D4
Digital Wireless System

D4™
DIGITAL 4-CHANNEL

Fill in for your records:

Serial Number:

Purchase Date:

LECTROSONICS®
Rio Rancho, NM, USA
www.lectrosonics.com

# Table of Contents

Introduction

The D4 digital 4-channel wireless system was designed as a special purpose system for location production in film and television.

A typical application for this system is in television production as part of what is commonly called a "bag system." A portable mixer and several wireless microphone receivers are carried in an over-shoulder carrying case. The D4T transmitter is connected to the outputs of the mixer to transmit up to four audio channels to one or more D4R receivers mounted on video cameras.

The system is designed for line level analog audio signals and AES/EBU digital audio signals and can be set up as a 2-channel or 4-channel system with options that provide:

- Digital in/Digital out (< 1 mS latency)
- Digital in/Analog out
- Analog in/Digital out
- Analog in/Analog out (2.2 mS latency)

In the 4-channel mode, the D4 system operates on one of four 4.2 MHz channels in the 902 to 928 MHz band. Each channel carries four separate audio signals, digitally multiplexed within a common carrier. D4 systems can be run simultaneously on all four channels across the 902 to 928 MHz band to provide a total of 16 channels.

902 to 928 MHz Band			
907.776	912.384	916.992	921.600
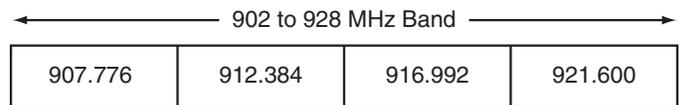
Center frequencies of the RF channels

A "spreading" technique is used in the design to increase immunity to noise and interference. The sampled audio signals are delivered to the FPGA where the spreading algorithm and encoding are applied.

The audio quality is suitable for any professional application in film, television and live sound. 48 kHz sampling and 24-bit A-D conversion assure excellent audio quality across a 20Hz to 20kHz audio bandwidth with only 0.05% distortion.

The LCD interface on the front panels make setup simple and straightforward. Power is provided by external sources from 6 to 16 VDC.

Rugged machined aluminum housings are finished in a Teflon impregnated nickle alloy plating with laser etched nomenclature for durability and legibility.

General Technical Description

D4T Transmitter

The transmitter can accept up to four inputs from digital or analog sources. Inputs 1 and 2 are selectable between two digital channels each or 1 balanced analog channel each and inputs 3 and 4 can each accept a single balanced analog signal.

The inputs can be configured as follows:

- Four balanced analog inputs using all four jacks
- Two digital channels using jack 1 and two balanced analog inputs using jacks 3 and 4
- Four digital channels using jacks 1 and 2

The input connectors are TA3 "mini XLR" types with the same pin numbering and configuration as standard XLR connectors for AES-EBU and balanced line level analog signals.

Input preamp circuits use a special balanced amplifier with very high common mode rejection to minimize hum and noise.

Analog input signals are sampled at 48kHz and converted to 24-bit digital audio and fed into the FPGA for further processing. The FPGA applies a spreading algorithm to expand the bandwidth of each channel to 4,2 MHz to improve immunity to interference and noise. The baseband signal is then delivered to the D-A to generate the I and Q signals for final output.

The modulated signal is filtered before and after the RF amp to suppress out of band noise and spurious signals. A circulator/isolator is used in the final RF output to minimize IM that can occur when external signals enter the output stage through the antenna. The isolator passes the transmitter output signal to the antenna but shunts returning signals to ground.

A USB port is provided to simplify firmware updates.
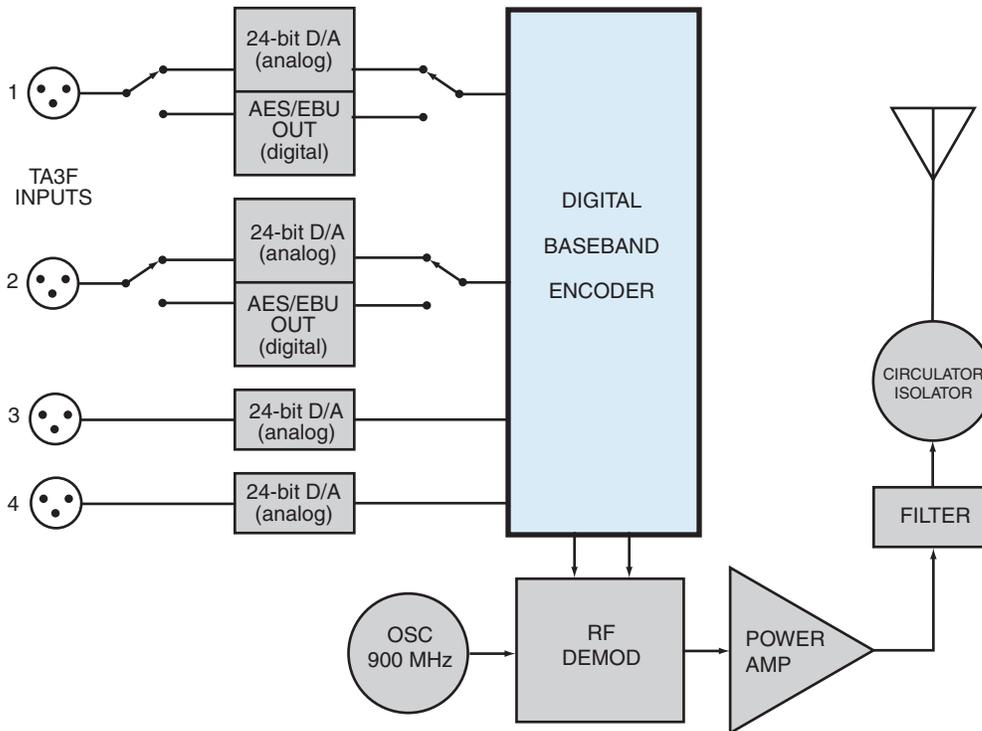
D4R Receiver

The receiver is essentially a mirror image of the transmitter. The incoming RF signal is converted back into the baseband signal that was generated in the transmitter, and the FPGA decodes the signal to generate the four audio channels in digital and analog formats as they appeared at the transmitter inputs.

Diversity reception is employed to suppress multipath dropouts, followed by SAW filters in the front-end to attenuate signals above and below the passband. The FPGA monitors and adjusts the level of the incoming RF signal to increase the dynamic range capabilities of the receiver.

From the IQ demodulator through the filters, amplifier and baseband ADC, the signal path and processing is the reverse of that in the transmitter. Decoding in the FPGA regenerates the original digital and analog audio signals and delivers them to the output stages.

The FPGA also delivers a signal to a DAC and amplifer for monitoring with headphones. The headphone output follows the receiver selected on the front panel.
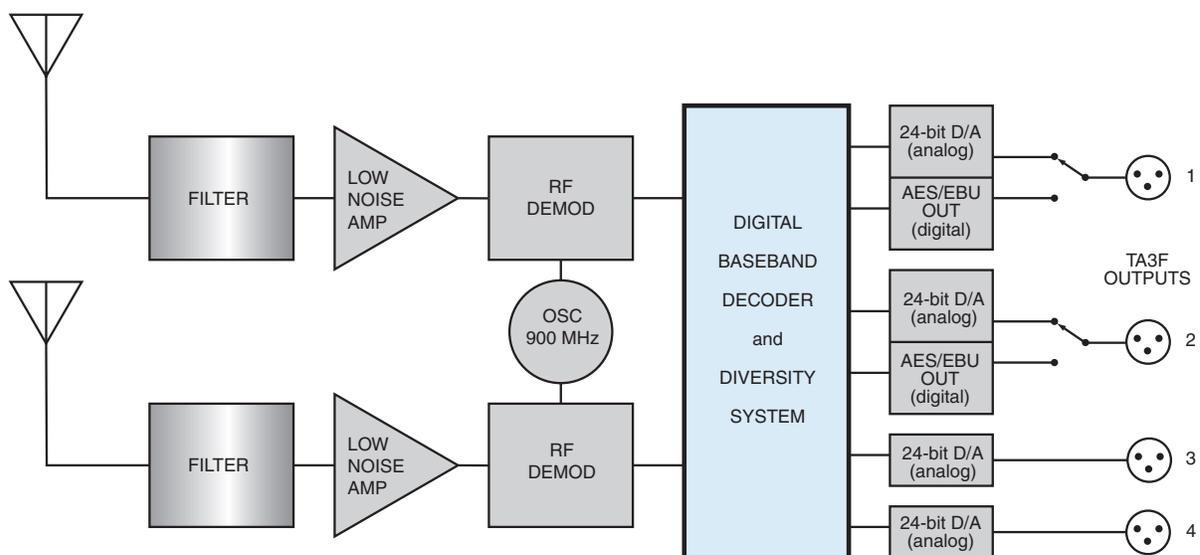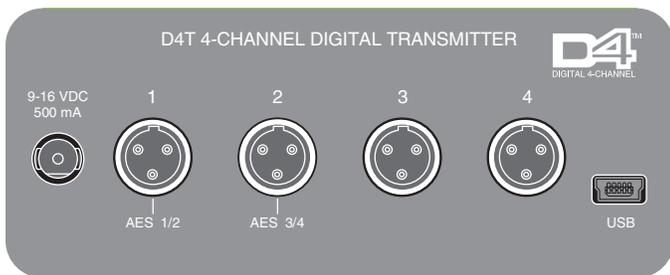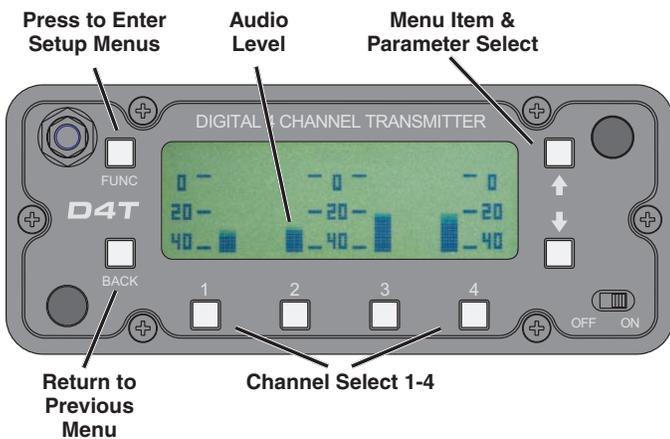
Front and Rear Panels

Setup and operation of the transmitter and receiver is a straightforward process using an LCD and push button interface on the front panels. The Main Window displays audio levels during operation, with a setup menu and screens to select operating modes and levels.

The rear panels provide the audio inputs and outputs, power receptacle and USB port. Channels 1 and 2 provide balanced analog signals and AES-EBU digital signals as selected from the LCD setup screens. Channels 3 and 4 are balanced analog audio only. The connectors are standard TA3M type.

The units are powered with an external source of 9 to 16 VDC, with power consumption of 500 mA for the transmitter and 250 mA for the receiver.

The USB port is used for firmware updates.

D4T Transmitter

Press to Enter Setup Menus **Audio Level** **Menu Item & Parameter Select**

Return to Previous Menu **Channel Select 1-4**

D4R Receiver

Press to Enter Setup Menus **Incoming RF level** **Audio Level** **Menu Item & Parameter Select**

Return to Previous Menu **Channel selected for headphone monitoring** **Channel Select 1-4** **Menu Item/Parameter Select Buttons**

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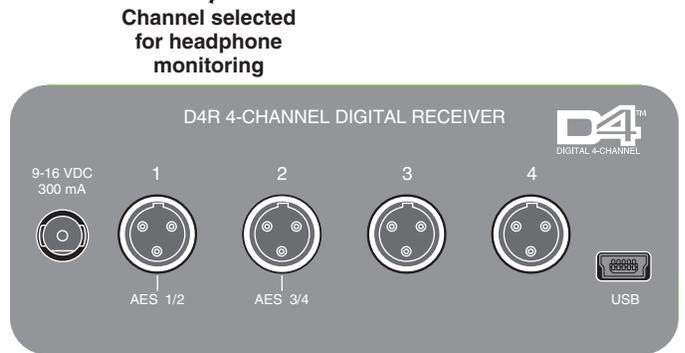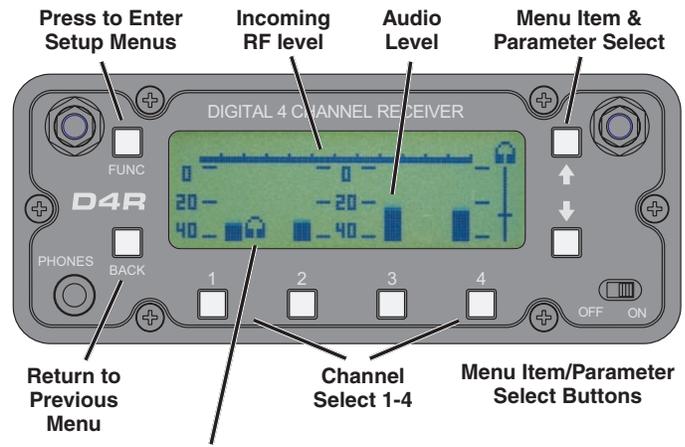
Transmitter Input Modes

The transmitter can be set up in three different configurations with the AES3 mode menu for 4-channel operation:

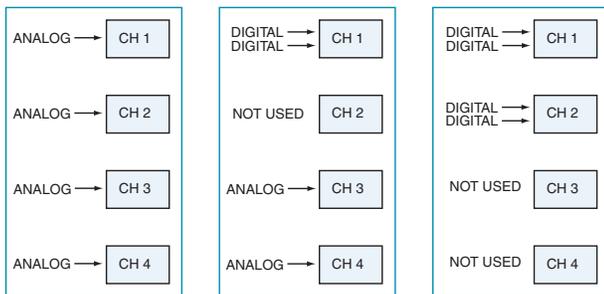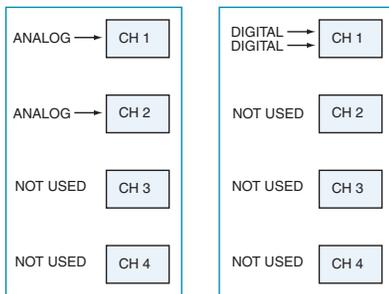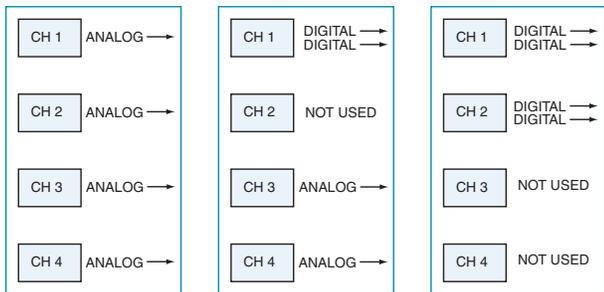| ANALOG → CH 1	DIGITAL DIGITAL → CH 1	DIGITAL DIGITAL → CH 1
ANALOG → CH 2	NOT USED → CH 2	DIGITAL DIGITAL → CH 2
ANALOG → CH 3	ANALOG → CH 3	NOT USED → CH 3
ANALOG → CH 4	ANALOG → CH 4	NOT USED → CH 4

Two different configurations are available for 2-channel operation:

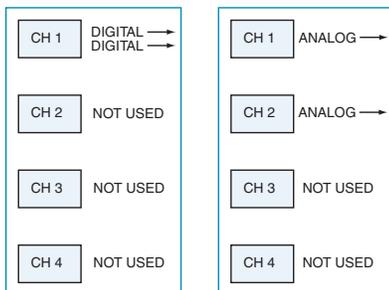| ANALOG → CH 1	DIGITAL DIGITAL → CH 1
ANALOG → CH 2	NOT USED → CH 2
NOT USED → CH 3	NOT USED → CH 3
NOT USED → CH 4	NOT USED → CH 4

Receiver Output Modes

The receiver audio outputs can be configured in the same manner as the transmitter for 4-channel operation:

CH 1 → ANALOG	CH 1 → DIGITAL DIGITAL	CH 1 → DIGITAL DIGITAL
CH 2 → ANALOG	CH 2 → NOT USED	CH 2 → DIGITAL DIGITAL
CH 3 → ANALOG	CH 3 → ANALOG	CH 3 → NOT USED
CH 4 → ANALOG	CH 4 → ANALOG	CH 4 → NOT USED

Two different configurations are available for 2-channel operation:

CH 1 → DIGITAL DIGITAL	CH 1 → ANALOG
CH 2 → NOT USED	CH 2 → ANALOG
CH 3 → NOT USED	CH 3 → NOT USED
CH 4 → NOT USED	CH 4 → NOT USED

Mixed Modes

The selected AES3 modes on the transmitter and receiver do not have to be identical. For example, analog signals can be fed into the transmitter from a mixer or wireless mic receivers, transmitted to the D4 receiver, which can be configured for four digital outputs to feed a digital recorder.

The sampling rate of the audio at the receiver digital outputs will always be at 48 kHz, regardless of the sampling rate of the signal fed into the transmitter.

NOTE: Transmitter and receiver must both be set to either the 2-channel or 4-channel mode.

Navigating the LCD

Navigation through setup screens is the same on transmitter and receiver. The Main Window will display audio levels for all active channels while the system is operating. Press the FUNC button to enter the setup menu.

Then press the UP and DOWN arrow buttons to select a menu item.
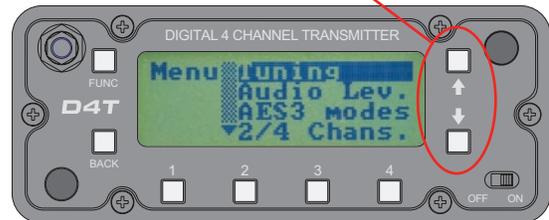
Press the FUNC button to enter the setup screen for the selected item. Then use the UP and DOWN arrow buttons to select a value or mode.

Press BACK once to return to the Menu or twice to return to the Main Wiindow.

System Setup Steps

The following steps are necessary to set up and operate the D4 system. Details for each step are on the next pages.

1) Attach antennas and power supplies to the transmitter and receiver.

2) Tuning Menu - select the same operating frequency on the transmitter and receiver.

3) 2/4 Channel Mode - set 2-channel or 4-channel modes the same on transmitter and receiver.

4) Select the AES3 modes on transmitter and receiver as needed for the connected equipment, mixer, recorder, etc. (see AES3 Modes)

5) Adjust audio input levels on the transmitter. (see Transmitter Audio Level Setup)

6) Adjust audio output levels of analog outputs on the receiver. (see Receiver Audio Level Setup)

7) Walk test the system to check for adequate operating range. If dropouts occur within the range needed, select a different operating frequency.

System Setup

Tuning Menu

Use UP/DOWN arrows to select menu item and press FUNC to enter setup

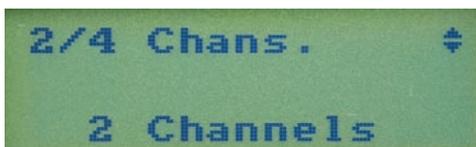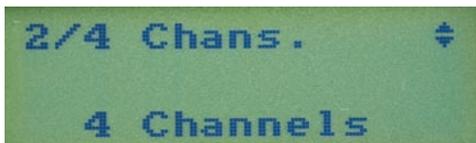Use UP/DOWN arrows to select channel, then press FUNC to return to menu

Tuning
Channel 1
907.776 MHz

2/4 Channel Modes

Use UP/DOWN arrows to select menu item and press FUNC to enter setup

Use UP/DOWN buttons to select desired mode

2/4 Chans.
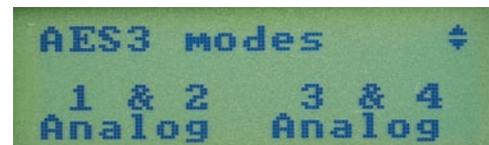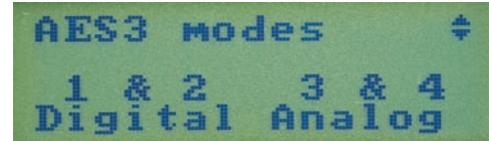**4 Channels**

2/4 Chans.
2 Channels

AES3 Modes

Use UP/DOWN arrows to select menu item and press FUNC to enter setup

Use UP/DOWN buttons to select desired mode

AES3 modes
1 & 2   3 & 4
Digital Digital

AES3 modes
1 & 2   3 & 4
Digital Analog

AES3 modes
1 & 2   3 & 4
Analog   Analog

Audio Level

Use UP/DOWN arrows to select menu item and press FUNC to enter setup

NOTE: The setup screens for Audio Level on the transmitter and receiver will be slightly different. See the next page for details.
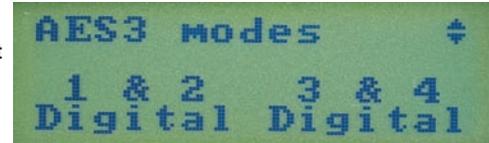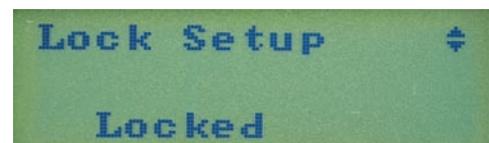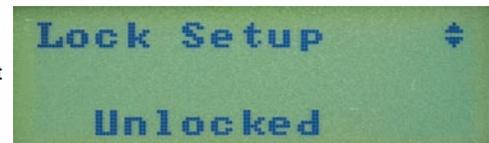
Locked/Unlocked Modes

Use UP/DOWN arrows to select menu item and press FUNC to enter setup

Use UP/DOWN buttons to select desired mode

Lock Setup
Unlocked

Lock Setup
Locked

D4T Transmitter
Audio Level Setup

Press FUNC and then select the menu item "Audio Lev. " and press FUNC again. The setup screen for audio level will vary slightly depending upon which AES3 mode has been selected. If the 2-channel mode has been selected, channels 3 and 4 will appear blank on the setup screen.

Use UP/DOWN arrows to select menu item and press FUNC to enter setup

When configured for four AES/EBU outputs, the channel levels will be preset to the AES standard.

When configured for two digital and two analog inputs, press the button under the analog channel to be adjusted and then use the UP and DOWN buttons to set the desired level.

In this example, the transmitter is configured for four analog channels. Select each channel with the button below it and use the UP and DOWN arrow buttons to set the desired level.

NOTE: The transmitter is designed for line level signals. There is no gain stage in the input section. Attenuation up to 20 dB can be applied to the input signal to reduce very high level signals to the optimal range for the transmitter.

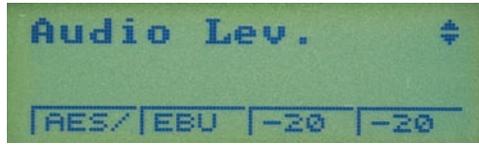# D4R Receiver
Audio Level Setup

Press FUNC and then select the menu item "Audio Lev. " and press FUNC again. The setup screen for audio level will vary slightly depending upon which AES3 mode has been selected. If the 2-channel mode has been selected, channels 3 and 4 will appear blank on the setup screen.

Use UP/DOWN arrows to select menu item and press FUNC to enter setup
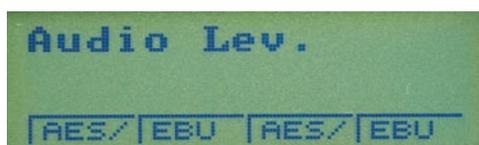
When configured for four AES/EBU outputs, the channel levels will be preset to the AES standard.

When configured for two digital and two analog inputs, press the button under the analog channel to be adjusted and then use the UP and DOWN buttons to set the desired level.
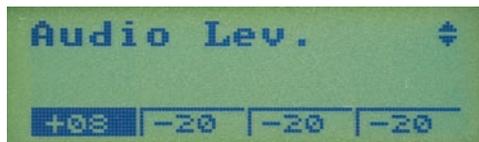
When configured for four analog outputs, press the button under the channel to be adjusted and then use the UP and DOWN buttons to set the desired level.

NOTE: The value shown in the setup screen on the receiver is the level of an analog signal in dBu at the output when the RF signal is fully modulated. AES/EBU outputs are preset to the industry standard value, so no adjustment is needed.

Antenna Placement and Orientation

The supplied antenna is a center fed half-wave type with a right angle elbow and rotating mount. For most applications, the whip antennas should be vertically oriented to provide a circular coverage pattern. In other orientations, the transmitter antenna should be parallel with and not directly above or below the receiver antennas.
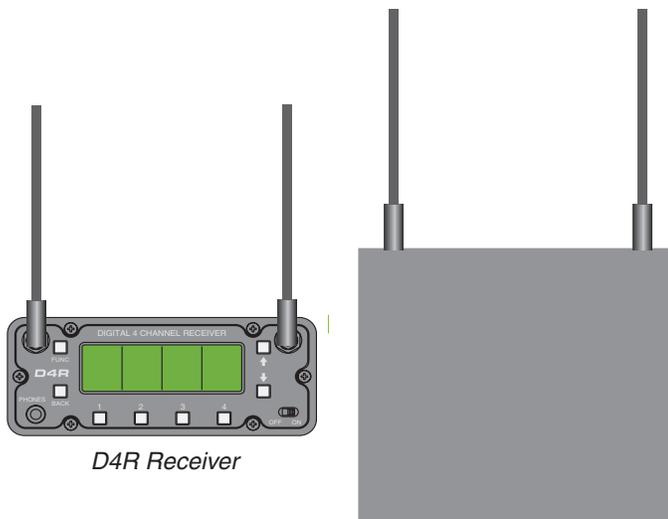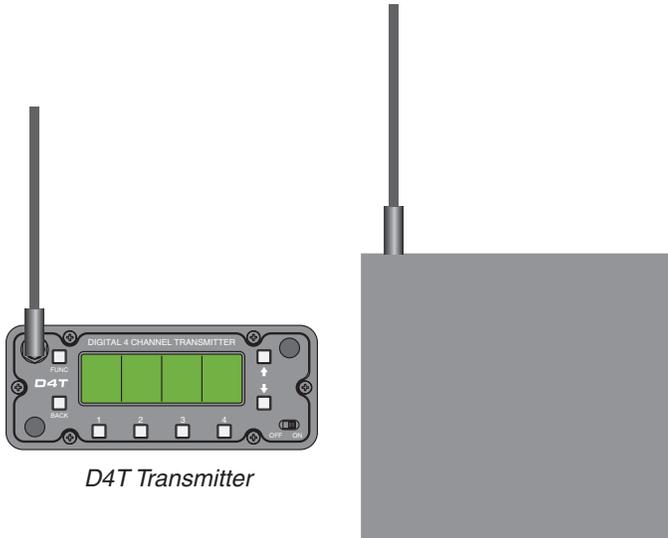

D4T Transmitter

D4R Receiver

Frequency Selection

For a single system, any of the four frequencies can be used for normal operation. With multiple systems operating in the same location, select a different frequency for each system.

Walk test each system through the area where it will be operating and listen for dropouts while observing the RF level indicator on the receiver LCD. It is best to have all equipment in the location turned on to check for interference and short operating range.

If the RF level on the receiver LCD indicates a weak overall level, try re-positioning the antennas. Re-orienting the antennas or moving them even a few inches away from nearby surfaces can also make a difference.

If dropouts are experienced during the walk test, but the RF level at the receiver remains strong, there could be interference on that frequency band. Switch the system to another frequency and walk test the system again to check for adequate operating range.

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Replacement Parts and Accessories

Power Supply

Lectrosonics PS70 (non-locking)
AC power supply with 60320 universal socket on housing, 100-240 VAC, 50/60 Hz, 1.6 A (max) input; 13.8 VDC, 2.8A, 40 W (max) output. Specify the AC power cord needed for your country or application.

Power Input Plug and Cables

- Shogyo MP121CR locking plug (no cable)
- Lectrosonics 21425 straight, non-locking plug with 6 ft. cable
- Lectrosonics 21472 right angle, non-locking plug with 6 ft. cable

Specifications

Overall System

Operating Spectrum:	902 - 928 MHz
Center frequencies (MHz):	907.776, 912.387, 916.992, 921.600
	Four systems can operate simultaneously for a total of 16 audio channels.
Modulation Type:	QPSK with spreading to 4.2 MHz
Sampling Rate:	48 kHz
Latency (overall system):	
Digital In/Digital Out:	Less than 1 mS
Analog In/Analog Out:	2.2 mS
Selectable Audio Channels:	• 4 digital
	• 2 digital, 2 analog
	• 4 analog
Audio Performance (overall system):	
Frequency Response:	20 Hz - 20 kHz
THD:	0.05 %

D4T Transmitter

Power output:	200 mW; spreading algorithm across 4.2 MHz bandwidth
Power requirements:	9 - 16 VDC
Power consumption:	500 mA
Dimensions:	4 x 4 x 1.5 inches
Weight:	

D4R Receiver

D4R Receiver

Power requirements:	9 - 16 VDC
Power consumption:	250 mA
Dimensions:	4 x 4 x 1.5 inches
Weight:	346 grams; 12.2 ozs.

FCC Notice

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. The equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help

Changes or modifications to this equipment not expressly approved by Lectrosonics, Inc. could void the user's authority to operate it.

Industry Canada Notices:

Operation of this device is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept interference, including interference that may cause undesired operation of the device.

This device has been designed to operate with the antenna listed below, and having a maximum gain of 6 dB. Antennas not included in this list or having a gain greater than 6 dB are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

Linx Technologies model: ANT-916-CW-HWR-RPS

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that permitted for successful communication

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 the interconnecting cables and then go through the **Troubleshooting** section in this 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' 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

For timely service, please follow the steps below:

A. DO NOT return equipment to the factory for repair without first contacting us by email 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 A.M. to 4 P.M. (U.S. 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.

Lectrosonics USA:

Mailing address:	**Shipping address:**	**Telephone:**
Lectrosonics, Inc.	Lectrosonics, Inc.	(505) 892-4501
PO Box 15900	581 Laser Rd.	(800) 821-1121 Toll-free
Rio Rancho, NM 87174	Rio Rancho, NM 87124	(505) 892-6243 Fax
USA	USA	

Web:	**E-mail:**
www.lectrosonics.com	sales@lectrosonics.com

Lectrosonics Canada:

Mailing Address:	**Telephone:**	**E-mail:**
49 Spadina Avenue,	(416) 596-2202	Sales: colinb@lectrosonics.com
Suite 303A	(877) 753-2876 Toll-free	Service: joeb@lectrosonics.com
Toronto, Ontario M5V 2J1	(877-7LECTRO)	
	(416) 596-6648 Fax	

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.

LECTROSONICS®

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27 February 2009