INDIAN INSTITUTE OF TECHNOLOGY BOMBAY
MATERIALS MANAGEMENT DIVISION
Powai, Mumbai 400076

Purchase Requisition No. 1000006463 (SRM/Rfx No. 6100000096)

Technical Specification of complete Setup for DC & RF Device Characterization Laboratory

Vendor should provide complete integrated solution for IV, CV and RF setup with RF & DC Probe station along with Test Equipments i.e (Semiconductor Parametric Analyser, Vector Network Analyser & Spectrum Analyzer)

1. Equipment being tendered are intended for primary use in system which will characterize DC parametric and RF response acquired through dedicated probe stations. The integrated DC-RF characterization system will offer a guided wizard customizable for sure connections and correct setup, easy calibration of network analyzer up to probe tip reference plane with automatic self-compensation to remove any placement errors thus yielding repeatable results.
2. Only vendors with necessary experience and competency to supply, integrate and install such functional system with all its hardware and software components will be selected as eligible bidders.
3. Vendor to deliver total solution to meet the test needs for the intended research and development. Vendors may be asked to provide necessary evidence to establish their experience & expertise and it is at institute discretion to accept/reject the same.

Broad General Technical Requirements (Vendor to provide specific confirmation as part of compliance):

1. System should be unified measurement platform equipped for wafer level, chip or SOC device characterization supplied with all specified accessories, probes, connectors, software, calibration fixtures such that the setup is self-sustaining and able to provide DC parametric analysis, IV and CV curves and calibrated RF characterization up to 8GHz and upgradable in future for semiconductor devices such as transistors, amplifiers, filters, other linear components to meet intended needs of the department in integrated and standalone modes.
2. Wherever called for within the specifications, the offered equipment must be upgradable to higher performance thresholds as defined.
3. Software supplied should be capable of functioning on equipment host and stand-alone PC to facilitate off-line analysis wherever feasible.

Key Features & Specifications of software :

- Characterization environment is for Precision Current-Voltage Analyzer Series. It is available either on user's PC or semiconductor parametric Analyzer

- Multiple measurement modes for quick setup and measurement execution (application test, classic test, tracer test, quick test and oscilloscope view)

- Graphical display, automated analysis capabilities and data generation to Excel and image for analysis and reporting

- Built-in database (workspace) records test data automatically and simplifies the data management without numerous data files

- Software must support remote control function supports the remote measurement execution of application tests that are created on GUI interactively, via the LAN interface

- It supports efficient and repeatable device characterization in the entire characterization process from measurement setup and execution to analysis and data management either interactive manual operation or automation across a wafer in conjunction with a semiautomatic wafer prober

- Data back capability and various data protection feature for shared usage by multiple users

- #Software Tool for comprehensive and intuitive on-wafer RF measurement and calibration to achieve accurate and repeatable S-parameter measurement. This toll should support on wafer 1-, 2-, 3-, and 4-port calibration for instant data measurement and live viewing and VNA control. Tool should be able to perform error set management for data comparison and augmentation

- Tool should support following calibration types:
  LRRM,LRM+, SOLT-LRRM, hybrid NIST-style multi-line TRL,

* Covers Infinity Probes, ACP probes,|Z| Probes and T-Wave Probes, and is compatible with Velox, Nucleus and ProberBench prober control software

* Supports up to 12 VNA ports than can be mapped to four logical ports for calibration

*Extensive guidance, wizards and management features automate calibrationsetup, measurement, result data conversion and report creation

*Automatic load inductance compensation function ensures the most repeatable calibrations

Brief Write up on RF probe-stations.

RF Probe Station: The RF Probe station has ability to probe pads as small as 25 μm x 35 μm up to 67 GHz with stable system platform design with a vibration-isolation solution to protect contact quality over measurement time. Optimized

optics, backlash-free X-Y-Z movement of RF positioners with Load stroke, Y axis: 90 mm , Chuck Z height adjustment range: 10 mm , Z contact / separation / load stroke: 0 to 3 mm and a contact separation drive with 1 μm repeatability, enable precise probe placement and contact repeatability.

- A Tailored RF platen with Z-Height adjustment range: 40 mm , Separation lift: 200um & Separation repeatability: < 1um.
- RF micro positioners with ability to convert 2 sets of RF to DC positioners

it includes Proprietary calibration software for RF with Multi-line TRL cal, eLRRM, Hybrid LRRM-SOLR Cal (multiport),
16-Term SVD, LRRM and LRM+ methods for the best calibration accuracy. Further it includes Self-developed RF calibration substrate for RF probes.

Brief Write up on DC probe-stations.

DC Probe Station : The Probe system incorporates best known methods for I-V/C-V measurements through a very stable system platform design with a vibration-isolation solution to protect contact quality over measurement time. Optimized optics and backlash-free X-Y-Z movement of industry-standard positioners enable precise probe placement with with Load stroke, Y axis: 90 mm , Chuck Z height adjustment range: 10 mm , Z contact / separation / load stroke: 0 to 3 mm.

- Probe arms with built-in high quality coaxial cables optimize the signal path and allow to test a variety of devices down to pA levels with a high degree of confidence.

An intuitive operation workflow with universal chuck with 360 deg chuck rotiation , single-handed chuck adjustment, and a highly-planar chuck surface and movement, ensures ease of operation

Item No 1) Technical Specifications for RF Probe Station :

Sr No.	PARAMETER	SPECIFICATIONS
1	Substrate Size	1×1 cm2 to 6-inch diameter wafer.
2	Chuck Details	(i) RF Chuck: ≥ 6” inch diameter
		(ii) Dedicated RF chuck with imbedded ceramic AUX
		(iii) Chuck Planarity : <± 3 μm
3	X,Y, Theta stage	(i) Range of movement: Movement of stage to be at least 15cm × 15 cm in x-y direction
		(ii) Fine Theta travel: ± 8°
		(iii) Resolution in x-y positioning: < 5 microns or better
		(iv) Load stroke, Y axis: 90 mm
		(v) Chuck Z height adjustment range: 10 mm

		(vi) Z contact / separation / load stroke: 0 to 3 mm
4	Platen	(i) Platen space (typical): Universal platen: space up to twelve DPP105 positioners
		ii) Z-Height adjustment range: 40 mm
		(iii) Separation lift: 200um
		iv) Separation repeatability: < 1um
5	Vacuum Pump	Suitable vacuum pump compatible to system along with necessary accessories including vacuum tubing
6	Stereo Microscope and Digital CCD	Trinocular 6.7x stereo zoom
		Magnification: Total magnification ≥ 150X
		Microscope mount: system compatible microscope mount.
		Light source: LED / suitable light source and suitable power supply
		Head with CMOS port.
7	RF Micropositioners	(i) 4 sets of Magnetic base micropositioners
		(ii) Ability to convert 2 sets of RF to DC positioners
		(iii) Movement of micropositioners should be 12.5 mm in x-y-z directions
		(iv) Resolution: 2um or better

8	40Ghz RF probes	(ii) 2 x 40Ghz GSG probes: Two 40Ghz probes (GSG, 100um), Two RF cables, Cal substrate and Contact substrate IZI-Probe 1MX, Ni Tip, Std Bdy, 40GHz - HF Probetip for on-wafer probing - With 1MX technology for improved HF-test performance **Electrical charateristics:** - Frequency range: DC-40GHz , 50 Ohms , 2.92mm Maximum RF power 5 W at 40 GHz Maximum DC current 1.5 A Maximum DC voltage 100 V Tip configuration: GSG **Mechanical Characteristics** Contacts Solid nickel springs Insulator RF dielectric
9	Self-developed RF calibration substrate for single-ended GSG probes	For HF Calibration with |Z| Probe with GSG Configuration For pitches: 100um - Contains alignment signature (crosses) for production prober Material: Alumina DC accuracy: ±0.3% Dielectric Constant: $\varepsilon = 10.2$
10	40 GHz RF cables	(i) Three 40Ghz RF cable , straight K type (Female to Male)
11	Customized RF and DC probes	(ii) Two 40Ghz dual probe (GSSG, 100um) with Tungsten tip with Reduced Contact size of 19um (meant for 50um pad). Come with suitable cal substrate for calibration.
		(iii) One custom version of non linear 40Ghz probe configured with a reduced contact tip of 19um (GSG,tungsten, 100um pitch) and 8 DC needles placed on a wide PCB. Cabling is coax terminated with SMA.
		(iv) One custom version of non linear 40Ghz probe configured with a reduced contact tip of 19um (GSG,tungsten, 100um pitch) and 6 DC needles placed on a narrow pad PCB. Cabling is coax terminated with SMA.
		(v) One custom version of custom version of non linear DC probecard with 10 DC needles configured in a tight array.Cabling is coax terminated with SMA.
12	Self-developed RF calibration substrate GSSG probes	(i) Suitable for 100 μm pitches Material: Alumina 99.6% DC accuracy: ±0.3% Dielectric constant: 9.9
13	Self developed proprietary calibration software for RF with Multi-line TRL cal, eLRRM, Hybrid LRRM-SOLR Cal (multiport), 16-Term SVD, LRRM and LRM+	

14	Supplier should provide technical compliance including explanations without fail against each point given in the technical specifications for consideration of the offer.
15	Power requirement: As per Indian electrical standards (230V AC, 50 Hz)
16	Warranty: Comprehensive one year from the date of installation with additional 6 months extended warranty
17	Parent company should be an established company with good number of installations (at least 20) and after sales support in India as well.
18	Standard configurations will be required. NO CUSTOM BUILT SYSTEMS WILL BE ENTERTAINED.
19	Vendor should provide complete integrated solution for IV, CV and RF setup with both Probe station (2 x) as well as Test instruments (Semiconductor Parametric Analyser, Vector Network Analyser). At least 5 similar setup should be found in India.
20	Test pads layout & requirements for on-die measurements for module 1 as enclosed below in figure 1 & 2. Test pads layout & requirements for on-die measurements for module 2 as enclosed below in figure 3 & 4.

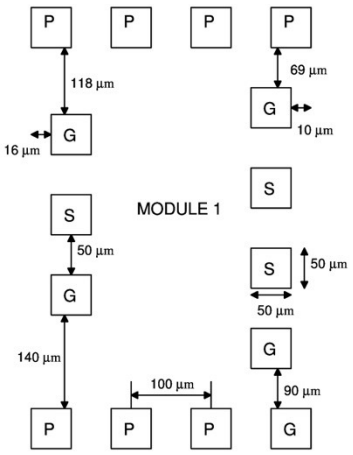

Fig-1: Test pads layout for module-1

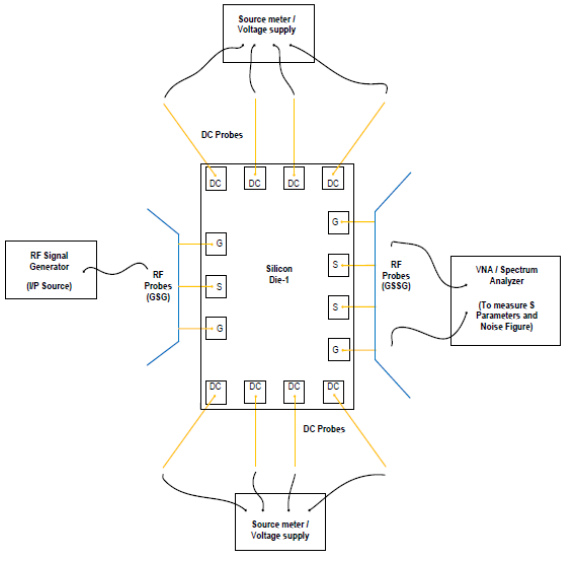

Fig-2: Requirements for on-die measurements for module-1

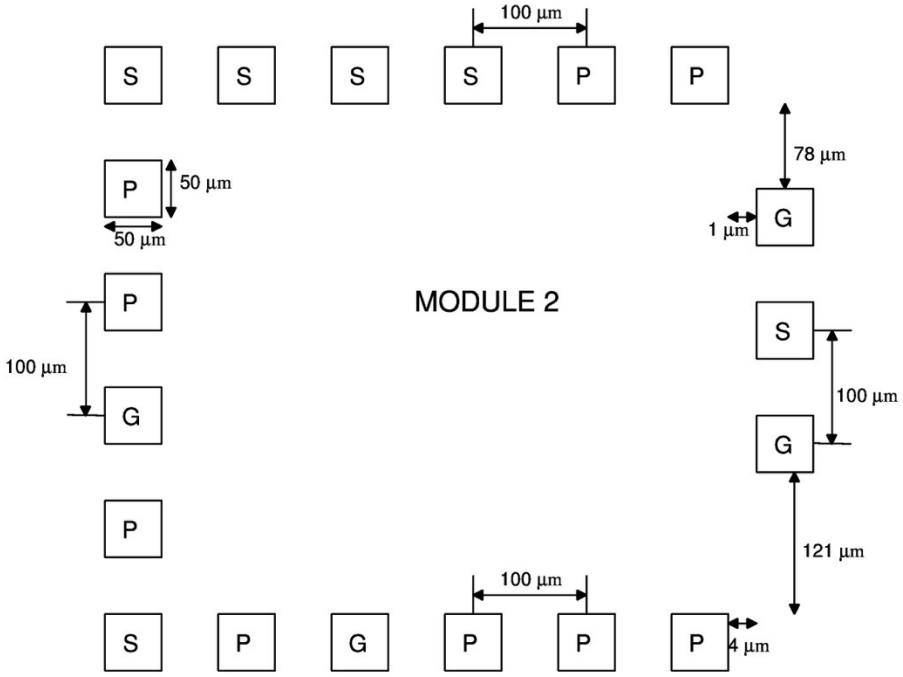

Fig-3: Test pads layout for module-2

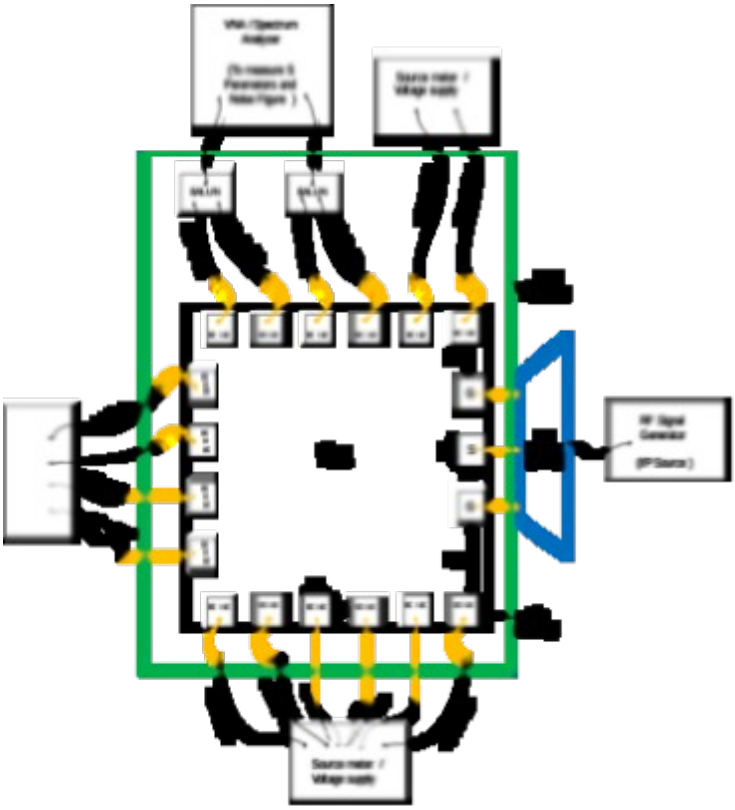

Fig-4: Requirements for on-die measurements for module-2

Item No 2) Technical Specifications for DC Probe Station :

Sr No.	PARAMETER	SPECIFICATIONS
1	Substrate Size	1×1 cm2 to 6-inch diameter wafer.
2	Chuck Details	(i) Chuck: ≥ 6" inch diameter
		(ii) Triaxial Vacuum Chuck with 3 integrated Auxillary chucks and Triaxial chuck cable
		(iii) Chuck Planarity : < ± 3 μm
3	X,Y, Theta stage	(i) Range of movement: Movement of stage to be at least 15cm × 15 cm in x-y direction
		(ii) Fine Theta travel: ±8°
		(iii) Resolution in x-y positioning: < 5 microns or better
		(iv) Load stroke, Y axis: 90 mm
		(v) Chuck Z height adjustment range: 10 mm
		(vi) Z contact / separation / load stroke: 0 to 3 mm
4	Platen	(i) Platen space (typical): Universal platen: space up to twelve DPP105 positioners
5	Vacuum Pump	Suitable vacuum pump compatible to system along with necessary accessories including vacuum tubing
6	Stereo Microscope and Digital CCD	Trinocular 6.7x stereo zoom
		Magnification: Total magnification ≥ 100X
		Microscope mount: system compatible microscope mount.
		Light source: LED / suitable light source and suitable power supply
		Head with CMOS port.
9	DC Micro-positioners	(i) 4 sets of Magnetic base micro-positioners
		(ii) 4 sets of probe arm with Triaxial connectors
		(iii) 4 sets of probe arm with Coaxial connectors
		(iv) Movement of micro-positioners should be 12.5 mm in x-y-z directions

		(v) Resolution: 2um or better
		(vi) 1 box 6um probe tips (25 tips)
10	Warranty	Comprehensive one year from the date of installation with additional 6 months extended warranty

Item No 3) Technical Specifications for IV- CV Parametric Analyzer :

Sr No.	PARAMETER	SPECIFICATIONS
1	A parametric analyzer with the below specifications are required	Main instrument should have atleast 10 slots and should allow upgrading with more SMUs if empty slots are available. Must have an inbuilt touch screen display. Must include necessary number of 3mtr cables for connections.
2	Ground Unit	A separate ground unit apart from the ten slots available for measurement modules should be available with atleast 4A sink current.
3	**Atleast three Modules with the below specifications**	
3.1	Maximum voltage range and resolution	100 V with measure resolution of 100uV with atleast 20mA of current at 100V
3.2	Maximum current range and resolution	100mA with measure resolution of 100nA
3.3	Minimum current range and resolution	1nA with measure resolution of 10fA
3.4	Pulse width range for pulsed measurement	500us to 2 s
4	**Atleast one capacitance measurement unit with the below specifications**	
4.1	Frequency range	1kHz to 5MHz with accuracy of better than +0.01%
4.2	Resolution	1mHz(minimum)

4.3	Signal output level range	10 mVrms to 250 mVrms
4.4	Accuracy	±0.008%
4.4	Output impedance	50 Ω, typical
4.5	DC bias	at least up to + 25V
5	**General Features**	
5.1	Should have convenient user interface preferably Windows based	
5.2	Interface for remote control	USB, GPIB, LAN
5.3	Built in Memory should be available	
5.4	Switching unit to switch between SMU & CMU including cables to do IV & CV measurements without physically changing the connection must be provided	
6	**Software or Firmware**	
6.1	Software to control the instrument and other accessories for setting up measurements, performing measurements, displaying and analyzing data and management of measurement data must be included	
6.2	Flexibility of performing the above, either from the software installed within instrument or external controller should be present	
6.3	Should have self-test, self-calibration and diagnostic menu	
6.4	Graphical display, automated analysis capabilities and data generation to Excel and image for analysis and reporting	
6.5	Should have readymade measurement setup in the form of library for at least Id-Vds, Rds-Id, Id-Vgs, Vth	
6.6	Should allow tracer test mode	Should allow interactive sweep control using a rotary knob present on the instrument itself, like a curve tracer allowing sweep in positive direction, negative direction or in both directions
6.7	Should have the provision for sequencing multiple tests without external programming	
7	Operating temperature range	+5 to 40 degrees Celsius

8	Future Upgradability	System should be future upgradable for high power device measurement upto 1500A High Voltage device measurement upto 10kV. System should be future upgradable to do IV measurements up to 3kV by using a single SMU which should get fit inside the mainframe. System should allow upgrading the high current capability for high voltage SMU for up to 2A at 1.2kV range at least with 4uA measurement resolution
9.	Warranty	Comprehensive one year from the date of installation

Item No 4) Technical Specifications for 13.6GHz RF Signal Analyzer

Sr No.	PARAMETER	SPECIFICATIONS
1	Frequency range	9 KHz - 13.6 GHz
2	Aging Rate	± 1 x 10–6 / year
3	Pre-defined Measurements	Channel Power, ACPR, Occupied BW, Carrier frequency, frequency counter
4	Counter resolution	0.001 Hz
5	Frequency span	0 Hz (zero span), 10 Hz to maximum frequency of instrument
6	Sweep time	Span = 0 Hz 1 μs to 6000 s Span ≥ 10 Hz 1 ms to 4000 s
7	Trigger functions	Free run, video, external, RF burst/IF trigger
8	Sweep points	1 to 40,001
9	Resolution bandwidth (RBW)	1 Hz to 8 MHz
10	Video bandwidth (VBW)	1 Hz to 8 MHz
11	Maximum safe input level	+30 dBm (1 W)
12	Amplitude accuracy	<1.5 dB
13	DANL	<-139 dBm at freq > 1 MHz

14	Phase noise CF = 1 GHz, 10 Khz offset	–106 dBc/Hz
15	Measurement feature	Phase noise measurement capability of a CW signal with log plot and spot frequency views and report phase noise directly in dBc/Hz. Must support automatic carrier search. Must have decade table.
16	Display	Multi- Touch screen color display with size of 10.6 inch diagonally.
16	Future upgradation	Instrument should software upgradable to do demodulation of digitally modulated signals like QPSK, QAM, BPSK, GMSK etc with unlimited traces and markers, signal recording capability with upto 10 license
17	Operating power	230 V ± 10%, 50 Hz. All necessary power cords with Indian (3-pin plug) type to be provided by vendor.
18.	Warranty	Comprehensive one year from the date of installation

Item No 5) Technical Specifications for 8.5GHz Vector Network Analyzer :

Sr No.	PARAMETER	SPECIFICATIONS
1	Frequency Range	10 MHz to 8.5 GHz
2	No of Test Ports	Four
3	No. of internal generators	Two Direct receivers and generators access should be available on all ports. Must have source and receiver attenuators on all ports.
4	Measurement & display capabilities	Vector calibrated S parameters (Magnitude and Phase) of 4 ports active or passive circuits & sub systems. Log-magnitude, Phase plot display. Smith Chart & Inverted Smith Chart visualization of impedance and admittance.
		Should be capable for measuring Noise figure with in-built low noise receivers enabling both low and high excess noise power devices.
		Set-up should have the capability to do vector noise corrected measurements.

		Necessary Impedance Tuner and Power sensor should be supplied along with set-up to do calibration.
5	Test Port connectors	3.5 mm (male), 50 Ω
6	Frequency Resolution	1 Hz
7	Leveled output power (for both ports)	+10 dBm for complete frequency range , 10 MHz to 8.5 GHz
8	Minimum settable power	-95 dBm on all ports
9	Power Resolution	0.01 Db
10	System Dynamic Range	10 MHz to 50 MHz : 90 dB 50 MHz to 500 MHz : 100 dB 500 MHz to 8.5 GHz : 124 dB
11	Phase Noise @10kHz offset (over full frequency range)	≤ -93 dBc/Hz
12	Input damage power level for test ports (at both the ports)	> +27 dBm RF, 40 VDC with-in built bias tee.
13	Inbuilt bias tee	±40 VDC/ ±200 mA with no degradation of RF specifications
14	In-built Display	Minimum 12 inches diagonal color active matrix LCD with
		1024 (horizontal) X 768 (vertical) resolution
15	Frequency Accuracy	± 1 ppm
16	Nominal IF Bandwidth	1 Hz to 15 MHz
17	Directivity (over full frequency range)	≥ 47 dB
18	Sources Match (over full frequency range)	≥ 34 dB
19	Load Match(guaranteed specs over full frequency range)	≥ 39 dB
20	Direct Access to internal receivers and source	Should be available
21	2nd and 3rd Harmonics (dBc) at maximum specified power level at port 1 over full frequency range	-51 dBc without external hardware
22	Parameter display Formats	Feature should be available in the instrument for the following- Log magnitude, linear magnitude, SWR, phase, group delay, electrical delay, real and imaginary, Smith chart, polar.
23	Sweep Type	Feature should be available in the instrument for the following- CW, Linear, step sweep, Power, Segment
24	Measurement points	1 to 100,001

25	Connectivity	VGA output, LAN, USB,GPIB
26	Data storage	Internal drive with minimum 80GB storage capacity
27	Capability to save internal data in ASCII (including S2P) format, all files should be compatible to Windows for easy data transportation and documentation	Feature should be available in the instrument.
28	Should have Internal signal combiner and mechanical switches	VNA should have internal signal combiner and internal mechanical switches. The internal combiner should be able to combine the output of two internal generators and the combined signal should be available at test port-1. The system should be able to measure the S-parameters as well as IMD (of the same DUT) through user interface over the front panel without the need for mating/de-mating of any hardware (connectors) in the set-up external to VNA. Internal mechanical switch should be available for entire frequency range. Variable tone spacing from 100KHz to 1 MHz should be provided. The same instrument should be able to perform Gain compression measurements with swept frequency and swept power and for Swept 2 tone inter-modulation measurements.
29	Calibration Kit	Electronic calibration kits, system specifications are guaranteed must be quoted as per frequency range of instrument.
30	Compatible key board and mouse	Shall be supplied along with the instrument
31	The equipment should be a single box configuration which should meet all technical specifications as above.	
32	Future Upgradability	The same single box Instrument should be frequency upgradable up to 26.5 GHz without using any external hardware. The instrument should be upgradable with pulse-generators inside the same box only for pulsed-RF measurements.
33	All parts/ accessories should have operating power: 230 V ± 10%, 50 Hz. All necessary power cords with Indian (3-pin plug) type to be provided by vendor.	
34	Accessories	(i) Three numbers of 3.5 male to female cables. (ii) Three numbers of 3.5 male to male adapters should be quoted. (iii) Three nos of BALUN each with following specifications: - DC to 500MHz. - 500MHz to 10GHz. - Zin = 100Ω & Zout = 50Ω.
35	Warranty	Comprehensive one year from the date of installation

Item No 6) Accessories :

Apart from above necessary equipment, the vendor shall also provide following items along with all the required accessories, make & Model. The Vendor shall also mention other recommendation as per lab setup.

S.No	Item Description	Quantity
1	16" to 25" Rack mounting including 3-shelf and suitable height to accommodate the test instruments for RF characterization at single place with facility to accommodate 2 or more test instruments in future.	2
2	Desktop with 22" LCD Monitor or All in one PC	2
3	Vibration Granite Platform to be quoted separately as per dimensions & weight carrying capacity of probe station	1
4	UPS (3kVA rating) with 30 minutes backup	1
5	Vibration/Isolation Table as per dimensions & weight carrying capacity of RF probe station.	1

Bid Evaluation / Special Terms for Bidders :

1. Bidders must provide point-by-point compliance to all tendered Technical Specifications, Technical Requirements and Special Terms. Where required, vendor must provide compliance, deviation if any and requisite justification to meet tender requirements in total. Without such details, bids may be summarily rejected at discretion of IIT Bombay.
2. Bids complying to only part requirements of tendered specifications are liable to be rejected. Bidder is accountable for supply, integration, installation and support of all quoted parts including any third party parts not manufactured by them, akin to a turnkey bid. All necessary authorisations must be obtained from third party/part suppliers confirming support to the primary bidder to quote, honour OEM warranty and support during integration, warranty period and for life of the product.
3. Vendors for main test equipment and probe stations must have their own technically equipped application engineer / engineering team to provide installation, training and after sales support.
4. Primary vendor OEM should have well established repair and calibration facility for all supplied main equipment within India.
5. Warranty: One year on the complete integrated solution.
6. At least 3 similar setup should be found in India.