ATTACHMENT
N65540-04-A-0465

Specifications - Portable 16 Channel Data Acquisition System

1. **Mechanical Configuration**
   The system must meet the following minimum requirements:
   a. Display – must be at least 17" diagonal size with 1280x1024 pixel resolution
   b. Display – must be of the flip-up style (like a notebook PC), so that it can be closed during non-operational times and completely protected from all sides
   c. Display – must be of the flip-up style so that it can be tilted at any viewing angle without the need to tilt the instrument itself
   d. Signal inputs – Must be accessible from the front side of the instrument. Rear or side signal input connectors are not acceptable
   e. Hard drive – must be internal, IDE type, at least 160 GB
   f. Interfaces – must include at least USB 2.0, Firewire (IEEE-1394), serial (RS232), and Ethernet (10/100/1000 base Tx)
   g. Size – the entire machine including keyboard and display (in closed position) must not exceed 18.5 x 14 x 8 in.
   h. Weight – must not exceed 20 kg (44 lbs)
   i. Battery operation – must have an optional battery pack which allows the unit in its DC-powered configuration, to run for approximately one hour without access to AC power
   j. Minimum system Memory 1024MB
   k. Minimum (CPU) Processor Intel Pentium 4 processor at 3.06 GHz
   l. Windows XP professional, installed
   m. Internal Sound card should be installed and tested
   n. Must have minimum 16 internal amplifier slots, digital I/O connector
   o. DVD writer must be included-performance DVD-R Read/Write, DVD-R Rewrite, CD-R Read/Write, CD Rewrite.
   p. Must have 16 channel PCI A/D board, 12 bit resolution, 1.25 MS/s aggregate

2. **Recording and Power Analysis Capabilities**
   The system must meet the following minimum requirements:
   a. Must perform three-phase power analysis (4 voltage and 4 current inputs) at any frequency up to 400 Hz.
   b. System must have a software or hardware phase lock loop to ensure that phase and RMS calculations are correct on a cycle-by-cycle basis.
   c. System must calculate, display on-line, and record to disk at least the following:
      i. a "vector scope" (phasing diagram) with selectable phases and inputs
      ii. a harmonic display with selectable FFT diagrams and phases
      iii. a cycle-by-cycle graph updated continuously, which shows all data
      iv. All calculated power values, including RMS voltage and current, watts, and VAR's.
      v. Harmonic distortion of any and all phases, displayed in either percentile or absolute value
   d. System must be able to also perform on-line acquisition from video cameras and sensors simultaneously and in synch
   e. System must be operable in a stream-to-disk and triggered mode
   f. When performing power analysis, the base frequency of the incoming signals will be tracked and the effective sample rate adjusted continuously to provide for phase accurate RMS and power readings
   g. System must be able to replay data captured in the continuous acquisition mode, at a 1:1 time ratio to the screen.

h. If audio is recorded via one of the analog channels during data acquisition, it must be available to be replayed in synch with the data during playback, via speakers which are built in to the system

3. Storage Capabilities

The following capabilities are firm requirements and must be met in order to make the system acceptable and useable for this application:

a. Storage – data must be stored to internal HDD on a continuous basis
b. Triggering – pre and post trigger durations must be easily selected via the setup screens, and data shall be stored according to these settings even when written to the hard drive
c. Storage space – the system hard drive must be at least 160 GB in capacity, so that at least 120 GB is available for data storage
d. System must allow a firewire external hard drive to be connected for data capture and/or transfer. Data capture to external HDD must be available up to 100 kS/s continuously and without interruption, as long as there is space on the HDD.

4. Signal Input Capabilities

The system must provide three basic signal input types and groups, in accordance with the following characteristics:

a. Dynamic Signal Inputs - Must be capable of recording at least 16 dynamic (AC) voltage waveform signal inputs at the same time
    i. Dynamic signal inputs must be via BNC, banana, or DUSB connectors on the front of the instrument itself – no additional expansion boxes can be attached
    ii. Each Dynamic signal input must be differential (neither side referenced to ground or any other channel)
    iii. Each Dynamic signal input must have software selectable input ranges and filters
    iv. Each Dynamic signal input must have at least ±350V over-voltage input protection and 1000 Vrms isolation (channel to channel and channel to ground)
    v. 8 ea Plug-in modules for High voltage and 8 ea Plug-in modules for Medium voltage are required for the following sensors and signals: **HIGH VOLTAGE** with up to ± 1000 V full-scale range selectable; **VOLTAGE AND CURRENT** up to ± 50V full-scale, for direct connection of current transformers/clamps/shunts which provide a voltage output; **F/V tach/pulse** signals from 100 Hz to 100 kHz, which will be converted to a voltage proportional to the incoming frequency. This F/V input module must have auto-trigger level detection, whereby it can identify the ideal trigger level for an incoming frequency signal and set automatically to it.

    vi. In addition, plug-in modules compatible with this system must be available and off-the-shelf for the following signals and sensor types: **strain gages** in full, half, or quarter bridge configuration, with programmable auto-balance, bridge completion, excitation voltage, shunt cal, zero cal, range, and low-pass filter; **constant current accelerometers** with selectable mA source current and ranges; charge accelerometers with programmable range and filtering; **LVDT's**, **RTD's**, and **potentiometric** and/or **ohmic** sensors from 100Ω to 10 kΩ sensitivity full-scale.

b. Quasi-static temperatures from these sensors:
   i. **THERMOCOUPLES** (J, K, T at a minimum) with built-in cold-junction compensation and linearization. Each thermocouple signal conditioner must be plug-in interchangeable with the single-channel dynamic modules in the previous section, and provide eight (8) thermocouple inputs per module.
   ii. In addition, it must be possible to connect an (optional) alternate break-out box to the 8-channel thermocouple signal conditioner, which allows 8 **RTD** sensors to be connected in lieu of the thermocouple sensors.

c. Furthermore, all required signal conditioning features from all signal conditioners must be software selectable within the acquisition software.

5. Data Sampling – Analog Inputs

Must contain two A/D cards, in accordance with the following specifications:

i. **Dynamic A/D Card** – System must include a 16-channel A/D card for conventional data acquisition and power quality analysis. This card must have an A/D subsystem with an aggregate sample rate of at least 1.25 MS/s, at 12-bit resolution. This board must provide also 8 digital I/O lines, two 24-bit counter-timers, and be fully supported within the data acquisition software installed on this system. Maximum time skew between channels must be within 5 us.

ii. **Transient Capture Card** – System must include an 8 channel A/D card with separate ADC's per channel for transient capture recording, with 1 MS/s/ch (one million samples per second per channel) sample rate capability. This board must have 12-bit resolution, 8 input ranges from ±50 mV to ±10 V, 8 MS (8 million samples) of on-board memory, expandable up to 256 MS. This board and its firmware must include a FIFO mode, channel trigger, external TTL trigger input/output, external TTL clock input/output, pulse-width trigger, window trigger, Steepness trigger, and OR trigger. The input impedance must be selectable to 50 Ω or 1 MΩ.

6. Input Setup User Interface and Capabilities

The system must provide a graphical user interface for setup and control of all operating parameters. These include, at a minimum:

i. Input calibration/scaling to engineering units, either by direct numeric scale entry, or via push-button calibration to incoming high and low calibration signals.
ii. System must also provide push-button calibration to incoming AC calibration signals via an RMS calibration function
iii. Selection of which input signals to monitor and record, selection of sample rate from all available possibilities, trigger level(s), and pre/post trigger parameters
iv. Set-up and monitoring of high/low alarm levels for each input
v. Saving of all setup parameters, including scaling and input calibration to an unlimited number of configuration files. Files can be saved and reloaded in the future in order to reduce setup time. Setups can be copied from one instrument to another and loaded
vi. Set-up and monitoring of mathematically derived channels using a high-level formula builder. Single and multi-channel operations must be possible, such as multiplying two channels together, and math, algebraic, and logic functions. In addition, constants must be able to be

defined and used within the expressions, for example:

([input1] * [input2]) / 123.4
where
123.4 is a user-defined floating point (or integer) constant

The resulting channels shall be viewable in the software and also able to be stored with the analog and digital data. built a formula parser where the operator can type in a formula. The operators & parameters must include at least:

1. Arithmetic functions (add, subtract, multiple, divide)
2. Square root and power (sqrt, ^)
3. Trigonometric (sin, cos, tan, asin, acos, atan)
4. Absolute value (abs)
5. Logic (=, <, > at a minimum)
6. Brackets (parentheses), for separating sub-expressions for independent evaluation

7. Data Display Capabilities, Data Acquisition Mode

The system must provide data displays of the following types, at a minimum:

i. Meter display – each input shown in a meter or bar graph, which can be set to display incoming data as an actual value, RMS value, AC RMS value, running average, minimum, or maximum value. It must be possible to show an image in the background of the display, which can be any jpg, gif, or bmp, and position the meters freely above it. This is important to create a graphical display of a system test, with clear indication of the location of all sensors and signal pickups. It must be possible to set high/low alarm levels on each input, which will cause the input to change color when the conditions are met.

ii. Video monitoring and recording displays - It must be possible to attach a Firewire or USB 1.1 or USB 2.0 "web camera," or PCI/external frame-grabber card, to the system and input a video feed. This video feed must be able to be sized and positioned anywhere on the Meter display, or shown on a separate video display

iii. Scope display – at least four oscilloscope graphs with independent time axis controls, each one of which can display up to four channels. Each independent scope graph must be selectable to free run, normal, or auto mode, and have trigger level and pre/post trigger levels selectable when in the normal or auto modes.

iv. Recorder display – must be able to display data in the traditional "strip chart recorder" mode of 8 vertical traces. The time-base/scroll-rate of this display must be user-selectable. It must be possible to stop the data from moving in order to zoom in on data from several minutes before, without interrupting recording. When this function is being used, the system must provide bar graphs that show the "live" or current input signal conditions. It must be possible to set high/low alarm levels for each input, and the system must indicate graphically whether these levels have been met or exceeded during a test, and provide an easy way to see exactly when the conditions were met or exceeded, and what the signal level was, without interrupting recording.

v. Video+Data display – must be able to display both signal input data and video data from any standard USB camera or video source, within a single display. The video window should be sizable, and the data must

be displayed below or above it in a horizontal strip chart fashion. The user must be able to choose which signal inputs are displayed in the strip charts, up to at least four inputs.

8. Printing Capabilities

a. The system software must allow captured data to be printed immediately after acquisition, in full-color, using any locally connected or network-connected industry standard printer
b. No special or proprietary paper or printers will be considered
c. Any Windows-compatible printer shall be connectable locally via either EPP parallel port interface, or via USB
d. Any Windows-compatible printer can be connectable remotely via standard Ethernet connection using TCP/IP and other standard Windows protocols.

9. Report Generation Capabilities

a. The system software must allow captured data to be reviewed on-screen immediately after acquisition, in full-color, using on-screen cursors for making measurements and altering the time-axis to "zoom in" on areas of interest and spread them out across the maximum useable width of the display.
b. The system software must provide easy exporting of the data to a variety of data formats, including: Microsoft Excel, Matlab, National Instruments Diadem, and delimited ASCII text format.
c. Video data acquired must be exportable to the Windows standard AVI multimedia format, and must include also the waveforms in a graph below the video window
d. The system software must be capable of saving or "trimming" a file to a subset of the original data file in its native format, as a means of reducing storage requirements.
e. The system software must be a stand-alone Windows program which can be installed on any computer in our facility, license and royalty-free, to facilitate the off-line analysis of acquired data by a wide group of users. All functions of the analysis portion of the system software must be useable when installed on any Windows PC, and when a data file is loaded into it, including report generation, zooming and on-screen measurements, printing of data files, and exporting selected data to other file formats.
f. The system software must be able to be given freely to any customer who receives data acquired by this system, without any license or royalty requirement. We intend to copy data and the system software onto CDROM media and distribute it to customers for their review, and there must be no technical or legal restriction or prohibition for us doing so.

10. Additional Interface cards

a. The system must be compatible with an IRIG/NASA time code card, and the software must obtain range time from this card in synch with the acquisition, in order to ensure that recorded data is properly time-stamped with up to 1 us resolution
b. It should be possible to add additional PCI interface cards in the future as our requirements develop.

11. General Physical Characteristics:

a. Operating temperature range of at least 25° F to 110° F
b. Shock and vibration capabilities in accordance with MIL-STD-810F or better
c. Power Input

i. Must operate from standard 120 VAC @ 60 Hz power
ii. Must be able to also operate from 120 VAC @ 400 Hz power; and 240 VAC 50 Hz power
iii. A standard IEC power cable must be provided for use in North America

d. Accessories
i. The system must include any and all operators manuals for the hardware and software, in both hard copy and electronic (PDF, MS-WORD, or HTML) formats.
ii. The system must include a vinyl carrying bag for local transportation, and to protect the built-in display when the system is not being used
iii. Common carrier rated, Hard shipping case with pull-out handle, wheel locking hasps and custom foam insert inserts must be provided

12. External Attachment:

a. 1 ea USB camera for adding video documentation to recorded data. Cable should be included and driver should be installed.
b. 1 ea Temperature Expansion Module-8 channel high precision thermocouple amplifier, RS-484 Interface 8 differential input channels, 8x 24 bit A/D converter, up to 6 samples/sec/channel, simultaneous sampling, 350 V isolation between channels, Thermocouple type K, Accuracy ± 0.5 °C typ. ± 0.2 °C. Cable 0.5 m cable from EPAD-BASE to EPAD-TH8 or from one EPAD-TH8 to the next EPAD-TH8.
c. Current Probes & Accessories
1. 8 ea 48" AC Current Probes with Switch Selectable, 6000/600 A, 40-20kHz, 1% Accuracy.
2. 8 ea 2" Window AC Current Probes with Switch Selectable 1000/100/10 A. 40 - 5kHz, 1% Accuracy
3. 8 ea Small CT Secondary Current Probes with Switch Selectable 200/20 A, 40 - 5 kHz
4. 6 ea Mueller (5656-B) Insulated BNC Cables (Male/Male)
5. 2 ea 15 feet Silvertronic (X062398-1) Voltage Lead Bundles 1000 V Cat III
6. 4 ea HCK XKF-414 (66.9012-200) Silicon Insulated Safety Banana Leads 1000 V Cat III, 200 cm
7. 16 ea Silvertronic (126024) Safety Alligator Test Clip 1000 V
8. 16 ea HCK (66.9121) Grip-Ci Grabber Safety Test Clip 1000 V Cat III
9. 16 ea HCK (66.9116) Grip-A Sprung Hook Safety Test Clip 1000 V Cat III
10. 8 each HCK SLK (28.0097-025) 410-SI 1 Foot Safety Banana Jumpers
11. 6 ea Mueller (32703) Safety Banana to Insulated BNC Adapter
12. 8 ea Mueller (BU-32601) Safety to Safety Sheathed Banana Coupler
13. 6 ea Pomona (3283) BNC Barrel Adapter (Female/Female)
14. 1 ea ESA Safety Ground Cable and Clip Safety-1
15. In-line fuse adapters for high-voltage leads, including a 1000 V 0.5A, fuse and replacement