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Shakers & Accessories



Wilcoxon Research manufactures instruments which generate vibration for structural research and modal testing. The vibration generator or “shaker” produces dynamic force operating on the mass reaction principle. Basically, a heavy mechanical component of the shaker is caused to oscillate by the drive signal from the power amplifier. A reaction force is generated, which excites the structure under test.

We manufacture two types of shakers – the low frequency electromagnetic shakers and the high frequency piezoelectric shakers.

Electromagnetic Shakers

The electromagnetic shaker operates similarly to a common speaker. A coil is driven within a permanent magnet field. The dynamic electromagnetic coil field causes the motion of a heavy mechanical component. In most models, the coil is attached to the structure. The heavy ring-shaped magnets are suspended and oscillate around the coil. The electromagnetic shaker generates force in proportion to input current.

Piezoelectric Shakers

The piezoelectric shakers utilize piezoelectric ceramic disks, which change thickness proportional to an applied voltage. These disks are sandwiched between a heavy mass and a light fixture, which attaches to the test structure. Although the displacement is very small, the use of multiple disks and high drive voltages can produce large forces at high frequencies.

Powering Systems

A power source is required to drive the shakers. The electromagnetic shakers are driven by conventional methods from an audio power amplifier. The piezoelectric shakers must be driven by high voltage and require an impedance matching network between the power amplifier and shaker. This impedance matching network steps up the drive voltage for the high force output.

Wilcoxon Shakers:

Shaker	Type	Power Amp	Matching Network	Nominal Force Output	Freq Range
F3 / Z602WA	Electromagnetic	PA7 or PA8	N/A	1 lb.	25 - 10,000 Hz
F4 / Z820WA	Electromagnetic	PA7	N/A	10 lbs.	10 - 7,500 Hz
F5B / Z11	Electromagnetic	PA7	N/A	0.4 lbs.	10 - 10,000 Hz
F10 / Z820WA	Electromagnetic	PA7 or PA8	N/A	20 lbs.	5 - 2,000 Hz
F7	Piezoelectric	PA7 or PA8	N7L (N8L)	100 lbs.	500 - >20,000 Hz
F7-1	Piezoelectric	PA8	N8HFS	10 lbs.	1 - 80,000 Hz
F4 / F7	Dual	PA7 or PA8	N7C	10 lbs.	10 - >20,000 Hz

Model F3 / Z602WA

Electromagnetic Shaker System



Model F3/Z602WA



Model Z602WA

MODEL F3 ELECTROMAGNETIC SHAKER

Usable Frequency Range	25 - 10,000 Hz
Blocked Force Output ¹	see graph
Maximum Continuous Current	0.75 amp rms
Nominal Electrical Impedance	16 Ω
DC Electrical Resistance	6 Ω
Resonant Frequency, blocked	< 50 Hz
Weight of Parts Rigidly Attached to Structure ³	0.30 lb (0.14 kg)
Suspended Weight ³	0.53 lb (0.24 kg)
Total Weight	0.83 lb (0.37 kg)
Temperature Range	0 to 80°C
Base Material	anodized aluminum
Connector ²	10-32 coaxial
Cable	R1-22-J93-10

MODEL Z602WA IMPEDANCE HEAD

Accelerometer Nominal Values

Voltage Sensitivity	100 mV/g (10.2 mV/m/s ²)
Frequency Response:	
± 0.5 dB	20 - 6,000 Hz
± 1.0 dB	15 - 10,000 Hz
± 3.0 dB	10 - 20,000 Hz
Power Requirements, voltage source	18 - 30 VDC
current regulating diode	2 - 10 mA
Bias Output Voltage, nominal	8 VDC
Output Impedance	<100 Ω
Electrical Noise, equiv g:	
Spectral	
10 Hz	15 μ g/ $\sqrt{\text{Hz}}$
100 Hz	5 μ g/ $\sqrt{\text{Hz}}$
1000 Hz	1 μ g/ $\sqrt{\text{Hz}}$
Connector ²	BNC
Output Cable	R1-2-J93-10

Force Gage Nominal Values

Voltage Sensitivity	100 mV/lb (22.5 mV/n)
Power Requirements, voltage source	18 - 30 VDC
current regulating diode	2 - 10 mA
Bias Output Voltage, nominal	12 VDC
Output Impedance	<100 Ω
Electrical Noise, equiv lb:	
Spectral	
10 Hz	5 μ lb/ $\sqrt{\text{Hz}}$ (22 μ N/ $\sqrt{\text{Hz}}$)
100 Hz	2 μ lb/ $\sqrt{\text{Hz}}$ (9 μ N/ $\sqrt{\text{Hz}}$)
1000 Hz	1 μ lb/ $\sqrt{\text{Hz}}$ (4 μ N/ $\sqrt{\text{Hz}}$)
Connector ²	BNC
Output Cable	R1-2-J93-10
Weight	0.13 lbs. (0.06 kg)
Mass Below Force Gage (including stud)	0.044 lb (20 grams)
Effective Stiffness	6 x 10 ⁸ lb/in (1 x 10 ⁸ N/m)
Diameter of Mounting Surface	0.55 inch (1.4 cm)
Mounting Stud, stainless steel	10 - 32
Recommended Screw Down Torque	20 in-lb (2 Nm)
Temperature Range	0 to 80°C
Base Material	anodized aluminum

- NOTES:**
- Blocked force output refers to the output against a mass of infinite mechanical impedance.
 - Refers to connector at the end of cable.
 - Weight includes the effect of Z602WA or dummy plug.

ACCESSORIES SUPPLIED: All input and output cables; mounting stud; spanner wrench; calibration data.

ACCESSORIES AVAILABLE: Power supplies, signal conditioners, power amplifiers, dummy plugs.

The Model F3 Vibration Generator is a reaction-type shaker generating dynamic forces for structural excitation in vibration research and testing. The reaction principle of operation, light weight and compact configuration allow this generator to be stud mounted in any position, directly to structures without external support or critical shaft alignment problems.

The Model F3 Electromagnetic Shaker is a cylindrical permanent magnet shaker. The magnet is in rigid contact with the outer case. A moving coil wound on an aluminum bobbin surrounds the magnet. This coil and bobbin is suspended from two natural rubber diaphragms ensuring pure axial motion. A low center of gravity minimizes rotational excitation by the shaker. The added dynamic weight is low since the suspended weight does not effect rotational or axial inertia above its resonance. This prevents inconsistencies often encountered whenever the rotational impedance of structures is low compared to the axial impedance.

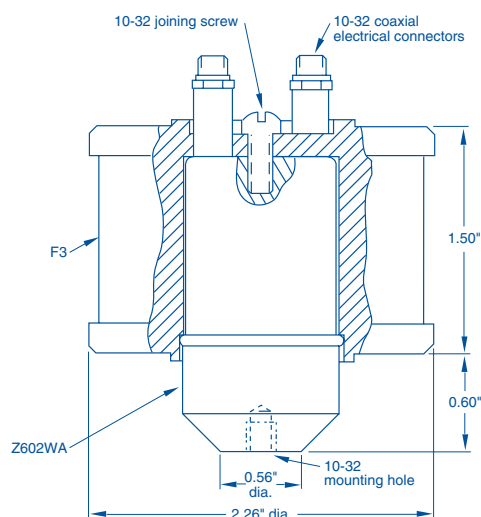
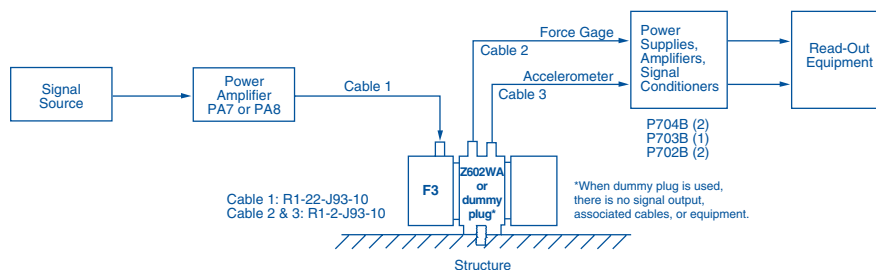
The Model F3 is designed for operation over a very wide range of audio frequencies. It can be supplied with a sensing transducer containing an accelerometer and a force gage (Model Z602WA Impedance Head) or a standard mounting block (dummy plug). The shaker drives the tested structure through the impedance head or dummy plug.

The Model Z602WA Impedance Head is a cylindrical structure containing a piezoelectric accelerometer and a piezoelectric force gage. This transducer can be used to measure applied force and structure motion. From these measurements mechanical impedance can be obtained. The high impedance charge signals from the piezoelectric force gage and accelerometer are internally amplified using the Piezofet[®] low noise charge amplifier. Each amplifier requires a constant current DC supply.

The Model Z602WA Impedance Head has a specimen contact diameter of 0.56 inches preventing excessive stiffening by impedance head attachment. The very low mass below the force gage (20 grams) makes it possible to take measurements on relatively light structures, such as airframes, models and light machinery.



RECOMMENDED SYSTEM DIAGRAM



The graph shows the peak force in pounds as a function of frequency in Hertz. The y-axis is logarithmic, ranging from 0.1 to 10 pounds. The x-axis is also logarithmic, ranging from 10 to 20,000 Hz. The curve starts at approximately 0.1 pounds at 10 Hz, rises to a broad peak of about 2.5 pounds at 50 Hz, then gradually decreases to about 0.5 pounds at 1,000 Hz. It then rises sharply to a peak of about 8 pounds at 4,000 Hz, followed by a sharp drop to about 0.3 pounds at 10,000 Hz, and a final small peak of about 1.5 pounds at 15,000 Hz.

Model F4 / Z820WA

Electromagnetic Shaker System

MODEL F4 ELECTROMAGNETIC SHAKER

Usable Frequency Range	10 - 7,500 Hz
Blocked Force Output ¹	see graph
Maximum Continuous Current	1.5 amp rms
Maximum Continuous Current w/ Air Cooling	2.5 amps
Nominal Electrical Impedance	25 Ω
DC Electrical Resistance	13 Ω
Resonance Frequency, blocked	<40 Hz
Forced Air Cooling Pressure, max.	25 psi (1.7 bar)
Weight of Parts Rigidly Attached to Structure ⁴	2.0 lb (0.9 kg)
Suspended Weight ⁴	4.8 lb (2.2 kg)
Total Weight ⁴	6.8 lb (3.1 kg)
Temperature Range	0 to 80°C
Base Material	anodized aluminum
Connector ²	Bendix PT06A-8-3S
Cable	R4M-22-J9B-10

MODEL Z820WA IMPEDANCE HEAD

Accelerometer Nominal Values

Voltage Sensitivity	100 mV/g (10.2 mV/m/s ²)
Frequency Response:	
± 0.5 dB	10 - 2,000 Hz
± 1.0 dB	6.0 - 3,000 Hz
± 3.0 dB	3.0 - 6,000 Hz
Power Requirements	
voltage source	18 - 30 VDC
current regulating diode	2 - 10 mA
Bias Output Voltage, nominal	12 VDC
Output Impedance	<100 Ω
Electrical Noise, equiv g:	
Spectral 10 Hz	20 μ g/ $\sqrt{\text{Hz}}$
100 Hz	2 μ g/ $\sqrt{\text{Hz}}$
1000 Hz	0.2 μ g/ $\sqrt{\text{Hz}}$
Connector ²	BNC
Output Cable	R2-2-J5-10

Force Gage Nominal Values

Voltage Sensitivity	100 mV/lb (22.5 mV/N)
Power Requirements:	
voltage source	18 - 30 VDC
current regulating diode	2 - 10 mA
Bias Output Voltage, nominal	12 VDC
Output Impedance	<100 Ω
Electrical Noise, equiv lb:	
Spectral 10 Hz	60 μ lb/ $\sqrt{\text{Hz}}$ (270 μ N/ $\sqrt{\text{Hz}}$)
100 Hz	10 μ lb/ $\sqrt{\text{Hz}}$ (44 μ N/ $\sqrt{\text{Hz}}$)
1000 Hz	1 μ lb/ $\sqrt{\text{Hz}}$ (4.4 μ N/ $\sqrt{\text{Hz}}$)
Connector ²	BNC
Output Cable	R2-2-J5-10
Weight	1.1 lb (0.5 kg)
Mass Below Force Gage (including stud)	0.31 lb (140 g)
Effective Stiffness ³	>5 x 10 ⁶ lb/in (87 x 10 ⁹ N/m)
Diameter of Mounting Surface	1.62 inch (4.1 cm)
Mounting Stud, stainless steel	3/8 - 16
Recommended Screw Down Torque	70 in-lb (7.9 Nm)
Temperature Range	0 to 80°C
Base Material	anodized aluminum

NOTES: ¹ Blocked force output refers to the force output against a mass of infinite mechanical impedance.

² Refers to connector at the shaker end of the cable.

³ The design of the Z820WA impedance head is such that the limiting stiffness it can be measured with an accuracy of 10 % is determined not by the impedance head, but by the local stiffness of the specimen under test. For a thick steel specimen this stiffness is approximately one tenth of the actual local stiffness or 7,000,000 lb/inch; for an aluminum specimen it is approximately 2,000,000 lb/inch.

⁴ Weight includes the effect of Z820WA or dummy plug.

ACCESSORIES SUPPLIED: All input cables; mounting stud; spanner wrench; adaptor cable.

ACCESSORIES AVAILABLE: Power supplies; signal conditioners; power amplifiers



Model F4/Z820WA



Model Z820WA

The Model F4 Vibration Generator is a reaction-type shaker generating large dynamic forces for structural excitation in vibration research and testing. The reaction principle of operation and compact configuration allow this generator to be stud mounted in any position, directly to structures without external support or critical shaft alignment problems.

The **Model F4 Electromagnetic Vibration Generator** is designed to encircle the Z820WA Impedance Head. The relatively light coil and bobbin of the F4 Generator are rigidly attached to the Z820WA Impedance Head and the heavy cylindrical magnets are suspended by two rubber diaphragms. The dynamic weight added to the test structure is relatively low since the rubber suspended weight does not affect axial or rotational inertia of the vibration generator core above the 40 Hz resonance frequency of the system.

The Model F4 is designed for operation over a very wide range of audio frequencies. It can be supplied with a sensing transducer containing an accelerometer and a force gage (Model Z820WA Impedance Head) or a standard mounting block (dummy plug). The shaker drives the tested structure through the impedance head or dummy plug.

The Model Z820WA Impedance Head is a cylindrical structure containing a piezoelectric accelerometer and a piezoelectric force gage. The transducer base can be used to measure applied force and structure motion. From these measurements mechanical impedance can be obtained.

The high impedance charge signals from the piezoelectric force gage and accelerometer are internally amplified using the low noise Piezofet® charge amplifier. Each amplifier requires a constant current DC supply.



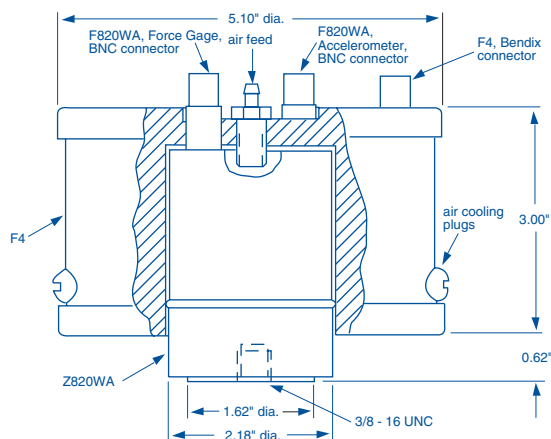
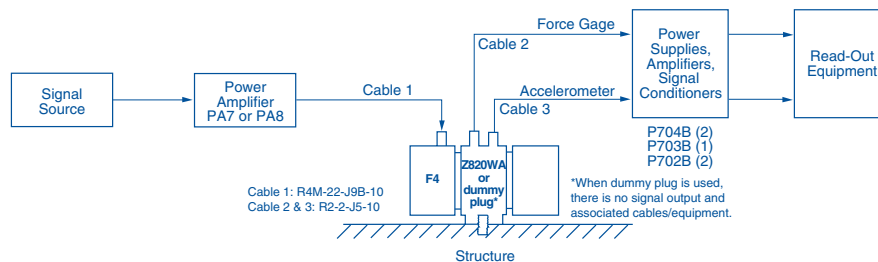
Model F4/Z820WA



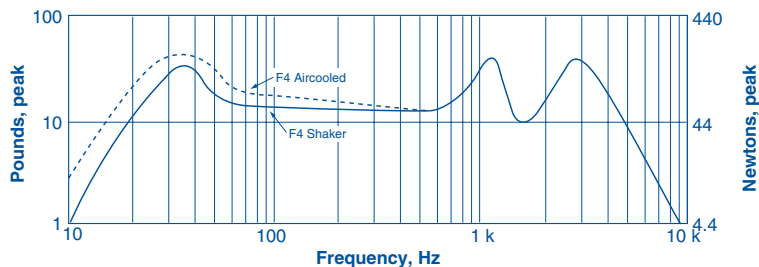
Model Z820WA

Model F4 / Z820WA Electromagnetic Shaker System

RECOMMENDED SYSTEM DIAGRAM



TYPICAL BLOCKED FORCE OUTPUT (F4 Shaker powered by PA7F)



Model F5B / Z11

Electromagnetic Shaker System



Model F5B/Z11

MODEL F5B ELECTROMAGNETIC SHAKER

Usable Frequency Range	10 - 10,000 Hz
Blocked Force Output ¹	see graph
Maximum Continuous Current	0.1 amp rms
Nominal Electrical Impedance	115 Ω
DC Electrical Resistance	56 Ω
Resonance Frequency, blocked	35 Hz
Weight	0.0354 lb (160 grams)
Total Weight (with Z11)	0.376 lb (170 grams)
Temperature Range	0 to 80°C
Base Material	hard anodized aluminum
Connector	BNC
Cable	R2-22-J9C-10

MODEL Z11 / IMPEDANCE HEAD (non-detachable)

Accelerometer Nominal Values

Charge Sensitivity	3.5 pC/g (0.36 pC/m/s ²)
Voltage Sensitivity ³	4.4 mV/g (.45 mV/m/s ²)
Capacitance ³	800 pF
Frequency Range, ±3 dB	10 - 10,000 Hz
Connector ²	Microdot 10 - 32
Cable	R1-3A-J2-6

Force Gage Nominal Values

Charge Sensitivity	250 pC/lb (56 pC/N)
Voltage Sensitivity ³	312 mV/lb (70 mV/N)
Capacitance ³	800 pF
Frequency Range, ±3 dB	10 - 10,000 Hz
Connector ²	Microdot 10 - 32
Cable	R1-3A-J2-6
Weight	0.022 lbs. (10 grams)
Mass Below Force Gage (force gage attached to specimen)	2.2 x 10 ⁻³ lb (1 gram)
Mass Below Accelerometer (accelerometer attached to specimen)	22 x 10 ⁻³ lb (10 grams)
Effective Stiffness (between force gage and specimen)	0.4 x 10 ⁶ lb/in (70 x 10 ⁹ N/m)
Effective Stiffness (between accelerometer and specimen)	2 x 10 ⁶ lb/in (350 x 10 ⁹ N/m)
Diameter of Mounting Surface	0.25 inch (0.64 cm)
Mounting Stud, integral	8 - 32
Maximum Screw Down Torque	15 in-lb (1.7 Nm)
Temperature Range	0 to 80°C
Base Material	titanium

- NOTES:**
- Blocked force output refers to the force output against a mass of infinite mechanical impedance.
 - Refers to connector at the shaker end of the cable.
 - Refers to condition at the end of the 6 foot, low-noise cable (180 pF).

ACCESSORIES SUPPLIED: Output cables.
ACCESSORIES AVAILABLE: Amplifiers; signal conditioners.

The Model F5B Vibration Generator is a reaction-type shaker generating dynamic forces for structural excitation in vibration research and testing. The reaction principle of operation, light weight and compact configuration allow this generator to be stud mounted in any position, directly to structures without external support or critical shaft alignment problems.

The Model F5B Electromagnetic Shaker is a cylindrical permanent magnet shaker. The magnet is in rigid contact with the outer case. A moving coil wound on an aluminum bobbin surrounds the magnet. This coil and bobbin is suspended from two flat, circular metal springs ensuring pure axial motion. A low center of gravity minimizes rotation excitation by the shaker. The added dynamic weight is low since the suspended weight does not effect rotational or axial inertia above its resonance. This prevents inconsistencies often encountered whenever the rotational impedance of structures is low compared to the axial impedance.

The Model F5B is designed for operation over a very wide range of audio frequencies. It can be supplied with a sensing transducer containing an accelerometer and a force gage (Model Z11 Impedance Head). The shaker drives the tested structure through the impedance head.

The Model Z11 Impedance Head is a cylindrical structure containing a piezoelectric accelerometer and a piezoelectric force gage. The transducer base can be used to measure applied force and structure motion. From these measurements mechanical impedance can be obtained.

The high impedance charge signals from the piezoelectric force gage and accelerometer should be conditioned using charge amplifiers or charge converters (CC701).

The Model Z11 Impedance Head has a specimen contact diameter of 0.25 inches preventing excessive stiffening by impedance head attachment. The very low mass below the force gage (1 gram) makes it possible to take measurements on relatively light structures, such as airframes, models and light machinery.

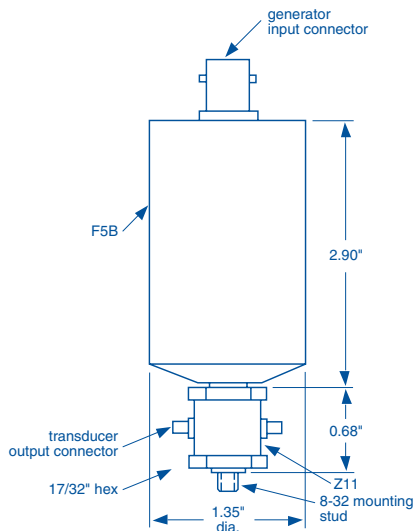
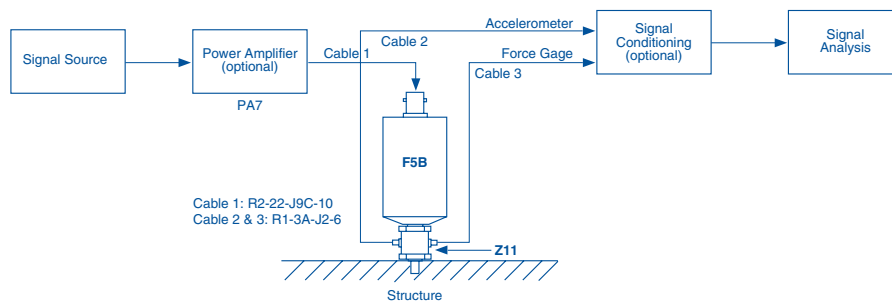


Model F5B/Z11

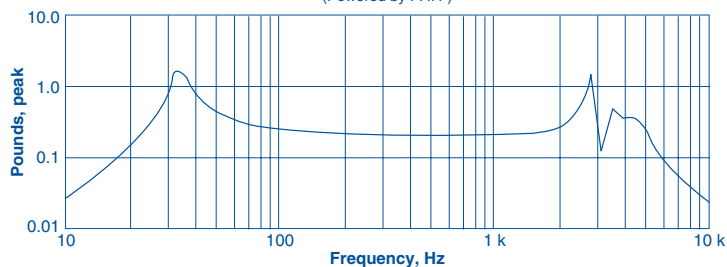
Model F5B / Z11

Electromagnetic Shaker System

RECOMMENDED SYSTEM DIAGRAM



TYPICAL BLOCKED FORCE OUTPUT (Powered by PA7F)



Model F10 / Z820WA

Electromagnetic Shaker System

MODEL F10 ELECTROMAGNETIC SHAKER

Usable Frequency Range	5 - 2,000 Hz
Blocked Force Output ¹	see graph
Maximum Continuous Current	4.0 amp rms
Nominal Electrical Impedance	8.5 Ω @ 100Hz
DC Electrical Resistance	5 Ω
Resonance Frequency, blocked	25 Hz
Weight ⁴	8 lb (3.6 kg)
Suspended Weight	20 lb (9.0 kg)
Total Weight	28 lb (12.7 kg)
Temperature Range	0 to 80°C
Base Material	anodized aluminum
Connector ²	Bendix SP00A-8-3
Cable	R4M-22-J9B-10

MODEL Z820WA IMPEDANCE HEAD

Accelerometer Nominal Values

Voltage Sensitivity	100 mV/g (10.2 mV/m/s ²)
Frequency Response:	
± 0.5 dB	10 - 2,000 Hz
± 1.0 dB	6 - 3,000 Hz
± 3.0 dB	3 - 6,000 Hz
Power Requirements:	
voltage source	18 - 30 VDC
current regulating diode	2 - 10 mA
Bias Output Voltage, nominal	12 VDC
Output Impedance	<100 Ω
Electrical Noise, equiv g, nominal:	
Spectral 10 Hz	100 $\mu\text{g}/\sqrt{\text{Hz}}$
100 Hz	10 $\mu\text{g}/\sqrt{\text{Hz}}$
1000 Hz	1 $\mu\text{g}/\sqrt{\text{Hz}}$
Connector ²	BNC
Output Cable	R2-2-J5-10

Force Gage Nominal Values

Voltage Sensitivity	100 mV/lb (22.5 mV/N)
Power Requirements:	
voltage source	18 - 30 VDC
current regulating diode	2 - 10 mA
Bias Output Voltage, nominal	12 VDC
Output Impedance	<100 Ω
Electrical Noise, equiv lb, nominal:	
Spectral 10 Hz	60 $\mu\text{lb}/\sqrt{\text{Hz}}$ (270 $\mu\text{N}/\sqrt{\text{Hz}}$)
100 Hz	10 $\mu\text{lb}/\sqrt{\text{Hz}}$ (44 $\mu\text{N}/\sqrt{\text{Hz}}$)
1000 Hz	1 $\mu\text{lb}/\sqrt{\text{Hz}}$ (4.4 $\mu\text{N}/\sqrt{\text{Hz}}$)
Connector ²	BNC
Output Cable	R2-2-J5-10
Weight	1.1 lb (0.5 kg)
Mass Below Force Gage (including stud)	0.31 lb (140 gram)
Effective Stiffness ³	>500 x 10 ⁶ lb/in (87 x 10 ⁹ N/m)
Diameter of Mounting Surface	1.62 inch (4.1 cm)
Mounting Stud, stainless steel	3/8 - 16
Recommended Screw Down Torque	70 in-lb (7.9 Nm)
Temperature Range	0 to 80°C
Base Material	anodized aluminum

- NOTES:**
- ¹ Blocked force output refers to the force output against a mass of infinite mechanical impedance.
 - ² Refers to the connector at the shaker end of the cable.
 - ³ The design of the Z820WA impedance head is such that the limiting stiffness it can be measured with an accuracy of 10% is determined not by the impedance head, but by the local stiffness of the specimen under test. For a thick steel specimen this stiffness is approximately one tenth of the actual local stiffness or 7,000,000 lb/inch; for an aluminum specimen it is approximately 2,000,000 lb/inch.
 - ⁴ Includes the effect of Z820WA or dummy plug.

ACCESSORIES SUPPLIED: All input and output cables; mounting stud; spanner wrench

ACCESSORIES AVAILABLE: Power supplies; signal conditioners; power amplifiers



Model F10



Model Z820WA

The Model F10 Vibration Generator is a reaction-type shaker generating very large dynamic forces for structural excitation in vibration research and testing. The reaction principle of operation and compact configuration allow this generator to be stud mounted in any position, directly to structures without external support or critical shaft alignment problems.

The Model F10 Electromagnetic Vibration Generator is designed to encircle the Z820WA Impedance Head. The relatively light coil and bobbin of the F10 Generator are rigidly attached to the Z820WA Impedance Head and the heavy cylindrical magnets are suspended by two rubber diaphragms. The dynamic weight added to the test structure is relatively low since the rubber suspended weight does not affect axial or rotational inertia of the vibration generator core above the 25 Hz resonance frequency of the system.

The Model F10 is designed for operation over a wide range of audio frequencies. It can be supplied with a sensing transducer containing an accelerometer and a force gage (Model Z820WA Impedance Head) or a standard mounting block (dummy plug). The shaker drives the tested structure through the impedance head or dummy plug.

The Model Z820WA Impedance Head is a cylindrical structure containing a piezoelectric accelerometer and a piezoelectric force gage. The transducer base can be used to measure applied force and structure motion. From these measurements mechanical impedance can be obtained.

The high impedance charge signals from the piezoelectric force gage and accelerometer are internally amplified using the low noise PiezoFET[®] charge amplifier. Each amplifier requires a constant current DC supply.

The Model F7 Piezoelectric Vibration Generator can be used in place of the Z820WA Impedance head. The Model F7 contains an integral impedance head. Consult the data sheet of the F7 for the technical details of the impedance head. The F7 requires a separate power amplifier and matching network.



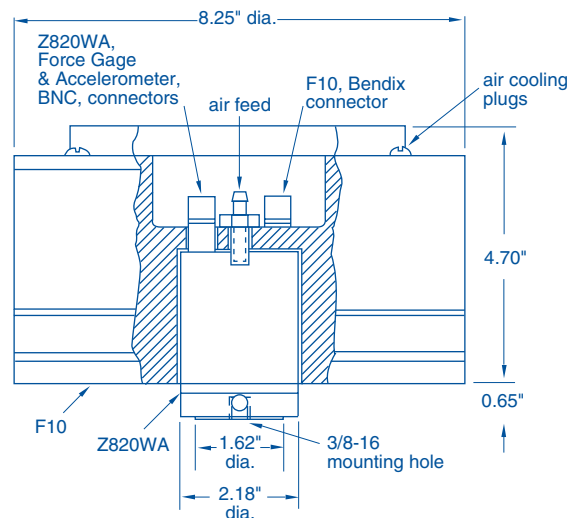
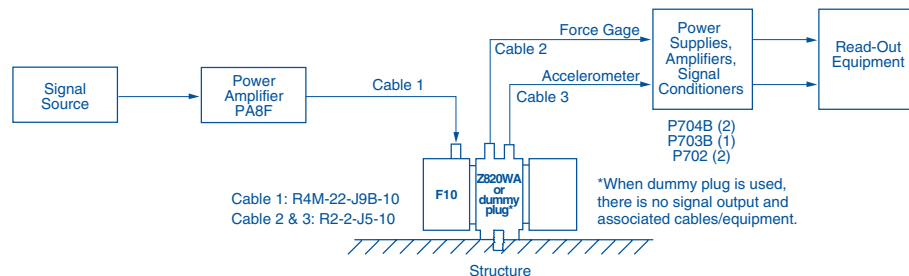
Model F10



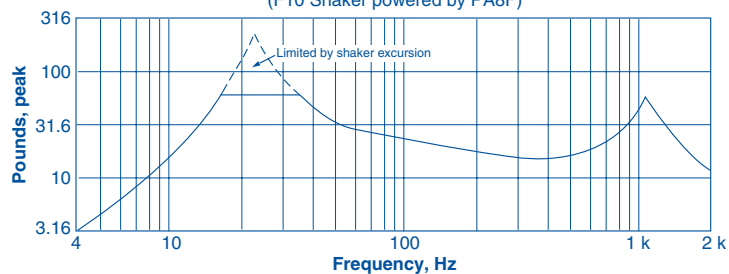
Model Z820WA

Model F10 / Z820WA Electromagnetic Shaker System

RECOMMENDED SYSTEM DIAGRAM



TYPICAL BLOCKED FORCE OUTPUT (F10 Shaker powered by PA8F)



Model F7

Piezoelectric Vibration Generator



Model F7

Vibration Generator

Usable Frequency Range	500 - >20,000 Hz
Blocked Force Output ¹	see graph
Maximum Input	800 V rms
Maximum Acceleration	1,000 g
Capacitance	8.0 nF
Connector ²	Bendix PT06A-8-3P
Cable	R4-4M-J9-10

Accelerometer Nominal Values

Charge Sensitivity9 (0.092) pC/g (pC/m/s ²)
Voltage Sensitivity ³	13 (1.33) mV/g (mV/m/s ²)
Capacitance ³	700 pF
Frequency Range, ± 3 dB	10 - 20,000 Hz
Connector ²	Microdot 10-32
Cable	R1-1-J1-6

Force Gage Nominal Values

Charge Sensitivity	175 (40) pC/lb (pC/N)
Capacitance ³	2 μ F
Connector ²	Microdot 10-32
Cable	R1-1-J1-6

Mass Below Force Gage (including stud)	20 gram
Effective Stiffness	3×10^6 (0.5×10^9) lb/in
Diameter of Mounting Surface	0.63 (1.60)
Mounting Stud, stainless steel	$\frac{3}{16}$ -16 in-lb (Nm)
Maximum Screw Down Torque	100 (11)
Base Material	titanium
Temperature Range	-50 to 80 °C
Weight	2.5 (1.1) lb (kg)

- NOTES:**
- ¹ Blocked force output refers to the force output against a mass of infinite mechanical impedance.
 - ² Refers to connector at the end of cable.
 - ³ Measured at the end of the supplied cable, 30 pF/ft.

ACCESSORIES SUPPLIED: All input and output cables; mounting stud; spanner wrench.

ACCESSORIES AVAILABLE: Power amplifiers; matching networks; signal conditioners.

The Model F7 Piezoelectric Vibration Generator utilizes the expansion/contraction properties of piezoelectric crystals for sonic and ultrasonic structural excitation. This portable reaction-type shaker generates large dynamic forces to very high frequencies for structural excitation in vibration research and testing. The reaction principle of operation, lightweight and compact configuration allow this generator to be stud-mounted in any position, directly to structures without external support or critical shaft alignment problems. The F7 Piezoelectric Vibration Generator is designed to mate with the F4 electromagnetic vibration generator to extend the frequency range down to low frequencies (see the specification sheet for Model F4/F7 for details).

A transducer base is located on the piezo-shaker. The F7 has a transducer base which contains a force gage and an accelerometer. This transducer measures the force applied to the structure (force gage) and the resulting motion (accelerometer). The transducer signals can be fed into either the read-out equipment or into signal conditioners. During the design of these bases, particular attention was given to yield a minimum mass below force gage.

The blocked force output curve refers to the force developed against a mass of infinite impedance. The graph shows typical frequency response and may vary between shakers. Matching of shakers to a common first resonance frequency is available on special order. Wide fluctuations in force output are present at very high frequencies; however, this shaker can be used as a source of structural excitation past 20,000 Hz at lower force outputs.

Applications for this instrument include such areas as biomedical research, production testing, mechanical impedance studies, high frequency vibration research and other areas where structural excitation over a wide frequency range is required.

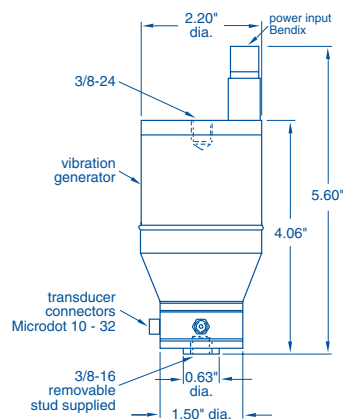
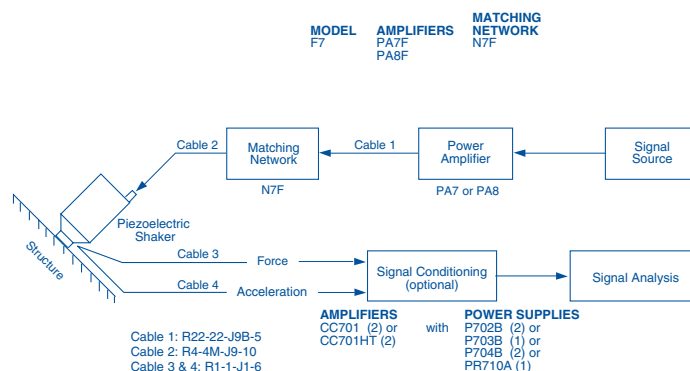


Model F7

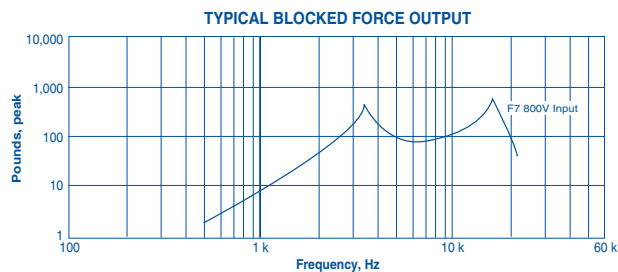
Model F7

Piezoelectric Vibration Generator

RECOMMENDED SYSTEM DIAGRAM



Model F7



For higher frequency applications up to 80kHz, Model F7-1 is recommended. Please contact Wilcoxon for details.

Model F7-1 Piezoelectric Shaker System

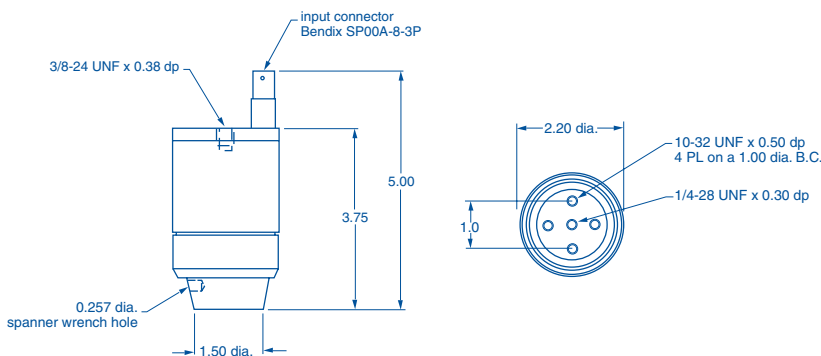


Model F7-1

MODEL F7-1 SHAKER

Usable Frequency Range	1 - 80 kHz
Blocked Force Output, 360 V rms input ¹	10 lb peak
Maximum Input Voltage	800 V rms
Capacitance	0.01 μ F
Operating Temperature, max.	82 °C
Weight	2.8 lbs
Contact Area	1.5 inch diameter
Input Connector	Bendix SP00A-8-3P
Cable Supplied	R4-4M-J9-10

NOTES: ¹ Blocked force output refers to the force output against a mass of infinite mechanical impedance.



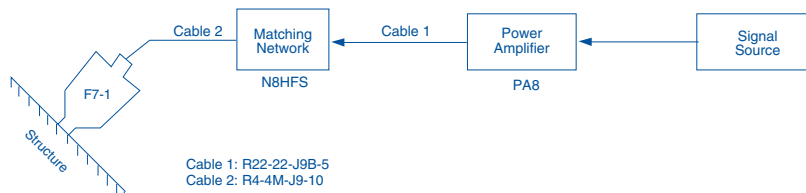
The Model F7-1 Piezoelectric Vibration Generator utilizes the expansion/contraction properties of piezoelectric crystals for sonic and ultrasonic structural excitation. This portable reaction-type shaker generates large dynamic forces to very high frequencies for structural excitation in vibration research and testing. The reaction principle of operation, lightweight and compact configuration allow this generator to be stud-mounted in any position, directly to structures without external support or critical shaft alignment problems.

The F7-1 Piezoelectric Vibration Generator is designed to mate with the F4 electromagnetic vibration generator to extend the frequency range down to low frequencies (see the specification sheet for Model F4 for details).

Some fluctuations in force output are present at very high frequencies; however, this shaker can be used as a source of structural excitation past 80 kHz at lower force outputs. The force variations at frequencies above 10 kHz are directly related to variations in the mounting stiffness, attachment method, and driving point mechanical impedance of the structure being excited by the F7-1.

Applications for this instrument include such areas as biomedical research, production testing, mechanical impedance studies, high frequency vibration research and other areas where structural excitation over a wide frequency range is required.

RECOMMENDED SYSTEM DIAGRAM





Model F4/F7



Model F7

A DUAL SHAKER FOR WIDE FREQUENCY RANGE STRUCTURAL VIBRATION

The Model F4/F7 Vibration Generator is designed to excite structures for vibration research and testing. By combining a high frequency piezoelectric vibration generator (Model F7) and a low frequency electromagnetic vibration generator (F4), the entire audio range can be excited. This compact, lightweight force generator can easily be attached directly to a test structure in any position with no external supports. It is capable of producing a high force-to-weight output over the wide frequency range of 10 Hz to greater than 20,000 Hz.

The Model F4 Electromagnetic Vibration Generator is designed to encircle the F7 Piezoelectric Vibration Generator. The relatively light coil and bobbin of the F4 Generator are rigidly attached to the F7 Generator and the heavy cylindrical magnets are suspended by two rubber diaphragms. The dynamic weight added to the test structure is relatively low since the rubber suspended weight does not affect axial or rotational inertia of the vibration generator core above the 30 Hz resonance frequency of the system.

The Model F7 Piezoelectric Vibration Generator produces vibrational forces at the high frequency range from approximately 1 kHz to above 50 kHz, however the force output is predictable to only 20 kHz. The Model F7 contains a stack of piezoelectric plates which requires a voltage step-up (impedance matching) for high force output levels. This step-up is provided by the N7F Matching Network.

Model F4 / F7

Electromagnetic / Piezoelectric Shaker System

MODEL F4 ELECTROMAGNETIC SHAKER

Usable Frequency Range	10 - 7,500 Hz
Blocked Force Output ¹	see graph
Maximum Continuous Current	1.5 amp rms
Maximum Continuous Current w/ Air Cooling	2.5 amps
Nominal Electrical Impedance	25 Ω
DC Electrical Resistance	13 Ω
Resonance Frequency, blocked	<40 Hz
Forced Air Cooling Pressure, max.	25 psi (1.7 bar)
Connector ²	Bendix PT06A-8-3S
Cable	R4M-22-J9B-10

MODEL F7 PIEZOSHAKE / IMPEDANCE HEAD

Vibration Generator

Usable Frequency Range ³	500 - >20,000 Hz
Blocked Force Output ¹	see graph
Maximum Input, voltage	800 V rms
Maximum Acceleration	1,000 g
Capacitance	8.0 nF
Connector ²	Bendix PT06A-8-3P
Cable	R4-4M-J9-10

Accelerometer Nominal Values

Charge Sensitivity	0.9 pC/g (0.092 pC/m/s ²)
Voltage Sensitivity ⁴	13 mV/g (1.33 mV/ms ²)
Capacitance ⁴	700 pF
Frequency Range, ± 3 dB	10 - 20,000 Hz
Connector ²	Microdot 10 - 32
Output Cable	R1-1-J1-6

Force Gage Nominal Values

Charge Sensitivity	175 pC/lb (39 pC/N)
Voltage Sensitivity ⁴	75 mV/lb (17 mV/N)
Capacitance ⁴	2,300 pF
Frequency Range, ± 3 dB	10 - 40,000 Hz
Connector ²	Microdot 10 - 32
Output Cable	R1-1-J1-6

F4 / F7 System

Mass Below Force Gage (including stud)	20 gram (0.044 lb)
Effective Stiffness	3×10^6 lb/in (0.5×10^9 N/m)
Diameter of Mounting Surface	0.63 inch (1.66 cm)
Mounting Stud, stainless steel	$\frac{3}{8}$ - 16
Recommended Screw Down Torque	100 in-lb (11 Nm)
Temperature Range	0 to 80°C
Base Material	anodized aluminum (F4), titanium (F7)
Weight of Parts Rigidly Attached to Structure, incl. F7	3.4 lb (1.5 kg)
Suspended Weight	4.8 lb (2.2 kg)
Total Weight	8.2 lb (3.7 kg)

NOTES:

- Blocked force output refers to the force output against a mass of infinite mechanical impedance.
- Refers to connector at the shaker end of the cable.
- May be used as an excitation source above 20 kHz, however, output frequency response is not predictable at higher frequencies.
- Refers to condition at the end of the 6 foot low-noise cable. (180 pF)

ACCESSORIES SUPPLIED:

All input and output cables; spanner wrench; mounting stud; adaptor cable.

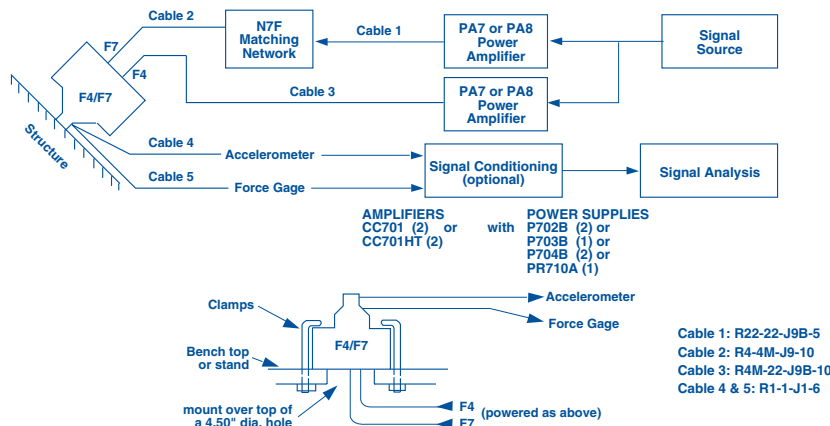
ACCESSORIES AVAILABLE:

Powering System: (2) PA7F Power Amplifiers; signal conditioners

Model F4 / F7

Electromagnetic / Piezoelectric Shaker System

RECOMMENDED SYSTEM DIAGRAM



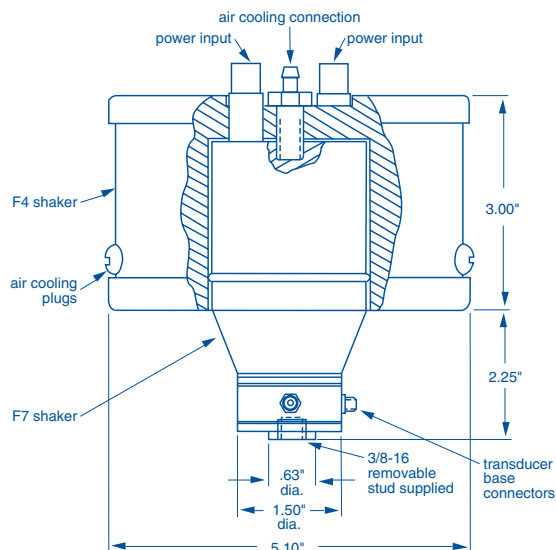
Model F4/F7



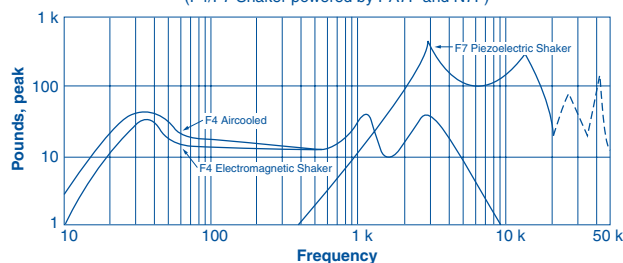
Model F7

The Model F4/F7 System has a transducer base which contains a force gage and an accelerometer. These transducers measure the force applied to the structure (force gage) and the resulting motion (accelerometer). The transducer signals can be fed into either the read-out equipment or into signal conditioners. During the design of these bases, particular attention was given to yield a minimum mass below force gage.

The Model F7 Piezoelectric Vibration Generator can be used in place of the Z820WA Impedance head. The Model F7 contains an integral impedance head. Consult the data sheet of the F7 for the technical details of the impedance head. The F7 requires a separate power amplifier and matching network.



TYPICAL BLOCKED FORCE OUTPUT
(F4/F7 Shaker powered by PA7F and N7F)





The PA7F has a solid state push-pull drive circuit and outputs. As with all Wilcoxon power amplifiers, the PA7F is 19" rack compatible. The PA7F features low noise and low distortion over its entire range of operation. The PA7F can drive most small to medium sized electromagnetic and piezoelectric vibration generators over the audio range.

Model PA7F

Power Amplifier

OUTPUT

Maximum Power Out (rated @ 8 ohm load):	400 watts maximum
THD at Rated Power	<1%
Frequency Response, -3 dB:	
PiezoFilter Out	4 - >20,000 Hz
PiezoFilter In	500 - >20,000 Hz

MODES OF OPERATION

Series	Piezoelectric shaker
Parallel	Electromagnetic shaker

CONTROLS

Front Panel	Power switch
Rear Panel	Mode switch
	Piezo filter switch

MISCELLANEOUS

Protection	AC line fuse, thermal shutdown based on heat sink temperature
Output Connectors	Speakon® connector
Input Connectors:	Isolated BNC input
Input Impedance:	
Series mode	20 kΩ
Parallel mode	50 kΩ
Sensitivity:	
Series	2.0 V _{RMS} for full output
Parallel	1.0V _{RMS} for full output
Size	5.25" high (plus 0.5" feet), 19" wide, 15.5" deep
Weight	30 lbs.
Compatible Shakers:	
Electromagnetic	F3, F4, F5B
Piezoelectric	F7
Compatible Matching Networks:	N7F

OPTIONS: PA7F-230 (230 VAC) Model available. Cooling fan assembly available.



Model PA8F

Power Amplifier



OUTPUT

Maximum Power Out (rated @ 4 Ω load):	800 watts maximum
THD at Rated Power	<1%
Frequency Response, -3 dB:	
PiezoFilter Out	4 - >20,000 Hz
PiezoFilter In	500 - >20,000 Hz

MODES OF OPERATION

Series	Piezoelectric shaker
Parallel	Electromagnetic shaker

CONTROLS

Front Panel	Power switch
Rear Panel	Mode switch
	Piezo filter switch

MISCELLANEOUS

Protection	AC line fuse, thermal shutdown based on heat sink temperature
Output Connectors	Speakon® connector
Input Connectors:	Isolated BNC input
Input Impedance:	
Series mode	20 k Ω
Parallel mode	50 k Ω
Sensitivity:	
Series	2.0 V _{RMS} for full output
Parallel	1.0 V _{RMS} for full output
Size	5.25" high (plus 0.5" feet), 19" wide, 15.5" deep
Weight	45 lbs.
Compatible Shakers:	
Electromagnetic	F10
Piezoelectric	F7-1, D-Series
Compatible Matching Networks:	N8F, N8HFS

For applications that require more power than the PA7F, Wilcoxon Research offers the PA8F Series. The PA8F has a solid state push-pull drive circuit and outputs. As with all Wilcoxon power amplifiers, the PA8F is 19" rack compatible. Other features include low-noise and low distortion over its entire range of operation. The PA8F amplifier is capable of driving most medium to large sized electromagnetic vibration generators to their lowest frequencies and with an N8 Series Matching Network, it is capable of driving piezoelectric vibration generators to their highest frequencies.

OPTIONS: PA8F-230 (230 VAC) model available. Cooling fan assembly available.





N7F



N8F

Matching networks provide the interface between power amplifiers and piezoelectric shakers. The impedance which the piezoshaker presents to the power amplifier is capacitive (reactive) and therefore decreases with increasing frequency. To provide improved performance from the shaker, impedance matching is needed. The matching network provides voltage step-up to allow the piezoelectric shaker to be driven at its full voltage level. At very high frequencies, lower output voltages are used to better match the reactive load. Additional functions such as channel separation, distortion reduction, fusing and shaker selection are also provided by some matching networks. All N7/N8 series networks are 19" rack mountable.

Model N7 & N8 Matching Networks

MODEL N7F

Input Voltage, max.	40 V rms
Output Voltage, max.	100, 200, 300, 500, 800 V rms
Connectors:	
input	Switchcraft B3M
output	Bendix SP00A-8-3S (F7)
.....	Bendix SP00A-8-3S (F7)
Dimensions (including handles)	19 W x 7.3 H x 13 D inch 483 x 184 x 330 mm
Weight	24 lbs 11.3 kg
Circuit Breaker	10 amps 2.5 air cool
Recommended Amplifier	PA7F
Compatible Shakers	F7

MODEL N8 SERIES	N8F	N8HFS	UNITS
Input Voltage, max.	60	120	V rms
Output Voltage, max.	300, 450, 800, 1150, 1500	360	V rms
Connectors:			
input	Switchcraft B3M	Switchcraft B3M	
output	HV BNC	Bendix SP00A-8-3S	
Dimensions	19 W x 7.3 H x 13 D	19 W x 7.3 H x 13 D	inches
(including handles)	483 x 184 x 330	483 x 184 x 330	mm
Weight	24	14	lbs
.....	11.3	6.4	kg
Circuit Breaker	20	10	amps
Recommended Amplifier	PA8F	PA8F	
Compatible Shakers	D-Series	F7-1	

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