

Annexure – A

1. Handy Instrument for Power Quality Measurement:

A. Purpose/Applications:

- Power Quality measurement of various events like Voltage Swell, Voltage Dip, voltage Interruption, Voltage unbalance and current unbalance rate Transient Over Voltage, Inrush Current with high sampling rate with graphical analysis tools on screen.
- Display of harmonics component of voltage, current and power up to 50th order for Power quality analysis with graphical analysis tools as well.
- Flicker rate measurement of various instrument of various load for power quality analysis.
- Integrated Energy and Maximum Demand measurement over specific time interval and its graphical analysis by trend graph.
- Leakage current measurement with external clamp CT sensor

B. Specifications:

- AC voltage 600/1000 V
- AC current 2000 mA to 3000 A (depending on a capacity of clamp-on probe used)
- AC power 3000 W to 3000 kW (depending on a clamp-on probe)
- DC voltage 100.0 mV/1.000 V/10.00 V
- **Voltage** : 600/1000 V
Accu.:±0.2%reading ±0.2%range
- **Current** : 2000 mA to 3000 A (depending on a capacity of clamp-on probe used)
Accu.:±0.2%reading ±0.2%range + Clamp accuracy
- **AC power** : 3000 W to 3000 kW Power
Accu.:±0.3%reading ±0.2%range + Clamp accuracy
- Power factor ±1.0%reading (Power factor 0.5-1.0)

C. Other Accessories:

Following two type of Clamp on Probes:

⌘ 50 A X 3 Clamps

(0.5 to 50 A, 40 Hz to 3.5 kHz)

Accuracy : ± 0.5% reading ± 0.1 mV on 50 Hz- 60 Hz range

P.A. Error: Less than ±2.0°

⌘500 A X 3 Clamps

(0.5 to 50 A, 40 Hz to 3.5 kHz)

Accuracy : ± 0.5% reading ± 0.1 mV on 50 Hz- 60 Hz range

P.A. Error: Less than ± 2.0°

⌘Necessary clamp on probe for leakage current measurement

⌘Necessary Voltage probes should also be provided along with the above probe.

D. Approx. Cost: 5 Lakhs

E. Preferable brand: - YOKOGAWA

2. Digital Power Analyzer:

A. Purpose/Applications:

→Measurement of various electrical Parameters:

Voltage, Current, Active power, Apparent power, Reactive power, Power factor, Phase angle, Peak voltage, Peak current, Voltage frequency, Current frequency, Active power integration, Current integration, Crest factor, Form factor, Impedance, Resistance, Reactance, Corrected Power, Harmonic Analysis.

B. Specifications:

- **Display Requirement :**

At least 8 Inch TFT Color LCD

- **Basic power accuracy (50/60 Hz) :**

± (0.1% of rdg + 0.05% of rng)

- **Power measurement frequency range :**

DC, 0.1 Hz to 1 MHz

- **Input voltage range :** 1.5 - 1000 V

- **Input current range :** 10 mA - 50 A

- **Power Accuracy :** ± 0.15% of total

- **Sampling Rate :** 2 MS/s (16-bit resolution)

- **Input Element :** 6

- **Band width:** DC, 0.1 Hz to 1 MHz(5 A direct Current input, External Current Sensor input)

DC, 0.1 Hz to 200 kHz (up to 50 A direct Current input)

C. Other Accessories:

Current Clamp-on Probe X 3 Nos. Set each of (5 A, 50 A, 1000 A)

Measurement bandwidth: 30 Hz to 5 kHz

Basic accuracy: ±0.3% of reading

Maximum allowable input: AC 1000 Arms 1400 A peak (AC)

Current output type: 1 mA/A

Necessary connecting cables should be provided along with the set.

D. Approx. Cost: 19 Lakhs

E. Preferable brand: - YOKOGAWA

3. Infrared Thermal Imaging Camera:

A. Purpose/Applications:

→Infra-Redthermo vision camera can be used to analyze the heat generation and temperature rise from remote measurement such as temperature rise of various parts of transformer, detect leakages by sensing heat dissipation in various line equipments and various such energy conservation study.

B. Specifications:

- **Infrared resolution** : 160 x 120 pixels
- **Minimum focus distance** : <0.5 m
- **Field of view** :31° x 23°
- **Thermal sensitivity** : 120 mK
- **Display type** :Atleast 3.5" TFT withAt least 4 colour representation
- **Measuring range** : -20 to +280 °C
- **Accuracy** : ± 2 °C, ± 2 % of mv
- **Emissivity** : 0.01 to 1
- **Analysis function**: Mean point measurement, hot/cold-spot recognition.
- **Image storage facility with USB export**
- **And Lithium ion rechargeable battery**

C. Other Accessories:

The required accessories with charging adaptor and carry case should be provided along with the kit.

D. Approx. Cost: 2.2 Lakhs

E. Preferable brand: - TESTO

4. Digital Multi-Function Meter:

A. Purpose/Applications:

→**Measurement of various environmental Parameters:**

Flow, Velocity, temperature, humidity, pressure, light intensity, radiant heat measurement.

→ Parameters for routine work and Especially in solar and micro grid related application.

B. Specifications:

Humidity & temperature probe

12 mm Dia 0 to 100 % RH -20 to +70 °C,

Accuracy: \pm (1.0% RH to 0.7% of reading) 0 to 90% RH \pm (1.4% RH + 0.7% of reading)

90 to 100% RH \pm 0.5°C

Thermal flow probe with Telescope

Thermal flow prob with telescope 0 to +20 m/s to +70°C 0 to 100 % RH \pm (0.03m/s +4% of reading) \pm 0.5°C \pm (1.8% RH +0.7% of reading)

Radiation temperature Sensor

Range: 0 to +120 °C

Resolution: 0.1 °C

Air Velocity Sensor Measurement:

Range: +0.1 to +15 m/s

Resolution: 0.01 m/s

Humidity Sensor Measurement:

Range: 0 to 100 %RH

Resolution: 0.1 %RH

Lux Measurement:

Range: 0 to 100000 Lux

Resolution: 1 Lux

C. Other Accessories:

Necessary instruments sensor set along with necessary connecting cables should be provided for measurement as describe

D. Approx. Cost: 3.8 Lakhs

E. Preferable brand: - TESTO

5. Digital Earth Resistance Tester:**A. Purpose/Applications:**

→4-Terminal Earth/Ground Resistance with Soil Resistivity TestersResistance measurement range to 200,000 Ω with Warning indicators to prevent test failure

B. Specifications:**Ground current Meas. (CT clamp):**

Range: 0.5 mA to 19.9 A

Accuracy: 5% \pm 3 digits

Resistance accuracy:

2% \pm 3 digits

Earth voltage range: 0 – 100 V **Earth voltage accuracy:** 2% \pm 2 V

C. Other Accessories:

- Red and black cable reels (50 m) yellow and green cable reels (30 m) and Earth electrode leads (4 m) green
- 4 mm shrouded plug and large croc clip and 4 auger-style spikes
- Carrying case
 - Clamp on CT to test resistance as per attached rod technique testing methodology

D. Approx. Cost: 2.4 Lakhs

E. Preferable brand: - MEGGER

6. Digital Oscilloscope**A. Purpose/Applications:**

→Toanalyse& test the voltages and currents of A, B, C phases and the voltage of neutral line simultaneously at the moment of switching

→Toanalyse the high voltage, high frequency, short time wave form of switching of capacitor bank on system

→ History memory recording function can be used to capture the high-speed transient discharge waveform

→ Inverter Grid connection test with fluctuation and high-speed sampling of switching and output waveforms is necessary for inverter evaluation & long time recording and analysis of PV module.

→ To capture how inverter operating conditions change with fluctuations in system load conditions over long periods of times.

→ It measures the delay time and angle delay between different channels. It is useful to detect the phase difference of voltage and current and help special users to execute power analysis.

B. Specifications:

Required Measurement Module:

Analog Voltage:-

Sample rate:100 kS/s (Voltage)

Bandwidth: 00 kHz (Voltage)

Resolution:16-Bit (Voltage)

Accuracy:± 0.25% (Voltage)

Measurement frequency of 0.01 Hz to500 kHz, Measured parameters (frequency,rpm, period, duty, power supply frequency,distance, speed)

Sample rate: 1 MS/s

Accuracy:± 0.1 %

Resolution:625 ps

Required Parameters:

- sampling rate 1 MS/s
- Frequency bandwidth 300 KHz
- DC accuracy ±(0.25% of 10 div)
- Display at least 10 inch TFT color LCD monitor
- Display resolution 1024 × 768 pixels (XGA)
- Measurement frequency of 0.01 Hz to 500 kHz, Measured parameters (frequency,rpm, period, duty, power supply frequency, distance, speed)

C. Other Accessories:

Shunt Resistor:10 Ω ± 0.1%

Safety BNC Adapter Lead:1000 Vrms-CAT II

3 X 3 Clamps on CT Set of 50 A, 500 A and 1000 A

Necessary cords and connecting cables with carry bag should be provided along with the instrument.

D. Approx. Cost: 7.5 Lakhs

E. Preferable brand: - YOKOGAWA

7. Digital Insulation Tester

A. Purpose/Applications:

→ Measuring voltage selectable in the 50 ... 500 V range with 50 V step and in the 500 V to 5000 range with 100 V step.

- Continuous indication of insulation resistance or leakage current
- Automatic discharge of capacitance of tested object after the insulation resistance measurement
- Measured test times of T1, T2 and T3 for measuring the absorption coefficient DAR and polarization index PI
- Indication of actual test voltage during the measurement, protection against measuring live Objects Two and three-lead measurement method.
- Data transmission to a PC through a USB cable, Built-in Rechargeable battery pack.

B. Specifications:

IR value Measurement:

Range: 0.1M to 200 GΩ

Resolution: 0.01 MΩ

Accuracy: ± (3% rdg.+5 dgt.)

AC Voltage Measurement:

Range: 0 - 600VAC (50 - 60Hz)

Resolution: 1 V

Accuracy: ± (2% +5 dgt.)

C. Other Accessories:

Necessary cords and connecting cables with carry bag should be provided along with the instrument.

D. Approx. Cost: 0.9 Lakhs

E. Preferable brand: - SONEEL

8. Solar Irradiance Meter:

A. Purpose/Applications:

→For Solar Related application to find out optimal incident angle and positioning of solar panels and Measurement of solar power for panel short circuit calculation.

B. Specifications:

Display: 3¾ digits LCD with maximum reading 3999.

Range: 1999 W/m² / 634 BTU / (ft² *h) **Accuracy:** Typically within ± 10 W/m² (±3 BTU / (ft² *h)) or ±5%, whichever is greater in sunlight

Additional temperature induced error ±0.38 W/m² /°C (±0.12 BTU/(ft² *h)/°C) from 25 °C

Angular accuracy: Cosine corrected

C. Other Accessories: NA

D. Approx. Cost:- 0.15 Lakhs

E. Preferable brand: - MEGGER

9. Micro Ohm Meter:

A. Purpose/Applications:

→ For Measurement of Resistance on various application.

B. Specifications:

Measurement Mode: Manual, Auto, Continuous, Inductive

Range: 0.1 $\mu\Omega$ to 2000 Ω

Accuracy: $\pm 0.2\%$ (On range)

C. Other Accessories:

Lead Resistance maximum 100 m Ω total for 10 A operation irrespective of battery condition.

D. Approx. Cost: 4.5 Lakhs

E. Preferable brand: - MEGGER