



SAMEER

Passion for performance

SAMEER

Society for Applied Microwave Electronics Engineering & Research

Annual Report 2013-14

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

Society for Applied Microwave Electronics Engineering & Research

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(2013-2014)

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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.

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 2013-14. During this period, SAMEER has carried out a number of core and sponsored projects - a total of twenty six core projects and thirty projects sponsored by our parent department DeitY as well as other R & D departments of Govt. of India. The projects are in the core areas of expertise such as Linear Accelerator (Linac), RF/Microwave/Millimeter wave technologies, Atmospheric and radar based instrumentation, communications, photonics, digital Signal processing, antennas and EMI/EMC. Projects in new areas such as Terahertz, Meta-material and MMICs have also been taken up keeping pace with the technology trends.

Important milestones have been achieved with the successful commissioning of a medical linear accelerator (LINAC) system at the Indian Institute of Head & Neck Oncology hospital, Indore for radio-therapy treatment of cancer patients and signing of an agreement with a private company for transfer of technology of the medical LINAC machine by SAMEER. This TOT is expected to give big boost to indigenous manufacturing of medical LINAC machines and provide radiotherapy treatment to cancer patients in the country. A Multi -Leaf Collimator (MLC) has also been developed for shaping of the X-Ray beam produced by LINAC System for precise treatment of cancerous tumor. Important project proposals are being formulated to meet immediate and long term needs for critical medical applications. These include development of MRI machine and high energy linear accelerator for generation of Technetium (Tc) 99 for medical imaging.

Important projects in atmospheric instrumentation development are continuing for a Ka- band cloud radar for Ministry of Earth Sciences (MOES) and a Stratospheric-Tropospheric (ST) radar to be commissioned at Gauhati University. Apart from these, SAMEER has installed a number of SODARs at user sites for environment monitoring.

Significant contribution has been made in the field of communications and digital signal processing. As part of the indigenous effort, two fire control systems for GRSE and MDL class of ships have been designed, developed and delivered after necessary environmental qualifications to OFB for end use by Indian Navy. One more FCS system is under development for Fincanterie ship. SAMEER shall support manufacturing of additional quantities of FCS system by transferring knowhow to production agencies to meet quantity requirements.

In millimeter wave technology, SAMEER has maintained the lead by design and engineering of various millimeter wave components. Fully engineered versions of transceiver for tracking radar have been delivered to user agency after thorough test and evaluation. This has elevated the confidence level of the user agency with SAMEER. This development is now leading to its adaptation to other similar applications with suitable changes in system specifications. SAMEER is now poised to take up further technologically challenging projects and get involved in strategic innovation and development for strategic applications. Based on the need for strategic requirements for microwave and millimeter wave sensors and systems, a proposal is under active consideration for augmenting the existing Millimeter Wave Laboratory as a centre of excellence in millimeter wave sensors and systems.

Realizing the advantages and importance of MMICs in electronics circuits, several MMICs such as mixer, fast response (10nsec) switches, higher order(2nd-4th)millimeter wave frequency multipliers, VCO, wide band LNA, medium power amplifier up to 60 GHz frequency have been taken up for development. These have been successfully designed and fabricated using fab facility abroad. This activity will be continued to meet future system requirements.

With the building of core expertise in varieties of antennas in microwave and millimeter wave frequencies, it has become possible to meet many customized

antenna requirements of user agencies for ground and airborne applications. The compact antenna test range facility available in SAMEER has provided very important support of test and evaluation in the development phase. This has resulted in successful development and deployment of many customized antennas in crucial strategic applications.

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. A significant step had been taken with the approval of a project to establish an Electromagnetic Environmental Effects (E3) laboratory at Visakhapatnam to meet the MIL STD EMI/EMC/EMP requirements of the strategic Departments.

SAMEER has been working on wide range of technologies, all needed for civilian and strategic departments. We constantly put effort to start initiatives in new technologies having direct relevance to our country and start working in the new directions. This important aspect provides growth path to SAMEER enabling the organization to contribute significantly to the growth of the nation. A proposal is being considered for setting up a laboratory to work on Microwave Tubes and high power components at IIT Guwahati in order to meet national requirements.

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 the Department of Electronics and Information Technology and confidence enjoyed by SAMEER from other Government Departments, SAMEER will continue its journey to contribute significantly in critical technology areas and also 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 institution 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 and 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 (LINAC), Atmospheric instrumentation, Photonics, Radars for various applications, RF/Microwave industrial systems and EMI EMC. Under the Jai Vigyan program, SAMEER has developed and commissioned a 6 MV LINAC Machine at IIHNO, Indore for cancer therapy. New advanced LINAC machine with variable photon as well as multiple electron energies is 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 atmospheric radars have been developed. Developments of a ST radar project for North East Region and a Polarimetric Doppler Radar for Cloud Profiling at Ka band for Ministry of Earth Science are going on at present.

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. It is also involved in sponsored projects in the areas of RF communications, DSP, Microwave antennas and Electronics packaging.

The Centre at Kolkata specializes in the areas of Antennas, Microwave 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 and a Compact Antenna Test Range (CATR) for evaluation of antennas and radomes for Government organizations and private industries.

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 • EMI/EMC <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 • NABL accredited EMC equipment calibration cell • Electronics Design Centre | <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 • 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 Radar 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 photonics components.

One of the important work areas at this center is Linear accelerator technology which finds application in cancer radiation therapy. One machine has been commissioned at the Indian Institute of Head & Neck Oncology Hospital, Indore and is operational now. An advanced version of Medical LINAC viz. Dual Photon energy and multiple electron energy medical LINAC is being developed at this centre. Multi-leaf collimator, a very important attachment of all modern LINAC has been successfully developed.

Atmospheric instrumentation is another major area of expertise in SAMEER. Atmospheric radars which are basically clear air Doppler radars, are 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 (ST) Radar and is being developed at this center. The ST radar will be developed with a state-of-the-art active aperture technology and installed at Gauhati University to study the

weather patterns which are specific to the topography of that region. Through an in-house core R&D programme, low power cloud radar was developed as a technology demonstrator. Based on the confidence and success of this core R&D project, a sponsored project for development of Ka band Cloud radar has been sanctioned by Ministry of Earth Sciences and is presently progressing.

This center has developed special infrastructure for integrated optics and photonics which has enabled development of 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 development-. The centre also has a NABL accredited EMI/EMC laboratory for offering test, measurement and consultancy services to industries.

RESEARCH AND DEVELOPMENT ACTIVITIES

Linear Accelerator Technology

MEDICAL ELECTRONICS DIVISION -1

Development of Dual photon and multiple electron energy medical LINAC

SAMEER is developing state-of-the-art dual photon energy and multiple

electron energy integrated oncology system with funding from DeitY. Generally, deep-rooted tumors are treated with photons of different energy, whereas electron beams are used for superficially located cancer. The project is in advanced stage of implementation. During this year, fabrication and testing of Stand and Gantry, Field optics, Water circulation system, Patient Support Assembly sub-systems have been completed.. Development of other subsystems like Beam bending subsystem, accelerating structure, Range finder, Multi Leaf Collimator etc are in progress. The iso-centre verification of the gantry has been completed with load. The alignment of beam bending magnet with LINAC yoke sub-assembly has been completed. The population of Gantry is in progress. The design and fabrication of control PCBs is completed. Development of software codes for various sub-assemblies like Gantry movement, target movement, carousel, PSA etc. is completed. Development of Graphical User Interface (GUI) is nearing completion.



Beam Bending Magnet Sub-system



Gantry and Stand sub-system

MEDICAL ELECTRONICS DIVISION

Development and Deployment of 6 MV Medical LINAC:

Under the National Jai-Vigyan mission program Phase II sponsored by DeitY, four Medical Linacs are to be developed and deployed at four hospitals. First unit of 6 MV Medical Linac SIDDHARTH-3 at IIHNO, Rau, Indore has been commissioned. The QA and Acceptance tests have been completed and submitted to Atomic Energy Regulatory Board (AERB), Mumbai. After clearance by AERB, the linac system is now operational and is being used for patient treatment. The next three units of 6 MV Medical Linac are fully tested for non-radiation tests and will be commissioned at user sites upon receiving confirmation of site readiness from the users.



**6 MV Linac "SIDDHARTH" at Indian Institute
of Head & Neck Oncology, Rau, Indore**

ii. Transfer of Technology (TOT) of 6 MV Medical LINAC

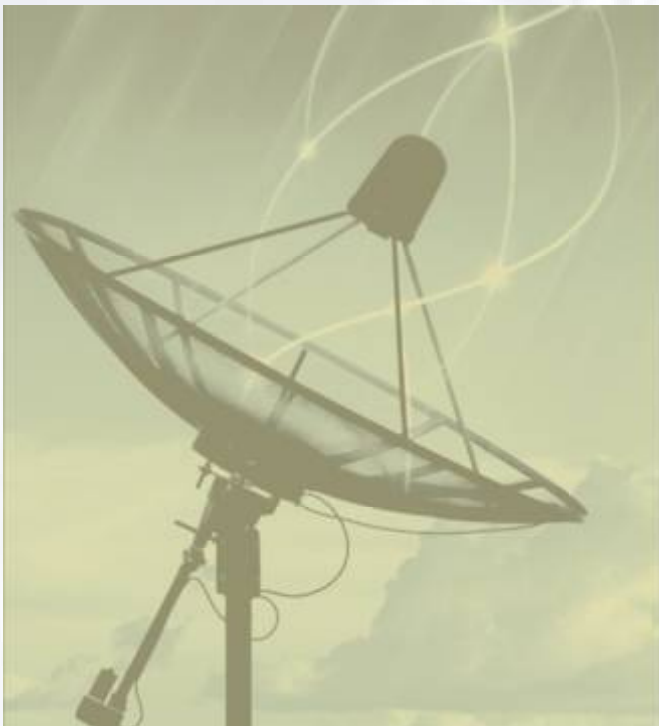
A ToT agreement was signed between SAMEER & M/s. Panacea Medical Technologies Pvt. Ltd; Bengaluru for transfer of technology of 6MV Medical LINAC on non-exclusive basis. The LINAC tube will be sourced from SAMEER and rest of the system is covered under the ToT agreement. The ToT will be done in three phases and the first phase of documentation and in-house training is nearing completion. About 3000 pages of documents related to mechanical and electrical engineering work in the system has already been delivered to the grantee. Two training sessions have been completed till date. In the second phase of TOT, two units of SIDDHARTH will be made by grantee under the guidance of SAMEER Scientists.

ATMOSPHERIC RADAR AND INSTRUMENTATION DIVISION (ARID)

Atmospheric Radar and Instrumentation Division (ARI Division) develops state-of-the-art systems required for atmospheric research by Indian atmospheric and meteorological scientists. Turn-key radar systems development from design, fabrication, testing, commissioning on site and supporting through maintenance is pursued in the ARI Division.

List of ongoing Projects in the financial year 2013-2014 is given below :

I DSP(H/W and S/W) & TSG, data processing software, Exciter



sub-system, Synch Buffer & Control Signal Distribution for 212 MHz Active Aperture ST radar.

- ii. Development of Ka-band Polarimetric Doppler Radar for cloud Profiling.
- iii. Microwave Radiometer System for temperature and humidity profiling of Troposphere.
- iv. Establishment of Phased Array SODAR to study the atmospheric phenomena in the lower atmospheric boundary layer in Silchar, Assam .
- v. Transportable Phased Array Doppler SODAR for weather related Studies for IMD Delhi.

Activities carried out for the above projects are stated below:

Core R&D Program

Microwave Radiometer System for temperature and humidity profiling of Troposphere

Under the core project, this division has undertaken development of a ground based multi-frequency microwave radiometer for Troposphere profiling of temperature and humidity profiling. This radiometer measures the amount of water vapour and temperature aloft by monitoring the microwave sky brightness temperature in 20-30 GHz and 50-60 GHz band. Forward model development completed. One research paper has been accepted for publication in journal. K band components procured and tested. V-Band components are being procured. The algorithm development for basic inversion problem using neural network is in progress. cRIO based data acquisition and control system development is in progress.

Sponsored Projects

System hardware for ST Radar at Gauhati University

This division is involved in the development of DSP hardware and software, data processing, digital receiver, algorithm development, GUI, data display, generation of timing signals and its distribution, exciter sub-system, synch buffer and its distribution. Following work has been completed under this project:

- I. Five numbers of Distributed CAN Controllers (DCC) are assembled, interfaced and tested.
- II. Nine numbers of 1:16 way, sixteen numbers of 1:9 way and one number of 1:4 way Sync buffer assembled and tested. To test for long distance, these were tested with 35 meters long cable length. All tests were found to be OK.
- III. A unit consisting of one Distributed CAN controller, one 1:16 Sync. Buffer and one 1:9 Sync. Buffer has been fabricated, assembled and tested. This has been developed to test a small array of 4x4 antennas to be installed at SAMEER campus.
- IV. Integration of all components comprising the Exciter sub-system has been completed. Measurement has been done and it meets the system requirements.
- V. Digital receiver Hardware has been configured. Most of the signal processing and data processing modules are completed.

Development of Ka-band Polarimetric Doppler Radar for Cloud Profiling

Based on the experience of development of "zenith looking 35.6 GHz Pulsed Doppler Polarimetric Radar prototype system for cloud profiling" under core programme, a project proposal has been sanctioned by MoES in February 2013 with project outlay of Rs. 780.6 lakhs and project duration of 3 years for development of similar system with high power transmitter, scanning antenna and

transportable capability.

The following work has been completed:

- i) Overall system design was carried out and a Preliminary Design Document (Document No.: SMR/ARID/CPR/MoES/07-2013/15) was prepared and submitted to MoES in the month of July 2013.
- ii) Preliminary Design Review was conducted in the month of August 2013 by a Standing Committee formed by MoES for monitoring of the project. Committee chairman was Prof P. R. Mahapatra, IISc Bangalore and Dr. P. S. Goel (ex secretary MoES) attended as special invitee. Overall System and sub-system design was critically reviewed by the members. PDR report was well appreciated and the committee expressed high satisfaction on the progress of the project.
- iii) Technical specifications of various components and sub-systems have been worked out. Procurement action for all the RF and Ka-band components has been initiated.

Establishment of Phased Array SODAR to study the atmospheric phenomena in the lower atmospheric boundary layer in Silchar (Assam) region.

The specially designed SODAR for

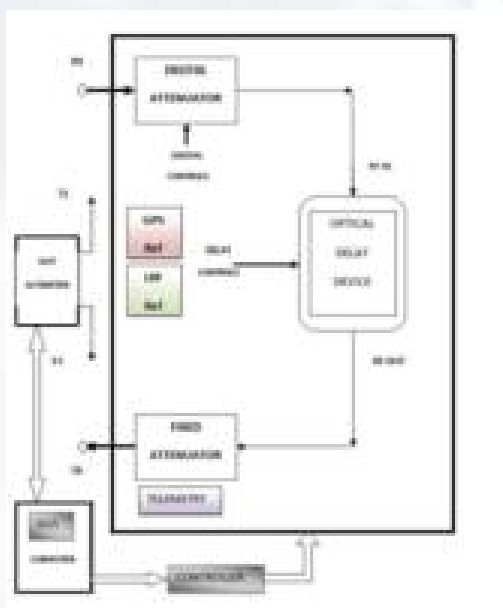
wind flow and turbulence studies would help the understanding of the atmospheric boundary layer at Silchar region of NE India. SODAR will help to understand the air pollution, fog, gravity waves, atmospheric flow and energy exchange in the region. The project was started during October 2013 and project duration is two years. This SODAR can be next converted into SODAR network which may be later expanded into full weather system network along with other existing weather systems in that region and may help in the regional weather forecasting, aviation and air pollution studies.

Portable Phased Array SODAR for weather related Studies for IMD

The system was integrated and tested at SAMEER Campus for its operational use during March 2013. Subsequently, the system was dismantled and has been transported to IMD Kolkata. Appropriate vehicle was identified and the vehicle has been procured in the month of March 2014 at IMD Kolkata. Assembly of the system on the vehicle (to make it portable) will be done at IMD Kolkata in the month of April/May 2014.

RADAR DIVISION

This division has developed expertise in FMCW radar and is working on its applications as altimeter and height sensing device based on sponsored projects.



Architecture of the ARM System

Core R&D program

Altimeter Range Measurement System (ARMS)

The Altimeter Range Measurement System has been successfully developed by SAMEER to characterize radar based altimeters and generic radars. The ARMS can be used as a RF range test bench for static simulation and calibration. Port-to-Port mode is set as default, however radiated mode is also possible. For field evaluation, a GPS receiver for data tagging and a Duplex RF Modem have been integrated and tested. The operating range of ARMS is 20-6000 meters over 2-18 GHz and typical accuracy is 1%. The ARMS is successfully deployed for ATP for Environmental Testing for the users.

Synthetic Aperture Radar (SAR) at X band

The hardware development for the FMCW based micro-SAR imaging radar was taken up as a demonstrator for this area of technology. As of date the FMCW micro-SAR has been successfully developed and demonstrated in the field using a stepper motor controlled moving platform on a Rail. The demonstration of the radar flying on a UAV will be scheduled based on availability of UAV. This project has been undertaken to develop technology for ground imaging by unmanned aerial vehicle. A planar microstrip array antenna with low side lobe level was achieved as per the SAR specs. Also a 1 Watt DDS based RF Transceiver and a FPGA based data



User Interface for ARMS & DUT Control

acquisition and memory card with off-line image processing was developed to meet the system requirements. The project is a joint activity with Defence Institute of Advanced Technology, Pune. Range Resolution of 84 cms and Azimuth Resolution of 14 cms has been successfully demonstrated during the Rail Experiment with scaled down range and platform speed. Combination of the compactness of FMCW technology and high resolution of SAR systems has been demonstrated which has led to small and cost effective imaging radar.



FMCW SAR hardware at X-band



FMCW SAR experimental Set-up motorised rail

RF/ MICROWAVE SYSTEMS (RFMS) DIVISION

RFMS Division continued working in core area of SAMEER, i.e., high power systems, ST Radar, antennas and industrial microwave systems. Both core R&D projects and sponsored projects are implemented in the division. These activities are listed as follows.

Core R&D Program

Implementation of an Active Aperture Wind Profiler

A small 4x4 active aperture with 16 Yagi-Uda antenna element fed individually by TR Module with complete Radar sub-systems is being designed, developed to demonstrate active aperture concept. A 4x4 array of Yagi Uda antennas has been installed in SAMEER and is being characterized for active and passive impedance and radiation pattern in near field. A 400 W TR module, signal processing card and digital receiver has been developed, which are being tested. After getting frequency (212 + 2 MHz) clearance for Mumbai in last week of January, 2014, significant development and testing has been made.

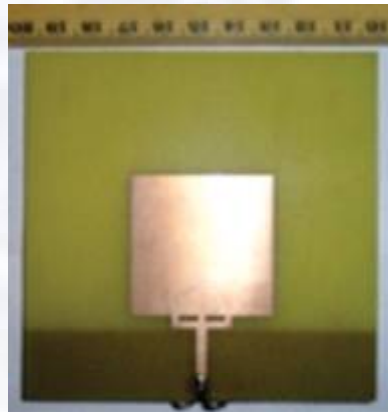
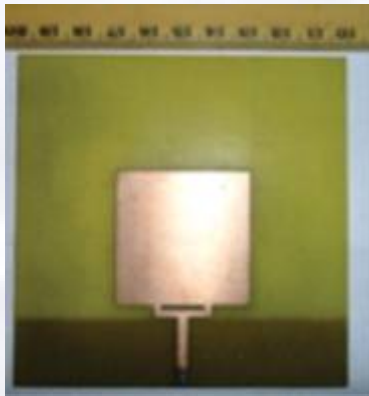
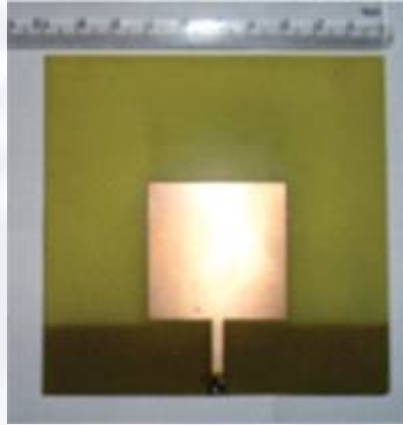
WB Planar Monopole Antenna

The aim of this project is design and development of novel UWB printed monopole antennas and generation of technology/knowhow. Various UWB antennas have been conceived, developed and tested. Following UWB antennas have been developed this year:

a. Sectoral Printed monopole antennas with ultra wide bandwidth and dual polarization.

b. Broadband Rectangular Monopole Antenna Configurations.

High Power Solid State Amplifier/Transmitter



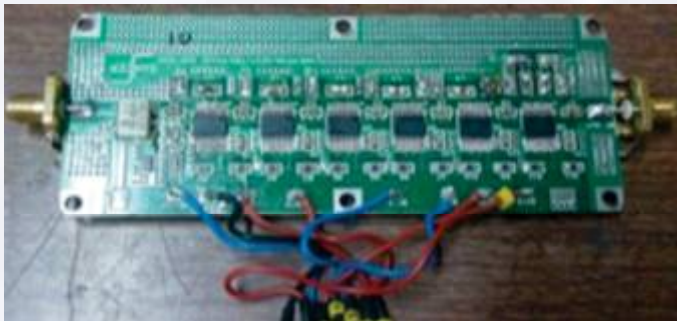
Sectoral Printed Monopole Antenna, Single, dual and triple feed Rectangular Monopole

The aim of this project is to develop high power Solid State Amplifiers so that tube driver amplifiers could be replaced by SSA. SSA upto 1 kW CW has been tested at 37.8 MHz and 500W pulse power has been tested at 400 MHz band. Now, development of Solid State Amplifiers at 1.3GHz frequency with CW power outputs 2W, 10W, 100 W and 250W has been initiated. Design has been finalized, RF devices have been identified and procurement has been completed.

Sponsored Projects

Design, Development and Installation of Stratosphere Troposphere (ST) Radar at Gauhati University for North-East Region

A high resolution VHF Stratosphere-Troposphere (ST) Radar with state of technology of active aperture to be installed at Gauhati University, Guwahati for North East region for better understanding of national atmospheric/climatic conditions. All the



Lumped element Six Bit phase shifter developed for TR module for ST Radar



Six Bit Microstrip phase shifter developed for ST Radar



FPGA based TR module controller for ST Radar

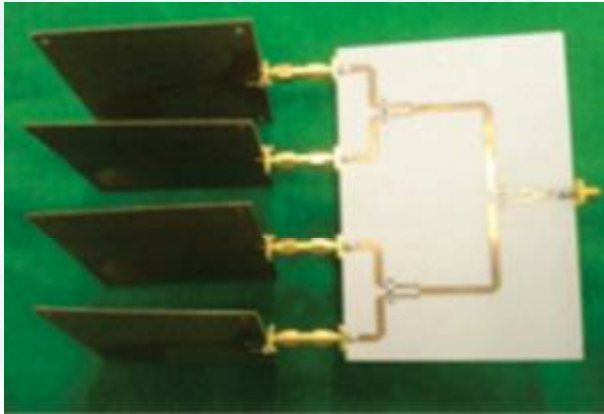
subsystems of this radar has been successfully developed. Many components have been indigenously designed and developed. Now batch fabrication of these subsystems is being carried out.

Design and development of Antennas for shared aperture (shape) applications

There is an increasing trend in communication or defense systems towards using a single antenna for multiple functions. Since space, weight, and antenna seating 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 and an ensemble of independent systems are favorable for the shared aperture systems. A feasibility study report for studying the feasibility of applying the Shared Aperture architecture to various platforms has been completed. A stacked four element Antipodal Vivaldi Antenna Array in combination with modified Wilkinson four-way power divider feeding network has been realized for possible EW applications as part of the project. Design Analysis Report is generated. The measured and simulated results agree well. This wide band Antenna can be used in a shared array configuration for sharing the antenna for various EW and CNI functions. The project is successfully completed.

Conformal V/UHF Antenna for Airborne Applications



element Antipodal Vivaldi array for EW/CNI applications

The design and development of airborne V/UHF conformal antenna has been undertaken. This antenna will meet all the pattern coverage requirements and will be qualified for structural and environmental tests. The design and electrical qualification of the antenna is completed. The environmental testing as per MIL Spec 810F is in progress.

6KW Microwave Source for Processing of Metal Nitrate Solution

This project, sponsored by a Govt Department, needs development of two sources each having a capacity to generate 3 kW CW/ Pulsed power at 2.45GHz along with applicator and automatic closed loop temperature control based on PID temperature controller and infrared temperature sensor. Development of sources is nearing completion. Applicator design is being finalized.

Development of High Power Transmitter:

A new development of 30 kW high power amplifier at 75 MHz frequency has been undertaken. All the subsystems required for

this unit has been developed. High Power Amplifier section is being redesigned to obtain desired frequency.

Data link Antennas for Aircraft

A feasibility study for design and development of data link antennas for aircraft has been initiated. A couple of antennas will also be fabricated and tested.

PHOTONICS DIVISION

R&D activities of the division are in the areas of Direct Optical waveguide writing, Fiber pigtail, of Integrated Optic devices and packaging, Optical gas sensor modules, growth of Quantum wells and Dots, Development of Optical Coherence Tomography, Development of wireless Communications using Tera Hertz Technology, Application of TeraHertz Technology for Imaging and spectroscopy.

Core R&D Program

The progress made in the core activities of the division is as follows:

Direct writing of optical devices using femtosecond laser

Femto-second laser based optical device writing system has been integrated and is being used for writing waveguide devices. Planar 1x2, 1x4 splitters have been written in BK7 glass. Experiments are in progress to make waveguide in Erbium doped glass for optical amplifier.

Development of Terahertz technology for imaging and spectroscopy

Terahertz generation using tunable lasers and femtosecond laser has been often reported in literature. A laboratory setup has been made for generation and detection of THz radiation using tunable lasers. Computer interface has been developed for remote operation of lasers for spectroscopy application. THz imaging setup is also made by introducing micro-positioner in the path of THz radiation. Further experiments are in progress.

Development of high resolution imaging

system using spectral domain-optical coherence tomography (SD-OCT)

OCT is an optical interferometer technique that acquires depth resolved images in scattering media such as biological samples in both 2D & 3D. Spectral Domain-OCT (SD-OCT) 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. Components like source, detector, and scanner were procured and characterized. Development of signal and image processing modules and experiments to generate OCT signal are in progress.

Development of GaAs based Quantum infrared Detectors in the transmission window of 8-12 microns

Quantum Well / Dot Infrared Detectors are made from semiconductor materials like Gallium Arsenide, Indium Gallium Arsenide etc. An array of these detectors together with optics and electronics would constitute Infrared Camera used for thermography. Synthesis of single layer and multi layers of INAs/GaAs quantum dots were successfully done using Molecular Beam Epitaxy (MBE) system and characterized with the facilities (SEM, HRXRD, AFM and PL) available at TIFR, IIT Bombay and Mumbai University.

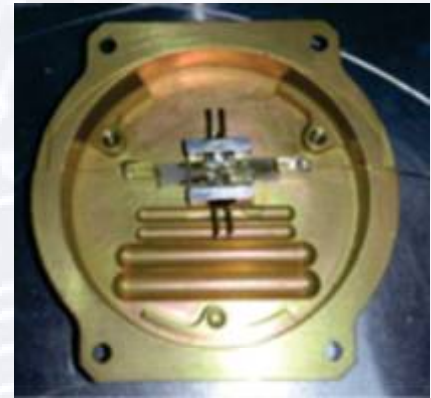
Growth of III-V Multi-Junctions by Molecular Beam Epitaxy

Molecular Beam Epitaxy (MBE) system is being used for growing of Semiconductor multi-junctions. The multi-junction technology has application in Photovoltaic devices having higher efficiencies, because less energetic photons pass through the upper layer(s) and get absorbed by lower layer, which increases the overall efficiency of photon absorption. MBE Ion pump was augmented and Silicon dopant cell was replaced. The structures of AlGaAs with varying Al concentrations have been synthesized and characterized by HRXRD. N type and P type doping runs for calibration were performed and dopant evaluation by SIMS is to be undertaken.

Sponsored Projects

Packaging of integrated optic gyro chip inside optical assembly mount of fiber optic gyroscope

Integrated optic gyro chips were packaged inside two inch diameter optical assembly mount. The device consists of a Y-branch splitter with phase modulator on each arm. Precision optical interconnection between waveguides and fiber was carried out to make low insertion loss device. The packaged gyro chips were delivered to user agency.



Packaged integrated optic gyro chip

Development of IR Laser absorption based gas sensor

A Lab prototype gas sensor is made with associated electronics for data acquisition. The sensing module for trace detection of Carbon monoxide (CO) includes a temperature controlled Quantum Cascade Laser (QCL) operating at 4.6 micron wavelength and a Multi-pass gas cell. This sensor would find application in Environmental monitoring. BEL, Pune is associated as an Industry partner.

Development of Broadband Wireless Communication system using Terahertz Technology

Terahertz wireless communication is an upcoming field. Technology survey was carried out to understand the challenges and opportunities in this field. Procurement of equipment and consumables has been initiated and some items received. System design for THz generation and detection has been finalized.



Lab Prototype for traces gas detection using multi pass gas cell

GYROTRON AND SYSTEMS DIVISION

After formation of the Gyrotron & Systems Division at SAMEER in 2011, the scope of the work has expanded many folds. Most of the important components of a gyrotron system are presently under the purview of this division.

Core R & D Program

Development of Sub-systems for Gyrotron

This project started in April 2012 with the objective to develop the important sub-systems for a 28 GHz, 10kW gyrotron. As the designs of the gyrotron sub-systems are interdependent, it is becoming imperative to design all the sub-systems for the gyrotron in order to develop the deliverables, namely Cathode, MIG and QOMC. During this period, electrical designs of the MIG, cavity and window have been perfected. In addition, work has also started on quasi-optical mode converter and depressed collector.

Sponsored Project

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

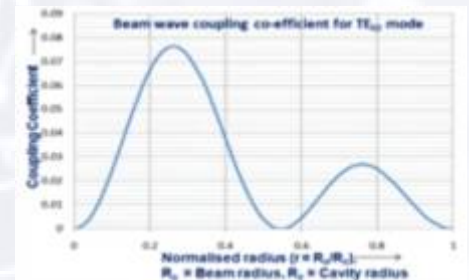


Fig.1. Plot of beam wave coupling coefficient for TE02 mode for the designed cavity

DST sponsored national programme on development of high-power Gyrotron. SAMEER took the responsibility of developing the window, which was successfully done and thoroughly characterised. The window UHV assembly was attached to the gyrotron at CEERI Pilani. A special coolant FC-40, will cool the sapphire dielectrics of the window. A FC-40 cooling and circulation system has been designed and fabricated for this purpose.



The Gyrotron after attachment of the window UHV assembly is being mounted for vacuum processing at CEERI, Pilani.



A FC-40 circulation system for cooling the Gyrotron Window

INDUSTRIAL AND METEOROLOGICAL SYSTEMS DIVISION

Core R & D Program

Development of Digital Ionsonde for Ionospheric Studies

The ionosonde is a 'stand-alone' system which uses radar technique to probe the Ionosphere. This system radiates pulsed electromagnetic radiation with carrier frequency in the range 1 – 20 MHz towards the sky. The received echo is subjected to the measurement of parameters like the amplitude, phase, Doppler & Polarization, as a function of the range. The angle of arrival target is computed from the relative phase difference of the prominent Doppler components. The parameters like critical frequency, virtual heights of ionospheric layers, electron density profile are computed from these echoes. The other parameters like maximum usable frequency (MUF) can also be derived from the ionospheric observations in near real time. Earlier units of Ionosonde used to operate with a transmitting power of a few to tens of Kilowatts. Due to the advances in the signal processing and digital technology, now it is possible to extract similar information by transmitting a few hundreds of watts.

SAMEER had successfully developed and tested the digital Ionosonde system at Dibrugarh University campus in March 2014. The Ionosonde system was operated for few days to obtain the Ionogram. In this activity SAMEER has successfully developed:

- a. 8 channel Receiver and DSP
- b. Magnetic Loop Antenna with impedance matching circuit

c. 1KW Transmitter

d. Integrated system test with simulation software

Vacuum Assisted RF Dryer

SAMEER has initiated a vacuum assisted radio frequency (VARF) dryer system as a core research program. Vacuum assisted radio frequency dryer ensures higher efficiency at significantly lower temperature in drying compared to other drying methods available. It is an environmental friendly, uniform heating process with wide application in Agro, chemical and Pharmaceutical industry. This technology is best suited for products wherein oxygen free heating is required. The system fabrication and development is under process.

Sponsored Projects

Hand Held Data Logger (HHDL) for Recording & Processing Surface Weather Data

IMD maintains a large network of 530+ surface observatories all over the country collecting surface meteorological observations at synoptic hours of the day to meet the requirements of forecasting, agricultural, transport, disaster management and various other sectors. In the current scenario, manually collected and entered synoptic observations from field stations are sent to main centers. This current manual system of surface observation coding and generation of synoptic message is likely to cause delay and is prone to computational errors. SAMEER has developed "Surface Observatory Automation" with objective of quality control in operational and standardization procedures and adhering to international measurement practices. Features of NDC data generation for data archival, Technical Section data generation and direct assimilation of data over global network, has made the

system unparalleled. The Surface Observation Automation system comprises of

- (1) Hand Held Data Logger (HHDL) hardware with built-in application software
- (2) PC based Synoptic Observatory Software (SOS)
- (3) Synoptic Server Software (SSS)

The system development and field trials have been completed and the system has been installed at 20 stations in Maharashtra under Mumbai RMC. It is proposed to complete the installation of the system all over India by March 2015.

Multi -Leaf Collimator (MLC) for Dual Energy LINAC System

Industrial & Meteorological Division has already designed & developed successfully a prototype of multi-leaf collimator, an attachment to the Medical Linear Accelerators.

A new, customized, small sized design of MLC for Dual Energy LINAC is taken up by this division. The available dimensions are 725 X 725 X 120 mm in which FPGA- based, CAN protocol-operated electronic intelligent system is placed along with 80 high density tungsten leaves. Eighty motors each of 10 mm size are used to provide independent motion to each leaf with 0.1 mm accuracy.

North –East Projects

Development of Digital Ionosonde system for Dibrugarh University

This activity is taken up in collaboration with Dibrugarh University, Assam. SAMEER has already developed Digital Ionosonde System under core R & D program to acquire and process Ionograms. It is proposed to develop software to estimate the angle of arrival,



Radiated Emission testing for Suburban trains

Ionospheric drift velocities and virtual height to real height scaling. Additionally, SAMEER will develop HF Delta Transmit Antenna. Dibrugarh University will collect the Ionospheric data regularly from the system after installation and will also developing Post processing & data visualization software. Currently various subsystems are under fabrication and software development is in progress.

EMI / EMC 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 continues to provide Test, Measurement and Design Consultancy services to customers to comply with National/International EMC Standards. It has NABL Accreditation as per ISO/IEC 17025:2005 and Accreditation from UKAS for ISO 9001:2008. It is also listed for International EMC Emission standards testing as per FCC, USA.

EMC Compliance testing is offered for electronic products from various manufacturing sectors including Industrial and Medical electronic products, Control and Communications and IT Industry. The NABL accredited EMI/EMC Test facility is located at CBD Belapur, Navi Mumbai. EMC testing is done as per various civilian and military standards like CISPR 11, CISPR 22, CISPR 24, IEC 61000-4 and 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 101 Customers availed of this service for conducting more than 153 tests on various electronic products. The Division thus contributes its share to the growth of the Indian electronic industry. The EMC test design and consultancy activity also plays a major role in assuring EMC compliant Products for the strategic sector as it is a major EMC laboratory conducting EMC

testing as per military standards in the western region. In the last year EMC Compliance tests were conducted as per MIL STD 461E/F on more than 50 different products to be used for strategic applications.

Apart from the EMC testing activities, the division also pursues Research in the field of Electromagnetic Interference and Compatibility and undertakes Core R & D programs in this area. Research Activities for development of EMC antenna sensors, High E field generators and NEMP simulators are currently being pursued.

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 also undertakes both research and test, design consultancy activities in line with high power electromagnetic which requires solving EMI issues at high power and studying High Power Microwave and High Power EM related issues. Study of state of art issues related to Signal Integrity and EMC for High speed digital systems is being undertaken in order to resolve EMC problems.

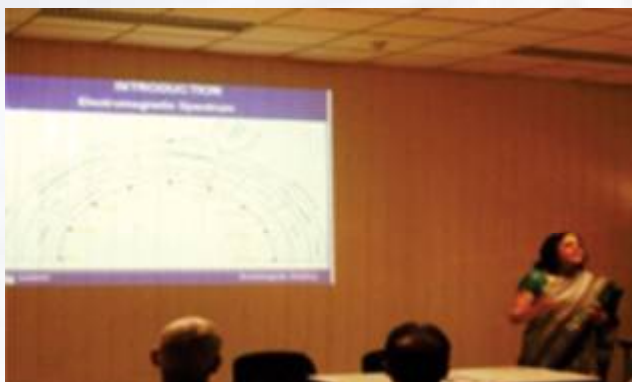
The major activities apart from EMC compliance testing in the lab, are the R&D on the following important areas in electromagnetics:

Core R&D Program

The core R & D effort is concentrated on studying High EMP and High Microwave Power generation and its effect on I T products. The two core R & D projects currently being pursued are:

Susceptibility of Electronic devices to HPEM and UWB sources

Susceptibility of modern digital technology to NEMP threat in the civilian domain has now become a reality. Failure or disruption of either the power grid or telecommunication can



One Day Workshop on "Understanding of EMI/EMC and EMC Standards" at the EMC Centre, Navi Mumbai.

cripple the economy of the country and thus protection of all digital technology has now become a necessity. The realization of the catastrophe that any IEMI would cause has created an urgent need in the scientific community to harden and immunize the frontier technologies from the impending NEMP threats. Foreseeing the need for smaller NEMP simulators, the division has developed and calibrated a RS 105 test set up using the conical plate structure. The division has also designed and developed the Impulse generator using a high voltage power supply. The exponential decaying pulse of 20KV with rise time of 2nS and 30nS width is applied at the narrow end which generates a 50KV/m field under the conical plate. By using the commercially available calibrated D dot probe, measurements have been made to ascertain the field uniformity within 6 db in the area covering 30cm (L) *20cm(W) * 12cm (H) .

Testing of various IT related equipment to ascertain their susceptibility to high Impulse E fields is in progress.

Very Fast Rise Time 200KV Transient Generator for E Field Generation

High Power EMP generation for testing of Defense products is the requirement of the country. Different labs have projected this requirement which is state-of-the-art and is not an off the shelf available technology for the country. Under this programme, Very Fast Rise Time 200KV Transient Generators would be developed and made available for integrating with the

requisite antenna to generate very high energy UWB pulsed Electric Fields for testing of equipments.

EMC Compliance for Rolling Stock

Radiated Emission testing was carried out for M/s L&T-Scomi for their Monorail coaches before they could be put in service by MMRDA at Wadala – Chembur in Mumbai. This work was being done for the first time in the country using the recently formulated International EMC Standards for Rolling Stock. This is India's first monorail. We have also done EMC compliance as per International and RDSO standards for the Railway Coaches for M/s Bombardier who were suppliers to MRVC for the suburban railway trains.

EMC Training

As a part of activity, training program was conducted every quarter for industries in the area of EMI/EMC wherein exposure was given to the design engineers from the industries to the International EMC standards and case studies were discussed highlighting mitigation techniques. The training programs has always received a very good response and every workshop catered to an appreciative audience of 35-40 industry participants.

EMC Audit

EMC measurement services for ambient noise survey and also do an EMC audit of the workplace for the Industry which helps them to contain Electromagnetic Interference issues in large installations were carried out.

Shielding Effectiveness measurements

Shielding effectiveness measurements have been carried out for different sizes of panels for M/s. Godrej, Mumbai and for M/s. Model Infra, Dharwad.

EMC Consultancy

Design Consultancy and solutions were offered to some IT product companies and M/s. Phil Audio for conducted and radiated emission testing compliance to International EMC standards.

Accreditations/ Audits

- i. NABL audit was conducted in July 2013 and NABL accreditation as per ISO/IEC 17025 was granted for three years till December 2016.
- ii. Surveillance audit for ISO 9001:2008 was conducted on 17th April 2013 and continuation of

accreditation was granted till May 2015.

- iii. FCC Listing for the Radiated emission and Conducted Emission facilities of the EMC Division, Mumbai was granted which is valid till May 2016.

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 machine 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:** Design of Yagi Antenna and its mounting structure is realised using mechanical CAD. Prototypes were fabricated for test, evaluation etc. The fabrication of final engineering models has commenced. Design of TR Module chassis and enclosures were prepared taking into account electronic packaging, thermal, environmental and mechanical fabrication issues. About five alternative designs were prepared and prototypes

fabricated accordingly for assembly, integration and evaluation etc. The lot by lot fabrication of mechanical chassis has commenced as per final engineering model. The cable layout in the antenna array is prepared for working out the design of conduits for various types of cables.

- b) **Cloud Radar:** Design of overall system configuration which consists of Parabolic Antenna with its drive mechanism, Electronic Packaging, Cooling mechanism, Flat bed Trailer, Control Cabin and a lifting platform is prepared. The detailed design of each subsystem is being done separately.
- c) **Doppler SODAR:** The fabrication of Mobile Sodar for IMD was completed and dispatched to Kolkata for Installation.
- d) **Medical Linear Accelerator (Jai Vigyan Phase II):** All the activities related to the installation of the system at IIHNO, Indore was completed. Participated in providing mechanical beam flattener of various designs to achieve the required beam flatness and symmetry. All the mechanical QA tests were completed as per AERB norms.
- e) **High Power Transmitter:** All the mechanical systems namely high power cavity with tuning plunger, Dual directional coupler and related components were assembled and kept ready for electrical testing
- f) **MW Heating Systems:** The design of special cavity in stainless steel material having double walled construction and special door which opens vertically with the help of counter weights is prepared. The MW waveguide flanges, bends and straight sections are also made. The entire unit is fabricated and is ready for electrical testing.

The division gets involved systematically in most of the projects and contributes towards completion by offering engineering solutions. 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, designing MW and RF components and assemblies, machining critical components requiring high accuracies, standardising machining processes etc. The division also has a chemical plating facility for plating the critical components to avoid corrosion and improve product life.

Training Program- Division engages apprentices in the Fitting/ Turning/ Milling and Chemical sections for a period of twelve months and provides hands on training as per the requirements of National Council for Technical and Vocational Training (NCTVT) a national level Government body.





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

EMI/EMC DIVISION

This Division has comprehensive test facility to carry out EMI/EMC compliance testing as per various National and International standards to cater to the needs of Manufacturer / Industry. The laboratory is equipped with the state-of-the-art instrumentation, which complies with the requirements of International Standards. EMI/EMC Testing laboratory for the civilian standard is accredited as per ISO 17025 Quality System.

EMC Division has ISO 17025 accredited calibration laboratory providing calibration services for wide range of EMC test instruments from all manufacturers.

More than 570 EMI/EMC Testing assignments were completed and 130 industries were benefited. Calibration services were availed by 40 laboratories of the country.

Design Consultancy Projects:

EMC Design assistance was provided for :

- i A Medical equipment to achieve compliance to CISPR Standard.



Medical Equipment

- ii. Multifunctional Colour Repeater (MFCR) to meet Radiated emission standard.
- iii. Main Interface Unit to meet Radiated emission standard.
- iv. EMC requirements for Audio and Digital subracks.
- v. Battery Chargers to meet various requirements of Radiated emission.
- vi. Two-way radio
- vii. Ambient electromagnetic measurement was carried out at Wireless Lab of C-DOT Alcatel Research Centre, Chennai.
- viii. Shielding Effectiveness evaluation of the enclosure was carried out for four Indian Industries.

Measurements at Customers Site:

- Normalized site attenuation and shielding effectiveness measurements were carried out for a shielded anechoic chamber for a customer at Chennai.
- Power Frequency Magnetic Field measurement was carried out for a traction transformer manufactured by a multinational company at Vadodara.

Accreditations/Audits:

- NABL Conducted desktop audit of EMI Testing and calibration services during September, 2013.
- TUV SUD has listed SAMEER-CEM as the recognized laboratory under TPS CARAT program for EMI/EMC testing.
- FCC listing of the 10m shielded anechoic chamber and conducted emission test facility is renewed and it is valid till January 29, 2017.

RESEARCH AND DEVELOPMENT ACTIVITIES

ELECTROMAGNETICS & ANTENNA DIVISION (EMAD)

Electromagnetics & Antenna Division has been actively involved in research and development projects in the areas of antennas and passive components. Division has successfully designed and developed antennas for strategic and civilian applications. With the background of Electromagnetics & Antenna engineering expertise, the division has also developed products through in-house core programs envisaging future needs.

Core R&D programme

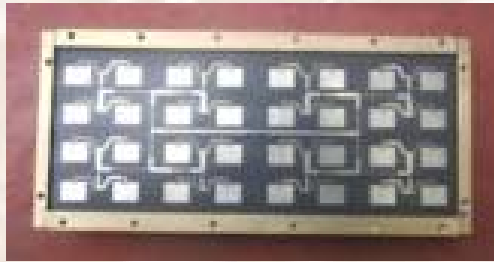
Development and Characterization of Wideband Extremely Low Profile VHF/UHF Antennas

A novel, extremely low profile VHF antenna in the form of a planar half loop configuration was developed, fabricated and tested for continuous operation from 30 MHz to 1000MHz. The design parameters were optimized by EM simulations. In order to improve the poor impedance matching at lower frequencies, the antenna was loaded with ferrite toroidal cores such as Nickel Zinc (Ni-Zn), Manganese Zinc (MnZn) and Iron. A significant improvement in the impedance matching was observed over the frequency band 30 – 300 MHz. Nickel Zinc (Ni-Zn) ferrite toroidal core was chosen as the loading material for optimum performance. Measurements were carried out to study the effect of height of ferrite core on the gain and radiation pattern of the antenna. The dimensions of the ferrite core was optimized based on rigorous measurements. V.S.W.R, gain and radiation characteristics of the optimized antenna configuration were measured and analysed.

Design, Analysis and Development of Planar Microstrip Array Antenna for FMCW SAR Applications

FMCW-SAR Application requires an antenna at the receiver side with high gain, low side lobe level and a radiation pattern with different beam widths (1: 3 ratios) in orthogonal planes. A planar microstrip array antenna with low side lobe level was designed for FMCW SAR application in the frequency range 9.7 – 10 GHz. The array elements are fed by a corporate feed network with proper amplitude and phase for the required distribution. A Chebyshev distribution is used for achieving low side lobe level for the planar array. The impedance and

radiation characteristics have been evaluated for the prototype antenna. The antenna underwent all trials successfully.



Planar Microstrip array antenna

Sponsored Projects

Design and Development of 403 MHz Radiosonde Receiver Antenna for IMD

A variant of planar monopole antenna was designed at 403 MHz for radiosonde receiver system for establishing the communication with weather balloons that measures various atmospheric parameters. The antenna comprises an offset-fed vertical planar radiator, bent to form a horizontal section. Notches are formed at optimized locations on the vertical and horizontal sections of the antenna in order to generate circularly polarized waves. The design parameters such as dimensions of the radiator and the notch are optimized to achieve good return loss and axial ratio performance. Antenna offers directional gain with wide beam coverage which makes it suitable for radiosonde receiver systems for tracking the balloon in azimuth and elevation planes.

COMMUNICATION



403 MHz Radiosonde Antenna

SYSTEMS DIVISION (CSD)

Core Project

Studies on control of intra-system EMI for System on Package (SOP)

In the recent decade, artificial materials have become a topic of great interest in physics and microwave engineering. Examples of such artificial materials are: Electromagnetic Band Gap structures (EBG), Photonic Band Gap structures (PBG) and left-handed media (Metamaterials). EBG and PBG are periodic structures mostly used for suppressing surface waves and require signal, ground planes. In this core project, the applications of EBG to control intra-system EMI were studied and simulations carried out. Wherever applicable, prototype test vehicles were also fabricated and measured results were compared with simulated results.

During the second year of the core project, micro-strip transmission line loaded with Mirrored Complementary Triangular Split Ring Resonator (MCTSR) in the ground plane to achieve wide stop band response was implemented. This approach does not add any extra circuit or components for the rejection of frequency band, but instead utilizes the existing ground plane for the realization of MCTSR structure. The stop band structure was designed at 1.9 GHz, which exhibits 10 to 20 dB rejection level.

A coupled line narrow band filter with second harmonic suppression was designed and simulation studies were completed.

Complementary Circular Split Ring Resonator (CSRR) was designed to suppress the second harmonic frequency.

Sponsored Projects

CDMA Based Tele-command System

Code Division Multiple Access (CDMA) based Telecommand system has been developed for a Government laboratory. The salient features are

anti-jamming properties, user settable codes and FPGA based parallel signal processing for faster response. Integration, test and evaluation of transmitters and receivers was completed and system has been delivered.

Adaptive OFDM Transceiver

Design and development of Adaptive Orthogonal Frequency Division Multiplexing (OFDM) transceiver is completed. The system caters for a very high data transmission requirement. Digital modulation schemes of BPSK, QPSK and 16 QAM have been implemented in a hardware platform mainly based on FPGA. The modulation scheme is dynamically selected based on the channel noise conditions so that maximum throughput is achieved in the transceiver.

Two RF Channel CDMA Receiver

This project has been taken up by SAMEER for a critical application. Two simultaneous RF channels are to be received in the receiver which works on Code Division Multiple Access (CDMA) based technique. Simultaneous reception of two data channels is possible in each of the RF channel. The receiver will be a miniaturized as per the requirement of the user agency. Design of the system has been completed and development is in progress.

Spread Spectrum Transmitter

Spread Spectrum technology has anti-jamming property due to which the reliability of the communication link becomes very high. This system is being developed for one of the important applications of the user agency. Two CDMA codes will be generated for simultaneous transmission of signals in a single RF carrier. The transmitter can be controlled using Ethernet access. Preliminary design has been completed and the development is in progress.

DIGITAL SIGNAL PROCESSING DIVISION (DSPD)

Sponsored Projects

Development of Baseband Processing Module for Adaptive OFDM Based Communication System (DeitY GIA Project)

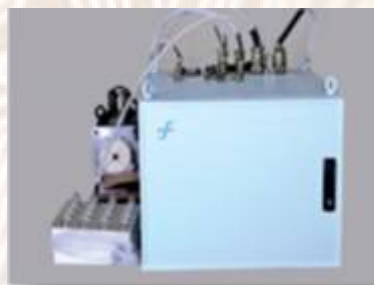
DSP division has designed and developed adaptive OFDM baseband module for broadband communication requirements. The adaptive baseband processor supports QPSK and 16QAM modulation modes which is user selectable with throughput supporting 23.7 Mbps for QPSK modulation and 47.4 Mbps for 16QAM modulation. The baseband signal bandwidth is 10MHz. The modular OFDM baseband hardware is a 10 layer mixed signal hardware which can support 10 MHz bandwidth analog I/Q signals for transmit signal generation & received signal processing, different memory types like volatile, non-volatile & FIFO and serial interfaces of different types- RS232, USB & Ethernet for data & control interfaces. There are two numbers of SPARTAN-6LX150 FPGAs in the hardware to support high density logic and arithmetic modules for various signal processing requirements.



This module has SNR estimation capability for supporting adaptive OFDM feature by which the modulation mode is selected based on the SNR supported in the system. The SNR estimation accuracy is ± 1 dB which can be improved by extending the precision of the fixed point processing. This module is completely validated as complete OFDM system with the designed RF module.

Development of Fire Control System (FCS)

DSP Division has developed the Fire Control System (FCS) Project based on the user requirements. The FCS System is an indigenous technology development with advanced features. The system consists of a Main Control Console (MCC), Remote Control Console (RCC) and four Launcher Control Units (LCU). The system is qualified for the EMC standard (MIL STD 461-C), Environmental Standard (JSS55555), ESS standard and 168 hrs. of Endurance test. The project is successfully completed and two systems are delivered to the end user (first in June 2013 and second in March 2014).

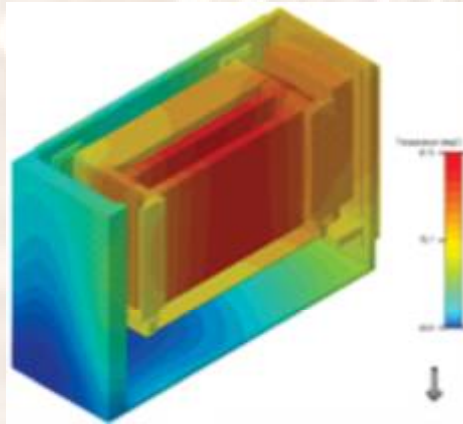


ELECTRONICS PACKAGING DIVISION (EPD)

The 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.

Thermal Simulation of ATR Chassis for Avionics Application

Half ATR Chassis of size 145 x 400 x 270mm consists of two numbers of DSP boards and appropriate power supplies and EMI filters, dissipation from the system is around 100 watts and the system has to work reliably at 55°C ambient. Power supply modules dissipate more than 30% of the total heat. Suitable thermal path from power supply modules to external ambient is designed to dissipate the heat from the power supply, so as to reduce the internal ambient temperature of the chassis. External wall of the chassis has heat sinks

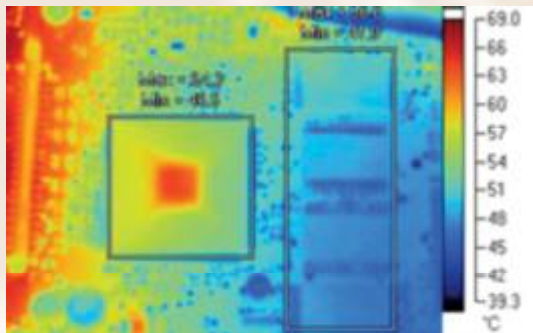


Thermal Simulation of ATR Chassis

to dissipate the heat to the external ambient. Suitable heat sinks are designed to dissipate the heat and to maintain the components at their specification limit.

Temperature & Flow Measurement for Industries

Thermal Design Consultancy, Flow and temperature measurement on electronic systems have been carried out for industries. Products ranges such as PCBs, Power amplifiers, power supplies, etc. were carried out for various organizations and for In-house products. Infrared thermal imager is deployed to identify the hot spots and to measure the hot spots temperature. Figure shows the thermal mapping of automotive control



Infrared Thermal Image of Automotive Control Board





Sector III Salt Lake



Sector V Campus, Saltlec

SAMEER KOLKATA

CENTRE FOR MILLIMETER WAVE RESEARCH

SAMEER Kolkata Centre, specializes in areas of antennas, microwave and millimeter wave technology. The centre is executing sponsored projects of National importance in the field of antennas and millimeter wave circuits & systems. Core projects are executed for development of expertise keeping in view the practical requirements and applications. 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 the field of EMI-EMC. The centre has few important divisions through which all R&D projects are executed and services are provided to various users.

RESEARCH AND DEVELOPMENT ACTIVITIES

ANTENNA DIVISION

This division aims at design and development of microwave and millimeter wave antennas for strategic and civilian applications based on user requirements and specifications.

Sponsored program

Development of Millimeter Wave Antennas

This project was sponsored by DeitY, MCIT, 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 (a) W-band Waveguide Slotted Array Antenna and (b) Ka-band Circularly polarized IFF antenna have been developed.

W-band Waveguide Slotted Array Antenna

The aim of this assignment is the design and development of waveguide slotted array antenna at W-band and corresponding comparator for monopulse application. Comparator network has been designed using rat-race hybrid. Tapered amplitude distribution has been applied among the slots to achieve low side lobe level. Performance of the feed horn has been optimized using HFSS. Engineering prototypes of the antenna and comparator have been fabricated. Achieved bandwidth is 1GHz (93.5-94.5GHz) with gain ≈ 39 dBi and side lobe level ≈ -25 dB.

Ka-band Circularly polarized IFF antenna

have been developed

The aim of this assignment is to design and develop waveguide slotted array antenna at Ka-band for Identification of Friend or Foe (IFF)



Top & backside view of Slotted waveguide array antenna



Comparator Circuit with E-to H-Plane Twist and Standard W-band flange

application. The antenna is designed with linearly polarised slotted array over which microstrip polarizer is placed for generation of circular polarization. Design has been carried out for both uniform and tapered amplitude distribution among the slots. Performance of the feed horn has been optimized using HFSS. Engineering prototypes of the antenna and polarizer have been fabricated for both uniform and tapered amplitude distribution. Achieved bandwidth is 600MHz (38.0-38.6GHz) with gain ≈ 32 dBi and axial ratio better than 3dB.

S/Ka band tracking antenna

This is a sponsored project from a Govt. R&D lab. The aim of this assignment is the design and development of tracking antenna system at



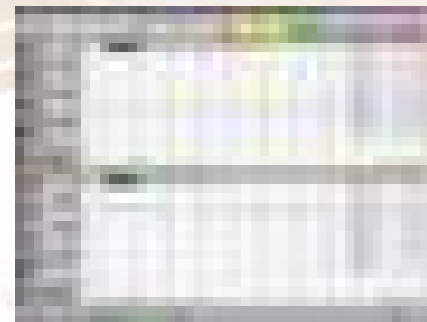
Top view of the antenna.

Inside View of the antenna with feed network.

both S-band and Ka-band using same radiating aperture. Associated band pass filters and comparators have to be designed at S-band and Ka-bands. S-band microstrip comparator has been designed. The same has been fabricated and performance measured as shown in Fig-2. Measured amplitude imbalance is better than 0.2dB and phase imbalance is ≈ 2 .

Multiband wrap around Antenna

This is a sponsored project from a Govt. R&D lab. The aim of this assignment is design and development of microstrip wrap around



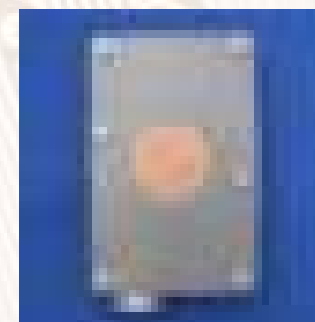
S-band comparator.

antenna for C-band, S-band and Ka-band communication applications. Individual antennas have been designed, fabricated and performance measured (with foam spacer and without teflon radome) at S-band for linear and circular polarization, at C-band for circular polarization, and squinted beam antenna at Ka-band for linear polarization for providing omni-directional coverage (at -10dB level) in azimuth plane in each of the bands.

Other Antennas Developed

Broadband Horn Antenna

Broadband waveguide based dual-ridged

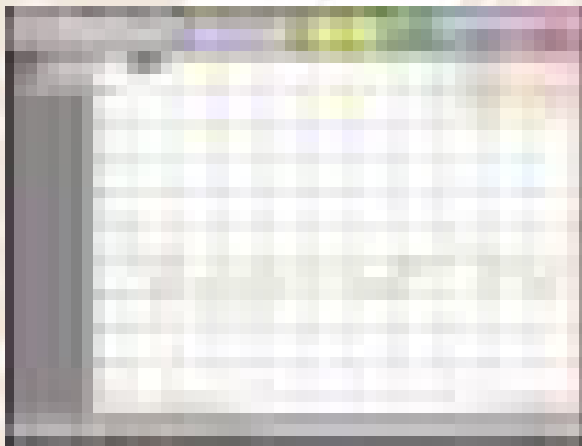
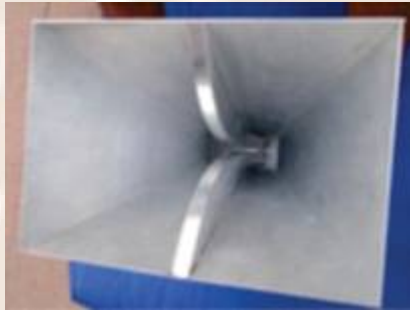


Ka-band squinted beam antenna (Top) and C-band EMCP antenna

horn antenna has been designed and developed, as shown in Fig. Ridges have been tapered exponentially to achieve broadband impedance matching. The antenna gives broadband impedance matching (2:1 VSWR) from 2-12GHz.

L-band capacitively coupled shorted patch antenna

Broadband shorted patch antenna has been developed using a capacitively coupled feed as shown in Fig. Capacitive feed has circular plate to couple electromagnetic

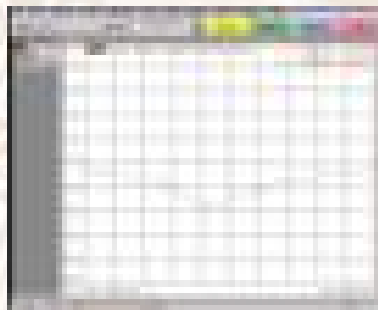


Broadband dual ridged horn antenna.

energy from the source to the shorted radiating patch. The antenna yields 2:1 VSWR bandwidth from 1.64GHz to 1.80GHz. The antenna radiates in the broadside direction with measured 3dB beamwidth of 80x65 and gain $\approx 7.2\text{dBi}$.

L-band stacked shorted patch antenna

Shorted stacked patch antenna has been developed for broadband operation as

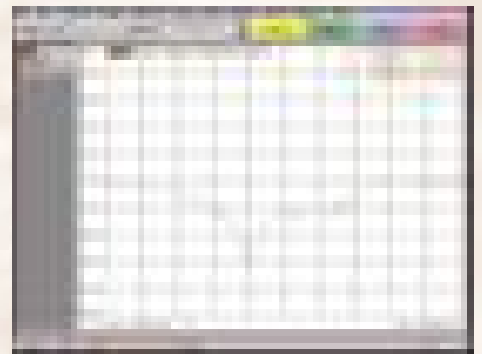
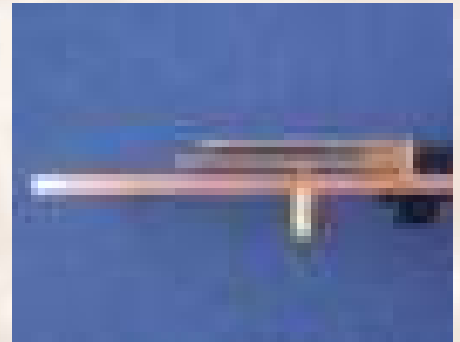


L-band capacitively coupled shorted patch antenna.

shown in Fig. A common shorting wall is used for the two stacked shorted patches. Broadband matching is achieved by proper selection of feed location and distance between the stacked patches. The antenna yields 2:1 VSWR bandwidth from 1.66GHz to 1.83GHz. The antenna radiates in the broadside direction with measured 3dB beam-width of 80x85 and gain $\approx 4\text{dBi}$.

Left Handed Maxwell's Systems:

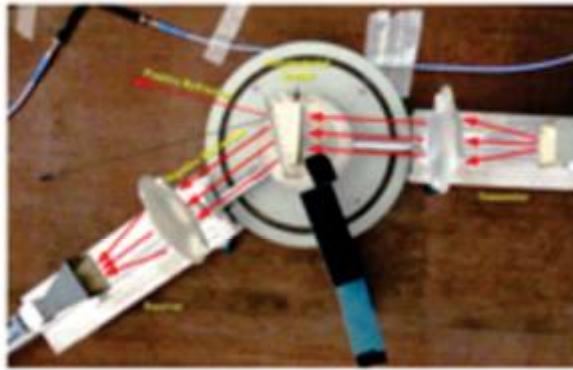
This project has been sponsored by a Govt. R&D



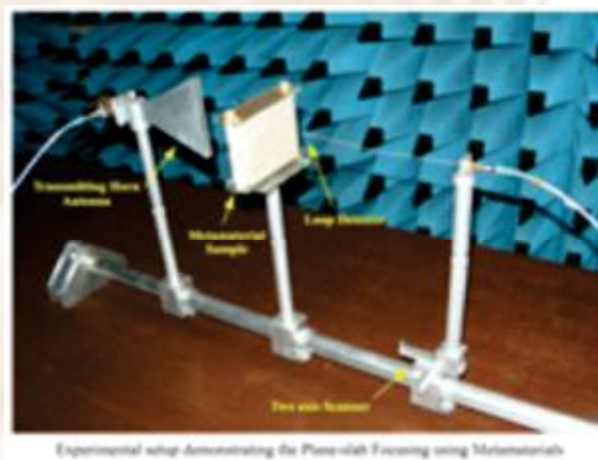
L-band stacked shorted patch antenna.

Organization. The primary objective of this project is to study, design, characterize and experimentally verify different types of Left Handed Mediums i.e. Metamaterials. Metamaterials are artificially engineered materials made of metal dielectric composites and these can have negative values of permittivity, permeability and refractive index. Various types of metamaterials have been designed and simulated using 3D FEM solvers. A free space focused beam test setup is prepared to characterize these metamaterials at X & Ka bands and various metamaterial samples have been tested. The reversal Snell's Law is verified by a metamaterial sample having refractive index of -1.74.

To establish plane slab focusing using Metamaterials, a test setup having two axis



scanner is prepared at X band. Experiments have been carried out indicating the restoration of source image at receiver plane.



Experimental setup demonstrating the Plane-wave Focusing using Metamaterials

CIRCUITS AND SYSTEMS DIVISION

Objectives of the division are design and development of microwave and millimeter wave based subsystems and systems for strategic and civilian applications. In house design and development capability of components provides strength to design and build complex systems for various applications. MMIC design is one area where importance is being given to continuously build the capability using Fab facilities abroad.

Core R & D program

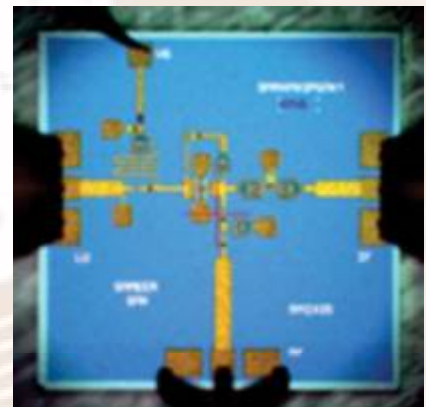
Ka-band MMIC mixer

The objective of the project is to design a low loss and low inter-modulation distortion Ka-band MMIC mixer chip for miniaturized and compact receivers. Two different configurations of resistive MMIC mixers have been designed, simulated, fabricated and tested. Simulations of the mixers have been carried out in schematic and momentum using UMS design kits. The optimized mixers have been incorporated in the MMIC tile which is repeated

several times to form the MMIC wafer. The diced mixers have been measured and the measured conversion loss of the mixers is less than 10 dB with an LO power of 0 to 4 dBm. The isolation between LO-RF and LO-IF ports of the mixers is better than 25 dB. RF and LO frequencies for the mixer are 35 GHz to 40 GHz. IF frequency is upto 5 GHz.

U-band Frequency MMIC Tripler

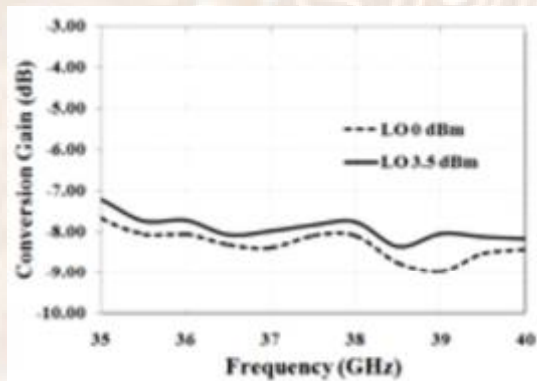
A 15.68 GHz to 47 GHz MMIC frequency tripler has been designed



Fabricated two resistive Ka-band MMIC mixers



Measured conversion loss



Measured Isolation between LO-RF and LO-IF

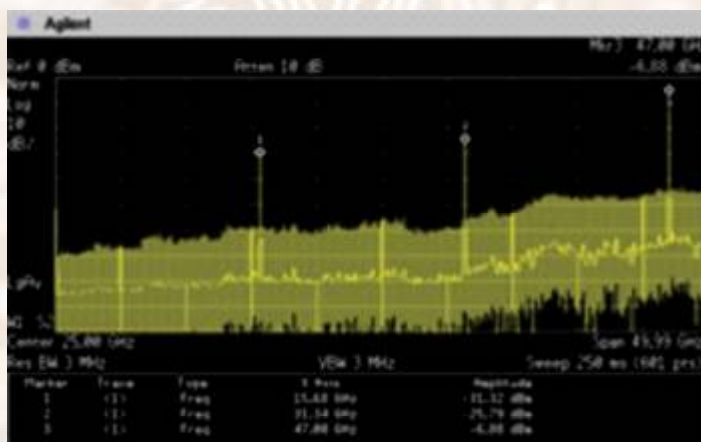
and developed using a single stage pHEMT based design. The tripler MMIC chip has been fabricated from UMS, France. Conversion loss below 7 dB and harmonic suppression in excess of 20 dBc have been achieved at 47GHz for 10 to 13 dBm of input signal at 15.68 GHz. Achieved 3 dB bandwidth is more than 4 GHz and DC power requirement is 20 mA, 3.5 V. Chip dimension is 1.5 mm X 2.0 mm.

V-band MMIC Frequency Quadrupler

A 14.25 GHz to 57 GHz MMIC frequency quadrupler has been designed



Simulation layout and fabricated chip of the U-band frequency tripler circuit

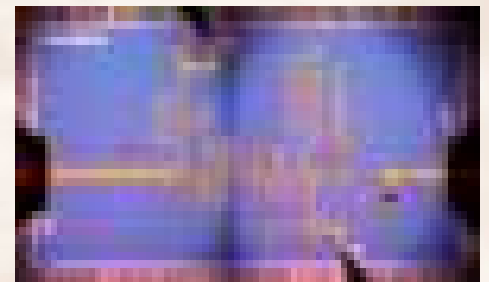
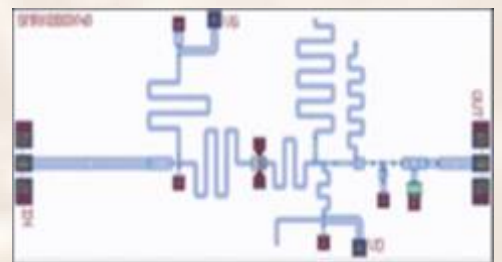


Output spectrum of MMIC tripler at 15.68 GHz

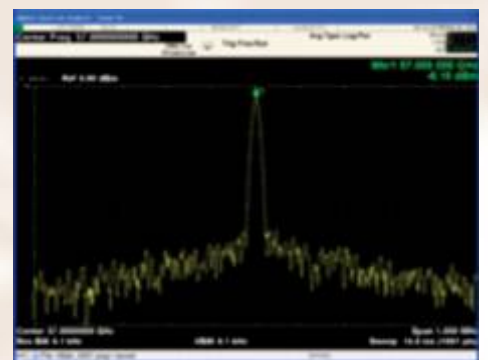
and developed using a single stage pHEMT based design. The quadrupler MMIC chip has been fabricated from UMS, France. Conversion loss below 15 dB and harmonic suppression in excess of 20 dBc have been achieved at 57GHz for 10 - 13 dBm of input signal at 14.25 GHz. Achieved 3 dB bandwidth is more than 2 GHz and DC power requirement is 20 mA, 3.5 V. Chip dimension is 3.5 mm X 1.5 mm.

W-band Attenuator

The objective of the project is to design an attenuator with an attenuation range of 2



Simulation layout and fabricated chip of the V-band frequency quadrupler circuit



Output spectrum of MMIC quadrupler including 1 dB adapter loss for 10 dBm input power at 14.25 GHz

to 20 dB over 1 GHz bandwidth at 94 GHz. Finline configuration of the attenuator has been chosen for the design. Bias circuit for the attenuator, taper line and diode impedance matching of the circuit has been designed and simulated. Optimization of the attenuator circuit to obtain maximum attenuation of greater than 20 dB has been completed. PCB fabrication and mechanical mount fabrication are in progress.

W-band Frequency Tripler

A 31.36 GHz to 94 GHz frequency tripler has been designed and simulated in Schottky diode based hybrid MIC configuration. It is a planar microstrip based circuit with transition to input and output waveguide through low loss microstrip to waveguide transition. Simulation result exhibits around 10 dB of conversion loss at 94.08 GHz for a corresponding input power of 10 dBm at 31.36 GHz. The circuit is under fabrication.

Ku-band MMIC Voltage Controlled Oscillator

Ku-band MMIC VCO has been designed using Process Design Kit (PDK) of United Monolithic semiconductor (UMS). Performance has been simulated and optimized using ADS. MMIC VCO is designed with 2 FETs, one for basic oscillator and the other for tuning with source and drain connected. This behaves as VCO with variation of the gate voltage. The optimized oscillator has been developed on MMIC wafer from UMS foundry and performance measured. It generates 7dBm output power at Ku band with tuning bandwidth of 200 MHz.

Wide-band (K-Ka Band) MMIC Low Noise Amplifier

MMIC based wideband (18-40 GHz) low noise amplifier



Fabricated MMIC VCO

has been designed using Process Design Kit (PDK) of United Monolithic Semiconductor (UMS). Cascaded multistage amplifier configuration and distributed amplifier configuration has been adopted with optimum matching for achieving high gain and low noise figure. The optimized LNA has been developed for both configurations on MMIC wafer from UMS foundry and performance measured. For cascaded configuration, achieved gain is $15 + 1$ dB over 18-40 GHz and the noise figure measured is within 2.7 dB at K-band and within 4dB at Ka-band. For distributed configuration, achieved gain is $8.5 + 1$ dB over 18-40 GHz with input return loss better than 10 dB and output return loss better than 15 dB over the whole band.

2.1.8 60 GHz Medium Power Amplifier

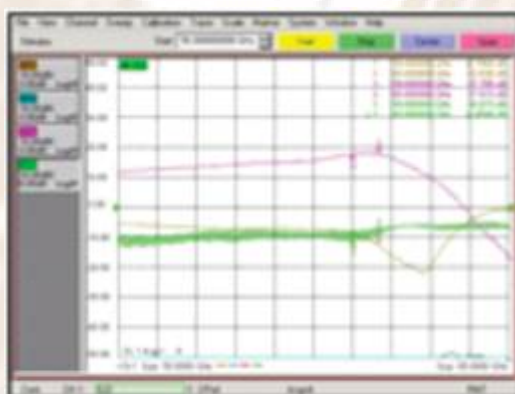
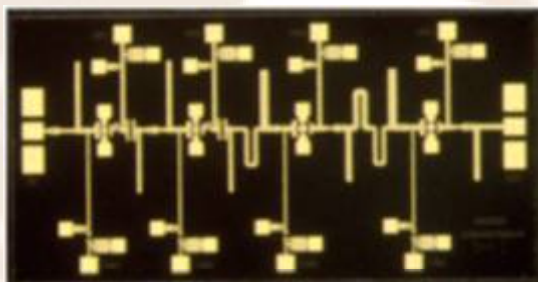
The MMIC based 60 GHz Medium Power Amplifier has been designed and



Wide-Band MMIC LNA.

developed as one of the subsystem for the core program MMIC based 60 GHz T/R module. It is a four stage cascaded GaAs HEMT MMIC medium Power amplifier at 59-60 GHz for high gain and high output referred P1dB. The MMIC has been fabricated using the foundry service from United Monolithic Semiconductor, France. The MMIC provides 17.8 ± 0.1 dB of gain, and an output power of +13 dBm at 1dB compression using bias voltage between +1.5 and +2.5V Volts. An input/output return loss better than -8.5 dB has been achieved over the band.

Sponsored projects



60 GHz MMIC Medium Power Amplifier

Development of Front-End of Wireless Data Link at 60 GHz:

This project was sponsored by DeitY, MCIT, Govt. of India. In this Project, it has been aimed to design and develop the front-end of wireless data link at 60 GHz. The front-end consist of Transmitter and Receiver with Antenna. The transmitter has been developed by integrating PLL, quadrupler, medium power amplifier and mixer. The final RF output has been transmitted through a lens antenna. In the similar way, the receiver consists of the receiving lens antenna, a low noise amplifier (LNA) and a mixer. A 2-3 GHz IF modulated (BPSK, QPSK, QAM) signal of +5dBm power has been injected at the I and Q channel of the transmitter. Finally +10dBm of power at 59-60 GHz has been transmitted using Lens antenna. The received signal is down converted to IF using receiver and demodulated to extract the desired signal. Signal constellation, spectrum, error vector magnitude (EVM) have been studied from the demodulated signal. Using 64-QAM, a maximum data rate of 150 Mbps has been achieved.

Development of W-band Coherent Transceiver

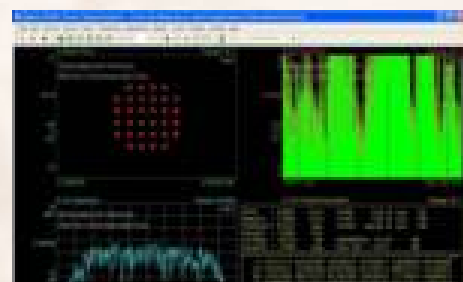


Fig. Transmitter section and Constellation diagram for 64 QAM

This project has been sponsored by a Govt. R&D laboratory. A Coherent Transceiver at W band (94 GHz) has been designed and developed under this program to be used as a sensor. More than twenty components in W band and other IF frequency band have been indigenously designed and developed to realize the transceiver. All components have gone through rigorous environmental test to make the unit working in the temperature range of -20°C to +55°C. Five engineering models have been supplied so far to the user agency and two more are going to be delivered shortly.

Development and Ka-Band Telemetry Transmitter:



Developed unit of W band Transceiver

This is a sponsored project from a Govt. R&D lab. In this project following components have been developed.

a) S-Band Up Converter:

S-Band up converter has been designed to up convert an IF signal of 70MHz to S-Band. Up conversion has been realized by mixing the IF signal with an S-band LO signal. The LO signal has been synthesized by a stable synthesizer with very low phase noise. A stable reference signal of 10MHz from a oven controlled crystal oscillator has been used to synthesize the LO signal. The up converter module produces an S-Band signal with phase noise of -107.2dBc/Hz @ 100 KHz offset and adequate power of $+17.48\text{dBm}$.

b) Ka-Band Up Converter:

Ka-Band up converter has been designed to up convert



Fig: S-band up-converter.

an signal from S-Band to Ka-Band. Up conversion has been realized by mixing the S-Band signal with a stable LO signal. The LO signal has been driven from a stable Ku-Band Phase Locked Oscillator (PLO). For rejecting LO leakage and lower side band signal, the IF to the mixer has been equally divided into two channels with 180 degree phase difference. The up converter module produces a Ka-Band signal with low phase noise of -108.8 dBc/Hz @ 100KHz offset and power of $+2.85\text{dBm}$.

c) Ka-Band Power Amplifier:

Ka-Band power amplifier module has been designed to



Fig: Ka-band up-converter.

have a high gain and high saturated output power. The amplifier module has waveguide input and output ports. Waveguide to microstrip transition have been used at input and output side. The module has a heat sink arrangement at the bottom of the amplifier for heat dissipation. The transitions and the heat sink have been designed in HFSS and the thermal analysis of the heat sink has been done in ANSYS Thermal. The amplifier has been fabricated and tested. Achieved gain from the amplifier is 13dB with a P1dB of 38.5dBm.

d) C-Band PLO:

C-Band phase locked oscillator has



Fig: Ka-band power amplifier.

been designed at 7.056 GHz. The module basically consists of fractional-N phase frequency detector (PFD), VCO and loop filter. Achieved output power and phase noise are $+16\text{ dBm}$ and -80dBc/Hz @ 1 kHz respectively.

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

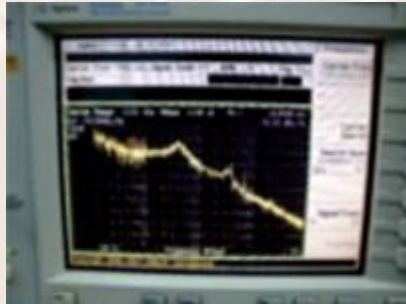
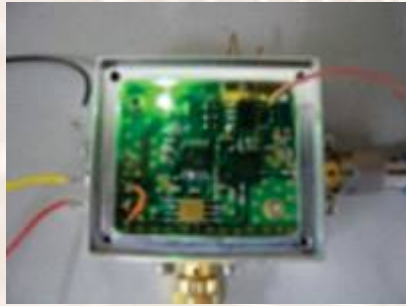
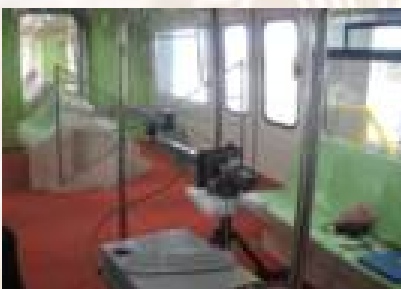


Fig: C-band phase locked oscillator.

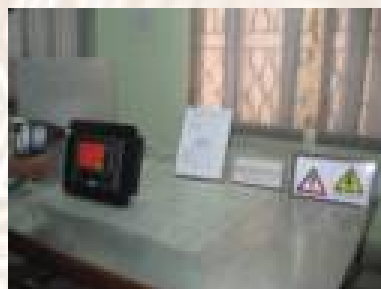
electrical products for EM compatibility and to take up core and sponsored R&D project relevant to the application in the area of EMI/EMC.

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. Test and measurement services (EMI/EMC and others test-measurements) have been provided to 28 different external customers.



EM survey inside the monorail car.



ESD test set-up for Driver Display Unit.

COMPACT ANTENNA TEST RANGE (CATR) FACILITY

Objective of the division is to provide antenna and radome measurement support to the private industries and Govt. agencies from all over the country. CATR is a unique facility available for characterization of different antennas in the frequency range of 1GHz-100GHz for different strategic and civilian applications. The facility is also equipped for radome performance evaluation in the frequency range of 1GHz-40GHz. The facility is being utilized by private industries and Govt. agencies for performance evaluation of their antennas and radomes. CATR facility has been availed by 12 different users.



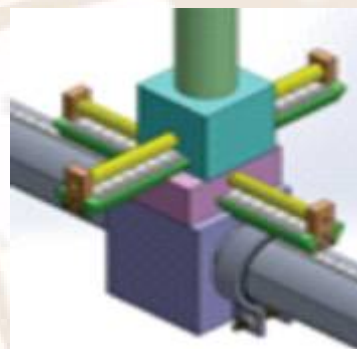
Radiation parameter measurement of a Ku-band offset feed parabolic dish and high gain LTE antenna.

MECHANICAL FACILITY

The division provides crucial support to all R&D projects by mechanical design, simulation, fabrication, assembly, inspection in shortest possible time of few hours to few days. 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 design,



Parts of W-band Antenna and comparator



Mechanical set-up for near field scanner arrangement.

MISCELLANEOUS ACTIVITIES

1. Visit of the Second Sub-Committee of Committee of parliament on official language

Second Sub-Committee of the Committee of Parliament on official language visited SAMEER Mumbai on 24th January, 2014 for the inspection in SAMEER. This was the first visit of the Committee of Parliament on official language to SAMEER Mumbai. Director, SAMEER felicitated the Hon'ble Committee Chairman Shri Satyavrat Chaturvedi along with Hon'ble Members of Parliament Dr. Prasanna Kumar Patasani and Shri Raghunandan Sharma. The committee was very happy to see the progress done in Scientific Organization like SAMEER. Further, the committee suggested improvements to enhance the implementation of Hindi in office works.



Photograph of the meeting on official language

TECHNICAL WORKSHOP SEMINARS CONFERENCES

ORGANIZED BY SAMEER

- i. One day Seminar on EMC Awareness titled 'Electro-Magnetic Interference/Compatibility for Electronic Product Designers' was held on June 28th, 2013 at the EMC centre, Navi Mumbai.
- ii. A two day workshop at Gauhati University, Guwahati on "Remote-sensing Techniques in the exploration of atmosphere and near earth environment (RemTEANE-13)" was organized during November 14-15, 2013.
- iii. One Day Workshop on "Understanding of EMI/EMC and EMC Standards" was held on 20th Jan. 2014 at the EMC Centre, Navi Mumbai.
- iv. An intensive three days workshop entitled, "Workshop on RF and Microwave Technology", was held at Tezpur University, Tezpur during March 24-26, 2014.
- v. Two Days Workshop was conducted during July 18-19, 2013 at SAMEER, Chennai. 131 Participants attended the workshop.

PARTICIPATION IN CONFERENCE WORKSHOP SEMINAR

Conference / Workshop

- 1) Gautam Shende attended Two days workshop on "Estimation and Evaluation of Total Uncertainty in Measurement as per NABL-141", 22 – 23 August, 2013 at IDEMI, Mumbai.
- 2) Kiran Thakur attended the National Symposium on High Power RF and Microwaves, at IPR Gandhinagar during 4-6th Sept. 2013.
- 3) Sulabha Ranade and Milind Joshi attended the two days National Conclave on Innovative Practices in Laboratory Management for NABL Accredited Labs held at Bangalore, 16-17 September 2013
- 4) Sandesh Bhat & R. Sandeep Kumar attended Vacuum Electronic Devices and Application VEDA-2013, IIT-Roorkee, Oct. 2013. Sandesh Bhat made an oral presentation on "Criticality in up grading to computerized control of power pulse generator for medical linac" at VEDA-2013,
- 5) A. Agarwal participated and gave a talk on "Cloud Radar and application" and "SODAR: Design and application" at workshop on "Remote-sensing Techniques in the Exploration of Atmosphere and Near Earth Environment, (RemTEANE-13) at Gauhati University, Guwahati on November, 14-15, 2013.
- 6) Dr. Tanuja Dixit & Dr. Abhay Deshpande attended the Indian Particle Accelerator Conference INPAC Kolkata, Nov. 2013. Dr. Tanuja Dixit made an oral presentation on "Electron Gun And Target Design For The Dual Mode Radiotherapy Linac at SAMEER" at INPAC Kolkata, Nov. 2013

- 7) Dr T Tiwari and Kiran Thakur attended 9th International Conference on Microwave, Antenna, Propagation, & Remote sensing, Organised by International Centre of Radio Science, Jodhpur during 11-14 December 2013.
- 8) Sulabha Ranade attended the tutorials & conference held in IIT Bombay for INDICON 2013 during 7-9, December 2013.
- 9) G. S. Isola and J. S. Pillai attended and presented papers at the International Radar Symposium India (IRSI-2013) in Bangalore during 10-14 Dec 2013.
- 10) Dr. K. P. Ray attended the International Conference on Microwave and Photonics (ICMAP 2013), Dec. 13-15, 2013, Dhanbad.
- 11) S. S. Kakatkar attended the IEEE Applied Electromagnetics Conference (IEEE AEMC 13) held at Bhubaneshwar, India from 18-20 Dec.2013.
- 12) Bhaskara Naik , attended "FICCI India Innovation Growth Programme 2014" on 15th Jan 2014 at "Hotel The Lalit", Mumbai.
- 13) Ajay Khandare and M. Suresh kumar attended "National Space Science Symposium (NSSS) 2014", at Dibrugarh University Assam from 28th Jan to 1st Feb 2014.
- 14) Anil Kulkarni attended International Seminar on Sandalwood at IWSST Bangalore during 26-28 Feb 2014.
- 15) S. Vijayakumari attended training program on "Advanced Techno Management Program for Women Scientists" at Management Development Institute, Gurgaon, New Delhi during December 23, 2013 to January 25, 2014.
- 16) K. Sridhar and A. Agarwal attended the International Defence Expo at New Delhi during February 06-07, 2014.
- 17) S. Vijayakumari, N. Palani and P.S. Penilop attended a seminar on MATHLAB & SIMULINK on July 04, 2013 at Chennai.
- 18) K. Sridhar and S. Prasad attended a Symposium on Electromagnetics and Engineering Education conducted by IEEE, Antenna Propagation Society, Chennai chapter at IIT, Madras on January 03, 2014.
- 19) I. Mahalakshmi, S. Rohini, Dr. Ch. V. Ramarao and M. Saketh attended one day seminar on Zynq 7000 (Xilinx FPGA) conducted by M/s. CoreEI Technologies at Clarion, Chennai on March 20, 2014.
- 20) G. Kalaichelvi, Gopinath Karna, Dr. Ch. V. Ramarao and M. Saketh attended a seminar on "Reliability Techniques, Standardization and Applications" organized by STQC, DeitY at SAMEER, Chennai on March 19, 2014.
- 21) G. Kalaichelvi, Dr. Ch. V. Rama Rao, J. Sathish kumar and M. Saketh attended a seminar on RF and Microwave Measurements conducted by National Instruments on February 04, 2014.
- 22) K. Mourougayane attended seminar and IEEE distinguished lecture on "Terahertz Technology and its applications" by Dr. Gautam Chattopadhyay, Principal Scientist, NASA, JPL, CalTech, USA on February 19, 2014.
- 23) K. Mourougayane attended the 2 Days Workshop on "4G Wireless Technology" organized by the Department of Electronics Engineering, MIT, Anna University in association with Centre of Excellence in Wireless Technology (CEWiT) during February 20-21, 2014.
- 24) K. Mourougayane attended seminar on "Cognitive Wireless Networking" and "Big Data Deception" by Dr. R. Chandramouli, Stevens Institute of Technology, USA on March 10, 2014.
- 25) K. Mourougayane attended one day workshop on Information and Communication Technology (ICT) for Smart Applications" Organized by CDAC, Chennai on March 29, 2014.
- 26) G. Kalaichelvi attended national level workshop on 'R&D issues and challenges' held at Adhiparasakthi Engineering College on November 20-21, 2013.
- 27) G. Kalaichelvi attended conference ICRTIT, 2013 (International Conference on Recent Trends in Information Technology), during July 25-27, 2013 of MIT, Anna University
- 28) G. Kalaichelvi attended Half day Seminar on "MISRA C: 2012, Plenty of Good Reasons to Change - Learn from the Committee Experts" in Chennai arranged by LDRA in the month of May 2013.
- 29) G. Kalaichelvi attended the orientation training of two days (13th & 14th June) provided by the vendor with the purchase of MATLAB and the toolboxes.
- 30) G. Kalaichelvi attended IEEE EMC Society seminar on "Reverberation

- Chambers" by Dr. Vignesh Rajamani on July 12, 2013 at SAMEER
- 31) G. Kalaichelvi attended the IEEE APS seminar on "Research and Publishing" at SAMEER on July 20, 2013
 - 32) G. Kalaichelvi attended a half day seminar on Comprehensive static analysis of embedded software (C/C++ & Ada) using Polyspace products by Mathworks on January 09, 2014
 - 33) G. Kalaichelvi attended IEEE EMC society half a day workshop on Reverberation Chamber and Immunity Testing by Bulk Current Injection" at SAMEER on 20th March 2014.
 - 34) Gopinath Karna attended International Conference on Communications, Networking & Signal Processing (ICCNASP-2013) at VIT University, Vellore, Tamilnadu, India.
 - 35) N. Palani attended 22nd National and 11th International ISHMT-ASME Heat and Mass Transfer Conference, held at IIT Kharagpur, India, during 28 - 31 December, 2013.
 - 36) G. Dhanushkodi attended International Workshop on Thermal Design and Management of Electronics, organized by IEEE CPMT Bangalore Chapter and Indian Institute of Science, Bangalore during December 18-19, 2013.
 - 37) Mahesh Chaluvadi attended a seminar on Waveguide Fed Slot Arrays and Microstrip Reflect Array on June 24, 2013 conducted by IEEE-APS Chennai Chapter.
 - 38) G. Vincentraj attended 3 Days Workshop on Electromagnetics organised by IEEE-APS, Madras section at SSN Engineering College, Chennai during November 11-13, 2013.
 - 39) G. Dhanushkodi attended and presented a lecture on "Design of Electronics systems considering Thermal & EMI/EMC Aspects" during two day Workshop on Electromagnetic Compatibility at SAMEER, Chennai, July 18-19, 2013.
 - 40) M. Saketh attended and presented a paper titled, "UWB Suppression of Simultaneous Switching Noise Using Multi-slit L-bridge EBG Structure" at International conference on Communication and Signal Processing, during August 03-05, 2013 held at Adhiparasakthi Engineering College, Melmaruvathur, India.
 - 41) Satyajit Chakrabarti attended pre-conference tutorial and international conference "ATMS-2014" organised by of "Antenna Test & Measurement Society of India" in Chennai during 11th-12th Feb 2014.
 - 42) Satyajit Chakrabarti, Bijit Biswas, G Arun Kumar and Ms. Mousumi Kundu attended international IEEE Applied Electromagnetics Conference 2013 (AEMC-2013), December 18-20, 2013 at Bhubaneshwar.
 - 43) Arun Kumar, G. Arun Kumar, Bijit Biswas and Mrs. Mousumi Sarkar attended pre-symposium tutorials and symposium at International radar symposium India 2013 (IRSI-13), December 10-14, 2013 at Bengaluru
 - 44) Gopinath Karna presented a paper titled "Implementation of

OFDM transceiver on Vertex 6 FPGA" in International Conference on Communications, Networking & Signal Processing (ICCNASP-2013).

Poster Presentations

- i. Dr. Abhay Deshpande: "Proposal For 30 MeV, 10 kW Linear Electron Accelerator" and "Design of S-Band RF Photocathode Gun" at INPAC Kolkata, Nov. 2013
- ii. Kiran Thakur: "Design and characterization of RF driver to drive high power Klystron" at ICMARS, Jodhpur 2013

Invited Talks

- i. Dr. K. P. Ray delivered an invited talk on "Conformal Antennas" at a CEP course for senior scientists on 'Airborne Surveillance Radar-Technologies and Trends', organized by LRDE, Bangalore during July 22-26th 2013.
- ii. Dr. K. P. Ray delivered an invited talk on "Research Activities of SAMEER" at National Seminar on Advances in Electronics and Allied Science & Technology (NaSAEAST- 2013), August 1-3, 2013 at Gauhati University.
- iii. Dr. K. P. Ray made presentation on food processing using Microwaves at workshop organized by CDAC, Kolkata on 6th Aug, 2013.
- iv. Dr. K. P. Ray delivered invited talk on "High power activities of SAMEER" at National Symposium on High Power RF & Microwave (HPRFM-2013), Institute of Plasma Research IPR, Gandhinagar, 4-6th Sept. 2013.
- v. Dr T Tiwari delivered invited talk on "Design and development of S-band linear accelerator system for defence and space technology", in 9th International Conference on Microwave, Antenna, Propagation, & Remote sensing, Organised by International Centre of Radio Science, Jodhpur during 11-14 December 2013.
- vi. Amol Bhagwat delivered an invited talk on "Indigenous 6 MV Medical Linac" at InPAC at BARC, Mumbai in Dec 2013.
- vii. Dr. S. Das delivered an invited talk at BARC on "Gyrotron Based Terahertz Systems", on 3rd January 2014.

- viii. Dr. K.P.Ray delivered talks on 'Antennas, ST Radar & Medical Applications' at the Workshop on RF & Microwave technology held at Tezpur University, Assam on 23rd & 24th March 2014.
- ix. Dr. Arvind Agarwal delivered a talk on 'Cloud Radar' at the Workshop on RF & Microwave technology held at Tezpur University, Assam on 23rd March 2014.
- x. Dr. K.Chalapathi delivered a talk on 'Photonics' at the Workshop on RF & Microwave technology held at Tezpur University, Assam on 24th March 2014.
- xi. Amol Bhagwat delivered a talk on 'RF/Microwave applications: Medical Linac/ Medical Electronics' at the Workshop on RF & Microwave technology held at Tezpur University, Assam on 24th March 2014.
- xii. R. Krishnan delivered a talk on 'RF/Microwave Application: Industrial Linacs' at the Workshop on RF & Microwave technology held at Tezpur University, Assam on 25th March 2014.
- xiii. Sulabha Ranade delivered a talk on 'Fundamentals of Electromagnetic Interference and Compatibility' at the Workshop on RF & Microwave technology held at Tezpur University, Assam on 25th March 2014.
- xiv. Dr.Tanuja Dixit delivered an invited talk "Overview of Hadron Therapy accelerators in the world" at Advanced Accelerator Workshop, IIT-Bombay, March 2014
- xv. Dipankar Dan has delivered invited talk on " Overview of EMI-EMC" and "Introduction to Microwaves and its applications" in the short term training programme on "Electromagnetic Waves & its Various Applications" during 8th -12th July, 2013 at National Institute of Technical Teachers' Training and Research (NITTR), Kolkata.
- xvi. Kiran Thakur delivered talk on " Development of pulse modulator to drive 6.1 MW Klystron" at HPRFM, Ahmedabad 2013
- xvii. G. Mahesh delivered an invited lecture on 'Introduction to EMI/EMC' to faculty and students of VIT, Chennai campus on September 20, 2013.
- xviii. G. Mahesh delivered invited lectures on EMI/EMC at Government College of Engineering, Salem on October 23, 2013 in their Faculty Development programme (TEQIP).
- xix. Sanjay Baisakhiya delivered lecture on EMI/EMC Standards to participants of Environmental Electromagnetic Effects (E3) management course on September 16, 2013 at Naval Dockyard, Mumbai.
- xx. G. Vincentraj delivered lecture on Civilian EMI/EMC standards and Test facilities at SAMEER to participants of Joint EMI/EMC Course SER-30(D) during February, 2014 at Army Centre for Electromagnetics, Mhow.
- xxi. S. Vijayakumari delivered a lecture on RF, EMI/EMC in System Design in 3rd National Level Technical Symposium on 01.03.13 at University College of Engineering, Villupuram.

- xxii. S. Vijayakumari delivered a lecture in "Technical Symposium - AGNIMITHRA-2K14" at University College of Engineering, Villupuram, on February 28, 2014.
- xxiii. G. Kalaichelvi Conducted Tutorial & Practical Lab Session for the Faculty Of Engineering Colleges and Research Students during the Faculty Development Programme on "Information Theory and Coding" in the Department of Information Technology of MIT, Anna University, Chennai on June 15-17, 2013.
- xxiv. G. Kalaichelvi presented a technical seminar during "AVALANCE -13" in the Department of ECE of Meenakshi Sundararajan Engineering College titled "Reaching SHANNON's Bound - Specter & Solutions" featuring forward error correction and band aggregation techniques on August 16, 2013
- xxv. G. Kalaichelvi served as a member of the advisory committee of the conference titled 'National conference of recent innovations in Electronics and communication engineering' conducted in the Meenakshi Sundararajan engineering college on February 11, 2014 and chaired the session on 'Communication'.
- xxvi. G. Kalaichelvi presented an invited talk titled "Mathematics in the Future Generation of Wireless Technology" in the International conference on applications of mathematics in modern technology, held by post graduate and research department of Mathematics, of Queen Mary's College, on March 27, 2014 on the occasion of centenary celebrations.

Training Programme attended/conducted

- i. Milind Joshi and Shrikant Hangirgekar attended the 5 day training program on Laboratory Management & Internal Audit

- as per ISO / IEC 17025:05, 21-24 May 2013 held at IDEMI, Mumbai.
- ii. Dr. K.P. Ray SAMEER organized a five day training programme in SAMEER, Mumbai during 22-26 July, 2013 for SAMEER Personnel both technical and administrative regarding Administrative and Financial matters. CCS conduct rules, disciplinary measures, RTI, procurement policy, leave rules etc. Eminent resource personnel from DAE were invited for the training programme that was well attended by staff members. Similar training programme was organized for Administrative staff of SAMEER, Chennai with the resource personnel from IGCAR, BARC & IMSC, DAE, Chennai during November 25 to 29, 2013.
 - iii. Laboratory demonstrations of EMC tests as per MIL STD were conducted as a part of the E3 Management Course 2013 for Naval EMC centre on 20th September 2013.
 - iv. EMC Awareness & Demonstrations of EMC tests for trainee engineers from M/s IGATE Global Solutions Ltd was organized by EMI/C Division, SAMEER, Mumbai in October, 2013 at the EMC Centre, Navi Mumbai.
 - v. Sulabha Ranade attended the 5 day training program on "Laboratory Management & Internal Audit as per ISO / IEC 17025:05", 16-19 October 2013 held at Bangalore by CII Quality Management Institute.
 - vi. A. Agarwal attended the NIAS- DST training programme on "Policy for Science and Science for Policies" held at NIAS Bangalore, 16-20 December, 2013.
 - vii. Shrikant Hangirgekar and Ramesh Pawar attended the Training Program on "Measurement Uncertainty" 7 February 2014 at ERTL (W), Mumbai.
 - viii. K. Nirmala attended the NIAS-DST Training Programme for Women Scientists on "Science for Progress in India: Innovations in Technologies" held at this Institute from 10 - 14 February, 2014.
 - ix. First phase of Training under the Phase-I of ToT of 6MV SIDDHARTH Medical Linear Accelerator was conducted by scientists from MED2 and GFD. Engineers from M/s Panacea Medical Technologies, Bangalore attended the training in 16th -24th Dec 2013 as well as hands on testing on HV Modulator and further interactive training 17th -23rd March 2014 system.
 - x. The General Facility Division engaged 16 apprentices in the Fitting/ Turning/ Milling and Chemical sections for a period of twelve months ending Oct 2013 and provided hands on training as per the requirements of National Council for Technical and Vocational Training (NCTVT) a national level Government body.
 - xi. Satyajit Chakrabarti and Dipankar Dan attended NABL assessors course as per ISO/IEC 17025: 2005 organised by NABL, India at Chennai during 2nd -6th Sep 2013.
 - xii. Satyajit Chakrabarti and Dipankar Dan attended "2nd National Conclave for Laboratories" at Bangalore during 16th -17th Sep 2013 organised by NABL and Confederation of Indian Industries.
 - xiii. Scientists from SAMEER Kolkata centre attended training program on "Agilent E5052B signal source analyzer " held at centre on 4th July, 2013.
 - xiv. Scientists from SAMEER Kolkata centre attended training program on " IE solver, PO solver and hybrid solvers" held at the centre on 9th December, 2013.
 - xv. Aritra Banerjee, Mousumi Sarkar, Sukhendu Bhanja, Souma Chatterjee, Paramita Banerjee, Bijit Biswas, G. Arun Kumar attended a presentation on load-pull measurement system presented by representative of M/s Focus on load-pull measurement system.
 - xvi. Dr. Anuj Bhatnagar and Dr. Alok Verma attended Photonics Working Group meeting as invitees at DeitY on 15th July 2014.
 - xvii. Dr. S. Das attended during November 11-22, 2013 the programme on- Science Administration and Research Management - at Administrative Staff College of India, Hyderabad.
 - xviii. On-site EMC Training Programme was conducted for an automotive company at Coimbatore.

Prominent Visitors

- I Sri J. Satyanarayana, Secretary,

- DeitY visited SAMEER Kolkata Centre on 29th Dec, 2013.
- ii. Prof B. Rawat, University of Reno, Nevada, USA visited SAMEER Mumbai on December 30, 2013.
 - iii. Dr. Rajiv Gupta, Massachusetts General Hospital, MA, USA visited SAMEER , Mumbai on 12th December 2013 to carry out x-ray detection feasibility studies with students from MIT, USA & technical discussions with scientists from Medical Electronics Division-2
 - iv. A delegation of ABB Ltd visited SAMEER-CEM to get familiar with EMI/EMC Test facilities available at the Centre on March 10, 2014.
 - v. Team of senior engineers from M/s. Danfoss Industries Pvt. Ltd visited EMI/EMC Test lab of SAMEER-CEM on May 21, 2013.
 - vi. Prof. T. K. Sarkar of Syracuse University visited SAMEER Kolkata centre on 27th December, 2013 and delivered a lecture on "Higher Order Basis Based Integral Equation Solver (HOBBIES)".
 - vii. Project Manager and Safety manger of M/S ANSALDO-STIS, responsible for Mumbai Monorail Project, visited EMC Laboratory of SAMEER Kolkata, to discuss EMC issues in railway site and to finalize proposal for EM survey of monorail site at Mumbai.

Publications

- 1) S. Ghosalkar, K.P. Ray, R. Rangari, S. Gharge "Design of Phase Shift Control For Transmit/ Receive Module of ST Radar" , International Journal of Computers and Technology, ISSN 2277- 3061, Vol 12, No.4
- 2) K. P. Ray and S. S. Thakur, "Compact UWB Slot Antenna", International Journal of Informatics and Communication Technology (IJ-ICT), ISSN: 2252-8776, Oct. 2013.
- 3) D. Jagyasi, K. P. Ray, S. Choudhari and S. Krishnan "Six Bit Digital Phase Shifter using Lumped Network for ST Radar", International Journal of Computer Applications , Foundation of Computer Science, USA, pages 5-11, 2013.
- 4) K. P. Ray, C. Prince, S. S. Kakatkar and K. Nirmala, "Vertically polarized Cavity Backed Shorted Hexagonal Patch Antenna", Progress In Electromagnetics Research Letters (PIERS-L), Vol. 43, pp. 185-190, November 2013.
- 5) T Tiwari, "Study of R F window for portable type C-band linear accelerator system", Physical & Environmental Science Bulletin, vol. 1, no. 1, pp.19-24, May 2013.
- 6) T Tiwari, "Study of high power RF window for S-band linear accelerator system", National Symposium on High Power RF and Microwave (HPRFM-2013), pp. 63-64, 4-6 September 2013, Institute for Plasma Research (IPR) Gandhinagar.
- 7) T Tiwari, Manoj Phatangre, Tanuja Dixit, A P Deshpande, and, R Krishnan, "Design and development of beam flattener for magnetron based linear accelerator system", 9th International Conference on Microwave, Antenna, Propagation, & Remote sensing, pp. 124-125, International Centre of Radio Science, Jodhpur during 11-14 December 2013.
- 8) T Tiwari, "High power dielectric window for S-band linear accelerator system", 9th International Conference on Microwave, Antenna, Propagation, & Remote sensing, pp. 126-127, International Centre of Radio Science, Jodhpur during 11-14 December 2013.
- 9) J.S. Sajin, G.Praveen, H.U.Habiba and P.H.Rao, "Extremely Compact Phase Delay Line with CTSRR Loaded Transmission Line", Electronics Letters, Vol.50, No.3, pp.190-192, January 2014.
- 10) M.S Abdul Vahid, M.Sreenivasan, P.H.Rao, "Design optimization of low side lobe level microstrip array", IEEE Applied Electromagnetic Conference (AEMC-2013), Bhubaneswar, India, December 2013.
- 11) K. Sridhar, M. Saketh and P. Samundiswary, "UWB suppression of Simultaneous Switching Noise Using Multi-slit L-

- bridge EBG Structure" at International Conference on Communication and Signal Processing, during August 03-05, 2013 held at Adhiparasakthi Engineering College, Melmaruvathur, India.
- 12) S. Prasad and N. Jagan, "Electromagnetic Noise Mitigation in Mixed Signal Systems Using complimentary Split ring Resonator" at IEEE Applied Electromagnetics Conference held at KIIT University, Bhubaneswar, December 18-20, 2013.
 - 13) S. Prasad, "Novel MCTSRR structure for wide stop band response in a micro-strip transmission line" at IEEE Applied Electromagnetics Conference held at KIIT University, Bhubaneswar, December 18-20, 2013.
 - 14) N. Palani & G. Dhanushkodi, "Effect of Fin Tip Clearance on Performance of Heat-sink and Selection of Fan for Cooling of High Power RF Modules", 22nd National and 11th International ISHMT-ASME Heat and Mass Transfer Conference, Indian Institute of Technology, Kharagpur, December 28-31, 2013.
 - 15) Tanmay Banglorekar , Ajay Khandare and Meena Panase, "LabVIEW based communication system for Ionosonde with Hexadecimal data", International Journal Of Enhanced Research In Science Technology & Engineering, Vol. 2 Issue 1, Jan.-2013.
 - 16) Rohit Deshpande, Ajay Khandare and Meena Panase, "Timing and control signal Generation for ionosonde system based on LabVIEW" , International Journal of Emerging Technology and Advanced Engineering (IJETA), Vol. 3, Issue 2, February 2013, pp.230-233
 - 17) Tanmay Banglorekar , Ajay Khandare and MeenaPanase, "An introduction to the Ionosonde system and a LabVIEW based simulation of the data exchange between Ionosonde system and a computer on TCP/IP", National Conference on Recent Advances in Electronics and Telecom Engineering, 23rd March, 2013, organized by Institution of Engineers India, at Mumbai.
 - 18) Rohit Deshpande, Ajay Khandare and Meena Panase, "Generation of parameters, Simulation and Noise profile calculation for ionosonde system based on LabVIEW" , National Conference on Recent Advances in Electronics and Telecom Engineering, 23rd March, 2013 at Mumbai, organized by Institution of Engineers India.
 - 19) Niyati Chelawat, S. Chaurasia, Indrajit Boiragi, and Alok J. Verma, " Development of Photoacoustic gas cell for trace gas measurement by IR laser absorption technique" PHONONICS 2013: 2nd International Conference on Phononic Crystals / Metamaterials, Phonon Transport and Optomechanics, Egypt, June 2-June 7, 2013.
 - 20) Shivangi Chaurasia, Niyati Chetwal, Indrajit Bairagi and Alok J. Verma, " QCL based direct absorption for finding detection limit of CO trace gas sensor" , IVth International Conference on Perspectives in Vibrational Spectroscopy (ICOPVS 2013), Kerala, India, 06- 09 August, 2013.
 - 21) K. P. Ray, R. G. Rangari, S. S. Choudhari, V. S. Sarode and V. T. Acharekar "Design and Development of a 75MHz, 5kW CW/ Pulsed Amplifier", Proc. High Power RF and Microwave 2013 (HPRM2013), IPR Gandhinagar, September 2013.
 - 22) D. Jagyasi, K. P. Ray, S. Choudhari and S. Krishnan, "A Novel Tee Network based Six Bit Digital Phase Shifter for ST Radar" 5th International Academic Conference on Electrical, Electronics and Computer Engineering (IACEECE-2013), ISBN: 978-93-82702-30-6, pages 102- 107.
 - 23) K. P. Ray, K. Nirmala, S. S. Kakatkar, N. S. Madaka, C. Prince, "Broadband Modified Wilkinson Power divider Fed Antipodal Vivaldi Antenna Array," Intl. Conf. on Microwave and Photonics (ICMAP 2013), Dec. 13-15, Dhanbad
 - 24) S. S. Kakatkar and K. P. Ray, "Analysis Of Longitudinal Slot In A Rectangular Waveguide Using Image Series And Chebyshev-Toeplitz Algorithm," Intl. Conf. on Microwave and Photonics (ICMAP 2013), Dec. 13-15, 2013 Dhanbad.
 - 25) S. S. Kakatkar and K. P. Ray, "Efficient Analysis of

- Waveguide Longitudinal Slot with Edge Condition Using the Sum of Images", IEEE Appl. Electromag. Conf. (AEMC 13), Dec. 18-20, 2013 Bhubaneshwar
- 26) Arun Mallik and Anuj Bhatnagar, "Broadband characterization of photonic devices using Labview based automated laboratory setup", Journal of Instrument Society of India, Vol. 43, No. 3, pp. 198-200, 2013.
 - 27) Indrajit Boiragi, S. Chaurasia and Alok J. Verma, "Trace Ammonia (NH₃) sensing using SLED and Multipass gas cell for Atmospheric monitoring application", Journal of Instrument Society of India, Vol. 44, No. 1, pp. 16-19, 2013.
 - 28) A. K. Mallik, A. Bhatnagar, K. Mittholiya, R. Bernard, J. A. Dharmadhikari, D. Mathur and A. K. Dharmadhikari, "Ultrashort laser based direct writing of waveguides and splitters in borosilicate glass", National Laser Symposium Jan 08 - 11, 2014, Manipal University.
 - 29) S. Chourasia, R. Agrawal, S. Patil, I. Bairagi and A. J. Verma, "Direct absorption based Ppb level detection of trace CO using a high power CW DFB-QCL", National Laser Symposium, Manipal University, India, 6-8 January 2014
 - 30) Anil Kulkarni, Ajay Khandare, Suresh Kumar and Tanmay Banglorekar, "Development of Indigenous Digital Ionosonde System", National Space Science Symposium NSSS2014, 28 Jan to 1 Feb 2014, Dibrugarh University.
 - 31) Ajay Khandare, Anil Kulkarni, Bharati Shende and Renu Kumari. "Development of Scintillation Receiver for Ionospheric studies", National Space Science Symposium NSSS2014, 28 Jan to 1 Feb 2014, Dibrugarh University.
 - 32) Sagar Mhatre, Ajay Khandare and P.B. Borole " Doppler Wind Profiler Radar at 50 MHz" International Journal of Emerging Trends in Electrical and Electronics (IJETEE), April 2013, Vol 2. Issue 3.
 - 33) Anil Kulkarni, Ajay Khandare and Mandar Malve, "Wireless Sensor Network (WSN) for protection high cost trees from fire and poaching", International Seminar on Sandalwood at IWSB Bangalore during 26-28 Feb 2014.
 - 34) Sushma Pandey, Rohini A. Deshpande and Sulabha Ranade "Designing of CSIW Horn Antenna" IOSR Journal of Electronics and Communication Engineering (IOSR-JECE) e-ISSN: 2278-2834,p- ISSN: 2278-8735. Volume 7, Issue 6 (Sep. - Oct. 2013), PP 12-16
 - 35) Gyanendra Verma, Gautam Shende and Sulabha Ranade "Single Spark Gap Based Impulse Generator for NEMP Simulator", was accepted for Poster presentation at the National Symposium on High Power RF & Microwave 2013, 5th September 2013, Gandhinagar.
 - 36) Twisha Pandey, Tapas K Bhuiya, Ravi Singh and Bharti Singh "Miniature closed loop resonator bandpass filter Design using 'dumbbell and slot' Defected Ground Structure (DGS)", International Conference on Computer Science & Information Technology, 20th Jan. 2013, Mumbai
 - 37) Samruddha Thakur, Tapas K Bhuiya, S. S. Narkhede, Ravi Singh, "Microstrip Patch Antenna Array for Rainfall Radar", International Conference on Electrical, Electronics and Data Communication, ICEEDC-2013, 10th March 2013, Pune
 - 38) S. Rambabu, J. S. Pillai, A. Agarwal and H. J. Goswami, "Climatological study of Turbulence Structure Constant (Cn₂) Over Two tropical stations Mumbai and Guwahati of India", Current Science, Vol. 104, No. 7, 10 April 2013, pp. 944-950
 - 39) Arvind Agarwal, J. D. Abhyankar, K. Aurobindo. G. S. Isola, "1:5 Way In-Phase Equal Power Divider/Combiner using Enclosed Cylindrical Rod lines for High Power VHF Applications", International Radar Symposium India (IRSI 2013), Bangalore, India, 10-14 Dec 2013.
 - 40) S. Rambabu, Arvind Agarwal, J. S. Pillai, "A comparative analysis

- of atmospheric attenuation between Coastal and Inland stations of India for Ka-band Cloud Radar”, International Radar Symposium India (IRSI 2013), Bangalore, India, 10-14 Dec 2013.
- 41) Arvind Agarwal, K. Aurobindo, G. S. Isola, J. D. Abhyankar, P. Srivastava, J. S. Pillai, S. Rambabu , “Ka-Band polarimetric Doppler radar for profiling of low level clouds at Mumbai during monsoon season, International Radar Symposium India (IRSI 2013), Bangalore, India, 10-14 Dec 2013.
 - 42) P. Shrivastava, A. Agarwal, R. K. Shevgaonkar, “Target Signature Recognition Using Ultra Short Pulse Radar”, International Radar Symposium IRS-2013, 19-21 June, 2013, Dresden, Germany.
 - 43) G. Arun Kumar and Arun Kumar, "Low Conversion Loss Ka-band Suspended Stripline Mixer with Low LO Power", IEEE Applied Electromagnetics Conference 2013 (AEMC-2013), December 18-20, 2013.
 - 44) Bijit Biswas, and Arun Kumar, "Design of a Millimeter Wave Frequency Tripler at Q-Band," IEEE Applied Electromagnetics Conference (AEMC-2013), during 18th -20th December, 2013, Bhubaneswar, India.
 - 45) Satyajit Chakrabarti, “Transparaboloid Reflector Antenna at Ka-band,” IEEE Applied Electromagnetics Conference (AEMC-2013), during 18th -20th December, 2013, Bhubaneswar, India.
 - 46) S. Bhanja, M. Sarkar, T. Ghosal, A. Majumdar, “A Compact Modulator Circuit with High Current Protection For Low Chirp Pulsed IMPATT Oscillator,” IEEE Applied Electromagnetics Conference (AEMC-2013) during 18th - 20th December, 2013, Bhubaneswar, India.
 - 47) Ajay Tiwari, Brajraj Sharma, D Bhatnagar, K. B Sharma, Vijay Sharma, and Satyajit Chakrabarti, “Design of compact wideband Key-slotted circular microstrip patch antenna with finite ground plane,” IEEE Applied Electromagnetics Conference (AEMC-2013) during 18th - 20th December, 2013, Bhubaneswar, India.
 - 48) S. Mukherjee, M. Sarkar, S. Bhanja, A. Majumdar, “Computer Aided Design of Broad-band Rectangular Waveguide Directional Coupler at W band,” IEEE Applied Electromagnetics Conference (AEMC-2013) during 18th - 20th December, 2013, Bhubaneswar, India.
 - 49) Satyajit Chakrabarti and Arkadip Basu, " Stripline Fed Tapered Slot Antenna," International Conference on Antenna Test and Measurement - ATMS 2014, during 11th -12th Feb 2014, Chennai India.
 - 50) Shaswatee Paul and Dipankar Dan, “Analysis and Design of Power Line Filter Using Transmission parameters,” in IEEE Conference on “Emerging Trends in Computing and Communication 2014” during 22th -23th March, 2014, Kolkata India.
 - 51) Shaswatee Paul and Dipankar Dan, “A Proposed Model of Ferrite core Common-Mode Choke for Suppression of Conducted Interference,” in "International Conference on Functional Materials" during 5th -7th Feb, 2014, IIT Kharagpur, India.
 - 52) M. Sarkar, S. Bhanja, A. Majumdar, “Computer Aided Design of Millimeter Wave Continuous Wave Power Combiner, ” Microwave and Optical Technology Letter (MOTL), Vol.-56, Issue -3, pp. 705-709, March, 2014.

Students Training Program

- I Dr.Anuj Bhatnagar guided three students from SGSITS, Indore and one student from Kerala University for their M.Tech Projects.
- ii. Dr.Alok Verma guided two students from SGSITS, Indore for their M.Tech projects.
- iii. Sen Mathews guided one student from SGSITS, Indore for his M.Tech Project.
- iv. Roshan Makkar guided a student from SRM University, Tamil Nadu for the M.Tech project titled “Development Of High Resolution Imaging System Using Spectral Domain-Optical Coherence Tomography (Sd-Oct) At 1310 Nm Wavelength”,
- v. Roshan Makkar guided a student from Vivekanand Education Society's Institute Of

Technology, University Of Mumbai, Mumbai for his M.E. Project titled "Signal And Image Processing For Spectral Domain - Optical Coherence Tomography (Sd-Oct) System",

- vi. Dr. S. Das guided a student from from College of Engineering, Pune in his M. Tech. project on "Development of Graphic User Interface for a Gyrotron System for Detection of Concealed Radioactive Materials"
- vii. Sulabha Ranade guided two M. Tech. Students who have their Thesis based on the work done on SIW technology
- viii. Electromagnetics &Antenna Division gave training to 7 students for project work towards ME/M.Tech and MS Programme.
- ix. S. Vijayakumari guided a student from of Sri Sastha Institute of Engineering and Technology, Chennai on "Coupled Line Narrow Band Pass Filter with high rejection using CSRR" during November 2013 to January 2014.
- x. S. Prasad guided a student from Sri Venkateswara College of Engineering, Sri Perumbudur, Chennai on "Power Integrity on High frequency Analog Circuits in Mixed Signal PCB' during December 2012 to July 2013.
- xi. S. Prasad guided a student from Sri Venkateswara College of Engineering, Sriperumbudur, Chennai on "Design and Implementation of multi-layer Embedded Filter for L Band applications" during December 2012 to July 2013.
- xii. S. Rohini guided a student from Hindustan Institute of technology and Science, Chennai on "Optimization of Diversity Receiver using Genetic Algorithm" during December 2012 to July 2013.
- xiii. Sinivasa Rao co-ordinated the visit of P.G Students from the Department of ECE of Agni College of Technology on February 07, 2014 to SAMEER-CEM, Taramani Campus.

Chairperson / Examiners

- I Dr. K. P. Ray chaired a session on 'Remote sensing techniques in exploration to current atmospheric changes including Natural hazards', on August 2, 2013 at National Seminar On Advances in Electronics and Allied Science & Technology (NaSAEAST- 2013) Gauhati University.
- ii. Dr. K. P. Ray chaired a session on 'High Power Systems" on 4th September 2013 at National

Symposium on High Power RF & Microwave (HPRFM-2013), Institute of Plasma Research (IPR), Gandhinagar.

- iii. Dr T Tiwari was Chairman of technical session in 9th International Conference on Microwave, Antenna, Propagation, & Remote sensing, Organised by International Centre of Radio Science, Jodhpur during 11-14 December 2013.
- iv. Dr. K. P. Ray chaired two sessions at International Conference on Microwave and Photonics (ICMAP) 2013, Indian School of Mines, Dhanbad, during December 13-15, 2013.
- v. Dr. K. P. Ray was appointed a member of the Pre Design Review (PDR) Committee by DST for "ST Radar Project" being implemented at Cochin University.
- vi. Dr. Alok Verma evaluated ME (Electronics & Telecom) thesis and conducted viva at NIT Surat.
- vii. Dr. Alok Verma evaluated a PhD dissertation and taken viva of at MNIS, Mumbai.
- viii. Milind Joshi attended Master of Engineering (M. E.) Dissertation examination as an external examiner at Terna Engineering College, Nerul, Navi Mumbai affiliated to University of Mumbai.
- ix. Milind Joshi attended Master of Engineering (M. E.) Dissertation examination as an external examiner at Pune Institute of Technology (PICT), Pune affiliated to University of Pune on three occasions.
- x. Milind Joshi attended Bachelor of Engineering (B. E.) Project

examination as an external examiner (VII th & VIII th semester) at K. J. Somaiya College of Engineering, Mumbai affiliated to University of Mumbai.

Hindi Day

In the second half of September "Hindi Pakhwada" was celebrated in SAMEER. Hindi Officer of SAMEER organised a 'Hindi Day' on 27th September, 2013. On this occasion, Hindi Officer of BARC, 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. Hindi Day Function was also attended by Ex Director Finance, DeitY; Programme Director, Heads of the divisions and members of SAMEER.

SOCIAL AND CULTURAL EVENTS

All staff members of SAMEER Kolkata, along with their family members participated in a picnic organized on 11th Jan 2014 at Budge Budge Municipal Park, near Kolkata.

Participation in Exhibitions

Participated in India Telecom 2013 Exhibition at New Delhi from December 05-07, 2013

Patents

Patent documents for the in-house developed TE03 mode launcher sent by Dr. S.Das to DeitY for filing

ANNUAL ACCOUNTS 2013-14

AUDITOR'S REPORT

TO THE MEMBERS OF

SOCIETY FOR APPLIED MICROWAVE ELECTRONICS ENGINEERING & RESEARCH

REPORT ON THE FINANCIAL STATEMENTS

We have audited the accompanying financial statements of **SOCIETY FOR APPLIED MICROWAVE ELECTRONICS ENGINEERING & RESEARCH** ("the Society"), a Society registered under the Society's Registration Act, 1860, which comprise the Balance Sheet as at March 31, 2014, the Income and Expenditure [Account](#) for the year then ended, and a summary of significant accounting policies and other explanatory information.

MANAGEMENT'S RESPONSIBILITY FOR THE FINANCIAL STATEMENTS

Management is responsible for the preparation of these financial statements that give a true and fair view of the financial position and financial performance of the society in accordance with the Accounting Standards notified under the Companies Act, 1956 (the Act) read with the General Circular 15/2013 dated 13th September, 2013 of the Ministry of Corporate Affairs in respect of Section 133 of the Companies Act, 2013 and in accordance with the accounting principles generally accepted in India. This responsibility includes the design, implementation and maintenance of internal control relevant to the preparation and presentation of the financial statements that give a true and fair view and are free from material misstatement, whether due to fraud or error.

AUDITORS' RESPONSIBILITY

Our responsibility is to express an opinion on these financial statements based on our audit. We conducted our audit in accordance with the Standards on Auditing issued by the Institute of Chartered Accountants of India. Those Standards require that we comply with ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditor's judgment, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the society's preparation and fair presentation of the financial statements in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the society's internal control. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of the accounting estimates made by management, as well as evaluating the overall presentation of the financial statements.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our qualified audit opinion.

BASIS FOR QUALIFIED OPINION:

- a) No provision has been made for gratuity and leave encashment as stipulated by AS-15 Employee Benefits(Refer Note No.2(e) of Schedule 20)
- b) Provision for pension has been made on adhoc basis instead of providing as stipulated by AS-15 Employee Benefits(Refer Note No.2(f) 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.

QUALIFIED OPINION:

In our opinion and to the best of our information and according to the explanations given to us, except for the effects of the matters described in the Basis for Qualified Opinion paragraph, the aforesaid financial statements give the information required by the Act in the manner so required and give a true and fair view in conformity with the 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, 2014; and
- (b) In the case of the Statement of Income and Expenditure Account, of the excess of income over expenditure of the Society for the year ended on that date.

REPORT ON OTHER LEGAL AND REGULATORY REQUIREMENTS**1. Subject to above, we report that :**

- a. We have obtained all the information and explanations which to the best of our knowledge and belief were necessary for the purpose of our audit;
- b. In our opinion, proper books of account as required by law have been kept by the Society so far as appears from our examination of those books.
- c. The Balance Sheet and the Income and Expenditure Account dealt with by this Report are in agreement with the books of account.
- d. In our opinion, the Balance Sheet and the Income and Expenditure Account comply with applicable Accounting Standards read with the General Circular 15/2013 dated 13th September, 2013 of the Ministry of Corporate Affairs in respect of Section 133 of the Companies Act, 2013, except Accounting Standard 15 Employee Benefits.

For **B. Maheshwari & Co.**

Chartered Accountants

(Firm Registration No. 105839W)

CA Surendra Heda

(Partner)

Membership No.: 102316

Place : Mumbai

Date :05.09.2014

BALANCE SHEET AS ON 31ST MARCH 2014

| PARTICULARS | SHC. NO. | March 31, 2014 | March 31, 2013 |
|---|----------|----------------------|-----------------------|
| SOURCE OF FUNDS | | | |
| A. Capital funds | 1 | 1,171,354,270 | 93,42,99,517 |
| Less: Deprec. Amount transferred from I & E A/c | | 920,433,350 | 81,20,68,043 |
| B. Sponsored project funds | 2 | 372,146,445 | 61,10,26,310 |
| C. Income & Expenditure Account | | 1,644,659,449 | 1,43,36,86,320 |
| Total | | 2,267,726,814 | 2,16,69,44,104 |
| APPLICATION OF FUNDS | | | |
| ASSETS | | | |
| D. Fixed Assets | 3 | 976,628,225 | 92,85,35,234 |
| Add: Transferred from Sponsored Projects(Gross) | | 266,251,296 | --- |
| Gross Fixed Assets | | 1,242,879,521 | 92,85,35,234 |
| Less: Depreciation | | 978,641,630 | 79,29,38,487 |
| Net Value | | 264,237,892 | 13,55,96,748 |
| E. Capital Work in Progress | | 147,265,956 | 12,12,23,903 |
| | | 411,503,848 | 25,68,20,651 |
| F. Sponsored Project Assets | 4 | 1,040,029,838 | 1,02,55,79,414 |
| Less: Transferred to Fixed Assets | | 266,251,296 | --- |
| Net Sponsored Project Assets | | 773,778,542 | 1,02,55,79,414 |
| Less: Depreciation | | 719,626,693 | 72,79,24,280 |
| Net value | | 54,151,849 | 29,76,55,133 |
| Current Assets, Loans and Advances | | | |
| G. Current Assets | 5 | 146,683,881 | 10,88,63,345 |
| H. Loans & Advances | 6 | 71,908,878 | 8,84,61,551 |
| I. Cash & Bank Balances | 7 | 1,672,365,568 | 1,49,49,26,590 |
| | | 1,890,958,327 | 1,69,22,51,486 |
| Less: | | | |
| J. Current Liabilities | 8 | 88,887,211 | 7,97,83,167 |
| | | 1,802,071,116 | 1,61,24,68,319 |
| Total | | 2,267,726,814 | 2,166,944,104 |

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

As per our report of even date attached

For

B. MAHESHWARI & CO.

Chartered Accountants

Firm Registration No. 105839W

CA SURENDRA HEDA

PARTNER

Membership no. : 102316

Mumbai

Dated :05.09.2014

VINOD KUMAR SHARMA

HFA & REGISTRAR

DR. A. L. DAS

DIRECTOR

INCOME & EXPENDITURE ACCOUNT

FOR THE YEAR ENDED 31ST MARCH, 2014

| PARTICULARS | SCH. NO. | 2013-14 | 2012-13 |
|---|----------|----------------------|-----------------------|
| INCOME | | | |
| A. Grant received - Ministry of Communications, Information & Technology, (MCIT) less amount utilised for Capital Expenditure | 9 | 462,579,709 | 36,62,04,247 |
| B. Test measurement & Consultancy services | 10 | 55,134,790 | 4,61,08,425 |
| C. Other Income | 11 | 166,568,173 | 171,810,254 |
| Total (a) | | 684,282,672 | 584,122,926 |
| EXPENDITURE | | | |
| A. Salaries, Allowances & Staff benefits | 12 | 343,937,977 | 30,32,25,608 |
| B. Travelling & Conveyance | 13 | 17,506,104 | 1,51,65,056 |
| C. Administrative Expenses | 14 | 108,102,975 | 7,32,96,816 |
| D. Human Resource Development | 15 | 732,913 | 8,78,859 |
| E. Components, Consumables & Fabrication | 16 | 172,766,514 | 16,19,27,476 |
| F. Repairs & Maintenance | 17 | 32,002,624 | 3,61,59,751 |
| | | 675,049,107 | 59,06,53,566 |
| Less : Expenses Recovered - Sponsored projects | 18 | 194,173,934 | 21,86,15,023 |
| Total (b) | | 480,875,173 | 37,20,38,543 |
| Excess of Income over Expenditure (a - b) | | 203,407,499 | 212,084,383 |
| Less: Depreciation on Fixed assets | 19 | 108,365,306 | 105,015,339 |
| Balance after depreciation | | 95,042,192 | 107,069,044 |
| Add : Amount transfered from Capital Fund | | 108,365,306 | 10,50,15,339 |
| Add: Balance as per last year | | 1,433,686,320 | 1,22,16,01,937 |
| Add/(Less): Prior Period Income/(Expenses) | | 7,565,630 | -- |
| Balance carried forward to Balance Sheet | | 1,644,659,449 | 1,43,36,86,320 |

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

As per our report of even date attached

For
B. MAHESHWARI & CO.
Chartered Accountants
Firm Registration No. 105839W

CA SURENDRA HEDA
PARTNER
Membership no. : 102316

VINOD KUMAR SHARMA
HFA & REGISTRAR

DR. A. L. DAS
DIRECTOR

Mumbai
Dated :05.09.2014

SCHEDULE FORMING PART OF THE BALANCE SHEET AS ON 31ST MARCH, 2014

SCHEDULE 1 CAPITAL FUNDS

| PARTICULARS | MUMBAI | | CHENNAI | | KOLKATA | | TOTAL | |
|---|--------------------|---------------------|--------------------|---------------------|--------------------|---------------------|---------------------|---------------------|
| | March 31, 2014 | March 31, 2013 | March 31, 2014 | March 31, 2013 | March 31, 2014 | March 31, 2013 | March 31, 2014 | March 31, 2013 |
| Land - Leasehold | 1118,96,226 | 10,91,71,156 | - | - | 11,45,149 | 11,45,149 | 11,45,149 | 11,45,149 |
| Building | 102,79,000 | 90,97,914 | 397,73,270 | 3,73,89,613 | 324,01,619 | 3,24,01,619 | 1840,71,115 | 17,89,62,388 |
| Furniture & Fixtures | 2790,94,532 | 26,54,94,415 | 46,35,959 | 45,97,906 | 48,47,979 | 47,31,349 | 197,62,938 | 1,84,27,169 |
| Lab & Office Equipment | 174,50,338 | 1,56,27,844 | 2200,43,736 | 21,52,78,979 | 1814,90,780 | 16,34,05,507 | 6806,29,048 | 64,41,78,901 |
| Computers and peripherals | - | - | 85,68,496 | 79,58,350 | 349,64,563 | 3,28,84,493 | 609,83,397 | 5,64,70,687 |
| Electrical Equipment | 39,89,821 | 39,89,821 | 10,29,282 | 10,29,282 | 1,15,538 | 1,15,538 | 1,15,538 | 1,15,538 |
| Motor Vehicles | 79,47,900 | 79,31,149 | 84,79,447 | 84,11,514 | 14,09,143 | 14,09,143 | 64,28,246 | 64,28,246 |
| Library Books | 5,08,494 | 5,08,494 | 89,01,620 | 89,01,620 | 29,92,441 | 26,13,578 | 194,19,788 | 1,89,56,241 |
| Other Equipments | - | - | 2,70,391 | - | 2,05,084 | 2,05,084 | 96,15,198 | 96,15,198 |
| Software | - | - | - | - | - | - | 2,70,391 | - |
| Capitalization of closed sponsored Projects | - | - | - | - | 1889,13,462 | - | 1889,13,462 | - |
| TOTAL | 4311,66,311 | 41,18,20,793 | 2917,02,201 | 28,35,67,264 | 4484,85,758 | 23,89,11,460 | 11713,54,270 | 93,42,99,517 |

SCHEDULE 2 SPONSORED PROJECT FUNDS

| PARTICULARS | MUMBAI | | CHENNAI | | KOLKATA | | TOTAL | |
|--|--------------------|---------------------|---------------------|---------------------|--------------------|---------------------|--------------------|---------------------|
| | March 31, 2014 | March 31, 2013 | March 31, 2014 | March 31, 2013 | March 31, 2014 | March 31, 2013 | March 31, 2014 | March 31, 2013 |
| Balance as per last Balance sheet | 4675,07,688 | 42,52,87,172 | - | 5,17,30,002 | 2066,16,607 | 26,32,85,713 | 6110,26,310 | 74,03,02,887 |
| Add / Less: | | | | | | | | |
| Surplus on Closure of Sponsored Project | - | - | - | - | - | - | - | - |
| Deficit on closure of Sponsored Project | - 48,48,468 | -85,14,541 | - | -1,58,02,450 | - | - | - 48,48,468 | 2,43,16,991 |
| Amount refunded to Deity | - | - | 296,83,692 | -4,91,29,000 | 41,14,935 | - | 337,98,627 | -4,91,29,000 |
| Advance paid to co-agencies | - | - | - | - | - | - | - | - |
| Asset transferred to Kolkata | - 52,66,932 | - | - | - | - | - | 52,66,932 | - |
| Advance received during the year | - | 19,86,97,635 | - | 1,22,95,927 | - | 2,00,31,856 | - | 23,10,25,418 |
| Transferred to SAMEER Mumbai | 1514,77,151 | - | 327,15,731 | - | 169,65,800 | - | 2011,58,682 | - |
| Hindustan Steel Works Ltd. | - | 30,02,844 | - | - | - | - | - | 30,02,844 |
| TOTAL (a) | 6088,69,439 | 61,84,73,110 | - 6,98,562 | -9,05,521 | 2276,97,342 | 28,33,17,569 | 8358,68,219 | 90,08,85,158 |
| Less : Expenditure transferred-I & E account | | | | | | | | |
| Salaries, Allowances and Cont. to PF | 229,77,747 | 2,28,06,505 | 120,09,649 | 1,79,29,184 | 55,12,383 | 86,62,780 | 404,99,779 | 4,93,98,469 |
| Travelling & Conveyance | 55,06,116 | 39,97,799 | 10,42,687 | 16,50,977 | 5,48,099 | 9,10,874 | 70,96,902 | 65,59,650 |
| Administrative Expenses | 52,60,612 | 54,61,688 | 11,40,759 | 51,53,223 | 26,03,316 | 81,41,353 | 90,04,687 | 1,87,56,264 |
| Components & Consumables | 1145,40,373 | 9,68,76,144 | 105,51,920 | 2,36,21,940 | 117,87,320 | 1,91,88,198 | 1368,79,613 | 13,96,86,282 |
| Fabrication and Installation | - | - | - | - | 3,05,281 | 7,73,431 | 3,05,281 | 7,73,431 |
| Repairs & maintenance | - | 30,82,198 | 3,87,672 | 3,58,729 | - | - | 3,87,672 | 34,40,927 |
| Depreciation Wrongly Charged to Inc & Exp | - | - | - | - | 115,94,130 | - | 115,94,130 | - |
| Capitalization of Closed Projects | - | - | - | - | 1889,13,462 | - | 1889,13,462 | - |
| TOTAL (b) | 1482,84,848 | 13,22,24,334 | 251,32,687 | 4,87,14,053 | 2212,63,991 | 3,76,76,636 | 3946,81,526 | 21,86,15,023 |
| Less: Depreciation on Project assets (c) | 616,14,920 | 1,87,41,088 | 68,38,278 | 1,34,78,411 | 5,87,050 | 3,90,24,326 | 690,40,249 | 7,12,43,825 |
| NET TOTAL (a - b - c) | 3989,69,671 | 46,75,07,688 | - 326,69,528 | -6,30,97,985 | 58,46,301 | 20,66,16,607 | 3721,46,445 | 611,026,310 |

SCHEDULE FORMING PART OF THE BALANCE SHEET AS ON 31ST MARCH, 2014

SCHEDULE 3 Fixed Assets

| PARTICULARS | Gross Block | | Depreciation | | Net Block | |
|-------------------------|----------------------|--|---------------------|---|--------------------|--------------------|
| | As on 01.04.2013 | Additions / Deletions / Deductions | As on 31.03.2014 | For the Year Adjustment for Deletions / Deductions | As on 31.03.2014 | As on 31.03.2013 |
| Land-Leasehold Building | 11,45,149 | - | 11,45,149 | - | 1,145,149 | 11,45,149 |
| Residential Flats | 1654,24,204 | 312,71,338 | 1966,95,542 | - | 33,359,630 | 1,55,44,600 |
| Furniture & Fixtures | 2,06,06,858 | - | 2,06,06,858 | 82,23,786 | 7,212,402 | 82,42,746 |
| Lab & Office Equipment | 184,27,169 | 13,35,769 | 197,62,938 | 10,30,343 | 2,634,642 | 26,22,949 |
| Computer & Peripherals | 6336,23,151 | 2762,76,475 | 9098,99,626 | 13,24,076 | 217,488,075 | 10,32,66,322 |
| Electrical Equipment | 564,70,686 | 47,75,067 | 611,97,453 | 901,06,823 | 1,805,084 | 40,72,177 |
| Motor Vehicles | 1,15,538 | - | 1,15,538 | 68,36,446 | 31,987 | 49,318 |
| Library Books | 57,07,708 | - | 57,07,708 | 17,331 | 0 | 4,89,575 |
| Other Fixed Assets | 189,56,241 | 4,63,547 | 194,19,788 | 4,89,575 | 358,131 | 1,63,914 |
| Software | 80,58,531 | - | 80,58,531 | 2,69,330 | 0 | - |
| | - | 2,70,391 | 2,70,391 | 67,598 | 2,02,793 | - |
| TOTAL | 9285,35,234.1 | 3143,92,587 | 12428,79,521 | 1083,65,306 | 264,237,894 | 1355,96,748 |
| | | | | - 773,37,834 | 9786,41,631 | |

SCHEDULES FORMING PART OF THE BALANCE SHEET AS ON 31ST MARCH, 2014

SCHEDULE : 4 SPONSORED PROJECT ASSETS (GROSS BLOCK)

| PARTICULARS | MUMBAI | | CHENNAI | | KOLKATA | | TOTAL | |
|--|--------------------|---------------------|--------------------|---------------------|------------------|---------------------|--------------------|-----------------------|
| | March 31, 2014 | March 31, 2013 | March 31, 2014 | March 31, 2013 | March 31, 2014 | March 31, 2013 | March 31, 2014 | March 31, 2013 |
| Building Furniture & Fixtures | 938,72,858 | 9,29,92,074 | 502,50,172 | 4,80,95,622 | - | 2,61,62,611 | 1441,23,030 | 16,72,50,307 |
| Lab & Office Equipment | 34,16,126 | 34,90,145 | 24,00,321 | 24,00,321 | - | - | 58,16,447 | 58,90,466 |
| Computer & Peripherals | 1321,79,199 | 12,43,39,034 | 1066,64,258 | 10,65,90,408 | 37,59,197 | 24,35,85,525 | 2426,02,654 | 47,45,14,967 |
| Closed Project Assets | 161,79,563 | 1,45,42,497 | 32,93,974 | 32,93,974 | 11,57,366 | 14,19,723 | 206,30,903 | 1,92,56,194 |
| Closed Project Lab & Office Equipments | 3454,43,857 | 34,42,17,761 | - | - | - | - | 3454,43,857 | 34,42,17,761 |
| Closed Project Furniture & Fixtures | 58,18,149 | 57,44,130 | - | - | - | - | 58,18,149 | 57,44,130 |
| Closed Project Computers & Peripherals | 79,04,320 | 72,66,407 | - | - | - | - | 79,04,320 | 72,66,407 |
| Closed Project Prefabricated Structure | 14,39,182 | 14,39,182 | - | - | - | - | 14,39,182 | 14,39,182 |
| TOTAL | 6062,53,254 | 59,40,31,231 | 1626,08,725 | 16,03,80,325 | 49,16,563 | 27,11,67,859 | 7737,78,542 | 1,02,55,79,414 |

SCHEDULE 5 CURRENT ASSETS

| PARTICULARS | MUMBAI | | CHENNAI | | KOLKATA | | TOTAL | |
|--------------------------------|-------------------|--------------------|-------------------|--------------------|-------------------|--------------------|--------------------|---------------------|
| | March 31, 2014 | March 31, 2013 | March 31, 2014 | March 31, 2013 | March 31, 2014 | March 31, 2013 | March 31, 2014 | March 31, 2013 |
| Sundry Debtors | | | | | | | | |
| Considered Good | 21,11,445 | 16,94,228 | 128,92,076 | 58,99,013 | 15,07,766 | 20,87,388 | 165,11,287 | 96,80,629 |
| Considered Doubtful | - | 7,23,534 | 27,77,892 | 27,53,060 | - | - | 27,77,892 | 34,76,594 |
| Less : Provision for Bad Debts | 21,11,445 | 24,17,762 | 156,69,968 | 86,52,073 | 15,07,766 | 20,87,388 | 192,89,179 | 1,31,57,223 |
| | - | -7,23,534 | - | -27,53,060 | - | - | - | -34,76,594 |
| Interest Receivable on FD | 21,11,445 | 16,94,228 | 156,69,968 | 58,99,013 | 15,07,766 | 20,87,388 | 192,89,179 | 96,80,629 |
| Tax Deducted at source | 462,68,315 | 5,67,16,786 | 180,65,318 | 1,51,15,367 | 59,63,131 | 39,65,298 | 702,96,764 | 7,57,97,451 |
| Service Tax Receivable | 79,76,334 | 67,59,492 | 67,23,789 | 51,09,658 | 37,94,159 | 15,07,289 | 184,94,282 | 1,45,56,256 |
| Other Current Asset | 61,58,424 | 47,47,011 | - | - | 27,630 | 25,74,709 | 61,86,054 | 62,54,300 |
| TOTAL | 74,653,783 | 6,99,17,517 | 58,059,075 | 2,61,24,038 | 13,971,019 | 1,28,21,790 | 1466,83,881 | 10,88,63,345 |

SCHEDULE FORMING PART OF THE BALANCE SHEET AS ON 31ST MARCH, 2014

SCHEDULE 6
LOANS & ADVANCES

| PARTICULARS | MUMBAI | | CHENNAI | | KOLKATA | | TOTAL | |
|--|-------------------|--------------------|-------------------|--------------------|------------------|------------------|-------------------|--------------------|
| | March 31, 2014 | March 31, 2013 | March 31, 2014 | March 31, 2013 | March 31, 2014 | March 31, 2013 | March 31, 2014 | March 31, 2013 |
| Loans & Advances to Employees | 85,19,212 | 68,33,416 | 20,21,962 | 20,24,571 | 11,89,364 | 6,44,496 | 117,30,538 | 95,02,483 |
| Accrued Interest on Loans to Employees | 39,27,615 | 40,83,100 | 11,89,514 | 9,70,282 | - | - | 51,17,129 | 50,53,382 |
| Advances to Suppliers | 415,09,039 | 5,19,84,301 | 83,83,959 | 87,95,865 | 10,44,085 | 11,56,001 | 509,37,083 | 6,19,36,167 |
| Pre-paid Expenses | - | 2,86,256 | - | - | - | - | - | 2,86,256 |
| Deposits | 4,78,285 | 1,42,159 | 5,70,988 | 5,70,988 | 6,34,122 | 5,90,936 | 16,83,395 | 13,04,083 |
| Recoverable Expenses | - | 89,51,642 | - | - | - | - | - | 89,51,642 |
| Security Deposit | 18,34,658 | 14,27,538 | - | - | - | - | 18,34,658 | 14,27,538 |
| Other advances | - | - | 6,06,075 | - | - | - | 6,06,075 | - |
| TOTAL | 562,68,809 | 7,37,08,412 | 127,72,498 | 1,23,61,706 | 28,67,571 | 23,91,433 | 719,08,878 | 8,84,61,551 |

SCHEDULE 7
CASH & BANK BALANCES

| PARTICULARS | MUMBAI | | CHENNAI | | KOLKATA | | TOTAL | |
|-----------------------------|--------------------|---------------------|--------------------|---------------------|--------------------|---------------------|---------------------|-----------------------|
| | March 31, 2014 | March 31, 2013 | March 31, 2014 | March 31, 2013 | March 31, 2014 | March 31, 2013 | March 31, 2014 | March 31, 2013 |
| Cash in Hand | - | - | 4,270 | 19,103 | 15,428 | 15,052 | 19,698 | 34,155 |
| Balance with Schedule Banks | - | - | - | - | - | - | - | - |
| Fixed Deposits | 7565,70,764 | 69,53,00,000 | 6300,98,334 | 54,50,00,000 | 300,00,000 | 8,59,54,526 | 14166,69,098 | 1,32,62,54,526 |
| Fixed Deposits-Pension Fund | - | - | 245,27,892 | 1,14,90,686 | - | - | 245,27,892 | 1,14,90,686 |
| Current Account | 393,07,592 | 89,37,030 | 24,975 | 2,15,51,094 | 120,50,454 | 46,42,334 | 513,83,021 | 3,51,30,458 |
| Saving Account | - | - | 154,24,242 | 1,18,94,660 | 53,81,244 | 1,77,52,490 | 208,05,486 | 2,96,47,150 |
| Margin Money with Banks | 712,88,154 | 7,07,62,519 | - | - | 876,72,219 | 2,16,07,096 | 1589,60,373 | 9,23,69,615 |
| TOTAL | 8671,66,510 | 77,49,99,549 | 6700,79,713 | 58,99,55,543 | 1351,19,345 | 12,99,71,498 | 16723,65,568 | 1,49,49,26,590 |

SCHEDULE 8
CURRENT LIABILITIES

| PARTICULARS | MUMBAI | | CHENNAI | | KOLKATA | | TOTAL | |
|--|-------------------|--------------------|-------------------|--------------------|------------------|------------------|-------------------|--------------------|
| | March 31, 2014 | March 31, 2013 | March 31, 2014 | March 31, 2013 | March 31, 2014 | March 31, 2013 | March 31, 2014 | March 31, 2013 |
| Sundry Creditors | 151,78,061 | 1,53,28,806 | 29,474 | 1,26,834 | 12,29,957 | 22,22,108 | 164,37,492 | 1,76,77,748 |
| Other liabilities (Including Statutory Liabilities) | 179,49,275 | 1,06,59,484 | 129,42,137 | 1,48,70,677 | 14,93,343 | 24,14,437 | 323,84,755 | 2,79,44,598 |
| Service Tax Payable | - | - | - | - | - | 9,31,422 | - | 9,31,422 |
| Liability for Pension Fund | - | - | 246,52,051 | 2,11,78,998 | - | - | 246,52,051 | 2,11,78,998 |
| Advance Received from Customers | 7,44,123 | 7,44,123 | 146,68,790 | 1,13,06,278 | - | - | 154,12,913 | 1,20,50,401 |
| TOTAL | 338,71,459 | 2,67,32,413 | 522,92,452 | 4,74,82,787 | 27,23,300 | 55,67,967 | 888,87,211 | 7,97,83,167 |

SCHEDULES FORMING PART OF INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2014

SCHEDULE 9 GRANT RECEIVED - MCIT

| PARTICULARS | MUMBAI | | CHENNAI | | KOLKATA | | TOTAL | |
|---|-------------|--------------|-------------|-------------|-------------|-------------|-------------|--------------|
| | 2013-14 | 2012-13 | 2013-14 | 2012-13 | 2013-14 | 2012-13 | 2013-14 | 201-13 |
| Grant received - MCIT | 3145,00,000 | 28,40,00,000 | 1165,00,000 | 9,29,00,000 | 6,25,00,000 | 6,25,00,000 | 5100,00,000 | 43,94,00,000 |
| Grant received - MCIT for NER Project | 200,00,000 | 1,77,00,000 | | | 790,00,000 | | 200,00,000 | 1,77,00,000 |
| Total (a) | 3345,00,000 | 30,17,00,000 | 1165,00,000 | 9,29,00,000 | 790,00,000 | 6,25,00,000 | 5300,00,000 | 45,71,00,000 |
| Less: Amount utilised for Capital Expenditure | | | | | | | | |
| Building | 27,25,070 | 1,96,640 | 23,83,657 | 25,61,875 | | | 51,08,727 | 27,58,515 |
| Furniture & Fixtures | 11,81,086 | 7,92,663 | 38,053 | 39,670 | | 1,00,737 | 13,35,769 | 9,33,070 |
| Lab & Office Equipment | 136,00,117 | 2,57,85,761 | 47,64,757 | 1,24,82,494 | 1,16,630 | 2,22,68,008 | 364,50,147 | 6,05,36,263 |
| Computer and peripherals | 18,22,494 | 36,43,288 | 6,10,146 | - | 180,85,273 | 51,28,913 | 45,12,710 | 87,72,201 |
| Motor Vehicles | - | - | | - | 20,80,070 | - | - | - |
| Library Books | 16,751 | 18,300 | 67,933 | 20,941 | | 1,56,463 | 4,63,547 | 1,95,704 |
| Software | | | 2,70,391 | | 3,78,863 | | 2,70,391 | |
| Total (b) | 193,45,518 | 3,04,36,652 | 81,34,937 | 1,51,04,980 | 206,60,836 | 2,76,54,121 | 481,41,291 | 7,31,95,753 |
| Grant Received from NER Project Transferred to Sponsored Project Fund (c) | 192,79,000 | 1,77,00,000 | - | - | - | - | 192,79,000 | 1,77,00,000 |
| TOTAL (a-b-c) | 2958,75,482 | 25,35,63,348 | 1083,65,063 | 7,77,95,020 | 583,39,164 | 3,48,45,879 | 4625,79,709 | 36,62,04,247 |

SCHEDULE 10 TEST MEASUREMENT & CONSULTANCY SERVICES

| PARTICULARS | MUMBAI | | CHENNAI | | KOLKATA | | TOTAL | |
|---|------------|-----------|------------|-------------|-----------|-----------|------------|-------------|
| | 2013-14 | 2012-13 | 2013-14 | 2012-13 | 2013-14 | 2012-13 | 2013-14 | 201-13 |
| Test Measurement & Consultancy Services | 144,47,680 | 88,84,078 | 356,82,130 | 3,10,05,897 | 50,04,980 | 62,18,450 | 551,34,790 | 4,61,08,425 |
| TOTAL | 144,47,680 | 88,84,078 | 356,82,130 | 3,10,05,897 | 50,04,980 | 62,18,450 | 551,34,790 | 4,61,08,425 |

SCHEDULES FORMING PART OF INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2014

SCHEDULE 11 OTHER INCOME

| PARTICULARS | MUMBAI | | CHENNAI | | KOLKATA | | TOTAL | |
|---|-------------------|--------------------|-------------------|-------------------|-------------------|--------------------|--------------------|--------------------|
| | 2013-14 | 2012-13 | 2013-14 | 2012-13 | 2013-14 | 2012-13 | 2013-14 | 201-13 |
| Interest on Fixed Deposits | 746,64,560 | 7,09,25,085 | 545,52,046 | 456,58,701 | 100,70,971 | 1,20,60,883 | 1392,87,577 | 1286,44,669 |
| Interest on Saving A/c | - | - | 10,99,478 | 23,10,342 | - | - | 10,99,478 | 23,10,342 |
| Interest on Loan to Employees | 2,85,316 | 4,88,961 | 4,00,146 | 1,52,214 | 9,457 | 10,289 | 6,94,919 | 6,51,464 |
| Miscellaneous Receipts | 50,91,423 | 50,39,355 | 16,93,248 | 11,31,178 | 22,53,595 | 83,49,928 | 90,38,266 | 145,20,461 |
| Excess / Short Provision | - | - | - | 27,875 | - | - | - | 27,875 |
| Recovered from staff: Rent, water, vehicle, electricity | 5,34,120 | 12,76,437 | - | - | - | - | 5,34,120 | 12,76,437 |
| Income from NPCIL | 91,916 | - | - | - | - | - | 91,916 | - |
| Reimbursement from BARC | 106,48,365 | - | - | - | - | - | 106,48,365 | - |
| Surplus of Project closed | 51,73,532 | 85,76,556 | - | 158,02,450 | - | - | 51,73,532 | 243,79,006 |
| TOTAL | 964,89,232 | 8,63,06,394 | 577,44,918 | 650,82,760 | 123,34,023 | 2,04,21,100 | 1665,68,173 | 1718,10,254 |

SCHEDULE 12 SALARIES, ALLOWANCES & STAFF BENEFITS

| PARTICULARS | MUMBAI | | CHENNAI | | KOLKATA | | TOTAL | |
|---|--------------------|---------------------|-------------------|--------------------|-------------------|--------------------|--------------------|---------------------|
| | 2013-14 | 2012-13 | 2013-14 | 2012-13 | 2013-14 | 2012-13 | 2013-14 | 201-13 |
| Salaries, Allowances & Cont to Provident Fund | 1545,13,618 | 13,76,20,246 | 837,55,159 | 7,83,34,003 | 259,16,092 | 2,73,46,386 | 2641,84,869 | 24,33,00,635 |
| Bonus to staff | 1,12,255 | 3,50,580 | 89,804 | 2,97,333 | 58,718 | 90,092 | 2,60,777 | 7,38,005 |
| Leave Travel Concession | 38,01,623 | 17,05,199 | 6,14,796 | 4,81,206 | 7,80,494 | 2,52,644 | 51,96,913 | 24,39,049 |
| Medical Expenses | 119,45,813 | 64,26,968 | 27,73,535 | 24,09,910 | 9,41,998 | 6,97,742 | 156,61,346 | 95,34,620 |
| Tuition Fees | 36,589 | 7,350 | 6,66,401 | 5,16,464 | 1,99,765 | 1,60,413 | 9,02,755 | 6,84,227 |
| Wages / Labour charges | 31,19,134 | 12,71,956 | - | - | 10,86,373 | 16,09,395 | 42,05,507 | 28,81,351 |
| Gratuity | 39,24,082 | 22,97,594 | - | - | - | - | 39,24,082 | 22,97,594 |
| Pension | 357,01,123 | 3,17,70,601 | 51,23,524 | 36,25,370 | 10,00,000 | 10,00,000 | 418,24,647 | 3,63,95,971 |
| Commutation of Pension | 25,65,380 | 18,42,150 | - | - | - | - | 25,65,380 | 18,42,150 |
| Leave Encashment | 47,62,077 | 26,56,088 | - | - | - | - | 48,89,213 | 27,18,671 |
| Uniform to staff | 69,302 | 2,31,025 | 13,134 | 12,870 | 1,27,136 | 7,940 | 82,436 | 2,51,835 |
| Honorarium | 1,63,000 | 1,20,000 | 9,500 | 3,000 | 37,100 | 18,500 | 2,09,600 | 1,41,500 |
| News Paper Reimbursement | - | - | 30,452 | - | - | - | 30,452 | - |
| TOTAL | 2207,13,996 | 18,62,99,757 | 930,76,305 | 8,56,80,156 | 301,47,676 | 3,12,45,695 | 3439,37,977 | 30,32,25,608 |

SCHEDULES FORMING PART OF INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2014

SCHEDULE 13 TRAVELLING & CONVEYANCE

| PARTICULARS | MUMBAI | | CHENNAI | | KOLKATA | | TOTAL | |
|-----------------------------|-------------------|------------------|------------------|------------------|------------------|------------------|-------------------|--------------------|
| | 2013-14 | 2012-13 | 2013-14 | 2012-13 | 2012-13 | 2012-13 | 2013-14 | 2012-13 |
| Travelling Expenses | 107,75,225 | 70,34,030 | 36,84,875 | 36,18,671 | 15,46,655 | 19,57,906 | 160,06,755 | 1,26,10,607 |
| Motor Vehicle Expenses | 6,31,573 | 6,33,270 | 1,80,835 | 6,59,444 | 2,23,913 | 2,40,107 | 10,36,321 | 15,32,821 |
| Transportation & Conveyance | 1,24,831 | 8,27,996 | 26,299 | 45,645 | 3,11,898 | 1,47,987 | 4,63,028 | 10,21,628 |
| TOTAL | 115,31,629 | 84,95,296 | 38,92,009 | 43,23,760 | 20,82,466 | 23,46,000 | 175,06,104 | 1,51,65,056 |

SCHEDULE 14 ADMINISTRATIVE EXPENSES

| PARTICULARS | MUMBAI | | CHENNAI | | KOLKATA | | TOTAL | |
|--|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|--------------------|-------------------|
| | 2013-14 | 2012-13 | 2013-14 | 2012-13 | 2013-14 | 2012-13 | 2013-14 | 2012-13 |
| Advertisement & publicity | 7,30,589 | 4,41,141 | 1,87,827 | 1,63,729 | 5,64,764 | 2,95,749 | 14,83,180 | 9,00,619 |
| Audit Fees | 1,65,000 | 1,65,000 | - | - | - | - | 1,65,000 | 1,65,000 |
| Bad Debts (Ref. Note No. 2(k) of Schedule -20) | - | - | - | 28,00,000 | - | - | - | 28,00,000 |
| Bank charges | 8,39,219 | 11,80,173 | 66,701 | 18,688 | 72,391 | 30,696 | 9,78,311 | 12,29,557 |
| Books & periodicals | 13,288 | 18,244 | - | 4,939 | - | - | 13,288 | 23,183 |
| Canteen expenses | 21,23,639 | 18,25,742 | 13,93,791 | 11,34,261 | 4,78,525 | 4,08,681 | 39,95,955 | 33,68,684 |
| Development Charges | 38,39,704 | 21,25,219 | - | - | - | - | 38,39,704 | 21,25,219 |
| Electricity Charges | 183,01,200 | 125,17,156 | 25,63,651 | 26,13,113 | 37,43,159 | 31,65,994 | 246,08,010 | 182,96,263 |
| EMI / EMC expenses | - | - | - | - | - | - | - | - |
| Entertainment expenses | 6,26,346 | 4,05,650 | 58,224 | 73,248 | 3,14,358 | 1,99,377 | 9,98,928 | 6,78,275 |
| Foreign Exchange Fluctuation | - | - | - | - | 3,47,195 | 46,013 | 3,47,195 | 46,013 |
| Insurance | 5,00,596 | 1,38,658 | 86,438 | 1,53,482 | 20,149 | 34,876 | 6,07,183 | 3,27,016 |
| ISO-9001 Certification | - | - | 59,500 | 1,48,966 | - | - | 59,500 | 1,48,966 |
| Laundry expenses | 35,078 | 58,625 | - | - | - | - | 35,078 | 58,625 |
| Legal & Professional charges | 7,90,773 | 7,92,206 | 3,68,050 | 2,01,454 | 1,52,500 | 25,511 | 13,11,323 | 10,19,171 |
| Membership subscription | 68,585 | 47,034 | 47,534 | 3,58,000 | 36,988 | 87,679 | 1,53,107 | 4,92,713 |
| Miscellaneous expenses | 7,50,421 | 23,92,214 | 12,38,563 | 49,54,556 | 27,41,355 | 43,33,064 | 47,30,339 | 116,79,834 |
| Postage & Telegrams | 2,41,805 | 1,74,948 | 77,376 | 85,451 | 96,983 | 69,965 | 4,16,164 | 3,30,364 |
| Printing & Stationery | 13,23,342 | 11,82,504 | 2,82,645 | 1,62,059 | 4,97,640 | 3,96,300 | 21,03,627 | 17,40,863 |
| Project closed deficit | 3,25,064 | 62,015 | 296,83,692 | - | 59,34,258 | - | 359,43,014 | 62,015 |
| Provision for Bad Debts | - | 7,23,534 | - | 27,53,060 | - | - | - | 34,76,594 |
| Rent,Rates & Taxes | 21,43,096 | 38,01,398 | 70,876 | 1,05,653 | 2,66,202 | 2,67,723 | 24,80,174 | 41,74,774 |
| Security charges | 115,12,692 | 63,68,207 | 34,97,667 | 25,76,234 | 32,03,574 | 19,74,035 | 182,13,933 | 109,18,476 |
| Service Tax | - | - | - | - | - | - | - | - |
| Sundry Balances written off | - | 23,054 | - | - | - | - | - | 23,054 |
| Telephones | 9,67,482 | 9,04,897 | 4,22,872 | 3,76,383 | 1,54,397 | 1,80,379 | 15,44,751 | 14,61,659 |
| Testing & Functional charges | - | - | - | - | - | 42,26,500 | - | 42,26,500 |
| Theft of Cash | - | 29,200 | - | - | - | - | - | 29,200 |
| Transportation expenses | 34,88,982 | 31,52,656 | - | - | - | - | 34,88,982 | 31,52,656 |
| Water charges | 4,94,250 | 3,41,523 | - | - | 91,979 | - | 5,86,229 | 3,41,523 |
| TOTAL | 492,81,151 | 388,70,998 | 401,05,407 | 186,83,276 | 187,16,417 | 157,42,542 | 1081,02,975 | 732,96,816 |

SCHEDULES FORMING PART OF INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2014

SCHEDULE 15 HUMAN RESOURCE DEVELOPMENT

| PARTICULARS | MUMBAI | | CHENNAI | | KOLKATA | | TOTAL | |
|---|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| | 2013-14 | 2012-13 | 2013-14 | 2012-13 | 2013-14 | 2012-13 | 2013-14 | 2012-13 |
| Conference ,Seminar & Training expenses | 4,17,018 | 3,46,183 | 1,41,597 | 2,54,121 | 80,686 | 1,39,034 | 6,39,301 | 7,39,338 |
| Stipend to Apprentice Trainees | - | - | - | 42,933 | 93,612 | 71,588 | 93,612 | 1,14,521 |
| Contribution to SAMEER's sport club | - | 25,000 | - | - | - | - | - | 25,000 |
| TOTAL | 4,17,018 | 3,71,183 | 1,41,597 | 2,97,054 | 1,74,298 | 2,10,622 | 7,32,913 | 8,78,859 |

SCHEDULE 16 COMPONENTS, CONSUMABLES & FABRICATION

| PARTICULARS | MUMBAI | | CHENNAI | | KOLKATA | | TOTAL | |
|----------------------------|--------------------|---------------------|-------------------|--------------------|-------------------|--------------------|--------------------|---------------------|
| | 2013-14 | 2012-13 | 2013-14 | 2012-13 | 2013-14 | 2012-13 | 2013-14 | 2012-13 |
| Components & Consumables | 1209,89,315 | 9,30,26,090 | 104,80,756 | 2,05,15,148 | 234,86,732 | 2,75,62,094 | 1549,56,803 | 14,11,03,332 |
| Fabrication & Installation | 141,57,806 | 1,50,73,910 | 30,50,371 | 49,31,153 | 6,01,534 | 8,19,081 | 178,09,711 | 2,08,24,144 |
| TOTAL | 1351,47,121 | 10,81,00,000 | 135,31,127 | 2,54,46,301 | 240,88,266 | 2,83,81,175 | 1727,66,514 | 16,19,27,476 |

SCHEDULE 17 REPAIRS & MAINTENANCE

| PARTICULARS | MUMBAI | | CHENNAI | | KOLKATA | | TOTAL | |
|-----------------------------------|-------------------|--------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|
| | 2013-14 | 2012-13 | 2013-14 | 2012-13 | 2013-14 | 2012-13 | 2013-14 | 2012-13 |
| Residential Flats | 1,40,700 | 1,57,606 | - | - | - | - | 1,40,700 | 1,57,606 |
| Building maintenance | 115,60,868 | 1,68,48,040 | - | - | 12,24,265 | 10,45,526 | 127,85,133 | 178,93,566 |
| Equipment repairs and maintenance | 63,69,511 | 72,64,816 | 34,82,614 | 57,03,607 | 63,85,104 | 23,05,076 | 162,37,229 | 152,73,499 |
| Guest House maintenance | 14,10,399 | 8,12,840 | - | - | - | - | 14,10,399 | 8,12,840 |
| Garden maintenance | 8,04,429 | 7,07,300 | 3,48,223 | 3,19,562 | 1,58,656 | 1,16,773 | 13,11,308 | 11,43,635 |
| Others | 1,17,855 | 8,78,605 | - | - | - | - | 1,17,855 | 8,78,605 |
| TOTAL | 204,03,762 | 2,66,69,207 | 38,30,837 | 60,23,169 | 77,68,025 | 34,67,375 | 320,02,624 | 361,59,751 |

SCHEDULES FORMING PART OF INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2014

SCHEDULE 18 EXPENSES RECOVERED FROM SPONSORED PROJECTS

| PARTICULARS | MUMBAI | | CHENNAI | | KOLKATA | | TOTAL | |
|---|--------------------|---------------------|-------------------|--------------------|-------------------|--------------------|--------------------|---------------------|
| | 2013-14 | 2012-13 | 2013-14 | 2012-13 | 2013-14 | 2012-13 | 2013-14 | 2012-13 |
| Salaries, Allowances & Cont to Provident Fund | 229,77,747 | 2,28,06,505 | 120,09,649 | 1,79,29,184 | 55,12,383 | 86,62,780 | 404,99,779 | 4,93,98,469 |
| Travelling & Conveyance | 55,06,116 | 39,97,799 | 10,42,687 | 16,50,977 | 5,48,099 | 9,10,874 | 70,96,902 | 65,59,650 |
| Administrative Expenses | 52,60,612 | 54,61,688 | 11,40,759 | 51,53,223 | 26,03,316 | 81,41,353 | 90,04,687 | 1,87,56,264 |
| Components & Consumables | 1145,40,373 | 9,68,76,144 | 105,51,920 | 2,36,21,940 | 117,87,320 | 1,91,88,198 | 1368,79,613 | 13,96,86,282 |
| Repairs & Maintenance | - | 30,82,198 | 3,87,672 | 3,58,729 | - | - | 3,87,672 | 34,40,927 |
| Fabrication and Installation | - | - | - | - | 3,05,281 | 7,73,431 | 3,05,281 | 7,73,431 |
| TOTAL | 1482,84,848 | 13,22,24,334 | 251,32,687 | 4,87,14,053 | 207,56,399 | 3,76,76,636 | 1941,73,934 | 21,86,15,023 |

SCHEDULE 19 DEPRECIATION ON FIXED ASSETS

| PARTICULARS | MUMBAI | | CHENNAI | | KOLKATA | | TOTAL | |
|---------------------------------|--------------------|---------------------|--------------------|---------------------|--------------------|--------------------|---------------------|----------------------|
| | 2013-14 | 2012-13 | 2013-14 | 2012-13 | 2013-14 | 2012-13 | 2013-14 | 2012-13 |
| For the year : | | | | | | | | |
| Depreciation on Fixed Assets | 302,06,580 | 4,97,96,601 | 39,19,749 | 2,35,00,450 | 742,38,978 | 31,718,288 | 1083,65,306 | 105,015,339 |
| Depreciation on Projects Assets | 616,14,920 | 1,87,41,089 | 68,38,278 | 1,34,78,411 | 5,87,050 | 39,024,326 | 690,40,248 | 71,243,825 |
| Total | 918,21,499 | 6,85,37,690 | 107,58,027 | 3,69,78,861 | 748,26,028 | 70,742,615 | 1774,05,554 | 176,259,164 |
| Cumulative : | | | | | | | | |
| Depreciation on Fixed Assets | 4112,06,382 | 38,09,99,802 | 2631,73,486 | 25,92,53,737 | 3042,61,759 | 152,684,947 | 9786,41,626 | 792,938,486 |
| Depreciation on Projects Assets | 5865,22,560 | 52,49,07,640 | 1307,78,481 | 12,39,40,204 | 23,25,653 | 79,076,437 | 7196,26,694 | 727,924,280 |
| TOTAL | 9977,28,941 | 90,59,07,442 | 3939,51,967 | 38,31,93,941 | 3065,87,412 | 231,761,384 | 16982,68,320 | 1,520,862,766 |

SCHEDULE – 20

SCHEDULE FORMING PART OF THE BALANCE SHEET AS ON 31ST MARCH 2014 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 21 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 the 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 Communications & 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 Rs 1,00,89,917/- (Previous year Rs 23,03,597/-) .

(b)

i) Estimated amount of Contingent Liability of Rs.2,77,65,791/-
(P. Y. Rs. 1,95,71,042/-).

ii) Contingent Liability in respect of Income Tax:

| Assessment Year | Tax Demanded (Incl. Interest) | Appeal pending with |
|-----------------|-------------------------------|---------------------|
| 2008-09 | 2,89,08,377 | High Court (Mumbai) |
| 2009-10 | 4,25,97,120 | CIT (A) |
| 2010-11 | 3,14,00,188 | CIT (A) |
| 2011-12 | 7,78,08,430 | CIT (A) |

iii) Contingent Liability in respect of Property Tax of Rs 43,55,775/- at Chennai.

(c) Insurance coverage has not been taken for building, equipments and other Fixed Assets except at Mumbai Centre.

(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 deficit of Rs.2,89,50,159/-(Previous Year-Surplus of Rs.2,43,16,991/-) of the projects completed/closed during the year.

(e) No provision has been made for gratuity and leave encashment as on March 31, 2014 as stipulated under AS-15 Employees Benefits.

(f) During the year, the Society has provided **Rs.1,10,00,000/- (Mumbai Rs. 80,00,000/-, Chennai Rs.20,00,000/- and Kolkata Rs.10,00,000/-)** (Previous year 1,10,00,000/- (Mumbai Rs. 80,00,000/-, Chennai Rs.20,00,000/- and Kolkata Rs.10,00,000/-) 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 the process of identify the suitable agency as per government norms for managing the pension fund.

(g) The Society's Council met once during the year, on 12th of November 2013 . However, for urgent items of decisions, approvals are sought by circular send to the council members.

(h) During the year society has received **Rs.51,00,00,000/-** (previous year Rs. 43,94,00,000 /-) and **Rs. 2,00,00,000/-** (Previous Year Rs.17,700,000) towards NER Projects as grant from MCIT. Of the above, **Rs.4,81,41,291/-** (Previous year Rs.73,195,753 /-) is credited to Capital Fund, since it is utilized for acquisition of fixed assets and the balance sum of **Rs.46,18,58,709/-** (Previous year Rs.366,204,247/-) is credited to income & expenditure account.

- (i) 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.
- (j) Figures of previous year have been regrouped / rearranged wherever necessary, to make them comparable with the current year's figures.
- (k) Kolkata Centre has made payment of Rs.34,61,585/- under Service Tax Voluntary Compliance Encouragement Scheme, 2013.
- (l) Depreciation on Fixed Assets purchased for Sponsored Project (MMW) during the period 2006 to 2008, amounting Rs.1,15,94,130/- was charged to Income & Expenditure Account instead of charging to Sponsored Project Fund. Rectification for the same is done during the current year.
- (m) WDV of Assets for Sponsored Project CATR(Rs.8,93,38,761/-) & MMW(Rs.9,95,74,701) has been transferred to SAMEER Assets on closure of respective projects.
- (n) Surplus/ Deficit from closed projects are shown in other income and administrative expenses respectively.

For B.MAHESHWARI & CO.
Chartered Accountants
Firm Registration No. : 105839W

CA SURENDRA HEDA
PARTNER
Membership No.: 102316

Mumbai
Dated :05.09.2014

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

VINOD KUMAR SHARMA
HFA & REGISTRAR

DR. A. L. DAS
DIRECTOR

RECEIPT AND PAYMENT FOR THE YEAR ENDED 31ST MARCH 2014

| RECEIPTS | March 31, 2014 | March 31, 2013 | PAYMENTS | March 31, 2014 | March 31, 2013 |
|---|---|---|---|---|---|
| I. Opening Balances a) Cash in hand b) Bank balances i) In Current accounts ii) In deposit accounts iii) In saving accounts iv) FDR against bank guarantee | 34,155 1,34,64,43,891 3,51,30,458 2,96,47,150 8,35,58,474 | 27,789 1,27,26,10,064 1,37,24,615 5,76,65,463 6,41,92,600 | I. Expenses a) Establishment expenses b) Administrative expenses II. Payments made against Project expenses III. Acquisition of Fixed Assets | 37,12,76,226 3,81,84,735 10,43,69,406 | 29,30,59,761 13,17,55,533 3,27,62,482 |
| II. Grants received from MCIT, GoI. | 51,42,21,000 | 45,71,00,000 | IV. Other payments a) Advances and deposits b) Sundry Creditors | 3,65,39,279 8,31,42,264 14,51,87,941 | 9,36,26,758 11,85,67,672 10,66,10,909 |
| III Test & Consultancy charges | 5,97,58,883 | 4,71,64,079 | V. Closing Balances a) Cash in hand b) Bank balances i) In Current accounts ii) In deposit accounts iii) In saving accounts iv) FDR against bank guarantee | 19,698 1,52,88,69,209 5,13,83,021 2,08,05,486 7,12,88,154 | 34,155 1,34,64,43,891 3,51,30,458 2,96,47,150 8,35,58,474 |
| IV. Receipts from Sponsored Projects | 24,30,54,209 | 19,96,64,436 | | | |
| V. Other Receipts a) Interest on deposits with Banks b) Miscellaneous receipts c) Earnest Money Deposit d) Advances and deposits | 9,70,64,247 53,58,210 7,51,100 3,60,43,642 | 10,99,40,244 62,11,930 9,87,000 4,19,09,023 | | | |
| TOTAL | 2,45,10,65,419 | 2,27,11,97,243 | TOTAL | 2,45,10,65,419 | 2,27,11,97,243 |

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SAMEER

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Department of Electronics & Information Technology

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