# T5

## MULTI-FREQUENCY IFB TRANSMITTER
## EURO MODEL

## OPERATING INSTRUCTIONS
## and trouble-shooting guide

**LECTROSONICS, INC.**
**www.lectrosonics.com**

CE 0885

# INTRODUCTION

Thank you for selecting the Lectrosonics frequency agile, narrowband, T5 IFB transmitter. The T5 is the result of over 80 years of engineering experience with the very latest components, in a design that addresses the most demanding professional applications.

The Lectrosonics T5 IFB Transmitter along with the companion R5 IFB Receiver allow on-air talent to monitor program audio and receive cues from video directors and other production personnel.

The design of the T5 IFB Transmitter was the direct result of numerous conversations with users, production personnel and dealers across the US. The specific concerns and needs brought up in these conversations led directly to the development of the operational features offered on the T5. Two hundred fifty six frequencies are user selectable in 100 kHz or 25 kHz steps to alleviate interference problems in travelling venues. 100 kHz channel spacing is standard. 25 kHz channel spacing can be programmed into a unit by the factory or by authorized service centers.

The T5 IFB Transmitter is a rugged, machined aluminum package. The input section is adjustable for virtually any microphone or line level audio source. Level indicating LEDs are provided on the control panel to make level settings quick and accurate, without having to view the receiver. The antenna is a detachable, locking 1/4 wavelength flexible bronze cable that connects to a 50 Ohm mini-jack on the transmitter.

Only the T5 IFB Transmitter is covered in this manual. Companion receivers are covered in separate manuals. The T5 IFB Transmitter will operate with any Lectrosonics R5 IFB Receiver in the same frequency group.

# TABLE OF CONTENTS

INTRODUCTION ..... 2

GENERAL TECHNICAL DESCRIPTION ..... 3

FRONT PANEL CONTROLS AND FUNCTIONS ..... 5

REAR PANEL CONTROLS AND FUNCTIONS ..... 6

INSTALLATION AND OPERATION ..... 7

OPERATING NOTES ..... 7

MODE SWITCHES AND GROUND LIFT JUMPER ..... 8

TROUBLESHOOTING ..... 9

FREQUENCY BLOCKS AND RANGES ..... 10

REPLACEMENT PARTS and ACCESSORIES ..... 10

SPECIFICATIONS AND FEATURES ..... 11

WARRANTY ..... Back cover

*The T5 IFB transmitter is FCC type accepted under Part 74: 470 - 608MHz and 614 - 806MHz*

# GENERAL TECHNICAL DESCRIPTION

The T5 IFB Transmitter is comprised of a number of functional sub-systems as shown in the block diagram below.

### GENERAL

The T5 is designed to operate with the Lectrosonics R5 IFB Receiver and features microprocessor control of 256 frequencies of operation within any one of at least thirteen frequency bands. (See page 10.)

The T5 uses 20kHz deviation for an efficient use of bandwidth. The transmitter circuits are all regulated for frequency stability and high audio performance. The input amplifier is a discreet differential circuit which can be adjusted to allow the use of many different input sources.

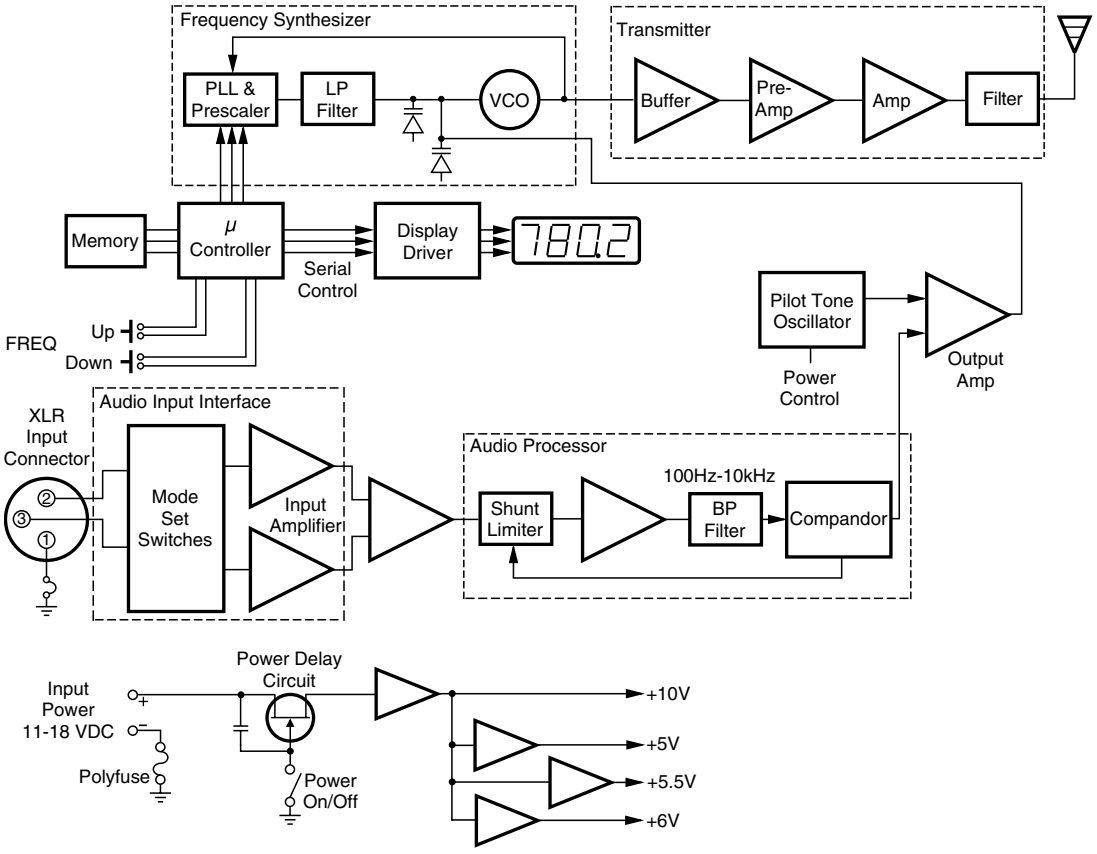
### AUDIO INPUT

The input sensitivity and XLR pin functions can be customized using a clever dip switch circuit. Several different combinations of gain and input hookup are possible without rewiring the mic connector. Pin 1 of the XLR input connector is normally connected directly to ground but an internal jumper can be moved if a floating input is desired.

The Audio (+) and (–) are “dry” inputs and can each withstand +/- 50Vdc. Direct connection to a phone line can damage the inputs.

### AUDIO PROCESSOR

The Audio Processor section has several functions. Audio limiting is accomplished in the Shunt Limiter while the Bandpass filter limits the audio bandwidth to 100Hz at the low end and 10kHz in the upper range. The single band compandor circuit is one half of a system that requires a matching receiver to decode the signal and restore it to its original dynamic range.




*T5 IFB Transmitter Block Diagram*

# GENERAL TECHNICAL DESCRIPTION

### COMPANDOR NOISE REDUCTION

The single band compandor is a high quality audio device that processes the input signal such that the large dynamic ranges of input signal can be transmitted to the receiver without overload or noise. A complementary system in the receiver recovers the original dynamics of the signal for full audio quality. Compression and expansion ratios are complementary at 2:1. High frequency pre-emphasis is implemented in the transmitter to provide another 10dB signal to noise improvement. Matching de-emphasis is provided in all receivers.

### PILOT TONE

The T5/R5 system utilizes an ultrasonic tone modulation of the carrier to operate the receiver squelch. This “pilot tone” consists of a 29.997kHz signal mixed with the audio signal, just after the compandor, to control the audio output muting of the receiver. The 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 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. This is extremely important in applications that include an automatic microphone mixer.

### FREQUENCY AGILITY

The transmitter uses a synthesized, frequency selectable main oscillator. The frequency is extremely stable over a wide temperature range and over time. Two push-button switches, located on the front panel of the unit, provide 256 frequencies in 100 kHz or 25 kHz steps over a 25.5 MHz range. This alleviates carrier interference problems in mobile or travelling applications.

### MICROCONTROLLER

Frequency adjustment and display are handled by the microprocessor. Nonvolatile memory is provided for holding the last frequency used even if power is removed from the unit for any length of time. Each time the transmitter is powered up it will display the last frequency used.

### TRANSMITTER

The T5 transmitter operates at 50mW*. The transmitter circuits are buffered and filtered for exceptional spectral purity. The extra clean signal that results reduces the chances for interference between multiple transmitter installations.

### ANTENNA

At UHF frequencies, where wavelengths and antennas are shorter than at VHF frequencies, a resonant length antenna is preferred. The antenna on the T5 consists of a flexible 1/4 wavelength bronze cable, detachable via a BNC
connector.

### POWER DELAY

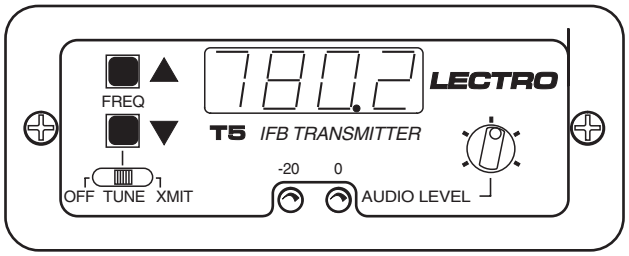
There is a 5 second power on delay to prevent audio thumps when switching from XMIT to TUNE or from TUNE to OFF. This delay also gives the PLL synthesizer time to fully stabilize. When the transmitter is powered OFF the Pilot Tone is first turned off muting the audio at the receiver before the rest of the transmitter is powered down preventing clicks, thumps or feedback from entering the sound system. When switching the power off then back on, always allow the display to extinguish before switching the power back on.

* May be 10mW depending on destination country.

# FRONT PANEL CONTROLS AND FUNCTIONS

**OFF/TUNE/XMIT Switch**

OFF - The unit is powered off.
TUNE - Enables the up and down frequency buttons and inhibits the transmitter section.
XMIT - Normal operation. In this position of the switch the unit is transmitting a modulated signal to the corre sponding receiver and the FREQ buttons are locked out.




*T5 Front Panel*

**POWERUP SEQUENCE**

When the unit is switched on (to TUNE or XMIT), the display cycles to:
1. "TEST MODE" momentarily illuminates all display segments (8.8.8.8.)
2. Momentarily shows firmware version number, (i.e. 4.0)
3. Displays frequency in MHz.

**DISPLAY INTENSITY**

The LED display brightness may be adjusted from 1 to 15, 15 being the highest intensity. To adjust the display intensity, turn the power off then hold the FREQ up button while turning the unit back on. The display will show the current setting. Use the FREQ up and FREQ down buttons to adjust the brightness setting. When finished turn the unit off, wait until the display extinguishes (about 4 seconds), then turn the unit back on.

**FREQ Buttons (Up and Down)**

The transmitter frequency is changed with these momentary buttons. Each push will change the frequency in 100 or 25 kHz increments. The FREQ buttons are enabled when the OFF/TUNE/XMIT switch is in the TUNE position. They are inoperative in the OFF and XMIT positions. When held in for more than 5 seconds, the speed of change increases to about five channels per second. When the highest or lowest frequency is reached, the unit will wrap around and continue in the same direction at the other end of the range. The T5 will "remember" the last channel used when powered off and will come on at that frequency.

**AUDIO LEVEL Control**

Used to adjust the audio input level for proper modulation. The gain range is +/-15dB. The reference for this control can be changed with the rear panel MODE switches. See the INSTALLATION AND OPERATION section for more information on the MODE switches.

**-20/0 LEDs**

These modulation LEDS indicate the proper setting of the MIC LEVEL control.

**-20 LED** - Flickers or glows when sufficient audio is present.

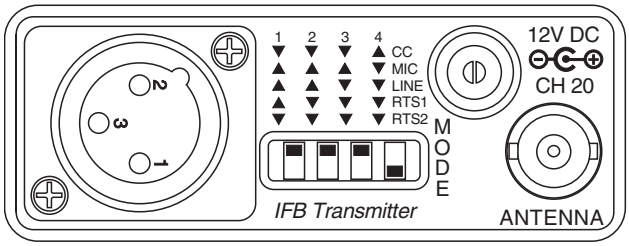
**0 LED** - Lights up when the input level is high enough to cause limiting. The input limiter has a very high overload threshold. Generally speaking, some limiting is desirable in normal operation to improve the signal to noise ratio of the system. The limiting action is not audible and does not create distortion.

**LED DISPLAY**

For normal 100 kHz frequency spacing, this 4-digit display indicates hundreds of MHz to the nearest 0.100 MHz. When the unit is programmed for 25 kHz spacing, the display indicates the six digit channel frequency which the unit is tuned to by shifting digits. The display will normally indicate frequency to the nearest 0.1 MHz, the four most significant digits and a decimal point. (example: 685.3) Frequency to .01 MHz resolution (fifth digit) is displayed by pressing the FREQ UP or DOWN button. The display will shift out the first (100 MHz) digit on the left and shift in the fifth (.01 MHz) digit on the right. (example: 685.3 shifts to 85.32 to indicate 685.325 MHz) The 5 kHz (.005 MHz) digit (sixth digit) of the 25 channel spacing is not displayed but is determined from the 10 kHz digit. (example: 685.30 = 685.300, 685.32 = 685.325, 685.35 = 685.500, and 685.37 = 685.375)

The display LEDs indicate low input power by blinking continuously on and off when the input voltage drops below 11.0 volts. The transmitter will shut off when the input voltage drops below 8.0 volts.

# REAR PANEL CONTROLS AND FUNCTIONS




*T5 Rear Panel*

**XLR JACK**

Standard XLR female jack will accept a variety of input sources depending on the MODE switches. The pin functions can be changed to suit the source depending on the** positions of the MODE switches. For detailed information on the MODE switches see the INSTALLATION AND OPERATION section.

**MODE Switches**

These dip switches adjust the audio input to accommodate a variety of audio sources. The rear panel is marked with the most common switch combinations.

CC = Clear Com (unbalanced)
MIC = Mic level (balanced)

For detailed information on these switches see the INSTALLATION AND OPERATION section.

**12V DC**

External power input. The nominal voltage to operate the unit is 12 VDC but any voltage in the range of 11 VDC to 18 VDC will work. Current consuption is 250 mA maximum.

**ANTENNA**

This is a standard BNC connector which can accept an integral whip or a cable to a remote antenna.

# INSTALLATION AND OPERATION

**1)** Pin 1 of the XLR input jack is normally tied directly to ground inside the unit. If a floating connection is desired, move the ground lift jumper inside the unit. (See next page for the location of the ground lift jumper.)

**2)** Set the MODE switches on the rear panel to match the specific input source to be used. (See next page for details on setting the MODE switches.)

**3)** Insert the power supply plug into the 12VDC jack on the rear panel.

**4)** Insert the microphone plug into the input jack, aligning the pins; be sure that the connector locks in.

**5)** Attach the antenna to the BNC connector on the rear panel.

**6)** Mute the sound system.

**7)** Turn the transmitter power switch to the "TUNE" position.

**8)** Adjust the transmitter to the desired frequency with the FREQ up and FREQ down buttons on the front panel. Each push changes the frequency by 100 or 25 kHz and if the button is held down the frequency will automatically change at a slow rate of 1 channel per second. If the button is held down for more than 5 seconds the frequency will automatically increase and decrease at a faster rate of about 5 channels per second.

**9)** Position the microphone in the location you will use in actual operation.

**10)** While speaking at the same voice level that will actually be used, observe the MODULATION LEDs. Adjust the AUDIO LEVEL control knob until the LEDs begin to light. Start at a low setting where neither LED lights as you speak. Gradually, turn the gain up until one LED lights, then the other. The -20 LED lights when the audio level is about 20dB below full modulation. The "0" LED lights when the limiter begins to operate. There is over 15dB of limiting range without overload above the "0" LED. It is desirable that it lights up 5-10 percent of the time during use.

**11)** Once the gain has been adjusted, the audio system audio can be turned on to make level adjustments. Set the power switch to the XMIT position and adjust the receiver and/or sound system level as required. **Please note,** there will be a delay between the moment the switch is thrown and the time when audio will actually **appear at the receiver output.** This intentional delay eliminates turn on thumps, and is controlled by the pilot tone squelch control.

# OPERATING NOTES

The AUDIO LEVEL control knob should not be used to control the volume of your sound system or recorder levels. This gain adjustment matches the transmitter gain to the appropriate input level.

If the audio level is too high — both LEDs will light frequently or stay lit. This condition may reduce the dynamic range of the audio signal.

If the audio level is too low — neither LED will light, or the -20 LED will light dimly. This condition may cause hiss and noise in the audio, or pumping and breathing in the background noise.

The "-20" LED turns on approximately 20dB below full deviation. The "0" LED turns on at full deviation and indicates that the input shunt compressor is operating. The input limiter will handle peaks over 15dB above full modulation, regardless of the gain control setting. The limiter uses a true absolute value circuit to detect both positive and negative peaks. The attack time is 5 milliseconds and the release time is 200 milliseconds. Occasional limiting is desirable, indicating that the gain is correctly set and the transmitter is fully modulated for optimum signal to noise ratio. Different voices will usually require different settings of the AUDIO LEVEL control, so check this adjustment as each new person uses the system. If several different people will be using the transmitter and there is not time to make the adjustment for each individual, adjust it for the loudest voice.

# MODE SWITCHES AND GROUND LIFT JUMPER

### MODE Switches

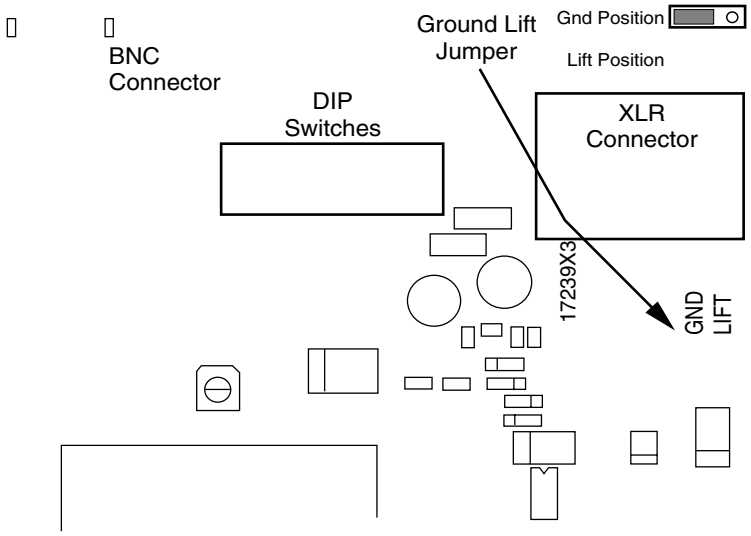
The MODE switches allow the T5 to accommodate a variety of input sources by changing the input sensitivity and the pin functions of the input XLR jack. Marked on the rear panel are the most common settings. Each setting is detailed below. Switches 1 and 2 adjust the XLR pin functions while switches 3 and 4 adjust the input sensitivity.

| Name | Switch Positions 1 2 3 4 | XLR Pins | Balanced? | * Input Sensitivity |
|---|---|---|---|---|
| CC | ▼▼▼▲ | 3 = Audio<br>1 = Common | No | -6 dBu |
| MIC | ▲▲▲▼ | 2 = Hi<br>3 = Lo<br>1 = Common | Yes | -40 dBu |
| LINE | ▲▲▼▼ | 2 = Hi<br>3 = Lo<br>1 = Common | Yes | +4 dBu |
| RTS1 | ▲▼▼▼ | 2 = Hi<br>1 = Common | No | +4 dBu |
| RTS2 | ▼▼▼▼ | 3 = Hi<br>1 = Common | No | +4 dBu |

** Approximate sensitivity with the "AUDIO LEVEL" control at mid-position and 1kHz signal.*

### GROUND LIFT JUMPER

The T5 transmitter is shipped with pin 1 of the XLR input connector tied directly to ground. If a floating input is desired, a ground lift jumper is provided. This jumper is located inside the unit on the PC board near the rear panel XLR jack. Place the jumper in the desired position as shown in the figure below.




*Location of Ground Lift Jumper*

# TROUBLESHOOTING

| SYMPTOM | POSSIBLE CAUSE |
|---|---|
| **DISPLAY NOT LIT OR BLINKING ON AND OFF** | • External power supply disconnected or inadequate.<br>• The External DC power input is protected by an auto-reset polyfuse. Disconnect power and wait about 10 seconds for the fuse to reset. |
| **NO TRANSMITTER MODULATION LEDs** | • AUDIO LEVEL turned all the way down.<br>• Mic capsule is damaged or malfunctioning.<br>• Mic cable damaged or mis-wired. |
| **NO RECEIVED SIGNAL** | • Transmitter not turned on.<br>• Receiver antenna missing or improperly positioned. (The headset cable is the antenna.).<br>• Transmitter and receiver not on same frequency. Check on transmitter and receiver.<br>• Operating range is too great.<br>• Transmitter antenna not connected.<br>• Transmitter switch in the TUNE position. Switch to XMIT mode. |
| **NO SOUND (OR LOW SOUND LEVEL), RECEIVER LED IS ON** | • Receiver output level set too low.<br>• Receiver earphone cable is defective or mis-wired.<br>• Sound system or transmitter input is turned down. |
| **DISTORTED SOUND**<br>lamps | • Transmitter gain (audio level) is far too high. Check mod level<br>on transmitter as it is being used. (Refer to Operating Instructions section for details on gain adjustment.)<br>• Receiver output may be mismatched with the headset or earphone. Adjust output level on receiver to the correct level for the headset or earphone.<br>• Excessive wind noise or breath “pops.” Reposition microphone and/or use a larger windscreen.<br>• Transmitter is not set to same frequency as receiver. Check that frequency on receiver and transmitter match. |
| **HISS AND NOISE, AUDIBLE DROPOUTS** | • Transmitter gain (audio level) far too low.<br>• Receiver antenna missing or obstructed. (The headset cable is the antenna.)<br>• Transmitter antenna missing or mismatched. Check that the correct antenna is being used<br>• Operating range too great.<br>• Defective antenna or cable. |

# FREQUENCY BLOCKS AND RANGES

The table below lists the factory designated frequency ranges available for the T5 IFB Transmitter.

Each T5 transmitter is built to cover a pre-selected range of frequencies (a “block”) as shown below. The transmitter will tune to any of 256 different frequencies within this factory assigned block.

The block number is determined by this formula:

25.6 × Freq. (MHz) = Lowest freq. (MHz) in the block

To determine a block number from a frequency:

Freq. (MHz) divided by 25.6 = Block number

It is handy to remember these formulas, in case you do not have a copy of the table. For example, suppose you need to know which block covers 685.500 MHz, without using the table:

685.500 divided by 25.6 = 26.77734375

The first two digits left of the decimal are the block number. In this case, 685.500 MHz falls within block 26.

The T5 IFB transmitter antennas are color coded to indicate the frequency block that they operate within. The length of the antenna varies with the frequency block. The actual length of the antenna is not as critical as it might appear in the table below. The usable bandwidth of the A6U antennas are +/- 50 MHz from the center frequency, so it is acceptable to use an antenna from an adjacent block above or below the operating frequency is some loss in range can be tolerated.

The color of the antenna sleeve is in keeping with standard resistor value color codes for the second digit of the block number.

| BLOCK | FREQUENCY RANGE | ANT SLEEVE COLOR | ANTENNA WHIP LENGTH |
|---|---|---|---|
| 21 | 537.600 - 563.100 | Brown | 4.74" |
| 22 | 563.200 - 588.700 | Red | 4.48" |
| 23 | 588.800 - 614.300 | Orange | 4.24” |
| 24 | 614.400 - 639.900 | Yellow | 4.01" |
| 25 | 640.000 - 665.500 | Green | 3.81" |
| 26 | 665.600 - 691.100 | Blue | 3.62" |
| 27 | 691.200 - 716.700 | Violet (Pink) | 3.46" |
| 28 | 716.800 - 742.300 | Grey | 3.31" |
| 29 | 742.400 - 767.900 | White | 3.18" |
| 30 | 768.000 - 793.500 | Orange/Black | 3.08" |
| 31 | 793.600 - 819.100 | Orange/Brown | 2.99” |
| 32 | 819.200 - 844.700 | Orange/Red | 2.92” |
| 33 | 844.800 - 865.000 | Orange/Orange | 2.87” |

# REPLACEMENT PARTS and ACCESSORIES

| Part No. | Description |
|---|---|
| 21586 | DC16A Pigtail power cable, LZR to strip & tin |
| A500 RA B(block #) | Antenna, flex |

# SPECIFICATIONS AND FEATURES

| | |
|---|---|
| **Operating Frequencies:** | 525.0 MHz to 862.0 MHz (See page 10.) |
| **Frequencies (Channels per block):** | 256 |
| **Channel Spacing:** | 100 kHz Standard (Programmable for 25 kHz spacing.) |
| **Spurious & Harmonic Suppression:** | 40 dB below carrier at freq. above 1 GHz<br>70 dB below carrier at freq. below 1 GHz |
| **Frequency Stability:** | ±.002% (20 ppm) @ 25° C |
| **Temperature Stability:** | ±.005% (50 ppm) from -30° C to +50° C |
| **Channel Selection:** | Momentary pushbutton switches, TUNE Up and Down |
| **Pilot Tone:** | 29.997 kHz |
| **Modulation:** | FM, ±20 kHz deviation audio, ± 4.5 kHz pilot tone |
| **Audio Response:** | 100 Hz to 10 kHz, ±1 dB, -3dB (system response) |
| **Audio Compressor:** | 2 to 1 |
| **RF Power Output:** | 50 mw, nominal |
| **Output Impedance:** | 50 ohms |
| **Audio Input Levels:** | +4 dBu, -6 dBu, and -40 dBu, dry inputs, (no phantom power and isolated inputs for +/-50Vdc max,) rear panel selectable for Line, Mic, RTS 1, RTS 2, and Clear Comm |
| **Audio Input Config:** | Balanced and Unbalanced, rear panel selectable for Line, Mic. RTS 1, RTS 2, and Clear Comm |
| **Audio Input Impedance:** | Greater than 2K balanced, greater than 1K unbalanced at any gain setting |
| **Gain Control Range:** | 43 dB, Semi-log Rotary control |
| **Audio Input Jack:** | Standard XLR female connector |
| **Input Power:** | 12 to 14 VDC typical, 250 ma. max.; Max. Input Range 11 to 18 VDC |
| **Power Input Jack:** | Coax type, locking LZR RL26AE |
| **Indicators:** | LED for -20 dB modulation<br>LED for 0 dB modulation<br>4 Digit 7-segment LED displays for frequency and power on with adjustable brightness |
| **Front panel controls:** | Audio Level rotary knob<br>Power OFF-TUNE-XMIT, *3* position slide switch<br>TUNE Up momentary pushbutton switch<br>TUNE down momentary pushbutton switch |
| **Rear panel controls:** | Mode Select, 4 section DIP switch |
| **Weight:** | 9 Oz. |
| **Size:** | 5.25" long (including connectors) x 3.25" wide x 1.25" high |

*Specifications subject to change without notice.*

This product meets the CE Compliance Standards - ETS 300 445; January 1996 and I ETS 300 422 (December 1995). A copy of the Declaration of Conformity may be requested from your dealer or by contacting the factory directly:

Lectrosonics, Inc.
Marketing Department
581 Laser Rd. NE, Rio Rancho, NM 87124 USA
tel: 505-892-4501 fax: 505-892-6243 e-mail: marketing@lectrosonics.com

## 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, Lectrosonics, Inc. will, at our option, repair or replace any defective parts without charge for either parts or labor. If Lectrosonics, Inc. cannot correct the defect in your equipment, it will be replaced at no charge with a similar new item. Lectrosonics, Inc. will pay for the cost of returning your equipment to you.

This warranty applies only to items returned to Lectrosonics, Inc. or an authorized dealer, shipping costs prepaid, within one year from the date of purchase.

This Limited Warranty is governed by the laws of the State of New Mexico. It states the entire liablility of Lectrosonics Inc. and the entire remedy of the purchaser for any breach of warranty as outlined above. NEITHER LECTROSONICS, INC. NOR ANYONE INVOLVED IN THE PRODUCTION OR DELIVERY OF THE EQUIPMENT SHALL BE LIABLE FOR ANY INDIRECT, SPECIAL, PUNITIVE, CONSEQUENTIAL, OR INCIDENTAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THIS EQUIPMENT EVEN IF LECTROSONICS, INC. HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. IN NO EVENT SHALL THE LIABILITY OF LECTROSONICS, INC. EXCEED THE PURCHASE PRICE OF ANY DEFECTIVE EQUIPMENT.

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

## 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 interconnecting cords and then go through the TROUBLESHOOTING 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 for repair and service. 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, INC.**

**581 LASER ROAD**
**RIO RANCHO, NM 87124 USA**

December 6, 2001