Request for Quote and Specifications of <u>Parametric Curve Tracers & High Voltage-High Current Measurement Tools for Semiconductor Wafer Characterization</u>

- The GEECI (Gallium Nitride Ecosystem Enabling Centre and Incubator) at SID-Indian Institute of Science is seeking bids from qualified industries for this tool as per the specifications below.
- Companies need to submit two bids, a technical bid and a commercial bid, in **<u>two separate</u>** sealed envelopes. The bids should be submitted no later than 30 days from the date of posting of this tender, as listed on the website date/time stamp, and by 5 pm on the 30th day or next weekday in case the 30th day falls on a weekend or a national holiday.
- Both technical and commercial bids should be addressed to "The Chief Executive, SID, IISc, Bangalore 560012, GST # 29AAATS5333E1ZJ."
- All quotations should be CIF Bangalore.
- Cost of last mile transportation, including any insurance, from port of shipment to IISc has to be quoted as an option.
- In case of courier shipments maximum permissible weight would be 70kgs.
- The envelopes should be addressed to "Prof. Srinivasan Raghavan, CeNSE, IISc, Bangalore, 560012" and submitted to the office at CeNSE, IISc in Room No. GF 15 between 9 am and 5 pm.
- All questions regarding this tender should be addressed to Prof. Srinivasan Raghavan at the email address sraghavan@iisc.ac.in
- Post such submission all vendors should send an email to sraghavan@iisc.ac.in with the subject line: "GEECI_Bidder's name_Tool Name" to intimate him of the submission within one day.
- Deviations from the technical specifications requested are allowed. Such deviations must be highlighted and justified. Their acceptance or rejection will be left to the discretion of the technical committee.
- The equipment sought will be placed at the Centre for Nano Science and Engineering (CeNSE), Indian Institute of Science (IISc). IISc is India's No. 1 institution on higher learning and the Center for Nano Science and Engineering is home to one of the best academic fabs in the world.
- The technical and commercial response, corresponding to the tool being offered, should be in the form of a compliance table with at least 5 columns. Serial number in column 1. Each of the items below, **<u>technical and non-technical</u>**, should be addressed in a separate row of the table in column 2. Compliance to this requirement, in Yes/No, deviation from it and justification should be provided in the neighbouring columns 3-5. Post the opening of a hard copy of the technical bid the committee will request for a soft copy of the files for further processing. Companies should **<u>NOT</u>** mail soft copies of the files unless specifically requested for.
- A compliance table for the terms and conditions mentioned at the end of the RFQ should also be included in all bids.
- Detailed technical specifications of the tool being offered should be included.
- Any additional capabilities or technical details, that you would like to bring to the attention of the purchase committee, can be listed at the end of the technical table.
- If multiple systems can fulfill the requirements, vendors can submit multiple bids.
- Vendors are encouraged to highlight the advantages of their tools over comparable tools from the competitors.
- The commercial bid should be broken up to the maximum extent possible into separate items with a cost against each to enable better comparison of price for various configurations across the bidders. As an option, please provide itemized cost for any *suggested* accessories/add-ons that may

enhance the usability, capability, accuracy or reliability of the tool. Vendors are encouraged to quote for as many add-ons as their tool portfolio permits.

Setup I. Parametric analyzer with IV, CV and Pulse IV capability for "semiconductor wafer testing"

System with High power SMU, CVU unit and two Pulse Measure unit with required accessories having following modules

Technical Specifications

I. General features required:

1. PC based instrument with Microsoft Windows operating system and I-V, C-V, sub-100 nano-second (pulse width < 100ns) pulse I-V and analyzer software.
2. Single box solution for current-voltage (I-V), capacitance-voltage (C-V), nano-second pulse generation (Fast I-V) capability.
3. Minimum Nine slot system for Source measure unit (SMU), Capacitance-voltage unit (CVU) and pulse I-V modules.
4. GPIB, LAN port for instrument control.
5. System should have Kelvin connection at GND unit.
6. System should have built in Capability to switch the measurements from I-V to C-V to Pulsed I-V from select menu without changing the connections on the DUT.
7. Pulse I-V should have auto-range measurement and sourcing feature.
8. System should have facility to control external switching system.
9. All cable, connector and appropriate accessories required for this system.
10. Provided software should have feature to control all hardware

II. Detailed features required:

1. System should have at least **six source measure units** with following capabilities
   a) Voltage Source and measure capability: ± 200 V.
   b) Voltage Source and measure range: **200 mV** – 200 V.
   c) Voltage measure resolution: ± 1µV.
   d) Voltage source resolution: ± 5µV.
   e) Current Source and measure capability: ± 1 A.
   f) Current sourcing and measurement Ranges : 1 pA to 1 A.
   g) Current Source resolution: 1.5fA .
   h) Current Measure resolution: ± 100 aA.
   i) All SMU should have separate A/D converter for accurate and high-resolution measurement.

2. System should be able to provide voltage and current in Bias; Common; Sweep; List sweep (custom point-by-point user-defined sweep); Step mode with above current and voltage capability)

3. System should have CV measurement capability with following feature
   a) Frequency Range : 1 KHz to 10 MHz .
   b) DC drive level: -30 V to +30 V.

c) AC drive voltage : 10 mV to 1 Vrms.

4. System Should have **four channels for** sub-100ns (pulse width < 100ns) pulse I-V capability
   i. Integrated (and Simultaneous) Pulse Generation & Measurement capability with auto-scale option
   ii. High Speed Voltage Outputs with Pulse widths ranging from sub-100ns (pulse width < 100ns) to DC
   iii. System should be able to generate +/- 40V amplitude pulses.
   iv. System should have pulse current measurement facility with auto-scale option
   v. Current measure ranges: 100 nA to 800 mA

5. System should have Kelvin connection at GND unit.

6. System should have built in capability to switch the measurements from I-V to C-V to Pulsed I-V from select menu without changing the connections on the DUT. **Four channels switching for IV, CV and Pulse IV should be provided.**

7. System should have facility to control external switching system.

8. System should come with a software (1-2 Nos.) with permanent license to configure hardware, perform wafer level tests and control wide range of fully automated and semi-automated probe stations for automated wafer testing as well as wafer level automated reliability testing for (like TDDB, HCI, NBTI, etc). In particular the software should be able to control (should have built-in drivers for) Cascade Software should be able to generate wafer map, wafer probing pattern and wafer description. User should be able to program measurements and test plan for the whole wafer. The software should allow test data management, test plan generation, auto saving data and extract parameters generated from every test. Test data should be in ASCII format. As well as the software should automatically generate wafer level report with various device parameters extracted as a function of wafer map, % yield and histograms / statistics across the wafer and generate related x-y graphs. (If there is a free/default characterization software, which comes by default with the integrated setup, the free software should be provided as well.)

<u>Setup II. Parametric analyzer with IV CV capability for "semiconductor wafer testing"</u>

System with High power SMU, one CVU unit and required accessories having following modules

Technical Specifications

I. General features required:

1. PC based instrument with Microsoft Windows operating system and I-V, C-V, sub-100 nano-second (pulse width < 100ns) pulse I-V and analyzer software.
2. Single box solution for current-voltage (I-V), capacitance-voltage (C-V), nano-second pulse generation (Fast I-V) capability.
3. Minimum Nine slot system for Source measure unit (SMU), Capacitance-voltage unit (CVU) and pulse I-V modules.
4. GPIB, LAN port for instrument control.
5. System should have Kelvin connection at GND unit.
6. Pulse I-V should have auto-range measurement and sourcing feature.
7. System should have facility to control external switching system.
8. All cable, connector and appropriate accessories required for this system.
9. Provided software should have feature to control all hardware

II. Detailed features required:

1. System should have at least **Four source measure units** with following capabilities
   a) Voltage Source and measure capability: ± 200 V
   b) Voltage Source and measure range: **200 mV** – 200 V
   c) Voltage measure resolution: ± 1µV
   d) Voltage source resolution: ± 5µV
   e) Current Source and measure capability: ± 1 A
   f) Current sourcing and measurement Ranges : 1 pA to 1 A
   g) Current Source resolution: 1.5fA
   h) Current Measure resolution: ± 100 aA
   i) All SMU should have separate A/D converter for accurate and high-resolution measurement.

2. System should be able to provide voltage and current in Bias; Common; Sweep; List sweep (custom point-by-point user-defined sweep); Step mode with above current and voltage capability)

3. System should have CV measurement capability with following feature
   a) Frequency Range : 1 KHz to 10 MHz
   b) DC drive level: - 30 V to +30 V
   c) AC drive voltage : 10 mV to 1 Vrms.

4. System should have Kelvin connection at GND unit.

Setup III: High Voltage integrated test setup with switching matrix (S500)

System with High Voltage SMU, High Current SMU, Low voltage SMU and required accessories having followed modules.

1. High voltage channel/SMU: **#12 Nos.**
    a. Voltage source and measure ranges: ± 3000 V or better.
    b. Current source and measure range: 1 nA to 120 mA or better.
    c. Required voltage source resolution: 5 mV @ 200V or better
    d. Required voltage measure resolution : 100 μV @ 200V or better
    e. Required current measurement resolution: 1fA at 1 nA range.
    f. System should have 120 mA of source and measure capabilities at 1500V and at least 20 mA or higher source and measure current capability at 3000V.
    g. It should be four quadrants SMU i.e. should have capabilities of apply voltage with dual polarity along with current sinking capabilities.
    h. It should be able to source and measure pulse current/voltage with min pulse width of 100μs, min. rise/falls times should be 30μs and resolution of 1μs.
    i. It should be fully GPIB controlled and automatically controlled by the characterization software from the same manufacturer (details below)
    j. System should be provided with four High voltage Triaxial cable per channel.

2. High current channel/SMU: **#2 Nos.**
    a. Source and measure voltage ranges: ± 40 V or better.
    b. Source and measure current range: 100 nA to 20ADC, 50A pulse or better
    c. Required voltage source resolution: 5 mV @100mV or better
    d. Required voltage measure resolution: 1V @100 mV or better
    e. Required current measurement resolution: 1 pA at 100 nA range.
    f. It should be four quadrants SMU i.e should have capabilities of apply voltage with dual polarity along with current sinking capabilities.
    g. It should be able to source and measure pulse current/voltage with min pulse width of 100μs, min. rise/falls times should be 30μs and resolution of 1μs.
    h. It should be fully GPIB controlled and automatically controlled by the characterization software from the same manufacturer (details below).

3. Medium power channels/SMUs should have capabilities of applying voltage up to 200V and current 1.5A or better: **#12 Nos.**
    a. Source and measure voltage ranges: 200 mV to ±200V or better.
    b. Source and measure current range: 100 pA to 1.5 A or better.
    c. Required voltage measurement resolution: 200 nV @200 mV range or better
    d. Required voltage source resolution: 5 μV @200 mV range or better
    e. Required current measurement resolution: 1 fA @1 nA current measurement range.
    f. It should be four quadrants SMU i.e should have capabilities of apply voltage with dual polarity along with current sinking capabilities.
    g. It should be able to source and measure pulse current/voltage with min pulse width of 200ns, min. rise/falls times should be 50μs and resolution of 1μs.
    h. It should be fully GPIB controlled and automatically controlled by the characterization software from the same manufacturer (details below).
    i. System should be provided with four low voltage Triaxial cable per channel.

4. System should have at least one six slots switch system for accommodating cards of 8 X 12 configuration with below specifications.
    a. Switch system should have support to GPIB, LAN communicate port.
    b. Single card should have 8 inputs ports and 12 output ports.
    c. Card switches should be bidirectional.
    d. No of cards required: 2no
    e. Card Max Voltage handling capability: 1300V.
    f. The offset current for switches should be < 1 pA.

5. System should come with a software (#1 Nos.) with permanent license to configure hardware, perform wafer level tests and control wide range of fully automated and semi-automated probe stations for automated wafer testing as well as wafer level automated reliability testing (like TDDB, HCI, NBTI, etc). In particular the software should be able to control (should have built-in drivers for) Cascade Software should be able to generate wafer map, wafer probing pattern and wafer description. User should be able to program measurements and test plan for the whole wafer. The software should allow test data management, test plan generation, auto saving data and extract parameters from data generated from every test. Test data should be in ASCII format. As well as the software should automatically generate wafer level report with various device parameters extracted as a function of wafer map, % yield and histograms / statistics across the wafer and generate related x-y graphs. Software should also be able to control 24 SMUs (or more) in parallel. (If there is a free characterization software, which comes by default with the integrated setup, the free software should be provided as well.)

6. HV Triax Cables (10m): 12 Nos.

7. Extra Triax Cables (10m): 12 Nos.

All of the above-mentioned technical specifications are highly desired. However, lower technical specifications may be considered if the above-mentioned specifications are found to be unsuitable in financial terms. The Institute reserves the right to go for lower specifications taking into consideration its technical preferences and financial constraints. Vendors are encouraged to highlight the advantages of their tools over comparable tools from the competitors.

Terms and conditions:

1. SEMI Standards (if applicable): The technical bid should include details of the SEMI standards the tool confirms to.
2. Shipping: On all systems the cost of shipping up to IISc should be included. IISc will take care of the customs clearance at Bangalore Airport. Please include your payment option. IISc would prefer to retain at least 40% of payment till instruments have been commissioned and successfully demonstrated.
3. Tool Training: Necessary training to operate the procured setup and required literature support should be provided without additional cost. In principle onsite installation should be

free of cost. The amount of time / day committed by the engineer during installation must be clearly stated. The engineers must spent enough time at the installation site (at least 4 days to train all engineers/staff and students).

4. **Tool Qualification and Acceptance:** Commissioning shall involve demonstration of tool performance as per terms and conditions mutually agreed upon between the client and vendor and characterized by the client within time frames agreed upon. Given the requirements in the RFQ, details of the stage wise certification protocols to be pursued for tool acceptance should be included in the technical bid. The PO will include a mutually agreed upon set of tool qualification criteria. Please list a set of acceptance tests for on-site (vendor) inspection and after installation at IISc.
5. **Tool footprint and utilities:** A floor plan should be part of the technical bid. A list of utility requirements should be part of the technical bid. The system should be compatible with 240±10V, 50 Hz single phase or 415±20V, 50 Hz 3 phase supplies. The MINIMUM set of utility requirements needed are provided in Table 1. If there are additional utility requirements please include them in the technical bid. Please list connector types for all utilities.
6. Software upgrade, if any, must be free of cost for next 5 years.
7. The vendor must assure that there are no bugs and glitches with the integration. In case of glitches or bugs at the time of installation, vendor must fix the issues in less than three days from the start date.
8. Maintenance: The cost of an annual maintenance contract and cost of emergency technical support that may involve an engineer being on site should be quoted for in the commercial bid and addressed in the technical bid. The availability of trained engineers in India for servicing the system will be preferred and should be described in the technical bid.
9. Maintenance: On all systems a set of basic tools required (like non-standard screw or spanner head that is required for routine tool maintenance) should be provided for performing routine maintenance.
10. Maintenance: System operation, process and troubleshooting manuals and detailed drawings are a must. Their inclusion must be indicated in the technical bid.
11. **Cost of Ownership and supply of spares:** The quote should include a listing of spares that need to be replaced periodically to ensure that the system is in operation in a stable fashion – the stability parameters being defined by the vendor and agreed to by the client – the cost of such items, the ability to guarantee their availability at this cost for a period of 5 years from the time of procurement. The aim of this exercise is to compare cost of ownerships between reactors.
12. Online support: System should have the capability for online diagnostics from a remote location in case of tool problems.
13. Post sales service and Indian Presence: Bidders should provide details of after sales service and support and in particular that available in India. If not India, the nearest geographical location should be specified. Please provide details of the number of trained personnel in India who can service the machine, the number of tools sold in India and the corresponding number in the southern region or in Bangalore.
14. Payment Terms and Conditions: On all systems the payment terms should be specified in the technical and commercial proposal and is subject to negotiation. Please include your payment option. IISc would prefer to retain at least 40% of payment till instruments have been commissioned and successfully demonstrated.

15. References: Bidders should provide details of other locations in India with similar tool installations. Vendor should have installed the same or similar tool at minimum 3 other locations in India.
16. References: Bidders should provide details of at least 10 other locations globally where similar tool installations have been deployed.
17. Company financials: Bidder shall have to submit audited accounts of financial year 2017-18, 2018-19 and 2019-20. Audited statement must be signed and stamped by qualified chartered accounted. Income Tax return for assessment year – 2017-18, 2018-19 and 2019-20.
18. The following documentation should be provided. ISO9001 quality certification. CE marking confirmation.
19. Guarantee: As high as possible (at least 3 years)
20. In case of software issues, vendor should be able to provide required solution within five days.
21. The lead time for the delivery of the equipment should preferably be less than 6 weeks from the date of receipt of our purchase order. The smallest lead time will be appreciated.
22. The validity period of the quotation should be 90 days at least.
23. System/computer required to operate the tool must come with the system with all software pre-loaded.
24. Free copies of analysis software must be provided with the tool (list out numbers)

Details to be provided in addition to other utility requirements the tool may require. If not applicable mark as NA: Not applicable.

				Electric		**Chilled Water**		**Gases**															**Exhaust**	**Thermic load**
Tool Foot Print, (LXBXH)			Area	Power consumption average	Peak power	Cooling capacity	Cooling Water Process	UHP Nitrogen	UHP Hydrogen	Dopant Silane	Pure Silane	Ammonia	Chlorine	He	Oxygen	Regular Nitrogen	CF4	CHF3	SF6	NO2	BCl3	Argon	Forming Gas		Thermic load to clean room
L (mm)	B (mm)	H (mm)	Sq. Metre	kW	kVA	kW	l/h	slpm	slpm	slpm	slpm	slpm	slpm	slpm	slpm	slpm	slpm	slpm	slpm	slpm	slpm	slpm	slpm	m^3/h	kW