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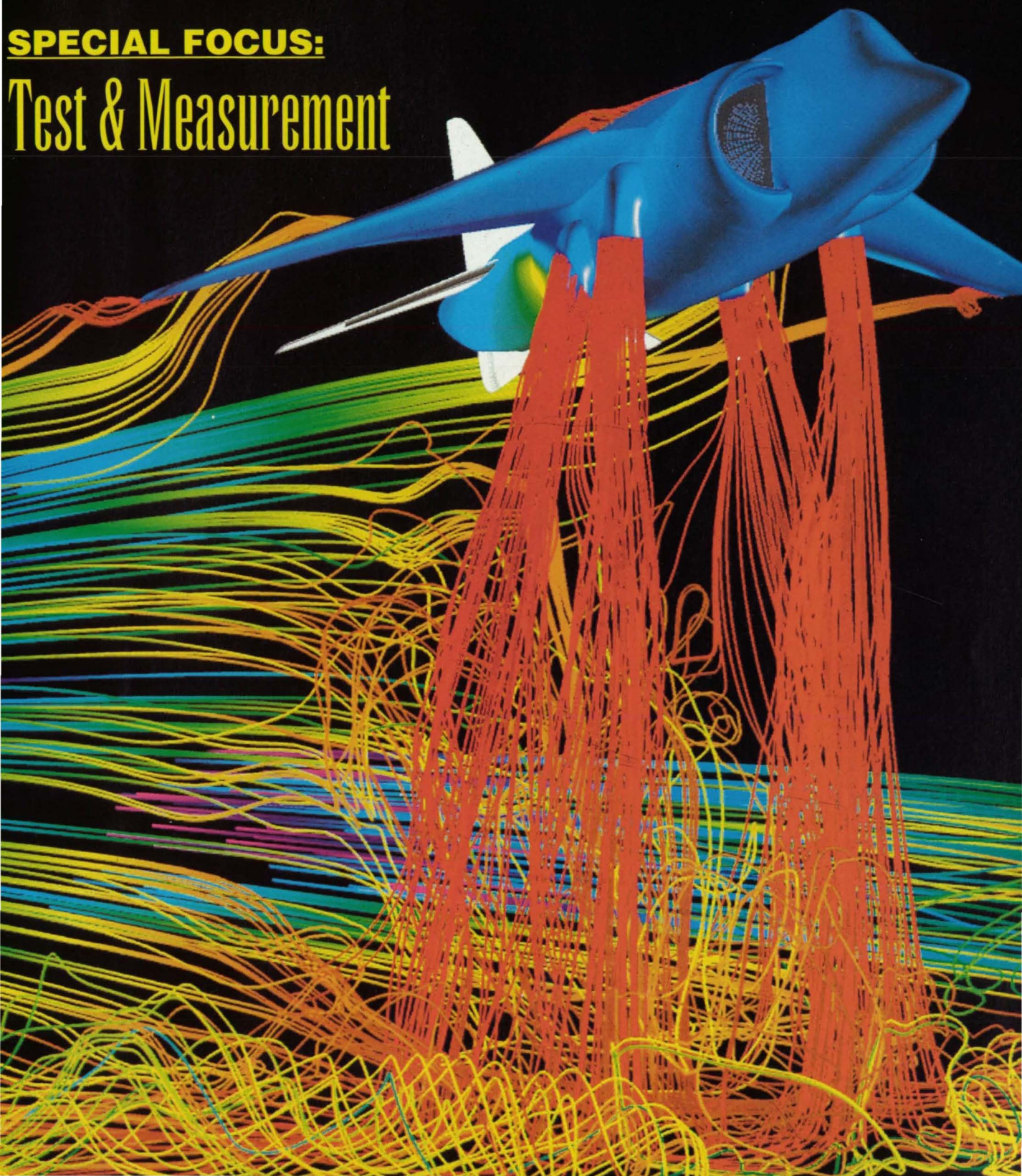

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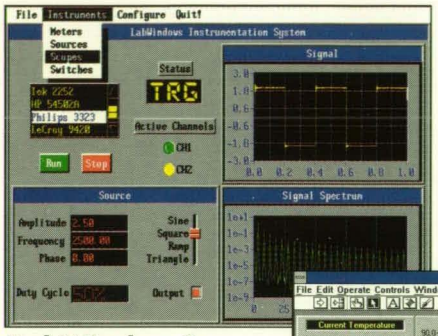

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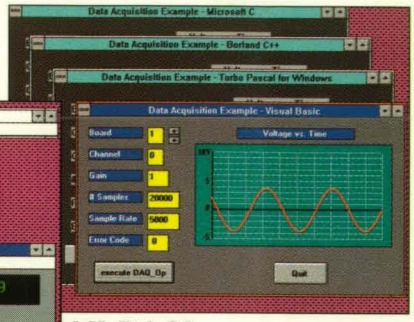

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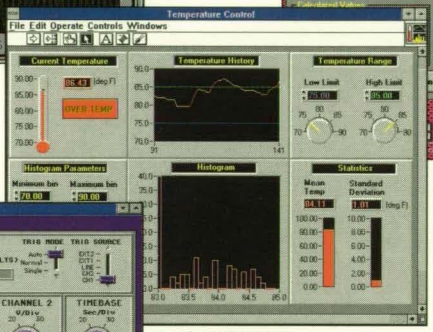

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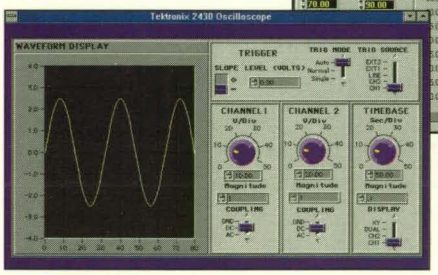
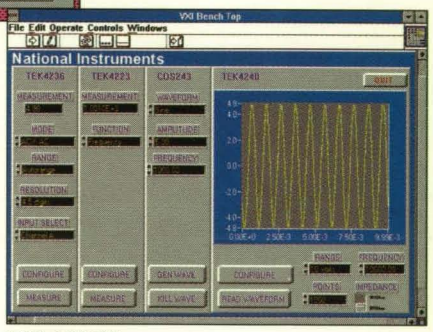


LabWindows/CVI



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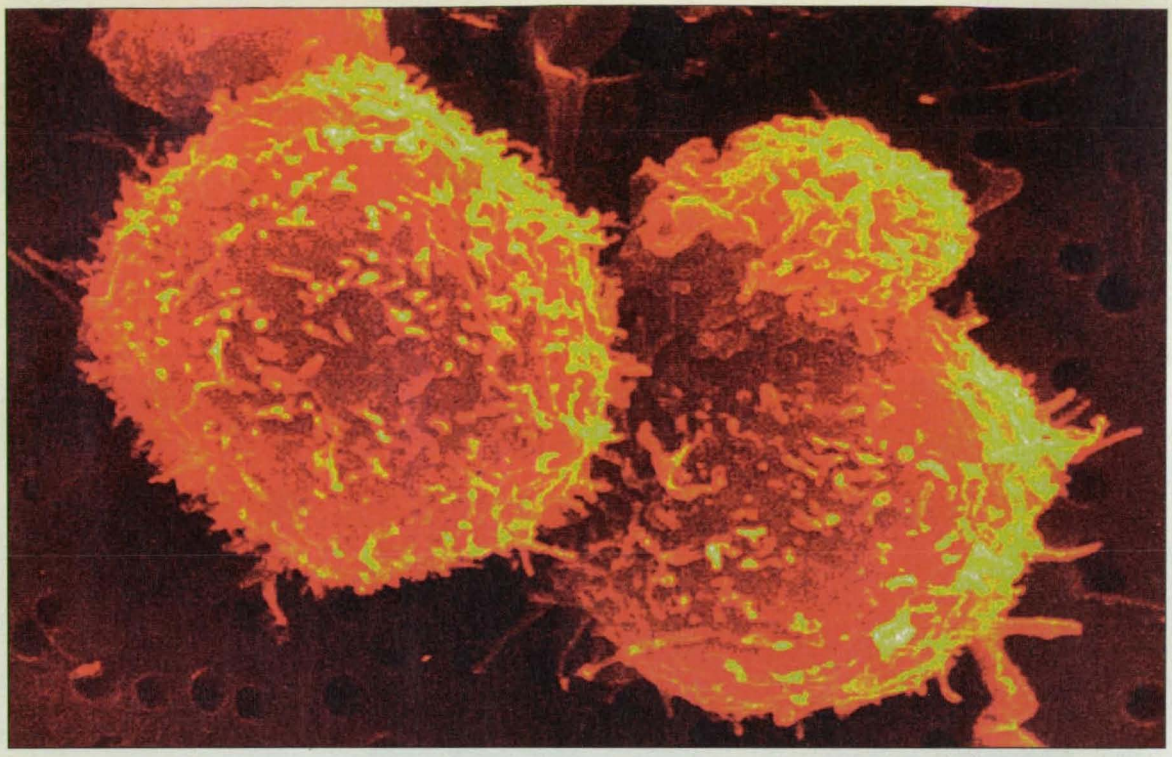

Electron microscope image of dust particles on a VLSI chip, rendered and enhanced with MATLAB. Data courtesy of MIT Microsystems Technology Labs.

See beyond the limits of ordinary image processing–with MATLAB®

The Image Processing Toolbox is the latest addition to the MATLAB Technical Computing Environment. In the world's most powerful system for numeric matrix computation, an image is simply a matrix. That's why you can take image processing further with MATLAB.

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The MATLAB Image Processing Toolbox gives you an unrivaled ability to visualize, manipulate, and analyze images and two-dimensional signals. It's easy to explore, apply, and create the innovative image processing methods that let you keep up with—and advance—the leading edge.

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The Image Processing Toolbox is different. It gives you all the tools you need within the interactive MATLAB environment. You can treat image data visually or numerically with equal ease. You never have to transfer or scale data or juggle multiple packages, so you get accurate results immediately.

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Image processing technology has become essential to scientific and engineering work. And now, within the MATLAB environment, you can easily integrate image processing with powerful computational techniques such as statistics, optimization, and neural networks.

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Low Profile 15-W DC/DC Converters

The new AHV 2800 Series of 15W DC/DC Converters features high power densities and ruggedized low profile packages only 0.405 inches high. They are available in single, dual and triple output models and are fully compliant with MIL-STD-704 (A-E), MIL-STD-883 and MIL-H-38534. All AHV 2800 DC/DC converters withstand the 80-Volt surge requirement of MIL-STD-704A and operate over the full military temperature range of -55°C to +125°C with no derating of power output. These devices all have nominal 28 VDC inputs and operate over a 16 VDC–40 VDC range.
The AHV 2800 Series feedback design is impervious to temperature, radiation, ageing or variations in manufacture. The unique circuitry provides high control loop gain, high phase margin, and an extremely wide bandwith.

For More Information Write In No. 516

Low Profile 12-W DC/DC Converters

The AHF 2800 Series of DC/DC Converters feature single or dual outputs over the full military temperature range. No derating in output power is required, making them suitable for use in rugged military applications. The low profile, small outline package is ideally suited to the tight board space requirements of many industrial and aerospace applications. Designed for nominal 28 VDC inputs, this family of converters meets all the requirements of MIL-STD-704D.

The proprietary magnetic feedback circuit provides for an extremely wide bandwidth control loop with a high phase margin. These converters are manufactured in a facility fully qualified to MIL-STD-1772. Two temperature ranges and screening grades are available to satisfy a wide range of requirements.

For More Information Write In No. 517

Triple Output 30-W DC/DC Converter

The ATR 2815T triple output DC/DC Converter provides 30 watts of output power over the full military temperature range with no derating. This device is pin compatible with ATO Series converters but offers twice the maximum output power in a lower profile package. A custom CMOS ASIC pulse width modulator and a patented magnetic feedback circuit reduce circuit complexity and enhance reliability. This converter provides 500-Volt input to output isolation and operates in a highly efficient single forward mode.

The advanced design features an extremely wide bandwidth control loop with high gain and phase margin. The control loop is compensated to provide optimum performance over the full military temperature range and over the 16- to 40-Volt input voltage range.

For More Information Write In No. 518

High-Power 40-W DC/DC Converter

The AFW 2805S hybrid DC/DC Converter features high power density and full military temperature range operation without output power derating. The advanced feedback design provides fast loop response for superior line and load transient characteristics and offers greater reliability than devices incorporating optical feedback circuits. The basic circuit topology is a push-pull configuration operating at a nominal switching frequency of 500KHz.

This device is designed to meet MIL-STD-704A input requirements offering full performance over a 16- to 50-Volt input range and operating at 80 Volts for 100 milliseconds or 100 Volts for up to 5 milliseconds. The AFW 2805S is packaged in a rugged parallel seam welded steel case using ceramic feedthrough pins to assure true long term hermeticity.

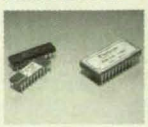
Write In No. 519

Space Application DC/DC Converters

Advanced Analog's high-performance DC/DC Converters are now being shipped for mission-critical space applications. To meet space requirements, proven radiation-hardened components are used in all necessary areas, such as the custom integrated circuits and power MOSFETs. And, because the magnetic pulse feedback circuits do not use opto-couplers or generate spurious RF energy, they are unaffected by time, temperature or radiation. These converters are all implemented using thick film hybrid technology and are fully certified and qualified to MIL-STD-883.

Write In No. 520

Military Video DACs



Advanced Analog introduces two new video D-to-A converters: the VDAC 1800 Series and the RGB DAC 3400SW. Both DACs are screened to MIL-STD-883.

The VDAC 1800 Series consists of 8-bit monolithic devices that provide latches for input data, and produce clean video output signals, driving 75- or 37.5-ohm loads at an update rate of up to 80 MHz. All models can also produce composite sync and blanking signals, plus reference black, reference white, and 10% bright.

The RGB DAC 3400SW combines three video-speed DACs, internal temperature-compensated reference, and all the control lines necessary for a complete RGB graphics color monitor interface. All this in a single, monolithic, low-power, CMOS/TTL-compatible IC.

Write In No. 521

Advanced Analog Takes Rad-Hard DC/DC Power To The Outer Limits.

Introducing a true 100K rad-hard DC/DC Converter for aerospace programs.

For mission-critical satellite and space probe systems, now there's a high-density power source specifically designed to stand up to hostile radiation environments: The ART2800 Series from Advanced Analog.

This new design uses thick-film hybrid technology and proven rad-hard components. It delivers up to 30 watts of single, dual or triple output power, over the full military temperature range. And it's guaranteed to withstand a total dose of 100K rad (Si)–with a 2:1 design margin–and to tolerate extreme dose-rate upset, latchup and neutron fluence.

The ART2800 Series meets the derating requirements of MIL-STD-975 and MIL-STD-1547, is designed to comply with MIL-H-38534, and is manufactured to space application requirements in a facility fully qualified to MIL-STD-1772.

Advanced Analog is the recognized technology leader in high-reliability microcircuits for military and aerospace applications. The first DC/DC Converter supplier approved by DESC on Standard Military Drawings, our DC/DC Converters and other devices have tested the outer limits from the Patriot missile to the MLRS to the Space Shuttle to the C-17 aircraft.

To get your rad-hard project off the ground quickly, call (408) 988-4930 today. Or fax us at (408) 988-2702.

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RSR 512 ROTARY DATA RECORDER

You may not need all 64 channels today.

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Of course, the RSR 512 doesn't just give you flexibility. It gives you speed. And lots of it. With a range of, you guessed it, 512:1.

Plus, it has a wide dynamic range of 70 dB. A frequency response of dc to 80 kHz. Even a high-speed digital output option.

So call and find out more about Metrum's extremely fast and very flexible RSR 512.

It's the rotary data recorder that'll get you where you want to go.

No matter how fast you want to get there.

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HOW TO GO FROM 1 TO 64 CHANNELS IN SECONDS.

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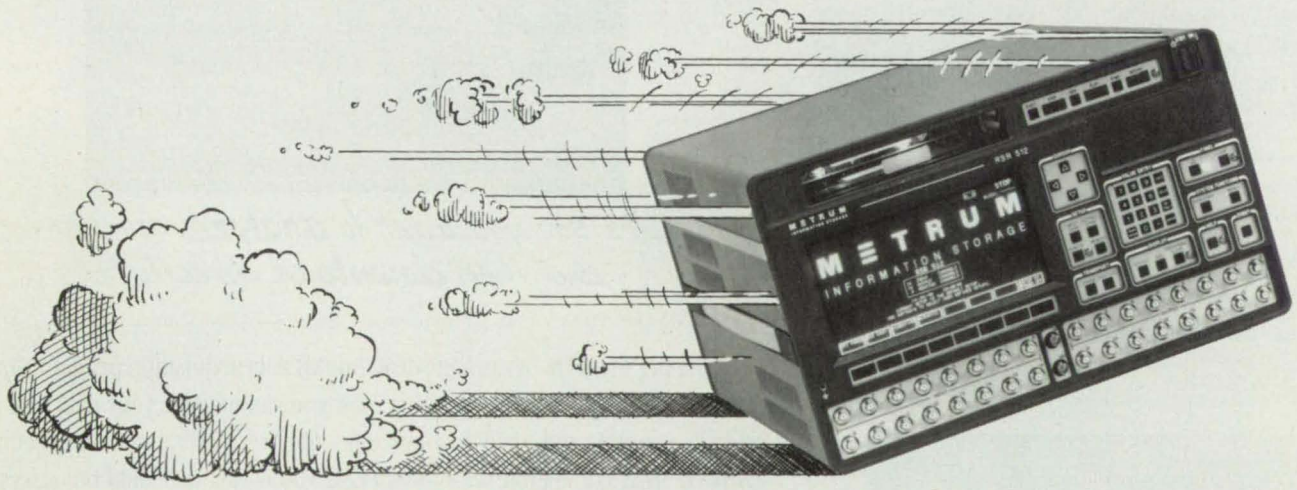


For literature write in 575
For a product demo write in 574

FOR MORE INFORMATION ON THE HOT METRUM RSR 512 RECORDER, CALL 1-800-METRUM-2.

QuikVu™ II DAS software adds a new dimension to TEAC's 100 Series DAT data recorders

MORE CHOICES, GREATER CAPABILITY, LESS COST. Now you can choose single or double speed, 2 to 16 channels with a maximum frequency response from DC to 20 kHz, at prices *as low as* $1175 per DAT channel*. The S/N ratio of the TEAC 100 Series recorder is greater than 78 dB, coupled with a maximum 1° phase differential between channels. Record times run up to 3 hours.

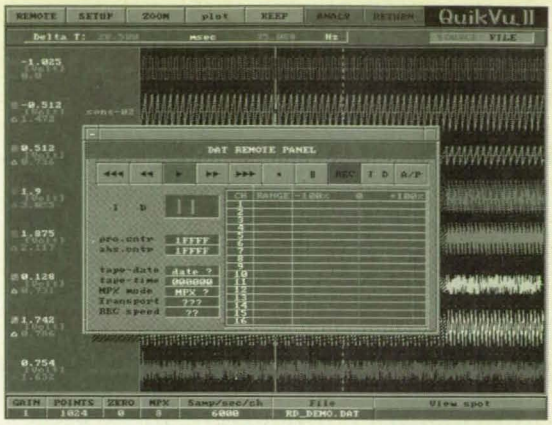
There's a full range of dedicated annotation features including time code, ID, tape counter, recorder conditions and voice memo. Control options including GPIB, direct digital control with digital download, and wired remote control unit.

If that's not enough, there's tape compatibility across most of the 100 Series recorder family; 3.072 Mbits/sec. biphase or 2.0 Mbits/sec. NRZL serial digital recording; and a built-in microphone and speaker. Plus optional Mil-Std-1553 record/playback or PCM interfaces.

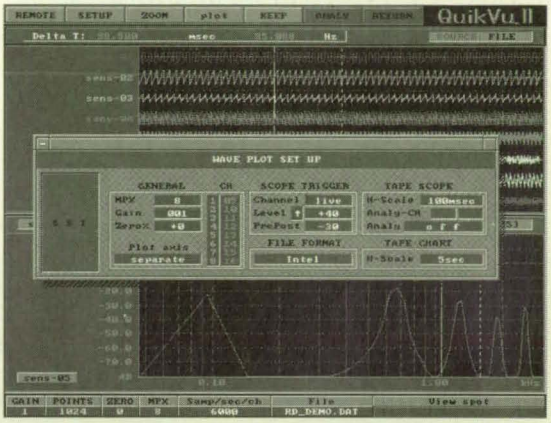
Suitable for either lab or field use, the 100 Series DAT data recorder weighs as little as 13 pounds; is rugged; and can operate on AC or DC power with optional battery backup.

Take a quick look at TEAC's *QuikVu™ II* and the 100 Series recorders and you'll know why we're still #1 in small format data recorders.

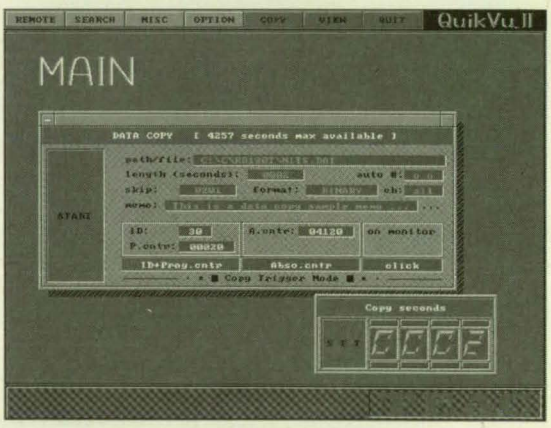
*RD-145T
Specifications, features and prices subject to change without notice.
QuikVu is a trademark of TEAC.



Let's say you want to **preview** *data before you record.*



Let's say you want to **manipulate** *triggers, start times and reference levels.*



Let's say you want to **analyze** *quickly and then* **download** *directly.*

Introducing *QuikVu™ II*, a single disk, 300KB data acquisition program you can learn to operate in less than 1 hour. Now you can manage your data with user-friendly prompts and English commands. Before, during and after recording. *QuikVu™ II* is compatible with most TEAC 100 Series DAT data recorders.

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FEATURES

TECHNICAL SECTION

(continued on page 8)

To Backup 50 GB, Two Recording Heads Are Better Than One.

Single:
Drives can operate independently.

Cascade:
Data automatically writes to the second tape when the first tape is full.

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Writes the same data to both tapes simultaneously.

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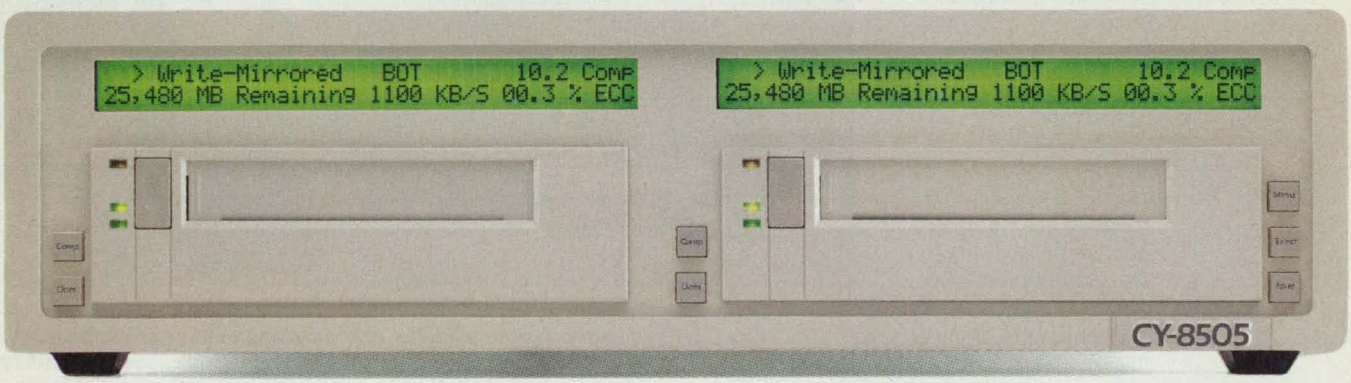
Writes data to two tapes at once, in alternate blocks, doubling capacity and speed.



Introducing the dual drive CY-8505 with the Advanced SCSI Processor.

Working independently, each drive can store up to 25 GB, at speeds of up to 90 MB per minute. So it's perfect for unattended backup.

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Each tape drive offers the most advanced in data recording technology. Our *hardware data compression* option is the fastest available. And it's switch-selectable, so you can read and write uncompressed data for compatibility with other sites. Add *accelerated file access* to locate a single file in an average of 85 seconds. And we even offer a *data encryption* option that lets you control access to sensitive data.

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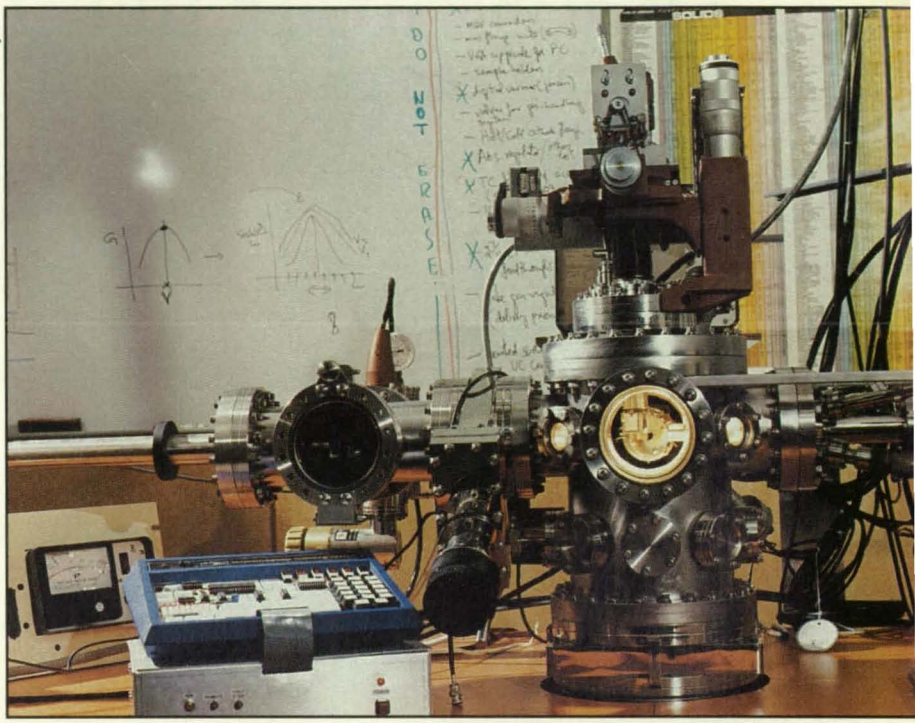

A computerized positioning system developed at Lewis Research Center enables robotic manipulation of samples in a custom-built secondary-ion mass spectrometry system. A microprocessor-based control subsystem supports manual local or computerized remote control for accurate, four-degree-of-freedom positioning. Turn to page 44. Photo courtesy Lewis Research Center

On the cover:

This computational fluid dynamics simulation depicting airflow pressures around a vertical takeoff and landing aircraft was created at NASA's Numerical Aerodynamic Simulation (NAS) facility. Located at Ames Research Center, the NAS supercomputer system provides six billion FLOPS of computational power and links approximately 1400 industry, university, and government users in a high-speed network. For more on NASA's use of computers for design, test, and analysis, see the tech briefs on pages 60, 64, and 75. Photo courtesy Ames Research Center

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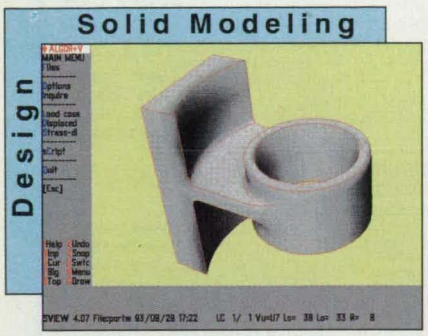

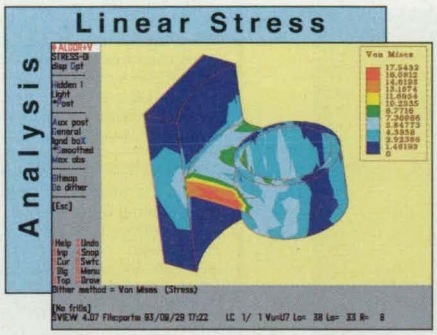

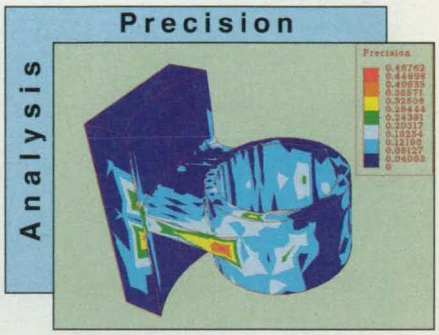

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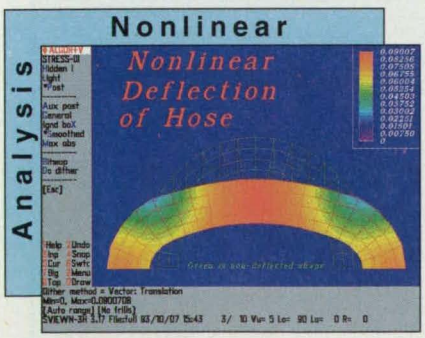

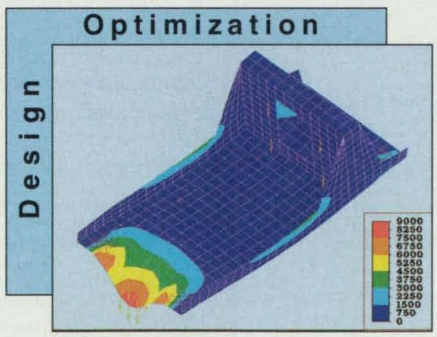

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NASA Tech Briefs

Official Publication of the National Aeronautics and Space Administration

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NASA Tech Briefs

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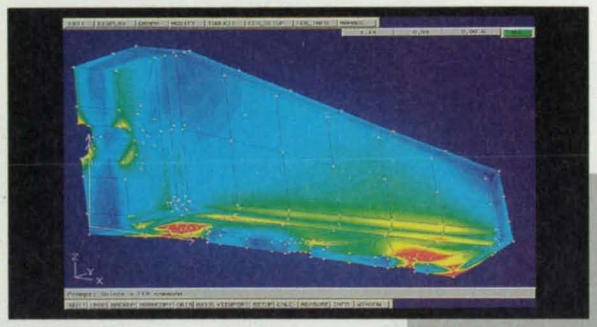

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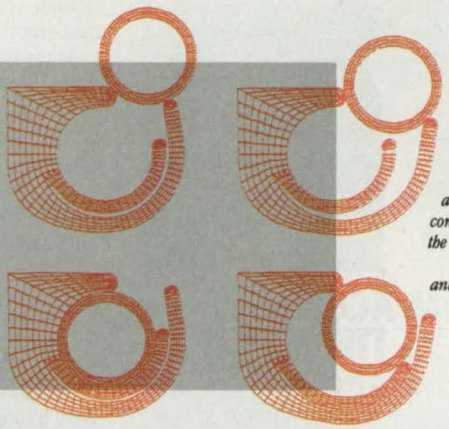
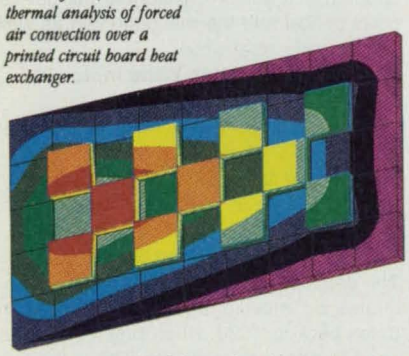


This nonlinear analysis of a snap connector illustrates the slide-line contact and hyperelastic analysis capabilities in V68.

Results of MSC/NASTRAN V68 thermal analysis of forced air convection over a printed circuit board heat exchanger.



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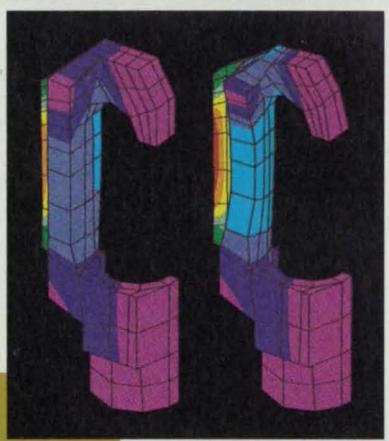

Initial design of a cable clamp and the optimized design determined by V68's new shape optimization capability. The optimized design on the right weighs 9% less than the original design, without exceeding the stress limits.

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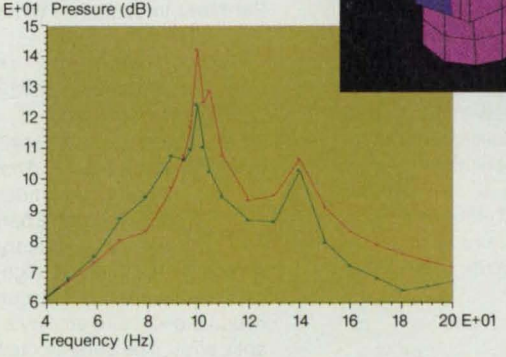
Sound pressure levels as determined by the acoustic optimization capability in V68. The red line shows the initial model and the blue line shows the optimized model, which results in a peak pressure reduction of 30dB.



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For More Information Write In No. 526

NASA PATENTS

NASA has a portfolio of 3000 patents and pending applications available now for license by businesses and individuals, including these recently patented inventions:

Conically Scanned Holographic Lidar Telescope

(U.S. Patent No. 5,255,065)

Inventor: **Geary Schwemmer**, Goddard Space Flight Center

Recent developments in holographic optical elements (HOEs) permit the design of lightweight telescopes particularly useful for lidar remote sensing applications. Constructed to diffract only a narrow wavelength band, a holographic telescope can reduce or eliminate the need for optical blocking and interference filters. Mr. Schwemmer has imbedded an HOE in an optical system receiver, enabling the telescope to collect light over its entire aperture and focus it to a small spot that will not move when the device is rotated.

For More Information Write In No. 700

Method of Reducing Drag in Aerodynamic Systems

(U.S. Patent No. 5,236,155)

Inventor: **Frank J. Hrach**, Lewis Research Center

Mr. Hrach has joined laminar flow control with boundary-layer thickening to reduce drag in aerodynamic systems. A conventional thruster moves an aircraft to create airflow over its surface and into ram air turbines mounted there. The turbines drive compressors that suck in lower-boundary-layer air through inlets in the aircraft shell, producing laminar flow control. The air is expanded in a nozzle to generate thrust and then released over the aircraft's surface to create boundary-layer thickening.

For More Information Write In No. 701

Phenylethynyl-Terminated Poly(Arylene Ethers)

(U.S. Patent No. 5,268,444)

Inventors: **Brian J. Jensen**, **Robert G. Bryant**, and **Paul M. Hergenrother**, Langley Center

A new series of phenylethynyl-terminated poly(arylene ethers) can be thermally cured to resins useful as adhesives, composite matrices, and moldings. Ethynyl and substituted ethynyl groups have been incorporated into conventional poly(arylene ethers) to provide resistance to jet fuel, hydraulic fluid, paint strippers, and other organic solvents as well as temperature cycling.

For More Information Write In No. 702

Method for Controlling Protein Crystallization

(U.S. Patent No. 5,256,241)

Inventor: **David A. Noever**, Marshall Space Flight Center

Protein crystallization is necessary in determining the three-dimensional atomic structure of proteins. Mr. Noever's technique uses active drop shaping to control evaporation and protein supersaturation for successful crystallizations. A drop of protein solution is placed between and in contact with a pair of plates. Adjusting the spacing between the plates provides an easy, inexpensive means of controlling crystallization conditions.

For More Information Write In No. 703

Wide-Angle Imaging System With Fiber-Optic Components Providing Angle-Dependent Virtual Material Stops

(U.S. Patent No. 5,266,795)

Inventor: **Arthur H. Vaughan**, Jet Propulsion Laboratory

Strip images having a 180-degree field of view, as provided by Mr. Vaughan's optical system, are needed in such applications as terrain mapping, oceanographic studies, planetary exploration, and cloud surveillance. The system employs an arc-shaped spherical mirror section for receiving light from a wide-angle strip of a target image and for reflecting the light into optical fibers for transmission to a detector. Inexpensively constructed and easily maintained, the device limits optical and thermal distortion as well as chromatic aberration.

For More Information Write In No. 704

Guanidine Based Vehicle/Binders For Use With Oxides, Metals and Ceramics

(U.S. Patent No. 5,256,452)

Inventors: **Warren H. Philipp**, **Lisa C. Veitch**, and **Martha Jaskowiak**, Lewis Research Center

The deposition of thin metallic films on substrates by metallo-organic decomposition dates back to 1830, when bright gold was used to decorate porcelain. The technique offers advantages over chemical vapor deposition for coating ceramic fibers with thick coatings of oxides and unreactive metals. The Lewis team uses guanadine salts of organic fatty acids as vehicles for coating substrates and as binders to hold the coating to the substrate prior to sintering or firing. The soaps can be burned off completely, leaving no undesirable residue.

For More Information Write In No. 705

Electronic Neural Network For Solving "Traveling Salesman" and Similar Global Optimization Problems

(U.S. Patent No. 5,255,349)

Inventors: **Anilkumar P. Thakoor**, **Tuan A. Duong**, **Alexander W. Moopenn**, and **Silvio P. Eberhardt**, Jet Propulsion Laboratory

An easily implemented, high-speed neural-network-based processor comprises a novel hybrid architecture employing a binary synaptic array. The array incorporates the fixed rules of "traveling salesman" problems, such as the number of cities to be visited on the salesman's tour. Two interconnected feedback networks each solve part of the problem independently and simultaneously, yet can exchange information dynamically.

For More Information Write In No. 706

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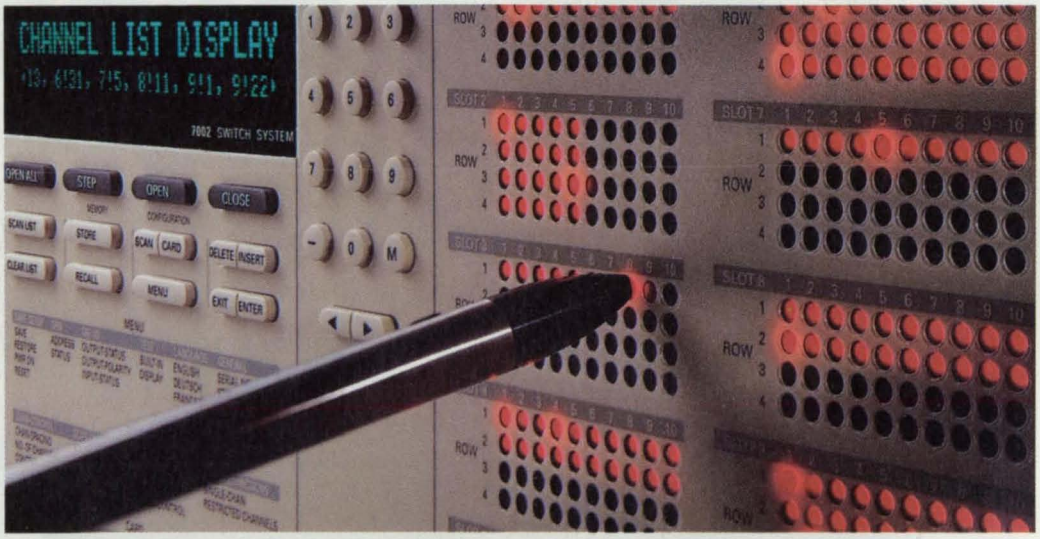

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TECHNOLOGY 2003

Post-Show Report

With over 7500 registrants from across the US and a host of new exhibitors and symposia, the Technology 2003 national technology transfer conference held December 7-9 in the Anaheim, CA convention center was by all measures the biggest and best of the series thus far.

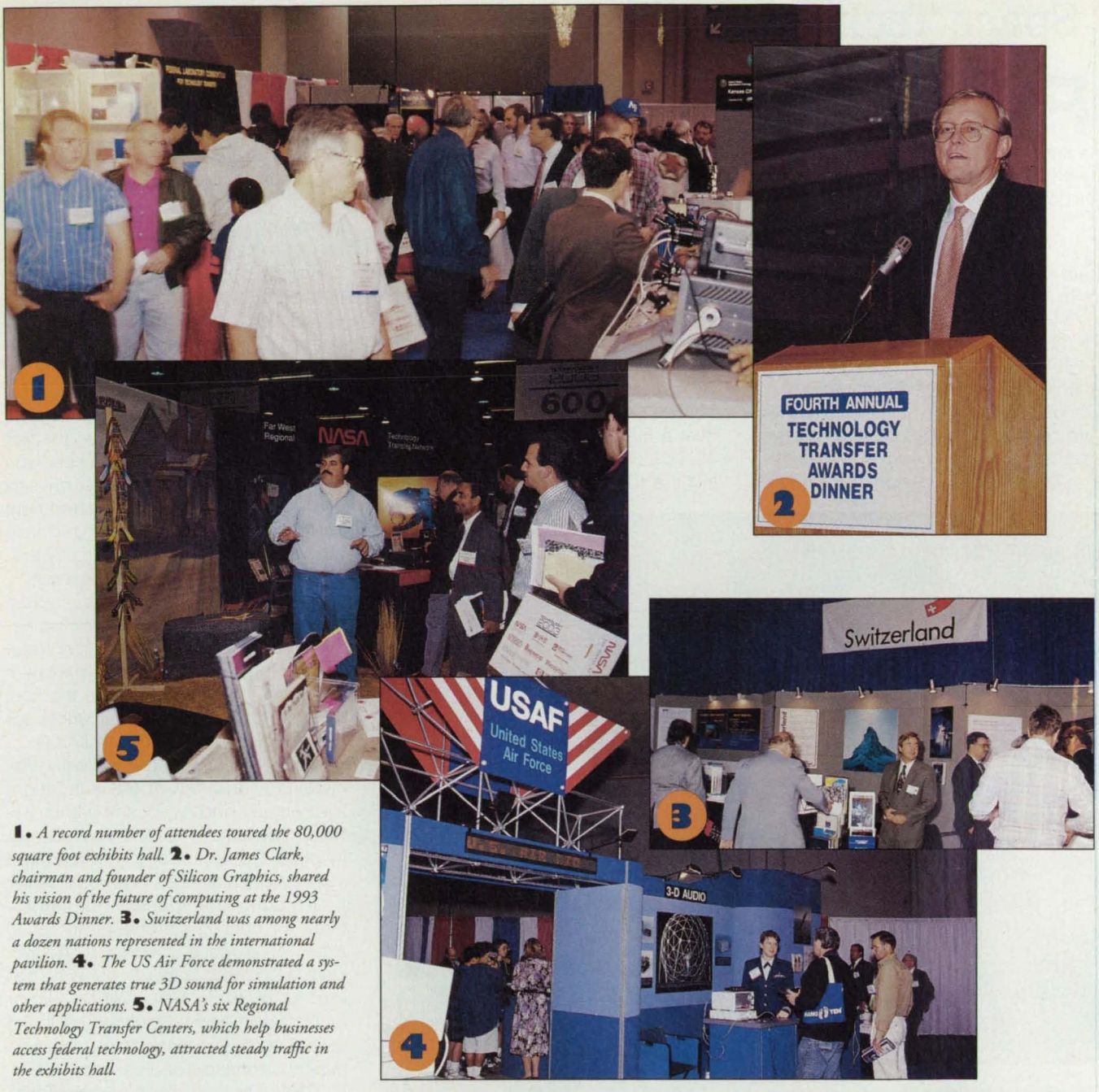
Thousands of engineers, executives, and scientists from a wide range of industries packed the Technology 2003 exhibits hall to see the best new US and international technologies available for commercialization.

The conference theme was defense conversion/technology reinvestment and the atmosphere was all business. Nearly 1000 attendees packed the opening plenary session focused on the government's Technology Reinvestment Project (see excerpts of speeches beginning on page 18). Robert Paster, president of Rocketdyne, set the tone with his opening remarks: "Proactive technology transfer, both as policy and as a reality, is in full swing." Greg Reck, NASA associate administrator, added: "The Clinton Administration has asserted its dedication to a new partnership between government, industry, and academia, to tearing down walls that have inhibited meaningful cooperation in the past...We can reclaim our leadership in the world marketplace by embracing a new paradigm, a new way of doing business. It's precisely this type of interchange (at Technology 2003) that will redefine the role of commercial technology in society."

In the exhibits hall and meeting rooms, attendees took these words to heart, crowding around government and company displays to explore cooperative R&D, licensing, and other commercial agreements with tech transfer agents. (We'll report on some successful tech transfers in upcoming issues.) As one federal lab exhibitor put it, "(the attendees) were ready to roll up their sleeves and get down to business, and so were we."

Over 230 exhibitors showed their latest inventions, services, and products, including 80 federal laboratories representing a dozen government agencies. First-time exhibitors included the National Security Agency, the Federal Aviation Administration, Indiana University, and a pavilion of international tech transfer

Post-Show Report



1. *A record number of attendees toured the 80,000 square foot exhibits hall.* **2.** *Dr. James Clark, chairman and founder of Silicon Graphics, shared his vision of the future of computing at the 1993 Awards Dinner.* **3.** *Switzerland was among nearly a dozen nations represented in the international pavilion.* **4.** *The US Air Force demonstrated a system that generates true 3D sound for simulation and other applications.* **5.** *NASA's six Regional Technology Transfer Centers, which help businesses access federal technology, attracted steady traffic in the exhibits hall.*

organizations from Russia, Israel, Italy, Austria, Switzerland, the United Kingdom, Canada, and other countries.

One highlight was an appearance in the NASA pavilion by actress Madlyn Rhue, who has multiple sclerosis. She described how NASA-spawned technology has helped to improve her quality of life (see story on page 16). Another was the awards dinner address by Dr. James Clark, chairman and founder of Silicon Graphics Corp., who demonstrated, using large-screen graphics, how 3D visual computing, virtual reality, and other advanced computing techniques are changing the way we present and use information.

Technology 2003 was the centerpiece of National Technology Transfer Week in Anaheim, which also featured meetings by the National Technology Transfer Society, the Federal Laboratory Consortium, and the American Society for Photogrammetry & Remote Sensing. In addition, there were special workshops sponsored by the General Services Administration (on how to market to the federal government), the California Economic Development Department (covering employment opportunities for local engineers), and Auburn University and NASA (on new precision casting technologies).

This year, Technology 2004 will be held a month earlier than usual — Nov. 8-10 in the Washington, DC convention center. Several exciting new features are planned, including an adjunct conference on federal photonics technology called LaserTech '94 (details to follow in upcoming issues). If you would like information on attending Technology 2004 and the other events of Technology Transfer Week, please write in number 451 on the reader information card.

Space Technology Brings Relief To MS Patients

For actress Madlyn Rhue, NASA technology has meant a dramatic improvement in her quality of life: a return to reading, drawing, and enjoying long lunches with friends—all nearly impossible several months ago.

Rhue suffers from multiple sclerosis (MS), a neurological disease afflicting approximately 300,000 people in the US. During an MS attack, inflammation occurs in regions of the central nervous system, accompanied by a loss of myelin—a fatty covering that insulates nerve cell fibers. Myelin facilitates the smooth, high-speed transmission of electrochemical messages between the brain and spinal cord and the rest of the body.

When myelin is damaged, information transmission may be slowed or blocked completely, leading to diminished or lost function. As the myelin disappears, it is replaced by scar tissue, hence the name "multiple sclerosis." At present, there is no cure or prevention for the disease.

At a Technology 2003 press conference, actress and multiple sclerosis patient Madlyn Rhue [above] related how a NASA-derived cool suit [at right] has alleviated her symptoms of blurred vision and fatigue.

Yet, as Rhue demonstrated at a Technology 2003 press conference, wearing a NASA-derived cool suit can offer symptomatic relief to many MS patients. Manufactured by Life Support Systems Inc. (LSSI), Mountain View, CA, the Mark VII Personal Cooling System (PCS) utilizes patented FlexiTherm™ panels integrated into a lightweight cap-vest garment. A water-based fluid cooled to about 10 °C is circulated through tubes in the cap and vest to comfortably lower body core temperature from 1/2 to 1 °C in approximately 30 to 40 minutes. This can alleviate such MS symptoms as fatigue, loss of balance, slurred speech, impaired vision, and loss of coordination. It also can enhance endurance during exercise and physical therapy.

"The application of cooling to treat MS has been in the medical literature for over a hundred years—studies in the 1970s indicated that it works by improving the transmission of signals along damaged nerves," said LSSI president John O'Neill. "However, the LSSI cool suit is the first practical system for cooling. Most of the earlier research was done by immersing patients in a sling into swimming pools with little floating icebergs. Can you imagine a physician telling a patient to do that three or four times a day?"

LSSI is conducting research on a new design that will reduce core temperature faster in less time. The company also works closely with the Multiple Sclerosis Association of America (MSAA) to give patients access to the cool suits.

"We have invested over a million dollars in our cooling program, supporting 60 clinics throughout the country," said MSAA president John Hodson, Sr. "I've lived with this problem most of my life and I haven't seen many things come down the pike that really help. Cooling's got my adrenaline flowing and I'm pleased to be a forerunner in the medical field making it available."

The association recently sponsored a clinical study of cooling technology conducted by Dr. Wallace Toutellotte, chief of neurology at the UCLA Medical Center. Two-thirds of the subjects experienced reduced fatigue and improved ability to ambulate for up to 3 hours after cooling. Several subjects also reported long-term improvements in quality of life over the study weeks.

Rhue, who has been using the cool suit since last October, recalled the first time she tried it on: "Within an hour, you could notice visible changes in my skin and eyes. My blurry vision cleared right up," she said. "With regular use my brain got so clear, I got busy on so many projects and, best of all, I didn't wear out."

MSAA hopes to expand its program to reach 100,000 patients in clinics nationwide. The association is testing ways, such as providing subsidies, to make it affordable for patients to have the cool suits at home. Current retail prices for the units range from $2000 to $3000.

MSAA and NASA are currently discussing a program of MS education, awareness, and advocacy within the NASA network, where the cool suit got its start. The technology originated in a 1968 program at Ames Research Center that produced a spacesuit undergarment for cooling astronauts. In 1971, Ames awarded a contract to Acurex Corp. to develop a liquid-cooled helmet liner for pilots. In 1980, William Elkins, formerly with Acurex, founded LSSI and gained control of the related patents to pursue commercial applications.

Elected last year to the Space Technology Hall of Fame by the US Space Foundation, the cool suit can be used to treat other conditions such as hypohidrotic ectodermal dysplasia, a rare skin disease characterized by the absence of sweat glands. The wide range of military, industrial, and recreational applications include armored vehicles, petrochemical refining, hazardous materials, boiler room operation, glass manufacturing, steel mills, firefighting, agricultural crop dusting, and race car cockpits. ❑

For more information on the cool suit, contact Life Support Systems Inc. 1400 N. Shoreline Blvd., Suite A-4, Mountain View, CA 94043. Tel: 800-929-9808; Fax: 415-962-9806.

The Delta Clipper Experimental DC-X.

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Some people called McDonnell Douglas Aerospace's mission "unthinkable": develop a prototype reusable single-stage rocket vehicle in less than two years. And do it on a budget that was unthinkably tight.

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For More Information Write In No. 632

Following are excerpts from speeches at Technology 2003 plenary sessions covering the Technology Reinvestment Project, a program of matching grants to explore commercial applications of government-funded R&D, and dual-use technology development.

Technology Transfer and Defense Reinvestment: An Industry Perspective

Robert D. Paster, President
Rocketdyne Division, Rockwell International

I'd like to expand briefly on NASA technology transfer efforts, the Technology Reinvestment Project (TRP), and Cooperative Research and Development Agreements (CRADAs), including an assessment of changes and mechanisms that characterize the new thinking in defense conversion and reinvestment.

NASA addresses technology transfer in several ways: (1) with *NASA Tech Briefs*; and (2) by urging local businesses to bring technical problems to regional NASA offices for resolution.

There is also NASA's ambitious outreach program, designed to bring its enormous range of research and technical expertise to industry for new spinoff creations.

Examples of spinoffs are emerging from the space station and the NASA/DOD National Aero-Space Plane programs. Novel elements for electrical contactors developed in connection with the space station's electrical power system now are marketed commercially by Kilovac Inc. The company is supplying power contactors to Lockheed for inclusion in the F-22, to Boeing/Sikorsky for use in the Army's Commanche helicopter, and to General Motors/Delco for their prototype electric car.

Materials developed for the National Aero-Space Plane have been applied in a diverse array of new products, including artificial limbs and joints, computer actuator arms, catalytic converter foils, camera shutters, and piston rings.

Similar performance can be expected with the TRP, now well underway. The 162 winning selections [as of December 1993]—involving more than 400 organizations representing a wide spectrum of technologies—will receive nearly $415 million in matching funds from the fiscal 1993 budget allotment.

Among the winners is a consortium including GM Hughes Electronics, IBM, Micromodule Systems, Microchip, Polycon, and Texas Instruments that has joined with Sandia National Laboratories to develop a new method of interconnecting integrated circuits on a common substrate. Power One Inc., together with Rockwell International, Polystor Corp., Aerojet, and Lawrence Livermore Laboratories, plans to develop an affordable manufacturing process for aerocapacitors—a super capacitor that offers a ten-fold increase in energy density over current capacitors. TRW Space and Electronics Group has proposed developing precision laser machine tools for drilling, cutting, welding, and heat-treating mechanical and composite parts on manufacturing assembly lines.

Finally, CRADAs make available leading-edge technology from federal laboratories. The Clinton Administration has called for the budgets of all federal laboratories to earmark 15 to 20 percent toward commercial projects.

Integral to all of this—and consistent with new policies toward business/government relationship—is the matter of cost-sharing.

In 1960, the Defense Department permitted contractors to consider independent research as allowable. However, costs of development were strictly limited to product lines for which the government had contracts. The government also consistently maintained that costs incurred in co-sponsored projects should be disallowed.

In the 1970s, IR&D concepts were developed. However, companies had to demonstrate the relationship between the costs and a particular military function. Arbitrary cost ceilings were imposed by Congress in the 1980s, resulting in inconsistencies and inequities throughout the industry. Concurrent with this stifling treatment of research costs, the government was very protective of nonrecurring funds expended on new products. A recoupment charge required the contractor to make payments to the US government when the contractor made a commercial sale or other transfer of products or technology.

Contrast these regulations with our current climate:

At the end of 1991, the DOD announced that IR&D costs incurred by defense contractors would qualify as in-kind contributions made under cooperative agreements. Furthermore, the DOD indicated that the resulting contracts were not the type of contract anticipated under the Federal Acquisition Regulations (FAR).

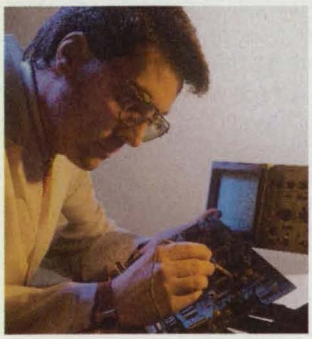
CRADAs were another step in the development of user-friendly instruments to initiate and define a program of cooperative research between industry participants and government laboratories. While CRADAs took a large step in promoting technology transfer, there were still difficult issues to be resolved in the areas of intellectual property, liability, publication, and nondisclosure terms.

More progress was made in the summer of 1993 when the FAR recoupment provisions were withdrawn and the Technology Reinvestment Project was established, giving ARPA statutory authority to award funds for research projects on user-friendly terms. The fundamental principal announced by ARPA was that government contract regulations would not apply. This means that (1) FAR does not apply; (2) intellectual property terms are negotiable; and (3) DCAA is not a participant.

You should view all of this as a watershed change from business—and government—as usual. The rules have changed, and you can expect very different results from the experience of the near past. What was once a restrictive arrangement has become a working—and growing—cooperative with benefits to both industry and government that are well beyond our most optimistic expectations. The bottom line for you here today is that it represents an extraordinary opportunity. I urge you to make the most of it.

continued on page 20

Final approach is no place to think about flight control actuators.



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For More Information Write In No. 580

The TRP's Progress and Future Prospects

Steven G. Wax, Chief of Staff
Technology Reinvestment Project

First, a reminder of where the Technology Reinvestment Project (TRP) fits in. The current administration is convinced that an integrated military/commercial/industrial base is essential to supply both advanced, affordable military systems and competitive commercial products. TRP is one of the key administration programs. It involves six agencies: NASA, the departments of Energy, Defense, and Transportation, the National Science Foundation, and the National Institute of Standards and Technology. There are three arms to the program: development, deployment, and manufacturing education and training. Technology development focuses on dual-use technologies, trying to foster that integrated base. Deployment is trying to assist small- and medium-sized businesses to make the best use of technologies and capabilities that already exist. Manufacturing education and training involves trying to reform the educational structure, to make manufacturing a more substantial part of the higher education curriculum.

The funding comes from eight programs within the defense conversion of $1.8 billion for fiscal year '93. Approximately $470 million of that was set aside for technology reinvestment falling in eight statutes, including $7 million for the Small Business Innovation Research program. Four of the statutes relate primarily to development, two are extension programs, and two are education programs.

It's important to know the requirements for the main TRP program. Everything is competitive. The emphasis is on partnerships between the federal government and the proposers, who must put up at least half of the money. We think that's extremely important since it commits the proposer to the project.

We received over 2800 proposals for the main solicitation due July 23 from a diverse array of participants. For the approximately $465 million available, we received requests for $8.5 billion. We are extremely sensitive to the hard work that went into every one of those proposals and the fact that we are going to be able to fund only a few of them.

We had a multi-tiered selection process. First, we divided the proposals by the three technology areas: technology development, technology deployment, and manufacturing. The first tiers were made up of over 300 evaluators from across the agencies who evaluated the proposals against the criteria, based on a quantitative scoring approach.

The fifth and final review looked at all three areas to make sure they matched and that the TRP was presenting a unified program. It then was presented to key members of each agency, who approved the recommended program without alterations. Every proposal was evaluated by, in general, a member from each of the agencies. Of all things, we are proudest of the evaluation process, which insures proposals are fairly selected.

Several TRP myths were debunked. The winners included companies we don't normally think of as defense contractors: Johnson & Johnson, Apple, and Rio Grande Medical. People said it was not for defense contractors, but we had winners from Rockwell, Hughes, and GE. Others said TRP is not for small business, yet 38 percent of the winning proposals had small businesses on them. And 47 percent of the technology development proposals had a small business as at least one of its proposers. Universities were well-represented as well. We were told the way we constructed the solicitation made it very difficult for national labs to participate, which also proved false. All the organizations got their labs involved.

People asked: Do I propose a big project with lots of people? A small project with just a few people? Where's your bias? The answer is we had no bias. We were interested in what you were proposing and how well it met the criteria. Consequently, we had a very large range in numbers of participants and dollar values on winning proposals, from 20-30 participants to some with just a couple. We had a dollar range from $80,000 to $20 million. We didn't bias by region.

We saw some very meaningful and unique collaborations. We also saw some that weren't so meaningful or unique. There were examples of site visits where we observed "partners" introducing themselves to one another. It's obvious in the proposal when a proposer really isn't fitting into the plans.

We also had a lot of participation from state and local governments. The fact that a state backs a proposal does not help it in the evaluation process, but can make the proposal viable. For example, if you are a small business and cannot come up with the matching funds, the state can help with that—but you win or lose on merits.

One other important area is the idea of cost matching. The whole concept of having proposers put up 50 percent is to show that the proposer wants to get to the end product just as badly as does the federal government. That's kind of unique, certainly for the DOD, which in general just pays somebody to get where defense wants to go. In this case, it's a true partnership.

Some things quite clearly were not a good cost match, such as cases in which the proposer put up things done long ago without thought to their value to the proposed program. If the proposers had one difficulty, it was with the business side of the TRP proposals—coming up with a good plan to get a product and coming up with a decent cost matching.

What's next? The FY '93 selections have been made—we're waiting for the final round of announcements. We have about $50 million dollars more to provide. We're also trying to make some decisions about FY '94. Our plan over the next several weeks is to send out letters to those proposers who will not receive funds. The first letter will be from ARPA, saying "we're sorry you weren't selected...." Our plan is to follow that with some help and feedback on how they did in the evaluation process. As for '94, the statutes again are well-funded, certainly in the technology development area, and there will be some breaks for small businesses. It's almost certain that we will be spending some '94 money on deserving '93 proposals.

continued on page 106

Attention Government, Industry, and University Technology Leaders:

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New Product Ideas

New Product Ideas are just a few of the many innovations described in this issue of *NASA Tech Briefs* and having promising commercial applications. Each is discussed further on the referenced page in the appropriate section in this issue. If you are interested in developing a product from these or other NASA innovations, you can receive further technical information by requesting the TSP referenced at the end of the full-length article or by writing the Technology Utilization Office of the sponsoring NASA center (see page 24). NASA's patent-licensing program to encourage commercial development is described on page 24.

Robotic Tool Changer for Automatic Welding

A new tool changer automatically chooses the designated tool, maneuvers the welding torch or other tool into the correct positions, and reliably connects water, gas, welding wire, high-voltage electrical signals, and ground.
(See page 89.)

Half-State Readout in Vertical-Bloch-Line Memory

An experimental method of readout would avoid potentially narrow margins of chirality-based chopping of magnetic stripes.
(See page 42.)

Metal-Film Hall-Effect Devices

New devices are made from multilayer metal films instead of the semiconductor materials. These devices are easier to fabricate, can be made with larger areas, are potentially more reliable, and are less vulnerable to impurities.

Oil-and-Gas-Fire Snubber

This snubber extinguishes the flames without the use of an explosive and with little or no use of coolant. The method should prove significantly less expensive and time consuming than other methods of extinguishing oil-and-gas-well fires.
(See page 50.)

Insoluble, Low-Dielectric-Constant Polyimides

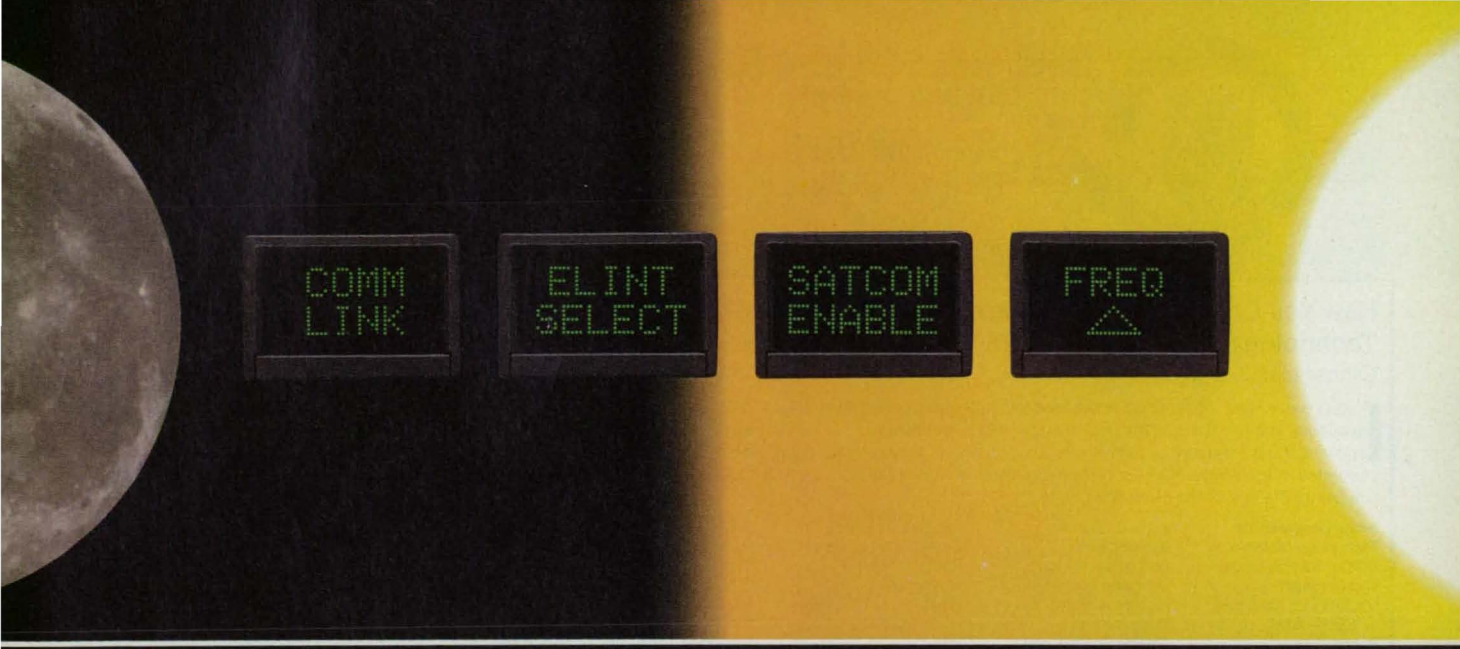
Fluorinated polymers with dielectric constants from 2.4 to 2.5 are highly insulating, resistant to moisture, mechanically strong, and thermally stable. They would make good candidates as insulating resins in microelectronics.
(See page 59.)

Aromatic Polyimides Containing *Meta*-Biphenoxy Moieties

Stable at high temperatures and featuring glass-transition temperatures lower than state-of-the-art polyimides, the new polyimides are more thermoplastically processable and show excellent potential for meeting the future needs of electronics and aerospace industries.
(See page 58.)

Polyimides Containing Pendent Ethynyl Groups

Films based on these groups are insoluble in dimethylacetamide or chloroform. Other features include increased glass-transition temperature and modulus of elasticity.
(See page 56.)



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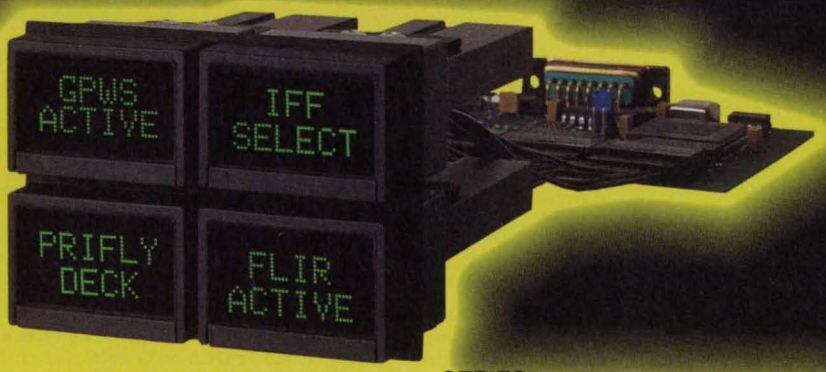

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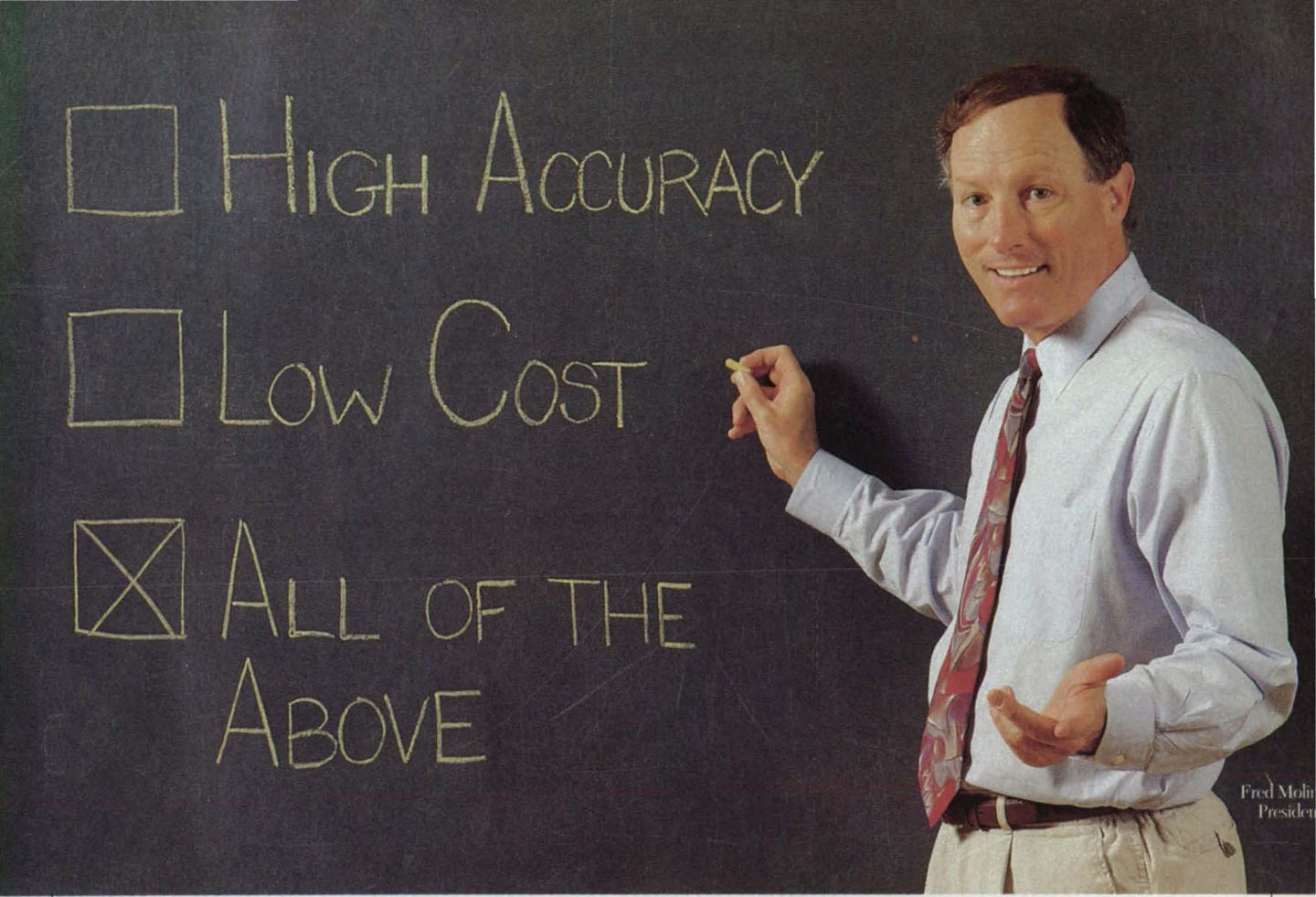

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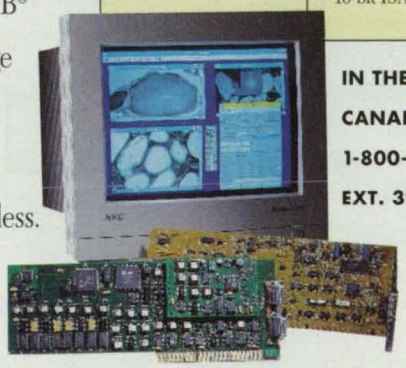

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System Measures Pressures Aboard a Compressor Rotor

The rotating pressure-measuring instrumentation includes an on-board calibration standard.

Lewis Research Center, Cleveland, Ohio

A computer-controlled, multichannel instrumentation system acquires pressure measurements from sensors mounted in the 1.52-m-diameter rotor of a compressor. (The speed of rotation is 1,920 rpm. The compressor is located at the Large Low Speed Centrifugal Compressor Research Facility at the NASA Lewis Research Center.) The system includes 5 miniature, electronically scanned pressure (ESP) modules, each containing 48 piezoresistive pressure sensors, a pneumatic calibration valve, and electronic circuits for addressing and amplifying the output of each sensor.

Five ESP modules are mounted on the centerline of the rotor, on an instrumentation tower (see Figure 1) located inside the nose cone of the rotor. The sensors in the modules include diaphragms, which are oriented perpendicular to the centerline to minimize the effects of centripetal acceleration. A 200-channel electrical slipring package is used to bring the electrical signals from these modules, and from on-board strain gauges, thermocouples, heaters, and other items to associated data-acquisition subsystems. The transducers are addressed and scanned at the rate of 10,000 measurements per second.

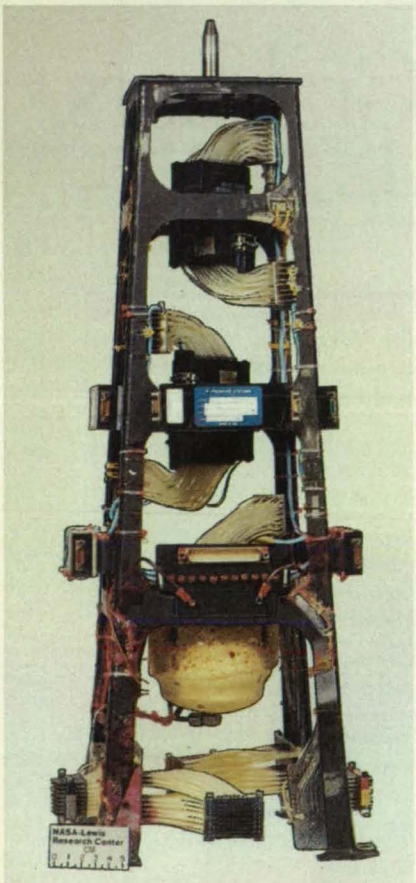

Figure 1. This **Instrumentation Tower** holds the ESP modules. The tower is mounted on the compressor rotor, inside the nose cone.

A pneumatic slipring seal assembly transfers control and calibration pressures from a stationary pressure calibration unit to the rotating ESP subsystem. Although the pneumatic seal provided by this assembly was found to function according to design specifications, its rate of leakage was not low enough to enable the attainment of the accuracy required for in-place calibration of the rotating ESP system. This leakage caused the calibration pressures seen at the ESP modules to differ from the pressures measured by the reference transducer in the calibration unit. Thus, it became necessary to install the reference transducer aboard the rotor near the sensor modules. This arrangement provided highly accurate measurement of the three calibration pressures as long as the rates of leakage of the pneumatic sliprings did not change during the calibration cycle.

Another problem arose in connection with the excessive heat produced within the pneumatic seal assembly by the friction of carbon rings rubbing on stainless-steel runners. This heat caused a change in ambient temperature from 70 °F (21 °C) at zero speed to 170 °F (77 °C) at design speed, and the change in temperature affected the accuracy of an otherwise highly accurate digital reference transducer that is normally used with the ESP system. The sensing element of this transducer is an oscillating quartz beam. Pressure applied to a bellows generates a torque on this beam, causing a change in the frequency of its oscillation. However, tests showed that this transducer was unsuitable for this application because it was very sensitive to changes in temperature and had a very long recovery time. Instead, an analog transducer that contained a variable-capacitance ceramic sensor was chosen because it displayed much less sensitivity to the change in ambient temperature. To further reduce the effect of changes of ambient temperature, the temperature of the transducer was maintained at 170 °F (77 °C) by a closed-loop proportional/integral/derivative controller, which regulated a heater mounted on the transducer.

Because the ESP subsystem was designed for use with only the digital pressure transducer, the 0- to 5-V signal from the analog pressure transducer had to be converted to a 36- to 40-kHz, 4-V (peak-to-peak) square wave so that the rest of the system could

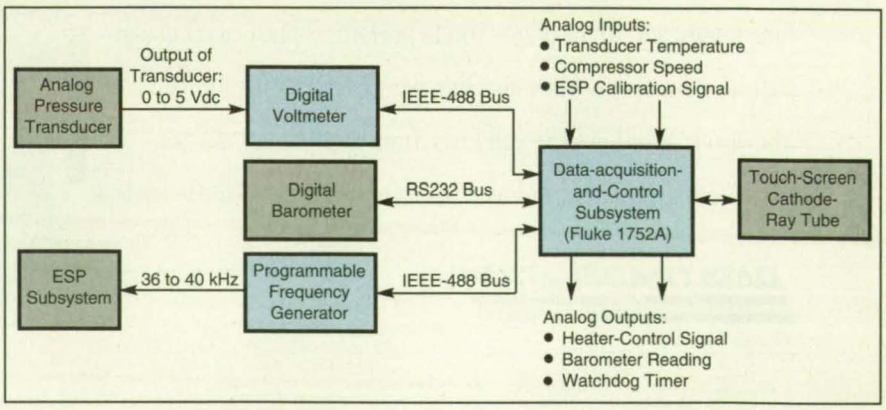

Figure 2. This **Instrumentation System** includes a subsystem that converts the analog output of a calibrating pressure sensor to a distinct frequency.

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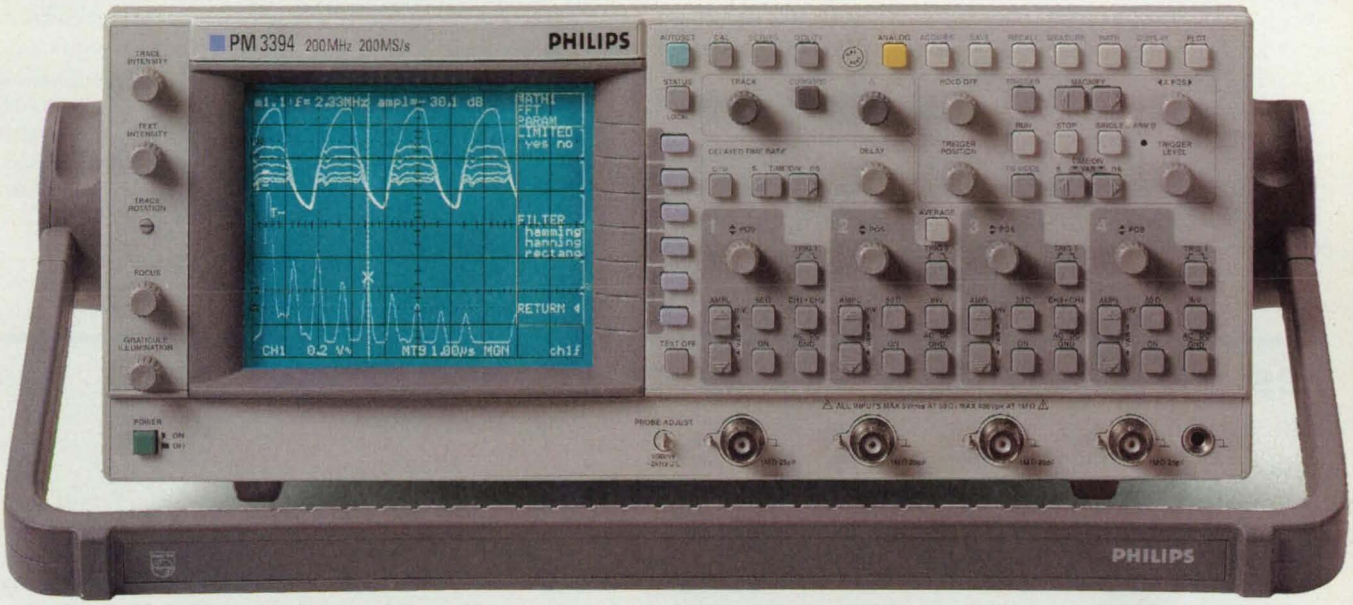

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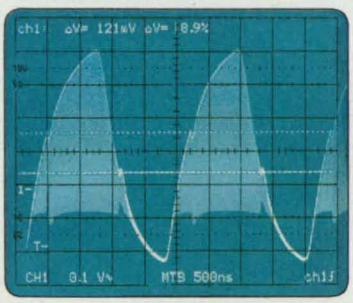

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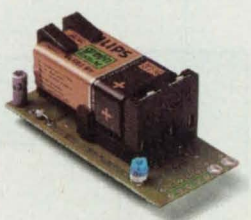

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interpret it. A subsystem was designed to convert the analog signal to a distinct frequency without significantly affecting the accuracy. The major components of this subsystem, shown in Figure 2, include a programmable frequency generator (PFG), a digital voltmeter (DVM), and a data-acquisition-and-control subsystem (DACS). Communication among these three components was accomplished by use of an IEEE-488 bus with the DACS acting as the bus controller.

The computer program written for the DACS handles a variety of tasks. It reads the analog output of the transducer from the DVM via the bus, converts it to units of pressure (psia), converts the pressure-unit signal to a frequency value, and sends this value via the bus to the PFG. It also monitors the output of the transducer for fluctuations, outside a specified range, that could indicate leakage in the pneumatic sliprings. This feature is disabled during calibration of the ESP subsystem because otherwise it would interpret the three different calibration pressures as an indication of leakage. In addition, the program monitors the test-cell barometric pressure (used as the reference pressure for the sensor modules) for a change that would necessitate an on-line recalibration of the rotating ESP subsystem to maintain the best accuracy. It reads the temperature of the transducer and converts it to a 1- to 5-V control signal that is fed to the heater controller. Finally, the program alerts the operator with an on-screen warning if either the analog output of the transducer or barometric pressure changes beyond specified limits.

This work was done by Robert J. Freedman of **Lewis Research Center** *and Richard G. Senyitko and Philip Z. Blumenthal of Sverdrup Technology, Inc. Further information may be found in NASA TM-103676 [N91-19401], "Rotating Pressure Measurement System Using an On Board Calibration Standard."*

Copies may be purchased [prepayment required] from the National Technical Information Service, Springfield, Virginia 22161, Telephone No. (703) 487-4650. Rush orders may be placed for an extra fee by calling (800) 336-4700. LEW-15491

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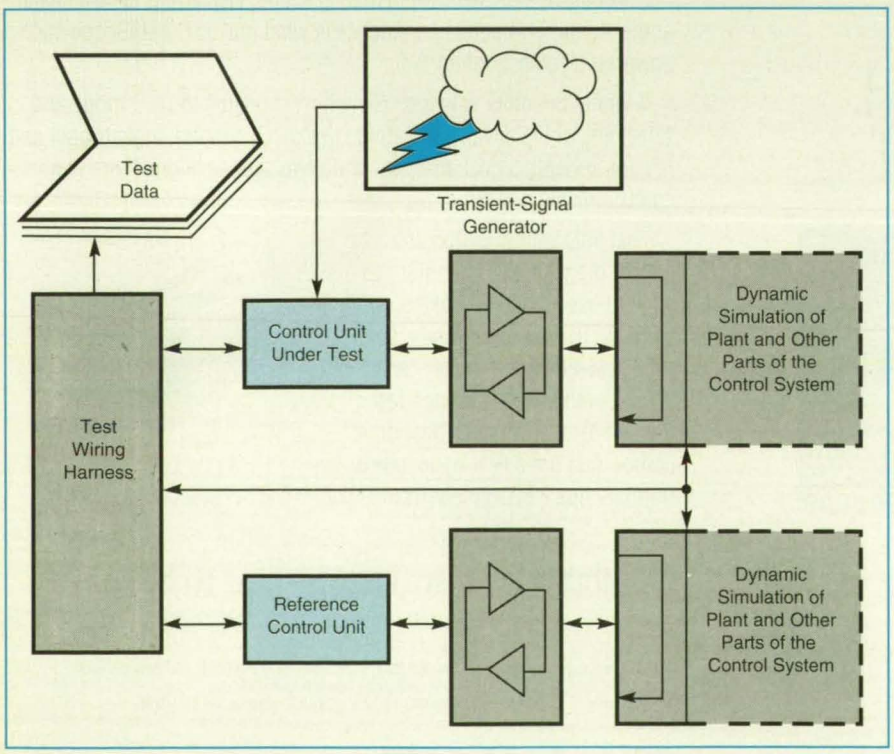
Effects of transient electrical signals are evaluated in laboratory tests.

Langley Research Center, Hampton, Virginia

One unavoidable byproduct of the reduction of aerodynamic drag in advanced aircraft designs is the reduction of the degree of static stability and the consequent need for critical flight-control systems to satisfy very high reliability specifications. The trend in avionics is toward the use of digital computers that interact with the sensors and control surfaces of the aircraft. In addition, fuel efficiency is increased in advanced designs by use of lightweight, composite materials rather than metals in aircraft structures. Therefore, as airframes become more transparent to electromagnetic (EM) radiation, EM impulses to these computers present a serious problem. These EM disturbances can be caused by lightning, high-energy radio-frequency (HERF) transmitters, and nuclear electromagnetic pulses (NEMP's).



Susceptibility to Upset by transient EM disturbances is evaluated by comparison of effects on test and reference units.

Transient electrical signals can cause two types of effects on digital computer systems. The first type is damage to components that necessitates repair or replacement of equipment. The second type is characterized by functional error modes, known collectively as "upset," which involve no damage to components. In the case of upset, normal operation can be restored to a system by such corrective action as resetting and/or reloading software or by an internal recovery mechanism, such as an automatic rollback of the system to a state that existed just prior to the disturbance.

Accordingly, a method of evaluating a nominally fault-tolerant, aircraft-type digital-computer-based control system has been devised. More specifically, the method provides for evaluation of susceptibility of the system to upset and evaluation of the integrity of control when the system is subjected to transient electrical signals like those induced by an EM source; in this case, lightning. The laboratory test configuration of this method (see figure) involves two control units: the unit under test and an unperturbed identical reference control unit. The control unit under test is perturbed by transient signals like those induced by lightning. Each control unit is made to interact with a simulation of the plant and other parts of the aircraft control system to determine the effect of EM impulses on aircraft control functions. The amount of data processing is reduced by recording only those responses in which the test and reference units differ.

There are plans to test a commercial electronic engine control unit for suscep-

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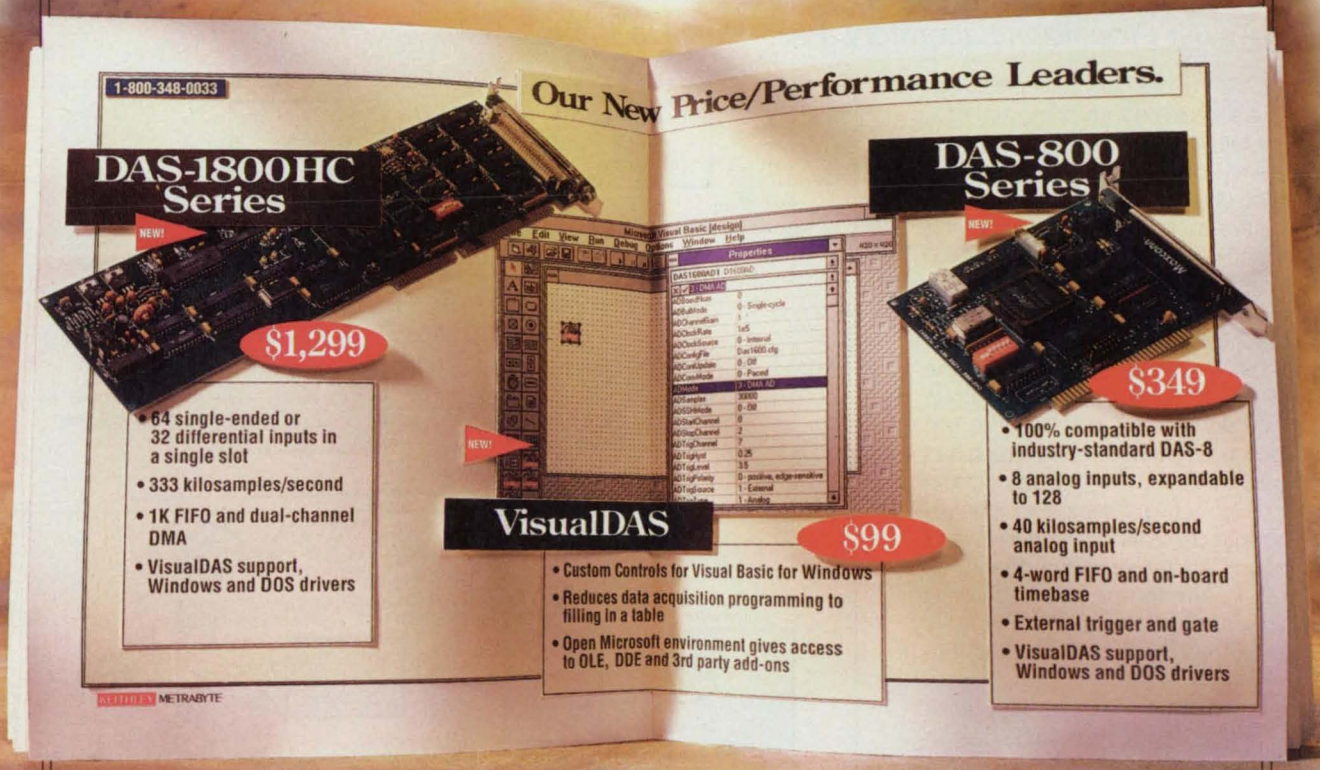

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tibility to upset by this method. Beyond aerospace applications, fault-tolerant control systems are becoming more widespread in industry; for example, in automobiles. This method supports practical, systematic tests for evaluation of the designs of fault-tolerant control systems.

This work was done by Celeste M. Belcastro of **Langley Research Center**. *Further information may be found in NASA TM-101665 [N90-14061], "Laboratory Test Methodology for Evaluating the Effects of Electromagnetic Disturbances on Fault-Tolerant Control Systems."*

Copies may be purchased [prepayment required] from the National Technical Information Service, Springfield, Virginia 22161, Telephone No. (703) 487-4650. Rush orders may be placed for an extra fee by calling (800) 336-4700. LAR-14498

Automated System Tests Ferroelectric Capacitors

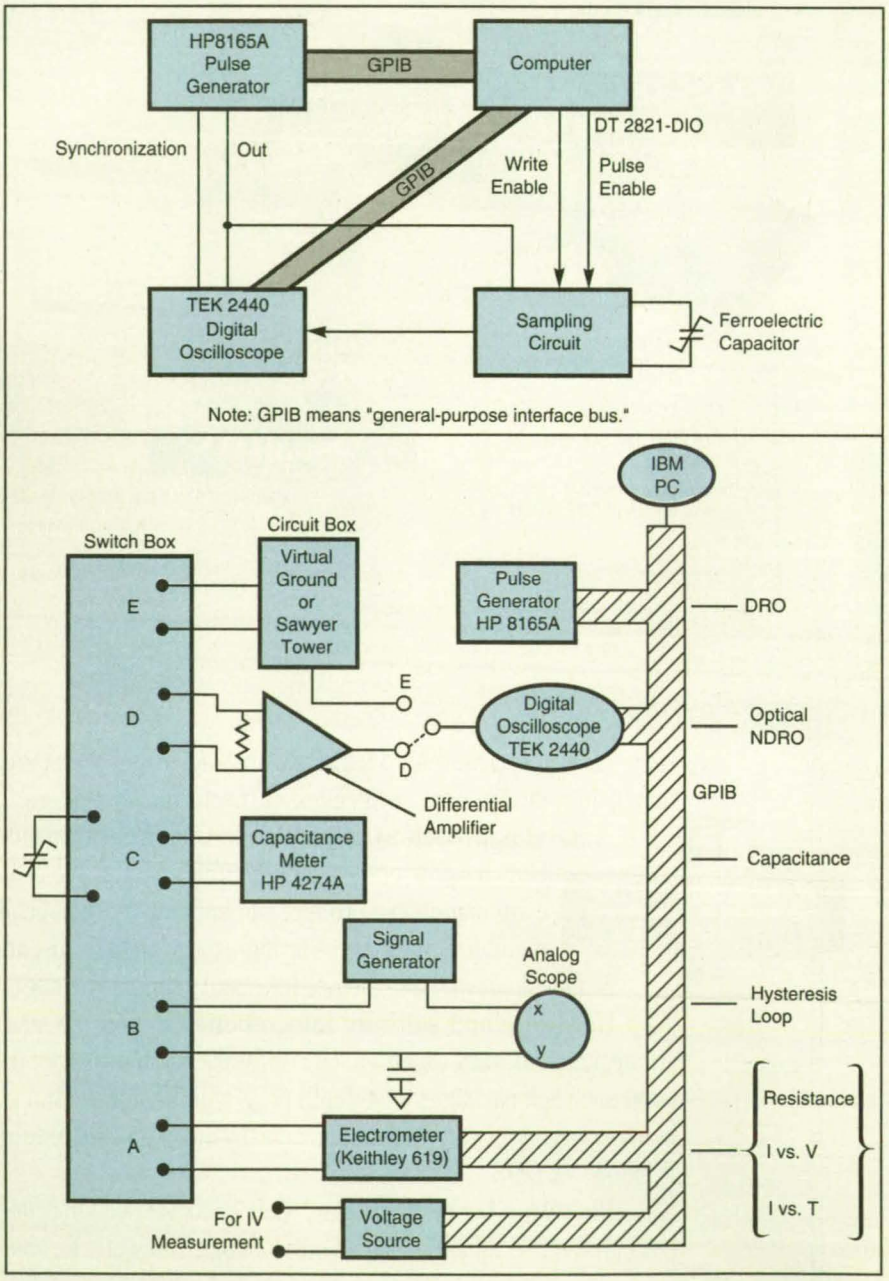
Polarization-switching parameters are measured under computer control.

NASA's Jet Propulsion Laboratory, Pasadena, California

The JPL Ferroelectric Tester (see Figure 1), is a dedicated, computerized multiprobe test setup, including a laser/optical source that allows measurement and recording of photoresponse behavior (nondestructive evaluation and readout) of a ferroelectric capacitor, along with conventional DRO (electrical destructive readout) signal, Sawyer/Tower hysteresis loop, capacitance, and resistance/leakage on the same sample without disturbing the probes. This highly integrated setup is quite flexible, versatile, and interactive, and allows convenient computer storage and analysis of the data. In particular, the flexibility of subjecting a sample to the various probes, repeatedly, in any selected sequence, with a verifiable guarantee that the sample has not been irreversibly altered during the course, is extremely valuable in correlating the various phenomena studied.

The setup allows overnight study of the write-time dependence of polarization and/or retention and fatigue from zero cycles onward on the ferroelectric capacitors and measurement of response to any desired sequence of operational pulse profiles conveniently by interactive experiment files. The electrical testing can be done on capacitors on a probe station (from 500-μm down to 10-μm feature size) as well as on chips of all varieties that can be inserted in a versatile ZIF socket. This system will provide data that will improve our understanding of the basic physics of polarization switching, including, notably, time dependence of polarization, fatigue, and polarization-retention characteristics. Such understanding is necessary for optimization of designs to maximize the performances of ferroelectric capacitors as nonvolatile memory devices.

The ferroelectric capacitor under test is connected to the sampling subsystem by incorporating it into a circuit like that of a typical ferroelectric-memory cell. This circuit can include an ordinary (linear-response) capacitor in series with the ferroelectric capacitor. The capacitance of the linear-response capacitor is chosen to be much greater than that of the polarization-switching capacitor so that most of the applied voltage pulse appears across the ferroelectric capac-



The Ferroelectric-Capacitor-Testing System applies voltage pulses and measures the responses of the ferroelectric capacitor to determine the write; "time dependence of polarization," polarization-retention and fatigue characteristics of the capacitor. (Note: Trademarks shown or equivalents can be used.)

itor. The current into or out of the ferroelectric capacitor is integrated (over the pulse interval) by measuring the voltage at the node between the two capacitors with a high-input-impedance operational-amplifier voltage follower. Alternatively, the current can be integrated by use of a standard current-integrator operational-amplifier circuit in which a linear-response capacitor serves as the feedback element. In both cases, the linear-response capacitor must be discharged before each test pulse by use of an analog switch.

The system operates under overall control by a personal computer, which executes special software called FETP (Ferroelectric Testing Program). The software consist of a command-line-interpreter program that receives its input either from a keyboard in an interactive control mode or from a text batch file in a noninteractive control mode. The computer controls the sampling subsystem via a data-acquisition circuit board. It also controls a digitizing oscilloscope and a pulse generator through general-purpose interface busses.

The pulse generator generates the voltage pulses necessary for presetting, writing, and reading the content of the ferroelectric capacitor. The amplitudes and durations of the presetting, writing, and reading pulses are set by the computer; these parameters can be made to remain constant during many repetitions, or else one of them can be made to change slowly during many repetitions to determine the response of the ferroelectric capacitor as a function of the slowly varied parameter.

The digitizing oscilloscope records the output pulse of the sampling subsystem (representing the response of the ferroelectric capacitor); it also records the pulse from the pulse generator for verification. The digitizing oscilloscope is synchronized with the pulse generator through its external-trigger input rather than through the general-purpose interface bus. The FETP software can fit lines (by use of a "best-fit" algorithm) to the regions of a response pulse that correspond to the times before, during, and after the reading pulse. It can also display the waveform, difference it with the best-fit lines, and/or record the waveform (or many waveforms) in magnetic-disk memory. FETP can also reread the waveform data from memory for further display and/or analysis.

This work was done by Mark Lakata and Sarita Thakoor of Caltech for **NASA's Jet Propulsion Laboratory**. *For further information,* ***write in 3*** *on the TSP Request Card. NPO-18696*

Equipment for Testing Beam-Waveguide Antennas

Portable units yield data on directivity, efficiency, and noise.

NASA's Jet Propulsion Laboratory, Pasadena, California

Two portable packages are designed for use in determining such radiometric quantities as (1) the directivity, efficiency, and noise temperature of a paraboloidal-dish antenna 34 m in diameter and (2) losses of signal power in parts of a beam waveguide through which the antenna is coupled to a receiving station. One of the packages takes measurements at a frequency of 8.45 GHz; the other, at 32 GHz.

Each package is a portable microwave receiving "front end" — essentially an input-coupling, heterodyning, and preamplifying unit that preprocesses the incoming signals and feeds them to a stationary, computer-controlled total-power radiometer system. Typically, a unit is transported to focal point F1 (see Figure 1), where it is used to measure antenna efficiencies and system noise temperatures. The differences between system temperatures at F1 and those on the ground give a measure of the additional contributions due to scattering from the tripod, spillover from main reflector, and leakage. The unit is then taken to one of the other focal points (F2 or F3), where system temperatures and antenna efficiencies are again measured. The differences between measurements at two positions are interpreted as measures of the degradations caused by the mirrors and shrouds of the beam waveguide.

Figure 2 is a block diagram of the 8.45-GHz unit. Depicted are such usual Cassegrain-antenna front-end components as a waveguide horn, polarizer,

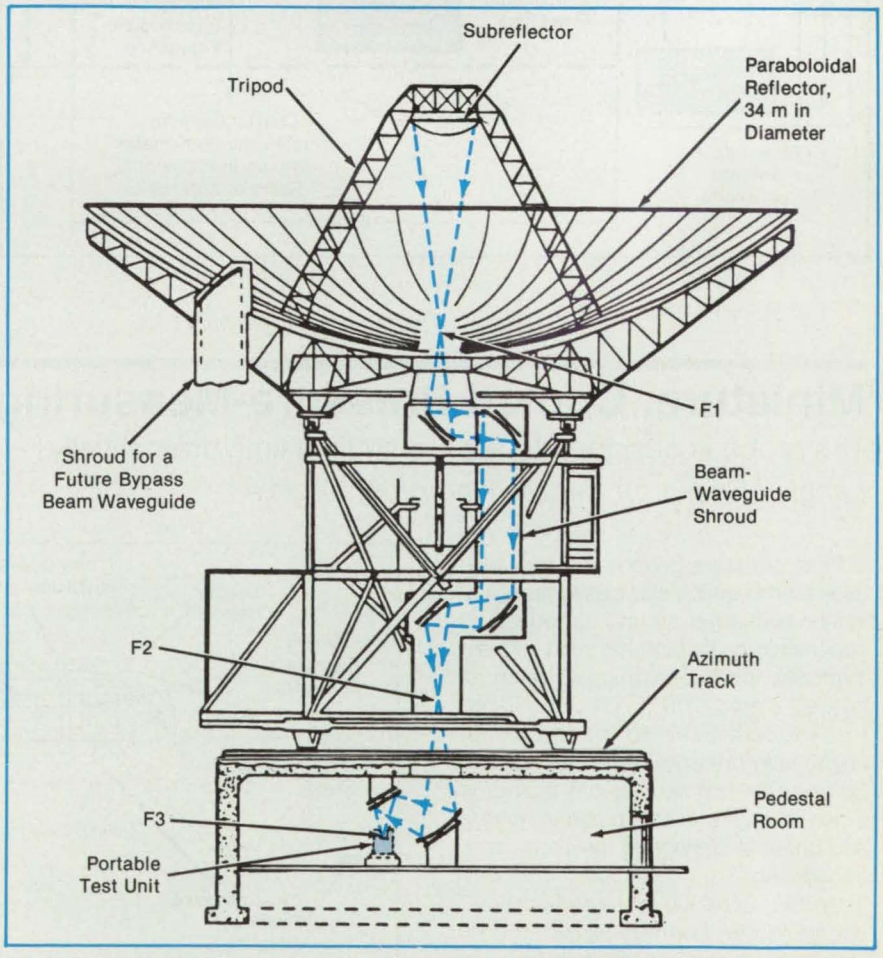
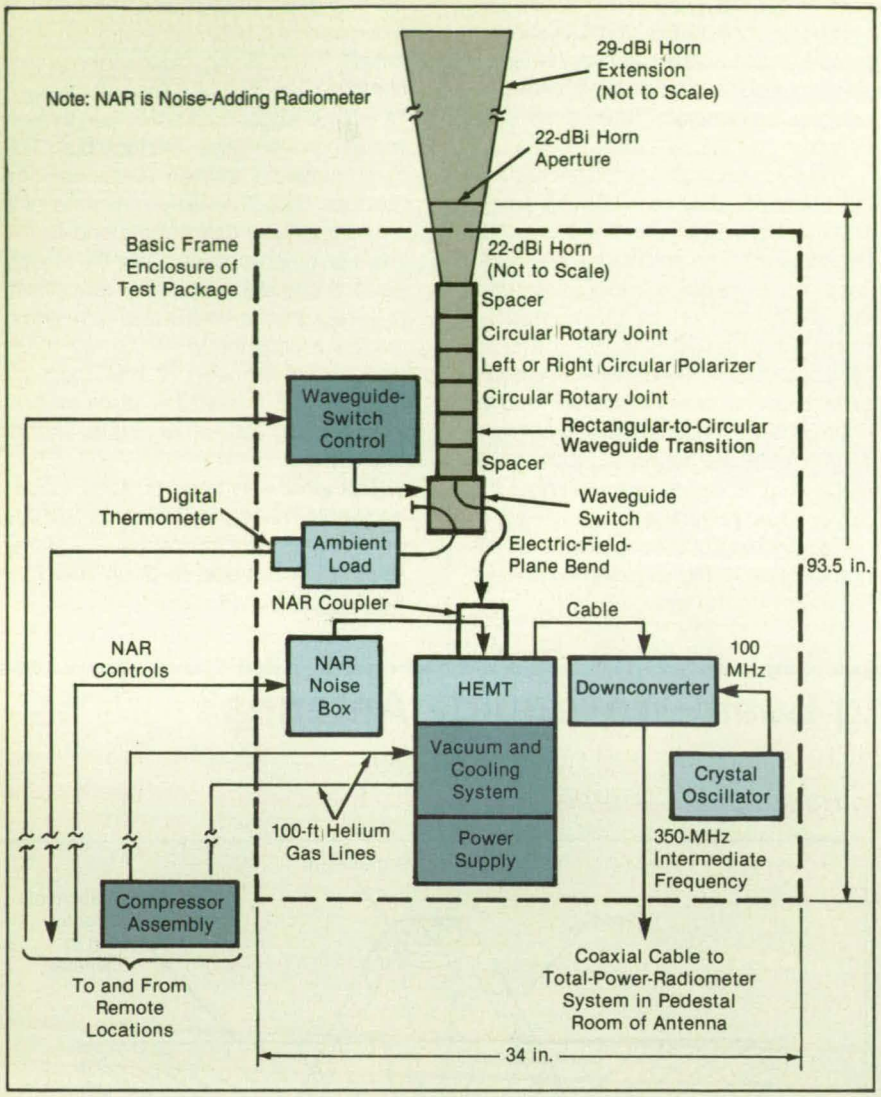


Figure 1. The **Beam Waveguide** below the main paraboloidal reflector includes flat, paraboloidal, and ellipsoidal mirrors, some enclosed in a shroud. Radiometric measurements are made at focal points F1, F2, and F3 to characterize the performances of the antenna and beam-waveguide components.



round-to-rectangular waveguide transition, waveguide switch, cooled high-electron-mobility-transistor (HEMT) low-noise amplifier, and downconverter. Noise-temperature calibrations are performed by use of a remotely controlled noise-diode assembly and a digital-readout thermometer embedded in an ambient-load-reference termination. To enable testing at both F1 and F3, it is necessary to make the horn convertible between directivities of 29 and 22 decibels above isotropic (dBi). Conversion is effected by attachment or removal of a horn extension of the same taper, going from aperture diameters of about 19 in. (48 cm) to 7 in. (18 cm).

This work was done by Tom Y. Otoshi and Dan A. Bathker of Caltech for **NASA's Jet Propulsion** *Laboratory. For further information,* ***write in 56*** *on the TSP Request Card.*
NPO-18622

Figure 2. The **Portable Test Unit** is used to make radiometric measurements at selected focal points of the beam-waveguide antenna. For measurements at each point, the phase center of the horn is aligned with that focal point.

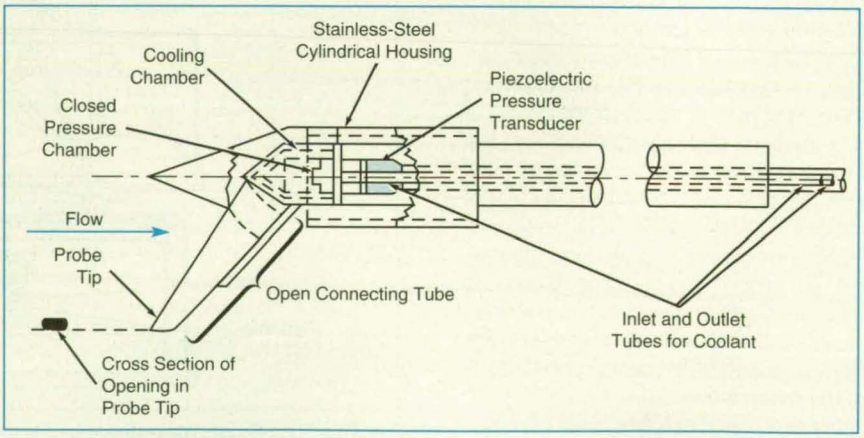
Miniature, Cooled Pressure-Measuring Probe

The probe is designed to reduce settling time dramatically.

Langley Research Center, Hampton, Virginia

Pitot pressure probes are typically used for measuring changes in pressure in the shock layer around a model in a supersonic or hypersonic wind tunnel. Typically, the hypersonic airstream is heated up to 500 °F (260 °C). The transducers used to measure the changes in pressure must be protected from the hot air to avoid thermally induced errors in the measurements and possible damage to the probe and transducers.

Consequently, the pressure transducers are either thermally insulated and mounted in the housing or support strut of the probe as far as possible from the tip of the probe or else mounted completely outside the test section.



The **Piezoelectric Pressure Transducer Is Cooled** by fluid in the cooling chamber constructed around the pressure chamber.

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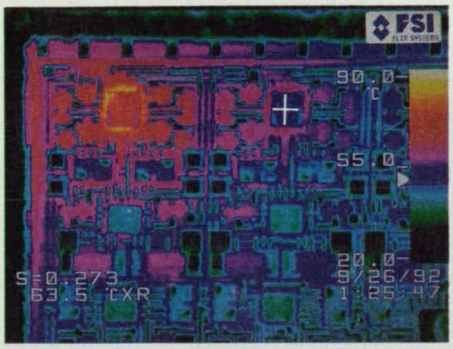
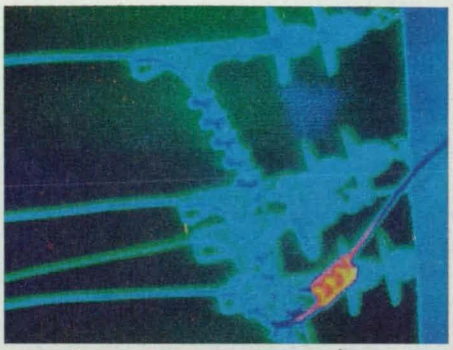
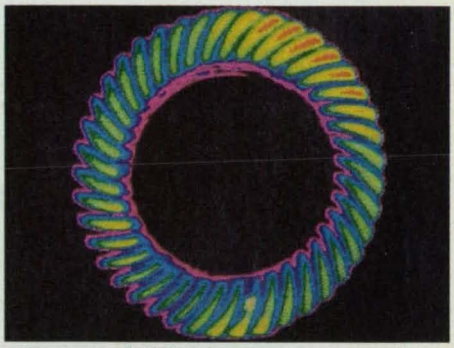


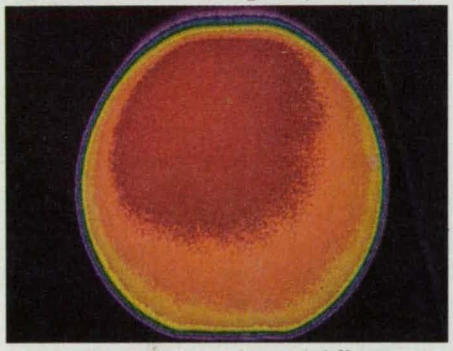
Even on the smallest hybrids, the IQ 325's high resolution imagery unveils fine details such as a non-working die (crosshairs).



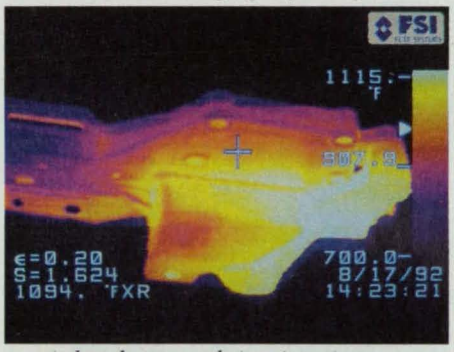
Inspect power equipment from a moving vehicle with the IQ 325's real-time imaging capability.



The rugged IQ Series can monitor on-line processes—such as inductive heating of components—in factory environments.



The IQ 812 detects thermal differences across the surface of this silicon wafer. That could be a yield problem.



At break-out, real-time imaging can check a metal casting's quality via its temperature values and distribution.

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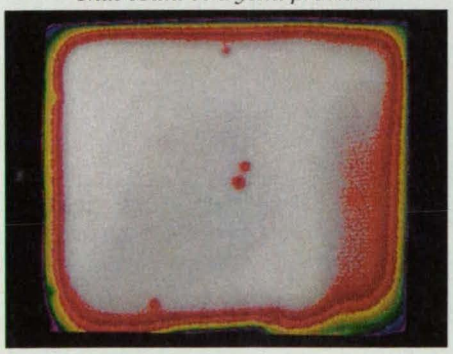

The IQ 812 displays the most minute temperature deviations to inspect composites for defects that may lead to catastrophic failure.

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Either arrangement requires a relatively long connecting tube between the tip of the probe and the pressure transducer. The relatively large volume of the connecting tube results in a relatively long "settling time" of the pressure probe, this being the time required for changes in pressure at the tip of the probe to appear at the pressure-sensing transducer.

Inasmuch as the tip of the probe is frequently moved relative to the surface of the model to measure changes in the distribution of pressure in the shock layer, settling time is critical. Efforts to reduce the settling time generally result in an increase in the size of the tip of the probe, leading to increased perturbations of the flow and consequent errors in pressure measurements. To avoid these errors, the tip of the probe should be no larger than about 30 percent of the boundary-layer height in the flow around and on the surface of the model. Typically, the outer diameters of the smallest connecting tubes in conventional pressure probes range from 0.020 in. (0.51 m) to 0.060 in. (1.52 mm).

A probe has been developed to overcome these disadvantages. The pressure-sensing transducer is mounted in this probe and connected to its tip by a short tube that has a cross-sectional area substantially smaller than that of conventional connecting tubes. The probe (see figure) includes a stainless-steel cylindrical exterior housing that holds a closed pressure chamber in which a piezoelectric pressure transducer is mounted. An open connecting tube that has a probe passes a portion of the high-velocity, high-temperature fluid stream into the closed pressure chamber.

Any change of pressure in the sampled stream propagates into the closed pressure chamber with a settling time inversely proportional to the cross-sectional area of the connecting tube. A cooling chamber formed around the pressure chamber is connected to a source of water or other cooling fluid via inlet and outlet tubes.

This fast-response, miniaturized, pitot pressure probe has been successfully used to survey the flow field about a 2:1 elliptical cone in a 20-in. (51-cm) mach-6 hypersonic wind tunnel. The airstream was heated up to 500 °F (260 °C) before expanding it through a nozzle to avoid liquefaction of the nitrogen and oxygen in the fluid stream.

This work was done by George C. Ashby, Jr., John W. Eves, and David R. White of **Langley Research Center**. *For further information,* **write in 40** *on the TSP Request Card.*

This invention has been patented by NASA (U.S. Patent No. 4,783,994). Inquires concerning nonexclusive or exclusive license for its commercial development shoud be addressed to the Patent Counsel, Langley Research Center [see page 24].
Refer to LAR-13853.

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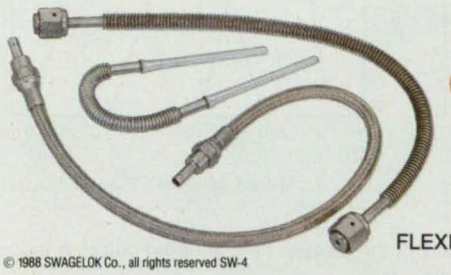

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Measuring Differential Delays With Sine-Squared Pulses

Ripple in a sum signal indicates differential delay.

Lyndon B. Johnson Space Center, Houston, Texas

A technique for measuring differential delays among red, green, and blue components of a video signal transmitted on different parallel channels exploits the sine-squared pulses that are parts of the standard test signals transmitted during the vertical blanking interval of the frame period. It is important to make such measurements because even differential delays as small as 10 ns can result in visible horizontal misregistration of color in standard 525-line television pictures. One of the advantages of this measurement technique is that it does not entail the expense of a test-signal generator. The technique is also applicable to nonvideo signals that include sine-squared pulses.

Figure 1 shows one way of implementing the technique. The three signals are fed through calibrated, adjustable delay lines, then summed, and the sum signal is fed to an oscilloscope. The delay lines are adjusted so that the first signal (e.g., red) is advanced by 250 ns with respect to the second signal (e.g., green) while the third signal (e.g., blue) is delayed by 250 ns with respect to the second signal.

The 250-ns delay is chosen because it corresponds to a differential phase of 90° between the sinusoids that are squared to produce the test pulses. If the signals are not otherwise differentially delayed with respect to each other, then each test pulse in the sum signal is a cosine-squared pulse with respect to time measured from the beginning of the preceding pulse. In that case, the sum signal has a flat top that lasts from the peak of the first pulse to the peak of the third pulse, as can be seen from the trigonometric identity $\sin^2 x + \cos^2 x = 1$.

If there is a differential delay between any two of the signals, then successive pulses are no longer related to each other exactly as sine and cosine, with the result that ripple is introduced into the sum signal (see Figure 2). The amount of ripple increases with the differential delay; it can be measured and used to compute the differential delay. Alternatively or in addition, the delay lines can be adjusted to impose compensating differential delays that restore the flat top to the sum signal. In this case, the differential delays can be read as the differences between the delay settings and the nominal 250-ns settings.

This work was done by Robert N. Hurst of General Electric Co. for **Johnson Space Center**. *For further information,* ***write in 57*** *on the TSP Request Card.*
MSC-22005

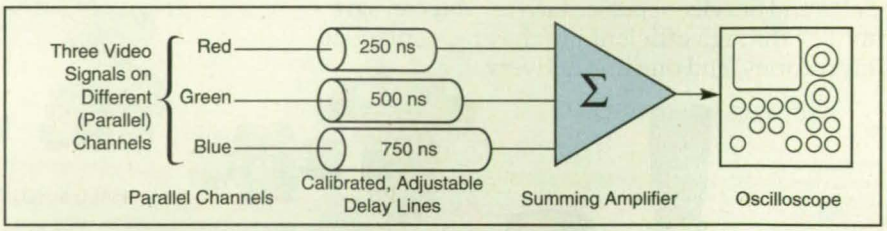

Figure 1. **Three Signals Containing Sine-Squared Pulses Are Delayed** by known different amounts, summed, and displayed.

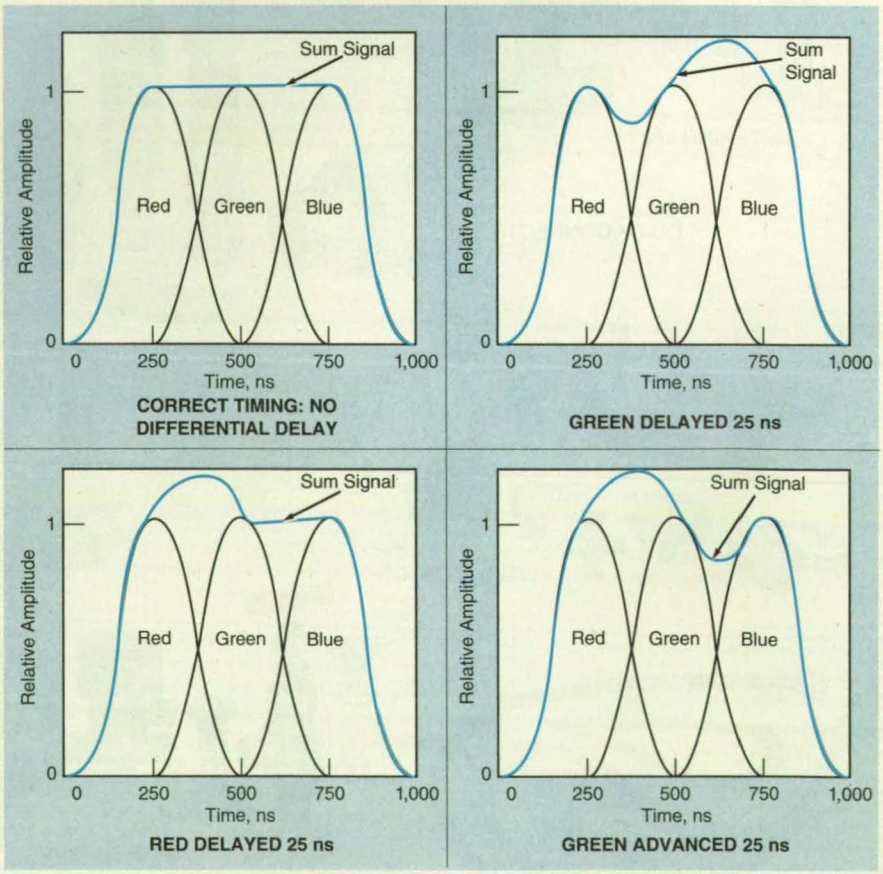

Figure 2. The **Ripple at the Peak** of the Sum of the delayed sine-squared pulses is indicative of differential delays in the three signals.

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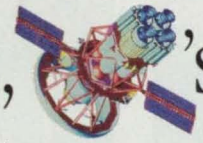
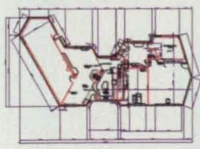
you can do Windows™ and walls and doors and floors, ceilings, whole  's,  's, trains, boats,  's, chains,  's, diamond rings,  's and things,  's, power plants, topo maps,  's, helicopters, roads and bridges, circuit boards,  's power lines,  's, airports, furniture,  , digital terrain models,  's, skateboards, the  's, chemical plants,  's, golf courses, anything you can think of ... even the kitchen  .

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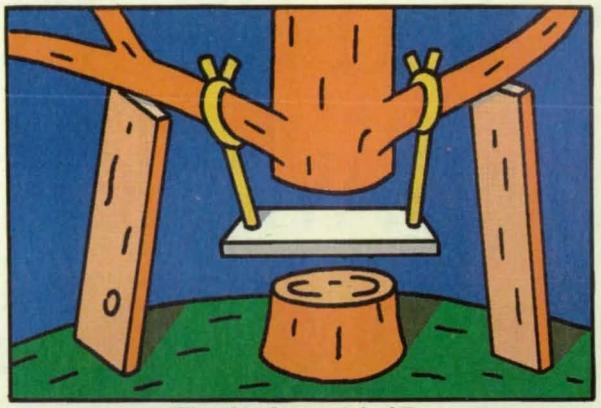
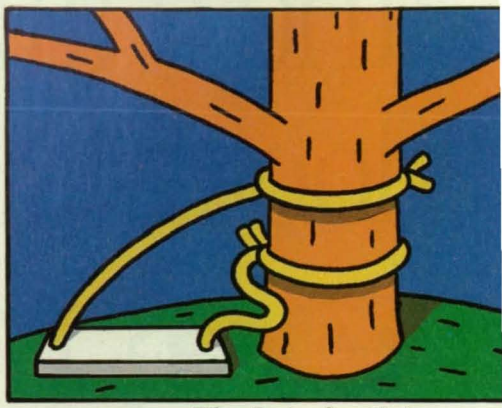
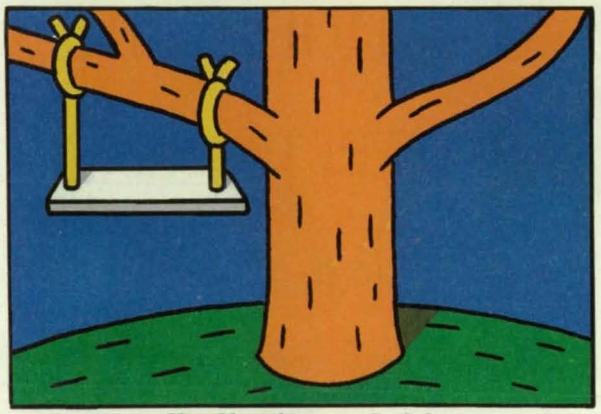


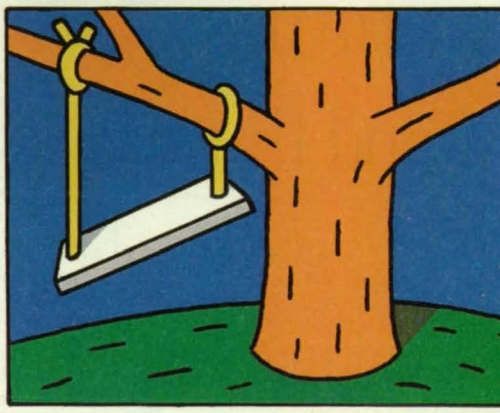
What Marketing Asked For



What Design Specified



How Manufacturing Built It



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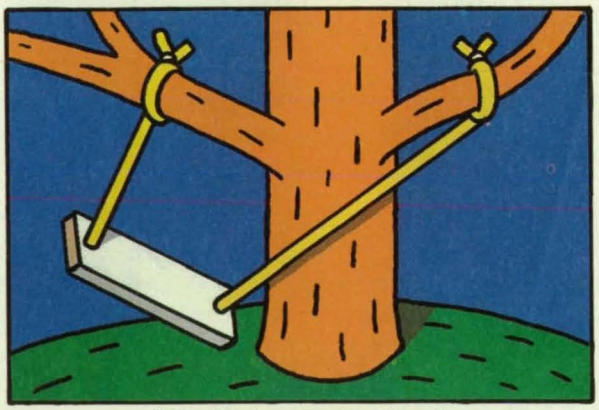
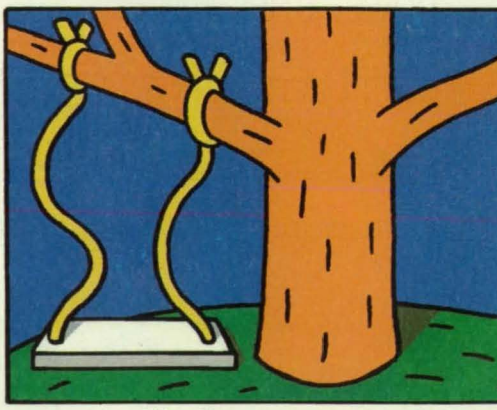
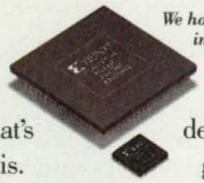


What Engineering Developed



What Documentation Described



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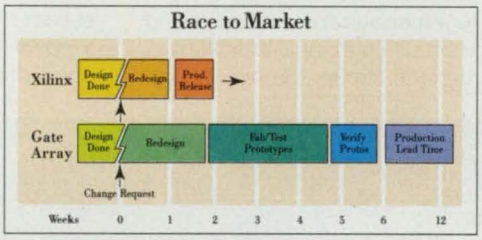

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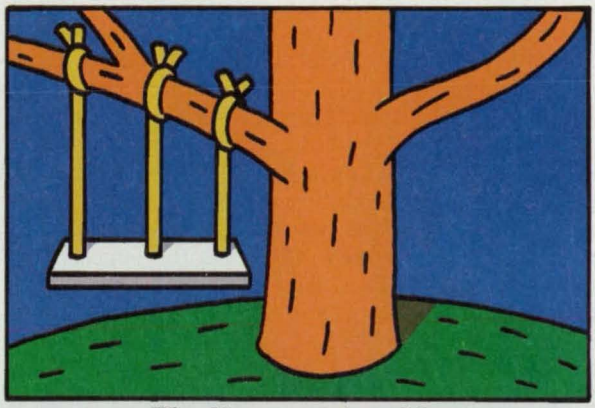
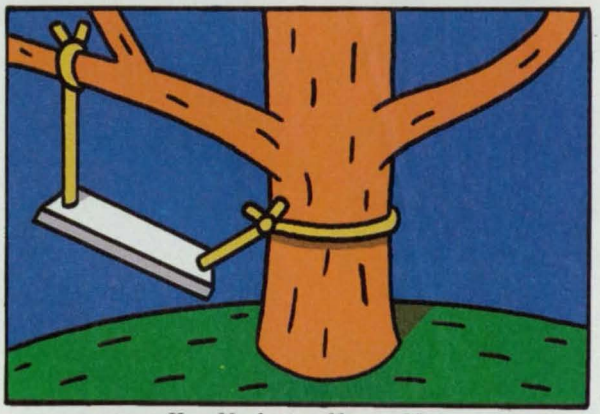
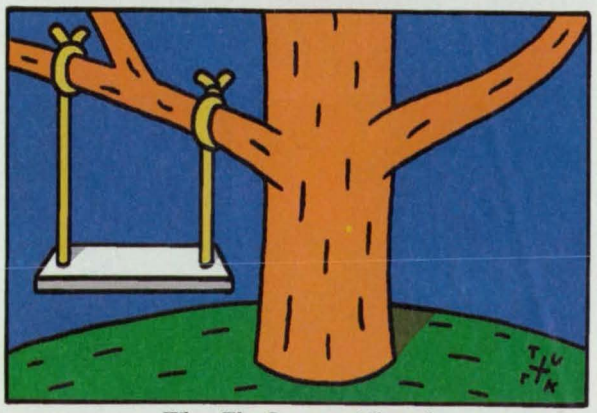


What Management Agreed On



How Marketing Changed It



What The Customer Wanted

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Optoelectronic Receiver for Communication and Control

Many operational and diagnostic features are integrated into a circuit chip.

Lewis Research Center, Cleveland, Ohio

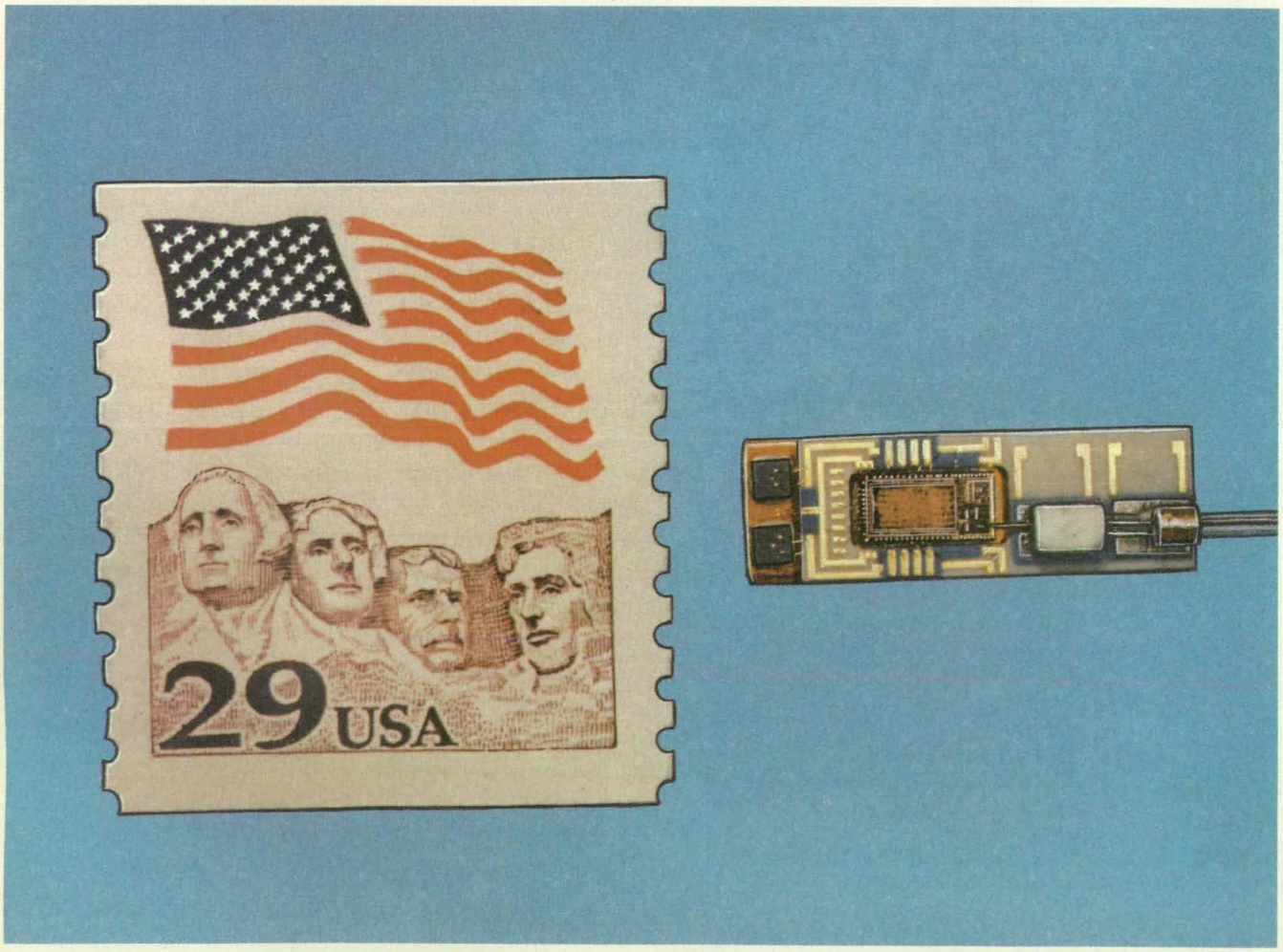
The figure shows a GaAs-based integrated circuit designed to serve as an optoelectronic interface in a phased-array antenna. The principal intended function of this circuit is to receive digital control signals that have been transmitted on an optical fiber and to convert these signals to electronic control signals, which are then applied to a monolithic microwave integrated circuit (MMIC). Interface circuits of this type could also be used in the reception of high-rate optical digital communications within computers, between computers, and in signal-distribution systems in aircraft, automobiles, and ships. The transistor/transistor-level outputs of these interface circuits would be compatible with many digital circuits.

In the phased-array-antenna system, control data and clock signals are encoded together and transmitted to the interface circuit on a single optical fiber. In the interface circuit, the optical signal is detected by an integrated metal/semiconductor/metal (MSM) photodetector and amplified by a three-stage GaAs amplifier/limiter. The signal is then decoded to separate the data signal from the clock signal. The clock signal is used to synchronize the entry of the data into an address/instruction register and a 1:8 demultiplexer. The data are then fed out through a driver circuit, which shifts the levels of the output data signals to the MMIC input levels.

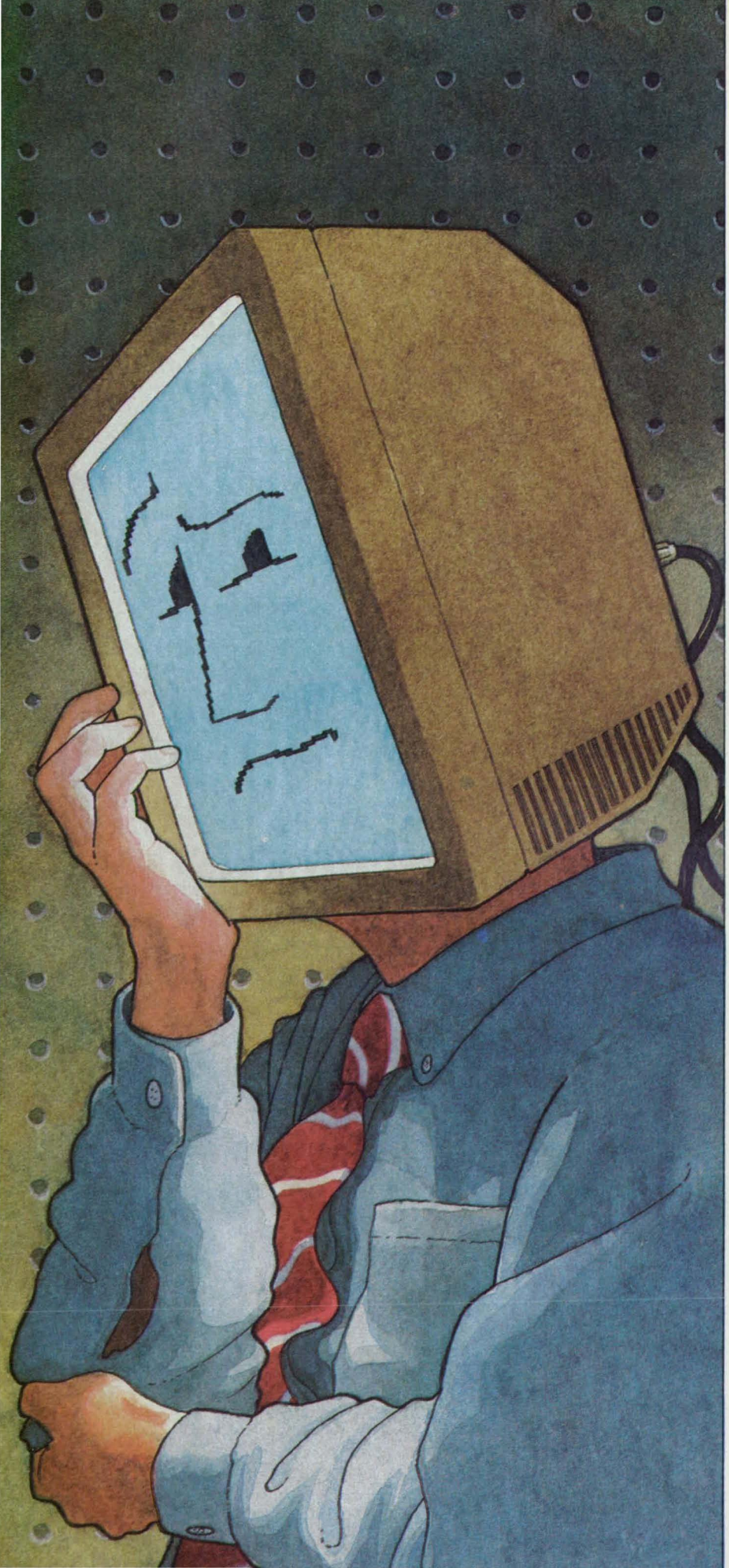
This interface circuit represents a significant improvement over preexisting interface circuits in that its clock-signal-recovery subcircuit requires little or no preamble for immediate synchronization. The circuit operates in both continuous and burst data modes at rates up to 500 Mb/s. The design incorporates several diagnostic features, including options for optical vs. electrical clock inputs and outputs of raw data, addresses, and instructions.

The circuit also features an optical-signal-detection subcircuit that can be used to minimize the consumption of power between data-transmission times by turning off the power to all subcircuits except the output registers and drivers. This last feature reduces the consumption of power to approximately one-seventh of its fully operational level. This is the first known integrated-circuit optoelectronic interface of its kind to incorporate so many operational and diagnostic features while satisfying military specifications at such high data rates.

This work was done by Richard Kunath of **Lewis Research Center** *and Mark Bendett and I. Ross MacTaggert of Honeywell, Inc. For further information,* ***write in 101*** *on the TSP Request Card.*
LEW-15531



An **Optoelectronic Interface Circuit** like this one is connected to each MMIC in a phased-array antenna. This circuit receives optical control signals and converts them to electronic control signals for the MMIC.



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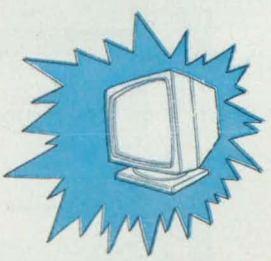

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Half-State Readout in Vertical-Bloch-Line Memory

Potentially narrow margins of chirality-based chopping of magnetic stripes would be avoided.

NASA's Jet Propulsion Laboratory, Pasadena, California

Half-state readout is an experimental method of readout in a Vertical-Bloch-Line (VBL) memory. Half-state readout is based on differential deflections of the magnetic stripe domains in which data bits are stored. To give meaning to an explanation of half-state readout, it is necessary to recapitulate from "Vertical-Bloch-Line Memory" (NPO-18467), *NASA Tech Briefs*, Vol. 17, No. 6 (June 1993), page 42: The storage medium in a VBL memory is a film of magnetic garnet or other suitable magnetic material. Blocks of data are stored in magnetic stripe domains, the locations of which are stabilized and demarcated by grooves in the film. The magnetic anisotropy of the film is such that the magnetization lies perpendicular to the film, the bulk of the film being magnetized in one direction and the stripes constituting ferromagnetic domains magnetized in the opposite direction.

A vertical Bloch line (VBL) is a twist of magnetization in a Bloch wall (the boundary of a domain) in the plane of the film. Two such twists constitute a VBL pair. If both VBL's in a pair have the same chirality, then the VBL pair is stable and its size is much less than 1 μm. Data are stored in VBL pairs: the presence or absence of a VBL pair at a bit-cell location represents a binary 1 or 0, respectively. Heretofore, readout has been effected by application of a suitable combination of bias magnetic fields to expand one end of the magnetic stripe into a head and convert the VBL pair (if any) at that location to a magnetic bubble domain, which can be detected via the magnetoresistive effect. Unfortunately, readout by this method has been potentially subject to errors caused by narrow margins of chopping, based on the chiralities of the Bloch walls, of the magnetic stripe domains.

Half-state readout is intended to avoid these narrow margins. Its principle of operation is such that the presence of a VBL pair is converted into one electronic signal, while the absence of a VBL pair is converted into a different electronic signal. The reading gate associated with a given stripe domain is designed to exploit the fact that the force exerted on the head of the magnetic stripe by a stripe-expanding magnetic field perpendicular to the plane of the ferromagnetic film is directed at angle $\alpha = \tan^{-1}(KS)$ from the lengthwise axis of the stripe in the plane of the film, where K is a constant and S is the net chirality summed over that portion of the Bloch wall that is subjected to the stripe-expanding magnetic field.

The figure illustrates the operation of a reading gate. Assume that the associated magnetic stripe domain contains no VBL pair. In such a case, the Bloch wall is unichiral and $S \neq 0$, so that $\alpha \neq 0$. Thus, when the stripe-expanding conductor in the reading head is energized to generate the stripe-expanding magnetic field, the head of the stripe is deflected. Then if stripe-chopping conductor B is energized, the stripe is cut, yielding a magnetic bubble, which can be transferred out and detected.

Now suppose that there is a VBL pair in the head of the stripe. The pair is split when the stripe-expanding conductor is energized, placing a single Bloch line near the readout head and reducing the net chirality, S, to zero, so that $\alpha = 0$. In such a case, the stripe expands straight ahead, missing chopping conductor B. Thus, no bubble is produced when chopping conductor B is energized. Optionally, however, a bubble can be obtained by energizing chopping conductor A.

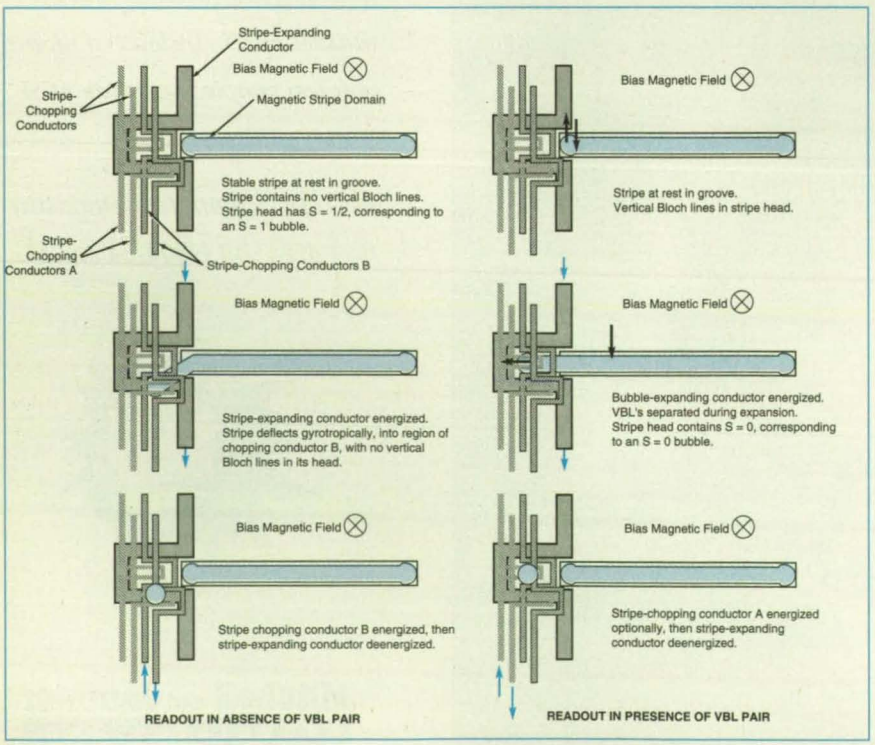
This work was done by Romney R. Katti, Jiin-Chuan Wu, and Henry L. Stadler of Caltech for **NASA's Jet Propulsion Laboratory**. *For further information,* ***write in 83*** *on the TSP Request Card.*

NPO-18644

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to

William T. Callaghan, Manager
Technology Commercialization
(M/S 79-23)
Jet Propulsion Laboratory
4800 Oak Grove Drive
Pasadena, CA 91109

Refer to NPO-18644, volume and number of this NASA Tech Briefs *issue, and the page number.*



The **Head of a Magnetic Stripe** is deflected in the absence of a VBL pair, but expands along a straight line if it contains such a pair. A deflected head can be chopped to obtain a magnetic bubble.

Metal-Film Hall-Effect Devices

Large positive and negative Hall coefficients are achievable.

Marshall Space Flight Center, Alabama

A family of Hall-effect devices is made from multilayer metal films instead of the semiconductor materials used heretofore. The metal films are easier to fabricate; they can be formed by deposition on a variety of substrates, and leads can readily be attached to them. Also in comparison with semiconductor Hall-effect devices, the metal-film Hall-effect devices can be fabricated with larger areas, are potentially more reliable, and are less affected by impurities. These devices would be especially useful at low temperatures.

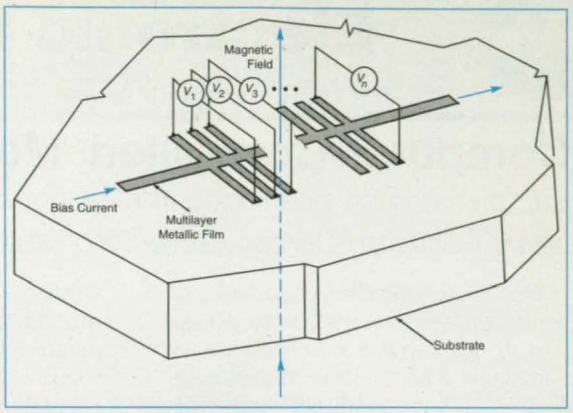
Like their semiconductor counterparts, the metal-film Hall-effect devices, can be used to measure magnetic fields. In a Hall-effect device, a bias current is passed through the sensing film, and an electric field perpendicular to the current is generated by the interaction of the current and the magnetic field via the Hall effect. The Hall electric field can be measured as a voltage that appears at contacts arranged across the current.

Metal films can be patterned as arrays of Hall probes (see figure). In this configuration, the bias current generates an independent voltage, proportional to the local magnetic field, across each probe arm, and each such voltage can be measured via contact leads at the tips of the arms. The device thus measures the spatial distribution of the magnetic field, making it possible to create a detailed image of the field.

Thus far, films with large positive and negative Hall coefficients have been made by alternately depositing layers of tungsten and niobium. Layers with constant thicknesses ranging from less than 10 Å to more than 30 Å have been fabricated and found to exhibit various Hall-effect properties. Other metals and their oxides may also be suitable for deposition.

This work was done by Palmer N. Peter of **Marshall Space Flight Center**. *No further documentation is available.*

Inquiries concerning rights for the commercial use of this invention should be addressed to the Patent Counsel, Marshall Space Flight Center [see page 24].
Refer to MFS-28764.



Multilayer Metal Film Is Deposited as a string of Hall-effect probes. The voltages across the probe arms (V_1, V_2, V_3, and the like) indicate the local magnetic field.

Computer-Controlled, Motorized Positioning System

Samples can be positioned in a vacuum system, in four degrees of freedom.

Lewis Research Center, Cleveland, Ohio

A computer-controlled, motorized positioning system has been developed for use in the robotic manipulation of samples in a custom-built secondary-ion mass spectrometry (SIMS) system. In SIMS, as in many analytical techniques, the orientation of a sample must be accurately controlled to carry out systematic measurements. In some cases, it may be necessary to position samples in situ; it is difficult to do this manually. The computer-controlled, motorized positioning system can position a sample repeatably and accurately, even during an analysis.

The system can position a sample in three linear orthogonal coordinates and one angular coordinate under manual local control, or microprocessor-based local control or remote control by a computer via a general-purpose interface bus (GPIB). To minimize the cost of equipment, the hardware and circuitry of this system were custom designed and built to automate an existing commercially available 4-axis, manually controlled manipulator. (Motorized manipulators for ultra-high-vacuum applications are available commercially but were not chosen for this system because they are expensive and often lack versatility; for example, a unit of this type cannot be switched or easily converted between manual control and remote control from a host computer via a GPIB.)

Figure 1 shows the motorized positioning mechanism mounted on a SIMS analysis chamber. Motor-drive mechanisms dedicated to the *x*, *y*, and *z* translational degrees of freedom and the one rotational degree of freedom are mounted on the manipulator body by use of custom-built brackets. Each drive mechanism includes a pair of timing pulleys coupled by a timing belt and driven by a biphase stepping motor. One pulley is attached to the motor shaft, while the other is mounted on the handle of the micrometer that was originally designed to be used in manual positioning along the affected axis.

Each motor provides angular steps of 3.6° (100 steps per revolution), and the micrometers have 500 divisions per revolution, each division representing a translation of 1 μm. For *x*, *y*, and *z*, a pulley ratio of 5:1 is used to increase the drive torque and refine the resolution from 5 μm per step to 1 μm per step. For the rotational axis, a pulley ratio of 3.6:1 is used to obtain a resolution of 1° per step.

The microprocessor-based control subsystem shown in Figure 2 was designed and built to provide for computerized control of the stepping motors. This subsystem includes custom-built circuitry connected, via an interface circuit, to a commercially available microcomputer. The microcomputer includes an MC6802 microprocessor, memory, display, keyboard, and power supply. The custom-made circuitry includes stepping-motor dri-

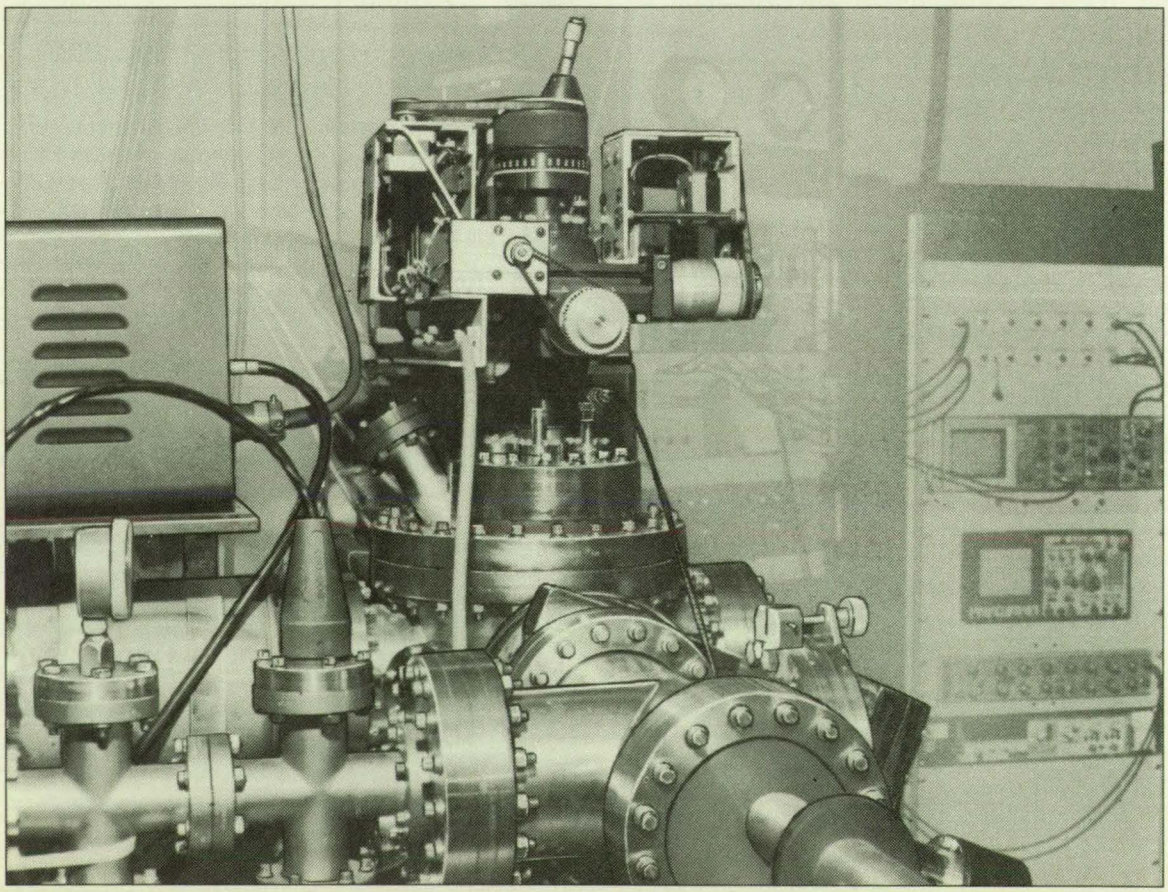


Figure 1. The **Positioning Mechanism**, part of the motorized positioning system, is mounted on the main analysis chamber of a SIMS system.

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vers, control-logic circuits, a GPIB interface, memory, a decoding circuit, and its own power supply.

Software is provided in this system at two levels. First, an assembly-language program resides in read-only memories in the microprocessor-based controller. This program interprets and executes both local instructions that originate from the keyboard of the microcomputer and remote instructions that come from a host computer via the GPIB. This program also tracks and displays one rotational and three translational manipulator coordinates, provided that the initial values of them were correctly entered into the memory of the microcomputer prior to operation. (Prior entry is necessitated by an open-loop design.)

The other level of software needed for the operation of the system pertains to the host computer. The software for the host computer was developed by use of a high-level scientific software package called ASYST. Routines for control of the position of the sample were easily incorporated into software written previously for control of, and acquisition of data from, the SIMS system.

The performance of the positioning system has been tested for backlash and repeatability by moving a silicon sample in complex patterns, bombarding it with 15-keV oxygen ions at each location, and measuring offsets in the resulting sputter patterns. Although the maximum measured backlash in all directions is about 80 μm, the positioning is highly repeatable (no offset is detected), provided that backlash is taken into account when moving the sample.

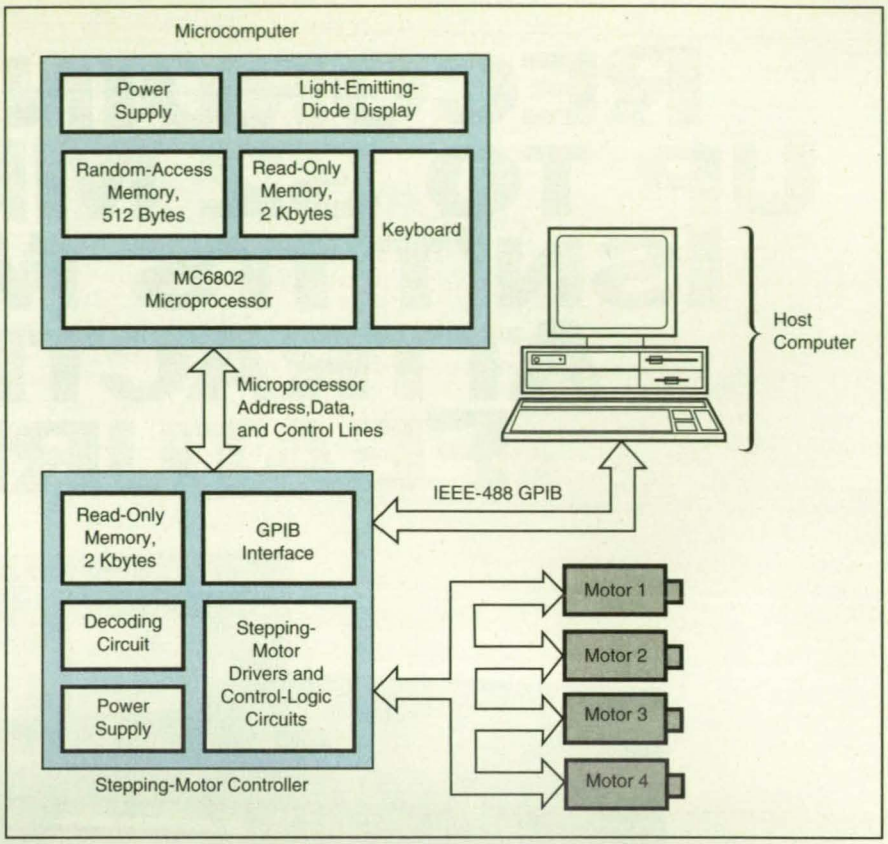

Figure 2. This **Microprocess-Based Control System** provides for manual local control (via the keyboard) or computerized remote control (from the host computer via the GPIB) of the positioning mechanism.

This work was done by Carlos Vargas-Aburto and Dale R. Liff of Kent State University for **Lewis Research Center**. *No further documentation is available. LEW-15452*

Measuring Frequency Instability of a Large Antenna

Contributions of instability from other sources are minimized.

NASA's Jet Propulsion Laboratory, Pasadena, California

The figure illustrates a technique for measuring the frequency instability of a 34-m-diameter radio-astronomical antenna with beam-waveguide coupling to the associated receiver signal-processing equipment. The measurements are intended primarily to reveal the contributions of wind and air-temperature effects on the antenna and beam-waveguide structures to the overall frequency instabilities of received signals. In comparison with older techniques for measuring the frequency instabilities of antennas, this technique is simpler, less expensive, potentially capable of providing instability data in shorter measuring times, and more precise.

The technique involves the reception of far-field signals transmitted from geostationary satellites at frequencies from 11.7 to 12.2 GHz. Both the 34-m antenna under test and a stable reference antenna of 10-ft (about 3-m) diameter are aimed to receive one of these signals, and the outputs of both antennas are fed to a phase-detector Allan-variance-measuring instrument located in the pedestal room under the 34-m antenna. Those phase variations that are common to the signal-propagation paths from the satellite through both antennas cancel each other at the output of a mixer in the Allan-variance-measuring instrument. Thus, the phase variations that remain should be attributable to differences between the 34-m antenna under test and the reference antenna.

To enable accurate determination of the frequency instability of the antenna down to a level of about 2×10^{-5}, it is necessary that the signal-propagation path from the reference antenna to the Allan-variance-measuring instrument be very phase stable, exhibiting a fractional frequency instability of no more than about 2×10^{-16}. This stringent frequency-stability requirement is satisfied by use of a fiber-optic system: The signal received by the reference antenna is amplified, filtered, and amplitude-modulated onto a laser beam, which is transmitted along 150 ft (about 46 m) of fiber-optic cable to a fiber-optic receiver located near the Allan-variance-measuring instrument.

The signal received by the 34-m an-

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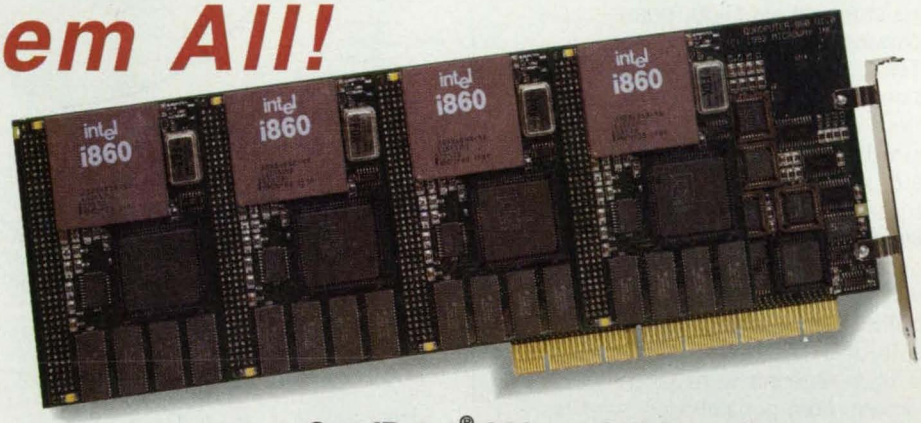

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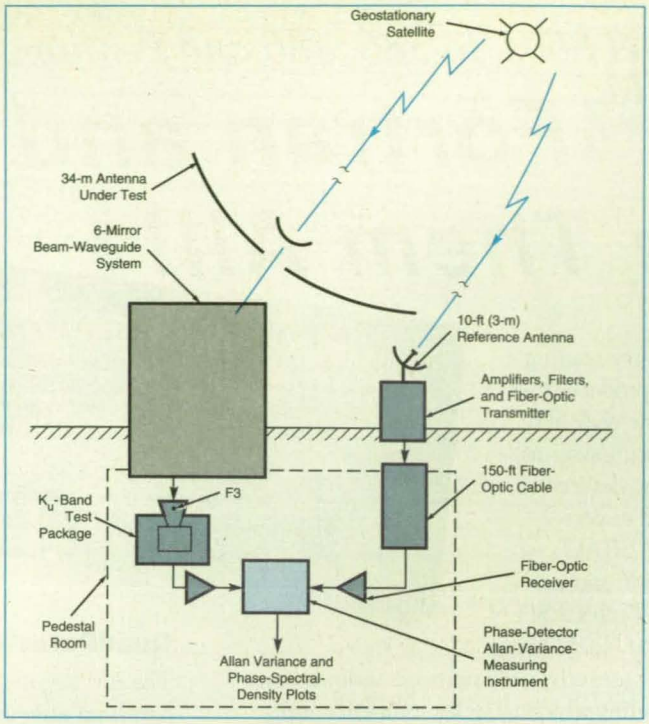
tenna under test is processed via a K_u-band test package placed near one of the focal points (called "F3") of the antenna/beam-waveguide system. The output of this test package and the output of the fiber-optic receiver are coupled to the Allan-variance-measuring instrument via short, phase-stable microwave cables.

Tests of the fiber-optic signal-propagation system alone (without the reference antenna) showed that this system exhibits typical Allan variances of the order of 4×10^{-16} during 1,000-s sampling intervals, and that the best performance achievable by this system is an Allan variance of about 1.1×10^{-6}, which satisfies the frequency-stability requirement. Preliminary measurements of the frequency instability of the 34-m antenna were taken by use of signals from geostationary satellites at elevation angles of 46.5° and 37°: these measurements showed a frequency instability that ranged between 1.3×10^{-15} and 2.2×10^{-15} for measuring intervals of 1,024 s, in good weather. Previous techniques yielded measurements no more precise than a few parts in 10^{14}.



The **Frequency Instability of the Antenna Under Test** (relative to that of the reference antenna) is determined from measurement of the phase deviation between the outputs of the two antennas. The fiber-optic system is used to minimize a spurious component of frequency instability contributed by propagation of the signal from the reference antenna to the Allan-variance-measuring instrument.

This work was done by Tom Y. Otoshi, George F. Lutes, and Manuel M. Franco of Caltech for **NASA's Jet Propulsion Laboratory**. *For further information,* ***write in 68*** *on the TSP Request Card.*
NPO-18991

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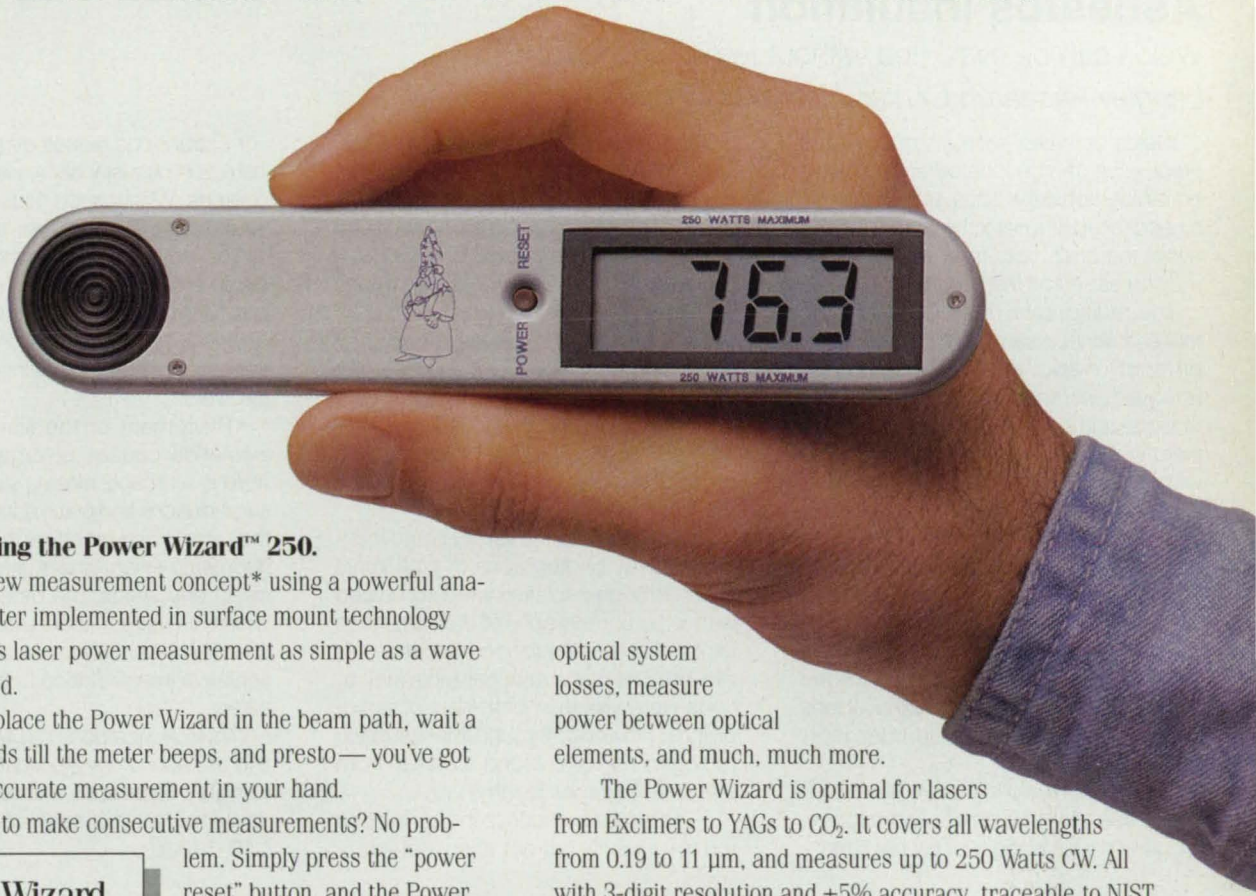

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*Patent Pending

For More Information Write In No. 599

Inspecting Pipe Radiographically Through Asbestos Insulation

Welds can be evaluated without removing insulation.

Langley Research Center, Hampton, Virginia

Welds between sections of insulated steampipe can be located and inspected radiographically. Thus, unless there is a need to repair a defective weld, one can avoid the cost, time, and hazard of removing asbestos insulation.

The radiographic inspection method makes it unnecessary for inspectors to rely on spot checks in which insulation is removed. Instead, it enables inspectors to locate and evaluate nondestructively any weld in a pipe system. They can do so without shutting down the steam, inasmuch as the intact insulation protects workers from injury and equipment from damage. Most important, they do not have to disturb the insulation and thereby cause the release of potentially carcinogenic asbestos particles. Elaborate asbestos-handling procedures that involve the use of tents, masks, and exhaust fans are unnecessary unless an unacceptable joint is found.

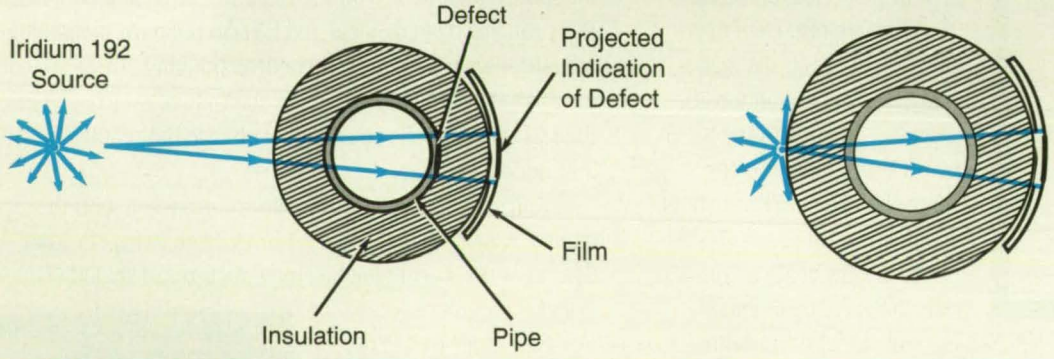
The hidden weld joints are first located by use of a low-power fluoroscope, which is moved along a pipe while a technician observes the fluoroscopic image. The low-energy x rays from the fluoroscope penetrate the insulation but not the pipe. Thus, a weld bead appears in silhouette on the fluoroscope screen. The technician can then accurately mark weld sites on the insulation for later inspection.

The radiographic inspection is then done by exposing x-ray film on one side of a pipe to an iridium-192 x-ray source on the opposite side. Depending on the diameter of the pipe, the iridium may be placed directly on the pipe or on a standoff (see figure).

To demonstrate the validity of the technique, x-ray photographs of pipe joints taken through insulation were compared with x-ray photographs of the same pipe joints after the insulation had been removed. The same unacceptable indications were visible in both sets of radiographs. However, through-the-insulation radiographs were found to differ from direct radiographs in three ways:

- The insulation reduces the contrast on the film slightly, but not unacceptably.
- Extraneous pieces of material in the insulation occasionally appear in the radiographs. Where such material affects interpretation of an image, the weld joint can be radiographed with the x-ray source slightly offset from its initial position. By comparing the two radiographic images, one can decide whether a piece of material that appears in the images is inside or outside the weld.
- Placement of the film outside the insulation causes enlargement of the weld in an image, making such defects as slag inclusions and pores appear larger than they are. However, rather than correct for geometric enlargement, interpreters can reject any welds, the defect images of which are larger than allowed in code specifications, thus implementing a conservative interpretation in the interest of safety.

This work was done by David P. Gianettino of Technology Applications, Inc., for **Langley Research Center**. *No further documentation is available.*
LAR-14930



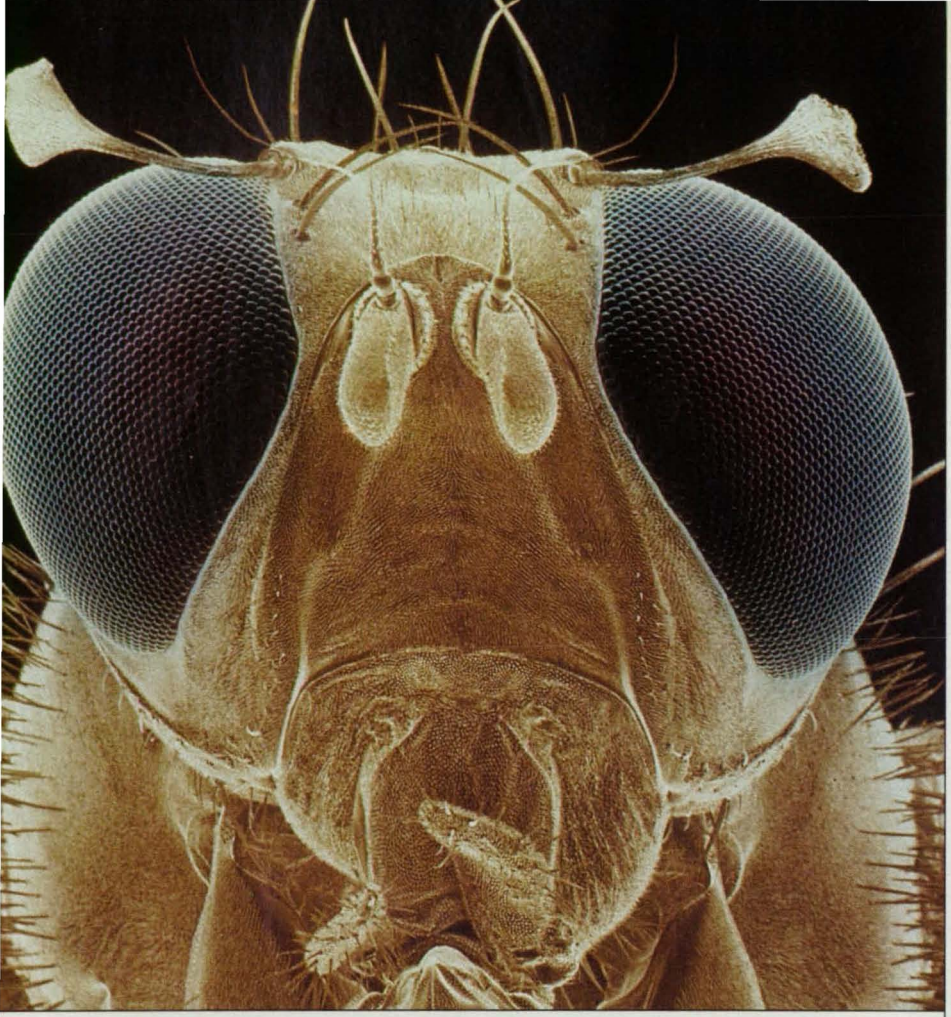
The **Iridium-192 X-Ray Source** is placed on or away from the insulation, depending on the diameter of the pipe.

Oil-and-Gas-Fire Snubber

The flame is diverted and extinguished without explosives.

Langley Research Center, Hampton, Virginia

Several methods are currently used to extinguish oil and gas fires. In some methods, one collapses the feed source and thus stops the fuel supply. In others, one extinguishes the flame while the fuel is still running. The first approach usually involves sudden application of force to collapse a pipe or to plug a hole solidly. The second approach most often



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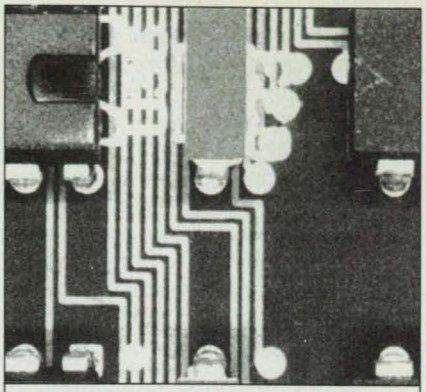

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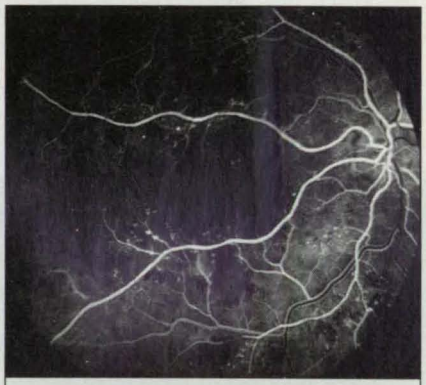

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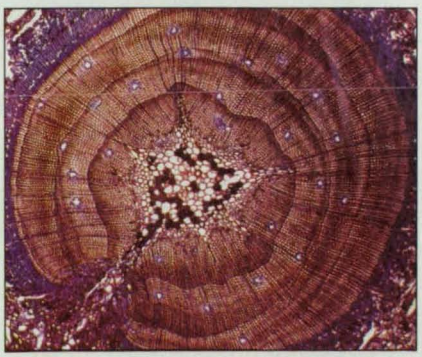

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involves setting off a powerful explosive device close to the flame source, thus forcing the flame away from the fuel long enough to extinguish it. In other methods, one generally tries to cool or dilute the flame below ignition conditions.

The oil-and-gas-fire snubber extinguishes the flames without the use of an explosive and with the use of little or no coolant. The snubber consists of a pipe with two branches and a selector valve to connect the pipe to either branch (see Figure 1). The snubber is placed over the oil or gas fire, then seated tightly against the ground with the flame coming out of one of the branches. If the ground is allowed to cool and small fires on the ground are extinguished, the only remaining flame will be coming from the open branch.

The flow is then rapidly redirected to the other branch (see Figure 2) in such a manner as not to raise the back pressure significantly during the switching process. The flame will not transfer to the new branch. Care must be taken to prevent backflash through the tube to the new exit; consequently, an internal flame suppressor (honeycomb, screen, or sprayed water) may be needed.

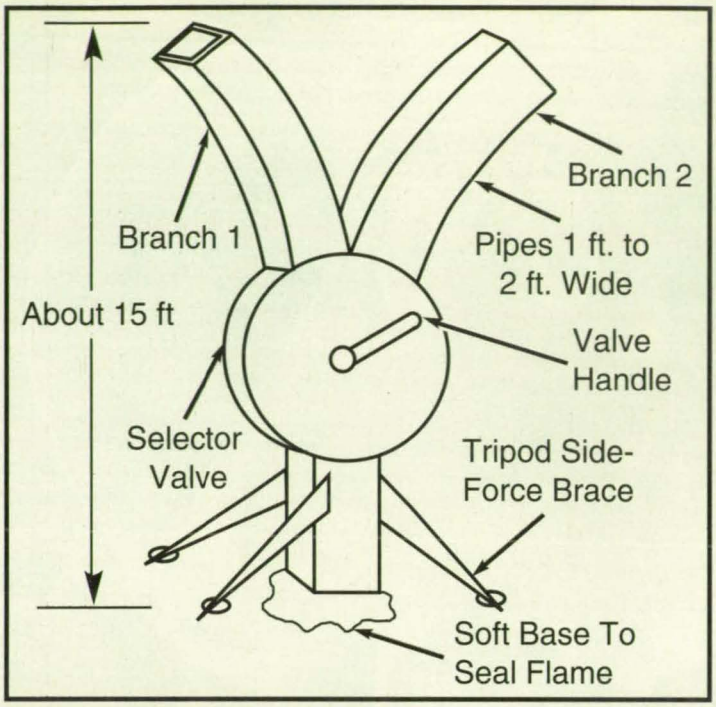


Figure 1. The **Oil-and-Gas-Fire Snubber** consists of a pipe with two exit branches and a large selector valve, which is positioned over a well, on the path of escaping fuel.

Each of two versions of the snubber would have different uses. The first version would be used only to extinguish the fire. The exit branch would be only long enough to keep the fuel away to prevent reignition. The second version

would be needed if a well could not be capped after a fire at the well was extinguished and oil and gas remained present in problem quantities. In this version, the exit branch would be long enough to extend to an oil-storage tank, and the gas would be separated from the oil and vented or burned at a convenient location.

Because the snubber has to be placed over the fire and because the forces (weight of the snubber and forces caused by flow of oil and gas) encountered in this operation can be fairly large, the methods of positioning and bracing the snubber are also important. For example, a tracked vehicle, such as a bulldozer, with a forward cranelike extension could be used to position the snubber and to turn the valve handle remotely. The snubber method should prove significantly less expensive and less time consuming than other more conventional methods have been.

This work was done by Leonard M. Weinstein of **Langley Research Center**. *No further documentation is available.*
LAR-14691

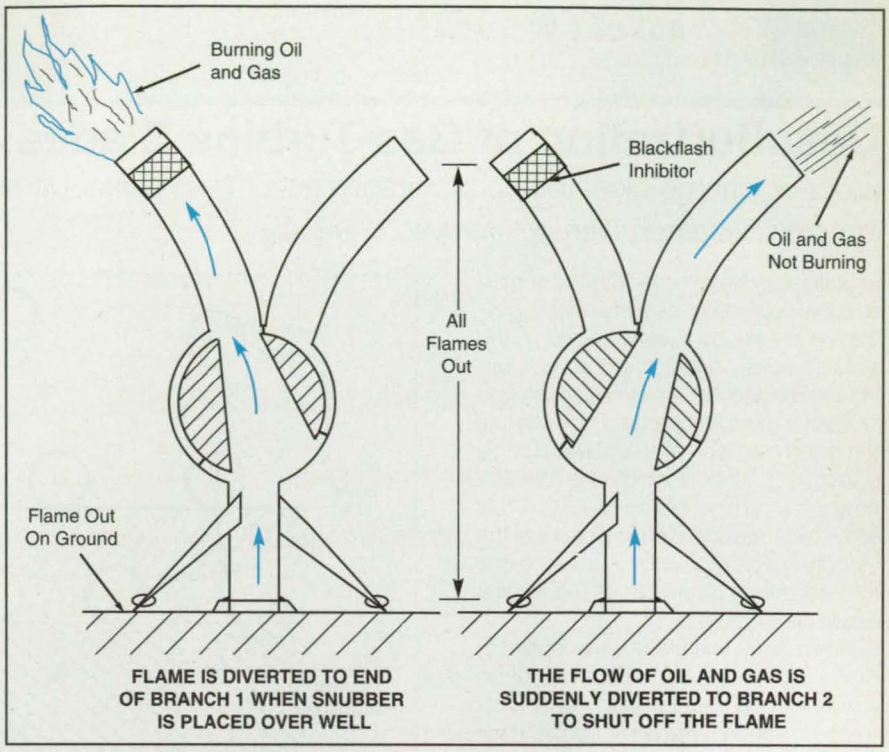


Figure 2. The **Flame Is Moved To One Side**; then the flow of fuel is moved to the other side, away from the flame.

Desulfurization of Gas-Turbine Blades

Glow-discharge cleaning could remove sulfur from nickel-based superalloys.

Langley Research Center, Hampton, Virginia

Sulfur can be removed from the nickel-base superalloy used to make gas-turbine blades by heating the alloy and simultaneously subjecting it to sputtering by directed Ar^+ ions from an ion gun or from a glow discharge. Reduction of the sulfur content of the superalloy by a factor of 10 could increase the lifetime of a turbine blade made of this alloy by a similar factor, because the stability of the protective surface oxide formed during operation of the turbine would be increased.

A thin and continuous scale or film of Al_2O_3 that forms on the surface of an advanced nickel-base superalloy protects the underlying alloy from further oxidative attack at temperatures above 980 °C. It has been found, however, that the segregation of indigenous sulfur to the alloy/oxide interface induces the otherwise adherent aluminum oxide scale to spall during thermal cycling (see Figure 1). The present method to prevent this spalling is to add small, precise amounts of yttrium and other lanthanides to the melt of the Ni-based superalloy to react chemically with the sulfur and form stable sulfides that lock up the sulfur and prevent it from segregating to the interface between the bulk alloy and the Al_2O_3 overlayer. However, the inherent reactivity of yttrium and other lanthanide elements requires an exceptionally high degree of control over the alloy chemistry during melting and casting, which often gives an inferior blade.

Figure 2 illustrates the glow-discharge version of the proposed sputtering/heating desulfurization process. Extrapolating from previous research on a Ti/Al/Nb alloy, it is expected that heating the nickel superalloy to a temperature of about 800 °C should result in dissolution of the surface carbon and oxygen followed by the subsequent segregation of sulfur to the grain boundaries, phase boundaries, and then to the interface or surface, from whence it would be depleted by impact of Ar^+ ions. A viscous flow of argon at a pressure between 0.1 torr (about 13 Pa) and 5 torr (about 0.7 kPa) would remove the sulfur from the vicinity of the surface, thereby preventing readsorption. (This flow would have to be turned off during

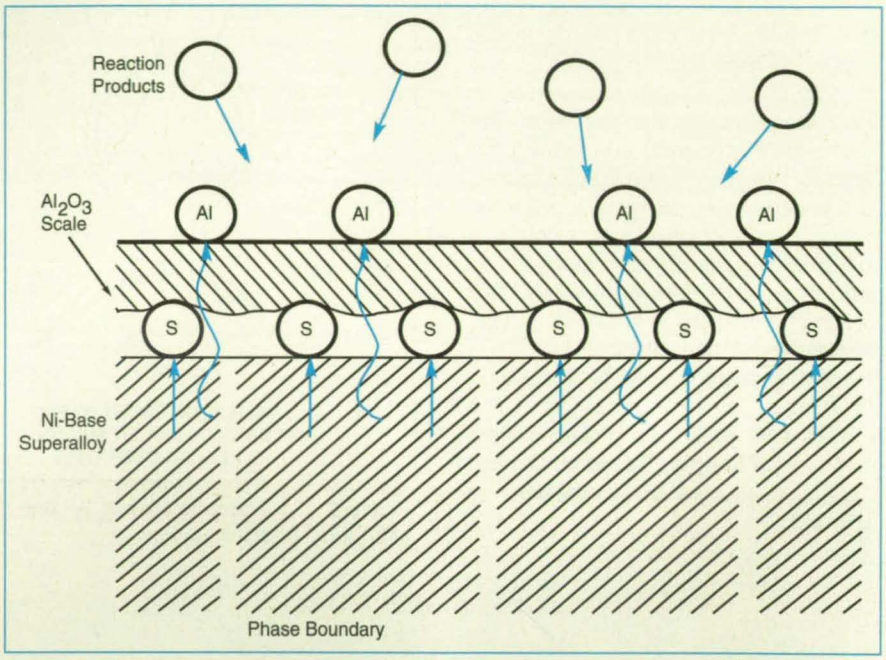


Figure 1. **A Protective Scale of Al_2O_3** forms on the surface of a turbine blade. However, segregation of sulfur to the surface causes spallation of the Al_2O_3 scale.

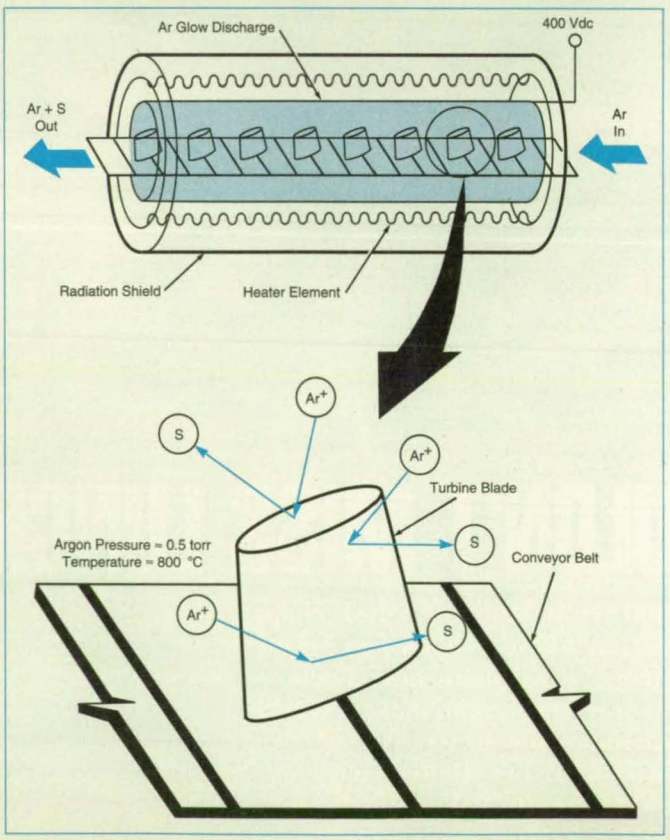
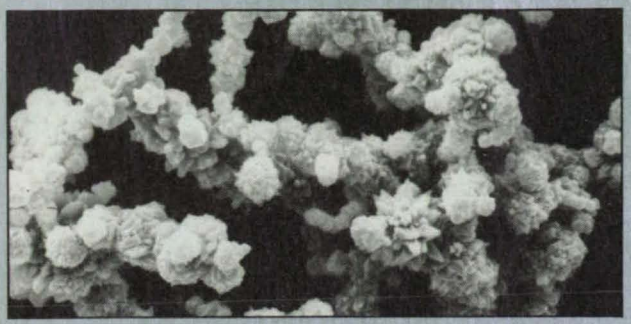
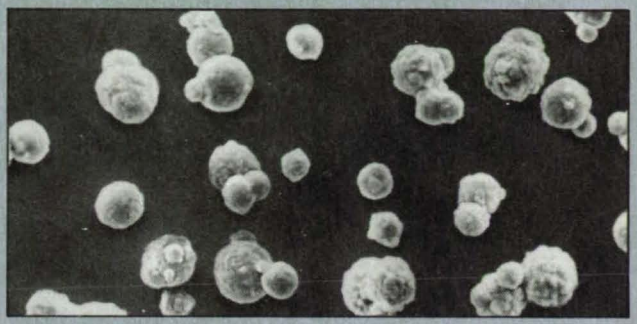


Figure 2. **Gas-Turbine Blades** made of Ni-based superalloy would be desulfurized by simultaneous heating and exposure to a glow discharge in flowing argon gas.

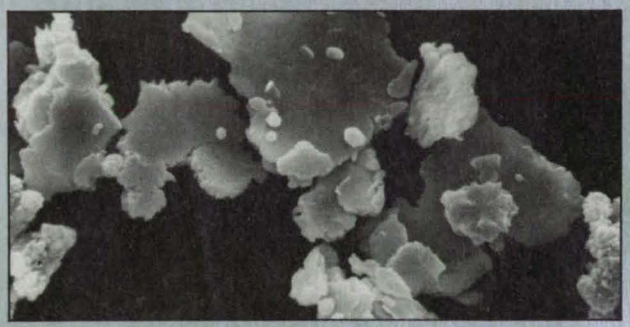
SPECIFY INCO SPECIALTY POWDERS FOR WIDE RANGE OF ELECTRONIC APPLICATIONS



Inco Type T 287 Filamentary Powder, particle size (FSSS) 2.6-3.3 microns, apparent density 0.75-0.95 g/cc, relative surface resistivity 0.30 ohms per square (□).



Novamet Silver Coated Nickel Spheres, 15% Ag, 2.5 g/cc apparent density, particle size 10 microns, screen mesh 99%-250, surface resistivity 0.03 Ω/□.



Novamet HCA-1 Flake, screen mesh 98% minus 400, apparent density 0.90 g/cc, thickness 1.0-1.1 microns, surface resistivity 0.25 Ω/□.

Novamet Nickel Coated Graphite, 60% fully encapsulated Ni, apparent density 1.6 g/cc, particle size (FSSS) 100 microns, screen mesh 63% −150/+250, surface resistivity 0.3 Ω/□.

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For More Information Write In No. 535

ion-gun sputtering because of the need for a large mean free path for the ions.) In the glow-discharge version of the process, the speed of the conveyor belt would be such that the blades would be in the heater-tube/glow-discharge region for a sufficient time to deplete the sulfur in the turbine blades. This time would be a function of the size and shape of the blades and of the time necessary for the sulfur to diffuse from the most distant regions of the bulk blade material to the surface. This technique is also amenable to a batch process.

This work was done by Ronald A. Outlaw of **Langley Research Center**. *For further information,* ***write in 43*** *on the TSP Request Card.*

Inquiries concerning rights for the commercial use of this invention should be addressed to the Patent Counsel, Langley Research Center [see page 24]. Refer to LAR-14784.

Polyimides Containing Pendent Ethynyl Groups

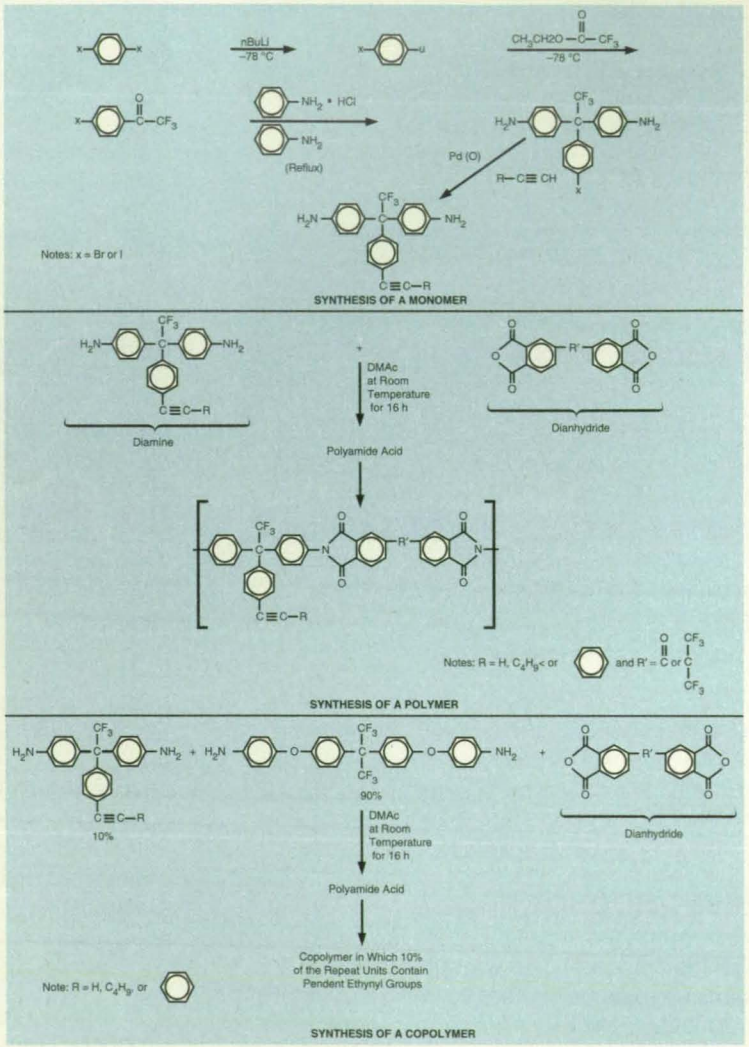
Upon heating, the pendent ethynyl groups react to form useful cross-linked resins.

Langley Research Center, Hampton, Virginia

A series of novel diamines containing pendent ethynyl groups have been synthesized and reacted with various dianhydrides to form polyamide acids that have been cyclodehydrated to form polyimides containing pendent ethynyl groups. Copolyimides of these diamines and other diamines have also been prepared. Upon heating, the ethynyl groups in these polymers react with one another to form cross-linked molecular structures. As a result of this curing reaction, the resistance to solvents, glass-transition temperature, and modulus of elasticity of a polymer of this type generally increase, accompanied by a corresponding decrease in tensile elongation and toughness. The cured polymers can be used as films, moldings, adhesives, and composite matrices.

In comparison with acetylene-terminated imide (ATI) oligomers, which typically form brittle films, the polyimides that contain pendent ethynyl groups exhibit high molecular weights and form tough films before the ethynyl crosslinking reaction takes place. Furthermore, the crosslink density of the cured resins made from polyimides that contain pendent ethynyl groups can be controlled by copolymerizing diamines that do not contain ethynyl groups with diamines that do contain the pendent ethynyl groups to form high-molecular-weight polymers. The crosslink densities of ATI's can be varied only by changing the molecular weights of the oligomers, thereby affecting the ability to make films and moldings.

The figure shows some typical syntheses. The ethynyl-containing monomer reacted with a suitable dianhydride in dimethylacetamide (DMAc) for 8 to 16 h at room temperature to form a polyamide acid. To form a film, for example, the polyamide acid can be cast onto a glass plate and subsequently dried at temperatures as high as 350 °C. Some of the films made in this way exhibit glass-transition temperatures when subjected to differential scanning calorimetry. These films are insoluble in either DMAc or chloroform. Alternatively, the monomers can be used to prepare amide acid copolymers and, ultimately, imide copolymers, as shown at the bottom of the figure. The copolymers are insoluble in DMAc or chloroform, but do swell somewhat.



Diamine Monomers and Resultant Polymers are synthesized according to the two reaction schemes shown.

This work was done by Paul M. Hergenrother and Brian J. Jensen of **Langley Research Center**. *For further information,* ***write in 103*** *on the TSP Request Card.*

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to the Patent Counsel, Langley Research Center [see page 24]. Refer to LAR-14825.

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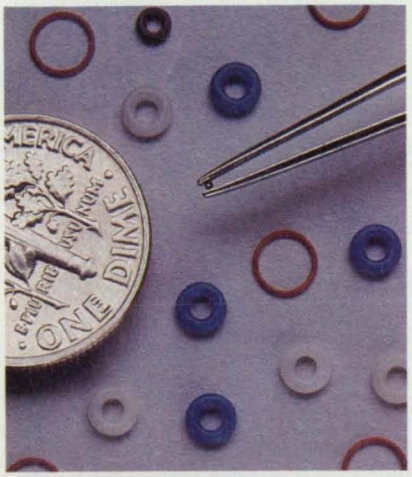

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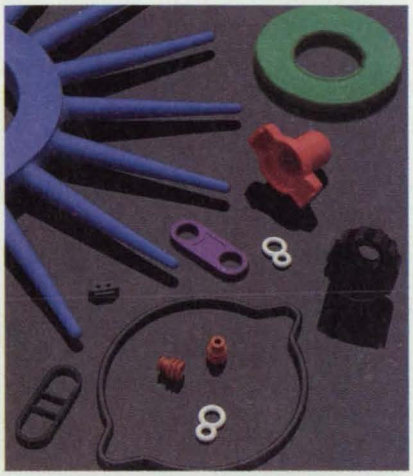

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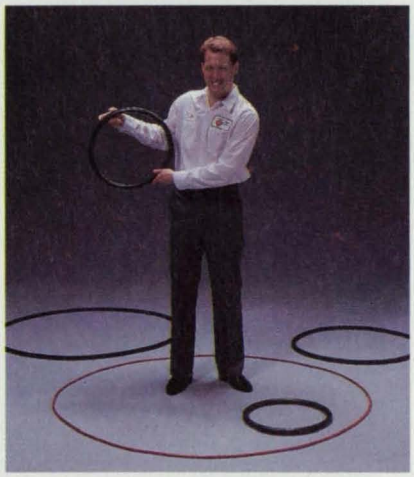

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Aromatic Polyimides Containing Meta-Biphenoxy Moieties

Low glass-transition temperatures make these polymers more thermoplastically processible.

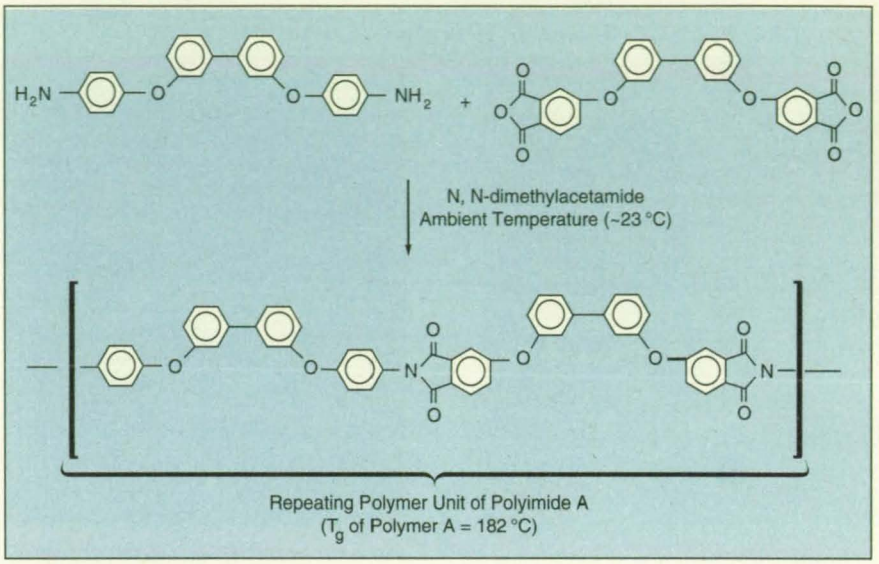
Langley Research Center, Hampton, Virginia

Because of their outstanding thermal stability, low density, resistance to radiation, electrical-insulating capability, toughness, and flexibility, linear aromatic polyimides are being used increasingly for applications in the aerospace and electronics industries. The synthesis of two novel monomers and their subsequent incorporation into aromatic polyimides yields polyimides that contain *meta*-biphenoxy moieties that exhibit stability at high temperatures and that have glass-transition temperatures (T_g's) lower than those of state-of-the-art polyimides that contain *para*-biphenoxy moieties. These polyimides show excellent potential for meeting future needs in both industries and possibly in others.

Novel linear aromatic polyimides that contain one or two *meta*-biphenoxy moieties per repeating polymer unit were prepared in experiments. These polyimides resulted from reactions between two novel chemical compounds that are synthesized in the experiments. One was a *meta*-linked diamine that contains biphenoxy; the other was a *meta*-linked dianhydride that contains biphenoxy. The general procedure for synthesis of a representative polyimide from both of these monomers is shown in the figure.

The table summarizes the physical properties of films of the nine novel polyimides that were prepared to prove the concept. All of the films were flexible or could be creased without breaking. The T_g's or softening temperatures ranged from 172 to 235 °C; these temperatures are quite low for linear aromatic polyimides. The low T_g's should enable the polyimides to be readily formed thermoplastically at temperatures slightly above their respective T_g's. More particularly, these T_g's are 25 to 118 °C lower than those of the corresponding state-of-the-art polyimides that incorporate the *para*-linked biphenoxy. The effectiveness of the incorporation of the *meta*-linked biphenoxy moiety is amplified in the case of polyimide A, which contains two of these moieties per polymer repeat unit. This affords a 118 °C decrease in T_g over that of the corresponding state-of-the-art polyimide, which contains two *para*-linked biphenoxy moieties.

In the electronics industry, polyimides are widely used as dielectric interlayers that must be formed into uniform coatings over a variety of subcomponents. In the aerospace industry, there is a need for polyimides that can be processed into parts for aircraft and spacecraft and that will withstand highly oxidative and intense-radiation environments like those on the outer structural surfaces of supersonic aircraft, and in environments like those in jet engines. Polyimides to serve as films and coatings for outer-space devices are also needed.



A **Representative Polyimide** that contains *meta*-linked biphenoxy moieties is synthesized from an amine and a dianhydride that each contain a biphenoxy moiety.

Polyimide*	Glass-Transition Temperature, °C	Inherent Viscosity, Deciliters/Gram	Color/ Appearance	Creasable	Crystallinity
A	182	0.66	Yellow/Gold	Yes	----
B	209	0.96	Yellow/Gold	Yes	None by WAXS
C	215	0.44	Yellow	Yes	----
D	Crystalline	0.53	Yellow/Translucent	Yes	Yes, Melt at 346 °C
E	190	0.99	Yellow/Gold	Yes	None by WAXS
F	172	0.55	Yellow/Gold	Yes	None by WAXS
G	235	0.68	Yellow	Yes	Yes, Melt at 386 °C
H	210	0.74	Yellow/Gold	Yes	----
I	202	0.90	Yellow/Brown	Yes	----

Note: "WAXS" means Wide-angle X-ray scattering.

* The capital letters in this column represent nine different polymers discribed in a NASA patent application.

Selected Physical Properties of films of some of the novel polyimides were measured.

This work was done by Terry L. St. Clair and Karen S. Whitley of **Langley Research Center** *and John R. Pratt of Lockheed Engineering & Sciences Co. For further information,* ***write in 6*** *on the TSP Request Card.*

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to the Patent Counsel, Langley Research Center [see page 24].

Refer to LAR-14517.

Insoluble, Low-Dielectric-Constant Polyimides

Fluorinated polymers with dielectric constants from 2.4 to 2.5 have been made.

Langley Research Center, Hampton, Virginia

The dielectric constant of the commercially available polyimide currently used as a state-of-the-art material in advanced electronics applications generally ranges from 3.2 to 4.0. Linear aromatic polyimides that have low (2.4 to 2.8) dielectric constants have been reported to be highly insulating, resistant to moisture, mechanically strong, and thermally stable. These properties were obtained partly by the incorporation of fluorine atoms into the polymer backbones, in each case through either one or both of the diamine and dianhydride monomer structures.

Low-dielectric-constant fluorinated polyimides are soluble in common organic solvents. While their solubility is beneficial in some applications, it is severely detrimental in others. A soluble polyimide cannot be used, for example, as a composite matrix resin in aircraft applications in which the polymer may come into contact with damaging hydraulic fluids and other chemical substances. Therefore, a process for making insoluble, low-dielectric-constant polyimides has been devised.

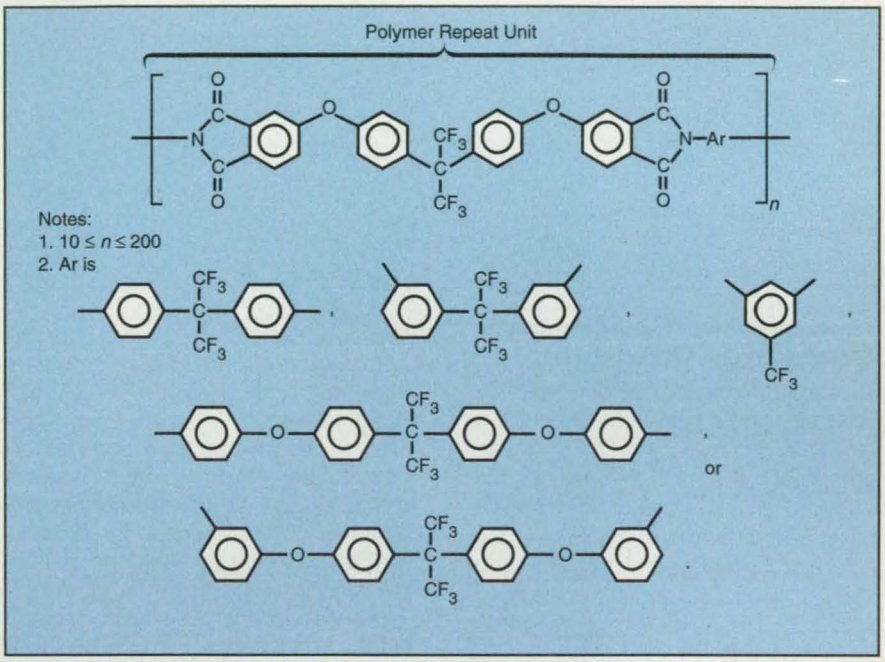
In this process, insoluble, low-dielectric-constant polyimides are produced by combining the dianhydride of bis[4-(3,4-dicarboxyphenoxy) phenyl]perfluoroisopropylidene (BFDA) with a fluorinated aromatic diamine, each molecule of which contains at least one or more CF_3 groups. Fluorine atoms in the CF_3 groups are present in both the dianhydride and diamine portions of the polymer repeat units. The figure shows the structural formula.

These fully fluorinated polyimides have dielectric constants in the range of 2.4 to 2.5 at 10 GHz. They are suitable for use as composite matrix resins in advanced aerospace applications. In addition, they have strong potential for use in the microelectronics industry, particularly as insulating resins in the production of printed-circuit boards.

This work was done by Anne K. St. Clair, Diane M. Stoakley, and Burt R. Emerson, Jr., of **Langley Research Center**. *For further information,* ***write in 92*** *on the TSP Request Card.*

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to the Patent Counsel, Langley Research Center *[see page 24].*

Refer to LAR-14540.



Fluorine Atoms in CF_3 Groups are contained in both the dianhydride and diamine portions of the polymer repeat unit.

Computer Programs

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Computer Programs

These programs may be obtained at a very reasonable cost from COSMIC, a facility sponsored by NASA to make computer programs available to the public. For information on program price, size, and availability, write in the reference number on the TSP and COSMIC Request Card in this issue.

Mechanics

Software for Three-Dimensional Stress and Thermal Analyses

ST3D inplements the boundary element method.
Lewis Research Center, Cleveland, Ohio

BEST3D is an advanced engineering software system for three-dimensional thermal and stress analyses, particularly of components of the hot sections of gas-turbine engines. BEST3D utilizes the boundary element method, offering, in many situations, more accuracy, efficiency, and ease of use than does the more familiar finite element method. This software performs engineering analyses of the following types: elastic, heat transfer, plastic, forced vibration, free vibration, and transient elastodynamic.

The fundamental representation required in BEST3D is an approximation of the geometry, displacement, and traction on the surface of the structure being analyzed. In contrast, a three-dimensional finite element analysis requires approximation of both geometry and displacement throughout the interior of the structure. Interior approximations can be required in problems of certain types in BEST3D — especially nonlinear analysis — but such interior discretizations need not be compatible with the primary surface discretizations. Isoparametric interpolation functions are used in BEST3D for both surface and interior mathematical modeling.

In addition to the use of interior models based on isoparametric shape functions, two newly developed methods are available in BEST3D for the approximation of volume effects: (1) the use of simply rectilinear cells in approximations of holes and hotspots and (2) the use of particular solutions to avoid any requirement of interior modeling in thermoelastic and plastic analyses.

A structure being analyzed in BEST3D can be broken into several subregions to improve computing efficiency and/or accuracy or to account for changes in materials or relative motion between parts of the structure. A compatible surface discretization is required on the interface that connects two subregions.

BEST3D input uses free-field format with different input data types identified by keywords. The input sections include identification of the type of problem, solution techniques, and output requirements; identification of properties of materials; definition of nodes and connectivity for all subregions; definition of subregion interface; and identification of boundary conditions, including mechanical boundary conditions, body forces, holes, and hot spots.

BEST3D can provide various output quantities needed for evaluation of components of hot sections. These include, but are not limited to, nodal temperatures, fluxes, displacements, tractions, and stresses. The specific output depends on the type of analysis and on the user's request.

BEST3D is written in FORTRAN 77 for CONVEX-series computers running CONVEX OS v9.0 and Sun-series computers running SunOS v4.1. Although no binaries are included on the distribution medium, sample data and four UNIX shell scripts are provided. As distributed, the shell scripts are intended to facilitate the installation and execution of BEST3D under SunOS; the BEST3D Implementation Guide explains how to modify these slightly for use on CONVEX computers. BEST3D requires 10 Mb of disk space and 7 Mb of random-access memory for execution. This package is available on a 0.25-in. (6.35-mm) streaming-magnetic-tape cartridge in UNIX TAR format. BEST3D v3.0 was released in 1991.

CONVEX is a trademark of CONVEX Computer Corp. Sun and SunOS are trademarks of Sun Microsystems, Inc. UNIX is a registered trademark of AT&T Bell Laboratories.

This program was developed by P. K. Banerjee of State University of New York at Buffalo, R. B. Wilson of United Technologies Corporation, Pratt & Whitney Division, and D. A. Hopkins of **Lewis Research Center**. *For further information,* ***write in 14*** *on the TSP Request Card.*
LEW-15351

Programs To Optimize Spacecraft and Aircraft Trajectories

POST and 6D POST can be used to solve guidance and flight-control problems.

POST/6D POST is a set of two computer programs, POST and 6D POST, that provide the ability to target and optimize trajectories of a powered or unpowered spacecraft or aircraft operating at or near a rotating planet. POST treats the point-mass, three-degree-of-freedom case. 6D POST, a direct extension of POST, treats the more-general rigid-body, six-degree-of-freedom (with point masses) case. This package of software can be used to solve a variety of performance, guidance, and flight-control problems for atmospheric and orbital vehicles.

The principal features of POST/6D POST include the capability to simulate up to 900 distinct trajectory phases (defined below) generalized mathematical models of planets and vehicles; modular packages of software that enable the high-fidelity simulation of aerodynamics, propulsion, and the like; and optimization capability that includes equality and inequality constraints. Typical applications

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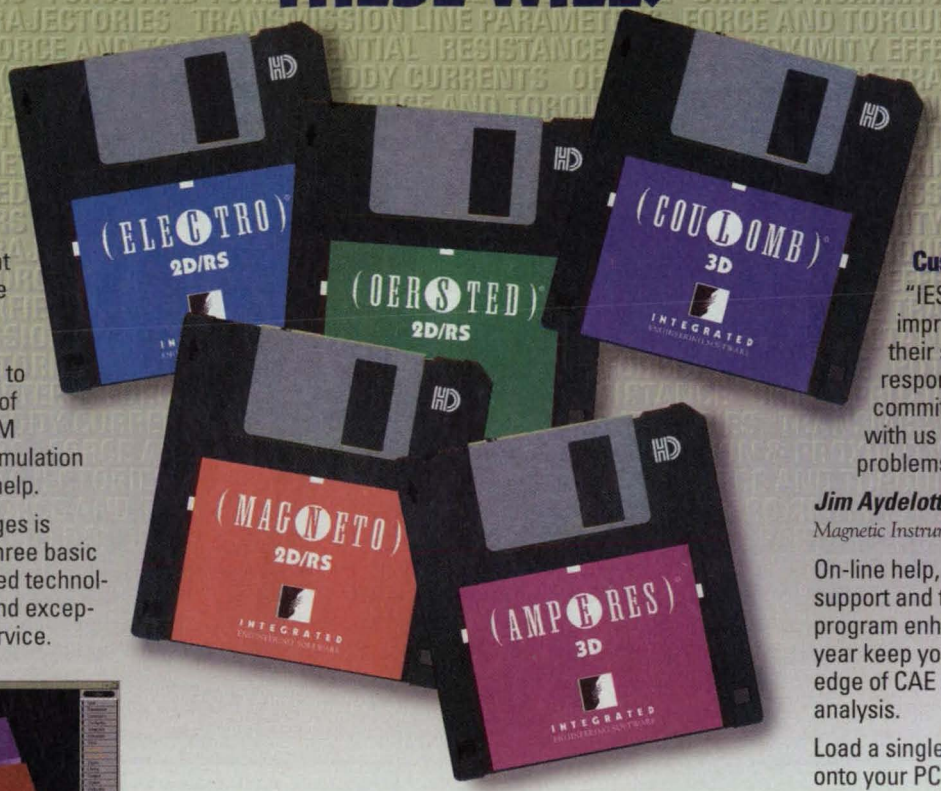
$$\nabla\times H = J + \epsilon\frac{\partial E}{\partial t} \qquad \nabla\times E = -\mu\frac{\partial H}{\partial t} \qquad \nabla\cdot E = \frac{\rho}{\epsilon} \qquad \nabla\cdot H = 0$$

THESE WILL.



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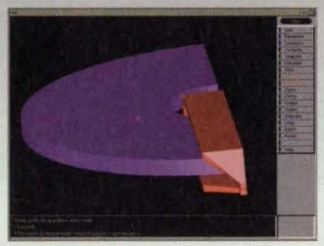

Solutions are obtained 4x faster using symmetry conditions.

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Dr. Kent Davey
Georgia Institute of Technology

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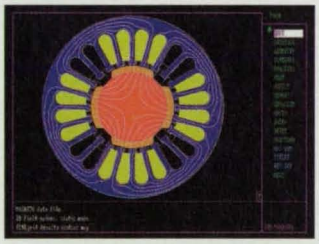

Torque vs. position curves for optimal motor design are readily calculated.

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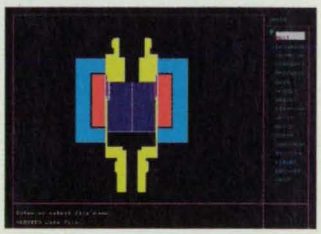

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of POST/6D POST include (1) computation of performance or capability of a vehicle in ascent, on orbit, and during entry into the atmosphere, (2) simulation and analysis of guidance and flight-control systems, (3) dispersion-type analyses and analyses of loads, (4) general-purpose six-degree-of-freedom simulation of controlled and uncontrolled vehicles, and (5) validation of performance in six degrees of freedom.

The basic flexibility of the simulation is achieved by decomposing a trajectory into a logical sequence of simulation segments, denoted as phases, which enable mathematical modeling of both the physical and the nonphysical aspects of the simulation accurately and efficiently. Computational routines are categorized according to five basic functional elements. These elements are the Planet Module, the Vehicle Module, the Trajectory Simulation Module, the Trajectory Auxiliary Calculations Module, and the Targeting/Optimization Module. These routines are accessible in either of the programs within the software package, except as specified otherwise.

The Planet Module implements an oblate-spheroid model, a gravitational model, an atmospheric model, and a winds model. The shape of the planet is oblate (i.e., nearly spherical in shape, with an equatorial diameter greater than or equal to the polar diameter). These models define the environment in which the vehicle operates.

The Vehicle Module implements the mass-properties, propulsion, aerodynamics, and aeroheating models. The Vehicle Module in POST includes its specific steering (guidance) model, and that in 6D POST contains an airframe model, a navigation-and-guidance model, an autopilot model, and a flight-controls model. These models define the basic vehicle-simulation characteristics.

The mass-properties model provides for a variety of descriptions of the weight of the vehicle. The weights of the vehicle and propellant, for example, can be described according to stage weight, propellant weight, payload weight, jettison weight, and propellant consumed.

The propulsion model contains thrust and flow-rate equations for rocket, jet, and ramjet engines and can simulate as many as 15 types of engines per phase. The gimbal angle of each engine can be either preprogrammed or calculated to balance the static moment equations.

The aerodynamic model enables the aerodynamic coefficients to be defined in terms of either axial and normal force or drag and lift force.

The aeroheating model contains both laminar and turbulent heating-rate options. The standard Chapman stagnation-point equation, which is generally used for laminar flow, can be modified by tabular input and used for turbulent flow.

The steering (guidance) model of POST controls the attitude of the vehicle during the simulation of the trajectory, and it is extremely flexible. The general types of steering options that are available are (1) body rates, (2) aerodynamic angles, (3) inertial Euler angles, and (4) relative Euler angles.

The sensor, navigation, guidance, and controls models, along with the autopilot model, are specific to the 6D POST portion of the software package, and work together to perform functions within the Vehicle Module.

The sensor model computes information that describes the behavior of the sensing elements of the navigation system of the vehicle. Sensor models called by this module necessarily depend on the vehicle and its subsystems. As a consequence, the sensor model must be designed and implemented for each par-

ticular application.

The navigation model estimates the state (position, velocity, and the like) of the vehicle on the basis of the outputs of sensors. This module also depends on the subsystems and vehicle and must be designed and implemented for each specific application.

The guidance model takes the output of the navigation model and computes a guidance command. Typically, the guidance command represents a desired change in the existing attitude of the vehicle.

The autopilot is designed to remove the errors between the command values of the guidance variables and their actual (or sensed) values. This is accomplished by deflecting engines, adjusting control surfaces, and/or firing reaction-control-system jets.

The controls model converts pitch, yaw, and roll autopilot commands into engine gimbal angles and/or deflection angles of aerodynamic control surfaces.

The Trajectory Simulation Module consists of the event-sequencing module that controls the cycling of the program, table-interpolation routines, and several standard numerical-integration routines that are used to solve the equations of translational and rotational motion numerically.

The Trajectory Auxiliary Calculations Module calculates such output data as parameters of conic sections, ranges (that is, distances), and auxiliary values of position, velocity, and attitude.

The Targeting/Optimization Module provides a general discrete-parameter iteration capability. The user can select the optimization variable, the dependent variables, and the independent variables from a list of more than 400 program variables.

The documentation includes a troubleshooting guide that contains error messages. The POST documentation also contains three sample problems: (1) ascent, (2) entry, and (3) orbital maneuvers. The documentation supplied at the base price applies to POST only. The documentation for 6D POST is available separately at a price of $138. There is a great deal of overlap in the documentation for POST and 6D POST; however, users who are specifically interested in 6D POST may want to purchase the documentation for 6D POST first. This version of the programs was completed in 1990.

POST and 6D POST are written in FORTRAN 77 and C language. Two machine versions are available: one for the SUN-series computers running SunOS (LAR-14871) and one for Silicon Graphics IRIS computers running the IRIX operating system (LAR-14869). Both programs require 7 Mb of random-access memory for execution. The standard distribution medium for POST/6D POST is a 0.25-in. (6.35-mm) streaming-magnetic-tape cartridge in UNIX tar format. It is available for use by United States citizens only.

Sun and SunOS are trademarks of Sun Microsystems, Inc. Silicon Graphics, IRIS, and IRIX are trademarks of Silicon Graphics, Inc. UNIX is a registered trademark of AT&T Bell Laboratories.

This program was written by G. L. Brauer, F. M. Petersen, D. E. Cornick, R. Stevenson, and D. W. Olson of Martin Marietta Corp. for **Langley Research Center**.

For further information on LAR-14869, ***write in 61*** *on the TSP Request Card.*

For further information on LAR-14871, ***write in 49*** *on the TSP Request Card.*

LAR-14869/LAR-14871

Machinery

Program Analyzes Performance of a Wind Tunnel

WT computes power and thrust from velocity and geometrical inputs.

The WT computer program was developed to calculate the rotor power required by, and the output thrust produced by, the fan in a closed-loop wind tunnel. The program uses blade-element theory to calculate aerodynamic forces along each blade of the fan: more specifically, it uses airfoil lift and drag characteristics at an appropriate blade aspect ratio. A tip-loss mathematical model that is also included reduces the lift coefficient to zero at the outer 3 percent of the blade radius.

Momentum theory is not used to determine the axial velocity at the rotor plane. Unlike a propeller, the wind tunnel rotor is prevented from producing an increase in velocity in the slipstream. Instead, velocities at the rotor plane are used as input. Other input for WT includes speed of rotation, geometry of the rotor, and characteristics of the airfoil. Inputs for rotor-blade geometry include the radius of a blade, radius of the hub, number of blades, and pitch angle. Airfoil aerodynamic inputs include angle at zero lift coefficient, positive stall angle, drag coefficient at zero lift coefficient, and drag coefficient at stall.

WT is written in APL2 by use of IBM's APL2 interpreter for IBM PC-series and compatible computers running MS-DOS. WT requires a CGA or better color monitor for display. It also requires 640K of random-access memory and MS-DOS v3.1 or later for execution. Both an MS-DOS executable code and the source code are provided on the distribution medium. The standard distribution medium for WT is a 5.25-in. (13.34-cm), 360K MS-DOS-format diskette in PKZIP format. The utility program to unarchive the files, PKUNZIP, is also included. WT was developed in 1991.

APL2 and IBM PC are registered trademarks of International Business Machines Corp. MS-DOS is a registered trademark of Microsoft Corp. PKUNZIP is a registered trademark of PKWare, Inc.

This program was written by L. A. Viterna of **Lewis Research Center**. *For further information,* ***write in 46*** *on the TSP Request Card.*
LEW-15534

Program Computes Performances of Scramjets

SRGULL was composed from five prior codes to provide enhanced capability for analysis.

The development of a single-stage-to-orbit aerospace vehicle intended to be launched horizontally into low orbit around the Earth, like the National Aero-Space Plane (NASP), has concentrated on the use of the supersonic combustion ramjet (scramjet) propulsion cycle. SRGULL, a scramjet-cycle-analysis computer code, is an engineer's software tool capable of nose-to-tail simulation of a hydrogen-fueled, scramjet engine integrated with an air-frame. The simulated flow is that of a real gas with equilibrium thermodynamic properties. This program facilities initial estimates of the performance of the scramjet cycle by linking a code for a two-dimensional forebody, inlet, and nozzle with the code for a one-dimensional combustor.

Five computer codes (SCRAM, SEAGUL, INLET, Program HUD, and GASH) originally developed at NASA Langley Research Center in support of hypersonic technology are integrated in this program to provide the capability for analysis of changing flow conditions. The one-dimensional combustor code is based on the combustor subroutine from SCRAM, and the two-dimensional code is based on an inviscid-flow Euler program (SEAGUL). Input data on kinetic-energy efficiency for mathematical modeling that involves variation of sidewall area can be calculated by the INLET program code. At the completion of analysis of the inviscid component, Program HUD, and integral boundary-layer code based on the Spaulding-Chi method, is applied to determine the coefficient of friction, which is then used in modified Reynolds analogy to calculate the transfer of heat.

The properties of flowing real gas — e.g., composition, enthalpy, entropy, and density — are calculated by the subroutine GASH. Input conditions for the combustor are taken from one-dimensionalizing the two-dimensional inlet exit flow. The SEAGUL portions of this program are limited to supersonic flows, but the combustor (SCRAM) section can handle supersonic and dual-mode operation. The computations of SRGULL have been compared to measurements taken in scramjet engine tests with excellent results.

SRGULL was written in FORTRAN 77 on an IBM-PC-compatible computer, using IBM's FORTRAN/2 or Microway's NDP386 F77 compiler. The program interacts fully with the user but can also run in batch mode. It operates under the UNIX, VMS, NOS, and DOS operating systems. Because of requirements on the sizes of blocks and segments, the source code is not directly compatible with all PC compilers (e.g., Lahey or Microsoft FORTRAN). SRGULL executable code requires about 490K of random-access memory and a math coprocessor on a PC. The SRGULL program was developed in 1989, although the component programs originated in the 1960's and 1970's.

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This program was written by J. T. Walton of Lewis Research Center and S. Zane Pinckney of **NASA Langley Research Center**. *For further information,* ***write in 137*** *on the TSP Request Card.*
LEW-15093

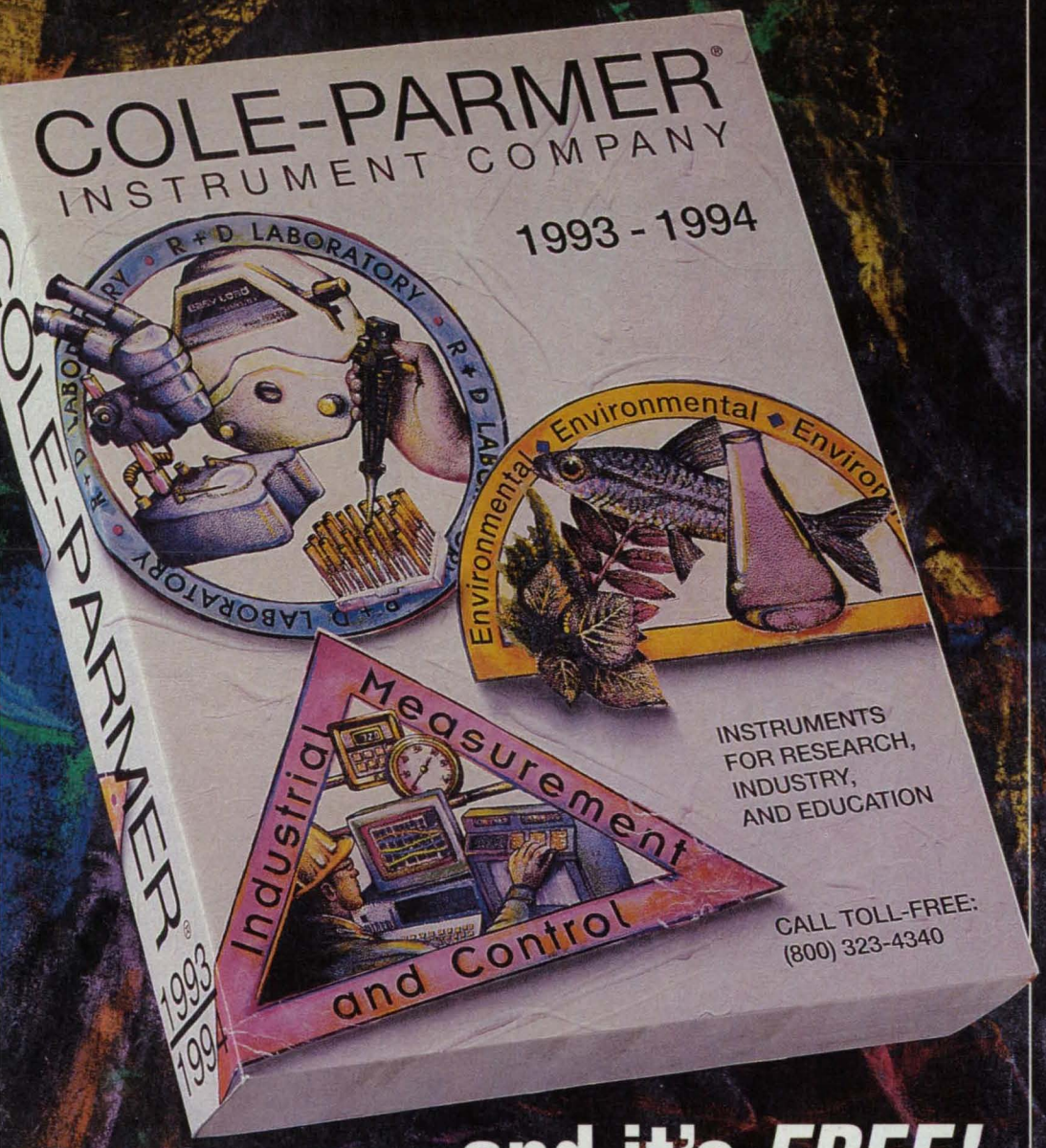
Mathematics and Information Sciences

Transportable Applications Environment Plus, Version 5.1

Users can construct custom interfaces for their own application programs.

Transportable Applications Environment Plus (TAE+) is a computer program that provides an integrated, portable programming environment for developing and running application programs based on interactive windows, text, and graphical objects. TAE+ enables both programmers and nonprogrammers to construct their own custom application interfaces easily and to move those interfaces and application programs to different computers. When used companywide for a wide range of application programs, TAE+ can be used to define a corporate user interface, with noticeable improvements in application developer's and end user's learning curves.

The main components of TAE+ are (1) the WorkBench, a What You See Is What You Get (WYSIWYG) software tool



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for the design and layout of a user interface; and (2) the WPT (Window Programming Tools) Package, a set of callable subroutines that control the user interface of an application program.

The WorkBench enables the developer of an application program to construct the layout of the display screen of the application program interactively by manipulating a set of interaction objects, including such input items as menus, buttons, icons, and scrolling text lists. Also included are such data-driven graphical objects as dials, thermometers, and strip charts, which TAE+ updates as the values of the data change. The person using the WorkBench specifies the windows and interaction objects that will make up the user interface, then specifies the sequence of the user-interface dialogue. The description of the designed user interface is then saved in resource files. The WorkBench also generates source code [C, Ada, C++, and TAE Command Language (CL)] that fully controls the user interface of the application program through function calls to the WPT's.

The WPT's are the run-time services used by application programs to display and control the user interfaces. Inasmuch as the WPT's access the WorkBench-generated resource files, such details as color, font, location, and type of object remain independent from the application code; this makes it possible to change the user interface without recompiling and relinking.

In addition to WPT's, TAE+ offers control of interaction objects from an interpreted TAE Command Language. TCL provides a means for the more experienced developer to develop a prototype of an application's user interface of the interaction objects of TAE+ and add programming logic without the overhead of compiling or linking.

TAE+ uses (1) Release 4 of Version 11 of the X Window System of Massachusetts Institute of Technology and (2) the Motif Toolkit 1.1 or 1.1.1 of the Open Software Foundation. The WorkBench and WPT's are written in C++, and the remaining code is written in C. TAE+ is available by license for an unlimited time. The licensed program product includes the TAE+ source code and one set of supporting documentation. Additional documentation may be purchased separately. Recommended minimum memory is 12 Mb, and 49 Mb are required in disk space to load the TAE+ tar-format tape. Each magnetic tape through which TAE+ is delivered to a particular computer includes prebuilt software libraries and executable binary code for that particular computer, as well as source code, so that users do not have to perform installation. A user who wishes to recompile the source code will need both a C compiler and Version 1.39 or a later version of GNU's C++, or else a C++ compiler based on AT&T 2.0 cfont. InterViews and idraw, two software packages developed by Standford University, are integrated into TAE+. TAE+ was developed in 1989, and Version 5.1 was released in 1991. TAE Version 5.2 is an enhanced release of Version 5.1 and will be available in January 1993.

TAE+ is currently available on media suitable for eight different computers: (1) DEC VAXstations running ULTRIX 4.1 or later (TK50 cartridge in tar format), (2) DEC RISC workstations running ULTRIX 4.1 or later (TK50 cartridge in tar format), (3) Sun3 series running SunOS 4.1.1 [on 0.25-in. (6.35-mm) tape cartridge in tar format], (4) Sun 4 (SPARC) series running SunOS 4.1.1 [0n 0.25-in. (6.35-mm) tape cartridge in tar format], (5) HP 9000/300 running HP-UX 8.0. (16-track cartridge tape in tar format), (6) HP 9000/700 running HP-UX 8.05 (4-mm data-grade cartridge tape in tar format), (7) VAX running VMS 5.4 (TK50 cartridge in VMS backup format), and (8) Silicon Graphics running IRIX 4.0.1 [on

0.25 in. (6.35-mm) tape cartridge in tar format]. An optional Motif Object Code license is available for either Sun version.

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This program was developed by the Data Systems Technology Division of **Goddard Space Flight Center**. *For further information,* ***write in 4*** *on the TSP Request Card.*
GSC-13445

Software for Nearly Optimal Packing of Cargo

PACKMAN attempts to satisfy multiple objectives in utilizing the available space.

PACKMAN is a computer program used to find nearly optimal arrangements of cargo items in storage containers, subject to such multiple packing objectives as utilization of the volumes of containers, utilization of containers up to the limits on their weights, and other considerations. Determining how to pack cargo into a three-dimensional space of limited size while considering additional constraints is a very difficult combinatorial optimization problem faced in several areas of industry. Traditionally, deciding how to arrange a set of cargo has been determined by human experts, who must assess the characteristics of the set of cargo to be loaded and the constraints placed upon its loading. As the number and complexity of these constraints grow to more than a few, human experts may have difficulty or fail in finding nearly optimal solutions.

PACKMAN allows a user to specify a single rectangular container of arbitrary length, width, and height, along with a set of cargo items, each of arbitrary rectangular dimensions and with specified characteristics, that the user intends to attempt to pack into the container. The user is also allowed to specify the criteria for packing and the degree of importance placed on each criterion.

The automatic packing algorithm employed by PACKMAN attempts to find the best positioning of those cargo items in the container, such that the volume and weight capacity of the container are both utilized to the maximum extent possible. The problem of packing *N* cargo items into a container subject to constraints is in the class of nonlinear multidimensional knapsack- and bin-packing problems, which are well known to be *NP*-complete. As the number of items *N* increases, the number of possible solutions grows so large that determination of the optimal solution becomes infeasible. Thus, the best packing solution found by the automated algorithm of PACKMAN for a particular combination of cargo items and container is not guaranteed to be the optimal solution; however, the problem-solving method that PACKMAN uses, known as simulated annealing, generates solutions that are usually within 2 to 3 percent of optimal.

PACKMAN is written in Common LISP for Macintosh computers running System 6.0.3 or higher, and requires version 1.3.2 of Macintosh Allegro Common Lisp for execution. This program will not run under version 2.0 of Macintosh Allegro Common Lisp without modification. PACKMAN requires 4 Mb of random-access memory and 1 Mb of disk memory. The PACKMAN source code uses Xerox's Portable Common Loops object-oriented LISP extensions, with permission from Xerox. All source code for the PACKMAN program is included (source code for

Portable Common Loops, however, is not provided). The standard distribution medium for PACKMAN is a set of two 3.5-in. (8.89-cm), 800K Macintosh diskettes. An electronic copy of the documentation in Microsoft Word format is included on the distribution medium. PACKMAN was released in 1991.

Allegro Common Lisp is a registered trademark of Franz, Inc. Macintosh is a trademark of Apple Computer, Inc. Microsoft Word is a trademark of Microsoft Corp.

This program was written by Theron R. Fennel and Rodney S. Daughtrey of Boeing Computer Services Co. and Doug G. Schwaab of Boeing Aerospace & Electronics Co. for **Marshall Space Flight Center**. *For further information,* ***write in 34*** *on the TSP Request Card.*
MFS-28700

TOAD Gateway

This program changes formats of data files.

The Transferable Output ASCII Data (TOAD) computer program (LAR-13755), implements a format that is designed to facilitate the transfer of data across communication networks and dissimilar host computer systems. Any data file that conforms to the TOAD format standard is called a TOAD file. The TOAD Gateway is an interactive software tool for converting data files (particularly those in TOAD format) to and from a variety of file formats. The TOAD Gateway currently reads and writes the following file formats: TOAD; Standard Interface File (SIF); Program to Optimize Simulated Trajectories (POST) input; Comma Separated Value and Tab Separated Value, common in PC and Macintosh spreadsheet and database packages; and a general free format. Additional modules for accommodating other formats are easily developed and installed.

The TOAD Gateway asks the user a few questions and accepts a variety of English answers, thereby serving the new or occasional user as an understandable and convenient software tool for basic management of data. Upon opening an incoming data file, the TOAD Gateway automatically determines its format and "plugs in" the appropriate in-terpreter. This feature is particularly beneficial when working with a data file that is in an unknown format. A companion program, the TOAD Editor (LAR-14423), manipulates the contents of TOAD files and extracts selected subsets of data.

The TOAD Gateway is written in FORTRAN 77 for interactive execution on workstations of the CONVEX C, Sun3 and Sun4, Silicon Graphics 4D and Personal IRIS, and DEC ULTRIX and VAX/ VMS series, all with little or no modification. The TOAD Gateway requires 0.5Mb of random-access memory for execution, though increasing the capacities of the TOAD Gateway will require additional memory. The standard distribution medium for the TOAD Gateway is a 0.25-in. (6.35-mm) streaming-magnetic-tape cartridge in UNIX tar format. It is also available in DEC VAX BACKUP format on either a 9-track, 1,600-bit/in. (630-bit/cm) magnetic tape or a TK50 tape cartridge. The TOAD Gateway was developed in 1990.

CONVEX is a trademark of CONVEX Computer Corp. Sun3 and Sun4 are trademarks of Sun Microsystems, Inc. DEC, VAX, VMS, and ULTRIX are trademarks of Digital Equipment Corp. Silicon Graphics 4D, IRIS 4D, and Personal IRIS are trademarks of Silicon Graphics, Inc. UNIX is a registered trademark of AT&T Bell Laboratories.

This program was written by Bradford D. Bingel of Computer Sciences Corp. for **Langley Research Center**. *For further information,* ***write in 72*** *on the TSP Request Card.*
LAR-14484

Physical Sciences

Program Predicts Microstructural Changes in Materials

MCFET combines a Monte Carlo procedure with a finite-element technique to model microstructural evolution.

The MCFET computer program, named for combined Monte Carlo Finite Element Technique, implements a specialized microstructural-lattice simulation technique. MCFET has been developed to simulate microstructural evolution in material systems in which modulated phases occur and the directionality of the modulation is influenced by internal and external stresses.

Because many of the physical properties of materials are determined by microstructure, it is important to be able to predict and control microstructural development. The microstructural-lattice model in MCFET can incorporate all relevant driving forces and kinetic considerations. Unlike the molecular-dynamics programs, this program was developed specifically to predict macroscopic behavior, not atomistic behavior.

In this approach, the microstructure is discretized into a fine lattice. Each element in the lattice is labeled in accordance with its microstructural identity. Diffusion of material at high temperatures is simulated by allowing exchanges of neighboring elements where and when the exchanges lower the total energy of the system. A Monte Carlo approach is used to select the exchange site while the change in energy associated with stress fields is computed by use of a finite-element technique.

The MCFET method has been validated by comparing it with a closed-form, analytical method for stress-assisted changes in the shape of a single particle in an infinite matrix. Sample MCFET analyses for multiparticle problems have also been run, and, in general, the resulting microstructural changes associated with the application of an external stress are similar to those observed in Ni/Al/Cr alloys at high temperatures.

This program is written in FORTRAN for use on a 370-series IBM mainframe computer. It has been implemented on an IBM 370 computer running VM/SP and an IBM 3084 computer running MVS. It requires the IMSL math library and 220K of random-access memory for execution. The standard distribution medium for this program is a 9-track, 1,600-bit/in. (630-bit/cm) magnetic tape in EBCDIC format.

This program was written by J. Gayda of **Lewis Research Center** *and D. J. Srolovitz of University of Michigan. For further information,* ***write in 55*** *on the TSP Request Card.*
LEW-14805

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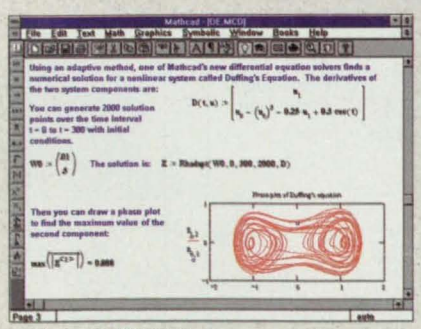

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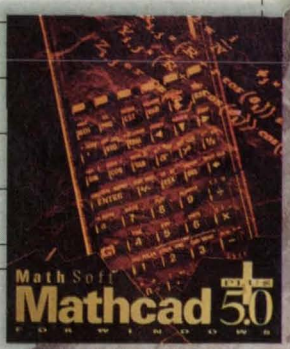

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For More Information Write In No. 485

Actuator Exerts Tensile or Compressive Axial Load

A shearpin limits the load.

Marshall Space Flight Center, Alabama

A compact, manually operated mechanical actuator applies a controlled, limited tensile or compressive axial force. The actuator is designed to apply loads to bearings during wear tests in a clean room. It is intended to replace a hydraulic actuator that is bulky and difficult to use, requires periodic maintenance, and poses the threat of leakage of hydraulic fluid, which can contaminate the clean room.

The actuator rests on a stand and imparts axial force to a part attached to a clevis inside or below the stand (see figure). A technician turns a control screw at one end of a lever. Depending on the direction of rotation of the control screw, its end of the lever is driven downward (for compression) or upward (for tension). The lever pivots about a clevis pin at the end opposite that of the control screw; this motion drives downward or upward a link attached via a shearpin at the middle of the lever. The link drives a coupling and, through it, the clevis attached to the part to be loaded.

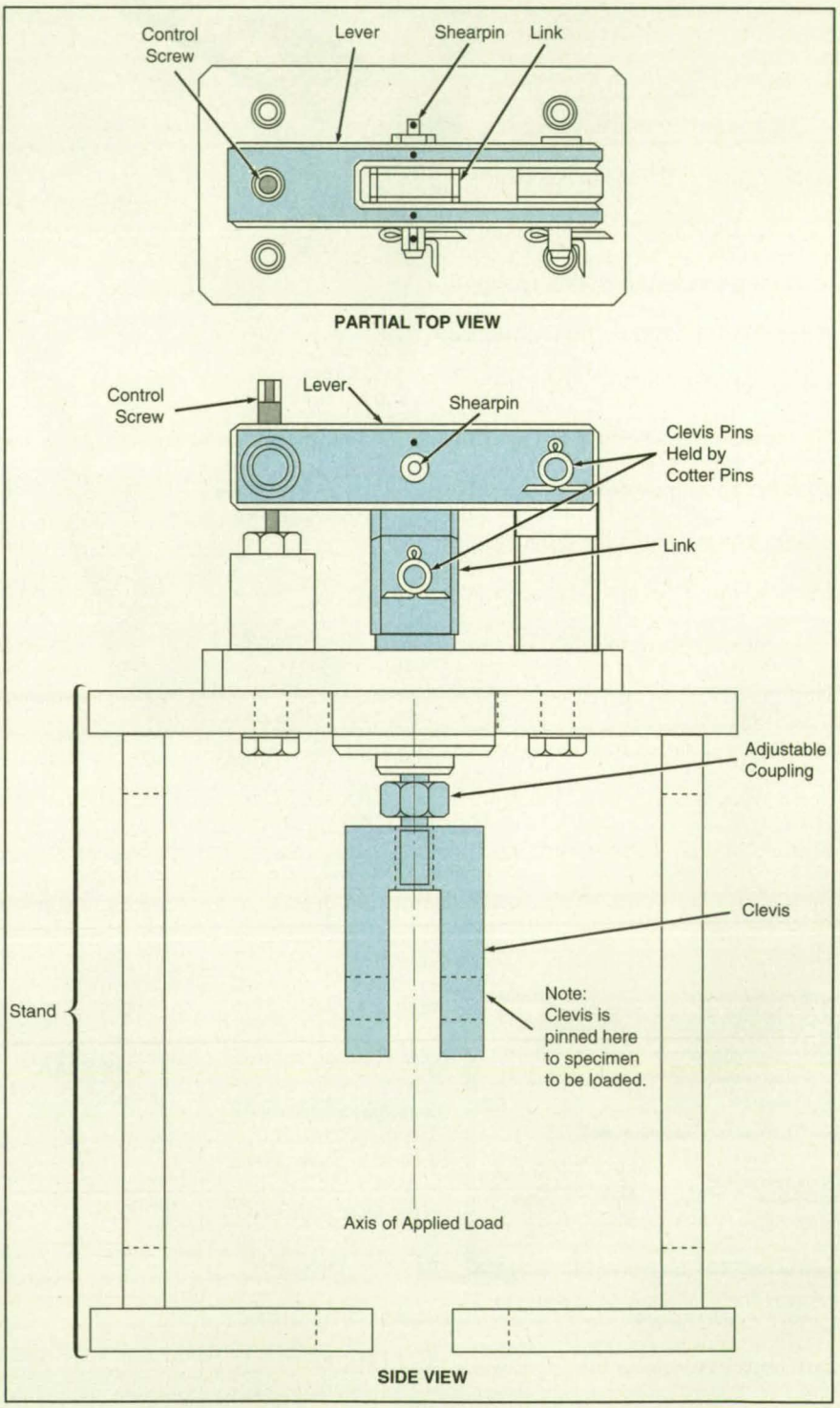
The control screw has a fine thread so that a large adjustment of the screw produces a relatively small change in the applied force. With the help of a load cell that measures the applied load, the technician can control the load to within ±10 lb. (45 N). An estimated input torque of only 40 to 50 lb•in. (4.5 to 5.6 N•m) is needed to apply the maximum allowable load of 2,550 lb (11.34 kN).

The shearpin at the middle of the lever breaks if a force greater than 2,800± 200 lb (12.45±0.89 kN) is applied in tension or compression, thus protecting the stressed part from overload. The shearpin is made of a maraging steel, which is chosen because it fails more predictably and cleanly in shear than other alloys do and is strong in small pin diameters. Batches of pins are made from the same raw stock to ensure that all fail at or near the same load.

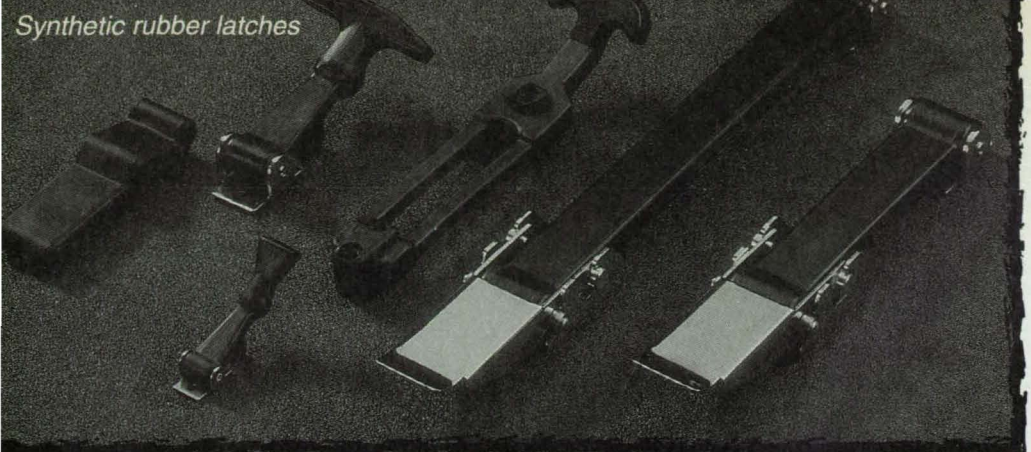
This work was done by John Nozzi and Cuyler H. Richards of Rockwell International Corp. for **Marshall Space Flight Center**. *For further information,* ***write in 65*** *on the TSP Request Card.*

Inquiries concerning rights for the commercial use of this invention should be addressed to the Patent Counsel, Marshall Space Flight Center [see page 24].

Refer to MFS-29912.

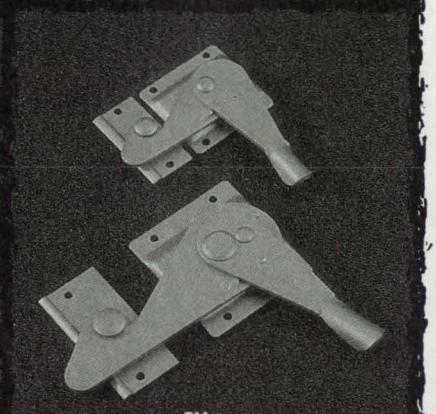


This **Mechanical Actuator** applies an axial load to a test specimen inside or under its stand.



Synthetic rubber latches

Butt-joint panel latches



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Six-Degree-of-Freedom Parallel Minimanipulator

Advantages include greater stiffness and relative simplicity.

Goddard Space Flight Center, Greenbelt, Maryland

Figure 1 illustrates schematically a six-degree-of-freedom manipulator that produces small, precise motions and that includes only three inextensible limbs with universal joints at their ends. The limbs have equal lengths and can be said to act in parallel in that they share the load on a manipulated platform. The mechanism is therefore called a "six-degree-of-freedom parallel minimanipulator." The minimanipulator is designed to provide high resolution and high stiffness (relative to the other mechanisms) for fine control of position and force in a hybrid serial/parallel-manipulator system.

Most of the six-degree-of-freedom parallel manipulators that have been proposed in the past contain six limbs, and their direct kinematic analyses are very complicated. In contrast, the equations of the direct kinematics of the present minimanipulator can be solved in closed form. Furthermore, in comparison with a typical six-degree-of-freedom parallel manipulator, the present minimanipulator can be made of fewer parts, the probability of mechanical interference between its limbs is smaller, its payload capacity can be made greater, and its actuators, which are base-mounted, can be made smaller.

The upper ends of the limbs are connected to the manipulated platform by universal (two-degree-of-freedom) joints. The lower end of each limb is connected via a universal (two-degree-of-freedom) rotary joint to a two-degree-of-freedom driver. The drivers are mounted directly on the baseplate, without any intervening power-transmission devices, like gears or belts, that could reduce stiffness and precision.

The position and orientation of the manipulated platform is governed uniquely, in all six degrees of freedom, by the positions of the drivers on the baseplate. Examples of two-degree-of-freedom drivers include bidirectional linear stepping motors, *x*–*y* positioning tables, five-bar linkages driven by rotary actuators, and pantographs. Figure 2 shows an example of a baseplate equipped with pantograph drivers. The position of each universal joint C_i (where i = 1, 2, or 3) is controlled by moving either or both of sliders A_i and B_i in their respective guide slots. The displacement reduction provided by the pantograph linkage and the inextensible limbs is equivalent to an increase in mechanical advantage; it increases the stiffness and resolution available at the manipulated platform.

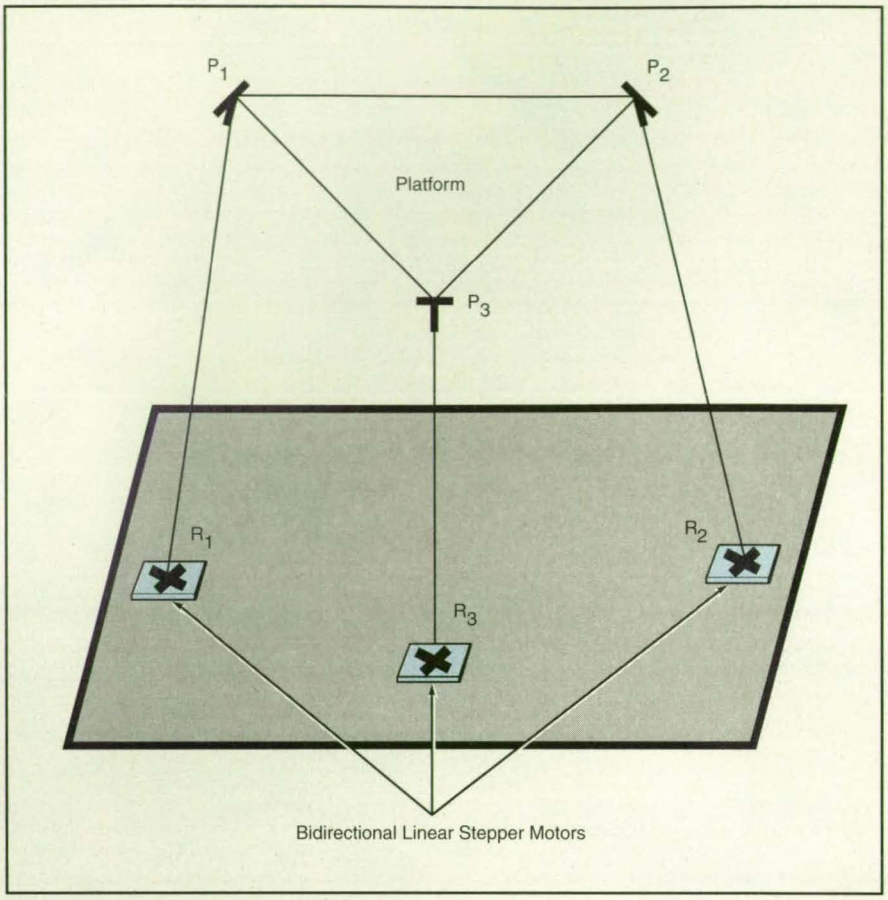


Figure 1. The **Six-Degree-of-Freedom Parallel Minimanipulator** is stiffer and simpler than earlier six-degree-of-freedom manipulators, partly because it includes only three inextensible limbs.

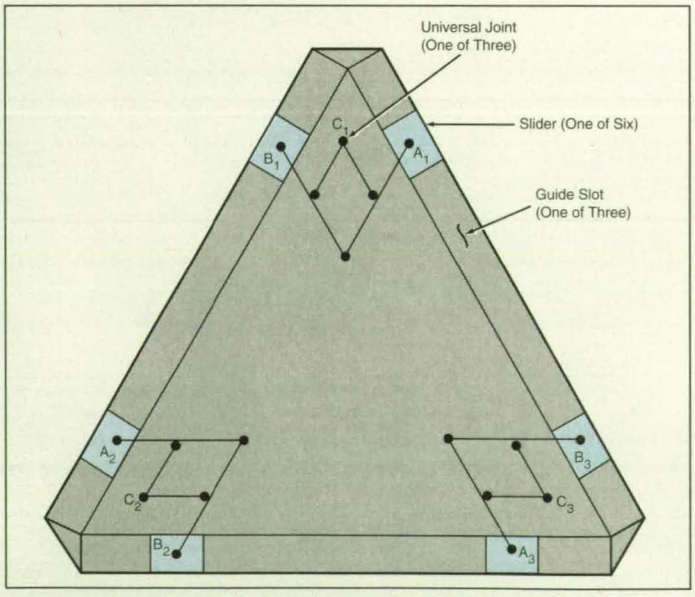


Figure 2. **Three Pantographs on the Baseplate** control the positions of the universal joints at C_i and thereby control the position and orientation of the manipulated platform.

This work was done by Farhad Tahmasebi and Lung-Wen Tsai of **Goddard Space Flight Center**. *For*

further information, ***write in 9*** *on the TSP Request Card.*

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to the Patent Counsel, Goddard Space Flight Center [see page 24].

Refer to GSC-13485.

Estimating Fluctuating Pressures From Distorted Measurements

Algorithms compensate for effects of pneumatic tubes.

Ames Research Center, Moffett Field, California

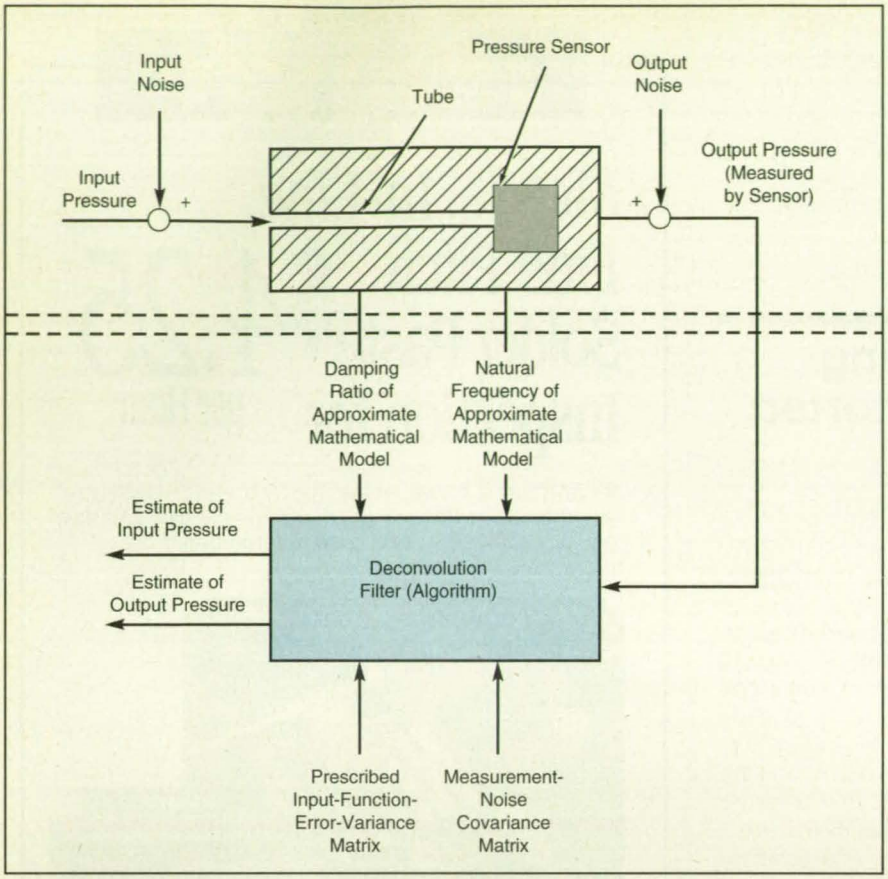
Two algorithms extract estimates of time-dependent input (upstream) pressures from the outputs of pressure sensors located at the downstream ends of pneumatic tubes. Typically, the input end of such a pneumatic tube lies exposed on the surface of a wind-tunnel model, aircraft, turbomachine part, or other object immersed in a flow, and the tube leads through the interior of the object to a pressure transducer at a protected location. The algorithms effect deconvolutions that account for the distorting effects (attenuation, change of phase, and reflection) of the tube upon the pressure signal. [The distortion of pressure measurements by pneumatic tubes was also discussed in "Distortion of Pressure Signals in Pneumatic Tubes," (ARC-12868), *NASA Tech Briefs*, Vol. 17, No. 3 (March 1993) page 96.]

The algorithms are derived from an approximate second-order differential equation that expresses the relationship between the pressures at the surface and sensor ends of the tube. The approximation is valid for frequencies up to the natural frequency (first resonance). The differential equation can be put in finite-difference matrix form, in which the finite differences are the incremxents of time between successive samples of the pressure signal. The solution to the matrix equation is numerically ill-conditioned in such a way that noise in the output of the sensor is overamplified by numerical instability, and this noise overwhelms any estimate of the input pressure unless a correction for the noise can be found.

Both algorithms deconvolve the input pressure (see figure) from the output pressure and correct for noise by use of minimum-variation estimation (Kalman filtering) theory. It is assumed that the error in the estimated input pressure at each increment of time is represented by a random variable characterized by a covariance matrix. It is essential to use the correct values for the elements of the covariance matrix. These values are selected in a process, called "filter tuning," that is typical of minimum-variance estimation algorithms. In initial trials, tuning was performed with simulated data based on solutions of the full wave equation for the propagation of the pressure signal in the tube-and-sensor assembly.

One of the algorithms is designed for postflight processing. This algorithm performs a two-pass forward filtering, backward-smoothing function. This algorithm uses all available measurements, including those taken both before and after a given instant, to estimate the input pressure at that instant.

The second algorithm is intended for real-time processing. It is implemented as a time-recursive filter. To estimate the



input pressure at a given instant, it uses only measurements made up to that instant.

This work was done by Stephen A. Whitmore of **Ames Research Center** *and Cornelius T. Leondes of the University of California at Los Angeles. Further information may be found in NASA TM-101716 [N90-19224], "Compensating for Pneumatic Distortion in Pressure Sensing Devices."*

Copies may be purchased [prepayment required] from the NASA Center for AeroSpace Information, Linthicum Heights, Maryland, Telephone No. (301) 621-0390. Rush orders may be placed for an extra fee by calling the same number.

ARC-12844

The **Varying Input Pressure Is Estimated** from the measured time-varying output pressure by one of two deconvolution algorithms that take account of measurement noise. The algorithms are based on minimum-covariance (Kalman filtering) theory.

Magnetic Check Valve

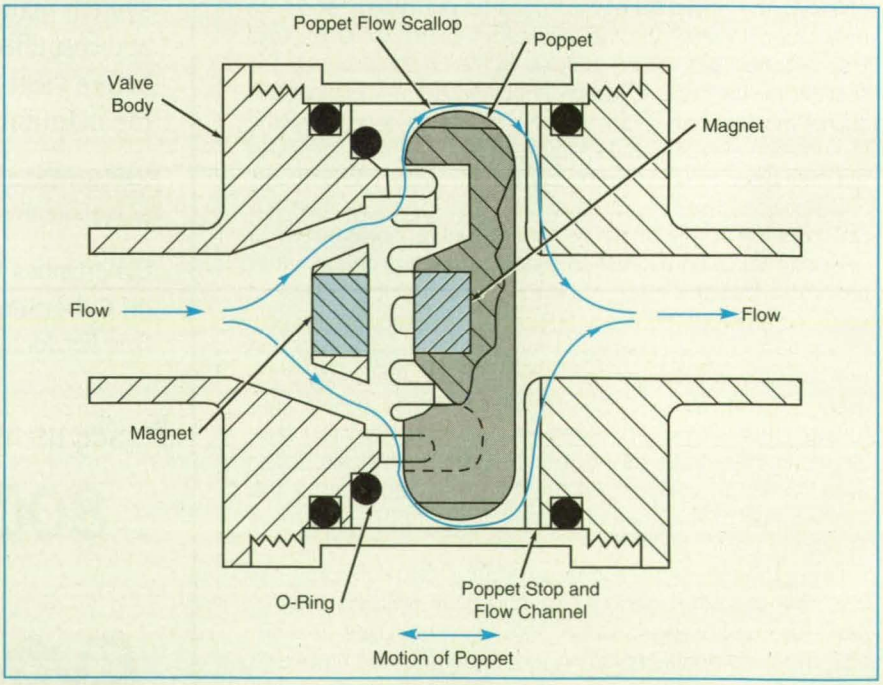
Oscillations would be suppressed, with consequent reduction of wear.

Lyndon B. Johnson Space Center, Houston, Texas

The poppet in a proposed check valve would be restored to the closed condition by magnetic attraction instead of spring force. It should therefore be immune to the sustained oscillations that plague spring-loaded poppets and wear them out quickly, often within hours. Wear also generates particles that contaminate the flow.

In the proposed check valve, a stationary magnetic disk would be mounted just upstream of the poppet, which would also contain a magnet (see figure). The valve body would be nonmagnetic. Forward pressure or flow would push the poppet away from the stationary magnetic disk so that the fluid would flow easily around the poppet. A stop in the valve body would prevent the poppet from being swept away. When flow stopped or started to reverse, magnetic attraction would draw the poppet back to the disk. The poppet would then engage a floating O-ring, thereby closing the valve and preventing reverse flow. The floating O-ring facilitates sealing at low loads.

The valve, when open, would not be



The **Magnetic Check Valve** would operate similarly to a spring-loaded check valve except that the seating force would be provided by magnets instead of a spring.

subject to flow-induced oscillation because it would not contain a mechanical element that would store and return energy to the poppet as does the spring of a conventional spring-loaded poppet. Moreover, the magnetic field would assist in centering and guiding the poppet, reducing the wear that would ordinarily be expected at the interface between the poppet and the valve body during stroking of the poppet. The magnet would also serve as a particulate filter for ferrous system contaminants.

Because the extent of the magnetic field would be limited, the stroke of the magnetic valve would necessarily be shorter than that of an equivalent spring valve. Therefore, the diameter of the valve seat would have to be made larger to accommodate the same flow. The valve body would therefore be wider than the equivalent spring-valve body. The poppet would also have to be enlarged to fit the enlarged seat, and the increase in the cross-sectional area of the poppet would reduce the differential pressure needed to push the poppet away from the seat. In addition, the absence of a spring in the magnetic valve would enable a reduction in the axial length of the valve body.

The magnetic seating (closing) force exerted on the poppet would be strongest when the poppet was seated and weakest when the poppet was fully open. This situation is opposite that in a spring-loaded valve. Thus, at full flow, a magnetic valve would offer less resistance to the flow. The valve features large flow capacity in a small envelope.

This work was done by Brian G. Morris and Richard J. Bozeman, Jr., of **Johnson Space Center**. *For further information,* ***write in 15*** *on the TSP Request Card.*

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to the Patent Counsel, Johnson Space Center [see page 24].
Refer to MSC-22046.

Temperature-Operated Valve

Outlet flow would be allowed in a prescribed temperature range only.

NASA's Jet Propulsion Laboratory, Pasadena, California

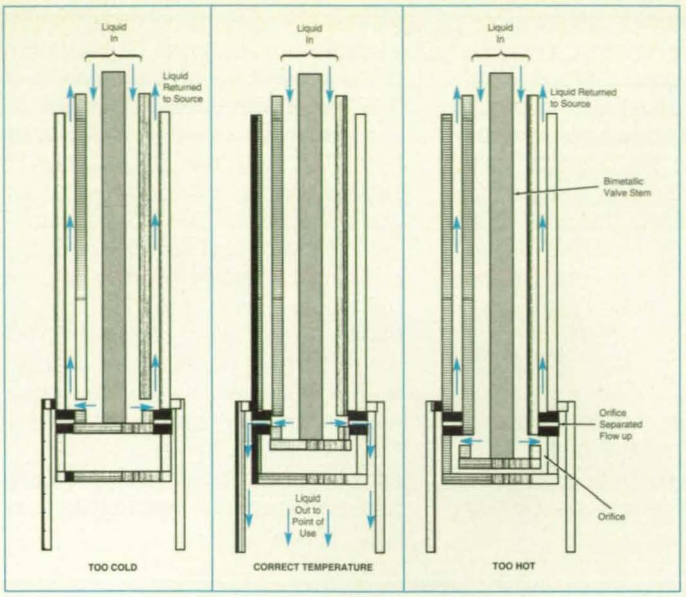
A proposed valve would help prevent waste by returning water (or other liquid) to its source when it is too hot or too cold for use. When the temperature is within the required range, the valve would let the liquid flow. In a shower, for example, the valve would prevent the outflow of dangerously hot or uncomfortably cold water.

The valve would contain two concentric pipes, the inner pipe being free to slide within the outer one (see figure). One end of the inner pipe would be moved by a bimetallic valve stem that would expand or contract with an increase or decrease in the temperature of the liquid.

At the proper temperature, which

could be preset by turning a knurled nut at the outlet to adjust the axial position of the stem, orifices in the inner pipe would become aligned with orifices in the outer pipe, and the liquid would flow through the valve to the outlet at which it would be used. At higher or lower temperatures, the orifices would be misaligned and the liquid would be returned to its source through the annular space between the pipes.

This work was done by Andrew D. Morrison of Caltech for **NASA's Jet Propulsion Laboratory**. *For further information,* ***write in 45*** *on the TSP Request Card.*
NPO-18650



The **Bimetallic Valve Stem** would position the orifice at the end of the inner pipe orifice so that liquid could flow to the outlet when the temperature lies within a small range of a preset value. If the liquid were too cold or too hot, the orifices would be misaligned and the liquid would be returned to the source.

Hydraulic Extractor for Electronic Connectors

This tool gently but firmly separates multipin connectors.

NASA's Jet Propulsion Laboratory, Pasadena, California

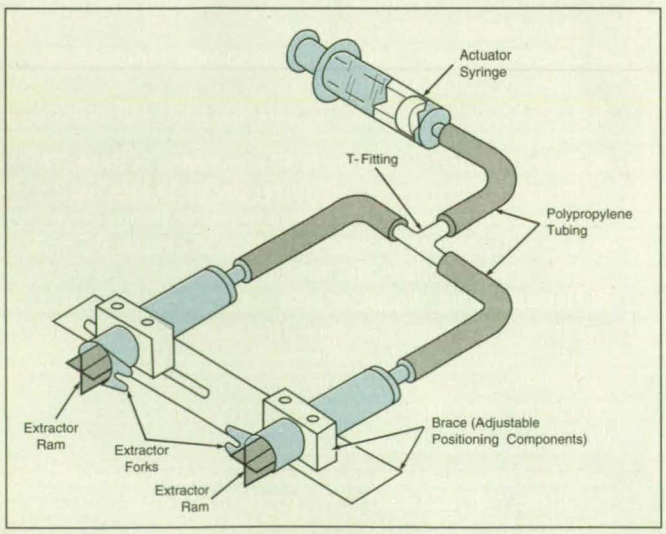
A tool separates multipin electrical connectors in electronic equipment. The tool is based on the use of hydraulic pressure to apply balanced forces to the connector and gently pull it free without damage.

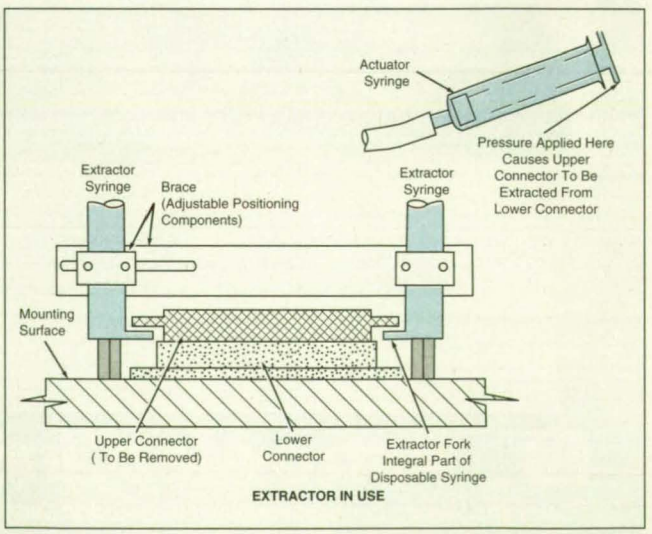
The tool can be easily assembled from readily available parts. The tool includes an actuator syringe, two extractor syringes of the disposable plastic 5-mL type, several pieces of flexible plastic tubing, and adjustable mounting components that brace the tool in the desired spacing configuration to suit the connector to be extracted (see figure). The tubes and syringes are filled with a suitable fluid.

In use, the tool is first positioned and braced over the connector to be extracted. Forks on the extractor syringes are placed below the lips of the connector to be extracted. The technician then pushes the plunger on the actuator syringe, thereby pressurizing the extractor syringes: the pressure extends the extractor rams so that they push against the mounting surface, and the extractor syringes and forks move apart pulling the upper connector away from the lower connector with equal force applied to both sides. This tool was designed specifically for use on "D"-type connectors, but can be adapted for use wherever a linear extraction motion would be used.

This work was done by Larry D. Smith of Caltech for **NASA's Jet Propulsion Laboratory**. *For further information,* ***write in107*** *on the TSP Request Card.*

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to the Patent Counsel, NASA Resident Office–JPL [see page 24].
Refer to NPO-18786.





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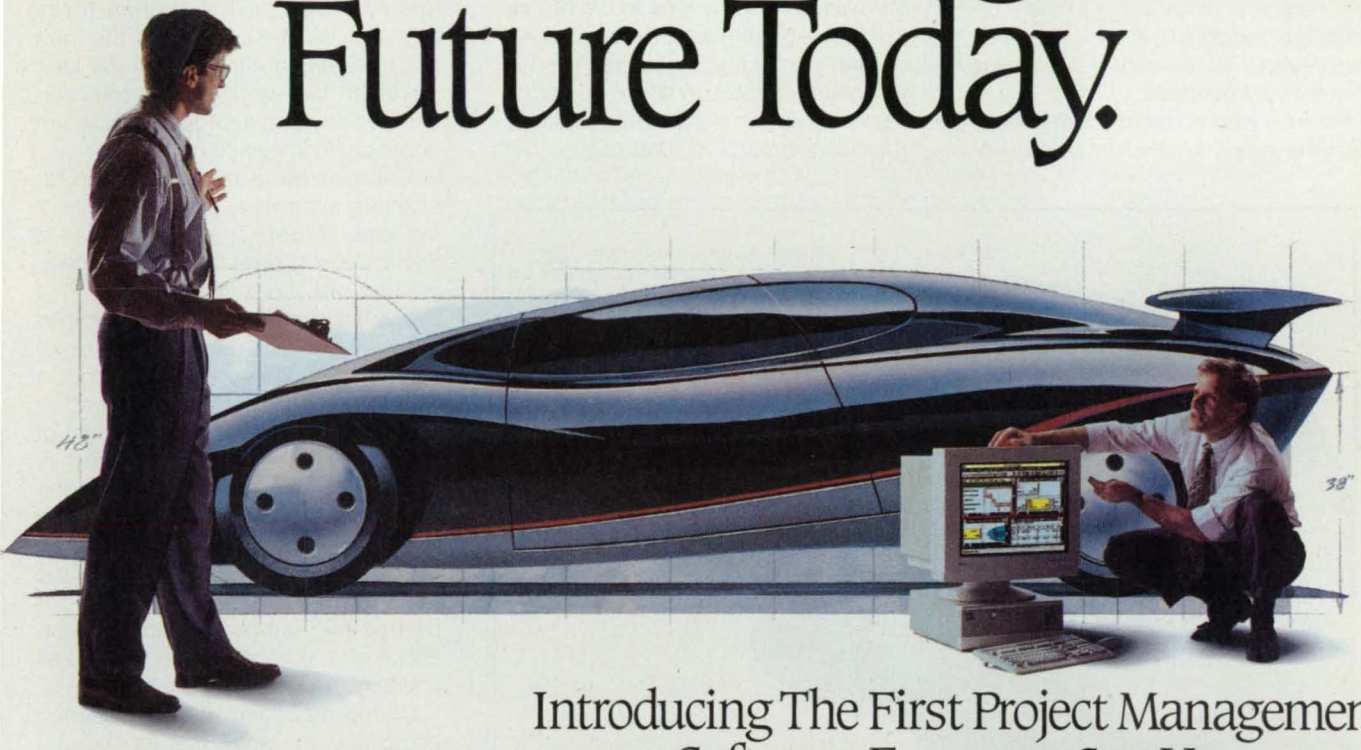

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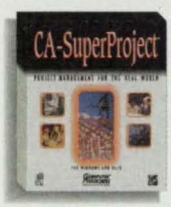

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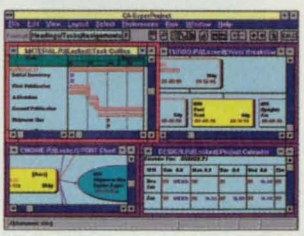

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For More Information Write In No. 621

Elongation Transducer for Tensile Tests

Clamping stress is distributed more evenly than in older extensometers.

Langley Research Center, Hampton, Virginia

An extensometer transducer measures the elongation of a tensile-test specimen with negligible distortion of the test results. The transducer is used in stress-versus-strain tests of small specimens of composite materials.

Previous extensometers exerted large clamping forces via their load points generating concentrated stresses at load points. Because of these concentrated stresses, thin specimens tended to fail prematurely, giving inaccurate measures of tensile strength. In contrast, this extensometer applies much of its clamping force via flat clamping surfaces rather than through its load points. The user adjusts the relatively small part of the clamping force at the points until it is just enough that the friction force between the specimen and the load points retains the location of the load points on the specimen. Concentrated stresses are thus kept to the minimum necessary for measurement.

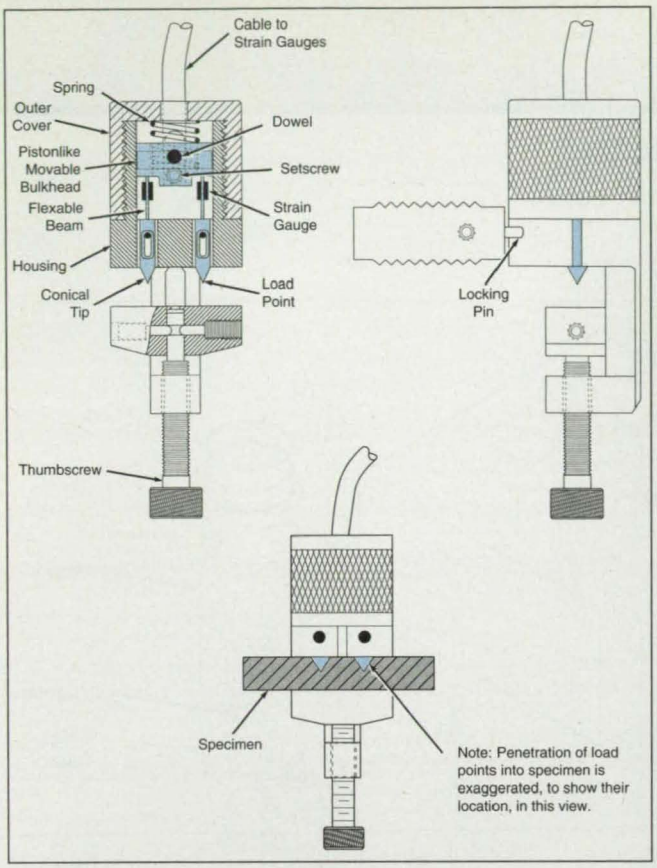
The specimen is placed between flat clamping surfaces of a jaw and a housing (see figure). The user rotates a thumbscrew to drive the jaw and specimen toward a pair of conical tips that define the load points. As the specimen presses against the tips, they in turn press (via flexible beams) against a spring-loaded, pistonlike bulkhead in the transducer housing. The amount of friction force applied to the specimen is determined by the compression of the spring and the position of the jaw. The compression of the spring is adjusted by turning a knurled outer cover on the housing; the compression is thus set so that the tips do not slip when the specimen is clamped in the transducer and stretched in the tensile test.

During mounting of the specimen and prior to the tensile test, locking pins maintain a fixed gap of 0.300 in. (7.62 mm) between the load points. This ensures a consistent starting point from measurement to measurement. Once the load points are set in the specimen, the locking pins are removed. The flexible beams that support the points are then free to bend.

Tension is applied to the specimen. As the specimen stretches, it pulls the load points apart. The flexible beams bend in cantilever fashion. Strain gauges on these beams measure the bending and thus the elongation of the specimen between the tips. The strain gauges are connected in a bridge circuit that puts out a 21.4 mV full-scale reading (at 10 V input) at a maximum elongation of 0.03 in. (0.76 mm). Thus, the transducer provides ample sensitivity and resolution for tensile testing of small specimens.

Inasmuch as the housing encloses the measuring elements, these are protected from damage in routine handling and use. Also, deflection stops in the housing prevent the overloading of the measuring elements in the event of excessive elongation of the specimen.

This work was done by Paul W. Roberts of **Langley Research Center**



The **Specimen Is Clamped Gently** between the jaw and the facing surface of the housing. The friction force of the load points on the conical tips onto the specimen depends on the compression of the spring, which is adjusted by turning the cover on the housing. Limp, light nylon-insulated electrical leads impose minimal extraneous loads on the measuring elements.

and Thomas R. Stokes of Modern Machine and Tool Co. No further documentation is available.

Inquiries concerning rights for the commercial use of this invention should be addressed to the Patent Counsel, Langley Research Center [see page 24].
Refer to LAR-14845.

Low-Flow-Rate Dry-Powder Feeder

Rates of flow are optimized for measurement of particle-size distributions.

Marshall Space Flight Center, Alabama

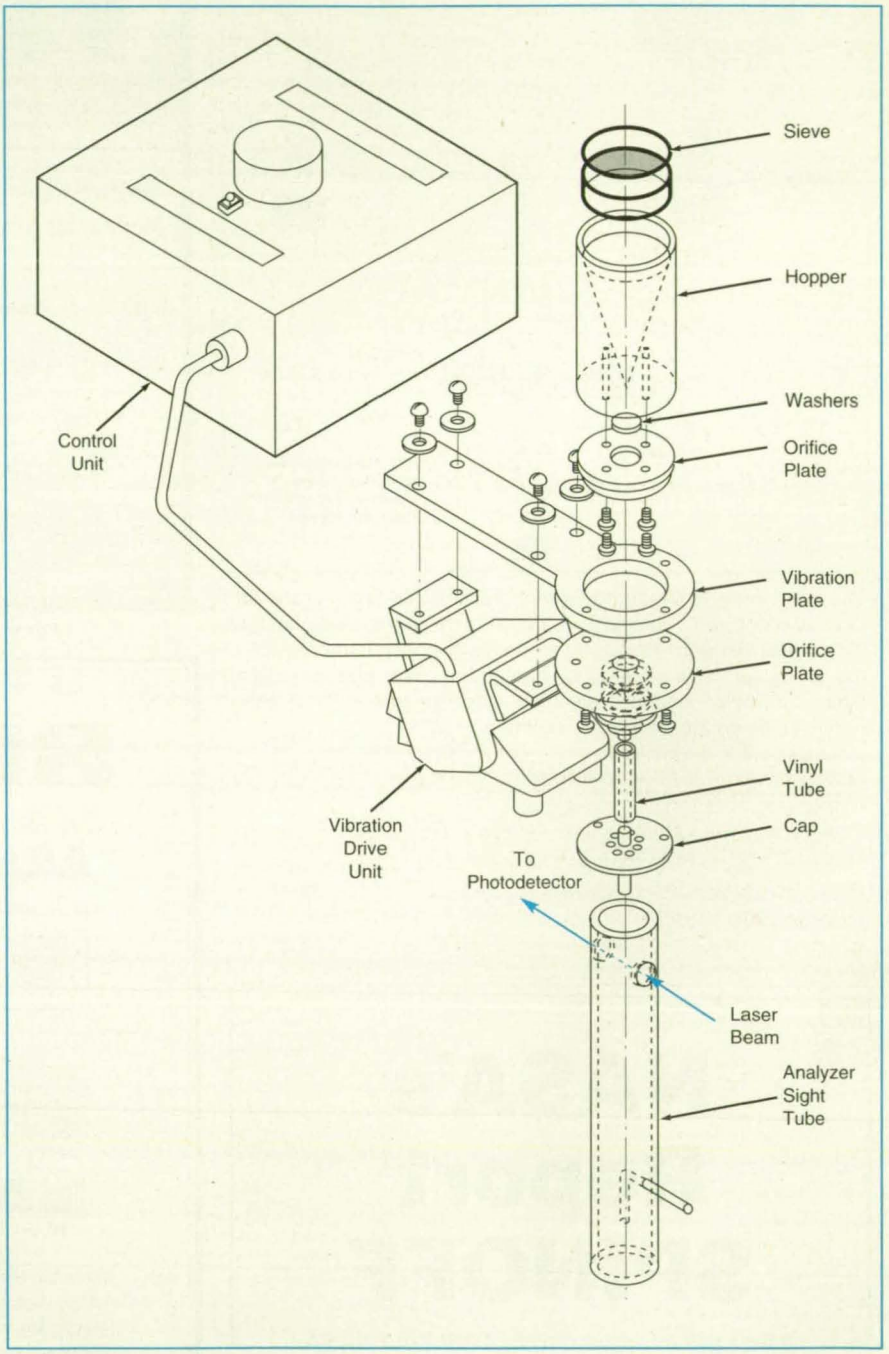
An apparatus feeds a small, precise flow of dry powder through the laser beam of an optical analyzer, which measures the patterns of light created by forward scattering (Fraunhofer diffraction) of the laser beam from the powder particles. From this optical measurement, the statistical distribution of the sizes of the powder particles is computed.

The powder-feeding apparatus provides the steady flow that is neither too dense nor too sparse for creation of the required diffraction patterns. Flow at too high a rate would be too dense in that it would result in multiple scattering; the optical analyzer would measure two or more particles at the same time and indicate a smaller particle than was actually there. Flow at too low a rate would be too sparse in that it would yield insufficient data for computation of the particle-size distribution. Too sparse a flow would also expose the photodetector in the optical analyzer to direct laser radiation in excess of its measurement range.

In the powder-feeding apparatus, the powder descends from a hopper through a series of orifices, which meter the flow. The subassembly that contains the hopper and metering orifices is vibrated to prevent bridging of orifices and thereby ensure steady flow at the maximum rate permitted by the orifices. After flowing through the lowest metering orifice, the powder stream continues downward through a flexible tube into a vertical analyzer sight tube, where the laser beam intercepts the stream monitored by the photodetector. The powder continues to flow down the sight tube and is collected at the bottom. The collected powder can be reused.

The rate of flow can be changed by replacing the metering orifices with other orifices of different diameters. Rates of flow usually range from 0.2 to 0.4 g/s depending on the bulk density and the particle-size distributions of the powders.

The feeder was developed for analyzing particle-size distributions of solid-propellant powders. The feeder could also be adapted to use in the pharmaceutical industry, in manufacture of metal powder, and in other applications in which the particle-size distributions of materials are used to control rates of chemical reactions and/or physical characteristics of processes.



Powder Falls from a hopper through orifices, passing through a laser beam. A control unit regulates vibration to provide a slow, uniform flow.

This work was done by Keith E. Ramsey of GenCorp Aerojet for **Marshall Space Flight Center**. *For further information,* ***write in 104*** *on the TSP Request Card.*

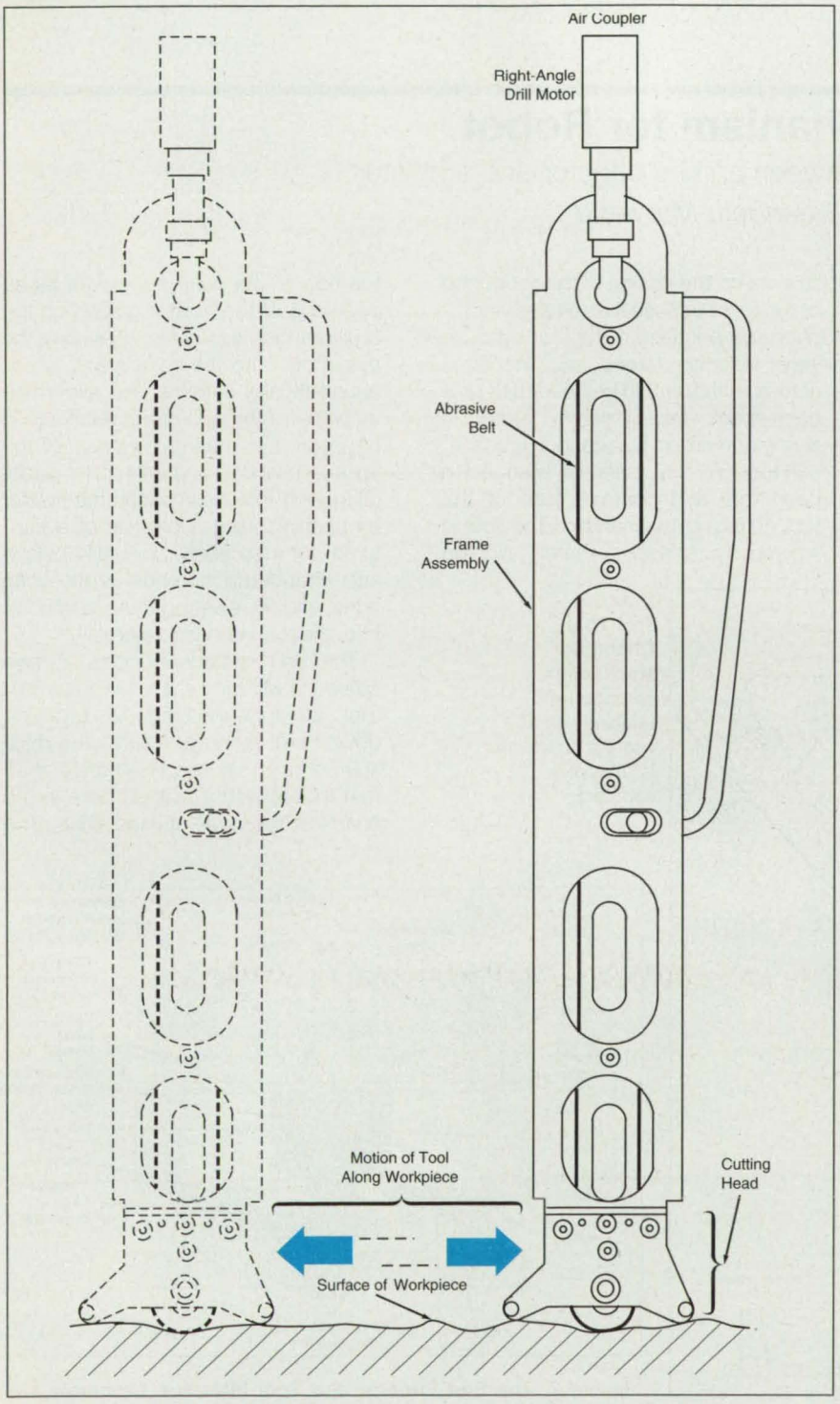
MFS-28738

Lightweight Tool Grinds Back-Side Weld Beads

This air-powered grinder enables high-quality rework of welds.

Marshall Space Flight Center, Alabama

A tool removes excess material from the back side of a weld in preparation for reworking it. The tool is used on a workpiece while the workpiece is still mounted in the welding fixture or welding machine. The workpiece can then be rewelded in its original position, so that full process control is maintained.



The **Abrasive Belt** makes contact with the workpiece at the lowerend of the cutting head.

Previously, it was necessary to remove the workpiece from the welding fixture or machine. A technician shaved or ground the back-side weld bead manually, then rewelded the workpiece manually. This procedure was time consuming and the welding operation was largely uncontrolled.

The tool (see figure) weighs only 5 lb (2.3 kg). It includes an abrasive belt that runs in a frame assembly. A right-angle drill motor, powered by compressed air, drives the belt. A cutting head at the end opposite the motor supports the tool on the workpiece. As the tool is moved along the weld bead, the belt grinds excess material away.

The tool can also be used for grinding material in spaces to which access is limited — for example, in pressure vessels and in the hulls of ships. It can also be used to grind materials other than metals.

This work was done by Robert L. Gallagher of Martin Marietta Corp. for **Marshall Space Flight Center**. *For further information,* ***write in 44*** *on the TSP Request Card.*

Inquiries concerning rights for the commercial use of this invention should be addressed to the Patent Counsel, Marshall Space Flight Center [see page 24]. Refer to MFS-28775.

Tool-Changing Mechanism for Robot

A tool is handed off securely between an end effector and a holster.

Goddard Space Flight Center, Greenbelt, Maryland

Figure 1 is a partially exploded view of a tool-changing mechanism for robotic applications. The mechanism effects secure handoff of the tool between the end effector of the robot and a yoke in which the tool is stowed when not in use. The mechanism can be operated in any orientation in normal or low gravitation. Unlike some other robotic tool-changing mechanisms, this one imposes lesser constraints on the design of the robot and of the tool because it is relatively compact and because it does not require large insertion forces and the large actuators that would be needed to produce them. Also, it can be stored in zero *g* and can survive launch loads.

A tool interface assembly is affixed to each tool and contains part of the tool-changing mechanism. The tool is stowed by (1) approximately aligning the tips of the yoke arms with flared openings of the holster guides on the tool interface assembly, (2) sliding the assembly onto the yoke arms, which automatically enforce fine alignment by virtue of the geometric relationship between the mating surfaces of the yoke-arm wheels and the holster guide, (3) locking the assembly on the holster by pushing wing segments of a captured nut (described more fully below) into chamfered notches in the yoke arms, and (4) releasing the end effector from the tool interface assembly.

The end effector includes a male splined shaft (not shown in Figure 1) that is spring-loaded to protrude downward. A motor rotates the male splined shaft via a splined drive shaft that mates with a splined bore in the shank of the male splined shaft. The

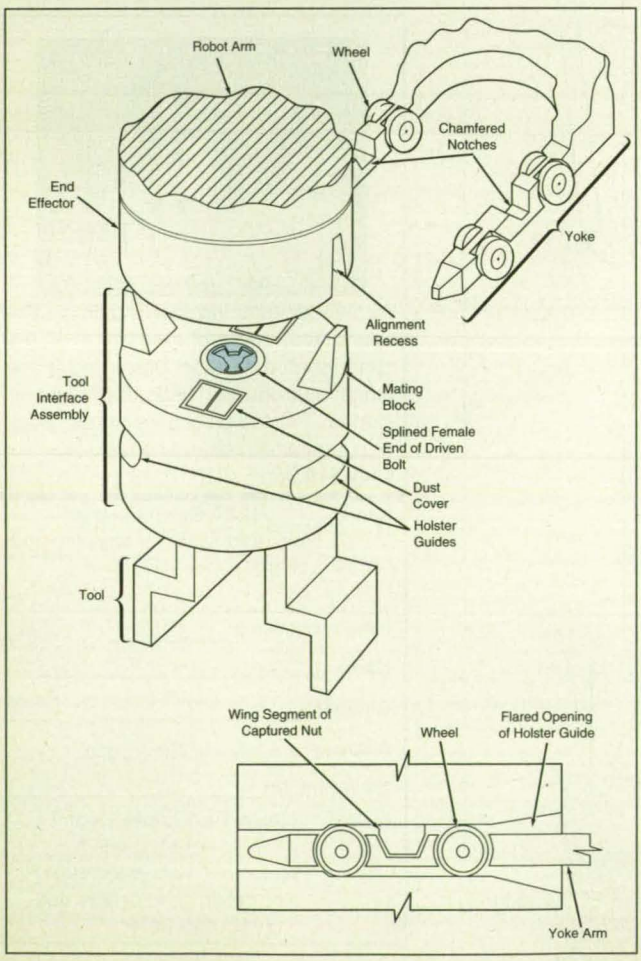


Figure 1. This **Tool-Changing Mechanism** operates with relatively small contact forces and is relatively compact.

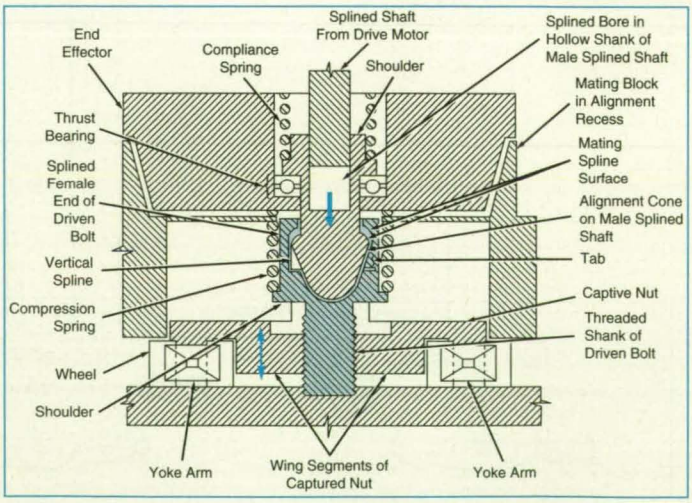


Figure 2. The **End Effector and Tool Interface Assembly** are shown in initial mating configuration, immediately before the beginning of the sequence of motions to release the tool from the yoke and secure it to the end effector.

sequence of movements in which the end effector takes the tool from the holster begins with the movement of the end effector into a position in which its alignment recesses can engage the mating blocks on the tool interface assembly. The end effector is then pushed downward into contact with the tool interface assembly. Meanwhile, the male splined shaft is rotated until the spring force can push it through the opening in the splined female end of a driven bolt, and an alignment cone at the end of the splined male shaft bottoms in a conical hole in the female end of the driven bolt (see Figure 2).

Assuming that the thread on the driven bolt is right handed, the male splined shaft is rotated clockwise until a vertical spline on this shaft engages a tab in the driven bolt, at which point the shaft and bolt rotate together. As the rotation continues, the driven bolt moves downward in a captive nut until mating splined surfaces on the male splined shaft and driven bolt make contact, which prevents further downward movement of the driven bolt.

As the rotation continues, the captive nut moves upward. The wing segments mentioned previously are thus pulled up, out of the chamfered slots on the yoke arms, so that the tool interface plate can be slid freely off the yoke. Simultaneously, two other wing segments of the captured nut (not shown) push up sets of electrical connectors, through the dust covers, to mate with electrical connectors in the end effector. Once this motion is completed, the tool is fully engaged with the end effector and can be slid off the yoke. To release the tool from the end effector and lock it on the yoke (steps 3 and 4 in the second paragraph), one simply reverses this sequence of motions.

This work was done by John M. Vranish of **Goddard Space Flight Center**. *For further information,* ***write in 7*** *on the TSP Request Card.*

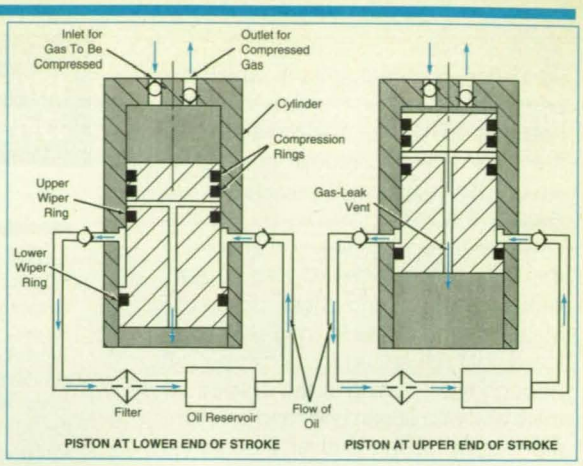
This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to the Patent Counsel, Goddard Space Flight Center [see page 24]. Refer to GSC-13435.

Piston-Skirt Lubrication System for Compressor

Filtered oil is supplied continuously.

Lyndon B. Johnson Space Center, Houston, Texas

A piston-skirt lubrication system provides a steady supply of oil to the piston rings of a gas compressor. Unlike in conventional lubrication systems for reciprocating compressors, there is no need for an oil-filled crankcase or an external oil pump. Instead, part of each piston acts as its own oil pump in that it circulates oil from a reservoir.



The **Annular Space at the Bottom** of the piston and cylinder constitutes the working volume of a small oil pump. The width of the annulus is exaggerated in the drawing; it need be no more than a few thousandths of the diameter of the piston.

Each piston and its cylinder are configured with a small step that increases in diameter at the bottom to form a thin annular oil-pumping space (see figure). A pair of wiper rings on the piston, below the compression rings, seal the top and bottom of this space. As the piston travels downward, it draws oil from the reservoir through a check valve into the annulus. Because the upper wiper ring is constantly exposed to lubricant on its lower side, it leaves behind a thin film of oil that lubricates the compression rings. The lower wiper ring simply functions as a seal to contain the lubricant within the annulus.

On the upward stroke, the piston forces oil out of the annulus through a check valve, returning the oil to the reservoir through a filter. Depending on the application, the reservoir can be open to the atmosphere, or it can be sealed and pressurized in a bellows to prevent contact between the oil and the atmosphere. The filter removes particles worn away from the piston rings and cylinder wall during normal operation.

Any compressed gas that leaks from the compression space of the cylinder through the compression rings is vented into the crankcase through ports in the piston. This keeps the gas out of the lubrication system, where it could contaminate the oil.

This work was done by Edgar C. Schroeder and Marion Burzynski, Jr., of Southwest Research Institute for **Johnson Space Center**. *No further documentation is available.*
MSC-22152

Floating Vacuum Skimmer for Emulsion Cleaning

This skimmer eliminates the need for a tedious operation.

Marshall Space Flight Center, Alabama

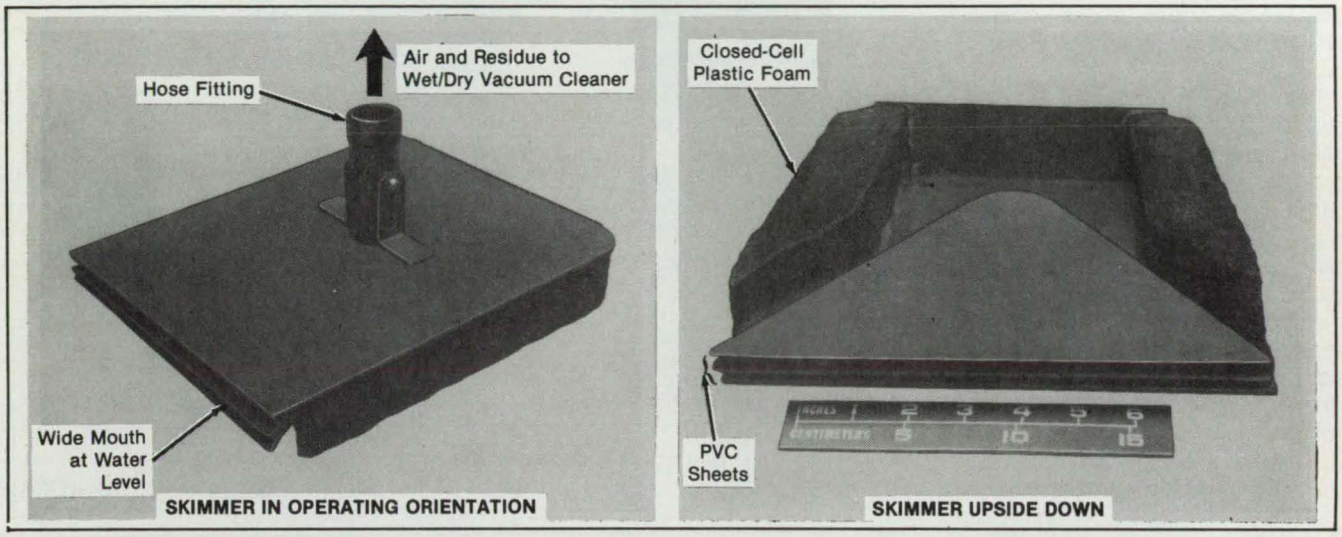


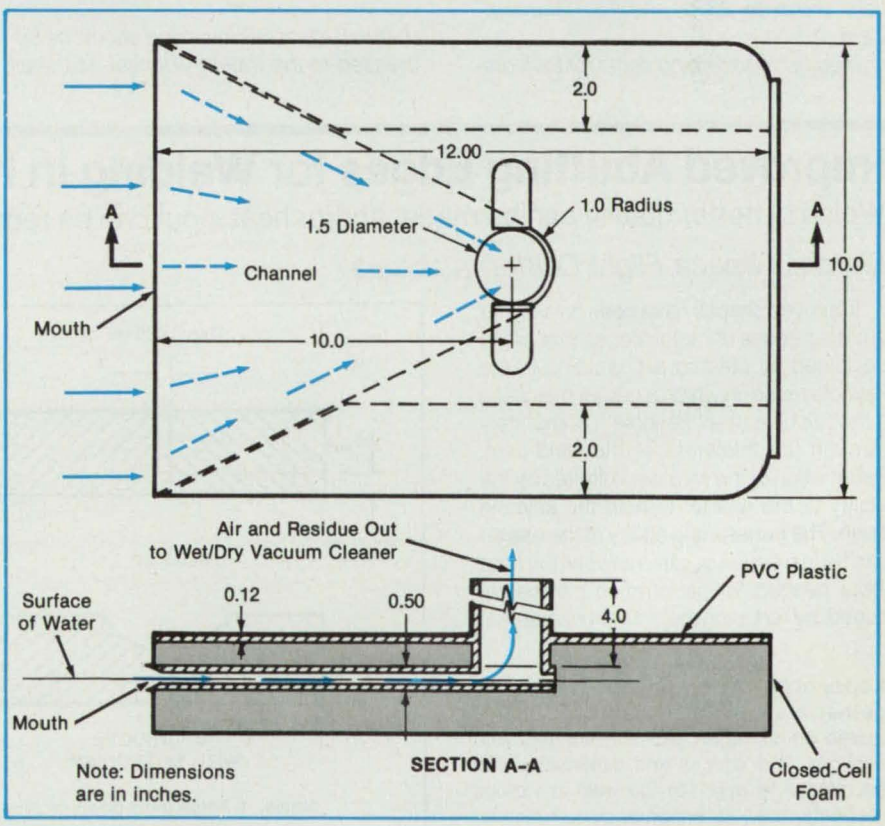
Figure 1. The **Floating Skimmer**, when connected to a wet/dry vacuum cleaner and placed on the surface of the liquid in an emulsion cleaning tank, draws off floating emulsified residue.

A simple device skims oil quickly and easily from the surface of the liquid in an emulsion-type cleaning tank. In such a tank, oil removed from the object being cleaned is emulsified and floats to the surface. The floating residue must be removed, or else it will recontaminate the cleaned object. Previously, the floating residue was removed by manual skimming with a cup — a tedious procedure.

The device (see figure) is a floating skimmer. Two pads of closed-cell foam provide flotation for a raft of polyvinyl chloride (PVC). The raft supports two PVC sheets, which form a widemouthed channel that tapers into a hose fitting. The hose is connected to a wet/dry vacuum cleaner, which draws the emulsified residue away.

The materials for the floating skimmer cost less than $5 (1991 prices). The time required to cut the materials and assemble the parts was less than 2 hours.

This work was done by Gene E. Morgan and Isabel B. Satra of Rockwell International Corp. for **Marshall Space Flight Center**. *No further documentation is available. MFS-29897*



These **Four Stages in Changing a Tool** are typical of the operation of the robotic tool changer.

Inert-Gas Diffuser for Plasma or Arc Welding

The inert gas excludes oxygen from weld beads until they cool sufficiently.

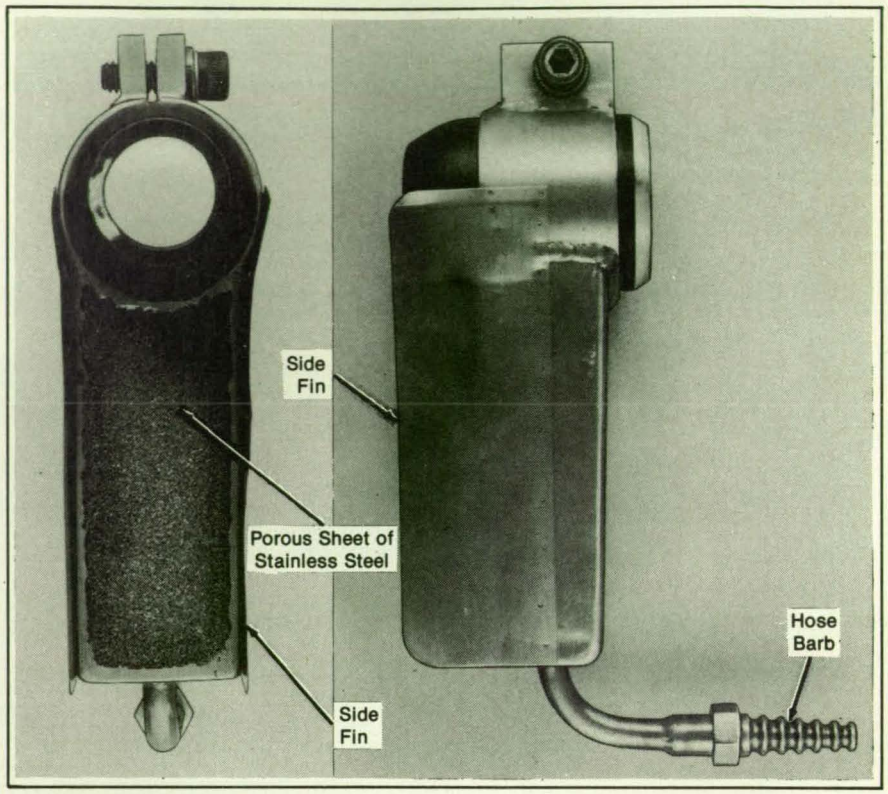
Marshall Space Flight Center, Alabama

An inert-gas diffuser provides a protective gas cover for a weld bead as it cools. The diffuser follows a welding torch, maintaining a continuous flow of argon over the newly formed joint and thus preventing it from oxidizing. The diffuser helps to ensure welds of consistently high quality. It was devised for plasma arc keyhole welding of plates of 0.25-in. (6.35-mm) or greater thickness but can also be used in tungsten/inert-gas and other plasma or arc welding processes.

The diffuser includes a stainless-steel chamber that is clamped onto the welding torch (see figure). The components of the chamber are welded together. A tapered barb at the inlet to the chamber fits gas hoses of all common inside diameters. The inlet flow is directed into the chamber in such a way that it purges any residual air, thereby eliminating the possibility that the weld puddle could entrap air. The underside of the chamber is a sheet of stainless steel 0.062 in. (1.6 mm) thick, with pores about 100 μm wide. As argon flows from inside the chamber through the pores, side fins direct the flow toward the weld bead.

This work was done by Jeffrey L. Gilbert, Carl N. Spencer, and Timothy J. Hosking of Rockwell International Corp. for **Marshall Space Flight Center**. *For further information,* ***write in 23*** *on the TSP Request Card.*

Inquiries concerning rights for the commercial use of this invention should be addressed to the Patent Counsel, Marshall Space Flight Center [see page 24]. Refer to MFS-29887



The **Inert-Gas Diffuser** follows the welding torch, protecting the weld bead from oxidation as the bead cools. Side fins help to retain the flowing inert gas.

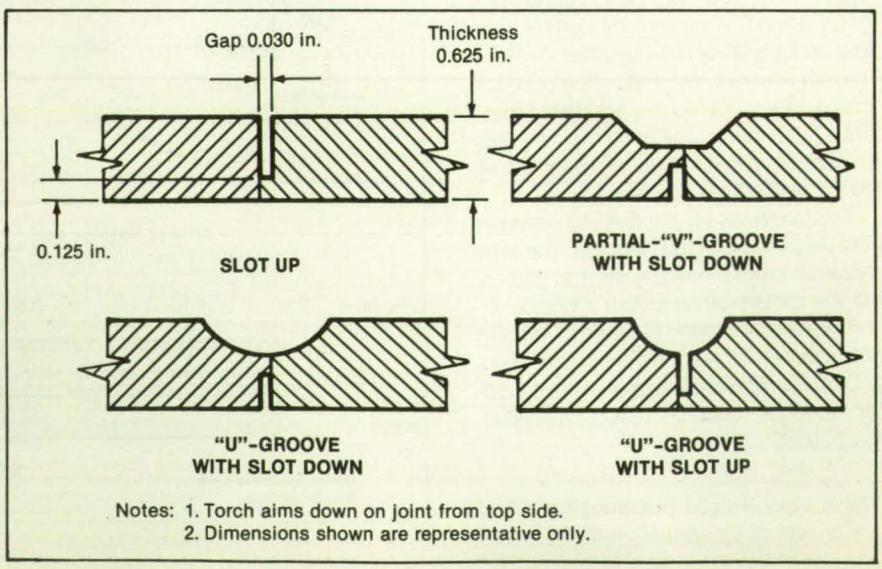
Improved Abutting Edges for Welding in Keyhole Mode

Welds of better quality can be made, and/or heat input can be reduced.

Marshall Space Flight Center, Alabama

Improved shapes have been devised for abutting edges of metal pieces that are to be joined by plasma arc welding in the keyhole mode, in which a gas jet maintains a molten hole (the "keyhole") completely through the thickness of the weld joint. Penetration of the keyhole is limited by the ability of the gas jet to hold the keyhole open. The penetrating ability of the gas jet can be increased or, alternatively, the heat input needed for penetration can be reduced, by reducing the amount of material

Edges of Metal Pieces To Be Welded Together are machined to provide the required combination gap and shaped, thin sections. The shapes and dimensions can be chosen to optimize the weld in various respects; e.g., to enhance penetration of the keyhole or to reduce the heat input to produce a joint of a given thickness.



Notes: 1. Torch aims down on joint from top side.
2. Dimensions shown are representative only.

the gas jet has to displace. This can be done by separating the abutting edges by a small fraction of an inch (about 1 mm) and/or thinning either or both metal piece(s) at the abutting edges.

Heretofore, in some cases, gaps between simple abutting square edges have been maintained by use of spacers, shims, and tack welds. In other cases, abutting edges have been machined to shapes that provide the requisite thin sections and/or gaps. Each of these prior approaches has entailed one or more disadvantages: it is difficult to use spacers and shims, tack welds present local obstacles to full penetration, and some of the shapes of abutting welds have been difficult to machine. Other disadvantages have included, variously, the need to use backup welding shields, difficulty in inspection, difficulty in maintaining and enforcing alignment during welding, difficulty in maintaining the quality of the weld, and the need to provide additional filler material.

The improved shapes (see figure) overcome these disadvantages to a large extent. No shims, spacers, or tack welds are needed, because the edges automatically provide the required gap when the pieces are butted tightly together. The edges can be machined easily, with shapes and dimensions chosen to provide the desired combination of thinning and separation of the pieces to be joined. The shapes and dimensions can be chosen to obtain deeper penetration of the keyhole for a given set of welding parameters. The shapes and dimensions can also be chosen to reduce the heat input needed to weld a joint of given thickness; the reduction in heat input improves the metallurgical properties of the weld joint. Other advantages include reduction of the amount of molten metal in the forming weld bead (with consequent better control of the shape of the weld bead on the underside), reduction of the number of weld passes needed for a joint of given thickness, and reduction of the costs of machining and inspection.

This work was done by Dennis D. Harwing and John M. Sanders of GenCorp Aerojet for **Marshall Space Flight Center**. *For further information,* ***write in 73*** *on the TSP Request Card.*

Inquiries concerning rights for the commercial use of this invention should be addressed to the Patent Counsel, Marshall Space Flight Center [see page 24]. Refer to MFS-28694

Robotic Tool Changer for Automated Welding

Parts can be welded, inspected, and reworked automatically.

Marshall Space Flight Center, Alabama

A prototype robotic tool changer for an automated welding system eliminates the need for most manual tool setups and the attendant problems: the robotic tool changer operates rapidly, always chooses the designated tool, maneuvers the tip of the welding torch or other tool in the correct position, and reliably connects water, gas, welding wire, high-voltage electrical signals, and ground. The robotic tool changer can also load tools other than those for welding — an eddy-current weld-flaw inspection probe, for example.

A control subsystem sends the end effector of the robot, on which the tool changer is mounted, to a tool-storage rack. If the tool changer is holding a

tool, it deposits that tool in a holder on the rack, and that tool separates from itself and the various supply lines. Then the tool changer is moved to the holder, where the tool for the next operation is located. There, the changer engages the new tool and its supply lines. The robot returns to the workpiece with the new tool and performs the next fabrication operation (see figure).

The tool-storage rack provides compressed air for blowing shop dust off the electrical contacts of each tool. It also cuts excess welding wire from each tool.

The robotic tool changer is intended for use in a robotic work cell that produces all good parts, no rejects. That is, in production, the robot would weld a part, test it for flaws, and rework it as necessary before releasing it. The ability to change tools automatically instead of manually would enhance the productivity of the work cell.

This work was done by Jeffrey L. Gilbert and Carl N. Spencer of Rockwell International Corp. for **Marshall Space Flight Center**. *For further information,* ***write in 100*** *on the TSP Request Card.*
MFS-29921

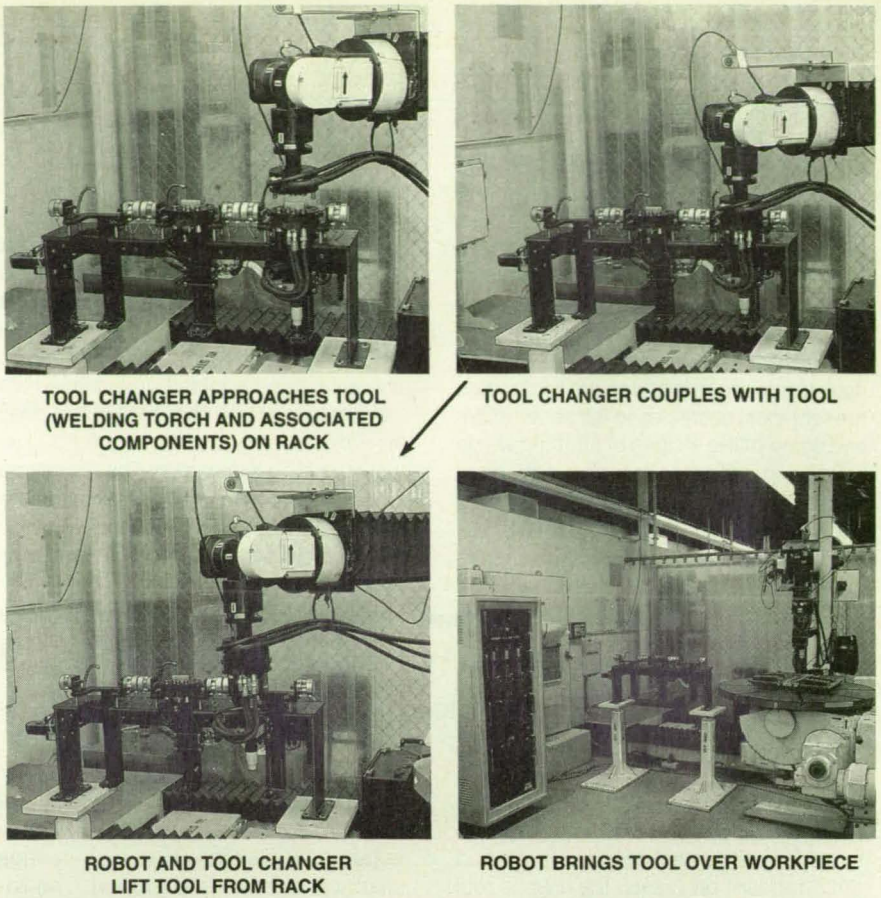


Figure 2. This **Simple Design** makes it possible to fabricate the skimmer quickly, at low cost.

Powder-Curtain Feeder for Coating Filament Tow

A web of fibers is coated and fused on both sides.

Langley Research Center, Hampton, Virginia

A device coats a web of fibers evenly with polymer powder as the web is drawn, yielding high-quality composite towpreg. The device is called a "powder-curtain feeder" because it creates a localized rain or curtain of powder particles that fall onto the web in a controlled amount, with little loss. The small amount of powder that falls to the side or through the web can be recovered easily.

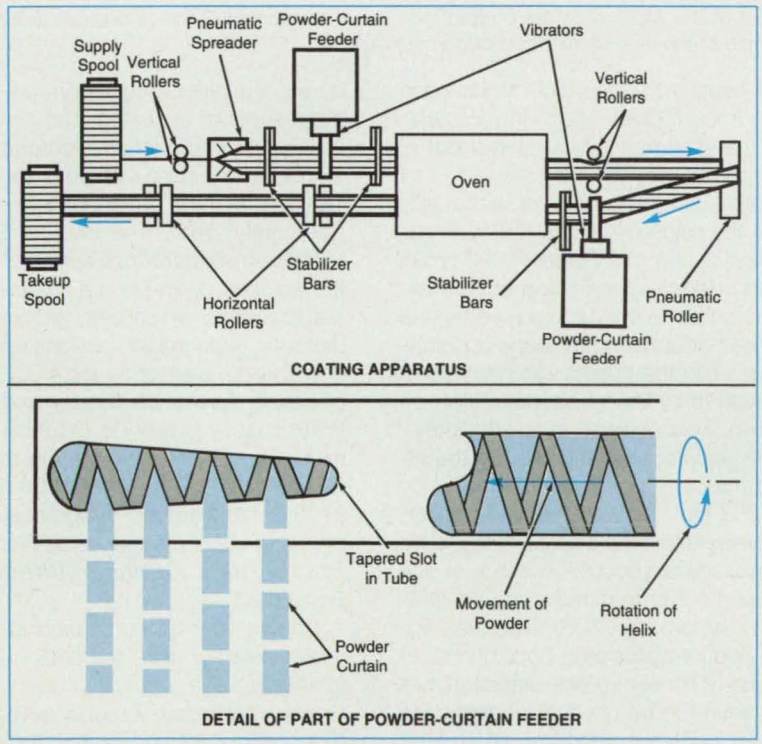
The powder-curtain feeder is part of an apparatus similar to the one described in "System Applies Polymer Powder to Filament Tow" (LAR-14231), *NASA Tech Briefs*, Vol. 17 No. 7 (July 1993), page 77. The powder-curtain feeder contains a helical feed mechanism that dispenses the polymer powder through a tapered slot. Vibrators on the feeder keep the powder flowing evenly. The polymer powder falls from the slot, forming the powder curtain. The web is pulled through the curtain and becomes coated with the polymer.

The web is first released from a spool and passes through vertical rollers that stabilize the web and prevent side-to-side movement as it rolls off the spool (see figure). An air jet spreads the web to its full width, and a series of horizontal bars maintains the width as the web passes through the powder curtain. Then the web passes under a bar that smooths the powder on the surface. The web then travels through an oven, which fuses the powder to the web.

After passing out of the oven, the web is inverted on a pneumatic roller. Then the web passes under a second powder-curtain feeder, which coats the previously uncoated side. Once again, the web passes through the oven, and the newly applied powder layer is fused to it. The resulting composite towpreg is then drawn onto a takeup spool for storage.

This work was done by Robert M. Baucom and John J. Snoha of **Langley Research Center** *and Joseph M. Marchello of Old Dominion University. For further information,* ***write in 42*** *on the TSP Request Card.*

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to the Patent Counsel, Langley Research Center [see page 24]. Refer to LAR-14926



The **Continuous Fiber Web** receives a powder coat first on one side, then on the other. A vibrating helical screw mechanism in the powder feeder provides an even flow of powder to form a powder curtain that descends onto the moving web.

Algorithms for Integrating Nonlinear Differential Equations

In comparison with previous algorithms, these are more stable and more accurate.

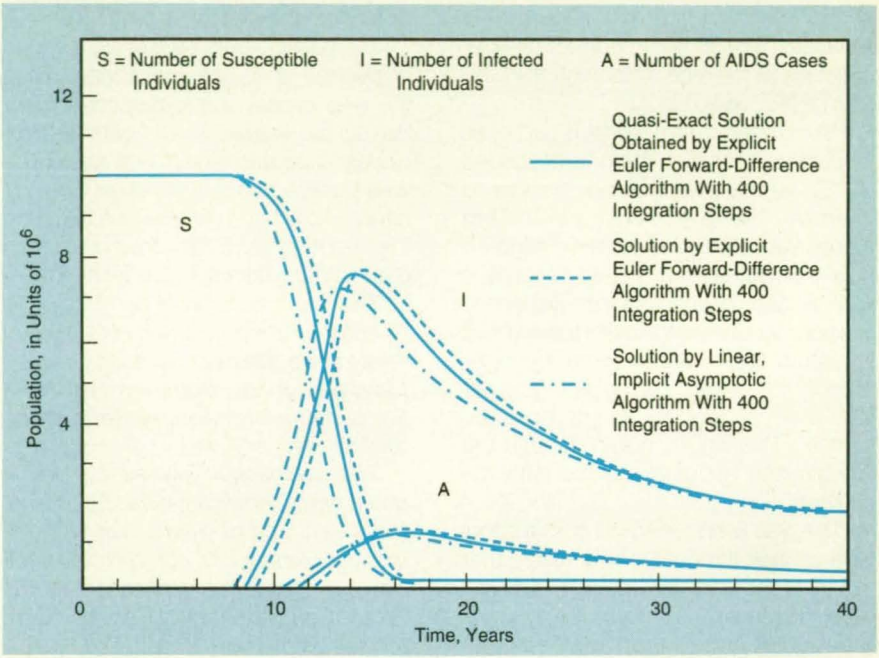
Lewis Research Center, Cleveland, Ohio

Improved algorithms have been developed for use in the numerical integration of systems of nonhomogenous, nonlinear, first-order, ordinary differential equations. In comparison with integration algorithms developed previously, these algorithms offer greater stability and accuracy. Several of these algorithms are asymptotically correct, thereby enabling the retention of stability and accuracy when large increments of the independent variable (which is often time) are used.

The derivation of these algorithms begins with the recasting of the differential equations into integral form. The integrands of the resulting integrals are expanded into Taylor or Euler–Maclaurin series, then integrated term by term. Expansion of the integrals about the lower limit, t, of the independent variable leads to an explicit formulation. The stability of this formulation for an exponentially decaying solution is unconditional in the case of a linear approximation and in the case of the exact solution, but it is conditional for quadratic and higher approximations.

To retain accuracy, even in the unconditionally stable cases, one must monitor the increment, Δt, of time or other independent variable in the explicit formulation. The explicit algorithm provides a representation that is asymptotically accurate when the solution is of the exponentially growing type, but is not asymptotically accurate in the case of a decaying exponential solution.

On the other hand, expansion about the upper limit of integration ($t+\Delta t$) leads to an implicit iterative formulation that is unconditionally stable in cases of exponentially decaying solutions. The implicit algorithm provides an asymptotically accurate representation when the solution is of the exponentially decaying type, but is not asymptotically accurate in cases of growing exponential solutions. The explicit and implicit solutions are therefore complementary in providing correct asymptotic representations for growing and decaying exponential solutions. Expansion about both limits leads to an implicit Euler–Maclaurin formulation that is conditionally stable but is often more accurate than are either of the preceding approaches, especially when the solutions are oscillatory in nature and contain both exponentially growing and decaying components. The explicit algorithms can be resolved by use of a self-adaptive time stepping technique, while the implicit algorithms can be resolved by use of Newton–Raphson iteration, which converges quadratically.



These **Three Solutions** of differential equations of a simplified mathematical model of the spread of the AIDS virus are plotted together as examples of the accuracies achievable by some of the algorithms described in the text.

The accuracies attainable by the algorithms have been demonstrated by applying them to systems of nonlinear, first-order, differential equations that arise in the study of viscoplastic behavior, the spread of the acquired immune-deficiency syndrome (AIDS) virus (see figure), and predator/prey populations. In general, the new implicit algorithm has been found to be unconditionally stable and to involve a Jacobian of smaller dimension than that required in such current implicit algorithms as the Euler backward-difference algorithm, yet it gives superior accuracy. The asymptotic explicit and implicit algorithms are suitable for solutions that are of the growing and decaying exponential kinds, respectively, while the implicit Euler–Maclaurin algorithm is superior when the solution oscillates; i.e., when there are regions in which both growing and decaying exponential solutions exist.

This work was done by A. D. Freed of **Lewis Research Center** *and K. P. Walker of Engineering Science Software, Inc. Further information may be found in NASA TM-103793 [N91-21797], "Asymptotic Integration Algorithms for Nonhomogeneous, Nonlinear First Order, Ordinary Differential Equations."*

Copies may be purchased [prepayment required] from the NASA Center for AeroSpace Information, Linthicum Heights, Maryland, Telephone No. (301) 621-0390. Rush orders may be placed for an extra fee by calling the same number. LEW-15522

Books & Reports

These reports, studies and handbooks are available from NASA as Technical Support Packages (TSP's) when a Request Card is cited; otherwise they are available from NASA Technical Information Service.

Mathematics and Information Sciences

Estimating Costs of Aerospace Construction

A report presents brief descriptions of techniques, instructional and reference literature, computer hardware and software, and compilations of data that have been used to estimate the costs of specially equipped buildings and other aerospace construction projects, mostly at Kennedy Space Center. The descriptions are replete with practical examples. Experiences gained in estimating costs of specific projects are also included.

This work was done by Joseph A. Brown of **Kennedy Space Center**. *To obtain a copy of the report, "Aerospace Construction Cost Estimating," **write in 105** on the TSP Request Card.*
KSC-11604

Machinery

Damping Bearings in High-Speed Turbomachines

A paper presents a comparison of damping bearings with traditional ball, roller, and hydrostatic bearings in high-speed cryogenic turbopumps. The concept of damping bearings was described in "Damping Seals and Bearings for a Turbomachine" (MFS-28345), *NASA Tech Briefs*, Vol. 14, No. 9 (September 1990), page 80. To recapitulate: a damping bearing includes a smooth journal that turns in a stator, the bearing surface of which contains a grid of small indented pockets. Pressurized liquid is supplied via orifices in the rotor or stator at the midlength of the bearing.

This work was done by George L. von Pragenau of **Marshall Space Flight Center**. *To obtain a copy of the paper, "From Labyrinth Seals to Damping Seals/Bearings," **write in 26** on the TSP Request Card.*
MFS-28754

Advances in Magnetic Bearings

A NASA technical memorandum reviews the state of the technology of magnetic bearings, focusing mainly on attractive bearings rather than repulsive, eddy-current, or Lorentz bearings. A typical attractive bearing includes U-shaped electromagnets on opposing sides of a journal, such that they attract the journal in opposing directions. Attractive bearings offer greater load capacities than other types do and are preferred for aerospace machinery.

This work was done by David P. Fleming of **Lewis Research Center**. *For further information, **write in 47** on the TSP Request card.*
LEW-15674

Terminal Model of Newtonian Dynamics

A paper presents a study of the theory of Newtonian dynamics of terminal attractors and repellers, focusing on issues of reversibility vs. irreversibility and deterministic evolution vs. probabilistic or chaotic evolution of dynamic systems. The theory developed in this paper is called "terminal dynamics" to emphasize the difference between it and classical Newtonian dynamics, in which all motions are regarded as predictable and reversible.

The theory of terminal dynamics also holds promise for explaining irreversibility, unpredictability, probabilistic behavior, and chaos in turbulent flows, in thermodynamic phenomena, and in other dynamic phenomena and systems.

This work was done by Michail Zak of Caltech for NASA's **Jet Propulsion Laboratory**. *To obtain a copy of the report, "Terminal Model of Newtonian Dynamics," **write in 50** on the TSP Request Card.*
NPO-18832

More About the Enhanced Projection-and-Assembly Method

A report discusses the enhanced projection-and-assembly (EP&A) method and its application to the Galileo spacecraft. The EP&A method is a method of approximating the dynamics of vibrations of large, flexible structures by use of mathematical models of reduced order.

The EP&A method and its predecessor, the projection-and-assembly (P&A) method, were described in "Enhanced Method of Reduction of Mathematical Models" (NPO-18402), *NASA Tech Briefs*, Vol. 16, No. 7 (July, 1992), page 70 and "Two-Stage Reduction of Dynamical Models" (NPO-18723), *NASA Tech Briefs*, Vol. 17, No. 10 (October, 1993), page 86. To recapitulate: In the P&A method, vibrational and rigid-body modes that contribute significantly to the dynamics of the overall structure are first selected, then projected mathematically onto the components of the structure. The resulting reduced-order mathematical models of the components are assembled to obtain a reduced-order model of the system

that captures the selected modes of the system. In the EP&A method, static correction modes are used to capture the static contributions of those modes that are neglected in the reduced-order model of the system.

This work was done by Allan Y. Lee and Walter S. Tsuha of Caltech for **NASA's Jet Propulsion Laboratory.** *To obtain a copy of the report, "An Enhanced Projection and Assembly Model Reduction Methodology for Articulated Multi-Flexible Body Structures,"* ***write in 87*** *on the TSP Request Card.*
NPO-18577

Particle-Displacement Tracking in Two Speed Ranges

Two NASA technical memorandums describe the use of particle-displacement tracking (PDT) to generate maps of velocity vectors in flows in two different speed ranges. The PDT particle-image velocimetry technique is a second generation of a particle-tracking technique previously discussed in "Processing Laser-Velocimetric Data by Vector Scanning" (LEW-14925), *NASA Tech Briefs*, Vol. 14, No. 10 (October 1990), page 98.

This work was done by Mark P. Wernet and Alexander D. Pline of **Lewis Research Center.** *For further information,* ***write in 30*** *on TSP Request Card.*
LEW-15675

Physical Sciences

The Greenhouse Effect Over Oceans

A paper presents an analysis of empirical data to determine the relationship between water vapor over the Pacific Ocean and the surface temperature of the water. This and similar studies contribute to understanding of the greenhouse effect, in which the atmosphere absorbs part of the thermal radiation emitted by the surface of the Earth, with consequent net warming of the atmosphere.

The data for the analysis came from 17 years of radiosonde reports from 46 midocean meteorological stations and from satellite-borne radiometers. The paper describes the method of deriving surface humidity and flux of latent heat from satellite observations. It reconsiders older hypotheses on the basis of the new data. It discusses evaporation as an oceanic thermostat. Finally, it discusses the spatial and temporal variability of the oceanic greenhouse effect.

This work was done by Wing-Yuen Timothy Liu of Caltech for **NASA's Jet Propulsion Laboratory.** *To obtain a copy of the report, "Evaporation and Thermal/Hydrologic Balance in the Pacific,"* ***write in 12*** *on the TSP Request Card.*
NPO-18855

Aerodynamic Effects of Deicing and Anti-Icing Fluids

A report presents the results of wind-tunnel tests of the aerodynamic effects of deicing and anti-icing fluids on airplane wings. The tests were conducted on a three-dimensional half-model airplane and a two-dimensional airfoil model at temperatures ranging from –29 to +10°C. The fluids used in the tests included three commercial fluids that were available for use during

the 1987–1988 winter season, one discontinued commercial fluid (for comparison with data from previous tests), and eight newer fluids that were experimental at the time of the tests.

This work was done by Harold E. Addy, Jr., of **Lewis Research Center** *and L. James Runyan, Thomas A. Zierten, and Eugene G. Hill of Boeing Commercial Airplanes. For further information,* ***write in 28*** *on the TSP Request Card.*
LEW-15746

Locating the Geocenter From GPS Measurements

A report presents an analysis of Global Positioning System (GPS) measurements taken during a 3-week geodetic experiment in early 1991. The experiment involved the constellation of 15 GPS satellites that were operational at that time, plus 21 GPS receiving stations at widely distributed sites, all but 4 of which were in the Northern Hemisphere. The analysis consisted principally of estimation of the location of the center of mass of the Earth (the geocenter) relative to the GPS receiving stations. As part of the analysis, the GPS estimates of the geocenter were compared with estimates obtained by satellite laser ranging (SLR), which is an established technique.

This work was done by Yvonne Vigue, Stephen M. Lichten, Geoffrey Blewitt, Michael B. Heflin, and Rajendra P. Malla of Caltech for **NASA's Jet Propulsion Laboratory**. *To obtain a copy of the report, "Precise Determination of Earth's Center of Mass Using Measurements From the Global Positioning System,"* ***write in 16*** *on the TSP Request Card.*
NPO-18883

Electronic Systems

Optimum Detection of Slow-Frequency-Hopping Signals

Two papers present theoretical analyses of various schemes for the coherent and noncoherent detection of *M*-ary-frequency-shift-keyed (MFSK) signals with slow frequency hopping. As used here "slow frequency hopping" (SFH) means that the rate of hopping of the carrier signal between assigned channels is low enough that multiple MFSK tones representing data symbols are transmitted on each hop. Also as used here, "hop" (as distinguished from "hopping") denotes residence of the carrier frequency in one of the assigned channels. Theoretical analyses of the detection of SFH signals have not been addressed previously in the open literature, and these analyses are more complicated than is the analysis of fast-frequency-hopping (FFH) signals (which involve multiple hops per symbol period). In these papers, special attention is focused on the continuous-phase-modulation (CPM) subset of SFH/ MFSK signals, for which the frequency modulation is such that the carrier phase remains continuous (albeit unknown) during each hop.

This work was done by Barry K. Levitt and Unjeng Cheng of Caltech for **NASA's Jet Propulsion Laboratory**. *To obtain a copies of the reports, both of which are entitled "Optimum Detection of Frequency-Hopped Signals,"* ***write in 60*** *on the TSP Request Card.*
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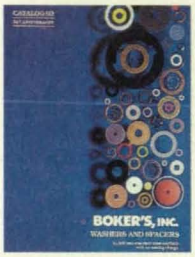

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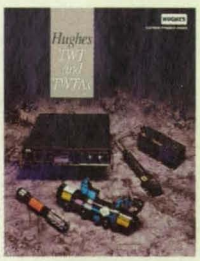

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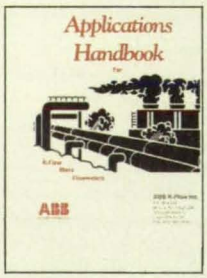

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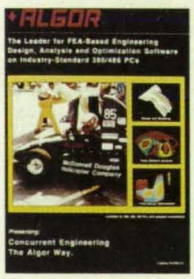

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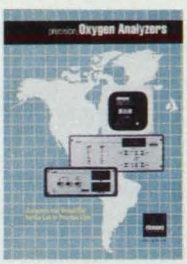

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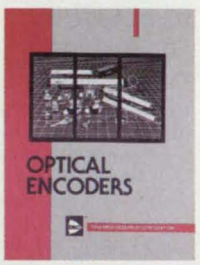

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SRS spectrum analyzers offer 90 dB dynamic range, frequency spans from 191 MHz to 100 kHz and a fast 100 kHz real-time bandwidth. The SR770's low distortion (-80 dBc) source generates sine waves, two-tone signals, white and pink noise, and frequency response measurements (to 100 kHz) with 0.05 dB precision. Both analyzers include THD, 1/3 octave, band and sideband analysis, GO/NO GO testing, selectable window functions and post acquisition math. Tel: 408-744-9040.

Stanford Research Systems

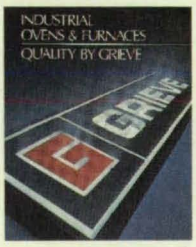
For More Information Write In No. 329

STOCK SPRING CATALOG

Stock Spring Catalog from Mid-West Express, division of Mid-West Spring, Romeoville, IL, describes its full-line of stock springs and kits. Music wire plated and stainless steel compression and extension springs, die springs, stainless torsion springs and continuous springs are included. Call 800-346-1400.

Mid-West Express

For More Information Write In No. 330



OVENS & FURNACES UP TO 2700 °F

Capabilities, specifications and prices for over 250 standard ovens and furnaces to 2700 °F as well as custom-designed heat processing systems. Includes: laboratory, bench, cabinet, truck, walk-in and conveyor ovens; clean room and pharmaceutical ovens; laboratory and industrial furnaces and environmental test chambers. For baking, drying, pre-heating, annealing, stress relieving, curing, sterilizing, depyrogenation and heat treating. Tel: 708-546-8225.

The Grieve Corporation

For More Information Write In No. 331

MECHANICAL TESTING CATALOG

MTS Direct is your one-stop source for mechanical testing equipment. Select from hundreds of products offered by leading companies, including: hardness testers, grips, data acquisition systems and many others. Toll-free phone and fax ordering. Direct shipment. 30-day money-back guarantee. Free 150-page color catalog.

Call 1-800-925-0505.
MTS Direct
P.O. Box 46210, Eden Prairie, MN 55344-2910

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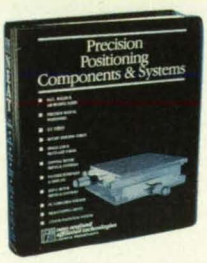
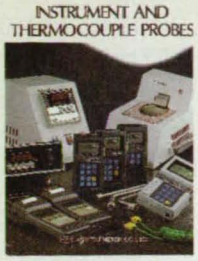


PRECISION POSITIONING AND MOTION CONTROL

155 page catalog covers NEAT's expanding line of Precision Positioning Components and Systems. Featured are single-axis, X-Y, multi-axis, rotary, high vacuum, and air bearing stages. NEAT provides complementary stepping and servo motor drives and controls, as well as turnkey solutions to automation, inspection, and production requirements. Stage travels range from 2-30+ in. with a repeatability of 1 µm, speeds to 80"/sec. and resolutions to 5 nm.

New England Affiliated Technologies

For More Information Write In No. 333

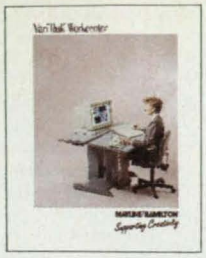


TEMPERATURE MEASUREMENT INSTRUMENTS AND PROBES

Over 3000 units for measuring temperature up to 2400 °F are detailed in this 72-page catalog. Accuracy of 0.2%, response time 0.2 sec. Temperatures of fluids & gases, stationary & moving surfaces, moving wires, ICs can be measured. Measurement of flat, round & irregular surfaces. Probes for use in the plant, lab or field. Accuracy traceable to NIST. Tel: 800-457-2999.

Anritsu Meter Co. of America

For More Information Write In No. 334

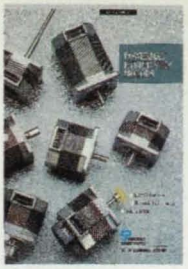


VARITASK™ TECHNICAL DESKING SOLUTION

Mayline's VariTask solves ergonomic problems for intensive computer users. Large work surfaces have power-adjust height and tilt controls. Great for CAD environments where drawing tablet and second monitor are needed. FREE full-color brochure. Video available upon request.

The Mayline Corporation

For More Information Write In No. 335

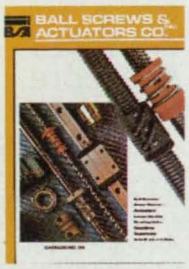


STANDARD AND CUSTOM POWERMAX™ STEP MOTORS

New 18-page specifier's guide features Powermax™, the highest torque available from NEMA 23 hybrid step motors. Illustrates standard motors and dozens of popular modifications made economical by flexible manufacturing. Pacific Scientific, Rockford, IL. Tel: 815-226-3100. Fax: 815-226-3080.

Pacific Scientific

For More Information Write In No. 336



Many new ball screw and ball nut sizes have been added to our ball screw product line, including metric models. New low cost Supernuts that feature a patented preload adjustment give positioning repeatability of less than .0005" and are offered for every leadscrew size. These new products are featured in the new BS&A catalog no. 94, as well as a complete line of bearing units, linear bearing assemblies and more. For catalogs or engineering assistance call: 800-882-8857. Fax: 408-629-2620.

Ball Screws & Actuators Co.

3616 Snell Avenue, San Jose, CA 95316.

For More Information Write In No. 337

LOW SPEED WIND TUNNEL TESTING

ViGYAN Inc. offers aerodynamic testing in its Hampton, Virginia facility. An open-return wind tunnel, with a test-section of 3 ft. height and 4 ft. width and a speed range of 27 to 122 miles per hour, has excellent flow quality as represented by a turbulence level under 0.1%. Aircraft models up to 30 inches in span can be tested for forces/moments and pressures at angles of attack up to 70 degrees and sideslip angles up to 20 degrees.

ViGYAN Inc.

For More Information Write In No. 338

PRESSURE TRANSDUCERS/TRANSMITTERS

Taber pressure transducers/transmitters are outlined in a new brochure. They are available in low and high models in a variety of pressure ranges. Differential transducers provide high differential overload pressure and high line pressure capability. Oceanographic transducers are completely submersible, highly accurate pressure sensors. For more information contact: John Pinder. Tel: 800-333-5300.

Taber Industries

For More Information Write In No. 339

SELECTOR CHART ES-160

Conap, Inc. supplies epoxy and polyurethane potting systems, conformal coatings, adhesives, sealants, tooling resin systems and elastomers to the electronics, computer, aerospace, defense, and related industries. Conap, Inc., 1405 Buffalo Street, Olean, NY 14760. Tel: 716-372-9650.

Conap, Inc.

For More Information Write In No. 340

NEW LINE OF OVENS

Despatch Industries introduces a major new line of industrial ovens value-engineered to provide industry with dependable heat process equipment at a very attractive investment cost. Brochure describes the new ENCORE™ ovens engineered for exceptional value versus cost. Bench, reach-in, large batch and continuous ovens available.

Despatch Industries,

PO Box 1320, Minneapolis, MN 55440.

Tel: 1-800-860-3944. Fax: 612-469-4513.

For More Information Write In No. 341

REAL-TIME MULTI-PROCESSOR SYSTEMS

Comprehensive 4C brochure and MAXION™ data sheets provide complete product specifications on Concurrent's new standards-based real-time open computing systems. This system incorporates a revolutionary crosspoint multiprocessing architecture which eliminates performance bottlenecks encountered in traditional bus architectures. Call today: 1-800-631-2154.

Concurrent Computer

For More Information Write In No. 342

INSTRUMENTS CATALOG

The 1993-1994 Cole-Parmer catalog features over 1500 full-color pages and describes more than 35,000 products covering instruments, equipment, and supplies. The catalog features 32 pages of new products, special technical data and conversion factor sections, a newly-organized fittings section, and an expanded chemical resistance chart. Tel: 800-323-4340.

Cole-Parmer Instrument Co.

For More Information Write In No. 343

ADHESIVES/ SEALANTS/ COATINGS

Master Bond, Inc. manufactures over 3000 grades of adhesives, sealants, and coatings. Line consists of epoxies, anaerobics, cyanoacrylates, silicons, and acrylics. Both one- and two-part systems. Systems are designed to meet specific requirements. One-on-one assistance available with our highly knowledgeable technical staff. Tel: 201-343-8983; Fax: 201-343-2132.

Master Bond, Inc.

For More Information Write In No. 344

POWER CONVECTION® VACUUM FURNACES

Surface® Combustion offers a two-page "sell sheet" featuring its standard line of Power Convection, Single Chamber Vacuum Furnaces, designed for performing high quality heat treating processes including annealing, hardening, sintering, brazing, and other special vacuum processes. Specifications and performance data are listed. Tel: 419-891-7150; Fax: 419-891-7151.

Surface Combustion, Inc.

For More Information Write In No. 345

A NEW APPROACH TO SCIENTIFIC DATA ANALYSIS

Analysis Advisor is a free interactive analysis software tutorial that includes demonstrations of graphical and traditional programming methodologies for analysis. You can investigate Digital signal processing, Digital filtering, Windowing, Curve fitting, Signal averaging, Simulation, Interpolation, and Descriptive statistics. Requires Windows 3.1 and 8 MB of memory. Tel: 512-794-1100, 800-433-3488 (US and Canada); Fax: 512-794-8411.

National Instruments

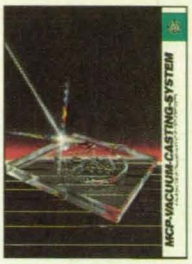
For More Information Write In No. 346

MCP's versatile Cool Spray Modelmaking produces molds (tooling) quickly and economically. The process creates durable and exact metallic shells utilizing (patterns or) models of any type material including SLA. Precise dimension and reproduction are achieved while reducing costs and build time to 10% that of traditional metal tooling.

MCP Systems, Inc.

Tel: 203-367-7761; Fax: 203-368-4787.

For More Information Write In No. 347



RAPID PROTOTYPING WITH MCP VACUUM CASTING SYSTEM

With the MCP Vacuum Casting System you can produce all the precise copies you require for your product development and testing purposes such as for TV and computer housings, automotive components, household plastic components, etc.

MCP Systems, Inc.

Tel: 203-367-7761; Fax: 203-368-4787.

For More Information Write In No. 348

DATA ACQUISITION SOLUTIONS

FREE 288-page Data Acquisition Catalog and Reference Guide, now with our New Product Supplement, features Keithley MetraByte's broad line of PC-based hardware and software solutions. Sample applications and specifications included. Request your FREE copy today!

Keithley MetraByte

Tel: 508-880-3000 or 800-348-0033;
Fax: 508-880-0179.

For More Information Write In No. 349

PROTOTYPING, TEST INTER-CONNECT

Call for a complete range of Interconnect Solutions including hundreds of Prototyping Adapters, Test Probe Adapters for PLCC and Quad Flat Pack, Surface Mountable Test Adapters, Programming Adapters, and other interconnect devices. QUICK TURN CUSTOM DESIGN SERVICE....

Ironwood Electronics

Tel: 612-431-7025

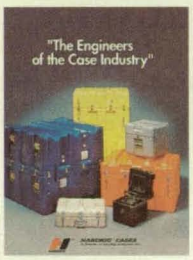
For More Information Write In No. 350

NOISE CONTROL PRODUCTS

New full-line color brochure describes world-leading SONEX and SONEX 1 acoustical treatments. Anechoic shapes provide 400% greater surface area, absorbing sound and eliminating excess noise better than other materials. The brochure highlights new products added to the SONEX line, basic applications, forms, and specifications of SONEX products for effective noise control and acoustic improvement. Tel: 800-662-0032 or 612-520-3620.

illbruck, inc.

For More Information Write In No. 351



Hardigg Cases offers over 225 standard rotationally molded transit cases, including a full line of 19" EIA rack mount cases, deck cases, and flange-mount cases. Hardigg's expert engineering, manufacturing, and test facilities provide start to finish custom design capability. A complete list of standard cases allows for rapid delivery...as few as three working days! Take advantage of over thirty years of experience...design a Hardigg case into your next project!

Hardigg Cases

For More Information Write In No. 352

PRECISION COUPLING COMPONENTS

Featuring a wide range of coupling devices in a variety of materials, this 32 page brochure is the latest from Berg. Designed to complement the Inch and Metric catalogs it contains Information Transmitting, Shock Absorbing, Misalignment Couplings. All designed and manufactured to meet the exacting demands of modern industry.

W.M. Berg Inc.

Tel: 516-596-1700; Fax: 516-599-3274.

For More Information Write In No. 353

PRECISION LINEAR COMPONENTS

Featuring a wide range of linear devices in a variety of materials, this 32 page brochure is the latest from Berg. Designed to complement the Inch and Metric catalogs it contains Linear Slides, Lead Screws, Linear Bearings and various Mounting Accessories. All designed and manufactured to meet the exacting demands of modern industry.

W.M. Berg Inc.

Tel: 516-596-1700; Fax: 516-599-3274.

For More Information Write In No. 354

NEW KEITHLEY-DIRECT CATALOG

Keithley Instruments is offering its new direct marketing catalog of selected test instruments and accessories. Many of the company's DMMs, switches, source-measure units and accessories are included. One of the featured products in this issue is a new electrometer. Call 1-800-552-1115 for your free copy.

Keithley Instruments Inc.,

28775 Aurora Rd., Solon, OH 44139.

For More Information Write In No. 355

OPTO-MECHANICAL PRODUCT GUIDE

Daedal's new Opto-Mechanical catalog contains hundreds of laboratory bench optical mounts, positioning devices and optical hardware. Complete specifications, dimensions and pricing are included. All products listed can be ordered by phone or fax, can be charged to Visa or MasterCard, and are shipped free to anywhere in the continental US. Tel: 800-245-6903; Fax: 412-744-7626.

Daedal Division

Parker Hannifin Corporation

For More Information Write In No. 356

COSMOS/M EXPLORER

The EXPLORER features a state of the art geometric modeler, graphic pre- and postprocessor, linear and nonlinear statics and dynamics, advanced dynamics, heat transfer, fluid flow and optimization in one fully integrated package. With this wide array of capabilities EXPLORER provides tremendous value at a remarkably low price. By breaking down the barriers to FEA, EXPLORER is opening the door to a whole new world of productivity. Tel: 310-452-2158 of Fax: 310-399-6421.

Structural Research & Analysis Corp.

For More Information Write In No. 357

GPS TIMING FOR PC VMEBUS

This information folder from Bancomm describes new PCbus and VMEbus board-level Global Positioning System (GPS) Satellite Receivers. These products provide worldwide precision time (100 nanosecond) and frequency (1 part in 10E7) references inside the host computer.

Bancomm

For More Information Write In No. 358

DUAL-LOOP INFRARED TEMP CONTROLLER

Use 1 or 2 infrared sensors coupled to feature-rich ANAFAZE multi-loop PID controllers to remote sense temperature & control machines, devices, processes, etc., accordingly. Applications are anywhere anything is moving, soft, sticky, or delicate. Call today for info! ANAFAZE, 334 Westridge Drive, Watsonville, CA 95076. Phone: 408-724-3800. Fax: 408-724-0320.

ANAFAZE

For More Information Write In No. 359

STOP CORROSION

LaQue Center's corrosion engineering services provide testing programs and consulting for failure analysis, material evaluation and selection, environmental-corrosion monitoring, and on-site corrosion inspections. Natural seawater and marine atmospheric exposure sites support component/equipment evaluations. Training course "Fundamentals of Corrosion and Its Control" available for on-site presentation.

LaQue Center for Corrosion Technology Inc.

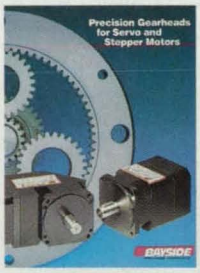
For More Information Write In No. 360

WINDOWS FOR ENGINEERS

Windows version of the DADiSP Worksheet uses Menus and Icons for Point-and-Click data acquisition; data analysis; data reduction & editing; series and scalar math; matrix math; statistics; peak analysis; FFTs and convolutions; digital filtering; 3D/4D graphic imaging. For a Free DADiSP Trail Kit, call 800-777-5151.

DSP Development Corp.

For More Information Write In No. 381



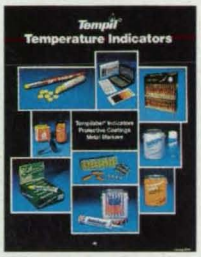
GEARHEADS GALORE

22-page catalog has complete technical information on full line of precision gearheads for servo and stepper motors. Low backlash, high torque planetary and right-angle designs are available in ratios from 3:1 to 100:1, with torques up to 15,000 in-lbs. The catalog features drawings, cutaway views, and application notes. Mounting kits are available for any motor.

Bayside Controls Inc.

Tel: 516-484-5353. Fax: 516-484-5496.

For More Information Write In No. 361

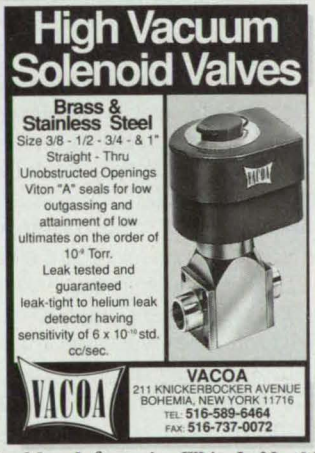


TEMPERATURE INDICATORS AND MONITORS

This most extensive line of temperature indicating products includes sticks, label monitors, indicating liquids and pellets for preheat/post-heat welding. The 8-page catalog discusses hand test kits, metal markers and protective coatings. Applications cover welding, metal-working, electronics, nuclear and machinery. Tempil Division, Tel: 908-757-8300; Fax: 908-757-9273.

Air Liquide America Corp.

For More Information Write In No. 362



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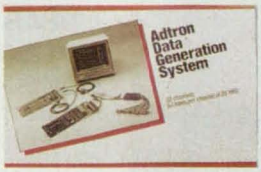
For More Information Write In No. 364

EASY, ECONOMICAL, DIGITAL WAVEFORM GENERATION



Adtron's PC-based Data Generation System facilitates testing, development and evaluation of digital components and systems, performing the work of numerous specialized instruments. DGS offers the capabilities of pattern, word and pulse generators while employing the cost-effectiveness and convenience of IBM personal computers.

Adtron

For More Information Write In No. 365

ANALYTICAL SERVICES—FAST TURN-AROUND

Brochure describes the wide range of materials characterization services that are provided by the firm's Analytical Services Division. Among those described in the brochure are surface area, pore and particle size distribution, density, permeability, chemisorption and pressure testing. Also available are instruments for sale or lease. Tel: 607-257-5544. Toll Free in USA and Canada: 1-800-825-5764. Fax: 607-257-5639.

Porous Materials Inc.

For More Information Write In No. 366

AUTOMATED PRESSURE GAGE CALIBRATION SYSTEM

Fully Programmable Automated Pressure Gage Calibration System, available in pressure ranges from vacuum up to 60,000 psi, interfaces to virtually any computer system. Window and DOS version Software provided for IBM-PC Compatible Systems. Both electronic and mechanical over-pressure fail-safe systems. Tel: 607-257-5544. From USA and Canada: 1-800-APP-VALVE. Fax: 607-257-5639.

Advanced Pressure Products

For More Information Write In No. 367

COMPUTER CONTROLLED VALVES

Brochure describes company's line of remote and computer controlled on-off, metering and servo valves, pressure generators, automated pressure and flow control systems, pressure gauge calibration systems and capability for custom configurations. Pressure range from high vacuum to 60,000 psi. Tel: 607-257-5544. Toll Free in USA and Canada 1-800-825-5764. Fax: 607-257-5639. Address: 83 Brown Road, Bldg. 4, Ithaca, NY 14850.

Advanced Pressure Products

For More Information Write In No. 368

New full-color positioning equipment technology guide from Anorad provides an overview of engineered motion control solutions for many industries, including automation, laser processing, semiconductor and electronics. The brochure presents Anorad's broad array of positioning technologies including linear, rotary and air bearing stages; linear servo motors and controls. An easy use selection guide is included to help users select the most appropriate equipment for their application.

Anorad Corporation

For More Information Write In No. 369

SEALING ASSEMBLIES

Conax Buffalo offers a 28-page catalog on Conax Buffalo Pressure and Vacuum Sealing Assemblies with comprehensive information on soft sealed technology for wires and probes. Complete technical data and ratings for each product type, from standard sealing glands to complete assemblies, are included, as well as information on custom engineering and applications. Catalog includes a postpaid reply card for technical assistance.

Conax Buffalo

For More Information Write In No. 372

FREE CATALOG! LINEAR MOTION COMPONENTS

All products ship within 24 hours.

- Ball Slides
- Crossed Roller Slides
- Positioning Slides
- Recirculating Bearings
- Shafts & Supports.

Call TOLL FREE: 1-800-447-2042, In CT: 203-790-4611, or Fax: 203-748-5147. **TUSK Direct, Inc.**, Clarke Industrial Park, P.O. Box 326, Bethel, CT 06801.

TUSK Direct, Inc.

For More Information Write In No. 375

TOOLING COMPONENTS AND CLAMPS

This 500-page catalog contains an assortment of components including toggle clamps, modular fixturing, clamping devices, power workholding, chuck jaws, pins, knobs, drill bushings, leveling feet, power workholding, and much more.

Carr Lane Mfg.

For More Information Write In No. 378

continued from page 20

Post-Show Report

NASA's Proactive Approach To Technology Transfer

Frank Peñaranda
NASA Deputy Assistant Administrator

As part of the Space Act, NASA is required to disseminate the technology that it develops for space use to the private sector.

We realized from the very beginning that we had to be proactive. As has been said very often, technology transfer is a contact sport. We have to reach you, individually, where you live, so that you have a ready-made and easy access point to federal technology.

We've established a network of agents—non-federal agents, which is important because some people feel that federal employees don't know how to sympathize and be sensitive to the needs of the industrial and commercial community. We've employed a network of individuals with lots of experience in the business community, who have started businesses of their own, who are experts not only in technology but in the application of technology, business development, and capital acquisition. We have structured these agents into six Regional Technology Transfer Centers that encompass the entire 50 states [see list on page 24]. Their charter is to integrate and link every principal industrial community in their region to the federal laboratory system.

The reason we divided up the country into regions is that we realized the communities, the culture, and the industrial base differ in each of these regions. Understanding their particular problems would be difficult if we did it centrally out of Washington, DC.

The centers can categorize your needs into technology solutions. Very often, you may think your need is for technology, but probably it is not. It may be just money. It may be assistance rather than a packaged technology—that's very important because the federal laboratories offer much more than shrink-wrapped technologies that you can run with and commercialize. They offer capabilities that you, as individuals, cannot afford to build. We're talking about expert scientists and engineers as well as very expensive facilities.

The federal labs have an entry point—the technology transfer offices. We have this network of agents that can help you acquire the facilities and capabilities of any of our agencies. Become acquainted with them, talk to them, they can help you not just acquire technologies, but secure capital, develop business plans, and form alliances with other businesses that may be seeking similar expertise. The technology, by the way, may not be resident to the federal laboratories, but to another commercial organization. They have access to that information, too, and can help you build strategic alliances.

Our emphasis in the past has been to take the mature technologies coming out of NASA and make them accessible. Our new thrust, and clearly the thrust of the entire administration, is to emphasize partnering. It is believed that the best way to insure there's going to be some commercial product coming out is a partnership in which the private company is putting something on the table. The TRP certainly has demonstrated that it is a very good vehicle to pursue.

NASA is going to push strongly dual-use technology development either with or without partners. The concept of devoting 10-20 percent of the federal budget to more relevant use of federal assets and technology to the private sector is clearly a goal that we all want to achieve. One of the best ways to achieve that goal and leverage the entire budget of an agency such as NASA is to pursue two objectives—the commercial objective as well as the mission objective from its very inception. So we're going to proactively seek the involvement of the industrial community from the time we dream up a planetary or aircraft mission so that we can include your input in our development plan and then can pursue it with dual-use goals in mind. ❑

For more information on the TRP, contact Technology Reinvestment Project, 3701 North Fairfax Drive, Arlington, VA 22203-1714, Tel: 1-800-DUAL-USE.

POSITIONS WANTED

Ph.D in physical chemistry seeks consulting or captive position in R&D. Good professional, communication, and people skills. Experience in electrochemistry, spectroscopy, biosensors, materials and environmental chemistry. Feasibility studies, R&D management, literature searches. More than 35 papers and patents. US citizen. Tel: 508-966-4963.
Box number 97B

BSME, 8 years in quality and design engineering for power transmission systems for commercial/defense applications. Inspection for aerospace and ordnance hardware, auditing of quality, product, manufacturing engineering systems and cause/corrective action. Knowledge of ANSI Y14.5, GDT inspection methods, multi-axis machining and gear grinding. Willing to travel. Tel: 216-884-3142.
Box number 98B

Sensible technical communications: proposals, technical presentations, manuals, handbooks, form design. Background: program manager, technical writer, instructor with hands-on EE background & TQM experience in aerospace and commercial development/production and technical/project team leadership. Contract or permanent. BSEE, MEE; certified professional manager.
Box number 99B

Senior manager with 25 years experience in all phases of manufacturing engineering and operations in hybrid microelectronics and semiconductors. Major strengths in capital and expense control, organizing, planning, communication, cost reductions and problem solving. Demonstrated ability to create and sustain support of multiple factories from start-ups to expansions.
Box number 1C

Industrial laser applications, R&D, job shop management and services, quality control, customer service, and lasers systems. Long experience in development of welding, drilling and cutting processes for aerospace, medical products, and other high tech industries. Would consider providing consulting services or full-time positions. I have always been a key player at all my previous positions.
Box number 2C

P&L responsibility (sales, service, marketing, manufacturing) for multimillion dollar industrial product/systems integration for major computer company. Overhauled hardware/software marketing strategy yielding 40% revenue (workstation 800,000 units/year) CAGR. Exceptional ability to identify value-based high-profit opportunities, define user/product needs, develop/implement strategies. International sales development. MSEE.
Box number 3C

Registered electrical engineer actively recruiting new employer. Principal area of interest: computer applications in power engineering. Project manager, software systems engineer. Combination of skills: computer systems, power systems, and practical hands-on experience. Productive in all phases of control systems and software development. MS, also nuclear plant experience.
Box number 4C

Sr. project engineer. BSEE, secret clearance. Energetic self-starter. Excellent communications skills. Over 10 years in the aerospace industry, including computer integration of embedded real-time systems, electro-optical test, ATE, analog and digital design. Proven record of problem solving and work around plans. Software and systems requirements to DOD 2167A. Willing to relocate.
Box number 5C

Engineering/project management: 20+ years, background in industrial furnaces, aluminum, recycling, refractory, melting, casting, heat treating, field installation, and startup. Foreign experience, practical financial and marketing know-how, business development, excellent communicator, performance-oriented. Seeking senior level position, open to travel, location and salary open.
Box number 6C

Ph.D physical chemist/surface scientist. 5+ years as research director in coatings R&D firm. Author/PI of 4 SBIR fundings (totaling $718K) to develop advanced coatings for aerospace power/propulsion systems. Experienced in vacuum deposition, surface diffusion, field emission, Auger electron and x-ray photoelectron spectroscopy, scanning electron microscopy, and vacuum system design.
Box number 7C

MSCS with 20 years computer experience. Award-winning software marketing manager. Experienced with UNIX, VMS, MS-DOS, several computer languages, and computer hardware/electronics. Seeking a marketing, product, or training manager position or liaison role between technical and business disciplines. Willing to relocate, prefer the mountainous mid-west.
Box number 8C

Ph.D seeking position in space science industry or government. Background in space pathophysiology, life sciences, and animal model development. Strong technical and management skills, over 10 years collegiate teaching experience and certification in clinical laboratory science. Highly motivated, innovative, team-oriented, resourceful, with good communication skills. Willing to relocate.
Box number 9C

Vice President in a $7 million sales engineering and manufacturing company is seeking management opportunity in a growth-oriented small- or medium-sized company. 30 years experience includes: domestic and export sales, organizing rapid product development, engineering, manufacturing, and university teaching. Ph.D level education.
Box number 10C

Mechanical engineer with liquid supercomputer cooling experience. BSME from U.W. Madison, 6 years experience. Proficient in DOS, Windows, AutoCAD, Lotus 1-2-3, MS Word, MathCAD, and ALGOR FEA. Experience in flow control, pump and valve selection, filters, tester design, project management, FEA, hydraulics, and pressure control. Tel: 715-835-5907.
Box number 11C

Ph.D aerospace engineering. 16 years diverse experience in design and R&D of projects in aerodynamics, propulsion, acoustics, turbulence, and other subjects in fluid mechanics (experimental, computational and theoretical), structural dynamics and stress analysis. FORTRAN, UNIX, supercomputer proficient. 4 years project management. Good publication record. Willing to relocate.
Box number 12C

Ph.D in mechanical engineering with 8 years manufacturing experience seeks development/engineering lead position in diagnostic sensing and control of manufacturing processes and machines. Strong background in digital signal processing, machine instrumentation and computer interfacing. DOS, UNIX, C, MATLAB. Excellent analytical skills for process modeling and signal interpretation.
Box number 13C

Imaginative MSEE designer/programmer, lately in avionics, medical electronics; analog/digital circuits, embedded microcontrollers, signal conditioning, power control, displays, PCB layout, C, FORTH, assembler, AUTOCAD, Novell LANs, neural networks. Took multichannel micro-based aircraft recorder from concept to installation. 3 patents. Will relocate. Tel: 303-651-3181.
Box number 14C

Metallurgist seeks R&D, production or design position. MS in materials science, BS in metallurgy. Specialties: materials characterization, thermodynamics, gas-solid reactions, nickel-based superalloy processing. 5 years aerospace experience; 5 years teaching experience. Will relocate. Tel: 510-653-5681. Internet: hall@qal.berkeley.edu
Box number 15C

Hardware and software documentation specialist, with background in manufacturing, statistical process control, network system support and engineering, data analysis, and system diagnostics. Experienced in the complete documentation task throughout the life cycle. Thank you for this opportunity.
Box number 16C

Internationally known radiation effects and hardening expert with 20+ years experience. Program and project management, systems integration and test, and component engineering. Over 50 publications and 2 patents. Secret clearance. Ph.D industrial management, UCLA. California registered professional engineer. Will travel or relocate, prefer Southern California. Tel: 310-923-5003.
Box number 17C

5 years experience in military avionics development. 13 years in USAF. BSEM from USAF Academy. ATP with 2000 hours. Extensive experience in Theater Missile Defense. Familiar with contractors and federal government agencies currently dealing with TMD problem. US citizen with TS/SBI clearance. Available August 94. Will relocate worldwide. References available.
Box number 18C

Product development specialist has technology in wear resistant polymeric materials applicable to biomaterials, gears, and bearings. Proven fast track records in product introduction, including prosthetic devices, from idea conception to product introduction to market in less than 3 years with FDA approval. Seeking new product challenge on project basis. Willing to accept on cost plus profit-sharing basis. Tel: 717-764-8112.
Box number 19C

To Request Resumes:

To obtain resumes corresponding to the above ads, fill out this form and mail to: Gregg McQueen, *NASA Tech Briefs*, 41 East 42nd St., New York, NY 10017; or call 1-800-944-NASA and ask for Gregg McQueen.

Send resumes for the following box numbers (limit 5):

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Box_____ Box_____

Name: _____

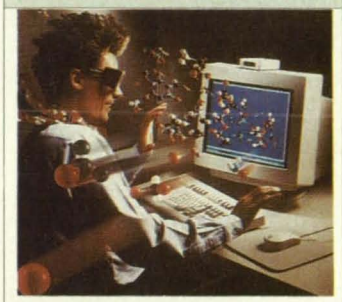
Company Name: _____

Street Address: _____

City/State/Zip: _____

New on the Market

The SmartReader portable **data logger** from ACR Systems Inc., Surrey, BC, automatically records temperature, relative humidity, electric current, pressure, or industry-standard process variables without plugs, signal conditioning, or complex setups. The palm-size unit has a memory of 32,000 readings, is powered by a ten-year lithium energy cell, and connects to IBM PCs to display graphs and print data.
For More Information Write In No. 709



The CrystalEyes™ PC **stereo viewing system** has been announced by StereoGraphics Corp., San Rafael, CA, for use with most popular desktop PCs. Incorporating patented liquid crystal eyewear, the system combines stereo electronics with an infrared emitter in a single package that sits atop the monitor. Untethered glasses synchronized by the emitter allow any number of users to simultaneously view the screen image.
For More Information Write In No. 716

Autodesk Inc., Sausalito, CA, has introduced two products that work with AutoCAD® to provide **solid modeling** for design and drafting of mechanical components and **surface modeling** for design of complex free-form models. AutoCAD® Designer automates mechanical design production by integrating a 3D feature-based parametric solid modeler into AutoCAD. Bidirectional associativity between solid models and AutoCAD drawings provides users with dimension-driven editing during the design iteration process. AutoSurf™ Release 2, priced at $1500, offers NURBS curve and surface modeling for the design of complex mechanical parts.
For More Information Write In No. 718

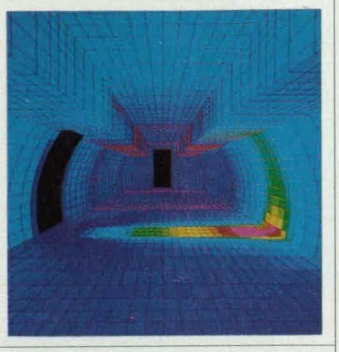
A digital **color video printer** from Toshiba America Consumer Products Inc., Buffalo Grove, IL, provides 1280 x 1024 resolution and can display 16.7 million colors. The HC-1600A Image Master prints full size or 2-, 4-, or 16-split multi-screen images on a single printout, with a time-lapse function that shows events at intervals of 60, 100, and 200 ms, and 1 sec.
For More Information Write In No. 717

The Intelligent OS **database management system** from Computer Pundits Corp., St. Paul, MN, can be used to create databases and control peripherals and the native operating system with only English language commands. The system uses the fastest integrated software available, and includes auto indexing and field expansion, variable record length, and Natural Language SQL.
For More Information Write In No. 719

Kubota Pacific Computer Inc., Santa Clara, CA, has announced the industry's two fastest **3D graphics workstations**. The Kenai™ 3600 midrange workstation supports a maximum of 512 MB and includes internal slots for two 3.5" HH disks and one 3.5" HH removable media device. The Kenai 3800 high-end station has one gigabyte of memory and is designed for such applications as computational fluid dynamics and molecular modeling.
For More Information Write In No. 710

Lectra Systems Inc., Marietta, GA, has unveiled GRAPHIC INSTINCT™, an interactive **intelligent sketch pad and electronic pen** that simulates a felt tip marker, pencil, pen, and brush for natural sketching without the use of a mouse, keyboard, or buttons. Using visual menus and icons, the user can enlarge, reduce, modify, and erase by a touch of the pen. The system duplicates shading, blending, and saturation.
For More Information Write In No. 715

New on the Market



A finite volume, multiblock unstructured **CFD code** from Computational Fluid Dynamics Services, Pittsburgh, PA, allows users to model real fluid flow and heat transfer problems having complex geometries and physics. Dubbed CFDS-FLOW3D, the program can model fully-compressible, supersonic, chemical reaction, combustion radiation, and multiphase flows. Turbulence models include low Reynolds k-epsilon and differential Reynolds stress.

For More Information Write In No. 711

LABTECH Corp., Wilmington, MA, has introduced the Universal Driver, which **supports over 400 popular real-time I/O devices** for LABTECH NOTEBOOK and LABTECH CONTROL software. In addition to plug-in boards, the **driver set** supports I/O that connects via RS-232, GPIB, and industrial data highways.

For More Information Write In No. 714

DTM Corp., Austin, TX, has announced the **creation of metal molds and manufacturing tools using its SLS™ Selective Laser Sintering process**. Known as the RapidTool™ process when used with metals, SLS technology expedites industrial design and product development by enabling quick and accurate fabrication of solid, 3D objects from CAD/CAM/CAE-generated designs.

For More Information Write In No. 712

Dolch Computer Systems, Milpitas, CA, has introduced the industry's first **Pentium™-based, liquid-cooled portable computing platforms**. The PAC-586™ features a full 47 MIPS while the A-PAC™ contains high-performance stereo speakers. Each model is equipped with five full-length open slots for expandability and can accommodate a floppy drive, a hard drive up to 1 GB, and a 5¼ drive such as a Bernoulli or CD-ROM drive. Both portables are available in 386 and 486 versions running at 33 to 66 MHz.

For More Information Write In No. 707

The CTS-8500 series of **noncontact position measuring systems** has been announced by Kaman Instrumentation Corp., Colorado Springs, CO. The units combine eddy current position sensing with the company's laser-based position sensing to measure nonconductive webs backed by a conductive reference surface. They can configure web thicknesses ranging from 2.5 mm to 60 mm.

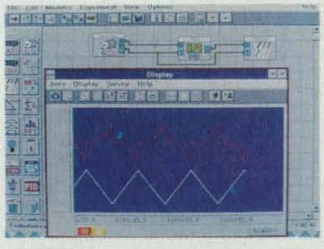
For More Information Write In No. 713

Speakeasy Computing Corp., Chicago, IL, has released a PC-DOS version of its **numerical problem solving software** featuring a vocabulary of over 1000 words. Originally developed at Argonne National Laboratory, Speakeasy's capabilities include array and matrix algebra, econometric modeling, statistical analysis, linear and quadratic programming, differential equation solving, and interactive graphics. New features include hyper-text help facilities and command recall.

For More Information Write In No. 720

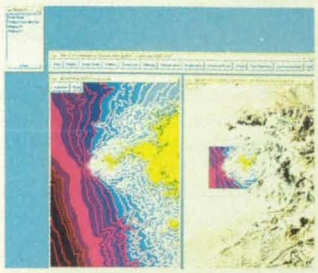
Strawberry Tree Inc., Sunnyvale, CA, has released WorkBench for Windows, an icon-based **data acquisition and control** program. Features include a user-configurable module bar, single window setups, and comprehensive online help. Dynamic data exchange provides real-time export capabilities, and a DLL interface allows easy expandability.

For More Information Write In No. 708



New on the Market

ENVI™ **image processing software** from Research Systems Inc., Boulder, CO, enhances analysis and visualization of spaceborne or aircraft digital imagery, including Landsat, SPOT, Geoscan, Daedalus, and hyperspectral AVIRIS. ENVI features flexible image output, linked dynamic image overlays, array-based image math, and advanced analysis of reference spectral libraries.
For More Information Write In No. 729



A 40 MHz **vision processor** introduced by Imaging Technology Inc., Bedford, MA, supports complex, high-speed image processing in the VxWorks and OS/9 real-time operating systems. The series 150/40 is well-suited for web inspection, food packaging and inspection, container and bottle inspection, and aerospace and defense applications.
For More Information Write In No. 728

Applied Concepts Inc., Wilsonville, OR, has unveiled the first **electronic switch** to provide both local and remote switching of SCSI computers and peripherals. The SCSI Switch connects imaging laser printers, page scanners, RAID arrays, tape backup systems, and CD-ROMs on independent buses, without reconfiguring cables or bus terminators.
For More Information Write In No. 731

Gespac Inc., Mesa, AZ, has announced an evaluation version of ISaGRAF®, a Windows **programming tool** to turn any PC, VME, G-64 or STD bus computer into a high-performance PLC. Priced at $175, the package supports five languages specified in the IEC-1131 standard, which can be mixed within an application: SFC, Ladder Diagrams, Function Block Diagrams, Structured Text, and Instruction List.
For More Information Write In No. 733

Fast, accurate, and rugged **industrial robots** for assembly and materials handling have been released by Staubli Unimation Inc., Sewickley, PA. The RX 90 handles loads weighing 13-20 lbs. and has a 985 mm reach and a six-axis repositioning repeatability of ±0.02 mm. The RX 130 has a 40 lb. capacity, a 1360 mm reach, and ±0.025 repeatability. Both are immune to electrical interference and feature manual safety brake unlocking.
For More Information Write In No. 724

COMRAD radio transceivers from Communications Research and Development Corp., Indianapolis, IN, allow **wireless data transmission** between computers and peripheral devices. Using a 900 MHz radio band, the units exchange data at a range up to 200 ft. inside buildings and a third of a mile in unobstructed areas. Users can transfer files between computers, control data acquisition and laboratory equipment, share a plotter, and simultaneously receive and transmit data.
For More Information Write In No. 726

Linear/nonlinear **finite element analysis software** from MARC Analysis Research Corp., Palo Alto, CA, is available for the CHALLENGE™ symmetric multiprocessing supercomputers from Silicon Graphics. The program features automated contact analysis, reduced integration elements using hourglass control, and an extensive library for modeling materials with nonlinear properties. Subroutines allow the user to customize geometry, loads, and boundary conditions.
For More Information Write In No. 734

New on the Market

Intergraph Corp., Huntsville, AL, has introduced Interplot, a series of **network plotting** products for high-volume CAD environments. Running under Windows NT, IPLOT and APLOT software enhance MicroStation and AutoCAD, respectively, with accelerated plot submission and advanced plot customization. The series also includes plotter drivers and a plot server featuring 32 MB of memory and a 540 MB or 1 GB SCSI disk drive.

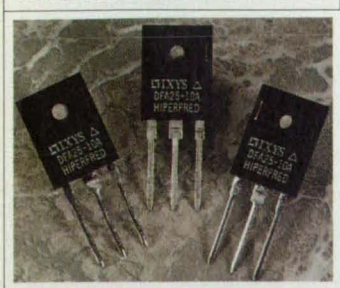
For More Information Write In No. 723

PHOENICS-2 **computational fluid dynamics software** from Phoenics North America, Atlanta, GA, incorporates models for turbulence, surface-to-surface radiation, and stress-strain analysis with fluid flow and heat transfer. Options include a conjugate gradient solver, a colocated velocity option, and improved multi-blocking and fine-grid embedding. PHOENICS-2 can incorporate data from all CAD and FEA packages.

For More Information Write In No. 732

PC-controlled, high-voltage **switching power supplies** from Bertan High Voltage, Hicksville, NY, have outputs of 100, 200, or 300 W and voltage outputs from 0-500 V up to 0-60 kV. A "virtual instrument" front panel, written in LabView for Windows, permits users to monitor and control power supply parameters including voltage, current, and power output.

For More Information Write In No. 721



IXYS Corp., Santa Clara, CA, has unveiled a fast recovery **epitaxial diode** for use in switching power conversion and motor drive circuits. The new HiPerFRED™ has a voltage range of 1000 V, a fast switching speed (t_{rr}=30 nsec), a 13 KW avalanche power rating, low leakage current (I_R=20μA), and a soft recovery factor of 1.

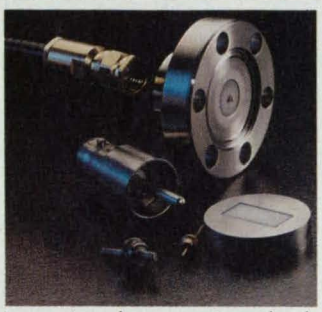
For More Information Write In No. 725

WIKA Instrument Corp., Lawrenceville, GA, has introduced a line of OEM **pressure transmitters** for hydraulics, pneumatics, HVAC, construction, and other industrial uses. Model 891.24.540 transmitters feature thin-film technology for pressure ranges of 0-600 to 0-15,000 psi. Model 891.14.540 transmitters use a piezoresistive sensing element for absolute and gage-referenced pressure ranges 100IN WC to 400 psi.

For More Information Write In No. 722

Byte Dynamics Inc., Spokane, WA, has released Fuzzy Logic Designer™, Windows-based **software that generates portable C source code** for sophisticated rule-based analysis or control. Input and output membership functions and their relationships are depicted graphically. A simulation mode can illustrate a design's response to multiple input parameters.

For More Information Write In No. 730

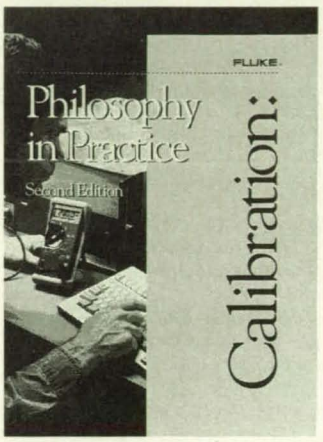


Innovative glass-ceramic technology from Ceramaseal, New Lebanon, NY, offers increased environmental resistance, design flexibility, and miniaturization capability for manufacturing high-performance **connectors and feedthroughs**. A proprietary reflow process allows powdered preforms to fuse to a component's hardware, resulting in a hermetic seal that also compensates for small inconsistencies in the connector walls. The company has used the material to create single-pin miniature feedthroughs and 50-pin cryogenic connectors.

For More Information Write In No. 727

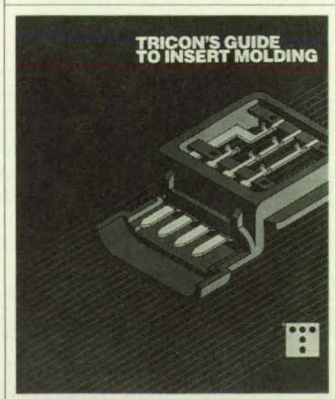
New Literature

A 544-page guide to **dc and low-frequency metrology** has been published by Fluke Corp., Everett, WA. Designed for both beginning and experienced metrologists, *Calibration: Philosophy in Practice* includes sections on primary and secondary standards, calibrators and calibration, statistics, practical considerations, and laboratory management.
For More Information Write In No. 738



A 94-page pocket reference guide to **PC-compatible hardware and software** is available from Industrial Computer Source, San Diego, CA. The quick-reference compendium of commonly needed facts and figures discusses diagnostic codes, CPU summary, XT and AT add-on card dimensions, BIOS entry points, DOS keystrokes, keyboard scan codes, and ASCII control codes.
For More Information Write In No. 747

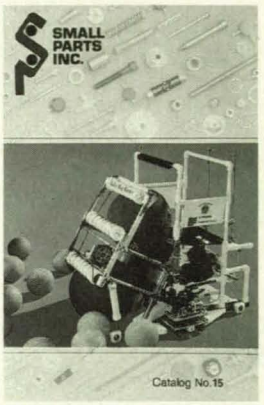
A self-study guide to the theory, operation, design, and construction of **oscillators** has been published by the TAB Books division of McGraw-Hill Inc., Blue Ridge Summit, PA. *Mastering Oscillator Circuits through Projects and Experiments* provides working knowledge of dc power supplies, relaxation and feedback oscillators, monostable and astable multivibrators, and both audio and RF sine-wave oscillators.
For More Information Write In No. 743



An engineering guide from Tricon Industries Inc., Lisle, IL, explains the principles, advantages, and design considerations associated with **insert molding**. Through cutaways and exploded views of conventional and insert-molded electrical and electronic components, the literature identifies ways to reduce parts counts, eliminate assembly steps, and maximize design integrity. Applications include connectors, interconnects, circuit devices, multifunctional switches, rotating sensors, and contacts.
For More Information Write In No. 746

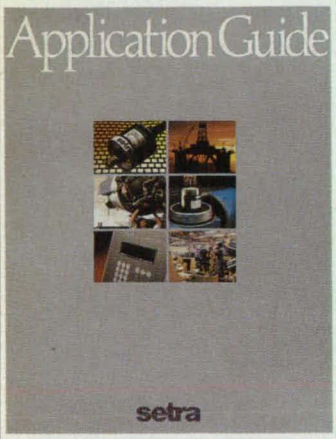
Engineering Measurements Co., Longmont, CO, has released literature describing its **vortex shedding and insertion vortex flowmeters**. Vortex meters are available up to 12" diameters with optional redundancy. Insertion vortex meters offer the advantages of in-line vortex meters at high pipe sizes and/or in the same holes where insertion turbine meters are currently installed.
For More Information Write In No. 735

A 320-page catalog of engineering findings from Small Parts Inc., Miami Lakes, FL, showcases hard-to-find **components, materials, and precision tools**. Featured products include stainless steel hypodermic tubing and guide wire, nylon cloth, tygon and PEEK tubing, stainless steel luer fittings, gas springs, linear motion slides, fiberglass structural shapes, and spring release hinges.
For More Information Write In No. 741



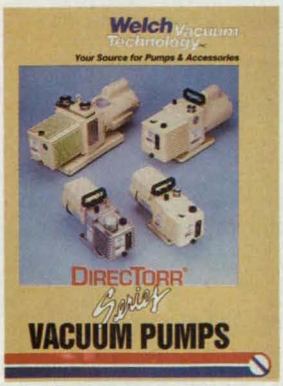
Viatran Corp., Grand Island, NY, has released a technical note entitled *Pressure, Its Unit of Measure and Pressure References*. The booklet reviews the relationship of **pressure** to temperature, Boyle's Law, and Charles's Law, and explains the most commonly used pressure references: absolute, gage, sealed gage, vacuum, and differential. Tables provide equivalents of 1 psi and pressure unit conversion constants.
For More Information Write In No. 748

New Literature



An eight-page application guide from Setra, Acton, MA, is designed to assist in the selection of high-accuracy **pressure transducers and transmitters** for such applications as HVAC/R, industrial process control, and OEM environments. The guide provides a data sheet on media compatibility, pressure ranges, accuracy, and thermal effects, as well as a pressure conversion chart.
For More Information Write In No. 737

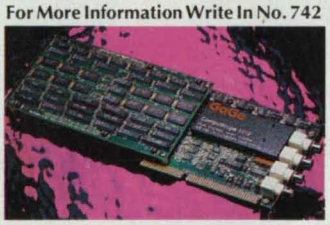
A line of precision sensors and instruments providing an integrated system for **experimental modal analysis** is showcased in a new guide from PCB Piezotronics Inc., Depew, NY. It features the high-resolution, lightweight Flexcel® sensors for accurate multichannel measurements. The sensing system reduces total test time, simplifies bookkeeping, automates channel identification, and reduces the overall cost of testing, according to the manufacturer.
For More Information Write In No. 739



Welch Vacuum Technology Inc., Skokie, IL, has published a brochure describing its DIRECTORR® series of direct-drive **vacuum pumps**. They feature a nonfluctuating vacuum and antisuckback valve protection. A special section describes pumps and accessories for laboratory applications of gel drying, rotary evaporation, and vacuum filtration use.
For More Information Write In No. 745

PICO Electronics Inc., Mt. Vernon, NY, has released a catalog highlighting new 100 W dual-output **dc-dc converters, transformers, and inductors** in surface mount and plug-in. Also featured are dc-dc convertors with input voltages from 18 to 380 Vdc and output from 3.3 to 100 Vdc. The units are protected against over-voltage, over-temperature, and short-circuiting.
For More Information Write In No. 740

A catalog of **high-performance PC-based instruments** from Gage Applied Science, Montreal, Quebec, features the CompuScope 1012, the industry's fastest 12-bit A/D card. Multiple cards can be used in a master/slave configuration to achieve 20 MSPS, 12-bit sampling on up to eight simultaneous channels, with a common clock and trigger.
For More Information Write In No. 742



A 300-page **electronic components** catalog published by Digi-Key Corp., Thief River Falls, MN, features more than 1300 new products. Manufacturers include Amp, Assmann, E-Switch, Injectorall Electronics, International Rectifier, Jewell, Linear Technology, National Semiconductor, Memcor-Truohm, Microtran, Needham's Electronics, Panasonic, Power-One, and Raychem.
For More Information Write In No. 736

Analytical software and books are highlighted in literature from Palisade Corp., Newfield, NY. Combining both catalog and educational booklet, the publication addresses risk analysis, solvers, forecasting, decision trees, neural networks, preference tools, and financial software.
For More Information Write In No. 744

MARKETPLACE

ADVERTISERS INDEX

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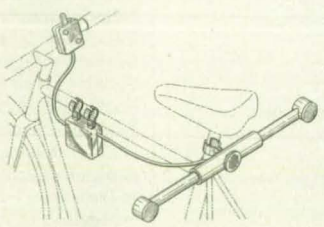
THE TECHNOLOGY CONNECTION

Inventions

BIKER'S DELIGHT SIGNAL LIGHT

A novel bicycle safety unit alerts traffic and pedestrians to a bicyclist's presence. The rear of the bike is illuminated to warn approaching traffic and signal lights can indicate left and right turns. An adjustable mounting bar provides high visibility at great distances and can be suited to the needs of the rider. The practical, easy-to-use device can easily be transferred from one bicycle to another. It is the only bicycle lighting system designed for daytime use.



Contact: John Izzo, Sr., 56 Richmondale Avenue, Westport, CT 06880.
Tel: 203-227-7815.

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WITH SINGLE, DUAL OR TRIPLE OUTPUTS

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- Reverse Polarity Protection

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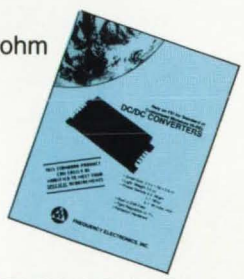
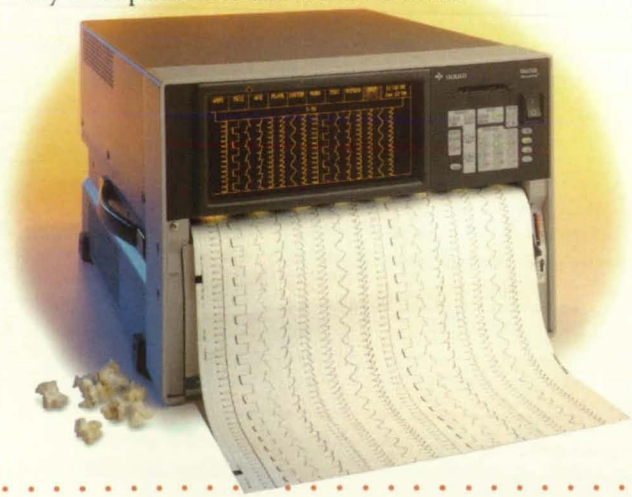


FREQUENCY ELECTRONICS, INC.
55 Charles Lindbergh Blvd., Mitchel Field, NY 11553
516-794-4500 • FAX: 516-794-4340
For More Information Write In No. 623

The screen on our new recorder is so big, this may be all that's missing.

Ready for some real wide-screen excitement? The real-time monitor on the Gould TA6000 thermal array recorder is a full 50% larger than competitive monitors! That means you get a clearer view of details as they occur — from 8 to 64 channels of waveforms. Scrolling speeds range from 0.01 to 200 mm/s, either synchronized or non-synchronized with the chart paper. And an optional high resolution color monitor is available to view waveforms up to 100 feet away.

But the show doesn't stop there. With the TA6000 recorder, setup is vastly improved: It's simpler since you don't have to run the chart, while basic recorder control is accomplished with easy-to-use pushbuttons and touchscreen menus.



This allows faster and more reliable test setups, and can generate greater productivity.

There are more reasons why the TA6000 is getting "thumbs up" reviews from everyone who sees it: The modular design is expandable, with an optional internal hard drive for signal capture that can range from 210 megabytes to 1 gigabyte. RS-422 and IEEE-488 communication ports are standard, and four dedicated slots are available for signal conditioning modules so you can expand without sacrificing functions.

The TA6000 is one feature presentation you don't want to miss. Call us today for more details at (216) 328-7000, or mail or fax this coupon to (216) 328-7400.

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