MICRO

MEASUREMENT AND CONTROL

SYSTEMS CATALOGUE

MICROLINK

Measurement and Control Systems Catalogue

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MICROLINK

INTRODUCTION

Welcome to the *Microlink Measurement and Control Systems Catalogue*, we hope you find it useful and informative. It has been designed to to give you an overview of the systems and services we offer and to convince you that we can design a MICROLINK system to suit your application.

MICROLINK systems use a personal computer to acquire and analyse data, make measurements, conduct tests or monitor and control an industrial process. We are able to supply and recommend a variety of computer systems and peripheral hardware—just call us if you have something specific in mind. If you wish we can supply a kit of parts for you to build your own system; alternatively we can handle the complete package for you from initial briefing, planning, system specification, installation and product training. From then on you can always call for free technical support.

How to use this Catalogue

The Catalogue is divided into 5 Sections.

Section 1 Introduces the Company and explains how we offer a cost-effective systems integration service.

Section 2 Highlights the benefits of computerised measurement and control systems and gives specific examples.

Section 3 Shows the components used to build systems, including the major software packages we supply and a summary of the hardware.

Section 4 Is a reference guide to what the hardware specifications really mean and their relevance to measurement systems.

Section 5 Gives comprehensive information about the hardware.

The Company

Microlink Measurement and Control Systems Ltd is a division of Biodata, a British company established in 1973. Biodata manufacture the MICROLINK range of data acquisition and control products and we use these, and other quality assured products, to provide a complete systems building service.

Quality

When considering a measurement and control system you need to be sure that not only is it what you want on day one, but that it can be maintained and, if necessary, replicated or modified in a few years time. In 1990 the company was one of the first measurement and control companies in the UK to achieve certification to ISO 9001 (BS 5750, EN 29001), which covers all aspects of our operation from design through to after-sales support. We can repair, recreate or modify any system we manufacture.

BSI REGISTERED FIRM — NATIONAL ACCREDITATION OF CERTIFICATION BODIES

Certificate No FM 10631

EN ISO 9001 : 1994

INTRODUCTION

Sales Engineers

Our aim is to understand your requirement and to supply a system to satisfy your need. This understanding begins with your initial contact with the Sales Office and continues with the on-site visits by our skilled graduate sales engineers. They are well used to involving themselves in a wide variety of projects. Their task is to discuss your project, in your terms, and to help translate your requirements into specifications in electronics, computer and software terms. They are pleased to demonstrate how MICROLINK systems can be quickly set-up to access the real signals from your equipment. We believe you will find that a discussion with our sales engineers will make a very valuable contribution to the development of your project.

Bespoke Design

The MICROLINK system has developed in response to users' requests for solutions to ever widening data acquisition and control problems. We recognise that many projects, if they are to perform as originally intended, may require specialised items of hardware—to interface a special transducer or to switch signals with unusual characteristics, for instance. Because the measurement hardware is designed and built by us, we are able to provide an excellent design modification service; and, importantly, to provide continuing after-sales support for these design modifications. We find that typically minor, low cost, changes to hardware can have a dramatic effect on the productivity of systems, meeting your requirement rather than changing it.

Windows Software

The key to a measurement and control system that works, and that people will use, is the software. It must be consistent, intuitive and tolerant of the occasional wrong entry. Microsoft Windows has become the dominant operating environment for PCs and lends itself to these criteria. It is a "multi-tasking" environment and allows several programs to run side by side—enabling you to pick and choose the software to suit your application.

We offer a range of Windows engineering software, detailed in Section 3. These packages can pass data between themselves as needed so a combination of off-the-shelf software can be combined in a single system, significantly reducing costs. We offer modular software, so you only need to buy those part of the range you need, with the option for later expansion. Particular elements of the process, however, may benefit from custom software for your task. Our software engineers can specify and produce this for you.

Free After-Sales Support

Our technical support is second to none. Since we design and build the hardware and software, the answer to nearly every question about even the most complex system can be found from an expert working in the same building.

The Bottom Line

Computerised measurement and control projects are used for a whole variety of reasons, ranging from the purely **financial**—where the computerised system can be shown to reduce costs; through **quality improvements**—such as better process monitoring and understanding, or by more exhaustive product testing; through to purely **research and development** reasons—to see whether something can be done, or under what conditions a process can be made to work economically. Whatever your reason for considering such a project, you should talk to us because we build systems that do save money, do lead to quality improvements and do provide the information required.

The Products

- Range of computerised measurement and control hardware and software, united by a common user interface.

The Service

- Systems Integrators to the Industrial, Laboratory and Education markets.

The Users

- MICROLINK systems have been used in many different industries by many different companies; some of our more recent customers are detailed on the facing page.

MICROLINK Customers Include

A B Automotive Electronics
AEA Technology
AEI Cables
Alcan International
AWE Aldermaston
Beta Instruments Co.
BNFL
BNR Europe
Bradtec
Brewing Research Foundation
Britax Excelsior
British Aerospace
British Antarctic Survey
British Ceramic Research
British Gas
British Steel Corporation
Cardiff Institute of Higher Education
Celltech
Ciba Pharmaceuticals
Consumer Research Association
Courtaulds Research
Cranfield Institution of Technology
Dataloop
Delta Biotechnology
Domino UK
Dowty Aerospace
Duracell Technical Research
Endress & Hauser
Episoft
E.S.H. Testing
Falcon Catering Equipment
Ffestiniog Railway Company
Flexibox
Flight Data Company
Ford New Holland
Gas Measurement Instruments
GEC Alsthom
GEC Marconi
Glacier Vandevell
Glaxo UK
Health and Safety Executive
IBM U.K.
Imperial Chemical Industries
Imperial College of Science and Technology
Institute of Horticultural Research
JBR Recovery
Knauf GmbH
Kodak
Komat'su UK
Lucas Automotive
Lucas Electrical
Marconi Radar
Marine Biological Association
Mechtric Engineering
Mercury Communications
Meteorological Office
National Engineering Labs
National Physical Laboratory
National Power
N.E.I. Mining
NNC
National Rivers Authority
Norlab Instruments
Northampton Refrigeration Company
Oxford Automotive Components
Oxford Instruments
Oxford Magtech
Pilkington Glass
Pirelli General PLC
Plymouth Marine Laboratory
Redland Engineering
Royal Observatory
Royal Ordnance
Royce Thompson
Rushton Gas Turbines
Rutherford Appleton Lab
Scapa Porrit
Schlumberger
Scobie and Junor
Seafish Industry Authority
Servosolutions
Shaffner Intepro
Shell Research
Space Technology Systems
Syntex Research
Tempered Spring
Tetrapak
Torftech
UMIST
UNISYS
United Biscuits U.K.
University College Cardiff
University College Dublin
University College London
University College Swansea
University of Aberdeen
University of Birmingham
University of Bradford
University of Cambridge
University of Glasgow
University of Hull
University of Leicester
University of Leeds
University of Manchester
University of Newcastle
University of Plymouth
University of Salford
University of Southampton
Vibrometer
Ward Building Systems
Westinghouse Electronics
West Midlands Fire Service
Watts Blake Bearne

Sales Information

United Kingdom Sales Office

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FAX +44 (0)161-833 2190
EMAIL sales@microlink.co.uk

Quotations

Price and delivery quotations made by Biodata Ltd or its authorised field sales representatives in the UK or overseas are valid for 30 days unless otherwise stated.

Discounts

Quantity discounts are available on large orders, consult Biodata Ltd for details.

Technical Support

If you do have a problem with your system, then our Technical Support team is available to help you get your system up and running as quickly as possible.

Standard Terms and Conditions of Sale

The purchase by the buyer of Biodata Ltd products represents acceptance of the Biodata Ltd terms and conditions of sale. Full details of these terms and conditions of sale, together with full details of the software purchase licence are available on request from Biodata Ltd.

Order Cancellation

All orders with Biodata Ltd are binding and are subject to a restocking charge if cancelled.

Guarantee

Biodata Ltd will repair or replace without charge any MICROLINK which fails in normal service within one year of purchase date. This excludes failure caused by misuse. An extended warranty is available on an annually renewable basis.

System Integrators

MICROLINK systems are available from qualified system integrators around the World. Enquiries received from these countries may be sent to the local office.

Netherlands, Belgium and Luxemburg

Evert J. W. Vrieze
BIG BEN Instrumenten
Dienstencentrum
Geldropseweg 26
5611 SJ Eindhoven
Netherlands
Tel: 00.31.40.212.83.59
Fax: 00.31.40.296.00.34
E-mail: bigben@xs4all.nl

Germany

Wolfgang Ebert
WES Electronic GmbH
Philipp-Reis-Str. 10
61130 Nidderau
Tel: 06187/21021
Fax: 06187/21023

Hong Kong

Eric Chan
Topbase Engineering Ltd
Room 1003 Tower A
New Trade Plaza
Shatin, N.T.
Hong Kong
Tel: 852-2649-5240
Fax: 852-2649-5329
E-mail: jafo@hk.super.net

China

Xu ZhongDong, CMCC
PO BOX 849-26
ZIP CODE 100830
No 8 Fu Cheng Road
Beijing, P R China
Email: xuhongdong@hotmail.com

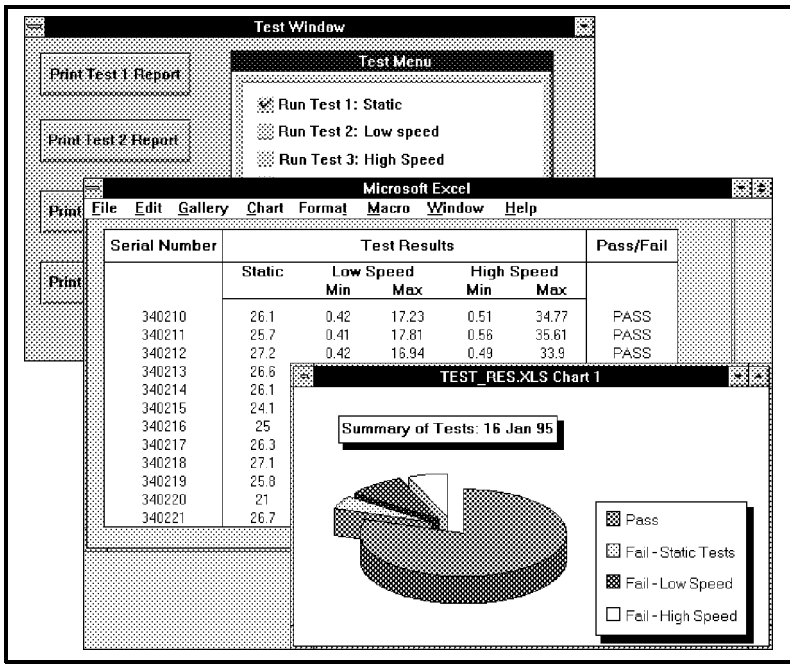
MICROLINK

Section 2

SYSTEMS

Computerised Measurement and Control Systems

Personal computers brought to the engineer and scientist the power to get the data they need, whenever they need it. Because of the standardisation of the PC, and the adoption of MS-DOS and Windows as the standard operating system, there is a wide variety of low cost computers, peripherals and software applications available to be used in any combination. We use this standardisation to specify cost-effective, versatile, computerised measurement and control systems.



MICROLINK systems are based around PC compatible computers, generally running Windows software.

Solutions for Today and Tomorrow

Demands upon technicians, engineers and scientists are changing all the time. The pressure is on to get meaningful results quickly. The emphasis is on information—not just data, and to this end the MICROLINK system is fully supported by the latest powerful software packages, allowing you to generate meaningful results quickly and easily, again and again.

We were one of the UK's first data acquisition hardware manufacturers to recognise the power and flexibility that Windows offers our customers. We invested the time, effort and money to meet the challenge, resulting in some of the most effective software available. Our software is so well designed and developed that other hardware manufacturers also use it. We have taken the time to consider the requirements of our customers, and our software reflects this.

Microlink Systems address an enormous variety of applications. Our particular strength is making them work for you. The key issues are understanding the technology, understanding the requirement and matching the two to give the true meaning of the word "system".

All our products are sold as a solution to a requirement, be it a simple plug-in board or a factory wide system covering the needs of every department.

Many of our customers are familiar with measurement and control systems. Demanding workloads and the pressure to get results, however, means that they look to us to provide a configured solution. The flexibility of our Windows based systems allow a given requirement to be addressed using off-the-shelf software applications, which will be already familiar to many people. We will configure these to meet your requirements, leaving you with the option to expand and adapt the system as your needs change. Of course, you can always telephone us for free after-sales support.

The Benefits of a MICROLINK System

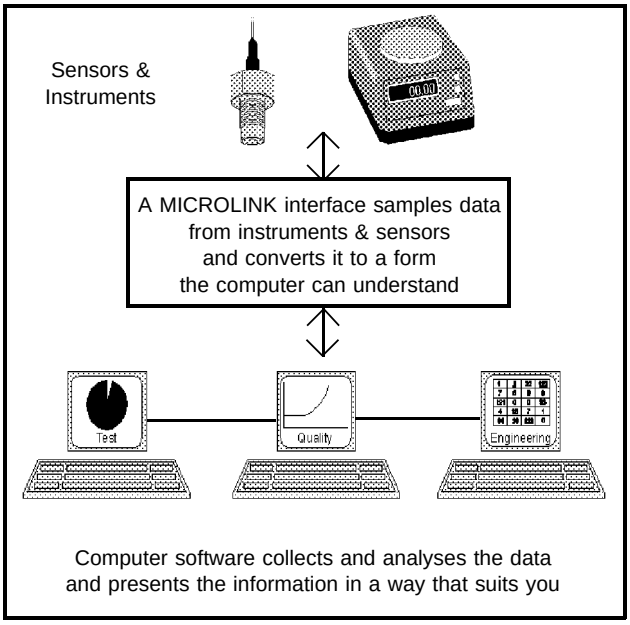
MICROLINK system solutions have brought the following benefits to our customers:

- reduced testing time,
- product testing to comply with industry standard methods,
- traceablity of results,
- reproducible results,
- increased accuracy,
- improved quality control,
- straightforward archive recovery,
- automatic report generation,
- data available at multiple locations.

Integrated Software Strategy

Our strategy has been to link flexible measurement and control hardware to industry standard software packages. These packages can automatically exchange data within the computer, giving the flexibility you require.

The graphical user interface (GUI) offered by Windows makes all applications familiar and easy to use, greatly reducing the training time involved and ensuring immediate productivity.



Computer software collects and analyses the data and presents the information in a way that suits you

Departmental Solutions

One MICROLINK system can be used by many different departments. Information gathered on the shop floor, say, is immediately available to production managers, quality control managers and managing directors—in their separate offices around the building, or even on separate sites. Instead of discovering production quality and totals after the event, you have the information as it happens.

Managers can obtain as much or as little detail as they require, presented in whatever form suits them best: charts, graphs, tables, reports; long or short term trends; maintenance management or total process control. Once you've decided what you want to know, an up-to-date answer will always be available.

Are MICROLINK Systems Suitable for your Application?

MICROLINK systems are used in hundreds of different applications for test, measurement, data logging, waveform capture and control in industry, R & D, education and medicine. Whether you have a low speed logging application or a transient capture requirement involving millions of readings a second—in the end you profit from:

- full compliance with EN 29001 (BS 5750 / ISO 9001),
- formal system acceptance procedures,
- technical support,
- on-site commissioning,
- full documentation,
- software upgrades,
- change control,
- system integration,
- component recommendations.

Our aim is to provide you with the best possible solution to your requirement in the light of these issues—all of which are considered when preparing quotations for a MICROLINK system.

Finally all MICROLINK products are designed, built and tested in the UK at our factory in Manchester. The bottom line is quite simply over 20 years experience in creating systems that work!

Generic Applications

MICROLINK systems are used across the complete spectrum of industrial, educational, R & D and medical applications. The following examples give you a flavour of the hundreds of systems now in place. First general application areas are covered, and then actual systems. Please call us for details of application examples in your specific area.

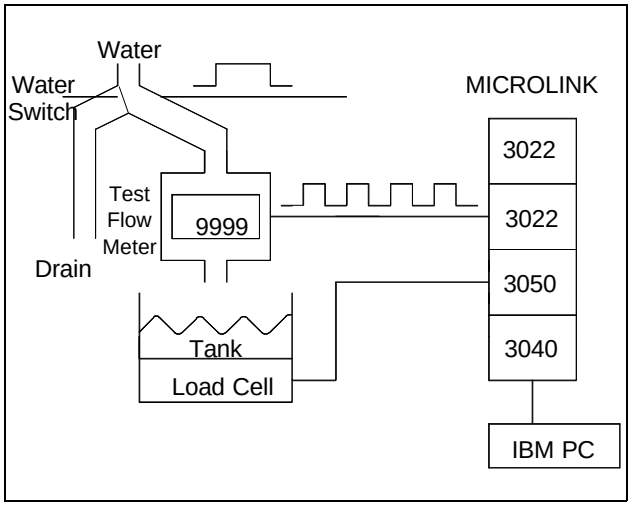
Product Testing

Many MICROLINK systems have been installed for testing manufactured items, and for **quality control** purposes. For example, companies and testing institutions need to check domestic appliances for potential dangers in operation—that cookers and fires do not have unexpected hot spots, and indeed that refrigerators do not create unexpected warm spots. Because of the potentially large number of temperature measurement points required, an expandable modular system is an ideal solution. When used with a slow, but comprehensive, logging package like *SCAN1000*, a 486 computer can be made to automatically produce the data and reports, and to store the test records. Several appliances can be logged from at once, reducing overall testing time.

Sub-assemblies such as printed circuit boards are also tested with MICROLINK systems. Examples include boards for domestic burglar alarms, motor controllers, cheque readers and brake system controllers. These involve measuring the outputs of analogue and digital circuits, in response to a number of input states. These input states can be set up by the computer. Digital inputs and outputs, voltage outputs and DC analogue measurements can all be handled under computer control and the results fed back to a database for quality control records.

Test Rigs

There are obvious benefits of using a PC in test rig instrumentation. The data can be displayed, manipulated, and filed in a database of test results and hard copy test reports can be produced through standard software packages. The computer can also make control decisions—continuously and in real-time.



Flow Meter Calibration

The requirement here is to accurately calibrate the output of a liquid flow meter. The meter produces logic level pulses at a rate proportional to the volume of liquid flowing through the meter.

Rigs that employ **fluid flow**, for valve or filter testing for example, usually operate fairly slowly and can be instrumented with the MICROLINK 600, 1500 or 3000 hardware. Pumps or valves can be controlled through relays or analogue signals. More sophisticated pumps can be controlled over RS232 links.

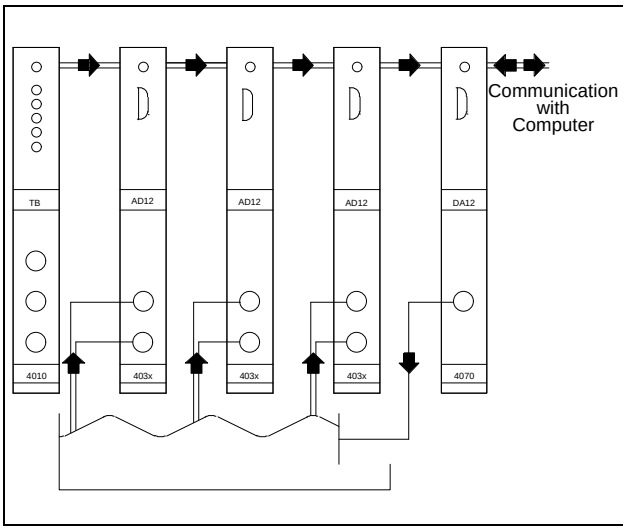
Testing mechanical and electrical items that operate more quickly can involve sampling the signals at rates from hundreds to many thousands of times per second. Signals from transducers monitoring torque, current and shaft speed in a rig to test **induction motors**, for example, can be monitored with a MICROLINK analogue input system in conjunction with chart recorder replacement software like *Windspeed Chart*. Other fast response systems can involve optical components. For example, **post code readers** have been tested using a MICROLINK 4000 Series waveform capture system to examine the shape of pulses recorded from post code dots.

Wind Tunnels and Wave Tanks

MICROLINK systems are used in Wind Tunnels and Wave Tanks, for example to record analogue values from models towed in wave tanks or to investigate wave action on models of harbour designs. Wave action can be controlled by using a digital-to-analogue converter with the required wave shape downloaded into memory. This is particularly useful for generating random waves.

Wind tunnels often have large numbers of analogue outputs for readings to be taken at different positions, and studies are usually on dynamic effects, so systems built around multi-channel analogue inputs, fast analogue-to-digital converters and crystal controlled timing are suitable. They can be used with *Windspeed* software to replace multi-channel FM tape recorders or UV chart recorders.

Inside the wind tunnel the model may be rotated in the air flow by stepper motor controllers, using the computer to download movement programs.



Testing in Wave Tanks

This system is used in model ship testing in wave tanks, and also for checking the designs of harbours. The computer reads a waveform file from disk and sends the data to the MICROLINK 4070. This controls the wave generating motor. When the water stabilises to the imposed waveform, the wave heights at a number of locations in the tank are recorded against time for 1 complete cycle of the driving waveform.

Engine Testing

MICROLINK, with its ability to cope with both fast and slow logging, is an ideal component for building engine test systems. **Pressure signals** are typically captured using waveform capture modules. These use timing pulses from the shaft position as an external clock. The waveform capture can be triggered from a detector marking TDC (top dead centre) allowing accurate relative time comparisons to be made. Other parameters linked to engine revolutions, for example **valve positions** and **needle positions**, can be monitored using appropriate sensors.

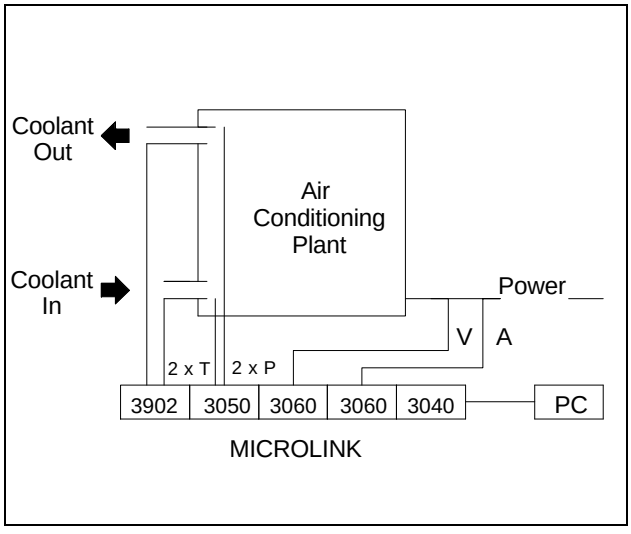
Temperatures in the engine can be monitored at a slower sampling rate and measurements can be made with thermocouples or platinum resistance devices (Pt100). Pulses from engine revolutions can also be counted.

Data Logging

MICROLINK hardware has the flexibility to create a wide variety of data logging systems. In **high energy physics**, it can provide a lower cost option to CAMAC equipment for logging environmental parameters.

MICROLINK has been used as the logging and control interface for a telemetry system to **monitor water flow from a reservoir system**. Water flows are monitored using analogue input modules, analogue valve positions can be similarly monitored, while on-off valve positions are logged through AL8 modules which latch changes. **Rainfall is monitored** using rain gauges that produce pulse outputs counted using counter modules. Control of the valves and flow is achieved through digital to analogue modules with voltage or 4–20 mA outputs.

Other field data logging applications investigate the **effects of heavy lorries on road structure** using up to 130 strain gauges embedded into the road and logging events lasting around 600 milliseconds, so a clock module is used to control precise timing of sampling.



Air Conditioning Plant

This is a system to catch problems in an air conditioning plant. The system logs the power input by monitoring 3-phase voltage and current signals, also the coolant pressure and temperature both in and out of the plant. Logging to disk stops when a problem occurs and the logged values are then plotted against time to show how these variables were changing prior to the failure.

MICROLINK's range of solutions for logging relatively fast changing events using an internal clock allows data logging from thermocouples during the **combustion of sample material**. In this case *Windspeed* software is used to record and replay the data onto hard disk in the computer.

Environmental Logging

Environmental logging is a major area of research. The **energy requirements of an experimental house** have been studied. The house was instrumented with flow meters, thermocouples, a gas flow meter and 6 electricity meters; connected to a MICROLINK and a PC.

At a remote radar dome external conditions can endanger the dome, so environmental monitoring through MICROLINK to a PC can be used to both warn and initiate corrective action.

On the air outputs of power stations the electrostatic precipitation machines need to be logged automatically. Similar problems arise in the air scrubbers for steel plants, where air flows, temperatures and pressures need to be monitored.

Production Logging

Data logging from production machines is another major area where MICROLINK is used. On an extrusion machine, temperatures, pressures and speed are monitored throughout a shift to give a record that can be consulted whenever defects in the extruded product are found. Machine tools can be instrumented with transient capture instruments (such as the MICROLINK 600 or 4000 Series) so that transient problems can be captured and changes in the signature of the tools can be used to implement planned maintenance.

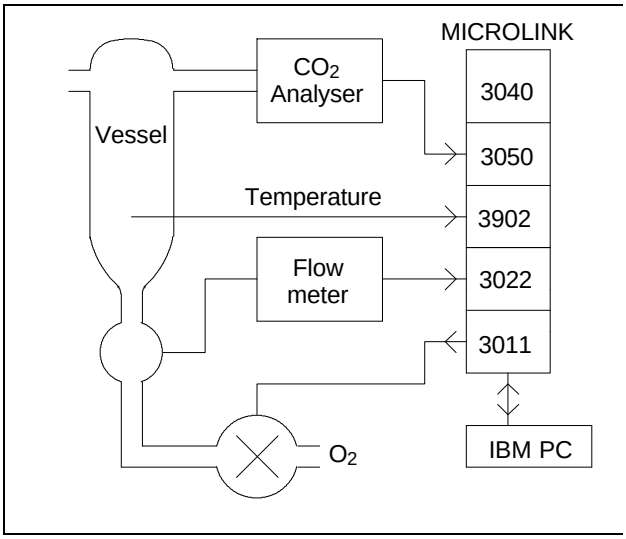
Quality Assurance

Data logging is an essential part of quality assurance and MICROLINK 4000 has been used, for example, to **monitor welding machines** for critical applications like fuel cans. In this case a database of welding waveforms has been created so that in future production welds can be compared with known good and bad examples.

Reactor Vessels

These are special cases of plant logging and control. Normally temperatures are monitored using Pt100 or thermocouple devices; pH is also a commonly monitored parameter. This may be a conditioned transducer giving a normal voltage reading, or a pH electrode. Another example is monitoring the consumption of such things as feedstock via flow meters which give pulses that can be counted. In other cases we have interfaced the RS232 outputs of balances to record weights of chemicals being used. Valves and so forth can be controlled through relays, or through analogue control (voltage or 4–20 mA current), using suitable output devices.

Because the conditions inside continuous reactor vessels change relatively slowly, a data logging software package like *SCAN1000* is usually appropriate. However, there is often a requirement to increase the logging rate when the rate of change of parameters in the vessel increases. A software solution is to use 2 recorders within *SCAN1000*, the second recorder being triggered by an increase in rate of change as monitored by the first timebase. The split backplane and A-D converter buffers in the MICROLINK 3000 Series offer options for dealing with split rate logging in hardware. For runaway conditions the MICROLINK 580, 680 and 4000 have transient capture solutions.



Fermentation Vessel Application
This system is used to control oxygen flow through a continuous fermentation vessel. Accurate control is important to maximise the production of the vessel.

Biotechnology

The MICROLINK 1500 data acquisition and control system offers unique facilities for the biotechnology and fermentation markets. The modular nature of the system allows systems from bench-top prototypes to process systems to be implemented quickly and easily from a range of standard modules.

Microprocessor control in the MICROLINK hardware allows all data to be returned in engineering units, as well as offering PID and alarm monitoring, independent of the PC operation. A single module offers up to 16 inputs, either thermocouple, PT100, voltage or current (or a combination). High impedance inputs allow laboratory electrodes such as pH and dissolved oxygen to be integrated with other signals. Digital inputs and outputs allow valves, pumps and motors to be controlled and monitored. Analogue outputs allow the control of heaters and stirrers from software, or automatically using PID control loops.

Windmill software, which runs under Microsoft Windows, allows multiple processes to be independently logged and charted in real-time on one PC.

SCAN1000, similar in concept to the *Windmill* software, is designed more for the process market where less skilled operators may be involved in running the system. Password protection guards all functions preventing operators from initiating inappropriate action. The software allows the real-time analysis of collected data, using its own spreadsheet program.

Both *SCAN1000* and *Windmill* support networking, so you can observe your process from anywhere on the network.

System configuration and consultancy are a vital part of our product strategy, and our graduate systems consultants are highly experienced in the field of Biotechnology systems requirements.

Interfacing Instruments

Scientists often need to use personal computers to automatically control and collect data from the wide variety of **analytical instruments**.

Spectrometers are a commonly interfaced class of instruments. They usually have analogue voltage outputs which can be digitised and recorded. Mass spectrometers and others that have scanned outputs will usually require a MICROLINK clock module to link the waveform collection to the instrument scan. If the instrument has its own digital control of the scan then often the clock module can be driven externally, giving precise locking of the digitisation to the scanning rate.

For more experimental systems where the scan itself needs to be under the control of the computer, stepper motors are commonly used, for example to control a monochromator. The stepper motor itself can be handled by a MICROLINK SMC module programmed to step the motor while the computer monitors the analogue output. For instruments that have transient signal outputs, such as NMR spectrometers, then the MICROLINK 4000 Series is appropriate.

Many other types of analytical instruments have been interfaced to computers: calorimeters, fluorimeters, bioluminescence meters, gas analysers and so on. These may have analogue outputs, or they may present data on RS232, RS422, RS485 lines, or as BCD digital outputs.

Higher Education

MICROLINK is often selected for use in University Science and Engineering departments, as a tool for undergraduate and postgraduate projects. Its great benefit is its flexibility. It can be used one day as a laboratory demonstration and the next taken into the field for an applied research project. The modular construction makes it a cost effective solution for departments with restricted budgets.

Typically systems are chosen to cover general types of function. For example recording voltage signals, measuring temperatures with thermocouples, controlling heaters and pumps with analogue voltages and switching relays for valves and electronic circuits.

Application Stories

To illustrate applied MICROLINK systems in a little more detail, we have included a few recent applications on the following pages.

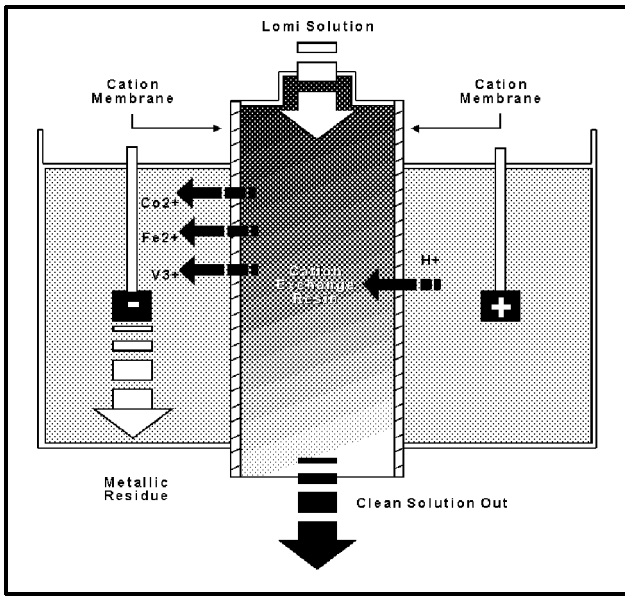
Monitoring Radioactive Metal Removal

A University based research and development company has developed a process to remove radioactive elements from the cooling water of nuclear reactors.

The idea behind the process is essentially that of an electrochemical cell stripping the radioactive metals from an ion-exchange resin, which is the primary metal removing agent. This results in small volumes of radioactive metal, rather than large volumes of contaminated resin. Called the Elomix process it won the prestigious R&D 100 award for technical development.

A wide variety of process parameters needed to be collected from the pilot scale test rig, including temperature, pressure, flow rate and digital input and output data. Flexibility and low cost were of key importance and so they chose the MICROLINK 3000 data acquisition hardware together with the modular *Windmill* software to monitor the test rig.

A considerable amount of control of the rig operation was required and Microsoft *Excel* has performed well as a powerful and flexible control tool. Macros written in *Excel* call data from the *Windmill* applications and control the analogue and digital inputs and outputs in the MICROLINK system.



A MICROLINK system monitors data from the ion exchange process.

The system will continue to offer the scale and robustness required when the process grows into a fully operational unit.

Testing Air Conditioners

Air conditioners and refrigeration units in the restaurant cars of new trains need monitoring, to ensure correct temperatures are maintained. To improve accuracy and efficiency a MICROLINK 3000 with *SCAN1000* software was chosen.

In one test thermocouples are positioned around the cars and alarms are set to warn if the temperatures exceed the specified limits. The engineer leaves the MICROLINK logging for 8 hours. He then checks what happened during the day, scrolling back through the history. All the readings from all parts of the car are simultaneous and accurate, and a permanent record of events can be automatically generated.

Another test involves heating the car 2 ^{o}C above normal temperature and cooling it to 2 ^{o}C below normal temperature. The test takes five hours and the MICROLINK checks that the temperatures remain constant.

Calibrating a Computer Model of a Superconducting Magnet

A company manufacturing a superconducting magnet used computer aided design to produce a complex cylindrical pressure vessel for holding liquid helium coolant and the superconducting magnet itself. (The magnet is large enough to perform magnetic resonance imaging of the whole human body.)

The stresses in the vessel during pressurisation had been calculated by a computer—but the company wanted to check these calculations against real-world data. To do this they chose a MICROLINK system.

Using 40 quarter bridge high precision strain gauges, a MICROLINK 3000 took measurements from a prototype of the vessel. The system comprises an integrating 16-bit converter, bridge input modules and *Windmill* software to log and chart the data. This enables the engineers to record the strains in the actual vessel during the stages of evacuation and cooling. Temperature and pressure measurements are also made to follow the stages of preparing the superconducting magnet.

The empirical logged data is passed to the design computer for comparison with the calculated strains. On the basis of comparative results the computer model is then modified so that the two sets of data correlate. The customer needed to have confidence in the computer method so that in the future the project can all be done with computer simulation thus avoiding the need for extensive experimental validation. It was important therefore that the measuring system used could provide the accuracy and resolution in the measurement of strain to make these readings suitable as calibration data.

Other applications of the MICROLINK system include assessing stresses in suspension components from which the magnet is hung; measuring stresses of the system during cool down; and ensuring that vessels comply with safety standards, for example if they were to receive a shock load during transportation.

During on-site commissioning, experienced engineers from Biodata were able to advise on all aspects of operation, from transducer wiring to computer configuration.

Computerised Testing of Refrigerated Display Cabinets

Refrigerated display cabinets for supermarkets have to meet stringent EC regulations, particularly in the light of lysteria and salmonella scares. A UK manufacturer has turned to a MICROLINK data acquisition system to guarantee the accuracy of their design and performance testing procedures.

The refrigeration cabinets are monitored in four environmentally controlled test rooms by a MICROLINK 3000. Each cabinet contains an array of up to 200 thermistors and PT100 sensors, which continually measure temperatures. The four MICROLINKs read the temperatures and send this and other test data to a central PC over an RS485 link.

The computer is running *SCAN1000* software. This logs the temperatures in ^{o}C, records coolant flow and lets the operator see at a glance the current state of the system. A further program allows a temperature distribution image to be plotted. Both the data and the image are then imported into their existing *Ami-Pro* word processor for automatic report generation. All the software runs in the Microsoft Windows environment, so several programs can be running at the same time.

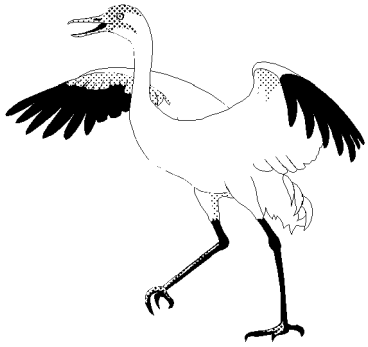
The power and flexibility of MICROLINK and *SCAN1000* has led to an immediate increase in the throughput from the design phase to production, reducing considerably the time needed to bring new products to the market place. This has been done while significantly improving the reliability of test data, ensuring full compliance with the EC regulations in this public and media sensitive market.

Water Pollution Monitoring

The River Tame's normal flow contains 55% industrial waste and sewage effluent. During dry weather this can rise to 90%. To clean up the River Tame, the National Rivers Authority has installed a purification system.

Water is fed from the river into a lake where silt settles to the bottom, forming a layer that may be more than 1 metre deep. The silt is pumped by a small pontoon-style dredger into the consolidation plant, where it is treated to separate the pollutants from the water.

Previously it was difficult for the NRA to monitor the performance of the plant. Now the amount of silt being pumped, the quantities of solids extracted and the volume of water treated are automatically measured by a distributed MICROLINK 1500 system. This includes a PC running *SCAN1000* software which mimics the process, constantly updating data such as flow rates and pollutant concentrations. The system keeps totals of the quantities being processed allowing the efficiency of the plant to be monitored.



The NRA has improved the water quality so much that a coarse fishery has been established downstream with chub, dace, barbel and roach. The Lea Marston lakes also provide important habitats for wintering water birds with up to 1500 tufted duck, 800 pochard and 1200 coot being counted at once.

The NRA's 1500 system currently comprises 16 analogue inputs. There are plans to extend it, however, incorporating measurements at either end of the lake. The MICROLINK 1500 can have over 1000 input/output channels distributed over 1 km.

Improving the Efficiency of Tablet Production

Several pharmaceutical product manufacturers are now using MICROLINK to improve the efficiency of tablet production. In the research laboratory tests are conducted to measure the forces involved in compressing powder into tablet form for consumption. Pharmacists are interested in determining the minimum force required to produce a coherent tablet of maximum hardness with good manufacturing features.

For each tablet the powder mixture is fed into a compression machine, punched into tablet form and ejected. By identifying the lowest forces required for compression consistent with tablet manufacturing criteria, the machine can compress the tablet without undue ejection stress.

Typically, analogue voltage signals in the compression machine are derived from the upper and lower punch mechanisms via load cells and, together with the signal from a displacement transducer, are fed to a charge amplifier and A-D converter to an oscillograph for data display and measurement. With the MICROLINK system it is now possible to capture the data at high speed for display and analysis on a PC.

At the end of a test, data is downloaded to the controlling computer. All procedure definition, triggering and data capture are accomplished using *Windspeed WaveCap* software. Waveforms are then displayed on the screen for inspection and interrogation.

Logging from Several RS232 Devices

There are many applications where there is a need to log data from several instruments which output their data on RS232 ports. These instruments might be balances, analytical instruments, recorders and so on. The main problem where there are several instruments is to ensure that data is not lost even if all the instruments decide to send their data at the same time.

A MICROLINK 3000 with one RS232 module for each external instrument provides both an input and output buffer for each instrument. The MICROLINK 3000 talks to the computer over GPIB which provides the speed to keep up with the multiple serial communications between the instruments and the MICROLINK. Matters can be further simplified by adding an ALT (Alarm Input Tree) module for each group of eight RS232 modules. Software in the RS232 module itself provides the capability to signal the receipt of the first character of the message, which sets a flag in the ALT module. The computer software polls the ALT module waiting for a flag to be set. When it is, the software can determine which RS232 module is receiving data and take in the whole message, either by looking for an end of message character, or by trying to read the next character from the module, stopping when a suitable timeout period is exceeded.

If another instrument starts to send data while the computer reads the message from the first, the ALT flag is set and the incoming characters stored in the RS232 input buffer. This is 768 characters, enough for nearly 10 lines of text.

We have implemented these procedures in a *Visual Basic* program running under Windows. The completed message from each instrument is passed over DDE to an *Excel* spreadsheet as soon as it is received. In the spreadsheet the numeric data in the message is extracted and stored in a table for analysis and reporting.

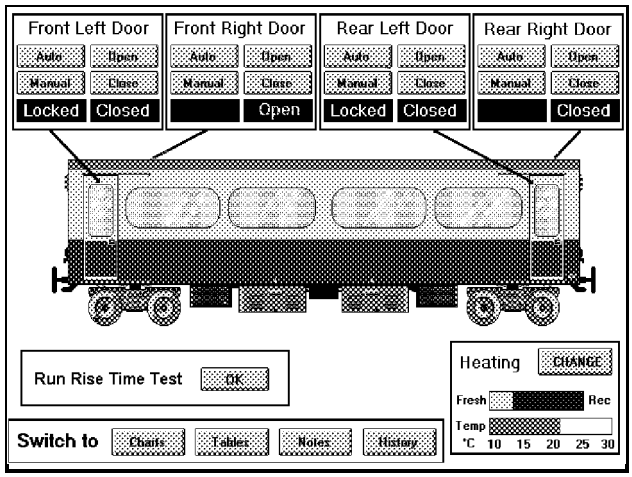
Brake Testing on Trains

The accuracy and efficiency of safety checks on new trains has been improved with MICROLINK 3000 and Windows software. The system is so versatile that it can be set to run a wide range of tests including brake checking.

In one brake test the MICROLINK system measures the time taken for the maximum braking pressure to be reached. Previously measurements were made with a stop watch. Now the engineer uses a MICROLINK connected to a computer running *Windspeed Streamer* (data capture) and *Famos* (data analysis) software. He can display a graph of, say, brake pipe pressure, air supply pressure and brake cylinder pressure against time; so the curve of the brake cylinders getting to full pressure can be seen. The rise time of the brake cylinder curve is automatically compared with pre-set specifications, and if there is a mis-match then the brakes have failed the test.

At the end of the tests the graphs are printed out and provide a permanent record of the procedures and results. These are kept for 10 years in fire proof cabinets.

The test engineer commented: "This takes a considerable time out of testing, it also takes the human error element out of it…the quality control's better and the graphs we print out are self-explanatory."



Compressor Endurance Testing

Air compressors, used in the braking systems of commercial vehicles, must be tested continuously at full speed for 3000 hours. Pressures and temperatures are monitored during variations in such things as the speed of crankshaft or conditions of load and off-load. If any rig fails during test then a completely new 3000 hour test must be initiated (equivalent to 18 test weeks or nearly 5 months). Previously testing had to be confined to the working day, since technical staff were required to monitor the test rigs by inspection and to shut down the system when the test became critical.

Now, with the installation of the MICROLINK and *SCAN1000* computerised monitoring and control system, continuous 24 hour testing is possible. This has halved the testing phase and prevented significant cost penalties associated with test rig failures.

Under the new computerised system, transducer signals are passed via MICROLINK hardware to a PC running the *SCAN1000* software. User defined procedures allow the alarm limits on peak temperatures and pressures of delivered air, water coolant and lubricating oil to be set for each channel. Real-time trends and alarm conditions are instantly available for inspection on the computer screen.

If the system goes into an alarm state the software signals a MICROLINK module to switch off the mains voltage supply to the relevant test rig prior to failure and a status report is generated.

For the client, the key to the purchase decision was the multitasking capability of the software in a Windows environment. The principal advantage here over competing solutions considered is that several tasks can run simultaneously using the same computer and software, allowing multiple test rigs to be independently monitored from individual MICROLINKs.

The continuous 24 hour testing halves previous test schedules, doubling output, reducing labour costs and avoiding rig replacement costs. The net benefit is the increased confidence that new product development schedules will not be jeopardised and that the customer prototype approval phase has been halved.

Monitoring Explosions in Gas Pipes

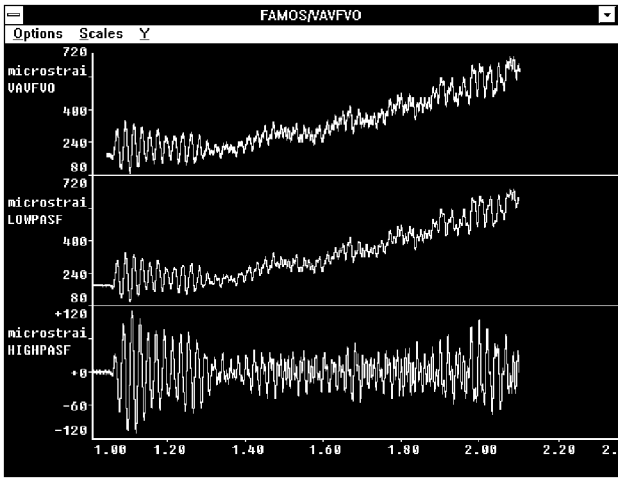
A University Department of Fuel and Energy is using a MICROLINK 4000 to monitor the effects of explosions in steel pipes. By using two MICROLINK 4000 frames they can monitor 32 analogue inputs, comprising 3 pressure channels from piezo-electric transducers, and 29 temperatures from low thermal mass thermocouples. A TB-linker module synchronises the sampling of pulses in both frames.

Windspeed WaveCap software running under Windows is used to set up the data collection and store the data in *Famos* compatible files. The *Famos* waveform analysis software is used to analyse the data and measure the progress of the heat pulse from the explosion as it travels down the pipe.

Recording Dynamic Stress

A British company is using *Windspeed Streamer* software to collect data from commercial vehicle fan blades. The signals recorded are from strain gauges bonded to the fan blades and connected via slip-rings. Additionally 2 channels of rotational speed are recorded from the engine and the fan itself, and 3 channels of temperature using thermocouple measurements. These are all input to a MICROLINK 3000 system fitted with a 3052 bridge and voltage input module, a 3041 buffered A-D module and a 3070 high speed clock and multiplexer. To collect data from a moving vehicle, the MICROLINK is fitted with a power supply which allows it to run from a 12 or 24 V DC supply.

The system logs different signals at different speeds. It records the strain gauge data at 5000 samples per second for each gauge, and the remaining signals (which vary more slowly) at 1000 samples per second for each channel. The *Streamer* software records this data for between 20 and 240 seconds, onto the hard disk of a portable computer. This time interval allows the operator to collect data which covers the full range of fan performance requirements.



Pre- and post-filtered data from Famos

Once the data has been recorded, *Windspeed ReView* is used to provide a quick check that good quality data has been recorded. Off-line analysis is done with *Famos*. Scripts have been developed which automate the signal analysis, by filtering the recorded waveforms and then identifying points of maximum stress. Readings taken at these points provide the basis of a quality assurance report for the commercial vehicle manufacturer.

Temperature Monitoring from Domestic Appliances

We've been involved in the development of a more reliable method of ensuring gas appliances comply with British safety standards. The safety tests require that temperatures on the outer surfaces of gas appliances conform to specified limits.

The equipment consists of a test bed with facilities to connect up to 736 thermocouples to a MICROLINK system. The MICROLINK takes readings at fixed time intervals over a few hours and converts the readings to temperatures.

The user can edit the default parameters in software—choosing, for example, temperature range, sampling interval, test duration and whether temperature is displayed as absolute or as the difference between ambient and absolute. Alarm states are clearly shown and a complete record of the test can be printed out. The results are analysed to determine whether the appliance passes or fails the safety test and may be compared to specimen data from historical files.

Electrochemical Research

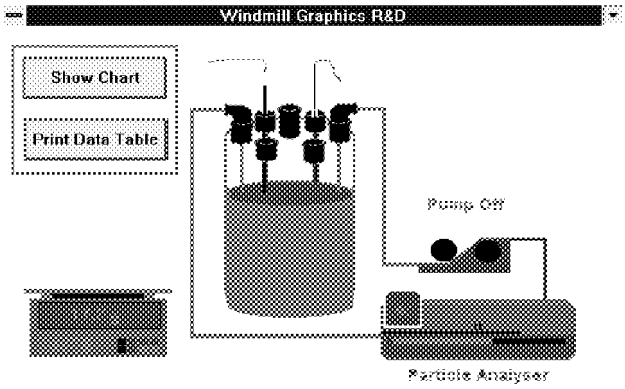
Windmill software offers unrivalled flexibility when configuring bespoke data acquisition systems. This flexibility is particularly useful in a laboratory environment, where many instruments and devices frequently need integrating into a single system. The cost of developing custom software to perform the task can frequently be prohibitive, as well as resulting in a rigid solution inappropriate to a Research and Development environment.

The MICROLINK system was recently selected as the ideal solution for an electrochemistry application at a University. The application, sponsored by one of the worlds leading battery manufacturers, involves the control and collection of data from a wide variety of sources including:

- pH electrodes,
- dissolved oxygen electrodes,
- thermocouples,
- sensitive load cells (bridge signal),
- digital input and output for valve control,
- RS232 data from laboratory balance,
- DDE data from proprietary particle size analysis software.

Few systems can offer an off-the-shelf capability to collect this array of information; *Windmill*, however, can easily cope. The *Windmill Graphics* application can show a summary of all key parameters, as well as allowing Chart/Trend displays to be generated at a click of the mouse. A *Logger* application stores data from all of the devices into a single file, which can be analysed with a spreadsheet.

We configured the software tools to meet a defined requirement, but they retain the flexibility to accommodate customer refinements as the application develops—with the confidence of unlimited technical support.



The electrochemical cell is fitted with a number of sensors, which are sampled at regular intervals by the MICROLINK. Instruments from other manufacturers are an integral part of the system and are handled by off-the-shelf Windmill *software.*

Industrial Testing

The flexibility of the MICROLINK system, coupled with the skills and experience of our systems integrators, are frequently called upon for use in industrial test applications. A leading manufacturer of industrial seals critical to many industrial processes (Oil, Food, Power, Biotechnology, etc.), chose MICROLINK as the solution to their quality assurance and design validation requirements.

Designed to operate under the most arduous conditions of temperature, pressure, flow and caustic or volatile environments, frequently for many years, their products are designed, constructed and tested under stringent industry standards.

The MICROLINK system, incorporating *Windmill* measurement software, has dramatically improved the testing of the seals (and other products). All data is given in engineering units, allowing the straightforward adjustment for calibration essential to this and many other test processes. The Windows based software allows industry standard applications such as *Excel* and *Access* to be used, securing the technical future of the system.

Encompassing a wide range of control, interlock, test sequencing, operator interaction and feedback—as well as data analysis and report generation—the system was designed, with close consultation with the user, to meet the standards laid down by the industry. Three or more test rigs to be monitored at any one time, simplifying use and reducing hardware costs.

Integrated into existing procedures, all test parameters are now precisely controlled by computer. The result is a system that has removed the need to allocate skilled personnel to repetitive test monitoring, leaving them free for more productive duties. Mimic displays providing dynamic test feedback have the added benefit of impressing visiting customers.

Networked Strain Gauges

The MICROLINK collects data from an enormous variety of transducers and sensors. The 3000 Series, for example, has a module designed to collect data from strain gauge signals. This unique module (the 3052) allows bridge signals from strain gauges to be configured as full, half or quarter bridge arrangements.

The sophisticated design of the module and the processing power of the MICROLINK 3000, allow each bridge to be independently balanced before data collection. Analogue-to-digital converters offering up to 16-bit resolution mean that the smallest strains can be measured precisely. Information such as gauge factor and Poisson's number are specified independently for each strain gauge. All data is stored in Microstrain.

The capability of the MICROLINK 3000 system to collect strain data continuously, at rates of up to 50 000 samples per second, was critical when a UK based excavator company was reviewing the market. The MICROLINK 3000 system also has the advantage of Ethernet communications, which means that the system can be sited up to 185 metres from the controlling PC and still run at the required speed.

To provide a complete solution the entire system was engineered into a vibration-proof housing. *Streamer* data capture software, in combination with the *Famos* analysis software, has led to a big increase in the speed with which test results are generated, critical if the demands upon the test engineers are to be met. Test records are archived, maintaining test data for years to come.

Materials Testing

A company producing china clay needs to analyse the chemical composition of the clay, and determine the properties of the material. As part of this process they use a dilatometer, which is a device familiar to those involved in materials engineering. In this case the device heats a sample of the core and measures the amount by which it expands when heated to a given temperature.

This is a simple idea, but one that requires careful thought when put into practise. There are commercial dilatometer systems available, which function very well; they lack flexibility, however, when it comes to the computerised acquisition of test data, as well as being expensive.

The company had been thinking for several years about adding computer control to their existing dilatometer, and the MICROLINK system offered them distinct technical advantages. It also had the benefit of costing a third the amount of a proprietary system. The system implementation was not straightforward; high accuracy measurement of temperature and displacement are required under difficult circumstances.

The ability of the MICROLINK system to condition a displacement transducer with a range of 2 mm, while also allowing full control of system calibration, was critical the success of the system. A high resolution integrating analogue-to-digital converter means that all readings are resolved extremely accurately, while remaining highly immune to environmental noise. This was of particular importance since the heating control for the dilatometer was provided by a phase Angle Trigger unit, notorious for radiating RF noise.

As well as the data acquisition element, control was vital to the application. The combination of Windows based software (*Windmill*) and the powerful Interface Management Language (running in the MICROLINK) could handle a wide variety of digital inputs and outputs as well as three-term PID loops, for the control of the dilatometer heating. There's future potential for the use of the database *Microsoft Access* for the storage and retrieval of results, making the MICROLINK solution ideal for a sophisticated laboratory.

Print Monitoring on Packaging Lines

In Sweden a packaging producer is using a modified 3020 system to calibrate the position of printing on the packaging.

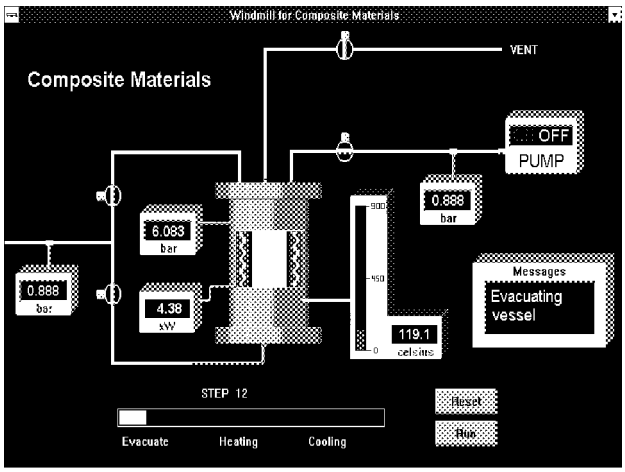
The printer rotates, printing two cartons per revolution. Two counters from a MICROLINK 3020 module register the position of the printhead during printing. They do this by counting pulses emitted by the printer as it rotates. One counter counts for the first half of the revolution, returning its count when the printhead starts printing. When this counter has been read it activates the second, which counts the pulses emitted during the second half of the revolution—and so the process continues.

A *Visual Basic* program continuously monitors the counters and calculates the print position for each box. These readings are transferred into two columns of a spreadsheet, so that print position can be optimised and made constant.

Composite Materials Manufacturing

A manufacturing rig for composite materials is now completely computer controlled. *Windmill* software and MICROLINK 3000 hardware ensure reliable process control and real-time data display. *Windmill Test-Seq* runs a complex sequence file which handles gas replacement, through evacuation and repressurisation; temperature ramping, holding accurate temperature values, and controlled cooling, while at the same time monitoring rig conditions for safe operation.

Windmill Graphics displays the current rig conditions throughout the operation. *Windmill Logger* records all rig parameters during the run with the logged files providing quality assurance information.



Windmill Graphics *shows up to the minute manufacturing information.*

Monitoring Quality for Die-Cast Production

Driven by the ever increasing demands from the motor manufacturers for improved quality from their suppliers, there is a need for improved process monitoring among the manufacturers of die-cast components.

Casting small components with lead or magnesium-zinc alloys involves a short machine cycle time, with the cooling time lasting perhaps a few hundred milliseconds depending on component size.

Temperature measurements of the cast itself is made using thermocouples machined into the inside faces of the dies. Strain gauges mounted at strategic points around the die are used to monitor the actual forces exerted, and to complement these the pressures used during the die closure are also monitored.

Injection Monitoring

Displacement transducers are used to accurately monitor the injection of material into the die. By recording digital events along with all the analogue signals, the performance of the machine's control system can be logged.

Recording data from around 10 input signals at more than 1 kHz on each input generates a lot of data very quickly, so a statistical sampling approach is sensible. Data from several successive machine cycles is collected using *Windspeed Streamer* software. If the data section of interest is relatively short compared to the machine cycle time, data collection can be triggered from the initial movement of the injection piston, or from the control signal to start the injection.

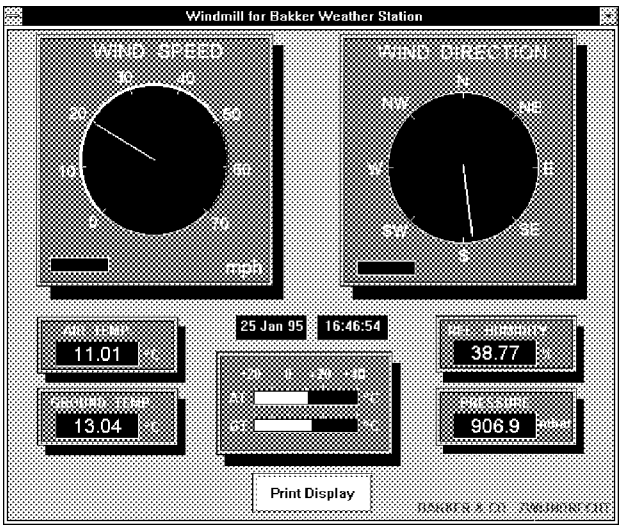
Signal Analysis

Famos, a signal analysis package, is used to produce report standard graphs and to extract data values of interest from the recorded data. For example rates of cooling, peak strain values or averaged values over several cycles. By passing these values to a statistical process control package, drift in the parameters of the production process can be quickly spotted and rectified.

Weather Display Station

A fire station in the Netherlands is using a MICROLINK system to keep them constantly updated of current weather conditions. Large screens show wind speed and direction, air and ground temperature, pressure and humidity—as illustrated. When a fire alarm is raised, the fire fighters immediately get a printout of the screen which they take with them in the fire appliance. This provides useful information for tackling the fire; showing which way the flames are likely to blow for example.

The system incorporates a MICROLINK 551 multi-function card and *Windmill Graphics* software. The 551 collects the required analogue data through its voltage inputs. One of its counters records the total rainfall for each 24 hour period. *Graphics* displays all the data simply and clearly. The data is made available on Network DDE so that several screens can display the same information.



Windmill Graphics *displays information clearly and unambiguously—important in emergency situations.*

Monitoring Temperature Fluctuations in Flames

As part of an ongoing project to maximise energy efficiency, the Energy Research Laboratory of an Asian Power Company is measuring temperature fluctuations inside naked flames, the gas velocities and pressures and flame colour variations. To help them achieve this we've modified our 4030 Channel Input module to accept readings from a small R-type thermocouple.

The Energy Research Lab uses a MICROLINK 4000 system receiving data from a special thermocouple amplifier with a gain of 1000. A cold junction reference can be connected to one of the other channels if necessary.

The system is completed by three Windows based programs *WaveCap*, *ReView* and *Famos*. *WaveCap* is used to capture data; *ReView* to select sections of the captured waveforms containing temperature variations and *Famos* to analyse the data and produce reports.

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