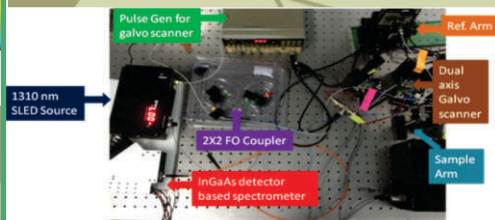


Annual Report 2012-13



R&D Institute of Government of India
Ministry of Communications & Information Technology
Department of Electronics & Information Technology

Society for Applied Microwave Electronics Engineering & Research

GOVERNING COUNCIL

(2012-2013)

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VISION, MISSION AND OBJECTIVES

Vision

To be a Premier R&D Institution of International repute in RF/ Microwave and Millimeter wave technology.

Mission

To achieve excellence in application-oriented research in the areas of RF/Microwave/ Millimeter wave Technology and Electromagnetics.

To achieve excellence in application oriented research in the areas of Microwave/RF Electronics and Electromagnetics.

Long Term goals in support of mission statement

SAMEER has the following long term objectives to achieve its mission:

1. To work in Research and Development activities to strengthen its area of focus.
2. To engage in product development driven by technology.
3. To become multi-disciplinary institution and to cater to diversified applications.
4. To work in partnership with multiple institutions in high technology areas.
5. To undertake training and consultancy in areas of core competence.
6. To keep pace with rapidly changing technology by continuous training of its manpower.

OBJECTIVES

- To contribute to the growth of science and technology of microwave electronics and allied areas through intensive research, design, development, training of manpower and setting up of facilities for national progress.
 - To encourage and promote the development of microwave electronics in the country in order to achieve self reliance.
 - To encourage advancement of microwave electronics through scientific research, development, education and to promote industrial applications and wider utilization of microwave technology and products.
 - To develop the technology in national interest as a sponsored or grants-in-aid project for developing technology demonstration models and batch production of successful products if required. The projects are taken up
- (1) that are state-of-the-art technology (2) that serve as import substitution leading to reduction of undesirable foreign dependence (3) for which intensive R&D capability is needed (4) which are needed in small quantity and are not commercially available readily (5) which are in initial stages of development and usage before large scale usage builds up (6) for which the know-how from other R&D units can be taken and extended from their specific applications to broad range of applications (7) which are in the nature of spares of important systems ceased to be available in the market due to multiple reasons including obsolescence .
- To co-operate and collaborate with national and international institutions, research laboratories and other professional organizations.
 - To organize study programmes, lectures, symposia, conferences, exhibitions and similar promotional activities.
 - To build up library of books, periodicals and papers, films and other video aids.
 - To undertake, aid and promote publications on RF and microwave electronics and allied subjects.
 - To set up national facilities, regional centers and other units in selected fields of specialization for carrying out specialized experiments or for dissemination of knowledge.
 - To set up, as appropriate, joint programmes to develop and share knowledge, expertise and experience with educational, research and other professional organizations in India and abroad particularly in the developing countries.
 - To do all such other lawful acts, deeds or things which are cognate to the objectives of the society or conducive to the attainment of all or any of the above objectives.



REVIEW STATEMENT

I am very happy to present the Annual Report of SAMEER for the Financial Year 2012-13.

During this period, SAMEER has carried out a large number of core and sponsored projects- a total of twenty three core projects and twenty eight projects sponsored by our parent department as well as other R & D departments of Govt. of India. The areas include Linear Accelerators (Linac), RF/Microwave/Millimeter wave technologies, Atmospheric and radar based instrumentation, communications, photonics, digital Signal processing, antennas, EMI/EMC etc.

Linac technology has been the major program of SAMEER. Linac for radio-therapy treatment of cancer patients has been a continuous process with up-gradation in user interface and controls. Technology of the machine is in the process of transfer to private industry to enable mass production. SAMEER is also gearing up its infrastructure to meet the demand of the industries for the components of Linac.

Atmospheric instrumentation development is another important activity. A demonstration model of low power Ka-band cloud radar has been completed. Another, Ka- band cloud radar with higher specifications is currently under development for Ministry of Earth Sciences (MOES). The ST radar development project is going on in full swing and it is expected to be commissioned at Gauhati University during 2014-15.

Significant contribution has been made in the field of communications and digital signal processing. SAMEER has been constantly supporting CDMA based tele-command system for secured communications. As part of the indigenous effort, a fire control system has been designed, developed and delivered to user agency after necessary environmental qualifications.

In millimeter wave technology, SAMEER has established its credibility in terms of design and engineering of various millimeter wave components. A trans-receiver has been indigenously built for the first time in the country with all the major components designed and developed in house. The system has been evaluated successfully for compliance to electrical specifications. Full engineering models are getting ready for necessary trial. It is expected that success of this project will lead to large scale production to meet the requirements of country.

SAMEER is actively working on varieties of antenna in microwave and millimeter wave frequencies. Design work is in progress in concept areas of multifunction conformal shared aperture antennas, particularly applicable for Airborne vehicles where number of actual antennas to be deployed can be reduced by as much as 50% by making them multi functional and sharing the antenna apertures. These will also minimize

radar cross sections, an important parameter in air-borne vehicle.

SAMEER continues to provide test, measurement, calibration and design consultancy services to industries, government laboratories and institutions. SAMEER has the technical advantage as all the EMI/EMC laboratories are NABL accredited and test certificates issued remain valid nationally and internationally. SAMEER also has MILSTD EMI/EMC facility in a limited extent and this facility provides manufacturers as well as designers relevant compliance of standards of their products.

SAMEER has been working on wide range of technologies, all needed for civilian and strategic departments. It has established a brand name among the users as the products designed, developed and delivered by SAMEER meet all user requirements and provide satisfactory performance over a period of years.

In SAMEER, we always look forward to new technologies having direct relevance to our country and start working in the new directions. This important initiative provides growth path to SAMEER enabling the organization to contribute significantly in the growth of the nation.

I am grateful to our parent department, Department of Electronics and Information Technology (DeitY) for all the encouragement and whole hearted support extended during the period. I am sure with the constant support of Department of Electronics and Information Technology and confidence enjoyed by SAMEER from other government departments, SAMEER will continue its journey to achieve higher technological goals in the coming years.

Dr. Ananta Lal Das

Director, SAMEER

PREAMBLE

Society for Applied Microwave Electronics Engineering & Research (SAMEER) is an autonomous R & D institute under Department of Electronics and Information Technology(DeitY)), Ministry of Communications and Information Technology (MC&IT), Govt. of India since 1984. It was created with sole objective of pursuing research and development in the field of RF & microwaves. Ever since its formation, SAMEER has been involved in development of many RF and Microwave based systems and products which are required by various government agencies like Defense, Space, Ministry of Earth Sciences. The headquarters and laboratory of SAMEER are located at Powai, Mumbai. The other two Centers of SAMEER are located at Chennai and Kolkata known as Centre for Electromagnetics and Centre for Millimeter Wave Research respectively..

Under various core and sponsored research programmes, SAMEER Mumbai has contributed in the areas of Linear Accelerators, Atmospheric instrumentation, Optoelectronics, Radars for various applications, RF/Microwave industrial systems and EMI EMC. Under the Jai Vigyan program, SAMEER has developed 6 MV Linac Machines for cancer therapy. New advanced Linac machines with variable photon as well as multiple electron energies are under development. The infrastructure for batch fabrication of Linac Tube and LINAC machines has been established at Kharghar campus. Atmospheric instrumentation is another area where many atmospheric radars have been developed. Recently development of a ST radar project for North East Region has been taken up. Through core research a low power prototype version of a Cloud Radar has been developed.

Chennai Centre specializes in the areas of Antennas, Communications, Digital Signal processing (DSP) and Electromagnetic Interference /Compatibility (EMI/EMC). It offers comprehensive test, consultancy, training, engineering and research services to national agencies and electronics industries in India. It is also involved in sponsored projects in the areas of RF communications, DSP, RF & Microwave antennas and Electronics packaging.

The Centre at Kolkata specializes in the areas of Antennas and Millimeter wave technology. It is involved in the development of RF, Microwave and Millimeter-wave (MMW) components, sub-systems and system for various users in the country. The centre has a NABL certified EMI/EMC Test and Measurement facility for evaluation of electronic products for CE marking. A Compact Antenna Test Range (CATR) and a state-of-the-art millimeter wave laboratory have been established at the Centre.

SAMEER

Society for Applied Microwave Electronics Engineering & Research

MUMBAI	CHENNAI	KOLKATA
<p>A) Core R&D</p> <ul style="list-style-type: none"> • Medical Electronics • Radar Instrumentation • Atmospheric Instrumentation • Signal Processing • High Power RF and Microwave Components & Systems • Photonics <p>B) Facilities</p> <ul style="list-style-type: none"> • Mechanical Design & Fabrication Facilities • Computer & Information Technology Group • Technical Information Centre <p>NAVI MUMBAI</p> <ul style="list-style-type: none"> • EMI/EMC Test, Measurement and Design Consultancy • NABL accredited EMI EMC facility • Linear Accelerator tube processing Laboratory • Radiation Shielded Test Facility 	<p>A) Core R&D</p> <ul style="list-style-type: none"> • Electromagnetics & Antennas • EMI/EMC Test, Measurement and Design Consultancy • RF/ Microwave Communication • Electronics Packaging & Thermal Design • Digital Signal Processing <p>B) Facilities</p> <ul style="list-style-type: none"> • CE accredited EMC facility • ISO 9001 certified EMC Test and Evaluation Lab • EMC and Thermal Design Consultancy • Mechanical workshop • Antenna measurement • Technical Information Centre • EMC equipment calibration cell • Electronics Design 	<p>A) Core R&D</p> <ul style="list-style-type: none"> • Microwave & millimeter wave Components, subsystems and Systems • Electromagnetics & Antennas • EMC • Digital Signal Processing <p>B) Facilities</p> <ul style="list-style-type: none"> • Compact Antenna Test Range • Facility for Millimeter wave test and evaluation facility • RF simulation • MIC and assembly • EMI/EMC measurement and design consultancy • Mechanical Design & Precision fabrication



SAMEER MUMBAI

Centre for Microwave Wave Research

This centre has been actively working in Linear Accelerators for Medical applications, RF and Microwave based radar instrumentation, Photonics, RF/Microwave heating/ drying applications, High power components, meteorological instruments, gyrotron and radio altimeters. In addition to this, EMI/ EMC services are offered to various industries. Core and sponsored activities are taken up for design, development and engineering of electronic systems required in various applications. The center is equipped with facilities to develop new processes for fabrication of opto-electronic components.

One of the important work areas at this center is Linear accelerator technology which finds application in cancer radiation therapy. We have now established a batch fabrication facility at Kharghar Navi Mumbai for batch fabrication of Linac tubes and Medical Linac machines. This is a major step in LINAC indigenization program with significant impact on cancer treatment program at national level. An advanced version of Medical Linac viz. Dual Photon energy and multiple electron energy medical Linac and the Multi-leaf collimator which is a very important attachment of all modern Linac is also under development at this centre.

Another Major area of expertise in SAMEER is Atmospheric instrumentation. Atmospheric radars which are basically clear air Doppler radars were developed for probing the various layers of the atmosphere and collecting vital information on atmospheric dynamics. A major project which has been funded by DeitY is Stratospheric –Tropospheric Radar which is under development at this center. The ST

radar will be developed with a state-of-the-art active aperture technology and installed at North East to study the weather patterns which are specific to the topography of that region. The design has been frozen and subsystems are being developed. We had initiated development of cloud radar through our core research program and built a low power technology demonstration model at Ka band. A sponsored project for development of Ka band Cloud radar has been sanctioned by Ministry of Earth Sciences.

This center has developed special infrastructure for integrated optics and photonics which enables us to develop certain key optoelectronics products and systems. There are also interdisciplinary research initiatives in the areas like Digital Signal Processing, high power RF and Microwave components/ systems and Radar Instrumentation. The research activities are initiated through core research programs which help in establishing the basic concept and prototype developments. We also have modern NABL accredited EMI/EMC laboratory for offering test measurement and consultancy services to the industries.

RESEARCH AND DEVELOPMENT ACTIVITY

1. Linear Accelerator Technology

SAMEER has been working in the field of linear accelerator technology since past three decades. As a result of this long standing experience we have developed

Linacs for medical radiotherapy. The 6 MV Medical Linac machines developed in-house under the Jai Vigyan program (Phase I) for cancer treatment are commissioned at Cancer Institute Chennai and MGIMS Sewagram, Wardha. Number of exposures given to cancer patient using these indigenously developed LINAC machines exceeds 1,30,000. Further as a part of Jai Vigyan Program Phase II four more units of 6 MV Medical Linac machines are developed using improved technology. One machine is under installation in Indore. Remaining three machines are now getting ready for deployment at identified Government hospitals at Amaravati, Navi Mumbai and Madurai. The technology of 6 MV Medical LINAC is being transferred to the Industry partner for commercialization. The special infrastructure facility created at Kharghar Navi Mumbai will be used for making a batch fabrication of Medical and industrial LINAC machines. SAMEER has taken up challenging task of developing more advanced Linacs which will utilize multiple electron and photon energies for specialized treatments. SAMEER has further taken up development of Multi leaf collimator and Electron portal imaging systems to make an integrated oncology system. In this context we have signed a MoU with Tata Memorial Hospital which is a premier health care institute and Pune University for collaborative research and development in this area.

1. 1 Medical Electronics Division -1

The main objective of this division is to establish linear electron accelerator based technologies for radiation therapy. The division has successfully established compact electron linac which is now used for Cancer Therapy in hospitals across India. A more advanced Medical Linac using Dual photon and multiple electron energy is being developed by this division

using Linac tube processing and radiation testing facilities at Kharghar, Navi Mumbai.

Dual photon and multiple electron energy integrated oncology system.

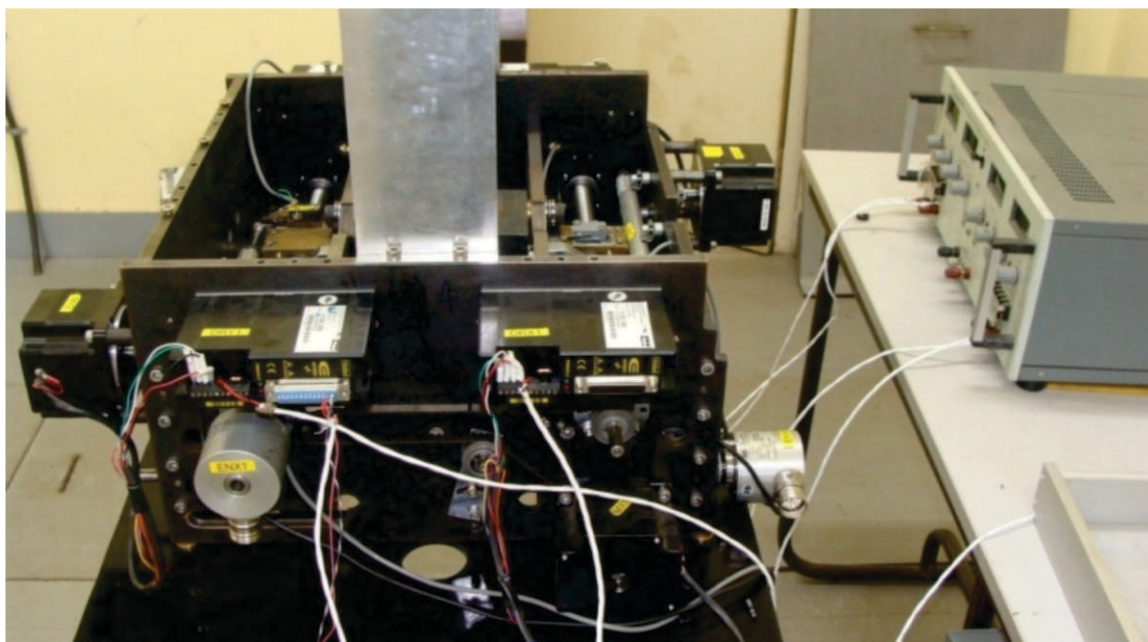
This is an advanced Medical Linac system which is under development at SAMEER. It can generate two photon energies at 6MV and 15 MV and Multiple electron energies 6 , 9 , 12 , 15 , 18 MeV to cater to various need of medical fraternity for cancer treatment. The Linac will also be equipped with Multi Leaf Collimator and asymmetric jaw secondary collimator.

Developments of some of the major subsystems completed include:

- i. Fabrication of gantry subsystem
- ii. Fabrication and testing of asymmetric jaw collimator
- iii. Design of 2700 doubly achromatic beam bending chamber

1.2 Medical electronics Division -2

Using the core expertise in high voltage modulators, microwave systems, signal Processing, automation and system



Asymmetric jaw secondary collimator



Gantry for the Dual energy Linac

The system will be equipped with Linac tube, beam bending chamber, modulators and computerized control consoles. It will have primary, secondary and tertiary collimators and online health monitoring system.

engineering, the division has built Medical Linacs at 4MV and 6MV energies which are used for cancer radiotherapy which are deployed at various hospitals. Under the Jai Vigyan mission project (Phase II) of Government of India, the design, development and deployment of four units of 6 MV Medical Linac (SIDDHARTH) are being carried out. The first unit is being installed at Indian Institute of Head and Neck Oncology (IIHNO), Indore.

The second unit earmarked for Cancer Foundation Hospital, Amravati is in final stage of its integrated testing. The third and fourth units are earmarked for ACTREC, Kharghar, Navi-Mumbai

Siddharth 3 at Indian Institute of Head and Neck Oncology (IIHNO) , Indore



and Vadamalayan Hospital, Madurai respectively. The non radiation testing viz. high voltage, microwave and mechanical movements is completed. The "ASHA" 3D Treatment Planning System has already been procured.

The Division is also providing maintenance support for earlier projects viz. RF Source for 10 MeV Accelerator and 6 MV Medical Linacs at MGIMS, Wardha and Cancer Institute, Chennai.

2. ATMOSPHERIC RADAR AND INSTRUMENTATION DIVISION (ARID)

Atmospheric Radar and Instrumentation Division (ARID) develops state-of-the-art systems required for atmospheric research by atmospheric and meteorological scientists. The division has expertise in design, development, testing of state-of-the-art atmospheric radars & instruments. This group with the experienced electronics and RF engineers takes up turn key projects and carries out complete system design and development. They also install, operate and maintain various atmospheric equipment.

i. Phased Array SODAR for Boundary Layer Studies for Krishnadevraya University, Anantpur

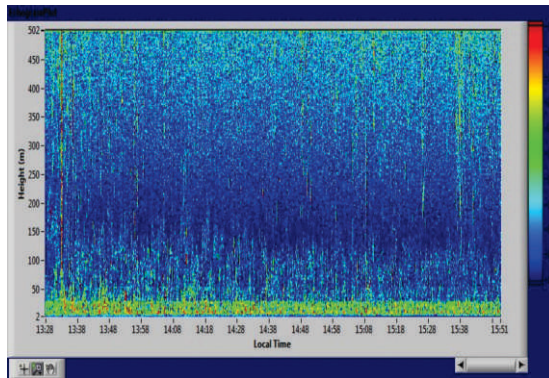
A stand alone Phased Array Sodar with data output suitable to boundary layer Studies has been developed, installed and commissioned at Sri Krishnadevraya University, Anantpur in September 2012. The system allows users to control and transfer the data, through a remote computer/Laptop via Wi-Fi/LAN. This system is being operated continuously and unattended without any breakdown.

ii. Portable Phased Array SODAR for weather related Studies for IMD

A stand alone Phased Array SODAR, fitted on a mobile platform suitable for operation in remote areas has been developed. The system is powered by solar panels. It has been designed in such a way that it will work either on battery or on AC power supply. Normally the charging of battery is done through solar panel. Provision is also made to charge the batteries through AC Power supply. System was



Phased Array SODAR System being tested at SAMEER campus



integrated and tested at SAMEER campus and transported to IMD Kolkata. Photograph shows the system in the assembled condition at SAMEER campus for field trials. The reflected signals from the atmosphere which indicates boundary layer formations are shown as echograms.

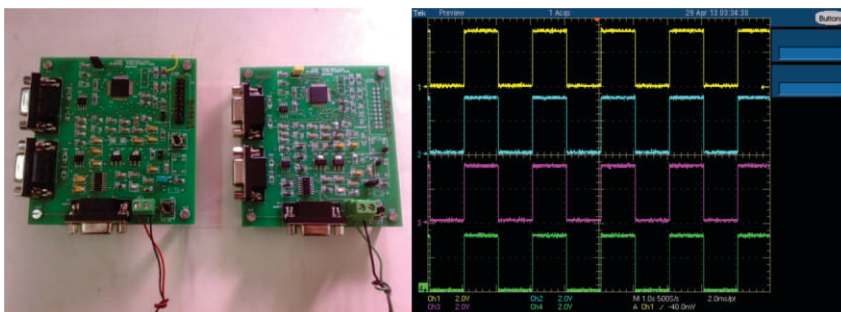
iii. System hardware for ST radar at Guwahati University

The Division is contributing to ST Radar project by development of DSP hardware, software, digital receiver, algorithm development, GUI, data display, generation of timing signals, exciter sub-system and its distribution. Following work has been completed under this project:

Computation of Cn2 , Turbulence structure constant for Guwahati and Mumbai for different seasons was prepared and a report was generated on climatological variation of Cn2 over Mumbai & Guwahati. A paper has been accepted by "Current Science" journal for publication.

Design of Distributed CAN (Control area network) controller is being carried out. Programs for downloading data via CAN bus was developed and tested in simulator. The CAN programs was tested with ARM7 processor development board and found to be functional. Both receive and transmit modes were tested and found to be working. The Distributed CAN Controller PCB layout is completed. The layout was checked for its correctness. The board has been tested and is functional. The final version of PCB is in progress.

- Individual components of Exciter module have been tested and characterized. The integration of all components comprising the Exciter is being carried out.
- The schematics for Synchronous Signal distribution was designed and prototype boards have been tested. The final version of PCB has been launched for fabrication.
- The ST radar Digital receiver and signal processing is being developed using NI Flex RIO, LabVIEW and FPGA. In this connection the NI Flex RIO hardware is tested with 212 MHz signal from a signal generator using a program developed. A Lab VIEW based simulation programs for digital down conversion to baseband is developed and tested. A consensus



Populated CAN distribution board

CAN message being broadcast to four TR modules

averaging program to be implemented in the ST radar data processing as quality assurance is developed and tested.

iii. Design and simulation of Homing receiver

The design and simulation of homing receiver project was taken up by SAMEER from a Government Laboratory. The job of receiver is to home on to sonobuoys. The Receiver system design works on the principle of phase Monopulse technique. Under this project complete design document along with simulation results were carried out which included the subsystems like, Phase Shifter/Switching Network, RF Receiver Sub-System, Frequency synthesizer design, digital processor design, system monitoring,



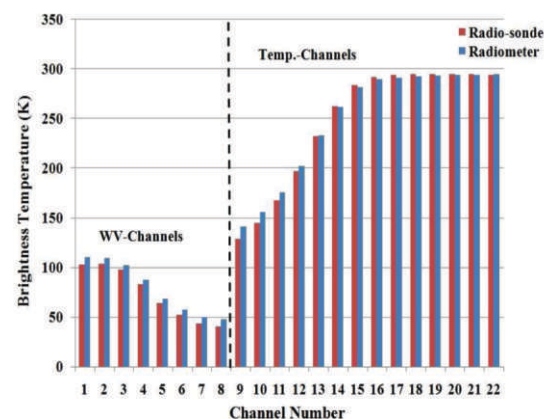
GUI generated in Lab-view through system simulation

Homing receiver output indicators and power supply. Working Principle of total system has been simulated in Lab VIEW and GUI has been generated. Simulation of RF Subsystem has been done using ADS and simulation of digital processor has been performed by Verilog simulation software. This design document also includes circuit diagrams of all the subsystems, BOM and mechanical housing design. This document has been delivered to the user. GUI for the receiver is shown below.

CORE R&D PROGRAM

i. Microwave Radiometer System for temperature and humidity profiling of Troposphere

Development of a ground based multi-frequency microwave radiometer for Tropospheric profiling of temperature and humidity profiling was taken up. The radiometer will comprise of two separate subsystems in the same cabinet, one for temperature (50–60 GHz) and the other for water vapor (20–30 GHz) profiling.



Comparison between estimated brightness temperature (forward model) and radiometer measured brightness temperature on 4th August 2011

Development of algorithm for the atmospheric absorption in the 20-30 GHz and 50-60 GHz bands has been completed. Basic algorithm development for millimeter wave radiometer control and data acquisition system using NI system has been completed. PDR documentation was prepared and reviewed. The radiometer software was tested (forward model) for the computation of brightness temperature using GPS sonde data measured at IITM Pune and the same was compared with IITM radiometer brightness temperature. Results were encouraging and both (estimated and measured) matched very well as shown in figure. Algorithm development for the data retrieval using neural network is in progress.

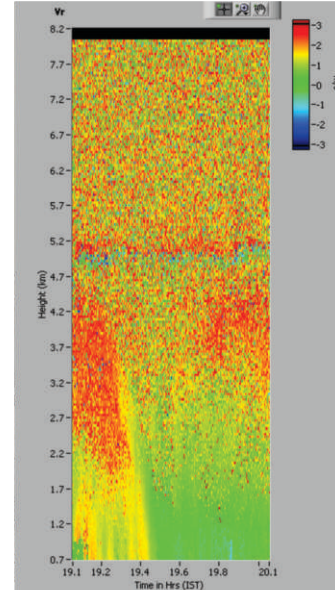
a) Ka Band Polarimetric Doppler Radar

A new project entitled "Development of Ka Band Polarimetric Doppler Radar for Cloud Profiling" has been sanctioned by Ministry of Earth Sciences in the month of February 2013. This radar with scanning capability will be able to measure cloud parameters from the height of 300 m to 15 km with a typical height resolution of 50m. Through core R&D program a prototype Ka Band Radar was developed and shown in the

photograph. The echogram Height vs Time shows the cloud melting into rain at a height of about 5 KM from the surface of the earth. The experiment was conducted in SAMEER Powai Campus.



SAMEER's Ka-band zenith looking cloud profiling radar



3. RADAR DIVISION

Radar Division executes projects in areas of distance measuring instruments (radar altimeters) for various custom applications and simulators to test these radars. With the expertise in the areas of RF design, signal processing and system engineering the division has executed several custom-built FMCW Radars for different agencies. The Radars are designed to operate in rugged environments. Test Simulators, which have programmable features, have also been designed to evaluate the radar systems. Several narrow band radars and distance measuring instruments like "altimeters" have been successfully developed using digital signal processing techniques to enhance performance and intelligence.



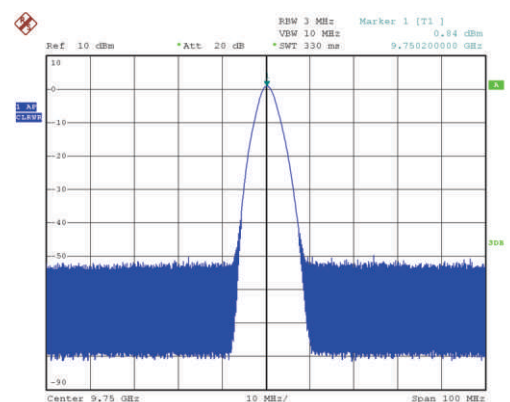
The RF module (DDS and PLO section)

i. Synthetic Aperture Radar at X-Band

The Hardware for a FMCW based Synthetic Aperture Radar in X-band for low-level Airborne Imaging is being developed as a Technology Demonstrator. A digitally synthesised wideband chirp (100-500 MHz) and phase locked VCO design was completed since a stable RF front end is a key requirement for radar imaging. Also a state of art Digital Acquisition and Memory board is being designed to store the sampled raw ADC radar data for off-line image forming and processing. A SAR Antenna with 20 db Gain has been designed for the project by EM & Antenna Group, Chennai. The RF module (DDS and PLO section) is illustrated.

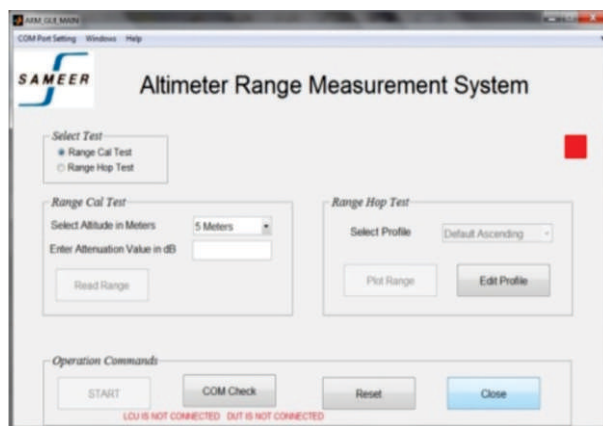
ii. Altimeter Range Measurement System

The design of a RF range simulator and test bench useful for static and field evaluation of radar altimeter is under progress. The operating range of the ARMS is 20 mts – 6000 mts over 2 to 18 GHz radar frequency. The ARMS system uses 8-level range banks using RF-over-

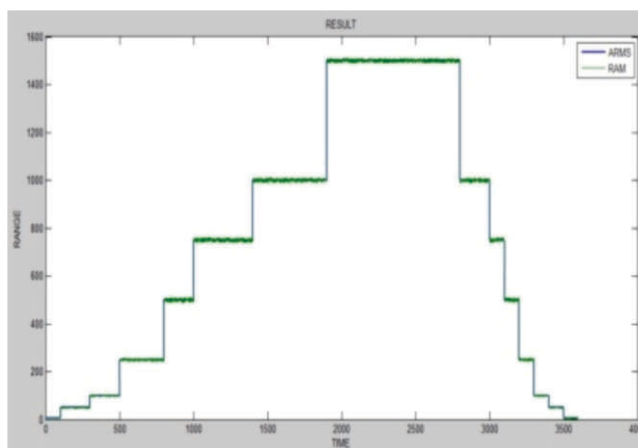


RF Carrier Plot at 9.75 GHz

Optics technique for providing precise range delays. Typical range accuracy is 1% (± 25 ns). The system also incorporates a RF attenuator which can be controlled over the serial interface by the host UI. The system also incorporates a RF Modem, GPS receiver and S band telemetry system for field evaluation purposes. Intuitive UI software for the default and user specific range calibration tests has been developed. The Logic Controller Unit which controls the delay (range), power (attenuation) and range hop profile has been developed and is illustrated below.



Radar Test Bench UI



User Defined Test Plot



4. RF/ MICROWAVE SYSTEMS (RFMS) DIVISION

The RFMS Division works in the areas of antennas, high power sources/amplifiers, industrial microwave systems and VHF/UHF atmospheric instrumentation. Accordingly, both core and sponsored projects have been taken up in these fields.

Core R&D Program

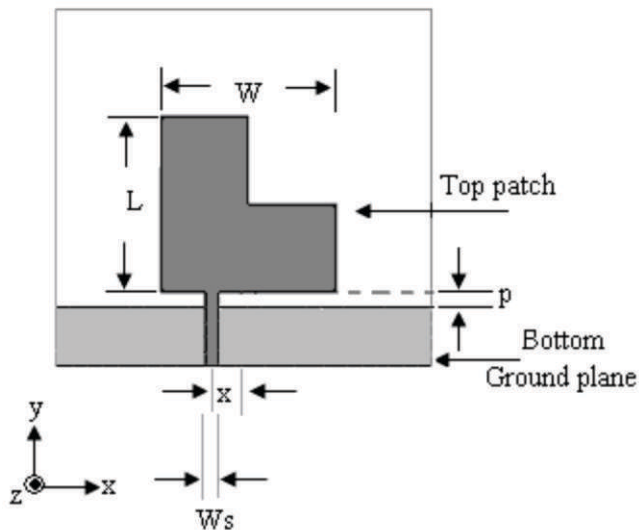
I. Implementation of an active aperture wind profiler

A small 5 X 5 active aperture with 25 Yagi-Uda antenna elements fed individually by TR Module with complete Radar sub-systems is being designed and developed. The active

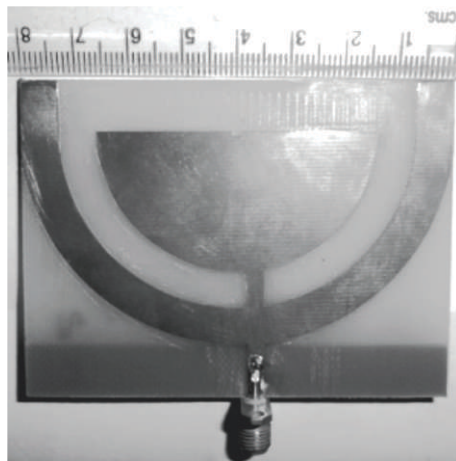
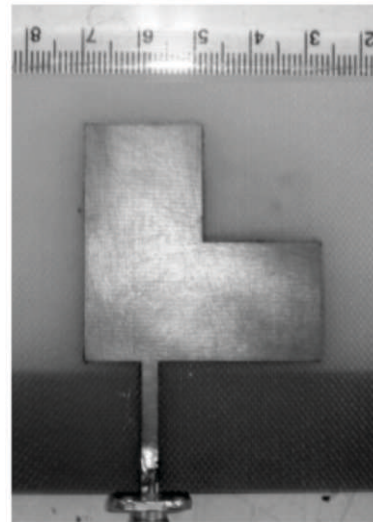
aperture Radar concept will be demonstrated using this small Radar. All the subsystems have been designed and are being developed and tested. Presently, antenna design has been finalized and 25 element arrays have been installed at SAMEER, Mumbai centre.

ii. UWB Planar Monopole Antenna

The aim of this project is design of novel ultra-wide band UWB antennas and generation of technology. A L-shaped dual polarized UWB antenna has been designed, developed and tested. Technology of another configuration of compact printed UWB antenna has been characterized and tested, which has semicircular annular shape. This antenna meets all the pattern characteristics of monopole antenna.



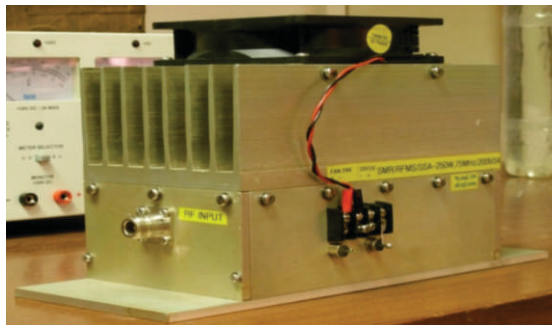
L-shaped dual polarised printed monopole antenna



Printed monopole semi-circular patch within semi-annular ring.

iii. High Power Solid State Amplifier/Transmitter

The objective of this project is to develop 1 kW solid state amplifier for both pulsed as well as CW applications. Further, the technology will be extended to 2 kW power level and then power combining



300W Solid State Amplifier at 75MHz

technique will be used to achieve 5-10 kW. At present 300W CW VHF SSA has been designed, developed and tested.

SPONSORED PROJECT

i. Design, development and installation of Stratosphere Troposphere (ST) Radar at Gauhati university for North-East region

The project involves design, development and installation of ST Radar as national facility at Gauhati University for north east states with emphasis on cost effective indigenization of this sophisticated technology. SAMEER, with its proven capability in similar field, aims to execute this state-of-the-art technology based project and to take lead in this field at national level. System design of this prestigious active aperture Radar has been



Developed unit of TR Module for ST Radar project.

completed. The design and development of all the sub-system is in progress.

Progress made, subsystem wise, is as follows

The design of four elements Yogi Uda Antenna, after three theoretical and experimental iterations, has been finalized.

Design of the Transmit Receive Module with 400 W peak power has been completed. One developmental model has been fabricated and tested. Further characterization and other interface cards are been developed.

ii. 30kW 75 MHz CW Amplifier for Gov. user agency

A new transmitter at 75 MHz with CW output power of 30 kW is being developed indigenously. All the subsystems of this transmitter system namely low power control circuits and driver amplifier have been developed and tested except for the final stage of high power amplifier (HPA). The HPA unit has been

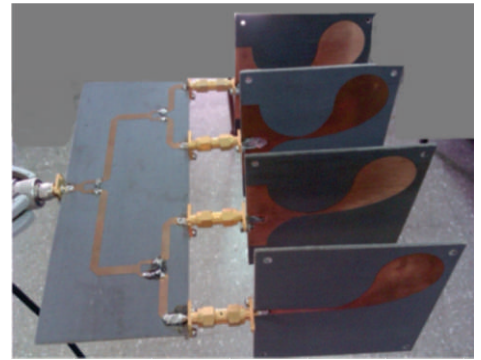


Low power controller rack of the 30 kW Transmitter at 75 MHz

redesigned and being fabricated. Thereafter, integration and testing will be carried out.

iii. Design and development of antennas for shared aperture (shape) applications.

There is an increasing trend in communication and defense systems towards using a single antenna for multiple functions. Since space, weight, and antenna siting for optimal coverage are at a premium on these platforms, it is desirable to reduce the number of antennas by consolidating the functionality of several systems into a single shared aperture broadband antenna. Cost comparisons between shared aperture systems



Bunny ear Vivaldi Antenna Array

and an ensemble of independent systems are favorable for the shared aperture systems. A project has been undertaken to study the feasibility of applying the shared aperture architecture to various platforms. The concept will be proven by design and development of a wideband array antenna.

iv. Conformal V/UHF antenna for airborne applications

The design and development of airborne V/UHF conformal antenna has been undertaken. This antenna, which will be mounted on the fin of the aircraft, has to cover the frequency band of 100 - 400 MHz. It has been designed to meet all the pattern coverage requirements and will be qualified for structural and environmental tests.

v. 6 kw variable power microwave system for processing of solution

A project has been undertaken to develop a 6kw microwave source for processing metallic solution. The system design of this variable power 6 kW system, wherein option for both CW and pulsed operation will be available, has been completed. The applicator will be multi-mode type for batch processing. The realization of the system is in progress.

Following microwave based systems were developed and commissioned

i. Soya bean Processing Units using High Power Microwave for CIAE (ICAR), Bhopal

Under the MOU between SAMEER and Central Institute of Agricultural Engineering (CIAE), Bhopal, a high power microwave system, with variable power from 0.5-3 kW at 2.45 GHz, has been designed, developed and commissioned for Soya bean processing to disable 'Tripsy Enzyme'. Using this microwave system, CIAE will carry out extensive field trials to produce good quality, low cost soy flour.

ii. Electromagnetic Energies for Bio stimulation and Post Harvest Conservation of Seeds and Agri-products

Microwave design guidelines and consultancy has been provided to NRL, PUSA Institute, Indian Agricultural Research Institute (IARI) New Delhi for project funded by ICAR.



High Power Pulsed/CW Microwave System for processing of soy beans grain for Central Institute for Agricultural Engineering (CIAE)

Specifications have been worked out for designing the microwave system which would be used to expose various types of seeds, grains, and post harvest yields to increase the shelf life. Following two Microwave technology based systems were developed for this purpose.

A 3 kW microwave variable power system with conveyor belt applicator has been designed, developed and commissioned at IARI.

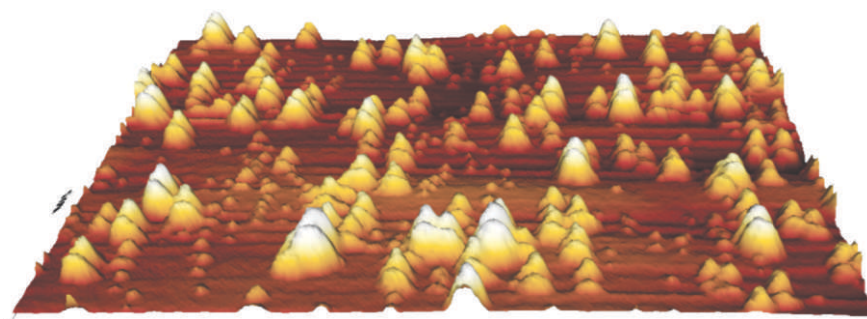
A Microwave system, with variable high power (1- 5 kW) pulsed/CW, has also been designed and developed for post harvest laboratory of PUSA Institute, IARI.



Variable Power Pulsed/CW Microwave System for processing of seeds for PUSA Institute



5 kW CW Microwave System for Drying Agro Products for Indian Agricultural Research Institute (IARI)



Atomic Force Microscopy image of Quantum dots synthesized by MBE

5. PHOTONICS DIVISION

R & D activities in the areas of Gallium Arsenide based Quantum well materials, direct optical waveguide writing, optical gas sensors, Packaging of Integrated Optic devices, development of THz technology, development of Optical Coherence Tomography are being pursued in this group. Two new core activities based on Molecular Beam Epitaxial system for growth of GaAs based quantum infrared detector material and Growth of III-V Multi-junctions were continued from the previous year.

Core R&D Program

I. Synthesis of GaAs base quantum dot Infrared Photo detector materials in the transmission window 8-12 microns

The optical properties of self-assembled quantum dots (QDs) are being widely studied because of their applications in optoelectronic devices such as lasers for optical communications or quantum dot infrared photo detectors (QDIPs) and photovoltaic devices. The success of quantum well structures for IR detection applications has stimulated the development of QDIPs. The detection mechanism is based on the intra-band photo excitation of electrons from confined states in the conduction band to the continuum. The emitted electrons drift towards the collector in the electric field provided by the applied bias and photocurrent is created.

We have grown a conventional structure, where the photocurrent is collected through the vertical transport of

carriers between top and bottom contacts. The device heterostructure comprises of repeated InAs QD layers buried in GaAs /InGaAs barriers with top and bottom contact layers at active region boundaries. The quantum dots are directly doped with silicon in order to provide free carriers during photo excitation, and an AlGaAs barrier is included in the structure to block dark current created by thermionic emission.

We have successfully synthesized InAs/GaAs quantum dots by MBE, the results have been accepted for presentation at the International conference on Advanced Nanomaterials and Emerging Engineering Technologies (ICANMEET 2013). The photograph below shows growth of quantum dots of InAs on GaAs of height up to 25nm.

ii. Synthesis of III-V Multi junctions by MBE for applications in Photovoltaic.

Multi junction solar cells created from III-V semiconductor materials exhibit high efficiencies matched by no other existing photovoltaic technology. The most common form of multi-junction solar cells is composed of 3 layers of different materials, and hence it is called triple-junction solar cells, (usually III-V materials) that have different band gaps and hence absorb different portions of the solar spectrum. The top layer has the largest band gap while the bottom layer

has the smallest band gap. This design allows less energetic photons to pass through the upper layer(s) and be absorbed by lower layers, to generate Electron-Hole pairs, which thereby increases the overall efficiency of the solar cell. One important design consideration is that the photocurrent generated in each layer must be the same since the layers are in series. In addition, the band gaps of each layer should differ by approximately equal energies so that the spectrum of incident radiation is most effectively absorbed. Multi junctions are primarily used in systems in outer space and as collector cells where a large amount of sunlight is incident onto the cell. Triple-junction solar cells are currently made of GaInP, GaAs and Ge which have band gaps of 1.8 eV, 1.4 eV and 0.7 eV. We are targeting GaAs, GaInNAs and Ge, which have band gaps of 1.4 eV, 1.0 eV (targeted) and 0.7 eV.

We have successfully synthesized the ternary and quaternary alloys viz., GaAsN, GaInNAs on GaAs and successfully synthesized 5-stacks of QDs on GaAs. Highly stacked QD layers are suitable for solar cells where thick layers are required for sufficient absorption of solar radiation.

iii. Development of High Resolution Imaging System using Spectral Domain-Optical Coherence Tomography (SD-OCT):

OCT is an optical interferometry technique that acquires depth resolved images in scattering media such as biological samples in both 2D & 3D. We would be using a variant of Fourier Domain OCT known as Spectral Domain-OCT (SD-OCT) which requires low coherence optical source and high speed spectrometer equipped with a high speed line detector. It enables non contact, non invasive examination of any suspected tissues such as under the skin, in oral cavity, retina etc. without any need of biopsy. The targeted specifications are 10-15 micron axial resolution and lateral resolution of 15-20nm in biological tissues using 1310nm low coherent optical

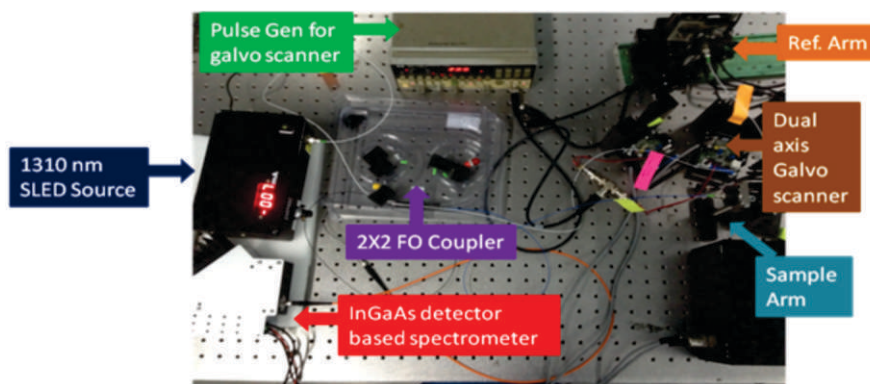
source having typical bandwidth of 80 nm or more. Literature Survey and Preliminary Block level system designs were done. SLED Source, Spectrometer and Galvo scanner were procured and tested.

iv. Development of Terahertz technology for imaging and spectroscopy

Research and development in the least explored THz band of electromagnetic spectrum is initiated with an aim to develop terahertz based systems which have wider societal applications. The final objective is to develop systems which cater to the needs of national security and biomedical applications. However, in the first step, it is important to understand the terahertz technology by means of extensive literature study, design and simulation of key components such as sources and detectors, expertise development in their actual fabrication and finally their usage. As part of this project, the following activities are planned

- a) Laboratory prototype of Terahertz imaging system
- b) Detection of concealed explosives using Terahertz spectroscopy

Extensive literature survey on THz technology has been completed and six volume report prepared. The system design for imaging and spectroscopy



Schematic of SD-OCT setup on optical bench

system finalised. Procurement of optical and THz related components initiated and purchase orders placed. One paper on laser based imaging technique published in Indian Journal.

Sponsored project

i. Development of IR absorption based Water sensor for Moon

This project work was part of Physical Research Laboratory funded project for "Developing Wireless Sensing Network of Tuned Laser diode absorption based sensors to detect water vapour at the surface of Moon". The role of SAMEER was to design and develop small, light weight optical sensor to detect traces water vapour. One unit of a Lab prototype was developed, tested and delivered. This unit has a laser at 1854nm with corresponding detector and associated electronics.

ii. Development of DSP controlled IR Laser absorption based gas sensor for pollution monitoring

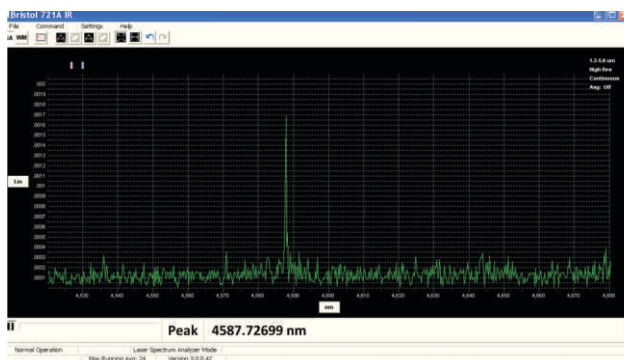
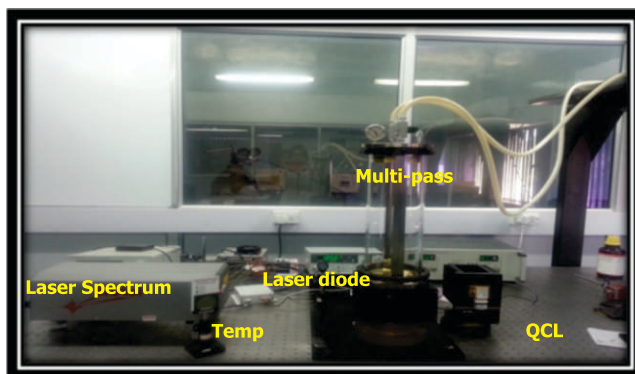
This DST sponsored project was taken with an aim to develop trace gas sensors for pollution monitoring. BEL, Pune is involved as a Industry partner for maturing this technology for Indian industries. A Quantum Cascade

Laser (QCL), operated at 4.6 μm wavelength, was used to detect traces of Carbon Monoxide gas inside a Multipass cell. Direct absorption technique is established using Laser Spectrum Analyzer. This activity is continued next year for making a portable proto- type which can be used for Industrial application. Detection of Carbon Monoxide gas was demonstrated using Direct absorption technique using an experimental set up made in the laboratory. The set up consists of Quantum Cascade Laser operated at 4.6 micron, Multipass gas cell and IR spectrum Analyzer.

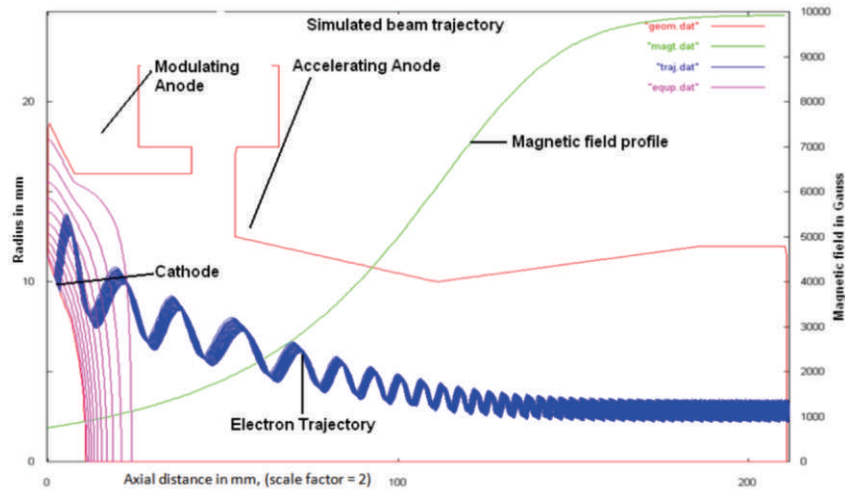
iii. Packaging of Integrated Optic Gyro Chip inside Optical Assembly mount of Fiber Optic Gyroscope

In this collaborative project sponsored by a Govt Lab, SAMEER's role is to package Integrated Optic Chips inside optical mount of Fiber Optic Gyroscope. The objective is to provide the user a packaged unit meeting the environmental qualifications.

Three devices packaged and delivered to user for test and qualification.



Setup for direct absorption technique, picture insert (Laser peak at 4.6 μm wavelength)



Simulated electron trajectory for the designed Magnetron Injection Gun (MIG)

6. GYROTRON AND SYSTEMS DIVISION

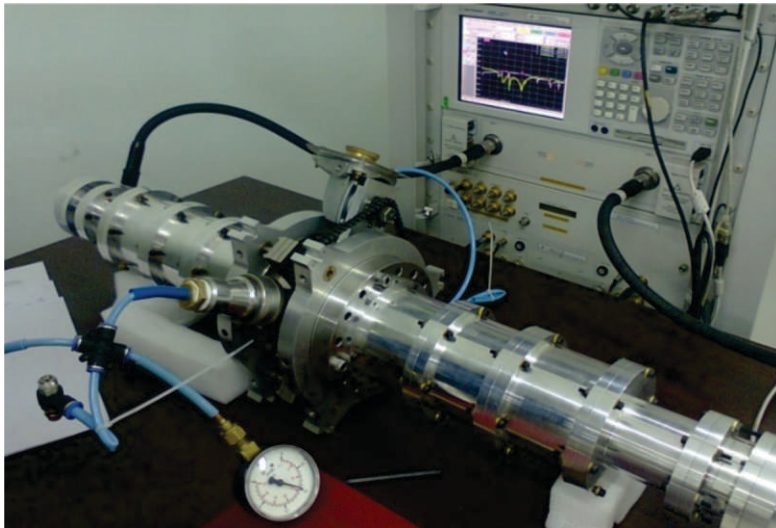
Gyrotron activity is gaining momentum in India. Gyrotron & Systems Division has started the activity with dielectric window and expanding the scope to most of the important components of a Gyrotron system.

i. Development of Sub-systems for Gyrotron

This project has started from April 2012 with the objective to design and develop the important sub-systems for a 28GHz, 10kW Gyrotron. During this period, electrical designs of gun, cavity and window have been taken up.

ii Design and Development of Window for 42 GHz 200 kW CW/ Long pulse gyrotron

Five institutes, namely: CEERI, Pilani; IPR, Gandhinagar; BHU, Varanasi; IIT, Roorkee and SAMEER, Mumbai are involved in the DST sponsored national program on development of high-power Gyrotron. SAMEER took the responsibility of developing the window; which has been successfully done and thoroughly characterized. Two sets of the UHV assemblies of the window, after all characterization, have been handed over to the nodal agency CEERI, Pilani for integration to the first Indian Gyrotron.



Characterization of the 2nd window for Gyrotron



Measurement setup for moisture measurement

This system can be used in the Measurement of moisture content of a stationary or moving bulk granular/ particular materials and adulteration monitoring of liquid products such as oil, honey, ghee etc.

7. INDUSTRIAL AND METEOROLOGICAL SYSTEMS DIVISION

This division is executing various project under core as well as sponsored activities

Core R&D Program

i. Moisture Measurement System using Microwaves

Design and development of a prototype non-destructive, non-contacting moisture measurement system for pulse/grain using microwaves has been completed and demonstrated. It is a standalone unit which estimates the moisture content of a grain sample kept in a holder and can be further extended to on-line moisture monitoring in drying system or any other relevant applications.

Microwave moisture measurement system by free space microwave transmission method works on the principle that water has a very high dielectric constant compared to most other materials. When microwaves interact with water molecules within the material they slow down (and hence change phase) and weaken (attenuate) as the energy is transferred to the material. Therefore the system can calculate the moisture content based on

these changes. The additional parameters which affect the measurement are bulk density, temperature of the material and frequency of operation. These parameters can be measured and can be taken into accounts.

ii. Development of HF Radar for Ionospheric studies

An Ionosonde is vertically sounding HF radar which detects the electron density of ionospheric plasma as a function of height. The Ionosonde transmits a broad spectrum of radio waves (1-20 MHz) vertically upward through the atmosphere. These radio waves pass through the neutral atmosphere, but are reflected back from electrically charged ionospheric layers. Different frequencies are reflected by different ionospheric layers. From these reflected signals and their time of travel a profile can be constructed of the electron density at different heights.

SAMEER has taken up development of an Ionosonde as a Core program. The development of Receive antenna 8 channel receiver and DSP system have been completed. The PC based Signal Processing and data analysis software is in the advanced stage of development. The system integration is in progress.

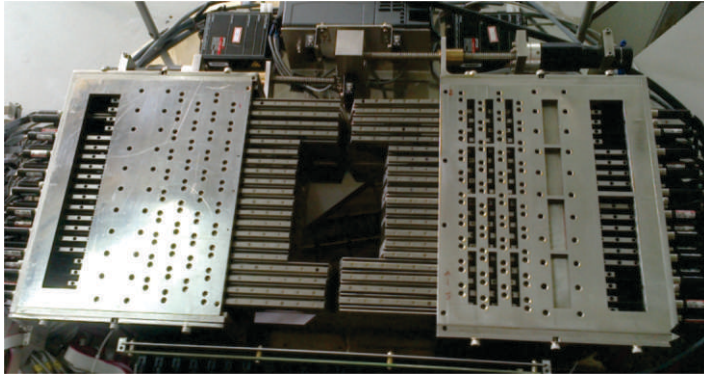
iii. Vacuum Assisted RF Dryer:

A project on design and development of Vacuum Assisted Radio frequency Dryer System has been initiated as a core Research program. At present, different conventional dryers are available to the industry. Vacuum offers oxygen free drying environment which can play a major role for products. Vacuum can result into better flavor and higher nutrition of the product. The mechanical drawing of vacuum based applicator has been completed and fabrication of the same has been tendered out. The control panel with PLC has been fabricated and being wired.

Sponsored Projects

i. Design & development of Multi-leaf Collimator (MLC)

MLC is an important attachment to the Medical Linear Accelerators used for cancer treatment. The rationale for using MLCs in conventional radiation oncology is to improve the efficiency of



MLC system without cover

treatment delivery for malignancy.

IA major limitation to the efficacy of radiotherapy treatment is the production of undesirable complications by the irradiation of healthy tissue inherent in a given radiotherapy technique. Many organs are relatively sensitive to radiation damage (the spinal cord, salivary glands, lungs, and the eyes are common examples) and must be given special consideration during radiotherapy treatment planning. In general, treatment planners attempt to optimize the dose distributions achievable with a given treatment strategy to deliver a tumorocidal dose of radiation to a target volume while minimizing the amount of radiation absorbed in healthy tissue.

A smart FPGA based controller, 82 motors with driver circuits are customized to achieve the precision motion of each leaf with better than 0.1 mm accuracy. The communication between the controller

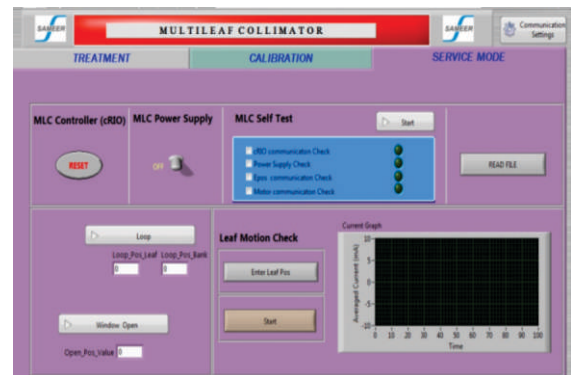
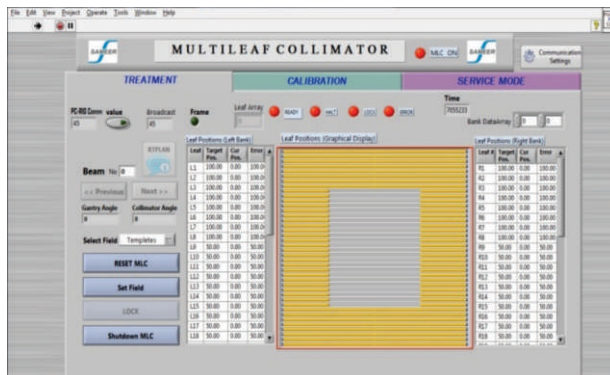
and the respective drivers is established on a CAN bus protocol.

The front end Graphical user interface is developed using Labview software which has three modes: Normal operations, calibration mode and maintenance & Service mode. The system is in final stages of integration and test bench results are meeting the required system specifications.

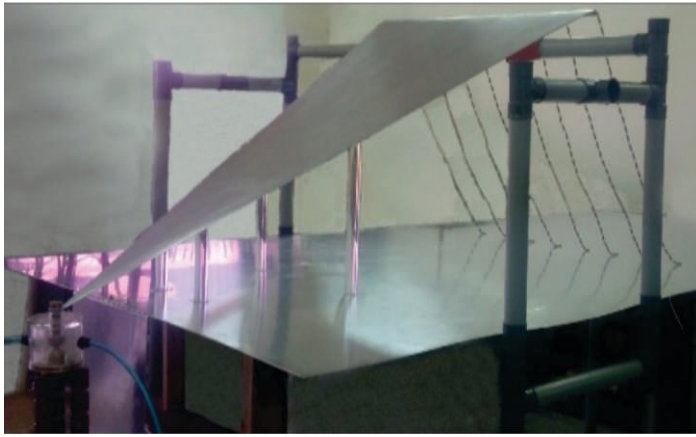
ii. Hand Held Data Logger for Recording & Processing Surface Weather Data:

Surface weather observations are the fundamental data used in weather forecasting. IMD manually records surface weather parameters every three hours to generate the synoptic messages, which are sent to Meteorological Centers (MC) through telephones. In MC, these synoptic messages are entered in the Met Message Switching System. Under the umbrella MOU with India Meteorological Department (IMD) SAMEER has taken up the project to automate the data collection and synoptic message generation and exchange process.

The development and field trials of the complete system have been completed and it is ready for implementation in IMD's surface observatory network.



Graphical User interface



Conical Plate NEMP Simulator

DIVISION

The EMI/EMC division has expertise in the field of EMC testing for commercial electronic products as well as electronics required for defense and space applications (MIL STD products). It provides Test, Measurement and Design Consultancy services to customers for their satisfaction in achieving Electromagnetic Compatibility in electronic products to comply with National/International EMC Standards. It has ISO/IEC 17025:2005 and ISO 9001:2008 accreditations. It is also listed for International EMC standards testing at FCC.

The division has the necessary experience and expertise for undertaking projects for high pulsed power microwave applications viz. High Power Pulsed Radar Transmitters. The division undertakes both research and test, design consultancy activities in line with high power electromagnetics which requires solving EMI issues at high power and studying High Power Microwave and High Power EM related issues. Study of state-of-the-art issues related to Signal Integrity and EMC for High speed digital systems is being undertaken in order to resolve EMC problems. Apart from the EMC testing activities the division also pursues Research in the field of High Power EMC and undertakes core R & D programs in this area. Research Activities for development of antenna sensors using Substrate Integrated Waveguide technologies has been done. Two core R & D activities are as follows:

Core R&D Program

I. Design and Development of NEMP Simulator

An Impulse generator has been designed & developed using a high voltage power supply which charges and discharges through a very low inductance capacitor onto a conical plate transmission line which is terminated with a suitable load which can withstand 25KV. The spark gap for switching this distributed matched load to the conical transmission line plate is developed indigenously. The Conical parallel plate waveguide launcher of the NEMP pulse has been designed so that a uniform field of 50KV / m is generated in a volume of 30x20x12 cm³.

ii. SIW technology based antennas and other subsystems

Rectangular dielectric loaded substrate integrated waveguide (SIW) H-plane sectoral horn antennas, operating at various frequencies in the range of 8 GHz to 26 GHz have been fabricated and tested. These antennas have been simulated and fabricated on a substrate of thickness 3.2mm and the dielectric material used is PolyTetraFluoroEthylene (PTFE). Under this project the goal was to design and develop SIW based waveguide components using planar techniques. We developed Planar SIW horn antennas which gave broad bandwidth in the frequency range 8 – 26 GHz and which could be fed with SMA connectors. The design was then suitably fine tuned so

that the antennas could be fed by microstrip line. The SIW technology was studied and waveguide interconnects as well as microstrip to waveguide transitions were designed and tested.

NABL Accredited EMI - EMC Test facility

The EMI EMC Division is responsible for smooth running of EMI/EMC Test facility located at CBD Belapur Navi Mumbai which is NABL accredited. EMC testing is done as per various civilian and military standards like CISPR 11, CISPR 22, CISPR 24, IEC 61000-4, MIL-STD-461C/D/E. Design Consultancy and solutions are also offered to customers for making their products compliant with various EMC standards. The test and consultancy service is routinely made available to customers desirous of obtaining CE marking and exporting their products. In the last year as many as 70 Customers availed of this service for conducting more than 120 tests on commercial products. The Division has immensely contributed to the growth of the Indian electronic industry by offering them EMI EMC services and solutions. It also plays a major role in assuring EMC test services to the strategic sector as it is the only laboratory conducting EMC testing as per military standards in the western region. During 2012-13, 50 different tests were conducted on 40 different products for strategic applications.

A Plant of NPCIL was experiencing EMC problems at site. A team from the division studied the total Power plant control electronics and gave design and testing consultancy at site for EMC mapping of the Control electronics and offered solution to the persistent EMC problem.



SIW Technology based X band and Ku band components

The Division has special strength in understanding electro-mechanical requirements of the core R & D. The division supports various projects by giving active support in designing electrical enclosures, mechanical designing Microwave and RF components and assemblies, machining critical components requiring high accuracies, standardizing machining processes etc. The division also has a chemical plating facility for plating the critical components to avoid corrosion and improve product life.



9. MECHANICAL DESIGN AND FABRICATION FACILITY

General Facility Division

General Facility Division provides mechanical engineering support to all on-going project activities in terms of mechanical design, fabrication, quality control, integration / assembly and installation of various electronic & microwave components / subsystems / systems. The division has qualified and experienced manpower and a mix of conventional and CNC machines tools for mechanical fabrication and CAD facilities. The division also has chemical plating facility which contributes to various on-going projects in terms of precision cleaning, electro-polishing and electroplating of critical Microwave components.

Core R&D / Sponsored program

The division participated in the following projects.

- a) ST- Mode Radar
- b) Cloud Radar
- c) Doppler SODAR
- d) Medical Linear Accelerator (Jai Vigyan Phase II)
- e) High Power Transmitter for RIB
- f) MW Heating Systems

The division gets involved systematically in most of the projects and contributes towards completion by offering engineering solutions.



SAMEER CHENNAI

CENTRE FOR ELECTROMAGNETICS

Introduction

SAMEER Chennai centre specializes in the areas of EMI/EMC, advanced communication systems, Digital Signal processing, Antennas and thermal engineering. The centre has executed sponsored projects of national importance in communications, DSP and antennas. Core projects are executed for competence building. The centre has provided unique test, measurement, calibration and consultancy services in EMI-EMC, antennas and thermal engineering to Industries and Govt. departments. The centre has two campuses-main campus is in CIT campus, Taramani and 2nd campus is located in Perungudi.

TEST, MEASUREMENT, CALIBRATION AND DESIGN CONSULTANCY SERVICES

1. EMI/EMC DIVISION

Ethis Division continued to provide EMI/EMC test, measurement and design consultancy services to industries/user agencies during 2012-13. Test and calibration laboratories are equipped with state of the art test instruments. EMI/EMC Test Laboratories for Civilian Standards and Calibration Laboratories are accredited as per NABL 17025 Quality Systems.

More than 443 numbers of EMI/EMC Testing assignments were completed and 286 industries were benefited.

EMC Calibration lab has updated its NABL Scope of accreditation to cover additional parameters and extended frequency range of calibration up to 18 GHz thus benefiting many customers. Calibration services were availed by 35 laboratories of the country and 95 assignments were carried out.

Design Consultancy projects:

- i. EMC Design assistance was provided for control panel to achieve compliance to MIL-STD 461E.
- ii. EMC Design assistance was offered for Tele-presence Codec to achieve compliance to CISPR 22 Standard.
- iii. EMC Design consultancy was offered for Auxiliary Control System to meet radiated emission requirements of MIL-STD 461C.
- iv. EMC Design consultancy was offered for Echo Sounder to meet Conducted emission requirements of MIL-STD 461E.
- v. As part of consultancy for establishment of EMC Lab at Hyderabad, EMC Division scientist visited their premises to witness the third party evaluation of their 10m chamber.
- vi. Ambient electromagnetic measurement was carried out at Wireless Lab at Chennai.
- vii. Shielding Effectiveness evaluation of the enclosure was carried out for four Indian Industries.

Some of the measurements carried out are shown in the photographs : from 3.8 GHz to 4.8 GHz was achieved.



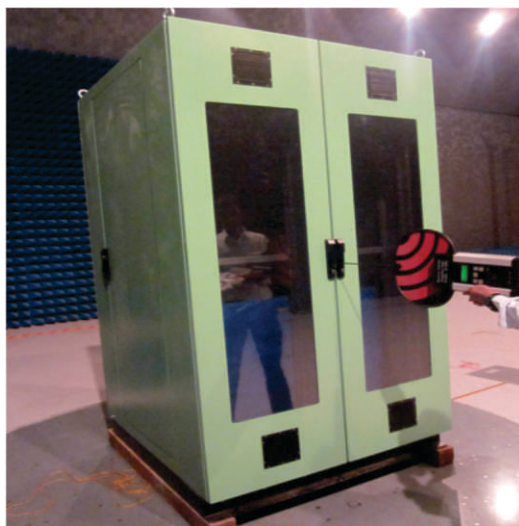
EMI Evaluation of Medical Equipment

Measurements at Customers Site :

- i. EMI/EMC Evaluation of 30 kVA Rotary Converter and Control Panel and induction motors.
- ii. EMI/EMC Evaluation of 70 kW Main Ballast Pump Motor.
- iii. EMI/EMC Evaluation of 25 kVA Brush type AC Generator

Accreditations / Audits :

- i. NABL Conducted re-assessment audit of EMI Testing and calibration services during December 15-16, 2012. EMC Division successfully completed this audit and NABL has issued accreditation certificate for testing and calibration services.
- ii. Mahesh as a NABL certified technical assessor in EMC area has carried out NABL audit during August 10-11, 2012 to assess the compliance of lab to ISO/IEC 17025 requirements.



Shielding Effectiveness

RESEARCH AND DEVELOPMENT ACTIVITIES

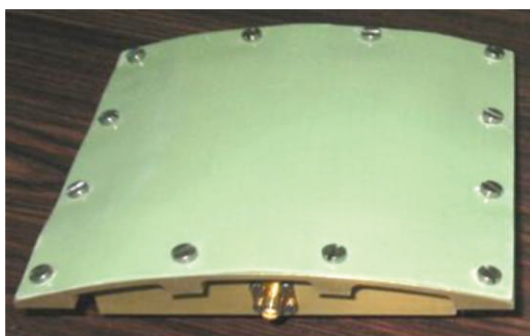
1. ELECTROMAGNETICS & ANTENNA DIVISION (EMAD)

Electromagnetics & Antenna Division has been actively involved in research and development projects, in the areas of antennas and microwave components. Division has successfully designed and developed antenna sub-systems for various applications. With the background of Electromagnetics & Antenna engineering expertise, the division has also developed products through in-house core programs envisaging future needs. An MoU was signed for the development of various ground and airborne antennas with a Govt laboratory. This has facilitated the Centre to undertake sponsored projects meeting the requirements of the user.

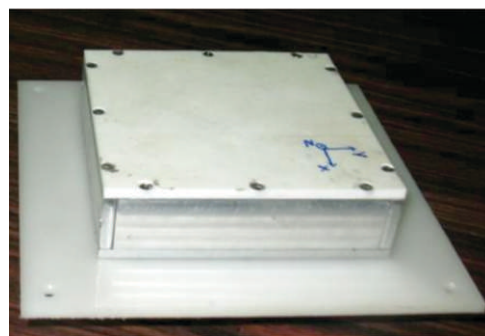
SPONSORED PROJECTS

i. Development of specialised Antennas

The antennas developed are critical in nature in a way that these antennas should be part of the airborne vehicle



Antenna for Airborne Vehicle



Ground Antenna

to get the data of the target from the ground accurately during vehicle flight. The onboard antennas will be placed on the airborne vehicle to receive the information of the target through Target Update Receiver. These antennas are developed to create small foot print on the airborne vehicle. The positions and placements of these antennas on the airborne vehicle are optimized to get better than 85% coverage during the flight. The ground antennas were designed for circular polarization capability. The wide beam axial ratio performance of the antenna ensures the required coverage. All these antennas are tested successfully for all the stringent environmental, thermal and electrical specifications. Antennas were tested in actual conditions and it met all requirements.

ii. Omnidirectional Antenna for Radio Sonde Receiver for IMD

A variant of conventional monopole antenna was



Antenna for Radiosonde Receiver

designed and developed for the receiver system for tracking weather balloons that measures various atmospheric parameters. Antenna was developed at 403 MHz to have omni-directional coverage in azimuth and hemi-spherical coverage in elevation.

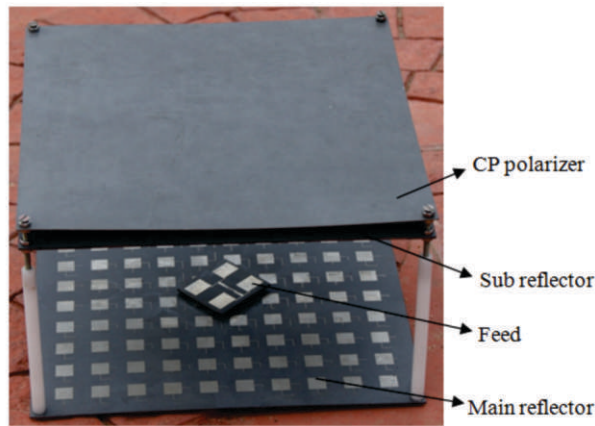
CORE R & D PROGRAMME

(a) Circularly Polarized Multilayer Microstrip Folded Reflect Array

A Circularly Polarized (CP) multilayer microstrip folded Reflect Array in X-Band is developed. This array consists of microstrip patch array as main reflector for polarization twisting and focusing, an embedded 2 x 2 microstrip patch feed, a sub-reflector for polarization selection and an additional printed planar cross-dipole polarizer to convert linearly polarized wave to CP wave. The sub reflector and cross dipole polarizer are optimized using a full wave solver for realizing low axial ratio, gain and bandwidth. The proposed antenna exhibits 13% gain bandwidth with measured peak gain of 19dB and 2 to 3% of axial ratio bandwidth.

Dual Band Circularly Polarized Printed Slot Pair Antenna on a Shared Aperture

A Circularly Polarized (CP) printed slot antenna configuration on a shared aperture is developed. Antenna is designed to operate at two distinct frequency bands of 4 GHz and 8 GHz. Dual slot CP elements at



Circularly Polarized Folded Reflect Array

two frequencies are created on a common shared aperture and the antenna is fed by a single microstrip feed line. To achieve unidirectional beam, the slot antenna is backed by a stepped reflector. The stepped reflector is optimized to provide proper phase for pattern combining and axial ratio improvement at both the frequency bands. Antenna operates over a frequency range of 3.5 to 4.5 GHz and 7.5 to 8.5 GHz for a VSWR <2. 3 dB axial ratio beam width is 15o and 44o for 4GHz and 8GHz respectively on the shared aperture. The novelty lies in the design of shared aperture and back reflector. Unidirectional patterns are obtained by employing stepped back reflector and Frequency Selective Surface (FSS).

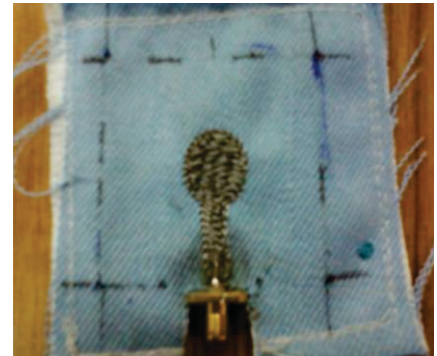
iii. Pattern Reconfigurable Ultra Wideband Thin Antenna on LCP

An Ultra Wide Band (UWB) monopole antenna on a shaped ground plane is designed. This compact and thin antenna operates from 3.1 to 10.6 GHz. The radiating element is created by stitching the conductive thread instead of the copper metallization. The ground plane is created by using a Liquid Crystal Polymer (LCP) material ($\epsilon_r=2.9$). The substrate of the designed antenna is made from

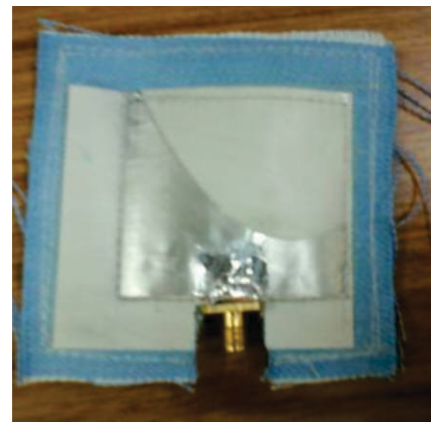


Shared Aperture Antenna

jeans fabric ($\epsilon_r=1.7$) while the radiating element is made from stainless steel conductive coated thread. By changing the shaped ground, the direction of the radiation pattern can be changed. Radiation pattern is steered over an angle of 60 degrees on the both the sides of beam pointing angle.



Front view



back view

Pattern Reconfigurable Ultra Wide Band Thin Antenna

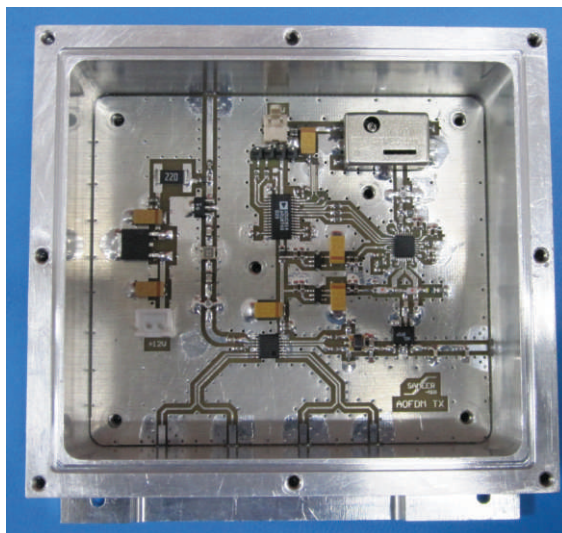


2. COMMUNICATION SYSTEM DIVISION (CSD)

SPONSORED PROJECTS

I. Adaptive OFDM Receiver

Orthogonal Frequency Division Multiplexing (OFDM) is a method of encoding digital data on multiple carrier frequencies. Adaptive modulation schemes including BPSK, QPSK and QAM are being implemented in the OFDM based system so that optimum data throughput is achieved. The modulation schemes will be selected without the knowledge of the user based on channel conditions.



Outdoor Transmitter Module

System simulation, design and development of RF and baseband hardware have been completed. FPGA code development and integration are in progress.

ii. CDMA Based Telecommand System

Code Division Multiple Access (CDMA) based Telecommand system is being developed for a Govt. Agency for ground to air control applications. The system consists of ground based transmitter and air borne receiver. Since Telecommand systems are one of the

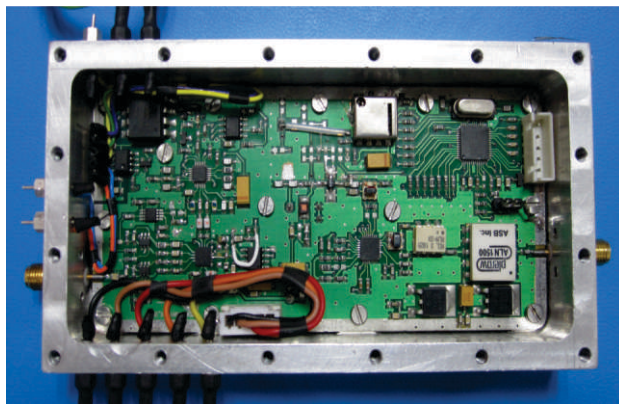


Telecommand Unit

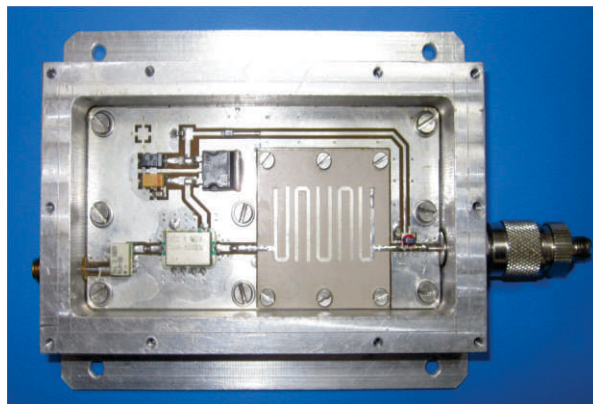
critical modules of the total deployment, CDMA based system is being attempted for this segment. The Telecommand system consists of CDMA based transmitter and receiver units. The CDMA codes and the frequency can be set by the user during the system deployment.

iii. Secured Two Way Communication System

As an extension of 'Two RF Channel CDMA receiver', 'Secured Two Way Communication System' is being developed for a Govt. Agency. The two way communication system caters for ground to air and air to ground communications requirements. RF prototype version has been completed and the base band signal processing work is in progress. The system is being designed to meet many environmental conditions as well as EMI/EMC standards.



Outdoor Unit for Ground System



Down Converter Module

CORE R & D PROGRAMME

Studies on Control of Intra-system EMI in Mixed Signal Circuits

With the evolution of electronics technology, integration of high speed digital circuits, RF Analog circuits, Memory elements, Micro Electro Mechanical Systems (MEMS), Sensors and Electro-optical devices has become necessary. This integration supports communication and computing capabilities integrated in a tight module and leads to noise coupling between dissimilar modules. In this core R&D programme, noises being generated in mixed signal systems and methods of mitigation without compromising on the performance and dimension are being simulated and experimented. Results are being published in technical forums including conferences.

3. DIGITAL SIGNAL PROCESSING DIVISION (DSPD)

The Division has developed an indigenous Data Acquisition and Control System on the specifications provided by end user. The system is tested for its functional performance to meet the requirements of end application and also the environmental and EMC specifications.

SPONSORED PROJECTS

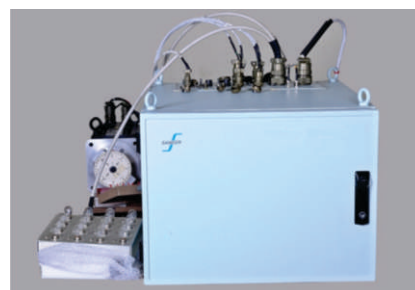
A Fire Control System has been designed, developed in this Division. The system is designed with state of the art technology. The system is interfaced to vehicle based sub-systems and hence data acquisition and launching



Main Controller



Sub-system 1



Sub-system 2

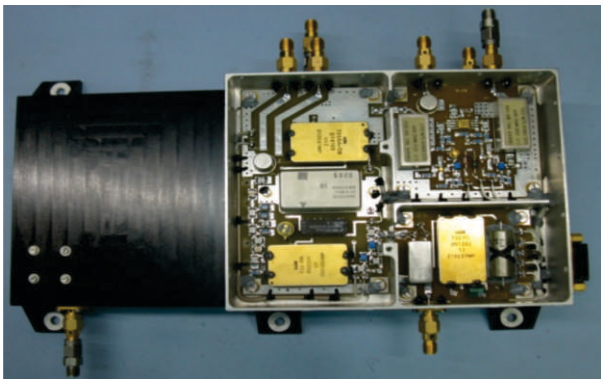
4. RF TECHNOLOGY DEVELOPMENT DIVISION

SPONSORED PROJECTS

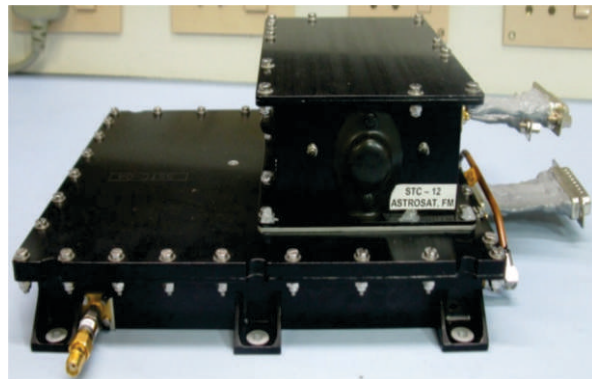
S-BAND TT&C TRANSPONDER

S-Band Telemetry, Tracking and Command Transponder consists of receiver, local oscillator and transmitter packages. The transponder, which is used for remote sensing application, is capable of operating in either coherent or non-coherent mode.

Delivered four numbers of S-Band TT&C Transponders are in space and are used in CARTOSAT-2B and Megatropiques remote sensing applications. One more transponder has been delivered during this year which is to be used in ASTROSAT application. Also, two more transponders are under fabrication for Resourcesat-2B applications.



Local Oscillator



Transmitter



Receiver

5. ELECTRONICS PACKAGING DIVISION (EPD)

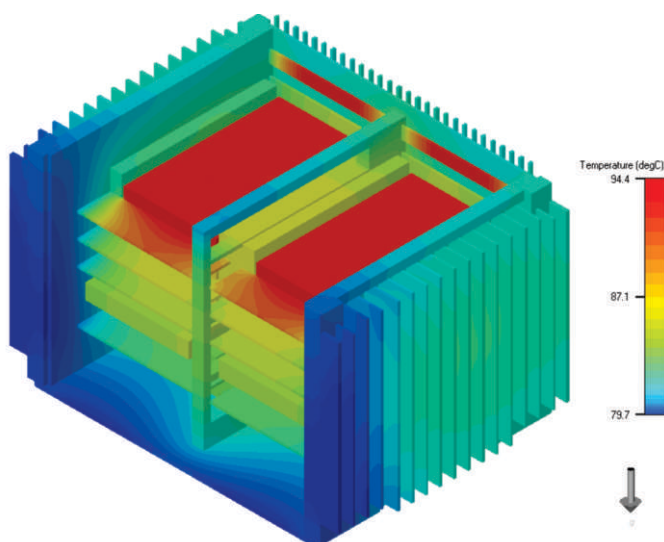
Cooling of electronic systems is one of the focal points in the design process and the key to a successful product launch. Reliability of the electronic product depends on the temperature of the chip. Many options ranging from natural convection to liquid-cooling are available to attain successful operation. Thermal division is offering thermal solutions to Government and Private R&D Labs.

SPONSORED PROJECTS

i. Thermal Simulation and Validation of Power PC

Power PC is a multilayered PCB of size 233 mm x 266 mm consisting of processors, ASCII devices, regulators etc. Power PC is housed inside the VME sub rack. Total heat dissipation from the board is around 135 Watts and is proposed to draw air from the fan tray placed at the bottom of the VME chassis.

The objective of this simulation is to study the air flow requirement of the board to keep the components temperature within their specification limit at extreme ambient of 55oC. Temperature of the individual components and the air flow pattern over the PCB are predicted. Components temperature and the air flow



Thermal Simulation of Mission Payload

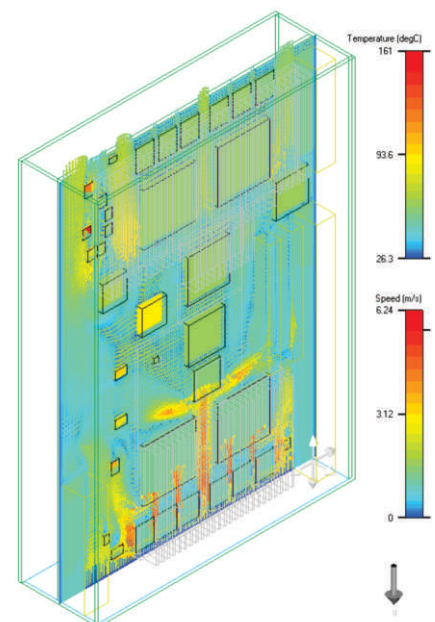
through the channel formed between the adjacent PCBs are validated with the measurement done on the actual system.

ii. Thermal Simulation of Mission Payload

Payload consists of ten PCBs of size 250mm x 200mm housed inside an aluminum chassis and the total heat dissipation from the system is around 110 Watts. All are metal clad boards, conduct the heat from components to the chassis. Thermal simulation is done to design extended fins on the chassis to dissipate the heat at an ambient of 55oC. Fin geometry is optimized to dissipate the heat effectively in order to maintain the components within their specification limit.

iii. Temperature & Flow Measurement for Industries

Flow and temperature measurements on electronic systems have been carried out for industries. Products range such as PCBs, Power amplifiers & Power.



Thermal simulation of Power PC



Sector III Salt Lake



Sector V Campus, Saltlec

SAMEER KOLKATA

CENTRE FOR MILLIMETER WAVE RESEARCH

SAMEER Kolkata Centre specializes in the field of microwave and millimeter wave technology and antennas. The centre is executing sponsored projects of national importance in the field of millimeter wave circuits & systems and antennas. Core projects are executed for competence building. The centre provides test and measurement services in the areas of EMI-EMC, antennas and radomes to Industries and Govt. Departments. Design consultancy services are also provided in EMI-EMC. The centre has two campuses- main campus is in Sector-V, Saltlake Electronics Complex and 2nd campus housing all test facilities is located in Sector-III of Saltlake.

RESEARCH AND DEVELOPMENT ACTIVITIES

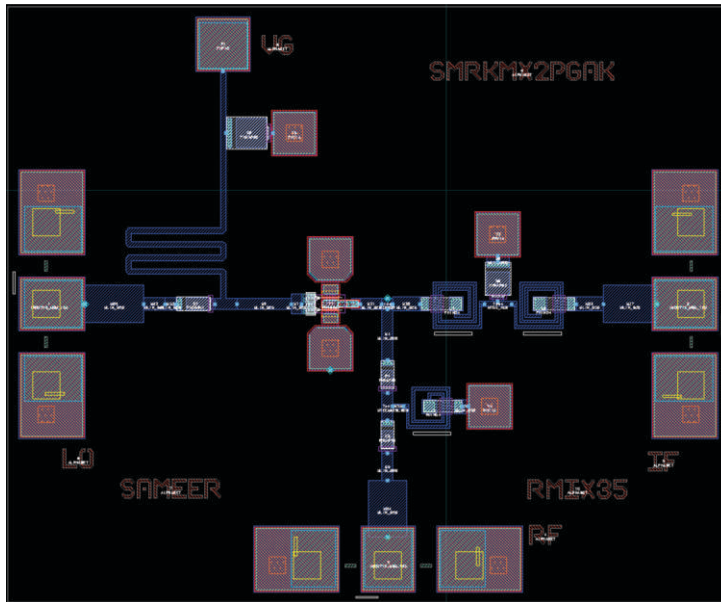
1. CIRCUITS AND SYSTEMS DIVISION

Objectives of this division are to i. design and develop microwave and millimeter wave based sub-systems and systems for strategic and civilian applications, ii. Undertake core projects to build up core competence and iii. Execute sponsored projects to build systems or subsystem hardware to meet national requirements.

Core R & D program

I. Ka-band MMIC mixer

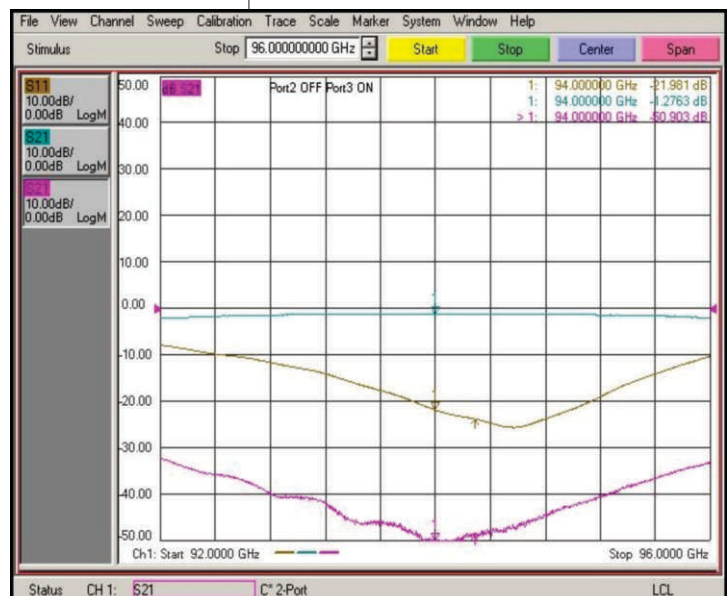
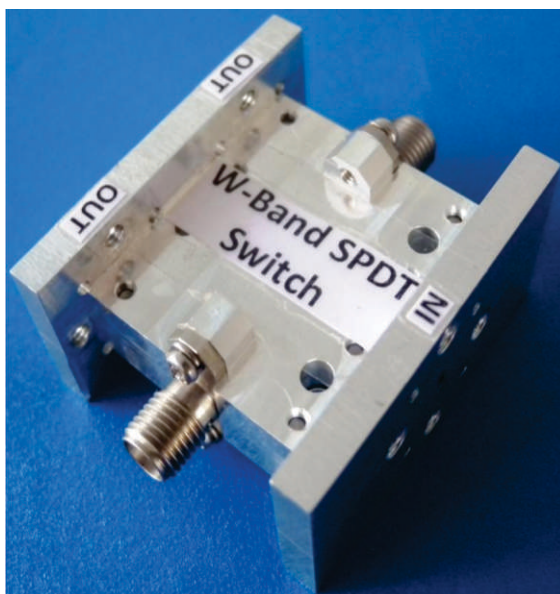
Low loss Ka-band MMIC mixer chip is being developed with low intermodulation distortion for miniaturized and compact receivers. It needs less LO power for pumping the device, has higher dynamic range and gives comparable noise performance to diode mixers. Two different configurations of resistive MMIC pHEMT mixers have been simulated using UMS (United Monolithic Semiconductor) design kits. The simulated conversion loss of the mixers is less than 10 dB for an LO power of +5 dBm. The isolation between LO-RF and LO-IF ports of the mixers is better than 20 dB and 40 dB respectively. The bandwidth of the mixers is 5 GHz. The MMIC mixer circuit is under fabrication.



Layout of resistive Ka-band MMIC mixer

ii. W-band SPDT PIN Switch

W-band SPDT switch has been developed using suspended stripline technology and is based on PIN diodes. It has been designed, fabricated and tested in shunt configuration with centre frequency at 94 GHz. The measured insertion loss for the switch is less than 1.5 dB and the return loss for the switch in ON state is better than 10dB. The Isolation of the switch is better than 30dB over a bandwidth of 4 GHz. The rise time and fall time for the switch are less than 10 nsec.



W-band SPDT switch with measured S-parameters.

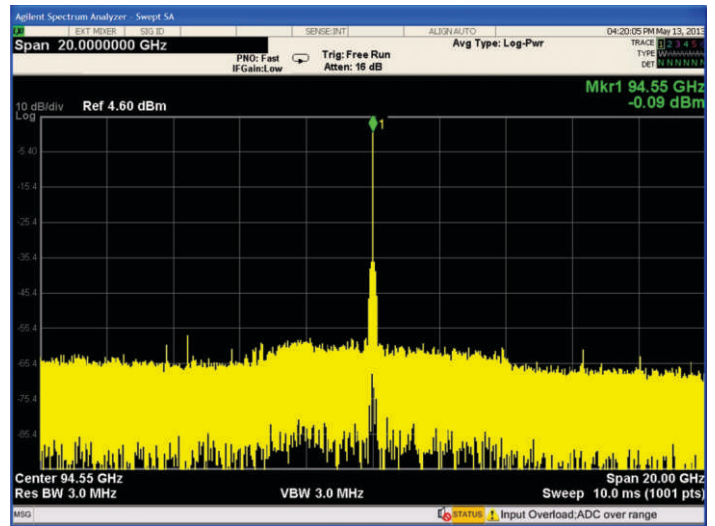
iii. Millimeter Wave MMIC Multiplier

A 47GHz frequency tripler is being developed for millimeter wave applications. Single stage pHEMT based tripler has been designed and simulated in MMIC configuration using UMS design kit for low conversion loss, small size, fabrication repeatability and high yield. Simulation result exhibits a conversion loss of about 7dB and harmonic suppression of

about 25 dB with +7 dBm to +10 dBm of input power. The MMIC tripler circuit is under fabrication.

iv. Millimeter-wave CW Gunn Oscillator

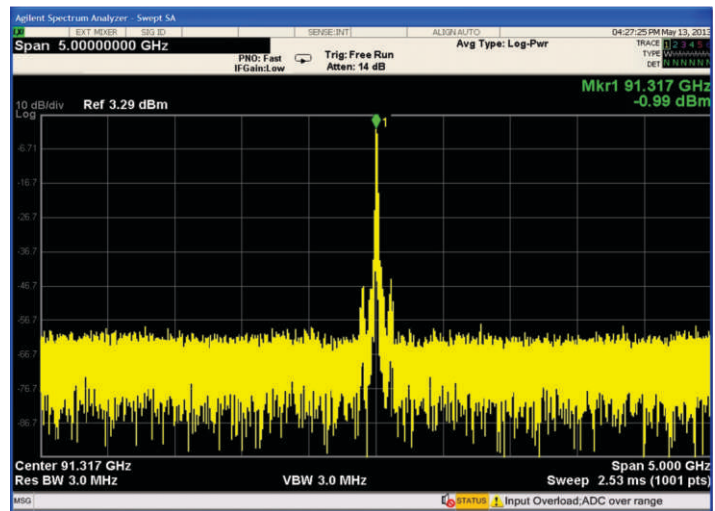
W-band CW Gunn oscillator has been designed and developed. The diode is of lower frequency. Its 2nd harmonic is coupled to the output of the cavity to obtain CW power at W-band. The free running oscillator is also injection-locked. Achieved power is about +13 dBm.



CW Gunn Oscillator Cavity with measured output spectrum.

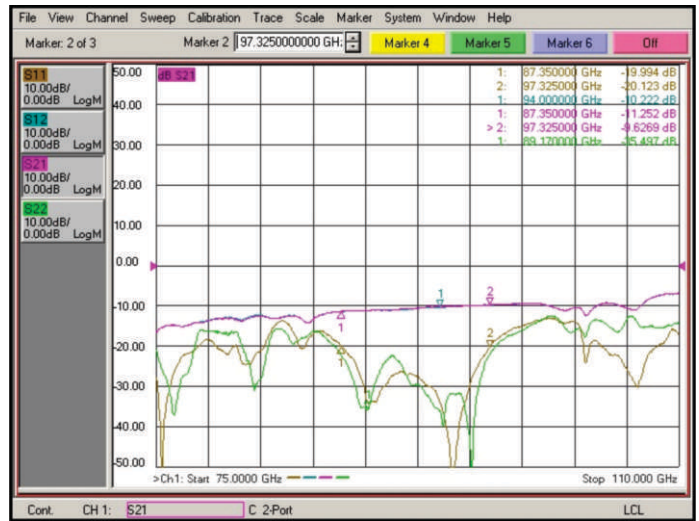
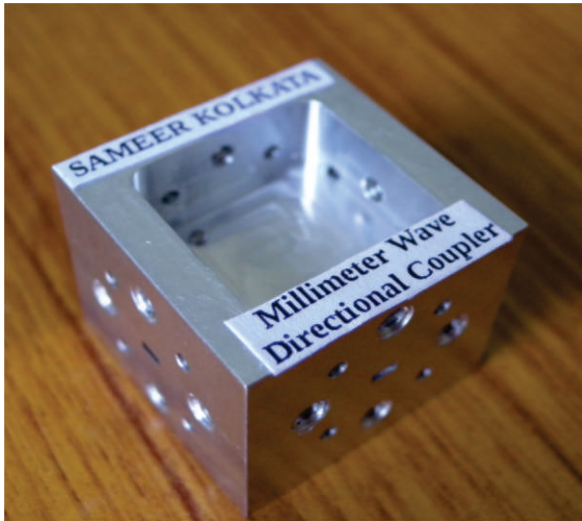
v. Millimeter-wave Voltage Controlled Oscillator

Millimeter wave voltage controlled oscillator (VCO) has been designed and developed using Gunn Diode and Varactor Diode. The Gunn diode used is of lower frequency. Its 2nd harmonic has been coupled to the output of the cavity to obtain CW power at W band. Tuning bandwidth of 150 MHz has been achieved with amplitude flatness within + 0.15 dBm and the same of 280 MHz is obtained with amplitude flatness of + 1.5 dBm.



vi. Millimeter-wave Directional Coupler

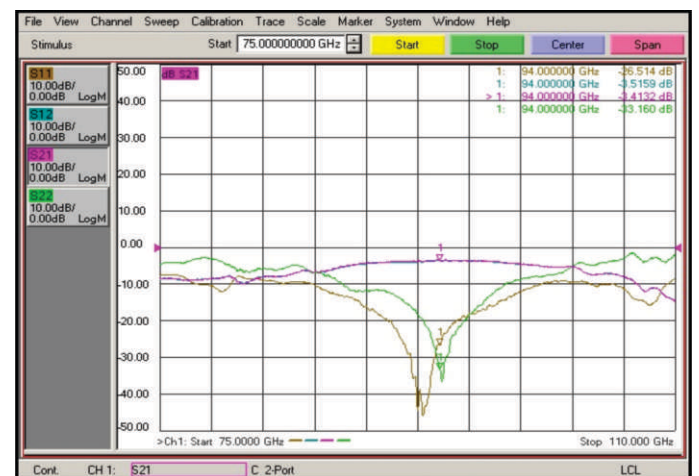
W-band cross-slot directional coupler has been designed and developed. Reduced height waveguide configuration has been used. Achieved coupling is 10.5 dB with 30 dB directivity.



Millimeter-wave Directional Coupler with measured S-parameters.

vii. Millimeter-wave Magic-Tee

W band magic-tee has been designed and developed. Funnel like structure and iris have been used to achieve broadband matching. Achieved insertion loss is approximately 0.7 dB with return loss better than 20 dB and isolation better than 25 dB.

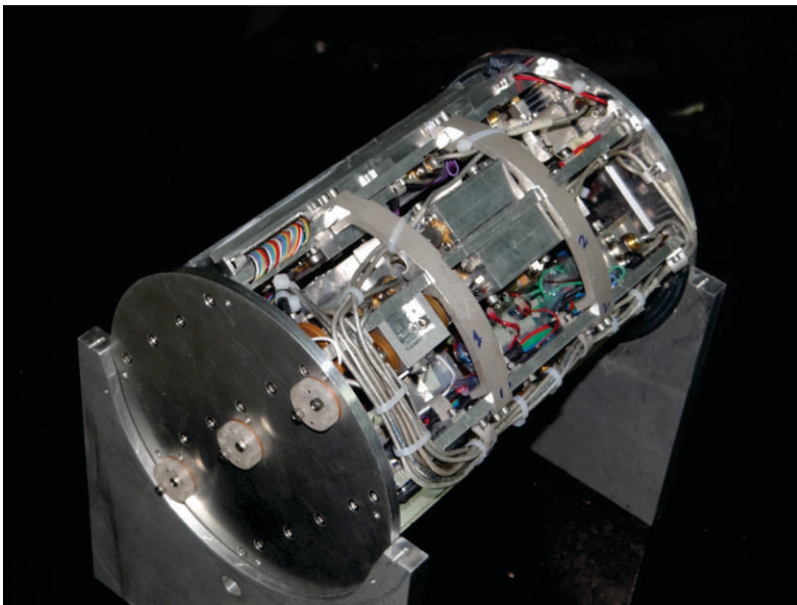


Millimeter-wave Magic Tee with measured S-parameters.

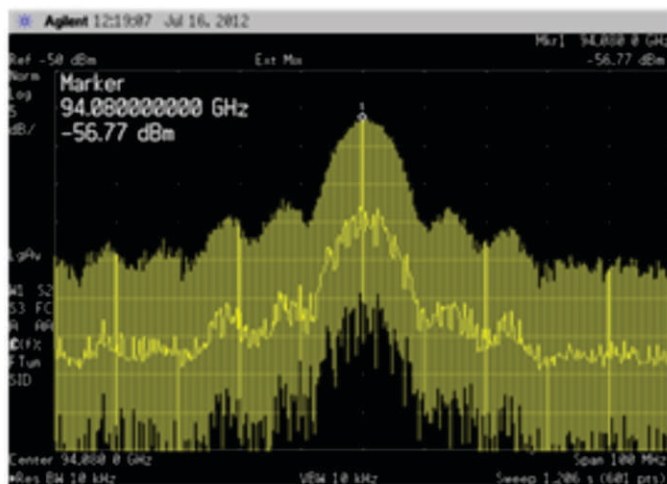
SPONSORED PROJECTS

I. Development of W-band Coherent Transceiver

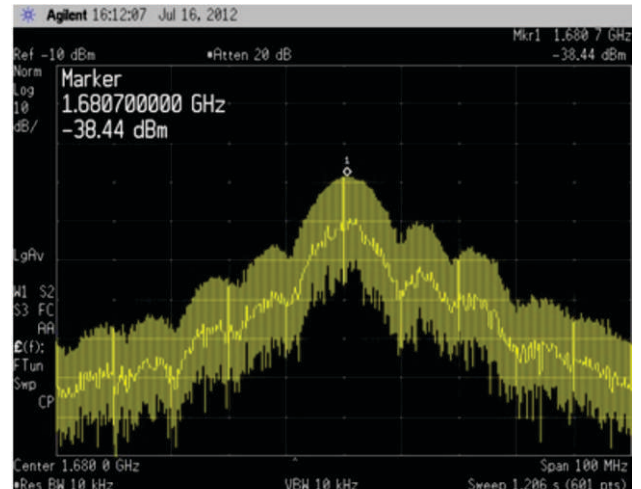
This project has been sponsored by a Gov. R & D Lab. The objective is to develop Coherent Transceiver at W-Band. First prototype unit has been delivered. This meets almost all electrical specifications. A fully engineered unit complying all thermal and electrical specifications has now been made. Other environmental specifications were taken into consideration in the mechanical design and assembly. Another unit is being made ready for taking to user site for further evaluation. These units have been developed with higher transmitter power of 33 Watt. The receiver performance has been upgraded by incorporating a W-band LNA in the chain and reducing the gain of the IF amplifier. This modification has lead to an overall improvement in the receiver noise figure. The system has also been tested with temperature variation from -20C to +55C to comply with user's requirement.



Upgraded W-band coherent transceiver



Transmitter output spectrum at W-band

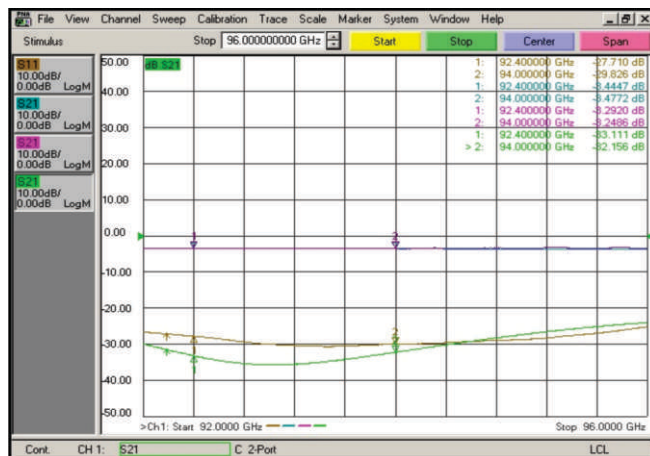


Receiver output spectrum at L-band

Some of the components developed in 2012-13 for improved performance of the system include the following:

a. W-band Short slot Hybrid

Reduced size W-band Short slot hybrid has been designed and developed considering the space constraint in the receiver section and for injection locking of W-band oscillator in the transmitter section of the W-band transceiver. The designed hybrid exhibits less than 0.5 dB insertion loss. Return loss and Isolation are better than 30 dB over 4 GHz bandwidth. Amplitude and phase imbalance between through and coupled ports is less than ± 0.25 dB and less than ± 1.5 deg respectively. The total dimensions of the hybrid are 30mm x 48mm x 20mm.



W-band Short slot hybrid with measured S-parameters.

b. W-band Low Noise Amplifier :

W-band MMIC based LNA has been developed for use at the RF front-end of the receiver unit of the W-band coherent transceiver system. This LNA module limits the overall noise figure of the receiver and also increases the receiver gain. The LNA has been designed with procured MMIC chip that has been packaged with proper bonding with waveguide interface at input and output. Noise figure of 6 dB, output P1 dB of +5 dBm and small signal gain of 15 dB has been achieved.



W-band low noise amplifier with measured S-parameters.

c. W-band Narrow Band Pass Filter:

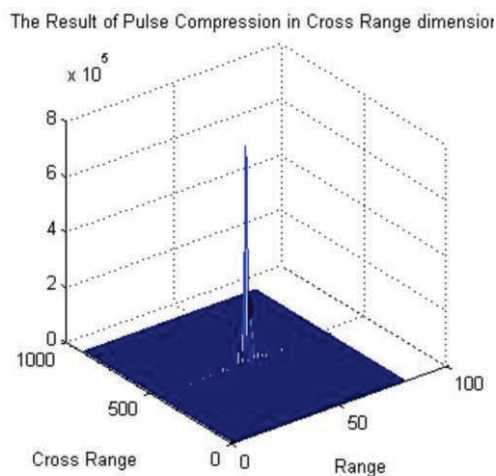
A narrow band pass filter has been designed and developed at W-band for use at the final output of the LO chain in the receiver unit of the system. This filter reduces level of any unwanted signal present in the LO spectrum and therefore reduce the overall noise figure of the receiver unit. The designed filter is a metal insert E-plane filter. It has 1GHz bandwidth with 1.5 dB insertion loss and 20 dB return loss with sharp roll-off.



W-band narrow band pass filter with measured S-parameters.

ii. Modeling and simulation of Millimeter wave (MMW) transceiver for imaging application

MMW seekers need longer detection range which means more transmitter power and more sensitive receivers plus new signal processing techniques to enhance range resolution. In this project modeling of Radar RF system and SAR processing unit has been done with commercially available SystemVue software. The two models are integrated to develop a complete seeker model of MMW transceiver for imaging application. Image of a point target is successfully constructed from the model.



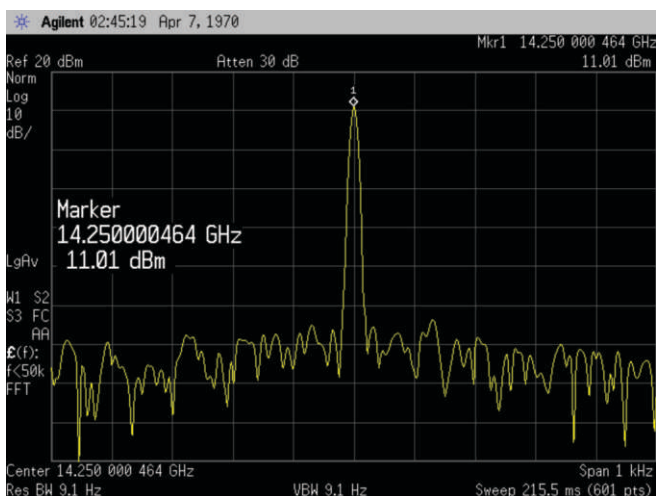
Simulation result of radar Echo from point target.

iii. Development of the front-end of wireless data link at 60 GHz

This project was taken for design and development of front end at 60GHz for wireless data link. This is useful for short-range highly secured ultra-high speed communication due to use of high atmospheric attenuation band. MMIC chips have been used for development of critical components/sub-systems. Some of the developments are given in following section.

a. Development of Phase Locked Oscillator

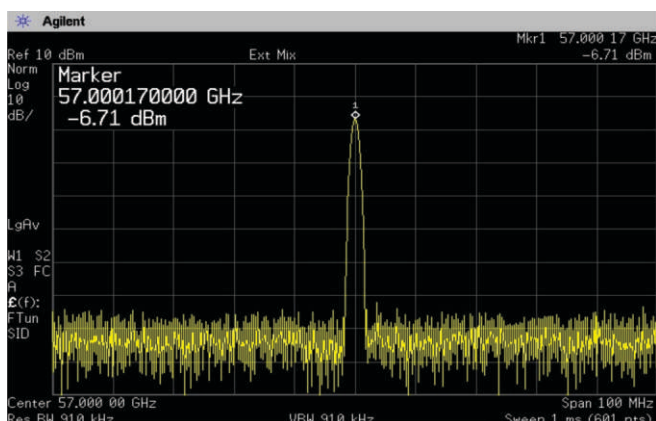
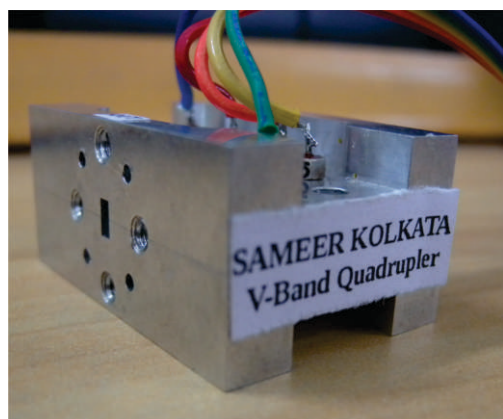
Phase locked Oscillator has been developed at 14.25GHz with about 300MHz tuning bandwidth. The oscillator output signal is then up-converted to V-Band transmitter signal using a quadrupler. Achieved output power is about 11dBm with phase noise of -93dBc/Hz @100KHz.



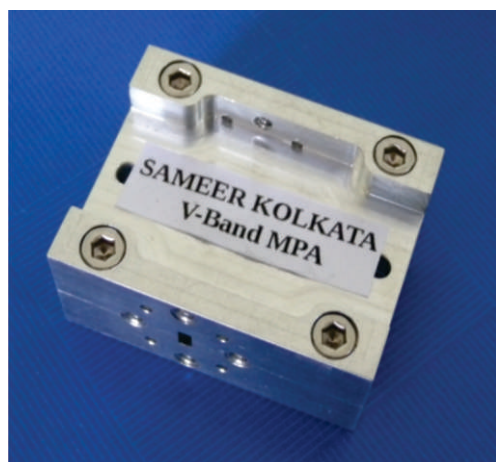
Phase Locked Oscillator at 14.25 GHz with measured output spectrum.

b. Development of MMIC based Quadrupler

V-band MMIC based quadrupler has been developed. The MMIC has been mounted on a microstrip substrate with integrated biasing and RF connections. The waveguide output is realised through microstrip to waveguide transition. Achieved output power is about -7dBm with conversion loss of 11dB at +4dBm input power level.



V-band MMIC based quadrupler with measured output spectrum.



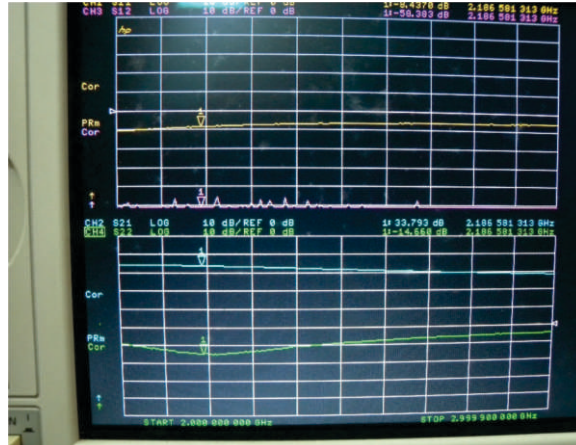
c. Development of V-Band MMIC based Medium Power Amplifier

V-band MMIC based medium power amplifier has been developed with about 2GHz bandwidth. The MMIC has been mounted on a low dielectric substrate with integrated biasing and RF connections. Both input and output configurations are waveguide. Suitable microstrip to waveguide transitions have been used at either end. Achieved gain is better than 20dB.

V-Band MMIC Medium Power Amplifier

d. Development of a MIC based IF Amplifier at 2-3 GHz frequency range

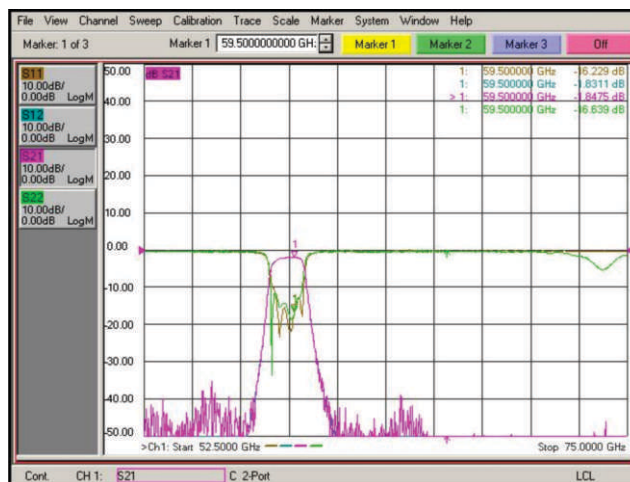
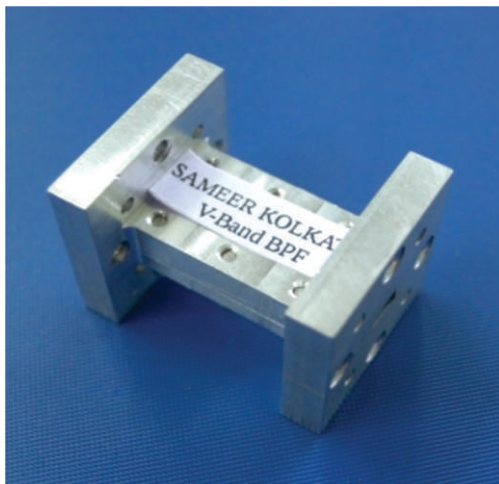
MIC based IF amplifier has been designed using ADS Circuit simulator in the frequency range of 2-3GHz. Subsequently 2-stage cascaded amplifier module has been developed using pHEMT as the active device. The MIC has been mounted on soft substrate with integrated biasing and RF connections. Achieved gain is better than 30dB over the entire frequency range with 1dB compression point at +4dBm and with -80dBm sensitivity.



S-band IF Amplifier with measured output spectrum.

e. Development of Band Pass Filter at V-Band

Band pass filter at V-band has been designed and developed. Waveguide based design consists of metal inserted in E plane. The filter is used after the I/Q mixer in the transmitter section to minimize the spurious generated at the mixer output. Achieved 3dB bandwidth is about 1.6GHz with pass band insertion loss of about 1.8dB. Both input and output reflection coefficient is better than -15dB.



Band pass filter at V-Band with measured S-parameters.

2. ANTENNA DIVISION

Objectives of the division are to design and develop microwave and millimeter wave antennas for strategic and civilian applications as part of sponsored projects, establish competence for technology development in the field of microwave and millimeter wave antennas by undertaking core projects and provide necessary test and evaluation support in antennas and radomes to Govt. Departments and private industries in the Compact Antenna Test Range facility, available at the centre.

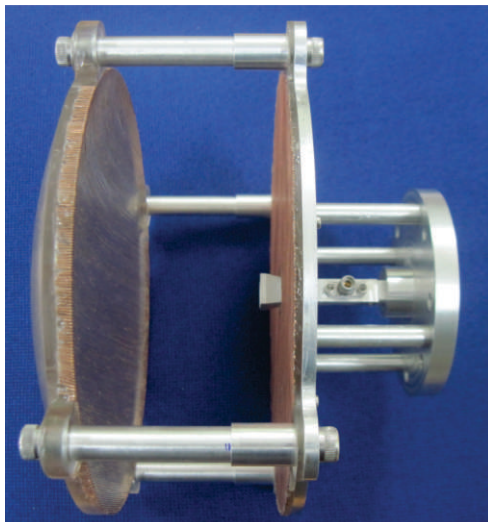
Core R & D program

i. Development of Millimeter Wave Antennas

This project is sponsored by DeitY, MC&IT, Govt. of India. The aim of this project is to establish competence for technology development in the millimeter wave antennas for civilian and strategic applications. Under this project, Ka-band transparaboloid reflector has been developed and design of Ka-Band Circularly Polarized IFF antenna has been carried out

a. Design and development of Transparaboloid Reflector antenna at Ka band:

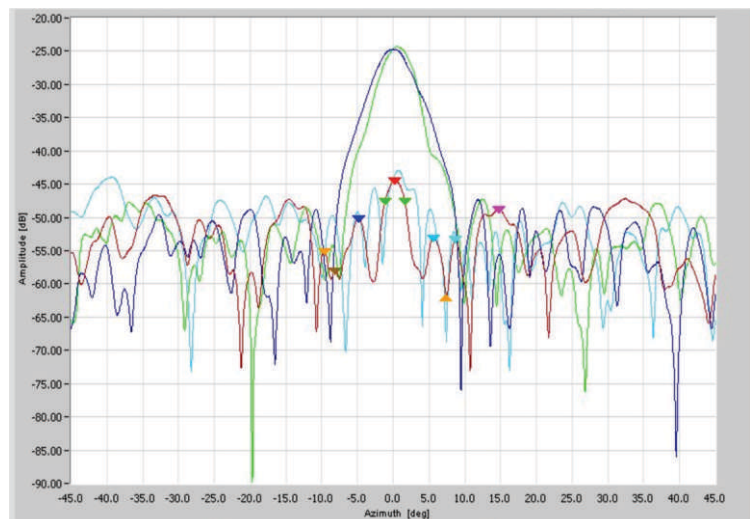
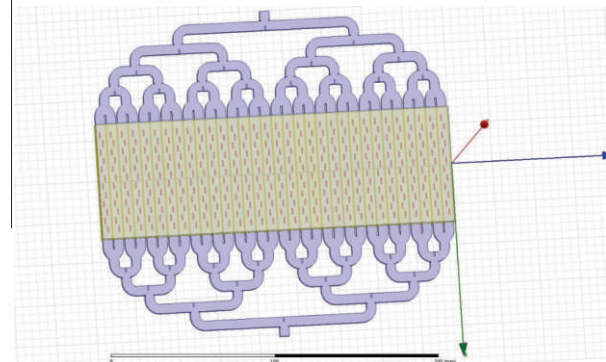
The aim of this assignment is the design and development of transparaboloid reflector antenna at Ka - band. It consists of trans-reflector, twisted reflector and horn antenna. Design and simulation of the Ka-band transparaboloid antenna with all its constituents have been carried out satisfactorily. Performance of the feed horn has been optimized using HFSS. A Math-CAD software has been developed for designing transreflector and twist reflector. Engineering prototype of the antenna has been made. Achieved bandwidth is 4GHz (33-37GHz) with gain ≈ 24 dBi. The beamwidth of the antennas is $\approx 4.5^\circ \times 4$ and meets the required specifications.



Ka band trans-paraboloid reflector antenna with measured E and H-plane radiation pattern.

b. Design and development of Ka-Band Circularly Polarized IFF antenna

A planar array of 12 X 32 slots has been designed. To achieve circular polarization, a polarizer is being designed. Simulation study of 12 x 32 linearly polarized planar slotted array antennas with feed structure has been carried out. Optimization of the unequal 1 x 32 way power divider network is in progress. Since phase matching is a critical issue, dielectric loading in waveguide is being tried to achieve the desired phase at all ports. The layout of 12 x 32 planar slotted array antennas is shown in Fig along with corporate feed structure.



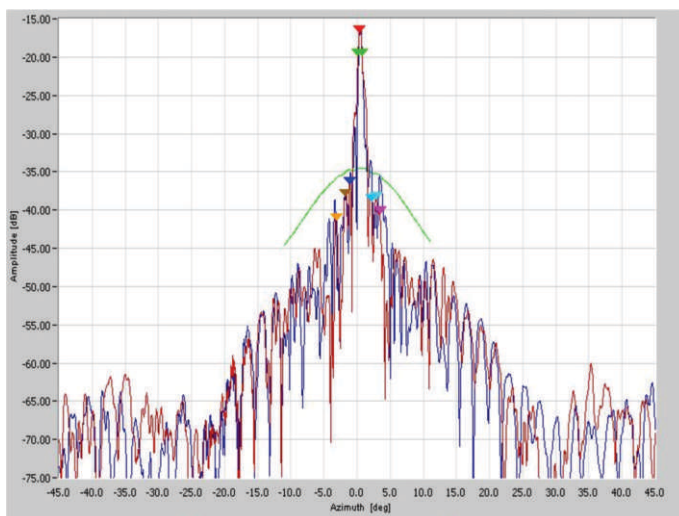
SPONSORED PROJECTS

i. Development of S/Ka band telemetry antenna system

This is a sponsored project from a Govt. R&D lab. The S/Ka Band Telemetry Antenna System has been indigenously developed and delivered to the end user. The antenna is dual circularly polarized (simultaneous LHCP and RHCP) at Ka-band and dual linearly polarized (both Vertical and Horizontal) at S-band. Cassegrain reflector configuration has been used for Ka-band and prime focus reflector configuration has been used for S-band. The same main reflector (diameter 1.8m) has been used for both Ka-band and S-band communication. For present application, the sub-reflector (diameter is $\approx 165\text{mm}$) is basically a metallic Frequency Selective Surface (FSS). The FSS is designed such that it allows S-band signal to pass through it with low insertion loss and reflects the Ka-band signal. The final product is shown in Fig. The gain of the overall antenna at Ka-band is $\approx 50\text{dBi}$ at either ports and at S-band is $\approx 28.5\text{dBi}$. The 3dB beamwidth of the antenna at Ka-band is $\approx 0.45^\circ \times 0.45^\circ$ and at S-band is $\approx 4.5^\circ \times 4.5^\circ$.



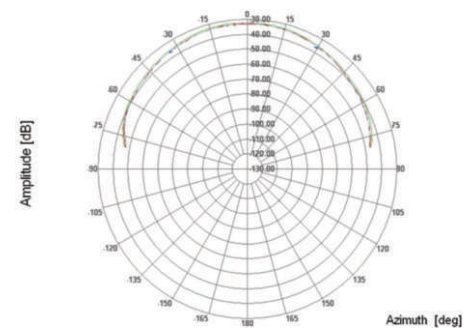
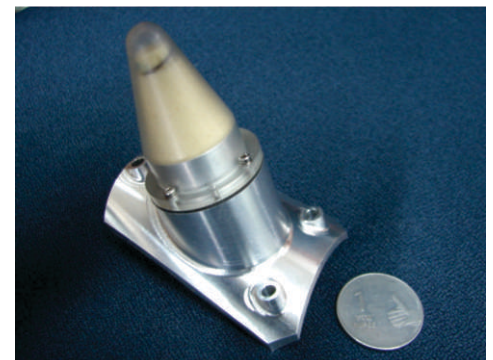
S /Ka band Telemetry antenna.



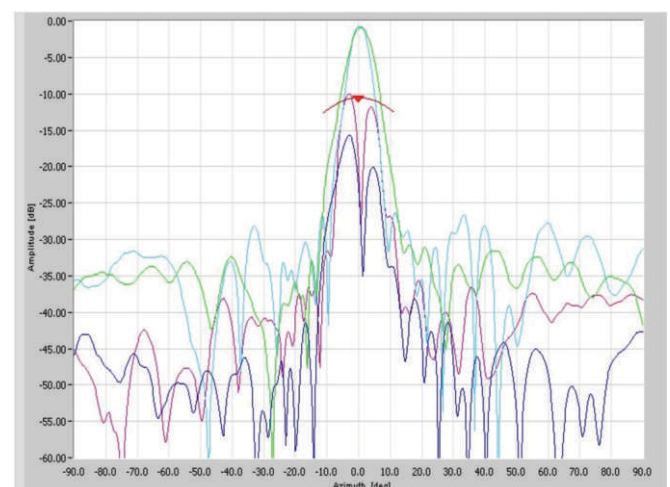
Measured radiation pattern at Ka-band

ii. Design and Development of Data Link Transmitting Antenna at X-band

This is a sponsored project from a Govt. R&D lab. Helical antenna covered with rexolite radome has been designed and developed for the data transmission at X-band. The size and shape of the ground plane have significant impact on the gain. By using cylindrical cup shaped ground conductor antenna gain $\approx 9.1\text{dBi}$ with 3dB beamwidth $\approx 60^\circ$ could be achieved.



X-band data link transmitting antenna with measured radiation pattern



Measured radiation pattern at S-band.

iii. Design and Development of Data Link Receiving Antenna at X-band

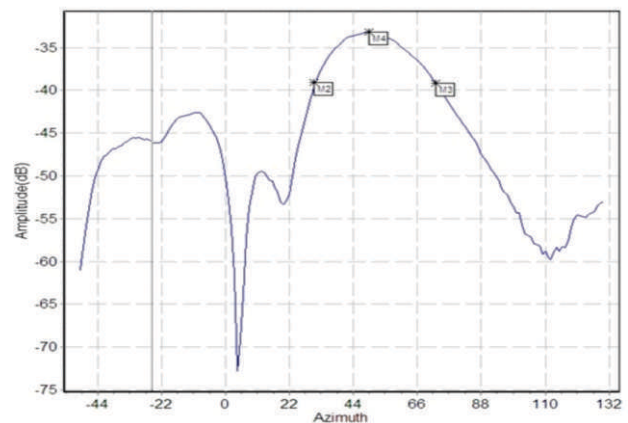
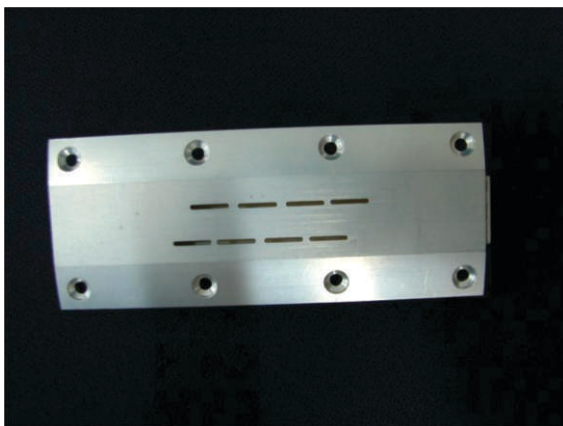
This is a sponsored project from a Govt. R&D lab. Radial dielectric loaded horn antenna has been designed and developed at X-band for the data reception. Achieved gain of the antenna is more than 3.0dBi with 1100 beamwidth in azimuth plane and 1440 beamwidth in elevation plane.



X-band data Link Receiving Antenna with measured VSWR

iv. Design and Development of Radio Proximity Fuse (RPF) Antenna at Ku-band :

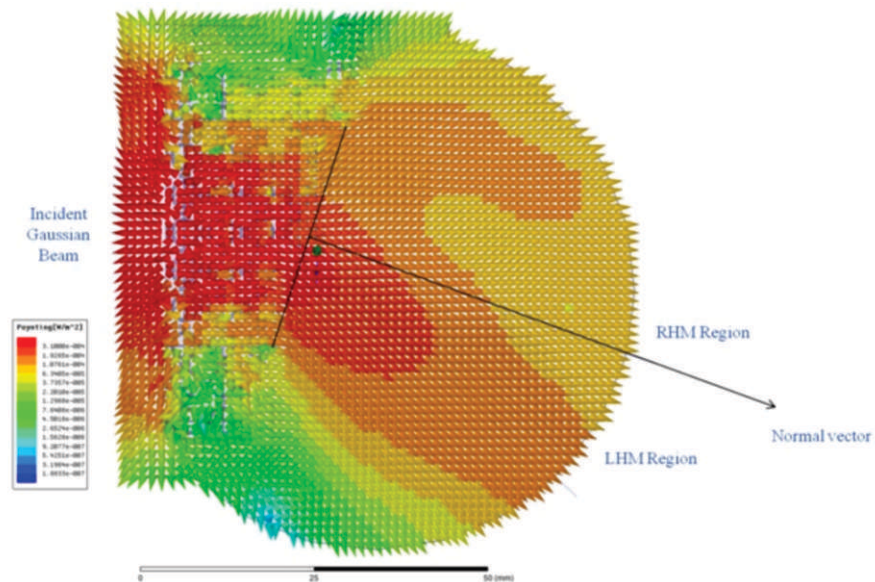
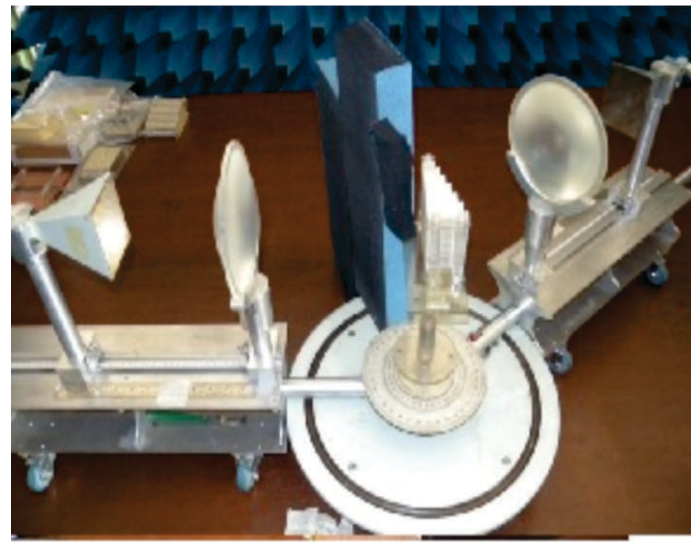
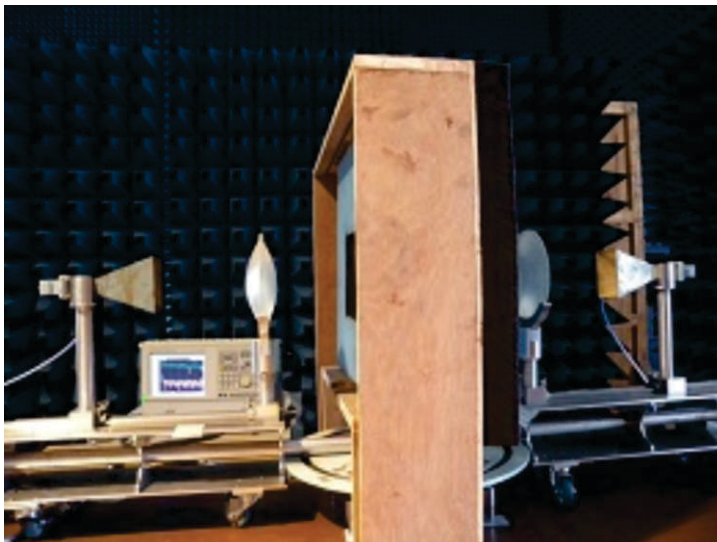
This is a sponsored project from a Govt. R&D lab. Ku-band travelling wave slotted waveguide array antenna has been designed and developed for radio proximity fuse application. Slots have been used on both side of center of waveguide with non-resonant element spacing and uniform phase difference. Achieved gain is 8dBi with 3dB beamwidth of 300 and beam squint of 47o from bore-sight.



Ku-band Radio Proximity Fuse Antenna with measured radiation pattern.

v. Left Handed Maxwell's Systems

This project has been sponsored by a Govt. R & D Organisation. A free space focused beam LHM characterization setup has been prepared for measurement of transmission and refraction properties of LHM samples at X-band and Ka-band. Various LHM samples have been analyzed, designed, fabricated and performance measured. Simulation and experimental studies have been performed on LHM samples for different polarization, vertical lattice constant and capacitor loading at X band. Negative refraction and plane slab focusing has been simulated at RF/Microwave frequencies considering actual LHM samples without any assumptions. Refractive index has been found in between -1 and -2 for different LHM samples at X band. A periodic loaded transmission line (PLTL) based leaky wave antenna has been designed and simulated.



Negative refraction simulation in LHM using HFSS

Compact Antenna Test Range (CATR) Facility

CATR is a unique facility available for characterization of different antennas in the frequency range of 1GHz-100GHz for different applications. The facility is also equipped for radome performance evaluation. The facility has been utilized by industries and Govt. agencies for performance evaluation of their antennas and radomes. CATR facility has been availed by 30 different users during 2012-13.



Base station antenna measurement

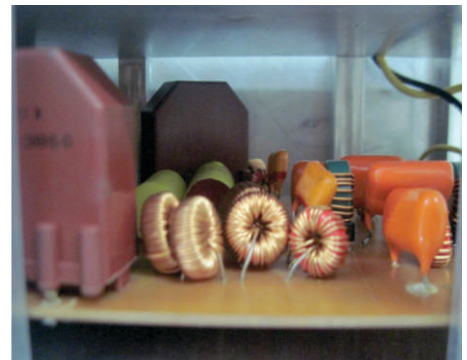
3. EMI-EMC

Objectives of the division are to provide test, measurement and consultancy services to private industries and Govt. agencies for evaluation of their electronics and electrical products for EM compatibility and to take up core and sponsored R&D project relevant to the application in the area of EMI/EMC.

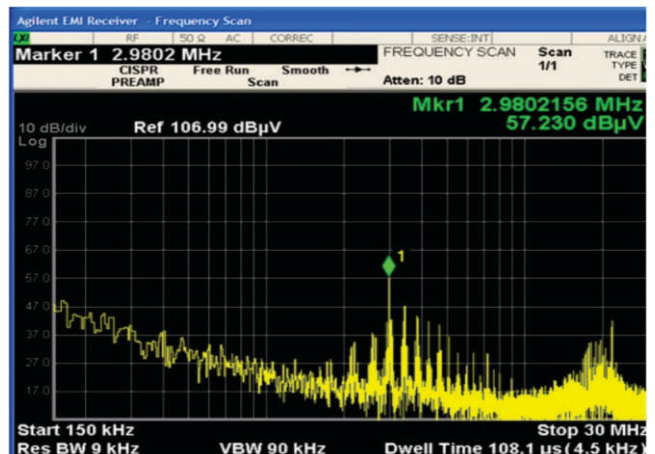
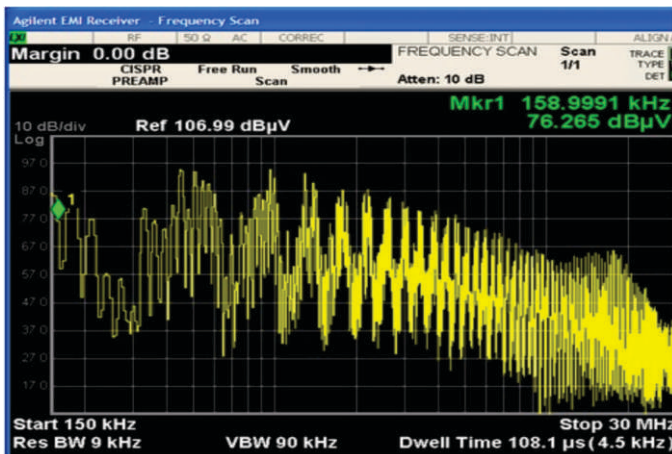
Core R & D program

Power line filter with surge protection for CE compliance to CISPR standard :

Power line filter for suppression of conducted emission and high energy surge on power line has been designed and developed. Engineering prototype has been tested in the frequency range 150 KHz to 1GHz in 50Ω set up. It has also been tested in



Power line filter with surge protection.

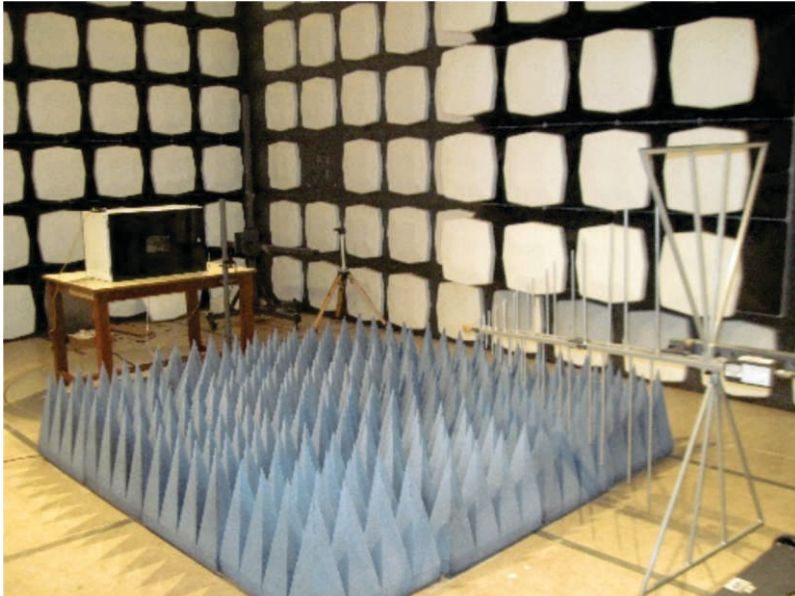


Conducted noise suppression of SMPS with and without Power line filter

actual CE test set-up with SMPS as DUT in CE frequency range. Better than 50dB insertion loss has been achieved in CE range. Surge suppression is about 18dB up to 4KV.

Test, Measurement and Consultancy services

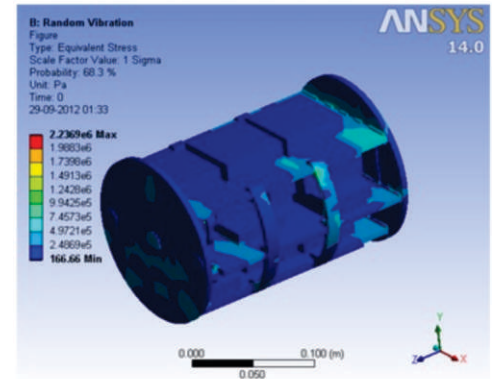
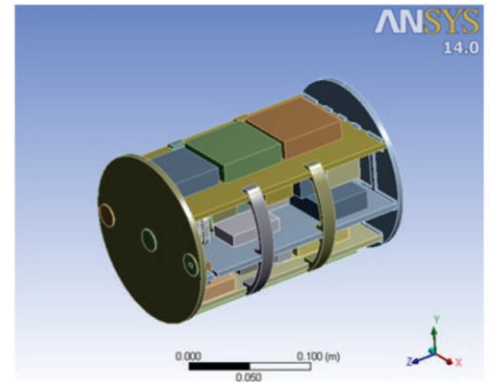
Test, measurement and consultancy services have been provided to the industries and Govt. agencies for evaluation of their electronics and electrical products for EM compliance. Total 21 number of test-measurements (EMI/EMC and others test-measurements) have been provided to different customers



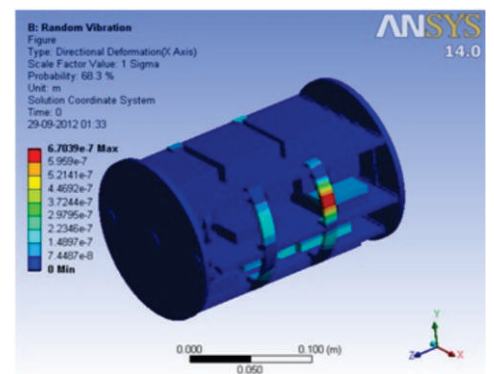
4. MECHANICAL ENGINEERING DIVISION

Objectives of the division are i. Mechanical design of all electronic components and system hardware, ii. System assembly and its simulation study to meet mechanical related environmental parameters such as vibration, shock etc, iii. Selection of materials to comply with environmental specifications, iv. Device new methods to meet fabrication and assembly challenges, v. Generation of engineering drawings, vi. Fabrication in CNC and conventional machines, inspection of fabricated items and assembly of components, and vii. Maintenance of all machines and CAD tools. All these are done to meet different core and sponsored projects of the centre.

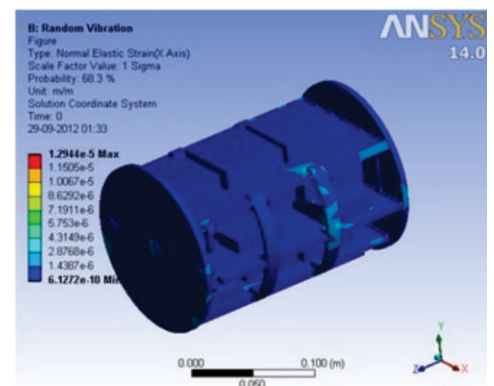
- a. The division is equipped with state-of-the-art CNC, VMC, Wire-cut, EDM and other precision fabrication facilities. The CAD tools have enabled the team to generate mechanical models and drawings in short time. Using these facilities the division has met the fabrication and assembly needs for different antennas, components, sub-systems and systems within the stipulated time to meet the delivery schedule.



ANSYS model of the W-band Coherent Transceiver Equivalent Stress analysis



Directional Deformation analysis

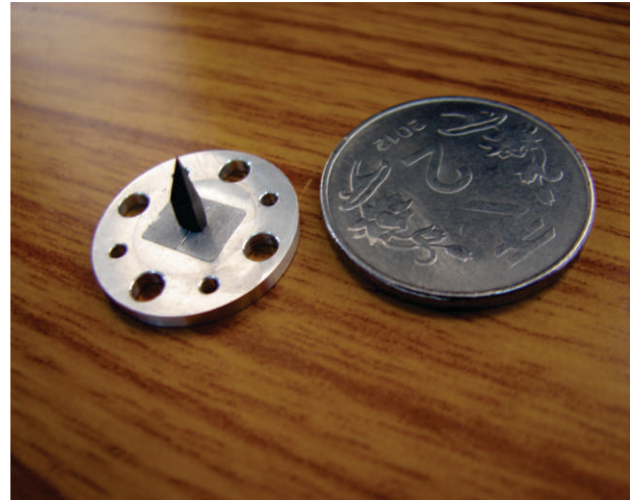


Normal Elastic Strain analysis

- b. Mechanical simulation using ANSYS software: ANSYS model of the whole coherent transceiver has been generated and subsequent stress-strain vibration analysis has been carried out. The models are shown below.

Based on the above simulation results, mechanical design and assembly were done for the hardware.

- c. The division has fabricated critical components like customized W-band waveguide bends, terminations and co-axial connectors.



Customized Waveguide Bends Termination



Coaxial SMA Connector and Spanner

- d. Mechanical design and fabrication of a test set-up for characterization of left handed Maxell's system.



Mechanical set-up for characterization of left handed Maxell's system

TECHNICAL WORKSHOP SEMINARS CONFERENCES

ORGANIZED BY SAMEER

1. SAMEER Mumbai organized a two days workshop on "Managing Electro-Magnetic Interference and Compatibility and Pulse (EMI / EMC/EMP)", during 18-19 May 2012. Around 45 design engineers and managers attended the workshop from the Electronic Industry.
2. A "Theme meeting on Joint Research and Development of Atmospheric Instrumentation for Operational Meteorology " was organized on 24th July 2012 at SAMEER Mumbai campus..
3. SAMEER Mumbai organized one day workshop on "EMI/EMC Measurements and Standards MIL STD 461C/D v/s MIL STD 461E/F" and around 30 design engineers from M/s Mazgaon Docks Limited attended the workshop on 14th September 2012
4. SAMEER Chennai conducted workshop on 'Project Management' at Centre for Quality Management, Anna University, Chennai, on December 30, 2012.
5. SAMEER Chennai conducted workshop on 'Employee Involvement towards Total Quality Management", on March 09, 2013 for the benefit of faculty and non-teaching staff of College of Engineering, Guindy, Chennai.

PARTICIPATION IN CONFERENCE WORKSHOP SEMINAR Conference / Workshop

1. K. P. Ray presented a research paper on "Printed Annular Ring with Circular Patch Monopole UWB Antenna", at ICACC- 2012, Cochin on 11th August, 2012. He also chaired a session in this International Conference.
2. Ramesh Babu and Arun Kumar Heddallikar attended workshop on "Advanced Design Systems Workspaces and Simulation Tools" conducted by Agilent Technologies during 7-9 Aug. 2012.
3. Anuj Bhatnagar and Roshan Makkar attended "Photonics 2012", International conference on "fiber optics and photonics", IIT Madras, 10-11 Dec. 2012.
4. Roshan Makkar attended "India Innovation Growth Programme 2013", organised by FICCI in Mumbai on 28th Jan. 2013.
5. Alok Verma attended International Conference on "Recent Advance in Electronics & Communication Engineering", held at Thakur College of Engineering, Mumbai on 19th Feb. 2013.
6. K. Mittholiya attended National symposium of "Optical Society of India" held at Pondicherry University, during 23-25 Jan. 2013.
7. T. Tiwari attended "National Conference on Recent Trends on Microwave Technique and Applications", Microwave 2012, held at University of Rajasthan, Jaipur, during 30th July to 1st August 2012.
8. S. S. Kakatkar and Rajesh Rangari attended the pre-symposium tutorials and presented papers at International Symposium on "Microwaves (ISM-12)" during 11-14 December 2012 at Bangalore, India.

9. Sulabha Ranade, Gyanendra Verma and Gautam Shende attended Workshop on "High Power Electromagnetics" during 14-18 September 2012 at CPRI, Bangalore Organized by SEMCE(I), Bangalore, India.
10. Milind Joshi , Shrikant Hangirgekar and Ramesh Pawar attended Pre conference workshop on "EMC" , Organized by Society of EMC Engineers (INDIA) 04-05 December 2012 at NIMHANS Convention Centre, Bangalore, India.
11. Sulabha Ranade, Milind Joshi and Gyanendra Verma attended the 12th International Conference on "Electromagnetic Interference and Compatibility", during 6-7 December 2012 at the NIMHANS Convention Centre, Bangalore, India.
12. Anil Kulkarni attended workshop "Tropmet 2012" organized by Indian Meteorological Society held at Dehradun during 20-22nd Nov 2012.
13. Tapas K. Bhuiya, attended International Symposium on Microwaves-2012 and presented a research paper on "Broadband and high gain dipole antenna with a split coaxial balun", during 11-14 Dec. 2012, Bangalore.
14. Narugopal Nayek attended the National Conference on "Vacuum Electronic Devices & Applications (VEDA-2012)" at CEERI, Pilani, during 21-24 Sept. 2012.
15. R.P. Pinto attended seminar on "SAR Principles and RSAT Results & Objectives" by Dr. Tapan Mishra, SAC, Ahmedabad held at SAMEER Kolkata on 6th June 2012.
16. Abhishek Dabi & Chhatrasal Chandra attended seminar on "System Design and Analysis using MatLAB and SimuLink" by M/s Mathworks Inc. on 21st Nov. 2012.
17. R.P. Pinto, Hitendra Pethkar, Arun Kumar Heddallikar ,Abhishek Dabi and Chhatrasal Chandra attended seminar on "Radar Instrumentation for Polar Research" by Prof. Prasad Gogineni, Dept. of EE&CS University of Kansas, USA held at IIT Mumbai on 28th December 2012.
18. Abhishek Dabi & Chhatrasal Chandra attended seminar on "SAR Signal Processing Algorithms and System Calculation for Azimuth and Elevation resolution requirements" conducted by Dr. Chimoy Bhattacharya, Defence Institute of Armament Technology (DIAT), Pune during 4- 8 February 2013.
19. Prafull Irpache attended a seminar on "Matlab Software" by Mathworks at Hotel Leela, Mumbai on 22nd November 2012.
20. S. Vijayakumari, Sc-E and S. Prasad, Sc-D attended two day seminar on Wireless Body Area Networks – Challenges and Enabling Technologies organized by Department of Electronics and Communication Engineering, College of Engineering, Anna University, Chennai during 22- 23 March, 2013.
21. G. Kalaichelvi, Sc-E, attended the conference ICRTIT, 2012 (International Conference on Recent Trends in Information Technology), April 19-21, 2012.
22. G. Kalaichelvi, Sc-E, attended Mathworks Conference "MATLAB EXPO, 2012" on August 08, 2012.
23. G. Kalaichelvi, Sc-E, attended INCEMIC (International Conference on EMI/EMC), Bangalore, December 06-07, 2012.
24. G. Kalaichelvi, Sc-E, attended "Embedded Control and Monitoring Conference" on January 23, 2013, by National Instruments.
25. P. Satheesan, Sc-D attended a Workshop on 'Strategies for Marketability of SME Products,' conducted by Brain Child Solutions Ltd., Chennai on June 30, 2012.
26. Scientists of EMC Division attended International Conference and Workshop on Electromagnetic Interference and Compatibility (INCEMIC 2012) held at NIMHANS, Bangalore during December 04-07, 2012.
27. DSPD Scientists attended a MathWorks seminar, titled "Modeling, Simulation and Analysis of Systems using MATLAB and Simulink" on July 04, 2012.
28. G. Kalaichelvi, Sc-E, attended a Distinguished IEEE COMSOC Lecture by Dr. Xavier N. Fernando, Professor and Multimedia Stream Coordinator, Ryerson University, Toronto, Canada titled "Radio over Fiber for Wireless Communications" on July 12, 2012.
29. G. Kalaichelvi, Sc-E, attended a seminar on "Benefits of Automating Coding Standard Enforcement & Code Review Process" on November 22, 2012.
30. G. Kalaichelvi, Sc-E, attended an in-house seminar by .Dheena Moongilan on January 24, 2013 titled "Grounding Architecture Design for Telecommunication Products - EMC and PS Considerations".

31. G. Kalaichelvi, Sc-E, attended an UGC seminar on "Research Methodology" on March 02, 2013, in MIT, Anna University.
32. Shri Satyajit Chakrabarti, Shri Vivek Singh, Shri Dipankar Dan and Shri Partha Sardar have attended the 6th International Conference on Antenna Test and Measurement (ATMS 20132) during 12th-13th Feb, 2013 at Kolkata.
33. Shri Vivek Singh and Shri Dipankar Dan have attended the Preconference Tutorial on Antenna Test and Measurement (ATMS 2013) on 11th-13th Feb, 2013 at Kolkata.
34. G. Arun Kumar and Bijit Biswas have attended the 5th International Conference on Computers and Devices for Communication (CODEC-2012), held during December 17-19, 2012 at Hyatt Regency, Kolkata.
35. Scientists from SAMEER Kolkata Centre have attended lectures delivered by Prof. Rahmat Samii of University of California, Los Angeles and Prof. Gautam Chattopadhyay of California Institute of Technology at Salt Lake Sector-III campus on 13th Feb 2013.
36. Shri Dipankar Dan has attended international conference IC3S organised by of KIIT University, Bhubaneswar during 5th -7th Oct 2012.
37. Shri Satyajit Chakrabarti and Shri Dipankar Dan have attended 12th conference "INCEMIC -2012" organised by "Society of EMC Engineers of India" in Bangalore during 6th -7th Dec 2012.
38. Shri Satyajit Chakrabarti and Shri Dipankar Dan have attended pre-conference tutorial of "INCEMIC -2012" organised by of "Society of EMC Engineers of India" in Bangalore during 4th -5th Dec 2012.
39. Shri Sibabrata Mondal has attended seminar on "Design of Work-holding and Fixturing" at IMTMA Technology centre, BIEC, Bangalore, during 23rd to 24th August 2012.
5. K. P. Ray delivered an invited talk on "Ultra Wide Band Antenna Technology" at Second International Conference on Advances in Computing and Communications (ICACC-2012), Cochin, on 11th August, 2012.
6. K. P. Ray delivered two invited talks on "Planar Transmission Lines and Antennas" at a workshop by IEEE AP-MTT Chapter at NIST, Behrampur during 22-23 Sept 2012.
7. K. P. Ray delivered an invited talk on "Concept of Transmission Lines and Microstrip Antennas", at the ISTE Seminar, VIT Pune on 22nd Dec, 2012.
8. K.P.Ray delivered special lectures on Microwave Theory and Antennas in VESIT, Mumbai University.
9. K. P. Ray delivered a talk on "High Power Microwave System for Tea Processing" at the DST review meeting held at INSA on 10th October, 2012.
10. Sulabha Ranade delivered an Invited talk on "EMI-EMC Effects on Instrumentation" during the Structured Training Programme on Instrumentation at SDSC SHAR during 19 – 23 Nov. 2012.
11. Sulabha Ranade delivered a talk on "Signal Integrity Issues in High Speed Digital Circuits" during a training program at SAMEER , Chennai.
12. Sulabha Ranade conducted a half day session on "EMC Measurements as per Military standards MIL STD 461 E/F "at EMC Centre , Navi Mumbai. 40 engineers from M/s Mazgaon Docks Limited participated in the one day Training program .
13. Sulabha Ranade delivered a talk on "EMC for high speed digital circuit design", workshop on Managing Electro-Magnetic Interference and Compatibility and Pulse (EMI / EMC/EMP) during 18-19 May 2012 organized by SAMEER.
14. Sulabha Ranade delivered a talk on "Introduction to EMI/EMC and CE Marking ", workshop on Managing Electro-Magnetic Interference and Compatibility and Pulse (EMI / EMC/EMP) during 18-19 May 2012 organized by SAMEER.

Invited Talks

1. J. V. Chande delivered a talk on " SAMEER's objectives and achievements "at Indian Audit and Accounts Department , P&T Audit Office, Santa Cruz (West), Mumbai, on 12th April 2012.
2. J. V. Chande delivered a talk on "Atmospheric Instrumentation Research at SAMEER" in a "Theme meeting on Joint Research and Development of Atmospheric Instrumentation for Operational Meteorology " at SAMEER Mumbai on 24th July 2012.
3. K. P. Ray delivered an invited talk on "Industrial Application of High Power Microwaves" at a workshop titled School on Pulsed Power Technology 2012 (SPPT – 2012) organized by BARC, Mumbai on 13th Sept 2012.
4. K. P. Ray delivered an invited talk on "Shielding Methodology for EMI Compliance" at a workshop on EMI/EMC organized at EMI/ EMC centre, Navi-Mumbai on 18th May 2012.

15. Anil Kulkarni delivered an invited talk on "GPS Meteorology and estimation water vapour using GPS" at National Electronics Research & Training Unit (NERTU) Hyderabad in 5th SERC school on 27th June 2012.
16. Milind Joshi delivered a talk on "EMC Antennas", workshop on Managing Electro-Magnetic Interference and Compatibility and Pulse (EMI / EMC/EMP) during 18-19 May 2012 organized by SAMEER.
17. Milind Joshi delivered a talk on "EMC Measurements", workshop on Managing Electro-Magnetic Interference and Compatibility and Pulse (EMI / EMC/EMP) during 18-19 May 2012 organized by SAMEER.
18. Abhay Deshpande delivered a talk on "About LHC, Higg's Boson and accelerators!", SAMEER Mumbai on 16th July 2012..
19. T. Tiwari delivered an invited talk entitled, "Dielectric window for C band linac system", National Conference on Recent Trends on Microwave Technique and Applications, Microwave 2012, organised by University of Rajasthan, Jaipur, during 30th July to 1st August 2012.
20. T. Tiwari delivered an invited talk entitled, "High energy linear accelerator system : Basic and applied research", Centre for Development of Physics Education CDPE, University of Rajasthan, Jaipur on 1st August 2012.
21. G. Dhanushkodi gave a Lecture on "Electronics Cooling Concepts & SAMEER Capabilities" at Instrument Research and Development Establishment, DRDO, Dehradun, September 06, 2012.
22. A.A. Ramesh delivered lecture on "Accreditation of EMI/EMC Facility" and "Commercial EMI/EMC Standard" at Army Centre for Electromagnetics (ACE), Mhow, Madhya Pradesh on February 19, 2013 for gathering of senior tri-services officers.
23. K. Sridhar delivered Inaugural address for the Electronics and Communication Engineering Association of Sri Lakshmi Ammal Engineering College, Chennai on August 29, 2012.
24. K. Sridhar delivered a Guest lecture on 'Recent Trends in Communication Systems' at GKM college of Engineering and Technology, Chennai-600 063 on October 05, 2012.
25. S. Vijayakumari delivered a Guest Lecture on 'RF and EMI/EMC in System Design' at University College of Engineering, Villupuram, Tamilnadu on March 01, 2013.
26. S. Vijayakumari delivered Inaugural Address at a State Level Technical Symposium "ELECTROGENIA-2K12" on September 17, 2012 organized by Nadar Saraswathi Engineering College, Theni, Tamilnadu.
27. Dr. P.H. Rao delivered an inaugural talk on "Smart and Reconfigurable Antennas for Future Communication Applications," CSIR sponsored national workshop on recent advancements in microwave engineering, December 17-18, 2012, PEC, Chennai.
28. G. Kalaichelvi presented an invited talk titled "Mathematics in Mobile Communications" in the National Seminar on "Algebra and analysis Gateway to Modern Technology" in Meenakshi College for Women on January 29, 2013.
29. Shri P. Satheesan delivered seminar lecture on 'Business Process Re-engineering', on March 19, 2013 in Anna University, Chennai.
30. Shri Satyajit Chakrabarti has delivered series of lectures on "Electromagnetic Interference and Compatibility " as guest lecturer for the M Tech students of Dept. of Radio Physics and Electronics, University of Calcutta.
31. Shri Arijit Majumder has delivered series of lectures on "Microwave and Millimeter wave Devices and Circuits" as guest lecturer for the M Tech students of Dept. of Radio Physics and Electronics, University of Calcutta.
32. Shri Satyajit Chakrabarti has delivered one invited talk on "Activities at SAMEER Kolkata" in the MCKV Engineering College, Belur (near Kolkata) on 25th Aug 2012.
33. Shri Satyajit Chakrabarti has delivered one invited talk on "EMI- EMC and Wireless/Mobile Communication" in the MCKV Engineering College, Belur (near Kolkata) on 25th Aug 2012.

Training Programme attended/conducted

1. K. P. Ray was deputed for Senior Management Training Programme at National Institute of Advanced Studies (NIAS) for DST, Ministry of Science and Technology sponsored programme on "Technology Forecasting, Assessment and Management", during 17-21 December 2012.
2. K. P. Ray organized an orientation training programme for 22 newly recruited scientists in SAMEER on 31st August and 3-4 September, 2012.
3. Sulabha Ranade was deputed to the Tenth NIAS –DST Senior Management Training program on "Multi Disciplinary Perspectives on Science , Technology and Society" during 24 September - 5 October , 2012 at NIAS , Bangalore.
4. One day training on "Matlab Software and Toolboxes" by Mathworks was organised at SAMEER on 26th February 2013.
5. One day training on "IE3D" software by Tessolve Services Pvt. Ltd. was arranged at SAMEER on 8th Jan. 2013.
6. One day training on "VNA measurements" by M/s Meera Agencies was organised at SAMEER on 1st August 2012.
7. Dr. Ch. V. Ramarao , Manukonda Saketh, attended a Five Day Training Programme on VHDL Programming conducted by NIELIT, DeitY, Chennai during January 23-24, 2013 and January 29-31, 2013.
8. G. Kalaichelvi attended the Training Programme on "SYSTEMVUE" during May 18-19, 2012 from Agilent Technologies.
9. G.Kalaichenlvi attended the training Programme on MATLAB- Fundamentals during May 21st to 23rd- 2012 conducted by the MATHWORKS.
10. Shri Satyajit Chakrabarti and Shri Dipankar Dan have attended training on "General Requirements for The Competence of Testing and Calibration Laboratories And Internal Audit as per ISO / IEC 17025 :2005" organised by IDEMI Mumbai during 19th -22nd Mar 2013.
11. Scientists from SAMEER Kolkata centre attended training program on "Agilent Vector Signal Generator and Vector Signal Analyzer" held at this centre during 24-26th September, 2012.
12. Scientists from SAMEER Kolkata centre attended training program on "Agilent System Vue 2012.06" held at this centre during 24 - 26th September, 2012.
13. Shri Sibabrata Mondal, Shri Indranil Paul & Shri Chandan Pal have attended one week training on Power SHAPE 2012, DELCAM at Kolkata.
14. Shri Ananda Sarkar, Shri Ardhendu Sekhar Pal, and Shri Ranjan Das have gained hands-on training experience on Laser Preseter in CMC VNC at SAMEER Kolkata Centre during June 2012.

Deputation

1. Arijit Majumder, G. Arun Kumar, Bijit Biswas, Souma Chatterje and Mousumi Sarkar were deputed to United Monolithic Semiconductors, France for a 3 day training program on MMIC Foundry course held during 16th - 18th October, 2012.
2. C S Nainwad was deputed to Tectra GmbH, Frankfurt, Germany for training on operation and maintenance of Plasma Ion Gun source during 25th Feb to 01st March, 2013.

Prominent Visitors

1. Shri J. Satyanarayana, IAS , Secretary to the Govt. of India, DeitY, visited SAMEER, Mumbai on 27.4.2012.
2. Dr. Ajay Kumar, IAS, Joint Secretary & Dr. Debashish Dutta, Group Co-ordinator of DeitY, visited SAMEER, Mumbai on 5.5.2012.
3. Prof. Junji Urakawa (Head, Accelerator Test Facility), Prof. Kawakubo, Dr. Sakae Araki, Dr. Masafumi Fukuda, Dr. Kazuyuki Sakaue, Dr. Alex Aryshev and

Dr. R. Kuroda from High Energy Accelerator Research Organization (KEK), Japan visited SAMEER on 13th March 2013. The following scientists delivered a lecture on "Advanced Accelerators":

Prof. Urakawa, " Terahertz generation and its application"

Prof. Kawakubo, " Elementary lecture on Injection/Extraction in a circular accelerator".

Dr. A. Aryshev, " Review of advanced beam diagnostics at modern accelerators".

4. Prof. Nema Chandra Karmakar, Monash University, Australia visited Kolkata centre on 18th Dec 2011.
5. Dr. Somnath Mukherjee, RB Technology, Milpitas, CA , USA visited Kolkata centre on 18th Dec 2011.
6. Prof. S. Ananthakrishnan, Adjunct Professor & Raja Ramanna Fellow, Electronic Science Department, Pune University Campus, visited Kolkata centre on 18th Dec 2011
7. Prof. Ajoy Kar of Harriot Watt University visited Kolkata centre on 20th December, 2012 and delivered a lecture on " Ultra Fast Laser Inscription: Science Today and Future"

Publications

1. K. P. Ray, S. S. Thakur and R. Deshmukh, "Wideband L-Shaped Printed Monopole Antenna", International Journal of Electronics and communications (AEU), ELSEVIER Publication, 66 (2012), pp. 693-696.
2. A.A. Deshmukh, K. P. Ray and A. Kadam, "Proximity Feed Rectangular Microstrip Antennas", International Journal of Microwave and Optical Technology, Vol. 7, No. 3, May 2012, pp. 192 – 200.
3. A.A. Deshmukh and K. P. Ray, "Formulation of Resonance Frequency for Dual Band Slotted Rectangular Microstrip Antennas", IEEE Antennas and Propagation Magazine, Vol. 54, issue 4, August 2012, pp.78-97.
4. K. P. Ray, S. S. Thakur and R. Deshmukh, "UWB Printed Sectoral Monopole Antenna with Dual Polarization", Microwave & Optical Tech. Letters (John Wiley, USA), vol. 54, no. 9, pp. 2066-2070, Sep. 2012.
5. K. P. Ray, M. D. Pandey, R. Rashmi and S. P. Duttagupta, "Compact configurations of hexagonal microstrip antennas", Microwave Opt. Technol. Letters (John Wiley, USA) Vol. 55, No. 3, pp. 604–608, March 2013.
6. J. A. Dharmadhikari, R. Bernard, A. Bhatnagar, D. Mathur, and A. K Dharmadhikari, "Axicon-based writing of waveguides in BK7 glass", Optics Letters, Vol. 38, No. 2 , pp. 172-174, January 15, 2013.
7. Jayashree A. Dharmadhikari, K. Pradyna, Anuj Bhatnagar, Deepak Mathur and Aditya K . Dharmadhikari, "Effect of chirp on the indexcontrast of waveguides written in BK7 glass with ultrashort laser pulses", Optics Communications, 287, pp. 122–127, January 2013.
8. Suma H., Chithira S. and Anuj Bhatnagar, "Laser based optical imaging system", Journal of Instrument Society of India, vol. 42, no. 2, pp. 122-124, June 2012.
9. Anuj Bhatnagar, "Unidirectional motion of vehicle on a sinusoidal path-Can it cause illusory forward and backward motion?", Resonance, Indian Academy of Sciences and Springer, vol. 17, no. 4, pp. 387-392, April 2012.
10. Ashish Lohana, Sulabha Ranade and Jyoti Varavadekar , "A Review on Differential Lines and Its Study Based On Differential S Parameters", IOSR Journal of Electronics and Communication Engineering , Volume 4 , Issue 4.
11. Hemendra Kumar, Ruchira Jadhav and Sulabha Ranade, "A Review on Substrate Integrated Waveguide and its Microstrip Interconnect", IOSR Journal of Electronics and Communication Engineering (IOSR-JECE) ISSN: 2278-2834, ISBN: 2278-8735. Volume 3, Issue 5 (Sep. – Oct.. 2012), PP 36-40.
12. Twisha Pandey, Tapas K. Bhuiya, Ravi Singh, Bharti Singh and Rajesh Harsh "A Review on Microwave Based Moisture

- Measurement System for Granular Materials" IOSR-JECE, Volume 3, Issue 2 (Sep-Oct. 2012), pp. 37-41.
13. D.Bhanu Pratap, Jaydeep Krishna , Meena S. Panse and Rajesh Harsh, "Design of Firmware and Software Application for Motion Control of Multi Leaf Collimator in Radiotherapy using compactRIO-9025 as controller", Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 Vol. 2, Issue 3, May-Jun 2012, pp.1375-1378.
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 52. Tanuja Dixit, R. Krishnan, Abhay Deshpande, Ganesh Gaikwad, Chandrakant Nainwad, Asmita Kawade, Sneha Mane, Jyoti Gondane, and Arpit Rawankar, "Automated system for linac shunt impedance measurement", National Conference on Vacuum Electronic Devices & Applications, September 21-24, 2012, CSIR-CEERI, Pilani, Rajasthan.
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 67. Srinivasan M K, Makesh Kumar V, Sanjay Baisakhiya and Dr. Subbarao B," Study of Radiated ESD Transient Field" International Conference on electromagnetic Interference & Compatibility (INCEMIC) 2012,Bangalore,India.
 68. T. Pounraj, S. Poonguzhali, Microwave Characterization of Breast Cancer Model International Conference on Electromagnetic Interference & Compatibility (INCEMIC) 2012, Bangalore, India.
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- Suppression in High Speed Mixed-Signal Systems," 12th International Conference on Electromagnetic Interference and Compatibility (INCEMIC- 2012).
71. Gusain, Harender Singh, Raghavan, S, Dr. Rao, P.H., "Shared aperture printed slot antenna," IEEE conf. 3rd International Conference on Computing Communication & Networking Technologies (ICCCNT- 2012).
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 73. Kailash Kashyap. G, Praveen G, Gusain, Harender Singh, Dr. Rao, P.H., "Circularly polarized printed crank-line array antenna," IEEE Conf. 3rd International Conference on Computing Communication & Networking Technologies (ICCCNT- 2012).
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 75. G. Kalaichelvi, Sc-E, The paper titled "Reinforced HMM based Learning Model of dynamic spectrum allocation in UHF – ISM Band of 902-928 MHz for Cognitive Radio" presented in IEEE Conference ICRTIT, 2012 April 19-21, 2012 of MIT, Anna University, bagged the BEST PAPER AWARD.
 76. G. Kalaichelvi, Sc-E, The paper titled "Wireless Service Opportunity and Interference Analysis in UHF-ISM Band of 902-928 MHz for cognitive radio technology" presented during December 06-07, 2012 in the international Conference on EMI/EMC (INCEMIC 2012) was selected as one of the two best paper of the session.
 77. P. Satheesan, Sc-D et al, (2013), "Adaptability of Management Strategies in the Development of MSME – An Overview", Wide Spectrum Research Journal, ISSN: 2250-2815, February, 2013.
 78. Shri Ajay Tiwari and Satyajit Chakrabarti, "Development of Fractal Antennas", International Conference on Antenna Test and Measurement - ATMS 2013, Kolkata India.
 79. Dipankar Dan , "Development of antenna with Substantially Hemispherical beamwidth", International Conference on Antenna Test and Measurement - ATMS 2013, Kolkata India.
 80. Dipankar Dan, P Majumder, S Chakrabarti, Sanjoy Kr. Roy and Jagabandhu Das, "Determination of RF Susceptibility Level of Electric Detonator used in Mining Industry", International Conference "INCEMIC 2012".
 81. Dipankar Dan "Determination of RF energy Threshold Level for Ignition of Electro Explosive Devices", International Conference "IC3S 2012".
 82. G. A. Kumar and Arun Kumar, "Design of Low loss, High speed, and High Isolation Ka-band SPST Pin Switch in Suspended Stripline Configuration" Microwave and Optical Technology Letters, Vol. 54, No. 8, August 2012.
 83. G. Arun Kumar and Arun Kumar, "Low Loss and High Isolation Ka-band SPDT switch", 5th International Conference on Computers and Devices for Communication (CODEC-2012), December 17-19, 2012, Kolkata India.
 84. Bijit Biswas, and Arun Kumar, "A Diode Based Millimeter Wave Frequency Doubler," 5th International Conference on Computers and Devices for Communication (CODEC-2012), December 17-19, 2012, Kolkata, India.
 85. Amitesh Kumar, Arijit Majumder, S Chatterjee, S Das and Subal Kar, "A Novel Approach to Determine the Plasma Frequency for Wire Media: Useful for Metamaterial Applications," Metamaterials (Elsevier), Volume 6, Issues 1–2, Pages 43–50, November 2012.
 86. Amitesh Kumar, Arijit Majumder, S Chatterjee, S Das and Subal Kar, "Novel Techniques to Determine Plasma Frequency of Wire Media," in 99th Indian Science Congress, 2012.
 87. S Chatterjee, Arijit Majumder, Amitesh Kumar, S Das and Subal Kar, "Analytical and simulation studies on Spiral Resonator(SR) and its variants-TTSR and NBSR," in 99th Indian Science Congress, 2012.
 88. Amitesh Kumar, Arijit Majumder, S Chatterjee, S Das and Subal Kar, "Simulation and its based characterization of different negative permeability plasmonic structures at X band ", Asian Journal of Physics, Under publication, 2013.
 89. Amitesh Kumar, Arijit Majumder, S Chatterjee, S Das and Subal Kar, "Possibilities for Left-Handed Maxwell Systems (Metamaterials) Application in LASER, Nano-Technology and Sub-Wavelength imaging for Medical Diagnostics," poster presented in SPI-2013.

Awards

- G. Mahesh, Sc-D, SAMEER-CEM received "Young EMC Engineer Award" from Society of EMC Engineers (India) during International Conference on Electromagnetic Interference and Compatibility (INCEMIC 2012) held at Bangalore during December 06-07, 2012.



Technical Report

1. T. Tiwari, Manoj Phatangare, and R Krishnan, "Service and maintenance manual for 9 MV linear accelerator system", Volume-I, X-ray head, Document No. SMR/SHAR-9/05, November 2011.
2. T. Tiwari, Manoj Phatangare, and R Krishnan, "Service and maintenance manual for 9 MV linear accelerator system, Volume-II, Modulator, Document No. SMR/SHAR-9/06, November 2011.
3. T. Tiwari, Manoj Phatangare, and R Krishnan, "Service and maintenance manual for 9 MV linear accelerator system, Volume-III, Control console, Document No. SMR/SHAR-9/08, November 2011.
4. T. Tiwari, Manoj Phatangare, and R Krishnan, "Operating manual for 9 MV linear accelerator system", Volume-IV, Operator's guide, Document No. SMR/SHAR-9/07, November 2011.
3. Mr. Roshan L. Makkar guided one student from Tezpur University, for M.Tech project on "Application of SD-OCT in near Infra red Imaging".
4. Dr.S.Das guided one student for B.E. Project on "pulsed power supplies and MIG design".
5. P. Salil, Sc-D guided a student of M.E. (Electronics and Communication Engineering) of Muthayammal Engineering College, Coimbatore for the project titled "Shielding for EMC for Intentional Radiators using FSS".
6. P. Salil, Sc-D guided a student of M.E. (Electronics and Communication Engineering) of Muthayammal Engineering College, Coimbatore for the project titled "Frequency tuning of FSS Structures using Active Elements".
7. Project / Thesis Work by a post graduate student from Sri Venkateswara College of Engineering, Sriperumbudur on "Effect of Power Integrity on High Frequency Circuits" was carried out in Communication and System Division.
8. Project / Thesis Work by a post graduate student from Sri Venkateswara College of Engineering, Sriperumbudur on "Design and implementation of Embedded Passive Filter on High Frequency thin laminate for L-Band application" was carried out in Communication and System Division.
9. Project / Thesis work by a post graduate student from Sri Venkateswara College of

Students Training Program

1. Dr. Anuj Bhatnagar guided the three students from Cochin University of Science & Technology, Cochin, and one student from Tezpur University for their M.Tech Project:
2. Dr.Alok Verma guided one student from

Engineering, Sriperumbudur on "Optimization of Diversity Receiver using Genetic Algorithm" was carried out in Communication and System Division.

10. Project / Thesis work by a post graduate student from Sri Venkateswara College of Engineering, Sriperumbudur on "Down link performance of Single Carrier CDMA with Frequency Domain Equalization" was carried out in Communication and System Division.
11. Project / Thesis Work by a post graduate student from B.S. Abdur Rahman Crescent University on "Sub carrier pairing based optimal channel and relay selection for MIMO system using graph based approach" was carried out in Communication and System Division.
12. Electromagnetics & Antenna Division has given training to 7 students for project work towards M.E / M.Tech and MS Programme.
13. G. Kalaichelvi, Sc-E guided a PG student from VIT, in the area of "Cognitive Radio".
14. One student, West Bengal University of Technology did 6 months Project on "Stripline Fed Broadband Tapered Slot Antenna" under guidance of Shri Satyajit Chakrabarti.
15. One B. Tech. Student, from SEACOM Engineering College, Howrah, received two months vocational training on EMI/EMC under guidance of Shri Dipankar Dan.

Examiners

1. K. P. Ray acted as a member of the Board of Examiner for evaluation of the Ph.D. thesis for IIT, Kharagpur.
2. K. P. Ray was the panellist for promotion interview of Scientist C for DAE at BARC, Mumbai.
3. K. P. Ray acted as a member of the Board of Examiner for evaluating a Ph D thesis of Department of Electronics Sciences, South Delhi Campus, University of Delhi.
4. K. P. Ray, as an external examiner, conducted viva for two M. Tech students and two first stage Ph D presentation of EE Dept. IIT, Bombay.
5. K. P. Ray is on the Editorial Board of International Journal on RF and Microwave Computer-Aided Engineering, John Wiley, USA. He is also a reviewer of MTT, IEEE, USA, IET (Formerly Proc. IEE), UK, International, Journal of Antennas & Propagation (IJAP), USA, Elsevier Publication, International Journal of Electronics and Communication, Progress in Electromagnetic Research (PIER) M, USA, IETE, India.
6. K. P. Ray was a member in Advisory committee for following International/National conferences;
 - Second International Conference on Advances in Computing and Communications (ICACC- 2012), Cochin

- National Conference on Electronic Technologies, GEC, Goa.
7. Milind Joshi acted as external examiner for Dissertation examination for Master of Engineering (M. E.) at Terna Engineering College, Mumbai.
 8. Milind Joshi acted as external examiner for Dissertation examination for Master of Engineering (M. E.) at Pune Institute of Technology (PICT), Pune.
 9. Milind Joshi acted as external examiner for B.E. Project (VII & VIII semester) at K. J. Somaiyya college of engineering, Mumbai.
 10. Alok Verma evaluated Ph.D thesis "Performance modeling of Quality of Service & Media control for 3G and Next Generation Network" and conducted viva for Mr Santosh Kumar Singh at NMIMS's Mukesh Patel Institute of Technology & Management, Mumbai on 14th January 2013.
 11. Poornima Shrivastava acted as external examiner for ME dissertation examination at V.E. Institute of Technology Mumbai, March 2013.
 12. Poornima Shrivastava acted as external examiner for ME dissertation examination at K.J. Somaiya College of Engineering Mumbai, Feb 2013.

Participation in

Exhibitions

SAMEER participated in the Exhibition "India Telecom 2012" organized by DeitY / DOT at New Delhi during December 13-15, 2012.

SOCIAL AND CULTURAL EVENTS

Mumbai

Hindi Day:

1. In the second half of September 2012 "Hindi Pakhwada" was celebrated in SAMEER. Dr. K. P. Ray, Hindi Officer organised an essay competition amongst the newly joined scientists in SAMEER. On 27th September, 2012, Hindi day was celebrated. On this occasion, Shri Janeshwar Kumar Tyagi, Ex Director Finance, DeitY was the Chief guest of the function and addressed the gathering. He stressed the importance of the National Language. The function was presided over by Director, SAMEER, who encouraged all the members of SAMEER to use Raj Bhasha Hindi.

Satarkta Divas:

Dr. K. P. Ray, Chief Vigilance Officer, SAMEER, had organized a Satarkta Divas, wherein oath was taken by SAMEER members. This day was given wide publicity.

G. Kalaichelvi organized at SAMEER Chennai Independence Day Celebrations. Around 25 Tree Saplings were planted on August 15, 2012 by the employees in the two campuses.

All staff members of SAMEER Kolkata along with their families participated in a picnic organized on 12th Jan 2013 at Kamala Garden, Duttapukur, near Kolkata. Photograph of all the participants is shown below.

Patents

One Patent has been granted against application no. 121/Kol/2005 titled "Planar waveguide based Comparator for monopulse application in particular in Ka-band" developed by SAMEER Kolkata.

Miscellaneous

1. NABL Surveillance audit was conducted for EMI/EMC Facility at Kharghar and continuation of NABL accreditation was granted.
2. ISO 9001:2008 audit was conducted for EMI/EMC Facility at Kharghar in May 2012 and accreditation was granted till May 2015. Process for grant of FCC listing was initiated.



ANNUAL ACCOUNTS
2012-13

AUDITOR'S REPORT

The Members,

Society for Applied Microwave Electronics Engineering & Research (SAMEER)

1. We have audited the attached Balance Sheet of Society for Applied Microwave Electronics Engineering & Research ('the Society'), a Society registered under the Society's Registration Act, 1860 as at March 31, 2013 and the Income and Expenditure Account for the year ended on that date annexed thereto. These financial statements are the responsibility of the Society's management. Our responsibility is to express an opinion on these financial statements based on our audit.
2. We conducted our audit in accordance with auditing standards generally accepted in India. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatements. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall financial statement presentation. We believe that our audit provides a reasonable basis for our opinion.
3.
 - a. No provision has been made for gratuity and leave encashment (Refer Note No. 2(f) of Schedule 20)
 - b. Provision for pension has been made on adhoc basis for Mumbai, Chennai and Kolkata centres instead of providing as stipulated by AS 15 - Employee Benefits. (Refer Note No. 2(g) of Schedule 20)

In the absence of necessary details as mentioned above, we are unable to quantify the impact of the same on the financial results.

4. Subject to the above, we report that:
 - I. We have obtained all the information and explanations which to the best of our knowledge and belief were necessary for the purposes of our audit;
 - ii. In our opinion, proper books of account have been kept by the Society so far as appears from our examination of those books;
 - iii. The Balance Sheet and Income and Expenditure Account dealt with by this report are in agreement with the books of account;
 - iv. In our opinion, the Balance Sheet and Income and Expenditure Account dealt with by this report comply with the applicable accounting standards except Accounting Standard - 15 (Employee Benefits).
5. In our opinion and to the best of our information and according to the explanations given to us, the Balance Sheet and Income and Expenditure Account read with the notes thereon and subject to our comments given in Para 3 and 4 above, give a true and fair view in conformity with accounting principles generally accepted in India:
 - a. in the case of the Balance Sheet, of the state of affairs of the Society as at March 31, 2013;
 - b. in the case of Income and Expenditure Account, of the excess of income over expenditure of the Society for the year ended on that date.

For

SORAB S. ENGINEER & CO.
Chartered Accountants
Firm Registration No: 110417W

CA. N.D. ANKLESARIA
PARTNER
Membership No: 10250

Place : Mumbai
Dated : 07.10.2013

BALANCE SHEET AS ON 31ST MARCH 2013

PARTICULARS	SHC. NO.	March 31, 2013 ₹	March 31, 2012 ₹
SOURCE OF FUNDS			
A. Capital funds	1	93,42,99,517	861,103,764
Less: Deprec. Amount transferred from I & E A/c		81,20,68,043	707,052,704
B. Sponsored project funds	2	61,10,26,310	740,302,887
C. Income & Expenditure Account		1,43,36,86,320	1,221,601,937
Total		2,16,69,44,104	2,115,955,884
APPLICATION OF FUNDS			
ASSETS			
D. Fixed Assets	3	92,85,35,235	855,339,481
Less: Depreciation		79,29,38,486	687,923,146
Net value		13,55,96,749	167,416,335
E. Capital Work in Progress		12,12,23,903	114,760,790
		25,68,20,652	282,177,124
F. Sponsored Project Assets	4	1,02,55,79,414	969,489,426
Less: Depreciation		72,79,24,281	656,680,456
Net value		29,76,55,133	312,808,970
Current Assets, Loans and Advances			
G. Current Assets	5	10,88,63,345	104,119,785
H. Loans & Advances	6	8,84,61,551	81,117,571
I. Cash & Bank Balances	7	1,49,49,26,590	1,408,220,531
		1,69,22,51,486	1,593,457,887
Less:			
J. Current Liabilities	8	7,97,83,167	72,488,097
		1,61,24,68,319	1,520,969,790
Total		2,166,944,104	2,115,955,884

Significant Accounting Policies and Notes to Accounts - As per Schedule 20

As per our report of even date attached

For & on behalf of
SORAB S. ENGINEER & CO
Chartered Accountants
Firm Registration No. 110417W

CA N.D. ANKLESARIA
PARTNER
Membership no. : 10250

RAJESH HARSH
F & A

AMOL BHAGWAT
REGISTRAR

DR. A. L. DAS
DIRECTOR

Mumbai
Dated :07.10.2013

INCOME & EXPENDITURE ACCOUNT

FOR THE YEAR ENDED 31ST MARCH, 2013

PARTICULARS	SCH. NO.	2012-13 ₹	2011-12 ₹
INCOME			
A. Grant received - Ministry of Communications, Information & Technology, (MCIT) less amount utilised for Capital Expenditure	9	36,62,04,247	346,971,901
B. Test measurement & Consultancy services	10	4,61,08,425	37,716,221
C. Other Income	11	15,60,07,804	131,225,116
Total (a)		56,83,20,476	515,913,238
EXPENDITURE			
A. Salaries, Allowances & Staff benefits	12	30,32,25,608	278,283,968
B. Travelling & Conveyance	13	1,51,65,056	11,879,625
C. Administrative Expenses	14	7,37,24,178	57,111,432
D. Human Resource Development	15	8,78,859	716,488
E. Components, Consumables & Fabrication	16	16,19,27,476	115,968,781
F. Repairs & Maintenance	17	3,57,32,389	19,768,397
		59,06,53,566	483,728,691
Less : Expenses Recovered - Sponsored projects	18	21,86,15,023	172,962,402
Total (b)		37,20,38,543	310,766,289
Excess of Income over Expenditure (a - b)		19,62,81,933	205,146,949
Less: Depreciation on Fixed assets	19	10,50,15,339	85,403,184
Balance after depreciation		9,12,66,594	119,743,765
Add : Amount transfered from Capital Fund		10,50,15,339	85,403,184
Add: Balance as per last year		1,22,16,01,937	1,10,40,11,643
Less: Assets created out of Surplus		--	87,556,655
Add : Surplus on Closure of Sponsored Project		1,58,02,450	--
Balance carried forward to Balance Sheet		1,43,36,86,320	1,221,601,937

Significant Accounting Policies and Notes to Accounts - As per Schedule 20

As per our report of even date attached

For & on behalf of
For **SORAB S. ENGINEER & CO**
Chartered Accountants
Firm Registration No. 110417W

CA N.D. ANKLESARIA
PARTNER
Membership No. : 10250

RAJESH HARSH
HEAD, F & A

AMOL BHAGWAT
REGISTRAR

DR. A. L. DAS
DIRECTOR

Mumbai
Dated :07.10.2013

SCHEDULE FORMING PART OF THE BALANCE SHEET AS ON 31ST MARCH, 2013

SCHEDULE 1
CAPITAL FUNDS

PARTICULARS	MUMBAI		CHENNAI		KOLKATA		TOTAL	
	March 31, 2013 ₹	March 31, 2012 ₹	March 31, 2013 ₹	March 31, 2012 ₹	March 31, 2013 ₹	March 31, 2012 ₹	March 31, 2013 ₹	March 31, 2012 ₹
Land - Leasehold	-	-	-	-	11,45,149	11,45,149	11,45,149	11,45,149
Building	10,91,71,156	10,89,74,516	3,73,89,613	3,48,27,738	3,24,01,619	3,24,01,619	17,89,62,388	17,62,03,873
Furniture & Fixtures	90,97,914	83,05,251	45,97,906	45,58,236	47,31,349	46,30,612	1,84,27,169	1,74,94,099
Lab & Office Equipment	26,54,94,415	23,97,08,654	21,52,78,979	20,27,96,485	16,34,05,507	14,11,37,499	64,41,78,901	58,36,42,638
Computers and peripherals	1,56,27,844	1,19,84,556	79,58,350	79,58,350	3,28,84,493	2,77,55,580	5,64,70,687	4,76,98,486
Electrical Equipment	-	-	-	-	1,15,538	1,15,538	1,15,538	1,15,538
Motor Vehicles	39,89,821	39,89,821	10,29,282	10,29,282	14,09,143	14,09,143	64,28,246	64,28,246
Library Books	79,31,149	79,12,849	84,11,514	83,90,573	26,13,578	24,57,115	1,89,56,241	1,87,60,537
Other Equipments	5,08,494	5,08,494	89,01,620	89,01,620	2,05,084	2,05,084	96,15,198	96,15,198
TOTAL	41,18,20,793	38,13,84,141	28,35,67,264	26,84,62,284	23,89,11,460	21,12,57,339	93,42,99,517	86,11,03,764

SCHEDULE 2
SPONSORED PROJECT FUNDS

PARTICULARS	MUMBAI		CHENNAI		KOLKATA		TOTAL	
	March 31, 2013 ₹	March 31, 2012 ₹	March 31, 2013 ₹	March 31, 2012 ₹	March 31, 2013 ₹	March 31, 2012 ₹	March 31, 2013 ₹	March 31, 2012 ₹
Balance as per last Balance sheet	42,52,87,172	518,461,839	5,17,30,002	2,76,30,887	26,32,85,713	297,647,001	74,03,02,887	843,739,727
Add / Less:								
Surplus on Closure of Sponsored Project	-85,14,541	480	-1,58,02,450	-	-	-5,46,476	2,43,16,991	-5,45,996
Amount refunded to DeitY	-	-	-4,91,29,000	-	-	-	-4,91,29,000	-
Advance paid to co-agencies	-	-12,50,000	-	-	-	-	-	-12,50,000
Asset transferred to Kolkata	-	-	-	1,38,51,485	-	-	-	1,38,51,485
Advance received during the year	19,86,97,635	8,02,81,593	1,22,95,927	5,34,28,185	2,00,31,856	4,73,67,712	23,10,25,418	18,10,77,490
Transferred to SAMEER Mumbai	-	-	-	-54,80,000	-	-	-	-54,80,000
Other receipts	-	-80,78,710	-	-	-	-	-	-80,78,710
Hindustan Steel Works Ltd.	30,02,844	-1,29,11,952	-	-	-	-	30,02,844	-1,29,11,952
TOTAL (a)	61,84,73,110	57,65,03,250	-9,05,521	8,94,30,557	28,33,17,569	34,44,68,237	90,08,85,158	1,01,04,02,044
Less : Expenditure transferred-I & E account								
Salaries, Allowances and Cont. to PF	2,28,06,505	2,15,17,264	1,79,29,184	1,82,97,385	86,62,780	1,58,13,198	4,93,98,469	5,56,27,847
Travelling & Conveyance	39,97,799	36,69,978	16,50,977	13,34,506	9,10,874	2,92,223	65,59,650	52,96,707
Administrative Expenses	54,61,688	33,90,140	51,53,223	4,84,619	81,41,353	1,27,16,361	1,87,56,264	1,65,91,120
Components & Consumables	9,68,76,144	7,18,88,304	2,36,21,940	53,14,053	1,91,88,198	1,32,08,426	13,96,86,282	9,04,10,783
Fabrication and Installation	-	-	-	-	7,73,431	-	7,73,431	-
Repairs & maintenance	30,82,198	44,02,493	3,58,729	6,33,452	-	-	34,40,927	50,35,945
TOTAL (b)	13,22,24,334	10,48,68,179	4,87,14,053	2,60,64,015	3,76,76,636	4,20,30,208	21,86,15,023	17,29,62,402
Less: Depreciation on Project assets (c)	1,87,41,088	4,63,47,899	1,34,78,411	1,16,36,540	3,90,24,326	3,91,52,316	7,12,43,825	9,71,36,755
NET TOTAL (a - b - c)	46,75,07,688	42,52,87,172	-6,30,97,985	5,17,30,002	20,66,16,607	26,32,85,713	61,10,26,310	74,03,02,887

SCHEDULE 3
Fixed Assets

SCHEDULE FORMING PART OF THE BALANCE SHEET AS ON 31ST MARCH, 2013

PARTICULARS	Gross Block				Depreciation				Net Block	
	As on 01.04.2012 ₹	Additions ₹	Deletions / Deductions ₹	As on 31.03.2013 ₹	As on 01.04.2012 ₹	For the Year ₹	Adjustment for Deletions / Deductions ₹	As on 31.03.2013 ₹	As on 31.03.2013 ₹	As on 31.03.2013 ₹
Land-Leasehold	11,45,149	-	-	11,45,149	-	-	-	-	11,45,149	11,45,149
Building	16,26,65,689	27,58,516	-	16,54,24,205	13,68,19,955	1,30,59,647	-	14,98,79,602	1,55,44,603	2,58,45,734
Residential Flats	2,06,06,858	-	-	2,06,06,858	1,13,33,772	10,30,343	-	1,23,64,115	82,42,743	92,73,086
Furniture & Fixtures	1,74,94,098	9,33,070	-	1,84,27,168	1,47,86,983	10,17,238	-	1,58,04,221	26,22,947	27,07,115
Lab & Office Equipment	57,30,86,888	6,05,36,263	-	63,36,23,151	44,91,92,477	8,11,64,350	-	53,03,56,827	10,32,66,324	12,38,94,411
Computer & Peripherals	4,76,98,485	87,72,201	-	5,64,70,686	4,48,27,308	75,71,204	-	5,23,98,512	40,72,174	28,71,177
Electrical Equipment	1,15,538	-	-	1,15,538	48,889	17,331	-	66,220	49,318	66,649
Motor Vehicles	57,07,708	-	-	57,07,708	45,51,600	6,66,531	-	52,18,131	4,89,577	11,56,108
Library Books	1,87,60,537	1,95,704	-	1,89,56,241	1,83,03,632	4,88,695	-	1,87,92,327	1,63,914	4,56,905
Other Fixed Assets	80,58,531	-	-	80,58,531	80,58,531	-	-	80,58,531	-	0
TOTAL	85,53,39,481	7,31,95,754	-	92,85,35,235	68,79,23,147	10,50,15,339	-	79,29,38,486	13,55,96,749	16,74,16,334

SCHEDULES FORMING PART OF THE BALANCE SHEET AS ON 31ST MARCH, 2013

SCHEDULE : 4

SPONSORED PROJECT ASSETS (GROSS BLOCK)

PARTICULARS	MUMBAI		CHENNAI		KOLKATA		TOTAL	
	March 31, 2013 ₹	March 31, 2012 ₹	March 31, 2013 ₹	March 31, 2012 ₹	March 31, 2013 ₹	March 31, 2012 ₹	March 31, 2013 ₹	March 31, 2012 ₹
Building	9,29,92,074	8,87,53,160	4,80,95,622	4,80,95,622	2,61,62,611	2,61,62,611	16,72,50,307	16,30,11,393
Furniture & Fixtures	34,90,145	31,57,096	24,00,321	23,50,009	-	-	58,90,466	55,07,105
Lab & Office Equipment	12,43,39,034	21,27,16,997	10,65,90,408	9,61,76,066	24,35,85,525	24,02,41,349	47,45,14,967	54,91,34,412
Computer & Peripherals	1,45,42,497	1,00,74,042	32,93,974	32,93,974	14,19,723	12,06,163	1,92,56,194	1,45,74,179
Closed Project Assets							-	
Closed Project Lab & Office Equipments	34,42,17,761	22,74,72,147	-	-	-	-	34,42,17,761	22,74,72,147
Closed Project Furniture & Fixtures	57,44,130	27,25,316	-	-	-	-	57,44,130	27,25,316
Closed Project Computers & Peripherals	72,66,407	60,17,657	-	-	-	-	72,66,407	60,17,657
Closed Project Prefabricated Structure	14,39,182	10,47,218	-	-	-	-	14,39,182	10,47,218
TOTAL	59,40,31,230	55,19,63,6337	16,03,80,325	14,99,15,671	27,11,67,859	26,76,10,123	1,02,55,79,414	96,94,89,426

SCHEDULE 5

CURRENT ASSETS

PARTICULARS	MUMBAI		CHENNAI		KOLKATA		TOTAL	
	March 31, 2013 ₹	March 31, 2012 ₹	March 31, 2013 ₹	March 31, 2012 ₹	March 31, 2013 ₹	March 31, 2012 ₹	March 31, 2013 ₹	March 31, 2012 ₹
Sundry Debtors								
Considered Good	16,94,228	11,11,986	58,99,013	2,19,70,410	20,87,388	5,23,657	96,80,629	2,36,06,053
Considered Doubtful	7,23,534	-	27,53,060	-	-	-	34,76,594	-
	24,17,762	11,11,986	86,52,073	2,19,70,410	20,87,388	5,23,657	1,31,57,223	2,36,06,053
Less : Provision for Bad Debts	-7,23,534	-	-27,53,060	-	-	-	-34,76,594	-
	16,94,228	11,11,986	58,99,013	2,19,70,410	20,87,388	5,23,657	96,80,629	2,36,06,053
Interest Receivable on FD	5,67,16,786	4,54,47,553	1,51,15,367	1,93,34,572	39,65,298	26,84,696	7,57,97,451	6,74,66,821
Tax Deducted at source	67,59,492	37,93,283	51,09,658	35,47,158	26,87,106	16,80,521	1,45,56,256	90,20,962
Service Tax Receivable	47,47,011	31,81,899	-	-	15,07,289	8,44,050	62,54,300	40,25,949
Other Current Asset	-	-	-	-	25,74,709	-	25,74,709	-
TOTAL	6,99,17,517	5,35,34,721	2,61,24,038	4,48,52,140	1,28,21,790	57,32,924	10,88,63,345	10,41,19,785

SCHEDULE FORMING PART OF THE BALANCE SHEET AS ON 31ST MARCH, 2013

SCHEDULE 6 LOANS & ADVANCES

PARTICULARS	MUMBAI		CHENNAI		KOLKATA		TOTAL	
	March 31, 2013 ₹	March 31, 2012 ₹	March 31, 2013 ₹	March 31, 2012 ₹	March 31, 2013 ₹	March 31, 2012 ₹	March 31, 2013 ₹	March 31, 2012 ₹
Loans & Advances to Employees	68,33,416	85,79,581	20,24,571	18,67,642	6,44,496	6,07,878	95,02,483	1,10,55,101
Accrued Interest on Loans to Employees	40,83,100	43,57,186	9,70,282	9,23,022	-	-	50,53,382	52,80,208
Advances to Suppliers	5,19,84,301	3,64,76,130	87,95,865	1,67,58,916	11,56,001	21,53,335	6,19,36,167	5,53,88,381
Pre-paid Expenses	2,86,256	-	-	-	-	-	2,86,256	-
Deposits	1,42,159	79,220	5,70,988	5,70,988	5,90,936	5,90,936	13,04,083	12,41,144
Recoverable Expenses	89,51,642	69,25,523	-	-	-	-	89,51,642	69,25,523
Security Deposit	14,27,538	11,42,300	-	-	-	-	14,27,538	11,42,300
Other advances	-	-	-	84,914	-	-	-	84,914
TOTAL	7,37,08,412	5,75,59,940	1,23,61,706	2,02,05,482	23,91,433	33,52,149	8,84,61,551	8,11,17,571

SCHEDULE 7 CASH & BANK BALANCES

PARTICULARS	MUMBAI		CHENNAI		KOLKATA		TOTAL	
	March 31, 2013 ₹	March 31, 2012 ₹	March 31, 2013 ₹	March 31, 2012 ₹	March 31, 2013 ₹	March 31, 2012 ₹	March 31, 2013 ₹	March 31, 2012 ₹
Cash in Hand	-	-	19,103	27,484	15,052	305	34,155	27,789
Balance with Schedule Banks								
Fixed Deposits	69,53,00,000	61,12,68,562	54,50,00,000	54,04,65,336	8,59,54,526	10,03,00,000	1,32,62,54,526	1,25,20,33,898
Fixed Deposits-Pension Fund	-	-	1,14,90,686	-	-	-	1,14,90,686	-
Current Account	89,37,030	10,39,710	2,15,51,094	4,65,72,033	46,42,334	54,44,870	3,51,30,458	5,30,56,613
Saving Account	-	-	1,18,94,660	8,55,332	1,77,52,490	1,74,78,133	2,96,47,150	1,83,33,465
Margin Money with Banks	7,07,62,519	6,41,92,600	-	-	2,16,07,096	2,05,76,166	9,23,69,615	8,47,68,766
TOTAL	77,49,99,549	67,65,00,872	58,99,55,543	58,79,20,185	12,99,71,498	14,37,99,474	1,49,49,26,590	1,40,82,20,531

SCHEDULE 8 CURRENT LIABILITIES

PARTICULARS	MUMBAI		CHENNAI		KOLKATA		TOTAL	
	March 31, 2013 ₹	March 31, 2012 ₹	March 31, 2013 ₹	March 31, 2012 ₹	March 31, 2013 ₹	March 31, 2012 ₹	March 31, 2013 ₹	March 31, 2012 ₹
Sundry Creditors	1,53,28,806	90,65,355	1,26,834	41,52,203	22,22,108	76,43,397	1,76,77,748	2,08,60,955
Other liabilities (Including Statutory Liabilities)	1,06,59,484	1,07,00,403	1,48,70,677	97,93,199	24,14,437	15,41,933	2,79,44,598	2,20,35,535
Service Tax Payable	-	-	-	-	9,31,422	20,343	9,31,422	20,343
Liability for Pension Fund	-	-	2,11,78,998	1,84,02,623	-	-	2,11,78,998	1,84,02,623
Advance Received from Customers	7,44,123	8,20,369	1,13,06,278	97,76,135	-	5,72,138	1,20,50,401	1,11,68,641
TOTAL	2,67,32,413	2,05,86,127	4,74,82,787	4,21,24,160	55,67,967	97,77,811	7,97,83,167	7,24,88,097

SCHEDULES FORMING PART OF INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2013

SCHEDULE 9

GRANT RECEIVED - MCIT

PARTICULARS	MUMBAI		CHENNAI		KOLKATA		TOTAL	
	2012-13 ₹	2011-12 ₹	2012-13 ₹	2011-12 ₹	2012-13 ₹	2011-12 ₹	2012-13 ₹	2011-12 ₹
Grant received - MCIT	28,40,00,000	29,64,00,000	9,29,00,000	8,75,00,000	6,25,00,000	5,55,00,000	43,94,00,000	43,94,00,000
Grant received - MCIT for NER Project	1,77,00,000						1,77,00,000	
Total (a)	30,17,00,000	29,64,00,000	9,29,00,000	8,75,00,000	6,25,00,000	5,55,00,000	45,71,00,000	43,94,00,000
Less: Amount utilised for Capital Expenditure								
Building	1,96,640	1,22,60,785	25,61,875	-	-	-	27,58,515	1,22,60,785
Furniture & Fixtures	7,92,663	51,467	39,670	36,200	1,00,737	5,55,698	9,33,070	6,43,365
Lab & Office Equipment	2,57,85,761	3,75,04,145	1,24,82,494	2,35,89,227	2,22,68,008	97,83,569	6,05,36,263	7,08,76,941
Computer and peripherals	36,43,288	19,95,170	-	11,66,640	51,28,913	40,16,141	87,72,201	71,77,951
Motor Vehicles	-	8,59,850	-	-	-	-	-	8,59,850
Library Books	18,300	-	20,941	3,74,684	1,56,463	2,34,523	1,95,704	6,09,207
Total (b)	3,04,36,652	5,26,71,417	1,51,04,980	2,51,66,751	2,76,54,121	1,45,89,931	7,31,95,753	9,24,28,099
Grant Received from NER Project Transferred to Sponsored Project Fund (c)	1,77,00,000	-	-	-	-	-	1,77,00,000	-
TOTAL (a-b-c)	25,35,63,348	24,37,28,583	7,77,95,020	6,23,33,249	3,48,45,879	4,09,10,069	36,62,04,247	34,69,71,901

SCHEDULE 10

TEST MEASUREMENT & CONSULTANCY SERVICES

PARTICULARS	MUMBAI		CHENNAI		KOLKATA		TOTAL	
	2012-13 ₹	2011-12 ₹	2012-13 ₹	2011-12 ₹	2012-13 ₹	2011-12 ₹	2012-13 ₹	2011-12 ₹
Test Measurement & Consultancy Services	88,84,078	43,16,964	3,10,05,897	3,16,83,757	62,18,450	17,15,500	4,61,08,425	3,77,16,221
TOTAL	88,84,078	43,16,964	3,10,05,897	3,16,83,757	62,18,450	17,15,500	4,61,08,425	3,77,16,221

SCHEDULES FORMING PART OF INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2012

SCHEDULE 11 OTHER INCOME

PARTICULARS	MUMBAI		CHENNAI		KOLKATA		TOTAL	
	2012-13 ₹	2011-12 ₹	2012-13 ₹	2011-12 ₹	2012-13 ₹	2011-12 ₹	2012-13 ₹	2011-12 ₹
Interest on Fixed Deposits	7,09,25,085	6,06,99,928	4,56,58,701	3,80,25,258	1,20,60,883	55,59,878	12,86,44,669	10,42,85,064
Interest on Saving A/c	-	-	23,10,342	14,83,337	-	-	23,10,342	14,83,337
Interest on Loan to Employees	4,88,961	7,04,058	1,52,214	1,91,934	10,289	20,298	6,51,464	9,16,290
Miscellaneous Receipts	50,39,355	23,47,401	11,31,178	9,20,551	83,49,928	2,08,00,869	1,45,20,461	2,40,68,821
Excess / Short Provision	-	-	27,875	-	-	-	27,875	-
Recovered from staff: Rent, water, vehicle, electricity	12,76,437	4,71,604	-	-	-	-	12,76,437	4,71,604
Surplus of Project closed	85,76,556	-	-	-	-	-	85,76,556	-
TOTAL	8,63,06,394	6,42,22,991	4,92,80,310	4,06,21,080	2,04,21,100	2,63,81,045	15,60,07,804	13,12,25,116

SCHEDULE 12 SALARIES, ALLOWANCES & STAFF BENEFITS

PARTICULARS	MUMBAI		CHENNAI		KOLKATA		TOTAL	
	2012-13 ₹	2011-12 ₹	2012-13 ₹	2011-12 ₹	2012-13 ₹	2011-12 ₹	2012-13 ₹	2011-12 ₹
Salaries, Allowances & Cont to Provident Fund	13,76,20,246	11,75,90,523	7,83,34,003	7,08,26,759	2,73,46,386	2,90,15,579	24,33,00,635	21,74,32,861
Bonus to staff	3,50,580	3,96,633	2,97,333	3,16,901	90,092	2,648	7,38,005	7,16,182
Leave Travel Concession	17,05,199	35,95,618	4,81,206	3,66,051	2,52,644	-	24,39,049	39,61,669
Medical Expenses	64,26,968	53,29,640	24,09,910	30,72,310	6,97,742	4,75,116	95,34,620	88,77,066
Tuition Fees	7,350	5,06,370	5,16,464	6,02,114	1,60,413	63,176	6,84,227	11,71,660
Wages / Labour charges	12,71,956	8,46,588	-	-	16,09,395	12,60,094	28,81,351	21,06,682
Gratuity	22,97,594	36,03,675	-	-	-	-	22,97,594	36,03,675
Pension	3,17,70,601	2,78,50,133	36,25,370	42,13,346	10,00,000	10,00,000	3,63,95,971	3,30,63,479
Commutation of Pension	18,42,150	45,79,016	-	-	-	-	18,42,150	45,79,016
Leave Encashment	26,56,088	24,06,605	-	-	62,583	7,859	27,18,671	24,14,464
Uniform to staff	2,31,025	1,88,508	12,870	7,886	7,940	2,120	2,51,835	1,98,514
Honorarium	1,20,000	1,22,700	3,000	19,000	18,500	17,000	1,41,500	1,58,700
TOTAL	18,62,99,757	16,70,16,009	8,56,80,156	7,94,24,367	3,12,45,695	3,18,43,592	30,32,25,608	27,82,83,968

SCHEDULES FORMING PART OF INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2013

SCHEDULE 13

TRAVELLING & CONVEYANCE

PARTICULARS	MUMBAI		CHENNAI		KOLKATA		TOTAL	
	2012-13 ₹	2011-12 ₹	2012-13 ₹	2011-12 ₹	2012-13 ₹	2011-12 ₹	2012-13 ₹	2011-12 ₹
Travelling Expenses	70,34,030	53,25,443	36,18,671	24,52,461	19,57,906	7,80,611	1,26,10,607	85,58,515
Motor Vehicle Expenses	6,33,270	8,82,453	6,59,444	8,74,105	2,40,107	1,39,249	15,32,821	18,95,807
Transportation & Conveyance	8,27,996	10,30,938	45,645	2,98,555	1,47,987	95,811	10,21,628	14,25,303
TOTAL	84,95,296	72,38,834	43,23,760	36,25,121	23,46,000	10,15,671	1,51,65,056	1,18,79,625

SCHEDULE 14

ADMINISTRATIVE EXPENSES

PARTICULARS	MUMBAI		CHENNAI		KOLKATA		TOTAL	
	2012-13 ₹	2011-12 ₹	2012-13 ₹	2011-12 ₹	2012-13 ₹	2011-12 ₹	2012-13 ₹	2011-12 ₹
Advertisement & publicity	4,41,141	7,23,198	1,63,729	4,74,268	2,95,749	1,61,513	9,00,619	13,58,979
Audit Fees	1,65,000	1,65,000	-	-	-	-	1,65,000	1,65,000
Bad Debts (Ref. Note No. 2(k) of Schedule -20)	-	3,14,182	28,00,000	-	-	1,52,794	28,00,000	4,66,976
Bank charges	11,80,173	7,35,781	18,688	4,754	30,696	34,699	12,29,557	7,75,234
Books & periodicals	18,244	4,21,476	4,939	1,350	-	-	23,183	4,22,826
Canteen expenses	18,25,742	10,06,955	11,34,261	7,97,984	4,08,681	3,99,408	33,68,684	22,04,347
Development Charges	21,25,219	-	-	-	-	-	21,25,219	-
Electricity Charges	1,25,17,156	75,08,696	26,13,113	23,41,170	31,65,994	22,86,191	1,82,96,263	1,21,36,057
EMI / EMC expenses	-	-	-	-	4,27,362	3,96,410	4,27,362	3,96,410
Entertainment expenses	4,05,650	3,33,143	73,248	1,40,979	1,99,377	1,30,370	6,78,275	6,04,492
Foreign Exchange Fluctuation	-	-	-	-	46,013	3,00,976	46,013	3,00,976
Insurance	1,38,658	4,42,983	1,53,482	35,700	34,876	1,41,499	3,27,016	6,20,182
ISO-9001 Certification	-	-	1,48,966	40,684	-	-	1,48,966	40,684
Laundry expenses	58,625	23,502	-	-	-	-	58,625	23,502
Legal & Professional charges	7,92,206	13,78,761	2,01,454	1,93,109	25,511	53,296	10,19,171	16,25,166
Membership subscription	47,034	36,302	3,58,000	16,762	87,679	36,365	4,92,713	89,429
Miscellaneous expenses	23,92,214	20,57,286	49,54,556	5,98,948	43,33,064	40,74,180	1,16,79,834	67,30,414
Postage & Telegrams	1,74,948	1,57,424	85,451	1,52,211	69,965	48,481	3,30,364	3,58,116
Printing & Stationery	11,82,504	8,27,911	1,62,059	2,05,169	3,96,300	1,90,770	17,40,863	12,23,850
Project closed deficit	62,015	480	-	-	-	-	62,015	480
Provision for Bad Debts	7,23,534	-	27,53,060	-	-	-	34,76,594	-
Rent, Rates & Taxes	38,01,398	28,63,769	1,05,653	64,746	2,67,723	68,466	41,74,774	29,96,981
SAMEER Contribution to A104 Account	-	50,15,000	-	-	-	-	-	50,15,000
Security charges	63,68,207	11,57,374	25,76,234	33,10,745	19,74,035	11,04,286	1,09,18,476	55,72,405
Service Tax	-	8,04,507	-	-	-	-	-	8,04,507
Sundry Balances written off	23,054	-	-	-	-	-	23,054	-
Telephones	9,04,897	11,92,492	3,76,383	4,45,246	1,80,379	1,46,503	14,61,659	17,84,241
Testing & Functional charges	-	-	-	-	42,26,500	90,21,150	42,26,500	90,21,150
Theft of Cash	29,200	-	-	-	-	-	29,200	-
Transportation expenses	31,52,656	22,74,534	-	-	-	-	31,52,656	22,74,534
Water charges	3,41,523	99,494	-	-	-	-	3,41,523	99,494
TOTAL	3,88,70,998	2,95,40,250	1,86,83,276	88,23,825	1,61,69,904	1,87,47,357	7,37,24,178	5,71,11,432

SCHEDULES FORMING PART OF INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2013

SCHEDULE 15

HUMAN RESOURCE DEVELOPMENT

PARTICULARS	MUMBAI		CHENNAI		KOLKATA		TOTAL	
	2012-13 ₹	2011-12 ₹	2012-13 ₹	2011-12 ₹	2012-13 ₹	2011-12 ₹	2012-13 ₹	2011-12 ₹
Conference ,Seminar & Training expenses	3,46,183	6,54,688	2,54,121	38,500	1,39,034	23,300	7,39,338	7,16,488
Stipend to Apprentice Trainees	-	-	42,933	-	71,588	-	1,14,521	-
Contribution to SAMEER's sport club	25,000	-	-	-	-	-	25,000	-
TOTAL	3,71,183	6,54,688	2,97,054	38,500	2,10,622	23,300	8,78,859	7,16,488

SCHEDULE 16

COMPONENTS, CONSUMABLES & FABRICATION

PARTICULARS	MUMBAI		CHENNAI		KOLKATA		TOTAL	
	2012-13 ₹	2011-12 ₹	2012-13 ₹	2011-12 ₹	2012-13 ₹	2011-12 ₹	2012-13 ₹	2011-12 ₹
Components & Consumables	9,30,26,090	6,01,66,537	2,05,15,148	64,72,787	2,75,62,094	2,23,67,363	14,11,03,332	8,90,06,687
Fabrication & Installation	1,50,73,910	2,55,47,682	49,31,153	11,54,924	8,19,081	2,59,488	2,08,24,144	2,69,62,094
TOTAL	10,81,00,000	8,57,14,219	2,54,46,301	76,27,711	2,83,81,175	2,26,26,851	16,19,27,476	11,59,68,781

SCHEDULE 17

REPAIRS & MAINTENANCE

PARTICULARS	MUMBAI		CHENNAI		KOLKATA		TOTAL	
	2012-13 ₹	2011-12 ₹	2012-13 ₹	2011-12 ₹	2012-13 ₹	2011-12 ₹	2012-13 ₹	2011-12 ₹
Residential Flats	1,57,606	3,35,831	-	-	-	-	1,57,606	3,35,831
Building maintenance	1,68,48,040	56,63,838	-	-	10,45,526	3,80,570	1,78,93,566	60,44,408
Equipment repairs and maintenance	72,64,816	40,83,046	57,03,607	55,21,704	18,77,714	23,60,113	1,48,46,137	1,19,64,863
Guest House maintenance	8,12,840	6,21,881	-	-	-	-	8,12,840	6,21,881
Garden maintenance	7,07,300	2,90,948	3,19,562	3,78,178	1,16,773	1,10,027	11,43,635	7,79,153
Others	8,78,605	22,261	-	-	-	-	8,78,605	22,261
TOTAL	2,66,69,207	1,10,17,805	60,23,169	58,99,882	30,40,013	28,50,710	3,57,32,389	1,97,68,397

SCHEDULES FORMING PART OF INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2013

SCHEDULE 18 EXPENSES RECOVERED FROM SPONSORED PROJECTS

PARTICULARS	MUMBAI		CHENNAI		KOLKATA		TOTAL	
	2012-13 ₹	2011-12 ₹	2012-13 ₹	2011-12 ₹	2012-13 ₹	2011-12 ₹	2012-13 ₹	2011-12 ₹
Salaries, Allowances & Cont to Provident Fund	2,28,06,505	2,15,17,264	1,79,29,184	1,82,97,385	86,62,780	1,58,13,198	4,93,98,469	5,56,27,847
Travelling & Conveyance	39,97,799	36,69,978	16,50,977	13,34,506	9,10,874	2,92,223	65,59,650	52,96,707
Administrative Expenses	54,61,688	33,90,140	51,53,223	4,84,619	81,41,353	1,27,16,361	1,87,56,264	1,65,91,120
Components & Consumables	9,68,76,144	7,18,88,304	2,36,21,940	53,14,053	1,91,88,198	1,32,08,426	13,96,86,282	9,04,10,783
Repairs & Maintenance	30,82,198	44,02,493	3,58,729	6,33,452	-	-	34,40,927	50,35,945
Fabrication and installation	-	-	-	-	7,73,431	-	7,73,431	-
TOTAL	13,22,24,334	10,48,68,179	4,87,14,053	2,60,64,015	3,76,76,636	4,20,30,208	21,86,15,023	17,29,62,402

SCHEDULE 19 DEPRECIATION ON FIXED ASSETS

PARTICULARS	MUMBAI		CHENNAI		KOLKATA		TOTAL	
	2012-13 ₹	2011-12 ₹	2012-13 ₹	2011-12 ₹	2012-13 ₹	2011-12 ₹	2012-13 ₹	2011-12 ₹
For the year :								
Depreciation on Fixed Assets	4,97,96,601	2,86,62,957	2,35,00,450	2,83,83,726	70,308,499	2,83,56,501	143,605,550	8,54,03,184
Depreciation on Projects Assets	1,87,41,089	4,63,47,899	1,34,78,411	1,16,36,540	434,116	3,91,52,316	32,653,616	9,71,36,755
Total	6,85,37,690	7,50,10,856	3,69,78,861	4,00,20,266	7,07,42,615	6,75,08,817	176,259,166	18,25,39,940
Cumulative :								
Depreciation on Fixed Assets	38,09,99,802	33,12,03,201	25,92,53,737	23,57,53,288	230,022,782	12,09,66,659	870,276,321	68,79,23,148
Depreciation on Projects Assets	52,49,07,640	50,61,66,552	12,39,40,204	11,04,61,792	1,738,603	4,00,52,111	650,586,447	65,66,80,456
TOTAL	90,59,07,442	83,73,69,753	38,31,93,941	34,62,15,080	23,17,61,385	16,10,18,770	1,520,862,768	1,34,46,03,603

SCHEDULE 20

SCHEDULE FORMING PART OF THE BALANCE SHEET AS ON 31ST MARCH 2013 AND THE INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDED ON THAT DATE

SIGNIFICANT ACCOUNTING POLICIES AND NOTES TO ACCOUNTS

1. SIGNIFICANT ACCOUNTING POLICIES

(i) Accounting Convention

The financial statements are prepared under the historical cost convention. The Society follows the mercantile system of accounting and recognizes income and expenditure on the accrual basis except Insurance Claims, which are accounted on receipt basis and Bonus, Gratuity, Leave Encashment, and Leave Travel Concession (LTC), which are accounted on actual payment basis.

(ii) Fixed Assets

Fixed assets are created out of funds received from Ministry of Communication, Information & Technology (MCIT) / Surplus lying in Income & Expenditure Account. Fixed Assets are stated at original cost less accumulated depreciation. Assets created out of funds received from project sponsors are shown as 'Sponsored Project Assets'. Depreciation for the year is recouped from Capital Funds A/c.

The opening balance of fixed assets, which is classified as equipment is inclusive of computer equipment. Such classification was necessitated due to difficulty in detailed categorization in earlier years considering that some of these assets are more than 20 years old.

(iii) Depreciation

In terms of Notification 10(1)/2000-Fin-II dated 25/01/2002 issued by MCIT, the Society has provided for depreciation on fixed assets.

Fixed assets are depreciated using straight line method over the useful lives of assets. Depreciation on additions is charged for the full year as per rates given below:

Particulars	Rate of depreciation %
Laboratory & Office Building	10.00
Residential Flats	5.00
Furniture & Fixtures	10.00
Equipments	15.00
Computer & Peripherals	60.00
Motor Vehicle	15.00
Library Books	25.00
Other Equipments	15.00

Depreciation is charged to Capital Fund, since grant amount utilized for acquiring fixed assets is credited to Capital Fund.

(i)

Foreign Currency Transactions

Transactions in foreign currency are recorded in rupees by applying the exchange rates on the date of the transaction. Gains or Losses on settlement of the transactions are recognized in the Income & Expenditure account.

At the Balance Sheet date, monetary assets and liabilities denominated in foreign currency are translated at the exchange rate prevalent at the date of the balance sheet. The resulting difference is also recorded in the Income and Expenditure account.

(ii)

Components & Consumables

Components & Consumables are treated as consumed in the year of purchase, since the management considers these as low value items.

(iii)

Retirement Benefits

Contribution to Provident Fund is charged to revenue. Provision for retirement benefit, viz., Pension Fund has been made on ad hoc basis, pending valuation of the same by an independent actuary. Payment of gratuity and leave encashment is accounted on cash basis.

(iv)

Research and Development Expenditure

The main objective of the Society is to contribute to the growth of science and technology of microwave electronics and allied areas through intensive research, design, development, training of manpower and setting up of facilities for national progress.

Out of expenses incurred by the Society in the nature of Research and Development, revenue expenditure is charged to the Income & Expenditure Account (except otherwise mentioned in the notes elsewhere) and capital expenditure is added to the cost of Fixed Assets in the year in which it is incurred.

(v)

Treatment of Grant Received from Ministry of Communication, Information & Technology (MCIT) Out of the total grant received from MCIT, to the extent assets are created out of the grant, the same is treated as Capital Fund and the balance amount of Grant is treated as revenue income of the year.

(vi)

Treatment of Funds received from Sponsors of the projects and Expenditure on Projects Funds received from sponsors of the projects are treated as sponsored project funds. Revenue expenditure relating to projects is reduced from sponsored project fund and net balance is carried forward in the accounts.

Advance paid to Co-agencies for executing projects are shown under sponsor project funds. On completion of a project, the advance paid to co-agencies are booked as revenue or capital expenditure.

Revenue expenditure is charged at actual incurred on the projects, and/or as identified by the management, except in respect of 'Overheads' which are included under Administrative Expenses, which are allocated as mutually agreed upon as per the terms of contract with the project sponsoring institutions.

(vii)

Revenue recognition

Revenue from Annual Maintenance Contracts and certain Testing Charges is accounted on confirmed closure of the entire project. Insurance claims received are accounted on cash basis.

(viii)

Taxation

The Society is registered u/s 12A (a) of the Income Tax Act, with the Income Tax Authorities. Provision for income tax liability, if any, is made in accordance with the applicable provisions of the Income Tax Act, 1961.

2. NOTES TO ACCOUNTS

- (a) Estimated amount of Capital Commitments not provided for is ` 2,303,597/- (Previous year ` 10,594,565/-)
- (b) i. Estimated amount of Contingent Liability for letter of credit outstanding ` 19,571,042/- (P. Y. ` 23,224,422/-)
- ii. In the assessment for A.Y. 2008 2009 the Assessing Officer (A.O.) has taken the view that Depreciation cannot be claimed on all those Assets on which exemption under Section 11 of the Income Tax Act 1961 is allowed as application of Income. SAMEER disputed this view before the CIT(A) and succeeded based on the view taken by the Honorable High Courts on similar issues in other cases. The Income Tax Department has filed an appeal before the Income Tax Appellate Tribunal against the Order of CIT(A) for A.Y. 2008 2009 which has been decided in favour of SAMEER.
- (c) Insurance coverage has not been taken for building, equipments and other Fixed Assets.
- (d) The surplus/ (deficit) of Sponsored Projects is being recognized as income/expenditure by the Society, in the year of completion of the project. The Income & Expenditure Account includes net Surplus of ` 24,316,991/-(Previous Year- Surplus of ` 545,996/-) of the projects completed / closed during the year. Detail breakup is given below :

	Rupees (₹)
Surplus (Gross)	24,379,006
Deficit (Gross)	-62,015
Net	24,316,991

- (e) No provision has been made for gratuity and leave encashment as on March 31, 2013 as stipulated under AS-15 Employee Benefits.
- (f) During the year, the Society has provided ` 11,000,000/- (Mumbai ` 8,000,000/- Chennai ` 2,000,000 and Kolkata ` 1,000,000/-) [Previous year ` 13,000,000/- (Mumbai ` 8,000,000/-, Chennai ` 4,000,000 and Kolkata ` 1,000,000/-)] on adhoc basis towards its pension liability.
- The provision is made for pension liability and deposited into a separate bank account. SAMEER has initiated action for the process of identifying a suitable agency as per government norms for managing the pension fund. Pension liability is grouped under Current Liabilities and Investments in Fixed Deposits is grouped under Cash and Bank Balances.
- (g) The Society's Council met once during the year, on 1st November, 2012. However, for urgent items of decisions, approvals are sought by circular sent to the council members.
- (h) During the year society has received ` 439,400,000/- (previous year ` 439,400,000/-) and ` 17,700,000 towards NER Projects as grant from MCIT. Of the above, ` 73,195,753/- (Previous year ` 92,428,099/-) is credited to Capital Fund, since it is utilized for acquisition of fixed assets, ` 17,700,000 has been transferred to Sponsored Project Fund and the balance sum of ` 366,204,247/- (Previous year ` 346,971,901/-) is credited to Income & Expenditure account.

- (i) Service Tax Returns from 2007 onwards have not been filed by SAMEER Kolkata Centre pending on line registration for which an application has been submitted to the Service Tax Authorities.
- (j) Bad Debts of ` 28 Lakhs is on account of erroneous billing for DRDL Projects done in the previous years which is not recoverable.
- (k) Sundry debtors, loans and advances, sundry creditors are subject to confirmation and subsequent reconciliations, if any. Management has scrutinized / reviewed the balances of all debtors and advances and initiated necessary action for recovery and write off.
- (l) Figures of previous year have been regrouped / rearranged wherever necessary, to make them comparable with the current year's figures.

As per our Report of even date attached

For **SORAB S. ENGINEER & CO.**
Chartered Accountants
Firm Registration No. 110417W

CA N. D. ANKLESARIA
PARTNER

Mumbai
Dated :07.10.2013

For **SOCIETY OF APPLIED MICROWAVE
ELECTRONICS ENGINEERING & RESEARCH**

RAJESH HARSH
HEAD, F & A

AMOL BHAGWAT
REGISTRAR

DR. A. L. DAS
DIRECTOR

RECEIPT AND PAYMENT FOR THE YEAR ENDED 31ST MARCH 2013

RECEIPTS	March 31, 2013 ₹	March 31, 2012 ₹	PAYMENTS	March 31, 2013	March 31, 2012 ₹
I. Opening Balances			I. Expenses		
a) Cash in hand	27,789	44,690	a) Establishment expenses	293,059,767	274,619,579
b) Bank balances			b) Administrative expenses	131,755,533	122,953,602
i) In Current accounts	13,724,615	22,012,548	II. Payments made against Project expenses	32,762,482	33,774,597
ii) In deposit accounts	1,272,610,064	1,206,742,134	III. Acquisition of Fixed Assets	93,626,758	29,820,214
iii) In saving accounts	57,665,463	39,141,994	IV. Other payments		
iv) FDR against bank guarantee	64,192,600	60,007,568	a) Advances and deposits	118,567,672	97,261,950
II. Grants received from MCIT, GoI.	457,100,000	439,400,00	b) Sundry Creditors	106,610,909	98,687,454
III Test & Consultancy charges	47,164,079	33,095,107	V. Closing Balances		
IV. Receipts from Sponsored Projects	199,664,436	105,302,360	a) Cash in hand	34,155	27,789
V. Other Receipts			b) Bank balances		
a) Interest on deposits with Banks	109,940,244	72,215,698	i) In Current accounts	35,130,458	13,724,615
b) Miscellaneous receipts	6,211,930	19,062,295	ii) In deposit accounts	1,346,443,891	1,272,610,064
c) Earnest Money Deposit	987,000	2,491,820	iii) In saving accounts	29,647,150	57,665,463
d) IT Refund			iv) FDR against bank guarantee	83,558,474	64,192,600
e) Advances and deposits	41,909,023	65,821,713			
TOTAL	2,271,197,243	2,065,337,927	TOTAL	2,271,197,243	2,065,337,927

SAMEER - Mumbai

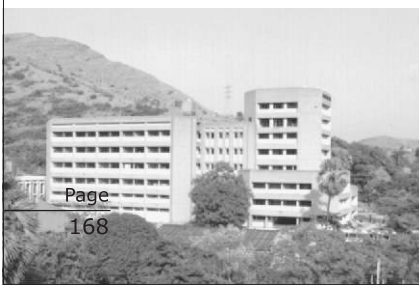
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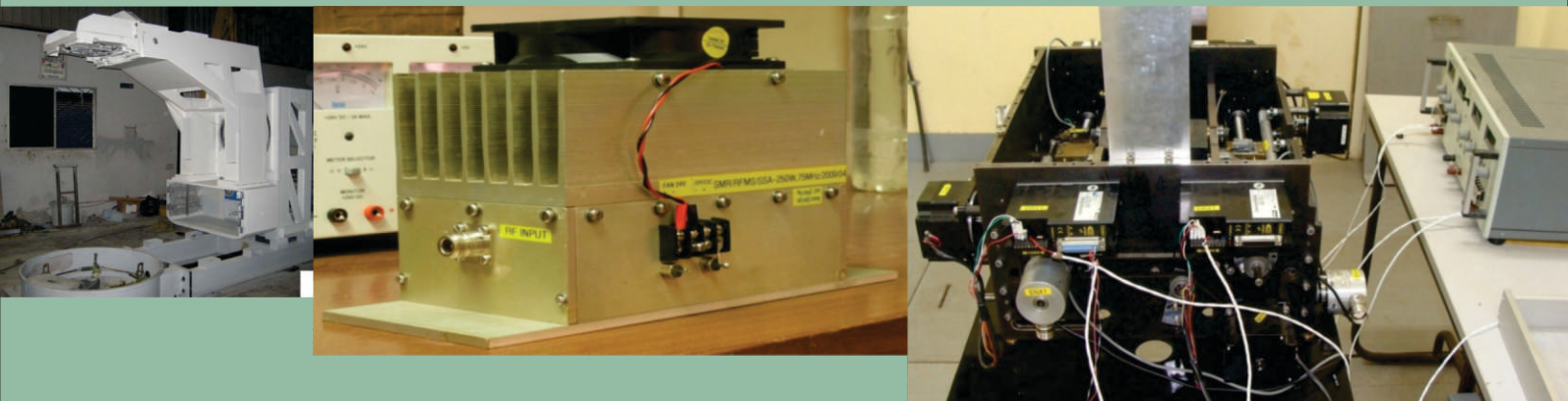
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