

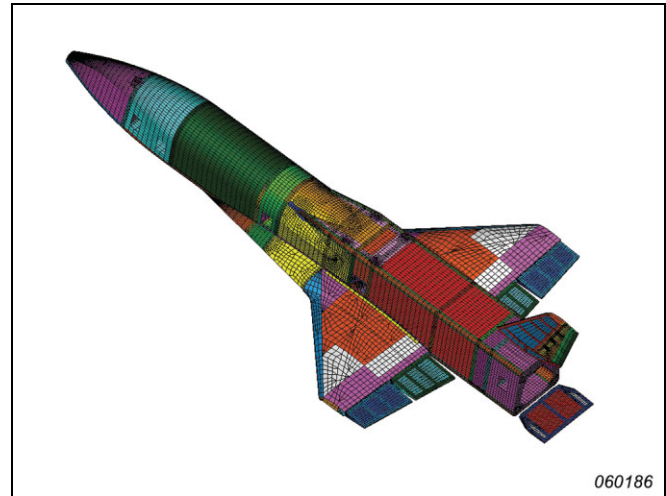
# PRODUCT DATA

Test for I-deas Modal Analysis Software: Comprehensive Modal — BZ-6015, Basic Modal — BZ-6016 and Advanced Modal — BZ-6017

*Test for I-deas modal software provides test engineers with comprehensive capabilities for processing modal test measurements and displaying the modal analysis results. It includes capabilities for modal parameter estimation and data display on geometry including animation, graphing function data, math processing, data access and management, and open architecture and interfacing.*

*Modal test measurements can be obtained using Test for I-deas Stationary Processing BZ-6005 or transferred from third-party data acquisition software. Test for I-deas Comprehensive Modal BZ-6015, Basic Modal BZ-6016 or Advanced Modal BZ-6017 provide instrument control, PC-based DSP, curve-fitting and live displays for operating modal and deflection shapes, as well as SISO, SIMO and MIMO random-based modal analysis.*

*Specialised capabilities for test/finite element analysis correlation are available with Test for I-deas Correlation BZ-6020, and Test for I-deas Structural Modification BZ-6019 allows the effects of simple structural changes to be evaluated.*



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## Modal Testing using Stationary Processing BZ-6005

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Test for I-deas Stationary Processing module adds the instrumentation and signal conditioning control for live or post-processed modal testing FRF measurement computations. With the Test Geometry component, impact and modal shaker testing can be performed from a geometry-based user interface, which indicates in a progressive geometry-integrated display which measurement location is next, which have already been made, and which still remain, as shown by colour-coded direction vectors at the measurement nodes.

Also included in Stationary Processing are the SISO, SIMO, MISO and MIMO routines required for computation of cross spectral matrices and FRFs from live time history data or from stored measurements, as well as the H1, H2, and Hv FRF algorithms.

If FRFs are imported from an external source, the Stationary Processing module is not required.

Test for I-deas modal analysis software provides a complete set of tools for estimating the modal model to describe the vibrational behaviour of a structure. Modular applications allow you to choose between simple (Basic Modal BZ-6016) or advanced (Advanced Modal BZ-6017) tools to suit your requirements. While combined software package Comprehensive Modal BZ-6015, provides both basic and advanced functionality for seamless analysis integration when needed.

**Basic Modal**

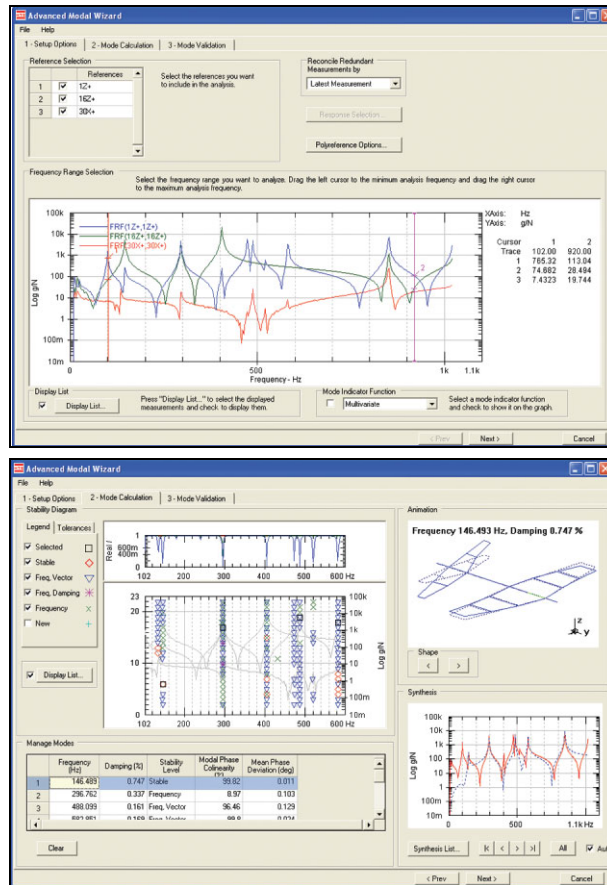
The Basic Modal module provides test engineers with a comprehensive yet easy-to-use 3-step process that guides you through the capabilities for processing modal measured test functions to extract information required to generate and display modal analysis results. It includes capabilities for modal parameter estimation, non-structural data preparation for display on geometry, MAC calculations and FRF synthesis. For normal FRFs, the basic modal capability offers SDOF curve-fitting, frequency and time domain methods.

**Advanced Modal**

Adding the Advanced Modal module opens up the world of multiple-reference structural testing, and rounds out the full suite of industrial-strength curve-fitting and modal analysis capabilities in the world’s strongest structural testing package.

Included in the Advanced Modal module are time domain polyreference and the 3-step Modal Analysis Wizard, including a frequency domain polyreference method specifically designed to be especially effective for those cases with heavy structural damping, for example those constructed of modern composites, plastics, or built-up assemblies.

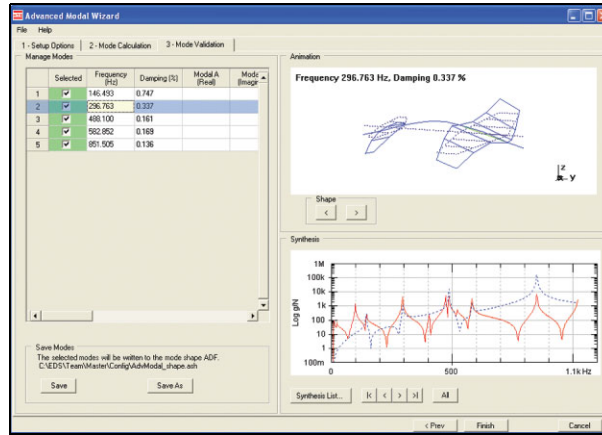
**Fig. 1**  
*Example of steps 1 – 3 from the 3-step Modal Analysis Wizard that guides you through the capabilities for processing modal measured test functions*



**Step 1** – Select the data to work with and confirm the setup of options, including number of references and how you want to handle redundant data.

**Step 2** – Interactively inspect the results of curve fit on the current set of data, and add to the accumulating table of modal results. Then go back to step 1 and select another set of data as required.

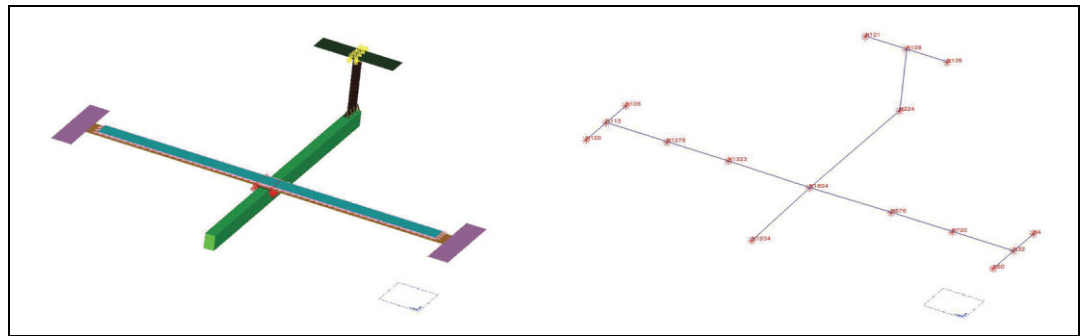
Step 3 – Confirm and save results.



## Geometry-based Data Display

The Test Geometry provided by Test for I-deas Core Test BZ-6000, includes tools to create 2D and 3D wireframe, element-based and surface geometries for use in geometric post-processing applications such as static deformations, animations, colour contour and arrow displays as well as a wide variety of other geometry-based data displays. Also included is basic Operating Deflection Shape (ODS) calculation, display for time and spectra, and the former Test for I-deas Model Preparation and Geometric Post-processing tasks.

**Fig. 2**  
Advanced graphic displays help you better understand and communicate modal analysis results



Presenting data measured at many locations on the structure using a geometry-based display can provide a very efficient way of understanding and communicating the test results. The extensive geometry display capabilities of the system are leveraged to provide convenient ways of displaying test data. Special features such as an intelligent, adaptive cursor highlight the geometry attribute of interest as it traverses the screen. A Model Preparation task provides easy-to-use methods for constructing geometry appropriate for testing applications. Geometry can be constructed using features such as:

- Geometry plotting: Deformed geometry plotting and animation for single or multiple viewports
- Line, shaded displays: Wireframe, hidden line removed, and shaded image deformation displays available as static plots on all supported graphics hardware devices. Wireframe and hidden line removed animation is available on most supported devices and shaded image animation is available on certain advanced graphics devices
- Arrow and criterion plotting: Vector arrow plots of data at nodes and criteria plots showing data above, below, within, or outside a defined range
- Contour displays: Data at nodes can be displayed on geometry using either line or colour contours. You control up to 78 contour levels and intervals
- Transient animation: Displays of transient events defined from time histories can be animated on deformed geometry providing a clear understanding of the response measurement as a function of time
- Animation of order tracking measurements: Order track data from rotating machinery tests can be animated on geometry with the full range of animation features including wireframe,

hidden line removed, and shaded image displays. The responses at a specified order and rpm or the total response can be animated

- Creation of test measurement points (nodes) by keyboard entry and copy/paste, reflect, interpolate, and cursor-picking measurement points from a detailed finite element model
- Global and local coordinate systems in Cartesian, cylindrical, or spherical systems. Local systems can be used to account for off-axis measurements
- Tracelines for wireframe displays
- Surface definition for advanced hidden line removed and shaded image displays and animation
- Definition of groups of measurement points on different regions of the geometry for automation of data processing/displays. A forms- and icon-based user interface allows the results to be easily applied to the display of test results on geometry. Results from modal analysis, order track tests, operating tests, or any other type of vector data at measurement points can be displayed

If no geometric displays are required, for example if only resonance frequency and damping values without shape displays are needed, the Test Geometry component is not required.

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## Methods

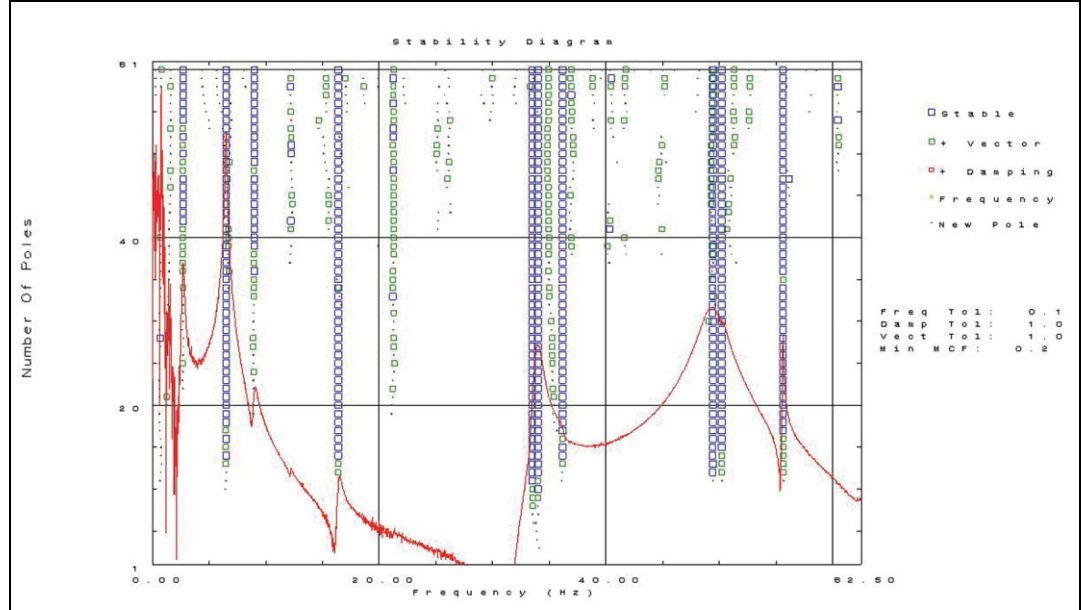
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Different modal parameters (resonance frequencies, damping, and residues) and mode shape (coefficients of structural deformation) estimation methods cover the full range of test situations and structure types:

- The Mode Indicator function is a single plot identifying all of the modal frequencies. It is produced from operations performed on a global set of frequency response function measurements. This aids in locating local modes, evaluating force input points, and determining modal density. The Normal Mode Indicator function identifies modes from single reference modal tests. The Multivariate Mode Indicator function identifies modes from multiple reference tests, including repeated modes, and yields normal mode force patterns

**Fig. 3**

The pole stability diagram can be used with mode indicator functions to select the best modal parameter fits



- The Pole Stability diagram can be used with Mode Indicator functions to cursor-select the best modal parameter fits. Modes curve-fit with different number of poles may be selected and combined into a single data set
- Local modal parameter and shape estimation: Search peaks and SDOF polynomial provide a fast method for widely separated modes. Circle-fitting is particularly useful for very lightly damped structures. Complex exponential provides a basic MDOF fitting method

- Global modal parameter and shape estimation: Methods for single reference data include the direct parameter frequency domain algorithm which is very stable for narrow band applications
- Methods for single or multiple reference data include polyreference, a classical time domain algorithm with wide-frequency band application. Orthogonal polyreference provides a wider frequency band application than the direct parameter method and supports data with uneven and even frequency spacing. Computational roots within frequency band are minimised
- Frequency and damping estimation: To provide additional flexibility, a global, multiple reference frequency domain mode shape estimation method can be used with other methods for estimating the frequencies and damping (such as the time domain polyreference method)
- Shape and calculations: Modal shape normalisation and modal mass calculations
- Validation: Synthesis (cursor-picked geometry to synthesise frequency response function and compare to measurement), and modal assurance criteria (quantitative method for determining the linear independence of mode shape pairs and 3D graphs of results)

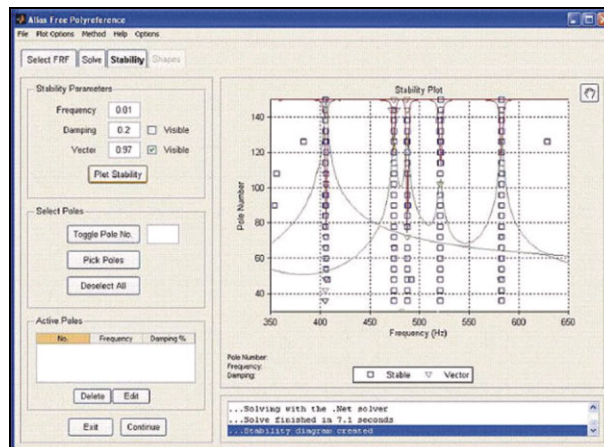
### AFPoly

AFPoly™ stands for “Alias Free Polyreference” and refers to a multi-reference modal parameter estimation technique that has been recently developed. AFPoly is a frequency domain Laplace method that uses orthogonal polynomials, and accounts for out-of-band poles when solving for modal parameters (shape coefficients, damping, and natural frequency).

The AFPoly GUI uses this technique in a step-by-step manner.

1. After importing Test for I-deas frequency response functions (FRF) into the GUI, the user will solve for roots. A stability diagram helps the user select the valid roots.
2. Shapes are extracted and verified by overlaying various test and synthesized mode indicator functions.
3. Once the shapes have been verified, they can then be exported.

**Fig. 4**  
Example of the AFPoly graphical user interface (GUI)



Some of the many benefits of using AFPoly are:

- Increased accuracy in parameter estimation due to removal of aliasing that affects other curve fitters
- Ability to fit lightly damped and highly damped modes across a large frequency range in a single pass
- Fast, efficient solver: AFPoly utilises parallel-processing on your dual-processor machine for faster solution times
- Simple, straight-forward GUI that is easy to learn and use

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## Specifications – Test for I-deas Modal Analysis Software: Comprehensive Modal BZ-6015, Basic Modal BZ-6016 and Advanced Modal BZ-6017

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### PREREQUISITE

Test for I-deas Core Test BZ-6000

### Modal Analysis Tools

**Mode Indicator:** A single plot identifying all of the modal frequencies

- Normal Mode Indicator Function: Identifies modes from single reference modal tests
- Multivariate Mode Indicator Function: Identifies modes from multiple reference tests

**Pole Stability Diagram:** Used with Mode Indicator functions to select the best modal parameter fits

**Wizards:** A 3-step Modal Analysis Wizard guides you through setup, mode calculation and mode validation

### METHODS

**Local Modal Parameter and Shape Estimation:** Search peaks, SDOF polynomial, circle-fitting and complex exponential

**Global Modal Parameter and Shape Estimation:** Direct parameter frequency domain algorithm (for narrow band applications)

**Methods for Single or Multiple Reference Data:** Polyreference and orthogonal polyreference (supports data with uneven and even frequency spacing)

**Frequency and Damping Estimation:** To provide additional flexibility, a global, multiple reference frequency domain mode shape estimation method can be used with other methods for estimating the frequencies and damping (such as the time domain polyreference method)

### SHAPE AND CALCULATIONS

Modal shape normalisation and modal mass calculations

### VALIDATION

Synthesis and modal assurance criteria (quantitative method for determining the linear independence of mode shape pairs and 3D graphs of results)

### Geometry

#### DISPLAY TYPES

**Line, Shaded Displays:** Wireframe, hidden line removed, and shaded image deformation displays are available as static plots on all supported graphics hardware devices. Wireframe and hidden line removed animation is available on most supported devices and shaded image animation is available on certain advanced graphics devices

**Contour Displays:** Use either line or colour contours. Up to 78 contour levels and intervals

#### DISPLAY FEATURES

- Creation of test measurement points (nodes) and groups of measurement points on different regions of the geometry
- Global and local coordinate systems in Cartesian, cylindrical, or spherical systems
- Tracelines (wireframe displays)
- Surface definition for advanced hidden line removed, shaded image displays and animation
- Geometry plotting
- Arrow and criterion plotting

#### RESULTS DISPLAYED

Results from modal analysis, order track tests, operating tests, or any other type of vector data at measurement points can be displayed

- Transient animation: Displays of transient events defined from time histories can be animated on deformed geometry
- Animation of order tracking measurements: Responses at a specified order and rpm or the total response can be animated

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## Ordering Information

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**BZ-6015-F** Test for I-deas Comprehensive Modal

**BZ-6016-F** Test for I-deas Basic Modal

**BZ-6017-F** Test for I-deas Advanced Modal

### SERVICES

M1-6015-F Annual Software Maintenance and Support Agreement

M1-6016-F Annual Software Maintenance and Support Agreement

M1-6017-F Annual Software Maintenance and Support Agreement

M2-6015-F Annual Software Maintenance and Support Agreement

M2-6016-F Annual Software Maintenance and Support Agreement

M2-6017-F Annual Software Maintenance and Support Agreement

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Brüel & Kjær reserves the right to change specifications and accessories without notice

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