CASE STUDY

Production quality testing for worldwide manufacturing

With component production facilities around the world contributing to the manufacture of exacting measurement equipment, Brüel & Kjær needs detailed and strictly centralised control of production test targets. When a new system was called for to maintain R&D targets in production by tracking and analysing test outcomes around the world, we decided to build our own.

Brüel & Kjær

The company

Brüel & Kjær is a multi-national high-tech company with a strong focus on R&D, producing sound and vibration measurement hardware and software for worldwide markets. In a highly competitive marketplace, our goal is to produce the very best quality systems and solutions, and to continue be the go-to supplier for definitive responsibility and engineering perfection. As one of the oldest companies in sound and vibration, we are very proud of this heritage that we have worked hard to earn, and are determined to safeguard it while navigating contemporary challenges.

Significant investment in R&D is central to Brüel & Kjær's strategy, as well as its enduring success. Precision manufacturing of our equipment in carefully controlled conditions is also vital to maintaining the quality standards that our customers expect.

History

Per Brüel and Dr Viggo Kjær founded the company just north of Copenhagen, Denmark in 1942, then manufacturing the world's first analyzer with constant bandwidth proportional to frequency.

Brüel & Kjær Sound and Vibration Measurement A/S quickly established itself as a name synonymous with superlative quality in the field of sound and vibration equipment. It remains a world-leader in terms of quality and size, producing a string of firsts in microphone, accelerometer and equipment design.

Nowadays, analysis software and complete solutions are important parts of Brüel & Kjær's competencies. The addition of the LDS range of vibration test systems in 2009 brought even wider capabilities, and the incorporation of Lochard in the same year enhanced Brüel & Kjær's strong offerings of environmental monitoring solutions.

The 2000s saw the introduction of world-leading technologies such as TEDS, automatic input ranging technology (Dyn-X), and advanced equalisation technology (REq-X). That decade also saw the introduction of the current generation of award-winning sound level meters and the successful LAN-XI data acquisition hardware – the modular backbone of many of our systems.

The challenge

"You have the oversight from headquarters' remote connections. They can't adjust it locally. We want full control, especially on production sites, because we do not want them to change anything. If something needs to be changed, we will do it and then push it to their systems."

Jesper Bo Vedel
Manager of Test Engineering

The key area for our R&D department is maintaining and meeting targets during the actual production of the equipment that they have developed. This fairly universal aspect is especially critical for high value electronic components and assemblies such as we make.

While go/no go testing is important to give a fast pass or fail, high value assemblies cannot be simply rejected and it is necessary to 'drill down' into the results to analyse the reasons for any failures to meet designated specifications. Equally, documenting the consistency of effective production is a vital part of modern manufacturing.

In sum, data is key. And time is short. According to Test Engineer Nils-Jørn Rahbek, "If something costs a penny to make, you can just throw it away. But we don't throw away the things we make as they are so valuable. So we test deeply."

Remote manufacturing

In the modern business climate, remote manufacturing is widespread, and Brüel & Kjær is no exception. Consequently, we need a system that monitors, analyses and responds to product and component quality issues quickly, covering assembly plants in multiple locations around the world.

Waiting for incoming quality inspection: LAN-XI analyzer modules made in Thailand await their initial quality control testing at the Denmark headquarters

With our primary R&D expertise and infrastructure located in our Denmark headquarters, we need a testing service that has infrastructure at the various assembly plants, while delivering results remotely to test engineers located elsewhere. Test engineers need to track production quality expressed in terms of numerical values that govern whether or not the tested unit has met expected targets.

The bottom line is that the test should ensure components, circuit boards and finished products roll off the production lines around the world, including at subsidiary companies and suppliers, with a specified level of quality commensurate with our demanding and exacting standards, in order to retain our pre-eminent market position. All while minimising any reduction in the rate of production.

Searching for a solution

We set out to find an objective, automated test solution capable of assessing the electro-acoustic quality of products, allowing those that do not meet the appropriate level of quality to be rejected.

Requirements were:

- Location on production sites around the world
- Full oversight from headquarters over the remote locations
- Complete central target control without the possibility of local adjustment

We needed a test engine to make this possible and looked at the market to get one. However, as the ones available didn't offer everything we wanted, we decided to make our own.

Our experts in production testing and measurement innovation are used to creating systems like this, and a custom solution was able to provide the entire package – not just instrumentation but design, domain expertise, software and operating services.

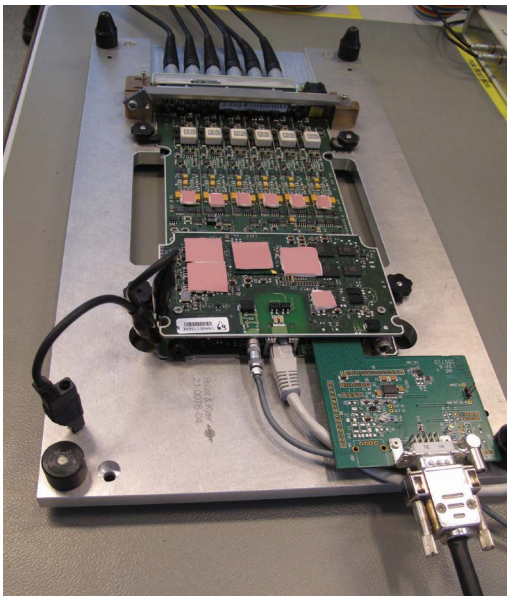
Brüel & Kjær's large global support network enables us to draw on our extensive service experience and established resources throughout the world. Consequently, the system allows us to track test results from sub-suppliers in Thailand, China, Japan, Taiwan, other locations in Denmark, France and the US, and headquarters in Nærum, Denmark.

"Confidence, and the ability to see the quality is what we want. With this system we have so much visibility that we feel very safe – and we trust it to deliver"

Torben Bjørn, Vice President of Operations

Remote test capability

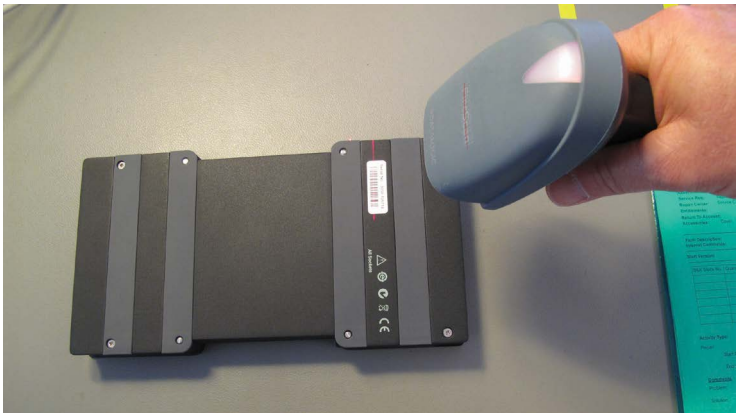
Inside a LAN-XI module: a PCB board undergoes testing



Located in different manufacturing facilities around the world, our test system checks and calibrates LAN-XI data acquisition modules before they are shipped to customers. Checks are made on around 1000 parameters such as frequency response, distortion, and many other digital tests necessary to ensure that the module will perform perfectly for the customer. As a flexible solution, the testing is not static or fixed either, so if we come across an issue that demands a new test, it can easily be incorporated.

A barcode scanner detects the serial number of the unit, and then automatically reads the sub-assemblies inside via a microchip. Then a job number is assigned to facilitate tracking later on. The printed circuit boards have the production data programmed into them, and this information covering which circuit boards are mounted in which modules is then recorded into the database, so we can track the lot numbers in each.

A barcode scanner reads the serial number and identifies the sub-assemblies within



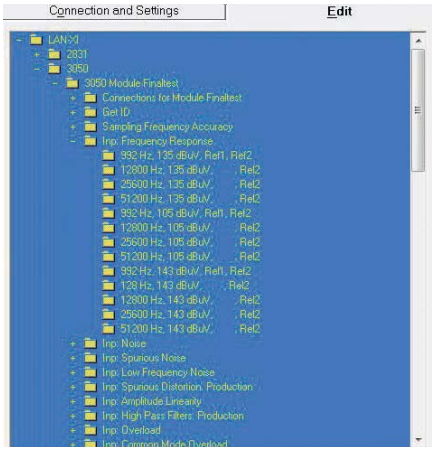
Using the internet, the system allows engineers located remotely from the assembly plant to view a variety of key metrics functions. These include production throughput and first time yield metrics, the ability to analyse failure modes and testing performance, as well as drilling into the measurement details of individual tests to view performance.

Remotely maintaining quality and oversight

'Report Manager' is a tool that assists with reporting what has been measured – such as for calibration or remote monitoring. There are two levels of reporting: in rudimentary html, giving all the necessary figures, or reporting with a word processing program. The latter is ideal for producing calibration certificates and so on that need to adhere to the differing presentation standards around the world.

Familiar 'tree-like' architecture allows similar tests to be copied and repeated easily

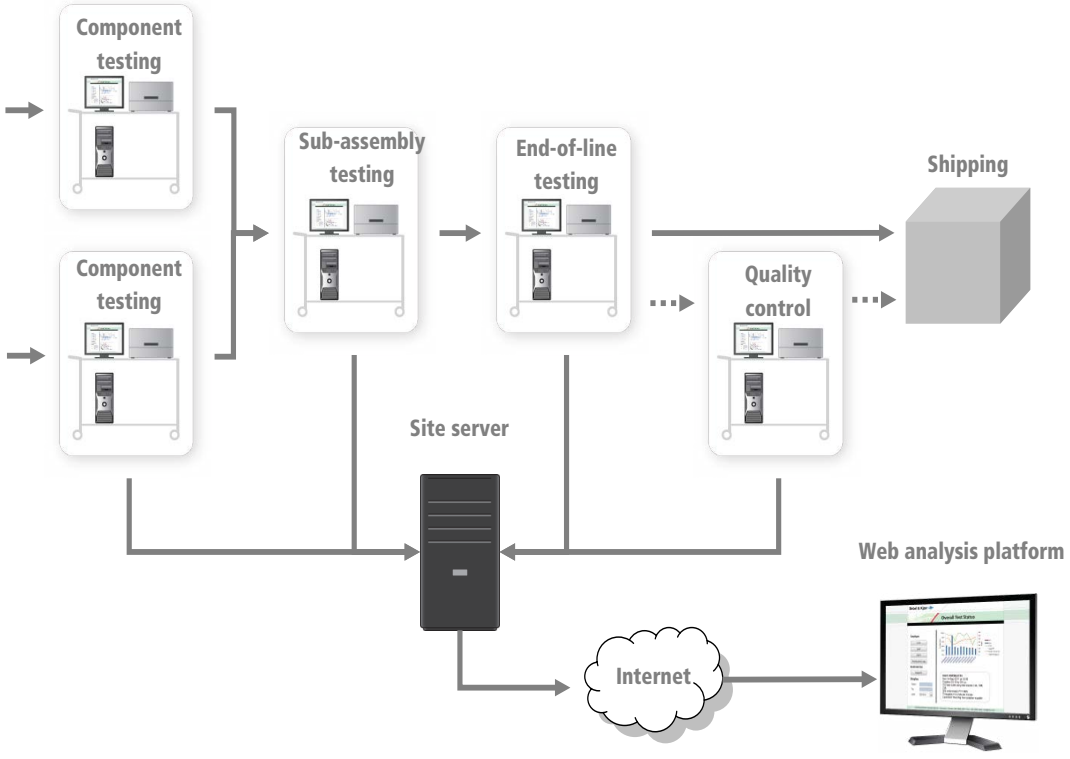
The fundamental purpose though, is to be able to look at what you have actually tested, and to show the status of each individual item in each test. A simple, Windows®-style interface allows intuitive navigation, with a normal 'test tree' of expandable links like any other windows system. Instructions can also be brought up on-screen.



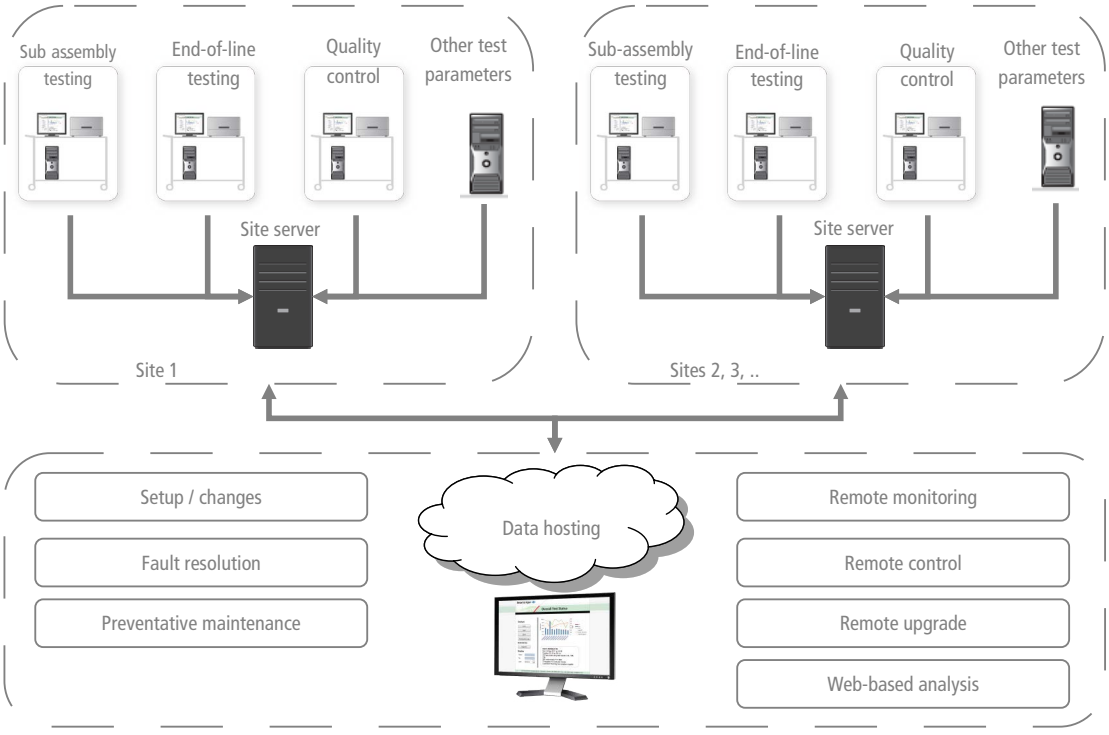
At the same time, it allows remote access to test parameters, to control or change the test, and to share the test data amongst our teams and suppliers. Centralised restrictions on the test parameters mean that we don't risk transferring targets to subsidiaries and sub-suppliers and then risk them being adapted locally. Instead, when there is a failure, the local test manager sees the pass/fail criteria, after which we can change things remotely if necessary, as well as drilling down into the data to investigate failures.

According to Jesper Bo Vedel Manager of Test Engineering, “We have the oversight from headquarters’ remote connections, and it can’t be adjusted locally. We want full control, especially over production sites, because we do not want them to change anything. If something needs to be changed, we will do it centrally, and then push it to their systems.”

Testing at each stage of the production process is fed back into the site server. This is accessible via the internet, only by authorised people who set the desired targets remotely



Our systems operate on multiple production lines across different locations in the world



Data management

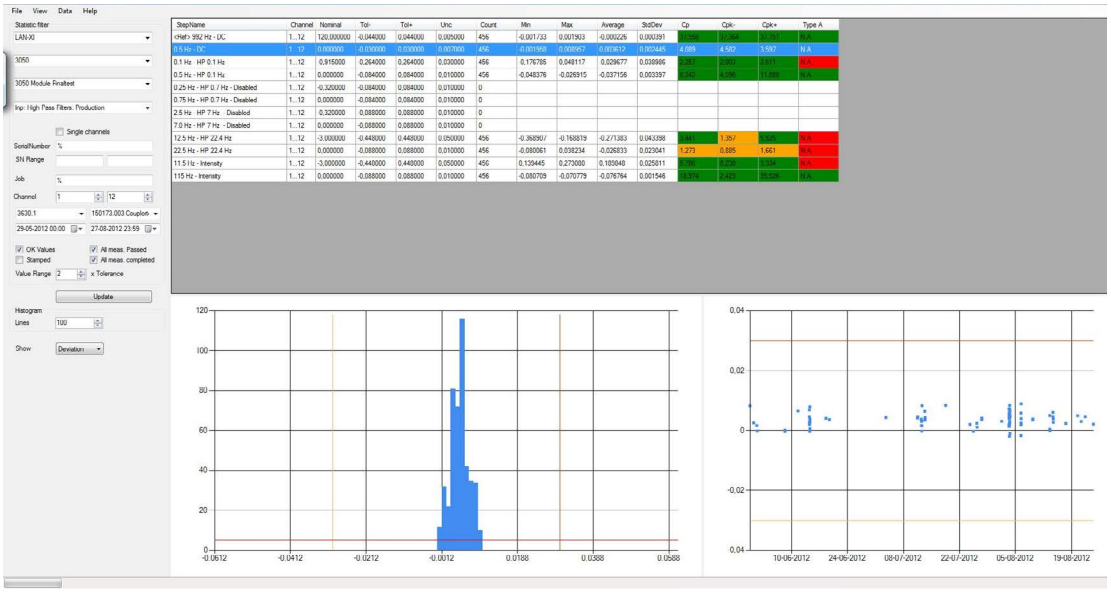
A database manager helps to set up all the measurements, control instruments, and save data in a database. Data is carried on a server that is local to the manufacturing location, and backed up every night. Rather than permanent monitoring, it records the tests permanently for later analysis, as and when it is required.

This all takes place at Brüel & Kjær's Class-A data centre in Melbourne, Australia. With more than 20 years of remote management experience, here we have existing operations that encompass most of our noise monitoring solution customers – who include many of the world's airports.

All test data is collated, securely stored and maintained, and is accessible 24/7 to authorised users of the system. The system can operate on multiple production lines across multiple locations, providing a single entry point for monitoring production testing. According to Torben Bjørn, Vice President of Operations, "Confidence, and the ability to see the quality is what we want. With this system we have so much visibility that we feel very safe – and we trust it to deliver."

Trend analysis

The database manager allows us to keep track of many parameters, such as seeing if any changes in components or deterioration in components have an adverse effect on the final product – in which case we can go into the data and see. According to Test Engineer Nils-Jørn Rahbek, "As an example, a software change could have an influence on the measurements made on the LAN-XI modules. They include a lot of software, and it could have an influence on something like distortion for example. Or it may be just different production runs that we need to keep a track of."



Remote access to test statistics of sub-components and complete products guarantees effective oversight. Here the distributions of different test results are easily visualised

Manager of Test Engineering, Jesper Bo Vedel adds, "Changes to a product such as new log numbers or software versions might just make a small change, but it might put us on the edge of something bigger. Then we would modify the test to catch any potential problems looking forwards."

The platform provides data in real-time so that current throughput and First Time Yield information is immediately and continuously available, provided there are suitable communication links. Alarms can be triggered should these key production line criteria fall below acceptable limits, with authorised staff able to view summary test results, as well as drilling down into the detailed individual tests.

Trend analysis can reveal how the quality of incoming component suppliers varies, and how any changes in assembly processes are affecting quality. Historiograms show how trends are distributed, and assist analysis of them.

Benefits

- Provides a consistent level of electroacoustic test quality across the products
- Remotely delivered test results provide visibility, delivering the data needed to work with component suppliers to maintain quality levels
- Shows long-term trends and issues early to enable action before they affect production
- Delivers trustworthy results checked by central, HQ experts
- Continuous quality improvements
- Flexibility and mobility of production lines
- Focus on constant cost reduction
- Less expensive global travel
- Less dependence on operator skill level
- Cross-functional data sharing
- Secure data hosting

The finished product: 12-channel LAN-XI modules complete with their various components, following final testing. With the wealth of stored test information on their components and on each individual model, highly detailed analysis is possible at any time

Future

There is a great potential for solutions such as used by Brüel & Kjær in the electronics, mobile phone and automotive markets. As Manager of Test Engineering, Jesper Bo Vedel says, "It's highly applicable to any high-value components. You can follow the production workflow and process. Instead of finding out too late that you have a production failure – like after delivery – this can save the huge amount of lost test time and expense by testing so many different parameters."

A customised solution provides an unlimited amount of flexibility to create a test system specific to the customer's needs, with possibilities including:

- Putting test systems at every stage of production
- An overall model statistics page
- Different authorisation levels as required – enabling, for example, only partial summary data available to one group with detailed information available to another
- Training of local managers as necessary
- Both ends of the production process – the supplier and the manufacturer – can perform quality checks
- Testing of sub-suppliers to help the full traceability of the testing.
- Capable of operating across multiple production lines in multiple locations

Solutions based on LAN-Xi data acquisition hardware are also expandable to 1000+ channels

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