

NEW FACILITIES IN ELECTRONICS AND COMMUNICATION ENGINEERING DEPARTMENT



NEW FACILITIES IN ELECTRONICS AND COMMUNICATION ENGINEERING DEPARTMENT

❖ Existing Laboratories

First and foremost 2 existing laboratories in Electronics and Communication Engineering Department were improved .Improvement was strengthened under industry involvement and Center of Excellence(Texas Instruments). The laboratories which were strengthened are listed below:

SR NO.	LABORATORY NAME	FACILITIES
1.	Microcontroller Design Laboratory	lab setup for microcontroller lab featuring Advance 8051 microcontroller <ul style="list-style-type: none">• Educational Practice Board for C8051F340 (Model - EPB_F340)• All-in-one General Purpose Board (Model - ASK25)• Eclipse based Integrated Development Environment (IDE) Tool
2.	Analog Electronics Laboratory (Linear Integrated Circuits Lab)	ASLK Pro kits

Microcontroller Lab

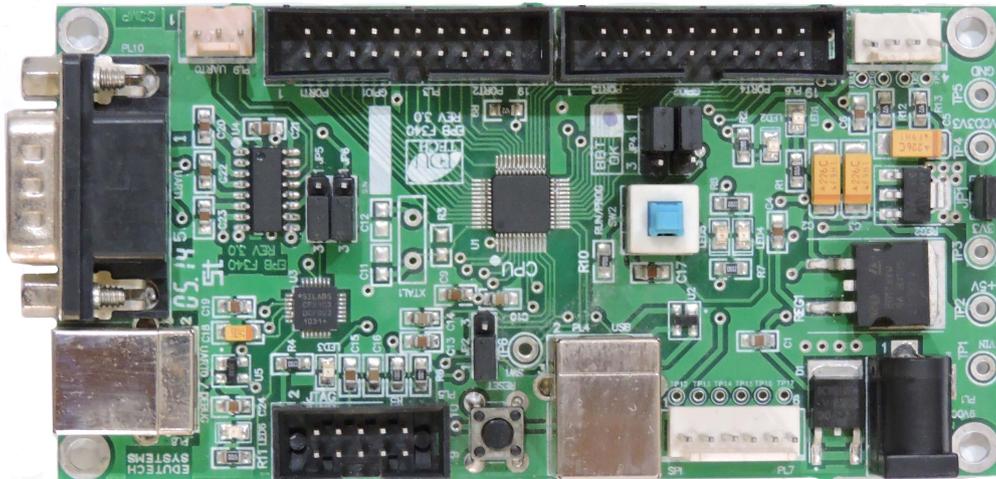
Edutech offers a comprehensive lab setup for microcontroller lab featuring Advance 8051 microcontroller

Description

The Basic Microcontroller Lab program is specially designed keeping in mind the curriculum requirements. This lab offers 8 bit platform thus enabling the students to have a complete experience to work with 8051 microcontroller. This lab also includes different development tools in the form of IDEs. The pluggable GPIO interfacing kit offered in this lab setup can be interfaced with different target CPU boards thus mastering the art of programming and interfacing. The documentation provided includes lesson plans, manuals and workbooks with complete procedures of operations and experimentation.

Educational Practice Board for C8051F340 (Model - EPB_F340)

The EPB-F340 Mini is low cost CPU target boards build around C8051F340 CPU from Silicon Lab. This board enables the learner to get introduced to the latest version of the 8051 core The following are the features of this board:



Controller

- C8051F340 CPU Operating up to 48MHz
- 4KB on-chip RAM and 64KB on-chip Flash memory
- On board JTAG emulation connector
- Universal Serial Bus (USB) Function Controller
- High-speed pipelined 8051-compatible microcontroller core
- In-system, full-speed, non-intrusive debug interface (on-chip)
- On chip Universal Serial Bus (USB) Function Controller
- True 10-bit 200 ksp/s differential / single-ended ADC with analog multiplexer
- On-chip Voltage Reference and Temperature Sensor
- On-chip Two Analog Voltage Comparators
- Precision internal calibrated 12 MHz internal oscillator
- Internal low-frequency oscillator for additional power savings

- On Chip Programmable Counter/Timer Array (PCA) with five capture/compare modules and Watchdog
- On Chip SMBus/I2C and SPI serial interfaces

On board Data Transfer Interfaces

- DB9 connector for UART0, 3 pin header for UART1

On board Functionalities

- JTAG emulation connector
- Reset and Run/Program mode (Boot Mode) switch
- Two 20-pin FRC Connector for 32 Port I/O (5 V tolerant),
- Two user LEDs, Flash Programming using USB port

Mechanical Parameters

- Size: 55mm X 110mm; Input Voltage - 9V DC

JTAG Emulator for Real time debugging

- Add-on interface to Single stepping, Debug, Flash, Execute program and directly pluggable to EPB_F340

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Learn, Test, Apply



Microcontroller Lab

All-in-one General Purpose Board(Model-ASK25)

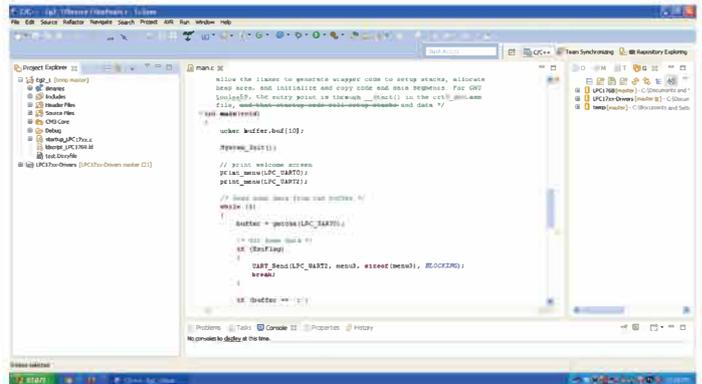
The All-in-one GPIO board is specially designed to suit the experimentation on different GPIO devices with the micro controllers.

Features:

- On board display options include 8 LED, 16x2 character LCD, 2 digit 7-segment display
- Switches include 4 general purpose keys and 2X2 matrix keyboard
- I2C and SPI based EEPROMs for protocol demonstration experiments
- Stepper motor interface with built-in H-bridge driver IC
- DC motor interface with DC motor
- Relay output
- Facility to provide 2 channel ADC input using potentiometer and unity gain amplifier for protection



Eclipse based Integrated Development Environment (IDE) Tool:



The general purpose Eclipse based IDE is a easy to use development platform which can be used for windows as well as Linux environment.

This IDE tool supports different microcontroller platforms like 8051, PIC, AVR, ARM7.

Project Interfacing Kits



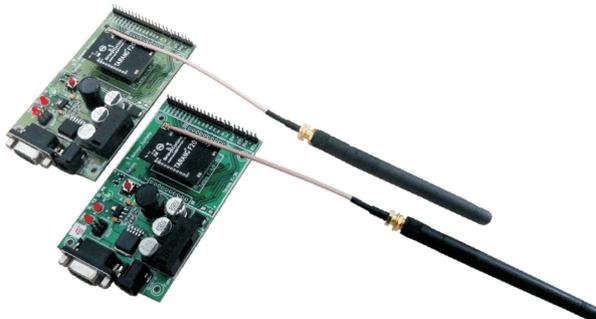
Thermal printer:



RFID



Finger Print Sensor



ZigBee Interfacing Kit



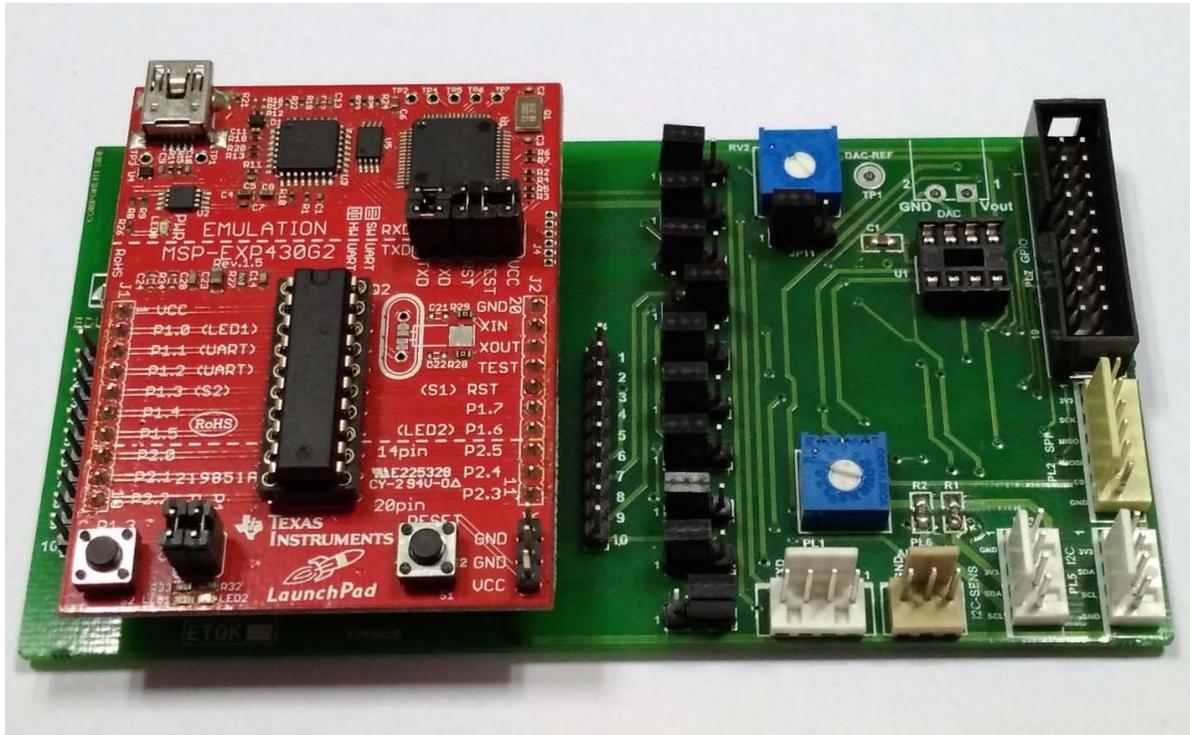
GSM Modem Interfacing Kit

*Images are for reference only

MSP430 LAB Setup

Model: EPB_MSP430

Edutech offers complete lab setup for the MSP430 Platform especially for UG, PG curriculum and Research work. EPB_430 is an all-in-one high-performance low power platform. It features all the features of MSP430 core and all peripheral's interfacing options available.



Features

- **CPU : MSP430G2553**
- Low Supply-Voltage Range: 1.8 V to 3.6 V
- Internal Frequencies up to 16 MHz
- 16KB Flash, 512B RAM
- Ultra-Low Power Consumption,
- Five Power-Saving Modes
- Ultra-Fast Wake-Up in Less Than 1 μ s
- 16-Bit RISC Architecture,
- Basic Clock Module Configurations
- Internal Very-Low-Power Low-Frequency(LF) Oscillator
- 32-kHz Crystal, External Digital Clock Source
- Two 16-Bit Timer_A with Three Capture / Compare Registers
- 16 Capacitive-Touch Enabled I/O Pins
- Serial Communication Interface(USCI)
- Enhanced UART Supporting Auto Baud Rate Detection (LIN)
- IrDA Encoder and Decoder
- On board dual inline PTH to interface various signals
- Accelerometer for MSP430
- On-Chip Comparator for Slope ADC Conversion
- 8 Channel 10-bit ADC (Sampling Rate: 200KSPS)
- On board 10K potentiometer for ADC input
- On board TTL UART connector to interface various sensors
- Serial Onboard Programming,
- Onboard I2C connector to interface various sensors
- On-Chip Emulation Logic with Spy-Bi-Wire
- On board 20 pin FRC connector to interface GPIO devices
- On board user LED.
- 4 Pin Relimate - I2C Connector
- 6 Pin Relimate - SPI Connector
- 4 Pin Relimate - UART Connector
- 3 Pin Relimate - ADC connector
- 2 Pin Green terminal DAC Connector
- On board 8 bit DAC with fix reference voltage as well as variable reference voltage provision
- Reserved Interface : 84 Pins header consists MIPI, MIPI-CSI Dual LVDS, EDP, PWM, SPI, UART, ADC, GPIO, I2C, I2

MSP430 LAB Setup

MSP430F5529 CPU Kit



Model: EPB_F5529

- CPU: USB-enabled MSP430F5529 MCU
- Up to 25-MHz System Clock, 1.8-V to 3.6-V operation, 128KB of flash, 8KB of RAM,
- 5 timers, 12-bit ADC, Analog comparator
- 4 serial Interfaces (SPI, UART, I2C),
- Integrated USB, The eZ-FET lite emulator, with the application UART.
- Ability to emulate and develop USB applications with a single USB cable
- Power sourced from the USB host.
- The 5-V bus power is reduced to 3.3 V, using an onboard dc-dc converter.
- Male and female 40-pin Booster Pack plug-in module headers, configured for stacking.
- 20-pin Booster Pack plug-in modules can also be attached.
- Compatible with the 40-pin Booster Pack plug-in module development tool standard

Tools

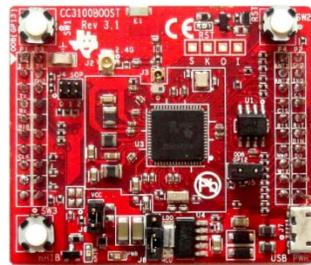
Code composer studio:

IDE for lab from Texas Instruments which is compatible with all the TI CPUs



Learn, Test, Apply

Wi-Fi CC3100 wireless network processor Kit



Model: EPB_CC3100

- CC3100 Wi-Fi Network Processor in QFN package
- Industry's first devices to be Wi-Fi CERTIFIED™ at the chip level by the Wi-Fi Alliance™
- 2 20-pin stackable connectors (Booster Pack headers) to connect to TI Launchpad and other Booster Packs
- On-board chip antenna with option for U.FL-based testing
- Power from on-board LDO using USB OR 3.3V from MCU Launchpad
- 2 push buttons, 4 LEDs, Jumper with 0.1 Ohm resistor for current measurement
- 0.8-megabit serial flash
- 40 MHz crystal, 32 KHz crystal and oscillator
- U.FL and chip antenna
- USB
- 4 Layer PCB with 6 mm spacing and track width
- All the Specifications mentioned for CC3100 chip features will be supported by Wi-Fi CC3100 wireless network processor Kit.

Hardware

Lab includes:

- EPB_MSP430
- MSP430F5529 CPU Kit
- Wi-Fi CC3100 wireless network processor Kit
- All in one General purpose input output kit
- Printout copy of well documented workbook
- CD/DVD



MSP430 LAB Setup

All in one General purpose input output kit – Model: ASK-25

- The All-in-one GPIO board is specially designed to suit the experimentation of different GPIO devices with the micro controllers
- On board display options includes 8 LED, 16x2 character LCD (Operating in 4-bit or 8-bit mode), 2 digit 7-segment display
- Switches includes 4 general purpose keys to provide digital input to GPIO pins of microcontroller
- 2X2 matrix keyboard
- I2C and SPI based EEPROMs for protocol demonstration experiments
- Stepper motor interface with built-in H-bridge driver IC
- DC motor interface
- 1 Relay output
- Facility to provide 2 channel ADC in put using potentiometer and unity gain amplifier for protection
- On board buzzer to generate various frequencies
- Compatible with different educational practice boards
- Useful resource to learn basic programming techniques to interface basic GPIO components to the controller
- Supplied in wooden box packing



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Edutech Learning Solutions Pvt. Ltd.

Getting to know ASLK PRO

The Analog System Lab kit ASLK PRO is divided into many sections. Refer to the photo of ASLK PRO when you read the following description.

- 1** There are three **TL082 OP-Amp** ICs labelled 1, 2, 3 on ASLK PRO. Each of these ICs has two amplifiers, which are labelled A and B. Thus 1A and 1B are the two OP-AMPs on OP-AMP IC 1, etc. The six OP-amps are categorized as below.

OP-Amp	Type	Purpose
1A	TYPE I	Inverting Configuration only
1B	TYPE I	Inverting Configuration only
2A	TYPE II	Full Configuration
2B	TYPE II	Full Configuration
3A	TYPE III	Basic Configuration
3B	TYPE III	Basic Configuration

Thus, the OP-amps are marked TYPE I, TYPE II and TYPE III on the board. The OP-Amps marked TYPE I can be connected in the inverting configuration only. With the help of connectors, either resistors or capacitors can be used in the feedback loop of the amplifier. There are two such TYPE I amplifiers. There are two TYPE II amplifiers which can be configured to act as inverting or non-inverting. Finally, we have two TYPE III amplifiers which can be used as voltage buffers.

- 2** Three **analog multipliers** are included in the kit. These are wide-bandwidth precision analog multipliers from Texas Instruments (**MPY634**). Each multiplier is a 14-pin IC and operates on internally provided $\pm 10V$ supply.
- 3** There are two **digital-to-analog converters (DAC)** provided in the kit, labeled **DAC I** and **DAC II**. Both the DACs are **DAC7821** from Texas Instruments. They are 12-bit, parallel-input multiplying DACs which can be used in place of analog multipliers in circuits like AGC/AVC. Ground and power supplies are provided internally to the DAC. **DAC Logic Supply Jumper** can be used to connect logic power supplies of both **DAC I** and **DAC II** to either

LDO or **DC/DC** converter located on the board. Using **Tri-state switches** you can set 12-bits of input data for each DAC to desired value. Click the **Latch Data button** to trigger Digital-to-analog conversion.

- 4** We have included a **wide-input non-synchronous DC/DC buck converter TPS40200** from Texas Instruments on ASLK PRO. The converter provides an output of 3.3V over a wide input range of 5.5-15V at output currents ranging from 0.125A to 2.5A. Using **Vout SEL jumper** you can select output voltage to be either 5V or 3.3V. Another jumper allows you to select whether input voltage is provided from the board (+10V), or externally using screw terminals.
- 5** We have included **two transistor sockets** on the board, which are needed in designing an LDO regulator (*Experiment 10*), or custom experiments.
- 6** A **specialized LDO regulator IC (TPS7250)** has been included on the board, which can provide a constant output voltage for input voltage ranging from 5.5V to 11V. Ground connection is internally provided to the IC. Using **ON/OFF jumper** you can enable or disable LDO IC. Another jumper allows you to select whether input voltage is provided from the board (+10V), or externally using screw terminals.
- 7** There are two **1k Ω trimmers** (potentiometer) in the kit to enable the designer to obtain a variable voltage if needed for a circuit. The potentiometers are labeled **P1** and **P2**. These operate respectively in the range 0V to +10V, and -10V to 0V.
- 8** The kit has a **screw terminals to connect $\pm 10V$ power supply**. All the ICs on the board are internally connected to power supply. Please refer to *Appendix D* for schematics of ASLK PRO.
- 9** We have included **two diode sockets** on the board, which can be used as rectifiers in custom laboratory experiments.
- 10** The top right portion of the kit is a **general-purpose area which can be used as a proto-board**. $\pm 10V$ points and GND are provided for this area.

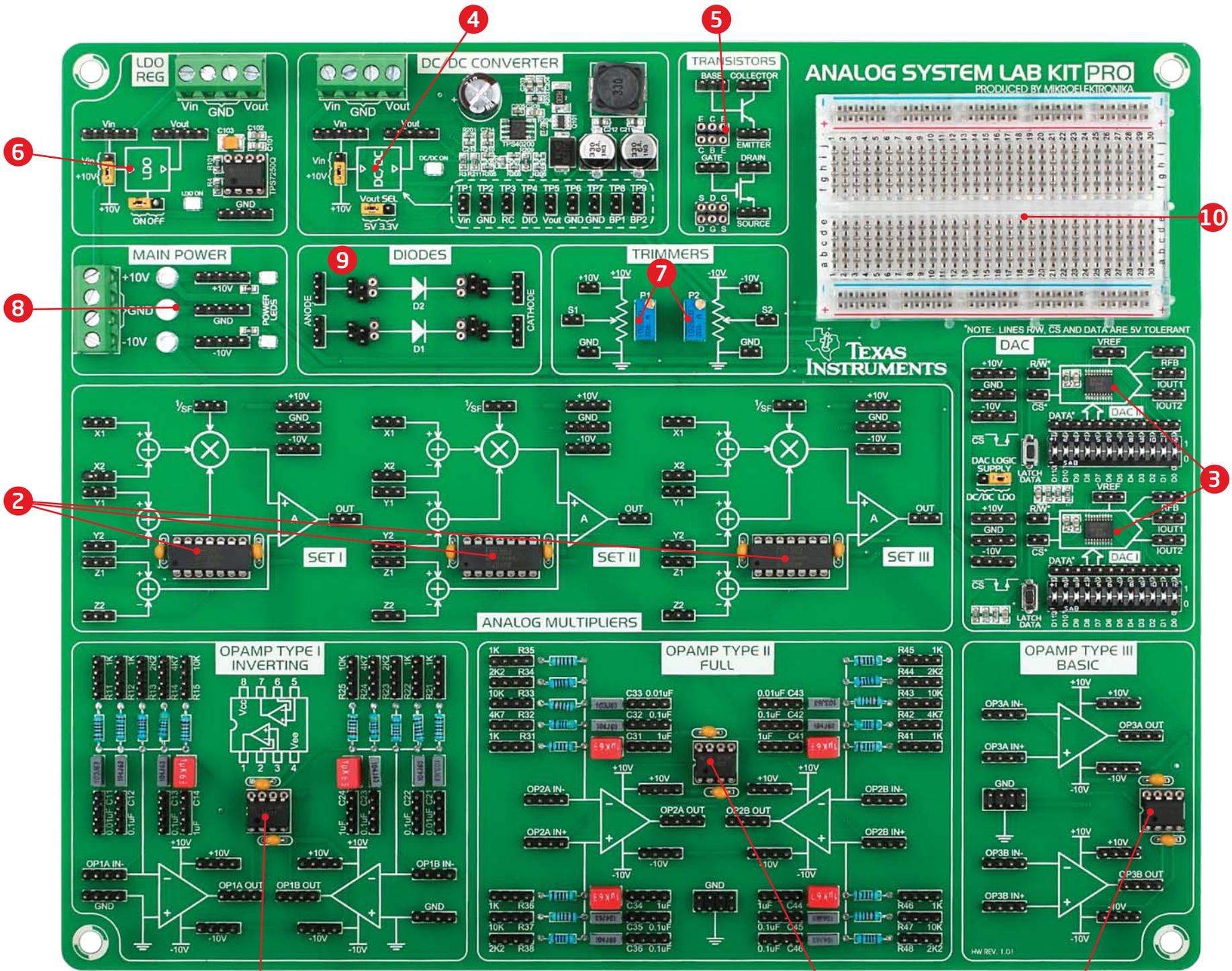


Photo of ASLK PRO

**CREATION OF
NEW
LABORATORIES**

❖ New Laboratories

4 New laboratories with state of the art facilities were incorporated in Electronics and Communication Engineering department under TEQIP.

Sr No	Laboratory Name	Facilities
1.	Digital Signal Processing Laboratory	All-in -One Educational Practice Board for DSP lab <ul style="list-style-type: none"> • Model - EPB_C6748 • Model - EPB_C6713
2.	Analog Signal Processing Laboratory	Hardware component implementation and analysis with Agilent Analog Electronic Lab Solution with Trainer Kit including Oscilloscope, Power supply, Multimeter, GPIB & Kit
3.	VLSI Design Laboratory	TEQIP II <ul style="list-style-type: none"> • Software Xilinx ISE System Edition 16.4 • Microwind 3.5 package • System Crafter SC Version • Advance VLSI Proto Board • Xilinx Spartan[®] 6FPGA • Xilinx Virtex[®] Board with aerial Ethernet cable of 5 V Power supply • CPLD(Xilinx Xc 95108PC84) Development Board TEQIP III <ul style="list-style-type: none"> • Cadence Virtuoso 6.1.7 (10 user)
4.	IoT laboratory	Following modules are available: <ul style="list-style-type: none"> • IOT Node - EPB_1768 • IOT Node - EPB_M4 • All-in- one General Purpose Board • IOT Gateway • Sensor Modules

❖ Laboratories Under Development

Sr No	Laboratory Name	Facilities
1.	Industrial Instruments Laboratory	using PLC , PID and SCADA controllers

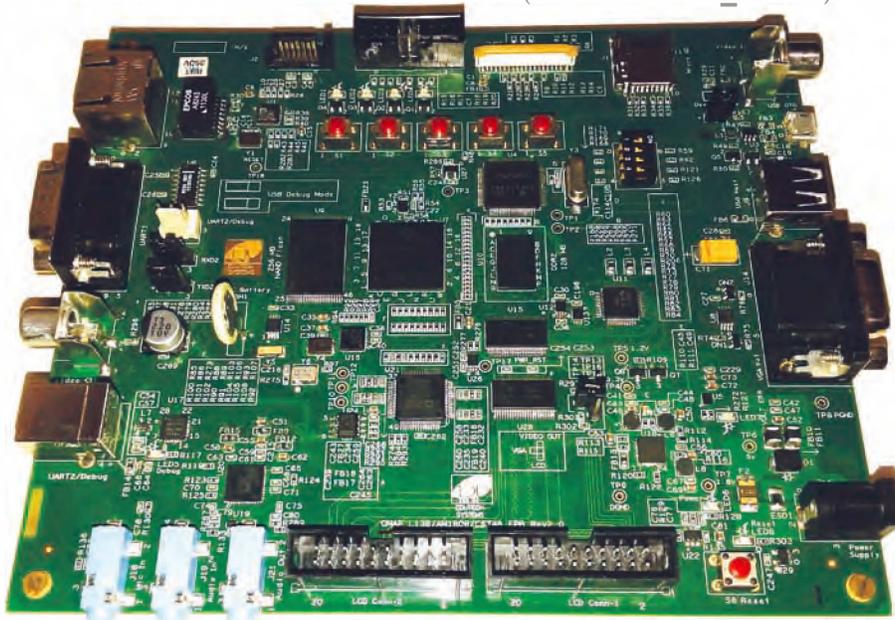
All-in-One Digital Signal Processing Lab

Edutech offers a complete All-in-one DSP Lab solution focusing various levels of experimentation on Signal Processing, Image, Video and Audio Processing topics designed especially for UG and PG curriculum.

Features

- All-in-one DSP Lab focusing Basic Signal Processing Experimentation, Audio, Video and Image related experimentation on a single ALL-in-One DSP Board
- Comprehensive Lab Solution for UG and PG curriculum.
- The lab package contains All-in-one DSP board/s, USB Emulator and camera interface.

All-in-One Educational Practice Board for DSP Lab (Model - EPB_C6748)



Features of All-in-One Educational Practice Board for DSP Lab

Processor

- TMS320C6748 - Fixed/ Floating Point Digital Signal Processor
- DSP with up to 456 MHZ performance.
- On board 14 Pin (2x7 Pin) JTAG emulation connector
- Boot mode selection switch

Memory

- On board 256 MB Flash memory
- On board 128 MB DDR2 RAM memory

Data Transfer Interfaces

- On board DB9 connector for UART-1 interface
- On board 3 pin header for UART-2 interface
- On board USB TYPE B Connector for UART-2 interface for Debug Console
- LED indication for USB connection for Debug Console
- On board Reset Switch with LED indication
- On board USB Type A Connector for USB host interface
- On board micro USB Type A Connector for USB OTG interface
- On board RJ45 connector for 10/100 Ethernet interface
- On board I2C based Temperature sensor
- On board I2C based RTC interface with battery backup
- On board SPI based micro SD card interface
- On board provision for SATA connector

Input/Output Interfaces and other Facilities

- On board Power-On LED indication
- On board 4 User LED at GPIO Pin as GPIO Test point
- On board 5 user push buttons for various applications

Special Functionality

- Boot mode selection switch
- On board Video in port available
- On board VGA out connector
- On board Provision for composite video out
- Provision for Graphics LCD interface
- On board audio jack and speaker (Mic in) interface
- On board audio codec for speaker out
- Provision for CMOS sensor connector to interface CMOS camera
- On board Temperature sensor with interrupt out facility
- On board jumper selection to switch various video out options
- On board LED to indicate power surge
- On board LED to indicate high voltage input
- On board excessive voltage protection circuit with LED indication
- Various test points for various signals
- On board jumper selection to switch UART2 between USB connector and 3 pin connector

Development Tools

USB JTAG Emulator

USB JTAG Emulator for program downloading and debugging on DSP board, compatible with latest version of CCS (V5)



Code Composer Studio

Integrated development tool (IDE) for DSP lab from Texas Instrument



Experiment List

Basic DSP Lab Experiments

- Signal generation using lookup table/Function (Square, Sine, Ramp, Sawtooth)
- Signal Modulation (AM, FM, DTMF)
- FIR Filter (Moving Average, Low Pass, Band Stop, Band Pass)
- IIR Filter (Using Cascade Second Order Filter, Cascade Second Order Transposed)
- FFT and DFT
- Fast Convolution

Image Processing

- Raster Display, loop back an image
- Sobel Filters (Edge Detection using 3x3, 5x5, 7x7 algorithms)
- Image Smoothing using convolution algorithms
- Image Sharpening using convolution algorithms
- Image Restoration using Median filtering
- Median Filter (Low Pass filters, Image Smoothing)
- Lower to threshold (Image Segmentation, Morphological Transforms)
- Negative imaging

Video Processing

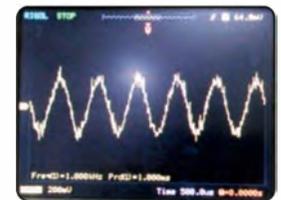
- Program for Video loopback
- Face detection algorithms
- Program to display Text on Video
- Program to display a shape on Video

Audio Processing

- Audio Loopback
- Filters
- Step response of AIC codec Anti aliasing filter



Amplitude Modulation



Sine Wave



Clipping



Ramp Wave



Edge Detection



Median Filter



Image Thresholding



Image Convolution

Hands-on Training Program on DSP available.
For more details, mail us on info@edutechonline.com or
visit www.embeddedlabs.in/ training option

Optional Interfacing Modules

Finger print module with enclosure (Model- ASK19):

- Image acquiring time - <0.5s
- Storage capacity – 256
- FAR - <0.001%
- Average searching time - <1s
- Working environment – (-10 to 40) Degree C
- Working current – 100mA peak
- Matching mode- 1:1 and 1:N
- Character file size – 256
- Serial Communication Interface
- Template size – 512 bytes
- Power supply through 2 pin relimate connector
- UART relimate Connector to TTL signal
- Power Supply Connector
- USB B Power Supply Connector
- UART DB9 Connector



GSM Modem with enclosure (Model- ASK18):

- Modem: SIM800
- Standard RS-232 serial communication interface using 9 pin DB9 connector provided for communication
- Controlling through AT commands.
- Modem can be linked to a PC, micro-controller or DSP based embedded system for sending SMS.
- Data circuit asynchronous, transparent and non-transparent up to 14400 bits/s and baud rate of 9600 to 115,200 bits/s
- Metal enclosure case
- Power supply – 12V SMPS power supply



RFID Interface Module with enclosure (Model- ASK13):

- Low cost
- Long read range
- Small outline
- Wide voltage range: 9 V DC regulated, linear
- Interfaces: RS232
- Read Range: Up to 5 cm
- Frequency: 125KHz
- Format: 64 bits, Manchester coding
- Transponder: Read only
- Encapsulated in acrylic enclosure case



MATLAB TOOLS DETAIL

MATLAB Version: 9.6.0.1072779 (R2019a)							
MATLAB License Number: 40802647							
Operating System: Microsoft Windows 8.1 Pro Version 6.3 (Build 9600)							
Java Version: Java 1.8.0_181-b13 with Oracle Corporation Java HotSpot(TM) 64-Bit Server VM mixed mode							
S.NO	TOOL NAME	VERSION		S.NO	TOOL NAME	VERSION	
1.	MATLAB	Version 9.6	(R2019a)	48.	Phased Array System Toolbox	Version 4.1	(R2019a)
2.	Simulink	Version 9.3	(R2019a)	49.	Powertrain Blockset	Version 1.5	(R2019a)
3.	5G Toolbox	Version 1.1	(R2019a)	50.	Predictive Maintenance Toolbox	Version 2.0	(R2019a)
4.	AUTOSAR Blockset	Version 2.0	(R2019a)	51.	RF Blockset	Version 7.2	(R2019a)
5.	Aerospace Blockset	Version 4.1	(R2019a)	52.	RF Toolbox	Version 3.6	(R2019a)
6.	Aerospace Toolbox	Version 3.1	(R2019a)	53.	Reinforcement Learning Toolbox	Version 1.0	(R2019a)
7.	Antenna Toolbox	Version 4.0	(R2019a)	54.	Risk Management Toolbox	Version 1.5	(R2019a)
8.	Audio Toolbox	Version 2.0	(R2019a)	55.	Robotics System Toolbox	Version 2.2	(R2019a)
9.	Automated Driving Toolbox	Version 2.0	(R2019a)	56.	Robust Control Toolbox	Version 6.6	(R2019a)
10.	Bioinformatics Toolbox	Version 4.12	(R2019a)	57.	Sensor Fusion and Tracking Toolbox	Version 1.1	(R2019a)
11.	Communications Toolbox	Version 7.1	(R2019a)	58.	SerDes Toolbox	Version 1.0	(R2019a)
12.	Computer Vision Toolbox	Version 9.0	(R2019a)	59.	Signal Processing Toolbox	Version 8.2	(R2019a)
13.	Control System Toolbox	Version 10.6	(R2019a)	60.	SimBiology	Version 5.8.2	(R2019a)
14.	Curve Fitting Toolbox	Version 3.5.9	(R2019a)	61.	SimEvents	Version 5.6	(R2019a)
15.	DSP System Toolbox	Version 9.8	(R2019a)	62.	Simscape	Version 4.6	(R2019a)
16.	Data Acquisition Toolbox	Version 4.0	(R2019a)	63.	Simscape Driveline	Version 2.16	(R2019a)
17.	Database Toolbox	Version 9.1	(R2019a)	64.	Simscape Electrical	Version 7.1	(R2019a)
18.	Datafeed Toolbox	Version 5.8.1	(R2019a)	65.	Simscape Fluids	Version 2.6	(R2019a)
19.	Deep Learning Toolbox	Version 12.1	(R2019a)	66.	Simscape Multibody	Version 6.1	(R2019a)
20.	Econometrics Toolbox	Version 5.2	(R2019a)	67.	Simulink 3D Animation	Version 8.2	(R2019a)
21.	Embedded Coder	Version 7.2	(R2019a)	68.	Simulink Check	Version 4.3	(R2019a)
22.	Filter Design HDL Coder	Version 3.1.5	(R2019a)	69.	Simulink Code Inspector	Version 3.4	(R2019a)
23.	Financial Instruments Toolbox	Version 2.9	(R2019a)	70.	Simulink Coder	Version 9.1	(R2019a)
24.	Financial Toolbox	Version 5.13	(R2019a)	71.	Simulink Control Design	Version 5.3	(R2019a)
25.	Fixed-Point Designer	Version 6.3	(R2019a)	72.	Simulink Coverage	Version 4.3	(R2019a)
26.	Fuzzy Logic Toolbox	Version 2.5	(R2019a)	73.	Simulink Design Optimization	Version 3.6	(R2019a)
27.	GPU Coder	Version 1.3	(R2019a)	74.	Simulink Design Verifier	Version 4.1	(R2019a)
28.	Global Optimization Toolbox	Version 4.1	(R2019a)	75.	Simulink Desktop Real-Time	Version 5.8	(R2019a)
29.	HDL Coder	Version 3.14	(R2019a)	76.	Simulink PLC Coder	Version 3.0	(R2019a)
30.	HDL Verifier	Version 5.6	(R2019a)	77.	Simulink Real-Time	Version 6.10	(R2019a)
31.	Image Acquisition Toolbox	Version 6.0	(R2019a)	78.	Simulink Report Generator	Version 5.6	(R2019a)
32.	Image Processing Toolbox	Version 10.4	(R2019a)	79.	Simulink Requirements	Version 1.3	(R2019a)
33.	Instrument Control Toolbox	Version 4.0	(R2019a)	80.	Simulink Test	Version 3.0	(R2019a)
34.	LTE HDL Toolbox	Version 1.3	(R2019a)	81.	SoC Blockset	Version 1.0	(R2019a)
35.	LTE Toolbox	Version 3.1	(R2019a)	82.	Spreadsheet Link	Version 3.4.1	(R2019a)
36.	MATLAB Coder	Version 4.2	(R2019a)	83.	Stateflow	Version 10.0	(R2019a)
37.	MATLAB Compiler	Version 7.0.1	(R2019a)	84.	Statistics and Machine Learning Toolbox	Version 11.5	(R2019a)
38.	MATLAB Compiler SDK	Version 6.6.1	(R2019a)	85.	Symbolic Math Toolbox	Version 8.3	(R2019a)
39.	MATLAB Report Generator	Version 5.6	(R2019a)	86.	System Composer	Version 1.0	(R2019a)
40.	Mapping Toolbox	Version 4.8	(R2019a)	87.	System Identification Toolbox	Version 9.10	(R2019a)
41.	Mixed-Signal Blockset	Version 1.0	(R2019a)	88.	Text Analytics Toolbox	Version 1.3	(R2019a)
42.	Model Predictive Control Toolbox	Version 6.3	(R2019a)	89.	Trading Toolbox	Version 3.5.1	(R2019a)
43.	Model-Based Calibration Toolbox	Version 5.6	(R2019a)	90.	Vehicle Dynamics Blockset	Version 1.2	(R2019a)
44.	OPC Toolbox	Version 4.0.7	(R2019a)	91.	Vehicle Network Toolbox	Version 4.2	(R2019a)
45.	Optimization Toolbox	Version 8.3	(R2019a)	92.	Vision HDL Toolbox	Version 1.8	(R2019a)
46.	Parallel Computing Toolbox	Version 7.0	(R2019a)	93.	WLAN Toolbox	Version 2.1	(R2019a)
47.	Partial Differential Equation Toolbox	Version 3.2	(R2019a)	94.	Wavelet Toolbox	Version 5.2	(R2019a)

IOT Lab Components

IOT Node - EPB_1768



- Node features a 32-bit ucontroller working up to 100MHz,
- 68 KB on-chip SRAM and 512 KB on-chip Flash memory
- On board 20 pin JTAG emulation connector
- Facility to interface serially with Gateway
- On board I2C, SPI interface facility for interfacing sensors

On Board Data Transfer Interfaces

- USB & 3 pin header for UART-0 interface
- DB9 connector for UART-1 interface with Tx Rx indication LED
- USB host interface, DB9 connector for CAN
- 256 Kbit serial I2C EEPROM interface
- Serial I2C based Temperature sensor
- Serial SPI based MMC card interface

Input/Output Interfaces

- Power-On LED indication
- 20 Pin Connector for GPIO lines available for actuators

Special On Board Functionality

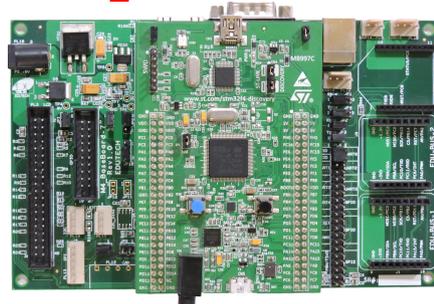
- 34 pin TFT LCD interface connector, RJ45 connector for Ethernet interface, Audio out speaker interface
- Temperature sensor with interrupt out facility
- 2x5 Pin connector for 6 channel ADC interface
- Potentiometer to test On-Chip ADC, Reset Switch with LED indication, Switch for Run/Program mode (Boot mode selection) with LED indication

IOT Node set also contains one unit of portable sensor node that uses a wireless connection to post the data to the cloud

IOT Gateway

- Embedded gateway featuring CPU up to 1.2GHz Quad Core, 1GB RAM
- On board Wifi and Bluetooth for wireless connectivity
- Nodes can be connected to the gateway via Ethernet, Serially or using Wifi or Bluetooth
- Collects the data from the nodes and posts it to cloud

IOT Node - EPB_M4



- Node features the STM32F407 - 168MHz Freq
- 1 Mbyte of Flash memory, 192Kbytes of RAM,
- On-board Debugger/JTAG
- LEDs: for USB communication, power on, user, USB OTG, Push buttons: User and Reset
- USB connector for UART4, DB9 connector for UART6, 3Pin and 4Pin Header for UART4 & 6,
- USB OTG FS and HID, SDIO based SD card
- EDU-BUS connector with ADC, PWM, UART, I2C, SPI, GPIO interface, & on board Accelerometer
- 20Pin connector for 16 GPIO Line
- 40Pin TFT LCD interface, Ethernet interface
- Audio 3.5 jack interface, On board MIC
- Facility to interface serially with Gateway
- On board interface facility for interfacing sensors

All-in-one General Purpose Board

The All-in-one GPIO board is specially designed to suit the experimentation on different GPIO devices with the micro controllers.

Features:

- On board display options include 8 LED, 16x2 character LCD, 2 digit 7-segment display
- Switches include 4 general purpose keys and 2X2 matrix keyboard
- I2C and SPI based EEPROMs
- Stepper motor interface
- DC motor interface with DC motor
- Relay output
- Facility to provide 2 channel ADC input using potentiometer and unity gain amplifier for protection
- Compatible with different educational practice boards
- Useful resource to learn basic programming techniques to interface basic GPIO components to the controller



Sensor Modules

A set of variety of sensors are offered with the lab. These sensor modules can be interfaced with the nodes using I2C and SPI protocols. The sensors includes - Moisture sensor, Dust sensor, Water sensor, Accelerometer, Magnetometer, Gyroscope, Pressure sensor, PIR Motion sensor, Ultrasonic Ranger, Temperature and Humidity sensor, REED switch, Vibration sensor, Touch Key sensor etc.

Skill List Explored

Protocols	Sensors	Cloud	Language	Ecosystem
UART,SPI	Driver Development	Web Services	C, C++	ARM Cortex
I2C,WIFI	Sensor Interface	Event Management	JAVA	Linux, Mbed
Bluetooth, COAP	Sensor Communication	Security	JAVA Script	RTOS
MQTT, REST	Sensor Calibration	Event Trigger	Python	OSGi framework
IPV4 (Ethernet)	Sensor Applications	Dynamic resource allocation	XML	Eclipse IDE, GNU

Smart IoT Lab – Learning Outcome

Understanding of basic skills needed to implement IoT concept

Working with the IoT trainer Node – writing C code, compiling, flashing and testing

Setup of IoT Gateway

Interfacing different IoT training nodes to gateway using different wired and wireless protocols

Get started working with UART, Ethernet and WIFI protocols

Study of different sensors and their characteristics

Writing sensor drivers and testing the sensor output on the UART port of IOT training Node

Configuration of the cloud platform

Sending data from the IOT node to the gateway using different communication options viz. Serial, Ethernet and WIFI

Transferring data from gateway to the cloud

Exploring the web services like Mail, Messaging (SMS), and Tweeter etc.

Tracking of cloud data as per the requirement

Implementing practice case study and further developing customized application

Experiment List

Using Serial and Ethernet Protocol

- Programs to monitor analog data received on ADC remotely on cloud
- Program to toggle LEDs remotely using cloud application
- Programs to remotely toggle relay using cloud application
- Control speed and direction of stepper motor remotely using cloud application
- Control speed and direction of DC motor remotely from cloud
- Interfacing various sensors to the node and reading the data on the cloud and perform necessary action based on the information received

Using Wireless Protocol (BLE and Wi-Fi)

- Program to interface Bluetooth and Ultrasonic Ranger to monitor distance and send to the cloud
- Program to interface Bluetooth and implement DC Motor
- Program to interface Wio node and Temperature and Humidity sensor and monitor values on the cloud

Using Cloud Service

- Program to cross communicate between nodes
- Program to add trigger to send email if ADC value is above certain level or below
- Program to add trigger to send twitter message if ADC is above certain level or below
- Program to add trigger to send SMS with message bird if ADC is above certain level or below

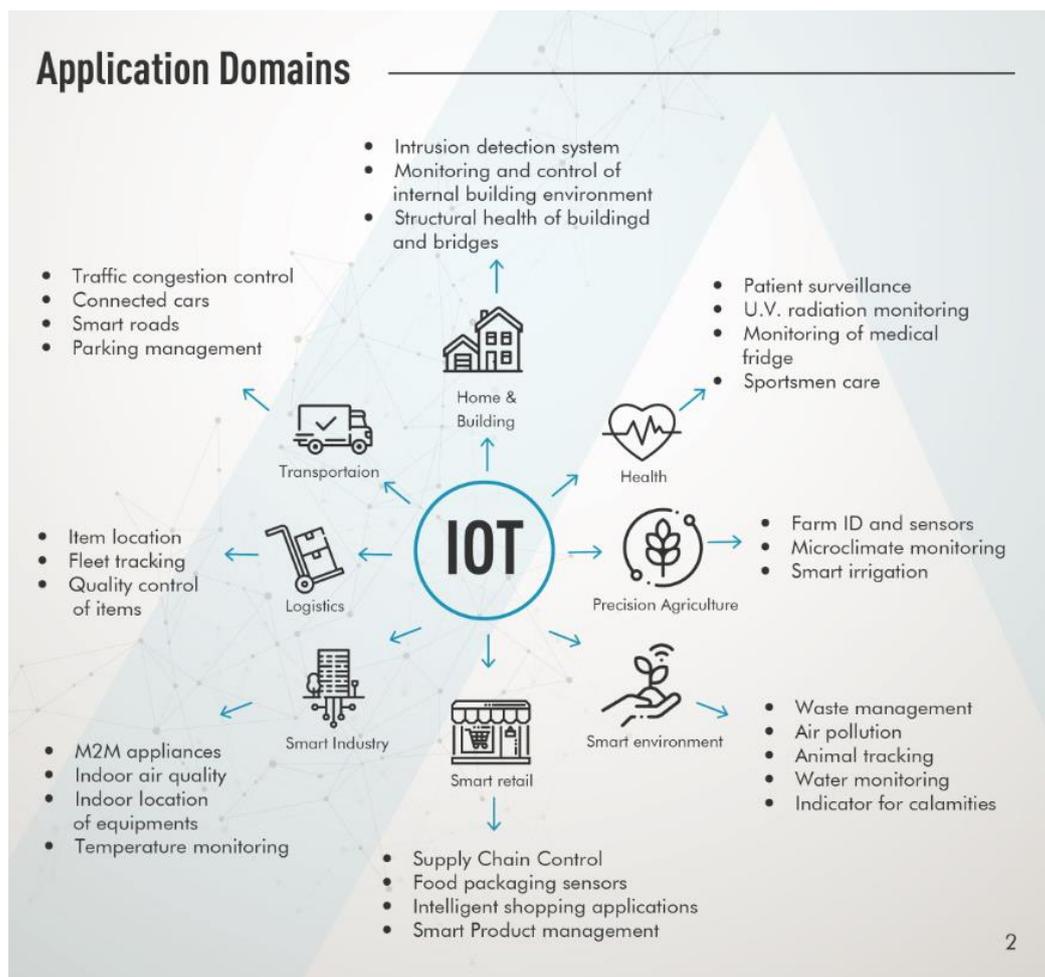
Case Study

- Some case studies involving cloud, remote data logging and its access, service tracking system etc. for general reference.

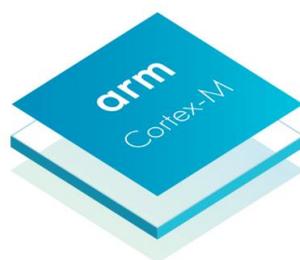
Lab Content

- IoT Nodes - 5 Units(Three Units of Cortex-M3 & Two Units of Cortex-M4), All in One General Purpose Board - 5 Units, IoT Gateway - 1 Unit, A set of sensors - 1 Set, Portable Sensor Node - 1 Unit, Amazon Echo Dot, DVD ROM, Workbook and sample working codes, IDE for Lab, Accessories and cables

Edutech Smart IOT Lab Solution:



New Offerings:



1. Integration of Voice Commands (Amazon Echo Dot) for remote control operations
2. Configuring Amazon cloud into IoT ECO System
3. Using Google Cloud and its services to control devices and sensors provided with IoT Lab
4. Addition of ARM Cortex M4 Node for more powerful computation and communication

Eclipse based Integrated Development Environment (IDE) Tool:

- The general purpose Eclipse based IDE is a easy to use development platform which can be used for windows as well as Linux environment.
- This IDE tool supports different microcontroller platforms like 8051, PIC,AVR,ARM7 and Cortex M3.
- It can be interfaced with the debugger using external plug in. This tool is unique as it allows users to work with multiple controller platforms thus reducing the learning time and making it easy to develop applications, projects and lab exercises

Specifications for Smart IoT Solution (Model - EPB_IOT)

- Different variety of IOT Nodes featuring Three ARM Cortex-M3 & Two Cortex-M4 demonstrate various features like Ethernet, USB, Sensor interfacing, UART, I2C, SPI etc. These nodes enabled to user to learn sensor interfacing and peripheral programming required for IOT application.
- One unit of Embedded Gateway with HDMI and Ethernet connectivity, USB ports, on board Wifi, on board Bluetooth. Quad Core 1.2GHz CortexA53 64bit CPU, 1 GB RAM. The embedded gateway should be able to connect to the nodes and transmit data to the cloud. The necessary image containing cloud services compatible for IoT should be ported on the board. Also the procedure to configure the same should be provided to end user.
- Five unit of All-in-one GPIO board designed to suit the experimentation of IoT applications to be provided having following features, On-board display options includes 8 LED, 16x2 character LCD, 2 digit 7-segment display, Switches includes 4 general purpose keys and 2X2 matrix keyboard, I2C and SPI based EEPROM, Stepper motor and DC Motor interface, Relay output, Facility to provide 2 channel ADC input using potentiometer and unity gain amplifier for protection
- Experimentation using AWS (Amazon Web service) along with the provided nodes featuring real time IOT experimentation.
- Voice enabled control using Amazon Alexa enabled Echo Dot with provided node hardware.
- Experimentation using Google Cloud VM along with the provided nodes featuring real time IOT experimentation.
- Voice enabled control using Google Assistant Application on Android OS.
- One unit of Router with power supply
- A Bluetooth module for connecting the node to embedded gateway.
- A portable sensor kit with facility to interface temperature-humidity sensor to log data on IOT gateway using Wi-Fi protocol.
- Three unit of Cortex M3 Base Board for Interfacing Sensors
- A set of sensors for sensing of data and posting it to cloud. The set of sensors should be compatible with nodes and should be provided with proper connectivity options like base board where the sensors can be mounted. The sensors should be compatible with I2C, SPI protocols etc. The sensors should be pluggable. The base board should have 34 pin connector for I2C, SPI, UART, PWM lines available as well as a 10 pin connector for ADC interface with the node.
- 2KG stepper motor and +5V DC motor for demonstration of cloud based control using IoT application
- An IDE configured for IoT applications to be provided for entire lab.
- Workbook(Softcopy) Manual featuring basic examples to get started with the target board as well as examples to use internet and communicate with cloud, with detailed working procedures will be provided with the setup.
- The workbook contains examples related to interfacing of sensors as well as posting the data of the sensors on the cloud and take necessary action as required.