

ACOUSTIC EMISSION BASED DATA ACQUISITION SYSTEM
WITH SENSORS

A. GENERAL REQUIREMENTS

- a) Acoustic Emission system, used as a non-destructive technique to find defects during structural proof tests, is required for applications with sensors bandwidth (1 kHz – 1MHz) and multiple channels.
- b) Sampling rate is selectable among 10 kHz – 10MHz.
- c) Per channel ADC for each parametric input channels for a wide dynamic range.
- d) Digital filter selection through software for each channel individually.
- e) AE data transfer rate of over 20 Mega Bytes/second to computer.
- f) Built-in AE feature extraction for high speed transient data analysis at high hit rates.
- g) Built-in waveform and hit processing feature in the AE card for high speed transfer of waveforms on all AE channels.
- h) Digital signal processing circuitry FPGA with digital filters, larger hit buffer, larger waveform FIFO buffer for achieving high accuracy and reliability.
- i) AE system shall be able to hold the configuration settings for the similar type of hardware under test.
- j) AE chassis with appropriate industrial ruggedness flow through card cooling, AE Hit LEDs and optional AE audio output compatibility for AE monitoring using sound feedback.
- k) Also one Digital output shall be provided for enabling alarm warning when the user defined set values are exceeding.
- l) Synchronization between multiple chassis and systems is required as per specifications defined. The digital data transfer bus (from input modules to controller) shall be selected to have specifications as defined.
- m) Acquired parameters are also to be transmitted from controller to display nodes using suitable protocol for displaying parameters in the display nodes through Ethernet.
- n) Online monitoring of parameters.
- o) Random selection of channels through input files in online display.
- p) Offline processing of acquired data for further data analysis.
- q) Software package for AE data acquisition, waveform processing, online display, analysis and archival.
- r) Rack mountable system with provision for augmentation.
- s) AE data acquisition system contractor shall provide system architecture drawings representing all elements of the AE system for full channel capacity requirement with their proposal.
- t) AE system shall provide the necessary hardware and software to satisfy the following major

requirements:

- Data acquisition at the selected sampling rate
 - Data display in real time with random channel selection
 - Waveform and hit processing
 - Data storage
- u) System shall have diagnostic features to detect failures.
- v) The party shall provide spares support for a period of minimum 10 years.
- w) Hardware and software compatibility: All equipments shall be of modular design to facilitate interchangeability of parts and to ensure easy maintenance. Plug and play hot swappable of module shall be possible. Any change in hardware versions in future shall have software compatibility with the original AE system supplied.
- x) The chassis, controller, network and software compatibilities shall be selected so that it isexpandable to accommodate future requirements.

B. 100 CHANNEL DATA ACQUISITION SYSTEM

1. SPECIFICATIONS

1.1. Signal Conditioning Requirements

- | | |
|------------------------------------|----------------------|
| 1 AE inputs | : 96 channels |
| a. Input impedance | : 50 Ω |
| b. Pre-amplifier power supply | : 28 VDC |
| c. Frequency response | : 1 kHz – 1MHz |
| 2 Analog input (parametric) | : 4 channels |
| a. Input range | : ± 10 V |

1.2. Signal Processing

- | | |
|-------------------|------------------------------------------------------------------------------------|
| 1. Filter type | : Configurable Low pass/ High pass/ Band passfilter. Programmable through software |
| 2. ADC resolution | : ≥ 16 bit |
| 3. Sampling rate | : Software selectable from 10 kHz – 10MHz. |

1.3. AE card Processing Features

- | | |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------|
| Time of hit | : Range: 0-400 μ s, Resolution: ≤ 1 μ s |
| Amplitude | : Range: 10- 100 dB
Resolution: ≤ 1 dB |
| Threshold | : Range: 15 – 99 dB
Resolution: ≤ 1 dB
Software selectable for each AE-channelindividually. Fixed or floating threshold. |

Rise time	: Range: 0-50 msec or better Resolution: $\leq 1 \mu\text{s}$
Duration	: Range: 0-1000 msec Resolution: $\leq 1 \mu\text{s}$
Signal Strength	: Range: 0- 1.3×10^8 picovolt-sec Resolution: ≤ 3 picovolt-sec
AE timing parameters like Hit Definition Time (HDT) or Duration Discrimination Time (DDT), Hit Lockout Time (HLT) or Rearm Time (RT) and Peak Definition Time (PDT) or Peak definition window (PDW)	: Range: 10 μs – 50 ms or better Resolution: $\leq 1 \mu\text{s}$ Configurable through software
AE timing parameter-Maximum Duration Time	: Range: 1 ms – 1000 ms Resolution: $\leq 1 \text{ms}$ Configurable through software
Automated sensor test feature	: Provided computer controlled pulsing of each active AE channel for determining of sensor coupling efficiency and system verification

1.4. Instrument Controller/ All in one PC along with 19inch rack mountable chassis

CPU shall be high performance latest version with necessary parallel processors having standard control unit and arithmetic logic unit (certified for Industrial Control applications).

1. Chassis: 19inch Rack mountable chassis that can accommodate 96 AE channels, 4 Parametric Channels and other control functions, and need to be communicate with Operating PC with USB 3.0 or higher cable.
2. Monitor: 23.8 inch LED backlit monitor with resolution 1920x1080 or better, kept on PTable with extended VGA cable interface
3. Latest processor: i7 or better, RAM: 8GB or better
4. Hard Disk: 1 TB SSD or higher, DVD-Burner
5. 6 X USB, 2 X 100/1000Base T LAN or latest
6. Operating System: Windows 10 or latest
7. Operating voltage : 230 V AC $\pm 10\%$, 50 Hz Indian plug top / 24V DC

8. Cooling : Fan cooling
9. CE certified and manufactured according ISO 9001
10. Hard Disk Health, Network connectivity status indication
11. LED Indication/ Alarms : System failure & Power ON indication, Temperature Alarm
12. Peripherals : Mouse, Wired Keyboard
13. Operating temperature : 20°C to 40°C

1.5. Time synchronization to get uniform time stamp

1. The party shall mention about the synchronization scheme between multiple chassis and input modules.
2. Chassis to chassis synchronization time error $\leq 1\mu\text{s}$

**1.6. Data Acquisition & Visualization system (Online & Offline) – PC based – 1 no.
- Department scope of supply**

C. AE SENSOR SPECIFICATIONS

1.	Operating frequency	:	100-400 kHz or better
2.	Resonant frequency	:	150 kHz
3.	Shock limit	:	500g
4.	Case material	:	Stainless Steel
5.	Face material	:	Ceramic
6.	Sensor connector	:	SMA/SMC/BNC/Microdot
7.	Temperature range	:	-50°C to 100°C
8.	Weight in gram	:	<40
9.	Automated sensor test feature	:	Must be supported

D. AE PRE-AMPLIFIER SPECIFICATIONS

1.	Preamplifier gain	:	40dB
2.	Filter Bandwidth	:	32-1100 kHz
3.	Input Impedance	:	$\geq 10\text{k}\Omega$
4.	Power requirement	:	28 VDC
5.	Output connector	:	BNC
6.	Output Range	:	$\geq 10\text{ VPP}$ at 50Ω
7.	Sensor coupling test through software	:	Must be provided
8.	Weight in grams	:	≤ 160
9.	Temperature Range	:	-40°C to 65°C
10.	Suitable cable to connecting AE sensor to Preamplifier	:	Must be provided (Maximum length-100 cm) proved with end connectors compatible for sensor at one end & pre-amplifier at the other end
11.	Automated sensor test feature	:	Must be supported

E. SOFTWARE REQUIREMENTS

Configuration settings

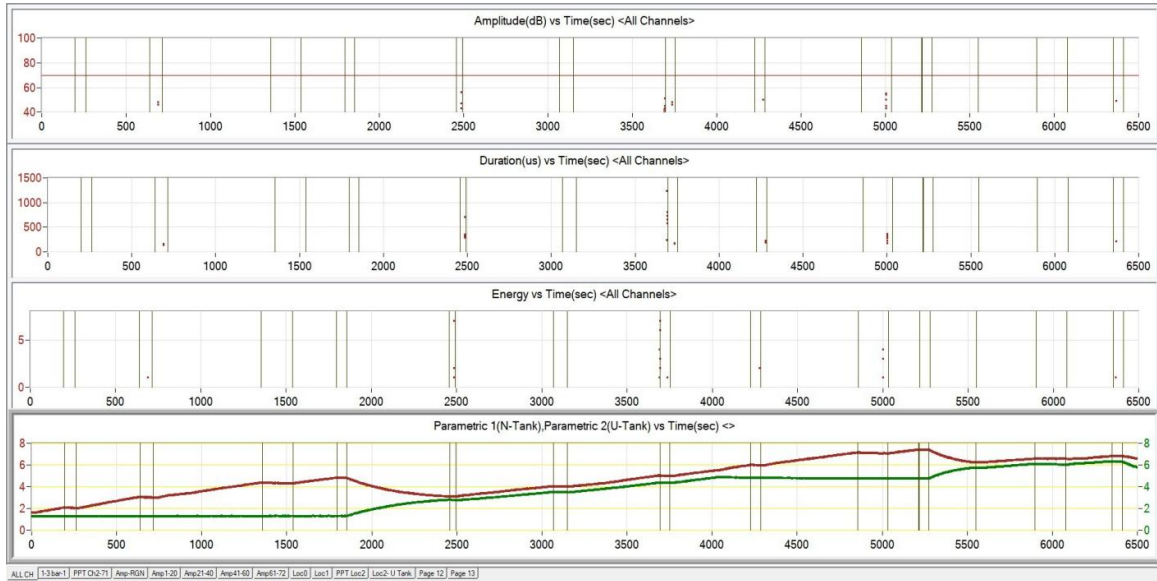
- a) The acquisition software shall be capable of scanning the selected user required channels at user required sampling rate.
- b) Channel legend, description, gain and filter settings, type of voltage Input ranges and other programmable features shall be user selectable.
- c) All configuration setting shall be done through system Controller and remotely at control room through data processing node.
- d) Configuration updation shall be done during start-up.
- e) The AE system configuration setup shall be saved and can be loaded for AE acquisition.
- f) Up on power failure or system restart, the last set configuration shall be retained.

Acquisition Software

- a) Acquisition software for AE monitoring should continuously acquire and store the AE parameters in a reproducible format.
- b) Acquisition software shall be running in the AE monitoring system kept at CTR located nearly 400m away from Control room. The acquisition software shall be capable of being operated remotely. Acquisition ON/OFF and recording/file writing shall start manually from CTR and remotely from control room through data processing node.
- c) Acquired data to be transmitted to display nodes.
- d) Data shall be stored in controller hard disk/PC.
- e) Controller shall have sufficient storage capacity for storing the sampled data for 12 hours continuously.
- f) Windows operating system environment.

Online Display

- a) The online display shall be provided to the display node.
- b) The online display shall be of graphical form. Various graphing options shall be available and shall be selectable per AE channel.
- c) Each parameter to be displayed individually or in group on the display node. The graphical display shall start manually (keyboard control).
- d) The graphical display shall have different scales for each parameter and shall have multiple parameters per screen.
- e) Multiple tabs at a time for displaying a group of channel parameters shall be possible and the graphical change over to different screen shall be manually (keyboard control).
- f) Time line display for the AE hits occurred per selected channels shall be available. Time line display for an AE signal is shown below.



Offline Processing

- a) Offline processing of selected channels with selectable filters shall be possible.
- b) Offline processing shall be possible in graphical format.
- c) There shall be possibility of having data segmenting setup; the required functional ranges of acquired AE data can be filtered for effective noise removal.

F. LIST OF ITEMS REQUIRED (BILL OF MATERIALS)

Sl. no.	Item description	Qty (no.)
1.	100 channel Data acquisition system	1 Set
1.a.	Acoustic emission sensor based inputs	96
1.b.	Parametric based Analog inputs	4
2.	Instrument Controller/ All in one PC along with 19inch rack mountable chassis	1 Set
3.	Acoustic emission sensor	50
4.	Acoustic emission preamplifier	50
5.	Acoustic emission sensor preamplifier connecting cable, 1000 mm long	50
6.	Application Software - Data Acquisition & Visualization	One pack
7.	Driver Software and Life Time Licenses	
7.a.	Data Acquisition & Visualization (Online) Module	1 user license

Sl. no.	Item description	Qty (no.)
7.b.	Data Visualization (Offline) Module	3 user licenses
8.	Accessories like Connection boards, Connectors, system cables, power cable , other interconnecting cables & Consumables	As required based on specifications
9.	Hardware and Software operational manual along with specification (hard copy + softcopy in CD)	One set

G. PROCUREMENT CONDITIONS-TECHNICAL

1. The manufacturer must have at least ten years experience in the field of manufacturing multi-channel Data acquisition & control system. If the item is from a foreign manufacturer, the Indian Agent should be in a position to take care of supply & all post-installation supports such as service/ maintenance, upgradration & procurement.
2. Product brochures with specifications, model nos. and part nos. are essential. Offers without product brochures will not be considered.
3. Block diagram representation which explains the system configuration is required.
4. Specification compliance statement to confirm meeting of specifications should be provided along with the offer.
5. Bill of materials with product model nos. & quantities satisfying the system configuration shall be submitted.
6. All commercial terms related to this procurement mentioned in our e-Tender shall be clearly answered. Cost breakup shall be given to know cost details of every item mentioned in the BOM.
7. A copy of software, driver software, operating system, Installation & Operation manuals shall be provided. Similarly for the Hardware of the AE system, Installation & Service manuals shall be provided. The manuals shall be supplied as Hard & Soft copies.
8. Software shall be supplied in DVDs along with operational manual, Driver Software and Life Time License for Data Acquisition & Visualization(Online) and Data Visualization (Offline).
9. The Software package shall take care of all our requirements. During Development phase, mutual interactions and clarifications can be done to meet the customization requirements.
10. Guarantee/Warranty for Hardware & Software of the system shall be provided for min. 3 years from the date of commissioning. During the guarantee period, full

Hardware & Software related supports are to be provided and all software updates (or upgrades) are also needed to be provided at free of cost.

11. AE system Test certificates & Calibration charts for Sensors/ Preamplifiers shall be provided.
12. The party shall demonstrate the entire system performance and functioning at Department site.
13. The minimum requisite spares, if any, that need to be stocked for trouble free operation for 5 years shall also be offered separately. The cost of spares shall be considered while arriving at L1 supplier. The spares should take care of day to day operations and the NAMC requirements.
14. The vendor shall take up the installation and commissioning of the system at site.
15. The system shall be accepted by Department, only after satisfying system performance and functional tests as per specifications.
16. Supplier has to give operation training at department site.
17. All service related calls shall be attended within a period of 3 days.
18. Items required to be supplied by LPSC(B) shall be mentioned and discussed.
19. The preferred Delivery/ Work execution period is 4 months.
20. Options shall be quoted with BOM & Cost details.

H. Pre-Qualification Criteria

1. The tender is public with two parts through ISRO EGPS to our empanelled vendors & open for the Public. Registration with EGPS is compulsory. The two parts are called as Techno-Commercial bid (part-I) & Price bid (part-II).
2. Any vendor with substantial experience in the field of manufacturing and commissioning of exclusive Acoustic emission testing systems with 96 AE channels or more in India or abroad or an agent for distributing and commissioning such systems and well versed in solving the problems related to the software/hardware electronics of the system are eligible to supply and submit their offers against this commercial bid. Documents shall be submitted as a proof.
3. The vendor or the principals shall have minimum 10 years previous experience in supply/ installation /demonstration / training of the exclusive acoustic emission testing system and software. Documents shall be submitted as a proof for above.
4. Supporting documents like certificates, copy of the previous Purchase order etc. need to be furnished along with the quote for verification.
5. The vendor shall arrange for a free demonstration of the capabilities of the offered system to the technical committee for assessing the performance, if necessary.
6. The supplier has to demonstrate all the functions of the system as per the

specifications on demand during the installation at LPSC (B).

7. The party has to mandatorily give a local content declaration. The local content is defined as “The amount of value added in India which shall be the total value of the item procured (excluding net domestic indirect taxes) minus the value of imported content in item (including all custom duties) as a proportion of the total value, in percent”