

Annexure-1

Technical Specifications

1. Proposed system :

Considering the limited space availability in the test rig area, portable compact table top system with integrated computer and monitor is proposed for the above data acquisition system. Proposed system shall be capable of operating at non-air conditioned environment.

2. Scope of work :

End-to-end system engineering, Design, development, integration, wiring and commissioning of Portable and compact table top data acquisition system with integrated signal conditioner. Above scope of work shall include development and supply of genuine Windows based user friendly software with GUI and necessary computer systems.

3. Salient features of the proposed system :

- a. Data Acquisition System with Integrated Signal Conditioning shall be a single standalone configuration. Usage of external signal conditioner is not acceptable.
- b. Data acquisition start/stop automation shall be possible.
- c. All hardware & software shall be of the latest state-of-art technology, field proven models/versions.
- d. Sampling rate shall be selectable among DC-200 Ks/Sec or better.
- e. All hardware used shall be modular, expandable and easily stackable.
- f. Each channel shall have individual Analog to Digital Converter (ADC) for digitizing the analog output signal of field sensors and ADC shall be a part of Signal Conditioning Module.
- g. TEDS Support shall be available for all channels.
- h. Digital Input/output module for commanding of Flow Control Valve.
- i. D-sub/Circular connector with suitable locking mechanism shall be provided for DAS input card connector. Mating connector also to be supplied.
- j. The digitized data shall be stored in DAS controller hard disk as well as in data processing and display node.
- k. Customized Application software shall be developed & installed in the data processing and display node. Software shall be developed as user friendly with state-of-art GUI and shall be free to use in different computers along with DAQ modules. Software should support for addition of channels, if required in future.

- l. The system configuration and capacity should be able to acquire and store the required channels in the maximum sampling rate for the continuous duration of at least 8 hours, with multiple files for quick processing and retrieval.
- m. The data acquisition software shall have provision for on-line processing and monitoring of parameters (mV/Engineering Unit), on line trend graph display, off line processing and analysis.
- n. DAQ should support transient acquisition and analysis.
- o. Real time high speed camera interface should be provided in synchronous with data acquisition.

4. Data acquisition requirements :

- a. No. of channels required : Min. 64 channels (**with provision for future expansion**)
- b. Each channel shall be isolated.
- c. **Data resolution : 24 bit or better**
- d. There shall be a provision to connect high speed video camera (for future requirement)

Details of Sensors / Channels to be acquired			
S.No	Description	Signal / Type	Channels
4.1	Pressure transducer output	0-20 mV @10 V excitation	5 Nos.
4.2	Load cell output (Model : HBK MCS10 – BG3 200)	Tri-axial load cell – 6 Nos. (Sensitivity : 1.5 mV/V) Excitation voltage :1-12V	20 Nos.
4.3	Displacement (Ratio metric AC LVDT) +/- 125 mm Meggit/Sensorex	V rms (sensitivity : 5.5 mV/V/mm)	2 Nos.
4.4	Temperature sensor - RTD	Std Sensors: Pt100 / Pt200	6 Nos.
4.5	High speed video camera and audio interface	High speed video camera	1 No.
4.6	Strain gauge (350Ω)	Double element rosette strain gauge - 350 Ω	10 Nos.
4.7	Solenoid valve powering	Automated powering (ON/OFF) of solenoid valves (28V supply)	5 Nos.
4.8	Accelerometer	Std IEPE type	6 Nos.
4.9	Limit switch status monitoring	Acquisition provision for limit switch status (NO/NC)	9 Nos.

Note: Standard modules and its multiples with nearly equivalent channels may be considered

5. Scope of Supplier/Service Provider :

- a. Procurement of all items related to ISC-DAS (Integrated Signal conditioner-Data Acquisition System) and realization
- b. Integration of hardware & Installation of all required software.
- c. Provide necessary Excitation voltage (Programmable) for all the above sensors.
- d. Installation, commissioning, testing of the system at VSSC
- e. Providing required documentation and impart training.
- f. **All the sensors and load cells along with connectors (sensor side) shall be provided by VSSC** and wiring from sensor to DAQ shall be done by the party. Approximate 35m cable length may be considered for wiring requirement.

6. Specifications for DAS and Controller :

S.No.	Description	Specification
6.1.	Type of configuration	Portable and compact table top integral Chassis to accommodate 8/16 channel ADC cards and processing unit with integral data storage.
6.2.	Input Power	220-230 VAC, 50-60Hz
6.3.	Power Dissipation	Less than 350W
6.4.	Cooling	Suitable cooling for panel/chassis to be provided
6.5.	Indications/alarms	Temperature alarm, system failure, power on
6.6.	Connectors	Suitable mating connectors to be provided for all channels separately. Preferably D-sub/Circular connector with suitable locking/fastening provision
6.7.	Operating temperature	10 to 50°C
6.8.	Humidity	50 to 95% non-condensing
6.9.	Shock & vibration	Shock : EN60068-2-27:2009 or better Vibration (Random) :EN6071-3-2:1997 or better
6.10.	Controller	Integral Embedded controller holding the ADC cards with built-in storage.
6.11.	Processor	Intel Core i5 or better processor - 64 bit
6.12.	RAM	8 GB or higher
6.13.	Secondary memory	SSD 512 GB or higher
6.14.	Processor speed	2.5GHz or better
6.15.	Communication interface	Gigabit Ethernet / LAN.
6.16.	Data Interface	USB 3.0 (Minimum 4 Nos.)
6.17.	Operating system	Windows 10 or higher (64 bit)
6.18.	Digital data interface	Dual Ethernet data outputs for main and redundant network

6.19.	Ethercat interface	Each controller should have dedicated ethercat interface for external hardware/control unit interface
6.20.	Display	17" or higher Integral LED touch display for the ease of operation
6.21.	Weight & Mobility	Total weight of the unit: < 25 kg (including all modules) A water proof rugged carry case shall also be provided for storage and transportation to different locations.

7. Specification for Digital bus

Sl. No.	Description	Specification
7.1	Digital bus	PXI/ PXI Express /VXI /LXI/ EherCAT/Proprietary bus
7.2	Bus throughput rate	≥ 100MBytes /second
7.3	Synchronization clock	≥10MHz between all input cards/Chassis.

8. Specification for Universal input Signal Conditioner module :

SN	Description	Specification
8.1	Input Modes	Voltage, 120Ω & 350Ω Quarter Bridge Strain Gauge, 350Ω Half Bridge Strain Gauge, Full Bridge, Potentiometric Sensors, Current (direct or using shunt), IEPE interface, Charge interface, LVDT interface (AC Ratio metric LVDT),RTD interface (Sensors: Pt100, Pt200, Pt500, Pt1000, and Pt2000,)
8.2	Bridge completion	Quarter Bridge 120Ω & 350Ω internal completion must be supported and there should not be any external bridge completion network.
8.3	Voltage input	±10V, ±1V, ±100mV, ±10mV
8.4	Number of channels	8/16/32 channels per card
8.5	Input configuration	Differential or Single-Ended. Should be selectable in the hardware and software
8.6	Common Mode Rejection	100 dB or better
8.7	Input Impedance	10MΩ or better
8.8	Channel Cross Talk	Better than -120 dB @ 10kHz
8.9	Noise Floor	Better than -100 dB @ 10kS in ±10V Range
8.10	Dynamic Range	Better than -120 dB @ 10kS in ±10V Range

8.11	Gain Accuracy	Better than $\pm 0.1\%$ of reading
8.12	Anti-Aliasing Filter	Analog Anti-Aliasing Filter is required for individual channels and shall be selected automatically.
8.13	Configurable Digital Filter	10 pole digital filters with programmable cut-off frequency up to 50kHz and configurable filter prototype (Bessel, Butterworth, and Chebyshev) should be available.
8.14	Isolation	Channel to Channel and Channel to Ground, channel to excitation. Isolation should be integral part of the card.
8.15	Isolation voltage	≥ 1000 V
8.16	Common Mode Voltage	+/- 500 V (Max.)
8.17	Quantity	Individual ADC for each channel. The ADC shall be part of signal conditioner module.
8.18	Type	Delta-Sigma or SAR
8.19	Sampling rate	DC-200 KS/second - selectable.
8.20	Resolution	24-bit or better
8.21	Excitation Voltage Levels	Programmable from 0 thru 12 VDC. (16 bit or better DAC) Resolution : 1 mV or better
8.22	Excitation Voltage Accuracy	Better than $\pm 0.1\%$
8.23	Excitation Current Limit	45mA or better
8.24	Excitation isolation	Should isolated by ≥ 500 V
8.25	Excitation Protection	Continuous short to ground
8.26	Remote Sense	Remote sense of excitation voltage for individual channels.
8.27	Protection	Short circuit & short to ground detection and isolation of the affected channel.
8.28	Excitation Stability	Better than $\pm 0.1\%$ (for a period of 24 hours)
8.29	Bridge configuration - Input Types	Quarter (3-Wire), Half Bridge (3-Wire & 5-Wire), Full Bridge (4-Wire & 6-Wire).
8.30	Bridge Range	Up to 1000 mV/V free programmable.
8.31	Bridge Completion resistor	120 and 350 Ω internal resistors shall be part of the module. Resistor accuracy : 0.05% or better

8.32	Internal Shunt Calibration	To be done using software for all channels together or on individual channel basis. Both Internal and External Shunt Calibration should be supported. During shunt calibration, percentage of deviation should be monitored.
8.33	Lead Wire Compensation	Lead Wire Compensation should be supported. Lead Resistance before and after compensation should be monitored and adjusted.
8.34	Transducer Electronic Data Sheet (TEDS)	Should be supported for all channels.

9. Specification for Digital input/output & counter module :

Sl. No.	Description	Specification
9.1.	Type	TTL
9.2.	No. of channels	8 DIO+2 counters
9.3.	Output Current	20mA Continuously
9.4.	Isolation	Channel to Channel and Channel to Power Supply and Channel to chassis
9.5.	Isolation voltage	>500VDC.

10. Provision for Real time Synchronised High Speed video recording :

Sl. No	Specification
10.1.	DAQ should support synchronous high speed video recording during acquisition. The frames rate should support 1000 FPS or higher
10.2.	Hardware support for video recording shall be provided.
10.3.	Audio recording transducer and playback provision along with input data should be possible. Audio and video shall be fully synchronized with other channels.
10.4.	Both low speed and High speed Camera recording provision should be supported and hardware /Software should support the feature of multi channel acquisition during recording and play back with different frames rate starting from 1frames/sec to 1000FPS.
10.5.	The functionality for the above shall be demonstrated by existing camera available at VSSC.

11. Specification for Application Software :

- a. Provision for entering CALIBRATION CONSTANT (up to 4th Order Polynomial) in the configuration window.
- b. Software shall have the provision for piece wise linearization (20 points) for temperature measurement channels.
- c. The configuration file shall be saved in retrieval format for further reference.
- d. Separate screen shall be made for displaying the health/ status of controller, servers, input modules, network switches and other systems.
- e. The acquisition software shall be capable of scanning the user selected channels at required sampling rate.
- f. Channel legend, description, gain and filter settings, type of voltage Input ranges, excitation, first & fourth order constants for engineering unit conversion and other programmable feature shall be user selectable.
- g. Logging of set configurations in notepad or in spreadsheet format.
- h. All configuration setting shall be done through system Controller and remotely at control room through programming node.
- i. Configuration update shall be done during start-up.
- j. For strain measurements, software-based temperature compensation (using fourth order constants) and material compensation shall be possible.
- k. The software should acquire and synchronize high-speed video data with analog input data.
- l. The acquisition software shall be capable of being operated with acquisition ON/OFF and file writing ON/OFF features and shall be possible controller and remotely from control room through data processing node.
- m. Data shall be stored in controller hard disk/PC and in servers (Multiple file creation based on size and manual selection)
- n. Linux/Windows operating system environment.
- o. Calibration of microphones should be possible from the software using sound calibrator.
- p. Audio recording and replay at different speed levels should be possible.

12. Features of Online Display :

- a. The online display shall be provided to all display nodes.
- b. The online display shall be of graphical and numerical form (user selectable).
- c. Field parameter values to be displayed in the display node with 500ms update for data display and with 100ms update for trend display.
- d. Online FFT tool for online analysis.
- e. The engineering Unit (EU) or Voltage selection shall be made available in the numerical display and graphical display.

- f. The graphical display shall start manually (keyboard control) or based on countdown clock/synch signal or time based.
- g. The graphical display shall have different scales for each parameter and shall have four parameters per screen.
- h. The numerical and graphical display shall have the option for colour change when threshold limits are reached.
- i. Graphical display with predicted graph at background (Lower and upper boundary values shall be accepted as input from excel file format).

13.Features for Offline Processing :

- a. Offline processing of selected channels in Engineering unit or Voltage also in numerical and graphical format, shall be possible.
- b. Parameters constants (1st order and 4th order) for engineering unit conversion shall be accepted from separate input file (data base).
- c. Mathematical and statistic analysis tools (like FFT analysis, RMS plot, Time Domain plot, Average, Min, Max, and Curve Fitting) shall be available for analyzing offline processed data.

14.General Terms and Conditions :

- a. Full system engineering with respect to the specifications given by VSSC is the responsibility of the vendor.
- b. Detailed design document shall be provided to VSSC and approval shall be obtained before processing. Design document shall include detailed technical specifications of the modules, features, overall architecture etc.
- c. Complete wiring diagram and set of documents which includes, data sheets for the accessories or modules used, user manual, warranty certificate, calibration certificate etc., shall be provided to VSSC, upon completion of installation and commissioning.
- d. Experience of successful execution similar systems to other Govt / PSU organisations or ISRO centers are mandatory and details of the same shall be provided for verification.
- e. Entire features mentioned in the specifications shall be demonstrated during commissioning and necessary training shall be provided to VSSC team.
- f. All the sensors, solenoid valves, limit switches etc. shall be provided by VSSC and necessary wiring for the above is the responsibility of the vendor.
- g. Calibration of the entire system after connecting with the sensors and accessories is the responsibility of the vendor and duly approved calibration certificate shall be provided to VSSC, if applicable.

- h. Minimum 3 year onsite warranty is mandatory.
 - i. **Delivery:** Items shall be delivered to VSSC, within 03 months from the date of receipt of P.O and installation activities shall be completed within 01 month from the date of site clearance from VSSC.
 - j. Technical support for maintenance/repair of the modules/accessories used shall be available in India and supplier has to ensure the same.
 - k. All the modules and accessories shall be of latest model at the time of supply, obsolete/out dated models are not acceptable. Vendors shall ensure the availability of spare parts or similar model modules/accessories in the market for minimum period of 5 years from the date of supply, if required for maintenance. Vendors should take the responsibility to arrange equivalent model items for replacement or up-gradation, in future.
 - l. Standard off the shelf items which are closely matching with the VSSC specifications shall also be considered for evaluation.
 - m. Technical Support for annual maintenance of the entire system shall be provided by the vendor. Charges for AMC (Annual Maintenance Contract) for minimum 5 years, shall be quoted separately along with price bid, which shall be mentioned in the purchase order and separate order for AMC shall be released after warranty period, if required. AMC charges shall not be considered for price bid evaluation.
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