

Technical Specification for Numerical Relay Test Kit

Scope:

This specification covers Design, Manufacture, Testing, Supply and Delivery of Numerical Relay Test Kit and associated accessories suitable to test all types and models of distance, current, voltage, frequency, reclosing relays and protection schemes of transmission lines, transformer, reactor and bus bar of major manufacturers in automatic as well as in manual mode

Functional Requirement :

- The equipment should be suitable to test all types and models of distance, current, voltage, frequency, reclosing relays and protection schemes of transmission lines, transformer, reactor and bus bar of major manufacturers in automatic as well as in manual mode (including high burden electromechanical relays)
- The equipment should be menu driven, suitable for dynamic and transient testing, with facility of transient (COMTRADE format) record play back.
- The equipment should be suitable for testing two winding transformer differential protection.
- The equipment should be able to simulate all the waveforms and transients as recorded in the disturbance recorder.
- The equipment should be suitable for testing of the relays in the sub stations having conventional protection as well as protection based on IEC 61850 protocol using GOOSE /GSSE messages.
- The equipment should be suitable for testing of the relays in the sub stations having sample value based relay testing.(All relays)
- The equipment must facilitate for transducer calibration with a provision to input for 4- 20mA current signals or 0 to +/- 10 V DC.
- The equipment must have state sequencer module to simulate any of the power system conditions context wise and must have facility to introduce 50 states minimum with time duration as low as 10mSecs for each state and L/R constant as low as 0 sec.
- The equipment shall have GPS receiver accessories to perform end to end testing.
- The equipment should be operable in manual /semi automatic and automatic mode and should meet the following specification:
 1. The software should facilitate for plotting the characteristics of distance relay in manual mode by specifying minimum of 6 states to facilitate for plotting of any polygon characteristics based on requirement. The software must facilitate to enter impedance value in polar /rectangular form.
 2. The relay test kit shall have a separate software module in a relay test kit for checking the harmonic restraint (2nd & 5th) in case of transformer.
- a) The kit shall have a provision to mention settings of the relay under test for blocking in % of differential current settings.

- b) The software shall automatically calculate the harmonic current based on various vector groups of transformers.
 - c) Provision to test the unblocking condition for the 5th harmonic in restrained trip region of differential relay characteristic.
 - d) Provision to test the harmonic restrain feature with cross/sum/average based feature
 - e) Provision to test the single phase differential relays.
3. The equipment must generate at least four independent voltages and six independent currents with the facility to control their amplitudes, phase angles and frequency independently.
 4. The equipment should have multistep f^+ , f^- , df/dt , dv/dt , dc/dt dp/dt etc facility with a provision to simulate various rates of power system parameters. The function shall facilitate to enter minimum of 3 states with offset timing in each state. There shall be a provision to continue the test with or without the receipt of binary input to the kit and facilitate for measurement of time duration from a specified reference.

Voltage & Current Outputs :

1. Voltage Generators : 04 Nos
 2. Range : 4 X 0-300V, 75 VA or better
 3. Resolution : 10mV or better
 4. Accuracy : 0.2% or better
 5. Distortion: 0.2% or better
 6. Output power with each single phase 300V(L-N) shall be minimum 50VA
 7. Current Generators : 04 Nos
 8. Range : 6 phase, 30A each, 430VA each phase (without external current amplifiers)
 9. 3 phase, 60 A each, 860VA each
 10. 1- Phase, 100A, 1000 VA each
 11. Resolution : 1mA or better
 12. Accuracy : 0.2% or better
 13. Distortion: 0.2% or better
- All amplifier outputs shall be completely independent with regard to phase, amplitude and frequency and have over voltage and short circuit protection. Specifically all the voltage and current generators shall have over voltage/short circuit protection. The current/voltage amplifiers should not get over heated, while supplying the rated output continuously. Further the equipment should be stable even during extensive continuous usage and should not get hanged or re started.
 - Further the equipment should give sufficient compliance voltage even at low currents for successful testing of electromechanical high burden relays (e.g. CDG,CAG,CDD etc)at minimum taps at 2,5 and 10 times the plug setting. The same is applicable for high set elements of these relays also.
 - All current and voltage generators must be independently adjustable in amplitude, phase and frequency. Outputs shall be fully over load and short circuit proof and protected against external high voltage transients.

- The equipment should have auxiliary DC output, which shall be software controlled, 0-250V and 50W minimum (continuous rating) with continuous/step less control. The DC supply should have short circuit protection, galvanically isolated and over load indication.
- The equipment shall have minimum eight binary out puts and 10 inputs preferably with galvanic isolation. Software controlled input should be capable of sensing potential free relay contacts (NO/NC) as well as potential of 0- 250V AC/DC. (on to Off or Off to On configuration) Associated timers should have time resolution of 100 μ s or better. The software controlled outputs should have potential free contacts(NO/NC) with breaking capacity of 0.2A /250V AC/DC.

Binary Inputs and Timer :

There should be at least 6 inputs (binary) in single/two groups (galvanically separated) with independent contacts each with voltage minimum 220 volts DC and AC.

Measuring Time: 0-24 Hours minimum

Resolution: 1ms or better

Phase Angle Measurement :

Range: 0 to 360 deg

Resolution: 0.1deg

Accuracy : ± 0.2 deg

Generator Frequency :

Continuous signals : 10Hz to 1kHz

Transient signals: DC 1 Hz to 3KHz

Frequency Accuracy: 0.01 % or better

Frequency resolution: 1mHz or better

Communication :

The equipment must be capable of operating with a PC, a laptop computer preloaded with easy to use relay testing software (WINDOWS based) should also be provided.

Software of the kit should be Windows based , menu driven and very much user friendly

- It should have all the templates, routines/ modules/versions/advanced features, available or required for complete testing(including checking of all the features and dynamic testing) of different types and models of relays of all the major manufacturers.
- The pre configured test menu/modules/templates/routines should be based on generic versions of relays and should be easily editable. It should also be easily possible to graphically make templates for testing of any relay with the facility of changing reach values, number of points to be tested, operating angle, fault timings etc. without the need of writing equations or any algorithms. All the required features for dynamic testing like ramping of vectors (voltage / current / impedance / phase angle/ frequency etc along with provision of limiting values), applying of multiple sequences/states superimposition of harmonics etc are also to be provided.

Software :

- Specifically for distance relays it should be easily possible to graphically draw the relay characteristics and test the relay at required number of points (in terms of impedance values), both in manual and automatic mode for phase to phase as well as phase to

- earth faults. In the automatic mode, it should be possible to test all the zones simultaneously within required tolerance. In the manual mode it should be possible to apply faults directly in R-X plane by using mouse or by entering data in terms of impedance values to the maximum resolution possible, or multiple faults in different zones. The result, i.e. time taken by the relay to operate should be displayed on the same screen having impedance value. Further, it should be possible to import the relay characteristic using RIO files of all the numerical relays of different manufacturers and then perform the testing using the imported characteristics. It should also offer all the methods of impedance variation viz. constant current, constant voltage and constant source impedance methods. Equipment should be able to conduct test for zone mapping, zone verification, SOTF testing, PSB checking, verification of fault locator etc.
- It should also have the facility of transient data playback, by accepting transient fault recorded by disturbance recorders/ numerical relays in COMTRADE formats, from floppy and CD etc along with facility to extend the pre fault, post fault durations. It should accurately simulate the disturbance signal along with DC and high frequency component and preferably binary signal as well as (with sampling rate of 3kHz or better). Further it should offer repeatability of results, example same fault location for a particular record etc.
 - The software should have suitable modules for complete testing over current and earth fault, over and under voltage, power swing, frequency and differential relays including pick up/ drop off check and characteristic check.
 - Further it should also generate proper reports in user friendly formats and the report should be exportable to common office software.
 - The equipment should have the capability to accept transient fault data recorded by disturbance recorder and replay these for a detailed evaluation of the relay under test. The simulation software shall be windows based and shall at a minimum support the following disturbance recorder file formats: COMTRADE & EMTP.
 - Software up gradation done in future shall be made available at free of cost as and when updates are made and updates should be made available through web or through links sent by e-mail.
 - The firm shall upload the software required for operation of kit along with other tender documents. The same software will be downloaded during pre bid demonstration.

Communication Network :

The equipment shall have the Ethernet connectivity as a standard feature. The Ethernet port shall be suitable for control through external PC as well as for IEC 61850 purposes. GOOSE/GSSE configuration software module should be provided with the kit for effective checking of protections/IEDs based on IEC61850 protocol. It shall read, write, poll and check data modules/values in detail. It shall have the facility to transfer GOOSE information to suitable modules during testing of IEDs. Specifically it will be responsibility of the supplier to demonstrate the working of IEC61850 module for input/output GOOSE messaging and capturing of live data.

Test Leads & Accessories :

Complete set of test leads, PC cables, licensed OS software and anti virus for PC, licensed software for the testing kit, combination plugs, power supply cables, original hard and soft carrying case(which should be robust/rugged enough for proper safety of the kit during transportation), manual (both in soft copy and hard copy) etc required for carrying out all types of testing. The test leads shall be supplied in two sets one with 6mtrs length and one set shall be of 3 mtrs length. Additional crocodile adapters to all the test leads to be provided.

Protection/ Control:

The equipment should be designed to operate under the adverse conditions of external influence like electro static discharge, magnetic field electromagnetic field induction, RF interference, input waveform distortion and harmonics, input voltage and frequency variation.

Weight :

It should be highly portable and trolley mounted for smooth movement in live switchyards.

Power Supply:

It shall work on single phase 230 Volts $\pm 10\%$, 50 Hz $\pm 5\%$ supply and 80 to 250 DC SUPPLY with $\pm 10\%$, with standard socket. The kit shall have inbuilt security and safety circuits for variations in input supply and shall perform satisfactorily without the use of any external stabilizers. Provision shall be made for extending earthing to the kit in testing place for the safety of equipment and personnel.

Laptop :

One compatible of IBM/HP/DELL make Laptop shall be provided loaded with user application software for controlling, supervising the test system and displaying all measurement values in addition to error and data management.

Minimum Specification :

Processor : Intel core i5

Operating System : Original latest operating System compatible to the kit.

Hard Disk : 320GB

RAM : 4 GB

CD Drive : DVD and CD with Read/Write facility

USB Ports : 3 Nos

LAN : 10/100/100GB Ethernet cord

Antivirus with one year validity

Guarantee : 3 years from the successful demonstration at site.

Storage/Memory :

It should store/record minimum 10000 test records in kit or Laptop.

Operating Temp: 0 to 50 deg C

Environment :

The test kit shall be compatible for EMI/EMC environment required for EHV switchyard as per IEC61000.

Guarantee/Warranty :

Kit shall be guaranteed for any defects for minimum 36 months from date of successful demonstration at site. If the kit needs to be shifted to suppliers works for repairs, supplier will have to bear the cost of, spares, software, transportation etc of kit for repair at test lab/works. The commencement of warranty period will start after the successful and final demonstration, inclusive of repetitive if any, of kit at site. All the materials, including accessories, cables, laptops (wherever supplied) etc. are to be covered under warranty/guarantee period.

1. If any problem in the kit is reported in the guarantee period, then the kit shall be collected by the firm within ten days of the report of problem for free repairs and the transportation/transit insurance cost shall also be borne by the supplier .
2. Repair period shall be maximum of one month from the date of kit collected by the firm.

Any period over and above (as 1 & 2 above), stipulated time shall be liable to extend the guarantee period for the delay period for which firm shall arrange to extend the Bank Guarantee.

Training :

Supplier shall have to ensure that the kit is made user friendly. Apart from detailed demonstration at site, the supplier shall also have to arrange necessary training to end user engineers at different sites of destination.

Calibration Certificate :

Unit shall be duly calibrated before supply and the date of calibration shall not be older than two month from the date of supply of Kit.

Commissioning, Handing over the Instrument:

Successful bidder will have to commission the instrument to the satisfaction of end user.

Service :

Bidder will have to submit the documentary evidences of having established mechanism for prompt services in India as required as per the specifications. The service support including supply of spares shall be ensured for a period of minimum 10 years. The service support rendered by the bidder for the equipments supplied earlier to KPTCL will be one of the requirements during evaluation of the bid.

