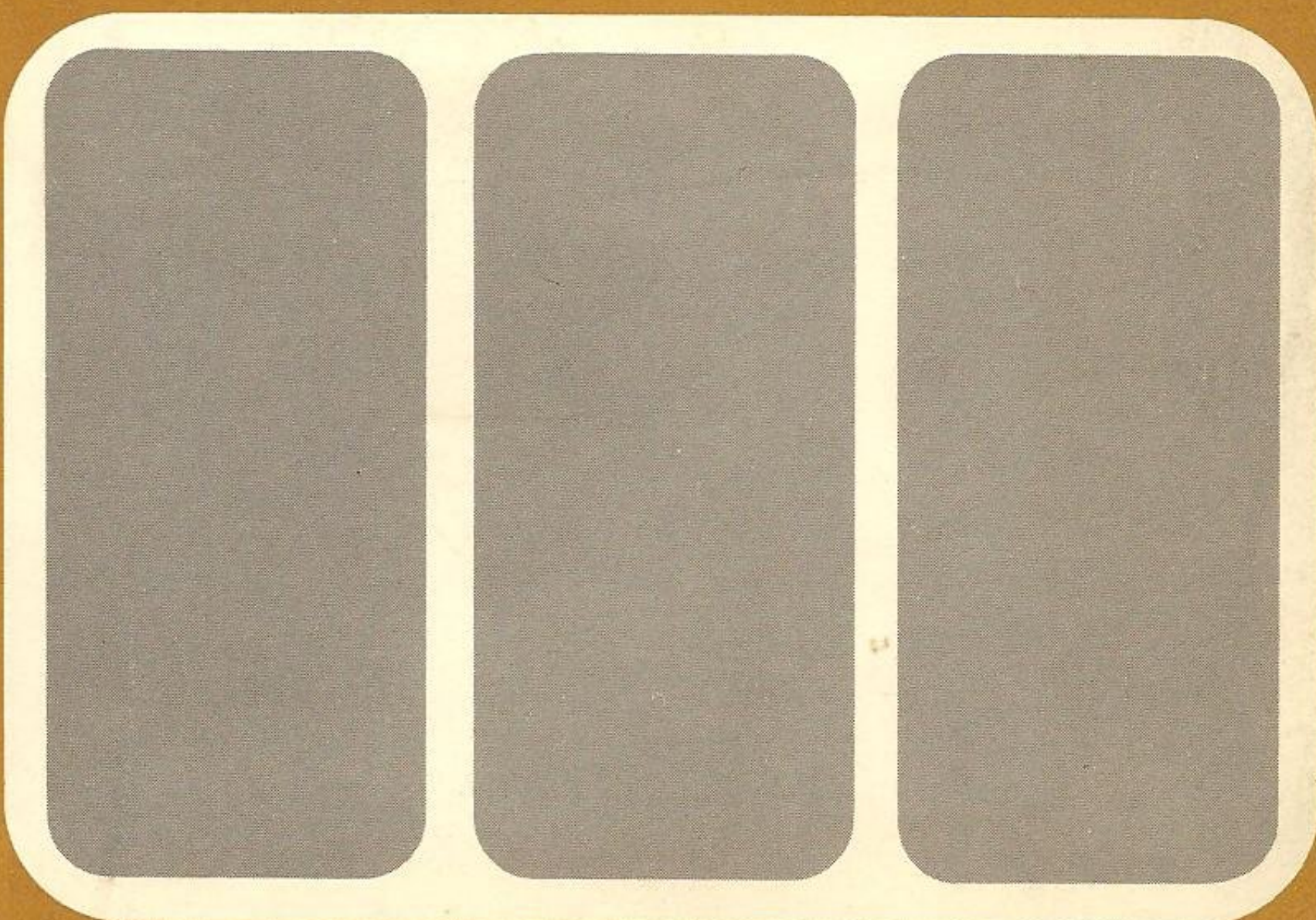


Advanced Technology
— from Concept
to Hardware
— Backed by 36 Years
Experience in
Producing Precision
Instrumentation



Short Form Catalog



CEC/INSTRUMENTS DIVISION

 **BELL & HOWELL**
WE'RE REWRITING THE BOOK.

TECHNOLOGY, QUALITY, SERVICE

Bell & Howell's Electronics & Instruments Group, CEC/Instruments Division, is one of the nation's most experienced manufacturers of precision electro-mechanical equipment. Established in 1937, the Instruments Division's exceptional record in quality is the result of two factors — ultra modern equipment and skilled, dedicated employees, enabling the company to provide its customers superior products and exceptional service for those products in the field. As a result of Bell & Howell's recent acquisition of Astro-Science Corporation, Bell & Howell now provides the most comprehensive and advanced line of instrumentation tape recorders/reproducers with the broadest range of capabilities available anywhere from one source. The addition of the Astro-Science™ line of equipment for use in such hostile environments as air, sea and space to CEC/Instruments Division's ultra precise laboratory and portable recorders gives the user the widest choice of products for his specific requirements. CEC/Instruments Division also is a leading manufacturer of pressure and vibration transducers and associated amplification and monitoring equipment, recording oscillographs, galvanometers and signal conditioners, and digital data acquisition and processing equipment. Users can select complete systems or components as they require.

Complete Line of HIGH-PERFORMANCE TRANSDUCERS for Test Engineering, Manufacturing

Bell & Howell offers a complete line of bonded and unbonded pressure transducers for test engineering, process industry and manufacturing applications.

TOP PERFORMANCE

Among these transducers, an unbonded strain gage pressure model, the 4-326, has proven that it has the finest performance capabilities of any comparable product manufactured. The general-purpose 4-326 is offered in four standard models to cover a wide selection of performance specifications with a choice of pressure ranges 0-10 through 0-10,000 psi. It is a symmetrical,



thermally balanced unit with minimum sensitivity to temperature changes. This symmetry and balance allows excitation voltages to 10v dc with a correspondingly high output of 40 mv. The 4-326 is designed to operate in high vibrational shock and acceleration environments.

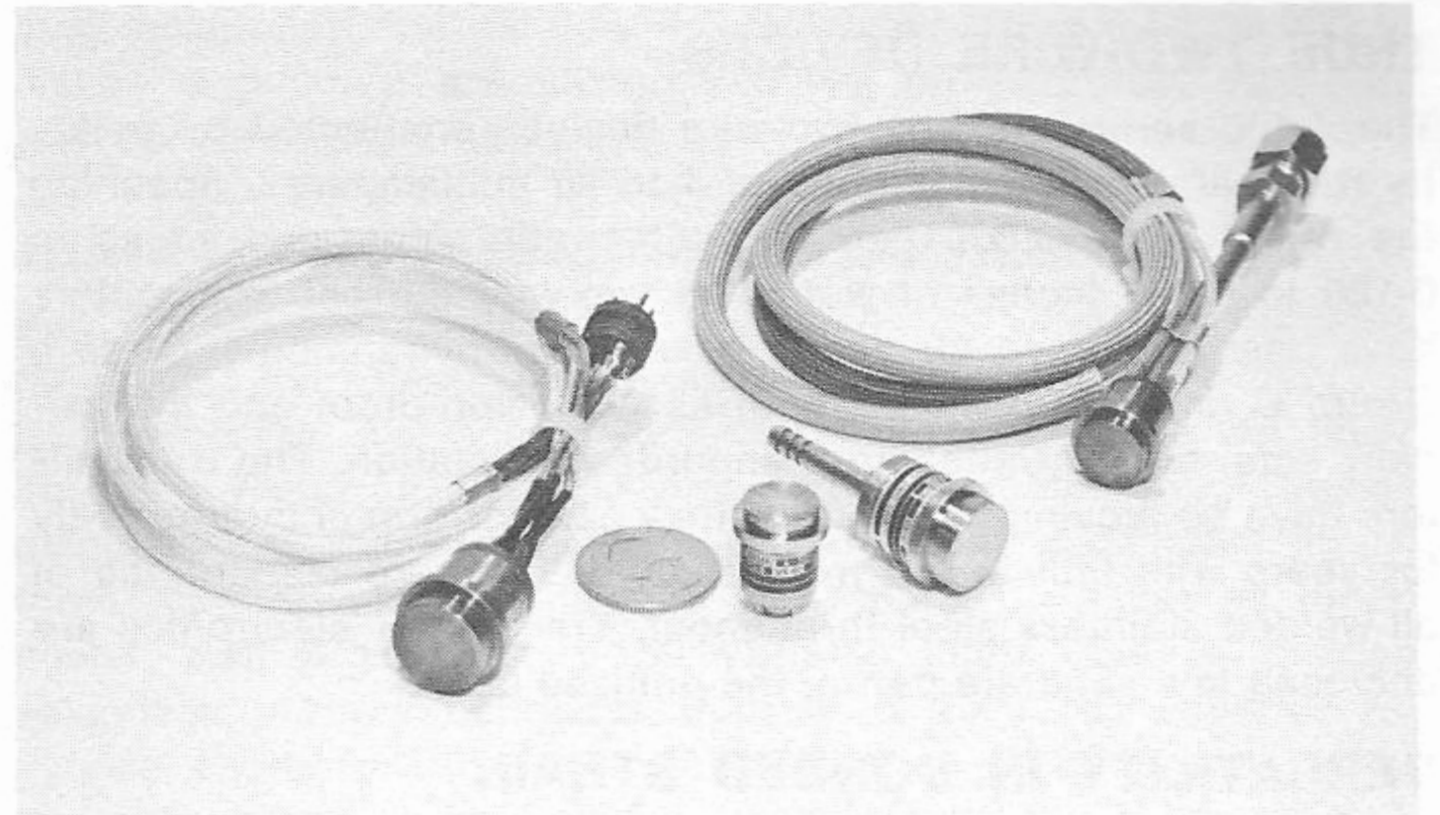
ACCURATE, DURABLE, LIGHT-WEIGHT

Another general-purpose model, the Type 4-356, is an unbonded strain gage pressure transducer designed for superior performance in the areas most concerned with pressure measurements: Accuracy, durability, size and weight. It is especially suitable for such applications as process control, test stands, cryogenic testing, airborne missiles and rockets, and aircraft maintenance and control systems. The combined linearity and hysteresis specification of the unit is conservatively rated at $\pm 0.25\%$. The unit operates without damage over an operating temperature range of -460° to $+300^{\circ}\text{F}$. The all-welded pressure cavity coupled with the all-welded pressure sensor capsule ensures redundancy in pressure integrity.

Weighing only $2\frac{1}{2}$ ounces, the 4-356 measures $1\frac{1}{2}$ by $\frac{7}{8}$ inches. This results in a unit that will fit into almost any pressure measurement application, particularly since the cavity volume of 0.023 cu. in. is small enough to not affect the accurate measurement of the media under pressure. The low-cost Type 4-366 operates at 10 to 10,000 psig in absolute and sealed gage models with acceptable performance for many applications in normal temperature service.

TRANSDUCERS FOR EVERY PURPOSE

Other high-performance pressure transducers offered by Bell & Howell, covering the broadest range of applications available in the industry, include the 4-312, the 4-313, the 4-316, the 4-317, the 4-350 series, the 4-351, the 4-353, the 4-361, the 4-393, the 4-394, and the 4-395.

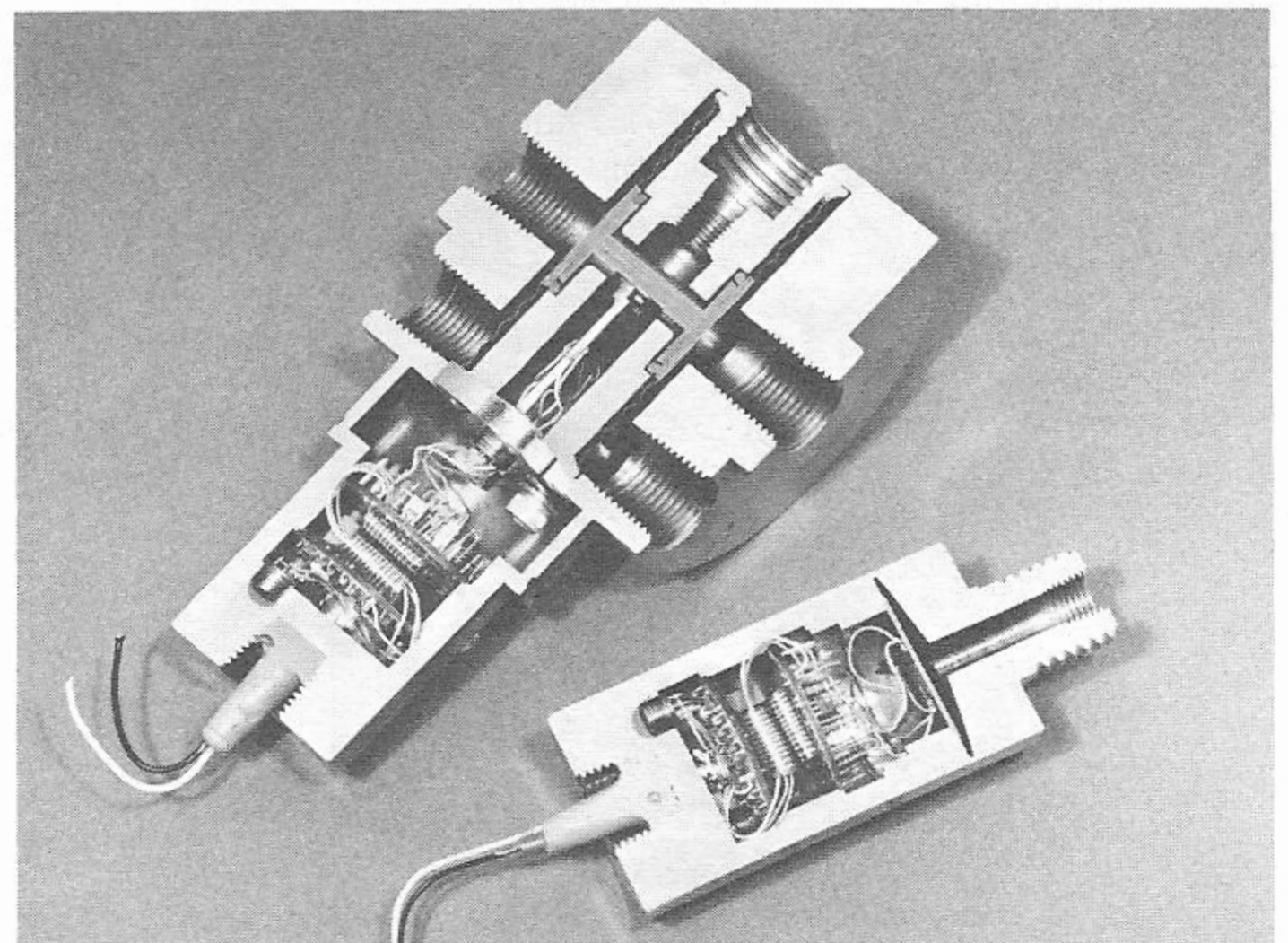


Bell & Howell also manufactures and markets laboratory and portable magnetic tape recorders-reproducers and recording oscillographs which are compatible with all high-performance transducers for test engineering applications.

MINIATURE PRESSURE TRANSDUCER

The Bell & Howell Miniature Pressure Transducer is a small, light-weight, low-cost, yet highly accurate diffused silicon semiconductor transducer for use in automotive and other applications. Each transducer is compensated to perform over a broad temperature range and is factory calibrated. Long-term stability and the ability to maintain calibration under extreme temperature and pressure cycling conditions were key design considerations. These transducers are resistant to corrosive atmospheres and are designed to provide years of continuous trouble-free service.

PRECISION INDUSTRIAL TRANSMITTERS for use in Plants and Processes



Designed for industrial uses such as process control, oil and gas production, power generation plants, pipeline stations, sewage treatment plants and shipboard control systems, the Industrial Pressure Transmitters feature high reliability, compact size and unitized construction. They are ideal for pressure and flow measurements requiring repeatability for long periods of unattended operation.

TRUE TWO-WIRE DEVICES

The 4-400 series are true two-wire devices unaffected by polarity reversal, providing outputs of 4 to 20 milliamperes. Spanning the range of 0-10,000 psi, and differential pressure ranges of 0-100 to 0-400 inches of water, all two-wire current transmitters have been approved for use in hazardous environments, Class I, Group C and D, Division I, both as explosion-proof and intrinsically safe, by the Canadian Standards Association. The transmitters have no moving parts. Thus, they can perform uninterruptedly for years with little or no maintenance. They are constructed of all-welded stainless steel throughout. Transmitter electronics are enclosed in a separate part of the unitized case.

VERSATILITY IN BONDED STRAIN GAGE TRANSDUCERS

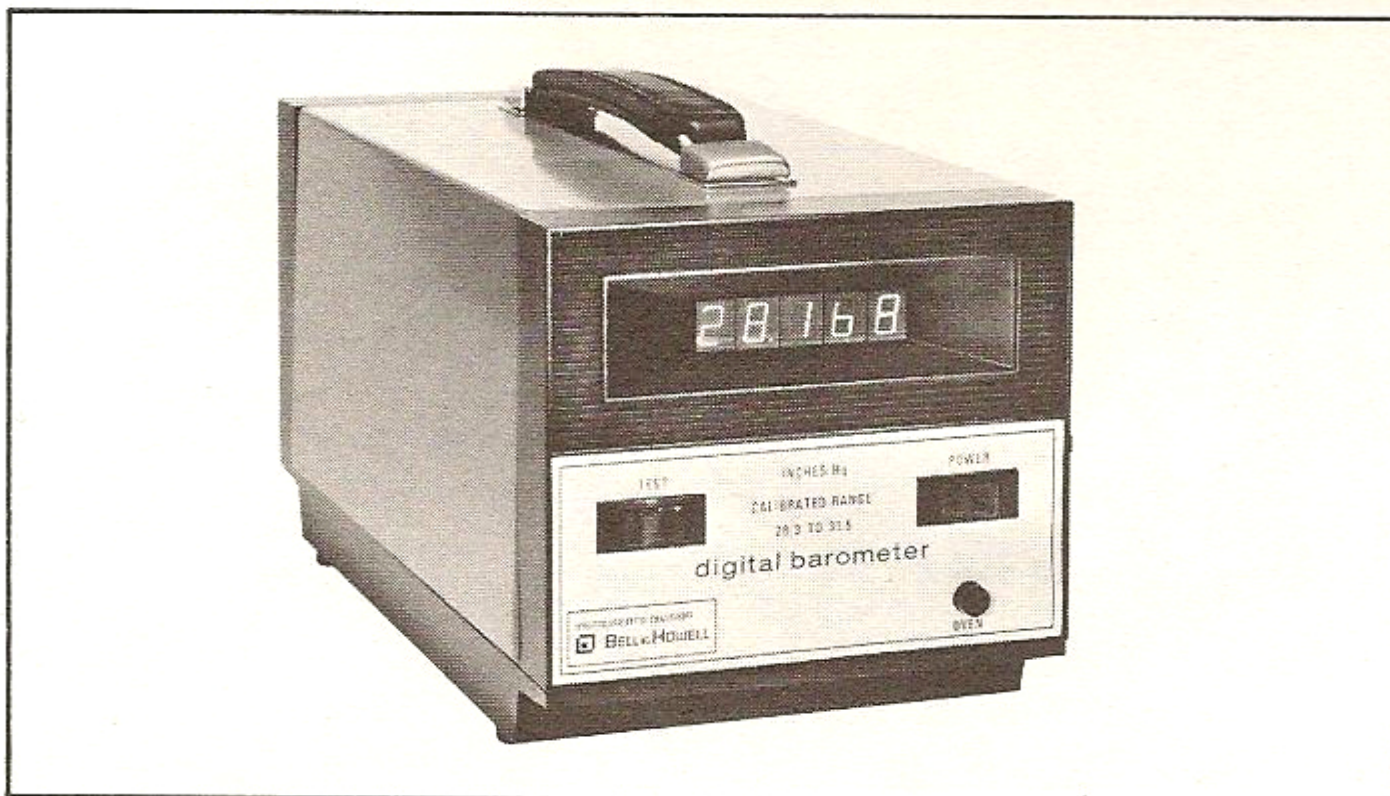
Bell & Howell Types 4-402 and 4-451 Bonded Strain Gage Pressure Transducers also are available in four-wire configuration to provide users with increased design flexibility for measuring static and differential pressures. This versatile product line offers differential pressure measurements of 30 to 50 inches of water in low-range devices and 75 to 400 inches of water in high range. The static pressure units are available in full range of 10 psi through 10,000 psi. They may be ordered with dc millivolt or voltage output. These sensors are designed to conform to intrinsic safety and explosion-proof requirements. The welded, unitized stainless steel construction and mechanical principles of operation are identical to the two-wire transmitters.

Precision Primary PRESSURE STANDARDS AND SYSTEMS

Bell & Howell offers a complete line of precision primary pressure standards for use in test engineering, the laboratory and areas where finite calibration of instruments is essential.

CALIBRATION AT ITS EASIEST

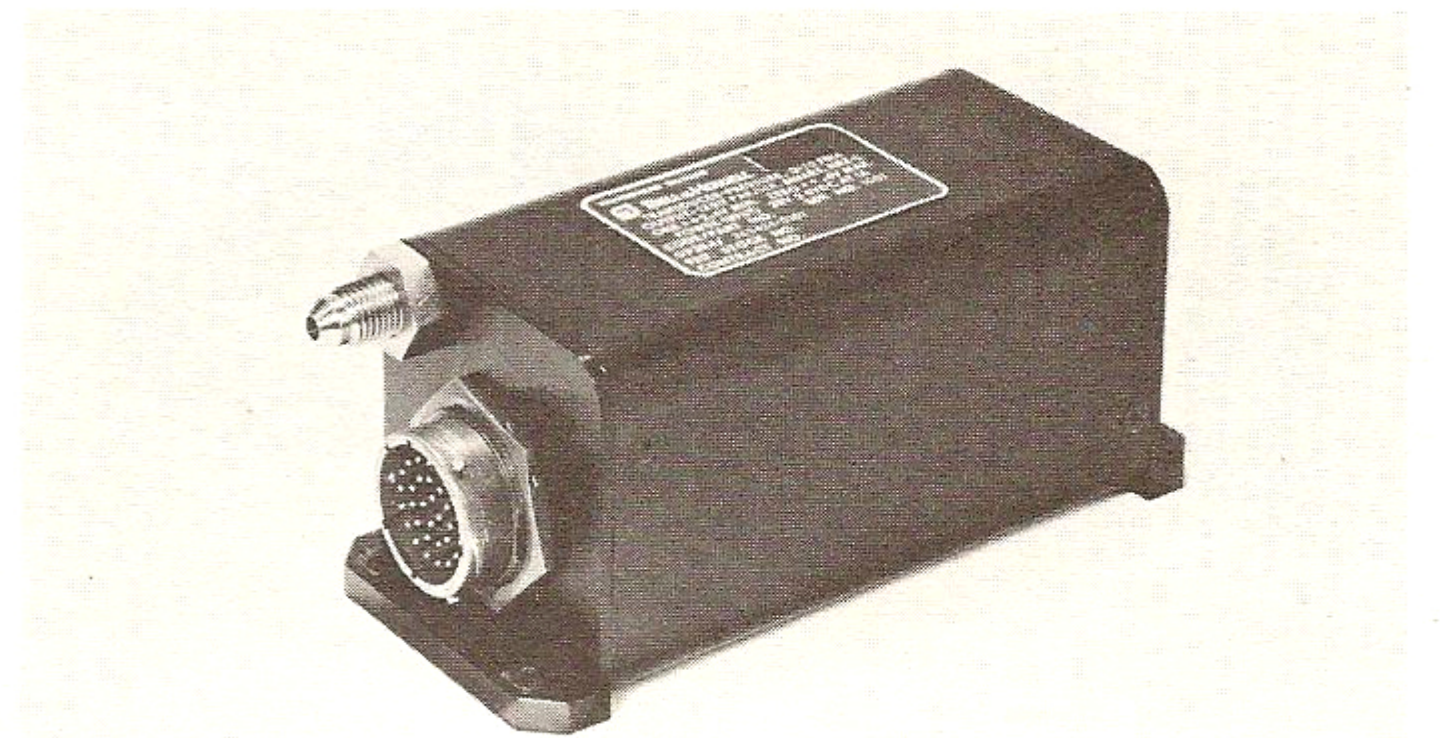
Our Digital Manometer is the ideal replacement for cumbersome mercury columns or quartz bourdon-tube laboratory instruments. Portable and light weight, the unit is accurate to 0.05



percent of full scale. It has a continuous 5-digit display in selectable units, and features BCD digital output for compatibility with computers or other data-gathering devices. In normal service, the Digital Manometer operates for six months without the necessity of calibration. Unlike conventional mercury manometers, the Model 4-462 Digital Manometer does not require temperature or gravity correction. Since it contains no mercury, the possibility of environmental pollution is eliminated. Since the unit has no moving parts — only solid-state electronics — maintenance costs are drastically reduced.

A similar product, using the same principles of operation, is Bell & Howell's Digital Barometer for use in weather stations, research laboratories, airports for altimeter calibrations, wind tunnels, engine test facilities, metrology laboratories and maritime or shipboard installations. When installed in remote locations, the 4-461 Digital Barometer can be linked directly to a central computer or other data-gathering devices to provide continuous data on barometric pressures. Its 5-digit display can be specified to read out millibars, inches of mercury or pounds per square inch.

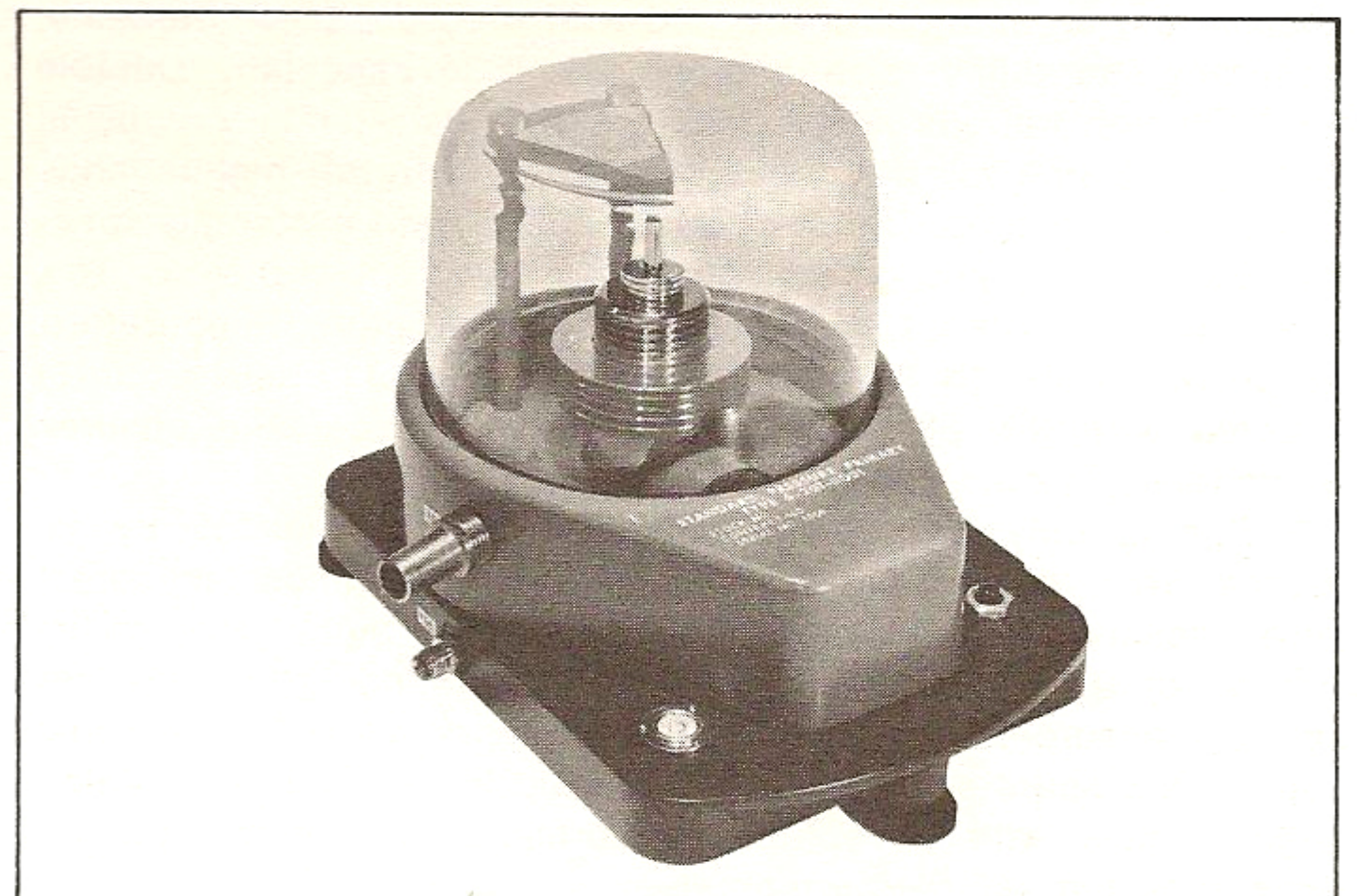
A companion product is the Digital Transducer, a high-speed, high-accuracy digital output unit which employs a dual capacitor sensor as a means of generating frequency. This frequency is applied to an integrated circuit counter and presented to a register for readout in digital formats. The Model 4-464 is avail-



able with natural binary or BCD codes in serial or parallel output. Instruments can be ordered in various pressure ranges as absolute, gage or differential pressure configurations. Accuracy is 0.05 percent of full range.

PINPOINT ACCURACY

Bell & Howell's Primary Pressure Standard is a high accuracy dead-weight tester designed for precisely measuring gas pres-



sures between 0.30 and 500 psi. The Model 6-201 is an ideal laboratory instrument for calibrating both gage and absolute secondary pressure standards and pressure measuring devices. The 6-201 uses individual sets of precision weights in conjunction with precisely honed piston-cylinder combinations. This makes possible pressure measurements in increments of 1 percent of full scale in each of the instrument's six pressure ranges. The instrument depends only on fundamental dimensions of mass, diameter and time for measurements, thus eliminating the need for any other instrument for its calibration.

PRECISE AND RUGGED

Bell & Howell's Solid-State Electromanometer is a rugged, precision pressure-measuring system which features secondary-standard accuracies for laboratory, field and precision process control applications. Accuracy is equal to that of precision mercury manometers, without their limitations.

MOTION PRODUCTS— Vibration Transducers and Monitors for Aeronautical, Industrial Applications

Bell & Howell offers a wide variety of vibration monitoring equipment, including individual transducers as well as complete systems. Units for vibration analysis and testing are available for a broad range of frequencies and displacements, and are designed to perform in high or low-temperature environments. Equipment available includes vibration meters, variable frequency bandpass filters, passive filters, portable vibration monitoring kits and airborne vibration monitoring systems. Bell & Howell also supplies complete kits and a selection of cables compatible with all equipment.

EVEN AIRBORNE, IT KEEPS YOU ON TOP

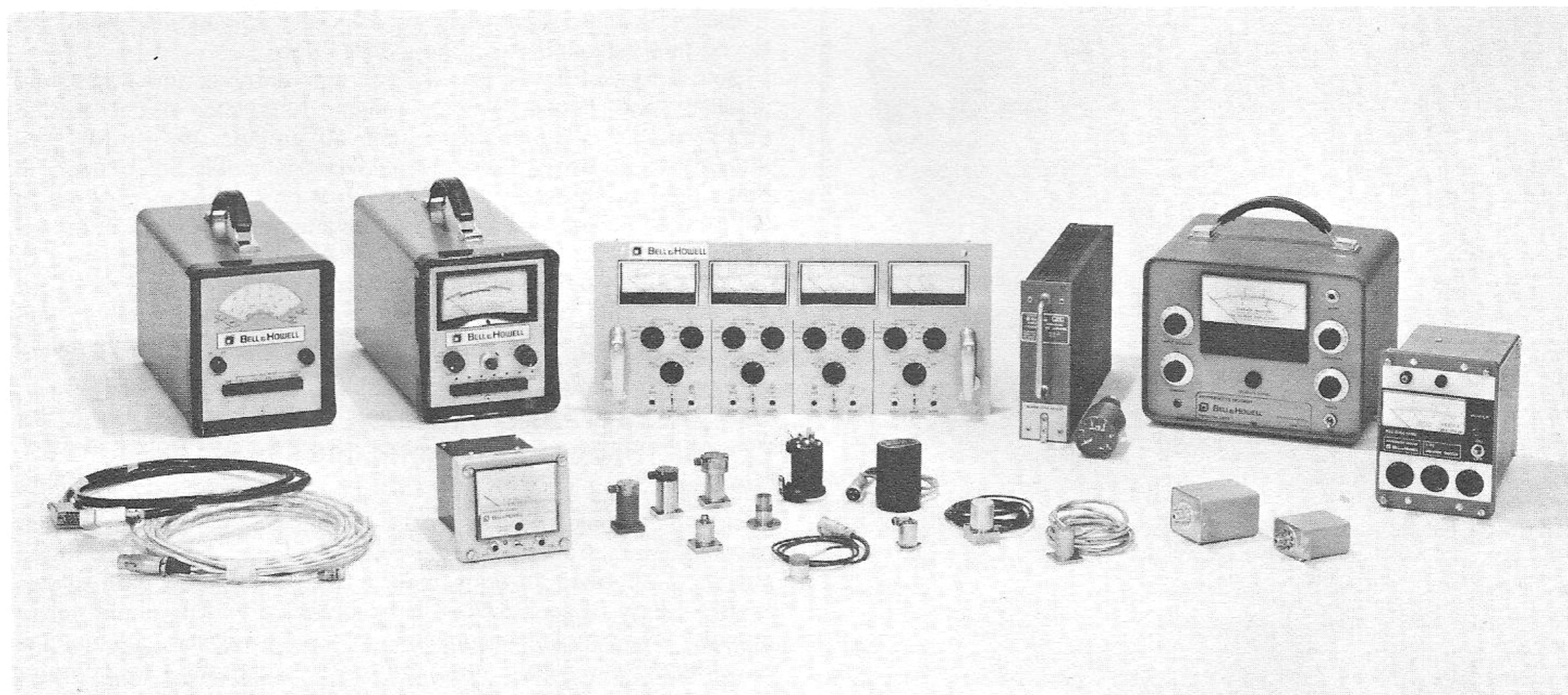
A standard airborne vibration meter compatible with two proven transducers is manufactured and marketed by Bell & Howell. Both transducers, the Models 4-125 and 4-126, are field repairable, reliable to +700°C and feature frequency responses from 45 to 1500 Hz. The units have been successfully proven on hot sections of aircraft jet engines (such as the turbine case) where heat dissipation and air flow are restricted. More than 30,000 of these transducers are currently flying on 707, 720, 727, 737 and DC-8 and DC-9 aircraft.

WINNERS IN JET ENGINE TEST CELLS

Bell & Howell manufactures a number of vibration monitors, filters and transducers with features which make them ideal for jet engine test cell applications. A typical example is the 1-157 Vibration Meter, a portable unit which indicates peak-to-peak displacement and average velocity. It has six selectable inputs, three internal test circuits, and is available in either ac or dc power. Bell & Howell's 1-159 Variable Filter features precise selectivity, narrow bandpass from 8 to 2500 Hz, superior response characteristics and available in ac or dc power. Other meters available from Bell & Howell include the Models 1-117, 1-167 and 1-175.

'IT PAYS TO LISTEN TO YOUR MACHINERY'

For the user of heavy machinery, Bell & Howell offers a line of vibration monitoring equipment which is low-cost, reliable and economical to operate. Bell & Howell's equipment, designed with the experience and expertise we've gained for 36 years, performs the specialized task of providing early warning vibration protection to the operator of industrial machinery. The Type 1-175 Vibration Monitoring System, using application-proven transducers, is easy to install and operate, ruggedly constructed, and has modular design with a wide range of options for tailoring the unit to specific applications. The system has IC electronics for long, trouble-free life, two independent alarms with manual reset and adjustable time delay. Output is 0 to 5 volts, and vibration signal filtering is available. Ideal companions are vibration transducers Types 4-102, 4-103, 4-128, and 4-155.

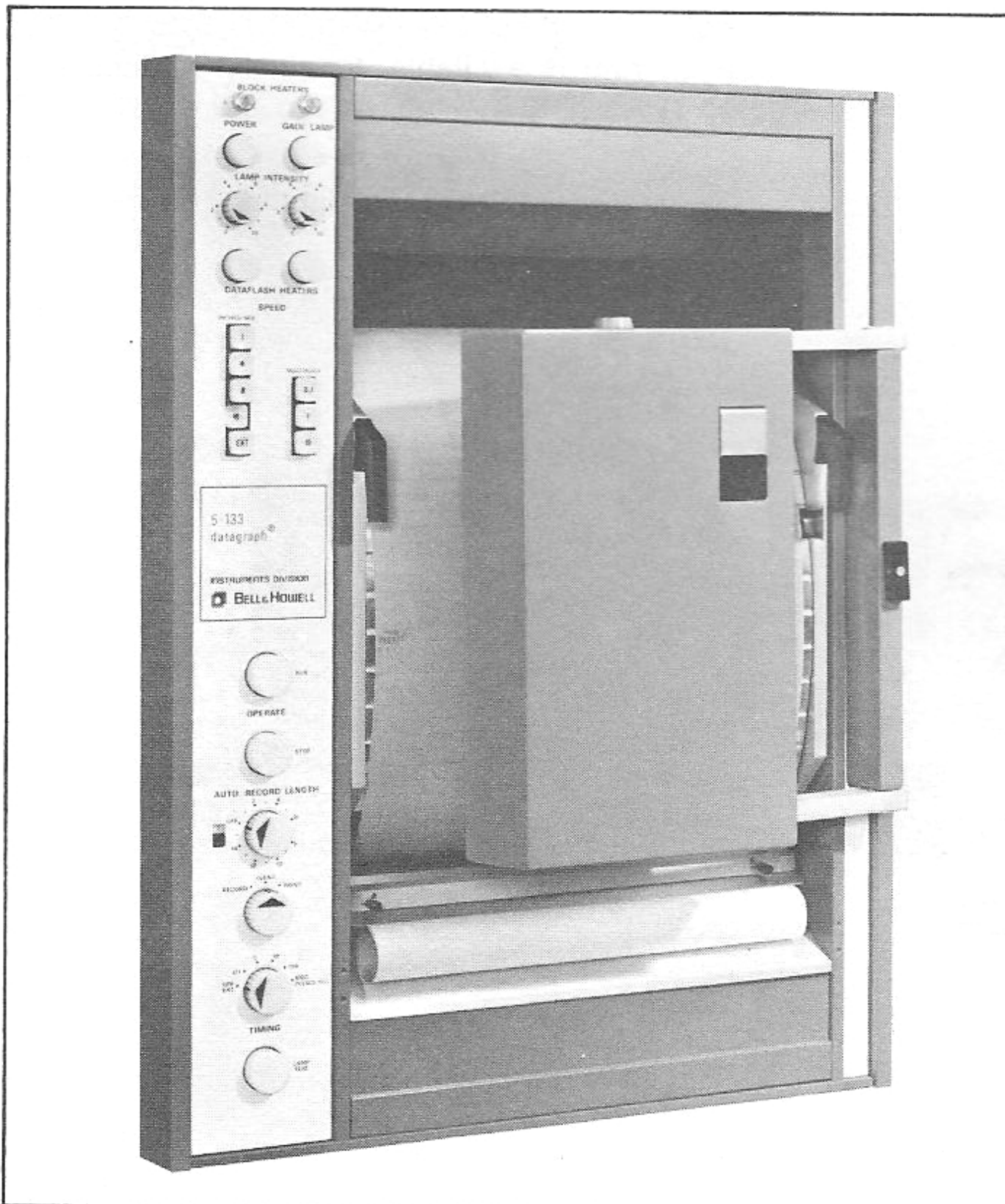


DATA DISPLAY PRODUCTS for Use in Laboratories and Manufacturing Operations

Bell & Howell's complete line of Data Display products — including recording oscillographs, signal conditioners, amplifiers and galvanometers — have become standards of excellence in industry and the laboratory. This equipment has made major contributions to the fields of scientific research, test engineering, medicine, process industries. All Data Display equipment is compatible with Bell & Howell's transducers, the most complete line of such precision instrumentation available in the industry. Data display equipment is available as components or complete data acquisition systems.

RECORDING OSCILLOGRAPHS WITH CHARACTER

Bell & Howell manufactures three precision recording oscillographs with a range of specifications and features designed to meet the requirements of any data acquisition application. The 5-133 Oscillograph is a rack-mounted direct-writing instrument using a high actinic light source as the galvanometer illuminator. 36 channels of data are recorded on 12-inch wide light-sensitive paper at 12 transport speeds from .1 to 160 inches per second without chemical processing of any kind. Dynamic measurements from dc to 25 kc can be recorded. Direct print modes include DATAFLASH®, which produces visible data for immediate read-out at transport speeds up to 16 ips. Normal secondary latensification provides immediate readout of records at up to 1.6 ips. The oscillograph provides either slot-exit or internal take-up. Also featured are automatic record length, five interval flash timing and trace identification. Individual XLR-type input connectors are standard on the basic instrument.



The Type 5-134 Oscillograph combines quality data, maximum flexibility, time saving and low operating costs. It is a portable light-beam type instrument capable of recording up to 18 channels of data on 7-inch-wide direct-print paper. Light source is a 100-watt mercury vapor concentrated arc with sufficient intensity to produce writing speeds in excess of 75,000 inches per second using Bell & Howell's DATAFLASH direct print papers. Ten servo-controlled speeds range from .1 to 100 ips in either a continuous run or momentary (jog) run mode. Outstanding characteristic of the 5-134 Oscillograph is the consistently high-quality data it produces. Data resolution is to -46db with minimum

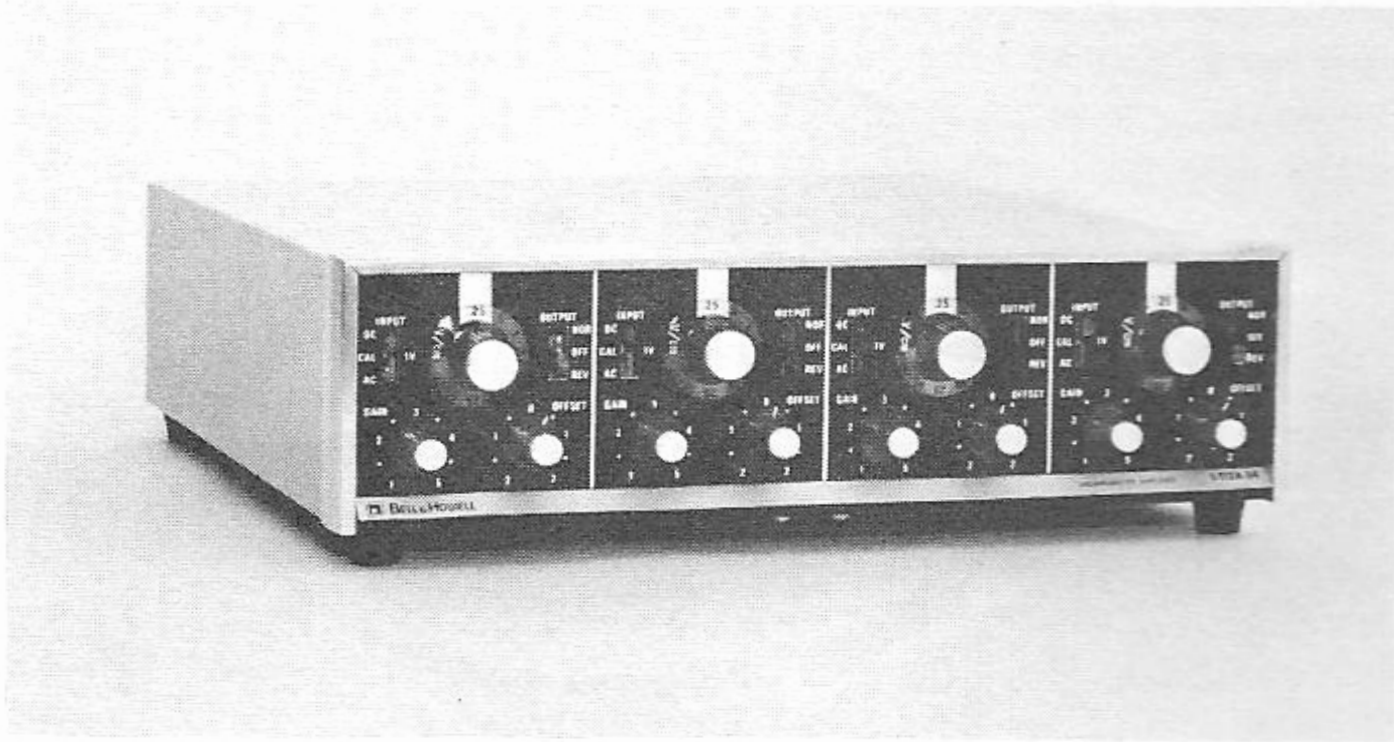


trace width $-.011$ nominal static and $.007$ dynamic. Linearity is within ± 0.5 percent with most Bell & Howell galvanometers. Record quality is further assured by long-term timing accuracy, (1 percent), automatic time interval selection and high dual gridline selection. The dual gridline provides accurate reference traces on the record at either $\frac{1}{10}$ or $\frac{1}{2}$ -inch spacing. Metric spacing is available simply by inverting the gridline mask. In addition to 3-interval timing, the 5-134 features automatic or jump timing which automatically selects the timing interval when the oscillograph record speed is switched either up or down. In addition, the 5-134 features trace numbering for easy trace identification. A timing identification feature automatically prints the timing interval selected on the record edge.

Bell & Howell's newest oscillograph entry is the 5-139, the smallest and lightest-weight 12-inch ultraviolet direct writing unit available. Weighing less than 50 pounds, its rugged construction assures extremely stable optics when being used in other than a laboratory environment. It can accommodate up to 32 Bell & Howell 7-300 series galvanometers which offer flat frequency responses up to 25 kHz. Any paper width from 3 to 12 inches can be used in the magazine, which has capacity for 200 feet of thin base paper. Twelve push-button selectable and two variable speed ranges are provided by a four-motor servo drive system.

VERSATILITY AND PRECISION IN SIGNAL CONDITIONING AND AMPLIFICATION

Bell & Howell's Type 1-172 is a single-ended floating amplifier designed to make it easy to use oscillographs, and to prevent galvanometers from being damaged by large unexpected input signals. Calibrated in volts/inch, a single damping card allows a wide range of sensitivities to be obtained with a single galvanometer. The usual time-consuming damping network calculations have been eliminated. Fast error-free setup adds to operator convenience. The amplifier features precision internal calibration, switch-selectable sensitivities, trace position control, polarity reversal, and trace offset, right on the front panel. There is no

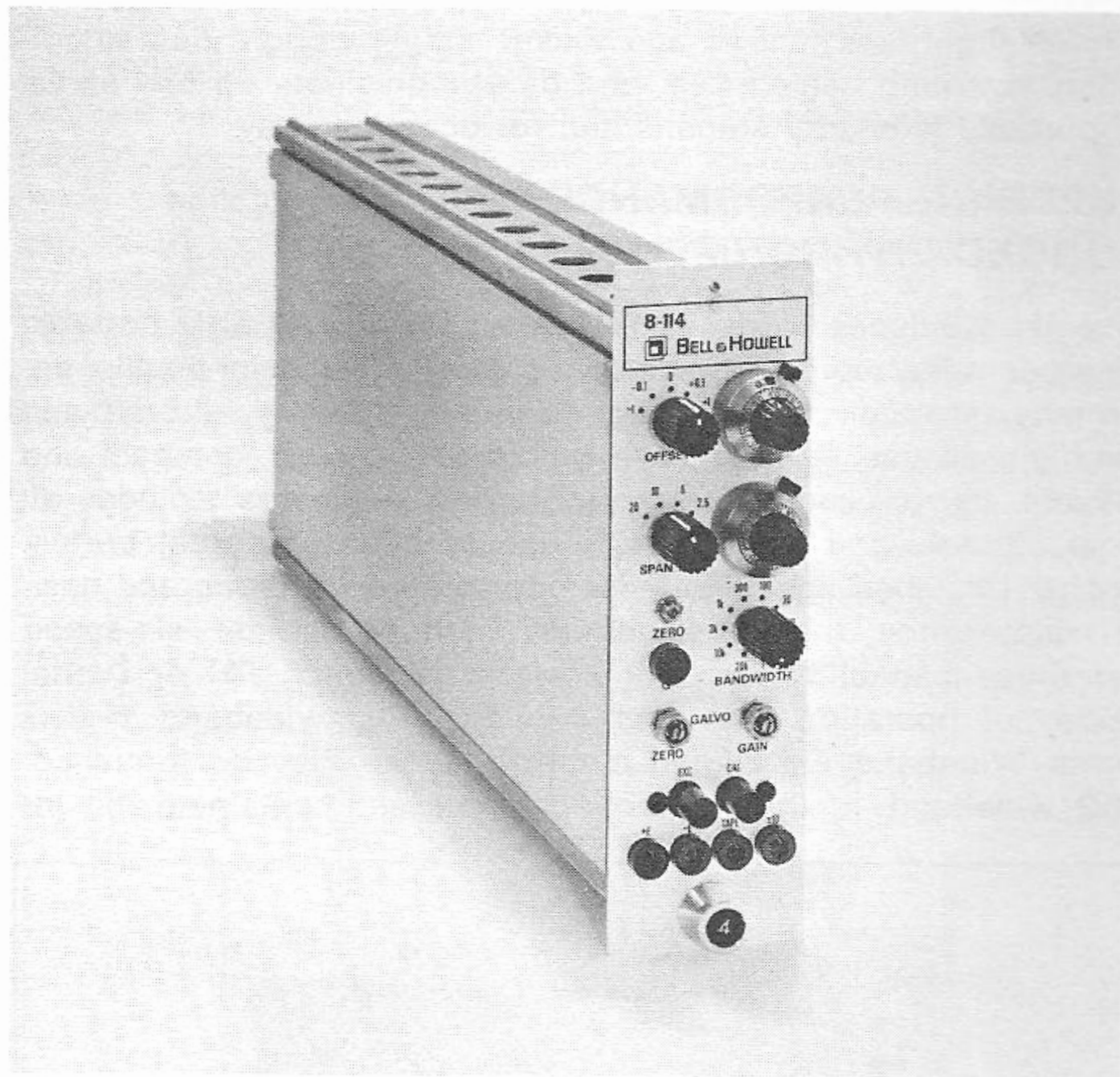


Versatile, Precisely Accurate Magnetic INSTRUMENTATION TAPE RECORDERS/ Reproducers for Science and Industry

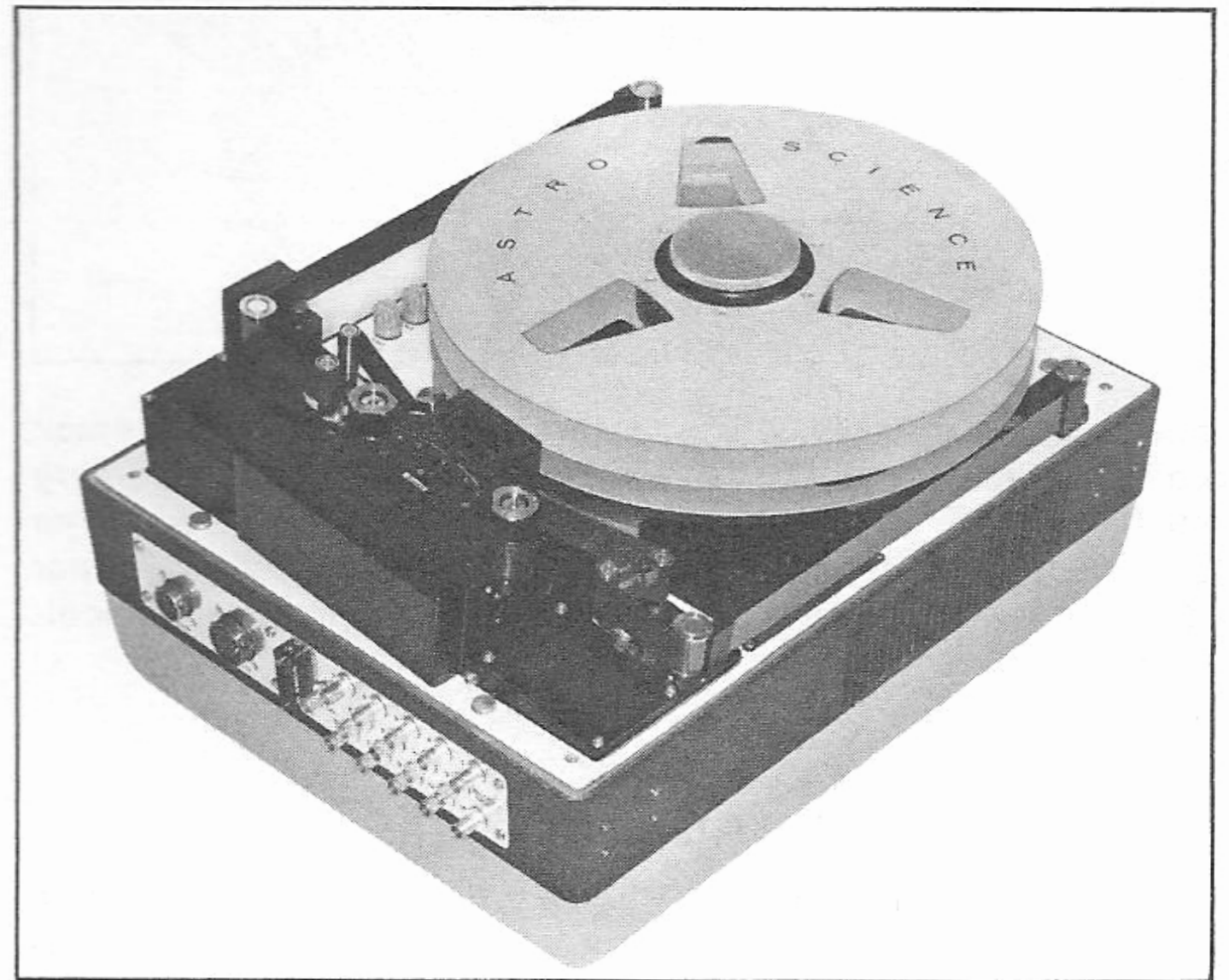
For more than 20 years, Bell & Howell has provided top-quality magnetic tape equipment to science, industry and the government, using the most advanced electronic technology. Now, with the addition of the Astro-Science™ line of recorders for use in hostile environments, we offer the broadest line of equipment available in the industry for use under and on the sea, on land, in the air and space. We have delivered thousands of portable and laboratory instrumentation grade tape systems to our customers. We have achieved a major technological breakthrough with our Hi-Den™ Pulse Code Modulation System, which offers the highest packing density of data known — 33,000 bits per inch of tape — at the lowest error rate, 1 in 10 million bits.

The Astro-Science Model M-14E Series is the first wideband portable recorder/reproducer designed specifically for use in hostile environments typically encountered in airborne, ship-board and mobile applications. Based on time-proven and field-tested concepts and techniques, it uses the basic dual capstan drive and concentric reel mechanism which was pioneered by Astro-Science and successfully used in hundreds of Astro-Science high environmental recorders. Before its incorporation into the M-14E Series, a large tape-wrap around the capstans to

restriction on galvo impedance or optical arm length of the oscillograph in use. The 1 megohm input impedance of the 1-172 makes the input compatible with oscilloscope probes. This allows the operator to apply even higher voltages to the input when using an attenuation probe. If an overload condition occurs, the galvanometer will swing to a maximum safe deflection and the trace will broaden to indicate the overload.



Three functions, including power supply for transducer excitation, bridge completion and signal conditioning and amplification — are combined into the versatile 8-114 and 8-115 Signal Conditioning Modules. Only one instrument is needed to take low-level signals from a variety of sources and drive magnetic tape recorders, lightbeam oscillographs or other devices. The 8-114 and 8-115 feature three separate outputs: 1 v rms for tape, ± 10 v with active filtering for input to DVMs, A/D converters and other devices, and ± 5 v for galvanometers. All three outputs are available simultaneously. Input offset and amplifier gain are read directly from front panel controls. The Model 8-114 is designed to work primarily with bridge type transducers and has an input dynamic range of 2.5 mv to 40 mv for full-scale output. The Model 8-115 has an input dynamic range of 1 mv to 10 v for full-scale output. The remote sensing feature of both instruments allows the use of long lines between the transducer and signal conditioner by sensing and compensating for the resultant voltage drop caused by cable resistance. The units offer a single-step shunt calibration. Optional modes include multi-step, relay-controlled shunt/voltage insertion calibration cards.

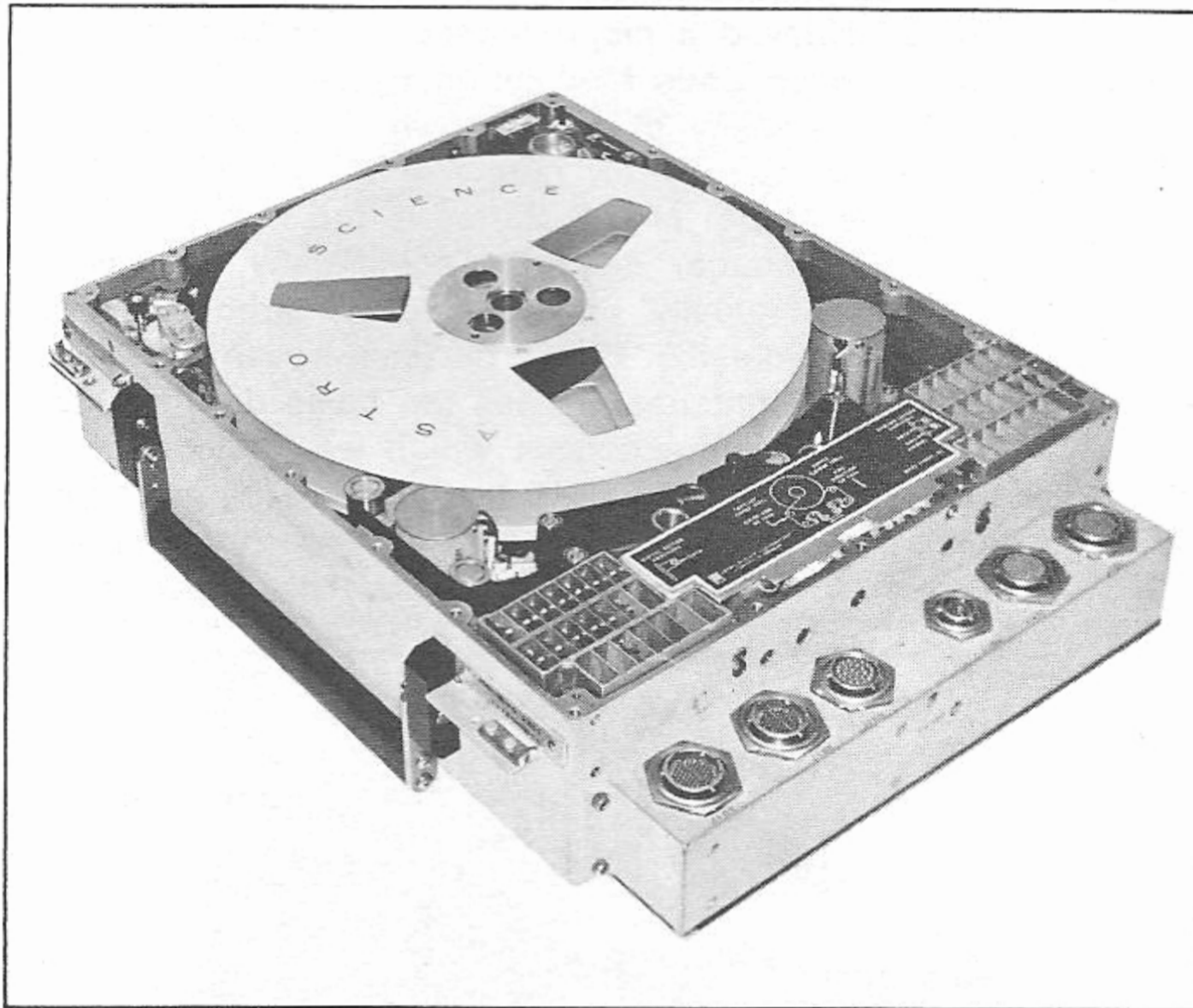


eliminate pinch rollers was successfully used and tested in several Astro-Science recorders for space-borne and sounding rocket applications where severe environments exist. In essence, the M-14E Series is a wideband recorder which was field-tested at the conceptual stage to insure laboratory quality performance under severe conditions. The result is a wideband recorder with environmental integrity coupled with unexcelled tape transport and signal-handling characteristics and minimum size and weight. It is the smallest and lightest weight wideband 2 MHz system available which handles 1-inch tape on 14-inch NAB reels. It records and reproduces 14 tracks in the IRIG configuration with a record/reproduce density of 16,667 cycles per inch, providing a bandwidth of 400 Hz to 2 MHz ± 3 db at 120 ips with propor-

tional bandwidth at other tape speeds. The direct electronics are phase equalized for pulse response as well as amplitude equalized for flat frequency response. Phase response is adjustable. Time base error is extremely low. The unit can also be provided in a 28-track configuration.

BREAKTHROUGH IN SIZE, WEIGHT AND MULTI-CHANNEL CAPABILITY

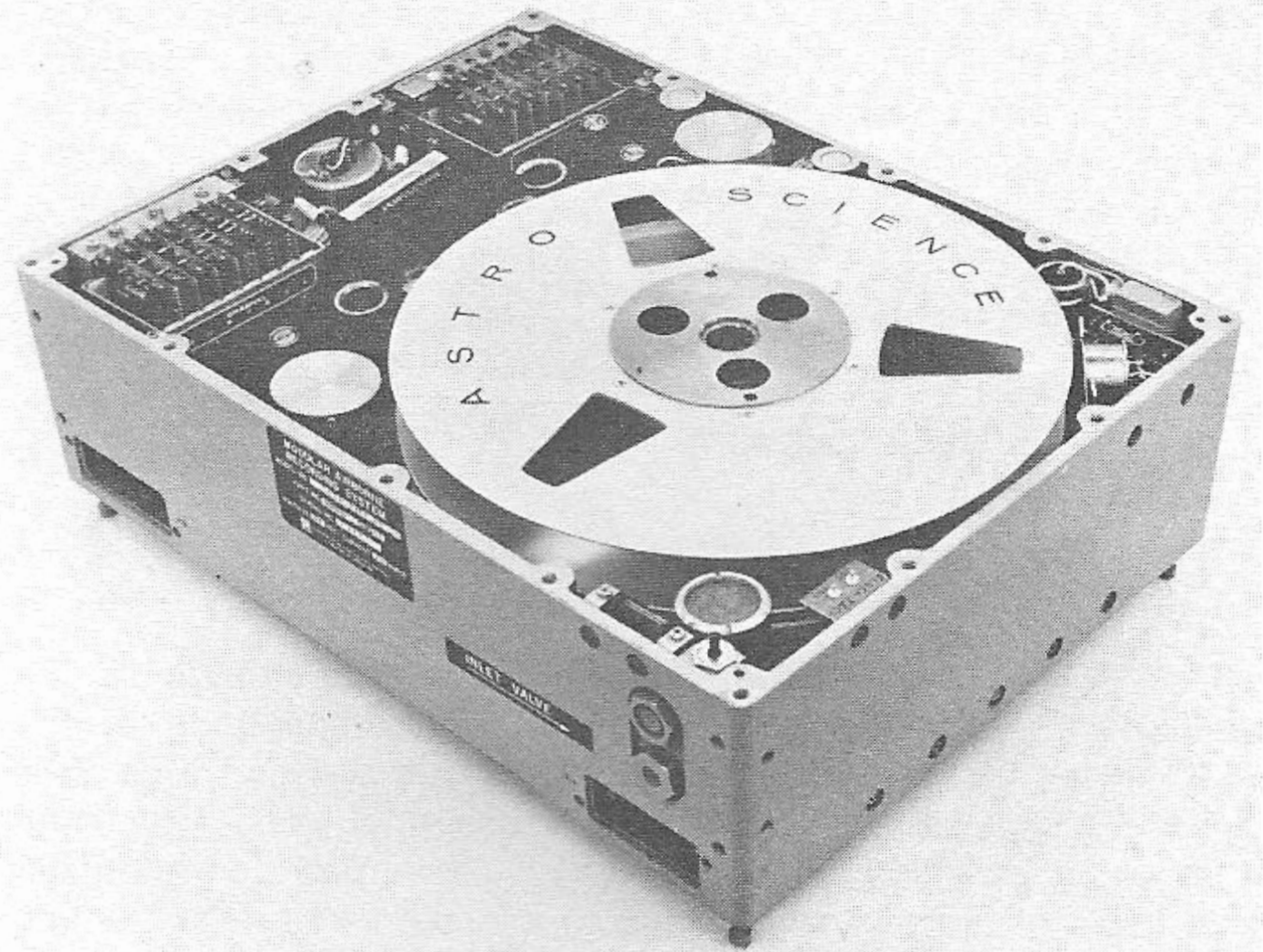
The new Astro-Science MARSTM Series recorder represents a breakthrough in size, weight and multi-channel/multi-speed recorders for airborne and portable applications. This recorder series also uses the Astro-Science basic dual capstan drive and concentric reel mechanism for use in hostile environments where space conservation is critical. Two basic MARS Series are available — the MARS-1000 handling 10½-inch NAB reels and MARS-1400 for 14-inch NAB reels. Each recorder is available in various track configurations with either direct analog or digital electronics. These units operate at six electrically-selectable tape



speeds of 1⅞ through 60 ips and are available in 14 or 28-track configurations with 1 MHz at 60 ips wideband direct recording capability; or in 42-track configurations with 250 kHz at 60 ips direct recording capability. Digital recording is 1000 bits per inch per track. FM electronics are also available for intermediate band and wideband applications.

MULTI-BAND RECORDER FOR AIRBORNE APPLICATIONS

The Astro-Science MARS-2000 Magnetic Tape Recorder is a multi-band, general purpose unit designed for airborne applications. The MARS-2000 provides up to 14 channels for recording Direct and FM signals on 10½-inch NAB-type reels. Six electrically-switchable speeds — 1⅞ through 60 ips — are standard. Historically, airborne recorders have been special-purpose systems designed for record-only applications. Wideband recorders have received emphasis by industry almost to the total neglect of intermediate band applications. Astro-Science has capitalized on its success with the wideband series of MARS recorders to produce a companion state-of-the-art intermediate band recorder. Both units feature record and reproduce capabilities for Direct and FM analog signals. Weighing only 32 pounds without tape, the MARS-2000 is the smallest multi-band recorder available which accommodates 10½-inch NAB reels. Featuring modular construction, the MARS-2000 is used in such applications as



aircraft flight test, missile and rocket test, shipboard data acquisition, overland vehicle test and data acquisition, on test sleds, in portable telemetry stations and for oceanography.

SUPERIOR PERFORMANCE IN RUGGED ENVIRONMENTS

The Astro-Science Model M-14G is a wideband, 2 MHz portable tape recorder/reproducer designed for use in semi-hostile environments encountered in sub-surface, shipboard, aircraft and land vehicle use. It is light weight, state-of-the-art, compact and reliable. Its rack-mountable portable field enclosure includes all local controls and record/reproduce functions for total performance. Designed specifically for operator convenience and ease of maintenance, the M-14G offers a full 14-channel, six-speed reproduce capability for data analysis in Direct, FM or Digital modes of operation. The unit provides IRIG wideband 2 MHz Direct. Wideband FM Digital electronics can also be furnished. IRIG wideband 1.5 MHz is optional. The self-contained unit in-



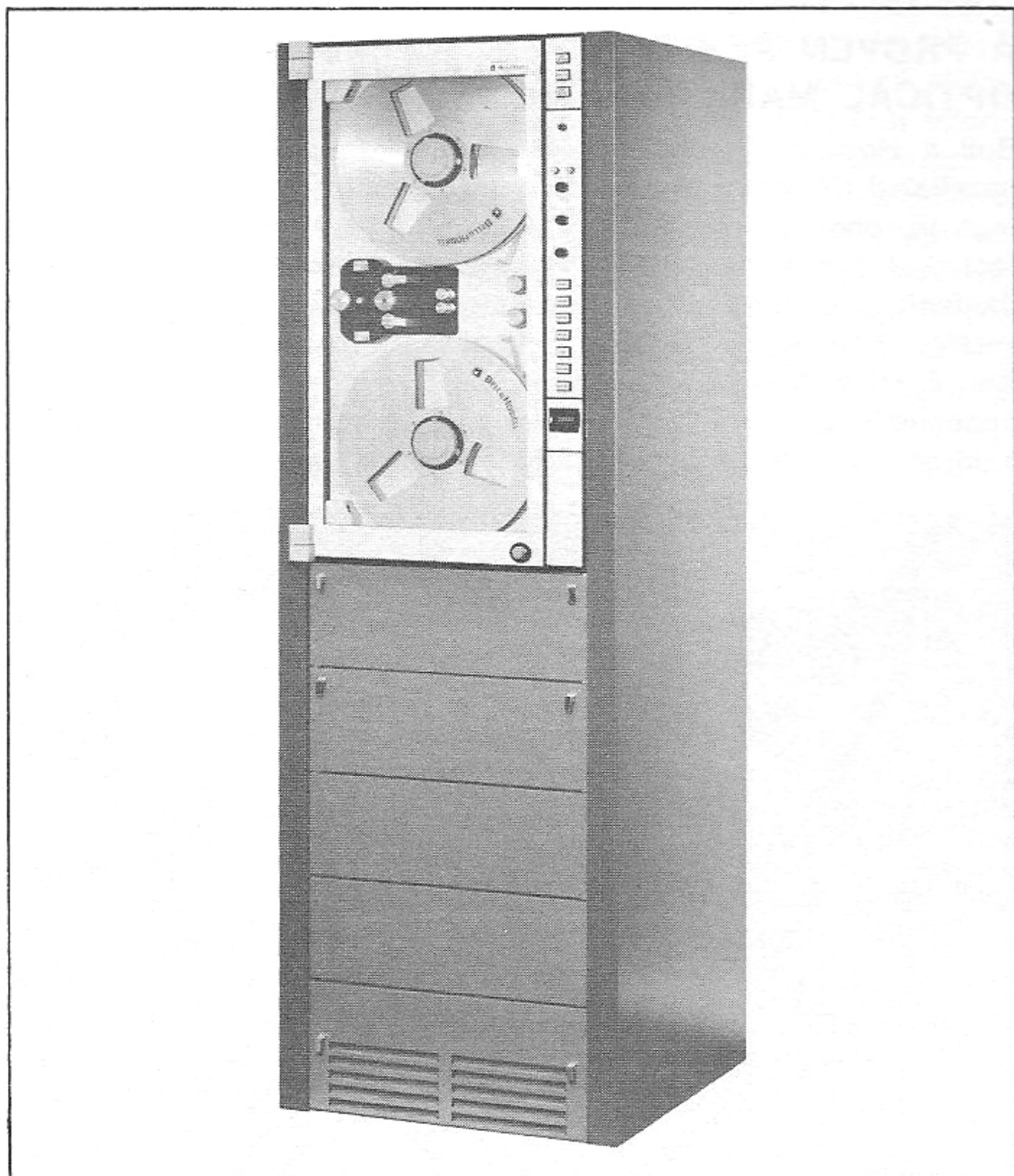
cludes ac power supply and all record/reproduce electronics. It simultaneously records and reproduces on 14 tracks on 1-inch tape. The unit can be expanded to 28 tracks, to 2 MHz/14-track at 60 ips, to wideband Group II FM, and to 2.88 MBPS/track digital.

AND THERE'S MORE

The Astro-Science line also offers an audio tape recorder/reproducer, the Model R-175, for shipboard use. The R-175 is a double bandwidth unit, equalized for instrumentation use with 2 or 4 tracks, switchable and extended record time of 6.4 hours using 7-inch reels. Another product, the Model E66 Series environmental tape recorder/reproducer is a remotely controlled unit featuring rugged simplicity for hostile environments in 2, 4, 7 or 14-track configurations. Also available is an all-purpose Digital Instrumentation Recorder, the Model ADIR-1093. It is computer-compatible with synchronous read/write in 7 or 9-track configurations and features both local and remote control.

LABORATORY-GRADE RECORDER/REPRODUCER

With our experience in providing solutions to customers' problems, we have combined, in one instrumentation tape recorder/reproducer, advanced techniques with old-fashioned simplicity and reliability. The VR-3700B is a versatile instrument designed to meet the most stringent demands of scientific research, engineering and telemetry data gathering applications. The unit features simplicity in design, operation and maintenance unique in laboratory recorders. The VR-3700B operates within a wide range of speeds and frequencies. It has 7, 14, 28, and 42 channels of record/reproduce. For ease of set-up, each amplifier assembly contains 7 record and 7 reproduce channels. All electronics are modular, electrically switchable and capable of operating at any 8 speeds in Direct or FM modes. Operating speeds are from $15\frac{1}{16}$ ips to 120 ips with speeds and electronics selected by a single rotary switch on the front panel. Both $\frac{1}{2}$ -inch and 1-inch tapes and reels up to 15 inches in diameter can be used.

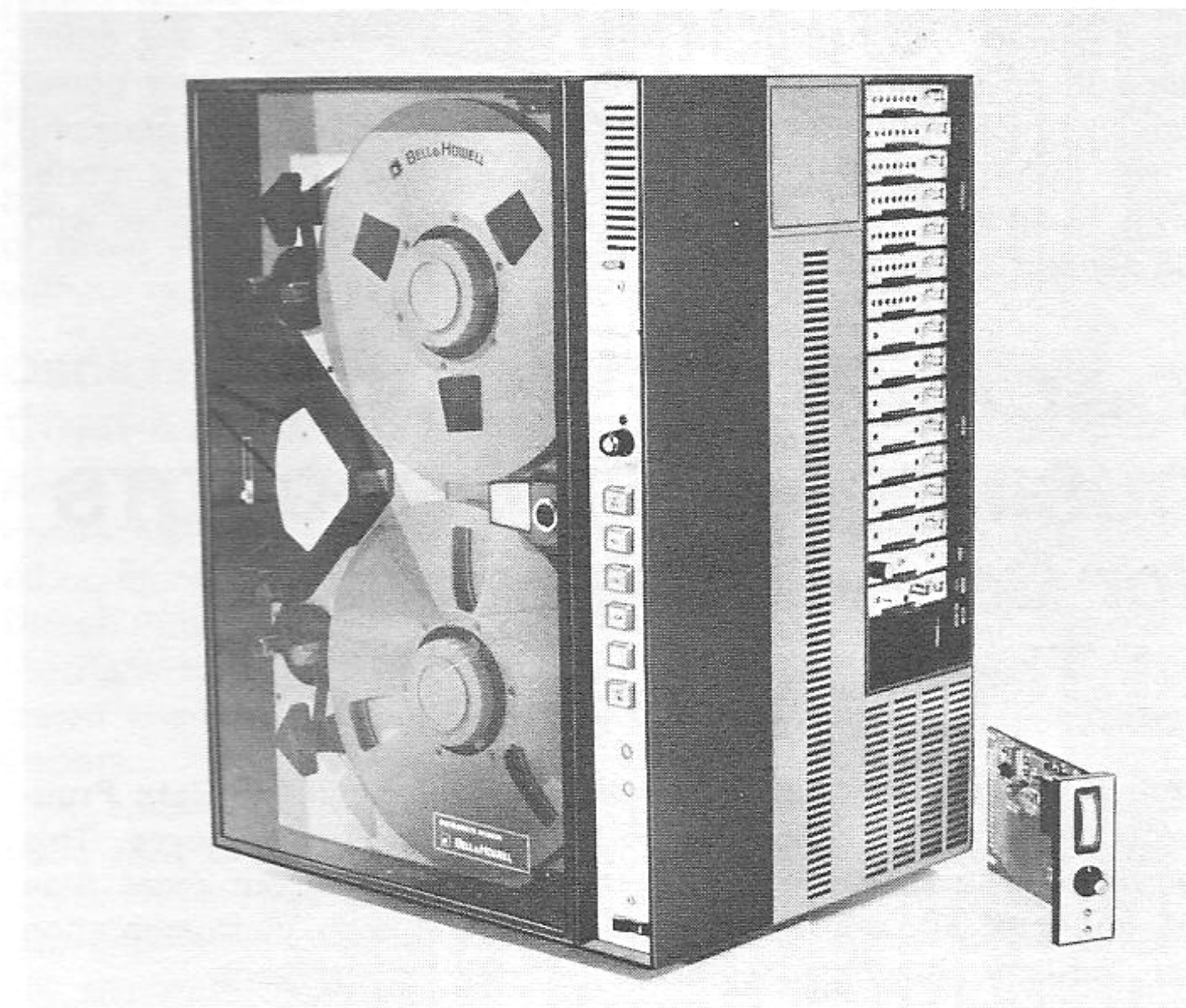


HIGH-DEN™ PCM—UNMATCHED ANYWHERE

At 33,000 bits per inch, Bell & Howell's Hi-Den PCM system electronics for use with the VR-3700B offer the highest data packing density in the recording industry, accompanied by the lowest bit error rate—less than 1 in 10^7 . These plug-in electronics accommodate any IRIG or DM telemetry formats in addition to Bell & Howell's own Enhanced-NRZ™ code. The reproduce electronics include the recording industry's only multi-speed, automatically switched bit synchronizer which operates at four adjacent tape speeds. The Hi-Den Enhanced-NRZ Code gives the user NRZ coding, universally recognized as having the highest packing density known, without the low-frequency response problems commonly associated with NRZ. Use of an enhancement bit provides a continuous indication of data integrity. Thus, by monitoring the reproduce side while recording data, the user is absolutely sure of the quality of recorded information. In reproducing from tape, the enhancement bits are checked and automatically extracted, returning the NRZ-L data as received. Hi-Den electronics will handle all common telemetry codes from input to output. Code conversions from one to another at input, on tape, or at output are available.

WIDEBAND PORTABLE RECORDER— OUR NEWEST ENTRY

Bell & Howell's portable wideband magnetic tape recorder/reproducer, the CPR-4040, offers unparalleled price-to-performance capability in its class in both field and laboratory applications. It is available with a wide assortment of options and accessories for tailoring to the user's specific requirements. The CPR-4040 is a co-planar, reel-to-reel recorder with the necessary



portability for most applications. The standard system provides for recording either Direct or FM data on $\frac{1}{2}$ or 1-inch tape using standard $10\frac{1}{2}$ -inch reels. The transport has seven electrically switchable, bi-directional tape speeds ranging from $15\frac{1}{16}$ to 60 ips. The Bell & Howell dual capstan design concept, coupled with a highly accurate tension sensing element, provides excellent isolation from tape motion disturbances and maintains constant tape tension, resulting in uniform head-to-tape contact. Tape is placed on each capstan at a wrap angle of 270° which is maintained by guide rollers in the tape path, thus providing for a well-defined closed-loop tape system. Direct signal electronics provide response to 1 MHz at 60 ips. Direct record and reproduce amplifiers are seven-speed, electrically

switchable. Plug-in equalizers are not required. Other options include dc power supply and tape loop adapter.

IT'S AT HOME IN FIELD OR LABORATORY

The Bell & Howell CPR-4010 is a rugged, portable instrumentation recorder/reproducer that provides laboratory caliber performance in rugged and remote field applications. The unit has up to seven channels on half-inch or 14 channels on 1-inch tape and accepts reels up to 10½-inches in diameter. The CPR-4010 has seven speeds ranging from $15\frac{1}{16}$ to 60 inches per second. One of the main design achievements of the compact unit is its ease of maintenance and repair. It has a hinged back panel for complete accessibility of all components and plug-in modules which can be easily changed.

All electronics of the CPR-4010 are housed within the basic unit, including monitor meters, voice logger, seven-speed servo card and all 14 record and reproduce amplifiers. Completely pre-wired to accommodate options, the unit's simplified operation is achieved through features such as single knob speed and equalizer control, simple mistake-proof AUTOLOAD™ tape loading, color coded amplifiers, and pushbutton controlled transport functions. The CPR-4010 is field-convertible from ½-inch to 1-inch tape. A 4-digit footage counter is part of the standard transport.

Maintainability and IRIG performance make the CPR-4010 ideal for a variety of data-gathering applications, such as engineering, oceanography, petroleum, scientific research, medicine, communications, chemistry and environmental test facilities.

A MOST NECESSARY ACCESSORY

Bell & Howell's TD-2903-4B tape degausser accepts reels up to 16 inches in diameter and 2 inches in width with center holes from $\frac{5}{16}$ to 3 inches. It provides uniform erasure of the entire tape in an automatic degaussing cycle, and features low power consumption and monitor meter to assure correct degaussing level. The TD-2903-4B is available in a 115v/230v 60 Hz model with 45-second erase time, and a 115v/230v 50 Hz model with 55-second cycle time.

Fast, Efficient BUSINESS DATA PRODUCTS for Capturing Information at The Source

Bell & Howell offers an expanding line of Business Data Products designed for efficient capture of data at the source. This equipment is designed and manufactured using our more than 35 years of know-how in producing top-quality instrumentation for industry, business, science and the government.

COMPACT, INTELLIGENT SYSTEM

Designed for capturing data at local or remote Optical Mark Reader stations, the SDG-2000 is a compact, intelligent system combining the functions of automatic data collection and source data entry. The system can be tailored to the user's specific requirements. In addition to acquiring data records from Optical Mark Reader stations, the SDG-2000 accommodates local keyboard entry; edits input records automatically as prescribed by the user; places formatted records directly on computer-compatible magnetic tape.

The basic SDG-2000 is housed in an attractive desk-like enclosure which contains the minicomputer-based control equipment, communications interface, compatible magnetic tape unit,



Bell & Howell series 8000 MDR™ Optical Mark Document Reader, and keyboard/printer operator's console and display for local data entry and program control. Operation of the SDG-2000 is under control of executive software which executes a number of functional data flow programs. The SDG-2000 also provides input/output device handlers for use by the functional programs. Each of the data flow programs is application-oriented through the use of Job Format Control (JFC) cards. These are conveniently prepared by marking OMR source data cards and inputting them through the local MDR Reader ahead of the batch data cards. Each program uses two JFC cards, one for input edit, format and code conversion parameters, and the second for output format and blocking parameters.

A PROVEN PERFORMER—THE MDR™ OPTICAL MARK DOCUMENT READER

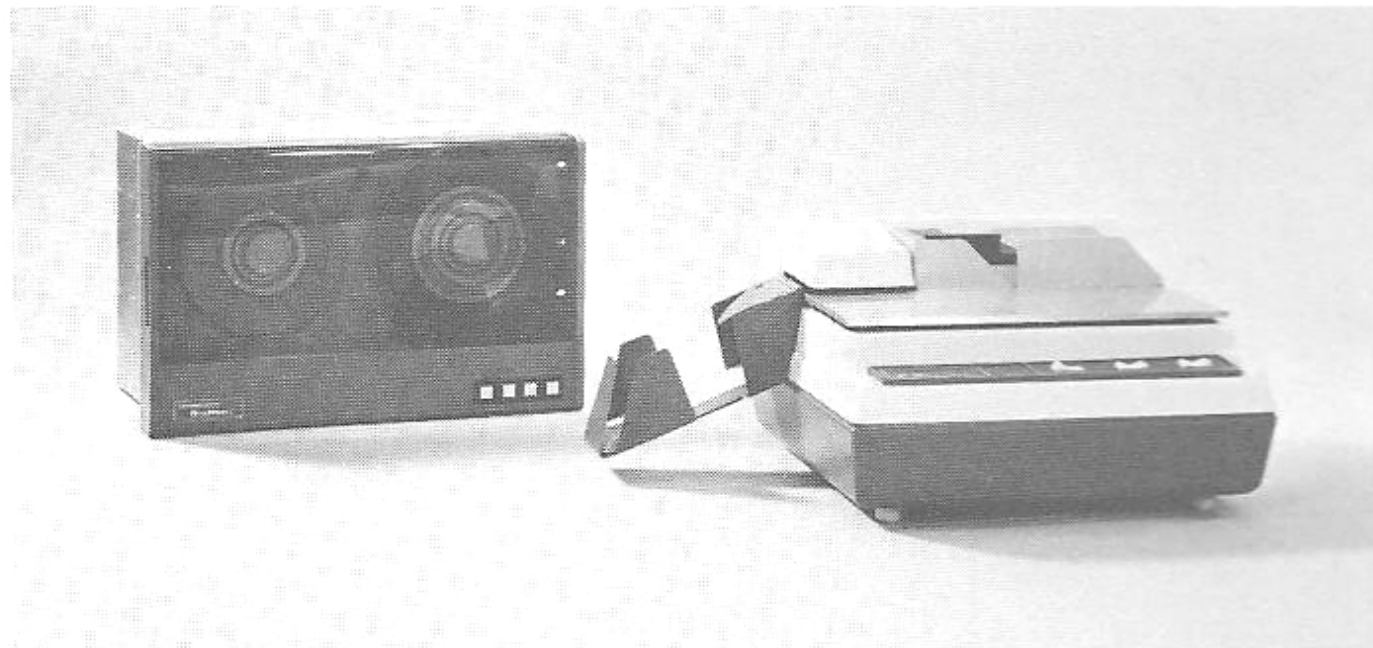
Bell & Howell's family of MDR Optical Mark Readers offer unparalleled flexibility in source data collection at significant savings in labor costs because of its relatively low price and the fact that it reduces and in some cases eliminates the need for dedicated operational personnel to achieve efficient data conversion. Four series of MDR Optical Mark Readers are available. Bell & Howell MDR-1000 series units read pencil-marked, key-punched and preprinted data (or any combination of the three) entered on standard or elongated cards, forms or page-size



documents of any length. Optically read data is translated into a standard business machine language and then transmitted via a local modem to teletypewriters, paper tape punches, magnetic tape units, card punches or computers. MDR-1000 Optical Mark Readers are available for either attended or unattended operational modes. The MDR-2000 series is a high-speed Optical Mark Reader otherwise identical to the low-speed MDR-1000 series. The MDR-8000 series Optical Mark Readers are designed to transfer either 7, 8 or 12 optically read parallel data bits to a specific customer system (interface). MDR-9000 series Optical Mark Readers are attended low-speed data terminals (dc interface) which perform the same functions as the MDR-1000 and MDR-2000 series.

MARK-TAPE™ DATA ACQUISITION SYSTEMS

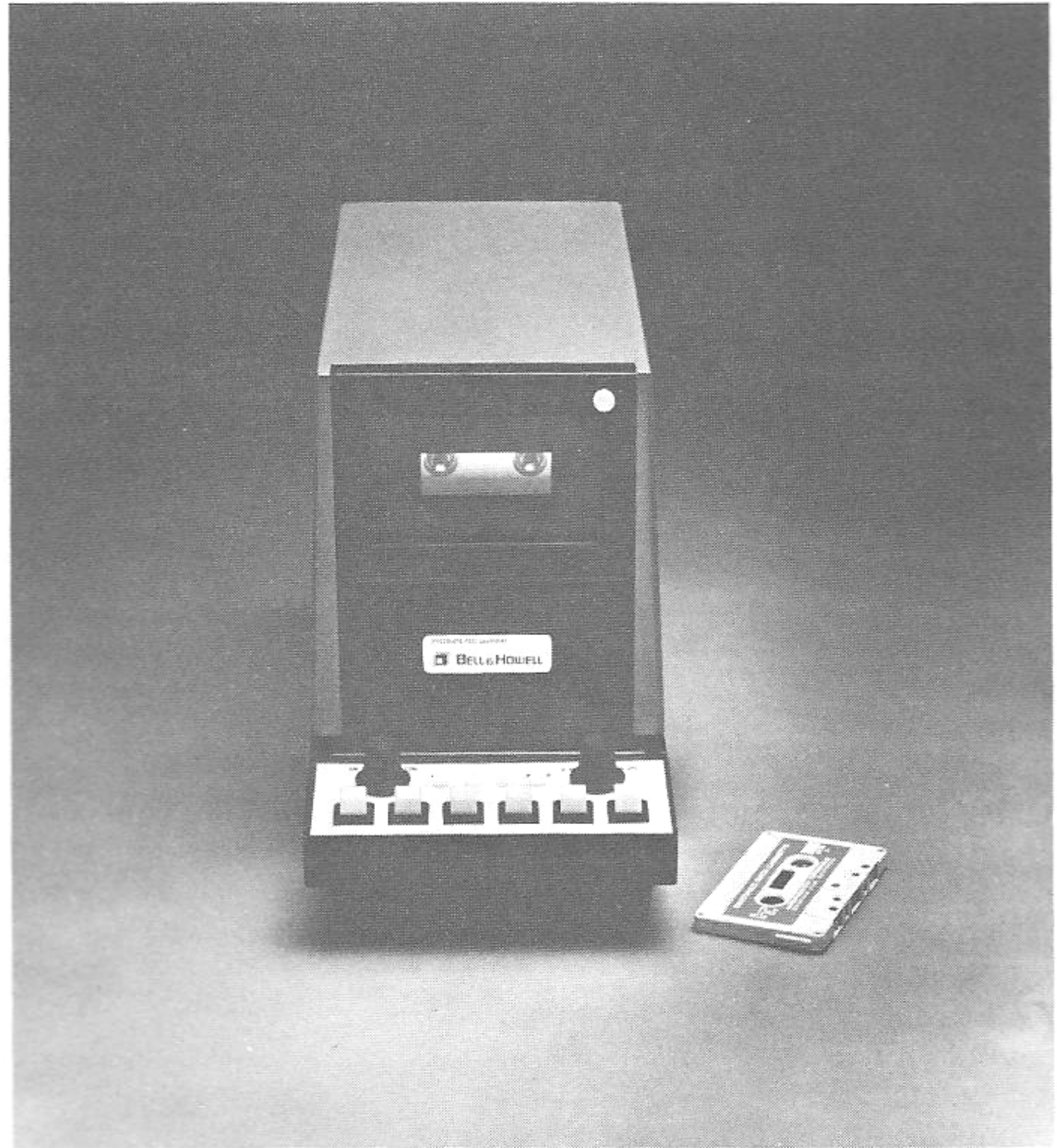
Bell & Howell's Mark-Tape system is a fast and efficient way of capturing almost any kind of source data directly on computer-compatible magnetic tape. Extremely versatile, the Mark-Tape system reads pencil-marked, keypunched and preprinted data (or any combination of the three) entered on standard or elongated tab cards, on forms, or on page-size documents of any length. Marked data is optically read, translated and written on a standard 8½-inch reel computer grade ½-inch tape in either



7 or 9 track. Mark-Tape I is designed for local or on-site data collection. The MDR reader is connected directly to the magnetic tape drive. All Mark-Tape I systems are supplied with: MDR Optical Mark Reader, magnetic tape drive, nine-foot interconnecting cable, card catcher, dust cover, and Operator's Manual. Mark-Tape II is designed for remote data collection over the standard telephone-switched network. Mark-Tape II receives data transmitted by MDR 2000 series readers. Several readers may transmit into one Mark-Tape II magnetic tape drive. All Mark-Tape II systems are supplied with: magnetic tape drive, communications controller, nine-foot interconnecting cable, and Operator's Manual. An optional cabinet is available for either tape drive. Mark-Tape I tape drive may be upgraded to a Mark-Tape II tape drive by the addition of a communications controller.

DIGITAL CASSETTE RECORDERS

Bell & Howell's improved Digital Cassette Recorder is an entirely new unit with performance and reliability characteristics approaching those of large reel-to-reel magnetic tape drives. The unit uses a tape drive system wholly external to the cassette which eliminates such problems as poor tape guidance, tape edge damage and reel-to-reel tension variation. Drive components and complex mechanical linkages subject to wear, failure and the need for periodic adjustment are eliminated. In operation, a device pulls a 2-inch loop of tape from the cassette and loads it on a capstan and precision guide assembly. The tape is automatically positioned in relationship to a magnetic head, tape guides and the capstan, all outside the cassette. Strain gages sense tape tension and hold it to 1.25 ounces, and a tachometer provides servo control of the capstan to sense rotational speed and maintain it at a constant rate. Using standard



Phillips-type cassettes, the unit is available in both single and dual-track models. Any operating speed between 2 and 20 inches per second may be selected with a dual-speed model optionally available. Start/stop times are 15-30 msec. It has search or fast forward/reverse speed of 50 ips. Recording density is 800 bits per inch and transfer rates are up to 16,000 bits per second. Test data indicates a mean-time-before-failure rate of more than 2300 hours — coupled with thousands of passes without tape damage.

OSCILLOGRAPH PAPERS AND MAGNETIC TAPE COMPATIBLE WITH BELL & HOWELL RECORDERS

Bell & Howell offers a complete line of oscillograph papers and chemicals compatible with all Bell & Howell recorders and most other manufacturers' equipments. These include DATAFLASH® Direct Print and DATARITE® Develop-out Oscillograph Recording Papers, DATARITE Developing Solution, high-speed, concentrated chemical kit and DATATRACE® Heat-Sensitive Recording Papers.

In addition, a complete line of instrumentation grade magnetic tape is available for use on our own and other manufacturers' recording equipment. This includes intermediate band, conventional wideband and high energy wideband tapes which are generally accepted as reference standards for equipment qualification, compatibility and performance.

The oscillograph papers and magnetic tape available from Bell & Howell are used to establish machine specifications. Normal inventory paper and tape stock is employed during the quality control phase of oscillograph and tape recorder manufacturing. Further, since this testing is routine and continuous, the customer has assurance that there are no "batch-to-batch" discrepancies in the product relative to the specifications which Bell & Howell demands of these instrument materials. Not only are the "machine" characteristics confirmed, but also those of the recording media — the identical supplies delivered to Bell & Howell customers. The end result is that Bell & Howell is able to assure absolute compatibility of the instrument supplies with all Bell & Howell recording equipment.

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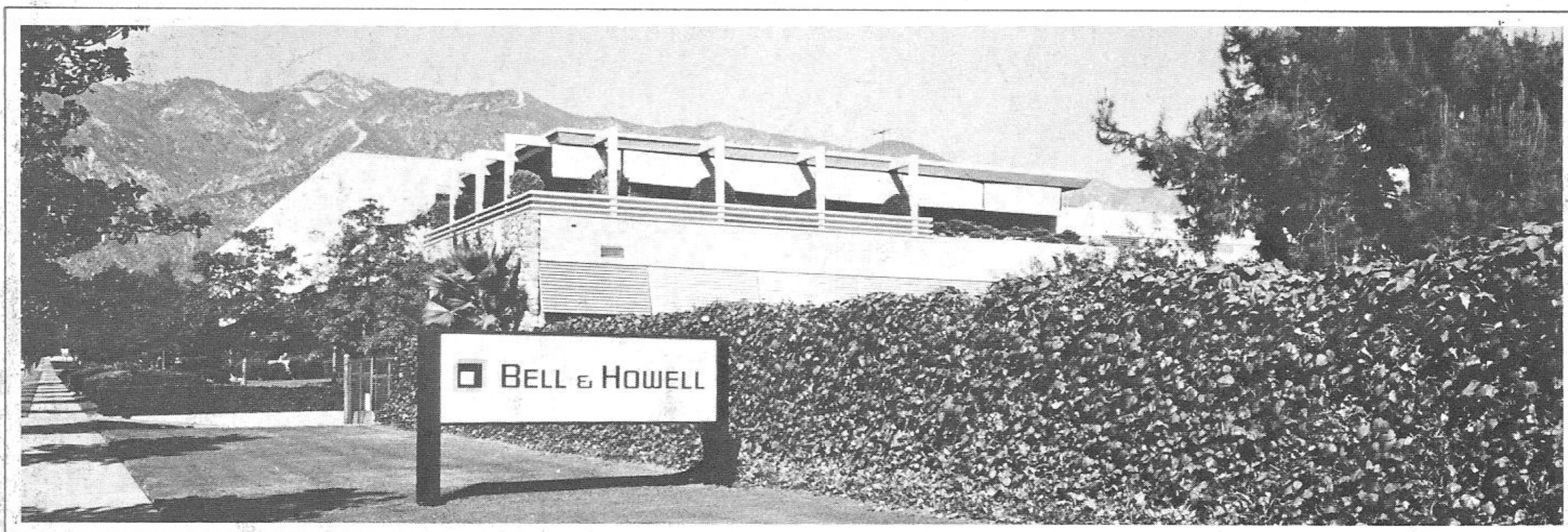
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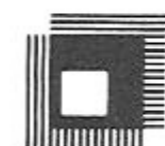
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