

FEATURES

- 16-Channels strain gage, bridge or voltage
- Ethernet control and data interface
- 10 kHz analog bandwidth
- Programmable 10 to 24,000 samples per second per channel
- 10 Hz to 3 kHz filters, 80 dB/octave
- IRIG A, B & G time decoding and stamping
- Synchronized sampling of multiple bricks to 1 microsecond
- 0.05% or better accuracy over full gain and temperature range
- Rugged and sealed for tough environments
- 20 to 30 Volt DC power



Pacific's Model 7216 aka "DAS Brick" brings a brand new look to strain gage and transducer data acquisition. A network appliance, it conditions, amplifies and digitizes the outputs of up to sixteen strain gage, bridge or voltage transducers. The rugged enclosure is designed for installation in wind tunnels, engine test stands and other facilities where it is desired to locate the DAS close to the test article reducing installation and cable cost and improving signal quality and reliability.

Fully self-contained the 7216 provides transducer excitation, bridge completion and balance. The transducer output is amplified, filtered to remove signal components that could produce alias errors and digitized to 24-bit resolution. The digitized transducer output is digitally processed providing multiple sample rates, an 80 dB/octave FIR filter and 32-bit floating point output format in millivolts referred to input, millivolts referred to output or user defined engineering units.

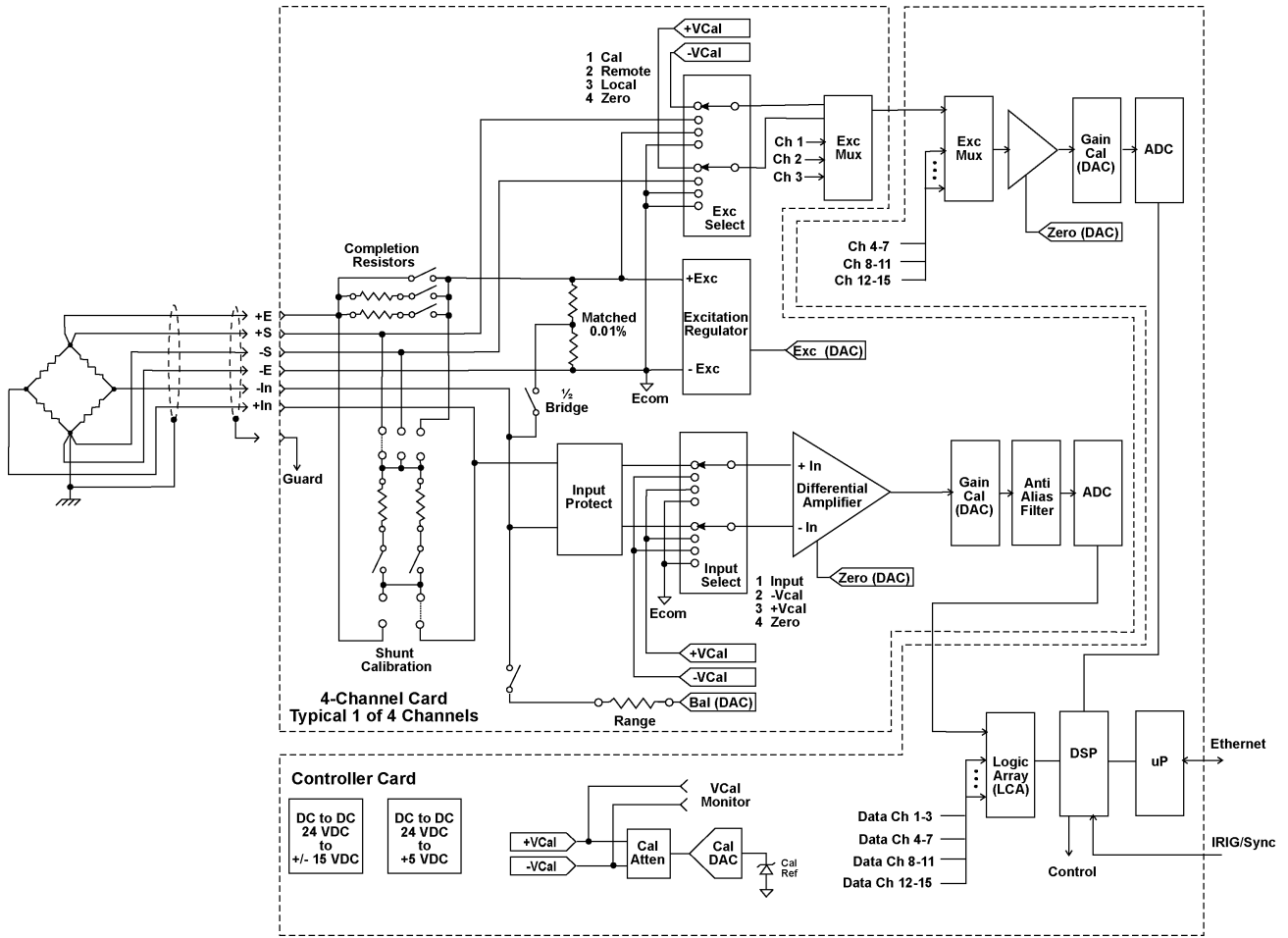
Programmable signal conditioning includes voltage excitation, bridge completion for 120 and 350 Ohm strain gages, shunt calibration and automatic balance. Conditioned and amplified transducer signals are digitized, processed and output at 10 to 24,000 samples per second as selected for individual channels. A digital signal processor (DSP) provides low-pass filtering selectable from 10 Hz to 3,000 Hz with 80 db/octave roll-off. The DSP can be custom programmed to provide alternate filter responses and perform application specific signal processing.

Each Brick has a 100BaseT Ethernet interface for control and data output, which simplify system wiring and provides remote and distributed operation. IRIG time may be employed to synchronize sampling on multiple Bricks within 10 microseconds or a timing pulse may be used to achieve better than 1 microsecond time alignment. Multiple Bricks with up to 4,096 channels may be connected on a single Ethernet LAN.

The case features interchangeable end plates that provide fully sealed, ambient air or forced air cooling. Forced air cooling provides the capability to operate over a wide temperature range according to application requirements. Occupying less than 500 cubic inches and weighing less than 14 pounds the Bricks can be installed in locations previously not suitable for data acquisition systems. The Ethernet interface and IRIG timing make it easy to distribute Bricks throughout the test facility minimizing sensor cabling and installation costs.

The Model 7216 does not sacrifice performance. In fact it features higher accuracy than most systems designed for a laboratory environment. That's because it is self calibrating, taking into account temperature and excitation variations. Accuracy is better than 0.025% for gains up to 200 and 0.05% for gains above 200 over the temperature range -20°C to +50°C, which can be extended to higher temperatures by forced air cooling.

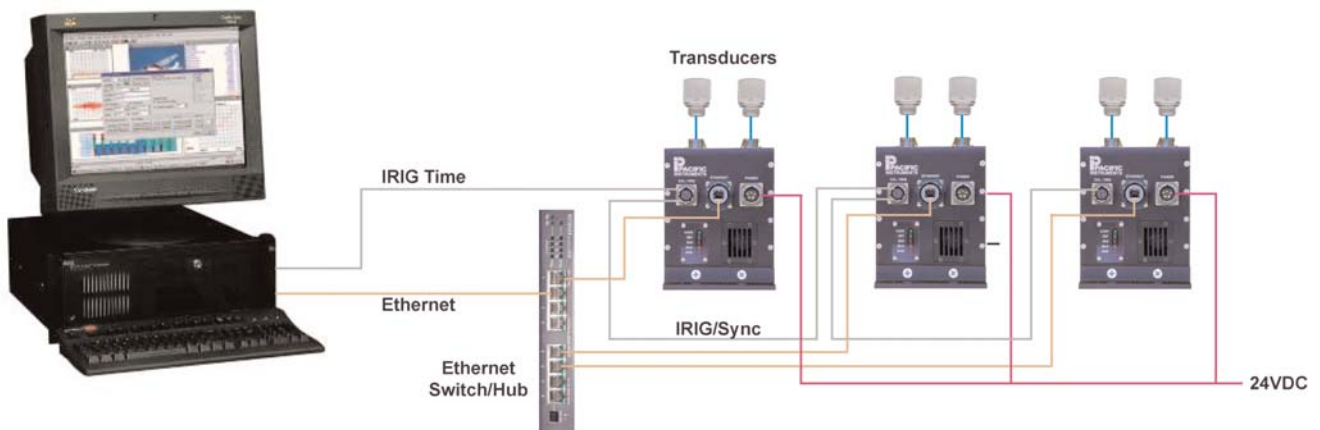
The 7216 is supported by Pacific's PI660 software that provides a ready-to-run application and API for user program development. Calibration and performance verification is accomplished by PANEL72 Maintenance and Calibration software. The ACS2000 Automatic Calibration System automates performance verification and periodic instrument calibration.



7216 Functional Block Diagram

Cabling transducers to a remote data acquisition system is costly and may require intermediate signal connections that introduce reliability problems. In addition the transducer and cable impedance can filter the signal, attenuating high frequency signal components. Locating data acquisition

hardware near transducers at many test facilities has required specially constructed and environmentally conditioned enclosures. Using the 7216 the data acquisition can be installed in unprepared locations and the only external connections are power, timing and Ethernet.



Typical 7216 Installation

MODEL 7216

Transducer Data Acquisition Brick

ACCURACY

The 7216 maintains $\pm 0.025\%$ uncertainty ($\pm 0.05\%$ for gains above 200) over the full temperature range by continuously correcting for temperature induced excitation, gain and zero variations. It is initially calibrated and correction vectors are stored in non-volatile memory. An internal sensor determines the correction vectors applied to the data according to the device temperature. Software is available for automatic recalibration. Voltage calibration, using an internal, NIST traceable precision voltage reference is provided to confirm accuracy.

SIGNAL CONDITIONING

The excitation output is programmable from 0 to 15 Volts with better than 1 millivolt resolution. Calibrated 1 Volt $\pm 0.1\%$ steps are also provided. Output current is 50 mA. The excitation voltage is continuously monitored by sense inputs connected to the sensor and adjusted as necessary to maintain a constant voltage over the full temperature range. Bridge completion is programmable for quarter-bridge, 120 and 350 Ohm gages, half and full bridges. Other values can be supplied on request. Two steps of shunt calibration are provided. Transducer balance employs a high-resolution DAC and is initiated by program instruction.

INSTRUMENTATION AMPLIFIER

The sensor inputs are protected up to ± 50 Volts differential and ± 30 Volts common mode. They are applied to a high-impedance, programmable gain, differential instrumentation amplifier. The amplifier has programmable gains from 1 to 1,000 providing full-scale input ranges of ± 10 mV to ± 10 Volts. Calibrated gain steps with $\pm 0.02\%$ accuracy are provided or the amplifier gain may be continuously programmed. Autozero maintains the amplifier output offset within ± 1 mV.

ANALOG TO DIGITAL

Conditioned and amplified transducer signals are digitized by a 24-bit resolution Sigma-Delta analog-to-digital converter that over-samples the analog signal enabling the use of a single-frequency anti-aliasing filter.

SAMPLING

Sampling is synchronized between channels and systems providing time aligned data. All channels are simultaneously sampled at the highest sample rate, 24 kS/s. The sample clock may be synchronized to IRIG A, B or G time. IRIG G time is generated by the unit connected to the external IRIG source or designated as the master time source if external IRIG is not used. Distributed to multiple system it maintains channel to channel time skew less than 1 microsecond for channels in the same or other systems using the same master time source. If the timing signal is not present or lost during acquisition sampling will continue at the last programmed rate using an internal clock.

FILTER

Finite Impulse Response (FIR) filtering is provided. Eighty sets of 128 FIR filter coefficients are available in each 7216 providing an extensive selection of filter frequencies and characteristics. The coefficients are user programmable, and each coefficient is 18 bits in length. The filters are loaded with customer-specified default coefficients providing logical filter cutoff selections and characteristics. The default filter frequencies and characteristics are easily changed using program instructions to satisfy future requirements.

DATA

Data are output in a digital format on the Ethernet interface. The output data is 32-bit floating point format and can be chosen via programming to be Volts, millivolts, microvolts, or user defined engineering units derived from a polynomial expression. Each system can output data from all channels at the maximum sample rate. Data rates in excess of 7 million samples per second are achievable from combined systems on a single LAN.

PROGRAMMING

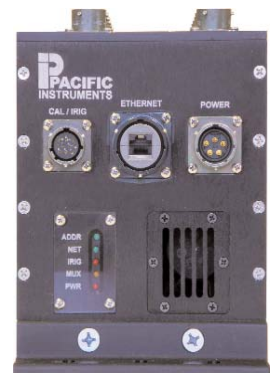
All operating parameters can be set and queried using the extensive, built-in command set. Setup information is saved in password protected EEPROM memory on board, and it is automatically restored when power is applied or the system reset. The command set is well documented, and source code programming examples are provided.

SOFTWARE

PI660 is the choice for test management, data acquisition, and data display. Ready to run out of the box it is a 32-bit application that runs on Microsoft Windows operating system. It provides all the tools for test definition, setup & tracking, transducer calibration, data acquisition, display, replay and export, and test quality validation. PI660 comes with an Application Programmer's Interface that greatly reduces the development time for custom operating software. PANEL72 is Pacific's maintenance and calibration software. It may be used to troubleshoot installation problems and calibrate the 7216.

COMMUNICATIONS

Initializing communication with the 7216 is simple. Commands are included that enumerate the 7216 devices on the network. After the enumeration operating software creates a socket interface between itself and each 7216. Simple Send and Receive network commands are used to communicate. Status LEDs that assist with initial setup are located on the connector end of the enclosure. Multiple systems, up to 4,096 channels, may be connected to a single Ethernet LAN.



SPECIFICATIONS

EXCITATION

Type	Constant voltage with remote sensing.
Range.....	Programmable from 1 to 15 Volts with 1 mV resolution. Calibrated 1-Volt steps $\pm 0.1\%$.
Current	50 mA limited to 70 mA maximum.
Regulation	Each channel individually regulated. $\pm 0.1\%$ over input voltage range and no-load to full load.
Stability	$\pm 0.01\%$ for 30 days, $\pm 0.001\%/^{\circ}\text{C}$ compensated. $\pm 0.05\%$ for 30 days, $\pm 0.005\%/^{\circ}\text{C}$ without compensation.
Noise	200 μV peak-to-peak, DC to 10 kHz

INPUT

Configuration	2 to 6 wire inputs, input (2), excitation (2), excitation sense with shield. Programmable bridge completion for half bridges and 120 Ohm and 350 Ohm quarter bridges. Other gage resistances by request.
Bridge Balance	Automatic by program control. Balance accuracy $\pm 0.05\%$ of range, ± 1 mV RTO. Stability $\pm 0.02\%$ for 8 hours, $\pm 0.005\%/^{\circ}\text{C}$. Range set by resistor up to 25 mV/V, 2.5 mV/V (350 Ohms) installed.
Input Impedance	50 Megohms, shunted by 500 pF.
Input Protection	± 50 Volts differential, ± 50 Volts common mode without damage.

CALIBRATION

Shunt	Two steps, single shunt. Internal or external shunt connection.
Shunt Resistors.....	Installed shunt resistors provide 0.502 and 0.250, $\pm 0.1\%$ mV/V for 350 Ohm bridge.
Gain	Individual channels are calibrated by a temperature-compensated, internal reference with $\pm 0.01\%$ stability. Output of the internal reference is provided on a connector for NIST traceable calibration.
Zero	Amplifier input disconnected and shorted for zero calibration.

AMPLIFIER

Range.....	± 10 mV to ± 10 Volts.
Gain	Programmable from 1 to 1,000 with 0.02% resolution.
Gain Steps	Fourteen calibrated gain steps are provided: 1, 2, 3, 5, 10, 20, 30, 50, 100, 200, 300, 500, 1000 with $\pm 0.02\%$ accuracy.
Gain Stability	$\pm 0.01\%$ for 30 days, $\pm 0.001\%/^{\circ}\text{C}$ compensated. $\pm 0.05\%$ for 30 days, $\pm 0.005\%/^{\circ}\text{C}$ without compensation.
Linearity	$\pm 0.01\%$.
Common Mode	60 dB plus gain in dB to 110 dB, DC to 60Hz.
CM Voltage	± 10 Volts operating.
Zero	Automatic zero to ± 2 μV RTI or ± 1.0 mV RTO whichever is greater.
Zero Stability	$\pm 5\mu\text{V}$ RTI, $\pm 1\text{mV}$ RTO at constant temperature, $\pm 1\mu\text{V}$ RTI/ $^{\circ}\text{C}$, $\pm 0.2\text{mV}$ RTO/ $^{\circ}\text{C}$. Short term: $\pm 2\mu\text{V}$ RTI, $\pm 0.4\text{mV}$ RTO for 8 hours (without correction).
Source Current	± 10 nA, ± 0.05 nA/ $^{\circ}\text{C}$.
Noise (10 kHz).....	2.0 μV RTI plus 0.3 mV RTO, RMS.
Bandwidth	10 kHz(-3dB).
Overload	Recovery time is 120 μs to within $\pm 0.1\%$ for a 10 times overload to ± 10 Volts.

ANALOG-TO-DIGITAL CONVERTER

Resolution	24-bits.
Sample Rate.....	24K samples per second per channel. Individual channels may be programmed to output data at rates from 10 Hz to 24 kHz..

ACCURACY

System	After calibration the system maintains better than $\pm 0.025\%$ full scale (2-sigma) uncertainty for gains up to 200 and $\pm 0.05\%$ full scale (2-sigma) uncertainty for gains above 200 over the operating temperature range.
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FILTER

Type	Finite Impulse Response (FIR) with 128 coefficients.
Response	Programmable from 10 Hz to 3 kHz with 80 dB/octave attenuation above cut-off.

TIME

Source	IRIG A, B or G.
Level	1-Volt peak-to-peak nominal.
Sync.....	Synchronized sampling of multiple bricks to within 10 microseconds without separate Sync.
Output	Days, Hours, Minutes, Seconds, Microseconds may be output at selected positions in the data stream. IRIG G output provided for multiple module synchronization.

INTERFACE

Interface.....	Ethernet 100BaseT, TCP/IP, control and data.
Data Format	Floating point, 32-bits. Output available in engineering units, Volts or millivolts.
Aggregate Rate	Supports all sixteen channels at the highest sample rate.
Sync.....	TTL input may be used to synchronize sampling of multiple bricks to within 1 microsecond.
Operation	Supported by PI660 and PANEL60 software.

GENERAL

Connectors	MIL, 1/4-turn locking.
Temperature	-20°C to $+50^{\circ}\text{C}$ operating. ambient air. -20°C to $+40^{\circ}\text{C}$ operating. fully sealed. Extended temperature range using forced air cooling. consult Pacific Technical Support.
Vibration/Shock	MIL-STD-810F.
Moisture	NEMA 13.
Power	20 to 30 VDC.
Dimensions.....	5.25" Wide, 7.75" High, 12" Deep excluding mounting flanges
Weight	14 lbs.

ORDERING INFORMATION

7216	16-Channel Transducer Data Acquisition Brick.
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