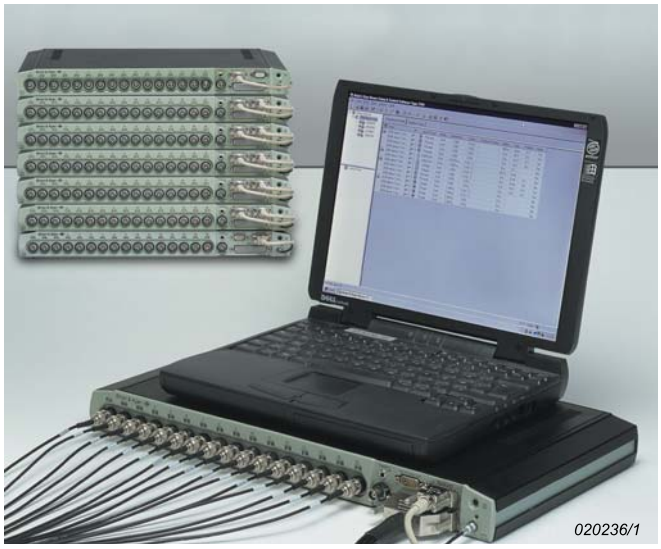
PRODUCT DATA

16-channel CCLD Conditioning Amplifiers Types 2694-A/B/C/D

The Type 2694 family of 16-channel CCLD conditioning amplifiers comprises of general signal conditioning amplifiers for voltage and CCLD analogue input that provide an analogue output. The amplifiers support CCLD transducers, such as accelerometers, microphone preamplifiers and tachometers, and are completely controlled by the provided Windows®-based software.*



* CCLD: Constant Current Line Drive, also known as DeltaTron®. ICP and IEPE compatible

Features and Uses

Uses

- 16-channel, general signal-conditioning amplifier for voltage and CCLD analogue input providing an analogue output
- Supports CCLD transducers such as accelerometers, microphone preamplifiers and tachometers
- For multichannel applications such as modal analysis, operational deflection shapes, microphone array measurements, etc., where typically between 16 and 512 channels are employed
- Typical measurements on satellites, gas turbines and large structures

Features

- Multiplexing function enables the number of transducer channels in the data acquisition unit to be increased 16-fold
- Fully supports transducer electronic data sheets (TEDS)
- Continuous logging of overloads as a function of time, overload type and overload channel
- Largest dynamic range of any conditioning amplifier on the market
- Floating and single-ended input to deal with ground loop problems
- Range of conditioning amplifiers with various functionality to choose from
- Optional filters available that can be interchanged by the user
- Powered by mains or DC supply
- Completely computer-controlled by means of supplied Windows®-based software
- Fits into a 19″ rack with 16 channels for each stackable unit
- OLE 2.0 interface description provided to enable user to customise measurements using an automation program

Brüel & Kjær

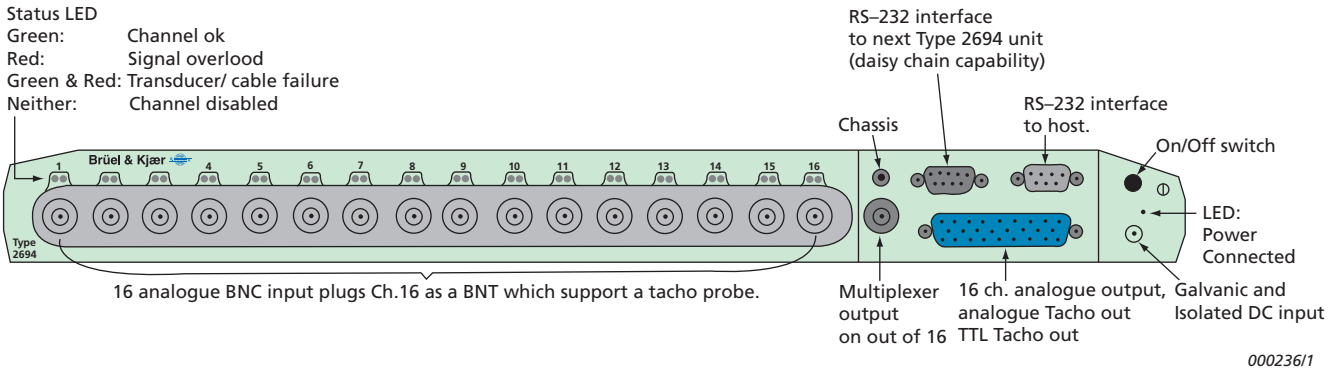
Conditioning Amplifier Type 2694 comes in four versions:

- Type 2694-A: Standard version
- Type 2694-B: Basic version; less functionality than Type 2694-A
- Type 2694-C: Customised version of Type 2694
- Type 2694-D: All 16 channels delivered with single and double integration filters

Table 1
Type 2694 family functionality

Functions	Type 2694-A	Type 2694-B	Type 2694-C	Type 2694-D
High-pass Filters 0.1 Hz	✓	–	✓	✓
High-pass Filters 1 Hz	✓ (2^{nd} order)	✓ (1^{st} order)	✓ (2^{nd} order)	✓ (2^{nd} order)
Floating/Single-ended Input	✓	✓	✓	✓
Gain: –10 dB	✓	–	✓	✓
Gain: 0 dB	✓	✓	✓	✓
Gain: +10 dB	✓	–	✓	✓
Gain: +20 dB	✓	✓	✓	✓
Gain: +30 dB	✓	–	✓	✓
Gain: +40 dB	✓	–	✓	✓
CCLD Input	✓	✓	✓	✓
Voltage Input	✓	✓	✓	✓
TEDS Transducer Support	✓	✓	✓	✓
Optional Filters Possible	Yes	No	Yes	Yes
Filters installed, for example A-, B-, C-, D- or single- and double-integration in 1 to 16 channels	–	–	Optional	–
Filters Installed: single-and double-integration in all 16 channels	–	–	–	✓
Multiplexer Functionality	✓	✓	✓	✓
Signal Overload	✓	✓	✓	✓
Transducer Voltage Overload	✓	–	✓	✓
Channel Disable/Enable	✓	–	✓	✓
Tacho (ch. 16)	✓	✓	✓	✓

Fig. 1 *Front panel of Signal Conditioning Amplifier Type 2694*

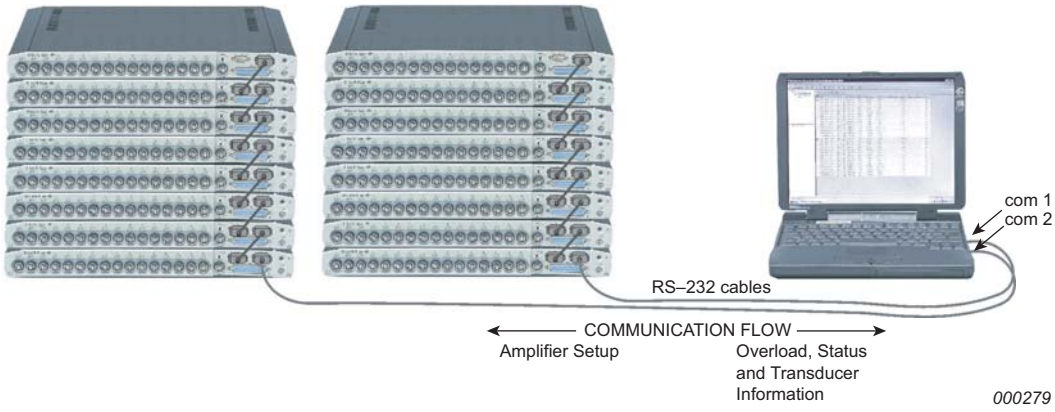


Control Software

A Windows®-based control software program is supplied with Type 2694. The software enables the conditioning amplifier to be configured for specific measurement tasks. Type 2694 always retains the last setup used before it is switched off. The control software also monitors overloads and collects transducer data during measurements. The minimum system requirement is a PC capable of running Windows® and Internet Explorer.

The software, which includes a description of the OLE interface that documents the objects, properties, parameters, methods, etc., used in the Setup and Control Software BZ-5291, is available for use when developing an external OLE 2.0 automation program. This description does not describe everything involved in how to develop an OLE 2.0 program, but is intended as a reference for OLE 2.0 programmers.

Fig. 2
Type 2694 conditioning amplifiers can be daisy-chained to at least 16 Type 2694 units per COM port. The more COM ports that are used, the faster the RS–232 interface becomes. Communication flow is as indicated

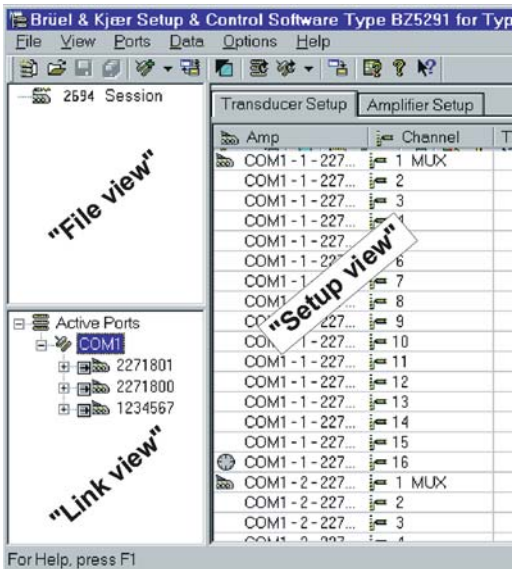


Setting up Type 2694 Amplifiers

The Type 2694 family of conditioning amplifiers is automatically detected by the software and displayed in the “File view” and “Link view”**.** You designate the port(s) used for the range of conditioning amplifiers yourself. You can select or de-select each Type 2694 amplifier for specific tests, which can be convenient in fixed test setups.

You can also set up a Type 2694 conditioning amplifier, even if it is not attached. This can be done from configuration files that you have previously saved to disk for later use in measurement situations. By dragging the active Type 2694 conditioning amplifier into the “Setup view”, detailed setup of the amplifier and transducer settings can be performed.

Fig. 3
File, Link and Setup views



Alternatively, you can load setups from the file view and adapt them to the current configuration by dragging and dropping previously saved configurations of Type 2694 conditioning amplifiers from the "File view" to the "Link view".

Setting up Channel-dependent Parameters

The individual parameters of the selected Type 2694 conditioning amplifier(s) can be shown in the "Setup view". These are shown in the Amplifier Setup and Transducer Setup, where parameters that belong to the amplifier and transducer, respectively, are grouped. Both the Amplifier and Transducer Setups can be modified to include or exclude setup and monitoring parameters in any order or type of setup.

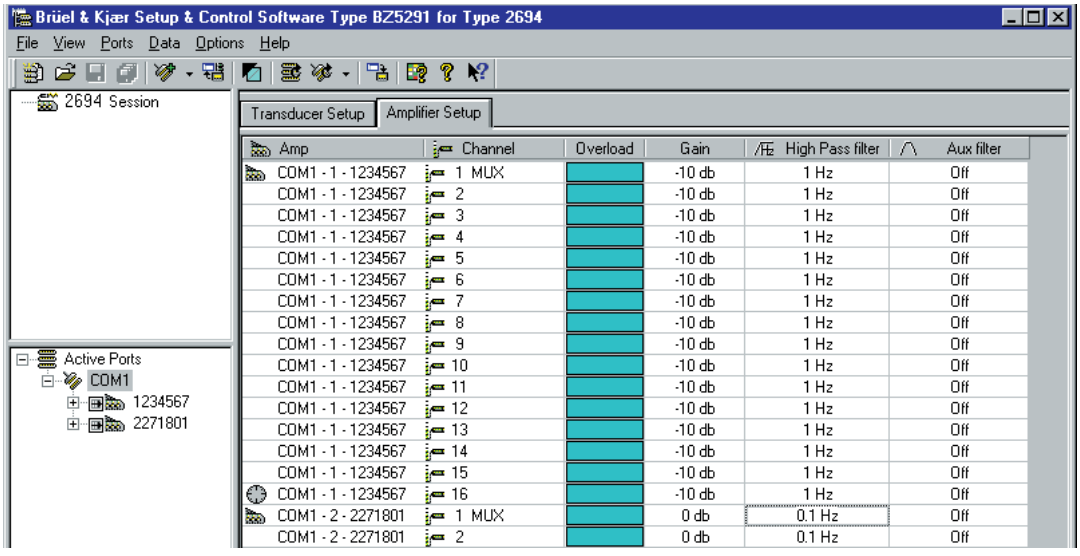
Amplifier Setup

In the Amplifier Setup, you can specify the settings of filters and the gain for each channel. This includes high-pass filters, optional filters, gain in steps of 10 dB, multiplexer channel, tachometer, and whether single-ended or floating inputs are used. During measurement, the Amplifier Setup monitors overloads in the overload column, and indicates them by changing colour. See Fig. 4 for an example.

Transducer Setup

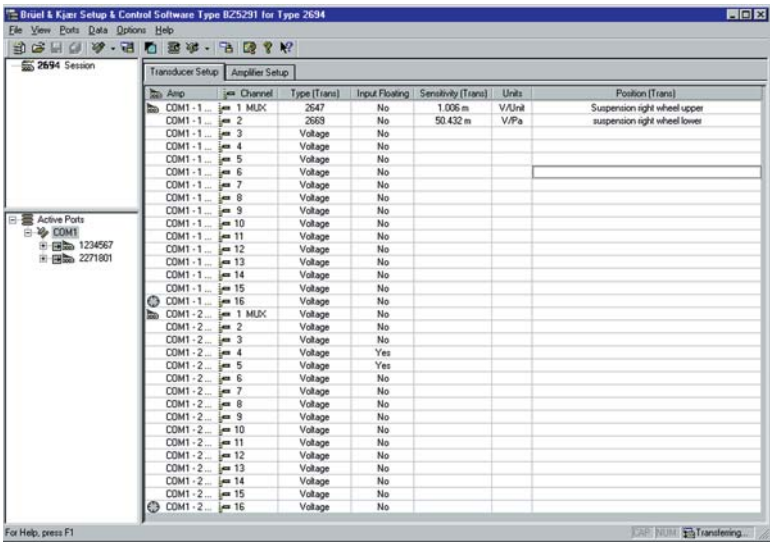
In the Transducer Setup, you can key in transducer sensitivities and transducer types, or they can be read automatically for IEEE P1451.4-capable transducers with standardised TEDS. This includes transducer type number, serial number and sensitivity. Full alphanumeric descriptions can also be attached to each channel if required. See Fig. 5 for an example.

Fig. 4
The Amplifier Setup



Amp	Channel	Overload	Gain	High Pass filter	Aux filter
COM1 - 1 - 1234567	1 MUX		-10 db	1 Hz	Off
COM1 - 1 - 1234567	2		-10 db	1 Hz	Off
COM1 - 1 - 1234567	3		-10 db	1 Hz	Off
COM1 - 1 - 1234567	4		-10 db	1 Hz	Off
COM1 - 1 - 1234567	5		-10 db	1 Hz	Off
COM1 - 1 - 1234567	6		-10 db	1 Hz	Off
COM1 - 1 - 1234567	7		-10 db	1 Hz	Off
COM1 - 1 - 1234567	8		-10 db	1 Hz	Off
COM1 - 1 - 1234567	9		-10 db	1 Hz	Off
COM1 - 1 - 1234567	10		-10 db	1 Hz	Off
COM1 - 1 - 1234567	11		-10 db	1 Hz	Off
COM1 - 1 - 1234567	12		-10 db	1 Hz	Off
COM1 - 1 - 1234567	13		-10 db	1 Hz	Off
COM1 - 1 - 1234567	14		-10 db	1 Hz	Off
COM1 - 1 - 1234567	15		-10 db	1 Hz	Off
COM1 - 1 - 1234567	16		-10 db	1 Hz	Off
COM1 - 2 - 2271801	1 MUX		0 db	0.1 Hz	Off
COM1 - 2 - 2271801	2		0 db	0.1 Hz	Off

Fig. 5
The Transducer Setup



Channel Description

The input signals enter the instrument via BNC sockets on the front panel (Fig. 6 and Fig. 7). Input number 16 is a BNT socket (compatible with BNC sockets) and supplies the power for an 8-volt tachometer probe. Output is via a 50-pole, sub-D socket (Fig. 8). There is also a 1-out-of-16 multiplexed output via a BNC socket. The input and output protection circuits provide effective protection against voltage transients, for example, electrostatic discharge, and burst and surge transients.

Fig. 6
Block diagram of Type 2694-A. Note that it is identical to Type 2694-D except that Type 2694-D has single- and double-integration on all channels

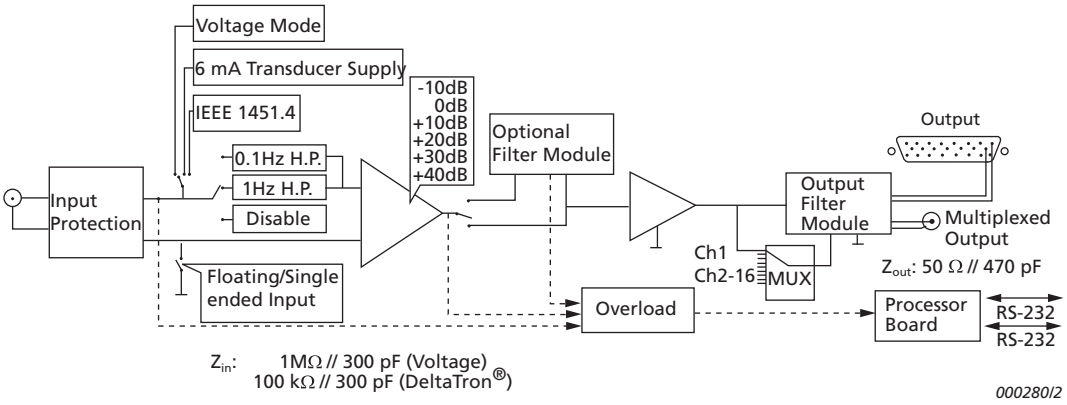


Fig. 7
Block diagram of Type 2694-B

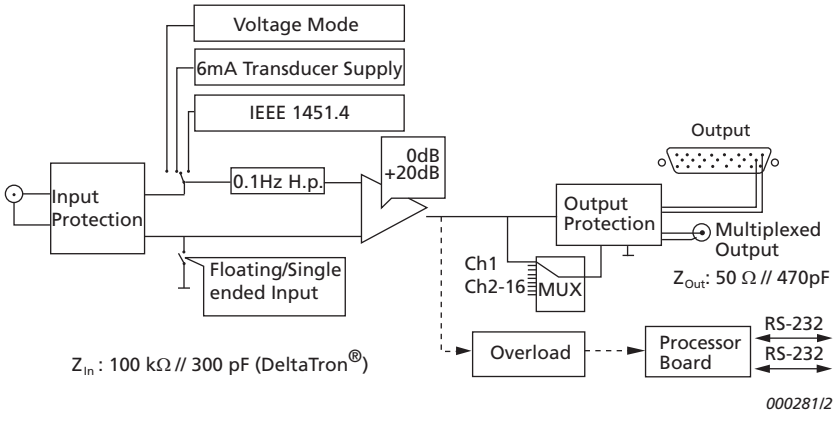
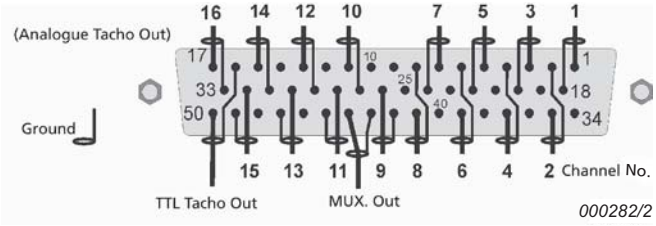


Fig. 8
Front view of pin connections on 50-pole, sub-D output socket



Support of Transducers with TEDS according to IEEE P1451.4

The Type 2694 family can identify transducers with built-in TEDS and which comply with the proposed standard IEEE P1451.4, "a mixed-mode smart transducer interface for sensors and actuators". Such transducers can, in stand-alone mode, be identified by their type numbers and serial numbers, and their sensitivities read and displayed via the Type 2694 control software.

Table 2
The two modes of access to IEEE P1451.4 data

Mode	Features	Implementation
Stand-alone	Access to 3 parameters – type number, serial number and sensitivity	Easy to use. Commands via RS−232. Supported by control software
Transparent Protocol	No limitations on access to data contained transducer. Independent of changes to IEEE P1451.4	Customised program required

In stand-alone mode, the internal processor in Type 2694 reads all data contained in the TEDS, extracts three parameters (type number, serial number and transducer sensitivity), and makes them accessible via the RS−232 connection using simple commands. Control Software BZ-5291, provided with Type 2694, displays these parameters where relevant.

The transparent protocol mode, which is also embedded in Type 2694, enables unlimited access to the IEEE P 1451.4-compatible data contained in the transducer. The transparent protocol is independent of any future changes to IEEE P 1451.4. Via a PC, you can freely read the TEDS in the transducers. This application requires a customised program.

Electrical Characteristics

Fig. 9
Amplitude response at low frequency

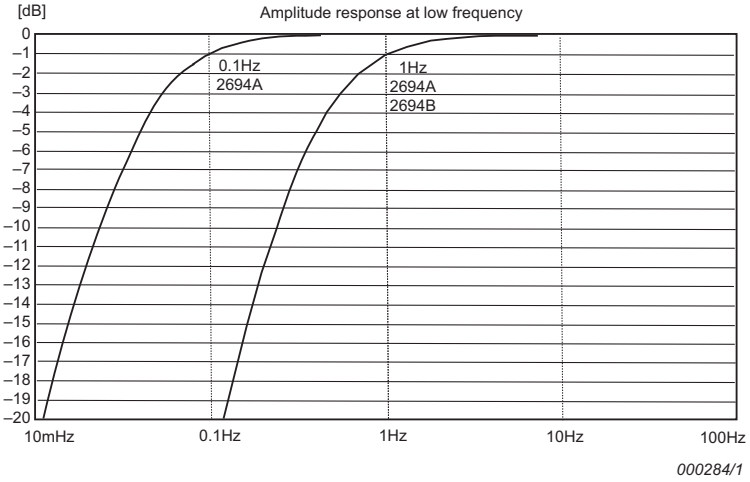


Fig. 10
Amplitude response as a function of gain setting

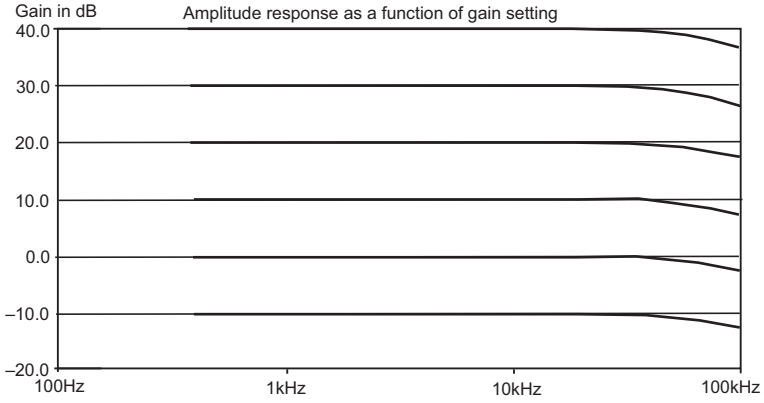


Fig. 11
Phase response as a function of high-pass filters and gain. Note that the phase at low frequency is independent of the gain

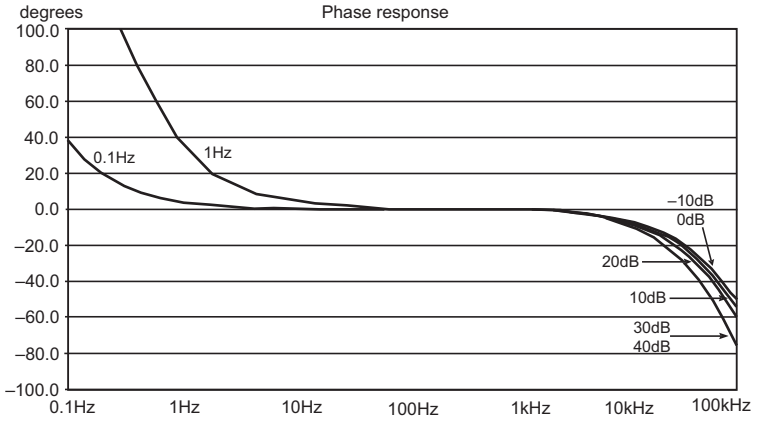


Fig. 12
Typical broadband output noise measured in 22 kHz bandwidth as a function of gain setting

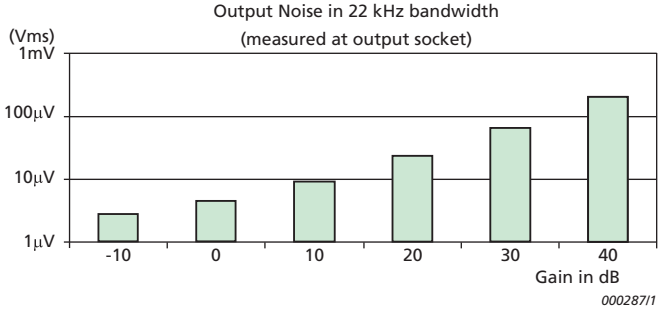


Fig. 13
Typical equivalent input noise measured in 22 kHz bandwidth as a function of gain setting

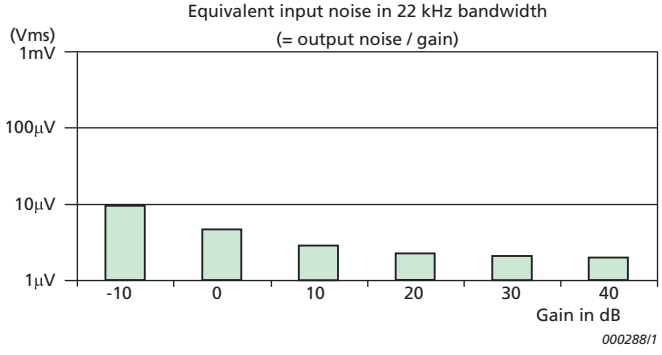


Fig. 14
Equivalent input noise per square root Hz (measured in 1 Hz bandwidth) as a function of frequency

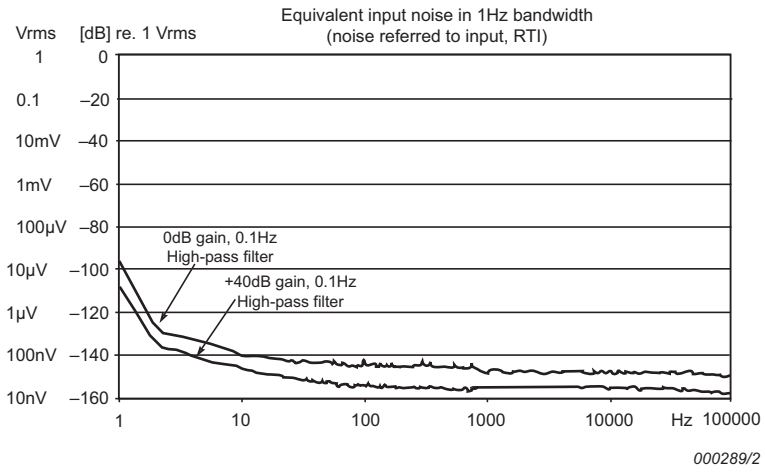


Fig. 15
Typical amplitude characteristics for velocity and displacement filters (i.e. single and double integration respectively) with 1 Hz cut-off frequency

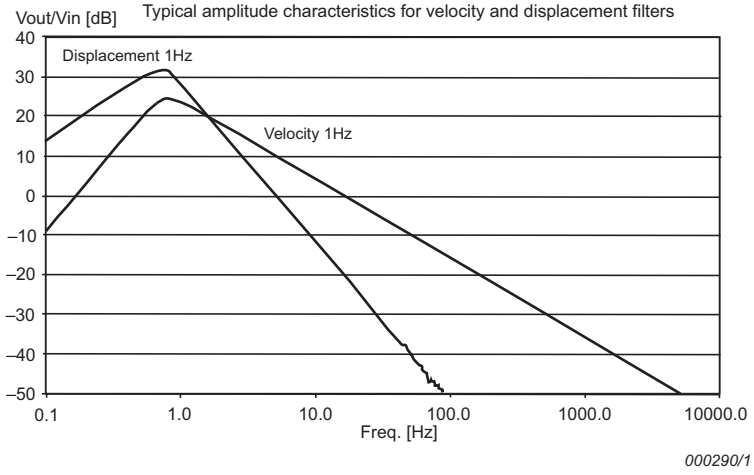
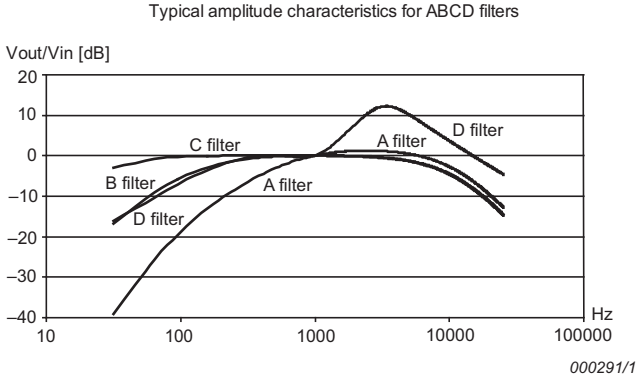


Fig. 16
Typical amplitude characteristics for acoustical A-, B-, C- and D-weighting filters

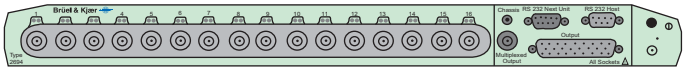


Standard and Optional Accessories

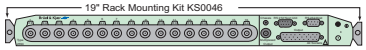
Fig. 17 provides a complete list of standard and optional accessories for Type 2694.

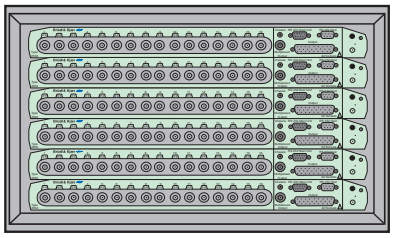
Fig. 17 *Type 2694 with associated transducers, selected cables and accessories*

2694 Conditioning Amplifier



Rack Mounting:





KQ-0158
Portable Rack
for max. 6 × 2694

2694 Standard Types:	**Type Number:**
Standard version	2694-A
Basic version, less functionality than Type 2694-A	2694-B
Customised version of Type 2694	2694-C
All 16 channels delivered with single and double integration filters	2694-D

2694 Standard Options:	**Type Number:**
Whole body vibration X, Y & Z direction filter	WH-3206
900Hz to 1100Hz bandpass filter	WH-3278
A, B, C and D weighting filters	ZE-0847
Single and double integration filter	ZE-0848

Individual filters available on request: Maximum of 6 high-pass poles or 8 low-pass poles, with a maximum of 8 poles in all

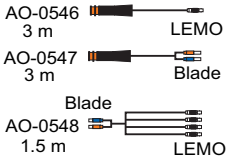
Software:

2694 Control Software BZ-5291
(included with 2694)

Powering:

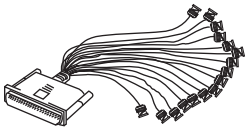
ZG-0426 Mains Adaptor
(included with 2694)

Supply Cables via
Cigarette Lighter



WB-1436
128 ch. Power Supply

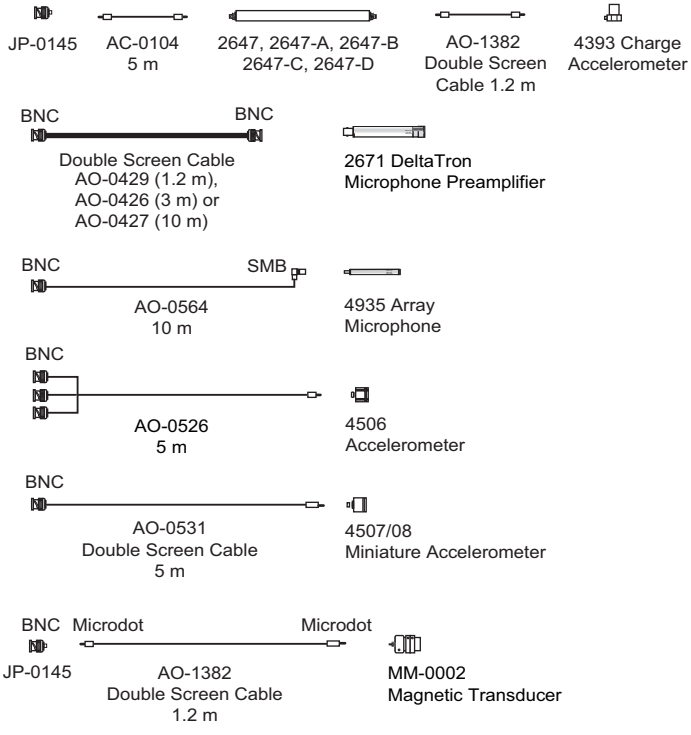
Output:



AO-0581
Break-out Cable
50 pol sub-D to 17 BNC
1.5 m

RS–232 interface Cable
(included with 2694)

Input (DeltaTron, IEPE, ICP):



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Compliance with Standards

Safety	EN/IEC 61010–1: Safety requirements for electrical equipment for measurement, control and laboratory use. ANSI/UL 61010–1: Safety requirements for electrical equipment for measurement, control and laboratory use.
EMC Emission	EN/IEC 61000–6–3: Generic emission standard for residential, commercial and light industrial environments. EN/IEC 61000–6–4: Generic emission standard for industrial environments. 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	EN/IEC 61000–6–1: Generic standards – Immunity for residential, commercial and light industrial environments. EN/IEC 61000–6–2: Generic standards – Immunity for industrial environments. EN/IEC 61326: Electrical equipment for measurement, control and laboratory use – EMC requirements. **Note:** The above is only guaranteed using accessories listed in this document.
Temperature	IEC 60068–2–1 & IEC 60068–2–2: 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)
Humidity	IEC 60068–2–3: Damp Heat: 90% RH (non-condensing at 40 °C (104 °F)).
Mechanical	Operating: MIL–STD–810C: Vibration: 12.7 mm, 15 m/s^2, 5 – 500 Hz Non-operating: IEC 60068–2–6: Vibration: 0.3 mm, 20 m/s^2, 10 – 500 Hz IEC 60068–2–27: Shock: 1000 m/s^2 IEC 60068–2–29: Bump: 1000 bumps at 250 m/s^2
Enclosure	IEC 60529: Protection provided by enclosures: IP 20

Specifications – 16-channel CCLD Conditioning Amplifier Types 2694-A/B/C/D

CCLD INPUT/VOLTAGE INPUT
Connector:
- Channel 1 to 15: BNC
- Channel 16: BNT (CCLD, voltage or tacho)

Grounding: Single-ended or floating
Input Impedance:
1 MΩ // 300 pF (Voltage mode*)
100 kΩ // 300 pF (CCLD mode)
Maximum Input:
- AC (peak): ±10 V
- AC (peak) + DC + Max. Common Mode Voltage (AC (peak) + DC): –11 to + 22 V

Common Mode: ≤ ±5 V
Input Protection: ±35 V_p (non-destructive); ±5 V_p Common Mode Voltage (non-destructive)
Common Mode Rejection Ratio: >60 dB (up to 1 kHz) @ –10 dB typical; >70 dB (up to 1 kHz) @ 0 dB to +40 dB typical
Amplifier Gain: –10 dB*; 0 dB; 10 dB*; 20 dB; 30 dB*; 40 dB*
Transducer Supply:
- CCLD Current: 6 mA ±15%
- CCLD Voltage: 25 V ±10%

Tacho Probe Supply (channel 16 only): +8 V DC max. 80 mA at BNT inner shield (short-circuit protected)
Frequency Range (–1 dB/–10%): 0.1 Hz to 50 kHz
High-pass Filter:
- A, C, D: f_{low} = 0.1 Hz or 1 Hz @ –1 dB (40 dB/decade). One pole in input and one pole* in output
- B: f_{low} = 1 Hz @ –1 dB (20 dB / decade)

Low-pass Filter (–1 dB): 50 kHz
Harmonic Distortion @ 1 kHz, V_{out} < 5 V_{rms}: <0.01%, typically <0.001%
Rise Time: <3.5 µs (100 kHz bandwidth)
Channel-to-channel Phase Match: Calculated values without optional filters:
f_{low} ≤f ≤50 kHz: ≤2 degrees
10 × f_{low} ≤f ≤5 kHz: ≤0.25 degrees
100 × f_{low} ≤f ≤500 Hz: ≤0.025 degrees
f_{low} >0.1 or 1 Hz

Flexible Filter Configuration: Built-in filters and optional filters*. In addition to the built-in, high-pass filters, a number of optional standard filters can be installed, for example, A-, B-, C-, and D- weighting (complies with IEC 651 Type 0) and single-/double-integration
Inherent Noise:
(referred to input, gain ≥20 dB)
≤3 µV A-weighting, typical value: <1.8 µV
≤5 µV lin. 2 Hz to 22.4 kHz, typical value: <2.8 µV lin. 2 Hz to 22.4 kHz
Typical Broadband Output Noise: <1.8 µV A-weighted; <2.8 µV lin. 2 Hz to 22.4 kHz

0 dB:	4.6 μV_{rms}	3.0 μV_{rms}
10 dB:	9.0 μV_{rms}	6.0 μV_{rms}
20 dB:	2 μV_{rms}	14.5 μV_{rms}
30 dB:	65 μV_{rms}	44.0 μV_{rms}
40 dB:	200 μV_{rms}	150 μV_{rms}

Dynamic Range (typical): >120 dB, 22.4 kHz BW @ 0 dB gain; >125 dB, A-weighting @ 0 dB gain (max. output voltage rms/ broadband output noise)
Accuracy: ±0.1 dB. All gain-steps @ 1 kHz, typically ±0.05 dB

ENVIRONMENTAL SUSCEPTIBILITY (REFERRED TO OUTPUT AT MAX. GAIN)
Magnetic Field: <10 µV / (A/m)
Electromagnetic Field (measured with LK-0013 on cable):
- Type 2694-A, -C, -D:
  - Radiated <1 mV @ 10 V/m
  - Conducted <20 mV @ 10 V (floating input)
  - Conducted <0.2 mV @ 10 V (single-ended)
- Type 2694 B:
  - Radiated <10 mV @ 10 V/m
  - Conducted <200 mV @ 10 V (floating input)
  - Conducted <2 mV @ 10 V (single-ended)

Vibration (10 to 500 Hz): <100 µV / (m/s^2)
Transducer Testing†: Transducer voltage overload ~ failure in transducer or in the cables between Type 2694 and transducer
Channel Separation: >100 dB @ 1 kHz

* Not available with Type 2694-B

† Not available with Type 2694-B

ANALOGUE OUTPUT
Connector: 50 pol. sub-D
Connector Multiplexed Output: BNC
Grounding: Single-ended
Output Impedance: 50 Ω //500 pF
Maximum Output: = 20 V_{pp} (without clipping)
Maximum DC Offset: <±10 mV (typical <±2 mV)
Output Current: >10 mA_{rms}
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

POWER SUPPLY
Floating (max. voltage between chassis and power supply ground): ±10 V
External DC Power Input: Complies with ISO 7637–1 (12 V) and ISO 7637–2 (24 V)
Input Range: 10 to 33 V DC
Mains Supply: Supported via Mains Adapter ZG-0400 (included with Type 2694), 90 – 264 V AC, 40 – 65 Hz
Always Power-on Mode: Type 2694 powers up as soon as electrical supply is selected
Switchable Power-on Mode: Type 2694 can be powered on and off either manually (using the on/off button), or via a command over the RS–232 cable
Power Consumption: 18 to 30 W (depending on input voltage and device configuration)

DIGITAL CONTROL INTERFACE
Serial Interface: RS–232
Computer Control: All functions are controlled via the RS–232 interface. You can 'daisy-chain' up to 16 units on each COM port
Support of Transducers with TEDS according to IEEE P 1451.4:
Type 2694 can on request (via RS–232) read: Serial Number, Transducer Type and Sensitivity from all relevant transducer types designed in accordance with the IEEE P 1451.4.
There is also implemented a transparent protocol option that makes it possible to collect the whole contents of the TEDS

DIMENSIONS AND WEIGHT
The members of the Type 2694 family are all designed to fit in a 19″ rack and use only 1 unit in height. All connectors are placed on the front panel
Overall Dimensions:
- Height: 43.6 mm (1.7″)
- Width: 449 mm (17.7″)
- Depth: 254 mm (10.0″)

Weight: 2.5 kg (5.5 lb)

Ordering Information

Type 2694-A	**Standard 16-channel CCLD Conditioning Amplifier**
Type 2694-B	**Basic 16-channel CCLD Conditioning Amplifier**
Type 2694-A	**Customized 16-channel CCLD Conditioning Amplifier**
Type 2694-A	**16-channel CCLD Conditioning Amplifier with Single- and Double-integration**

Type 2694-A/B/C/D includes the following accessories:
- ZG-0426: Mains Adapter 90 – 264 V AC
- BZ-5291: Control Software
- AO-1440: RS–232 Interface Cables, 1.9 m (6.2 ft)
- AO-0581-D-015: Break-out cable 50-pin sub-D to 17 BNC, 1.5 m (4.9 ft)

OPTIONAL ACCESSORIES

KQ-0158	Portable Rack
KS-0046	19″ Rack Mounting Kit
LK-0013	Ferrite Clamp
WH-3206	Whole Body Vibration X, Y and Z-direction Filter
WH-3278	900 to 1100 Hz Band-pass Filter
ZE-0847	A-, B-, C-, D-weighting Filters
ZE-0848	Single- and Double-integration Filter

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