TECHNICAL MANUAL

OPERATING, MAINTENANCE, INSTALLATION INSTRUCTIONS AND ILLUSTRATED PARTS BREAKDOWN

HF DSP RECEIVER
MODEL RX-330

TEN-TEC, INC.
P.O. BOX 8010
SEVIERVILLE, TN 37864

THIS MANUAL WAS PREPARED IN ACCORDANCE WITH MIL-M-7298C

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RECORD OF CHANGES

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WARNING

HIGH VOLTAGE

is used in the operation of this equipment.

DEATH ON CONTACT

may result if personnel fail to observe safety precautions.
Learn the areas containing high voltage within the equipment.
Be careful not to contact high voltage connections when installing,
operating or maintaining this equipment.
Before working inside the equipment, turn power off
and ground points of high potential before touching them.

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INTRODUCTION

This technical manual provides operation and maintenance instructions for the RX-330 HF DSP Receiver. The manual was prepared in accordance with MIL-M-7298C, "Manuals, Technical: Commercial Equipment". This manual is organized into nine chapters along with a Table of Contents and lists of tables and illustrations.

Chapter 1 presents general information about the Receiver, which includes functional capabilities, performance specifications, and physical dimensions. Chapter 2 provides information concerning the unpacking and initial installation of the receiver. A general theory of operation is provided in Chapter 3 which describes the functioning of the Receiver's individual circuit boards. Chapter 4 contains information on operation of the multi-drop RS 232 Interface.

Chapter 5 provides information on maintenance and troubleshooting measures to be employed at the user's level. Instructions pertaining to the reshipment or long term storage are provided in Chapter 6. A detailed list of unique single source parts is provided in Chapter 7. In addition, Chapter 7 contains a list of manufacturers for these parts and their addresses. Chapter 8 provides a listing of replaceable modules and parts. Chapter 9 contains detailed parts lists for each of the replaceable modules. Chapter 9 also contains schematic diagrams for the electronic circuits.

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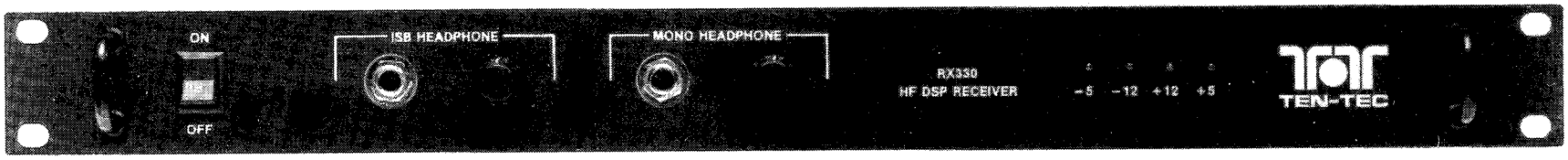

FIGURE I. RX330 FRONT VIEW

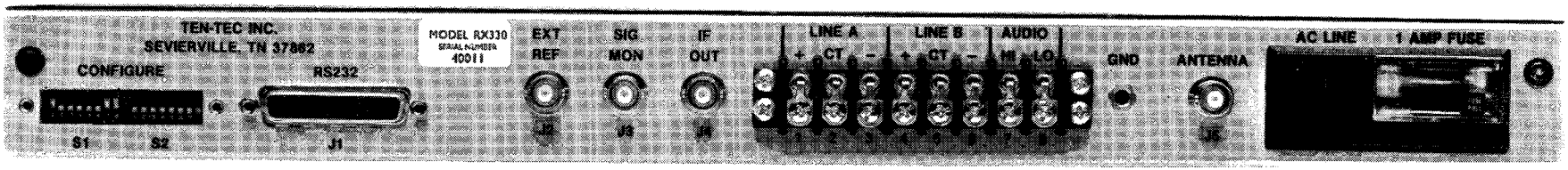

FIGURE II. RX 330 REAR VIEW

CHAPTER 1

GENERAL INFORMATION

1-1 PURPOSE AND FUNCTION The TEN-TEC RX-330 is a remotely controlled Monitor Receiver capable of tuning the .5 to 30 MHz HF range in 1 Hz steps. The Control Interface is Multi-drop RS-232, allowing multiple receivers to be addressed on one RS-232 line. Available detection modes are: USB, LSB, ISB, CW, AM, Synchronous AM, and FM. IF Bandwidth is selectable in 57 steps from 100 Hz to 16 KHz. Manual (MAGC) and automatic (AGC) gain control modes are selectable. In CW mode, the adjustable BFO has a range of ± 8000 Hz. In CW, LSB and USB modes, a passband tuning function allows simultaneous adjustment of BFO and receiver tuning over a ± 2000 Hz range. Three Audio and two IF outputs are provided.

The RX-330 power supply is internal, and accepts 48-440 Hz line power, 120/240 VAC, rear panel selectable.

1-2 SPECIFICATIONS

Frequency tuning system

Tuning Range: 500 KHz to 30 MHz. Tunable to 0 MHz with degraded performance.

Tuning Increment: 1 Hz minimum.

Synthesizer lock time: 10 mS nominal.

BFO: Tunable in CW mode only, ± 8 KHz, 10 Hz steps. Fixed frequency in SSB and ISB modes, disabled in AM and FM modes.

Accuracy: All internal oscillators can be locked to either internal or external frequency standards. The internal reference is adjustable by a continuously variable trimmer to allow calibration to any desired accuracy.

Stability (internal standard): ± 1 ppm per degree C within the operating range of 0 to 50 degrees C. An optional TCVCXO provides ± 1 ppm over entire range (0 to 50 degrees C).

External Frequency Standard: 1, 2, 5, or 10 MHz ± 1 ppm, 200 mV p-p, high impedance load. The receiver automatically detects and uses the external standard upon application, at power-up, or after any serial link activity. If the external standard input slews far outside the ± 1 ppm specified, the internal circuitry will lose lock until the input returns to within spec, or will re-lock at the next power-up or serial activity if the input is within specification at a valid reference frequency (1, 2, 5, or 10 MHz). A frequency-out-of-lock condition is always reported over the serial link. Removal of the external frequency standard input immediately returns the receiver to the internal standard.

Tuning Method: Remote control via multi-drop RS-232.

Frequency Indication: None visible. Frequency status reported by the RS-232 serial link.

Interface connections

RF Input:

Impedance:	50 Ohms, nominal.
VSWR:	2.5 : 1 maximum in preselector passband.
Connector:	rear panel BNC.
Protection:	internal surge protector.

Audio Outputs:

Two 600 Ohm lines

Level:	0 dBm nominal, center-tapped, ungrounded.
Connector:	3 rear panel screw terminals for each line.
Function:	Upper and lower sideband audio on separate lines in ISB mode. Same signal on both lines in other modes.

Stereo Headphone

Level:	10 mW maximum into 600 Ohm load. Front panel volume control.
Connector:	Front panel 1/4" stereo phone jack.
Function:	Upper and lower sidebands in ISB mode. Monaural output in other modes.

Single-ended Audio

Level:	10 mW maximum into 600 Ohm load.

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1-3 ENVIRONMENTAL CONDITIONS

Normal Operating

Temperature: 0 to 50 deg C (32-122F)
Humidity: Up to 95% Rel, non-cond.
Altitude: Up to 10,000 feet MSL
Shock: Not applicable
Vibration: Not applicable

Storage/Transport

Temperature: -46 to 71 deg C (-50-160F)
Humidity: Up to 95% Rel, non-cond.
Altitude: Up to 15,000 feet MSL
Shock: 10 G, 11 mS duration
Vibration: 1-1/2 G, 5 to 200 Hz

1-4 MECHANICAL

Size:
1.75H x 19W x 21.31D inches
44.45H x 482.6W x 541.4D mm

Weight:
12.2 lbs. (5.53 kg)

Cooling: Air convection cooled within fan ventilated rack cabinet. Units are directly stackable with no fillers required between chassis.

Mounting: Model RX-330 conforms to EIA standard 19 inch rack mount panel space and is 1 U (1.75) high. Slide mechanism attachment points (10-32 thread) are compatible with Jonathan slide type 375 QD.

Cable connectors Rear panel:
Receiver RF input: BNC female
IF output 455 kHz: BNC female
SIG MON: BNC female
External reference: BNC female
Remote Control: (Multi-drop RS-232) DB 25
Main Power: Detachable 3 conductor ac cord
Terminal Strip: #6 spade lug

Front Panel:
Mono headphone: 1/4" mono jack
Stereo headphone: 1/4" stereo jack

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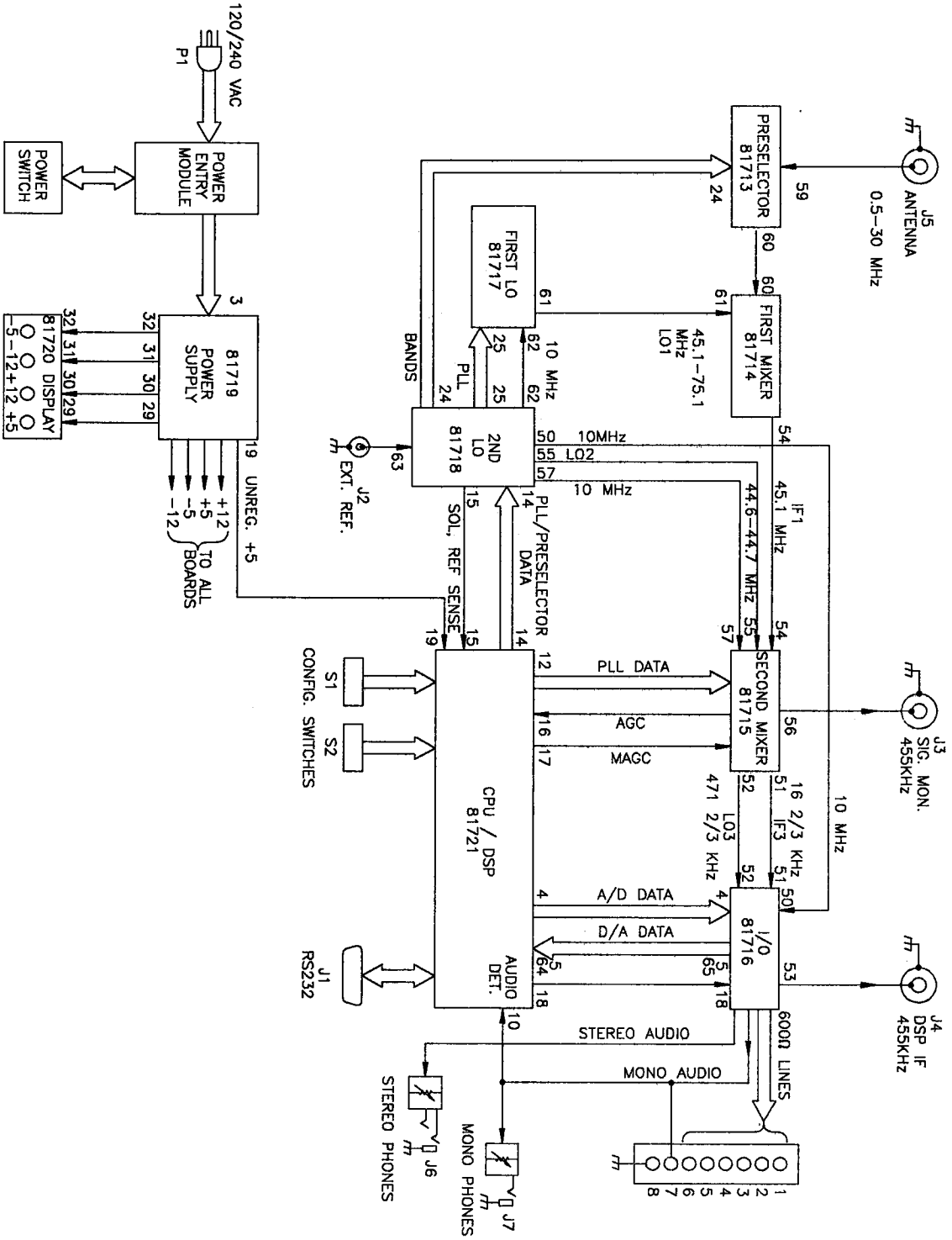

FIGURE 1-1 RX 330 INTERCONNECT DIAGRAM

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CHAPTER 2

PREPARATION FOR USE AND INSTALLATION

2-1 UNPACKING AND INSPECTION

Examine the shipping carton for damage before unpacking the unit. If the carton is damaged, open the carton in the presence of an agent of the shipping carrier if possible. If the carton is not damaged, retain the carton and packing materials for inspection if damage is found after the unit is unpacked.

Open the carton and remove the foam packing materials on top of the unit. Lift the unit free of the carton. No packing materials are required or provided inside the unit. Replace the foam packing material in the carton. The carton may be saved for possible reshipment if required.

Upon unpacking, inspect the unit for obvious external damage. Pay particular attention to dents or bent sheet metal. If damage is evident, remove the top cover of the unit and inspect for further damage such as damaged circuit boards. Do not attempt to operate the unit if such damage is noted until further checks are made.

2-2 MOUNTING RX-330 is designed for EIA standard 19 inch panel space rack. Slide mechanism attachment points (10-32th reading) are compatible with Jonathan slide type 375QD.

2-3 POWER The RX-330 is designed to operate from either 120 or 240 VAC. A small pc board located in the power entry module can be removed and reinserted to select proper ac voltage.

2-4 ANTENNA Connect the antenna to the BNC connector on the RX-330 labeled antenna (shown in Figure II).

2-5 IF OUT A 455 KHz signal with bandwidth dependent on filter selected (shown in Figure II).

2-6 SIG MON A 455 KHz signal with a fixed bandwidth of 16 KHz (shown in Figure II).

2-7 EXT REF Automatically turns off the internal 10 MHz reference if a 1 MHz - 2 MHz - 5 MHz or 10 MHz 200 mV p-p signal is applied (shown in Figure II).

2-8 RS-232 The RS-232 will accept a standard DB-25 connector (shown in Figure II).

2-9 LINE A Provides a 600 W balanced center tapped output (shown in Figure II).

2-10 LINE B Provides a 600 W balanced center tapped output (shown in Figure II).

2-11 AUDIO Provides a 600 W unbalanced output (shown in Figure II).

2-12 MONO HEADPHONE Provides a 600 W unbalanced output controlled by a front panel volume control (shown in Figure I).

2-13 ISB HEADPHONE Provides both sidebands controlled by front panel volume control (shown in Figure I).

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CHAPTER 3

GENERAL THEORY OF OPERATION

3-1 INTRODUCTION

The TEN-TEC Model RX-330 receiver combines a high dynamic range front end with a versatile DSP back end to provide extraordinary performance and flexibility. Refer to the overall block diagram Figure 9-1.

The RF signals applied to the receiver Antenna Input (J5) are bandpass filtered in one of eight bands of approximately one-half octave bandwidth. Balanced amplifiers and high level first mixer stages preserve the second and third order intercept points during conversion to the first IF of approximately 45.105 MHz. Two 2-pole crystal filters provide first IF selectivity to reject 1st mixer spurious products and the 2nd mixer image (at -910 KHz).

After conversion to the second IF of approximately 455 KHz in the second mixer stage, the signal is bandpass filtered to 16 KHz bandwidth and applied to an AGC'd 2nd IF amplifier with up to 80 dB gain. After post-filtering (again 16 KHz bandwidth), the signal is made available at the Signal Monitor output (J3) and also applied to the third mixer stage.

The third mixer converts the signal to a center frequency of 16 2/3 KHz where it is low pass filtered and applied to an analog to digital converter. The A/D converter produces a serial data stream at a 66 2/3 KHz sample rate for input to the Digital Signal Processor.

Serial data from the DSP at a 133 1/3 KHz sample rate is applied to a digital to analog converter. The D/A output samples are time de-multiplexed into two or three output channels, depending on the mode selection. Half of the D/A output time is devoted to the DSP'd IF output which is first converted back to 455 KHz by mixing with the third LO, then bandpass filtered to 16 KHz bandwidth,and finally made available at the IF Output connector (J4).

The other half of the D/A bandwidth is separated into USB and LSB audio channels in Independent Sideband mode, or into a single audio channel in all other modes.

3-2 PRESELECTOR (81713) Eight bandpass filters covering the frequency range of 500 KHz to 30 MHz are controlled by the DSP/CPU Board (81721). A six FET push-pull amplifier makes up for loss in the bandpass filter.

3-3 FIRST MIXER (81714) The input signal passes through a 30 MHz low pass filter to a diode mixer and mixes with the amplified first LO to produce an IF frequency of 45.105 MHz. The signal is applied to a six FET push-pull amplifier, then a 2 pole 45.105 MHz crystal filter. A second amplifier and 2 pole 45.105 MHz crystal filter produce an overall 4 pole response at the 1st IF to reject the 2nd mixer image. The 45.105 MHz signal is amplified again for use in the second mixer.

3-4 SECOND MIXER / 3RD LO (81715) The 2nd mixer / 3rd Lo board handles the conversion of the first IF of approximately 45.105 MHz to the second and third IFs of 455 KHz and 16 2/3 KHz respectively. It provides outputs to the Signal Monitor connector (J3 #56), the A/D converter (#51), AGC (#16), and LO3 (#52).

Required inputs are: 1st IF (#54), LO2 (#55), 10 MHz reference (#57), PLL data (#12), MAGC (#17), and power of $\pm$5 (#20) and +12V (#23). This board also distributes +12V power to the 1st Mixer and Preselector boards via connectors #21 and #22.

The 1st IF input (45.105 MHz) is applied to a high level diode ring mixer along with the amplified

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Controlled by SB select lines from connector #18, U15 sections y and z connect either one or both audio channels to the monaural audio driver U18a and to audio connectors #7, rear panel TB1, and front panel mono level control and phone jack J7.

3-6 FIRST LO (81717) The first conversion oscillator covers the range of 45.6-75.1 MHz. The VCO is split into four ranges to cover the 45.6-75.1 MHz spectrum. The VCO output is buffered by a J310 amplifier before being passed through a bandpass filter and on to the First Mixer (81714). An additional J310 amplifier isolates the VCOs from the MC145170P PLL Frequency Synthesizer IC. The MC145170P develops the reference frequency, accepts frequency information from the microprocessor and outputs a voltage that drives the loop filter and VCOs. Pin 11 of the MC145170P provides a lock detect signal to the SECOND LO Board (81718).

3-7 SECOND LOCAL OSCILLATOR (81718) The second LO board contains both 2nd LO and Reference frequency synthesizers. The 2nd LO synthesizer develops the second local oscillator injection frequency of 44.6 to 44.7 MHz in 1 KHz steps. The Reference synthesizer locks the 10 MHz internal reference oscillator to an optional external frequency standard.

Refer to 2nd LO schematic Fig. 9-25. The 2nd LO synthesizer is a two loop architecture. PLL chip U1 and charge pump U13 steer VCO Q1/D5/D6 over a range of 60 to 80 MHz in 200 KHz steps. The VCO output is buffered by Q2 and then divided by 200 in counters U2 and U3 to produce a tuning loop output of 300 to 400 KHz in 1 KHz steps for input to the mixing loop phase detector U6.

Phase detector U6, charge pump U7, VCO Q5, and mixer U4 form a mixing loop which translates the tuning loop output to the LO2 frequency range of 44.6 to 44.7 MHz, while preserving the 1 KHz tuning resolution.

The 45 MHz translation frequency required by the mixing loop is developed by first dividing the 10 MHz reference by 2 in U5 to produce a 5 MHz square wave, and then selecting the 9th harmonic with 45 MHz monolithic filter FL1. The resulting 45 MHz sine wave is applied to active mixer U7 along with a sample of the 2nd LO output to produce a 300 to 400 KHz intermediate frequency in the mixing loop.

Differential amplifier Q7/Q8 presents a high impedance to external reference input connector #63 and J2. A sample of Q8's output is detected by diode D13 and compared to a threshold voltage by U9b. When the external reference amplitude exceeds the threshold set by U9b, transistors Q9-Q11 change state, allowing the gate of FET switch Q12 to pull high. This condition connects the output of PLL U8, filtered by U9a, to VCO tuning diode D14, completing the loop and locking the VCXO Y1/Q13 to 10 MHz.

When no external reference is applied to J2, transistors Q9-Q11 conduct, holding the gate of FET switch Q12 low. In this condition the bias on tuning diode D5 is set by trimpot R1, and crystal Y1 is the frequency standard for the receiver.

3-8 DSP/CPU (81721) DSP/CPU BOARD 81721 The DSP/CPU board consists of two separate processor systems; the MAIN CPU (U1) which controls the RX330's interface and the DSP CPU (U22) which performs signal processing functions. The two system busses integrate together through parallel latches U5-U8. Communications between the MAIN CPU and DSP CPU is handled by a combination of hardware and software, providing bidirectional data capability.

The MAIN CPU system consists of CPU (U1), latch (U2), ROM (U3) and battery backed RAM (U4). Latches U23 and U24 buffer rear panel switch settings while IC's U9 and U10 are for address control. Three Serial/Parallel converters (U11-U13) add additional output capability to the system. Converter U12 provides VCO selection signals to the FIRST LO BOARD, converter U11 provides audio controls to the CONVERTER BOARD and U13 provides data to the MANUAL AGC DAC (U14). RS-

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