1 General Description

There are two basic types of X-Band Scanner Unit:

- with an integral transceiver module
- without an integral transceiver

Each type can have a number of variants dependent on motor supply and the options that are fitted.

The Scanner Unit comprises an Antenna, an antenna support casting, and a Turning Unit.

Included in the Turning Unit is a motor and gearbox, a Bearing and Heading Marker pcb, an Input pcb, and optionally a Performance Monitor and integral transceiver module.

The Transceiver Unit comprises, a base casting , a cover, a transceiver module, and an Input pcb.

Communication between the Transceiver and the Display is by means of a serial data link. Where a separate Transceiver Unit is used, an RF feeder (waveguide) is used to transfer the microwave energy between the Transceiver Unit and the Turning Unit.

The Scanner Unit and the Transceiver Unit are compatible with BridgeMaster II display units if a Display Compatibility Unit is used.

See Figures 2.1 to 2.4.

1.1 Physical Arrangements

The Turning Unit is constructed from upper and lower aluminium castings. The upper casting is hinged at one end to the lower casting for service and installation. The motor, gearbox and drive assembly are bolted to the upper casting. The transceiver module, when fitted, is bolted to the upper casting and can be removed as a unit for below decks servicing.

The terminal strips for the interconnecting cables to other units are under a screening cover on the base of the lower casting. The Performance monitor is housed beneath the upper casting and has a microwave transparent cover protecting it, fitted on the top surface of the upper casting

Four M10 x 45 bolts are used to attach the Scanner Unit to the radar platform or wheelhouse roof. The Antenna is attached to the Turning Unit by the Antenna Support Casting and this directly transfers the microwave signals between the Turning Unit and the Antenna.

Interconnections between the Scanner unit and other units in the system are made using screened cables, with the exception of the Bulkhead system, where the microwave signals are carried between the Turning Unit and the Transceiver via a waveguide.
All the cables that enter the Scanner Unit do so via waterproof cable glands that incorporate an EMC gasket that makes contact with the cable braid.

The separate Transceiver is designed to be bulkhead mounted and is attached using four M8 bolts, studs or screws (coachbolts).

1.2 Transceiver Module Overview (X-Band)

The transceiver module can be fitted in the Turning Unit, or mounted on a chassis for below decks bulkhead mounting as a separate unit. The module incorporates the Modulator pcb, a Power Supply pcb, Trigger pcb, the Receiver, and the microwave components.

Communication between the Transceiver Unit and the Display Unit is by means of two serial data links, one from the Transceiver to the Display Unit, and one from the Display Unit to the Transceiver.

This information is transmitted using a special data cable that incorporates four twisted pairs. Two pairs are used for data transmission, one pair is used for trigger, and the other pair is spare.

The data passed from the Transceiver to the Display includes:

- Heading Marker
- Incremental Bearing
- Transceiver Status
- Error Messages
- Built In Test Equipment (BITE) data
- Tuning Indicator
- Azimuth Data

The data transmitted from the Display to the Transceiver includes:

- Standby/Transmit
- Pulse Length
- Tuning
- AFC/Manual
- Sector Blanking
- Performance Monitor Control, and Installation Settings.

1.2.1 Power Supply

The power supply operates from the ship's AC mains, and provides all of the power requirements for the electronic modules within the Turning Unit and Transceiver. The AC mains is always present at the power supply even when the radar is switched off at the display.

The presence of active lines in the serial data link when the display is switched on is detected by the power supply, which then becomes active.

The power supply includes a Power Factor Correction circuit, and a number of switching regulators to generate the necessary voltage supplies. Overcurrent detection circuits protect the power supply against overloads on its outputs.

1.2.2 Trigger PCB

The Trigger PCB processes the serial data from the Display Unit, and generates the required control signals for the Transceiver. It monitors functions within the Transceiver, the Heading Marker, and encodes the information for transmission to the Display Unit. The data is transmitted each time a bearing pulse is received from the Turning Unit. The various timing signals required by the transceiver including the pulse repetition frequency (prf), are generated by the trigger pcb.

1.2.3 Modulator PCB

The modulator pcb generates the high voltage negative pulses required to drive the magnetron. The modulator pulse widths and timing signals are controlled from the trigger pcb. A spark gap on the modulator is fired if the magnetron fails to operate. Continual operation of the spark gap is detected and signal is fed back to the trigger pcb. When the trigger pcb detects this signal it switches the radar to standby, and generates an error signal to be transmitted to the Display Unit via the serial data link. The error signal causes the Display Unit to switch to standby and generate an error alarm. The modulator is a line type modulator. The transmitter pulse lengths are determined by the pulse forming network.

1.2.4 Microwave Circuit

The transceiver employs a conventional three port circulator to direct the path of the microwave energy to and from the antenna. A magnetron coupled to the circulator provides the RF energy to be transmitted. A solid state limiter coupled to the circulator protects the receiver from high powered microwave signals from the magnetron, or adjacent radars. A signal from the trigger pcb is used to enable swept attenuation to be applied to the solid state limiter to reduce the system sensitivity at short ranges.

1.2.5 Receiver

The receiver consists of a low noise amplifier, a mixer, a linear preamplifier, a logarithmic amplifier, and a video amplifier. The 60MHz output of the mixer is amplified by the linear preamplifier followed by a logarithmic amplifier, the output of which is detected, the resulting video signal is then further amplified before transmission to the Display Compatibility Unit, or Display.

The receiver also incorporates an AFC system. Once the receiver has been tuned, the AFC system ensures that the receiver remains on tune during variations in tuning due to thermal drift of the mixer and magnetron etc.

The operator can select between manual tuning and automatic tuning. A signal from the trigger pcb is used to select the mode of operation. A signal from the AFC circuit is fed to the trigger circuit to indicate the state of tune of the receiver. This signal is at its minimum value when the receiver is correctly tuned.

1.3 Turning Unit Overview (X-Band)

1.3.1 Drive System

The scanner motor is a 3-phase electronically commutated DC motor. The motor commutation drive signals are provided by the Motor Drive pcb which has the capability of prividing High and Low speed operation by link selection. The Motor Drive pcb is supplied with +50VDC from the Transceiver power supply (in both Aloft and Bulkhead fits).

The motor drives an integral 32:1 reduction gearbox. The output of the gearbox drives a pulley system with a single toothed belt having a reduction ratio of 3:1. The final pulley is attached to the Antenna torque tube assembly. The overall reduction between the motor and Antenna is approximately 96:1.

When standby is selected, rotation of the Antenna is inhibited. Unless in test mode, transmission from the radar is inhibited if the Antenna is not rotating. An isolating switch is provided to inhibit rotation for servicing on the Turning Unit.

1.3.2 Motor Drive Board (Incorporating the Dynamic Brake facility)

The Motor Drive PCB generates the supply and control signals for the 3-phase electronically commutated DC motor that turns the Scanner Unit. The Motor Drive PCB has the capability of providing High and Low speed operation by link selection on the PCB.

The Motor Drive PCB is supplied with +50VDC and +12V from the Transceiver power supply (in both Aloft and Bulkhead fits).

Pulling control line 'TU Enable' below 1.5 volts starts a slow build up of speed up to the maximum set by the speed selection link. The 6 output FET switches which perform the commutation, are protected by a current sensing and limiting circuit, in the event of overload or stall.

Signals from the Hall Sensors in the motor are used to control the commutation sequence, and are also used to provide a degree of speed compensation in high wind load conditions. An additional feature of the PCB is a Dynamic Brake which limits the 'windmilling' speed of the Antenna when the radar is turned-off, or in Standby mode. This circuit is passive and will operate with no supply voltage.

1.3.3 Pulse Bearing & Heading Marker System

A disc with 128 teeth is attached to the Antenna torque tube and combined with an opto-coupler generates 128 pulses per rotation of the Antenna.

A second opto-coupler together with a flag on the toothed disc generates a Heading Marker approximately 10° before the Antenna is pointing dead ahead. Correct alignment of the Heading Marker is set at installation by electronic adjustment within the Display Unit.

Both opto-couplers are on the Pulse Bearing PCB. The Pulse Bearing PCB multiplies the 128

bearing pulses by 32 to generate 4096 pulses per Antenna revolution. The 4096 azimuth pulses and the heading marker are routed through the Input PCB to the Trigger PCB where they are incorporated into the serial data to be transmitted to the Display Unit.

A jumper link LK1 is fitted to the Pulse Bearing PCB to select High or Low speed operation. The link should be set between pins 1 & 2 for Low Speed operation (Factory Default). For High Speed operation, pins 2 & 3 should be used. Note that if no link is fitted, the default is High Speed operation.

Where it is not possible to adjust the Heading marker alignment at the display, optional extra circuitry can be fitted to the Input pcb to allow the alignment to be made electronically within the Turning Unit. When this option is fitted an additional (isolated) Heading Marker output is provided. As an option for special applications a size 11 synchro can be fitted as an alternative source of bearing information.

1.3.4 Interconnections

The terminations for interconnections for the Transceiver and the Turning Unit are under a cover on the inside of the lower casting of the Turning Unit. The AC power from the isolating switch is terminated at a terminal block within the filter box on the inside of the lower casting of the Turning Unit. All other connections are made to plugs or removable terminal strips on the input pcb.