# LPQRA Cue Receiver

<u>*Section*</u>

***About Comrex***

Comrex has been building reliable, high quality broadcast equipment since 1961. Our products are used daily in every part of the world by networks, stations and program producers.

Every product we manufacture has been carefully designed to function flawlessly, under the harshest conditions, over many years of use. Each unit we ship has been individually and thoroughly tested. Most items are available off-the-shelf, either directly from Comrex or from our stocking dealers.

Comrex stands behind its products. We promise that if you call us for technical assistance, you will talk directly with someone who knows about the equipment and will do everything possible to help you.

Our toll free number in North America is 800-237-1776. Product information along with engineering notes and user reports are available on our website at www.comrex.com. Our E-Mail address is info@comrex.com.

***Warranty and Disclaimer***

All equipment manufactured by Comrex Corporation is warranted by Comrex against defects in material and workmanship for one year from the date of original purchase, as verified by the return of the Warranty Registration Card. During the warranty period, we will repair or, at our option, replace at no charge a product that proves to be defective, provided you obtain return authorization from Comrex and return the product, shipping prepaid, to Comrex Corporation, 19 Pine Road, Devens, MA 01434 USA. For return authorization, contact Comrex at 978-784-1776 or fax 978-784-1717.

This Warranty does not apply if the product has been damaged by accident or misuse or as the result of service or modification performed by anyone other than Comrex Corporation.

With the exception of the warranties set forth above, Comrex Corporation makes no other warranties, expressed or implied or statutory, including but not limited to warranties of merchantability and fitness for a particular purpose, which are hereby expressly disclaimed. In no event shall Comrex Corporation have any liability for indirect, consequential or punitive damages resulting from the use of this product.

***Copyright Notice***

# SECTION 1. INTRODUCTION

## *CUE SYSTEM*

The Comrex Cue System relays program and instructions from a transmitter (installed in a van, studio, press box, stadium, etc.) to pocket receivers. It is built for ENG/SNG field control and configured specifically to provide maximum field operating range with broadcast-quality audio.

This system consists of the LPQRA Receiver and the CTA Transmitter. The LPQRA has a 6 kHz audio response for accurate program monitoring, ceramic filters for interference-free operation and high level output for intelligibility in noisy environments. It operates in the frequency bands of 26.1-26.48 MHz. This frequency band is assigned by the FCC for use in remote pickup, cueing and wireless microphone applications. The LPQRA is intended to be used with the CTA Transmitter.

## *WHAT COMES WITH THE LPQRA?*

The following items are shipped with the LPQRA:

(1) Telex earset assembly with 1/4” plug
(1) Black leather belt pouch
(1) Operating manual
(1) Warranty card (Please fill out and return.)

## *SPECIFICATIONS*

*Frequency Range:* 26.1-26.48 MHz

*Audio Output:* 500 mW into 8 ohms

*Antenna:* Headphone cable

*Sensitivity:* .5 microvolts

*Battery:* (1) 9V Alkaline (operates approximately 20 hours)

*Weight:* 10 oz.

*Size:* 3” x 1” x 5”

# Section 2. Setup and Operation

### *Controls and Connections*

The only controls on the LPQRA are the On/Off switch and the Volume control knob. The antenna for the LPQRA is the cord of the headphone, which proves to be quite effective as an antenna. An “earphone” (or “headphone”) is supplied with the receiver. The battery needed to power the LPQRA is a standard 9V Alkaline (only!) type which can be found in most parts of the world.

### *Setup*

The setup procedure for the LPQRA is extremely simple. Just install the battery and plug in the headphone. Move the On/Off switch to the “ON” position. Make sure that the power indicator is lit, place the earphone next to the ear, and turn up the volume to a satisfactory level.

*Note: You can improve the performance of the earphone. The earphone as supplied comes with a nylon hook which holds the earphone in place. Almost any hearing aid store can make you a custom earplug which will replace the hook. Often these plugs can be made while you wait. The earphone will then attach to the plug. You will improve the sound quality, and some of the background noise will be eliminated.*

# SECTION 3. TECHNICAL DESCRIPTION

### *INPUT/FRONT END*

The input signal to the receiver is the voltage developed in the earphone/antenna cable by the RF field created by the CTA transmitter. The input connector is J1. Capacitor C1 is a bypass capacitor which holds the inner conductor and the shield of the headphone cord to the same RF potential. L1, L2 and C4 comprise the input matching network. You will notice that this is essentially a single tuned circuit with an inductive tap. L2 provides a ground return for the earphone at audio frequencies and a proper match for the earphone/antenna at RF frequencies. L3 isolates the audio output circuitry at RF frequencies but permits audio signals to pass to the earphone. The tap which is the junction of C3 and C2 connects to the source of Q1 which is an RF "J-FET" operated in the grounded gate configuration. The main function of this RF amplifier is to make up losses which occur in the various tuned circuits and to isolate the local oscillator from the antenna. The gain of a grounded gate is approximately given by the formula Eo/Ein = Rl/Rin (assuming resonance in all tuned circuits). The transconductance of the FET is not included in the gain equation. This means that one does not have to worry that the input transistor will get weaker as time passes. The transistor will either be operating properly or not at all.

The output of the RF amplifier is developed in the tuned circuit which is made up of L4 and C6. C8 couples L4, C6 to L7, C12 and from there to the input of U1.

### *1ST MIXER*

U1 is an NE-602 integrated circuit. This unit was developed for use in "Cellular Telephone Systems." It contains a "double balanced" mixer and an oscillator. The oscillator portion of this IC and its associated components comprise a "third overtone" crystal oscillator. The components which make up the oscillator are C9, C10, C14, L5, X1 or X2 and the channel selector switch SW1. L5 and C9 form a series resonant circuit which traps the crystal fundamental, so that the oscillator is forced to operate at its "third overtone" frequency. Switch SW1 determines which crystal is in control and thereby which channel will be received. L6 and C11 isolate oscillator signals from the rest of the receiver circuitry.

The selected input signal and the local oscillator are mixed in the mixer portion of the NE-602 and fed to the balanced input/unbalanced output tuned circuit made up of L8, C15, C16 and C17.

### 1st I.F.

This circuit is tuned to 10.7 MHz which will be the difference between the frequency of the desired channel and the frequency of the crystal (if the crystal is cut for the correct frequency). The configuration of the network is designed to match the output of the mixer to the input of the first ceramic filter FL1. FL1 passes 10.7 MHz and rejects frequencies which are over 150 kHz away from 10.7 MHz. The output of FL1 is fed into a tuned capacitively tapped circuit consisting of L9, C18 and C19. The output of this circuit is AC coupled into the input of the second mixer which is located in U2.

### FM/I.F. Sub-circuit

U2 contains quite a collection of circuits, including an oscillator, a mixer, a multistage limiter-IF amplifier, a quadrature detector and an output amplifier for demodulated audio. The oscillator portion of the IC is controlled by crystal X3 which is cut for 11.155 MHz. The input 10.7 MHz and the local 11.155 MHz signals are multiplied together in the internal mixer. The 455 kHz difference is fed out of the mixer into the 455 kHz filter FL2. This filter is much narrower in bandpass than FL1. It provides rejection of adjacent channel signals. The output of FL2 feeds into the amplifier/limiter portion of U2. In this section, the signal is increased in level and symmetrically limited. Then the limited FM signal is coupled into the quadrature detector portion of U2 and demodulated into audio. The tuned circuit L10 determines the center frequency of the detector. The demodulated audio is fed into the output amplifier portion of U2 and is de-emphasized. The de-emphasis components external to U2 are C25, C28 and R4.

### Audio

The audio is modified in volume to suit the users taste by the Volume control which is potentiometer R6. U3 is an audio amplifier integrated circuit which raises the audio energy to a level sufficient to drive the earphone. Associated components C31, C32, C33, R7 and R8 couple and compensate U3.

### DC Power

D1 is used to prevent damage to the receiver if the battery is put in incorrectly. SW2 is the On/Off switch. D2 is a light emitting diode which is used to indicate that the power switch is in the “ON” position. Capacitors and resistors not mentioned above are used as dropping resistors and bypass capacitors.

# Section 4. Troubleshooting

### *Checking the Crystals*

If you have an LPQRA Receiver that is not working, first check for a broken crystal. We have made every effort to shock mount the crystals, but if it receives a hard blow and all you hear is a “rushing” noise, a crystal has been broken. You will save time and money by ordering replacement crystals directly from the crystal manufacturer. You may wish to keep a small emergency replacement stock in case of crystal breakage. For more information, refer to Section 5 “Ordering Crystals,” on page 9.

The second oscillator crystal is working if you can see 11.155 MHz signals on pin 1 or 2 of U2 with a scope (be sure that it is a high frequency scope with a high frequency probe). If you do not see a signal, the crystal is probably broken. Install a new second oscillator crystal. Checking the first oscillator crystal or crystals is a bit more difficult. Connect a high frequency scope to pin 4 or 5 of U1, and turn on the CTA Transmitter. You should be able to see 10.7 MHz. If you do not, replace the first oscillator crystal for that channel.

### *Tuning Steps*

The LPQRA is so straightforward and ruggedly built that it should not have to be “tuned up” unless, it has been treated to something beyond “normal” usage. Should tuning be required, follow the steps below:

1. Obtain a signal generator which can cover the frequency range 26.1-26.48 MHz. Be sure that it is a professional generator with a good attenuator and one which can be frequency modulated +/- 3 kHz at 1 kHz. Hopefully, your signal generator will contain a SINAD detector. This is really just a distortion meter, so if the generator doesn’t have one, you can use an audio distortion meter.

2. Using the above techniques, make sure that the crystals are working.

3. Connect the SINAD detector or the audio distortion meter to the negative side of C32, using the anode side of D1 as a ground return for the meter. Do not try to use the case since it is insulated. Also, connect the scope to the negative side of C32 and the anode of D1. Turn on the receiver. You should hear a “rushing” noise.

4. Loosely couple the output of the signal generator to the headphone cord. The headphone cord should be kept out in the open, away from ground or metal objects. Do not wear the earphone while you are doing these tests because some RF will be absorbed, giving you poor results.

5. Set the generator to the proper channel frequency. Set the modulation frequency to 1 kHz and the deviation to +/- 3 kHz, turn up the generator output until you see audio on the scope. If you see audio on the scope, move to the next step. If you see distorted or low audio, you will need to turn the core in L10 until you get maximum audio. If you now see audio and it is a decent sine wave, you can proceed.

6. Looking at the SINAD meter or the indication on the distortion meter, you will now want to tune all of the tuned circuits for lowest distortion or greatest SINAD (the SINAD meter is usually calibrated in terms of quieting with the lowest distortion producing the highest SINAD reading). Reduce the signal generator as things improve. You are looking for the lowest distortion (or highest SINAD) for the smallest number of microvolts.

*Note: L10 which is the quadrature coil will result in the highest audio output and best looking sine wave when it is properly tuned. Do not attempt tune-up of other coils until you have obtained a good clean sine wave at maximum level by tuning L10.*

7. You will probably notice that tuning L5 has almost no effect on sensitivity. This is as it should be. This coil is part of a “fundamental” trap. It doesn’t have much effect other than to prevent the crystal oscillator from operating at the fundamental frequency of the crystal. It is possible to kill oscillation by running the core down all the way. The best location for the core of this coil is at the top. Also, you will notice that tuning L1 has little effect. This, too, is as it should be. We designed this circuit for low “Q” on purpose.

The LPQRA is designed and manufactured under rigid controls, so that it will provide long, trouble-free service. Please contact Comrex Customer Support if you have any questions concerning the operation of the LPQRA.

## Section 5. Ordering Crystals

***Serial Numbers 1063 through 1636***

The first oscillator crystal is a 3rd overtone anti-resonant crystal with a 5 picofarad load in an HC-25 holder. To determine the crystal frequency, add 10.7 MHz to the operating frequency of the LPQRA receiver. For example, if your LPQRA operates on 26.15 MHz, the crystal frequency should be 36.850 MHz (26.15+10.7=36.85). To order from Sentry MFG: The case is SCM-25 part number 1850 (specify desired frequency).

The second oscillator crystal is an 11.155 MHz fundamental anti-resonant crystal with a 32 picofarad load in an HC-25 holder. To order from Sentry MFG: The case is SGP-25 part number 2002 (specify desired frequency).

***Serial Numbers 1 through 1062 and 1637 to the Present***

The first oscillator crystal is a 3rd overtone anti-resonant crystal with a 5 picofarad load in an HC-18 holder. To determine the crystal frequency, add 10.7 MHz to the operating frequency of the LPQRA receiver. For example, if your LPQRA receiver operates on 26.15 MHz, the crystal frequency should be 36.850 MHz (26.15+10.7=36.85). To order from Sentry MFG: The case is SCM-18 part number 2492 (specify desired frequency).

The second oscillator crystal is an 11.155 MHz fundamental anti-resonant crystal with a 20 picofarad load in an HC-18 holder. To order from Sentry MFG: The case is SCM-18 part number 2108 (specify desired frequency).

***Sentry MFG***

First and second oscillator crystals are available from:

Sentry Manufacturing
PO Box 250
Chickasha, OK 73023
800-252-6780

*Note: If you are in a rush, crystals may be ordered on an emergency basis for twice the price.*