UR195

COMPACT UHF RECEIVER

OPERATING INSTRUCTIONS
and troubleshooting guide

LECTROSONICS, INC.

Rio Rancho, NM

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INTRODUCTION TO THE 195 SYSTEM

The 195 Series system was designed for the most critical studio and sound reinforcement applications. The system design represents a significant step forward in wireless microphone technology. Every stage in the entire audio/radio chain from transmitter input to receiver output was evaluated and analyzed to produce the operating parameters and performance requirements for this entirely new design. The audio system provides the lowest distortion and best signal to noise ratio of any wireless mic system ever built. The RF link is extremely stable, providing the highest reliability and freedom from drop outs and interference.

The UR195 employs the most advanced circuit and mechanical design ever applied to a wireless microphone receiver. The audio processing is the finest quality system ever developed for wireless microphone systems. The UR195 re-defines the state of the art in high end wireless microphone receivers.

The entire radio/audio system was designed from a "cold start," utilizing all that has been learned thus far. Many new types of IC's and semi-conductors are available now that were only ideas a few years ago. The UR195 design takes advantage of these new devices.

UT195 TRANSMITTER

The UT195 hand-held transmitter design was the result of considerable research. The RF and audio performance of the transmitter was considered first, followed by an analysis of the typical user's needs and the practicality of various design possibilities. The basic circuitry had to accommodate any frequency in the VHF or UHF spectrums. The mechanical design had to provide a comfortable "feel," yet be rugged, foolproof and easy to operate. The operating features and functions faced several contradictions in the needs of different types of users. This led to the development of a very versatile design wherein the transmitter can be configured for either "fool proof" operation or to provide user control of the audio level, metering and indicators. The final UT195 design combines the benefits of superior performance, ruggedness, user convenience, and flexibility.

UM195 TRANSMITTER

The UM195 is a small belt-pack style transmitter which can be clipped on the belt, slipped into a pocket, or even taped to the user's body under clothing. It offers the same high performance and wide deviation as the UT195 and is compatible with all of Lectrosonics' 195 series receivers. The UM195 comes with a standard lavalier microphone but practically any mic can be adapted to work with this transmitter. The transmitter audio level can easily be monitored and set from the from panel.

DUAL-BAND COMPANDOR

Compandors have long been a source of audible distortion in wireless microphone systems. The basic problem is that when the full bandwidth of the audio signal is processed by a single compandor, the attack and decay times will always be a compromise. If the time constants are fast, high frequency transient distortion will be low, but low frequencies will be distorted. If the time constants are slowed down, low frequency distortion will be low, but high frequency transients will then be distorted. The 195 system introduces a new approach to solving this basic problem with compandors, called "dual-band companding."

There are actually two separate compandors in the 195 system, one for high frequencies and one for low frequencies. A crossover network ahead of the compandor separates the frequency bands at 1kHz with a 6dB per octave slope, followed by separate high and low frequency compandors. The attack and release times in the high frequency compandor are fast enough to keep high frequency distortion at an extremely low level. The low frequency compandor uses slower time constants, reducing low frequency distortion to well below that of a conventional compandor.

75kHz DEVIATION

Wideband, 75kHz, of deviation improves the capture ratio, signal to noise ratio, and AM rejection of a wireless system dramatically.

NO PRE-EMPHASIS/DE-EMPHASIS

The signal to noise ratio of the 195 system is high enough to preclude the need for conventional pre-emphasis (HF boost) in the transmitter and de-emphasis (HF roll off) in the receiver. Pre-emphasis and de-emphasis in an FM radio system usually provides about a 10dB improvement in the signal to noise ratio of the system, but the high frequency boost in the transmitter must be removed in a purely complementary manner or else the frequency response of the original audio signal will be altered.

Pre-emphasis can also cause distortion in the IF filtering stage in the receiver, since the high frequencies have been boosted, which increases the level of the harmonics in the FM signal. As this signal is passed through the IF filters in the receiver, distortion can be produced, most noticeable at full modulation. De-emphasis cannot be applied until the signal is converted into audio, so there is no way around this problem short of eliminating pre-emphasis altogether. Neither of these problems occur in the 195 system. The dual-band compandor in the 195 Series system essentially provides a dynamic pre-emphasis/de-emphasis function with extremely low distortion.

EXCEPTIONAL THERMAL STABILITY

If temperature shifts cause the oscillators to drift, or values to change in the detector, serious distortion will result. The components in the 195 Series systems meet very stringent tolerances for thermal drift. System distortion in the 195 series remains at very low levels over a very wide temperature range. This is especially important in applications where the receiver and/or transmitter must be operated near heat generating devices, outdoors in direct sunlight, or with the receiver mounted in an equipment rack.

GENERAL TECHNICAL DESCRIPTION - UR195 RECEIVER

The UR195 is a high performance, dual-conversion, UHF receiver. The RF performance is extremely stable over a very wide temperature range, making the UR195 perfectly suited to the rough environmental conditions found in the field. The proprietary audio processing includes a dual-band compandor for very low distortion and a superior signal to noise ratio. The squelch system is operated by a separate pilot tone and mutes the audio output directly at the output connector. The audio output is calibrated for exact level matching, with a ten LED bar graph meter.

SIX-POLE HELICAL RESONATOR FRONT-END

The UR195 utilizes a six-pole helical resonator for front-end filtering. The helical resonators are custom manufactured in-house to provide the high performance needed, yet still fit into the small UR195 package. This outstanding front-end keeps the UR195 from being affected by high power, adjacent RF signals and also provides extremely high image rejection.

GaAs FET FRONT-END FILTER COUPLING

The UR195 utilizes an ultra low noise GaAs FET amplifier in the front-end section to compensate for the required losses between filter stages. The GaAs FET devices are extremely quiet, especially at the higher frequencies in the UHF band.

DOUBLE BALANCED DIODE MIXERS

A double balanced diode mixer is used in the UR195 to produce the 10.7 MHz IF signal. The mixer produces output at only the sum and difference signals, with minimal spurious signals. This mixer offers a very high overload threshold and a high degree of isolation between ports. This translates to the ability of the receiver to accept higher input signals without overloading and causing distortion and less cross talk between receivers in multiple system installations.

10 POLE LINEAR PHASE FILTER

The 1st IF amplifier is a 4 stage amp with 2 poles of filtering after each stage. The filters are high quality, low distortion, constant group delay ceramic filters. This special type of filter is needed to accommodate the wide deviation of the 195 system. The 2nd IF incorporates 2 more poles of filtering.

DIGITAL PULSE COUNTING DETECTOR

The UR195 receiver uses an advanced digital pulse counting detector to demodulate the FM signal, rather than a conventional quadrature detector. The most common problem with quadrature detectors is thermal drift, particularly those that operate at higher frequencies like 10.7 MHz. The UR195 design presents an elegantly simple, yet highly effective solution to this age old problem.

The UR195 detector basically works like this: A stream of DC pulses is generated at 455kHz. The pulse width is constant, but the timing between pulses varies with the frequency shift of the FM signal. The pulse stream is controlled by the FM signal coming from the IF section which has been heavily limited. The average voltage of the pulses within any given time interval varies in direct proportion to the frequency modulation of the radio signal, producing the audio signal.

This type of detector eliminates the traditional problems with quadrature detectors and provides very low audio distortion and no thermal drift. The counting detector also adds additional AM rejection, in addition to the limiting in the IF section. The amplitude of the pulses is constant, so level differences in the IF signal do not affect the pulse.

2:1 EXPANDER (Dual–Band Compandor)

This circuit is the other half of the dual-band compandor in a 195 system. “Dual-band Companding” is a closed loop system, that is, whatever is done in the transmitter must be mirrored in the receiver. The transmitter compresses the audio signal in two separate audio bands using two separate time constants in order to avoid the inevitable trade-offs in a single-band compandor. The companion circuit in the receiver then re-expands this compressed signal restoring the original dynamic range and frequency characteristics of the signal.

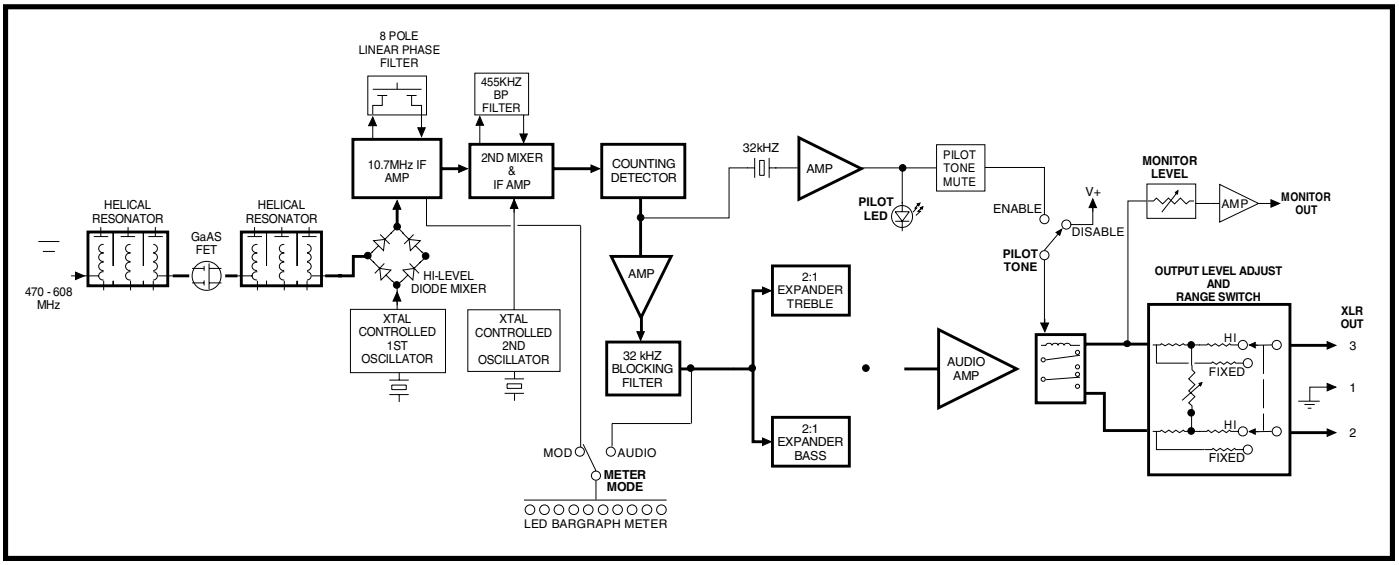


Figure 1 - UR195 Block Diagram

The audio signal leaves the Detector circuit and is fed through an amplifier to the 23 kHz Low Pass Filter where all the high frequency noise (including the 32 kHz pilot tone) is filtered out. After the 23 kHz low pass filter, the signal is split into two parts via a 1 kHz low pass filter and a 1 kHz high pass filter. The separated signals are then processed in separate channels of the NE572 2:1 Expander. Each channel of the 2:1 Expander is optimized for its respective frequency band. The two outputs of the 2:1 Expander are then summed in an op-amp summer and sent to the output amplifier as one signal.

PILOT TONE MUTE (SQUELCH)

The 195 system utilizes a separate ultrasonic tone modulation of the basic carrier to operate the receiver squelch. In the transmitter, a 32kHz tone is injected into the audio signal path just after the compandor. The supersonic pilot tone is filtered out of the audio signal immediately after the detector in the receiver so that it does not influence the compandor or various gain stages.

The basic benefit of the pilot tone squelch system is that the receiver will remain squelched (muted) until it receives the pilot tone from the matching transmitter, even if a strong RF signal is present on the carrier frequency of the system. Once a pilot tone is received, the receiver will remain open during all signal conditions.

The mute circuit drives a relay which physically disconnects the output amplifier from the output. This provides complete muting of the audio and the noise. The Pilot LED on the front panel will glow when the pilot tone has enabled the receiver audio output.

OUTPUT LEVEL ADJUST AND RANGE SWITCH

The front panel Output control will adjust the audio output within the range set by the VAR/FIX range switch (located on the back panel.) In the VAR position the adjustment range is from –30dBm to 0dBm, and the FIX position sets the audio output to a fixed +8dBm with no front panel control.

POWER SUPPLY

The UR195 may be operated from the supplied CH12 adapter, or from an external 12 to 18 VDC source. The power supply has a built in Poly-Fuse to protect the unit. This fuse is self healing by simply turning off the receiver for about 15 seconds.

FRONT PANEL CONTROLS AND FUNCTIONS

PWR LED

When lit, this LED indicates that power is applied to the UR195 and adequate voltage is present to operate the unit.

PILOT LED

The audio output muting (squelch) function of the UR195 is controlled by a 32kHz tone modulation of the RF carrier. The audio output is muted until this tone is present. This LED will remain on as long as the receiver audio is enabled by the pilot tone.

TRANSMITTER AUDIO LEVEL METER

When the meter function switch is in the Mod position, the modulation (audio level) of the incoming signal is indicated by a fast responding LED strip. The strip is calibrated in 6dB steps over an expanded scale (54dB) which provides an extremely accurate visual "picture" of the signal dynamics, even at a distance away from the receiver. Audio signal peaks easily exceed the response time of VU meters, however, the LED strip is fast enough to track even brief transients.

RF LEVEL INDICATORS

With the function switch in the RF position, the LED strip indicates the level of the incoming RF signals. The LED strips are calibrated to provide accurate indications from 1uV to 1mV. The LEDs are highly visible from a distance, making antenna set up more accurate. The LED strip is especially useful in trouble-shooting difficult antenna installations.

MONITOR

This is a high quality audio output to drive a wide variety of different types of headphones. It is also useable as a secondary audio output to feed recorders or external audio devices. The Monitor jack is a mini stereo type with the same signal applied to the tip and ring contacts. Stereo or mono headphones may be used without any loss of volume or damaging the UR195.

POWER SWITCH

This slide switch, and its corrosponding LED indicator, switches the receiver from Off to On. At turn on and off there is a delay built into the receiver to allow various stages to stabilize before the audio output is activated. This will prevent an audio "thump" when powering up the receiver.

AUDIO OUTPUT

The front panel Output control will adjust the audio output within the range set by the VAR/FIX range switch (located on the back panel.) In the VAR position the adjustment range is from –30dBm to 0dBm, and the FIX position sets the audio output to a fixed +8dBm with no front panel control.

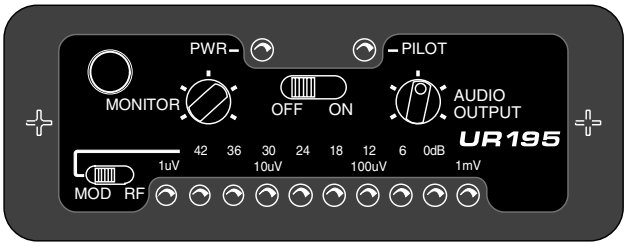


Figure 2 - UCR195 Front Panel

REAR PANEL CONTROLS AND FUNCTIONS

EXTERNAL POWER JACK

The UR195 can be powered from external 12 to 18 Volts DC applied directly to this jack, or conventional 110 VAC sources via the supplied CH12 adapter. The UR195 is protected from reverse polarity conditions with a diode bridge which allows external DC to be applied without regard to polarity. If an external positive ground power source is used, the case of the unit must be left floating and not tied to the same common as the positive ground supply. If the UCR195 common is tied to the common of the positive ground supply, there are protection circuits built into the unit that will shut the unit down before any harm is done.

AUDIO OUTPUT XLR JACK

This jack is a standard 3 pin XLR connector since this is the most commonly used type of connector. Audio High (+) is on pin 3, Audio Low (–) is on pin 2, and audio Common (Gnd) is pin 1.

RANGE SWITCH

The range is set by the VAR/FIX range switch (located on the back panel.) In the VAR position the adjustment range is from –30dBm to 0dBm, and the FIX position sets the audio output to a fixed +8dBm with no front panel control.

ANTENNA CONNECTOR

This is a standard 50 Ohm BNC type jack for the RF input to the receiver.

Figure 3 - UR195 Rear Panel

ANTENNA USE AND PLACEMENT

Position the antenna so that it is more than 3 or 4 feet from large metal surfaces. If this is not possible, try to position the antenna so that it is as far away from the metal surface as is practical. You can also let the metal surface work for you by aligning the antenna perpendicular to the surface. This will provide a ground plane for the antenna. It is also good to position the receiver and/or antenna so that there is a direct “line of sight” between the transmitter and the receiver antenna. In situations where the operating range is less than about 50 feet, the antenna positioning is much less critical.

A wireless transmitter sends a radio signal out in all directions. This signal will often bounce off nearby walls, ceilings, etc. and a strong reflection can arrive at the receiver antenna along with the direct signal. If the direct and reflected signals are out of phase with each other a cancellation may occur. The result would be a “drop-out.” A drop-out sounds like either audible noise (hiss), or in severe cases, may result in a complete loss of the carrier and the sound when the transmitter is positioned in certain locations in the room. Moving the transmitter even a few inches will change the sound of the hum or hiss, or eliminate it. A drop-out situation may be either better or worse as a crowd fills and/or leaves the room, or when the transmitter or receiver is operated in a different location.

The UR195 receiver offers a sophisticated front end design which overcomes drop-out problems in almost any imaginable situation. At UHF frequencies, drop outs (noise ups) are often so brief that they sound like a "click" rather than a burst of noise. Generally, drop outs are virtually non-existent within several hundred feet of operating range. In the event, however, that you do encounter a dropout problem, first try moving the antenna at least 2 or 3 feet from where it was. This may alleviate the drop-out problem. If drop-outs are still a problem, try moving the antenna to an entirely different location in the room or move the antenna in closer to the transmitter location.

Lectrosonics transmitters radiate power very efficiently, and the receivers are very sensitive. This reduces drop-outs to an insignificant level. If, however, you do encounter drop-outs frequently, call the factory or consult your dealer. There is probably a simple solution.

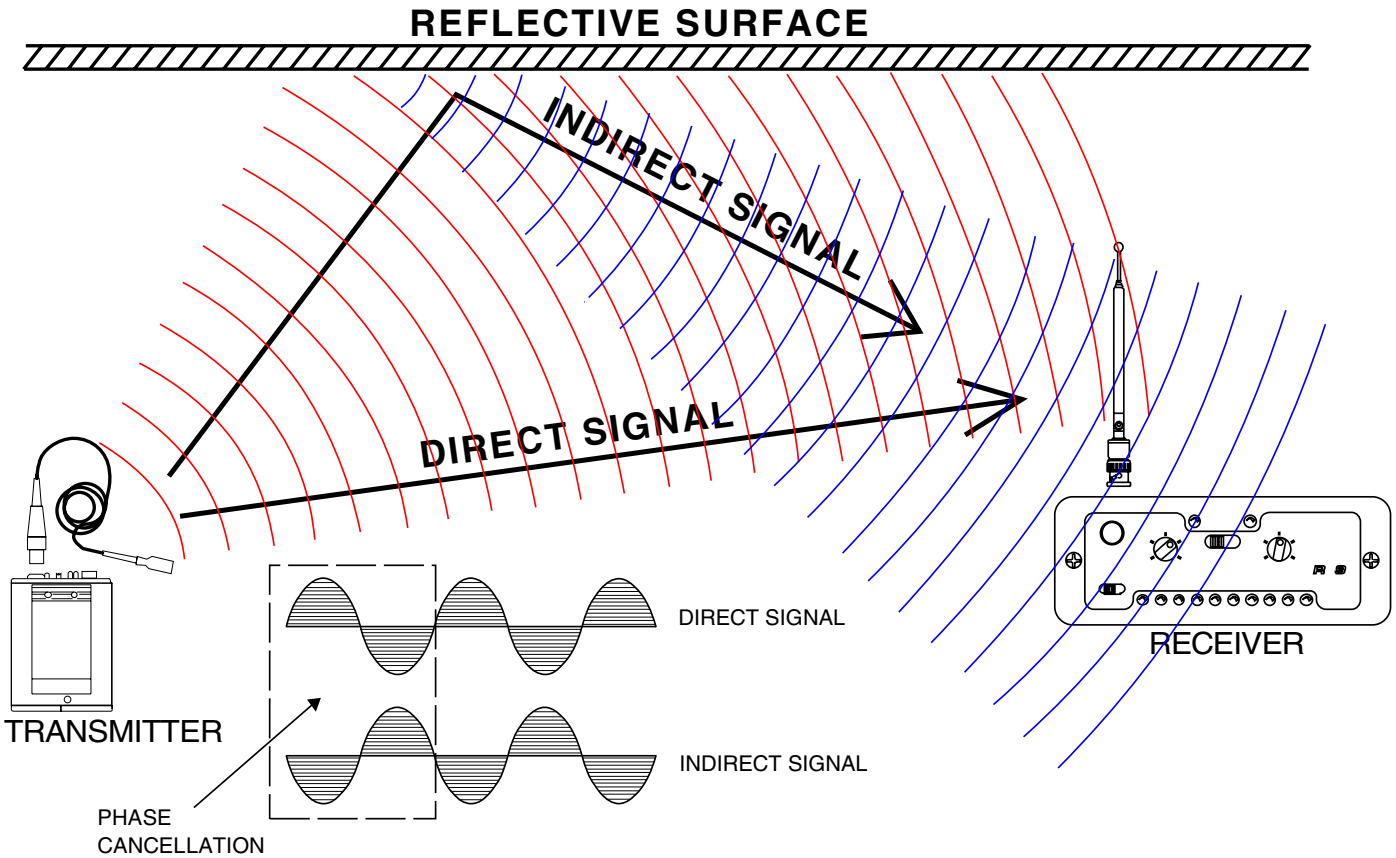


Figure 4 - Drop-outs

OPERATING INSTRUCTIONS

1. Connect the power cord.

2. Attach the antenna.

3. Connect the audio cable to the audio output XLR.

4. Set the front panel Audio Output Level control to minimum and set the Power switch to On. Check to see that the front panel Power LED lights up.

5. Adjust the transmitter gain. THIS IS PERHAPS THE MOST IMPORTANT STEP IN THE SET UP PROCEDURE. See your transmitter manual (Operating Instructions section) for details on how to adjust the transmitter gain. In general, adjust the transmitter gain so that the voice peaks will cause the 0dB LED on the front of the receiver to light on the loudest peak audio levels. This will result in the best possible signal to noise ratio for the system without causing overload distortion.

6. Adjust the Audio Output control according to the type of input on your equipment. The Range switch (located on the back panel) sets the adjustment range of the front panel Audio Output control and has two positions.

VAR: Allows an adjustment from –30dBm to 0dBm

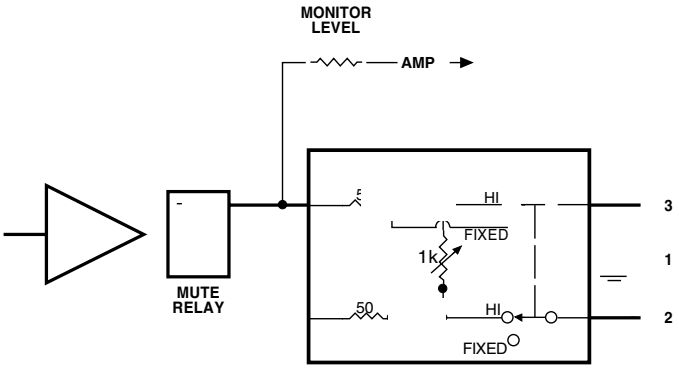
FIX: Sets the audio output to a fixed +8dBm with no front panel control.

The input levels of different cameras, VCRs, and PA equipment vary, which may require that you set the Audio Output control to an intermediate position. Try different settings and listen to the results. If the output of the receiver is too high, you may hear distortion or a loss of the natural dynamics of the audio signal. If the output is too low, you may hear steady noise (hiss) along with the audio. The UR195 audio output is designed to drive any audio input device from microphone level to +8dBm line level.

Note:

When using the +8 dBm FIX position of the output range switch, do not ground pin 2 or pin 3 of the XLR output! The output impedance is only 50 Ohms (unbalanced) when in the FIX position and this is not enough to isolate the audio amplifier from a short to ground. Distortion will result.

UR195 Simplified Audio Output Circuit



UR195 REPLACEMENT PARTS and ACCESSORIES

Part No.	Description
A-500S	UHF Rubber Duck Antenna, straight connector
A-500RA	UHF Rubber Duck Antenna, right angle connector
32251	Velcro mounting strips
35753	Zippered, padded vinyl system pouch
CH12	AC Power Adapter, 110V input, 12VDC output

TROUBLESHOOTING

POWER SUPPLY AND FUSE

LEDs not lit or dimly lit

AC power cord disconnected.

External power supply disconnected or inadequate.

Main power supply fuse tripped. Turn the receiver off, remove the cause of the overload and turn the receiver back on.

PILOT TONE SQUELCH

The PILOT indicator lamp on the front panel lights up to indicate that the audio has been turned on at the transmitter, and that the audio output on the receiver is enabled. When the lamp is on, the audio is enabled. When the lamp is off, the audio is muted.

PILOT lamp on, but no sound

Audio output cable bad or disconnected. Try monitoring at the headphone output on the front panel. The headphone output signal is taken just ahead of the output transformer.

Audio Output level set too low.

PILOT lamp does not come on when transmitter audio switch is turned on

It takes several seconds for the relay to actuate the PILOT lamp. Turn the transmitter power and audio switches on and wait 5 to 10 seconds for the lamp to come on.

ANTENNAS AND RF SIGNAL STRENGTH

RF Level is weak.

Antenna is disconnected or there is a bad connection

Antenna may need to be moved or re-oriented

Improper length of antenna, or wrong antenna. UHF whip antennas are generally about 5 to 6 inches long. UHF helical antennas may be shorter, but are often less efficient.

AUDIO SIGNAL QUALITY

Poor signal to noise ratio

Transmitter gain set too low

Noise may not be in wireless system. Mute the audio signal at the transmitter and see if noise remains. If the noise remains, then turn the power off at the transmitter and see if it remains. If the noise is still present, then the problem is not in the transmitter.

If noise is still present when the transmitter is turned off, try lowering the audio output level on the UR195 rear panel and see if the noise lowers correspondingly. If the noise remains, the problem is not in the receiver.

Receiver output is too low for the input of the device it is feeding. Try increasing the output level of the UR195 and lowering the input gain on the device the UR195 is feeding.

Distortion

Transmitter input gain too high. Check and/or re-adjust input gain on transmitter according to the LEDs on the transmitter and then verify the setting with the transmitter audio level LED strip on the UR195 front panel.

Audio output level too high for the device the UR195 is feeding. Lower the output level of the UR195.

SERVICE AND REPAIR

If your system malfunctions, you should attempt to correct or isolate the trouble before concluding that the equipment needs repair. Make sure you have followed the setup procedure and operating instructions. Check out the inter-connecting cords and then go through the TROUBLE SHOOTING section in the manual

We strongly recommend that you **do not** try to repair the equipment yourself and **do not** have the local repair shop attempt anything other than the simplest repair. If the repair is more complicated than a broken wire or loose connection, send the unit to the factory or an authorized service center equipped to service the UCR195 receivers. Don't attempt to adjust any controls inside the units. Once set at the factory, the various controls and trimmers do not drift with age or vibration and never require readjustment. **There are no adjustments inside that will make a malfunctioning unit start working**.

LECTROSONICS service department is equipped and staffed to quickly repair your equipment. In-warranty repairs are made at no charge in accordance with the terms of the warranty. Out of warranty repairs are charged at a modest flat rate plus parts and shipping. Since it takes almost as much time and effort to determine what is wrong as it does to make the repair, there is a charge for an exact quotation. We will be happy to quote approximate charges by phone for out of warranty repairs.

RETURNING UNITS FOR REPAIR

You will save yourself time and trouble if you will follow the steps below:

A. DO NOT return equipment to the factory for repair without first contacting us by letter or by phone. We need to know the nature of the problem, the model number and the serial number of the equipment. We also need a phone number where you can be reached 8 am to 4 pm (Mountain Standard Time).

B. After receiving your request, we will issue you a return authorization number (R.A.). This number will help speed your repair through our receiving and repair departments. The return authorization number must be clearly shown on the outside of the shipping container.

C. Pack the equipment carefully and ship to us, shipping costs prepaid. If necessary, we can provide you with the proper packing materials. UPS is usually the best way to ship the units. Heavy units should be "double-boxed" for safe transport.

D. We also strongly recommend that you insure the equipment, since we cannot be responsible for loss of or damage to equipment that you ship. Of course, we insure the equipment when we ship it back to you.

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(800) 821-1121
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Web: *http://www.lectrosonics.com*

email: *sales@lectrosonics.com*

SPECIFICATIONS AND FEATURES

Receiver

Operating Frequencies: 470 to 608 MHz, crystal controlled

Receiver Type: Dual conversion, superheterodyne

Frequency Stability: ±0.002 %

Front end selectivity: -22 dB at ±4 MHz

IF Selectivity: >90 dB at ±300 kHz (10.7 IF)

IF Frequency: 10.7 MHz (1st IF); 455 kHz (2nd IF)

IF bandwidth: ±150 kHz at ½ power points

Sensitivity
20 dB Sinad: 0.63 uV (-111 dBm), A weighted
60 dB Quieting: 1.0 uV (-107 dBm), A weighted

Squelch quieting: Greater than 125 dB

AM rejection: Greater than 60 dB, 2uV to 1 Volt (Undetectable after processing)

Modulation acceptance: ±75 kHz

Image and spurious rejection: > 98 dB

Third order intercept: –5 dBm

FM Detector: Digital Pulse Counting Detector

Antenna input: BNC female; 50 Ohm impedance

Audio outputs
Rear Panel XLR: Nominal 600 Ohm Balanced VAR: Variable –50 dBm to –30 dBm; FIXED: +8 dBm line level

Monitor out: Front panel 3.5mm stereo mini jack – high level output for stereo or mono phones @ 32 Ohms or higher – can be used as a high quality audio output.

Front Panel Controls and Indicators: Power on/off switch and LED; Dual function 10 segment LED level display; Pilot tone indicator; Monitor output jack and Level control

Rear Panel Connectors: XLR audio output jack; External 12VDC input

Rear Switch: Audio Output Range: VAR/FIXED

Power Options: 12V DC, 1.7 Watts (140 mA)

Weight: 16 ozs. (with batteries)

Dimensions: 3.2" wide x 1.22" high x 5.1" deep

System (UR195 receiver with UM195 transmitter)

Audio Processor: Dual band compandor with no pre-emphasis/de-emphasis

Total Harmonic Distortion
1 kHz: < 0.45% (60 kHz deviation)
30 Hz to 20 kHz: < 1% (30 kHz deviation)

Signal/Noise ratio: 60 dB, at 0.63 uV (-111 dBm) signal input, A-weighted 109 dB for full quieting, A weighted

Frequency Response: ±1 dB, 30 Hz to 21 kHz, 400 Hz reference, 30 kHz deviation

LIMITED ONE YEAR WARRANTY

The equipment is warranted for one year from date of purchase against defects in materials or workmanship provided it was purchased from an authorized dealer. This warranty does not cover equipment which has been abused or damaged by careless handling or shipping. This warranty does not apply to used or demonstrator equipment.

Should any defect develop, we will, at our option, repair or replace any defective parts without charge for either parts or labor. If we cannot correct the defect in your equipment, we will replace it at no charge with a similar new item. We will pay for the cost of returning your merchandise to you.

This warranty applies only to items returned to us, shipping costs prepaid, within one year from the date of purchase.

This warranty gives you specific legal rights. You may have additional legal rights which vary from state to state.

LECTROSONICS, INC.

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July 6, 1999