5 Description of Circuitry and Devices (FCC Rules, 2.1033)

5.1 Function of Each Semiconductor or Active Device

ANTENNA UNIT

TRANSCEIVER MODULE (RTR-080)

RF unit controller PCB 03P9346 (RFC)

CR1 - CR4:	Voltage protection
CR5:	Rectifier
CR6 - CR8:	Voltage protection
CR9:	LED
Q1 - Q4:	Pulse amplifier
Q5 - Q12:	Transistor switch
U1:	Operational amplifier
U2:	Voltage regulation
U3:	Buffer
U4:	Voltage regulation
U5:	Operational amplifier
U6:	Oscillator
U7:	A/D converter
U8:	Comparator
U9:	Inverter
U10 - U11:	Buffer

Modulator PCB 03P9244 (MD)

CR1 - CR3, CR5:	Reverse-Voltage Protection
CR4:	Rectifier
Q1-Q4, Q21:	Switching
Q5 - Q20:	FET Gate Driver
U1:	Regulator
U2:	Photo-Coupler

Chassis Mounted Parts

CR802 - CR803:	Clipper
CR801:	Limiter
HY801:	3 Ports Circulator
U801:	MIC Frequency Converter with Limiter
V801:	Magnetron

IF amplifier PCB 03P9335 (IF AMP)

CR1:	Reverse voltage protection
CR2:	RF detection
CR3 - CR4:	Voltage shifter
CR5:	RF gate
CR6:	Reverse voltage protection
CR7:	Voltage shifter
CR8 - CR9:	RF limiter
CR10:	RF switch
Q1:	RF switch
Q2 - Q3:	Pulse amplifier
Q4:	RF switch
U1:	Comparator
U2:	Pulse amplifier
U3:	Log detector
U4:	Gated amplifier
U5:	Comparator
U6:	Switch
U7:	Variable gain controller
U8:	DC regulator
U9:	Variable gain controller
U10:	Switch
U11 - U12:	Video amplifier
U15:	DC regulator
U16:	Pulse amplifier
U17:	NAND gate
U18:	Comparator
U19:	DC regulator
U20 - U22:	3 dB Hybrid
U23:	Comparator
U24:	AND gate

Bearing Signal Generator PCB 03P9347 (BP GEN)

U1:	Comparator
U3:	Photo-interrupter
Q3 - Q4:	Buffer

Terminal Board 03P9349 (TB)

Active device: none.

Power Board 03P9348 (PWR)

CR1:	Q3 driver
CR2:	Protection for Reverse connection
CR11, CR21, CR31, CR41:	Switching
CR42:	Q41 driver
CR51:	Switching
CR52:	Reverse voltage protection
Q1 - Q2:	Q3 driver
Q3:	Switching
Q11:	Overcurrent protection
Q22 - Q24:	Switching
Q31:	Overcurrent protection
Q41:	Switching
Q42:	Q41 driver
U1:	5 V regulator
U2:	Voltage detector
U11:	12 V line switching controller
U12:	12 V line overcurrent detector
U21:	Magnetron heater line switching controller
U22:	5 V line overcurrent detector
U31:	5 V line switching controller
U41:	-12 V line switching controller
U51:	32 V line series regulator

5.2 Description of the circuitry and devices provided for determining and stabilizing frequency, for suppression of spurious radiation, for limiting modulation, and for limiting power

ANTENNA UNIT

TRANSCEIVER MODULE (RTR-080)

RF unit controller PCB 03P9346 (RFC)

In the RFC Board, the following 4 main functions are incorporated:

(1) generating TX modulator trigger pulses with the specified pulse-length that fire the modulator FETs in MD Board.
TX trigger signals that are transmitted with the form of serial commands from the Processor unit trigger the internal digital counter included in the Field Programmable Gate Array U17 for counting up to the specified value, and then the TX modulator trigger pulses with the specified pulse-length are produced.

(2) controlling the tuning voltage input to the MIC.
Micro-Processor U19 reads the tuning indication voltage transferred from the IF Amplifier Board through the internal A/D converter and generates/adjusts the tuning voltage through the internal D/A converter for maximizing the tuning indication voltage by using the feedback-control technologies.

(3) generating the Gain- and STC-control voltages to input the IF Amplifier Board.
According to the control parameters transferred from the Processor unit, Micro-Processor U19 calculates the Gain and STC control voltages (waveforms) and places those data into the internal memory of the Field Programmable Gate Array U17, and generates the Gain- and STC-control voltages through the D/A converter U13.

(4) transferring the Heading and Bearing signals with the form converted to the serial commands to the Processor unit.
The Heading and Bearing signals transferred from BP GEN Board is converted to the specified serial bit streams (commands) in the Field Programmable Gate Array U17, and then output to the Processor unit.

Modulator Board 03P9244 (MD)

The function of the modulator board is to produce a high tension pulse that drives the magnetron.

The high voltage (TX-HV) is charged into C1 to C4 through R1/R2 while the magnetron is inactive. This high voltage is discharged through the pulse transformer T801 when FETs Q1 - Q4 are conductive. T801 boosts the voltage and makes the magnetron oscillate.

Because the magnetron oscillates only when the FET is conductive, transmission pulselength can be changed by the pulselength fed to the gates of FETs.
Also the magnetron current is proportional to the discharging current via the FETs, thus the transmission power can be changed by the number of FETs conductive.

The four pulses TRIG.1 to TRIG.4 are produced on the RFC board and applied to the gates of Q1/Q2/Q3/Q4 via the current amplifiers Q5 to Q20.

The relay K1 and coil L1 are provided to eliminate the ringing at the trailing edge of the transmission pulse across the primary winding of T801. This relay is active when the short pulse 1 (Short 1) is selected.

Duplexer and Mixer

Since the radar system uses a single antenna for transmission and reception, and the efficient device is required for switching the transmitter and the receiver, this radar employs circulator HY801. The circulator HY801 is a passive directional coupler with three ports. The incoming signal is bent in the specific direction and emerges from another port with little loss, the other port being isolated. In the same manner, the received signal entering into another port is transferred to the other port, isolating one port. This operation of the circulator protects the receiver during transmission and minimizes loss of the received signal during reception.

The diode limiter is a self-activating switch made of two PIN diodes. Its function is to attenuate the strong transmission signals from the magnetron and other boat radars through the antenna and to protect the MIC (microwave IC) U801. The PIN diode conducts at a certain level of microwave power. When the diode is the cut-off state, the input impedance of the diode limiter matches the impedance of the waveguide, and the

microwave energy is delivered to the MIC. When the diode is put into a conductive state, the waveguide is short-circuited and most of the input energy is reflected back to the transmitter side. The strong signal is thus weakened down to about 50 mW by the diode limiter.

U801 is a microwave IC (MIC) incorporating a local oscillator and mixer diodes. The received microwave signal of 3050 MHz coming from the diode limiter is mixed with the local oscillation signal in the mixer diodes and converted to IF signal of 60 MHz.

IF amplifier PCB 03P9335 (IF AMP)

The 60 MHz IF signal from MIC is amplified by the IF amplifier, gain- and STC-controlled and delivered to the Processor unit.

The IF amplifier consists of 5 main parts, i.e. the first stage amplifiers (Q1, Q2 and Q3,) VGA (Variable Gain Amplifiers) (U7 and U9), the driver amplifier (U16), the logarithmic amplifier (U3) and the tuning amplifier (U2, T2, T4, U4, U6 and U5) for tuning indicator.

- In the first stage amplifiers Q2 and Q3, the input IF signal is split into 2 stages by the 3 dB Hybrid Splitter U20 and then each of the split IF signals are amplified, and finally combined by the 3 dB Hybrid Combiner U21 for improving the saturation level of the IF signal.
- In the VGA (U7 and U9), the IF signal is gain- and STC-controlled.
- In the driver amplifier (U16), the cable loss of IF signal caused between the Antenna unit and the Processor unit is compensated precedently. The amplified IF signal is then output through the TNC type connector (J823) of which the output impedance is 75 Ω.
- In the logarithmic amplifier (U3), the 60 MHz IF signal is detected and the video signal is generated. The video signal is also used for the Sub-display and for the auto-STC control. The video signal for the Sub-display is combined with the 60 MHz IF signal from the driver amplifier U16 by the Duplexer located in the output stage, and then output through the TNC type connector (J823) of which the output impedance is also 75 Ω.
- In the tuning amplifier (U2, T2, T4, U4, U6 and U5) for the tuning indicator, the 60 MHz IF signal from MIC is amplified by the IF amplifier U2, filtered with the band width of 2 MHz by the T2, amplified with the timing gate, detected by the diode CR2, and then output through the buffered amplifier U5. This detected signal consists of a DC voltage with the peak for the center frequency of the 60 MHz input IF signal.

Bearing Signal Generator PCB 03P9347 (BP GEN)

Bearing signal generator in the PCB generates a square wave signal used for synchronizing the sweep-rotation of the Display with the rotation of the Antenna radiator.
U3 Photo-interrupter is composed of a LED and a photo-transistor, and in the shape of “U”. The LED and the photo-transistor are enclosed in the U-shaped package with a gap that the rotating timing disc goes through.
The timing disc is provided with 60 slits at regular intervals along its perimeter. This disc is fitted on the scanner motor shaft and rotated at a speed of 360 rpm.
The photo-transistor receives the LED light through the slit of the timing disc, and converts into the electric current. The output of the photo-transistor generates the signal voltage across R3, and then is reshaped by the comparator IC U1, and buffered and sent to the Processor unit for the use of the sweep-rotation signal.