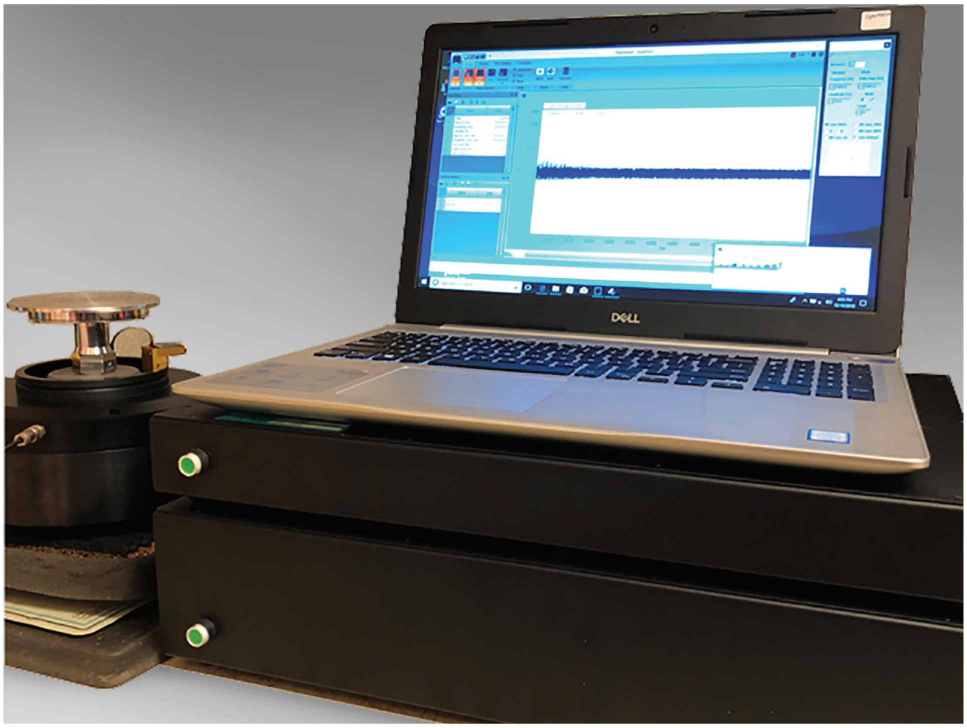

FELIX™ PIND
Computer Aided Test System for PARTICLE IMPACT NOISE DETECTION

- Windows 10
- Easy Calibration
- Digital Power Amplifier

SPECTRAL DYNAMICS

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Version A

SPECTRAL DYNAMICS

For over fifty years the PIND Products Group of SPECTRAL DYNAMICS, INC. has given users simple, reliable, and inexpensive tools to perform **Particle Impact Noise Detection (PIND)** testing to increase the reliability of electronic components.

Our non-destructive high frequency acoustic test monitors for loose particles moving inside high reliability internal cavity electronic components such as relays, transistors, hybrids, integrated circuits, and switches – particles that have the potential of causing short circuits and serious malfunctions in system operations.

A shaker is used as a linear motor to excite loose particles to move within the component cavity. Upon striking the lid of the cavity, some of the particle kinetic energy (½mv2) is converted to a wide band acoustic pressure wave that travels through the lid, through the attachment media, and onto the top surface of the Impact Detection Sensor. The acoustic wave is detected by the sensitive ultrasonic crystal or crystals within the sensor and converted to an electrical signal. To keep the particle moving, a very accurate shock, generated internal to the shaker and controlled by the computer, monitoring the motion of the sensor, is employed.

SD FELIX™ PIND SYSTEM

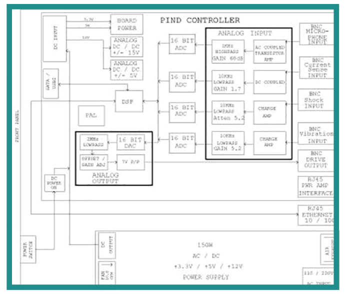
ADVANCED TECHNOLOGY THAT'S EASY TO USE

A small metal flake as shown above can cause serious malfunction in electronic components

Our SD FELIX™ M4, featured on the cover, is the most advanced system available today. Combining sensors that monitor and display the shaker motion with computer generatedcontrol to correct for changes in test conditions, the SD PIND test system generate accurate and repeatable test conditions. Its ultra-sensitive, ultrasonic (155 kHz) sensor with multiple crystals can detect particles smaller than 15 microns in diameter impacting the package cavity.

The multiple computer technology not only creates the motion but also allows the user to program the motion including both shock and vibration at the precise amplitude and timing to simulate the whole range of testing requirements. The interactive Windows10 interface allows the operator to enter the desired stored test sequence or enter a new configuration with variable amplitude of shock or the amplitude, timing, and frequency of the vibration. The SD FELIX™ system has four channels used to acquire the data from the vivration, the shock, and the detection crystals as well as expansion to monitor the power amplifier.

- Data is Acquired
- Data is Displayed
- Data is used for Corrections
- Data is Stored for Further Analysis



FOUR UNIQUE CHANNELS OF DATA ACQUISITION

The FELIX™ system uses four unique channels of data collection. All four channels use the same clock to digitize the data at 2.5MSamples per second.

The high-speed Acoustic channel has a center frequency of 155 KHz to minimize noise and maximize signal. The amplification is set to 60dB and the precision fixed anti-aliasing filters are set so the 8X oversampling produces a bandwidth of over 2MHz. Further filtering used to limit the frequency of interest to the peak sensitivity of the sensor. The tiny signals created by the crystal are increased in size to be digitized without aliasing and the data is sent to the onboard Computer System on Module (SOM).

The vibration channel features an advanced charge amplifier again with powerful anti-aliasing filters to deliver preprocessed data to the SOM for decimation and filtering down to 20KHz and converted to the frequency domain as well as the time domain.

In a separate shock channel, the output from the measuring sensor is processed with anti-aliasing protection down to 50KHz.

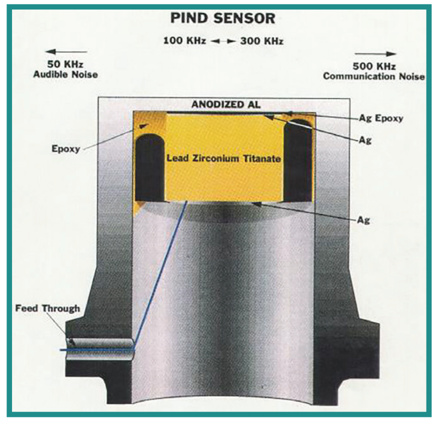
Finally, the fourth channel is designed as expansion and could be used to monitor the output current of the unique differential digital 600-Watt Power amplifier so that the current into the shaker can be compared to the motion measured by the sensor for the health and maintenance of the system.

Motion is generated by the digital output channel with full anti-imaging filters which feeds the Digital Power Amplifier to generate both the vibration and the shock excitation. Yes, the shock is also computer generated!

In the PIND Test, the particles are never measured directly. We put loose particles in motion with a vibration, ock, and then detect the impacts of those particles as they contact the lid of the cavity.

PIND DETECTION

Acoustic energy, generated by the particle impact with the cavity lid, propagates as an accoustic wave through the material until it reaches the sensor wear plate. The acoustic pressure causes it to deflect slightly pushing on the crystal, which then generates an electrical output. Please note that if the signal is forced to propagate further such as through the substrate, it will lose significant energy.



For maximum sensitivity, Impact sensors use a piezoelectric element of Lead Zirconate Titanate (most often called PZT-5A) at peak resonance. These are simply the most sensitive detectors available capable of detecting surface displacements of less than 10^{-11} meters. Their exact sensitivity and resonant frequency can both vary at time of manufacture and over time with use. For military specifications, the frequency of resonance is allowed to vary from 150 to 160KHz.

SINGLE CRYSTAL SENSORS

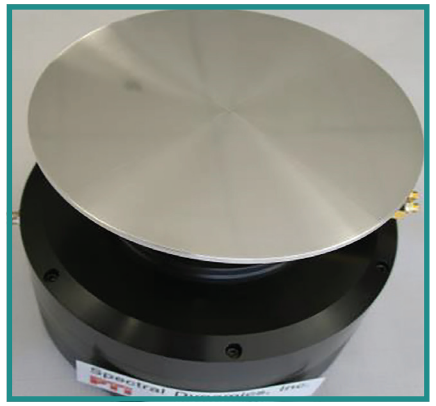
The sensor is defined in terms of its longitudinal sensitivity in the physical parameter of pressure as -77.5dB+/-3dB ref 1V/microbar as described in the absolute calibration method of ANSI S1.2-1988, using a full-field three sensor underwater reciprocity calibration technique to accurately measure the crystal response.

Less accurate methods of sensitivity measurement used include capacitive pickup calibration or ultrasonic white noise calibration, which can be used to measure the sensor output but are only relative measurement methods and can made accurate only by referencing the absolute underwater calibration method.

All SD PIND sensors have a complete Faraday shield around each crystal to protect the sensor from unwanted stray electrical signals. This protection enhanced by the five-conductor, seven-layer flexible circuit that attaches the sensor to the shaker mounted connector eliminates the need for Transient Detectors with Spike indicators required on older PIND systems.

The sensor peak sensitivity can be dampened by a variety of factors but the most common reason for sensors to lose sensitivity over time is the bond that holds the crystal to the front surface wear plate will begin to micro crack with use and age.

MULTIPLE CRYSTAL SENSORS



As the sensor crystal and the source of the acoustic wave get farther apart the measured energy is reduced. JEDEC Recommended Practice 114 graphically outlines the decay of detection is down to less than 50% at distances over 0.75 in from the impact site. For the PIND test it is then important that the lid of the part to be tested be placed a close to the crystal in the sensor as possible.

The Model 100-5S155-4 sensor incorporates five separate impact detection crystals within the single sensor. The most sensitive area of the sensor are those areas where each detection crystal is located. For testing small parts, it is important to place the part directly on one of the four target areas.

VIBRATION

The particles are put into motion by vibrating the electronic component on top of the shaker at a fixed frequency. The accuracy of the shaker motion is required to be within 10%. For the Heavy Duty M230 shaker, with the larger 100-5S155-4 multiple crystal sensor the capacity is within tolerance at 130 Hz to above 400 grams.

SHOCK

The shock is used in the PIND test to free particles that adhere to the cavity wall. The smaller particles are more prone to exhibit the property of adhesion and stop moving during the vibration cycle.

The shock amplitude must be held to within 20%. Unique to the SD PIND system is an "Active Shock". The computer controls of the shaker motion which is active during the shock until the striker in the armature collides with the shock anvil deep inside the shaker. The shock is created by the stopping of the armature velocity creating a dynamic shock pulse that travels up the sensor to the DUT. The computer control allows a programming change to shock amplitude to accommodate the larger loads. Older mechanical shocks using a spring-loaded tapper actuated shock must be reset by manually adjusting the screws for any parts that weigh over 25 grams.

The SD PIND shock is calibrated and programmable from 500 to 1500 g's and the display reads the calibrated value of the shock waveform during the test for the actual DUT. In addition there is a selectable boost for heavier parts or a negative boost to get lower values than the calibration range. In this way the dynamic conditions are always monitored and accurate throughout the variety of test conditions and devices being tested.

UNIQUE FEATURES OFFER CONVENIENCE AND FLEXIBILITY

Whether you're testing electronic components for cardiac pacemakers, manned spacecraft or undersea cables, you'll enjoy the convenience and flexibility of the special features which set our system apart from any other PIND test system.

- The SD FELIX™ system easily exceeds the requirements of all military standards for PIND testing (U.S. MIL-STD-883, 750, 202,39016D) and since everything is in software it can be expanded later for any test configuration imaginable.
- Imbedded sensors that monitor and display the actual shaker motion with computer analysis to correct for any changes in test conditions, the SD FELIX™ test system generates accurate and repeatable test conditions.
- The unique SD FELIX™ PIND shaker creates accurate "Active Shocks" with adjustable shock levels by controlling the velocity ofthe shaker head and correcting for device differences prior to impact.
- The SD FELIX™ system offers a low profile, low stray magnetic field design that eliminates any need for an expensive special testbench, required for conventional shakers with external shock fixtures.
- The SD FELIX™ system is an all-DIGITAL system with no knobs or screws to adjust. It is fully programmable to your ownspecifications or as required by MIL standards. Since everything is generated by the computer, the user can create differentamplitudes, frequencies, and durations. There is future expansion to more complex motion environments including RandomVibration and advanced Shock conditions.
- The SD FELIX™ system is fully automated at the touch of a button—or optional external activation that talks to Windows 10.

PROGRAMMABLE SOFTWARE FOR MORE VERSATILITY

The FELIX™ system is programmed in C++ directly in the Windows10 O/S making the program readily compatible with ither tools like Windows Office. Reports, printing, and Networking are easy and simple. With a native Windows Program ensures that the latest security features are employed.

FELIX™ software allows for Data collection of the vibration, shock, and acoustic channels. Each type of signal can be replayed for more in depth understanding of the interactions between the acoustic noise and the motion environment.

FELIX™ SPECIFICATIONS

SPECIFICATIONS for SPECTRAL DYNAMICS
MODEL FELIX™-M4 PIND TEST SYSTEM

The FELIX™-M4 system is designed to test both small parts and large parts on one system. The unique 100mm diameter sensor has five (5) detection crystals and attaches onto a 35-pound convective cooled low-profile Neodymium magnet shaker with a single 10/32 screw. This modular design allows for field replacement of the sensor. The system adjusts the power to the shaker to accommodate weights from 0.1 up to 360 grams. At vibration frequencies of 60Hz the system can test DUTs that weigh over 400 grams.

SYSTEM INCLUDES:

2600-9702-1	Main Chassis with Four Input Channels, One Output Channel Computerized Programmable Control, 110VAC
2600-9701-1	Fully Differential Digital Power Amplifier 600 Watts
4501-M230	Heavy Duty 34 Force-Pound PIND Vibration and Shock Shaker
2600-9501	Intel Core i5 Windows10 Pro Laptop with Ethernet connection
2600-FELIX	Windows 10 Software including adjustable amplitude, timing, frequency for vibration as well as adjustable amplitude for shocks. User created motion profile. Adjustable Shock Delay Timing 25-250 Millisecond
100-5S155-4	100 mm diameter surface Impact Sensor/Accelerometer with Five (5) Detection crystals
100-S140BM	Sensitivity Test Unit (STU)
2600-9455	Kit, FELIX™ Accessories including:
(3)110-SCM4	Low Noise BNC-Microdot Cables
XP-STU	External STU Pulsar Box
W080-0410, 0330, ETHERNET	Associated Cables
MANUAL	FELIX™ Manual
LT-FELIX	Operation/Maintenance Manual
CH04-ACWS	4oz Bottle Water Soluble Acoustic gel
4501-DOT1	50mm double sided adhesive dots
Calibration Certificate	Mil-Std 45662A, Mil-Std 883H, 750, 202
WARRANTY	One Year Return to Factory Warranty (Parts and Labor)

MOTION CREATION SPECIFICATIONS:

Vibration Frequency Range	40 to 250 Hz, Sinusoidal
Amplitude	5.0.to 20.0 'G' Peak, Display on Screen
Amplitude Program Resolution	0.1 'G'
Repeatability	0.5 'G' Peak for levels above 5g, with Computer Control
Adjust Maximum D.U.T. Test Weight without calibration changes	Maximum 400 Grams over the entire range Maximum 500 Grams at 60 Hz
Shock creation 500-1500g	
Method	Active Shock creation with computer control of shaker armature
Adapts Shock to D.U.T. Weight	
Amplitude	Programmable 500 to 1500 'G'
Repeatability	Within 50 'G'
Pulse Width	<100 Microsecond at 50% Amplitude 90-150 Microsecond at 10% Amplitude
Shock Delay	Adjustable timing
Maximum D.U.T. Test Weight without calibration changes	Amplitude falls slightly with load Maximum capacity 400 Grams with 1000 g Amplitude (May require Programmed value to be increased)

MAXIMUM WEIGHT SPECIFICATION:

Shaker Limitation	500 Grams
Vibration Limitation	400 Grams w/ Sensor 40-250Hz
Shock Limitation	400 Grams may require increasing Program Value

ELECTRICAL SPECIFICATIONS:

Power requirements	Selectable 100,120,220,240 VAC +/-10% at 50 or 60 Hz
Power Consumption	Maximum 600 Watts
Acoustic Detection Circuitry	60 dB Gain +/- 2 dB 150-160 kHz Software Band pass Filter
Threshold	Dynamic adjustable
Outputs:	Windows 10 Graphics displays

IMPACT SENSOR ASSEMBLY SPECIFICATIONS:

Sensitivity (each crystal) -77.5 dB +/- 3 dB re 1V per Microbar at 155 kHz
Measured using ANSI 2.1-1988, Underwater Reciprocity
Cable Integral Four Conductors fully shielded Flex Cable
EMI Protection Full Faraday Shield including all cabling
Attachment Fully Field replaceable w/10/32 screw
Accelerometer 2.1pc/G ±10%, 100 Hz located inside Impact Sensor

100-S155-4:

Number of Crystals	Five, one in center with four mounted in a square at 50mm
Diameter	100 mm (4 in)
Weight	250 Grams
Sensitivity area	Sensitivity within 6dB over a clover leaf pattern about 70mm diameter

STU SENSOR SENSITIVITY -77.5 dB +/- 3 dB ref 1V per Microbar at 155 kHz reference ANSI 2.1-1988.

EXTERNAL STU PULSER OUTPUT 250 microvolts +/- 20%

PHYSICAL SPECIFICATIONS:

Control Unit	17x12x2, 10 pounds
DPA-600	17x12x4, 15 pounds
M230 Shaker	10cm High X 18cm Día (4 X 7 in), 30 pounds
2600-9501	Clamp shell Laptop 5-pound INTEL Core i75

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