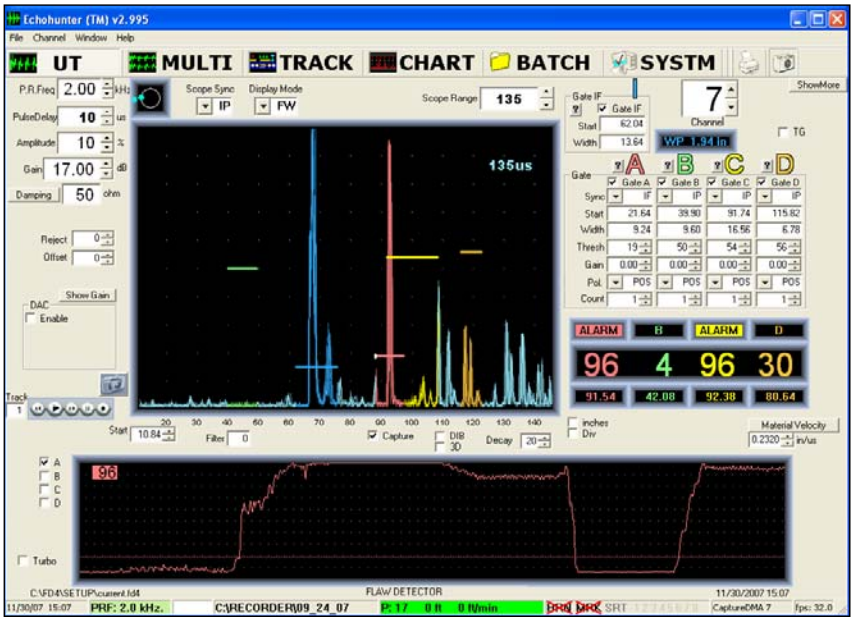
Echomac® FD-4

Magnetic Analysis Corporation

FD-4 Ultrasonic Inspection Instrumentation

Ultrasonic Instrumentation for In-line Flaw Detection & Thickness Measurement

- *Up to thirty-two independent test channels in a single computer chassis*
- *User configured flaw detection or thickness gauging for each channel*
- *Simultaneous A-scan and strip chart display for all channels*
- *Adjustable pulse firing sequence to avoid crosstalk in multi-channel applications*
- *Four independent flaw gates in each channel*
- *Sixteen-segment distance-amplitude correction (DAC)*
- *Summary reports can be generated for each production run*
- *Full network support for remote desktop view and control*



Echomac FD4 - UT Instrumentation Setup Display

The Echomac FD-4 A-Scan screen, shown above, displays detection of an OD surface notch 0.3 mm deep using shear waves that also detect ID defects. The horizontal bars indicate gate thresholds. The strip chart display in the lower portion of the screen, shows the peak amplitude of the signal within the gate.

The Echomac® FD-4 provides outstanding performance for inspecting tube, bar or plate.

The Echomac FD-4 is a computer based ultrasonic inspection instrument designed for in-line flaw detection, and thickness and outside diameter measuring. Easily configured for multi-channel operation, the Windows® operating system provides full network support for remote viewing and control.

Up to 32 independent channels can be installed in a single system. Using the FD-4's EchoHunter® software, the customer can easily configure each channel for any combination of thickness and flaw detection. The pulsers for each channel are synchronized with individually adjustable delays.

The strip chart display shows the peak values of signals within each gate. The flicker free A-scan captures non-repetitive events or flaws of short duration, even in very high speed UT scanning systems, typical of rotating transducer heads. A-scan display modes include basic sample mode, persistence mode with adjustable hold time, and a dynamic 3-D mode where the prior signals fade into the background as the displacement of the transducer and reflector changes.

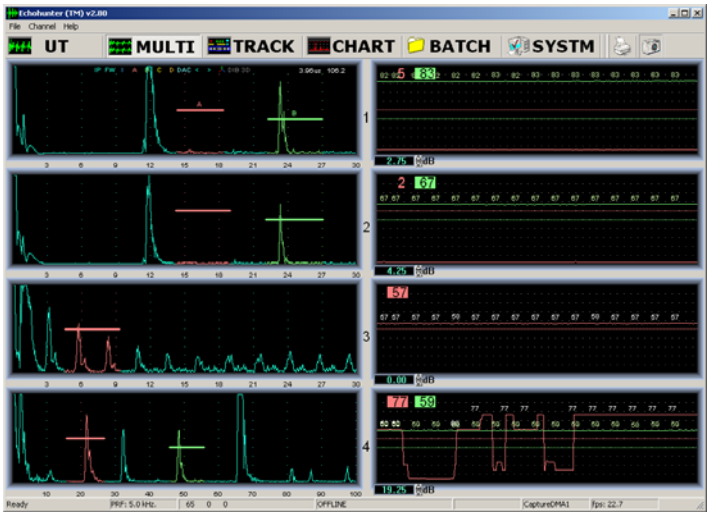
The operating parameters for each channel are displayed on one screen and are adjusted using the convenient mouse. A simple "copy and paste" sequence lets you transfer parameter settings from one channel to another, where appropriate. An unlimited number of setups can be named, saved, and recalled, using the hard drive, or they can be archived to a CDR, DVD-R, or usb flash device. High resolution color printing of setups, wave forms or strip chart recordings can be done with ease.

Summary reports of the total number of pieces or length tested, number of rejects, date of test, material and customer data, are shown at the end of each run.

ECHOHUNTER® SOFTWARE

The convenient ECHOHUNTER® software package comes with multi-channel A-scan viewer / recorder, test signal recorder, end suppression, tracking system, strip chart viewer, production logging, data compression, storage, color printing, and remote network interface.

MULTI CHANNEL SCREEN FOR FD-4



In the Multi Channel display mode, shown above, the A-scan and stripchart displays are presented for each channel simultaneously. All channels can be shown on one screen at a time. The strip chart display (in the right half of the panel) shows the peak captured signal levels in color highlighted boxes, along with the numerical local peak values within each gate.

The Multi Screen has custom controls for many of the frequently used parameters such as gate position, DAC, and receiver gain.

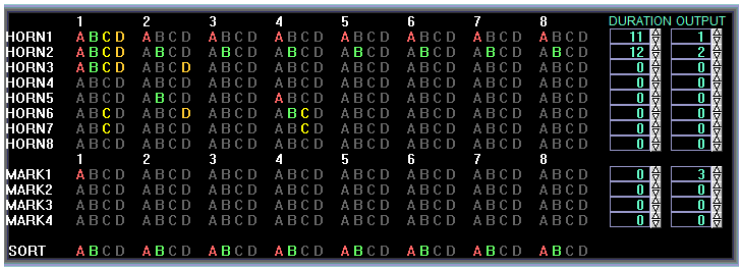
TRACKER SCREEN

The Tracker Panel is used to set up the end suppression and production tracking system for defect marking and accept/reject sorting.

CHANNEL MAPPER

Echohunter software can operate, display, and record 32 channels.

ALARM ROUTING MATRIX SCREEN



The Alarm Routing Matrix Screen, shown above, provides a convenient way to assign the routing of multiple thresholds to the desired output devices.

CHART VIEWER

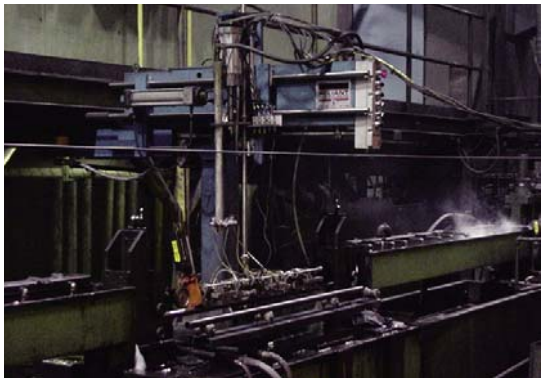
Chart viewer for customers to view production recordings

WALL THICKNESS and DIMENSIONAL MEASUREMENT

Each channel of an Echomac FD-4 can operate in either flaw detection or wall thickness measuring mode. In combination with a rotary tester, a three channel FD-4 can continuously measure wall thickness, as well as inside and outside diameter of a tube. Two of the dedicated channels measure wall thickness on opposite sides of the tube, while the third channel monitors the sound velocity in the water to compensate for variations due to change in temperature.

Ovality and eccentricity can also be measured with appropriate transducer assembly.

APPLICATIONS



Squirter type ultrasonic inspection station on a weld-line at Wheatland Tube, Arkansas. MAC Echomac electronics are operating with this test system.

◻ Tube and Bar Testing

Multi-channel full body operation is well suited for testing for longitudinal and transverse cracks and wall thickness in a single station when using MAC's Echomac rotary tester or other rotaries.

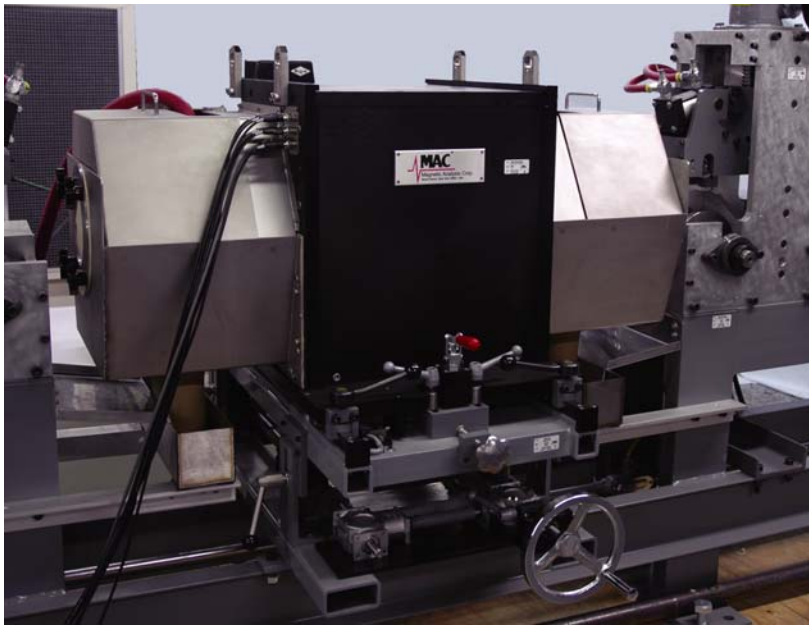
Tube inspection using an Echomac Ultrasonic Rotary mounted on an elevating platform, Demagnetizer to remove residual magnetism, and a MAC series Eddy Current encircling coil test.

◻ Immersion Testing

Immersion testing with longitudinal or shear waves. Direct readout of water-path, and dual gates with adjustable thresholds simplifies application. Use with traditional "spin the tube", "stuffing tank" or "squirter" type installations.

◻ Rotating Transducer Testing

Achieve higher throughput speeds with rotary transducer operation. Use Echomac FD-4 with MAC's Echomac Rotary Mechanism or other rotary systems.



MAC Echomac 7 channel ultrasonic rotary mounted on an elevating platform, for inspecting 4" (101.6mm) diameter material. Rotating transducers are housed in the black enclosure, which also contains the pressurized water couplant.

◻ Plate and Strip Testing

Parallel operation of 32 test channels in each FD-4 instrumentation allows plate testing in either pulse-echo or through-transmission mode. Additional FD-4's instruments can be incorporated to provide any number of additional test channels. System is also compatible with c-scan software.

Replace Older Ultrasonic Units

Replace older equipment without replacing transducers, or expand your inspection capability as application requirements change. Both immersion type installations and rotary installations can operate with the Echomac FD-4 electronics. Typical applications for Echomac FD-4 replacement include in-line inspection of tube, bar or plate.

SPECIFICATIONS

PULSER

Type of pulser:	Spike pulser.
Pulse amplitude:	500 V, adjustable
Pulse damping:	Hi and Low settings, 50 ohms or 200 ohms.
Rise time:	10 ns or less.
Pulse repetition frequency (PRF):	0.6 to 15 kHz, adjustable in 0.1 kHz steps.
Pulse delay:	1 to 1000 µs , adjustable in 1 steps.

RECEIVER

Gain:	0 to 60 dB, adjustable in 0.25 dB steps.
Differential gain:	Adjustable in the full gain range for each gate interval.
Frequency range:	0.4 to 30 MHz.
High pass filter:	Cut-off frequencies at 0.4 MHz.
Adjustable filter:	Available as option.
Oscilloscope display:	FW, PHW, NHW, and RF.
Linear reject:	Digital, adjustable from 0 to 40% in 1-% steps.
Modes of operation:	Pulse-echo, through transmission optional.

GATE

Number of gates:	Four gates, plus interface.
Gate synchronization:	Internal pulse (IP) or interface (IF).
Minimum delay after interface:	20 ns.
Gate start range:	0.02 to 1000 us, adjustable in 0.02 us steps.
Gate width:	0.02 to 1000 us, adjustable in 0.02 us steps.
Defect evaluation:	Alarm threshold adjustable from 0% to 100% in 1-% steps.
Alarm output:	Opto-isolated logic and AC solid state relays.
Alarm logic:	Positive or negative, independently selectable for each gate.
Peak and valley detection:	For positive alarm mode the largest signal within the gate is held until it is recorded on strip chart. In negative alarm mode the smallest signal is held in a similar manner.

DISTANCE-AMPLITUDE(DAC) CORRECTION

DAC curve:	16-segment, no width limitations, any segment can be increasing or decreasing, mouse drag adjustment.

THICKNESS CIRCUIT

Thickness Resolution:	2.5 ns, approximately 0.0003 inch for steel
Thickness Modes:	Average, and min/max capture for rotary
Error Detection Circuit	An adjustable measuring gate restricts thickness measurement to a specific location, prohibiting false readings in case of missing echoes. Slew rate control restricts measurements from rapidly changing from previous measurement.
Alarm Thresholds:	Independently settable for minimum and maximum deviations from nominal value.

DIMENSIONAL MEASUREMENT

Three-transducer mode of operation for simultaneous measurement of OD, ID and wall thickness of tubes. Two transducers are located on opposite sides of the tube, the third transducer has a fixed artificial target for water velocity compensation due to temperature change.

DIMENSIONAL MEASUREMENT *(continued)*

A-SCAN DISPLAY

Digitization:	100 MHz, 8-bit, independent for each channel
Depth:	500 points
Range:	1 us. or greater
Sync:	IP or IF with delay.
Processing:	Each channel has a dedicated ADC, processor, and DMA engine for capturing and displaying consecutive traces. Specialized peak capture mode of operation is implemented in both hardware and software.
Persistence/Decay:	Previous traces can be displayed in decaying intensities to hold infrequent events. DIB processing mode allows much longer and infinite hold.

STRIP-CHART PRESENTATION AND RECORDING

General:	Strip-charts are presented on the monitor in combination with the A-scan and setup parameters or individually.
Number of traces:	Any and all gates up to 32 channels.
Recording:	There are 32 recording channels and 4 gates.
Reporting:	Summary reports are given at the end of production run containing total number of pieces or length tested, number of rejects, date of test, material and customer information.

TUBE & BAR TRACKING

Implemented in hardware, end suppression and defect marking is fast and high precision.

COMPUTER

Industry standard IBM compatible standard rack mount computer with Windows® platform

NETWORK

10/100 Ethernet, TCP/IP. Remote application can control test parameters and view all signal waveforms.

OPERATING CONDITIONS

AC power requirement:	Under 800 VA from a 115 V or 230 V, 50 or 60 Hz line for an eight-channel installation.
Enclosure:	Standard 19" rack-mount computer enclosure and rack mount monitor. These units typically operate in air-conditioned cabinets.
Weight:	55 lbs. (24.75 kg)
Operating temperature range:	0 to 50 degree C (32 to 122 degrees F).

MAC
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