

## TRANSDUCER SIGNAL CONDITIONING & RECORDING FOR SEVERE ENVIRONMENTS

The 5800 is a rugged, battery operated data acquisition and recording system with high performance, dual-mode signal conditioning. It is typically used for recording transient data in harsh physical environments as would be encountered in explosives and explosive effects testing.

Ethernet gives systems of multiple recorders a clean and simple interface using commercially available hubs and switches for programming and data debriefing. Control and clock distribution are done by a PCM encoded bus carried on Category 5 or optic cable. Once programmed, only the clock/control bus is required for synchronized data recording.

Data acquired by the 5800 is digitized and recorded in non-volatile, solid-state memory. It records calibration, pre-trigger and post-trigger data. In a typical test scenario recording of pre-trigger data is initiated by a TTL input, program instruction, or automatic sequencer. A TTL input or on-board discriminator triggers post trigger data recording.

The quantities and sample rates of pre and post-trigger data storage are programmable, enabling the 5800 to be configured according to the characteristics of the data being acquired. Sample rate can be changed during acquisition without interrupting data flow to capture high-speed events, yet have sufficient memory space to record long-term effects. The 5800 can be configured for multiple records, each using the same pre and post-trigger sampling profile. Data is debriefed and transferred to permanent storage by the Ethernet interface.

Individual channel modules that plug into the 3 or 16-channel recorder condition, amplify, filter, digitize and store the transducer signals. Simultaneous sampling provides excellent time correlation between channels and external events. The digitizer is available with 14, 16 or 24-bit resolution and sample rates up to 10 Million samples per second.

Each channel has two inputs: one for bridges, voltage, RTDs, potentiometers and thermocouples; the other AC coupled with current excitation for transducers with built-in electronics. Signal conditioning includes programmable excitation and completion for  $\frac{1}{4}$ ,  $\frac{1}{2}$  and full bridge, AC-coupling, automatic balance, voltage and four-step shunt calibration, programmable gain and a four frequency, eight-pole filter.

A high-level instruction set is provided for user programming or PI580, a Windows application, may be used. Operating parameters are stored in non-volatile memory and automatically loaded when the system is powered up or reset.

PI580 software is a ready-to-use application with graphical user interface. The operator programs a test on or off line using drop-down hardware specific menus or downloads an Access compatible test database file. Tests files may be saved for reuse or as the starting point for a new test. PI580 exports recorded data to several binary and ASCII data formats compatible with popular data analysis applications.



5871-ST - 3-Channel  
Data Recorder

5881 - Command  
Module

### FEATURES

- Record fast events, up to 10 MS/s
- One pre-trigger and two post-trigger sample rates
- 3 or 16 channel, battery operated enclosures
- Up to 50 Gs shock
- Ethernet interface with Windows software
- Dual inputs, bridge and ICP
- Programmable for  $\frac{1}{4}$ ,  $\frac{1}{2}$  and full bridges
- Voltage & shunt calibration
- Automatic, hands-off operation



5872 16-Channel Data Recorder

## Programming

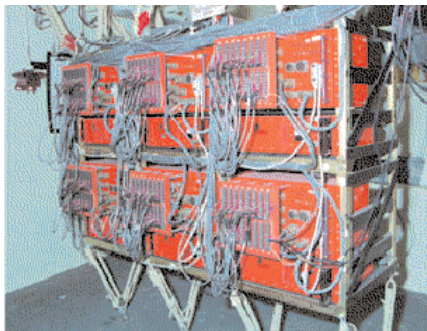
Channel and system parameters are programmed by high-level instructions written to the Ethernet interface or by PI580 Windows application software. Operating parameters are stored in non-volatile memory and automatically loaded when the system is powered up or reset. Data recorders may be programmed in place or configured and programmed prior to fielding.

Programmable channel parameters are input configuration, excitation, calibration modes and levels, gain, and filter frequency. Sample rates, number of pre and post-trigger samples, trigger level and delay, power mode and autostart sequence are programmed by groups of three channels in the 5871 or two eight channel groups in the 5872. Operating parameters may be read back to verify system programming and configuration.

## Installation

Data recorders are ruggedized and battery powered, allowing installation near the measurement to keep input cables short preserving higher signal frequencies. Hardware is available for mounting in 19-inch frames or enclosures.

The 5871 and 5881/3 have self-contained rechargeable batteries. A line operated power supply is available for operating and charging the battery. The 5872 and 5882 require an external battery or other power source. The 5893 is a DC-UPS that provides power from the AC line and automatically switches to battery when line power is interrupted. Programmable power modes conserve battery power when setting up or waiting for a test.



**96-Channel installation with DC-UPS power sources**

## Control

Sample timing and data recording is controlled by a PCM encoded control bus that is distributed from the Control Module to each Data Recorder. The Command Module has TTL inputs for system control including Clock, Start, Trigger and Autostart. The encoding of control signals makes the system immune to noise on the control bus that could cause false triggering and loss of data. The control bus synchronizes data recorded across multiple recorders.

The 5881 and 5882 Command Modules employ Category 5 cable for recorders within 50 meters of the Command Module. The 5883 Command Module employs optic cable for distances up to 1 km.

## Calibration

A portion of the data storage memory may be used for calibration data acquired before and after test data. Multi-point calibrations are recorded by specifying the calibration mode, stimulus and number of samples for each point.

Calibration modes include voltage substitution using a programmable internal reference and four shunt resistors. Additional calibration modes measure and record excitation voltage, excitation current, zero with input shorted and gage zero without excitation.



**5800 is used extensively for underwater explosive testing**

## Data Recording

Test data recording begins with a Start control from the Command Encoder or an Ethernet instruction. Data is continuously recorded in successive memory locations at the programmed pre-trigger sample rate. The oldest data is overwritten when the number of samples taken exceeds the total for the record.

When Trigger is received from the Command Module or internal discriminator the data recorder acquires the programmed number of post-trigger samples at the post-trigger sample rates. When all post-trigger samples are recorded, recording stops, memory is write protected and the recorder is reset for the next record. Data memory is backed-up for 40 hours by an independent power source.

The Autostart facility provides a means to automatically initiate recording of calibration and test data using a single TTL input to the Command Module. It runs a preprogrammed file that can contain up to 64 instructions. For example, it can load operating parameters, autobalance channels, select and record pre and post test calibration data, select operating power, clear write protect and start the system for test data acquisition. After data is recorded, it can power down the recorder to await debriefing.

## Debriefing

Program instructions transfer data from channel memories to computer storage media. Data transfer rate is 450K bytes per second for a single recorder and multiple recorders are interlaced for faster debriefing. Debriefing is non-destructive. Data is not erased from the channel memory until it is overwritten with new data.

An Ethernet instruction retrieves data that provides elapsed start to trigger time. By synchronizing the start time for all recorders, data may be time correlated for recorders that triggered at different times and to other test events and data.



**Explosive effects test**

### SPECIFICATIONS

#### EXCITATION (CONSTANT VOLTAGE)

Range.....0 to 12 Volts in 1-Volt  $\pm 0.1\%$  steps.  
 Output Current..50 mA, limited to 70 mA maximum.  
 Regulation ..... $\pm 0.2\%$  over the input voltage range and no load to full load.  
 Stability..... $\pm 0.1\%$  for 8 hours,  $\pm 0.01\%/^{\circ}\text{C}$ .  
 Monitor.....Excitation voltage and current is digitized output and recorded. Accuracy is  $\pm 0.1\%$ .

#### BRIDGE INPUT

Configuration.....Four-wire.  
 Completion .....Programmable completion is installed for 350 Ohm and 120 Ohm  $\frac{1}{4}$  and all  $\frac{1}{2}$  bridge circuits. The  $\frac{1}{4}$  bridge completion resistors are in resolderable sockets and may be replaced to accommodate other values.  
 AC Coupling.....Programmable high pass filter, 2.25 Hz. Input impedance is 100K Ohms.  
 Filter .....Selectable low pass input filter, 16 kHz.  
 Connector .....Miniature, 8-pin, threaded, round DIN. 5871ST has six-position terminal strip.

#### AUXILIARY INPUT

Power .....6 mA,  $\pm 10\%$  (range is 1 to 20 mA).  
 Input .....AC coupled input (<2.25 Hz) to accept charge transducer with integral or line preamplifier.  
 Impedance.....100K Ohms.  
 Connector .....BNC. Screw terminals on 5871ST.

#### BRIDGE BALANCE

Type .....Automatic, may be turned off without affecting the setting.  
 Range..... $\pm 2$  mV/V for 350 Ohm bridge. Range is setable by resistor from <0.1 mV/V to >10 mV/V.  
 Resolution.....0.025% of range.  
 Accuracy..... $\pm 0.1\%$  of range,  $\pm 1$  mV  
 Stability..... $\pm 0.1\%$  for 8 hours,  $\pm 0.01\%/^{\circ}\text{C}$   
 Time .....5 seconds maximum to balance.

#### VOLTAGE CALIBRATION

Range.....Three ranges,  $\pm 10$  Volts,  $\pm 1$  Volt and  $\pm 100$  mV.  
 Resolution.....0.025% of range (12-bits).  
 Accuracy..... $\pm 0.25\%$ .

#### SHUNT CALIBRATION

Type .....Four-step shunt calibration.  
 Value .....Four shunt resistors. Resistor values of 150K, 75K, 15K, and 7.5K ohms give 0.583, 1.16, 5.77, and 11.4 mV/V for a 350 Ohm bridge,  $\pm 1\%$ . Resistors are mounted in resolderable terminals. Alternate values may be customer specified.

#### AMPLIFIER

Impedance.....25 Megohms shunted by 500 pF.  
 Protection ..... $\pm 50$  Volts differential or common mode.  
 Input Range..... $\pm 10$  mV to  $\pm 10$  Volts full scale.  
 Gain .....Programmable steps 1, 2, 3, 5, 10, 20, 30, 50, 100, 200, 300, 500 and 1,000.  
 Accuracy..... $\pm 0.1\%$ .  
 Stability..... $\pm 0.02\%$  for 8 hours,  $\pm 0.005\%/^{\circ}\text{C}$ .  
 Linearity ..... $\pm 0.02\%$ .  
 Bandwidth .....5841/43 - 100 kHz (-3dB). Slew rate is 5 V/ $\mu\text{S}$ .  
 5842/44 - 300 kHz (-3dB). Slew rate is 10 V/ $\mu\text{S}$ .  
 Common Mode..60 dB plus gain in dB to 110 dB minimum for 350 Ohm source unbalance, DC to 60 Hz.  
 CM Voltage ..... $\pm 10$  Volts.  
 Zero Stability .... $\pm 5$   $\mu\text{V}$  RTI,  $\pm 1$  mV RTO at constant temperature.  
 $\pm 1$   $\mu\text{V}/^{\circ}\text{C}$  RTI,  $\pm 0.2$  mV/ $^{\circ}\text{C}$  RTO.  
 Noise.....10  $\mu\text{V}$  RTI plus 1 mV RTO RMS.

#### ANALOG FILTER

Type .....Eight-pole, Bessel, low-pass (48dB/octave terminal slope).  
 5841/43.....5 kHz, 10 kHz, 20 kHz, 50 kHz (-3 dB) and wide-band or may be customer specified.  
 5842/44.....10 kHz, 20 kHz, 50 kHz, 100 kHz (-3 dB) and wideband or may be customer specified.

#### DIGITAL FILTER (5843)

Low Pass .....Automatically scales with sample rate, Fs. Response is  $\pm 0.1\%$  to .45Fs for Fs < 50K,  $\pm 0.3\%$  to .45Fs for Fs < 100K and  $\pm 0.7\%$  to 0.45Fs for Fs = 200K. Response is -120 dB minimum above 0.55 Fs.

#### DIGITAL

Sampling .....One pre-trigger and two post-trigger sample rates per record.  
 Rates (5841)....1M, 500K, 200K, 100K, 50K, 20K, 10K, 5K, 2K, 1K, 500, 200, 100, 50, 20 and 10 S/s.  
 Rates (5842)....2M, 1M, 500K, 200K, 100K, 50K, 20K, 10K, 5K, 2K, 1K, 500, 200, 100, 50, and 20 S/s.  
 Rates (5843)....200K, 100K, 50K, 20K, 10K, 5K, 2K and 1K S/s.  
 Rates (5844)....10M, 5M, 2M, 1M, 500K, 200K, 100K, 50K, 20K, 10K, 5K, 2K, 1K, 500, 200 and 100 S/s  
 Resolution .....24-bits (5843), 16-bits (5841), 14-bits (5842/44).  
 Correlation ..... $\pm 1$  nS sample to sample,  $\pm 50$  nS channel to channel.

#### MEMORY

Type .....CMOS, with power back up for 40 hours.  
 Size.....1M words (2M and 5M optional).  
 Records .....Programmable pre and post-trigger data in 4096 word blocks. Multiple records without debriefing.  
 Write Protect....Enabled on power up and after recording data. Must be cleared before recorded data can be overwritten.

#### TRIGGER

Sources .....External (from CM's TTL input), discriminator or Ethernet program command.  
 Delay .....0 to 60 seconds with 1 microsecond resolution.  
 Discriminator....Programmable full scale with 0.4% resolution. First channel triggers all channels in recorder group.

#### GENERAL

5871 Capacity..3 channels in one group.  
 5872 Capacity..16 channels in two 8-channel groups.  
 Size.....4.125" wide, 5.125" high, 15" deep exclusive of (5871/81/83) connectors, 17" deep overall. Mounts in 19-inch rack with optional mounting tray.  
 Size (5872).....17" wide, 10.5" high, 12" deep. Mounts in 19-inch rack with optional adapter kit.  
 Power .....10.5 to 20 VDC.  
 Power (5882) ...10.5 to 20 VDC, AC adapter supplied.  
 Temperature.....0 to +55 $^{\circ}\text{C}$ .  
 Altitude.....0 to 20,000 ft.  
 Vibration .....20Hz to 2kHz, 5Gs peak, 0.1 inch maximum displacement.  
 Shock .....50Gs, 11ms,  $\frac{1}{2}$  sine any axis.  
 Humidity.....95%.

#### UPS POWER SUPPLY (5893)

Description .....Provides DC power from 120 VAC line and switches to internal battery when AC line power is not present.  
 Output..... $\pm 13.8$  VDC 10 Amps when powered by AC line.  
 Size.....17.5" wide, 5.125' high, 16" deep.

#### 5872 FAN COVER

Description .....Alternative cover that provides xxx CFM cooling air using 10.5-15 VDC fans.

### DATA/PROGRAMMING AND CONTROL INTERFACES

Data/Prog.....Ethernet 100BaseT interface for each channel group.  
Multiple groups using Ethernet hubs and switches.  
Control.....Control Module distributes PCM encoded clock,  
autostart, start and trigger signals.

Cat. 5.....5881/82 Control Modules each operate up to 16  
recorder channel groups over a distance of up to 50  
meters using Category 5 (Ethernet) cable.  
Optic Cable.....Two 5883 Control Modules make a transmitter-receiver  
pair that operate up to 16 recorder channel groups over  
a distance of 1 km using fiber optic cable.

## ACQUISITION & RECORDING SOFTWARE

**PI580 is a complete software operating environment for Windows. This ready to use, turnkey application has everything needed to program and operate the 5800 and export recorded data files.**

### Ready-to-Run

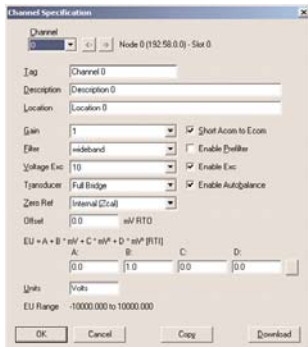
Unlike general purpose programming languages, PI580 is an application that is ready to use out of the box and specifically tailored for transducer data acquisition and recording. Versatile and easy to use, its operator interface employs menus and toolbars to program 5800 hardware and acquire and record calibration and test data.

### Database Programming

Program channel and system operating parameters in a Microsoft Access or compatible database or spreadsheet. Then download the database file to program channel, group and system hardware.

### Select and Name Channels

Select channels for a test from the system inventory. Assign each channel a "Tag" or name that will make measurement identification easy and enter the engineering units of measure.



PI580 Channel parameter programming screen

### Menus Simplify Programming

The built-in programming menus are configured to the installed channel hardware. Menus feature drop-down selection of parameters such as excitation, gain and filter frequency for channel programming and sample rates for group profile programming.

### Real Time Data Displays

Data displays are useful for monitoring channels before, during and after a test. Display types include: Tabular, system status, strip chart, bar chart, picture (bitmap), X-Y Chart, and multi-channel plot. Data is displayed in A/D counts, millivolts and engineering units.

### Pre and Post Trigger

With PI580 you select the pre and post-trigger memory by entering the time period for each. Using the selected sample rates, PI580 calculates the pre-trigger and post-trigger memory sizes.

### Trigger Level and Delay

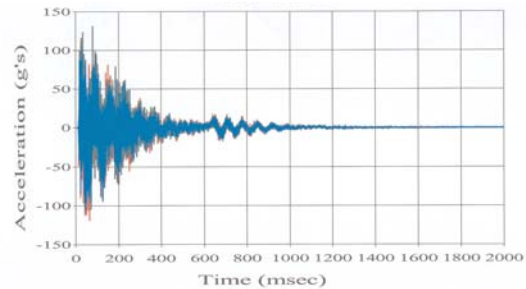
The trigger level is set for the first channel in each recording group using engineering units. Select internal or external trigger and set trigger time delay in microseconds.

### Debrief Recorder

Debriefing of the data recorder can be done for a single channel or multiple channels. Operator may specify which records to debrief. PI580 exports recorded data in binary and ASCII formats compatible with display/analysis programs including Excel, DPLOT, DADiSP and FAMOS.

### Calibrate Recorded Data

PI580 supports all 5800 calibration modes with up to eight calibration steps per channel recording the calibration data to memory. It will automatically calculate the slope and offset for engineering units calibration.



Plot of exported data

## ORDERING INFORMATION

### RECORDER CHANNEL MODULES

- 5841 ...Transducer Recorder Module, 1 MS/s, 16-bit, 1M storage.
- 5842 ...Transducer Recorder Module, 2 MS/s, 14-bit, 1M storage.
- 5843 ...Transducer Recorder Module, 200 KS/s, 24-bit, 1M storage
- 5844 ...Transducer Recorder Module, 10 MS/s, 14-bit, 1M storage

### OPTIONS

- 2M.....Increase storage to 2M samples.
- 5M.....Increase storage to 5M samples. (5841/42/44)

### ENCLOSURES

- 5871 ...Data Recorder, 3 channels, battery powered, Ethernet interface (add ST for screw terminals).
- 5872 ...Data Recorder, 16 channels in two groups of eight, 12 VDC, Ethernet interface for each group.

### COMMAND-MODULES

- 5881 ...Command Module, Cat.5, battery powered.
- 5882 ...Command Module, Cat 5., 12 VDC.
- 5883 ...Command Module, Optic, battery powered.

### OPTIONS

- 5758 ...Fan Cover for 5872.
- 5850 ...Mounting Tray for 5871/81/83.
- 5891 ...Power Supply, 115 VAC for 5871/81/83.
- 5892 ...Power Supply, 115 VAC for 5872
- 5893 ...Uninterruptable Power Supply.

### SOFTWARE

- PI580 ..Operating Software for Windows 2000/XP.