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INTRODUCTION

The Optoelectronics R-10 represents a revolution in communications testing and monitoring

technology. For the first time, a small handheld instrument can find and demodulate nearly all FM communications - without user intervention and adjustment. Signals ranging from 30 to beyond 1000 MHz are locked on and demodulated, yielding not only an audio output but a measurement of FM deviation and relative signal strength.

Such revolutionary capabilities demand a new term - the

Interceptor. The R-10 is not a receiver, although it performs many of the same functions. While a typical receiver requires advance knowledge of the frequency of the signal, the R-10 does not. It finds signals and uses their own frequency to tune itself and will even follow a drifting signal.

What does this mean to the R-10 owner? A few possibilities ...

- Two way radio technicians can check the modulation of transmitters with an instrument they can carry in their back pocket.
- News reporters can monitor all two-way radio traffic at the site of an emergency, without prior knowledge of the frequencies in use.
- Security professionals can find "bugs" and differentiate between spurious RF sources and actual modulating transmitters.

In short, any time you want to listen to a signal, but don't know what frequency to listen to, the R-10 is the answer.

The R-10 exploits Optoelectronics' *NearField* technology to make all of this possible. If a receiver merely locked onto the first signal it came across, the proliferation of RF signals in today's cities would immediately paralyze it. However, the R-10 responds only to signals above a user set

level - signals found in the near field of a transmitter. Conventional receiver's squelch systems are only adjustable over a narrow signal level range and in any case search the frequency spectrum thousands of times more slowly than the innovative R-10 circuitry. The R-10 is truly a revolutionary instrument.



SPECIFICATIONS

Frequency Range	30 to 1000 MHz, to over 2.2 GHz with reduced sensitivity
Sensitivity	Typically -40 dBm or better
Demodulation	FM, less than 75 kHz deviation
Power requirements	7.2 VDC at 150 mA or less
Battery life	More than 4 hours

INSTALLATION

While the R-10 is a typically used hand held and there is no actual installation, a few pointers on its inputs and output are in order.

Direct antenna input

For the R-10 to function, it must be provided an input signal to operate on. While there is no limit to the variety of antennas that could be used to provide a signal, an informed choice can enhance operation. Since many R-10 applications are similar to that for which Optoelectronics' frequency counters are used, the antenna suite available for these counters is ideal for use with the R-10.

The most general purpose and cost effective of these antennas is the simple telescoping whip with BNC connector (Model TA100S supplied with the R10). It can be adjusted in length to emphasize a particular frequency range or shortened to attenuate a overly strong signal. Its main drawback is it's rigidity, making it impractical for use while the R-10 is carried in a pocket.

For these applications, a selection of "rubber duck" flexible whips is available, covering a wide range of frequencies. While a particular model may emphasize a certain range of frequencies, most will operate over a very wide range at reduced sensitivity. The possible exception to this may be the 900 MHz whips which are very inefficient at the extreme low frequency range of the R-10.

Direct Antenna Input

Do not overlook using the R-10 with external antennas as well, especially in a vehicle. Multipath dropouts can impair operation in a moving vehicle, but the stronger signal delivered by an roof-mounted whip or similar antenna can help the R-10 maintain lock in the fades.

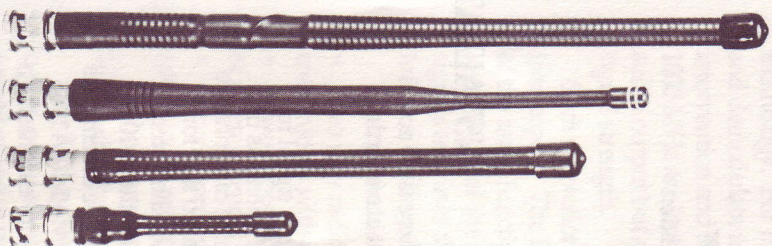
Use with preselctors

At times, the extremely broadband nature of the R-10 may interfere with operation. Strong local broadcast stations may cause the R-10 to lock up even in the presence of other desired signals. If the desired signals are known to exist in a particular frequency range, these problems can be eliminated with a bandpass preselctor. Adding this filtering ahead of the R-10 will limit frequency range, but results in enhanced sensitivity. Optoelectronics manufactures a range of variable and fixed tuned preselctors that will force the R-10 to only accept signals within their pass band.

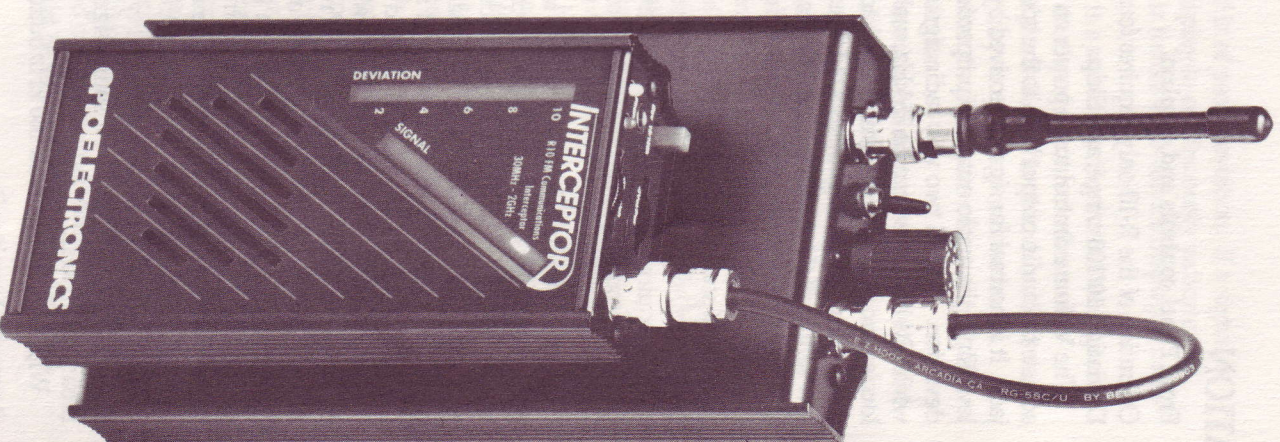
With a fixed preselctor, the user can expect greatly enhanced sensitivity in receiving signals. By eliminating most of the thousands of signals in a typical environment, smaller signals can be found with greater speed. Locking up on

undesired strong signals can be eliminated.

To use the any of the preselctors, merely connect it in line between the antenna and the input to the R-10. Be sure to use a high quality, well shielded cable between the preselctor and R-10 to prevent RF feedback problems. The preselctor will only pass signals within its frequency range, forcing the R-10 to respond in this range. If the preselctor in use is a tunable unit, it must be adjusted to the approximate frequency of interest. See the preselctor's user manual for information on tuning.



*From left to right
Models: RD27, RD800,
RD100 and RD440*



OPERATION

Front Panel controls and displays

Operation of the R-10 only requires four controls: **Volume**, **Squelch**, **Deviation 10/100** range, and **Skip**.

The **Volume** control turns power on and off to the unit and adjusts the audio output both to the speaker and the headphone jack. It is normal for signals received by the R-10 to vary in audio level since the audio output is proportional to the signal's FM deviation. Typical two way radio signals have only 5 KHz deviation while FM broadcast can be 75 KHz, making broadcast signals much louder and requiring volume control adjustment.

The **Squelch** control adjusts the threshold for signal detection. A low setting of the control will allow the R-10 to find small signals, but may also permit strong local broadcast signals to be received. Higher settings prevent the reception of unwanted signals, at the expense of some loss in sensitivity. When in the near field of a transmitter, signals are usually very strong and full sensitivity in not always required or desirable. A little experience using the R-10 will quickly demonstrate the best Squelch control setting for a given application.

The **Skip** button causes the R-10 to temporarily ignore the signal it's presently locked on and go in search of another. This feature may be useful if you are in the presence of several strong signals and the R-10 has not locked on the desired one. Sometimes the R-10 may lock on a harmonic of the desired signal and the Skip button can be employed to make the R-10 find the fundamental.

The two front panel bargraphs show relative signal strength and peak FM deviation of the signal being received. The deviation display shows the peak FM deviation of the received signal. (Since the signal uses Frequency Modulation to transmit audio, the deviation is a measure of how far the instantaneous frequency varies from the nominal center frequency.) This display has two ranges to accommodate most signals that will be encountered with the unit. Two way radio signals will typically have a maximum deviation around 5 KHz, TV sound signals around 25 KHz, and FM broadcast 75 KHz.

With the **Deviation 10/100** KHz button out, each segment of the

deviation meter represents 1 KHz of peak deviation. If a signal is encountered that causes the display to continuously indicate "10", press the **Deviation 10/100** KHz button in to reduce display sensitivity to 10 KHz per segment.

The signal strength display is a relative indication of the signal being received. The setting of the Squelch control affects the calibration of the display and if the R-10 has to re-lock on the same signal the bargraph indication may vary from previous levels.

The **Green LED** indicates when the R10 locks onto a signal. The **Yellow LED** is a power on indicator.

The headphone jack can be used to connect most any headphone to permit private monitoring of signals. Either a mono or stereo headphone plug may be used and level limiting is used to prevent headphone damage if the volume is adjusted too high. The headphone jack can also be used to deliver R-10 audio to external instruments.

MOBILE RADIO TESTING

Hand held frequency counters have been helping two-way radio technicians check out transmitters for frequency for some time. However, without lugging around a heavy service monitor, measuring the modulation of the transmitter has been impossible. The R-10 changes all of this. A small, handheld instrument can now be used to listen to the transmitted audio, verify its quality, and with the bargraph indicator, measure the peak deviation.

Accomplishing this could not be much easier. Connect a short antenna to the R-10's RF input. Adjust the R-10 Squelch control to a fairly high setting so the unit will not respond to other local transmitters. Key the transmitter you wish to monitor. Within a second or two, the R-10 will lock onto the transmitter's signal, demodulate any audio present, and display the peak FM deviation. If the deviation is higher than 10 KHz, press the **Dev 10/100** button to change the range of the bargraph from 10 to 100 KHz peak. Adjust the Volume control for the desired audio output level. That's it.

It is important not to use too much antenna in this application since the signals from a close transmitter will be very strong and overload may result. Overload can be assumed when the R-10 locks up on a noisy signal that should be strong or when the deviation

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MOBILE RADIO TESTING *Continued from page 7*

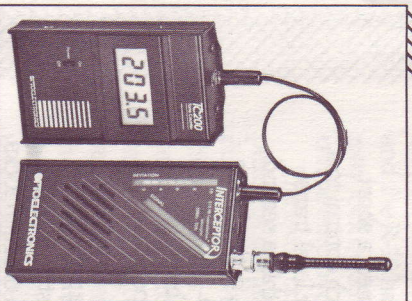
indicator reads 2 or 3 times the expected level (this indicates the R-10 is hearing the second or third harmonic of the desired frequency). If you suspect overload, merely shorten the R-10 whip if adjustable, or move the R-10 further from the transmitting antenna. It may be necessary to press the **Skip** button to allow the R-10 to re-lock is the transmitter is on continuously.

If it is desired to monitor only a particular band of frequencies, the use of a preslector ahead of the unit can make a remarkable difference. For example, if the primary intended use of the R-10 is



to check cellular phones, the addition of the Optoelectronics' CF800 fixed tuned preslector for this band will prevent the inadvertent reception of the cell site as well as greatly increase reception range. A tunable preslector, such as the Optoelectronics APs-104, can extend this advantage to any frequency below 1 GHz. Check the Optoelectronics catalog or contact Optoelectronics directly for the latest information on available presectors.

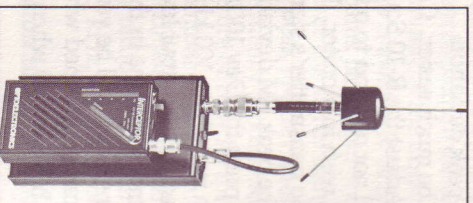
Measuring DTMF Tone with decoding unit



Measuring CTCSS Tone with TC200

The audio output of the R-10 can be used to measure various characteristics of the transmitted audio. By

connecting a frequency counter such as the Optoelectronics TC-200 tone counter, CTCSS tones can be accurately measured. DTMF and other signaling tones can also be checked by feeding the output of the R-10 to suitable test equipment.



R10 with CF 800 Fixed Tuned Preslector

The R-10's high sensitivity and de-

TRANSMITTER FINDING

modulation make it ideal for finding hidden transmitters. Operation is similar to that described above, but in this case, an effective antenna is a must. Please see the section **Installation** for a description of the various antenna types and uses.

Once the optimal antenna has been attached, the R-10 is switched on and the Squelch control set to the lowest setting that allows continuous scanning. If the area to be swept is near another source of RF energy (or if you happen to already be in the vicinity of the transmitter) the R-10 will tend to lock up on that signal. The demodulation and audio output of the R-10 allow the origin of the signal to be determined. The typical surveillance transmitter uses FM which the R-10 easily demodulates - if the R-10 locks up on this signal, you will hear ambient room audio on the R-10 speaker.

Walk around the suspected area while watching the R-10 signal strength bar graph, trying to maximize the reading. When you get very near the transmitter, the hidden transmitter will probably hear the R-10 audio and transmit that, resulting in audio feedback.

At this point you should be within a few feet of the device and some educated noisemaking while listening to the R-10 should pinpoint it's location.

Listening to two-way radio traffic in the

COMMUNICATIONS MONITORING

field could not be easier with the R-10. Previously, it was necessary to carefully program the local frequencies into a scanner to listen to such traffic. And when you heard something, it was impossible to tell if it was from across the road or across town.

No programming is necessary with the R-10. Just connect an antenna, turn the unit on, and adjust the squelch control to the that allows the R-10 to sweep and not lock on local broadcast signals. When anyone transmits with the local area, the R-10 will lock on the signal and let you listen in. If another signal appears while listening to the first, the R-10 will stay with the first until it disappears, then lock on the new signal.

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COMMUNICATIONS MONITORING *Continued from page 9*

If it is desired to have the R-10 immediately go on to a new signal, the **Skip** button will cause the unit to resume sweeping.

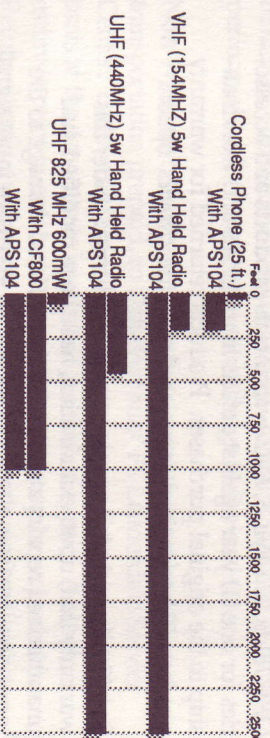
As mentioned above, the use of a preslector can significantly enhance operation. If reception of only a certain range of frequencies is desired, preslection can eliminate most unwanted lockups and boost sensitivity. Optoelectronics offers a number of fixed and tunable preselectors for use with the R-10.

Note: While operating the R-10 directly from an antenna, there is no limit to the signals you may pick up - even things you had no idea were there. This device is very sensitive and is capable at low squelch settings of hearing signals less than 100 microvolts, a small signal by commercial broadcast standards. So the extreme broadband coverage of the R-10 can be a shortcoming if you happen to be near some substantial RF source.

Two-way radio, TV audio, and FM broadcast interfering signals can be identified by listening to the audio. More subtle and typically more problematic are TV video carriers which can be very strong and sound like a quiet buzz in the speaker. Other signals may carry no discernible audio at all. The R-10 can not discriminate between these signals and desired ones, and hearing them does not mean there's anything wrong with the R-10. To the contrary, it just means it's operating normally and finding signals.

The R-10 depends on the operator ensuring the desired signal is the strongest signal. If this is impossible, the **Skip** button can be used to search for additional signals if several are of sufficient level to lock on.

TYPICAL R10 PICK-UP DISTANCE



BATTERY CHARGING AND MAINTENANCE

The R-10 uses a pack of Nickel Cadmium cell for power when not connected to an external power source. These batteries should provide power for the R-10 for a minimum of 4 hours. When the R-10 ceases to function, the battery must be charged by reconnecting the unit to the charger. Plug the provided transformer into the jack near the bottom of the R-10 to initiate charging. A fully discharged battery pack takes approximately 8 hours to charge, a partially discharged pack proportionately less.

While the batteries used in the R-10 are very tolerant of abuse, two situations are to be avoided:

- Try not to run the battery pack to complete exhaustion. Occasional complete discharges do no harm, but avoid leaving the unit on long past when proper operation has ceased.
- Avoid repeated shallow discharge/charge cycles. This provokes the so-called "memory" effect, temporarily reducing battery capacity. Try to use 50% or more of the battery capacity before recharging.

The battery pack plugs into the main circuit board of the R-10 and is easily replaceable at the end of its useful life. Contact Optoelectronics for replacement battery packs. Be sure to properly dispose of the defective battery pack.