

# **Theory Operation of Marine Radio**

## **MRF55EU & MRF75EU**

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## ● Functional Description

The Cobra models MRF55EU and MRF75EU are Marine band FM Radio transceivers operated in the frequency range 155.5MHz to 162.425MHz with DSC. Functional as follows:

1. MRF55: Channel Up / Down, Emergency channel key CH16/9, UIC key, Channel Scan key, TX power HI/Low key, Dual watch channel key, Call/set key, Distress key, Squelch control volume, DC power ON/Off and Audio Volume control, External Speaker Jack and GPS Jack, PTT key.

2. MRF75: Channel Up / Down, Emergency channel key CH16/9, UIC key, MEMO Channel Scan key, TX power HI/Low key, Tri watch channel key, Call/set key, Distress key, Squelch control volume, DC power ON/Off and Audio Volume Up/Down control, PA Function, External Speaker & PA Jack and GPS Jack, PTT key.

## ● MCU Description

The MCU used Toshiba's TMP86CM47U micro-controller, there are 32k X 8bits ROM and 1k X 8bits RAM, LQFP44 pins package. These pin assignment as below table:

PIN	Description	Model	PIN	Description	Model
1	V <sub>SS</sub> = GND	55/75	23	Control LCD SDI data pin	55/75
2	X-in, crystal 8 MHz	55/75	24	WX alert data pin detect	55/75
3	X-out, crystal 8 MHz	55/75	25	TX Hi / low power control	55/75
4	Test, connect to GND.	55/75	26	Keys scan pin	55/75
5	V <sub>DD</sub> , +5VDC input	55/75	27	Keys scan pin	55/75
6	DC power on control	F75	28	Beep tone Hi/low control	55/75
7	TX on/off control (on = low)	55/75	29	Digital volume data pin	F75
8	Reset pin	55/75	30	Digital volume clock pin	F75
9	DC power on key scan	F75	31	Open	55/75
10	LCD backlight control	55/75	32	EEPROM clock pin	55/75
11	LCD backlight control	55/75	33	RX/TX signal indication	55/75
12	NMEA (GPS data) input	55/75	34	Pull high to +5VDC	55/75
13	EEPROM data pin	55/75	35	AVDD (connect +5VDC)	55/75
14	Volume down key scan	F75	36	AVSS (connect to GND)	55/75
15	Volume up key scan	F75	37	Pin 37 to 41 for 1300Hz and 2100Hz FSK generator.	55/75
16	Squelch output control	55/75	38		
17	Inhibit audio when DSC on	55/75	39		
18	Control LCD driver A0 data pin	55/75	40		
19	PLL STB. HI=F75, Low=F55	55/75	41		
20	PLL clock data output	55/75	42	PLL data output	55/75
21	Beep tone generator	55/75	43	DSC detect pin	55/75
22	Control LCD CS1 pin	55/75	44	Squelch input detect	55/75

Remarks: MCU pin19 (BUS14) for MRF55 and MRF75 models select by resistor R371 and R340 control. R371 open for MRF55 model, R340 open for MRF75 model selection.

## ● Keys Scan

Key scan by MCU pin26 (BUS01) and pin27 (BUS02) control, apply difference step DC voltage input to A/D pin26 and pin27. ----- MRF55/75

MRF75 only --- Digital volume rotary operation by encoder K300 control MCU pin14 (bus15) and pin15 (bus16) realization. The DC power operation by encoder K300 push switch control MCU pin9 (bus11) achieved.

## ● DC Power Controller

The unit DC power supplies is 13.8V and path as follows:

MRF55: T102 – L124 – SW100 (Rotary switch) – IC111 (LM7805) – VCC+5V output.

MRF75: T102 – L124 – R125 – IC108 (LM7805) -- +5V output to MCU (CPU-DC).

→ Q124 (KTA1276Y) -- IC111 (LM7805) – VCC+5V output.

55/75 RX: Vcc+5V – Q122 E – Q122 C – RX-Vcc+5V output.

55/75 TX: While the PTT key was press down, the TX-ON control pin of MCU is low, so, Q120 will working and the Q122 cut-off.

Vcc+5V – Q120 E – Q120 C – TX-DC-5V output.

## ● VCO & PLL

1. The VCO oscillator stage by Q112, L115, VD100 and some resistors and capacitors component buildup. TX and RX VCO change by Q111 control.

2. The PLL IC used Toshiba brand TB31202FN and the local frequency is 20.95MHz.

## ● TX Pre-amplifier

TX pre-amplifier stage by RF transistors Q127, Q110 and coils L106, L114 and external some resistors and capacitors buildup the 160MHz amplifier.

## ● TX Driver & Final Amplifier

TX driver and Final amplifier stage by Mitsubishi's RF power module RA35H1516M buildup. The pin1 is RF signal input, the pin2 is Gate control, the pin3 is DC power supplies input, the pin4 is RF power output and the heat sink is ground.

## ● High – low TX power control circuit

The IC112 LM358M, transistor Q108 and Q109, diode D102 and external resistors and capacitors buildup the Automatic Power Controller.

TX High power output 25 watts @ 50Ω loading:

High power mode the CPU pin25 output is low, the transistor Q105 is rest. Then

adjust the VR101 to change IC112 pin3's voltage and the Q116 collect output can automatically to control the RF power module pin2's Gate voltage to control the power gain output.

TX Low power output 1 watt @ 50Ω loading

Low power mode the CPU pin25 output is high, the transistor Q105 is working. Then adjust the VR101 to change IC112 pin3's voltage and the Q116 collect output can automatically to control the RF power module pin2's Gate voltage to control the power gain output.

## ● Low Pass Filter

The Low pass filter is by three group LC buildup. There are L107 match C100, L100 match C102 and L101 match C103.

## ● TX modulation path

TX modulation audio amplifier used low power quad operation amplifier IC107 LM324 buildup. IC107 pin1 to pin3 is amplifier, other three group make the limiter for maximum modulation.

## ● RX Receiver

The RF amplifier stage used double turn circuit to achieved. The main part are L116, L117, Q114, L119 and L120.

RX receiver is dual conversion super-heterodyne type with the first IF 21.4MHz and the second IF 450KHz. PLL supplies the local frequencies below 21.4MHz to convert 21.4MHz signals. Q114 amplifies the incoming RX signals. Q115 mixes the incoming RX signal and local to generate IF frequency possessing audio information. There stage 450KHz amplifier circuit IC104 amplify the 450KHz signal to make enough level for discriminate the audio signal. IFT L123 and R171 are working as a FM detector. The RX audio through Volume control coupling the audio amplifier IC TDA2003 output to speaker.

## ● DSC Receiver

MRF55/75EU used an individual circuit to receive channel 70 signal. This circuit include:

1. RF amplifier Q1, 2. Local amplifier Q3, 3. Mixer Q2, 4. Intermediate frequency amplifier Q4, Q5, Q6. 5. Discriminator D3, D4.