UCR411

TECHNICAL DATA

Digital Hybrid Wireless™ Compact Receiver

Feature Highlights

- Digital Hybrid Technology*
- SmartSquelch™
- SmartDiversity™
- SmartNR™ noise reduction
- 256 selectable UHF frequencies
- Auto-tracking front-end filters
- Constant group delay SAW filter
- Digital pulse counting detector
- DSP-based pilot tone
- Graphics type backlit LCD display
- Balanced XLR audio output
- Internal batteries or external DC powering options

The UCR411 receiver provides professional performance and a versatile feature set in a compact design for field and location production. All settings are made from the front panel with a powerful LCD interface, making the unit ideal for use in Quad Paks, on sound carts, in portable bags and in rack mount multi-couplers. To alleviate interference problems in an increasingly congested RF spectrum, an RF spectrum analyzer is built into the receiver. The receiver tunes across its 25.6 MHz tuning range and records RF activity with markers on the LCD screen. Finding clear operating frequencies is a quick, simple process. The UCR411 is compatible with all 400 Series Lectrosonics wireless transmitters and can be powered with internal 9V batteries or external DC.

The mechanical design of the receiver combines field proven features developed over many years of experience in motion picture and television production markets. The machined aluminum housing and panels are surfaced with electrostatic powder coated and anodized finishes with laser etched markings to withstand the rigors of field production.

***US Patent Pending**

Digital Hybrid Technology*

An industry first, this proprietary combination of digital audio and analog RF provides the superb audio quality of a pure digital system and the outstanding operating range of the finest FM wireless systems. The digital audio chain eliminates a compandor and its artifacts, and provides audio frequency response flat to 20 kHz. The RF link takes advantage of the spectral efficiency characteristics of an aggressively optimized FM radio system.

SmartSquelch™

A conventional squelch design faces several compromises.

- Squelch too aggressively and audio may be lost.
- Squelch too little and excessive noise may be heard.
- Respond too rapidly and the audio will sound “choppy.”
- Respond too sluggishly and entire words or syllables can be cut off.

SmartSquelch™ achieves an optimal balance of these trade-offs by combining several techniques that remove distracting noise without the squelching action itself becoming a distraction. The circuitry will perform the following functions:

- Wait for a complete word or syllable before squelching.
- Assess recent squelching history and RF signal strength.
- Assess audio content to determine available masking.

By adjusting squelching behavior dynamically for the optimal result under varying conditions, the receiver can deliver acceptable audio quality from otherwise unusable signals.

SmartDiversity™

Microprocessor controlled antenna phase combining is utilized for diversity reception to keep the receiver small, yet still deal effectively with multi-path dropouts. The embedded firmware analyzes RF level, the rate of change of RF level and the audio content to determine the optimum timing for phase switching, and the optimum antenna phase. This adaptive technique operates over a wide range of RF levels to anticipate dropouts before they occur. The system also employs “opportunistic switching” to analyze and then latch the phase in the best position during brief squelch activity.

SmartNR™

With a noise floor at -120dBV and a frequency response to 20kHz, high frequency noise in the audio is more apparent than in conventional wireless systems. The Smart Noise Reduction algorithm works by attenuating only those portions of the audio signal that fit a statistical profile for randomness or “electronic hiss”. Because it isn’t simply a sophisticated variable low pass filter as in Lectrosonics’s 195 and 200 series designs, much greater transparency is thus obtained. Desired high frequency signals having some coherence such as speech sibilance and tones are not affected.

The Smart Noise Reduction algorithm has three modes, selectable from a user setup screen. When switched **OFF**, no noise reduction is performed. When switched to **NORMAL**, the factory default setting, enough noise reduction is applied to remove most of the hiss from the mic preamp and some of the hiss from lavaliere microphones. When switched to **FULL**, enough noise reduction is applied to remove most of the hiss from nearly any signal source of reasonable quality, assuming levels are set properly at the transmitter.

LECTRO™

Digital Audio Systems

Without question, digital audio systems produce stellar sound quality very inexpensively. Advances in processing speeds and storage media in recent years have made digital techniques the undeniable choice for professional audio applications.

Analog RF Links

While digital audio systems are obviously superior to analog audio systems, RF transmission system designs are challenged by limited bandwidth. Wireless microphone systems operate in designated channels defined by spectral bandwidth. The government in almost every country regulates the channel spacing and a spectral mask limiting the amount of energy that can be transmitted above and below the center of the channel. The transmitted energy must remain inside the spectral mask defined by the government in the country where the wireless system is to operate.

All else being equal, a digitized audio signal occupies a good deal more bandwidth than the original audio signal. The same applies to digital and analog RF signals. A digital transmission over the air requires some combination of additional power, more RF bandwidth and/or compression of the audio data to achieve adequate operating range and keep the energy inside the defined spectral mask. Because of this, digital wireless microphones typically lack the operating range of conventional FM systems.

With regard to using RF power and spectrum efficiently, an analog RF link has many advantages in wireless mic systems, among them long battery life, excellent range, and the ability to use many systems in close proximity without interference.

Digital Hybrid Wireless™ (US Patent Pending)

The Lectrosonics Digital Hybrid Wireless uses innovative technology to combine the advantages of digital audio with the advantages of analog RF transmission, thus delivering the excellent range of an analog system and the superior sound quality of a digital system. A proprietary algorithm encodes the digital audio information into an analog format which can be transmitted in a robust manner over an analog FM wireless link. The receiver employs the latest filters, RF amplifiers, mixers and detector to capture the encoded signal and a DSP recovers the original digital audio.

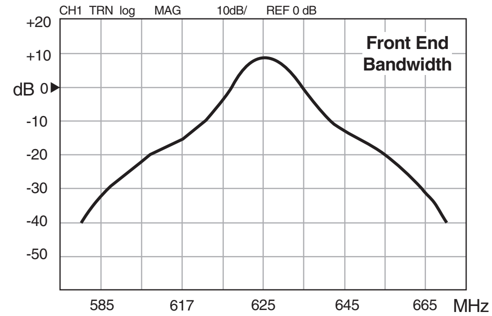
This digital/analog hybrid technique has some very beneficial properties. Because the information being transmitted is digitally encoded, immunity to noise is much higher than a compandor can offer. Because the encoded audio is sent in analog format, spectral and power efficiency and operating range are not compromised. Under weak RF conditions, the received signal degrades gracefully, like an analog system, delivering as much usable audio as possible at maximum range. Because the audio is not companded, no compandor artifacts are present at any audio or RF signal level.

DSP-based Pilot Tone

The 400 Series system design utilizes a DSP generated ultrasonic pilot tone to control the receiver audio muting (squelch). Brief delays at turn-on and turn-off eliminate thumps, pops or other transients that can occur when the power is switched on or off. The pilot tone frequency is different for each of the 256 frequencies in the tuning range of a system (frequency block.) This eliminates squelch problems in multi-channel systems where a pilot tone signal can appear in the wrong receiver via intermodulation products. The DSP generated pilot tone also eliminates the need for fragile crystals allowing the receiver to survive shocks and mishandling much better than older analog-based pilot tone systems.

Frequency Tracking Front-end Filters

The front-end consists of 4 transmission line resonators with variable capacitance applied to each resonator to re-tune it as the frequency is changed. The tuning range covers a full 25.6MHz block of frequencies. The design provides tunable, narrow filtering as selective as most fixed frequency designs, with the overload performance of the best front-ends available.



High Current, Low Noise Amplifiers

The gain stages in the front end use special transistors in a feedback regulated high current circuit that combines low noise, low gain, and high power. The design takes all three of these parameters into consideration at once, to provide low noise RF amplification, excellent sensitivity and extremely low susceptibility to intermodulation.

Combining the high power gain stages with the tracking front end produces a receiver that is immune to single and multiple interfering signals close to the operating frequency and in addition, strongly rejects signals that are much farther away.

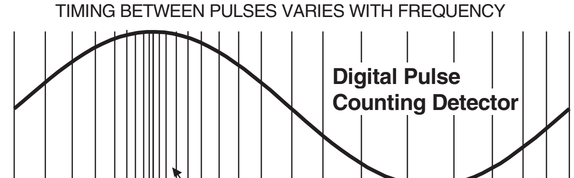
Surface Acoustic Wave (SAW) Filter

SAW filters in the first IF section operating at 244MHz combine sharp skirts, constant group delay, and wide bandwidth in one filter. These filters are made of quartz and are temperature stable. This special type of filter allows primary filtering as early as possible, at as high a frequency as possible and before high gain is applied to the signal. After the sharp filtering action of the SAW filters, the signal is converted to the second IF at 10.7 MHz, then finally to the third IF at the low frequency of 300 kHz, where the counting detector generates the audio signal.

Digital Pulse Counting Detector

An advanced digital pulse counting detector is used to demodulate the FM signal at 300 kHz rather than a conventional quadrature type of detector, to eliminate thermal drift and provide additional AM rejection. A stream of precision pulses is generated at 300KHz and locked to the FM signal coming from the third IF section. The pulse width is constant but the timing between pulses varies with the frequency shift of the FM signal. The integrated voltage of the pulses in a given time interval within the waveform varies in direct proportion to the frequency modulation of the radio signal. Closely spaced pulses produces a higher voltage and widely spaced pulses a lower voltage. The resultant varying DC voltage is the audio signal, as shown in the diagram below.

TIMING BETWEEN PULSES VARIES WITH FREQUENCY

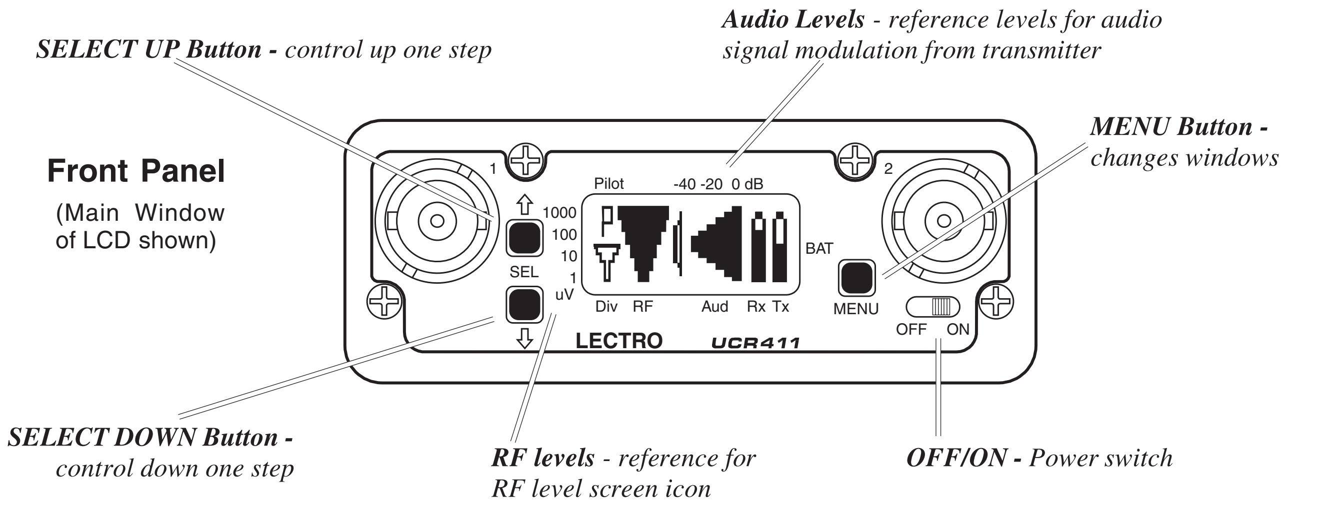


SUM OF PULSE VOLTAGE INCREASES AT HIGHER FREQUENCIES
THE VARYING DC VOLTAGE = THE AUDIO SIGNAL

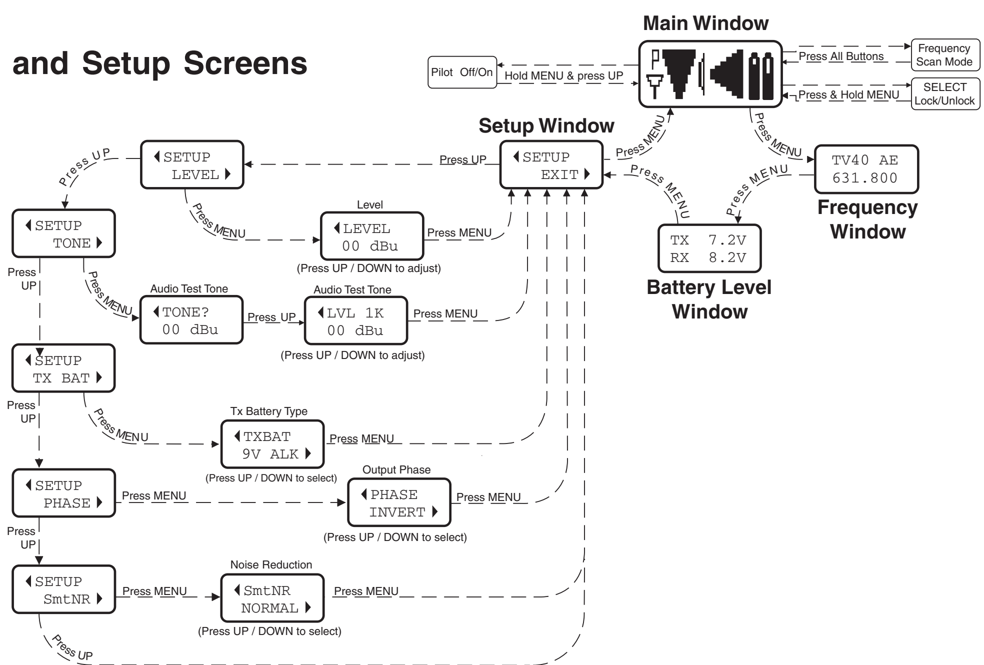
Backlit LCD Graphics Display

The interface for setting up and operating the UCR411 receiver is an LCD display and three switches on the front panel of the receiver. All information regarding the status of audio and RF signals and battery levels in the receiver and the transmitter are simultaneuously shown in the Main Window of the display.

A “locked” operating mode can be enabled by holding the MENU button down for several seconds. In this mode no changes can be made to the settings already stored, and the scanning mode cannot be entered.



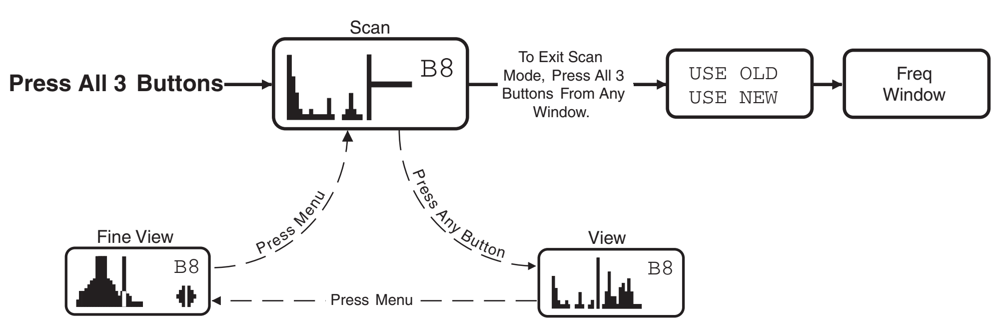
Main Window and Setup Screens

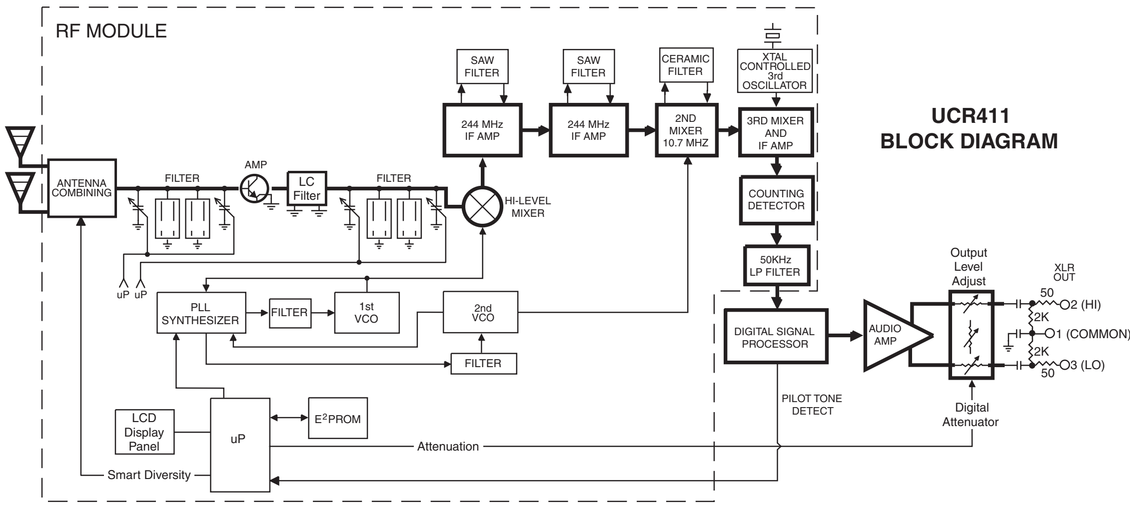


Scanning Windows

A special scanning mode is provided to conduct RF site surveys and locate clear operating frequencies.

A scrollable window provides a graphical illustration of RF signals within the tuning range of the receiver.





UCR411 BLOCK DIAGRAM

Operating Frequencies (MHz):

Block 21	537.600 - 563.100	Block 26	665.600 - 691.100
Block 22	563.200 - 588.700	Block 27	691.200 - 716.700
Block 23	588.8 00- 607.900 614.100 - 614.300	Block 28	716.800 - 742.300
		Block 29	742.400 - 767.900
Block 24	614.400 - 639.900	Block 30	768.000 - 793.500 (export)
Block 25	640.000 - 665.500	Block 31	793.600 - 805.600 (export)

Frequency Adjustment Range: 25.5 MHz in 100 kHz steps

Receiver Type: Triple conversion; superhet

IF frequencies: 244MHz, 10.7 MHz and 300kHz

Frequency Stability: ±0.001 %

Front end bandwidth: ±5.5MHz, @ -3dB

Sensitivity: **20 dB Sinad:** 0.9 uV (-108 dBm), A weighted
60 dB Quieting: 1.12 uV (-105 dBm), A weighted

AM rejection: >60 dB, 2 uV to 1 Volt

Modulation acceptance: 85kHz

Image and spurious rejection: 85 dB

Third order intercept: +8 dBm

Diversity method: Phased antenna SmartDiversity™

FM Detector: Digital pulse counting detector operating at 300kHz

Antenna inputs: Dual BNC female jacks; 50 Ohm impedance

Audio output: Rear panel XLR connector; can drive 600 Ohm, adjustable from -50 to +5dBu in 1 dB steps (into nominal 10k bal. load)

Audio Performance (overall system):

Frequency Response: 32 Hz to 20 kHz (+/-1dB)

THD: 0.2% (typical)

SNR at receiver output (dB):

SmartNR	no limiting	w/ limiting
OFF	103.5	108.0
NORMAL	107.0	111.5
FULL	108.5	113.0

Input Dynamic Range: 125 dB (with full Tx limiting)

(Note: the dual envelope “soft” limiter in 400 Series transmitters provides exceptionally good handling of transients using variable attack and release time constants. The gradual onset of limiting in the transmitter begins below full modulation, which reduces the measured figure for *SNR without limiting* by 4.5 dB)

Overall Latency (time delay): 3mS

Audio Test Tone: 1KHz, -50 to +5dBu, <1%THD

Front Panel Controls and Indicators:
- LCD display
- Menu - up/down buttons
- Power switch

Rear Panel Features:
- XLR audio output jack
- External DC input
- Battery compartment

External Power: Minumum 10 Volts to maximum 18 Volts DC 1.6W; 170mA at 12VDC

Battery Life: 6 to 8 hrs. continuous, w/ two alkaline 9V batteries; up to 20 hrs. continuous w/ two lithium 9V batteries

Weight: 15.2 ozs. (with two alkaline 9V batteries)

Dimensions: 3.23" wide x 1.23" high x 4.75" deep

The rear panel rotates for access to the battery compartment.

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