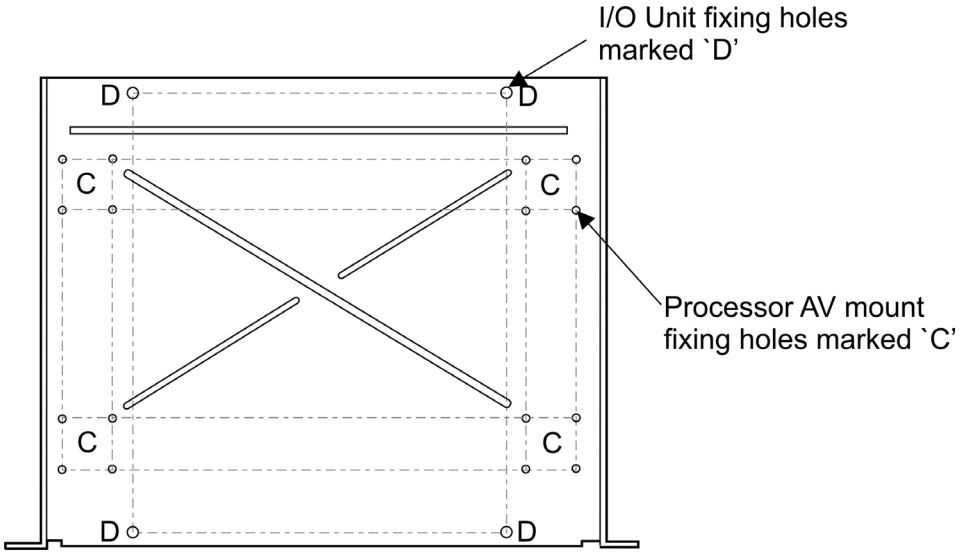


Figure 3.115 Fixing hole positions for Processor and PCIO Unit

6.10.7.2 Installing the PCIO Unit to the Console

To fit the PCIO unit to the console assembly do the following:

1. Attach the PCIO unit to the unit shelf using the four bolts, washers, nuts and two plain washers listed above. The two plain washers are fitted to the PCIO unit's rear attachment brackets. The two front holes for the PCIO unit are marked on the shelf as 'D', see Figure 3.115.
2. Fit the assembled PCIO unit and shelf to the pedestal, directly above the upper cable support shelf using the four screws and washers. Ensure the unit shelf rear locators are properly engaged in the cable support shelf.

6.10.8 Installing Processor and PCIO connector cables

Table 13 below lists description and connection details of all the cables to and from the Processor and PCIO unit.

Cables are tywrapped together and clipped through the cable restraints provided on the console chassis.

Table 13: Cable Installation Details

Part Number	Description	From	To
65823 512	Cable Assy - Video	Monitor	Processor Unit
Power Cable	Cable - Mains	PCIO Unit	Monitor
Power Cable	Cable - Mains	PCIO Unit	Processor Unit
65900 520	Cable Assy - SC	PCIO Unit	Processor Unit
65900 521	Cable Assy - USB	PCIO Unit	Processor Unit
65900 523	Cable Assy - Trackball	Trackerball	Processor (PS2 Input)
65900 528	Brilliance & Buzzer cable	PCIO Unit	Monitor
65900 530	Cable Assembly Earth	Processor Unit	Pedestal Earth
65900 530	Cable Assembly Earth	PCIO Unit	Pedestal Earth
65900 621	Cable Assembly Power Control Switch	Switch	PCIO Unit
65900 624	Cable Assembly USB Connector	USB	Processor Unit (front)

6.10.9 Installing the Termination Assembly

The installation of the termination assembly is an optional requirement.

To assemble the termination assembly to the pedestal framework you will need the following:

- four M6 x 16 pan head screws (4012704)
- four M6 single coil washers (4709209)
- four M6 cage nuts (MA00014738)

To install the termination assembly to the pedestal framework do the following:

1. Remove any mounting plate and/or cable tray that may have been previously installed in the required position.
2. Using the four M6 screws, washers and nuts, attach the termination assembly to the rear of the framework at a convenient height. It is recommended to fit the assembly as high up the pedestal framework as possible.

6.10.10 Installing cables from the Termination Assembly to the PCIO

The following three cable types are used for connection between the Termination assembly and the PCIO unit:

- part number 3218376 (16-2-2C)
- part number 3209342 (16-2-4C)
- part number 3211274 (16-2-6C)

The table below lists cable type, signal and connection details of external cables from the termination block to the PCIO unit.

Table 14: Cable connections in Termination Block and PCIO

Termination Block			PCIO Unit			
No.	**Cable Type**	**Colour**	**Slot**	**Connector**		**Signal**
1	16-2-2C	Red	5	TSCA (Input)*	1	Serial Compass - COM 3 (38400)
2		Blue			2	
3		Screen			3	
4	16-2-4C	Red	9 *	TSCB (Input)	1	AIS - COM 5 (38400)
5		Blue			2	
6		Green		TSCN (Output)	1	
7		Yellow			2	
8		Screen		TSCB	3	
9	16-2-2C	Red	10	TSCG (Input)	1	Comms - COM 7 (4800)
10		Blue			2	
11		Screen		See Footnote†		
12	16-2-2C	Red	12	TSCR (Output)	1	Comms - COM 7 (4800)
13		Blue			2	
14		Screen		See Footnote†		
15	16-2-4C	Red	13 *	TSCC (Input)	1	Comms - COM 7 (38400, I/O)
16		Blue			2	
17		Green		TSCP (Output)	1	
18		Yellow			2	
19		Screen		TSCC	3	
20	16-2-2C	Red	14	TSCD (Input)	1	Comms - COM 3 (4800)
21		Blue			2	
22		Screen		See Footnote†		
23	16-2-4C	Red	18	TSCJ (Input)	1	Comms - COM 9 (4800, I/O)
24		Blue			2	
25		Green		TSCT (Output)	1	
26		Yellow			2	
27		Screen		See Footnote†		
28	16-2-2C	Red	19	TSL	1	Pulse Log
29		Blue			2	
30		Screen		See Footnote‡		
31	16-2-2C	Red	20	TSR	1	Relay Output
32		Blue			2	
33		Screen		See Footnote‡		
34	16-2-2C	Red	21	TSR	1	Relay Output
35		Blue			2	
36		Screen		See Footnote‡		

37	16-2-6C	Red	22	TSC (type dependant)		Analogue compass
38		Blue				
39		Green				
40		Yellow				
41		White				
42		Black				
43		Screen		See Footnote‡		
44	16-2-2C	Red	17	TSCE (Input)	1	
45		Blue			2	
46		Screen		See Footnote†		
47	16-2-4C	Red	16	TSR	7	Relay Output (and Digital output)
48		Blue			9	
49		Green		(TSD)		
50		Yellow				
51		Screen		See Footnote‡		

L	16-2-2C	Red	Cable Clamp	TSA	1	
N		Blue			2	
E		Screen	**	E5		

*. Clamp over outer sheath.
†. Clamp over outer sheath, strip braid away with outer sheath as required.
‡. Clamp braid and connect ring terminal, screw to plate.
**. Connect braid to ring terminal.

Secure cables to the termination assembly using the ty-raps (MA00009928).

6.11 Crimping co-axial cables

The co-axial cables must be prepared for insertion into BNC connectors as described below.

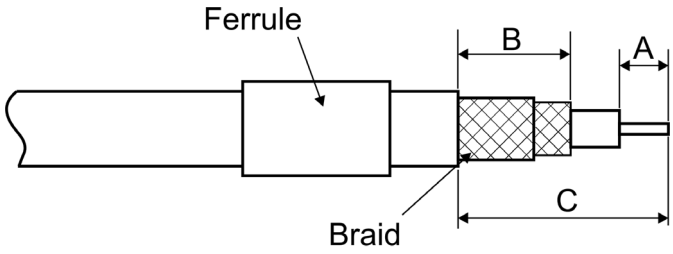
Tools Required

You will need a crimping tool (MA00018119).

Procedure

Prepare the cable end as follows:

1. Slide the ferrule onto the cable and strip away the outer cable cover to dimension C as shown in Figure 3.116.
2. Where the cable is double screened strip back the outer braid, remove the clear mylar sheath separating the outer and inner braids and strip back the inner braid and inner dielectric to the lengths shown in Figure 3.116.



A = 4mm (0.157inch)
B = 8.5mm (0.335inch)
C = 15mm (0.591inch)

Figure 3.116 Preparing Cable End

3. Slide centre contact onto inner copper wire until the contact bottoms against cable dielectric. Crimp centre contact using crimping tool.

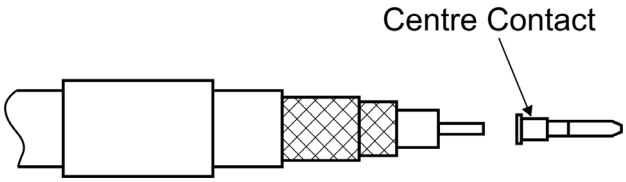


Figure 3.117 Inserting Centre Contact

4. Fan braids out and slide cable into connector body until the cable bottoms against insulator. Slide ferrule over braids in the direction shown in Figure 3.118.

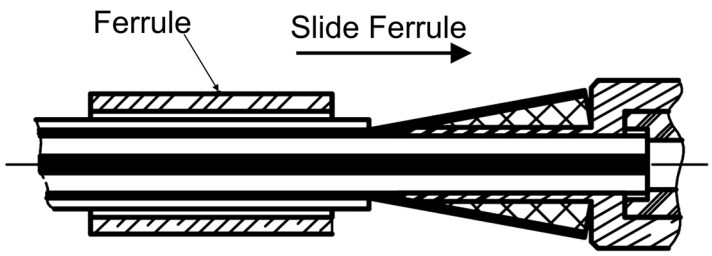


Figure 3.118 Inserting Cable into connector body

5. Crimp the ferrule with crimping tool, Cut excess braid if necessary, see Figure 3.119.

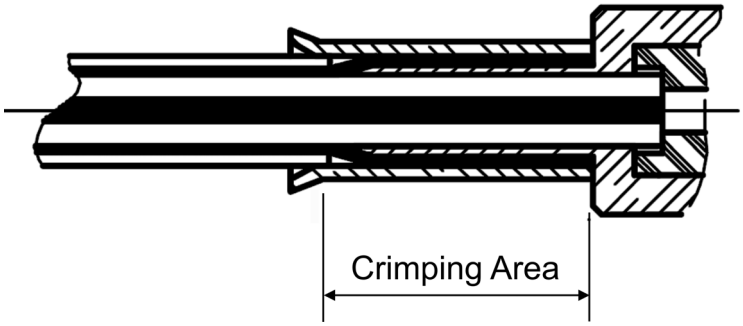


Figure 3.119 Crimping the ferrule

6.12 Authorising the System

Before VisionMaster FT can be run, the USB pre-programmed security block, supplied with each node, must be installed in one of the three USB sockets at the rear of the Processor unit, (the fourth USB socket is used to connect the Processor to the PCIO unit).

All security blocks are labelled with the System PIN, the S63 permit code, the ARCS permit code, and the product type identifier.

The following USB security device part numbers define the product type installed:

- 32SDV 001 ARPA only
- 32SDV 002 ARPA / Chart Radar
- 32SDV 003 ECDIS
- 32SDV 004 ECDIS with Radar Overlay
- 32SDV 005 Multi-Node System
- 32SDV 006 Multi Function Workstation

On a multi-node system, in addition to the security block, a security string is required to be entered in the configuration tool when commissioning the system. See Chapter 4, 'Configuration'.

The Security String contains an encryption of the following data:

- the System PIN
- the number of nodes in the system of each product type (e.g. 2 ARPAs and 1 ECDIS)
- the list of purchasable features that have been purchased.

The ship is provided with paperwork that contains the information that is encrypted into the security string.

6.13 Despatch Kits

To help assemble the equipment, Despatch Kits, including assembly instructions, are sent as shown in the following table:

Table 15: Despatch Kits

Unit	Despatch Kit
Processor and PCIO Kits	
PCIO Unit	65900600
Processor Unit	65900637
Display Kits	
Display Unit	65923608
Deckstand Console	65923609
Modular Console	65923610
Control Panel	65923611
19" Integrated Tabletop	
19" Integrated Tabletop Display	65919607
Pedestal Kits	
Pedestal Shelf	65923680
Cable Tray	65923681
Mounting Plate	65923682
Display Unit Side Panel	65923683
Termination Kit	65923688
S-band Systems	
Turning Unit	65830660
Antenna Unit	65612610
Bulkhead Transceiver	65831660
X-band Systems	
Turning Unit	65801660
Bulkhead Transceiver	65825660

6.14 S-Band and X-Band Installation Kits

6.14.1 S-band

There are three Installation Kits for S-band Bulkhead Transceiver installations:

- 10 metre S-band Coaxial Cable Kit Type 112/MIK/10
- 20 metre S-band Coaxial Cable Kit Type 112/MIK/20
- 30 metre S-band Coaxial Cable Kit Type 112/MIK/30

There are various length installation kits common to all S-band installations:

- 33 metre S-band Cable Kit Type 115/MIK/33
- 67 metre S-band Cable Kit Type 115/MIK/67
- 100 metre S-band Cable Kit Type 115/MIK/100
- 130 metre S-band Cable Kit Type 115/MIK/130
- 150 metre S-band Cable Kit Type 115/MIK/150
- 180 metre S-band Cable Kit Type 115/MIK/180

6.14.2 X-Band

There are three installation kits for X-band Bulkhead Transceiver installations:

- 10 metre X-band Waveguide Kit Type 116/MIK/10
- 20 metre X-band Waveguide Kit Type 116/MIK/20
- 30 metre X-band Waveguide Kit Type 116/MIK/30

There are various length Installation Kits common to all X-band Installations:

- 33 metre X-band Cable Kit Type 119/MIK/33
- 67 metre X-band Cable Kit Type 119/MIK/67
- 100 metre X-band Cable Kit Type 119/MIK/100
- 130 metre X-band Cable Kit Type 119/MIK/130
- 150 metre X-band Cable Kit Type 119/MIK/150
- 180 metre X-band Cable Kit Type 119/MIK/180

6.14.3 Connector Kit for Long Cable Runs

A special connector kit is available for installations where cable lengths of up to 300m require the use of low loss video cable type FSJ4-75.

- Video Connector Kit Type 117/MIK

Most of the above kits can be supplied with LSZH equivalent cables.

7 System Component Interconnections

This section contains information on the interconnection of system components, any setting up that is required and details of all system fuses.

7.1 Cabling and Interconnection Diagrams

The following figures give cabling and interconnection details of the S-Band and X-Band VisionMaster FT systems.

- Figure 3.120 '*Intermodule Cabling*'
- Figure 3.121 '*Cabling Diagram for S-Band Bulkhead Transceiver -Sheet 1*'
- Figure 3.122 '*Interconnection Diagram for S-Band Bulkhead Transceiver - Sheet 2*'
- Figure 3.123 '*Cabling Diagram for S-Band Masthead Transceiver -Sheet 1*'
- Figure 3.124 '*Interconnection Diagram for S-Band Masthead Transceiver - Sheet 2*'
- Figure 3.125 '*Cabling Diagram for X-Band Bulkhead Transceiver -Sheet 1*'
- Figure 3.126 '*Interconnection Diagram for X-Band Bulkhead Transceiver - Sheet 2*'
- Figure 3.127 '*Cabling Diagram for X-Band Masthead Transceiver -Sheet 1*'
- Figure 3.128 '*Interconnection Diagram for X-Band Masthead Transceiver - Sheet 2*'
- Figure 3.129 '*PCIO Connections*'
- Figure 3.130 '*Interswitch Cabling Diagram*'

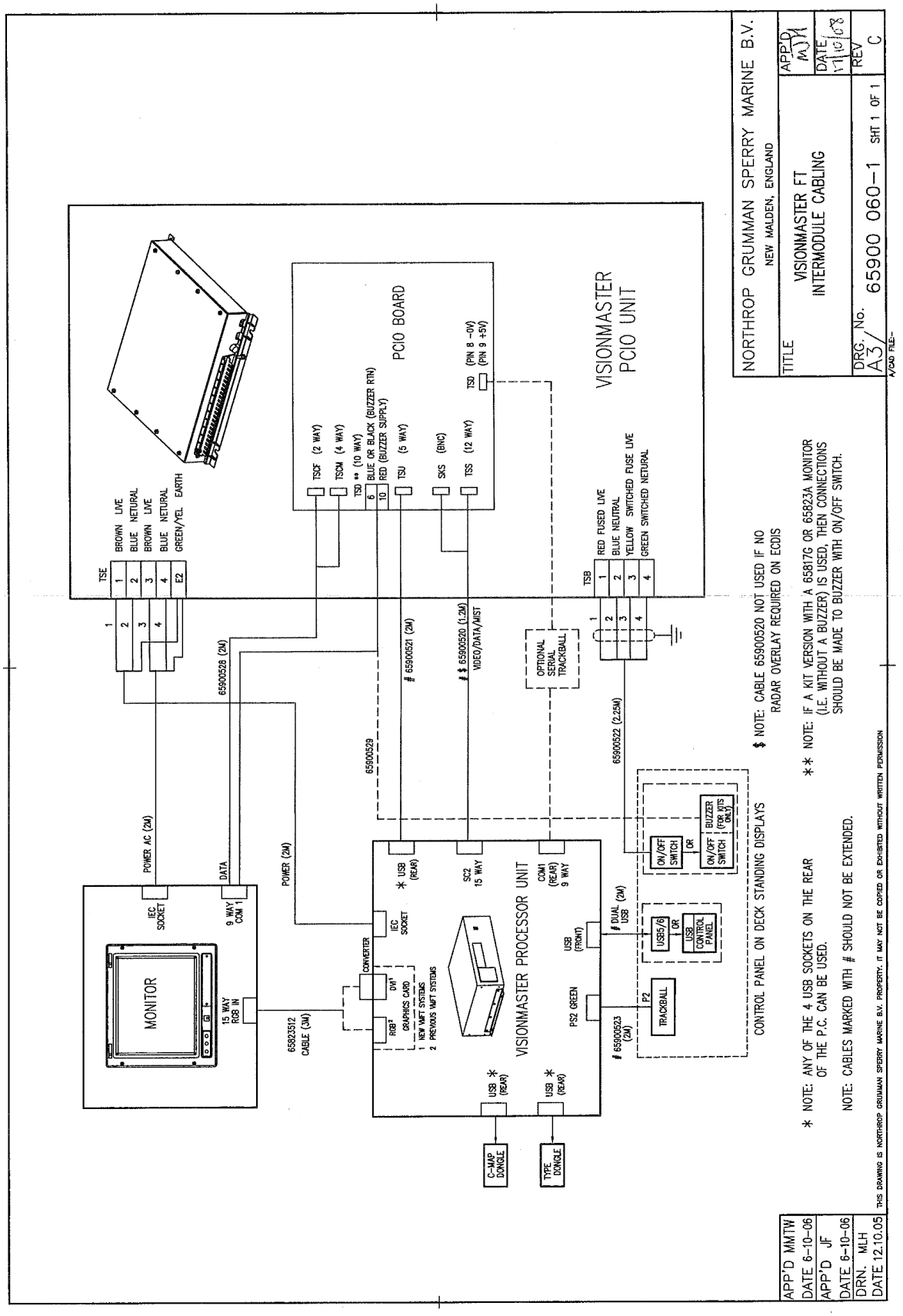


Figure 3.120 Intermodule Cabling

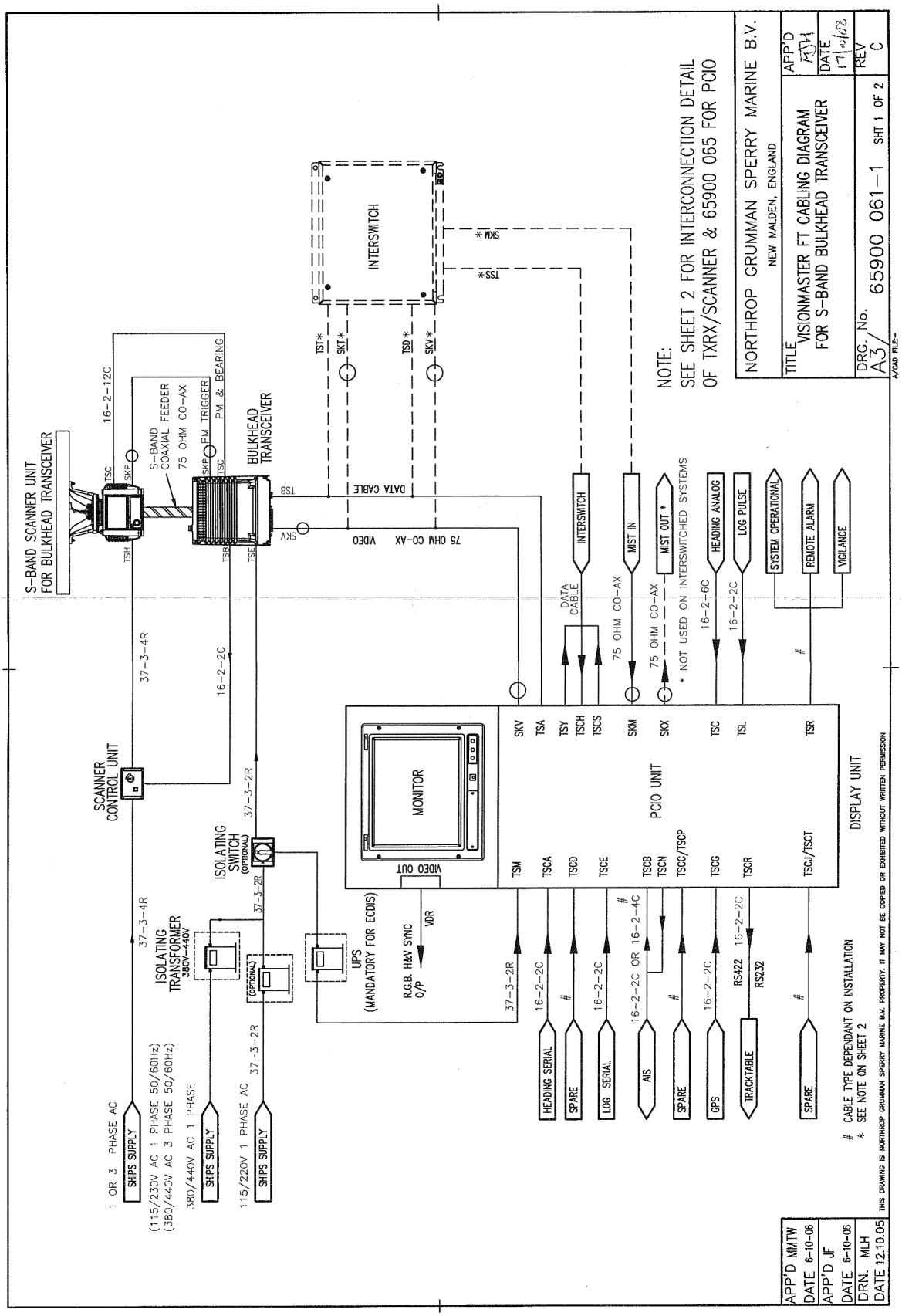


Figure 3.121 Cabling Diagram for S-Band Bulkhead Transceiver -Sheet 1

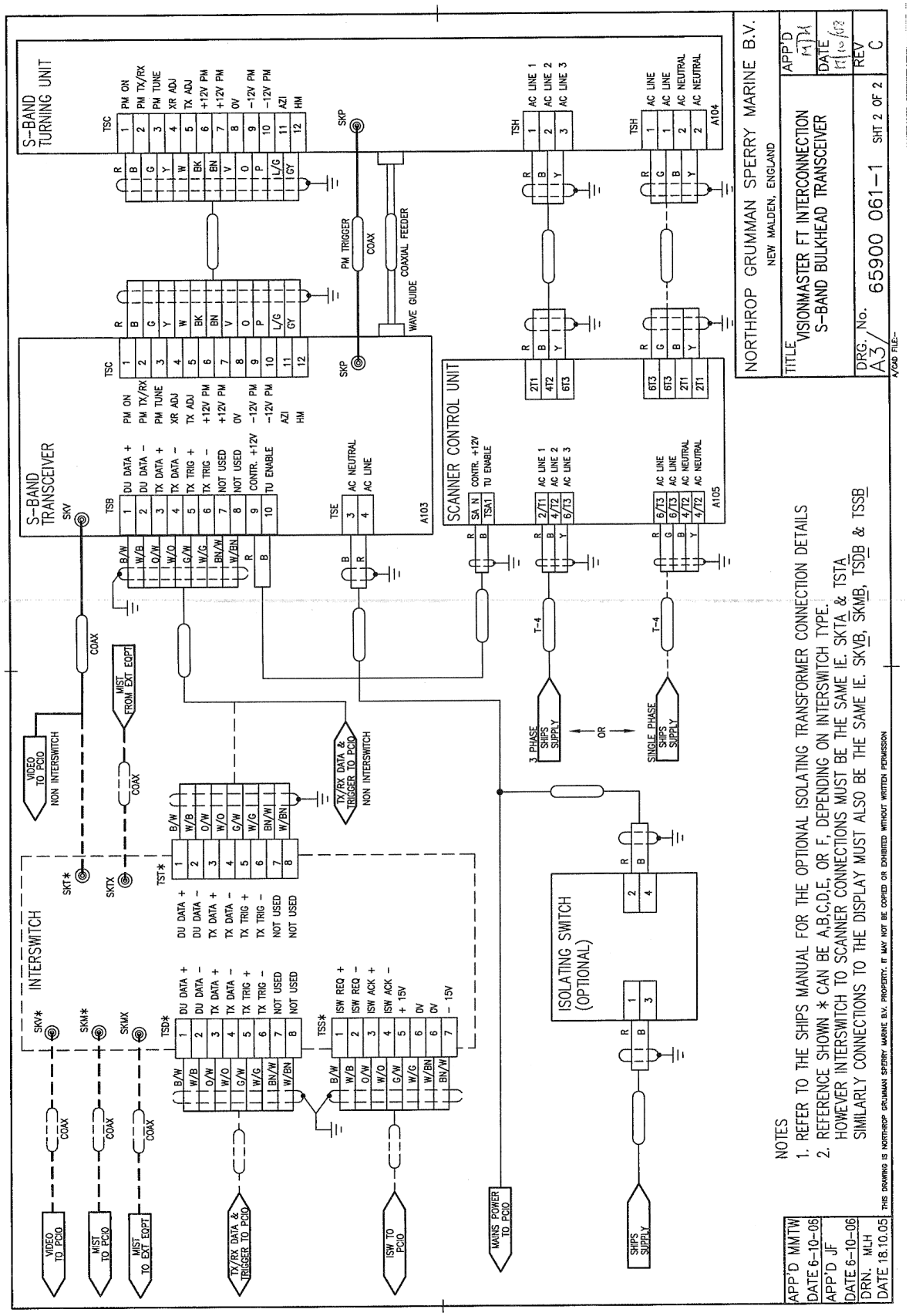


Figure 3.122 Interconnection Diagram for S-Band Bulkhead Transceiver -Sheet 2

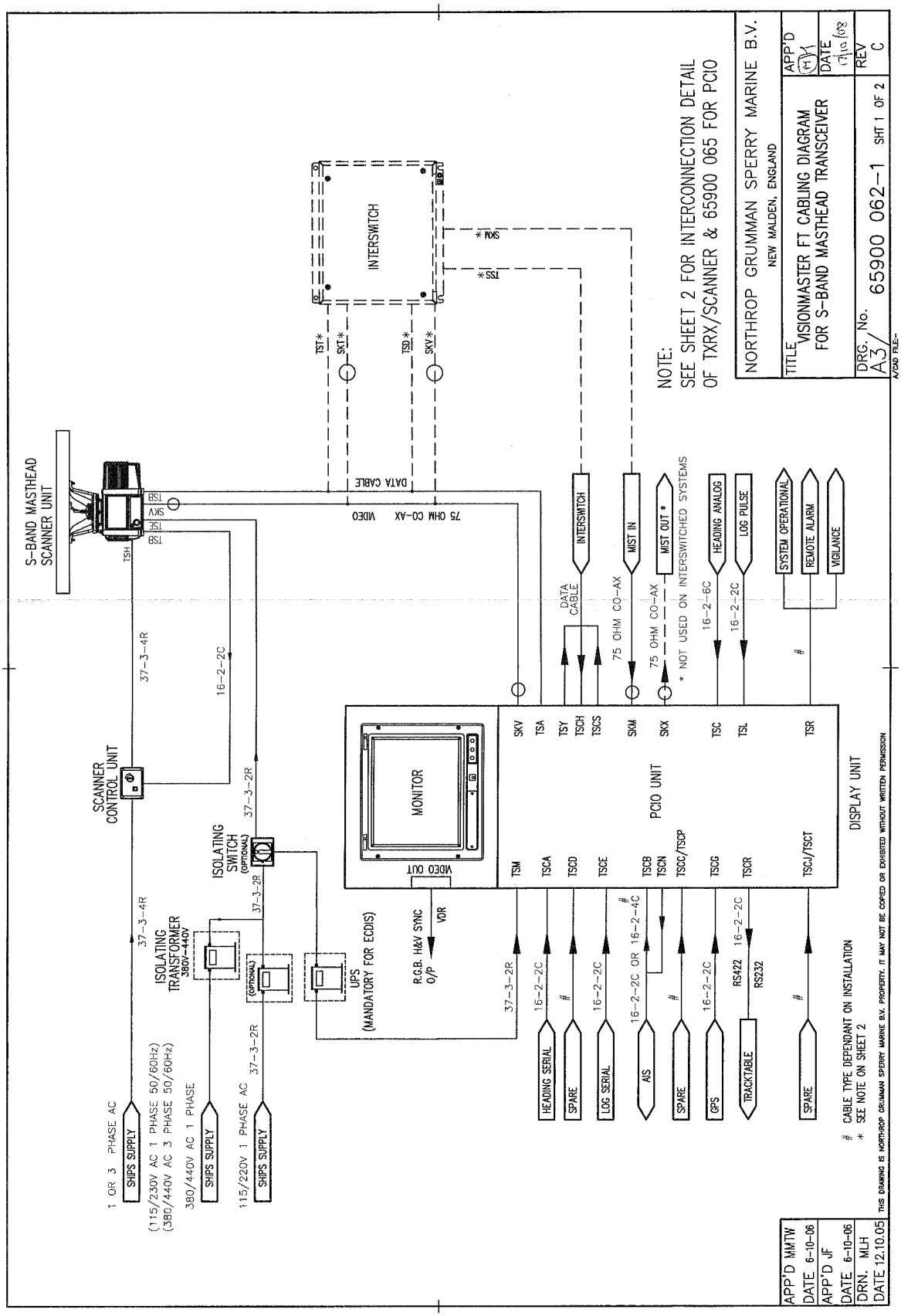


Figure 3.123 Cabling Diagram for S-Band Masthead Transceiver -Sheet 1

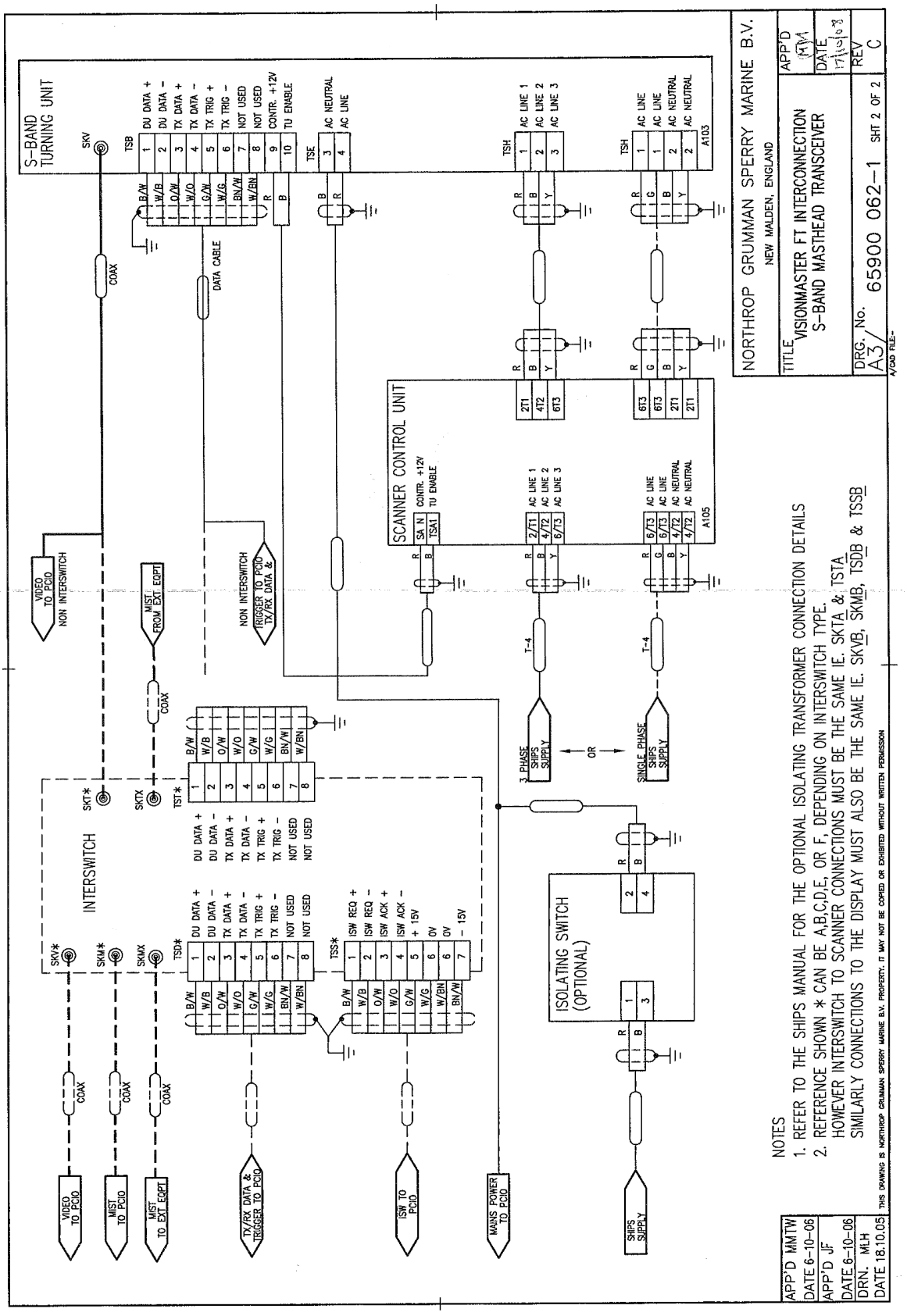


Figure 3.124 Interconnection Diagram for S-Band Masthead Transceiver -Sheet 2

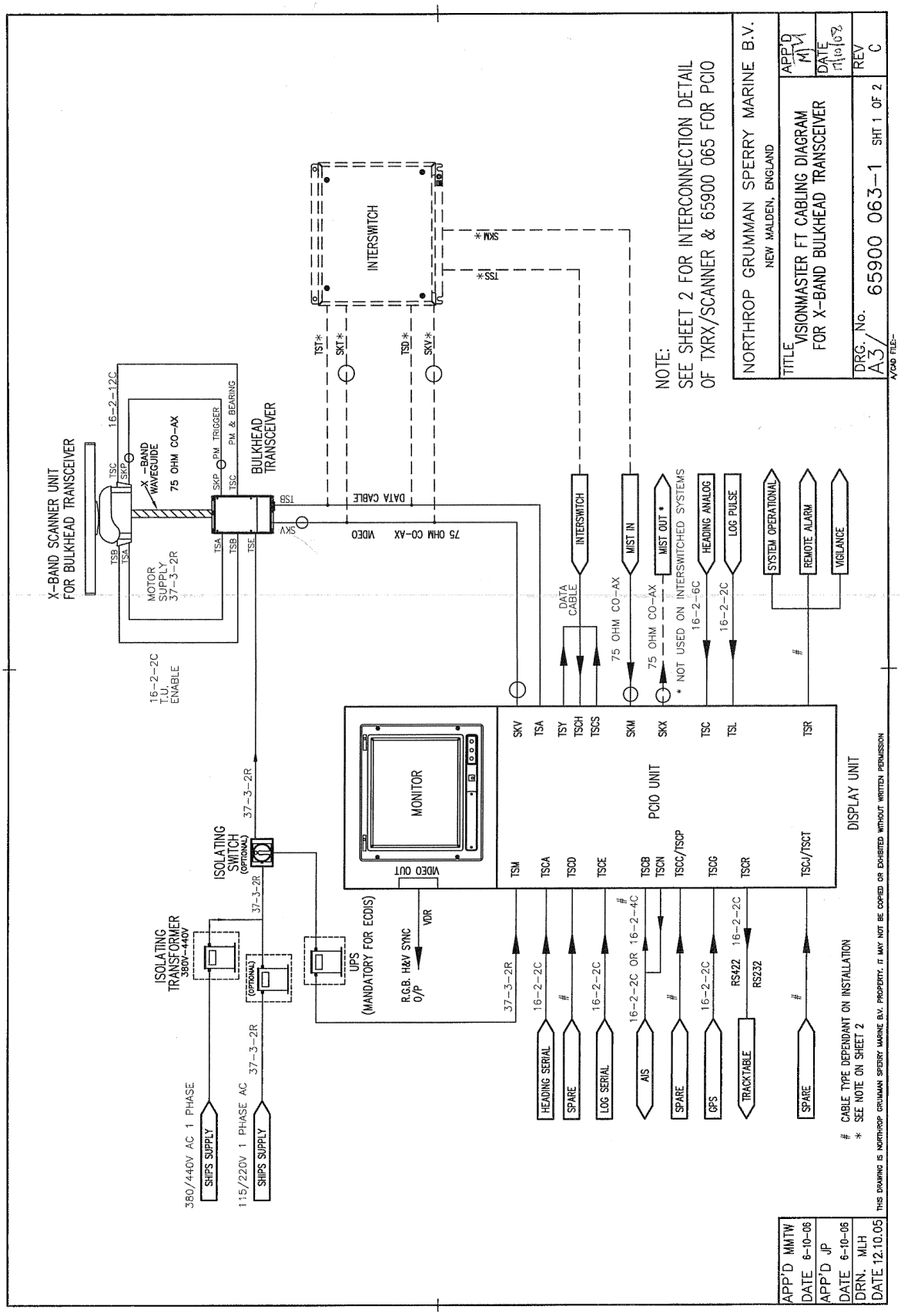


Figure 3.125 Cabling Diagram for X-Band Bulkhead Transceiver -Sheet 1

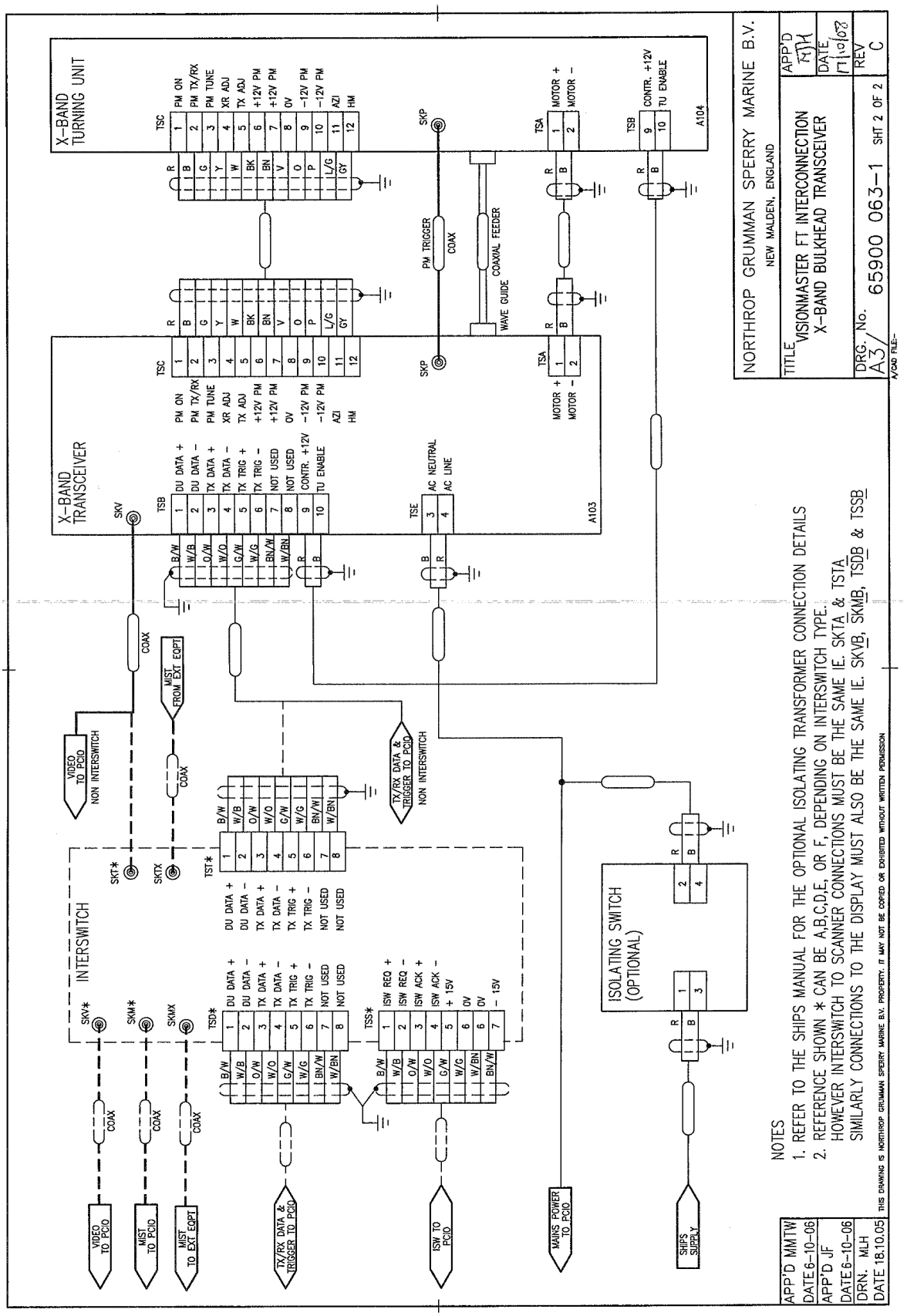


Figure 3.126 Interconnection Diagram for X-Band Bulkhead Transceiver -Sheet 2

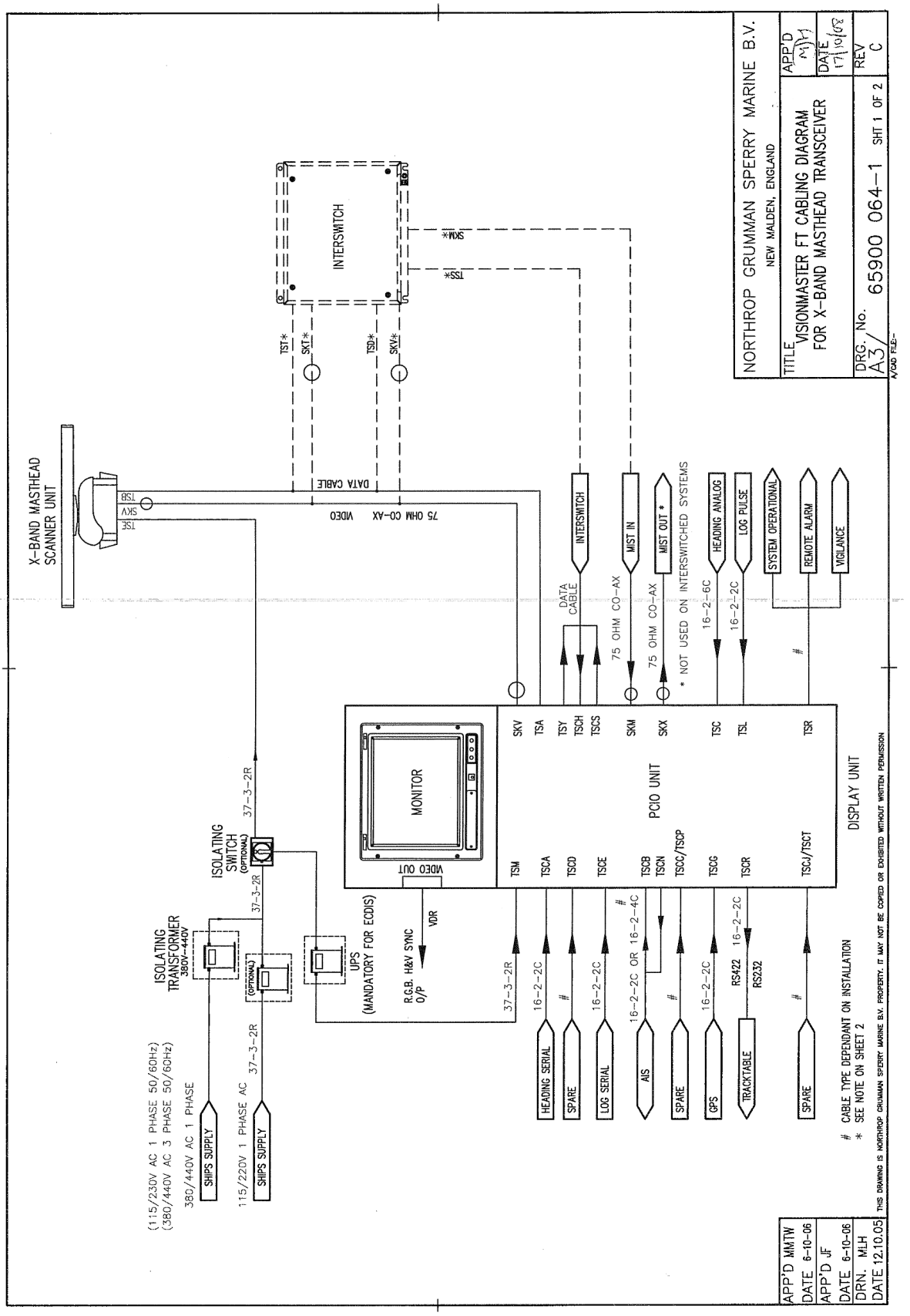


Figure 3.127 Cabling Diagram for X-Band Masthead Transceiver -Sheet 1

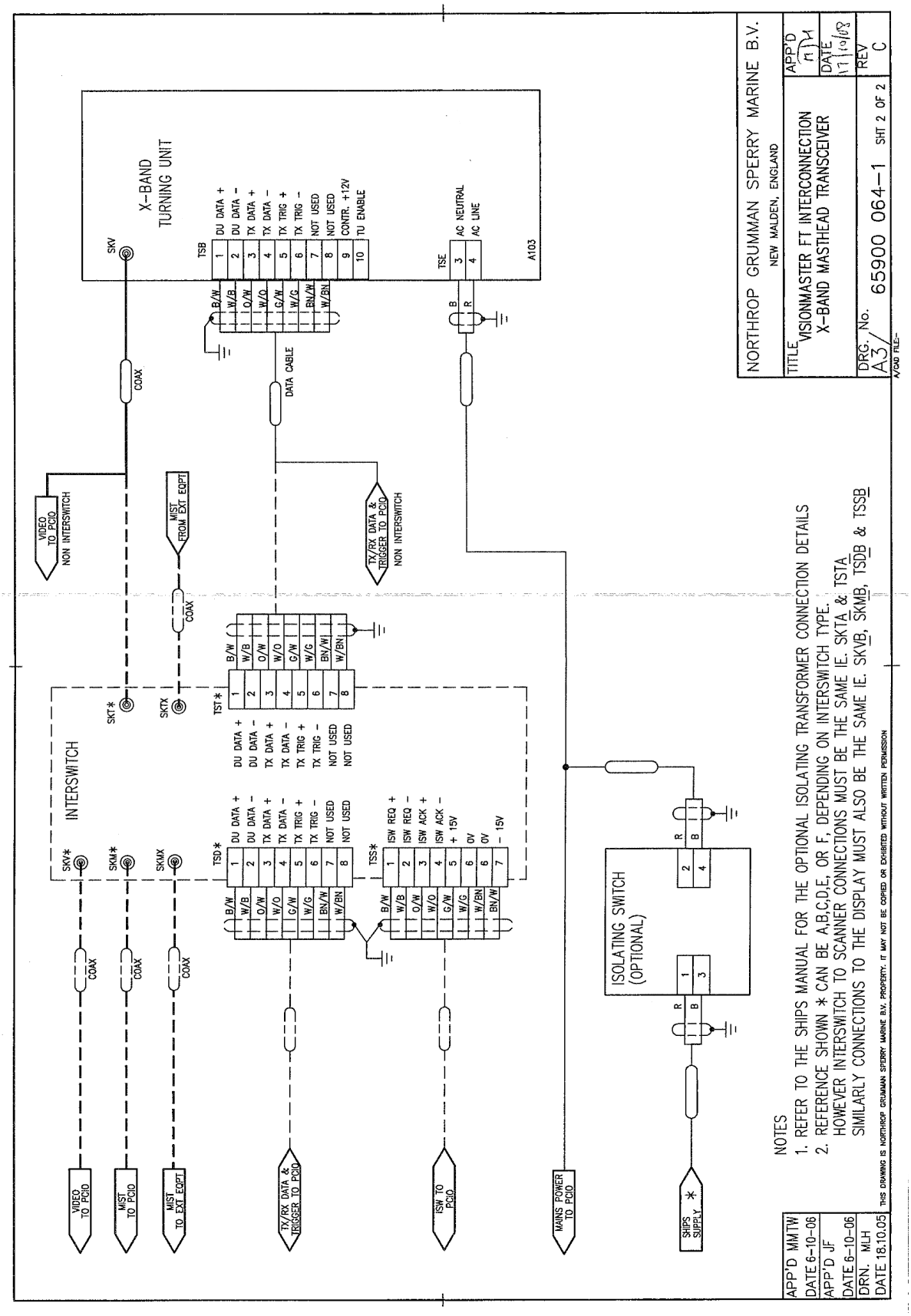


Figure 3.128 Interconnection Diagram for X-Band Masthead Transceiver -Sheet 2

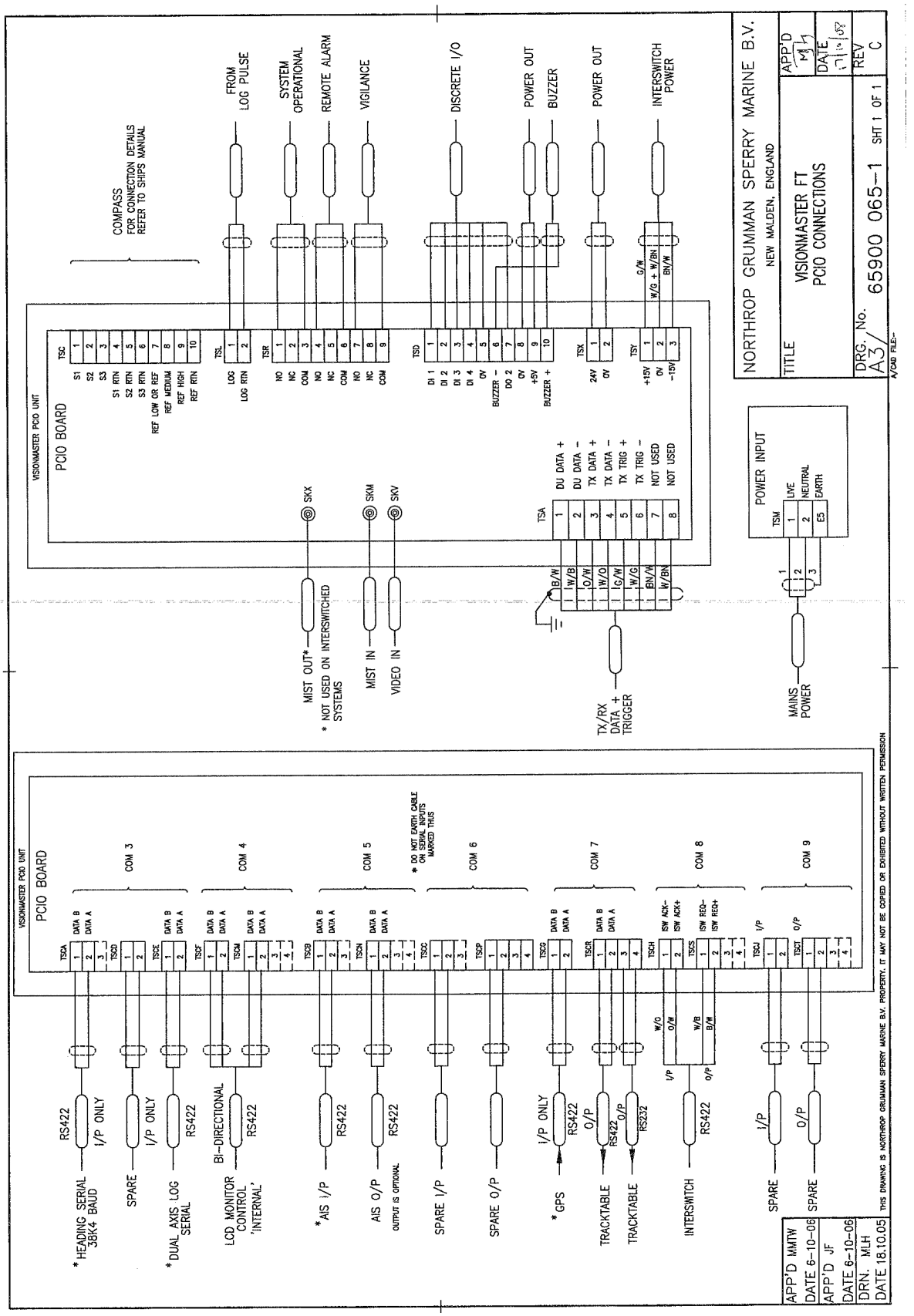


Figure 3.129 PCIO Connections

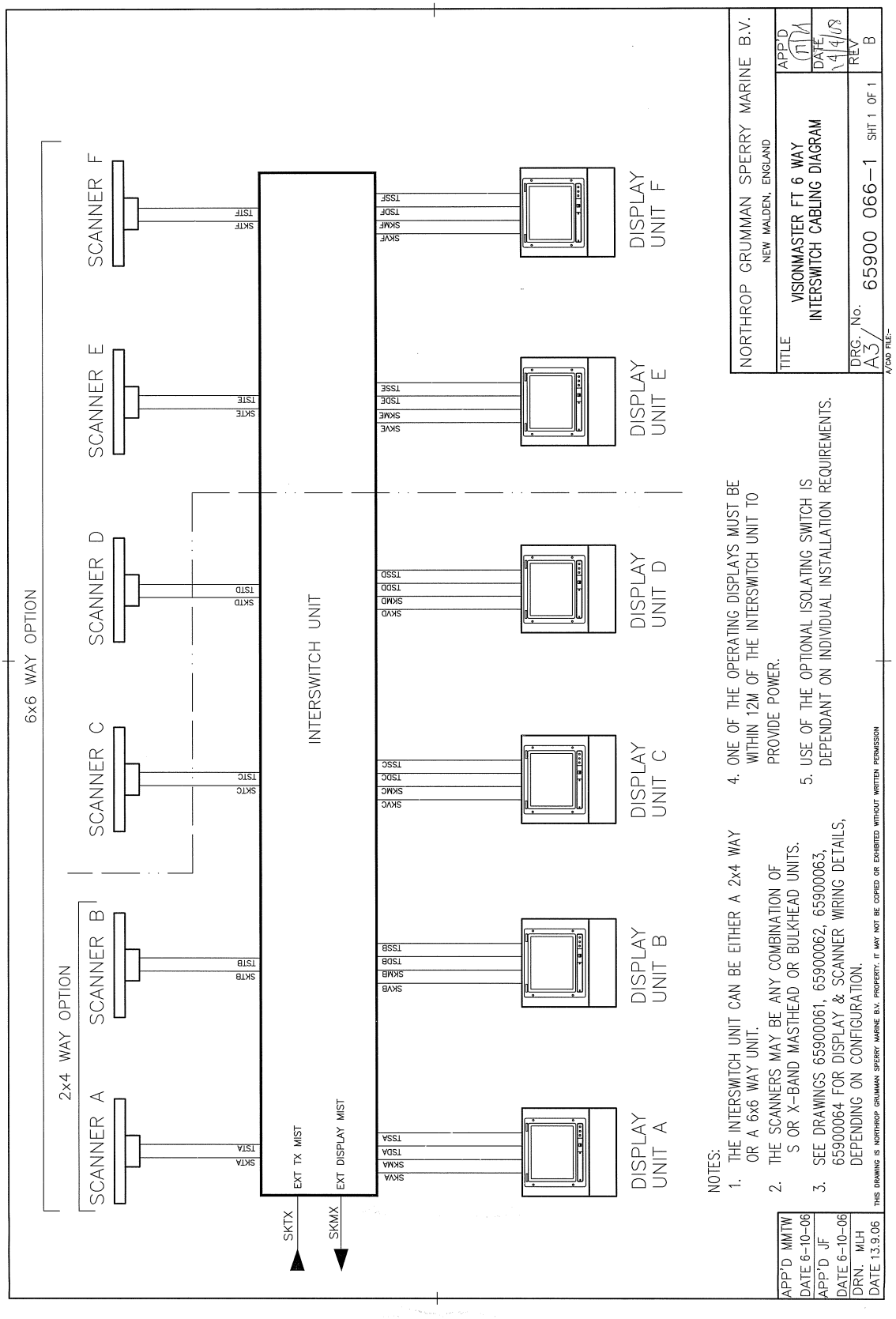


Figure 3.130 Interswitch Cabling Diagram

7.2 Compass Cabling and Link Settings

Compass cabling and linking information for VisionMaster FT Series Radars is detailed below for stepper and synchro type compasses.

Note: *Details of cabling information for compasses with a serial output are described in Section 7.2.1 'Standard Compass Board Links and Interconnections' and Section 7.2.2 'Special Compass Board Links and Interconnections'.*

The Compass Interface board is mounted as a daughter board onto the PCIO board in the PCIO Unit.

The type of compass interface board fitted will determine the type of compass that can be used with the system. Two compass interface boards are available: Standard and Special.

Table 16: Compass Interface Boards - Standard & Special

Interface Board	Compass Type	Ratio	Signal Voltage	Impedance
Standard 65800831	Stepper – S Type	360:1	16-100V DC line-line 8-100V DC line-line return.	10kΩ Min
	Stepper – M Type	180:1		
	Synchro (50–500Hz)	360:1	16-100V RMS line-line	10kΩ Min
			25-165V RMS reference	47kΩ Min
Special 65800832	Synchro (50-500Hz)	180:1 90:1 36:1 1:1	9.3-37V RMS line-line	40k to 60kΩ
			32-126V RMS line-line	133k to 200kΩ
			26-150V RMS reference	100kΩ Min

At system power up, the system detects the type of compass interface board (standard or special), if any.

During system configuration, the compass type must be selected if the standard compass interface board is fitted, and the number of cycles per compass revolution (ratio) selected if the special compass interface board is fitted. For information on configuring the compass type and ratio settings refer to *'PCIO Sensor Interface'* in Chapter 4 '*Configuration*'.

7.2.1 Standard Compass Board Links and Interconnections

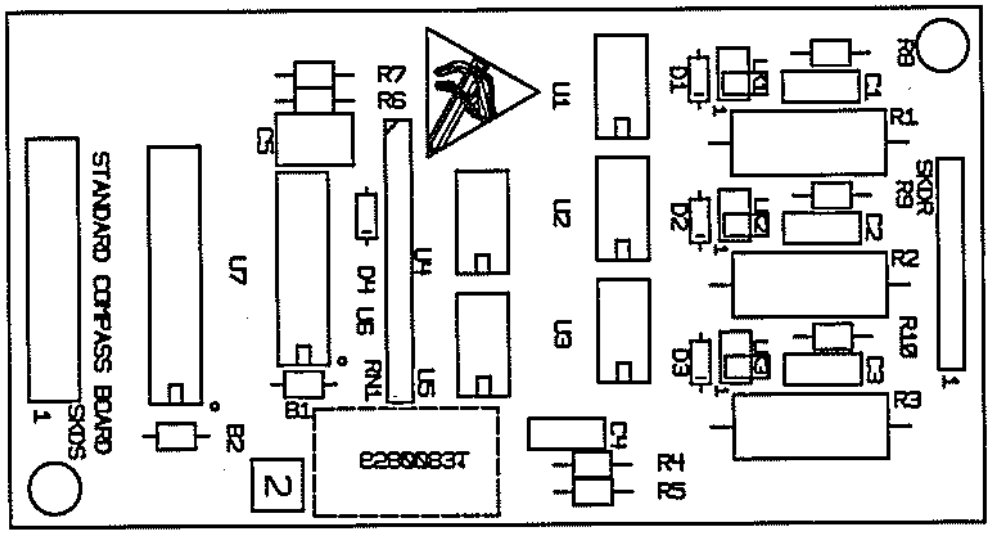


Figure 3.131 Standard Compass Interface PCB

There are three links on the Standard Compass Board, LK1, LK2 and LK3.

These need only be fitted between the pins if the 'OFF' state current from an 'S' type stepper compass is too high and causes the board to generate compass errors, otherwise leave in the parked position as shown in Figure 3.131.

Compasses should be connected in accordance with Table 17 and Table 18.

Table 17: Stepper Compass Settings

Stepper Compass					
S Type +ve Ref.		S Type -ve Ref.		M Type	
PCIO Panel		PCIO Panel		PCIO Panel	
TSC1	Common Ref.	TSC1	S1	TSC1	S1
TSC2	Common Ref.	TSC2	S2	TSC2	S2
TSC3	Common Ref.	TSC3	S3	TSC3	S3
TSC4	S1	TSC4	Common Ref.	TSC4	Common Ref.
TSC5	S2	TSC5	Common Ref.	TSC5	Common Ref.
TSC6	S3	TSC6	Common Ref.	TSC6	Common Ref.
TSC7	no connection	TSC7	no connection	TSC7	no connection
TSC8	no connection	TSC8	no connection	TSC8	no connection
TSC9	no connection	TSC9	no connection	TSC9	no connection
TSC10	no connection	TSC10	no connection	TSC10	no connection

Table 18: Synchro Compass Settings

Synchro Compass					
Ref. Below 61V RMS		Ref. 61V - 115V RMS		Ref. Above 115V RMS	
PCIO Panel		PCIO Panel		PCIO Panel	
TSC1	S1	TSC1	S1	TSC1	S1
TSC2	S2	TSC2	S2	TSC2	S2
TSC3	S3	TSC3	S3	TSC3	S3
TSC4	- - +	TSC4	- - +	TSC4	- - +
TSC5	- - + Link	TSC5	- - + Link	TSC5	- - + Link
TSC6	- - +	TSC6	- - +	TSC6	- - +
TSC7	Synchro Ref.	TSC7	no connection	TSC7	no connection
TSC8	no connection	TSC8	Synchro Ref.	TSC8	no connection
TSC9	no connection	TSC9	no connection	TSC9	Synchro Ref.
TSC10	Ref. Return	TSC10	Ref. Return	TSC10	Ref. Return

7.2.2 Special Compass Board Links and Interconnections

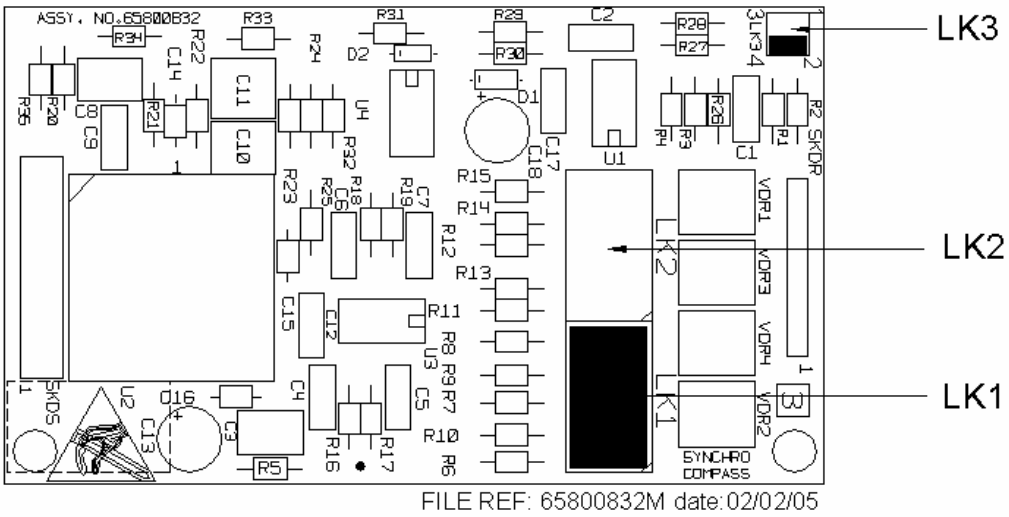


Figure 3.132 Special Compass Board Interface PCB

There are three links on the Special Compass Board, LK1, LK2 and LK3.

The voltage at the S1, S2 & S 3 inputs defines whether a shorting link is fitted to position LK1 or LK2.

If the input voltages are greater than 32V RMS, the link must be fitted in position LK1, otherwise, fit the link in position LK2.

The default setting is with the link fitted in position LK1.

The reference voltage shown in Table 19 determines the setting of LK3.

Table 19: Reference Voltage for LK3

Reference Voltage	LK3
150V RMS	2 - 4
115V RMS	3 - 4
50V RMS	1 - 2
26V RMS	1 - 3

The default setting is with pins 2 and 4 of LK3 linked.

Compasses should be connected in accordance with the following table:

Table 20: Compass Settings

Synchro Compass	
I/O Panel	Compass
TSC1	S1
TSC2	S2
TSC3	S3
TSC4	(no connection)
TSC5	(no connection)
TSC6	(no connection)
TSC7	Syncro Ref
TSC8	(no connection)
TSC9	(no connection)
TSC10	Ref. Return

7.3 Log Cabling

A dual axis serial log is connected to a two way serial input (TSCE).

The log input can accept signals from a water-locked, single axis, pulse or Doppler log with 100 to 2560 pulses per nm at a speed range of 0 to 99.9 knots. The signal can be from a closing contact or be a TTL compatible signal (1=2.4 to 5V, 0=0 to 0.4V).

The log signal is connected to TSL 1, the log return to TSL 2.

7.4 PCIO Board

The PCIO Board has three high speed serial inputs (38400 baud) and six low speed serial inputs (4800 and 9600 baud).

Communication to the Processor unit is via an embedded USB hub (TSU). Video and data to the Scan Converter (SC) card is via an 12 way connector (TSS).

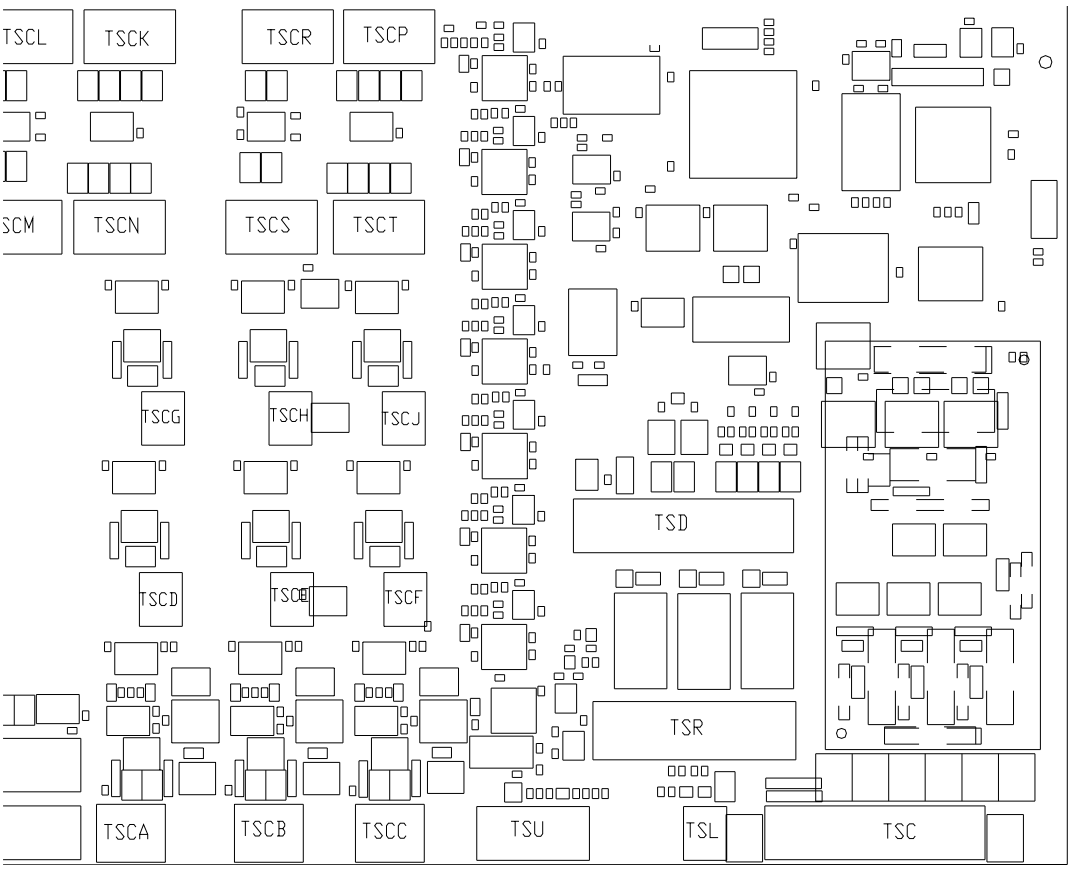


Figure 3.133 PCIO Board

7.4.1 PCIO Board - Serial Inputs and Outputs

Table 21 below gives details of the serial input and output connections.

Table 21: PCIO Board Serial Inputs and Outputs

Port	Terminal	Function	Features
COM 3	TSCA 1	Data B (RS422 or RS232 rtn)	Heading and ROT input, 38400 baud*
	TSCA 2	Data A (RS422 or RS232 signal)	
	TSCA 3	Isolated earth	
	TSCD	Spare	Input only
	TSCE 1	Data B (RS422 or RS232 rtn)	Log Input, 4800 baud *
	TSCE 2	Data A (RS422 or RS232 signal)	
COM 4	TSCF 1	Data B (RS422 rtn)	Monitor control input, 9600 baud
	TSCF 2	Data A (RS422 signal)	
	TSCM 1	Data B (RS422)	Monitor control output, 9600 baud
	TSCM 2	Data A (RS422)	
COM 5	TSCB 1	Data B (RS422 or RS232 rtn)	AIS input, 38400 baud *
	TSCB 2	Data A (RS422 or RS232 signal)	
	TSCB 3	Isolated earth	
	TSCN 1	Data B (RS422)	AIS output, 38400 baud (optional)
	TSCN 2	Data A (RS422)	
	TSCN 3	Data A (RS232 signal)	
	TSCN 4	0 V	
COM 6	TSCC	Spare Input	
	TSCP	Spare output	
COM 7	TSCG 1	Data B (RS422 or RS232 rtn)	GPS, 4800 baud (input only) *
	TSCG 2	Data A (RS422 or RS232 signal)	
	TSCR 1	Data B (RS422)	Tracktable output, 4800 baud
	TSCR 2	Data A (RS422)	
	TSCR 3	Data A (RS232 signal)	
	TSCR 4	0 V	
COM 8	TSCH 1	Data B (RS422 or RS232 rtn)	Interswitch input, 4800 baud
	TSCH 2	Data A (RS422 or RS232 signal)	
	TSCS 1	Data B (RS422)	Interswitch output, 4800 baud
	TSCS 2	Data A (RS422)	
COM 9	TSCJ	Spare Input	
	TSCT	Spare Output	

*. Do not earth cable on these serial inputs

7.4.2 Additional Input and Outputs

The PCIO board provides the following additional ports:

- Transceiver connections
- Pulse Log
- System Operational indicator via relay contacts
- Remote Alarm via relay contacts
- Vigilance Alarm via relay contacts
- Buzzer output via Discrete I/O

Table 22: Additional PCIO Inputs and Outputs

Port	Terminal	Function	Features
Transceiver	TSA 1	DU DATA +	Data to Transceiver
	TSA 2	DU DATA -	
	TSA 3	TX DATA +	Data from Transceiver
	TSA 4	TX DATA -	
	TSA 5	TX TRIG +	Trigger from Transceiver
	TSA 6	TX TRIG -	
	TSA 7	Not used	
	TSA 8	Not used	
Transceiver (BNC connectors)	SKX	MIST OUT	MIS Trigger from SC card
	SKM	MIST IN	MIS Trigger to SC card
	SKV	VIDEO IN	Video from Transceiver
Pulse Log	TSL 1	LOG	
	TSL 2	LOG RTN (0V)	
System Operational	TSR 1	System Op (N/O)	System Operational with Relay Contacts. Normally Open (N/O) and Normally Closed (N/C) available. N/C shorts to return in alarm condition *
	TSR 2	System Op (N/C)	
	TSR 3	System Op (Common)	
Remote Alarm	TSR 4	Remote Alarm (N/O)	Remote Alarm with Relay Contacts. Normally Open (N/O) and Normally Closed (N/C) available. N/C shorts to common in non-operational condition *.
	TSR 5	Remote Alarm (N/C)	
	TSR 6	Remote Alarm (Common)	
Vigilance Alarm	TSR 7	Vigilance Alarm (N/O)	Vigilance Alarm with Relay Contacts. Normally Open (N/O) and Normally Closed (N/C) available. N/O shorts to return during output pulse *.
	TSR 8	Vigilance Alarm (N/C)	
	TSR 9	Vigilance Alarm (Common)	
Buzzer	TSD 6	Buzzer signal	Buzzer signal goes to low volts to sound buzzer.
	TSD 10	Buzzer (+12 V)	

*. Contacts rated at: 1.0A @ 24VDC, 0.6A @ 110VDC, 0.6A @ 125VAC (50/60Hz).

7.4.3 Ancillary and Interswitch Outputs

The PCIO board provides the following power output ports, protected by re-usable fuses:

- Ancillary Power Output (+24 V)
- Interswitch Power Output (+/- 15 V)
- Ancillary Power Output (+5 V)

Table 23: Ancillary and Interswitch Outputs

Port	Terminal	Function	Features
Ancillary Power Output	TSX 1	+ 24 V	< 700 mA
	TSX 2	0 V	
Interswitch Power Output	TSY 1	+ 15 V	< 700 mA
	TSY 2	0 V	
	TSY 3	- 15 V	< 300 mA
Ancillary Power Output	TSD 8	0 V	
	TSD 9	+ 5 V	< 200 mA

7.4.4 Relay Outputs

The three Relay Outputs provide a set of contacts; Normally Open, Normally Closed and Common. The relay is set ON for a logic '1' written to the appropriate latch bit. These may be used to switch external circuits with current/voltages up to 2.0A/15VDC.

7.5 System Fuses

Switch – Fuse Current Ratings

The table below shows the ratings for the ship's switch fuse for the radar and the S-band motor.

	Radar	S-Band Motor	
Ship's Supply		Single Phase	Three Phase
110/120V AC	10A	10A	10A
220/240V AC	5A	5A	5A
380/440V AC	-	-	5A

Processor Electronics Unit Fuses

	Supply	Rating	Code No.	Location
Mains Fuse (FS1) (external)	110/120V AC	5A	2180413	On outside of PCIO unit
	220/240V AC			
Mains Fuse (FS1) (internal)	110/120V AC	3.15A	2162326	On PSU PCB inside the PCIO unit
	220/240V AC			

Transceiver Unit Fuses

For X-Band fuse location refer to Figure 3.16 (masthead transceiver) and Figure 3.24 (bulkhead transceiver).

For S-Band fuse location refer to Figure 3.54 (masthead transceiver) and Figure 3.58(bulkhead transceiver).

	Supply	S-Band	X-Band	Code No.
Mains Fuse (FS1)	110/120V AC	3.15A	-	MA00007245
	110/120V AC	-	5A	2180413
	220/240V AC	3.15A	3.15A	MA00007245

Fuse Types

MA00007245 - 3.15A, 1¼" (31mm) ceramic, anti surge, cartridge.

2180413 - 5A, 1¼" (31mm) ceramic, anti surge, cartridge.

2162326 - 3.15A, 20mm ceramic, anti surge, cartridge.

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APPENDIX A

ECDIS DISPLAY CALIBRATION PROCEDURE

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Installation Procedures A-4
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A.1 ECDIS Colour Calibration File

The colour calibration file for a VisionMaster LCD monitor provides the necessary data for the ECDIS to provide the proper red, blue & green video output levels for compliance with IEC 61174, ECDIS.

The calibration file is supplied on a 3 ½ " floppy disk. When a display is installed or replaced, it is required that this colour data file be installed on the navigation PC which is connected to this monitor.

A combined backlight and buzzer control cable is also required to connect the monitor to the PCIO port.

A.1.1 LCD Backlight & Buzzer Control Cable

The purpose of this interface cable is to provide a means for the PC to control the LCD backlight. The control will vary the display's brightness for various Day/Night conditions via RS-422 communications.

VisionMaster uses this interface cable to automatically set the LCD backlight to the correct luminance for the ambient light condition selected by the operator, based on the calibration data stored in the PC. When a different setting is selected, the software outputs a serial message to the LCD, setting the backlight brightness to the calibrated level for this setting. The software will monitor periodic communications of this serial interface to detect failure and will display an alarm message to the user if the serial interface fails.

A.2 Installation Procedures

A.2.1 Installing the Colour Calibration File

The following procedures should be utilised to install the new colour calibration data.

Note: *If a colour calibration file is not available, contact Sperry Marine for this information, quoting Display model and serial numbers.*

Note: *If you receive your colour calibration file on a 3 ½ " floppy disk you must first transfer the file to a USB memory stick before following the procedure below.*

To install the ECDIS colour calibration file do the following:

1. With the calibration file transfered to a memory stick, insert the memory stick into one of the USB connectors at the front of the VisionMaster PC.
2. From the **Start** button at the lower left corner of the desktop open Windows Explorer and navigate to the following directory:

   C:\Program Files\Sperry Marine\VisionMaster\Output\ColorFiles\ECDIS
3. If there is an existing 'EcdisColors.dat' file, rename the file to: 'EcdisColors.old'
4. Navigate to the memory stick and copy the new calibration file, 'Mon_VM_3p3.dat', to the directory shown in step 2.
5. Rename the new file as: 'EcdisColors.dat'.

A.2.2 Installing the Backlight & Buzzer Control Cable

1. Connect the LCD backlight and buzzer control cable from the monitor to the PCIO, as shown in Figure 3.120 '*Intermodule Cabling*', in Chapter 3 '*Installation*'.
2. Configure the system so the PCIO serial and discrete output ports are assigned to the LCD backlight control and buzzer output. Refer to Volume 2, Chapter 1 '*Configuration*', (Section 5.3.2 '*Configuring a PCIO Serial Port*' and Section 5.4 '*Monitors*').
3. Verify no alarms or warning are present.
   Alarms and Warnings that may be displayed in case of issues are:
   - **Colours Not Approved** - indicates that the correct colour calibration file is missing, invalid, has an incorrect filename, or is located in the wrong directory.
   - **Monitor Comm Error: Bad Data** - indicates that the monitor failed to acknowledge a command.
   - **Monitor Comm Error: No Response** - indicates that the system is unable to communicate with the monitor.

For information on other alarms and warnings, refer to the ECDIS and Chart Radar User Guides.

4. Set and test display brightness and colours as described in section Section A.3.1 '*Monitor Brightness Check*'.

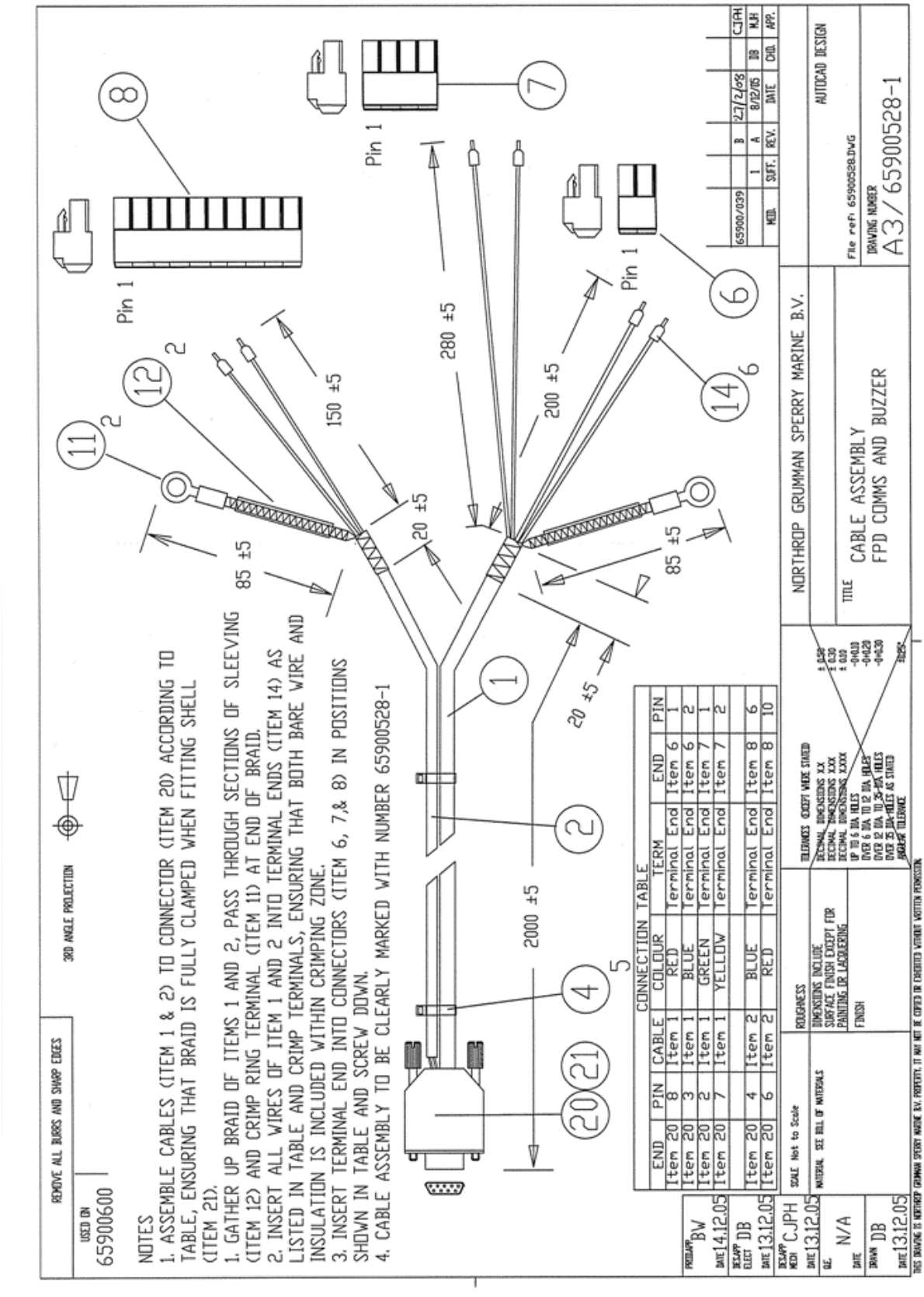


Figure A.1 Cable Assembly for Monitor Comms & Buzzer

A.3 Adjustment for Ambient Lighting Conditions

To match the VisionMaster display to ambient lighting conditions, the display brilliance is selected from a list of pre-defined Day/Night settings. Darker settings are intended to reduce the effects of the display on the operator's vision at night.

Colours used in the display of electronic charts are affected when a selection is made. To ensure that all chart information is visible, the controls on the monitor must be set properly.

For information and selection of the Day/Night modes and Brightness Check, refer to the 'Brilliance' chapter in the ECDIS and Chart Radar User Guides.

The LCD monitor has a single brightness adjustment control on the front panel. Contrast adjustments for LCD monitors are preset to an optimal setting, and there is no contrast control on the monitor. The brightness adjustment control is marked with an indexed setting, calibrated at the time of system installation. Before making an adjustment for ambient light, the control should be set to its indexed position.

On workstations that are configured for an LCD monitor, the system has the capability to automatically set the optimal monitor brightness level, based upon known display characteristics of the hardware. The automatic adjustment is made whenever a new ambient light option is selected. Once the automatic setting for monitor brightness has been made, the manual controls can be used to change monitor brightness from the preset level if necessary.

To ensure that the chart display conforms to established standards, it is recommended that the monitor brightness check be performed after changing the setting for ambient light.

In addition to the brightness check, a periodic test of chart colours should be made to evaluate the performance of the monitor. This evaluation is made via the SENC Color Diagram facility. Refer to the 'Brilliance' chapter in the ECDIS and Chart Radar User Guides.

A.3.1 Monitor Brightness Check

The brightness check is a method for accurately setting the monitor's brightness control to an optimal setting. This adjustment is made from the Brightness Check window.



Figure A.2 Brightness Check Window

The Brightness Check window contains a gray box within a black rectangle. When the brightness check is performed, the operator adjusts the monitor controls while observing the gray box. All colors used in the electronic chart should be clearly visible when the gray rectangle can just be seen.

To perform the Brightness Check:

1. From the **Brilliance** menu, select the **Brightness Check** submenu.
2. Turn the brightness control so that the white index line is at the top position.
3. Turn the brightness control down (anti-clockwise) and observe the grey box in the centre of the window.
4. If the box is not visible, increase the brightness setting until it can be just distinguished in the window; or
5. If the box is clearly visible, leave the brightness control at the indexed setting.

After the brightness check adjustments have been made, the `black level' of the monitor is correctly set. Use the brightness control only if further adjustment is required for visibility.

APPENDIX B

RS422/485 PCI SERIAL CARD

INSTALLATION

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B.1 RS-422/485 PCI Serial Card

This Appendix describes the installation of a Dual Port RS422/485 PCI Serial Card into the Processor unit of a VisionMaster consule (deck mounted or tabletop version).

Note: *The PCI Serial Card is not suitable for installation into a 19" Integrated Display.*

The default communication protocol setting for the card is RS485, but in general, the card should be configured for RS422.

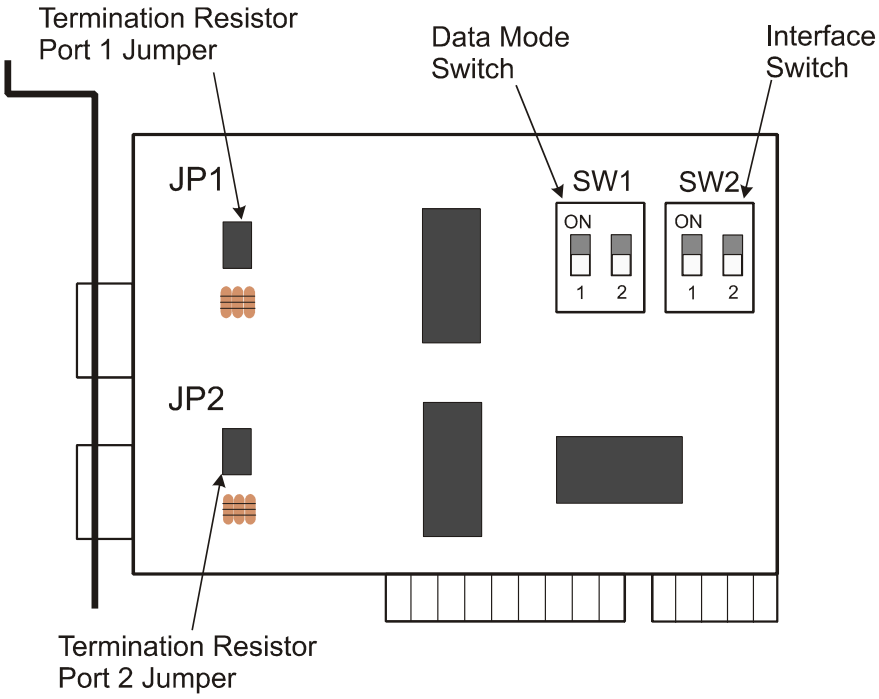
For information on configuring the PCI serial card after installation, refer to VisionMaster Ship's Manual - Volume 2, Chapter 1 '*Appendix B Configuring An Extra Serial Output*'.

B.2 Installation Procedures

B.2.1 Preparing the PCI Card

Before installing the PCI card into the card slot in the Processor set the termination jumpers and switches to the interface type (RS485 or RS422) as described below and shown in Figure B.1.

Note: *The configuration for most applications, including Hatteland monitors, is RS422 with no termination.*



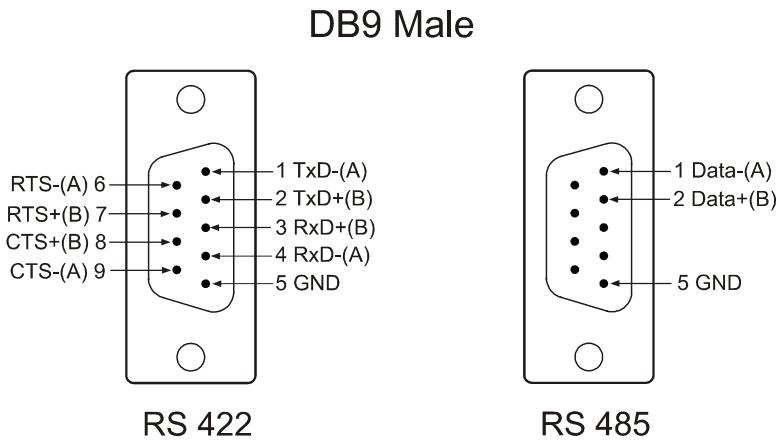


Figure B.1 Outline Drawing of PCI Serial Card

B.2.1.1 RS422 Configuration for VisionMaster Systems

1. Set the SW2 Interface switches for Port 1 and Port 2 to **OFF**
2. Set the SW1 Data Mode switches for Port 1 and Port 2 to **ON** or **OFF** (invalid when SW2 is set to **OFF**)
3. Set the JP1 Termination Resistor Port 1 to **OPEN**
4. Set the JP2 Termination Resistor Port 1 to **OPEN**

B.2.1.2 RS485 Configuration

1. Set the SW2 Interface switches for Port 1 and Port 2 to **ON**
2. Set the SW1 Data Mode switches for Port 1 and Port 2:
   a. **ON** to Automatic Data Direction Control Mode
   b. **OFF** to By TRS Mode
3. Set the JP1 Termination Resistor Port 1 (valid when SW2 is set to **ON**):
   a. **OPEN** not using Termination Resistor
   b. **SHORT** using Termination Resistor
3. Set the JP2 Termination Resistor Port 1 (valid when SW2 is set to **ON**):
   a. **OPEN** not using Termination Resistor
   b. **SHORT** using Termination Resistor

B.2.2 Installing the PCI Card into the Processor



WARNING! – Lethal Voltage Hazard

Lethal voltages may be exposed when access covers are removed. Only qualified persons should work on the equipment when power is applied. ALWAYS isolate the unit from the mains supply when removing or replacing covers.



CAUTION – Electrostatic Sensitive Devices (ESSDs)

The Processor unit contains ESSDs. Take care not to damage these devices by discharge of electrostatic voltages.

Before installing the PCI serial card shut down the system from the VisionMaster FT application, and when fully powered down, switch the On/Off switch located on the underside of the Control Panel to OFF.

1. Turn the On/Off switch at the rear of the Processor to Off.
2. From the front of the Processor disconnect the two USB cables from the control panel USB port.

3. Remove the four screws and washers securing the Processor shelf to the console frame. Pull the Processor and shelf forward and lever the unit down to access the rear cables.
4. From the rear of the Processor disconnect the following two cables (the remaining cables to the Processor do not need to be disconnected) :
   a. power cable from the PCIO unit;
   b. video/data cable from the PCIO unit.
5. Unscrew the nine pan head screws securing the top cover of the Processor.
6. With the top panel removed, disconnect a pan head screw securing one of the PCI blanking plates at the rear of the unit.
7. Plug the PCI card firmly into the free 32-bit PCI slot.
8. Secure the PCI card to the Processor chassis with the blanking plate screw.
9. Replace the top cover.
10. Power up the Processor. The BIOS will automatically set the IRQ and I/O address.
11. For software installation, refer to VisionMaster Ship's Manual - Volume 2, Chapter 1 '*Appendix B Configuring An Extra Serial Output*'.

CHAPTER 4

FAULT REPORTING AND FIRST LINE SERVICING

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1 Introduction

Fault diagnosis to component level is not possible without the use of specialised test equipment.

The majority of the printed circuit boards (PCBs) are assembled using surface-mount techniques.

Service repair is therefore by module (PCB) replacement only.

The module may be covered by the Service Exchange scheme.

1.1 Contact

If a unit has a fault, please contact you supplier or local dealer, or if on International trade, contact:

Northrop Grumman Sperry Marine B.V.		
SERVICE CONTROL	Telephone:	+(44)(0) 208 329 2400
Burlington House	Or	+(44)(0) 208 329 2000
118 Burlington Road		
New Malden	Fax:	+(44)(0) 208 329 2458
Surrey KT3 4NR		
England		

or:

Request support online by going to www.sperrymarine.northropgrumman.com and clicking on the customer support link.

For general non-urgent enquiries, the following e-mail address is also available:

service.uk@sperry.ngc.com

1.2 Information Required for Service

Please give the following details when reporting a fault:

- Name of vessel (Satcom or Fax number if fitted).
- Equipment type, including prefix and suffix letters.
- Software status (version number).
- Next port of call, ETA (estimated time of arrival) and ship's agents.
- Fault description (with as much detail as possible).
- Contact name.

2 Fault Identification and Isolation



WARNING! – Lethal Voltage Hazard

Lethal voltages are exposed when the covers are removed from the units.Only qualified persons should work on the equipment when power is applied. ALWAYS isolate the unit from the mains supply when removing or replacing the cover. To make the units safe it is necessary to isolate them from the mains supply. It is **not** adequate to turn the unit off: there are high voltages present at any Power Supply that is not mains isolated.

2.1 VMFT Ship's Manual FT System Fundamentals

To help simplify the diagnosis of system faults, the following paragraphs describe some fundamental characteristics of the VMFT Ship's Manual FT units.

2.1.1 Power Supply Start-up



WARNING! – Lethal Voltage Hazard

Once mains is applied to the PSU board in the Transceiver, high-voltage DC is present on all primary power components. This voltage is present even when the unit is switched off. The high voltage is only removed if the unit is isolated from the mains supply.

For the Power Supply to operate the DU Data+ and DU Data- signal lines must be active. It is not necessary for serial data to be present: a DC voltage >2.5V between the lines will start the Power supply.

Note: *A test link LKA on Power Supply PCBs can be set to position 1–2 to make the Power Supply operate independently of the DU Data input. This link must only be used in this position as a service aid. It must be reset to position 2–3 for normal operation otherwise the PCIO will not be able to switch the Transceiver on or off.*

2.1.2 Azimuth and Comms

There are four separate signals between the PCIO unit and the Transceiver:

- serial control messages from the PCIO;
- video;
- RS422 trigger; and
- serial tellback messages from the Transceiver.

The tellback messages are a serial message stream. They contain the azimuth, heading marker information, BIST and status tellback bits. The messages are made up of a number of characters.

As the antenna rotates azimuth pulses are produced. Each pulse causes the Transceiver or TCU to send one character of data. If the antenna stops rotating, synthetic azimuth pulses are produced by the Pulse Bearing PCB to maintain the serial comms between the Transceiver and the PCIO. The frequency of the messages is reduced under this condition.

If azimuth pulses are lost no messages will be sent to the PCIO causing a "TX Comms" alarm.

2.1.3 Fault Identification and Isolation

Each of the various signals in the radar system may pass through several of the units before reaching its final destination. Therefore, a low video alarm on a Display could be caused by a failure in the Transceiver, PCIO unit, Processor unit, Interswitch (if fitted) or cabling. The fault in a particular unit may then be due to defective hardware or lack of power to that unit.

With many of the faults it is only possible to identify a particular missing signal. It is then simply a case of using an oscilloscope to trace inputs to and outputs from each unit in turn in order to isolate the fault. Once this has been done, the faulty unit can be examined in more detail using the diagnosis charts in the relevant section.

Note: *The service engineer must check the following before proceeding with fault diagnosis:*

1. *Ships mains is present at each of the units where expected.*
2. *All isolating switches are in the correct operating position.*

2.2 Monitor Unit

Note: *The following sub-sections refer to 340mm and 250mm monitors on deck mounted and tabletop console assemblies. The LCD unit on the 19" integrated tabletop includes a brilliance control only; there are no test controls as descibed below.*

There are two basic types of flat panel monitor:

- 250mm radar circle, 19" screen diagonal (Hatteland)
- 340mm radar circle, 23" screen diagonal (Hatteland or Melford)

2.2.1 Normal Operation Controls

The monitor controls include an On/Off button and a brightness adjustment control.

2.2.2 Hatteland Monitor Test Controls

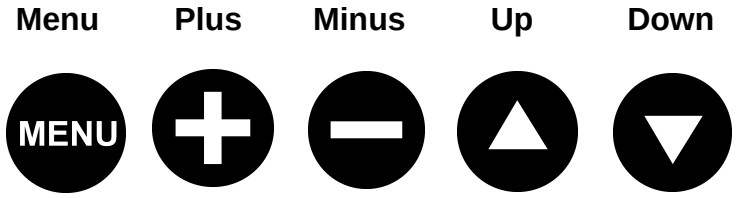
This section applies to the following Hatteland modules: 65817G, 65823A, 65923C, 65919C and 65919T.

An LED between the On/Off button and the brightness control shows the operational status of the monitor.

- A Green LED shows when the power supply is active;
- A Red LED shows if the monitor is switched off or there is a power supply trip.

The On Screen Display (OSD) controls are located under a small metal cover located on the lower left side of the monitor fascia. To access the OSD controls, remove the cover, which is held by two screws

The following monitor OSD controls are available:



Before using the OSD controls turn the brightness control fully clockwise. Check that the LED adjacent to the brilliance control is illuminated green.

To use the OSD controls:

- Press **Menu**. The OSD main menu will appear superimposed over the lower right area of the VisionMaster screen.
- The OSD includes sub menu icons at the top and bottom of the screen. To move to each successive icon press **Menu**.
- Select options within a sub menu by pressing **Up** or **Down**, the selected option will turn yellow.

- Use the **Plus** or **Minus** buttons to increase/decease values.
- Use the **Plus** or **Minus** buttons to move the selection left or right, the selected option will appear green.
- To confirm a selection press **Plus**, to abort press **Minus**.

There are two OSD main menus:

- Simplified OSD menu, which includes three icons across the top of the OSD and six icons across the bottom of the OSD.
- Advanced OSD menu, which includes six icons across the top of the OSD and six icons across the bottom of the OSD.

Note: *It should not normally be necessary to access the Advanced OSD menu. Only those functions that are relevant to the operation of the VisionMaster FT radar are described in detail in Section 2.2.2.2 'Advanced OSD menu'.*

To access the Advanced OSD menu, press and hold the **Down** button while switching the power on.

2.2.2.1 Simplified OSD Menu

The simplified OSD main menu includes the following nine sub menus:

The three top icons are:

- Frequency and Phase
- Status
- Position

The six bottom icons are:

- Picture in Picture
- Language
- Video Source
- Utilities
- Volume
- Exit

Frequency and Phase

These functions modify the image horizontal size and fine-tune the image quality.

- **Frequency** has a default value of 0 and should not be changed.
- **Phase** adjusts the image quality and has a default value of 100%. Use the **Plus** and **Minus** buttons to fine tune the data sampling position. It is not possible to give a typical figure for this parameter, as each unit may be different.

- **Sharpness** adjusts the image sharpness, the default value is 100%. Use the **Plus** and **Minus** buttons to change the sharpness. The values range from 0 to 4, with 4 as maximum value.
- **Picture Type** should be at a default setting of **Still**.

Status

This sub menu displays, but cannot adjust, the monitor resolution and frequency as follows:

Table 1: Monitor Resolution and Frequency Status

Parameter	Horizontal	Vertical
Resolution	1280	1024
Frequency	63.9kHz	60kHz

Position

These functions move the image within the display area.

- The **Plus** and **Minus** buttons move the image right and left respectively.
- The **Up** and **Down** buttons move the image up and down respectively.

Picture in Picture

The picture in picture (PIP) parameters include PIP size, PIP source and horizontal/vertical position.

- **PIP Size** - ensure that the PIP window size is set to **0** (minimum value).
- **PIP Source** - select the video input source to be displayed.
- **Horizontal/Vertical** - adjust the PIP window horizontally and vertically (defaults to 0%).

Language

This sub menu allows the user to choose between English, Danish and Simplified Chinese for the text and messages in the OSD menus.

Video Source

This menu displays the video source. It is preset to Analog RGB and must not be changed.

Utilities

This menu displays several sub menus but only the OSD Settings will be of use for a VisionMaster FT Display.

The **OSD Setting** sub menu displays the following parameters with their default values:

Table 2: Monitor OSD Settings

Parameter	Default Value	Notes
OSD H-Position	100	Do not change
OSD V-Position	100	Do not change
OSD Background	Translucent	User may prefer Opaque
OSD Rotate	Normal	Do not change
User time Out	10 seconds	User may need to increase this



CAUTION

Do not change settings in Utilities sub menus Direct Access, Calibrate RGB gain or Load Factory Defaults**.**

Do not change the default settings in Advanced Utilities **.**

Volume

This menu has no function for a VisionMaster FT Display.

Exit

Selecting this sub menu will exit the OSD main menu. Press the **Plus** or **Minus** buttons to save the current settings and then exit.

2.2.2.2 Advanced OSD menu

If **Load Factory Defaults** is activated in error, or the brilliance or aspect ratio are incorrectly set, then it will be necessary to use the Advanced OSD menu functions to check and, if necessary, set certain parameters.

All of the Simplified Menu functions are repeated on the Advanced OSD menus. Only the additional functions are described below.

Brightness and Contrast

The values set by activating Load Factory Defaults are 50 for the Brilliance and 50 for the Contrast.

Color Temperature

The default value is 8000K and must be set to this value.

Graphic Scaling Modes

The default setting is **Fill to Aspect Ratio** and must be set to this value.

Utilities

Additional sub menus are shown compared with the Simplified OSD menu.

2.2.3 Melford Monitor Test Controls

This section is for Melford console (23.1") models 65923E and 65923M.

Turn the brilliance control fully clockwise. Check that the 'ON' LED adjacent to the set-up controls is illuminated.

To the left of the brilliance control, there are four pushbuttons marked MENU, SCROLL, MINUS and PLUS.

MENU is used to activate the On-Screen Display (OSD). Once the OSD is shown, the MENU pushbutton is used to enter or exit a specific sub menu.

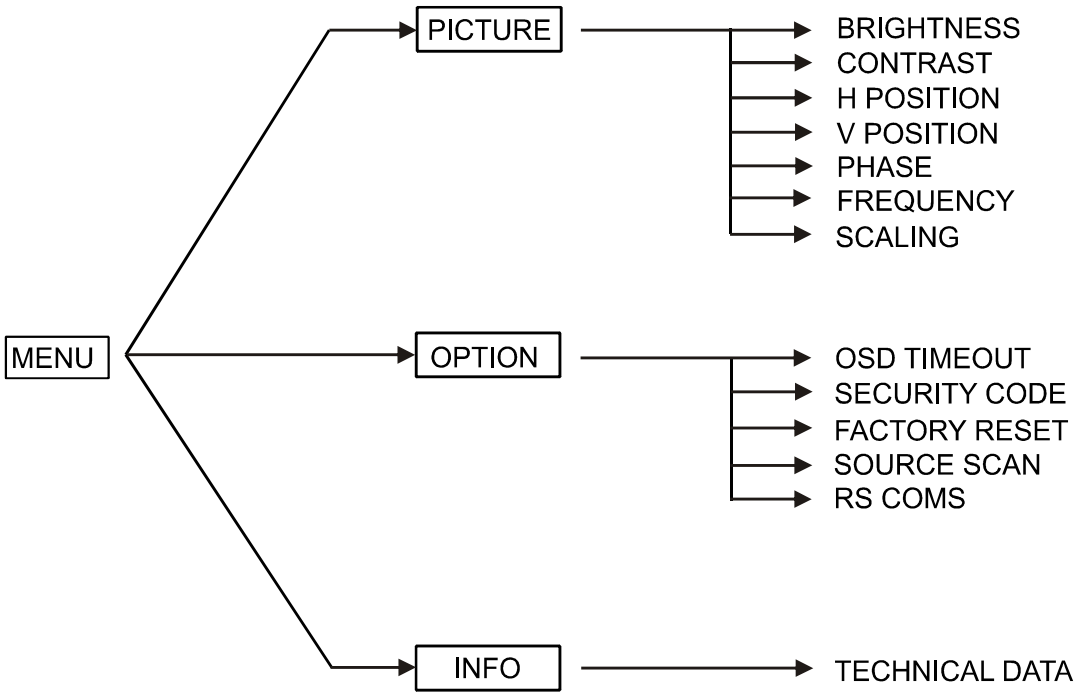
SCROLL enables you to move through top level and sub menus.

MINUS & PLUS adjust the selected value.

The menu structure is illustrated below. To activate:

1. Press MENU.
2. A prompt for a code appears, Press SCROLL, PLUS, MENU, MINUS.
3. Press SCROLL to select the menu item (shown by the highlight).
4. Press MENU to open that submenu.
5. Use SCROLL again to pick (highlight) the item required.
6. Use MINUS or PLUS to adjust the value (if applicable).

The menu screen will time-out after a default time of 60 seconds of inactivity.



Typical values are shown in Table 3 below.

Table 3: Melford Monitor Parameter Values

Parameter	Setting
Brightness	19
Contrast	68
H Position	50
V Position	50
Frequency	1744
Scaling	Fill Aspect ratio
Security Code En	Enable
OSD Timeout	60
Source Scan	Off
RS Comms	422
Mode	13
Resolution	1280 x 1024
H Frequency	63,979 KHz
V Frequency	60 Hz

2.2.3.1 Phase control

The phase control does not have a typical value as it varies from unit to unit. Adjust this parameter to make the picture as sharp as possible.

2.2.3.2 Reset

The RESET function, on the Option submenu, relies on the monitor being presented with full screen graphics in order to assess how the signal should be shown.

After performing a reset, the brightness, contrast and OSD Timeout settings must be re-adjusted to their nominal values shown above.

2.2.4 Monitor Cables

Check the connector security of the following Monitor cables:

- AC power from the PCIO to the IEC power input
- 15 way video cable from the Processor unit
- 9 way comms and buzzer cable from the PCIO unit.

On the Hatteland monitor ensure the switch at rear of the monitor is set to RS422, in order to receive the correct monitor comms with VisionMaster.

2.3 Control Panel

The control panel assembly on deck mounted and tabletop console assemblies houses the following serviceable modules:

- Control Panel or Trackball
- On/Off switch
- USB connector (included if the control panel assembly houses a trackball).

On the 19" integrated tabletop version the complete control panel (basic or trackball only) is a serviceable module.

2.3.1 Control Panel Cables

Check the connector security of the following cables:

For a basic control panel (BCP)

- Two USB cables from Processor unit for radar controls and USB socket on BCP.
- PS2 cable from Processor unit to trackball.
- Power control switch to PCIO unit.

For a trackball with separate USB connector:

- PS2 cable from Processor unit to trackball
- Power control switch to PCIO unit
- Dual USB cable to Processor unit

2.4 Processor Unit

The following section refers to Processor units used on deck mounted and tabletop 250mm and 340mm console assemblies.

2.4.1 General Description

The Processor unit is based on an Intel Pentium processor running Windows XP at 1280 x 1024 resolution, 32 bit colour at 60Hz. It contains the Scan Converter (SC) interface PCB that processes data from the top unit.

The front of the Processor unit includes the following:

- Power On LED and HDD (hard disk drive) LED
- two USB ports (both going to the control panel)
- one DVD/CD ROM drive
- an Air In filter (air out is at the rear of the unit)

The rear of the Processor unit includes the following:

- two PS2 inputs, one of which is used by the trackball
- one serial input
- one parallel input
- four USB ports (two ports can be used for security devices, one is used for the PCIO and one is spare)
- one mains power input
- Processor unit On/Off switch

2.4.2 Physical Arrangements

Two metal brackets attached to the left and right side of the Processor unit are used for the attachment of four AV mounts. The assembly is then attached to the lower pedestal support shelf.

2.4.3 Processor Unit Cables

Check the connector security of the following Processor unit cables:

- AC power from the PCIO to the IEC power input
- Rear USB port to PCIO unit
- Processor SC card (15 way) to PCIO unit
- Processor graphics card (15 way) to Monitor unit
- PS2 port to trackball
- Front USB port to control panel

2.5 Processor for 19" Integrated Tabletop

The following section refers to the Processor used in the 19" integrated tabletop.

2.5.1 General Description

The Processor PCB is attached to a plate (see Figure 4.43). The processor runs Windows XP at 1280 x 1024 resolution, 32 bit colour at 60Hz. It includes a slot for the Scan Converter (SC) interface PCB that processes data from the top unit.

The Processor plate assembly includes the following:

- Fan assembly
- two PS2 inputs, one of which is used by the trackball
- one serial input
- one network port (10/100/1000 Base-T)
- ten USB ports (two ports are at the front of the tabletop, two ports can be used for security devices, one port is used for the control panel, one is used for the PCIO and four are spare).

2.5.2 Processor Unit Cables

Check the connector security of the following Processor unit cables:

- USB port to PCIO unit
- Processor SC card (15 way) to PCIO unit
- Processor graphics card (15 way) to LCD
- PS2 port to trackball
- USB port to control panel

2.6 PCIO

The following section describes the separate PCIO unit used on deck mounted and tabletop 250mm and 340mm console assemblies, and the PCIO board used in the 19" integrated tabletop version.

Any differences between the PCIO board and the PCIO unit are described in the relevant sections.

2.6.1 General Description

There are two PCIO Unit variants; one fitted with a standard compass board and one fitted with a special compass board.

The following inputs are provided on the PCIO PCB:

- analogue compass data (stepper or synchro)
- analogue log (pulse) data
- nine serial data inputs, (one being a dedicated serial compass input).

The following outputs are provided:

- six serial data outputs
- three relay outputs for vigilance alarm, remote alarm and system operational
- one buzzer output to monitor.

2.6.2 Technical Description

2.6.2.1 PCIO Microcontroller PCB

The PCIO is operated by a microcontroller. This supervises the receipt and transmission of external data to the Processor in a number of formats.

Serial Inputs/Outputs

Three serial inputs (1, 2 and 3) are connected to the microcontroller, via a 4-channel UART and are transmitted to the Processor Control Port at a baud rate up to 38400. Only IEC 61162 format sentences are accepted at these inputs. The drive to these inputs may be either RS422 or RS232.

External 61162-2 heading data sentences may be received at Serial Input 1. These will be used, when the serial heading source mode 1 is selected, to supply heading data into the PCIO. They will be checksum checked before use by the PCIO to generate heading output messages.

External 61162-1 heading data sentences may be received at Serial Input 2. These will be used, when the serial heading source mode 2 is selected, to supply heading data into the PCIO. They will be checksum checked before use by the PCIO to generate heading output messages.

External 61162-1 sentences may be received at the Serial Input 3. These messages, when recognised as complete sentences, will be combined with other sentences appearing at the Processor Control Port output. These input sentences are not checksum checked by the PCIO but passed through to the Processor and are checked there.

Heading data sentences presented at the Serial Input 1 and 2 will also be combined at the Processor Control Port output, limited to a maximum message rate of 10Hz, with the other sentences received and generated.

Six serial inputs/outputs (4 through to 9) are provided that transmit external character based messages. These inputs and outputs are associated with USB devices 2 through 7, see Section 2.6.2.2 '*USB Port*'.

Serial messages received from the Processor are announced by interrupts to the microcontroller. The data is collected and the message type is interpreted by the microcontroller. The stored data either effects a configuration and control function or is stored ready for output message generation.

Relay Outputs

Three Relay outputs are provided for vigilance alarm, remote alarm and system operational. Each output provides a set of contacts; Normally Open Normally Closed and Common. The relay will be set ON for a logic '1' written to the appropriate latch bit. These may be used to switch external circuits with current/voltages up to 2.0A/15VDC.

Discrete Outputs

Two discrete (digital) outputs are provided. These outputs are pulled up to +5v via diodes so that the output may pull down an externally provided higher voltage (15V/1A max). The output will be pulled down for a logic '1' written to the appropriate latch bit. They are clamped to chassis for protection by transient suppressors.

Internal Timer

The internal timer is configured to generate an interrupt every 5ms. This generates the highest priority event timing for the main program and will drive a scheduler. This will initiate all the transmission of serial data and regulates the accesses to the various other inputs and outputs. External interrupts will have higher priority. Events requiring lower rates will occur less often in the scheduler.

2.6.2.2 USB Port

The USB port communicates all message and control data between the PCIO and the Processor. The PCIO contains seven USB UART devices that are connected via a USB Hub to the associated Processor USB Port.

The USB device number and serial ports associated with each UART are shown below.

USB No.	Serial Port
1	PC Control Port
2	Serial Input/Output 4 Port
3	Serial Input/Output 5 Port
4	Serial Input/Output 6 Port
5	Serial Input/Output 7 Port
6	Serial Input/Output 8 Port
7	Serial Input/Output 9 Port

The Input/output signals for each serial port are shown on the PCIO PCB by flashing red LEDs.

The baud rate for USB device 1 is set to 115200 by default. For USB devices 2 to 7, the baud rate required is defined by the requirements of the associated serial inputs and outputs.

2.6.2.3 Compass PCB

The compass PCB (standard or special) is mounted onto the microcontroller PCB. Appropriate input interfacing for the Stepper or Synchro inputs is provided on this PCB and a binary input is made available to be read by the microcontroller. The compass type is indicated by a three bit compass type code. Only one byte of the data can be read at a time. The interrupts are disabled during a read and each byte is read twice to ensure a valid correctly aligned value is obtained.

2.6.2.4 Watchdog Timer

The watchdog timer is driven by a toggling Watchdog output signal. This signal is shown by a flashing red LED on the microcontroller PSB. If a failure of the software lasts for a period longer than the Watchdog device delay, (approximately 1½ seconds), the LED will stop flashing and the watchdog device will generate a hardware reset to the microcontroller. This will ensure that a 'hung' system will always try to recover.

The Watchdog link is normally set at pin1 to pin2. If the link is set pin2 to pin3, the reset will repeatedly occur, if the link is not fitted at all the reset will not be generated except at power-up.

2.6.2.5 Power Supply Unit PCB

The power supply unit PSB provides a 24V external supply and a +/-15v external supply for an Interswitch (if fitted). It also supplies +/-15v to the PCIO PCB, which uses regulators to provide +/-12V, +5V and +3.3V.

2.6.3 PCIO Cables

On the PCIO unit check the connector security of the following power cable:

- Mains power to TSM terminal

On the PCIO PCB check the connector security of the following power cable:

- +/- 15V power to DC/DC Converter

Cables to Transceiver or Interswitch:

- 75 ohm Co-Ax from SKV terminal - Video In
- 75 ohm Co-Ax from SKM terminal - MIST IN
- 75 ohm Co-Ax from SKX terminal - MIST OUT
- Data cables from COM ports 3 to 7.
- Data cable from COM 8 to Interswitch (if fitted)

Cables to Processor:

- Video/Data cable (combined coax)
- USB cable from TSU terminal

2.7 Fault Isolating Flow Charts (Console Assembly)

Flowcharts for the isolation of faults on the console assembly (Monitor, PCIO unit and Processor unit) and the 19" Integrated tabletop are shown on page 23 to page 34.

Flowcharts 2a, 2b, 3 and 4 cover the monitor and 19" integrated LCD picture faults. Flowcharts 5 to 11 cover the error messages that may appear which are relevant to the Console assembly hardware.

The Flowcharts should be read in conjunction with the following notes.

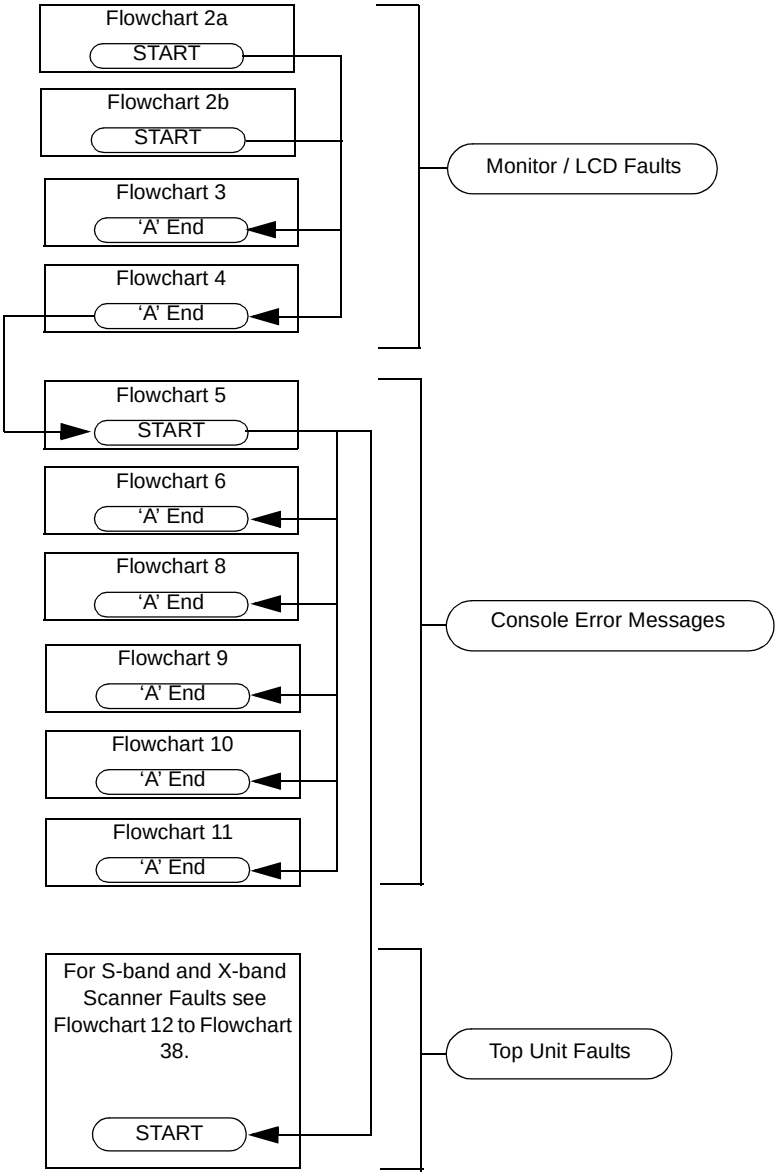
Notes: *Before using the following fault finding flow charts visually check the console modules to make sure there are no loose plugs or connections. After checking the module connection status always check that the configuration of all components on the system is correct by accessing the Configuration tool, see Volume 2, Chapter 1, 'Configuration'.*

If faults cannot be rectified after reference to the console assembly fault finding flowcharts you may need to contact the VisionMaster FT service department to resolve the problem. Prior to contacting the service department use Table 4 to help specify the problem you may have with the console assembly.

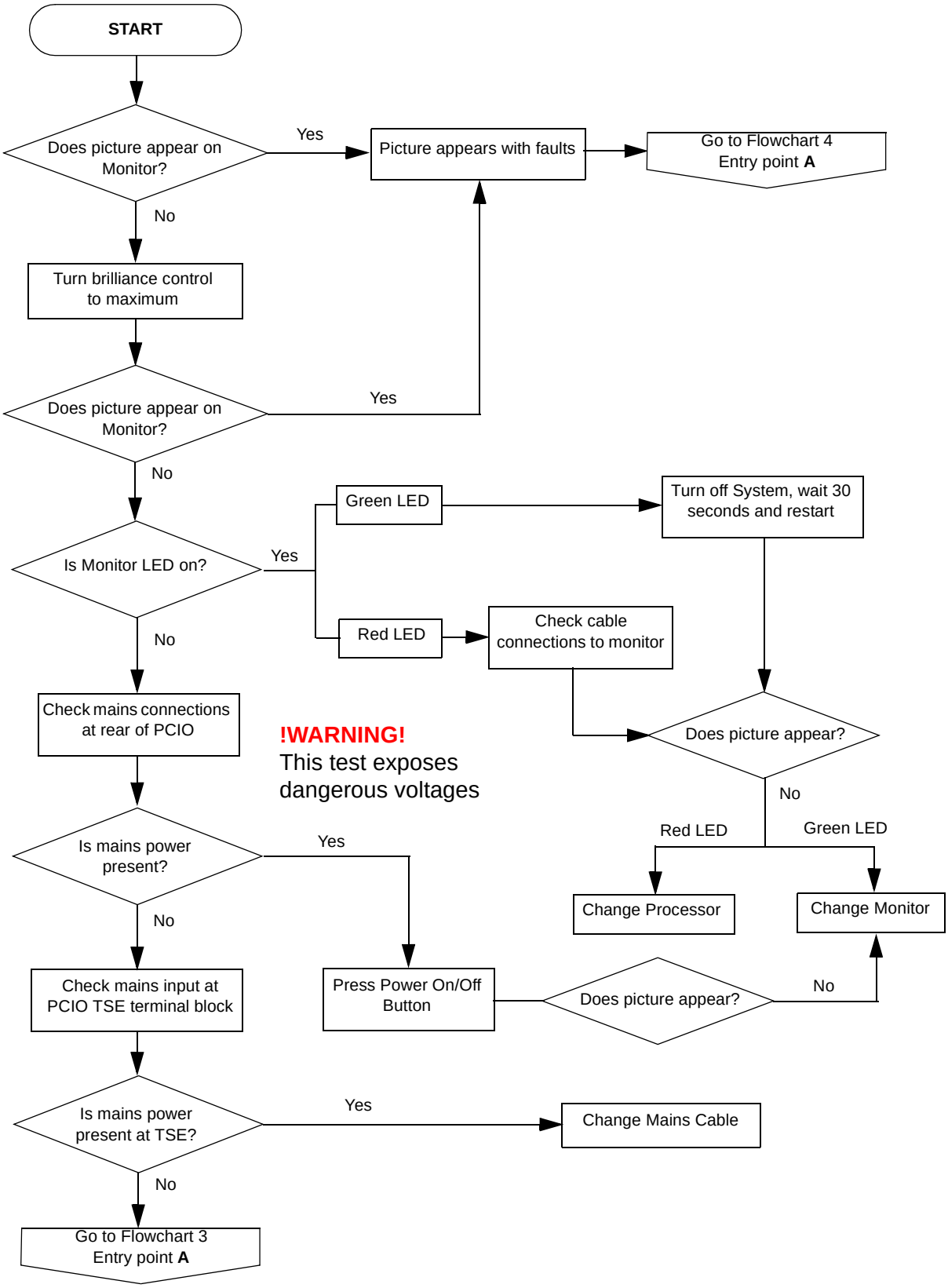
Table 4: Queries and Symptoms on Console faults

General Query	Specific Query	Example Symptoms
Is the display distorted?	Digital Distortion	Broken or missing text, misaligned text.
	Size Distortion	Non-circular range rings. Or picture too large/too small for the screen.
Are the colours correct?	Incorrect Colours	Different colours shown from those set.
	Discolouration	Set colours vary.
Where is the fault in the picture?	Within Radar Circle	Missing targets, no gain, strange patterns.
	Text and Synthetics outside radar circle	Missing text or strange patterns.
Is picture showing incorrect data?	Picture is OK but data is incorrect, or operation is incorrect	Incorrect data in menu. Non-function of menu.
Is the picture frozen?	Picture is partially frozen	Radar video updates appear but synthetics are frozen.
	Picture is fully frozen	No visible changes on screen and no audible alarm.
		No visible changes on screen and audible alarm.

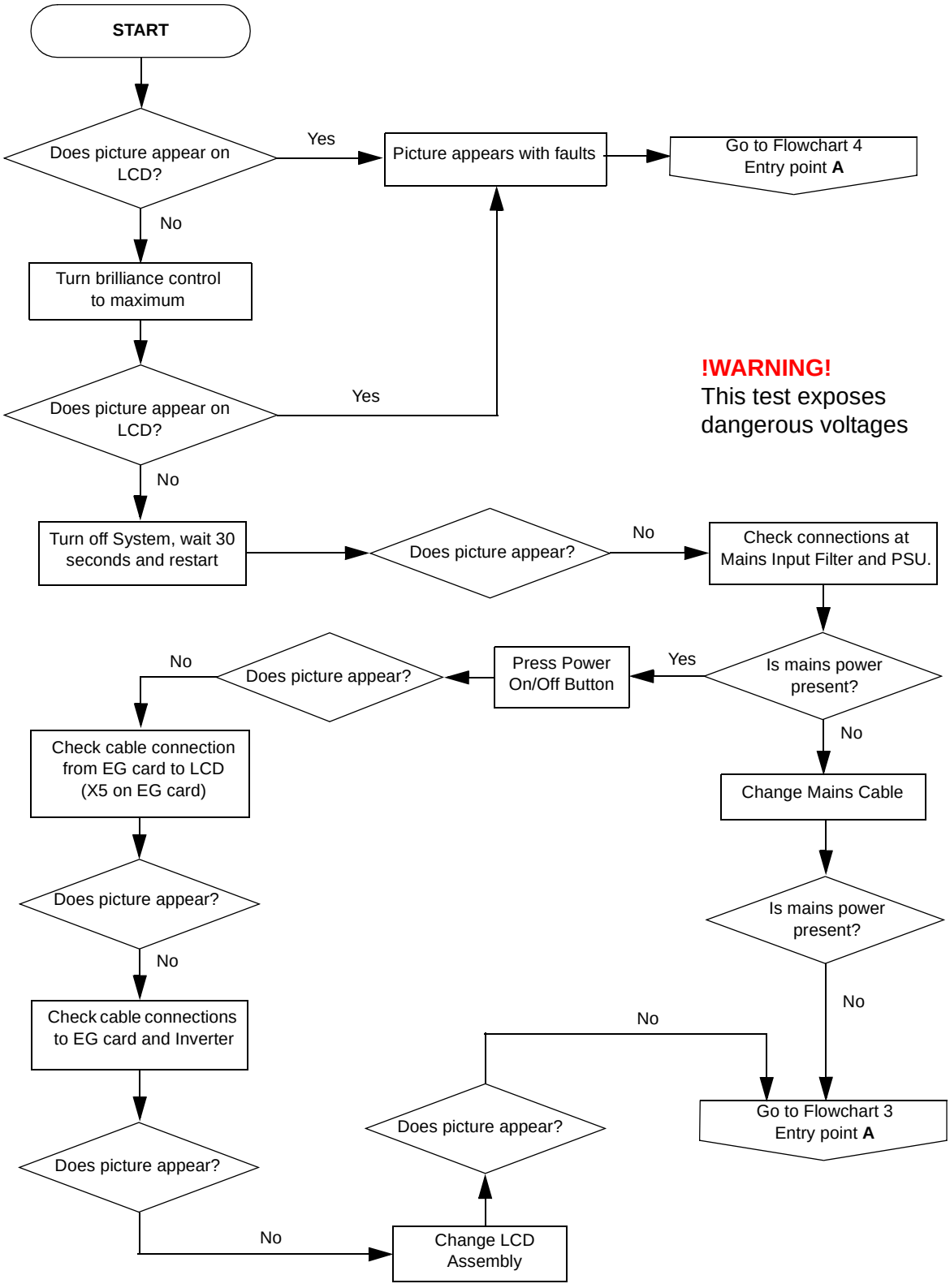
FLOWCHART 1 Overall Flowchart - Console Assembly



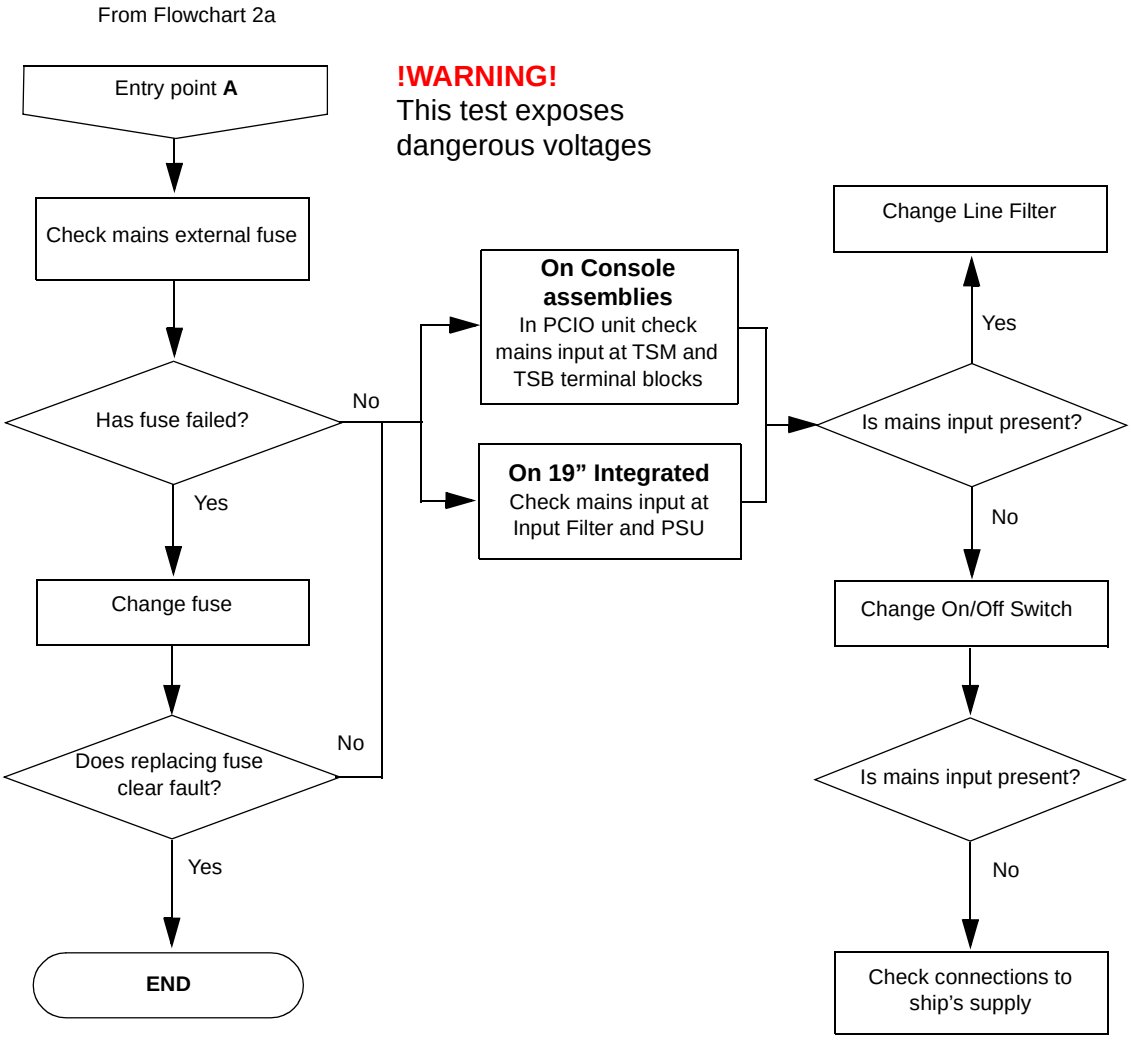
FLOWCHART 2A Console Faults (No Picture)



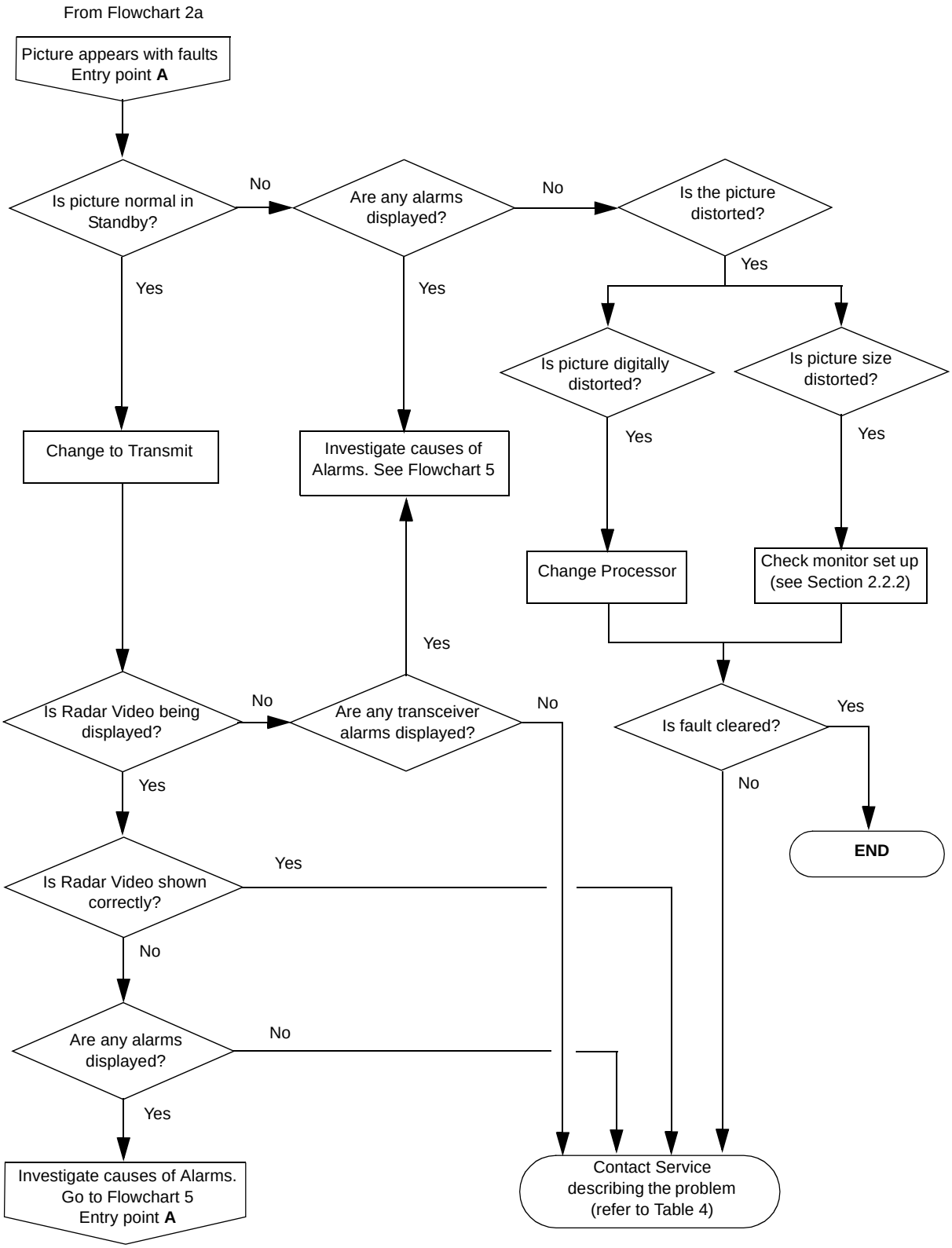
FLOWCHART 2B LCD Faults on 19" Integrated Tabletop (No Picture)



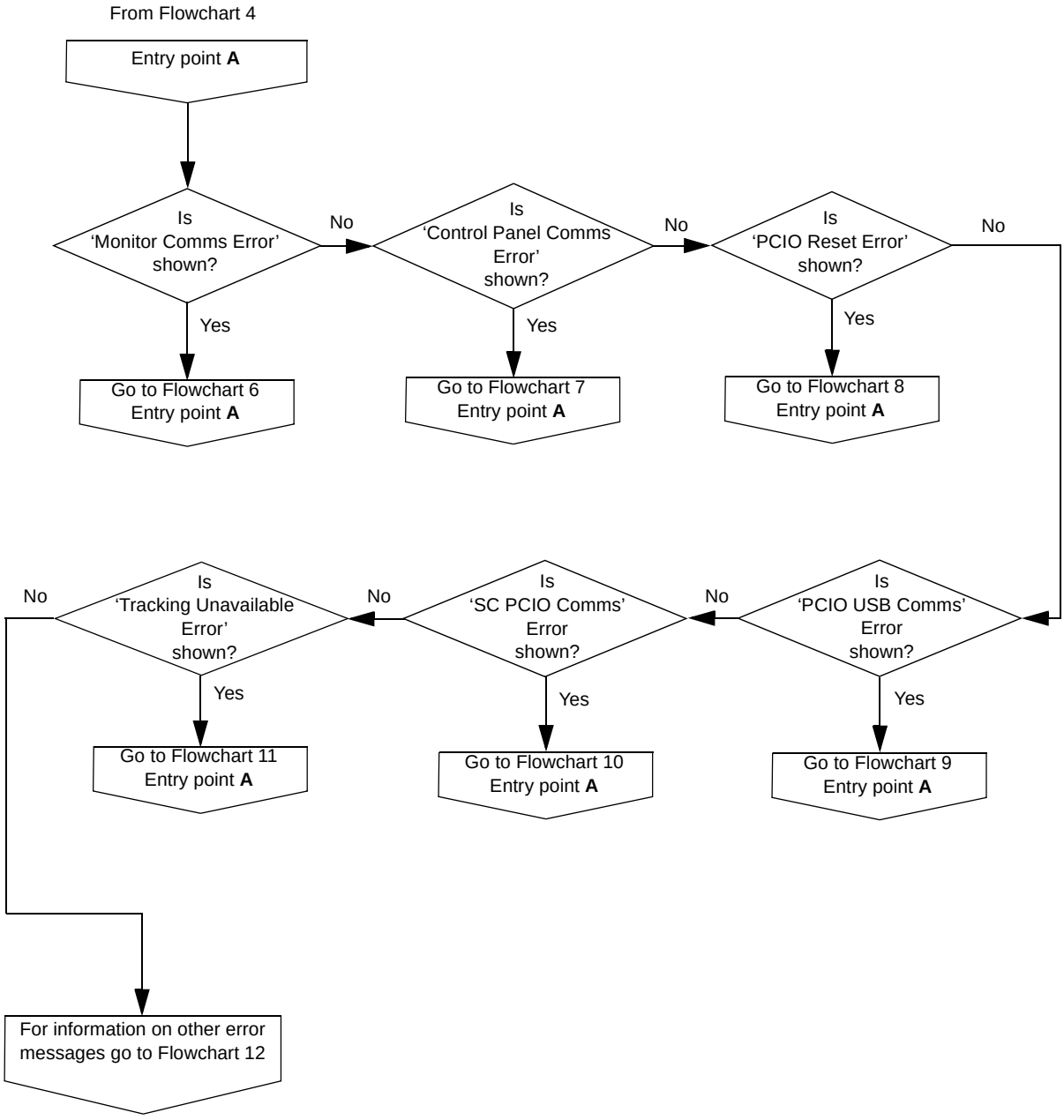
FLOWCHART 3 Console Faults (No Picture contd.)



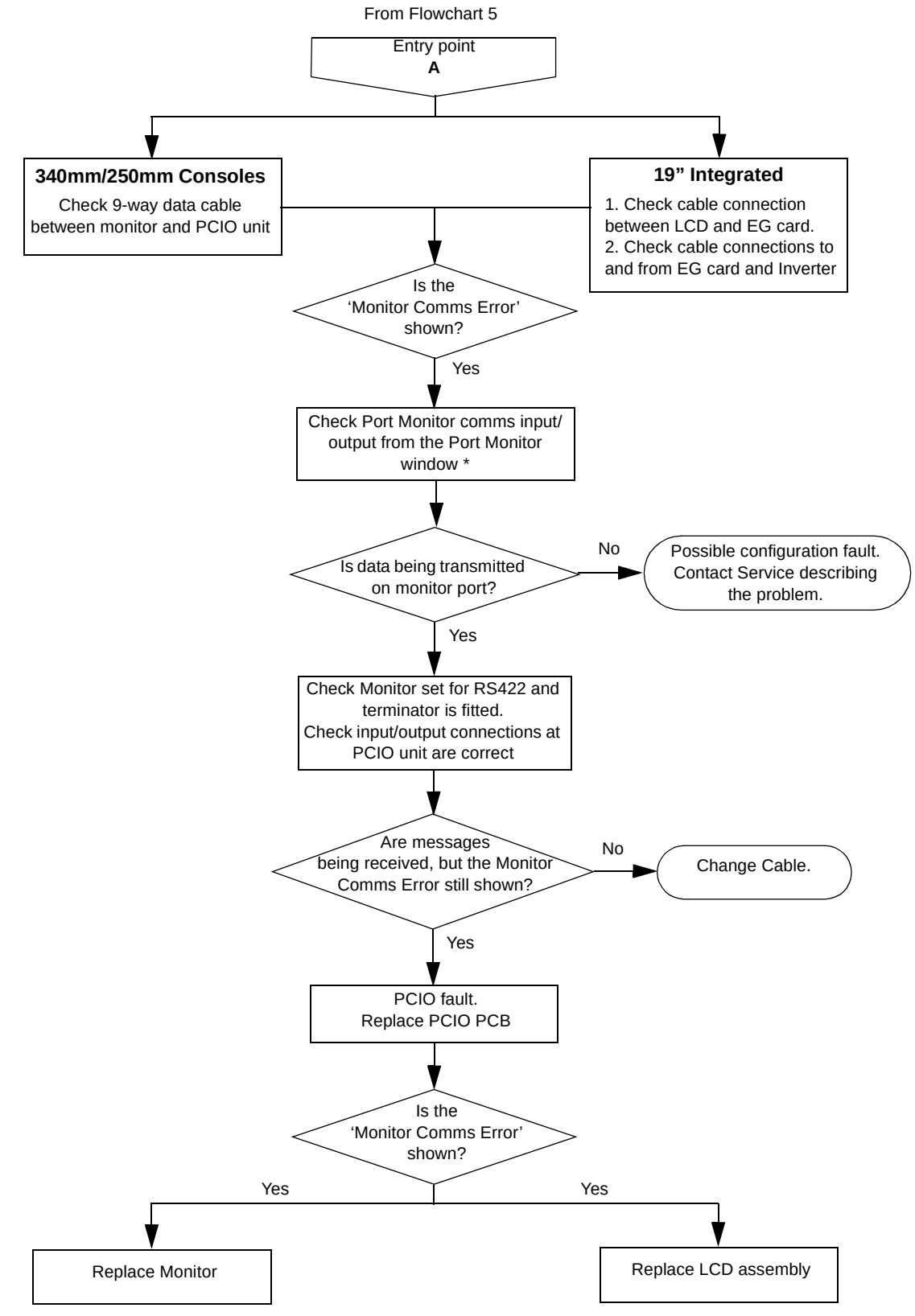
FLOWCHART 4 Console Faults (Picture appears with faults)



FLOWCHART 5 Console Hardware Error Messages

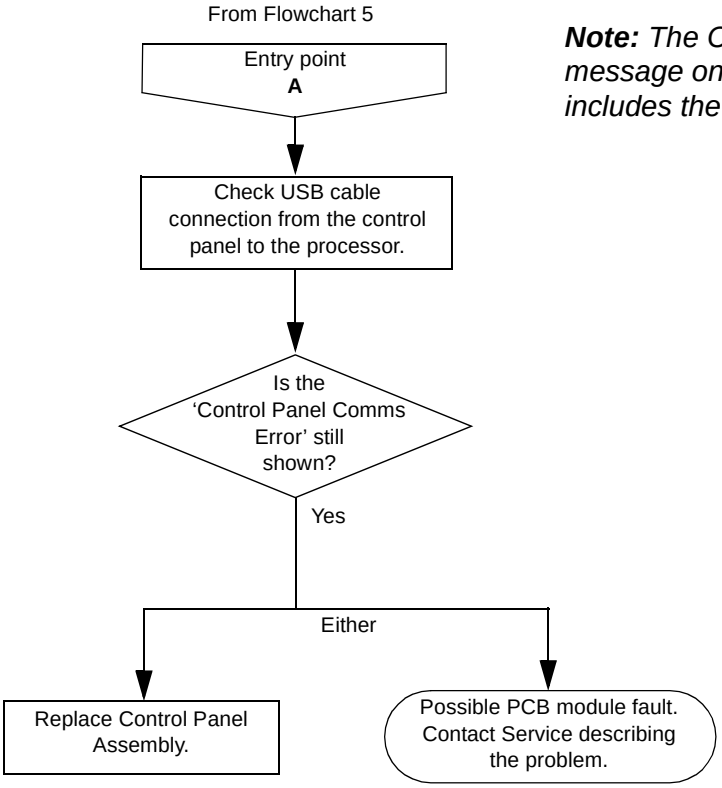


FLOWCHART 6 Error Messages (Monitor Comms Error)



*. See Service (Commissioning) section in Chapter 5 'Diagnostics and Commissioning'

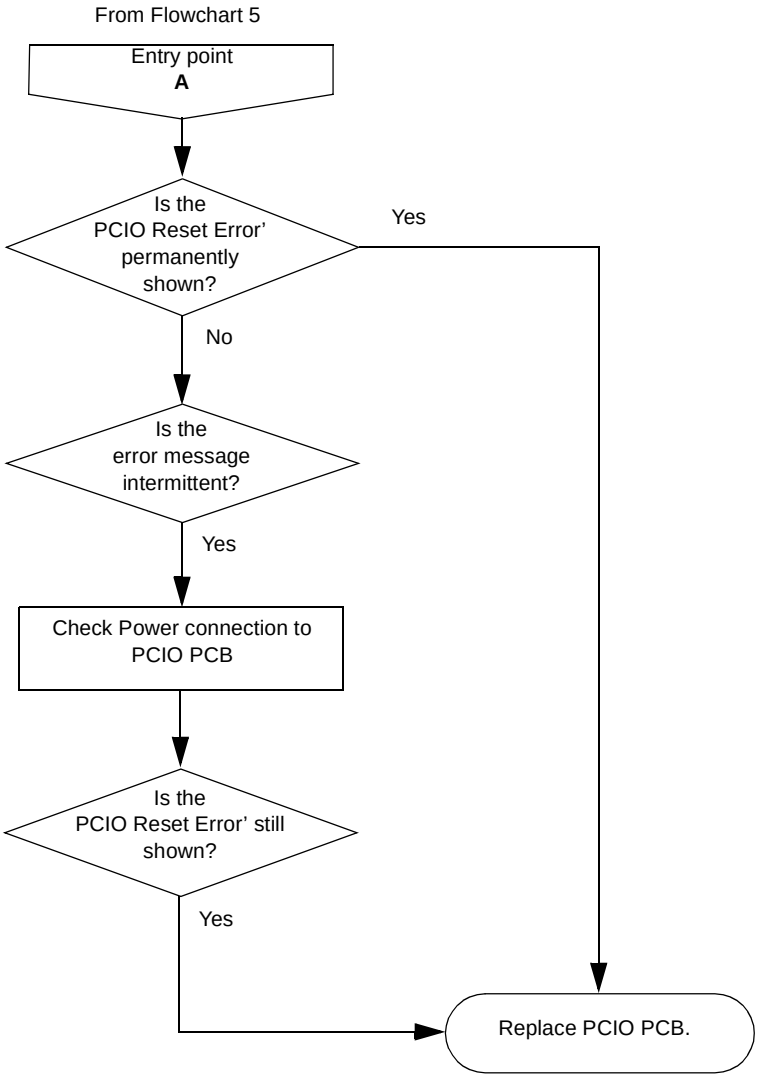
FLOWCHART 7 Error Messages (Control Panel Comms Error)



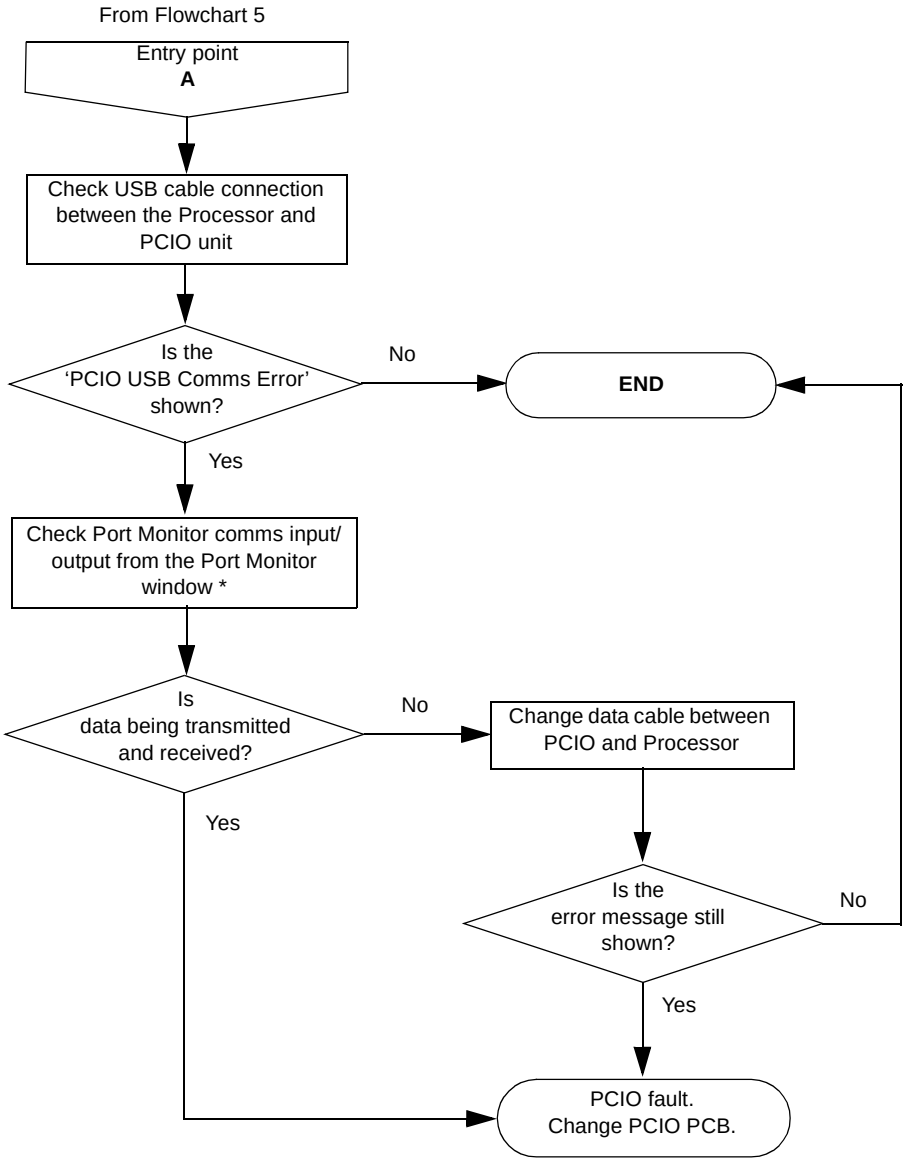
Note: *The Control Panel Comms Error message only appears if the Console includes the basic control panel (BCP).*

*.

FLOWCHART 8 Error Messages (PCIO Reset Error)

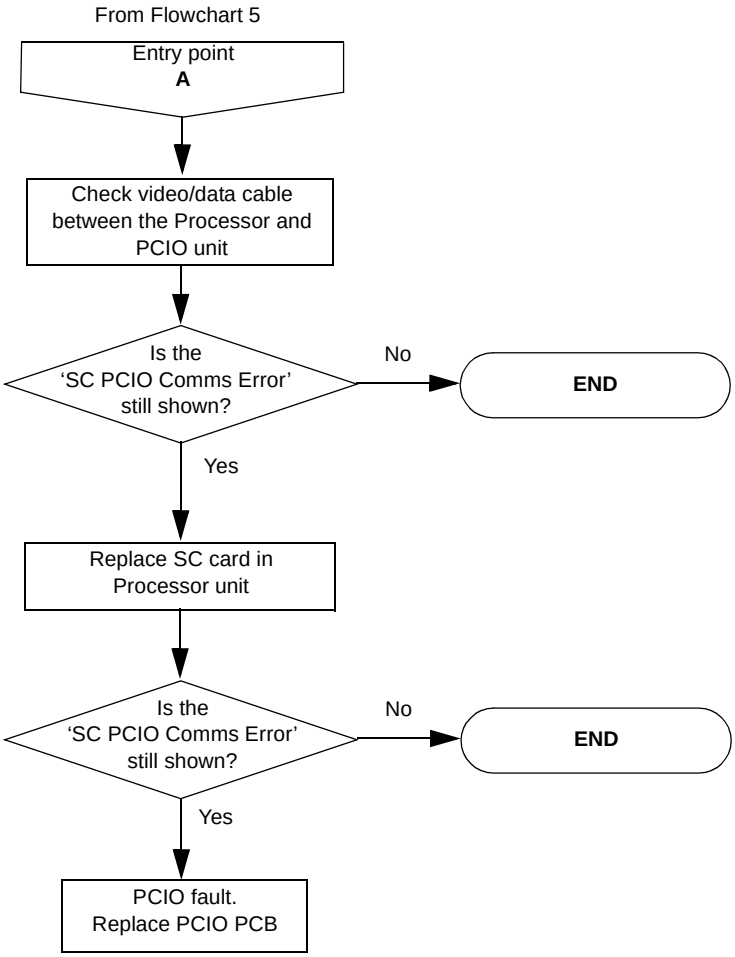


FLOWCHART 9 Error Messages (PCIO USB Comms Error)

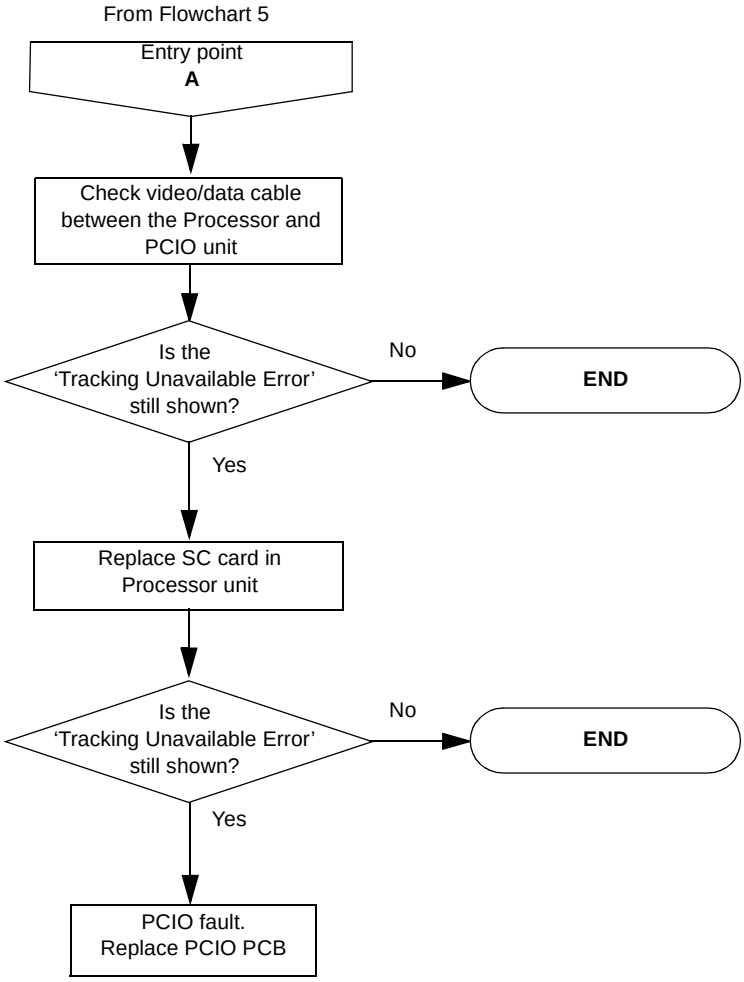


*. See Service (Commissioning) section in Chapter 5 'Diagnostics and Commissioning'

FLOWCHART 10 Error Messages (SC PCIO Comms Error)



FLOWCHART 11 Error Messages (Tracking Unavailable Error)



2.8 Scanner Unit (S-band and X-band)

2.8.1 Technical Description

There are four basic types of Scanner Unit:

- S-band with an integral transceiver module
- S-band without an integral transceiver (bulkhead mounted)
- X-band with an integral transceiver module
- X-band without an integral transceiver (bulkhead mounted)

Each type has variants dependent on motor supply and the options that are fitted.

Each Scanner Unit includes the following assemblies:

- Antenna
- Antenna Support Casting
- Turning Unit.

The Turning Unit includes the following items:

- Motor and Gearbox
- Bearing and Heading Marker PCB
- Input PCB
- optional Performance Monitor
- optional integral Transceiver module.

The Transceiver Unit includes the following items:

- Base casting
- Cover
- Transceiver module
- Input PCB.

A serial data link is used to communicate between the Transceiver and the Console. If a separate Transceiver Unit is used, an RF feeder (coaxial for S-band; waveguide for X-band) is used to transfer the microwave energy between the Transceiver unit and the Turning Unit.

2.8.2 S-Band Unit Physical Arrangements

The S-band Turning Unit is constructed from a central aluminium casting, with a motor and gearbox attached to one side. The terminal strips for interconnecting cables to other units are under a cover on the opposite side to the motor and gearbox.

At either end of the Turning Unit there is an aluminium cover. The Performance Monitor (if fitted) is housed under the front cover. The integral Transceiver Unit is housed under the rear cover. If Transceiver Unit is bulkhead mounted, a shallower cover is used.

The Transceiver Unit can be removed for below decks servicing.

Four M16 bolts are used to attach the Scanner Unit to the radar platform or wheelhouse roof. The Antenna is attached to the Turning Unit by the Antenna Support Casting. An RF feeder cable is used to transfer the microwave signals between the Turning Unit and the Antenna.

Interconnections between the Scanner Unit and other units in the system are made using screened cables. All the cables that enter the Scanner Unit do so via waterproof cable glands that use an EMC gasket which makes contact with the cable braid.

The bulkhead mounted Transceiver is attached using four M8 bolts, studs or screws (coachbolts).

2.8.3 X-Band Unit Physical Arrangements

The X-band Turning Unit is constructed from upper and lower aluminium castings. The upper casting is hinged at one end to the lower casting for service and installation. The motor, gearbox and drive assembly are bolted to the upper casting. The transceiver module, when fitted, is bolted to the upper casting and can be removed as a unit for below-decks servicing.

The terminal strips for the interconnecting cables to other units are under a screen cover on the base of the lower casting. The Performance monitor is housed beneath the upper casting and has a microwave-transparent cover protecting it, fitted on the top surface of the upper casting.

Four M10 x 45 bolts are used to attach the Scanner Unit to the radar platform or wheelhouse roof. The Antenna Support Casting attaches the Antenna to the Turning Unit. This directly transfers the microwave signals between the Turning Unit and the Antenna.

Interconnections between the Scanner unit and other units in the system are made using screened cables. The exception is the Bulkhead system, where the microwave signals are carried between the Turning Unit and the Transceiver via a waveguide.

All the cables that enter the Scanner Unit through waterproof cables glands. These incorporate an EMC gasket that makes contact with the cable braid.

The separate Transceiver is designed to be bulkhead mounted and is attached using four M8 bolts, studs or screws (coachbolts).

2.8.4 Transceiver Module Overview

The Transceiver module can be fitted in the Turning Unit, or mounted on a casting for below-decks bulkhead mounting as a separate unit.

Both Transceiver units (integral and bulkhead mounted) contain the following modules:

- Modulator PCB;
- Power Supply PCB;
- Trigger PCB;
- Receiver;
- microwave components.

Communication between the Transceiver unit and the PCIO unit is via two serial data links; one from the Transceiver to the PCIO unit, and one from the PCIO unit to the transceiver.

This data is transmitted using a special cable that consists of four twisted pairs:

- two pairs are used for data transmission as above
- one pair is used for the trigger
- the other pair is spare

The data passed from the Transceiver to the PCIO includes:

- Heading Marker
- Incremental Bearing
- Transceiver Status
- Error Messages
- Built In Test Equipment (BITE) data
- Tuning Indicator

The data transmitted from the PCIO to the Transceiver includes:

- Standby/Transmit
- Pulse Length
- Tuning
- AFC/Manual
- Sector Blanking
- Performance Monitor control, and Installation Settings

2.8.4.1 Power Supply

The power supply operates from the ship's AC mains, and supplies all of the power requirements for the electronic modules within the Turning Unit and Transceiver. The AC mains is always present at the power supply even when the radar is switched off at the Display.

The presence of data on the serial data link, when the Display is switched on, is detected by the power supply, which then becomes active.

The power supply includes a Power Factor Correction circuit, and a number of switching regulators to generate the necessary voltage supplies.

Overcurrent detection circuits protect the power supply against overloads on its outputs.

2.8.4.2 Trigger PCB

The Trigger PCB processes the serial data from the PCIO Unit, and generates the required control signals for the Transceiver. It monitors functions within the Transceiver and the Heading Marker and then encodes the information for transmission to the PCIO.

The data is transmitted each time a bearing pulse is received from the Turning Unit.

The Trigger PCB generates the various timing signals required by the Transceiver, including the Pulse Repetition Frequency (PRF).

2.8.4.3 Modulator PCB

The Modulator PCB generates the high-voltage negative pulses needed to drive the magnetron. The modulator pulse widths and timing signals are controlled from the Trigger PCB.

A spark gap on the modulator is fired if the magnetron fails to operate. Continual operation of the spark gap is detected, and a signal is fed back to the Trigger PCB. When the Trigger PCB detects this signal it switches the radar to standby, and generates an error signal that is sent to the PCIO Unit via the serial data link. The error signal causes the display to switch to standby and generate an error alarm.

2.8.4.4 Microwave

The Transceiver uses a conventional three-port circulator to direct the path of the microwave energy to and from the antenna. A magnetron, coupled to the circulator, produces the RF energy that is transmitted.

A solid-state limiter, coupled to the circulator, protects the Receiver from high-powered microwave signals from the magnetron, or adjacent radars. On Scanner Units and Transceivers fitted with 'additional features' options, a biased limiter is fitted in place of the standard limiter.

A signal from the Trigger PCB is used to enable swept attenuation to be applied to the solid-state limiter. This reduces the system sensitivity at short ranges.

2.8.4.5 Receiver

The receiver consists of the following:

- low noise amplifier;
- mixer;
- linear pre amplifier;
- logarithmic amplifier;
- video amplifier.

The mixer has a 60MHz output, which is amplified by the linear pre-amplifier followed by the logarithmic amplifier. When the output is detected, the resulting video signal is then further amplified before transmission to the PCIO.

The Receiver also includes an AFC system. Once the Receiver has been tuned, the AFC system makes sure the Receiver remains in tune during variations in tuning due to thermal drift of the mixer, magnetron etc.

The operator can select between manual tuning and automatic tuning. A signal from the Trigger PCB is used to select the mode of operation. A signal from the AFC circuit is fed to the trigger circuit to indicate the state of tune of the Receiver. This signal is at its minimum value when the Receiver is correctly tuned.

2.8.5 Automatic Start-up Sequence

The automatic start-up sequence described below, should be read in conjunction with Figure 4.19 '*S-band Turning Unit Schematic*' for S-band scanners and Figure 4.36 '*X-Band Turning Unit (Aloft) Schematic*' for X-band scanners.

2.8.5.1 Start-up



WARNING! - LETHAL VOLTAGE HAZARD

When mains power is applied to the Transceiver PSU board the Power Factor Correction (PFC) circuitry starts and generates 390V.

When mains power is applied, the PFC is active and cannot be manually switched off.

The start circuitry only controls the flyback converter. High-voltage DC is present on primary power components whenever mains power is present on the board.

The Power Supply in the Transceiver is only active during normal operation when there is a PCIO connected to it. The RS422 serial data stream from the PCIO is used to drive an opto-coupler in the PSU. This detects the presence of either polarity voltage and enables the flyback converter in the PSU.

The RS422 serial data stream from the PCIO enters the Input Board on connector TSB1, 2 (as "DU DATA +" and "DU DATA-"). It is then passed to the Trigger Board via PLYB 16, 17, and then on to the PSU via PLTH 11, 12 (as "PSU START" and "PSU START RTN").

For test purposes the PSU can be turned on in the absence of a serial data stream by linking pins 1–2 on LKA (PSU).

2.8.5.2 Transmit Enable

When the operator selects Transmit the TU Enable signal is activated LOW on the Trigger PCB (PLYH 10).

On the S-band Scanner Unit this signal is fed, via the Power Supply Unit, to the Input PCB and, via TSB 10, to the Scanner Control Unit to start the antenna rotating.

On the X-band Scanner Unit, this signal is fed to the Power Supply Unit and via the Turning Unit On/Off and Input PCB to the Motor Drive PCB to start the antenna rotating.

Once the antenna has done one complete revolution, transmission is started. When standby is selected transmission is immediately halted and, after one complete revolution of the antenna, TU Enable is disabled.

The Modulator starts to generate radar pulses when the Trigger PCB sends MOD TRIGGER pulses (to PLVC 9).

Note: *The CHARGE TRIGGER pulse (on PLVC 8) is present even in Standby mode.*

A signal indicating that the Magnetron has fired is fed via MAG SAMPLE from PLVC 7 on the Modulator PCB to the Trigger PCB. This signal is processed on the Trigger PCB and outputs as TX TRIG (PLYB 20 and 21) to the Input PCB (PLZB 20 and 21) and then to the PCIO Unit via TSB 5 and 6.

Note: *TX DATA is sent from the Transceiver to the PCIO. DU DATA is sent from the PCIO to the Transceiver.*

The Trigger PCB processes the serial data input from the PCIO, and generates the required control signals for the Transceiver. The data is transmitted each time a bearing pulse is received from the Turning Unit.

The Trigger PCB generates the various timings signals required by the Transceiver including the Pulse Repetition Frequency (PRF).

2.8.5.3 Magnetron Operation

The Modulator PCB generates the high-voltage negative pulses required to drive the magnetron. The modulator pulse widths and timing signals are controlled from the Trigger PCB.

A spark gap on the Modulator is fired if the magnetron fails to operate. Continual operation of the spark gap is detected and a signal is fed back to the Trigger PCB.

On detection of this signal, the Trigger PCB switches the radar to Standby, and generates an error signal. This is transmitted to the Display Unit via the serial data link. The error signal causes the Display Unit to switch to Standby and generates an error alarm.

When Standby is selected, rotation of the Antenna is inhibited. Transmission from the radar is inhibited if the Antenna is not rotating (unless in Test Mode).

On the Trigger PCB, there is a timer circuit. This is basically a capacitor that slowly discharges (between 4 seconds and 18 seconds) when power is removed from the PCB. On power-up the microcontroller measures the charge remaining on the capacitor. It determines whether the Transceiver has been switched off for long enough to require inhibiting transmit. Transmit is inhibited for three minutes until the magnetron heaters have had time to warm up again.

The other analogue signals into the Trigger PCB come from the Modulator. The Modulator supply voltage and the magnetron current (only when transmitting) are measured and sent to the PCIO as an aid to fault finding.

The spark gap detect signal is generated by the modulator when the magnetron arcs over. If it reaches a predetermined level the microcontroller inhibits transmission for approximately one second and sends an error message to the Display.

2.8.6 Turning Unit Overview (S-band)

2.8.6.1 Drive System

The scanner motor is an AC induction motor. It drives either a 12:1 or a 20:1 reduction gearbox. The output of the gearbox drives the final output helical gear via a pinion. This gives an overall reduction between the motor and Antenna of approximately either 30:1 or 60:1 dependent on whether the Turning Unit is a high-speed variant or not.

A Scanner Control Unit connects the scanner motor to the ship's AC Supply. This unit includes a contactor, controlled by the Transceiver, to switch the scanner motor on.

When standby is selected, rotation of the Antenna is inhibited. Transmission from the radar is inhibited if the Antenna is not rotating (unless in test mode). An isolating switch is supplied, for AC systems, to switch the scanner motor supply off for safe servicing.

2.8.6.2 Bearing and Heading Marker System

A disc with 128 teeth is attached to the antenna torque tube and, combined with an opto-coupler, generates 128 pulses per rotation of the Antenna.

A second opto-coupler together with a flag on the toothed disc generates a Heading Marker. This is approximately 10° before the Antenna is pointing dead ahead. Correct alignment of the Heading Marker is set at system configuration.

Sometimes it is not possible to adjust the Heading Marker alignment at configuration. Optional extra circuitry can be fitted to the Input PCB to let the alignment be set electronically within the Turning Unit. When this option is fitted an additional (isolated) Heading Marker output is supplied.

As an option, for special applications, a size 11 synchro can be fitted as an alternative source of bearing information.

2.8.6.3 Interconnections

AC power to the motor is by direct connection to terminal strips in the terminal box attached to the motor. The terminations for interconnections for the Transceiver and the Turning Unit are under a cover on the side of the Turning Unit. The AC power from the isolating switch is terminated at a terminal block within the filter box. All other connections are made to plugs or removable terminal strips on the input PCB.

2.8.7 Turning Unit Overview (X-band)

2.8.7.1 Drive System

The scanner motor is a 3-phase electronically commutated DC motor. The motor commutation drive signals are supplied by the Motor Drive PCB, which can give high- and low-speed operation by link selection.

The motor drives an integral 32:1 reduction gearbox. The output of the gearbox drives a pulley system with a single toothed belt having a reduction ratio of 3:1. The final pulley is attached to the Antenna torque tube assembly. The overall reduction between the motor and Antenna is approximately 96:1.

When standby is selected, rotation of the Antenna is inhibited. Transmission from the radar is inhibited if the Antenna is not rotating (unless in test mode).

A switch is provided on the Scanner Unit to inhibit rotation for safe servicing.

2.8.7.2 Motor Drive Board (Including the Dynamic Brake Facility)

The Motor Drive PCB generates the supply and control signals for the 3-phase electronically commutated DC motor that turns the Scanner Unit.

Link LK1 is used to select between high- or low-speed operation. The link should be set between pins 1 and 2 for low-speed operation (Factory Default). For high-speed operation, the link is parked on pin 1, or not fitted. For remotely selectable antenna speed the link should be set between pins 2 and 3. If no link is fitted, the default is high-speed operation.

On Scanner units fitted with the 'additional features' option, additional circuitry allows the links to be selected by a remotely mounted switch. This gives the operator the option to change the antenna rotation speed.

The Motor Drive PCB is supplied with +50VDC from the Transceiver power supply (in both Aloft and Bulkhead versions).

Pulling control line 'TU Enable' below 1.5 volts starts a slow build up of speed up to the maximum set by the speed selection link. The 6 output FET switches, which perform the commutation are protected by a current sensing and limiting circuit, in the event of overload or stall.

Signals form the Hall Sensors in the motor are used to control the commutation sequence, and are also used to provide a degree of speed compensation in high wind load conditions. An additional feature of the PCB is a Dynamic Brake that prevents the antenna from 'windmilling' when the radar is turned off or on standby. This circuit is passive and will operate with no supply voltage.

2.8.7.3 Bearing and Heading Marker System

A disc with 128 teeth is attached to the Antenna torque tube and, combined with an opto-coupler, generates 128 pulses per rotation of the Antenna.

A second opto-coupler together with a flag on the toothed disc generates a Heading Marker approximately 10° before the Antenna is pointing dead ahead. Correct alignment of the Heading Marker is set at system configuration.

Both opto-couplers are on the Pulse Bearing PCB. The Pulse Bearing PCB multiplies the 128 bearing pulses by 32 to generate 4096 pulses per antenna revolution. The 4096 azimuth pulses and the heading marker are routed through the Input PCB to the Trigger PCB. They are then incorporated into the serial data to be transmitted to the PCIO Unit.

Link LK1 is used to select between high- or low-speed operation. The link should be set between pins 1 and 2 for low-speed operation (Factory Default). For high-speed operation, the link is parked on pin 1. For remotely selectable antenna speed, the link should be set between pins 2 and 3. If no link is fitted, the default is high-speed operation.

On Scanner units fitted with the additional features option an additional relay allows the links to be selected by the same remotely mounted switch used to select the antenna rotation rate. This makes sure speed settings match those remotely selected on the motor drive PCB.

On scanner units fitted with the additional features option, a method is given (on the Input PCB) to allow the heading marker alignment to be made electronically within the Turning Unit. When this option is fitted an additional (isolated) Heading Marker output is supplied. As an option for special applications a size 11 synchro can be fitted as an alternative source of bearing information.

2.8.7.4 Interconnections

The terminations for interconnections for the Transceiver and the Turning Unit are under a cover on the inside of the lower casting of the Turning Unit. The AC power from the isolating switch is terminated at a terminal block within the filter box on the inside of the lower casting of the Turning Unit. All other connections are made to plugs or removable terminal strips on the Input PCB.

2.8.8 Trigger PCB

2.8.8.1 General Description

The Trigger PCB controls the operation of the Transceiver, under instruction from the PCIO. There are two serial links, which are used to transfer control messages from the PCIO to the Trigger PCB and Transceiver information back to the PCIO.

The Trigger PCB generates the control and tuning signals required by the Modulator, Receiver, Performance Monitor (PM) and Biased Limiter. The PSU is enabled with a signal from the Trigger PCB.

Signals To/From the Trigger PCB

To/From the PCIO unit:

- Serial Data to PCIO
- Serial Data from PCIO
- Trigger to PCIO

To/From the Modulator:

- Pulse Length select lines
- Charge and Modulator Triggers
- Magnetron Heater Turndown signal (only used for S-band, Long Pulse operation)
- Voltage/Current Monitor signals
- 10/25kW and S-band/X-band Configuration signals

To/From the Receiver:

- Tuning Voltage signal
- Bandwidth Control signal
- AFC/Manual control
- AFC Trigger
- Tune Indicator signal

To Biased Limiter

- Trigger signal

To the Performance Monitor:

- On/Off signal
- Mode Control signal
- Tuning Voltage signals

To/From the Power Supply PCB:

- +30V, +12V, +5V, 0V and -12V Supply lines
- Turning Unit Enable
- Power Supply Start and Return

2.8.8.2 Functional Description (Trigger PCB)

The 80C51 family microcontroller supplies overall control of the Trigger PCB functions. Program memory and RAM are included within the microcontroller IC. Serial I/O is handled by the microcontroller's internal UART and an external RS422A driver and receiver. Baud rate is fixed at 76800 baud for operational use but is link selectable to 19200 or 38400 baud for test purposes. The serial data format is 8-bit data, 1 stop bit and even parity.

The PCIO sends serial messages consisting of four or five characters depending on the message content. Control messages are four bytes long and tuning messages are five.

The tuning voltage levels are sent as 12-bit values. These are converted on the Trigger PCB using a four-channel DAC. They are then amplified/ buffered and distributed to the Receiver and PM.

The Bearing signal from the Turning Unit is used to start serial transmission from the Trigger PCB. Each time one of the 4096 azimuth pulses per revolution is generated and fed into one of the microcontroller's interrupt pins, a character (one byte) is sent to the PCIO. One bit in each of the characters sent is dedicated to the heading marker. On every new heading marker pulse from the Turning Unit, the bit is toggled.

The Power Supply in the Transceiver is only active during normal operation when there is a PCIO connected to it. The RS422 serial input from the PCIO is used to drive an opto-isolator, which detects the presence of either polarity voltage and enables the PSU.

2.8.8.3 Trigger Outputs

The following trigger signals are generated by the Trigger PCB:

- Pre-Trigger
- Charge Trigger
- Modulator Trigger
- PCIO Trigger
- Performance Monitor Trigger
- AFC Trigger
- Swept Attenuation Initiate

The Charge Trigger is the timing signal used to recharge the Modulator PFN. This is generated by the microcontroller using an internal timer routine set to the appropriate PRF for the pulse length selected.

A wobbulation factor is added to the basic timing to make sure no two radar transmissions are locked together. The wobbulation is calculated according to the number of serial messages received before going to transmit and the position of the antenna between each trigger pulse.

An optional Pre-trigger will be produced approximately 11µs before the Modulator trigger. This is not normally fitted and is intended for use in Special Options applications.

The Modulator Trigger is used to let the charge out of the PFN into the magnetron and is the trigger that starts the modulator firing. It is delayed from the Charge Trigger by 100µs and gated off when the Transceiver is in standby.

In standby, the PCIO and PM Triggers are generated from the Modulator Trigger pulse. When the transceiver is in transmit mode the triggers begin on the leading edge of the magnetron sample pulse and end after a preset time, adjustable using RV1.

The AFC Trigger is used by the Receiver when in AFC mode and is only generated when the Transceiver is in transmit mode. The pulse is started on the front edge of the Modulator Trigger and terminates on the back edge of the magnetron sample pulse.

The Swept Attenuation Initiate pulse is the timing signal fed to the Limiter Drive PCB, which generates the control for the biased limiter. It is started by the edge of the Pre-trigger (approximately 2µs prior to magnetron firing) and terminated 2.5µs after the leading edge of the magnetron sample pulse.

The PCIO and PM Triggers are essentially the same trigger and are present at all times when the radar is powered up. They are initiated by the Modulator Pulse and last for approximately 2.5µs.

2.8.8.4 Analogue Outputs

The Trigger PCB generates four tuning signals:

- LO Tune
- PM Tune
- Xr Adjust
- Xt Adjust

These signals are coded as 12-bit digital values and incorporated into the serial messages from the PCIO. A 12-bit, four-channel DAC is used to generate the tuning signals from the message data. Additional buffering is added to the LO and PM Tune outputs of the DAC and ×3.5 amplification to the Xr and Xt Adjust signals.

LO Tune is the 0V to +5V receiver tuning control and PM Tune the 0V to +5V PM main tuning control. Xr and Xt Adjust are 0V to +15V signals used to control the receive and transmit attenuators in the PM.

2.8.8.5 Analogue Inputs

There are various analogue inputs to the Trigger PCB from other PCBs in the Transceiver. There are also some on-board signals that are fed into an eight channel 8-bit ADC, and converted to digital values. These are used for further processing by the microcontroller, or are passed to the PCIO via the serial message link.

The signals on the Trigger PCB that are measured are the dropout timer and +12V and +30V supplies. The timer circuit is basically a capacitor that slowly discharges (between 4s and 18s) when power is removed from the PCB.

The microcontroller determines whether the transceiver has been switched off for long enough to require inhibiting transmit. Transmit is inhibited for three minutes until the magnetron heaters have had time to warm up again. The power supply levels are measured and the results sent to the PCIO as an aid to fault diagnosis.

One channel of the ADC is used to detect if a PM has been fitted to the system. The voltage on this channel will be lower than a preset value if a PM is present otherwise it will be pulled to the +5V supply rail. This information is encoded and sent as part of the configuration message to the PCIO.

The Receiver sends a tune indicator signal to the Trigger PCB, which shows how close it is to being on tune. This signal is coded as part of the serial message and sent to the PCIO.

The other analogue signals into the Trigger PCB come from the Modulator. The Modulator supply voltage and the magnetron current (only when transmitting) are measured and sent to the PCIO as an aid to fault finding.

The spark gap detect signal is generated by the modulator when the magnetron arcs over. If it reaches a predetermined level the microcontroller inhibits transmission for approximately one second and sends an error message to the PCIO.

2.8.8.6 Digital Outputs

The digital outputs from the Trigger PCB are all simple on/off control signals to various parts of the transceiver.

Signals to the Receiver select wide or narrow bandwidth (Wideband) and AFC (AFC On) or manual tuning mode. Narrowband is selected when the modulator is transmitting in long pulse and briefly during pulse length changing. AFC or manual mode is selected by the radar operator and is part of the control message sent from the PCIO.

Modulator signals MP and SP are used to set the pulse length as requested by the radar operator:

- SP set to 0V indicates short pulse operation
- MP set to 0V indicates medium pulse operation
- Both SP and MP set to +5V indicates long pulse operation.

- SP and MP both set to 0V is an illegal state and will not happen in normal operation.

Turndown enable is used to reduce the heater current in the magnetron. It is only set when an S-band magnetron is fitted and is transmitting in long pulse.

The control signals PM On/Off and PM Tx/Rx are used to switch the PM on and to switch it between system test mode and receiver test mode.

TU Enable is the control signal fed to the Motor Drive PCB to start the antenna rotating. When the operator selects transmit, the TU Enable signal is activated to start the antenna rotating.

Once the antenna has done one complete revolution transmission is started. When standby is selected, transmission is immediately halted and, after one complete revolution of the antenna, TU Enable is disabled.

2.8.8.7 Optional I/O

There are several optional I/O signals for use with Special Options variants of the PCB:

- Pre-trigger (as describe in the section on triggers)
- External Trigger Input
- Radar Inhibit

The External Trigger input is used when the modulator needs to be triggered from an external source rather than the Trigger PCB. Trigger signals fed to this input are PRF limited to prevent damage to the modulator.

Radar Inhibit is a method of inhibiting transmission without using the appropriate command in the serial message. An active signal at this input will cause the microcontroller to inhibit transmission within one trigger pulse at either of the internal PRFs.

2.8.9 Built In Self Test (BIST)

The microcontroller performs several self-test operations and reports the results to the PCIO as part of the serial message link.

Error situations that are monitored in the Transceiver are:

- Serial message corruption
- Loss of PCIO messages
- Loss of Heading Marker signal
- Loss of either Charge or Modulator Trigger
- Magnetron arcing

Error situations will in all cases cause the microcontroller to inhibit transmission until the error has been cleared. The other signals that are monitored and sent directly to the PCIO without further action by the microcontroller are the power supply lines and magnetron current (described in Section 2.8.8.2 '*Functional Description (Trigger PCB)*'.

2.8.9.1 Test Modes

There are two test modes for the Trigger PCB. The production test mode is used solely during production testing of the PCB and is initiated by fitting the test link LK4. This must only be done on the production test bed as connecting this link when incorporated into a Transceiver could lead to unpredictable and possibly dangerous operation.

The second test mode, of use to service engineers, can be initiated by fitting the two links LK5 and LK6 to position 2–3. When in this mode the Transceiver can be removed from the turning unit, reconnected to the PCIO below decks (with suitable test cables) and run as per normal operation. A dummy load MUST be connected to the RF output.

In this mode, the Transceiver has been removed from the Turning Unit and the Pulse Bearing PCB outputs. The bearing and heading marker information normally required for Trigger PCB operation is simulated on a section of test circuitry on the Trigger PCB.

2.8.10 Transceiver Power Supply

2.8.10.1 General Information

The power supply is an AC to DC inverter that generates the supplies for the Transceiver. The inverter is housed on a single board and is powered by an AC supply of nominal 110/120V (low voltage) or 220/240V (high voltage) in the frequency range 50 to 60Hz.

The power unit uses a boost converter front-end to supply a regulated high-voltage DC to a flyback converter supplying the output. Some of these supplies use additional switch mode converters to supply regulated outputs.

The outputs supplied by this power supply are:

- Variable -600V
- +30V
- +20V
- Magnetron heaters (via further regulator, +12V, -12V and +5V)
- +50V for the Motor Drive PCB (for the X-band Turning Unit variant).

The power unit has the following features:

- -600V adjustable over the range -550V to -650V for control of magnetron current via modulator.
- Output short circuit protection.
- Universal input from 95V to 276V without tap changing. Power factor corrected providing a PF of better than 0.9.

The opto-coupler detects the presence of a serial data stream from the PCIO at PLTH 11, 12. The flyback converter switches on and the photo-transistor in U5 is turned on, pulling down the gate of Q2 to below its threshold voltage. Q2 turns off, letting the voltage increase on compensation pin 1 of U4. The output of IC U4 is enabled. In the PSU off state, Q2 is kept on by current in R37 from Vcc.

For test purposes the PSU can be turned on in the absence of a serial data stream by linking 1–2 on LKA.

Note: *After the mains supply is applied to the PSU board, the Power Factor Correction (PFC) circuit starts and generates 390V. While mains power is applied, the PFC is active and cannot be manually switched off. The start circuitry only controls the flyback converter and so high-voltage DC is present on primary power components whenever mains is present on the board.*

2.8.11 Modulator PCB

2.8.11.1 Functional Description

The principal function of the Modulator PCB is to generate an 8kV, 8A negative pulse to drive the cathode of the magnetron. An SCR is used to resonantly charge a Pulse Forming Network (PFN) to -1200V from the -600V Modulator HT supply. The Charge Trigger starts the charging cycle. The number of sections of the PFN can be selected by the replays that are controlled by the Pulse Length Control Lines. The number of sections of the PFN used defines the length of the output pulse.

At a defined time after the PFN is fully charged it is discharged by three series-connected Insulated Gate Bipolar Transistors through a pulse transformer. The Modulator Trigger starts the discharge. The Pulse Transformer, which has a set-up ratio of 12:1, transforms the resulting pulse to 8kV. A saturable reactor, connected across the primary of the pulse transformer, speeds up the back edges of the medium and short pulses.

Other functions include:

- regulating the magnetron heater supply;
- monitoring a spark gap to make sure the magnetron operates correctly; and
- generation of a timing reference for the Radar Trigger.

2.8.11.2 Inputs to the Modulator PCB

- -600V Modulator HT Supply
- +20V Modulator Trigger Supply
- +16V - +27V Magnetron Heater Bulk Supply
- +12V
- -12V

Short Pulse Control Line	When 0V selects short pulse.
Medium Pulse Control Line	When 0V selects medium pulse.
Charge Trigger	Starts charging of Pulse Forming Network. Typically 1Amp current pulse.
Modulator Trigger	Starts discharging of Pulse Forming Network. Typically 4µs, 3.5V positive pulse.
Turn Down Enable	DC voltage controls the magnetron heater voltage. 0V on long pulse, 3.5V Standby Medium and Short Pulse.

2.8.11.3 Outputs from the Modulator PCB

Primary sample	Positive pulse sample from pulse transformer used to initiate Radar Trigger. Typically 40V amplitude.
Magnetron current sample	A DC voltage proportional to the magnetron current derived from the secondary of the pulse transformer. Typically +2.5V.
TX Active	A signal that is normally 0V that rises to >2.5V if the spark gap operates continuously for 2 seconds. This signal is used by the Trigger PCB to indicate a transmitter fault to the PCIO.
HT Sense	Sample of Modulator HT Supply fed to Trigger PCB for inclusion in BITE message sent to PCIO.
TX Define	Link settings used to define modulator type to Trigger PCB. 0V or 3.5V dependant on link settings.

2.8.11.4 Magnetron Heater Supply

The magnetron heaters are derived from the Magnetron Heater Supply at PLVD1 and PLVD2. This supply may vary between 16V and 27V.

The setting of link LK1 (fitted to the Modulator PCB) configures the Modulator PCB for the intended magnetron. Refer to Figure 4.10 '*Modulator PCB Link Settings*' for further information.



WARNING!

NEVER measure the heater voltage while the Transceiver is transmitting.

Table 5: X-band & S-band Magnetron Heater Supply

System	Mode	**Required Magnetron heater voltage** (measured between TSJ1 and TSJ2)
10kW X-band	Standby, Short Pulse, Medium Pulse and Long Pulse	6.1V
25kW X-band	Standby, Short Pulse and Medium Pulse	6.1V
	Long Pulse	Can be reduced to 5.1 V depending on the type of magnetron fitted
30kW S-band	Standby, Short Pulse and Medium Pulse	6.1V
	Long Pulse	Can be reduced to 5.1 V depending on the type of magnetron fitted

2.9 Error Messages and Tellbacks for Transceivers

2.9.1 Error Messages

The following errors may be reported by the Transceiver:

2.9.1.1 Message Failure

The Transceiver expects to receive a message from the PCIO at least once per second. If the message rate drops below this level, the transmitter is switched to Standby and a 'Message Fail' error is shown. The Transmitter will remain in Standby until the next message is received which contains a 'transmit request bit' set to transmit.

Possible causes

- Controlling device failure.
- Inter unit cabling.
- Inter PCB cabling in Transceiver.
- Defective Input PCB (signal is only looped through).
- Defective Trigger PCB.

2.9.1.2 Corrupt Data

The Transceiver checks the parity of each character in an incoming message and verifies the checksum for each complete message. If enough corrupt messages are received a Corrupt Data error is returned.

The Transceiver stays in the state it was in when it received the last valid message. Normal operation will be resumed, and the Corrupt Data error will be cleared, when the next valid message is received.

Possible causes

- Controlling device failure.
- Bad connections or earth bonding on inter unit cabling between Transceiver and controlling device.
- Defective Inter PCB cabling in Transceiver.
- Defective Input PCB (signal looped through only).
- Defective Trigger PCB.

2.9.1.3 Spark Gap Detect

The Modulator contains a spark gap to protect the pulse transformer from excessive voltage if the magnetron misfires.

If the spark gap operates for more than two seconds this is detected and a Spark Detect error is signalled. The Transmitter is switched to Standby.

Possible causes

- Magnetron instability at end of its life.
- Missing magnetron heaters, due to Modulator PCB failure.
- Failure of Magnetron Heater Supply from the Power Supply PCB.
- Defective Inter PCB cable from Power Supply to Modulator PCB.
- Defective Modulator PCB.
- Defective Trigger PCB.

2.9.1.4 Heading Marker Failure

When operating normally the transmitter will not transmit unless the antenna is rotating. Antenna rotation is confirmed by checking for the presence of the Heading Marker.

If the Heading Marker is missing, but azimuth pulses are still present, the Transceiver will be switched to Standby and a Heading Marker Failure error message is shown on the Display.

Transmission is restored if a Heading Marker is detected, provided the PCIO has not switched the transmitter to standby.

Possible causes

- Defective Inter unit cabling from Transceiver to Scanner unit.
- Defective Digitiser or Pulse Bearing Board in Turning Unit.
- Incorrectly configured Input PCB.
- Defective Input PCB.

2.9.1.5 Mod Trig Fail, Charge Trig Fail

The Trigger PCB generates the Modulator, and Charge Triggers. If either pulse is detected as missing a Trigger Error message is returned.

Possible causes

- Defective Trigger PCB.

2.9.2 Transceiver BITE Data

The following information is transmitted from the Transceiver to the PCIO unit to be shown in the TxRx BITE folder of the Diagnostics sub menu.

Table 6: Transceiver BITE data

Parameter	Normal Range	Remarks
Magnetron Current	6.0A to 9.5A	25kW and 30kW
+12V Supply	+11V to +13.4V	
+30V Supply	+26V to +36V	
Modulator Volts	-500V to -680V	
Swept Gain	On or Off	BME transceivers only
Spark Gap	Pass	
Corrupt Data	Pass	
Message Failure	Pass	
Heading Marker	Pass	
Mod Trigger	Pass	
Charge Trigger	Pass	

Transceiver BITE data is only approximate and must not be used for making adjustments. A deviation from the above values shows a possible fault condition.

2.9.3 Tellbacks

Within the serial data transmitted by the Transceiver are a number of status tellbacks to show the Transceiver status. This data is monitored and shown on the Display unit.

The following tellbacks are used:

2.9.3.1 Transmit

This bit is set if the controlling device requests transmit and:

- The transceiver has completed its warm up.
- The Heading Marker has not failed.
- There is not a Message Fail error.
- There is not a Spark Gap error.

2.9.3.2 Inhibit

This bit is set whenever the Display unit requests 'Transmit' and the transmitter is inhibited. For example, when the Radar Silence input is active on units fitted with the 'additional features' option.

2.9.3.3 Medium Pulse and Short Pulse

These bits reflect the status of the pulse length control signals within the Transceiver. They show the status as follows:

Table 7: SP and MP bits

Selection	SP Bit	MP Bit	Receiver Bandwidth
Short Pulse	1	0	Wide
Medium Pulse	0	1	Wide
Long Pulse	0	0	Narrow
(Illegal Code)	1	1	Undefined

2.9.3.4 Wide-band

This bit shows the bandwidth selected for the receiver; when set to "1" "wideband" is selected.

The selected bandwidth is linked to the pulse-width as shown in Table 7.

2.9.3.5 AFC On

This bit indicates the tuning mode selected for the receiver; when set to "1" AFC mode is selected. For some Transceivers, this bit may be permanently set to "1" as a result of internal link settings.

2.9.3.6 Timer

This bit indicates the status of the magnetron "warm-up" timer within the Transceiver. It is set to "0" for a preset period of 180 seconds after the Transceiver is turned on. The timer lets the magnetron cathode reach its operating temperature before the HT is applied.

After the warm-up delay the Transceiver can be turned off. If it is turned back on within 10 seconds the timer will be overridden, letting it immediately return to the transmit condition.

2.10 Fault Isolating Flowcharts for S-band and X-band Scanner Units.



WARNING! LETHAL VOLTAGE HAZARD

When the covers are removed from the equipment, dangerous voltages are exposed.

Only qualified persons should work on the equipment when power is applied.

Always isolate the turning unit from the ship's supply before working on it.

Always isolate the transceiver from the ship's supply while removing or replacing the transceiver cover.

Flowcharts for isolating faults for S-band and X-band Scanner Units are given on the following pages. Flowchart 12 shows the overall flow through Flowchart 13 to Flowchart 38.

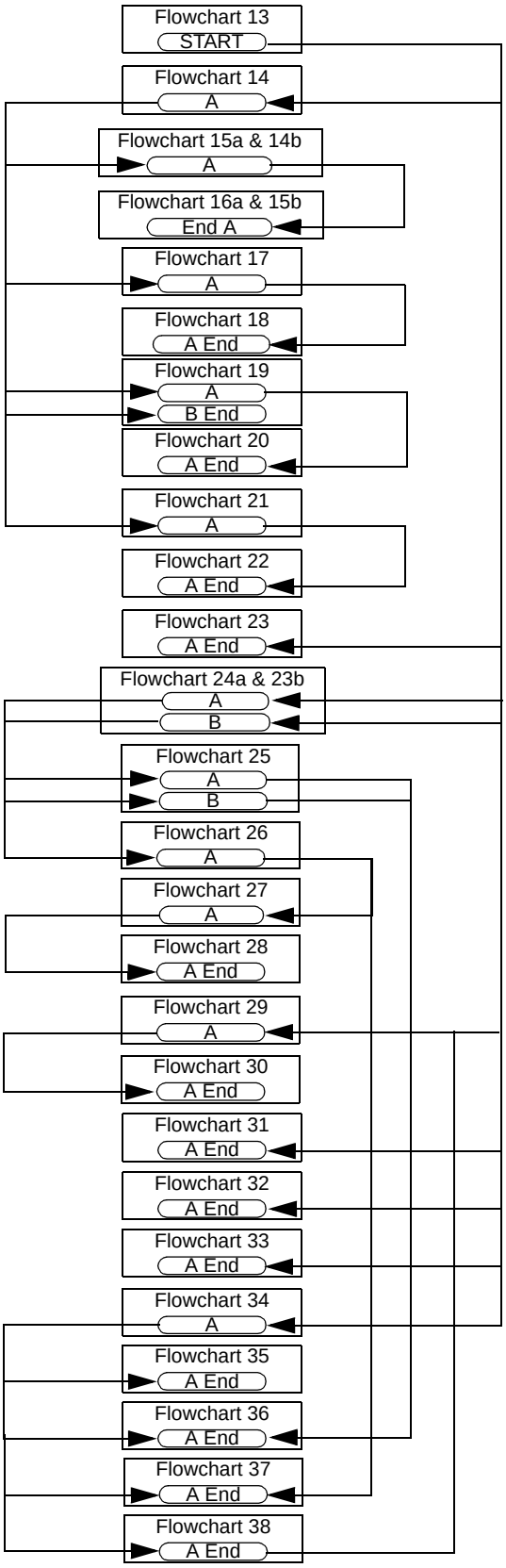
The Flowcharts should be read in conjunction with the following notes.

Note: *Before using the following fault finding flow charts visually check the components to make sure there are no loose plugs or connections.*

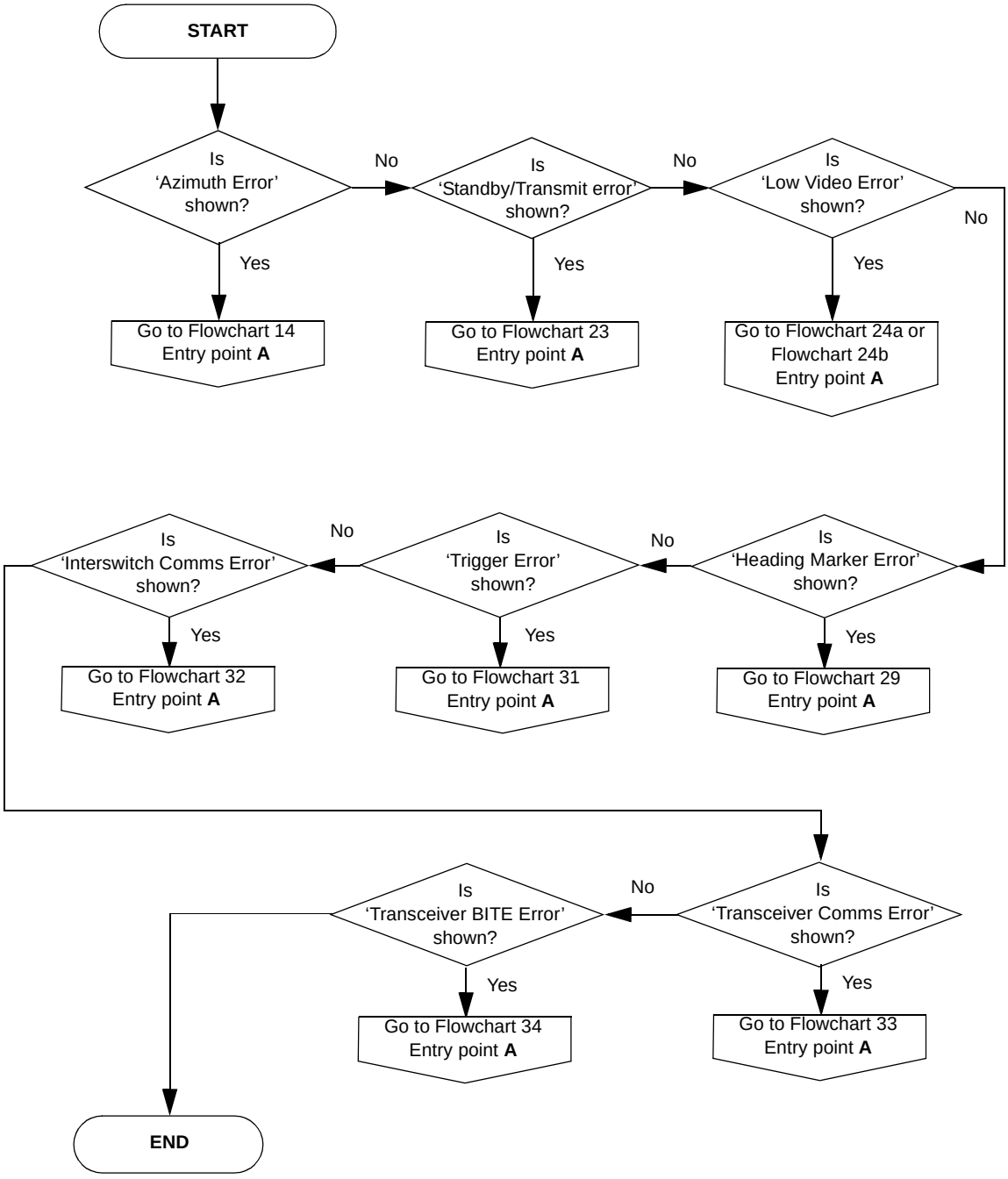
Note: *After checking the connection status of the components always check that the configuration of all components on the system is correct by accessing the Configuration tool, see Chapter 4, 'Configuration'.*

Fault Isolating Flowcharts for S-band and X-band Scanner Units. Fault Reporting and First Line Servicing

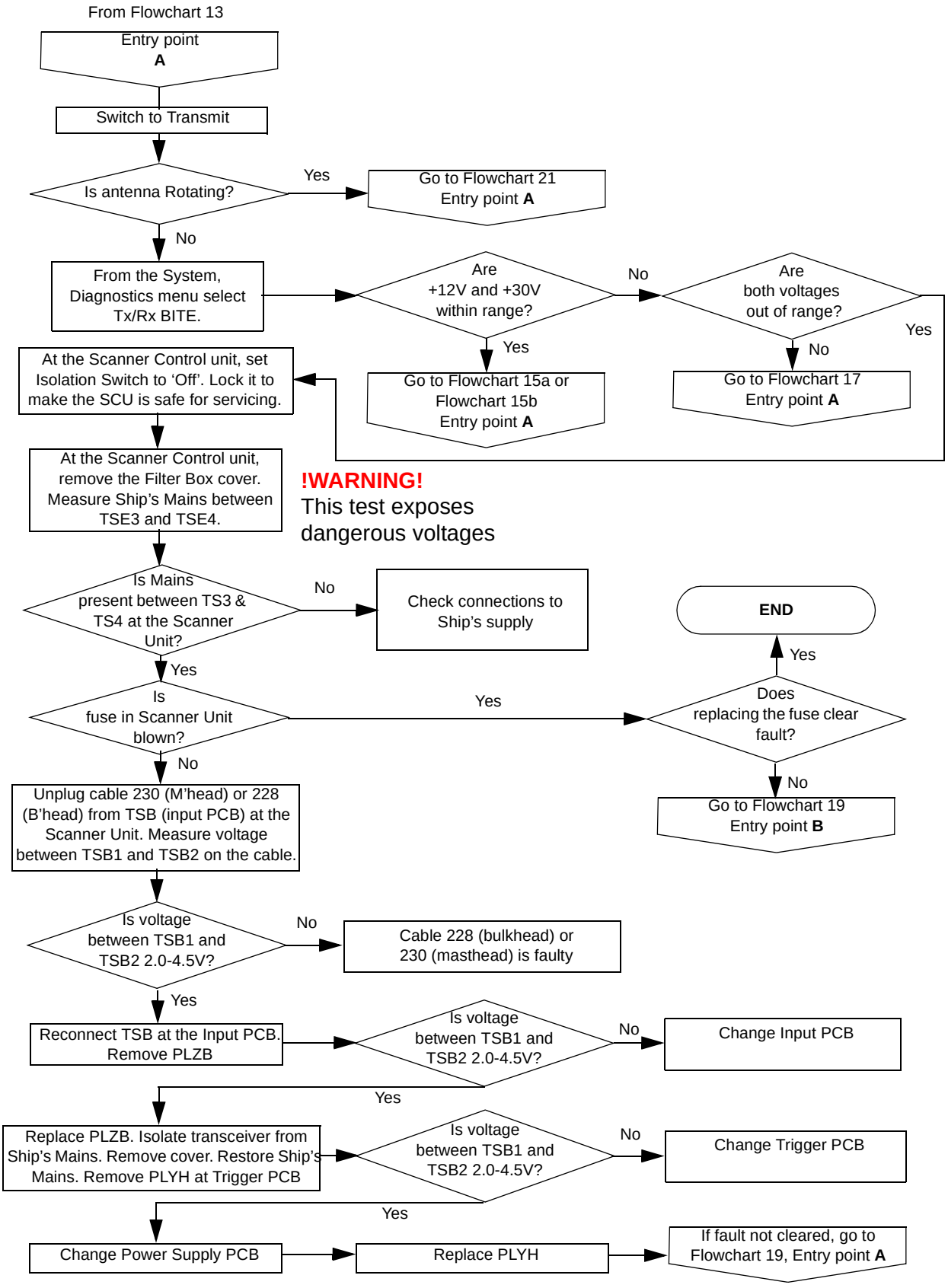
FLOWCHART 12 Overall Flowchart - Scanner Units



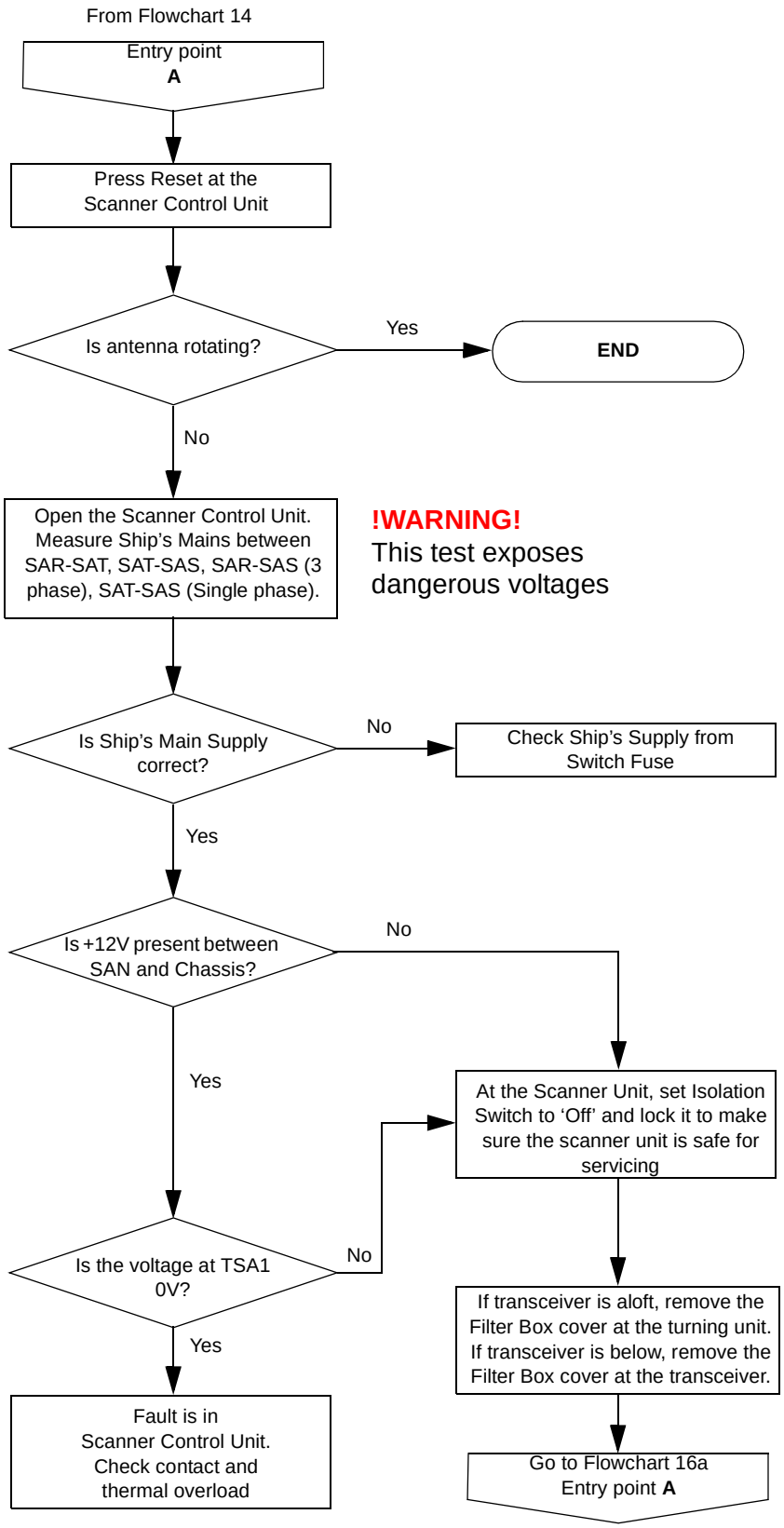
FLOWCHART 13 S-band and X-band Hardware Error Messages



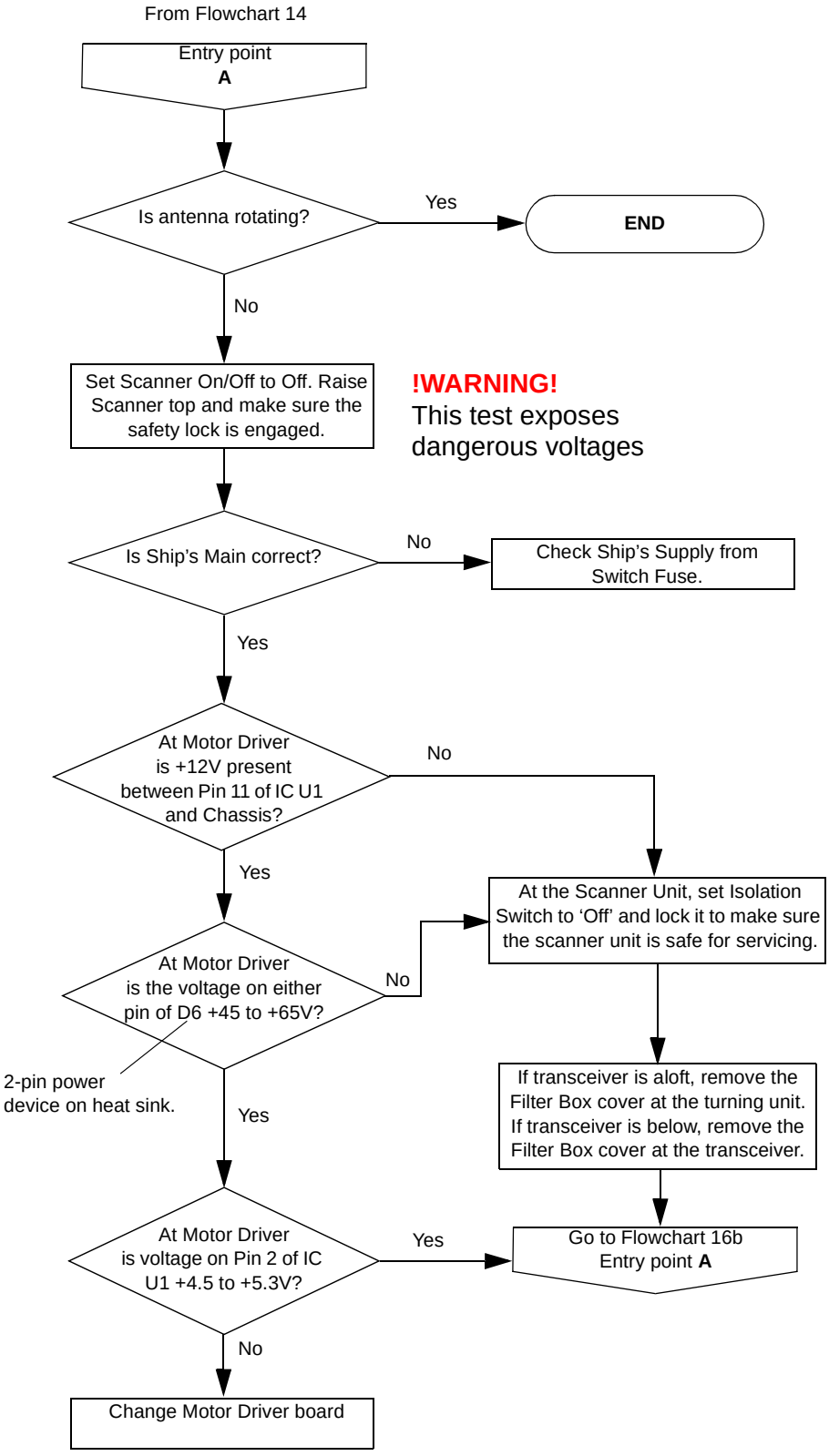
FLOWCHART 14 Azimuth Error Message



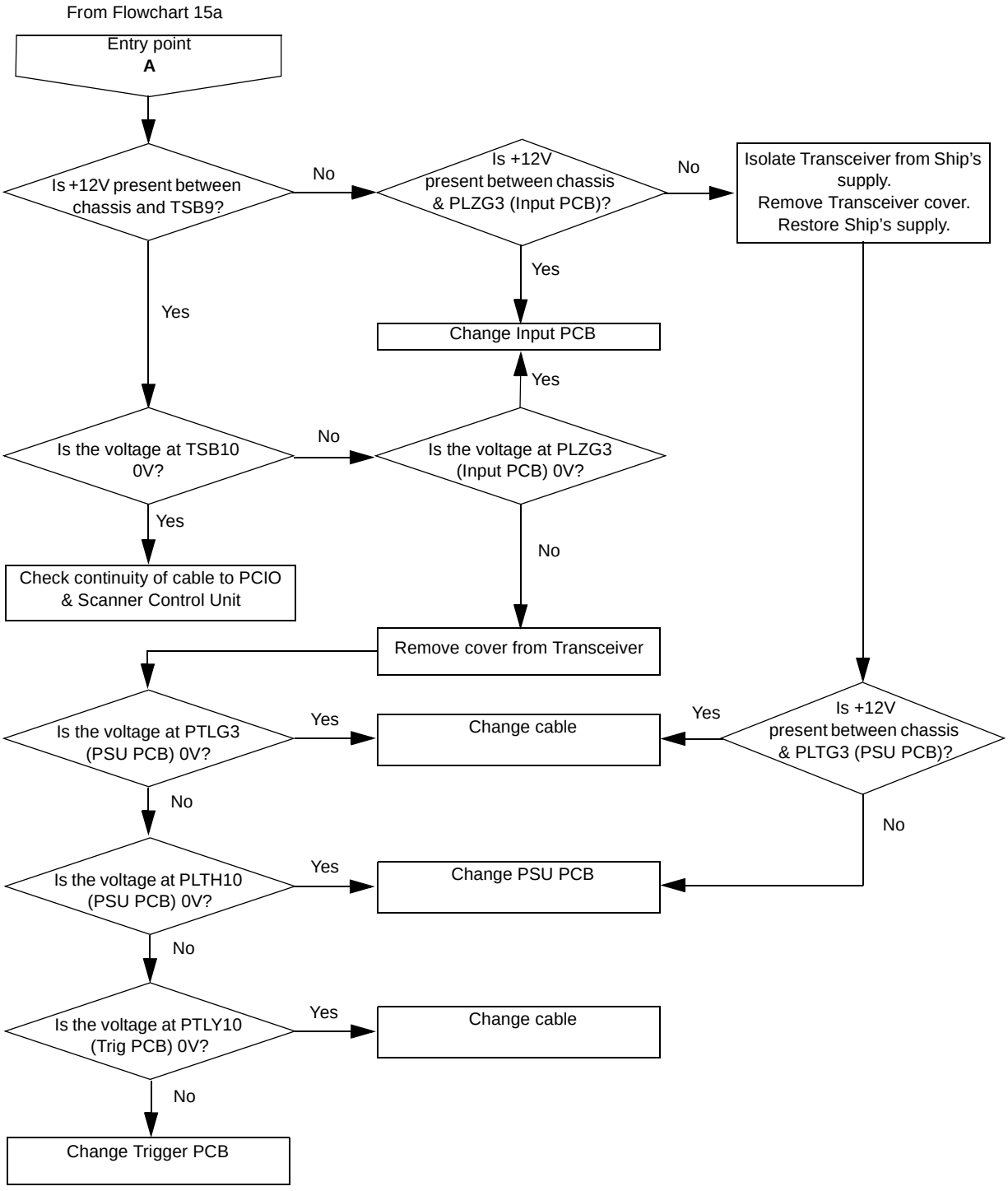
FLOWCHART 15A Azimuth Error Message (S-band Scanner)



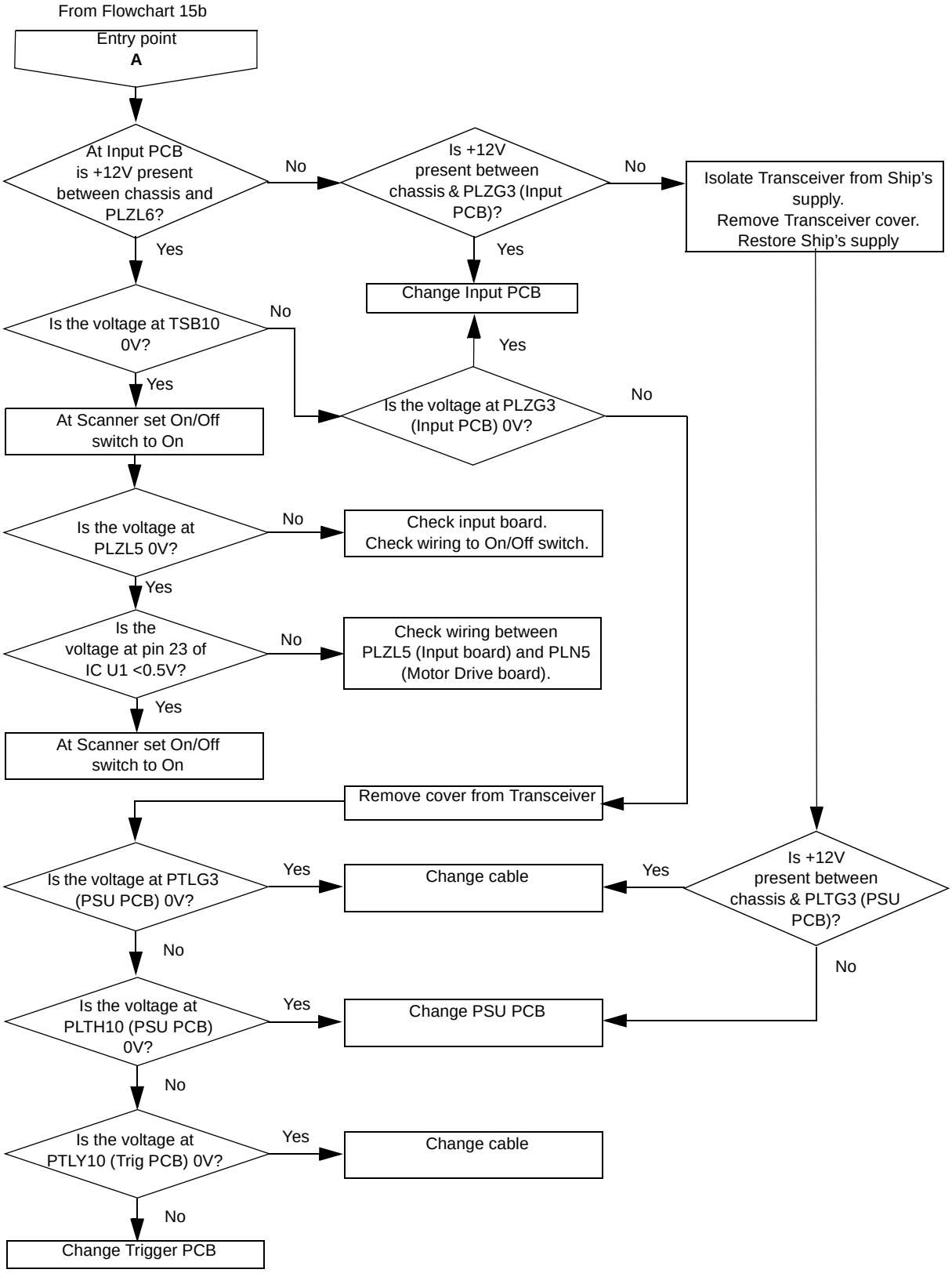
FLOWCHART 15B Azimuth Error Message (X-band Scanner)



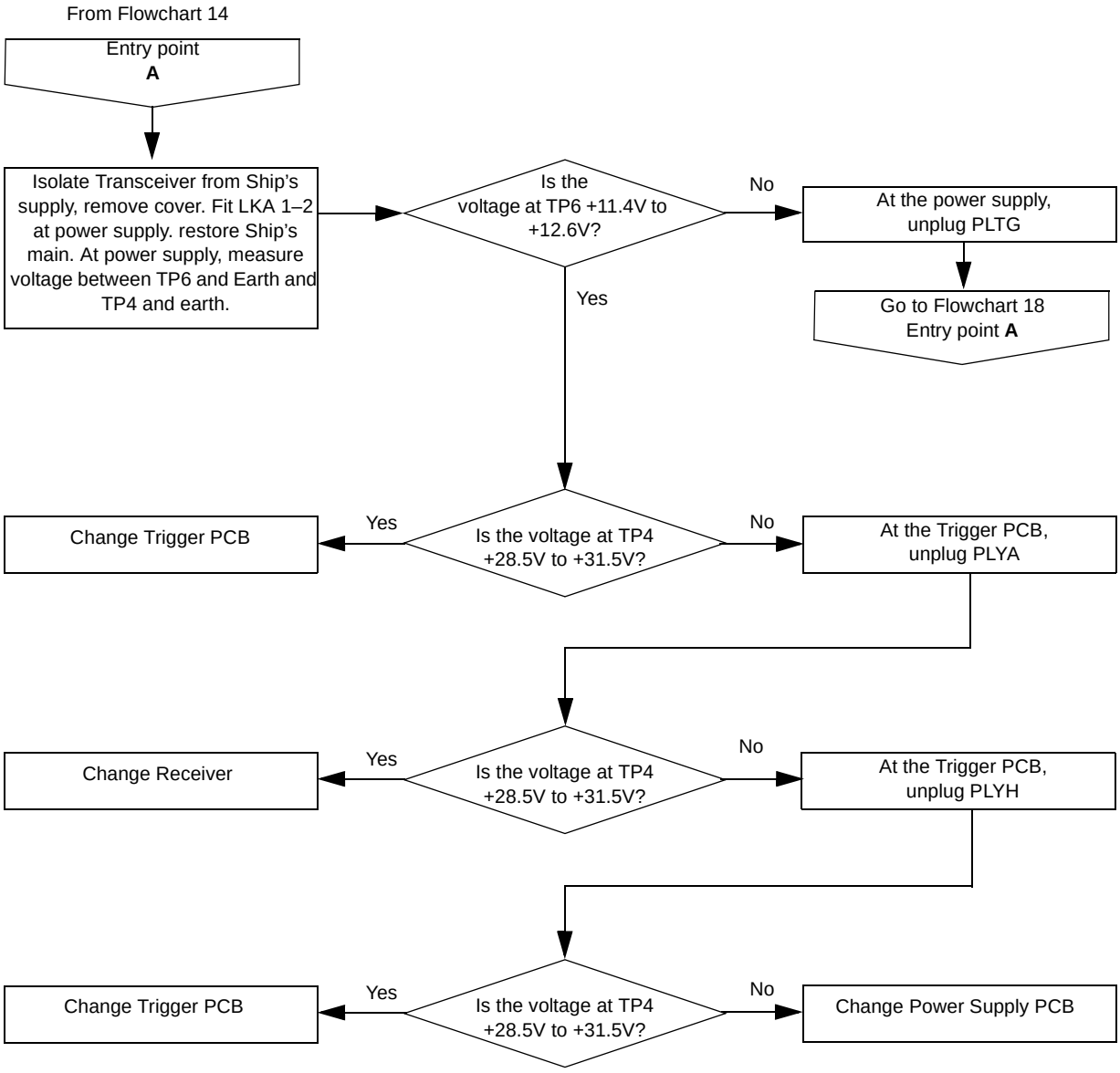
FLOWCHART 16A Azimuth Error Message (S-band Scanner)



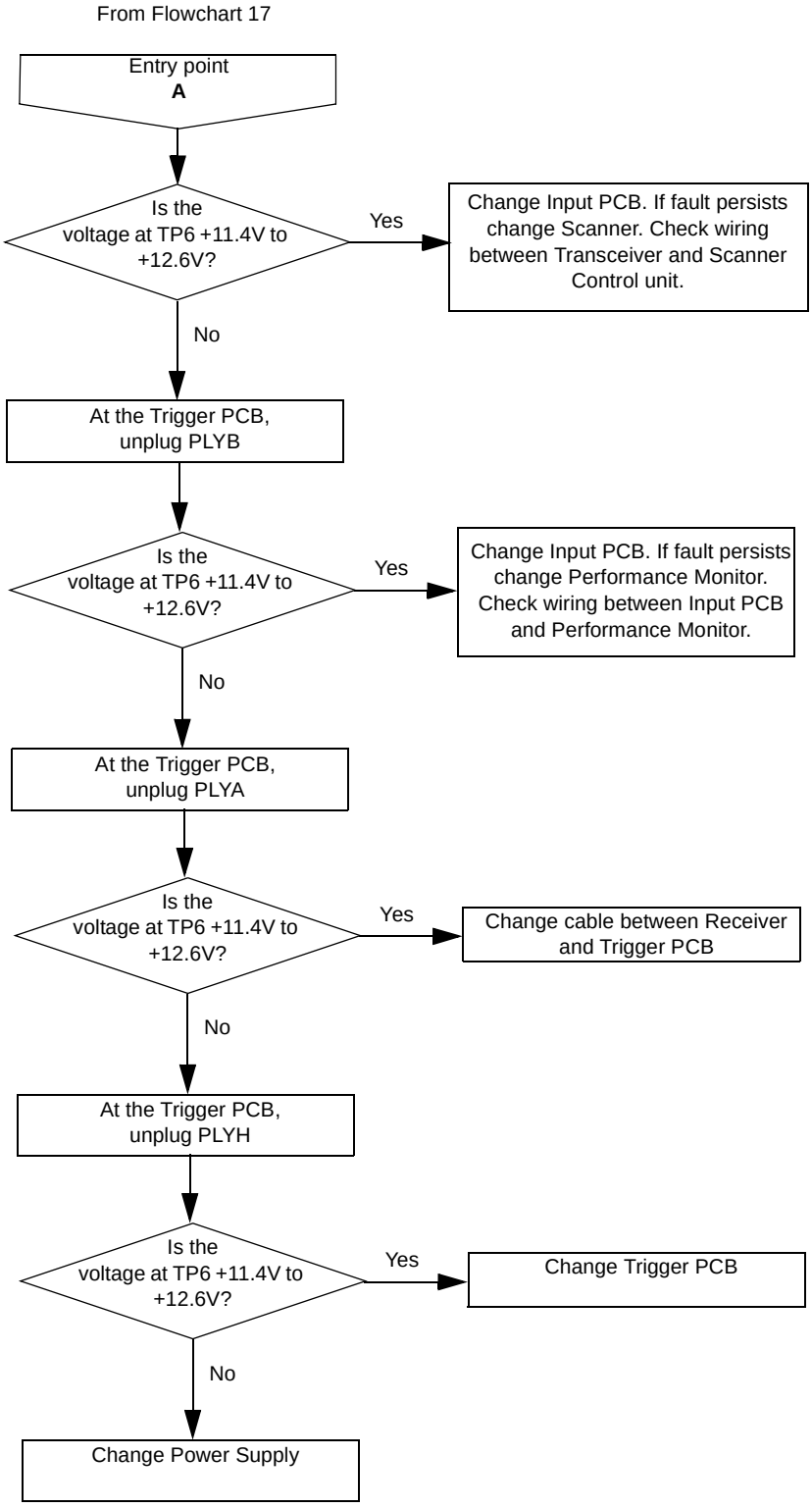
FLOWCHART 16B Azimuth Error Message (X-band Scanner)



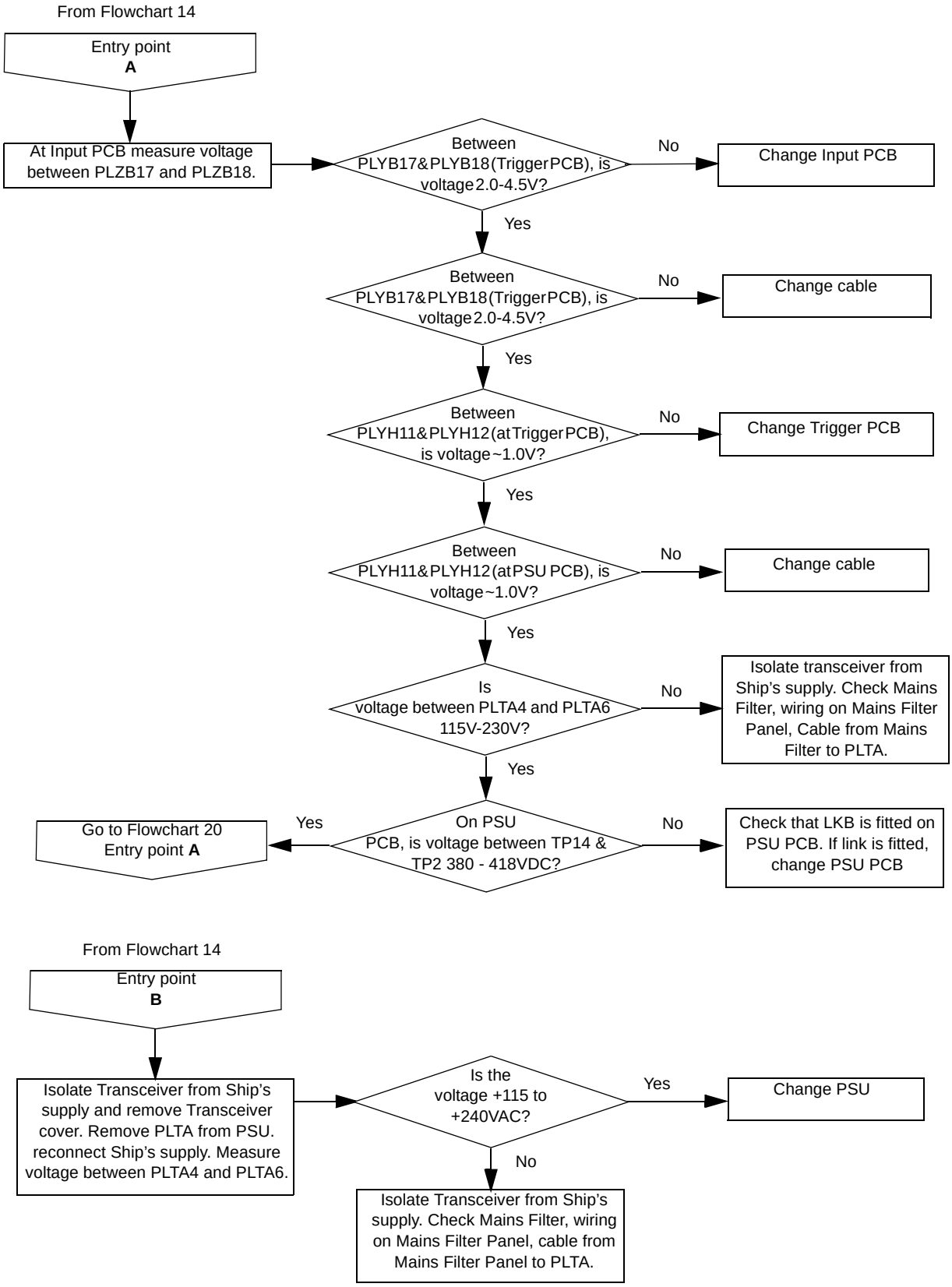
FLOWCHART 17 Azimuth Error Message (contd.)



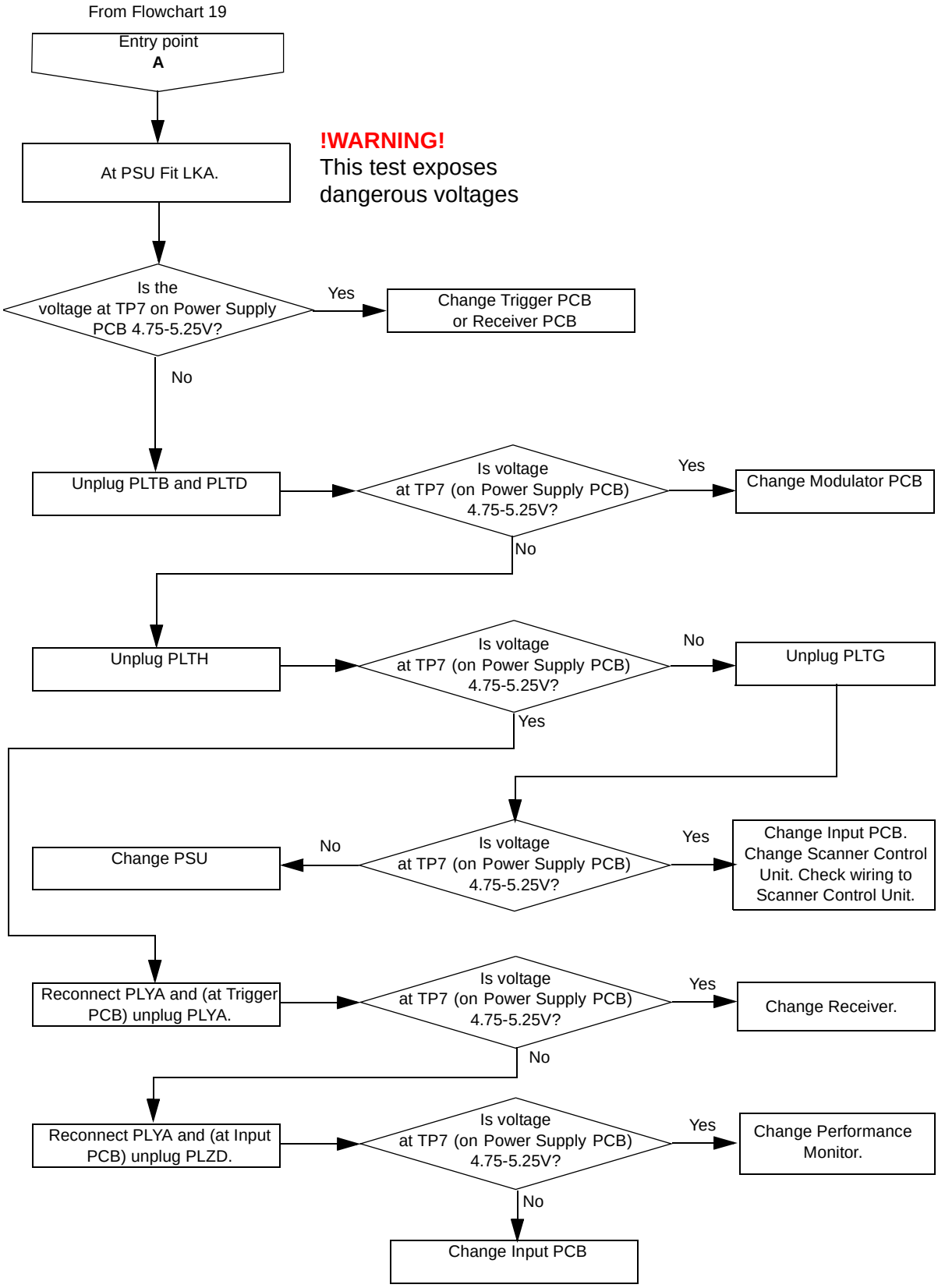
FLOWCHART 18 Azimuth Error Message (contd.)



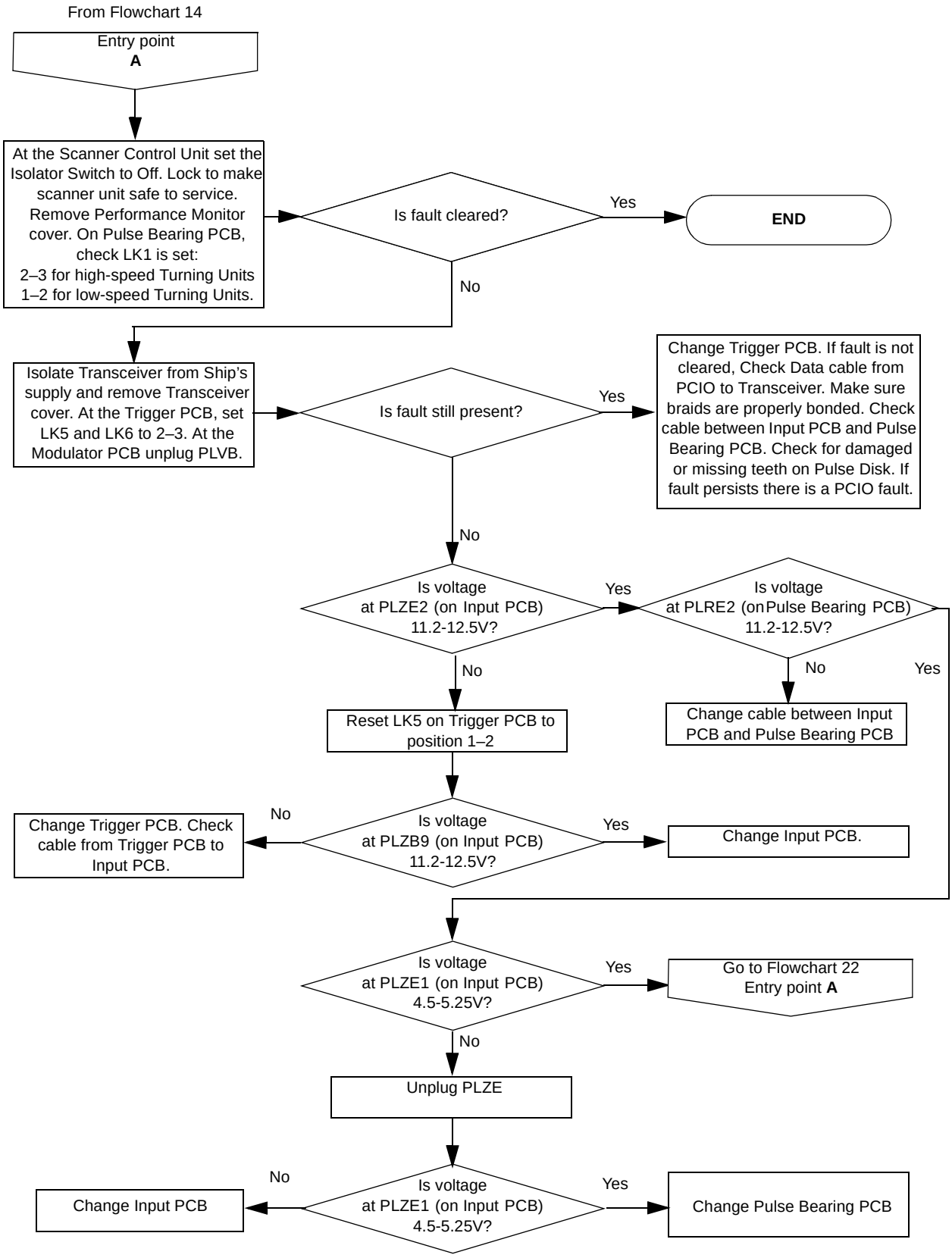
FLOWCHART 19 Azimuth Error Message (contd.)



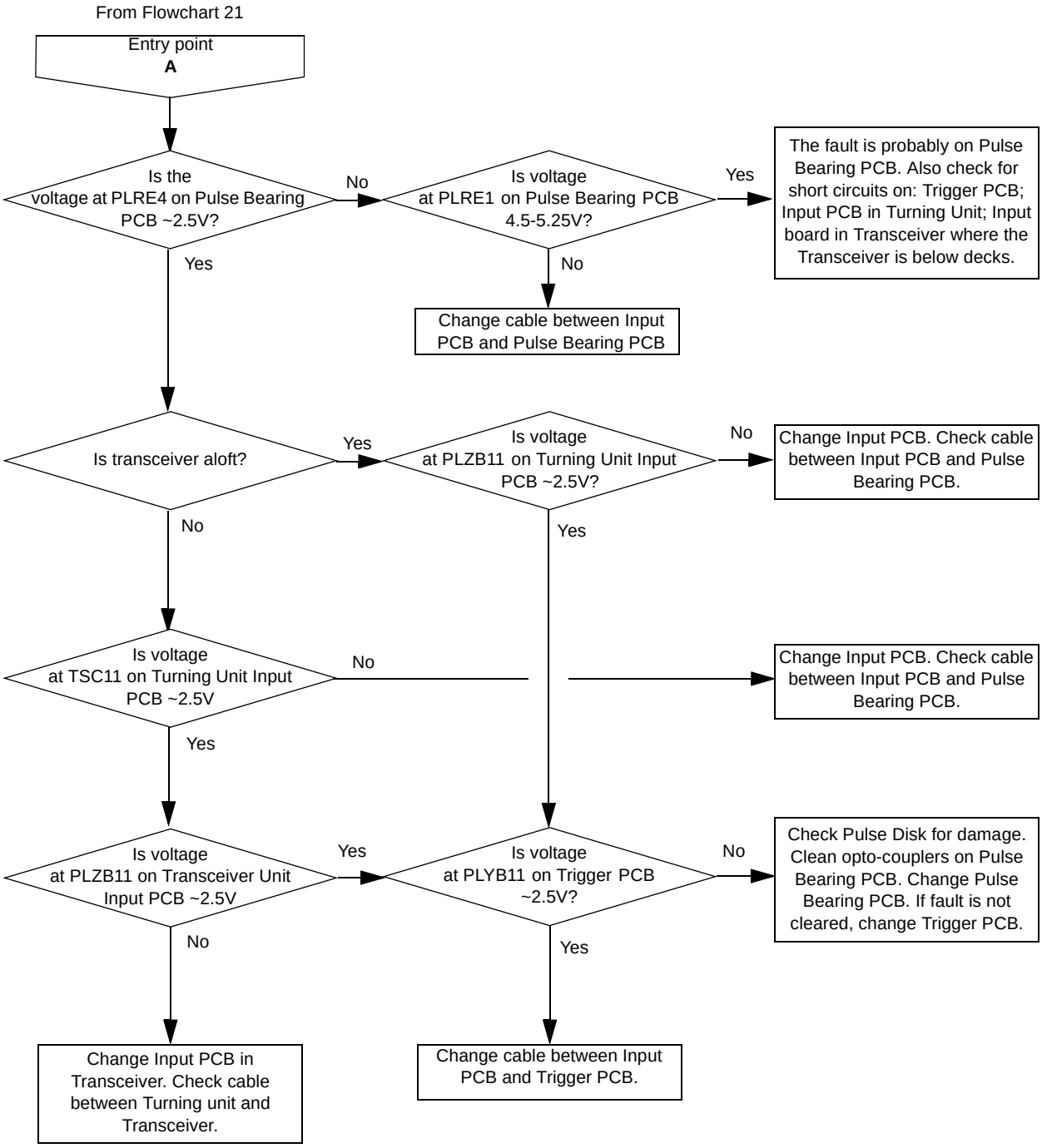
FLOWCHART 20 Azimuth Error Message (contd.)



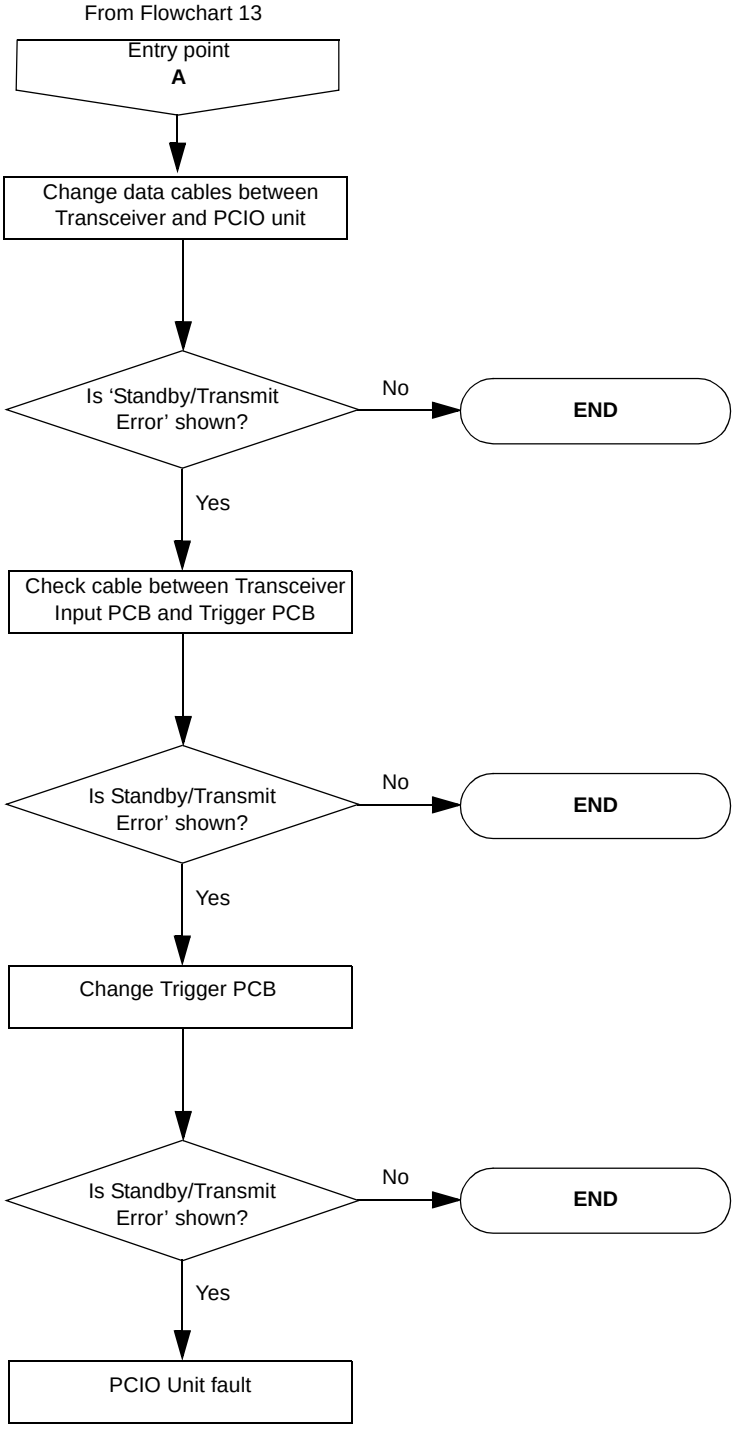
FLOWCHART 21 Azimuth Error Message (contd.)



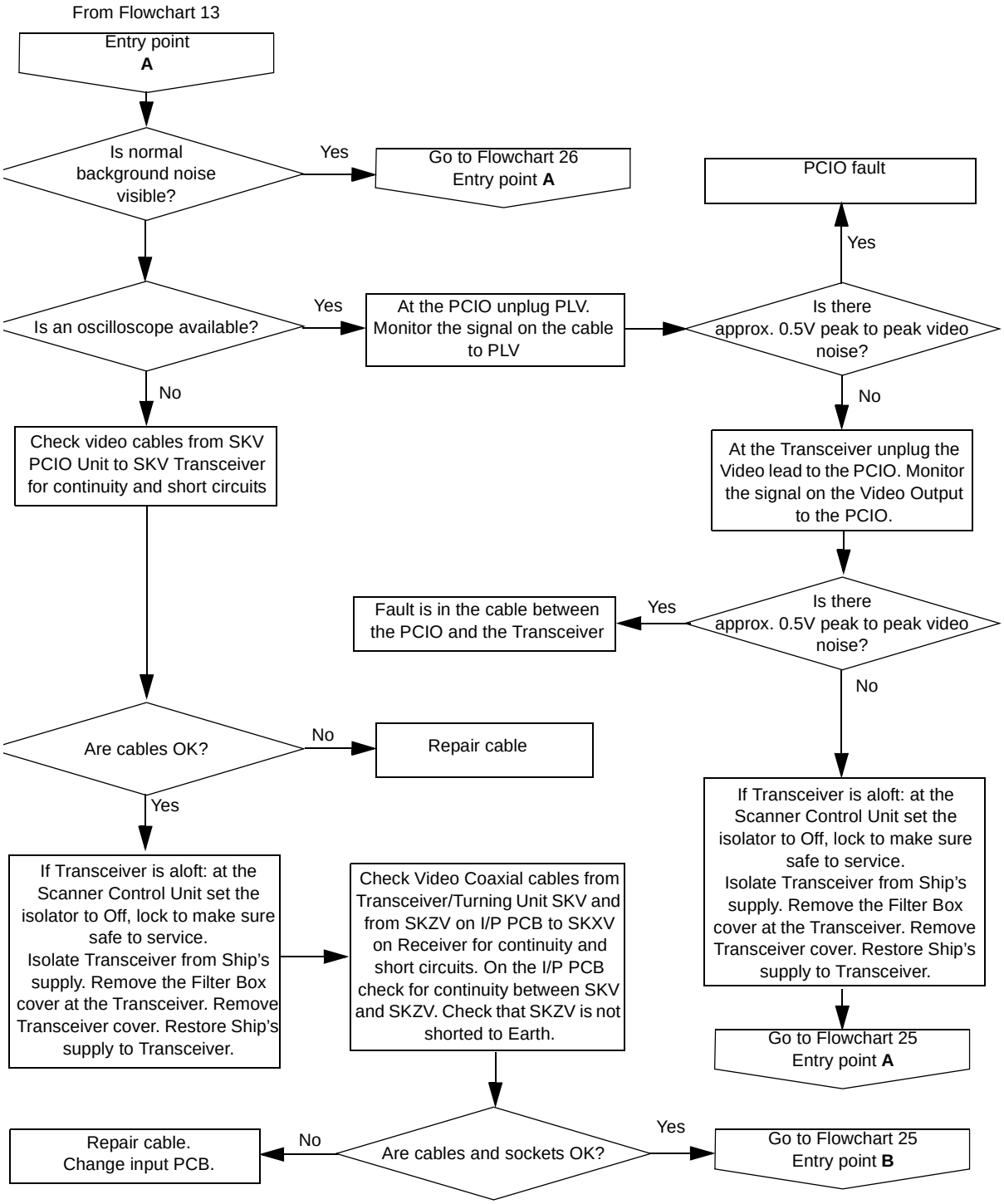
FLOWCHART 22 Azimuth Error Message (contd.)



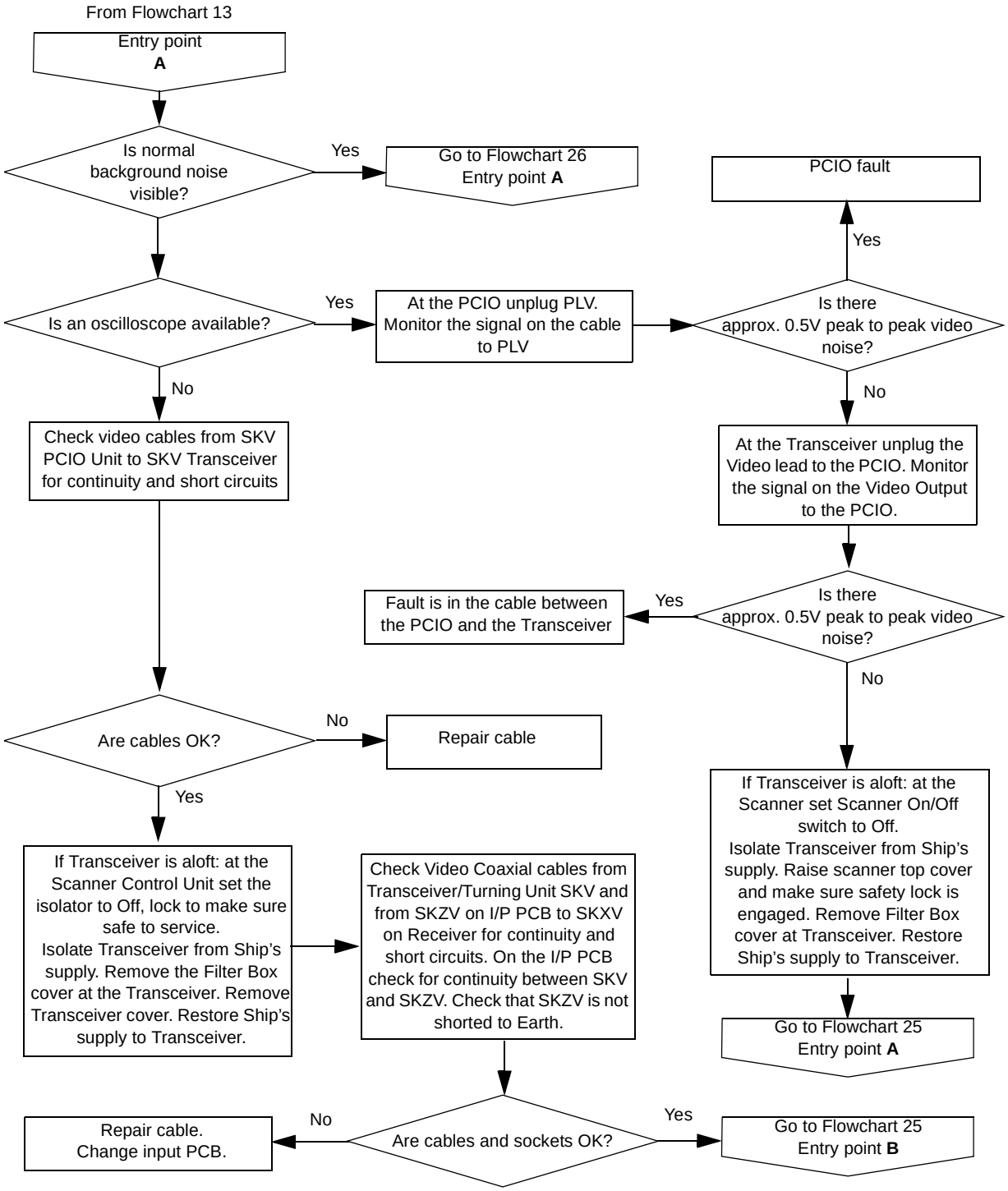
FLOWCHART 23 Standby/Transmit Error Message



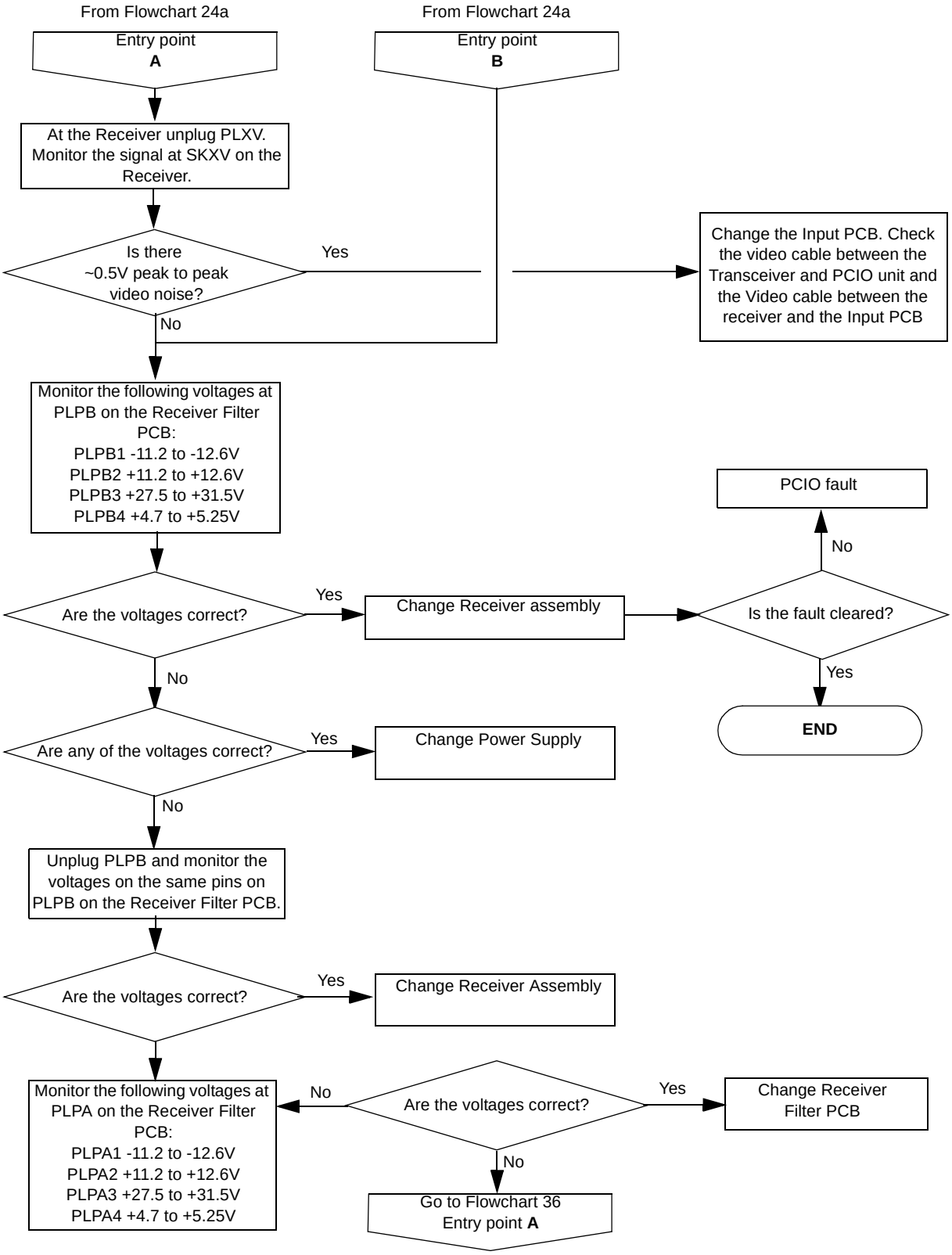
FLOWCHART 24A Low Video Error Message (S-band Scanner)



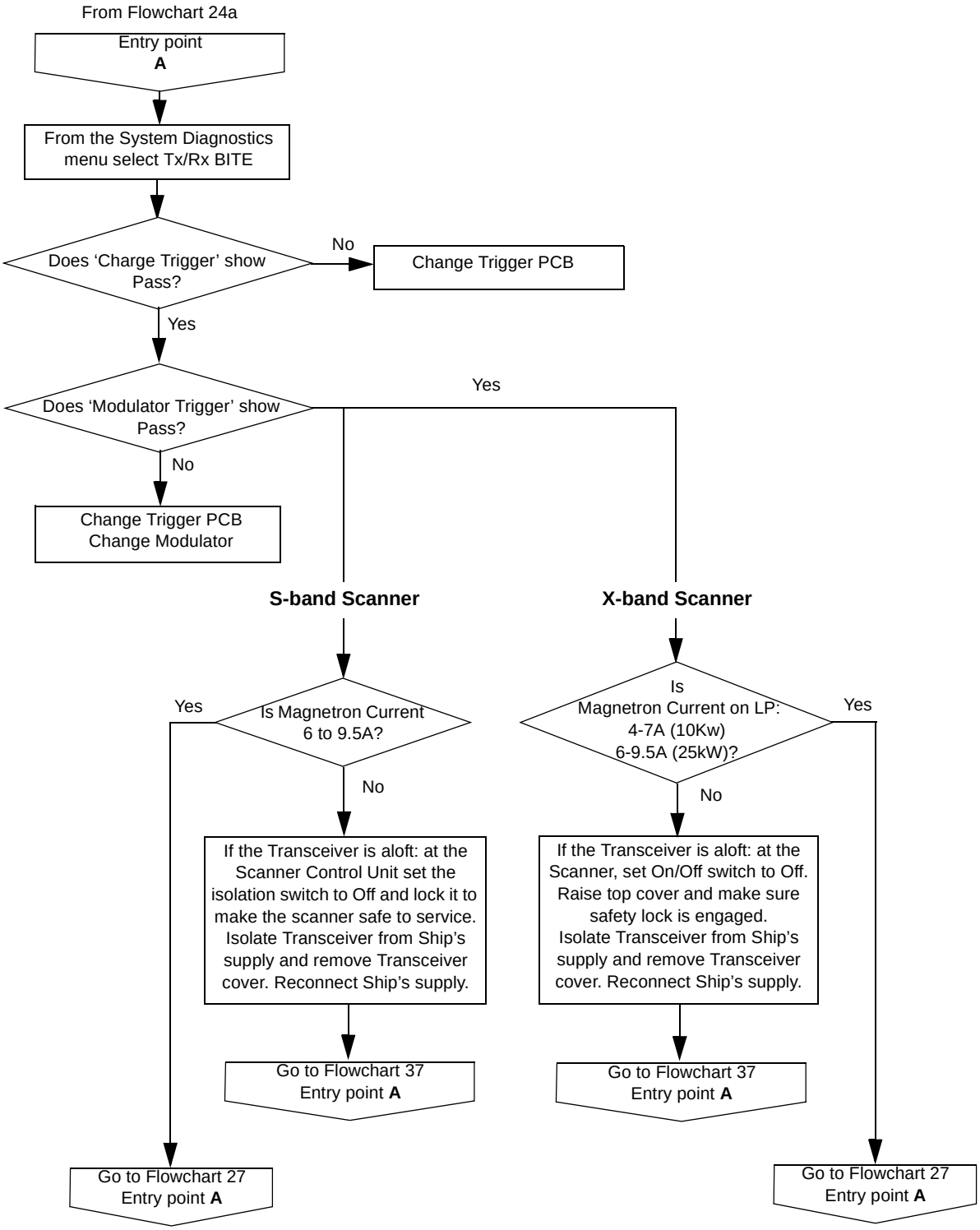
FLOWCHART 24B Low Video Error Message (X-band Scanner)



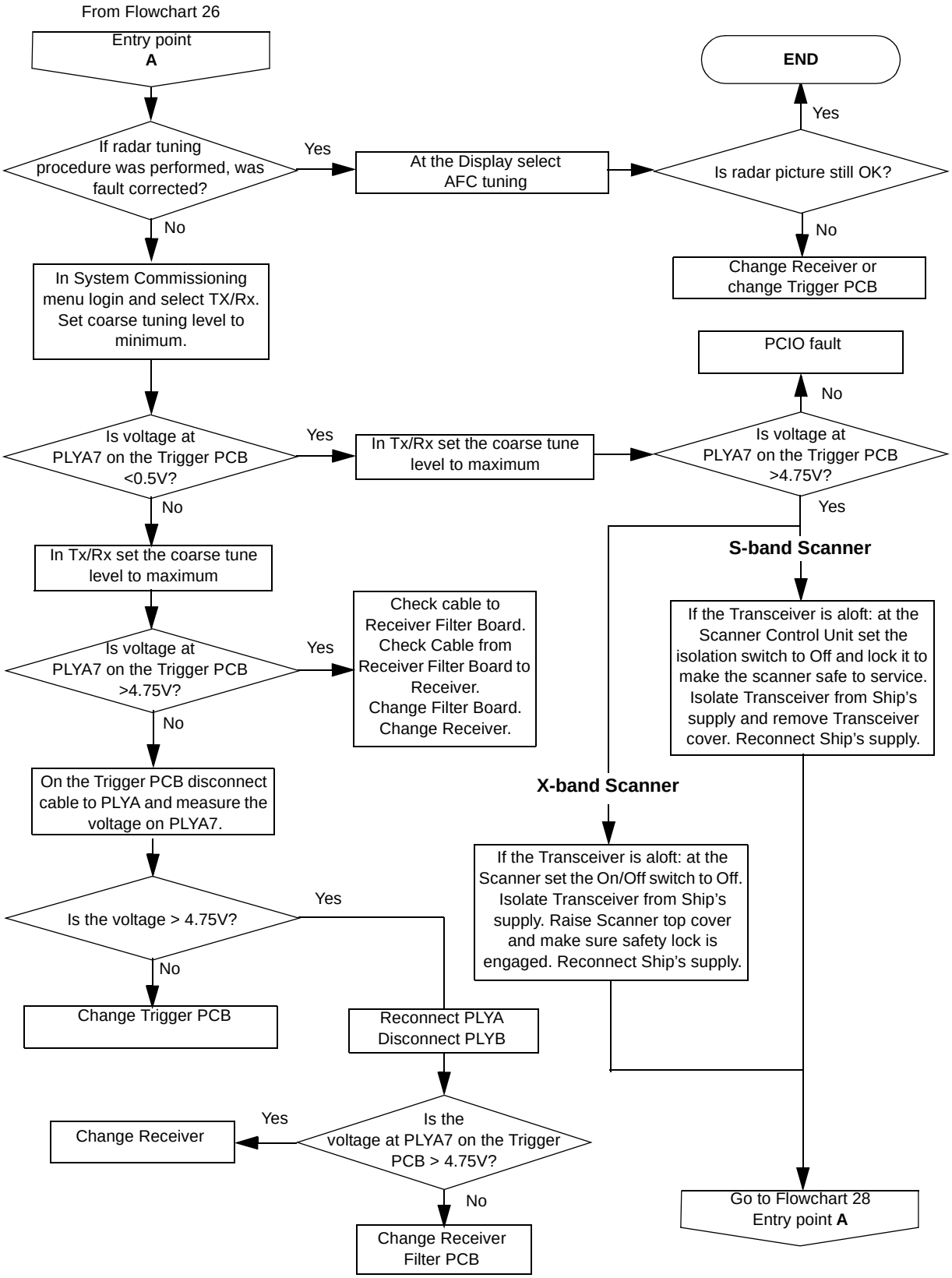
FLOWCHART 25 Low Video Error Message (contd.)



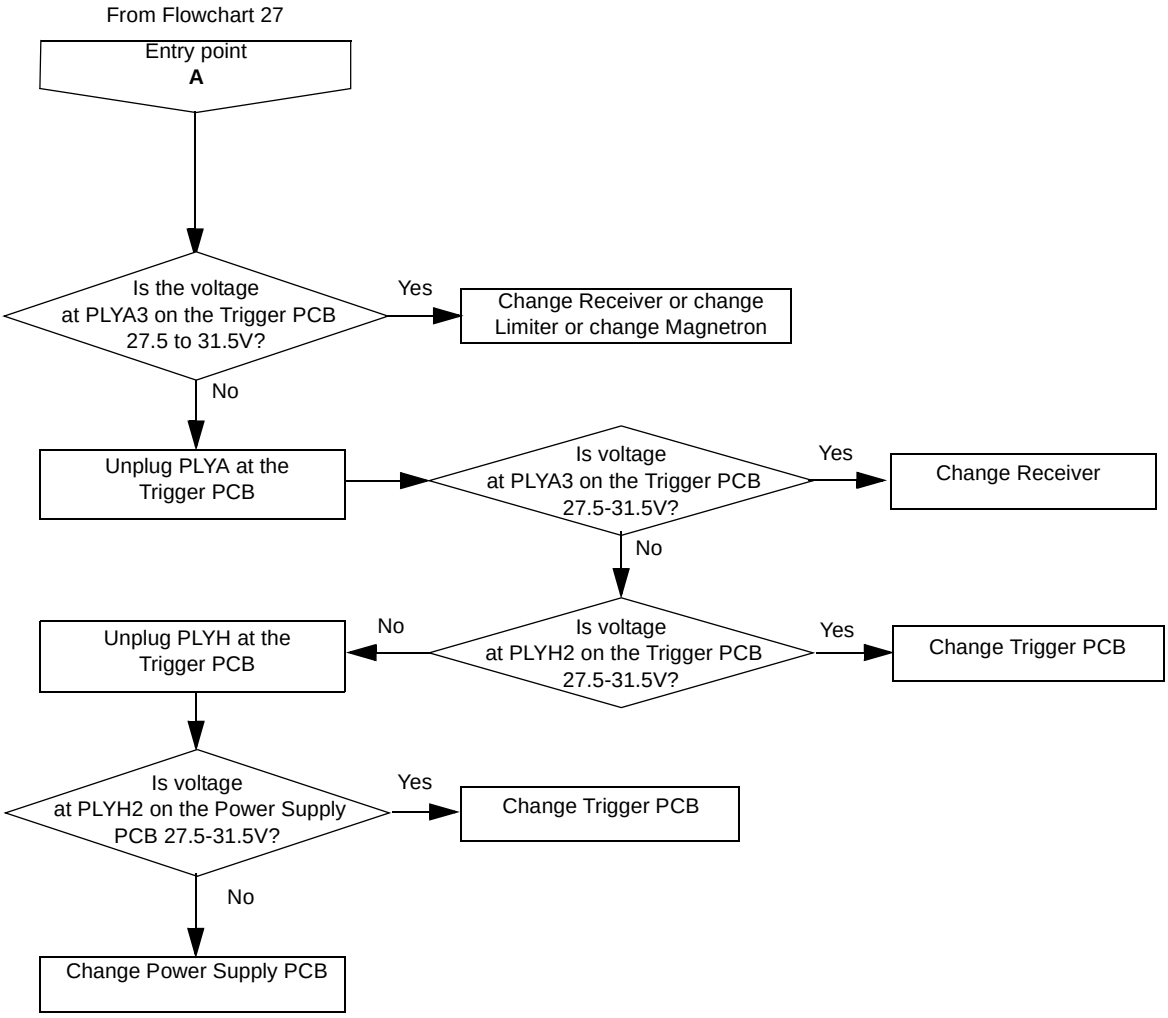
FLOWCHART 26 Low Video Error Message (contd.)



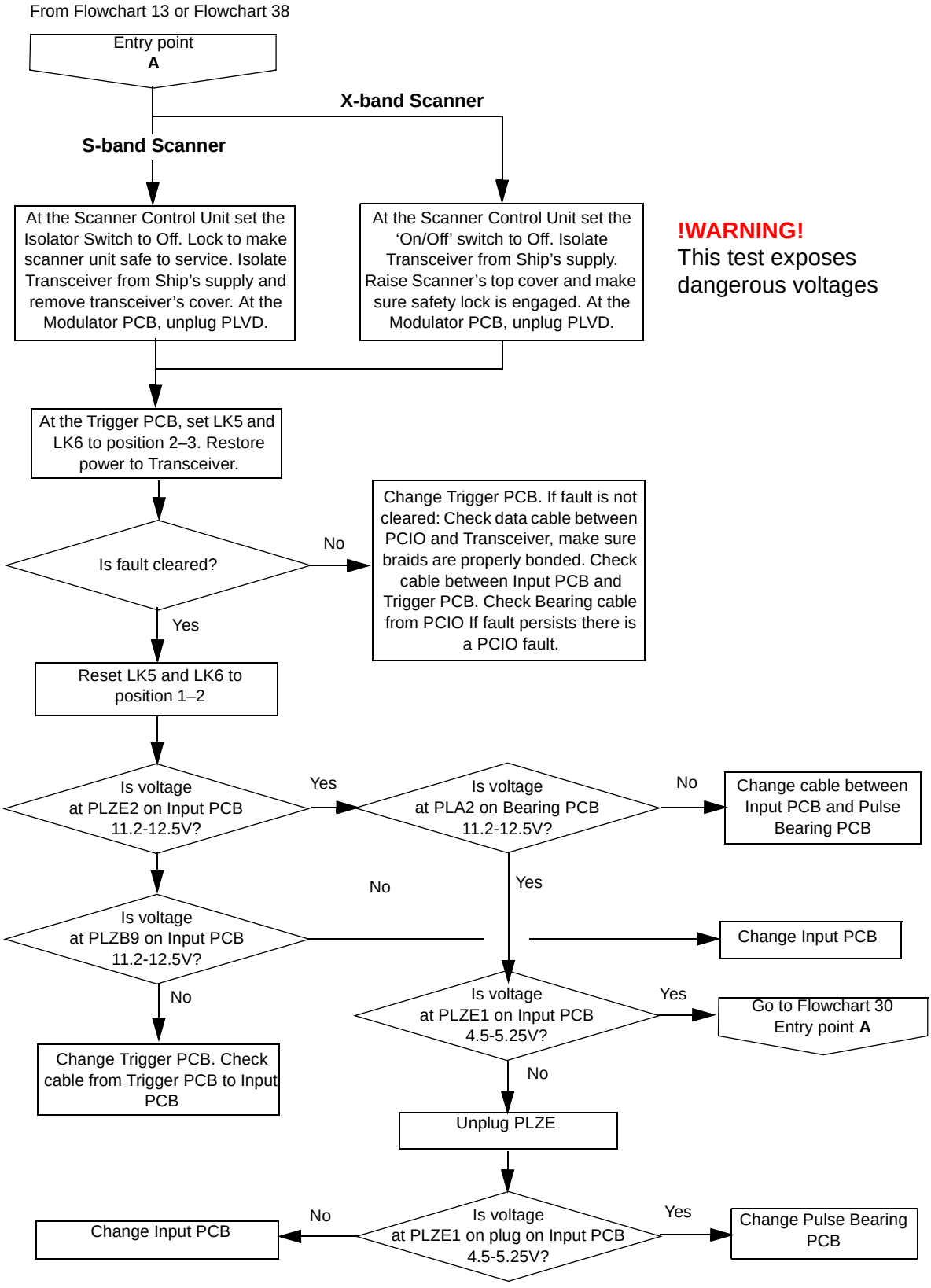
FLOWCHART 27 Low Video Error Message (contd.)



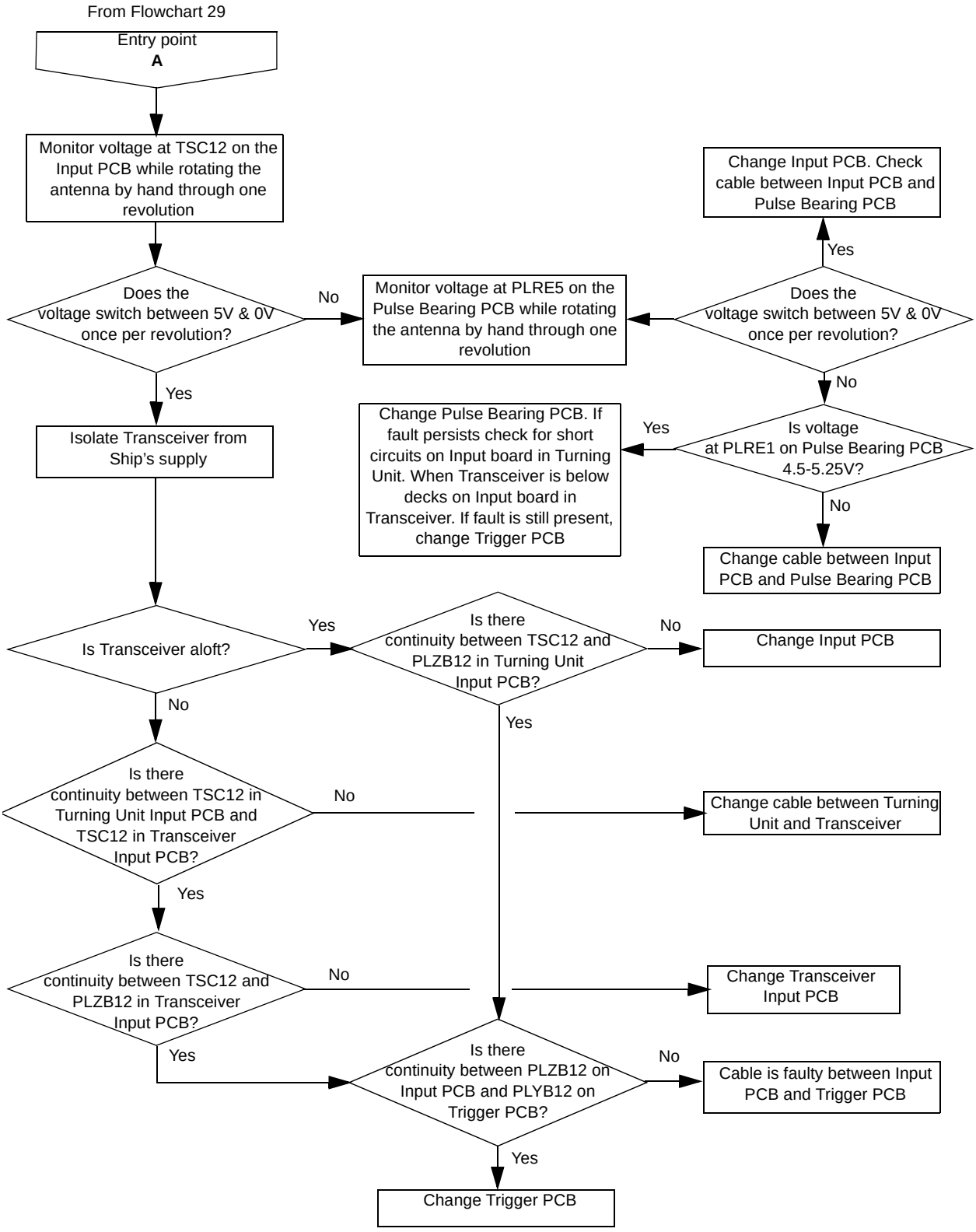
FLOWCHART 28 Low Video Error Message (contd.)



FLOWCHART 29 Heading Marker Error Message

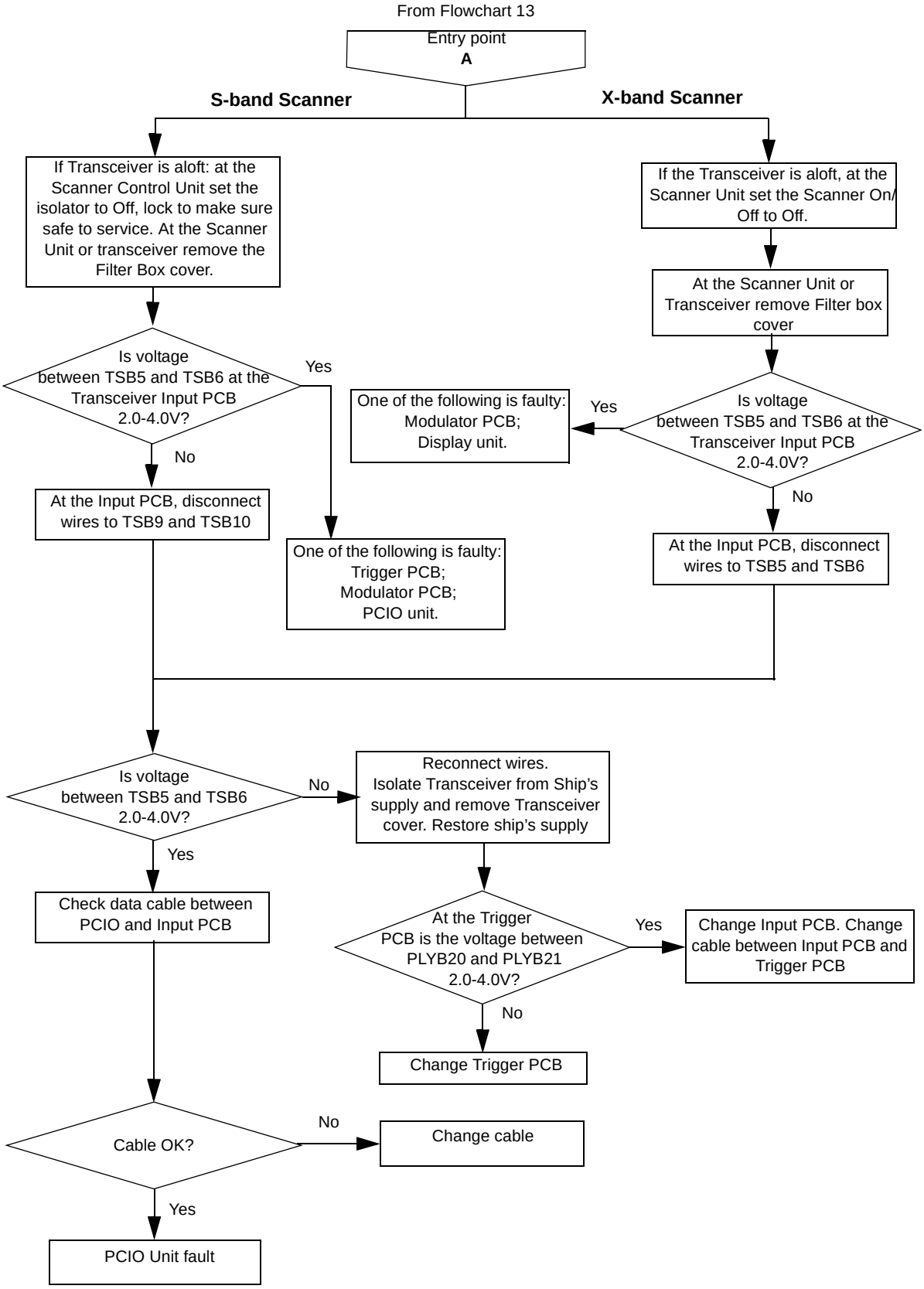


FLOWCHART 30 Heading Marker Error Message (contd.)

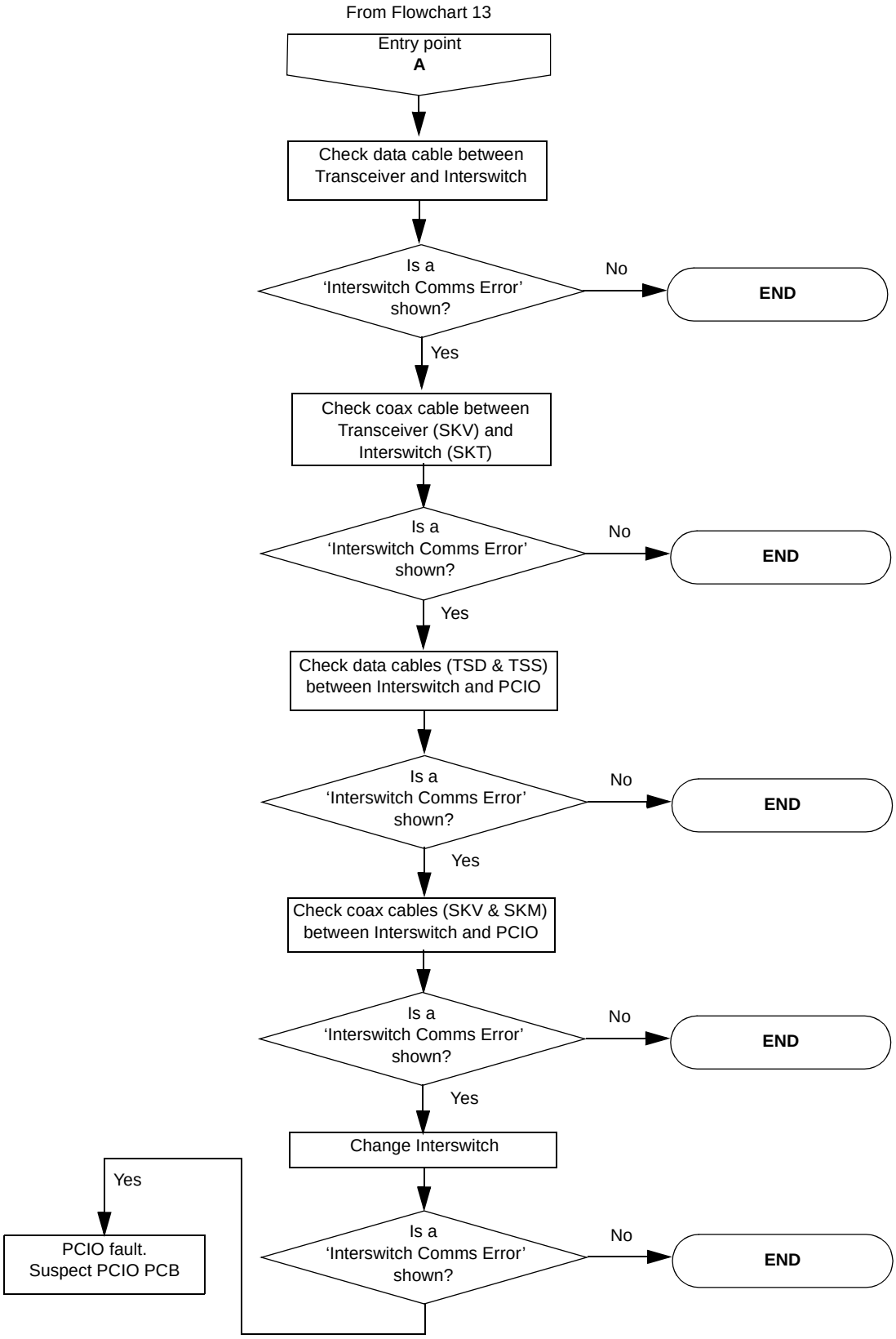


Fault Isolating Flowcharts for S-band and X-band Scanner Units. Fault Reporting and First Line Servicing

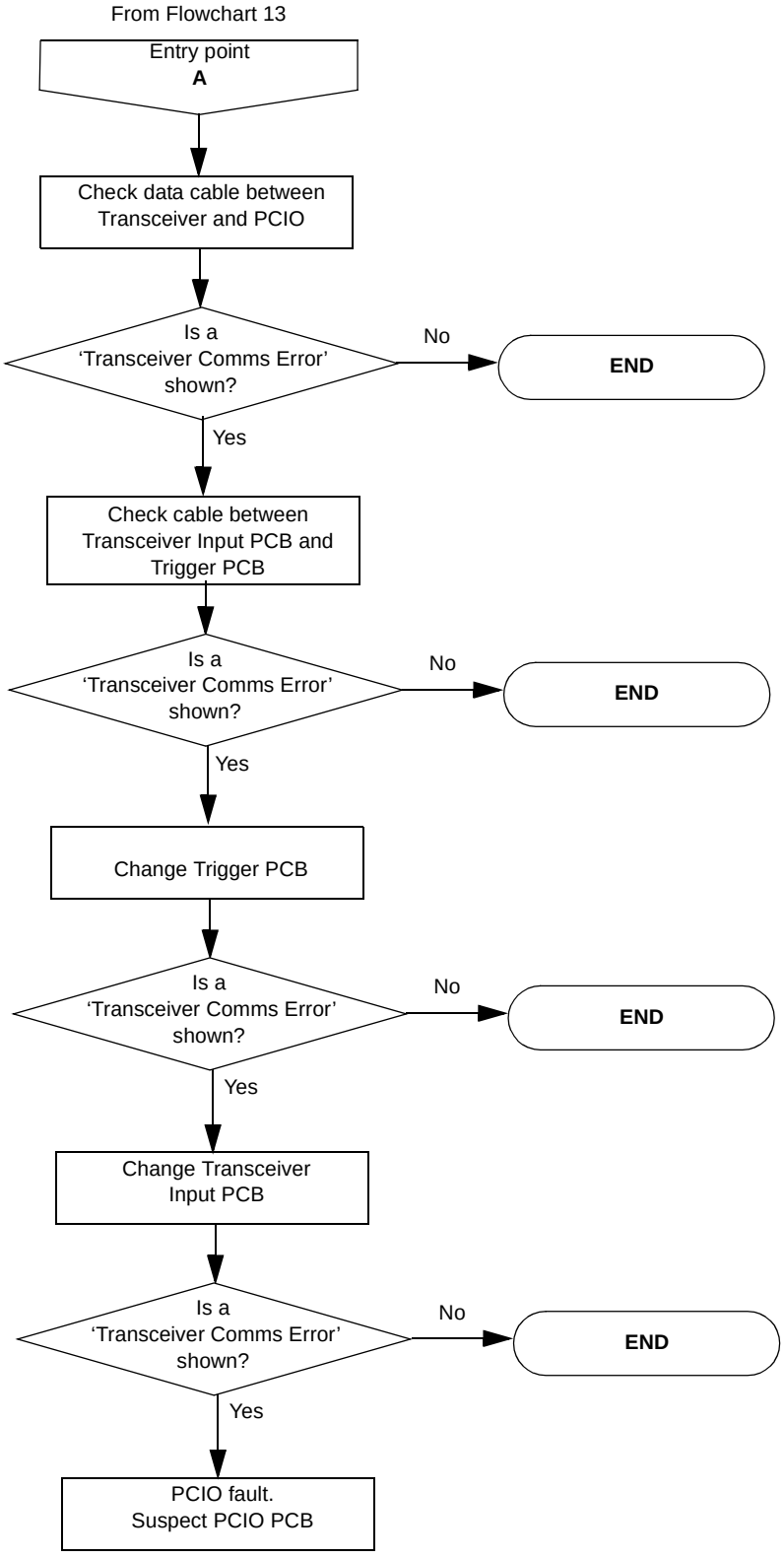
FLOWCHART 31 Trigger Error Message



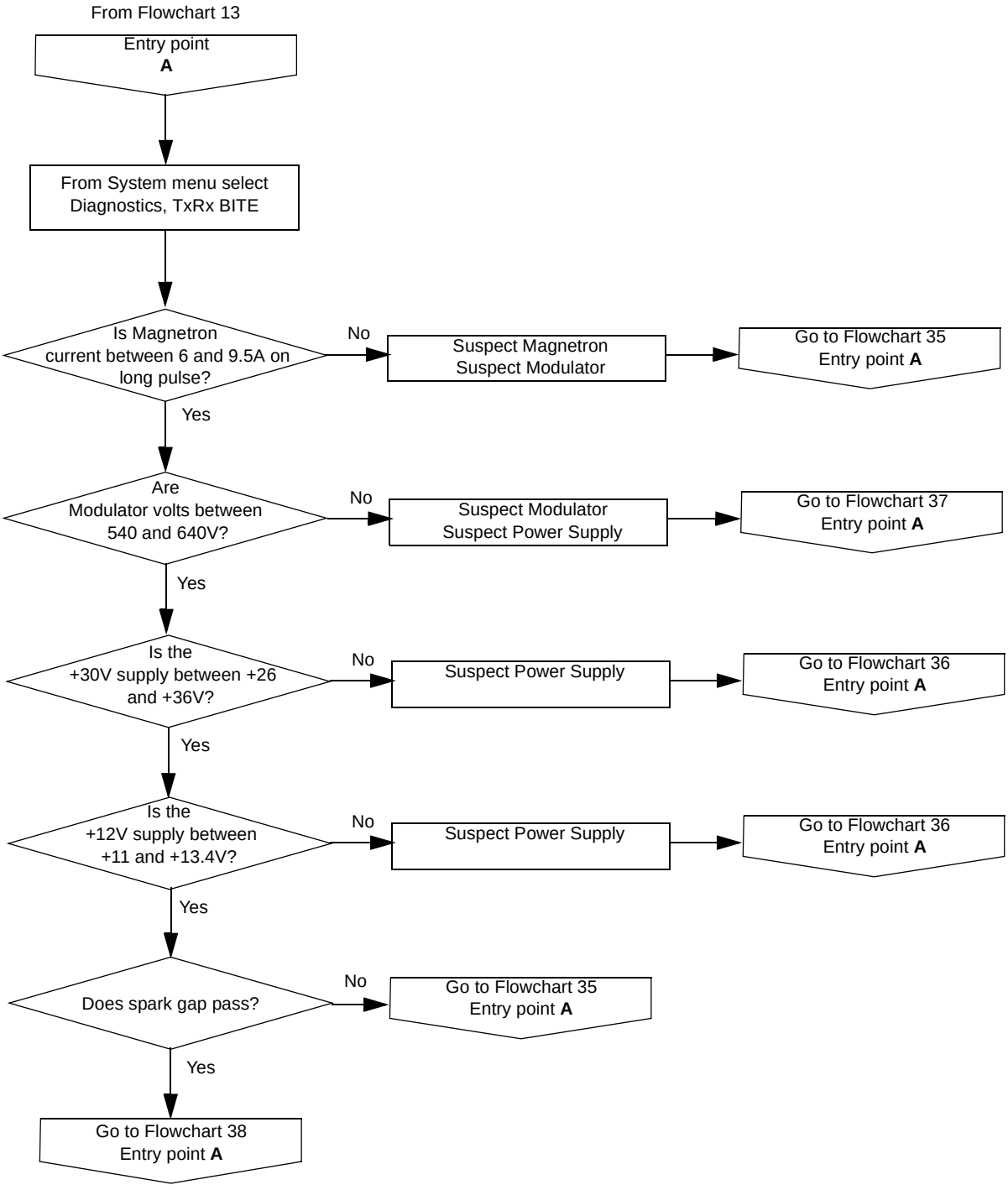
FLOWCHART 32 Interswitch Comms Error Message



FLOWCHART 33 Transceiver Comms Error Message

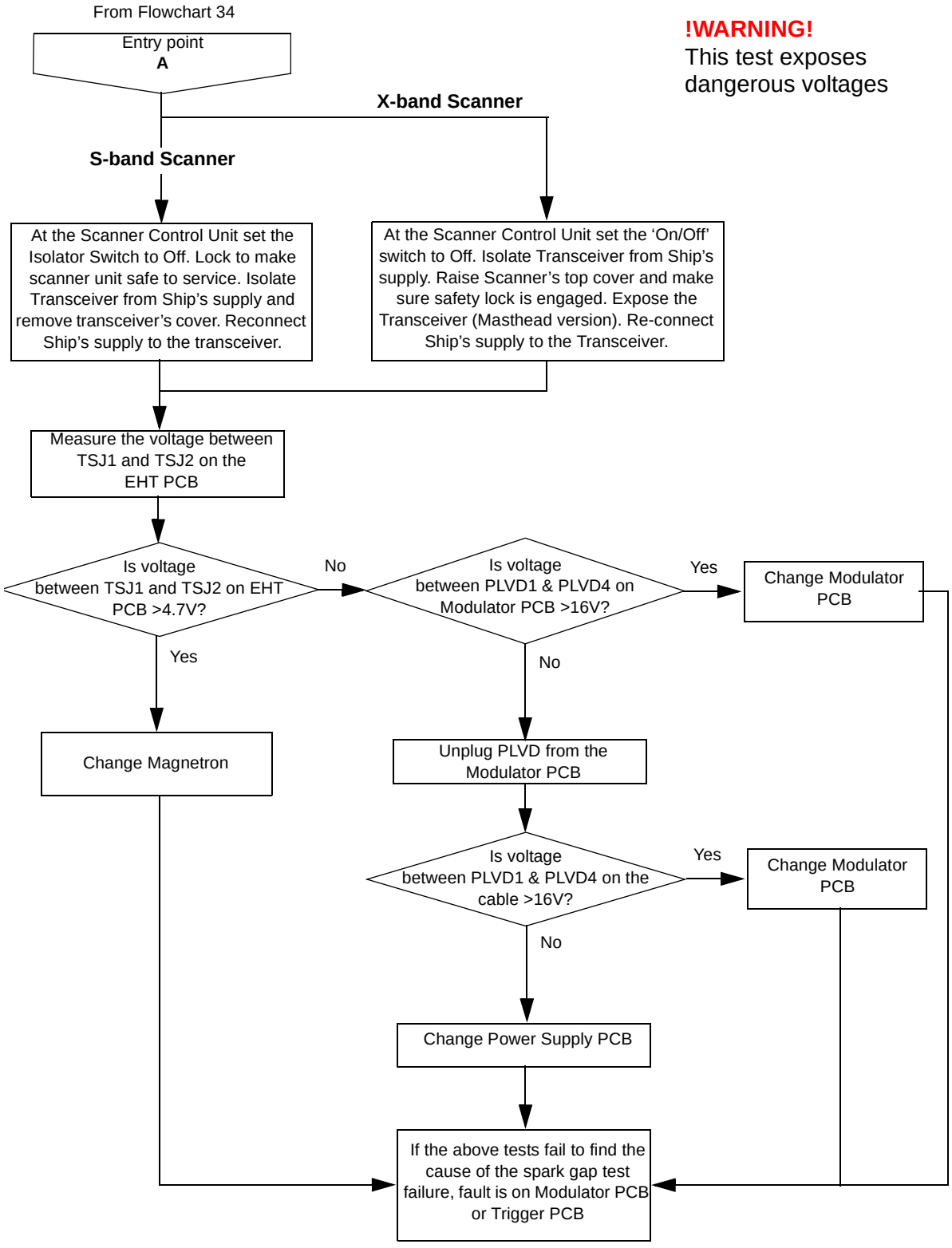


FLOWCHART 34 Transceiver BITE Error Message

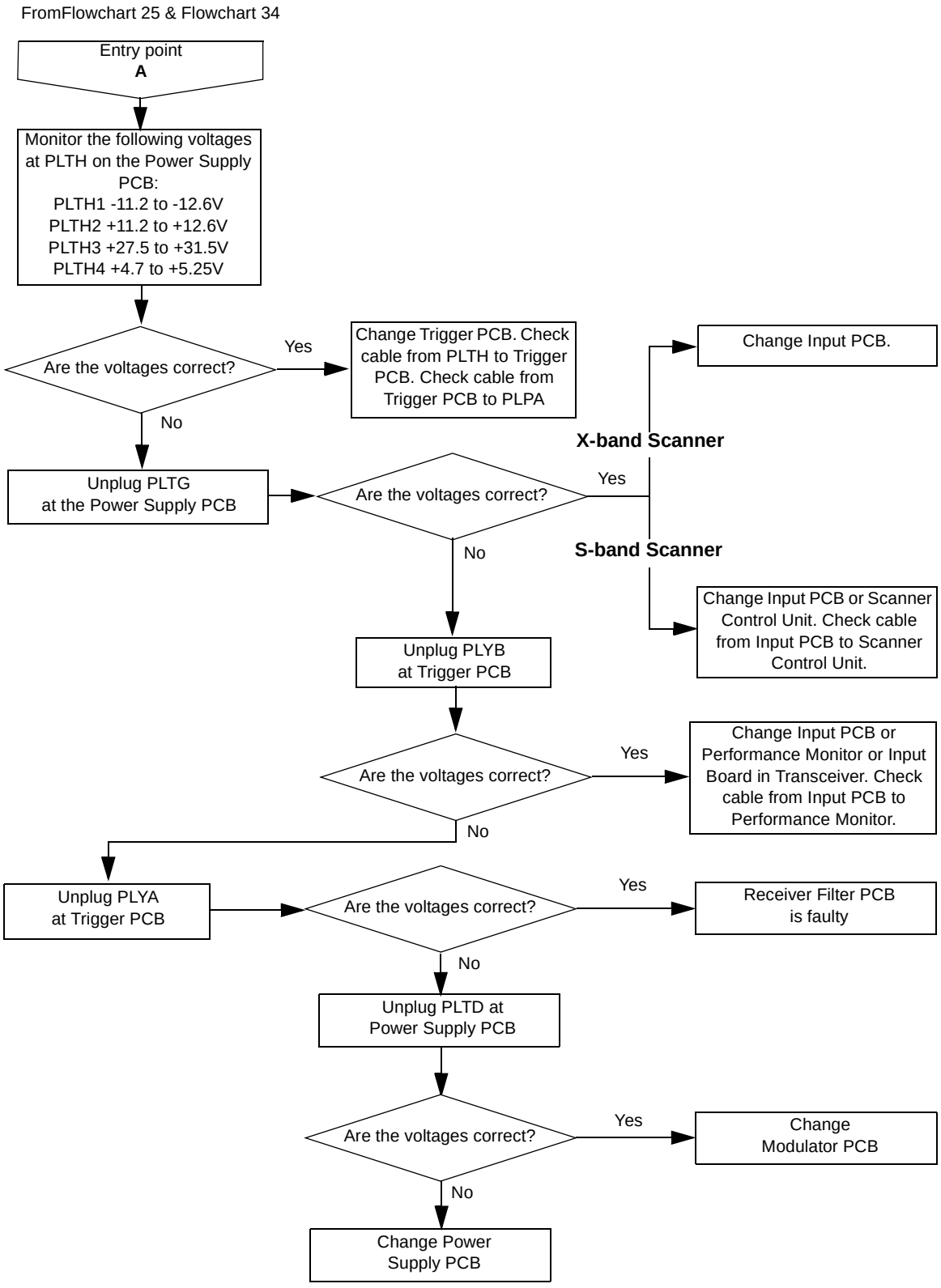


Fault Isolating Flowcharts for S-band and X-band Scanner Units. Fault Reporting and First Line Servicing

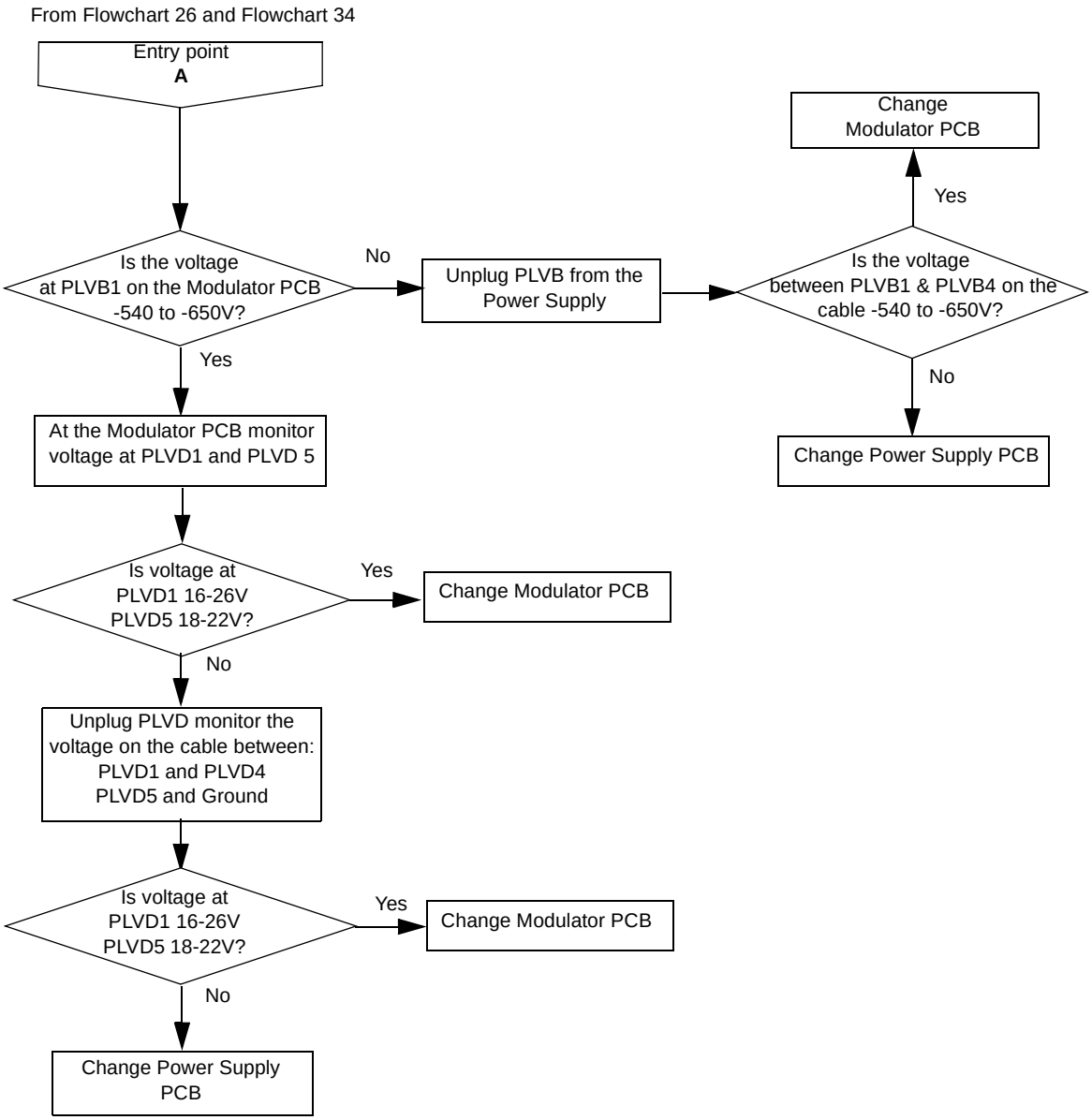
FLOWCHART 35 Transceiver BITE Error Message (Spark Gap Test Failure)



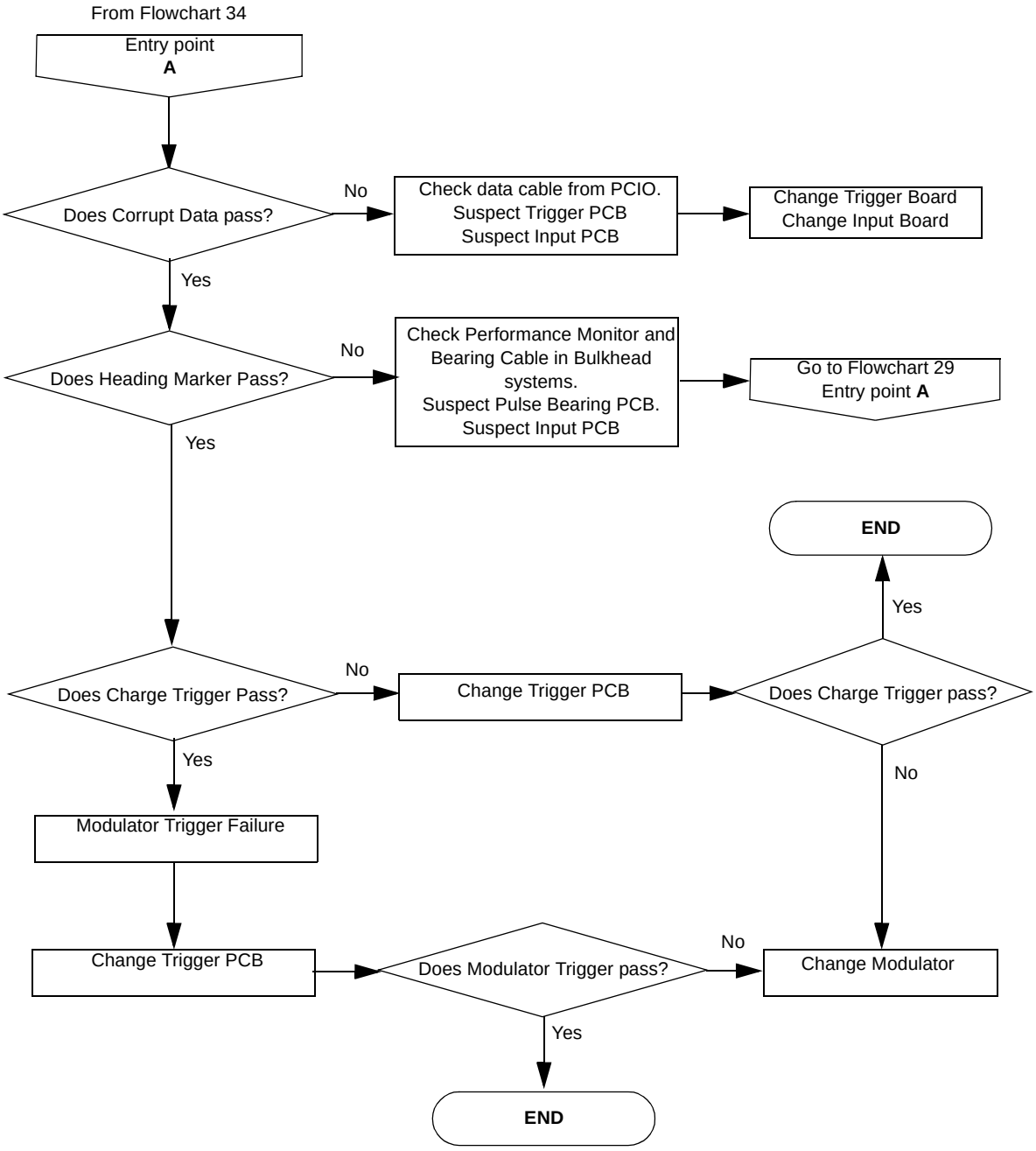
FLOWCHART 36 Transceiver BITE Error Message (contd.)



FLOWCHART 37 Transceiver BITE Error Message (contd.)



FLOWCHART 38 Transceiver BITE Error Message (contd.)



3 First-line Servicing

WARNING! – Lethal Voltage Hazard

Lethal voltages are exposed when the covers are removed from the units.Only qualified persons should work on the equipment when power is applied. ALWAYS isolate the unit from the mains supply when removing or replacing the cover. To make the units safe it is necessary to isolate them from the mains supply. It is **not** adequate to turn the unit off: there are high voltages present at any Power Supply that is not mains isolated.

3.1 S-band Scanner Unit

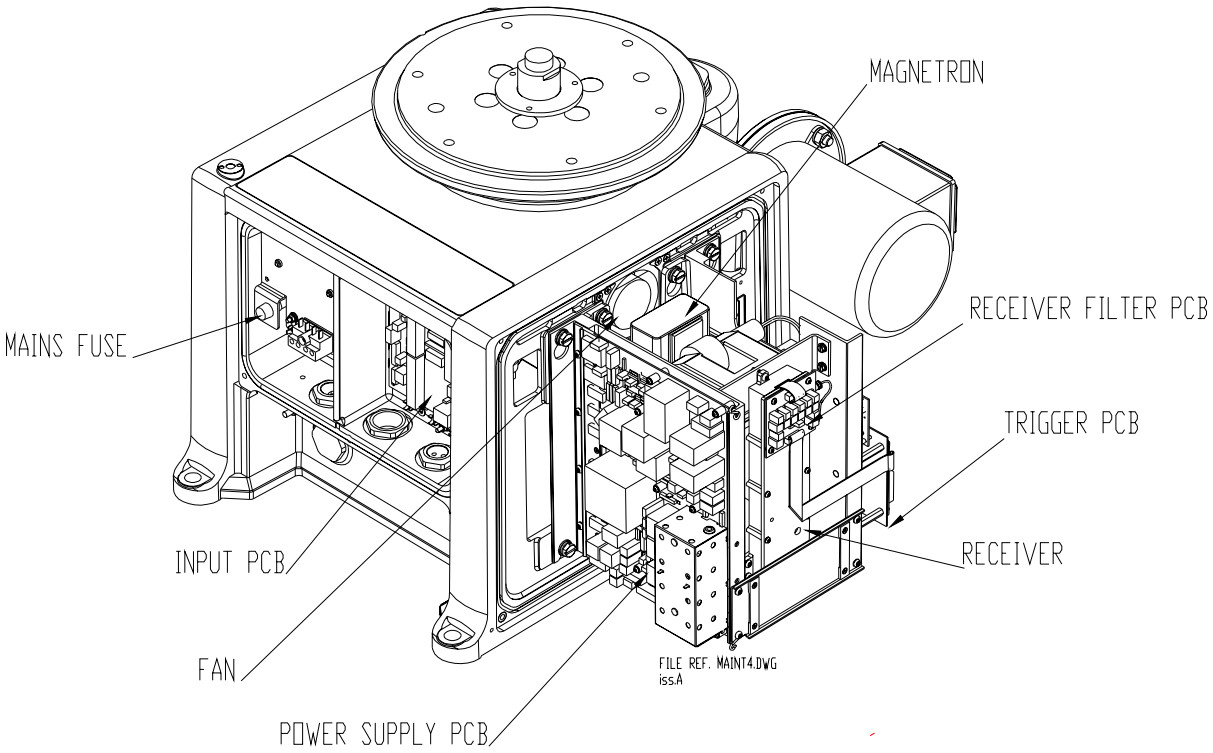


Figure 4.1 Location of Major Parts

3.1.1 Access to Masthead Transceiver

See Figure 4.2 for instructions on how to access the masthead transceiver.

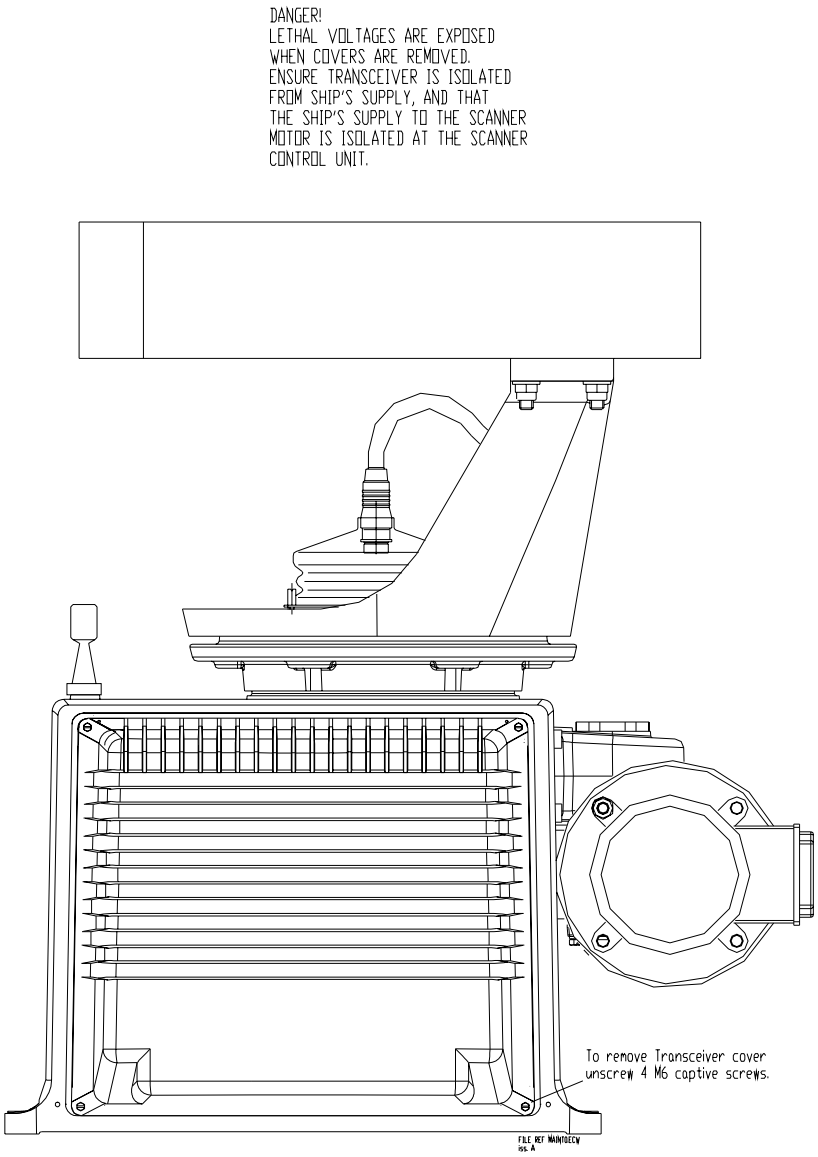


Figure 4.2 Access to Transceiver – Masthead Transceiver

3.1.2 Access to Bulkhead Transceiver

See Figure 4.3 for instructions on how to access the bulkhead transceiver.

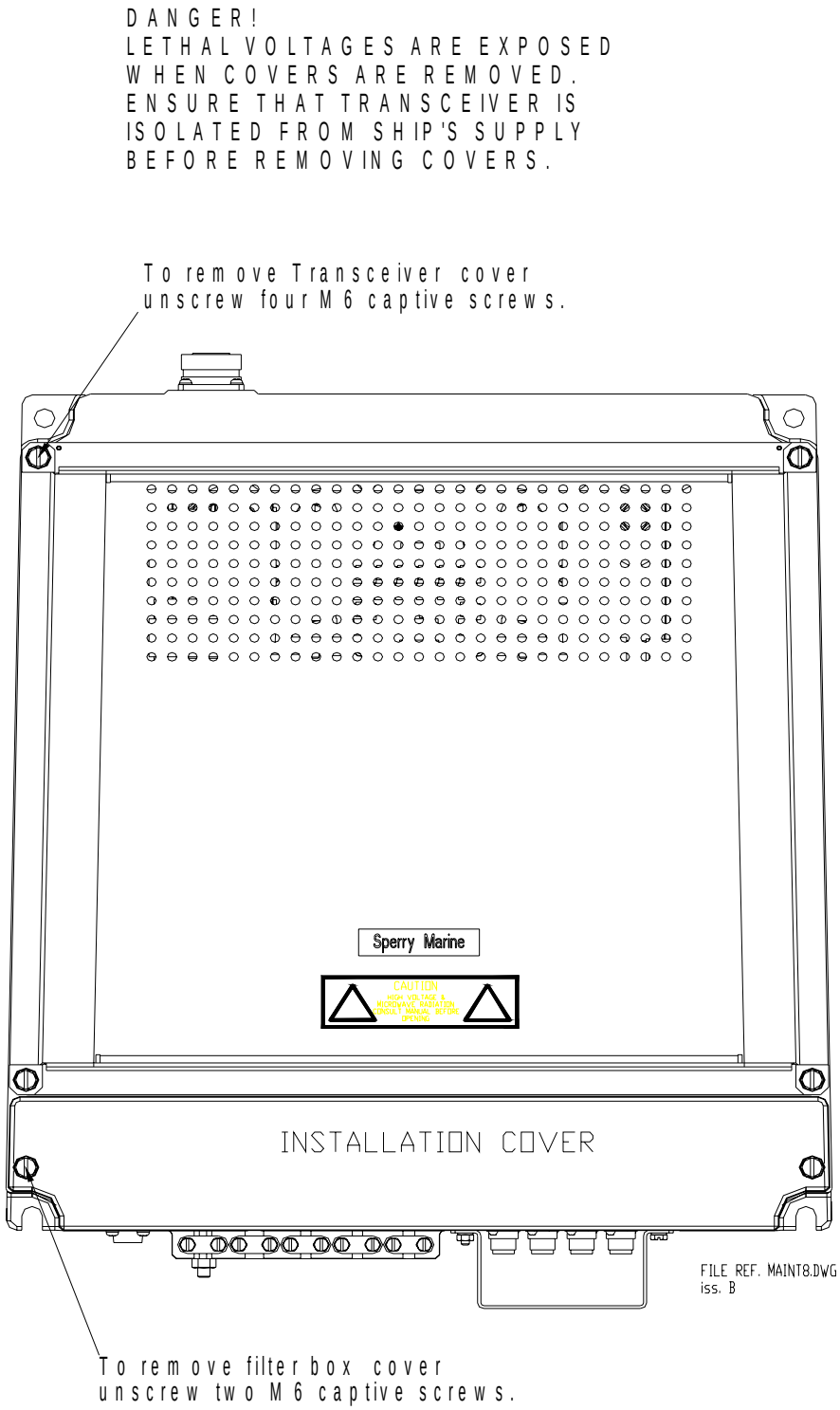


Figure 4.3 Access to Transceiver – Bulkhead Transceiver

3.1.3 Replacing the Transceiver in the Masthead Turning Unit

See Figure 4.4 for instructions on removing and replacing the Transceiver from the masthead Turning Unit.

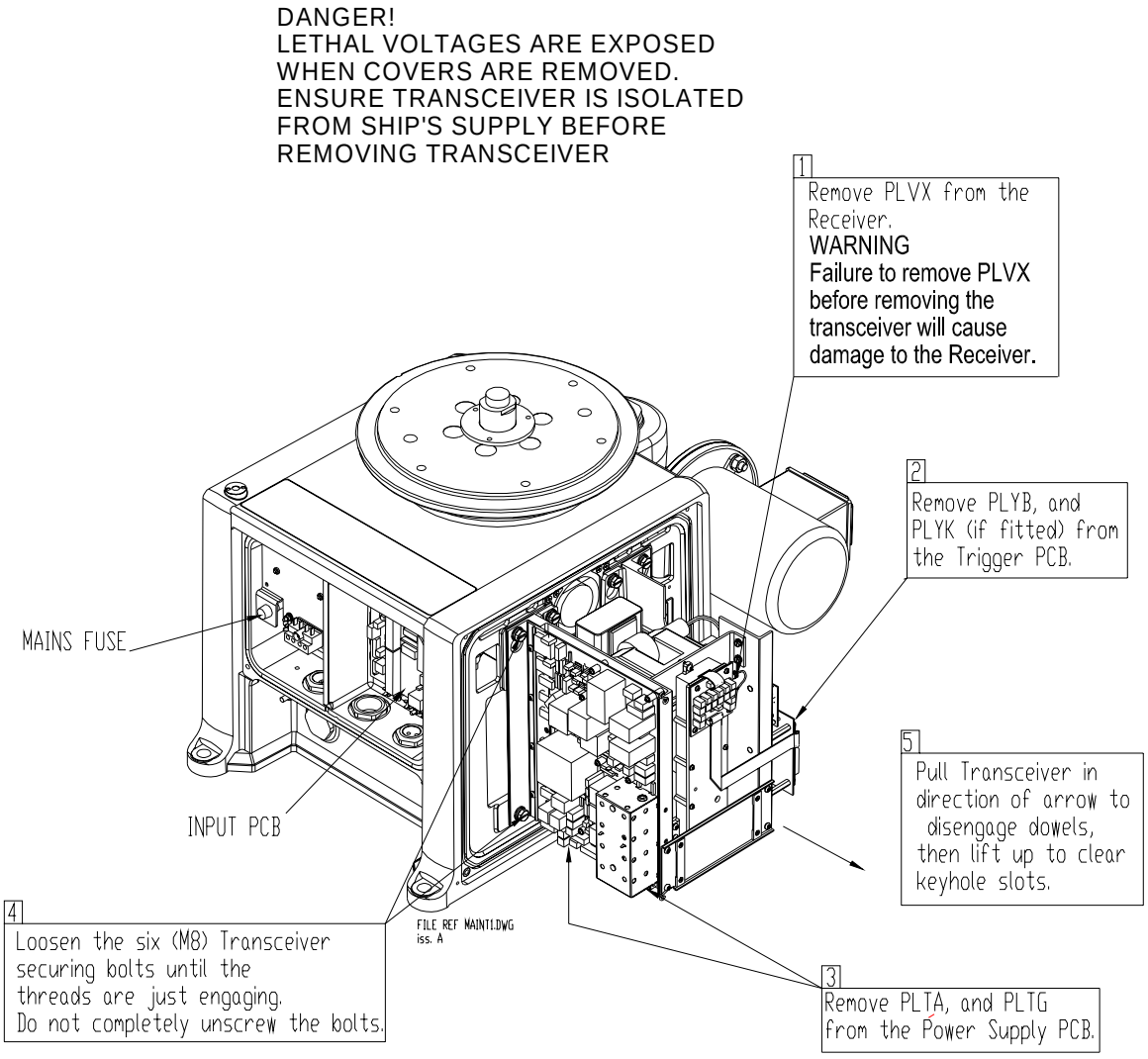


Figure 4.4 Removing the Transceiver from the Masthead Turning Unit

3.1.4 Replacing the Transceiver in the Bulkhead Turning Unit

See Figure 4.5 for instructions on removing and replacing the Transceiver from the bulkhead Tuning Unit.

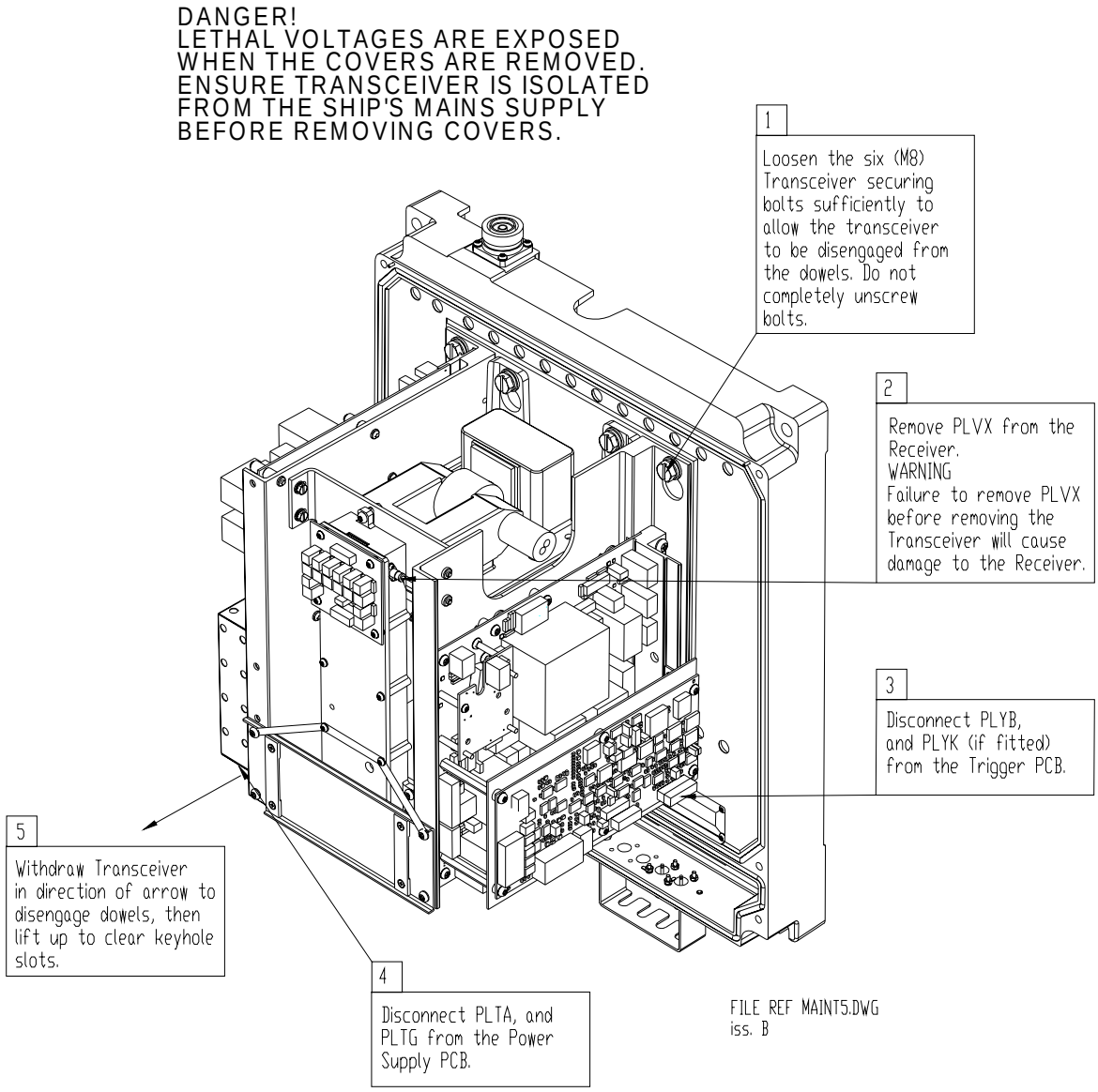


Figure 4.5 Removing Transceiver Assembly 65830630 – Bulkhead Transceiver

3.1.5 Magnetron Replacement – Masthead Transceiver

1. At the Scanner Control Unit set the isolating switch to the 'OFF' position and lock it.
2. Rotate the antenna until the front face is pointing away from the Transceiver.
3. Isolate the radar from the ship's mains supply using the isolating switch supplied.
4. Refer to Figure 4.2, and remove the Transceiver cover from the scanner unit.
5. Refer to Figure 4.6, and follow the procedure for removing and replacing the magnetron.

When a magnetron is replaced, the magnetron current must be set as follows:

6. On the Trigger PCB set links LK5 and LK6 to position 2–3.
7. Reconnect the ship's mains supply, and switch the radar ON.
8. Wait 3 minutes for the magnetron time delay to expire, and select long pulse.
9. Set the magnetron current as detailed in Section 3.1.7.
10. Isolate the radar from the ship's mains supply using the isolating switch supplied.
11. Reset LK5 and LK6 to position 1–2.
12. Replace the Transceiver cover.

3.1.6 Magnetron Replacement – Bulkhead Transceiver

1. Isolate the radar from the ship's mains supply using the isolating switch supplied.
2. Refer to Figure 4.3 and remove the transceiver cover.
3. Refer to Figure 4.6, and follow the procedure for removing and replacing the magnetron.

When a magnetron is replaced, the magnetron current must be set as follows:

4. Reconnect the ship's mains supply, and switch the radar ON.
5. Wait 3 minutes for the magnetron time delay to expire, and select long pulse.
6. Set the magnetron current as detailed in Section 3.1.7.
7. Isolate the radar from the ship's mains supply using the isolating switch supplied.
8. Replace the transceiver cover.

3.1.7 Setting the Magnetron Current

1. On the Trigger PCB set LK5 and LK6 to 2–3.

   This is the service position and will let the transmitter transmit when the antenna is stationary.

2. Restore the ship's supply to the Transceiver.
3. Select Long Pulse, transmit at the Display.
4. Measure the voltage between TP100 and ground on the Modulator PCB.

   A DVM with an input impedance >10 Mohms must be used for this measurement. Use of a meter with lower impedance could cause damage to the magnetron.

5. Adjust RV1 on the Power Supply PCB to give the correct voltage on TP100. The voltage is recorded on the label on the pulse transformer on the Modulator PCB.
6. Switch off
7. On the Trigger PCB set LK5 and LK6 to 1–2.

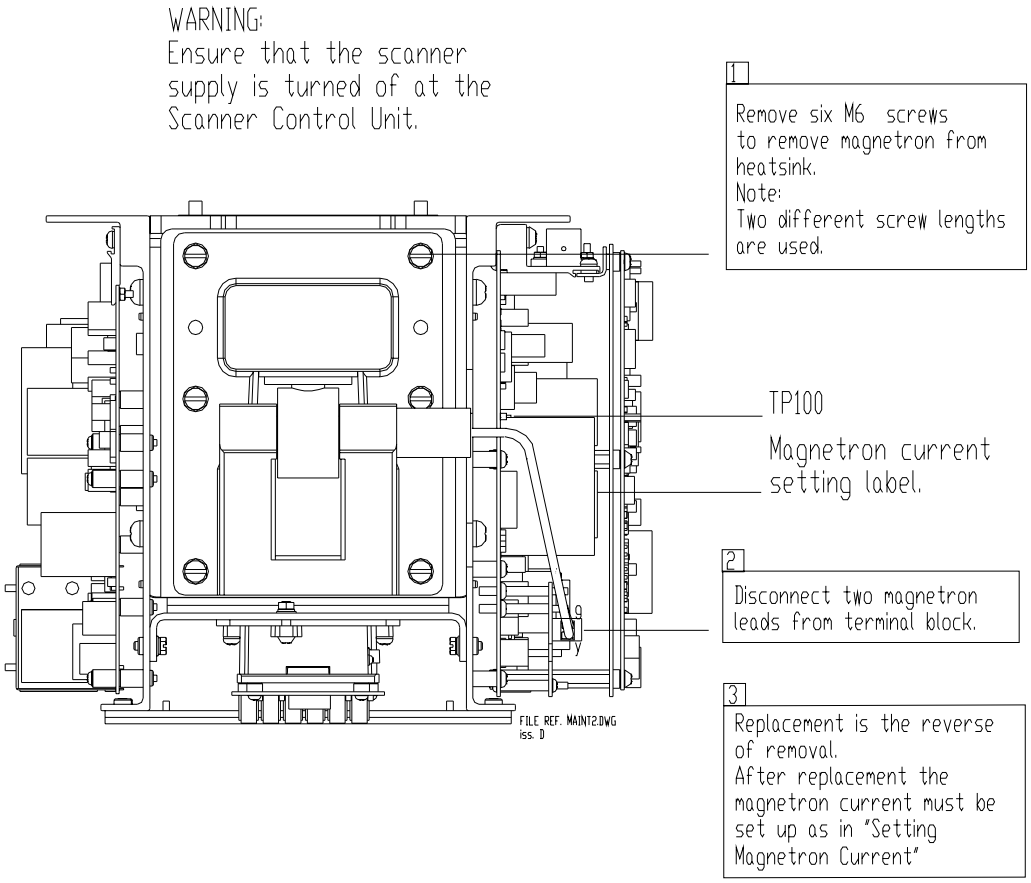


Figure 4.6 Magnetron Replacement

3.1.8 Trigger PCB – Replacement

See Figure 4.7 and Figure 4.8 for instructions on replacement of the Trigger PCB.

Set the links as shown in Figure 4.8.

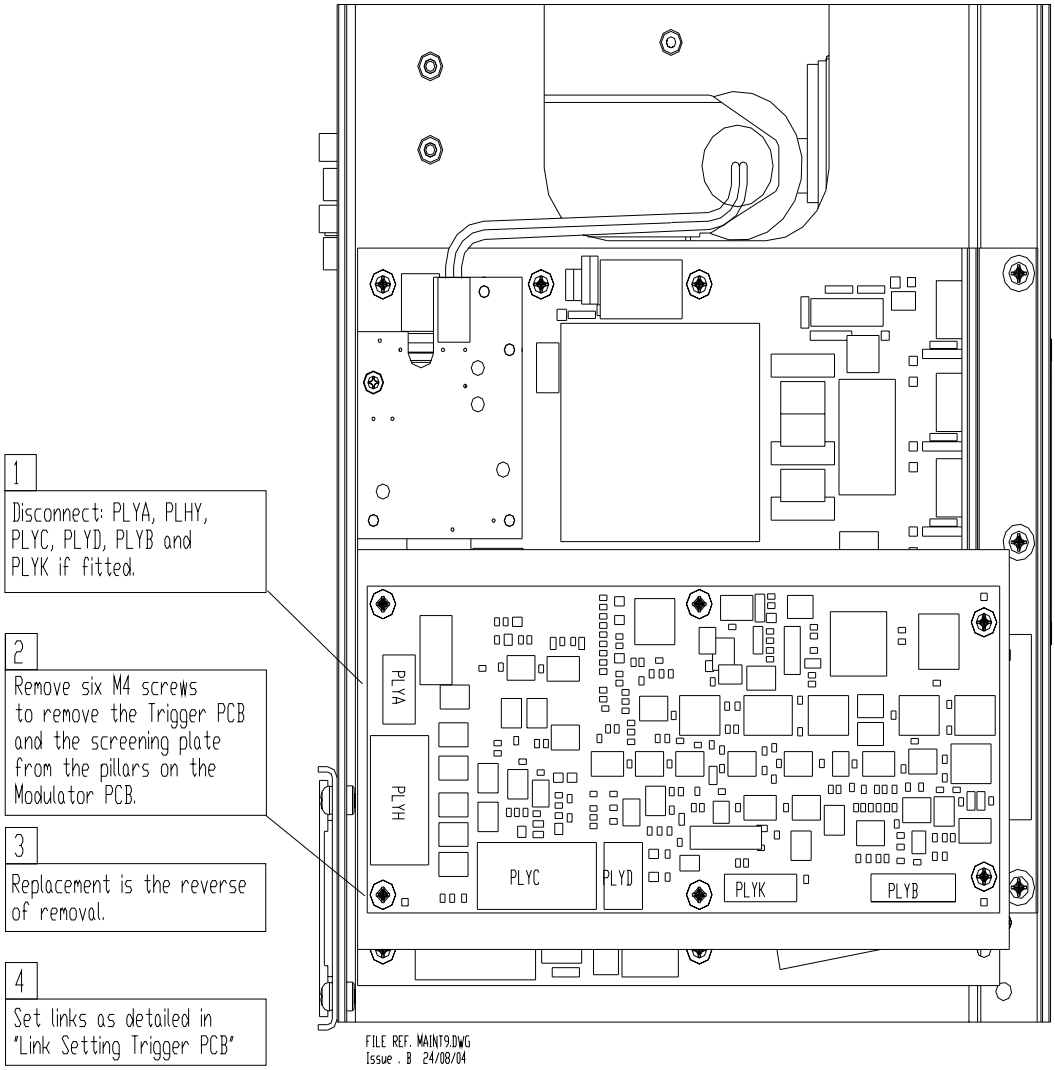
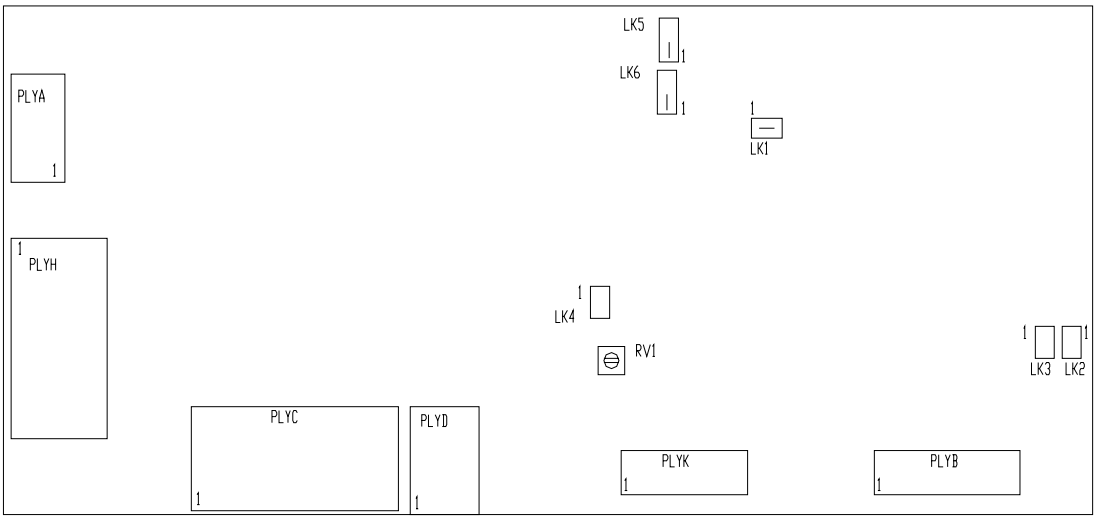


Figure 4.7 Replacing the Trigger PCB



FILE REF. TRIGGER.DWG
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ATE TEST LINKS
LK1 FITTED
LK4 NOT FITTED

BAUD RATE LINKS
LK2 NOT FITTED
LK3 NOT FITTED

SERVICE LINKS
LK5 NORMAL OPERATION FITTED 1 - 2
LK6 NORMAL OPERATION FITTED 1 - 2

LK5 SERVICE FITTED 2 - 3
LK6 SERVICE FITTED 2 - 3
WHEN FITTED 2 - 3 THE TRANSMITTER
WILL OPERATE WHEN THE ANTENNA IS
STOPPED.

RV1 SWEPT GAIN DELAY
FACTORY SET DO NOT ADJUST

Figure 4.8 Trigger PCB Link Settings

3.1.9 Modulator PCB – Replacement

See Figure 4.9 and Figure 4.10 for instructions on replacement of the Modulator PCB.

Set the links as shown in Figure 4.10.

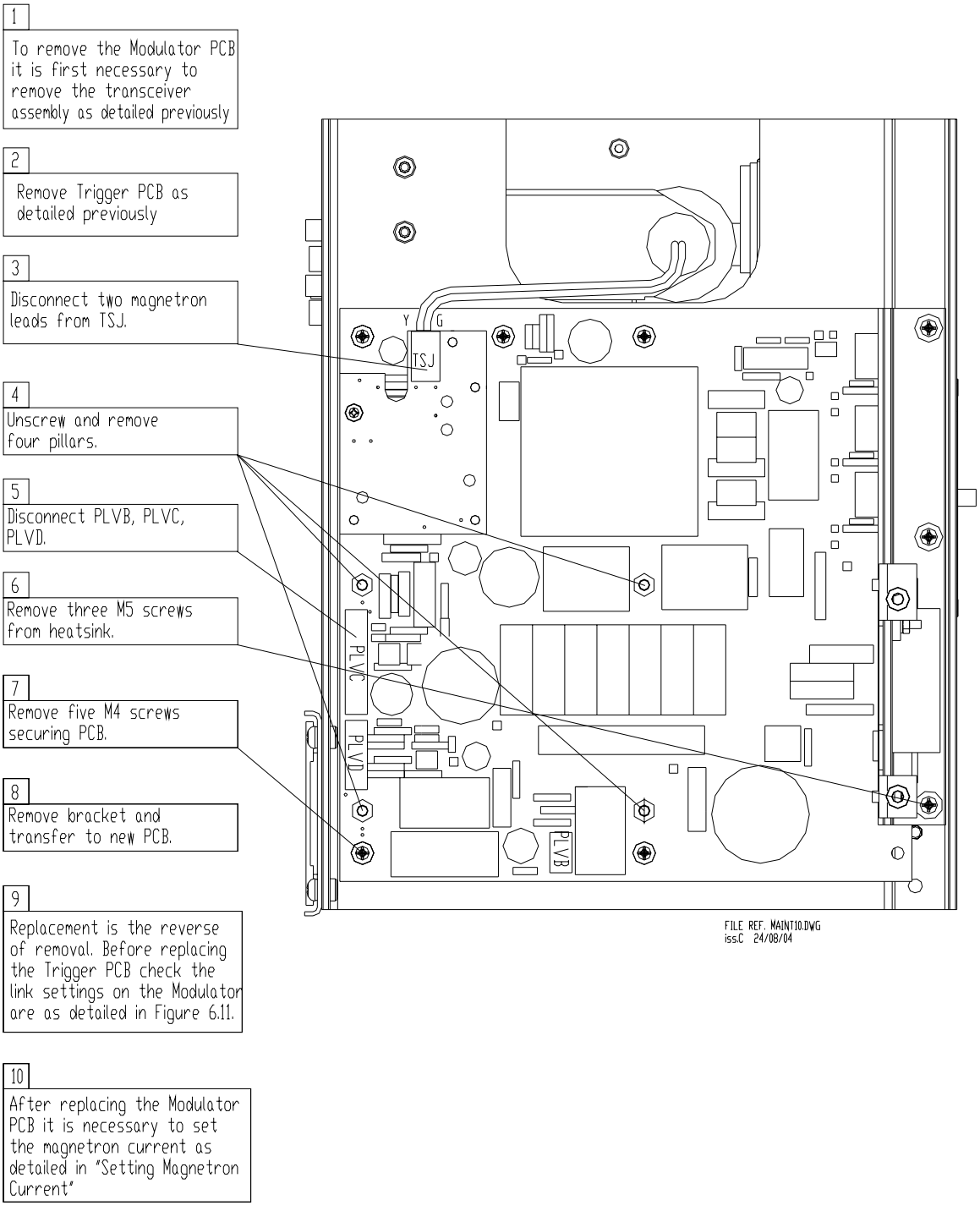
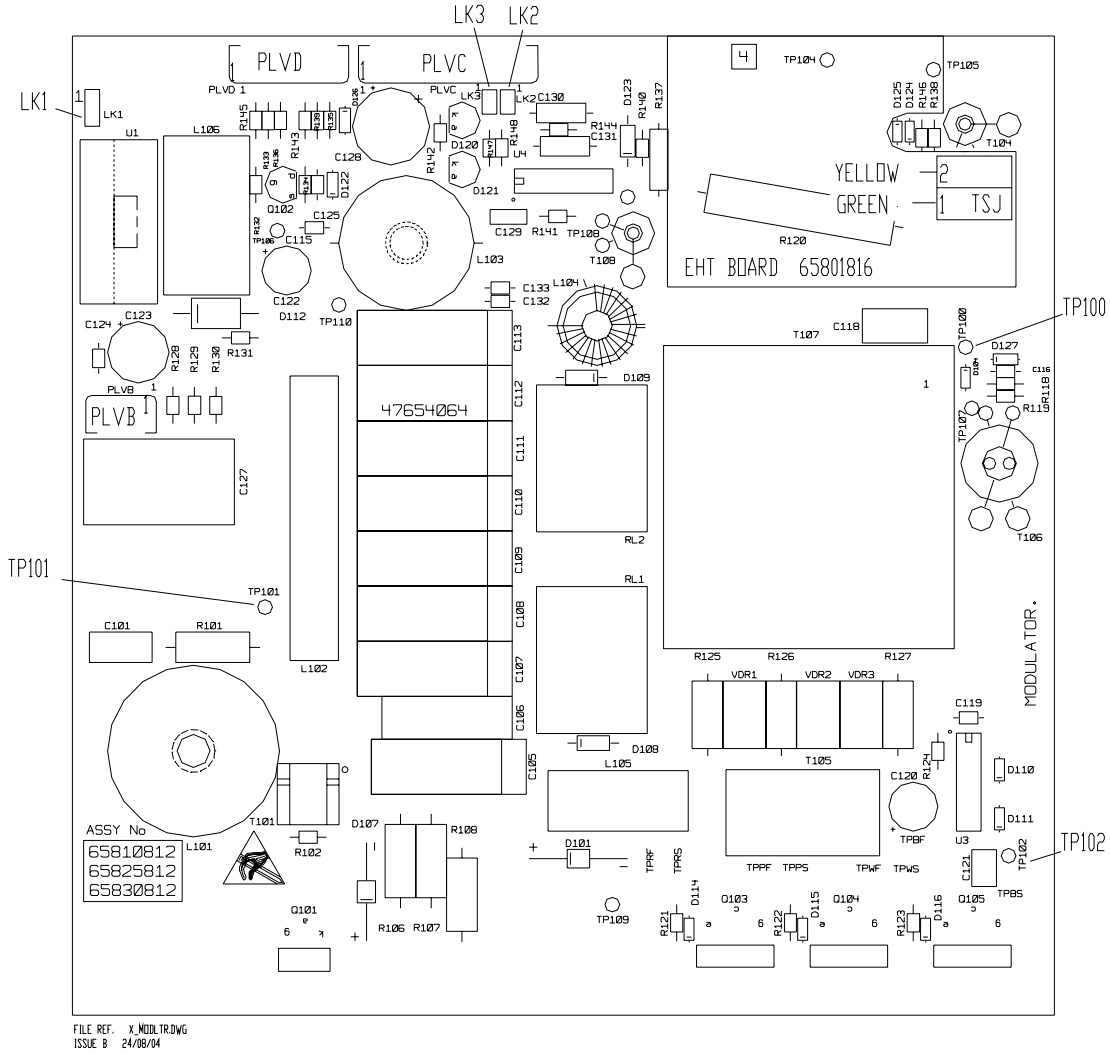


Figure 4.9 Replacing the Modulator PCB



MODULATOR LINK SETTINGS FOR 65810812 / 65825812 / 65830812

	S-BAND	10 kW X-BAND	25 kW X-BAND
LK1	FITTED 2 - 3	FITTED 1 - 2	FITTED 1 - 2 FOR MAGNETRON MG5424
LK1			FITTED 2 - 3 FOR MAGNETRON M1458
LK2	FITTED	NOT FITTED	NOT FITTED
LK3	NOT FITTED	FITTED	NOT FITTED

NOTE THAT LINK 1 IS CONFIGURABLE FOR HEATER TURNDOWN ON 25kW X-BAND
NOTE THAT LINKS 2 & 3 ARE HARDWIRED FOR SPECIFIC USEAGE ON LATER MODULATORS.

TEST POINTS:
TP100 MAGNETRON CURRENT MONITOR
TP101 CHARGE TRIGGER
TP102 MODULATOR TRIGGER

Figure 4.10 Modulator PCB Link Settings

3.1.10 Power Supply PCB Replacement

See Figure 4.11 and Figure 4.12 for instructions on replacement of the Power Supply PCB.

Set the links as shown in Figure 4.12.

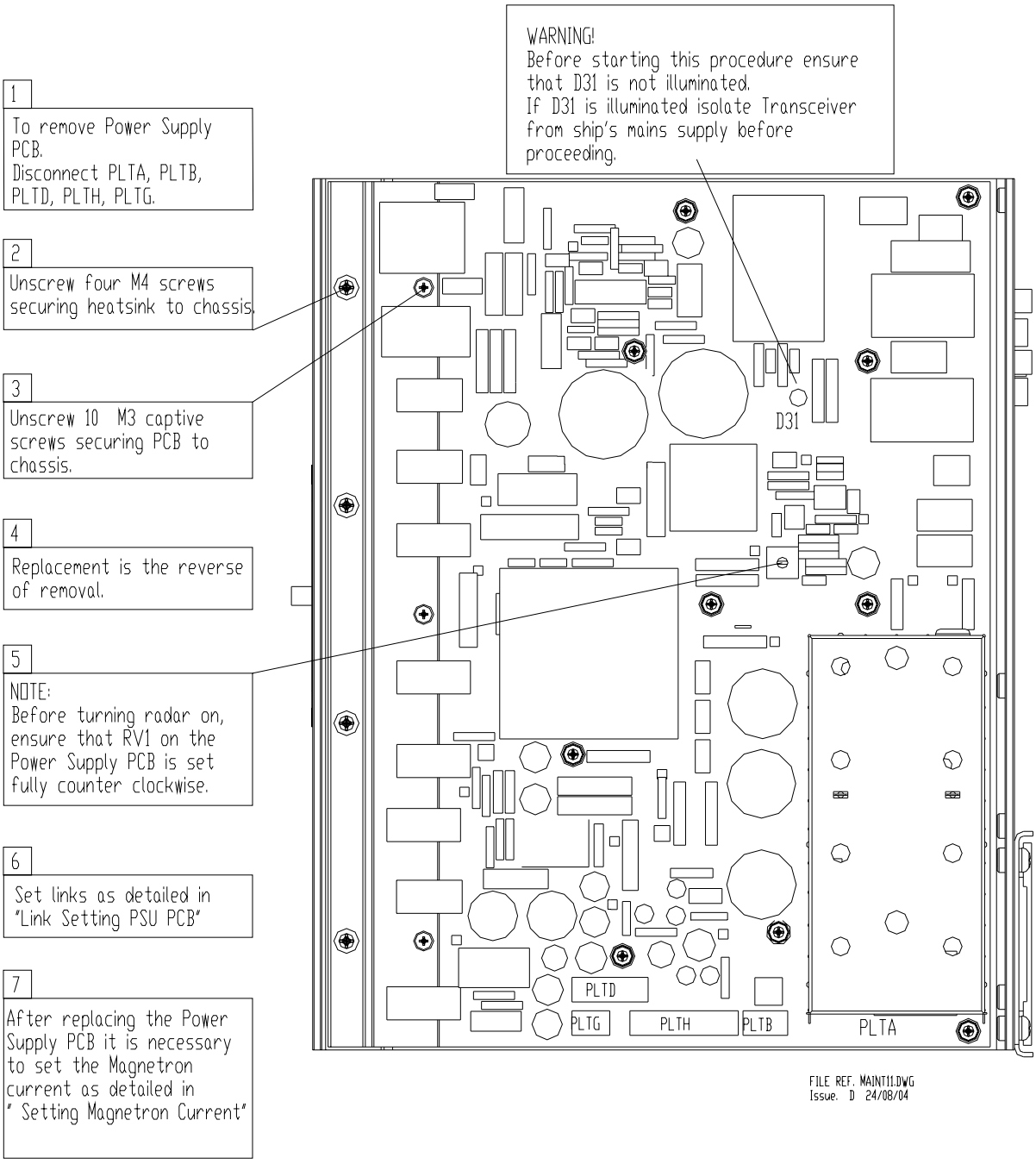
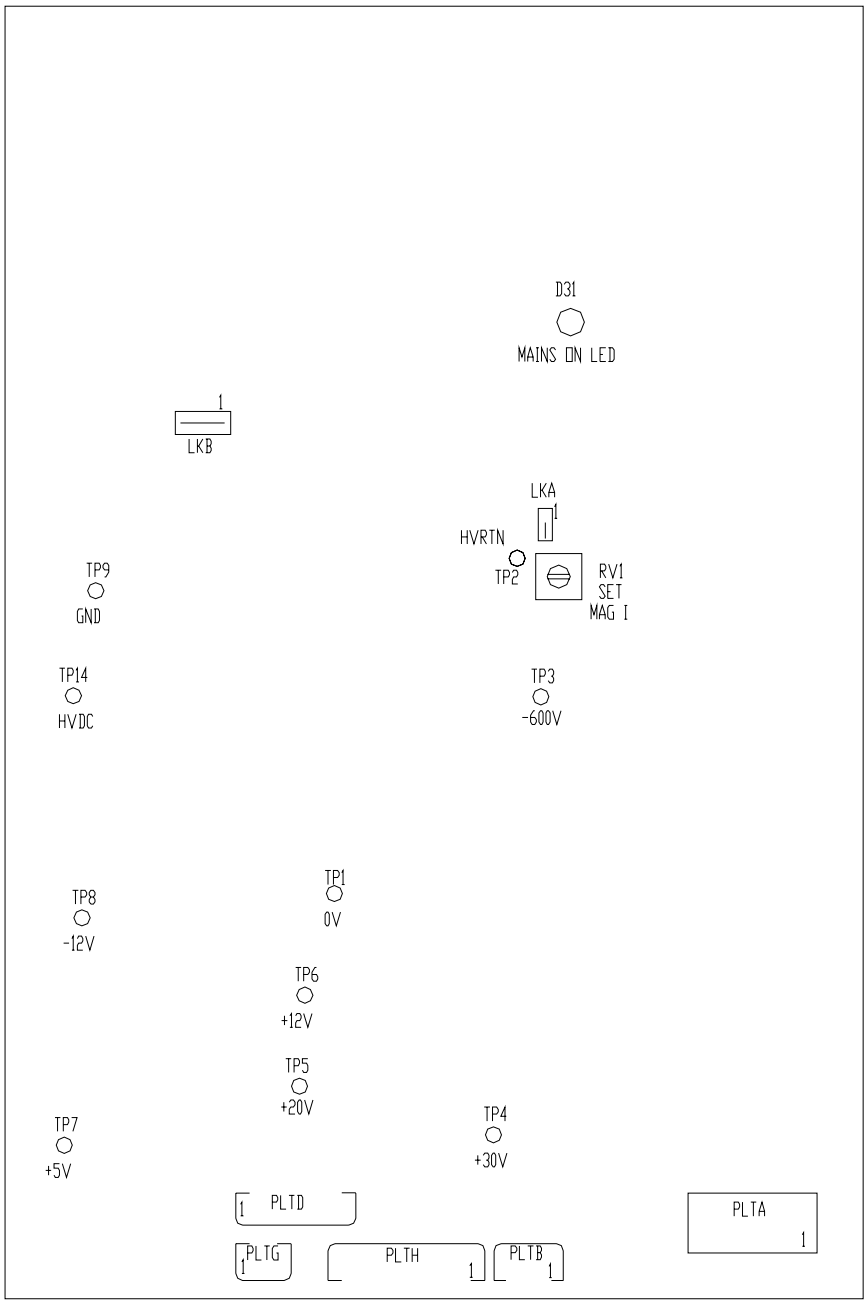


Figure 4.11 Replacing the Power Supply PCB



TEST POINTS
TP1 0V
TP3 -600V
TP4 +30V
TP5 +20V
TP6 +12V
TP7 +5V
TP8 -12V

The above voltages are measured with respect to TP1.

TP2 HVRTN
TP14 HVDC (380V)

The voltage on TP14 is measured with respect to TP2.

"LKA" START TEST LINK
LKA NORMAL OPERATION FITTED 2 - 3
LKA TEST FITTED 1 - 2
WHEN IN THE TEST POSITION THIS LINK ALLOWS THE POWER SUPPLY TO OPERATE WITHOUT BEING CONNECTED TO THE CONTROL SIGNALS FROM THE DISPLAY COMPATIBILITY UNIT.

"LKB" HIGH VOLTAGE ISOLATION LINK
LKB NORMAL OPERATION FITTED
LKB ISOLATE HV SUPPLY NOT FITTED

THIS LINK CAN BE USED TO ISOLATE THE POWER FACTOR CORRECTION CIRCUIT FROM THE REST OF THE POWER SUPPLY AS AN AID TO FAULT FINDING.

FILE REF PSU.DWG
Issue. D 24/08/04

Figure 4.12 Power Supply PCB Link Settings

3.1.11 Receiver Assembly – Replacement

See Figure 4.13 and Figure 4.14 for instructions on replacement of the Receiver Assembly:

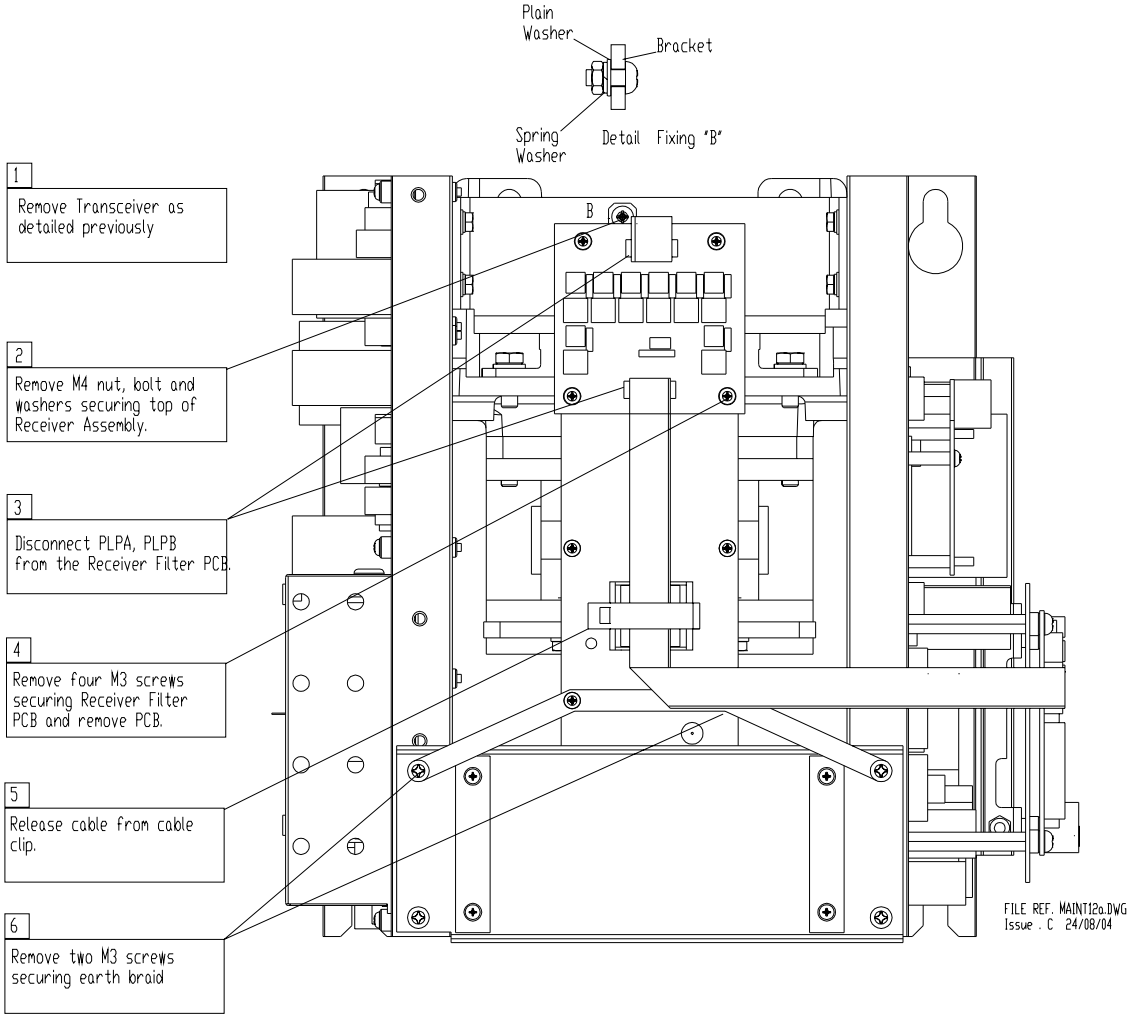


Figure 4.13 Replacing the Receiver Assembly 65830616

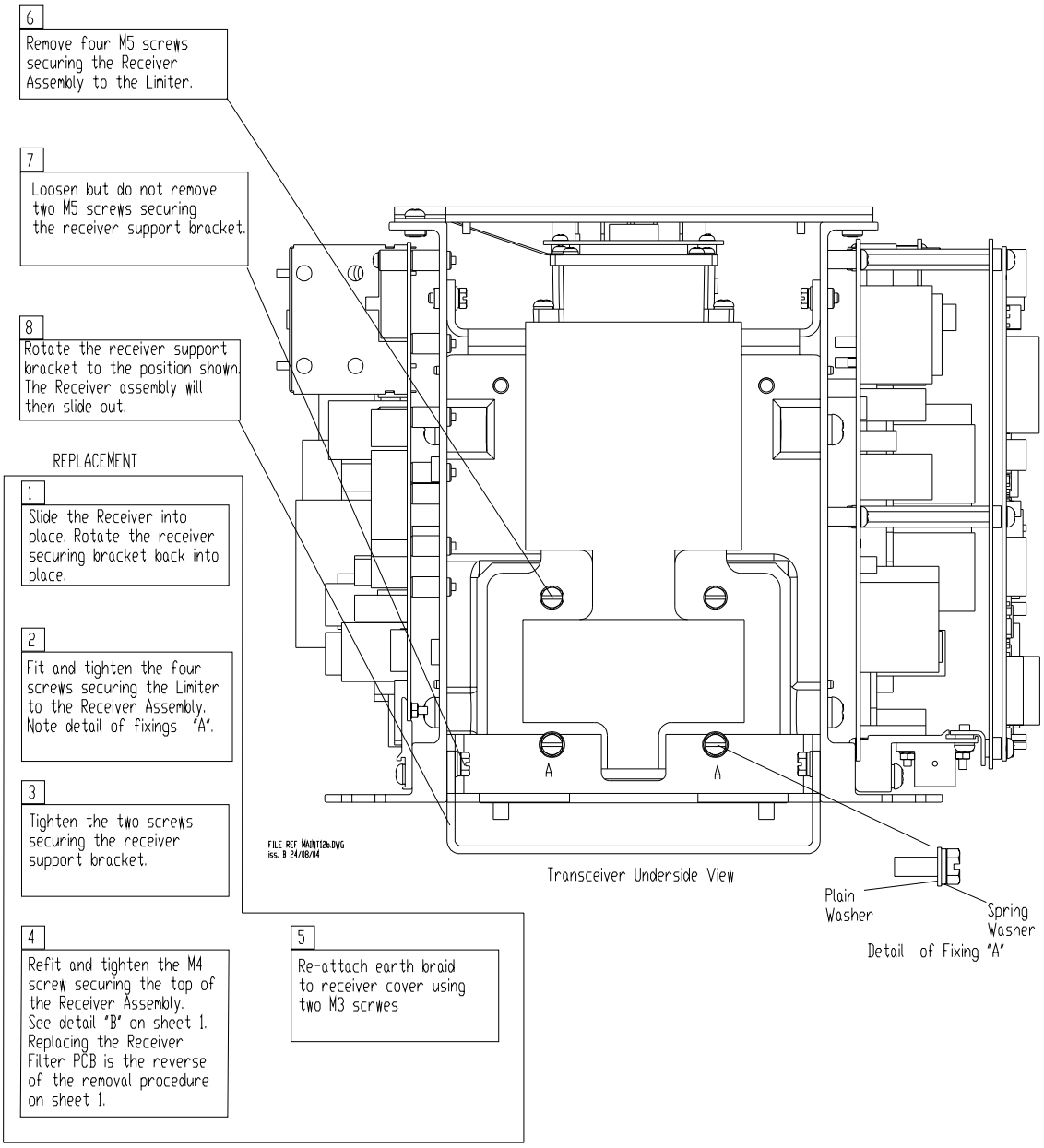


Figure 4.14 Replacing the Receiver Assembly 65830616

3.1.12 Bearing and Heading Marker PCB – Replacement

1. At the Scanner Control Unit set the isolating switch to the 'OFF' position and lock it.
2. Rotate the antenna until the front face is pointing away from the transceiver.
3. Isolate the radar from the ship's mains supply using the isolating switch supplied.
4. Refer to Figure 4.15, and remove the Performance Monitor cover.
5. The location of the Pulse Bearing PCB is shown in Figure 4.16.

6. Remove the two securing screws and remove the PCB.
7. Replace the PCB and secure with the two screws (two dowels of different diameters locate the PCB in the correct orientation).
8. Align the Heading Marker using the configuration tool.

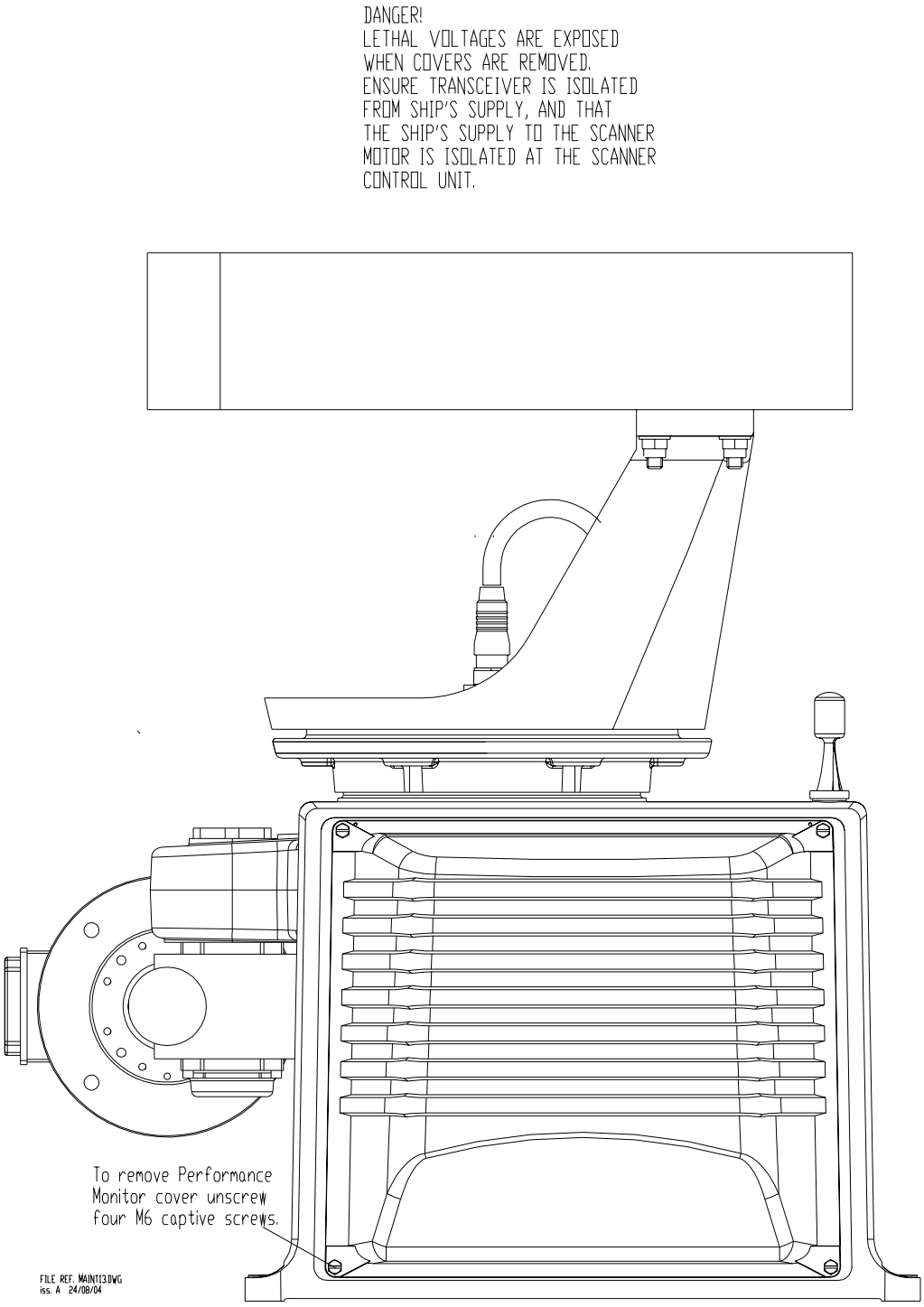


Figure 4.15 Access to Performance Monitor, Bearing and Heading Marker PCB

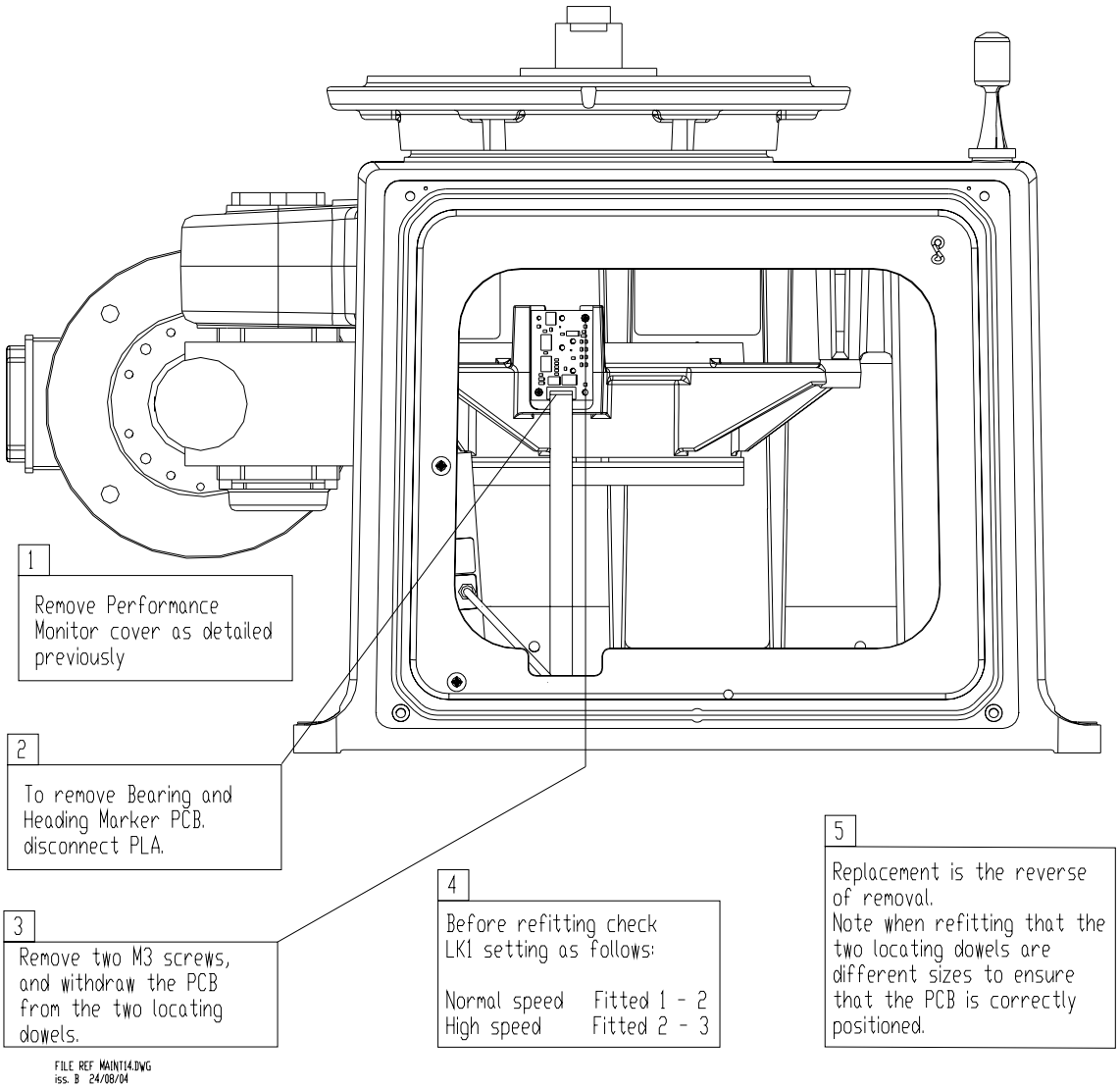


Figure 4.16 Replacing the Bearing and Heading PCB

3.1.13 Performance Monitor – Replacement

See Figure 4.15 and Figure 4.17 for instructions on replacement of the Receiver Assembly:

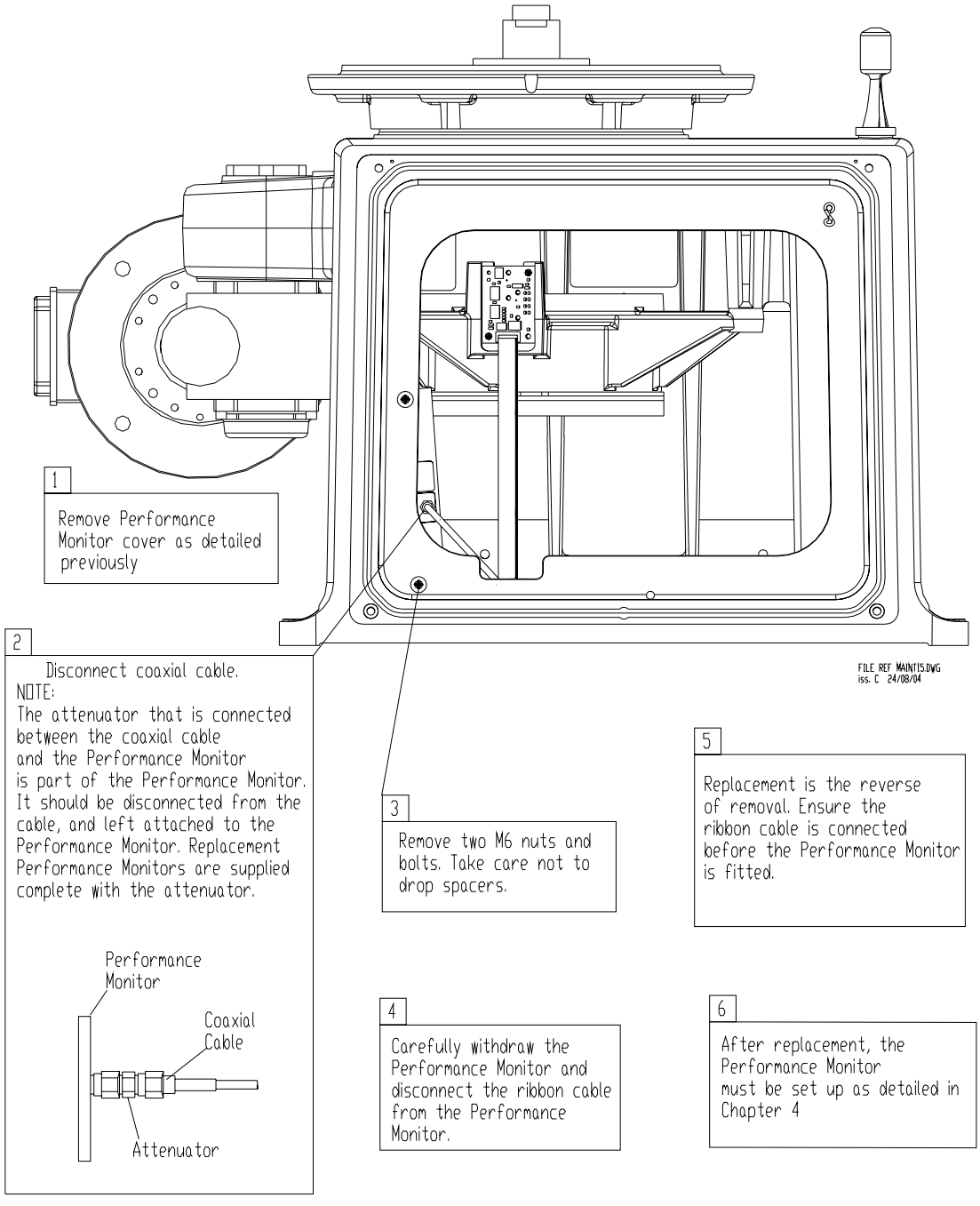


Figure 4.17 Replacing the Performance Monitor

3.1.14 Fan Assembly – Replacement

See Figure 4.18 for instructions on replacement of the Fan Assembly:

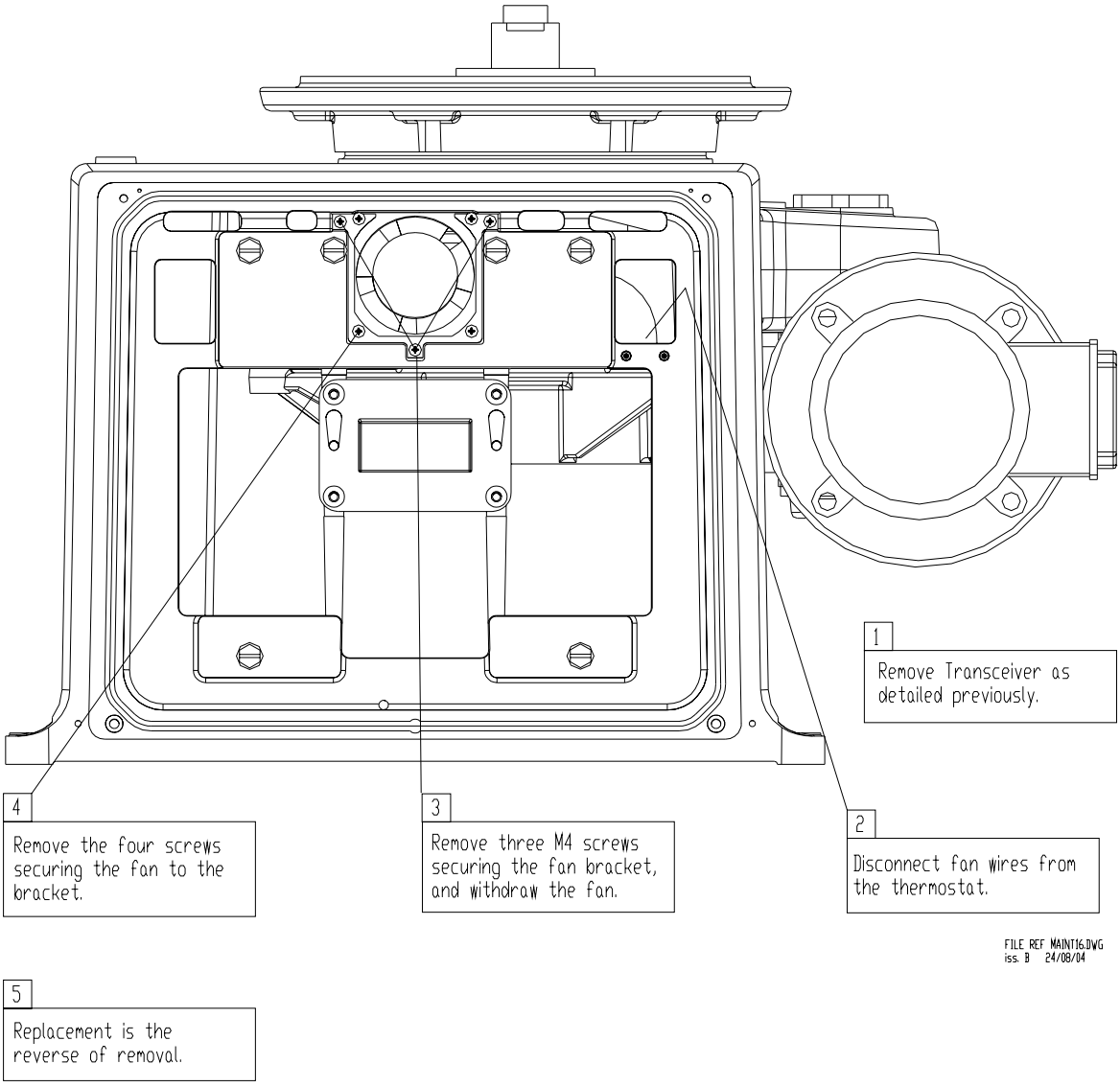


Figure 4.18 Replacing the Fan Assembly

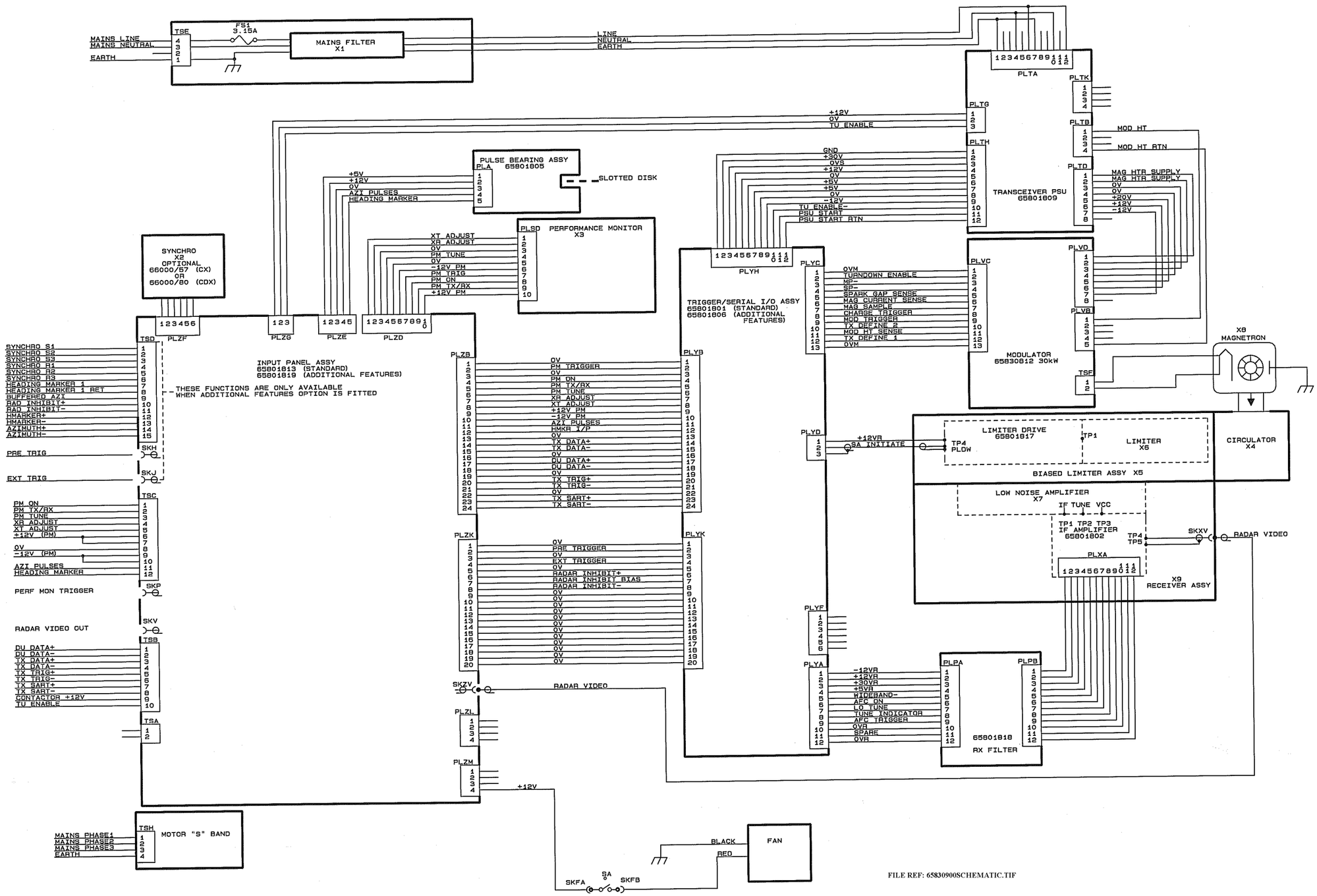


Figure 4.19 S-band Turning Unit Schematic

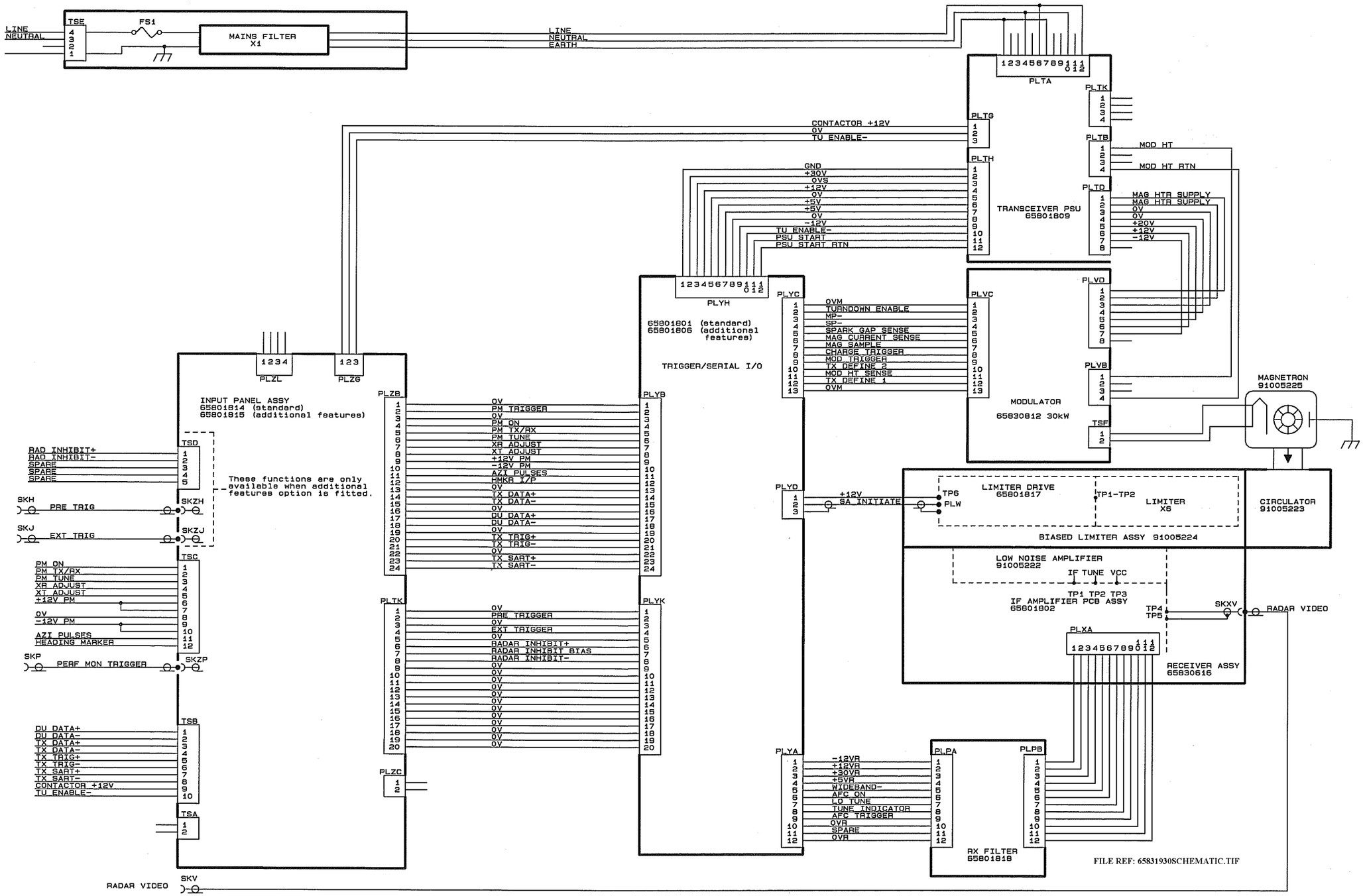


Figure 4.20 S-band Bulkhead Transceiver Schematic

3.2 X-band Scanner Unit

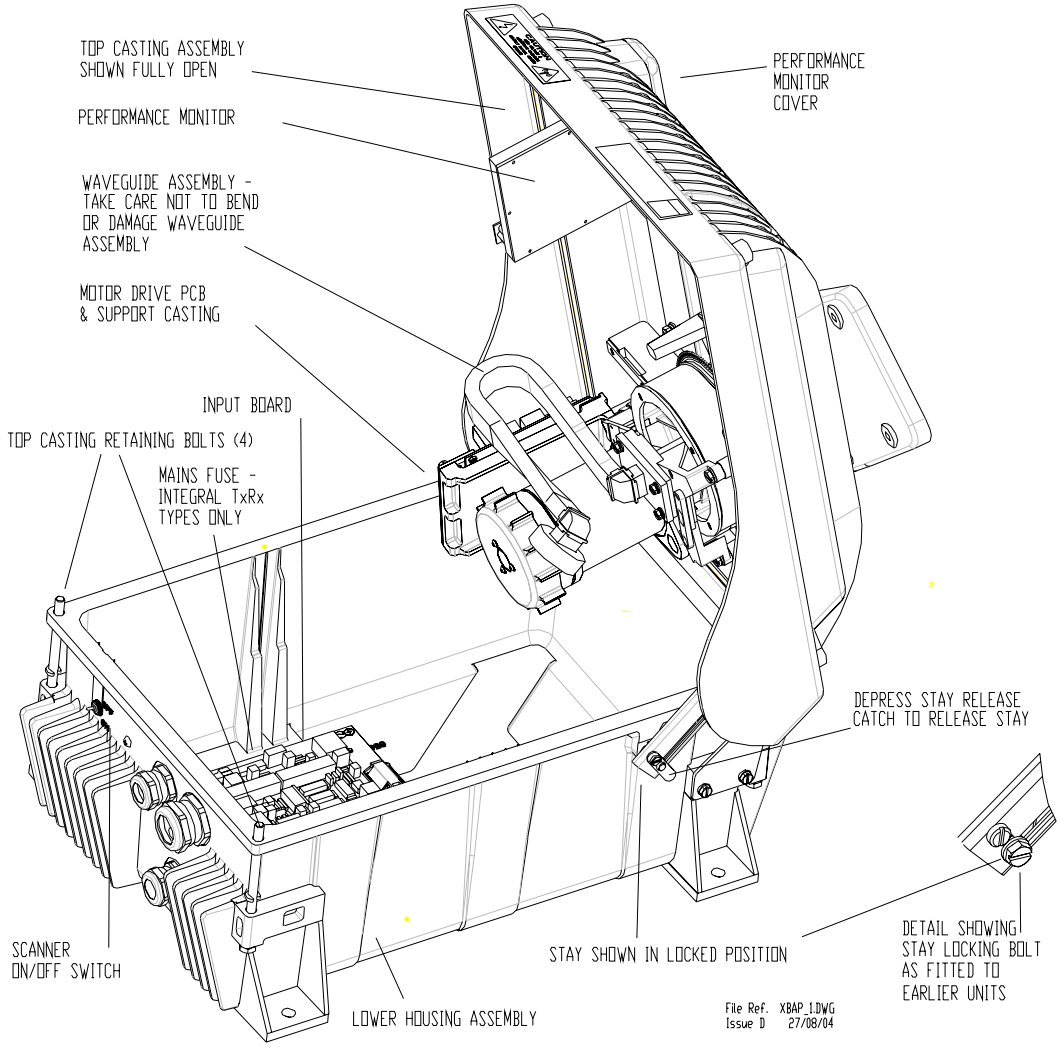


Figure 4.21 Main Assemblies of X-band Bulkhead Turning Unit

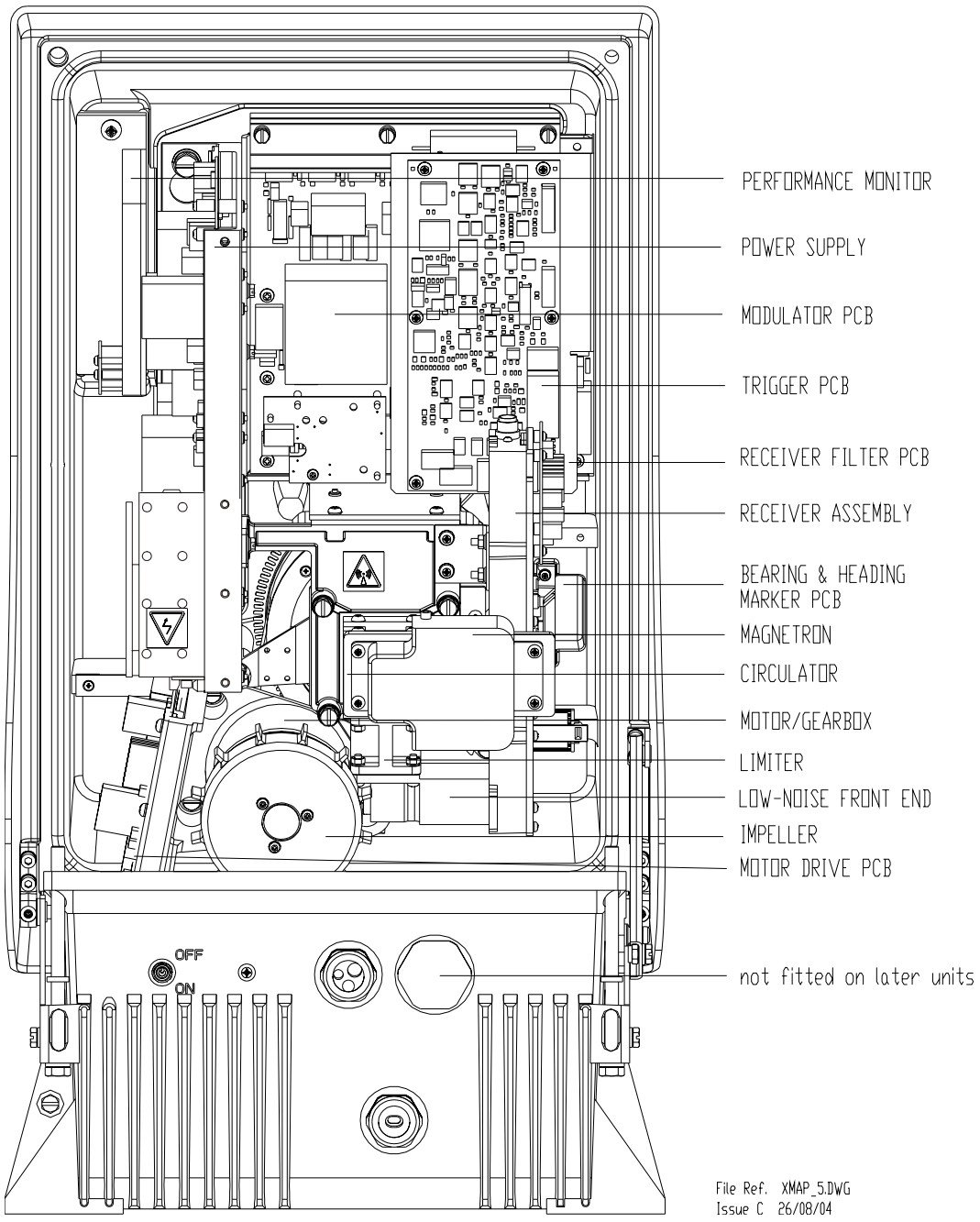


Figure 4.22 Main Assemblies of X-band Masthead Turning Unit

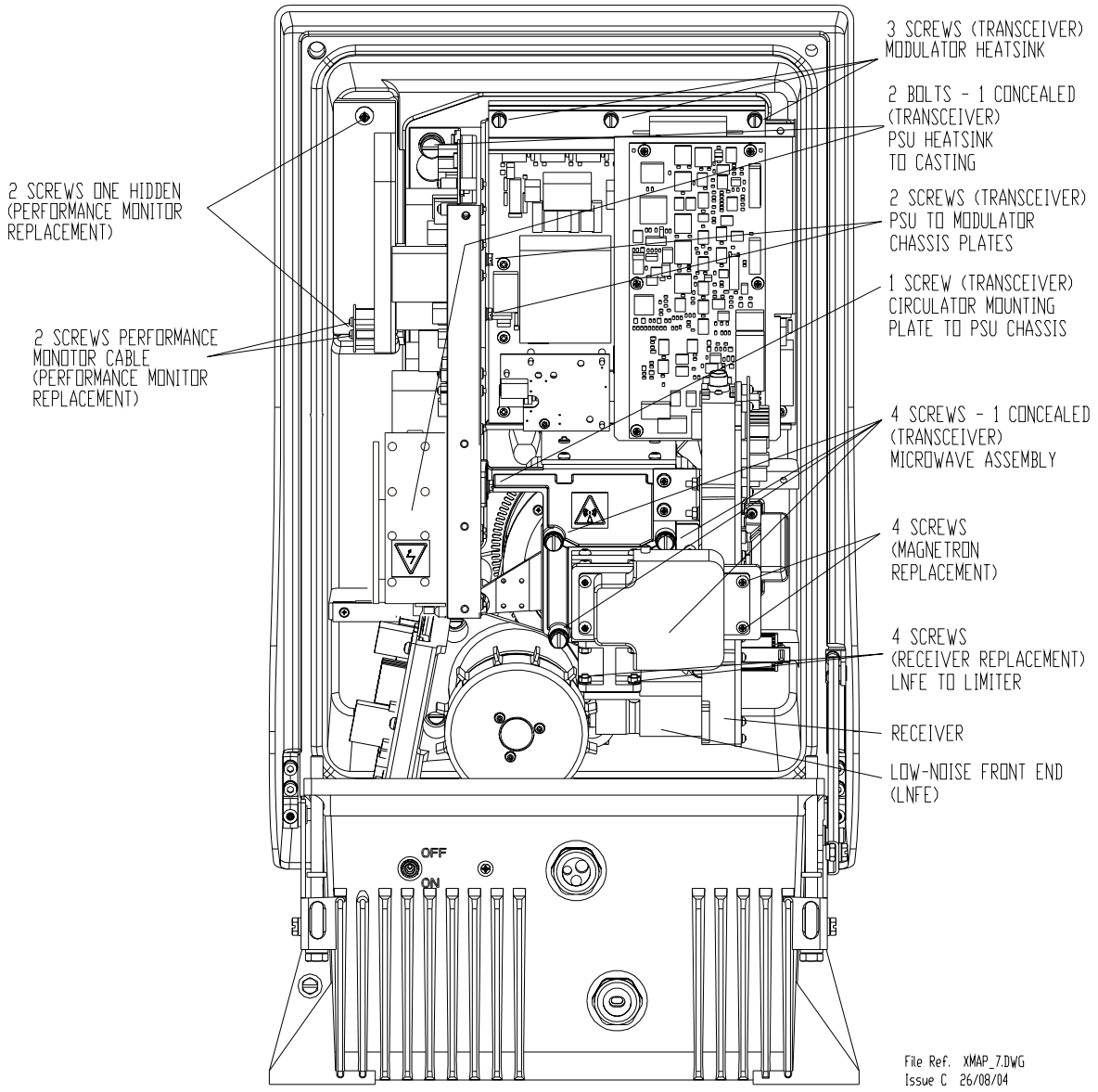


Figure 4.23 Fitment of Main Assemblies on X-band Masthead Turning Unit

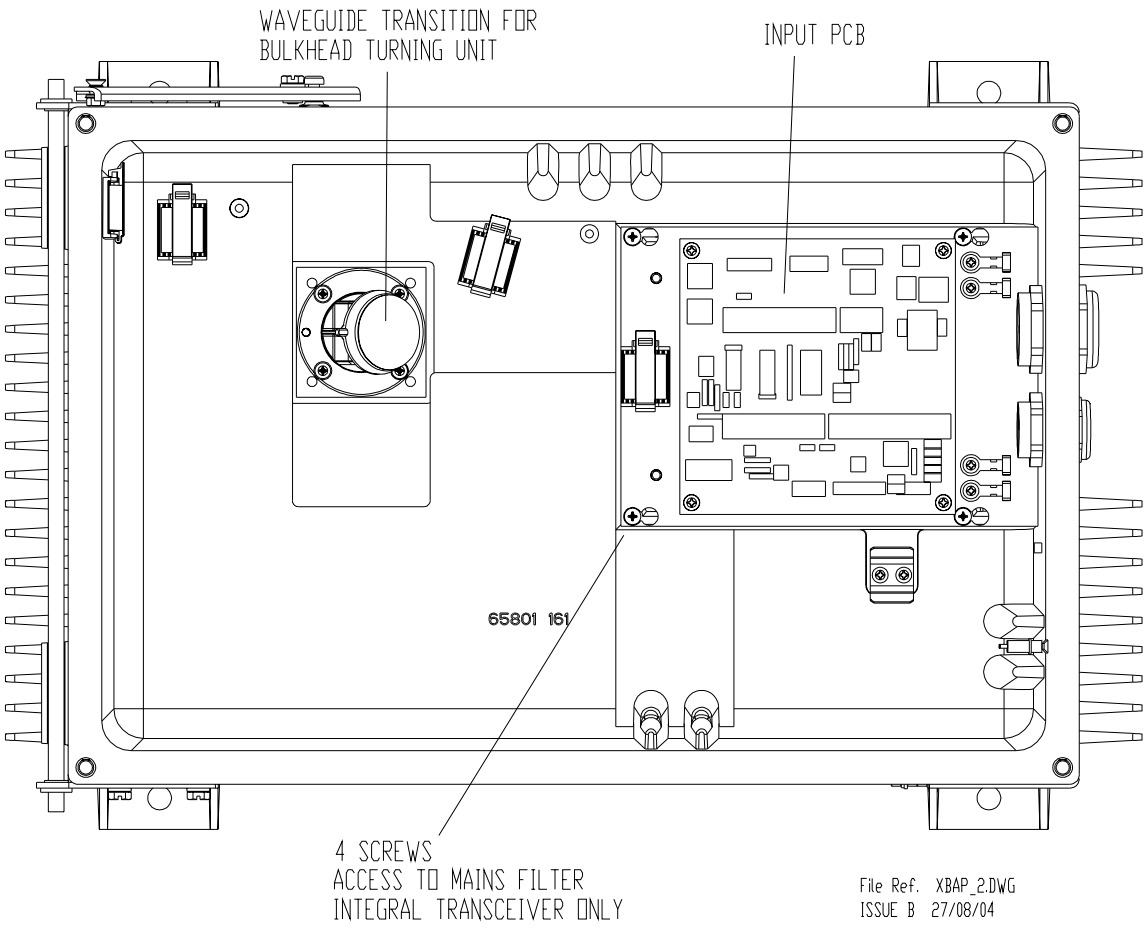


Figure 4.24 Assemblies Fitted to Lower Casting – Bulkhead Turning Unit

3.2.1 Access to Masthead Transceiver

1. Select **Shutdown System** in the Display System menu and wait for the VisionMaster FT application and Windows to fully power down.
2. Switch the Control Panel On/Off switch to Off.
3. Isolate and remove both Ship's Switch Fuses in DC systems.
4. Isolate the radar from the ship's mains supply using the Isolating Switch provided for AC systems.
5. Turn the antenna into the service position: across the Transceiver axis, clear of any obstructions.
6. Undo the four captive bolts on the underside of each upper casting (these secure the upper casting to the base casting).
7. Raise the upper casting into the upright position and make sure the support stay engages in the locked position.

8. On earlier units the sliding locking bolt should be pushed to the bottom of the slot in the stay to prevent inadvertent release of the upper casting. Refer to Figure 4.25.

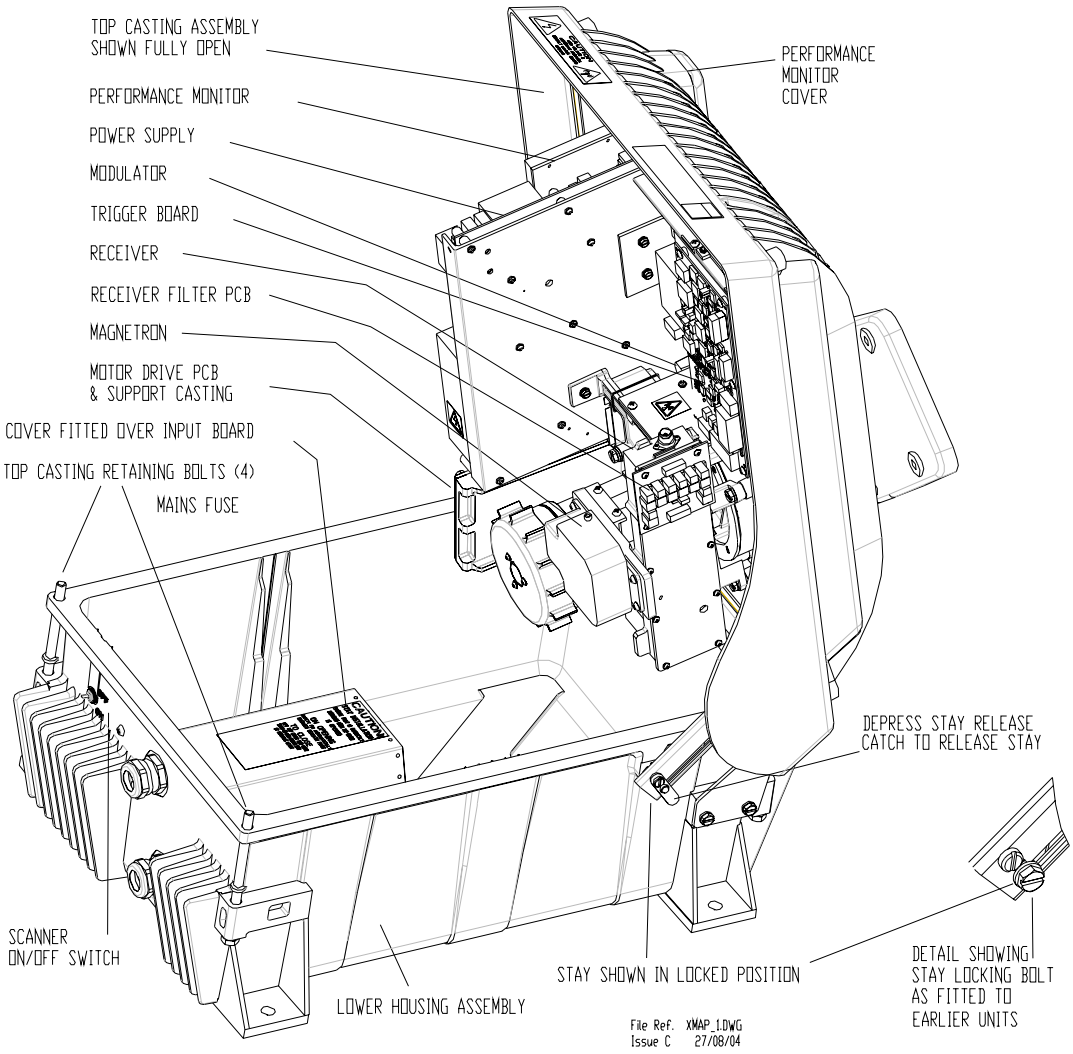


Figure 4.25 Internal view of X-band Masthead Turning Unit (showing Transceiver)

3.2.2 Access to Bulkhead Transceiver

1. Select **Shutdown System** in the Display System menu and wait for the VisionMaster FT application and Windows to fully power down.
2. Switch the Control Panel On/Off switch to Off.
3. Isolate and remove both Ship's Switch Fuses in DC systems.
4. Isolate the radar from the ship's mains supply using the Isolating Switch provided for AC systems.
5. Undo the four screws that retain the upper cover to the lower chassis and lift clear.

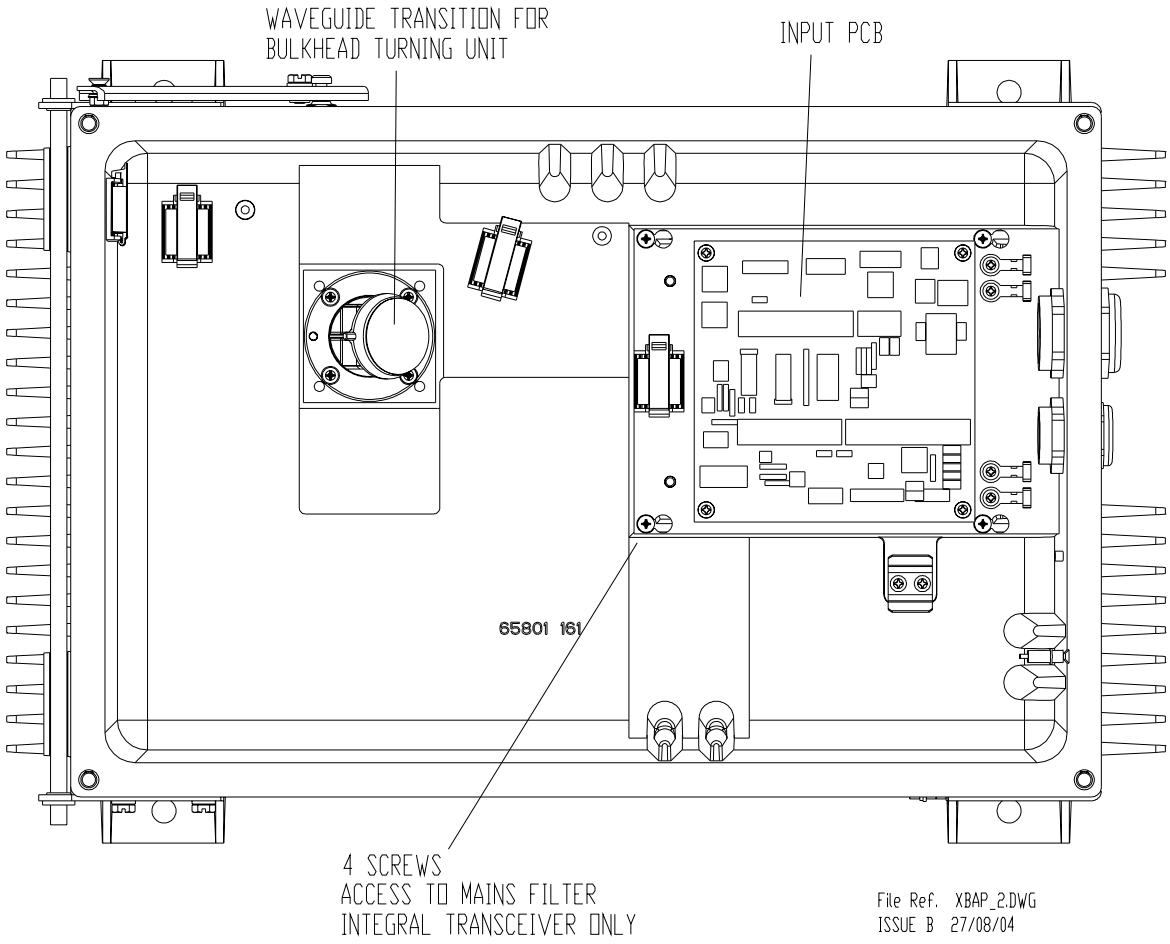


Figure 4.26 X-band Bulkhead Turning Unit – assemblies fitted to lower casting

3.2.3 Replacing the Transceiver in the Masthead Turning Unit

1. Refer to Section 3.2.1 '*Access to Masthead Transceiver*', paying attention to all safety aspects.
2. Check that the transceiver is fully isolated from the ship's supply.

Note: *The Masthead and Bulkhead Transceiver Units are identical and only minor differences exist in terms of fixtures.*

3. Disconnect the cables from the following sockets:

SKV	Video co-axial cable to receiver assembly.
PLYB	Ribbon cable to Trigger PCB.
PLTK	Cable from PSU to Motor Drive PCB.
PLTA	Cable from PSU to Input Filter PCB (mains supply).
PLTG	Cable from PSU to Input PCB.

4. Refer to Figure 4.23.
5. Release the four M6 captive screws that hold the microwave assembly to the waveguide transition (around the base of the Circulator plate).
6. Remove the three screws that hold the Modulator heat sink to the chassis.
7. Slacken the two large bolts that hold the PSU heat sink to the chassis.
8. Before sliding up and removing the Transceiver, make sure that no cables are caught on any of the metalwork to avoid damage.
9. The PSU heat sink has slotted holes: slide upwards (towards the microwave output transition) and remove without fully removing the two bolts.

The replacement sequence is as follows:

10. Place the Transceiver approximately onto the upper casting using the two large slotted holes in the PSU heat sink.
11. Slacken the two screws that hold the PSU chassis plate to the Modulator chassis plate, see Figure 4.23.
12. Slacken the screw that holds the Circulator mounting plate to the PSU chassis plate.
13. Fit and only **partially** tighten the three screws in the Modulator heat sink.
14. Fully tighten the four M6 microwave assembly-retaining screws.
15. Fully tighten the three screws in the Modulator heatsink.
16. Fully tighten the two large bolts in the slotted holes in the PSU heat sink.
17. Fully tighten the two screws that hold the PSU chassis plate to the Modulator chassis plate.
18. Fully tighten the screw that holds the circular mounting plate to the PSU chassis.

Note: *This sequence is important to make sure the microwave alignment takes priority in terms of mechanical tolerances.*

19. Replace all cables removed earlier.

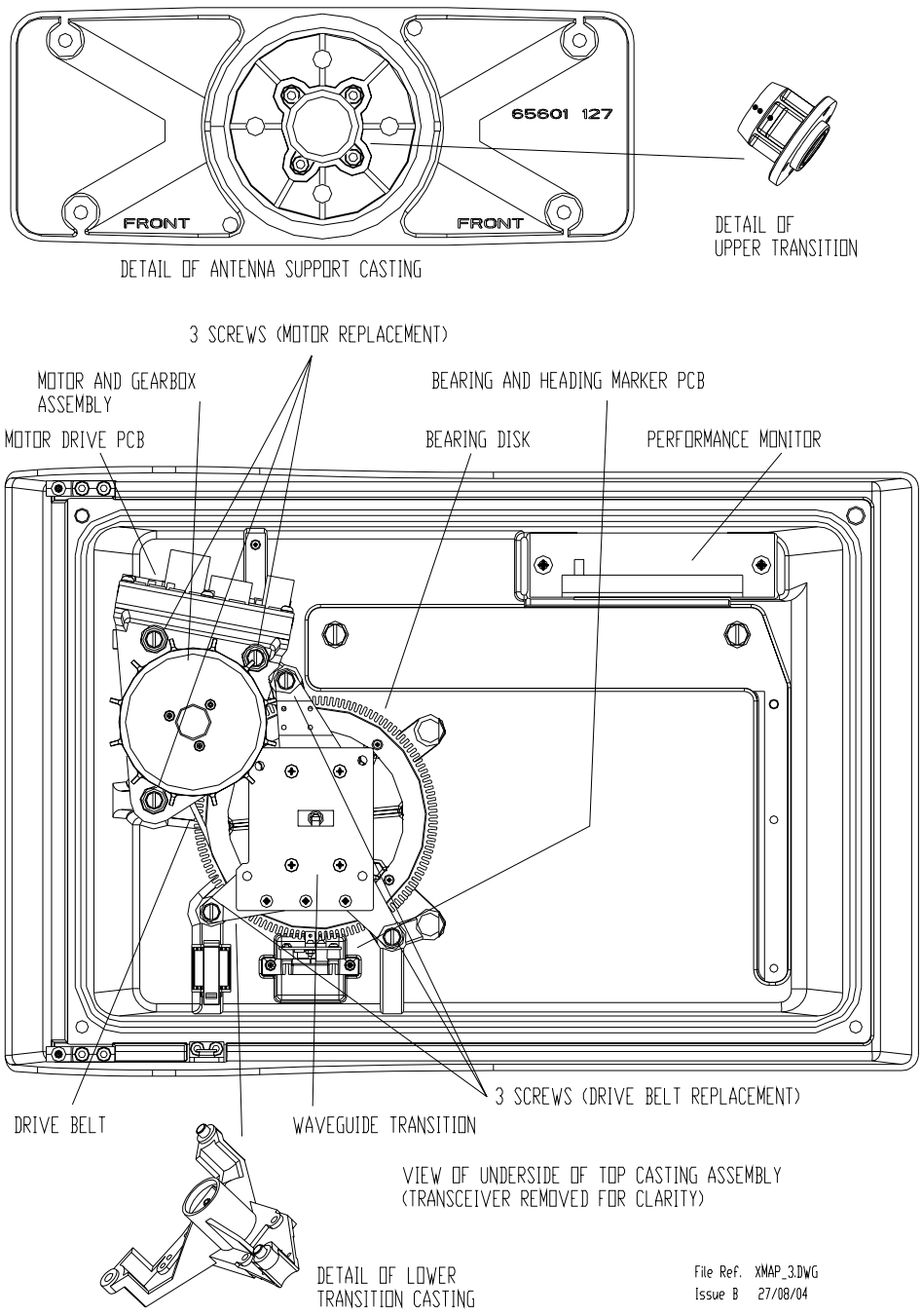


Figure 4.27 View inside Upper Casting with Transceiver removed

3.2.4 Replacing the Transceiver in the Bulkhead Turning Unit

1. Refer to Section 3.2.2 '*Access to Bulkhead Transceiver*', paying attention to all safety aspects.
2. Check that the Transceiver is fully isolated from the ship's supply.

Note: *The Masthead and Bulkhead Transceiver Units are identical and only minor differences exist in terms of fixtures.*

3. Disconnect the cables from the following sockets:

SKV	Video co-axial cable to receiver assembly.
PLYB	Ribbon cable to Trigger PCB.
PLTK	Cable from PSU to Input PCB (motor supply).
PLTA	Cable from PSU to Input Filter PCB (mains supply).
PLTG	Cable from PSU to Input PCB.

4. Refer to Figure 4.23 and Figure 4.28.
5. Release the four M6 captive screws that hold the microwave assembly to the waveguide transition (around the base of the Circulator plate).
6. Remove the three screws that hold the Modulator heat sink to the chassis.
7. Slacken the two large bolts that hold the PSU heat sink to the chassis.
8. Before sliding up and removing the Transceiver, make sure that no cables are caught on any of the metalwork to avoid damage.
9. The PSU heat sink has slotted holes: slide upwards (towards the microwave output transition) and remove without fully removing the two bolts.

Note: *On Bulkhead Transceivers, a small clip is fitted to the chassis to retain the lower edge of the Modulator PCB and support plate. This is purely a slide-in fixture and does not require undoing.*

The replacement sequence is as follows:

10. Locate the Transceiver approximately onto the chassis using the two large slotted holes in the PSU heatsink.
11. Make sure the small clip fitted to the chassis engages the lower edge of the Modulator PCB and support plate during the replacement process.
12. Slacken the two screws that hold the PSU chassis plate to the Modulator chassis plate, refer to Figure 4.28.
13. Fit and **partially** tighten the three screws in the Modulator heat.
14. Fully tighten the four M6 microwave assembly-retaining.

15. Fully tighten the three screws in the Modulator heat sink.
16. Fully tighten the two large bolts in the slotted holes in the PSU heat sink.

Note: *This sequence is important to make sure the microwave alignment takes priority in terms of mechanical tolerances.*

17. Replace all cables removed earlier.

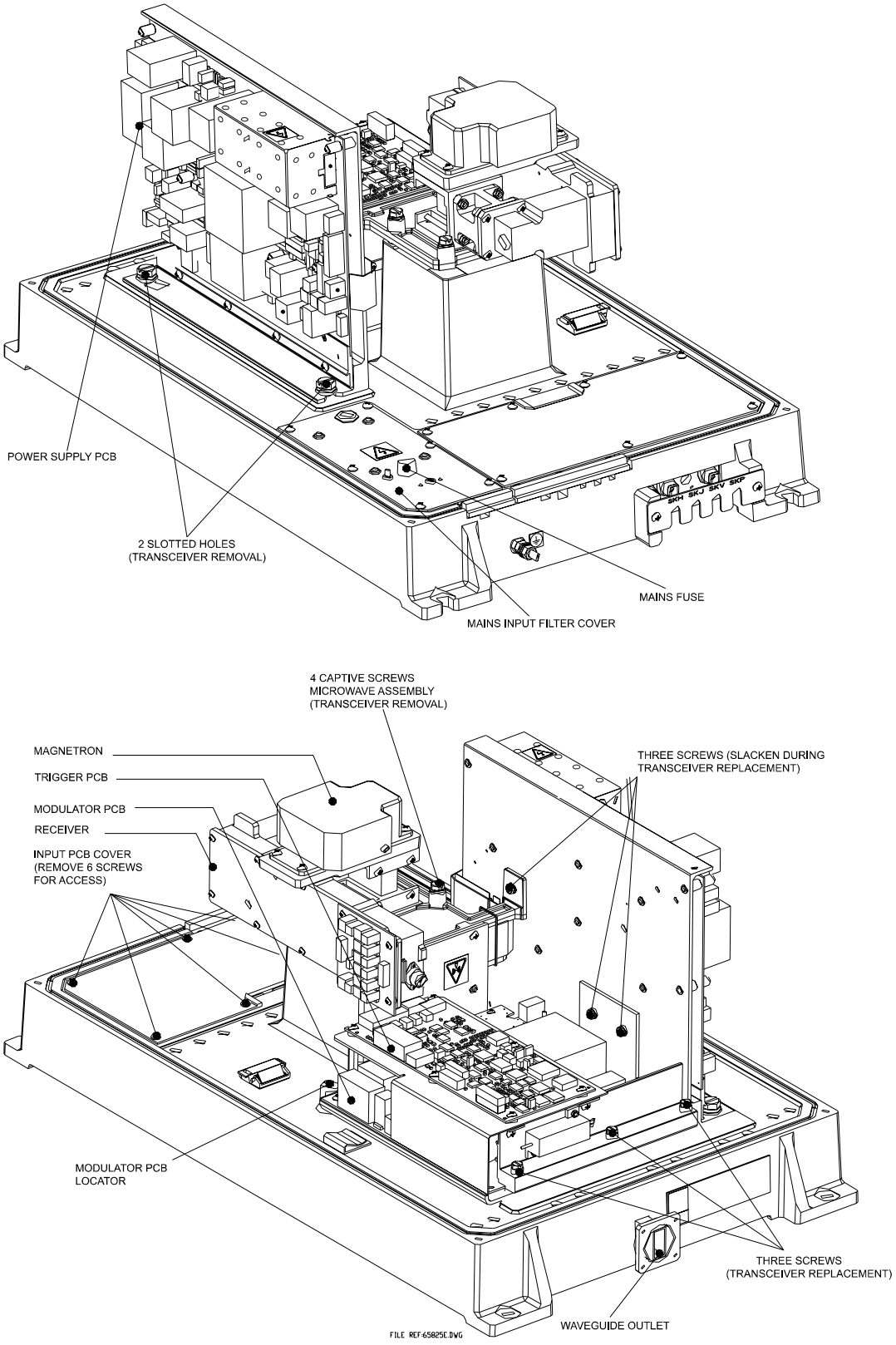


Figure 4.28 Bulkhead Transceiver - View with Cover Removed

3.2.5 Magnetron Replacement – Masthead and Bulkhead Transceivers

1. Refer to Section 3.2.1 '*Access to Masthead Transceiver*' or Section 3.2.2 '*Access to Bulkhead Transceiver*', paying attention to all safety aspects.
2. Check that the Transceiver is fully isolated from the ship's supply.
3. Refer to Figure 4.23.
4. Disconnect the two EHT leads from the Modulator PCB terminal block.
5. Remove the four screws holding the Magnetron to the Circulator plate.

The replacement sequence is as follows:

6. Replacement is the reverse of the removal process.
7. Make sure the polarity of the EHT leads is correct. The PCB is marked 'Y' for yellow and 'G' for green.
8. Make sure any earth bonding leads to the Magnetron are refitted.

After replacement the magnetron current must be set up as in the following sub-section.

3.2.6 Setting the Magnetron Current

1. On the Trigger PCB set LK5 and LK6 to 2–3.

   This is the service position and will let the Transmitter transmit when the antenna is stationary.
2. Restore the ship's supply to the Transceiver.
3. Select Long Pulse, transmit at the Display.
4. Measure the voltage between TP100 and ground on the Modulator PCB.

   A DVM with an input impedance >10 Mohms must be used for this measurement. Use of a meter with lower impedance could cause damage to the magnetron.
5. Adjust RV1 on the Power Supply PCB to give the correct voltage on TP100. The voltage is recorded on the label on the pulse transformer on the Modulator PCB.
6. Switch off.
7. On the Trigger PCB set LK5 and LK6 to 1–2.

3.2.7 Trigger PCB – Replacement

1. Refer to Section 3.2.1 '*Access to Masthead Transceiver*' or Section 3.2.2 '*Access to Bulkhead Transceiver*', paying attention to all safety aspects.
2. Check that the Transceiver is fully isolated from the ship's supply.
3. Refer to Figure 4.29 and Figure 4.30 for the necessary procedure for replacing the Trigger PCB.
4. Set the links as shown in Figure 4.30.

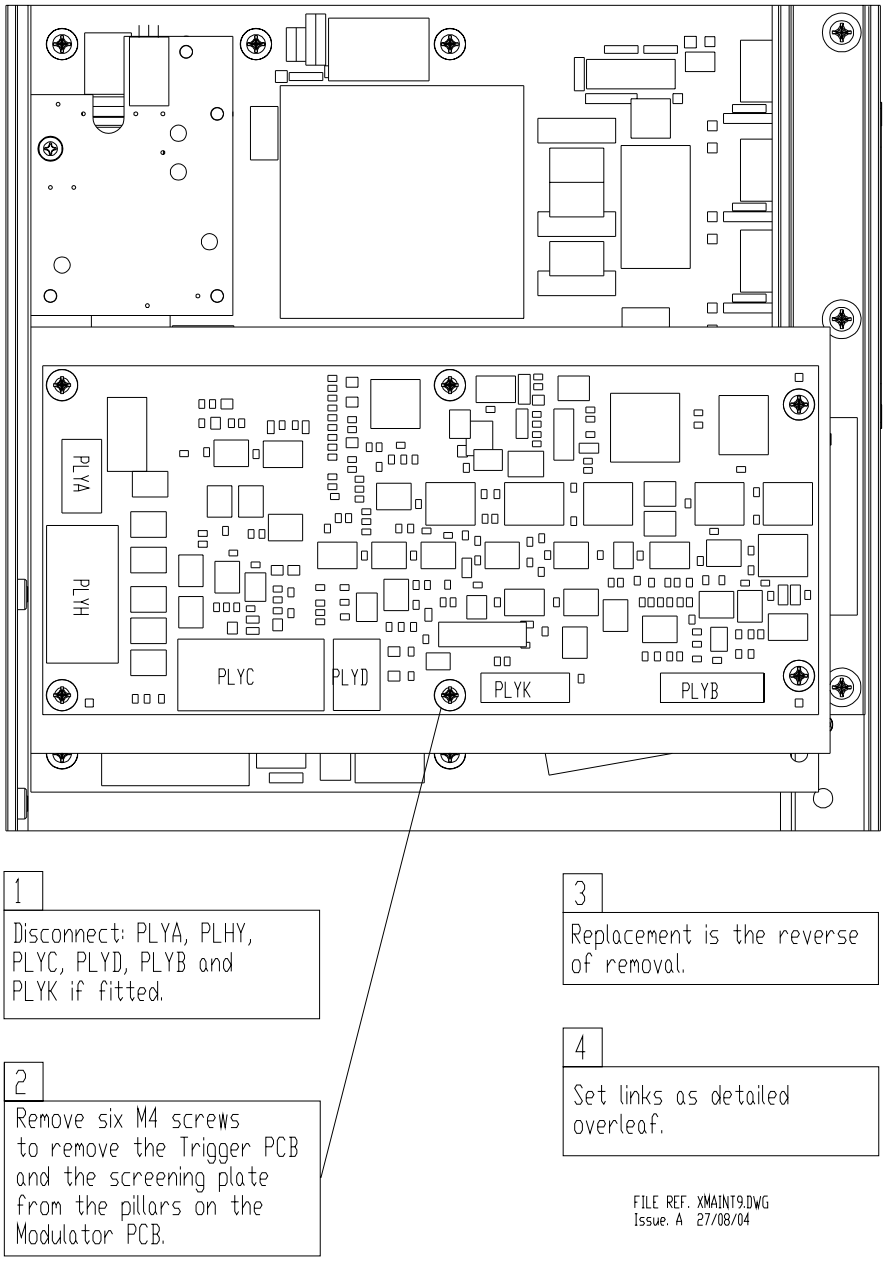
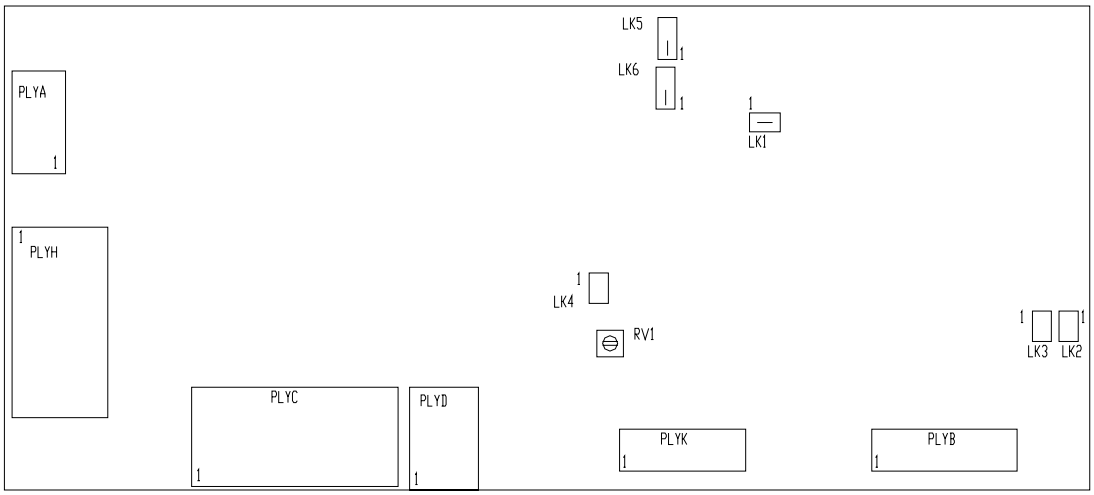


Figure 4.29 Replacing the Trigger PCB



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ATE TEST LINKS
LK1 FITTED
LK4 NOT FITTED

BAUD RATE LINKS
LK2 NOT FITTED
LK3 NOT FITTED

SERVICE LINKS
LK5 NORMAL OPERATION FITTED 1 - 2
LK6 NORMAL OPERATION FITTED 1 - 2

LK5 SERVICE FITTED 2 - 3
LK6 SERVICE FITTED 2 - 3
WHEN FITTED 2 - 3 THE TRANSMITTER
WILL OPERATE WHEN THE ANTENNA IS
STOPPED.

RV1 SWEPT GAIN DELAY
FACTORY SET DO NOT ADJUST

Figure 4.30 Trigger PCB Link Settings

3.2.8 Modulator PCB – Replacement

1. Refer to Section 3.2.1 '*Access to Masthead Transceiver*' or Section 3.2.2 '*Access to Bulkhead Transceiver*', paying attention to all safety aspects.
2. Check that the Transceiver is fully isolated from the ship's supply.
3. Refer to Figure 4.31 and Figure 4.32 for the necessary procedure for replacing the Modulator PCB.
4. Set the links as shown in Figure 4.32.

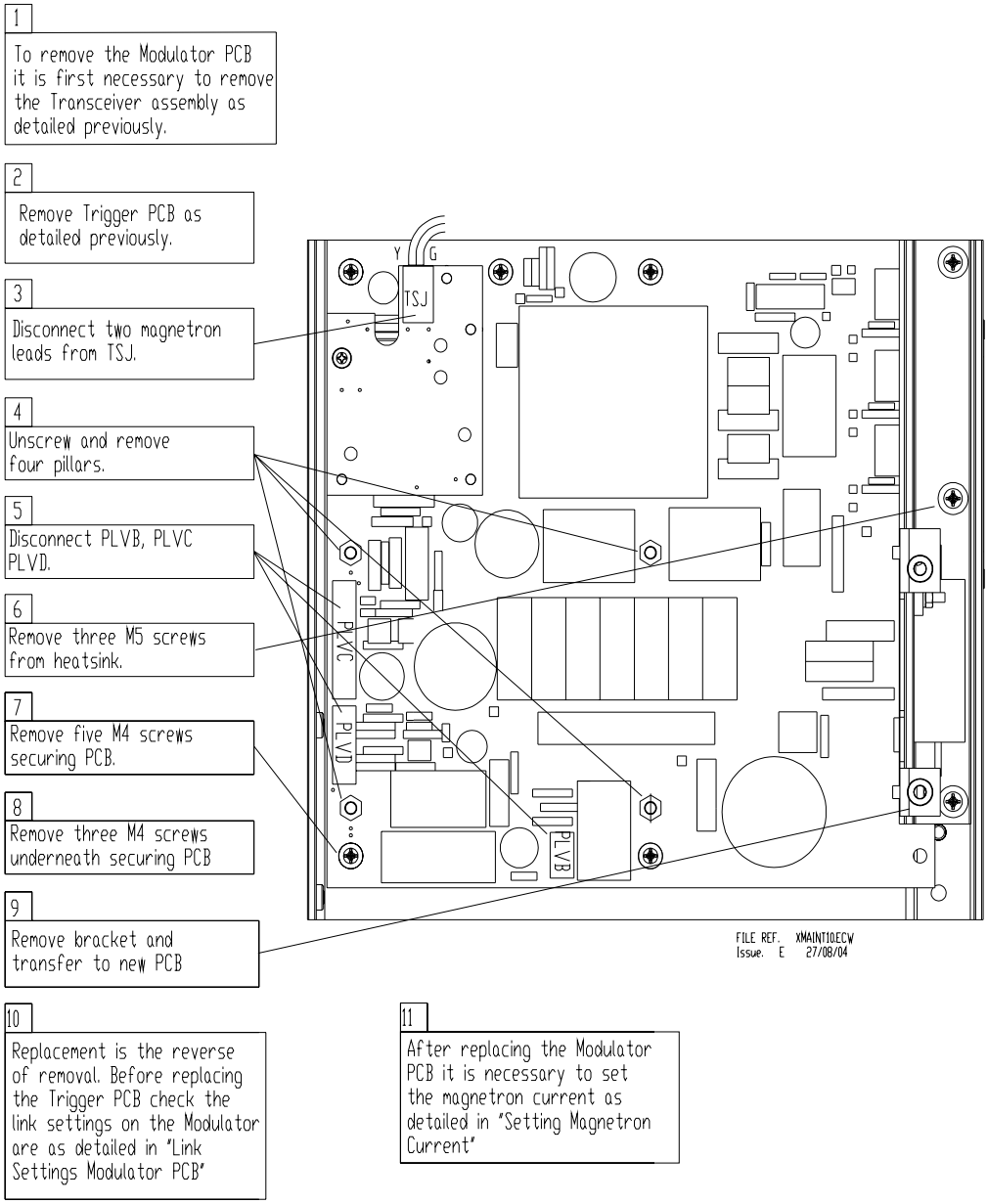
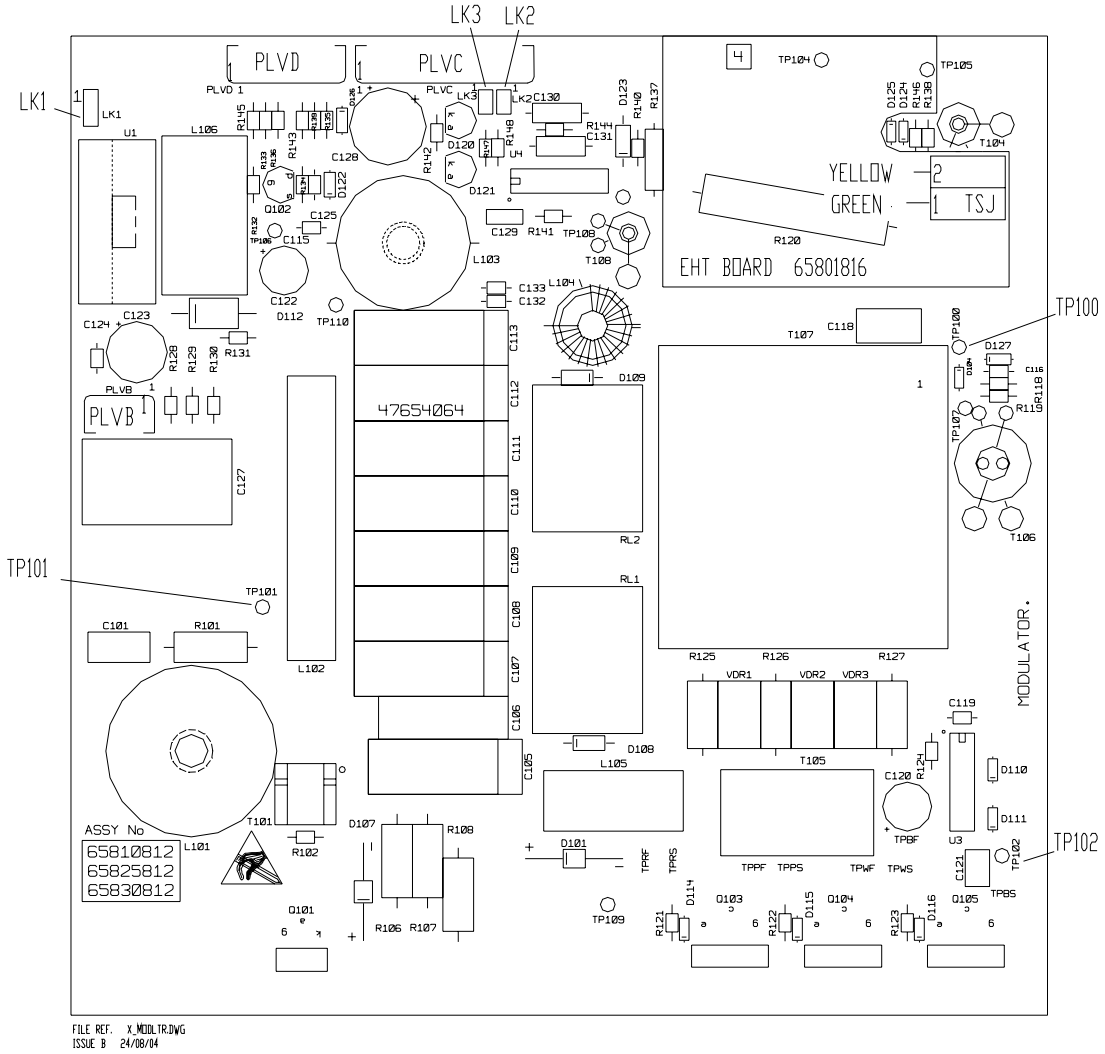


Figure 4.31 Replacing the Modulator PCB



MODULATOR LINK SETTINGS FOR 65810812 / 65825812 / 65830812

	S-BAND	10 kW X-BAND	25 kW X-BAND
LK1	FITTED 2 - 3	FITTED 1 - 2	FITTED 1 - 2 FOR MAGNETRON MG5424
LK1			FITTED 2 - 3 FOR MAGNETRON M1458
LK2	FITTED	NOT FITTED	NOT FITTED
LK3	NOT FITTED	FITTED	NOT FITTED

NOTE THAT LINK 1 IS CONFIGURABLE FOR HEATER TURNDOWN ON 25kW X-BAND
NOTE THAT LINKS 2 & 3 ARE HARDWIRED FOR SPECIFIC USEAGE ON LATER MODULATORS.

TEST POINTS:
TP100 MAGNETRON CURRENT MONITOR
TP101 CHARGE TRIGGER
TP102 MODULATOR TRIGGER

Figure 4.32 Modulator PCB Link Settings

3.2.9 Power Supply PCB – Replacement

1. Refer to Section 3.2.1 '*Access to Masthead Transceiver*' or Section 3.2.2 '*Access to Bulkhead Transceiver*', paying attention to all safety aspects.
2. Check that the Transceiver is fully isolated from the ship's supply.
3. Refer to Figure 4.33 and Figure 4.34 for the necessary procedure for replacing the PSU PCB.
4. Set the links as shown in Figure 4.34.

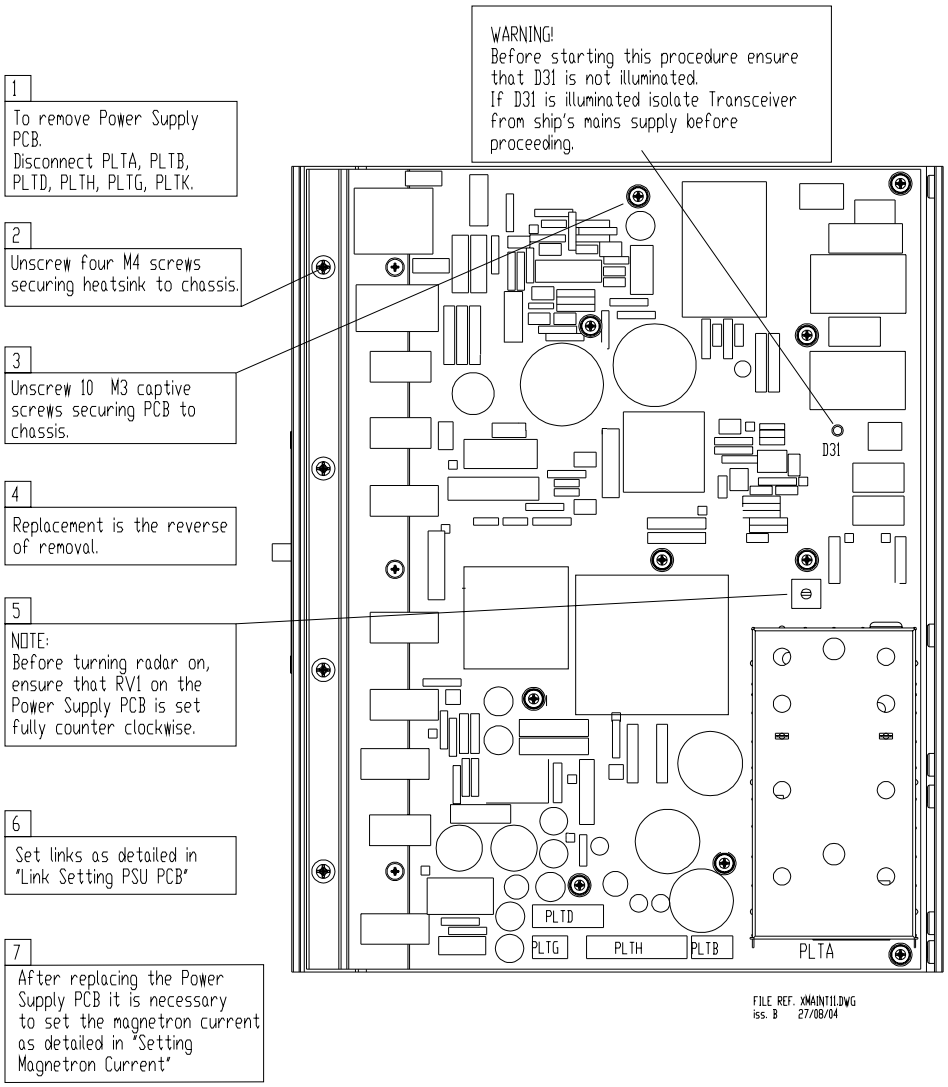
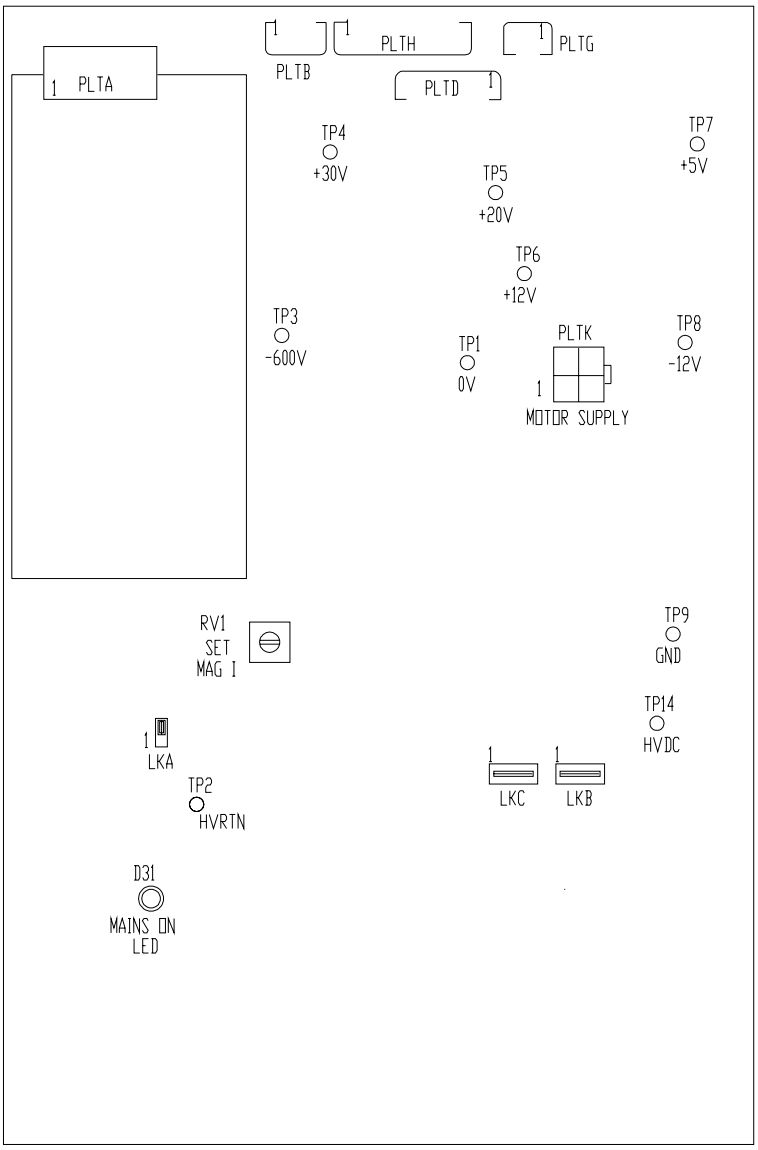


Figure 4.33 Replacing the Power Supply PCB



"LKA" START TEST LINK
LKA NORMAL OPERATION FITTED 2 - 3
LKA TEST FITTED 1 - 2
WHEN IN THE TEST POSITION THIS LINK ALLOWS THE POWER SUPPLY TO OPERATE WITHOUT BEING CONNECTED TO THE CONTROL SIGNALS FROM THE DISPLAY UNIT.

HIGH VOLTAGE ISOLATION LINK
LKB NORMAL OPERATION FITTED
LKB ISOLATE HV OPERATION NOT FITTED
THIS LINK CAN BE USED TO ISOLATE THE POWER FACTOR CORRECTION CIRCUIT FROM THE REST OF THE POWER SUPPLY AS AN AID TO FAULT FINDING

LKC - MOTOR SUPPLY ISOLATION LINK NORMALLY FITTED

TEST POINTS
TP1 0V
TP3 -600V
TP4 +30V
TP5 +20V
TP6 +12V
TP7 +5V
TP8 -12V
THE ABOVE VOLTAGES ARE MEASURED WITH RESPECT TO TP1
TP2 HVRTN
TP14 HVDC (380V)
THE VOLTAGE ON TP14 IS MEASURED WITH RESPECT TO TP2.

FILE REF XPSU.DWG
ISS. B 24/08/04

Figure 4.34 Power Supply PCB Link Settings

3.2.10 Receiver Assembly – Replacement (Masthead)

1. Refer to Section 3.2.1 '*Access to Masthead Transceiver*', paying attention to all safety aspects.
2. Check that the Transceiver is fully isolated from the ship's supply.
3. Remove the Transceiver Assembly as described at Section 3.2.3.
4. Unplug the ribbon cable from the Receiver to the Receiver Filter PCB.
5. Unplug the ribbon cable from the Receiver Filter PCB to the Trigger PCB.
6. Refer to Figure 4.23 for location of the screws securing the Low Noise Front End (LNFE) to the Limiter.

Note: *The replacement Receiver is supplied with the LNFE already fitted.*

7. Remove the four screws that hold the LNFE to the Limiter.
8. Remove the bracket that secures the Receiver to the microwave assembly at the Receiver end.
9. Remove the whole Receiver assembly.
10. Before fitting the replacement assembly, remove the Receiver Filter PCB from the old unit, and fit it to replacement unit.
11. Replacement is the reverse of the removal process.

3.2.11 Receiver Assembly – Replacement (Bulkhead)

1. Refer to Section 3.2.2 '*Access to Bulkhead Transceiver*', paying attention to all safety aspects.
2. Check that the Transceiver is fully isolated from the ship's supply.
3. Refer to Figure 4.23 and Figure 4.28.
4. Unplug the ribbon cable from the Receiver to the Receiver Filter PCB.
5. Unplug the ribbon cable from the Receiver Filter PCB to the Trigger PCB.
6. Unplug the video co-axial cable from the Receiver.
7. Refer to Figure 4.23 for the location of screws securing the Low Noise Front End (LNFE) to the Limiter.

Note: *The replacement Receiver is supplied with the LNFE already fitted.*

8. Remove the four screws that hold the LNFE to the Limiter and remove the whole assembly.
9. Before fitting the replacement assembly, remove the Receiver Filter PCB from the old unit, and fit it to replacement unit.
10. Replacement is the reverse of the removal process.

3.2.12 Bearing and Heading Marker PCB – Replacement

1. Refer to Section 3.2.1 '*Access to Masthead Transceiver*' or Section 3.2.2 '*Access to Bulkhead Transceiver*', paying attention to all safety aspects.
2. Check that the Transceiver is fully isolated from the ship's supply.
3. Refer to Figure 4.23.
4. The PCB is attached to a support casting and should be removed as a combined assembly as follows:
   a. Slacken the two screws retaining the support casting.
   b. Slide it towards the outside of the upper casting to clear the screws.
5. Unplug the cable from the PLRE.
6. Remove the PCB and support casting.

Note: *When refitting the PCB to the support casting there are dowel pegs of different diameters used to locate the PCB in the correct orientation.*

7. Before refitting the assembly, check that the link LK1 is set for either normal-speed (pins 1–2) 28 RPM or high-speed (pins 2–3) 45 RPM.
8. For PCB assembly 65801826 see Section 3.3.4 in Chapter 8 '*Additional Features*'.

3.2.13 Heading Marker Alignment

Alignment of the Heading Marker is set at system configuration, see *Ship's Manual Volume 2*, *Chapter 1 'Configuration'*.

3.2.14 Performance Monitor – Replacement

1. Refer to Section 3.2.1 '*Access to Masthead Transceiver*' or Section 3.2.2 '*Access to Bulkhead Transceiver*', paying attention to all safety aspects.
2. Check that the Transceiver is fully isolated from the ship's supply.
3. Remove the two retaining screws that hold the Performance Monitor to the upper casting (see Figure 4.23) and withdraw the unit.
4. Un-screw the bar that retains the RF absorber to the body of the Performance Monitor.
5. Disconnect the ribbon cable to the Performance Monitor.
6. Replacement is the reverse of the removal process.

7. Make sure the ribbon cable is reconnected to the Performance Monitor, the RF absorber is refitted.

Note: *After replacement, the Performance Monitor must be set up as described in Ship's Manual Volume 2*, *Chapter 2 - Diagnostics and Commissioning.*

3.2.15 Motor Drive Board – Replacement

1. Refer to Section 3.2.1 '*Access to Masthead Transceiver*', paying attention to all safety aspects.
2. Check that the Transceiver is fully isolated from the ship's supply.
3. Unplug the three cable assemblies from the Motor Drive PCB.
4. Remove the three screws (refer to Figure 4.35).
5. Slide the PCB out of the retaining clip at the opposite end of the PCB.
6. Before fitting the replacement PCB, make sure the speed setting link LK1 is correctly set for the intended operational speed.
   a. Position 1 & 2 marked 'LO' is for 28 RPM operation.
   b. Position 2 & 3 marked 'HI' is for 45 RPM operation.
7. If in doubt, compare the setting with the old PCB.
8. For PCB Assembly 65801827 see Section 3.3.5 in Chapter 8 '*Additional Features*'.
9. Replacement is the reverse of the removal process.
10. Make sure all three cable-assemblies are reconnected to the PCB.

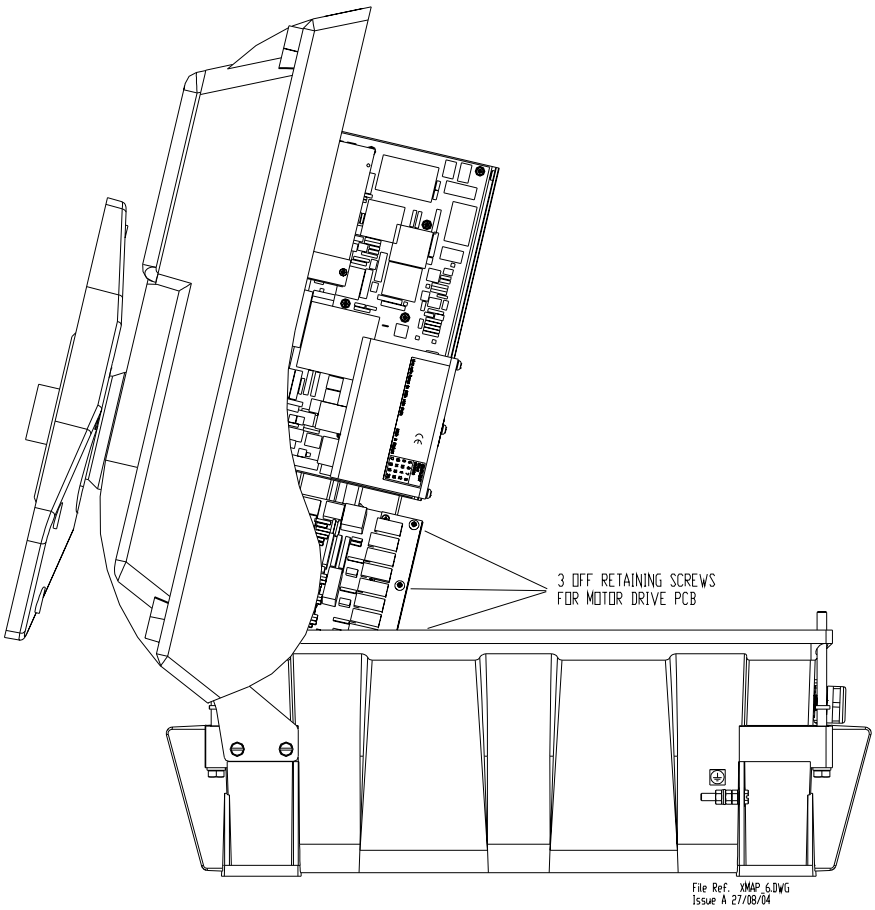


Figure 4.35 Motor Drive Board Retaining screws

3.2.16 Motor and Gearbox Assembly – Replacement

1. Refer to Section 3.2.1 '*Access to Masthead Transceiver*', paying attention to all safety aspects.
2. Check that the Transceiver is fully isolated from the ship's supply.
3. Refer to Figure 4.27 for the location of the three screws that retain the motor support casting to the upper casting.
4. Remove the screws.
5. Withdraw the motor support casting complete with Motor Drive PCB from the belt drive.
6. Remove the four screws that retain the motor and gearbox assembly to the support casting.

Note: *These four countersink screws are fitted with screw retaining fluid. When fitting the new motor, these screws should be refitted using 'Loctite Screwlock 222' low breaking-strength fluid.*

7. Remove the impeller from the old motor
8. Fit the replacement impeller.

9. Replacement is the reverse of the removal process, taking care to engage the motor pulley into the drive belt.

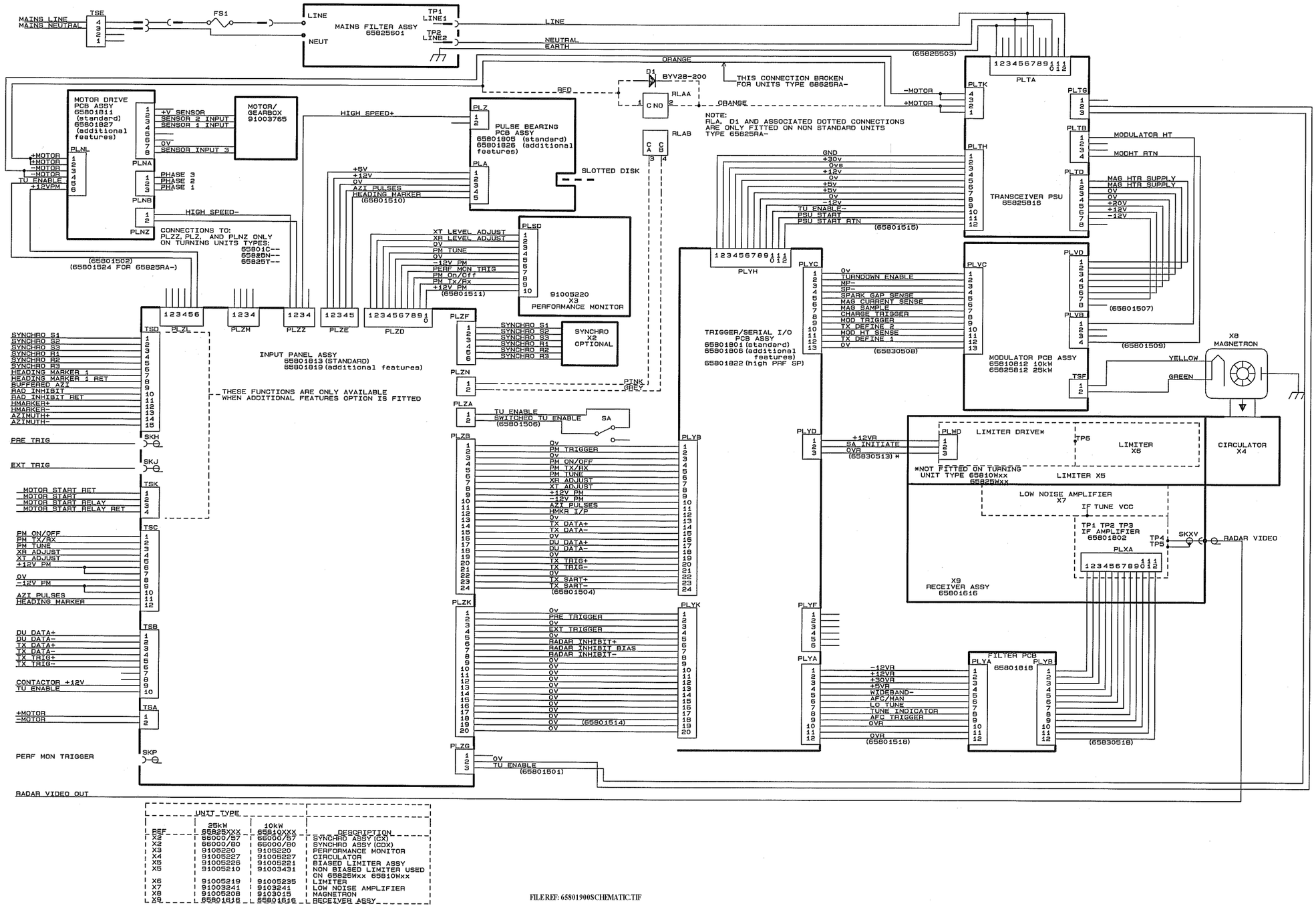
3.2.17 Drive Belt – Replacement

1. Refer to Section 3.2.1 '*Access to Masthead Transceiver*', paying attention to all safety aspects.
2. Check that the Transceiver is fully isolated from the ship's supply.
3. Remove the Transceiver as detailed at Section 3.2.3.
4. Remove the motor support casting and motor assembly as detailed in Section 3.2.16.
5. Refer to Figure 4.27.
6. Remove the three bolts (as shown in Figure 4.22) that attach the waveguide transition support casting to the rotating joint.

Note: *Since the waveguide transition support casting has two sleeve-inserts to aid accuracy in alignment, some resistance may be felt when removing it.*

7. Care should be exercised when removing the casing to avoid damage to the assembly or to the brass microwave probe at the centre of the hub.
8. Fit the replacement drive-belt.
9. Re-assembly is the reverse of the removal process.
10. Care should be exercised to avoid damage to the brass microwave probe at the centre of the hub during re-insertion into the transition.
11. Make sure the motor pulley is correctly engaged into the drive-belt.

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REF	UNIT TYPE 25kW 65825XXX	UNIT TYPE 10kW 65810XXX	DESCRIPTION
X2	66000/57	66000/57	SYNCHRO ASSY(CX)
X2	66000/80	66000/80	SYNCHRO ASSY(CDX)
X3	91005220	91005220	PERFORMANCE MONITOR
X4	91005227	91005227	CIRCULATOR
X5	91005226	91005221	BIASED LIMITER ASSY
X5	91005210	91003431	NON BIASED LIMITER USED ON 65825Wxx 65810Wxx
X6	91005219	91005235	LIMITER
X7	91003241	9103241	LOW NOISE AMPLIFIER
X8	91005208	9103015	MAGNETRON
X9	65801616	65801616	RECEIVER ASSY

FILE REF: 65801900SCHEMATIC.TIF

Figure 4.36 X-band Turning Unit (Aloft) Schematic

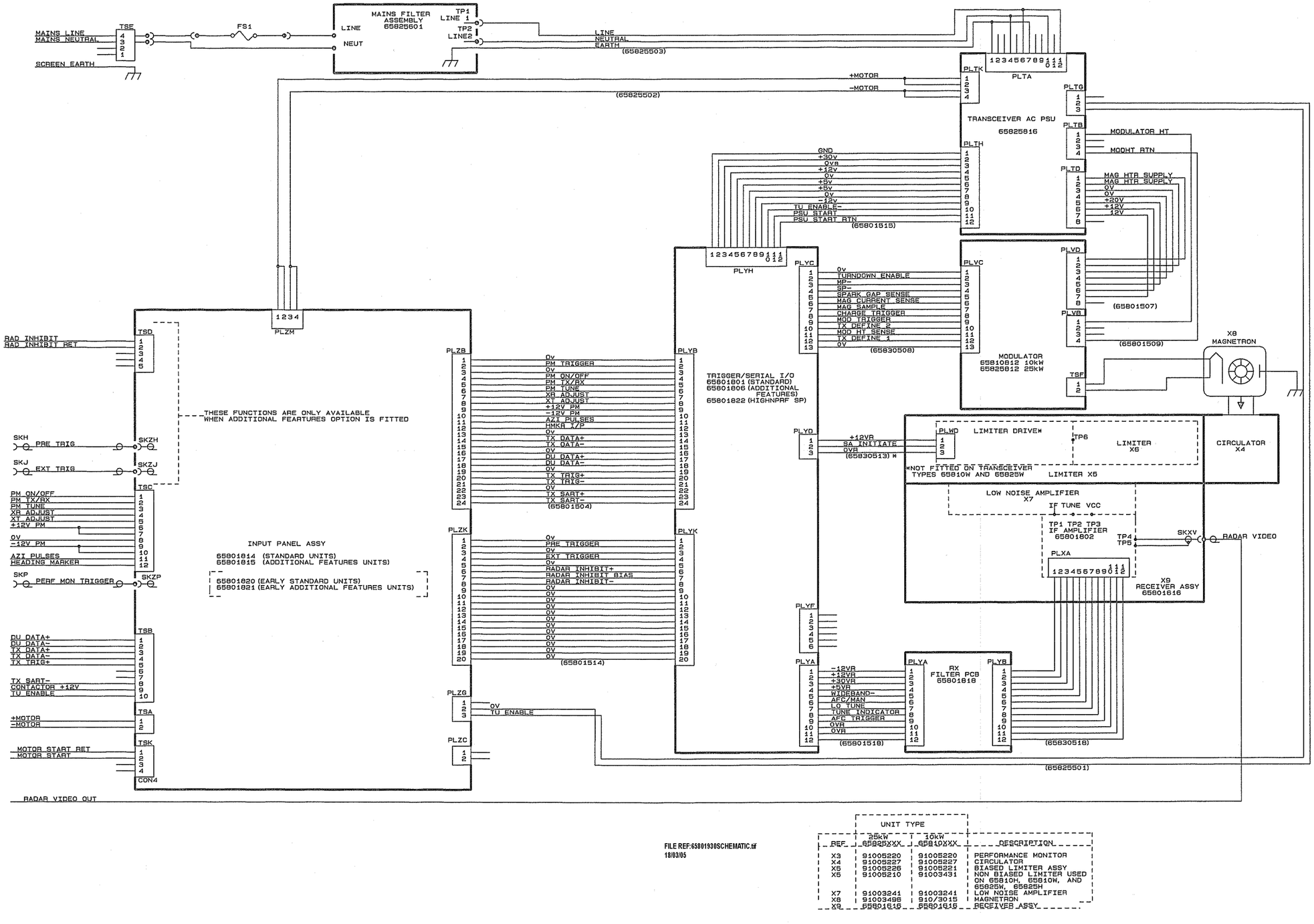


Figure 4.37 X-band Transceiver Schematic

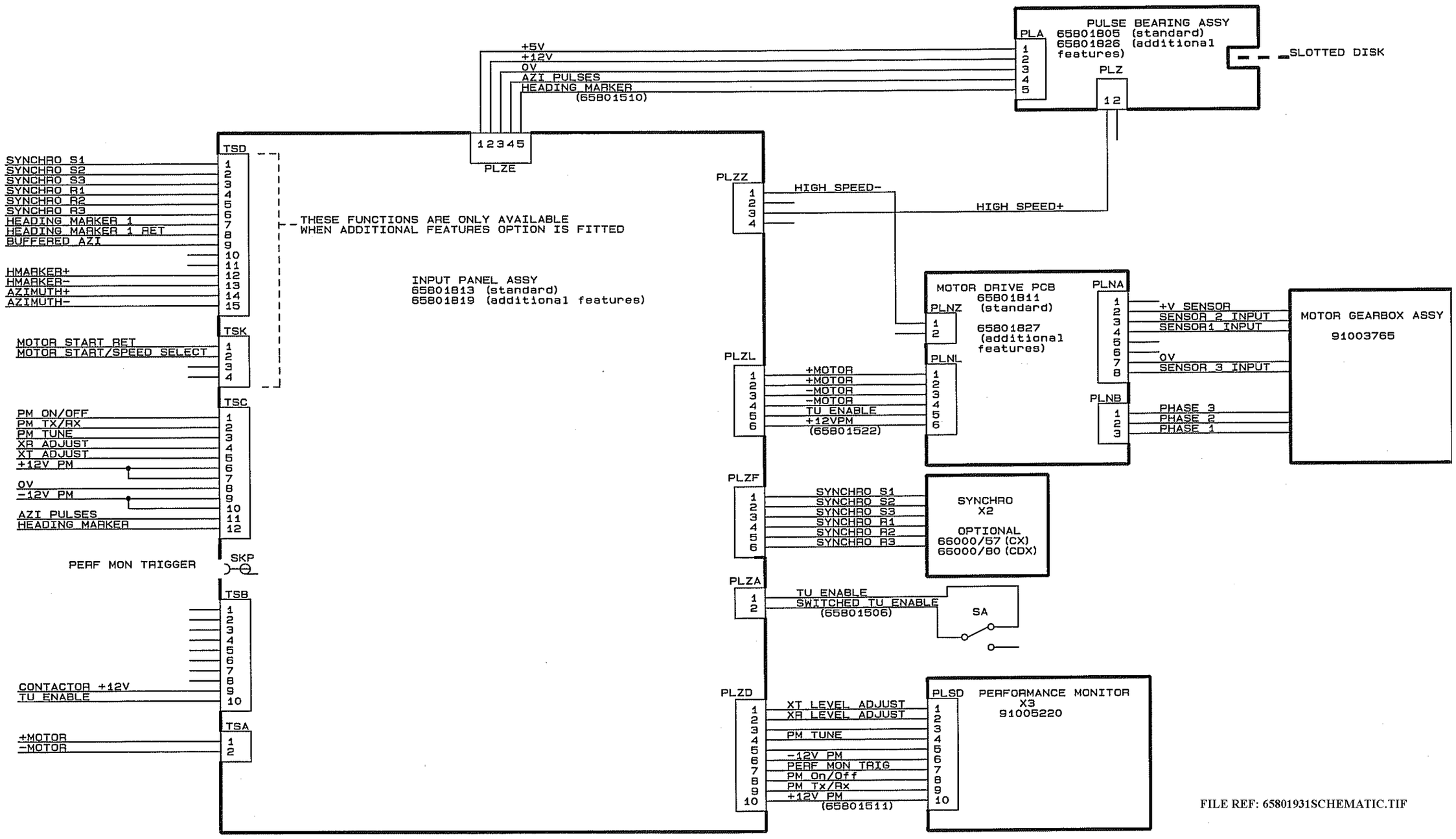


Figure 4.38 X-band Turning Unit (Bulkhead) Schematic

3.3 19" Integrated Tabletop Display



WARNING! – Lethal Voltage Hazard

Lethal voltages may be exposed when access covers are removed. Only qualified persons should work on the equipment when power is applied

Shut down the system from the VisionMaster FT application and switch the On/Off switch located on the front of the enclosure panel to OFF.

Isolate the unit from the mains power supply before removing covers.

3.3.1 Replacing the Control Panel

There are no attaching parts connecting the control panel to the enclosure assembly.

1. To remove the control panel insert a flat bladed screwdriver between the control panel side and the enclosure top and lever the control panel upwards. Take care not to damage the paint work on the enclosure.
2. When there is a sufficient gap between the control panel and the enclosure, pull firmly upwards from the far edge of the panel. The control panel can now be removed from the assembly.
3. For instructions on removing individual control panel modules, refer to Section 3.4.2 '*Control Panel Assembly*'
4. Replacing the control panel is a reversal of the removal procedure. When connected ensure the cable(s) are tie wrapped.

3.3.2 Removing the Fan Filter

There are two fans, positioned on each side of the enclosure chassis.

The fan filter, behind the plastic fan filter cover, should be removed and cleaned periodically, see Section 2 *'Maintenance Plan'* in Chapter 5 '*Routine Maintenance*'.

To remove the fan filter:

1. Insert a flat bladed screwdriver into a slot on the side of the fan housing and use the screwdriver to lever off the plastic fan cover, see below.

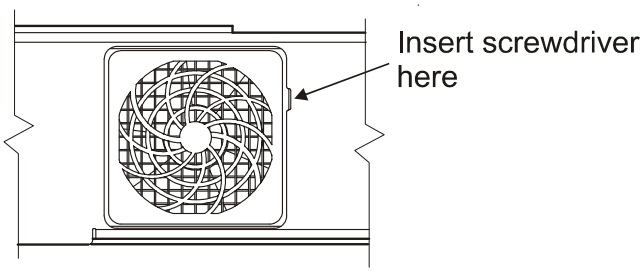


Figure 4.39 Removing the Fan Filter

2. Remove the filter from the fan housing and clean.
3. Re-insert the fan filter and filter cover into the fan housing.

3.3.3 Replacing the DVD Writer

1. With the control panel removed, the DVD writer may be removed from the housing.
2. Remove the eight M3 pan head screws and eight M3 washers (four each side) which secure the DVD to the DVD bracket (see Figure 4.40). Carefully pull the DVD unit out from the front of the enclosure.
3. From the rear of the DVD unit disconnect the DVD PWR cable to the DC/DC converter, and the DVD SATA cable to the graphics card.
4. Replacing the DVD writer is a reversal of the removal procedure.

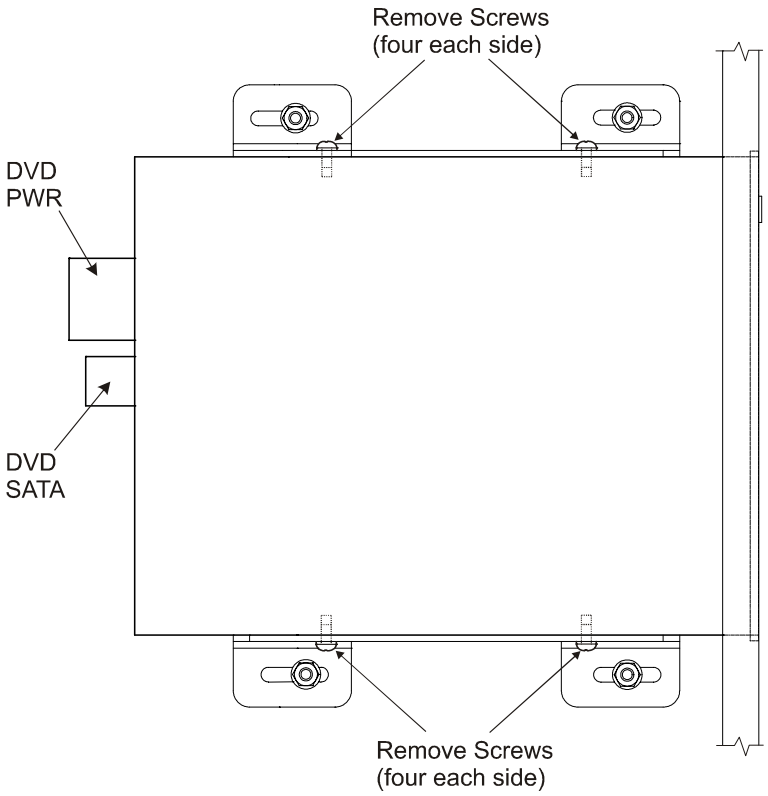


Figure 4.40 Removing the DVD Writer

3.3.4 Replacing the On/Off Switch

1. With the control panel removed and the system powered down, disconnect the red and purple wires that connect the On/Off switch to the DC/DC converter.
2. Remove the two M3 nuts and M3 washers securing the switch to the enclosure.
3. Remove the switch plate and On/Off switch.
4. Replacing the On/Off switch is a reversal of the removal procedure.

3.3.5 Replacing the LED and Buzzer Panel PCB

1. With the control panel removed and the system powered down, disconnect the buzzer board interface cable. Disconnect the cable's earth lead, which is attached to the top left PCB retaining screw.
2. Remove the four M3 pan head screws and four crinkle washers that attach the PCB to the pillar studs.
3. When replacing the LED and Buzzer panel PCB, ensure the paper cover has been removed from the buzzer before assembly.
4. After connecting the interface cable to the PCB, add a blob of silicone sealant to each end of the cable connector, see Figure 4.41.

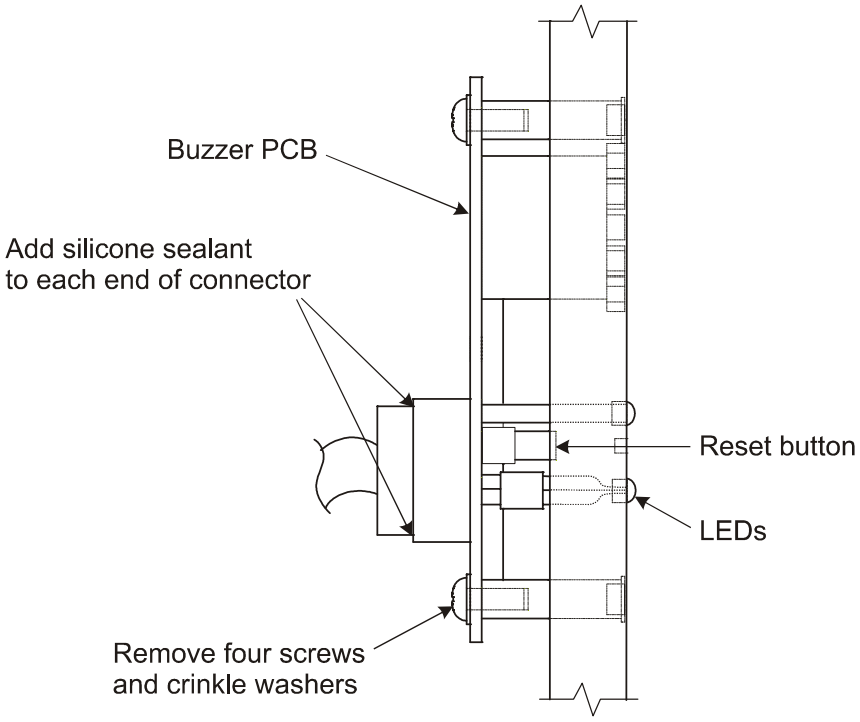


Figure 4.41 Removing the LED and Buzzer Panel PCB

3.3.6 Replacing the LCD Assembly

Before detaching the LCD assembly from the display chassis, remove all external cables from the Inverter card and EG card. Note the position, polarity and orientation of all components removed from the assembly.

1. Remove the four M5 nuts and M5 washers from the left hand and right hand support brackets of the display chassis (two each side). The nuts are screwed to studs on the LCD plate, see Figure 4.42.
2. From the front of the LCD, remove the four M4 screws and M4 washers securing the bottom of the LCD plate to the display chassis.
3. Replacing the LCD assembly is a reversal of removal.

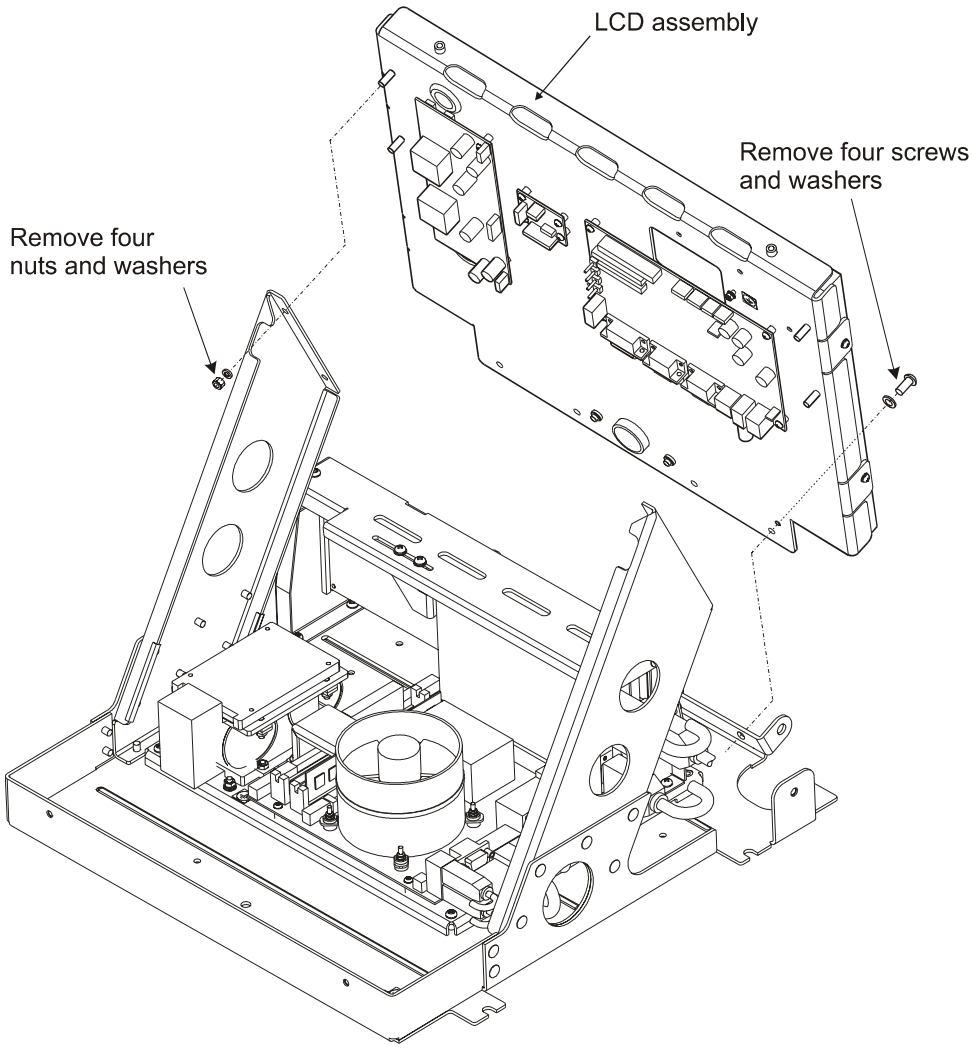


Figure 4.42 Removing the LCD Assembly

3.3.7 Removing the Processor Plate Assembly



CAUTION – Electrostatic Sensitive Devices (ESSDs)

The Processor unit contains Electrostatic Sensitive Devices (ESSDs). Take care not to damage these devices by discharge of electrostatic voltages.

Before detaching the processor plate assembly from the display chassis, remove all external cables and USB devices from the Processor board, SC3 card, Graphics card and hard disk drive. Note the position, polarity and orientation of all components removed from the assembly.

The Processor plate assembly is attached to the display chassis by five screws. Two screws are accessible from the top of the processor plate; the other three are accessible from the underside of the display chassis, see Figure 4.43.

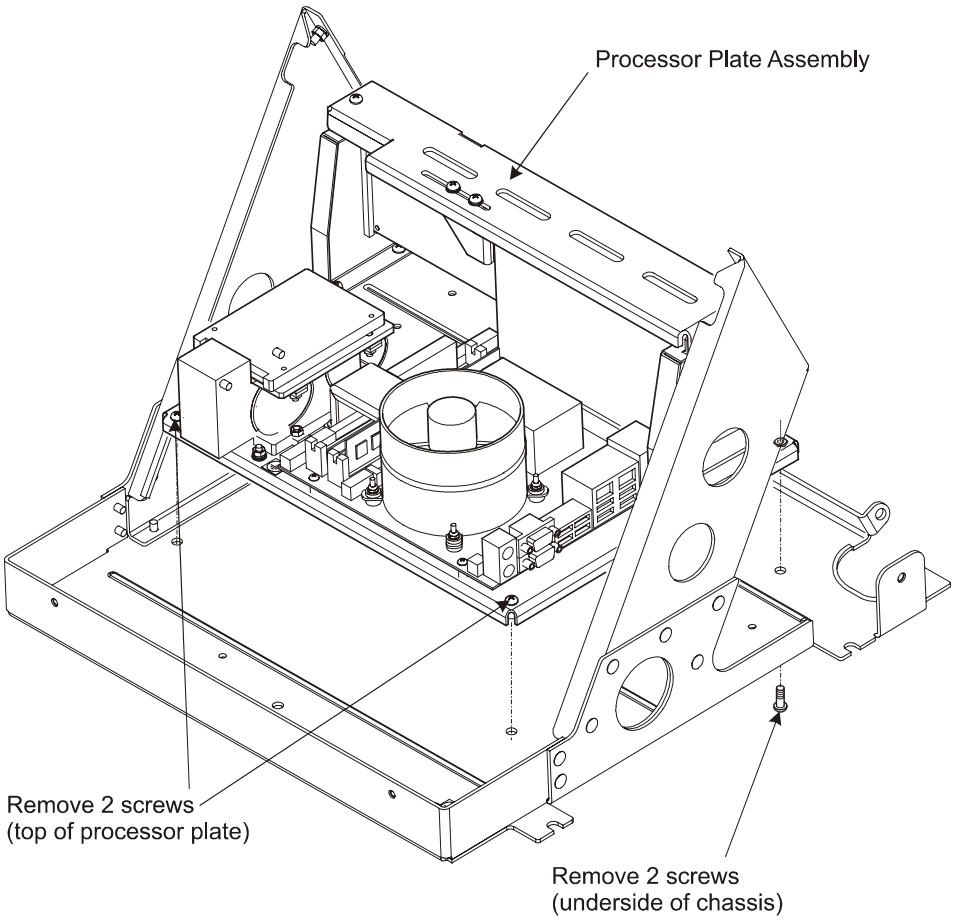


Figure 4.43 Removing the Processor Plate Assembly

1. Pull open the Processor assembly and chassis and secure in position with the stay.
2. Remove two M4 screws with M4 washers and one M4 countersunk screw from the underside of the processor chassis.
3. Close the processor assembly and remove the two M4 screws and M4 washers from the topside of the processor chassis.
4. Move the Processor assembly a few centimetres to the right in order to remove the assembly from the plate chassis.

3.3.8 Removing Modules from the Base Enclosure



WARNING! – Lethal Voltage Hazard

Lethal voltages are exposed when the covers are removed from the units. Only qualified persons should work on the equipment when power is applied. ALWAYS isolate the unit from the mains supply when removing or replacing modules. To make the units safe it is necessary to isolate them from the mains supply. It is **not** adequate to turn the unit off; there are high voltages present at any Power Supply that is not mains isolated.



CAUTION – Electrostatic Sensitive Devices (ESSDs)

The PCI/O and DC/DC Converter contain Electrostatic Sensitive Devices (ESSDs). Take care not to damage these devices by discharge of electrostatic voltages.

Figure 4.44 shows a plan view of the base enclosure with the line replaceable modules and their attaching parts annotated.

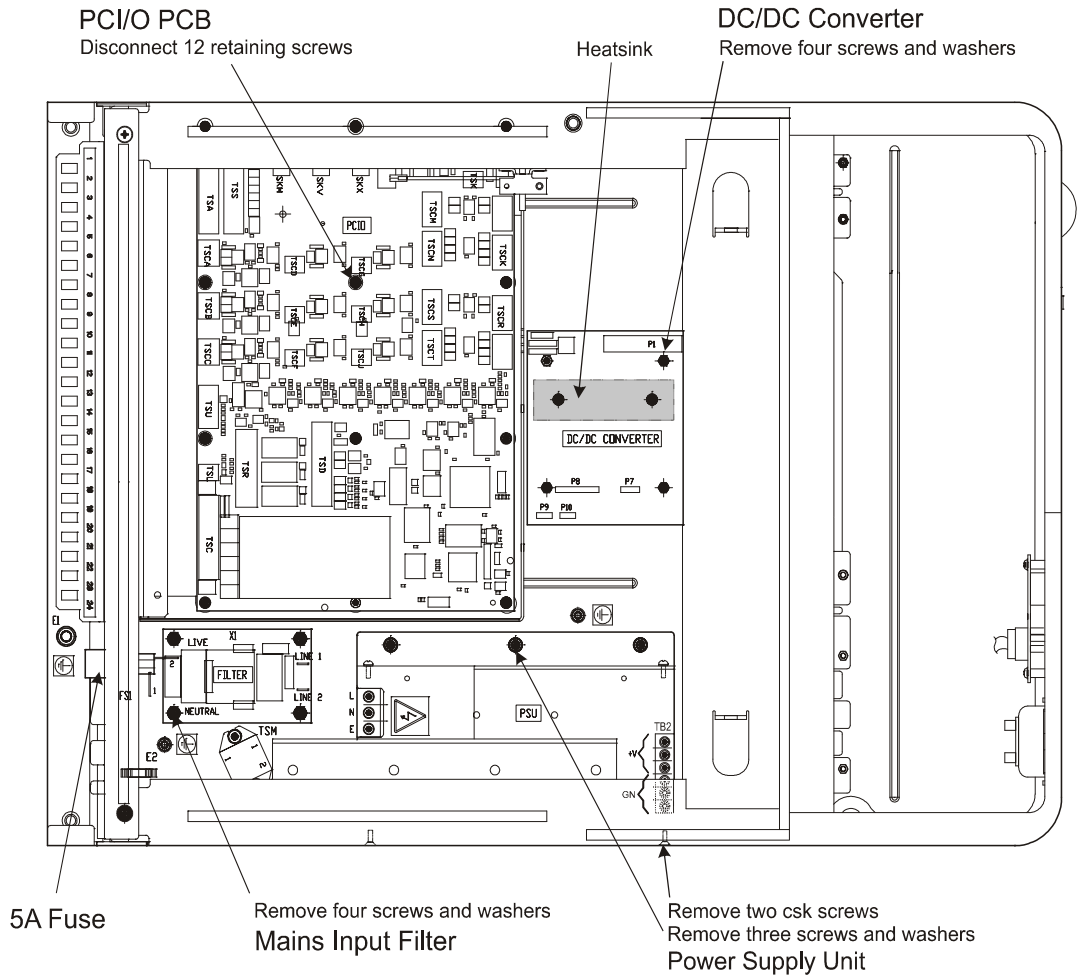


Figure 4.44 Removing Base Enclosure Modules

3.3.8.1 Replacing the PCI/O PCB

1. To disconnect incoming cables to the PCI/O PCB, from the rear of the enclosure remove the five M4 countersunk screws securing the cable clamp top plate.
2. Disconnect cable tie wraps, earthing tags and internal cable connections from the PCI/O PCB.
3. With all cables disconnected from the PCI/O PCB, remove fastener securing the 9-way ribbon power cable to the PCB shield and disconnect cable from the PLP terminal.
4. Unscrew the 12 retaining screws and remove the PCB from the enclosure.
5. Remove the compass PCB from the main PCB.
6. Replacing the PCI/O PCB is a reversal of removal.

3.3.8.2 Replacing the DC/DC Converter

1. Disconnect all incoming cables to the DC/DC Converter board.
2. Remove the four attaching M3 screws and M3 washers and remove the DC/DC Converter from the enclosure.

Note: *There will be a certain ammount of resistance when removing the converter board, this is due to compound bonding the underside of the board to the heatsink.*

3. Before replacing the DC/DC Converter apply an adequate ammount of fresh bonding compound to the heatsink*.*

3.3.8.3 Replacing the Mains Input Filter

1. Disconnect the mains power leads coming into the input filter and disconnect the leads going out to the PSU.
2. Remove the four M4 screws and M4 crinkle washers and remove the mains input filter from the enclosure.
3. Replacing the mains input filter is a reversal of removal*.*

3.3.8.4 Replacing the Power Supply Unit

1. Disconnect all incoming cables to the Power Supply Unit (PSU).

Note: *Because of limited access it is easier to remove and re-fit the cables to the TB2 terminal after PSU removal and before final installation.*

2. From the side of the enclosure chassis, remove the two M3 countersunk screws.
3. Remove the three M4 screws and M4 washers which secure the PSU bracket to the enclosure chassis.
4. Carefully manoeuvre the PSU out of the enclosure by lifting the unit up from the side attached to the bracket.
5. Remove the cables from the TB2 terminal.
6. Before replacing the PSU, re-connect the cables to the TB2 terminal.

3.3.9 Replacing the 5A Fuse

Unscrew the fuse holder at the rear of the enclosure chassis, remove fuse and replace.

3.4 Console Assemblies (deck mounted and tabletop kit versions)

3.4.1 Monitor Unit - Replacement



WARNING! – Lethal Voltage Hazard

Lethal voltages may be exposed when access covers are removed. Only qualified persons should work on the equipment when power is applied. ALWAYS isolate the unit from the mains supply when removing or replacing covers.

1. Shut down the system from the VisionMaster FT application, and when fully powered down, switch the On/Off switch located on the underside of the Control Panel to OFF.
2. Switch the Monitor power switch to OFF, if not switched off from main On/Off switch.
3. Remove the four M6 screws securing the monitor to the display chassis.
4. Attach the two M8 extraction screws to the upper holes of the monitor (marked as 'A' in Figure 4.45) and use these to pull the monitor forward until it rests on the edge of the control panel.
5. From the underside of the monitor, disconnect the mains power cable, video cable and two earth tags (one from the pedestal and one from the display chassis). Remove Monitor from chassis.
6. Attach the M8 screws to the upper holes of the replacement monitor and gently lower the monitor into the chassis.
7. Attach the power cable, video cable and earth tags to the monitor.
8. Secure replacement monitor using the four M6 screws.

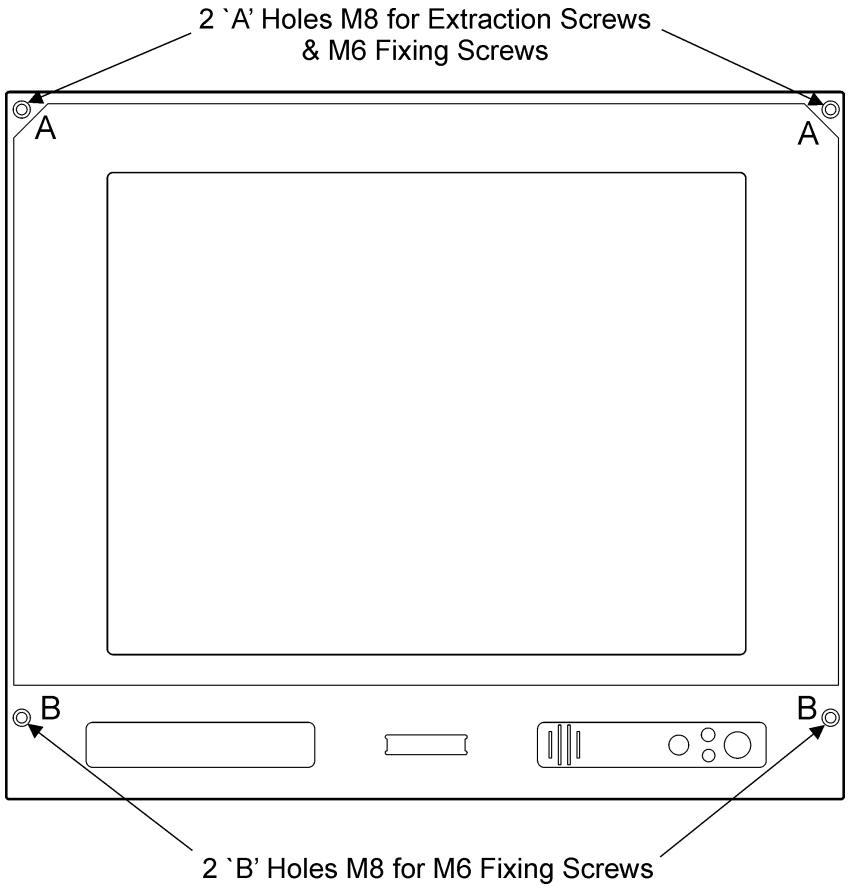


Figure 4.45 Monitor Unit

3.4.2 Control Panel Assembly

	WARNING! – Lethal Voltage Hazard
	Lethal voltages are exposed when the covers are removed from the units. Only qualified persons should work on the equipment when power is applied. ALWAYS isolate the unit from the mains supply when removing or replacing modules To make the units safe it is necessary to isolate them from the mains supply. It is **not** adequate to turn the unit off: there are high voltages present at any Power Supply that is not mains isolated.

The Control Panel Assembly is supplied in two versions:

1. With control panel keyboard, see Figure 4.46.
2. Without control panel keyboard and with separate USB connector module, see Figure 4.47.

Before replacing any control panel assembly modules shut down the system from the VisionMaster FT application, and when fully powered down, switch the On/Off switch located on the underside of the Control Panel to OFF.

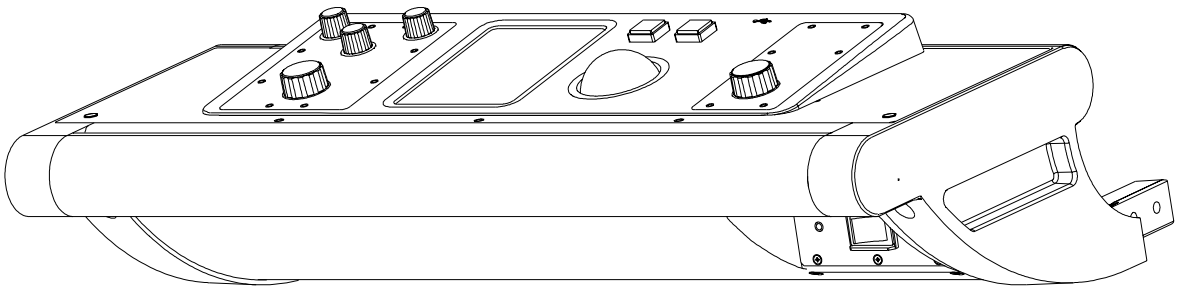


Figure 4.46 Control Panel Assembly with keyboard

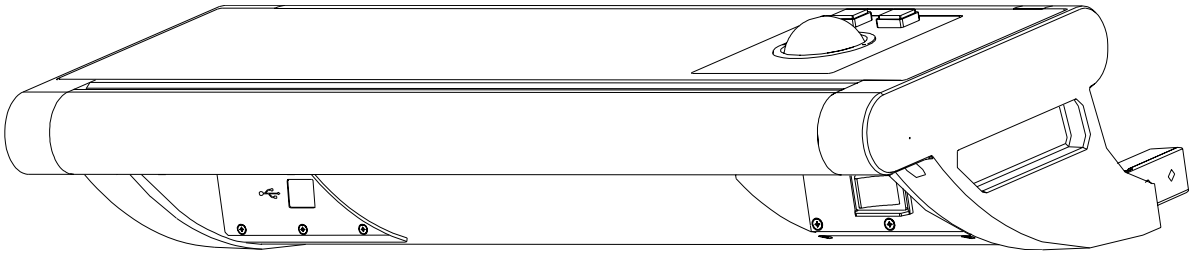


Figure 4.47 Control Panel Assembly without keyboard

3.4.2.1 Replacing the Control Panel assembly with Keyboard

The following procedure describes the replacement of a complete control panel. For instructions on replacing the individual control panel modules, refer to Figure 4.48 below and sections 3.4.1.1 to 3.4.1.4.

1. From the Processor unit disconnect the control panel USB cable and the two trackball cables.
2. Remove the module mounting plate from control panel housing by unscrewing the two M5 cap head screws and three M4 nuts, these are located on the underside of the control panel housing.
3. Dislodge the mounting plate by pulling the plate forward and uncliping it from the back of the control panel tray.
4. Unscrew the two M5 pan head screws securing the control panel to the mounting plate and the two M5 nuts holding the mounting strap to the mounting plate.
5. With the control panel removed, unscrew the two M5 pan head screws securing the control panel to the mounting strap.
6. Assembly of a replacement control panel is a reversal of the removal procedure.

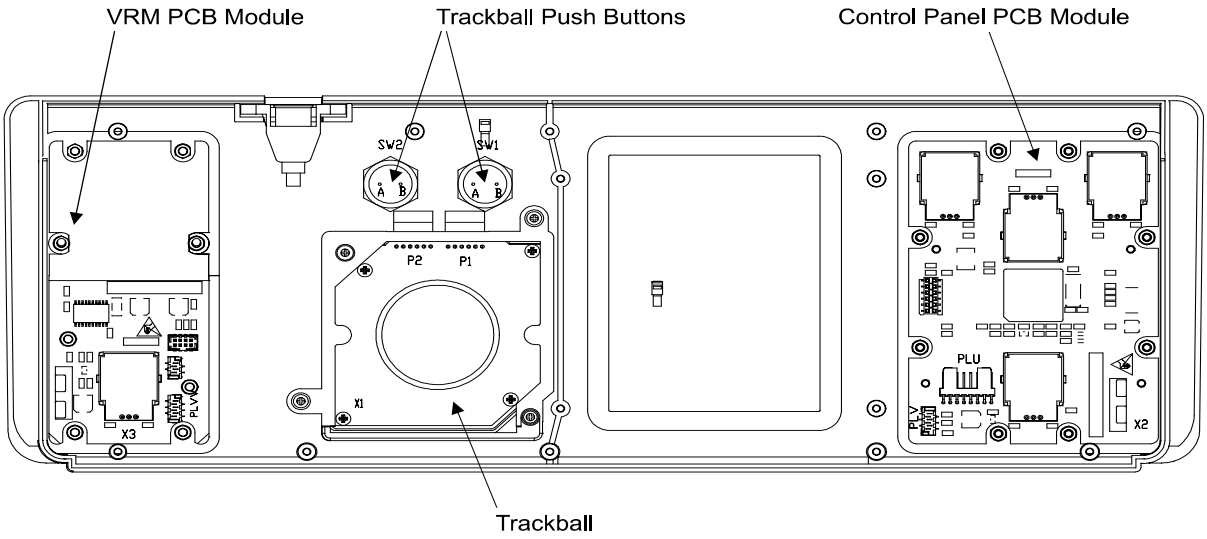


Figure 4.48 Control Panel with rear cover removed

Replacing the Control Panel PCB Module

1. Remove the EBL knob and three gain knobs from the front of the control panel.
2. Remove the rear cover from control panel by unscrewing the ten self-tapping screws.
3. With the rear cover removed, disconnect the USB cable from the module and disconnect the internal cable connecting the module to the VRM module.
4. Unscrew the eight nuts and washers securing the module to the control panel housing.
5. Carefully remove the module from the control panel housing.
6. Replacing the control panel module is a reversal of the removal procedure.

Replacing the VRM Panel PCB Module

1. Remove the VRM knob from the front of the control panel.
2. Remove the rear cover from control panel by unscrewing the ten self-tapping screws.
3. With the rear cover removed, disconnect the internal cable connecting the module to the control panel module.
4. Unscrew the six nuts and washers securing the module to the control panel housing.
5. Carefully remove the module from the control panel housing.
6. Replacing the VRM module is a reversal of the removal procedure.

Replacing the Trackball

1. With the rear cover removed, disconnect the PS2 cable from P2.
2. Disconnect the cable from P1 which connects the left and right push buttons.
3. Remove the four self-tapping screws from the trackball clamp.
4. Remove the trackball and clamp from the control panel housing.
5. Before inserting a new trackball set the DIP switches as shown on Figure 4.49.

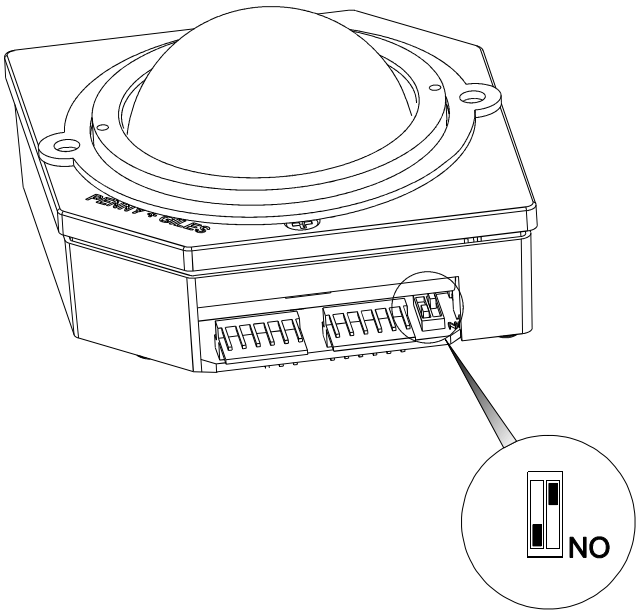


Figure 4.49 Setting the Trackball DIP switches

Replacing the Trackball Buttons

1. Disconnect the cables from the left and right trackball push buttons.
2. From the underside of the control panel unscrew the nuts securing the two push buttons.
3. Insert replacement push buttons and secure with the two nuts. Reconnect the cables from the trackball to the push buttons.

3.4.2.2 Replacing the Trackball on assembly without Keyboard

1. From the Processor unit disconnect the trackball cable.
2. Remove the module mounting plate from control panel by unscrewing the two M5 cap head screws and three nylon inserts, these are located on the underside of the control panel housing.
3. Unscrew the four M4 nuts securing the existing trackball and remove nuts S/C washers and trackball from mounting plate.
4. Secure replacement trackball to the mounting plate with the four M4 nuts and S/C washers. Coat the trackball mounting plate screw threads with screwlock provided.
5. Connect the cable to trackball P2 plug.
6. Place assembled trackball and mounting plate into the control panel housing and secure the mounting plate with the two M5 cap head screws and three nylon inserts.

3.4.2.3 Replacing the Power Control Switch

1. With the module mounting plate removed (see Section 3.4.2.2), remove the cable tie and disconnect the switch cable and associated earth lead from the rear of the power switch unit.
2. Unscrew and remove the five M3 countersunk screws securing the existing power control switch to the bracket and remove the unit.
3. Secure replacement power control switch to the bracket with the five M3 countersunk screws. Coat the screw threads with screwlock provided.
4. Connect the cable from the PCIO unit to the rear of the switch unit, connect the earth lead on the cable assembly to the earth stud between the two plain washers.
5. Secure cable with tie wrap assembled through two slots on the rear of the switch bracket.

3.4.2.4 Replacing the USB Connector on assembly without Keyboard

1. Disconnect the dual USB cables from the front of the Processor unit.
2. With the module mounting plate removed (see Section 3.4.2.2), unscrew and remove the five M3 countersunk screws securing the existing USB connector assembly to the bracket and remove the unit.
3. Secure replacement USB connector assembly to the bracket with the five M3 countersunk screws. Coat the screw threads with screwlock provided.
4. Connect the dual USB cables from the USB connector board to the front of the Processor unit.

3.4.3 Processor Unit



WARNING! – Lethal Voltage Hazard

Lethal voltages may be exposed when access covers are removed. Only qualified persons should work on the equipment when power is applied. ALWAYS isolate the unit from the mains supply when removing or replacing covers.



CAUTION – Electrostatic Sensitive Devices (ESSDs)

The Processor unit contains ESSDs. Take care not to damage these devices by discharge of electrostatic voltages.

Before replacing the processor Scan Converter (SC) PCB shut down the system from the VisionMaster application, and when fully powered down, switch the On/Off switch to OFF.

3.4.3.1 Replacing the Scan Converter PCB

1. Turn the On/Off switch at the rear of the processor unit to Off.
2. From the front of the processor unit disconnect the two USB cables from the control panel USB port.
3. Remove the four screws and washers securing the Processor shelf to the console frame. Pull the Processor and shelf forward and lever the unit down to access the rear cables.
4. From the rear of the Processor disconnect the following two cables (the remaining cables to the Processor do not need to be disconnected) :
   a. power cable from the PCIO unit;
   b. video/data cable from the PCIO unit.
5. Unscrew the nine pan head screws securing the top cover of the Processor unit.
6. Unscrew the one pan head screw securing the Scan Converter (SC) PCB to the processor frame (the SC PCB is positioned to the left of the processor box looking forward).
7. Carefully disengage the SC PCB from the main processor PCB and remove from the processor box.
8. Adjust the six S1 switches mounted on the front edge of the PCB so that switch 1 and 2 are off and switch 3 to 6 are on, see Figure 4.50.
9. On an SC3 card, adjust the six S1 switches mounted on the top left of the PCB so that switch 2 is off and switch 1 and swiches 3 to 6 are on, see Figure 4.51.
10. Installation of a replacement SC PCB is a reversal of removal.

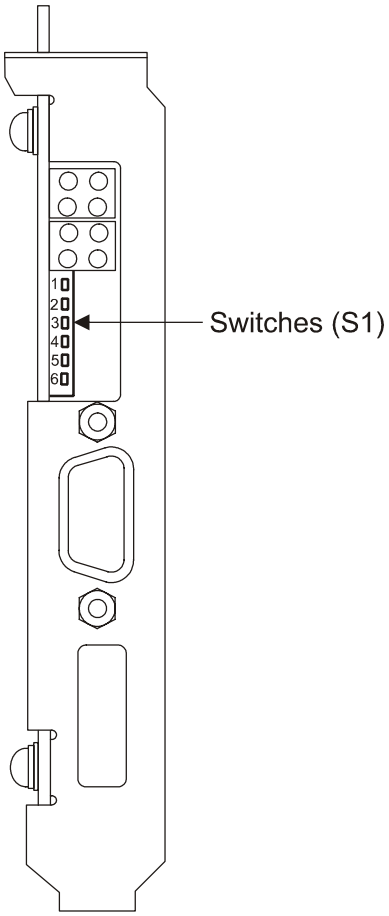


Figure 4.50 Location of S1 switches on front edge of SC PCB

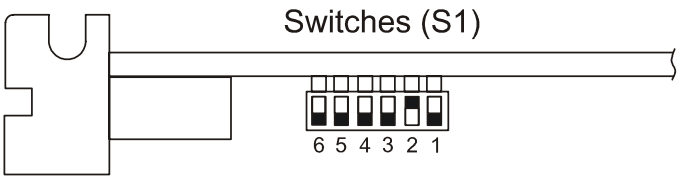


Figure 4.51 Location of S1 switches on top left of SC PCB

3.4.4 PCIO Unit

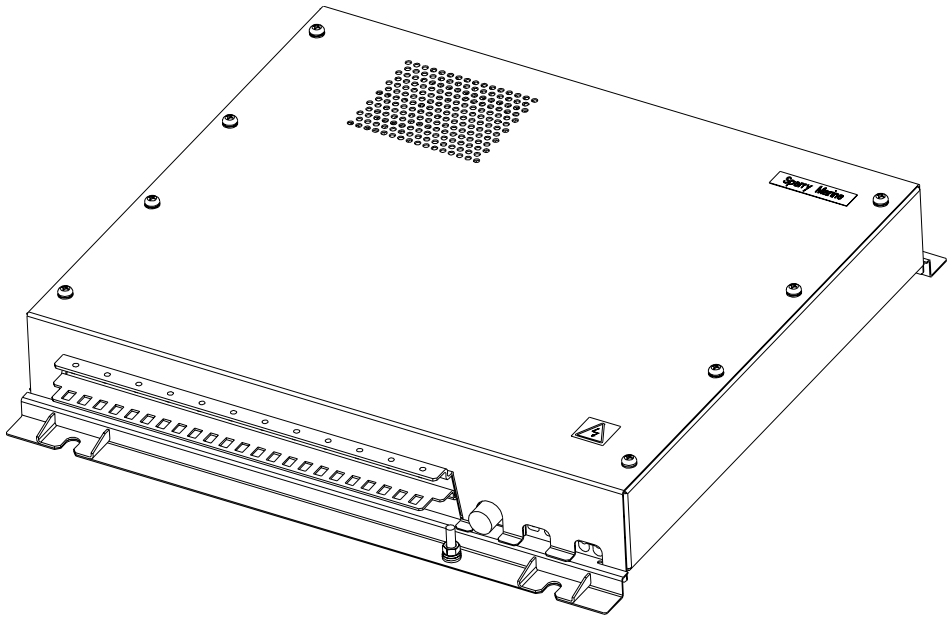


Figure 4.52 PCIO Unit



WARNING! – Lethal Voltage Hazard

Lethal voltages may be exposed when access covers are removed. Only qualified persons should work on the equipment when power is applied. ALWAYS isolate the unit from the mains supply when removing or replacing covers.



CAUTION – Electrostatic Sensitive Devices (ESSDs)

The PCIO unit contains ESSDs. Take care not to damage these devices by discharge of electrostatic voltages.

Before replacing the serviceable modules in the PCIO unit shut down the system from the VisionMaster FT application, and when fully powered down, switch the On/Off switch located on the underside of the Control Panel to OFF.

Before disconnecting cables and removing modules within the PCIO unit note the polarity and orientation of all components.

3.4.4.1 Removing the PCIO Unit

Although completely removing the PCIO unit from its support shelf is not always necessary when replacing individual modules, it may be preferable, depending on ease of access for servicing. If the preference is for removing the PCIO refer to step 5 below.

1. Remove the four screws and washers securing the PCIO support shelf to the pedestal chassis. Disengage the self rear locators and slide the PCIO unit shelf forward until all the top of the unit is accessible.
2. Remove the eight M5 pan head screws, S/C washers and plain washers securing the PCIO unit cover. Carefully lift and remove the top cover away from the unit.
3. To disconnect incoming cables from the rear of the unit remove the five M4 countersunk screws securing the cable clamp top plate.
4. Disconnect cable tie wraps, earthing tags and internal cable connections from the PCIO modules.
5. With all external cable connections disconnected remove the four M8 bolts, S/C washers, plain washers and nuts securing the PCIO unit to the support shelf. Carefully lift and remove the PCIO unit away from the pedestal assembly.

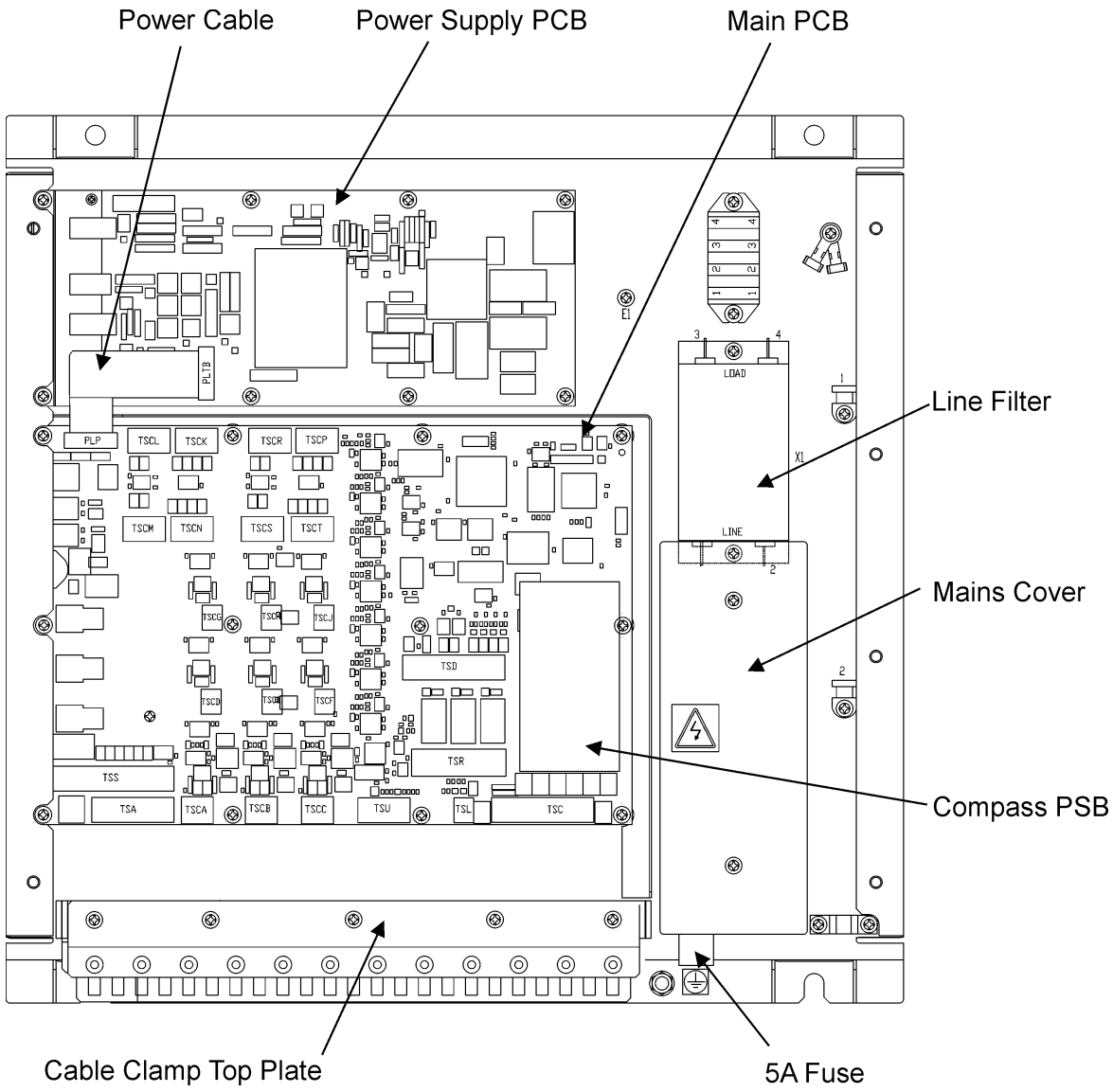


Figure 4.53 PCIO Unit with top cover removed

3.4.4.2 Replacing the Main PCB

1. With all cables disconnected from main PCB, remove fastener securing the 9-way ribbon power cable to the PCB shield and disconnect cable from the PLP terminal.
2. Unscrew the 12 PCB retaining screws and remove the PCB from the unit.
3. Remove the compass PCB from the main PCB.
4. Replacing the main PCB is a reversal of removal.

3.4.4.3 Replacing the Power Supply PCB

1. Disconnect the cable from the 4-way terminal block to the power supply PLTA terminal.
2. Disconnect the 9-way ribbon cable from the main PSB to the power supply PLTB terminal.
3. Unscrew the six power supply PCB retaining screws and remove the PCB from the unit.
4. Replacing the power supply PCB is a reversal of removal.
5. For a circuit diagram of the Power Supply PCB see Figure 4.54.

3.4.4.4 Replacing the Compass PCB

The compass board PCB is attached to the main PCB by a 20 pin connector at PLS terminal and an eight pin connector at PLR terminal.

To remove lift the compass PCB on either side to disengage the connectors from the main PCB.

3.4.4.5 Replacing the Line Filter

1. To access one of the two attaching screws for the line filter remove the two pan head screws, S/C washers and spacers securing the mains cover.
2. Disconnect the live and neutral connectors to the line filter terminals 3 and 4 from the TSE terminal block.
3. Disconnect the live, neutral and earth connectors to the line filter terminals 1 and 2 from the TSB terminal block.
4. Remove the two pan head screws and S/W washers securing the line filter to the PCIO unit.
5. Replacing the line filter is a reversal of removal.

3.4.4.6 Replacing the 5A Fuse

Unscrew the fuse holder on the side of the main box, remove fuse and replace.

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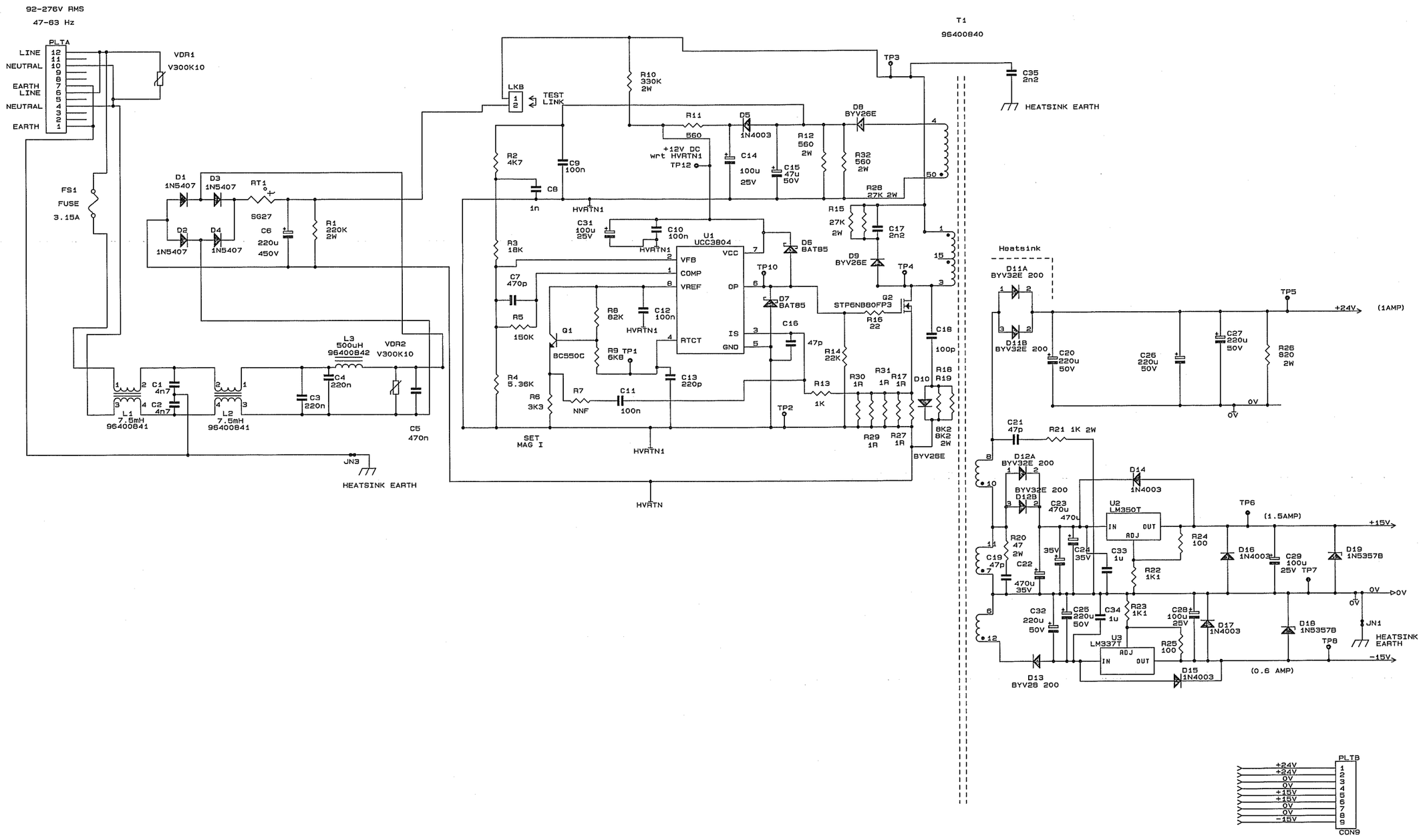


Figure 4.44 Power Supply PCB - circuit diagram

4 Limited Spares List for Field Replacement

4.1 19" Integrated Tabletop

Module	Part Number
LCD assembly	65919608
Processor Plate assembly	65919602
Control Panel	T65919669
DVD Writer	RA00002873
On/Off Switch	RA00002824
LED and Buzzer Panel PCB	65919801
PCI/O PCB	T65900800
Power Supply Unit	RA00002857
DC/DC Converter	65919800
Mains Input Filter	65919822
Fuse 5 A (External)	RA00002832

4.2 250mm & 340mm Console Assemblies

Module	Part Number
Hatteland Monitors 19" Monitor Kit 19" Monitor Desktop 19" Monitor Deckstand 23.1" Monitor Kit 23.1" Monitor (Desktop or Deckstand)	 65817G 65919T 65919C 65823A 65923C
23.1" Monitor Unit (Melford) (Desktop or Deckstand)	65923E
Processor Unit (with SC2 Card) Processor Unit (no SC Card) Processor Unit (with SC3 Card)	65901AR 65901AN 65901AT
PCIO Unit (standard compass) PCIO Unit (special compass)	65900AA 65900AB

4.2.1 Processor Unit

Assembly	Part Number
SC2 Card PCB	T65900810
SC3 Card PCB	T65900812

4.2.2 PCIO Unit

Assembly	Part Number
Main PCB	T65900800
Power Supply PCB	T65900801
Compass Standard PCB	T65800831
Compass Special PCB	T65800832
Line Filter	1585800
Fuse 5 A (External)	2180413 (or RA00002832)
Fuse 3.15 A (Internal)	2162326

4.2.3 Control Panel Modules

Assembly	Part Number
Control Panel	T65900667
Control Panel module*	T65900660
VRM Panel module*	T65900661
Trackball*	RA00000919
Trackball Button Replacement Kit*	T65900701
Trackball assembly	T65900614
USB Ports	T65900635
On/Off Switch	T65900625

*. Part of the 65900667 assembly

4.3 2-Way Interswitch 65842A

Assembly	Part Number
PCB Assembly	T65842800

4.4 6-Way Interswitch 65846A

Assembly	Part Number
PCB Assembly	T65846800
Bypass PCB Assembly	T65846801

4.5 Spares for Transceivers and Turning Units

The tables below list the spares for standard Transceivers and Turning Units.

For units fitted with 'additional features' options see Section 4 in Chapter 8 '*Additional Features*'.

In the tables below replace "xx" with 10 or 25 as appropriate. (e.g 658xxA becomes 65825A or 65810A), and "yy" with suffix as described in Chapter 2 *'System Configuration'* (e.g 65825WAR is a 25KW Turning Unit without biased limiter, with performance monitor, and AC mains input).

4.5.1 S-band Turning Units (Masthead and Bulkhead)

Assembly	Part Number
TRIGGER PCB ASSEMBLY	T65801801
INPUT PCB ASSEMBLY (MASTHEAD TRANSCEIVER)	T65801804 or T65801813*
INPUT PCB ASSEMBLY (BULKHEAD TRANSCEIVER)	T65801814
POWER SUPPLY PCB ASSEMBLY	T65801809
BEARING AND HEADING MARKER PCB ASSEMBLY	T65801805
RECEIVER FILTER PCB ASSEMBLY	T65801818
RECEIVER ASSEMBLY	T65830616
MODULATOR PCB ASSEMBLY	T65830812
LIMITER ASSEMBLY	T91005224
MAGNETRON	T91005225
CIRCULATOR	T91005223

Assembly	Part Number
PERFORMANCE MONITOR	T91003746
MAINS FILTER PCB ASSEMBLY	T91005228
FUSE	MA00007245
FAN – AXIAL 80x80x25 24VDC (MASTHEAD Tx/Rx)	T65830656
THERMAL SWITCH (FOR FAN – MASTHEAD Tx/Rx)	MA00007765

*. 65801804 can be replaced with T65801813
65801813 must be replaced with T65801813

4.5.1.1 S-band Motors/Gearboxes

Motor	Part Number	Gearbox Housing Assy
MOTOR 110/120V AND 220/240V Normal Speed	T91003757	T65830665
MOTOR 110/120V AND 220/240V High-Speed	T91003759	T65830667
MOTOR 220/240V AND 380/440V 3ϕ Normal Speed	T91003751	T65830645
MOTOR 110/120V 3ϕ Normal Speed	T91003752	T65830645
MOTOR 220/240V AND 380/440V 3ϕ High-Speed	T91003753	T65830646
MOTOR 110/120V 3ϕ High-Speed	T91003754	T65830646

4.5.2 Standard X-band Turning Units and Transceivers

65825A, 65825G, 65825H, 65825P, 65825W, 65825Lyy, 65825Myy, 65825Pyy, 65825Wyy,

65810A, 65810G, 65810H, 65810P, 65810W, 65810Myy, 65810Pyy, 65810Wyy

Assembly	Part Number
TRIGGER PCB ASSEMBLY (STANDARD)	T65801801
TRIGGER PCB ASSEMBLY (FOR UNITS PART No. 658xxP, 658xxG, 658xxPyy)	T65801822
INPUT PCB ASSEMBLY (TURNING UNIT)	T65801813
INPUT PCB ASSEMBLY (TURNING UNIT) (FOR TURNING UNIT PART No.65825Lyy)	T65801819
INPUT PCB ASSEMBLY (FOR BULKEAD TRANSCEIVERS PART No. 658xxH, 658xxG)	T65801814

Assembly	Part Number
INPUT PCB ASSEMBLY (FOR BULKHEAD TRANSCEIVERS PART No. 658xxA, 658xxP, 658xxW)	T65801820
POWER SUPPLY PCB ASSEMBLY AC MAINS INPUT	T65825816
POWER SUPPLY PCB ASSEMBLY DC MAINS INPUT	T65810816
BEARING AND HEADING MARKER PCB ASSEMBLY	T65801805
RECEIVER FILTER PCB ASSEMBLY	T65801818
RECEIVER ASSEMBLY	T65801616
MODULATOR PCB ASSEMBLY	T65810812
LIMITER ASSEMBLY (10kW) (NITS FOR UNITS PNo 65810A, 65810P, 65810G, 65810Myy, 65810Pyy, 65810SDy,	T91005221
LIMITER (10KW) (FOR UNITS PNo. 65810W, 65810H, 65810Wyy	T91003431
LIMITER ASSEMBLY (25KW) FOR UNITS PNo. 65825A, 65825G, 65825Lyy, 65825Myy, 65825Pyy,	T91005226
LIMITER 25KW FOR UNITS PNo. 65825H, 65825W, 65825Wyy	T91005210
MAGNETRON (10kW)	T91003582
MODULATOR PCB ASSEMBLY (25kW) (STANDARD)	T65825812
MODULATOR PCB ASSEMBLY (25Kw HIGH PRF) FOR UNITS PNo. 65825P, 65825Pyy.	T65825813
MAGNETRON (25kW)	T91003496
CIRCULATOR	T91005227
PERFORMANCE MONITOR	T91005220
MOTOR DRIVE & DYNAMIC BRAKE PCB ASSEMBLY	T65801811
MOTOR & GEARBOX ASSEMBLY	T91003765
IMPELLER	65801136
MAINS FILTER PCB ASSEMBLY	T65825601
FUSE	MA00007245
BELT DRIVE (40W)	MA00008979
FAN – AXIAL 80x80x25 24VDC (BULKHEAD Tx/Rx)	T65830656
THERMAL SWITCH (FOR FAN – BULKHEAD Tx/Rx)	MA00007765
CABLE ASSY – SCANNER ON/OFF (INC SWITCH)	T65801506

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CHAPTER 5

ROUTINE MAINTENANCE

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2 Maintenance Plan 9-4

1 Introduction

The VisionMaster FT System is designed to function reliably for many years. To make sure of the best possible performance, you must complete specific maintenance tasks at regular intervals. This chapter has details of the recommended maintenance plan.

2 Maintenance Plan



WARNING! – Lethal Voltage Hazard

Before the following maintenance tasks are started (except the 3 monthly actions), the equipment must be isolated from the mains supply. No components or assemblies should be touched for at least five minutes after isolation. This is to make sure any high-voltage capacitors have discharged.

Interval	Action	Notes
3 Monthly	Check the Monitor screen for dirt.	Use a soft cloth to clean the screen. If available, use an anti-static spray. Water, isopropyl, alcohol and similar non-abrasive cleaning fluids may also be used to clean the screen. **Solvents must not be used as a cleaning agent**.
3 Monthly	Clean the Processor Unit fan filter. Note that in a dusty environment the fan filter should be cleaned more frequently than every 3 months.	For good reliability, air must continuously circulate inside the Processor unit. To avoid dust build up on the air intake clean the fan filter. To access the filter remove the plastic cover.

Interval	Action	Notes
6 Monthly	Check the window of the Antenna for excessive dirt.	Excessive dirt or carbon deposits from the ship's funnels may cause reduced radar performance. Use hot soapy water to clean the antenna window. **Never use solvents**.
6 Monthly	Check all external nuts, bolts and washers on the Scanner Unit, for corrosion and for correct tightness.	The nuts, bolts and washers must be replaced if they are heavily corroded, and suitable anti-corrosion compound applied.
6 Monthly	In the S-band Scanner unit check for oil leaks in the gearbox. In the X-band Scanner unit check for condition of the drive belt.	If leaks are detected, contact the VisionMaster FT Service Engineer.

Interval	Action	Notes
6000 hours	Replace Magnetron in Scanner Unit	The magnetron operational life is dependant on the condition of the drive and pulse length usage. For information on replacing a magnetron for S-Band and X-Band Scanner Units, refer to Chapter 8 'Fault Reporting and First Line Servicing'.

Interval	Action	Notes
10 years	Replace hard disk in Processor Unit	It is recommended that the hard disk in the processor be replaced after a period of 10 years. **CAUTION** **This task must only be undertaken by an approved service engineer. For details on contacting Sperry Marine Service, refer to Chapter 8 'Fault Reporting and First Line Servicing, Section 1 'Introduction'.**

If damage to any of the items being checked during routine maintenance is observed, call for a service repair.

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CHAPTER 6

MODIFICATIONS

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6.1 Introduction

This chapter will be used for recording system and equipment modifications (including the issue of Modification Leaflets), and for conveying information released after publication.

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CHAPTER 7

INTERSWITCH UNITS

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1 Interswitch Units - General View

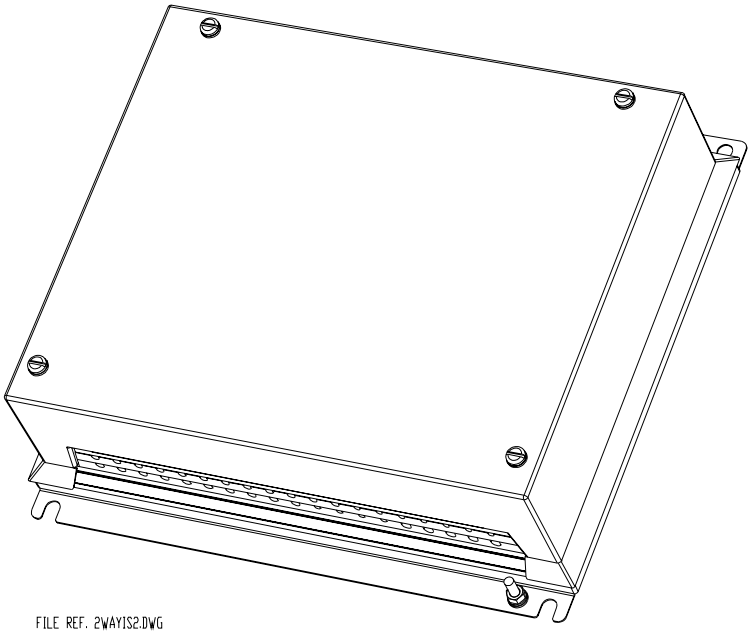


Figure 7.1 2-Way Interswitch Unit 65842A – General View

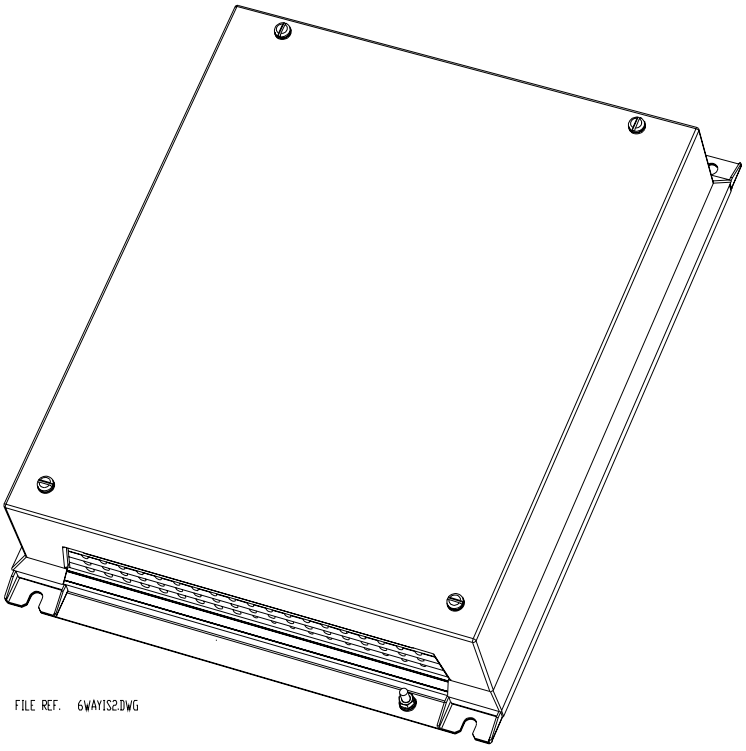


Figure 7.2 6-Way Interswitch Unit 65846A – General View

2 Interswitch Units - General Description

The Interswitch Units are used as part of a Marine Radar System for installation in ships' bridges and wheelhouses.

An Interswitched system comprises more than one radar combined so that the whole system can be controlled and configured from any display position. This is often desirable when only one operator is on duty, as it gives the choice of selecting a particular radar for a particular condition, i.e, S-Band in heavy rain and open waters, or X-Band for high definition in congested areas. It also permits multiple display operation when required and allows for standby radars to be immediately operational in the event of a failure.

Note: *The Interswitch Units work directly with the BridgeMaster E Series range of Scanner Units and VisionMaster FT range of Displays, but requires compatibility units for interfacing with the original BridgeMaster or Master Series units in hybrid systems. For information on compatibility units, refer to the Ancillary Units and Radar Systems manual, 65800012.*

The 2-Way Interswitch allows one or two Transceivers to be connected to up to four Displays.

The 6-Way Interswitch Unit allows a combination of up to 6 Displays with up to 6 Transceivers.

The Interswitch Unit is housed in a purpose designed enclosure with the electronic circuitry contained on a single PCB. Surface mount devices are used throughout the design. A separate Bypass PCB houses the bypass and distribution connectors.

Connectors are fitted to the Bypass PCB to enable manual bypassing of the Interswitch control logic in the event of an Interswitch failure. The Bypass PCB enables the logic PCB to be removed for servicing without affecting the bypass function.

Power for the Interswitch Unit is derived from the System Display or Display Compatibility units, with any display capable of powering the Interswitch Unit.

The following Despatch Kits contain all necessary fixings and connectors:

- for 2-Way Interswitch Despatch Kit, 65842600
- for 6-Way Interswitch Despatch Kit, 65846600

Refer to Chapter 3, Installation for typical system installation details.

3 System Configuration

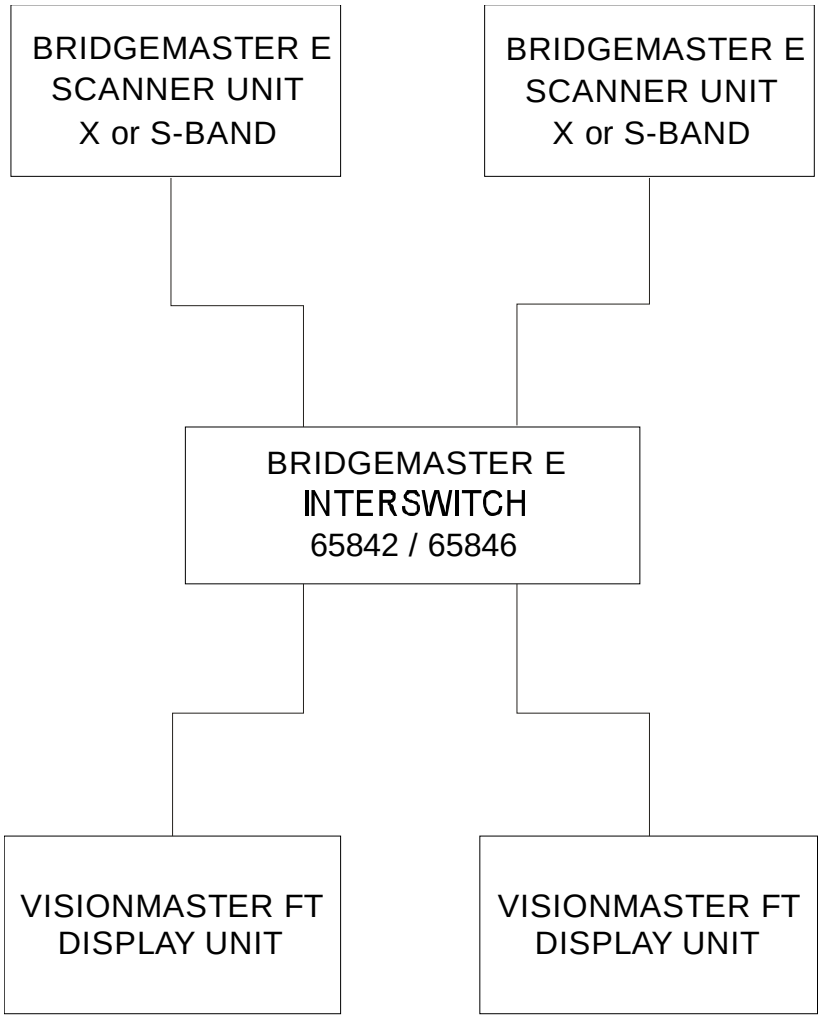


Figure 7.3 Placement of Interswitch Unit in typical VisionMaster System

4 Installation and Commissioning

4.1 Siting Considerations

The maximum separation between the Interswitch and an operating VisionMaster FT PCIO unit should not exceed 30 metres. (i.e. if only one VMFT display in the system may be functioning, and the other displays are turned off; the distance between the interswitch and the display that is functioning must not exceed 30 metres).

4.2 Interswitch Hardware Configuration

4.2.1 Dil Switches

In order to indicate which Displays and Transceivers are connected to the Interswitch, set the appropriate switches to the 'off' position.

On the 2-Way Interswitch PCB board there are two 4-way DIL switches. SW1 selects Display Units while SW2 selects Transceivers.

On the 6-Way Interswitch PCB board there are two 6-way DIL switches. SW1 selects Display Units while SW2 selects Transceivers.

Table 1: Link Settings 1 & 2

Mode	Link	Setting
Global	LK1	2-3
Local	LK1	1-2
Normal	LK2	12
Reset Defaults	LK2	2-3

Link 1 selects LOCAL or GLOBAL setting. If the system is in the Local Mode, a Display Unit can only change the Transceiver to which it is connected and select either master or slave mode. If the system is in the Global Mode, any display can completely re-configure the entire system.

Inserting Link 2 at position 2-3 loads the default settings at power-up. For a 2-way Interswitch that is fully populated, the default state will be as shown below:

- DUA master to TXA DUB master to TXB
- DUC slave to TXA DUD slave to TXA

For a 6-way Interswitch the default setting will be one to one connection.

Links 3 & 4 are for test and diagnostic purposes only.

Table 2: Link Settings 3 & 4

Link Settings	
LK3	Factory set 1-2
LK4	Not fitted

4.2.2 Installation Drawings

For installation of the 2-Way Interswitch and 6-Way Interswitch, refer to Figure 7.4 and Figure 7.5.

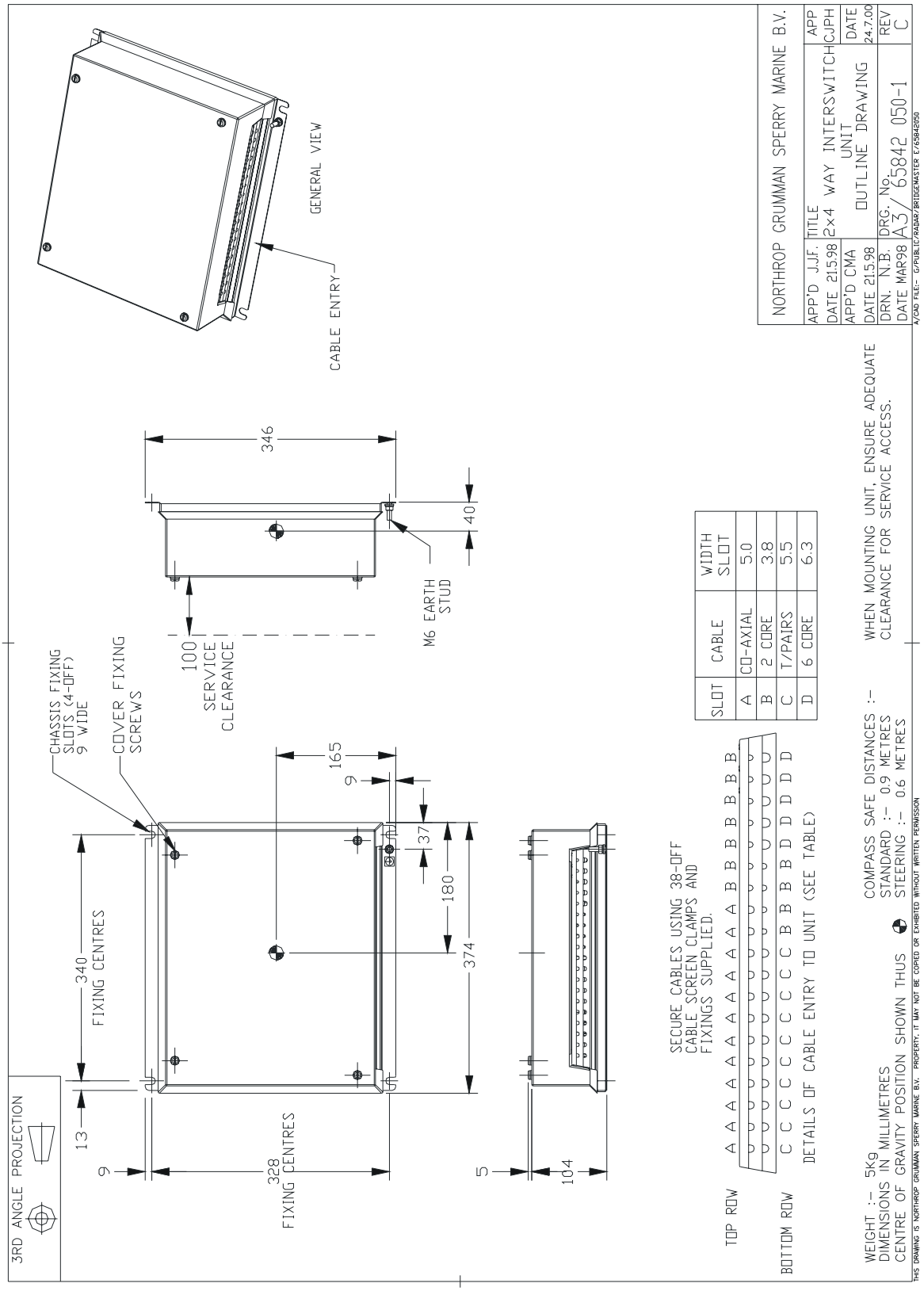


Figure 7.4 2-Way Interswitch Unit – Installation Drawing

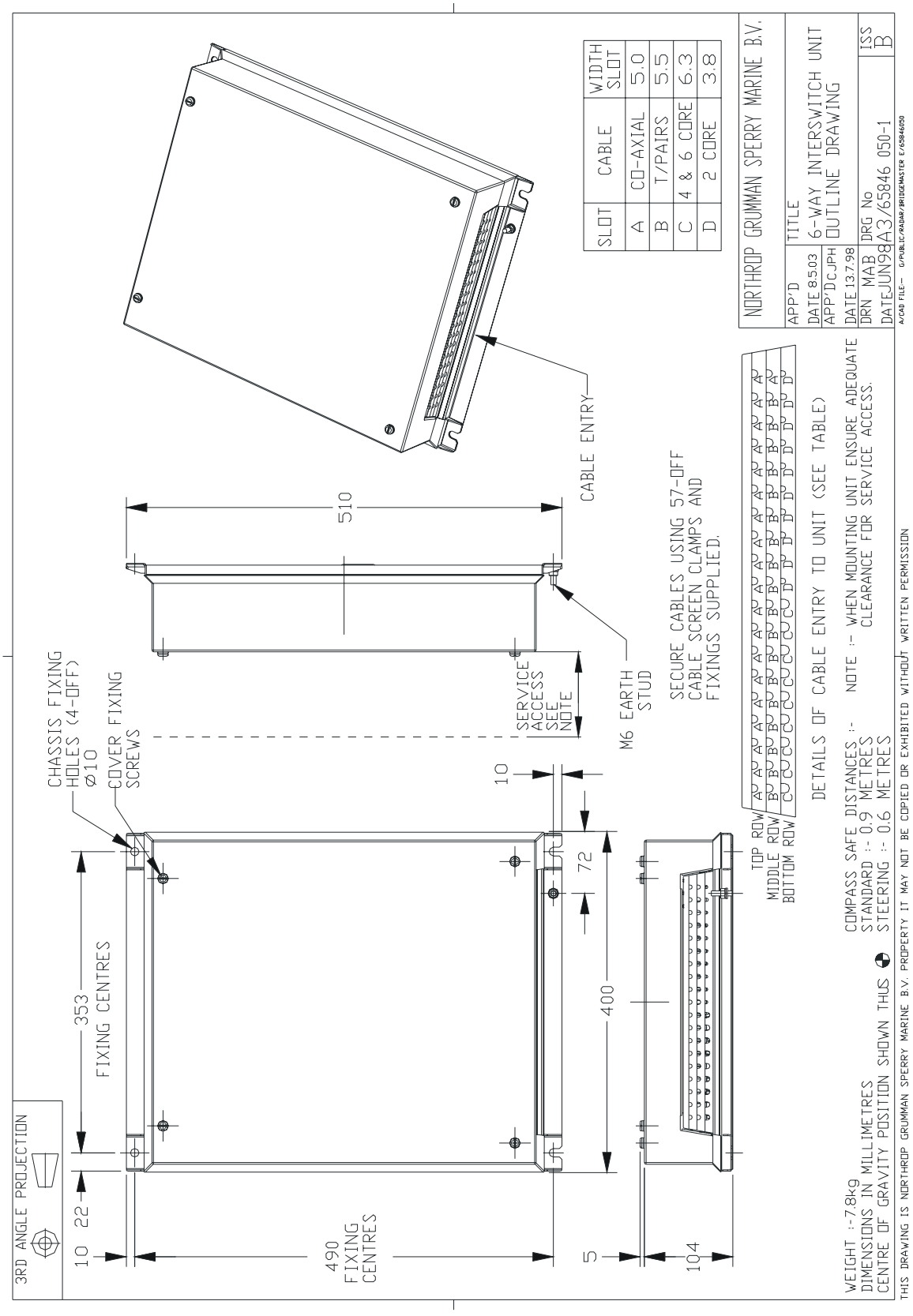


Figure 7.5 6-Way Interswitch Unit – Installation Drawing

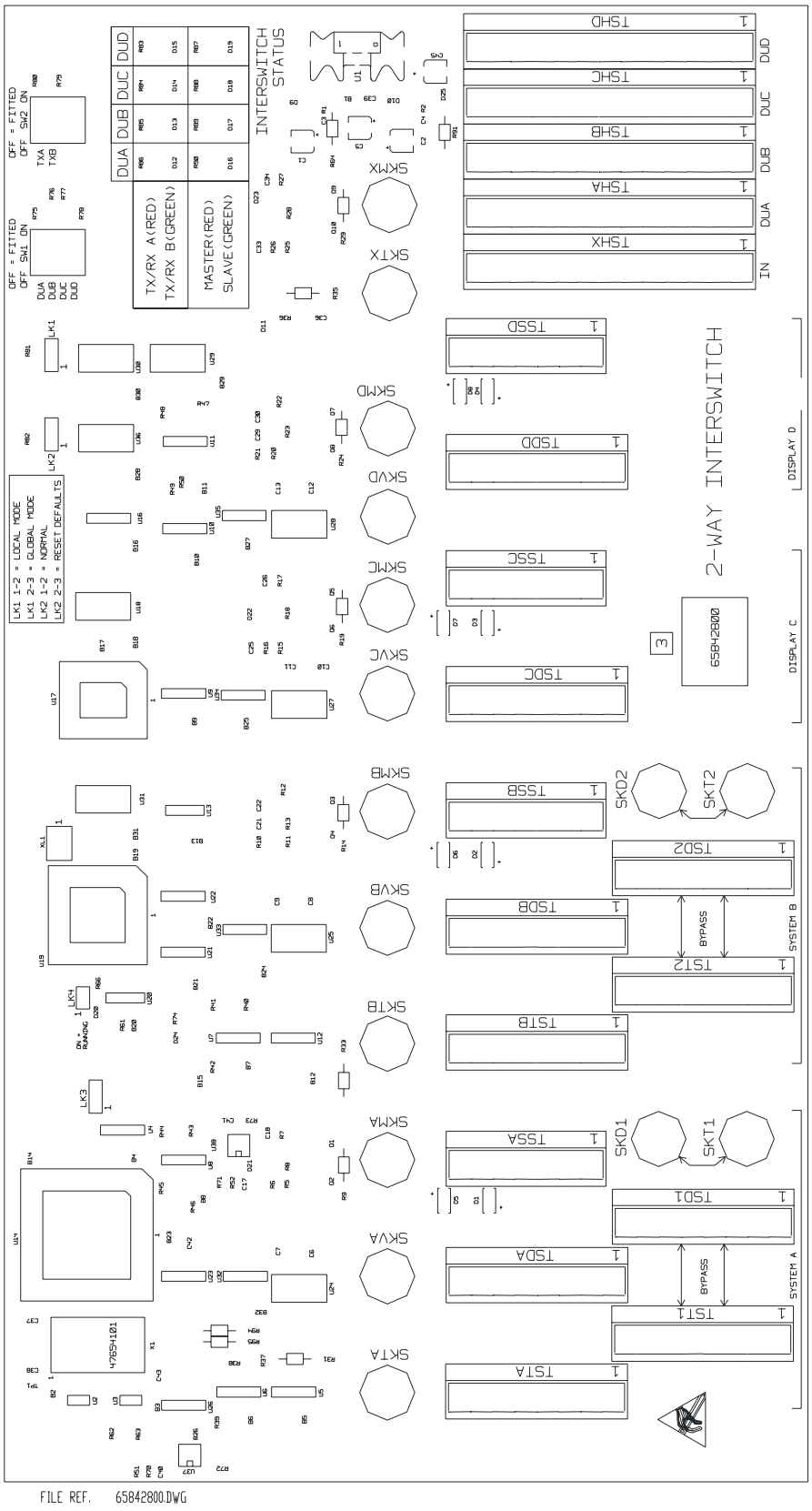


Figure 7.6 2-Way Interswitch PCB Assembly 65842800

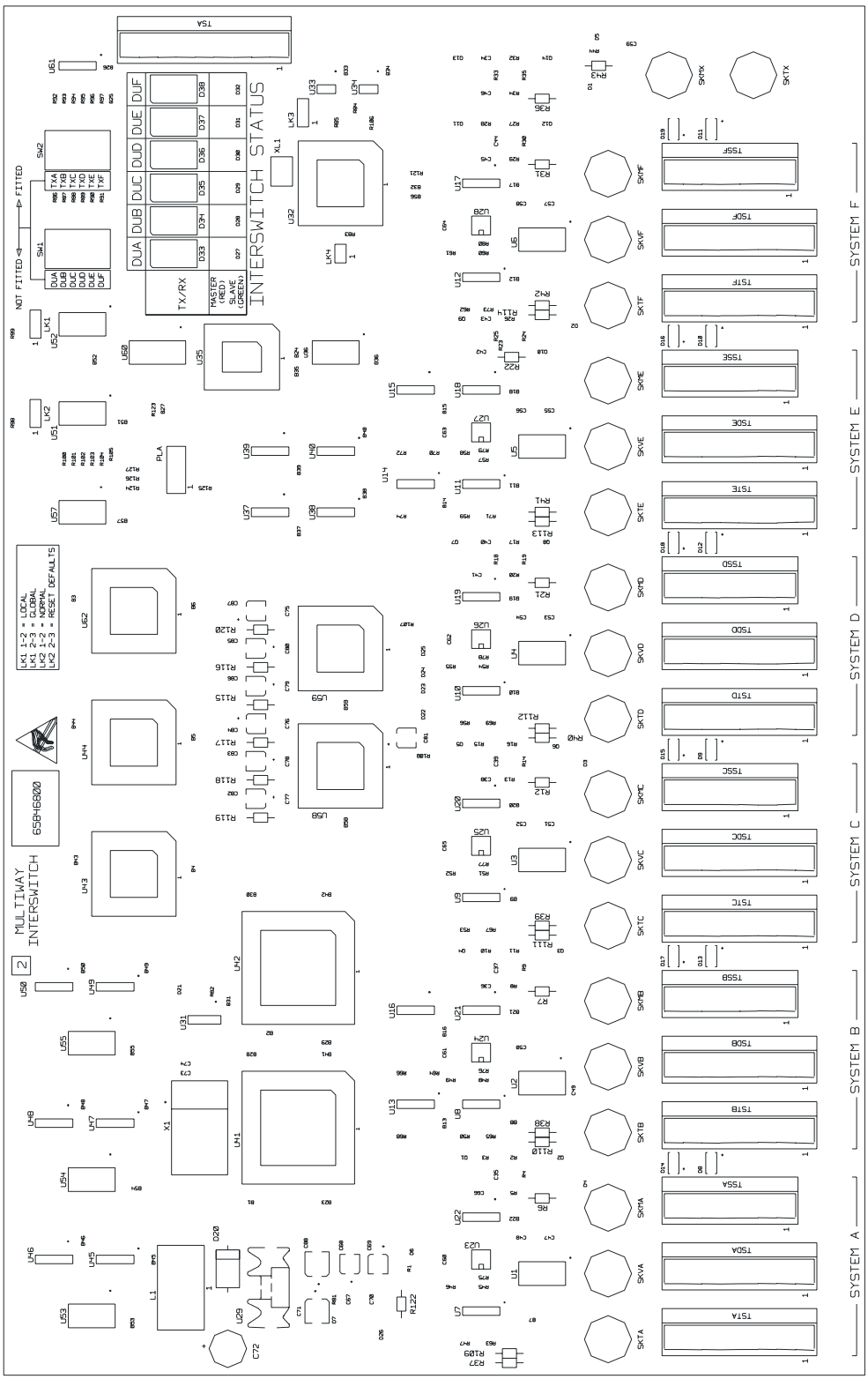


Figure 7.7 6-Way Interswitch PCB Assembly 65846800

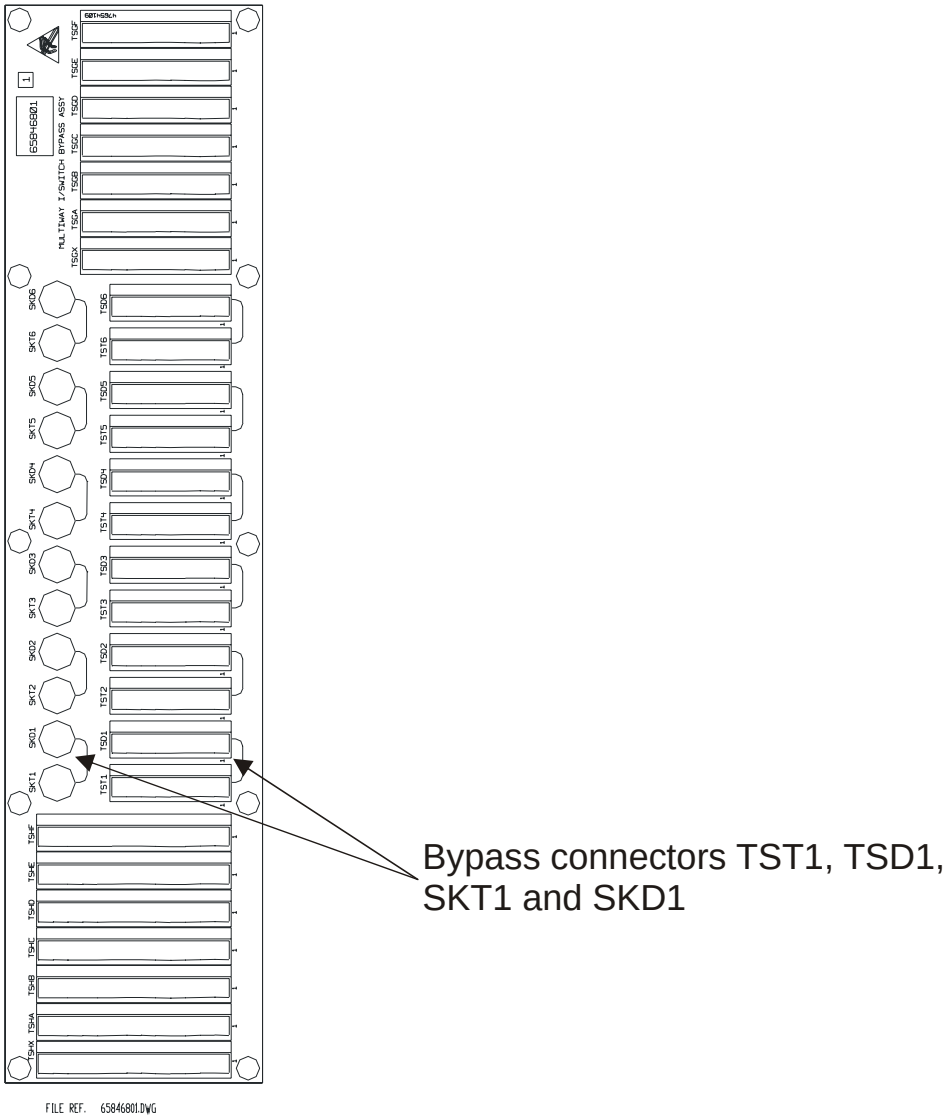


Figure 7.8 6-Way Interswitch Bypass PCB Assembly 65846801

4.2.3 Interface to Transceiver and Display Unit

There is a bi-directional serial port to send and receive signals between the display unit and the transceiver. The signals sent and received are RS422 differential. One receives the configuration requests from the display, the second one returns acknowledge and configuration signals back from the Transceiver to the display unit.

Trigger, Video and SART video are sent down separate cables. The Trigger and SART video are also received as RS422 differential signals. The video is received via a coaxial cable.

Two additional twisted pair cables bring in the power supply to the Interswitch Unit from the display or Display Compatibility Unit.

Table 3: Radar Video Input

Parameter	Values
Peak amplitude	2.5V to -5.5V
Shoulder noise	-0.25V minimum
Input Impedance	75 Ω ± 10%

4.2.4 Bypass Connections for 2-Way Interswitch

On the Interswitch PCB, additional connectors are provided. These allow a display to be connected to a Transceiver, bypassing the Interswitch. This permits TXA to be connected to one Display and TXB to be connected to another of the 4 possible Displays. 2 displays will be therefore out of action.

Note: *MIST will not be available to any Display in Bypass Mode.*

4.2.5 Bypass Connections for 6-Way Interswitch

On the Bypass PCB, 65846801, additional connectors are provided. These allow each display to be connected to one Transceiver, bypassing the Interswitch logic PCB 65846800. This precludes any slave Transceiver operation.

To bypass the Interswitch Unit in the event of an Interswitch Unit failure:

1. Remove the transceiver cables from TSTA and SKTA on Interswitch PCB Assembly 65846800 and connect them to TST1 and SKT1 on the Interswitch Bypass PCB assembly. This can be repeated for each transceiver using TST**, and SKT** (where ** can be 1, 2, 3, 4, 5or 6)
2. Remove the cables for the display that it is required to connect to the transceiver from TSD* and SKD* on the Interswitch PCB assembly (where * can be A, B, C, D, E or F), and connect them to TSD1 and SKD1 on the Interswitch Bypass PCB assembly.

This can be repeated for the other displays by using TSD** and SKD** (where ** can be 1, 2, 3, 4, 5, or 6).

Note: *MIST will not be available to any Display in Bypass Mode.*

4.2.6 General Distribution Connectors

These enable LOG, COMPASS, NAV I/P etc to be distributed to all the display units via parallel connected terminal blocks. The parallel terminal blocks on the interface PCB comprise:

- For the 2-Way Interswitch: 1 input terminal block and 4 output terminal blocks.
- For the 6-Way Interswitch: 1 input terminal block and 6 output terminal blocks.

4.2.7 System Status for the 2-Way Interswitch

Visual indication of the system status is provided by green and red LEDs which show whether a display is connected to Transceiver A or Transceiver B. Additional green and red LEDs show whether the Display Unit is master or slave to the Transceiver. If a Display has not been configured, then the associated LEDs will not be illuminated.

Table 4: Typical Examples of Status Panel Read-Outs for 2-Way

Displays	A	B	C	D
Tx/Rx A (Red) Tx/Rx B (Green)				
Master (Red) Slave (Green)				

Red LED

Green LED

4.2.8 System Status for the 6-Way Interswitch

Visual indication of the system status is provided by seven segment displays which indicate which Transceiver (A to F) is connected to which display unit. Additional green and red LEDs show whether the display unit is Master or Slave to the Transceiver. If a Display is not configured, then the associated LEDs will not be illuminated.

Table 5: Typical Examples of Status Panel Read-Outs for 6-Way

Displays	A	B	C			D
Transceiver	A	C	C	A	E	F
Master (Red) Slave (Green)						

Red LED

Green LED

4.2.9 Mutual Interference Suppression Trigger (MIST)

There is one input from an external source which is mixed with the triggers from each Transceiver. The combined signal is fed out as an external display MIST. Each Display is supplied with this composite trigger excluding the trigger from the Transceiver that the Display is currently connected to.

4.2.10 Interconnections

All connections to the Interswitch physically plug directly into the Interswitch logic PCB.

The cables to the Turning Units/Transceivers consist of a quad twisted pair cable with overall screen for Trigger, SART Video and the bi-directional serial data, and a co-ax cable for Video.

The cables to the Display Units consist of two quad twisted pair cables. One provides the Transceiver signals for Trigger, SART Video, bi-directional serial data, bi-directional interswitch control data, positive and negative power. The Transceiver video input and output are via co-ax cables, as is the output MIST.

The Interswitch Unit has one External Transceiver MIST co-ax input, one External Display MIST co-ax output. The 2-Way Interswitch has four co-ax Display MIST outputs; the 6-Way six co-ax Display MIST outputs.

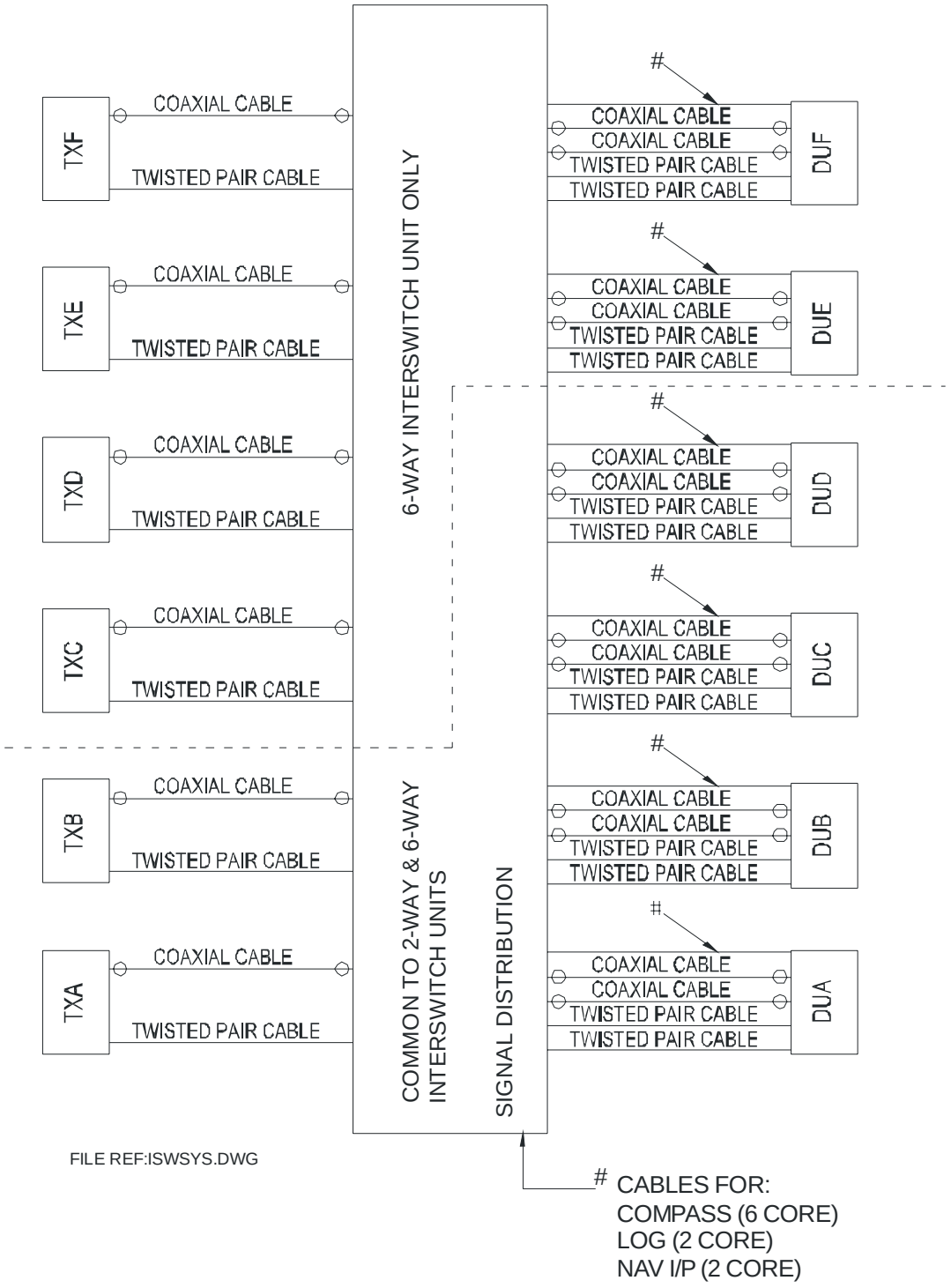


Figure 7.9 Block Diagram – Interswitched System

5 Technical Specification

5.1 Interswitch Power Supply

Each Display Unit supplies +12V (+15V) & -12V (-15V) to the Interswitch.

The +12V (+15V) inputs are diode OR'd to produce ≈ +11V (+14V).

The -12V (-15V) inputs are diode OR'd to produce ≈ -11V (+14V).

An on-board regulator produces +5V for the logic.

For the 6-Way Interswitch a second regulator produces -5V.

5.2 Interswitch Unit Hardware Description

An 89C52 microcontroller with on-board Flash memory running at 12 MHZ communicates with the Display Units via bi-directional serial links. The data transferred includes status i.e. Display is master or slave, which Transceiver is connected to which Display. A watchdog facility is also provided.

For a 2-Way Interswitch one Quad UART is used for the bi-directional serial communication with the Display Units or Compatibility Unit. For a 6-Way Interswitch two Quad UARTs are used for the bi-directional serial communication with the Display Units.

Received data generates interrupts for the microcontroller which reads the data from the UART and acts upon that data. A message is then returned with the new status. Any change of status is stored in an EEPROM allowing the Interswitch to return to the current status in the event of a power failure.

For the 2-Way Interswitch Logic multiplexers are used to route the signals between the Display Units and Transceivers and analogue 'T' switches route the video.

For the 6-Way Interswitch CPLDs are used to route the signals between the Display Units and Transceivers and analogue Cross-point switches are used to route the video.

The microcontroller also drives the LED status display.

6 Environmental Specification

6.1 Temperature

Operating -15°C to +55°C

Storage -25°C to +70°C

6.2 Relative Humidity

95% at 40°C (non condensing)

6.3 Weights and Dimensions

	Height (mm)	Depth (mm)	Width (mm)	Nominal Weight (kg)
2-Way Interswitch Unit 65842A	346	109	374	5.0

	Height (mm)	Depth (mm)	Width (mm)	Nominal Weight (kg)
6-Way Interswitch Unit 65846A	510	109	400	7

6.4 Compass Safe Distances

	Standard	Steering
2-Way & 6-Way Interswitch Units	0.9 m	0.6 m

CHAPTER 8

ADDITIONAL FEATURES

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1 Introduction

This chapter contains the additional information required to cover the installation and operation of radar systems equipped with the 'Additional Features' option.

The additional features are as follows:

- Isolated Ship's Heading Marker output, RS422, and uncommitted relay contacts
- 4096 Pulse Bearing Data output, RS422, and open drain FET output
- External Triggering input
- Pre-trigger output
- Radar Silence input (transmission inhibit control). Selectable for RS422, RS423 voltage levels, and on later units closing contact input.
- Antenna Rotation in Standby Input (X-band only)
- Remote selection of high and normal rotation rates for antenna.
- Optional synchro or resolver bearing output.

Note: Some options are mutually exclusive.

2 Technical Specification

2.1 General

This section only gives details of the technical specification for the 'additional features', for all other parameters see Chapter 1 '*Technical Specification*'.

Except where indicated, the following specification applies equally to X-band and S-band Transceivers, and Turning Units.

2.2 Isolated Ship's Heading Marker Output

Output 1

Table 1: Heading Marker Output 1

Parameter	Value
Output Type	Uncommited contact (solid-state relay)
Voltage Rating	24V DC maximum
Current Rating	0.7A maximum
Closure Duration	20° approx.
Adjustment Range	±10° approx. w.r.t. true heading
Adjustment Increment	0.088°
Reference	Leading edge
Sense	Selectable to be rising or falling edge

Output 2

Table 2: Heading Marker Output 2

Parameter	Value
Output Type	RS422 (differential)
Output Drive	To drive 120ohm twisted pair
V_{out} high	2.0V min. Isource -20mA
V_{out} low	0.5V max. Isink 20mA
Closure Duration	20° approx.
Adjustment Range	±10° approx. w.r.t. true heading
Adjustment Increment	0.088°
Reference	Leading edge
Sense	Selectable to be rising or falling edge

2.3 Pulse Bearing Output

Output 1

Table 3: Pulse Bearing Output 1

Parameter	Value
Output Type	Open drain FET (referenced to 0V)
Pulses per Revolution	4096
Voltage Rating	25V DC maximum
Current Rating	100mA maximum
Mark Space Ratio	<1.5:1

Output 2

Table 4: Pulse Bearing Output 2

Parameter	Value
Output Type	RS422 (differential)
Pulses per Revolution	4096
Output Drive	To drive 120ohm twisted pair
V_{out} high	2.0V min. Isource -20mA
V_{out} low	0.5V max Isink 20mA
Mark Space Ratio	<1.5:1

2.4 Synchro and Resolver Bearing Output

The turning unit may be fitted with one size 11 synchro or resolver. This is not aligned, any alignment must be made externally.

Control transmitter (CX) or control differential transmitter (CDX) synchro options are available.

The reference supply is assumed to be from an external source.

The standard synchros that are available are:

11CX4c

Table 5: Synchro 11CX4c Outputs

Parameter	Value
Type	Control transmitter
Ratio	1:1
Reference Voltage	115V rms
Output Voltage	90V rms line to line
Frequency	400Hz

11CDX4b

Table 6: Synchro 11CDX4b Outputs

Parameter	Value
Type	Differential control transmitter
Ratio	1:1
Input Voltage	78V rms line to line
Output Voltage	90V rms line to line
Frequency	400Hz

The standard resolver that is available is:

11M6P1

Table 7: Resolver 11M6P1 Outputs

Parameter	Value
Type	Data transmission
Ratio	1:1
Input Voltage	26V rms line to line
Output Voltage	11.8V rms line to line
Frequency	400Hz

2.5 Pre-trigger Output

Table 8: Pre-trigger Outputs

Parameter	Value
Amplitude	8V min. 15V max
Duration	1.0 µs nominal
Polarity	Positive
Rise Time (10% - 90%)	<100ns
Time wrt Magnetron Output	-11µs typical
Drive Capability	75 ohms

2.6 Radar Silence Input

RS422

Table 9: RS422 Inputs

Parameter	Value
Input Type	RS422 (differential)
Response Time	Within 1 PRI
Input Impedance	120 ohms

Closing Contact

Table 10: Closing Contact Inputs

Parameter	Value
Input Type	Uncommitted closing contact
Voltage on Open Contact	6V max
Sink Current Through Closed Contact	4mA max
Response Time	Within 1 PRI
Sense	Selectable

RS423

Table 11: RS423 Inputs

Parameter	Value
Input Type	RS423 bipolar
Response Time	Within 1 PRI
Minimum Differential Input Voltage	+/-2V
Input Voltage	+/-7V max
Input Current	<-10mA for Vin -7V other input at 0V
Sense	Selectable

2.7 External Trigger Input

Table 12: External Trigger Inputs

Parameter	Value
Amplitude	4.0V min. 40.0V max
Duration	0.2µs min. 40µs max
Polarity	Positive
Rise Time (10% - 90%)	<50ns
Delay to Magnetron Output	11µs approx.
Input PRF	5.5kHz max 200Hz min. (Output PRF limited within the TxRx)
Input Impedance	75 ohms
Average Input Power*	0.4W max

* Trigger pulse amplitude, duration and PRF must be considered in limiting the input power.

The presence of a signal at the external trigger input will automatically select external trigger operation.

2.8 Forced Antenna Rotation in Standby Input

An isolated closing contact can be connected to an X-band turning unit to force the antenna to rotate when it is in standby mode. Rotation is forced when the contact is closed.

Note: This function cannot be used in conjunction with the remote speed change option. They are mutually exclusive.

Table 13: Forced Antenna Rotation

Parameter	Value
Input Type	Uncommitted closing contact
Voltage Applied to Open Contact	5.5V max
Sink Current Through Closed Contact*	1mA max
Sense	Rotation enabled when contact is closed

* The switch or contacts should be specified for switching low currents.

2.9 Antenna Speed Selection Input

An isolated closing contact can be connected to the X-band turning unit to enable remote selection between normal and high speed antenna rotation.

In the absence of the closing contacts, links are used to preset the rotation speed to normal or high speed.

Note: This function cannot be used in conjunction with the Forced Antenna Rotation in Standby feature.They are mutually exclusive.
For 10kW DC systems, high-speed operation should only be used where a 1.2m (4ft) antenna is fitted to the Turning Unit. For 1.8m (6ft) and 2.4m (8ft) antennas the antenna rotation speed must be preset to the Normal setting.

Table 14: Antenna Speed Selection

Parameter	Value
Antenna Speed Normal	28 rpm nom.
Antenna Speed High	45 rpm nom
Control Signal Type	Uncommitted closing contact
Signal Sense	Closed contacts select 28rpm Open contacts select 45rpm
Voltage Applied to Open Contact	< 5.5V DC
Sink Current Through Closed Contact	<500µA

3 Installation and Interconnections

3.1 General

To make use of the 'additional features', extra cables need to be fitted to the Turning Unit or Transceiver.

To help with fitting the extra cables, the Turning Units are supplied with additional cable glands.

For details see Figure 8.1 and Figure 8.2.

3.2 Interconnections

Only the extra connections needed for 'additional features' are listed in this section. For all other connections see Chapter 2 *'System Identification'*.

3.2.1 X and S-band Turning Unit Connections

Cable No:		EMC CAT –	Cable Type: PT1YM (75ohm coax)		
From Turning Unit			To:		
Unit Connector No: SKH			Unit Connector:		
Cable Connector Type: L734PNI			Cable Connector Type:		
Manufacturer; Belling Lee			Manufacturer:		
Line No.	Function	Pin No.	Colour	Pin No.	Remarks
1	PRE-TRIGGER O/P	PIN	INNER	PIN	Masthead transceiver only
2	SCREEN	OUTER	BRAID	OUTER	

Cable No:		EMC CAT –	Cable Type: PT1YM (75ohm coax)		
To: Turning Unit			From:		
Unit Connector No: SKJ			Unit Connector:		
Cable Connector Type: L734PNI			Cable Connector Type:		
Manufacturer; Belling Lee			Manufacturer:		
Line No.	Function	Pin No.	Colour	Pin No.	Remarks
1	EXT-TRIGGER I/P	PIN	INNER	PIN	Masthead transceiver only
2	SCREEN	OUTER	BRAID	OUTER	

Cable No:	EMC CAT –		Cable Type: 16 - 2 - 6C		
From: Turning Unit			To:		
Unit Connector No: TSD			Unit Connector No:		
Cable Connector Type: 159749 BL3.5/15			Cable Connector Type:		
Manufacturer: Weidmuller			Manufacturer: Connector:		
Line No.	Function	Pin No.	Colour	Pin No.	Remarks
1	SYNCHRO S1	1	R		
2	SYNCHRO S2	2	B		
3	SYNCHRO S3	3	G		
4	SYNCHRO R1 (Ref)	4	Y		
5	SYNCHRO R2 (Ref Ret)	5	W		
6	SYNCHRO R3	6	BK		
7	SCREEN	ETAG	BRAID		

Cable No:	EMC CAT –		Cable Type: 16 - 2 - 6C		
From: Turning Unit			To:		
Unit Connector No: TSD			Unit Connector No:		
Cable Connector Type: 159749 BL3.5/15			Cable Connector Type:		
Manufacturer: Weidmuller			Manufacturer: Connector:		
Line No.	Function	Pin No.	Colour	Pin No.	Remarks
1	RESOLVER S1	1	R		
2	RESOLVER S2	2	B		
3	RESOLVER S3	3	G		
4	RESOLVER R1	4	Y		
5	RESOLVER S4	5	W		
6	RESOLVER R3	6	BK		
7	SCREEN	ETAG	BRAID		

Cable No:	EMC CAT –		Cable Type:*		
From: Turning Unit			To:		
Unit Connector No: TSD			Unit Connector No:		
Cable Connector Type: 159749 BL3.5/15			Cable Connector Type:		
Manufacturer: Weidmuller			Manufacture:		
Line No.	Function	Pin No.	Colour.	Pin No.	Remarks
1	ISOLATED HMKR	7			
2	ISOLATED HMKR RET	8			
3	PULSE BEARING 4096	9			
4	RADAR SILENCE	10			Masthead Transceiver only
5	RADAR SILENCE RET	11			
6	HEADING MKR+ (RS422)	12			Twisted Pair
7	HEADING MKR- (RS422)	13			
8	PULSE BEARING+ (RS422)	14			Twisted Pair
9	PULSE BEARING- (RS422)	15			
Unit Connector No: TSK			Unit Connector No:		
Cable Connector Type: 171634 BL5.08/4			Cable Connector Type:		
Manufacturer: Weidmuller			Manufacture:		
Line No.	Function	Pin No.	Colour.	Pin No.	Remarks
10	SPEED SELECT/ MOTOR START	1			X-band only Function depends on link settings
11	SPEED SELECT RET/ MOTOR START RET	2			
12	SCREEN	E/TAG	Braid		

* Cable gland is designed to fit 8-core cable type 6224C (MA00007419). Any alternative cable should have similar dimensions to 6224C.

3.2.2 X and S-band Transceiver Connections

Cable No:	EMC CAT –		Cable Type: PT1YM (75ohm coax)		
From Transceiver Unit			To:		
Unit Connector No: SKH			Unit Connector:		
Cable Connector Type: L734PNI			Cable Connector Type:		
Manufacturer; Belling Lee			Manufacturer:		
Line No.	Function	Pin No.	Colour	Pin No.	Remarks
1	PRE-TRIGGER O/P	PIN	INNER	PIN	
2	SCREEN	OUTER	BRAID	OUTER	

Cable No:	EMC CAT –		Cable Type: PT1YM (75ohm coax)		
To: Transceiver Unit			From:		
Unit Connector No: SKJ			Unit Connector:		
Cable Connector Type: L734PNI			Cable Connector Type:		
Manufacturer; Belling Lee			Manufacturer:		
Line No.	Function	Pin No.	Colour	Pin No.	Remarks
1	EXT-TRIGGER I/P	PIN	INNER	PIN	
2	SCREEN	OUTER	BRAID	OUTER	

Cable No:	EMC CAT –		Cable Type: 16 - 2 - 2C or 6224C		
To: Transceiver Unit			From:		
Unit Connector No: TSD			Unit Connector No:		
Cable Connector Type: 171635 BL5.08/5			Cable Connector Type:		
Manufacturer: Weidmuller			Manufacturer: Connector:		
Line No.	Function	Pin No.	Colour	Pin No.	Remarks
1	RADAR SILENCE	1			If RS422 use twisted pair
2	RADAR SILENCE RET	2			
3	SCREEN	ETAG	BRAID		

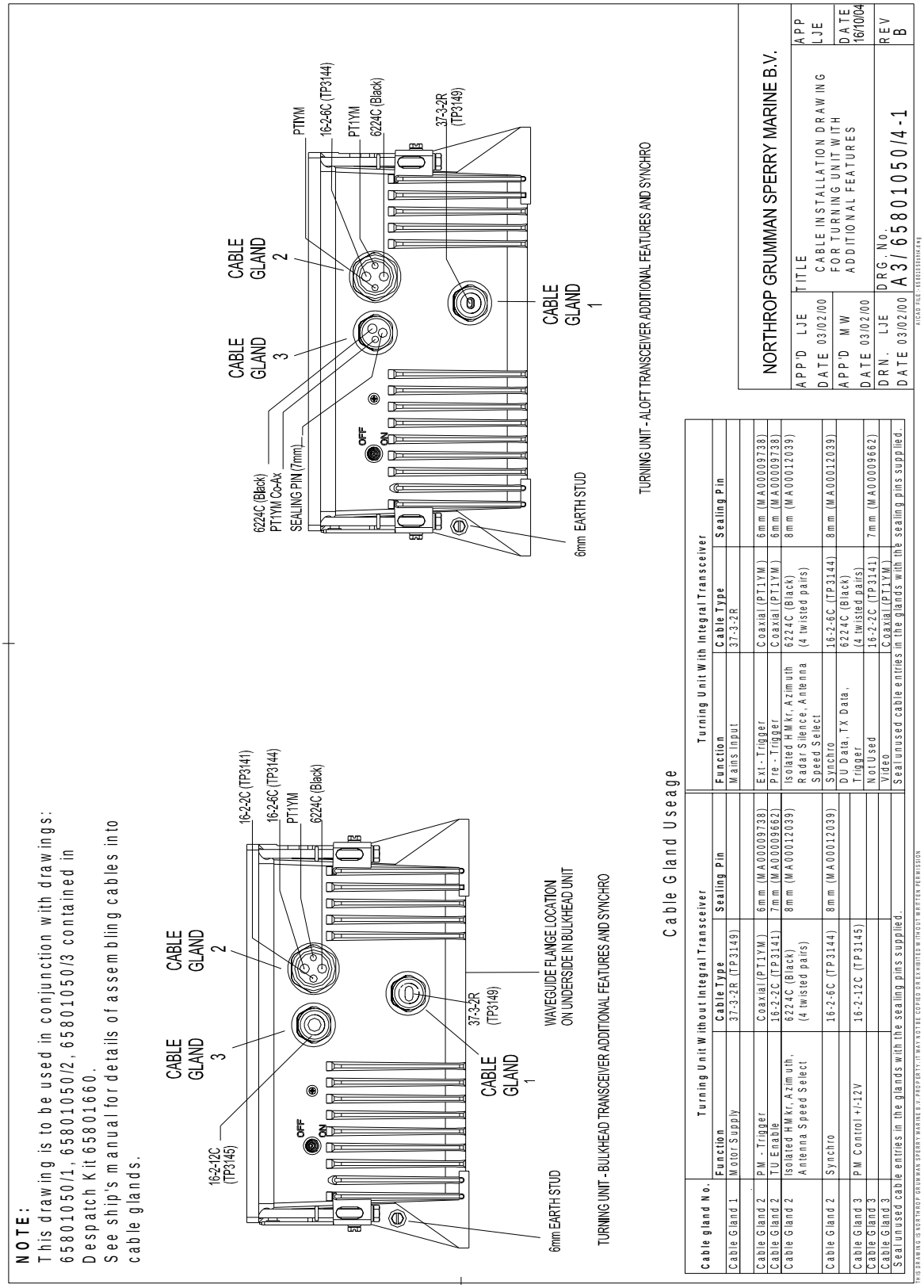


Figure 8.1 X-band Turning Unit Cable Entry Installation Drawing

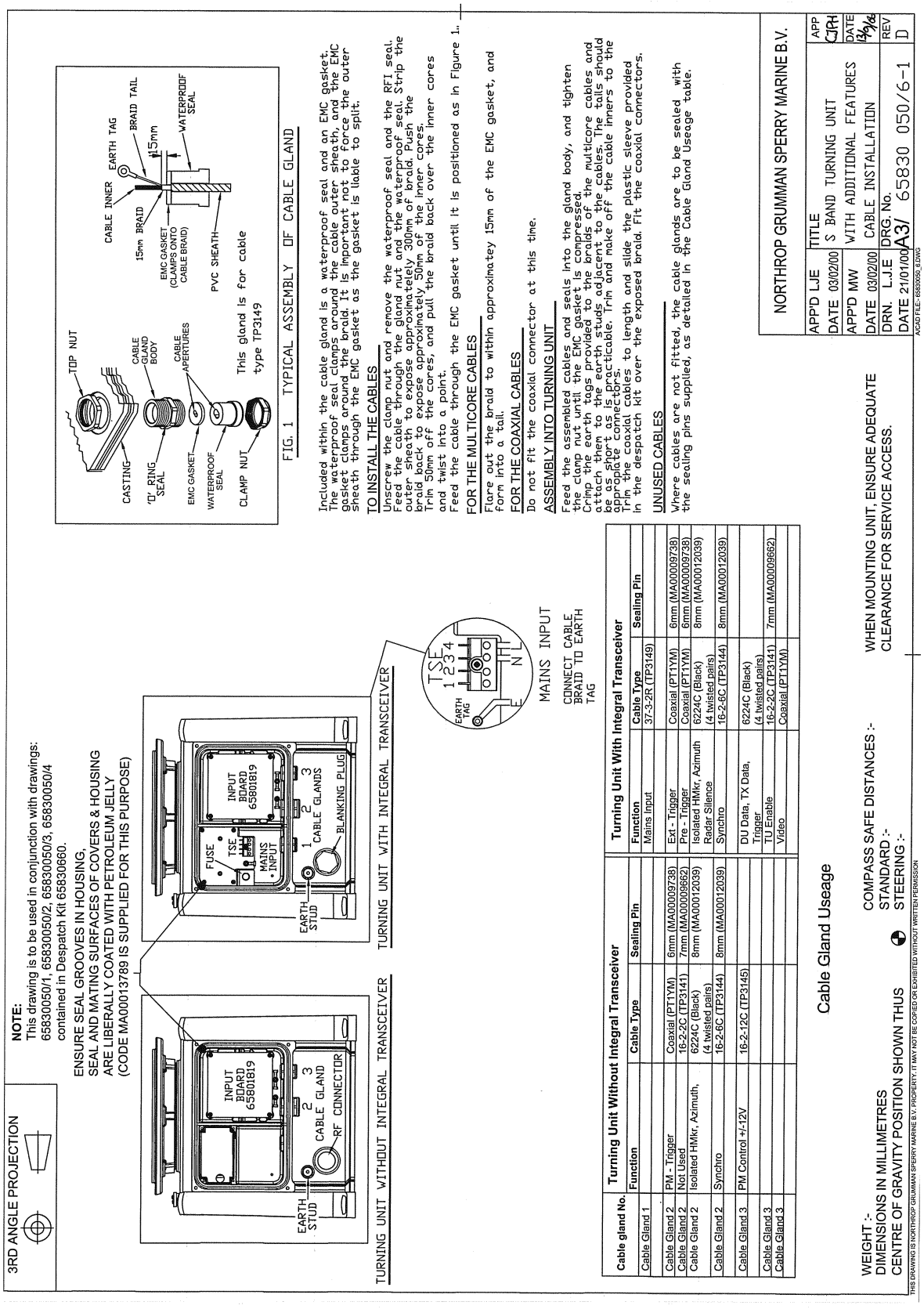


Figure 8.2 S-band Turning Unit Cable Entry Installation Drawing

3.3 Configuring Printed Circuit Boards

3.3.1 Input PCB Assembly 65801815

Used in S-band and X-band bulkhead transceiver types 65810F, 65810L, 65825F, 65825L, 65831B

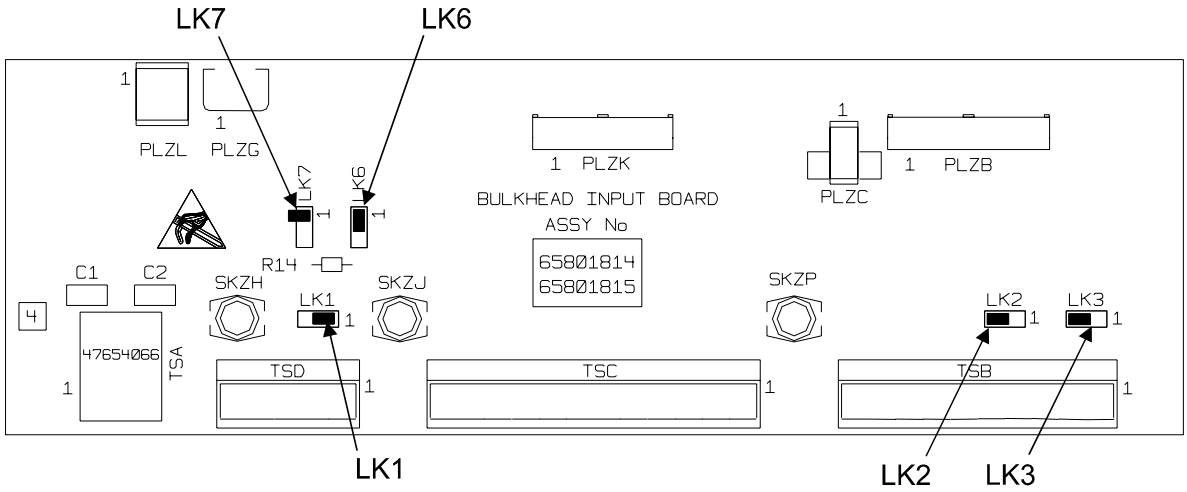


Figure 8.3 Input PCB Assembly 65801815

3.3.1.1 Default Settings

Table 15: Default Settings for Input PCB Assembly

Unit Type		LK1	LK2	LK3	LK6	LK7
65810F	65825F	1–2	2–3	2–3	1–2	Parked
65810L	65825L	1–2	2–3	2–3	1–2	Parked
65831B		1–2	2–3	2–3	1–2	Parked

3.3.1.2 LK1, LK6 and LK7: Radar Silence

These links let the radar silence input be configured for different signal types.

When LK6 is fitted in position 2–3 a 120 ohm terminating resistor is connected across the input. If a termination is not required (for example, for daisy-chained inputs) fit the link in position 1–2.

3.3.1.3 Input types

RS422

LK1 not fitted or parked on pin 1 (in other words, not linking two pins.)

LK6 fitted 2–3

LK7 not fitted (park on pin 1)

Transmission is inhibited when the input at TSD1 is positive wrt that at TSD2

To change the sense of operation of the input reverse the connections to TSD1 and 2

RS423

LK1 not fitted or parked on pin 1 (in other words, not linking two pins.)

LK6 fitted 1–2

LK7 fitted 1–2

Connect the input to TSD1

Transmission is inhibited when the voltage at TSD1 is positive.

To change the sense of operation of the input:

LK1 not fitted or parked on pin 1 (in other words, not linking two pins.)

LK6 fitted 1–2

LK7 fitted 2–3

Connect the input to TSD2.

Transmission is inhibited when the voltage at TSD2 is negative.

Closing Contact or No Input (default setting)

Closing contact option not available on early units fitted with Trigger PCB 65801803

LK1 fitted 1–2

LK6 fitted 1–2

LK7 not fitted (park on pin 1)

Connect input to TSD2

Transmission is inhibited when TSD2 is shorted to 0V. (TSC8)

To change the sense of operation of the input:

LK1 fitted 2–3

LK6 fitted 1–2

LK7 not fitted (park on pin 1)

Connect input to TSD1

Transmission is enabled when TSD1 is shorted to 0V. (TSC8)

3.3.2 Input PCB Assembly 65801819

Used in S-band and X-band Turning Units

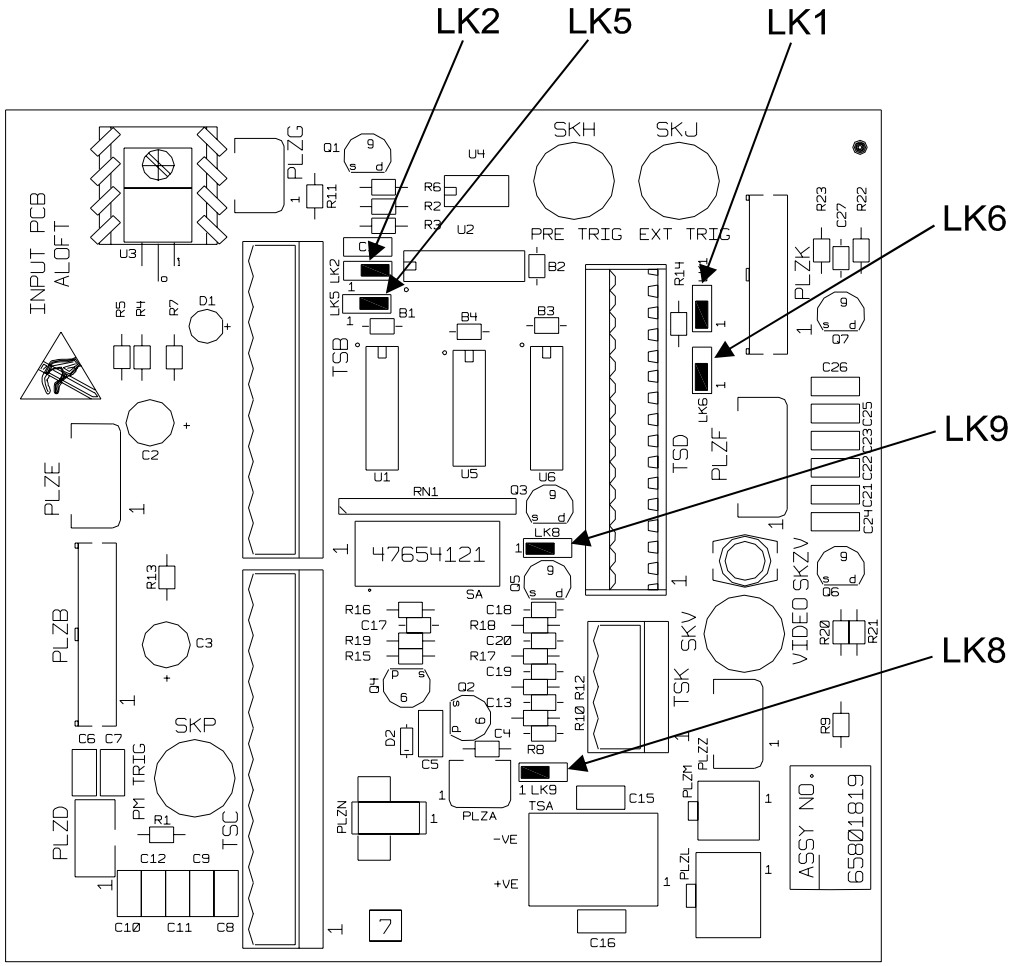


Figure 8.4 Input PCB Assembly 65801819

3.3.2.1 Default Settings

The default setting for Turning Units 65801Cxx, 65825Nxx, 65825Txx, 65810Nxx, 65810Txx is for high-speed rotation.

To select normal speed rotation link TSK1 to TSK2.

Table 16: Default Settings for Input PCB Assembly 65801819

Unit Type	LK1	LK2	LK5	LK6	LK8	LK9
65801CAx	x*	2–3	2–3	x	1–2	2–3
65810Nxx	1–2	2—3	2–3	1–2	1–2	2–3
65810Txx	1–2	2–3	2–3	1–2	1–2	2–3
65825NAx	1–2	2–3	2–3	1–2	1–2	2–3
65825TAx	1–2	2–3	2–3	1–2	1–2	2–3
65830Cxx	x	2–3	2–3	x	1–2	parked
65830Nxx	1–2	2–3	2–3	1	1–2	parked
65830Txx	1–2	2–3	2–3	1	1–2	parked
65825Lxx	x	x	x	x	1–2	1–2

* 'x' doesn't matter for this unit.

Remote selection of antenna rotation speed is not available on turning unit type: 65825Lxx, 65830Cxx, 65830Nxx.

3.3.2.2 LK1, LK6 and LK 8: Radar Silence

Only applicable to Turning Unit Types 65810Nxx, 65810Txx 65825Nxx, 65825Txx, and 65830Nxx, 65830Txx.

These links let the radar silence input be configured for different signal types.

When LK6 is fitted in position 2–3 a 120 ohm terminating-resistor is connected across the input. If a termination is not required (for example, daisy-chained inputs) fit the link in position 1–2.

3.3.2.3 Input Types

RS422

LK1 not fitted or parked on pin 1 (in other words, not linking two pins.)

LK6 fitted 2–3

LK8 fitted 1–2

Transmission is inhibited when the input at TSD10 is positive with respect to TSD11

To change the sense of operation of the input, reverse the connections to TSD10 and TSD11.

RS423

LK1 not fitted or parked on pin 1 (in other words, not linking two pins.)

LK6 fitted 1–2

LK8 fitted 1–2

Link TSD11 to 0V on TSC8

Connect the input to TSD10

Transmission is inhibited when the voltage at TSD10 is positive.

To change the sense of operation of the input:

LK1 not fitted or parked on pin 1 (in other words, not linking two pins.)

LK6 fitted 1–2

LK8 fitted 1–2

Link TSD10 to 0V on TSC8.

Connect the input to TSD11.

Transmission is inhibited when the voltage at TSD11 is negative.

Closing Contact or No Input (default setting)

No closing contact option available on units with Trigger PCB 65801803

LK1 fitted 1–2

LK6 fitted 1–2

LK8 fitted 1–2

Connect input to TSD11

Transmission is inhibited when TSD11 is shorted to 0V (TSC8)

To change the sense of operation of the input:

LK1 fitted 2–3

LK6 fitted 1–2

LK8 fitted 1–2

Connect input to TSD10

Transmission is enabled when TSD10 is shorted to 0V (TSC8)

3.3.2.4 LK2: Heading Marker Polarity Selection

Heading Marker Polarity Normal

LK2 fitted 2–3

Defined as valid on falling edge of signal on TSD12 and rising edge of signal on TSD13 or, contact closure between TSD5 and TSD7.

Heading Marker Polarity Inverted

LK2 fitted 1–2

Defined as valid on rising edge of signal on TSD12 and falling edge of signal on TSD13 or, contact opening between TSD5 and TSD7.

3.3.2.5 LK5: Fixed/Adjustable Heading Marker Selection

This link lets you select between an adjustable heading marker that can be preset to lead or lag the true heading, or a fixed heading marker. Usually the link will be set to the adjustable heading maker position.

The standard heading marker output (on TSC12) occurs approximately 10° before ship's head. The timing of the isolated heading marker output can be delayed in increments of 0.088° from this, covering an approximate range of ±10° about ship's head.

Adjustment is achieved by setting DIL switch SA in a binary sequence. Switch 1 sets the least significant bit. When all switches are set to OFF (binary 00000000) the output is set to approximately 10° before ship's head. When all switches are set to ON (binary 11111111) the heading marker is delayed to approximately 10° after ship's head. A binary setting of 10000000 (when only switch 8 is ON) equates approximately to ship's head (0°).

Fixed Heading Marker Position

LK5 fitted 1–2

The fixed Heading marker precedes true heading by approximately 10°

The fixed heading marker output is only available in RS422 format.

Adjustable Heading Marker Position

LK5 fitted 2–3

Heading marker can be preset to lead the or lag the true heading.

3.3.2.6 LK9

This link is used to select one of two options. Remote selection of antenna rotation speed, or forced antenna rotation.

The two functions are mutually exclusive.

LK9: Remote Speed Selection LK9

This link has to be set in conjunction with LK1 on the Pulse Bearing PCB (65801826), and LK1 on the Motor Drive PCB (65801827).

When LK9 is set to enable remote selection of antenna rotation speed a short circuit between TSK1 and TSK2 selects normal speed, and an open circuit selects high-speed.

Remote Speed Selection Enabled

LK9 fitted 2–3

Remote Speed Selection Disabled

LK9 not fitted or parked on pin1 (in other words, not linking two pins)

LK9: Forced Antenna Rotation

Only applicable to Turning Unit Type 65825LAR, 65801Cxx, 65810Nxx, 65810Txx, 65825Nxx, 65825Txx.

This link allows an external switch to override the internal control logic to force the antenna to rotate when it would normally be inhibited, for example when the Transceiver is switched to standby.

The function can only be used if the Remotely Selectable Antenna Speed facility is not required.

Forced Rotation Enabled

LK9 fitted 1–2

Forced Rotation Disabled

LK9 fitted 2–3 or parked on pin1(in other words, not linking two pins)

If TSK1 is shorted to TSK2 the antenna will rotate and override the internal control logic.

3.3.3 Input PCB Assembly 65801821

Used in X Band bulkhead transceiver types 65810B, 65810T, 65825B, 65825T.

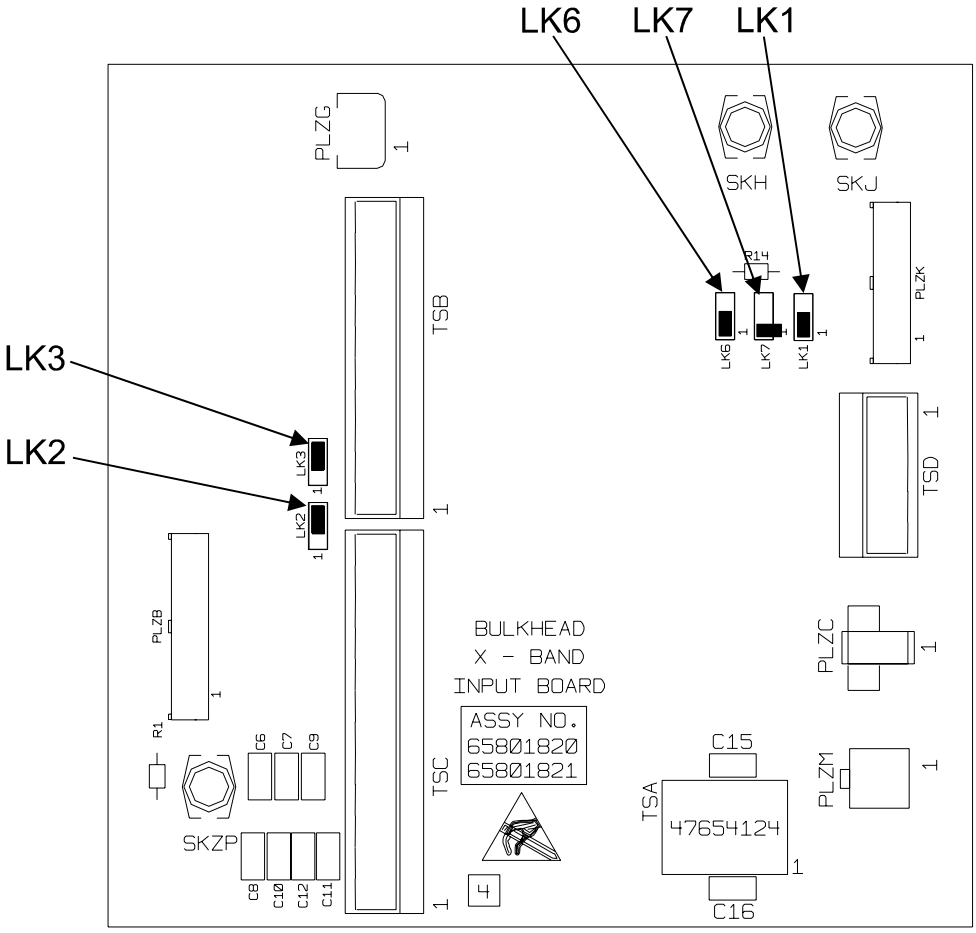


Figure 8.5 Input PCB Assembly 65801821

3.3.3.1 Default Settings

Table 17: Default Settings for Input PCB Assembly 65801821

Unit Type		LK1	LK2	LK3	LK6	LK7
65810B	65825B	1–2	2–3	2–3	1–2	Parked
65810T	65825T	1–2	2–3	2–3	1–2	Parked

3.3.3.2 LK1, LK6 and LK7: Radar Silence

These links let you configure the radar silence for different signal types.

When LK6 is fitted in position 2–3 a 120 ohm terminating resistor is connected across the input. If a termination is not required (for example, for daisy-chained inputs) fit the link in position 1–2.

3.3.3.3 Input Type

RS422

LK1 not fitted or parked on pin 1 (in other words, not linking two pins.)

LK6 fitted 2–3

LK7 not fitted (park on pin 1)

Transmission is inhibited when the input at TSD1 is positive wrt that at TSD2

To change the sense of operation of the input reverse the connections to TSD1 and 2

RS423

LK1 fitted 2–3

LK6 fitted 1–2

LK7 fitted 1–2

Connect the input to TSD1

Transmission is inhibited when the voltage at TSD1 is positive.

To change the sense of operation of the input:

LK1 fitted 1–2

LK6 fitted 1–2

LK7 fitted 2–3

Connect the input to TSD2.

Transmission is inhibited when the voltage at TSD2 is negative.

Closing Contact or No Input (default setting)

Closing contact option not available on units fitted

LK1 fitted 1–2

LK6 fitted 1–2

LK7 not fitted (park on pin 1)

Connect input to TSD2.

Transmission is inhibited when TSD2 is shorted to 0V (TSC8).

To change the sense of operation of the input:

LK1	fitted 2–3
LK6	fitted 1–2
LK7	not fitted (park on pin 1)

Connect input to TSD1.

Transmission is enabled when TSD1 is shorted to 0V (TSC8).

3.3.4 Pulse Bearing PCB Assembly 65801826

Fitted to X-Band Turning Unit types 65801Cxx, 65810Nxx, 65810Txx, 658825Nxx, 65825Txx.

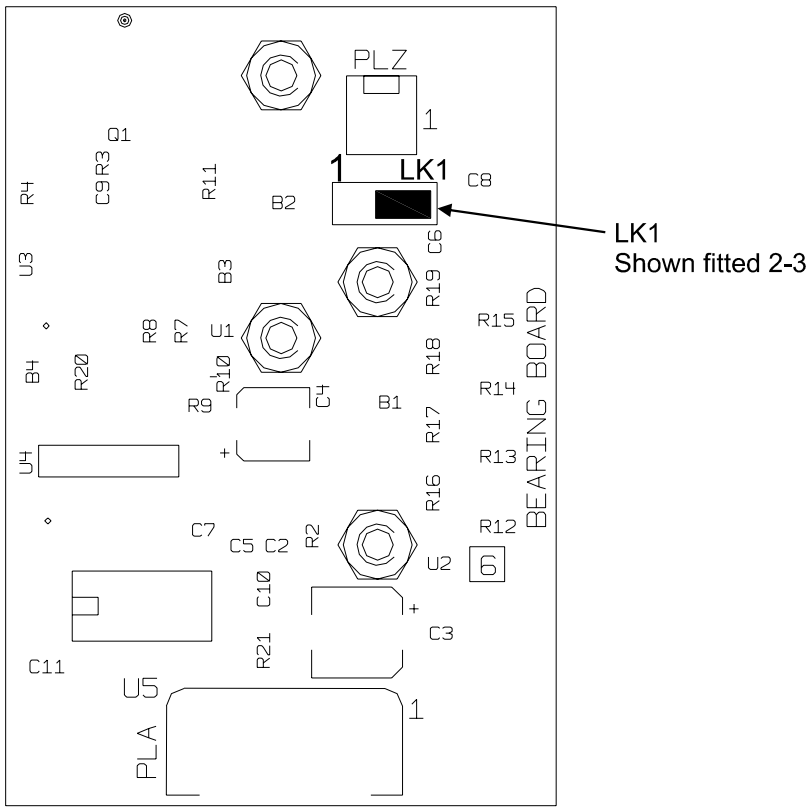


Figure 8.6 Pulse Bearing PCB Assembly 65801826

3.3.4.1 LK1: Speed Select

Normal Speed Selected

LK1 fitted 1–2

High-Speed Selected

LK1 not fitted or parked on pin1 (in other words, not linking two pins)

Selectable Speed Selected

LK1 fitted 2–3

3.3.5 Motor Drive Board 65801827

Fitted to X-band Turning Unit types 65801Cxx, 65810Nxx, 65810Txx, 658825Nxx, 65825Txx.

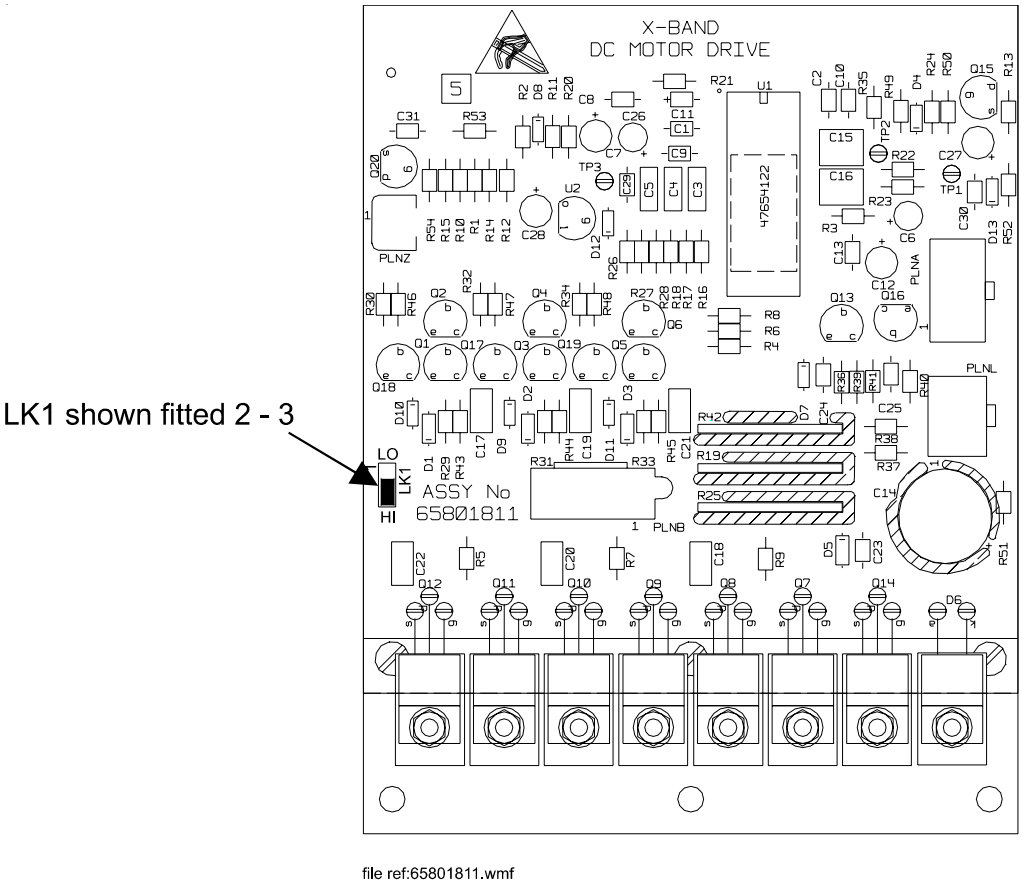


Figure 8.7 Motor Drive PCB Assembly 65801827

3.3.5.1 LK1: Speed Select

Normal Speed Selected

LK1 fitted 1–2

High-Speed Selected

LK1 not fitted or parked on pin1 (in other words, not linking two pins)

Selectable Speed Selected

LK1 fitted 2–3

4 Spares List for Field Replacement Modules

Standard PCBs are replaced by Additional Features variants in systems with additional features. The following list shows the boards that are different in the Additional Features systems. During the life of the equipment there has been some rationalisation and modifications to some of the PCBs. As a general rule the PCBs fitted to later units can be used as replacements for those used in earlier units.

Input PCB T65801819 can be used to replace **Input PCB** T65801804

Pulse Bearing PCB T65801826 can be used to replace **Pulse Bearing PCB** T65801805

Motor Drive PCB T65801827 can be used to replace **Motor Drive PCB** T65801811

Trigger PCB T65801806 can be used to replace **Trigger PCB** T65801803, but if the radar silence input is being used with the RS422 format it will be necessary to connect a 120 ohm resistor between input terminals on the tagstrip.

4.1 X-band Turning Unit (Masthead Transceiver)

Table 18: X-band Turning Unit (Masthead Transceiver) Spares

Description	Spare Part Number		
Turning Unit Type	65810Nxx, 65825Nxx,	65810Txx, 65825Txx	65825Lxx
Trigger Board*	T65801803 or T65801806	T65801825	T65801801
Input Board	T65801819	T65801819	T65801819
Pulse Bearing PC	T65801826	T65801826	T65801805
Motor Drive PCB	T65801827	T65801827	T65801811

* 65801806 can be used to replace T65801803 fitted to earlier units, but if the radar silence input is being used with the RS422 format it will be necessary to connect a 120 ohm resistor between TSD10 and TSD11

4.2 S-band Turning Unit (Masthead Transceiver)

Table 19: S-band Transceiver (Masthead Transceiver) Spares

Description	Spare Part Number
Trigger Board*	T65801803 or T65801806
Input Board	T65801819

* T65801806 can be used to replace T65801803, but if the radar silence input is being used with the RS422 format it will be necessary to connect a 120 ohm resistor between TSD1 and TSD2.

4.3 X-band Turning Unit (for use with Bulkhead Transceiver)

Table 20: X-band Turning Unit (Bulkhead Transceiver) Spares

Description	Spare Part Number
Input PCB	T65801819
Pulse Bearing PCB	T65801826
Motor Drive PCB	T65801827

4.4 S-band Turning Unit (for use with Bulkhead Transceiver)

Table 21: X-band Turning Unit (Bulkhead Transceiver) Spares

Description	Spare Part Number
Input Board	T65801819

4.5 X-band Bulkhead Transceiver 65810F, 65810L, 65825F, 65825L

Table 22: Transceiver 65810F, 65810L, 65825F, 65825L Spares

Description	Spare Part Number	
Transceiver Type	65810F, 65825F	65810L, 65825L
Trigger Board*	T65801803 or T65801806	T65801825
Input Board	T65801815	T65801815

* T65801806 can be used to replace T65801803, but if the radar silence input is being used with the RS422 format it will be necessary to connect a 120 ohm resistor between TSD1 and TSD2.

4.6 X-band Bulkhead Transceiver 65810B, 65810T, 65825B, 65825T

Table 23: Transceiver 65810B, 65810T, 65825B, 65825T Spares

Description	Spare Part Number	
Transceiver Type	65810B, 65825B	65810T, 65825T
Trigger Board*	T65801803 or T65801806	T65801825
Input Board	T65801821	T65801821

* T65801806 can be used to replace T65801803, but if the radar silence input is being used with the RS422 format it will be necessary to connect a 120 ohm resistor between TSD1 and TSD2.

4.7 S-band Bulkhead Transceiver Unit 65831B

Table 24: Transceiver Unit 65831B Spares

Description	Spare Part Number
Trigger Board*	T65801803, T65801806
Input Board	T65801815

* T65801806 can be used to replace T65801803, but if the radar silence input is being used with the RS422 format it will be necessary to connect a 120 ohm resistor between TSD1 and TSD2.

5 Circuit Diagrams

This sections includes circuit diagrams for the Input PCBs, for the main unit schematic diagrams see Chapter 4 '*Fault Reporting and First Line Servicing*'.

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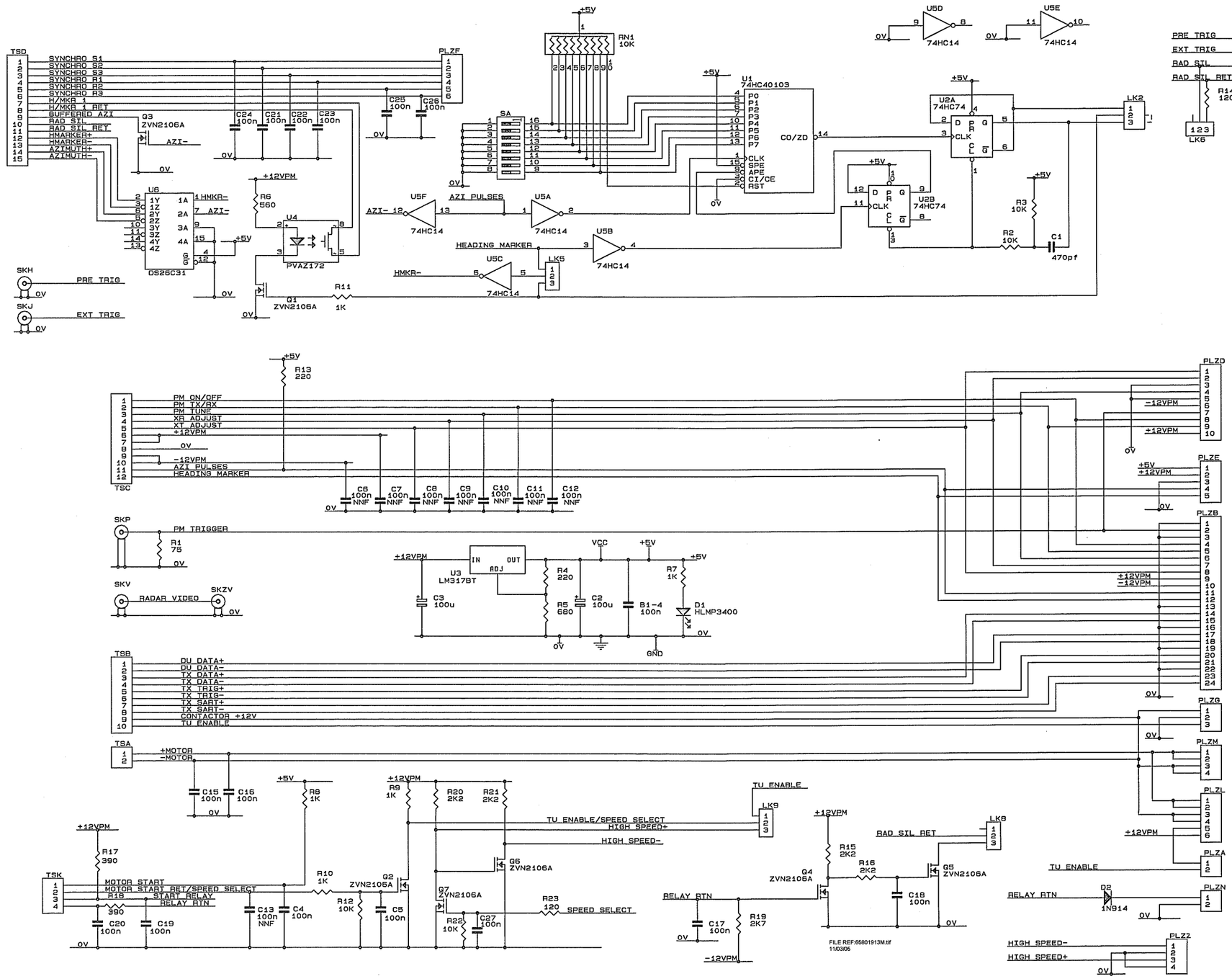


Figure 9.8 Circuit Diagram Input PCB 65801819

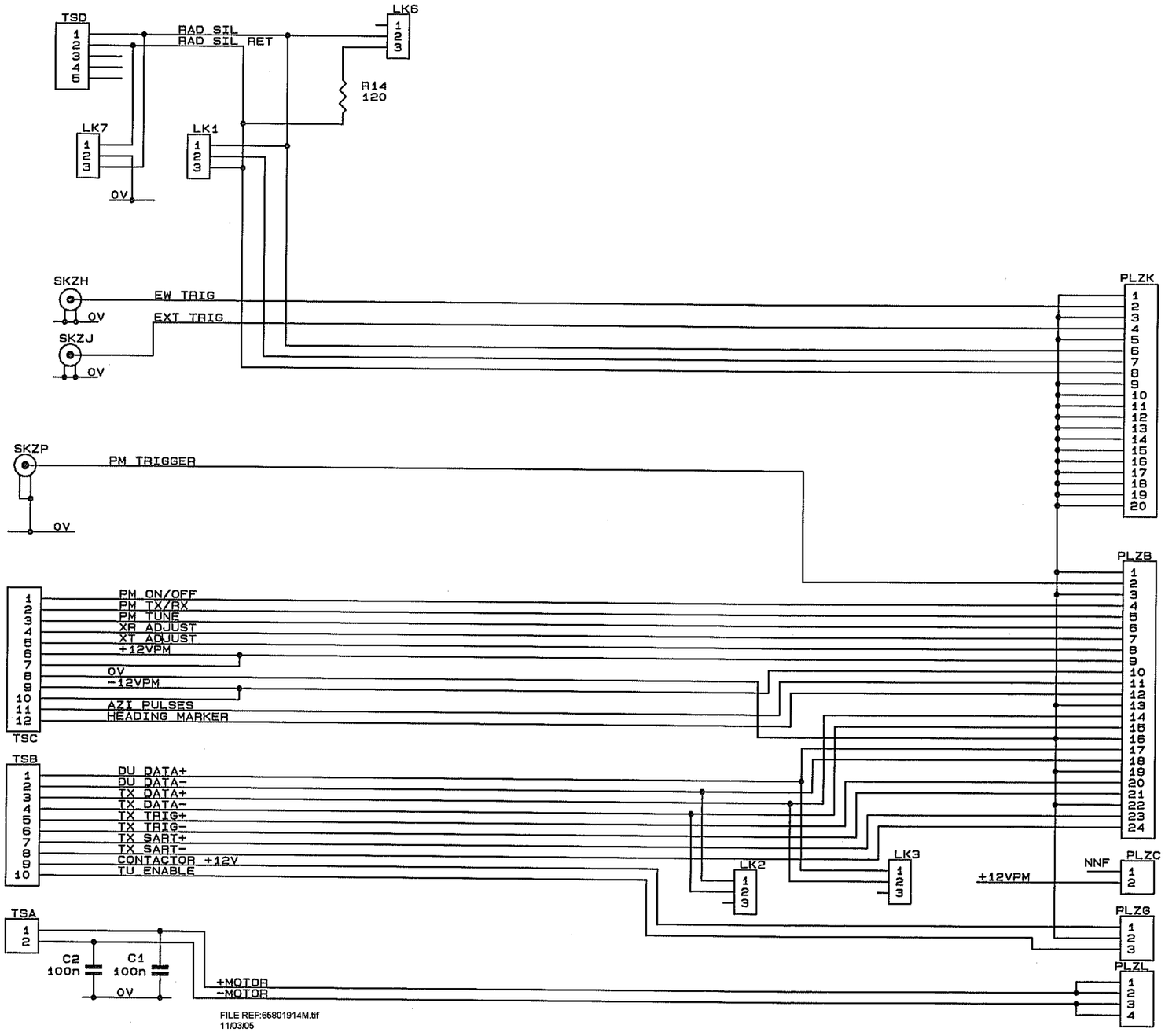


Figure 9.9 Circuit Diagram Input PCB 65801815

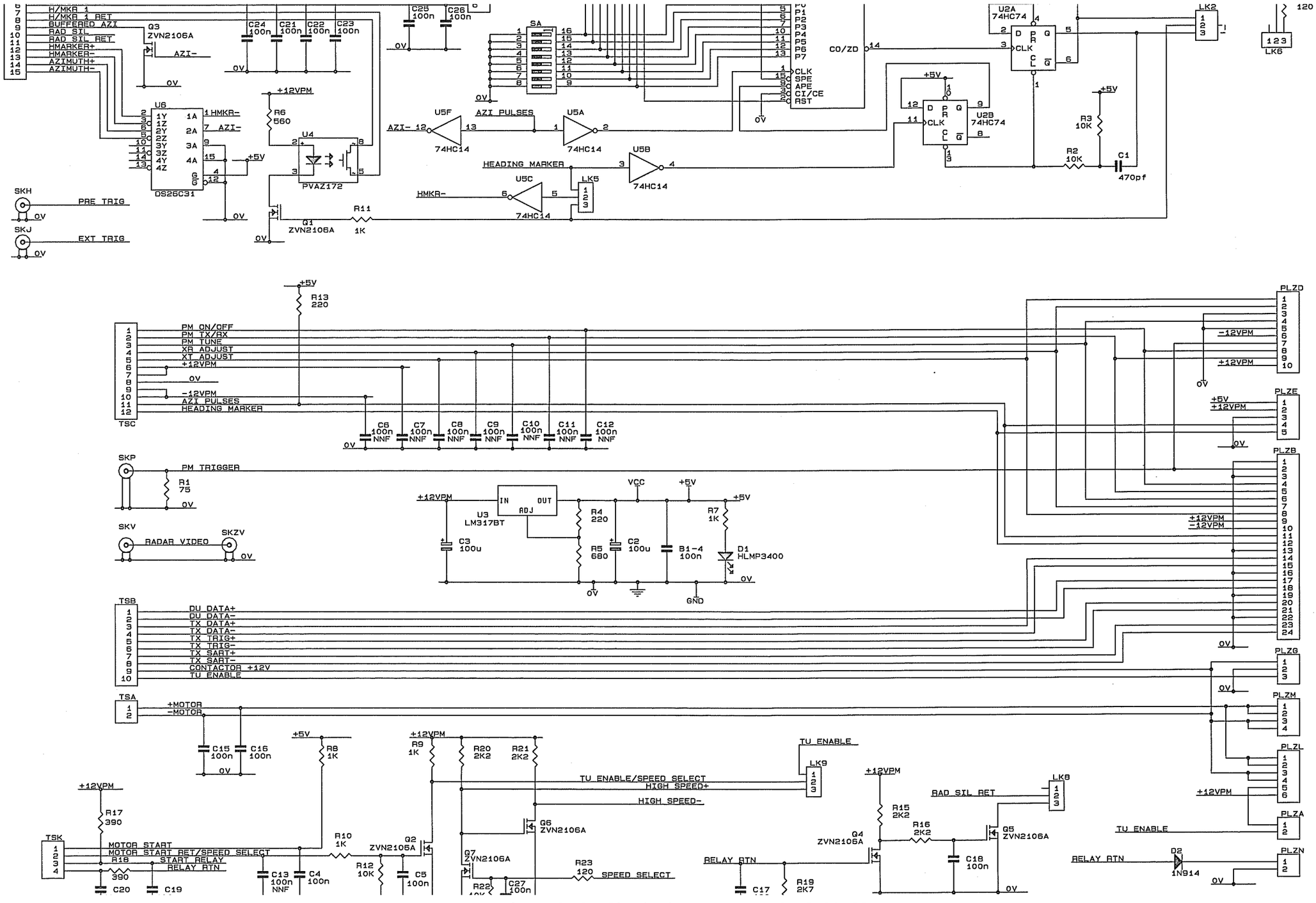


Figure 9.10 Circuit Diagram Input PCB 65801821

GLOSSARY

Glossary of Terms

A

Acquisition Zone	An area on the video circle that has been defined by the operator. Any target that enters this zone is automatically acquired and tracked.
Activated Target	A symbol representing the automatic or manual activation of a sleeping target for the display of additional graphically presented information including: a vector (speed and course over ground); the heading; and ROT or direction of turn indication (if available) to display actually initiated course changes.
Automatic Identification System (AIS)	A system capability which enables ships and shore stations to obtain identifying and navigation information about other ships at sea, using an automated transponder.
Antenna	Slotted waveguide array for transmitting and receiving microwave signals. 10cm S-band (9 or 12ft aperture) or 3cm X-band (4, 6 or 8 ft aperture)
Anti-clutter	Removal of unwanted reflections on the radar screen caused by rain, sleet etc. (*see* Clutter).
Azimuth	The number of degrees from North (or other reference direction) that a line runs, measured clockwise.
ARCS	Admiralty Raster Chart Service. A service of British Admiralty, suppliers of electronic charts with world coverage, in the HCRF data format.
Automatic Radar Plotting Aid (ARPA)	A system wherein radar targets are automatically acquired and tracked and collision situations computer assessed and warnings given.
Azimuth Pulse	Azimuth (AZ): The number of degrees from North (or other reference direction) that a line runs, measured clockwise.

B

Backup Navigator Alarm	The Backup Navigator Alarm is affected by activating a commissioned PCIO relay output by way of an active alarm
BSB Electronic Charts	A supplier of raster-format electronic charts. Electronic charts based on the paper charts supplied by NOAA or CHS are available in the data format established by BSB.
Bulkhead Transceiver	Transmitter/Receiver mounted below decks with microwave or co-axial connection to the Turning Unit.

C

Chart Database	Structured collection of chart data sufficient for safe and efficient navigation on an ECDIS or Chart Radar system
Chart Format	The industry standard the defines the structure of a chart database (e.g. the ENC chart database uses the S-57 format)
C-MAP	C-Map Cartographic Service. Commercial supplier of vector-format navigational charts, which are not fully compliant with ECDIS standards as defined by IMO.
Consistent Common Reference Point (CCRP)	The CCRP is a location on own ship, to which all horizontal measurements such as target range, bearing, relative course, relative speed, closest point of approach (CPA) or time to closest point of approach (TCPA) are referenced, typically the conning position of the bridge.
Checksum	A numeric value used to verify the integrity of a block of data. When data is transmitted from point to point in a packet, the sending computer counts the bytes and adds a check digit at the end of the packet. The receiving computer calculates the bytes received and compares the sender's count with the receiver's count to determine if there is any change that might indicate tampering with the information.
Clutter	Unwanted reflections on a radar screen, commonly from rain, snow or sleet.
CM93v3	CMAP's proprietary and unofficial chart format.
Cross-Track Error	The distance by which the ship's actual position deviates left or right from the Route Plan track.
Course-up	Stabilised display – the ship's bearing is shown at the top of the video circle with 000° elsewhere on the circle (representing True North).

D

Datum	Any point, line, or surface used as a reference for a measurement of another quantity.
Dead Reckoning	A method of estimating the position of a ship without astronomical observations, as by applying to a previously determined position the course and distance traveled since.
Denso Paste	Soft brown petrolatum primer containing moisture-displacing corrosion-inhibiting compounds. Apply using a stiff brush or gloved hand.

DGPS	Differential GPS (see also GPS). Position sensor intended for precise commercial navigation in coastal waters. The DGPS employs an additional receiver for the reception of correction signals from a land-based transmitter to be applied to the satellite-based GPS position information.
Digitized Chart	A data format for electronic charts that are made using a digitizer device with paper navigational charts. On ships equipped to make digitized charts, these charts can be used for operating in areas for which electronic charts from official or commercial sources are not available. Digitized charts do not conform to any standards for chart display.
Distance To Go (DTG)	Distance to next action, such as a turn, while running a Voyage Plan.
DnV	Det norske Veritas. Independent maritime organization performing classification, certification, quality-assurance and in-service inspection of ships and mobile offshore units with the objective of safeguarding life, property and the environment.
Dongle	A small hardware device that, when plugged into a computer, enables a specific program to run on that computer. The program is disabled, or operates in a degraded mode if the device is not present.
Dynamic Brake	Braking is accomplished by electrically switching motors to act as generators that convert motion into electricity instead of electricity into motion.

E

Electronic Bearing Line	An EBL control is used to show the relative or true bearing of a target on the display. The EBL is moved with the cursor, and the bearing is read of the screen in degrees. One end is always anchored, either at the center of the screen or at a operator-defined point on the video circle.
ECDIS	Electronic Chart Display and Information System. A standard of the International Maritime Organization (IMO), governing electronic navigational systems.
ENC	Electronic Nautical Chart. Chart data conforming to specification published in IHO Special Publication No. 57 (S57). Charts complying with this specification are available from various suppliers.
ENC (C-MAP)	Official S-57 encrypted charts converted to CMAP's proprietary chart database format.

F

Flyback Converter	Power supply switching circuit. During the first half of the switching period, the transistor is on and energy is stored in a transformer primary. During the second half period, this energy is transferred to the transformer secondary and the load.

G

Gain	The ratio of the signal output of a system to the signal input of the system expressed in dB. A gain of 10 would imply that the signal power had increased by a factor of 10. There are two general usages of the term in radar: (a) antenna gain (or gain factor) is the ratio of the power transmitted along the beam axis to that of an isotropic radiator transmitting the same total power; and (b) receiver gain (or video gain) is the amplification given a signal by the receiver.
GGA	NMEA sentence which provides the GPS current fix data.
Greenwich Mean Time (GMT)	The international time standard, based on local standard time at longitude 0º 0' 0" (in Greenwich, England). Also called Coordinated Universal Time (UTC).
Global Positioning System (GPS)	A system by which receivers anywhere on earth can obtain accurate position data. The term "GPS" is also used to refer to the receiver device.
Great Circle	A circle drawn around the Earth such that the center of the circle is at the center of the Earth. Following such a circle plots the shortest distance between any two points on the surface of the Earth.
Guard Zone	An adjustable zone around the vessel. Once a guard zone is set, any target that enters the guard zone will trigger an alarm.

H

Head-up (H UP)	Unstabilised display – the ship's heading marker is always shown vertically upwards indicating straight ahead movement.
HCRF	Hydrographic Chart Raster Format. Electronic format used for BA-ARCS charts.
Heading Line	Line that projects forward showing where own ship is headed relative to the targets seen on the video circle.

Heading Marker	A heading marker on the display provides an important reference to direction. When the antenna is pointing ahead, it sends a pulse to the radar display that causes a line to show on the screen that represents the vessel's head. You can refer echoes displayed on the screen to your vessel's head and get the relative bearing of the echo. If the heading marker is not pointing exactly ahead, relative bearings will be wrong. You can quickly check for any such mistake by heading toward a small prominent visible object and see if the radar echo appears under the heading marker.
Heatsink	Device used to conduct away and disperse the heat generated by electronic components.
HSC	Heading-to-Steer Command. Heading order sent to an autopilot from an external electronic navigation aid, such as the ECDIS.

I

International Hydrographic Office (IHO)	The IHO has developed an ENC product specification as the standard for ECDIS data, and has published this specification in its Special Publication No. 57 (S-57).
International Maritime Organization (IMO)	An agency of the United Nations, responsible for improving maritime safety and preventing pollution from ships. The governing body responsible for SOLAS regulations and ECDIS specifications.
Integral Transceiver	Transmitter/Receiver housed in the Turning Unit.
Interswitch Unit	Enables radar systems to be connected together so that any Display Unit may be connected to any Scanner Unit.
I/O Interface	The collection of components that define the hardware, protocols, and formats used to communicate with an interfaced device. This will include a set of I/O Ports (in most cases, this will be a set of one).
I/O Port	A logical channel through which data is transferred, which may handle protocols needed to pass the data, but functions with no cognizance of the meaning of the data involved. A common example is a serial (RS-232) communications port.

L

Local Time Offset	Offset between local time and UTC.
Lock-o-seal	Two piece seal element (rubber ‘O’-ring with a metal backup ring) designed specially for bolts, studs and other fasteners.
Lost Target	A target representing the last valid position of a target before its data was lost. The target is displayed by a "lost target" symbol.

M

Magnetron	Device that is comprised of an electric circuit inside a strong but variable magnetic field, designed to generate coherent microwaves.
Master Display	A Master Display has complete control over a Transceiver. A Transceiver can only have one Master Display. A Master Display can only have one Transceiver.
Modulator	A modulator is a circuit or device that combines two different signals in such a way that they can be pulled apart later.
Monitor	The viewing unit, a Flat Panel Monitor (also known as FPD or LCD).
Multi-Function Workstation	A workstation that has been configured to be displayed in a number of presentation options (i.e. Chart Radar, ECDIS or CID).
Multi-Node system	A number of workstations, linked by a LAN, which have been configured as specific product types.
Multi-target Tote	A display panel showing details of multiple acquired targets.

N

NIMA	National Imagery and Mapping Agency. An agency of the United States government, supplying navigational charts to the United States Navy.
Nautical mile (NM)	The nautical mile is closely related to the geographical mile which is defined as the length of one minute of arc on the earth's equator. By international agreement, the nautical mile is now defined as 1852 meters (1.15 standard miles).
National Marine Electronics Association (NMEA)	An association of manufacturers that has published widely used standards for navigation and other marine sensor communication. Their published standards include NMEA 0183, Standard for Interfacing Marine Electronic Navigational Devices, Version 1.5, December 1987, and Version 2.0, January 1992. This standard is commonly referred to as simply "NMEA 0183." The ECDIS is designed to use messages from any navigation, weather, or machinery sensor that conforms to this standard.
NOAA	National Oceanic and Atmospheric Administration. Agency of the US government, supplying navigational charts. NOAA charts are available in the BSB electronic format.
North-up (N UP)	Stabilised display – the bearing scale shows 000° at the top of the video circle (assumed to be True North). The ship's heading marker is shown at the appropriate bearing.

O

Opto-coupler	A component capable of optically transferring an electrical signal between two circuits and, at the same time, electrically isolating these circuits from each other. It consists of an infrared LED emitting section at its input, and a silicon photodetector, at its output, with other circuitry sometimes included as part of the device.

P

Parallel Index Lines	A set of parallel lines placed on the video circle to aid navigation.
Parity	An error-checking procedure in which the number of 1s must always be the same – either even or odd – for each group of bits transmitted without error.
Past Position Dots	Equally time-spaced past position marks of a tracked or reported target and own ship. The co-ordinates used to display past positions may be either relative or true.
Performance Monitor	A unit, which warns the operator of reduced radar performance. May be integral with the Turning Unit (X-band) or separate (S-band).
Product types	A small set of defined products, any one of which the VisionMaster application can function as. Product types apply to individual nodes.
Pulse Repetition Frequency	The number of radar pulses transmitted each second. The pulse transmission rate is automatically lengthened for longer ranges.

R

Random Access Memory	Memory used in computer systems. RAM is volatile memory, which does not hold data when the power is turned off
Range Rings	A set of concentric circles labeled by distance from the central point, useful for judging distance (especially from own ship).
Relative Motion – Relative Trails	Own ship is shown at a fixed point in the video circle (normally the centre). All target trails are shown relative to own ship's movement. This means stationary targets will have trails if own ship is moving.
Relative Motion – True Trails	Own ship is shown at a fixed point in the video circle (usually the centre). Target trails show their direction. Staionary targets do not produce trails.

Resolver	A type of rotary electrical transformer that is used for measuring the angle of a rotating machine such as an antenna platform. The primary winding of the transformer, fixed to the rotor, is excited by a sinusoidal electric current, which by electromagnetic induction causes currents to flow in two secondary windings fixed at right angles to each other on the stator. The relative magnitudes of the two secondary currents are measured and used to determine the angle of the rotor relative to the stator.
Rhumb Line	A line on a sphere that cuts all meridians at the same angle; the path taken by a ship or plane that maintains a constant compass direction.
Route	A set of waypoints that define the intended path of travel.

S

S-band	The S-band, or 10 cm radar short-band, is the part of the microwave band of the electromagnetic spectrum ranging roughly from 1.55 to 5.2 GHz.
S57	Internationally accepted standard for electronic charts in the ENC vector-format. ENC data is standardized according to ECDIS specifications published in IHO Special Publication No. 57. Charts complying with this specification are available from various suppliers.
S57 PIN	Is used to generate a 16-character string which represents the encrypted hardware ID portion of the S-57 User Permit.
S63 Chart permit file	A file generated by the data manufacturer that is used, in conjunction with an S63 permit code to decrypt chart data for a particular set of ARCS charts or S57 cells.
S63 permit code	A code that identifies a license for using S57 charts. This is sometimes referred to as the S57 User Permit.
Scanner Unit	Comprises the Antenna and Turning Unit.
Scanner Control Unit	A unit which switches power to the S-band Turning Unit, under the control of the Display.
System Electronic Navigational Chart (SENC)	SENC is a database resulting from the transformation of the ENC by ECDIS, updates to the ENC by appropriate means, and other data added by the mariner. It is this database that is accessed by ECDIS for the display generation and other navigational functions, and is the equivalent to an up-to-date paper chart. The SENC may also contain information from other sources.
Sentence	A self contained line of data
SevenCs	A chart engine format

Slave Display	Display that is used to observe a radar image. It has limited functionality.
Sleeping Target	A target symbol indicating the presence and orientation of a vessel equipped with AIS in a certain location. No additional information is presented until activated thus avoiding information overload.
SOLAS	Safety of Life At Sea. A set of conventions adopted by the IMO and all of its signatory countries in 1974. These conventions regulate many of the features of ships used in international trade, including navigation equipment and its functionality
Sperry security block	A dongle used to identify a VM system (through a PIN), and identify permits for charts that are licensed on a system-by-system basis.
Standard Display (STD)	The standard set of chart objects (buoy information, conspicuous landmarks, etc.) specified for ECDIS display, in compliance with IMO standards.
Stern Line (SL)	A line, drawn across the video circle, showing the stern's direction. A stern line can be useful when ownship is backing into port or harbour.
Synchro	A motorlike device containing a rotor and a stator and capable of converting an angular position into an electrical signal, or an electrical signal into an angular position.
System PIN	Personal Identification Number that uniquely identifies a system.

T

Target	Object of interest on a radar display. Targets can be labelled (acquired) and tracked.
Trial Manoeuvre	Facility used to assist the operator to perform a proposed manoeuvre for navigation and collision avoidance purposes, by displaying the predicted future status of all tracked and AIS targets as a result of own ship's simulated manoeuvres.
Trigger PCB	A control board housed in the Transceiver. It controls the Modulator, Magnetron and sends signals to the Display to indicate when the magnetron has fired a pulse.
True Motion	Own ship moves across the video circle. Stationary targets do not produce trails.
TTMG	Track To Make Good. In the context of the ECDIS, TTMG denotes a temporary plan which may be activated at any time, and which by default consists of a 500 nm track line on present heading.

Turning Unit	Contains the Antenna rotation motor, the microwave rotary joint, and may contain an integral Transceiver.

U

Universal Time Coordinated (UTC)	The international standard of time, kept by atomic clocks around the world. Formerly known as Greenwich Mean Time (GMT), local time at zero degrees longitude at the Greenwich Observatory, England. UTC uses a 24-hour clock.

V

Variable Range Marker	An adjustable range ring used to measure the distance to a target. When the VRM is adjusted over the leading edge of a return with the cursor control, the distance to the object is shown on the screen.
Vector	Direct connection between two points, either given as two sets of coordinates (points), by direction and distance from one given set of coordinates (True Vector), or a point in a vector space defined by one set of coordinates relative to the origin of a coordinate system (Relative Vector).
Video Circle	The area on the Display that shows the radar image.
Vigilance Alarm	A system alarm generated when the operator fails to give evidence of fitness.

W

Watch Alarm	The purpose of a watch alarm system is to monitor bridge activity and detect operator disability which could lead to marine accidents. The system monitors the awareness of the Officer of the Watch (OOW) and automatically alerts the Master or another qualified OOW if for any reason the OOW becomes incapable of performing theOOW's duties. This purpose is achieved by a series of indications and alarms to alert first the OOW and, if he is not responding, then to alert the Master or another qualified OOW. Additionally, the watch alarm may provide the OOW with a means of calling for immediate assistance if required. The watch alarm should be operational whenever the ship's heading or track control system is engaged, unless inhibited by the Master.
Waveguide	Hollow rectangular, oval or round tube used to convey microwave RF energy from one point to another in a radar transmitter or receiver.
Waypoint	A geographical location (for example, latitude and longitude) on a route indicating a significant event on a vessel’s planned route (for example, course alteration point, calling in point, etc.).

WGS-84	World Geodetic System 1984. Chart datum specified in accordance with the IMO ECDIS standard.
Wheel-over	The geographic location, represented by a line where rudder movement should be activated to accomplish a planned turn. The wheel-over line may be displayed perpendicular to the approaching track or parallel to the departing track of each turn.
Wobbulation	Low frequency modulation of the Pulse Repition Frequency (PRF) to help suppress interference.

X

X-band	The X-band (3 cm radar spot-band) of the microwave band of the electromagnetic spectrum roughly ranges from 5.2–10.9 GHz. The relative short wavelength at X-band frequencies makes possible high-resolution imaging radars for target identification and target discrimination.

Glossary of Abbreviations

Symbols	
µA	Microamp (0.000001 amps)
µs	Microsecond (0.000001 seconds)
Ω	Ohms
ϕ	Phase
A	
A	Ampere
AC	Alternating Current
ADC	Analog to Digital Converter
AFC	Automatic Frequency Control (fine tuning)
AIS	Automatic Identification System
ARPA	Automatic Radar Plotting Aid – a system wherein radar targets are automatically acquired and tracked and collision situations computer assessed and warnings given.
AZ	Acquisition Zone
B	
BA	British Admiralty.
BCR	Bow Crossing Range
BCT	Bow Crossing Time
BIST	Built-In Self-Test
BITE	Built-In Test Equipment
BSH	German Federal Maritime and Hydrographic Agency (BSH) that provide type approval to EC Council Directives
C	
CD ROM	Compact Disk Read-Only Memory
CDX	Control differential transmitter
CHS	Canadian Hydrographic Service
COG	Course Over Ground
CPA	Closest Point of Approach [to own ship]
C UP	Course-up

CRT	Constant Radius Turn
CSE	CourSE [through water]
CX	Control transmitter
D	
dB	Decibel.
DC	Direct Current
E	
EBL	Electronic Bearing Line
EMC	Electromagnetic Compatibility
EPA	Electronic Plotting Aid
ERBL	Electronic Range and Bearing Line
ETA	Estimated Time of Arrival
ETD	Estimated Time of Departure
F	
ft	Foot or feet
FPD	Flat Panel Display
G	
GMT	Greenwich Mean Time
GPS	Global Positioning System
GZ	Guard Zone
H	
HDG	Heading
HL	Heading Line
HO	Hydrographic Office.
H UP	Head-up
Hz	Hertz (unit of Frequency)
HT	High tension (meaning high voltage)
I	
in	Inch
I/O	Input/Output

K

Km	Kilometre
kt	Knot (one nautical mile per hour – 1.15 mph)
kV	Kilovolt (1000 Volts)
kW	Kilowatt (1000 Watts)

L

LAN	Local-Area Network
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LNFE	Low Noise Front End
LP	Long Pulse (available from 3 NM and upwards)

M

m	Metre
mA	Milliamp (0.001 Amps)
MHz	Megahertz (1000000 Hertz)
MIS TRIG OUT	Mutual Interference Suppression Trigger Out – trigger used to suppress the video for 12µs to inhibit interference from other radars.
MMSI	Maritime Mobile Service Identity
MOB	Man overboard
Mod Trigger	Modulator Trigger
MP	Medium Pulse (available in the 0.5 NM to 24 NM range)

N

nm	Nautical mile.
NDI	Nautical Data International. Licensed distributor of CHS charts in the BSB electronic format.
NM	Newton Metre
NMEA	National Marine Electronic Association
NNF	Not Normally Fitted
ns	nanosecond (0.000000001 seconds)
N UP	North-up

P

PCB	Printed Circuit Board
PCIO	PC Imput/Output
PEU	Processor Electronics Unit
PFC	Power Factor Correction
PFN	Pulse Forming Network
PM	Performance Monitor
PPI	Plan Position Indicator
PRF	Pulse Repetition Frequency
PRI	Pulse Repetition Interval
PSU	Power Supply Unit

R

RAIM	Receiver Autonomous Integrity Monitoring
RAM	Random Access Memory
RF	Radio Frequency
RFI	Radio Frequency Interference
RM(R)	Relative Motion – Relative Trails
rms	Root mean square (AC voltage that equals DC voltage that will do the same amount of work)
RM(T)	Relative Motion – True Trails
RNS	Raster Navigational Chart
ROT	Rate of Turn
rpm	Revolutions per minute
RR	Range Rings
RVAP	Radio Video Adaptive Processor

S

SART	Search and Rescue Transponder
SCU	Scanner Control Unit
SL	Stern Line
sm	Statute mile – A mile as measured on land, 5,280 feet or 1.6 kilometers. Distances at sea are measured in nautical miles.

SOG	Speed Over the Ground
SP	Short Pulse (available below 3 NM)
STW	Speed Through Water
T	
T BRG	Target Bearing/True Bearing
TCPA	Time to Closest Point of Approach [to own ship]
TM	True Motion
TRP	Temporary Route Plan
TTG	Time To Go. Time to next action, such as a turn, while running a Route Plan.
Tx/Rx	Transmitter/Receiver (Transceiver)
TX BIST	Transceiver Built-In Self Test
TX COMMS	Transceiver Communications
U	
UTC	Universal Time Coordinated
V	
V	Volt
VA	Volt amperes
VMS	Voyage Management System
VRM	Variable Range Marker
W	
W	Watts
X	
XTE	Cross-Track Error

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