



Technology

टेक्नोलॉजी फोकस

FOCUS

ISSN : 0971-4413

BULLETIN OF DEFENCE RESEARCH AND
DEVELOPMENT ORGANISATION

Vol. 18 No. 3 June 2010

SATCOM Datalink for Airborne Early Warning and Control System

The airborne Ku-band datalink is designed and developed for the first time in the country. The efficient design provides a datalink capacity of full 64 kbps as throughput to meet the operational requirements. The beyond line-of-sight link provides advantage to the Services to have capability of data transfer from the operational AEW&C system within the entire beam coverage area of the satellite.

Airborne Early Warning and Control (AEW&C) System is a force multiplier being designed and developed by Defence Research and Development Organisation (DRDO) with Centre for Airborne Systems (CABS), Bangaluru, as the nodal agency for the Programme.

Airborne Early Warning and Control System is a system of systems consisting of multiple sensors for surveillance, and signal intelligence and electronic warfare and is based on a modified EMB-145 executive jet. The data from all the sensors are integrated at the Mission System Controller and presented to the onboard operators for situational awareness on multiple reconfigurable Operator Workstations. The AEW&C system aids the operator in fighter control missions for support in air defence operations and has the capability to communicate with the fighters over V/UHF datalinks. The recognisable air surveillance picture is communicated to the ground



Ku-band

Ground Control System

AEW&C Platform



Ku-band datalink configuration for AEW&C system.

command and control network of IAF using line-of-sight (LOS) datalink in C-band and beyond LOS Satellite Communication (SATCOM) link in Ku-band.

An airborne SATCOM datalink has been designed and developed for the first time in the country as part of the AEW&C Programme by Defence Electronics Application Laboratory (DEAL), Dehradun, a constituent laboratory of DRDO, based on the requirements provided by CABS. The hardware for the Base Band Unit (BBU) has been configured based on the commercial off-the-shelf (COTS) solution evolved by CABS. The solution meets the requirement of providing commonality in hardware between various sub-systems of AEW&C providing better inventory management facility to the user. CABS has also evolved the most suitable form factor for all LRUs taking into account the space constraints of the aircraft. Packaging of the sub-system units has also been done accordingly.

The design is based on the Ku-band transponder of geostationary satellite (GSAT-2), which has a footprint covering the main-land of the Indian subcontinent. The operational requirements include capability of air-to-ground communication with a data-rate of 64 kbps in full duplex mode including two voice channels.

The Ku-band datalink has an airborne segment and a ground segment. The airborne segment of



Ku-band antenna and RF system for AEW&C.

the Ku-band datalink antenna has the capability to track the satellite position during all possible aircraft manoeuvres. The Ku-band datalink receives the aircraft altitude information from the navigation system of the aircraft on an ARINC

interface via the Mission System Controller at an update rate of 100Hz.

The aircraft antenna tracks the satellite position and transmits the data at upper Ku-band to the GSAT-2, which receives the transmission and retransmits it at lower Ku-band to the ground. Similarly, the ground segment transmits the data at upper Ku-band to the satellite, which receives and retransmits it at lower Ku-band to the aircraft. The ground segment is part of the Ground Exploitation System of the AEW&C.

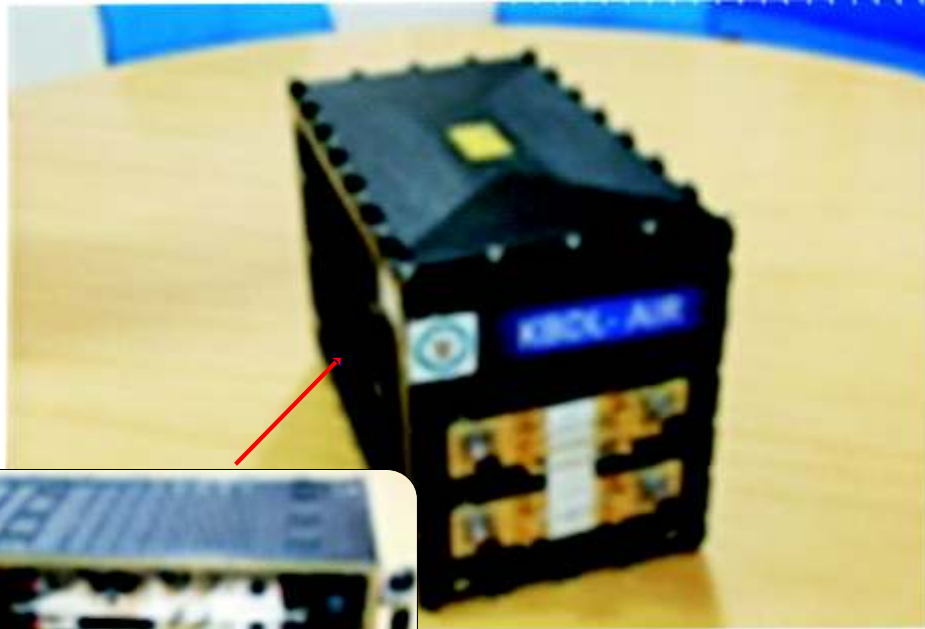
The airborne segment of Ku-band datalink consists of a 0.45 m dish antenna, RF system, Antenna Control Unit (ACU), and a BBU. The ACU



Antenna control unit of Ku-band datalink of AEW&C.

controls the antenna motion to fully compensate the antenna for aircraft motion. Algorithms in the ACU direct the feed/reflector system to rotate in polarisation to match the polarisation of the satellite and the antenna and to move in elevation and azimuth to compensate for aircraft motion. In addition, to accepting both vertical and horizontal polarisations, the ACU corrects the polarisation errors generated by the relative positions of the satellite and the antenna, and allows for offsets to account for built-in skew of the polarisation seen in some satellites. Upon power-up, the ACU performs antenna-referencing functions to align itself with the body of the vehicle.

The BBU receives the analog voice from the Mission Communication System and digitises the voice, which is coded by a vocoder. This digitised voice is multiplexed with the channel protected data to form a 75 kbps raw data stream. To provide further protection against channel deteriorations, the multiplexed data is passed through convolution encoder that generates a data stream of 150 kbps. This data is fed to spread spectrum modulator where it is spreaded with PN sequence and finally Binary Phase Shift Keying (BPSK) modulated with intermediate frequency (IF) carrier.



Baseband unit of Ku-band datalink of AEW&C

The modulated output is up-converted into UHF band depending on the instantaneous satellite allocation frequency. This L-band signal is translated to Ku-band frequencies and amplified by a solid-state power amplifier and is fed to the antenna feed.

In the receive chain, the Low Noise Block Converter (LNBC) receives the signal via 0.45 m antenna feeds and down-converts the received signal to L-band. The down-converted signal is fed to L-band down converter sub-modules of BBU where it is further down-converted to send IF. The signal is then demodulated and the data is recovered from demodulator and fed to viterbi decoder for removing the redundant information added in

the transmit chain during the convolution operation. The software for the BBU has been developed in-house by DEAL. The airborne antenna and RF unit has been developed by Rantec, USA.

The airborne and ground segments of the prototype Ku-band datalink system have been developed and link has been established between the two segments via GSAT-2 satellite. The qualification of the airborne antenna and RF unit and the antenna control unit has been successfully completed. The qualification of the BBU has been initiated. The transfer of voice over two channels and data at a rate of 64 kbps has been successfully demonstrated at DEAL and CABS.

SPIN-OFF DEFENCE TECHNOLOGIES

The life-support technologies developed by the life sciences laboratories of DRDO have helped to improve the health and operational efficiency of Indian troops posted at difficult environmental and operational conditions. The spin-off benefits of these technologies have been also useful to society at large.

Many of today's consumer items are actually being the offshoot of military technologies. For example, Internet and computer grew out of military technologies as did many articles of clothing, printed circuits, and many manufacturing processes and methods. Defence Research and Development Organisation (DRDO) of India, a premier institution in the field of defence research and development, is engaged in the development of cutting-edge defence technologies for the three Services of India.

A large number of the technologies generated by the various laboratories/ establishments of the DRDO are of dual nature and have potential spin-offs in civilian sector too. Some of the products developed based on the DRDO technologies include mosquito repellent; explosive detection kit; short-range surveillance radar; acoustic life detector for identifying

jawans/people trapped under the debris in the aftermath of avalanches, landslides, and earthquakes (technology is an offshoot of technology developed for underwater listening); Attracticide for control of Dengue and Chikangunya mosquito; lightweight iron removal unit using fibre-reinforced plastic technology developed for LCA Tejas, etc.

Keeping the motto of affordable healthcare technology to the masses, DRDO in association with Department of Science and Technology, Department of Rural Development and Ministry of Welfare, started the Society for Biomedical Technology (SBMT) to promote healthcare by providing indigenous solutions in the field of equipment and devices using spin-off technologies from Defence R&D and other scientific organisations. Some of these technologies are:

KALAM-RAJU CORONARY STENT

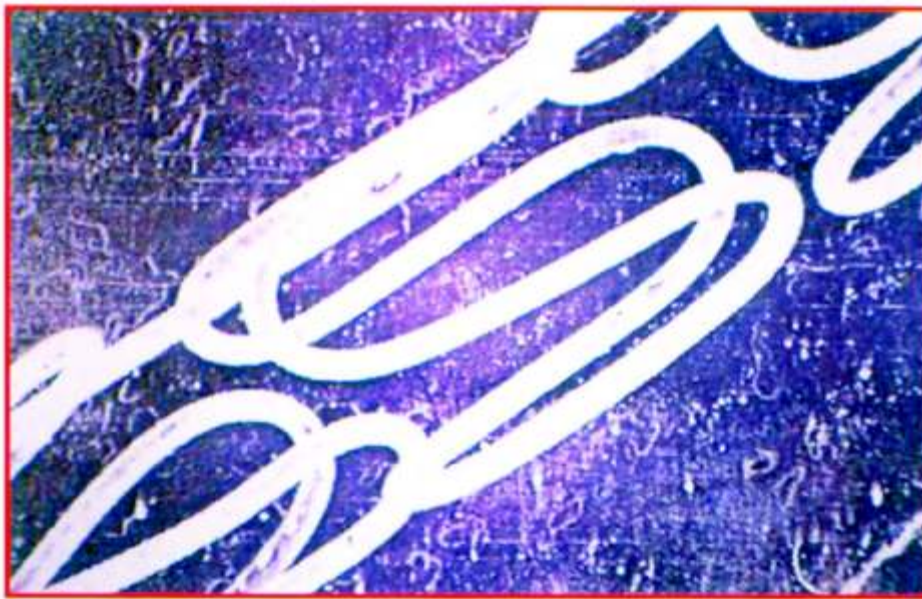
Coronary stents are widely used by cardiologists to dilate blocked arteries in patients of coronary artery disease. Kalam-Raju coronary stent has been developed from weapon grade, lightweight biocompatible titanium as a substitute for expensive imported stents. The stent has undergone extensive multi-centric clinical trials and has been implanted in more than 1600 patients suffering from coronary artery disease.

Salient Features

- Cheap and cost-effective
- Biocompatible and indigenously developed

Transfer of Technology

Andhra Cardiology Associate Pvt Ltd
CARE Hospital, NIMS Lane
Banjara Hills, Hyderabad-500 034



Kalam-Raju coronary stents.

FLOOR REACTION ORTHOSIS

A lightweight, low-cost indigenous Floor Reaction Orthosis (FRO) has been developed from weapon grade titanium for polio patients whose quadriceps muscles are paralysed. The FRO works on cantilever principle, wherein when body weight is applied, the reaction forces from the floor causes turning movement which locks the frail knee



Floor reaction orthosis.

joint. The FRO consists of three modular pieces—foot piece, lateral uprights, and knee piece. Using plaster of paris and cast polypropylene sheet, the modular pieces are welded to make the final product.

Salient Features

- Low cost
- Lightweight
- Biocompatible

Transfer of Technology

Artificial Limbs Manufacturing Corporation of India, GT Road Kanpur-208 016

CRITICAL CARE VENTILATOR

An indigenous fully functional critical care ventilator, named Inventa, has been designed and developed to meet the needs of Indian Healthcare System. The system takes just minutes to start

ventilating a patient and all the vital parameters are displayed on the screen which helps to make clinical decisions faster and effective. The ergonomically designed handle and castors provide ease of mobility and the unique tilting provision provided in Inventa helps in monitoring the ventilator from many positions in the Intensive Care Unit. With user-friendly keypad, wide nine inch screen and scroll and select knob, the system is easy to operate.

Salient Features

- Monitoring of ventilator from all positions.
- Fitted with unique visual and audible alarms for identification.
- Rugged, energy efficient.
- Indigenous and cost-effective.

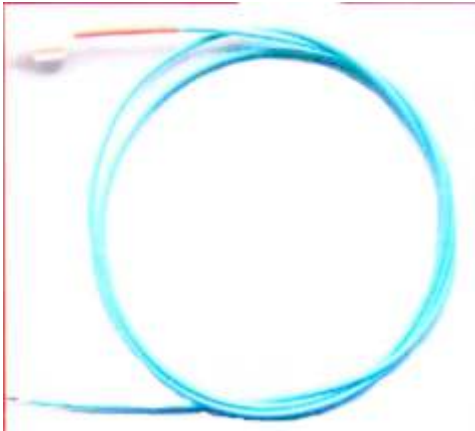
Transfer of Technology

Pricol Limited
702, Avanashi Road
Coimbatore-641 037



Critical care ventilator.

CORONARY CATHETERS



Cardiovascular catheters required for diagnostic procedures and angioplasty have been developed using indigenous polymeric and biocompatible materials. Contours design has been completed for Judkins type diagnostic catheters and 145-angled pigtail. Lab models of catheter tubes and guidewires have been successfully developed. The prototypes have been clinically evaluated and the transfer of technology has been done for the catheters of one meter length. Work is in progress to develop catheters of various lengths.

Salient Features

- Indigenous polymeric material.
- Cost-effective.

Transfer of Technology

Uday Kanal Electronics Ltd
Uday House, Plat No. 53/1
Road No. 7, Moral MIDC
Andheri (E), Mumbai-400 093

ORBITAL IMPLANTS

Hydroxyapatite-based porous integrated orbital implants of different designs and sizes for direct implantation and cosmetic rehabilitation of the anophthalmic patients have been developed. The new development is expected to revolutionise the treatment procedure after enucleation surgery and rehabilitation of the anophthalmic patients. These bioactive intra-orbital implants can provide a natural look to the eye along with a degree of mobility, which mimics that of the fellow eye in all directions with minimum socket complications. This will definitely reduce post-enucleation socket syndrome, which is generally associated with a retraction of ptosis



Orbital implants.

of the upper eyelid and an enophthalmic appearance.

Salient Features

- Cosmetic rehabilitation of the anophthalmic patients.
- Eliminates tissue grafting.
- Reduces post-enucleation syndrome.

Transfer of Technology

Central Glass & Ceramic Research Institute
196 Raja SC Mullick Road
Kolkata-700 032

ARTIFICIAL LIMBS

The problem of locomotor disability is a major issue in case of rehabilitation of the amputees in the Armed Forces as well as in civil population. DRDO has designed and developed cost-effective, lower-limb prosthesis (both above and below the knee) using advanced materials like lightweight aluminium alloys, carbon-epoxy composite, polyurethane and other synthetic materials. Modular concept was adopted. More than 500 below-knee limbs have been supplied to Artificial Limb Centre, Pune for use.

Salient Features

- Modular design to facilitate repair and replacement of individual components separately.



- Use of carbon fibre and alloys enables it to be strong without any weight penalty.
- Endo-skeletal design (the weight-bearing pilon is centrally placed) makes it cosmetically more acceptable and lightweight.
- Costs only 20 per cent of imported one, thus more affordable.

Transfer of Technology

515 Base Workshop, Bangalore

HEALTHCARE

DRDO has also developed a number of healthcare products many of which are available for transfer of technology. Some of these are:

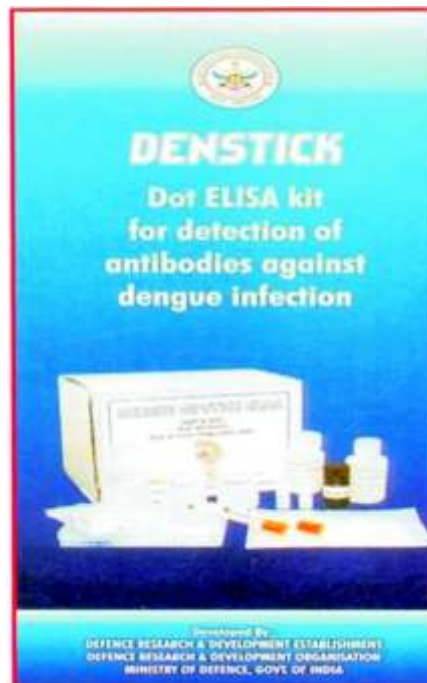
DENGUE ANTIBODY DETECTION KIT

A Dot Elisa kit for the detection of the antibodies against dengue infection based on detection of circulating IgM and IgG antibodies in patient's serum. Diagnosis of Dengue fever is difficult as the initial symptoms are overlapping with many other viral diseases.

The kit provides pre-coated nitrocellulose strips which are to be loaded with patient's serum and then treated with respective conjugates followed by substrate showing brown colour dots, indicating dengue infection.

Salient Features

- Results available within 3 hours
- Can also indicate about the primary or secondary dengue infection.



- Can be performed on site.
- Shelf-life of 6 months at 4°C.

Transfer of Technology

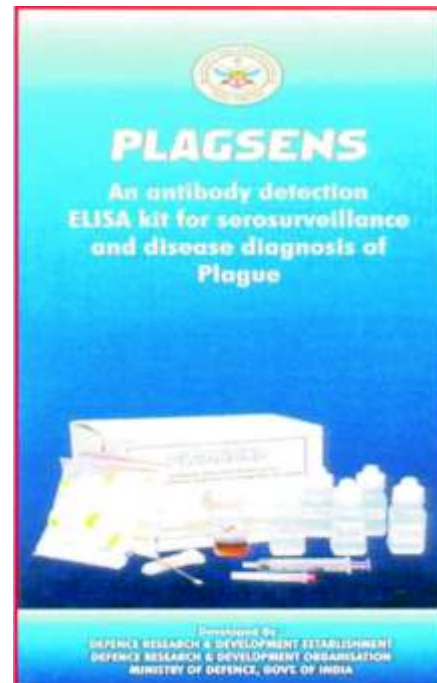
Interested firms can apply.

PLAGUE DETECTION KIT

An Elisa kit for *Yersinia Pestis* organism identification required for early detection of plague so that necessary measures are taken immediately to prevent the epidemic. In the kit, rabbit antibodies are coated to the nitrocellulose membrane and the organism. *Yersinia Pestis* binds to this antibody. The resulting substrate is detected using enzyme substrate reaction. Appearance of brown dots indicates positive results.

Salient Features

- Results can be obtained within one hour.



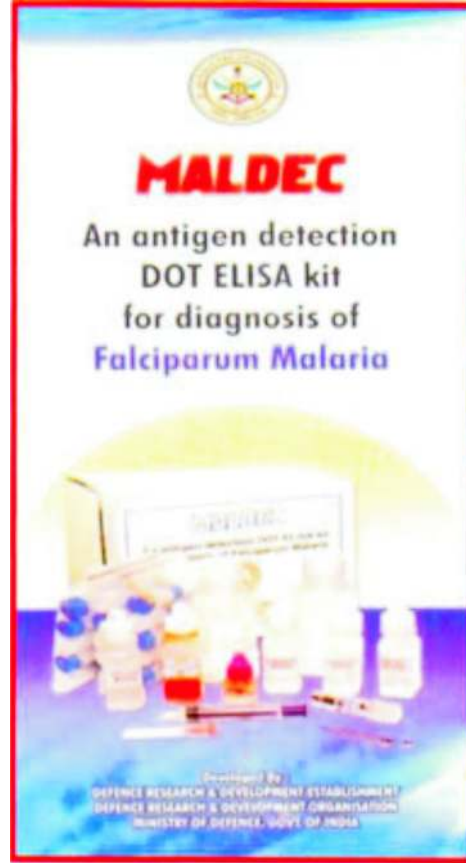
- Sample needed is just one drop of finger-prick drawn blood.
- Suitable for rapid field use.
- Shelf-life of more than 6 months at 4°C.

Transfer of Technology

Interested firms can apply.

MALARIA DETECTION KIT

An antigen detection dot-ELISA kit has been developed for diagnosis of *Falciparum* malaria. Malaria caused by *Plasmodium falciparum* is a major problem in most of the states of our country. This form of malaria not only causes high morbidity but also leads to high mortality with the manifestation of dangerous cerebral form of malaria. *Plasmodium falciparum* synthesises several



proteins containing large amount of amino acid histidine, commonly called as Histidine Rich proteins (HRP). The kit detects the *Plasmodium falciparum* specific HRP-II antigen. In this case rabbit polyclonal antibodies to HRP-II are coated to the nitrocellulose membrane. Antigen present in plasma/serum binds to the antibody and the resulting complex is detected using enzyme-substrate reaction with appearance of brown coloured dots.

Salient Features

- Suitable for field use.
- Results available within one hr.
- No specialised training required.
- Useful for mass screening.

Transfer of Technology

Interested firms can apply.

Technology Focus focuses on the technological developments in the Organisation, covering the products, processes, and technologies.

सम्पादकीय मंडल

समन्वयक

डॉ अ ल मूर्ति, निदेशक, डेसीडॉक, मेटकॉफ हाउस, दिल्ली

सदस्य

डॉ सुदर्शन कुमार, निदेशक सामग्री निदेशालय, डीआरडीओ भवन, राजाजी मार्ग, नई दिल्ली
श्री आर शंकर, निदेशक सीवी एन्ड ई निदेशालय, डीआरडीओ भवन, राजाजी मार्ग, नई दिल्ली
कमोडोर पी के मिश्रा, निदेशक नेवल आर एन्ड डी निदेशालय, डीआरडीओ भवन, राजाजी मार्ग, नई दिल्ली
श्री सुधीर कुमार मिश्रा, निदेशक मिसाइल निदेशालय, डीआरडीओ भवन, राजाजी मार्ग, नई दिल्ली
श्री रन्जीत ईलयास, रक्षा मंत्री के वैज्ञानिक सलाहकार के स्टॉफ अधिकारी, डीआरडीओ भवन राजाजी मार्ग, नई दिल्ली

सम्पादकीय स्टॉफ/Editorial Staff

मुख्य सम्पादक अ ल मूर्ति	सह-मुख्य सम्पादक शशी त्यागी	सम्पादक बी नित्यानंद मनोज कुमार	सम्पादकीय सहायक दीप्ति अरोरा	ग्री-प्रेस समन्वयक एस के त्यागी	मुद्रण एस के गुप्ता हंस कुमार	विपणन आर पी सिंह
Editor-in-Chief AL Moorthy	Assoc. Editor-in-Chief Shashi Tyagi	Editors B Nityanand Manoj Kumar	Editorial Assistant Dipti Arora	Pre-press Coord. SK Tyagi	Printing SK Gupta Hans Kumar	Distribution RP Singh

टेक्नोलॉजी फोकस के पाठक अपने सुझाव संपादक, टेक्नोलॉजी फोकस, डेसीडॉक, मेटकॉफ हाउस, दिल्ली-110 054 को भेज सकते हैं।
दूरभाष: 011-23902475
फैक्स: 011-23819151; 011-23813465
ई-मेल: director@desidoc.drdo.in
इंटरनेट: <http://www.drdo.org/pub/index.shtml>

Editorial Committee

Coordinator

Dr AL Moorthy, Director, DESIDOC, Metcalfe House, Delhi

Members

Dr Sudarshan Kumar, Director of Materials, DRDO Bhavan, New Delhi
Shri R Shankar, Director of CV&E, DRDO Bhavan, New Delhi
Cmde PK Mishra, Director of Naval Research & Development DRDO Bhavan, New Delhi
Shri Sudhir K Mishra, Director of Missiles, DRDO Bhavan, New Delhi
Shri Ranjit Elias, SO to SA to RM, DRDO Bhavan, New Delhi

Readers of *Technology Focus* are invited to send their communications to the Editors, *Technology Focus* DESIDOC, Metcalfe House, Delhi-110 054. India
Telephone: 011-23902475
Fax: 011-23819151; 011-23813465
E-mail: director@desidoc.drdo.in
Internet: <http://www.drdo.org/pub/index.shtml>