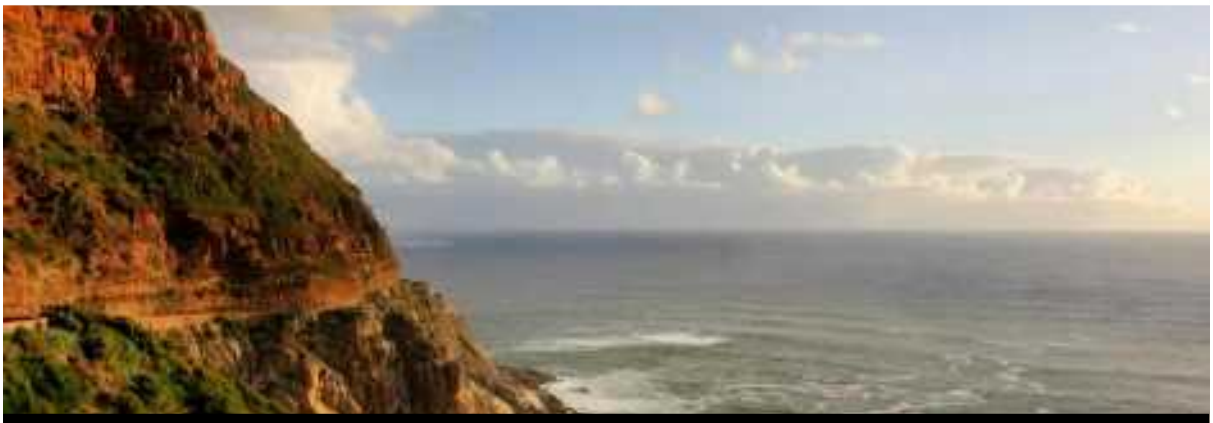
SBS-900 Shore Based Radar Systems

Operator and Maintenance Handbook



KH-1602-2 issue 1

SITUATIONAL INTELLIGENCE, THE WORLD OVER

KELVIN HUGHES

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1 Contents

SBS-900 Shore Based Radar Systems

The Kelvin Hughes SBS-900 series is a range of X or S-band SharpEye™ transceivers designed for use in shore based radar applications. The SBS-900 range has been designed to enable system integrators to provide a radar sensor or range of sensors that meets the following requirements:

Equipment	Standards
SBS-900 series	Coastal Surveillance Systems or a Vessel Traffic Services system as defined by IALA recommendations V-128
	Designed to meet IEC60945 clause 4.5.1 for class B protected equipment for both emissions and immunity
	All Kelvin Hughes designed equipments are designed to meet the requirements of IEC 60950, Safety of information technology equipment.
	Kelvin Hughes designed equipments are constructed so that access to high voltages may only be gained after having used a tool, such as a spanner or screwdriver. Warning labels are prominently displayed both within the equipment and on protective covers.

All Kelvin Hughes Ltd designed equipment is designed and manufactured to Kelvin Hughes' own standards of practice being designed to meet the applicable requirements of the following directives:

Equipment	Standards
CE marking	All KH designed equipments are designed and constructed to Kelvin Hughes' own standards of practice and are CE marked where required, meeting the applicable requirements of the following directive: • RTTE Directive 1995/5/EC
Electromagnetic Emissions	Designed to meet the requirements of unwanted emissions in the out of band domain (ITU-R-SM.1541)
	Designed to meet the requirements of spurious emissions (ITU.R.SM.329.9)

Document history

Issue number	Release date	Details
1	August 2014	First release

Amendment record

When an amendment is incorporated into this handbook, the details should be recorded below. Any equipment modifications should also be shown.

Amendment Number	Date inserted *(DD-MM-YYYY)*	Initials	Equipment Mod number

2 Health & Safety warnings

When working on Kelvin Hughes equipment, operators, engineers and agents are expected to work within the health and safety guidelines noted in the handbook, as issued by their respective employer or as stated by site regulations, shipyard or vessel owner.

Risk assessments of a working area must be undertaken prior to commencement of any work and must be regularly reviewed.

2.1 Hazards

ELECTRICAL HAZARDS:
Some equipment does not have safety interlocks fitted.

Lethal single and three phase AC and DC voltages may be present when units are open and exposed.

Before accessing any internal parts, ALL power sources to the equipment must be fully isolated; this must include the isolation of all UPS supported supplies to the system.

MAINS VOLTAGES:
All Kelvin Hughes equipment is supplied with mains input voltage set for 220v, 50/60 Hz ac unless otherwise stated on labels attached to the equipment.

WARNING: Some equipment contains materials which may produce toxic fumes if burnt.

Beryllium warning: The SharpEye™ X and S band transceivers mounted within the SBS-800 series are factory sealed units which contain no field serviceable parts. The SharpEye™ transceivers *must not* be dismantled in the field as some components within the factory sealed processor contain Beryllium which is hazardous to health.

Class 1 laser product: There is a class 1 laser within the sealed SharpEye transceiver processor which can represent a risk if the processor is dismantled.
When fitted, the LAN fibre optic cable that connects to the SharpEye™ transceiver and the to the MISM type 5 modules within the radar distribution unit is considered as a class 1 laser.

2.2 Antenna rotation warning

ANTENNA ROTATION SAFETY NOTICE:

When single and three-phase power is connected to the system and switched ON, the antenna will rotate *immediately* regardless of the RUN command status.

Use the *antenna rotation* keyswitch or *man aloft* safety switches to stop antenna rotation in an emergency.

Refer to the maintenance section of the operator's handbook for details on stopping the antenna and isolating a system.

2.3 Radiation hazards

Radiation hazard: non-ionising

Avoid exposure to the main beam of a stationary radar antenna.

Avoid standing closer than 2 metres from the central front face of the antenna.

Users of cardiac pacemakers should be aware of the possibility that radio frequency transmissions can damage some devices or cause irregularities in their operation. Anyone using such devices should understand the risks present before exposure.

2.4 Microwave radiation levels

The Council of the European Union Recommendation 1999/519/EC (Annex III table 2) specifies the maximum RF non-ionising field strength (power density) safe range for human exposure averaged over a six minute period as $10W/m^2$ in a frequency band of 10 to 300GHz.

Calculations for all SBS-900 systems show that the rotating antenna safe distance is within the antenna turning circle although KH do not recommend any personnel to be in close proximity to a rotating antenna due to RF exposure and the high risk of injury that can be caused by a rotating antenna.

SBS-900 system	State	Range Within Which the Power Density Exceeds $10W/m^2$
X-band 3.7m or 5.5m standard antenna	Rotating antenna	1.3m
	Non-rotating Antenna	3.0m
S-band 3.9m standard antenna	Rotating antenna	1.2m
	Non-rotating Antenna	3.0m
X-band Enhanced 5.5m antenna	Rotating antenna	1.7m
	Non-rotating Antenna	4.0m
X-band Enhanced 6.4m antenna	Rotating antenna	2.0m
	Non-rotating Antenna	5.0m

The safe range for a non-rotating antenna is far greater due to the lack of averaging but this is not a permitted operational mode and the system includes interlocks to prevent this mode of operation for a prolonged period.

Note: 5m of waveguide is assumed.

2.5 Working aloft

SAFETY ALOFT:

When working aloft or near any radar scanners, moving or RF radiating equipment, ALL power sources to the platform and equipment must be fully isolated.

Before working aloft ensure someone in authority or at ground level knows of your intentions and ensure that suitable clear warnings are in place.

Ensure all means of access aloft are secure and beware of wet or slippery ladder rungs and working areas.

All working at height health and safety requirements and procedures, including the inspection and use of personal protective equipment (PPE), must be adhered to at all times as advised and required by your employer, site regulations, shipyard or vessel.

2.6 Man aloft switch/ antenna isolation.

Antenna rotation and transmission can be inhibited via a Man Aloft Switch (MAS) or an *'Antenna OFF/ Free'* keyswitch. These mechanisms can be used by a person who sees a potential hazard such as a loose halyard and decides to protect the antenna.

When activated, the reason for loss of turning is detected by the system and is reported to the local and remote users

Safety switches	
Antenna Rotation keyswitch	The *Antenna Rotation* keyswitch is located on the door of the internally mounted Radar Distribution Unit (RDU) The key for the RDU keyswitch is captive when set to Free (enable rotation) but can be removed when the keyswitch is to OFF. When in the OFF position all single and 3-phase AC power to the antenna and transceiver is isolated thus stopping antenna rotation and transmission. The key should be removed and retained by the person who intends to enter the potentially hazardous volume of the rotating antenna.
Man aloft switch (MAS)	The man aloft switch (MAS) is designed to be installed such that it is still viewable for the person who is carrying out maintenance tasks. When set to the '*OFF*' position the transceiver/ gearbox is isolated from all single and 3-phase AC power thus stopping the antenna rotation and transmission.

The Man Aloft switch, Motor ON/ OFF and Antenna Rotation keyswitch form part of a safety current loop. This safety loop is purely hardware (no software), when the current loop is opened, AC mains supplies to the transceivers and antenna inverter are switch OFF by use of contactors.

Kelvin Hughes recommends that the key switches noted above are used in conjunction with the man aloft switch but also recommend that radar users carry out a safety assessment and risk mitigation procedure in terms of interlocks *prior to approving any work on the equipment*.

Full details on isolating the systems from the AC supplies can be found in the planned maintenance section of the relevant systems Operator & Maintenance handbook.

2.7 Anti-static handling

CAUTION: Handling of electrostatic-sensitive semiconductor devices
Certain semiconductor devices used in the equipment are liable to damage due to static voltage. Observe the following precautions when handling these devices in their un-terminated state, or sub-units containing these devices:
Persons removing sub-units from equipment containing these devices must be earthed by a wrist strap and a resistor at the labelled point provided on/ within the equipment.

- Soldering irons used during authorised repair operations must be low voltage types with earthed tips and isolated from the mains voltage by a double insulated transformer.
- Outer clothing worn must be unable to generate static charges.
- Printed circuit boards fitted with these devices must be stored and transported in anti-static containers.
- Fit new devices in a special antistatic safe handling area.
- Fully isolate and mechanically disconnect all sources of AC before attaching ESD protective wrist straps to the various points in the system.

2.8 RoHS statement

Restriction of Hazardous Substances (RoHS): For details on RoHS statements please contact Kelvin Hughes; contact details can be found in at the end of this handbook.

2.9 End of life disposal

When the equipment detailed in this handbook has reached the end of its serviceable life, the various parts that make up the system must be disposed of in accordance with local industrial waste disposal regulations.

Please contact your local regulatory body for disposal instructions or contact Kelvin Hughes for a list of any potentially hazardous material contained within the system.

SharpEye™ specific disposal notice
The SharpEye™ transceiver(s) located within the transceiver enclosure are factory sealed units that contains no field serviceable parts or lifed components.

Components within the SharpEye™ processor (all variants) contain traces of **beryllium** and **trivalent chromium**.

Please contact Kelvin Hughes regarding the repair or a SharpEye™ or its end of life disposal instructions. Contact details for Kelvin Hughes can be found at the end of this handbook.

2.10 AC supplies

All AC mains powered equipment is provided with a power rating plate that details the power requirements and additional information for the equipment.

The power rating plate is attached to the front cover of the equipment and indicates the following:

- Equipment name
- Part & serial numbers
- Equipment weight
- Supply voltage & frequency range(s)
- Current ratings
- IP rating
- Product hazard warnings

Example of power rating plate

AC sources: Standard SBS-900 systems require the following switched and protected AC inputs:

- Two sources of UPS supported 2 wire 115/ 230VAC single phase supplies + protective earth.
- 3 wire 440VAC three-phase supply + protective earth.

Health & safety: The information found on the power rating plates must be used in conjunction with the Health & Safety notices shown in this handbook.

Cable requirements: The AC power requirements and cable specifications can be found in the external interfacing section of the systems installation and commissioning handbook.

Wiring: Wiring is to be carried out in accordance with the system manual using the cables defined. Please refer to the systems installation and commissioning handbook for full details.

Disconnection devices: To comply with CE approval and EN60950 requirements it is recommended that the AC supplies to the system are made with clearly labelled, readily accessible disconnection devices as follows:

Single phase: Standard CE approved mains outlet sockets (not supplied).

Three phase: Class B, red, 4-pole plug & socket (not supplied).

Fuses: All accessible fuses and over current protection devices are detailed in the corrective maintenance section of the handbook.

Replacement fuses must be of the correct type and rating.

2.11 Grounding/ earth points

All parts of the system must be fully and correctly connected to a proven earth point prior to connecting any source of AC power.

The system must never be switched ON or operated with an earthing point disconnected.

Connection point: All Kelvin Hughes equipment is fitted with a single protective earth connection point which is indicated on the mechanical installation drawings.

Conductivity tests: During installation and maintenance, the earth connections must be tested for conductivity using a high current impedance meter such as a Megger or similar.

Wrist Straps: Fully isolate and mechanically disconnect all sources of AC before attaching ESD protective wrist straps to the various points in the system.

3 Software licensing and virus protection

3.1 Software

Only approved software may be used on Kelvin Hughes equipment. The use of unapproved or unlicensed software on any Kelvin Hughes equipment is strictly prohibited. The use of such software voids the warranty status of the unit.

Any Kelvin Hughes designed software supplied whether pre-installed, supplied on CD/ DVD or other removable media, is the copyright of Kelvin Hughes Ltd, which will not accept any responsibility for any damage or loss caused in whatever way by the use or misuse of the software. This copyright applies to software that can be supply in various formats including but not restricted to CD, DVD, USB memory device, email or obtained via the Kelvin Hughes agents download area.

Software supplied with Kelvin Hughes equipment may not be resold or re-distributed without the express permission of Kelvin Hughes Ltd.

3rd party software supplied with the system such as the RadarView program remains the copyright of the original manufacturer. See the manufactures documentation for copyright information.

3.2 Virus precautions

Many systems supplied by Kelvin Hughes Ltd including the optional Service Displays are now PC based and it should be noted that such systems do not have anti-virus protection installed.

It is the responsibility of installation engineers, service engineers, maintainers and system users to ensure that virus threats are not transferred to the system via removable media.

WARNING*:* Prior to use, all removable media used on or in Kelvin Hughes products MUST be fully scanned for viruses on a PC installed with up to date anti-virus software.

Any media containing potential virus infections must not be used.

Charges relating to systems found to be infected with a virus will be passed onto the company found to be using removable media that has not been suitably scanned.

Note: Kelvin Hughes cannot be held responsible for damage caused to systems by virus infections.

Removable media referred to includes but is not restricted to USB memory sticks, USB hard drives, floppy discs, CD/ DVD's and all forms of removable media.

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4 Handbooks

The system handbook is split into two volumes that contain the following details. Additional handbooks and technical data can be found in the handbook annexes:

KH-1602-1 Installation, Termination and Commissioning Handbook	**KH1602-2** Operation and Maintenance Handbook
Contents: 1. Contents 2. Health and safety warnings 3. Software licensing & virus precautions 4. Handbooks 5. System overview 6. Equipment specifications 7. External interfacing 8. Options 9. Mechanical installation 10. Termination 11. Setting to work 12. Completion of installation 13. System acceptance test (SAT) 14. Abbreviations 15. Contacting Kelvin Hughes 16. Annex A: Antenna Sub system 17. Annex B: Supporting documentation Note 18. SBS-900 variants 19. Index	**Contents:** 1. Contents 2. Health and safety warnings 3. Software licensing & virus precautions 4. Handbooks 5. Technical description 6. Local operator instructions 7. Remote operator instructions 8. Service display/ RadarView control 9. Planned maintenance 10. Corrective maintenance 11. Abbreviations 12. Contacting Kelvin Hughes 13. Annex A: RadarView user manual 14. Annex B: Antenna sub system maintenance Note 15. Index

Advanced Antenna / Antenna Turning unit (ATU):

Manufacturer's handbook: The SBS-900 series can be supplied with a range of Advanced antennas and Antenna Turning Units.

The installation and maintenance instructions for the advanced antennas and the antenna turning unit (ATU) are detailed in a separate handbook located in Annex B of the Installation and Commissioning handbook.

The Advanced Antenna Turning Unit and antenna must be installed in accordance with the manufactures requirements which include but are not restricted to: Health and safety, unpacking, lifting and installation requirements.

Handbook reference: Installation and Maintenance Manual
Radar Antenna System type KAH20-AS-00000

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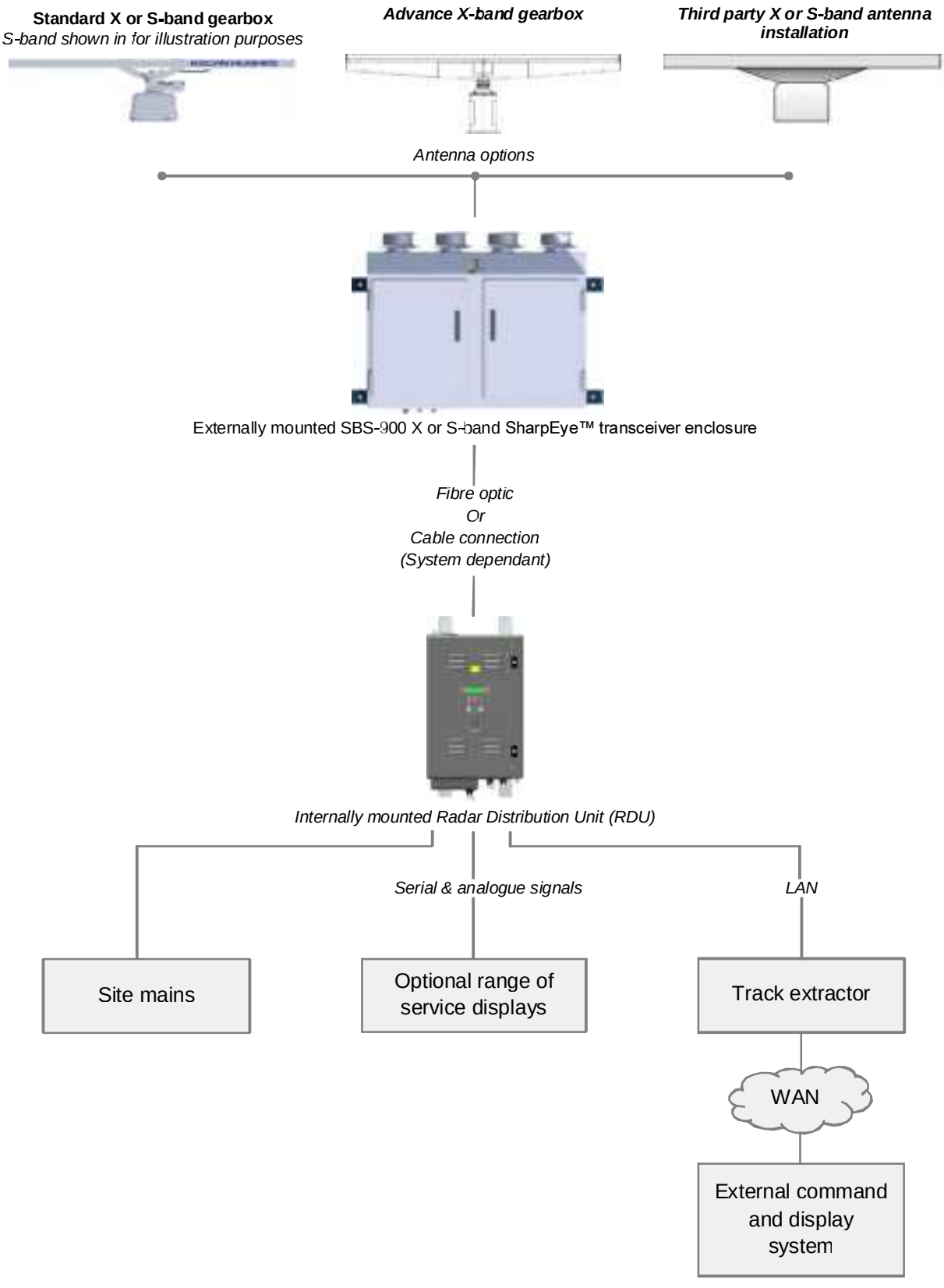
5 Technical overview

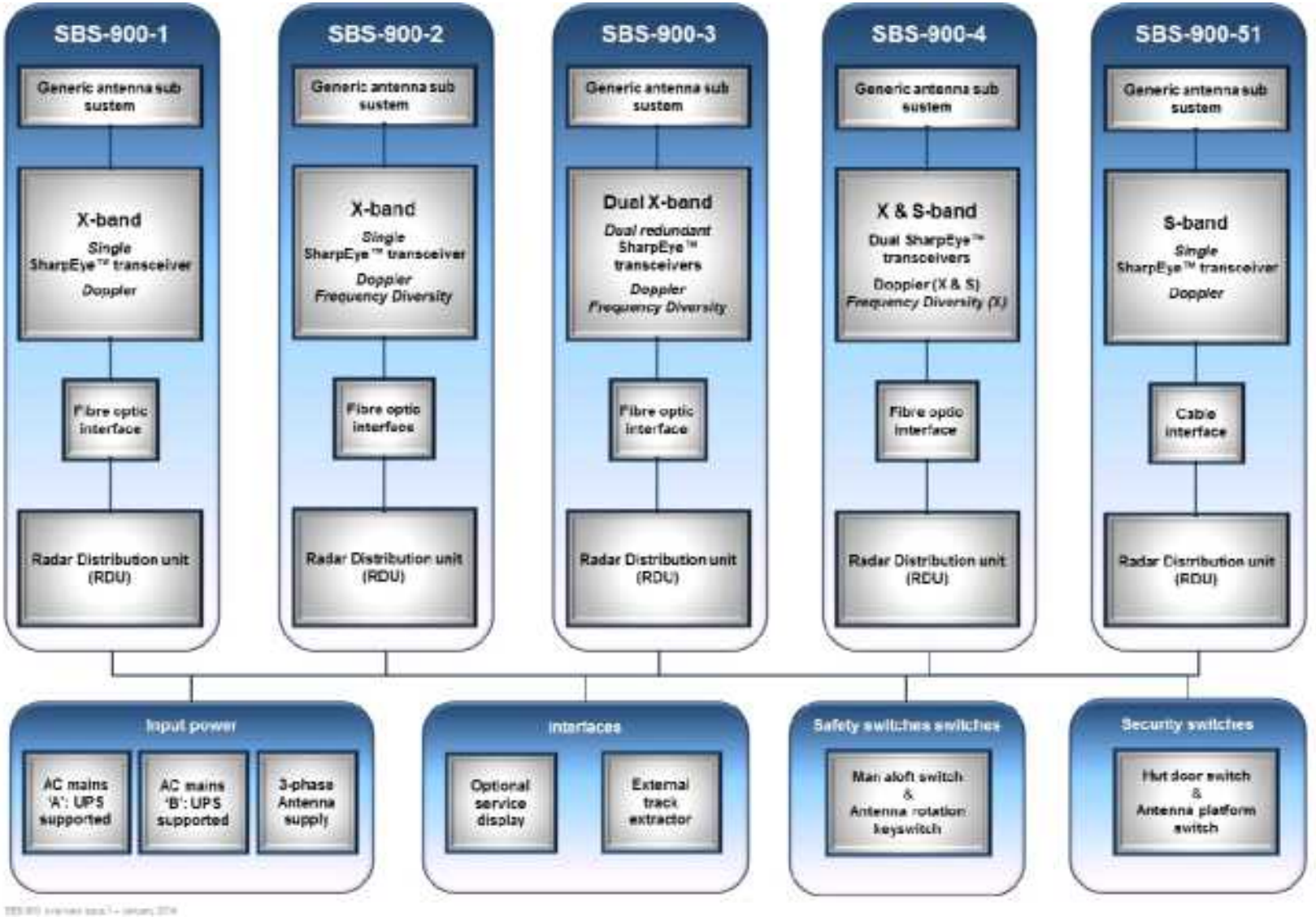
5.1 Generic system



Example of a generic SBS-900 system

Note: *Third party antenna interfacing is subject to initial inspection and compatibility checks.*

5.2 SBS-900 overview



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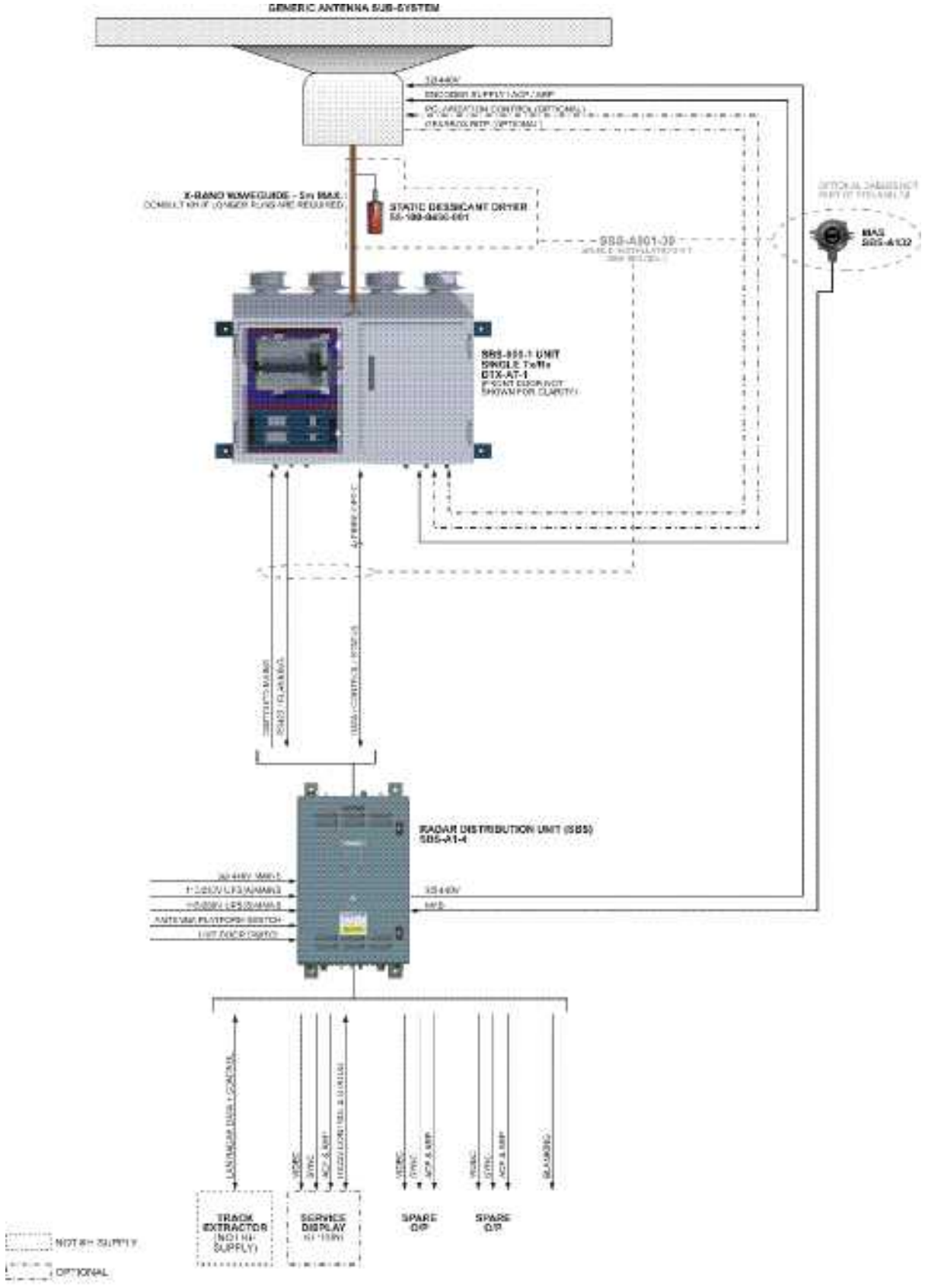
5.3 SBS-900-1



TYPICAL SBS-900-1 SYSTEM

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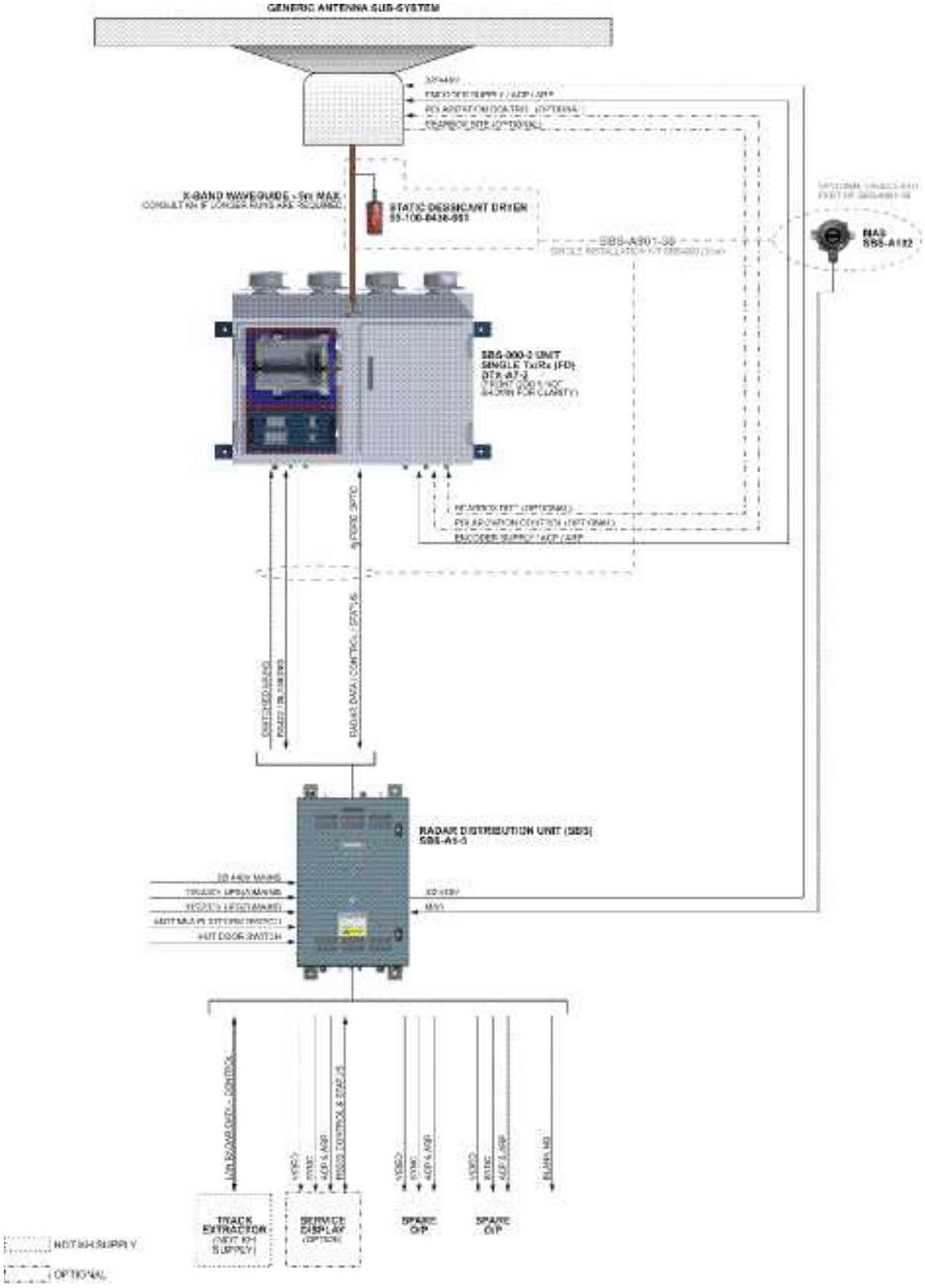
5.4 SBS-900-2



TYPICAL SBS-900-2 SYSTEM

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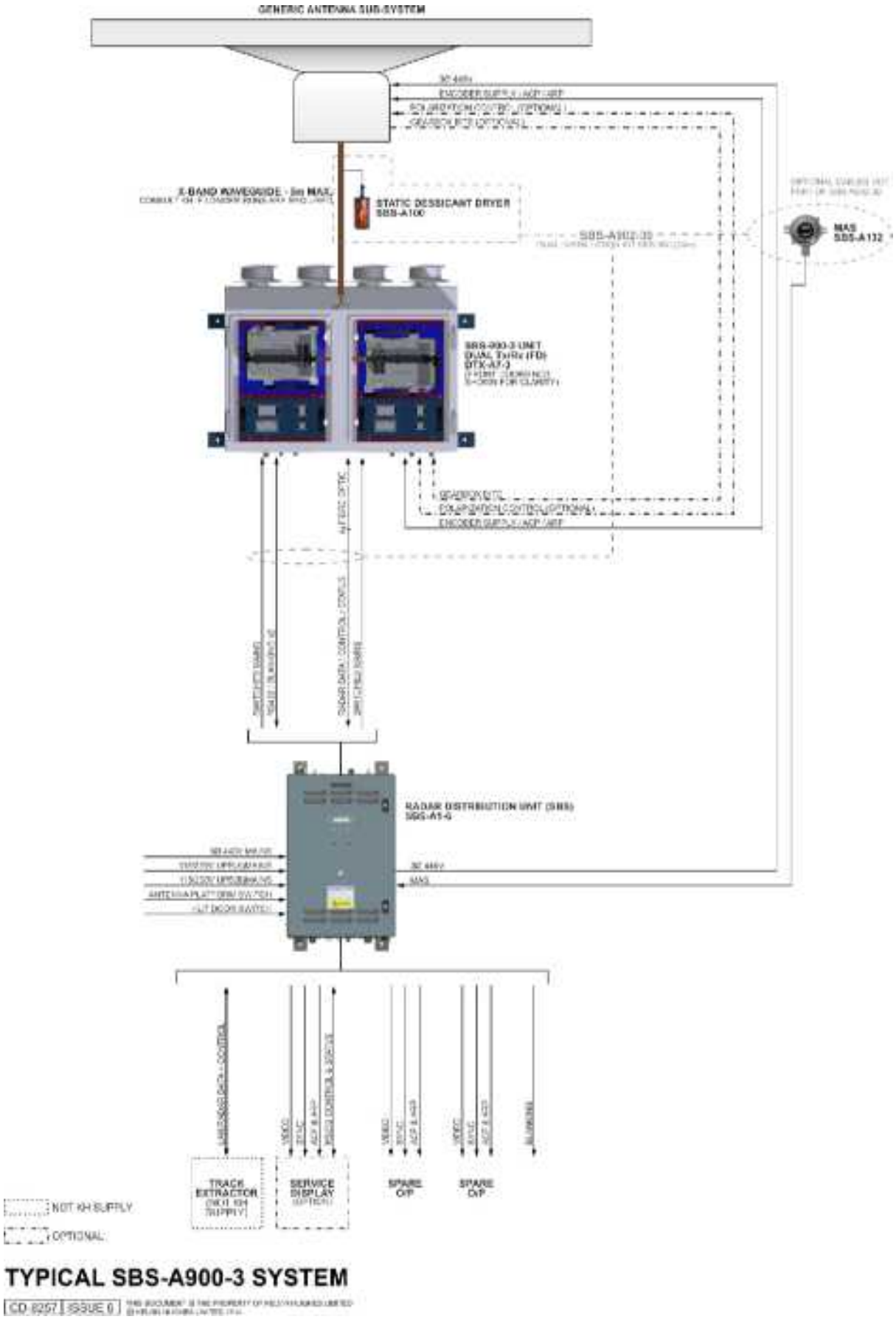
5.5 SBS-900-3



TYPICAL SBS-A900-3 SYSTEM

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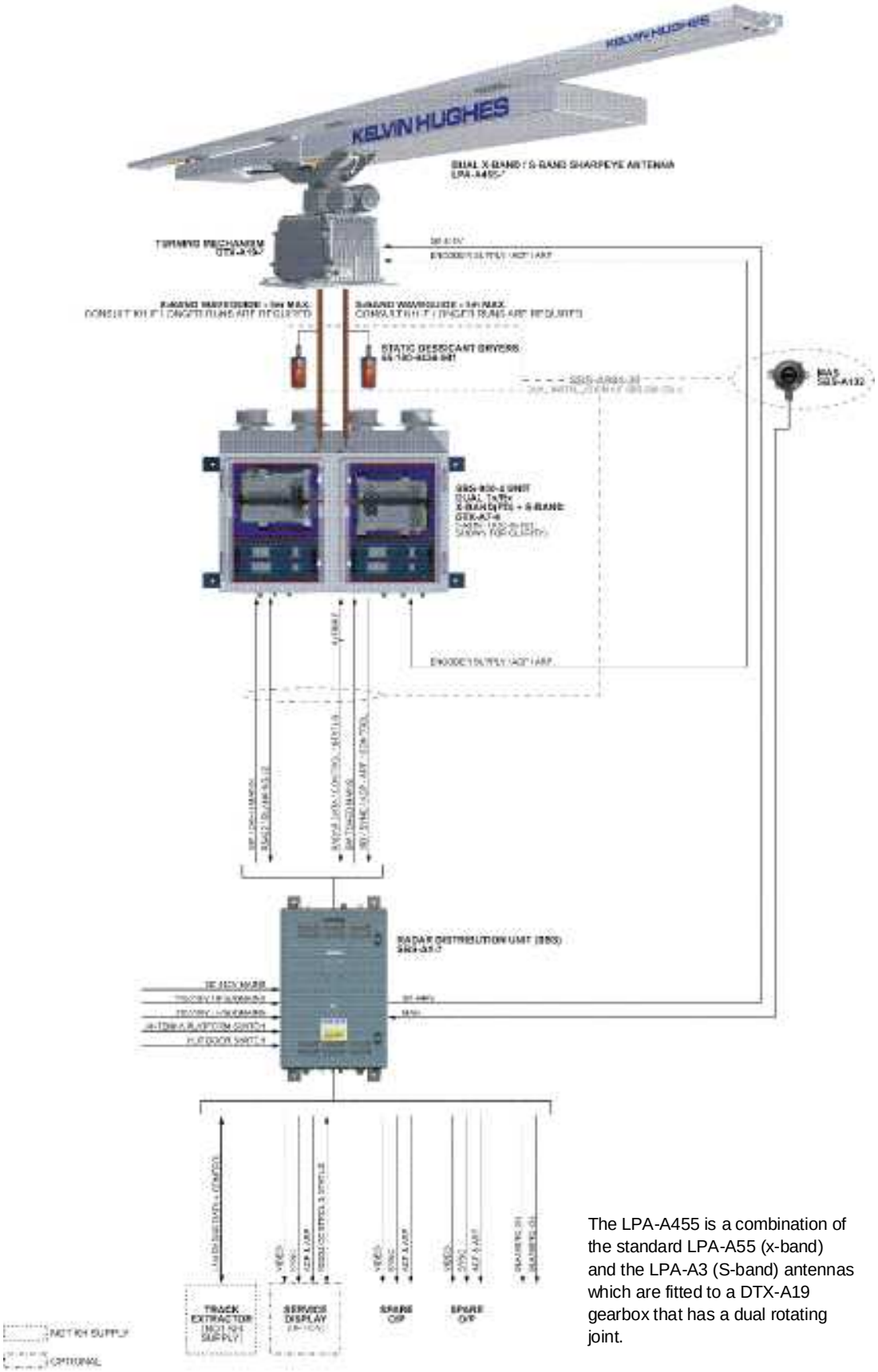
5.6 SBS-900-4

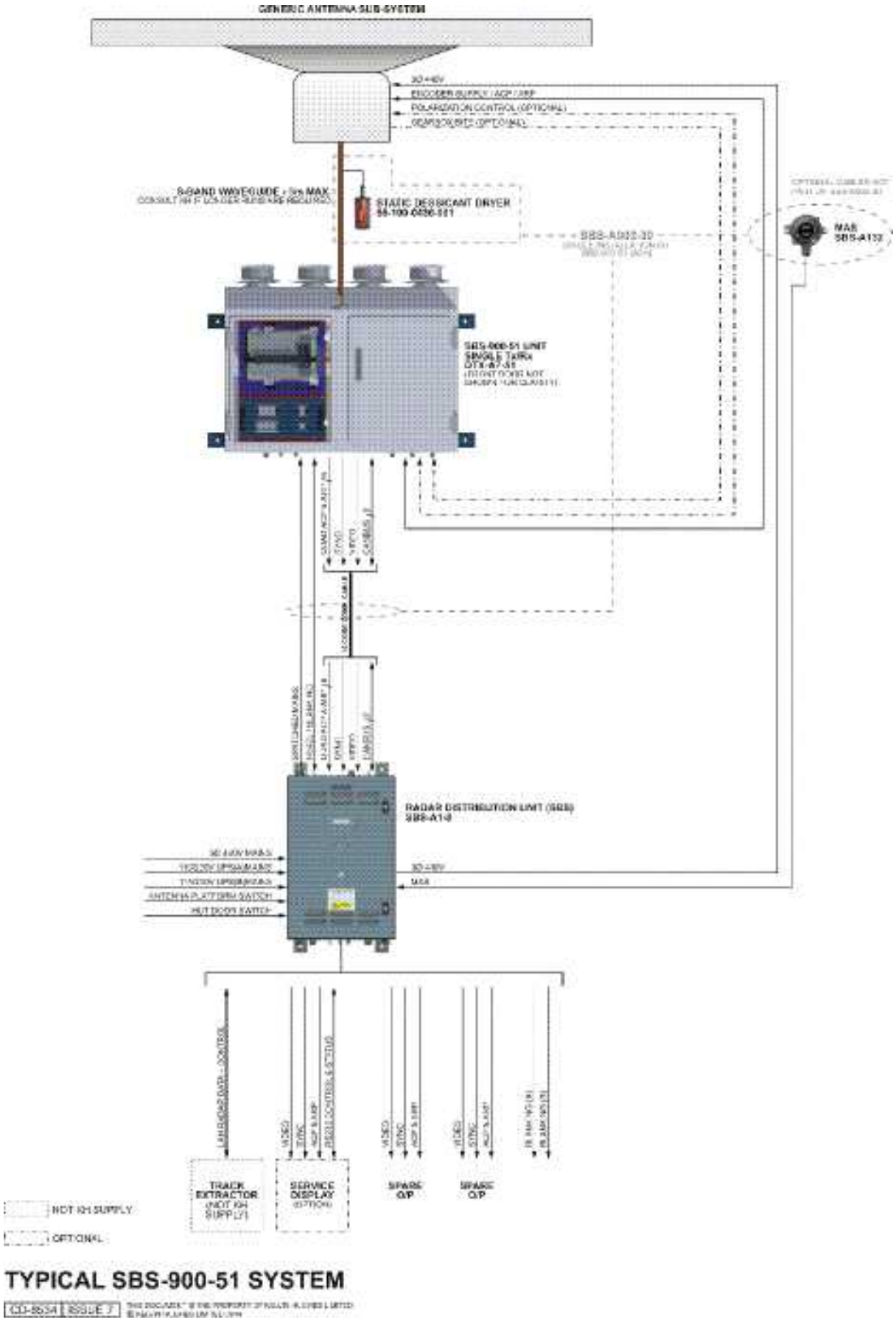


TYPICAL SBS-900-4 SYSTEM

The LPA-A455 is a combination of the standard LPA-A55 (x-band) and the LPA-A3 (S-band) antennas which are fitted to a DTX-A19 gearbox that has a dual rotating joint.

The SBS-900-4 allows the operator to select between X or S band transmission.

5.7 SBS-900-51



TYPICAL SBS-900-51 SYSTEM

5.8 Standard antenna sub system

The standard antenna solution comprises a Kelvin Hughes manufactured gearbox and range of Low Profile Antennas (LPA) that can be used on all variants of the SBS-900 range:

***Antenna*:** The gearbox can be fitted with a range of X or S-band Low Profile Antennas (LPA).

The antenna utilises polyrod technology and a horizontally polarised end fed slotted array enclosed in a polycarbonate plastic case.

Example of a Kelvin Hughes X-band LPA

Single antenna: The waveguide feed from the antenna is connected to the rotating joint of the gearbox.

Combined X & S band antenna: The waveguide from each antenna is connected to a special dual waveguide connection at the rotating joint of the gearbox.

SBS system		Equipment colour	
		Signal white RAL9003	Silver grey RAL7001
X-band	SBS-900-1 SBS-900-2 SBS-900-3	LPA-A37 (3.7m) or LPA-A55 (5.5m)	LPA-A37-BAAA (3.7m) or LPA-A55-BAAA (5.5m)
S-band	SBS-900-51	LPA-A3 (3.9m)	LPA-A3-BAAA (3.9m)
Combined X & S-band	SBS-900-4	LPA-A455 (5.5m & 3.9m)	LPA-A455-BAAA (5.5m & 3.9m)

Gearbox: The synchronous antenna motor is driven by a 3-phase voltage which is supplied and controlled from an inverter within the RDU. This inverter is configured to provide a soft start and a soft stop for the Motor and adjustable antenna RPM. [Note] Three phase power is connected via a junction box mounted on the motor.

A DC supply from the transceiver enclosure powers the ACP/ ARP encoder within the gearbox enclosure. ACP and ARP signals are connected to the transceiver enclosure by cables.

The gearbox has a removable service access door that allows easy access to the ACP/ ARP connections, the encoder and the RF coupling in S-and systems. There are no other electronics within the unit.

SBS system		Equipment colour	
		Signal white RAL9003	Silver grey RAL7001
X-band	SBS-900-1 SBS-900-2 SBS-900-3	DTX-A3-AXZX	DTX-A3-BXZX
S-band	SBS-900-51	GTX-A11	GTX-A11-BAAA
Combined X & S-band	SBS-900-4	DTX-A19	DTX-A19-BAAA

Specifications: Full specifications on the standard antenna and gearbox range can be found in the installation and commissioning handbook (KH-1602-1).

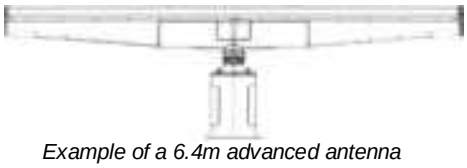
Note: *Antenna speeds/ RPM are factory configured.*

5.9 Advanced antenna sub system

The advanced antenna solution comprises an X-band antenna and Antenna Turning Unit (ATU) that can be used on with the SBS-900-1, SBS-900-2 and SBS-900-3 X-band systems.

***Antenna*:** The advanced antenna sub system comprises of a HI-gain 5.5 or 6.4m antenna

The antenna is rotated using a servo motor at 1 RPM but can be configured during setting to work only for speeds between 1 and 10 RPM.



Example of a 6.4m advanced antenna

The waveguide feed from the antenna is connected to the rotating joint of the Antenna Turning Unit.

Antenna range	Description	
SBS-A55-10HW	10 RPM	5.5 m, Horizontal polarisation, white
SBS-A55-10CW		5.5 m, Circular polarisation, white
SBS-A64-10HW		6.4 m, Horizontal polarisation, white
SBS-A64-10CW		6.4 m, Circular polarisation, white
SBS-A55-20HW	20 RPM	5.5 m, Horizontal polarisation, white
SBS-A55-20CW		5.5 m, Circular polarisation, white
SBS-A64-20HW		6.4 m, Horizontal polarisation, white
SBS-A64-20CW		6.4 m, Circular polarisation, white

Note: *White is according RAL 9016. For grey variants (RAL 7001) the above Kelvin Hughes part numbers have suffix G instead of W.*

Gearbox: Two Antenna Turning Units are available:

- ST1-F10 (10 RPM)
- ST1-F20 (20RPM)

Both are powered by a three-phase supply generated and controlled by a static inverter mounted within the RDU. This inverter is configured to provide a soft start and a soft stop for the Motor and adjustable antenna RPM. **Note**

Three phase power is connected via a junction box mounted within the Antenna Turning Unit. The gearbox is fitted with an encoder giving 1024 ACP's and 1 ARP and servo motor.

A +5VDC supply from the transceiver enclosure powers the ACP/ ARP encoder within the gearbox. ACP and ARP signals are connected to the transceiver enclosure by cables.

Handbook: The installation, termination, commissioning processes and requirements for the advanced range of antennas and the ST1-F10 & ST1-F20 Antenna Turning Unit (ATU) are not included in this section. Note

Please refer to Annex B or to the handbooks provided with the equipment for full installation details.

Note: *Antenna speeds/ RPM are factory configured.*

5.10 Transceiver enclosure

The DTX-A7 is a range of external mounted waterproof enclosures that contains the relevant X or S-Band SharpEye™ transceiver(s), an azimuth signal interface, system power supplies, a waveguide switch (where required) and an RF connection to the antenna sub-assembly.

The system is designed to be externally mounted and is convection cooled by the use of heatsinks and four wind turned rotary ventilators mounted on top of the assembly.

For areas operating in high ambient temperatures additional powered cooling fans can be fitted as an option (SBS-A179).

Example of a DTX-A7-3 shown with access doors removed for clarity

Connection to antenna

The system is connected to the antenna sub-system via a bespoke waveguide connected to the top of the system. The waveguide/ flexwell is supplied preassembled with a static desiccator drying unit (55-100-0436-001).

Turning data (ACP/ ARP) is interfaced to the enclosure from the turning unit via cable connections.

⚠	**NOTICE: Maximum flexwell/ waveguide distance** The maximum flexwell/ waveguide run between the DTX-A7 transceiver enclosure and the antenna sub-assembly is **5 metres**.

Waveguide dryer: A static desiccator is supplied pre-assembled onto the waveguide as part of all SBS-900 systems.

The unit is a totally passive device and requires no electrical power.

It connects directly into a gas inlet port that forms part of the flexwell/ waveguide assembly.

The clear wall of the unit allows visual inspection of the desiccant condition. As moisture is adsorbed the colour will change from deep blue to pink/white. When 80% of the desiccant material has changed colour, the unit should be replaced.

A pressurised waveguide dryer (SBS-A131-1) is also available as an option.

Connection to Radar Distribution Unit

Data Signals: The following signals are transferred between the DTX-A7 enclosure and the Radar Distribution Unit:

- Digital signals in the form of radar video, display sync, ACP and ARP
- System control, status and BITE data
- Blanking signals

Connections between the two units are via:

- **SBS-900-1, -2, -3 & -4:** Fibre optic cable
- **SBS-900-51:** Cable connection

Power: The enclosure is AC powered and controlled by the Radar Distribution Unit. In single transceivers a single AC supply is provided, in dual systems two AC supplies are provided (one for each transceiver).

Internal AC-DC power supplies provide all the internal DC power requirements of the enclosure. A DC supply is also provided to power the ACP/ ARP encoder in the antenna sub-system.

- For **Standard** systems sub-systems the encoder supply is +15VDC
- For **Advanced** antenna sub- systems the encoder supply is +5VDC

Over current protection devices: The Transceiver enclosure is fitted with internal breakers for the AC supply(s) to the enclosure.

- **MCB1** isolates the AC supply to the left hand side of the enclosure.
- **MCB2** isolates the right hand side of the enclosure.

All breakers must be in their OFF position before commencing any form of service or maintenance work on the system.

Access: Access to the unit is via two lockable (8mm hex key), waterproof doors mounted on the front of the unit.

Location: The DTX-A7-X waterproof enclosure is designed to be externally mounted located within 5 metres of the gearbox/ antenna turning unit.

Interlocks: Maintenance and ENCOM safety switches are provided via an Antenna Rotation keyswitch fitted on the RDU and an externally mounted *Man Aloft* switch

Breakers for the AC input are located within the transceiver enclosure.

If no azimuth (rotation) is detected, the SharpEye will automatically switch to standby within 60 seconds of signal loss.

SharpEye™ transceiver

SharpEye™ transceiver technology radically departs from conventional marine navigation transceivers through the transmission of low power RF pulses and application of pulse compression and Doppler techniques. The technology benefits from the following:

- Solid state transmitter for high reliability
- Dynamic range of 126 dB (*including sensitivity time constant (STC) & pulse compression gain*)
- Digital pulse compression
- Minimum discernible signal (MDS) of -125dBm
- Receiver noise figure ≤5.5dB
- Internal monitoring, no external components required to monitor operation
- Pulse Doppler processing for improved rain and sea clutter rejection
- Range discrimination: 7.5nm (24nm) and 15nm (48nm)

Solid state technology: Solid state transistors obviate the need for a warm-up time. When the Radar Distribution Unit is switched ON the SharpEye™ is powered. When a Run command is received by the transceiver, it is ready for transmission within 40 seconds.

Output power: When transmitting, the amplifiers generate a nominal peak power of 170Watts with a maximum duty cycle of 13% at the transceiver output flange.

System monitoring: Comprehensive built in test (BIT) facilities within the transceiver provide on-line monitoring of the following parameters within the transceiver:

- RF power
- Antenna system VSWR
- Power supplies
- Temperature
- Receiver sensitivity
- Antenna rotation data

Should the system detect a fault condition which could lead to early failure of the transceiver, i.e. a *high VSWR*, then the transceiver switches to a low power state which permits transmission to continue in the short term. The built in test monitoring also outputs a “Low RF Power” warning message if the RF power output falls below 100 W. The design is “fail-soft” thereby providing graceful degradation in the event of single or multiple transistor failures.

SBS-900 Range:

System ID	SharpEye™ Transceiver	Doppler	Frequency Diversity
SBS-900-1	X-band	✓	✗
SBS-900-2	X-band	✓	✓
SBS-900-3	X-band (dual redundant)	✓	✓
SBS-900-4	X and S-band (dual transceiver)	✓ (X & S-band)	✓ (X-band only)
SBS-900-51	S-band	✓	✗

5.11 Radar Distribution Unit

There are 5 Radar Distribution Units used in the standard SBS-900 range with the only difference being the configuration and interfacing of the individual units.

The operation of each of the Radar Distribution Units is identical.

SBS system:	SBS-900-1	SBS-900-2	SBS-900-3	SBS-900-4	SBS-900-51
RDU:	SBS-A1-4	SBS-A1-5	SBS-A1-6	SBS-A1-7	SBS-A1-8

The SBS-A1-X Radar Distribution Unit (RDU) is a radar processing and distribution unit that accepts radar video inputs from the external transceiver enclosure and provides signal outputs in digital form.

The RDU accepts radar data via fibre optic cable or cable connection (cable on *SBS-900-51 only*) and outputs digitised video including control and status data via a LAN to the track extractor.

A Kelvin Hughes TCP/IP specific protocol is used based on the Asterix format.

The RDU also provides an interim two way serial interface for a range of service displays which offer local control of the system for maintenance and monitoring purposes.

Control modes: The RDU can be operated in either of the following modes:

Remote control	In normal operation, the system is remotely controlled via a 3rd party command & display system or track extractor and WAN with the RDU acting as an interface. ***Note**: The infrastructure of the track extractor and WAN are not detailed in this handbook.*
Local control	 In local control, the system can be locally operated using controls mounted on the front of the Radar Distribution Unit (RDU); controls include: - *Local* or *Remote* control selection. - Local transceiver *Run* and *Standby* control. - Viewing of status and BITE data on an integrated LCD display. - Viewing and adjustment of system configurations.
Optional service display	A range of optional service displays are available which enables a maintainer to view, control and display the radar locally for commissioning and maintenance purposes.

AC Breakers: To comply with CE and EN60950 requirements it is recommended that the AC connections to the RDU are via clearly labelled, readily accessible disconnection devices:

- **Single phase supply:** Standard CE approved mains outlet sockets (not supplied).
- **Three phase supply:** Class B, red, 4-pole plug & socket (not supplied).

Antenna Rotation Safety Notice

Depending on the status of the safety switches, when three-phase power is connected and switched ON, the antenna may rotate immediately regardless of the RUN command status.

AC requirements

Single phase: Two independent sources of UPS supported, single phase, 115/ 230VAC supply are connected to the RDU.

The AC voltages are fed to an AC-DC power supply via user accessible breakers located within the RDU. The internal power supply provides all the DC power requirements of the RDU.

Switched AC supply is sent from the RDU to the DTX-A7 transceiver enclosure.

3-phase: A 440VAC 3-phase input is fed via a user accessible breaker to an internal static inverter. This generates and controls the three phase requirements of the turning mechanism solution.

Caution: *When the three phase supply is connected and switched ON, the inverter unit is powered and sends three-phase voltages to the antenna motor which may rotate immediately (see safety switches).*

Safety switches: A normally closed safety current loop is provided for the serial connection of safety switch contacts including an external Man Aloft switch.

Antenna rotation switch: An Antenna Rotation safety keyswitch is provided on the RDU and is part of the safety current loop. This switch can be set to OFF, removed and retained by the maintainer for safety.

RDU Antenna Rotation switch

Man Aloft Switch (MAS): An externally mounted switch that can be set to Free (rotate) or OFF.

When either the **Antenna Rotation** *or* **Man Aloft** switches are set to **OFF** or if the safety current loop is broken/ open, the single and 3-phase AC supplies from the RDU to the transceiver enclose and gearbox are isolated thereby stopping Antenna Rotation and system transmission.

External Man Aloft Switch

Security Switches: There is also provision for an optional set of normally closed *Antenna Platform* and a *Hut Door* switches that are used for monitoring purposes only. These switches do not isolate or control any part of the system, when fitted and enabled, the systems report the status of these switches to the RDU.

5.12 System control

Remote Control	In normal operation, the system is remotely controlled by the track extractor with the RDU acting as an interface. An optional Service Displays enables the system maintainer to view, control and display the system for maintenance purposes.	
Local Control		In Local control, the system can be operated using controls mounted on the front of the Radar Distribution Unit (RDU); controls include: - *Local* or *Remote* control selection. - Local transceiver *Run* and *Standby* control. - Viewing of status and BITE data on an integrated LCD display. - Viewing and adjustment of system configurations.

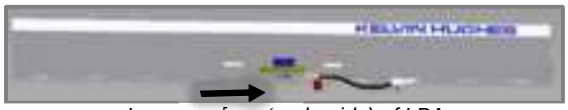
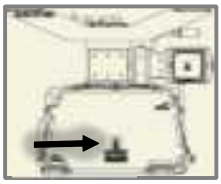
Safety switches: The following switches are on a safety current loop which, when broken/ open isolate the transceiver and turning unit from the single and three-phase AC supplies thus stopping antenna rotation and transmission.
- *Antenna Rotation*: A door mounted removable keyswitch to stop antenna rotation & transmission.
- *Man Aloft Switch*: An externally masthead mounted switch to stop antenna rotation & transmission.

***Security switches*:** *Hut door* and *antenna platform* switch.
The state of these switches is reported to the track extract, service display etc. The switches do not isolate or control any aspect of the system and are for switch status reporting only.

5.13 Unit identification

The equipment included in the SBS-900 series can be identified as follows.

The full part and serial number of a system should always be quoted when contacting Kelvin Hughes for assistance or spares.

Description	Part number & serial number location *(arrow indicates label position)*
Standard low profile antennas (all variants) LPA-A37 (x-band) LPA-A55 (x-band) LPA-A455 (dual X & S-band) LPA-A3 (S-band)	 *Lower surface (underside) of LPA*
Standard gearboxes (all variants) DTX-A3 (x-band) DTX-A19 (dual X & S-band) GTX-A11 (S-band)	
Advanced systems Antenna and Antenna Turning Unit (ATU)	Please refer to the manufacturers handbook supplied with the Advanced antenna for details
Transceiver Enclosure (all variants) DTX-A7	
Man aloft switch SBS-A132	
Radar distribution unit SBS-A1 *(all variants)* ***Note**: If a option has been added to a system, an additional label is added noting the option number.*	

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6 Local operation instructions

6.1 Antenna rotation warnings

ANTENNA ROTATION SAFETY NOTICE:

When three-phase power is connected to the system and switched ON, the antenna *will rotate immediately* regardless of the RUN command status *(see conditions below)*.

When three-phase AC mains supplies are connected and switched ON using the breakers located within the RDU, the antenna *may* rotate immediately.

The system will only transmit when a RUN command is received from the track extractor, service display or is set to RUN using the Local controls located on door of the Radar Distribution Unit.

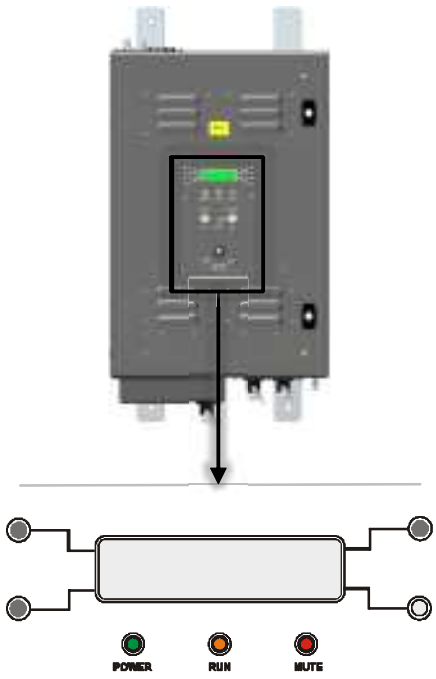
Antenna rotation can be stopped by any of the following methods:

***Antenna Rotation* Switch:**	Place the *Antenna Rotation* keyswitch located on the front of the Radar Distribution Unit into the OFF position.
***Man Aloft Switch*:**	Place the masthead *Man Aloft* switch into the OFF position.
RDU Breakers:	Isolate the three phase AC supplies using the breaker located within the Radar Distribution Unit.
Software Emergency Stop:	Press the *Antenna stop* button in the service display RadarView software (see below).

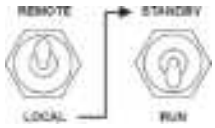
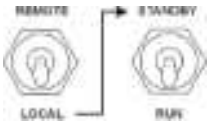
Caution: The software *Antenna Stop* function from the Service Display MUST NEVER be used as the primary means of system isolation for working aloft.

6.2 Local control overview

6.2.1 RDU Local controls



Radar Distribution Unit front panel

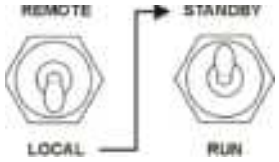
LCD display		A backlit LCD display shows the system status, menus, error and alarm messages
Green LED *Power*	OFF	No power, the RDU is not switched ON
	ON	The power is switched ON and the system is being controlled *Locally* or *Remotely*
	Flashing	The power is switched ON but the system is not controlled (no master)
Yellow LED *RUN*	OFF	The system is in standby
	ON	The transceiver has entered RUN mode and is transmitting
	Flashing	The system is unable to run because: - The *Man Aloft* switch or *Antenna Rotation key switches* are set in the OFF position - A fault is preventing transmission; check the status of the unit
Red LED *MUTE*	OFF	No Mute commands are being received, the system is transmitting for a full 360°
	ON	The transceiver is muted (no transmission)
	Flashing	The system is operating with sector blanking applied
Switch set to **Remote**		The system is in *Remote Control* and is operated from the track extractor or remote command & display system. *The Standby/ RUN switch has no function and can be in any position*
Switches set to **Local** & **Standby**		The system is in *Local control* with the transceiver in *Standby* mode. The track extractor or remote command & display system has no control [Note].
Switches set to **Local** & **RUN**		The system is in *Local control* and the transceiver is set to *RUN*. The track extractor or remote command and display system has no control [Note].
Antenna rotation **OFF**		The antenna is inhibited. All AC mains power to the transceiver enclosure and antenna sub-system is isolated. *The system cannot be run.*
Antenna rotation **FREE**		The antenna is free to rotate. Power is applied to the transceiver enclosure and antenna sub-system. *The system is available for use.*

6.2.2 Remote/ Local switch

A switch on the front of the Radar Distribution Unit allows the selection of *Remote* or *Local* operation. The following explains the basic operation of the system in these two modes.

> **Antenna Rotation Warning**:
>
> Depending on the position of the safety switches, the antenna will rotate regardless of the position of the *Remote/ Local* or *Standby/ Run* switches.

Local

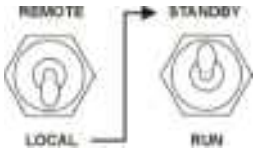


With Local selected, the system is in Local control and is used by the installation engineer or system maintainer to configure, test or locally control the system,

Remote control of the system is not possible.

With the optional Service Display off-line, system control, status and default information can be accessed, adjusted and viewed in the display panel which shows *control, status* and *defaults:*

See Section 6.2.4 pages 39 onwards for full details on the operation of the front panel.



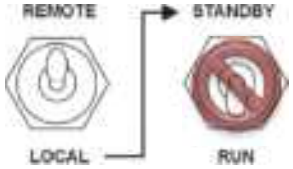
Standby: With the Standby/ Run switch in the *Standby* position, the SharpEye™ is in a ready state but does not transmit.

Run: With the Standby/ Run switch in the *Run* position, the SharpEye™ transmits.

Local control disabled?

When the optional Service Display is connected and is '*on-line*', Local control at the RDU is not possible as the service display has control. For RDU Local control, the optional service display must be '*off-line*'; see *Service Display control* in the following section for details on Service Display operation.

Remote



When Remote is selected, the system is controlled by the external command and display system or track extractor.

The *Standby/ Run* switch has no function and local / Service Display control is not possible.

System status and default information can still be accessed and viewed in the display panel which shows *status* and *defaults:*

See Section 6.2.4 pages 39 onwards for full details on the operation of the front panel.

6.2.3 System control status

System status	Remote control	RDU Local control	Service display Local control
RDU set to Local  **Service display On-line**	Remote control not possible	Local control at the RDU is not possible.	**The service display has control of the system.**
RDU set to Local  **Service display Off-line, Disconnected or Switched OFF**	Remote control not possible	**In local mode, the RDU controls the system using the controls on the front of the unit.**	The service display has no control.
RDU set to Remote  	**The system is controlled by the track extractor**	Local control at the RDU is not possible.	The service display has no control.

6.2.4 LCD panel operation

The LCD display on the front of the RDU is a backlit, two line, 16 character display.

Push buttons located either side of the display allow the control of the setup menus, local control and status monitoring.

The buttons are used in association with the information displayed in the LCD panel.

The bottom right button contains a warning lamp which flashes when an alarm condition is present.

6.2.5 LCD display button functions

The display menus and functions are controlled using the four push buttons located around the LCD display.

Adjustment & selection of the various menu functions depend on the symbol adjacent to each button as shown below:

←	Select menu item to the left, usually associated with the top left button.
→	Select menu item to the right, usually associated with the top right button.
↰	Go to previous level menu, usually associated with the bottom left button.
↴	Go to next level menu, usually associated with the bottom right button.
▶	Select the option to the left, usually associated with the bottom left button.
◀	Select the option to the right, usually associated with the bottom right button.
→ ■	Move the current cursor position to the right, usually associated with the bottom left button.
+	Increase the current item's value.
-	Decrease the current item's value.

6.2.6 Alarms

When the system is in Local control [Note 1] and an alarm condition exists, the lower right button will flash red and an audible alarm will be generated.

View alarm condition: To view the alarm message/ condition, select the ***Status* menu** and the alarm condition(s) will be displayed in the lower section of the LCD display.

Where present, the ▶ symbol against *the lower right* button indicates that additional alarm conditions exist. Pressing the ▶ button scrolls through any additional alarm messages.

Silence the audible alarm: To silence the alarm, select the **Status** menu and then press the lower right hand (red/ flashing) button. The audible alarm will be silenced but the message will continue to display until the condition is cleared.

Example [Note 2]**:** In the example shown below, an X-band transceiver is in Local control with a **PSUB PWR ALARM** displayed indicating that the AC mains input B has failed, is switched OFF or there is a fault with the power supply.

The ← and → arrows allow navigation away from the alarm messages to other functions available within the Status menu (see section 6.6.4 pages 56 onwards).

Additional alarms conditions are present as indicated by the ▶ symbol.

The ↑ symbol returns the display to the main menu.

Example of system status with active alarms

When an alarm has been acknowledged and more than one alarm condition exists, the display automatically scrolls through the list of alarms.

Note 1: When the Radar Distribution Unit is set to Remote, alarm messages are still generated and displayed but the audible alarm and flashing warning LED is disabled.
Note 2: The alarm shown is an example and may not be a valid alarm for the SBS-900 system.

6.3 Switch ON, OFF & Emergency stop

6.3.1 Switch ON

Prior to switching the system ON the following must be checked:

First time switch ON: Ensure the setting to work/ commissioning of the system has been successfully completed and signed off.

Power: Check that all sources of external AC power are available and are switched ON.

Antenna: Ensure the antenna is clear of all obstructions and that it is safe to rotate.

Transmission: Ensure it is safe to transmit.

ANTENNA ROTATION SAFETY NOTICE:

When three-phase power is connected to the system and switched ON, the antenna *will rotate immediately* regardless of the RUN command status.

The following describes the local switch-ON sequence for the SBS-900 transmission systems only and does not include the switch on procedures for the track extractor or optional service display.

DTX-A7 Transceiver enclosure		Ensure that the AC breaker(s) located within the transceiver enclosure are in the ON position. [Note] **Note:** In normal operation, this switch would be left in the ON position as it is only used/ switched OFF for maintenance purposes.	
Safety Switches	Man Aloft Switch	Ensure that the externally mounted *Man Aloft* Switch (MAS) is in the **FREE** position.	 *Man Aloft Switch*
	Radar Distribution Unit	Ensure that the *Antenna Rotation* keyswitch on the front of the Radar Distribution Unit is in the **FREE** position.	 *Keyswitch on door of RDU*
Radar Distribution Unit **AC power**		Within the Radar Distribution Unit LED's will illuminate on each breaker indicating that AC mains inputs are present within the system. [Note] Place all RDU breakers into the **ON** (UP) position. **Antenna Rotation Warnng:** When three phase AC mains is present and the breakers are in the ON position, the Radar Distribution Unit is switched ON and the antenna will rotate (see warnings in section 6.1 page 35).	 *RDU AC breakers*
System available for use		When power is available, switched ON and the switches set as shown above, the system is available for use and the antenna will rotate.	

Note: The LED indicators located on power breakers are an indication that mains voltages are present. They are NOT an indication that the breakers are switched ON.

6.3.2 Switch OFF

Switch OFF: The following describes how to switch OFF the SBS-900 system for operation purposes.

The following does not include the switch OFF/ shut down procedures for the track extractor, optional service display or external equipment attached to the system.

System isolation: Please refer to the maintenance section of the system handbook (KH-1602-2) for details on isolating the system from the mains supplies for maintenance purposes or working aloft.

Caution

The following details switching the SBS-900 system OFF for operation purposes only.

The following must not be used as a primary means of system isolation for maintenance procedures or working aloft.

Radar Distribution Unit ***Safety Switches***	Place the *Antenna Rotation* keyswitch on the front of the Radar Distribution Unit into the **OFF** position. This removes all AC power to the DTX-A7 Transceiver Enclosue and the Antenna sub-system As an additional safety precaution, when in the OFF position the key can be removed.  *Keyswitch on door of RDU*
Radar Distribution Unit ***AC power***	Place all three breakers within the Radar Distribution Unit to the **OFF** position. System status: - The Radar Distribution Unit is switched OFF but is not isolated from the AC input supplies. - The DTX-A7 Transceiver Enclosure is switched OFF thus stopping any transmission. - The antenna sub-system is switched OFF and will not rotate. The LED indicators on the breakers remain illuminated. **Note**

Note: *The LED indicators located on power breakers are an indication that mains voltages are present. They are NOT an indication that the breakers are switched ON.*

6.3.3 Emergency antenna stop

In an emergency, antenna rotation and system transmission can be stopped using ANY of the following mechanisms.

STOP antenna rotation **Use *any* of the functions shown**	**RDU keyswitch:** Place the *Antenna Rotation* keyswitch on the front of the Radar Distribution Unit into the ***OFF*** position. As an additional safety precaution, when in the OFF position the key can be removed.	 *Keyswitch on door of RDU*
	Man Aloft Switch (MAS): Place the externally mounted masthead *Man Aloft* switch to the OFF position. This has the same effect as using the Antenna Rotation switch noted above.	 *Man aloft switch*
	Service Display: RadarView software When the system is being operated via the service display (software must be On-line), select ***Channel A*** *then* ***Manage Radar***. Select the Emergency Stop button. This has the same effect as using the Antenna Rotation Keyswitch or the Man Aloft switch. Caution: This function is disabled when the Service Display is Off-line.	 *Example of Manage Radar window in RadarView program*

What happens?

When the *Antenna Rotation* or *Man Aloft* switches are set to OFF or when the *Emergency Stop* software function is activated, single and three-phase AC power to the DTX-A7 transceiver enclosure and to the Antenna sub-assembly are isolated thus stopping antenna rotatation and RF transmission.

System isolation:

Please refer to the maintenance section for details on isolating the system from the AC mains supplies for maintenance purposes or working aloft.

Caution: When the emergency stop functions are used, single and three phase AC voltages are still present within the RDU.

The following procedures must not be used as a primary means of system isolation for maintenance procedures or working aloft.

6.4 Local control operational states

For the purposes of the following explanations, *track extractor* means the user's command and display system or track extractor.

System OFF	System configuration	• Single and three-phase AC supplies to the RDU are available. • Breakers within RDU are OFF. • *Antenna Rotation* keyswitch & *Man aloft* switch both set to OFF. • *Remote/ Local* & *standby/ RUN* switches on the RDU set to *Remote* & *standby*. • No commands being received from the Service Display.
	System status	• AC power is present within the RDU but as the breakers are in the OFF position, the dual redundant power supply is OFF and no DC rails are being generated. The Radar Distribution Unit is OFF. • Single and three-phase mains voltages are NOT sent to the transceiver / gearbox.

System RUN ***Safety switches OFF***	System configuration	• Single and three-phase AC supplies to the RDU are switched ON. • The AC Breakers within RDU are ON. • *Antenna Rotation* keyswitch OR *Man Aloft* switch set to OFF. • *Remote/ Local* & *standby/ RUN* switches on the RDU set to *Local* & *Standby*.
	System status	• The RDU detects that the *Antenna Rotation* keyswitch OR *Man Aloft* switches are in the OFF position. This breaks the safety switch current loop. • The single and three-phase relays are opened and AC power to the transceiver/ gearbox is switched OFF. • Antenna rotation and transmission is not possible • The Service Display has no control over the system.

System standby	System configuration	• Single and three-phase AC supplies to the RDU are available. • The AC Breakers within RDU are ON. • *Antenna Rotation* keyswitch & *Man Aloft* switch both set to FREE. • *Remote/ Local* & *standby/ RUN* switches on the RDU set to *Local* & *Standby*.
	System status	• The RDU is switched ON. The software reads the condition of the Antenna Rotation keyswitch and Man Aloft switch, detects these are in the FREE position so makes relays within the breakers sending AC power to the transceiver/ gearbox. • The antenna commences rotation regardless of the RUN command State. [Note] • The SharpEye transceiver switches ON and after a 30 to 40 second warm-up time enters a standby state waiting for a RUN command from the RDU. • System and BITE data from both the RDU and transceiver is available. • The system is now in standby waiting commands from the Service Display.

System RUN	System configuration	• Single and three-phase AC supplies to the RDU are switched ON. • The AC Breakers within RDU are ON. • *Antenna Rotation* keyswitch & *Man Aloft* switch both set to FREE. • *Remote/ Local* & *standby/ RUN* switches on the RDU set to *Local* & RUN.
	System status	• The RDU detects that the RDU switches are set to *Local* and *RUN.* • The RUN command is sent to the transceiver which commences transmitting. • Radar signals, ACP, ARP and heading line data is sent to the radar I/O module within the RDU.

***Note**: Antenna rotation can be over-ridden in the Control Defaults menu.*

Transceiver operational states

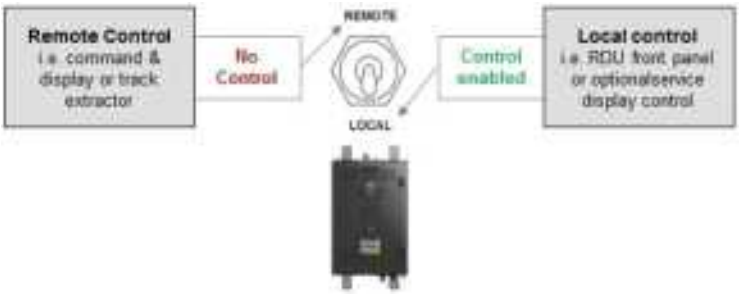
The following table shows the various operation states of the X or S-band SharpEye™ transceivers within the DTX-A7 transceiver enclosure:

Operation state	Description
OFF	Power is not applied to the transceiver and it is switched OFF.
Initialise	On completion of initialisation the transceiver switches to *standby* or, if any of the self-test checks fail, to *fault state.* The system initialisation typically takes 30 to 40 seconds after which time the system becomes available for operation.
Standby	In standby the transceiver establishes communication with the Radar Distribution Unit and reports its status. The transceiver receives and acts on commands from the RDU. In Standby the antenna rotates but the system does not transmit.
Transmit	When a RUN command is received from the Radar Distribution Unit and azimuth and heading line signals are present, the SharpEye™ transmits. The transceiver initially outputs at low power. The radar returns are then processed enabling the VSWR to be checked without the risk of damage to the transceiver. If the VSWR is within limits then the transceiver automatically switches to full power. If the VSWR is high, indicating an antenna fault, a warning message is sent to the Radar Distribution Unit and the transceiver enters the degraded *Low* Power state.
Degraded (Low power)	The transceiver continuously runs background performance checks on forward power, reverse power, receiver sensitivity and temperature. If any of these parameters falls outside predetermined levels a warning message is sent to the Radar Distribution Unit indicating the nature of the fault. The transceiver continues to operate, but with reduced performance and functionality.
Fault	If the performance or functionality is degraded such that the transceiver cannot operate it enters the fault state and a fault message is sent to the display equipment. The transceiver stops radiating RF and there is no video output to the Radar Distribution Unit. A spurious fault *may* be cleared by re-powering the equipment.
Communication error	If communication is lost between the Radar Distribution Unit and the SharpEye™, the RDU reboots the SharpEye leading to a potential 60 second gap in coverage.

6.5 Switch from Local to Remote

When Local control is no longer required, the system MUST be switched to Remote.

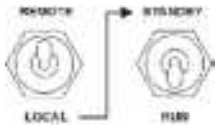
Caution: If the system is left in Local mode, remote operation by the command & display system or Track Extractor will NOT BE POSSIBLE.



Changeover: The system can only be changed from *Local* to *Remote* control using the switch on the Radar Distribution Unit; it is not possible to remotely change from Local to Remote.

6.5.1 Set to RUN & switch to Remote

The system can be set to *Remote* before the track extractor is on-line or ready (see below), this may be desirable when handing the system back to the Remote operating station.

Local selected		With *Local* selected use the front panel or service display to place the transceiver into *RUN.* Ensure the system is transmitting and is configured as required for operation.
Switch to Remote		Switch from *Local* to *Remote*. The system continues to transmit and is ready to accept control commands from the command & display system or track extractor.

6.6 Menus

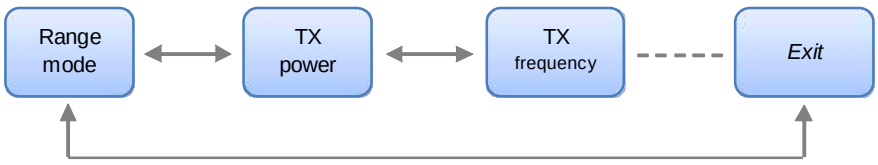
There are four menus that can be selected from the RDU LCD display.

Menu availability depending on the position of the RDU Local & Remote switch settings as detailed below:

Menu	RDU Menu availability		Description
	Local control	**Remote Control**	
Control menu	✓ Note	✘	This menu contains the operator and maintainer adjustable parameters for the system such as *range mode*, *Mute ON/ OFF*, *sea and rain filters* etc.
Status menu	✓	✓	The current status of the system can be viewed but not adjusted. For example signal status, transceiver run-time and temperature figures etc.
Default menu	✓	✓	The setup/ configuration of the system can be viewed but not adjusted.
Setup menu	✘	✘	The Setup menu is not available or required for 'normal' system operation. The menu is used by the system maintainer or commissioning engineer to configure the system.

6.6.1 Navigating within menus

Within all RDU menu structures it is possible to move back and forward between menus using the left ← and → right buttons located to the side of the LCD front panel:



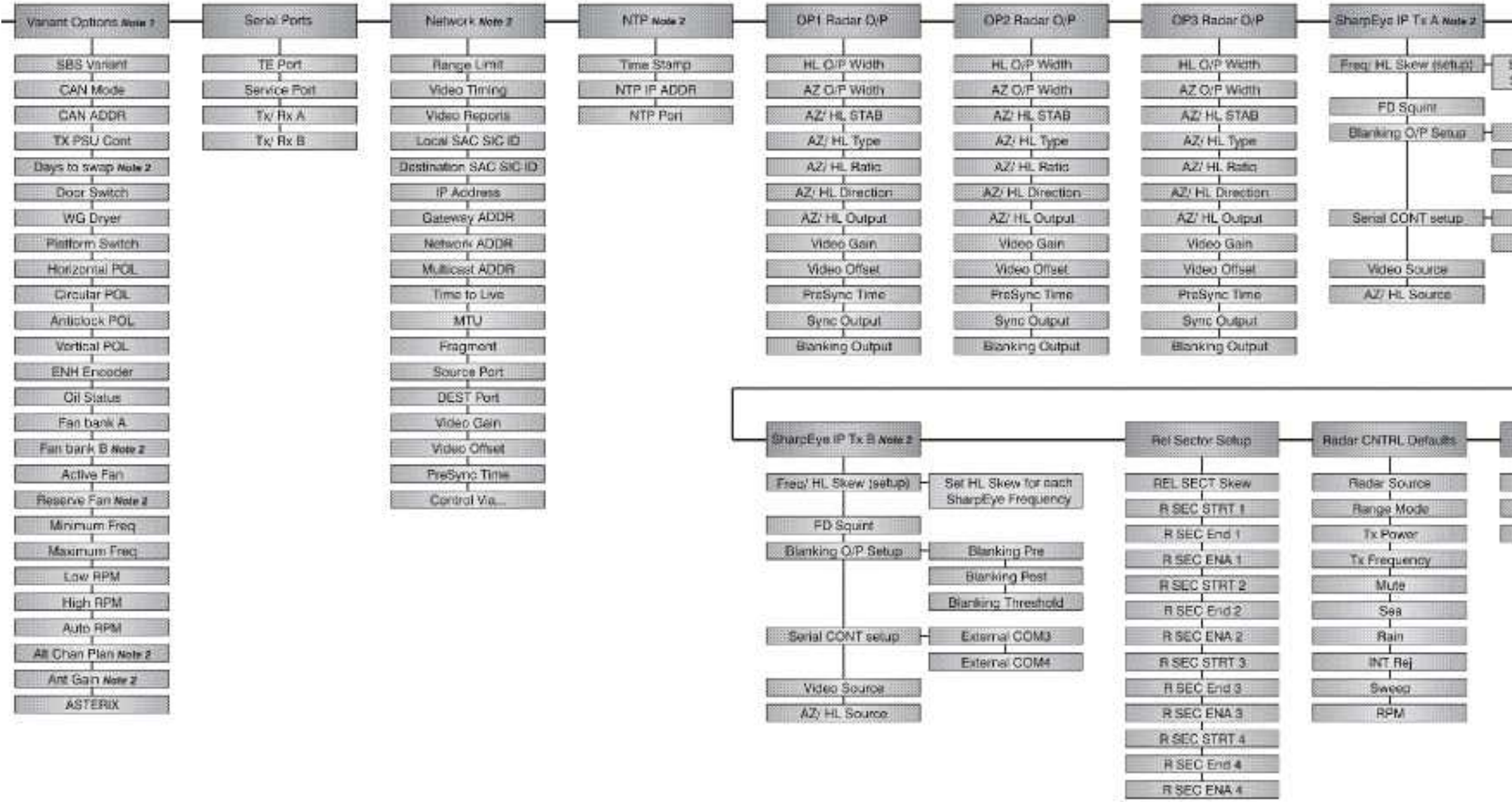
Note: In local control, the optional service display must be 'off-line' to obtain the Control Menu.

Page intentionally blank

Depending on the variant option selected, some menus will not be present.

is not available in normal operation and can only be accessed by authorised engineers who commission or maintain the system.
erator functions within the Setup menu.

adjustment of values within the Setup menu can reduce transceiver performance, disable functionality and/ or render the system un-operational.



ontents will vary depending on the Variant Option selected, for example, in single transceiver systems the SharpEye IN Tx B menu will not be present.
resent (system variant dependant).

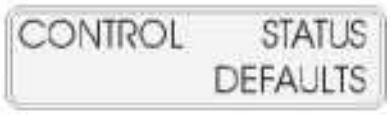
SBS-A1 Radar Distribution Unit SETUP MENU structure

6.6.3 Control menu

When operating in Local mode, the **Control menu** on the Radar Distribution Unit can be used by the operator or the system maintainer to adjust the system settings.

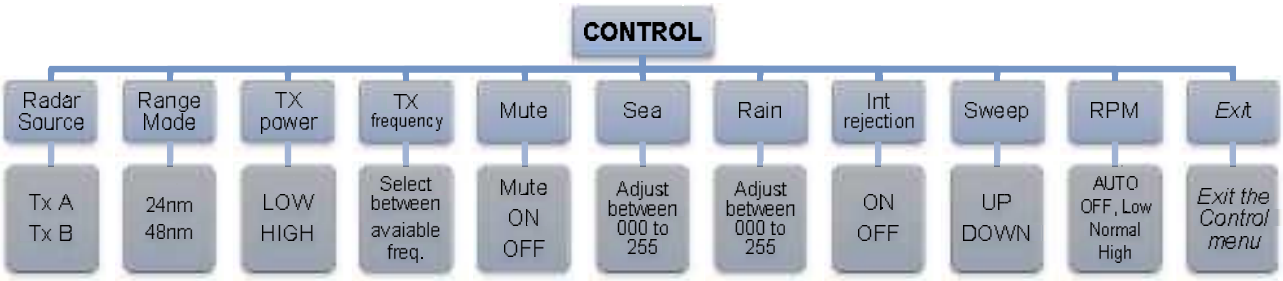
Menu availability: The *control menu* is only available on the RDU when the *Remote/Local* switch is set to *Local* and the service display is off-line, is not connected or is switched OFF.

When Remote is selected, the control menu is not available.



When *Control* is selected from the front panel, the various functions shown below can be selected and adjusted using the LCD display buttons as described in section 6.2.4 pages 39 onwards.

There is no **Save Changes** button or function, any adjustments are immediately adopted.



⚠	***Caution:*** *Incorrect configuration in the Control menus can degrade the performance of the system or inhibit operation. The Control menus should only be used by a suitably trained technician/ maintainer.*

6.6.3.1 Radar Source

Dual Systems: In dual transceiver systems, radar source selects the transceiver to be used.

- **SBS-900-3:** Select between Tx A or Tx B (both x-band)
- **SBS-900-4**: Select between Tx A (X-band) or Tx B (S-band)

Single system: The radar Source menu has no function in single transceiver systems, the TX is automatically selected and cannot be changed.

- **SBS-900-1**: TX A selected (X-band)
- **SBS-900-2**: TX A selected (X-band)
- **SBS-900-51:** TX B selected (S-band)

6.6.3.2 Range Mode

Within the *Range mode* menu, the transceiver instrument range can be selected between 24 and 48nm.

24nm: Limits the transceiver to an instrumented range of 24nm. This offers twice the range discrimination of the 48nm range.

48nm: Limits the transceiver to an instrumented range of 48nm.

6.6.3.3 TX Power

The output power of the SharpEye™ transceiver can be switched between High *(default)* and Low.

High power: The SharpEye™ transceiver transmits at full power.
This is the recommended default setting.

Low power: Low power is used in close waters or in a high clutter environment where a high output power may produce excessive unwanted reflections from buildings, bridges and vessels.

The transceiver will utilise the standard frame pattern but with output power reduced to less than 40W.

> ***Caution:*** As a result of reduced output power, range performance *will be reduced* and the system may not meet the expected operational detection performance.

When low power is selected, a *low power* status is automatically generated to advise the operator that the system is operating at a reduced output power.

Where the SharpEye™ detects a VSWR or a high temperature within the transceiver the system automatically switches to low power mode and generates system alarms.

6.6.3.4 TX Frequency

The frequency of the SharpEye™ transceiver can be selected which may be necessary to reduce interference from other transceivers to obtain the best picture quality.

Seven frequency bands are available between 9.21and 9.49GHz, each band being 20MHz wide and each band being separated by 20MHz.

6.6.3.5 Mute

The *Mute* function allows a 360 degree transmission inhibit to be enabled/ disabled.

Mute **ON**: Transmission is muted/ stopped i.e. no RF is radiated from the antenna however the antenna continues to rotate.

The RED Mute LED on the front of the RDU illuminates.

Mute **OFF**: The system transmits fully for 360 degrees.

The RED Mute LED on the front of is OFF.

Mute LED illuminates when Mute is enabled

6.6.3.6 Sea & rain

The level of *Sea and Rain* filtering can be adjusted between **000** (*minimum*) to **255** (*maximum*).

Sea: Filters the effect of sea clutter on returns.

Rain: Filters the effect of rain clutter on returns.

The levels are set using the ◀ (decrease value) and ▶ (increase value) buttons to produce the best quality picture in the prevailing conditions.

Caution: Care should be exercised when adjusting Sea and Rain filters as reducing the filter level can reduce signal returns from wanted / actual targets.

6.6.3.7 Int. Rejection

The Int. Rejection (*Interference Rejection*) filtering reduces the effect of in-band asynchronous interference from other radars thus reducing clutter on screen.

Int. Rejection can be enabled, disabled and configured as shown below. **Note**

OFF: Interference rejection OFF/ disabled.
Lower: Select lower of adjacent traces.
Higher: Selects higher of adjacent traces. **Note**
Average: Selects the average of adjacent traces. **Note**

6.6.3.8 Sweep

Sweep sets the signal sweep direction of the SharpEye™ transceiver RF pulses during medium and long pulse transmissions only.

Sweep UP: Default setting.

Sweep DOWN: This reverses the sequence of the RF pulses and may assist in the reduction of in-band asynchronous interference from other radars in the same Locality thus potentially improving the quality of returns.

Note: *Higher and Average interference rejection modes cannot be selected, these are for future developments*

6.6.3.9 RPM

The *RPM* function allows the operator to stop rotation (OFF), select auto or one of three pre-defined antenna rotation speed. **Note 1**

- Antenna speeds are configured at the factory and are enabled or disabled during setting to work.
- The RPM value set by selecting low, normal and high cannot be configured by the operator.
- Depending on the system configuration, different antenna speeds may not be available.

Auto: Automatically selects the optimum antenna RPM for the range mode in use. **Note 1**

OFF: Antenna rotation is stopped. **Note 2**

Low: Where enabled, the low antenna rotation speed configured during setting to work can be selected.
- *Low speeds increase the probability of target detection whilst reducing the update rate.*

Normal: The standard antenna rotation speed configured during setting to work can be selected.
- *Normal speed offers the best overall detection performance.*

High: Where enabled, the high antenna rotation speed configured during setting to work can be selected.
- *High speeds increase the update rate whilst reducing the probability of detection.*

6.6.3.10 Exit control menu

Selecting Exit closes the Control menu and returns the display to the default menu.

There is no **Save Changes** button or function, any adjustments are immediately adopted.

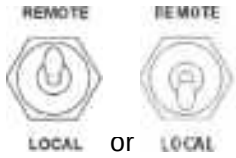
Note 1: *Antenna speed selection is system dependant and is not available on all models. Please consult with Kelvin Hughes for additional details.*

Note 2: *Setting the antenna speed to OFF in the RPM menu must NOT be used as a primary means of isolating the antenna and its sub-systems for safety critical purposes.*

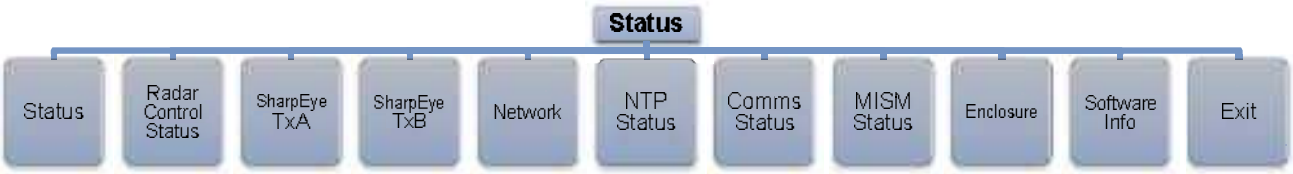
6.6.4 Status menu

The **Status menu** on the Radar Distribution Unit is used by the operator or the system maintainer to view but not configure or adjust the current system settings.

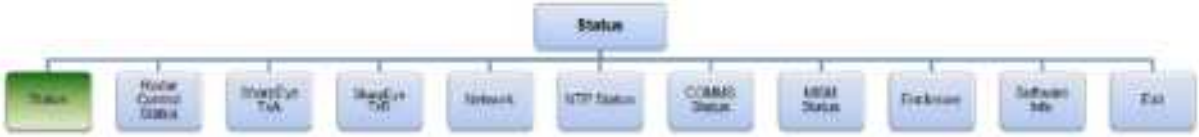
The *Status menu* is available on the RDU in both the ***Remote*** *and* ***Local*** setting.



When *Status* is selected from the front panel, the various functions shown below can be selected and viewed as described in section 6.2.4 pages 39 onwards.



6.6.4.1 System status



When the status menu is initially selected the system status is shown with any active alarms.

In the example shown below, an X-band transceiver is in Local control with a **PSUB PWR ALARM** displayed indicating that the AC mains input B has failed, is switched OFF or there is a fault with the power supply. **Note**

Example of system status with active alarms

The ▶ symbol against *the lower right* button indicates that additional alarm conditions exist. Pressing the ▶ button scrolls through these alarms.

ALARMS: When an alarm condition exists, the lower right button will flash red and an audible alarm will sound.

To silence the alarm, select the Status menu and press the *lower right* button. The audible alarm will stop however the alarm condition will continue to display until the condition is cleared.

Where an alarm has been acknowledged and more than one alarm condition exists, the display automatically scrolls through the list of alarms.

See section 6.2.6 page 40 for additional information on alarms.

Note: The alarm shown in the example may not be applicable to the SBS-900 system.

6.6.4.2 Radar Control Status

By scrolling through the *Radar Control Status* menus, the following system configurations and settings can be viewed but not adjusted.

A full description of each function is shown in the *Control menu* section 6.6.3 pages 51 onwards.

Radar Source	Transceiver A or B selection in dual systems
Range mode	Current instrumented range of 24nm or 48nm.
TX power	SharpEye™ output power of Low or high.
TX frequency	Shows which of the 7 SharpEye™ transmission frequencies is selected.
Mute	Indicates if the Mute is switched ON or OFF.
SEA	Shows the configured value of the Sea filter ($000^{min.}$ to $255^{max.}$).
RAIN	Shows the configured value of the Rain filter ($000^{min.}$ to $255^{max.}$).
Int rejection	Shows if interference rejection is set to OFF or Lower.
Sweep	Shows if the sweep is set to Forward (default) or reverse.
RPM	Shows the selected speed (revolutions per minute) of the antenna motor.
Rel sector 1	Rel sector *1 to 4* will show Enabled or Disabled for each blanking sector. When Enabled, the start/ stop bearings of the selected sector is also shown.
Rel sector 2	
Rel sector 3	
Rel sector 4	
Exit	Exits the Radar control status menu.

6.6.4.3 SharpEye

By scrolling through the *SharpEye* **Tx A** or SharpEye **Tx B** menus (see table below), the following transceiver conditions can be viewed but cannot be adjusted.

Note: *In Single transceiver systems, the Tx A or Tx B menu may not be available.*

System	Transceivers	TX A	Tx B
SBS-900-**1**	Single	X-band	N/A
SBS-900-**2**	Single	X-band	N/A
SBS-900-**3**	Dual	X-band	X-band
SBS-900-**4**	Dual	X-band	S-band
SBS-900-**51**	Single	N/A	S-band

SharpEye	HL	Shows the antenna RPM based on HL frequency.	
	Azimuth	Shows the value of the azimuth being received or Fail if no signal is present. The normal value is 4096.	
	Video	Shows if the video is OK (present) or Fail if no signal is present.	
	Sync	Shows the current Sync value (PRF) or Fail if no signal is present.	
	Blanking	Shows if blanking is OK (present) or Fail if no signal is present.	
	Status 0: Mode ↴	Run Mode	Standby or Run.
		Mute	ON or OFF.
		Range	24nm or 48nm.
		Frequency	SharpEye™ transmission frequency (1 to 7).
		Sweep	Forward or reverse.
		Power	High or Low.
		RPM	Shows the RPM as detected by the SharpEye™
		25us Pre sync	Pre-sync from the SharpEye™ transceiver Enabled or Disabled.
		Video range	Show the instrumented video range in µs.
	Status 1: Alarm ↴	RX	Receiver OK or Fail.
		VSWR	VSWR OK or Fail – if Fail the transceiver automatically switches to low power mode.
		TX power	Output power OK or Fail.
		PLO	Programmable Local oscillator OK or Fail.
		SYNTH	SharpEye™ internal synth OK or Fail.
		Temp	Internal temperature OK, warning or shutdown.
		Turning	Antenna turning data OK or Fail.
		HL	Heading line (ARP) OK or Fail.
		AZ IN	Azimuth in (ACP) OK, reverse or Fail.
		FPGA2	FPGA 2 OK or Fail.
	Status 2: GSR ↴	Sea	Sea clutter: 000 (minimum) to 255 (maximum).
		Rain	Rain clutter: 000 (minimum) to 255 (maximum).
		Int Rej	Shows the current Interference Rejection setting.
		Doppler filter	Select levels of 4, 8, 16, 32 or 64.

Continued on following page

SharpEye (*continued*)	Status 3: VERS ↴	ZM number	System software identification number.
		Software VERS	The version number of the above ZM number.
		FPGA version	Version of code loaded into the FPGA.
	Status 5: Times ↴	Time-ON	Number of hours the SharpEye™ has been switched ON *(HH:MM).*
		Run-time	Number of hours the system has been transmitting *(HH:MM).*
	Status 8: Temp ↴	FPGA 1 temp	The current temperature of FPGA 1 (Deg. C).
		FPGA2 temp	The current temperature of FPGA 2 (Deg. C).
	Exit	Exit the SharpEye Tx A or Tx B menu	

6.6.4.4 Network

The IP addresses and network status can be viewed but not adjusted.

Note: *In some configurations, the menu will not be present.*

Temp	Shows the temperature in Degrees C.
Range Limit	TBC
Video Timing	TBC
Video reports	TBC
Local SAC SIC ID	TBC
Destination SAC SIC ID	TBC
IP Address	TBC
Gateway Address	TBC
Netmask Address	TBC
Dest Address	TBC
Control Port	TBC
MTU size	TBC
Fragment	TBC
MAC Address	TBC
Exit	Exit the Network menu.

6.6.4.5 NTP Status

The IP addresses and network status can be viewed but not adjusted.

Note: *In some configurations, the menu will not be present.*

Time Stamp	TBC
IP Address	TBC
NTP Port	TBC
Time (hh:mm:ss)	TBC
Exit	Exit the Network menu.

6.6.4.6 COMMS status

By scrolling through the *COMMS status* menus, the following system conditions can be viewed but cannot be adjusted.

System	Transceivers	TX A	Tx B
SBS-900-**1**	Single	X-band	N/A
SBS-900-**2**	Single	X-band	N/A
SBS-900-**3**	Dual	X-band	X-band
SBS-900-**4**	Dual	X-band	S-band
SBS-900-**51**	Single	N/A	S-band

In the following Active/ Inactive means:

Active: A correctly configured and connected system is switched ON and sending serial command or status request messages.

Inactive: A correctly configured and connected system may be switched OFF or is not sending serial messages.

SharpEye TX-A	The transceiver is active or inactive Note 1
SharpEye TX-B	The transceiver is active or inactive Note 1
Comms S/E A1	TBC
Comms S/E B1	TBC
TE display	Track Extractor (TE) is active or inactive Note 2
Service display	Service display is active or inactive Note 2
Network Card	TBC
Enclosure	TBC
Exit	Exit the Comms status menu

Note 1: If communication between the RDU and the transceiver is lost, the RDU carries out a single power reset to the transceiver (cycles the AC mains). If communication is not re-established the COMMS status will show Inactive.

Note 2: A request status from the track extractor or optional service display is not necessary when in the Control menu.

6.6.4.7 MISM status

By scrolling through the *MISM status* (Modular Interface System Module) menus, the status of each of the 12 slots on the backplane can be viewed.

A1 MISB 5 B1 MISM 5 A2 MISM 5 B2 MISM 5 A3 I/O Mk2 B3 I/O Mk2 A4 I/O Mk2 B4 Signals A5 Signals B5 Comms A6 Signals B6 I/O Mk2 MISB PSU	**Possible MISM conditions:** Empty: **A PCA is not fitted in the slot.** Error: **The PCA is in the wrong slot for the RDU variant.** Missing: **The PCA required by the software is not present i.e. is not loaded.** Present: **The correct PCA is fitted.** Error messages: **If a module is fitted in the wrong slot or is missing, the RDU will not function further than reporting the error.**
Exit	Exits the MISM status menu

6.6.4.8 Enclosure

The status of the transceiver enclosure and optional antenna sub-assembly monitoring can be viewed in the Enclosure menu.

Encl Temp	Internal temperature of the transceiver enclosure in Degrees C. Note: The temperature sensor is located on SBS-A126 PCA.		
Oil level MON	Status of the optional oil level monitoring Note: Advanced antenna sub systems only.		
Oil Temp MON	Optional Oil Temperature status Note: Advanced antenna sub systems only.		
ENH Encoder	Shows if an enhanced encoder is enabled or disabled Note: Enabled for Advanced antenna sub systems only.		
WG / FIB / POL	Shows if a polarised antenna is enabled. Note: Advanced antenna sub systems only.		
Fan A1	Optional SBS-A179 Powered Fan assembly	Status of Fan A1	**Note:** In single transceiver systems. Fan bank A or B may not be present in the menu structure.
Fan A2		Status of Fan A2	
Fan A3		Status of Fan A3	
Fan B1		Status of Fan B1	
Fan B2		Status of Fan B2	
Fan B3		Status of Fan B3	
PSU Tx A: 3.3V	Indicates the power supply voltage. **Note:** In single transceiver systems Tx A or Tx B voltages may not be present in the menu.		
PSU Tx A: 15V			
PSU Tx A: 13V			
PSU Tx B: 3.3V			
PSU Tx B: 15V			
PSU Tx B: 13V			
PSU INT: 15V	Indicates the power supply voltage.		
PSU INT: 5.0V	Indicates the power supply voltage.		
Exit	Exits the Enclosure menu		

6.6.4.9 Software info

By scrolling through the *software info* menus, the various software versions for the system can be identified:

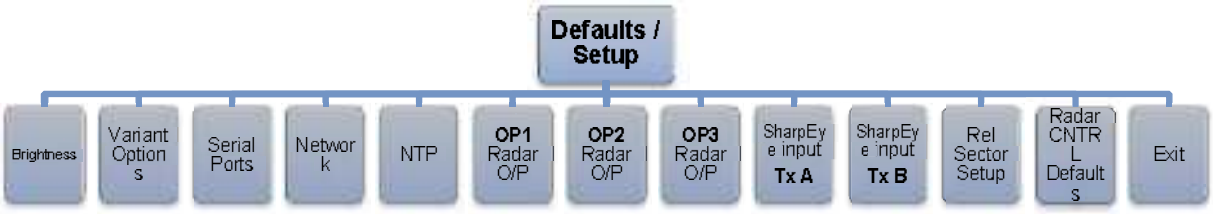
MISB Backplane	These menus display the software part and version umbers loaded into the system.
MISB FPGA number	
SharpEye Tx A S/W	
SharpEye Tx A FPGA	
SharpEye A1 Software	
SharpEye A1 FPGA	
SharpEye B1 Software	
SharpEye B1 FPGA	
SharpEye B2 Software	
SharpEye B2 FPGA	
SharpEye B Software	
SharpEye B FPGA	
Network Software	
Enclosure	
Exit	Exits the Software Info menu.

6.6.4.10 Exit Status menu

Selecting Exit closes the status menu and returns the display to the default menu. As no changes can be made, there is no Save Settings function.

6.6.5 Default and Setup menu

Depending on the system status, the RDU front panel will show **Defaults** or **Setup.**



Default: This is the normal operational setting and is used by the operator or system maintainer to view the system configurations (read only).

Setup: When configured for commissioning, the Setup menu is used by an authorised technician or system maintainer for configuration/ setting to work. The Setup menu is not used during normal operation.

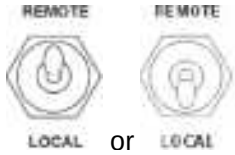
Description: The basic outline of the menu is detailed on the following pages. Detailed explanations for each setting can be found in the *Setting to Work* section of the system Installation and Commissioning handbook (reference KH-1602-1).

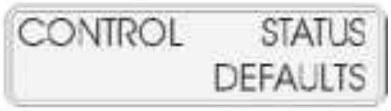
Menu variations: The menu structure can vary depending on the system variant selected. For example in a single X band system, the *SharpEye IP Tx B* and *Fan Band B* menus are not present.

Default menu (normal use)

When the service display is inactive (off-line), the *Default menu* is available in both *Remote* and *Local* modes.

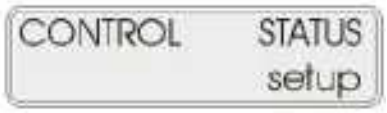
Settings in the Default menus can be viewed but **cannot** be adjusted.

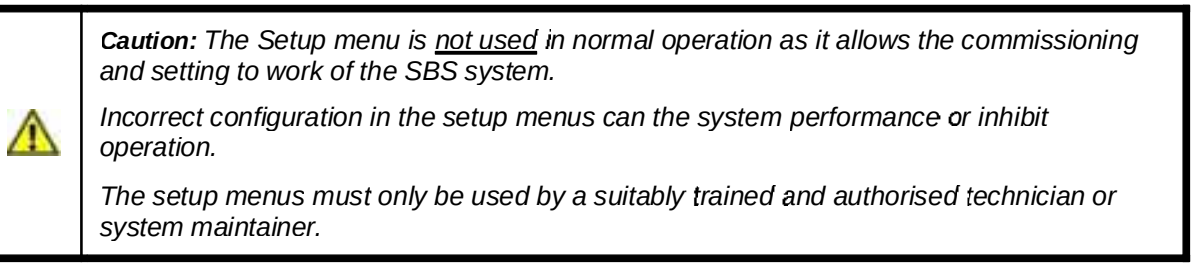




Setup menu (Commissioning/ setting to work)

The *Setup menu* is only available when the service display is offline, the switch is set to *Local* and the RDU is configured to be commissioned.





Caution: *The Setup menu is <u>not used</u> in normal operation as it allows the commissioning and setting to work of the SBS system.*

Incorrect configuration in the setup menus can the system performance or inhibit operation.

The setup menus must only be used by a suitably trained and authorised technician or system maintainer.

6.6.5.1 Brightness

Brightness is used to set the backlight brilliance of the LCD front panel on the Radar Distribution Unit.

Bright +	Increases the backlight brilliance of the front panel.
Bright -	Decreases the backlight brilliance of the front panel.

6.6.5.2 Variant Options

The Variant Options menu shows the system configuration.

SBS variant	Shows the SBS system number *i.e. SBS-900-1*.
CAN Mode	Shows the CAN mode as OFF, RIU, TIU or Fixed.
CAN Address	To Be Confirmed.
TX PSU CONT	Set to Always ON in SBS-900 systems.
Days to Swap	Shows the number of days until the transceiver automatically swaps (Dual transceiver systems only).
Door switch	Enabled where a Hut door security switch is connected.
WG dryer	Enabled when the optional pressurized waveguide dryer is installed.
Platform switch	Enabled where an Antenna Platform security switch is fitted.
Horizontal POL Circular POL Anti-clock POL Vertical POL	Enabled when a polarised antenna is being fitted.
ENH Encoder	Fitted is displayed when an enhanced encoder is installed.
Oil status	Enabled when the optional oil monitoring input from the Advanced antenna Turning Unit is installed.
Fan Bank A	Enable or disable the optional powered fan kit for Tx A. *Note: In single Transceiver systems, this menu may not be present.*
Fan Bank B	Enable or disable the optional powered fan kit for Tx B. *Note: In single Transceiver systems, this menu may not be present.*
Active Fan	Set the temperature that Fan Bank A switches on or set to permanently ON. *Note: In single Transceiver systems, this menu may not be present.*
Reserve Fan	Set the temperature that Fan Bank B switches on or set to permanently ON. *Note: In single Transceiver systems, this menu may not be present.*
Minimum FREQ	Displays the minimum available SharpEye™ frequency.
Maximum FREQ	Displays the maximum available SharpEye™ frequency.
Low RPM	Enabled when LOW RPM antenna speeds have been commissioned.
High RPM	Enabled when HIGH RPM antenna speeds have been commissioned.
Auto RPM	Enabled when AUTO RPM antenna speeds have been commissioned.
Alt Chan Plan	This allows the system to *Note: System specific menu, this may not be present in standard system.*
Ant Gain	Allows the selection of the antenna gain when Alt Chan Plan is selected. *Note: System specific menu, this may not be present in standard system.*
EXIT	Exits the Variant Options Menu.

6.6.5.3 Serial Ports

The serial ports menu displays the baud rates configured for the serial outputs to the transceiver, Service Display (SKL: Service display serial port) or the optional analogue track extractor (SKK: TE serial port).

TE port	Displays the Baud Rate for the Track Extractor (TE) output
Service port	Displays the Baud Rate for the Service Display.
TX/ RX A	Displays the Baud Rate for the SharpEye™ TX / Rx A.
TX/ TX B	Displays the Baud Rate for the SharpEye™ TX / Rx B.
EXIT	Exits the Serial Ports menu

6.6.5.4 Network

The Network menu shows the system settings for the network.
Note: In ASTERIX enabled systems, this menu may not be present.

Range limit	48nm is the factory default
Video timing	Frame is the factory default
Video reports	Continuous is the factory default
Local SAC SIC ID	To Be Confirmed.
Destination SAC SIC ID	System area code and security identifier
IP ADDR	Default IP address for the Radar Distribution Unit
Gateway ADDR	Default gateway address for the Radar Distribution Unit
Network ADDR	Default Netmask address for the Radar Distribution Unit
Multicast ADDR	Default multicast address for the Radar Distribution Unit
Time to Live	To Be Confirmed.
MTU	1500 is the factory default
Fragment	IP is the factory default
Source port	To Be Confirmed.
Dest port	To Be Confirmed.
Video Gain	To Be Confirmed.
Video Offset	To Be Confirmed.
Pre-Sync Time	To Be Confirmed.
Control Via…	To Be Confirmed.
Exit	Exits the Network menu

6.6.5.5 NTP time

Display of the NTP (Network Time Protocol) time settings.
Note: In ASTERIX enabled systems, this menu may not be present.

Time stamp	Displays if NTP time is ON or OFF
NTP IP ADDR	Shows the default IP address (192.168.022.071)
NTP port	Shows the default port (00123)

6.6.5.6 OP1, 2 & 3 Radar O/P

This menu displays the RDU analogue levels for outputs 1, 2 and 3.

HL O/P widths	Displays the heading line output pulse width
AZ O/P width	Displays the azimuth output pulse width
AZ/HL STAB	Displays if the azimuth is stabilised or unstabilised. This is set to UNSTAB for all SBS-900 systems
AZ/HL type	Displays if the Heading line is Quadrature or Pulsed. This is set to Pulse for all SBS-900 systems
AZ/HL ratio	Displays the Azimuth / Heading Line ration. This is set to 4096:1 for all SBS-900 systems
AZ/HL DIRECTN	Set to Normal for all SBS-900 systems
AZ/HL O/P	Displays a value between 0 and 63 that is used to set the azimuth and heading line output voltage. **Note**
Video gain	Displays a value between 0 and 63 that is used to set the video output gain. **Note**
Video offset	Displays a value between 0 and 63 that is used to set the video output offset with respect to ground/ 0V. **Note**
PRESYNC time	Displays the pre-sync (Sync Delay) time used for range alignment.
Sync output	Displays a value between 0 and 63 that is used to set the Sync output. **Note**
Blanking O/P	Displays a value between 0 and 63 that is used to set the blanking output amplitude **Note**
EXIT	Exits the OP1, 2 or 3 Radar O/P menu

Note: This is NOT an indication of the actual voltage output level.

6.6.5.7 SharpEye IP Tx A & B

Note: The Tx A or Tx B menu may not be present in single transceiver systems.

FREQ/ HL Skew	*New sub menu* ➔	HL SKEW	Displays the Heading Line skew for each SharpEye frequency that is enabled.
		Exit ↖	Returns to the SharpEye IP menu.
FD Squint	To Be Confirmed		
Blanking O/P	*New sub menu* ➔	Blanking Pre	Displays the value of the pre blanking pulse.
		Blanking Post	Displays the value of the post blanking pulse.
		Blanking Threshold	TBC
		Exit ↖	Returns to the SharpEye IP menu.
Serial control	*New sub menu* ➔	External COM 3:	TBC
		External COM 4:	TBC
		Exit ↖	Returns to the SharpEye IP menu.
Video source	Indicates which MISM PCA is the source the Video		
AZ HL source	Indicates which MISM PCA is the source the ACP/ ARP		
EXIT	Exits the SharpEye IP Tx A or Tx B menu		

6.6.5.8 Rel Sector

The following menu displays the start and stop bearings of each of the four relative blanking sectors. It also shows if the sectors are enabled or disabled.

R SEC START 1	Relative Sector 1	Displays the start bearing of mute
R SEC END 1		Displays the end bearing of mute
R SEC ENA 1		Shows if the Mute Sector is Enabled or Disabled
R SEC START 2	Relative Sector 2	Displays the start bearing of mute
R SEC END 2		Displays the end bearing of mute
R SEC ENA 2		Shows if the Mute Sector is Enabled or Disabled
R SEC START 3	Relative Sector 3	Displays the start bearing of mute
R SEC END 3		Displays the end bearing of mute
R SEC ENA 3		Shows if the Mute Sector is Enabled or Disabled
R SEC START 4	Relative Sector 4	Displays the start bearing of mute
R SEC END 4		Displays the end bearing of mute
R SEC ENA 4		Shows if the Mute Sector is Enabled or Disabled
EXIT	Exits the Rel Sector menu	

6.6.5.9 Radar CNTRL (Control) Defaults

This menu displays the Radar Control Defaults settings.

Radar Source	Shows which transceiver is selected in dual systems
Range mode	Current instrumented range of 24nm or 48nm.
TX power	SharpEye™ output power of Low or high.
TX frequency	Shows which of the SharpEye™ transmission frequencies is selected.
Mute	Indicates if the Mute is switched ON or OFF.
SEA	Shows the configured value of the Sea filter ($000^{min.}$ to $255^{max.}$).
RAIN	Shows the configured value of the Rain filter ($000^{min.}$ to $255^{max.}$).
Int rejection	Shows if interference rejection is set to OFF or Lower.
Sweep	Shows if the sweep is set to Forward (default) or reverse.
RPM	Shows the selected speed (revolutions per minute) of the antenna motor.
Exit	Exits the Radar control status menu.

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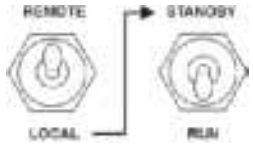
7 Remote operation instructions



When the Radar Distribution Unit is set to *Remote* operation, the external command and display system or track extractor has control of the system.

For test purposes, the optional service display can be configured for Remote control and be connected to the track extractor (TE) port to test the serial port functionality.

RDU Local control: With the switch set to *Remote*, Local control of the system via the Radar Distribution Unit is NOT possible.

7.1 Remote control operator instructions

External command and display and track extractor
Operator instructions for the external command and display or track extractor systems are not included in this handbook; please refer to the suppliers system handbooks for instructions.

Service display (optional)
The operator instructions for the service display and service display control software can be found in Annex A of this handbook.

7.2 External commands

The commands sent and received by the SBS-900 system are detailed in a separate document reference *KSD-4750: Serial Control of SBS Radar Systems* which is available upon request.

Alternatively a copy can be found in Annex B of the system installation manual KH-1602-1.

7.3 Remote control operational states

For the purposes of the following explanations, track extractor means the user's command and display system or track extractor.

System OFF	System configuration	• Single and three-phase AC supplies to the RDU are available. • The AC Breakers within RDU are OFF. • *Antenna Rotation* keyswitch & *Man aloft* switch both set to OFF. • *Remote/ Local* & *Standby/ RUN* switches on the RDU are set to *Remote* & *Standby*. • Commands being received from the Service Display.
	System status	• AC power is present within the RDU but as the breakers are in the OFF position, the dual redundant power supply is OFF and no DC rails are being generated. The Radar Distribution Unit is OFF. • Single and three-phase mains voltages are NOT sent to the transceiver / gearbox.
System RUN ***Safety switches OFF***	System configuration	• Single and three-phase AC supplies to the RDU are switched ON. • The AC Breakers within RDU are ON. • *Antenna Rotation* keyswitch OR *Man Aloft* switch set to OFF. • *Remote/ Local* & *Standby/ RUN* switches on the RDU are set to *Remote* & *Standby*.
	System status	• The RDU detects that the *Antenna Rotation* keyswitch OR *Man Aloft* switches are in the OFF position. This breaks the safety switch current loop. • The single and three-phase relays are opened and AC power to the transceiver/ gearbox is switched OFF. • Antenna rotation and transmission is not possible. • The Service Display has no control over the system.
System Standby	System configuration	• Single and three-phase AC supplies to the RDU are available. • The AC Breakers within RDU are ON. • *Antenna Rotation* keyswitch & *Man Aloft* switch are both set to FREE. • *Remote/ Local* & *Standby/ RUN* switches on the RDU are set to *Remote* & *Standby*. • No commands being received from the Service Display.
	System status	• The RDU is switched ON. The software reads the condition of the Antenna Rotation keyswitch and Man Aloft switch, detects these are in the FREE position so makes relays within the breakers sending AC power to the transceiver and gearbox. • The antenna commences rotation regardless of the RUN command State. **Note** • The SharpEye transceiver switches ON and after a 30 to 40 second warm-up time enters a standby state waiting for a RUN command from the RDU. • System and BITE data from both the RDU and transceiver is available. • The system is now in standby waiting for system commands.
Remote control ***System RUN***	System configuration	• Single and three-phase AC supplies to the RDU are available. • The AC Breakers within RDU are ON. • *Antenna Rotation* keyswitch & *Man Aloft* switch both set to FREE. • *Remote/ Local* & *Standby/ RUN* switches on the RDU set to *Remote* & *Standby*. • A RUN command is being received.
	System status	• The RDU detects the RUN command which is sent to the transceiver. • The SharpEye is in a standby state with the antenna running. When the run command is received from the RDU the system commences transmitting. • Radar signals, ACP, ARP and heading line data is sent to the radar I/O module within the Radar Distribution Unit. • The RDU processes the transceiver data and sends it to the track extractor and optional service display.

***Note**: Antenna rotation can be over-ridden in the Control Defaults menu.*

Transceiver operating states

The following table shows the various operation states of the SharpEye™ transceiver.

The antenna will rotate regardless of the transceiver state.

Operation state	Description
OFF	Power is not applied to the transceiver which is switched OFF.
Initialise	On completion of initialisation the transceiver switches to *standby* or, if any of the self-test checks fail, to *fault state.* The system initialisation typically takes 30 to 40 seconds after which time the system becomes available for operation.
Standby	In standby the transceiver establishes communication with the Radar Distribution Unit and reports its status. The transceiver receives and acts on commands from the RDU. In Standby the antenna rotates but the system does not transmit.
Transmit	When a RUN command is received from the Radar Distribution Unit and ACP/ARP signals are present, the SharpEye™ transmits. The transceiver initially outputs at low power. The radar returns are then processed enabling the VSWR to be checked without the risk of damage to the transceiver. If the VSWR is within limits then the transceiver automatically switches to full power. If the VSWR is high, indicating an antenna fault, a warning message is sent to the Radar Distribution Unit and the transceiver enters the degraded *Low* Power state.
Degraded (Low power)	The transceiver continuously runs background performance checks on forward power, reverse power, receiver sensitivity and temperature. If any of these parameters falls outside predetermined levels a warning message is sent to the Radar Distribution Unit indicating the nature of the fault. The transceiver continues to operate, but with reduced performance and functionality.
Fault	If the performance or functionality is degraded such that the transceiver cannot operate it enters the fault state and a fault message is sent to the display equipment. The transceiver stops radiating RF and there is no video output to the Radar Distribution Unit. A spurious fault *may* be cleared by re-powering the equipment.
Communication error	If communication is lost between the Radar Distribution Unit and the SharpEye™, the RDU reboots the SharpEye™ leading to a potential 20 second gap in coverage.

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8 Service display/ RadarView control

8.1 Overview

SBS systems can be controlled and radar returns viewed using the optional range of service displays. Service displays can be used as a maintenance/ commissioning tool or when correctly configured, as a primary means of system control.

There are a number of service display options for the SBS series as follows:

Service display part number & description		SBS-900-1 SBS-900-2 SBS-900-51	SBS-900-3 SBS-900-4
SBS-A3-2	Single radar sensor Base components for integration into a 3rd party supplied PC	✓	✓
SBS-A3-3	Single radar sensor display RS232/ ASTERIX control & monitoring	✓	✓
SBS-A3-5	Single radar sensor LAN/ ASTERIX and RS232 control & monitoring (No radar input card fitted)	✗	✓ LAN kit required. See Note

All service displays are supplied with the following software pre-loaded.

ZM-2283 RadarView software	**RadarView Software:** This software provides the radar processing and display and has integrated control and monitoring functions for the SBS series. **Operator instructions:** The use and operator instructions for the ZM-2283 RadarView and SBS control software can be found in Annex B.

8.2 SBS-A3-2 Base system

The SBS-A3-2 allows the serial control of a single transceiver system via a customer supplied third party PC/ Microprocessor. See the *options* section in the system overview handbook for the minimum PC specification.

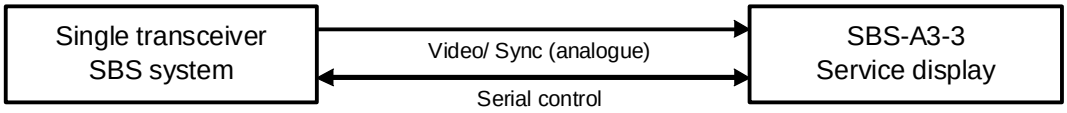
The kit provides all the hardware and software to be installed onto a PC to make the system compatible with the SBS series and comprises the following:

Kelvin Hughes part number	Description
SBS-A109	19" rack mountable (1U) service display patch panel and cables
ZM-2283	RadarView software including SBS radar control and replay software for maintenance displays. Supports of HPx-200 and/ or Asterix video.
45-980-0041-001	HPx-200 PCI radar interface card
ZM-2602	SBS service display graphic V2

Note: The SBS-A3-5 service display can only be used with the LAN kit is fitted.

8.3 SBS-A3-3 Single transceiver

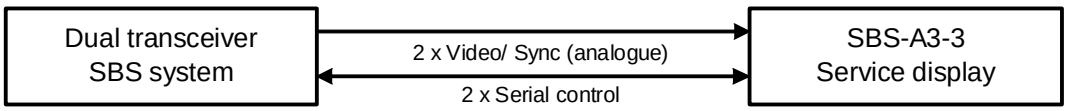
The SBS-A3-3 kit contains a 19" rack mountable (2U) microprocessor preloaded with all the necessary software and an interface place for connecting the system to a single transceiver system.



Kelvin Hughes part number	Description
45-975-0183-001	19" (2U) rack mountable microprocessor.
SBS-A109	19" rack mountable (1U) service display patch panel and cables
ZM-2283	RadarView software including SBS radar control and replay software for maintenance displays. Supports of HPx-200 and/ or Asterix video.
45-980-0041-001	HPx-200 PCI radar interface card (preinstalled into the PC)
ZM-2602	SBS service display graphics card (preinstalled into the PC)
SBS-A124-11	Cable kit for connecting the SBS-A109 plate to the SBS system (11m) **Note:** Other cable lengths are available; please contact Kelvin Hughes for additional details.

8.4 SBS-A3-4 dual transceiver

The SBS-A3-4 kit contains a 19" rack mountable (2U) microprocessor preloaded with all the necessary software and two interface places for connecting to a dual transceiver system.

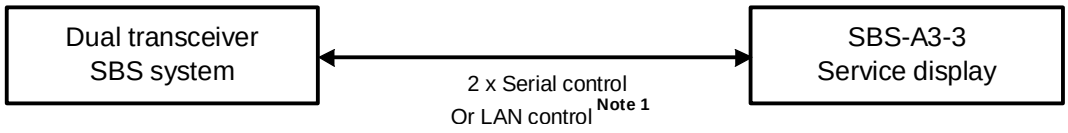


Kelvin Hughes part number	Description
45-975-0183-001	19" (2U) rack mountable microprocessor.
SBS-A109	2 x 19" rack mountable (1U) service display patch panel and cables
ZM-2283	RadarView software including SBS radar control and replay software for maintenance displays. Supports of HPx-200 and/ or Asterix video.
45-980-0041-001	2 x HPx-200 PCI radar interface card (preinstalled into the PC)
ZM-2602	SBS service display graphics card (preinstalled into the PC)
SBS-A124-11	Cable kit for connecting the SBS-A109 plate to the SBS system (11m) **Note:** Other cable lengths are available; please contact Kelvin Hughes for additional details.

8.5 SBS-A3-5 ASTERIX control

The SBS-A3-5 kit contains a 19" rack mountable (2U) microprocessor preloaded with all the necessary software for connection to a dual transceiver system.

The service display can accept ASTERIX video and control is possible via Serial or LAN connection.
Note



Kit contents

The *SBS-A3-4 dual radar service* kit comprises of the following:

45-975-0183-001	19" (2U) rack mountable microprocessor.
ZM-2283	RadarView software including SBS radar control and replay software for maintenance displays. Supports of HPx-200 and/ or Asterix video.
ZM-2602	SBS service display graphics card (preinstalled into the PC)
SBS-A220-11	Cable kit for connecting the SBS-A109 plate to the SBS system (11m) Note 2

8.6 Keyboard, monitor & Mouse

The processor requires a flat screen display, standard USB QWERTY keyboard and USB mouse (not supplied). If these are required the following commercial off the shelf products can be supplied:

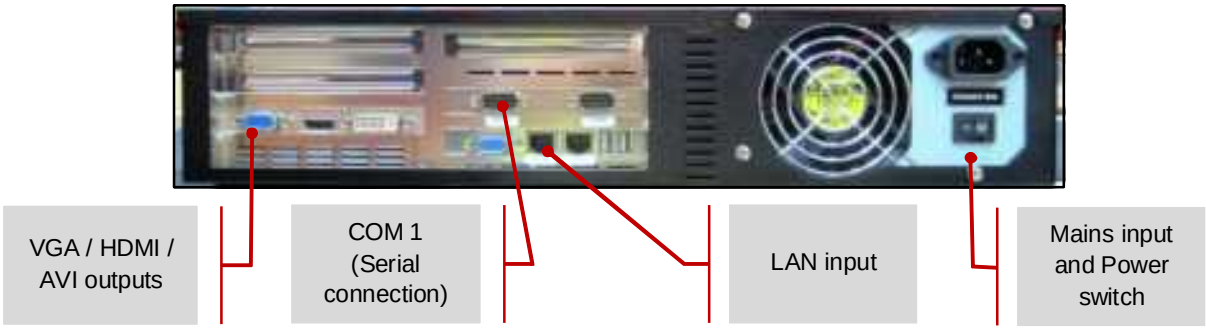
Kelvin Hughes part number	Description	
Monitor 45-975-0189-001	22 inch wide screen LCD monitor. Auto-ranging AC input 110VAC to 230VAC 47Hz to 63Hz. Case colour black.	
Keyboard 45-975-0191-001	USB QWERTY keyboard, case/ key colour black.	
Mouse 45-975-0190-001	Black USB optical scroll mouse with three buttons.	

Note 1: LAN control is only available when the LAN interface kit has been fitted to the Radar Distribution Unit (kit reference SBS-A129).
Note 2: Other cable lengths are available; please contact Kelvin Hughes for additional details.

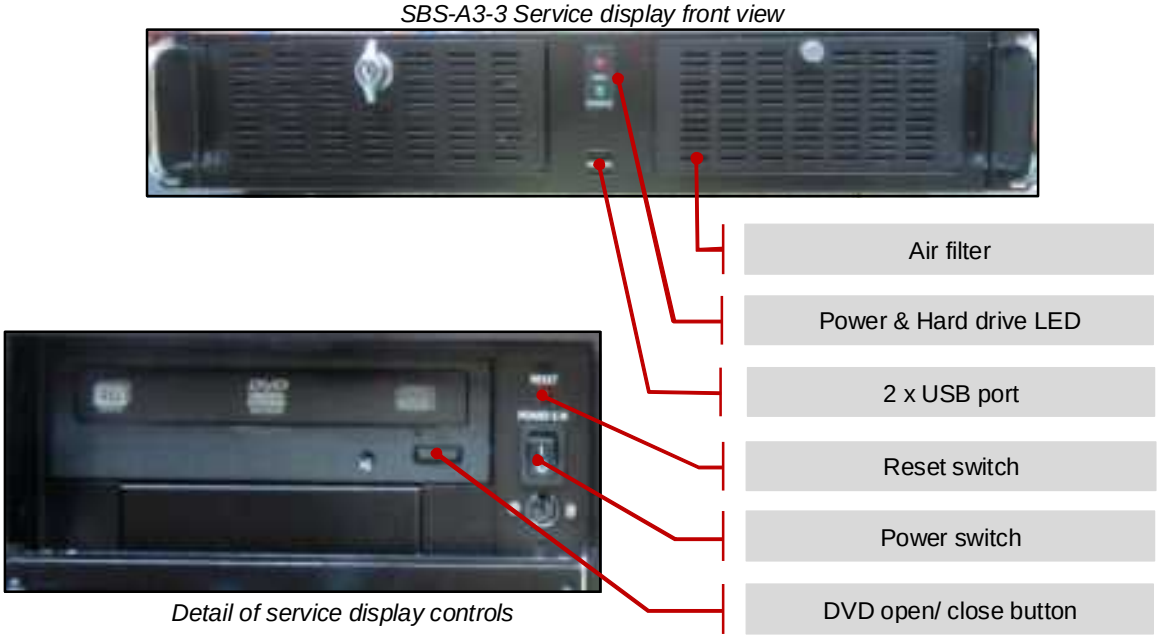
8.7 Service Display PC overview

The following gives an overview of the 19" (2U) rack mounted microprocessor used in the SBS-A3-*3*, *-4* & *-5* service displays.

Note: *The make and model of the service display PC may change from the version shown however the switch functionality and input/ output connectivity will be similar.*



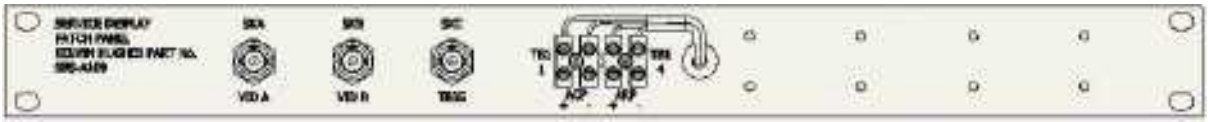
SBS-A3-3 Service display front view



Detail of service display controls

SBS-A109: 19" rack mountable (1U) service display interface plate:

The following plate is used to connect signals to the service display (1 plate required per transceiver).



The system runs the software required to display and control a single radar sensor but does not include a monitor, keyboard or mouse.

8.8 Switching ON/ OFF

SBS-A3-2: Third party system

The operation of third party PC equipment used in the SBS-A3-2 service display is not detailed within this handbook. Please refer to the user manuals supplied with the original third party equipment.

SBS-A3-X: 2U 19 inch processor rack

The following details the switching ON/ OFF of the microprocessor used in the SBS-A3-*3*, *-4* & *-5*.

Switch ON	i. Ensure an AC mains supply is connected to the system and is switched ON (115/ 230VAC auto-ranging) ii. Open the front panel of the service display processor. iii. Place the power switch into the ON (I) position. iv. The green power LED illuminates and the processor will start.
Run RadarView application	When the service display has started, run the RadarView application from the desktop. A brief overview of the operation of RadarView software can be found in the following section.  *RadarView desktop icon*
Reset	If a system lockup or freeze occurs, temporarily press the *Reset* switch which restarts the processor. ***Caution**: Pressing reset aborts all programs that are running. All unsaved work and temporary configurations will be lost. The main system configurations and settings are retained.*
Closing the RadarView application	Prior to switching the OFF service display, the RadarView application must be closed.
Shut-down and switch OFF	Ensuring the RadarView application has closed, shut down the system using the *Start*/ *shutdown* function from the Windows desktop. When Windows has shut-down, place the power switch into the OFF (0) position or if the switch is spring loaded, press and hold the OFF button for 5 seconds)

8.9 Emergency Stop

The Emergency Stop is a function within the RadarView software that isolates power to the transceiver enclosure and antenna turning sub assembly. This function is only available when the service display/ RadarView is *ON-line*.

If the Service display is *off-line* the Emergency Stop function cannot be accessed/ used.

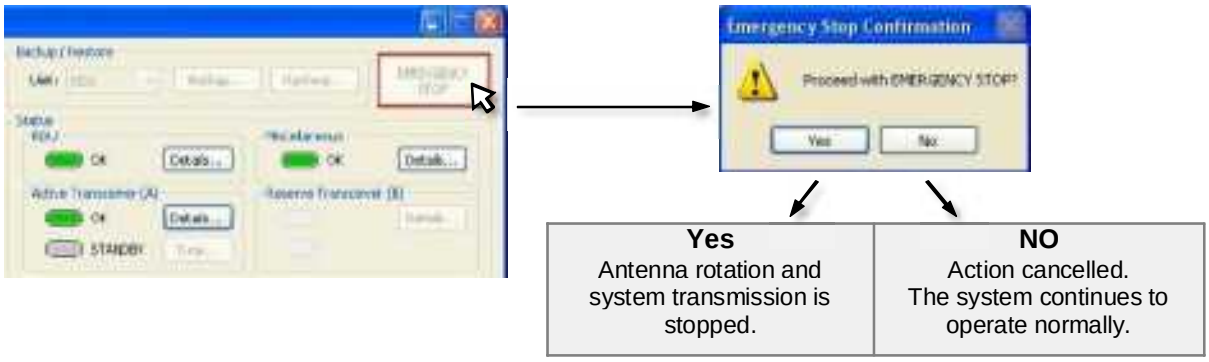
Emergency Stop is designed to be used by the operator if an emergency situation is detected that requires immediate shutdown of the transmission system.

Caution: The software Emergency Stop function must never be used to stop the system for maintenance purposes or for working aloft.

The system must be fully isolated from all sources of power prior to carrying out any maintenance task or before working aloft.

To activate the Emergency Stop function, select ***Channel A*** *then* ***Manage Radar…*** from the RadarView main screen.

Press the Emergency stop button and the following occurs:



Yes	NO
Antenna rotation and system transmission is stopped.	Action cancelled. The system continues to operate normally.

When the Emergency Stop is activated, the following system changes occur:

RadarView software	
Antenna Speed:	*Stop* is automatically selected.
Transceiver Mode:	*Standby* is automatically selected.
Stop button:	The *Emergency Stop* button text changes to *Restart.*

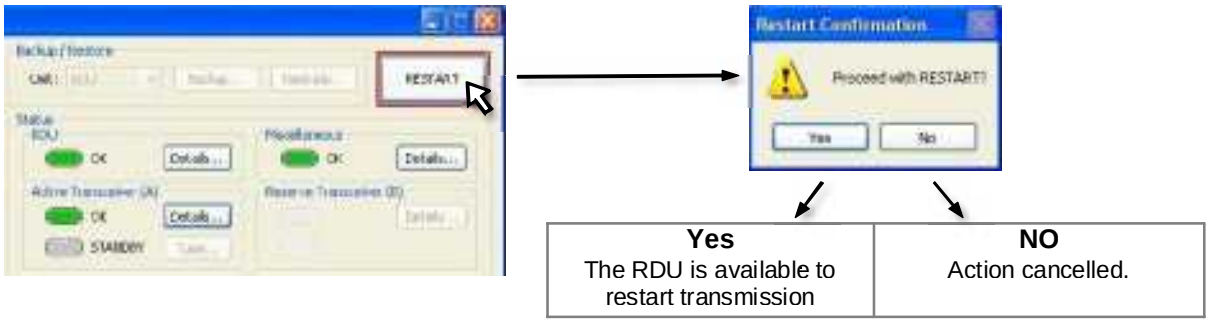
Radar Distribution Unit	
AC power:	Single & three phase relays (R1, R2 and CON1) switch OFF.
Alarm:	An *Emergency Stop* alarm is generated at the RDU.
Antenna rotation	AC power is removed from the Antenna Sub-System. Antenna rotation is stopped.
Transceiver Enclosure	AC power is removed from the transceiver Enclosure. System transmission is stopped.

Emergency Stop – system re-start

When the situation that caused the Emergency Stop function to be activated has been cleared, the system must be restarted:

Pressing the *Restart* button is pressed configures the RDU so that it is ready to go to RUN.

Further operator action is required from the RadarView software to then commence system transmission and antenna rotation:



Yes	**NO**
The RDU is available to restart transmission	Action cancelled.

Antenna Speed: Select the *required antenna speed*.
Transceiver Mode: Switch from *Standby* to *RUN* to commence transmission.

The system will now operate normally.

8.10 RadarView operator overview

8.10.1 Overview

The manufactures operator handbook for RadarView can be located as follows:

 Printed copies	In printed copies of this handbook, a copy of the *RadarView user manual* can be found in section *Annex B.*
 Electronic copies (PDF)	In electronic copies, the *RadarView user manual* can be found in the root directory of the KH1600 document (PDF format).
Document details and copyright notice: Cambridge Pixel RadarView user manual	SPx RadarView for Windows User Manual Document number: CP-25-110-27 Kelvin Hughes Ltd is not responsible for the content of the RadarView user manual which remains the copyright of Cambridge Pixel Ltd. *Document reference CP-25-110-27 contains proprietary information that is sensitive to the commercial interests of Cambridge Pixel Ltd. The contents of this document should not be communicated to third parties without the prior written consent of the Company.*

The following offers a brief overview of the RadarView operator's screen. Users must refer to the manufactures handbook noted above for full instructions.

The RadarView application is run by double clicking on the desktop icon; this will open the main PPI view shown below.

Example of RadarView screen for an SBS-900-2 system

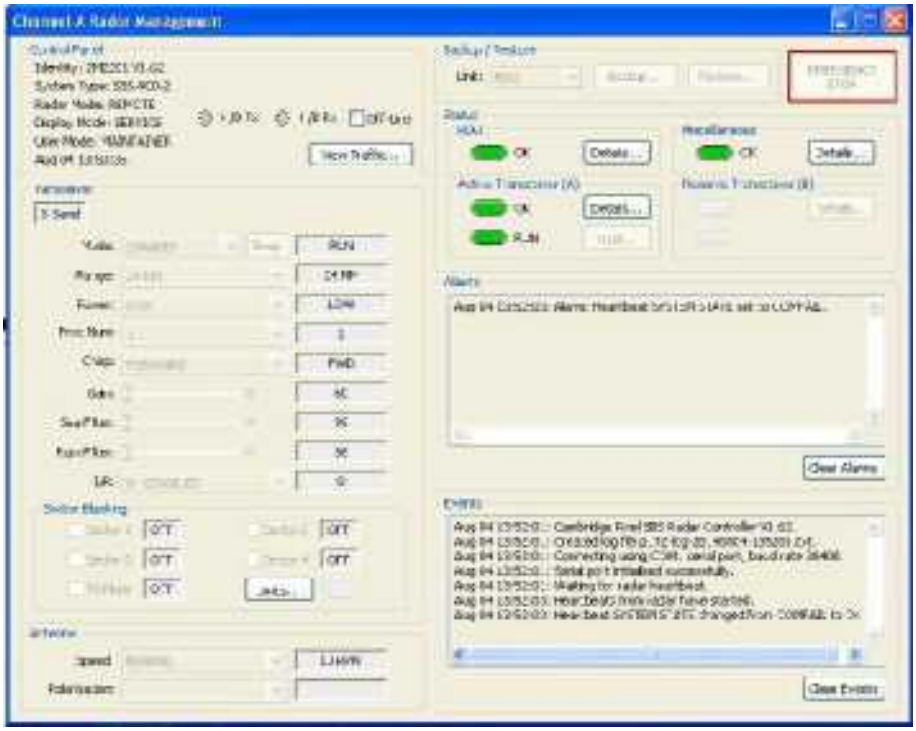
8.10.2 RadarView – manage radar

Selecting '**Channel-A / Manage Radar…'** opens the Manage Radar screen which allows the remote control and viewing of:

- The Radar Distribution Unit (RDU).
- Transceivers.
- System information.

The screen also allows the activation of the **Emergency Stop** function.

Each section is detailed on the following pages.



Control Panel

- View system information (software version etc.).
- **H/B:** Shows the transmitted and received Heartbeats (flashes green).
- **Off-line**: *Select* to take the service display Off-line.
- **View Traffic…**: Opens a new window showing the messages flowing between the service display and the RDU.

View Traffic window

Transceiver

Shows the current transceiver settings.

Antenna

Shows the current antenna speed.

Sector Blanking

Shows the status of blanking sectors & Mute ON/ OFF.

Tune

Shows the current tune level

Backup & Restore

Backup or restore the RadarView settings.

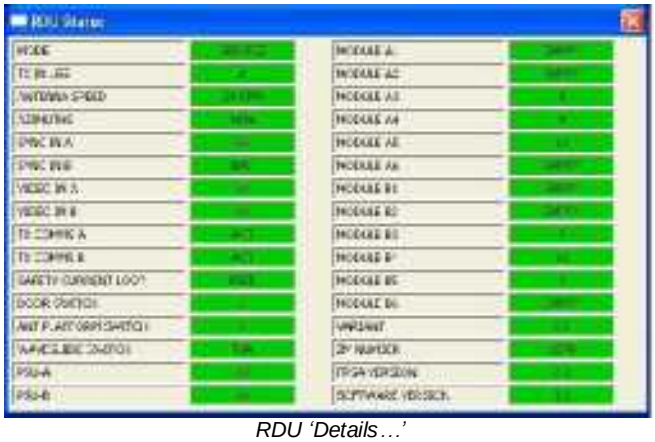
Emergency Stop

Selecting Emergency Stop sends an antenna/ trasnmission stop command to the RDU. All AC power is removed from the transceiver/ gearbox.

Status – RDU

Select the ***Details…*** button for information.

Status Green: No fault conditions exist.
Status Red: A fault condition is present.



RDU 'Details…'

Status – Active or Reserve Transceiver

Select the ***Details…*** button for information.

Status Green: No fault conditions exist.
Status Red: A fault condition is present.

Example of the Active Transceiver window

Status – Miscellaneous

Select the ***Details…*** button for information.

Status Green: No fault conditions exist.
Status Red: A fault condition is present.

Example of Miscellaneous status

8.10.3 Transceiver status

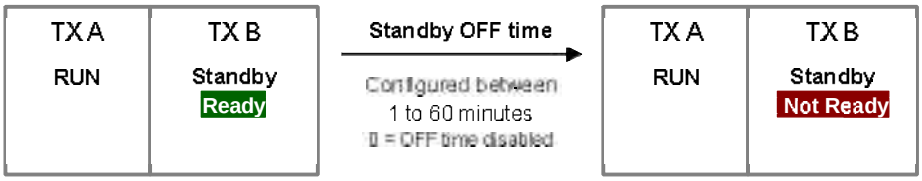
Transceiver warm up: At switch ON, the transceiver enters a short initialisation period where the transceiver(s) will show as *Not Ready* and the TX status indicator in the RadarView software will show as Red.

After the initialisation period, the TX status indicator changes to Green signifying that the transceiver is ready for use.

Magnetron heater *turn-down*: The system is shipped with the magnetron heaters configured to be always ON, i.e. when the system is *switched ON* and in *Standby* the transceiver remains in a *Ready* state indefinitely.

During commissioning it is possible to set the magnetron heaters to switch OFF when set to Standby after a pre-determined time. When the heaters are OFF, the transceiver is Not Ready and the 90 second delay would be required before the unit becomes available for use.

Heater turn-down/ Standby OFF delay may be a site requirement to preserve the life of the magnetron.



⚠	**Caution:** The RadarView software DOES NOT report when the heaters have switched OFF and will continue to show the transceiver as Ready (green).

If the system is swapped to a transceiver that has been switched OFF, there will be a 90 second delay whilst the transceiver warms up.

View heater time: To view the heater turn-down time, select the following menus on the LCD display of the transceiver(s):

- *Defaults / Heater / SBY OFF delay:* Available values are 0 (disabled) to 60 minutes.

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9 Planned maintenance

9.1 Standard Antenna Systems

Equipment: The following pages detail the monthly, annual, 3 and 5-year planned maintenance schedules for the following Standard antenna sub-systems.

LPA-A37 LPA-A55 LPA-A3 LPA-A455	X and S-band Low Profile Antennas (all variants)
DTX-A3 GTX-A11 DTX-A19	X and S-band gearboxes (all variants)
DTX-A7	Downmast transceiver enclosure (all variants)
SBS-A1	RDU - Radar Distribution Unit (all variants)
55-100-0436-001	Static desiccator

Recommended maintenance schedule:	
Annual:	▪ General inspection and cleaning of the system ▪ Fan checks ▪ Safety checks
3-year:	▪ Replacement of gearbox oil
5-year:	▪ Replacement of static inverter and RDU power supply fans

Maintenance record: The following pages have been designed to be printed, completed and stored as a maintenance record for standard systems.

Any damage that is identified as part of an inspection should immediately be reported to Kelvin Hughes and appropriate action taken to prevent further damage occurring.

Procedure: Prior to carrying out any maintenance the system must be fully isolated from all sources of AC power including any UPS supported supplies, the required maintenance task(s) should be undertaken and on completion, the power restored and the system fully tested.

Spares: Where required, only Kelvin Hughes approved spares must be used. The use of unapproved spares invalidates the warranty status of the unit could lead to a malfunction of the system.

Adverse weather: It is strongly recommended that the gearbox inspections noted in Annual Maintenance procedures are carried out at the earliest safe opportunity after the system has been exposed to severe or adverse weather conditions.

Health & safety: All safety warnings for the system noted in section 2 must be observed at all times when working on, inspecting or maintaining any part of the system or its associated sub systems.

9.2 Advanced Antenna Systems

The planned maintenance procedures for the Advanced ST1-F10/ 20 Antenna Turning Unit (ATU) and antenna range are briefly outlined below but are not detailed in this handbook.

ST1-F10/ 20 Antenna Turning Unit & antenna

Please refer to the installation and maintenance handbook supplied with the advanced equipment for full details on planned maintenance.

Electronic copies of these handbooks (Pdf) are available on request.

For reference use only, the recommended maintenance schedule is:

Recommended maintenance schedule for ATU and antenna:	
Every 6 months:	▪ General inspection of the ATU and the antenna.
Every 6 years:	▪ Replacement of the crossed roller bearing of the bearing-mounted antenna mounting flange. ▪ Replacement of the gearbox complete with motor ▪ Replacement of the rotary joint.

Transceiver enclosure and Radar Distribution Unit:	
The transceiver enclosure and Radar Distribution Unit MUST be inspected in line with the Standard system planned maintenance schedule which is shown in the following section. This includes the inspection of the following equipment:	
DTX-A7	Downmast transceiver enclosure (all variants)
SBS-A1	RDU - Radar Distribution Unit (all variants)
55-100-0436-001	Static desiccator

WARNING:

Lethal voltages are present within the equipment.

All maintenance procedures must be carried out with all relevant power sources switched OFF, fully isolated and disconnected.

Health & Safety precautions: All health & safety notices noted in this document and the enhanced system handbook must be read and observed at all times.

9.3 System isolation

In addition to the normal health and safety requirements, the system must be made safe prior to carrying out any maintenance task by fully isolating all AC power including any UPS supported supplies to the system as shown below:

Man aloft switch (MAS)	As an additional safety precaution, the Man Aloft Switch can be placed into the **OFF** position. This acts as a backup safety measure to removing the *Antenna Rotation* keyswitch.	
RDU Antenna rotation switch	Place the *Antenna Rotation* keyswitch on the front of the Radar Distribution Unit into the **OFF** position. The key should be *removed* and retained until the maintenance task being undertaken has been completed.	
DTX-A7 Transceiver enclosure	Ensure that the AC breaker(s) located within the transceiver enclosure are in the OFF position. **Note:** The LED's on each breaker are illumiated when AC supplies are still connected to the transceiver enclosure.	
RDU AC power	Within the Radar Distribution Unit, ensure all breakers are in the **OFF** position. **Note:** When switched OFF, the LED's on each breaker remain illumiated indicating that AC supplies are still connected to the RDU.	
External AC	Isolate and disconect ALL single and 3-phase AC supplies to the Radar Distribution Unit including all UPS supported supplies and physically remove all power sockets. **The system is now fully isolated from all sources of AC supply.**	

9.4 Annual maintenance procedure

SBS-900 Annual planned maintenance record sheet	***Inspection sheet 1 of 10***

Equipment details			
Antenna Sub-System [Note]			
Gearbox/ Antenna Turning Unit		**Antenna**	
Part No.		Part No.	
Serial number:		Serial No.	
Transceiver enclosure			
Part number	**DTX-A7-**		
Serial number(s)			
Radar Distribution Unit (RDU)			
Part number	**SBS-A1-**		
Serial number(s)			
Man Aloft Switch (MAS)			
Part number	**SBS-A132**		
Serial number			
Inspection date:	(DD/ MM/ YYYY)		
Inspected by:	*Print:*	*Sign:*	
Tools required	• Blower or soft brush. • Medium flat head screwdriver (*for opening RDU and transceiver enclosure*). • Mild detergent *Note: Do not use abrasive cleaners or products containing alcohol.* • Soft abrasive free cloth. • Safety ohmmeter, bridge Megger or Multimeter. • Spanners (*6mm, 10mm and as required for custom earth attachments*). • Wire brush or emery cloth.		
Skill level	Basic electrical training, working at heights awareness.		
Time	Approximately three hours depending on equipment location and accessibility		

Note - Advanced ATU and antennas: Please refer to the advanced installation and maintenance handbook supplied with the equipment for full details on planned maintenance of advanced equipment.

The maintenance procedure for the Advanced antenna sub-system is NOT covered or recorded in this document.

SBS-900 Annual planned maintenance record sheet

Inspection sheet 2 of 10

WARNING: Prior to commencing any maintenance procedure, users must familiarise themselves with the health & safety warnings noted in the planned maintenance and health and safety sections of the system handbooks.

Prior to carrying out planned maintenance, the system must be fully isolated from ALL single and 3-phase AC supplies including any UPS supported supplies.

Caution: When the gearbox and antenna have been operating in strong sunlight or elevated temperatures, the gearbox casing and antenna surfaces will be extremely hot.

Antenna inspection

Task	Description	Pass	Fail
Cleaning	Clean the antenna facia with a soft cloth moistened in a mild non-abrasive soap solution. ***Note[1]**: Cleaning the antenna is important as the system performance can be degraded if the antenna transmission face becomes obscured by dirt.* ***Note[2]**: The antenna facia must never be painted.*	☐	☐
Physical inspection	Ensure that all securing bolts are tights, secure and show no signs of severe corrosion or damage.	☐	☐
	Check that waveguide couplings are securely fastened and appear to be waterproof.	☐	☐
	The antenna should be checked to ensure that there is no obvious external damage, cracking or potential faults that could lead to a general failure of any part of the system.	☐	☐
	Check the antenna for signs of excessive vertical end play.  *Example of antenna end-play* If the end play is more than +/-10mm please consult with Kelvin Hughes.	☐	☐

Caution:

- The following tests should only be undertaken when it is safe to manually rotate the antenna i.e. the system is fully isolated from *all* sources of power and the antenna can be *safely* accessed and reached.
- Do not use excessive force.
- Do not take unnecessary risk when turning the antenna such as reaching too far or leaning outside safety guardrails.
- *This task should be disregarded if there are any safety concerns.*

Task	Description	Pass	Fail
Manual antenna rotation	Noting the above safety precautions and where safe to do so, manually rotate the antenna and ensure that it is free from obstruction and turns smoothly	☐	☐
		Antenna not accessible ☐	

SBS-900 Annual planned maintenance record sheet

Inspection sheet 3 of 10

Gearbox inspection			
Task	**Description**	**Pass**	**Fail**
General cleaning	Clean all exterior surfaces with a soft, cloth moistened in a mild non-abrasive soap solution.	☐	☐
Physical inspection	Ensure that all securing bolts for the gearbox and antenna are secure and show no signs of severe corrosion or damage. Pay particular attention to the bolts that hold the gearbox assembly onto the mounting plate.	☐	☐
	Inspect the gearbox including all mounting points for *any* signs of stress damage. ***Severe weather:*** *This inspection should be carried out at the earliest safe opportunity after the system has been exposed to severe or adverse weather conditions.*	☐	☐
	Check that cable glands, cable entries and waveguide couplings are securely fastened and appear to be waterproof.	☐	☐
	Within reason and where safe to do so, check all accessible or exposed cables for any signs of damage and ensure they are safely secured into/ onto cable trays or trunking.	☐	☐
	The system should be checked to ensure that there is no obvious external damage or potential fault conditions that could lead to a general failure of any part of the system.	☐	☐
	Check for any signs of oil leaks from the gearbox assembly.	☐	☐
Earth bonding and continuity	Ensure that the earth bonding nuts and bolts are tight and free from corrosion. If corrosion is present, clean and re-terminate as described in section 9.7 page 114.	☐	☐
	Test the earth bonding conductivity by attaching one lead of the test equipment [note1] to earth/ chassis and the other to an unpainted part of the equipment under test. Check earth bonding for continuity, the resistance should not exceed 0.1 ohms. If a test fails, investigate the bonding, rectify (see section 9.7 page 114) and repeat the test. **Note[1]:** Safety ohmmeter, bridge Megger or Multimeter.	☐	☐

SBS-900 Annual planned maintenance record sheet

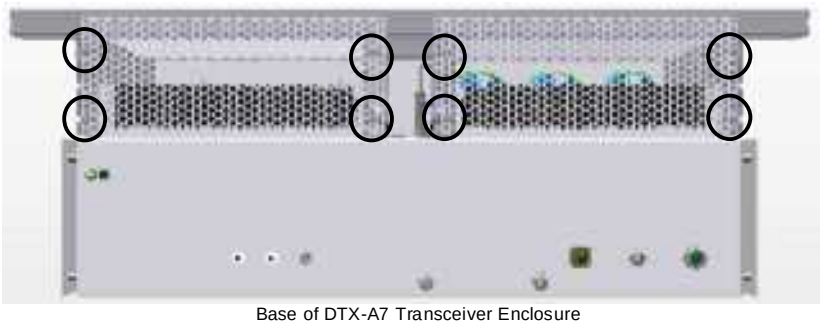
Inspection sheet 4 of 10

Radar Distribution unit (RDU)				
Task	**Description**		**Pass**	**Fail**
Cleaning	External surfaces	Clean with a soft, non-abrasive cloth moistened in a mild soap solution.	☐	☐
	Internal surfaces	Open the door of the Radar Distribution Unit using a screwdriver. Carefully clean out the unit using blower and/ or soft brush.	☐	☐
Physical inspection	External	Ensure that all mounting bolts are secure.	☐	☐
		Ensure all connectors are securely in place; inspect internal cabling for condition and wear.	☐	☐
		Check that all air vents are clear of obstructions and dust.	☐	☐
	Internal	Ensure all PCB's and connectors are securely in place; inspect internal cabling for condition and wear.	☐	☐
		Check that all air vents and fans are clear of obstructions and clear of dust accumulation.	☐	☐
	General	The system should be checked to ensure that there is no obvious internal, external damage or potential fault conditions that could lead to a general failure of any part of the system.	☐	☐
Earth bonding and continuity	On the underside of the RDU, visually inspect the earth terminal for damage and corrosion. If corrosion is present, clean and re-terminate as described in section 9.7 page 114.		☐	☐
	Check that the earth bonding strap between the RDU door and chassis is present, clean and re-terminate as described in section 9.7 page 114.		☐	☐
	Test the earth bonding conductivity by attaching one lead of the test equipment [note1] to earth/ chassis and the other to an unpainted part of the equipment under test. Check the earth bonding for continuity, the resistance should not exceed 0.1 ohms. If a test fails, investigate the bonding, rectify and repeat the test. **Note[1]:** Safety ohmmeter, bridge Megger or Multimeter.		☐	☐

SBS-900 Annual planned maintenance record sheet

Inspection sheet 5 of 10

DTX-A7-xx Transceiver enclosure			
Task	**Description**	**Pass**	**Fail**
General cleaning	Clean all exterior surfaces with a soft cloth moistened in a mild non-abrasive soap solution.	☐	☐
Physical inspection	Ensure that all securing bolts are secure and show no signs of severe corrosion, damage. Pay particular attention to the main chassis supporting bolts.	☐	☐
	Inspect the unit including all mounting points for *any* signs of stress damage. ***Severe weather:*** *This inspection should be carried out at the earliest safe opportunity after the system has been exposed to severe or adverse weather conditions.*	☐	☐
	Check that cable glands, cable entries and waveguide couplings are securely fastened and appear to be waterproof.	☐	☐
	Within reason and where safe to do so, check all accessible or exposed cables for any signs of damage and ensure they are safely secured into/ onto the cable tray or trunking.	☐	☐
	The system should be checked to ensure that there is no obvious external damage or potential fault conditions that could lead to a general failure of any part of the system.	☐	☐
	Check that the four wind turned rotary ventilators mounted on top of the assembly are free from dust and obstructions and can rotate freely.	☐	☐
	Check that no moisture or water is present within the enclosure.	☐	☐
Static Desiccator	The sachets in the static Desiccator must be changed every 12 months. The two sachets are within the desiccator which is located on the base of the enclosure or on earlier units between the two front access doors. Used/ removed sachets must be disposed of in accordance with local disposal regulation. When the sachets have been replaced, ensure that the desiccant enclosure cap is securely in position and fully tightened. Replacement sachet: 55-100-0494-002 Notes Sachet shelf life: 2-years **Notes:** - The part number noted above is for 1 sachet, two are required. - Split or torn sachets must not be used. - Replacements must be from a sealed package (replacements have a shelf life of 2-years). - Two sachets MUST be used.	☐	☐

SBS-900 Annual planned maintenance record sheet			***Inspection sheet 6 of 10***
Transceiver enclosure			
Task	**Description**	**Pass**	**Fail**
Base plate air baffle	The air baffle plates located on the base of the Transceiver Enclosure should be checked and cleaned as necessary.  Base of DTX-A7 Transceiver Enclosure Each baffle is retained by 4 cross-head screws as indicated above. The plates should be removed and any dust or foreign objects removed from the plate and the heatsinks above using a brush or blower. If necessary, the ducted fans on the top of the unit can also be removed to assist in cleaning the heatsink void. These are retained by two crosshead screws at either end of the enclosure.  Side view of DTX-A7	☐	☐
Earth bonding and continuity	Ensure that the earth bonding nuts and bolts are tight and free from corrosion. If corrosion is present, clean and re-terminate as described in section 9.7 page 114.	☐	☐
	Test the earth bonding conductivity by attaching one lead of the test equipment [note] to earth/ chassis and the other to an unpainted part of the equipment under test. Check earth bonding for continuity, the resistance should not exceed 0.1 ohms. If a test fails, investigate the bonding, rectify (see section 9.7 page 114) and repeat the test. **Note:** Safety ohmmeter, bridge Megger or Multimeter.	☐	☐

SBS-900 Annual planned maintenance record sheet

Inspection sheet 7 of 10

Man aloft switch			
Task	**Description**	**Pass**	**Fail**
Physical inspection	Ensure that all fastenings are secure and show no signs of severe corrosion or damage.	☐	☐
Switch action	Ensure the switch operation is smooth and that both the *Free* and *OFF* positions can be selected.	☐	☐
Earth bonding and continuity	Test the earth bonding conductivity by attaching one lead of the test equipment [note1] to chassis/ earth and the other to an unpainted part of the equipment under test. Check the earth bonding for continuity, resistance should not exceed 0.1 ohms. If test fails, investigate the bonding, rectify and repeat the test. **Note[1]:** Safety ohmmeter, bridge Megger or Multimeter.	☐	☐

55-100-0436-001 Static desiccator			
Task	**Description**	**Pass**	**Fail**
Physical inspection	The clear wall of the static desiccator unit allows visual inspection of the desiccant condition. As moisture is adsorbed the desiccant colour will change to either: Deep blue (dry) to pink/white (wet). or Orange (dry) to purple (wet). When 80% of the desiccant material has changed colour, the unit should be replaced. To prevent moisture from entering the breather hole, the unit must be replaced as shown with the "non-fitting end" that contains the breather hole pointing downwards. **Maintenance frequency note:** In areas of high humidity it may be necessary to increase the inspection period of the desiccant.  *Static Desiccator*	☐	☐

Restore power to the system			
On completion of the above maintenance tasks and noting that the following *will cause antenna rotation and system transmission*, restore power to the system.			
Security switches	*Place the Antenna rotation* and *man aloft* switches in the FREE positions.	*Antenna rotation*	☐
		Man aloft	☐
AC Breakers	Switch the single and three-phase breakers within the RDU ON. ***Caution:*** *This will cause the antenna to rotate*	☐	
Remote control	Place the Remote/ Local switch on the RDU to the *Local* position.	☐	
Test	Test the system and ensure full functionality.	☐	

SBS-900 Annual planned maintenance record sheet

Inspection sheet 8 of 10

Powered tests: Safety switch tests

The following tests should be carried out with power restored to the system.

Caution: *When carrying out the following test, do not contravene any health and safety precautions regarding working aloft, antenna or electrical safety.*

The following tests will Stop and Start antenna rotation and system transmission. The area around the antenna must be kept clear at all times during these tests.

Task	Description	Pass	Fail
Antenna Rotation keyswitch (RDU)	- Set the system to *RUN* so that it is transmitting and the antenna is rotating. - Place the *Antenna Rotation* keyswitch (located on the door of the Radar Distribution Unit) into the OFF position. **Remove and RETAIN the key.** - The yellow LED on the front panel of the Radar Distribution Unit will flash. - Ensure that the system has stopped transmitting, that antenna rotation has stopped and that the appropriate system alarms are generated.	☐	☐
Man aloft switch (MAS)	- Where safe to do so, change the *Man Aloft* switch to the *OFF* position. - Reinsert the key into the *Antenna Rotation* Keyswitch and set to *FREE.* - As the Man Aloft Switch is OFF the system should not transmit and the antenna rotation should not rotate. - Place the *Antenna Rotation* keyswitch back to the OFF position. **Remove and RETAIN the key.**	☐	☐
Man aloft switch & Antenna Rotation keyswitch	- Change the *Man Aloft* switch to the *FREE* position. - Reinsert the key into the *Antenna Rotation* Keyswitch and set to *FREE.* - *Ensure system transmission and antenna rotation commence.*	☐	☐
Hut door switch ***Where fitted***	- Open the hut door. - Ensure the appropriate system alarm is generated at the RDU. - Close the HUT door.	☐ Not fitted ☐	☐
Antenna platform switch ***Where fitted***	- Where it is possible *and SAFE to do so*, open the antenna platform access door. - Ensure the appropriate system alarm is generated at the RDU. - Close the antenna platform access door.	☐ Not fitted ☐	☐

SBS-900 Annual planned maintenance record sheet

Inspection sheet 9 of 10

Powered tests: Cooling fan checks

The following tests require access to the internal electronics within the Radar Distribution Unit and the transceiver enclosure.

Caution: *Lethal AC, DC and high voltages are present within the system. Exercise extreme caution when carrying out the following checks.*

RDU: There are two fans mounted within the RDU on the power supply assembly:

Task	Description	Pass	Fail
Antenna isolation	Isolate the 3-phase supply to the Radar Distribution Unit.	☐	☐
RDU fan operation	- Open the door to the RDU. - Visually confirm that the two fans on the dual redundant power supply are running.	☐	☐
Transceiver enclosure	Where fitted, ensure that the SBS-A179 powered fan kits are operational.	☐	☐
		Not fitted ☐	

SBS-900 Annual planned maintenance record sheet

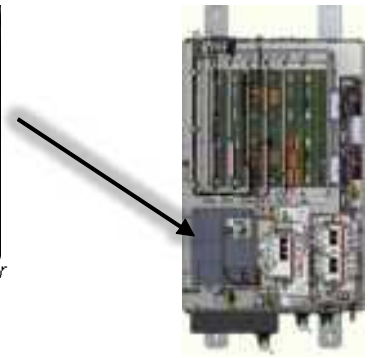
Inspection sheet 10 of 10

Fan condition check

The fan within the static inverter located within the Radar Distribution Unit has a service life of approximately 30,000 hours.

The fan run time must be checked and the fan replaced where necessary.

Toshiba VF-S11 inverter



Radar distribution unit

Fan run-time

- On the static inverter control panel press the **MODE** button twice and ensure that ***Fr-F*** is displayed
- Press the down (**V**) button once and the cumulative operating hours will be displayed.

  The run-time will be indicated by *Tx.xx where: T0.01* = 1 hour, *t1.00* = 100 hours.

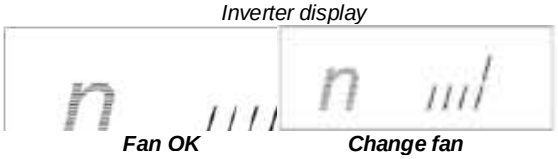
  Record the run-time and proceed to the next step
- Press the down (**V**) button again and 4 single height lines should be shown:

  The fan should be changed when the last line changes to a double height line:

  If any of the first three lines are double height, this indicates a potential fault condition within the inverter which should be replaced.

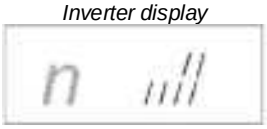
  If the recorded time is ≥ 30000 (t300.00) hours the fan must be changed.

Inverter display



Fan OK ***Change fan***

Inverter display



Change inverter

Task	Description	Result	
Fan condition check	Inverter fan run time *(e.g. t0.50)*		
	Fan inverter OK or Change fan Please refer to the Corrective Maintenance section for details on changing the inverter fan.	*Fan OK*	*Change fan*
		☐	☐

9.5 3-year maintenance

3-year maintenance:
Changing gearbox oil (Standard systems only)

Inspection sheet 1 of 2

Kelvin Hughes DTX-A3-xxxx gearbox and antenna

After three years of use, the oil in the standard gearbox should be changed:

Advanced Antenna Turning Unit and antenna: Please refer to the installation and maintenance handbook supplied with the equipment for full details on planned maintenance.

Equipment details			
	Transceiver/ gearbox		
Part number:	DTX-A3-AXZX ☐	GTX-A11 ☐	DTX-A19 ☐
	DTX-A3-BXZX ☐	GTX-A11-BAAA ☐	DTX-A19-BAAA ☐
Serial number:			
Oil change date:	(DD/ MM/ YYYY)		
Changed by:	*Print:*	*Sign:*	
Tools required	• 5mm across flats hexagonal wrench/ Allen key. • Suitable syringe or equivalent with small pipe attached for reaching into gearbox. • Suitable container to hold at least 200ml of oil. • Mineral oil ARAL DEGOL BG320 quantity 200 ml. *Kelvin Hughes Part No. 55-100-0391-001* • Protective gloves.		
Skill level	Basic electrical and mechanical training, working at heights awareness.		
Time	Less than two hours depending on equipment location and accessibility		

3-year maintenance:
Changing gearbox oil (Standard systems only)

Inspection sheet 2 of 2

Health & safety precautions

WARNING: Prior to commencing any maintenance procedure, users must familiarise themselves with the health & safety warnings noted in the planned maintenance and health and safety sections of the system handbooks.

AC power: Prior to carrying out any planned maintenance, the system must be fully isolated and disconnected from all sources of single and 3-phase supply including any UPS supported supplies.

Caution: When the transceiver, gearbox and antenna have been operating in strong sunlight or elevated temperatures, the gearbox casing and antenna surface will be extremely hot.

Gearbox: Under no circumstances should any attempt be made to remove the motor from the gearbox or the gearbox from the main chassis as this will lead to *major loss of oil* and *damage to the sealing gaskets*.

Gloves: Protective gloves must be worn at all times when the changing oil in the gearbox.

CoSHH: Please refer to the CoSHH (Control of Substances Hazardous to Health) sheet supplied with the oil for information on the oil including hazard identification, first aid, fire precautions and disposal recommendations.

Temperature: Due to the pour point of the oil, this task should not be carried out when the ambient temperature is below -15 deg C.

Oil: When the gearbox has been operating in elevated temperatures, the oil removed from the gearbox *may be hot*.

Disposal: Oil removed from the gearbox must be disposed of in accordance with local waste disposal regulations.

Drain/ filler hole

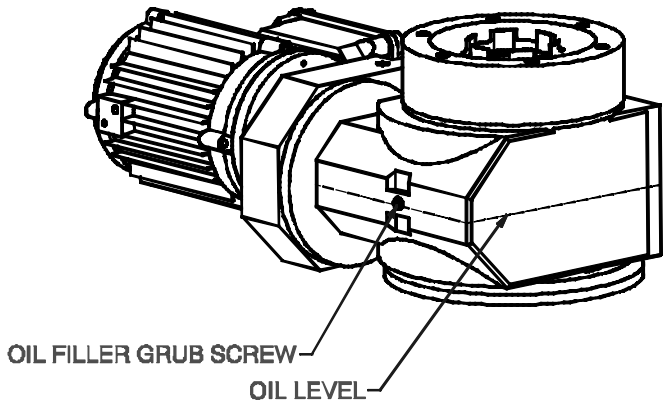
Remove and *carefully retain* the 5mm oil filler grub screw from the gearbox.

Using a syringe or equivalent and a suitable container which will hold at least 200ml, remove as much oil as is possible from the gearbox.

Refill

Refill with the specified oil using a suitable syringe or equivalent.

Refill the oil to the level shown opposite. Refit and tighten the 5mm grub screw.



Completion of task

When the oil has been replaced and the filler grub screw securely replaced, restore power to the system and ensure that the gearbox and system are fully operational.

9.6 5-year maintenance three-phase inverter

The 5-year maintenance schedule depends on the static inverter mounted within the Radar Distribution Unit.

After 5 or 10-years of use, the static inverter located within the Radar Distribution Unit must be changed as over time the electrolytic capacitors within the inverter can dry out.

A number of versions of the inverter are available as detailed below.

Visual confirmation of the inverter fitted is strongly recommended prior to commencing the procedure or obtaining spares.

Manufactures part number	Unit detail	Replacement schedule
VF-S11		Every 5-years
VF-S15 *Note: 440V and 220VAC variants*		Every 10-years
Vf-nC3		Every 5-years

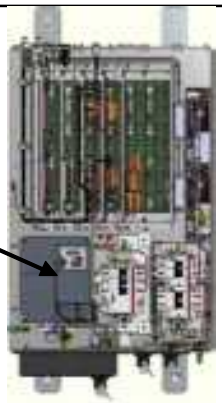
9.6.1 5 year maintenance: VF-S11

5-year maintenance: Changing the static inverter in the RDU

Inspection sheet 1 of 6

After 5-years of use, the static inverter located within the Radar Distribution Unit must be changed as over time the electrolytic capacitors within the inverter can dry out.

This maintenance procedure applies to Radar Distribution Units fitted with the inverter detailed below.

Equipment details			
Radar Distribution Unit (RDU)		**Replacement Inverter**	
Part number	SBS-A1-	Part number	45-690-0065-001
Serial number		Serial number	
Toshiba VF-S11 With the exception of the user replaceable fan, the VF-S11 inverter is a sealed unit that contains no field serviceable or repairable parts. The unit must never be dismantled or repaired in the field.		 *Toshiba VF-S11 inverter*  *Radar distribution unit*	
Inverter replacement date	(DD/ MM/ YYYY)		
Changed by	*Print:*	*Sign:*	
Tools required	A general selection of flat and cross headed screwdrivers.		
Skill level	Mechanical and electrical training including awareness of single and three phase AC supplies.		
Time	Less than two hours depending on equipment location and accessibility		

Health and safety

WARNING: Prior to commencing any maintenance procedure, users must familiarise themselves with the health & safety warnings noted in the planned maintenance and health and safety sections of the system handbooks.

AC power: Prior to carrying out any planned maintenance, the system must be fully isolated and disconnected from all sources of single and 3-phase supply including any UPS supported supplies.

Warning: When powered lethal voltages are present on the terminals and within the inverter.

5-year maintenance: Changing the static inverter in the RDU

Inspection sheet 2 of 6

Disconnect the power: All AC sources including UPS supported supplies must be FULLY isolated *and disconnected* from the Radar Distribution Unit prior to commencing this or any maintenance task.

Disconnection:

Ensure the system is fully disconnected from all AC power sources.

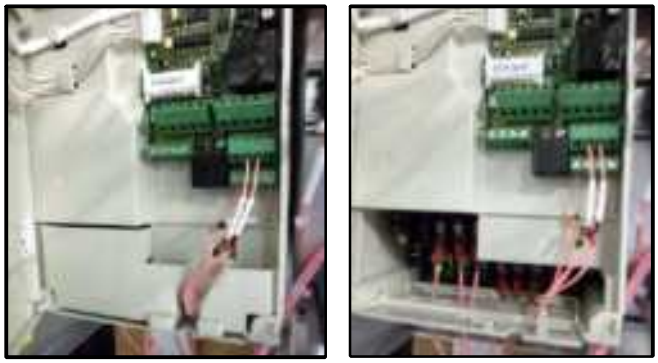
Disconnect/ unplug PL4: This is the 3-phase supply to the antenna motor and is located on the base of the Radar Distribution Unit. *This must not be reconnected until the replacement inverter has been configured*.

The screw terminals within the inverter can be accessed by opening the door of the inverter.

The main screw terminals are further protected by a removable safety cover. This is retained by plastic lugs on each side and can be gently pulled from the enclosure.

IMPORTANT: Prior to disconnecting any cables make a full note of the positions/ pin numbers, polarity and cable markers of ALL cables being removed. The cable pin outs are *not shown* in this document.

Having noted the cable locations, disconnect all cables from the inverter.



Static inverter within the RDU opened.
Terminal protection cover fitted (left) and removed (right).

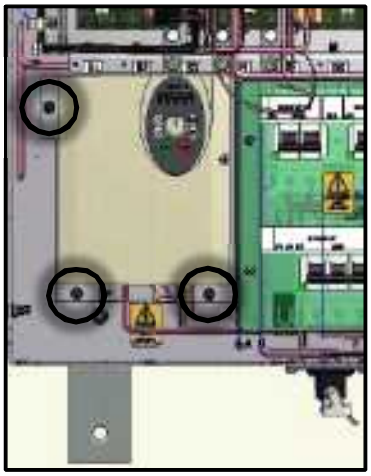
Removal and replacement

The inverter is mechanically retained into the RDU chassis by 3 bolts as shown.

Removed and retain these bolts (they are required for refitting).

The inverter can now be removed from the RDU.

The replacement inverter can now be installed using the same mounting points and fasteners.



Reconnect

DO NOT reconnect PL4 (3-phase supply to antenna motor).

Reconnect all other cables ensuring that they are replaced using the positions, polarity and/ or marker numbers noted when removing them earlier.

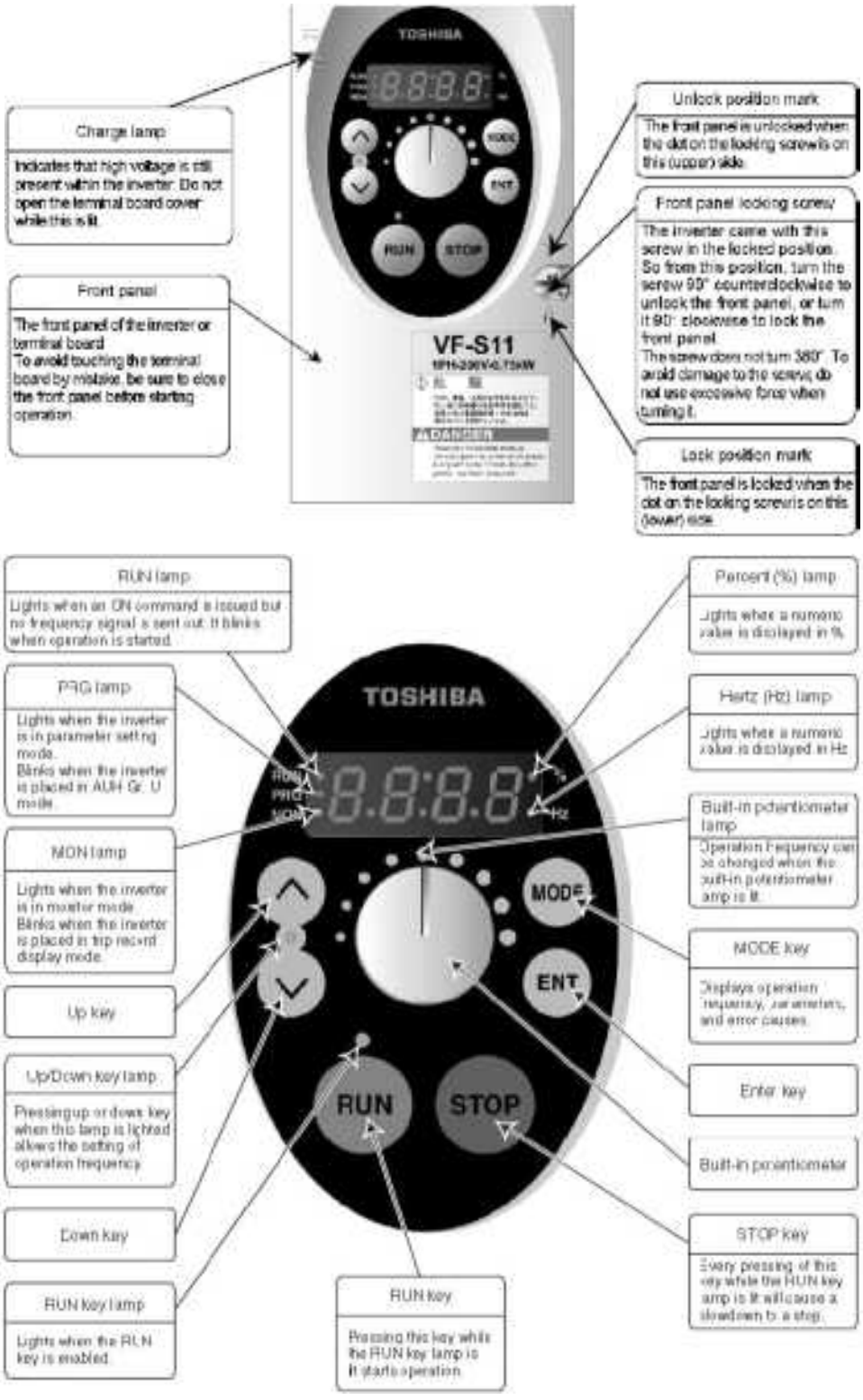
The inverter will now need to be commissioned as shown on the following page.

5-year maintenance: Changing the static inverter in the RDU

Inspection sheet 3 of 6

When a new inverter is switched ON for the first time, it must be configured as shown below BEFORE connecting the three-phase output to the antenna motor (PL4 on the Radar Distribution Unit).

Inverter operation overview



5-year maintenance: Changing the static inverter in the RDU

Inspection sheet 4 of 6

Inverter first time POWER ON

DO NOT reconnect the three-phase connection (*PL4 on the base of the RDU*) to the antenna motor.

Reconnect and switch ON the single and three-phase AC power to the RDU and switch the system ON.

At first switch-ON the inverter initialises and the readout displays *n50*, which indicates 50Hz input conditions will be set. If this does not occur, press⇧ until n50 is displayed.

Press ENTER. The inverter will set the relevant internal settings; the display will show *HELLO* then settle at 0.0.

Operator controls

- Whilst programming, the *Prg* indicator will illuminate when the main menus are selected and Flash when the *F.---* settings menu have been selected.
- Press⇧ to scroll down through a function menu.
- Press ⇩ to scroll up through a function menu.
- At any menu function press ENT to read the current setting then press the ⇧⇩ buttons to change the setting.
- Press ENT to accept the new setting and return to function menu.
- When the menu reaches *F---*, Press ENT to access F100 then ⇧ to scroll F101, F102 etc.
- At any *F---* function press Ent to read the current setting then press the ⇧⇩ buttons to change the setting.
- To Exit the menus, press the MODE button until 0.0 is displayed.

Inverter configuration

When a replacement inverter is first switched on, the following parameters must be checked and set. Firstly press the *MODE* button to enter programming mode then select and configure the following:

Custom Settings for **TOSHIBA VF-S11** static Inverter			
Function	*Description*	**Set to**	*Available modes*
CN0d	*Command mode*	**0**	***0: Remote Control*** *1: Inverter operation panel*
FN0d	*Frequency setting mode*	**5**	*0: Internal potentiometer setting* *1: VIA* *2: VIB* *3: Operation panel* *4: Serial communication* ***5: External contact up/down*** *6: VIA+VIB (Override)*
typ	*Standard setting mode (Input frequency)*	**1**	*0: -* ***1: 50Hz default setting*** *2: 60Hz default setting* *3: Standard default setting (initialisation)* *4: Trip record clear* *5: Cumulative operation time clear* *6: Initialization of type information* *7: Save user-defined parameters* *8: Call user-defined parameters* *9: Cumulative fan operation time record clear*

5-year maintenance: Changing the static inverter in the RDU

Inspection sheet 5 of 6

Function	*Description*	**Set to**	*Available modes*
FR	*Forward / reverse*	**0**	***0: Forward run*** *1: Reverse run* *2: Forward run (F/R switching possible)* *3: Reverse run (F/R switching possible)*
ACC	*Acceleration time*	**2.0**	*0.0-3200*
dEC	*Deceleration time*	**10.0**	*0.0-3200*
FH	*Maximum frequency*	**50**	*30.0-500.0 (Hz) Set by TYP*
UL	*Upper limit frequency*	**50**	*0.5 - FH (Hz) Set by TYP*
LL	*Lower limit frequency*	**0**	*0.0 - UL (Hz)*
uL	*Base frequency (motor)*	**50**	*25-500.0 Set by TYP*
uLu	*Base frequency voltage 1*	**440**	*50-660 (500/600V class) As required*
Pt	*V/F Control mode selection*	**0**	***0: V/F constant*** *1: Variable torque* *2: Automatic torque boost control* *3: Vector control* *4: Energy-saving* *5: Dynamic energy-saving (for fans and pumps)* *6: PM motor control*
ub	*Torque boost*	**5**	*0.0-30.0*
tHr	*Motor thermal protection level*	**34** or **80**	*The power limit setting depends on the gearbox in use:* ***Standard systems**: Set to **34**% (750W motor)* ***Advanced systems**: Set to **80**% (1.5KW motor)*
0LN	*Thermal protection level*	**0**	*Overload protection OFF, overload stall ON*
Sr-1	*Pre-set speed frequency 1*	**11**	*11Hz (10 RPM)*
Sr-2	*Pre-set speed frequency 2*	**22**	*22Hz (20 RPM)*
Sr-3	*Pre-set speed frequency 3*	**44**	*44Hz (40 RPM)*
Sr-4	*Pre-set speed frequency 4*	**0.0**	*0Hz*
Sr-5	*Pre-set speed frequency 5*	**0.0**	*0Hz*
Sr-6	*Pre-set speed frequency 6*	**0.0**	*0Hz*
Sr-7	*Pre-set speed frequency 7*	**0.0**	*0Hz*
F---	***Extended parameter***	***ENT***	***Press ENT to enter extended F--- menus.***
F109	*Analogue / logic input function select*	**2**	*Contact input*
F111	*Assigns F input (forward) for an external stop safety command which overrides all software & manual control settings.*	**2**	*Trip stop command from external input device disabled.*
F170	*Base frequency 2*	**50**	*25.0-500.0 Set by TYP*
F300	*PWM carrier frequency*	**4.0**	*2.0 - 16.0*
F301	*Auto restart*	**0**	***0: Disabled*** *1: At auto-restart after momentary stop* *2: ST terminal on or off* *3: At auto-restart or when turning STCC on or off* *4: At start-up*
F302	*Repetitive power ride-through*	**0**	***0: Disabled*** *1: Automatic setting* *2: Slowdown stop*
F303	*Retry selection (set for 5 times at 1 second intervals)*	**5**	*0: Disabled* *1-10*
F417	*Motor rated speed* *2820 - for 50Hz 'typ' setting* *3384 - for 60Hz 'typ' setting*	2820 or 3384	*100-32000*
F607	*Motor 150% overload time limit*	10	*10 to 2400 seconds*
F634	*Annual average ambient temp*	3	*31 to 40°C*

5-year maintenance: Changing the static inverter in the RDU

Inspection sheet 6 of 6

Measuring the three phase output

The three phase output of the inverter is a pulse width modulated (PWM) sine wave which cannot be accurately measured using a standard DVM (Digital voltmeter).

If measured the 440VAC output will actually measure approximately 220VAC +/-10% depending on the multimeter being used.

Completion of task

On completion of the inverter commissioning, switch the system OFF and reconnect the three-phase output to the antenna motor (*PL4 on the base of the RDU*).

Switch the system ON and ensure that the inverter is operational and that the antenna is rotating.

When operational, the inverter will have the following status:

- The charge light will be ON
- The Run indicator will be ON
- The display will show 22Hz for 20RPM systems and 44Hz for 40 RPM systems.

With the inverter ON and the *antenna rotation* and *man aloft* switches are in the FREE position the antenna should rotate.

Remote control operation

When the inverter and fan replacement is completed, ensure that the *Local/ Remote* switch on the Radar Distribution Unit (RDU) is in the *Remote* position.

Ensure that the system can be remotely controlled and is fully operation.

9.6.2 5-year maintenance VF-nC3

5-year maintenance: Changing the static inverter in the RDU	***Inspection sheet 1 of 6***

After 5-years of use, the VF-nC3 static inverter located within the Radar Distribution Unit must be changed as over time, the electrolytic capacitors within the inverter can dry out.

This maintenance procedure applies to Radar Distribution Units fitted with the inverter detailed below.

Equipment details			
Radar Distribution Unit (RDU)		**Replacement Inverter**	
Part number	SBS-A1-	Part number	45-690-0066-001
Serial number		Serial number	
Toshiba VF-nC3 With the exception of the user replaceable fan, the VF-nC3 inverter is a sealed unit that contains no field serviceable or repairable parts. The unit must never be dismantled or repaired in the field.		 *Toshiba VF-nC3 inverter*  *Radar distribution unit*	
Inverter replacement date			(DD/ MM/ YYYY)
Changed by	*Print:*	*Sign:*	
Tools required	A general selection of flat and cross headed screwdrivers.		
Skill level	Mechanical and electrical training including awareness of single and three phase AC supplies.		
Time	Less than two hours depending on equipment location and accessibility		

Health and safety

WARNING: Prior to commencing any maintenance procedure, users must familiarise themselves with the health & safety warnings noted in the planned maintenance and health and safety sections of the system handbooks KH-1601-1 or KH-1601-2.

Prior to carrying out planned maintenance, the system must be fully isolated and disconnected from all single and 3-phase AC supplies. See *system isolation* in the planned maintenance section of the system handbook KH-1601-2.

Warning: When powered lethal voltages are present on the terminals and within the inverter.

5-year maintenance: Changing the static inverter in the RDU	*Inspection sheet 2 of 6*

Single phase input inverter removal and replacement

Disconnect the power: As noted in the health and safety warning, all AC sources must be FULLY isolated *and disconnected* form the radar distribution unit prior to commencing this task.

Disconnection:

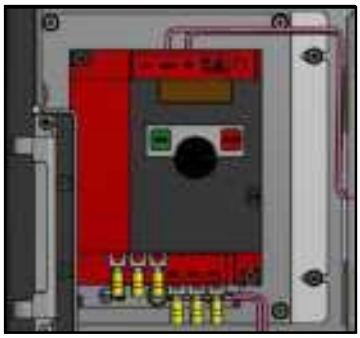
- Ensure the system is *fully* isolated from all sources of power including UPS supplies
- Disconnected from all power sources from the RDU
- Disconnect PL4 (3-Phase out to antenna motor) from the base of the RDU

Disconnect the inverter

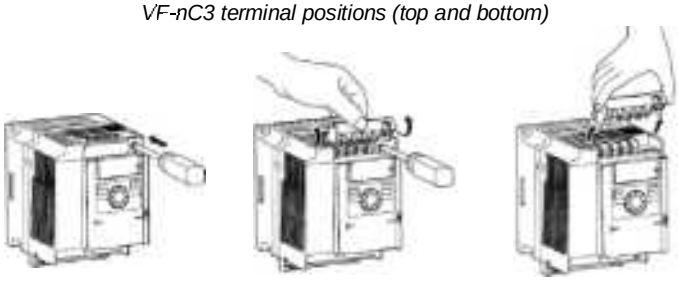
IMPORTANT: Prior to disconnecting any cables, make a note of the cable positions and cable numbers as these are NOT shown in this handbook.

The main screw terminals can be accessed by removing the covers as shown.

Noting the cable numbers and locations, disconnect all cables to the inverter.



VF-nC3 terminal positions (top and bottom)



Terminal cover removal

Replacement inverter

Kelvin Hughes spare part number for Toshiba VF-nC3: 45-690-0066-001

Caution: *The use of alternatives or unapproved spares invalidates the warranty status of the unit and can effect or inhibit system performance.*

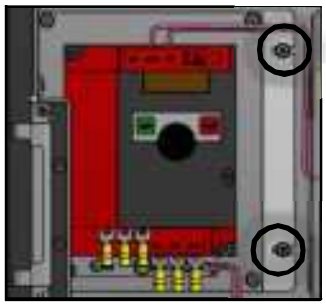
Removal and replacement

The inverter is retained into the RDU chassis by 2 bolts as shown.

Remove and retain these bolts.

The inverter can be removed from the RDU.

The replacement inverter can now be installed using the same mounting points and fasteners.



5-year maintenance: Changing the static inverter in the RDU

Inspection sheet 3 of 6

Antenna motor connection

<u>DO NOT</u> CONNECT PL4

PL4 is the 3-Phase output to antenna motor.

The inverter must be configured BEFORE power is connected to the antenna.

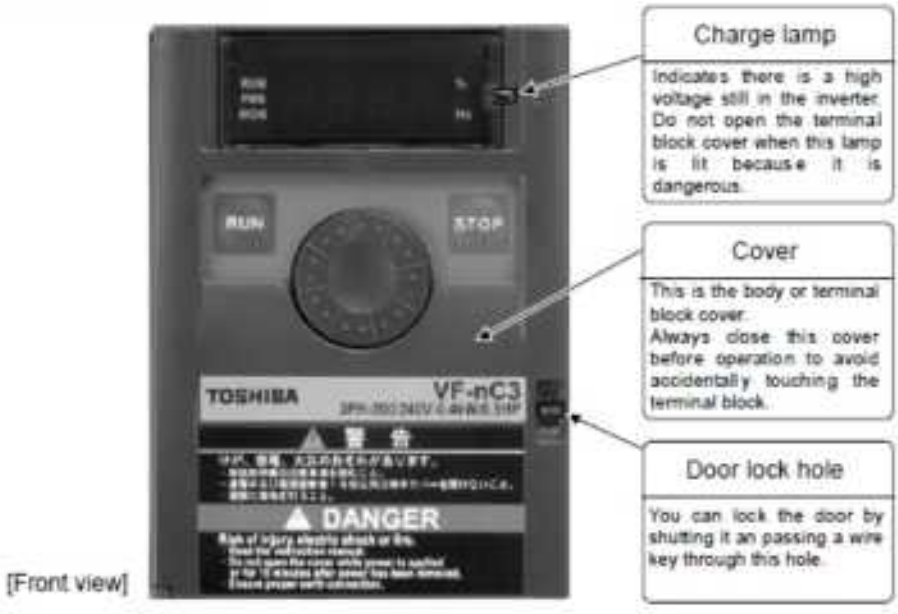
Reconnect all cables to the inverter

Reconnect all other cables ensuring that they are replaced in the correct positions, polarity and/ or marker numbers as noted when removing them earlier.

The inverter MUST now be commissioned as shown on the following pages.

Inverter control overview

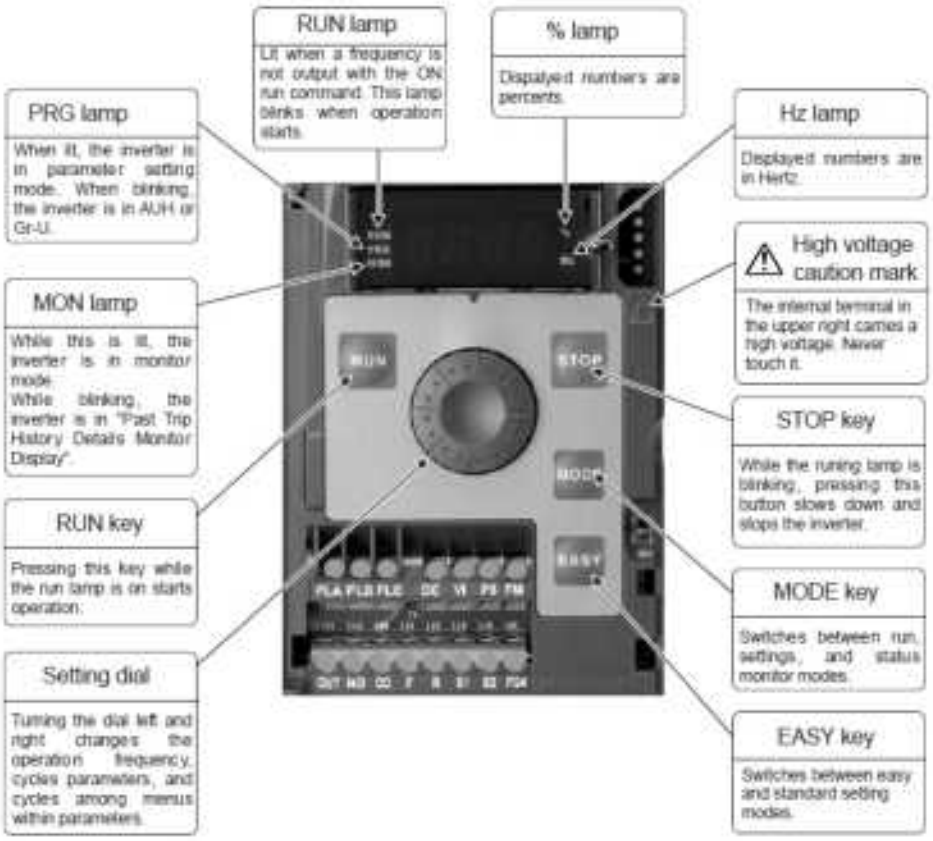
After replacing the inverter and prior to applying AC power to the RDU/ inverter, engineers must familiarise themselves with the inverter operation as shown below:



[Front view]

5-year maintenance: Changing the static inverter in the RDU

Inspection sheet 4 of 6



A. First time POWER ON

i. With PL/ SK 4 *disconnected* apply power to the RDU.
ii. The inverter initialises and the display will show HELLO then settle at 0.0.

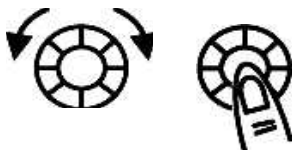
B. Region Setting

i. If the display is flashing SEt, then a region code has to be entered.
ii. Rotate the wheel to ASIA and press wheel to set, (init will appear) display should now be 0.0.
iii. If Set is not flashing it is necessary to restore the inverter back to the factory default setting prior to entering a new region code.
iv. Press MODE and by following the guidance below set “typ” to 13. After reset, set the region code to ASIA as detailed above.

C. Custom Settings

The Inverter parameters must then be changed as follows:

i. Press MODE, AUH should appear, then rotate wheel to CnOd and press wheel to set parameter as shown in the following page. (Pressing the wheel after each setting should advance to next function).
ii. Rotate the wheel clockwise to scroll down through the function menu as listed below. Rotating the wheel counter clockwise will scroll up the menu.
iii. At any function press the wheel to read the function setting. Rotate wheel to change setting.
iv. Press the wheel to enter a new setting and return to function menu.
v. To exit menus, press STOP button (4 times) until 0.0 is displayed



5-year maintenance: Changing the static inverter in the RDU

Inspection sheet 5 of 6

First time switch ON inverter configuration

Custom Settings for TOSHIBA VFNC3 Inverter			
Function	Description	**Set to**	Operation
CN0d	Command Mode	**0**	0 - GTX-A104 SKA control 1 - Inverter operation panel
FN0d	Frequency Setting Mode	**0**	0 - GTX-A104 SKA control 1 - Inverter operation panel 2 - Inverter panel potentiometer
FnSL	Meter Selection Mode	**0**	N/A
Fn	Meter gain adjustment	**0**	N/A
Fr	Forward / Reverse	**0**	0 - Forward 1 - Reverse
ACC	Acceleration Time	**5**	5 seconds
dEC	Deceleration Time	**10**	10 seconds
FH	Maximum Frequency	**50**	Ignore; set by 'typ'
UL	Upper Limit Frequency	**50**	Ignore; set by 'typ'
LL	Lower Limit Frequency	**0**	0Hz
uL	Base Frequency, (Motor)	**50**	Ignore; set by 'typ'
uLu	Supply Voltage	**230**	Ignore; set by 'typ'
Pt	V/F Control Mode Selection	**0**	Voltage / Frequency constant 3 - Sensor less Vector control
ub	Torque Boost	**5**	5% boost
tHr	Motor thermal protection level	**34** **or** **80**	The power limit setting depends on the gearbox in use: **Standard systems**: Set to **34**% (750W motor) **Advanced systems**: Set to **80**% (1.5KW motor)
0LN	Electronic Thermal Protection Level	**0**	Overload Protection OFF Overload Stall ON
Sr-1	Pre-set Speed Frequency 1	**11**	11Hz (10RPM)
Sr-2	Pre-set Speed Frequency 2	**22**	22Hz (20RPM)
Sr-3	Pre-set Speed Frequency 3	**44**	44Hz (40RPM)
Sr-4	Pre-set Speed Frequency 4	**0**	0Hz
Sr-5	Pre-set Speed Frequency 5	**0**	0Hz
Sr-6	Pre-set Speed Frequency 6	**0**	0Hz
Sr-7	Pre-set Speed Frequency 7	**0**	0Hz
typ	Default parameters	**1__0** **or** **2__0**	1 __0, sets FH, UL, uL & F170 to 50Hz 2__0, sets FH, UL, uL & F170 to 60Hz *Note: SET 4 selects factory default settings of various parameters including 50Hz operation suitable for Europe region.*
SEt	Region	**3**	Set at initial power or at OEM factory to Asia
PSEL	Registered Parameter display	**0**	Ignore; set by 'typ'
F1--	Extended Parameter	**Press wheel**	
F109	Analogue / Logic input function select	**0**	Voltage signal input (0 - 10 V) for V1
F127	Sink / Source input selection	**0**	Sink
F170	Base Frequency	**50**	Ignore; set by 'typ'
F300	PWM Carrier Frequency	**4**	4kHz
F301	Auto Restart	**0**	Disabled
F302	Repetitive Power Ride-Through	**0**	Disabled
F303	Retry Selection	**5**	5 times at 1 second intervals
F417	Motor Rated Speed	**2820** **3384**	**2820** for 50Hz 'typ' setting **3384** for 60Hz 'typ' setting
F607	Motor 150% overload time limit	**10**	10 to 2400 seconds

5-year maintenance: Changing the static inverter in the RDU

Inspection sheet 6 of 6

Measuring the three phase output

The three phase output of the inverter is a pulse width modulated (PWM) sine wave which cannot be accurately measured using a standard DVM (Digital voltmeter).

If measured the 440VAC output will actually measure approximately 220VAC +/-10% depending on the multimeter being used.

Completion of task

On completion of the inverter commissioning, switch the system OFF and reconnect the three-phase output to the antenna motor (*PL4 on the base of the RDU*).

Switch the system ON and ensure that the inverter is operational and that the antenna is rotating.

When operational, the inverter will have the following status:

- The charge light will be ON
- The Run indicator will be ON
- The display will show 22Hz for 20RPM systems and 44Hz for 40 RPM systems.

With the inverter ON and the *antenna rotation* and *man aloft* switches are in the FREE position the antenna should rotate.

Remote control operation

When the inverter and fan replacement is completed, ensure that the *Local/ Remote* switch on the Radar Distribution Unit (RDU) is in the *Remote* position.

Ensure that the system can be remotely controlled and is fully operation.

9.6.3 Power Supply Fans

5-year maintenance: Changing the RDU PSU fans	*Inspection sheet 1 of 1*

PSU fans: Regardless of the inverter fitted within the system, the two fans mounted on the power supply unit within the RDU have a manufacturers MTBF of 50K hours.

Radar Distribution Unit Power Supply

Radar distribution unit

Fan fail: In the event of a failure, a *fan failure* warning is displayed on the RDU front panel, service display or command and display system. The power unit continues to operate when a fan fails; the faulty unit must be replaced as soon as possible.

Replacement: These fans must be changed every 5 years as part of a routine maintenance schedule.

Procedure: The procedure for replacing the fan is detailed in section 10.8.7.4 page 193.

Fan replacement		
Fan replacement part number:	45-690-0080-003 (Order x2 for replacement) Note: The replacement part is the fan only and does not contain the casework which must be removed from the old fan.	
Fan replacement date		(DD/ MM/ YYYY)
Changed by:	*Print:*	*Sign:*

9.7 10-year maintenance: VF-S15

10-year maintenance: Changing the static inverter in the RDU	***Inspection sheet 1 of 6***

After 5-years of use, the VF-nC3 static inverter located within the Radar Distribution Unit must be changed as over time, the electrolytic capacitors within the inverter can dry out.

This maintenance procedure applies to Radar Distribution Units fitted with the inverter detailed below.

Equipment details			
Radar Distribution Unit (RDU)		**Replacement Inverter**	
Part number	SBS-A1-	Part number	45-690-0084-002
Serial number		Serial number	
Toshiba VF-S15 With the exception of the user replaceable fan, the inverter is a sealed unit that contains no field serviceable or repairable parts. The unit must never be dismantled or repaired in the field.		 *VF-S15 inverter*  *Radar distribution unit*	
Inverter replacement date			(DD/ MM/ YYYY)
Changed by	*Print:*	*Sign:*	
Tools required	A general selection of flat and cross headed screwdrivers.		
Skill level	Mechanical and electrical training including awareness of single and three phase AC supplies.		
Time	Less than two hours depending on equipment location and accessibility		

Health and safety

WARNING: Prior to commencing any maintenance procedure, users must familiarise themselves with the health & safety warnings noted in the planned maintenance and health and safety sections of the system handbooks KH-1601-1 or KH-1601-2.

Prior to carrying out planned maintenance, the system must be fully isolated and disconnected from all single and 3-phase AC supplies. See *system isolation* in the planned maintenance section of the system handbook KH-1601-2.

Warning: When powered lethal voltages are present on the terminals and within the inverter.

10-year maintenance: Changing the static inverter in the RDU

Inspection sheet 2 of 6

Disconnect the power: All AC sources including UPS supported supplies must be FULLY isolated *and disconnected* from the Radar Distribution Unit prior to commencing this or any maintenance task.

Disconnection:

Ensure the system is fully disconnected from all AC power sources.

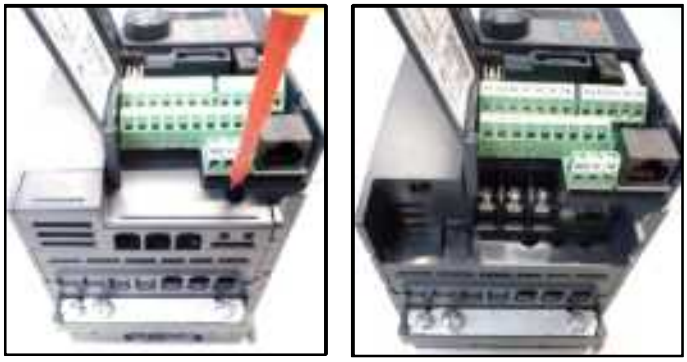
Disconnect/ unplug PL4: This is the 3-phase supply to the antenna motor and is located on the base of the Radar Distribution Unit. *This must not be reconnected until the replacement inverter has been configured*.

The main screw terminals protected by a removable safety cover. This is removed by gently pushing a small screwdriver into the locking tab as shown.

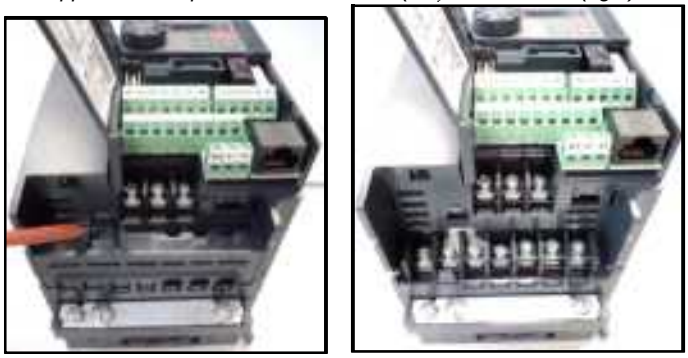
The 2nd lower protective tab can then be removed.

IMPORTANT: Prior to disconnecting any cables make a full note of the positions/ pin numbers, polarity and cable markers of ALL cables being removed. The cable pin outs are *not shown* in this document.

Having noted the cable locations, disconnect all cables from the inverter.



Upper terminal protection cover fitted (left) and removed (right).



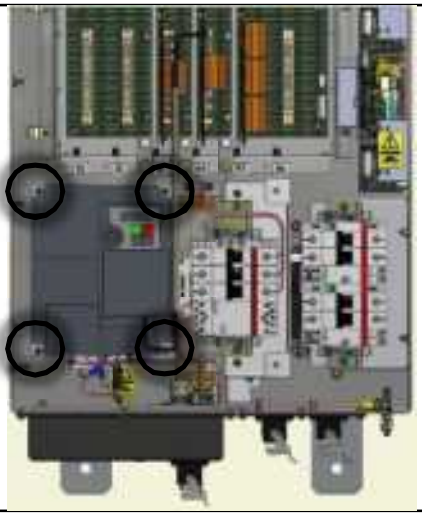
Lower terminal protection cover fitted (left) and removed (right).

Removal and replacement

The inverter mounted onto a plate that is held in the RDU chassis by 4 bolts.

Removed and retain these bolts as they are required for refitting.

The inverter can now be removed from the RDU.



10-year maintenance: Changing the static inverter in the RDU	***Inspection sheet 3 of 6***
The inverter is mounted onto a flat plate; this must be removed and fitted to the replacement inverter. The replacement inverter assembly can now be installed using the same mounting points and fasteners.	
Reconnect **DO NOT reconnect PL4 (3-phase supply to antenna motor).** Reconnect all other cables ensuring that they are replaced using the positions, polarity and/ or marker numbers noted when removing them earlier. The inverter will now need to be commissioned as shown below.	

A. Switch Settings:

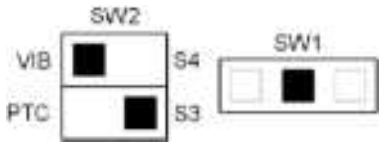
There are two switches within the inverter that need to be configured as follows.

The switches are located behind the access door on the front of the unit.

These switches MUST be set before power is applied to a replacement inverter and before any changes are made to the inverter setup menus.

SW1: Set to the middle position.

SW2 Set as shown.



B. First time POWER ON

Switch ON the AC mains supply connected to PL3. The inverter will initialise and the readout should display n50. This indicates 50Hz input conditions will be set (if not, press ⇧ button until n50 is displayed).

Press ENTER. The inverter will set the relevant internal settings; the display will show HELLO then settle at 0.0.

10-year maintenance: Changing the static inverter in the RDU

Inspection sheet 4 of 6

C. Custom Settings

The Inverter parameters must then be changed as follows:

Press the MODE button.

- Whilst programming, the Prog indicator is ON for main function path and Flashing for F.---setting path.
- Press⇧ buttons to scroll down through the function menu as listed below. Pressing ⇩ button scrolls up the menu.
- At any function press ENT to read the function setting. Press ⇧⇩ buttons to change setting.
- Press ENT to enter new setting and return to function menu.
- When the menu reaches F---, Press ENT to access F100 then ⇧ to scroll F101 F102 to F990.
- Pressing ⇩ scrolls F100, F990, F880 .. to F100.
- At any F--- function press Ent to read function setting and ⇧⇩buttons to change Setting.
- Press Ent to enter the new setting and return to the Function menu.
- To exit menus, press MODE button until 0.0 is displayed.

Custom Settings for TOSHIBA Inverter			
FUNCTION	**DESCRIPTION**	**SET**	**OPERATION**
CN0d	Command Mode	**0**	**0 – Remote Control** 1 - Inverter operation panel
FN0d	Frequency Setting Mode	**5**	0: Internal potentiometer setting 1: VIA 2: VIB 3: Operation panel 4: Serial communication **5: External contact up/down** 6: VIA+VIB (Override)
typ	Standard Setting Mode (Input frequency)	**1**	0: - **1: 50Hz default setting** 2: 60Hz default setting 3: Standard default setting (Initialization) 4: Trip record clear 5: Cumulative operation time clear 6: Initialization of type information 7: Save user-defined parameters 8: Call user-defined parameters 9: Cumulative fan operation time record clear

10-year maintenance: Changing the static inverter in the RDU			***Inspection sheet 5 of 6***
FR	Forward / Reverse	**0**	**0: Forward run** 1:Reverse run 2: Forward run (F/R switching possible) 3: Reverse run (F/R switching possible)
ACC	Acceleration Time	**2.0**	0.0-3200
dEC	Deceleration Time	**10.0**	0.0-3200
FH	Maximum Frequency	**50.0**	30.0-500.0 (Hz) *Set by TYP*
UL	Upper Limit Frequency	**50.0**	0.5 - FH (Hz) *Set by TYP*
LL	Lower Limit Frequency	**0.0**	0.0 - UL (Hz)
uL	Base Frequency, (Motor)	**50.0**	25-500.0 *Set by TYP*
uLu	Base frequency voltage 1	**440**	50-660 (500/600V class) *As required*
Pt	V/F Control Mode Selection	**0**	**0: V/F constant** 1: Variable torque 2: Automatic torque boost control 3: Vector control 4: Energy-saving 5: Dynamic energy-saving (for fans and pumps) 6: PM motor control
ub	Torque Boost	**5.0**	0.0-30.0
tHr	Motor Thermal Protection Level	**34 or 80**	The power limit setting depends on the gearbox in use: **Standard systems**: Set to **34**% (750W motor) **Advanced systems**: Set to **80**% (1.5KW motor)
0LN	Electronic Thermal Protection Level	**0**	Overload Protection OFF Overload Stall ON
Sr-1	pre-set Speed Frequency 1	**11.0**	11Hz (10 RPM)
Sr-2	pre-set Speed Frequency 2	**22.0**	22Hz (20 RPM)
Sr-3	pre-set Speed Frequency 3	**44.0**	44Hz (40 RPM)
Sr-4	pre-set Speed Frequency 4	**0.0**	0Hz
Sr-5	pre-set Speed Frequency 5	**0.0**	0Hz
Sr-6	pre-set Speed Frequency 6	**0.0**	0Hz
Sr-7	pre-set Speed Frequency 7	**0.0**	0Hz
F---	Extended Parameter	**ENT**	
F109	Analogue / Logic input function select	**2**	Contact Input
F111	Assigns F input (Forward) for an External Stop safety command which overrides all software and manual control settings.	**2**	Trip stop command from external input device disabled.
F170	Base Frequency 2	**50.0**	25.0-500.0 *Set by TYP*
F300	PWM Carrier Frequency	**4.0**	2.0 - 16.0
F301	Auto Restart	**0**	**0: Disabled** 1: At auto-restart after momentary stop 2: ST terminal on or off 3: At auto-restart or when turning STCC on or off 4: At start-up

10-year maintenance: Changing the static inverter in the RDU			*Inspection sheet 6 of 6*
F302	Repetitive Power Ride-Through	**0**	**0: Disabled** 1: Automatic setting 2: Slowdown stop
F303	Retry Selection (set for 5 times at 1 second intervals)	**5**	0: Disabled 1-10
F417	Motor Rated Speed	**2820** **3384**	**2820** for 50Hz 'typ' setting **3384** for 60Hz 'typ' setting
F607	Motor 150% overload time limit	**10**	10 – 2400 seconds
F634	Annual Average Ambient Temperature	**3**	21 to 30°C

Measuring the three phase output

The three phase output of the inverter is a pulse width modulated (PWM) sine wave which cannot be accurately measured using a standard DVM (Digital voltmeter).

If measured the 440VAC output will actually measure approximately 220VAC +/-10% depending on the multimeter being used.

Completion of task

On completion of the inverter commissioning, switch the system OFF and reconnect the three-phase output to the antenna motor (*PL4 on the base of the RDU*).

Switch the system ON and ensure that the inverter is operational and that the antenna is rotating.

When operational, the inverter will have the following status:

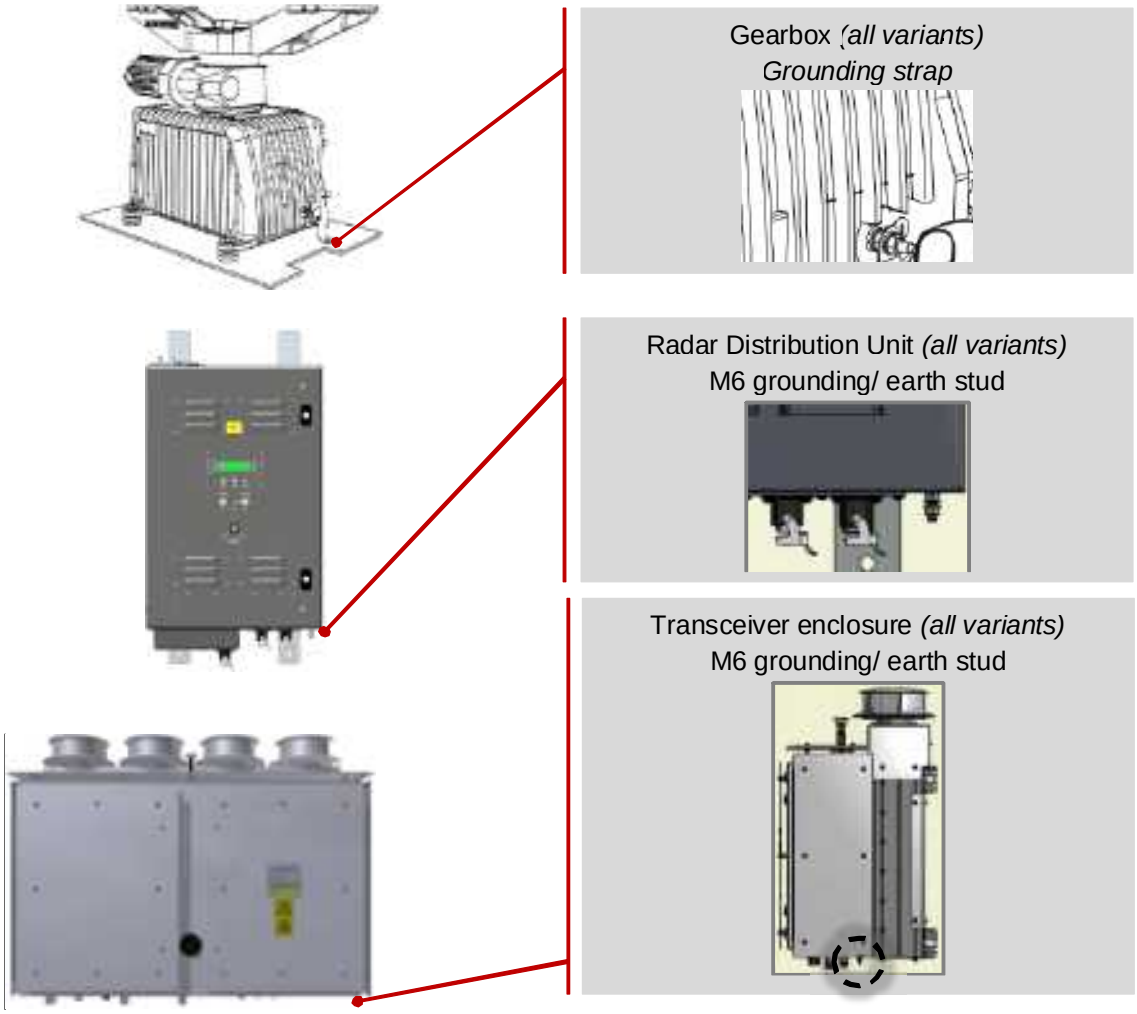
- The charge light will be ON
- The Run indicator will be ON
- The display will show 22Hz for 20RPM systems and 44Hz for 40 RPM systems.

With the inverter ON and the *antenna rotation* and *man aloft* switches are in the FREE position the antenna should rotate.

9.8 Earth bonding maintenance

Where an earth/ chassis bonding point has been found to be corroded or fails a conductivity test, the bonding joint should be dismantled, cleaned and reassembled as follows:

⚠	***Caution:*** *Isolate the system before commencing this task.* Under no circumstances should straps or equipment be disconnected from earth/ chassis before all power supplies are isolated removed at source.



Earth bonding cleaning procedure

- Fully isolate the equipment from the single and 3-phase AC power supplies including any UPS supported supplies.
- Release the nuts/bolts securing the equipment/ straps.
- Clean the affected parts with a wire brush or emery cloth to provide bright metal surfaces.
- Refit the equipment/straps and tighten all nuts/bolts.
- Carry out a continuity check in accordance with the appropriate maintenance procedure.
- If the test is satisfactory, restore the equipment power supplies and test the system.

10 Corrective maintenance

The following section details the corrective maintenance tasks that can be carried out on all standard SBS-900 systems

Health & Safety notices: When carrying out any corrective or planned maintenance, the health and safety notices shown in section 2 must be observed at all times.

Fibre optic cables: Where fibre optic cables are removed as part of any maintenance procedure the protective dust caps must be fitted to prevent damage to the fibre optic terminals or dust ingress within the connector.

10.1 General precautions

Antenna Rotation Safety Notice:

When three-phase power is connected to the system and switched ON, the antenna *may rotate immediately* regardless of the RUN command status.

Use the *antenna rotation* keyswitch, *man aloft* safety switches or *antenna control* in the command and display system to stop antenna rotation in an emergency.

WARNING: Prior to commencing any maintenance procedure, users must familiarise themselves with the health & safety warnings noted in the planned maintenance and health and safety sections of the system handbooks.

AC supplies: Prior to carrying out any maintenance, the system must be fully isolated and disconnected from all single and 3-phase AC supplies. This must include the full isolation of any UPS supported supplies to the equipment.

Caution: *The motor/ gearbox assembly* ***must NEVER be dismantled*** *as this would cause significant loss of oil and damage to oil seals.*

Caution: When the gearbox and antenna have been operating in strong sunlight or elevated temperatures, the gearbox casing and antenna surfaces will be extremely hot.

10.2 Standard systems overview

10.2.1 Power connections

AC/ DC power:	**RDU:**	Two sources of UPS supported single phase AC and a separate three phase supply are connected to the RDU. Internal breakers and contactors control the AC voltages to the rest of the system. An internal power supply generates all the DC rails required by the RDU.
	Transceiver Enclosure	Single or dual (system dependent) sources of AC power are connected from the RDU and are internally protected and switched by the use of breakers. Internal power supplies generate all the DC rails required by the transceiver enclosure. A separate DC rail is provided to power the ACP/ ARP encoder in the antenna sub-system.
	Antenna sub-system	The antenna motor is driven by the three phase output of the RDU (see below). A DC rail from the transceiver Enclosure is used to power the ACP/ ARP encoder.
Three phase measurement:		The three phase output of the inverter is a pulse width modulated (PWM) sine wave which cannot be accurately measured using a standard DVM (Digital voltmeter). If measured the 440VAC output will actually measure approximately 220VAC +/-10% depending on the multimeter being used.

10.2.2 Over current protection devices

Kelvin Hughes gearboxes:	There are no fuses or breakers located within the gearbox for the AC supplies to the Kelvin Hughes gearbox. The safety mechanisms within the Radar Distribution unit and transceivers which include the *Man Aloft Switch* and *Antenna Rotation* keyswitch should be used to isolate the system. See section 9.3 page 87 onwards for full details.

10.2.3 Service door removal

Service Door removal: The service door on the turning mechanism must be opened to gain access to the electrical terminations for the ACP and ARP signals and for connecting the flexwell in S-Band systems (X-band systems connect externally).

Opening the service access door is not required for any other reason.

⚠	***Caution:*** *The service access door is heavy, care should be exercised when removing and handling the door.*

The door removal process is identical for both X and S-band systems

Safety clips: There are two safety P-clips that must be removed to detach the door.

These clips MUST be re-attached when replacing the service door.

Safety lanyard: To prevent a drop hazard, the door is fitted with an internally mounted safety lanyard. If required this lanyard can be unclipped and the door carefully lowered to a safe position.

Door bolts: There are nine M8/ 13mm bolts restraining the door. Care should be taken when removing these bolts are they are NOT captive.

Release points: The door is mounted on two locating lugs. It may be necessary to gently leaver the door open using the two door release points marked on the door.

Care should be taken to ensure the paint is not damaged whilst removing the door.

Replacement: Prior to replacing the door, the following should be checked:

- The system is fully isolated from all sources of AC power
- Ensure the door is correctly located on the mounting lugs and that the restrain clips have been replaced.
- Pay attention to the safety lanyard as this can easily become trapped in the door when being closed.
- Tighten all bolts on the main door, the 3-phase motor cover and cable glands ensuring a full waterproof seal is achieved.
- To prevent corrosion, any chipped or damaged surfaces must be painted with polyurethane paint.

10.2.4 Antenna removal

The Low Profile Antenna will need to be removed and temporarily stored for some maintenance tasks. The lifting procedures are listed below.

Where an antenna is to lifted, all safety and lifting requirements noted in below must be read, understood and fully observed.

WARNING*:* Antennas are heavy items and must be lifted using suitable lifting equipment, a secured block and tackle or by rope strops.

CAUTION: During removal and installation, the antenna must be secured and supported at all times to prevent any risk of falling or slipping.

Antennas must never be left unsupported on the swing casting.

- All health and safety requirements must be checked and observed at all times when lifting *any* equipment. All appropriate personal protective equipment (PPE) must be worn.
- Where special equipment such as cranes hoists and jigs is required, consideration must be given to the authority to use such equipment.
- During lifting, a safety zone shall be established beneath the lifting area around any cranes or platforms. Safety personnel must ensure that persons do not encroach on the area of work.
- Consult with the lifting operator to obtain the best and safest method of securing lifting strops or ropes to the equipment and advise lifting operators of the areas of a system that are susceptible to damage such as antenna fascia's, swing castings etc.
- Check that the centre of gravity of the equipment cannot cause the lifting strops or ropes to slip or move.
- All straps, lifting cables or ropes must be thoroughly checked to ensure that there is no risk of the unit slipping or falling from the lifting strap or lifting equipment.
- If lifting a transmitter/ gearbox with the antenna pre-assembled, the lifting equipment, ropes or straps must not place any pressure on any part of the antenna or the swing casting.
- Kelvin Hughes cannot be held responsible for any damage that occurs to supplied or 3rd party equipment as a result of incorrect lifting procedures or handling or equipment.

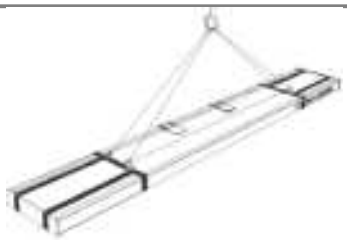
X-band Antenna removal

In addition to the normal tools required for installation and service work, an 8.0mm hex-key will be required to remove and install the X-band LPA.

Support the antenna

Ensure the antenna is fully supported ready to be lifted.

Antenna weight:
LPA-A37-xxxx 3.7m low profile antenna: 20Kg
LPA-A55-xxxx 5.5m low profile antenna: 30Kg

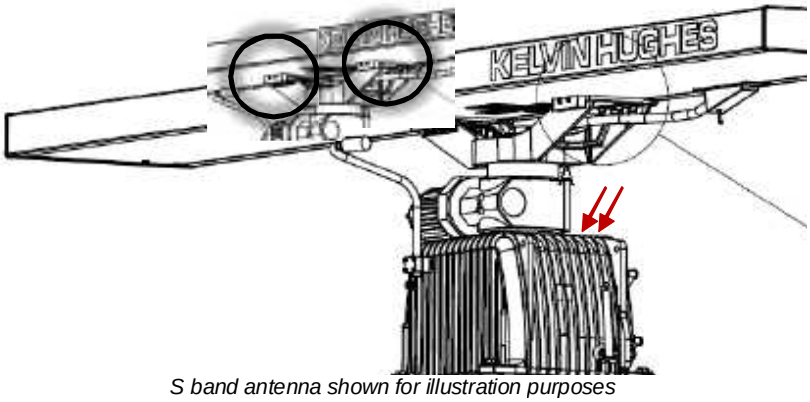


S band antenna shown for illustration purposes

Release forward bolts

On both arms of the swing casting, remove and retain the 4 bolts and washers indicated.

Retain these bolts and washers as they will be required when reinstalling the antenna.



S band antenna shown for illustration purposes

Disconnect the 4 x 4BA bolts that connect the antenna waveguide to the rotating joint.

Remove and retain the 'O' ring from the connection as this will be required for refitting.

Loosen final bolts and remove antenna

Observing all safety requirements and ensuring the antenna is **fully** supported and ready for lifting, remove and retain the bolts and washers that hold the antenna onto the swing casting.

Retain these bolts and washers as they are required for reinstallation of the antenna.

⚠ **The antenna is now loose** and is ready to be lifted.

The antenna should be carefully stored ensuring that the waveguide is not crushed, bent or damaged. The antenna must never be handled by the waveguide.

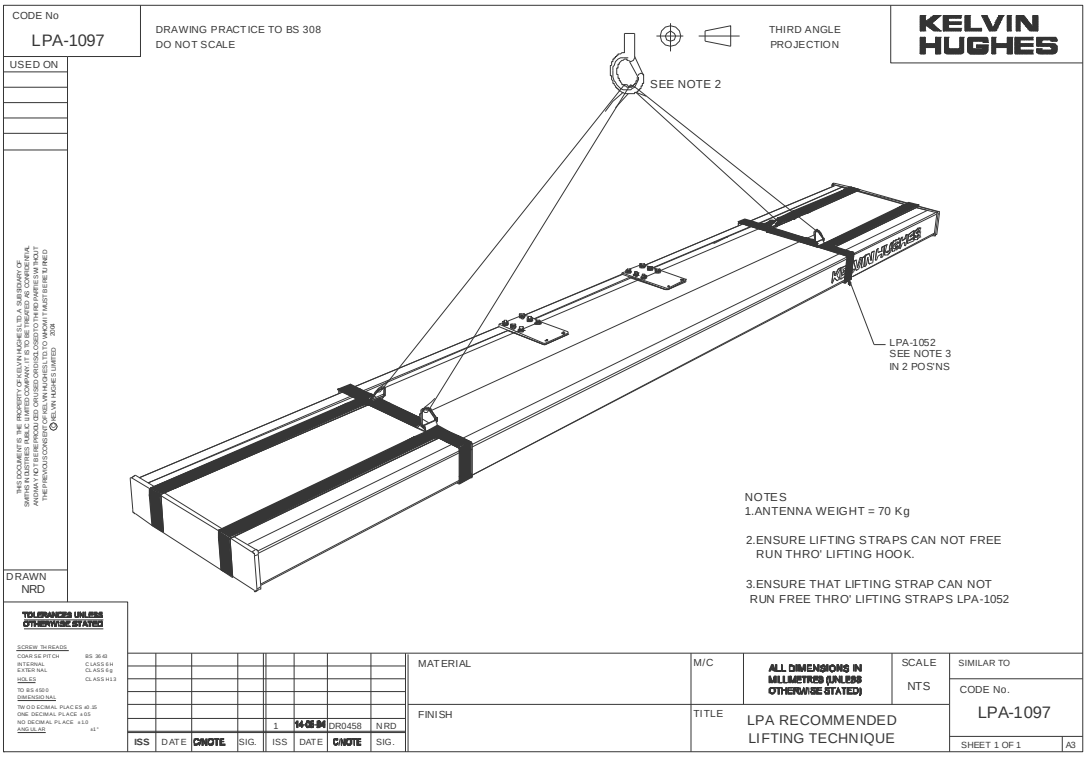
S-band Antenna removal

⚠	***Caution:*** All safety precautions regarding the lifting and handling of antennas noted in this section must be read, fully understood and observed.

The Kelvin Hughes LPA-A3 and LPA-A3-BAAA S-band low profile antennas are supplied with a set of lifting straps which must be used for lifting the antenna. These straps are individually marked with the antenna's serial number and must be retained with the equipment for possible future maintenance work.

Prior to use, the straps must be fully checked for any signs cuts, abrasions and signs of chemical damage. If there is any evidence of damage the lifting straps *must not be used* and should be replaced.

Replacement lifting strap can be order from kelvin Hughes by quoting part number LPA-1052 (two required) and the serial number of the antenna.



⚠	***Caution: Lifting straps maximum weight*** *The lifting straps supplied with S-band low profile antennas have a maximum weight limit of 200Kg.* *They must only be used for lifting the LPA–A3 or LPA-A3-BAAA antennas and are not designed for lifting of any other equipment.*

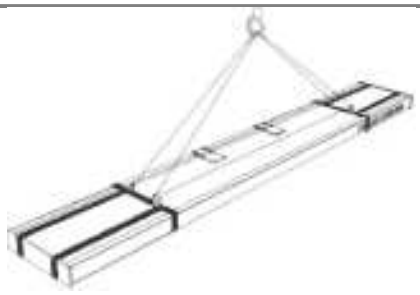
Tools: In addition to the normal tools required for installation and service work the following tools will be required to remove and re-install the S-band LPA onto the transceiver/ gearbox.
1.5mm and 8.0mm hex/ Allen key
10mm socket set (recommended)

Support the antenna

Ensure the antenna is fully supported ready to be lifted.

The LPA-1052 lifting supports originally supplied with the antenna MUST BE USED.

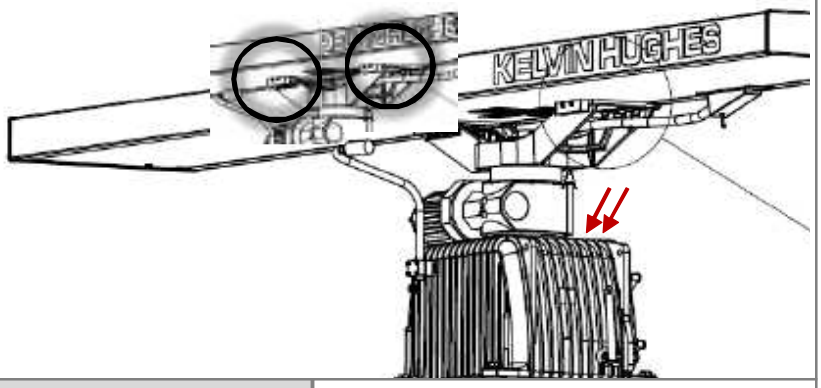
Array weight: 70Kg



Release forward bolts

On both arms of the swing casting, remove and retain the 4 bolts and washers indicated.

Retain these bolts and washers as they are required when reinstalling the antenna.



Release waveguide coupling

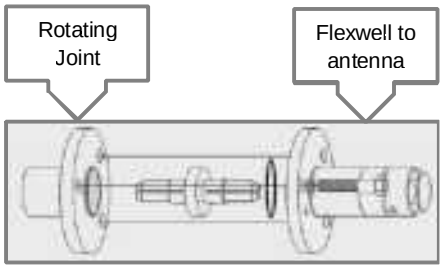
Remove the three bolts that hold the waveguide coupling together.

Separate the waveguide and remove the coupling bullet and 'O' ring.

A new bullet and 'O' ring are supplied as part of the installation kit.

When removing the bolts that retain the array to the swing casting, two bolts holes are 'slotted' allowing the array to be moved. This can be of assistance when removing the RF bullet in the waveguide coupling.

⚠ CAUTION: The array **must be supported at all times** when removing any bolts and especially if the two slotted guides are the only fasteners retaining the array to the swing casting.



Waveguide coupling showing bullet and 'O' ring

Example of swing casting

Loosen final bolts and remove antenna

Observing all safety requirements and ensuring the antenna is **fully** supported and is ready for lifting, remove and retain the 10 bolts and washers that hold the antenna onto the swing casting. Retain these bolts and washers as they are required for reinstallation of the antenna.

⚠ **The antenna is now loose** and is ready to be lifted.

The antenna should be carefully stored ensuring that the waveguide is not crushed, bent or damaged. The antenna must never be handled by the waveguide.

10.3 Standard X-band

10.3.1 Antenna

The corrective maintenance for the standard LPA-A37 and LPA-A55 Low Profile Antennas is restricted to keeping them clean and inspecting for damage.

See *Planned Maintenance/ Annual Maintenance* for cleaning and inspection details.

Standard DTX-A3-AXZX gearbox fitted with an LPA-A55-AAAA

10.3.2 Gearbox

The DTX-A3-AXZX and DTX-A3-BXZX gearbox housing is a cast enclosure with a service cover that allows access to the azimuth/ heading line (ACP/ ARP) encoder and it connections.

There are no other electronic assemblies within the gearbox casing.

The X Band gearbox comprises of the following sub-assemblies:

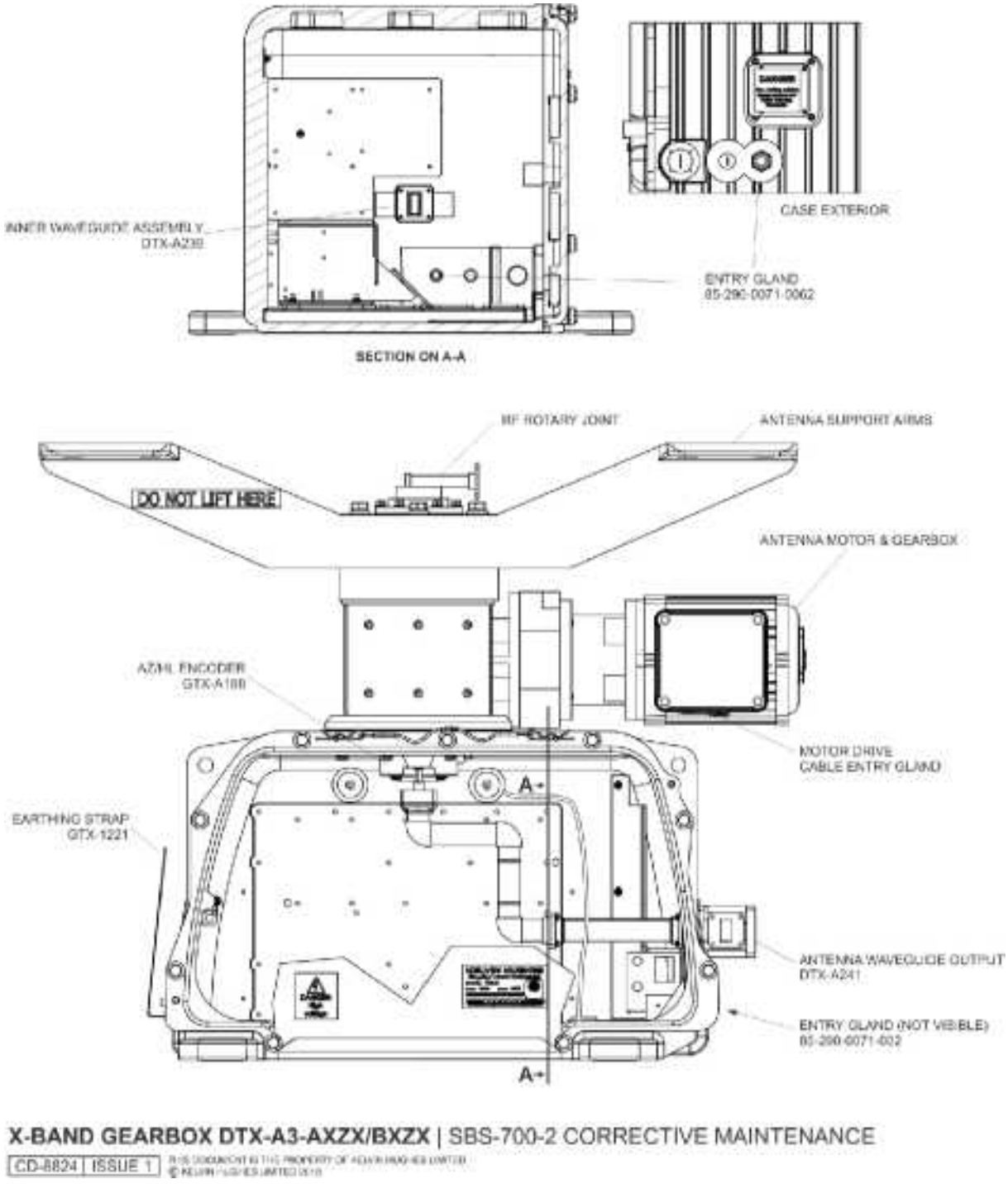
10.3.3 Spares listing

X Band system description	Part number	
	Casing colour Signal white	Casing colour Silver Grey
Complete assembly	DTX-A3-AXZX	DTX-A3-BXZX
Antenna motor / gearbox assembly	55-100-0273-001	DTX-A186
Motor coupling gasket	55-100-0273-003	55-100-0273-003
RF rotary Joint Rotating joint gasket	DTX-A183 GTX-A1246	DTX-A183-64 GTX-A1246
Service access door seal	55-100-0311-001	
Azimuth/ heading line quadrature encoder	GTX-A188	
Door seal	55-100-0311-001	

Tools: In addition to the normal tools required for service and maintenance work, the following tools will be required:

M8/ 13mm spanner: Used for the removal of the transceiver service door.
1.5mm hex/ Allen key: Grub screws retaining azimuth encoder.

10.3.4 Internal layout



10.3.5 ACP/ARP encoder

GTX-A188	Optical quadrature azimuth and heading line encoder	

The sealed ACP/ ARP encoder is situated inside the gearbox housing and is located around the rotating joint shaft. It outputs 1024 pulses (two azimuth streams 90deg phase shifted and two inverse azimuths) per revolution.

The encoder also outputs a heading line pulse and an inverse heading line pulse for each revolution of the antenna. The azimuth, heading line output signals and DC power input are connected to TB1 which is internally located in the base of the gearbox.

The encoder is supplied with +15V DC supply from the transceiver enclosure.

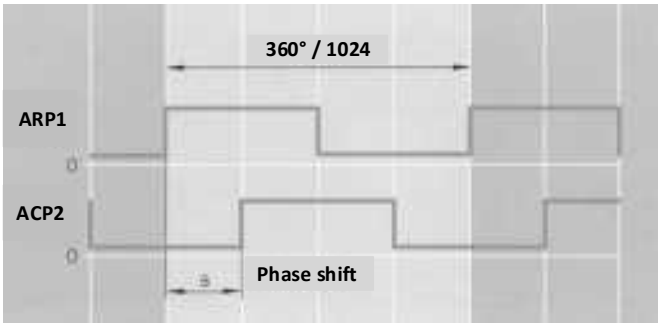
The Quadrature ACP comprises of two 90° phase shifted square wave pulse trains ACP1 & ACP2 whose frequency is dependent on antenna rotation rate.

- 1024 ACP pulses are required per 360° antenna rotation from each pulse train.
- ACP2 lags ACP1 by 90° for an antenna rotating clockwise when viewed from above.
- The output pulses have an amplitude of +15V.

Each rising or falling edge is decoded from these two pulse trains to provide 4096 ACPs per antenna revolution.

The ARP pulse width is required to be equal to at least one 4096 decoded period but does not have to have any specific timing in relation to ACPs i.e. it can be asynchronous w.r.t ACPs.

Polarity : Positive
Stabilisation : Relative
Format :1024 bi-phase quadrature ACP & ARP
Ratio : 1:1 with scanner rotation
Amplitude : 5V to 15V differential
Impedance : Into 1kΩ

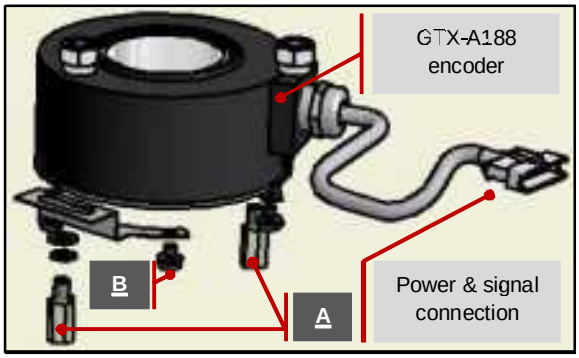


Note: *The azimuth encoder is a sealed unit and contains no field serviceable or repairable parts.*

Encoder removal

The azimuth encoder can be removed as follows:

a) Fully isolate the entire system from all sources of AC power.
b) Unplug the azimuth encoder flying lead from the housing cable form (located in the top of the housing).
c) Noting the position and order of washers, unscrew, remove and retain the two pillars **(A)** that hole mounting bracket from the base of the rotating joint.
d) Slacken the two M3 (1.5mm hex key) grub screws securing the azimuth encoder to the gearbox and carefully remove the azimuth encoder, ensuring the cable is not damaged.



Example of GTX-A188

Noting the position and order of washers, unscrew, remove and retain the *four* cross head bolts (**B**) that retain the supporting bracket to the encoder.

Encoder replacement

To replace the azimuth encoder, reverse the removal procedure shown above.

The encoder must never be hammered into position.
Using a hammer to fit the encoder can damage the device.

Heading Marker Note: There is no heading orientation mark on the encoder. When a replacement encoder is fitted the heading line must be configured/ adjusted in the *setup* menu of the radar distribution unit.


GTX-A188 encoder and waveguide


Detail of encoder mounting

DTX-A3-AXZX & DTX-A3-BXZX

10.3.6 RF rotary joint

The RF 'Ro-Jo' or rotary joint is the mechanism by which the RF from the waveguide is coupled to the rotating antenna waveguide.

The joint is secured to the centre of the swing casting and connects to the waveguide on the underside of the antenna.

Time: The removal and replacement of the rotating joint can take between 4 to 5 hours to complete depending on accessibility and availability of lifting equipment.

There are a number of tasks involved in the removal and replacement of the rotating joint:

a) Removal of the antenna
b) Removal of the RF coupling and azimuth encoder from within the gearbox housing
c) Removal and replacement of the rotating joint
d) Re-assembly of the RF coupling and azimuth encoder
e) Re-installation of the antenna

Spares required	Casing colour Signal white	Casing colour Silver Grey
Replacement rotating joint Rotating joint gasket	DTX-A183 GTX-A1246	DTX-A183-64 GTX-A1246

Antenna removal

See section 10.3.1 for the precautions and instructions on removing the antenna.

RF coupling and encoder removal

Coupling: Within the gearbox enclosure, disconnect the base of the Ro-Jo from the inner waveguide assembly.

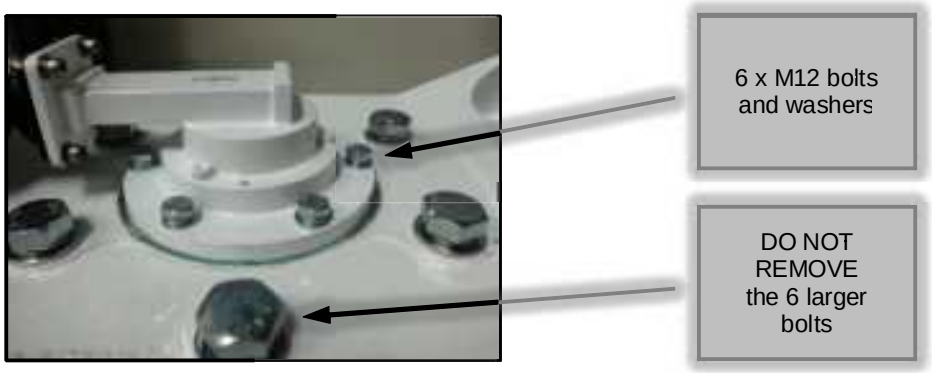
Ensure the inner waveguide is suitably supported to prevent any stress on retaining fasteners.

Encoder: Prior to removing the rotating joint, it is necessary to remove the azimuth encoder from the inside of the gearbox housing. Full details can be found in section 10.3.5 page 130.

Rotating joint removal

With the antenna, internal waveguide and azimuth encoder removed, the rotating joint can now be removed.

Noting their positions, remove *and retain* the 6 x M12 bolts and washers shown below:



The entire rotating joint can now be gently removed from the transceiver housing.

Remove and discard the gasket which MUST NOT be re-used. A replacement gasket ordered with the rotating joint (GTX-A1246) must be used when the new Ro-Jo is assembled.

This completes the removal process.

Replacement

Rotating joint	To replace the rotating joint, reverse the above procedure using the new GTX-A1246 replacement gasket.
Waveguide coupling & azimuth encoder	Reverse the removal process.
Antenna	Reverse the removal procedure detailed in the above section. - Tighten and torque load the 12 antenna retaining bolts to 56 Nm and apply Loctite 222 on their threads during assembly. - Waterproof the waveguide joint by sealing with a layer of greased plastic compound such as Henley's compound or Denso-Tape. - After installation, the antenna should be checked to ensure that it can freely rotate without obstruction.

10.4 Standard dual X & S-band

10.4.1 Antenna

The corrective maintenance for the standard LPA-A455 Low Profile Antennas is restricted to cleaning and inspecting for damage.

See *Planned Maintenance/ Annual Maintenance* for cleaning and inspection details.

Standard DTX-A19 fitted with an LPA-A455

10.4.2 Gearbox

The DTX-A19 and DTX-A19-BAAA gearbox housing is a cast enclosure with a service cover that allows access to the azimuth/ heading line (ACP/ ARP) encoder and it connections and the S-band flexwell connection.

There are no other electronic assemblies within the gearbox casing.

The gearbox comprises of the following sub-assemblies:

X Band system description	Part number	
	Casing colour Signal white	Casing colour Silver Grey
Complete assembly	DTX-A19	DTX-A19-BAAA
Antenna motor / gearbox assembly	TBC	TBC
Motor coupling gasket	TBC	TBC
RF rotary Joint Rotating joint gasket	TBC	TBC
Service access door seal	55-100-0311-001	
Azimuth/ heading line quadrature encoder	TBC	

Maintenance details

Section under construction

Please consult Kelvin Hughes for maintenance procedures for the following equipment:
DTX-A19 gearbox (all variants)
LPA-A455 antenna (all variants)

Contact details can be found in section 12 of this handbook.

10.5 Standard S-band

10.5.1 Antenna

The corrective maintenance for the standard LPA-A3 and LPA-A3-BAAA Low Profile Antennas is restricted to cleaning and inspecting for damage.

See *Planned Maintenance/ Annual Maintenance* for cleaning and inspection details.

Standard GTX-A11 fitted with an LPA-A3

10.5.2 Gearbox

The GTX-A11 and GTX-A11-BAAA gearbox housing is a cast enclosure with a service cover that allows access to the azimuth/ heading line (ACP/ ARP) encoder and it connections and the S-band flexwell connection.

There are no other electronic assemblies within the gearbox casing.

The gearbox comprises of the following sub-assemblies:

10.5.3 Spares listing

X Band system description	Part number	
	Casing colour Signal white	Casing colour Silver Grey
Complete assembly	GTX-A11	GTX-A11-BAAA
Antenna motor / gearbox assembly	TBC	TBC
Motor coupling gasket	TBC	TBC
RF rotary Joint Rotating joint gasket	TBC	TBC
Service access door seal	55-100-0311-001	
Azimuth/ heading line quadrature encoder	TBC	
Door seal	55-100-0311-001	

10.5.4 ACP/ARP encoder

GTX-A188	Optical quadrature azimuth and heading line encoder	

The sealed ACP/ ARP encoder is situated inside the gearbox housing and is located around the rotating joint shaft. It outputs 1024 pulses (two azimuth streams 90deg phase shifted and two inverse azimuths) per revolution.

The encoder also outputs a heading line pulse and an inverse heading line pulse for each revolution of the antenna. The azimuth, heading line output signals and DC power input are connected to TB1 which is internally located in the base of the gearbox.

The encoder is supplied with +15V DC supply from the transceiver enclosure.

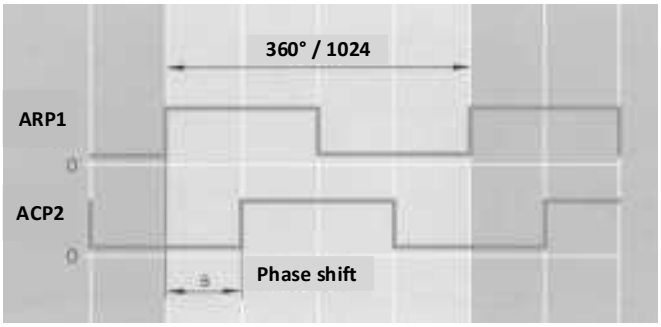
The Quadrature ACP comprises of two 90° phase shifted square wave pulse trains ACP1 & ACP2 whose frequency is dependent on antenna rotation rate.

- 1024 ACP pulses are required per 360° antenna rotation from each pulse train.
- ACP2 lags ACP1 by 90° for an antenna rotating clockwise when viewed from above.
- The output pulses have an amplitude of +15V.

Each rising or falling edge is decoded from these two pulse trains to provide 4096 ACPs per antenna revolution.

The ARP pulse width is required to be equal to at least one 4096 decoded period but does not have to have any specific timing in relation to ACPs i.e. it can be asynchronous w.r.t ACPs.

Polarity : Positive
Stabilisation : Relative
Format :1024 bi-phase quadrature ACP & ARP
Ratio : 1:1 with scanner rotation
Amplitude : 5V to 15V differential
Impedance : Into 1kΩ

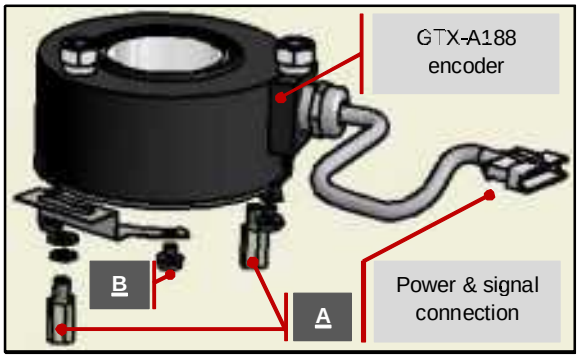


Note: *The azimuth encoder is a sealed unit and contains no field serviceable or repairable parts.*

Encoder removal

The azimuth encoder can be removed as follows:

e) Fully isolate the entire system from all sources of AC power.
f) Unplug the azimuth encoder flying lead from the housing cable form (located in the top of the housing).
g) Noting the position and order of washers, unscrew, remove and retain the two pillars **(A)** that hole mounting bracket from the base of the rotating joint.
h) Slacken the two M3 (1.5mm hex key) grub screws securing the azimuth encoder to the gearbox and carefully remove the azimuth encoder, ensuring the cable is not damaged.



Example of GTX-A188

Noting the position and order of washers, unscrew, remove and retain the *four* cross head bolts **(B)** that retain the supporting bracket to the encoder.

Encoder replacement

To replace the azimuth encoder, reverse the removal procedure shown above.

The encoder must never be hammered into position.
Using a hammer to fit the encoder can damage the device.

Heading Marker Note: There is no heading orientation mark on the encoder. When a replacement encoder is fitted the heading line must be configured/ adjusted in the *setup* menu of the radar distribution unit.

10.5.5 RF rotary joint

The RF 'Ro-Jo' or rotary joint is the mechanism by which the RF from the transceiver waveguide is coupled to the rotating antenna waveguide.

The joint is secured to the centre of the casting swing casting and connects to the waveguide on the underside of the antenna.

Example of rotating joint with yellow transit caps fitted

	Time: The removal and replacement of the rotating joint can take between 4 to 5 hours to complete depending on accessibility and availability of lifting equipment.

There are a number of tasks involved in the removal and replacement of the rotating joint:

f) Removal of the antenna
g) Removal of the RF coupling and azimuth encoder from within the transceiver housing
h) Removal and replacement of the rotating joint
i) Re-assembly of the RF coupling and azimuth encoder
j) Re-installation of the antenna

Spares required	Casing colour Signal white	Casing colour Silver Grey
Replacement rotating joint	GTX-A150-2-S Note	GTX-A150-2-BAAA-S Note

Note: *The Rotating joint is delivered in kit form containing the ro-jo, a replacement gasket and coupling bullet.*

Antenna removal

See section 10.2.4 for the precautions and instructions on removing the antenna.

RF coupling and encoder removal

Coupling: Within the gearbox enclosure, disconnect the base of the Ro-Jo from the inner waveguide assembly.

Ensure the inner waveguide is suitably supported to prevent any stress on retaining fasteners.

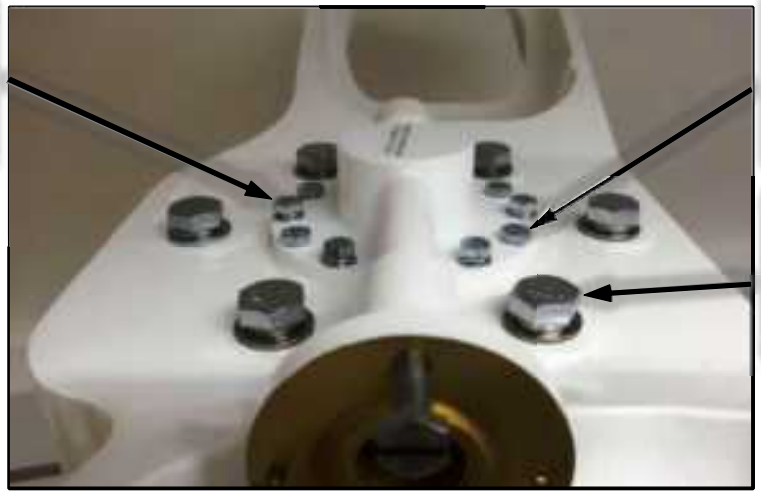
Encoder: Prior to removing the rotating joint, it is necessary to remove the azimuth encoder from the inside of the gearbox housing.

Rotating joint removal

With the antenna, internal RF coupling and azimuth encoder removed, the rotating joint can now be removed.

Noting their positions and thread depths, remove *and retain* the bolts and washers shown below:

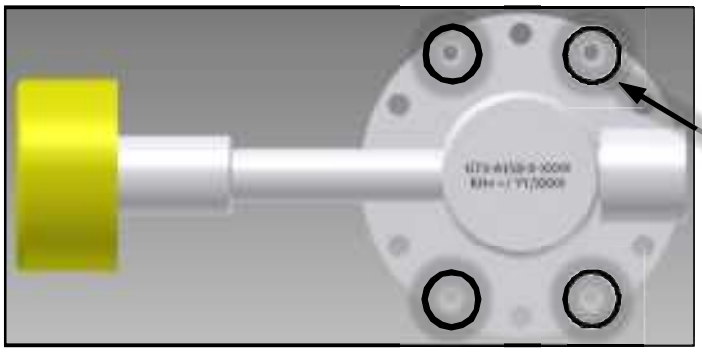
6 off M6 x 20mm bolts with washers



4 off M6 x 6mm bolts with no washers

DO NOT REMOVE the 6 larger bolts

Take four of the M6 x 20mm bolts and refit them into the holes used by the M6 x 6mm bolts



The holes that contained the four M6 x 6mm bolts are threaded.

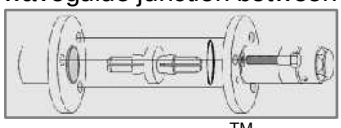
Place four M6 x 20mm bolts into these threaded holes and gently *tighten* each of the bolts in turn, this will push the rotating joint out of the housing.

When loosened, the entire rotating joint can be gently removed from the housing.

Remove and discard the gasket which MUST NOT be reused. A replacement can be found in the spares kit.

This completes the removal process.

Replacement

Rotating joint	To replace the rotating joint, reverse the above procedure using the replacement gasket, bullet and 'O' ring found in the spares kit.
RF coupling & azimuth encoder	Reverse the removal process shown in section 10.5.4 pages 136 onwards.
Antenna	Reverse the removal procedure detailed in the above section. - Ensure the replacement bullet and 'O' ring are correctly installed in the waveguide junction between the ro-jo and the antenna waveguide.  To avoid SharpEye™ SWR errors at start up, ensure that ALL connectors are correct and secure. Pay particular attention to the coupling bullets, Ro-Jo to Flexi Waveguide & Co-Ax Adaptor. - Tighten and torque load the 12 antenna retaining bolts to 56 Nm and apply Loctite 222 on their threads during assembly. - Waterproof the waveguide joint by sealing with a layer of greased plastic compound such as Henley's compound or Denso-Tape. - After installation, the antenna should be checked to ensure that it can freely rotate without obstruction.

10.6 Advanced antenna sub systems

Enhanced ATU and antennas: The corrective maintenance procedures for the advanced ST1-F10/ 20 Antenna Turning Unit (ATU) and range of antennas are not detailed in this section.

ST1-F20 Antenna Turning Unit & antenna

Please refer to the installation and maintenance handbook supplied with the equipment for full details on corrective maintenance.

Spares: Where required, only Kelvin Hughes approved spares must be used. The use of unapproved spares can invalidate the warranty status of the unit or lead to a failure of the system.

Adverse weather: It is strongly recommended that the gearbox inspections noted in section 9.4 are carried out at the earliest safe opportunity after the system has been exposed to severe or adverse weather conditions.

Health & safety: All safety warnings for the system noted in section 2 must be observed at all times when inspecting and maintaining any part of the SBS system or its associated sub systems.

System isolation: Please refer to section 9.3 page 87 for details on isolating the system from all sources of AC power.

WARNING

Lethal voltages are present within the equipment.

All maintenance procedures must be carried out with all relevant power sources switched OFF, fully isolated and disconnected.

Caution: When the system has been operating in strong sunlight or elevated temperatures, gearbox casings and antenna surfaces will be extremely hot.

10.7 Transceiver enclosure

10.7.1 Safety notices

ANTENNA ROTATION SAFETY NOTICE:

When three-phase power is connected to the system and switched ON, the antenna *may rotate immediately* regardless of the RUN command status.

Use the *Antenna Rotation* keyswitch, *Man Aloft* safety switches or *antenna control* in the command and display system to stop antenna rotation in an emergency.

WARNING: Prior to commencing any maintenance procedure, users must familiarise themselves with the health & safety warnings noted in the planned maintenance and health and safety sections of the system handbooks.

AC supplies: Prior to carrying out any maintenance, the system must be fully isolated and disconnected from the single and 3-phase AC supplies. This must include the full isolation of any UPS supplies connected to the system.

10.7.2 System Part numbering

A number of options can be specified for the DTX-A7-* SBS-900 transceiver enclosure.

Currently, these options can be factory fitted or retro fitted in the field.

In order that the equipment can be ordered correctly, built & identified and supported in the future with any valid number of options, the equipment part number is to be suffixed by a 6-digit option number as below when an option is fitted:

The option code contains a digit for each available option, where:

- **0** = Indicates the option is not required, not fitted or not available.
- **1** = Indicates the option is required or fitted.
- **n** = Indicates the particular type of option is required or fitted.

DTX-A7-*-	0 = Not fitted	Not allocated. Reserved for future use	Not allocated. Reserved for future use	Not allocated. Reserved for future use	Not allocated. Reserved for future use	0 = Not applicable
	SBS-900 FAN KIT , SBS-A179					Project Specific Option, (see below)

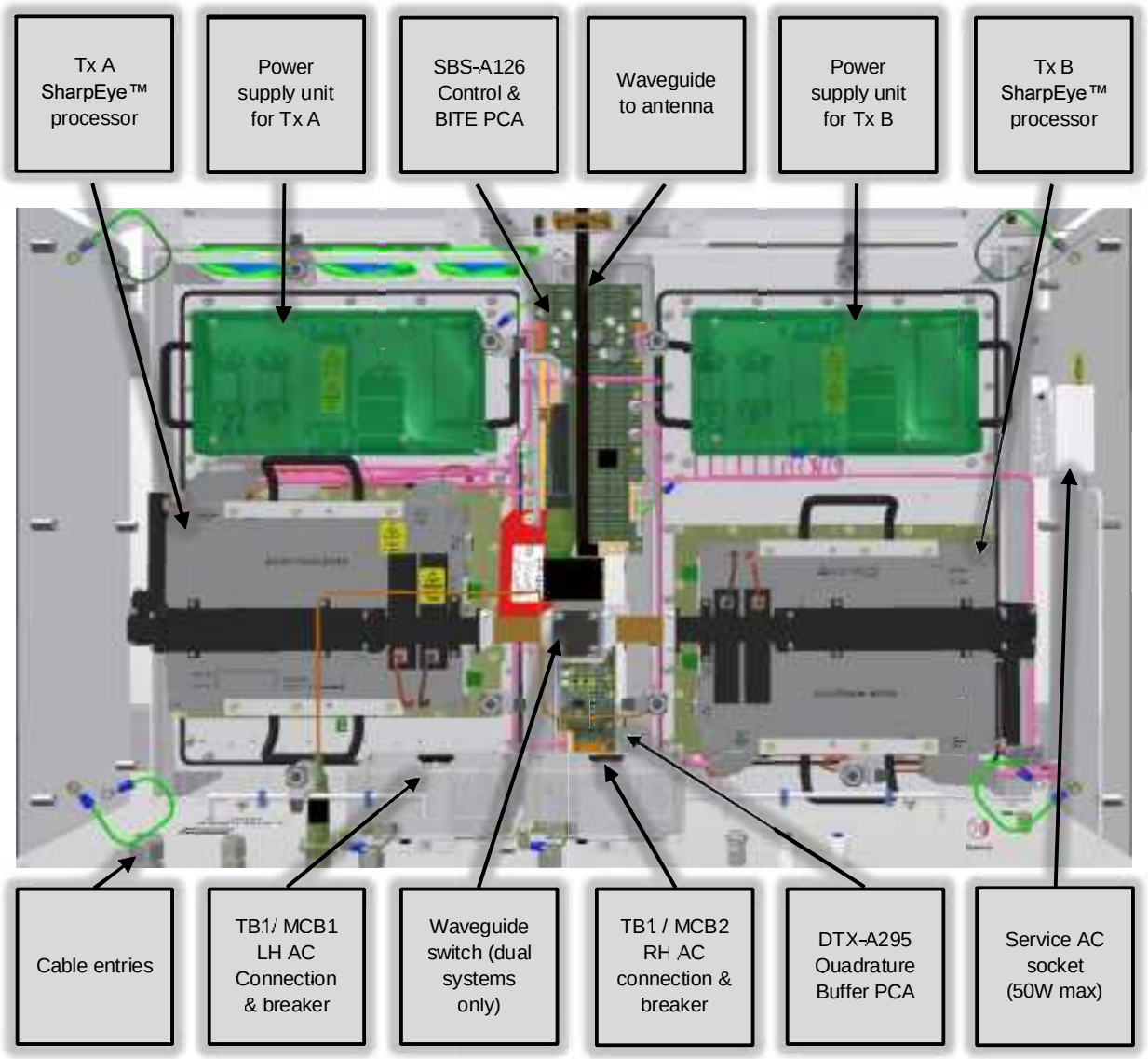
Example: DTX-A7-3-200000 is an SBS900-3 Transceiver Enclosure with two optional fan kits fitted (dual transceiver).

10.7.3 AC Input & breakers

Single Phase AC supply: Depending on the system, the transceiver enclosure receives one or two sources of single phase AC supply from the Radar Distribution unit.

AC Mains input A	AC Mains input A & B
SBS-900-1 **DTX-A7-1** SBS-900-2 **DTX-A7-2** SBS-900-51 **DTX-A7-51** The AC input terminates on LH-TB1 (left hand side)	SBS-900-3 **DTX-A7-3** SBS-900-4 **DTX-A7-4** The AC input terminates on RH-TB1 (right hand side)

10.7.4 Overview



DTX-A7 dual transceiver enclosure shown with doors and front cover removed for clarity

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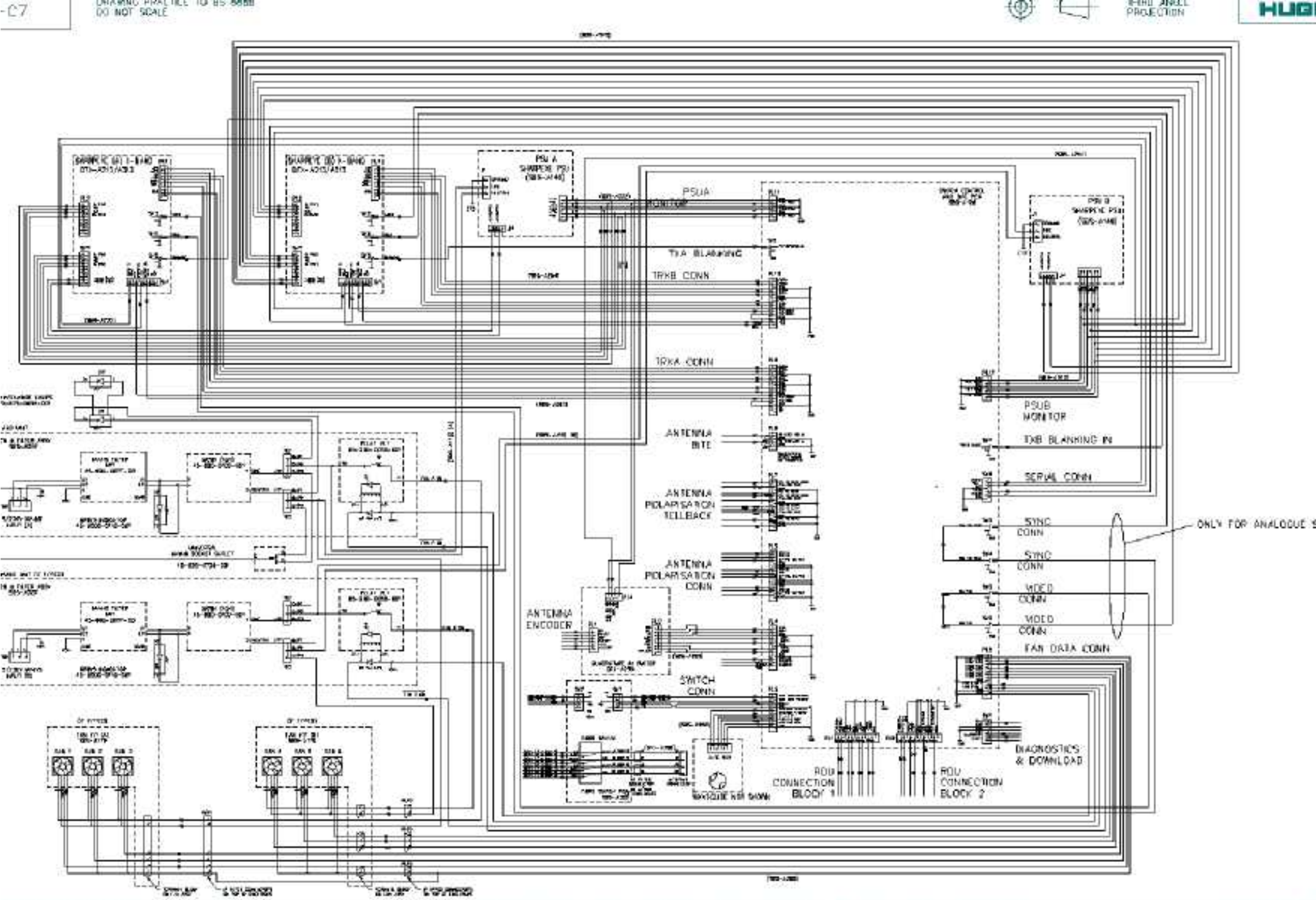

UNLESS OTHERWISE STATED

MATERIAL

SCALE

TITLE

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10.7.6 Power unit assembly

AC-DC power supply unit
Part number SBS-A146

The AC-DC power supply unit is a single assembly that provides the DC outputs required by the transceiver enclosure.

The PSU assembly consists of a mains rectification unit and a number of DC/ DC converters mounted onto a chassis.

WARNING: Lethal AC and DC voltages of up to **450VDC** are present within the SBS-A146 assembly. Ensure the system is fully isolated prior to disconnecting the unit.

AC supplies: Prior to carrying out any maintenance, the system must be fully isolated and disconnected from all single and 3-phase AC supplies. See *system isolation* in the planned maintenance section of the system handbook.

UPS (Uninterruptable Power Supply): Where connected, ensure that UPS supplies to the RDU are fully isolated prior to carrying out *any* maintenance task on the system.

Location: Depending on the system there will be one or two power units in the chassis.

Single transceiver systems: One PSU located in the left hand side of the enclosure.

Dual transceiver systems: Two power supplies one on the left and another on the right hand side of the enclosure.

10.7.6.1 Spares & repairs

The repair of the SBS-A146 is limited to unit replacement only.

- The power supply assembly contains no field serviceable or user adjustable parts.
- The unit must NOT be dismantled in the field as specialist equipment is required for testing the electrical safety barriers.
- Circuit diagrams and sub assembly spares for the power unit assembly are not available.

10.7.6.2 Output checks

With the system switched ON, the voltages for the Transceiver Enclosure power supply can be check using the menus on the RDU.

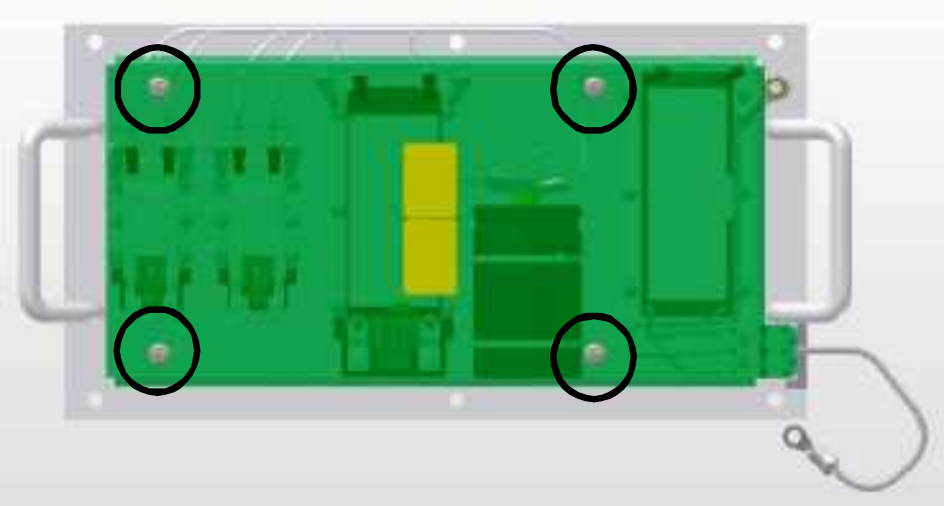
From the RDU front panel select ***Status*** then ***Enclosure***. In the Enclosure menu, the following power supply rails can be checked:

PSU A	PSU B	Internal supplies
PSU Tx A 3.3V	PSU Tx A 3.3V	PSU INT +15V
PSU Tx A 15V	PSU Tx A 15V	PSU INT +5.0V
PSU Tx A 13V	PSU Tx A 13V	

10.7.6.3 Removal & Replacement

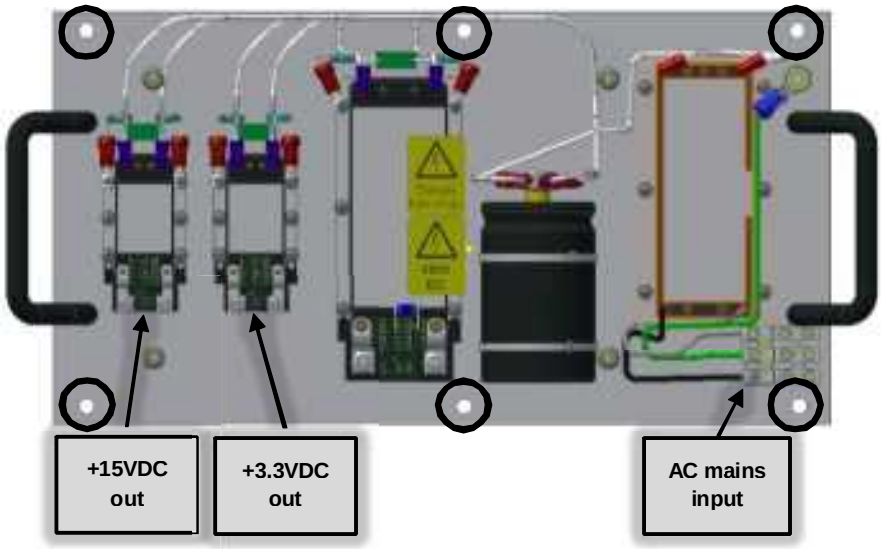
Disconnection: Ensure that the system is fully isolated from all AC power sources.

Remove the safety cover from the assembly; this cover is retained by four nuts and washers *(circled below)* which will be required for refitting.



Carefully note the position and cable numbers of the input and output cables indicated below.

CAUTION: The cable numbers are not detailed in this handbook.



SBSA-146 power supply assembly shown with safety cover removed

Removal: The SBS-A146 assembly is retained into the enclosure by 6 nuts and washers *(circled above)*.

Remove and retain these fasteners as they will be required for refitting.

The SBS-A146 assembly can now be removed from the enclosure.

Replacement: To replace the power supply, reverse the above removal process.

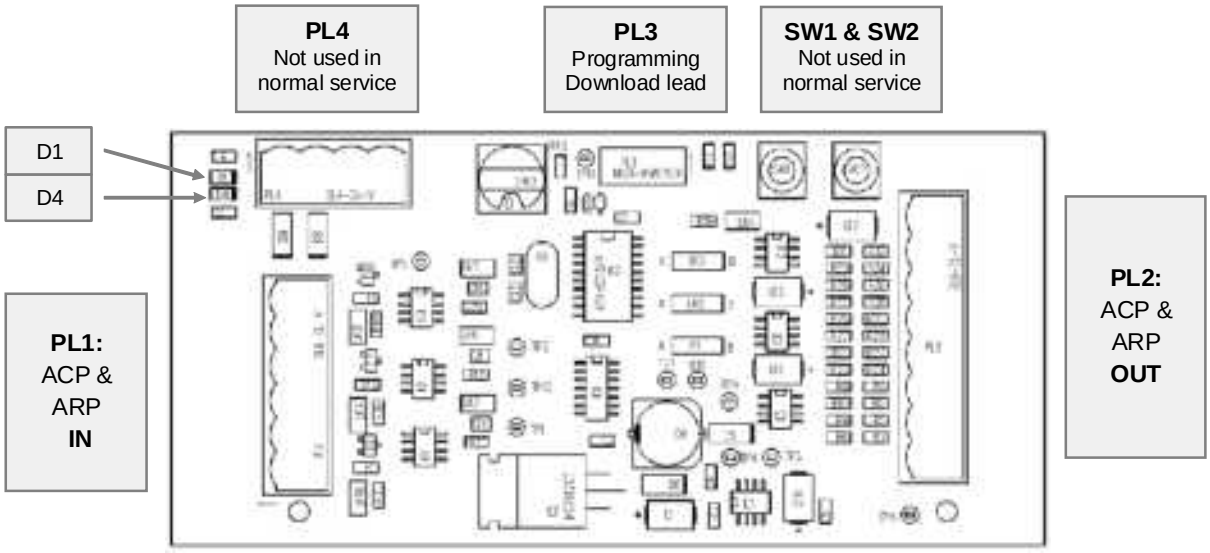
10.7.7 DTX-A295 quadrature buffer PCB

The DTX-A295 converts pulsed 90:1 or 180:1 Azimuth and HL inputs into 4096 Quadrature differential signals. The board uses a small processor to multiply the incoming Azimuth pulses in accordance with the rate of turn detected.

Inputs are opto-coupled for signal integrity and isolation purposes.

The PCA is powered by the power supply located within the transceiver enclosure and can operate from an input of between +12V to 24VDC. The PCA generates all required DC rails from the input voltage with all rails being isolated (including GND) from the input supply.

10.7.7.1 PCB layout and connector details



PL1	
PL1-1	ACP1
PL1-2	nACP1
PL1-3	ACP2
PL1-4	nACP2
PL1-5	ARP
PL1-6	nARP

PL2	
PL2-1	+12V
PL2-2	ACP1
PL2-3	nACP1
PL2-4	ACP2
PL2-5	nACP2
PL2-6	ARP
PL2-7	nARP
PL2-8	GND/ 0V

10.7.7.2 LEDs

D1 (Green): Processor status	
Processor running (Normal)	Flashing at 1Hz (0.5 sec ON and OFF)
No heading line	LED ON for 2 seconds
No azimuth	LED OFF for 2 seconds

Example: If the AZ OK but there is no HL then the LED will be ON for 2 seconds, OFF for 0.5 second, ON for 2 seconds etc.

D4 (Green): DC present	
DC power ON	ON
No DC power to PCB	OFF

10.7.7.3 Links and switches

Links	Factory default position	*Optional settings*
1, 2 & 3	**A position** Direct buffer mode	**B position** Processor mode
4	**Open** Test mode disabled	**Made** Enables test mode (*factory use only*)
5,6 & 7	**Open** Signal input filter disabled	**Made** Signal input filter enabled
8,9 &10	**Open** Low input voltage signals disabled	**Made** Low input voltage signals enabled

Switches				
SW1 SW2	Not used (factory use only)			
SW3	0	Quad IN	4	90 Pulsed IN Quad OUT
	1	8192 Pulsed IN Quad OUT	5	Quad IN 4096 OUT
	2	4096 Pulsed IN Quad OUT	6 to F	Spare/ not used
	3	180 Pulsed IN Quad OUT		

Note: When changing any links or switch settings, the PCA must be powered OFF/ ON to accept the link setting changes.

10.7.7.4 Removal & replacement

Disconnection: Ensure that the DTX-A7 Transceiver Assembly is fully isolated from all sources of AC power.

Noting their polarity, carefully disconnect **PL1** and **PL2.**

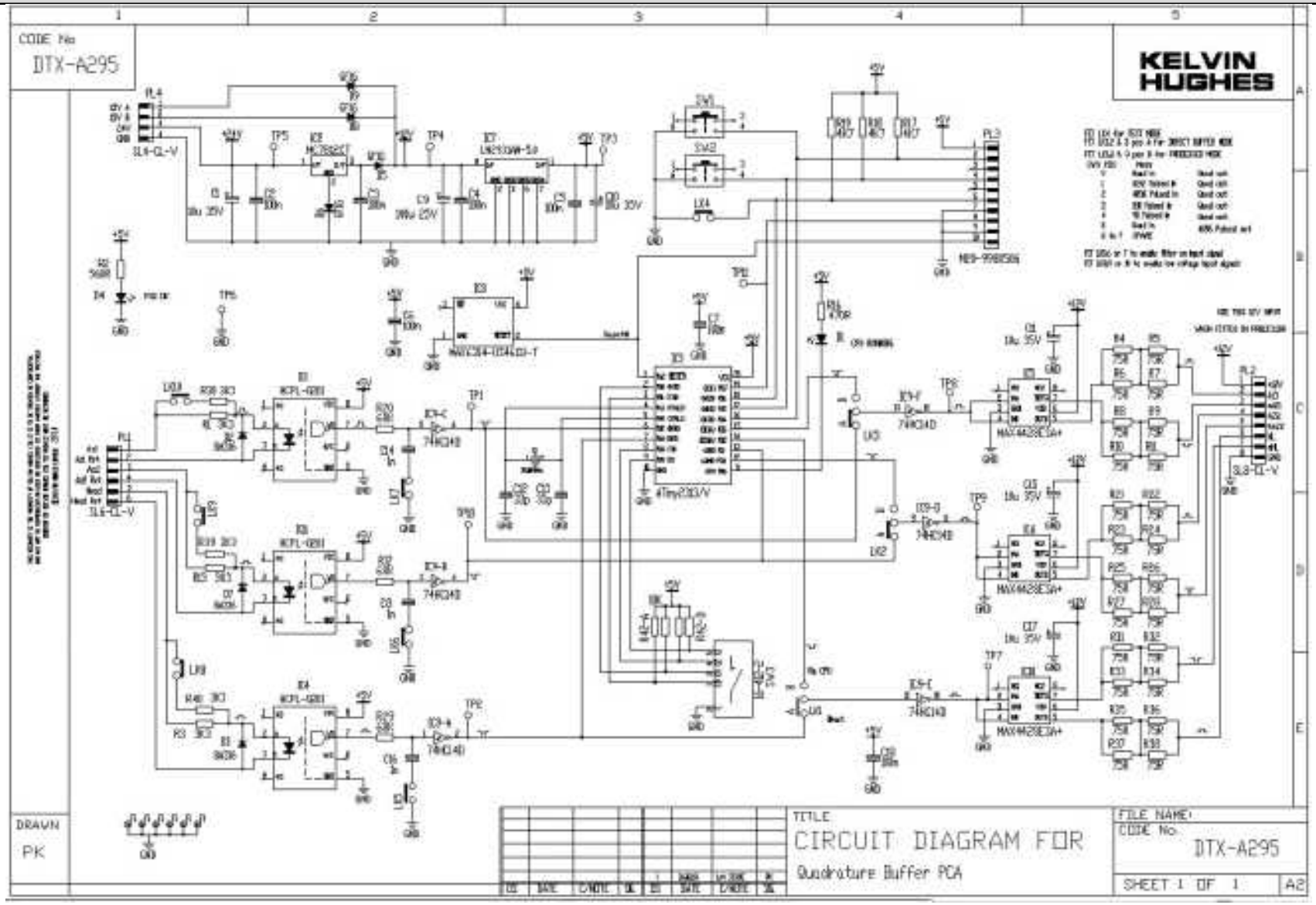
Removal: The DTX-A265 PCA is retained onto the chassis by 4 nuts. Remove and retain the nuts as they will be required for refitting.

The PCA may now be removed from the DTX-A7 enclosure.

Replacement: Ensure that all links and switches on the replacement board are set in the same position as those on the PCA that has just been removed.

To replace the board reverse the removal process.

10.7.7.5 Circuit diagram



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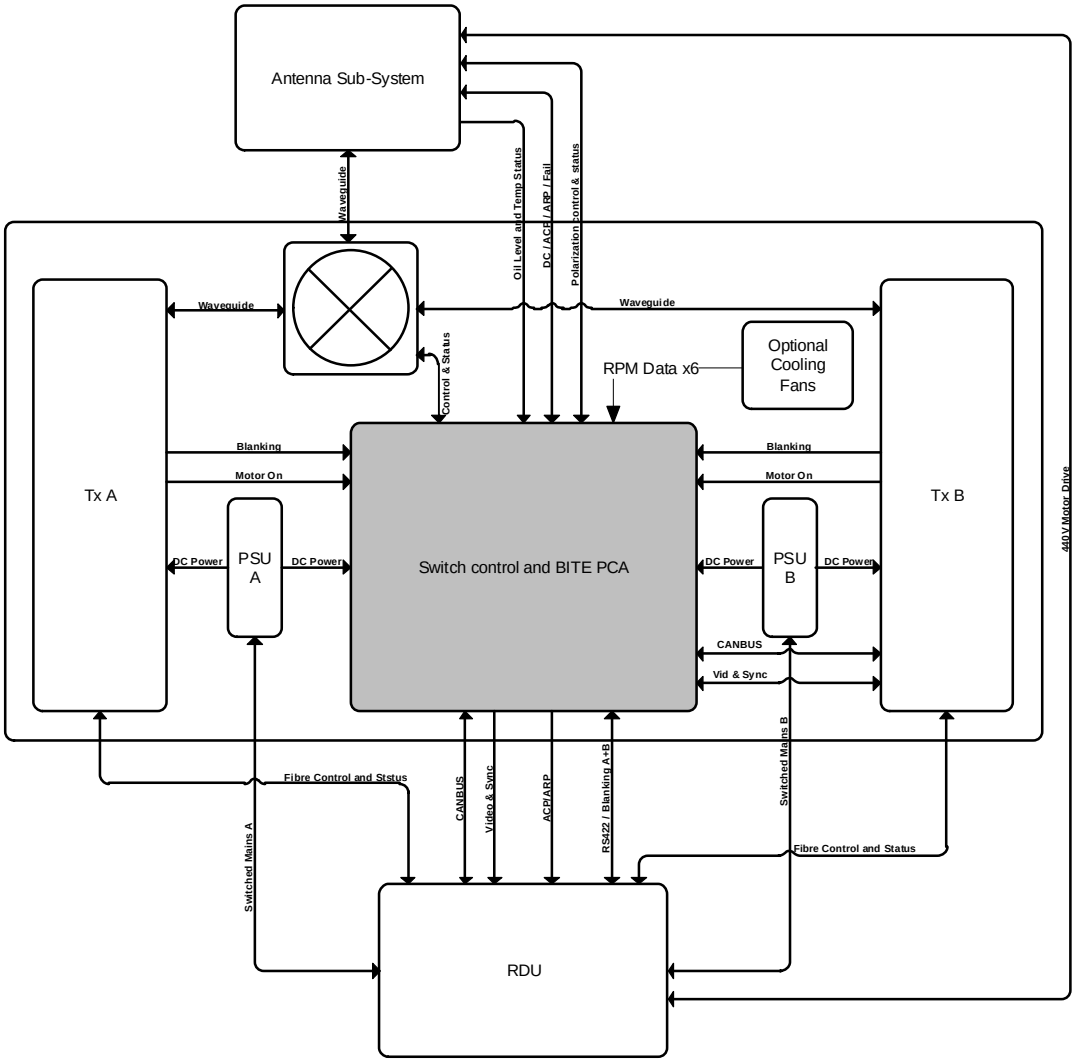
10.7.8 SBS-A126 Switch Control & BITE PCA

10.7.8.1 **Overview**

The Switch control and BITE PCA system is a non-critical link in the system where one or two SharpEyeTM transceivers are located within the same enclosure and share a single antenna sub-system.

The role of the Switch control and BITE PCA is to:

- Derive power for the +5V advanced antenna sub-system ACP/ ARP encoder.
- Derive power for the +28V waveguide switch.
- Provide power to the +15V Standard antenna sub-system ACP/ ARP encoder.
- Monitor and digitally transmit voltage levels via RS422.
- Monitor system states and transmit via RS422 to the RDU.
- Monitor enclosure temperature using on-board sensor and transmit via RS422 to the RDU.
- Receive commands via RS422 and activate waveguide switch and polarisation switch.
- Distribute Signals from the Antenna encoder to the SharpEye™ transceivers and the RDU.
- Drive the blanking outputs from the SharpEye™ transceivers to the RDU.
- Allow throughput of video, sync and CAN signals to transceiver B.



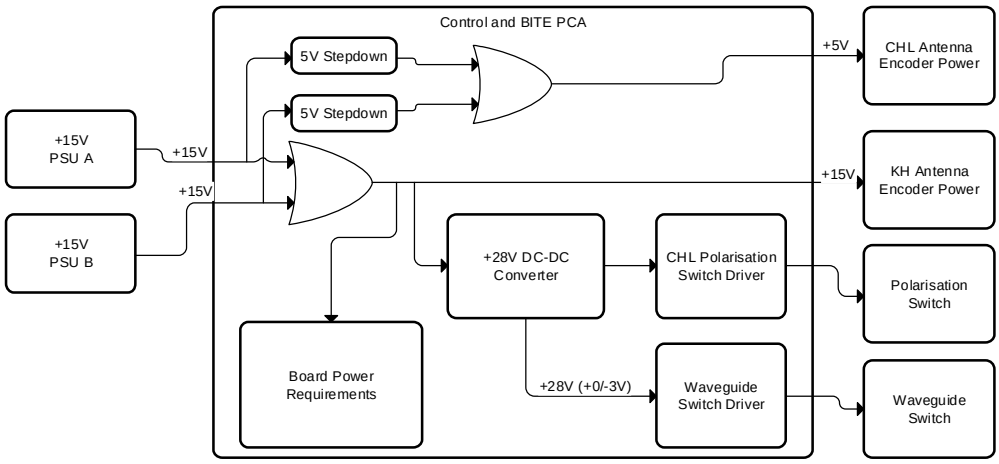
Simplified Switch control and BITE PCA interconnection diagram

PCA failure: If a failure of the Switch control and BITE PCA should occur then the default transceiver (Tx A) will still be able to operate. Manual control of the waveguide switch, and therefore Tx B, is still available.

Start-up: During start up, the waveguide switch is to be set to Tx A, and the polarisation switch to horizontal. Once the communication between the PCA and the RDU has been established and start-up checks are complete, then the processor takes over the control of the waveguide and polarisation switches as commanded by the RDU.

Power: The PCA is powered by the 15VDC output of the power supply. When either PSU A (single transceiver systems) or PSU B (dual transceiver systems) is powered, the PCA is powered and operational.

On board DC-DC conversion provides all the power requirements of the PCA.



SBS-A126 PCA DC power schematic

10.7.8.2 Encoder DC power selection

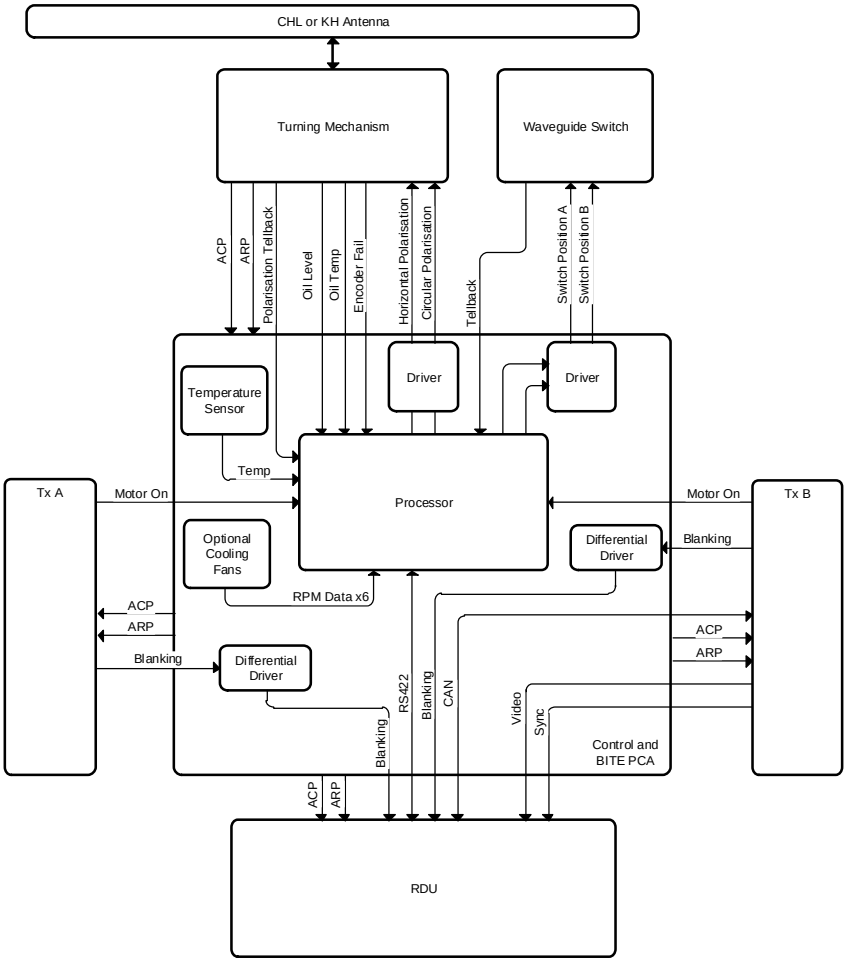
Encoder power: The SBS-A126 PCA provides a DC power source for the ACP/ ARP encoder in the antenna sub-assembly.

Link 8: Depending on the system installed, link 8 must be set to select the appropriate DC output voltage.

SBS-A126 DC output	**Standard** antenna sub-systems	**Advanced** antenna sub-systems
Encoder power SBS-A126: PL4 Pins 11 and 12	+15VDC	+5VDC
Link 8 setting	Set to '**A**' position	Set to '**B**' position

10.7.8.3 Signal interfaces:

There are multiple interfaces for the Switch control and BITE PCA. The status of the various inputs is monitored and transmitted to the RDU.



SBS-A126 signal interface schematic

Oil level: The oil level indicator monitors a normally closed voltage free contact. An open circuit indicates a 'low oil' fault condition. This is only available on advanced antenna sub-systems.

Oil temp: The oil temperature indicator monitors a normally closed voltage free contact. An open circuit indicates an 'over temperature' fault condition. This is only available on advanced antenna sub-systems.

Encoder fail: The encoder on advance antenna sub-systems has a TTL (+5.0VDC) encoder fail signal. A received signal of ≥2.5V indicates normal operation, a signal of <0.5V indicates an 'Encoder Fail' fault condition.

Polarisation control: This is only available on advanced antenna sub-systems and controls the status of the antenna polarisation. The default position is horizontal.

Polarisation tellback: The current polarisation position is fed to the PCA and reported to the RDU.

Waveguide switch selector: (Dual transceiver systems only) Two +28V outputs provided for the waveguide switch control. One output will cause the waveguide switch to set to transmitter A, and the other sets the waveguide switch to transmitter B. The default position is transceiver A. The selector switch defaults to the A position if there is a fault in the communications to the PCA.

Waveguide switch tellback: (Dual transceiver systems only) The current position of the waveguide switch is sensed and reported back to the RDU.

Motor on: Two motor ON signal inputs are monitored, one from each of the transceivers. Each has a signal level of 15V DC when the motor is on, and 0V when the motor is off. The status of the motor used to indicate which transceiver is running but does not control the motor ON/ OFF function.

Blanking: Two blanking inputs are to be received by the card. A blanking input is received for each transceiver via a 75Ω SMB connection.

ACP/ARP: The Azimuth Clock Pulse (ACP) and Azimuth Reset Pulse (ARP) are distributed from the encoder to both SharpEye™ transceivers, the signals are also transmitted to the RDU. The signals are not amplified and continue to operate in the event of a power failure on the board.

Power fan sensing: Inputs receive, monitor and report the outputs (RPM) of the optional forced air fans.

10.7.8.4 Indicators

LED	Colour	LED status
+15V Input A (input from PSU A)	Green	ON: +15V input ON OFF: +15V input OFF
+15V Input B (input from PSU B)	Green	ON: +15V input ON OFF: +15V input OFF
+15V (PCA power on)	Green	ON: +15V OK OFF: +15V OFF
+5V (Generated on PCA)	Green	ON: +5V PSU OK OFF: +5V PSU Off
+1.5V (Generated on PCA)	Green	ON: +1.5V PSU OK OFF: +1.5V PSU Off
+28V (Generated on PCA)	Green	ON: +28V PSU OK OFF: 28V PSU Off
Motor on Tx A	Red	ON: Motor On (Tx A) OFF: Motor OFF
Motor on Tx B	Red	ON: Motor On (Tx B) OFF: Motor OFF
Waveguide switch tellback position	2 x Red	A ON: Waveguide switch in position A Waveguide B ON: Waveguide switch in position B Both OFF: Waveguide switch in transition position
Oil level	Red	ON: Oil level OK OFF: Oil level low
Oil temp	Red	ON: Oil temp OK OFF: Oil temp high
Encoder fail	Red	ON: Encoder OK OFF: Encoder fail
Polarisation HP/VP tellback	Bi-Colour	RED ON: Waveguide switch in horizontal position Green ON: Waveguide switch in vertical position Both OFF: Waveguide switch in transition position
Polarisation Circular tellback	Bi-Colour	Red ON: Waveguide switch in CW position Green ON: Waveguide switch in ACW position Both OFF: Waveguide switch in transition position
Optional Fan tellback	Red	ON: All fan speeds OK OFF: One or more fan speed fail

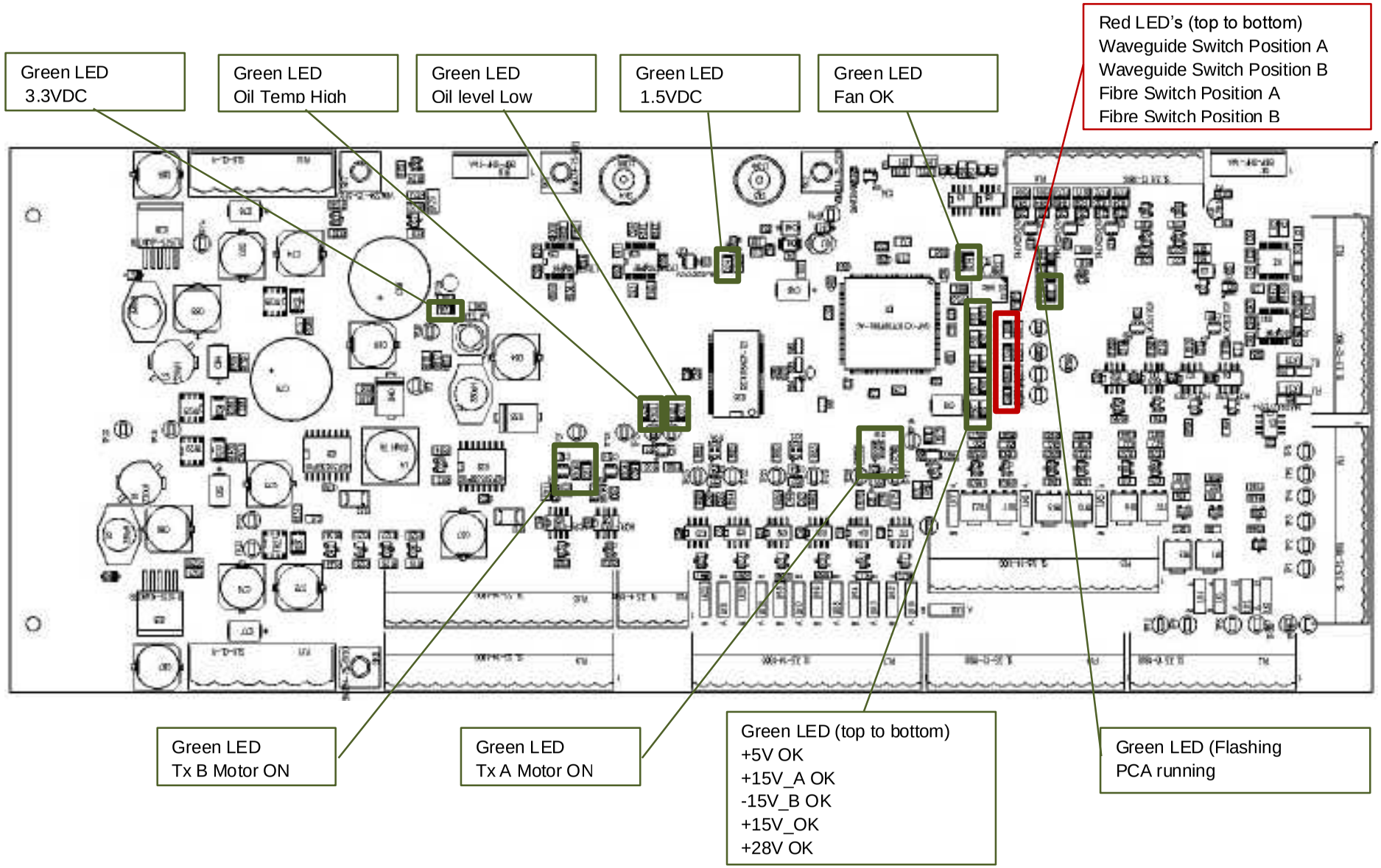
10.7.8.5 Test points

Test Point	Description of test
+15V A	+15V PSU A onto the PCA
+15V B	+15V PSU B onto the PCA
+15V Board Derived	+15V combined DC supply to PCA
+5V	+5VDC
+28V	+28VDC
+1.5V	+1.5VDC
ACP U_{A0}	Enable connection of an oscilloscope between its differential inputs to monitor waveform.
ACP U_{A1}	Enable connection of an oscilloscope between its differential inputs to monitor waveform.
ARP	Enable connection of an oscilloscope between its differential inputs to monitor waveform.
Motor on	Test signal level input at the input to the board
Waveguide switch position A +28V control	Test +28V output to the waveguide switch actuator.
Waveguide switch position B +28V control	Test +28V output to the waveguide switch actuator.
Waveguide switch tellback position A	Test continuity of waveguide switch tellback signal between the tellback position A signal and the tellback switch common signal connections.
Waveguide switch tellback position B	Test continuity of waveguide switch tellback signal between the tellback position B signal and the tellback switch common signal connections.
Oil level	Test continuity of oil level switch between the two oil level signal connections.
Oil temp	Test continuity of oil temp switch between the two oil temp signal connections.
Encoder fail	Test voltage input
Polarisation tellback A	Test voltage input
Polarisation tellback B	Test voltage input
Polarisation tellback C	Test voltage input
Polarisation tellback D	Test voltage input
Motor on Tx A	Test signal voltage level at input, between +ve and –ve input.
Motor on Tx B	Test signal voltage level at input, between +ve and –ve input.

10.7.8.6 Links

Link function	Ref	Position A or Open	Position B or Made	SETTING
Antenna Encoder Power output	LK8	15V	5V	**B**
Polarity sw. A Pwr Option	LK5	+28V switching supply output	External Supply	**A**
Polarity sw. B Pwr Option	LK6	+28V switching supply output	External Supply	**A**
Polarity sw. C Pwr Option	LK7	+28V switching supply output	External Supply	**A**
Polarity Sw.A Tellback A opto power option	LK14	+15V pull up selected	Active high external input	**A**
Polarity Sw.A Tellback A opto power option	LK13	Active low input	0V	**A**
Polarity Sw.A Tellback B opto power option	LK12	+15V pull up selected	Active high external input	**A**
Polarity Sw.A Tellback B opto power option	LK10	Active low input	0V	**A**
Polarity Sw.B Tellback A opto power option	LK18	+15V pull up selected	Active high external input	**A**
Polarity Sw.B Tellback A opto power option	LK17	Active low input	0V	**A**
Polarity Sw.B Tellback B opto power option	LK16	+15V pull up selected	Active high external input	**A**
Polarity Sw.B Tellback B opto power option	LK15	Active low input	0V	**A**
Polarity Sw.C Tellback A opto power option	LK22	+15V pull up selected	Active high external input	**A**
Polarity Sw.C Tellback A opto power option	LK21	Active low input	0V	**A**
Polarity Sw.C Tellback B opto power option	LK20	+15V pull up selected	Active high external input	**A**
Polarity Sw.C Tellback B opto power option	LK19	Active low input	0V	**A**
RDU RS422 TX termination	LK24	No Termination	Termination	**Open**
RDU RS422 RX termination	LK25	No Termination	Termination	**Open**
RDU Comms mode	LK26	RS422	RS232	**Open**
Test Mode	LK11	Normal Mode	Test Mode	**Open**
Debug	LK9	No Debug	Debug Enabled	**Open**
13V/36V BITE option	LK23	13V	36V	**Open**
Waveguide Sw. Tellback A opto power option	LK4	+15V pull up selected	Active high external input	**A**
Waveguide Sw. Tellback A opto power option	LK2	Active low input	0V	**A**
Waveguide Sw. Tellback B opto power option	LK3	+15V pull up selected	Active high external input	**A**
Waveguide Sw. Tellback B opto power option	LK1	Active low input	0V	**A**

10.7.8.7 PCA Layout



PL1: Connection to RDU	
PL1-1	Gnd
PL1-2	ACP1
PL1-3	nACP1
PL1-4	Gnd
PL1-5	ACP2
PL1-6	nACP2
PL1-7	Gnd
PL1-8	ARP
PL1-9	nARP
PL1-10	Gnd
PL1-11	Tx B CAN+
PL1-12	TXB CAN-

PL2: Serial & Blanking	
PL2-1	Gnd
PL2-2	Tx A blanking OUT
PL2-3	Gnd
PL2-4	Gnd
PL2-5	Tx B blanking OUT
PL2-6	Gnd
PL2-7	Gnd
PL2-8	RS422 Tx+
PL2-9	RS422 Tx-
PL2-10	Gnd
PL2-11	RS422 Rx+
PL2-12	RS422 Rx-

PL3: Waveguide Switch	
PL3-1	Fibre position B tellback IN
PL3-2	Fibre position A tellback IN
PL3-3	+5V fibre position B
PL3-4	Gnd
PL3-5	WG position B tellback
PL3-6	WG position A tellback
PL3-7	+V In WG
PL3-8	+28V WG position A
PL3-9	+28V WG position B
PL3-10	Gnd

PL4: Antenna connections	
PL4-1	nARP
PL4-2	ARP
PL4-3	Gnd
PL4-4	nACP2
PL4-5	ACP2
PL4-6	Gnd
PL4-7	nACP1
PL4-8	ACP1
PL4-9	Gnd
PL4-10	Encoder Fail IN
PL4-11	Encoder Power
PL4-12	Encoder Power

PL5: Ant. Polarisation	
PL5-1	Pol. AA
PL5-2	Pol. AB
PL5-3	Ext Pol. DC A
PL5-4	Gnd
PL5-5	Gnd
PL5-6	Pol. BA
PL5-7	Pil. BB
PL5-8	Ext Pol. DC B
PL5-9	Gnd
PL5-10	Gnd
PL5-11	Pol. CA
PL5-12	Pol. CB
PL5-13	Ext Pol. DC C
PL5-14	Gnd

PL6: Fans IN	
PL6-1	Gnd
PL6-2	FAN1 IN
PL6-3	FAN2 IN
PL6-4	FAN3 IN
PL6-5	FAN4 IN
PL6-6	FAN5 IN
PL6-7	FAN6 IN
PL6-8	Gnd
PL6-8	+12V Fans A
PL6-10	+12V Fans B
PL6-11	Gnd
PL6-12	Gnd

PL7: Tellback	
PL7-1	Pol. Pair A pos. B
PL7-2	+V IN pol. pair A
PL7-3	Gnd
PL7-4	Pol. TB pair A pos. A
PL7-5	Pol. TB pair B pos. B
PL7-6	+V IN pol. pair B
PL7-7	Gnd
PL7-8	Pol. TB pair B pos. A
PL7-9	Pol. TB pair C pos. B
PL7-10	+V IN pol. Pair C
PL7-11	Gnd
PL7-12	Pol. TB pair C pos. A
PL7-13	Gnd
PL7-14	+28VDC

SK8: Tx A & B serial	
SK8-1	RxD A
SK8-2	TxD A
SK8-3	Gnd
SK8-4	RxD B
SK8-5	TxD B
SK8-6	Gnd

PL8: BITE connection	
PL8-1	+3.3VDC
PL8-2	Gnd
PL8-3	Oil sensor switch
PL8-4	Gnd

PL9: TX A connection	
PL9-1	ACP1
PL9-2	nACP1
PL9-3	Gnd
PL9-4	ACP2
PL9-5	nACP2
PL9-6	Gnd
PL9-7	ARP
PL9-8	nARP
PL9-9	Gnd
PL9-10	Tx A Mon +
PL9-11	Tx A Mon -
PL9-12	Gnd
PL9-13	N/C
PL9-14	N/C

PL10: TX B connection	
PL9-1	ACP1
PL9-2	nACP1
PL9-3	Gnd
PL9-4	ACP2
PL9-5	nACP2
PL9-6	Gnd
PL9-7	ARP
PL9-8	nARP
PL9-9	Gnd
PL9-10	Tx B Mon +
PL9-11	Tx B Mon -
PL9-12	Gnd
PL9-13	Tx B CAN +
PL9-14	Tx B CAN -

PL11: PSU A	
PL11-1	Gnd
PL11-2	+15VDC
PL11-3	Gnd
PL11-4	+3.3VDC
PL11-5	Gnd
PL11-6	+13VDC

PL12: PSU B	
PL12-1	Gnd
PL12-2	+15VDC
PL12-3	Gnd
PL12-4	+3.3VDC
PL12-5	Gnd
PL12-6	+13VDC/ +36VDC

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10.7.9 SharpEye™ error messages

If a fault condition is detected within the SharpEye™ transceiver, a fault message is sent to the Radar Distribution Unit and in certain conditions the unit switches to a degraded *low power* state of operation.

The following is a list of possible alarm conditions that can occur within the SharpEye transceiver.

SharpEye™ error Message	Description
Rx sensitivity	If the minimum detectable signal rises above a pre-set level the transceiver sends a receiver sensitivity warning message.
VSWR	If the VSWR on the RF output is worse than 1.4:1 the transceiver sends an antenna VSWR warning message and switches to the degraded 'low power' state of operation. If the VSWR on the RF output is worse than 2.0:1 the transceiver enters *fault mode* and is shutdown.
SYNTH	The synthesiser has not initialised correctly; cycling the power may clear this condition (emergency stop).
Tx power	If the RF output power falls below 100W the transceiver sends an RF Power LOW warning message and switches to the degraded 'low power' state of operation.
Over temperature	If the temperature of the RF power transistors in the transceiver exceeds a predetermined limit, the transceiver sends an 'over-temperature' warning to the Radar Distribution Unit and switches to the degraded 'low power' state. If the temperature exceeds a further pre-set limit the transceiver switches to the fault state and transmission is stopped. As the temperature returns to within the predetermined limits, the transceiver returns to the degraded state and then to normal transmit operation.
Turning info lost	If the antenna stops rotating when not commanded to stop, a warning message is sent to the display equipment and the transceiver switches to the fault state and transmission is stopped.
ARP/HL not detected	If an azimuth or heading line pulse is not detected, a message is sent to the transceiver and for safety reasons transmission is stopped within 60 seconds.
Azimuth status (1)	Antenna rotation is checked for clockwise rotation (viewed from above). If anti-clockwise rotation is detected, a message is sent and transmission is stopped within 60 seconds.
Azimuth status (2)	If missing pulses between heading lines are detected, a message is sent and transmission is stopped within 60 seconds.

SharpEye™ error Message	Description
FPGA2 failed	If the transceiver detects a hardware fault, it sends a warning message to the display equipment and switches to the Degraded state of operation.
Degraded (Low power)	The transceiver continuously runs background performance checks on forward power, reverse power, receiver sensitivity and temperature. If any of these parameters falls outside predetermined levels a warning message is sent to the Radar Distribution Unit indicating the nature of the fault. The transceiver continues to operate, but with reduced performance and functionality. ⚠ ***Caution:*** As a result of reduced output power, range performance *will be reduced* and the system may not meet the expected operational detection performance.
Fault	If the performance or functionality is degraded such that the transceiver cannot operate it enters the fault state and a fault message is sent to the display equipment. The transceiver stops radiating RF and there is no video output to the Radar Distribution Unit. A spurious fault *may* be cleared by re-powering the equipment.
Communication error	If communication is lost between the Radar Distribution Unit and the SharpEye™, the RDU reboots the SharpEye leading to a potential 60 second gap in coverage.

10.7.10 X-band transceiver processor

10.7.10.1 Overview

The solid state SharpEye™ transceiver(s) are secured inside the transceiver enclosure and are controlled by the Radar Distribution Unit.

⚠	***SharpEye processor – sealed unit:*** • The SharpEye™ processor uses solid state components and has no 'lifed' items. • The unit has no field serviceable or repairable parts and must be returned to the manufacturer for repair. • The processor must never be dismantled as it is a sealed unit that contains beryllium *(see health and safety notices in section 2)*.

Spares kits: Where a SharpEye™ processor is supplied as a spare, it is shipped in a kit form that includes:

- A spare processor
- A ruggedised delivery case that must be used for returning the removed processor
- Instructions on returning the removed unit

Precautions

⚠	**HEAVY ITEM:** The SharpEye™ transceiver is a heavy item. Care should be exercised when removing and moving the processor. **HOT SURFACES:** If the SharpEye™ has been in operation or the transceiver enclosure has been exposed to strong sunlight, the processor unit will be hot to the touch.

⚠	Do not operate the SharpEye™ system with the waveguide or antenna disconnected.

No. of people: Due to the weight of the processor and depending on the level of access to the transceiver Enclosure, it is recommended that changing the processor is carried out by two people.

Health & Safety: All health and safety notices shown in section 2 must be observed at all times including those regarding working aloft.

Tools

Tools: In addition to the normal tools required for service work, the following tools will be required to carry out this replacement.

- 4BA open ended spanner
- 5.0mm Allen key (recommended 150mm long)

10.7.10.2 Removal & replacement

The following process shows the removal of a single X-band SharpEye™ processor located in the left hand side of the enclosure.

The removal and replacement processes are exactly the same for the removal of the right hand processor

Prior to undertaking this task, maintainers should familiarise themselves with the processes detailed below.

Removal

a) Fully isolate the entire system from all power sources including any UPS services.
b) As a safety precaution, switch OFF the AC mains breaker(s) located within the transceiver enclosure.
c) To improve access, remove and retain the clear cover over the power supply unit.

CAUTION: When AC power is removed, residual DC voltages will be present for a short period on the terminals of the capacitors within the power supply unit

d) Noting the positions, orientation and connector numbers, disconnect ALL internal connections to the SharpEye™ processor as detailed below:

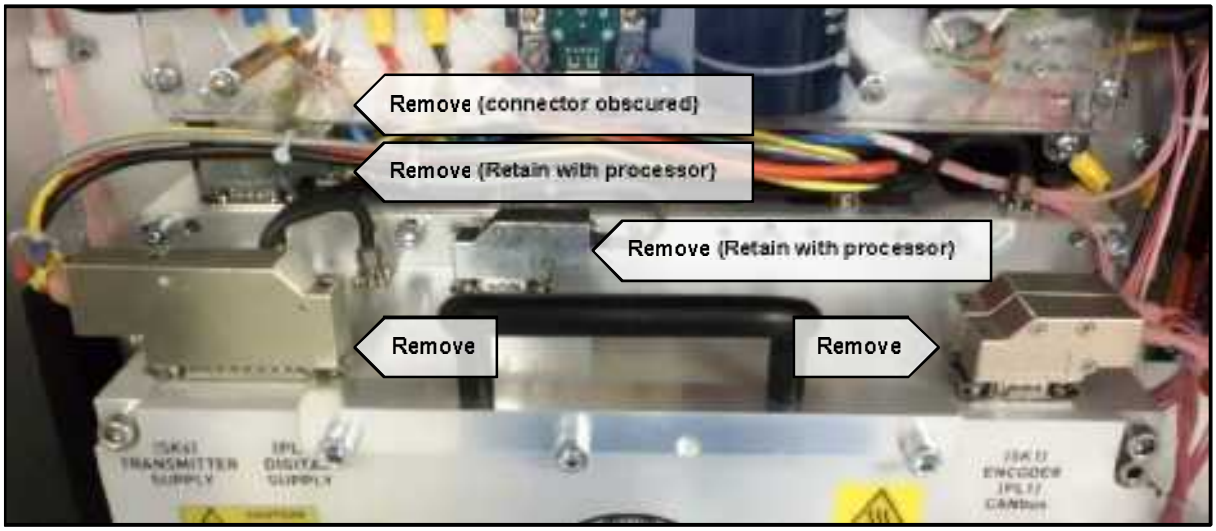
- ***SK6*** *(transmitter power), located on the top left hand side of the unit.*
- ***PL2*** *(digital supply), also located on the top left hand side of the unit.*
- ***SK1*** *(encoder) and* ***PL1*** *(CANBus), located on the top right hand side of the unit.*
- ***SK5*** *(Blanking), located on the right hand side of the unit.*
- ***Fibre Optic cable:*** *Carefully note the positions of each cable and gently remove.*

Note: *The D-type connectors have sliding metal retainers which must be moved fully one way before the connector can be removed.*

Locked

Unlocked

e) ***Interconnections:*** *There are two interconnecting connectors on the top of the processor which can be removed to improve access. These must be replaced and returned with the processor.*



X-band SharpEye™ processor showing connectors

d) *The waveguide coupling (SBS-A203) between the SharpEye™ processor and the main waveguide must now be removed.*

Remove and retain the 4 x 4BA bolts that fix the SBS-A203 waveguide coupling to the main waveguide within the enclosure

There is a waveguide shim between the SBS-A203 and the waveguide.

Note its position and orientation, remove and retain this as it must be replaced during reinstallation.

Remove and retain the 4 x 4BA bolts that fix the SBS-A203 waveguide coupling to the SharpEye waveguide interconnection.

There is a waveguide shim and an 'O' ring between the SBS-A203 and the SharpEye waveguide interconnection, remove and retain these.

The SBS-A203 waveguide coupling can now be removed.

e) **Fibre Optic connector:** The fibre optic connector can restrict access. To prevent damage to this connector and the cables, it is recommended that the connector is carefully unscrewed from the chassis and gently lowered out of the way.

The connector is retained into the chassis by 4 cross head bolts accessed from the base of the enclosure.

The connector also has a waterproof seal that should be carefully retain as it MUST be replaced.

Fibre cable and connector restricting access

Detail of fibre connector on base of enclosure

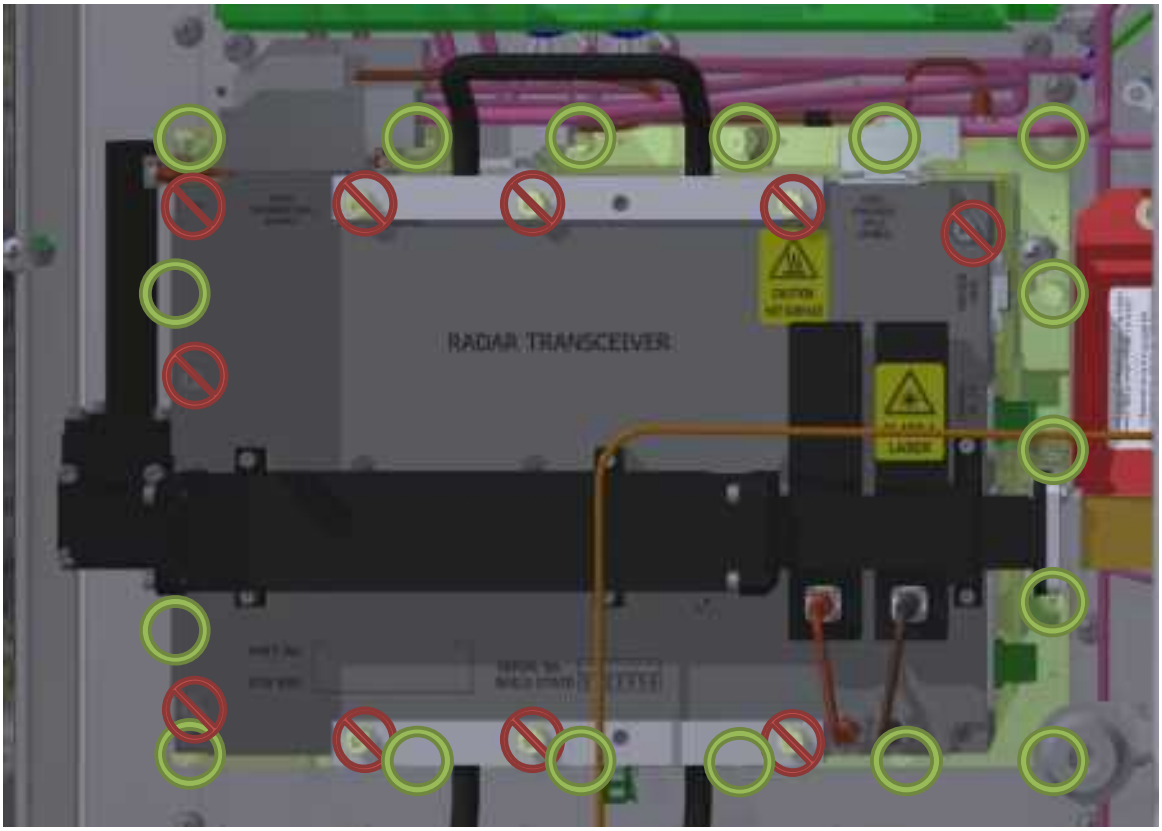
f) **Static Desiccator:** If required, the static desiccator can be removed to improve access. The desiccator assembly can be removed by unscrewing the retaining ring within the enclosure.

The unit is fitted with a waterproof seal that should be carefully retained as it MUST be replaced.

g) **Processor removal:** The SharpEye™ processor is retained into the Enclosure by 17 x 5mm hex bolts. These should be removed, retained and the processor carefully lifted from the assembly using the carrying handles.

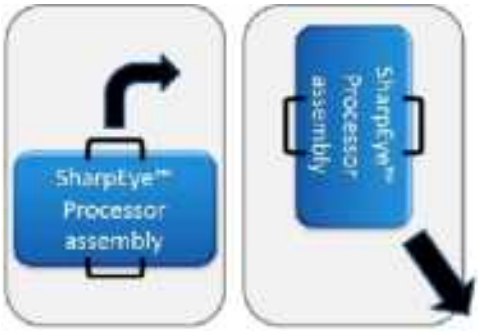
⚠	**Caution:** The bolts on the SharpEye™ processor itself MUST NOT BE REMOVED; removal of these bolts invalidates the warranty status of the unit (see below).

Bolts to be removed **DO NOT remove**
Note: Some of the bolts circled below are obscured in the drawing.



X-Band SharpEye™ Processor

Removal hint: Rotating the processor by 90 degrees makes it easier to remove the unit from the processor.



Processor replacement

Replacement: The processor is replaced by reversing the removal procedure.

Supporting lugs: The processor can be temporarily rested on two logs inserted into the backplate of the enclosure. This helps to support and align the processor during the replacement processes but does not secure the unit into place.

Caution: *As noted in the previous section, the processor is a heavy item; care should be exercised when replacing the unit.*

Retaining bolts: Replace the 17 retaining bolts and washers removed earlier in the removal process. ALL 17 fasteners *MUST be replaced*.

Caution: *The bolts ensure that a full thermal bond is achieved between the processor and the heatsink in the enclosure. Failure to replace a bolt increases the possibility of a poor bond leading to SharpEye™ processor overheating issues.*

Waveguide: Replace the waveguide joiner removed earlier between the SharpEye™ processor and the main waveguide. All nuts, bolts, washers and waveguide shims/ O-rings must be replaced.

Pay particular attention to the orientation of the waveguide shim.

Connectors: Reconnect all connectors.

The D-type connectors have sliding metal retainers which must be moved fully one way to lock the connector into position

Locked

Unlocked

Re-fit…: Where removed to improve access, refit the following:

- The fibre Optic cable/ connector
- Static desiccator
- Clear power supply protection cover.

Unit inspection: Prior to restoring AC power to the system carry out the following checks:

- All fasteners are securely tightened.
- All connectors are securely fitted in the correct positions.
- All RF (Waveguide) couplings are securely and correctly fitted and tightened.

Test: When the SharpEye™ processor has been successfully re-fitted, apply AC power to the system and test.

Part and serial number log:

Use the following form to log the part and serial numbers of the removed and replacement unit:

The details required below can be found on the front of the SharpEye processor.

Replacement unit fitted:	
Part Number	
S/W VER. (software version)	
Serial No.	
Build State	
Replacement date (dd / mm / yyyy)	

Unit return

The SharpEye™ processor is a sealed unit that must be returned to Kelvin Hughes for repair or in line with RoHS requirements, for safe disposal when the equipment has reached the end of its serviceable life.

The removed unit must be returned to Kelvin Hughes Ltd in the ruggedised case supplied with the kit.

Warranty Seals

The breaking of any warranty seals invalidates the warranty status of the unit.

Removed unit to be returned:	
Part Number	
S/W VER. (software version)	
Serial No.	
Build State	
Replacement date (dd / mm / yyyy)	

10.7.11 S-band Transceiver processor

10.7.11.1 Overview

The solid state SharpEye™ transceiver is secured into the right hand side of the transceiver enclosure and is controlled by the Radar Distribution Unit.

⚠	***SharpEye processor – sealed unit:*** • The SharpEye™ processor uses solid state components and has no 'lifed' items. • The unit has no field serviceable or repairable parts and must be returned to the manufacturer for repair. • The processor must never be dismantled as it is a sealed unit that contains beryllium *(see health and safety notices in section 2)*.

Spares kits: Where a SharpEye™ processor is supplied as a spare, it is shipped in a kit form that includes:

- A spare processor
- Full removal and installation instructions
- A ruggedised delivery case that must be used for returning the removed processor

Precautions

⚠	**HEAVY ITEM:** The SharpEye™ transceiver weighs approximately 15Kg. Care should be exercised when removing and moving the processor. **HOT SURFACES:** If the SharpEye™ has been in operation or the transceiver enclosure has been exposed to strong sunlight, the processor unit will be hot to the touch.

⚠	Do not operate the SharpEye™ system with the waveguide or antenna disconnected.

No. of people: Due to the weight of the processor and depending on the level of access to the transceiver Enclosure, it is recommended that changing the processor is carried out by two people.

Health & Safety: All health and safety notices shown in section 2 must be observed at all times including those regarding working aloft.

Tools

Tools: In addition to the normal tools required for service work, the following tools will be required to carry out this replacement.

- 4BA open ended spanner
- 5.0mm Allen key (recommended 150mm long)

10.7.11.2 S band processor removal & replacement

The following process shows the removal of a single S-band SharpEye™ processor located in the right hand side of the enclosure.

Prior to undertaking this task, maintainers should familiarise themselves with the processes detailed below.

Removal

The removal process is identical to the X-band processor removal shown in the previous section. Please refer this section for instructions.

RF coupling: The only difference between the X-band and S-band removal is the RF coupling. In the S-band system the waveguide is replaced by a semi-rigid RF coupling.

⚠	**Semi-rigid coaxial cable handling precautions:** - Take care when removing and re-installing the coaxial cable. - The rigid coaxial cable must not be bent, crushed, deformed or damaged in any way. - If the cable is accidently damaged*, it must be replaced*. Damage to this cable can reduce the transceiver performance or in the worst case stop transmission.

Replacement

Replacing the S-band SharpEye processor is carried out using the replacement processes described in the X-band section.

The only difference between the X-band and S-band removal is the RF coupling. In the S-band system the waveguide is replaced by a semi-rigid RF coupling.

Refitting the semi-rigid RF cable: When refitting the cable, ensure you observe the handling precautions noted below.

- The nut on the semi-rigid RF cable should be tightened to 1.0Nm.
- If no torque wrench is available the fastenings should be gently tighten to '***finger tight***'.
- DO NOT over tighten as this can deform and damage the cable.

⚠	**Semi-rigid coaxial cable handling precautions:** - Take care when removing and re-installing the coaxial cable. - The rigid coaxial cable must not be bent, crushed, deformed or damaged in any way. - If the cable is accidently damaged*, it must be replaced*. Damage to this cable can reduce the transceiver performance or in the worst case stop transmission.

Part and serial number log:

Use the following form to log the part and serial numbers of the removed and replacement unit:

The details required below can be found on the front of the SharpEye processor.

Replacement unit fitted:	
Part Number	
S/W VER. (software version)	
Serial No.	
Build State	
Replacement date (dd / mm / yyyy)	

Unit return

The SharpEye™ processor is a sealed unit that must be returned to Kelvin Hughes for repair or in line with RoHS requirements, for safe disposal when the equipment has reached the end of its serviceable life.

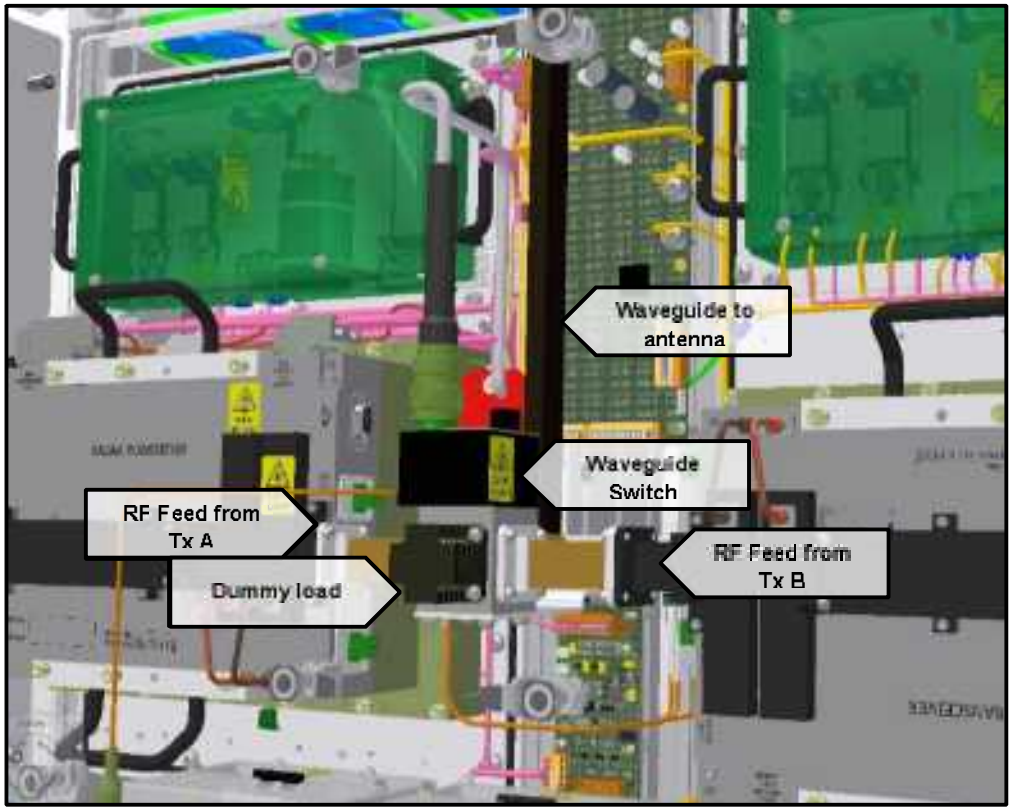
The removed unit must be returned to Kelvin Hughes Ltd in the ruggedised case supplied with the kit.

Warranty Seals

The breaking of any warranty seals invalidates the warranty status of the unit.

Removed unit to be returned:	
Part Number	
S/W VER. (software version)	
Serial No.	
Build State	
Replacement date (dd / mm / yyyy)	

10.7.12 Waveguide switch



Waveguide switch assembly

The RF outputs of Tx A and Tx B are connected to the antenna via a waveguide switch internally mounted in the centre of the transceiver enclosure.

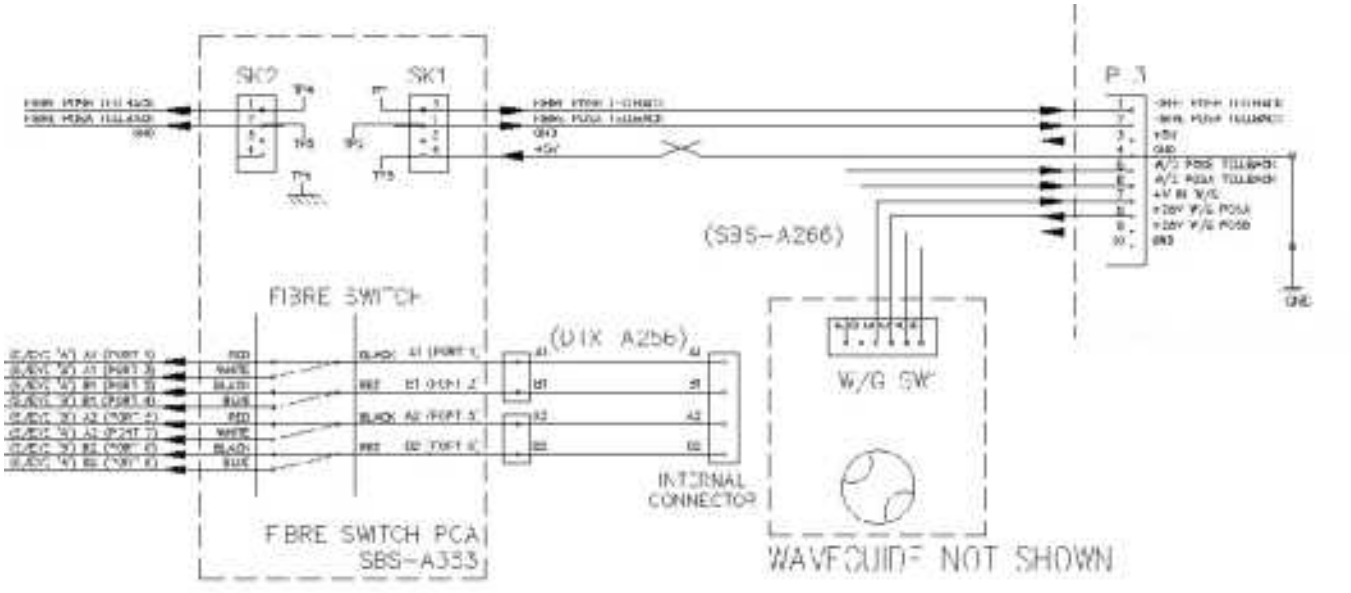
10.7.12.1 Operation

Power: The waveguide switch operates from +28VDC from the SBS-A126 PCA. This supply is available as soon as the transceiver enclosure switches ON.

Control: During Local or Remote operation, the waveguide switch is controlled by the Radar Distribution Unit via the SBS-A126 PCA and requires no operator input.

Tx A selected	- The Tx A select line will be at +28VDC - When the switch has selected Tx A, the Tx (A) SEL tell back line goes Hi confirming that the switchover has been successful. - The Tx (B) select and Tx (B) tell back lines are both at zero volts.
Tx B selected	- The Tx B select line will be at +28VDC - When the switch has selected Tx B, the Tx (B) SEL tell back line goes Hi confirming that the switchover has been successful. - The Tx (A) select and Tx (A) tell back lines are both at zero volts.

10.7.12.2 Schematic



Extract from Transceiver system diagram reference DTX-C7

If there is a fault condition that prevents the waveguide switch selecting a transceiver, the RDU will make 10 attempts at reselecting the switch. After the 10th attempt the system reverts to the original transceiver and the RDU will display an alarm stating *Waveguide Switch Fail*.

In this condition and providing the waveguide switch is not jammed is possible to manually change the position of the waveguide switch using the rotary control on the top of the switch.

10.7.12.3 Removal & replacement

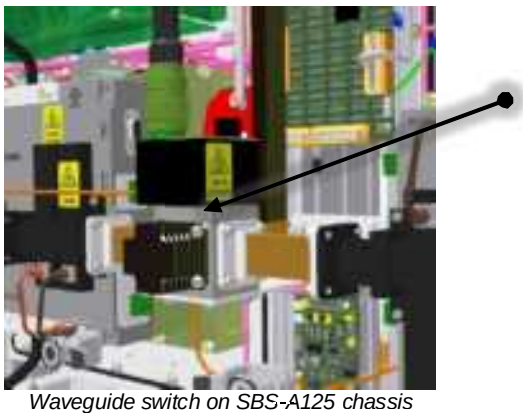
Tools: In addition to the normal tools required for service and maintenance work, the following tools will be required:

4BA spanner: Used for the removal of the waveguide bolts.

The waveguide switch cannot be repaired in the field and contains no user accessible parts.

Removal: The waveguide switch is removed as follows:

1. Fully isolate and disconnect the system from all sources of AC power including any UPS supported mains.
2. Disconnect the connector from the top of the waveguide switch.
3. Remove and retain all nuts, bolts and washers that retain the switch into the transceiver enclosure. All fastenings must be retained as they will be required for refitting.
4. Once the fastenings are removed the switch can be removed.



Waveguide switch on SBS-A125 chassis

Waveguide switch port identification:

The ports are identified by numbered labels (1, 2, 3 &4) attached to the main switch.

Port 1: RF feed for antenna

Port 2: RF feed for transceiver B

Port 3: dummy Load

Port 4: RF feed for transceiver A

Refitting: To refit the waveguide switch, reverse the above removal process making a carful note of the port locations on the switch noted above.

RF seal: Ensure that all RF couples are correctly aligned and tightened. Incorrectly terminated RF couplings can lead to RF leakage which can be hazardous to health and cause system performance issues.

Caution: When reinstalling the switch take extreme care when fitting and tightening the bolts into the switch assembly as it is easy to cross thread or break the bolts.

10.7.13 Static desiccator

The DTX-A7 Transceiver Enclosure is fitted with a static desiccator. With the exception of changing the two desiccant packets contained within the unit, the desiccator assembly requires no maintenance.

The desiccator is accessed externally on the base of the Enclosure or on earlier units is located between the two access doors on the front of the enclosure.

Example of desiccator

Example of desiccator with cover removed

The unit contains two desiccant sachets which must be changed annually (see Annual Planned Maintenance section 9.4 pages 88 onwards).

When removing and replacing the desiccant sachets care should exercised to ensure that the packets are not torn or split. Split or damaged sachets must not be used.

Spares part number

Replacement sachet: 55-100-0494-002
Sachet shelf life: 2-years

Note: The part number noted above is for 1 sachet, two are required.

10.7.14 Service socket

AC socket: A universal switched AC service socket is provided within the transceiver enclosure and is located on the right hand side of the unit.

Maximum load: The maximum load on this AC output is 100W

10.7.15 Illumination

When the AC breaker is switched ON, LED illumination is provided within the Transceiver enclosure. There is no switch for the lighting which remains illuminated at all times when AC power is present and switched ON.

10.7.16 Spares listing

Description	Part numbers(s)
SharpEye™ transceiver assembly Note 1	Please contact Kelvin Hughes Ltd for details.
Control and BITE PCA	SBS-A126
Power Converter module Assembly (PSU)	SBS-A146
AC line filter	45-690-0077-001
AC Mains relay (12VDC 16A)	85-200-0059-001
LED (for AC breaker)	45-6000-0118-001
MCB 10A DIN rail mounting	45-600-0102-001
Quadrature puffer PCA	DTX-A295
Wind turned rotary ventilator	45-925-0032-001 (1 per)
Static Desiccator sachets	55-100-0494-002
LED strip light (1 per)	45-625-0032-001

Note 1: The SharpEye processor will be shipped as a spares replacement kit containing the main processor and a ruggedised transport/ returns case.

10.8 SBS-A1-1 Radar Distribution Unit

10.8.1 System part numbing

In addition to the main part number for the system, a number of options can be added to the Radar Distribution Unit (RDU). These options are identified by a 6-digit Option number which is added as a suffix to the main part number.

The option code contains a digit for each available option, where:

- **0** = Indicates the option is not required, not fitted or not available.
- **1** = Indicates the option is required or fitted.
- **n** = Indicates the particular type of option is required or fitted.

SBS-A1-4-	**0**	**0**	**0**	**0**	**0**	**0**
	LAN Interface SBS-A129	Additional Analogue Output Fitted SBS-A260	Antenna Motor Drive Inverter Option *(see below)*	MantaDigital Interface Kit SBS-A270	Antenna Polarisation Control Kit SBS-A302	Product Specific Option *(see below)*

Antenna Motor Drive Inverter Option:
To cater for global and specific customer requirements the RDU can be supplied with one of three types of motor drive static inverter fitted.

The kits are factory fitted therefore the option needs to be specified with the main order.

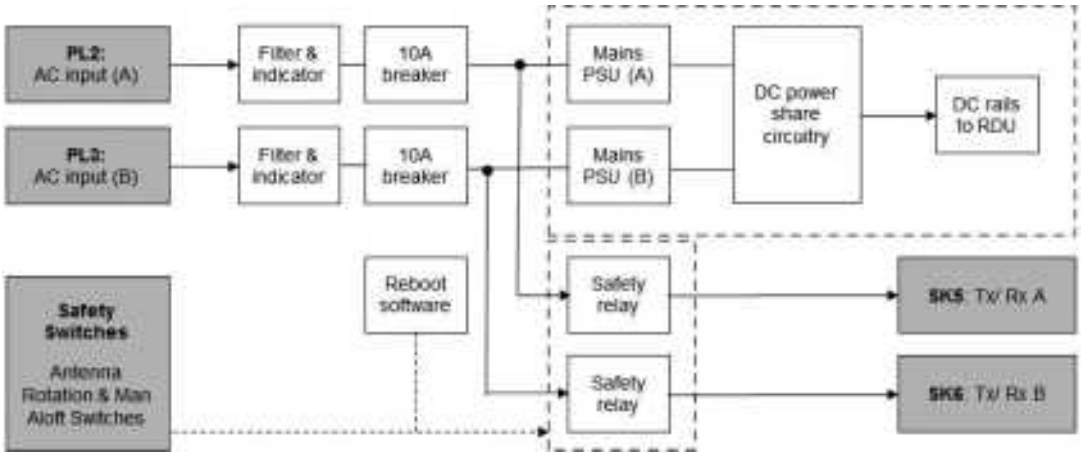
Part No.	Output voltage	Option Code
SBS-A403	440V Three Phase Inverter Kit	0
SBS-A229	220V Single Phase Inverter Kit	1
SBS-A404	220V Three Phase Inverter Kit	2

Product Specific Options:
This code is used for project specific variations to hardware or software and would be defined in the specification for the system.

10.8.2 AC power

Single phase supply: Dual single phase AC mains inputs are required. It is recommended that each mains input is provided via a separate external UPS which is not supplied as part of the SBS system.

- The AC supplies are fed to the dual redundant AC-DC power unit via a set of user accessible over current protection devices in the form of circuit breakers and contactor relays.
- Switched single phase AC outputs are also routed to the transceivers.



AC power loss:

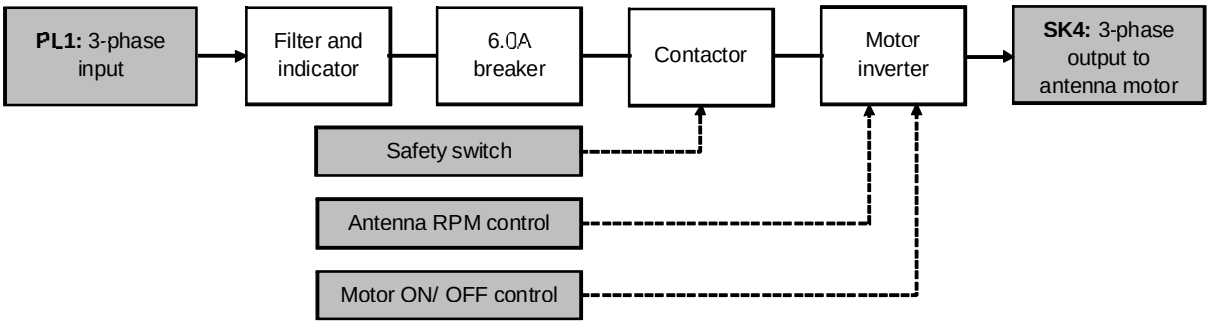
Main input A: In the event of the loss of *mains input A*, the dual redundant AC-DC power supply will continue to operate using the *mains input B* power source, however AC power to the Tx/ Rx A (SK/ PL5) will be lost.

In an emergency and with all supplies isolated, AC power may be restored to Tx A by temporarily reversing mains input A & B.

Main input B: In the event of the loss of *mains input B*, the dual redundant AC-DC power supply will continue to operate using the *mains input A* power source, however AC power to the Tx/ Rx B (SK/ PL6) will be lost.

Operators are alerted to the loss of any AC input through system alarms.

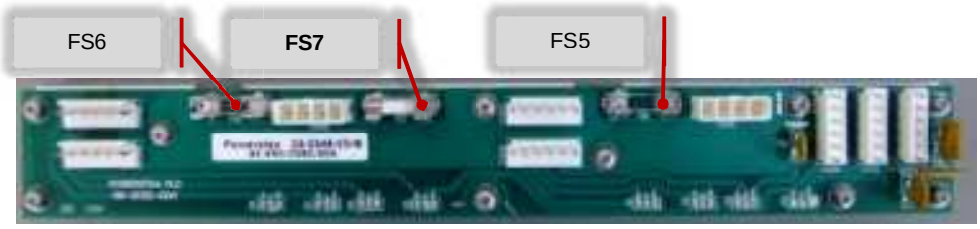
Three-phase: A separate 3-phase input powers the antenna drive motor via a static inverter located within the Radar Distribution Unit. The 3-phase input is fed to a static inverter via a set of user accessible over current protection devices in the form of circuit breakers and contactor relays.



10.8.3 Fuses

Safety I-loop fuse: The +24VDC supply to the Radar Distribution Unit safety I-loop is protected by a user accessible fuse located on the top of the RDU.

PSU backplane: The power sharing PCB mounted on the back of the power supply has three fuse holders which serve different purposes depending on the system installed. The PCB also contains four self-resetting thermal fuses.



Power share PCB fitted to the 45-690-0080-001 power supply assembly

FS7: Used on all standard SBS-900 systems to protect the main +5V rail.

FS5 & FS6: Only used in SBS-A1-11 systems to independently protect each +5V rail (FS7 is not fitted).

Fuse ratings

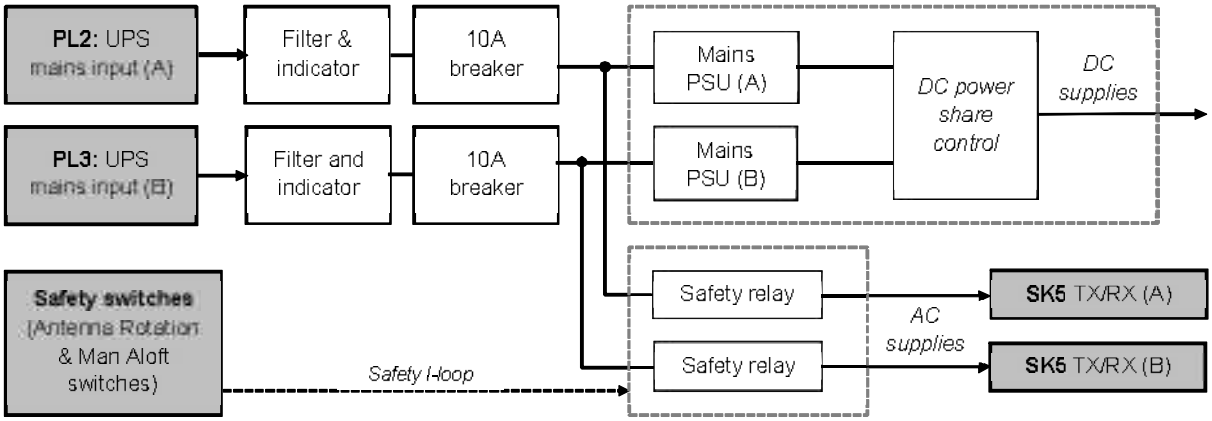
Safety I-loop		
F1	500mA 240VAC, Ceramic, time lag, 5 x 20mm. Kelvin Hughes part number 45-650-0060-002	
Power supply		
F1	+24VDC @ 3A	Self-resetting thermal fuses. *Self-resetting thermal fuses cannot be replaced or manually reset. If a fault condition exists, switch the system OFF and allow the thermal fuse to reset.*
F2	+15VDC @ 1.85A	
F3	-15VDC @ 0.9A	
F4	+5VDC @ 3A	
FS5	10A 250V, ceramic, time lag, 5 x 20mm. *Please contact Kelvin Hughes for the correct part number*	
FS6 & 7	15A 250V, ceramic, time lag, 5 x 20mm. *Please contact Kelvin Hughes for the correct part number*	

Replacement fuses must be of the exact type specified above.

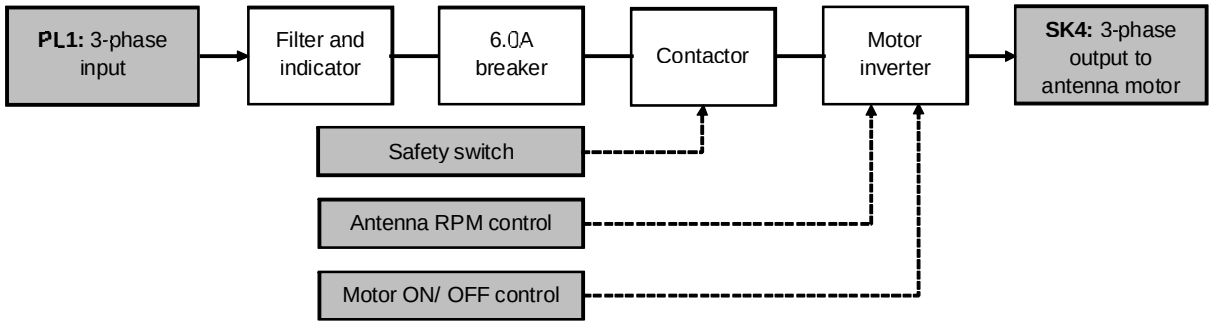
10.8.4 Breakers

The Radar Distribution Unit is fitted with three user accessible DIN rail mounted earth leakage trips/ breakers located in the base of the RDU behind the main access door.

The output of the breakers is fed to the rest of the system via contactors that are controlled by the RDU as shown below.



RDU Single phase AC input schematic



RDU single and 3-phase AC input and breaker schematic

AC power indication: When AC supplies are connected to the RDU, LED indicators illuminate on the breakers regardless of their state indicating that AC mains is present within the system.

Earth leakage: Due to the use of EMC filters on all AC supply inputs, earth leakage current to a maximum of 100mA will exist on the 3-phase input.

All parts of the system must be fully and correctly earthed prior to connecting any source of AC power.

RCD trips: If an RCD trip is fitted in the supply outlet it must be a 100mA RCD Type A or similar.

Spare: If replaced, the breakers within the RDU must be of the exact same type.

10.8.5 RDU overview

The Radar Distribution Unit provides the interface between the transceiver enclosure and the user's command and display system, track extractor and optional service display.

The RDU comprises on the following main components:

Processor: A card frame mounted in the top half of the unit carries the modular interface system backplane (MISB) and modular interface system modules (MISM). The MISM modules used in the SBS-900 series are:

Radar Processing Module Type 5	*NTX-A462* *SharpEye radar data and control and LAN output*
Modular radar I/O type 9	NTX-A477 (3 off) *Analogue radar input/ output circuitry for track extractor, service display and spare output.*
Modular communications module type 11	NTX-A478 Serial RS232 or *RS422 communications to service display and track extractor.* *CANBus communication to optional Kelvin Hughes MANTADigital processor.*
Modular signal I/O type 4 Mk 2	NTX-A490 *Safety and security switch inputs and inverter control*

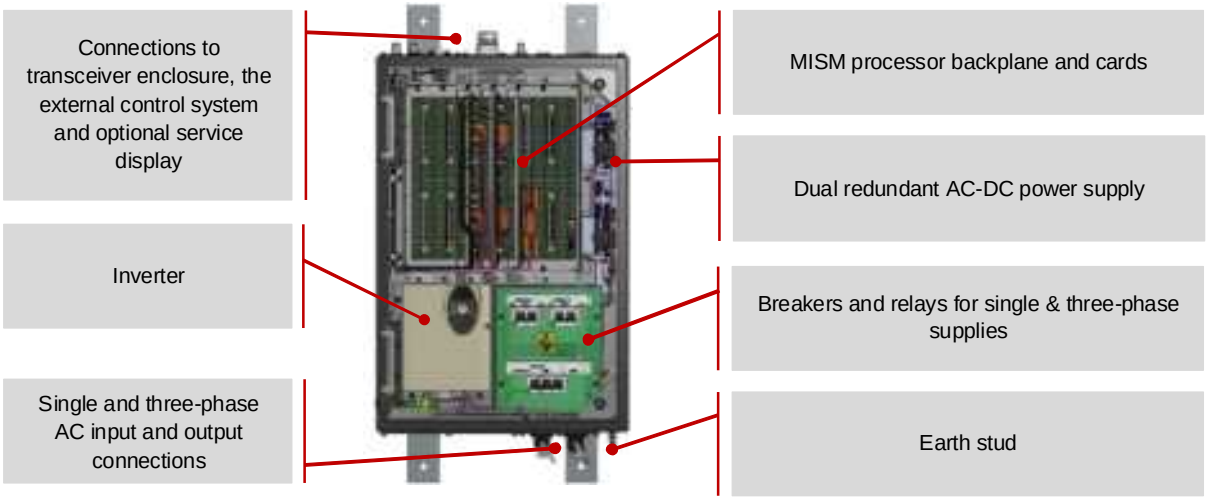
RDU processor backplane

Power supplies: DC power for the RDU is provided by a dual redundant auto ranging power supply. The power unit has auto-ranging inputs so manual voltage setting is not required.

Three-phase inverter: A three-phase inverter that provides power for the antenna sub-assembly motor. The Inverter provides a 'soft-start' of nominally 2 seconds and a 'soft-stop' (braking) of nominally 10 seconds. This reduces the high currents associated with starting and stopping a motor under load.

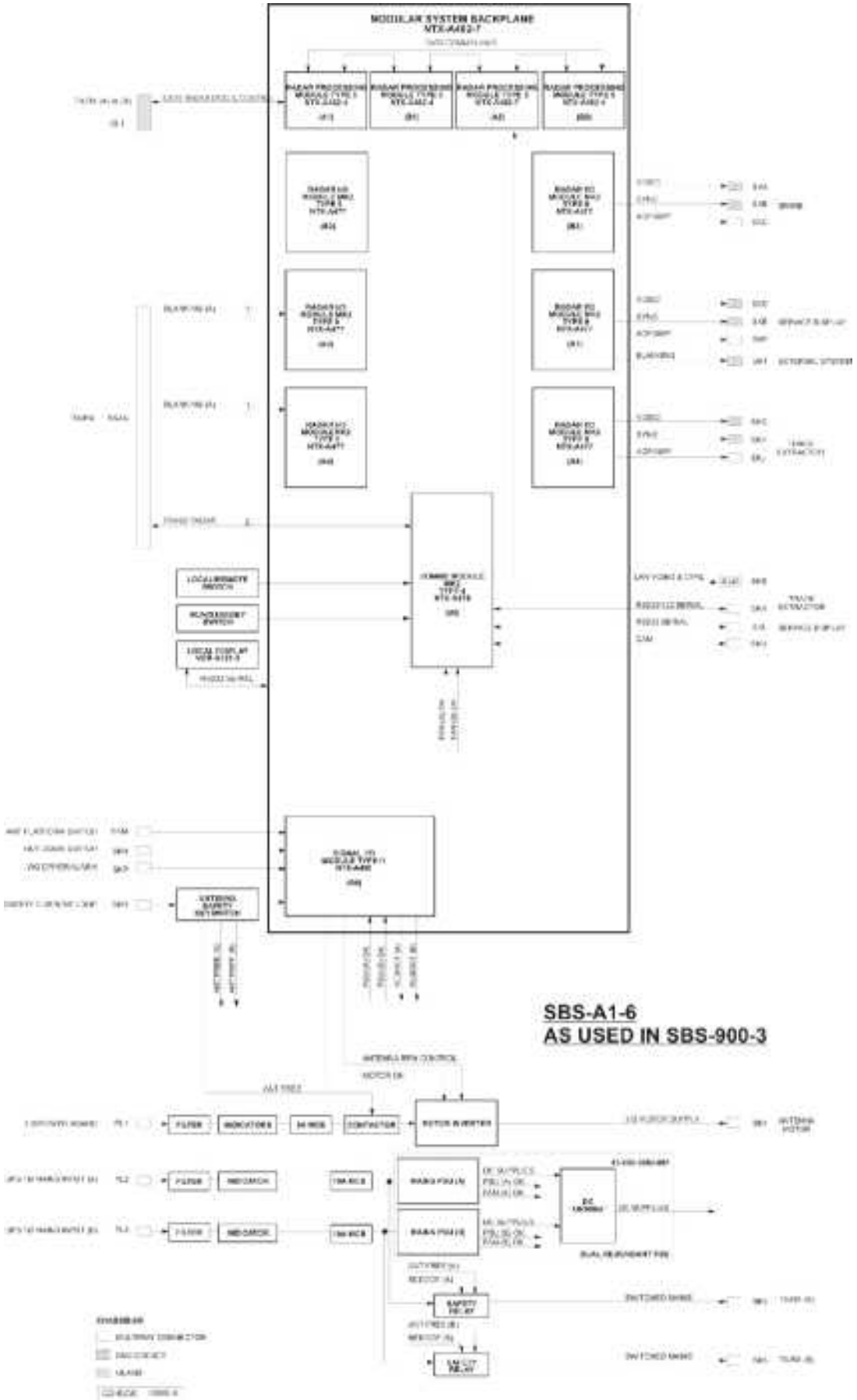
AC breakers: The RDU contains a set of internally DIN rail mounted breakers for the single and three-phase AC mains inputs.

The DIN rail also contains contactor relays which isolate the mains supplies when the safety i-loop (*Antenna Rotation* or *Man Aloft Switches) is broken.*



Example of an RDU
Shown with door removed for clarity

10.8.6 Schematic



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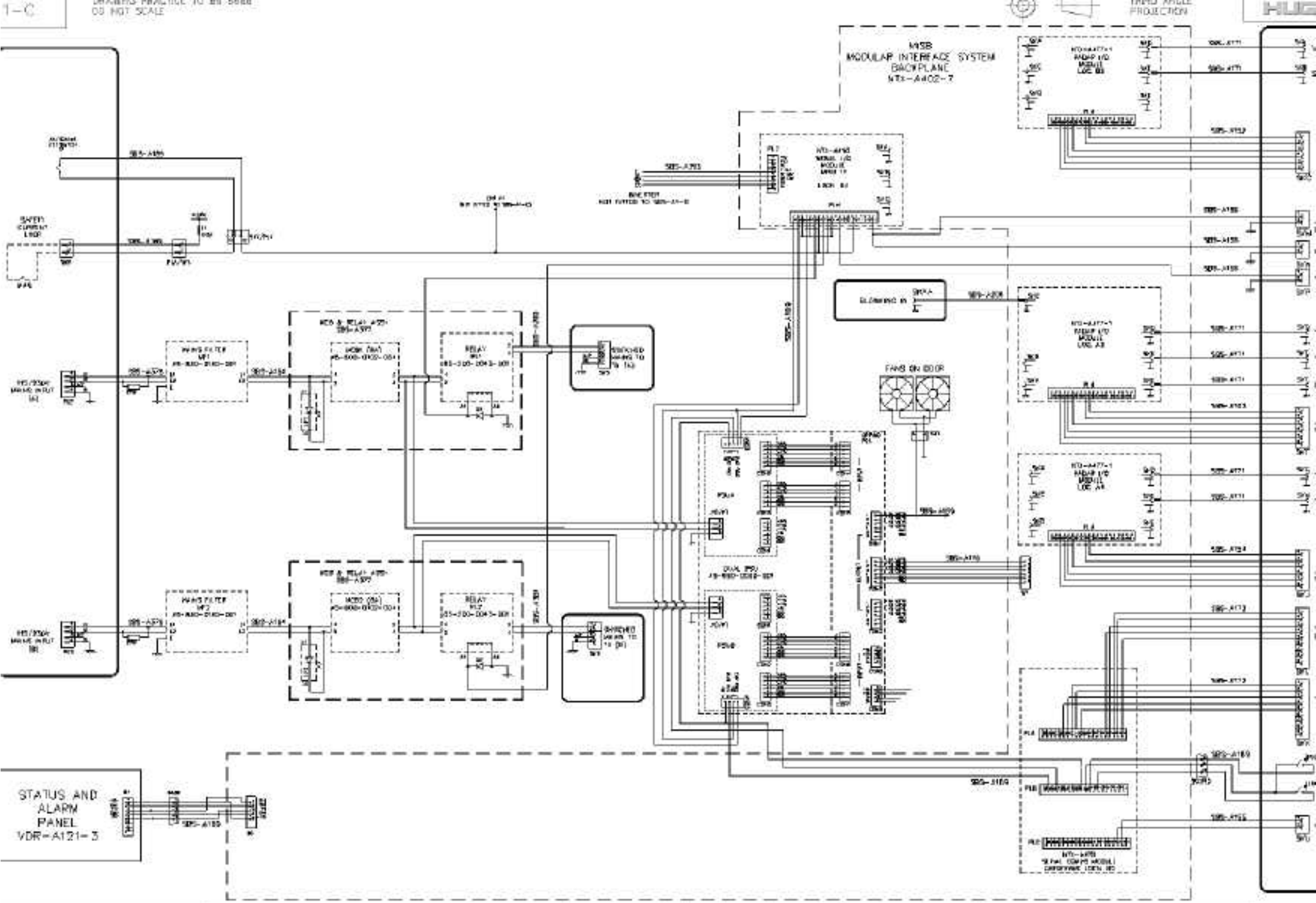
MSB
MODULAR INTERFACE SYSTEM
BACKPLANE
VDR-A402-7
STATUS AND
ALARM
PANEL
VDR-A121-3
FANS ON DOOR

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10.8.7 Dual redundant power supply

Dual redundant AC-DC power supply unit
Part number: 45-690-0080-001

The dual redundant power supply unit is a single unit that provides the DC output requirements of the Radar Distribution Unit.

The PSU assembly consists of two AC-DC power units and a separate PCB that provides the power sharing diodes for the dual redundancy output. The Radar Distribution Unit is capable of running on just one of these power supplies (see AC power loss regarding transceiver power in previous section).

As noted below, the power supply must not be operated (switched ON) on a test bench or when electrically and mechanically disconnected from the RDU.

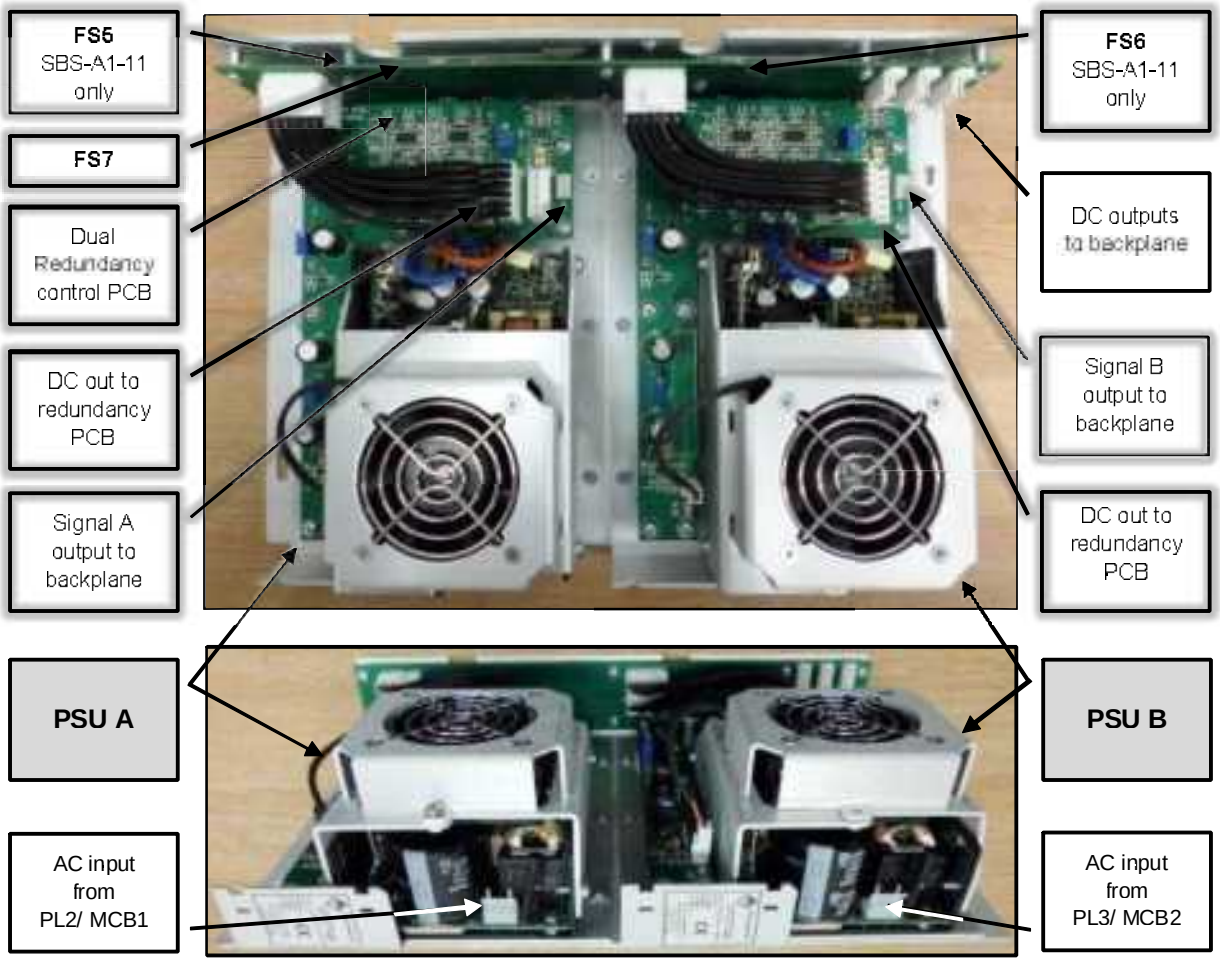
WARNING: High earth leakage current devices are fitted to the dual power supply. Do not operate the power unit disconnected from the Radar Distribution Unit Chassis and disconnected to the MISM backplane.

WARNING: Prior to commencing any maintenance procedure, users must familiarise themselves with the health & safety warnings noted in the planned maintenance and health and safety sections of the system handbooks.

AC supplies: Prior to carrying out any maintenance, the system must be fully isolated and disconnected from all single and 3-phase AC supplies. See *system isolation* in the planned maintenance section of the system handbook.

UPS (Uninterruptable Power Supply): Where connected, ensure that UPS supplies to the RDU are fully isolated prior to carrying out *any* maintenance task on the system.

Input:	100 to 240VAC 50/60Hz full range input
Power source:	PL2: *Mains IN 'A'* on the base of the RDU and MCB1 supply AC power to *PSU A and to the transceiver enclosure via SK5.* PL3: *Mains IN 'B'* on the base of the RDU and MCB2 supply AC power to *PSU B and to the transceiver enclosure via SK6 (dual systems only).*
Outputs:	+24.1VDC +/- 0.6V +15VDC +/- 0.7V -15VDC +/-0.7V +5VDC (4.5 to 5.9VDC)
Signals:	Power good and fan fail signals
Fans:	The power supply is fitted with two fans that report their status to the RDU (Good/ Fail). In the event of a fan failure, the power unit continues to function. Failed fans must be replaced at the earliest safe opportunity.
Spares:	The power supply is a line replacement unit and contains no field serviceable or user adjustable parts.
Repair:	The unit must not be dismantled in the field as specialist equipment is required for testing the electrical safety barriers. Circuit diagrams are not available for the unit.



Dual redundant PSU layout

10.8.7.1 Power indication

When AC power is applied to the power supply the following LED's will illuminate on both the power supply and on the backplane:

LED's on PSU

Amber LED
(Within PSU casework)
AC input OK

Green LED
(Within PSU casework)
+24VDC OK

Green LED
(On external PCB)
All power share rails OK

DC power LEDs
Located on backplane next to the PSU
D6 = +1.2VDC OK
D7 = +1.5VDC OK
D8 = +3.3VDC OK
D9 = -5VDC OK
D1 Flashing @ 1Hz (green) = processor running

DC power LED's on backplane

10.8.7.2 PSU removal

Power supply fail warning: If a PSU failure warning is received on the RDU, optional service display or command and display system, first check that AC power is present at the RDU input and at the power supply. If AC power is available at the unit the PSU will need to be changed.

Removal: The power supply unit is retained within the Radar Distribution Unit by two 'keyed' locating posts and two bolts.

WARNING: High earth leakage current devices are fitted to the dual power supply. Do not operate the power unit when mechanically or electrically disconnected from the RDU chassis or with SK1 of the MISM backplane disconnected.

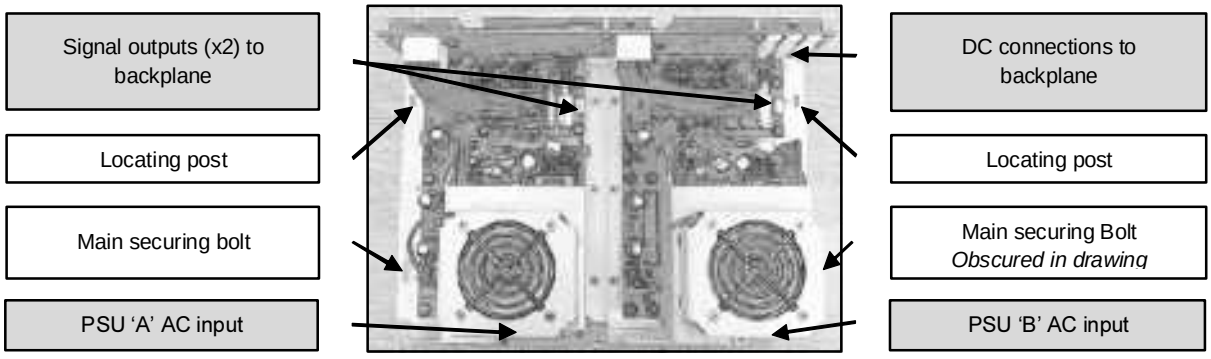
WARNING: Prior to commencing any maintenance procedure, users must familiarise themselves with the health & safety warnings noted in the planned maintenance and health and safety sections of the system handbooks.

AC supplies: Prior to carrying out any maintenance, the system must be fully isolated and disconnected from all single and 3-phase AC supplies. See *system isolation* in the planned maintenance section of the system handbook.

UPS (Uninterruptable Power Supply): Where connected, ensure that UPS supplies to the RDU are fully isolated prior to carrying out *any* maintenance task on the system.

Prior to removal, the following connections will need to be removed:

- PSU 'A' and 'B' AC inputs
- DC connections to backplane
- Signal outputs to backplane
- Earth connection to PSU mounting pillar (pink cable marked PSU)



10.8.7.3 PSU replacement

Replacement: To replace the power supply reverse the removal process shown in the previous section.

Seating: When re-installing the unit, ensure the assembly is securely positioned onto the locating lugs as this ensures the unit connects with the RDU chassis which acts as a heatsink.

Earth warning: A warning label attached to the RDU door notes that the power supply must NEVER be operated (switched ON) when it is mechanically and electrically disconnected from the RDU and SK1 of the MISM backplane.

Earth cable: The earth cable from the common earthing point in the base of the RDU MUST be reconnected to the power supply chassis.

Earth/ ground cable from common earth point in base of RDU

45-690-0080-001 power unit

10.8.7.4 Fan replacement

Replacement fan part number: 45-690-0080-003

Note: The replacement part is the fan only and does not contain the casework which must be removed from the faulty fan.

Fan life: The two fans mounted on the RDU power supply have a manufacturers MTBF (mean time between failure) of 50000 hours. It is therefore recommended that the fans are changed every 5 years as part of the routine maintenance procedures.

PSU operation: In the event of a failure, a *fan failure* warning is displayed on the RDU front panel, service display or command and display system. The power unit continues to operate when a fan fails; the faulty unit must be replaced as soon as possible.

Replacement: Firstly identify which of the two fans on the power unit is inoperative, fan (A) is the lower fan, fan (B) is the upper fan.

WARNING: Prior to commencing any maintenance procedure, users must familiarise themselves with the health & safety warnings noted in the planned maintenance and health and safety sections of the system handbooks.

AC supplies: Prior to carrying out any maintenance, the system must be fully isolated and disconnected from the single and 3-phase AC supplies. See *system isolation* in the planned maintenance section of the system handbook.

UPS (Uninterruptable Power Supply): Where connected, ensure that UPS supplies to the RDU are fully isolated prior to carrying out *any* maintenance task on the system.

It is not necessary to remove the power unit to replace the fan.

The fan is mounted in a removable case which is mounted on the PSU chassis and restrained by a single screw and four locating lugs.

Remove the screw and unplug the fan from the power unit.

Noting the orientation of the fan and the cable position, remove the fan from its case which is retained by four nuts, bolts and washers.

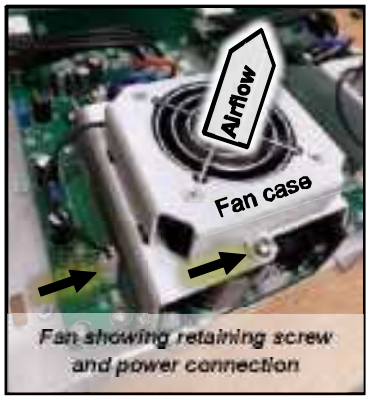
Checking the direction of the airflow (blows out from the power unit), secure the replacement fan into the case using the original nuts, bolts and washers.

Place the fan assembly onto the PSU chassis and secure with the single screw removed earlier.

***Caution**: ensure the power cable exits the casework as shown and is not trapped under the case.*

Reconnect the power to the system, switch on and check that:

- The replacement fan is operational.
- The fan fail warning messages is no longer displayed on the RDU, service display and command and display system.



Fan showing retaining screw and power connection


Fan in mounting case


Fan cable exit

10.8.8 NTX-A402 backplane

Modular Interface System Backplane (MISB)
Part number: **NTX-A402-7**
Backplane software: **ZM-2279**

The modular interface system backplane within the Radar Distribution Unit is a flexible backplane system designed to provide interconnect and communication resources to the installed MISMs. The modular interface system backplane incorporates a microcontroller with multiple serial communication interfaces. A field programmable gate array (FPGA) provides digital routing and processing resources. This allows modules to interface to other modules and the serial communication interfaces.

The modular interface system backplane also incorporates analogue cross point switching to allow radar video to be routed between modules.

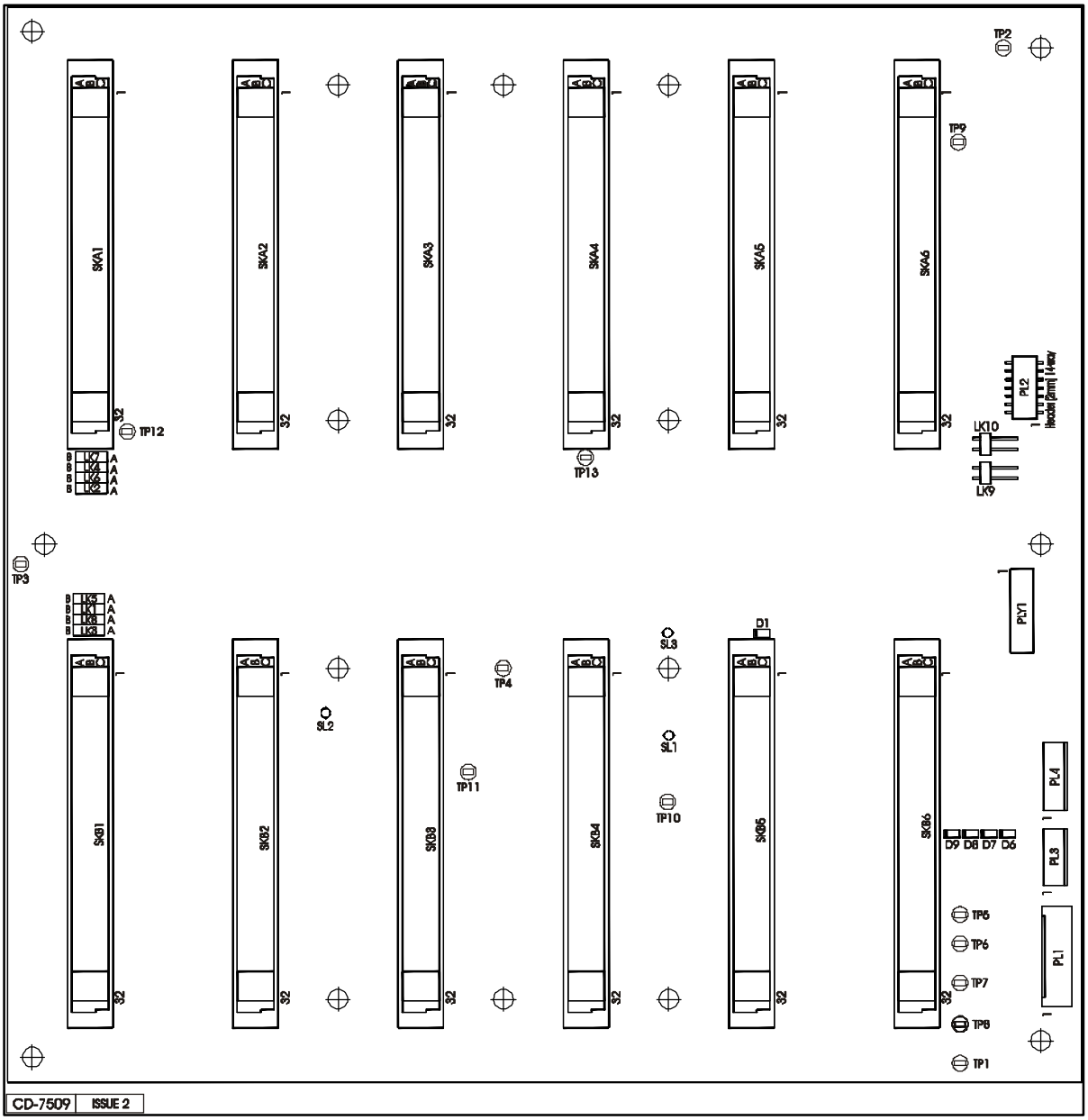
LEDs, links and test points

LEDs *(all green)*	
D1	Flashes when the microcontroller is operating normally
D6	Lit when +1.2V supply present
D7	Lit when +1.5V supply present
D8	Lit when +3.3V supply present
D9	Lit when -5.0V supply present

Links			
LK1	Position A	Video B2 Out routed to SW IP 04 (input)	***Note: Links 1 to 8*** *Links 1 to 8 are configured during manufacture and should not be changed during operation or service unless specifically instructed to do so by Kelvin Hughes Ltd.* *The default link settings are:* *Links 1 to 4 = B position* *Links 5 to 8 = A position* *The links are used to route the video via a 16 x 16 analogue cross point switch which is controlled by the microcontroller. This routes any of the video inputs to one or more of the 16 video outputs. The video inputs and outputs are 75Ω, 1 V peak-peak radar video. The video cross point switch provides outputs with the same characteristic as the input.*
	Position B	Video B2 Out routed to SW OP 04 (output)	
LK2	Position A	Video A2 Out routed to SW IP 03 (input)	
	Position B	Video A2 Out routed to SW OP 03 (output)	
LK3	Position A	Video B1 Out routed to SW IP 02 (input)	
	Position B	Video B1 Out routed to SW OP 02 (output)	
LK4	Position A	Video A1 Out routed to SW IP 01 (input)	
	Position B	Video A1 Out routed to SW OP 01 (output)	
LK5	Position A	Video B2 In routed to SW IP 08 (input)	
	Position B	Video B2 In routed to SW OP 08 (output)	
LK6	Position A	Video A2 In routed to SW IP 07 (input)	
	Position B	Video A2 In routed to SW OP 07 (output)	
LK7	Position A	Video A1 In routed to SW IP 05 (input)	
	Position B	Video A1 In routed to SW OP 05 (output)	
LK8	Position A	Video B1 In routed to SW IP 06 (input)	
	Position B	Video B1 In routed to SW IP 06 (output)	
LK9	Open	Normal operation *(default)*	
	Made	Test Mode *(Kelvin Hughes use only)*	
LK10	Open	Normal operation *(default)*	
	Made	Setup Enabled *(setting to work use only)*	

Test points			
TP1	Ground/ 0V	TP8	+24V
TP2	Ground/ 0V	TP9	+3.3 V
TP3	Ground/ 0V	TP10	+1.5 V
TP4	Ground/ 0V	TP11	+1.2 V
TP5	+5.0VDC	TP12	A-5V
TP6	-15VDC	TP13	Debug *(Kelvin Hughes use only)*
TP7	+15V		

Location of LEDs, links and test points



NTX-A402 backplane

Power

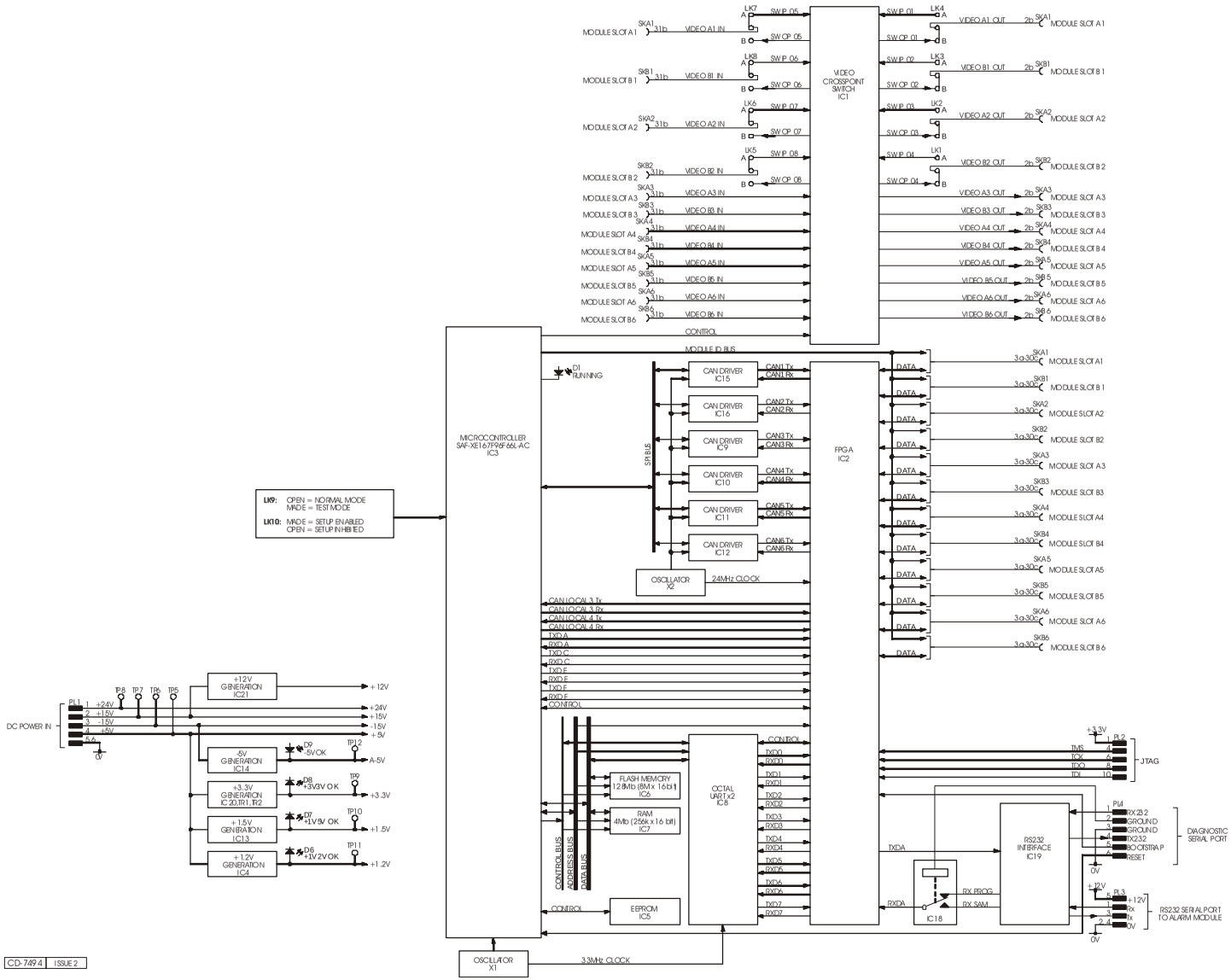
The backplane is provided with voltages from connector *CON2* on the dual redundant power to *PL1* on the backplane:

Voltage (DC)	Tolerance	PSU	NTX-A402 backplane
+24.1V	±0.3V	CON2-1	PL1-1
+15V	±0.4V	CON2-2	PL1-2
-15V	±0.4V	CON2-3	PL1-3
+5.0V	±0.2V	CON2-4	PL1-4
0V		CON2-5	PL1-5
0V		CON2-6	PL1-6

The backplane generates the following supplies internally:

Voltage	Generated from	LED's (all green)	Test point	Notes
+12V	+15V input	No LED	No test point	The +12V is used for the status and alarm panel and can be measured at PL3 pin 5
+3.3V ±0.25V	+5.0V input	LED D8	TP9	General use
+1.5V ±0.1V	+5.0V input	LED D7	TP10	General use
+1.2V ±0.1V	+5.0V input	LED D6	TP11	FPGA core supply
A +5.0V Regulated by +5.0V	+5.0V input	No LED	No tests point	This rail is derived from the +5.0V supply via a low pass filter network and is used to power the video switching circuitry
A -5.0V ±0.25V	-15V input	LED D9	TP12	The A (analogue)-5V is also used to power the video switching circuitry

Backplane schematic



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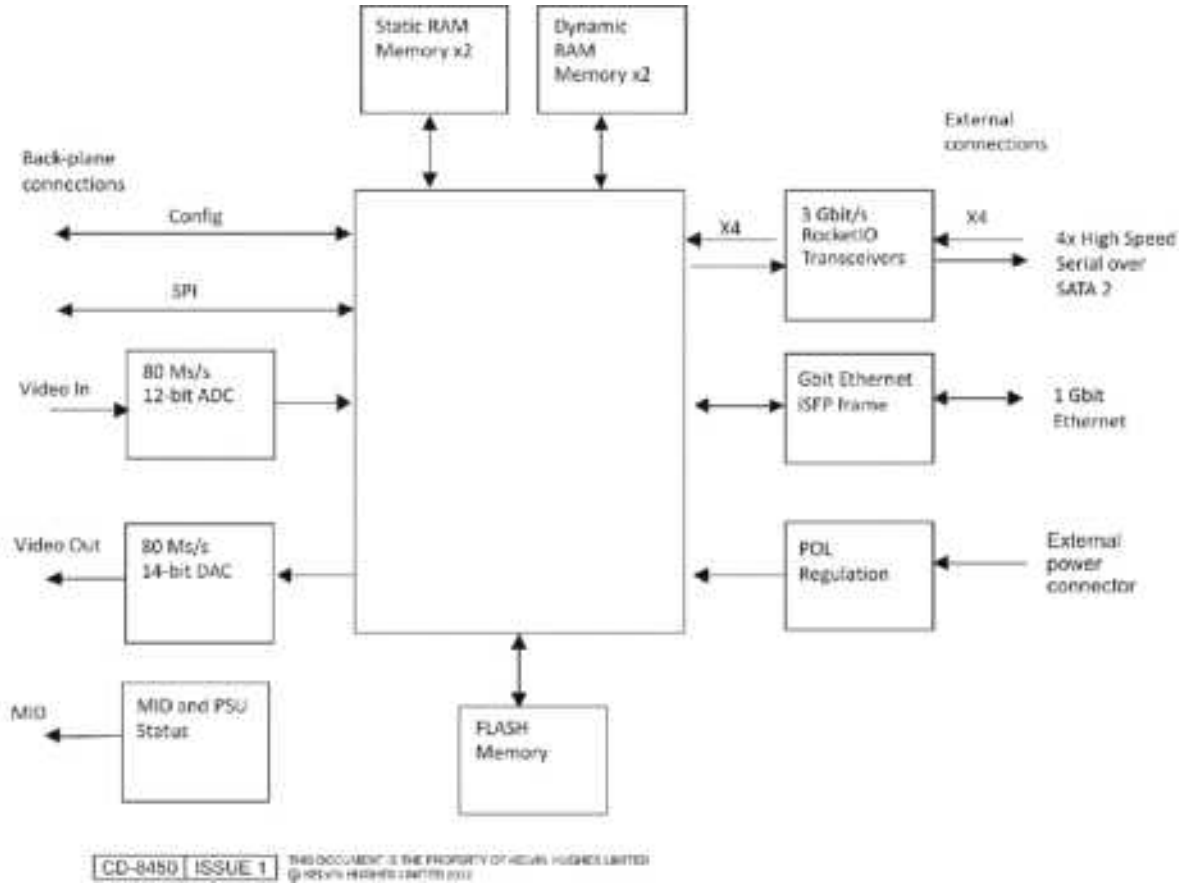
10.8.9 NTX-A462 Radar processing module

Modular interface system module (MISM) Type 5 (Radar processing module type 5)
Part numbers NTX-A462-101 (SX) & NTX-A462-102 (FX)

Backplane locations: TBC

Overview: The purpose of the Modular Interface System Module (MISM) Type 5 (Radar Processing Module) is to provide Field Programmable Gate Array (FPGA) and memory resources and have the following interfaces:

- One fibre optic SFP Small form-factor pluggable transceiver connector
- Four high speed SATA II interfaces

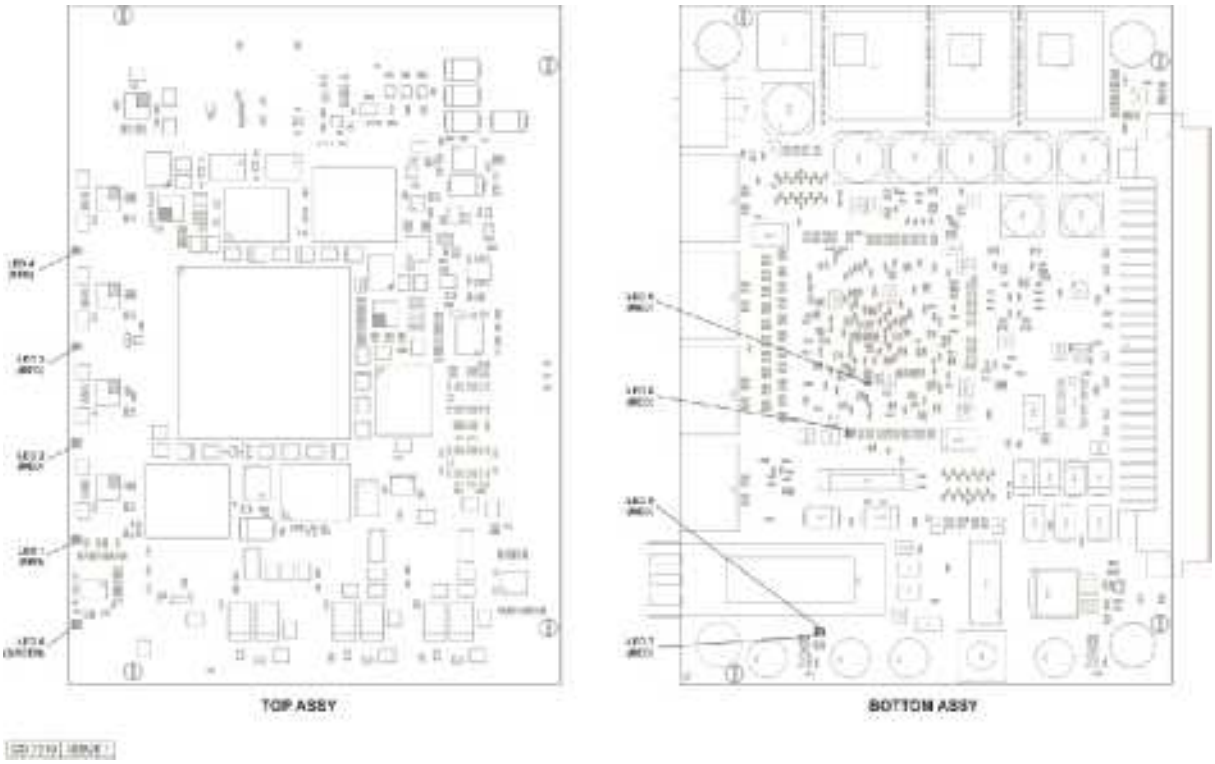


DC power: The MISM Type 5 uses +15 V, +3.3 V and -15 V supplies from the Modular Interface System Backplane (MISB).

Fibre Optic link: The SFP socket SK7 provides the fibre optic interface complaint to the INF-8074i standard. The connector consists of an SFP cage and connector assembly which can connect up to six fibre optic cables.

LED's

LED Number	Function
LED1	"CHANNEL UP" or "DATA VALID CH1". On the NTX-A462-1 fitted in bays A1 and B1this is "CHANNEL UP" which indicates the presence of data input from the LAN. On the NTX-A462-3 fitted in bay A2 this is "DATA VALID CH1" which indicates the presence of valid data input from module A1 via the SATA link.
LED2	"DATA VALID" This red LED indicates presence of decoded zero range trigger pulse.
LED3	"RUNNING" This red LED indicates FPGA is loaded and running and should normally be flashing.
LED4	This red LED is not used.
LED5	"FPGA NOT LOADED" This Red LED indicates FPGA has failed to load and should normally be unlit.
LED6	"FLASH MEMORY CHECKSUM ERROR" This Red LED indicates a checksum error in flash memory and should usually be unlit.
LED7	"SFP TX FAULT" This Red LED indicates failure of SFP TX module or that the module is not fitted. This LED should be lit on NTX-A462-1 fitted in bays A1 and B1 and unlit on NTX-A462-3 fitted in bay A2.
LED8	"POWER SUPPLIES OK" This Green LED illuminates when the power monitor IC36 detects the power rails are within limits. The +5 V, +3.5 V, +1.8 V, AVTTRX, AVTTTX, AVCC and AVCCPLL voltage rails are monitored. This LED should normally be on.
LED9	"SFP LOSS" This Red LED indicates a Loss Of Signal (carrier) such as when the media is disconnected or broken, or when the signal level is below an acceptable level. It is also illuminated in the absence of an SFP due to pull-up R164. This LED should normally be off.



10.8.10 NTX-A477-1 radar I/O module

Modular interface system module (MISM) Type 9 (radar I/O module Mk 2)
Part number NTX-A477-1

Backplane locations: A3 (service display output)
A4 (Track extractor output)
B3 (Spare output)

Overview: The radar I/O module interfaces the following signals with the backplane:
- Analogue radar input (video, sync, azimuth and heading line)
- Analogue radar output (video, sync, blanking, azimuth and heading line)
- An auxiliary video channel is used for an ESM Blanking pulse input from the Tx/ Rx
- A blanking output is used to output an ESM blanking pulse

The board is controlled by the backplane which selects the radar input from one of many input channels and route the data to the output channels using the video switching circuitry.

Video IN: Radar video is received on SKA at +1.0V to +6.0V peak-to-peak with an input impedance of 75ohms and is routed to the radar I/O PCB.
The video is applied to an operational amplifier which provides a 2.0V peak-to-peak output which is dropped to 1.0V peak-to-peak (TP5) for application to the backplane. The video amplifier gain and offset is manually set and controlled from the backplane at 1.0V peak-to-peak ensuring the correct input level. The offset circuit allows the amplifier to compensate for any DC offset in the input signal, thus providing the correct signal level to the backplane.
LED D5 flashes when the video input is detected by the backplane.

Video OUT: Video out of the radar I/O PCB is sent to the backplane terminated at 75ohms to provide an output of between +1.0V to +5.0V peak-to-peak to SKD which can be measured at TP9.

Sync IN: Radar sync is input on SKB at 3.0V to 15V pulses and an input impedance of 75ohm and is routed to the radar I/O PCB. The sync is processed and passed via a high speed differential comparator to the backplane as an LVTTL signal (TP8).
LED D4 is lit when the sync input is detected by the backplane.

Sync OUT: The sync output from the radar I/O PCB is amplified by to provide sync pulses between 3.0V and 14V on SKE and TP11. The sync level is controlled from the backplane and an operational amplifier.

Aux video/ blanking: The auxiliary video input/ blanking from the radar I/O PCB is amplified to provide blanking pulses between 3.0V and 14V on SKF and TP10. The blanking pulse level is controlled from the backplane and an operational amplifier.

Azimuth: The Azimuth inputs (Az1 and Az2) utilises the same circuitry as for a pulsed format, but are all terminated by a link selectable 120Ω resistor (links 1, 2 & 6 for RS422). Azimuth can be received as pulsed, quadrature, RSS422 or +5.0V to +17.5V peak-peak (adjustable during system configuration/ factory set to +15V).

Heading line: The heading line utilises the same circuitry as for a pulsed format, but are all terminated by a link selectable 120Ω resistor.
ARP/ Heading line signals can be received as pulsed, quadrature, RSS422 or +5.0V to +17.5V peak-peak (adjustable during system configuration, factory set to +15V).

LEDs, links and test points

LEDs *(all green)*	
D4	Lit when sync pulses (in & out) present at the backplane
D5	Lit when video signals are present
D6	Lit when auxiliary video (*blanking*) pulses are present
D7	Lit when azimuth signals are present
D8	Lit when heading line pulses are present
D10	Lit when +5.0V is present
D11	Lit when -5.0V is present

LED Status	
ON	An input is being received and an output generated at the backplane
Flashing	Only an input or an output is available at the backplane
OFF	No input is being received or no output is available from the backplane from the backplane

Links (factory default settings in **BOLD**)		
LK1	**Open**	Heading line un-terminated
	Made	Heading line terminated 120Ω for RS422
LK2	**Open**	Azimuth 2 un-terminated
	Made	Azimuth 2 terminated 120Ω for RS422
LK3	**Position A**	Pulsed heading line input
	Position B	Closing contact heading line input
LK4	**Open**	Heading line input for >5VDC
	Made	Heading line input for RS422 levels or <5VDC
LK5	**Open**	Azimuth 1 input for >5VDC
	Made	Azimuth 1 input for RS422 levels or <5VDC
LK6	**Open**	Azimuth 1 un-terminated
	Made	Azimuth 1 terminated 120Ω for RS422
LK7	**Open**	Azimuth 2 input >5VDC
	Made	Azimuth 2 input for RS422 levels or <5VDC
LK8	**Position A**	Variable azimuth and heading line amplitude
	Position B	RS422 azimuth and heading line level amplitude

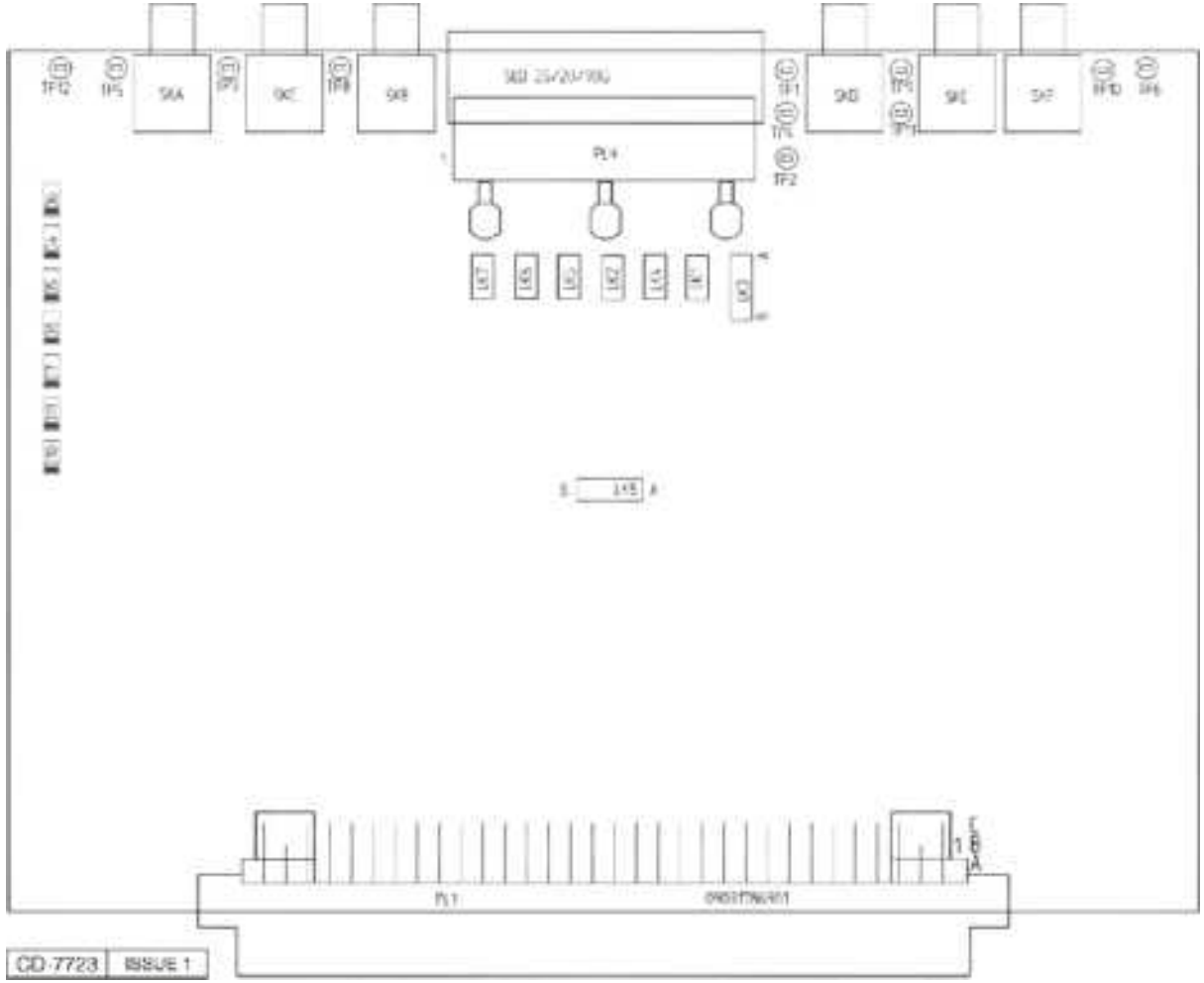
Test points		
TP1	Heading line IN	LVTTL heading line pulses (3.3VDC)
TP2	Az1 IN	LVTTL pulse for each azimuth pulse
TP3	*Not accessible for service or maintenance use*	
TP4	Az2 IN	LVTTL pulse for each azimuth pulse
TP5	Video IN	1.0V peak to peak video
TP6	Analogue ground	0V
TP7	Aux video IN	LVTTL video or blanking pulses
TP8	Sync IN	LVTTL pulses
TP9	Video OUT	1.0V to 5.0V peak to peak video
TP10	Blanking pulse OUT	3.0V to 14V pulses
TP11	Sync OUT	3.0V to 14V pulses
TP12	Analogue ground	0V

Power

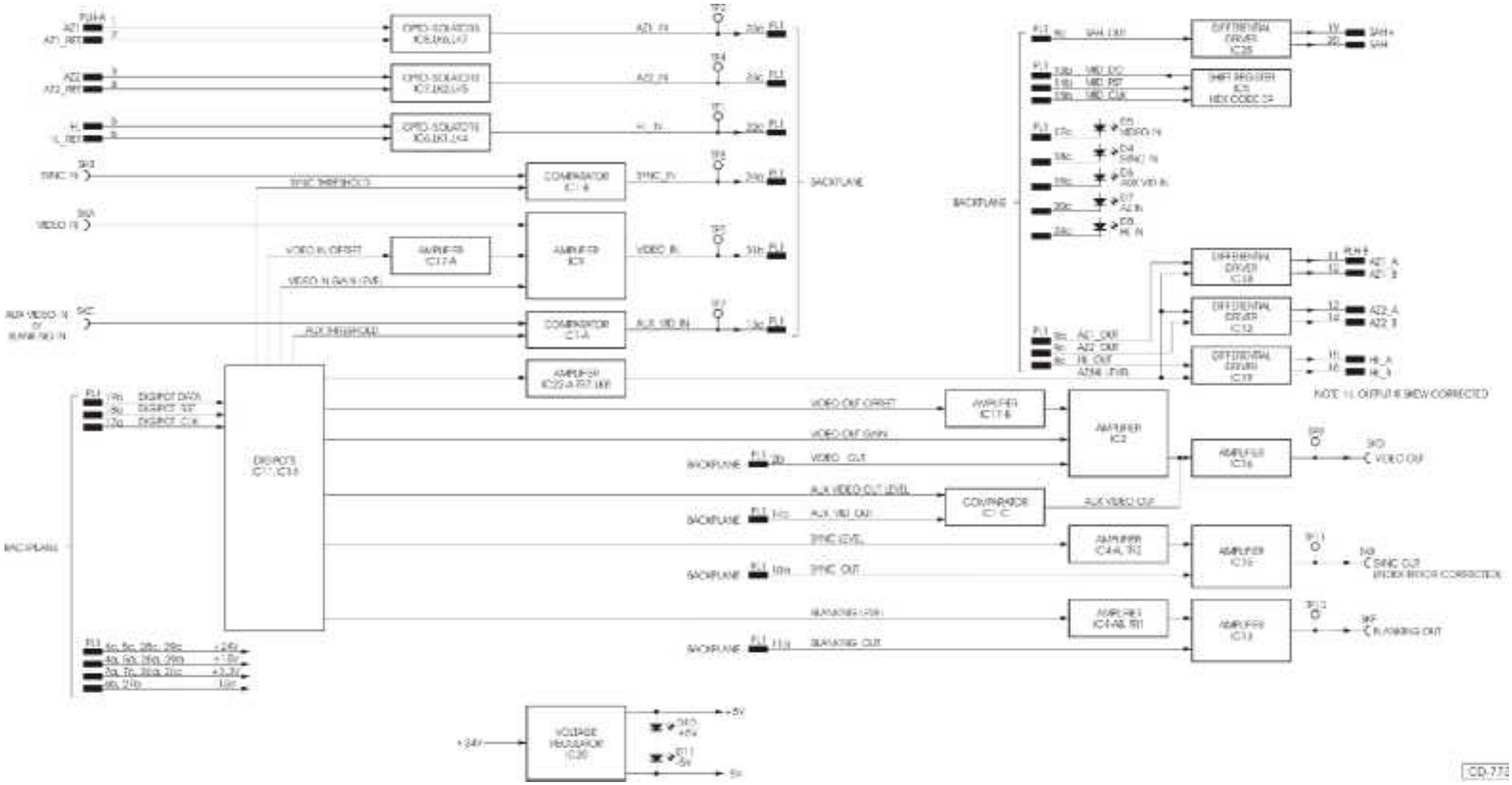
The Radar I/O PCA uses +24V, +15V, +3.3V and -15V directly from the backplane. The +24V is applied to a Voltage Regulator to generate a +5.0V and -5.0V supply for the internal circuits.

- LED D10 is lit when the +5.0V supply is present.
- LED D11 is lit when the -5.0 V supply is present.

Location of LEDs, links and test points



NTX-A477-1 radar I/O module **NTX-A477-1 schematic**


BACKPLANE
DIFFERENTIAL DRIVER
AMPLIFIER
COMPARATOR
VOLTAGE REGULATOR
NOTE 11: OUTPUT IS SKEW CORRECTED

10.8.11 NTX-A478 serial coms module

Modular interface system module (MISM) type 4 Mk2 serial coms module
Part number NTX-A478

Backplane location: B5

Overview: The serial communications module within the Radar Distribution Unit is controlled by the backplane and provides the following interfaces:
- Three CANBus V2.0B interfaces.
- Six RS232/422 serial interfaces.
- Four opto-isolated parallel inputs and/ or relay isolated outputs.

CANBus: The V2.0B CAN bus controllers are located on the backplane; the PCB only provides the physical interface to the external CAN bus. The board converts and buffers the CAN bus LVTTL transmit and receive signals.

RS232/422 serial interfaces: The board has six identical RS232/422 interfaces. The LVTTL serial transmit and receive signals on the backplane interface are configured for bi-directional operation by a multi-protocol transceiver. Each input can be configured by links which are *MADE* for RS232 and *OPEN* for RS422.

Parallel inputs/ outputs: The PCB has four identical parallel input/output ports. Each port can be configured as an input and/or output, with the following options (*port 1 shown below as an example*):
- Opto-isolated input, with LK10 set to Position B and LK13 OPEN.
- Isolated output, with LK10 and LK11 both set to position A, LK12 not fitted and LK13 MADE.
- Input and output, with LK10 set to Position A and LK13 OPEN.

LEDs, links and test points

LED *(green)*	
D1	Lit when internally generated +5.0V is present

Links (factory defaults in **BOLD**)		
LK1	Open	CANBus 1 un-terminated
	Made	CANBus 1 terminated into 120Ω
LK2	Open	CANBus 2 un-terminated
	Made	CANBus 2 terminated into 120Ω
LK3	Open	CANBus 3 un-terminated
	Made	CANBus 3 terminated into 120Ω
LK4	**Open**	Serial interface 1 set to RS422 operation
	Made	Serial interface 1 set to RS232 operation
LK5	**Open**	Serial interface 2 set to RS422 operation
	Made	Serial interface 2 set to RS232 operation
LK6	**Open**	Serial interface 3 set to RS422 operation
	Made	Serial interface 3 set to RS232 operation
LK7	**Open**	Serial interface 4 set to RS422 operation
	Made	Serial interface 4 set to RS232 operation
LK8	**Open**	Serial interface 6 set to RS422 operation
	Made	Serial interface 6 set to RS232 operation
LK9	**Open**	Serial interface 5 set to RS422 operation
	Made	Serial interface 5 set to RS232 operation

Links (factory defaults in **BOLD**)			
LK10	**Position A**	Isolated output	**Parallel 1**
	Position B	Opto-isolated output	
LK11	**Open**	Normally open output contact	
	Position A		
	Position B	Normally closed output contact	
LK12	**OPEN**	Isolated output	
	Position A	Non-isolated output ground	
	Position B	Non-isolated output +15V	
LK13	**OPEN**	Opto-isolated input	
	MADE	Isolated output	
LK14	**Position A**	Isolated output	**Parallel 2**
	Position B	Opto-isolated output	
LK15	**Open**	Normally open output contact	
	Position A		
	Position B	Normally closed output contact	
LK16	**OPEN**	Isolated output	
	Position A	Non-isolated output ground	
	Position B	Non-isolated output +15V	
LK17	**OPEN**	Opto-isolated input	
	MADE	Isolated output	
LK18	**Position A**	Isolated output	**Parallel 3**
	Position B	Opto-isolated output	
LK19	**Open**	Normally open output contact	
	Position A		
	Position B	Normally closed output contact	
LK20	**OPEN**	Isolated output	
	Position A	Non-isolated output ground	
	Position B	Non-isolated output +15V	
LK21	**OPEN**	Opto-isolated input	
	MADE	Isolated output	
LK22	**Position A**	Isolated output	**Parallel 4**
	Position B	Opto-isolated output	
LK23	**Open**	Normally open output contact	
	Position A		
	Position B	Normally closed output contact	
LK24	**OPEN**	Isolated output	
	Position A	Non-isolated output ground	
	Position B	Non-isolated output +15V	
LK25	**OPEN**	Opto-isolated input	
	MADE	Isolated output	

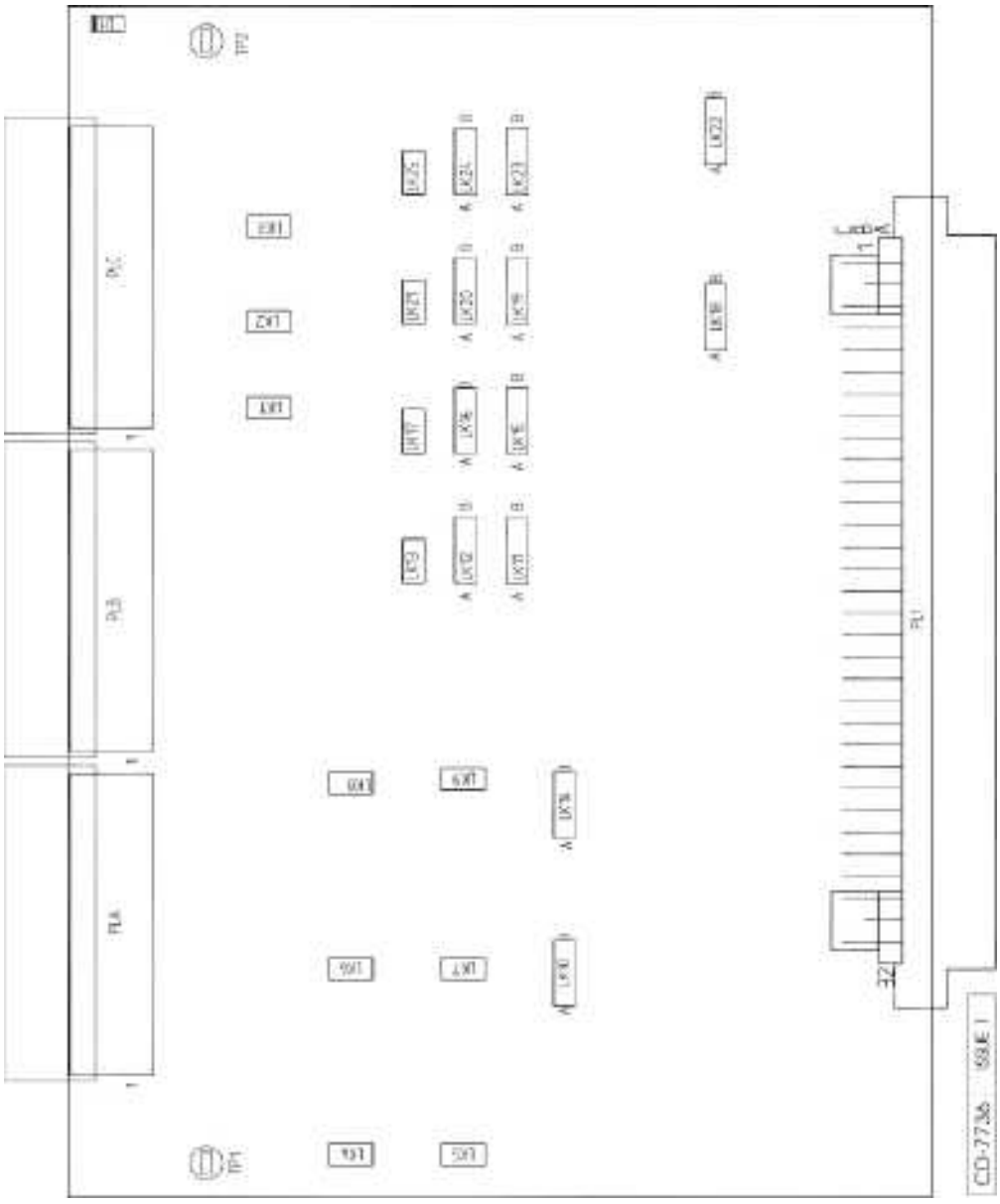
Test points	
TP1	Ground / 0V
TP2	Ground / 0V

Power

The PCB uses +15V and +3.3V supplies directly from the backplane.

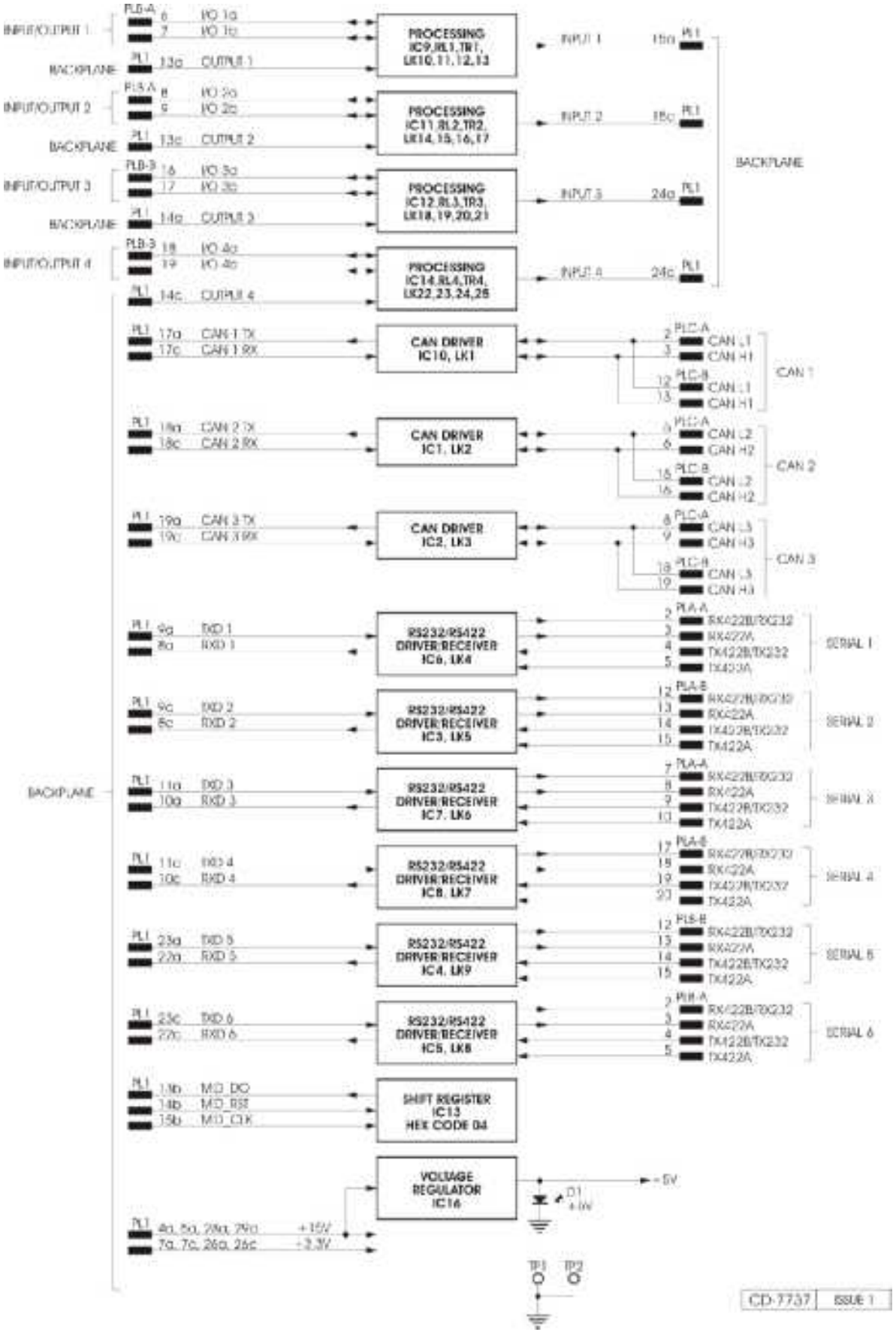
A +5.0V DC rail is generated on the PCB from the +15V supply, LED D1 (green) is lit when this +5.0V supply is present.

Location of LEDs, links and test points



NTX-A478 Serial communications PCB

NTX-A478 schematic



10.8.12 NTX-A490 signal I/O module

Modular interface system module type 11 signal I/O module
Part number NTX-A490
Backplane location: B4

Overview: The signal I/O Module within the Radar Distribution Unit is controlled by the backplane and provides the following interfaces:

- Three switched relay outputs: F-OUT, S1-OUT and S2-OUT.
- Three co-axial outputs: SKA, SKB and SKC.
- Four I/O channels configurable using links to be inputs or outputs.
- Two Input only channels and two output only channels.

Coaxial outputs: There are three identical coaxial outputs with adjustable voltage levels of between 5.0V and 15VDC.

Switched relay outputs: There are three Identical Relay outputs. These are primarily used to control the 3-phase inverter which supplies power for the gearbox motor.

Input/ outputs: *Configurable ports (channels 1 to 4):* The board has four configurable input/ output ports that can be configured using links to be:

- A pulse input with a relay output.
- An opto-isolated input.
- An isolated input.
- An input and output port.

Non configurable ports (channels 5 and 6): Pulsed inputs with a relay outputs.

LEDs, links and test points

LED *(green)*	
D24	Lit when internally generated +5.0V is present
D24	Lit when internally generated -5.0V is present

Links		
LK1	Position A	Pulse in/ Relay out **(default)**
	Position B	Differential output
LK2	Position A	Pulse in/ Relay out
	Position B	Differential output
LK3	Position A	+15V ref for input; input action low on IOB
	Position B	Input drive from IOA
LK4	Position A	Closing contact relay
	Position B	Opening contact relay
LK5	Position A	Ground ref for relay
	Position B	+15V ref for relay
LK6	Made	Connects IOB to relay ref
	Open	No action
LK7	Position A	Pulse in/ Relay out
	Position B	Differential output
LK8	Position A	Pulse in/ Relay out
	Position B	Differential output
LK9	Position A	+15V ref for input; input action low on IOB
	Position B	Input drive from IOA
LK10	Position A	Closing contact relay
	Position B	Opening contact relay
LK11	Position A	Ground ref for relay
	Position B	+15V ref for relay

Links		
LK12	Position A	Connects IOB to relay ref
	Position B	No action
LK13	Position A	Pulse in/ Relay out
	Position B	Differential output
LK15	Position A	+15V ref for input; input action low on IOB
	Position B	Input drive from IOA
LK16	Position A	Closing contact relay
	Position B	Opening contact relay
LK17	Position A	Ground ref for relay
	Position B	+15V ref for relay
LK18	Position A	Connects IOB to relay ref
	Position B	No action
LK19	Position A	Pulse in/ Relay out
	Position B	Differential output
LK20	Position A	Pulse in/ Relay out
	Position B	Differential output
LK21	Position A	+15V ref for input; input action low on IOB
	Position B	Input drive from IOA
LK22	Position A	Closing contact relay
	Position B	Opening contact relay
LK23	Position A	Ground ref for relay
	Position B	+15V ref for relay
LK24	Position A	Connects IOB to relay ref
	Position B	No action
LK25	Position A	Pulse in/ Relay out
	Position B	Differential output
LK26	Position A	Pulse in/ Relay out
	Position B	Differential output
LK27	Position A	Closing contact relay
	Position B	Opening contact relay
LK28	Position A	Ground ref for relay
	Position B	+15V ref for relay
LK29	Position A	Pulse in/ Relay out
	Position B	Differential output
LK30	Position A	Pulse in/ Relay out
	Position B	Differential output
LK31	Position A	Closing contact relay
	Position B	Opening contact relay
LK32	Position A	Ground ref for relay
	Position B	+15V ref for relay
LK33	Position A	Direct drive pulse out
	Position B	50Ω termination
	Not fitted	AC coupled out
LK34	Position A	Direct drive pulse out
	Position B	50Ω termination
	Not fitted	AC coupled out
LK35	Position A	Direct drive pulse out
	Position B	50Ω termination
	Not fitted	AC coupled out

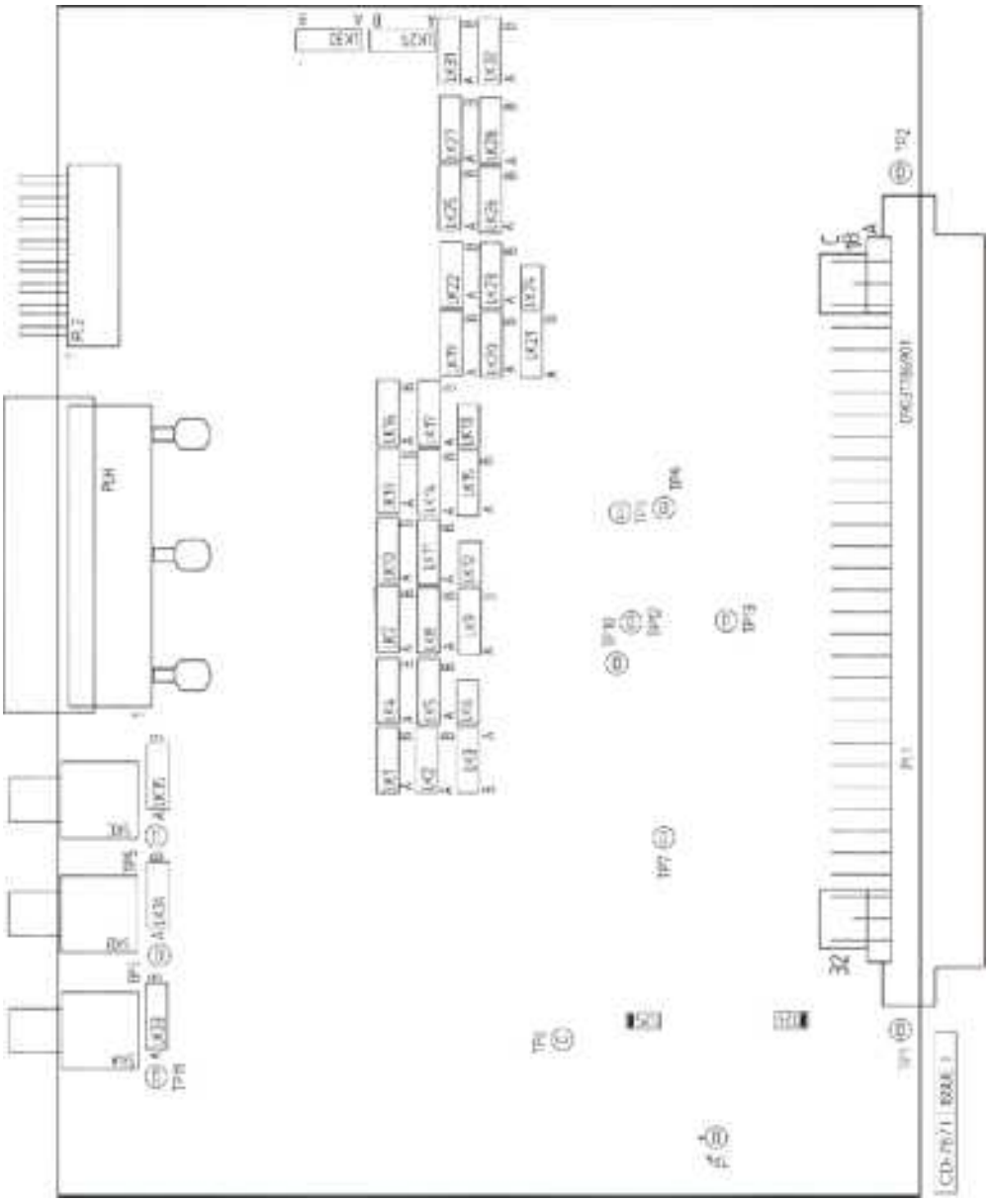
Test points			
TP1	Gnd	TP8	Input 2 (TTLV level)
TP2	Gnd	TP9	Input 3 (TTLV level)
TP3	Pulse output (SKB)	TP10	Input 4 (TTLV level)
TP4	+5.0V	TP11	Pulse output (SKA)
TP5	Pulse output (SKC)	TP12	Input 5 (TTLV level)
TP6	-5.0V	TP13	Input 6 (TTLV level)
TP7	Input 1 (TTLV level)		

Power

The board uses +24V, +15V and +3.3V supplies directly from the backplane. A +5.0V and -5.0V supply is generated o the PCB from the +24V rail.

- LED D24 (green) is lit when the +5.0V supply is present.
- LED D25 (green) is lit when the -5.0V supply is present.

Location of LEDs, links and test points



NTX-A490 signal I/O module

10.8.13 VDR-A121-3 status and control PCB

The Status and Control PCB Assembly (Front panel) provides indication of the unit status by means of an LCD display and a set of LEDs, and provides control of the unit functions by means of four pushbutton switches.

The unit is interfaced via a bi-directional RS232 serial data link on PL1 to SK3 on the backplane.

The four switches are momentary action pushbutton switches. The lower right switch also contains an integral LED indication, which may or may not be used depending on the requirements of the parent equipment.

When a switch is pressed the interface to the microprocessor is pulled down to ground and this is detected by the microprocessor. The switch functions and LED display are determined by the configuration software, not by the on-board software.

LEDs, links and test points

LEDs		
D1	Red LED - Lit when unit is being programmed (Kelvin Hughes use only)	
D2	Red LED	*Front panel LEDs*: The LED status depends on system activity.
D3	Green LED	
D4	Yellow LED	

Note: *PL4 is used for programming the PCB during manufacture and must not be used for any other purpose. Caution: Unauthorised use of this port can rendering the PCB defective.*

Power

The board uses the +12V rail direct from the backplane which is received on PL1 pins 1 & 2. (+12V) +12V DC from PL1 pins 1 and 2.

A 5.0V rail is internally generated, there are no LED's or test points for this rail.

Software

The status & control PCB runs ZM-2010 software which has no user configurable parameters.

10.8.14 Three-phase inverter VF-S15

Manufactures part number: **VF-S15**
Kelvin Hughes part number: **45-690-0084-002**

The Radar Distribution Unit can be fitted with different three-phase inverters designed to meet the site AC requirements.

This converts the incoming three-phase supply into a voltage suitable for the supply and control of the antenna motor.

The unit is also configured to provide a soft start and a soft stop for the Motor.

For systems where a three phase supply is not available and optional factory fitted 220VAC single phase input kit is available.

Maintenance: The maintenance or the inverter is restricted to replacement of the cooling fan if it becomes faulty.

The manufactures recommend that the fans are changed every 10 years which coincides with the recommended replacement of the complete inverter assembly.

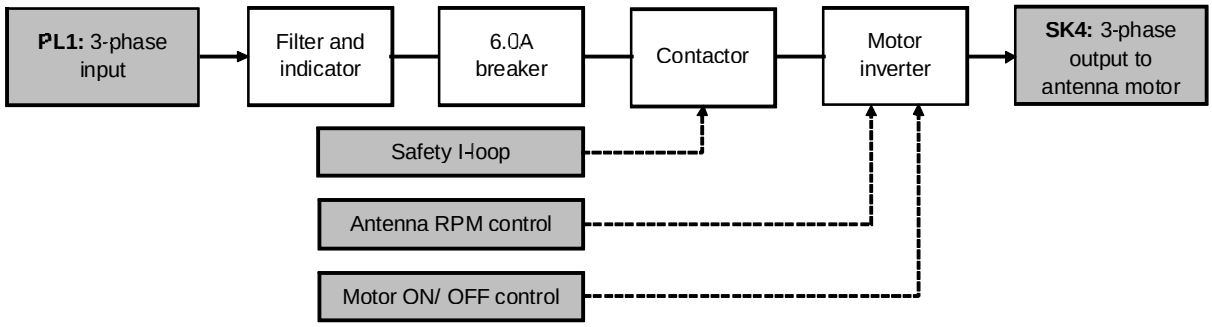
Note: With the exception of the user accessible and replaceable fan, the inverter is a factory sealed unit that contains no field serviceable parts.

WARNING: *Lethal voltages are present within the RDU and the three-phase inverter. The system must be fully isolated from all sources of power prior to commencing any inspection or maintenance procedures.*

Antenna rotation warning: *When AC voltages are applied to the system, three phase voltages are generated and the antenna WILL ROTATE even if no RUN command is present.*

WARNING: Unauthorised adjustment of the inverter parameters can potentially damage the antenna motor or stop the operation/ output of the inverter.

Basic schematic



The inverter voltages and speeds are set during manufacture, apart from the tasks detailed in planned maintenance; no operator action is required for the inverter.

Fan replacement

Health and safety notice

Fan replacement notes: When used under normal operational conditions, the fan has an operational life of 10 years and should only need replacing if it fails. Due to the drying of the electrolytic capacitors, the entire inverter must be replaced every *10 years*.

WARNING: Prior to commencing any maintenance procedure, users must familiarise themselves with the health & safety warnings noted in the planned maintenance and health and safety sections of the system handbook.

Prior to carrying out planned maintenance, the system must be fully isolated and disconnected from the single and 3-phase AC supplies. See *system isolation* in the planned maintenance section of the system handbook.

Warning: When the RDU is switched ON lethal voltages are present within the inverter.

The VF-S15 inverter is located within the Radar Distribution Unit (RDU).

Radar distribution unit

Repair: The inverter is a sealed unit that contains NO field serviceable or repairable parts.

The unit must never be dismantled or repaired in the field.

Inverter removal: To replace the fan, the inverter will need to be removed from the radar distribution unit. See section 9.6 page 100 for the inverter removal instructions.

Fan replacement: When the inverter has been removed, the fan can be accessed at the base of the unit.

Removal: The fan assembly is retained by two clips which are released by pressing towards the centre of the fan.

The fan assembly can now be removed.

Disconnect the power connector from the inverter.

Fan assembly removal

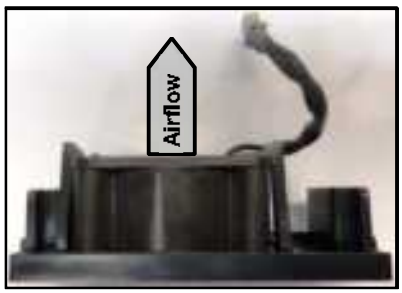
Fan power connection

Replacement: Noting the orientation and direction, the fan can now be removed from the plastic case and the replacement fan fitted.

The fan is retained in the case by 4 plastic clips.

The fan assembly can now be reconnected/ refitted and the inverter replaced into the RDU.

Fan removed from case



Fan noting airflow direction

10.8.15 Three-phase inverter VF-S11

Manufactures part number: **VF-S11**
Kelvin Hughes part number: **45-690-0065-001**

NOTICE: This part has been superseded by the VF-S15 (see previous section)

The Radar Distribution Unit can be fitted with different three-phase inverters designed to meet the site AC requirements.

This converts the incoming three-phase supply into a voltage suitable for the supply and control of the antenna motor.

The unit is also configured to provide a soft start and a soft stop for the Motor.

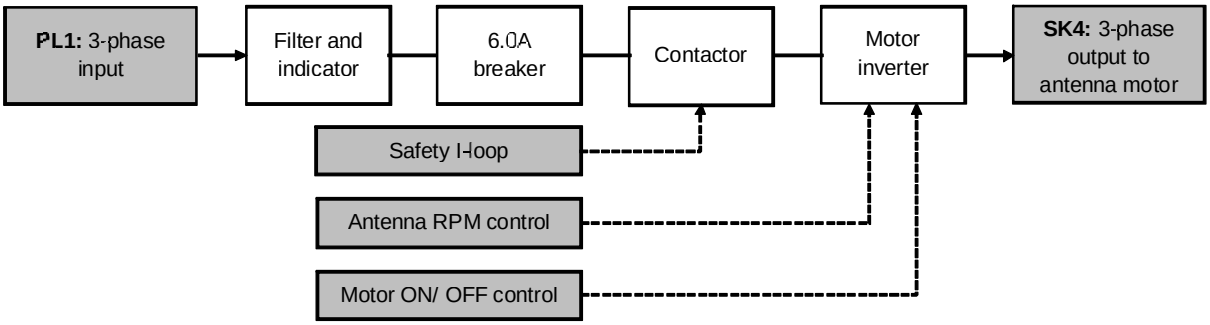
For systems where a three phase supply is not available and optional factory fitted 220VAC single phase input kit is available.

Note: With the exception of the user accessible and replaceable fan, the inverter is a factory sealed unit that contains no field serviceable parts.

WARNING: *Lethal voltages are present within the RDU and the three-phase inverter. The system must be fully isolated from all sources of power prior to commencing any inspection or maintenance procedures.*

Antenna rotation warning: *When AC voltages are applied to the system, three phase voltages are generated and the antenna WILL ROTATE even if no RUN command is present.*

Basic schematic for SBS-A1-2 and SBS-A1-3



The inverter voltage and speed is set during manufacture, apart from the tasks detailed in planned maintenance, no operator action is required for the inverter.

Caution: Unauthorised adjustment of the inverter parameters can potentially damage the antenna motor or stop the operation/ output of the inverter.

Fan replacement

Health and safety notice

WARNING: Prior to commencing any maintenance procedure, users must familiarise themselves with the health & safety warnings noted in the planned maintenance and health and safety sections of the system handbook.

Prior to carrying out planned maintenance, the system must be fully isolated and disconnected from the single and 3-phase AC supplies. See *system isolation* in the planned maintenance section of the system handbook.

Replacement fan part number: NTX-A518 (*fan and cable but not the plastic enclosure*).

The Toshiba VF-S11 inverter is located within the radar distribution unit (RDU).

The inverter is a sealed unit that contains no field serviceable or repairable parts.

The unit must never be dismantled or repaired in the field.

Toshiba VF-S11 inverter

Radar distribution unit

Warning: When powered lethal voltages are present within the inverter.

Inverter removal: To replace the fan, the inverter will need to be removed from the radar distribution unit. See section 9.6 page 100 for the inverter removal instructions.

When the inverter has been removed, the fan can be accessed at the base of the unit.

The fan assembly is retained by two clips which are released by pressing towards the centre of the fan.

The fan assembly can now be removed.

Disconnect the power connector from the inverter.

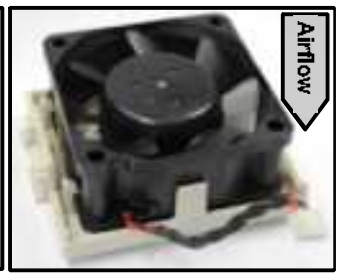
Fan assembly removal

Fan power disconnection

Noting the orientation and direction, the fan can now be removed from the plastic case and the replacement fan fitted.

The fan is retained in the case by 4 plastic clips.

The fan assembly can now be reconnected/ refitted and the inverter replaced into the RDU.



Reset the fan run-time counter

When the fan has been replaced, the run time counter in the inverter must be reset to zero as follows:

Caution: *The following task is carried out with the inverter switched ON and must must only be undertaken by a qualified electrical engineer who understands the voltage hazards present within the inverter and the Radar Distribution Unit.*

Setup: The Radar Distribution Unit must be switched ON.
The *Local/ Remote* switch on the door of the RDU is set to *Local*.
The man aloft and antenna rotation switches are both in the FREE position.

WARNING: The following task is carried out with the Radar Distribution Unit switched ON and powered. Lethal voltages are present within the unit so extreme care must be taken when carrying out the adjustments detailed below.

I. On the inverter press the **STOP** button and wait until **0.0** is displayed.
This stops the inverter producing a three-phase output but single and three-phase AC supplies are still present within the system.
II. Press the **Mode** button once, the **PRG** lamp will illuminate.
III. Press the button eight (8) times until **typ** is displayed.
IV. Press **ENT** once then press the button until menu **9** is displayed.
V. Press **ENT** again. *This reset the fan run-time counter to zero*.
VI. Press **MODE** until 0.0 is displayed.
VII. Ensure the **PRG** lamp is no longer illuminated.
VIII. Close and secure the RDU door then test the system

Inverter replacement

After 5-years of use, the static inverter located within the radar distribution unit must be changed as over time, the electrolytic capacitors within the inverter can dry out.

The inverter replacement procedure is detailed in section 9.6 page 100 of Planned Maintenance.

10.8.16 Single phase inverter: VF-nC3

Manufactures part number: **VF-nC3**
Kelvin Hughes part number: **45-690-0066-001**

An optional inverter is available that has a single phase AC voltage input. This is used where a 3-phase supply is not available on site.

The Radar Distribution Unit can be fitted with different three-phase inverters designed to meet the site AC requirements.

This converts the incoming single phase AC supply into a three-phase voltage suitable for the supply and control of the antenna motor.

The unit is also configured to provide a soft start, a soft stop for the Motor and antenna speed selection (system dependent).

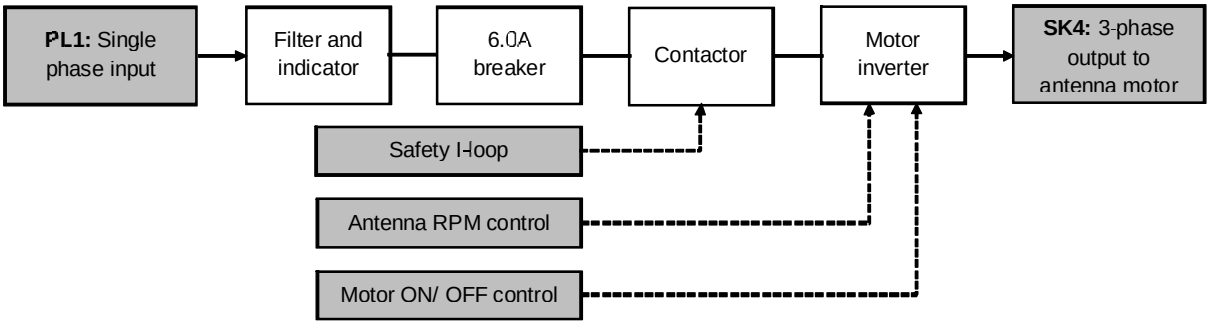
The inverter is not a retro fit item and must be specified at the point of order.

Note: With the exception of the user accessible and replaceable fan, the inverter is a factory sealed unit that contains no field serviceable parts.

WARNING: *Lethal voltages are present within the RDU and the inverter. The system must be fully isolated from all sources of power prior to commencing any inspection or maintenance procedures.*

Antenna rotation warning: *When AC voltages are applied, three phase voltages are generated and the antenna WILL ROTATE even if no RUN command is present.*

Basic schematic



The inverter voltage and speed is set during manufacture, apart from the tasks detailed in planned maintenance, no operator action is required for the inverter.

Caution: Unauthorised adjustment of the inverter parameters can potentially damage the antenna motor or stop the operation/ output of the inverter.

Fan replacement

Health and safety notice

WARNING: Prior to commencing any maintenance procedure, users must familiarise themselves with the health & safety warnings noted in the planned maintenance and health and safety sections of the system handbooks.

Prior to carrying out planned maintenance, the system must be fully isolated and disconnected from the single and 3-phase AC supplies. See *system isolation* in the planned maintenance section of the system handbook.

The Toshiba **VF-nC3** inverter is located within the Radar Distribution Unit (RDU).

The inverter is a sealed unit that, with the exception of the fan, contains no field serviceable or repairable parts.

The unit must never be dismantled or repaired in the field.

Warning: When powered lethal voltages are present within the inverter.

Toshiba VF-nC3 inverter

Radar distribution unit

Inverter removal: To replace the fan, the inverter will need to be removed from the Radar Distribution Unit. See section 9.6.2 page 107 for the inverter removal instructions.

When the inverter has been removed, the fan can be accessed at the top of the unit.

The fan assembly is retained by a single clip which is released by pressing towards the centre of the fan.

The fan assembly can now be removed.

Disconnect the power connector from the inverter.

Fan assembly on top of inverter

Fan power connection

Noting the orientation and direction, the fan can now be removed from the plastic case and the replacement fan fitted.

The fan is retained in the case by 4 plastic clips.

The fan assembly can now be reconnected/ refitted and the inverter replaced into the RDU.

Reset the fan run-time counter

When the fan has been replaced, the run time counter in the inverter must be reset to zero as follows:

Caution: *The following task is carried out with the inverter switched ON and must only be undertaken by a qualified electrical engineer who understands the voltage hazards present within the inverter and the Radar Distribution Unit.*

Setup: The Radar Distribution Unit must be switched ON.
The *Local/ Remote* switch on the door of the RDU is set to *Local*.
The man aloft and antenna rotation switches are both in the FREE position.

WARNING: The following task is carried out with the Radar Distribution Unit switched ON and powered. Lethal voltages are present within the unit so extreme care must be taken when carrying out the adjustments detailed below.

I. On the inverter press the **STOP** button and wait until **0.0** is displayed. *This stops the inverter producing a three-phase output but single and three-phase AC supplies are still present within the system.*
II. Press the **Mode** button once, the **PRG** lamp will illuminate.
III. Rotate the thumbwheel until **typ** is displayed.
IV. Press the thumbwheel and again rotate the wheel until menu **9** is displayed.
V. Press **ENT** again. *This reset the fan run-time counter to zero*.
VI. Press **MODE** until 0.0 is displayed.
VII. Ensure the PRG lamp is no longer illuminated.
VIII. Close and secure the RDU door then test the system

Inverter replacement

After 5-years of use, the static inverter located within the radar distribution unit must be changed as over time, the electrolytic capacitors within the inverter can dry out.

The inverter replacement procedure is detailed in the routine maintenance section 9.6.2 page 107.

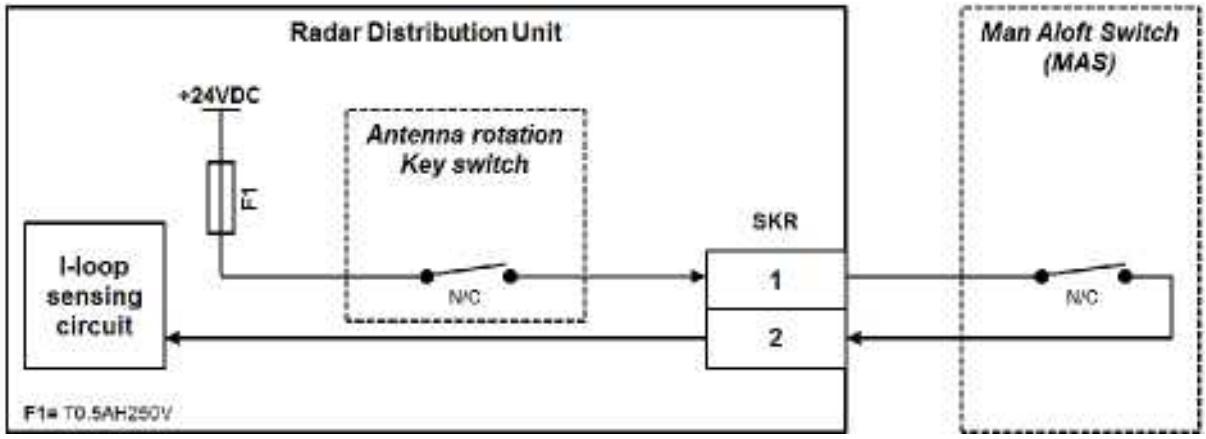
10.8.17 Safety and security switches

Safety switches

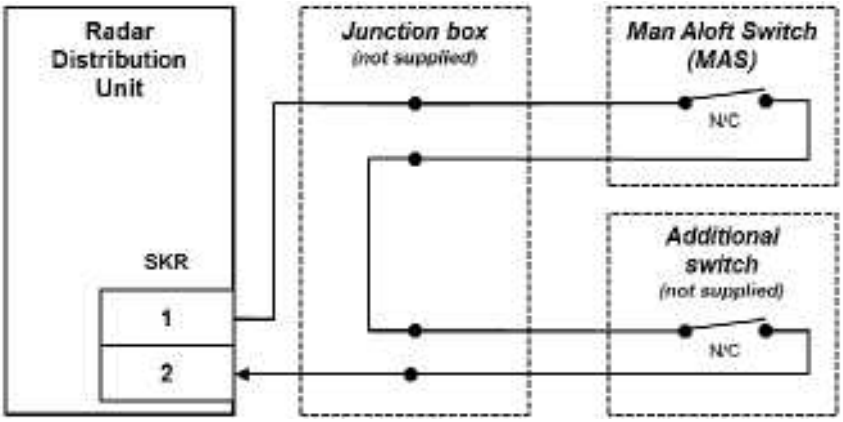
The safety switches form part of a safety current I-loop. When either the ***Antenna Rotation*** *or* ***Man Aloft*** switches are set to **OFF** or if the safety current loop is **open**, single and 3-phase AC supplies to the transceiver/ gearbox are isolated thereby stopping antenna rotation and system transmission.

Antenna rotation Key switch	Man aloft switch
The Antenna Rotation keyswitch is located on the front door of the RDU. This switch can be set to OFF and the key removed and retained by the maintainer. 	An externally mounted waterproof masthead switch. This switch can be set to *FREE* or *OFF* 

Safety current loop: Serial connection of normally closed switches.			
Polarity	Positive	Amplitude	Fused (500mA anti-surge) +24V



Additional switches: The Antenna Rotation keyswitch and Man Aloft switch are provided as standard however additional switches can be serially connected as shown:



Security switches

Connections are provided on the RDU for two security switches. The system reports the status of these switches to the command and display system, track extractor or optional service display.

The normally closed (N/C) switch inputs switches are for monitoring purposes only and do not isolate or control any aspect of the system.

Where fitted, these switches must be enabled during setting to work of the system.

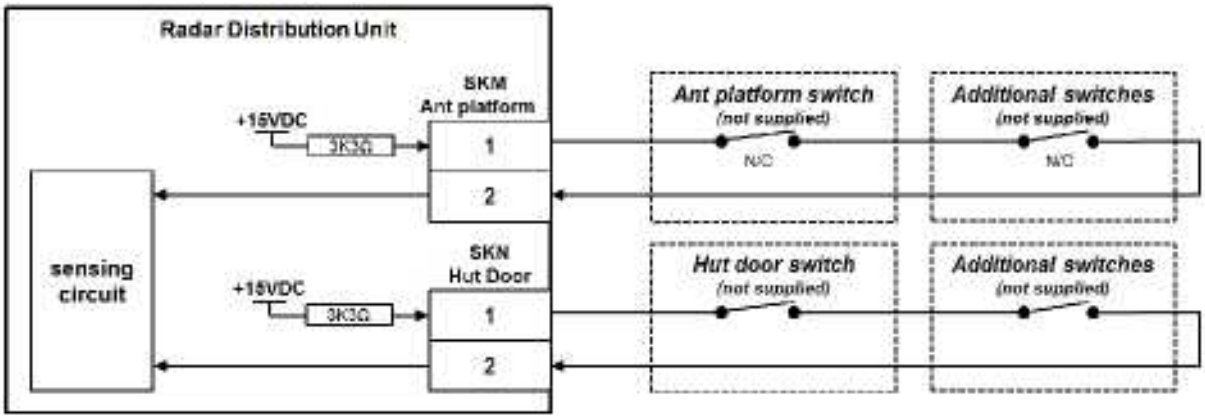
Two switch connections are available as follows:

SKM / Ant Platform: This is designed for a security switch on the gate or access point to the antenna platform.

SKN / Hut door: This is designed for a security switch on the equipment building or hut access door.

Additional security switches can be serially added using a junction box (not supplied) in a similar fashion to the security switches as shown on the previous page.

Antenna platform/ Hut door switch: Normally closed (N/C) switch returning a voltage back to RDU.			
Polarity	Positive	Amplitude	+15V with series 3k3Ω current limiting resistor



10.8.18 Spares listings

SBS-A1-xx Radar Distribution Unit	
Part number	**Description**
VDR-A121-3	STATUS & ALARM PCA
85-200-0043-001	RELAY 2NO, DIN RAIL MOUNTED
45-6000-0118-001	LED GREEN, DIN RAIL MOUNTED
45-600-0102-001	MCB, DIN RAIL MOUNTED (10A)
45-600-0102-004	MCB 6A DIN RAIL 2 POLE S202-D6
40-666-2234	DIODE TYPE 1N4003
45-690-0080-001	DUAL PSU C-0204-090-240-7467-1
45-650-0060-009	FUSE CERAMIC 2.5A 5x20mm TIME LAG
NTX-A680	SIGNAL I/O MODULE (MISM 11)
NTX-A478	SERIAL COMMS MODULE (MISM 4 MK2)
NTX-A477-1	RADAR IO MODULE Mk2 (MISM 9)
NTX-A402-7	MODULAR INTERFACE SYSTEM BACKPLANE
NTX-1336	KEY SWITCH
45-600-0103-001	KEYSWITCH 2 WAY IP67
45-611-100	SWITCH SINGLE POLE ON/OFF TYPE 501
45-600-0101-001	SWITCH SPDT, IP67, ON-ON TOGGLE 20A
45-680-0140-001	MAINS FILTER 12A FN2080-12/06
45-680-0140-003	MAINS FILTER 6A TYPE FN2080-6-06
45-650-0060-002	FUSE CERAMIC 0.5A 5x20mm TIME LAG
45-825-0039-001	Fan 24VDC 80x80x38mm 8214J/2H4P
NTX-A462-101	Radar Processing Module (MISM-5) SX
NTX-A462-102	Radar Processing Module (MISM-5) FX
45-980-0039-003	SFP Transceiver (Single Mode)
45-825-0030-001	FAN 5V 35x35x10
55-100-0527-001	O Ring 22 X 2.5 FKM 80 (FP80 18 01)
SBS-A403: 440V Three Phase Inverter Kit	
45-690-0084-002	INVERTER 3 PHASE 440V
NTX-A518	INVERTER COOLING ASSY
45-690-0065-002	FILTER 3-PHASE TYPE HLD 110-500/12
85-200-0044-001	CONTACTOR
45-6000-0118-001	LED GREEN, DIN RAIL MOUNTED
45-625-0657-001	THREE PHASE VOLTAGE INDICATOR
45-600-0102-002	MCB 6A DIN RAIL 3 POLE
40-666-2234	DIODE TYPE 1N4003
SBS-A229: 220V Single Phase Inverter Kit	
45-690-0066-001	TRANSISTOR INVERTER
SBS-A405	VF-nC3 Inverter Fan Assy
45-680-0140-001	MAINS FILTER 12A TYPE FN2080-12/06
85-200-0044-001	CONTACTOR
45-6000-0118-001	LED GREEN, DIN RAIL MOUNTED
45-600-0102-001	MCB 10A DIN RAIL 2 POLE
40-666-2234	DIODE TYPE 1N4003
SBS-A404: 220V Three Phase Inverter Kit	
45-690-0084-001	INVERTER 3 PHASE 240V
NTX-A518	INVERTER COOLING ASSY
45-690-0065-002	FILTER 3-PHASE TYPE HLD 110-500/12
85-200-0044-001	CONTACTOR
45-625-0657-001	THREE PHASE VOLTAGE INDICATOR
45-600-0102-002	MCB 6A DIN RAIL 3 POLE
40-666-2234	DIODE TYPE 1N4003
Additional	
55-100-0436-001	STATIC DESSICATOR SD-003
SBS-A132	MAN ALOFT SWITCH (SBS)

10.9 Alert messages

The following table lists the alarms that may be displayed on the LCD front panel of the Radar Distribution Unit.

Alarm conditions can relate to individual equipment performance or be to report an issue with an external input. An alarm on the system does not necessarily indicate a fault condition; the alarm may be generated to alter the operator to a loss of signal, security switch status or an issue with the system power.

RDU LCD Message	System status	Description
Air Dryer	Information warning only; no change in system performance.	This is an indication of low pressure and/ or high humidity in waveguide.
Antenna Platform Open	Information warning only; no change in system performance.	The antenna Platform switch is open.
ARP/HL not detected	Message received from SharpEye™ processor. Antenna rotation and system transmission will have stopped.	If an azimuth or heading line (HL) pulse is not detected by the SharpEye™ processor, a message is sent to the transceiver and for safety reasons transmission is stopped within 60 seconds.
Azimuth status (1)	Message received from SharpEye™ processor. Antenna rotation and system transmission will stop.	Antenna rotation is checked for clockwise rotation (viewed from above). If anti-clockwise rotation is detected, a message is sent and transmission is stopped within 60 seconds.
Azimuth status (2)	Message received from SharpEye™ processor. Antenna rotation and system transmission will stop.	If missing pulses between heading lines are detected, a message is sent and transmission is stopped within 60 seconds.
Communication Failure	The system will continue to operate in its last configuration but cannot be controlled. **Caution:** The software *Emergency Stop* function is disabled.	Communication has been lost with the track extractor, command & display system or service display. The system continues operation until control is restored or the system is manually switched to Local control. **Caution:** When communication to the RDU is lost, the Emergency Stop function on the track extractor, command & display system or service display will NOT function.
FPGA2 failed	Message received from SharpEye™ processor. Antenna rotation and system transmission will have stopped.	If the transceiver detects a hardware fault, it sends a warning message to the display equipment and switches to the Degraded state of operation.
Hut Door Open	Information warning only; no change in system performance.	The hut door switch is open.
Oil level low	Information warning only; no change in system performance.	The oil level in the CHL antenna gearbox is low and should be inspected at the earliest safe opportunity.

RDU LCD Message	System status	Description
Oil level temperature	Information warning only; no change in system performance.	The oil temperature in the CHL gearbox is high. At the earliest safe opportunity, a general inspection of the antenna should be made to see if there is any reason for the elevated oil temperature. The oil level should also be checked.
Over temperature 1	Message received from SharpEyeTM processor. Transceiver switches to Low power mode. See note below	If the temperature of the RF power transistors in the transceiver exceeds predetermined limits, the transceiver sends an 'over-temperature' warning to the Radar Distribution Unit and switches to the degraded 'low power' state.
Over temperature 2	Message received from SharpEyeTM processor. Antenna rotation and system transmission will stop. See note below	If the temperature exceeds a further pre-set limit the transceiver switches to the fault state and transmission is stopped.
Over temperature notes: As the SharpEye™ processor temperature returns to predetermined limits, the transceiver returns to the degraded state and then to normal operation.		
PSUA PWR alarm	Depending on the fault condition the system may operate normally or antenna rotation and system transmission may have stopped. See note below	Indicates a fault condition with one half of the dual redundant power supply within the RDU or a problem with AC input A (PL2). If the fault is with the power supply, the system will operator normally using PSUB outputs. If *AC input A* has failed or is lost, power to the transceiver will also be lost stopping antenna rotation and system transmission.
PSUB PWR alarm	Information warning only; no change in system performance. See note below	There is a fault with PSUB on the dual redundant power supply within the RDU or a problem with the AC input B (PL3). The system will operator normally using PSUA outputs.
PSU A or B PWR alarm notes: The cause of any power supply related alarms must be investigated at the earliest safe opportunity and corrective action taken.		
Safety current I-loop open	Antenna rotation and system transmission will have stopped.	The Safety current I loop is open. Check that the Antenna Rotation, Man Aloft Switch or any additional safety switches are in the FREE/ normally closed position.
Rx sensitivity	The system will be operational however target detection may be reduced.	If the minimum detectable signal rises above a pre-set level the transceiver sends a receiver sensitivity warning message.
Standby	Antenna rotation and system transmission will have stopped.	The system is in standby mode, ensure that no fault conditions exist that could be preventing the system entering Run mode.
SYNTH	Message received from SharpEye™ processor. Antenna rotation and system transmission will have stopped.	The SharpEye™ processor synthesiser has not initialised correctly. Cycling the power to the transceiver may clear this condition.

RDU LCD Message	System status	Description
Tx power	Message received from SharpEye™ processor. The transceiver will switch to Low power mode (see below).	If the RF output power falls below 100W the transceiver sends an RF Power LOW warning message and switches to the degraded 'low power' state of operation.
Turning info lost	Message received from SharpEye™ processor. Antenna rotation and system transmission will have stopped.	If the antenna stops rotating when not commanded to stop, a warning message is sent to the display equipment and the transceiver switches to the fault state (see below) and transmission is stopped.
VSWR	Message received from SharpEye™ processor. The transceiver will switch to Low Power or Fault mode.	If the VSWR on the RF output is worse than 1.4:1 the transceiver sends an antenna VSWR warning message and switches to the degraded 'low power' state of operation (see below). If the VSWR on the RF output is worse than 2.0:1 the transceiver enters fault mode (see below) and is shutdown. This can be an indication of a problem with the SharpEye™ processor, the connecting waveguide or the antenna.

SharpEye™ modes

In some of the alarm conditions noted above, the SharpEye™ transceiver may enter one of the three following states.

If any of these states is detected attempt a system reset. Should the fault condition persist please contact Kelvin Hughes for further assistance.

Transceiver low power mode	The transceiver continuously runs background performance checks on forward power, reverse power, receiver sensitivity and temperature. If any of these parameters falls outside predetermined levels a warning message is sent to the Radar Distribution Unit indicating the nature of the fault. The transceiver continues to operate, but with reduced performance and functionality. ***Caution**:* As a result of reduced output power, range performance *will be reduced* and the system may not meet the expected operational detection performance.
Transceiver fault mode	If the performance or functionality is degraded such that the transceiver cannot operate it enters the fault state and a fault message is sent to the display equipment. The transceiver stops radiating RF and there is no video output to the Radar Distribution Unit. A spurious fault *may* be cleared by re-powering the equipment.
RDU to transceiver communication error	If communication is lost between the Radar Distribution Unit and the SharpEye™, the RDU reboots the SharpEye leading to a potential 60 second gap in coverage.

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11 Abreviations

AC	Alternating Current
ACH	Anti-condensation heater
ACP	Azimuth Clock Pulse
AIS	Automatic Identification System
ARP	Azimuth Reset Pulse
BIT / BITE	Built In Test / Built in Test Equipment
CANBus	Controller Area Network Bus
CFAR	Constant false Alarm Rate
CW	Continuous Wave
DC	Direct Current
ECDIS	Electronic Chart Display & Information System
EDPC	Enhanced Digital Pulse Compression
EM	Electromagnetic
EMC	Electromagnetic Compatibility
EMCON	Electromagnetic Control
ESM	Electronic Surveillance Measure
FAT	Factory Acceptance Test
FCS	Fire Control System
FD	Frequency Diversity
FSM	Functional Status Message
GaN	Gallium Nitride
GPS	Global Positioning System
HL	Heading Line
HRDPC	High Resolution Digital Pulse Compression
IALA	International Association of Lighthouse Authorities
IBS	Integrated Bridge System
IEC	International Electrotechnical Committee
IF	Intermediate Frequency
ILS	Integrated Logistic Support
IMO	International Maritime Organisation
I/O	Input/ Output
IP	Internet Protocol
IRS	Interface Requirement Specification
KH	Kelvin Hughes
KSD	Kelvin (Hughes) Software Document
LAN	Local Area Network
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LNFE	Low Noise Front End
LPA	Low Profile Antenna
LRU	Line Replaceable Unit
m	Metre
MAC	Media Access Control
MAS	Man Aloft Switch
MDP	MantaDigital™ Processor
MDS	Minimum Detectable Signal
MISM	Modular Interface System Module
MMI	Man Machine Interface
MTD	Moving target Detection
MTTR	Mean Time To Repair
nm	Nautical Mile
PC	Personal Computer
PCB	Printed Circuit Board
PRF	Pulse Repetition Frequency
PWM	Pulse Width Modulation
RAL	German Colour Standard
RACON	Radar Beacon
RDU	Radar Distribution Unit
RF	Radio Frequency
RPM	Revolutions Per Minute
Rx	Receive
SART	Search And Rescue Transponder
SBS	Shore Based Systems
SETD	Systems Engineering Technical Document
STC	Sensitivity Time Control
TBA	To Be Advised
TBC	To Be Confirmed
TCP	Transmission Control Protocol
TFT	Thin Film Transistor
™	Trademark
Tx	Transmit
U	Height unit of 19” rack system
UDP	Universal Datagram Protocol
UPS	Uninterruptable power supply
USB	Universal Serial Bus
VSWR	Voltage Standing Wave Ratio
WAN	Wide Area Network
WI	Work Instruction

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12 Contacting Kelvin Hughes

12.1 Contact Kelvin Hughes

	**Address:**	**Kelvin Hughes Limited** **Voltage** **Mollison Avenue** **Enfield, UK** **EN3 7QX**
	Phone:	+44 (0)1992 805 200
	Fax:	+44 (0)1992 805 310

Service	**email:**	service@kelvinhughes.co.uk
	Phone:	+44 (0)1992 805 301

Technical advice	**email:**	technical.advice@kelvinhughes.co.uk
	Phone:	+44 (0)1992 805 302

Spares	**email:**	spares@kelvinhughes.co.uk
	Phone:	+44 (0)1992 805 301

Internet	**Website:**	www.kelvinhughes.com

12.2 On-line service request

A service request can be made via the Kelvin Hughes web site as follows.

From the Kelvin Hughes web page ***www.kelvinhughes.com***, select ***Marine Systems***, ***World Service***, ***Request Service*** and then complete the on-line form.

12.3 Kelvin Hughes regional offices

The following details the regional offices of Kelvin Hughes. A full list is also available in the **Contact** tab of the Kelvin Hughes website @ www.kelvinhughes.com

13 Annex A: RadarView software & service display control software

 Printed copies	In printed copies of this handbook, a copy of the *RadarView user manual* can be found in this section.
 Electronic copies (PDF)	In electronic copies, the *RadarView user manual* is can be found in the root directory of the KH1601 document (PDF format).
Cambridge Pixel RadarView user manual Details and copyright notice	SPx RadarView for Windows User Manual Document number: CP-25-110-27 Kelvin Hughes Ltd is not responsible for the content of the RadarView user manual which remains the copyright of Cambridge Pixel Ltd. *Document reference CP-25-110-27 contains proprietary information that is sensitive to the commercial interests of Cambridge Pixel Ltd. The contents of this document should not be communicated to third parties without the prior written consent of the Company.*
Kelvin Hughes Service display control software.	Details on the Kelvin Hughes software that interfaces the optional service display with the Radar Distribution Unit/ transceiver.

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14 Annex B: Antenna sub system maintenance

Manufacturer's handbook: The SBS-900 series can be supplied with a range of Advanced antennas.

The installation and maintenance instructions for these antennas and the antenna turning unit (ATU) are detailed in a separate handbook contained in this Annex.

The Antenna turning unit/ gearbox and antenna must be installed in accordance with the manufactures requirements which include but are not restricted to: Health and safety, unpacking, lifting and installation requirements.

Handbook reference: Installation and Maintenance Manual
Radar Antenna System type KAH20-AS-00000

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