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|  | <p style="text-align: center;">INDIAN INSTITUTE OF TECHNOLOGY MADRAS Chennai 600 036</p> <p style="text-align: center;">Telephone : [044] 22574466 E-mail: deepav@iitm.ac.in</p> |  |
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Dr. Deepa Venkitesh
Project Coordinator

Ref: ELE/DEEPA/05/2016
Dated: 26.07.2016

Limited Tender No: ELE/DEEPA/05/2016

Due Date: 10 .08.2016, 5:30pm

Dear Sir/Madam,

On behalf of the Indian Institute of Technology Madras, offers are invited for the supply of the following items.

- A. Arbitrary Wave Generator
- B. Optical IQ Transmitter
- C. Optical Coherent Receiver
- D. Real Time Scope

The technical requirements are attached.

Vendor must quote for all items and for the integrated package, complying the technical requirements as per the attachment.

All additional options possible should be mentioned clearly with corresponding quote in the bid.

Instructions to the Bidder

- (i) **Preparation of Bids:** - The Limited tenders should be submitted under two-bid system (i.e.) Technical bid and Financial bid in two separate sealed envelopes.
- (ii) **Delivery of the tender:** - The tender shall be sent to the below-mentioned addresses either by post or by courier so as to reach the following address before the due date and time specified in our Schedule:

Dr.Deepa Venkitesh, ESB337A, Dept. of Electrical Engineering, IIT Madras-600 036.

- (iii) **Opening of the tender:** - A committee duly constituted for this purpose will open the offer/Bids. The technical bids will be opened first and a technical committee, which will decide the suitability of the bid as per our specifications and requirements, will examine it.

- (iv) **Prices:** - The price should be quoted in net per unit (after breakup) and must include all packing and delivery charges to the Department. The offer/bid should be exclusive of taxes and duties, which will be paid by the purchaser as applicable. However the percentage of tax & duties should be clearly indicated.

The price should be quoted without custom duty and excise duty, since I.I.T. Madras is exempt from payment of excise duty, and the custom duty will be paid at concessional rate against duty exemption certificate.

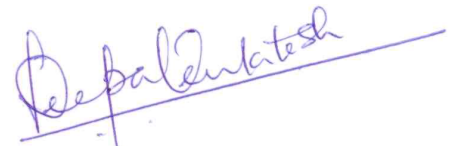
In case of import supply, the price should be quoted on EX-WORKS, CIF basis indicating the mode of shipment.

- (v) **Agency Commission:** - Agency commission, if any, will be paid to the Indian agents in Rupees on receipt of the equipment and after satisfactory installation. Agency Commission will not be paid in foreign currency under any circumstances. The details should be explicitly shown in Tender even in the case of 'Nil' commission. The tenderer should indicate the percentage of agency commission to be paid to the Indian agent. The foreign Principal should indicate about the percentage of payment.

- (vi) **Terms of Delivery:** - The item should be supplied to our Department as per Purchase Order. In case of import supply, the item should be delivered at the cost of the supplier to our Institution. The Installation/Commissioning should be completed within three months from the date of Purchase Order.

- (vii) IIT Madras reserves the full right to accept / reject any tender at stage without assigning any reason.

Yours sincerely,

A handwritten signature in blue ink, reading "Depalankatesh", is written over a horizontal blue line.

SCHEDULE

Important Conditions of the tender

1. The due date for the submission of the tender is **Due Date: 10 .08.2016, 5:30pm**
2. The offers / bids should be submitted in two bids systems (i.e.) Technical bid and Financial bid. The Technical bid should consist of all technical details / specifications only. The Financial bid should indicate item-wise price for each item and it should contain all Commercial Terms and Conditions including Taxes, transportation, packing & forwarding, installation, guarantee, payment terms, pricing terms etc. The Technical bid and Financial bid should be put in separate covers and sealed. Both the sealed covers should be put in a bigger cover. The Limited Tender for supply of

- A. Arbitrary Wave Generator**
- B. Optical IQ Transmitter**
- C. Optical Coherent Receiver**
- D. Real Time Scope**

should be written on the left side of the Outer bigger cover and sealed.

3. **Performance Security:-** The successful bidder should submit Performance Security for an amount of 5% of the value of the Purchase Order. The Performance Security may be furnished in the form of an Account Payee DD, FD Receipt from the commercial bank, Bank Guarantee from any nationalized bank of India will be acceptable.

Only after submission of Performance Security, Purchase Order/Work Order will be released / L.C will be opened.

Performance Security in the form of Bank Guarantee:- In case the successful bidder wishes to submit Performance Security in the form of Bank Guarantee, the Bank Guarantee should be routed through the Beneficiary Bank to the end user bank. Otherwise, the Indian Agent of the foreign vendor has to submit a Bank Guarantee from a Nationalized Bank of India.

The Bank Guarantee should remain valid for a period of sixty days beyond the date of completion of all contractual obligations of the supplier including the warranty obligations.

4. If an Indian agent is involved, the following documents must be enclosed:
Foreign principal's proforma invoice indicating the commission payable to the Indian Agent and nature of after-sales service to be rendered by the Indian Agent.
 - ✓ Copy of the agency agreement with the foreign principal and the precise relationship between them and their mutual interest in the business.
 - ✓ The enlistment of the Indian agent with Director General of Supplies & Disposals under the Compulsory Registration Scheme of Ministry of Finance.
5. The offer/bids should be sent only for a machine that is available in the market and supplied to a number of customers. A list of customers with details must accompany the quotations. Quotations for a prototype machine will not be accepted.
6. Original catalogue (not any photocopy) of the quoted model duly signed by the principals must accompany the quotation in the Technical bid. No prices should ever be included in the Technical bid.
7. Documentary proof for the claimed position and repetition accuracies must be obtained from the principals and submitted along with the relevant pages of the standards.
8. Compliance or Confirmation report with reference to the specifications and other terms & conditions should also be obtained from the principal.
9. **Validity:** Validity of Quotation not less than 90 days from the due date of tender.
10. **Delivery Schedule:-** The tenderer should indicate clearly the time required for delivery (less than three months from the date of Purchase Order) of the item. In case there is any deviation in the delivery schedule, liquidated damages clause will be enforced or penalty for the delayed supply period will be levied.
11. **Risk Purchase Clause:-** In the event of failure of supply of the item/equipment within the stipulated delivery schedule, the purchaser has all the right to purchase the item/equipment from other sources on the total risk of the supplier under risk purchase clause.
12. **Payment:-** No Advance payment will be made for Indigenous purchase. However 90% Payment against Delivery and 10% after installation are agreed to wherever the installation is involved. In case of import supplies the payment will be made only through 100% Letter of Credit i.e. (90% payment will be released against shipping documents and 10% after successful installation wherever the installation is being done).
13. **Advance Payment:-** No advance payment is generally admissible. In case of specific percentage of advance payment is required, the Foreign Vendor has to submit a Bank Guarantee equal to the amount of advance payment and it should be routed through the

Beneficiary Bank to the end user Bank. Otherwise, the Indian Agent of the foreign vendor has to submit a Bank Guarantee through a Nationalized Bank of India.

14. **On-site Installation:** - The equipment or machinery has to be installed or commissioned by the successful bidder within 15 to 20 days from the date of receipt of the item at site of IIT Madras.
15. **Warranty/Guarantee:** - The offer should clearly specify the warranty or guarantee period for the machinery/equipment complying to the attached document. Any extended warranty offered for the same has to be mentioned separately. (for more details please refer our Technical Specifications).
16. **Late offer:** - The offers received after the due date and time will not be considered. The Institute shall not be responsible for the late receipt of Tender on account of Postal, Courier or any other delay.
17. **Acceptance and Rejection:** - I.I.T. Madras has the right to accept the whole or any part of the Tender or portion of the quantity offered or reject it in full without assigning any reason.
18. **Do not quote the optional items or additional items unless otherwise mentioned in the Tender documents / Specifications.**
19. **Disputes and Jurisdiction:** -
 - a. **Settlement of Disputes:** Any dispute, controversy or claim arising out of or in connection with this PO including any question regarding its existence, validity, breach or termination, shall in the first instance be attempted to be resolved amicably by both the Parties. If attempts for such amicable resolution fails or no decision is reached within 30 days whichever is earlier, then such disputes shall be settled by arbitration in accordance with the Arbitration and Conciliation Act, 1996. Unless the Parties agree on a sole arbitrator, within 30 days from the receipt of a written request by one Party from the other Party to so agree, the arbitral panel shall comprise of three arbitrators. In that event, the supplier will nominate one arbitrator and the Project Coordinator of IITM shall nominate one arbitrator. The Dean IC&SR will nominate the Presiding Arbitrator of the arbitral tribunal. The arbitration proceedings shall be carried out in English language. The cost of arbitration and fees of the arbitrator(s) shall be shared equally by the Parties. The seat of arbitration shall be at IC&SR IIT Madras, Chennai..
 - b. **The Applicable Law:** This Purchase Order shall be construed, interpreted and governed by the Laws of India, Court at Chennai shall have exclusive jurisdiction subject to the arbitration clause.
20. All Amendments, time extension, clarifications etc., will be uploaded on the website only and will not be published in newspapers. Bidders should regularly visit the above

website to keep themselves updated. No extension in the bid due date/ time shall be considered on account of delay in receipt of any document by mail.

Acknowledgement:- It is hereby acknowledged that the tenderer has gone through all the conditions mentioned above and agrees to abide by them.

**SIGNATURE OF TENDERER
ALONG WITH SEAL OF THE
COMPANY WITH DATE**

Intention to procure the following items

- A. Arbitrary Wave Generator**
- B. Optical IQ Transmitter**
- C. Optical Coherent Receiver**
- D. Real Time Scope**

Vendor must quote for all items and for the integrated package. All additional options possible should be mentioned clearly with corresponding quote in the bid.

| A. ARBITRARY WAVEFORM GENERATOR | | |
|---------------------------------|--|--|
| S.NO | PARAMETER | SPECIFICATIONS |
| 1 | No of channels | 2 (possibility of up gradation to 4 channels in future) Quote separately for single channel and four channel options |
| 2 | Max Sample Rate | > 65 GSa/s on two channels simultaneously |
| 3 | Vertical Resolution | >= 8 |
| 4 | Output Type | Single-ended or differential on each channel |
| 5 | Analog Bandwidth | >25 GHz per channel Quote separately for possible upgrades. |
| 6 | Memory | 1 MS/channel, possibility to upgrade. Quote separately for possible upgrades. |
| 7 | Rise/Fall Time (20-80%) | <= 18 ps |
| 8 | Amplitude Range | Single Ended : Upto 1 Vpp into 50 Ω Differential : upto 2 Vpp into 50 Ω |
| 9 | Skew between two output channel | 7 ps or better |
| 10 | Random jitter, RMS | < 200 fs |
| 11 | Amplitude Flatness | ± 2 dB for DC to 10 GHz ± 3 dB for 10 GHz to 25 GHz or better |
| 12 | Software for IQ Signal Generation | Software should generate and download dual I/Q signals with flexible signal parameters (e.g. pulse shape, delay) |
| 13 | Patterns | PRBS and User Defined |
| 14 | Optical Signal Properties (Desired Specifications) | Should be able to adjust signal properties like - Phase noise - Polarization control - Polarization mode dispersion (PMD) emulation - IQ Rotation - Non Linear Equalization to compensate for the transfer characteristic of an electro-optical modulator |
| 15 | Pulse Shaping | Pre-defined filter coefficients – Rectangular, raised cosine, root-raised cosine, Gaussian – Filter roll-off – User-defined coefficients |
| 16 | Modulation Formats | Complex modulated (BPSK, QPSK, 8-PSK, 8-QAM (circ.), 16-QAM, 32-QAM, 64-QAM, 128-QAM, 256-QAM) with user-definable constellation rotation angle (phase offset), OFDM – User-defined constellation |
| 17 | Additional Requirements | Terminations for all outputs with appropriate bandwidth and impedance should be provided Matching cables should be provided for each channel |
| 18 | Warranty | 3 years |

| A. IQ Transmitter | | |
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| 1 | RF Bandwidth | > = 40 GHz |
| 2 | Automatic Bias Control (ABC) for modulators | Automated Bias Control (ABC); should support bias with ABC, at any point in the transfer curve; and any modulation format – including OOK, OFDM, QPSK, QAM. |
| 3 | No of IQ modulators and corresponding drivers | Quote separately for options 1. Two modulators for X and Y polarization 2. PM emulation with a single IQ modulator |
| 4 | DC Extinction Ratio | > 18 dB |
| 5 | Return Loss | Optical : Better than - 30 dB Electrical : Better than -15 dB |
| 6 | Insertion Loss | <= 12 dB |
| 8 | Modulator operating wavelength range | C+L Band |
| Should have an in-built / external laser with the following specs | | |
| 9 | Laser Wavelength | C Band |
| 10 | Laser Linewidth | < 100 kHz |
| 11 | Laser Power | > 15 dBm |
| 12 | Tuning resolution | <= 1 MHz |
| 13 | RIN of the laser | < = -145 dB/ Hz |
| 14 | Frequency accuracy | Better than +/- 2.5 GHz |
| 15 | SMSR | > = 40 dB |
| 16 | Other requirements | <p>Hardware calibration data should be provided for use in pre-emphasis of AWG waveforms. Drivers should be linear to support multi-level amplitudes-test report on linearity should be provided.</p> <p>Built-in power meter for output power monitoring.</p> <p>Dedicated software controller with full functionality of built-in Laser and ABC.</p> <p>USB, Ethernet connectivity with SCPI support for remote control should be given.</p> <p>Attenuators with appropriate bandwidth to be provided to adjust the input RF voltage from a 1V source.</p> <p>Matching cables with spares to be provided for connection from AWG.</p> <p>Independent access for the laser source should be provided.</p> <p>Ability to connect and external laser source should be provided.</p> <p>RF phase delays to interface with AWG to emulate independent I/Q and X/Y data at 32 Gbaud to be provided.</p> |
| 7 | Warranty | 3 years |

C. Optical Coherent Receiver, Optical Modulation Analyzer

| Sl. No | PARAMETER | SPECIFICATIONS |
|--------|--|--|
| 1 | Description | Coherent Receiver to work with 4 channel Real-time High Bandwidth Oscilloscope – The four electrical outputs corresponding to XI, XQ, YI, YQ should be separately available. |
| 3 | Electrical Bandwidth | >= 42 GHz Quote separately for higher bandwidth options |
| 4 | Receiver polarization extinction ratio (PER) | > 20 dB |
| 5 | Number of outputs | 4 – corresponding to I and Q for two polarisations |
| 6 | EVM noise floor | <= 2 % rms |
| 7 | Amplitude error of receiver | <= 2 % rms |
| 8 | Phase error of receiver | <= 1 degree |
| 9 | Quadrature error of receiver | <= 0.5° |
| 10 | Supported Modulation Formats | BPSK, mPSK, mQAM, mPAM, OFDM |
| 11 | Baud Rate | >=32 GBaud |
| 12 | External Local Oscillator Input | C+L Band |
| 13 | Internal Local Oscillator Wavelength Range | C Band |
| 14 | Relative Intensity Noise of internal LO | Better than -145 dB/Hz |
| 15 | Absolute wavelength accuracy | < ± 22 pm |
| 16 | Linewidth of the internal laser | < 100 kHz |
| 17 | Wavelength step | <= 1 pm |
| 18 | Wavelength Accuracy | Better than 10 pm |
| 19 | Measurements | Standard measurements for advanced modulation formats |
| 20 | Graphic Traces | Standard graph traces for advanced modulation formats Spectral measurements for the signal |
| 21 | BER Measurements | Capability for True BER measurement |
| 22 | Compensation Algorithms | CD, PMD, Phase noise, frequency offset, polarization mixing |
| 23 | Other requirements | Ability to access the LO laser Ability to use an external LO laser as input Matched terminations with appropriate bandwidth should be provided Matched cables with spares of appropriate bandwidth, to connect to the oscilloscope should be provided |

D REAL TIME OSCILLOSCOPE SUPPORTING OPTICAL MODULATION ANALYSER

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| 1 | Number of channels | 4 |
| 2 | Oscilloscope Bandwidth for Data Acquisition | >= 33 GHz per channel on 4 Channels Simultaneously Upgrade options to be quoted separately |
| 3 | Sample Rate | >= 80GS/s on all four channels simultaneously Upgrade options to be quoted separately |
| 4 | Oscilloscope Noise Floor | <2 mV RMS at 50 mV/div at full Bandwidth |
| 5 | Oscilloscope Internal Time Base Stability | 0.1 ppm + 0.1 ppm/year ageing or better |
| 6 | Sample Memory Per Channel | > =30 Mpts Per Channel on all 4 channels simultaneously Quote for memory upgrade options separately |
| 7 | Bandwidth Upgradability | Quote separately for all upgrade options |
| 8 | Vertical Sensitivity | 1 mV/div to 1 V/div |
| 9 | Timebase Range | 2 ps/div to 20 s/div |
| 10 | Vertical Resolution | > = 8 bit |
| 11 | Other requirements: | <ul style="list-style-type: none"> • Optical Modulation Analysis software for analyzing complex IQ Signals. • Single software for OMA and Oscilloscope. • Capability to access oscilloscope functions through the OMA software. • Must support recording for raw waveforms. • Must support recording of processed waveforms. • Should have the ability to do a play back and analysis at a later stage. • Capability to import user defined DSP algorithms at any stage of DSP chain |

Terms and conditions:

1. All optical connectors should be of FC/APC type.
2. All electrical connectors in the system should preferably be of the same type. Appropriate adaptors with spares to be provided otherwise.
3. Matching cables, terminations and spares for all electrical cables must be provided.
4. Quote should be inclusive of the computer/laptops of appropriate configuration and the software should be preloaded in the system/laptops.
5. Vendor should be able to characterize the complete setup at 32 Gbaud – AWG, Coh Tx, Coh Rx, and RT Scope and do a complete pre-distortion.
6. Vendor should install the entire setup onsite, specifications should be demonstrated onsite and the vendor should provide detailed in-house training to the users.
7. Lead time after the release of PO should be <= 3 months.
8. The vendor must ensure support for the OMA and AWG for cross functioning.
9. Warranty for 3 years from the date of installation, free software upgrade until end of life, support for atleast 6 years after end of life
10. Quotes should include CIF
11. Compliance table should be provided for each item. Technical and commercial bids to be given in two separate sealed envelopes.

Vendor qualifying Eligibility:

1. Authorized Vendor or manufacturer should have well-established repair / service set up in India.
 2. Vendor should be able to attend the repair / fault intimation within 3-5 working days.
 3. Must show evidence of installing similar high-speed coherent communication systems in with R&D Labs /Universities.
 4. Vendor should have capability and expertise to provide training.
- Necessary documents must be provided to support the above.