UE ECM - 586

UE WIDE BAND ULTRASONIC DETECTION SENSOR

Instruction Manual

OVERVIEW

The UE ECM-1 is an Ultrasonic Detection unit that is targeted for continuous monitoring. The unit offers an overall dynamic range of roughly 100 decibels, and is configured for air borne ultrasonic detection.

ULTRASOUND TECHNOLOGY

The Ultrasound Technology utilized by this system is generally referred to as “Airborne Ultrasound”. Airborne Ultrasound is concerned with the transmission and reception of ultrasound through the atmosphere without the need of sound conductive (interface) gels. It incorporates methods of receiving signals generated through one or more media via wave signals. When it is used to detect/monitor problems within a specific media, the technology may be referred to as Airborne/ Structure borne Ultrasound (A/B Ultrasound).

A/B Ultrasound is concerned with sound waves that occur above human perception. The normal “audible” environment in which the human ear is capable of sensing is 20 Hertz to 20 kHz (1,000 Hertz is 1 kiloHertz or 1 kHz). The average threshold of human perception is 16,500 Hertz or 16.5 kiloHertz. These audible wavelengths range in size from as small as 3/4 inch (1.9 cm) to as large as 56 feet (17 m). The frequencies sensed by airborne ultrasound instruments such as the UE UCA586 are above 20 kHz to 100 kHz. The wavelengths are magnitudes smaller than the audible, ranging from 1/8 inch (0.3 cm) to 5.8 inch (1.6 cm).

The short wave nature of the ultrasonic signal provides many advantages over lower frequencies.

1. High frequency amplitudes drop off quickly as they move from the source of emission.
2. The signals tend to radiate in straight paths providing relative ease of detection.
3. Since the signal strength diminishes rapidly, the sound source is easily separated from background noise.
4. Subtle changes are detected before a major failure occurs.

UE ECM-1 INSTALLATION & OPERATION

POWER REQUIREMENTS

The UE ECM-1 requires a 24 Volt, DC power source @ 200 milliamperes total. The power connections are to be made to the I/O cable. Refer to the Pin Out/Description Diagram for the connections.

SENSITIVITY CONTROL

In order to accommodate the entire 100 decibel dynamic range, some adjustment in the field is required. This is set by the multi turn potentiometer located on the front panel the unit. The sensitivity is preset at the factory to maximum or fully clockwise. If this is too sensitive, use a screwdriver and turn the potentiometer counterclockwise to decrease the sensitivity.

THRESHOLD CONTROL

The threshold adjustment is available if an alarm output is required. This is the adjustment used to get a simple output signal change when the ultrasonic input has either exceeded or gone below a setpoint. There is a Alarm Threshold Sense output at pin 8 on the DB9 connector or on the Blue colored I/O Cable wire. This can be detected as a voltage from 0-10 VDC which is where the threshold or set point is currently adjusted to. To raise the level, turn the potentiometer clockwise and to lower the level turn the potentiometer counterclockwise.

VOLTAGE AND CURRENT OUTPUTS

The sensor provides voltage, and current outputs. The voltage and current outputs are continuous analog signals that are proportional to the ultrasonic activity sensed.
The voltage output has a range of 0 to 10 volts DC full scale. A 2.5 volt change in output voltage corresponds to a 10dB change in ultrasonic input signal. Therefore, the entire 10 volt range represents a 40 dB change in ultrasonic input level.

The current output has a range of 4 mA to 20 mA DC. Therefore, the full 4 mA to 20 mA range represents an ultrasonic level change of 40dB. The output can be connected to a 250 OHM resistor from current output to current output return and fed to a 5V A to D converter if digital monitoring is required. Refer to the diagram for connections. Note: Current output is 4-20 mA output (pin 2) and current output return is pin 3 .

HETERODYNED AUDIO OUTPUT

The sensor provides an audio output for use with a speaker or a pair of headphones. The signal can also be fed into a spectrum analyzer for waveform analysis. The output level is preset at the Factory @ 90 dBA for the full scale output.

ALARM OUTPUT

The sensor provides an alarm output which is an open collector transistor. The open collector can switch 24 volts DC @10 mA maximum. The alarm is preset at the Factory to transition at 50% of full scale. There are no “dead bands”. The alarm output stops conducting when the input or ultrasonic signal level exceeds the threshold level or set point

SYSTEM SETUP

Once the system is connected and functioning properly, the sensor should be exposed to the user’s steady state source of ultrasound this ultrasonic source should represent a normally functioning electrical cabinet, valve, bearing, etc. During exposure, the user should monitor the current or voltage output. The sensitivity should be adjusted so that this steady state ultrasonic level is converted to an output that is located somewhere in the lower portion of the applicable range (4.3 to 5.0 mA on the current output or .5 to 1.0 volt on the voltage output).

The unit will now sense the increases in ultrasonic activity above the ambient condition.

UE ECM-1 PIN OUT

PIN#	**I/O CABLE COLOR**	**DESCRIPTION**
1	Orange	0-10 VDC Output
2	Red	4-20 mA Output
3	Green	4-20 mA Return
4	White	Heterodyned (Audio) Output
5	Black	Ground
6	Yellow	Open Collector Output rated at + 24 VDC, 10 mA
7	Black	Ground
8	Blue	Alarm Threshold Sense 0 to +10 VDC Full Scale Output
9	Brown	Power Supply Voltage Input. 20 to 30 VDC, nominal 24VDC @200 mA maximum.

PANEL INDICATORS:

LED	FUNCTION
Blue	ECM-1 Powered Up & Ok to Monitor
Red	Alarm Red = Alarm Condition

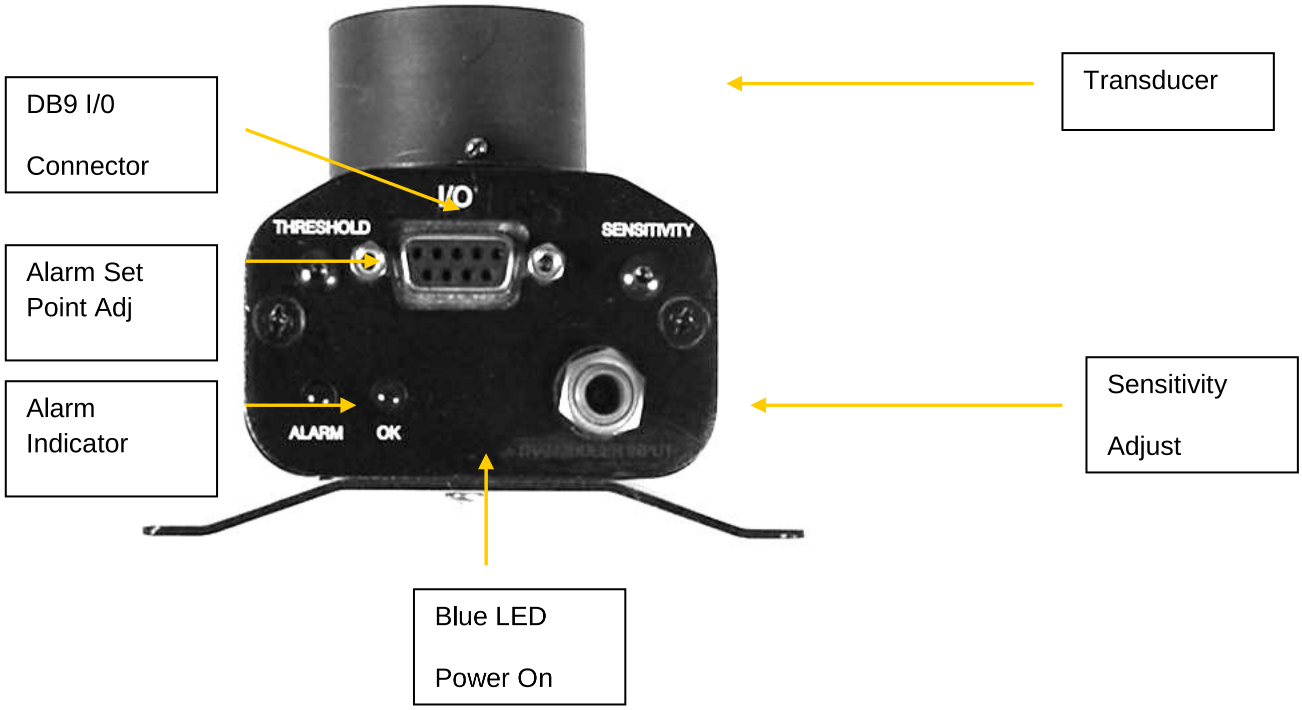
PANEL Adjustments:

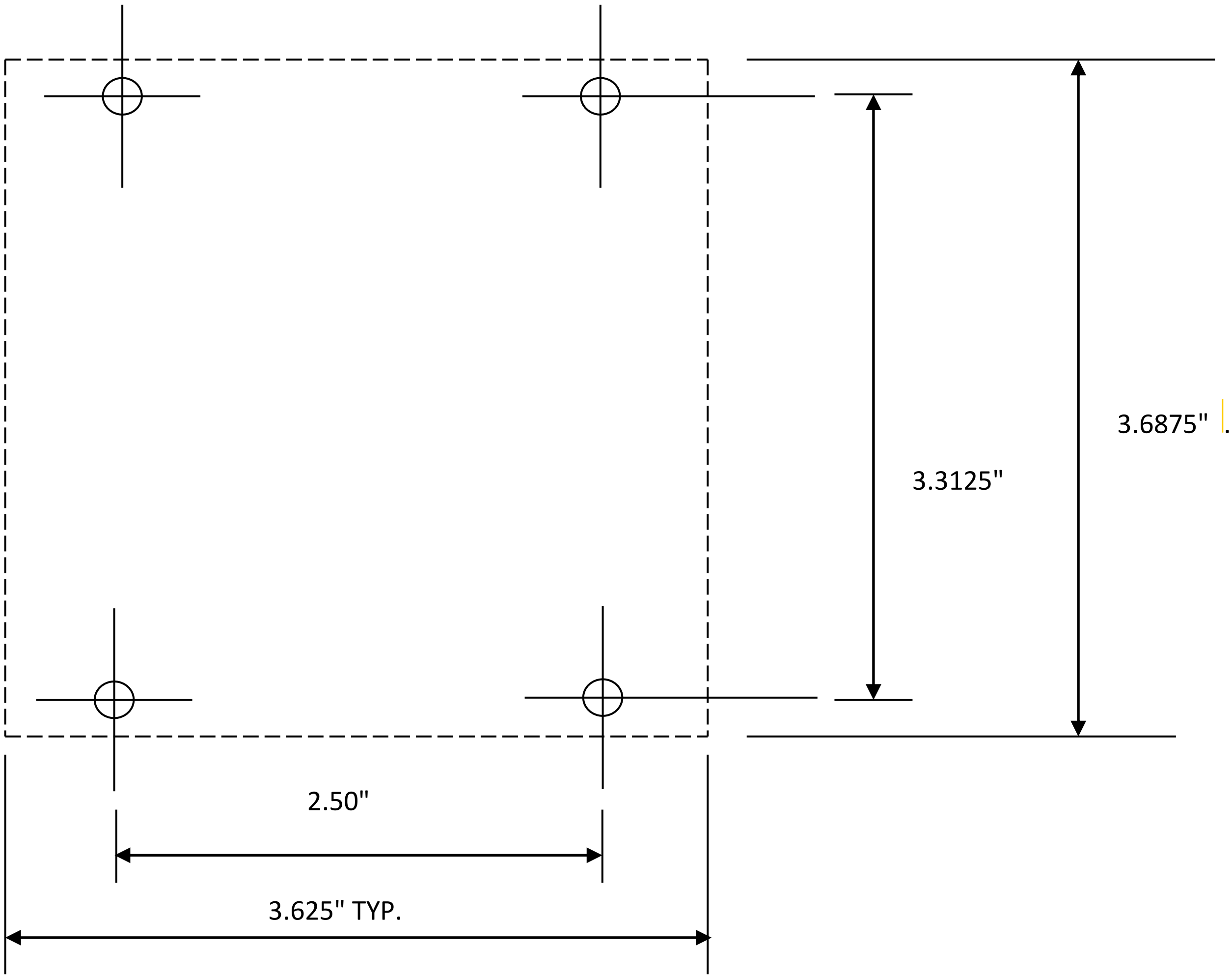
Sensitivity Adjust

Alarm Set Point (Threshold) Adjustment

The Sensitivity Adjust is located on the front panel. Use a screwdriver and turn the adjustment screw clockwise to increase and counter-clockwise to decrease the sensitivity.

The Alarm Set Point Adjustment is located on the front panel. Use a screw driver and turn the adjustment screw clockwise to increase and counter-clockwise to decrease the set point





(4) HOLES .1875" DIA

EVALUATING WAVE FILES TO DETERMINE THE SEVERITY OF THE ULTRASONIC EMISSIONS

We are often asked at which voltages and on what type of equipment is ultrasound most effective. The answer is not simple since it often depends on the individual asking the question. First of all, determining the definition of low, mid and high voltages is relative. Those in the power distribution arena will look at 12 kV as low voltage, those who work in a typical manufacturing plant will look on 440 Volts as high voltage. The main electric problems detected ultrasonically are partial discharge, arcing, tracking and corona. Ultrasound detects the ionization of air, as it produces turbulence. This can be from Corona, Tracking or Arcing. Heat is produced when there is either Resistance due to corrosion or from Tracking and Arcing. Since Heat is produced by the flow of current through corrosion or resistance, you can have a “hot spot” detectable with IR, and have no Ultrasound because there would be no ionization.

Low voltages

The main concern in low voltage equipment is arcing. Typically 110, 220 and 440-volt systems are inspected with infrared imaging and/or spot radiometers for temperature changes. Hot spots, usually an indication of resistance, can be indicative of a potential for equipment failure or it could indicate a possible fire hazard. When arcing occurs, it is often accompanied by heat. However, it is not always possible to detect a hot spot if the equipment is covered. Ultrasound will hear arcing in circuit breakers, switches, contacts and relays. In most instances, a quick scan of a door seal or vent will detect the ultrasound emission. Listening for internal arcing in circuit breakers and switches can be accomplished with the contact probe. For example, touch a circuit breaker switch with the contact probe to listen for internally generated arcing. Remember to use caution whenever using the contact probe. Be sure you do not touch any surface that can conduct electricity. The most effective method of low voltage inspection will be to combine infrared imaging with an ultrasonic probe. Please keep in mind that since air cannot be a conductor of electricity below 1000 volts, corona cannot exist. Any “buzzing” sounds are either loose components vibrating at 60 (or 50) Hz or tracking.

Mid and High Voltage inspection

Higher voltages often produce more potential for equipment outage. Problems such as arcing, destructive corona or tracking (sometimes referred to as "baby arcing") as well as partial discharges and mechanical looseness all produce detectable ultrasound that warn of impending failure. Detecting these emissions is relatively easy with ultrasound. The acoustic difference among these potentially destructive events is the sound pattern. Arcing produces erratic bursts, with sudden starts and stops of energy, while corona is a steady "buzzing" sound. Destructive corona has a build up and drop-off of energy resulting in a buzzing sound accompanied by subtle popping noises.

If the subject equipment is at a distance while scanning for these emissions, use a parabolic reflector such as the UE UWC (Ultrasonic Wave Form concentrator) or the UE LRM (Long Range Module). These accessories more than double the detection distance of the standard scanning modules.

Partial discharge (PD) which occurs inside electrical components such as in transformers and insulated buss bars, is another problem that can be detected with ultrasound. Partial discharge can be quite destructive. It is effected by and causes deterioration of insulation. This is heard as a combination of buzzing and popping noises. The contact probe is employed for PD detection. Again, when using this probe exercise caution. If your Ultraprobe has frequency tuning, try 20 kHz. To learn more about our Ultrasonic Wave Form Concentrator and our Long Range Module, visit our website: http://www.uesystems.eu

ANALYSIS OF RECORDED SIGNALS

While it is relatively easy to determine arcing, tracking or corona by the sound pattern, there can be occasions where it may prove confusing. It may be possible that a strong buzzing sound related to corona might in fact be nothing more than mechanical looseness. Both Spectral analysis and Time Domain can be a useful tools in analyzing electric emissions. Since all Ultraprobe instruments heterodyne ultrasound down into the audible range, either the headphone jack or the Instrument itself (the Ultraprobe 10000) may be used to record sounds. You must use a suitable recording device that has a suitable bandwidth in the lower frequencies.

DIGITAL VOICE RECORDERS ARE NOT ACCEPTABLE as they only can record signals above 300 Hz, which is not low enough to be useful for the 50 or 60 Hz peaks. Laptop Computers, MP3 Recorders or a Quality Cassette Recorders work well for recording the signals in the field.

When recording the sound emissions, you need to make certain that the signal is not distorted. On the Analogue instruments, you should not let the signal go over 50% of full scale on the signal strength indicator. On the Digital Instruments, you should try to maintain the signal strength to between 4 to 6 segments.

These recorded sounds can then be downloaded to a PC with a sound card and viewed as a spectrum or time series for analysis. It is necessary to examine both the Spectrum and the Time Domain images to make a final decision on the severity.

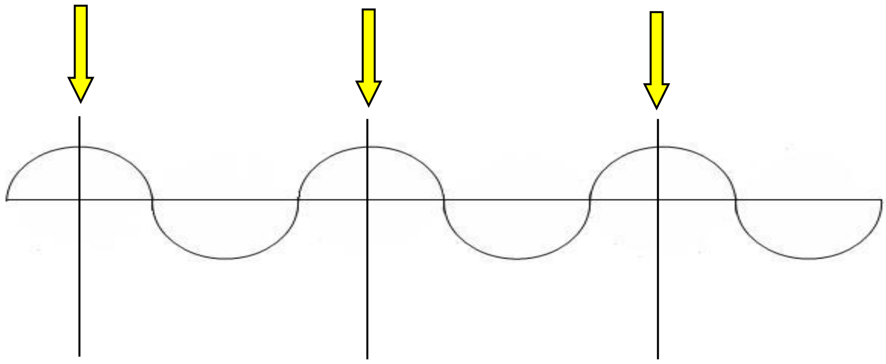
The main harmonic of an electrical emission (60 Hz in the USA and 50 Hz elsewhere) will be most prevalent in corona. As the condition becomes more severe, there will be fewer and fewer 60 Hz harmonics observed. As an example, arcing has very few 60-cycle components. Mechanical looseness will be “rich” in 60 Hz Harmonics and will have little frequency content between the 60 Hz peaks and will also demonstrate harmonics other than 60 Hz.

Examining the Time Domain image can also be of help. In the case of Corona, you will have a uniform band of signal with very few peaks that extend above the average “band”. With Tracking, you will begin to see the peaks created by the discharges extend above the average “band”. With Arcing, you will see several “bursts” of energy, which correspond with the discharges. In all cases, both the Spectrum and the Time Domain should be examined before the final determination is made.

The following pages can be used as a guide to help determine how severe the discharge is when playing a suspect wave file in UE Spectralyzer:

Electrical discharges take place in the Positive portion of the sine wave. Depending on the severity, the discharges take place in different points of the sine wave and have different durations in time. For example, for air to be a conductor of the discharge, you must have over a 1000 volt potential. This means that the actual discharge takes place only at the peak of the positive portion of the sine wave.

EXAMPLE OF DISCHAGE POINTS FOR CORO



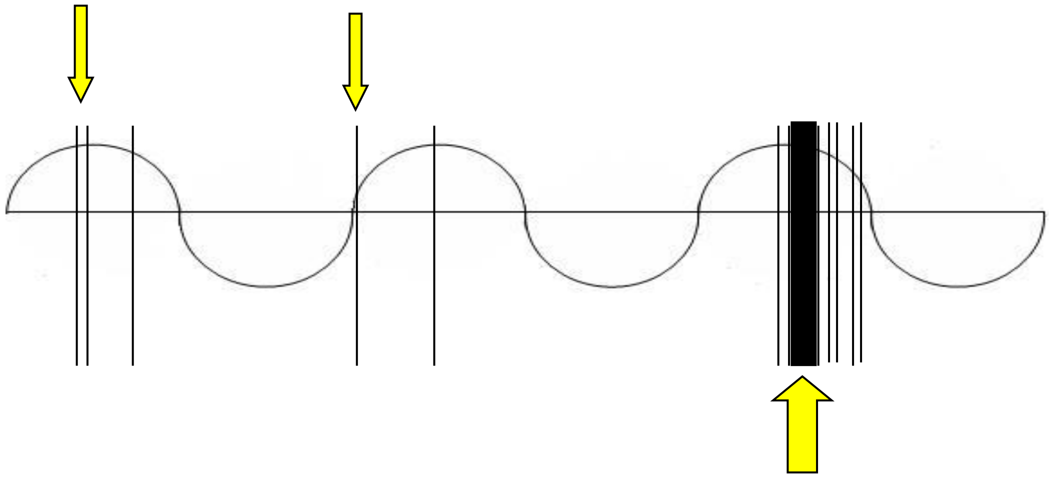
CORONA

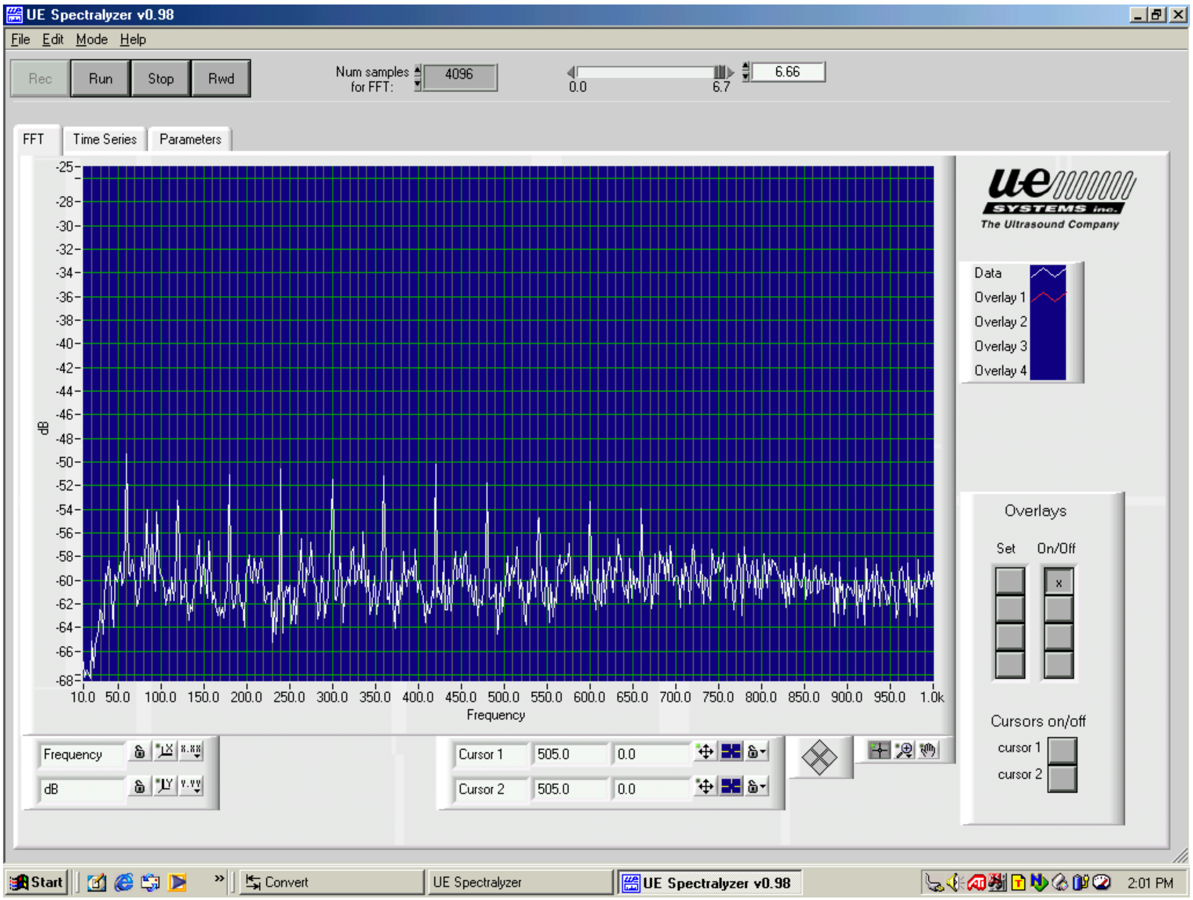
Note that the discharge points only occur at the highest voltage point of the sine wave. This means that the amplitude peaks in the Time Domain are somewhat equally spaced as the discharges are only at the positive peak of the sine wave. This is best viewed in the Spectrum View.
The next stage of Severity is Tracking and then Arcing.

TRACKING

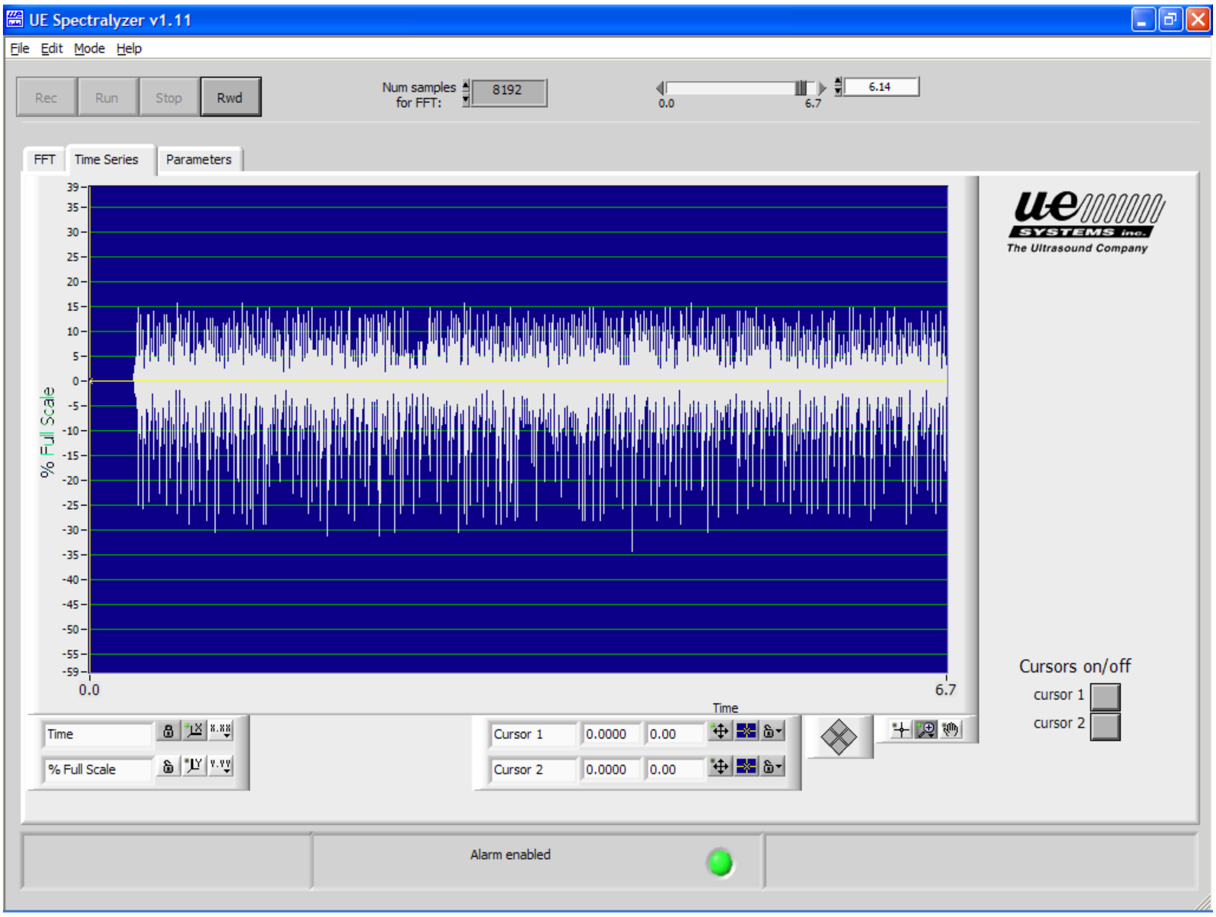
When you have tracking, there is a low current pathway to ground across an insulator so the discharge does not have to take place at the peak of the waveform. It therefore can happen anywhere on the positive portion of the cycle. This can be seen by the location of the vertical lines indicated by the arrows on the left side of the diagram. The spacing for the peaks in the Time Series would be similar non uniform spacing. They correspond to the “popping” sounds heard in the headphones (Heterodyned Ultrasonic signal) that are not uniformly spaced in time. As the Tracking becomes more severe, there are more discharge events and therefore more non uniform spaced narrow peaks.
ARCING

When you have Arcing, the discharge to ground across an insulator is a high current path over an insulator that does not require a high potential. This is a “burst of energy” that lasts for extended periods of time. It is indicated by the arrow on the right side of the diagram. The “buzzing” Sound that is heard with corona and the initial stages of tracking is not heard with arcing. Only the “bursts” of discharge can be heard. These will be seen as wide peaks in the time series.

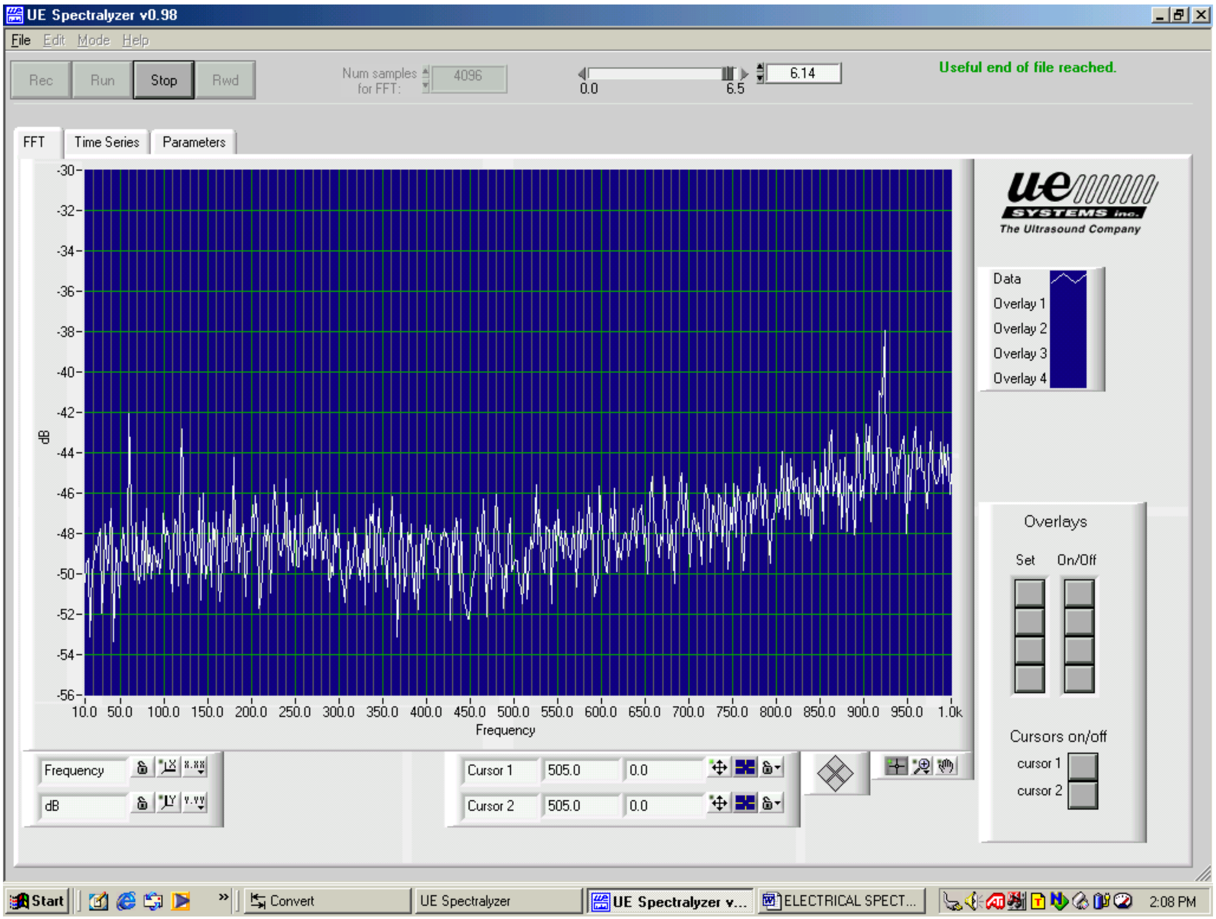




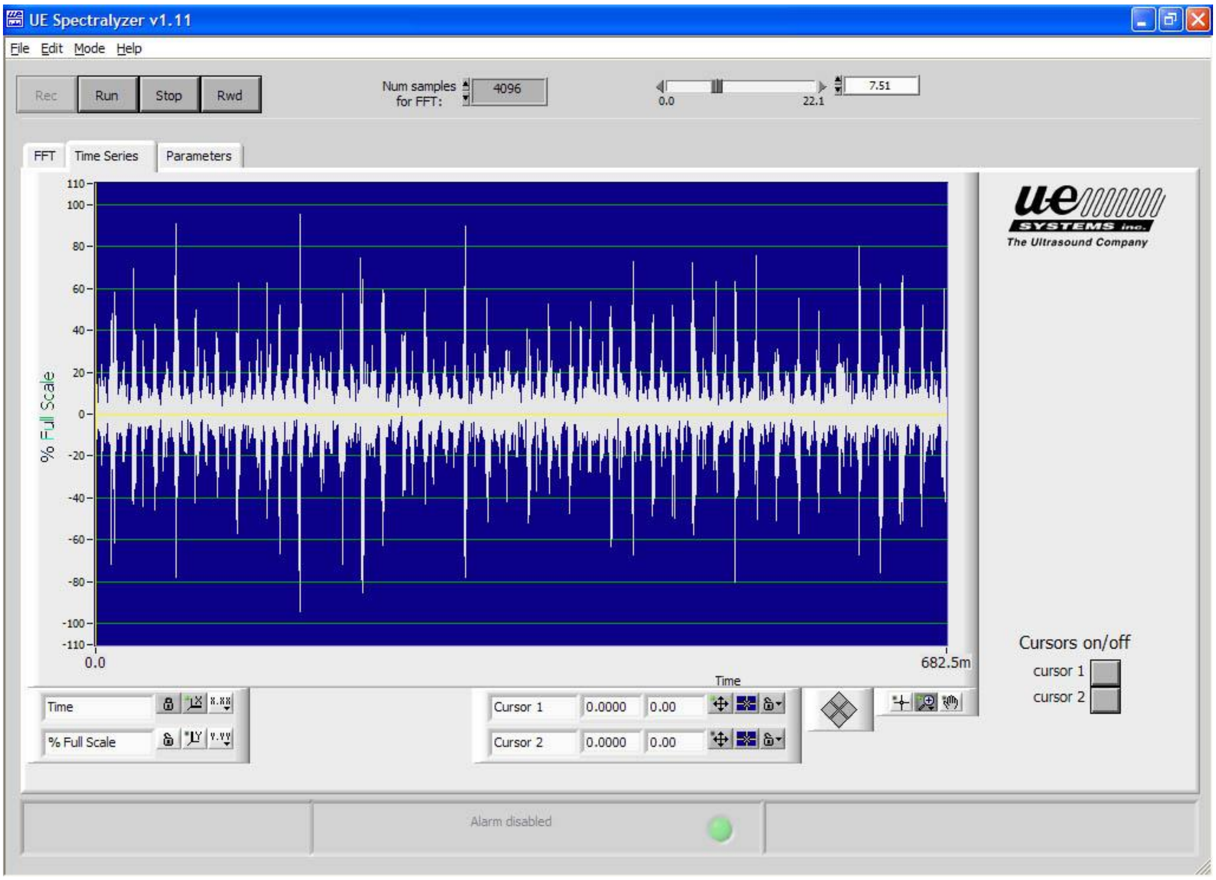
CORONA SPECTRUM



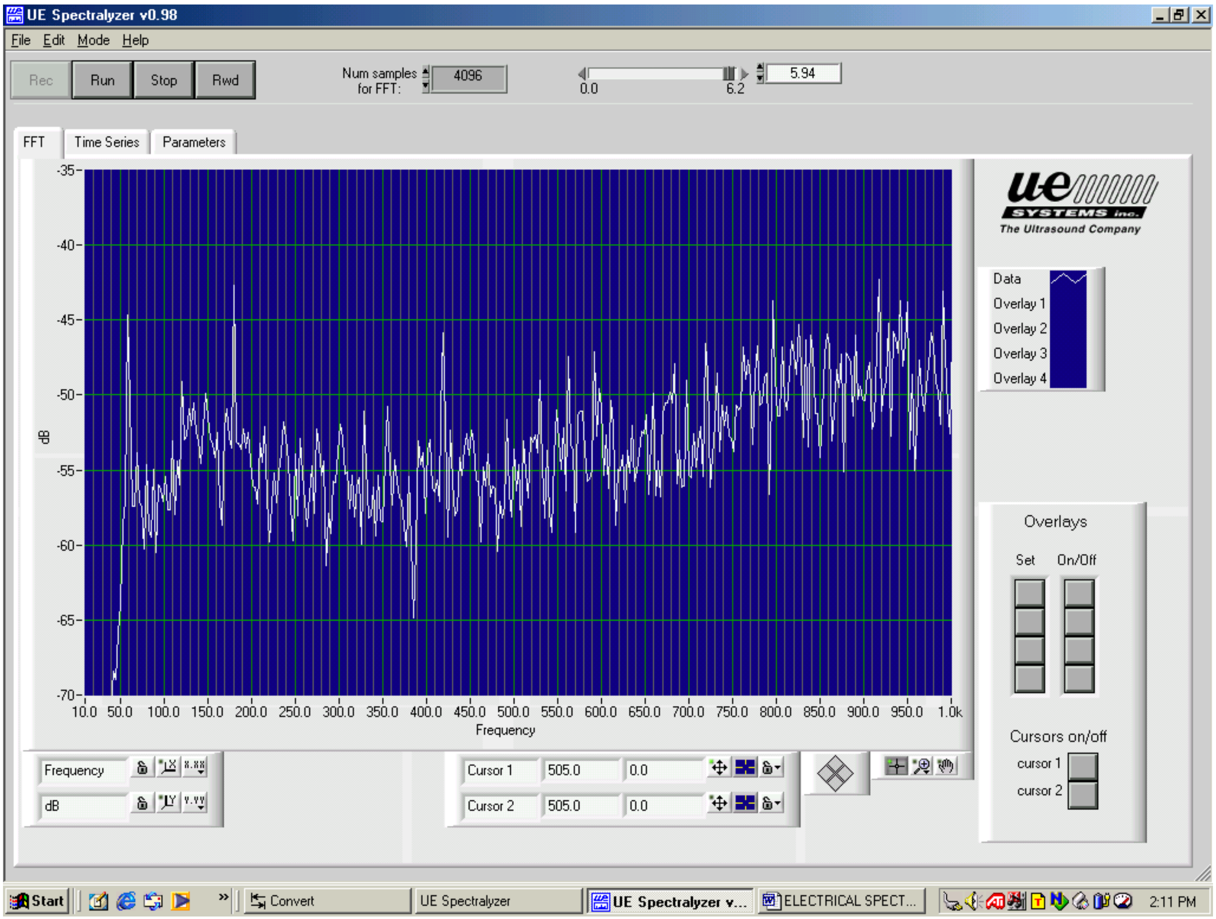
CORONA TIME SERIES



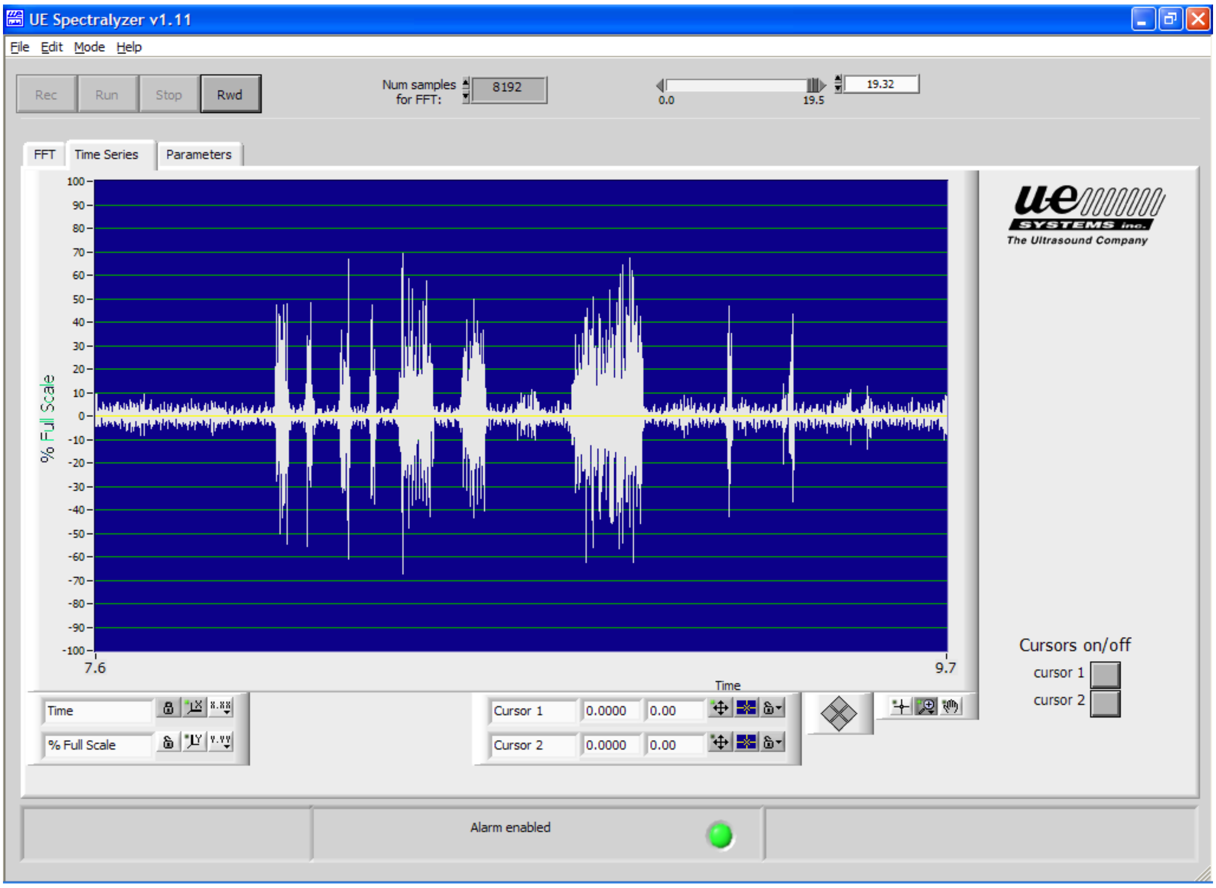
TRACKING SPECTRUM



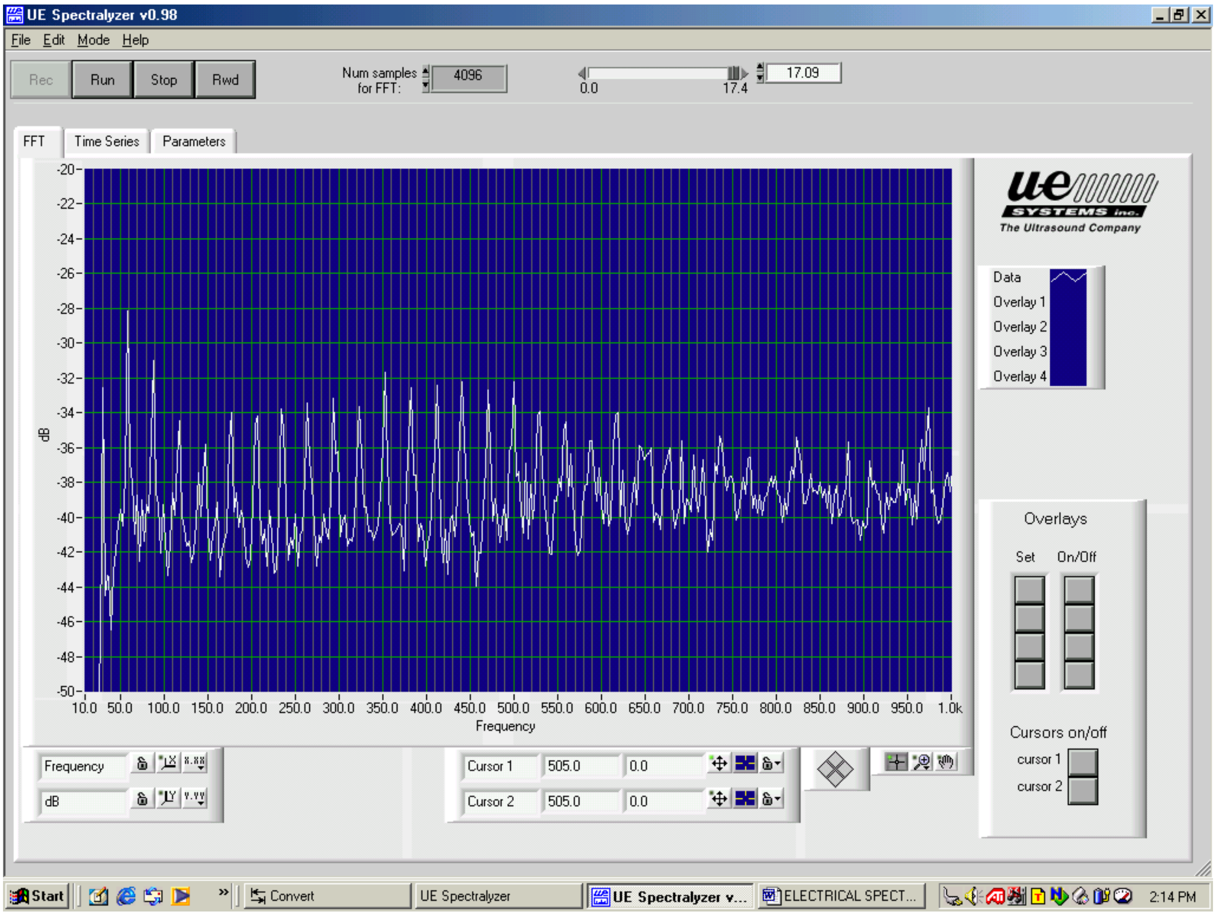
TRACKING TIME SERIES



ARCING SPECTRUM



ARCING TIME SERIES



LOOSE COMPONENT SPECTRUM

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