Radar Systems International

MARCONI

No. 6

More S600 Series Radar for Malaysia

Marconi Radar Systems to supply third transportable defence system

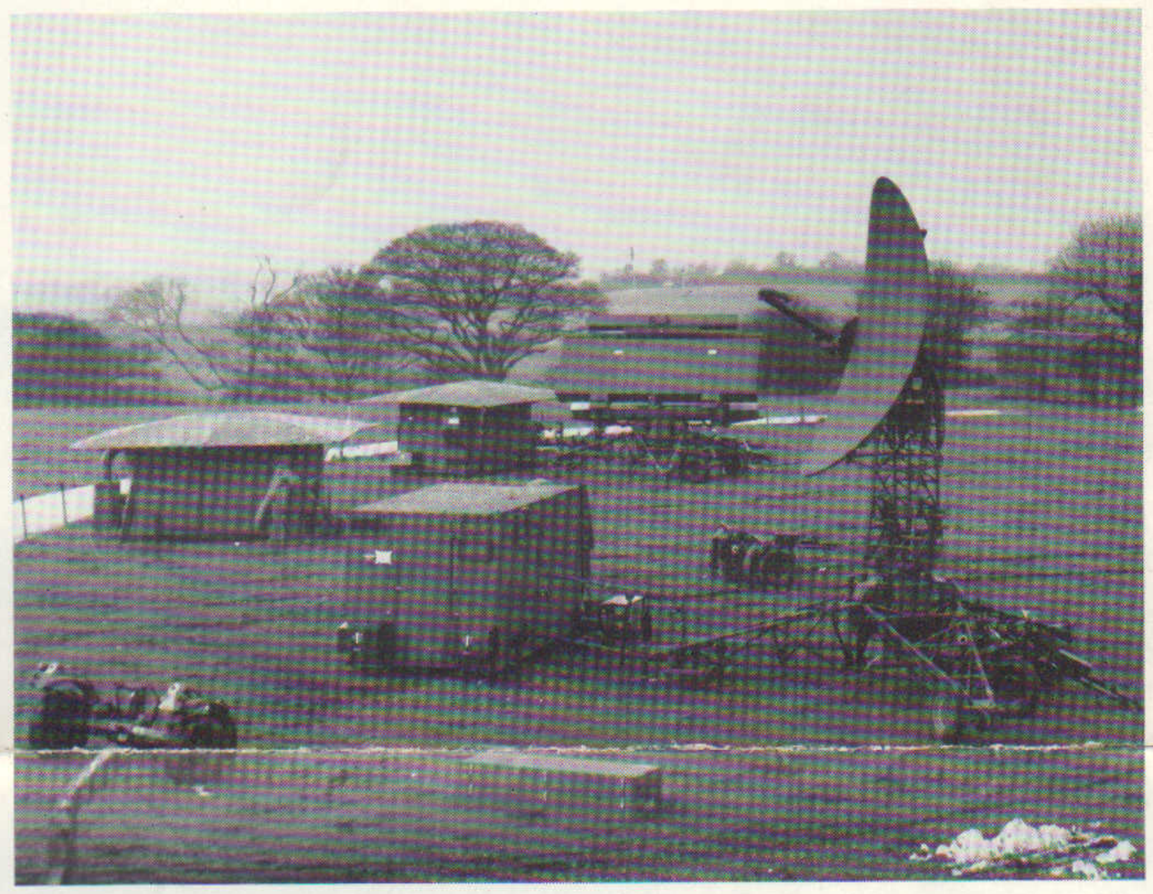
The Malaysian Government has ordered a third transportable defence radar system from Marconi Radar Systems Limited to supplement the two similar systems ordered from the Company a year ago (as announced in the No. 2 edition of this Journal). This latest order brings the value of this series of Malaysian contracts to nearly £3 million. Total world sales of the S600 now stand at around £10 million.

Based on the Marconi S600 range of radars, the equipment will be of major importance in Malaysia's defence planning. Delivery schedules in the contracts are extremely demanding with all three systems due to be in Malaysia by the end of 1971. Marconi's ability to meet this time scale played a significant part in winning the orders.

The Company is assisting the Malaysian Government with site surveying and technical advice, as well as providing extensive training and support services. Royal Malaysian Air Force personnel have already started a comprehensive course at the Marconi College in Chelmsford, Essex, and another party will arrive at the beginning of next year.

The S600 Series is a comprehensive range of compatible radar units and auxiliary modules from which defence or civil systems of varying complexity can be assembled. It can meet requirements ranging from simple coast surveillance to complete national defence.

Unique in its flexibility and mobility, the S600 Series has recently been subjected to exhaustive helicopter air lift trials in the United Kingdom which have again emphasised how quickly and easily systems can be transported from site to site and brought into operation.



A transportable S600 Series radar system comprising 10 cm (S) Band Surveillance and 5.5 cm (C) Band Heightfinder radars, with their Electronics Cabins and (left) an Operations Cabin, deployed at a Marconi Test Site

MARCONI RADAR IN NEW GUIDED WEAPON DESTROYER FOR ARGENTINE

Over £3 million order for target tracking radars

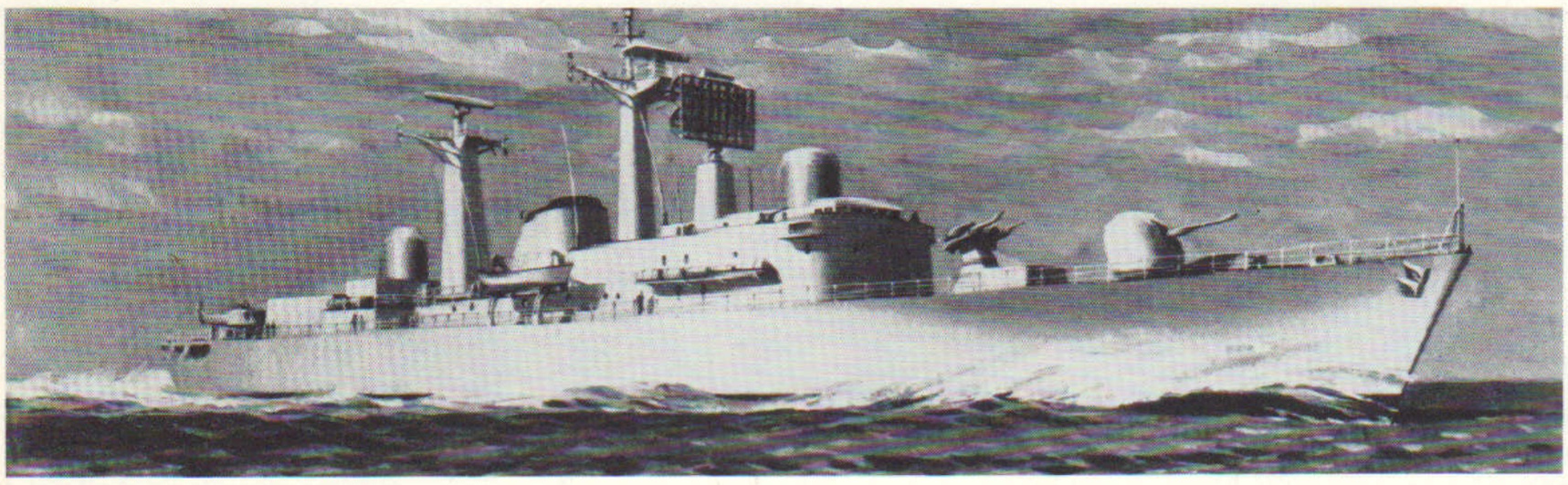
Two Type 42 Destroyers recently ordered by the Argentine Navy are to be fitted at a cost of well over £3 million, with target tracking radars made by the Leicester establishment of Marconi Radar Systems. It is the first export order received for this radar, Type 909, possibly the most advanced of its kind in the world.

As a sub-contractor to Vickers, who are building the first destroyer in Barrow and supervising the construction of the second in Argentina, Marconi will supply four 909s, two for each ship. The systems, used with the SEA DART surface-to-air missile, automatically acquire and track targets and 'illuminate' them with radar beams which reflect back to the missile's receiver to act as homing signals. The complete SEA DART system (GWS 30) is being installed in Royal Navy Type 42 and Type 82 destroyers as the main British naval air defence system.

Marconi Radar Systems will also supply a range of spares and tools to be carried on each of the Argentine Navy vessels. The Company will be supervising the installation of the radar systems in the destroyers and will take part in acceptance and handover trials in both UK and Argentinian waters. It is expected that both destroyers will be in service by the mid-1970s.

The 909 Radar

A single 8 foot aerial of the Cassegrain type is used to provide both tracking and illuminating facilities. The radar incorporates a number of special features designed to reduce the effectiveness of enemy jamming and other counter measures or decoy techniques being used by the selected target.



An artist's impression of the new Type 42 Destroyer (by courtesy of Vickers Ltd.)

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The show within the show!

Once again Marconi Radar Systems put on a show of a complete air defence radar system at Farnborough '70 with the well proven S600 series radar. This year the 23 cm (L) Band radar was employed for surveillance cover instead of the 10 cm (S) Band radar used at Farnborough '68. Well over a hundred thousand square miles of airspace was under constant surveillance by the completely transportable, high power complex, made up of an operations cabin and the 23 cm (L) Band and 5.5 cm (C) Band aerials each with their associated electronics cabin.

Providing plan position, height, track and speed data of aircraft within more than 200 miles of Farnborough, the complex employed one of the most advanced display systems in the world, based on digital plot extraction, digital MTI and digital display techniques using a new range of equipment on show for the first time. Visitors to the Marconi Radar Systems pavillion were able to examine the display presentation of the data gathered by the equipment operating in the adjacent radar park.

In the radar park, visitors were able to enter the Operations Cabin Type S5013 in a working environment and to examine the automatic target height extraction equipment and operator displays in operation. The cabin, in its standard form, accommodates four operators, three of whom are provided with 40 cm (16 inch) p.p.i displays Type S3009, automatic height read-out on selected targets and passive selection indentification feature (s.i.f) decoding controls. Control facilities are provided for voice and digital data communication with aircraft and ground stations. The fourth operator acts as an administrative or liaison officer using ground communication control facilities. To obtain a height indication for an aircraft represented on any of the three p.p.i displays, an operator merely moves his trackerball so as to place a display ring marker around the echo of the particular aircraft in question and then presses his 'Request Height' key. The remainder of the sequence of events follows automatically; this includes the height converter unit function of the determination of range and bearing of the marked target, and the determination of heightfinder azication and nod angle so that the heightfinder makes one 'sample nod' on the selected aircraft and a digital read-out of the required height, in hundreds of feet, is given on the operator's console.

The Electronics Cabin Type S5016 was used in association with the 23 cm (L) Band transportable aerial Type S1016. Contained within this cabin was the well proven 2MW L Band Transmitter/Receiver Type S2011 and the new Digital Signal Processor Type S7100 providing double cancellation MTI in digital form, from which data was extracted via the new Primary Radar Plot Extractor Type S7200 and presented on the new Digital Display Type S3015 in the radar pavillion. A good quality, clean radar picture was obtained.

Heightfinder equipment on display included the 5.5 cm (C) Band transportable aerial Type S1017 working in association with the Electronics Cabin Type S5012. Contained within this cabin was the 1 MW C Band Transmitter/Receiver Type S2013 together with an automatic height extractor unit, aerial servo and the necessary dehumidifying and air drying equipment.

The successful transportable S600 Series radar system presentation on the radar park at Farnborough '70. In the foreground is the IVR field site equipment with the transmissometer housing opened for inspection

An IVR field site at Gatwick

IVR WORKING DEMONSTRATION

The Marconi Instrumented Visual Range system Type IVR 1, was shown working in the radar park at Farnborough '70 while a second field site was installed at the edge of the main runway. Following the announcement in the No. 4 edition of this journal, IVR systems are now installed in four major British civil airports, while a system at Manchester and a second system at Heathrow are nearing completion.

The IVR system provides, for the first time, a method for automatically monitoring the visibility on an airfield and presents air traffic controllers with a continuous report of a pilot's visual range along a runway as he lands his aircraft. As such, the system serves to decide the category of flying operations to be conducted and offers an important contribution to terminal area safety.

Measurements of visibility taken by field sites adjacent to the runway are digitized and transmitted over telephone lines to the IVR central processing equipment in the airport central telecommunications room. After computation, the runway visual range is then displayed by digital readout on a six-inch square panel in the air traffic control consoles. At Farnborough, the central processing equipment and a digital display were shown operating from the field site in the adjacent radar park. Hence visitors were able to see a complete IVR system in operation.

SOLID STATE DATA DISPLAY SHOWN FOR THE FIRST TIME

A small size, five digit solid-state data display was shown for the first time by Marconi Radar Systems at Farnborough '70. The display is made up of tiny slices of glass ceramic, no larger than a finger tip, each carrying a matrix of Gallium Arsenide Phosphide light-emitting diodes, which can be switched on to provide a pattern of brightly lit red dots, making up high contrast letters, numbers or symbols. At Farnborough, the display was programmed to give a predetermined presentation of numerals from 0 to 9 and letters from A to Z; the presentation was automatically changed at preset time intervals.

The display was developed at the Research Laboratories of the Marconi Company on behalf of Marconi Radar Systems. Major features of this development are in the production of a display format in which the total area of each character display module is completely utilized as a display surface, and in the development of a matrix addressing system, which enables each character display to be connected to the character generator by 12 wires rather than the 36 wires normally needed to connect each diode individually.

A series of these displays can be arranged in rows to provide number displays, words or even sentences of any length. Since each symbol covers virtually the total area of its support structure, spacing between characters is kept to a minimum and a five letter word or number will occupy only 32.5 mm long by 8.5 mm high. Total thickness of the display unit is approximately 5 mm.

Completely solid-state with an extremely low power dissipation, the displays are ideally suited to provide a compact, high speed read-out for a radar data processing system or display, since characters are 'written' by digital switching pulses, which are compatible with computer logic. Each character is displayed on a 7×5 matrix of 35 Gallium Arsenside Phosphide diodes. Measuring 0.5 mm square, each diode is mounted to provide a 0.5 mm spacing between each successive one. Each character device is constructed as a complete unit, measuring only 6.5 mm×4.5 mm with 12 connection pins on the back of the ceramic base on which the diodes are mounted.

The Solid State Data Display

New equipments introduced at Farnborough '70

Myriad III – Digital Signal Processor – Digital Plot Extractor – Digital Displays

Myriad III

Now, from the same stable as the renowned Myriad I and Myriad II microminiature on-line computers, comes Myriad III, the most flexible on-line computer ever produced. Unveiled by Marconi Radar Systems at Farnborough '70, the new computer is also more powerful, smaller, lighter and cheaper than its predecessors, not only in the Myriad range but in most other ranges. Myriad III is hardware and software compatible with Myriad I and Myriad II systems and has the great advantage of having a readily available comprehensive software library representing a capital investment of between £3 million and £4 million.

Designed specifically to meet the stringent demands of the advanced radar systems of the future, the computer is built up from a number of 'building bricks' to give a physical flexibility which will allow the fullest integration of real time computing power into the vast and complex machinery of modern air traffic control and defence radar data processing systems.

The computer employs the very latest in micro-electronic logic technology with high-level TTL (Transistor Transistor Logic) micro-circuits used extensively throughout. These tiny circuits have enabled the designers to provide the computer with very high operational speeds. For example, access to any data in the high capacity, 262,144 word store can be achieved in 700 nanoseconds. Use of these circuits has also made the computer extremely reliable, while at the same time keeping it small and light.

The 'building bricks' make it possible to expand a complete, but low-capacity initial installation into a massive and powerful integrated data processing system, controlled via a highly sophisticated network of super highways. Myriad III compatibility means that existing Myriad systems could also be expanded and speeded up with the new computer.

Myriad III has been included in the Marconi-Elliot Computer Systems Limited range, but its development and introduction have been financed by Marconi Radar Systems Limited who will be the principal user.

The Basic Myriad III System

The basic machine comprises a number of modular 'building bricks.' The main units are the Central Processing Unit, Store Units, Power Units, Operators' Control Unit, Programmers'/Engineers' Control Unit and a Highway extension unit. A Master Peripheral Unit, designed to accept standard control modules, accommodates the input/output control circuits for the immediate peripheral devices such as the Paper Tape Reader, Paper Tape Punch, Teletypewriters, Line Printer, Watchdog Timer, Real Time Clock, etc. as well as external highway drive units.

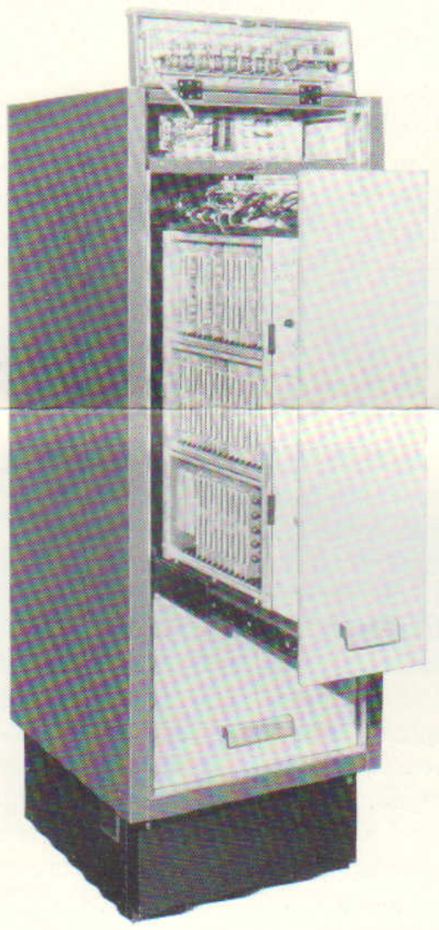
The Myriad III Programmers'/Engineers' control panel

Digital Signal Processor

The first digital signal processor capable of working directly with plot extraction equipment, the new Marconi Digital Signal Processor Type S7100, was working and on show for the first time ever at Farnborough '70. Designed to work directly with a plot extraction system if required, the new processor utilizes digital techniques and presents an extension to the well proven Marconi range of analogue processors. The new equipment, built on a modular basis, is housed in a small, lightweight cabinet measuring 1.68 m (5 ft 6 in) high by 584 mm (1 ft 11 in) wide by 648 mm (2 ft 1½ in) deep. From this single cabinet, it can provide double cancellation MTI, PRF stagger, PRF discrimination and pulse length discrimination systems. The modular form of construction enables a build-up of facilities to be made as required.

Suitable for use with coherent or non-coherent transmitters, the new processor provides numerous video outputs including fully-processed video with clutter switching, MTI only and logarithmic only in both analogue and digital form. A range of trigger outputs is provided to drive a complete radar system, including secondary surveillance radar.

The logic elements used are transistor-transistor devices, giving high speed and good noise protection. The stores are static shift registers, using low-level metal oxide silicon logic compatible elements.



Digital Signal Processor Type S7100 with control panel raised and left-hand frame extended to show printed circuit boards and controls

Digital Plot Extractor

The new Marconi Primary Radar Plot Extractor Type S7200 was working at Farnborough '70 to extract radar information from digital MTI data, to provide a form suitable for display.

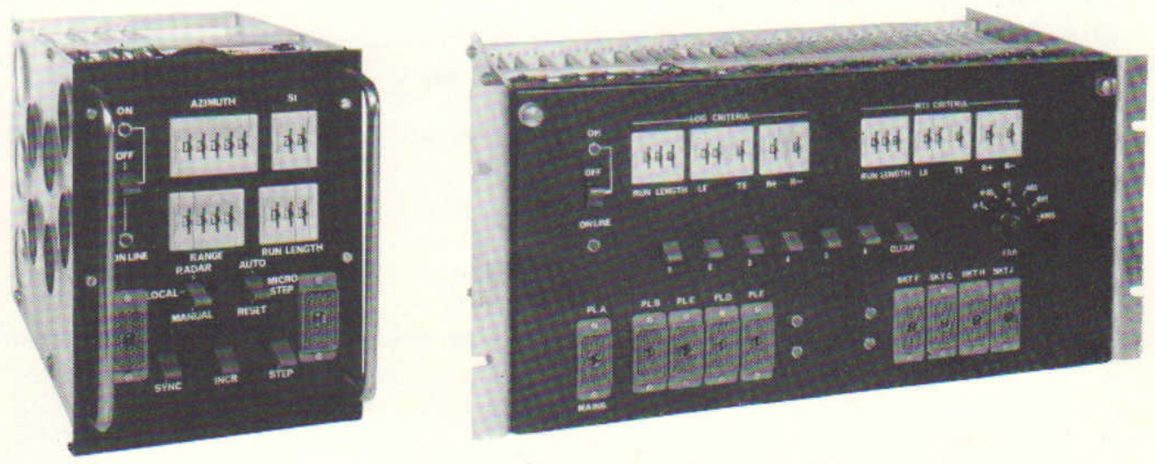
Designed to be used either in conjunction with the Marconi Digital Signal Processor Type S7100 as a system or in conjunction with conventional analogue radar systems, the new equipment provides extracted data either direct to a computer in a data processing system or in a serial form suitable for transmission over a narrow band link. Being modular in concept, the S7200 is engineered to meet any system requirement with a minimum of redundancy and hence maximum cost effectiveness. The modules used in the extractor are:

Analogue strike extraction
Digital strike extraction
Plot forming with azimuth plot position calculator
Polar to cartesian co-ordinator converter
Link interface
Computer interface
Test target generation
Azimuth interface
Data modems

Several configurations are possible, the analogue and digital strike extractors being alternative input modules. The computer interface module can be fitted after the extractor, plot forming or plot position calculator modules depending on the overall system design and the subsequent data loading.

The modules are housed in a cabinet measuring 1.83 in (6 ft) high by 578 mm (1 ft 10¾ in) wide by 490 mm (1 ft 7¼ in) deep. The plot forming module is mounted directly into the cabinet while the other modules fit into bins which are in turn mounted in the cabinet.

Circuitry in each module is constructed on double-sided, plated-through printed circuit boards using mainly dual in-line integrated circuit packages. The boards are attached to the module at 136-way edge connectors, themselves linked by a printed circuit back wiring board of a similar type. Both packages and connectors are easily removable for replacement.



Typical Plot Extractor modules – Test Target Generation (left) and Plot Forming

Digital Displays

For the first time, the digital output from the new digital signal processor plot extractor combination was presented on a digital timebase display at Farnborough '70. Designated the Marconi Digital Display Type S3015, the unit is part of a new range of displays developed by Marconi Radar Systems Limited. The new range of 400 mm (16 in) displays is modular in concept and consists of the S3014 analogue display, the S3015 digital display and the S3016 colour display. All three displays employ many common electronic modules and mechanical assemblies.

The S3014 display is an analogue unit with modular video and deflection facilities, intended primarly for use as a p.p.i display for radar data.

The S3015 digital display has great advantages in being of modular design in that it can be built up to form a synthetic dynamic display to receive positional data, symbol data and video data from a central system or it can be arranged to incorporate a complete digital timebase and marks generation system to provide autonomous working as a marked p.p.i from sine/cosine turning data and control data, all in digital form. The latter alternative was demonstrated at Farnborough and additionally, the marks generator was used to drive an associated display unit, Marconi Type S3114, to present tabular data on a 350 mm (14 in) rectangular screen.

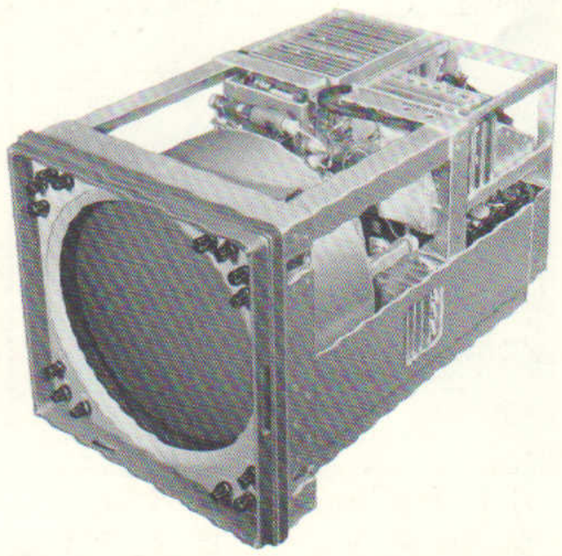
Digital Display Type S3015 (right)

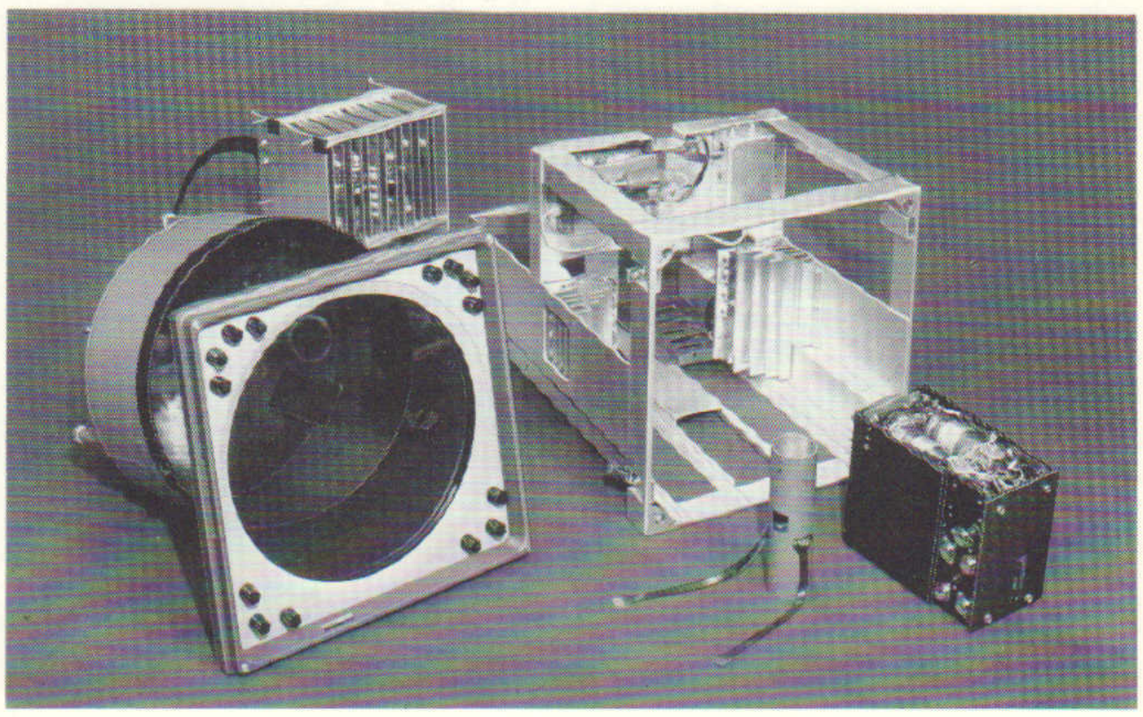
Component parts of the display unit range

Colour Display

The S3016 colour display is capable of displaying two or three colours simultaneously, thereby greatly facilitating category selection in current air traffic control complexes.

The display incorporates a special cathode ray tube which has two separate phosphor layers laid one behind the other with a transparent barrier layer between them. The front phosphor provides a green output, the rear a red output. Colour change is achieved by electrically switching the extra-high-tension. This changes the beam velocity so that at the lowest value, only the rear phosphor is excited, the barrier layer preventing excitation of the front phosphor. At the highest value, the beam penetrates the barrier layer and excites only the front phosphor, whilst at an intermediate value, both phosphors are excited and a third colour is produced.





Who's who in Radar

Christopher D. Colchester *was born in Croydon, Surrey in 1912 and was educated at Rugby and Peterhouse, Cambridge where he gained a first class honours degree in Mechanical Sciences.*

Mr. Colchester joined the Marconi Company in 1933 to work in the telephone laboratory of the research department on radio telephone terminals and sound broadcasting studio equipment. During the war years he was concerned with the development of radar equipment for the Admiralty, and afterwards, after a brief spell on a new series of radio telephone equipment, he became involved in various studies for radar defence systems. In the 1950's he pioneered U.K work on 23 cm radar systems, and also carried out much of the early work on advanced signal processing equipment.

In 1965, Mr. Colchester was appointed Assistant Director of Engineering of the Marconi Company and is now Chief Scientist of Marconi Radar Systems Limited.

C. D. Colchester

I. F. Donaldson

Ian Donaldson *was born in Linlithgow, Scotland in 1929 and was educated at Melville College, Edinburgh and the University of Edinburgh where he received his B.Sc degree.*

Mr. Donaldson joined the Marconi Company in 1950 as a graduate apprentice. From 1952 to early 1965 he worked in the Marconi Research Laboratories on the development of display and data processing equipments and systems, being associated particularly with the Passive Detection and Linesman Display projects.

In 1965, he transferred to Marconi Radar Division to become a Systems Manager and Mr. Donaldson is now Technical Manager of the Chelmsford Division of Marconi Radar Systems Limited.

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Operations centre for Canadian Forces Base at Lahr in West Germany

As announced in the No. 5 edition of this journal, Marconi Radar Systems handed over an interim military air traffic control radar system to Canadian Air Group at Lahr on 18th August. The interim small single-beam aerial was delivered in a matter of weeks, with the final radar, the new Marconi S654 23 cm (L) Band dual-beam system, to follow twelve months later.

For the project, the Company has engineered the complete operations centre, one of the most sophisticated schemes of its type, which is sited 600 yards from the radar aerial. Console suites for each of four control positions incorporate radar displays, communications control equipment, navigation instruments and flight plan processing strips. From these control positions, air traffic controllers are able to perform general area surveillance and exercise terminal area control for both Lahr and Soellingen (a second Canadian Forces base in the Rhine valley) together with Lahr arrivals and departures control. Another control position in the operations room enables an operator to assist with high level control over the German airfield at Bremgarten and will also be used to deal with any emergencies and overloads occuring in the Lahr terminal area.

Marconi Radar Systems has also installed its new video map generator, Type 3202 to generate boundary and reference markings on the displays. A sophisticated polarized lighting system has been developed for the operations room to illuminate all control panels, writing surfaces and data display boards without degrading the presentation of video data on the radar displays. Additionally, all ancillary equipment required in the centre has been integrated into the overall system design.

Part of the Lahr Display Centre

Complete back-up equipment, emergency facilities and support systems for the operations centre have been set up in a separate room adjacent to the operations room.

DIGITAL RADAR SIMULATORS FROM MARCONI RADAR

The integration of Elliott experience in radar based digital simulation into Marconi Radar Systems Limited has now been achieved. This completes the Company's range of systems to cover the whole spectrum of ground control data processing equipment. Over the past few months the transfer of personnel, records and facilities has been a major operation, every effort being made to minimize the disturbance to work in hand.

Elliott Automation were the pioneers of digital simulation equipment for radar training purposes and, as a result of 10 years background in both civil and military applications, bring a commanding lead in this specialized field to Marconi Radar Systems Limited. Worthy of mention is the fact that the value of orders for radar simulators already received is greater than the combined total of all those of our competitors in this field.

The world's first fully digital radar simulator, manufactured by Elliott Automation, was delivered more than eight years ago to the Royal Radar Establishment, Great Malvern for evaluation trials. These trials successfully proved the technique and encouraged the concept of environmental simulation as a means of achieving high operational standards without the need for costly flying time or long periods of closely supervised active operational training. The success of this development led to the provision of advanced digital simulation equipment for the entire training requirements of R.A.F Strike Command both in the U.K and overseas. Included in these requirements is a complex simulator sub-system of the Lineman/Mediator Control Centre for combined Civil/Military automation of air traffic over the U.K. Designed to provide advanced training, this equipment, designated simulator M, has been working up to its interface with other sub-systems on site for more than two years and has, on several occasions, been used to give demonstrations within these limits to high ranking officials of our military and civil user organizations as well as to a number of important overseas vistors.

Among the other successes against international competition for this type of business, is a contract for the supply of simulation equipment for all the requirements of NATO air defence ground control stations. Delivery of this equipment has already started and acceptance tests on the proving installation at Fullerton, U.S.A are already well advanced.

Regular readers of *Radar Systems International* will have seen in Edition 3 the article on Digital ATC Simulation for Eurocontrol. Hardware and software production for the contract is now well advanced and system commissioning under way. This is a particularly interesting system in terms of the operating flexibility since it must be capable of use in many configurations, and incorporates a wide range of input and output devices. Apart from adaptability to provide operational training in various forms (as required by the member countries of Eurocontrol), it is intended to use the system for formal program training.

Farnborough '70 was used to publicly identify the emergence of simulation as a fully integrated activity of Marconi Radar Systems Limited, which is now offering fully developed civil and military systems to cover the whole range of radar requirements.

The world wide need for re-equipment with modern radar control training systems is already evident, and with a complete range of products, backed by the highly developed networks of the Marconi sales and field services organizations, Marconi Radar Systems Limited have every hope and expectation of obtaining a major share of this business.

Aircraft control units for civil and military ATC training within the London Air Traffic Control Centre