Semiconductor Factory Automation

AMHS VIBRATION ANALYSIS

Tri-Axial Accelerometer Test Tool

INT02001 (Standard) INT02001-R (Reticle)

GCI's Tri-Axial Accelerometer Test Tool provides a precise vibration measurement solution for AMHS suppliers and end users. The tool (also known as the **GCI Vib Tool**) was first designed to measure vibration levels experienced by 150mm and 200mm wafers during manual transportation. As wafer sizes grew, the Vib Tool was instrumental in profiling 300 mm FOUP transportation solutions. Standard packaging allows the Vib Tool (INT02001) to be securely mounted into a 300 mm FOUP. New packaging allows the GCI Vib Tool (INT02001-R) to also be used for 150 mm reticle transportation analysis.

The GCI Vib Tool provides two recording modes: Time Domain and On-Board Data Reduction. For both modes, time domain data is sampled at 512 Hz on each axis (X, Y, and Z).

Time Domain Mode streams the sampled data directly to internal flash memory. Data reduction for this mode takes place on the PC using the GCI VibPlot Application, which provides detailed graphical analysis of the time domain data.

On-Board Reduction Mode uses data reduction algorithms to convert the time domain vibration data into frequency domain, multi-point data records. The time domain data sampled at 512 Hz is converted (using FFT's and averaging methods) to a series of 1/2 second data records in real time. The converted data is streamed to internal flash memory. In this mode, the time domain data is not available for post reduction analysis.

Figure 1 - GCI Vib Tool (INT02001) with 300 mm FOUP

Figure 2 - GCI Vib Tool (INT02001)

Figure 3 - GCI Vib Tool (INT02001-R) with 150 mm reticle pod

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Time-Domain Recording Mode

In Time-Domain Mode, data is streamed to the internal flash memory file system at a rate of 512 samples per second, per axis. Each recording session is stored under a sequential file name. Several recording sessions can be processed before data is uploaded to the PC for analysis. Recorded data files remain in the internal flash memory until deleted by the user.

Data files can be uploaded to the PC using the GCI Information Center Application (InfoCenter App) via the Vib Tool's RS-232 interface. The InfoCenter App automatically performs post-processing of the data using the same algorithms used during On-Board Reduction Mode. The reduced data is displayed graphically, and automatically saved in .CSV file format for import into other Windows Applications. The time domain data is stored in a separate file, and is available for more in depth analysis using the GCI VibPlot Application.

VibPlot performs post-processing and graphical analysis on the time domain data. Graph options are provided to display RMS, Peak, or True RMS data at the top of the screen. Below this can be displayed time-domain and FFT data, or three dimensional spectrograms or waterfall plots.

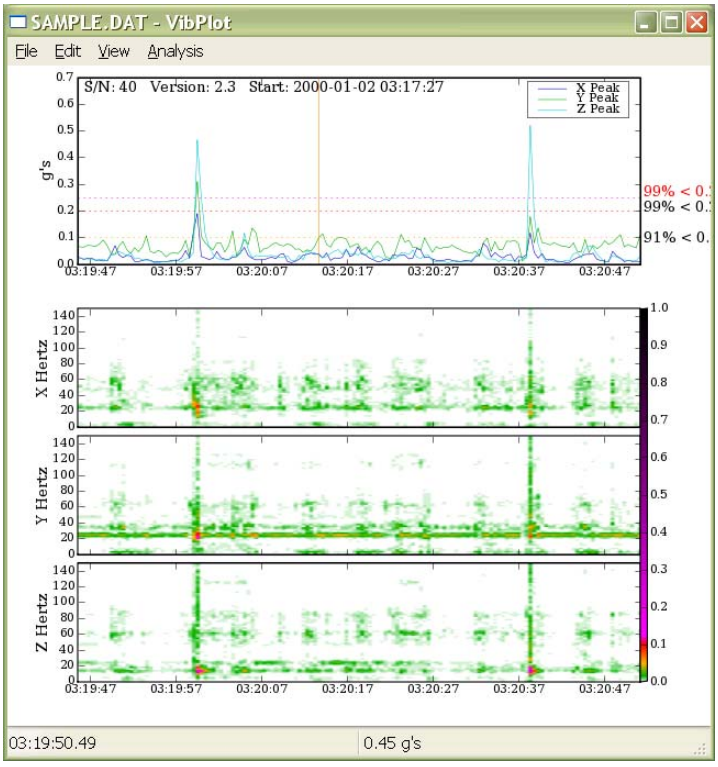

Figure 5 - VibPlot includes color spectrograms and waterfall plot options

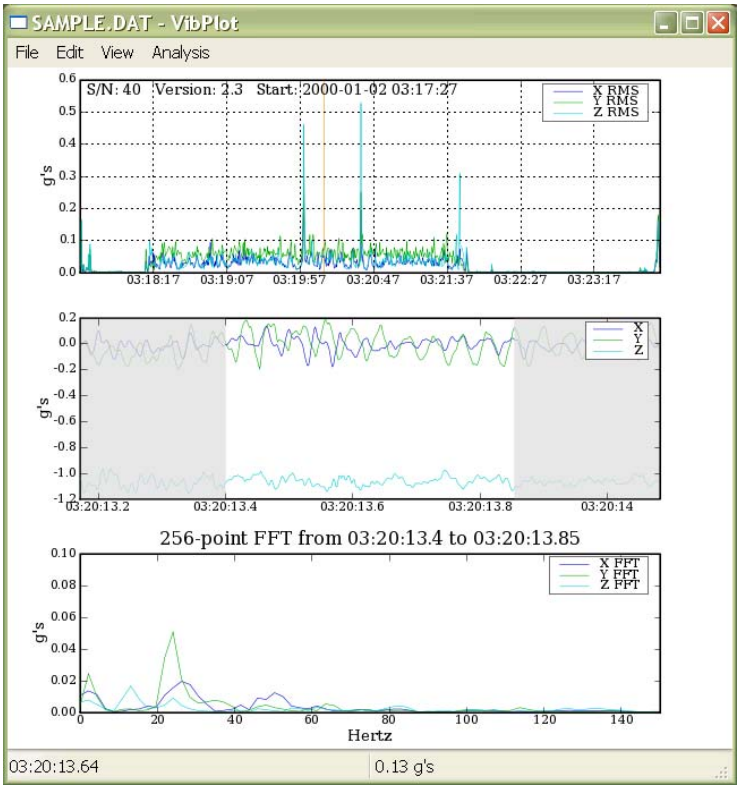

Figure 4 - VibPlot dispalys time domain and reduced data

A graphics cursor is displayed in the top graph allowing the user to select a specific 1/2 second data point for display of time domain and FFT data. The center graph in Figure 4 highlights the 256 time domain data points used to calculate the RMS data selected (at the cursor location). The grayed portion's of the graph show the 1/4 second of time domain data before and after the selected 1/2 second time interval.

The bottom graph in Figure 4 displays the results of an FFT on the highlighted data in the middle graph. The FFT converts the 256 time domain data points into the frequency domain. This bottom graph shows the amplitude (in g's) of the data for each frequency (from 0 to 150 Hz).

When viewing Peak vibration data, error tolerances are also displayed. The bottom graph in Figure 5 shows a color spectrogram for the three axes. Each spectrogram shows the results of the FFT (vertically) for each 1/2 second of recorded data (horizontally) with color showing the amplitude of the data (in g's). The color scale is shown at the far right of the graphs.

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On Board Data Reduction Mode

On-board data reduction takes 256 samples in the time domain every 1/2 second (for each axis), and computes data points in the frequency domain using FFT's and averaging algorithms. A 13 point data record is generated for each 1/2 second time slice. The data record includes the following reduced data types:

- RMS - Calculates the sum of amplitudes over the frequency spectrum for each axis - three data points per record.
- Peak - Determines the maximum amplitude in the frequency spectrum for each axis - three data points per record.
- Frequency at Peak - Stores the frequency where the Peak amplitude was found for each axis - three data points per record.
- True RMS - Calculates the true RMS of all three axes - one data point per record.
- N - Calculates the number of frequencies that contain amplitudes higher than an operator set value - three data points per axis.

Reduced data records are streamed to the internal flash memory file system. Each recording session is stored under a sequential file name. Several recording sessions can be processed before data is uploaded to the PC for analysis. Recorded data files remain in the internal flash memory until deleted by the user.

Data files can be uploaded to the PC using the GCI Information Center Application (InfoCenter App) via the Vib Tool's RS-232 interface. Uploaded data files are displayed graphically, and automatically saved in .CSV file format for import into other Windows Applications.

The InfoCenter App displays separate RMS, Peak and True-RMS vibration graphs. When used with the VIBCOM add-on, location details are also displayed, based on user selectable warning and error limits. This allows the user to customize the graphs to show location details associated with areas of the track that caused vibration levels that exceed set limits.

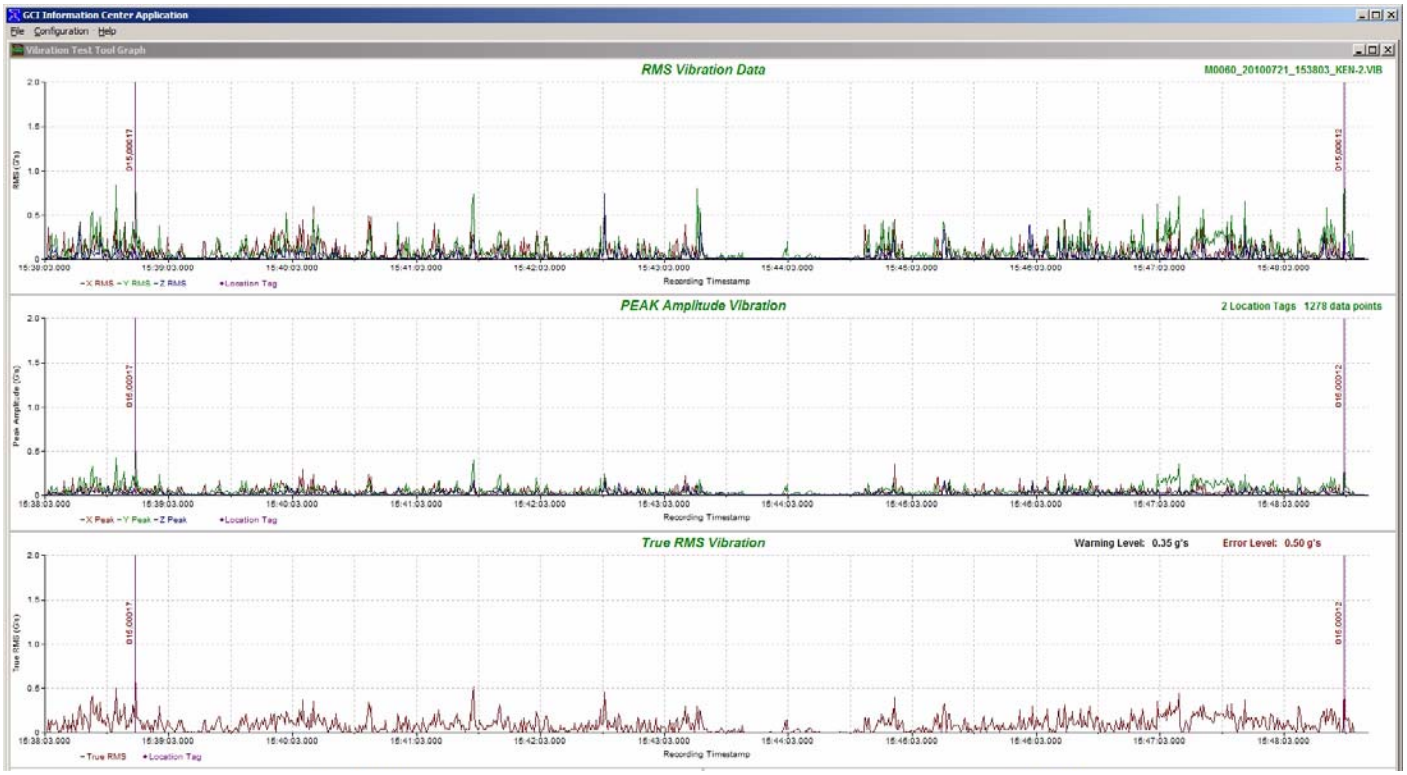

Figure 6 - Reduced data graphed by GCI InfoCenter App

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Specifications

- Simultaneous Tri-Axial Recording: X, Y, and Z axes
- Amplitude Response: 0.03 to 2.00 g
- Amplitude Resolution: 0.01g
- Amplitude Accuracy: ± 0.02g
- Frequency Response: 2 to 150 Hz
- Frequency Resolution: 2 Hz
- Frequency Accuracy: ± 2 Hz
- Rechargeable Ni-MH battery (up to 30 hours of operation)
- Internal 1 GB Flash Memory
- Real-time clock/calendar
- On Board Data Analysis Types:
  - RMS
  - Peak
  - Frequency at Peak
  - true RMS, and N
- RS-232 Interface
- Battery Charger

- Dimensions (INT02001)
  - Height: 12.5 cm (5.00 inch)
  - Width: 13.7 cm (5.38 inch)
  - Depth: 12.3 cm (4.86 inch)
  - Weight: 1.8 kg (4 lb.)

- Dimensions (INT02001-R)
  - Height: 29.3 mm (1.15 inch)
  - Width: 130 mm (5.12 inch)
  - 150 mm with mounting bracket
  - Depth: 130 mm (5.12 inch)
  - 150 mm with mounting bracket
  - Weight: 590 g (1.3 lb.)