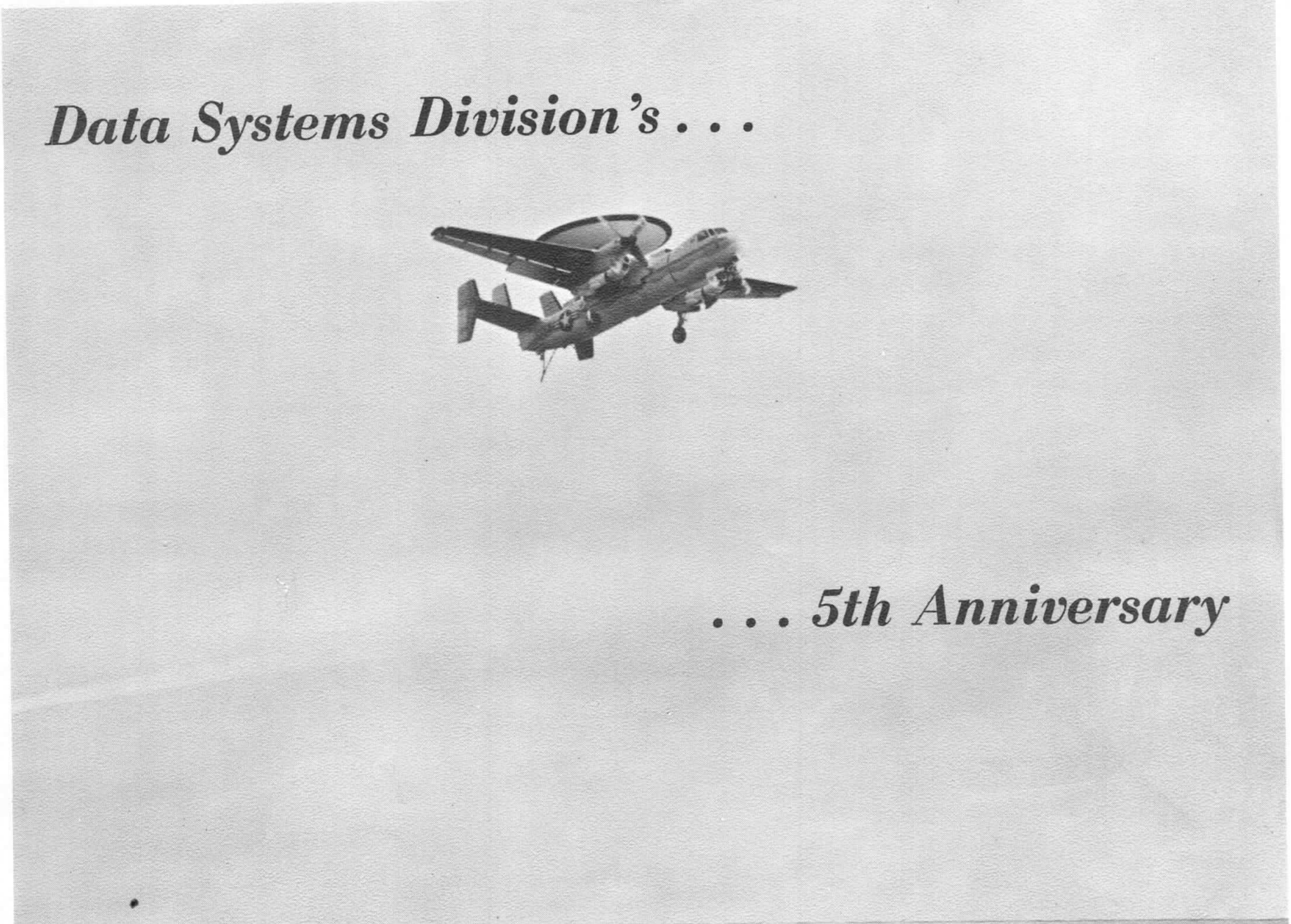
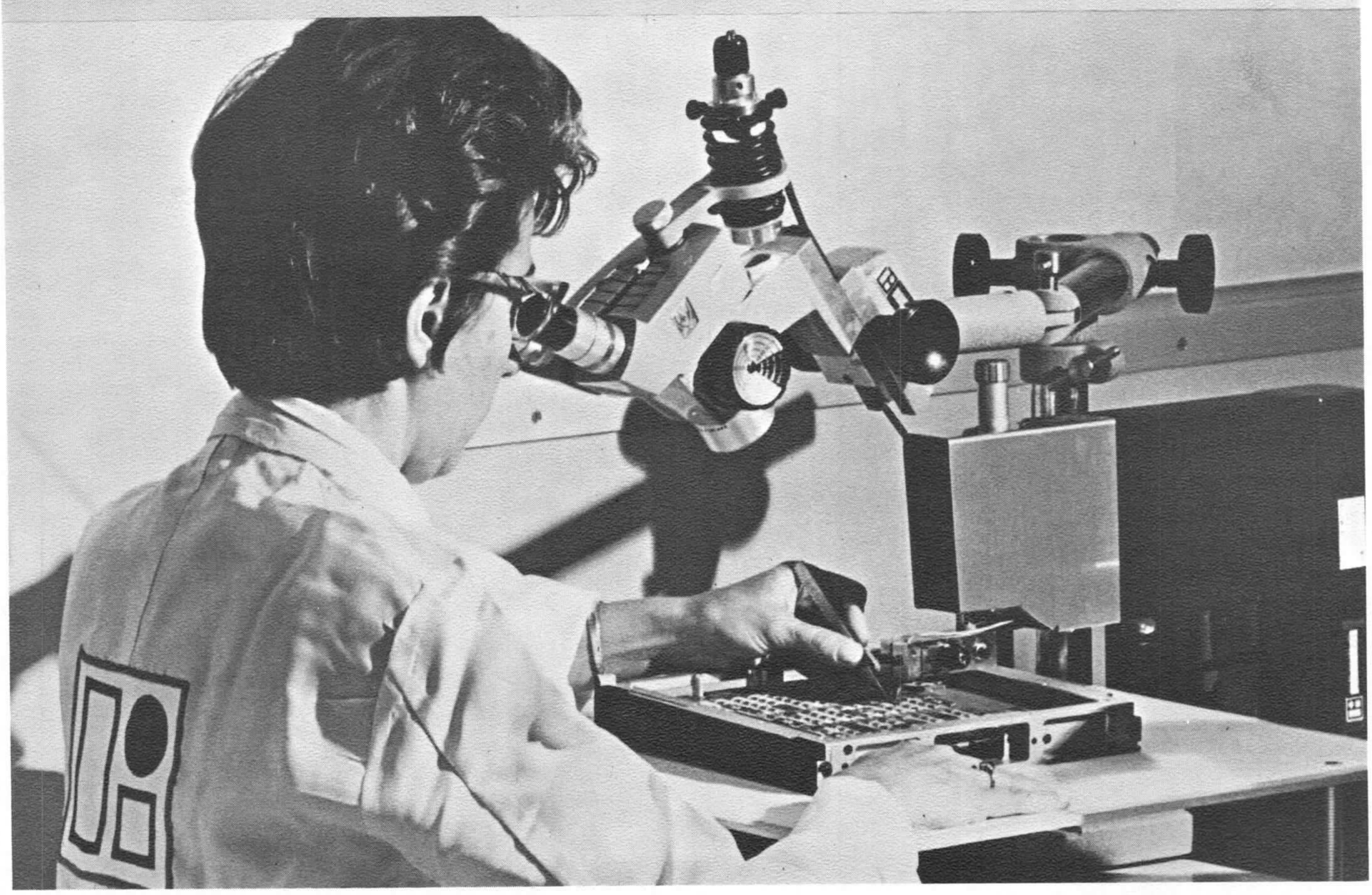
August 1, 1966

News & Opinion

Data Systems Division's . . .



. . . 5th Anniversary



News & Opinion

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Data Systems Division of Litton Industries

Published on alternate weeks for the employees of Data Systems Division to inform them about the affairs of their company and provide a forum for expression of ideas, thereby fostering understanding through free communication.

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Fred Fajardo, Manager

Associate Editor............Milly Ziebarth
Coordinator............Jan Munson
Staff Writer............Yvonne Preble
Artist............Johnna Painter

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In this Issue

This issue of "News & Opinion" has been published to mark August 1, 1966, the fifth anniversary of Data Systems as a division of Litton Industries. But rather than take too long a look at the past, this issue concentrates on the division's achievement and projects a glimpse of the future. In this light, the theme of this issue focuses on the division's microelectronics capability in relation to DSD's systems expertise.

On the cover of this issue is a DSD employee working in our Microelectronics Laboratory. In the background is the Grumman E2A "Hawkeye" aircraft, a key element the Navy's carrier based Airborne Tactical Data System. DSD has supplied advanced command and control systems for ATDS and is currently involved in applying microelectronics techniques to that program.

A Message from the President

One of the most significant elements of the success story of Litton Industries has been the prediction and integration of the technologies and the market place requirements of the future. DSD today stands on the threshold of reaping the rewards of successful predictions in each of these areas.

It is obviously true that predictions are only the beginning of the success story. The establishment of these technologies and markets is solely dependent upon the caliber of the division's personnel. DSD personnel today should take great pride in their accomplishments of the past at the same time that they are preparing for the even greater challenges of tomorrow.

These challenges include present profitable execution of past and future contractual requirements with highly reliable and maintainable hardware. The role of the new Product Effectiveness organization and the continued success and expansion of the Hi-Q Program will help to ensure this execution.

These challenges also include continued planning and effort in defining tomorrow's technologies and market places — we cannot rest on our laurels. Our organization and our people have established their capabilities to cope with this challenge.

Join me in looking back with pride, and forward with anticipation. The DSD success story has only begun.

C. Gordon Murphy

President, Data Systems Division

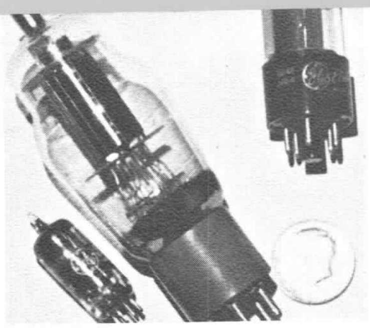


Photo by Kedroff

From the vacuum tube . . .

Microelectronics — A Short History

. . . to the transistor . . .

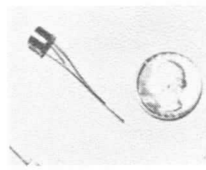
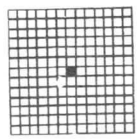


Photo by Kedroff



. . . to the integrated circuit. (solid square at left is actual size)

In the last 10 years, and especially in the last five, the science fiction flavor that went along with conversations about microelectronics has disappeared. Spurred from many directions, but primarily by military and space needs for making little black boxes smaller, lighter and more reliable, microelectronic technology has been shooting forward from $50 million a year in sales in 1964 toward a predicted $750 million in 1973.

The beginnings of microelectronics are credited to the decade of the 1940's. In the 1950's, while vacuum tubes were still the stars on the electronic stage, talented engineering could pack some 6,000 components into a cubic foot of space while maintaining performance speeds measured in thousandths of a second.

With the introduction and wide spread use of the transistor, the possible packing density of miniature circuits was on the order of 100,000 parts per cubic foot and speeds had been shortened to millionths of a second. In the 1960's, the use of thin film and integrated circuits brought the packing density to a possible 10 million components per cubic foot with switching speed measured in billionths of a second.

Future business and results of microelectronics look bright, but there was a time in the late 50's and early 60's when component and electronic systems manufacturers had to marshal all their foresight to decide if they should gamble large chunks of engineering talent and research dollars on the bet that microelectronics was to be a major trend in the industry.

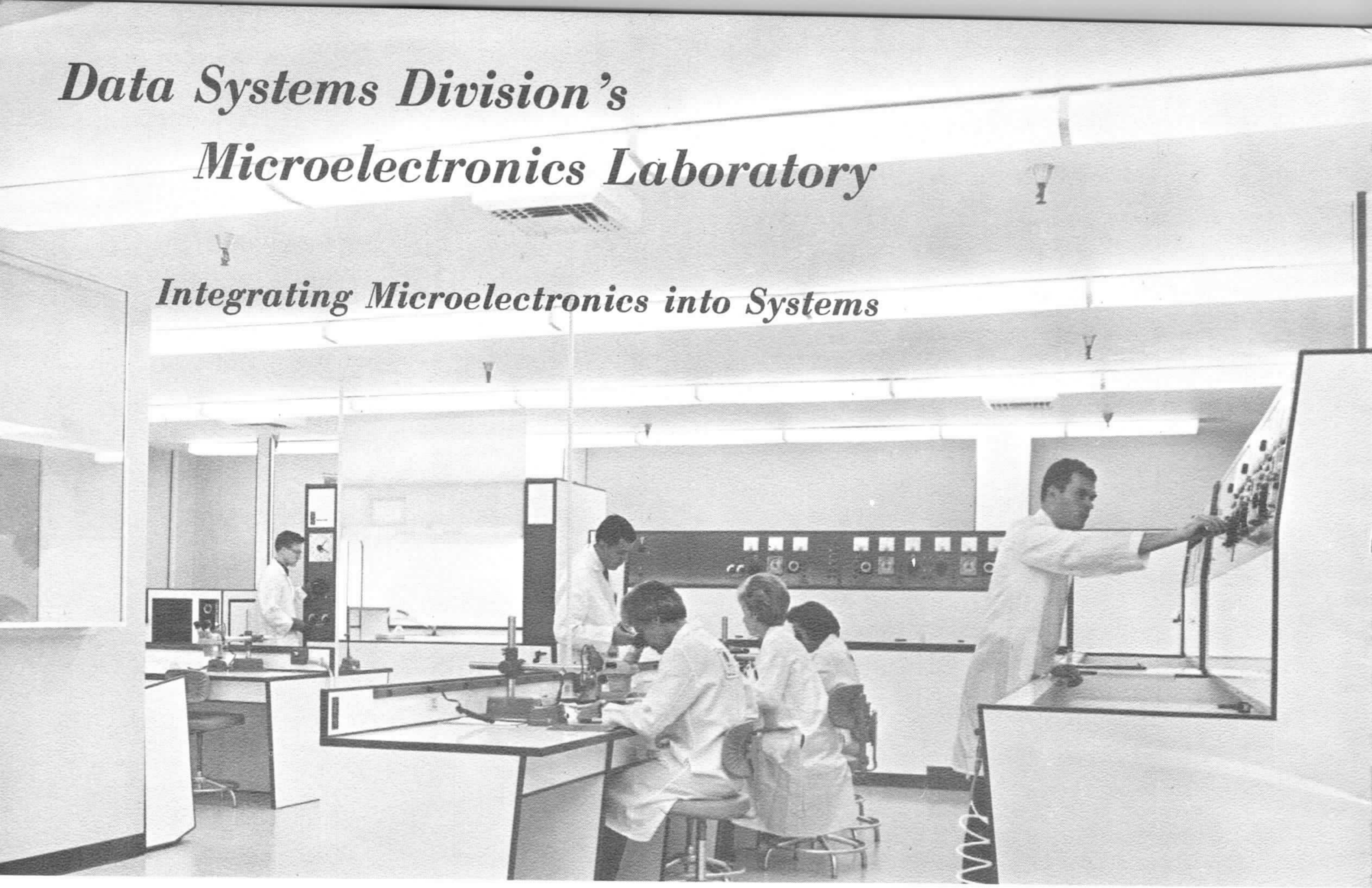
Even when thin film and integrated circuits became technically and economically practical, new problems emerged simultaneously. It was one thing for a manufacturer to solder more than seven dozen transistors and resistors onto a sizeable printed circuit card but, through the chemical and photographic processes of microelectronics, the equivalent of these components could be contained in an integrated circuit chip as thin as a snow flake and no larger than the pupil of a person's eye at high noon.

Handling and connecting these tiny circuits into reliable compact subsystems led to the development of new skills, manufacturing and test equipment. Effectively packing large quantities of microcircuits into the smallest possible area, quickly became the concern of electronic companies searching for the best place in the sun in the fiercely competitive military and space field.

The methods employed to achieve high density packing of microcircuits vary from company to company, depending largely on their talent, the extent of their financial commitment and their technical point of view. At the Data Systems division the commitment of the company to microelectronics has been complete and, according to DSD engineers, the methods developed in the division's Microlectronic Laboratory have made DSD a leader in the application of microelectronics to advanced data systems.

Data Systems Division's Microelectronics Laboratory

Integrating Microelectronics into Systems



Microelectronics technology and its integration into complex military systems has become a way of life at Data Systems division.

This was made possible by a decision made three years ago. At that time, DSD management began making significant investments in the division's engineering and manufacturing capability in order to expedite microelectronics research. It was reasoned that military requirements for complex electronic systems would eventually dictate the need for companies whose capabilities could go beyond systems expertise. A new dimension had to be added to DSD's experience in systems —experience in microelectronics.

Techniques in microelectronics used today at DSD are a result of years of in-house research which enabled the division to extend the frontiers of the state-of-the-art.

The introduction in September, 1965, of DSD's L-304 Microelectronic General Purpose Computer, the first of the L-300 and L-3000 family of digital computers, demonstrated that the division had reached the necessary level of sophistication in microelectronics technology to produce a real-time, light-weight computer with the high reliability required to meet the needs of an airborne military environment.

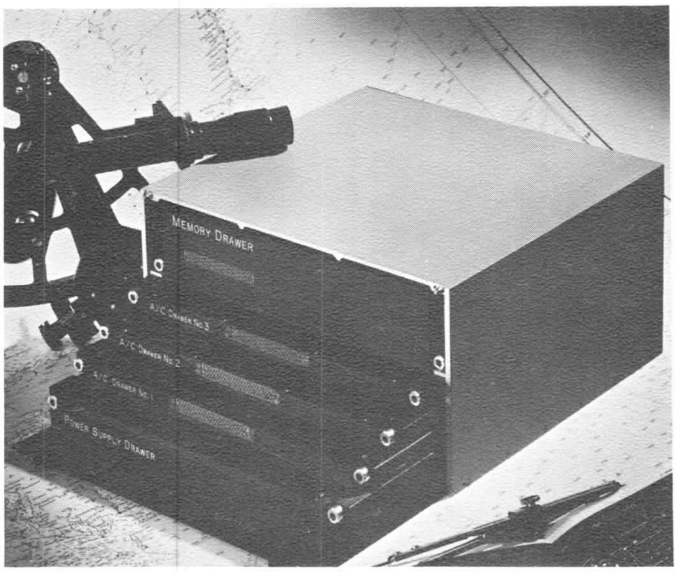
According to DSD engineers, the key to achieving this capability was the development of unique microelectronics application techniques —the most important of which was the development of an advanced chemical process used to produce multilayer etched circuit boards.

The greater the number of layers in a multilayer circuit board the more difficult it is to manufacture. DSD, in producing an airborne version of the L-304 for the military, has built 15-layer circuit boards. However, the number of layers is dictated by the nature of customer requirements and, when the need arises, the division can and will go beyond 15 layers. DSD has been able to increase the number of layers by using advanced photo chemical processes and a plated-up post technique as compared to a plated-through hole process. This method, which requires a complex series of sequential manufacturing steps, produces a highly reliable multilayer board.

To test the multilayer boards rapidly, DSD engineers have designed and built a continuity functional tester. Accurately touching more than 5,200 points simultaneously, the tester performs over 12 million tests in a matter of minutes.

The meticulous work performed by those in the multilayer board lab, combined with many safety checks and inspection points, has resulted in a high yield of reliable boards. Plans are under way to make the process even more reproducible with automatic inspection and the further use of chemicals in cleaning processes.

Microelectronic techniques and conventional printed circuit board technology will continue to be used together for many years. But as the need for microelectronics skills increase, the division will step up its program of retraining electronic assemblers in microelectronics skills. To date, some 40 DSD employees have completed this retraining program.



The introduction of the 27 pound L-304E Microelectronic General Purpose Computer (above) in September, 1965 signaled the division's entry into the microelectronics field.

The Photo Process — circuit pattern is photographed on multilayer board. Process is repeated twice on each layer — once for the circuit and once for the layer interconnecting posts.

Photo be Kedroff

Then they're etched — ferric chloride acid removes copper leaving only the photographed pattern on the multilayer board.

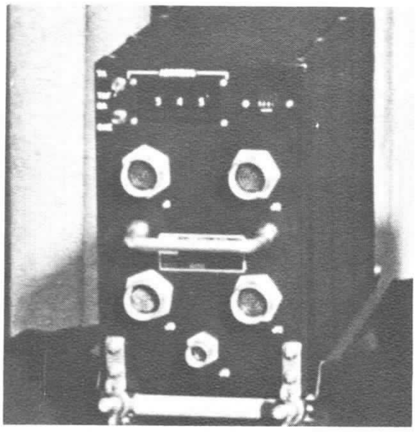
Photo be Kedroff

Photo be Kedroff

Next they're plated — copper is electrolytically plated to multilayer board in two steps, one forming the interconnecting posts and the other the base for the circuit pattern.

Microelectronic Hardware for Systems

Digital Data Communications Set AN/ASW-27



Another member of DSD's family of advanced microelectronic equipments is the AN/ASW-27 Digital Data Communication Set. DSD has sponsored development work in the area of digital data link systems for the past two years and was recently announced as low bidder for the initial production contract for the AN/ASW-27 "two-way" data terminal.

The two-way data link terminal processes information into digital format for transmission in both directions between an aircraft and its control station so that instructions can be sent to the aircraft and data on the actual status of the aircraft can be sent back to the control station to provide positive control. One of its many uses is the automatic control of aircraft during landings aboard carriers.

Typical of Litton's advanced microelectronic equipments, the AN/ASW-27 provides extremely high reliability and its size, weight and power requirements are a small fraction of its conventional predecessor.

Microminiature Power Supplies

Data Systems has devoted a significant amount of talent and knowledge toward applying its experience in systems and microelectronics for the design and production of microminiature power supplies.

In accordance with the importance of miniaturizing power supplies in an era of microelectronic technology, a Special Products department was set up this year at DSD. This department operates like a small company, complete with its own marketing, engineering, manufacturing – yet is still able to call on the full resources of the division.

Intimate knowledge of systems, enables the department to custom tailor microminiature power suppiles to the needs of DSD and customer equipments.

Originally, microminiature power supplies were developed by DSD under contract to the U.S. Navy Bureau of Ships. The design of these power supplies combines the advantages of microelectronic circuits with state-of-the-art semiconductors and magnetic materials to provide units which incorporate simplicity of manufacture, extremely high reliability, ease of maintenance, and precise output characteristics.

Special Products department engineers say that within three months they will be able to introduce five new power supply models with output voltage ranges from 1-30 volts and current ratings up to 15 amps. These models will incorporate an automatic feature which will cause the power supply to shut off in case of a short. The power supply will then automatically resume its normal operation when the cause of the short is removed.

In addition, while the majority of power supplies produced by Special Products operate from a prime power of 115 volts 3 phase 400 cycle, a new series of power supplies will soon be available which will deliver the same voltage and current ratings but operate from either plus 28 volts DC power or 115 volts AC, single phase, 60 cycle/400 cycle prime power.

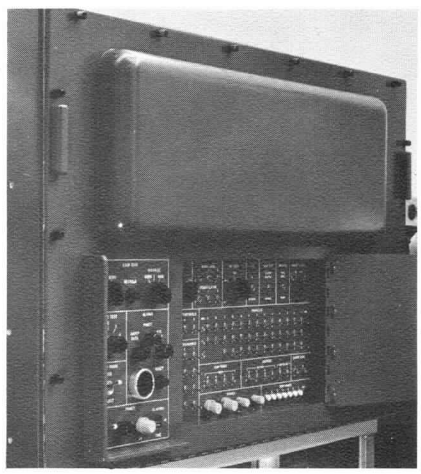
Battery Terminal Equipment AN/GSA-77

Data Systems Division delivered four prototype microelectronic data processing units designed for use by U.S. Army surface-to-air missile batteries around the world.

Designated the AN/GSA-77 Data Converter, Coordinated Air Defense Systems, these are units of the Battery Terminal Equipment (BTE) designed to provide a digital data processing link between missile batteries and their Army Air Defense Command Posts (AADCP). The units are to undergo extensive environmental and field evaluation tests.

The man who operates the DSD BTE doesn't need more than a basic knowledge of electronics to perform his duties and he doesn't need the traditional manual to carry out maintenance functions. Because of the high reliability of this unit, not more than an average of one malfunction every 2500 hours of operation can be expected and then the equipment can be restored to operation in minutes.

While the DSD BTE is in operation, its self-check capabilities automatically perform complete functional checks every few minutes. An audible and visual alarm is automatically triggered when a malfunction is detected and the unit's built-in testing circuits rapidly localize the malfunction area. In such an event, by referring to the small maintenance decal affixed to the BTE instead of to an elaborate maintenance manual, the equipment operator with the aid of the built-in hand-held circuit card tester, can locate a faulty card, pull it, replace it, and have the unit in operation again – all within 5 minutes or less.



Modular Display

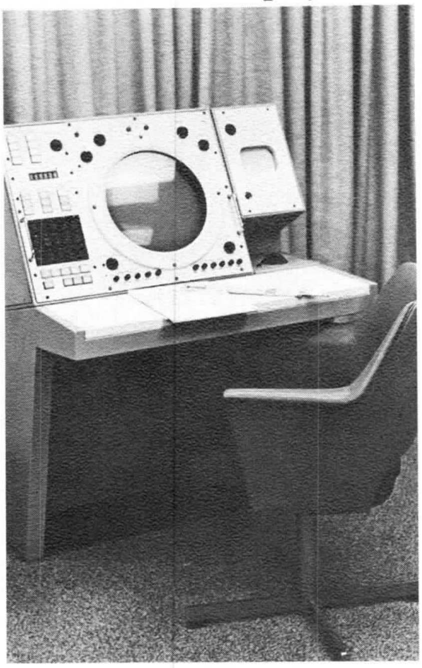


Photo by Kedroff

Data Systems' microelectronic Modular Display has been designed to meet the future head on.

Backed by many years of designing and building command and control systems, the division's engineers have constructed a prototype modular display which is heavily committed to the "Universal Console" concept. In this sense, the DSD display embodies modularity which enables it to be used in a variety of applications without compromising cost and performance effectiveness.

Designed to meet tactical display requirements of the future, the DSD Modular Display makes extensive use of intergrated microelectronic circuits. This reduces the size, weight and power requirements of the console while greatly increasing its reliability.

Because it can be changed to meet different and varying system requirements, the DSD Display can be easily and economically tailored to more (and sometimes less) complex applications.

This type of display is currently being proposed for part of the shipboard Canadian Command and Control System 280 (CCS 280).

Digital Message Entry Device

Two versions of a microelectronic communications device for tactical forces has been introduced by Data Systems during the last 10 months.

The first was the Digital Message Entry Device (DMED), a data communications unit no bigger than a soldier's canteen and weighing four pounds including the four flashlight batteries that power it.

Through the use of numeric switches DMED allows forward military elements or airborne observers to communicate, in one short burst, vital military information to command and control centers with less danger of being jammed, intercepted or garbled, such as can happen to voice communication. Receiving terminals, also built by DSD, decode the transmitted DMED messages and display them in printed text form.

A unique feature of the DMED with its associated terminals is that soldiers speaking another language can communicate with American units. Each of the 22 numeric switches on the unit represents a single piece of information agreed to in advance. The equivalent meaning of each switch is on changeable cards attached to the cover of the unit, and can be written in any language. Translation to another language is performed by the receiving terminals.

A second and latest version of the DMED concept is under development at DSD for the Army. Designated the Digital Meterological Message Entry Device (DMMED), it is designed for use by forward elements in support of artillery units.

A key factor in the accuracy of artillery units is the weather conditions between the gun implacement and the target. By using DMMED, forward observers can transmit weather information to computers, which then correlate this data with all available information being gathered for a successful artillery operation.

The DMMED unit, which is somewhat larger than the simpler DMED, contains 39 switches, a different type of digital code and can transmit over standard telephone lines as well as radio.

Data Systems is currently under contract to build two DMMED units for feasibility tests and demonstration.

IFF Coder/Decoder AN/GPA-122

Under development for the U.S. Air Force at DSD is a new microelectronic IFF (Identification Friend or Foe) system designed to increase the effectiveness of tactical aircraft control systems.

The Coder/Decoder's SIF (Selective Identification Feature) capability simplifies and speeds the work of manual controllers by providing for control, validation and identification of friendly aircraft.

The units are primarily designed for use by manual aircraft control and warning squadrons operating in areas of high traffic density. Under such circumstances, the DSD Decoder allows a great improvement in the operational effectiveness of AC & W controllers without necessitating sophisticated semi-automatic command and control facilities.

The Decoder unit does not itself generate IFF/SIF data, but rather provides for the control, filtering, and "tagging" of available IFF/SIF

video so as to simplify and expedite the work of manual AC & W controllers. The units are completely compatible with existing IFF/SIF facilities, and are used with existing radar indicator consoles with no modifications required. A key feature of the system is that since the new IFF system is a product of microelectronic technology, installation has been greatly simplified.

The unit provides simultaneous visual and aural alarm of any aircraft emergency, whether military, civil, or communications failure. It also provides simultaneous passive decoding and distinctive display of up to six aircraft per operator; individual operator selection of aircraft is independent of other operator selections.

The AN/GPA-122 includes a built-in self-test capability that immediately detects malfunctions and allows those malfunctions to be quickly identified and repaired.

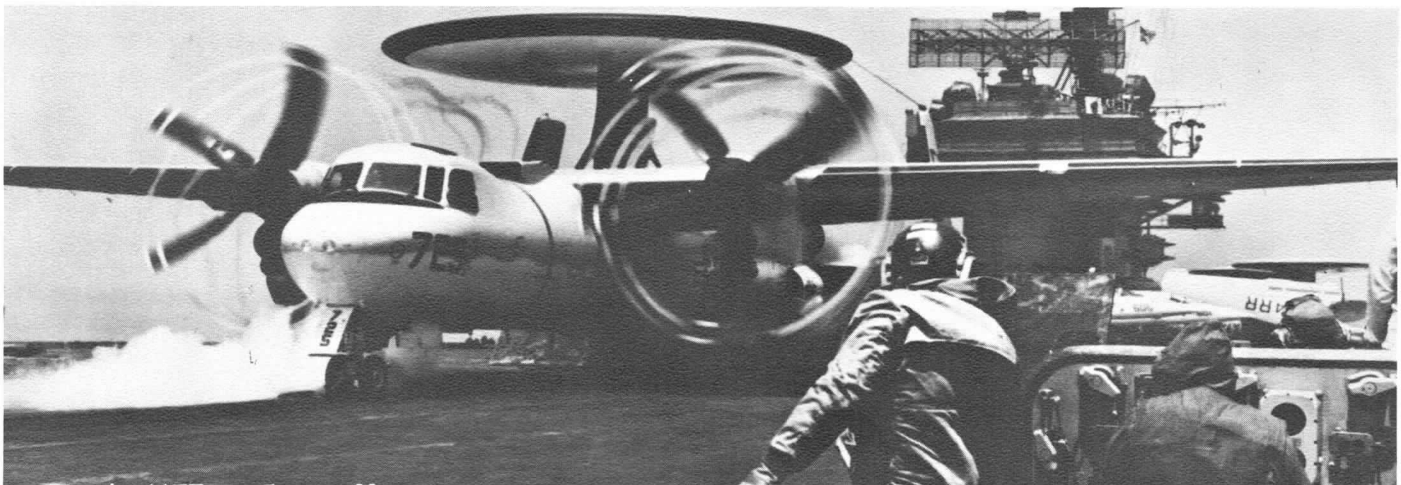
Division's Microelectronic Equipment and ATDS

Inside the carrier-based E2A "Hawkeye" aircraft.

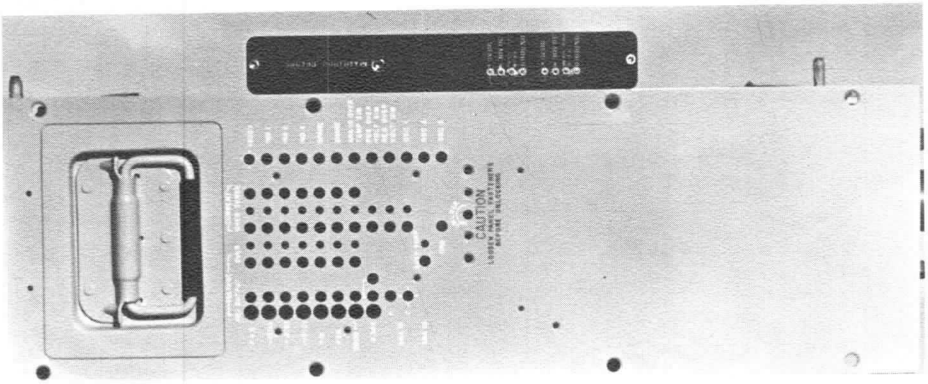
The Grumman E2A "Hawkeye," so named for its ability to spot and track enemy air and sea forces and direct intercept and counter attack action, will soon have the capability of its complex electronic brain expanded through substitution of new advanced microelectronic computers for those currently being used aboard the aircraft. The E2A is the heart of the Airborne Tactical Data System (ATDS).

Under consideration for such a major modernization, is an advanced version of the L-304 Microelectronic General Purpose Computer currently in production by the Data Systems division. In addition, DSD is developing microelectronic buffering equipment which when united with the L-304 is suitable for integration into the ATDS as a replacement of the current computer-programmer in the E2A.

The L-304 is a smaller, lighter, faster general purpose computer with a performance flexibility never before achieved in aircraft use. A key advantage of the Litton L-304 computer is that it can be reprogrammed to change its functional use to meet changing mission requirements, a capability not present in the unit currently in use without first changing its hardware. The unique modular design coupled with the microminiaturized components, has made it possible to almost



E2A "Hawkeye"



The ability to "shrink" a power supply (above) and memory drawer (right) by the application of microelectronics techniques has been illustrated at DSD. The black drawers are from the division's microelectronic L-304F computer.

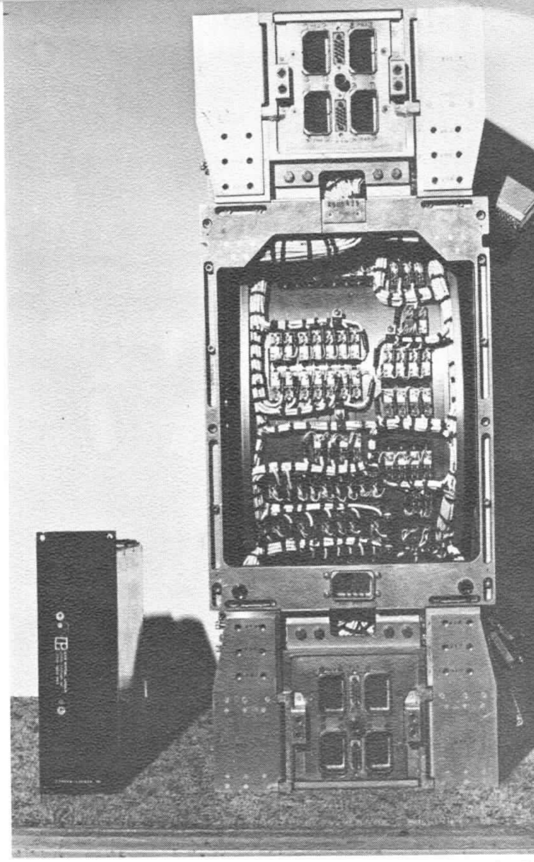


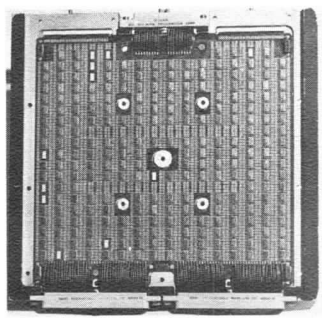
Photo by Kedroff

double the performance of the computer portion of the system and at the same time reduce critical weight and size. Through the use of microcircuits and advanced packaging techniques including multilayer-laminated circuit boards, reliability has been increased substantially.

Currently the E2A "Hawkeye" is performing important missions in the Viet Nam area. Operating off carriers in that area, the aircraft and its electronic command and control center can ring a task force with an umbrella of early warning detection which provides the information and lead-time necessary to carry out decisive fleet tactical missions. The E2A is also carrying out such additional duties as: air traffic control, guiding sorties to target, and directing air search and rescue operations.

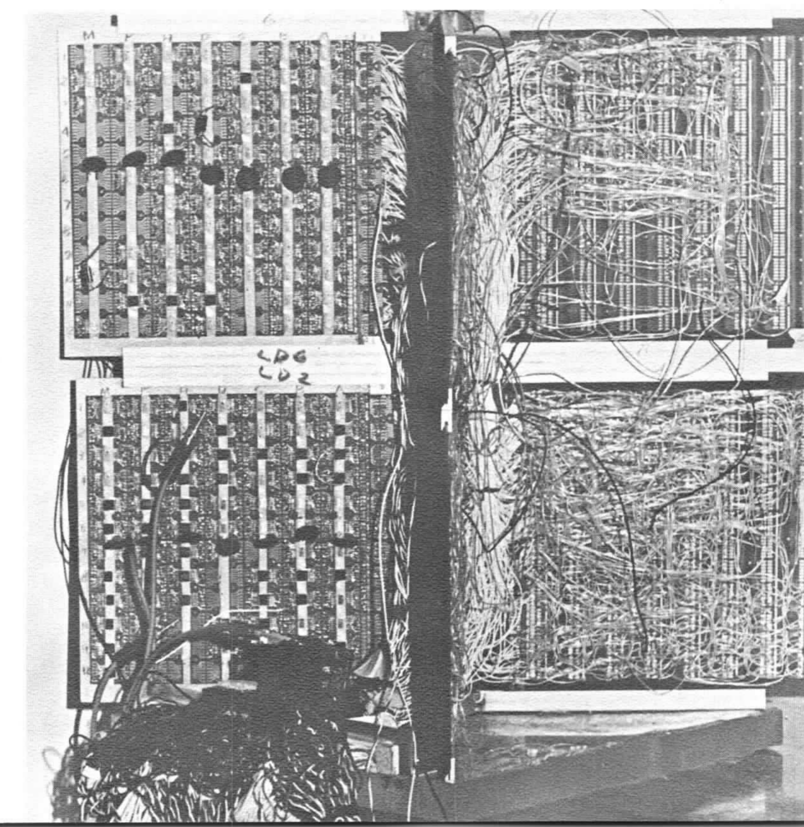
Jim Mahoney, director, ATDS programs at DSD, stated that the microelectronic equipment suitable for retrofitting into the E2A is currently in an advanced hardware stage undergoing comprehensive bench testing and will very shortly undergo qualification and flight test.

The L-304's command and control capability allows it to have up to 64 program levels with each level having its own separate program operating with another on a time-shared basis. In addition, should the power fail, the computer's memory retains data it has stored. The multiprocessor arrangement allows for continued operation should a processor, memory module or peripheral unit fail.



Elimination of masses of wires (below) is possible by the application of DSD's multilayer board technology (right) which do not require wires or hot soldering.

Photo by Kedroff



- Future Programs -

A marriage of systems expertise and microelectronics technology

AWACS

Data Systems division recently was awarded a study contract by the Air Force for the command, control and communications subsystem of the Airborne Warning and Control System (AWACS).

The AWACS is similar in concept to the Navy's microminiaturized version of the Carrier Based Airborne Tactical Data System except that the Air Force system is expected to encompass larger system functions, will be capable of more types of operations, and will be housed in a larger aircraft than the Navy's E2A.

Should DSD win the hardware contract to build AWACS, the system will use an advanced version of the division's microelectronic L-304 General Purpose Computer and Modular Display.

If a limited war situation emerges in any part of the world, the function of AWACS would be to provide an immediate and initial air control capability in the early stages of the outbreak until a ground based command and control system, such as 407L, is deployed. From this point on, AWACS would fulfill a supplementing role to the newly arrived command and control system, by providing extended radar coverage and radio relay capability.

The contracting agency is the Air Force's Electronic System division. Assisting DSD as its subcontractors during the six months study are Electronic Communications, Inc., and Bunker Ramo. At the conclusion of the study, the Air Force will initiate a formal Contract Definition Phase similar to the one just completed July 13 by DSD on the 407L program.

TACFIRE

A key command and control system earmarked to support the Army artillery men of the future on the battlefield is the Tactical Fire Distribution System (TACFIRE).

This is a program that has attracted intense interest at Data Systems because it is felt the division's advanced microelectronics and systems capability could be fully utilized to produce a highly effective and reliable TACFIRE system.

The purpose of TACFIRE is to provide for the automatic control and utilization of Army field artillery in a battlefield environment from the Corps level down to the individual firing batteries.

The system is expected to consist of a number of artillery fire direction centers at every level of command, each provided with advanced microelectronic computing and display equipment, plus supporting data input facilities.

"If Data Systems division is chosen to produce this system," said George Romano, director, Advanced Army Systems, "we plan to use an advanced version of the L-304 computer with unique maintenance features similar to those pioneered by DSD for the Army Battery Terminal Equipment (BTE)."

The Army is expected to release the Contract Definition Phase of TACFIRE in the latter half of this year.

CCS 280

A program that promises to illustrate Data Systems division's expertise in the design, development and production of military systems using microelectronic technology is the Canadian Command and Control System 280 (CCS 280).

The contract, which has not yet been awarded, involves the production of the CCS 280 for use by the Canadian Navy in a new fleet of Helicopter Destroyers (DDH). CCS 280 is considered highly sophisticated antisubmarine warfare command and control equipment.

Award of this contract to Litton would mean that DSD and Litton Systems (Canada) Ltd., would supply the Helicopter Destroyer fleet with microelectronic digital command and control centers. These would embody DSD's L-304 Microelectronic General Purpose Computer and the newly developed microelectronic Modular Naval Display.

The contract was bid to specifications. DSD and Litton Systems (Canada) cooperated on the preparation of the proposal and if Litton wins the award, production will be handled jointly.

According to Bill Stratton, director of International Programs Office, "This type of equipment will have world-wide Naval and Air Force applicability."

ASW

Data Systems division's research and development of advanced microelectronic systems has been concentrated toward helping the Army, Navy, Marine Corps and Air Force increase their combat efficiency on land and in the air. However, the problems of antisubmarine warfare on and under the high seas have not been neglected.

Development is being conducted at DSD on an advanced microelectronic data processing system for use aboard submarine or surface ships. The system is generally compatible with most sonar receivers but is specifically designed for use with a sonar that can be towed by cable behind the "mother ship."

Processed sonar information is made available for use in other system elements and is presented visually on displays which are built to DSD specifications by the McKiernan-Terry division of Litton Industries.

Research and development of this type of system is complementary to the command and control systems efforts at DSD and is aimed at applying the latest advances in the fields of microelectronics and signal processing techniques to the antisubmarine warfare problems.

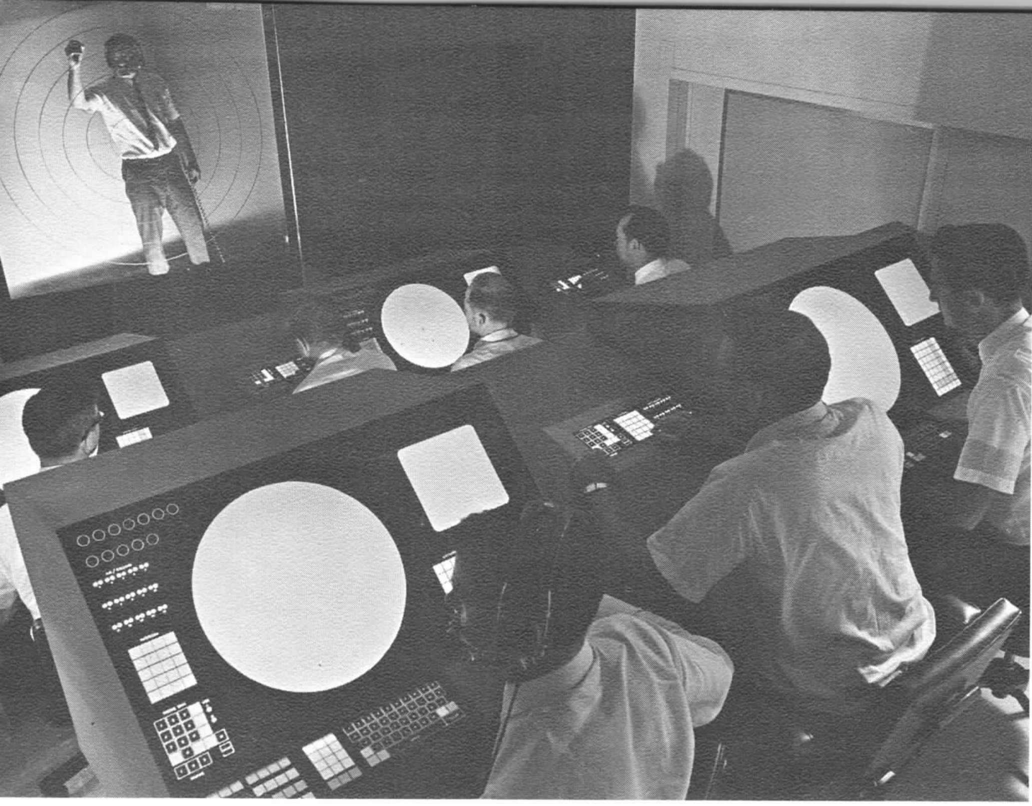
TADPS

A recently acquired contract by the Data Systems division calls for the development, design and production for the Army of a transportable automatic data processing system for use in a battlefield environment.

Despite the short delivery schedule required by the customer, DSD was able to bid successfully for the contract because of its experience in the systems field, its microelectronic background and the applicability of currently existing DSD hardware.

The system is all microelectronic in construction. Much of the data processing equipment used will be identical to that currently under development for the Navy's Carrier Based Airborne Tactical Data System (ATDS). To fill the system's requirement for a high speed printer, DSD called upon the Monroe Data/Log division of Litton Industries. They will supply an advanced version of their MC 4000 Ultra High Speed printer. The original machine was one of the first commercial products to use integrated circuits.

In addition to the hardware described above, DSD will supply all operational and support software.



Pictured above is the operation group "A" module mock-up, a part of the CRC/CRP 407L Tactical Air Control Center.

407L Program - for the Air Force of the Future

According to Major John O'Neill, in an article in the "Armed Forces" management magazine, the 407L Program is one of the top priority programs of the Air Force Electronic Systems Command.

Data Systems Division, recently submitted a proposal for a contract to build the operations centers for the Air Force's 407L Tactical Air Control System. The formal Contract Definition Phase of this program ended July 13.

The 407L will be a highly mobile command and control system which can be transported by C130 aircraft, helicopter or M35 truck for quick transportability and deployment. It will give the Air Force an increased capability in aircraft warning and control, and support of battlefield operations.

The 407L Systems Program Office of the Air Force's Electronic Systems Division is the procuring agency. The system is earmarked for use by the TAC, PACAF, and USAFE.

407L will bring to the battlefield extensive use of microelectronic technology. The system embodies three operations centers: Tactical Air Control Center (TACC) – the command post for the senior Air Force officer; Control and Report Center or Post (CRC or CRP) – which provides aircraft control and warning including air traffic regulation; Direct Air Support Center (DASC) – which provides command and control functions for aircraft in direct support of Army ground forces.

In the fall of this year the Air Force will release the hardware contract for the system which will call for production of six Tactical Air Control Squadrons, each squadron consisting of one TACC, one CRC, two CRPs, and two DASCs.

Microelectronic equipment proposed for use in 407L by Data Systems are the advanced versions of the division's L-304F General Purpose Computer, a 16 inch Modular Multipurpose Display and, on an option basis, DSD data links.

The system and the needed personnel to operate it, according to the DSD proposal, will be housed in shelter modules, some of which will have hard walls and will be similar in size to those used in the Marine Tactical Data System. A second type of shelter module will embody a revolutionary new concept. These shelters will have flexible walls and have been designated DS-1000.

Key features of the flexible shelter module are that it is easily folded for transportability, can quickly be set up in the field, and is made of rugged material for high reliability under stringent usage conditions. According to Litton engineers, there is no known company in the United States currently producing a satisfactory shelter for 407L; this made it necessary for the DS-1000 shelter to be developed with Litton in-house funds. DSD proposes using the DS-1000 shelter in all three operations centers.

Experience in advanced data processing systems is being applied to other than hardware uses by Data Systems division. In a joint effort with Litton's Westrex and Mellonics divisions, DSD established the Litton Scientific Support Laboratory (LSSL) at Fort Ord, California, in response to a recently acquired Army contract.

Making use of the science of electronic data processing and telemetry, LSSL scientists and military personnel are part of a unique unit – the Combat Developments Command Experimentation Command (CDCEC) – the only one of its kind in the U.S. Army. Their job is to focus on the tactics and equipment American fighting men will use on some battlefield of the future.

CDCEC, the largest subordinate unit of the Army Combat Developments Command whose headquarters is at Fort Belvoir, Va., is the "laboratory" where doctrines, concepts and tactics are tested to provide answers to such basic and vital questions as: how will tomorrow's Army fight? how should it be equipped? and how should it be organized?

To help answer these questions, CDCEC was established in November, 1956, at Ford Ord.

Commanded by a Brigadier General, CDCEC has the mission of testing concepts and equipment and the gathering and evaluating of data to be used in the fashioning of tomorrow's Army. They also develop standards of methodology for tests and evaluations.

In addition to CDCEC's general and special staff sections, it is composed of four project teams, augmented by civilian scientists (LSSL) on contract to the command, a large electronic and instrumentation section, plus troop command.

The troop command consists of the 194th Armored Brigade, primarily with a tank battalion, a mechanized infantry battalion, an armored squadron and a composite artillery battalion equipped with both 105mm and 155mm self-propelled howitzers among its equipment. Supporting units include a Combat Engineer Company, and a maintenance company. Supporting groups – General and Instrumentation – also have assigned to them, a Transportation Company, a Signal Company and the Meteorological Team.

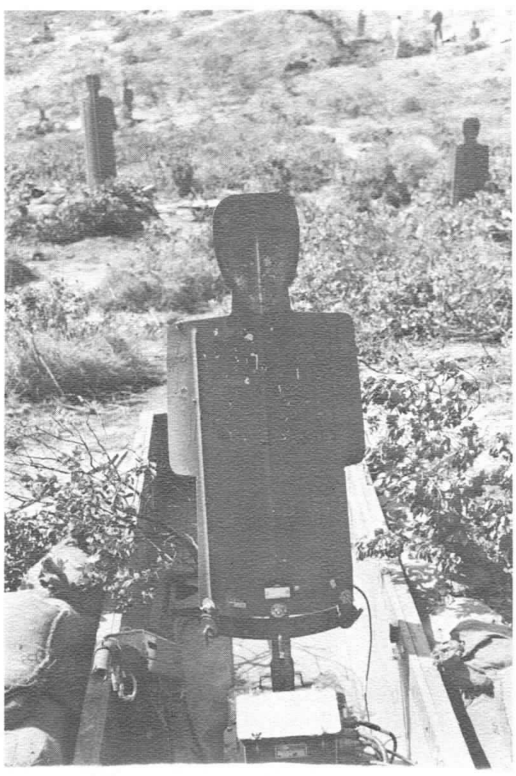
In controlled experiments, using the latest instrumentation and telemetry equipment, the soldier-scientist teams run the gauntlet in tests from the effective deployment and tactics of the infantry rifle unit to the survivability of aircraft against small arms fire.

While most of CDCEC's sophisticated instrumentation and recording equipment is purchased from commercial manufacturers, some is designed and fabricated by the teams to fit specific experiments. Other components are made to Department of Army or Department of Defense specifications.

At the conclusion of each experiment, the data is compiled and the team report written and forwarded to higher headquarters, the Combat Developments Command, who in turn make recommendations to the Pentagon.

Gun-fire simulator, seen at lower left of the target in foxholes gives reality to the combat soldier in training with its life-like noise and flash. The gun can be programmed to stimulate rifle, automatic or machine gun fire. Computer operated tape (photo at right) records the "hits" and can be used to operate a number of the gunfire simulators. U.S. Army Photos

LSSL - Looking Toward the Army of the Future



Men at the Top

C. GORDON MURPHY
President

Murphy joined DSD in 1964 as vice president, Program Management, and was appointed president of the division in February, 1965.

Prior to joining Litton, he was at Hughes 11 years, holding such positions as associate director, Space Systems division; program manager, SYNCOM Communications Satellite Program; and associated synchronous satellite efforts; director, Advanced Program Development during Hughes' diversification efforts in 1959-61; associate manager, Washington Office; and manager, Research and Development Contracts.

He received a BS degree (with honors) from the California Institute of Technology and a Master of Business Administration degree from Harvard University.

Photo by Kedroff

JAMES R. MELLOR
Vice President
Advanced Programs

Mellor's responsibilities include the planning, coordination, and direction of the division's efforts to acquire new business, as well as the management of these programs after acquisition. This encompasses marketing, company-sponsored research and development programs for advancing the state-of-the-art, as well as the system engineering and system integration for the above activities.

Organizations that fall under his jurisdiction include the Systems Analysis Laboratory, Military Requirements, Advanced Navy Systems, International Systems, Avionics Systems, Air Force Systems, Army Systems, and Advanced Marine Corps Systems.

He joined Litton in 1958 as a research scientist for the MTDS Program office and rose rapidly to his present position. Previously, Mellor was associated with Hughes as head of the Systems Design and Integration organization; the U.S. Army Signal Corps Engineering Laboratories as head of Electronics Display Circuits, AN/FSG-1 System; and the University of Michigan on a research and teaching fellowship in the area of development and high density storage tube display and control.

He holds patents in high intensity storage tube field, rapid electronic survey device, and large scale command display system and is credited with writing over twenty papers in these areas.

A graduate of the University of Michigan, he holds BS and MS degrees in electrical engineering and an MS in mathematics.

DR. ROBERT C. PRIM
Vice President and Director
407L Program

On July 23, 1965, Dr. Prim was appointed to head the 407L Program through the Contract Definition Phase. He had held the position of vice president, Research & Engineering since he joined DSD in March, 1964.

At the age of 19, he was graduated with a BSEE from the University of Texas. Later he earned an MS and a Ph.D in mathematics from Princeton University, where he also served as research associate in mathematics for one year.

Dr. Prim joined the Bell Laboratories in 1949. From then until 1961 he was engaged in consultation, research, and management in the fields of mathematics, theoretical mechanics, semiconductor physics and systems analysis. He also conducted broad studies of air and missile defense systems. In 1958, he was appointed director of Mathematics and Mechanics Research at Bell Labs.

During his career, he has participated in a number of government projects including serving on the Gaither Committee which studied the country's over-all strategic posture for the White House in 1957. From 1961 to 1963, while on loan from the Bell Labs, Dr. Prim served as special assistant for Command and Control to the director of Defense Research and Engineering. He was awarded the Secretary of Defense's Meritorious Civilian Service Medal. Immediately prior to joining DSD he was vice president of Research for the Sandia Corp.

Photo by Kedroff

He holds one patent and is the author of 22 technical papers in the fields of fluid dynamics, transistor physics, and network theory, in addition to many classified papers.

CHARLES A. KRAUSE
Vice President of Engineering and Manufacturing

In 1960, Krause joined Litton as manager of the FSG-1 Retrofit program and has risen progressively to his present position. Other positions he has held at DSD include director of the Marine Tactical Data Systems programs, director of Operations, and vice president of Operations.

As vice president of Engineering & Manufacturing, his responsibilities encompass Computer Projects Engineering, Subsystem Projects Engineering, Equipment Engineering, Electronic Engineering, 407L Project Engineering, the Van Nuys Manufacturing organization and the division's Salt Lake City Facility. He is also acting director of Product Effectiveness (Quality, Reliability and Value Engineering).

Krause brought to Litton 15 years of experience in the management of the design, production, and support phases of data systems projects, design and mechanization of data processing systems, and research and development in components, circuitry and system techniques. He has held key positions in such firms as the Nortronics division of Northrop; the Norden division of United Aircraft, NCR, and Hughes.

A graduate of Iowa State University (BSEE) and Purdue University (MSEE), he is credited with four published technical articles and three patents.

Photo by Kedroff

KEN WALSH
Vice President, Administration

Walsh's responsibilities include the performance of Contract Administration, Integrated Logistic Support, Materiel and Subcontracts, Technical Information, and Special Products departments. Established last March, Special Products is the only semi-autonomous department at DSD, operating like a small company with its own marketing, engineering, manufacturing, planning and expediting capabilities.

In addition, the newly established Litton Scientific Support Laboratory (LSSL) at Fort Ord, Monterey, is under his jurisdiction.

Walsh joined DSD in 1961 as manager of the Contracts organization and progressed to director of Contracts and Pricing; and to vice president of Administration in March, 1965.

Previously, he was associated with Marquardt Corp. for ten years and has been an instructor of administration and political science at the University of Southern California.

Walsh holds a BA from the University of Iowa and an MS from the University of Southern California – both in administration. He has also completed course work for a Ph.D in administration.

Photo by Kedroff

JOHN D. SMITH
Vice President & Director
Marine Tactical Data System Programs

Smith is responsible for Systems Engineering and the Production and Support departments associated with the MTDS programs.

He joined Data Systems in 1962 as manager of the Mechanical Engineering department and was promoted to director of Engineering that same year. In March, 1964, he was appointed to vice president.

Smith brought to Litton 23 years of experience in engineering, much of it in the area of the management of the design of large data processing systems. Prior to joining DSD, he was manager of the Display Laboratory at the Hughes Ground Support Systems with a responsibility encompassing design and construction of display equipment for the Naval Tactical Data System.

He holds a BSEE from the University of Denver and an MSEE from the University of Southern California.

Photo by Kedroff

The TAOC is designed to bring automation to the battlefield by helping Marines direct supporting aircraft and missiles. It contains automated command features never before available and is the only system of its kind in the Free World.

The key characteristic of TAOC is its transportability. It can be moved speedily to inaccessible battlefields, as in Viet Nam, and set up for operation.

The TAOC is made up of 13 huts and several radars which can operate in the most primitive environments. All major decisions of the TAOC flow from operators in huts equipped with electronic control and display equipment.

Marine Tactical Data System

Data Systems Division is more than mid-way toward completion of one of its oldest and largest contracts.

The contract calls for the design and production of seven Air Operations Centrals (AOCs), an advanced command and control system using some microelectronic technology and designed to help the U.S. Marine Corps coordinate air control missions.

AOC System #1 has been accepted preliminarily, and is undergoing government evaluation tests. Final acceptance on AOC #1 is expected in September. AOC Systems #2 and #3 have been delivered to the field for final integration tests. System #4 is due for delivery soon and production of System #5 will be completed in August. Production of Systems #6 and #7 will begin in the fall.

The Air Operations Central (AOC) is the heart of the Marine Tactical Data System (MTDS); when radar sensors (which DSD does not build) are added to an AOC, the system becomes known as the Tactical Air Operations Central (TAOC).

The operators sit before display consoles containing large cathode ray tubes (resembling the screen in a television set), a target acquiring pencil and various punch keys. With these electronic tools, they can follow all the air activities tracked by the radars and processed by the TAOC computers.

A large amount of tactical and operational data on each displayed target is available to the operator in the form of readouts from the TAOC's central computer through the operator's use of the target acquiring pencil. The readouts provide the operator the necessary information to make appropriate tactical or operational decisions.

Using the communication channels in the TAOC, operators implement their decisions by selecting the appropriate interceptor aircraft and/or missile and transmitting the necessary command data to the inteceptor(s) or other operations center(s).

Data Systems Division
Litton Industries
P.O. Box 7601
Van Nuys, Calif.

D A ERIKSEN
10339 ZELZAH AVE APT 45
NORTHRIDGE CALIF