

Application Brief:

64 Dual Mode Charge Amplifiers



The 27000 signal conditioning system with 64 channels of dual mode charge amp/filters and GUI.

Application

Instrumentation engineers dealing with piezoelectric transducers are often faced with the problem of choosing the most appropriate transducer for the measurement. Charge output devices offer advantages of wide dynamic range and can operate in harsh environments. Piezoelectric devices with built-in microelectronics (often referred to as ICP® sensors) have the advantage of low output impedance and voltage sensitivity that is less dependent on cable length. Signal conditioning requirements are different for the two types of transducers and often instrumentation engineers have separate signal conditioning equipment on hand to support each transducer type.

A system is needed that will accommodate 64 channels of both high output impedance charge transducers or low output impedance ICP® type transducers for vibration measurements operating to 25.5 kHz. Also needed are programmable gain with vernier resolution to provide precise system scaling to transducers with different sensitivities and programmable anti-aliasing filters to make the system data acquisition ready. A built-in test subsystem with provisions for verifying system performance, checking transducers, cables and connections would greatly reduce measurement error, maintenance cost and system downtime.

Salient Features

- 64 Dual Mode, charge and voltage (ICP®), channels per 7" rack mountable chassis
- Isolated or grounded inputs
- Programmable gain of 0.0625 to 4096 with 0.05% setting resolution
- Programmable ICP current level
- 4, 6 or 8-pole filters, cutoffs available from 1 Hz to 25 kHz with bypass
- Elliptic, Time-Delay, Butterworth, Bessel
- Pre and post filter overload detectors
- Adjustable full-scale output $\pm 1V$ to $\pm 10V$
- 1.0° phase match between channels
- Automatic DC offset correction
- T-Insertion for checking of transducer, cable, connectors and signal conditioner channel
- Test input, monitor output
- Cards are hot swappable with restoration of last setup
- Multi-pin, BNC or Microdot input connectors
- Powerful Graphical User Interface
- Built-in self test for verification of system performance

System Specifications

Number of Channels: 64 dual mode charge amplifier/filters in a 7"H x 19"W rack

Computer Interface: RS-232 (GPIB or Ethernet TCP/IP optional)

Charge Mode:

Full-scale Input Range (MU):
2.5 to 160,000 pC/transducer sensitivity

Transducer Sensitivity Settings:
0.001 pC/MU to 9999 pC/MU

Charge Converter Gain Range:
0.0625 mV/pC to 4096 mV/pC

Noise, RTI, Max Gain: 3 fC + 1.6 fC/nF

Frequency Response:
-3 dB at 0.5 Hz (12 dB per Octave)

CMRR: 60 dB, 50 Hz to 200 Hz

Voltage Mode:

ICP® Current Source: Prog. from
1 mA to 12.75 mA w/ 50 μA resolution

Compliance Voltage: 24V

Gain Range: 0.0625 to 4096 with
0.05% continuous resolution

Gain Accuracy: $\pm 0.1\%$

Programmable Filter:

Filter Type: EL8, 8-pole, 8-zero elliptic low-pass

Pass-Band Ripple: 0.1 dB p-p

Cutoff Frequency (F_c) Amplitude: -0.1 dB

Stop-Band Attenuation: 90dB minimum

-40dB Frequency: 1.441 F_c

-80dB Frequency: 1.618 F_c

-90dB Frequency: 1.788 F_c

Cutoff Frequency Settings:

1 Hz to 255 Hz in 1 Hz steps

300 Hz to 25.5 kHz in 100 Hz steps

Bypass: -3 dB at 0.5 Hz and 50 kHz

Filter Match: $\pm 0.5^\circ$ and ± 0.05 dB (DC to F_c)

T-Insertion: Test signal is applied across a 100 Ω resistor inserted in series with the ground return. T-insertion tests the transducer, cable, connectors and signal conditioner channel.

Auto-Offset: Automatic adjustment of offsets to less than 5 mV RTO at any gain setting.

Shunt Cal: Test bus signal is applied to charge converter through a precise 1000 pF capacitor.

Test Input: A switch at the input of each channel allows the injection of a test signal.

Output Monitor: A switch at the output of each channel provides connection to the monitor bus.

Solution

The System 27000 with 27304 quad dual mode charge amplifier/filters provides 64 channels of piezoelectric transducer conditioning in 7 inches of vertical rack space. Dual mode operation is available through a single microdot connector at each channel's input. In charge mode, two conversion ranges are provided. For ICP transducers and transducers with remote charge amps, a voltage input with programmable current excitation is utilized. 8-pole Elliptical filters with programmable cutoff frequencies from 1 Hz to 25.5 kHz are included in each channel.

Programmable gain is distributed both before and after the filter to protect against out-of-band overloads while providing the best signal to noise ratio. Gain of up to 4096 is provided

with 0.05 percent resolution. Pre and post filter overload detectors warn the user against overload of both in band and out of band signals. Microdot input connector adapters are used for the inputs. Output connections are multipin.

T-insertion is provided to inject dynamic signals directly through the input cables, transducer and the rest of the measurement system verifying gain, cabling, and connections. Shunt cal allows calibration signals to be injected directly at the input of the charge converter and output monitor allows the user to directly monitor the output of any channel in the system via a single rear panel connector.

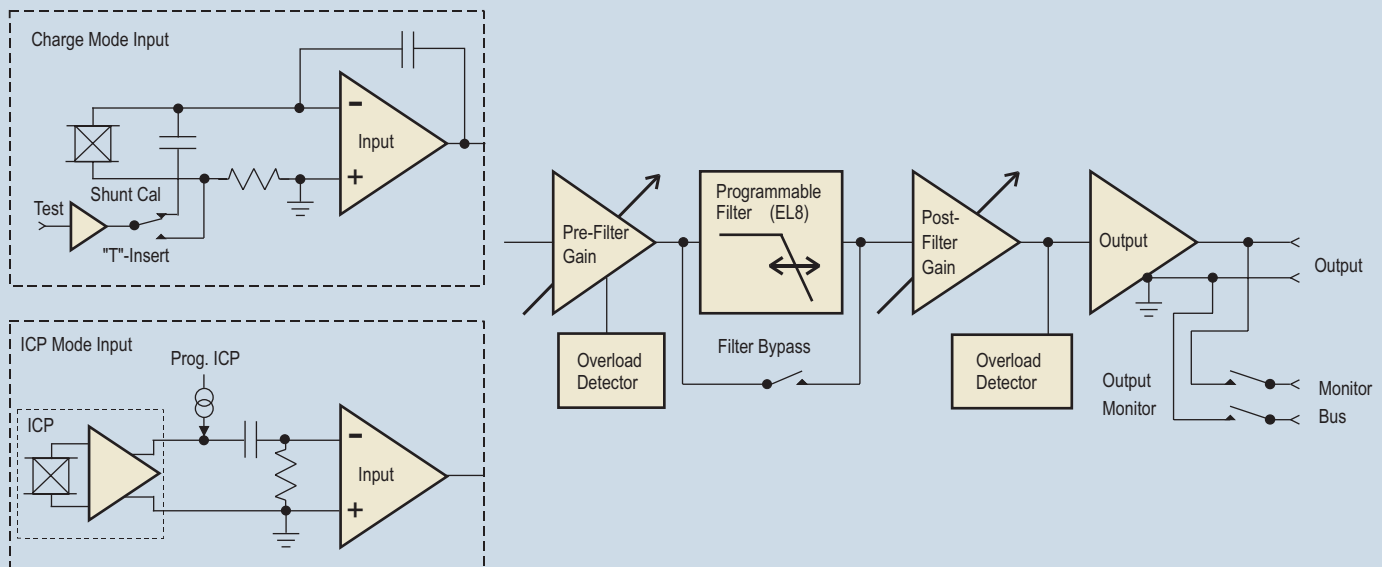


The 27000 chassis allows for a direct shielded coaxial connection to the 27304 input charge converter and the mating I/O cables to result in the lowest noise pickup. 27304 cards may be "hot swapped" from the front of the unit without disconnecting any rear panel cables.



The GUI lets the user easily customize displays in accord with the test. Built-in security, a link to Excel spreadsheets and smart gain and filter algorithms are unique features of the GUI.

Channel Block Diagram



Graphical User Interface

Built-In Test

A Graphical User Interface (GUI) is supplied to furnish control panels for configuration, set up, operation and test. On power-up, the GUI automatically builds a display to control the exact set of signal conditioners found in the 27000 mainframe. The GUI allows customizing display and control panels to the user's preference. Security features allow the user to control access to critical programmed system parameters.

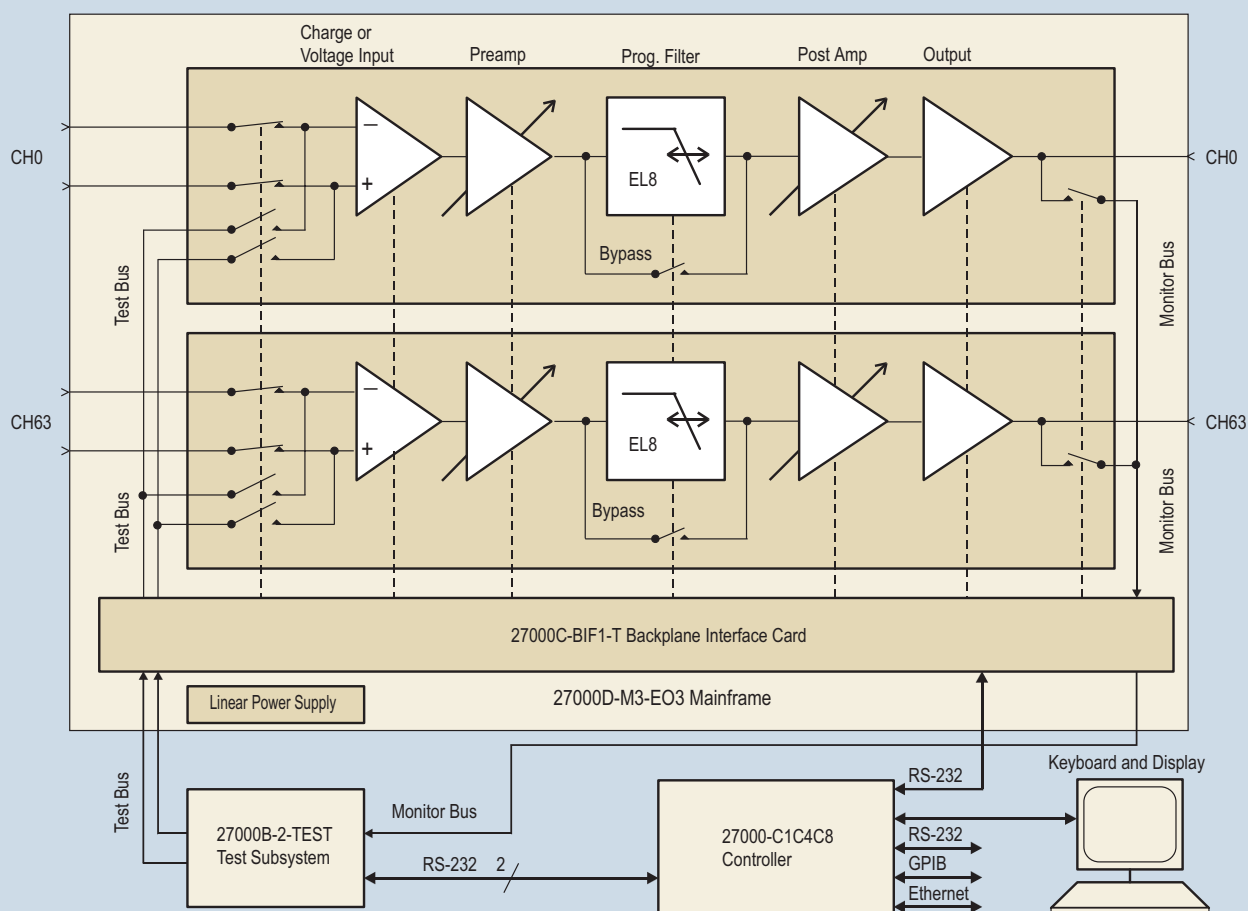
System setups can be stored for later retrieval. In addition, system setup information may be loaded from or stored to a file. The GUI operates on systems running Windows operating systems.

The GUI contains a collection of algorithms to automate tedious setup tasks and databases that allow the user to import transducer information including type, sensitivity, last calibration date and serial number. Based on user input, the GUI apportions the gain in each channel to provide best signal-to-noise ratio while minimizing the chance of an overload occurring on out-of-band signals. Anti-aliasing filters can be programmed from user input on required attenuation of aliases and channel sampling rate.

The performance verification of test instruments is a critical part of insuring data integrity of any measurement system. The 27000 GUI provides control for a complete suite of tests that may be run on the instrument "in-place" without disconnecting any cables or removing the system from the equipment rack. The tests verify system performance and are NIST traceable; the same tests that are run at the factory. For facilities compliant to ISO9001, these built-in tests will become a part of your test equipment verification procedures.

Two levels of test are provided. The Factory Acceptance Test (FAT) does a complete parametric performance checkout of the conditioner. Parameters such as Common Mode Rejection Ratio (CMRR), noise, offset, gain, frequency response, amplitude match and phase match are tested to original specifications. For a quick checkout of the equipment prior to a test run, the Go/No-Go test may be run to measure system performance of the current programmed setup.

System Block Diagram



System Block Diagram: The system includes 64 channels of dual mode charge amplifier/filters in a single 7" rack mountable chassis. The chassis includes a low-noise linear power supply and a control interface to the signal conditioning cards. By using the test and monitor busses, the test subsystem can perform an end-to-end test on the 27000 system. The 27000 GUI provides control of the signal conditioning and test hardware through a PC based system controller. RS-232, GPIB and Ethernet interfaces are available.

Test Subsystem

Factory Acceptance Test

The FAT is a full parametric test and is normally run at regular maintenance intervals. All programmable settings of the channel are measured and compared to original factory specifications. The system operator is able to specify which channels are to be tested and which individual tests will be performed. Tests that may be selected for FAT are:

- Filter Frequency Response (Amplitude and Match)
- Gain Accuracy
- Output Offset Voltage
- AC/DC Coupling
- Maximum Level
- Noise (100 kHz BW, RTO+RTI)
- Common Mode Rejection Ratio (CMRR)
- Overload
- Amplifier Frequency Response
- T-Insertion
- ICP Gain
- ICP Operating Voltage

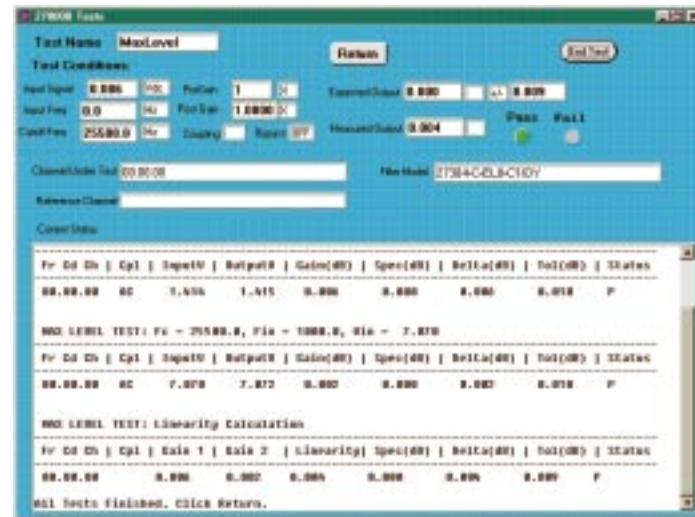


On the FAT test selection panel the user can select any tests to run on any set of channels and optionally save the results to a file for later retrieval. A test summary is listed for quick diagnosis.

Go/No-Go Test

The Go/No-Go Test checks the system at current channel settings only. It is intended as a quick check of the system prior to taking data. Failed channels/cards are quickly identified so spares can be plugged in, minimizing system downtime. A list of Go/No-Go tests that are performed includes:

- Cutoff Accuracy
- Gain Accuracy
- Offset Voltage
- Coupling
- Maximum Level



The FAT test screen reports the test conditions and provides a tabular listing of the test results during the execution of the test sequence.

Hardware Requirements

Item	Qty	Description
1	1	27000D-M3-E03 Mainframe
2	1	27000C-BIF1-T Backplane interface card with test option
3	1	27000-C1C4 Local Controller with Keyboard, Display, Mouse, RS-232 Interface, GPIB, and Ethernet Interface
4	16	27304-C-EL8-C1INOPY Quad Programmable Dual Mode Charge Amplifier Card 27304-C-EL8 Quad Prog Dual Mode Charge Amp w/ EL8 Filter Option C1 T-Insertion Calibration Option I Programmable ICP Current Source Option N Programmable Input Attenuator Option O Output Overload Detection Option P Enhanced Filter Option Y Output Ground Reference
5	32	27304-I-MICRODOT Microdot input connector adapter

Item	Qty	Description
6	1	27000-FT1 Fan Tray Assembly
7	1	SM22 Rack Mount Kit
8	1	27000-GUI-WIN 27000 Graphical User Interface Software
9	1	27000-GUI-WIN-SL 27000 Graphical User Interface Site License
10	1	27000B-2-TEST Test Subsystem Instrumentation and Cables
11	1	27304-FAT-WIN Factory Acceptance Test Software
12	1	27304-FAT-WIN-SL Factory Acceptance Test Software Site License
13	1	27304-GNG-WIN Go/No-Go Test Software
14	1	27304-GNG-WIN-SL Go/No-Go Test Software Site License

