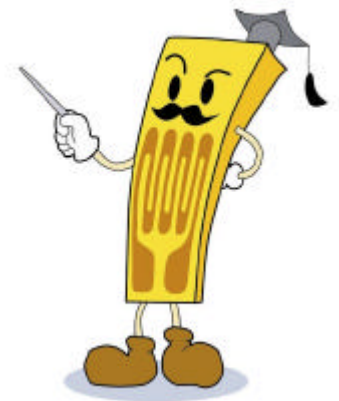


# Miniature Damped Accelerometer Series ASE-A

Kyowa Electronic Instruments Co. Ltd.,



[kyowa-ei.co.jp](http://kyowa-ei.co.jp)

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# Introduction

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## 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



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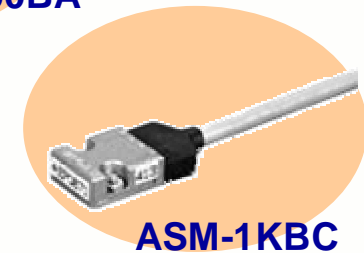
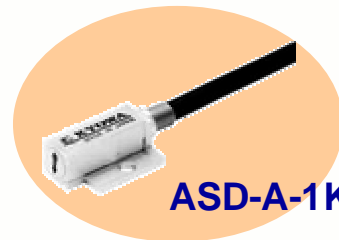
# Introduction

## 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



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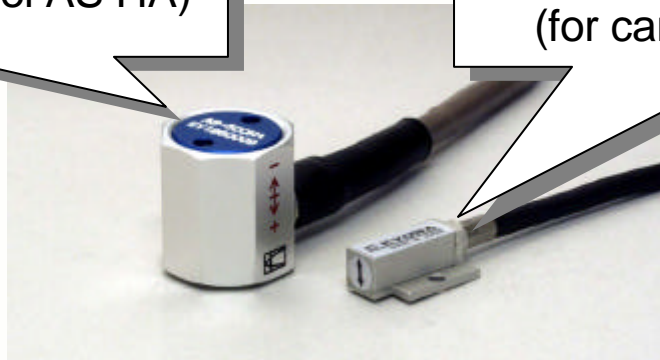
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# Comparison of Damped and Undamped Accelerometers

**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)

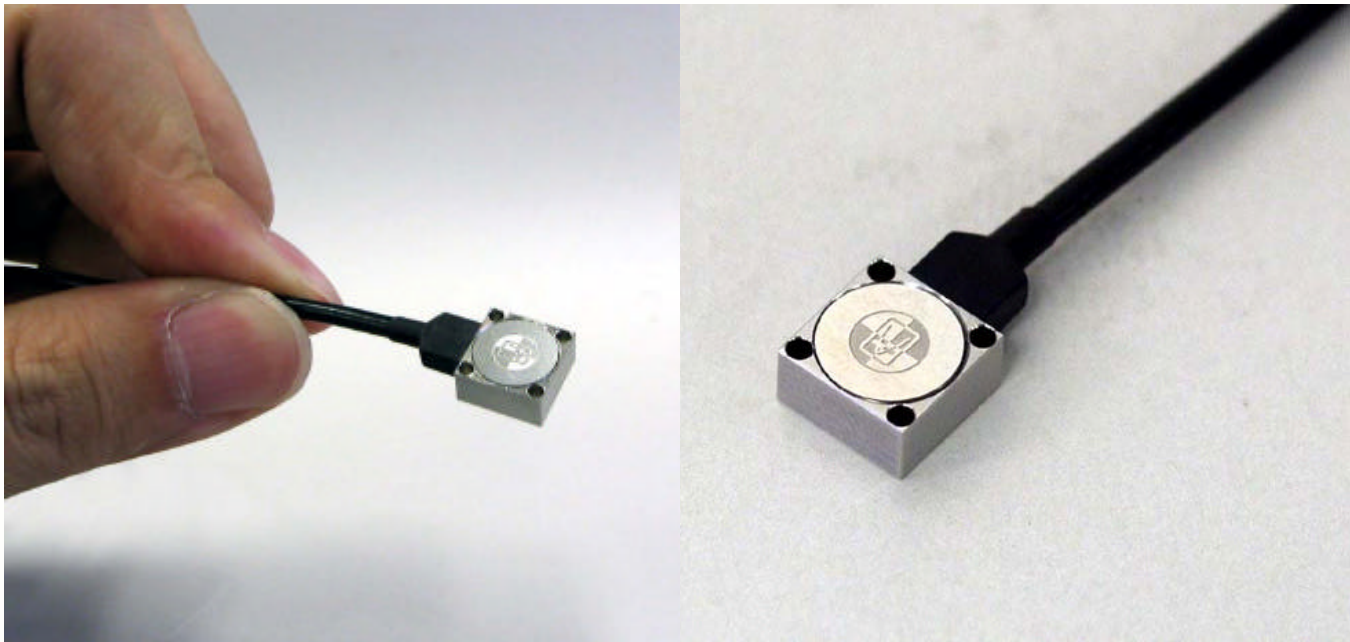


## ■ Size

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



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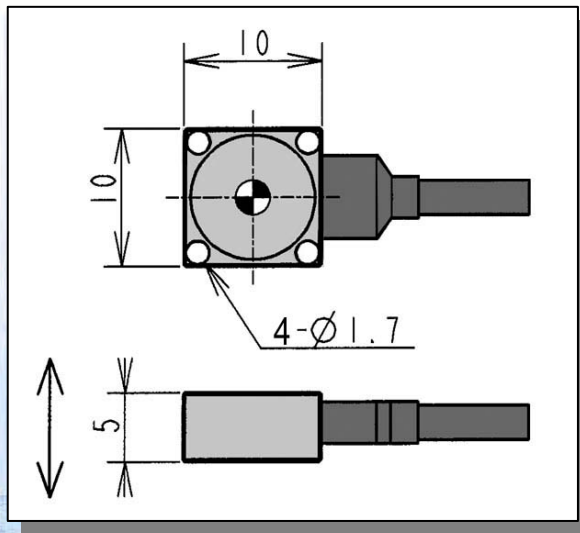


# New Damped Accelerometer ASE-A Series

## Small, Light Weight Design

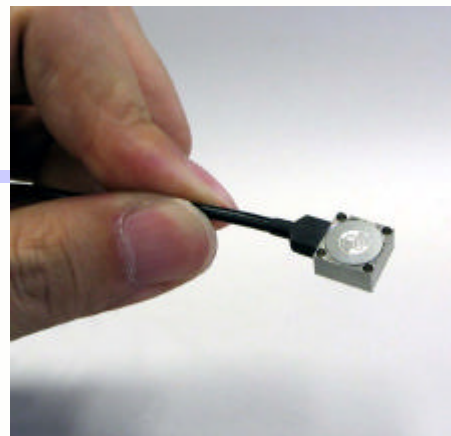
Utilizing sputtering technology, size and weight are minimized

- 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

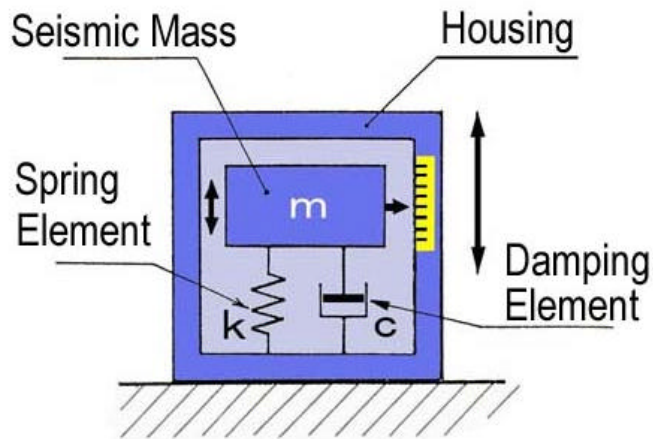
Damping ratio: Approx. 0.7



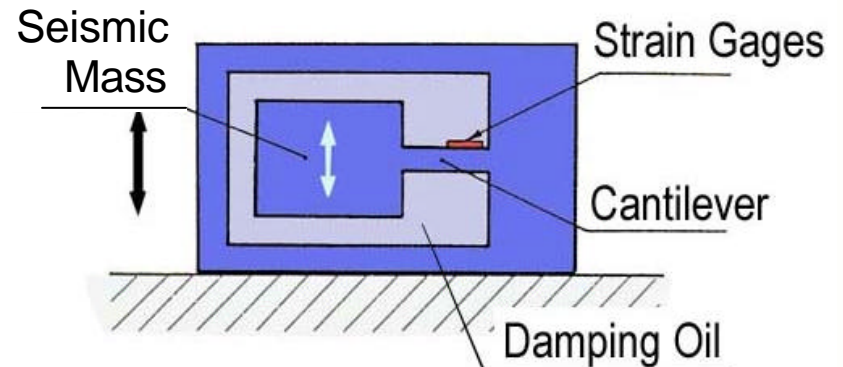
# Fundamental Structure of Accelerometers

**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.

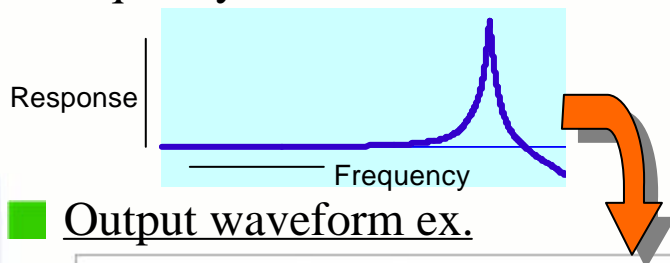


# Comparison between Damped and Undamped Accelerometers

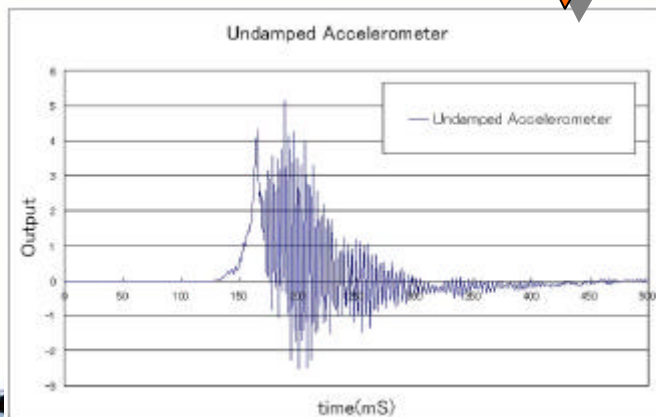
## Undamped Type

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

### Frequency characteristics



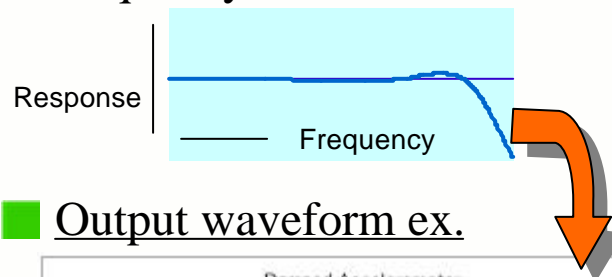
### Output waveform ex.



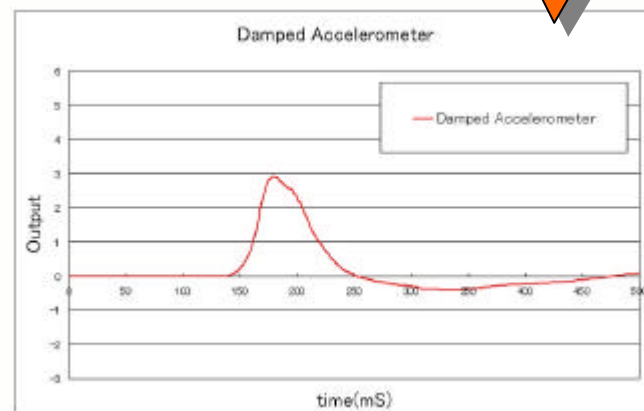
## Damped Type

Larger size. No resonance peak in the frequency characteristic.

### Frequency characteristics



### Output waveform ex.



# New Damped Accelerometer ASE-A Series

## Application Example of New Damped Accelerometer ASE-A

### ■ Application Example for Pedestrian Head Protection Performance Tests

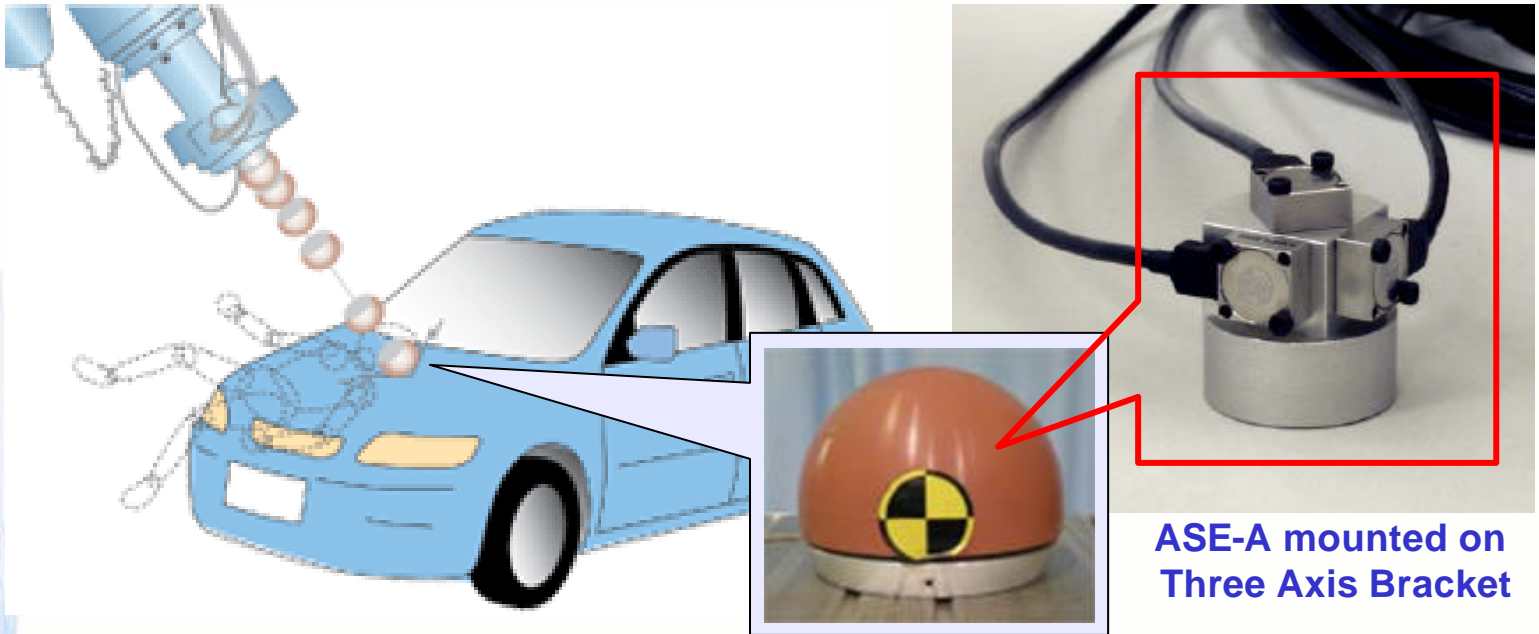


Photo by courtesy of  
National Organization for Automotive Safety & Victims' Aid

**ASE-A mounted on  
Three Axis Bracket**



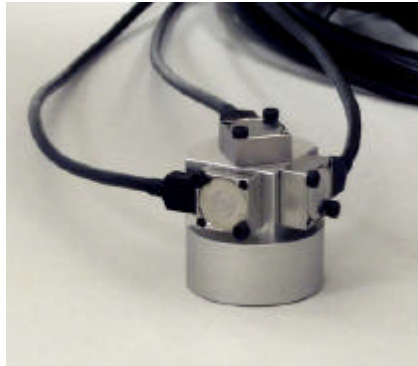
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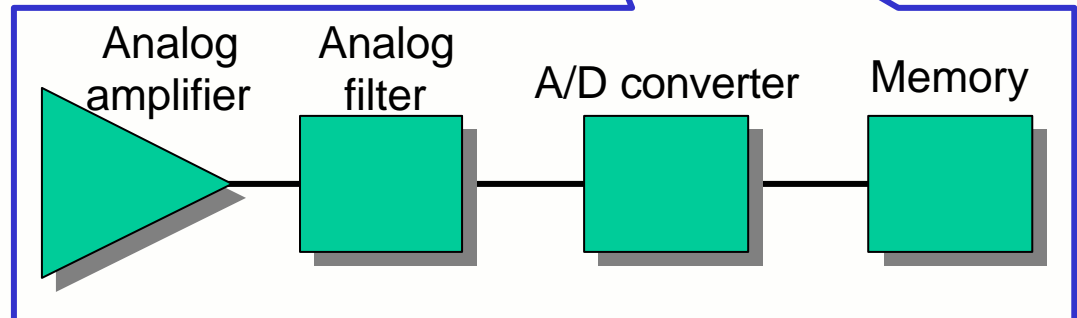
# New Damped Accelerometer ASE-A Series

## Application Example of New Damped Accelerometer ASE-A

### ■ Application Example for Pedestrian Head Protection Performance Tests

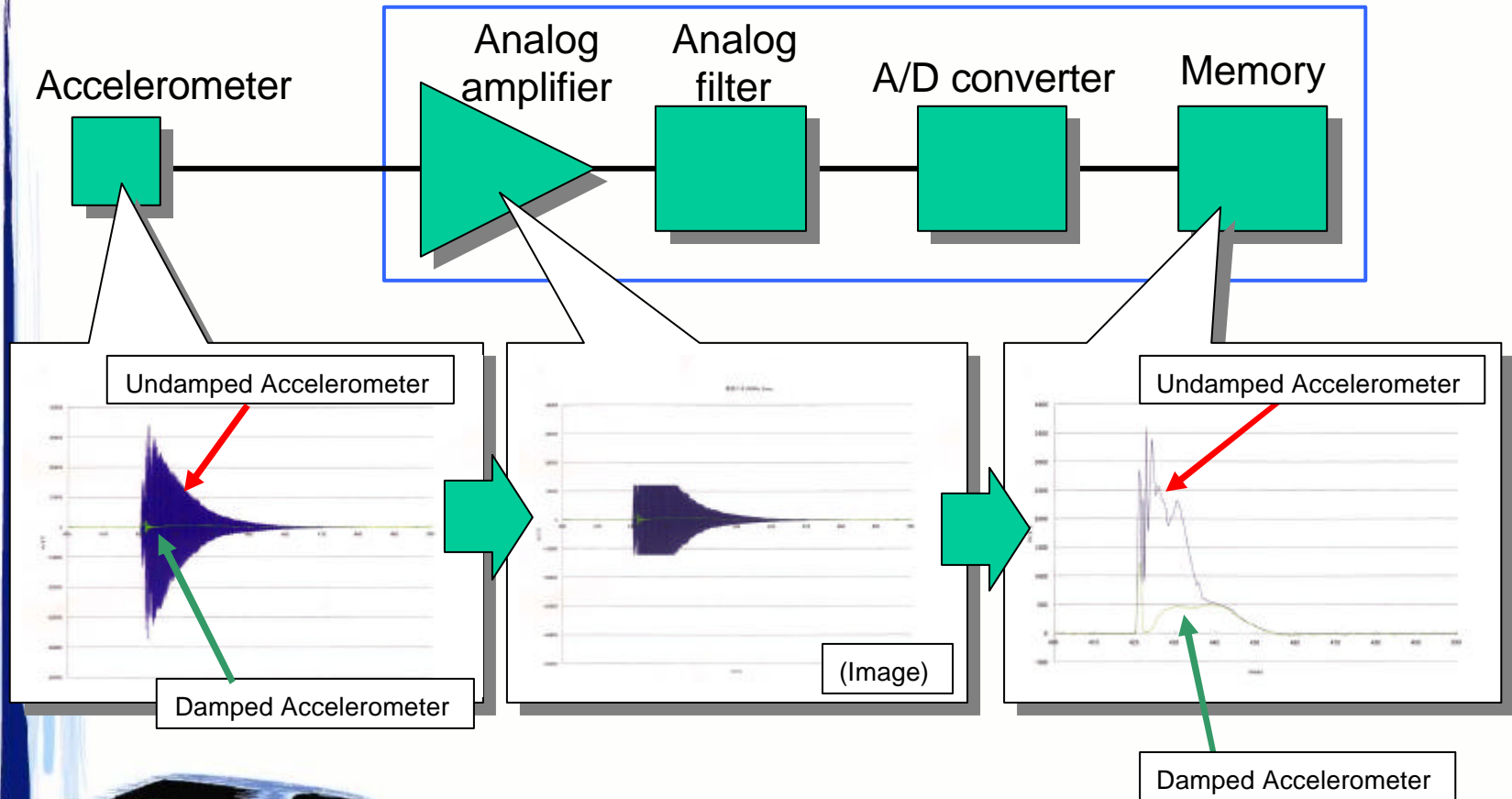


**Data Acquisition Unit  
DIS-3000B**



# Undamped Accelerometer Measurement Problems

If resonance output signal appears...



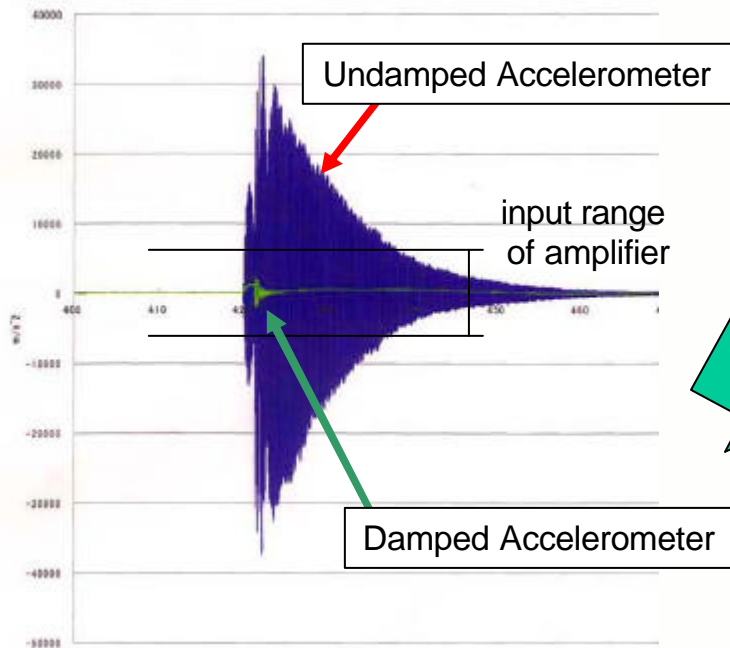


# Undamped Accelerometer Measurement Problems

If the resonant waveform signals exceed input range of amplifier...

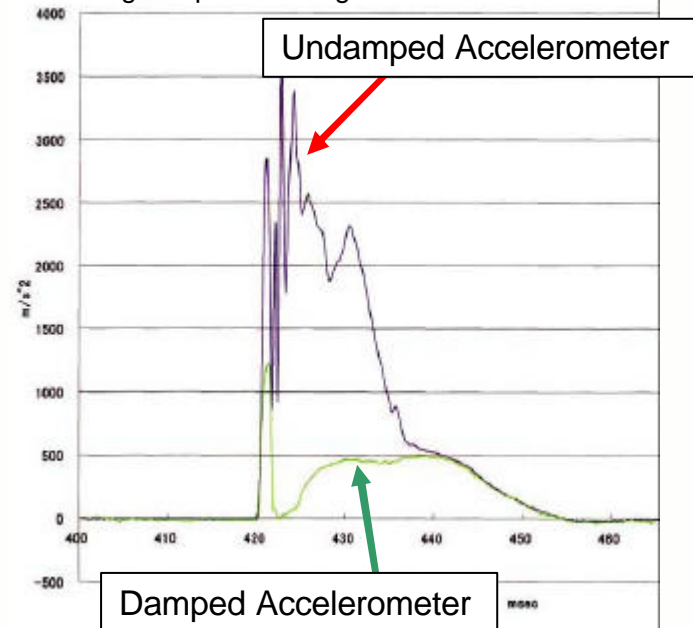
## Accelerometer Output Signal

160kHz AD sampling by DAT



## Recording Data

10kHz AD sampling by On-board DAS  
using low-pass analog filter  $f_c=1650\text{Hz}$



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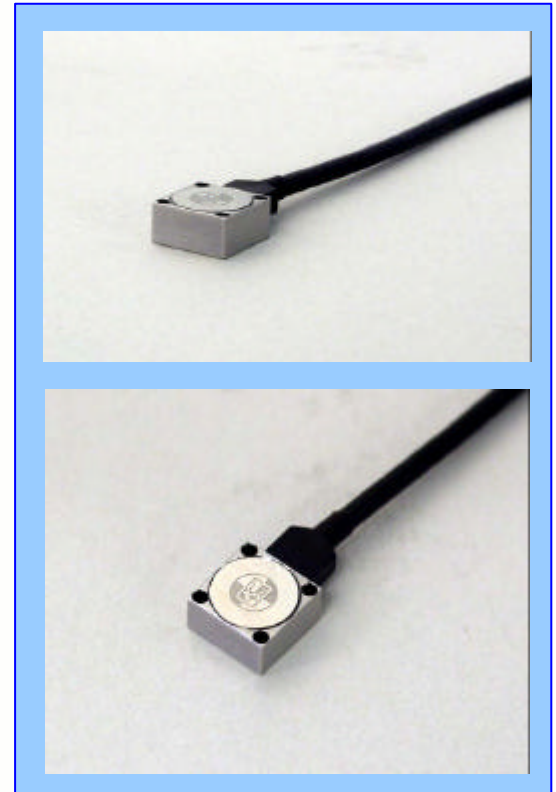
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# New Damped Accelerometer ASE-A Series

## Characteristics of ASE-A

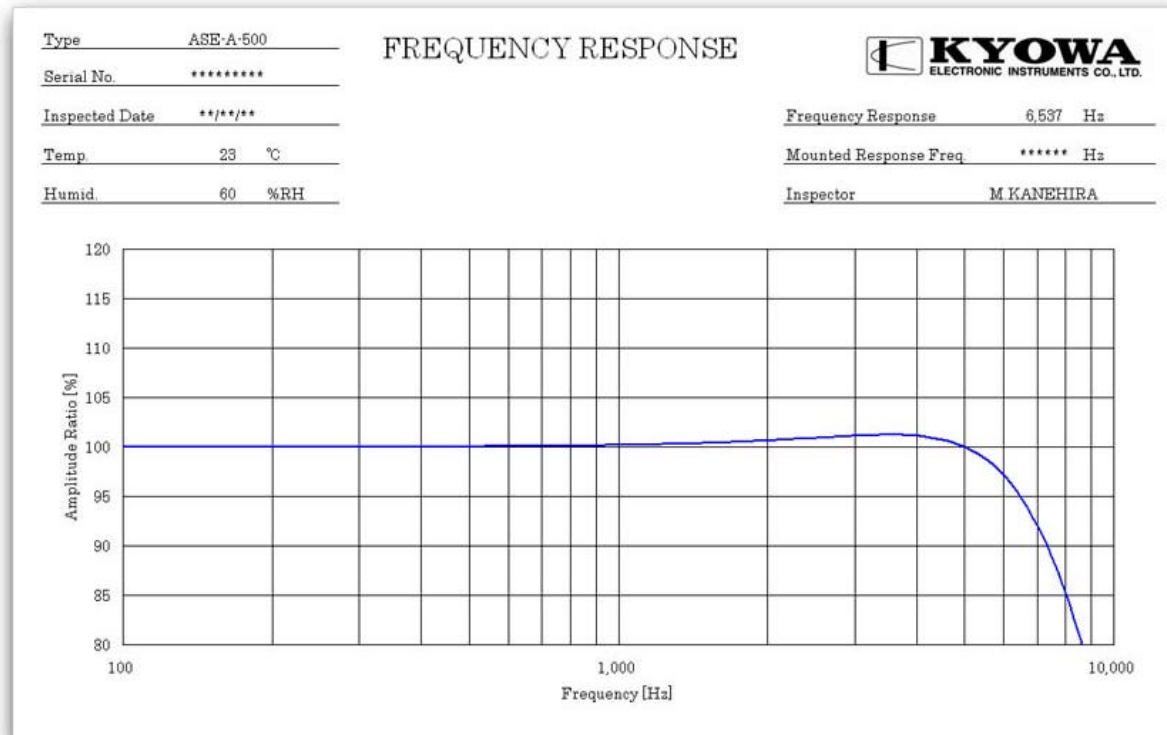
### ■ Specifications of New Accelerometer (500g range version)

- 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



# New Damped Accelerometer ASE-A Series

## Frequency Response of ASE-A



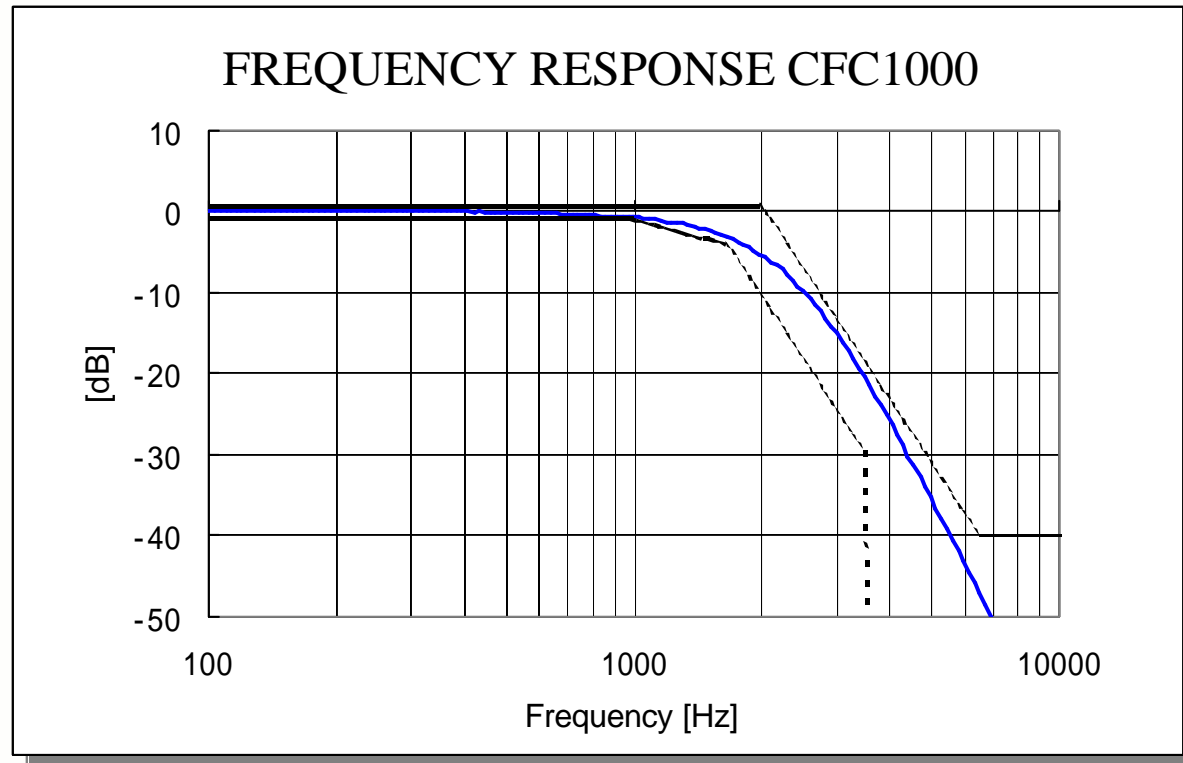
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# New Damped Accelerometer ASE-A Series

## Frequency Response of ASE-A

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



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# New Damped Accelerometer ASE-A Series

## New Model ASE-A Series Damped Accelerometer Applications

### ■ Side Impact Tests



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



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

### ■ Frontal Impact Tests



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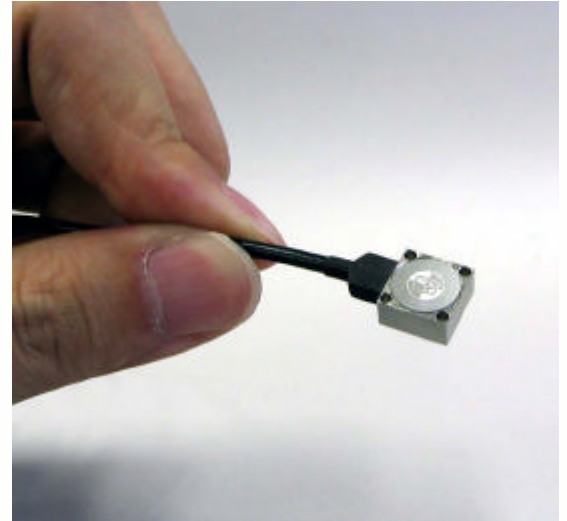
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# New Damped Accelerometer ASE-A Series

## 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

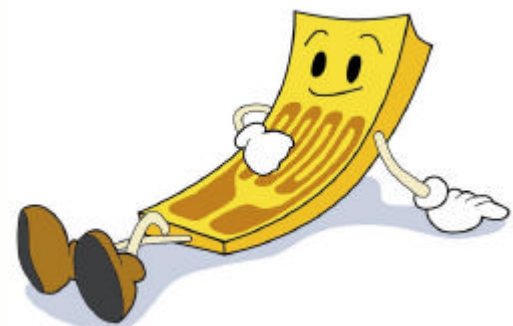
- ◆ Pedestrian head protection performance tests
- ◆ Car body deformation measurements in car crash testing
- ◆ Car performance tests



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Thank You for your attentions!



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