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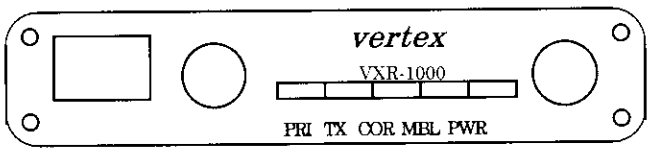
VXR-1000

OPERATING MANUAL



The VXR-1000 Series was designed to provide extended handheld coverage by repeating tarnsmissions in both directions through an existing high power mobile radio.

Reliability is assured by a highly integrated surface mount circuit design and a aluminum extrusion chassis. Important channel freqency data is stored in EEPROM, and is easily programmable by dealers using a personal computer and the Yaesu VPL-1 Programming Cable and CE-22 Soft-ware.

Please take a few minutes to read this manual carefully. The information presented here will allow you to derive maximum preformance from your radio. After reading it, keep the manual handy for quick reference, in case questions arise later on.

We're glad you joined the Yaesu team. Call on us any time, because our business is communications. Let us help you get your message across.

This is device complies with Part 15 of the FCC rules. Operation is subject to the condition that this device does not cause harmful interference.

Specifications

General

Frequency Range	450 - 470Mhz
Number of Channels	16 Channels
Channel Spacing	12.5 / 25khz
Supply Voltage	13.8V DC
Ambient Tmperature Range	-30℃ to +60℃
Frequency Stability	2.5ppm
RF Input-Output Impedance	50Ω
Audio Output Impedance	8 Ω

Receiver

Cirquit Type
Double Conversion Superheterodyne

Sensitevity

EIA 12dB SINAD	0.35μV
20dB Quieting	0.45μV
Threshhold Squelch	0.2μV to 2μV
Adjacent Channel Selectivity	60dB
Intermodulation Rejection	60dB
Spurious and Image Rejection	60dB
Conducted Spurious Emissions	-57dBm
Audio Output	1W into 8 ohms W/<5% THD
Hum and Noise	40dB

Transmitter

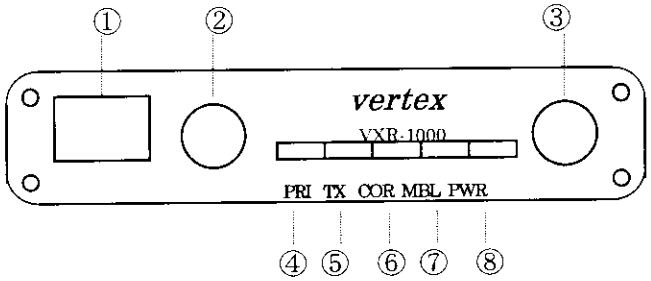
Power Output	5 / 2.5 / 1 / 0.5W
Modulation	16K0F3E /11K0F3E
Maximum Deviation	±5khz /±2.5
Conducted Spurious Emissions	60dBc
FM Hum and Noise	40dB

Physical

Dimension	25.4mm(h)×111mm(w)×136mm(d)
Weight	400g

CONTROL & CONNECTORS

Front panel



① Microphone Jack
Connect the microphone plug to this jack.

②VOLUME Knob
This knob adjusts the receiver volume.

③CHANNEL Selector Knob
This knob select the operating channel.

④ PRI
When on,indicates that the unit is at priority count zero and will repeat all transmissions.

⑤ TX
When on,Repeater is transmitting to the handheld.

⑥ COR
This lamp blinks red when Repeater is receiving carrier from a handheld, and glows red while Repeater is sub-audible tone from the handheld.

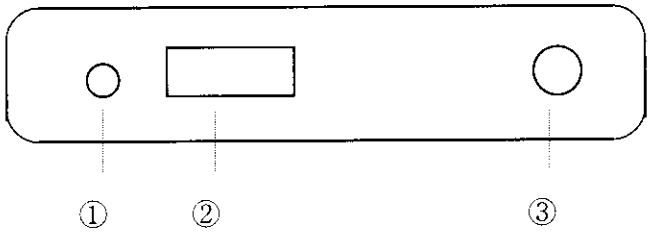
⑦ MBL
This lamp blinks red when Mobile is receiving

signal from repeat base, and glows red while Mobile is transmitting to the repeat base.

⑧ PWR

Proper operation of the repeater

Rear



①Antenna Socket

The 50-ohm BNC antenna connector

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②EXT SP (External Speaker)

External loudspeakers may be connected to this 2-contact, 3.5-mm mini-phone jack.

③DSUB 9-Pin Accessory Connector

External TX audio line input,PTT,and external RX audio line output signal may be obtained from this connector for use with accessories

Functional Description

When the user leaves the vehicle, they activate the radio via their mobile radio front panel or a separate switch. When the mobile radio is receiving carrier and proper tone, the radio will begin transmitting on the handheld's receive frequency. The user is able to hear and respond to all radio traffic,including other handhelds at the site. The radio can be programmed to give the handhelds priority in a conversation by priodically sanpling for handheld activity(carrier and proper tone) during base to handheld transmissions, key the mobile radio and repeat handheld to base.
The radio has a fixed 3 minute time out timer for base to handheld tramsmissions. If the mobile COR is active for more than 3 minutes it will send a error blip and cease transmission until the mobile COR is inactive.The 3 minute time-out is in affect regardless of whether the radio is programmed for priority sampling or not.

NOTICE

There are no user-serviceable points inside this transceiver. All service jobs must be referred to your Authorized Service Center or Network Administrator.

Trunking Operation

When the radio is connected to a trunking mobile and the handheld operator wishes to access the system, they key their handheld briefly then release.The radio will attempt to acquire a voice channel on the trunking system by keying the mobile for 200mS and monitoring the on-air detect line from the mobile. If it does not see the radio transmit at all (system is busy), it will send a low tone to the handheld operator to alert them that the system is busy.The radio will automatically retry every 5 seconds and send busy tone to the handheld with each unsuccessful attempt to indicate progress of the call attempt. If unsuccessful after 30 seconds,the radio will transmit inercept tone to alert the handheld operator that the call attempt failed.
When the radio detects that the mobile is transmitting,
it will continue to monitor the on-air line until the transmitter remains keyed for at least 250mS to ensure that the radio is merely handshaking or retrying. After successful acquisition of a voice channel,it will continue to hold the mobile PTT active for 2 seconds and transmit a go-ahead blip to the handheld operator. The user then keys their handheld to speak on the voice channel. If the user does not key up within the 2 seconds period, the radio will unkey the mobile and send intercept tone as before.

Optional Accessories

MH-25A8J	Microphone
MSL-100	External Loudspeaker
VPL-1	Programming Cable
CT-29	Programming Interface Box
CE-22	Programming Software (for IBM PC/compatibles only)
CT-52	T9101482 Programming Connection Cable
T9101411	Radio-to-Radio Cloning Connection Cable

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VXR-1000U Alignment

The VXR-1000 has been aligned at the factory for the specified performance across the frequency range specified for each version.

Realignment should therefore not be necessary except in the event of a component failure, or alteration of version. All component replacement and service should be performed only by an authorized Yaesu representative, or the warranty policy may be voided.

The following test equipment is required for alignment:

- IBM PC/compatible computer w/Yaesu VPL-1 cable,FRB-4 and CE-22 channel programming diskette.
- RF signal generator: calibrated output level at 1000 MHz (0 dBμ =1.0 μV - closed circuit)
- Deviation meter (linear detector)
- Oscilloscope
- AF millivoltmeter
- SINAD meter
- Inline wattmeter: 1000 MHz
- Regulated DC power supply: adjustable from 10 to 17 V, 3 A
- 50-ohm non-reactive dummy load: 10 W at 1000 MHz
- Frequency counter: 0.2 ppm accuracy at 1000 MHz
- AF signal generator
- DC Voltmeter: high impedance
- RF Sampling Coupler (attenuation pad)

Before beginning, connect the transceiver and PC using the VPL-1 cable and FRB-4 as described in the EEPROM Programming chapter, and download the EEPROM data from the transceiver to the computer.

Store this data in a disk file so that it can be saved and retrieved later. Using the table below, program the channel, CTCSS, and DCS alignment settings for your transceiver version. Upload this file to the transceiver.

		Alignment Channel Frequencies (MHz)				
		CH 1	CH 2	CH 3	CH 4	CH 5
Ver.	Freq.	450.00	470.00	460.00	470.00	470.00
D	CTCSS	OFF	OFF	OFF	151.4 Hz	OFF
	DCS	OFF	OFF	OFF	OFF	023
	POWER	5.0W	5.0W	5.0W	5.0W	5.0W

PLL & Transmitter

Set up the test equipment as shown for Transmitter & PLL alignment. Adjust the supply voltage to 13.8 V for all steps. Refer to the Tx & PLL Unit Alignment Points photo for alignment locations.

PLL Reference Frequency

- Tune the transceiver to the channel 3, connect an attenuator pad and frequency counter between the ANT connector, key the transmitter and adjust TC2001 on the RF Unit (±100 Hz).

PLL VCV

- Connect the RF sampling coupler in-line between the antenna jack and the RF dummy load. Connect the frequency counter to the coupler.
- Connect the DC voltmeter between VCV test point TP2006 on the PCB and chassis ground.
- Set the transceiver to *low band edge* channel 1. Key the transmitter and adjust T2001 on the PCB for 0.5 V on the voltmeter.
- Select *high band edge* channel 2, and confirm the high-end VCV is at 3.5 V ± 0.3 V .

Transmitter Output Power

- Select channel 3, transmit and adjust the output power level for 5.0 watts by the the PC.

CTCSS Modulation Level

- Select *band center channel* 4, with 151.4 Hz CTCSS encode. Transmit and adjust VR1006 on the PCB for 0.8 kHz ± 0.1 kHz deviation as indicated on the deviation meter.

DCS Modulation Level.

- Select *band center channel* 5, with DCS 023 enabled. Transmit and adjust VR1009 on the PCB for 0.85 kHz ± 0.1 kHz deviation as indicated on the deviation meter.

Microphone Audio Modulation Level

- Select band center channel 1, and adjust the AF generator for 40 mV output at 1 kHz to the **MIC** jack.
- Transmit and adjust VR1005 on the PCB for 4.5 kHz ± 0.1 kHz deviation as indicated on the deviation meter.

Squelch Threshold

- Select *band center channel* 2, and adjust SG level for -8 dBμ (0.4 μV).
- Adjust the squelch threshold level by the PC so that it just closes (**RX** LED turns off).

VXR-1000U Circuit Description

Reception and transmission are switched by RX5V/TX5V from the MPU. The receiver uses double-super heterodyne circuitry, with a 44.3 MHz 1st IF, and 455 kHz 2nd IF. The 1st LO uses a 44.3 MHz receive IF produced by the PLL synthesizer.

The 2nd LO uses 43.845 MHz (44.3 MHz-455 kHz) signals oscillated by the crystal. The 2nd mixer and other circuits use a custom IC to convert and amplify the 2nd IF, and detect FM to obtain demodulated signals.During transmit, the above synthesizer oscillates the desired frequency directly, for amplification to obtain RF power output. During transmit, voice modulation and CTCSS (or DCS) modulation are applied to this synthesizer.Transceiver functions, such as tx/rx control, PLL synthesizer settings, and channel programming, are controlled using the MPU.

Receiver

Incoming RF signals from the antenna connector is delivered to the MAIN UINT and passes through a low-pass filter (LPF) consisting of coils L2001,L2002,L2004 & L2024, capacitors C2002,C2004,C2009,C2111,C2112,C2113 & C2114 and antenna switching diodes D2001, D2002 and D2013 to the receiver front end.

The signal is then band-pass filtered and amplified by Q2001 (**2SC3356**). The signals are then input to 1st MIXER Q2004 (**SGM2016M**) where unwanted frequencies are stripped. The 44.3 MHz 1st mixer product then passes through monolithc crysral filter XF2001 & XF2002, and is amplified by Q2010 (**2SC2714Y**) and input to IF IC Q2013 (**MC3372ML**). This IC contains the 2nd mixer, a local oscillator, limiter amplifier, FM detector, and audio amplifier. The 2nd LO in the IF-IC is produced from crystal X2002 (43.845 MHz), and the 1st IF is converted to 455kHz by the 2nd mixer and stripped of unwanted components by BPF CF2001,CF2002. After passing through a limiter amplifier, the signal is demodulated by the FM detector.

Demodulated receive audio from the IF-IC passes through LPF and HPF Q1005 (**NJM2902M**) within IC Q1016 (**MX165CDW**), and after volume adjustment by VR1010, is amplified by SP AMP Q1003 (**LA4425A**) and output to the SP jack.

PLL synthesizer

The 1st LO maintains stability from the PLL synthesizer by using 12.8 MHz reference signal from crystal X2001. PLL synthesizer IC Q2009 (**MC145191F**) consists of a prescaler, reference counter, swallow counter, programmable counter, a serial data input port to set these counters based on the external data , a phase comparator, and charge pump.

The PLL-IC divides the 12.8 MHz reference signal by 1,280 using the reference counter (10.0 kHz comparison frequency). The VCO output is divided by the prescaler, swallow counter and programmable counter. These two signals are compared by the phase comparator and input to the charge pump. A voltage proportional to their phase difference is delivered to the low-pass filter circuit, then fed back to the VCO as a voltage with phase error, controlling and stabilizing the oscillating frequency. This synthesizer also operates as a modulator during transmit.

The VCO is comprised of Q2008 (**2SC3356**) and D2003 (**HVU350**), and oscillates at 44.3 MHz during receive, and at the fundamental frequency during transmit, with direct FM-modulation using varactor diode D2004 (**HVU350**). The VCO output passes through buffer amplifier Q2011 (**2SC3356**), and a portion is input to the PLL IC, and at the same time amplified by Q2016 (**2SC3356**) to obtain stable output. The VCO DC supply is regulated by Q2017 (**2SC2812**). Synthesizer output is switched to the 1st MIXER by diode switch D2010 (**1SS184**) during receive, and to drive amplifier Q2015 (**μPC2710**) for transmit. The reference oscillator utilizes the PLL synthesizer, and is composed of crystal X2001 (12.8 MHz), the temperature compensation circuit D2007 (**1SS353**, TH2001,TH2002), and transmit (DCS) modulation circuit D2005, D2006 (**HVU350**).

Transmitter

Voice audio from the microphone or external inputs, after passing through LPF Q1005 (**NJM2902M**), limiter amplifier , and LPF Q1006 (**NJM2902M**), is adjusted for optimum deviation level and delivered to the next stage.

Voice input from the microphone or external inputs and CTCSS are FM-modulated to the VCO of the synthesizer, while DCS audio is modulated by the reference frequency oscillator of the synthesizer. Synthesizer output, after passing through diode switch D2010 (**1SS184**) and being attenuated by the ATT, is amplified by driver Q2015 (**μPC2710**) and power module Q2003 (**M67799H**) to obtain full RF output. This then passes through ANT SW D2001, D2002 and a LPF circuit and finally to the antenna connector.

RF output power from the final amplifier is sampled dy C2117,C2118 and is rectified by D2017(**1SS321**).The resulting DC is fed through Automatic Power Controller Q2018 (**TA75S01F**) to transmitter RF amplifier Q2003 and thus the power output.

Generation of spurious products by the transmitter is minimized by the fundamental carrier frequency being equal to the final transmitting frequency, modulated directly in the transmit VCO. Additoinal harmonic suppression is provided by a low-pass filter consisting of L2001,L2002&L2024 and C2002,C2004,C2009,C2111,C2112,C2113&C2114, resulting in moer than 60dB of harmonic suppression prior to delivery to the antenna.

DCS Demodulator

DCS signals demodulated from the RF-UNIT, and are applied to LPF Q1040-3, Q1040-4 (**NJM2902M**) and limiter comparator Q1040-1 (**NJM2902M**).

CTCSS encoder/decoder

Generation, demodulation, and detection of the CTCSS tones are carried out by IC Q1014 (**MX165C**).

MPU

Operation is controlled by 8-bit MPU IC Q1039 (**HD64F3334YTF**). The system clock uses a 9.8304 MHz crystal for a time base. IC Q1015 (**RH5VL45AA**) resets the MPU when the power is on and monitors the voltage of the regulated 5V power supply line.

EEPROM

This retains Tx and Rx data for all 16 channels, CTCSS data, DCS data, prescaler dividing, IF frequency, local oscillator injection side (upper/lower), and REF oscillator data (internal/external).