



PARTICLE IMPACT NOISE DETECTION

Vibration Shock and Acoustics to insure the highest of reliability



S P E C T R A L
D Y N A M I C S

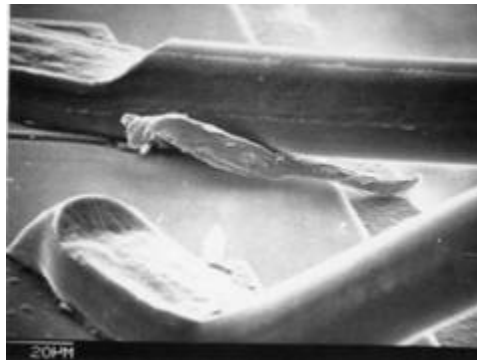
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For over thirty years the PIND Products Group of SPECTRAL DYNAMICS, INC. has given users a simple, reliable, and inexpensive method of **Particle Impact Noise Detection (PIND)** testing to increase the reliability of electronic components.

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 to excite loose particles within the component cavity. Upon striking the lid of the cavity part of the particle energy is converted to a wide band pressure wave that travels through the lid and is detected by the sensitive ultrasonic sensor to which the device under test is attached. To keep the particle moving a very accurate shock, generated internal to the shaker and feedback controlled by electronics monitoring the motion of the sensor is employed.



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

SD 4511 PIND SYSTEM

ADVANCED TECHNOLOGY THAT'S EASY TO USE

Our SD Model 4511M, featured on the cover, is the **most advanced system available today**. Combining sensors that monitor and display the shaker motion with feedback control to correct for any changes in test conditions, the SD PIND test system **generates accurate and repeatable test conditions**. Its ultra-sensitive, ultrasonic (155 kHz) sensor can detect particles as small as one mil in diameter impacting the package cavity.

The microprocessor technology not only controls the motion but also allows the user to program over twenty steps at the precise "g" level to simulate the whole range of testing requirements. The operator simply enters the desired amplitude of shock or the amplitude duration and either vibration frequency or cavity height. The SD system then calculates the appropriate frequency and generates the proper shaker motion — automatically.

You'll be amazed at how **quick and easy** it is to program and reprogram the 4511 to your own internal routines -or to meet rigorous military standards.

PROGRAMMABLE SOFTWARE FOR MORE VERSATILITY

The PTI system can be tailored to your specific test requirements through the versatility of our **specially-designed and thoroughly tested software** —With our pre-programmed software (MPP), you can order up to nine pre-programmed sequences in the PROM (Programmable Read Only Memory),

which the system can deliver on demand. There is an optional expansion of this memory to up to 99 pre-programmed sequences.

With the LFP option, the system will automatically reduce the maximum allowable vibration amplitude for low-frequency testing at frequencies as low as 25 Hz for an assortment of relay, hybrid and discreet component testing. And if additional tests are required, we can alter the software to meet your specifications.

UNIQUE FEATURES OFFER CONVENIENCE AND FLEXIBILITY

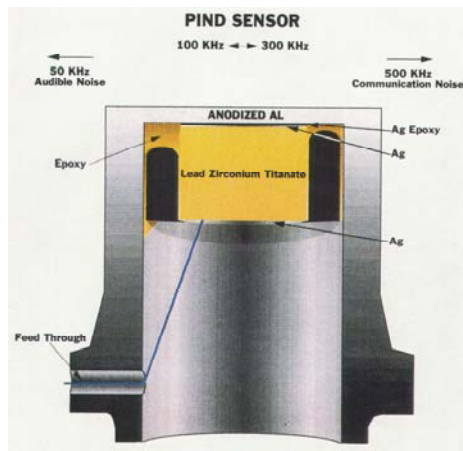
Whether you're testing electronic components for cardiac pacemakers, manned spacecraft or undersea cables, you'll enjoy the convenience and flexibility of the special features which set our system apart from any other PIND test system.

- The SD 4511 system easily exceeds the requirements of all military standards for PIND testing (U.S. MIL-STD-883, 750, 202, 39016D).
- Imbedded sensors that monitor and display the actual shaker motion with feedback control to correct for any changes in test conditions, the SD 4511 test system generates accurate and repeatable test conditions.
- The unique SD 4511 PIND shaker creates accurate shock levels by controlling the velocity of the shaker head and correcting for device differences prior to impact.
- The SD 4511 system offers a low profile, low stray magnetic field design that eliminates any need for an expensive special test bench, required for conventional shakers with external shock fixtures.
- The SD Model 4511 system is an all DIGITAL system with no knobs or screws to adjust. It is **fully programmable** to your own specifications or as required by MIL standards. -allowing the user to enter different g levels, frequencies, and durations.
- The SD 4511 shaker automatically steps through programmed sequences with the touch of a button—or optional foot pedal.

IN the PIND Test, the particles are never measured directly. We put loose particles in motion with a vibration, keep them in motion with a shock, 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 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.



To get 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 $-77.5\text{dB} \pm 3\text{dB}$ 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.

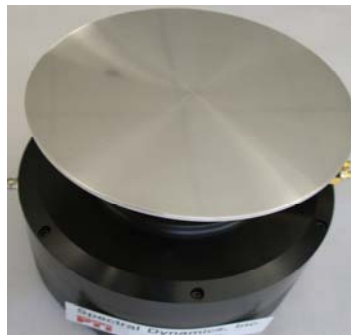
Less accurate methods of sensitivity measurement used include capacitive pickup calibration or ultrasonic white noise calibration, which can be used to measure the sensor output but are only relative measurement methods and can made accurate only by referring back to the absolute underwater calibration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

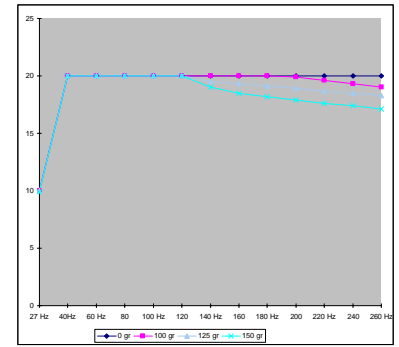
As the sensor crystal and the source of the acoustic wave get farther apart the measured energy is reduced. JEDEC Recommended Practice 114 graphically outlines the decay of detection is down to less than 50% at distances over 0.75 in from the impact site.. For the PIND test it is then important that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



The Model 100-5S155-6 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%. The following chart shows the capacity versus frequency for the E090-0120 Shaker. For 150 grams load the system is within tolerance up to about 200Hz.

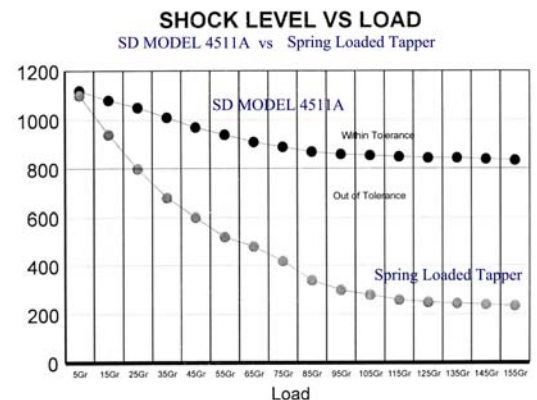
For the larger M230 shaker, with the larger 100-S140C/AL sensor the capacity is within tolerance at 130 Hz to above **420 grams**.

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 the feedback control of the shock pulse. As shown below, the control holds tolerance over the entire load range while the older 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 programmable from 100 to 2500 g's and the display reads the calibrated value of the shock for the actual part under test. In this way the dynamic conditions are always monitored and accurate throughout the variety of test conditions.



Model	Electronics	4511A	4511L	4511M	4511M6	4511L-R	4511M-R
4511-1000068	Microprocessor based Control Unit	Yes	Yes	Yes	Yes	Yes	Yes
W080-0330	Control Unit Power cable	Yes	Yes	Yes	Yes	Yes	Yes
W080-0210	Controller to Shaker Cable	Yes	Yes	Yes	Yes	Yes	Yes
W080-0610	Controller to Oscilloscope Cable	Yes	Yes	Yes	Yes	Yes	Yes
E0902160A	Monitor Oscilloscope	Option	Yes	Yes	Yes	Yes	Yes
	Shakers						
4501-M120	Normal PIND Shaker, Case optional	Yes	No	No	No	No	No
4501-M230	Heavy Duty PIND Shaker w.Case	No	Yes	Yes	Yes	No	No
4501-M230R	Wide Pulse Width PIND Shaker	No	No	No	No	Yes	Yes
	Sensors and Cables						
100-S140C/A	22mm Impact Sensor/Accelerometer	Yes	No	No	No	No	No
100-S140C/AL	50mm Impact Sensor/Accelerometer	No	Yes	No	No	Yes	No
100-4S155C4	100mmFourSensor/Accelerometer	No	No	Yes	No	No	Yes
100-5S155C6	150mmFiverSensor/Accelerometer	No	No	No	Yes	No	No
4501-500065-A	External STU Pulser Box	Yes	Yes	Yes	Yes	Yes	Yes
100-S140BM	STU Sensor	Yes	Yes	Yes	Yes	Yes	Yes
110-SCM4-W	STU Sensor Cable	Yes	Yes	Yes	Yes	Yes	Yes
110-SCM4-Y	Impact Sensor Cable	Yes	Yes	Yes	Yes	Yes	Yes
110-SCM4-B	Accelerometer Cable	Yes	Yes	Yes	Yes	Yes	Yes
	Software and Consumables						
4501-DOT1	22mm Acoustical Tape Circle	Yes	No	Yes	Yes	No	Yes
4501-DOT2	50mm Acoustical Tape Circle	No	Yes	Yes	Yes	Yes	Yes
CH02-ACWS	Acoustic Couplant Standard	Option	Yes	Yes	Yes	Yes	Yes
CH04-ACLPD	Acoustic Couplant Heavy Duty	Option	Option	Option	Option	Option	Option
4501-820259	PIND Software	Yes	No	No	No	No	No
4501-820261	PIND Software	No	Yes	Yes	Yes	No	No
4501-820255	PIND Software	No	No	No	No	Yes	Yes
LT-4511	PIND System manual	Yes	Yes	Yes	Yes	Yes	Yes

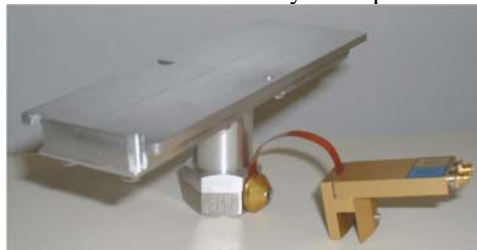
WHICH MODEL IS RIGHT FOR YOU?

Each of the six systems consists of a controller, shaker, sensor, STU subsystem, software, monitor scope, cables, consumables, and documentation:

- Our basic 4511A system, capacity up to 150 grams, has the normal shaker and a sensor with a mounting area of 22mm (0.875in.). It can always be upgraded with a monitor, larger shaker, sensor, or advanced software.
- The Model 4511L comes complete with the heavy duty shaker, a 50mm (2 in.) sensor, advanced software, and various options including the shaker shipping case and flex protector.
- Our largest Model, the 4511M has the heavy duty shaker and advanced software but sports a multiple crystal 100mm (4in.) mounting surface for the largest hybrids.
- The relay test specification given in MIL_STD 39016D requires a wider shock pulse than the requirements of MIL STD 883 or 750. Our -R series systems meet this requirement with a wide pulse width shaker and software.
- Finally, the 4511M6 is the largest system with a 150mm (6in.) sensor with five crystals for testing the largest parts to the MIL STD.

SERVICE AND PARTS REPLACEMENT

Options include Calibration kits, Shaker Dust Seals, and Sensor flex protectors. All of the system performance is controlled in software so we can tailor a system to your exact specifications including custom shock and vibration features in your system. We manufacture our own shakers and sensors so we can customize them to your requirement.



Above is a 6in by 2in five crystal sensor for testing advanced hybrids.

PREVENTIVE MAINTENANCE SAVES TIME AND MONEY

To insure that your PIND system is always performing at its peak, SPECTRAL DYNAMICS, INC. has developed a comprehensive maintenance program including complete system diagnostics, repairs, and exchanges. ALL with the accuracy provided by complete calibration and certification traceable to National Standards. Military standards require that each system – including sensors, amplifiers, thresholds and display monitors be

calibrated annually. However, to minimize costs over the long haul, SD recommends that you start your calibration interval at six months and then extend it to one year after you have sufficient confidence that operational procedures are correct.

After each calibration, we issue a 30-day warranty-or extended warranty if you prefer. And we offer priority two-day service or even same day when your PIND system is something that you cannot do without.

TRAINING TAILORED TO YOUR NEEDS

SPECTRAL DYNAMICS, INC. also provides a complete training program for users at all levels of experience. Our comprehensive two-day training seminars explain the intricacies of system operations, testing methods, particle behavior, calibration procedures, failure analysis, repair and maintenance procedures, and the latest military specifications.

These seminars consisting of lectures by experts and hands-on laboratory sessions are conducted in California. Or if you prefer, we will provide an on-site training program at your location tailored-made according to the specialized needs of your company.