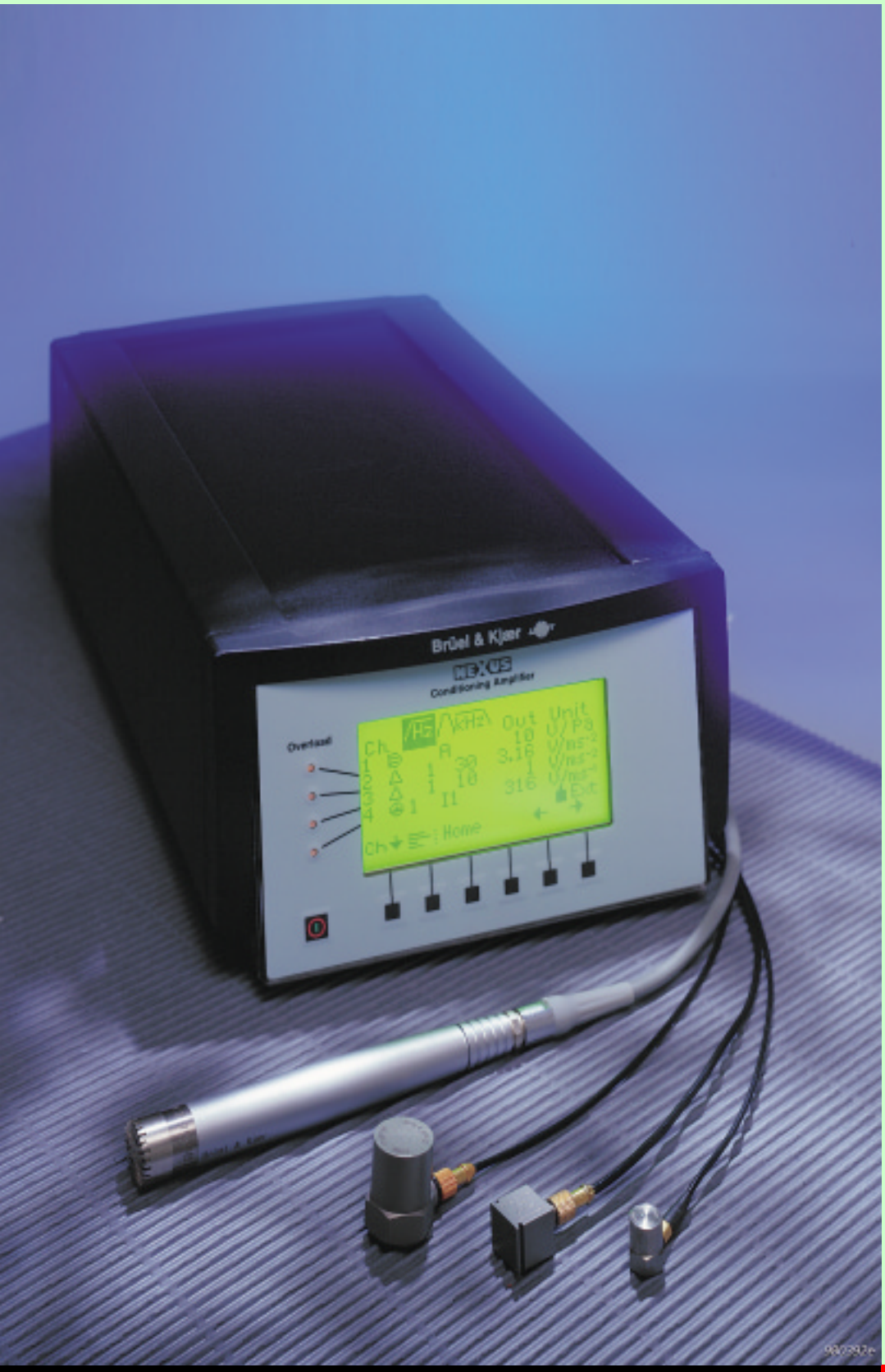
PRODUCT DATA

The NEXUS Range of Conditioning Amplifiers



The NEXUS™ concept is highly flexible. Based on a single mainframe, a number of input/output modules allow you to configure a conditioning amplifier to your exact requirements. You can have both acoustic and vibration inputs in the same instrument with one, two, three or four independent input channels. Your NEXUS can be reconfigured at any time, should your requirements change. If, for example, you have a 1-channel Charge Conditioning Amplifier, it can be updated to a 2-channel Charge/2-channel Microphone Conditioning Amplifier. A number of hardware/software updates, for example auxiliary modules with A-, B-, C- and D-weighting filters or integration, make the concept even more flexible. Microprocessors are used for control, display and interfacing purposes, but the signal is maintained analogue to obtain optimum signal/noise ratio and the lowest possible distortion. NEXUS supports transducers with TEDS according to IEEE P1451.4

2690 – 2693

Brüel & Kjær

USES

- ❍ Specially suited for automotive use. Developed in association with major car manufacturers
- ❍ General signal conditioning amplifiers for use with charge accelerometers, hydrophones and force transducers, condenser microphones, DeltaTron® accelerometers, DeltaTron preamplifiers, voltage input and sound intensity probes
- ❍ Conditioning amplifier for high-quality field and laboratory measurement systems
- ❍ Field recording of vibration and acoustic signals with portable DAT recorder

FEATURES

- ❍ Highly flexible construction which can be configured with different input modules and number of channels, according to your requirements
- ❍ High input signal range. Low noise. Extensive overload facilities
- ❍ 1, 2, 3 or 4 channel configurations as required. Combination of acoustic and vibration transducer inputs is possible
- ❍ Supports transducers with TEDS according to IEEE P1451.4
- ❍ 12 main standard versions available for: charge, microphone, sound intensity and DeltaTron input
- ❍ Compact robust design and battery operation make the conditioning amplifiers suitable for use in the field (and in the laboratory)
- ❍ Serial control interface (RS–232) allows computer control of set-ups and test functions. A large number of amplifiers can be controlled from a single PC
- ❍ High accuracy due to reliable construction and a wide range of calibration options. Built-in patented Charge Injection Calibration and patented Mounted Resonance Testing
- ❍ Wide range of filters that can be set up for specific tasks
- ❍ Rack-mounting fittings available

Portability and Rack Mounting

Fig. 1 UA 1482 Frame for SONY® SIR 1000

NEXUS Conditioning Amplifiers are equally suited for laboratory and field use. They are compact and self-contained with an optional re-chargeable battery. They are lightweight too, weighing around 3 kg (6.6 lb.), including battery. Rack-mounting fittings are available for in-car testing purposes as well as for stationary use. The photo below shows the Brüel & Kjær frames available for mounting NEXUS units in standard 19″ racks (KK 0049). The portable 19″ rack KQ 0158 can contain up to 9 NEXUS units. Up to 16 NEXUS channels and a DAT recorder can be mounted in a compact unit (UA 1409) which is particularly suitable for automotive use. UA 1409 has fittings for a carrying strap.

Reliable Design

To survive the harsh electrical environment in cars, NEXUS conditioning amplifiers have specifications that far exceed the strict European EMC immunity requirements. ISO 7637-1 "Road Vehicles – Electrical disturbance by conduction and coupling" requirements are met. Mechanical robustness is equally high and meets MIL–STD–810C and IEC 68–2–6 standards.

Environmental

Since all NEXUS amplifiers are built for portable outdoor use, they meet strict requirements for temperature and humidity. The operating temperature range extends from –10 to 55°C (14 to 131°F). The instrument will withstand rain if kept with the front panel facing upwards. However, because of the sockets on the back panel it is not watertight.

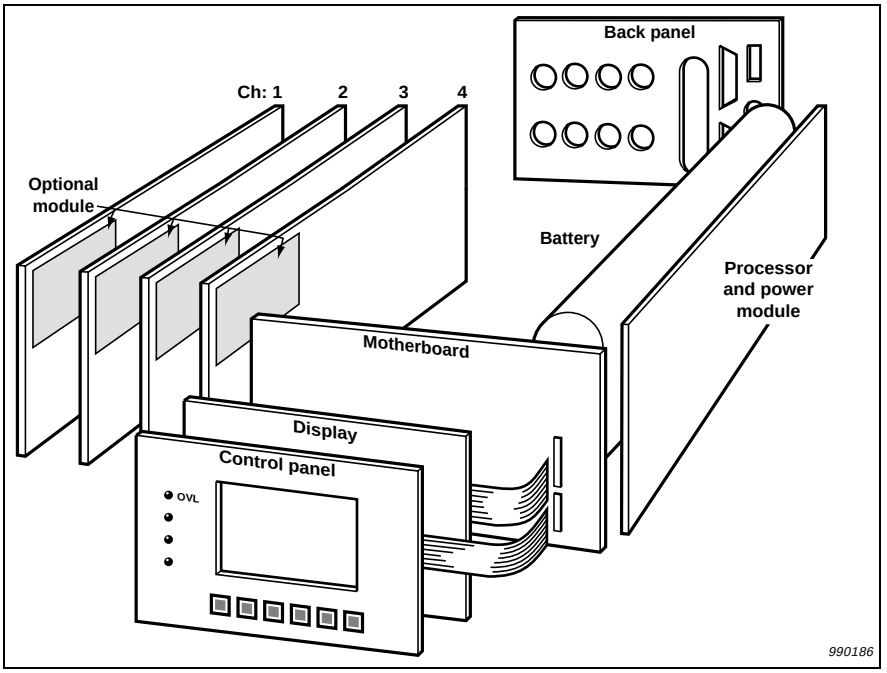
Modular Flexibility

Although a conditioning amplifier can be configured exactly to your requirements, a number of standard versions are available to cover the most widely used combinations.

NEXUS Standard Types and Options

NEXUS name and description	**NEXUS Type number**
2-Channel Microphone Conditioning Amplifier	2690 A 0S2
4-Channel Microphone Conditioning Amplifier	2690 A 0S4
2-Channel Microphone Conditioning Amplifier with Filters	2690 A 0F2
4-Channel Microphone Conditioning Amplifier with Filters	2690 A 0F4
2-Channel Intensity Conditioning Amplifier	2691 A 0S2
1-Channel Charge Conditioning Amplifier	2692 A 0S1
4-Channel Charge Conditioning Amplifier	2692 A 0S4
1-Channel Charge Conditioning Amplifier with Single and Double Integration	2692 A 0I1
4-Channel Charge Conditioning Amplifier with Single and Double Integration	2692 A 0I4
4-Channel DeltaTron Conditioning Amplifier	2693 A 0S4
4-Channel DeltaTron Conditioning Amplifier with Filters	2693 A 0F4
4-Channel DeltaTron Conditioning Amplifier with Single and Double Integration	2693 A 0I4
NEXUS standard options	**NEXUS Order number**
Upper Limiting Frequency 140 kHz	WH 3219
Whole Body Vibration X, Y and Z Direction Filters	WH 3206
900 Hz to 1100 Hz Band Pass Filter	WH 3278
Constant Power On	WH 3345
Single and Double Integration Filter	ZE 0788
A, B, C and D Weighting Filters	ZE 0794
Individual filters available on request	

Fig. 2 All Conditioning Amplifiers in the NEXUS range are based on the same mainframe and power supply. The modular design gives a high degree of flexibility. For the sake of accuracy and reliability and to reduce the cost of the instrument, replacement of modules must be performed at Brüel & Kjær



Custom-made Versions

You can have four separate channels for each of the inputs mentioned below, with the exception that sound intensity probes always require two channels. Any combination of the different channel types is possible. If you need other combinations of channels or number of channels, you can do so by using the ordering codes on the separate ordering information sheet. If you want to change the configuration of your NEXUS amplifier, it must be returned to Brüel & Kjær for updating and calibration.

Fig. 3 Back panel of a NEXUS Conditioning Amplifier. The picture shows a 4-channel Microphone Conditioning Amplifier Type 2690 A 0S4. Each input module has a 7-pin LEMO connector for connecting Brüel & Kjær's Falcon Range® microphones and a BNC output socket. The RS–232 interface connectors are also positioned on the back panel

Channel Description

Charge Channel

A conditioning amplifier can contain up to four modular channels. Each channel consists of a common module, an input module, an optional module and an output module. The common module contains filters,

gain settings and calibration functions. The input and output modules have additional gain settings and include high-pass filters.

A conditioning amplifier can contain up to 4 separate charge input channels. Each channel has comprehensive high- and low-pass filtering facilities. TNC input connectors are used and TNC to 10–32 UNF adaptors are provided. Input can be single ended or floating.

Single and double integration modes are available in some standard versions and also as an option for all input modules.

The Mounted Resonance Testing facility is very useful to get information about the mounting of the associated charge accelerometer and general errors in the measurement set-up.

Microphone Channel

You can have up to four microphone channels in a single conditioning amplifier.

7-pin LEMO sockets are used for connection to Falcon Range microphone preamplifiers. Floating inputs are used for maximum EMI (Electro Magnetic Interference) protection. The microphone polarization voltage can be set to 0 or 200 V, and the short-circuit protected microphone preamplifier supply voltage can be set to ±40 or ±14 V. In addition to the extensive low-pass filters, there is a 20 Hz high-pass filter that is useful for suppressing wind noise. An A-weighting type "O" filter is standard.

One of the comprehensive overload facilities is current overload detection. It is used to determine excessive drive current for the microphone preamplifier, thereby indicating an overload that may otherwise be very difficult to detect, especially in a set-up with long cables and high-frequency signal content.

The patented Charge Injection Calibration technique is also implemented, and will reveal set-up errors such as incorrect/missing polarization voltage and leakage in the microphone.

Sound Intensity Channel

One or two sound intensity probes can be used with a single conditioning amplifier containing two or four intensity channels. 7-pin LEMO connectors are used for connecting the probes.

The features of the sound intensity channel are very similar to the microphone channel, but it has IEC 1043 standard Class 1 and ANSI S1.12–1995 Class 1 phase- and gain-match specifications using the special intensity 20 Hz high-pass filter.

DeltaTron Channel

Up to four DeltaTron input modules can be fitted for conditioning of input signals from Constant Current Line Drive based accelerometers, microphone preamplifiers or "direct voltage" input.

The input BNT socket can be floating or single-ended. A constant current of 4 or 10 mA is supplied in the DeltaTron mode. It also supplies an 8 V DC voltage on the inner screen of the TNC socket for connecting a tacho probe.

The current overload detection circuit, similar to the one used for microphone input modules, has been implemented.

Reference and Test Generators

A reference generator is available with all channel types and can be used as an excitation signal for your measurement set-up. The output signal is a sinusoidal signal with 1 V RMS level. For charge channels a test tone is also available. It is a 159.2 Hz (±1%) sinusoidal signal which is applied in parallel with the charge input signal.

Output Module

The output module, identical for all channels, will drive 20 m of cable to 100 kHz, 100 m of cable (100 pF/m) to 20 kHz or up to 1000 m to 2 kHz. A BNC connector is used, and you can select single-ended or floating mode. The output is protected against short-circuiting and voltage overload, even when the instrument is switched off.

Flexible Filter Configuration

Built-in Filters

A number of filters are available as standard within NEXUS. The filters are low-pass filters with cut-off frequencies of 0.1, 1, 3, 10, 22.4, 30 and 100 kHz (40 dB/decade) and high-pass filters with 0.1, 1, 10 and 20 Hz cut-off frequencies (10, 20 Hz/80 dB/decade and A-weighting for microphone/intensity channels and a 20 Hz/40 dB/decade intensity filter for intensity channels.

Optional Filters

In addition to the built-in filters a number of optional standard filters can be installed upon request, for example A-, B-, C- and D-weighting and single/double integration. User-defined filters can be made on special request. Note that for embedded software versions greater than 1.2, there are no restrictions on the use of the optional filters in conjunction with the built-in standard high and low pass filters.

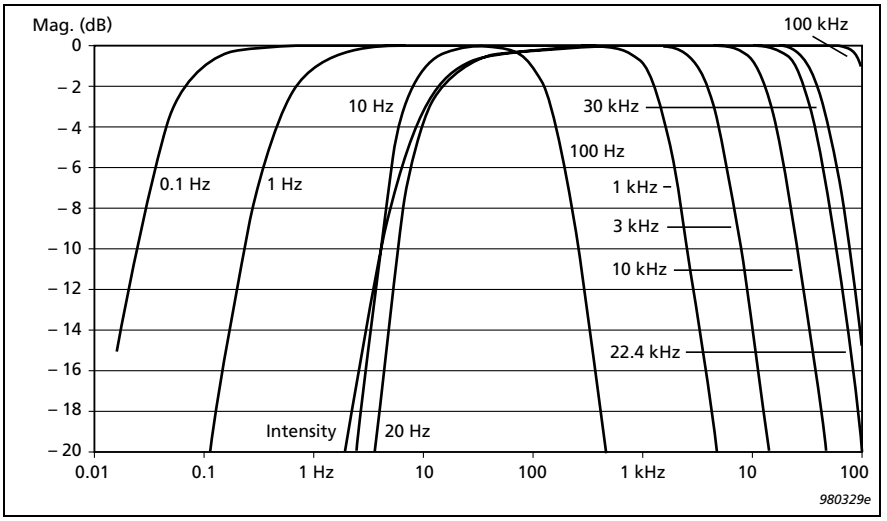


Fig. 4 Typical amplitude characteristics for NEXUS' high-pass and low-pass filters. Note that all low-pass filters were measured in conjunction with the 0.1 Hz high-pass filter

Fig. 5 Typical phase characteristics for NEXUS' high-pass and low-pass filters. Note that all low-pass filters were measured in conjunction with 0.1 Hz high-pass filter

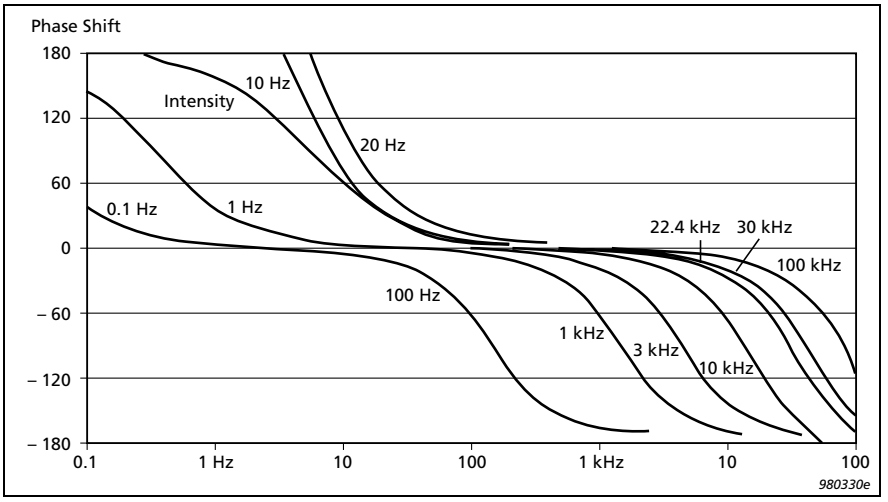


Fig. 6 Typical amplitude characteristics for velocity and displacement filters (i.e., single and double integration respectively) with 1 Hz and 10 Hz cut-off frequencies

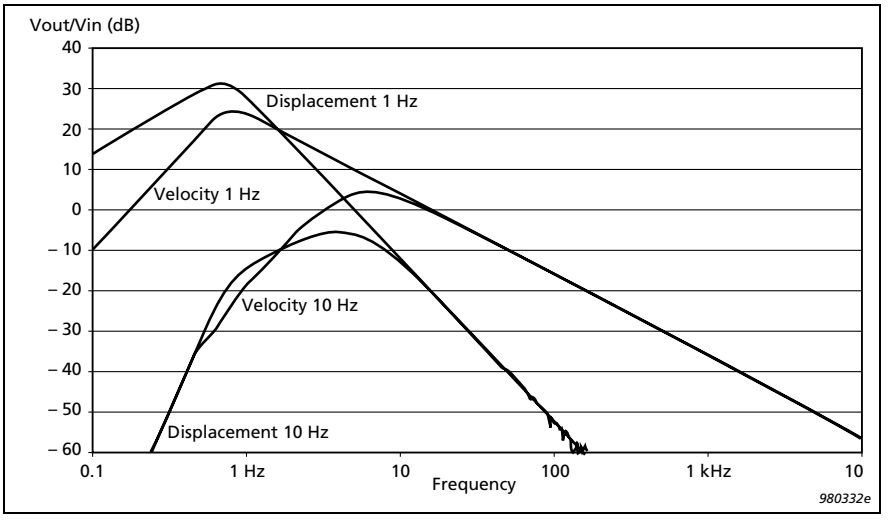
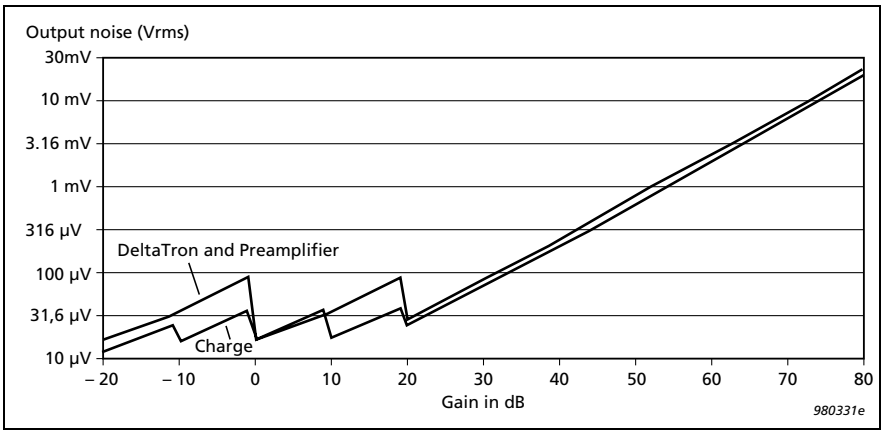


Fig. 7 Typical broadband output noise measured in 22 kHz bandwidth as a function of NEXUS' gain setting



Accuracy

An extremely accurate gain control is used in NEXUS amplifiers. For all gain steps and for each filter there is an automatic gain adjustment, the value of which has been stored during testing and calibration at Brüel & Kjær. This ensures that the gain step linearity is typically better than 0.02 dB.

Gain

The overall NEXUS gain is automatically calculated by the equation:

Gain = Output Sensitivity/Transducer Sensitivity

where Output Sensitivity and Transducer Sensitivity are set by the user.

If needed, it is possible to use an Application Correction Factor (e.g., if using an external attenuator). This will also be automatically calculated into the gain, using the equation:

Gain = Output Sensitivity/ (Transducer Sensitivity × Application Correction Factor).

Intelligent Battery

Fig. 8 Battery charger ZG 0405 can be bought as an extra accessory

The rechargeable battery used in NEXUS amplifiers is an intelligent nickel-metal hydride battery of the type used in modern lap-top computers. These batteries have built-in LEDs to inform you of the charge condition even if the battery is not mounted in the instrument (e.g., to check a spare battery). The charge condition can also be seen on the display. In addition to large capacity, nickel-metal hydride batteries have the advantage of no "memory effect", meaning that you do not have to regularly discharge them and that you can charge them from any starting charge condition.

Charging of the battery can be performed with the battery inside NEXUS; however, measurements cannot be made at the same time. The charging time is approximately 4 hours.

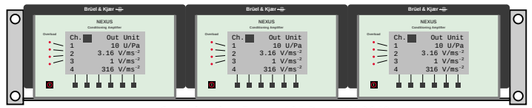
The supplied mains adaptor or an external 14 to 33 V DC supply is required to charge the battery.

Computer Control

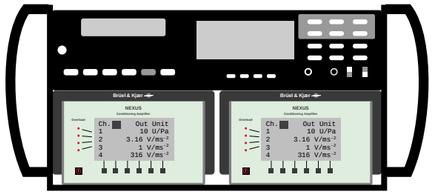
Serial RS–232 Interface

All functions can be controlled via the serial RS–232 interface. From January 1999, it is possible to switch the power on or off via the RS–232.

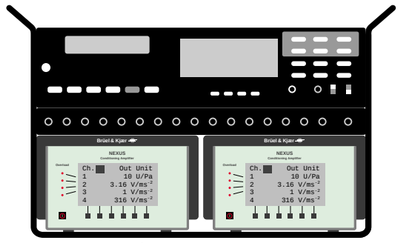
Rack Mounting



Combination Frame 19" Rack KK 0049



Frame for SONY DAT Series 200 Recorder UA 1409



Frame for SONY SIR 1000 UA 1482

Software

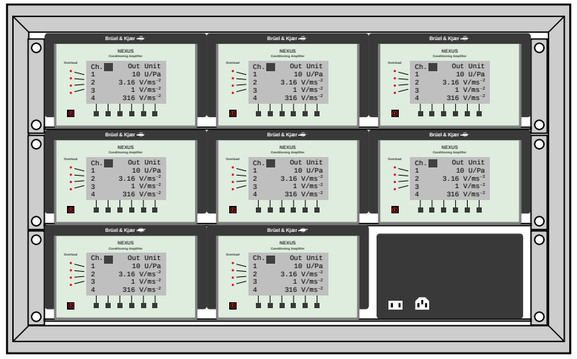
NEXUS Control Software
SW 7749
(to be released)

NEXUS standard types: Name and description	NEXUS Type number
2-Channel Microphone Conditioning Amplifier	2690 A 0S2
4-Channel Microphone Conditioning Amplifier	2690 A 0S4
2-Channel Microphone Conditioning Amplifier with A, B, C and D Filters	2690 A 0F2
4-Channel Microphone Conditioning Amplifier with A, B, C and D Filters	2690 A 0F4
2-Channel Intensity Conditioning Amplifier	2691 A 0S2
1-Channel Charge Conditioning Amplifier	2692 A 0S1
4-Channel Charge Conditioning Amplifier	2692 A 0S4
1-Channel Charge Conditioning Amplifier with Single and Double Integration	2692 A 0I1
4-Channel Charge Conditioning Amplifier with Single and Double Integration	2692 A 0I4
4-Channel DeltaTron Conditioning Amplifier	2693 A 0S4
4-Channel DeltaTron Conditioning Amplifier with A, B, C, and D Filters	2693 A 0F4
4-Channel DeltaTron Conditioning Amplifier with Single and Double Integration	2693 A 0I4

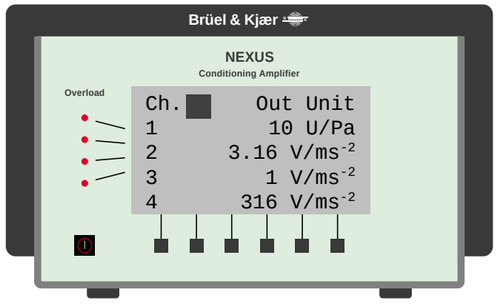
NEXUS standard options	Type number
Upper limiting frequency 140 kHz	WH 3219
Whole body vibration X, Y & Z direction filter ISO2632–1	WH 3206
900 Hz to 1100 Hz band pass filter	WH 3278
Constant power on	WH 3282
Single and double integration filter	ZE 0788
A, B, C and D weighting filters	ZE 0794
Individual filters available on request	

NEXUS with associated transducers, selected cables and accessories

Portable Rack
KQ 0158

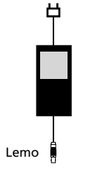


NEXUS
Conditioning Amplifier



Powering

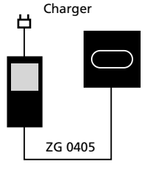
Mains Adaptor
ZG 0400
(included with NEXUS)



Lemo

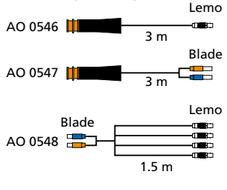
Nickel-Metal Hydride
Rechargeable Battery
QB 0048

Battery
Charger

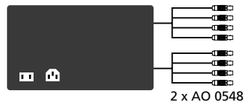


ZG 0405

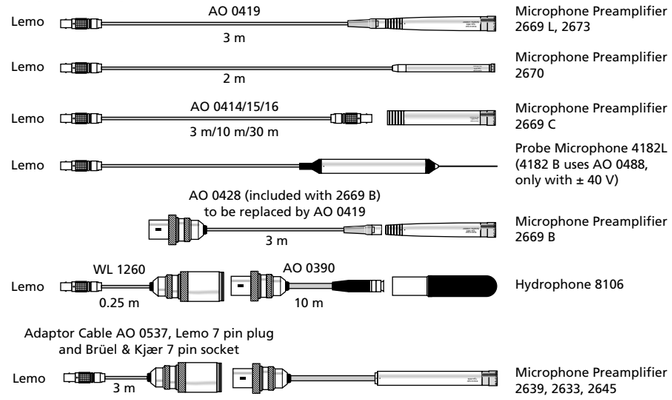
Supply Cables via
Cigarette Lighter



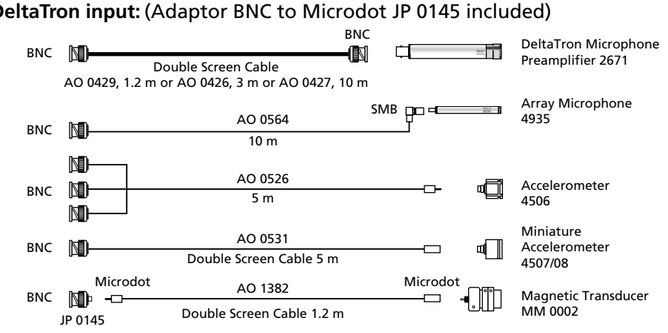
WB 1436
32 Ch. Power Supply



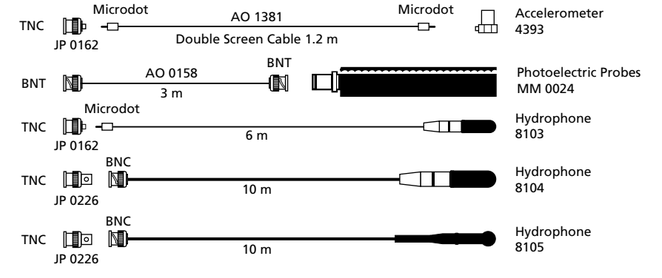
Microphone input:



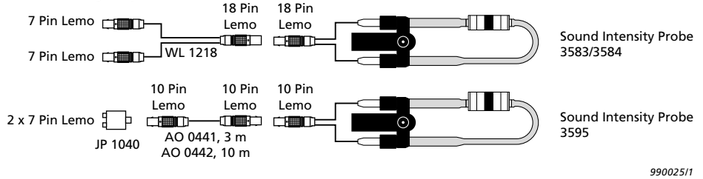
DeltaTron input: (Adaptor BNC to Microdot JP 0145 included)



Charge input: (Adaptor TNC to Microdot JP 0162 included)



Intensity input:



Controlling Several Amplifiers

You can “daisy-chain” up to 99 channels. Each unit can be automatically addressed from an optional PC-program.

DOS Program

A DOS program diskette is supplied with each instrument. It contains a tool program intended to help programmers write their own control software. The program includes the source code written in “C”. Additionally, there is a list of RS–232 commands.

NEXUS Set-up and Control Software Type 7749

Type 7749 is a PC-based software package for set-up and control of the NEXUS range of conditioning amplifiers and runs under Windows NT®. The software automatically detects IEEE P1451.4 capable transducers with standardised Transducer Electronic Data Sheets.

Transducer Testing

All types of overload are indicated on the front panel LEDs. If you select the relevant menu you can get information about the type of overload on the display, or you can get the data via the RS–232 interface.

Overload Detection

Comprehensive overload detection facilities are built into the conditioning amplifier: transducer current overload (DeltaTron and microphones), transducer voltage overload (DeltaTron), common mode input overload, signal overload and common mode output overload.

Peak Meter

A peak level meter allows you to monitor the instantaneous peak values for all channels and the maximum peak values (peak hold) since they were reset. Overload indications are also shown in this menu.

Charge Injection Calibration (CIC)

The patented Charge Injection Calibration technique makes it possible to remotely verify the condition of the entire measurement set-up including the microphone. Available on microphone channel only.

Mounted Resonance Test (MRT)

This is another patented Brüel & Kjær technique which is used to get information about the accelerometer mounting, and that the cable connections are in working order. A short voltage pulse is used to excite the transducer. The amplifier then switches to a measurement mode which allows the resonance frequency to be measured. The resulting value is shown on the display. It will work with a number of Brüel & Kjær charge accelerometers with resonance frequency between 3 and 40 kHz. Available on charge channel only.

Human Interface

Six pushkeys — nothing more is required to set up all parameters from the associated menus:

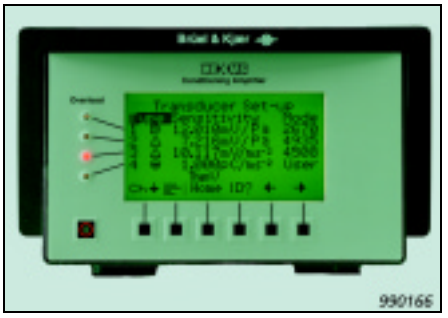
- Amplifier Set-up: For setting up filters and gain for each individual channel. Also displays information about battery capacity and overload condition
- Transducer Set-up: For selecting transducer type and entering calibrated sensitivity
- Transducer Supply: For setting up current supply, preamplifier/polarization voltages and cable length
- Floating/Correction: For selecting floating input/output and for entering application corrections
- Store/Recall Set-up: For storage/retrieval of five user-defined set-ups
- Display Set-up: For switching back-lighting on/off and adjusting the display contrast
- Transducer Test/Ref. Sig.: For selecting test or reference signals and CIC and MRT parameters
- Battery Set-up: For reading out status on battery charge condition and number of charging cycles
- Serial Interface: For setting up RS–232 parameters
- Self-test: For testing the digital hardware

Accessories

Fig. 9 (Left) Cables for powering NEXUS in a vehicle. From top to bottom: AO 0546 Supply cable with cigarette lighter to LEMO connector (3 m), AO 0547 Supply cable with cigarette lighter to spade terminals (3 m), AO 0548 Branched supply cable, spade terminals to 4 LEMO connectors (1.5 m); (Right) 19″ portable rack (KQ 0158) that can hold 9 × NEXUS units (shown) or 8 × NEXUS units and a 32-channel Power Supply WB 1436 (not shown)

Support of Transducers with TEDS according to IEEE P1451.4

Fig. 10 Transducer set-up. Note that the sensitivity and mode fields have been automatically read from the IEEE P1451.4 compatible transducers



NEXUS units with embedded software version 2.0 or later can identify transducers with built-in “Transducer Electronic Data Sheets” (TEDS) and which comply with the proposed standard IEEE P1451.4 “A mixed mode smart transducer interface for sensors and actuators”. Such transducers can be identified by their type numbers and their sensitivities read into the NEXUS unit.

Specifications 2690, 2691, 2692 and 2693

Charge Input

CONNECTOR: TNC
(TNC to 10–32 UNF adaptor JP 0162 included)
GROUNDING: Single-ended or floating
MAX. INPUT:
Differential Charge: 10 nC (peak)
Common Mode Voltage: 4.2 V (peak)
At gain ≥ 0.316 mV/pC (–10 dB gain with 1 nF transducer capacitance)
INPUT PROTECTION:
Differential Charge: ≤300 nC (peak)
Common Mode Voltage: ≤15 V (peak)
COMMON MODE REJECTION RATIO: >50 dB (typical)
(50 to 60 Hz with 1 nF transducer capacitance)
AMPLIFIER GAIN:
0.1 mV/pC to 10 V/pC (–20 to +80 dB gain with 1 nF transducer capacity)
TRANSDUCER SENSITIVITY RANGE:
10^{-19} to 10^{-6} C/MU
(MU = mechanical units: m/s^2; g, N, lb., Pa)
CALIBRATED OUTPUT:
Selectable in 10 dB steps. 100 dB attenuator range, 10^{-15} to 10^7 V/MU
±1 % for 0°C ≤ T_a ≤ +40°C and ±2 % for
–10°C≤T_a≤+55°C
Frequency range from $5\times f_l$ to $0.2\times f_u$
f_l = lower freq. limit: 0.1, 1.0 or 10 Hz
f_u = upper freq. limit: 0.1, 1, 3, 10, 30 or 100 kHz
FREQUENCY RANGE (–10%):
Acceleration: 0.1 Hz to 100 kHz (transducer cable length < 10 m)
Velocity (optional): 1.0 Hz to 10 kHz
Displacement (optional): 1.0 Hz to 1 kHz
LOW-PASS FILTER (–10%):
0.1, 1, 3, 10, 22.4, 30 or 100 kHz, attenuation slope 40 dB/decade
HIGH-PASS FILTER (–10%):
Acceleration: 0.1, 1.0 or 10 Hz
Velocity (optional): 1.0 or 10 Hz
Displacement (optional): 1.0 or 10 Hz
INHERENT NOISE (2 Hz to 22.4 kHz):
<5 fC referred to input, –10°C≤Ta≤+40°C
<10 fC referred to input, 40°C≤Ta≤+55°C
(amplifier sensitivity (>20 dB) with 1 nF transducer capacitance)
HARMONIC DISTORTION AND NOISE (2 Hz to 22.4 kHz, Q_{in} ≤2 nC peak, V_{out} ≤3.16 V peak):
<0.003% for amplifier gain ≤0.1 V/pC
(<40 dB gain with 1 nF transducer capacitance)
ENVIRONMENTAL SUSCEPTIBILITY (referred to input):
Magnetic Field: <0.2 fC/(A/m)
Electromagnetic Field: <20 fC/(V/m) or <4 fC/V
Vibration (10 to 500 Hz): <30 fC/(m/s^2)
MOUNTED RESONANCE TESTING*: EP Patent 715.722, US Patent 5.753.793
Mounted resonance testing of the accelerometer and cable interconnection, controllable from front panel and RS–232 interface
TEST TONE OSCILLATOR:
ω = 1000 rad/s (159.2 Hz), sinusoidal
Test Level: 1 mV to 10 V (±1%). Controllable from front panel and RS–232 interface
Reference Tone: 1 V (RMS), (±1%), 159.2 Hz
RISE TIME: >7.5 V/µs (100 kHz bandwidth)
CHANNEL TO CHANNEL PHASE-MATCH:
$2.1° - 0.1°\times(f/f_l)$ from f_l to $20\times f_l$
$0.1°$ from $20\times f_l$ to $0.1\times f_u$
$(f/f_u)°$ from $0.1(f_u)$ to f_u
f_l: lower freq. limit: 10 Hz
f_u: upper freq. limit: 0.1, 1, 3, 10, 30 or 100 kHz
OPTIONAL FILTERS:
Integration: single and double

*Brüel & Kjær patent

Microphone Input

CONNECTOR: 7-pin LEMO
GROUNDING:
Outer shield grounded to chassis
INPUT IMPEDANCE:
1 MΩ || 300 pF (AC coupled)
MAX. INPUT: 31.6 V (peak)
INPUT PROTECTION: ≤50 V (peak)
AMPLIFIER GAIN:
–20 to +60 dB (80 dB with reduced specs.)
TRANSDUCER SENSITIVITY RANGE:
10^{-12} to 10^3 V/MU
(MU = mechanical units: Pa, mm)
CALIBRATED OUTPUT:
Selectable in 10 dB steps**.** 100 dB attenuator range, 10^{-15} to 10^7 V/MU
(±0.1 dB for 0°C ≤ T_a ≤ +40°C and ±0.2 dB for –10°C≤T_a≤+55°C
Frequency range from $5\times f_l$ to $0.2\times f_u$
f_l = lower freq. limit: 0.1 or 20 Hz
f_u = upper freq. limit: 0.1, 1, 3, 10, 22.4, 30 or 100 kHz)
POLARIZATION VOLTAGE (±0.5 V or ±0.25%):
0 or 200 V (all channels simultaneously selected, short-circuit protected)
PREAMPLIFIER SUPPLY:
Fixed ±14 V, ±40 V or controlled automatically in accordance with input range (short-circuit protected)
FREQUENCY RANGE (–1 dB):
0.1 Hz to 100 kHz (gain ≤60 dB) (complies with IEC 1260 Class 0 and ANSI S1.11 Type 0–AA for f_l = 0.1 Hz and f_u = 100 kHz)
HIGH-PASS FILTER (–1 dB):
0.1 Hz, attenuation slope 40 dB/decade or
20 Hz, attenuation slope 80 dB/decade
LOW-PASS FILTER (–1 dB):
0.1, 1, 3, 10, 22.4, 30 or 100 kHz, attenuation slope 40 dB/decade
A-WEIGHTING FILTER:
Complies with IEC 651 Type 0
INHERENT NOISE (referred to input, gain >20 dB):
<2 µV A-weighted
HARMONIC DISTORTION AND NOISE (2 Hz to 22.4 kHz, V_{in} ≤20 V peak, V_{out} ≤3.16 V peak):
<0.003% for amplifier gain ≤40 dB
ENVIRONMENTAL SUSCEPTIBILITY (referred to input):
Magnetic Field: <0.2 µV/(A/m)
Electromagnetic Field: <10 µV/(V/m) or <10 µV/V
Vibration (10 to 500 Hz): <2 µV/(m/s^2)
CHARGE INJECTION CALIBRATION*:
Verification of the entire measurement set-up including the microphone, preamplifier and connecting cable. Controllable from front panel and RS–232 interface
Reference Tone: 1 V (RMS) ±1%, 1 kHz
OVERLOAD DETECTION:
Microphone preamplifier overload detection with respect to cable length (3 to 1000 meter)
RISE TIME:
>7.5 V/µs (100 kHz bandwidth)
CHANNEL TO CHANNEL PHASE-MATCH:
$5.1° - 0.1°\times(f/f_l)$ from f_l to $50\times f_l$ (f_l = 0.1 Hz)

Specifications 2690, 2691, 2692 and 2693 (cont.)

$2.1° - 0.1° \times (f/f_l)$ from f_l to $20 \times f_l$ ($f_l = 20$ Hz)
$0.1°$ from $50 \times f_l$ to $0.1 \times f_u$ ($f_l = 0.1$ Hz)
$0.1°$ from $20 \times f_l$ to $0.1 \times f_u$ ($f_l = 20$ Hz)
$(f/f_u)°$ from $0.1(f_u)$ to f_u
Where:
f_u = upper frequency limit: 0.1, 1, 3, 10, 22.4, 30 or 100 kHz
OPTIONAL FILTERS:
A-, B-, C- and D-weighting (one module)
(complies with IEC 651 Type 0)

Intensity Input

Specifications as for microphone input, except when using the "Intensity" filter.
CONNECTOR:
7-pin LEMO (two connectors on two input modules – adaptor required)
CHANNEL TO CHANNEL PHASE-MATCH AND FREQUENCY RESPONSE (with "Intensity" filter (20 Hz HP/22.4 kHz LP, 40 dB/decade):
Complies with IEC 1043 standard Class 1 and ANSI S1.12–1995 Class 1, with Brüel & Kjær sound intensity probes.
(Conditions: output sensitivity for the two channels must be equal. Transducer sensitivity must be equal within 0.5 dB)

DeltaTron® Input

CONNECTOR: BNT
GROUNDING: Single-ended or floating
INPUT IMPEDANCE:
1 MΩ ‖ 100 pF (AC coupled)
MAX. INPUT:
Differential Voltage: ≤31.6 V (peak)
Common Mode Voltage: 4.2 V (peak)
INPUT PROTECTION:
Differential Voltage: ≤50 V (peak)
Common Mode Voltage: ≤15 V (peak)
COMMON MODE REJECTION RATIO:
50 dB (50 to 60 Hz) (typical)
AMPLIFIER GAIN:
–20 to +60 dB gain (80 dB with reduced specs.)
TRANSDUCER SENSITIVITY RANGE:
10^{-12} to 10^{3} V/MU
(MU = mechanical units: m/s^2, m/s, g, N, lb., Pa)
CALIBRATED OUTPUT
Selectable in 10 dB steps**.** 100 dB attenuator range**,** 10^{-16} to 10^{7} V/MU**.**
(±0.1 dB for $0°C \le T_a \le +40°C$ and ±0.2 dB for $-10°C \le T_a \le +55°C$
Frequency range from $5 \times f_l$ to $0.2 \times f_u$
f_l = lower frequency limit: 0.1, 1.0 or 10 Hz
f_u = upper frequency limit: 0.1, 1, 3, 10, 22.4, 30 or 100 kHz)
CONSTANT CURRENT SUPPLY (±15 %):
+4 mA or +10 mA with a +28 V voltage source
Tacho Probe Supply:
+8 V DC at BNT inner shield (short-circuit protected)
FREQUENCY RANGE (–10%):
0.1 Hz to 100 kHz (gain <60 dB)
attenuation slope 40 dB
HIGH-PASS FILTER (–10%):
0.1 Hz or 1.0 Hz (with attenuation slope 40 dB) or
10 Hz (with attenuation slope 60 dB/decade)
LOW-PASS FILTER (–10%):
0.1, 1, 3, 10, 22.4, 30 or 100 kHz
INHERENT NOISE (referred to input, gain >20 dB):
<2.4 µV A-weighted
<3.3 µV lin. 2 Hz to 22.4 kHz
HARMONIC DISTORTION AND NOISE (2 Hz to 22.4 kHz, V_{in} ≤20 V peak, V_{out} ≤3.16 V peak):
<0.003% for amplifier gain ≤40 dB
RISE TIME:
>7.5 V/µs (100 kHz bandwidth)
ENVIRONMENTAL SUSCEPTIBILITY (referred to input):
Magnetic Field: <0.2 µV/(A/m)
Electromagnetic Field: <3 µV/(V/m) or <3 µV/V
Vibration (10 to 500 Hz): <2 µV/(m/s^2)
OVERLOAD DETECTION:
Preamplifier overload detection with respect to cable length (3 to 1000 meter)
CHANNEL TO CHANNEL PHASE-MATCH:
$5.1° - 0.1° \times (f/f_l)$ from f_l to $50 \times f_l$ ($f_l = 0.1$ or 1 Hz)
$2.1° - 0.1° \times (f/f_l)$ from f_l to $20 \times f_l$ ($f_l = 10$ Hz)
$0.1°$ from $50 \times f_l$ to $0.1 \times f_u$ for $f_l = 0.1$, 1 Hz
$0.1°$ from $20 \times f_l$ to $0.1 \times f_u$ for $f_l = 10$ Hz
$(f/f_u)°$ from $0.1(f_u)$ to f_u
Where:
f_u: upper freq. limit: 1, 3, 10, 22.4, 30 or 100 kHz
Reference Tone: 1 V (RMS) ±1% (0.1 dB), 1 kHz
OPTIONAL FILTERS:
A-, B-, C- and D-weighting (one module)
(complies with IEC 651 Type 0)
Integration: single and double (one module)
Other filters available upon request

General Specifications

Power Supply

INTERNAL BATTERY (not included):
Nickel-Metal Hydride rechargeable battery supporting SMBus and on-battery charge level meter. Provides typically 15 hours of continuous use with a single channel and 4 hours with four channels without backlighting and without optional filters. With backlighting on, and with optional filters, battery provides typically 3 hours of continuous use. If NEXUS is not used for more than a month, please remove the battery to prevent discharging. Charging time is approximately 4 hours
EXTERNAL DC POWER INPUT:
Complies with ISO 7637–1 (12 V) and 7637–2 (24 V)
Input Range: 10 to 33 V DC
MAINS SUPPLY:
Supported via supplied Mains Adaptor ZG 0426 (included), 90 – 264 V AC, 40 – 65 Hz

Digital Control Interface

SERIAL INTERFACE:
Conforms to EIA/TIA-574 (RS–232)
Baud rate: 2400, 4800, 9600
Parity: None
Data Bits: 8
Stop Bits: 1
Handshake: X-on/X-off
"Plug and play" interface coupling
Communication speed for a baud rate of 9600: Transmission time for one command of 5 characters is ~ 4 ms
Transmission time for one command of 5 characters and to receive an echo after each character is ~ 8 ms.
Execution time for one command is 100 ms to several seconds.

Specifications 2690, 2691, 2692 and 2693 (cont.)

Time to configure a complete 4-channel NEXUS using short form set-up with approx. 600 characters requires transmission time of 2 to 3 s (4 to 6 s with echo after each character).
Execution time in NEXUS is from 40 to 60 s.
For set-ups with over 1000 characters, the transmission time will be increased by at least 30 s due to delay in emptying receiver buffer.
Response time after requesting a status of one load: < 0.5 s
Response time after requesting a peak meter reading: < 0.5 s

Display Interface

DISPLAY:
64 × 128 pixel graphical display with back-lighting on/off
OVERLOAD DETECTION:
On both common-mode and differential signals applied before filters. LED overload indication at the front panel and overload indication via RS–232 control interface

Peak Meter

DYNAMIC RANGE: –30 to +10 dBV (peak)
RESOLUTION: 1 dB

Analogue Output

CONNECTOR: BNC
GROUNDING: Single-ended or floating
OUTPUT IMPEDANCE: = 50 Ω//500 pF
MAX. OUTPUT (differential voltage):
3.16 V peak (6.32 V peak to peak)
MAX. DC OFFSET: ±25 mV, typically < 2 mV
OUTPUT PROTECTION:
Differential Voltage: ≤50 V (peak)
Common Mode Voltage: ≤15 (peak)
Common Mode Rejection:
>50 dB (50 to 60 Hz) for Common Mode Voltage ≤2 V peak (voltage injected into instrument)
OUTPUT DRIVE CAPACITY:
100 m of cable length (100 pF/m) to 20 kHz
1000 m of cable length (100 pF/m) to 2 kHz

CHANNEL SEPARATION: better than – 100 dB at 1 kHz

Dimensions and Weight

Height: 90 mm (3.5″)
Width: 144 mm (5.7″)
Depth: 230 mm (9.1″)
Weight: Approx. 3 kg (6.6 lb.), for a 4-channel unit including battery

Includes

Type 2690-93 Conditioning Amplifiers include the following accessories:
ZG 0426: Mains Adaptor, 90 – 264 V AC
LK 0013: Ferrite Cable Clamp

Note: All values are typical at 25°C (77°F), unless measurement uncertainty is specified. All uncertainty values are specified at 2σ (i.e. expanded uncertainty using a coverage factor of 2)

Calibration

NEXUS amplifiers are supplied with a Manufacturer's Certificate of Conformance. An initial calibration can be supplied as an option. The calibration services in the table below are based on one channel. There is an extra charge for each additional channel:

Type	Initial Calibration	Recalibration
2690 A	2690 A–CAI	2690 A–CAF
2691 A	2691 A–CAI	2691 A–CAF
2692 A	2692 A–CAI	2692 A–CAF
2693 A	2693 A–CAI	2693 A–CAF

All other accessories are listed in the associated ordering information sheet (BA 0287).

Compliance with Standards

CE C-Tick	CE-mark indicates compliance with: EMC Directive and Low Voltage Directive. C-Tick mark indicates compliance with the EMC requirements of Australia and New Zealand.
Safety (Low voltage Directive)	EN 61010–1 and IEC 61010–1: Safety requirements for electrical equipment for measurement, control and laboratory use. UL 3111–1: Electrical Measuring and Test Equipment (Underwriter's Laboratories, USA).
EMC Emission (EMC Directive)	EN 50081–1: Generic emission standard. Part 1: Residential, commercial and light industry. EN 50081–2: Generic emission standard. Part 2: Industrial environment. CISPR 22: Radio disturbance characteristics of information technology equipment. Class B Limits. FCC Rules, Part 15: Complies with the limits for a Class B digital device.
EMC Immunity (EMC Directive)	EN 50082–1: Generic immunity standard. Part 1: Residential, commercial and light industry. EN 50082–2: Generic immunity standard. Part 2: Industrial environment. ISO 7637–1, 7637–2 and 7637–3: Road Vehicles – Electrical Disturbance by Conduction and Coupling. **Note 1:** Refer to "Environmental Susceptibility" in specifications. **Note 2:** The above is guaranteed using the accessories in this PD sheet only.
Temperature	IEC 68–2–1 & IEC 68–2–2: Environmental Testing. Cold and Dry Heat. Operating Temperature: –10 to +55 °C (14 to 131 °F) Storage Temperature: –25 to +70 °C (–13 to 158 °F) IEC 68–2–14: Change of Temperature: –10 to +55 °C (2 cycles, 1 °C/min.)
Humidity	IEC 68–2–3: Damp Heat: 90% RH (non-condensing at 40 °C (104 °F))
Mechanical	Operating (peak values) MIL–STD – 810C: Vibration: 12.7 mm, 15 m/s^2, 5 – 500 Hz Non-operating: IEC 68–2–6: Vibration: 0.3 mm, 20 m/s^2, 10–500 Hz IEC 68–2–27: Shock: 1000 m/s^2 IEC 68–2–29: Bump: 1000 bumps at 250 m/s^2
Enclosure	IEC 529 (1989): Protection provided by enclosures: IP43

Ordering Information — Types 2690, 2691, 2692 and 2693

Valid system combinations and ordering numbers are shown in the associated "The NEXUS Range of Conditioning Amplifiers – How to Order" sheet (BA 0287)

Optional Accessories

Type 7749	NEXUS Set-up and Control Software
AO 0537	7 pin Brüel & Kjær mic. plug to 7 pin LEMO Adaptor cable for split mic. supply
AO 1440	RS–232 Interface Cable
AO 0546	Supply Cable with cigarette lighter to LEMO connector (3 m)
AO 0547	Supply Cable with cigarette lighter to spade terminals (3 m)
AO 0548	Branched Supply Cable, spade terminals to 4 LEMO connectors (1.5 m)
BZ 5294	TEDS Editor
BZ 5294 MS4	Calibration License
BZ 5294 MS5	Developer's License
UA 2020 MS4	Calibration Kit
UA 2020 MS5	Developer's Kit
KK 0049	Combination Frame (19" rack). Holds up to 3 NEXUS units
KQ 0158	19" Portable Rack. Holds up to 9 NEXUS units or 8 NEXUS units and a power supply WB 1436
QB 0048	Nickel-Metal Hydride Rechargeable Battery DR 35
ZE 0794	A-, B-, C- and D-weighting filters
ZE 0788	Integration, single and double – contact Brüel & Kjær for a configured system
UA 1409	Frame for SONY DAT Series 200 recorder Holds up to 4 NEXUS units
UA 1482	Frame for SONY SIR 1000. Holds 1 or 2 NEXUS units
UA 2019	Interface Adaptor
WH 3219	Upper Limiting Frequency 140 kHz
WH 3206	Whole Body Vibration X, Y and Z Direction Filter according to ISO 2632–1
WH 3278	900 Hz to 1100 Hz Band Pass Filter
WH 3345	Constant Power On
WB 1436	32 ch. Power Supply (90 – 264 V)
WL 1218	Adaptor for 2×7 pin intensity probe: LEMO connectors to 18 pin LEMO connector
ZG 0405	Battery Charger (separate)

Brüel & Kjær reserves the right to change specifications and accessories without notice

BP 1702–16 00/12

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