

TECHNICAL SPECIFICATION OF AUTOMATIC TANδ AND CAPACITANCE MEASUREMENT BRIDGE WITH HV POWER SOURCE					
S. NO.	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFIED/TO BE CONFIRMED	OFFERED	DEVIATIONS	REMARKS
1.0	PURPOSE Automated PC based C,L, & tan δ (Dissipation Factor) Measuring Bridge is required for Tan Delta & capacitance measurement of electrical machines, coils of motors & generators.	Vendor to confirm			
2.0	SPECIFICATION Tech specs of the machine / equipment				
2.1	Dissipation Fctors (tan δ) , Range :- 0....100 (0...10000%) Resolution :- 0.0001 (0.01%) Accuracy :- ± 0.5 % rdg ± 0.01 %	Vendor to confirm			
2.2	Power Factor (Cos φ) Range :- 01 (0...100%) Resolution :- 0.0001 (0.01%) Accuracy :- ± 0.5 % rdg ± 0.01 %	Vendor to confirm			
2.3	Quality Factor Range :- 0.01..10000 Resolution :- 0.0001 (0.01%) Accuracy :- ± 0.5 % rdg ± 0.01 %	Vendor to confirm			
2.4	Capacitance Range :-> 0.1 pF (0.1 pf to 1 uF) Resolution :- 0.01 pF Accuracy :- ± 0.05 % rdg ± 0.3 pF	Vendor to confirm			

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2.5	Inductance Range :- 0- 999.9 kH Resolution :- 0.1 mH Accuracy :- $\pm 0.1\%$ rdg ± 3 mH	Vendor to confirm			
2.6	Test Voltage Range :- 015 kV rms Resolution :- 1 V Accuracy :- $\pm 0.3\%$ rdg ± 1 V	Vendor to confirm			
2.7	Test Current Range :- 20uA....1.0 A Resolution :- 0.001mA Accuracy :- $\pm 0.3\%$ rdg ± 1 uA	Vendor to confirm			
2.8	Test Frequency Range :- 45 to 65 Hz Resolution :- 0.1Hz Accuracy :- $\pm 0.2\%$	Vendor to confirm			
2.90	Operating Teamperature Range :- -10....50 ⁰ C	Vendor to confirm			
2.10	Humidity Range :- 5 to 95 % RH.	Vendor to confirm			
2.11	Protection Classes Range : Suitable protection for working in a high voltage area.	Vendor to specify			
2.12	Weight of equipment	Vendor to specify			
2.13	Size of equipment (W x H x D)	Vendor to specify			
	Accuracy value should be for valid @ 50 Hz	Vendor to confirm			
	Range is limited by test current and voltage of used power source.				

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2.17	AC HV Power Source :					
	1.0 Operating Voltage	: 0- 230±10%, 50Hz,				
	2.0 Output Voltage	: 0 to 15 KV AC				
		continuously variable				
	3.0 Maximum Output Current	: 1.0 A on HV side				
	4.0 Capacity	15 KVA , 45 to 65 HZ				
	5.0 Duty cycle	: 50 %				
	6.0 Overall accuracy	: ± 1.5% or better				
	7.0 The instruments (Digital) for indications & measurement include followings:					
	Voltmeter: For primary voltage					
	Ammeter: For primary current					
	KV Meter: For output voltage measurement					
	Ammeter: for leakage in milliamps and amps					
	Timer : For presetting hold time					
	7.0 Salient features					
	7.1 A zero start protection shall be built into the system, which will not allow the system to be switched on until & unless the system is set at zero KV output.					
	7.2 Leakage current setting (20% to 100% of maximum value) through a potentiometer should be provided on the control and metering panel.					
	7.3 Auto discharge to earth for any residual voltage of the set or the specimen after the set is switched off and on tripping case.					

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	7.4 Equipment to be supplied with all desirable safety features ensuring SAFE OPERATION of the equipment & safety of the personnel					
	8.0 General:					
	8.1 Supplier to submit following along with the offer:					
	1.0 Circuit/schematic of the equipment					
	2.0 Detailed BOM with rating/quantity & make of various components.					
	3.0 OGA drawings with weight of the equipment unit separately.					
	4.0 4 sets of the O & M manual along with drawings etc will be supplied					
	5.0 The equipment will be inspected at the supplier's works before dispatch.					
	6.0 Spare of output measurement meters (KV Meter & leakage amps meter- one number each) to be supplied along with the equipment.					
3.00	CONSTRUCTION :					
3.1	Technical Features					
	The loss analyzing system to be designed for determining impedance and dielectric losses (C,L,DF tan δ PF cos ϕ , QF etc.) of high voltage equipment and liquid or solid insulation. The instrument should operate on a combiant bridge / vector meter principal. Operation, control and display of all parameter through a laptop (reputed make) via software.					
3.2	A large colour TFT touch screen display and a window XP™ user interface should be provided for easy and intractive operation of the instrument.					

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3.3	Advance software functionality like automatic test object temperature correction, programmable test sequences with pass/ fail limits, graphical result presentation in digrams for trending visualization, etc				
3.4	Loss measurement and analysis on high voltage equipment.				
3.5	Built - in standard interface (Ethernet, USB) should be provided to enable easy data exchange with another external computer. All measurements and related setting and test object data should be saved in standard software so it be further used in any other environment. The Instrument itself should produce fully automatic test reports.				
3.6	Instrument to record all relevant value such as Capacitance, Inductance, Dissipation Factor $\tan \delta$, Power factor $\cos \phi$, Quality Factor, Equivalent series/parallel Impedances, Power, Current, Frequency, Voltage, Temperature, Temp. correction Factor, Test connection Factor, Test connection Mode and all settings.				
3.7	Instrument should read Values absolute and corrected to standard temperature.				
3.8	The instrument should have Three select measuring channels to minimize the reconnecting of the object.				
3.10	The instrument should have compact, reliable and safe construction for factory and field use along with optional field case.				
4.0	OPERATION AND CONTROL SYSTEM				
4.1	Connectivity				
	(a) Setups :- Should have a set menu for all configuration values, type of DUT, insulation type, temperature correction function, limits, work order, serial numbers, test personal, etc.				
	(b) Test Level :- Set the desired different test level (voltage and frequency).				
	(c) Connections :- Set the different connections (EUT wiring) e.g. GSTg A + B.				
	(d) Measuring Values :- Define the different values to be recorded. Eg. Voltage, Frequency, PF, Current, Temperature, PF @ 20° C, etc.				

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5.00	STANDARD CAPACITOR (100 Pf +/- 1%, max 30 kV AC)				
5.1	It should be Gas Insulated standard capacitors to be used in high voltage instrumentation applications as pre- comparison standard capacitance and dissipation factor measurements are made on electrical apparatus and insulating materials of all type including cables, capacitors, brushings , instruments - transformers and power - transformers.				
5.2	It should be possible to use Standard capacitors as a high voltage section of a capacitive divisor to allow extremely accurate voltage measurements such as those required for loss measurements on power - transformers.				
5.3	The capacitor should be suitable for indoor operation.				
5.4	They should be optimally designed for modern different transformer measuring bridge such as described above. The built -in guard electrodes should permit the capacitor in conjunction with bridge. The test voltage thus can be measured at the same time as the dissipation factor and capacitance measurements. The test voltage is determined by measuring the current flowing through the standard capacitor.				
5.5	Standard capacitors with nominal voltage upto 30kV should have the polished metal plate electrodes built in to a metal pressure tank and insulated with SF6. The pressure gauge and measuring connections should be located on cover plate for the above bridge. The high voltage shall be applied to the capacitor with a screened cable. It should have a high voltage bushing .				
5.6	It should have casters to ensure good mobility in the test facility.				
5.7	Technical Data / Design Data				
	Op temp	-5 to 50 deg C			
	Capacitance	100 pf \pm 1 % at 30 KV Max.			
	Temp co eff at constant gas volume	3×10^{-5} per deg			
	Pressure coefficient at constant temp	2.5×10^{-3} /100 kPa			
	Voltage drift (10- 100 Hz)	$< 3 \times 10^5$			
	Frequency drift (10- 100Hz)	$< 1 \times 10^5$			

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	Stability over 1 year	< 0.01				
	Calibration accuracy	0.05% + 0.01pF				
	Tan delta	< 1 x 10 ⁻⁵				
	Normal pressure of SF6	450+/- - 50kPa				
	Test pressure	1000 kPa				
	Gas loss per year	< 1 %				
	Insulation resistance	> 500 M Ohms				
	HV connection	Lemo RA3 Ht 415 / Suitable				
	Low voltage connection	Lomo 1 P RA 3S 140				
	Top electrode	Aluminum				
	ELECTRICAL SYSTEM :					
6.00						
6.1	BHEL input supply for HV source (230 VAC ± 10% , 50 ± 1.5 Hz AC)					
6.2	It should be suitable for working under normal distortion in voltage at shop standards.					
6.3	All the electrical and electronic components should be suitably tropicalized to work at an ambient temperature of 50°C maximum and relative up to 95 % maximum for three shift working.					
6.4	Vendor should ensure the proper earthing for the machine and its peripherals.					
6.5	The equipment shall be provided with (a) remote fuses / MCB/ Contactor for control panel, (b)Voltage control automatic / manual.(c) Oil if required (d)Electrical interlocking (e) Zero / maximum limit switch indication,(f) protection for over load and short circuit.					

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7.0	SAFETY ARRANGEMENTS :				
	Following safety feature in addition to other standard safety features should be provided on the machine / equipment :				
7.1	Equipment should have adequate and reliable safety interlocks / devices to avoid damage to the equipment , workpiece and the operator due to the malfunctioning or mistakes.Equipment function should be continuously monitored and alarm / warning indication through light / alarm number with messages should be available.				
7.2	A detailed list of all alarms / indications provided on equipment should be submitted by the supplier.				
7.3	All the cables etc. on the equipment should be well supported and protected.				
8.0	ENVIRONMENTAL PERFORMANCE OF THE EQUIPMENT :				
	The equipment shall conform to following factors related to environment :				
	(a) Safety / environmental protection enclosure should be provided by the Vendor.				
	(b) Paint of the equipment should be oil resistant and should not peel off.				
9.0	TOOLS FOR ERECTION, OPERATION & MAINTANANCE.				
9.1	Special tools and equipment required for erection of the equipment shall be brought by the vendor. Necessary tools like, spanners, keys, etc. for operation and maintenance of the equipment should be supplied. List of such tools should be submitted with offer.				

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10.0	SPARES : Item wise breakup of mechanical, electrical and electronic spares used on the equipment in sufficient quantity as per recommendation of Vendor for 2 years of trouble free operation on three shifts continuous running basis should offered by vendor. The list to include following in addition to other recommended spares: (Unit Price of each item of spare should be offered)				
11.0	DOCUMENTATION :- Five sets of following documents(Hard Copies) in English language should be Supplied along with the machine /equipment.				
11.1	Operating manuals of equipment with general arrangements drawings.				
11.2	Detailed Maintenance manual of equipment with all drawings of equipment assemblies / Sub - assemblies / parts including Electrical / Electronic circuit diagrams / PCB details/ schematic and wiring diagrams. All Assembly / Sub Assembly Drawing Shall be supplied with the part list				
11.3	Catalogues, Operation & Maintenance Manuals of all bought out items including drawings, wherever applicable.				
11.4	Complete Master list of parts used in the equipment shall be submitted by the vendor.				
12.0	ERECTION & COMMISSIONING				
12.1	Supplier to take full responsibility for carrying out the erection, start up, testing of equipment, it's control system & all type of other supplied equipment.				
12.2	Successful testing of components by the supplier shall be considered as part of commissioning. All tests, as mentioned at clause 19 (Equipment Acceptance) shall form part of the commissioning activity.				
12.3	Commissioning spares , required for commissioning of the equipment within stipulated time, shall be brought by the supplier on returnable basis.				

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12.4	Schedule of Erection and Commissioning shall be submitted with the offer.				
13.0	ACCURACY TESTS :				
13.1	Accuracy test required for the parameters mentioned in the specification shall be done and the machine /equipment supplied should be proved for the required parameters.				
14.0	AMBIENT CONDITIONS & THERMAL STABILITY :				
14.1	Total equipment and all supplied items should work trouble free and efficiently under following operating conditions and should give specified accuracies. Power Supply : - Voltage : 230 \pm 10 % VAC Frequency : 50 Hz \pm 5 % No. of phases = 1 Ambient Conditions : Temperature = 50° Celsius Relative Humidity = 95 % max.				
14.2	Weather conditions are tropical. Atmosphere may be dust laden during some part of the year. Equipment shall be kept in the normal shop floor condition. Max. temperature variation is up to 25 deg Celsius in 24 hours.				
14.3	Thermal stability of the complete equipment keeping in view specified Ambient Conditions and accuracy requirements of BHEL components and trouble free operation of the machine /equipment should be ensured by vendor.				
14.4	The equipment, including attachments and accessories, should be suitable for 24 hrs. Continuous operation to its full capacity for 24 hour a day and 7 days a week throughout.				

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15.0	EQUIPMENT ACCEPTANCE : (Test / Activities to be Performed by Vendor)				
15.1	The equipment should be tested and inspected completely before dispatch by BHEL Engineers at supplier's works and 5 copies of test and inspection certificates are to be furnished.				
15.2	Demonstration by actual use of all supplied attachments and accessories to their full capacity.				
15.3	Training of BHEL machine operators in operation of complete equipment & accessories etc. by the supplier.				
16.0	PACKING :				
16.1	Rigid packing for all items of complete equipment, all accessories and other supplied items to avoid any damage / loss in transit.				
17.0	GUARANTEE :				
17.1	The equipment should be guaranteed in respect of design. Material construction operation and against any manufacturing defects for a period of 24 months. from the date of supply or 18 months from the date of commissioning, whichever is later and 4 copies of guarantee certificates are to be furnished Free after sales service is to be provided during the guarantee period.				
17.2	GENERAL : The vendor should submit the following information				
17.3	Equipment Model				
17.4	Total Connected Load (KVA)				
17.5	Painting of Equipment / Electrical Panels : Ivory (Polyurethane Paint)				
17.6	Overall size and weight of the equipment				
17.7	List of standard accessories.				

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17.8	Vendor to submit, along with offer, the reference list of customers where similar equipment has been supplied mentioning the customer, equipment model, major specifications of the supplied equipment control system detail, year of supply etc.				
17.9	Detailed catalogues, sketches/ photographs of the equipment and accessories should be submitted with the offer.				
18.0	QUALIFYING CONDITIONS :				
18.1	Only those vendors, who have supplied and commissioned atleast three Tan Delta Bridge with source of 15 KV, 1A, 45-65 Hz for similar applications in the past Ten years and such is presently working satisfactorily for more than one year (more than six months if supplied to BHEL) after commissioning should quote.				
18.2	Hippotronics, Tettex hafely, Phonix Technology and equivelent make will be acceptable.				
18.3	The following information is to be submitted by the vendor about the companies where similar equipment has been supplied. This is required from all the vendors for qualification of their offer.				
18.4	The offered model should have proven performance record .				
	1. Name of the customer/company where similar equipment is installed (Copy of Purches Order should be furnished).				
	2. Complete postal address of the customer .				
	3. Year of commissioning. (Copy of Commissioning report should be furnished)				
	4. Application for which the equipment is supplied .				
	5. Name and designation of the contact person of the customer.				
	6. Phone, FAX no. and email address of the contact person of the Customer.				

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	7. Performance certificate from the customers, regarding satisfactory performane of the equipment supplied to them.				