DEI Capabilities

Introduction

Defense Electronics, Inc., was organized with a conscious awareness of the rapidly increasing dependency upon electronics for progress and security. Today DEI is engaged in the intensive utilization of science and technology to enable it to design, develop, and produce not only a wide range of advanced electronic products, but also complete electronic systems for use in major U. S. space and defense programs, as well as commercial, industrial, and medical applications.

The resources of Defense Electronics, Inc., in research and engineering, management, and manufacturing are constantly being applied in new directions to meet the ever changing challenges of the aerospace age, challenges which place the highest premium upon the capability for creative and dynamic innovation.

DEI has engineering teams that are recognized by Government and industry for their project management and technical competence, and for their ability to create and develop complex new equipment and systems. The company has repeatedly demonstrated its ability to assume complete responsibility for the engineering and management of total systems.

DEI is continuously engaged in company-funded research and development in anticipation of future aerospace, defense, and industry requirements.

The objectives of DEI in the future will be achieved both through concentration and intensification of our policy of promoting military and industrial instrumentation as an independent specialty field, and through awareness and exploration of promising new areas of endeavor.

Contents

For a quick look at our capabilities and facilities, turn to:

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DEI

Defense Electronics, Inc.

PRODUCERS OF
DEI AND NEMS-CLARKE
EQUIPMENT

Rockville, Maryland 20854

Areas of Capability

RF Equipment

VHF/UHF Transmitters
VHF/UHF Telemetry Receivers
Computer Controlled Receivers
VHF/UHF Multicouplers
VHF/UHF Preamplifiers
Surveillance Receivers
Predetection Up/Down Converters
Video Distribution Amplifiers
RF Spectrum Display Units
Predetection and Post-Detection Diversity Combiners
Two Channel and Three Channel Monopulse Tracking Receivers
Conical Scan Tracking Receivers
Instrumentation Wide Band FM Record/Reproduce Electronics
Frequency Synthesizers

Digital Equipment

PCM Decommutation Systems
PCM Signal Conditioners/ Synchronizers
PCM Signal Simulators
Computer Input/Output Interface Equipment
Bit Error Analyzers
Digital Editing Systems
Digital-to-Analog Converters
Satellite Simulators
Dataphone Interface Equipment

FM Products

Subcarrier Discriminators
Voltage Controlled Oscillators
Reference Oscillators
Mixer-Amplifiers
Analog-to-Digital Converters
Subcarrier Translators
Module Housings

Test Equipment

Phase-Stable Calibration Signal Generators
Collimation Transmitters
Boresight Transmitters
FM/FM Simulators (Data Insertion Converters)
PCM Bit Synchronizer Error Analyzers

Mil-Spec AN/ Products

Intruder Alarm Equipment and Systems
Radar Test Set Systems
Missile Cradles
Keyers and Drivers
Radio Sets

Systems

Telemetry Data Acquisition Systems
Telemetry Data Processing Systems
Telemetry Data Reduction Systems
Predetection Recording Systems
Post-Detection Recording Systems
Analog-to-Digital Recording Systems
Analog Recording Systems
Industrial Utilities Monitoring Systems
Monopulse Antenna Tracking Systems
Conical Scan Antenna Tracking Systems
Surveillance Receiving/Recording and Display Systems
Communications Systems
Mobile Van Mounted Systems
Airborne Receiving Systems
Pre & Post Detection Diversity Combining Systems
Remote Controlled Data Acquisition Systems
Computer Input Buffer Systems
Transponder Systems
Medical Data Systems

Broadcast Equipment

AM-FM-VHF (TV) Field Intensity Meters
Phase Monitors

Yesterday

Defense Electronics, Inc. (DEI), was incorporated under the laws of the state of Delaware in October 1959. DEI began operation as a research and development facility specializing in telemetry receiving equipment. The company progressed rapidly to the design, development, and production of complex instrumentation components and systems.

The emergence of a well conceived range of superior telemetry products soon placed DEI in the front ranks of telemetry equipment suppliers and assured the company of a sound and promising future. This era saw the appearance of telemetry receivers such as the TMR-2A and the TMR-5A; each pioneered new concepts in receiver design and established new performance standards for the industry.

The first major systems contract awarded to DEI was the TLM-63A Ground Station Telemetry Receiving System for the Atlantic Missile Range. Successful performance and on-time delivery on this project paved the way for other systems including prime contracts for predetection recording on the SATURN Program, PCM ground stations for ADVENT, PCM van installations for PMR support of the MINUTEMAN and TITAN Programs, the AMR Range Rehabilitation Program, an industrial utilities monitoring system, and the first completely computer-controlled telemetry receivers.

In the latter months of 1964, DEI moved into a large, modern plant constructed on a 17 acre site in the greater Washington, D. C. area. This permitted transfer of activities from five separate plants into a single, unified facility. The new building provides 97,000 square feet of floor space, with a potential for future expansion to 300,000 square feet.

Today

Over 400 skilled personnel are employed in the DEI plant, which has been organized to provide the separateness of activities, while maintaining the proper integration of company functions essential for the smooth progression of project performance.

Some recent programs of note have included a portable ship's instrumentation system (POSIP/OT) for operational testing of the POLARIS missile, and the delivery of large quantities of advanced dual channel telemetry, voice, and tracking receivers and dual channel dual input display units for the A/RIA (APOLLO re-entry instrumentation aircraft) program. The receivers supplied for the A/RIA program included integral predetection combining and record/playback features.

In August, 1967, an agreement was concluded for the acquisition by Defense Electronics, Inc., of certain assets of the Vitro Electronics Division of Vitro Corporation of America, primarily the well known Nems-Clarke telemetry and broadcast product line. The results of this acquisition are a substantially increased product range and a greatly expanded reservoir of capabilities for both engineering and manufacturing.

Through sales representatives in every major Western nation, DEI offers its quality electronic products throughout the free world. DEI equipment is currently installed and operating in West Germany, France, Sweden, Italy, Holland, Belgium, England, the Falkland Islands, Australia, Spain, and Israel. Overseas customers include both government agencies and private industry. Also available internationally are support services such as installation, personnel training, engineering support, and parts replacement.

An interesting area in which development work is progressing is the practical application of seismic phenomena for intruder alarm devices. These seismic devices have a potential for military, Government, industrial, and commercial security applications.

The appearance of DEI's second generation of solid-state miniaturized modular products and an all-integrated circuit receiver heralds a new age of sophisticated design concepts that demonstrates DEI's continued leadership in the telemetry and data handling fields.

DEI is actively contributing to the expanding requirements of biomedical research, and has supplied two medical-data acquisition, transmission, reception, and recording systems.

A healthy, controlled expansion rate, and the acquisition of the Nems-Clarke product line, have enabled DEI to emerge as the recognized leader in telemetry equipment and systems design and development, backed by a manufacturing capability which is noted for its versatility, flexibility, and efficiency.

Tomorrow

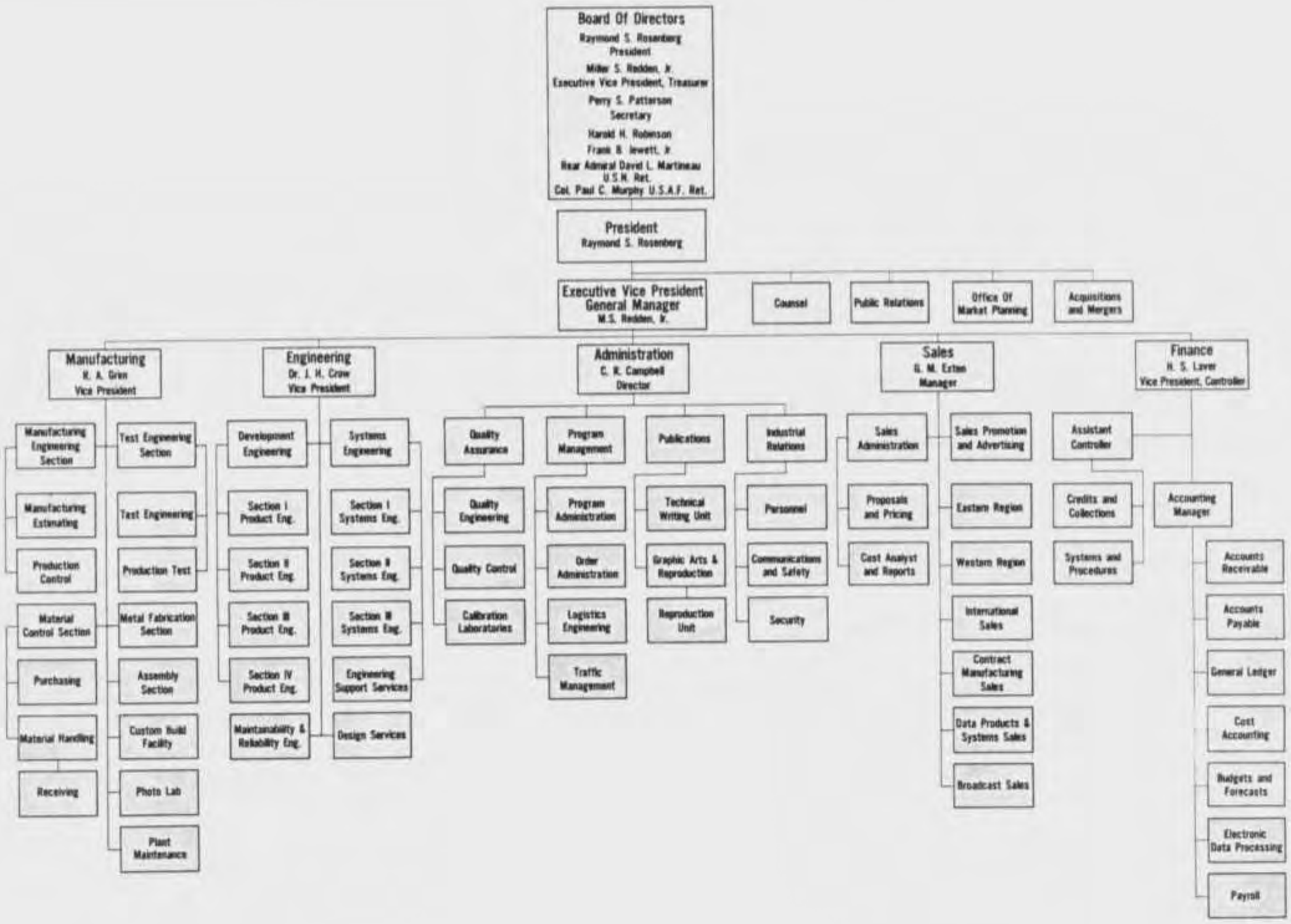
Defense Electronics, Inc., is constantly investigating new and challenging areas for the application of advanced design philosophies in response to the ever changing needs of our customers, both present and future. The flexible, well-organized capabilities and potential of DEI stand ready to pursue all avenues which hold sound promise for the realization of new and rewarding areas of growth.

Organization

Perhaps no single picture could present more completely and emphatically the story of DEI's total capabilities than a close examination of the corporate organization chart.

Here is a picture of a company organized and equipped to provide all the major services and facilities necessary for inhouse development and production of a variety of telemetry, data handling, and military electronic equipment and systems. In an era of specialization, the company is organized into functional departments to provide the most efficient and economical processing of a continuing volume of related tasks. Each major project is divided into functional tasks and each task is assured the total services of the pertinent department or section personnel to the full extent required.

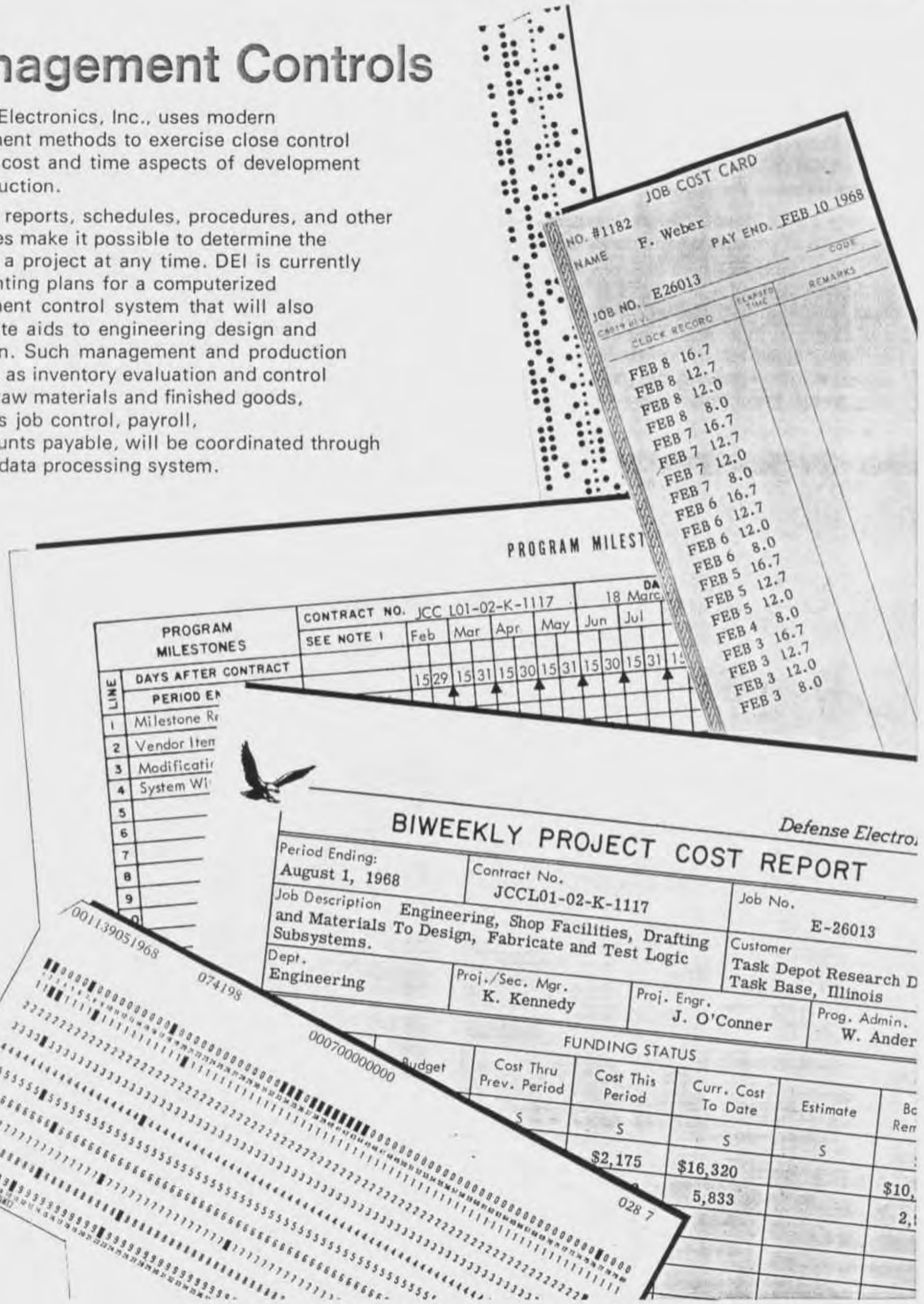
Superimposed over the entire organizational structure is the Program Manager approach to project supervision and administration. It is this dual method of operation — the total and unbroken management chain coupled with the skill and experience obtained through long-term specialization — that achieves the fastest and most consistently productive results for DEI customers.



Management Controls

Defense Electronics, Inc., uses modern management methods to exercise close control over the cost and time aspects of development and production.

Accurate reports, schedules, procedures, and other techniques make it possible to determine the status of a project at any time. DEI is currently implementing plans for a computerized management control system that will also incorporate aids to engineering design and evaluation. Such management and production functions as inventory evaluation and control for both raw materials and finished goods, as well as job control, payroll, and accounts payable, will be coordinated through this new data processing system.



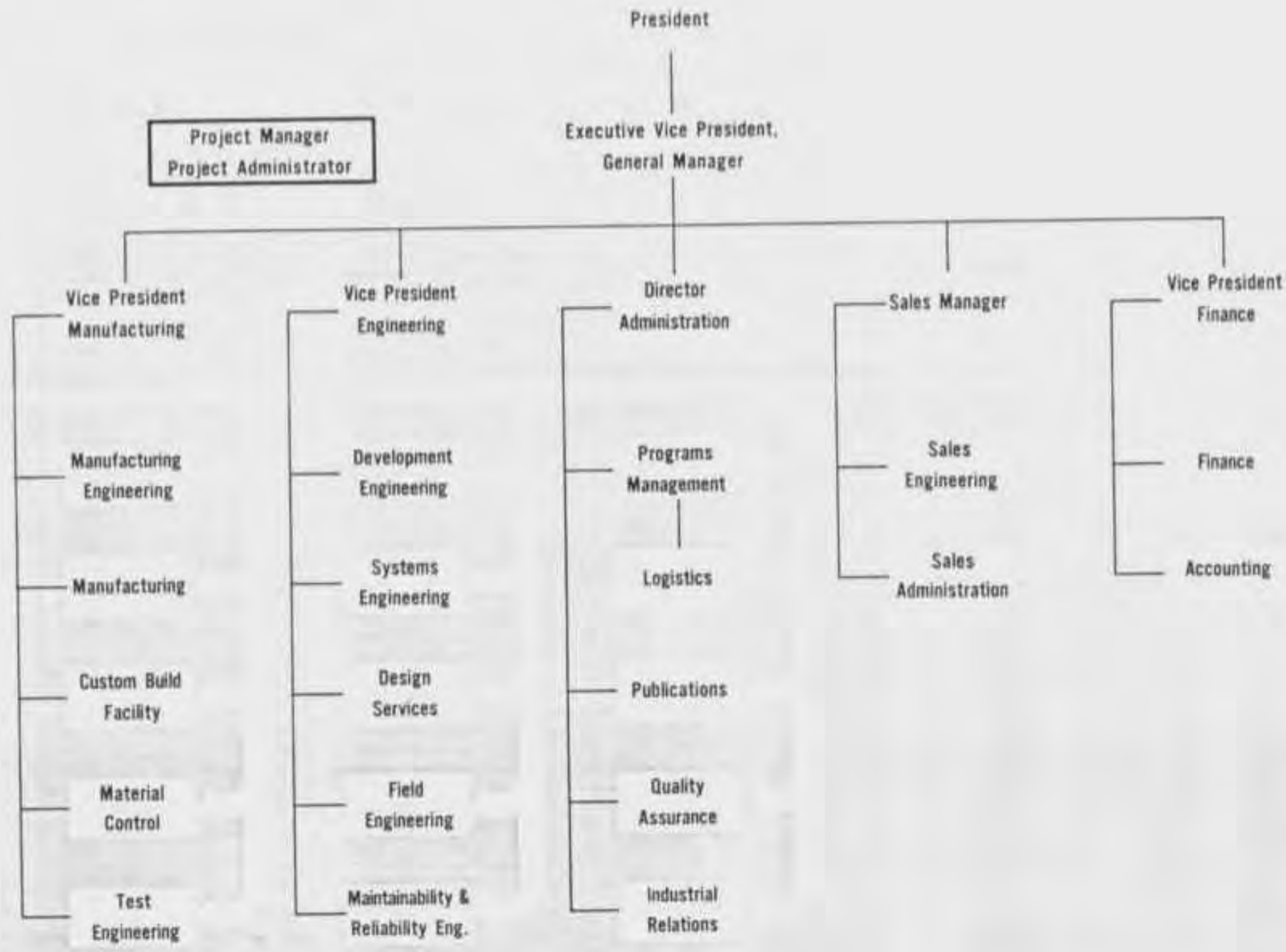
Project Management

The keys to the successful completion of a project are the management techniques established to plan, administer, monitor, and analyze all the activities related to the project.

At DEI a Project Manager is assigned to each program. The Project Manager is responsible for:

- Management and preparation of all necessary activities required for proposal presentation.
- Establishment of project objectives and plans for achieving the objectives on a timely basis and within budgeted funds.
- Coordination of the many operations necessary to assure successful compliance with plans and objectives.
- Review and analysis of the technological efforts in light of Customer requirements and in accordance with established plans and schedules.
- Recommendations and advice regarding improvements or corrective actions to facilitate the project, eliminate deficiencies, and pin-point potential problems.

Just as the Project Manager is designated to serve as the focal point for all technical activity related to his specific project, a Project Administrator is designated to manage all aspects of contract administration and serve as the formal channel of communication between the Customer and DEI. The Project Manager and Project Administrator function as the Project Management Team.



Planning and Control Techniques

As a first step toward evaluation and control, project objectives are established and a plan formulated. Specific goals and budgets for each objective are allocated to each participating operation in keeping with the overall plan, schedule and budget.

The following schedules and charts are utilized to plan and control the job. These documents are perpetually maintained throughout the life of the project and serve as the principal basis for creation of management summary data and customer reports.

- Work Plan and Progress Schedule
- Manpower Utilization Schedule
- Expenditure Forecast and Performance Chart
- Capital Equipment Utilization Schedule
- Procurement Schedule

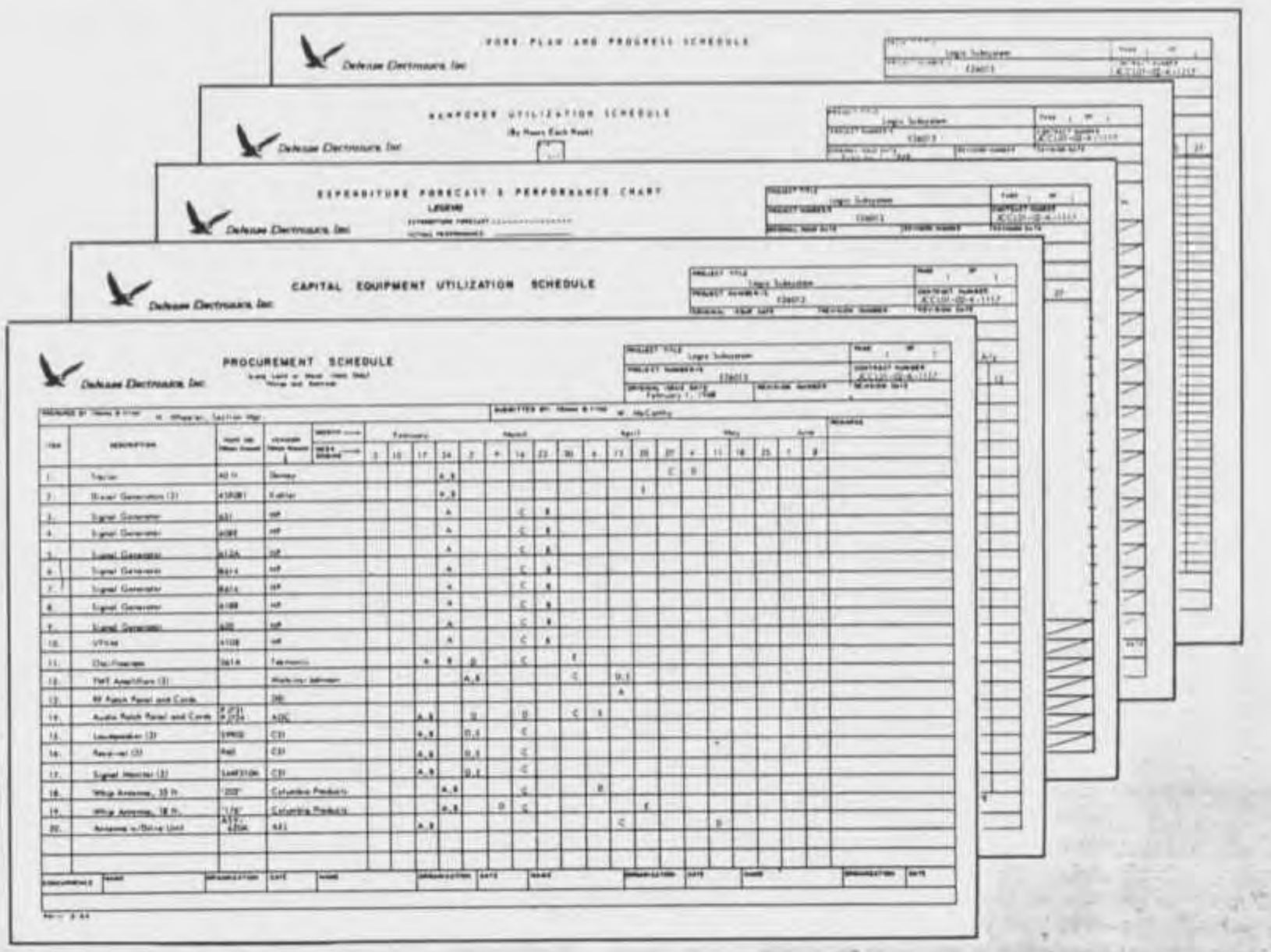
Many of the events are listed on the Work Plan and Progress Schedule and further planned and controlled through use of subordinate detailed PERT/Time Oriented Networks.

In addition to use of standard monitoring techniques and continuous liaison between Project Management and all participating operations, periodic checks of each program are maintained through:

- Regular progress review meetings
- Regular financial review meetings
- Shipping schedule reports
- PERT/Time Reporting System

Attendance at the status meetings include major subcontractors and subsequent meetings are scheduled in turn, as appropriate, at the facilities of major subcontractors. In this manner, the Project Manager is able to cite and evaluate the progress of team members through personal observation as well as through the PERT/Time Reporting System and the other controls in effect throughout the project.

The Project Management organization and concepts used by DEI assure a well-integrated team approach. The Project Manager representing DEI serves as a top-level focal point for the project from the proposal stage to the completion of the contract. Thus Project Management, through capable functional managers, assures high operating efficiency, reduction of cost, timely deliveries, and effective working relationships through excellent customer communications.



Engineering

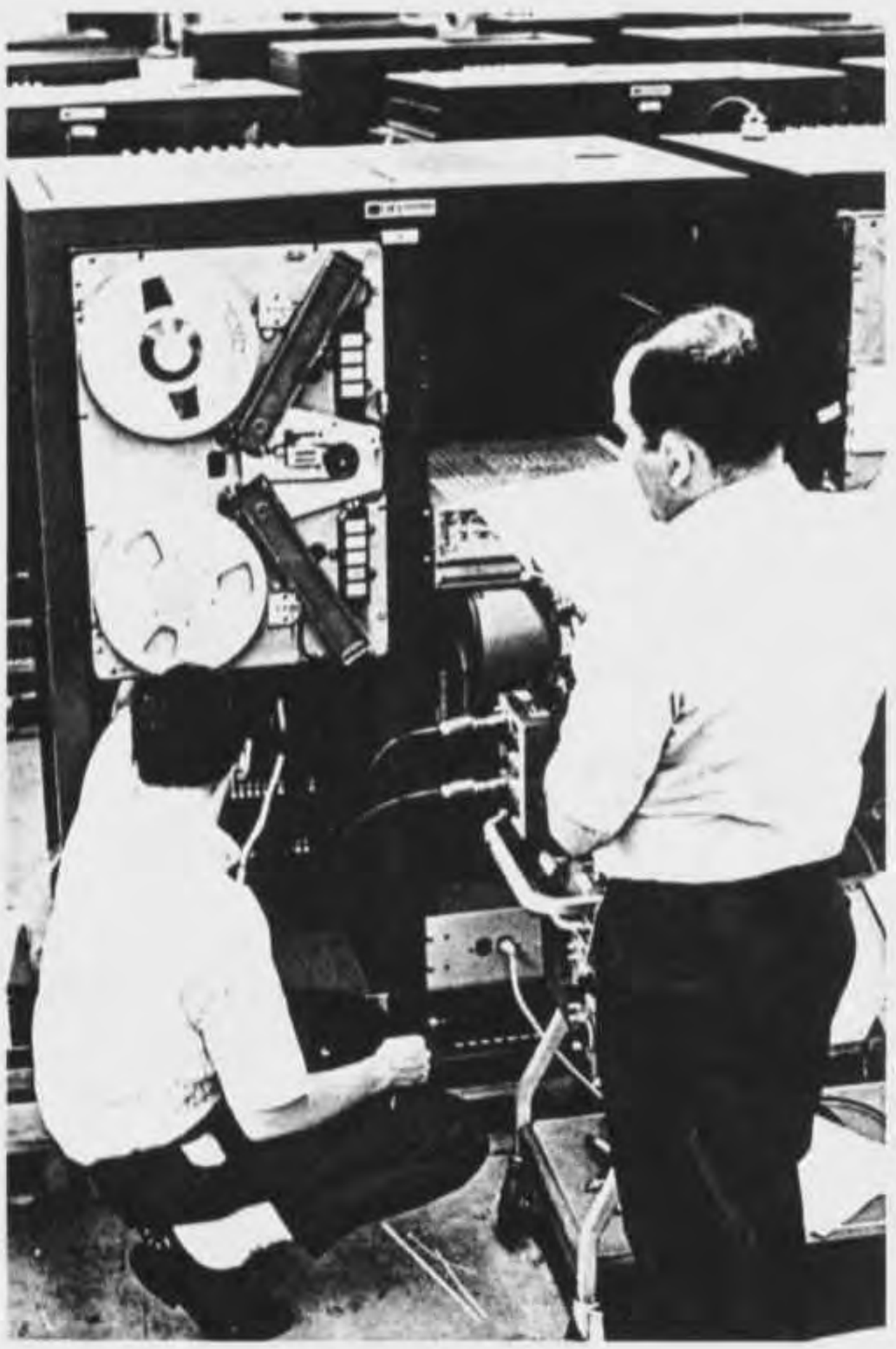
The Engineering Department of DEI is organized to provide complete engineering capability to engineering programs of all magnitudes, and in widely varying areas of specialization.

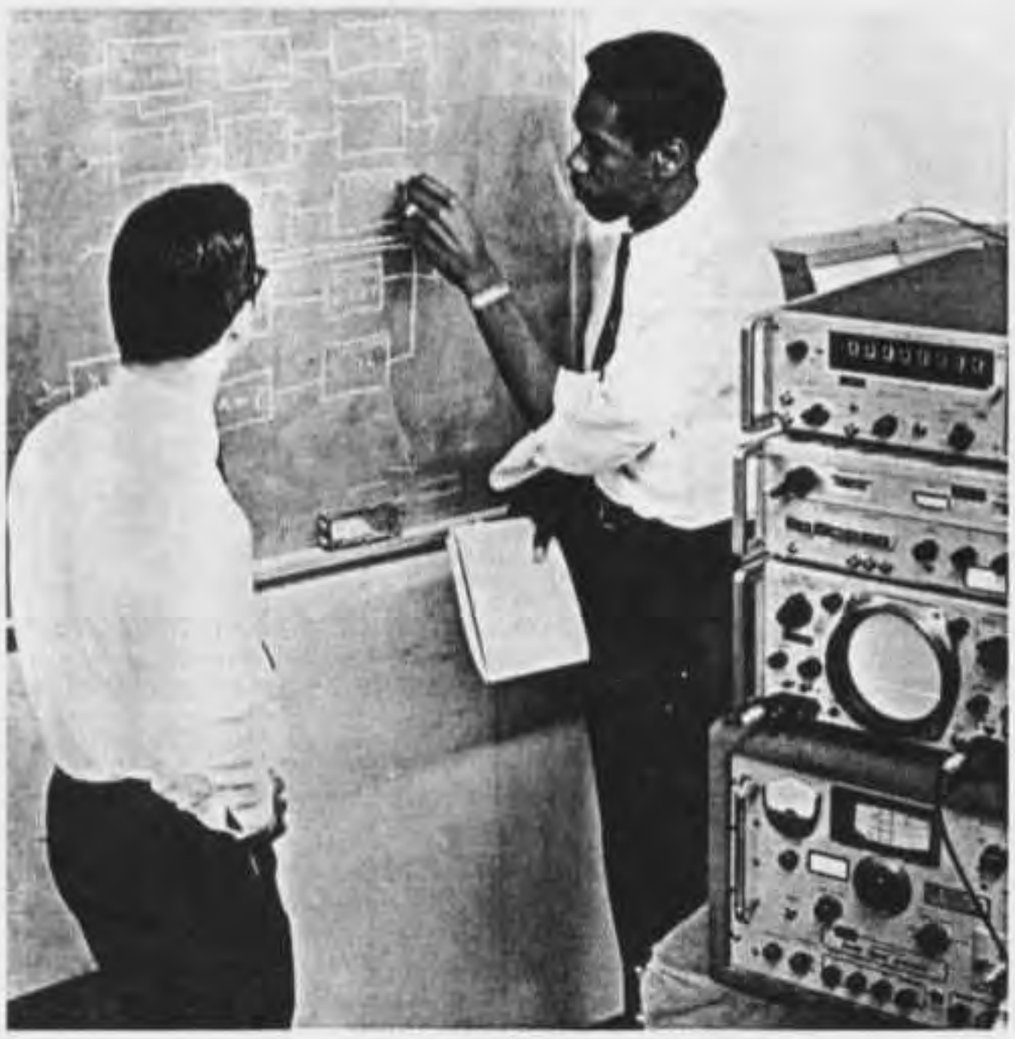
Under the direction of the Vice-President, Engineering, the department is organized into two major activities: Development Engineering and Systems Engineering. Existing within these two major activities are individual functional groups possessing highly specialized skills and providing unique resources that contribute to and ensure the success of diversified programs, both large and small.

Mechanical design, packaging, and engineering documentation in accordance with all applicable specifications are provided for all engineering projects by the professional personnel of the Design Services Section.

This concept of discrete contributing functions within a single department provides the necessary reservoir of technological disciplines for coordinated team efforts toward the optimum accomplishment of all engineering tasks.

The following pages describe briefly the various areas of engineering capability, and present concise descriptions of a few products which are representative of accomplishments within these areas.





Development Engineering

The Development Engineering staff of the Engineering Department comprises several "Product Engineering" Sections, each possessing unique knowledge, skills, and abilities based on extensive experience in its area of specialization. It is significant, however, that each section also boasts the versatility which is necessary to ensure the orderly accomplishment of complex engineering projects which involve areas of overlapping design responsibility.

The Product Engineering Sections maintain a staff of engineers highly skilled in the research, design, and development of RF, ancillary RF, seismic, FM, and data handling equipment ranging up to 10 GHz. Although the primary function of the Product Engineering Sections is the generation of new products for manufacturing on a proprietary basis, this capability is also available on a quick-reaction basis for custom design of customer-specified equipment.

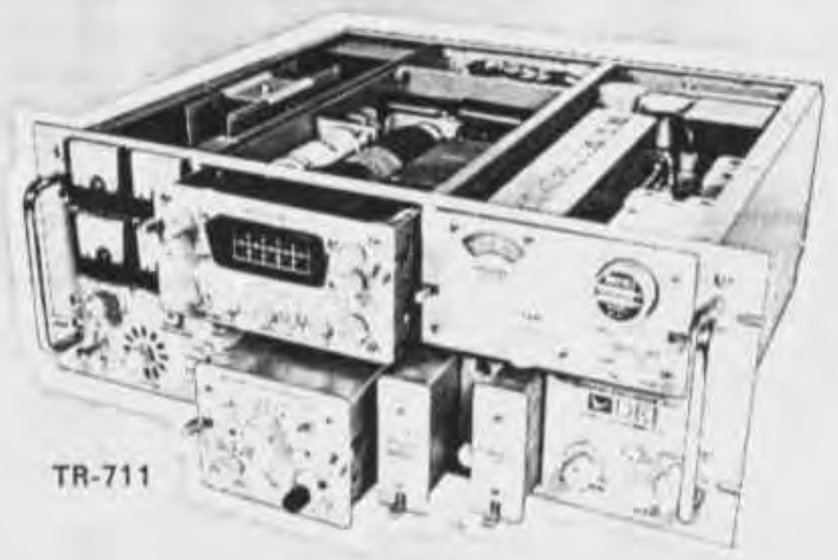
DEI development engineering capabilities are directed toward creation of reproducible engineering designs. Success in this aspect is evidenced by the variety of DEI catalog products currently being produced in quantity with no further engineering support. This is possible because of a policy which minimizes the use of selected or non-standard components and non-operational controls and adjustments. These objectives are accomplished without compromising reliable state-of-the-art performance.

Receivers

The high quality, diversified, line of telemetry receiving equipment designed and developed by the Development Engineering Department has earned for DEI a reputation for superior engineering features, superior performance, and reliability among aerospace customers throughout the world. A selection of DEI's standard proprietary receivers, typifying these features, is presented for your review.

The Model TR-711 Solid State Telemetry Receiver

is truly designed with the user in mind. Modular construction is employed throughout to achieve the utmost in versatility and to minimize receiver obsolescence. A complete complement of front panel plug-in modules is available, including RF tuning units from 55 MHz to 2300 MHz and IF filters with bandwidths from 10 kHz to 6 MHz. Other optional plug-in modules include: AM/FM, Phase-Lock, Phase, and High Capture Ratio Demodulators, Spectrum Analyzers, Oscilloscopes, and individual predetection Up/Down Converters. Any combination of these plug-in modules can be utilized, thus providing almost unlimited receiving combinations adaptable to any known or projected telemetry system or modulation format. Superior mechanical and electrical design, low power consumption, 110/220V ac, 50 to 400 Hz operation, and world-wide field proven high reliability make the TR-711 ideally suited for aircraft, mobile van, and shipboard installations.



TR-711

The Model R-1037G Multirange Telemetry Receiver

incorporates the improvements and refinements which have evolved during the production and delivery of more than seven-hundred R-1037G series receivers.

The R-1037G is a solid state universal receiver designed for the reception of all known or projected telemetry formats. The RF tuning range, the receiver bandwidth, and the demodulation capability are all determined by plug-in modules providing the receiver with a high degree of flexibility. Twelve RF tuners covering frequency ranges from 55 to 2300 MHz are currently available. Available IF bandwidths include all IRIG standards from 12.5 kHz to 3.3 MHz. Non-standard bandwidths can also be supplied. Plug-in demodulators include Foster-Seeley and phase locked loop FM detectors, longloop PM, and special types made to order. An AM demodulator is integral with all receivers.

Options include a front-panel plug-in spectrum display unit, internal plug-in pre-D record/playback modules, and adjacent channel rejection filters.

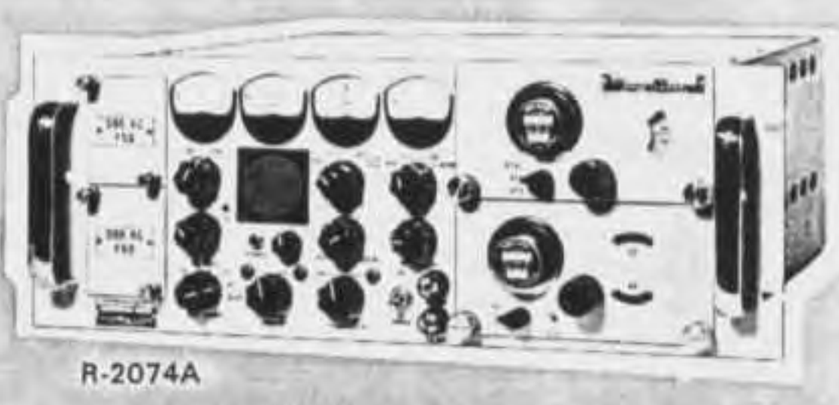
Mechanical features of this receiver include the use of rugged, reliable, taut band meters. Other features, which enhance maintainability, are the use of transistor sockets on all printed circuit boards, complete modularity, and a snap-on top cover.

R-1037G

R-1074A

The Model R-1074A-11A Telemetry/Tracking Receiver

is one of the most advanced receivers available from DEI. This receiver is designed for telemetry data reception and conical scan tracking applications within the 55-2300 MHz frequency bands. Options which can be incorporated include predetection up converters and down converters, sophisticated demodulators, AFC, and carrier operated relays. The receiver is unmatched in its flexibility and growth potential.



R-2074A

The Model ICR-10 Integrated Circuit Phase Lock Telemetry Receiver

is an *all-integrated-circuit* AM, FM, and PM receiver that features sophisticated performance and minimal size at a cost which is comparable with conventional solid-state receivers. Linear monolithic silicon integrated circuits are used for all active devices except the power supply.
The model ICR-10 is the first of a series of ultra-compact I-C receivers to be developed by DEI for ground-based, special airborne, mobile, and portable applications.

ICR-10

The Model GPR-20 General Purpose Receiver

is the first all solid-state fully portable, compact, lightweight 55-260 MHz AM/FM/Pulse/CW receiver for surveillance, laboratory, quick-look telemetry, RFI, spectrum analysis, and communications application. The GPR-20 features a low noise figure, minimal power consumption (250 hour conventional battery life), high reliability, and remarkable versatility. The receiver incorporates a unique combination of electrical and mechanical features for critical field monitoring or laboratory applications.
AM, FM, CW, and pulse reception is standard, as are dual IF bandwidths and a stretched-pulse audio monitor.

GPR-20

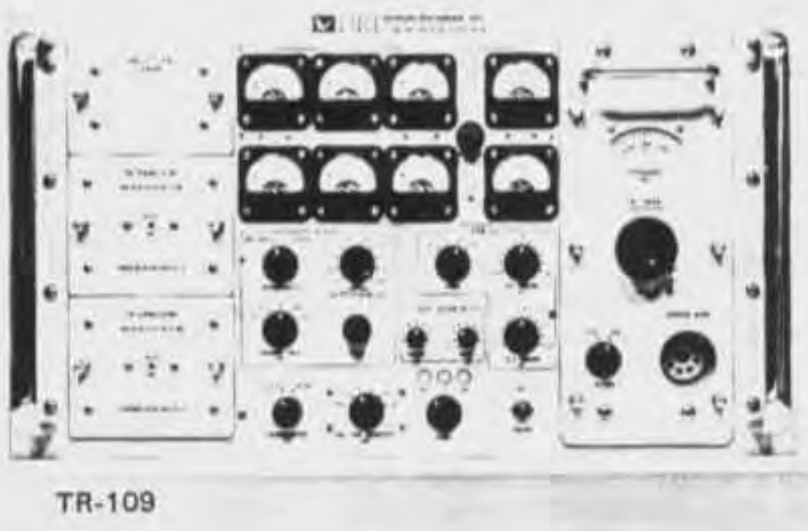
The Model CR-101 and Model CR-102 Computer Controlled Receivers

offer the primary advantage to the user of elimination of the delays and errors of the man-machine interface in telemetry data reception.
The CR-101 and CR-102 pioneer an entirely new field in telemetry receiving equipment — a marriage of the instrumentation receiver to the general-purpose digital computer. The computer can select any one of 768 operating modes for a receiver system without operator intervention, and can change operating modes within a few milliseconds. The CR-101 operates at VHF (216-260 MHz) frequencies and the CR-102 operates at UHF (2200-2300 MHz) frequencies.

CR-101

The Model TR-109 Dual-Channel Telemetry Receiver

is intended for the reception of telemetry and voice signals. The dual channels are optimally combined and down-converted, using AGC or out-of-band noise as weighing criteria, making available a pre-D combined output for recording. The receiver is capable of receiving signals of all formats over the 225-2300 MHz range.
The TR-109 features both manual and automatic search-and-lock. Flexibility and economy are assured by the completely modular design.



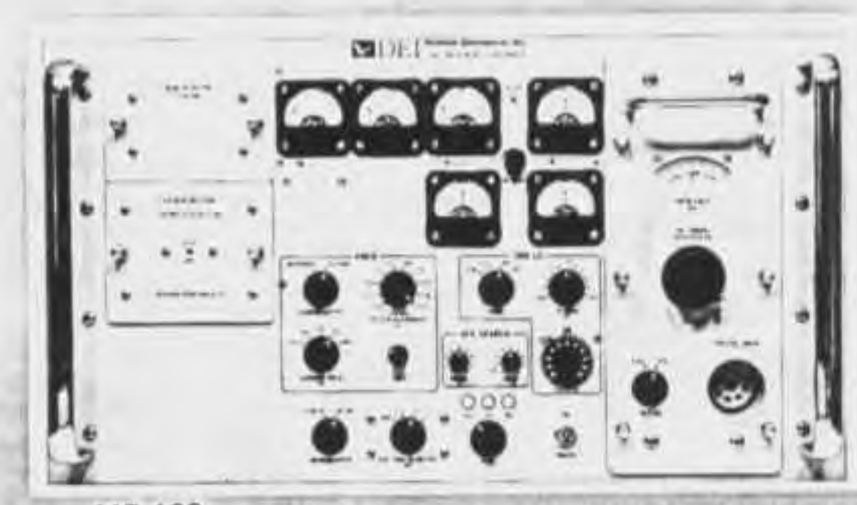
TR-109

The Model MR-109 Dual-Channel Monopulse Tracking Receiver

employs many of the design features of the TR-109. The receiver is capable of processing a sum channel and a single complex elevation and azimuth error channel, providing the antenna servo system with pointing data.

The R-2074A Dual-Channel Telemetry Receiver

is a completely modular dual-channel receiver that was devised specifically for applications requiring phase coherent translation and dual-channel signal processing, i.e., tracking and predetection combining applications. This receiver utilizes a dual-channel RF tuner which assures a minimal differential channel-to-channel phase shift caused by translation instabilities.
The receiver covers the frequency range of 55 to 2300 MHz. Demodulators include FM and phase-lock FM. All standard IRIG bandwidths are available.



MR-109

Ancillary Equipment

Signal Sources and Generators

The Development Engineering staff has successfully designed and developed a wide variey of extremely accurate and stable signal sources and generators, which are in use at major ground telemetry installations. These crystal-controlled signal sources provide a high degree of long-term frequency and power stability and short-term or phase stability. All are completely solid-state, providing highly-reliable operation in continuous unattended service.

The **ACT Series S-Band Transmitters** are designed for use as frequency standards in the calibration of S-band telemetry systems. The ACT series signal sources include FM, PM, and FM/PM capabilities, depending upon the particular model. The ACT-4A(1), pictured at right, provides a highly stable signal source for calibrating phase lock telemetry equipment operating at 2119 MHz. The output frequency may be varied ±200 kHz, and the level from 0 dBm to —140 dBm. Metering is provided for RF output level, and for modulation (phase deviation) in radians.

ACT-4A(1)

The **CSG Series Calibration Signal Generators** are highly stable and accurate sources of RF signals designed to be used in field operations as a secondary standard to calibrate and test both telemetry and tracking receivers. The units provide output frequencies in 1 kHz steps across the 136 MHz and 400 MHz telemetry bands and 10 kHz steps in the 1700 MHz band. These generators can be AM, PM, or simultaneously AM/PM modulated over a wide video bandwidth.

CSG-1

Diversity Combiners

Diversity combiners are designed to add the video or IF signals from two telemetry receivers, producing one output with a signal-to-noise ratio equal to, or better than, the signal-to-noise ratio of the better of the two inputs. The **DCA-5100A** is a dual channel optimal-ratio diversity combiner specifically designed for Pre-D telemetry systems. It provides the following five capabilities: predetection combining; post detection combining; predetection down conversion of the two associated receiving channels; up-conversion of a Pre-D recorded signal; demodulation of the up-converted signal. The choice of either the predetection or post detection combining mode is determined by a front panel switch selection.

DCA-5100A

Converter Demodulator

The **COD-1000/2000 Series** Single or Dual Channel Converter/Demodulator performs four functions which are essential to Pre-D recording systems. These functions are: down conversion to a record center frequency; monitoring of recording process; up-conversion for tape playback; demodulation of the up-converted frequency. The integral demodulation capability eliminates the need to tie up a complete receiver for monitoring and/or playback operation. This equipment is available in dual-channel (COD-2000 Series) or a single-channel (COD-1000 Series) configuration. Modular construction is used throughout allowing a choice of features.

COD-2000

Preamplifiers

The line of economical, compact, rugged preamplifiers is typified by the **TPA-70** (shown here) and the **SSP-101/SSP-136.** The TPA-70 is a low-noise preamplifier for use in S-band applications; the unit weighs only nine ounces and has a bandwidth of 2200-2300 MHz. The SSP series is available in a number of versions, for a wide range of center frequencies and bandwidths in the 55-300 MHz band.

TPA-70

Multicouplers

Multicouplers are available from DEI to meet any receiving system requirements. Typical of DEI multicouplers are those of the **TM Series.** This series of multicouplers provides coverage of all frequencies in the 130-1000 MHz range in only four bands, eliminating the need for a complex of limited-range multicouplers. These advanced general-purpose multicouplers allow the simultaneous operation of up to eight receivers from one antenna or preamplifier.

TM SERIES

Record/Playback Units

A broad line of advanced Pre-D record/playback equipment is produced by DEI. Pre-D record/playback up/down converters are available for all receiver IF center frequencies. In contrast to real time recording, predetection recording permits more than one opportunity to recover the data, and different parts of the record can be processed in different ways if desired. Predetection recording permits the storage of received information prior to demodulation with the advantages of extreme versatility and absence of threshold effects introduced by the demodulator.

The modular design of the **Model PD-104** exemplifies the design techniques used in the development of these units; front-panel plug-in down converters and up converters permit dual-channel operation in both record and playback modes. Tape speeds of 120, 60, 30, and 15 in/sec are handled by a single record or playback module. The up-converter (playback) uses the unique patented DEI system of up translation, permitting maximum data-bandwidth utilization without the usual attendant problems of phase distortion.

PD-104

Video Distribution

The **Model VD-101 Video Distribution Amplifier** is designed to provide multi-channel data distribution of telemetry receiver outputs. The all solid state amplifier comprises a basic chassis utilizing four plug-in modules of two types in any combination.

The V-101-1 Amplifier Module accepts input ranges from 0 to 10 volts peak-to-peak with a 75 ohm input impedance. Frequency response is from dc to 2.0 MHz ±0.5 dB. The V-101-1 amplifier output can be adjusted to provide up to 9 dB of gain with a maximum output rated at 10 volts peak-to-peak. Total distortion and spurious responses are less than 0.5% maximum and 0.25% typical. Four 75 ohm unbalanced outputs with individual gain controls are provided on the front panel of the module.

VD-101

The V-101-2 Amplifier Module provides two 75 ohm unbalanced outputs and two 150 ohm balanced outputs. The input dynamic range at 75 ohms input impedance is 5 volts peak-to-peak. Frequency response of the V-101-2 Module is dc to 2.0 MHz ±0.5 dB with an overall gain of 0 dB nominal. In addition to the front panel outputs, two connectors providing the 150 ohm balanced outputs are available at the rear of the main chassis immediately behind each plug-in module.

Display Units

Display units are available from DEI for a diversity of applications and input center frequencies. Included are dual and single trace units for portable, rack, or bench-mounted use. Two different examples of the choices available are the **Model PSD-2 Portable Signal Display Unit** and the **Model SD-102 Spectral Display Unit** both described below.

PSD-2

The PSD-2 is an extremely compact (11" x 2½" x 11") and lightweight display unit with rechargeable power pack, is compatible with surveillance and telemetry receivers having 10.7 MHz IF, 21.4 MHz IF or special center frequencies. Either linear or logarithmic response may be selected, marker frequencies of 100 kHz or 500 kHz are standard. The PSD-2 operates continuously for up to 18 hours without recharging. A specially fitted carrying case is available.

SD-102

The Model SD-102 Spectral Display Unit is a versatile display unit that simultaneously provides visual displays of two input signals. Either input can be independently switched to frequencies of 10 MHz or 50 MHz, with sweep width adjustable from 0-10 MHz. Sweep calibration markers of 500 kHz or 100 kHz are provided. Resolution is specified as 10 kHz, a two-to-one improvement over previously available display units of a similar type.

Broadcast Products

The Nems-Clarke broadcast product line features Phase Monitors and Field Intensity Meters used by practically all major radio and television networks and stations. These units are designed for rack mounting or for portable use, as appropriate.

Field Intensity Meters

FIM-120-E

The **Model 120-E** is a compact, light-weight, portable Field Intensity Meter for the measurement of radio signal intensities in the broadcast band of 540 to 1600 kHz. Its range of sensitivity from 10μV per meter to 10V per meter, makes it equally effective for interference studies at low signal strengths and for close-in measurements on high-power directional arrays. Provides both linear and logarithmic indications permitting its use with recording equipment for continuous observations. The unit operates from internal batteries for field applications. A battery check switch is provided. The FIM-120-E has been long recognized as the broadcast industry standard and is vastly superior to currently available solid state instruments.

Phase Monitors

PM-112

The **Model 112** is a new generation, solid-state phase monitor for directional AM antenna systems with up to nine towers. The Model 112 also indicates the relative amplitudes of the currents in the various antennas. The phase-angle meter has a continuous 0 to 180° scale. Readings are not affected by modulation and are presented instantly as each tower is selected, with no adjustment required. Loop current is read as a percentage of the reference tower current. Automatic day-night switching of reference levels can be incorporated. The Model 112 Phase Monitor can be adapted for remote control.

Subcarrier Discriminators

The SCD series of subcarrier discriminators is intended for use in telemetry applications where a particular subcarrier is to be separated from an FM multiplex signal, and is to be subsequently demodulated by phase-lock or pulse-averaging techniques.

Typical of these high-quality, low-cost demodulators are the SCD-4 and SCD-5 subcarrier discriminators. Internal tape-speed compensation circuits and delay networks are standard, as is choice of positive or negative deviation sense.

The **SCD-4** employs a unique pulse-averaging detector and all-silicon transistor circuitry. The 3½ inch panel height and two-module width allows 14 discriminators to be housed in a single DHA-4 series module housing assembly. Over 200 discriminators can be accommodated in one six-foot rack.

The **SCD-5** is a true phase-lock loop discriminator which enables a significant S/N ratio improvement to be obtained when operating with deviation ratios of 5 or greater. Channel selectors and low-pass filters can be changed without removing the discriminator from the housing. Up to five SCD-5 discriminators may be installed in one DHA-4 series housing assembly. The single meter indicates both input signal (subcarrier) strength and deviation from center frequency.

The **DSD-4 Digital Subcarrier Discriminator** — a significant addition to the Subcarrier Discriminator line, is a high-quality telemetry demodulator of advanced design intended for ground or airborne applications requiring digital output for computer interface or recording.

The demodulator accepts as its input an IRIG subcarrier and provides an 8-bit binary output. An analog output is also provided. Positive or negative deviation sense is standard. Both lowpass filters and channel selectors are interchangeable from the front panel. Up to five discriminators may be housed in one DHA-4 series housing assembly.

Ancillary FM Equipment

A wide range of ancillary equipment complements the SCD and DSD series discriminators:

Voltage Controlled Oscillators

The **SVO-1 Subcarrier High Level Voltage Oscillator** is a high-quality, high-level FM oscillator designed for use in telemetry/recording applications. The unit is provided with switchable offset and adjustable input sensitivity.

Subcarrier Reference Oscillators

The **SRO-1 Subcarrier Reference Oscillator** offers a selectable precision, high-stability low-distortion reference frequency source in a single module. Four selectable frequencies are supplied as standard: 200 kHz, 100 kHz, 50 kHz, and 25 kHz.

The **Model SRO-2 Subcarrier Reference Oscillator** offers a precision low-distortion reference frequency source in a single module. The unit supplies a single reference frequency up to 500 kHz, as specified by the customer.

Mixing Amplifiers

The **SMA-1 Subcarrier Mixer Amplifier,** a high-gain broadband amplifier, linearly mixes two or more signals for tape recording or other applications. The unit will accept and mix a video signal with up to four auxiliary signals and a reference frequency signal. The SMA-1 has video-level and reference-level controls.

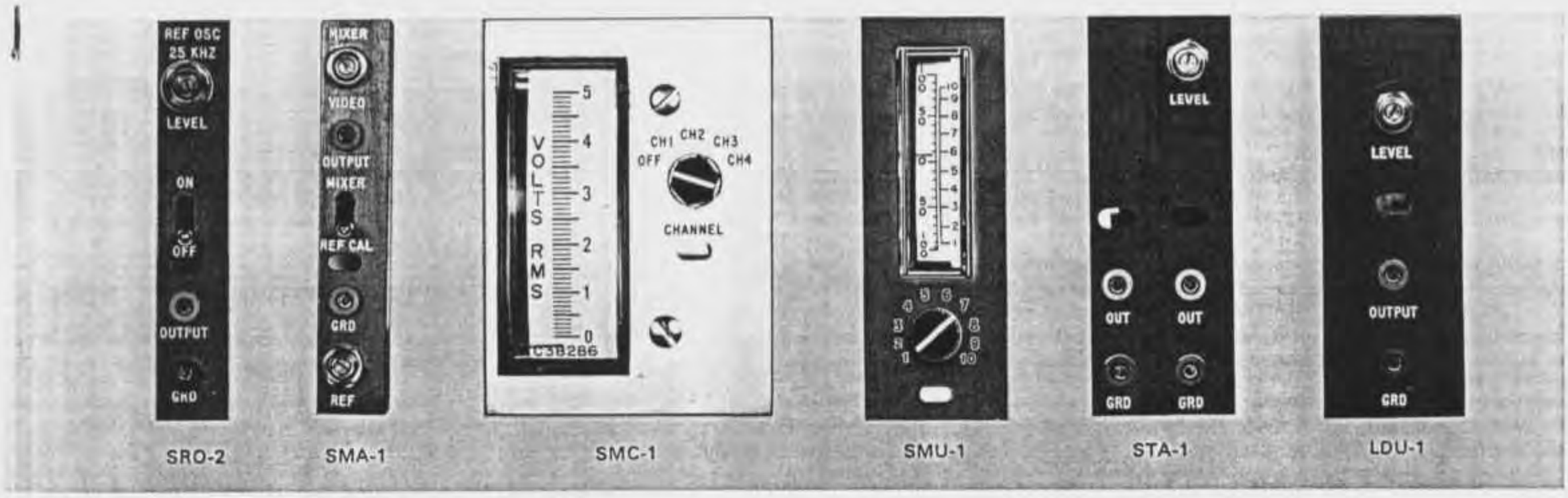
Auxiliary FM Devices

The **SMC-1 Subcarrier Metering Card** provides a means of monitoring video signal amplitude. A four-position switch on the front panel permits monitoring up to four independent signal sources. The meter is an average reading meter calibrated in rms for sine wave signals over the range of 0 to 5 volts.

The **SMU-1 Subcarrier Metering Unit** is used to measure the output of a discriminator for quick-look or calibration. Switch selection on the front panel permits monitoring signals from up to ten independent discriminators.

The **STA-1 Subcarrier Translator Assembly** functions as an up or down subcarrier multiplex translator. Any combination of frequencies within the range of 100 Hz to 300 kHz can be multiplexed and translated. The STA-1 Subcarrier Translator Assembly consists of a translator and a filter. The translator module can be used for either up or down translation.

The **LDU-1 Line Driver Unit** accepts a signal within the range of 100 Hz to 100 kHz and provides sufficient amplification to permit driving any standard signal line. The LDU-1 provides a direct coupled output and AC outputs of 600-ohm balanced, 135-ohm balanced, and 75-ohm unbalanced. A front panel gain control is provided for the adjustment of the output signal level.



SRO-2 SMA-1 SMC-1 SMU-1 STA-1 LDU-1

Data Products

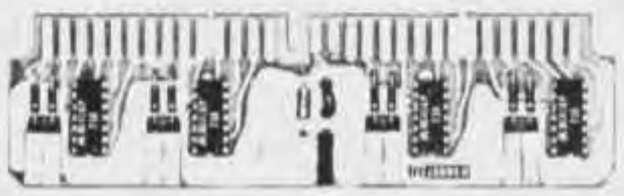
A complete and proven capability for the design and development of analog and digital data-handling products and subsystems is present within the Engineering Department of DEI. The data products engineering groups specialize in the development of all-solid-state analog and digital equipment of the highest quality, for all applications, providing not only an "off-the-shelf" source of data-handling equipment for those who assemble their own processors, but also providing DEI with a "total" data handling system capability.

DEI has standard modular data products in the following areas:

DISCRIMINATORS, OSCILLATORS, and MIXERS
I-C DIGITAL LOGIC MODULES
DIGITAL SIMULATORS, DIVIDERS and PROCESSORS
DIGITAL-ANALOG and ANALOG-DIGITAL CONVERTERS
DATA-ACQUISITION SYSTEM COMPONENTS

The Data Products engineering staff is well versed in many applications of digital and analog processing systems, as well as in the design of specific modules. Their directly-related design experience has enabled DEI to provide competent design and development of custom data-processing products and subsystems in areas which include:

PCM DECOMMUTATORS and PROCESSORS
COMPUTER INTERFACE EQUIPMENT
SPECIAL PURPOSE DATA PROCESSORS
DATA COMMUNICATION SYSTEMS
DATA STORAGE AND CONTROL



Integrated Circuit Digital Logic Modules

DEI's extensive library of high quality, high reliability INTEGRATED CIRCUIT modules are used as the basic building blocks for all of its data processing equipment and system requirements. These modules consist of four in-line packages and are assembled on two-sided 1-3/4 x 5-1/5 inch printed circuit cards with edge-mounted connectors. Ample test points are provided in the outputs of all logic circuits, and in many of their associated inputs. The extended performance of these modules is characterized by low power consumption, large noise thresholds, high speed operation, single power-supply operation, and excellent reliability.

The standard library is based on positive NAND logic of the diode-transistor logic type. Basic card functions include:

NAND Gate
NOR Gate
J-K Master Slave FF
NAND Buffer
AND-OR Invert Gate
D-Type Flip-Flop
Expander
J-K Flip-Flop
Special Purpose

Special Purpose cards are developed for specific situations, such as interface cards and those with unusual application requiring special attention.

The extensive modular product line includes:

Discriminators	Mixer Amplifiers
Digital	Analog-to-Digital Converters
Analog	Translators
Phase-Lock	Metering Units
Pulse-Averaging	Line Drivers
Voltage Controlled Oscillators	Compensation Delay Units
Reference Oscillators	Module Housing Assemblies

DEI is continually expanding its FM product line to meet the increasing needs of the industry and to ensure continued advancement in telemetry-system capability for the years to come.

FM Products

Frequency modulation is one of the most commonly used methods for wide-band communication of data. For high-quality transmission of data, each component subsystem must be designed to meet exacting standards. Defense Electronics, Inc., is continually improving products in this area by application of new components and original design techniques. Extensive experience in the development of FM components ensures the system designer of optimum performance and reliability of the individual products.

Representative of DEI's complete line of FM instrumentation and measurement products is the FM "Family" of plug-in modules.

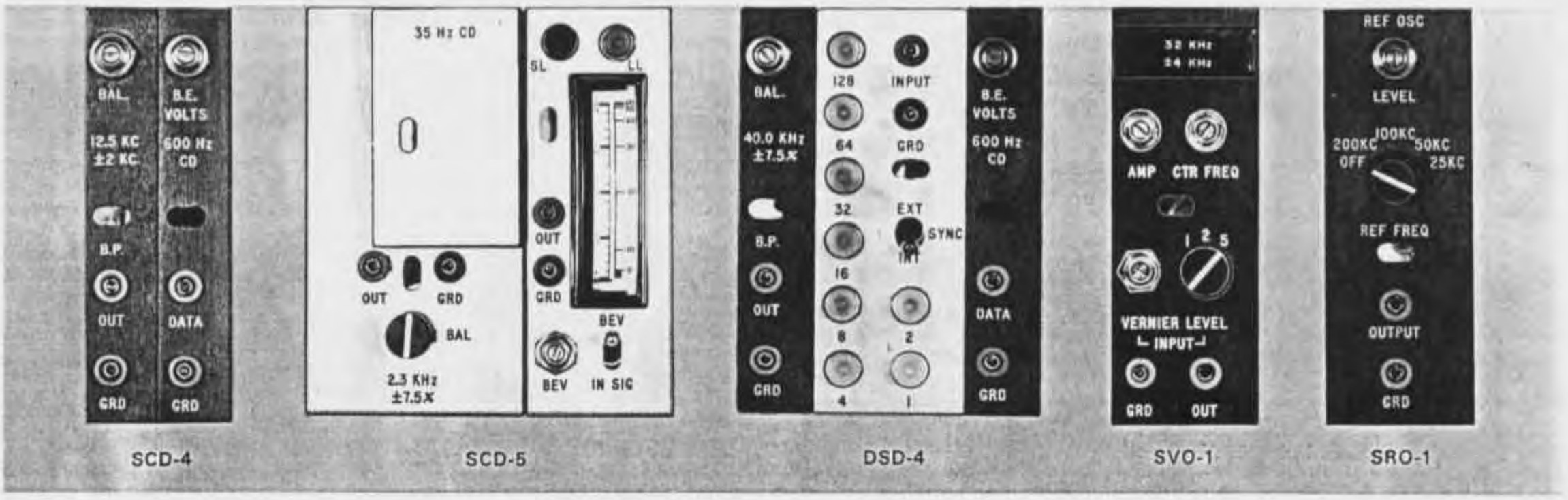
These products are supplied as subassemblies of a Module Housing Assembly for individual equipment use or, in concert, as complete telemetry systems for aerospace, biomedical, military, commercial, or industrial instrumentation.

Module Housing

The **DHA-4 Module Housing Assembly** provides housing facilities, input/output connections, and power supply voltages for the DEI "Family" of low-cost high-quality FM modular equipment. The DHA-4 requires only 3½ inches of panel space in a standard 19-inch equipment rack, and may also be used for bench testing the modules.

Up to 28 modules may be housed in the DHA-4 module housing assembly; for example, 14 SCD-4 Subcarrier Discriminators, each comprising two modules, can be accommodated. A complete operational FM data handling system can be contained in a single DHA-4 housing.

Incorporated in the DHA-4 are plus and minus 28V dc unregulated power supplies, and
plus and minus 18V dc regulated power supplies.



Digital Data Products

The stringent performance requirements of today's complex systems demand that system components be designed to exacting standards.

DEI's data products specialists combine high-level mathematical design techniques with many years of practical experience to achieve the goal of state-of-the-art products.

These quality products are the result of a combined effort by a team of specialists whose talents include: information theory, circuit design, network analysis, logic design, physical sciences, packaging, data and servo systems design, reliability, and computer sciences.

Representative of DEI's modular digital products are the equipments described below and on the following page.

PCM Signal Simulators

These units are general purpose PCM Signal Simulators designed to generate PCM formats in use and those anticipated in the near future. The outputs are available in NRZ(c), NRZ(m), NRZ(s), RZ and SP coding. Up to seven words can be generated with independently variable format and word lengths within the same data train. The effects of a pre-transmission filter, noise, and jitter can be simulated. The sync pattern or its complement may be selected. Subcommutation synchronization of both the recycling code and counting address (D) type is provided.

Data Insertion Converters

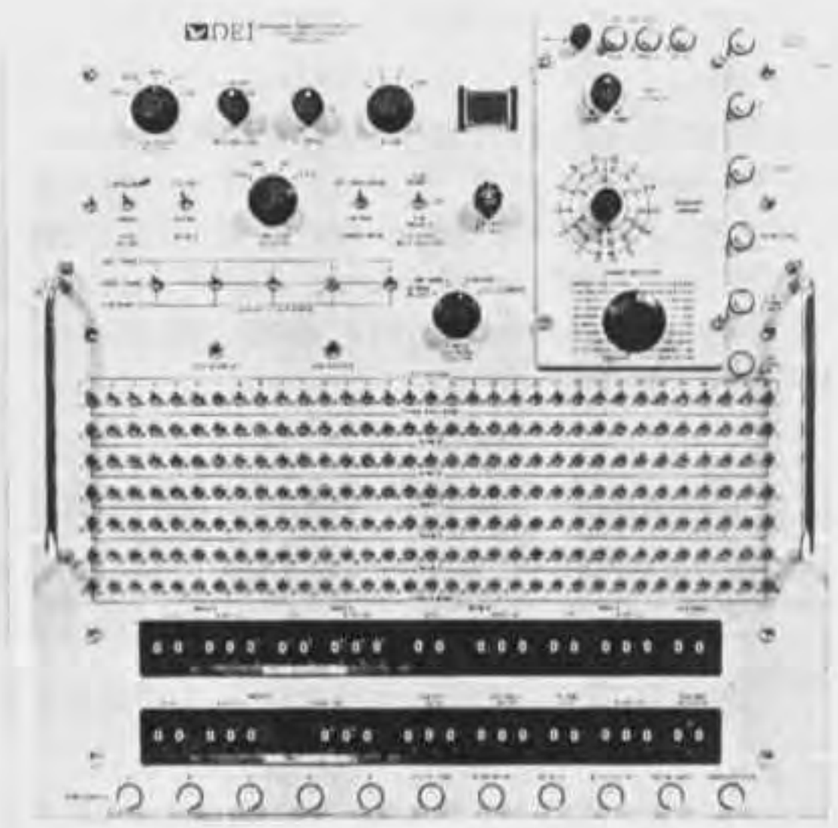
These units generate up to three composite FM/FM telemetry signals using standard IRIG subcarriers. Primary use is for ground station recording of auxiliary signals on magnetic tape. Stability (±0.5%) of bandwidth, linearity (±0.2% best straight line), and versatility allow their use as FM/FM simulators or ground-station calibration devices.

Bit Error Rate Monitors

The primary application is the measurement of the bit error rate of PCM processing stations in conjunction with a PCM signal simulator. These units accumulate, store, and display digital bit errors and compare serial data bits from dc to 2 MHz. These monitors provide a means for comparing two serial NRZ data bit streams on a bit-by-bit basis. The number of negative or positive comparison errors or matches are accumulated over a selectable interval from 10^3 to 10^7 bits or on a continuous basis. The number of errors or matches are displayed on a three or four decimal digit in-line display and in BCD form as a printer drive output. The series have provisions for processing code forms other than NRZ and therefore have wide application as general purpose comparators.

Digital Decade Dividers

These instruments are composed of DEI standard logic cards with a presettable seven decade frequency divider. The units accept either positive or negative pulse train inputs, or a sine wave input up to 3 MHz. An integral 2 MHz souce is provided to enable these units to function as pulse train generators. For example, the DD-107 provides simultaneous positive and negative output pulse trains, as well as a square wave having a frequency ratio of 1:2 when compared to the pulse trains.



DS-101 PCM Signal Simulator

DIC-1B Data Insertion Converter

BA-102
Bit Error Rate Monitor

DD-107
Digital Decade Divider

Typical Custom Data Products

DEI's Data Products group is well qualified to design data-processing equipment for unique and widely varying applications. Full use is made of the DEI library of standard logic cards in the development of this type of equipment, contributing both to economy and to reliability, and enhancing "quick-reaction" capability.

Data Communication Instrumentation

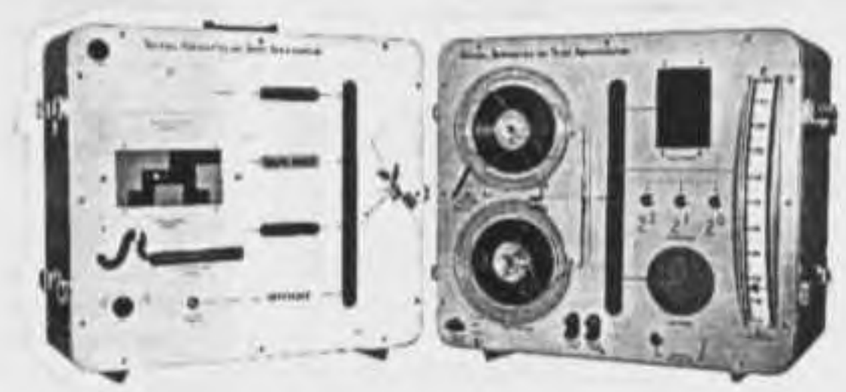
Accurate transmission of data over long lines is often a necessity in data acquisition systems. Where unique requirements preclude the use of general-purpose data modems, DEI has designed special purpose data modems, redundant coding and decoding systems, and line driver/receiver combinations. The **Model DCD-1 Dual Coder-Decoder Unit,** delivered to the Special Projects Office of the U. S. Navy for use in the POSIP/OT Instrumentation System, is shown.

DCD-1

Demonstrators

The broad scope of data products engineers includes the development of training aids and demonstrators which simulate the actual operation of complex telemetering and data-handling systems.

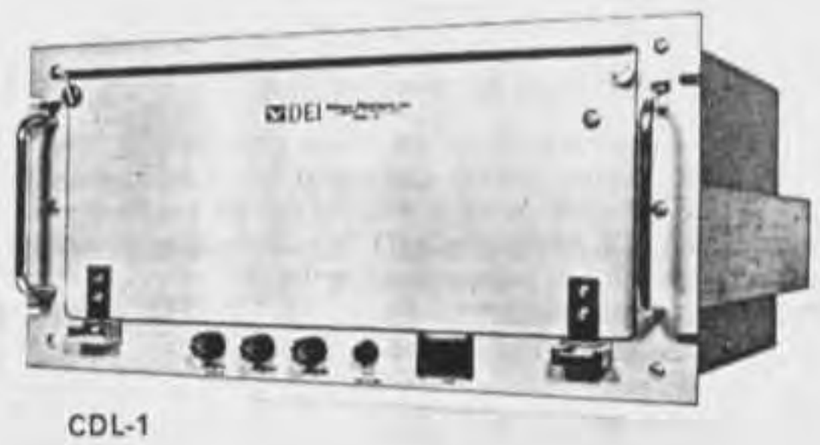
The **PFD-1(A) and PFD-1(B) Telemetry Encoder and Decoder Demonstration Units** are evidence of this capability. These two units function together as a four-channel encoder-decoder simulator, demonstrating the general principles of pulse-frequency modulation as employed in spacecraft telemetry systems. The four channels provide meteoroid, solar angle, temperature, and reference simulation.



PFD-1(A) AND PFD-1(B)

Special Purpose Data Processors

An example of DEI's competence in this area is the **Model CDL-1 Command Destruct Logic,** which forms an integral part of the POSIP/OT Instrumentation System. The CDL-1 is basically a logic decision unit for monitoring the various inputs which reflect the flight path of a Polaris missile, and, from these inputs decides which of three conditions exist: "In Limits", "Exceed Limits", and "No Data". The unit also incorporates a flight duration timer, a "no-data" display timer, and a "no-data limit" counter, and has provision for self-verification of its own logic performance.



CDL-1

PCM Decommutators

A diversity of design experience in PCM decommutator subsystems, stored-program decommutators, and computer-controlled telemetry processors, coupled with an existing family of proven high-reliability logic modules and other standard products, enables DEI to offer quick reaction to customer requirements for special or general purpose PCM Decommutators.

A typical special purpose system is the Computer-Controlled PCM Decommutation subsystem developed for the Quality and Reliability Laboratory at the NASA George C. Marshall Space Flight Center in Huntsville, Ala. This subsystem receives all operational commands via computer, and reconstructs serial PCM data for analysis by computer or visual displays.

CU-105
PCM Decommutator

Systems Engineering

Solving system integration problems quickly and efficiently is the responsibility of the Systems Engineering Sections of DEI's Engineering Department.

As evidenced by the sales of more than 80 ground stations including nine instrumentation vans, DEI's systems engineers are well qualified to solve the physical and electrical interface problems of integrating commercial and custom designed equipment into racks, vans, shelters, and consoles, and of adapting such equipment to ground, shipborne, or airborne use.

From day-to-day experience comes the constant awareness of the capabilities and performance of currently available and newly developed data handling equipment — knowledge vital to the successful development and integration of state-of-the-art systems.

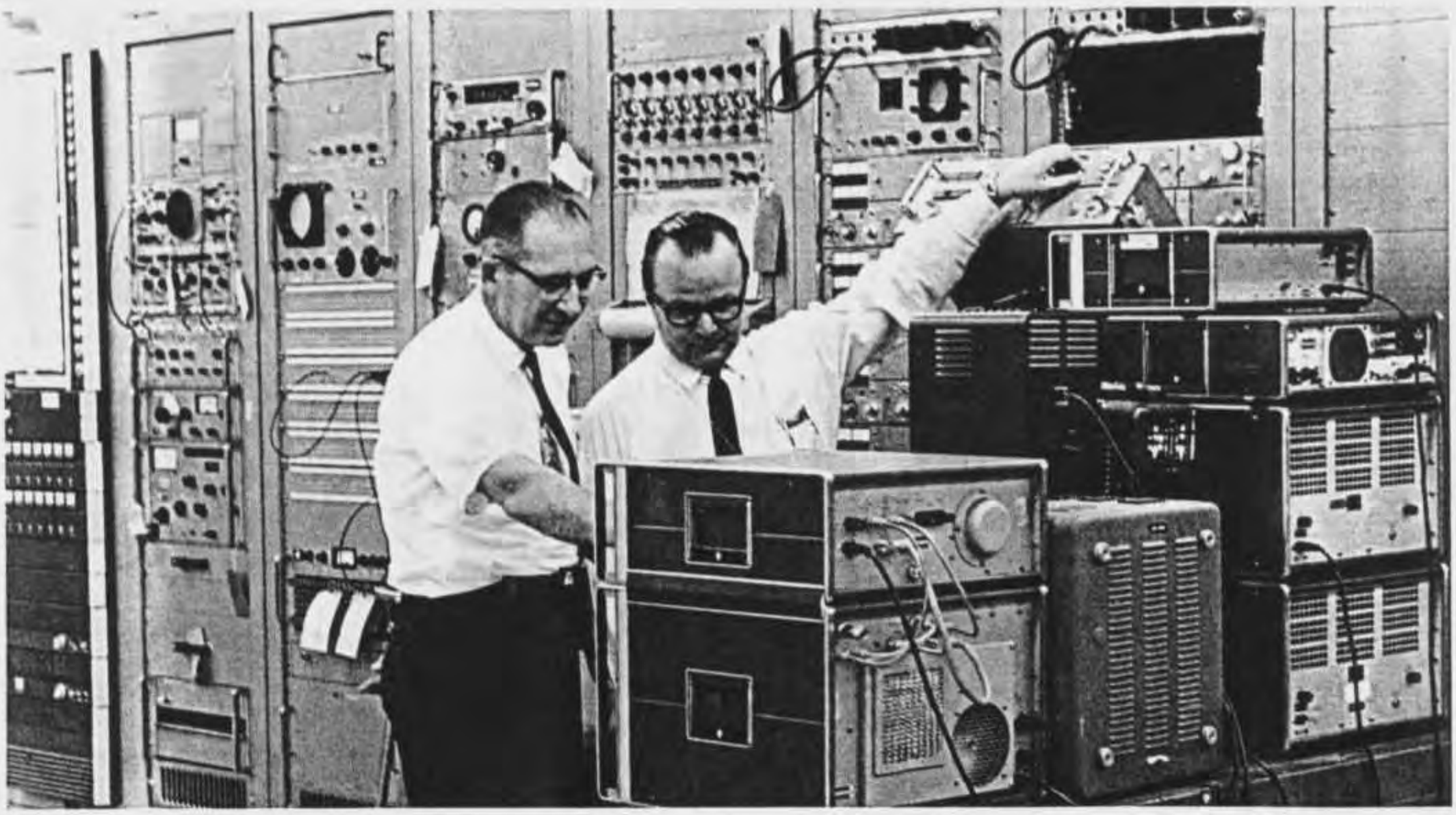
Facilities

At DEI, systems are recognized as a special type of equipment and the experience of DEI personnel in systems production has led to the preparation of a special area in the plant for systems design and production. The systems area has almost 10,000 square feet of floor space, separated from the rest of the building for project control.

The systems area includes a large open production area with a 17-foot ceiling so that major systems and vans can be accommodated simultaneously. An inclined ramp gives van and major equipment access, and a separate loading dock ensures an adequate shipping facility for completed stations. Facilities include both roof-top and open field antenna test areas.

Experience

DEI systems experience spans the field from general-purpose wide-range reconnaissance stations through telemetry receiving stations, numerous predetection recording stations, and FM/FM, PAM, PDM, and PCM demodulation equipment. The most complex systems have been complete mobile range stations for POLARIS support; the largest single contract has been for Atlantic Missile Range rehabilitation. It is particularly significant to note that the AMR stations were all delivered on or ahead of schedule, as complete and fully tested systems — a significant accomplishment for the series of nineteen 15-rack stations (one every ten days for 190 days) and sixteen other stations, consisting primarily of DEI proprietary products.



Systems Engineering at DEI in the areas of:

DATA ACQUISITION | DATA REDUCTION | DATA PROCESSING

DEI OFFERS EXTENSIVE SYSTEM EXPERIENCE GAINED IN THE PRODUCTION OF SUCH SYSTEMS AS

- Receiving/Predetection Recording Systems
- Data Receiving and RF Distribution Systems
- Antenna Tracking Systems
- PCM Decommutation Systems
- FM/FM Discriminator Systems
- PAM and PDM Decommutation Systems
- Data Acquisition Systems
- Computer Display Systems
- Computer Interface Systems
- Computer Controlled Systems
- Portable Missile Range Systems
- Monitoring Systems
- Industrial Data Collection Systems
- Intercept and Countermeasures Equipment and Systems
- Vehicle Simulator Systems

ACHIEVED BY INTEGRATING THESE AND SIMILAR UNITS OF EQUIPMENT

- Antennas
- Command/Control Units
- Computers
- Direction Finders
- Displays
- Diversity Combiners
  - Predetection
  - Post-detection
- FM/FM Discriminators
- Magnetic Tape Recorder/Reproducers
  - Predetection
  - Post-detection
- PAM and PDM Decommutators
- PCM Decommutators
- Receivers
- Recorders
  - Stylus
  - Oscillographic
  - Magnetic Tape
- Servo Controls
- Simulators
  - RF
  - Data
- Single Sideband Demodulators
- Test Equipment
- Time Code Generators/Translators
- Transmitters
- Voice Communications

USING SUCH DEI SYSTEM ENGINEERING SERVICES AS

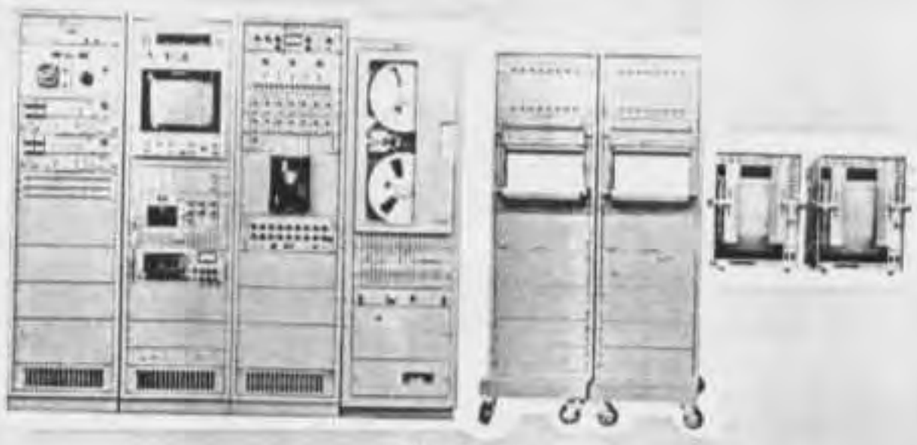
- Acceptance Testing
- Documentation
  - Drawings
  - Instruction Manuals
  - Spares and Logistics
- Environmental Testing
- Feasibility Studies
- Field Service
- Human Factors
- Installation Engineering
- Maintainability
- Program Management
- Reliability Studies
- RFI Suppression and Testing
- Training
- Value Engineering

Typical Systems

CCDS-1

CDDS-1

ADRS-1



TDRS-1

Computer-Controlled Data Acquisition System

DEI's Model CCDS-1 Computer-Controlled Data Acquisition System accepts analog data from on-line instrumentation transducers or from one or more multichannel instrumentation-type tape recorders. The data is digitized and recorded on magnetic tape usable in any digital computer employing the IBM or GE-225 seven-track format. The CCDS-1 is applicable for seismic and hydrodynamic data acquisition. Playing the digitized tape (any of three densities) back through the central processor or digital-to-analog converter provides an analog oscillographic readout for verification or comparison with original data. The central processor can be programmed to start and stop the oscillographic output at selected record numbers, which can be printed out at the beginning and end of the "verification" run and (within the printer's speed capacity) at intermediate rates.

Computer Data Display System

The **CDDS-1,** a special-purpose digital computer using standard DEI logic cards (integrated-circuit modules) and module files, provides real-time displays of data from a spacecraft computer after decommutation of the data by a PCM ground station. The data is scaled for display of the selected computer word in appropriate engineering units. Scale factors are stored in a core memory of the CDDS-1. The converted data appears on three decimal displays, one each for sign, decimal point, and engineering units. Built to SSD-64-64 RFI specifications, this computer is programmed by a paper-tape reader and a magnetic core memory. For quick system verification a special self-test mode utilizes a diagnostic routine permanently stored in the magnetic core memory unit.

Analog-to-Digital Recording Systems

Defense Electronics, Inc., has extensive experience in the design and production of information-handling systems that convert raw input data to computer-compatible language.

One such device is the **Model ADRS-1 Analog-To-Digital Data Recording System.** Although produced for laboratory use, this data-acquisition instrumentation system is adaptable to a wide range of applications. The system output is a seven-track IBM-compatible, low-density digital magnetic tape. It records the magnitude of data samples from any of three independent sources: from one to sixteen analog channels; a digital channel with selectable logic levels; or from one to six channels of analog information for which polarity is the only data of interest.

Data samples may be initiated either by a command synchronous with internal timing references, or by an external sample command. There may be a single command signal, or a series, with repetition rates to 8 kHz.

In this general-purpose DEI system, the tape format can be controlled for number of characters per word, record length, and a number of records per file. When the magnetic core memory reaches a given storage level, the organization of the logic provides for automatic recording of data. This feature gives the Model ADRS-1 a functional capability equivalent to an incremental recorder with a high-quality, high-speed, continuous-write capability.

PAM and PDM Decommutation Systems

To receive, record, and process FM/FM, PAM, and PDM telemetry flight test data from Navy DASH Drone Anti-Submarine Helicopters is the function of DEI's **Model TDRS-1 Telemetry Data Reduction System.** This equipment provides real-time information on physical and electrical parameters within the helicopter, and simultaneously records flight test data on a 14-track magnetic tape and displays time-history plots on chart recorders.

DASH data is received on two VHF carriers by a helical antenna. A preamplifier provides a high-quality signal to the multicoupler and DEI Model TR-711 Receivers. Receiver video outputs go to recording and data-reduction subsystems, while displays of AGC signals aid the operator in controlling the antenna azimuth angle.

Real-time or recorded receiver video data is separated and demodulated by 16 IRIG standard FM/FM subcarrier discriminators and by a 30-channel IRIG standard FM/FM decommutator. A time-code generator/translator provides IRIG time words for real-time serial recording on the tape, and visually displays recorded time during tape play.

Model TDRS-1 ancillary equipment includes an FM/FM test oscillator, a PAM/PDM simulator, a stripper/monitor oscilloscope for PAM/PDM data, and a reference oscillator/mixing amplifier.

Portable Missile Range Systems

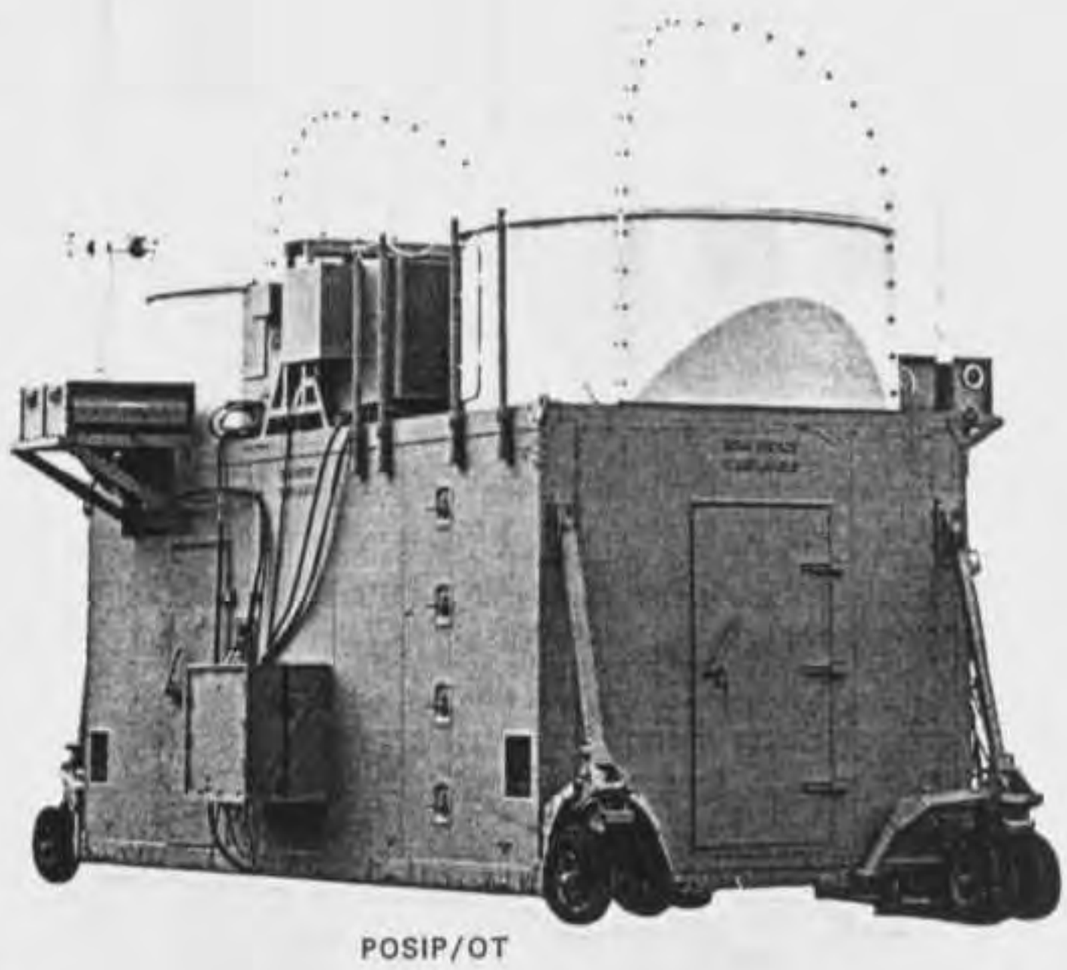
The **Portable Ship's Instrumentation System for Operational Test (POSIP/OT)** is a complete missile range safety system designed for shipboard use to monitor the flight of POLARIS type missiles during operational tests at remote ocean locations. The POSIP system computes the deviation of a missile from the intended ballistic path and, if necessary, transmits coded command/control signals for control or destruction of the missile.

Two basic functions are performed by POSIP, data acquisition and flight safety control. The telemetry data acquisition and storage group includes duplicate banks of receiving and predetection recording equipment and a set of RF distribution and checkout equipment. Timing information is also collected and recorded. The flight safety group includes a flight safety console, a voice communications transceiver, a special-purpose digital computer for operation with PCM decommutation equipment, an analog computer, dual command/control transmitters, an automatic direction finding system, and a gyroscopically-controlled stable antenna platform on the roof.

Receiving/Predetection Recording Systems

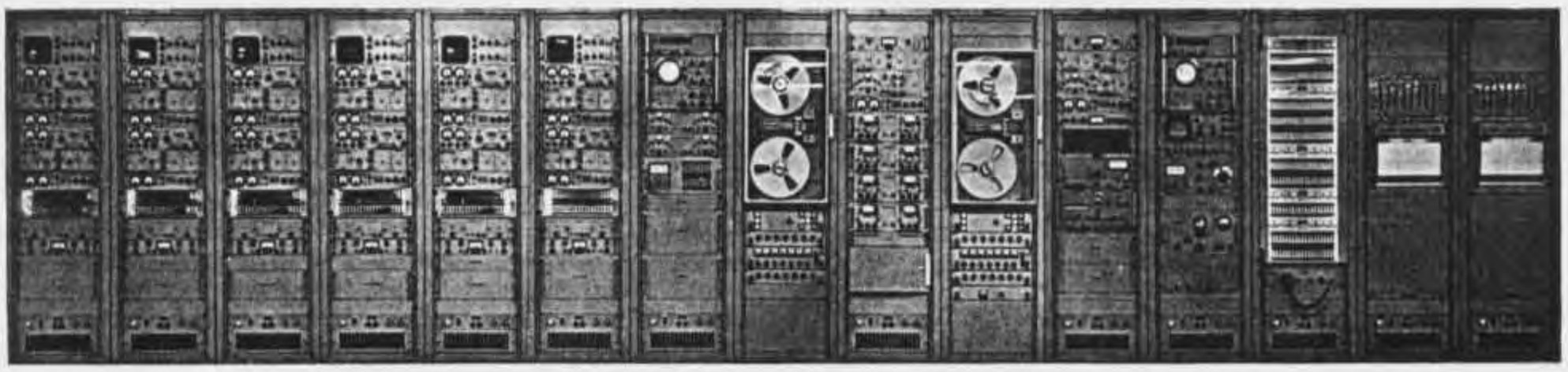
A pioneer in equipment and techniques for predetection recording of telemetry signals, Defense Electronics, Inc., is the most experienced producer of predetection systems.

An example of DEI's prominence in this field are the nineteen 15-rack **TRKI-12 Predetection Receiver/Record Systems** produced by DEI for the Atlantic Missile Range.
The TRKI-12 Predetection Receiver/Record System can handle up to twelve simultaneous telemetry signals of any modulation format. DEI developed and built more than 60% of the equipment in this system, specifically for the project. The TRKI-12 uses frequency translation methods that permit recording and reproduction of high bit rate PCM and other wide bandwidth signals with minimum distortion. Through an improved diversity reception concept, telemetry data for the diversity antenna systems can be optimally combined without introducing undesirable by-products or requiring special phase correction. Also used in this system is a wideband FM recording method covering true dc to 500 kHz bandwidth recordings.



POSIP/OT

TRKI-12



Automatic Monitoring System Cuts Costly Equipment Failure

A new monitoring concept using digital techniques to automate a central telemetry station has myriad new uses in any complex military or industrial application having measurable parameters that can be used to provide an indication of operating performance.

IUMS-1

The basic system approach has developed from the DEI 216-channel **Industrial Utilities Monitoring System, the IUMS-1,** installed at NASA's Marshall Space Flight Center and used to monitor utilities there in three separate facilities.

Seismic, infrared, acoustic, pressure, temperature, are typical of the indicators that can be utilized. Up to 50 utility systems and 250 total measurements (expandable to 1000 systems and 5000 measurements), at a rate of 20 measurements per second, can be monitored. Remote sensors and data phones collect and relay measurements on a continuous, real-time basis to a central location. Here data is automatically checked, displayed, and compared to pre-set limits which are programmed and stored in a computer-type memory. Data values are displayed in standard units of measure, i.e., degrees Fahrenheit, pounds per square inch, percent of relative humidity, etc. Flashing lights and buzzers call attention to potential problem areas.

More than just an alarm device, this modern industrial monitoring system enables plant personnel to observe trends in performance and anticipate problems before they occur.

DEI and the Medical Electronics Field

DEI equipment has played a major role in a Northwestern University study of the effects of physical impact upon the brain — specifically, through observation of football players during a game. From a telemetry transmitter in a football player's helmet, his brain waves are continuously transmitted to a DEI FM receiving and demodulation system, located in the stadium. As the game progresses and the player undergoes impact to the head, the system demodulation unit converts the received brain-wave signals into a visual display on the graph recorder, providing an electro-encephalogram (EEG). Simultaneously, a tape recorder stores the data for later computer analysis.

The success of these experiments, performed by the Biomedical Instrumentation Laboratory of Northwestern University's Medical School, opens new avenues for monitoring the condition and recovery of ambulatory hospital patients.

DEI has also supplied advanced electronic equipment for a similar project at Duke University. A patient whose condition requires frequent or continuous monitoring of his blood pressure,

pulse rate, temperature, brain waves, or heart function must normally remain in a hospital or make frequent trips to one. However, DEI designed an experimental data collection system to permit monitoring of the patient while he is recovering at home.

The system — consisting of a mobile receiving-recording unit mounted in a van or car, and a portable multiplex unit with the appropriate sensors — is taken to the patient's home. From the patient's bedside, data from sensors attached to the patient's body are transmitted to the van for visual display to medical personnel there or recorded for later analysis. EEG's, EKG's, and similar measurements can be made.

Use of this DEI system eliminates strain on the patient due to repeated trips to a hospital. Also, the patient's more relaxed condition makes it possible to obtain more accurate medical data. Several functions can be transmitted simultaneously over one RF link through the use of a FM/FM telemetry system similar to that employed for retrieving information from spacecraft and satellites.

Special Projects

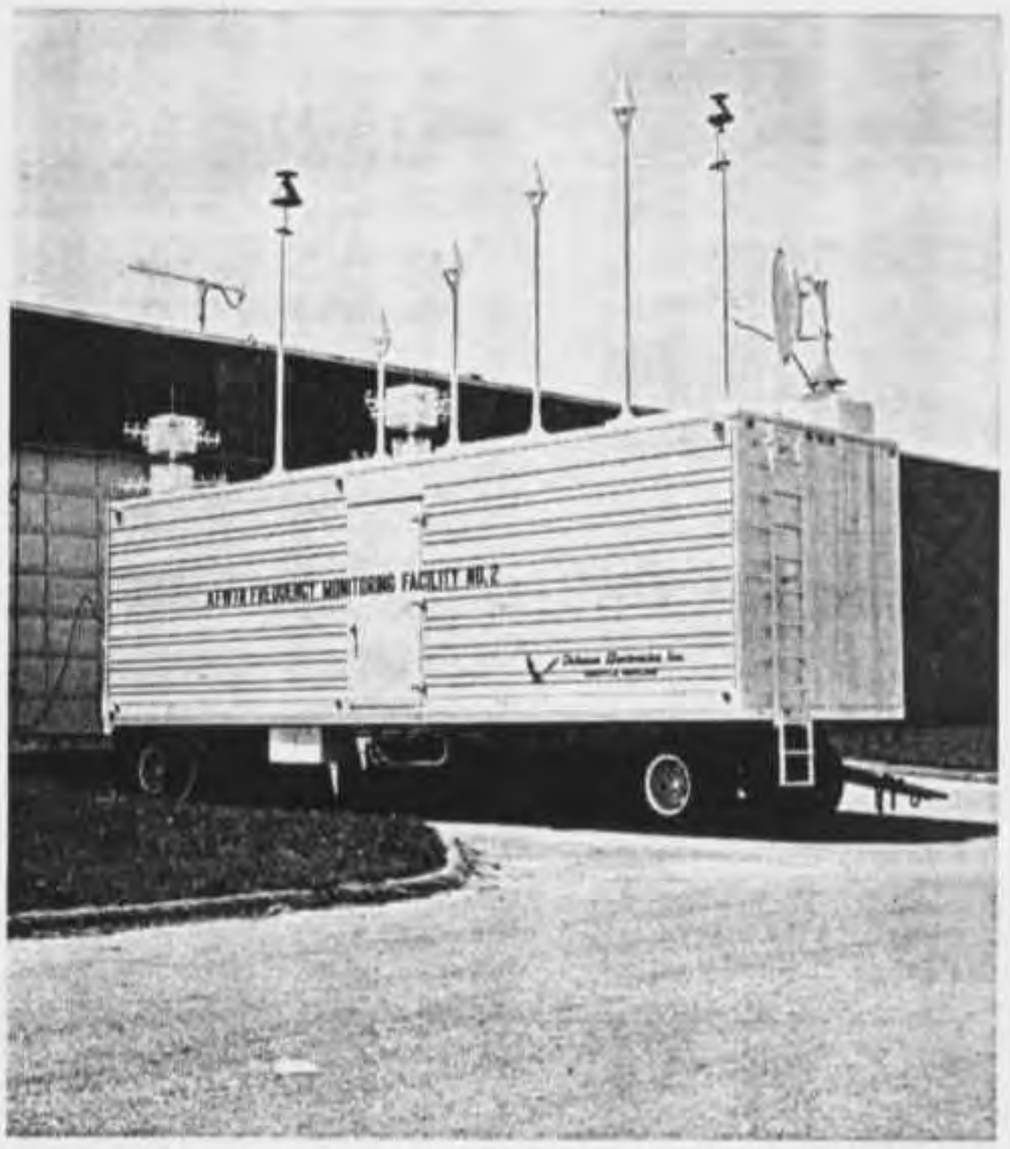
A segment of DEI's activities in both Systems and Product Engineering consists of "special projects" for various military and civilian security agencies. The proximity to these activities in and around the Washington, D. C. area has made DEI a prime source for equipment and systems on a quick reaction basis.

In the area of electronic intercept, DEI has developed and built receiving systems that scan the spectrum from VLF through HF, VHF, and UHF, to X-band and above. Nearly every conceivable antenna configuration has been used, including long wire, log periodic, parabolic reflectors, and phased arrays. DEI systems are highly mobile, air transportable, and quickly assembled for deployment at remote sites.

Special receivers and spectrum analyzers have been developed with unique characteristics for locating, evaluating, and monitoring previously unidentified signals. Other communications equipment produced for both military and civilian customers includes:

High-Density Magnetic Recording Techniques
Teletype and Voice-Communication Processing
Digital Coding and Decoding Devices
Rapid-Erection, Large-Aperature Antenna Systems

Requests for detailed information on "special project" services and products should be directed to the Security Officer of Defense Electronics, Inc.

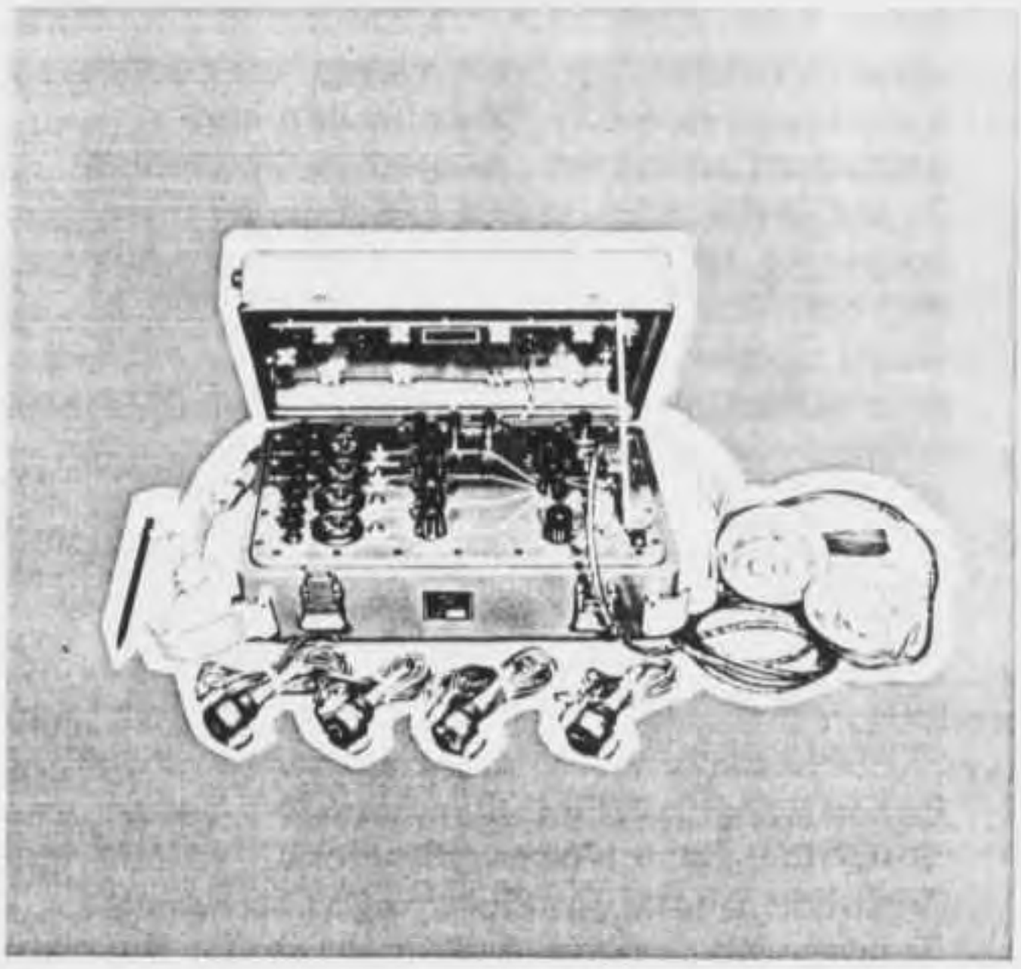


Seismic Intruder Alarms

DEI is currently engaged in the development of a series of intruder alarm devices using seismic detection techniques. These devices are virtually impossible to detect since they employ passive geophone sensors similar to those used in oil exploration. The sensors are buried in the ground near likely intruder approach routes.

Each sensor detects subaudible ground vibrations of vehicles, tunneling, men on foot, and animals, at distances up to 1000 feet or more depending on the terrain. Depending on the particular model, the sensors are linked by either hard wire or radio to a remote control monitor or by radio to aircraft operating at distances of 20 miles or more.

Of rugged construction and small size, these highly versatile units can be packaged in various configurations including air drop models specifically designed to withstand high impact, thus permitting rapid deployment of sensors in remote areas under surveillance.



Manufacturing

Men, Machines, Methods —
These three words best describe DEI's fully staffed, completely equipped, modern manufacturing facility.

Craftsmen representing all facets of manufacturing, extensive inhouse facilities, the latest equipment, a large production area, and well-planned production processes — all these contribute to DEI's manufacturing capabilities. The manufacturing area at Defense Electronics, Inc., occupies 36,400 square feet. Of this, 15,680 feet is devoted to the machine shop, sheet metal, printed circuit fabrication, while electronics assembly utilizes 9,000 square feet.

Quality electronic and electromechanical hardware can be fabricated, assembled, and tested entirely within DEI's plant. These production services are available to the customer individually or in combination as part of a total electronic development-manufacturing package.
DEI's diversified manufacturing capabilities and long record of quality production are matched by its on-time delivery performance.

Major DEI facilities and services are summarized in this section. For further manufacturing information and a complete, detailed list of DEI's production equipment, contact our Contract Manufacturing Specialist at Defense Electronics, Inc., Rockville, Maryland 20854 (Telephone, Area Code 301, 762-5700).

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DEI has been an active participant in the production of products for the Armed Forces. Typical of these products are the Radar Test Set Systems AN/APQ-120, Radio Sets AN/GRC-109, Servo Assemblies for AN/APQ-59, Missile Cradles for Shrike missiles, and Teletype Equipment Modifications.

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1 — Early steps in the manufacture of electronic-chassis are performed on this turret punch press. The machine does precision multichassis punching at a high rate of production. Sheet-metal capability is an essential part of Defense Electronic, Inc.'s., services.

2 — A real time-saver is the vertical tape-controlled mill, which is used for tooling, gear plates, and multipieces such as gang-panel work. The machine is representative of Defense Electronics, Inc.'s well-equipped, versatile machine shop.

3 — Defense Electronics, Inc., uses a semiautomatic conveyorized assembly line for greater efficiency and productivity. Each operator performs a short, repetitive task as units progress rapidly down the assembly line.

4 — Printed Circuit Boards are drilled for insertion of terminals and electronic components. This operation utilizes high speed miniature drills, drill plans, and templates to speed up production.

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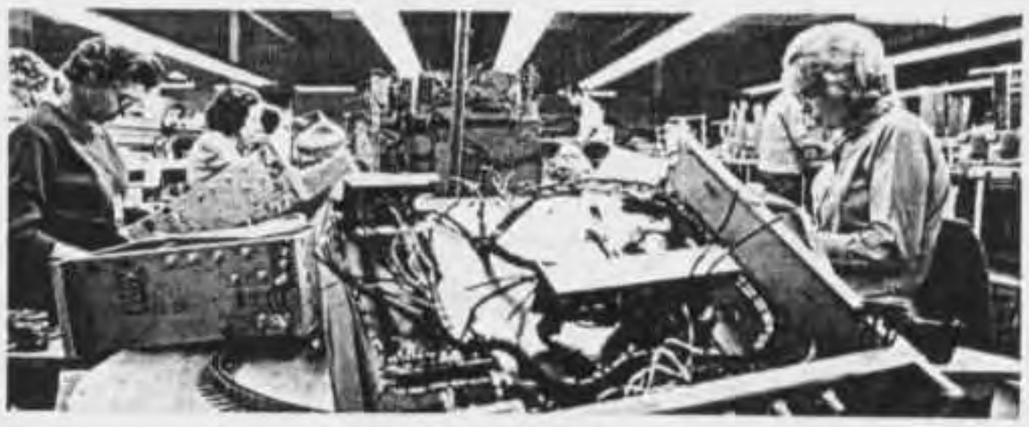

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Metal Fabrication

Basic to DEI's production process is a comprehensive metal fabrication facility, fully equipped to machine, form, weld, plate, and finish. The machine shop utilizes a complete line of lathes; grinders, and horizontal and vertical mills, including a vertical, computer-tape-controlled mill. Among the sheet metal shop's equipment are turret punch presses, hand presses, brakes, shears, and hand and power notchers. Also used are compression and vacuum molders. A cycle-surge gun welder accepting one-pound spools is among the latest in welding tools at DEI. Rounding out the welding facility are heliarc welders, tank and torch setups for silver soldering, soft soldering, plus spot welding.

Such tools as a Timesaver sander, a panel grainer, dust collectors, belt sanders, a Pangborn vibrator, and metal finishing tanks facilitate metal finishing. Facilities are available for plating in gold, silver, lead, or tin. DEI's paint shop is equipped with an explosion-proof spray booth and baking ovens. Production photo engraving and metal engraving are readily performed in-house. The metal engraving equipment includes Gorton grinders and engravers with suitable engraving type.

Sheet metal assembly is accomplished efficiently with the aid of pneumatic squeeze guns of various sizes, as well as supplementary production tools.

DEI's production of electronic assemblies starts with the in-house facilities for the production of rugged, high reliability printed circuit boards. The printed circuit facilities are fully equipped to process the board through each step, beginning with the master artwork and the preparation of precise-tolerance negatives and positives, to the final steps of printing, etching, plating and drilling.

Electronic Assembly

Assembly equipment and techniques at Defense Electronics, Inc. are among the most advanced in the industry. Fixed-station assembly benches, "lazy-Susan" rotary assembly wheels, and semi-automated conveyor lines are combined into a "progressive assembly line", much like an automobile manufacturing operation. In a series of short-cycle, repetitive steps, the product is built up as it progresses rapidly down the line.

Among the equipment used to automate assembly functions are machines to perform automatic crimping, eyeletting, terminal swagging and staking, wire cutting, sleeving cutting, coax cable stripping, component lead forming, vapor degreasing and wave soldering. Special hermetically-sealed cable assemblies can be molded, assembled and pressure tested at DEI facilities.

For final assembly, such tools as pneumatic screwdrivers implement the assembly process. Workers are provided with all possible aids for efficient assembly, such as glass illuminators on which to view color transparencies of the finished product.

Another advanced production concept implemented at DEI is the "clean room". In this 1000 square foot facility, electronic devices can be assembled and hand-soldered under a dust-free, controlled environment. Both the design of the room and the qualifications of the personnel involved conform to NASA specification NPS 200-4.

Custom-Build Facility

Highly skilled craftsmen in this specialized, flexible group handle short-order and small-quantity jobs efficiently, without interrupting normal production channels or large-scale assembly line runs. The Custom-Build Facility schedules, plans, and fabricates custom products and production prototypes. Thus, without sacrificing its normal high quality, DEI can respond quickly and economically to special orders, often working from minimum documentation.

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1 — Chassis holding fixtures on this semiautomatic equipment conveyor are on casters, so that the assembler can move the unit easily between stations. DEI's "progressive assembly line" is set up like an automobile manufacturing facility. The line can be used for either mechanical or electrical assembly.

2 — Printed circuitry forms the core of most electronic production today. DEI's carefully trained operators prepare printed circuit boards at production rates with the aid of this contact printer, which exposes both sides of the board simultaneously.

3 — Errors are reduced and efficiency improves when an operator uses this lazy-Susan rotating table for short-cycle, repetitive assembly tasks. Here, a DEI employee wires small electronic chassis using preassembled cable harnesses. Fixtures are quickly changeable as tasks are completed.

4 — Lastest techniques and equipment are used by DEI welders. Here, continuous welding of an aluminum chassis is performed using a cycle surge welder. Savings in welding time per chassis in production runs are up 30% or more over other methods.

5 — Backing up this turret punch press in DEI's sheet metal department are other power and hand machines for processing raw metal.

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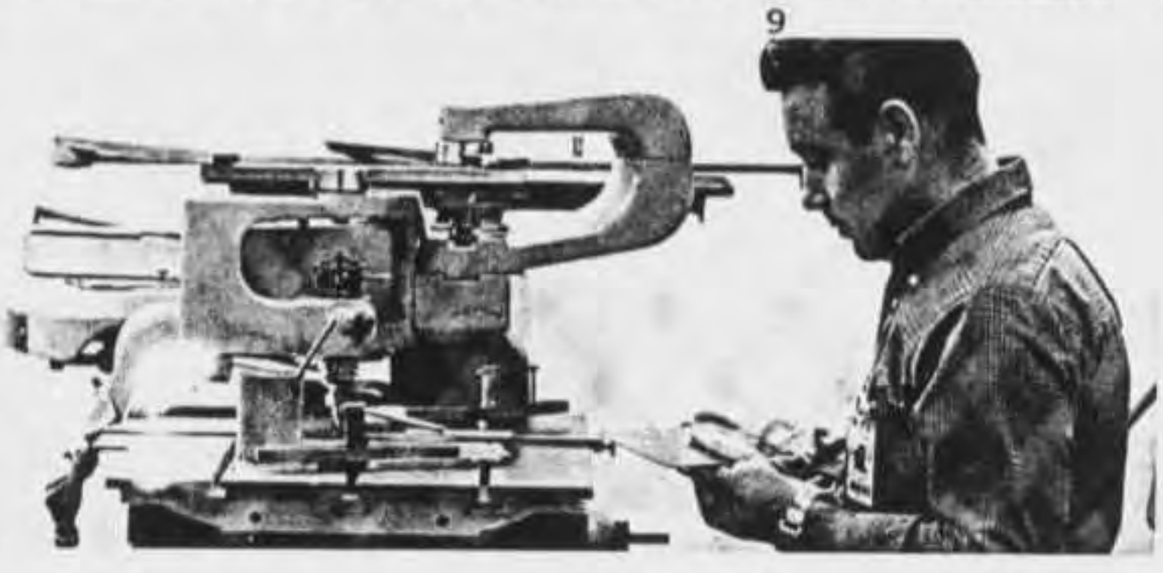

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6 — These rotating lazy-Susan devices speed up assembly at Defense Electronics, Inc. Here operators build sub-assemblies and tie in printed circuit boards. Rotating parts-bins and handy tool-mounts next to each table further increase assembly efficiency.

7 — This Taylor Winfield spot welder handles materials up to ¼ inch total thickness. DEI's welders are especially skilled at using spot welding techniques when continous welding cannot be easily done or would cause warping.

8 — Such attachments as quick-change collets, air-bar feeds, taper attachments, geometric heads, and chasers lend versatility to the variety of lathes in DEI's machine shop. Our Hardinge lathe includes a Sandex turret driver for higher production runs.

9 — To handle DEI's heavy output of printed-circuit boards, this flo-solder machine solders up to 270 P.C. boards per hour. The device automatically applies flux to the bottom of the boards then preheats and flow-solders the boards uniformly and completely.

10 — Defense Electronics, Inc., has facilities for a variety of metal engraving requirements, including intricate routing jobs. This skilled engraver, one of several employed in the plant, has the use of varied equipment, including four Gorton engravers, a full complement of type, and three grinders.

Major Customers and Projects

Air Force — Prime Contract ($7,000,000 plus), AMR Rehabilitation Program for up-dating of range telemetry capabilities with predetection data acquisition systems

Navy — POSIP/OT, command control shelters for use aboard ship in tracking, telemetry and command/destruct communications for the POLARIS missile

Navy — PMR Telemetry predetection data acquisition systems for installation aboard PMR operated tracking ships

Navy — Mobile PCM Stations for range support of MINUTEMAN and TITAN missile programs

NASA — Time and Materials Task for equipment and technical services to support APOLLO, NIMBUS, GEMINI, OGO and other major NASA programs

University of California — Van mounted FM/FM telemetry receiving system for Lawrence Radiation Laboratory

Air Force — Magnetic Tape Copy Station for making high quality copies of telemetry data recordings

Navy — Mobile Instrumentation Trailer and Automatic Tracking Antenna for use at PMR

Navy — Mobile Radio Receiving Station for BUSHIPS

NASA — Utilities Monitoring System for automatic data collection and processing of up to 5,000 utility data measurement points

RCA/Grumman/NASA — LEM communications ground support equipment

McDonnell/Air Force — GEMINI B Spacecraft computer data display system

Air Force — Fourteen track magnetic tape analog recorder/reproducer system

Department of State — ATS teletype equipment. Low level signal interface for teletype equipments

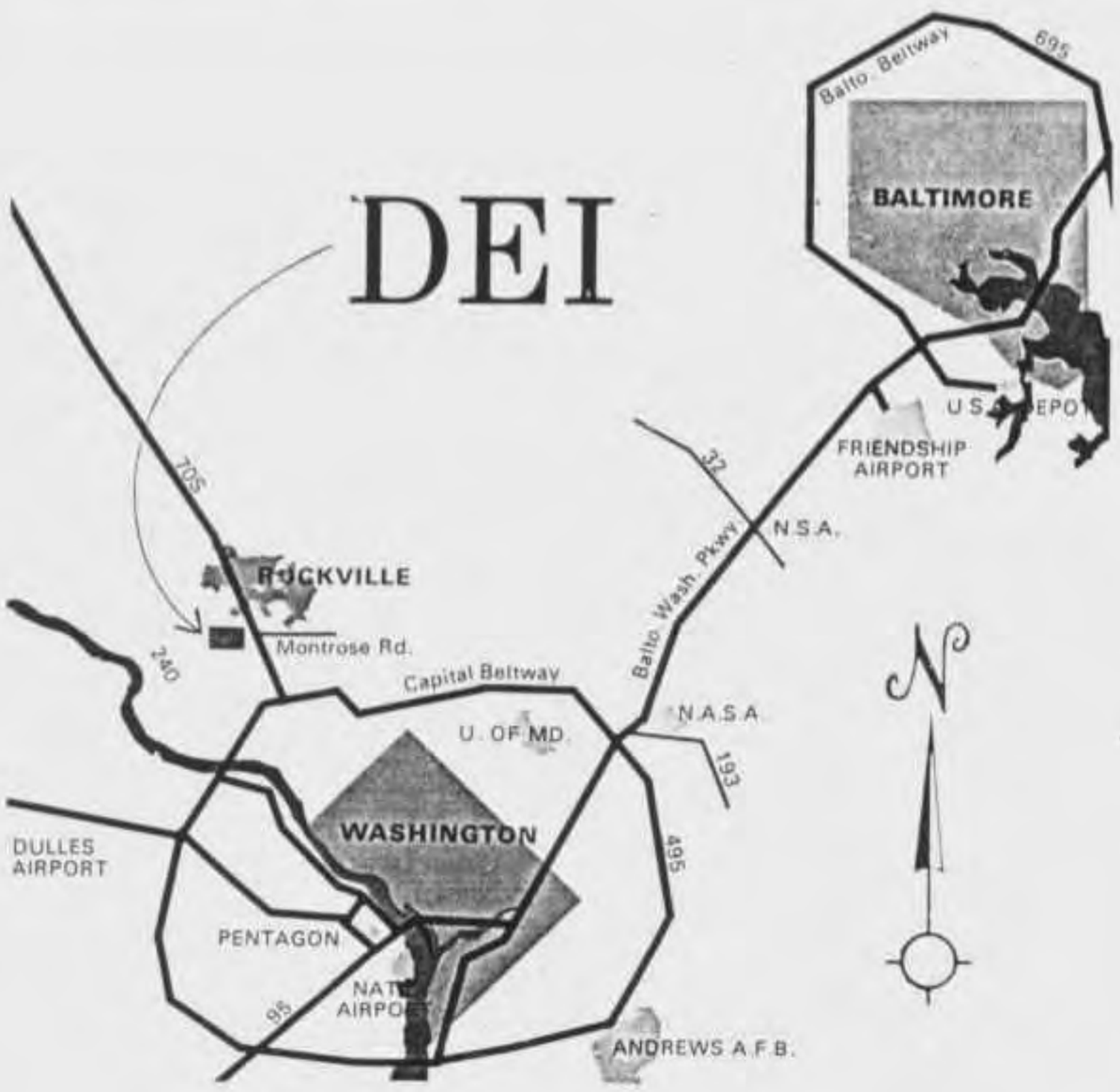
Department of the Army — High speed data digitizer system

Bendix/Douglas/USAF — Airborne telemetry receiving systems for APOLLO range instrumented aircraft (A/RIA)

EPSCO/U.S. Army — Three channel monopulse receiving subsystems for FIREBEE missile program

Air Force — Mobile AFWTR Frequency Monitoring Facility No. 2

In addition, DEI has had contracts with almost every major aircraft corporation and electronics prime contractor active in the aerospace industry.



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Facilities

DEI occupies a seventeen-acre industrial site at Rockville, Maryland, on the outskirts of Washington, D. C. Its modern plant houses the complex equipment, tools and facilities necessary for fabricating, assembling, and testing electronic equipment. DEI's location just off Interstate Highway 70S, minutes away from the Washington Beltway, makes it easily accessible from the Nation's capital and major transportation terminals, as well as from aerospace and military installations in the D. C. area. Neighboring facilities on Interstate 70S include the National Bureau of Standards, Atomic Energy Commission, COMSAT, IBM, Fairchild-Hiller, and numerous others.

DEI

Defense Electronics, Inc.

PRODUCERS OF
DEI AND NEMS-CLARKE
EQUIPMENT

Rockville, Maryland 20854