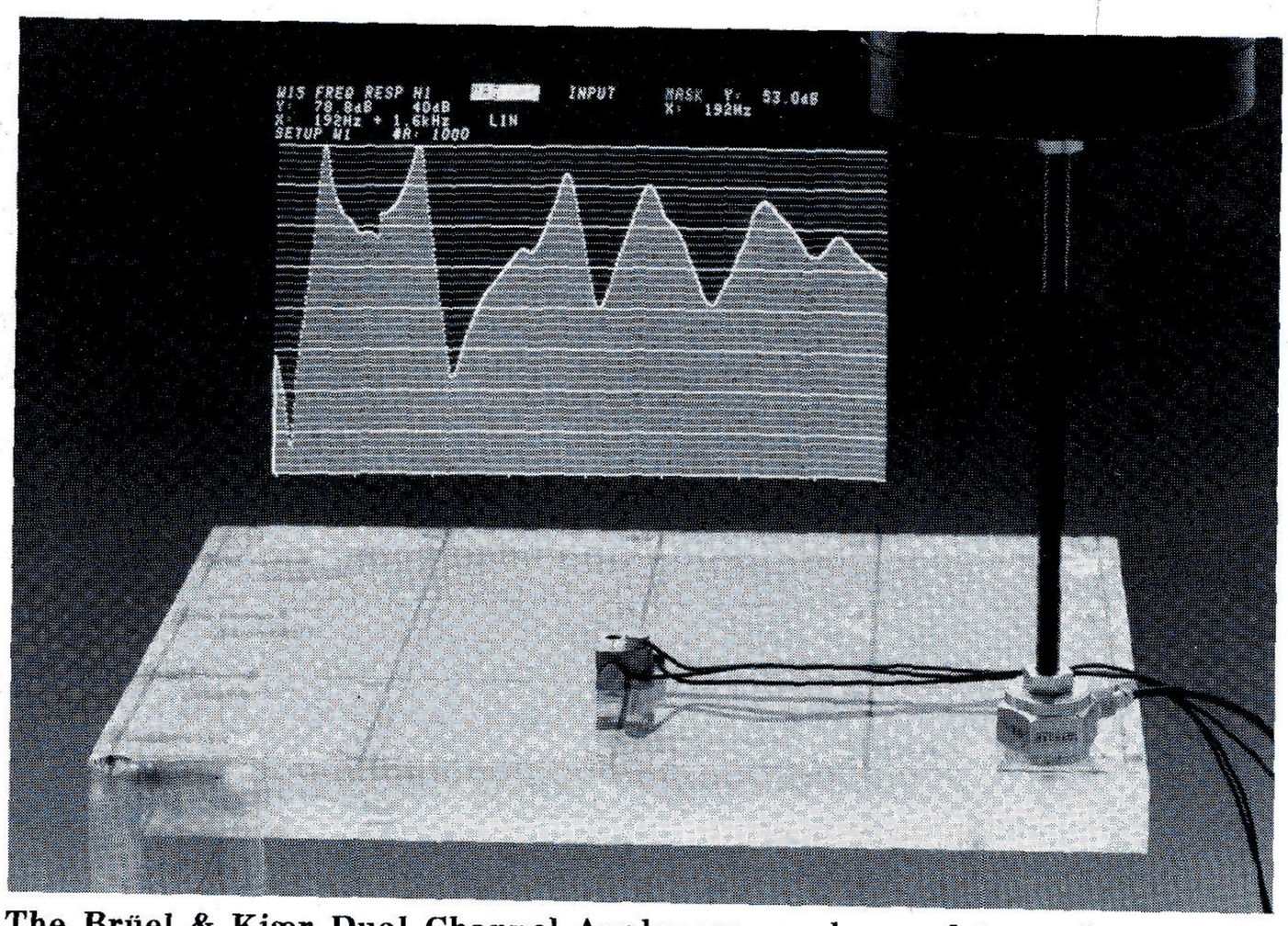
Brüel & Kjær Application Notes

Four-channel modal testing

Brüel & Kjær modal testing systems, based on Dual Channel Signal Analyzers Type 2032 and 2034, can be used to perform four channel modal tests. This is possible by selecting a new analyzer configuration in the Brüel & Kjær modal software.

The tests are made by using a single force input, applied by a vibration exciter, and by measuring the response in three orthogonal directions using a triaxial accelerometer.

The result of the new configuration is that tests requiring triaxial response measurements are accomplished faster and with greater accuracy.



The Brüel & Kjær Dual Channel Analyzers can be used to perform modal testing using a single force input and three response transducers. In this way modal tests requiring measurements in two or three translatory degrees of freedom at each point can be accomplished quickly and accurately

Introduction

Modal analysis of many structures can be accomplished satisfactorily by measuring the structural response in one direction only. For example, a modal test on a predominantely planar structure, where only the bending modes are within the frequency range of interest, falls into this category. However, to obtain an accurate modal model of structures whose modes exhibit significant motion in two or three directions, it is necessary to measure the structural response in more than one direction.

Another application which requires that the structural response is measured in three directions is substructuring, whereby the modal models for two or more structures are combined to determine the dynamic parameters for the assembled structure.

In tests where the force is applied using a vibration exciter or impact hammer, it is possible to measure the response in up to three directions for each point using a uni-axial accelerometer. It is, however, much quicker to make these measurements using a triaxial accelerometer, since the time consuming process of moving and attaching the response transducer is dramatically reduced.

Measurement Instrumentation

A typical Brüel & Kjær instrument set-up for four channel modal testing is shown in Fig. 1. The excitation force is applied by a vibration exciter/power amplifier combination using the excitation signal provided by the analyzer's built-in signal generator.

The application of Brüel & Kjær Dual Channel Signal Analyzers to four channel testing is achieved by using a new analyzer configuration in the Brüel & Kjær Modal Software WT 9101. Using the software, response measurements at a point can be made for one, two, or three directions (x, y, z, xy, xz, yz, or xyz). The configuration is designed for tests using a vibration exciter, and any one of the range of Brüel & Kjær vibration exciters can be used.

The response is measured using either a purpose-built triaxial accelerometer such as the Type 4321, or using three uni-axial accelerometers and a triaxial mounting block. The mounting block WA 0313 can be used for accelerometer Type 4374, and WA 0445 can be used for accelerometer Types 4375 and 4393. The response signals are fed to the appropriate channel B inputs of the analyzer (see Table 1). In order to achieve the phase matching specified for the Dual Channel Signal Analyzers the 3 Hz high-pass filters must be used.

Table 1 describes the necessary adaptors and modifications required for line-drive preamplifiers and for

stand-alone preamplifiers. Note that only a minimal amount of additional hardware is required to perform four channel testing.

Transferring measurements from the analyzer

Reconfiguration of the analyzer is achieved by following the procedure given in Appendix G of the Instruction Manual for the Modal Software WT 9101. The required analyzer configuration is available on disk, Brüel & Kjær number WT 9137, and is labelled BK_TRI. For further details contact your local Brüel & Kjær representative.

Transfer of the three measurements for each point is controlled automatically by the software program. The program is used to control the analyzer, and for the x, y, and z direction in turn, channel B is autoranged and the measurement is transferred once the required number of averages have been completed (see Fig. 2). A new measurement can then be initiated while the previous measurement is being stored.

Measurement processing

The procedure for extracting the modal parameters from the measured frequency response functions is accomplished by the Modal Analysis Program WT 9101 in the same manner as for two channel testing. No additional equipment or modification is required.

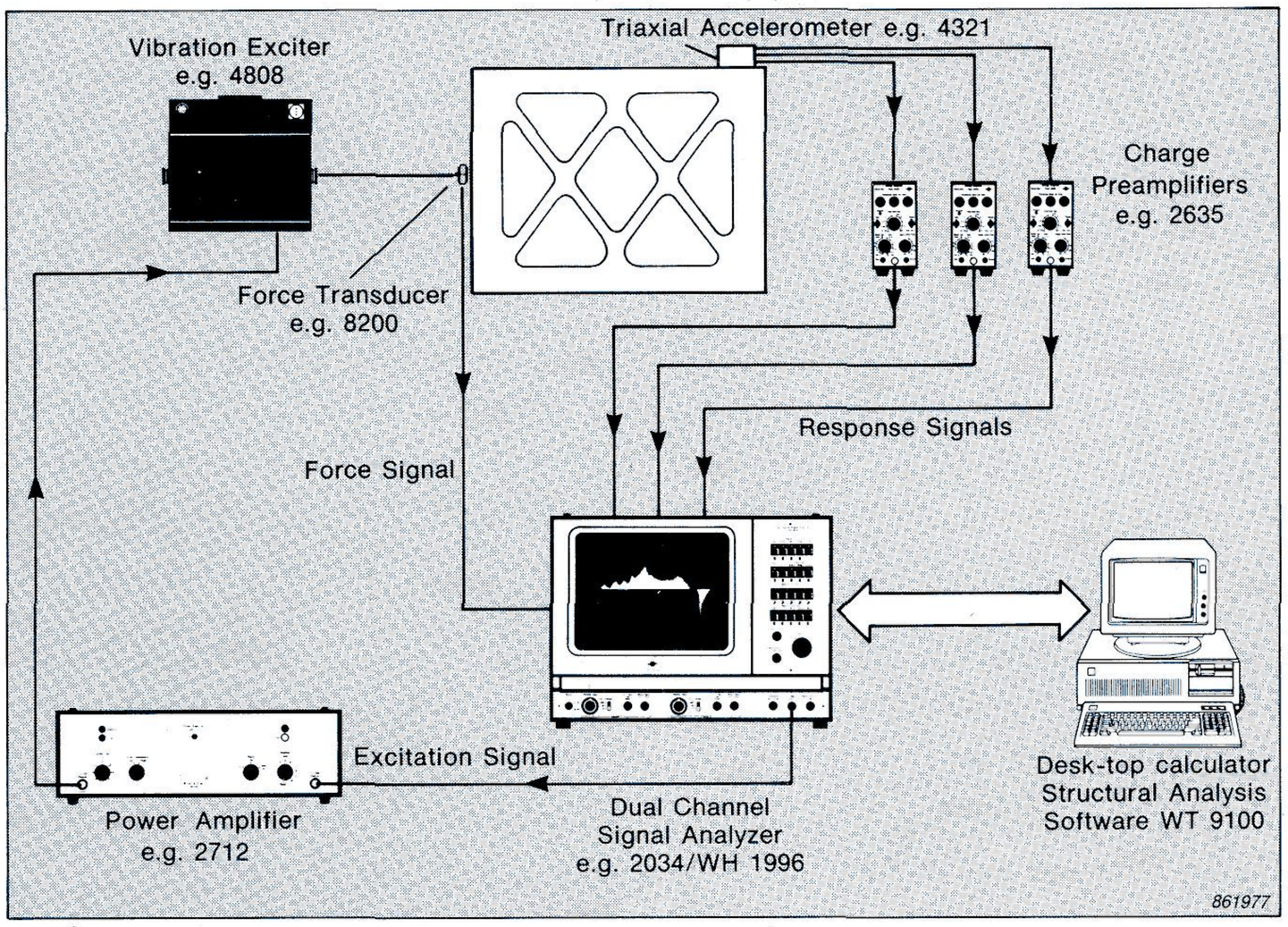


Fig. 1. Example of a Brüel & Kjær Modal Analysis System for four channel testing

Analyzer Input	Direction	Line-Drive Preamplifiers: Use a 2-Channel Line-Drive Supply Type 2813	Stand-alone Preamplifiers: Use a modified analyzer 2032/WH 1996 or 2034/WH 1996
Preamp.	x	Adaptor WJ 0118 (+ 1 Channel from 2813)	Adaptor WJ 0118
Acc.	y	—	Adaptor WA 0444 (BNC–TNC) or Adaptor JP 0162 (Microdot–TNC)
Direct	z	(1 Channel from 2813)	—

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Table 1. Details of the additional hardware required to use the Brüel & Kjær Dual Channel Analyzers for four channel modal testing

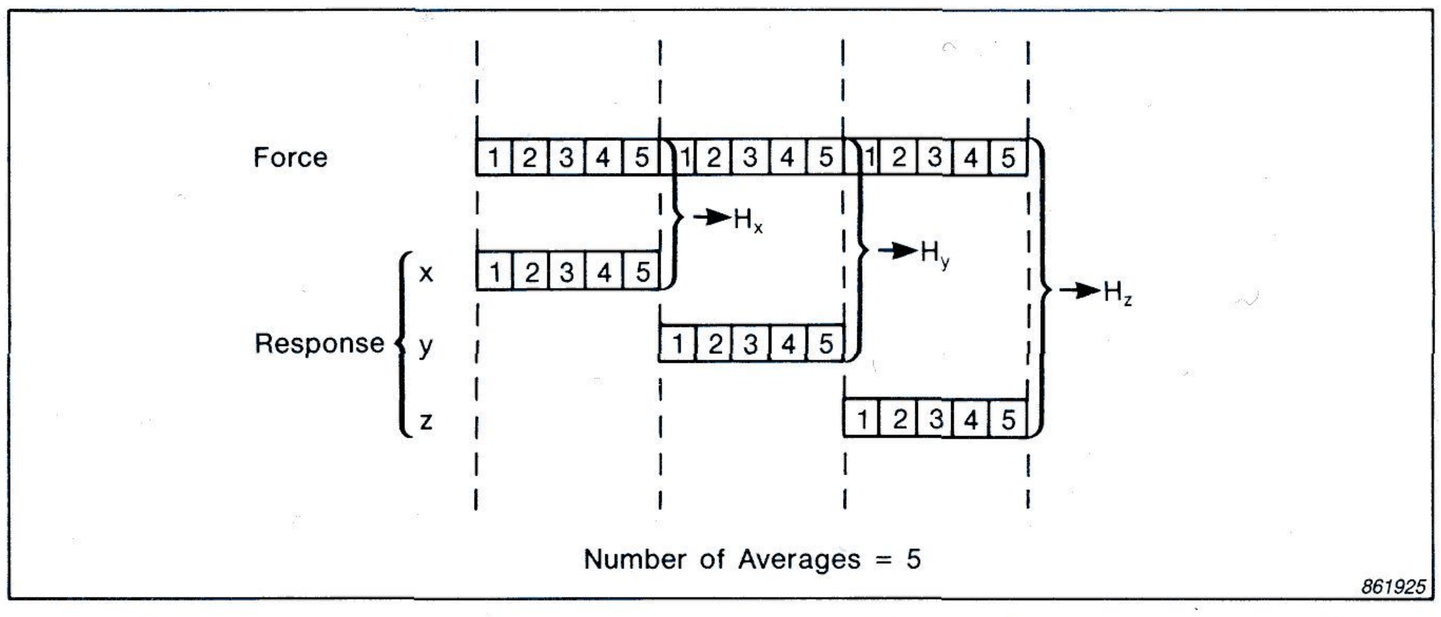

Fig. 2. The program transfers frequency response functions for the x, y, and z directions in turn once the required number of averages have been made

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