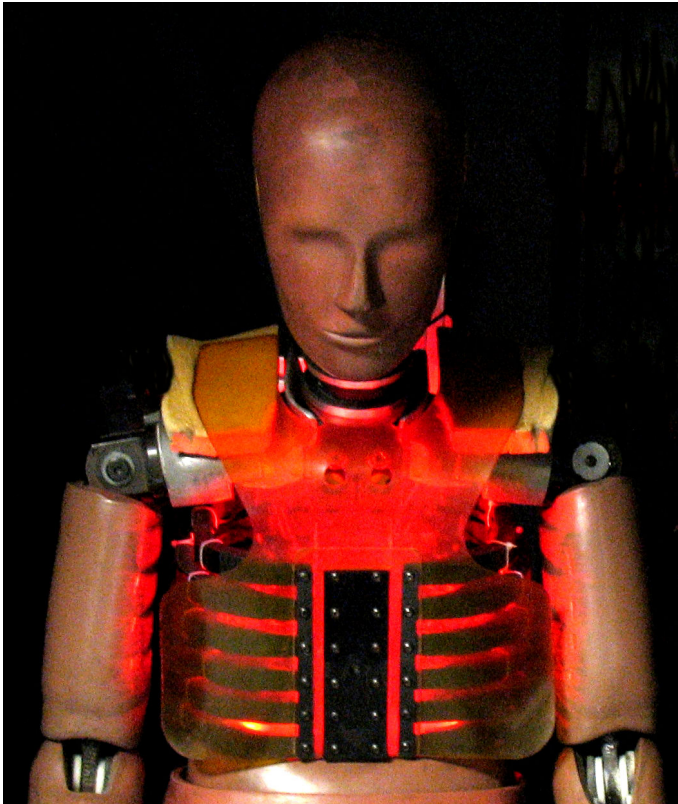


## **Hybrid III ATD – 50<sup>th</sup> Male RibEye™** **A Better Way to Measure Thorax Displacement**

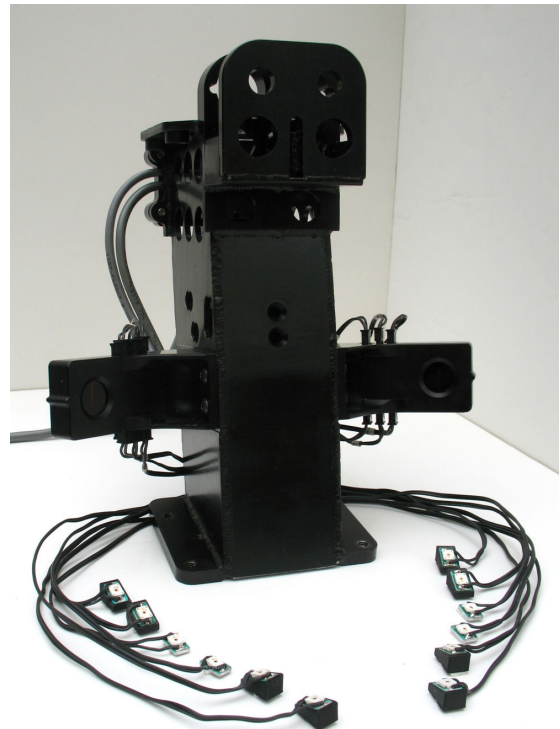


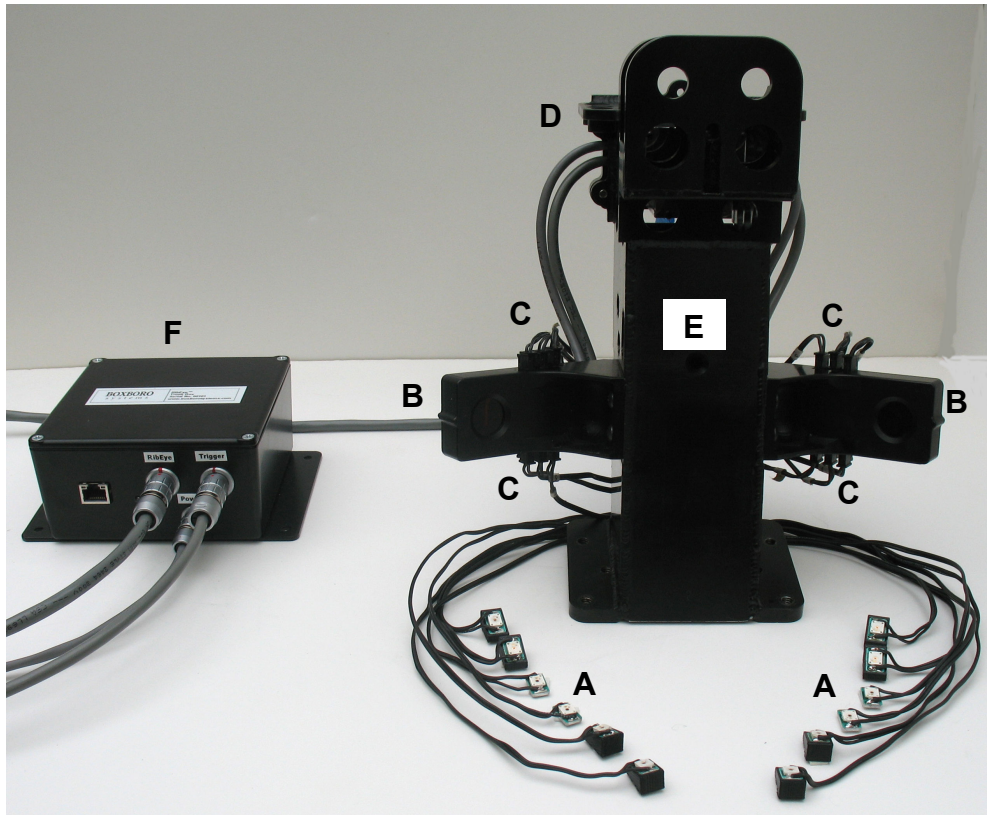
### **RibEye Advantages**

- Multiple point measurement: 12 points @ 10 kHz sample rate, captures linear and oblique loads
- Multiple-axis: measures X and Y positions for each LED
- Non-contact: no mechanical linkages between spine and ribs
- Shows seat-belt loading effects on all ribs
- Simple installation of LEDs
- Interfaces with existing data acquisition systems: open protocol for RibEye operation by DAS software
- Meets ISO 6487-2000 and SAE J211 specifications

### **Measurement Capabilities**

- Accuracy
  - +/- 0.2 mm typical
  - +/- 1 mm max. error
- Range
  - X axis: up to 85 mm chest compression
  - Y axis: +/- 90 mm from center of spine
  - Z axis from top rib to bottom rib
- Acquisition time @ 10 kHz sample rate
  - 30,000 ms (30 seconds) in RAM
  - 2 seconds in flash memory
  - (500 ms pre-trigger/1500 ms post-trigger)
- Temperature range
  - Operating, -18°-38°C (0°-100°F)
  - Max. accuracy, 18°-29°C (65°-85°F)





## RibEye Components

- A 12 LEDs mounted on ribs at measurement points
- B Two optical sensor heads to derive LED positions
- C LED connector blocks built into sensor heads
- D RibEye controller mounted in back of spine
- E New spine modified for mounting the RibEye
- F Trunk box (power, trigger, and communications connectors), located externally

## Other information

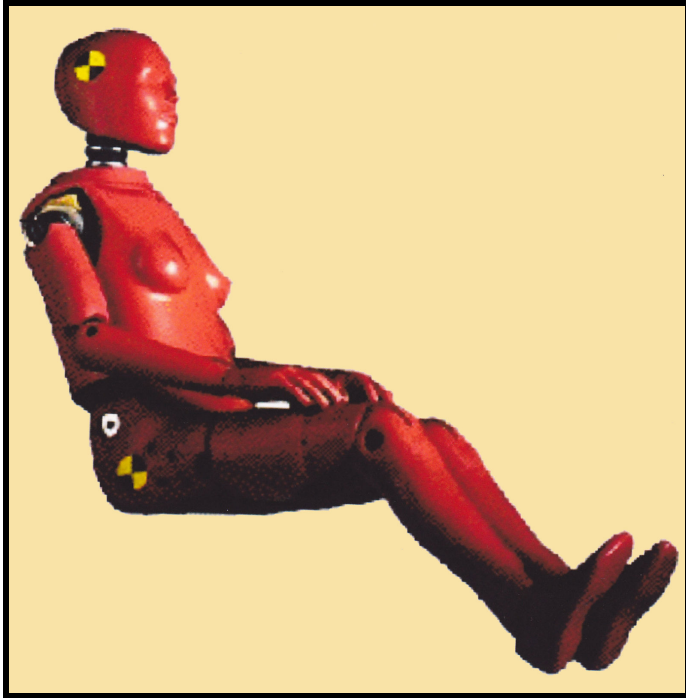
- PC-based control software exports data in Diadem, ISO, or CSV formats (PC not included)
- Power requirement:
  - 12-36 Volts DC
  - 8.3 W (data acquisition)
  - 5.3 W (idle)
  - 12.3 W (max.)
- U.S. Patent Number 7508530
- For more data, please see our website literature, including papers from the 2011 ESV Conference about third-party testing using the RibEye

[www.boxborosystems.com](http://www.boxborosystems.com)

| LED | RIB | POSITION | ISO CODES                | X (mm) | Y (mm) |
|-----|-----|----------|--------------------------|--------|--------|
| 1   | 1   | LEFT     | 1 1 RIBS 01 LE H3 DS X/Y | 0.0    | 0.0    |
| 2   | 2   | LEFT     | 1 1 RIBS 02 LE H3 DS X/Y | 0.0    | 0.0    |
| 3   | 3   | LEFT     | 1 1 RIBS 03 LE H3 DS X/Y | 0.0    | 0.0    |
| 4   | 4   | LEFT     | 1 1 RIBS 04 LE H3 DS X/Y | 0.0    | 0.0    |
| 5   | 5   | LEFT     | 1 1 RIBS 05 LE H3 DS X/Y | 0.0    | 0.0    |
| 6   | 6   | LEFT     | 1 1 RIBS 06 LE H3 DS X/Y | 0.0    | 0.0    |
| 7   | 1   | RIGHT    | 1 1 RIBS 01 RT H3 DS X/Y | 0.0    | 0.0    |



## **Hybrid III ATD – 5<sup>th</sup> Female RibEye™** **A Better Way to Measure Thorax Displacement**

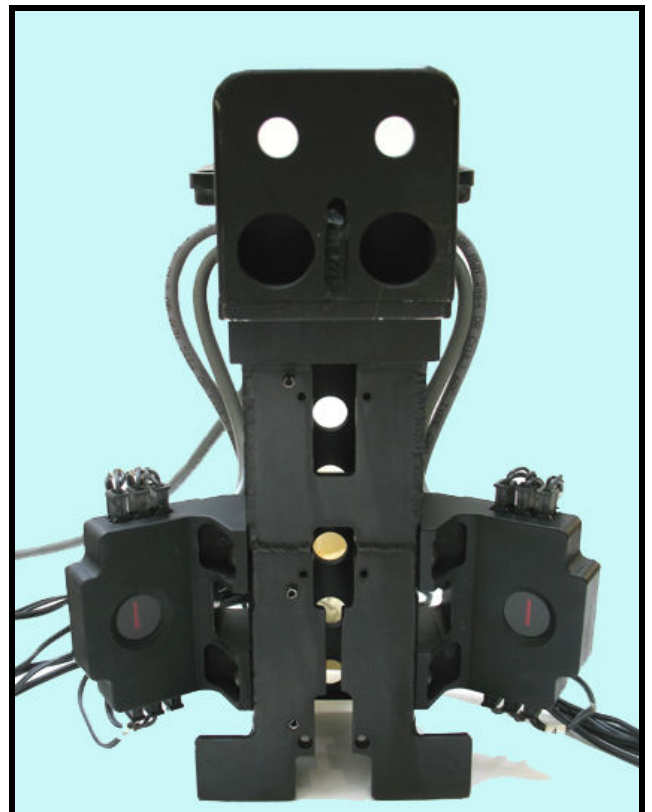


### **RibEye Advantages**

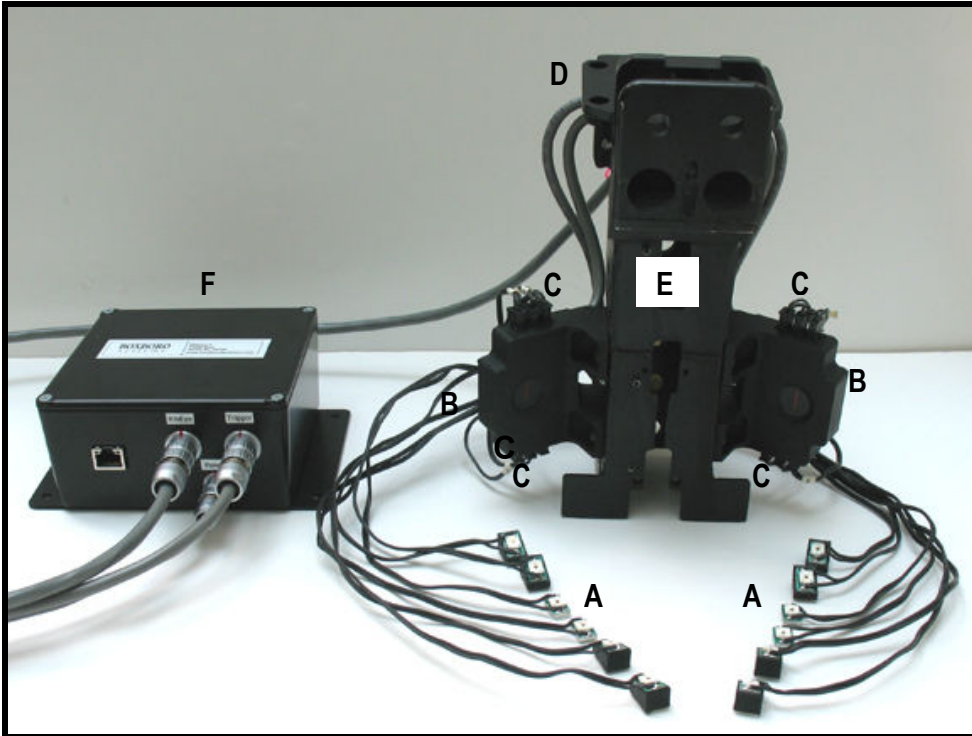
- Multiple point measurement: 12 points @ 10 kHz sample rate, captures linear and oblique loads
- Multiple-axis: measures X and Y positions for each LED
- Non-contact: no mechanical linkages between spine and ribs
- Shows seat-belt loading effects on all ribs
- Simple installation of LEDs
- Interfaces with existing data acquisition systems: open protocol for RibEye operation by DAS software
- Meets ISO 6487-2000 and SAE J211 specifications

### **Measurement Capabilities**

- Accuracy
  - +/- 0.2 mm typical
  - +/- 1 mm max. error
- Range
  - X axis: up to 60 mm chest compression
  - Y axis: +/- 75 mm from center of spine
  - Z axis from top rib to bottom rib
- Acquisition time @ 10 kHz sample rate
  - 30,000 ms (30 seconds) in RAM
  - 2 seconds in flash memory
  - (500 ms pre-trigger/1500 ms post-trigger)
- Temperature range
  - Operating, -18°-38°C (0°-100°F)
  - Max. accuracy, 18°-29°C (65°-85°F)



## RibEye Components



- A 12 LEDs mounted on ribs at measurement points
- B Two optical sensor heads to derive LED positions
- C LED connector blocks built into sensor heads
- D RibEye controller mounted in back of spine
- E New spine modified for mounting the RibEye
- F Trunk box (power, trigger, and communications connectors), located externally

## Other information

- PC-based control software exports data in Diadem, ISO, or CSV formats (PC not included)
- Power requirement:
  - 12-36 Volts DC
  - 8.3 W (data acquisition)
  - 5.3 W (idle)
  - 12.3 W (max.)
- U.S. Patent Number 7508530
- For more data, please see our website literature, including papers from the 2011 ESV Conference about third-party testing using the RibEye

[www.boxborosystems.com](http://www.boxborosystems.com)

RibEye Ver 3.0

Connect/Setup Plot Live Display Export

RibEye Status  
Connected - Idle

RibEye Type: 50th Male  
Serial Number: 00075  
Calibration Date: 25 January 2010  
Firmware Version: 50 S0005

Connect to RibEye via: IP Address  
Ethernet 192.168.0.152 DISCONNECT  
Find RibEyes

RibEye Installed in ATD: Hill 50TH  
Trigger Setting: Rising Edge  
Show Current XY's

ISO Test Object: 1 - Vehicle 1  
ISO Position: 1 - Front Left

| LED | RIB | POSITION | ISO CODES                | X (mm) | Y (mm) |
|-----|-----|----------|--------------------------|--------|--------|
| 1   | 1   | LEFT     | 1 1 RIBS 01 LE H3 DS X/Y | 0.0    | 0.0    |
| 2   | 2   | LEFT     | 1 1 RIBS 02 LE H3 DS X/Y | 0.0    | 0.0    |
| 3   | 3   | LEFT     | 1 1 RIBS 03 LE H3 DS X/Y | 0.0    | 0.0    |
| 4   | 4   | LEFT     | 1 1 RIBS 04 LE H3 DS X/Y | 0.0    | 0.0    |
| 5   | 5   | LEFT     | 1 1 RIBS 05 LE H3 DS X/Y | 0.0    | 0.0    |
| 6   | 6   | LEFT     | 1 1 RIBS 06 LE H3 DS X/Y | 0.0    | 0.0    |
| 7   | 1   | RIGHT    | 1 1 RIBS 01 RT H3 DS X/Y | 0.0    | 0.0    |

ARM

ERASE MEMORY

DOWNLOAD DATA

Data Buffer Operation: Circular Linear

Data to collect after Trigger (ms): 2000

Data in RibEye (ms): Start Time -500 Stop Time 1500

Data To Download (ms): Start Time -10 Stop Time 400

© 2012, Boxboro Systems LLC

## **WorldSID ATD – 50<sup>th</sup> Male RibEye™** **A Better Way to Measure Thorax Displacement**



### **RibEye Advantages**

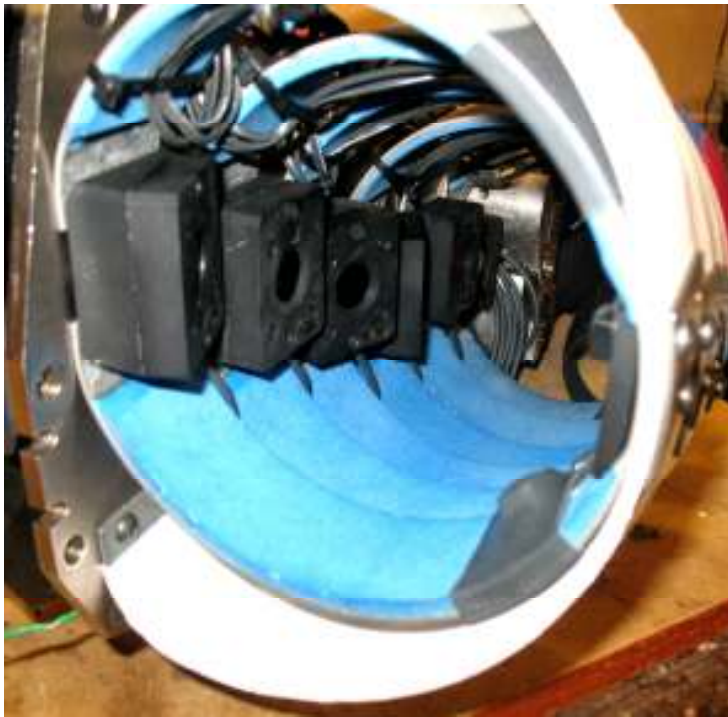
- Multiple point measurement:  
18 points @ 10 kHz sample rate,  
captures linear and oblique loads
- Six-LED version also available
- Multiple-axis: measures X, Y and Z  
positions for each LED
- Non-contact: no mechanical linkages  
between spine and ribs
- Mounts to existing holes in spine and  
ribs – no modifications to dummy
- Interfaces with existing data acquisition  
systems: open protocol for RibEye  
operation by DAS software
- Meets ISO 6487-2000 and  
SAE J211 specifications

### **Measurement Capabilities**

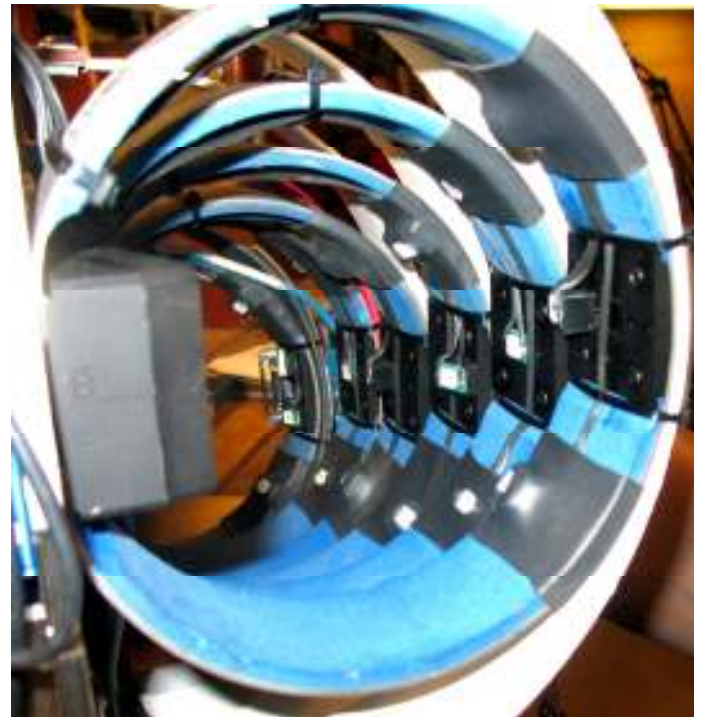
- Accuracy  
For Y and Z data:  
 $\pm 0.2$  mm typical  
 $\pm 1$  mm max. error  
For X data, max. error  $< 1.5$  mm
- Range  
X axis:  $\pm 130$  mm fore/aft  
Y axis: 85 mm chest compression  
Z axis: 80 mm up, 50 mm down
- Acquisition time @ 10 kHz sample rate  
25,000 ms (25 seconds) in RAM  
1.7 seconds in flash memory
- Temperature range  
Operating,  $-18^{\circ}$ - $38^{\circ}$ C ( $0^{\circ}$ - $100^{\circ}$ F)  
Max. accuracy,  $18^{\circ}$ - $24^{\circ}$ C ( $65^{\circ}$ - $75^{\circ}$ F)







**RibEye Sensors**



**RibEye LEDs**

## More information

- PC-based control software exports data in Diadem, ISO, or CSV formats
- Power requirement:  
12-36 Volts DC  
8 W (idle)  
12 W (data acquisition)  
20 W (max.)
- U.S. Patent  
Number 7508530
- For more data, please see our website literature, including user's manuals and technical conference papers about third-party testing using the RibEye

[www.boxborosystems.com](http://www.boxborosystems.com)

RibEye Ver 3.2 Beta

Connect/Setup | Plot | Live Display | Export

RibEye Status  
Connected - Idle

RibEye Type: WorldSID Male  
Serial Number: 112  
Calibration Date: 29 Nov 2012  
Firmware Version: WS50BS001

Connect to RibEye via: IP Address  
Ethernet | 192.168.0.237 | DISCONNECT  
Find RibEyes

RibEye Installed in ATD:  
wsid 50th #2  
Trigger Setting: Rising Edge

RibEye Pointed Toward Dummy: Left Side  
ISO Test Object: 1 - Vehicle 1  
ISO Position: 1 - Front Left  
Show Current XYZ's

| LED | RIB | POSITION | ISO-CODES                | X (mm) | Y (mm) | Z (mm) |
|-----|-----|----------|--------------------------|--------|--------|--------|
| 1   | 1   | REAR     | 1 1 SERR 00 RE WS DS XYZ | -58.8  | -77.1  | -52.3  |
| 2   | 1   | MIDDLE   | 1 1 SERR 00 MI WS DS XYZ | -28.9  | -92.3  | -54.0  |
| 3   | 1   | FRONT    | 1 1 SERR 00 FR WS DS XYZ | 23.4   | -77.8  | -60.0  |
| 4   | 2   | REAR     | 1 1 TRRI 01 RE WS DS XYZ | -45.2  | -92.7  | -2.0   |
| 5   | 2   | MIDDLE   | 1 1 TRRI 01 MI WS DS XYZ | -1.5   | -107.9 | -1.0   |
| 6   | 2   | FRONT    | 1 1 TRRI 01 FR WS DS XYZ | 45.2   | -94.2  | -2.8   |

ERASE MEMORY | DOWNLOAD DATA

Data Buffer Operation: Circular | Linear  
Data to collect after Trigger (ms): 2000

Data in RibEye (ms)  
Start Time: 200 | Stop Time: 1500  
Data To Download (ms)  
Start Time: .10 | Stop Time: 400

© 2012, Boxboro Systems LLC

## **WorldSID ATD – 5<sup>th</sup> Female RibEye™** **A Better Way to Measure Thorax Displacement**

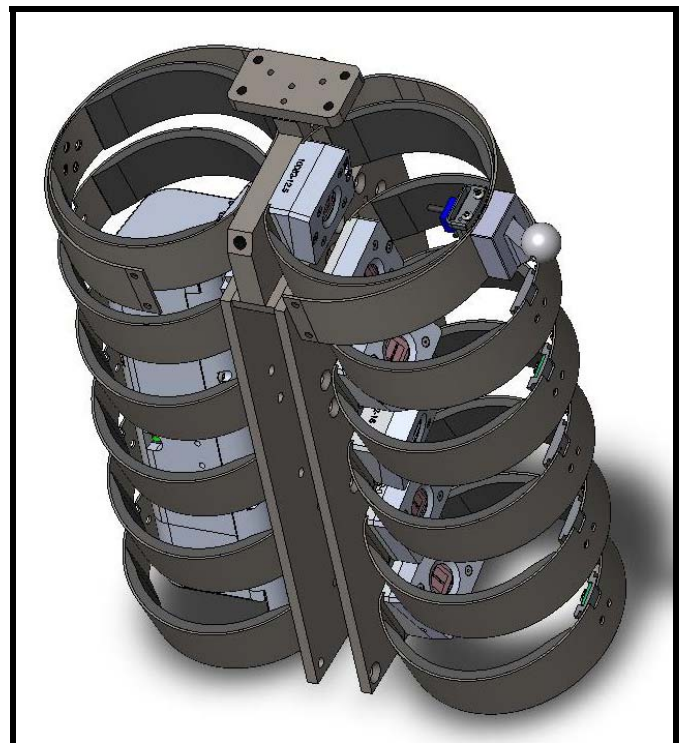


### **RibEye Advantages**

- Multiple point measurement:  
18 points @ 10 kHz sample rate,  
captures linear and oblique loads
- Six-LED version also available
- Multiple-axis: measures X, Y and Z  
positions for each LED
- Non-contact: no mechanical linkages  
between spine and ribs
- Mounts to existing holes in spine and  
ribs – no modifications to dummy
- Interfaces with existing data acquisition  
systems: open protocol for RibEye  
operation by DAS software
- Meets ISO 6487-2000 and  
SAE J211 specifications

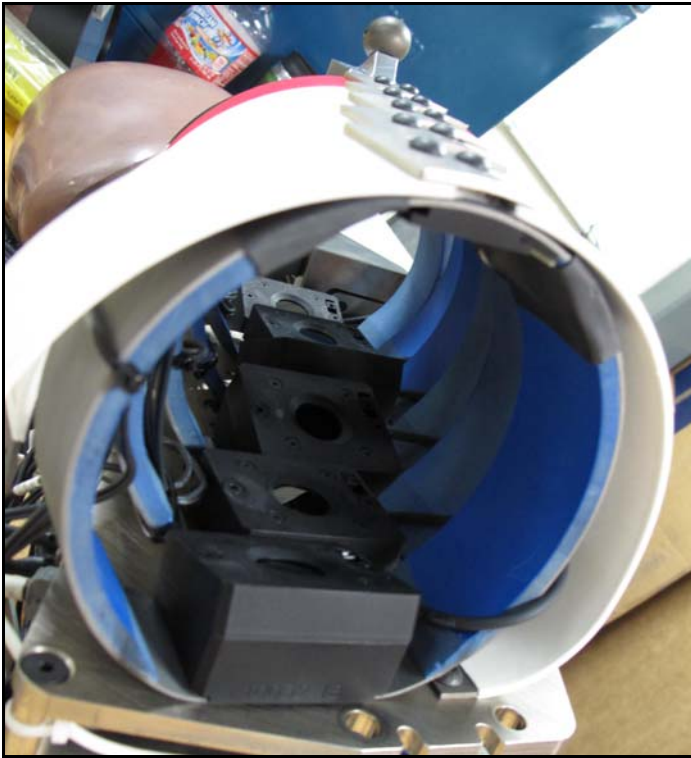
### **Measurement Capabilities**

- Accuracy
  - For Y and Z data:
    - $\pm 0.2$  mm typical
    - $\pm 1$  mm max. error
  - For X data, max. error  $< 1.5$  mm
- Maximum range
  - X axis:  $\pm 120$  mm fore/aft
  - Y axis: 67 mm chest compression
  - Z axis: 80 mm up, 65 mm down
- Acquisition time @ 10 kHz sample rate
  - 25,000 ms (25 seconds) in RAM
  - 1.7 seconds in flash memory
- Temperature range
  - Operating,  $-18^{\circ}$ - $38^{\circ}$ C ( $0^{\circ}$ - $100^{\circ}$ F)
  - Max. accuracy,  $18^{\circ}$ - $24^{\circ}$ C ( $65^{\circ}$ - $75^{\circ}$ F)



**WorldSID 5<sup>th</sup> Female RibEye Thorax**





**RibEye Sensors**



**RibEye LEDs**

## More information

- PC-based control software exports data in Diadem, ISO, or CSV formats
- Power requirement:  
12-36 Volts DC  
8 W (idle)  
12 W (data acquisition)  
20 W (max.)
- U.S. Patent  
Number 7508530
- For more data, please see our website literature, including user's manuals and technical conference papers about third-party testing using the RibEye

[www.boxborosystems.com](http://www.boxborosystems.com)

RibEye Ver 3.2 Beta

Connect/Setup | Plot | Live Display | Export

RibEye Status: Connected - Idle

RibEye Type: WorldSID Male  
Serial Number: 112  
Calibration Date: 29 Nov 2012  
Firmware Version: WS50BS001

Connect to RibEye via: IP Address  
Ethernet | 192.168.0.237 | DISCONNECT  
Find RibEyes

RibEye Pointed Toward Dummy: Left Side  
ISO Test Object: 1 - Vehicle 1  
ISO Position: 1 - Front Left  
RibEye Installed in ATD: wsid 50th #2  
Trigger Setting: Rising Edge  
Show Current XYZ's

| LED | RIB | POSITION | ISO CODES                | X (mm) | Y (mm) | Z (mm) |
|-----|-----|----------|--------------------------|--------|--------|--------|
| 1   | 1   | REAR     | 1 1 SHRI 00 RE WS DS XYZ | -58.8  | -77.1  | -52.3  |
| 2   | 1   | MIDDLE   | 1 1 SHRI 00 MI WS DS XYZ | -28.9  | -92.3  | -54.0  |
| 3   | 1   | FRONT    | 1 1 SHRI 00 FR WS DS XYZ | 23.4   | -77.8  | -60.0  |
| 4   | 2   | REAR     | 1 1 THRI 01 RE WS DS XYZ | -45.2  | -92.7  | -2.0   |
| 5   | 2   | MIDDLE   | 1 1 THRI 01 MI WS DS XYZ | -1.5   | -107.9 | -1.0   |
| 6   | 2   | FRONT    | 1 1 THRI 01 FR WS DS XYZ | 45.2   | -94.2  | -2.8   |

ARM

ERASE MEMORY

DOWNLOAD DATA

Data Buffer Operation: Circular | Linear  
Data to collect after Trigger (ms): 2000

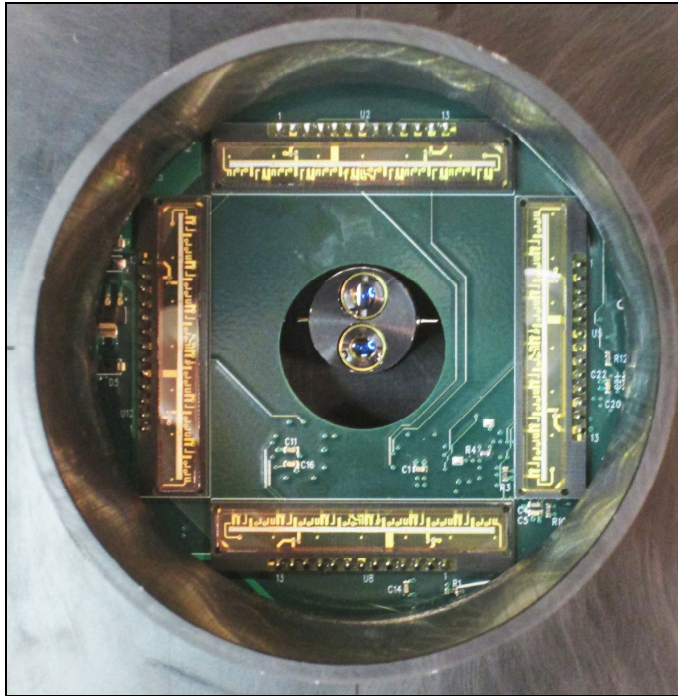
Data in RibEye (ms)  
Start Time: -200 | Stop Time: 1500  
Data To Download (ms)  
Start Time: -10 | Stop Time: 400

© 2012, Boxboro Systems LLC



## Deflection and Twist Measurement System (DTMS™)

A Better Way to Measure Dynamic Motion in Large Structures



*Sensor Array and Cross-Hair Laser*

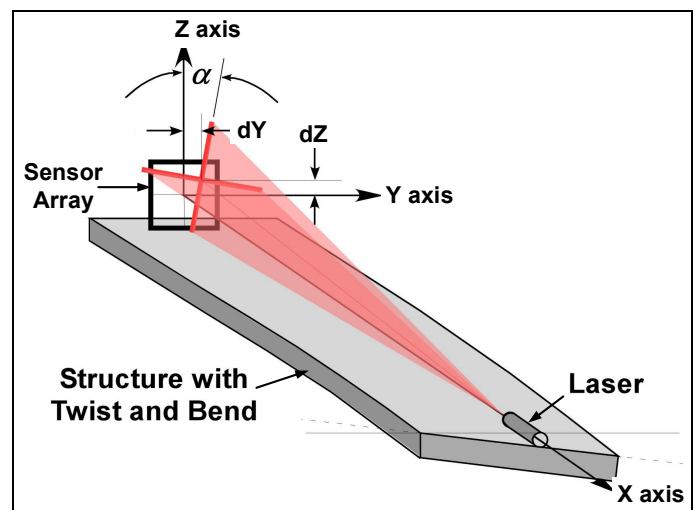
### DTMS Advantages

- Measures five degrees of freedom at multiple points selected by the user
- Records and displays dynamic mode shapes while the structure is moving
- Reports data relative to one end of the structure, not a fixed ground reference
- Results are not affected by the structure's motion or acceleration
- Accommodates unusual structural shapes and can be mounted inside hollow spaces
- Software included to provide configuration, data logging, and three ways to plot
- Simple communication via Modbus RTU protocol over RS485 network

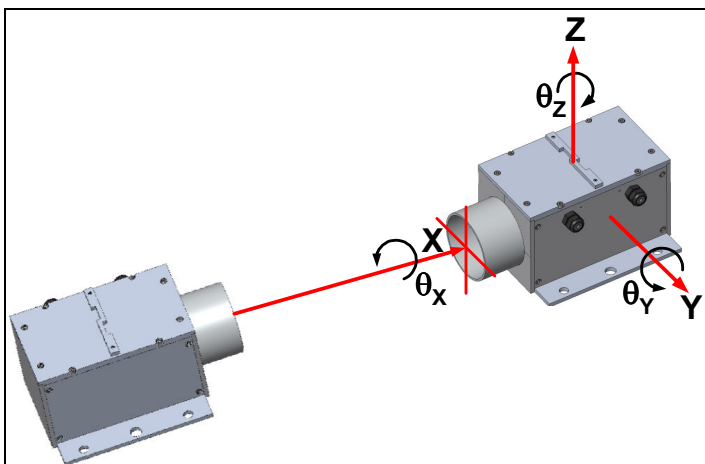
### Description and Capabilities

- Scalable laser tool available in half or full segments or string of multiple segments
- Applications include bridges, buildings, boat hulls, trains, crane booms, vehicle frames, and airplane wings
- Accuracy certified by independent U.S. lab with NIST/NPL traceability
- Deflection and twist reported in real time
  - ♦ Deflection accuracy: 0.2 mm
  - ♦ Twist accuracy: 0.1 degree
  - ♦ Frequency response: up to 100 Hz
- Y, Z measurement range per segment
  - ♦ 0 to 47 mm (+/- 23.5 mm)
- Maximum twist
  - ♦ X axis: 35 degrees per segment
  - ♦ Y, Z depend on number of segments

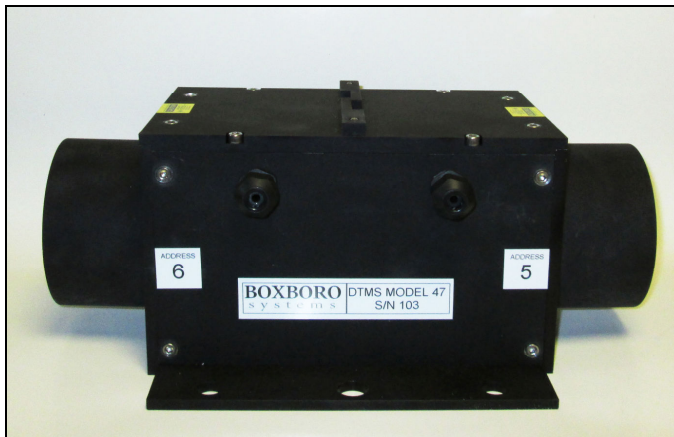
*Schematic of Half Segment*



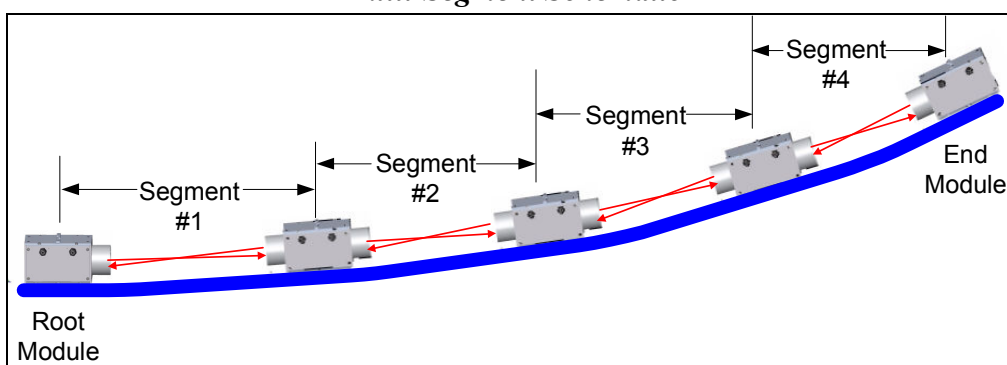
### Schematic of Full Segment with Coordinate System



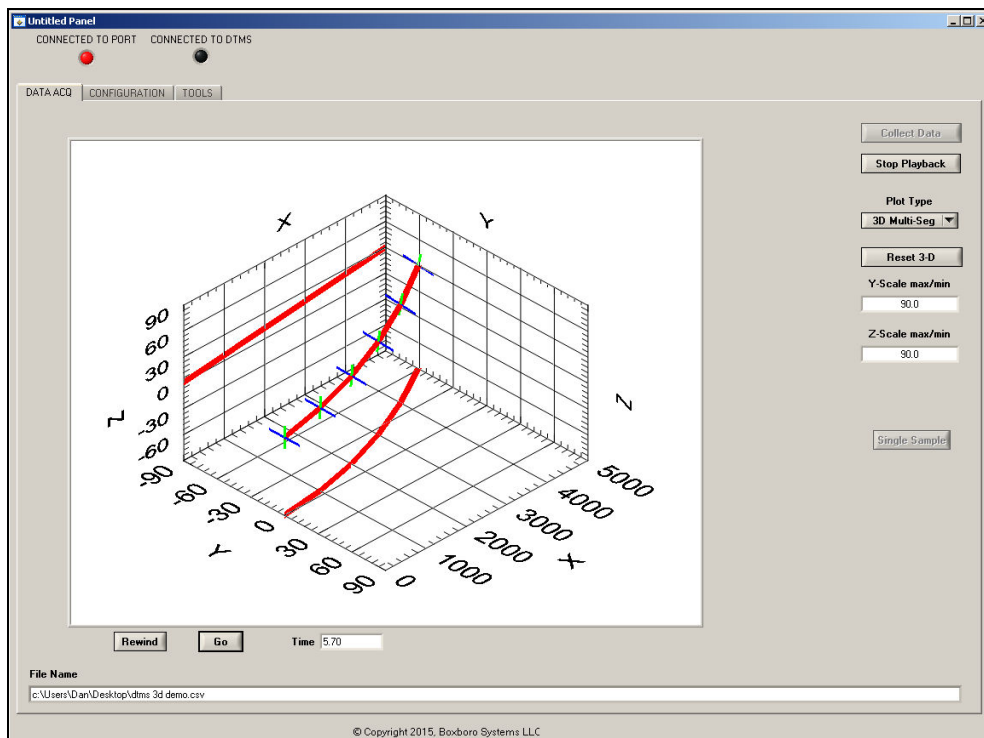
### DTMS Module Enclosure in Multi-Segment System



### Multi-Segment Schematic



### DTMS Data 3-D Plot



For more information, go to [www.boxborosystems.com](http://www.boxborosystems.com)  
or contact Dan Handman, 978-257-2219, [dan@boxborosystems.com](mailto:dan@boxborosystems.com)