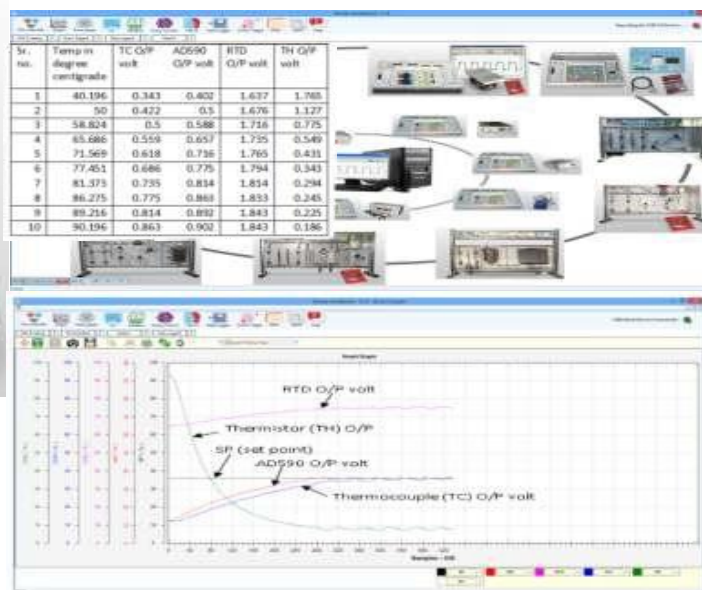


SENSOR / TRANSDUCER TRAINER (Model: TMS-MIT)

Trinity



SALIENT FEATURES

- ◆ Aesthetically designed injection moulded electronic desk. Master unit carrying useful experiment resources like Power supplies, DPMs, Computer Interface, Bar graph LED indicator Function Generator etc. while the central slot will carry replaceable experiment panel secured in an ABS molded plastic sturdy enclosure. Order MUs x 7 Nos. + 7 panels + addons as required.
- ◆ Has colorful screw less overlay showing schematic & its connection tag numbers for easy connectivity.
- ◆ Hands on learning by plotting sensor characteristics. Panel 1 to 6 are basic sensors, Panel 7 onwards are applied sensor panels. Set of Users Guide provided with each Unit
- ◆ Optionally PC interface using VWB software can be provided for MIT3/MIT6 panels(PC is not in scope of supply).

Master Unit

◆ Built in power supply :

DC supply +/- 12V, 500mA, Variable 7V to 14V @ 3Amp.

◆ Built in function generator

O/P waveform- sine, triangular & square, TTL O/P freq. 1Hz to 200KHz in ranges with amplitude & freq. control pots, o/p voltage 10Vpp.

◆ On board measurement

DC voltmeter 2V/20V (1 No) & LED BAR graph with 10 LED indicator to display 0-2.5V or 0-4V input.

◆ Computer interface (Optional)

Interfaces to PC USB port using USB IO Module through 25 pin D (M) connector on CIA card & Type A to Type mini B cable. PC is not in scope of supply. Dot net based Virtual Workbench Software (VWB) to support virtual instrumentation supplied. Opto isolated channels.

4ADC channels : 0 to 2.5V full scale

1DAC channel : o/p 2.5V/12V switch selectable full scale

V to I Function block: Input : 0-2.5Vdc, Output : 0-20 or 4-20mA, upto max. 2Vdc GND compliance

- V to PWM function block : I/P -0-2.5V, O/P-1KHz PWM O/P+9V.

◆ PC (WIN7/8/10) based Virtual Work Bench Software (PC with USB port not in scope of supply) For details refer VWB option under XPO-VLAB.

- PID in ON/OFF control mode.
- Event trigger to increase or decrease controller O/P in auto / manual mode.
- **Graph plotting** : Under process monitoring can draw XT/XY graphs
- **Data logger** : To create & fill observation table in auto as well as manual mode

◆ Mechanical Dimensions:

a) **Master Unit** : 460mm(W), 160mm (H), 350mm(D)

Net weight : 6Kg, **Gross weight** : 8Kg.

b) **Panel** : 215mm(W), 165mm(H), 40mm(D),

Net weight : 700 gm approx.

◆ Operating voltage : 220V / 230V ±10%, 50Hz, 75VA

Modular experiment panels

- Optionally can be ordered as standalone panels (except MIT10 onward) with built in power supply but without PC interface.
- Not all subassemblies under particular class of sensor can be assembled together on one panel. These are normally sold as separate units.

1) Strain Gauge Transducers (MIT1)



- Piezo resistive transducer for strain measurement.
- Micrometer 0-20mm (Accuracy 0.01mm) for strain generation.
- Strain gauges mounted on cantilever in half & full

Wheatstone bridge and **instrumentation amplifier** with Zero & span adjustment for calibration.

- Experiments on Gauge factor determination, Strain indicator, Displacement measurement using Strain gauges.



MIT1a : Piezo resistive transducer for pressure measurement (0-15psi)

Note : (cannot share with Level setup) Pressure sensor 0-15 psi (20 psi max.), gage type, Pressure generating handpump connected using T connector to the sensor and Bourdon pressure gauge for measurement & calibration. Cannot share MIT-1 with any other option add-on. Optionally McIlroy pressure measurement **P to I experiment (Model : MIT1aij):** Can be performed using MIT Master Unit (V to I FB)



MIT1b : Piezo electric transducer for impact measurement with attenuator & peak detector.



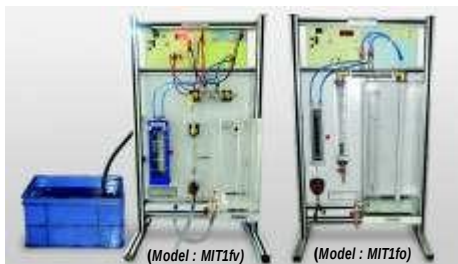
MIT1c : Force / Weight measurement using piezo transducer (0- 20 kg weighing scale sensor).



MIT1d: Level measurement by measuring water column height using pressure sensor by Air bubbler method in 500mm calibrated acrylic water tank, water pump, vibratory air pressure pump, manual bypass valve mounted on a compact (530 x 910mm) table top panel. Can not share MIT1 with a, f options simultaneously.

MIT1fv : Flow measurement using Venturi

MIT1fo : Flow measurement using Orifice



Compact, lightweight setup of size (190X700) consisting of venturi OR orifice plate sensor (200LPH), ball valve to isolate, uses DPT sensor mounted in MIT1, water pump, rotameter (1000 LPH for Venturi and 200 LPH for Orifice), U tube mercury manometer (70-0-70 mm of hg), 6 QRC's to measure differential pressure, flow measurement tank (5 litre), submersible water pump, Sump water tank (15 litre). [Cannot share MIT1 with option a,d simultaneously. Order venturi or Orifice separately]. cc, cv and cd determination for orifice & venturi.



MIT1 g : Static Torque Measurement Setup

(530 x 910 mm) : using 30 x 30 aluminum profile with Fulcrum long arm end of 300 mm (optionally 1000mm) mounted on bearing to carry weight pan to suspend 100 gms x 10 nos. while short arm is held by full bridge strain gauge sensor to display torque in kg (meter)

MIT1h : Flapper Nozzle mechanism demonstrator: Consists of :

- Micrometer 0-20mm (accuracy 0.01mm) provided to displace flapper.
- Nozzle (3.5mm Ø) mounted at right angle to flapper on MIT1 panel.
- Back pressure is displayed on Bourdon pressure gauge (0-15psi) & also applied to Piezo resistive pressure sensor (15 psi) with Signal conditioning circuit to convert pressure into voltage (0-2.5V) & V to I function block (0-20mA or 4-20mA output) on Master unit (MU) .
- Needs compressed air supply through external AFR (set to 1 bar). Compressor is not in Scope of Supply (Optional).

2) Displacement Sensing Transducers (MIT2)



- **Micrometer** 0-20mm (Accuracy 0.01mm)
- **Precision phase sensitive rectifier**
- Measurement frequency of 1KHz sine

- Signal conditioning circuit with zero and span adjustment for calibration of variac sensor output voltage 0-2.5V or suitable for DPM.
- **Zero & span adjustment for calibration of following transducers**
 - i) Resistive linear transducer : 0 -20mm
 - ii) Capacitive linear transducer : 0 -20mm
 - iii) Capacitive angular transducer : 0 - 90 degree
 - iv) Inductive linear transducer : 0 -20mm
 - v) LVDT transducer : 0 -20mm or (-10to+10mm)



Optional ADDONS

MIT2a : Level measurement by **capacitance** transducer using 500 mm calibrated acrylic water tank, water pump, manual flow valve mounted on compact light weight (530 x 910 mm) table top panel.

MIT2b : Level measurement by float type

: Rotary pot transducer using 500 mm calibrated acrylic water tank, water pump, manual flow valve mounted on compact light weight (530 x 910 mm) panel. Set up may be shared with (a)

MIT2c : Level measurement by torque tube method

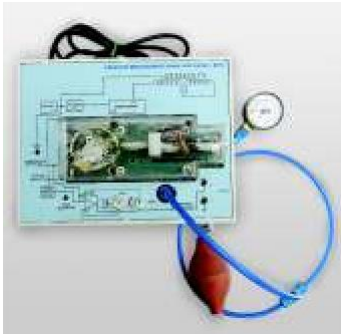
using displacer with rotary pot wheel & float transducer using 500 mm calibrated acrylic water tank, water pump, manual flow valve mounted on compact light weight (530 x 910 mm)





MIT2d : Angular measurement using rotary pot 0-180° Span.

MIT2e : Humidity measurement demonstrator using polymer hybrid sensor or using either capacitive or resistive type sensor.



MIT2f : Pressure measurement using LVDT :

- Bourden pressure gauge (0-15psi) mechanism coupled to LVDT sensor (0-20mm).
- Pressure measurement up to 0-15psi.
- Pressure generating hand pump connected using T connector to the sensor gauge and another bourden pressure gauge for measurement & calibration.

3) Speed Sensing Transducers (MIT3)



- **12V DC motor** with speed varying from 0-4000rpm & rotating slotted wheel having 8 slots
- Individual signal conditioning circuit with **programmable threshold comparator**.

- **F to V Converter with span & zero amplifier**
- **6 Nos. of Speed transducers & their experiments:**
 - 1) Magnetic pickup,
 - 2) Photo reflective,
 - 3) Photo interruptive
 - 4) Inductive pickup with
 - 5) Stroboscope envelop detector.
 - 6) Hall sensor.



Optional ADDON

MIT3a : Flow measurement :

Compact, lightweight set up of size (190mm x 700mm) with small water pump, **Vane type** flow sensor (200 LPH) & rotameter (200 LPH), 6 litres plastic water tank. (Size : 130 x 130 x 375mm)

4) Sound Sensing Transducers (MIT4)



- 40KHz gated oscillator to generate **Ultrasonic** sound waves.
- Sound Sensors:
 - i) **Ultrasonic Distance Measurement.**

- ii) Level measurement using ultrasonic sensor (optional)
- iii) Speed measurement using doppler effect (optional)
 - a) DC motor speed measurement using ultrasonic sensor
 - b) Fan speed measurement using ultrasonic sensor
 - c) Doppler amplitude measurement using MIT7 vibration setup

5) Light Sensing Transducers (MIT5)



Incandescent lamp with variable intensity

- **5 Nos. of Light sensors & their experiments:**

1) Photo diode with **I to V converter**

2) Photo transistor with **I to V converter**

3) Photo resistor/LDR with **R to V converter** using constant current source.

4) Photovoltaic cell / Solar cell

5) Opto coupler, Laser diode, Infrared LED, Red LED

Optional ADDON

a) Elementary Fiber Optics : (Model : MIT5a) 3 nos of transmitter diodes (RED (660nm) / BLUE / IR (950nm), 1 no detector (photo transistor), 1m PMMA Cable, I/Ps - TTL & AC Coupled (0-4V), O/Ps- AC, DC Coupled & TTL O/P,

Experiments performed : Setting up **ANALOG LINK** (10KHz BW)(Study DC Characteristics & frequency response of different transmitter diodes), Setting up **digital link** (50KHz BW) (observe effect of varying square wave frequency on receiver output). Needs external FG.

b) Optical filters (Model : MIT5b) for Red, Green, Blue & Yellow colour to determine sensitivity transducers for colors. (optional)

6) Temperature Sensing Transducers (MIT6)



- **Instrumentation Amplifier** to amplify thermocouple signals
- Built in heat bar / mini oven driven by **Power Amplifier** of sufficient wattage
- Temp. selection upto 95 degree C in 5 ranges with ON / OFF closed loop control.

Temp. sensors: i) Thermocouple J with room temp.

calibration pot. ii) Thermocouple K with room temp. calibration pot.

iii) Thermister (100K), iv) PT100, v) IC sensor (AD 590)

vi) Bimetallic switch

7) Vibration sensor and Air flow sensor experiment Panel - MIT7



Vibration (accelerometer) sensor

- i) Operation Range : Audio frequency (2KHz - 3.5KHz),
- ii) **Power amplifier** : 1W capacity as a vibration generator,
- iii) Piezo electric sensor
- iv) Determination of acceleration (accelerometer), velocity, displacement components.

Air flow sensor (Hot wire Anemometer) :

- i) Preheated thermister = 100 ohm, ii) DC fan (12V, 1 1/2") to generate variable airflow in a mini wind tunnel with manual outlet control, iii) Bridge amplifier to O/P 0 = 2V at various temperatures (Fan speed).

8) Electrical Parameters Measurement Sensor Panel: (MIT8)



Panel Facilitates measurements of AC voltage, current (peak, average, RMS), power-S (apparent), P (active), Q (reactive), cos (PF 0.5 lag to 0.5 lead), CT (5/1 Amp) as a current transducer and PT (230V/ 12V) as a voltage

transducer mounted on the panel itself.

Loading Setup provided with 100 W lamp bulb (**Process I modified**), multi tap Reactive (inductor, capacitor) load, 4 relays to automate PC based measurement. PC interface supported by master unit (Optional).

9) Encoder (Absolute /Incremental) Experiments Panel (MIT9)



Panel consists of 4 bit up/down counter with parallel loading to latch absolute encoder O/P (4 bit), comparator to stop turn table at set position, incremental encoder circuit with direction detect and incremental position clock. Position displayed on 5 Leds to indicate direction and position of turn table (1 of 16).

Encoder Set up : RTU base unit with turn table motor as prime mover with 5 track pattern stuck from below photo reflective emitter detector LED (5 pairs) signal conditioning PCB mounted from below & 9 pin D connector cable attached to MIT9 panel. Optionally working of Pyroelectric Infrared sensor (PIR sensor).

10) Temperature sensor calibration panel (MIT10)



Compact light weight setup (Model: MIT10a) (size: 190X700) consisting of process vessel (SS 304) with 750W heater, Bourdon Type Thermometer, provision to mount either one RTD/NTC (thermistor) & one K type TC or 2 TCs (standard & under calibration), EMT9 panel acts as heater controller consisting of signal conditioning circuit for RTD or NTC & TC. Acrylic Water Tank with Submersible Pump & Fish Tank compressor for cooling purpose.

- Optionally PC interface & control using CIP panel.

Model: MIT10b)

11) Dead Weight Pressure gauge & calibration Tester (MIT11)



Bourdon pressure Gauge
 : Dial = 4",
 Range = 10 kg/cm²
 QRC External calibration port, **Weights** : 5 kg, 2 kg, 1kg **Rack Size** : 4 x 3

12) Hall Sensor based AC/DC Current Measurement Expt. Panel (MIT12)



It needs current injector panel EMT23C & EMT39B for AC/DC current & DC voltage measurement, mounted in Alu. profile rack.

AC/DC current hall sensor (x2nos.): Closed Loop current measurement using Hall sensor IC (max. I/P upto 20A, 50/60Hz), Isolation = 2.1KV, Proportional O/P = 0 - 2.5V, 1 CH Optional. DC Voltage transducer (x2 nos): Using high speed opto coupler IC (max. up to 600Vdc), isolation = 2 KV, 1 CH Optional.

Function Blocks Used : Precision rectifier (x 2 nos) with gain = 5, LPF (x2nos) with gain = 2, Span Zero Circuit to interface with ADC (0-2.5Vdc) for both current and voltage, only 1 functional block each supplied, 2nd optional, zero current detector.

13) Smoke Detector Panel (FAT1)



- Photoelectric smoke sensor
- Operating voltage – 12VDC
- Standby current – 20uA
- Alarm current – 35mA @ 12VDC
- Alarm output – Remote LED
- Temperature range – 0% ~ 95%RH

14) Thermoelectric effect measurement panel (MIT15)

- Panel consists of thermoelectric modules- 2 nos. Size- 40X40mm, Operating voltage- $\pm 12V$, Wattage- 40W, foil type (35X30mm) PT100 sensor- 2 nos., loading/heating resistor (5 Ω /50W), heat sink & cooling fan (12V) are mounted in the aluminium tray. Needs variable 0-12V to drive Peltier module.
 - Forced air cooling to maintain heat sink at room temperature
- 1) **Peltier effect** : Study of Peltier effect (heater/cooler) using thermoelectric module (Range- 200 to 75 degree C).
 - 2) **Seebeck effect** : Study of Seebeck effect (electric voltage generator) using thermoelectric module (Range- 0 to 600mV).

15) I to P and P to I converter Trainer (MIT16)



- Compact light weight setup consisting of EMT8, EMT9 and CIP panels in the top row.
- $\pm 12V$ /500mA power supply, DPM display on EMT8.
- Industry standard I to P converter module with input 4-20mA, output 3-15psi & input air supply through AFR mounted on composite pvc board below (set to 1 bar).
- 3 numbers of bourdon pressure gauges of 0-2 bar with 2" dial (1no.), 0-15psi with 4" dial (2nos.).
- Piezo resistive pressure sensor 0-1bar mounted in CIP panel with signal condition circuit on EMT9 panel to convert pressure 0-15 psi into voltage 0-2.5V & V to I function block (0-20mA or 4-20mA output) on CIP panel.
- SS tubing 1/4" with 2 numbers of ball valves.
- Needs external compressed air supply (4-7 bars).



16) Study of super capacitor panel (P41)

(Provided with 22 banana Sockets)

Panel consists of 5 numbers of one Faraday (1F/5V) super capacitors and there exists provision to group them as 3F and 5F by using DPDT switch, provided with charging/ discharging resistors and leakage current measurement sensor, Comparator function block to measure charge and discharge time on DSO, onboard regulated supply to prevent damage to super capacitor due to over voltage. Need +12Vdc external power supply.

Experiment performed : 1) Experiment to determine charging and discharging time of super capacitor. 2) Experiment to determine leakage current of super capacitor.