



Dr. Binay Kumar
DEPARTMENT OF PHYSICS & ASTROPHYSICS
UNIVERSITY OF DELHI
DELHI – 1100 07

Phones: 27662289 (O)
27667793 (HOD)
27662026 (R)
Mobile: 9818168001
Fax : 27667061 (Deptt)
E-mail : bkumar@physics.du.ac.in
b3kumar69@yahoo.co.in

Ref No. BK/DRDO-ARMREB /Purchase/T2 (R)

Dated: 10-09-2015

TENDER NOTICE

Tenders in separate envelopes of technical and commercial bids kept in a one sealed outer envelope are invited for '**Piezoelectric, Ferroelectric and Pyroelectric characterization system**' (as per specifications in Appendix 'A'). It should reach to Dr. Binay Kumar, Principal Investigator, DRDO-ARMREB Project, Department of Physics and Astrophysics, University of Delhi, Delhi - 110 007, latest by 4.00 P.M. on 9th October 2015. The tender outer envelope should be super-scribed as "**Quote for Piezoelectric, Ferroelectric and Pyroelectric characterization system - due on 9th October 2015**".

(Dr. Binay Kumar)
Principal Investigator,
DRDO-ARMREB Project

Terms and Conditions

1. Vendors quoting complete system as described in “Appendix A” will be considered since the full systems installation and commissioning has to be done together and different components should be compatible to each other.
2. Quotation should be valid for a period of at least 180 days from the date of opening of the technical bids.
3. Vendor should have executed at least 3 projects in the last five years for the equipment quoted to the Universities or Research Institutes of repute in the Country. Documentary evidence is to be submitted for these 3 projects with complete contact details (Name, address, Tel, Email, etc). A detailed user list in India may also be provided.
4. Suppliers should have trained personnel in India who have experience of supporting similar systems. Details of after sales support directly from manufacturer are needed.
5. Spares (if any) needed for 5 year operation of the system must be quoted as optional.
6. Items of foreign origin should have insurance up to installation on site.
7. Vendors may be invited for presentation and clarification to the technical evaluation committee on short notice.
8. Vendor shall assure to maintain the inventory of spare parts after warranty is over for the maintenance of equipment supplied for a period of 10 years.
9. Clarifications may be sought on Technical/Commercial aspects, if felt necessary, before deciding to place the offer.
10. Price negotiations will be done only with the lowest bidder.

Two Bid System Tender: Separate *Technical* and *Commercial* Bids duly sealed and super-scribed as (i) “Technical Bids for Piezoelectric, Ferroelectric and Pyroelectric characterization system” (ii) “Commercial Bids for Piezoelectric, Ferroelectric and Pyroelectric characterization system” should be put in one envelope and super-scribed as **“Quote for Piezoelectric, Ferroelectric and Pyroelectric characterization system - due on 9th September 2015”** shall be submitted.

Technical quotation must contain the following:

- (a) Quotation should be directly from Original equipment manufacturer (OEM) or authorized sales agent.
- (b) Sole agency certificate (if applicable) and its validity from Foreign Principals (in case of foreign manufacturer).
- (c) Pre-installation requirements such as electrical load requirement, space etc. must be specified.
- (d) Any optional equipment/accessory advised for better functioning of equipment must be specified and quoted separately.
- (e) Details on installation, commissioning and training of the equipment must be specified.

- (f) Installation of equipments together with the demonstration and training for all the measurements mentioned in Appendix “A” at user site should be free of cost and must be included in the quotation.
- (g) State service-support for the equipment in India, specifically in Delhi/NCR, give details of service-centres with address, telephone numbers and name of service engineers available,
- (h) Vendor should quote the equipments strictly as per tender specifications including complete technical details along with make, model, and complete specifications. Detailed compliance sheets along with supporting documents to be attached with Technical Bid for evaluation. Certificate of compliance with any deviation from specification must be attached.
- (i) Original brochures and original specification sheets (from equipment manuals) directly obtained from the principal manufacturer of the quoted model must be enclosed along with supporting data.
- (j) Technical bid should include drawing of the system with internal arrangements of sub-assemblies, and system dimensional details/footprint along with peripherals and utilities.
- (k) Vendor must have supplied at least three similar equipments in India. User list with address, e-mail & Phone No. must be enclosed.
- (l) Any third party or customized item/accessory in the equipment is to be clearly mentioned with make and model.
- (m) An undertaking from OEM is required to facilitate the user on regular basis with technology/software updates.
- (n) **Non refundable Tender Fee of Rs. 1000/-** should be enclosed in with covering letter in the form of Demand draft in favor of “The Registrar, University of Delhi, Delhi”. Tender fee should be enclosed along with the Technical bid. The non-submission of Tender fee will lead to the rejection of the bid.
- (o) Vendor must submit **Earnest Money Deposit (EMD) for an amount of Rs. 1,00,000/-** (Rs. One lakhs only) in the form of Bank Guarantee in favor of “The Registrar, University of Delhi, Delhi” for the quoted item separately. EMD should be enclosed along with the Technical bid.
- (p) The non-submission of EMD will lead to the rejection of the bid. The irrevocable Bank Guarantee drawn on a Scheduled bank, shall be in the form acceptable to the University of Delhi as per **Appendix “B”**. The EMD shall remain valid for a period of 60 days beyond the final bid validity period. The EMD of unsuccessful bidders will be returned to them within 30 days after the award of the contract. The successful bid, if withdrawn, is liable for forfeiture of the EMD.
- (q) **Performance Bank Guarantee:** 10% of total purchase order value with validity up to one year after completion of warranty period must be submitted within 30 days from the date of purchase order.
- (r) Institute reserves the right to order equipment with better quality over

lower price and to accept or reject any or all the quotations without assigning reasons thereof.

- (s) Institute reserves the right not to purchase some part of the complete system as given in appendix A.

Commercial bid must contain the following:

- (a) Prices must be quoted on both FOB and FOR (Delhi) basis. All charges including all taxes (airport duty, custom clearance, if any) should be clearly indicated.
- (b) Guarantee or warranty conditions must be clearly specified.
- (c) Service charges per visit and AMC after warranty period must be specified.
- (d) Validity of quotation must be at least 6 months from the date of quotation.
- (e) Mode of payment is (Wire transfer/LC) for foreign purchases should be mentioned in the bid.
- (f) Name and address of the company on whose name the LC is to be opened should be clearly mentioned.
- (g) Supplier must submit TIN number / PAN number and bank details as applicable.

GENERAL

1. System Upgradeability Features

The offered system must be capable of being upgraded in future for the measurement of piezoelectric d_{31} coefficient with appropriate hardware and software required for performing the particular analysis.

2. Pre-installation requirements & Commissioning

Pre-installation requirements of electrical power, etc should be mentioned in the quotation. Installation and commissioning should be done by the supplier's trained engineer(s) of all the items at the work place at our site at Crystal Lab, Department of Physics & Astrophysics, University of Delhi, Delhi, India. Two research students should be trained.

3. Standard samples for the calibration and demonstration should be provided.

4. Performance Guarantee:

Accuracy & reproducibility of Polarization and Piezoelectric standard sample, minimum temperature attainable from RT to 650°C be demonstrated, without which installation will not be considered complete in working site at Department of Physics and Astrophysics, University of Delhi. Manufacturer must attach document along with their offer in support of fulfilling this clause of the technical specification.

Standard sample required for fulfilling the requested performance guarantee criteria must be included in the offer.

Factory Test Certificates with respect to various parameters mentioned in the specification etc should be enclosed along with the Piezoelectric/ Ferroelectric / Pyroelectric system shipment from factory.

One Hard copy of the complete sets of manuals (in English) along with a soft copy should be provided.

5. User Training

On-site user training at Physics Department, University of Delhi for minimum 3 working days after installation and commissioning of the system to be provided by the supplier.

6. Warranty and spare parts

The offered system must be warranted for a period of 12 months from the date of installation against manufacturing defects. Free replacement/service onsite.

The original equipment manufacturer (OEM) should confirm in writing that the spares for the quoted model will be available for a period of minimum ten years after installation of the instrument.

In case the OEM is bidding through an Indian agent, the OEM should give a written undertaking that they will be responsible for providing the warranty and annual maintenance as per the clauses above, even if there is a change in the Indian agency of the manufacturer. The undertaking from OEM should also include that if in future, OEM does not have any Indian agency, the service will be provided directly by the service engineer of the OEM without any extra charge.

7. Printed documents in support of claimed specification should be provided.

8. List of users for the offered model in India should be included.

9. Discounts/Rebates:The equipment will be used for basic research in the University of Delhi. Maximum special discounts/rebates should be indicated in the offer.

10. Resolution of Disputes and Jurisdiction: University of Delhi and the vendor shall make every effort to resolve amicably, by direct informal negotiation, any disagreement or dispute arising between them under or in connection with the contract. Otherwise, the **Vice Chancellor of Delhi University** shall appoint a **Sole Arbitrator** of the dispute who will not be related to the contract and whose decision shall be final and binding. Any dispute arising out of this purchase shall be under the jurisdiction of the courts of Delhi.

Appendix “A”

Genetic name of the system: Piezoelectric, Ferroelectric and Pyroelectric characterization system suitable for following characterizations:

This system will be used to draw **Polarization vs –Electric field (P-E) loop** of ferroelectric ceramic and single crystals. It will be used to evaluate the values of Saturation and Remnant polarization and Coercive Field at different temperatures. Various other related parameters like linear & non linear capacitance, remnant & non-remnant leakage, ‘left out’ etc. in the hysteresis loop and electrode diode reverse-bias leakage and partial switching will also be studied. Fatigue (retaining power as repeated cycles) and Imprint (retaining power in time) of various parameters can also be studied.

Variation of P-E loop with temperature will be used to determine **Pyroelectric coefficient** of the ferroelectric sample.

The set up will be used to study **Strain vs Electric field loop (butterfly loops)** for the determination of Piezoelectric constant d_{33} (and possibility of d_{31}) based on reverse piezoelectric effect. The test system should be capable of accurately measuring extremely small displacement resulting from application of external field after nullifying the ambient environmental effects.

Required software should be supplied. The whole system should be attached to the standard PC of latest configuration with networking features to share data with other researchers.

Some important additional tasks to be performed with the help of the set up are:

(a) Fatigue and Imprint of Hysteresis, Leakage, Pulse response, Displacement, Small Signal Capacitance. (b) Small signal capacitance (c) Leakage current (d) Pulse measurements including custom defined pulses (e) Simultaneous large & signal electric polarization and displacement (f) Resistance changes vs DC Bias (g) Hysteresis vs Voltage and period (h) PUND vs voltage & Pulse Width (i) Nonremanent & Remanent capacitance, etc.

Important Specifications for major components of the system:

1. Basic Ferroelectric Test Setup for drawing P-E loop

Voltage Range: ± 10 V (no external amp built in amplifier), 10KV (with external amp)

The High Voltage Interface up to ± 10 KV should have protection circuit with respect to voltage, and should fulfill internationally highest safety requirements including Over temperature shut down circuit, High temperature warning level, etc. All items should be CE and FCC certified.

Hysteresis Frequency range from 50 mHz to 5 kHz

Pulse width range: 1 μ s to 1 s

Minimum Charge resolution less than or equal to 1.0 pC

Maximum charge resolution ≥ 250 μ C (w/HVI: ≥ 25 μ C)

Maximum Area Resolution ≥ 100 cm²

Range of delay between pulses ≥ 25 ks;

Internal clock: 25ns

Minimum leakage current < 2pA

All the required connecting cables and software should be provided

2. High Voltage interface

Maximum Voltage rating: 10KV ; Input Power: 220V AC, 50Hz

High Speed protection Current Rating: 10 Amps

High Voltage Protection Trigger voltage: 2.1V

Low speed Protection Delay Time: 15ms

Insulation rating: >40KV DC (with HV cable & accessories)

With required connecting cables

3. High Voltage Power Amplifier

Input Voltage Range: 0 to ± 10 V DC

Output Voltage Range: 0 to ± 10 KV DC

Output Current Range: 0 to ± 2 mA DC

DC Voltage Gain: 1000V/V (Topology should be specified)

DC Voltage gain accuracy: Better than 0.1%

Offset Voltage : < ± 1 V

Output Noise: <50mV rms
Slew Rate: >30V/ μ s
Settling time to 1%: Less than 700 μ s
Temperature Drift: <180 ppm/ $^{\circ}$ C
Time Drift: < 50 ppm/hr

With Voltage Monitor of DC accuracy better than 0.1% and output noise less than 5mV rms.

Required connecting cables should be supplied.

4. Test Fixture for High Voltage and High Temperature: Test Fixture suitable for ceramic and crystals and should be compatible with the Ferroelectric measurement system (items 1-3)

Maximum Voltage: 10KV
Maximum tolerance temperature: 650 $^{\circ}$ C
High Temperature and high Voltage cables compatible with main system

5. Piezoelectric constant (d_{33}) measurement system: It should be based on the reverse piezoelectric effect giving 'butterfly loop (position vs electric field). It should be capable of measuring very small change in dimensions of piezoelectric samples on the application of external field using non contact Fibre Optic principles.

Output Signal: 0-10 Vdc
Drift: < 1% of full scale
Resolution $\leq 2.5 \text{ \AA}$
Accuracy: within 1 % for peak to peak reading of full scale
Output Signal: 0-10Vdc
Frequency response: 0-500 kHz
Interface: RS 232
Displacement data accuracy: < 1% for signals from dc to 100 Hz
Vibration data accuracy: $\leq 1\%$ for peak-to-peak of full scale
Display meter: Graphic LCD with 100 Hz response.
Measurement range of Fotonic probe: maximum of 4×10^{-4} Inch,
Sensing Frequency: 100 kHz
Accuracy of $\pm 1\%$ of full scale or equivalent.

Compatible software for displacement and strain measurements should be supplied. It should also include the Probe Positioning Fixture Capable of positioning the Fotonic probe over the sample to be measured and consisting of magnetic base, mounting clamp and micrometer or equivalent.

Required high Temperature and high Voltage cables should be supplied.

- 6. High Voltage Displacement Text Fixture:** Suitable for ceramic and crystals and should be compatible with the Piezoelectric measurement system (item 5). It should have stable platform of high quality insulating Teflon for displacement measurements with micropositioning chuck system and copper electrodes.

Maximum Temperature: 200 °C

25 KV cable connector

High temperature, high density insulating oil to prevent 'arcing'

Sample size: 1 cm across

2032R sensor

- 7. PC for data acquisition with necessary Software:**

Windows based with necessary standard software for the operation, data acquisition and analysis in respect of various Ferroelectric/Piezoelectric characterizations should be provided along with the latest configured PC (e.g. Intel i5/Core 2-duo etc processor, 4GB RAM, 500 GB HDD, Graphics adaptor card etc.) supporting the operational software.

8. All the above electrical components should be compatible with electrical parameters in India like 220 V, 50 Hz single phase ac supply, 3 pin plug system, etc. Any specific requirements like 3-phase power requirement, etc should be mentioned.

Appendix ‘B’

Format for submitting the EMD

(Note: This EMD bank guarantee certificate should be prepared by the vendor on a non judicial stamp paper of Rs.100/-)

Earnest Money Deposit Bank Guarantee

To
The Registrar
University of Delhi
Delhi-110007
Dear Sir,

Supply & Installation of “*Quotations for Item: -----(give Tender Reference No.)*”

WHEREAS

The University of Delhi located at Delhi (hereinafter called the University) has invited tenders for the Supply & Installation of “.....” on the terms and conditions mentioned in the tender document.

1. It is one of the terms of invitation of tenders that the tenderer shall furnish a Bank Guarantee as detailed in the tender document Clause 6 as Earnest Money Deposit.
2. M/s _____, (hereinafter called as Tenderer), who are our constituents intend to submit their tender for the said equipments and have requested us to furnish guarantee to the “University” in respect of the said sum of Rs. -----/ (Rupees----- only)

NOW THIS GUARANTEE WITNESSETH

1. We _____ (NAME OF THE BANK) do hereby agree with and undertake to the University of Delhi, their Successors, Assigns that in the event of the University of Delhi coming to the conclusion that the Tenderer have not performed their obligations under the said conditions of the tender or have committed a breach thereof, which conclusion shall be binding on us as well as the said Tenderer, we shall on demand by the University of Delhi, pay without demur to the University of Delhi, a sum of Rs. -----/(Rupees-----only) or any lower amount that may be demanded by the University of Delhi. Our guarantee shall be treated as equivalent to the Earnest Money Deposit for the due performance of the obligations of the Tenderer under the said Conditions, provided, however, that our liability against such sum shall not exceed the sum of Rs. -----/(Rupees ----- only).
2. We also agree to undertake to and confirm that the sum not exceeding Rs. ----- ---/(Rupees -----only) as aforesaid shall be paid by us without any demur or protest, merely on demand from the University of Delhi on receipt of a notice in writing stating the amount is due to them and we shall not ask for any further proof or evidence and the notice from the University of Delhi shall be conclusive and binding on us and shall not be questioned by us in any respect or manner whatsoever.

We undertake to pay the amount claimed by the University of Delhi within a period of one week from the date of receipt of the notice as aforesaid.

3. We confirm that our obligation to the University of Delhi under this guarantee shall be independent of the agreement or agreements or other understandings between the University of Delhi and the Tenderer.

This guarantee shall not be revoked by us without prior consent in writing of the University of Delhi. We hereby further agree that

Any forbearance or commission on the part of the University of Delhi in enforcing the conditions of the said agreement or in compliance with any of the terms and conditions stipulated in the said tender and/or hereunder or granting of any time or showing of any indulgence by the University of Delhi to the Tenderer or any other matters in connection therewith shall not discharge us in any way our obligation under this guarantee. This guarantee shall be discharged only by the performance by the Tenderers of their obligations and in the event of their failure to do so, by payment by us of the sum not exceeding Rs. ----- (Rupees -----only).

- Our liability under these presents shall not exceed the sum of Rs. ----- (Rupees -----only).
- Our liability under this agreement shall not be affected by any infirmity or irregularity on the part of our said constituents in tendering for the said work or their obligations there under or by dissolution or change in the constitution of our said constituents.
- This guarantee shall remain in force up toprovided that if so desired by the University of Delhi, this guarantee shall be renewed for a further period as may be indicated by them on the same terms and conditions as contained herein.
- Our liability under this presents will terminate unless these presents are renewed as provided hereinabove on the.....or on the day when our said constituents comply with their obligations, as to which a certificate in writing by the University of Delhi alone is the conclusive proof whichever date is later. Unless a claim or suit or action is filed against us within six months from that date or any extended period, all the rights of the University of Delhi against us under this guarantee shall be forfeited and we shall be released and discharged from all our obligations and liabilities hereunder.

Your's faithfully,

For and on behalf of _____ Bank

Authorized official

(Note: This guarantee will require stamp duty as applicable and shall be signed by the official whose signature and authority shall be verified).