INF GR/PS/133 R1
Brussels, 11-13 July 2005

Miniature Damped Accelerometer Series
ASE-A

Kyowa Electronic Instruments Co. Ltd.,

Accelerometers

Accelerometers are used to detect & measure acceleration of a mass such as a vehicle and its components.

When connected to the appropriate Data Acquisition System, they accurately quantify:

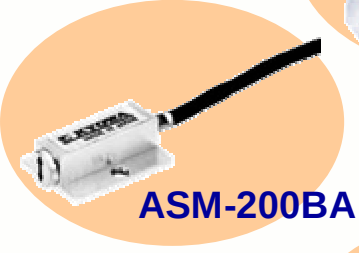
- Amplitude of vibration
- Frequency spectrum
- Velocity
- Displacement

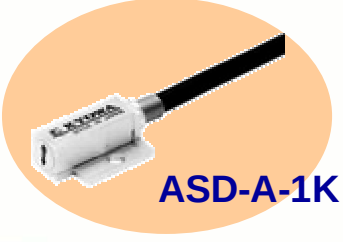
Accelerometers

Accelerometers are an essential sensor for automobile development and evaluation, experimental measurement, and analysis.

- **Widely utilized in various fields:**
  - Power train
  - Controllability
  - Drive train
  - Strength, Reliability
  - Car Crash Testing
  - Product Line


AS-HA


ASM-200BA


ASD-A-1K

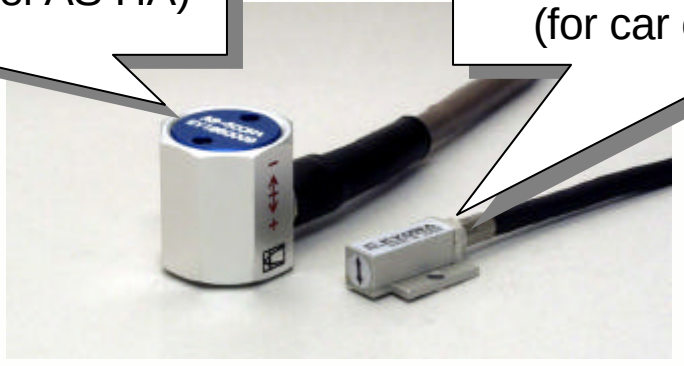

ASM-1KBC

Comparison of Damped and Undamped Accelerometers

Specific differences between damped and undamped Accelerometers are Size and Frequency characteristics

Damped Accelerometer
(Kyowa's current model AS-HA)

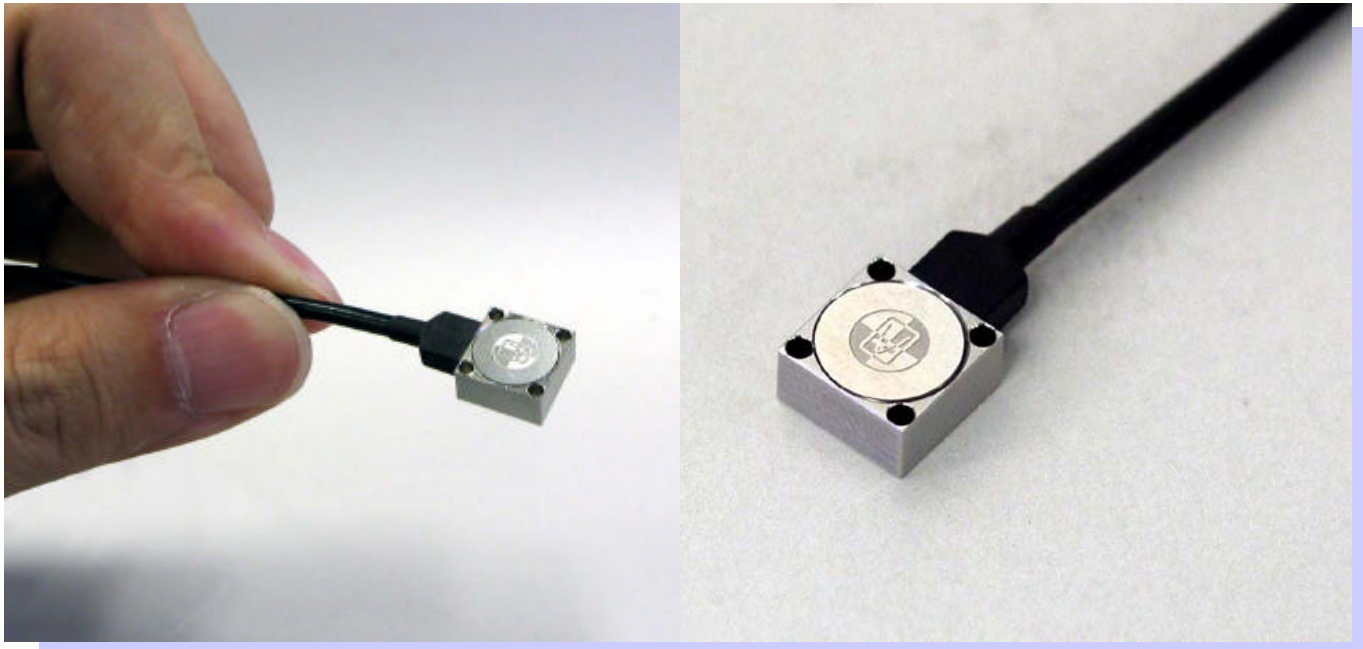
Undamped Accelerometer
(for car crash testing ASD-A)



- **Size**

Until now, Kyowa damped accelerometers were larger than undamped types because of the complicated internal structure needed for damping ratio design.

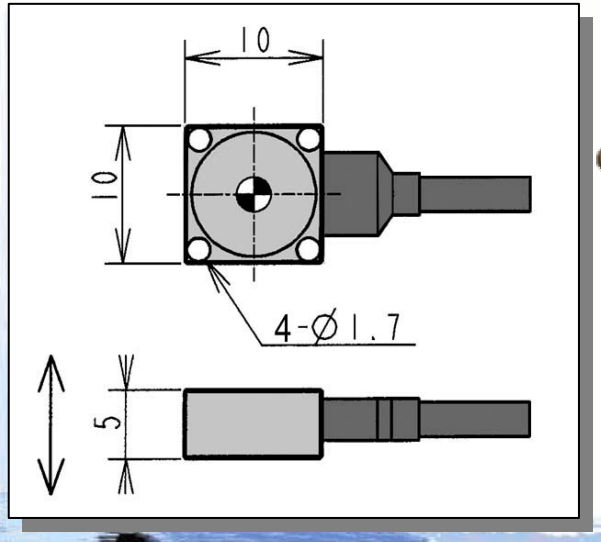
New Damped Accelerometer ASE-A Series



Small, Light Weight Design

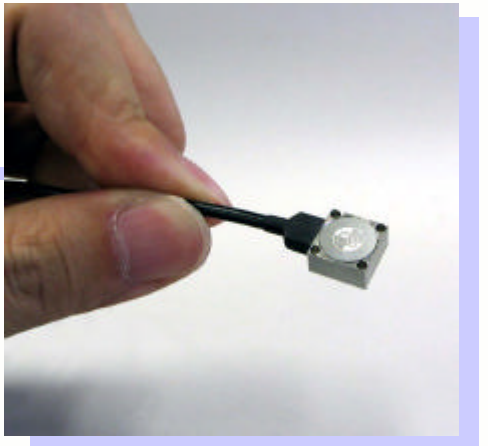
Utilizing sputtering technology, size and weight are minimized

- Dimensions: 10 x 10 x 5mm (0.4 x 0.4 x 0.2inch)
- Weight: Approx. 3grams (0.1oz)



- Minimal impact on the vibration mode of the object under measurement
- Ideal for space limited applications

Damping ratio



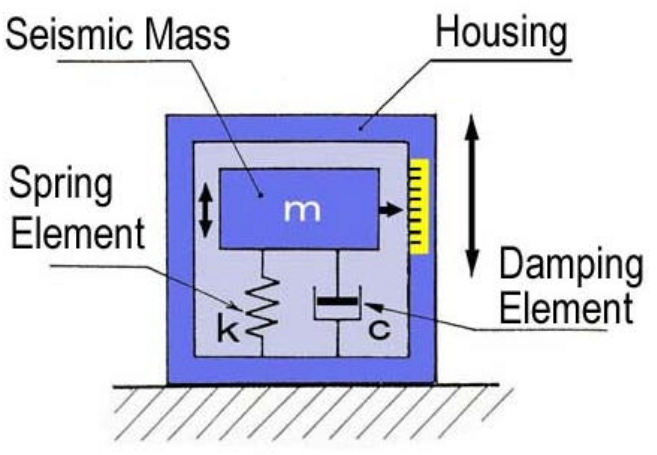
- Optimized damping

  Damping ratio: Approx. 0.7

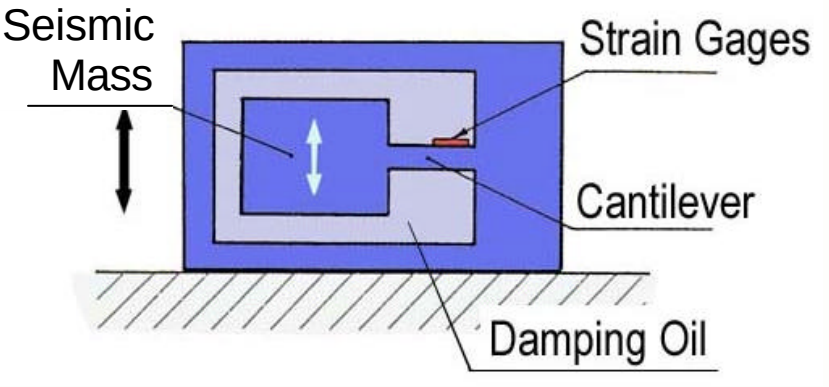
Fundamental Structure of Accelerometers

Common accelerometer structure consists of seismic mass, spring, and damping element.

Conceptualization



Example of Structure



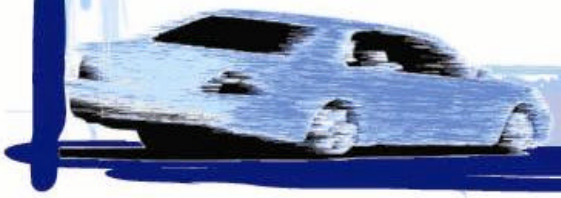
Advantages of Using Damped Accelerometers

Choosing the proper damping is an effective way to prevent transducer resonance output that exceeds the input amplifier accurate measurement range

What is “Optimized Damping”?

In order to respond faithfully to the input waveform, the delay time of the accelerometer output should remain constant throughout the frequency spectrum of the input waveform.

When the damping ratio is approximately 0.7, signals shift on the time axis in the amount of the delay time, but the original waveform of the signal itself is maintained.

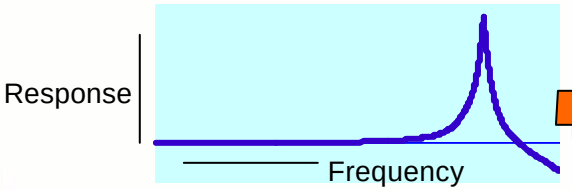


Comparison between Damped and Undamped Accelerometers

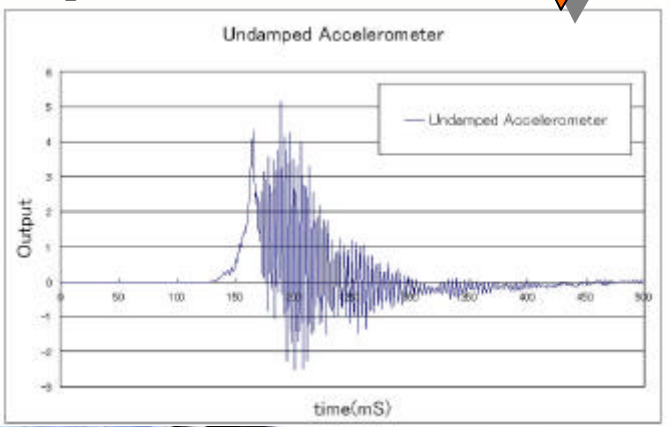
Undamped Type

Small in size. Has a resonance peak in the frequency characteristic.

- Frequency characteristics



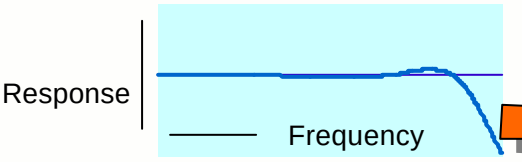
- Output waveform ex.



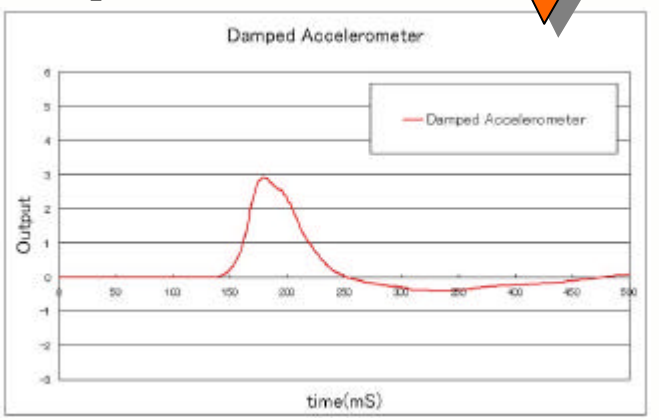
Damped Type

Larger size. No resonance peak in the frequency characteristic.

- Frequency characteristics

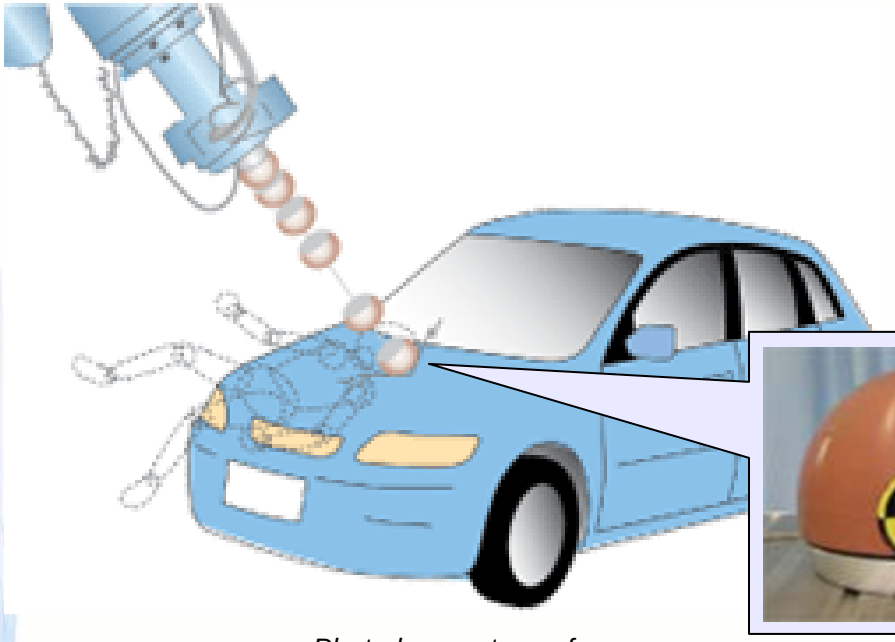


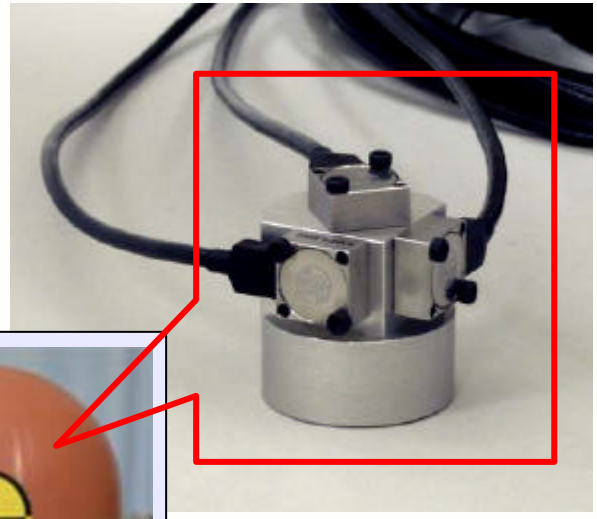
- Output waveform ex.



Application Example of New Damped Accelerometer ASE-A

Application Example for Pedestrian Head Protection Performance Tests



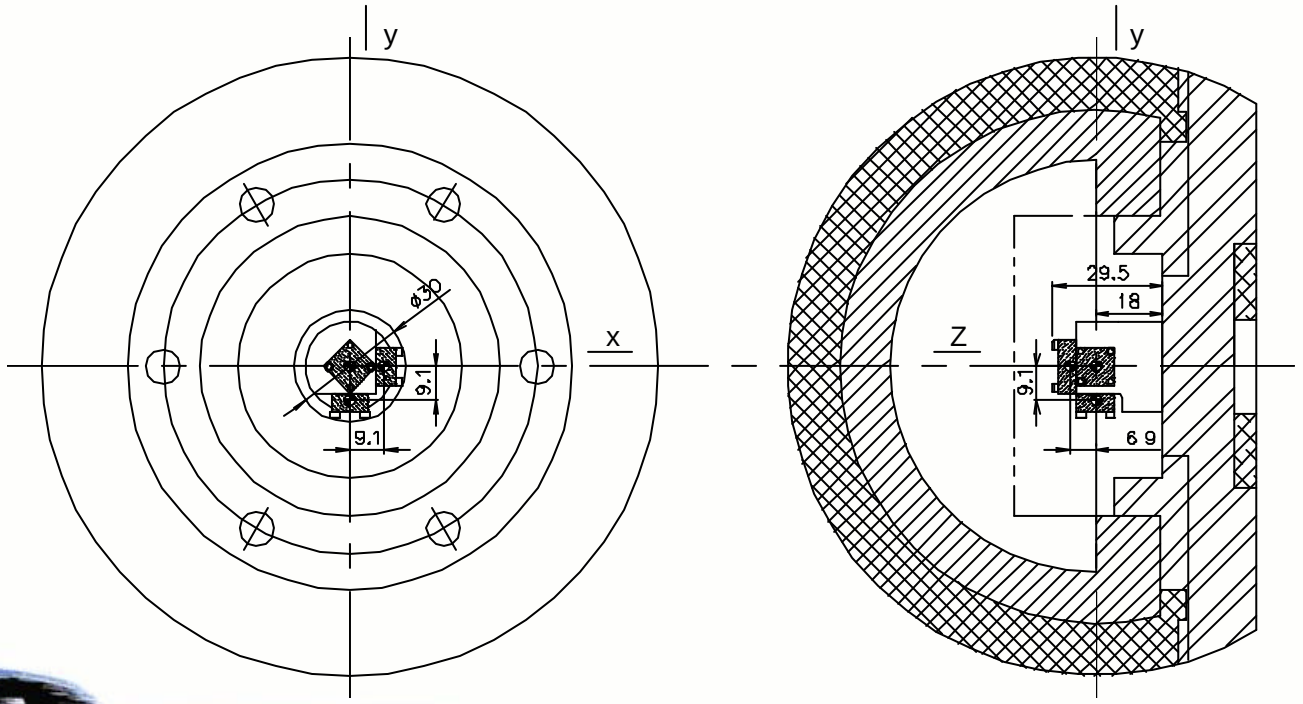


ASE-A mounted on
Three Axis Bracket

Photo by courtesy of
National Organization for Automotive Safety & Victims' Aid

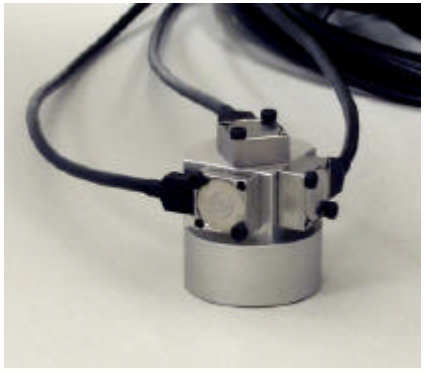
Accelerometer Positions (ASE-A)

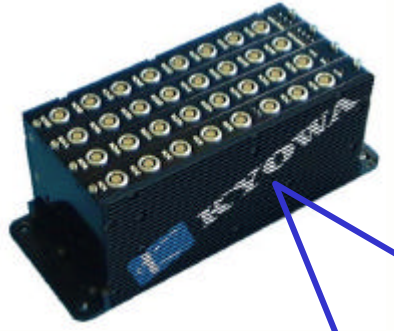
Seismic mass location	ACE-A (KYOWA) (mm)	AS-500HA (KYOWA) (mm)	IHRA requirement (mm)	PS121requirement (mm)
Seismic mass location of accelerometer in direction of measurement axis	9.1, 9.1, 6.9	27.7, 27.7, 4.7	+/- 10	+/- 30
Seismic mass location of accelerometer in direction perpendicular to measurement axis	0, 0, 0	0, 0, 0	+/- 2	+/- 2



Application Example of New Damped Accelerometer ASE-A

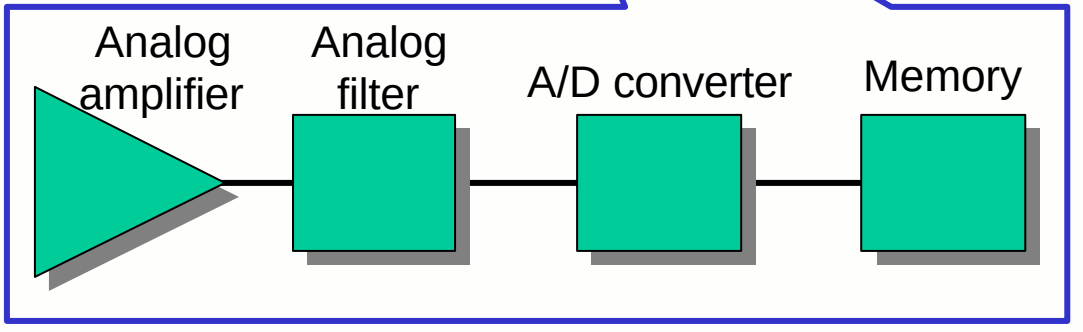
- **Application Example for Pedestrian Head Protection Performance Tests**





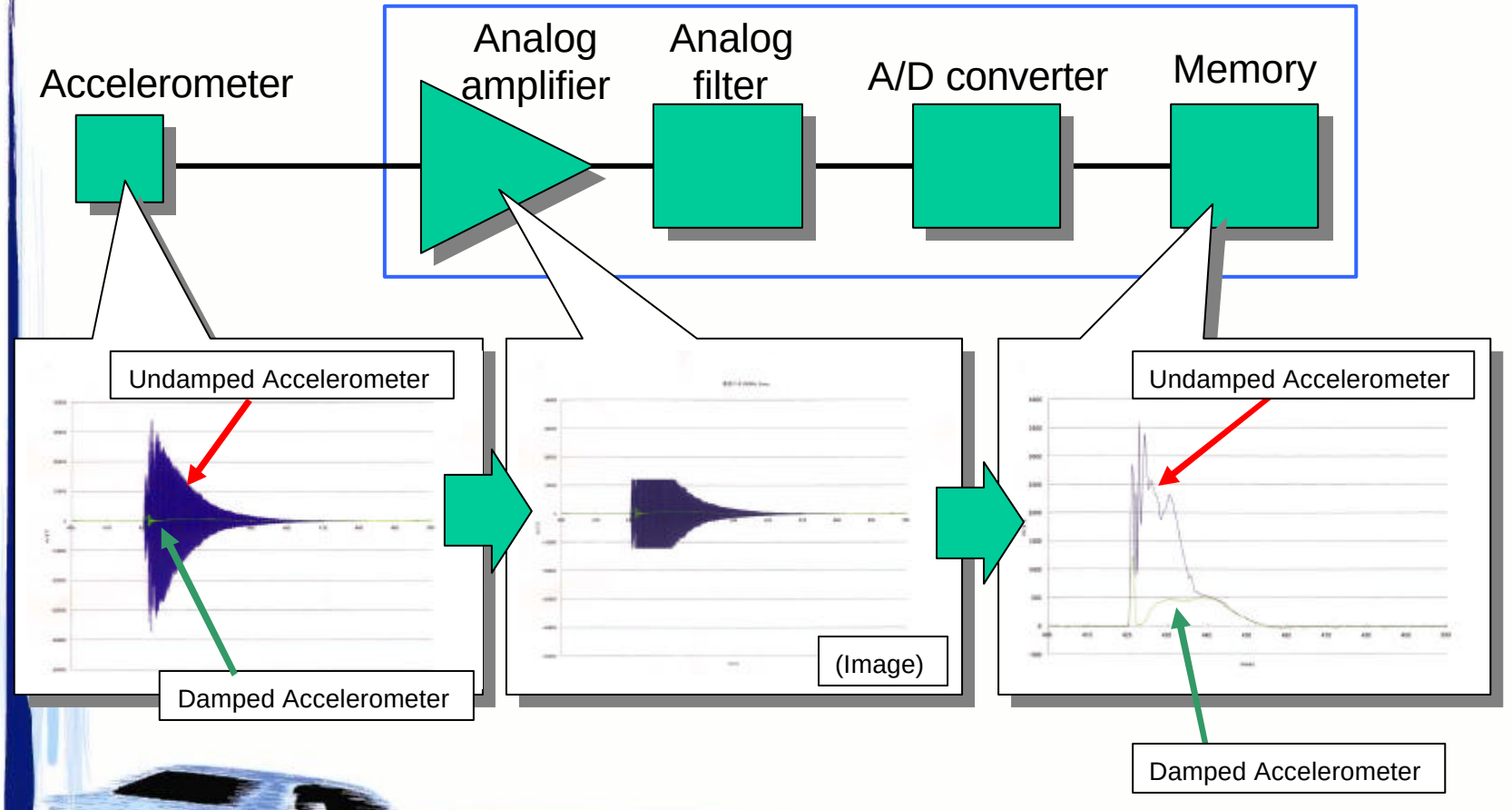
Data Acquisition Unit

DIS-3000B



Undamped Accelerometer Measurement Problems

If resonance output signal appears…

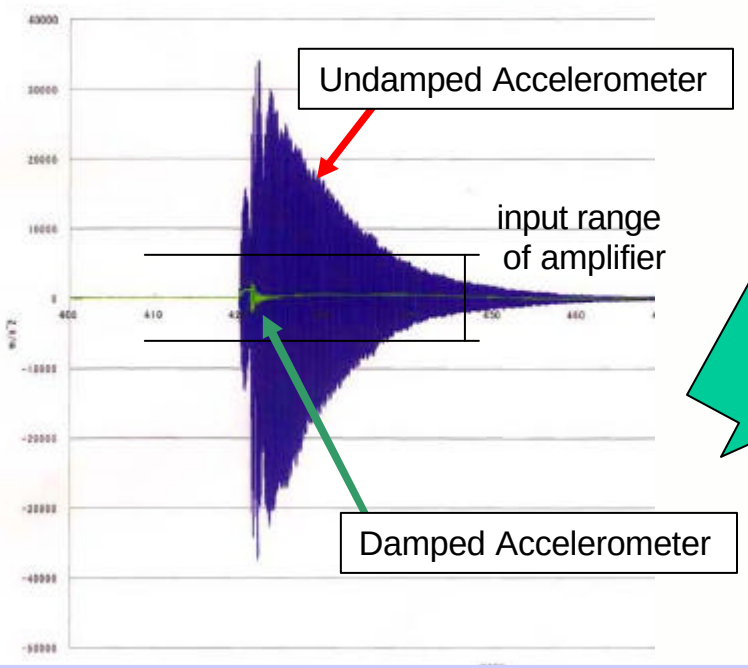


Undamped Accelerometer Measurement Problems

If the resonant waveform signals exceed input range of amplifier…

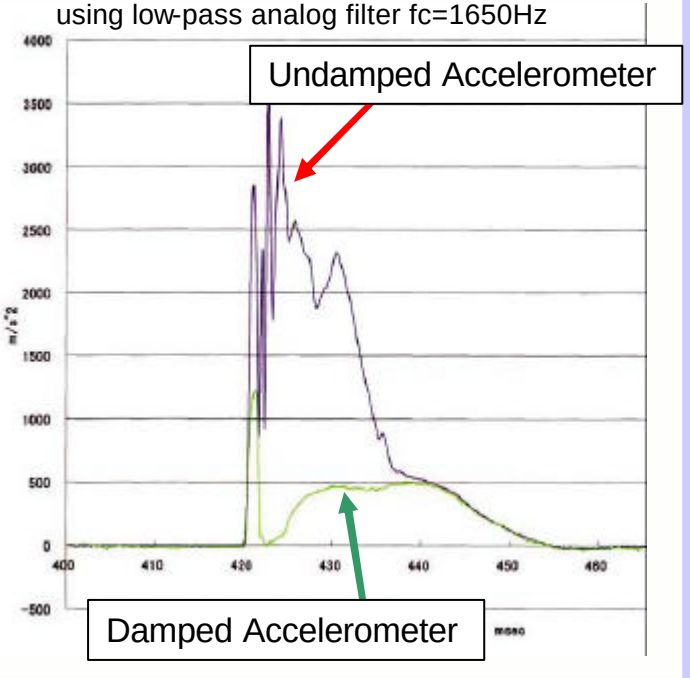
Accelerometer Output Signal

160kHz AD sampling by DAT



Recording Data

10kHz AD sampling by On-board DAS
using low-pass analog filter fc=1650Hz



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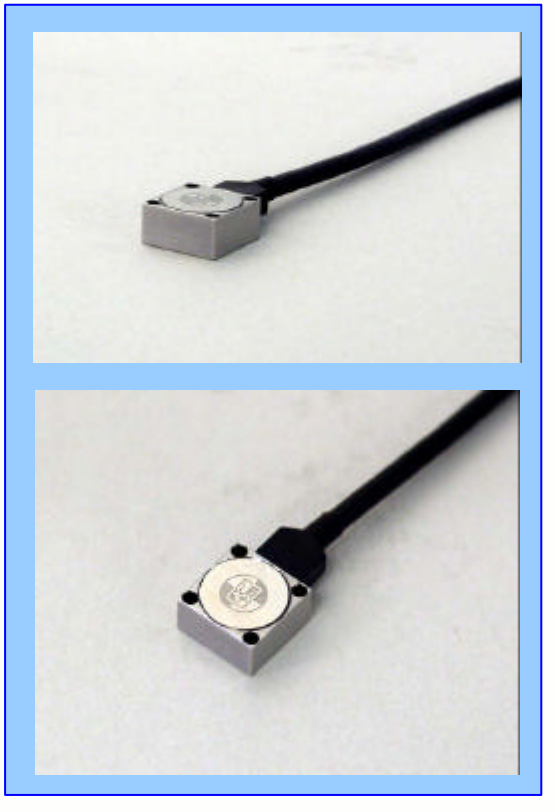
Characteristics of ASE-A

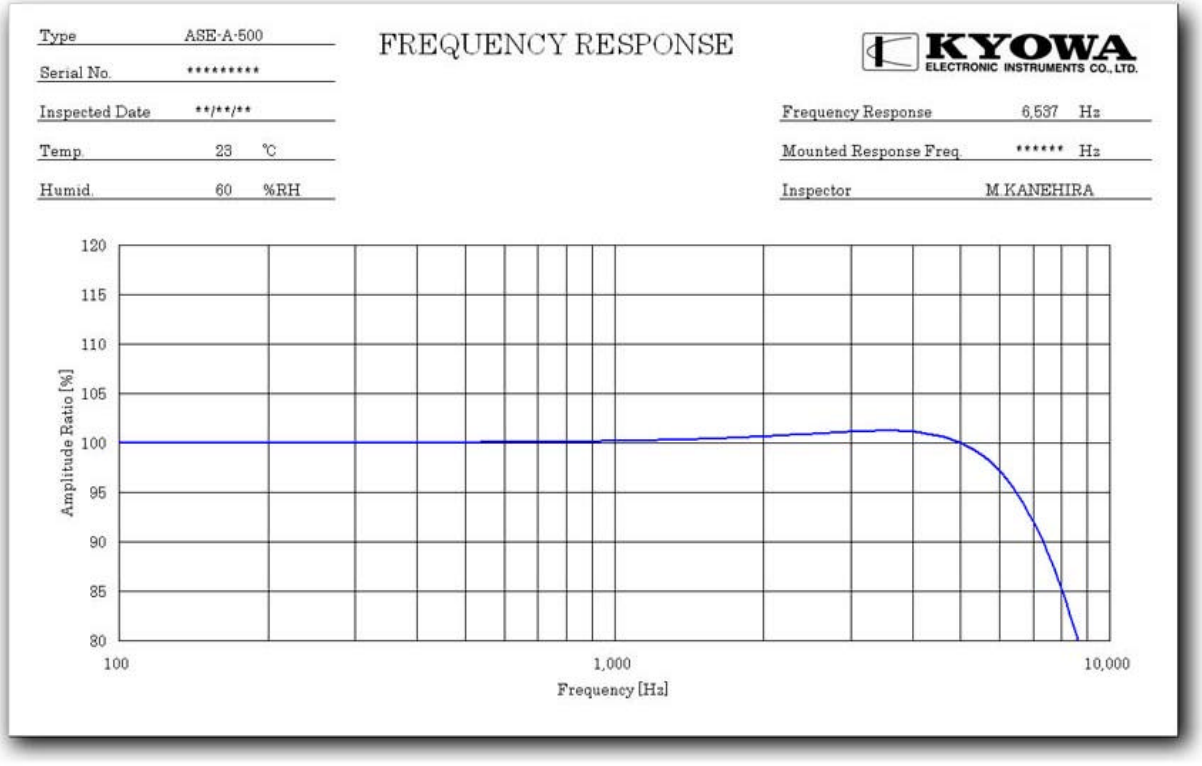
Specifications of New Accelerometer

(500g range version)

- Model: ASE-A-500
- Dimensions: 10 x 10 x 5mm
- Rated Output: 1mV/V min.
- Freq. Response(at 23C): 0 to 5kHz, +/-5%
- Damping Ratio: Approx. 0.7
- Non-linearity: +/-1%RO max.
- Acceleration Limits: 2,000g
- Excitation Voltage: 1 to 10V AC or DC

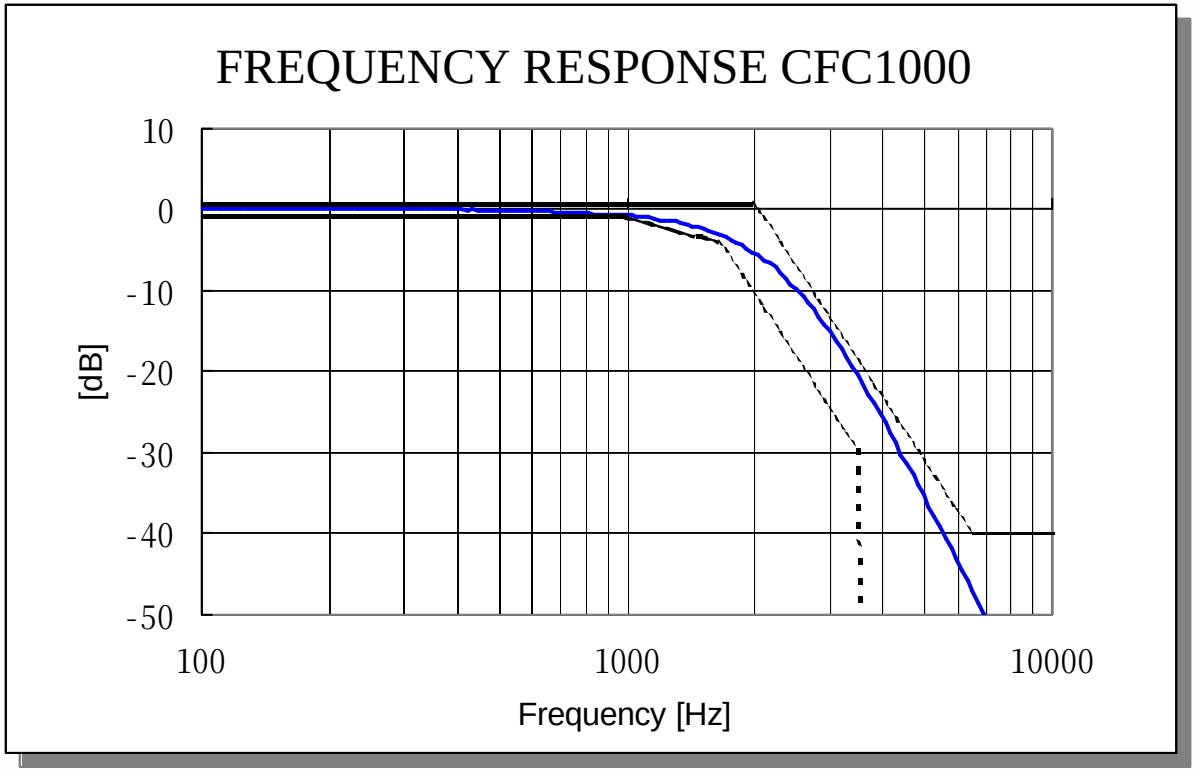


Frequency Response of ASE-A



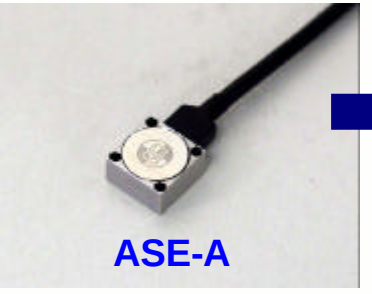
Frequency Response of ASE-A

with Kyowa's on-board DAS, DIS-3000B



New Damped Accelerometer ASE-A Series

New Model ASE-A Series Damped Accelerometer Applications



ASE-A

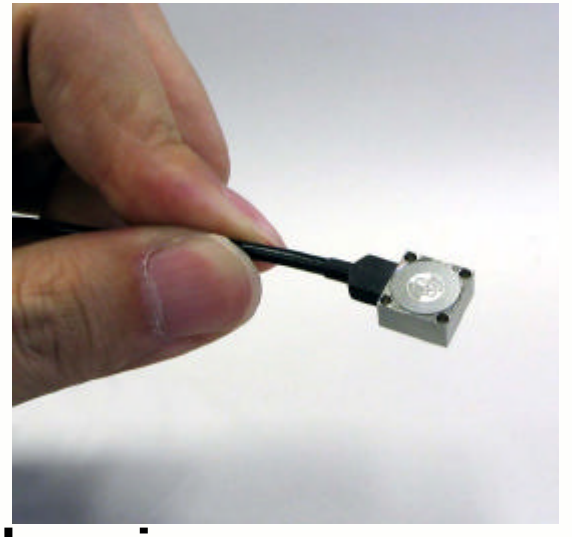
Kyowa On-board Data Acquisition Unit Model DIS-3000B

Side Impact Tests

Photo by courtesy of
National Organization for Automotive Safety & Victims' Aid

Frontal Impact Tests

Summary



Kyowa's New Damped Accelerometer Series

Size benefits

- Easy handling
- Miniaturization expands uses

Prevents resonance by optimized damping

- Improved measuring reliability & results

Immediate application benefits

- Pedestrian head protection performance tests
- Car body deformation measurements in car crash testing
- Car performance tests

Thank You for your attentions!