

## Technical specification of CT & PT Test Equipment

### 1.Key Features: -

- Ergonomic, Portable and Lightweight for testing of HT, EHTCT and PT (also LTCTs) accuracy, offline in the field with primary side Voltage/Current isolated and in Laboratory setup.
- Capable to perform Ratio and Phase error at multiple test points of Metering Current transformers, simultaneously, from 5/5 up to 3200/5 & 3200/1, in accordance with, IS 16227 and IEC 61869.
- Capable to test all Ratio and Phase error test points of Potential transformers, simultaneously, from 6.6kV /110V up to 66kV/110V under selectable full or no-load condition.
- Capable to perform Full load P.T. testing under simulated Voltage and Burden levels as per IEC IEC61869 standard & IS 16227.
- Capability to customize test points (different to IS) and error evaluation, as per user requirements.
- Facility to test overall C.T errors under load with Admittance measurement on secondary winding. Batch Testing of CT in Lab should also be possible.
- Measurement of Burden of C.T & P.T. secondary circuits (i.e., Current & Voltage Circuit Burden of Energy Meter).
- Customization of C.T Injection and Burden Test Points.
- Memory to store min. 1000 Test Results each for CT and PT.
- Facility for results (Pass/fail) Assessment as per customizable criteria.
- Automatic Demagnetization of C.T.
- Graphical Presentation of Excitation Curve.

### 2.0 Methodology/Principal of Operation

Equipment shall perform testing based on an indirect injection method/secondary injection method to simulate voltage, current and burden levels to test P.T. and C.T. for Ratio and phase error. Display and Recording of Accuracy Test results (after test completion) should be of minimum three digits after decimal.

### 3.0 Current Transformer Testing (Metering)

**3.1 C.T. Ratio Error Measurement-** Equipment should be capable to measure the ratio error of either a 1 Amp or 5 Amp metering C.T within 0.02%-0.05% accuracy class, across simulated levels of rated primary(I) currents as below.

120% of I, 100% of I, 80%, of I, 50% of I, 20% of I, 5%, of I,1% of I.

Test shall be performed/selectable on minimum six out of seven any of above-mentioned load points, at minimum four burden levels, (simultaneously) from 10% to 100% of rated burden with selectable power factor range of 0.5 to Unity. Load points should also be configurable, as per user requirement (different to IS). Reverse Polarity shall be indicated on display and test shall be continued.

### 3.2 Metering C.T. Measurable test ranges

Maximum ratio	:	3200:5 or 3200:1
Minimum ratio	:	5:5
1Amp / 5A VA rating	:	1.25VA to 100VA
Selectable %I primary	:	1% to 200%
Selectable % burden	:	10% to 100%
Selectable PF	:	0.5 to 1.0

### 3.3 Metering C.T. measurable parameters

- 1) Turns ratio
- 2) Ratio error
- 3) Ratio correction factor
- 4) Phase error
- 5) Winding resistance
- 6) 50Hz admittance
- 7) knee point
- 8) Instrument Security Factor

### 3.4 Metering C.T. Ratio accuracy

Ratio Ranges	Ratio Accuracy
5/5 to 3,200/5 & 3200/1	0.02%-0.05%

%Injection Ranges	Ratio Accuracy
5% to 120%	0.02% to 0.03%
120% to 200%	0.03% to 0.05%
1% of load accuracy would be 0.05%	

### 4.0 Admittance measurement range

50 Hz	100 $\mu$ S to 100mS $\pm$ 1.0%
1.6kHz or higher	100 $\mu$ S to 20mS $\pm$ 1.0%

### 5.0 C.T. Burden measurement range (Current Circuit of Energy meter)

1A Type	0 to 20 ohms /25VA
5A Type	0 to 10 ohms/300VA

### 6.0 C. T Phase error accuracy

1% to 120% of I primary : Min.2 min

### 7.0 Voltage/Potential Transformer (Metering)

#### 7.1 No load Condition

Equipment should be able to test turns ratio of a single phase/Phase wise inductive P.T. at reduced energization with its own internal solid state voltage source.

#### 7.2 Full Load P.T. Testing

Equipment offered should have facility to test P.T.'s ratio & phase angle error under simulated input voltage and burden conditions, simultaneously, in accordance with elements outlined in the IS 16227, IEC61869 and other Relevant Standards.

Testing to be performed up to 5 voltage(configurable) test points (any value between 80%-120%of V, as per user/site requirement), simultaneously at burden between 10% to 100% of rated burden under P.F from 0.8 or unity (selectable).

### 7.3 Measurement PT Ranges

Un burdened/ no load P.T. Test range

Maximum ratio	66kV / 110V
Minimum ratio	6.6kV/110V
VA rating	1.25VA to 100 VA

### 7.4 Burden based / full load P.T. Test range

Maximum ratio	66kV / 110V
Minimum ratio	6.6kV /110 V
VA rating	1.25VA to 100 VA
Prim winding res	0 to 25k ohms

### 7.5 P.T. Burden measurement range (Voltage Circuit of Energy Meter)

-/63.5V ,110V                      0 to 300VA

### 7.6 No Load, P.T. Turns ratio accuracy at fixed Voltage

Ratio Ranges	Ratio Accuracy
6.6/110V to 66kV/110V	0.02%

### 7.7 Full Load Test: -

Full Load test shall be performed in accordance with IS 16227, IEC 60044-2/IEC 61869 under simulated voltage and burden conditions.

Ratio Ranges	Ratio Accuracy
6.6kV/110V to 66kV/110V	0.1%

Accuracy based on burden to 50VA maximum.

### 7.8 P. T Phase error accuracy

Without Burden	with Burden
To 2 min.	To 5 min.

### 8.0 Measurement of Metering Circuit Burden

Offered equipment should be capable to measure current and voltage circuit burden of energy meter to check that C.T. or P.T. is not overloaded under normal service conditions.

**9.0 Admittance Measurement** –Equipment should have feature to perform admittance test of current transformer at 1.6KHz or higher freq.

## **10.0 HARDWARE FEATURES**

**10.1 Power Source** – Equipment must have internal solid state voltage source to generate up to min. 120V at 50Hz

### **10.2 Interfaces**

- Alphanumeric keyboard on front panel used to enter information about CT or PT
- Color TFT SCREEN, MIN.6 inch with back light
- Type A/USB slot, used for Test results/data downloading and firmware upgrade.
- Bluetooth, to down load test results to tablet, or Phone (Android).
- Option of Printing of Test results directly from Equipment to Printer must be provided

**10.3 Casing** – Equipment casing should be an injection molded plastic case which is robust and injection molded plastic case and hard wearing. It has an internal aluminum chassis and an aluminum front panel with a reverse screened polycarbonate finish.

**10.4 Transit Case** – A transit case, Made from ABS plastic, foam lined would be required to be provided for transportation.

### **11.0 Protection Features**

- a) Fuse for Mains input
- b) Flashing LED when terminals are live .
- c) Buzzer/proper indication in case of Dangerous Voltage Operating condition.

### **12.0 Operating Environment**

Operating Temperature: 0 to 50°C

Ambient Relative Humidity: to 90% (Typ.) non condensing

### **IP Category :**

Lid closed : IP 64

Lid Open : IP 30

### **13.0 Additional Features**

- Auto class assessment of metering CT's  
Batch testing Capability
- Self-Test features
- Equipment should be portable.

### **14.0 Application Software**

Application software must be provided without any additional cost for Test Result viewing and printing. It shall be compatible to MS Windows environment.

### **15.0 Technical Specification of Laptop computer:**

**15 12<sup>th</sup> Generation, 8GB Ram, 14inch Display with 1TB Storage(SSD).**

### Guaranteed Technical Particulars

Sr. No.	Particulars	Bidder Comment
<b>1</b>	<p><b>Key Features: -</b></p> <ul style="list-style-type: none"> <li>• Ergonomic, Portable and Lightweight for testing of HT, EHTCT and PT (also LTCTs) accuracy, offline in the field with primary side Voltage/Current isolated and in Laboratory setup.</li> <li>• Capable to perform Ratio and Phase error at multiple test points of Metering Current transformers, simultaneously, from 5/5 up to 3,200/5 &amp; 3200/1, in accordance with IS 16227 and IEC 61869.</li> <li>• Capable to test all Ratio and Phase error test points of Potential transformers, simultaneously, from 6.6kV /110V up to 66kV/110V under selectable full or no-load condition.</li> <li>• Capable to perform Full load P.T. testing under simulated Voltage and Burden levels as per IEC 60044-2/IEC61869 standard IS 16227.</li> <li>• Capability to customize test points (different to IS) and error evaluation, as per user requirements.</li> <li>• Facility to test overall C.T errors under load with Admittance measurement on secondary winding. Batch Testing of CT in Lab should also be possible.</li> <li>• Measurement of Burden of C.T &amp; P.T. secondary circuits (i.e., Current &amp; Voltage Circuit Burden of Energy Meter).</li> <li>• Customization of C.T Injection and Burden Test Points.</li> <li>• Memory to store min. 1000 Test Results each for CT and PT.</li> <li>• Facility for results (Pass/fail) Assessment as per customizable criteria.</li> <li>• Automatic Demagnetization of C.T.</li> <li>• Graphical Presentation of Excitation Curve.</li> </ul>	
<b>2</b>	<p><b>Methodology/Principal of Operation</b></p> <p>Equipment shall perform testing based on an indirect injection method/secondary injection method to simulate voltage, current and burden levels to test P.T. and C.T. for Ratio and phase error. Display and Recording of Accuracy Test results (after test completion) should be of minimum three digits after decimal.</p>	
<b>3</b>	<p><b>Current Transformer Testing (Metering)</b></p>	
<b>3.1</b>	<p><b>C.T. Ratio Error Measurement-</b> Equipment should be capable to measure the ratio error of either a 1 Amp or 5 Amp metering C.T within 0.02%-0.05% accuracy class, across simulated levels of rated primary(I) currents as below. 120% of I, 100% of I, 80%, of I, 50% of I, 20% of I, 5%, of I,1% of I. Test shall be performed/selectable on minimum six out of seven any of above-mentioned load points, at minimum four burden levels, (simultaneously) from 10% to 100% of rated burden with selectable power factor range of 0.5 to Unity. Load points should also be configurable, as per user requirement (different to IS). Reverse Polarity shall be indicated on display and test shall be continued.</p>	

<b>3.2</b>	<b>Metering C.T. Measurable test ranges</b> Maximum ratio : 3200:5 & 3200:1 Minimum ratio : 5:5 1Amp / 5Amp VA rating : 1.25VA to 100VA Selectable %I primary : 1% to 200% Selectable % burden : 10% to 100% Selectable PF : 0.5 to 1.0	
<b>3.3</b>	<b>Metering C.T. measurable parameters</b> 1) Turns ratio 2) Ratio error 3) Ratio correction factor 4) Phase error 5) Winding resistance 6) 50Hz admittance 7) knee point 8) Instrument Security factor	
<b>3.4</b>	<b>Metering C.T. Ratio accuracy</b> <b>Ratio Ranges</b> <b>Ratio Accuracy</b> 5/5 to 3200/5                      0.02% - 0.05% 5/5-3200/1  <b>%Injection Ranges</b> <b>Ratio Accuracy</b> 5% to 120%                      0.02% to 0.03% 120% to 200%                      0.03% to 0.05% 1% of load accuracy would be 0.05%	
<b>4</b>	<b>Admittance measurement range</b> 50 Hz                      100µS to 100mS ±1.0% 1.6kHz or higher                      100µS to 20mS ±1.0%	
<b>5</b>	<b>C.T. Burden measurement range( Current Circuit of Energy meter)</b> 1A Type                      0 to 20 ohms /25VA 5A Type                      0 to 10ohms/300VA	
<b>6</b>	<b>C. T Phase error accuracy</b> 1% to 120% of I primary : Min.2 min	
<b>7</b>	<b>Voltage/Potential Transformer (Metering)</b>	
<b>7.1</b>	<b>No load Condition</b> Equipment should be able to test turns ratio of a single phase/Phase wise inductive P.T. at reduced energization with its own internal solid state voltage source.	
<b>7.2</b>	<b>Full Load P.T. Testing</b> Equipment offered should have facility to test P.T.'s ratio & phase angle error under simulated input voltage and burden conditions, simultaneously, in accordance with elements outlined in the IS 16227, IEC 61869 and other Relevant Standards. Testing to be performed up to 5 voltage(configurable) test points (any value between 80%-120%of V, as per user/site requirement), simultaneously at burden between 10% to 100% of rated burden under P.F from 0.8 or unity (selectable).	



11	<p><b>Protection Features</b></p> <p>a) Fuse for Mains input  b) Flashing LED when terminals are live .  c) Buzzer/proper indication in case of Dangerous Voltage Operating condition.</p>	
12	<p><b>Operating Environment</b></p> <p>Operating Temperature: 0 to 50°C  Ambient Relative Humidity: to 90% (Typ.) non condensing  <b>IP Category :</b>  Lid closed : IP 64  Lid Open : IP 30</p>	
13	<p><b>Additional Features</b></p> <ul style="list-style-type: none"> <li>• Auto class assessment of metering CT's</li> <li>• Batch testing Capability</li> <li>• Self-Test features</li> <li>• Equipment should be portable.</li> </ul>	
14	<p><b>Application Software</b></p> <p>Application software must be provided without any additional cost for Test Result viewing and printing. It shall be compatible to MS Windows environment.</p>	
15	<p><b>Technical Specification of Laptop computer:</b>  I5 12<sup>th</sup> Generation, 8GB Ram, 14inch Display with 1TB Storage(SSD).</p>	

## TECHNICAL SPECIFICATIONS FOR 3 PHASE UNIVERSAL PROTECTION RELAY TEST KIT & ACCESSORIES

### **A. Scope of Work:**

Supply and Delivery of Universal 3-Phase Numerical Protection Relay Test Kit with licensed software suitable for testing of Static, Electromechanical and Numerical Protection Relays including IEC 61850 complied Relays used for various applications like Distance, Differential with harmonic restraint feature, Non Directional and Directional Over Current Relays and Earth Fault Relays, Under & Over Voltage Relays, Over Flux etc. Supply and Delivery of Laptop (with each kit) necessary to run the test kit is also in bidder's scope. All necessary driving software for numerical relay test kit including product support software, MS Office, antivirus of associated Laptop has to be supplied in CD separately for each Test Kit/Laptop.

**B. Functional Requirement:** The Universal 3-Phase Protection Relay Test Kit should be suitable for-

1. Testing of All Types (i.e. Electromechanical, Static, Numerical Protection Relays) & Models of Relays to be used in Protection Schemes of Distribution Lines, Transformers, Capacitor Banks etc. of all the Manufacturers (Alstom, GE, Areva, ERL, ABB, Siemens, ZIV, SEL, Schneider, Nari or any other Make) in fully Automatic Mode. Viz-

Testing of following-

A. Over Current Relays (Directional, Non-directional, Definite Time, Inverse Time) (50/51/67)

B. Negative Sequence Over Current Relays. (46)

C. Voltage Restrained Over Current Relays (Directional, Non-directional, Definite Time, Inverse Time) (50 V/51 V)

D. Earth Fault Relays (Directional, Non-directional, Definite Time, Inverse Time)

E. Voltage Relays (Over Voltage & Under Voltage) & Over Flux Relays (59/27)

F. Differential Relays (Including Harmonic Restraint Feature, Low Impedance/ High Impedance)(87)

G. Sync-Check etc.

H. REF Relays (64)

I. Breaker Failure Relay (50BF)

J. Synchronizing or Synchronism-Check Relays (25)

2. Testing of High Burden Electromechanical Protection Relays.

3. Dynamic & Transient Testing with facility of Transient (COMTRADE FORMAT) Record playback for both Analog & Digital Channels.

4. Testing of Relays in Substations having Conventional Protection as well as Protection based on IEC61850 Protocol using Goose.

**C. Scope of Supply: The Universal 3-Phase Protection Relay Test Kit shall comprise of.**

a. Surge Protector

b. The Universal 3-Phase Protection Relay Test Kit

c. Application Software (Testing kit must be supplied with software to meet our application requirements as per technical specifications and these softwares shall be valid for lifetime of the kit. i.e. no additional software purchases must be required for use of testing functionalities as per our technical requirements.)

d. Heavy Duty Transport Case

e. Laptop with related accessories.

f. Relay Connection Cable Kit.

**D. Standards:**

Unless otherwise specified elsewhere, in this specification, the rating, performance and testing of test set shall confirm to the latest revisions, available at the time of placement of order of the relevant standards as below.

STANDARD NO.

STANDARD TITLE

IEC 61010-1 Safety Requirement for Electrical Equipment for Measurement, Control and Laboratory Use.

IP 54 Degree of Protection IEC

61326-1 EMC

IEC 61000-4-2 Electrostatic Discharge

IEC 61000-4-3 Radio Frequency AM Electromagnetic Field IEC

61000-4-4 Fast Transients

IEC 61000-4-5 Surge Immunity Test

IEC 61000-4-8 Power Frequency Magnetic Field

IEC 60068-2-27 Shock Resistant (operation)

IEC 60068-2-6 Vibration during Transport and Operation & Drop test

IEC-60068 Environmental Testing

**E. Technical Specification of Microprocessor controlled Automatic Relay Test Kit:**

**I. AC Voltage Outputs (at least Four Independent Non-Convertible Voltage Generators):**

1. Control: Independent Control of Amplitude, Frequency and Phase Angle. Fourth Voltage can be set as Zero Sequence Voltage, Line Voltage, or any value Range:
2. Voltage Range: 4x 300V, 1 x 600 V
3. Accuracy:  $\pm 0.15\%$  of the rdg.  $\pm 0.05\%$  of Range or better
4. Resolution: 10mV or better
5. Output Power:  $\geq 4 \times 85 \text{ VA @ } 0\text{-}300\text{V}$  or  $1 \times 200 \text{ VA @ } 0\text{-}600 \text{ V}$  or better.
6. Operational Indicator: Overload, Distortion, Over Heat
7. Protection – Short Circuit – Unlimited for Each Phase to Neutral & Prolonged Overloads. During Short Circuit, Kit should detect it automatically and should stop working as a measure of Safety. The Protection Test Kit should have protection against live external PT/CVT Voltage Signal. If it finds the presence of live external PT Voltage, It should stop working automatically as a measure of Safety.

**II. AC Current Outputs (at least Six Independent Non-Convertible Current Generators):**

1. Control: Independent Control of Amplitude, Frequency and Phase Angle
2. Current Range: 06x 30A, 03 x 60A, 01 x 120A
3. Accuracy:  $\pm 0.08\%$  of the rdg.  $\pm 0.02\%$  of Range or better
4. Resolution: 1mA or better
5. Output Power:  $\geq 6 \times 430 \text{ VA RMS @ } 32\text{Amp}$ ,  $1 \times 1000 \text{ VA @ } 128\text{A}$  or Better
6. Operational Indicator: Overload, Distortion, Open Circuit, Over Heat
7. Protection – Open Circuit as well as Overload. During Open Circuit, Kit should detect it automatically and should stop working as a measure of Safety.
8. Remark: The above rating should be satisfied by the kit with / without any attachment of External Amplifier Unit.

### **III. Frequency (Voltage and Current Generator) :**

1. Range: 10 Hz to 1000Hz (Sine Signals)
2. Accuracy& Drift:+1ppm/1.0 ppm
3. Resolution: 0.001Hz
4. Kit should be able to generate continuous Sin Waves with frequency range 0.1 to 1000 Hz and to generate Transient Files with a Bandwidth from dc to 3.1 KHz.

### **IV. Phase Angle (Voltage and Current Generator):**

1. Range: 0 to +360°
2. Accuracy: + 0.2°
3. Resolution: 0.001°

### **V. Binary Inputs:**

1. Number:10 (at least)
2. Trigger Criterion:
  - i) Potential free or with Voltage,
  - ii) Trigger Condition : N.O./N.C./Edge/Boolean (Each Input Independent)
  - iii) DC Triggering (Site Selectable) – at 0 to 300 V.

### **VI. Binary Outputs:**

- i) Number: 4 (at least)
- ii) Type: Potential free

### **VII. Counter Inputs: 02 Nos. Sampling Rate: 100 KHz.**

### **VIII. Timer:**

1. Range: 0 – 9999.9 Sec,
2. Auto Ranging
3. Accuracy: 0.001%
4. Resolution: 0.050 ms

### **IX. Power Supply:**

1. Permissible Input Voltage: 85 to 260 V AC – Single Phase to Neutral Supply.
2. Permissible Frequency: 47 to 53 Hz

### **X. Surge Protector:**

Suitable External Surge Protective Device has to be provided to protect the kit from high voltage surge in power supply. Surge Protector should have Display of Voltage.

### **XI. Amplifier Neutrals, Measurements Input & Main Power Supply should be galvanically isolated.**

### **XII. Analog Measuring Inputs:**

- a. Voltage Range: -10 V To +10 V DC
- b. Current Range: -20 mA To +20mA DC
- c. Accuracy:  $\pm 0.05\%$  or better

XIV Control: Besides Operation of Protection Relay Test Kit through Laptop with Ethernet and USB, It should also preferably have feature to control through Hand Held Controller or Hand Held Tab or In- Built Controller using Windows/Android or other Apps. Communication of Hand Held Tab/ Controller/ Laptop with Kit should be through Wi-Fi or RJ45 or USB. Hand Held Controller or Hand Held Tab/In Built Controller shall be provided by Firm free of cost.

XV. Internal Memory: In case of In Built Micro Controller or Hand Held Controller, The Memory shall be 256 MB with extension up to 02 GB through USB (USB shall be provided by Firm free of cost). For Hand Held Tab, it should have at least 64 GB storage and 04 GB RAM.

XVI. Cooling Arrangement: The Test Kit Should have necessary Inbuilt Cooling Arrangement to dissipate the heat generated during Testing. Test Kit with External Cooling Arrangement / Accessory shall not be accepted.

XVII. Noise Suppression: The Test kit should have noise suppression capability i.e. it should be possible to test Protection Test Relays in extremely electrical noisy atmosphere in 66 KV HV Switch-yards.

### **G. Software Specification:**

(a) General Specifications of Software:

- The Protection Relay Test Kit should be provided with basic licensed software along with licensed software containing advance options for Differential, REF, Over Voltage & Under Voltage, Over Flux, Directional and Non-directional O/C & E/F Relay for whole life period of the kit. Voltage and current ramping feature should be available. In future, if any up gradation required in software then it shall have to be upgraded free of cost.
- Software should be compatible with Windows 10 or above version of Professional Operating System and should be compatible with future up gradations of Windows.
- If the setting file is not available, It should be possible to copy all the settings from the relay into a correctly chosen template of Relay Test

Module available with Library of Kit Software, thus creating a version of a setting file.

- The Software must have the facility to add Test Points in Manual as well as Automatic Mode directly as Symmetrical Component Values (Direct, Inverse, Positive, Negative & Zero Sequence)
- Protection Relay Test Kit shall have a mode for simultaneous control of all available test signals (all voltages, current, AC/DC) of the test set in magnitude, phase angle and frequency with the scope of timing measurement. Protection Relay Test Kit shall have scope to control the binary output of the test set.
- The Protection Relay Test Kit shall have Vector Diagram Representation that shows the Test Point Quantities during the Test and at any time after Test is finished if the specific Test Point is selected. The Software should also have Auto Report Generation facility.
- Protection Relay Test Kit shall have mode for generation of state sequencer to verify the programmable logic present in the protection relays, such as automatic re- closings or PSB or Switch On To Fault etc.
  
- The Software must have the facility to create Sequence of minimum 20 States for Typical Pre fault, Post fault Applications.
- Protection Relay Test Kit Software shall have mode for Ramping for determining Magnitude, Phase and Frequency threshold by ramping definition for all L-E, L-L, L-L-N, L-L-L Fault Loops etc.
- The Relay Setting Templates of all Manufacturers with respect to Various Protections viz Differential, REF, Over Voltage & Under Voltage, Over Flux, Directional and Non-directional O/C & E/F, should be provided by the Manufacturer of the Kit free of cost and should be up-gradable free of cost.
- Protection Relay Test Kit shall have mode for testing of Directional and Non-directional Relays.

- Protection Relay Test Kit shall have mode for testing of Electromagnetic/ Electromechanical, Static and Modern Numerical Distance Protection Relay with all its features.
- Protection Relay Test Kit shall have mode for testing of Differential Protection Relay, REF Protection Relay. This should include for testing of electromagnetic and modern numerical relay with all its features. This also includes testing of 2nd harmonic & 5<sup>th</sup> harmonic characteristics of the Relay, Slope Test, Slope Search and stability in differential module.
- Protection Relay Test Kit should have scope for trans-play facility of the fault from disturbance record in COMTRADE file format with 04 Voltage & 06 Current Channel Support.
- The Protection Relay Test Kit Software should have the feature to export the Automatically Generated Report in.pdf/.Doc.
- The Kit Software should have facility to create Single Test File for Multi functional Relays.
- GOOSE configuration software should be provided with the kit for effective checking of protective relays/IEDs based on IEC 61850 protocols. It shall subscribe and publish GOOSE data. It will be the bidder's responsibility to demonstrate all the above IEC 61850 complied features.
- The kit shall be supplied with Aluminium / Hard Fiber Trolley Case having adequate Mechanical Strength and Shock Absorbers so that it can be transported easily by testing crew.
- The Bidder Should provide suitable option to connect test kit with relay to inject Analog values to relay .
- i) Differential Relay Testing: It should have following features-
  - Templates for all manufacturers/provision to create template to perform automatic testing.
  - Kit should perform automatic slope characteristics testing by shot test as well as reach test.
  - Kit should be capable to inject 25A both sides (primary and secondary) for generator slope test in automated method for 5A secondary ratio.
  - Kit should perform automatic harmonics testing.
  - Kit software should have provision to inject 1-Phase faults (L1-E, L2-E &L3-E), Line to Line fault and 3-Phase faults on slope characteristics and verify it.
  - Kit software should have feature to test stability in Automatic Mode.
  - Kit software should have feature to test Line Differential Protection.
  - Advanced Differential Protection Testing.
- ii) Earth Fault & Over Current Relay Testing:
  - Manual and automatic test modes shall be available.
  - Earth Fault Protection / OC Protection characteristics of all the manufacturers should be available for automatic testing.
  - The test software must have a functionality for testing Earth Fault, Over-Current Protection covering ground fault, phase fault, positive, negative and zero sequence fault models.

- It must be possible to test directional and non-directional Earth Fault & Over- Current relays and provide test points in backward direction that are automatically assessed positive if the relay blocks.
- Library with all standard definite and inverse characteristic (IEC,ANSI, IAC, I2t) must be available. If any Characteristics is missing in library, the Supplier shall include/provide the same free of cost.
- Relay test kit software must test both IDMT characteristics as well as Directional feature at a time and same should display characteristics of both IDMT as well as Direction during testing.

**H. Technical Specification of Laptop computer:**

**I5 12<sup>th</sup> Generation, 8GB Ram, 14inch Display with 1TB Storage(SSD).**

a) On each failure of test set, supplier shall submit detailed report of failure analysis to the consignee.

b) Necessary life time licensed copy of interfacing and analysis software with test kit should be supplied free of cost with test equipment.

g. Accessories – Sufficient Quantity of Connecting Leads (Properly Socket - Terminated at Both End) for all Voltage, Current and Binary Input/Outputs each of length, Input Power Cable and other relevant Accessories required for “Rely Test Kit” and the “Laptop” shall be provided with Relay Test Kit. Supplier should also provide 12 Nos. of additional connecting leads with Terminal Adaptor for Relays..

**h. Operating Environment Conditions:**

Operating Temperature : 0°C to 50° C or Better. Storage Temperature : 0°C to 70° C or Better.

Humidity: 0-90% Non-Condensing or better.

i. Power Supply Requirement :

Nominal Supply Voltage : Single Phase, 230 V AC

Permissible Input Voltage : 85 V to 260 V AC Nominal

Frequency : 50 Hz  $\pm$  05 %

j. PORTABILITY: The Instruments should be easily portable single handed.

## TECHNICAL SPECIFICATIONS OF CIRCUIT BREAKER ANALYZER

1. **Functional Requirement:**
  - a) The instrument should be suitable for measuring the operation timing of main, and auxiliary contacts as well as coil currents.
  - b) It should measure the Static Contact Resistance of Circuit Breakers.
  - c) The instrument should be suitable for testing the CBs.
  - d) The test results should have repeatability, consistency & immunity to electromagnetic interference in live switchyard.
2. **No. of Channels**
  - a) Main Contact Channels: 6 (two break per phase).
  - b) Aux. Contact Channel: 04 (can configure as Dry/Wet)
  - c) SCRM Test Current Channels: 1 Channel
  - d) Coil Current Channel: minimum 2 (01 for Close and 01 for Open)
3. **Sampling Speed:** 20kHz - 10kHz - 2kHz - 1kHz - 500Hz - 200Hz - 100Hz
4. **Accuracy:**
  - a) Timing: Measured Value  $\pm 1\% \pm$  Resolution
  - b) Coil Current: Measured Value  $\pm 1\% \pm$  Resolution
  - c) Resistance: Measured Value  $\pm 2\% \pm$  Resolution
5. **Measurement Range:**
  - a) Timing: 0-40 Sec
  - b) Resistance: 0-8 m  $\Omega$ .
  - c) Coil Current: 0-25 A
6. **Resolution :** Timing 0.1ms
7. **SCRM Test Current**
  - a) DC Test current: 200 A, 100 A, 25 A.
  - b) Contact resistance range: 200  $\mu$ Ohm to 100.0 mOhm; user selectable.
8. Resistance measurement accuracy: Measured Value  $\pm 2\% \pm$  Resolution
9. **Test Leads and accessories**
  - a) Timing Cables: minimum 10 meters long
  - b) SCRM Cables: minimum 10 meters long
  - c) Auxiliary Contact Cable, Travel Cable, Coil Current Cable, breaker control cable
  - d) Other cables: Master Earthing cable, Input Mains power cord, USB cable for communication between laptop and kit.
10. **Power Supply:** It shall work on single phase 230 Volts  $\pm 10\%$ , 50 Hz  $\pm 5\%$  supply with standard socket and Battery operated.

11. **Weight & Carrying Case:** It should be portable and should be supplied with rugged carrying cases for instruments.
12. **PC Interface:** The Equipment should suitable to connect with PC/Laptop.
13. Inbuilt Thermal Printer or separate printer should also be provided.
14. Operating Temperature: 0 to+50°C
15. Relative Humidity : Max. 90% Non-Condensing.
16. **Software:** The software should be suitable for creating test set-up, testing & report generation, multiple signature, comparison as well as trend analysis of all important parameters including Timing, Coil Current, Travel. The Kit should have facility to store and export the test results to window based computer in PDF/WORD/EXCEL. The operation of the kit should possible with the help of inbuilt control along with Display and result storage facility.

## Technical specification for Automatic Capacitance & Tan – Delta Test Kit

SI No	Parameters	Specifications
1	Functional Requirement	Automatic Measurement of Capacitance & Tan Delta as per the test plan by auto-balancing No need of manual balancing. Automatic voltage setting through software as well as inbuilt control display. The equipment shall be capable of measuring Insulation Power Factor, Tan Delta (DF), Excitation Current, Watt Loss, Capacitance, Inductance, Medium Voltage Class transformer (1/2/3windings), Bus and Line VT, CT, LA, Bushings, etc.
		The Test Result should have repeatability & immunity to Electromagnetic interference. The Test Set Shall be capable of measuring Power factor, capacitance & Tan delta(DF) of each winding of transformers and bushings using different test circuit in UST, GST-G and GST modes without changing connections.
		Indication of Leakage current
		Automatic Interference Suppression.
		High quality design & easy availability of spares.
		Equipment should be portable with must have a “single piece design” for portability.
2	Display	It shall include supply of one laptop PC of Dell/Lenovo/HP make with latest specifications such as Core i5 Intel Processor, 4GB RAM, 320GB or better HDD, 15' TFT screen, Combo DVD Drive i.e having CD read / write facility complete with required cables and connectors with preloaded operating MS Window 7 professional or better with latest version of application software required for storage, analysis and record management. If kit is being controlled through inbuilt LCD monitor and kit is having data storage facility, then there is no need to supply laptop.
3	Memory	More than 1000 Results through inbuilt memory
4	Test	Executes all the test modes automatically
5	Voltage Setting	Fully Automatic through inbuilt control display/Laptop.
6	Analysis Software	Windows based analysis software
7	Protections & Safety	1. HV interlock
		2. Emergency Push Button
8	Input Power	230V $\pm$ 10% Single Phase AC or better at 50 $\pm$ 5% Hz Frequency
9	Output Power	3.6 kVA (Minimum)
10	Output Voltage	25 to 12KV, adjustable
11	Output Current	100mA continuous Minimum.300 mA (Minimum) for at least 02Min.

12	Test Frequency	15 Hz to 400 Hz, Resolution: 0.1Hz, Accuracy 1% of Reading. Voltage output could change with respect to output frequency.
13	<b>Measurement Parameters</b>	
a)	Capacitance	Range: 0- 5 $\mu$ F (Minimum) or better Resolution: 0.1pF or better maximum resolution. Accuracy: $\pm 0.5\%$ of the reading $\pm 0.1$ pF
b)	Tan Delta (DF)	Range: 0-100% Resolution: 0.01% Accuracy: $\pm 0.5\%$ of the reading $\pm 0.05\%$ .
c)	Voltage Measurement	Range: 25V to 12 KV Resolution: 1V Accuracy: $\pm 0.5\%$
d)	Current Measurement	Range: 0-5 Amps Resolution: 1mA Accuracy: $\pm 0.5\%$
e)	Power Factor	Range: 0 to100% (0-1) Resolution: 0.01% Accuracy: $\pm 0.5\%$ of the reading $\pm 0.05\%$
14	Safety features	IEC/EN 61010-1:2001
15	Applicable Standards	Electromagnetic Compatibility: EN61326-1:2013
16	Essential Accessories	<ul style="list-style-type: none"> <li>• Cables: 1 No. HV Cable-20Meter with clamps, 2 Nos. LV Cable-20Meter with clamps, Ground Cable with clamps &amp; other cables and accessories required for carrying out measurement.</li> <li>• Software: Data analysis software in windows XP/Vista/latest version with the features of Storing and downloading of files in data base for further analysis in PC.</li> <li>• Carrying Cases: Foam Padded Carrying Cases for Bridge&amp; Power supply, Carry Bag for Cables</li> </ul>
17	Cooling Arrangement:	Necessary in built cooling arrangement should be provided to dissipate the heat generated during testing. No external coolant/ accessory shall have to be required.
18	Weight	It should be easily portable and trolley mounted for smooth movement.

## Technical Specification for Earth Analyzer Test Set

### Scope:

The scope is for Supply of Earth Analyzer Test Set and complying to the latest relevant standards. The scope includes supply of the equipment with necessary accessories, installation and providing training. The equipment shall use the latest state of art technology and may comprise of all necessary components and accessories in order to ensure proper and hassle free working of the supplied equipment.

### **GENERAL: -**

Most important safety aspects of electrical distribution systems, power transformers, substations is proper grounded. There are many different parameters that need to be taken into account and rarely can a single instrument perform all the necessary measurements and tests. Earth Tester Shall Multi-functional, portable battery (Li-ion) or mains powered test instrument with excellent IP protection: IP65 (case closed), IP54 (case opened), intended for diagnosing of: Earth Resistance, Earth Impedance, Selective Earth Impedance, Specific Earth Resistance, Earth Potential, DC Resistance, AC Impedance and Impulse Impedance. The instrument shall have technical specifications / features as detailed below:

-

### **Should have following Measuring Functions:**

- Earth resistance 2,3 & 4 wire,
- Soil resistivity by wenner & schlumberger method
- Earth potential
- Step and Touch voltage

### **Technical specification:**

<b>Function</b>	<b>Specification</b>	<b>Range</b>	<b>Accuracy</b>
Earth resistance 2, 3, 4 - pole	Open-terminal test voltage 20 or 40 VAC	0.010 $\Omega$ to 19.99 k $\Omega$	$\pm(5\% \text{ of reading})$
	Short-circuit test current > 220 mA		
	Test frequency		
	50 Hz to 1KHz or better		
Selective earth resistance with iron clamp	Open-terminal test voltage 40 VAC	0.010 $\Omega$ to 19.99 k $\Omega$	$\pm(10\% \text{ of reading})$
	Short-circuit test current > 220 mA		
	Test frequency		
	50 Hz to 1KHz or better		
Selective earth resistance of pylons with flex clamp	Open-terminal test voltage 40 VAC Short-circuit test current > 220 mA Test frequency	0.010 $\Omega$ to 19.99 k $\Omega$	$\pm(10\% \text{ of reading})$
	50 Hz to 1KHz or better		
Soil resistance (Specific earth resistance) ro Wenner and Schlumberger method	Open-terminal test voltage 20 or 40 V AC Short-circuit test current >220 mA Test frequency 124 Hz	0.00 $\Omega$ m to 19.99k $\Omega$ m	$\pm(5\% \text{ of reading})$
Earth Potential	Open-terminal test voltage 40 V AC Short-circuit test current >220 mA Test frequency 65 up to 324 Hz	0.0 mV to 49.99 V	$\pm(5\% \text{ of reading})$

DC Resistance RLOW	Test current 100 mA or better	0.00 $\Omega$ to 1.99 k $\Omega$	$\pm(5\%$ of reading )
DC Resistance CONT	Test current 5 mA or better	0.0 $\Omega$ to 19.9 k $\Omega$	$\pm(5\%$ of reading )
AC Impedance	Test frequency 50 Hz to 1 kHz or better	0.00 $\Omega$ to 19.99 k $\Omega$	$\pm(5\%$ of reading )

**Instrument should have following features:**

1. **DISPLAY:** - The instrument shall have Digital LCD /LED display with TOUCH SCREEN/Key pad minimum 4.0inch size (easily readable from near as well as moderately far distance) with back light and shall show the relevant results and other parameters.
2. **INPUT SUPPLY :**  
Battery power supply and Mains power supply : 230VAC  $\pm 10\%$ , 50 Hz $\pm 5\%$  ,  
Over-voltage category : 300 V CAT II
3. **Measuring category :** 300 V CAT IV
4. **APPLICABLE STANDARDS :-**The test kit shall be compatible for EMI/EMC/Safety environment requirement as per IEC.
5. **MEMORY:-** The instrument shall have preferably in built memory storage of the test results.
6. **PROVISION OF SOFTWARE:-** The instrument shall have supplied software and USB / Bluetooth interface which can download digital data to a computer or Laptop. The software shall be provided free of cost.
7. **OPERATING SUPPLY:** The instrument should work on rechargeable Li-ion batteries with in build charging facility and mains power supply with wide range of 90V to 260V AC and auto power off timer.
8. **ENVIRONMENTAL PROTECTION:** The instrument shall IP 65 (close Case) & IP 54 (open case) or other International Standards for Environmental Protection and 300 V CAT IV Measuring Category.
9. **TEMPERATURE RANGE:** The instrument shall have operating temperature range from -0 to 50°C .
10. **RELATIVE HUMIDITY:** The instrument shall have RH better than 90% non-condensing .
11. **PORTABILITY:** The instrument should be light weight and easily portable. The instrument along with leads/ accessories shall be provided in a compact, sturdy, light, portable fiber glass or nylon carry case. The Tenderer shall mention the dimensions and weight of instrument.
12. **CONNECTION DIAGRAMS:** The instrument shall have parameters wise connection schematic diagrams facility / screens for verification of the proper connection before starting of the actual functional test which will help user for ease of operation.
13. **LIMIT:** The instrument shall have limit facility accordingly user can set min or max limit for the measured parameters and also have pass and fail indication on the display.
14. **ACCESSORIES:** The instrument shall be provided with following accessories:
  - a. Crocodile Clips -4pcs
  - b. Iron clamp – 2pcs
  - c. Flex clamp 5m -1pc
  - d. Voltmeter with NiMh batteries -1pc
  - e. Step Voltage test plates – 2pcs
  - f. Li-ion battery -1pc
  - g. Mains cable – 1pc
  - h. Software -1pc
  - i. Hard Carrying case -1pc

## TECHNICAL SPECIFICATIONS OF HIGH VOLTAGE TESTER

### Scope:

The scope is for Supply of High Voltage Tester and complying to the latest relevant standards. The scope also includes supply of the necessary hardware, software, accessories, installation and providing training. The equipment shall use the latest state of art technology and may comprise of all necessary components and accessories in order to ensure proper and hassle free working of the supplied equipment.

<b>Technical Specifications of AC/DC HV test set</b>	
<b>Functions:</b>	
1	On-site testing of paper-insulated mass-impregnated cables according to: – CENELEC HD 620/621 (VDE DIN 0276-620/621) – IEEE 400-2012 – IEC 60060-3
2	Voltage test on electrical equipment according to: – IEEE 62.2 – IEEE 95
3	Cable sheath testing according to: – IEC 60502 / IEC 60229 – CENELEC HD 620/621 (VDE DIN 0276-620/621)
<b>Features:</b>	
- Test voltages up to AC 80 kVrms or DC $\pm 110$ kV connected through Single Phased HV test Lead.	
- Oil-insulated maintenance-free high voltage transformer	
- Continuously adjustable output voltage	
- Safety control unit according to EN 50191	
- Voltmeter with 2 measurement ranges	
- Ammeter with 3 measurement ranges	
- Thermal overcurrent switch-off.	
- Robust two-part structure(HV Unit & Operating Unit)	
- The Operating Unit Contains all Operating and display elements and allows the HV unit to be controlled from a safe distance.	
- Depending upon the operating mode, a rectifier or resistance rod should be used in the HV unit.	
-The polarity of the test DC Voltage can be reversed by rotating the rectifier rod in the HV Unit.	
- Discharge and earth Rod suitable for the device supplied for the discharging of capacitive test objective test objects in DC Voltage Mode	
- A breakdown or overcurrent during the test must result in an automatic shutoff and safe discharge of the system	
-All devices should be short-circuit proof and have a current-compensated voltage measuring function	
<b>Technical Data</b>	
i	Output voltage ▪ AC 0 – 80 kVrms ▪ DC 0 to $\pm 110$ kV
ii	Output current (continuous): ▪ AC 14 mArms ▪ DC $\pm 5$ mA
iii	Short-circuit current ▪ AC 30 mArms ▪ DC $\pm 17$ mA
iv	Accuracy Voltmeter (kV) 2.5% Ammeter (mA) 2.5%
v	Power supply 200 – 260 V, 50Hz
vi	Relative humidity: 85% Non-condensing
vii	Safety and EMC: CE-compliant in accordance with Low Voltage Directive (2014/35/EU), EMC Directive (2014/30/EU), EN 60068-2-ff Environmental testing

### Technical Specifications of Digital Clamp Leakage Meter

**Scope:** The Meter is a unique earth leakage clamp meter. It not just has the ability to accurately read the TRMS AC leakage current of a system, it can also detect losses in the system and suggest possible reasons for the loss. The voltage, power, harmonic, power factor (PF), total harmonic distortion (THD) and crest factor measurements make this instrument suitable for any electrician and engineer.

S .No	Parameters	Description	
1	Name of Manufacturer	To be mentioned	
2	Type & model	To be mentioned	
3	MEASURING FUNCTIONS	<ul style="list-style-type: none"> <li>• TRMS AC voltage measurement</li> <li>• TRMS AC current measurement</li> <li>• Frequency measurement</li> <li>• Power parameters measurement</li> </ul>	
4	KEY FEATURES	• TRMS: accurate measurements on sinusoidal and non-sinusoidal signals.	
		• Jaw size: 28 mm.	
		• Shielded Jaw: shielded jaw allows the clamp meter to be used in the noisiest environments.	
		• Accurate: readings of AC current with an accuracy of 0.8 % and a base resolution of 0.01 mA or better and voltage with an accuracy of 0.5 % and a base resolution of 0.1 V or better.	
		• Power: measures various power parameters (active, reactive, apparent power, THD, PF, phase displacement).	
		• Intelligent loss analysis: complex algorithms detect loss and allow determining possible reasons for current loss.	
		• Harmonics: measures current or voltage harmonic components and a percentage value of a harmonic up to the 19th.	
		• THD and PF: dual display allows readings to be displayed along with Total Harmonic Distortion (THD) or Power Factor (PF).	
		• Peak value: the peak value of the waveform or crest factor can be displayed.	
		• Low Battery Indication	
		• Auto Power off	
		• MAX/MIN/HOLD mode: displays maximum, minimum or average measured value.	
• Should have automatic, Manual Range Selection.			
5	<b>STANDARDS</b>	This instrument has been designed in accordance with IEC 61010 series standards and EMC standards that regulates safety requirements for the electronic measuring equipment and current measuring clamps.	
6	<b>TECHNICAL DATA</b>		
	<b>FUNCTION</b>	<b>Measuring range</b>	<b>Accuracy</b>
	AC current	40mA, 400mA, 4000 mA	±(2.0 % of reading + 3 digits)
		40A	
		100A	
	Mains frequency	45Hz to 500Hz	
	AC/DC voltage	40V	±(2.0 % of reading + 3 digits)
		400V, 600V	
	THD	0 to 99.9 %	±(2.0 % of reading + 3 digits)
		100 to 999 %	
	Crest Factor	1 to 2.99	±(3.0 % of reading + 5 digits)
		3 to 9.99	

	Peak value	40 to 100 A 40 to 600V	$\pm(3.0\% \text{ of reading} + 3 \text{ digits})$
	Power factor (PF)	0 to 1	$\pm 5 \text{ digits}$
	Phase	-180° to +180°	$\pm 10 \text{ digits}$
	Power (W, Var, VA)	0 to 9999	$\pm(2\% \text{ of reading})$
	Power (kW, kVar, kVA)	10 to 99.99	$\pm(2\% \text{ of reading})$
	Harmonic (Current & Voltage )	Measuring upto 19th harmonic component.	
	Operation temperature	0 °C to 50 °C (0 to 85% Non- condensation)	
	Display	7 Segment Display, 3 3/4 digits LCD/LED screen with 3000 counts	
	Data update on display	twice a second	
	Over-range indication	-OL- is shown on the LCD screen, fast beep	
	Polarity indication	“-“ is shown automatically	
	Power supply	Battery Operated	
	Overvoltage category	CAT IV / 300 V; CAT III / 600 V	
	Standard set includes	<ul style="list-style-type: none"> <li>• Current clamp</li> <li>• Test lead with probe, 2 pcs</li> <li>• 1.5 V battery, type AAA, 2 pcs</li> <li>• Pouch</li> <li>• Instruction manual</li> <li>• General Conformity Certificate</li> </ul>	

**TECHNICAL SPECIFICATIONS OF DIGITAL INSULATION TESTER 10KV (PORTABLE)**  
**GUARANTEED TECHNICAL PARTICULARS (GTPS) FOR 10KV DIGITAL INSULATION TESTER**

**Scope:**

The insulation tester 10 kV is a portable instrument intended to measure insulation resistance by using high DC test voltages up to 10 kV and enables insulation resistance measurements up to 1TΩ, step voltage test, withstanding voltage test, Polarization Index, Dielectric Discharge and Dielectric Absorption Ratio calculation and capacitance measurement. The large LCD screen enables real-time graph R(t) to be displayed(Preferably). Results can be stored and downloaded to a computer via USB/RS232/ Bluetooth connection with the help of the optional software. The high quality instrument, shielded test leads and quality accessories included in the standard set enable to perform insulation testing quickly and effectively.

S.No.	Parameters	Description
1	Name of Manufacturer	To be mentioned
2	Type & Model	To be mentioned
3	MEASURING FUNCTIONS	Insulation resistance measurement Step voltage insulation resistance testing Withstanding voltage testing Diagnostic test (PI, DD, DAR) R(t) graph plotting Capacitance measurement Voltage measurement Frequency measurement
4	KEY FEATURES	Measuring range up to 1 TΩ. 0-10KV(500V,1000V,2.5kV,5.0KV,10KV) in steps (Digital) Withstanding voltage: testing of insulation with programmable ramp test voltage from 0 to 10kV and programmable threshold current. Step voltage: insulation resistance measurement with five discrete proportionately set test voltages and programmable timer per step. Automated testing: PI, DD, DAR calculations with automated resistance ranging. All data is displayed during one single measurement. Guard test terminal: for elimination of potential surface leakage currents. Fault finding: fully programmable step voltage and withstanding voltage test functions assist in diagnosing faults in insulation. Graph R(t): real time resistance against time graph plotting facility to graphically illustrate the response of a material to an applied test voltage (Preferably). Built-in timer: programmable timer from 1 s up to 99min. Instrument should work on rechargeable battery and on mains power supply ( without any battery) Instrument should have facility to give warning sound beep when high voltage (≥50 V rms) is present on the input terminals PASS or FAIL Indication: Instrument should have facility to set insulation resistance limit Minimum 1MΩ to 1TΩ Measured resistance is compared against the set limit and will indicate PASS or FAIL on the screen Help Menu: Instrument should have help menu contains schematic diagrams for connection for various test objects Custom Tests : Instrument should have facility to create commonly used pre-programmed custom tests parameters min upto 25Nos Message Window: Instrument should have message window to display warnings and messages

5	STANDARDS	Relevant Standard of Equipment Should be fully complied
6	<b>TECHNICAL DATA</b>	
	<b>FUNCTION</b>	<b>Measuring range</b>
	Test Voltage (DC V)	0 to 10000VDC variable in steps.
	Voltage output accuracy	± 05% of reading
	IR Measuring Range	0 to 1 TΩ or Better
	Insulation Accuracy (IR )	± 05% of reading
	Capacitance measuring Range	Range : 20nF to 50μF , Accuracy : ± 05% of reading
	Short circuit Current range	>5mA or better
	AC/DC Voltage Measurement	500 V AC/DC TRMS Accuracy: (± 05% of reading ) or better
	Frequency Measurement	10 Hz to 500Hz Accuracy : (± 05% of reading ) or better
	Insulation Leakage Current	Range: 10nA to 5mA with Accuracy : (± 05% of reading ) upto 5mA or Better
	Accuracy-DAR	0.01-100: (± 05% of reading )
	Accuracy: Polarisation Index	0.01-100: (± 05% of reading )
	Accuracy: Dielectric Discharge(DD)	0.01-100: (± 05% of reading )
	Timer Range	The kit should have three programmable timer from 1s upto 99 min for conducting diagnostic tests
	Testing parameters	The test kit should have automatic test sequence for Automatic IR Test, Polarization Index Test, Dielectric Absorption Ratio Test, Dielectric Discharge Test, Step Voltage Test and Withstand Voltage Test. The Equipment should also have preferably R(t) Graph testing facility.
	Remote Control	Instrument should have remote control function for distance control of the instrument via RS232 and USB communication for Automation purpose.
	Guard Terminal	Should be available with 300kΩ ± 5 % Resistance Or better
	Battery & Mains Operated	Mains :240VAC,50Hz & In Built rechargeable Battery power supply and Should work without batteries on Main supply & minimum 4 hrs continues testing .
	Communication Port	Bluetooth/ RS232/ USB
	Safety Category	CAT IV / 600V or Better
	Noise Rejection Current	max 4mA
	Display / Warning	Backalite LCD display & Visual or Sound warning
	Self-Calibration facility	Should check calibration at every startup
	Indication	Required visual indication for the test ON condition
	Operating Temp.	Operating : 0°C to +50°C
	Maximum relative humidity	90 %RH (0°C to 40 °C), non-condensing
	Filters option required ( Avg )	Time setting: 0, 5,10, 30 & 60sec or better
	IP Rating	IP 65 with case closed & IP 40 with Open case or better
	Storage	1000 measurement with date & time Stamping.
	Standard set includes	Shielded Test leads 3 meters (Red & Black) and Guard lead along with crocodile clips , Mains Cable , Rechargeable Battery , Calibration certificate , User manual , software , USB and RS 232 Cable.
	Weight	It should be easily Portable.

## HIGH VOLTAGE DETECTOR

### TS-1. General Note:

The High Voltage Detector (HVD) shall be suitable for detection of liveliness of electrical infrastructure including overhead bare conductor. A compatible telescopic type retractable hot stick made of suitable insulating material with proper reinforcement shall be part of the complete set of the HVD. The HVD shall start annunciating with flashing Red LED display along with buzzer beeps indicating that the line / infrastructure is LIVE and not safe to earth and/ or carry out any operation. It shall be suitable for use in both INDOOR and OUTDOOR environments. Nominal Sensing distance should be

- 1.1** for 66 KV System – 3 Mtr. –
- 1.2** for 33 KV System – 3 Mtr.
- 1.3** for 11 KV System – 1 Mtr.
- 1.4** for 415 V system – 130 mm.

### TS-2. Service Condition:

The High Voltage Detector to be supplied as per this specification shall be capable of detecting liveliness of any electrical infrastructure such as bus-bars and live-line on bare conductors under moderately hot, tropical climate and shall be suitable for satisfactory operation under the following tropical climatic condition.

- 2.1** Maximum Ambient Air Temperature: 50 Centigrade.
- 2.2** Minimum Ambient Air Temperature: -5 Centigrade.
- 2.3** Maximum Relative Humidity: 95% Non-Condensing.
- 2.4** Minimum Relative Humidity: 10%.
- 2.5** Maximum Rainfall: 2000 mm.
- 2.6** Maximum Wind Pressure: 150 Kg/ Sq.mm.
- 2.7** Climatic Condition: Moderate Tropical Climate.

### TS-3. System Condition:

The High Voltage Detector is intended to use in HT & LT sub transmission and distribution system. The network configuration type such as 3Φ3W, 3Φ4W, 1Φ2W are included. The equipment should be designed and compatible with the following parameter mentioned in tabulated form below –

System Voltage	Nominal System Voltage	66 KV	33 KV	11 KV	415 V
	Highest System Voltage	72 KV	36 KV	12 KV	440 V
Rated Frequency		50 Hz			
Insulation Resistance		Greater Than 100 MΩ			
Sound Pressure		90 dB/Meter ± 10dB/Meter			

**TS-4. Power Supply:**

The HVD shall be portable and conforms to the following features –

- 4.1** The equipment shall be powered by Dry Cell Battery of suitable voltage rating.
- 4.2** The Dry Cell Batteries shall be commercially available everywhere.
- 4.3** The Dry Cell Batteries shall be easily replaceable at field level.
- 4.4** Power consumption shall not be greater than 30 mA while in use.

**TS-5. Self-diagnostic feature:**

The High Voltage Detector shall be capable of performing complete self-diagnostic check in offline mode with buzzer and flashing LED to ensure proper working of the equipment before taking on site.

**TS-6. Applicable Standards:**

- 6.1** Probe – The HVD probe shall conform to IS 2071 (Part1)/ IEC 61243-1.
- 6.2** Hot Stick – The telescopic hot stick rod shall conform to IS 16622:2019/IEC 61235 / IEC 60855.

**TS-7. Detection Indication:**

- 7.1** The HVD shall give indication using high intensity LED with flashing arrangement in presence of live line or equipment there by providing clear and suitable indication in day light.
- 7.2** The HVD shall generate clear and adequately audible sound to indicate presence of live line or equipment so that it can be used in populated and noisy areas for easy operation.

**TS-8. Dimension:**

- 8.1** The HVD probe shall have universal connecting link for the attachment of the retractable telescopic hot stick.
- 8.2** Length of the retractable telescopic hot stick shall not be less than 4800mm.
- 8.3** The Outer Diameter of the retractable telescopic hot stick shall not exceed 45mm with tolerance as per Indian Standards.

## **TS-9. Constructional and General Requirements:**

- 9.1** The HVD shall be designed and constructed in such a way to avoid any hazard and danger to the operating personnel during use and under normal condition.
- 9.2** The HVD shall sense the liveness of the system in non-contact condition. However, even if the HVD comes in contact with the live parts, under no circumstance its functionalities shall be affected and safety of the user using the equipment shall not be compromised.
- 9.3** The HVD shall have the capability to warn the user by audio-visual means about liveness of an electrical system from a safe distance as per IE standards.
- 9.4** The HVD shall contain a buzzer which shall produce clear and adequately audible sound to indicate presence of live electrical system even in populated and noisy areas.
- 9.5** The HVD shall contain high intensity bright LED which shall provide clear visual indication to the user to indicate presence of live electrical system even in bright daylight condition.
- 9.6** The HVD shall have self-test functionality to diagnose the battery and its proper functioning.
- 9.7** The HVD shall have facility for easy replacement of battery.
- 9.8** The HVD shall have universal connecting link for easy attachment of retractable telescopic hot stick,
- 9.9** The HVD shall have IP65 protection class.
- 9.10** The retractable telescopic hot stick shall be of electrically non- conducting, non-allergic, non-hygroscopic, non-ageing material of tested quality. A silicon petticoat arrangement shall be fixed on the

stick for decrease of the flash over contact probability with the operator. The hot stick shall have a rubber gripper for holding it firmly when making measurements of H.T. Lines.

- 9.11** All insulating material used in the construction of the HVD shall be of non-hygroscopic, non-ageing and of tested quality.

- 9.12** The HVD shall conform to safety standards

EN 61326-1

CISPR 11:2019

IEC/EN 61000-4-2

IEC/EN 61000-4-3

IEC/EN 61000-4-8

## **TS-10. Carrying case:**

The HVD with its accessories shall be supplied with suitable carrying case so as to be carried by the operating personnel easily and individually.

## TECHNICAL SPECIFICATIONS OF DIGITAL MULTIMETER

### Scope:

The scope is for Supply of Digital Multimeter and complying to the latest relevant standards. The scope includes supply of the equipment with necessary accessories, installation and providing training. The equipment shall use the latest state of art technology and may comprise of all necessary components and accessories in order to ensure proper and hassle free working of the supplied equipment.

<b>GUARANTEED TECHNICAL PARTICULARS (GTPs) for Digital Multimeter</b>			
The digital multimeter has been designed for use both in the laboratories and in the harsh industrial maintenance and repair sector. TRMS functionality makes the multimeter suitable for a multitude of situations, while the large bright screen with backlight and incorrect lead connection alert make it ideal for working in dark areas.			
S.No.	Parameters	Description	
1	Name of Manufacturer	To be mentioned	
2	Type & model	To be mentioned	
3	MEASURING FUNCTIONS	<ul style="list-style-type: none"> <li>• TRMS AC, DC voltage measurement</li> <li>• TRMS AC, DC current measurement</li> <li>• Capacitance measurement</li> <li>• Resistance measurement</li> <li>• Diode test Display</li> <li>• Frequency measurement</li> <li>• Continuity test (acoustic signalling)</li> </ul>	
4	KEY FEATURES	<ul style="list-style-type: none"> <li>• TRMS: accurate readings on sinusoidal and non-sinusoidal signals.</li> <li>• Low Pass Filter facility, Over voltage and over current protection</li> <li>Seven Segment Dual Display with decimal point and polarity.</li> <li>• Frequency measurement: up to 1 MHz.</li> <li>• Lead alert: incorrect lead connection alert.</li> <li>• Auto-ranging: user can switch between auto and manual ranging.</li> <li>• Relative zero mode: relative function for comparing the difference between signals or removing background noise.</li> <li>• Data Hold: data hold feature freezes the display for later view.</li> <li>• MAX Hold: 25ms Max Hold feature freezes the maximum measured value.</li> <li>• Safe: CAT IV / 600 V, CAT III / 1000 V overvoltage protection. Drop Proof</li> <li>• The Indication of negative values on the analog scale.</li> <li>• Overload warning, Blown fuse indication, Low battery indication</li> <li>• Backlight: large bright 4 digits, 3000 counts or 6000Counts LED/LCD Display</li> </ul>	
5	STANDARDS	EMC: IEC61326-1 2012 Safety: DIN EN610102010 IEC61010-1-2010	
6	TECHNICAL DATA		
	<b>FUNCTION</b>	<b>Measuring Range</b>	<b>Accuracy</b>
i	DC voltage	0 to 1000 V	

ii	TRMS AC voltage (50 to 500 Hz)	0 to 1000 V	±1.5% of reading.
iii	DC current	0 to 10 A	
iv	TRMS AC current	0 to 10 A	
v	Diode test	Open-circuit voltage <1.6 VDC, Test current 0.25 mA.	
vi	Resistance	0 to 40 MΩ	±1.5% of reading.
vii	Frequency	50 Hz to 1 MHz	±1.5% of reading.
viii	Capacitance	500 nF to 3000 μF	±1.5% of reading.
7	Power supply	Batteries	
8	Overvoltage category	CAT IV / 600 V, CAT III / 1000 V	
9	Display	4 digits 3000 counts or 6000Counts with facility of Over Range(OL) & Polarity Display	
10	Update Rate	3 per second nominal	
11	Operating Temperature	0°C to 50°C	
12	Humidity	75% Non-Condensing or better	
13	Transient protection	6.5kV (1.2/50μs surge)	
14	Standard set includes	<ul style="list-style-type: none"> <li>• Multimeter with rubber holster</li> <li>• Test lead with probe, 2 pcs</li> <li>• Battery</li> <li>• Instruction manual</li> <li>• General Conformity Certificate.</li> </ul>	