

## **Annexure 1**

### **Specifications of Electronics Test Bench**

- Frames of High quality steel construction with suitable laminated bench top surface
- Powder coated MS vertical frames( size: 40 x 40 mm)- Blue colour
- Powder coated MS horizontal frames( Size: 80 x 40 mm)- Blue colour
- Bench surface Novopan sheet 25 mm thick- Grey colour
- Anti static mat to be provided on the Bench top surface

#### **Bench top unit**

- Bench top unit to be built in with modules, blank plate and suitable cutout to equip / mount various instruments as per specs
- The main power pre wired to cater all the instruments mounted with frontal controls in this bench top unit
- Front plates to be made of Printed 3 mm thick Aluminium plates with cut outs suitable for fixing the instruments

#### **Under Bench Cabinet( 2nos)**

- Storage space with lockable drawers( 3 nos) for keeping necessary stationary items/ tools and tackles etc with working chairs ( 2 nos)
- LED lamp to be provided for proper illumination

### **Specifications of Instrumentation/ control Setups to be provided in the Test bench**

#### **1. Three phase mains power supply**

415V AC, 50 Hz three phase main power supply

Rated current: 40 A

No: of poles: 4

Emergency off

Line indicating lamp( R,Y,B)

Three phase Multifunction meter

#### **2. Fixed DC power supply (Make: Keysight / Nagman/ Scientific/ Tektronix)**

Input Voltage: 230V Ac, 50 hz

Output Voltage: 24 V DC

Output Amps: 5 A

No: of sockets: 1 set of banana socket to be provided with indication

Digital meter; Voltage & Current to be provided

### **3. Regulated DC power supply (Make: Keysight / Nagman/ Scientific/ Tektronix)**

Output Voltage: 0-32 V Dc

Output current range: 0-2 A

Control: Separate control for voltage & current

Line Voltage: 230 V AC $\pm$  10%, 50 Hz single Phase

Metering: 3 digit DPM to indicate O/p Voltage & Current separately

Mode of operation: CV, CC mode with LED indication

Constant Voltage mode:

Line regulation:  $\pm 0.05\%$  +5 mv for  $\pm 10\%$  change in line output

Load regulation:  $\pm 0.05\%$  +5mV for load change from 0 to full load

Ripple & noise: 1mV rms max, 20 Hz to 20MHz

Protection: overload and short circuit

### **4. Three phase variable AC power supply( Make: AE/ Scientific/Keysight/ Chroma)**

Input: 415V AC, 3 phase, 50 Hz

Output: 0-440 V AC, 3 phase, 50 HZ

Max output current: 5 A

Cooling: Air cooled

Protection: 4 pole MCB to be provided on input

O/P power socket: Through 3 phase 5 pin industrial socket with plug top

Operation: Motorised by knob provided on unit

Increment/Decrement: Push button switch provided for voltage control

Indication: Mains on lamp RYB

### **5. Single Phase Variable AC power supply ( Make: AE/ Scientific/Keysight/ Chroma)**

Input Volts: 230v AC, 50 Hz, 1 Phase

Output volts: 0 to 250 vAC

Current rating: 4 A

Meter: Voltmeter(0-250V) & ammeter to be provided

O/P power socket: 230 V AC socket with on-off lamp indication switch

Protection: MCB to be provided on input

#### **6. Function generator ( Make: Tektronix/ Keysight/ Nagman )**

Display: 4.3 inch or better TFT colour LCD

25 MHz or better sine wave frequency

Two channels with the same performance with frequency resolution 1 $\mu$ Hz or better

Operating modes: continuous, Modulate, Sweep, Burst

Waveforms: sine, square, triangle, pulse, noise, harmonic

Built in 7 digit / second resolution or better with 80 MHz or better frequency counter

Built in high order harmonic generator

Arbitrary wave form generator with 16 bits resolution, 2M waveform length

Built in more than 160 arbitrary waveforms, including exponential rise, exponential fall, ECG, gauss, haversine, Lorentz, dual tone, Dc etc

Support AM, FM, PM, ASK, FSK, PSK, BPSK, QPSK, 3FSK, 4FSK, OSK, PWM modulations

Frequency sweep and burst capability

Amplitude Chara:

Amplitude range in 50 ohm: 1mVpp to 5.5Vpp( $\leq$ 55MHz)

Amplitude resolution: 1mVpp

Amplitude accuracy:  $\pm 1\%$  of setting  $\pm 5$ mVpp

#### **7. Digital Storage oscilloscope ( Make: Tektronix/ Keysight/ Nagman )**

Bandwidth: 100 MHz or better

Sampling rate: 1Gsa/s or better

Display: colour, 7 inch or better

Multiple automatic measurements

Trigger mode: Edge/ pulse width/line selectable video/slope etc

USB host and device connectivity: Standard

Provides software for PC real time analysis

Acquisition modes

Normal: normal data only

Peak detect: High frequency and random glitch capture

Average: Waveform average.selectable 4,8,16,32,64,128

Inputs coupling: AC, DC, Gnd

Inputs impedance: 1Megaohm+/- 2%, 20 PF+/-3pF

Probe attenuation: 1X, 10X

Supported probe attenuation factor:1X, 10X, 100X, 1000X

#### **8. AC power sockets( Make: L & T/Schneider/Siemens/Havells)**

Power socket: 230 V AC/15 A – 3 nos

Power socket: 230 V AC/5 A – 3 nos

On-off switch: On-Off lamp indication switch( for each sockets)

MCB: 1 no: MCB to be provided for protection against overload

#### **9. DMM ( Make: Fluke/ Tektronix/ Nagman/ Philips)**

Display: 3.5 inch colour display or better

Digits: 6.5 or better

Signal terminal : in both front and rear panels

Max measurement speed: 2500 readings per second

DCV

Uncertainty:  $\pm$  ( % measurement + % range)

Uncertainty: 0.0035 +0.0005

Measuring range: 0 mV-1000V

Max resolution: 100 nV

ACV

Uncertainty: 0.06 +0.03

Measuring range: 1mV-750V

Max resolution: 100 nV

Frequency range: 3 Hz to 300 kHz

DCI

Uncertainty: 0.05 +0.006

Measuring range: 0  $\mu$ A-12 A

Max resolution: 10pA

ACI

Uncertainty: 0.10 +0.04

Measuring range: 1  $\mu$ A-12 A

Max resolution: 100 pA

Frequency range: 3 Hz to 10 kHz

Resistance

Uncertainty: 0.01 +0.001

Measuring range: 0 ohm to 1 G ohm

Max resolution: 10 $\mu$ ohm

Frequency

Uncertainty: 0.01%

Measuring range: 3Hz to 1 MHz

Max resolution: 1 $\mu$ Hz

Capacitance

Uncertainty: 1 + 0.3

Measuring range: 0 nF- 100mF

Max resolution: 1Pf

#### **10. Soldering & Desoldering station ( Make: Weller/ Soldron)**

Voltage: 230 V Ac +/- 10%

Temperature range: soldering: 150- 420 deg Celsius

Desoldering: 210- 480 deg Celsius

Heating operating voltage: 24 VAC

Vacuum pump: - 500mmHg 24 VAC

## 11. Data Acquisition system( Make: Keithley/ Fluke)

Channel Capacity	20 independently programmable Channels
Measurement parameters	DC Volts, DC current, AC Voltage, AC current, Resistance, RTD, T/C
Digital Multimeter functionality	Better than 5.5 Digit
DC volt range	100 mV to 300 V or better
DC volt resolution	0.1 $\mu$ V to 1 mV or better
DC volt accuracy	$\pm$ (0.0025% of reading + 0.0005% of range) at 10V range or better
DC current range	100 $\mu$ A to 100mA or better
DC current resolution	0.1 nA to 100 nA or better
DC current accuracy	$\pm$ (0.020% of reading + 0.005% of range) at 10mA range or better
AC voltage range	100mV to 300 V at 10Hz to 20KHZ or better
AC voltage resolution	0.1 $\mu$ V to 1 mV or better
AC voltage accuracy	$\pm$ (0.06% of reading + 0.03% of range )at 10V, 10Hz to 20 kHz or better
AC current range	1 mA to 1A at 5Hz to 5 kHz or better
AC current resolution	1 nA to 1 $\mu$ A or better
AC current accuracy	$\pm$ (0.10% of reading + 0.04% of range )at 10mA, 3Hz to 5 kHz or better
Resistance range	100 $\Omega$ to 1 M $\Omega$
Resistance resolution	0.1 m $\Omega$ to 1 $\Omega$
Resistance accuracy	$\pm$ (0.010% of reading + 0.0006% of range) at 1M $\Omega$ range or better
RTD acquisition range	-200 $^{\circ}$ C to 600 $^{\circ}$ C
RTD acquisition resolution	0.01 $^{\circ}$ C or better
RTD acquisition accuracy	$\pm$ 0.1 $^{\circ}$ C (4 wire configuration) or better
Thermocouple types	R, S, N, E, B, K, J, T
K-type thermocouple acquisition range	-200 $^{\circ}$ C to 1370 $^{\circ}$ C
K-type thermocouple acquisition resolution	0.01 $^{\circ}$ C or better
K-type thermocouple acquisition accuracy	$\pm$ 0.3 $^{\circ}$ C or better with simulated Cold junction compensation
J-type thermocouple acquisition range	-200 $^{\circ}$ C to 750 $^{\circ}$ C
J-type thermocouple acquisition resolution	0.01 $^{\circ}$ C or better
J-type thermocouple acquisition accuracy	$\pm$ 0.3 $^{\circ}$ C or better with simulated Cold junction compensation

T-type thermocouple acquisition range	-200 °C to 400 °C
T-type thermocouple acquisition resolution	0.01 °C or better
T-type thermocouple acquisition accuracy	±0.3°C or better with simulated Cold junction compensation
Other thermocouple types acquisition accuracy	Better than 3°C
Software	Software for data acquisition and logging application to configure, test and collect data from multiple instruments with programming unit
Display	5 inch touchscreen colour TFT with LED backlight
Power supply	240VAC ±10%

## **12. Multi function Calibration unit with Inbuilt HART communication (Make: Additel / Fluke)**

**The unit shall SOURCE, SIMULATE & MEASURE Pressure, Temperature & Electrical signals**

### **Source (specs)**

#### **DC Voltage**

Range: 0 - 15 V or better

Resolution: 0.5 mv or better

Accuracy: 0.005% RDG+01.5 mv or better

#### **DC Current**

Range: 0 - 24 mA or better

Resolution: 0.5µA or better

Accuracy: 0.01% RDG+1.2 µA or better

#### **Resistance**

Range: 0 - 4000 ohms or better

Resolution: 100mΩ or better

Accuracy: 0.01% RDG+200 mΩ or better

#### **Voltage mV ( Thermocouple)**

Range: -10 to 75 mV or better

Resolution:1.5 $\mu$ V or better

Accuracy: 0.008% RDG+3  $\mu$ V or better

### **Measure (specs)**

#### **DC Voltage**

Range: 0 - 30 V or better

Resolution:0.1 mv or better

Accuracy: 0.005% RDG+1.5mv or better

#### **DC Current**

Range: 0-24 mA or better

Resolution:0.1 $\mu$ A or better

Accuracy: 0.01% RDG+1.5  $\mu$ A or better

#### **Resistance**

Range:0 - 4000  $\Omega$  or better

Resolution: 10m $\Omega$  or better

Accuracy:0.01% RDG+200m $\Omega$  or better

#### **Voltage mV ( Thermocouple)**

Range: -10 to 75 mV or better

Resolution: 0.1 $\mu$ V or better

Accuracy:0.008% RDG+3  $\mu$ V or better

#### **DC High Voltage**

Range: 0 - 300 V or better

Resolution:10 mv or better

Accuracy: 0.05% RDG+30 mv or better

#### **AC High Voltage**

Range: 300 V( 40 to 500 Hz) or better

Resolution:10 mv or better

Accuracy: 0.5% RDG+ 150 mv or better

The unit shall have a built in **Full HART communicator** and the required accessories for the same to be supplied along with the unit



The unit shall have a built in barometer with 60 Pa Accuracy

The unit shall have a Laptop for accessing the calibration data and generating the report

Data Logger: 500 results, Each result min 100,000 recordings and each recording records a max of 7 channel values

The Calibrator shall be Battery operated

Compatible to S,R,B,K,N,E,J,T,C,D,G,L,U type of thermocouples

The Party shall supply

- a. External power adapter compatible to the offered model
- b. Chargeable Battery
- c. Test probes ( 1 set) compatible to the offered model
- d. Pressure module connection cable
- e. USB cable

Warranty: 5 Years ( minimum)

### **13. Test leads**

Qty: 5 sets( Red & Black)