Muthoot Institute of Technology & Science

KEYSIGHT TECHNOLOGIES

CENTRE OF EXCELLENCE

RF COMMUNICATION LABORATORY

Department of Electronics & Communication Engineering

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The Indian telecom sector is growing day by day. India is currently the world's second-largest telecommunications market and has registered strong growth in the past decade and half. The telecom sector is expected to generate four million direct and indirect jobs over the next five years in the country. The Department of ECE at Muthoot Institute of Technology & Science (MITS), Ernakulam (www.mgmits.com), has set up a high-end RF communication lab in partnership with Keysight Technologies christened as **"MITS-Keysight Centre of Excellence"** for high-end research and industry level design and analysis of communication systems.

Objective of the Facility

- Imparting training to under graduate/ graduate students, PhD scholars, Research scholars, Innovators and Start-upsto make prominent contributions to the fast-growing telecom sector.
- Open up the facility to establisished companies, start ups and students working in telecom sector for testing their academic and industrial research ideas.
- Train the faculty and students of MITS to work in the latest area of telcommunication and partner with industry to provide telecommunication solutions.

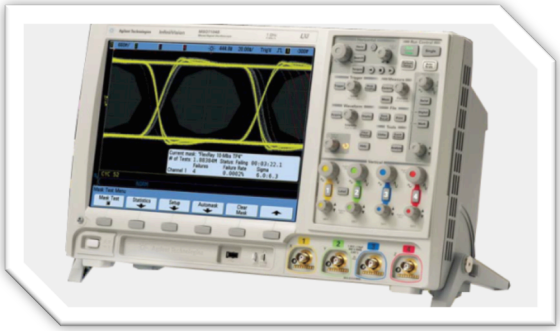
Diversity of MITS-Keysight RF Communication lab

MITS has got an advanced and well equipped RF design laboratory covering design and verification of the concepts of modern digital communication systems that operates from KHz-GHz range. The equipments are upto the mark of industrial design and manufacturing standards thus making this lab an active launchpad for budding innovators and scientists. The lab includes experiments on applications of various communication protocols such as GSM/CDMA/WLAN/Bluetooth etc., analysing different devices and components such as filters/amplifiers/antennas etc., modulation techniques and characteristics of microwave waveguide components. This lab is equipped with 13.6 GHz Spectrum analyser, 18 GHz Vector Network Analyser, Mixed Signal Oscilloscopes, Digital Oscilloscope, Arbitrary waveform generator, Function Generators, Transmitter and Receiver modules, Antennas, Circuit designing software, Antenna Designing software, Modules for Digital Modulation and Demodulation and Power Supply units.

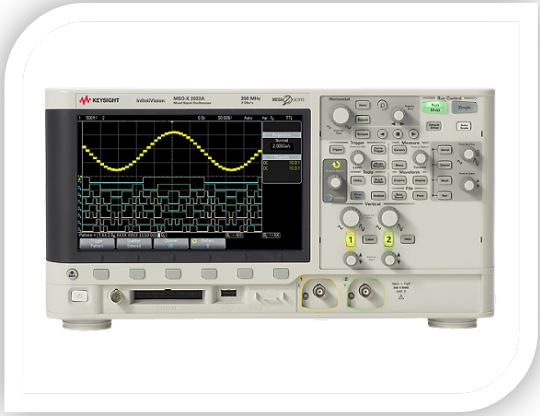
Hardware Capability

Arbitrary Waveform Generator (AWG) can generate any arbitrarily defined waveshape as their output along with standard waveforms. Our lab is equipped with AWG **33512B** by Keysight Inc. The key features includes 16-bit resolution with 1 mVpp to 10 Vpp amplitude for greater amplitude accuracy; 1 MSa/channel standard waveform memory, optional 16 MSa/channel for long waveforms; USB, LAN (LXI-C), GPIB standard for quick and easy connectivity to PC or network; 2 channels for operation;wide bandwidth of 20 MHz; operating modes such as Continuous, modulate, frequency sweep, burst, output gate;Modulation types such as AM, FM, PM, FSK, BPSK, PWM, Sum (carrier + modulation); Standard waveforms such as Sine, square, ramp, pulse, triangle, Gaussian noise,PRBS (pseudorandom binary sequence), DC along with built-in and user-defined arbitrary waveforms.

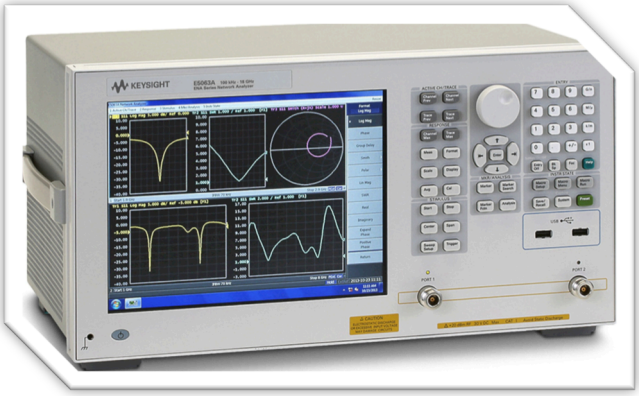
Signal Generator is used to generate repeating or non-repeating electronic signals in either the analog or the digital domain. It is generally used in designing, testing, troubleshooting, and repairing electronic or electroacoustic devices. Vector Signal Generators (VSG) are capable of generating digitally-modulated radio signals that may use any of a large number of digital modulation formats. Our lab is equipped with EXG-X series **N5172B** VSG from Keysight. Key features includes frequency range of 9KHz-3/6GHz; Output Power ranging from -144 dBm to +26 dBm; output digital modulation formats such as QAM, QPSK, FSK, BPSK, and OFDM; industry standard signals such as GSM, W-CDMA (UMTS), CDMA2000, LTE, Wi-Fi (IEEE 802.11), and WiMAX (IEEE 802.16).



Digital oscilloscope or **Digital Storage Oscilloscope** (often referred to as DSOs) input a signal and then digitize it through the use of an analog-to-digital converter.Having the data in digital form enables the oscilloscope to perform a variety of measurements on the waveform. Signals can also be stored indefinitely in memory. Our lab is equipped with InfiniiVision 2000X series DSO **X2012A** by Keysight. The main features of this DSO includes 100 MHz bandwidth; 2 channels for operation; Maximum Memory Depth of 1 Mpts; Maximum Sample Rate of 2 GSa/s; 8 bit ADC; in built Digital Channels, 20 MHz Function Generator, 5-digit Counter, 3-digit DVM.



Mixed Signal Oscilloscope (MSO) has two kinds of inputs, a small number (typically two or four) of analog channels, and a larger number (typically sixteen) of digital channels.While oscilloscopes are the most commonly used test instruments in an R&D environment, sometimes 2 and 4 channel oscilloscope measurements are insufficient to monitor and test critical timing interactions between multiple analog and digital signals. This is where an MSO proves useful because it provides enough of the traditional logic analyzer measurement capabilities without adding the complexity often associated with a logic analyzer. The MITS RF design lab is equipped with InfiniiVision 4000 X series MSO **X4104A** by Keysight. The key features of this MSO includes Bandwidth of operation 1 GHz; 4 analogand 16 digital channels of operation; Isolate signals in seconds with exclusive Zone touch triggering; Capture more data with 4 Mpts memory and standard segmented memory.



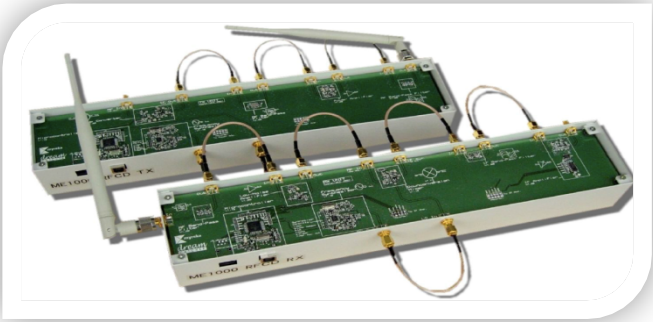
Network Analyzer measures the network parameters of electrical networks. Network Analyzersare commonly employed in measuring s-parameters because reflection and transmission of electrical networks are easy to measure at high frequencies. A Vector Network Analyzer (VNA) measures both amplitude and phase properties. Our lab is equipped with ENA series **E5063A** Vector Network Analyzer from Keysight. The key features includes 100KHz to 18GHz frequency range; 2-port, 50 ohm, S-parameter test set; finding S-Parameter, Return Loss, Time Domain, Insertion Loss/Gain; Dynamic Range 117 dB; 0 dBm output power; Noise floor -127 dBm.Devices that can be tested using E5063A include,

- Antennas for smartphones, cellular base stations, WLAN, and other wireless communication devices
- Other simple RF passive components such as RF cables/ connectors, couplers, isolators and filters
- Impedance test of PC board (PCB)
- Wireless power transfer coils/resonators
- Dielectric materials

Spectrum Analyser measures the magnitude of an input signal versus frequency. The primary use is to measure the power of the spectrum of known and unknown signals. By analyzing the spectra, dominant frequency, power, distortion, harmonics, bandwidth, and other spectral components of a signal can be observed that are not easily detectable in time domain waveforms. These parameters are useful in the characterization of electronic devices, such as wireless transmitters. MITS

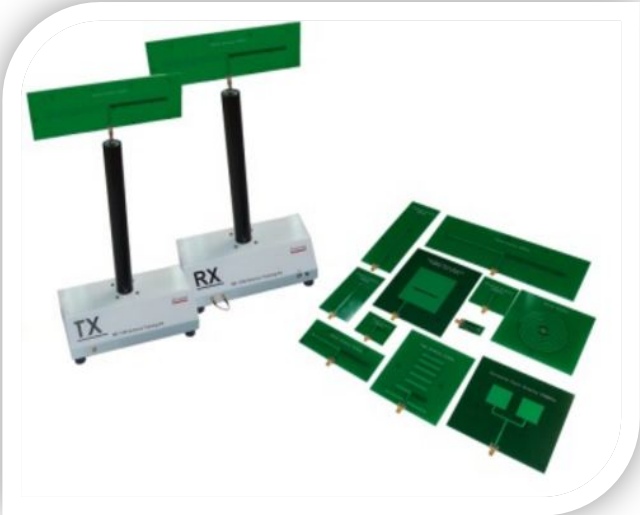
RF Communication lab is equipped with EXA X-Series **N9010A** Signal Analyzer (Spectrum Analyzer) from Keysight Technologies. Key features of this signal analyser includes Frequency range from 10 Hz to 13.6 GHz, Mixers to 1.1 THz; Maximum Analysis Bandwidth of 40 MHz; Bandwidth 25/40 MHz; Displayed average noise level DANL at 1 GHz is -163 dBm; Amplitude Accuracy ±0.27 dB. N9010A can be used for,

- Noise Figure Measurements
- Spurious Emission Measurements
- Conducted and Radiated Emissions Measurements for EMI precompliance testing
- Microwave and Millimeter Signal Measurements
- LTE TDD E-UTRA Base Station Transmit ON/OFF Power Measurement
- Measuring and Troubleshooting Digitally Modulated Signals



ME1000 Transmitter – Receiver Kit: Transmitter is an electronic device which generates a radio frequency alternating current. When a connected antenna is excited by this alternating current, the antenna emits radio waves.In addition to their use in broadcasting, transmitters are necessary component parts of many electronic devices that communicate by radio, such as cell phones, wireless computer networks, Bluetooth enabled devices, garage door openers, two-way radios in aircraft, ships, spacecraft, radar sets and navigational beacons. Receiver is an electronic device that receives radio waves and converts the information carried by them to a usable form. It is used with an antenna. The antenna intercepts radio waves (electromagnetic waves) and converts them to tiny alternating currents and extracts the desired information. Electronic filters separate the desired radio frequency signal from all the other signals picked up by the antenna. An electronic amplifier is used to increase the power of the signal for further processing, and finally the desired information is obtained through demodulation.The RF transceiver kit consists of a transmitter unit and a receiver unit. The units are made up of various RF modules such

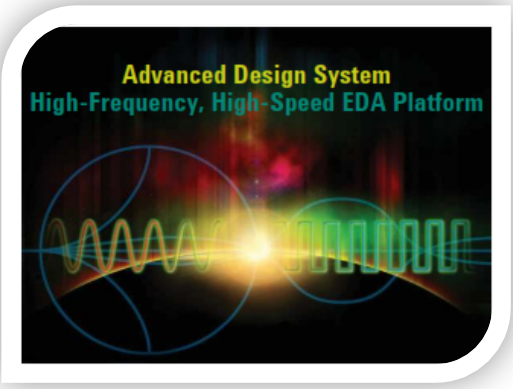
as low noise amplifier, power amplifier, band pass filters, mixer, frequency synthesizer, antenna etc. to form both the transmitter and receiver sections of a superheterodyne system. MITS RF Communication lab is equipped with Transceiver kit **ME 1000** from dreamCatcher. The key features of this kit includes Frequency synthesizer output power of −4.5 dBm (typical); Frequency synthesizer frequency range from 816 MHz to 880 MHz for Tx/Rx; Antenna frequency range from 806 MHz to 960 MHz for Tx/Rx; Antenna length of 210 mm for Tx/Rx.



ME1300 Antenna Propagation Kit: Antenna measurement techniques refer to the testing of antennas to ensure that the antenna meets specifications or simply to characterize it. Typical parameters of antennas are gain, radiation pattern, beamwidth, polarization, and impedance.The MITS RF Communication lab is equipped with an antenna propagation kit from Dreamcatcher, ME1300. The kit consists of an antenna transmitter module and an antenna receiver module, with a Radiation Pattern Plotting (RadPat) software. By using the recommended instrument, the Windows-based antenna radiation pattern plotting software can perform fully automated antenna measurements with selectable resolution (1 to 30 degrees per step). The features of this kit include, Transmitter Module - Frequency range: 2 MHz to 4 GHz , Maximum output power to antenna port: 3 mWΩ- Output impedance: 50 Note: This module requires an external signal source; Receiver Module - Frequency range: 50 MHz to 3 GHz (with built-in RF detector) , RF input level: –60 dBm to -5 dBm (with built-in RF detector Ω- Input impedance: 50, PC-based controlled rotator (0 to 359 degrees), Variable step size: 1 to 30 degrees/step.

ME1110 Analog/Digital Modulation Board is a versatile system that can produce a variety of digitally modulated band-pass signals. It is also programmed to produce standard analog modulated signals such as AM and FM signals. The default RF (radio-frequency) carrier used by the system is 10 MHz. One of its special features is the board contains two RF outputs. This allows the outputs to be connected to a Vector Signal Analyzer (for demodulation and observing the IQ constellation) and to a low-cost Spectrum Analyzer for observing the real-time spectrum. In addition to the RF outputs, the ME1110 board has a number of Analog and Digital outputs. For instance, the user can observe the Baseband IQ channels voltage, Baseband digital data, dataclock, symbol-clock, etc. to understand how a digital transmitter operates. This hardware kit is capable of producing various types of standard analog and digital modulation waveforms such as sine wave, AM, FM, BASK, FSK, BPSK, QPSK, 8PSK, 16-QAM, and 64-QAM.

Software Capability



Advanced Design System (ADS) provides an integrated design environment to designers of RF electronic products such as mobile phones,pagers, wireless networks, satellite communications, radar systems, and high-speed data links.Keysight ADS supports every step of the design process—schematic capture, layout, design rule checking, frequency-domain and time-domain circuit simulation, and electromagnetic field simulation—allowing the engineer to fully characterize and optimize an RF design without changing tools. ADS provides full, standards-based design and verification with Wireless Libraries and circuit-system-EM co-simulation in an integrated platform.

ADS is useful for,

- **Monolithic Microwave IC (MMIC) Designers**
- **Signal Integrity Engineers**: For the correct treatment of high-speed effects like distortion, mismatch, and crosstalk.
- **RF and Microwave Board Designers**: ADS provides integrated system, circuit, and EM simulators, layout, and powerful optimizers to help increase productivity and efficiency, validating high-yield designs prior to manufacturing.
- **Radio Frequency IC (RFIC) Designers**
- **RF System-in-Package and RF Module Designers**: ADS provides integrated circuit, system and 3D EM simulators for the design and verification of complex SiP and SoP designs such as RF front end and power amplifier modules.

SystemVue is a focused electronic design automation (EDA) environment for electronic system-level (ESL) design. It enables system architects and algorithm developers to innovate the physical layer (PHY) of wireless and aerospace/defense communications systems and provides unique value to RF, DSP, and FPGA/ASIC implementers. As a dedicated platform for ESL design and signal processing realization, SystemVue replaces general-purpose digital, analog, and math environments. SystemVue "speaks RF", cuts PHY development and verification time in half, and connects to your mainstream EDA flow.

SysVue is useful for,

- **PHY System Architects**
- **RF System Architects**
- **RF Hardware Designers**
- **PHY System Verifiers**
- **Baseband Hardware Designers**

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