

GEC AVIONICS

ISD

INSTRUMENT SYSTEMS DIVISION

Open Day Open Day Open Day Open Day

Saturday October 10th 1987

10:00am to 4:00pm.



WELCOME TO ISD

Whether you are here today as a Company Employee, a relative, a family friend or an invited guest may I offer you a sincere welcome to Instrument Systems Division.

The pages of this brochure will introduce you to our business and our products. Apart from getting a feel for advanced technology and the importance of our involvement in a worldwide export market I hope you will also identify with the many and varied contributions of the employees of the Division. Every member of the staff plays a part in the success of our business and I trust this will become apparent to you during your visit.

Instrument Systems Division, like most of the divisions at Rochester, is to all intents and purposes a self contained company with its own Marketing, Engineering, Production, Quality Assurance and Commercial personnel. Our Division employs nearly 600 people with a wide range of skills including many types of Engineers, Contracts Officers, Wiremen, Fitters, Testers, Buyers, Secretaries and Clerical staff. We have tried to present the Division to you as close to a normal working day as possible. Our products are sold in the United Kingdom and worldwide, with major exports to the United States.

We have two main product areas - Air Data Computers and Stores Management Systems. We have made Air Data Computers for thirty years including those fitted to the Buccaneer, VC10 and BAC 1-11. In recent years we made a major break-through in producing a microprocessor based

air data computer for helicopters which uses a unique swivelling pitot-static pressure probe to determine essential air data parameters in all three axes, including low speed operation. We have sold over 1000 of these systems for the Bell/US Army - Cobra Helicopter.

Our other line of business is Stores Management Systems. Modern military aircraft such as the Tornado do not have a bomb bay and all the stores it carries must be hung under the wings or fuselage on pylons. To release these stores at the right time and in the right sequence is essential if the aircraft trim is to be unaffected. Our twin channel digital stores management system does this and provides the high degree of safety required to ensure that stores cannot be inadvertently dropped or released in the wrong sequence.

Our last Open Day was in 1983 and those of you who visited us then will see many changes. ISD has grown considerably since then:

from 418 to 575 people
from £12 million annual sales to £40 million
from 1250 units per year to 3000

Much of this growth has been due to one project, the Standard Central Air Data Computer (SCADC). You will see this product in the five forms in many areas of the Division. The development contract was won in 1981 against American competition and we have current orders for 4000 units giving work for our staff well into the 1990's. Yesterday on the 9th October we celebrated the delivery of the 1000th unit, a significant milestone achieved in one year of production for the US Airforce and Navy.

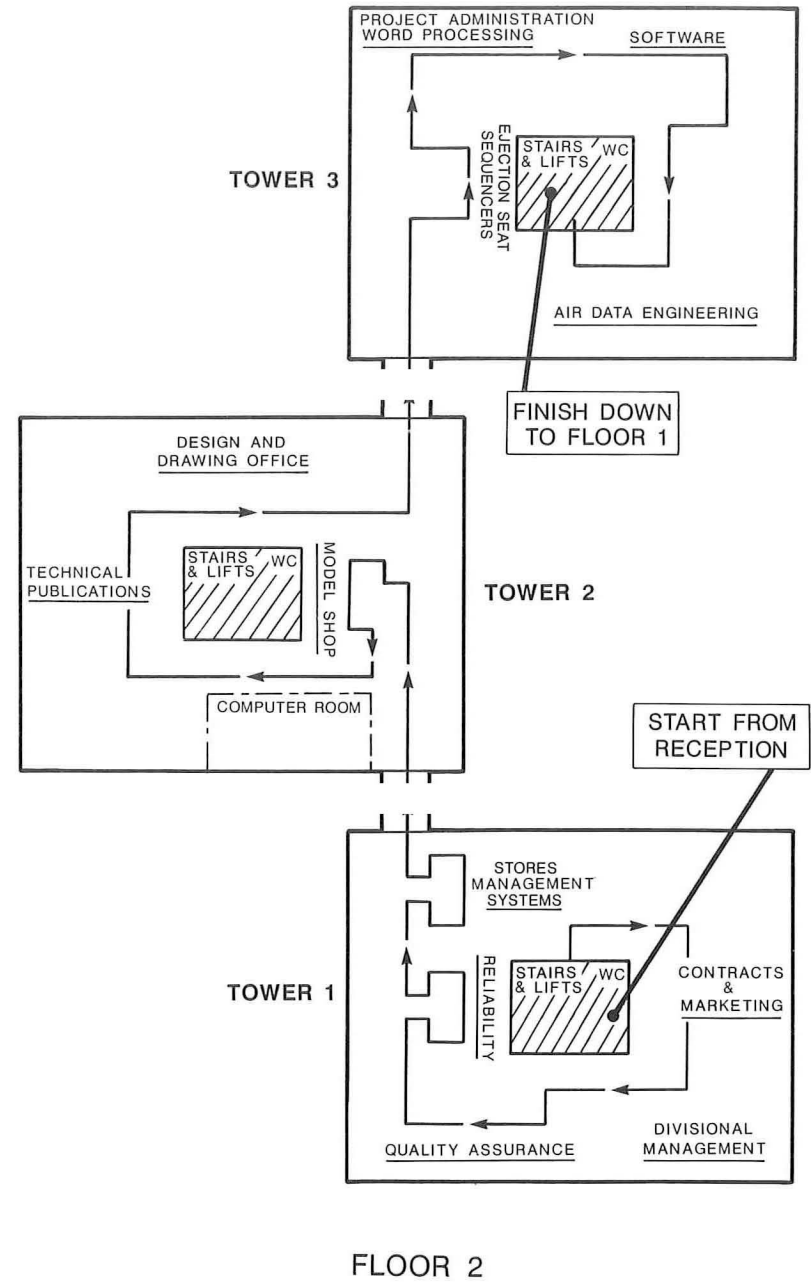
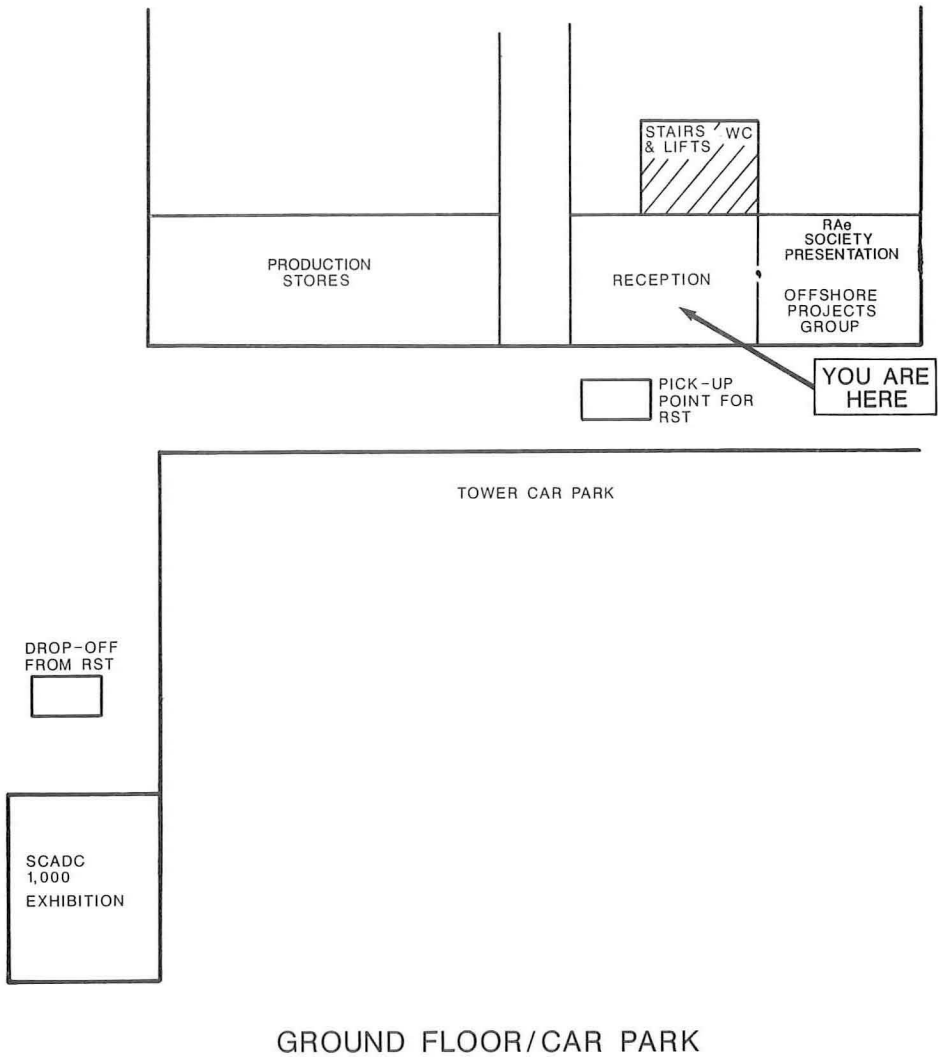
Avionic's is a demanding and challenging business requiring special skills and dedication. I am pleased to say that in Instrument Systems Division our people have the skills, dedication and determination that make a winning team.

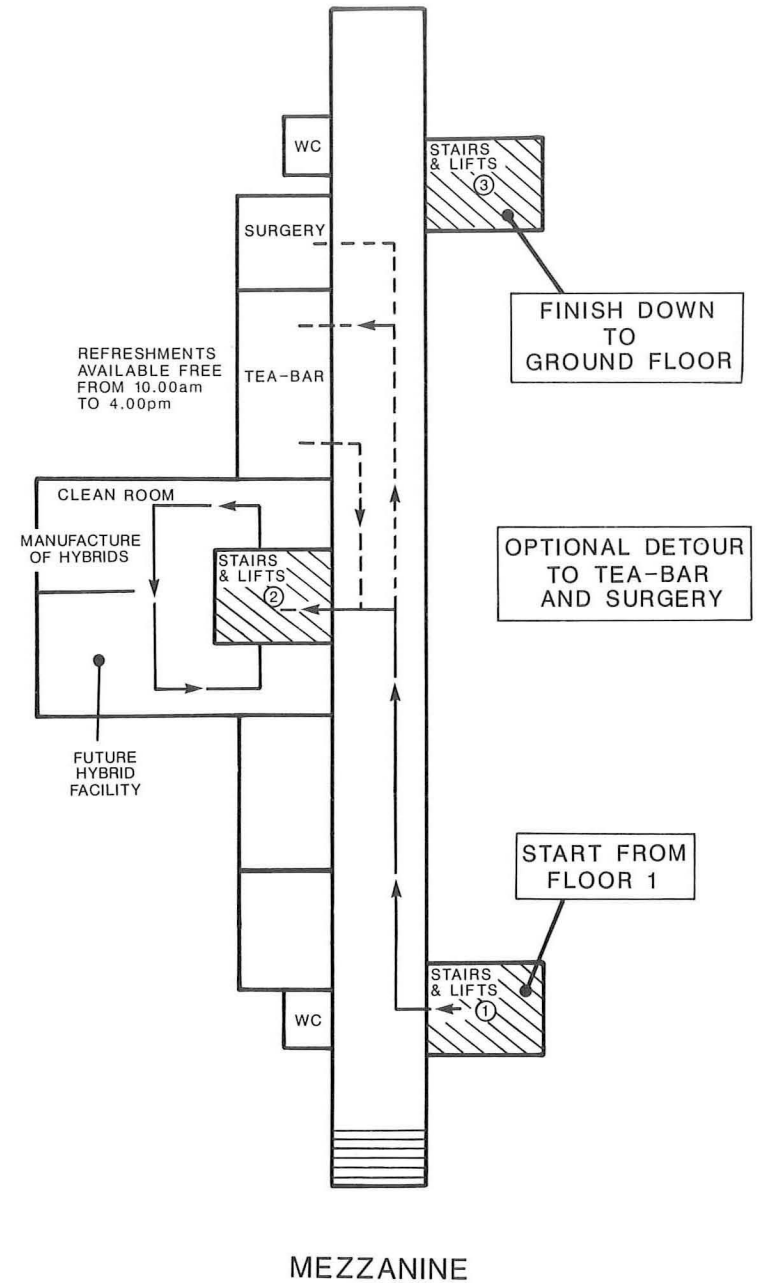
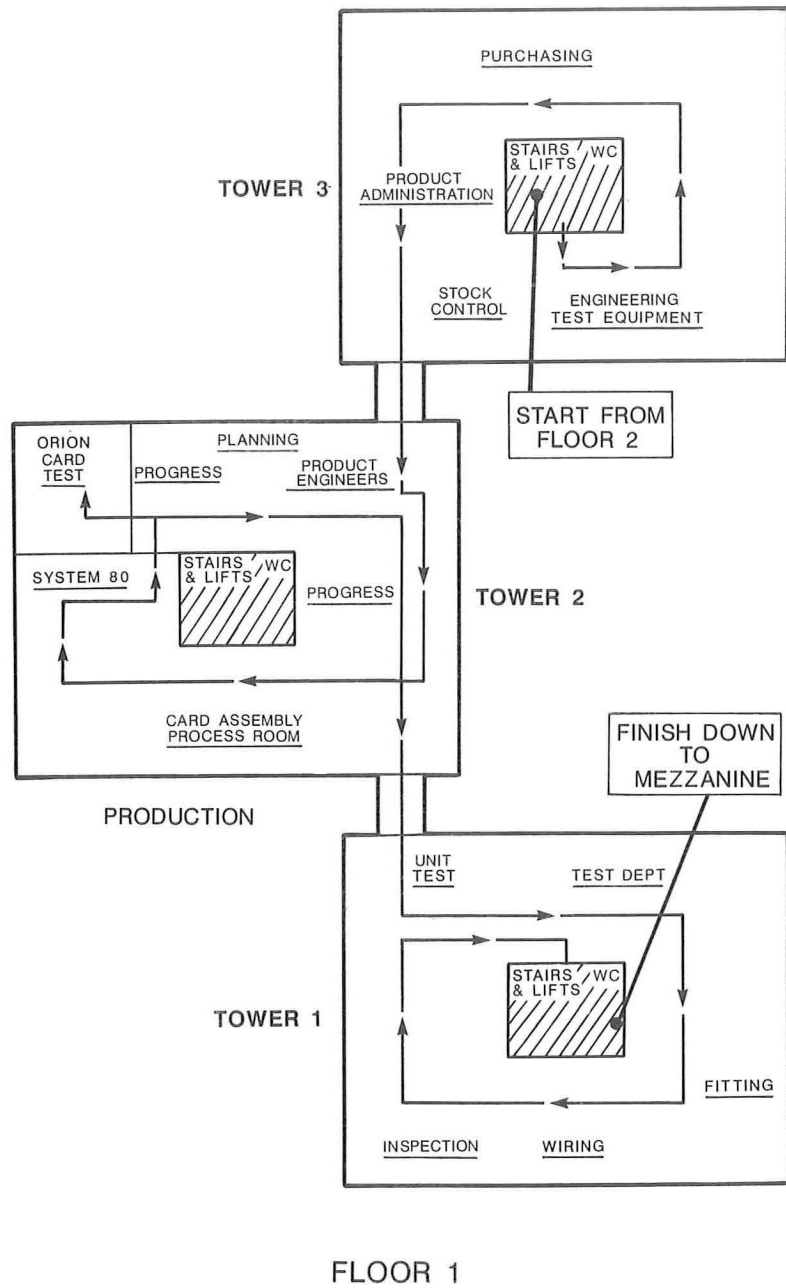
I hope you enjoy your time with us, find time to visit all the facilities but pause for refreshments on the way round.

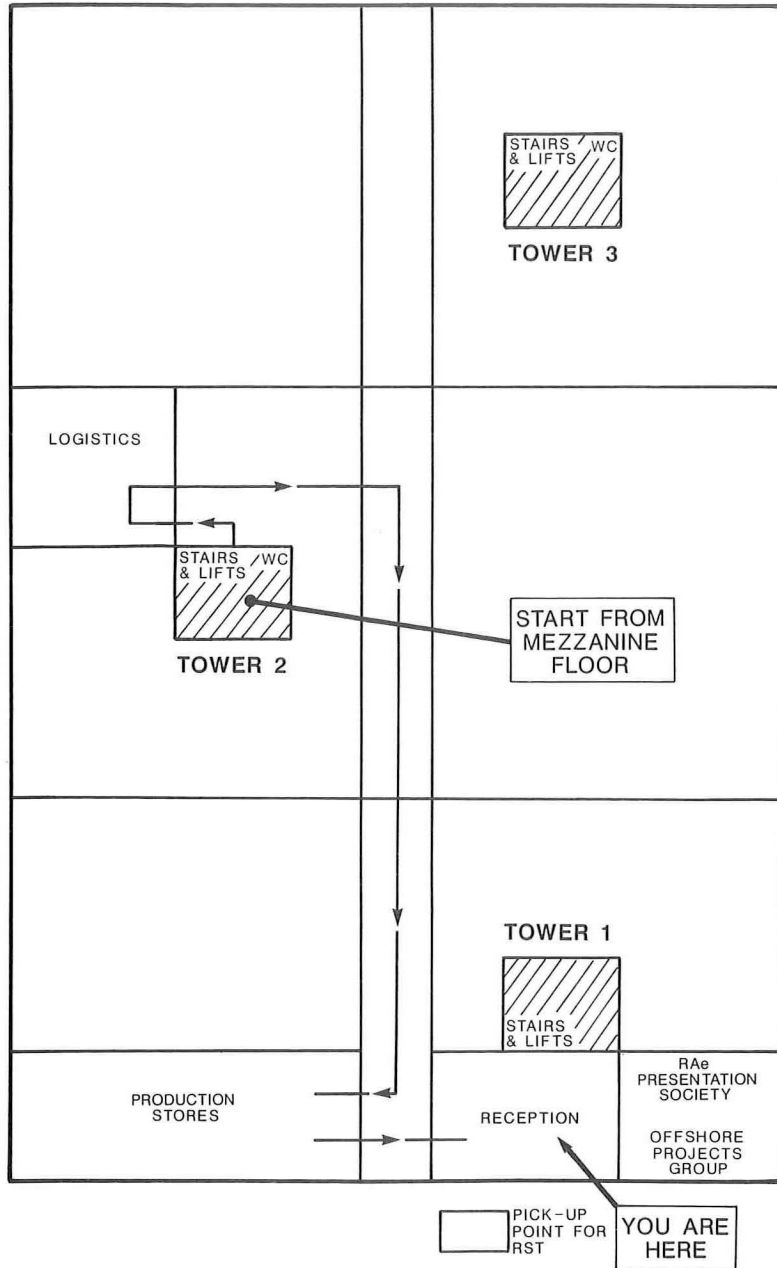

F. T. MACKLEY
DIVISIONAL MANAGER

OPEN DAY VISITORS

To avoid congestion please
follow route illustrated.







GROUND FLOOR

THIS IS HOW WE DO IT

DIVISIONAL MANAGEMENT

The Divisional Manager, Fred Mackley is responsible for all aspects of the Division's business and has senior managers to control the separate functions:

- Business Development/
Commercial/Financial: Peter Hewlett, Deputy Divisional Manager
- Engineering Department: Dave Silsbey, Technical Manager
- Production Department: Fred Wickham, Production Manager
- Quality Assurance Department: John France, QA Manager
- Microsystems: Stewart Inchmore, Microsystems Manager

These major departments are in some instances further divided as described later in this brochure.

MARKETING

The Marketing Department is responsible for keeping the division competitive in our market places around the world. Computer based market research data is used to monitor all potential business areas and the progress of new aircraft programs.

To ensure that potential customers are well aware of our capabilities considerable investment is made in sales brochures, videos, airshows, exhibitions and sales presentations and customer contacts.

ENGINEERING

This department comprises some 280 people involved in all technical matters from initial inquiry through to in-service support.

Technology advances and the need to tailor our products to meet customer requirements necessitate Engineering involvement even at the stage of initial customer inquiries. This 'marketing support' activity continues through study phases to submittal of detailed technical proposals. Upon receiving a contract for new equipment, Engineering activity then extends to the detailed design, development, evaluation and flight test of the new product. Engineering support of these tests is the key to the success of the program, and often involves long periods at the customer's premises.

An essential task is to produce the detail drawings to enable the product to be manufactured. Once the prototype equipment has been fully tested and accepted by the customer the finalised drawings are released for Production to commence. Engineering support is required throughout the Production program to investigate problems and introduce design improvements.

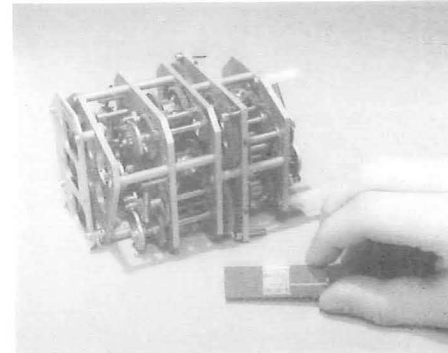
The department includes teams dedicated to test equipment, publications, post design services and logistics support who ensure that the equipment is adequately supported throughout its lifetime. They provide specialist test equipment, technical manuals, training, product improvements and spares and ensure that there is always expertise available to assist with any inquiries or problems that may develop.

A typical major equipment program requires 5 years to develop, with subsequent production and support over 20 years. With upwards of 20 major programs, spanning 20 years of technological change, in progress simultaneously it can be seen why the Engineering Department necessarily comprises approximately half of the total divisional personnel.

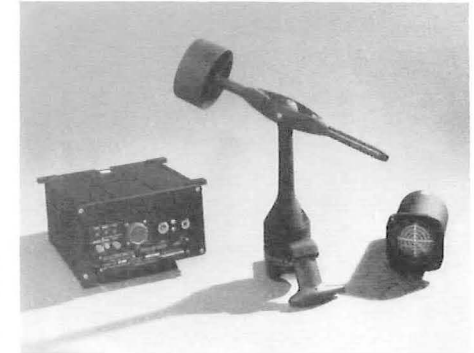
Within this large group, the various sections have specific duties and responsibilities as follows:

Air Data Projects Group

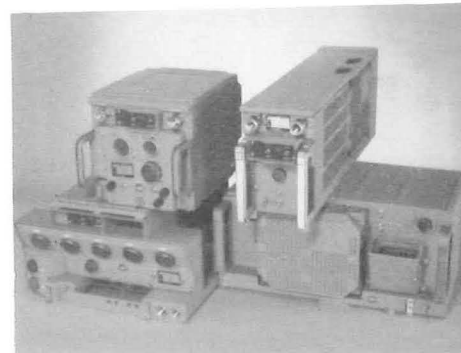
Encompasses project teams developing Air Data Computers for various fixed wing aircraft and helicopters. These computers sense features of the atmosphere such as pressure, temperature and direction of airflow and provide accurate output information such as height and speed to the pilot and to other systems on the aircraft.



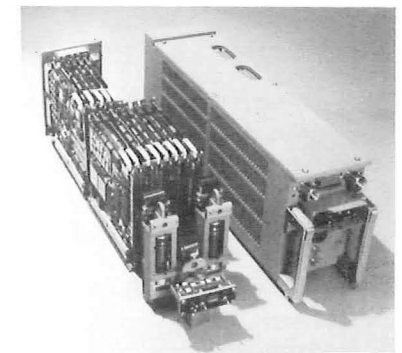
Analogue Computing Module and Digital Module which perform the same task



Helicopter Air Data Equipment fitted to the BHT Cobra



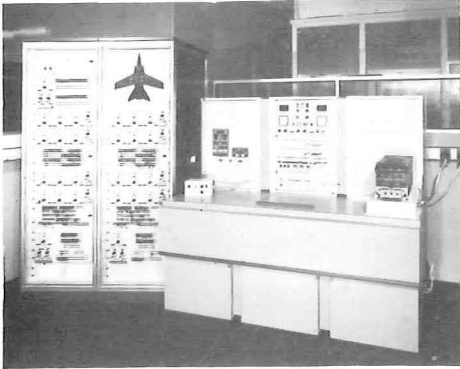
These 4 ADCs use 85% common parts and fit 35 different American aircraft



Digital ADC (cover removed)

Stores Management Systems Group

Stores Management Systems are required to assist the pilot in managing the wide range and complexity of stores carried on modern military aircraft. The major activities of this group include continuing support of the Stores Management System for the Tornado aircraft, and the development of a general purpose system, based on a modular concept. This new system provides great flexibility to meet the needs of future aircraft.



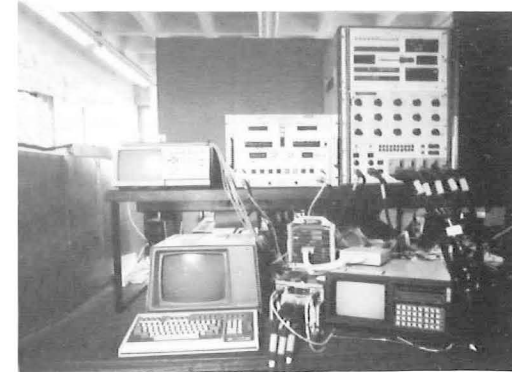
SMS Test Rig



VAX 870

Software/Engineering Group

The Software/Engineering Group works closely with the project teams to develop the computer programs which are a vital part of Digital Air Data and Stores Management Systems. The majority of these programs are related to microprocessor applications in the deliverable equipment or associated test equipment, and are developed using our own computing facilities which include a VAX 87001a, GEC 4085 system and a VAX 11/750. Powerful microprocessor development support systems provide the link between these general purpose computers, and the equipment which the software is designed to control.



Software Rig

Design Services Group

Mechanical Design, including electronic modules, detailed manufacturing drawings and prototype manufacture are the responsibilities of this group.

Increasing complexity of electronic systems, and ever reducing timescales for new product development have been matched by progressive introduction of Computer Aided Design facilities. The Applicon CAD system provides powerful tools to quickly and accurately carry out the tasks associated with design and detail drawing, as well as the more creative aspects of the design task.



Applicon CAD Terminals

The Model Shop is a small self contained manufacturing group covering a wide range of mechanical and electrical fabrication and assembly skills. They assemble models and prototype units, often using the barest minimum of design scheme information, solving the manufacturing problems on the job as they arise.

Post Design Services

After a product is established in service the responsibility for its support is handed over to the Post Design Services group who maintain production support, liaison with the customer and the development of production improvements.

Technical Publications

Employs the skills and processes of technical writing, illustrating, photography and reprographics to produce the vast array of technical documents required to support development and in-service equipment.

Also heavily involved in the marketing task, producing sales literature, presentation material, and Proposal documents.

Reflecting the general increased use of computing facilities, Word Processors and Graphics Work Stations are used to establish and maintain the documentation data base.

Logistics

Support of the Division's products, through development and in-service is essential. Equipment becomes very difficult to use if the test equipment, spare parts and related documentation are inadequate or if the customer does not know how to use them. The Logistics group ensure that all relevant data is prepared, collated and distributed to fulfil these requirements. Configuration control (identification of the exact standard of both equipment and documentation), packaging and customer training are also covered.

Reliability and Environmental Engineering Group

Equipment in modern aircraft must be shown to work safely and reliably under a variety of adverse operating conditions. To achieve this the engineers in this group provide advice and apply a variety of techniques coupled with extensive testing of the units before they are accepted into service.

Test Equipment Group

Responsible for the development of special test equipment to support products in service. Simple to operate test facilities which quickly and accurately isolate equipment faults are essential in order to minimize support costs. With today's emphasis on cost reduction in all phases of the equipment's life the work of this group is becoming increasingly vital.



A typical Test Set designed for the US Air Force

ISD MICROSYSTEMS

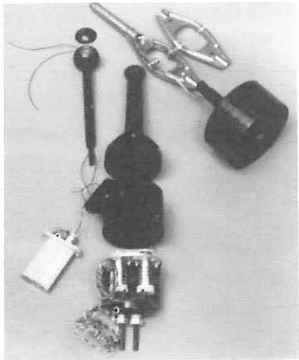
ISD Microsystems was formed recently by combining the Hybrid Design and Prototyping section of ISD with the Thick Film Production Unit from GAv Radlett.

The small clean room area is currently being extended to some 4000 square feet to accommodate the plant from Radlett. When complete the unit will provide a comprehensive Design Prototype and Production facility for Hybrids to all Divisions within GEC Avionics as well as the external companies.

Hybrid technology is the emerging technology for the future and ISD Microsystems are ideally placed to satisfy market requirements.

PRODUCTION

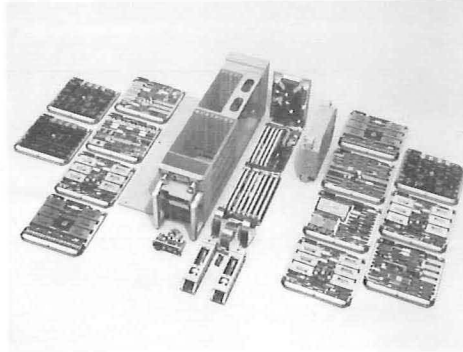
The Production department has increased in size by over 150% in the last year and now employs 240 people responsible for manufacture of the Division's products. Each month over 500 items of equipment are produced for a variety of customers. The department is organised to achieve an 'on time', 'on cost' delivery of equipment built to stringent specification requirements. The variety of the work and the relatively short production runs makes it essential to have a strong team in the Production department who schedule, plan the work, deal with technical matters and generally support the 'direct' workers who assemble, wire, test and inspect the products we supply.



The intricate mechanism of the Swivelling Probe

There has been a rapid change in recent years away from precision electro-mechanical equipment to digital equipment and this has led to a need for our operators to learn new skills and for us to introduce new techniques in material control. Material costs are now a dominant factor in our cost of production.

Computer controlled equipment now plays a key role in the manufacturing process. The Amistar and Royonic machines are used for the semi-automatic assembly of printed circuit boards which are then soldered on the Flow Soldering machine. The completed boards are cleaned to remove flux deposits, inspected on the Dynascope and then checked on the Marconi Automatic Electrical Inspection systems.



Digital ADC in modular form

Functional tests are performed on various types of test equipment much of which is ATE. This equipment comes from a number of sources but the four Orion ATEs have been designed and built by ATE Division at Rochester and the Automatic Transducer Characterization Stations (which run 24 hours a day, 7 days a week) designed and built on division.

Computers also play a significant part in our material control. The Computer Aided Manufacturing (CAM) suite carries information on Parts Lists, Drawing Lists, Stock Levels and the location of work on the shopfloor. The Production Stores has an automatic Stores Retrieval system which has now expanded to eight machines.

Within the Production Department are sections which have duties and responsibilities as follows:

Scheduling

This section is responsible for the timely execution of all the activities necessary to produce an item on time against a customer's Order. They make wide use of the information stored on the CAM suite.

This section holds over 15,000 Drawings, Specifications and Layouts which are issued to the various Production sections as required.

Stock Control

Stock Control are responsible for ensuring that all piece parts and components are available to meet a build program. There are almost 30,000 items under their control which must be segregated for use on their own relevant contracts. The CAM suite is used to control the movement of stock so that items all become available at the right time.

Buying

Buying are responsible for every item purchased by the Division whether it be material, components or a service. Wherever possible local suppliers are used as this minimises transportation costs and delays and eases any communication problems, however, the nature of our business means that we require many specialised parts and these can often only be obtained from overseas. Many of our components are purchased from the United States and the Far East.

It is the responsibility of the Buyers to obtain the best price, delivery and quality for the items we buy. They must keep a close link with our suppliers at all times to ensure we are aware of technological changes to the items we buy.

Progress

The responsibility to ensure that kits are available for the shopfloor at the correct time lies with the Progress Department. They are required to clear the way of any problems that may delay the program, whether they be technical or administrative.

Planning

Using the set of Manufacturing Drawings, the Planning Engineers compile assembly and wiring instructions for each assembly, or sub-assembly to ensure that fitting and wiring operations are carried out in the most efficient manner. Whenever changes occur to any item which has been 'planned', the Planning Engineer controls the configuration of the item by amending his assembly and wiring instructions.

Incoming Goods and Stores

All parts and components required by the Division enter via Divisional Incoming Goods Section. Parts are inspected for compliance with Order requirements and only when it is confirmed that they are satisfactory are they passed to the Production Stores.

All items in the Production Stores are stored and accounted for on a computerised system.

Production Engineering and Methods

It is the responsibility of this section to study each job in detail and determine the best method of manufacture, taking into account quantity, timescales, cost and facilities available. Recommendations for jigs, fixtures, processes, new equipment and production methods are generated and technical support for the Production Department is also by this section.



Production Store

Process Area

The Process Area is at the heart of the manufacture of printed circuit cards with over 30,000 boards being built annually either by hand or using the Royonic and Amistar computer guided machines and the Flow Soldering system. Over 16,000,000 solder joints are made each year.

This area also contains the Dynascope Viewer, Connect 10 and Marconi Automatic Electrical Inspection systems.



Royonic
Semi-Automatic Assembly



Loading PCBs
on Amistar machine

Fitting

The Fitting section contains skilled and experienced instrument fitters capable of working to tolerances of one thousandth of an inch. The fitters are involved in assembling delicate transducers, capsule units and gear boxes right through to general assemblies and test sets.



Fitting Area



RST Area

Test

Every unit produced in the Division is subjected to a thorough performance test to a procedure agreed with our customer. As the complexity of our equipment has increased so have test times, hence the increasing move towards Automatic Test Equipment. In addition to performance testing in our test section most equipments are also subjected to environmental cycles to highlight any inherent weaknesses in the components or processes used. This additional testing is known as Reliability Shakedown Testing (RST) and involves placing the units in special chambers where rapid changes of temperature and vibration can be applied. There are 20 chambers in our RST area, representing an investment approaching £3,000,000.

The Testers are skilled staff who must have a good working knowledge of the equipment and the ability to quickly locate any faults which may be present.

Inspection

The Inspection Department is responsible for verifying that products are in accordance with the Drawings and other Manufacturing data supplied to the Production Department. They are involved in the inspection of parts and components coming into the Division, stage inspection during build and final inspection of products prior to shipping.

Inspectors have a key role in ensuring that our products comply with the stringent standards and procedures that we have adopted to meet the needs of our customers.

QUALITY ASSURANCE

The success of our business depends upon work being conducted to very stringent levels of performance, reliability and safety. This is achieved by our team of highly qualified Engineers who design and develop our products and our skilled Production team who build them.

Quality Assurance act in an independent role to assist Divisional Management in the planning and verification of the many tasks that are required to ensure that our designs meet the required specifications and that all the items we deliver conform to the defined standard. They are responsible for the final certification and release of our products. If quality problems do arise Quality Assurance investigate them fully and take steps to ensure that they will not reoccur.

Within the Quality Assurance Department is a Barometric Standards Laboratory which calibrates pressure measuring equipment to very precise standards

Over the past two years the Quality Assurance Department has had to introduce new techniques and procedures to deal with the rapidly increasing output of the Division. Much of the data which was collated and analysed manually is now computer generated.

COMMERCIAL DEPARTMENT

The Commercial Department is responsible for administration, financial control and contractual management of the Division's business. This function is performed by three groups of personnel.

Cost and Budget Department controls all of the Division's finances ensuring that expenditure is properly incurred, reported and monitored against the Division's operational budget.

Contracts Department are involved throughout all phases of a contract, this includes bidding for new contracts, contract negotiation and administration, and delivery and shipment of equipments to the customer.

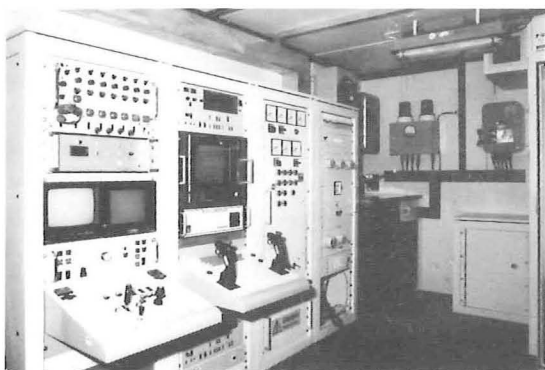
Divisional Services and Administration are responsible for the good housekeeping and maintenance of the Division. This department's function is also to liaise with Personnel, Wages and Mail Departments of the Company.



OFFSHORE PROJECTS GROUP (OPG)

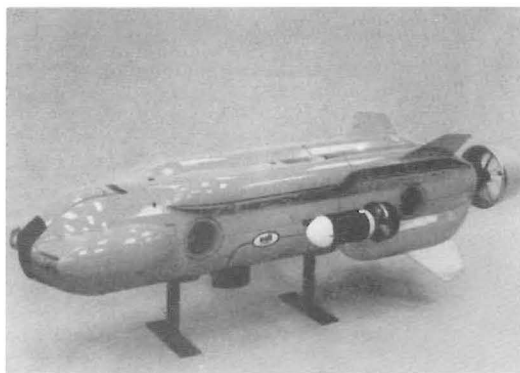
The Offshore Projects Group (OPG) of Instrument Systems Division which is located at Nailsea, Bristol makes use of the wealth of knowledge within the company on high reliability electronic systems to provide equipment for use underwater. Control systems for oil and gas installations in the North Sea and other offshore sites can now be placed on the sea bed with the knowledge that they will require no maintenance for 4 or 5 years. Use of this technology has significantly reduced the cost of extracting oil.

The Offshore Projects team of ISD (based at Nailsea) has developed MICROV - a fast, powerful and manoeuvrable inspection vehicle (Remotely Operated) which is equipped with Sonar and Viewing systems for use in the Offshore Oil Industry, and MIDAS a mine countermeasure ROV. ISD also manufacture subsea controls, incorporating new technologies such as 'touch screen' controls.



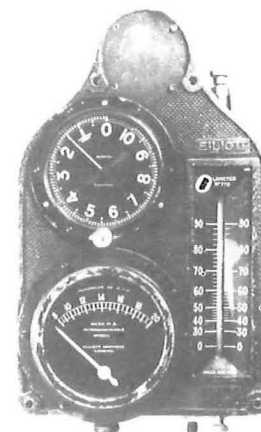
Control Console

MICROV



SOME BITS OF HISTORY

William Elliott started making instruments in the Strand in London in 1800. Two sons joined him in 1830 and formed the original Elliott Bros. New premises, known as Century Works, were opened in Lewisham in 1900 where fine instruments were still made, similar to those made for Faraday and Wheatstone earlier and also Gyros, Gunsights, Bombsights, Tachometers, Altimeters and Fuel Flowmeters for the Admiralty and Air Ministry. A panel of aircraft instruments made by Elliott's was fairly standard fit by the Air Ministry about 1909 - It was also fitted by Short Brothers (the world's first aircraft production factory).



Elliott Instrument Panel - adopted for the Royal Flying Corps in 1913

Between the two world wars the Company expanded and made analogue computers for Naval gun systems, True Windspeed Indicators and Direction Finders for fighters and bombers. In 1940 Elliott, BP Swift and Fisher Controls merged and occupied the old Shorts Factory at Rochester. This established the Rochester connection.

At the end of World War II research was set up at Borehamwood into new electronic equipment, plotting equipment, servo mechanisms, radio and radar, analogue and digital computers. In the 1950's licence agreements with Bendix Corporation in the USA provided work at Rochester whilst at Borehamwood contracts for autopilots, bombsights and a master reference gyro caused the formation of the Aviation Division. Among the successes were an autopilot for the Lightning aircraft, the inertial navigator for the Blue Steel missile and a navigation system for the Vulcan Bomber.

Aviation Division split into several divisions towards the end of the 1950's and Flight Instrument Division (FID) was one of these. FID together with AEID was the forerunner of ISD as we know it today. By 1962 all the divisions had transferred to Rochester and Elliott Flight Automation was formed. FID were producing Modular Air Data Computers for Lightning, Buccaneer, Nimrod, VC10, BAC 1-11, TSR2 and Jaguar. The cancellation of TSR2 was a blow in 1964 and we turned our eyes towards the United States market. FID obtained a contract for the C5-A Galaxy Transport Aircraft in 1967 which proved to be a foundation stone for future contracts from the USA. A plant was set up in Atlanta, Georgia USA in 1967 to satisfy our American customer requirements. In the same year we (Elliott Flight Automation) became part of the GEC group of companies as Marconi Elliott Avionic Systems Limited. This period was very successful and we won the Queens Awards to Industry in three successive years 1968, 1969 and 1970, the last being for Export and Technological Achievement.

In 1970 ISD was formed and we developed Digital Air Data Computers and Stores Management Systems. Development of Helicopter Air Data Computers continued with the swivelling probe and force balance transducer. In 1971 the contract for the Tornado IDS, SMS was awarded to the Division. The Tornado SMS is now in service and the intervening years have provided ample evidence to confirm the success of the features originally proposed. The Tornado SMS is early 1970s technology and this fact, together with an obvious need for simpler systems in certain applications, has led the Group to consider the capabilities of a new range of SMSs which is called the Modular SMS range. Since 1982 the SMS groups activity has been to define and carry out initial design of a range of plug-in avionic modules which can be packaged in different combination types and quantities into two unit sizes for individual customer requirements.

We used our aviation expertise in 1976 to develop a fail safe control system to be fitted to Well Heads on the floor of the North Sea. Our Nailsea Group supplied units for the recently opened BP Magnus Field. In 1977 our interests in Fuel Flowmeters were transferred to Powerplant System Division. In the same year our effort on Helicopter Air Data Systems were rewarded when we won the contract to supply the Air Data Subsystem on the Bell Helicopter Cobra AH-1S.

In 1981 we won the contract to develop the Standard Central Air Data Computer which is fitted to thirty-five aircraft variants in the USA.

ISD has now received all three production orders totalling \$135 million from the United States Air Force, for production of Standard Central Air Data Computers (SCADC). ISD began producing in late 1985 and is currently delivering units at a rate well exceeding 100 per month, a record for such equipment. This program, which alone accounts for 11% of all UK exports of aviation electronics, has created over 2,400 jobs for ourselves and our 80 UK subcontractors. The performance and reliability of these computers in service is already proving the wisdom of the US Air Force and US Navy decision to standardise with a range of latest technology air data computers. ISD is employing the latest production techniques in achieving these high delivery rates, including the use of ATED's commercially-developed ORION automatic test equipment.

ISD is at the forefront of ejection seat microprocessor-based technology. We are working with RAe Farnborough on an advanced ejection seat research program for which we are developing a flexible system which provides a multiplicity of outputs. This system will set new standards in performance and ultra reliability, thus enabling escape system safety envelopes to be significantly expanded.

