

# SYSTEM DATA

## IDA<sup>e</sup> Hardware Configurations for PULSE — Types 3560-B, 3560-C, 3560-D and 3560-E

*PULSE™ is a versatile, task-oriented sound and vibration analysis system. It provides the platform for a range of PC-based measurement solutions from Brüel & Kjær. A PULSE system consists of a PC with LAN interface, PULSE software, Microsoft® Windows® operating system, Microsoft® Office, and data acquisition front-end hardware. Up to 10 front-ends can be combined into one measurement system with more than 300 input channels.*

*This System Data describes the hardware available for Data Acquisition Front-ends Types 3560-B, C, D and E.*

*PULSE Software as well as PULSE Pocket Analyzer Type 3560-L and the PULSE Lite software are described separately.*



## USES AND FEATURES

### USES

- Multiframe systems comprising up to 10 front-ends with synchronous sampling between front-ends for real-time measurements on more than 300 channels:
  - Type 3560-B: 5 input and 1 output channel
  - Type 3560-C: 2 modules. Up to 17 input and/or 3 generator output channels
  - Type 3560-D: 7 modules. Up to 65 input and/or 10 generator output channels
  - Type 3560-E: 10 modules. Up to 96 input and/or 16 generator output channels)
- Signal and system analysis using all PULSE application packages for, or example:
  - Time data acquisition
  - General noise and vibration measurements
  - Basic and advanced acoustics
  - Structural Analysis
  - Machine Diagnostics
  - Electroacoustic testing

### FEATURES

- Dyn-X input modules with single, 160 dB input range
- Automatic detection of front-end hardware and transducers – supports IEEE 1451.4-capable transducers with TEDS (Transducer Electronic Data Sheet)
- Fully conditioned input and output channels for microphones and accelerometers, charge transducers, CCLD transducers and other transducers acting as voltage sources
- Full overload detection including out-of-band overload and indication of incorrect conditioning
- LAN interface allows the front-end to be placed close to the test object and reduces transducer cable length
- Rugged design for industrial use
- Battery (3560-B, C only)/external DC operated acquisition unit for field use
- Low-noise operation

## Introduction

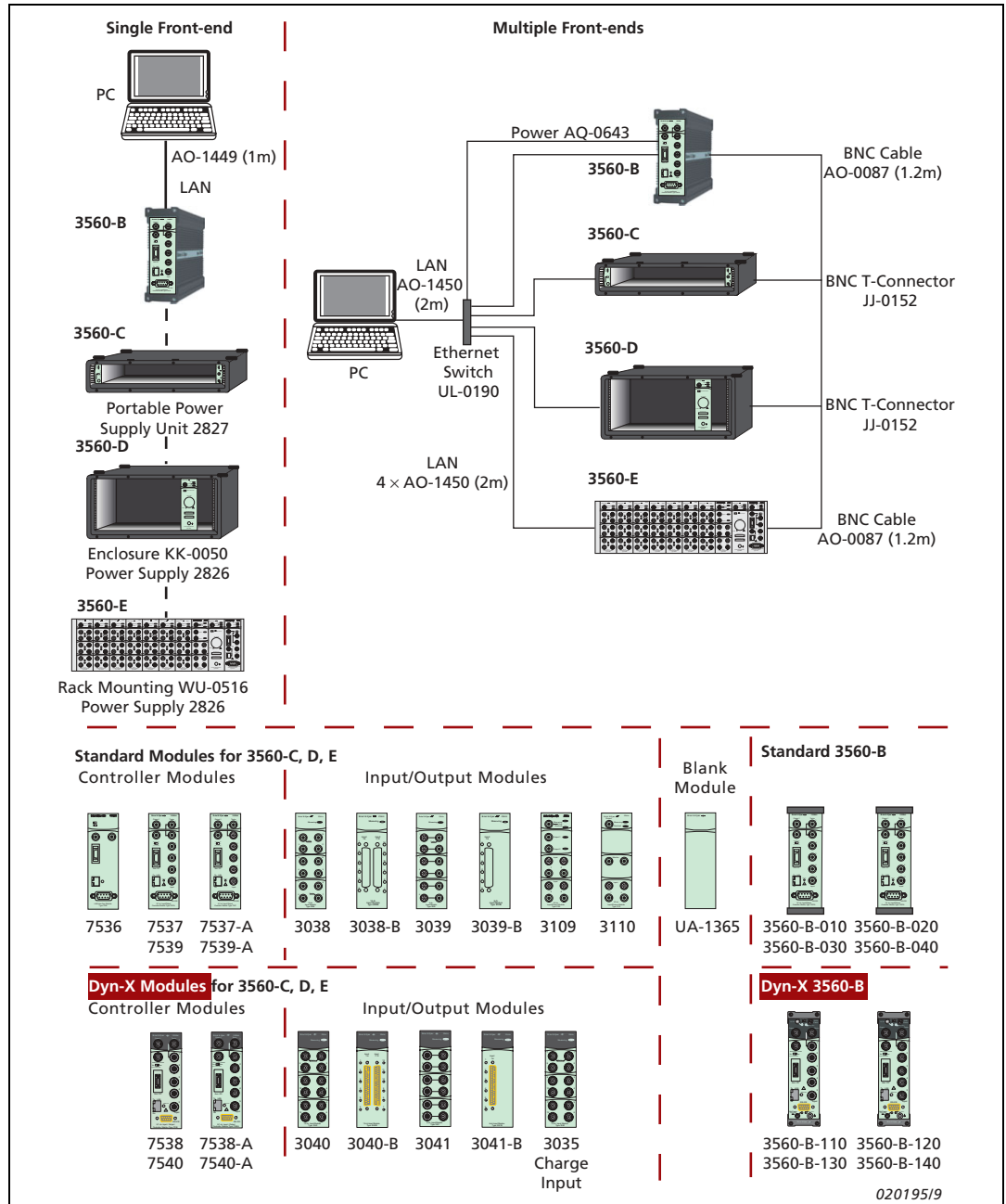
PULSE is a versatile, task-oriented system for noise and vibration analysis. It provides the platform for a range of PC-based measurement solutions from Brüel & Kjær.

A PULSE system consists of a PC with LAN interface, PULSE software, Windows® 2000 or XP, Microsoft® Office and IDA<sup>e</sup>-based data acquisition front-end hardware. A system can contain more than 300 input channels located in up to 10 front-ends. The input/output conditioning modules perform signal conditioning and digitise the transducer signals. The IDA<sup>e</sup> modules available for use in PULSE systems are shown in Fig. 1 and listed in the Ordering Information on page 23. Modules can be freely mixed in a single front-end or in a multiframe system. Further information on the controller and input/output modules is given in Table 1.

**Fig. 1**  
Overview of the components available for use in a PULSE System with LAN Interface

Standard configurations for a wide variety of applications are described in the "PULSE Analyzers & Solutions" Catalogue both printed (BF 0209) and on [www.bksv.com](http://www.bksv.com)

For information on PULSE Pocket Analyzer Type 3560-L, see the separate Product Data (BP 1967)



**Table 1** Types and modules comprising PULSE front-ends

Type	Product Name	Frequency Range	Aux. Channels	Simultaneous Channels	Connectors	Input Type											
<b>Type 3560-B</b>																	
3560-B-010	5-channel PULSE Data Acquisition Unit	0 Hz to 25.6 kHz	16 Aux Input <sup>d</sup> (10 samples/s) 2 Digital Output	5 Input 1 Sine Output	LEMO	Direct/CCLD <sup>a</sup> , <sup>b</sup> /Mic. Preamp. 1 Tacho Conditioning <sup>c</sup>											
3560-B-110					BNC	Direct/CCLD <sup>a</sup> 1 Tacho Conditioning <sup>c</sup>											
3560-B-020				5 Input 1 Generator Output	LEMO	Direct/CCLD <sup>a</sup> , <sup>b</sup> /Mic. Preamp. 1 Tacho Conditioning <sup>c</sup>											
3560-B-120					BNC	Direct/CCLD <sup>a</sup> 1 Tacho Conditioning <sup>c</sup>											
3560-B-030																	
3560-B-130																	
3560-B-040																	
3560-B-140																	
<b>Types 3560-C, D, E</b>																	
3109	Generator, 4/2-ch. Input/Output Module	0 Hz to 25.6 kHz	-	4 Input 2 Generator Output	BNC and LEMO	Direct/CCLD <sup>a</sup> /Mic. Preamp. 1 Tacho Conditioning <sup>c</sup>	1 of these modules Up to 17 input channels										
3110	Generator, 2/1-ch. Input/Output Module	0 Hz to 204.8 kHz		2 Input 1 Generator Output <sup>e</sup>													
3038	12-ch. Input Module	0 Hz to 25.6 kHz			12 Input	BNC				Direct/CCLD <sup>a</sup> 2 Tacho Conditioning <sup>a</sup>							
3040						2 × Sub-D				Direct/CCLD <sup>a</sup> /Mic. Preamp. <sup>b</sup>							
3038-B					6-ch. Input Module					6 Input	BNC and LEMO	Direct/CCLD <sup>a</sup> /Mic. Preamp. 1 Tacho Conditioning <sup>c</sup>					
3040-B											Sub-D	Direct/CCLD <sup>a</sup> /Mic. Preamp. <sup>b</sup>					
3039																	
3041																	
3039-B																	
3041-B	6-ch. Charge & CCLD Input Module	0 Hz to 25.6 kHz		-	6 Input	BNT/BNC and TNC				Charge/Direct/CCLD <sup>a</sup> Tacho Conditioning on BNT Connector							
UA-1365	Blank Module																
7536	Controller Module	-															
7537	5/1-ch. Input/Output Controller Module	0 Hz to 25.6 kHz	16 Aux Input <sup>d</sup> (10 samples/s) 2 Digital Output	5 Input 1 Sine Output	LEMO	Direct/CCLD <sup>a</sup> , <sup>b</sup> /Mic. Preamp. 1 Tacho Conditioning <sup>c</sup>	1 of these modules										
7538				5 Input 1 Generator Output													
7539				5 Input 1 Sine Output	BNC	Direct/CCLD <sup>a</sup> 1 Tacho Conditioning <sup>c</sup>											
7540										5 Input 1 Generator Output							
7537-A																	
7538-A																	
7539-A																	
7540-A																	

a. Constant Current Line Drive for DeltaTron<sup>®</sup> and ICP<sup>®</sup> Accelerometers or Microphone Preampifier  
 b. Using adaptor cables  
 c. All input channels can be used for tachometer operation  
 d. Only 12-channel currently supported in PULSE software  
 e. Upper frequency @ 102.4 kHz  
**Dyn-X modules** – See "Dyn-X Modules – Types 7538/38-A, 7540/40-A, 3035, 3040/40-B, 3041/41-B, 3560-B-110/120/130/140" on page 6.

**PULSE Type 3560-B – Compact Data Acquisition Unit, up to 5 Input Channels**

**FEATURES**

- Compact, robust casing for industrial and hard everyday use
- Battery operated (5 hours continuous) or DC powered (10 – 32 V)
- Silent operation to 35°C
- Cooling fans can be turned off for silent operation (will automatically restart if too hot)
- Synchronous sampling with other PULSE front-ends

Type 3560-B is a compact data acquisition system for battery/DC powered operation. The unit handles communication with the PC, measurement input and provides a sample clock. Eight versions are available, four standard and four Dyn-X – see the upper portion of Table 1.



050150

A handle, UA-1689, is available for mounting on top of Type 3560-B, making it easier to carry.

---

## PULSE Type 3560-C – Portable Data Acquisition Unit, up to 17 Input Channels

---

### FEATURES

- Houses one input/output module and one controller module
- Robust casing for industrial and hard everyday use
- Rain cover for front panel allows passage of cables
- Battery operated or DC powered (10 – 32 V)
- Cooling fans can be turned off for silent operation (will automatically restart if too hot)
- Synchronous sampling with other PULSE front-ends

Type 3560-C is a portable data acquisition system with a battery/DC powered Type 2827 power supply unit. It can hold any combination of 1 Controller Module and 1 Input/Output Module (see Fig. 1 and Table 1). The controller module handles communication with the PC while the input/output module handles measurement input and provides a sample clock. As an example, a Type 3560-C fitted with a 5/1-ch. Input/Output Controller Module Type 7537 and a 12-ch. Input Module Type 3038 can measure up to 17 input channels.



050151

### *Environmental*

To survive the harsh electrical environment found in, for example, cars, Type 3560-C has specifications that exceed the European EMC immunity requirements. ISO 7637-1 and 7637-2 “Road Vehicles – Electrical disturbance by conduction and coupling” requirements are met. Mechanical robustness is equally high, meeting MIL-STD-810C and IEC 60068-2-6.

Since all portable PULSE systems are built for outdoor use, they meet strict requirements for temperature and humidity. The operating temperature range extends from -10 to +50°C (+14 to 122°F). Type 3560-C will withstand rain if kept with the front panel facing upwards and the protection cover in place.

---

## PULSE Type 3560-D – Multichannel Portable Data Acquisition Unit, up to 65 Input Channels

---

### FEATURES

- Houses up to 5 input/output modules, Power Supply Type 2826 and one controller module
- Robust casing for industrial and hard everyday use
- DC powered (10 – 32 V) or via AC/DC convertor
- Main cooling fans can be turned off for nearly silent operation (will automatically restart if too hot)
- Synchronous sampling with other PULSE front-ends



050152

Type 3560-D is a data acquisition system comprising a frame that contains 7 modules. One of these must be the DC Power Supply Unit Type 2826, and one must be a Controller Module. The remaining 5 modules can be freely chosen from the I/O modules (see Fig. 1 and Table 1).<sup>a</sup>

---

a. Note that one input module is always required, so the minimum input module configuration for Type 3560-D is: Type 2826 + Type 7536 + one input module; or Type 2826 + one of Types 7537, 7537-A, 7538, 7538-A, 7539, 7539-A, 7540, 7540-A

---

## PULSE Type 3560-E – Multichannel Data Acquisition Unit, up to 96 Input Channels

---

### FEATURES

- Comprises up to 8 input/output modules, Power Supply Type 2826 and one controller module
- DC powered (10 – 32 V) or via AC/DC convertor
- Optional Rack Mounting Enclosure KQ-0155, Air Guide EA-0540 and Fan Unit UH-1037
- Synchronous sampling with other PULSE front-ends



050153

Type 3560-E is a rack-mounted data acquisition system comprising 10 modules. One of these must be the DC Power Supply Unit Type 2826, and one must be a Controller Module. The remaining 8 modules can be freely chosen from the I/O modules (see Fig. 1)<sup>a</sup>.

The system is delivered with a 19" Rack Mounting Kit, as shown above. A 19" Rack Enclosure KQ-0155, Air Guide EA-0540 and Fan Unit UH-1037 are available for rack-mounted systems.

---

### Power Supply

---

**Types 3560-B** and **3560-C** can either be powered by two internal Nickel-Metal Hydride batteries or from a 10 – 32 V DC power supply. A 100 – 240 V AC mains supply unit is included. The unit can be switched on and off from the front panel or, when using more than one front-end in one system, the on/off function can be controlled by another front-end using the Multiframe Control signal. A third possibility is to follow an external DC power supply, so that it switches on when the supply is connected.

When batteries are used<sup>b</sup>, indicators on each side of the front panel indicate the condition of the batteries, allowing hot swap without interrupting measurement. When connected to an external DC supply, the batteries are charged automatically.

**Types 3560-D** and **3560-E** can be powered from a 10 – 32 V DC power supply. An external 100 – 240 V AC mains supply unit, ZG-0430, is provided. The unit is a Type 2826 that can be switched on and off from the front panel or, when using more than one front-end in one system, the on/off function can be controlled by another front-end using the Multiframe Control signal. A third possibility is to follow an external DC power supply, so that it switches on when the supply is connected.

#### *DC Output*

To provide power for accessories such as a LAN switch or wireless LAN for interconnecting more front-ends, Types 3560-B, C and D have a 5 and 12 V DC output (LEMO FGG.00.302 connector) with fuse. Cables for these accessories must be ordered separately.

---

### Silent Operation, Cooling

---

**Type 3560-B** is silent, operating without fans at ambient temperatures up to 35°C (95°F). Above this temperature the fans start up, but can be switched off from the PULSE software.

---

a. Note that one input module is always required, so the minimum input module configuration for Type 3560-E is: Type 2826 + Type 7536 + one input module; or Type 2826 + one of Types 7537, 7537-A, 7538, 7538-A, 7539, 7539-A, 7540, 7540-A  
b. Batteries are **not** included.

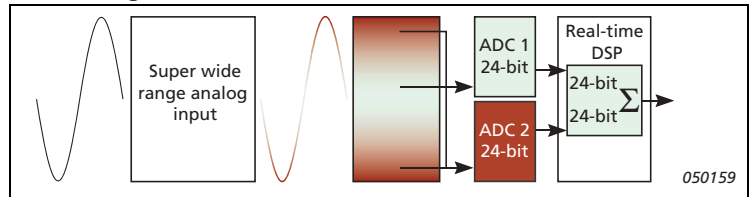
**Types 3560-C and 3560-D:** During operation fans keep the temperature of the unit within safety limits. In measurement situations where the fan noise<sup>a</sup> can influence measurement results, the fans can be switched off from the PULSE software. If overheating threatens, the fans are automatically turned on again.

**Dyn-X Modules – Types 7538/38-A, 7540/40-A, 3035, 3040/40-B, 3041/41-B, 3560-B-110/120/130/140**

**Fig. 2**  
Simplified block diagram of Dyn-X principle

**Dyn-X technology – Exclusive Range from 0 to 160 dB**

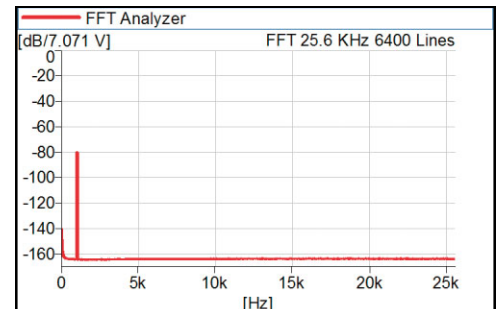
Dyn-X is an innovative range of state-of-the-art input modules with a single input range from 0 to 10 V<sub>p</sub> and a useful analysis range exceeding 160 dB.



To date, high-quality transducers and preamplifiers have outperformed measuring equipment with regard to linearity and dynamic performance, being able to deliver a noise- and distortion-free signal over a dynamic signal range of 120 to 130 dB broadband and 160 dB narrow-band.

**Fig. 3**  
160 dB analysis in one range. An FFT measuring a 1 KHz signal 80 dB below full scale (7 V<sub>rms</sub>). Note that noise and all spurious components measure 160 dB below full scale input

Now, with Dyn-X technology, the entire measurement and analysis chain for the first time matches or outperforms the transducer used for measurement. This eliminates the need for an input attenuator for ranging the analysis system input to the transducer output. All that you need to do to get excellent results is choose the right transducer.



**Transducer Overload**

Transducer max. output level can be entered in the software. If the input exceeds this level, then Dyn-X modules will give as overload warning on the front-end and in the PULSE Level Meter.

**Accuracy, Safety and Efficiency**

With no input range to set, you no longer have to worry about overloads, underrange measurements or discussions about the validation and verification of measurement results. And with no need for trial runs to ensure that the input range is correct, you have a far greater certainty of getting measurements right first time.

The measurement situations and applications below are examples of where the new Dyn-X technology can be usefully employed:

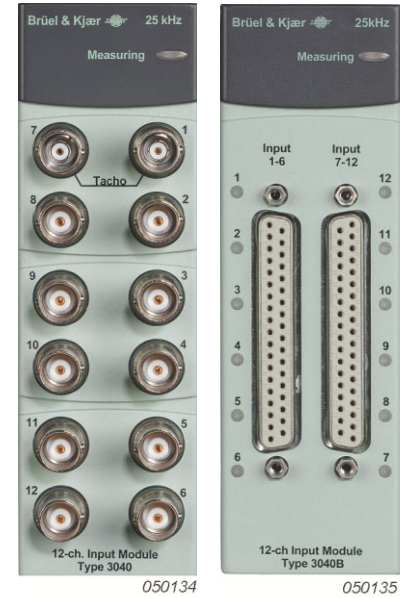
<i>When you need to get the measurement right first time</i>	<ul style="list-style-type: none"> <li>Crash testing</li> <li>Destructive testing</li> <li>Heavy machinery – run up/coast down</li> </ul>	<i>When signal levels are unknown</i>	<ul style="list-style-type: none"> <li>Run up/down</li> <li>Field testing</li> </ul>
<i>Where there's minimal user interaction</i>	<ul style="list-style-type: none"> <li>Road testing</li> <li>Field testing</li> </ul>	<i>When an overview of the whole measurement scenario is difficult</i>	<ul style="list-style-type: none"> <li>When measuring many channels</li> <li>When combining more signal types: Vibration, Sound, Temperature, Pressure, RPM, etc.</li> <li>Test cells</li> <li>In-car testing</li> <li>Sound, vibration and other parameters involved</li> </ul>
<i>When time is limited</i>	<ul style="list-style-type: none"> <li>Test cells</li> <li>Wind tunnels</li> <li>Road testing</li> <li>Flight testing</li> </ul>		
<i>When testing is unattended</i>	<ul style="list-style-type: none"> <li>Production line</li> <li>Noise monitoring</li> </ul>	<i>High-dynamic applications</i>	<ul style="list-style-type: none"> <li>Impulsive testing, room acoustics</li> <li>Run up/down</li> <li>Electroacoustics</li> <li>Structural measurements</li> </ul>

a. See the Acoustic Noise Emission specifications for Types 3560-C (page 13) and 3560-D (page 13).

## Input Channels

### Available Input Modules

	Standard	Dyn-X
<b>Input Modules</b>		
12-ch. Input Module	3038, 3038-B	3040, 3040-B
6-ch. Input Module	3039, 3039-B	3041, 3041-B
6-ch. Charge & CCLD Input Module	–	3035
<b>Input/Output Modules</b>		
Generator, 4/2-ch. Input/Output Module	3109	–
Generator, 2/1-ch. Input/Output Module	3110	–
<b>Input/Output Controller Modules</b>		
5/1-ch. Input/Output Controller Modules	7537, 7537-A (3560-B-010/020)	7538, 7538-A (3560-B-110/120)
5/1-ch. Input/Output Controller Modules with Generator	7539, 7539-A (3560-B-030/040)	7540, 7540-A (3560-B-130/140)



### USES

- Input channels for multichannel acoustic and vibration measurements

### FEATURES

- Support IEEE 1451.4 capable transducers with TEDS
- Automatic DC offset compensation
- Overload indicator indicates incorrect conditioning and cable breaks on connected transducers
- Overload detection including out-of-band frequencies

Functions and features available in the modules are determined by software implemented and downloaded from PULSE LabShop.

### Independent Channels

The input channels on a module can be set up independently; you can set up the high-pass filters and input gain separately and attach different types of transducers to different channels. The microphone polarization voltage can be switched on for all channels. (Note: Where polarization voltage is available, it is the same on all microphone channels in a module).

### IEEE 1451.4 Transducers

Input modules supports IEEE 1451.4 capable transducers with standardised Transducer Electronic Data Sheets (TEDS). This feature allows automatic front-end and analyzer setup, based on information stored in the transducer. This information includes, for example, sensitivity, serial number, manufacturer and calibration date.

### Transducer Conditioning Check

Input modules use two methods to detect transducer cable breaks or whether the wrong conditioning has been chosen. For microphones, their supply current is monitored. For DeltaTron<sup>®</sup> accelerometers (or microphones using DeltaTron<sup>®</sup> preamplifiers), the supply voltage is monitored. If conditioning errors such as a broken cable are detected, an error event is indicated as an overload on the specific channel.



**Table 2** Overview of modules with input channels

Standard	–	3038	3038-B	3039	3039-B	3109	3110	7537	7537-A	
								7539	7539-A	
<b>Dyn-X</b>	<b>3035</b>	<b>3040</b>	<b>3040-B</b>	<b>3041</b>	<b>3041-B</b>	–	–	<b>7538</b>	<b>7538-A</b>	
								<b>7540</b>	<b>7540-A</b>	
Input Channels	6	12	12	6	6	4	2	5	5	
Frequency Range	25.6 kHz						204.8 kHz	25.6 kHz		
BNC (CCLD <sup>a</sup> /Direct) <sup>b</sup>	5	10	–	5	–	4	–	–	5	
BNT (CCLD <sup>a</sup> /Direct/Tacho) <sup>b</sup>	Ch. 1	Ch. 1 and 7	–	Ch. 1	–	Ch. 1	2	Ch. 1	Ch. 1	
TNC (Charge)	6	–	–	–	–	–	–	–	–	
LEMO (Preamp.)	–	–	–	6	–	4	2	5	–	
37-pole D-sub	–	–	2	–	1	–	–	–	–	
Supports Charge Injection Calibration (CIC) check with LEMO microphone preamplifiers <sup>c</sup>	–	–	Yes <sup>d</sup>	Yes	Yes	Yes	Yes	Yes	Yes <sup>d</sup>	
Intensity Phase Matching	All BNT/BNC	5 + 6, 11 + 12	5 + 6, 11 + 12 <sup>d</sup>	5 + 6	5 + 6 <sup>d</sup>	Ch. 3 and 4	All	4 + 5	–	
		From 2005: All channels					From 2005: All channels			
		Dyn-X: All channels					Dyn-X: All channels			
AD converters	24-bit to 25.6 kHz					16-bit to 25.6 kHz	24-bit to 25.6 kHz, 16-bit to 204.8 kHz	24-bit to 25.6 kHz		
Floating/Non-floating	Yes					–	Yes			
Microphone Polarization	–	–	0 or 200 V						–	

a. Including DeltaTron<sup>®</sup> and ICP<sup>®</sup>

b. Charge operation can be obtained directly using Type 3035 or by using Charge to DeltaTron<sup>®</sup> Converter Type 2647 with other modules

c. Via dedicated application software and OLE interface

d. Via AO-0602 37-pole to 6 × LEMO Adaptor Cable

### 6-ch. Charge & CCLD Input Module Type 3035

6-channel Charge & CCLD Input Module Type 3035 is designed specifically to allow the direct connection of charge transducers to a PULSE system. Each channel also has DeltaTron capability for IEPE transducers, and can also be used for direct input of voltages. Type 3035 compliments the other input modules in the PULSE IDA<sup>e</sup> range, and incorporates Dyn-X technology to give a useful measurement range of 160 dB on each channel.

#### CCLD and Voltage Inputs

The voltage and DeltaTron inputs are via BNC connectors, and each channel has the same specification as the other Dyn-X input channels, such as those found on Types 3040 and 3041.

#### Charge Inputs

TNC connectors are provided for charge transducers. These provide the most stable charge contact for avoiding triboelectric noise from vibrations. TNC to microdot (10–32 UNF) adaptors are included. The Dyn-X technology ensures optimal transducer support and ease of use and makes it possible to condition all charge transducers in only two input ranges (1 nC or 10 nC), while still providing state-of-the-art performance. Selectable dedicated high-pass (0.1, 1, 10 and 30 Hz) are provided, while low-pass filters (0.1, 1, 3, 10 and 30 kHz) allow efficient damping of the high accelerometer sensitivity at resonance, thus optimising the useful dynamic range.



## Output Channels

### Available Generator Modules

	Standard	Dyn-X
<b>Input/Output Modules</b>		
Generator, 4/2-ch. Input/Output Module	3109	–
Generator, 2/1-ch. Input/Output Module	3110	–
<b>Input/Output Controller Modules</b>		
5/1-ch. Input/Output Controller Modules	7537, 7537-A (3560-B-010/020)	7538, 7538-A (3560-B-110/120)
5/1-ch. Input/Output Controller Modules with Generator	7539, 7539-A (3560-B-030/040)	7540, 7540-A (3560-B-130/140)

### USES

- Generator output channels for system excitation for acoustic and vibration measurements

### FEATURES

- Type 3109: 2 output channels: Full generator functionality to 25.6 kHz
- Type 3110: 1 output channel: Full generator functionality to 102.4 kHz
- Types 7539, 7539-A (3560-B-030/040), 7540, 7540-A (3560-B-130/140): 1 output channel: Full generator functionality to 25.6 kHz
- Waveforms determined by PULSE software (see BU 0229)
- Types 7537, 7537-A (3560-B-010/020), 7538, 7538-A (3560-B-110/120): 1 output channel: Sine waveforms up to 25.6 kHz; sine wave only



### Type 3109

The two output channels on Type 3109 can be used as signal generators with a frequency range from 0 to 25.6 kHz and can supply all the signals necessary for performing system analysis.

Type 3109 is designed around a powerful digital signal processor and a 24-bit D/A converter, and has exceptional flexibility, stability and accuracy. Output levels are adjustable in hardware, with maximum output ranging from 5 mV to 5 V RMS. Lower levels are possible by scaling the signal to the D/A converter. The signal is provided by a BNC connector and can be referred to ground or floating. It is possible to add a DC offset, but any unwanted DC offset is automatically removed.

#### *Emergency Stop*

The connector at the top of the module allows connection to an emergency stop control, allowing you to stop the generators immediately.

### Type 3110

The output channel on Type 3110 can be used as signal generator with a frequency range from 0 to 102.4 kHz and can supply all the signals necessary for performing system analysis. The generators are controlled from PULSE software.

Type 3110 is designed around a powerful digital signal processor and a 24-bit D/A converter, and has exceptional flexibility, stability and accuracy. The full dynamic output range is obtained from 7 mV to 7 V peak. Lower levels are possible by scaling the signal to the D/A converter. The signal is provided by a BNC connector and can be referred to ground or floating. It is possible to add a DC offset, but any unwanted DC offset is automatically removed.

### Monitor Output

An input monitor signal is available on a BNC connector for each input channel. The signal is taken after the high-pass filter but before the anti-aliasing filter. The signal level is  $2.236 V_p$  for full-scale input in any range. The signal is always referred to (chassis) ground.

### Types 7539, 7539-A, 7540, 7540-A

The output channels on these modules can be used as signal generators with a frequency range from 0 to 25.6 kHz and can supply all the signals necessary for performing system analysis.

The modules are designed around a powerful digital signal processor and a 24-bit D/A converter, and have exceptional flexibility, stability and accuracy. The signal is provided by a BNC connector and can be referred to ground or floating. It is possible to add a DC offset, but any unwanted DC offset is automatically removed.

### Types 7537, 7537-A, 7538, 7538-A

The output channels on these modules can be used as simple, high-quality sine tone generators with a frequency range from 0.001 to 25.6 kHz. The maximum output voltage is  $5 V_{rms}$  delivered in one output range through a 24-bit D/A converter. The signal is provided by a BNC connector, and may be referred to ground or floating.

---

## Controller Modules

---

### Available Controller Modules

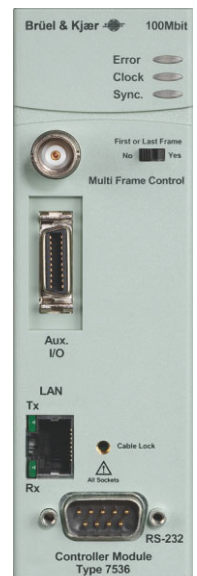
	Standard	Dyn-X
100 Mbit Controller Module	7536	—
5/1-ch. Input/Output Controller Modules	7537, 7537-A (3560-B-010/020)	7538, 7538-A (3560-B-110/120)
5/1-ch. Input/Output Controller Modules with Generator	7539, 7539-A (3560-B-030/040)	7540, 7540-A (3560-B-130/140)

### USES

- Communication interface between a PULSE Front-end and a PC running PULSE software, via LAN (Local Area Network)
- Measurement of voltage or physical parameters like position, wind speed or temperature via 12 auxiliary input channels

### FEATURES

- Sets up and transmits data from input modules, provides sampling clock and synchronisation of front-ends
- Connection of remote control for sound intensity measurements via RS-232 interface
- Data transfer according to standard TCP/IP protocol



050140

### Synchronisation and Stacking

Controller Modules control and route all communication between the PC and the input/output modules, and transmit or receive synchronisation and clock signals to or from other front-ends. This enables up to 10 units to be combined to act as one multichannel system. It also enables all front-ends in a system to be turned on or off simultaneously.

### RS-232

An RS-232 interface on the front panel allows communication with the optional Remote Control Unit ZH-0632 for sound intensity measurements. The interface is also used for setting up the LAN address and testing the front-end hardware.

### Auxiliary Channels

12 DC channels<sup>a</sup>, present on a single connector, are each sampled 10 times per second. The channels are single-ended and have six input ranges from 0.1 V to 31.6 V in 10 dB steps.



---

## PULSE Software and Applications

---

The base software for a PULSE system is Noise and Vibration Analysis Type 7700 with both FFT and CPB analyzers, though separate FFT and CPB licenses are available as FFT Analysis Type 7770 and CPB Analysis Type 7771. On this base, you can install any other PULSE software and applications such as Data Recorder Type 7701 and Time Capture Type 7705. For descriptions of the PULSE software please refer to the separate System Data, BU 0229.



---

a. 4 additional auxiliary inputs are included for future use, and 2 open drain outputs, which allow for simple on/off control.

## Compliance with Standards

(For environmental specifications and compliance with standards for PCs, see the specifications given by their respective manufacturers)

**TYPES 3560-B-010, -020, -030, -040, -110, -120, -130, -140,  
 TYPES 3560-C, 3560-D AND 3560-E WITH CONTROLLER MODULE TYPE 7536,  
 INPUT/OUTPUT CONTROLLER MODULE TYPE 7537, 7537-A, 7538, 7538-A, 7539, 7539-A, 7540 OR 7540-A  
 INPUT/OUTPUT MODULE TYPE 3035, 3038, 3038-B, 3039, 3039-B, 3040, 3040-B, 3041, 3041-B, 3109 OR 3110**

 	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.
<b>Safety</b>	EN/IEC61010-1: Safety requirements for electrical equipment for measurement, control and laboratory use. UL 61010B-1: Standard for Safety – Electrical measuring and test equipment.
<b>EMC Emission</b>	EN/IEC61000-6-3: Generic emission standard for residential, commercial and light industrial environments. EN/IEC61000-6-4: 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.
<b>EMC Immunity</b>	EN/IEC61000-6-1: Generic standards – Immunity for residential, commercial and light industrial environments. EN/IEC61000-6-2: Generic standards – Immunity for industrial environments. EN/IEC61326: Electrical equipment for measurement, control and laboratory use – EMC requirements. <b>Note:</b> The above is only guaranteed using accessories listed in this System Data.
<b>Temperature</b>	IEC 60068-2-1 & IEC 60068-2-2: Environmental Testing. Cold and Dry Heat. Operating Temperature: -10 to +50°C (14 to 122°F) Storage Temperature: -25 to +70°C (-13 to 158°F)
<b>Humidity</b>	IEC 60068-2-78: Damp Heat: 93% RH (non-condensing at 40°C (104°F))
<b>Mechanical</b>	Operating (peak values) MIL-STD-810C: Vibration: 12.7 mm, 15 ms <sup>-2</sup> , 5–500 Hz Non-operating: IEC 60068-2-6: Vibration: 0.3 mm, 20 ms <sup>-2</sup> , 10–500 Hz IEC 60068-2-27: Shock: 1000 ms <sup>-2</sup> IEC 60068-2-29: Bump: 1000 bumps at: 250 ms <sup>-2</sup>
<b>Enclosure</b>	IEC 60529: Protection provided by enclosures: <b>3560-B:</b> IP 40; <b>3560-C:</b> IP 32; <b>3560-D:</b> IP 40; <b>3560-E:</b> IP 20

### EFFECT OF RADIATED/CONDUCTED RF, MAGNETIC FIELD AND VIBRATION

**Radiated RF:** 80 – 1000 MHz, 80% AM 1 kHz, 10 V/m  
**Conducted RF:** 0.15 – 80 MHz, 80% AM 1 kHz, 10 V  
**Magnetic Field:** 30 A/m, 50 Hz

**Vibration:** 5 – 500 Hz, 12.7 mm, 15 m/s<sup>2</sup>  
 Input measured in 7.071 mV range with shorted input. All values are RMS. Conducted RF immunity on all channels is only guaranteed using an external connection from measuring ground to chassis terminal on Types 2826 or 2827

Input/Output	Radiated RF	Conducted RF	Magnetic Field	Vibration
Direct/CCLD	<10 μV	<130 μV	<4 μV	<80 μV
Preamplifier	<10 μV	< 25 μV	<8 μV	<80 μV
Generator	<60 μV	< 25 μV	<4 μV	< 5 μV
Charge	<130 fC	<130 fC	<10 fC	<80 fC

## Specifications – PULSE Types 3560-B/C/D/E

Multi-analyzer Systems Type 3560-B, 3560-C, 3560-D and 3560-E with LAN interface are modular, expandable, multi-analysis systems that include the following components:

- Pentium® PC
- PULSE software

- Microsoft® Windows® 2000 or Windows® XP operating system
- Microsoft® Office 2000 or XP
- Front-end comprising: Power Supply/Frame, Controller Module and a number of Input/Output Modules (see below)

## Specifications – Portable PULSE Type 3560-B

### POWER REQUIREMENTS

Fulfills the requirements of ISO 7637-1 and 7637-2 with batteries

**Voltage:** 10 – 32 V DC

**Power Consumption:**

**Nominal:** 14 W

**Max.:** 26 W (while charging battery)

**Ext. Power Connector:** LEMO coax., FFA.00.113, ground on shield

### BATTERIES

**Optional Accessories:** 2 × DR35 NiMH or NI 1030, 10.8 V (nominal)

**Working Time (Continuous):** 5 hours

**Charging Time:** 5 hours/battery

### ACOUSTIC NOISE EMISSION (at 1 m)

Silent operation to 35°C (95°F) when not charging batteries. When charging batteries, fan operation may start at a lower ambient temperature

**DC OUTPUT**

+ 5 V ± 0.5 V; max. 0.4 A (1 A fused)

+12 V ± 1.0 V; max. 0.4 A (1 A fused)

**Connector:** LEMO FGG.00.302**DIMENSIONS (WITHOUT PROTECTIVE COVER)****Height:** 182 mm (7.2")**Width:** 64 mm (2.5")**Depth:** 270 mm (10.6")**Weight:** 2.5 kg (5.5 lb.) without batteries**Specifications – Portable PULSE Type 3560-C****POWER SUPPLY/FRAME**

Type 2827

**AVAILABLE MODULES**

See "Ordering Information – PULSE Systems 3560-B, 3560-C, 3560-D, 3560-E" on page 23

**POWER REQUIREMENTS**

Fulfills the requirements of ISO 7637–1 and 7637–2 with batteries

**Voltage:** 10 – 32 V DC**Power Consumption:**

Without DC output and when fitted with:

1 × 7536 Controller Module

1 × 3109 4/2-ch. or 3110 2/1-ch. Input/Output Module

**Nominal:** 30 W**Max.:** 42 W (while charging battery)**Ext. Power Connector:** LEMO coax., FFA.00.113, ground on shield**BATTERIES****Optional Accessories:** 2 × DR35 NiMH or NI 1030, 10.8 V (nominal)**Working Time (Continuous):** 2½ hours**Charging Time:** 5 hours/battery**ACOUSTIC NOISE EMISSION (at 1 m)**

	dB SPL, A-weighted at 1 m	dB Lw, A-weighted
<b>Fan Off</b>	<17	<25
<b>Normal (22°C)</b>	32	40
<b>Max.</b>	33	41

**DC OUTPUT**

+5 V ± 0.5 V; max. 0.4 A (1 A fused)

+12 V ± 1.0 V; max. 0.4 A (1 A fused)

**Connector:** LEMO FGG.00.302**DIMENSIONS (WITHOUT PROTECTIVE COVER)****Height:** 105 mm (4.1")**Width:** 376 mm (14.8")**Depth:** 300 mm (11.8")**Weight:** 5 kg (11 lb.) with Controller Module and Input/Output Module. When fitted with batteries, 6 kg (13 lb.)**Specifications – Multichannel Portable PULSE Type 3560-D****POWER SUPPLY**

Type 2826

**FRAME (INCL. FAN UNIT)**

KK-0050

**AVAILABLE MODULES**

See "Ordering Information – PULSE Systems 3560-B, 3560-C, 3560-D, 3560-E" on page 23

**POWER REQUIREMENTS****Voltage:** 10 – 32 V DC**Power Consumption:**

Without DC output and when fitted with:

1 × 7536 Controller Module

35 W nominal with 1 input module

100 W nominal with 5 input modules

**Ext. Power Connector:** Neutrik® Powercon 3-pole**Max. No. of Tacho Probes:** 4 in full frame**DC OUTPUT**

+5 V ± 0.5 V; max. 0.4 A (1 A fused)

+12 V ± 1.0 V; max. 0.4 A (1 A fused)

**Connector:** LEMO FGG.00.302**ACOUSTIC NOISE EMISSION (at 1 m)**

	dB SPL, A-weighted at 1 m	dB Lw, A-weighted
<b>Fan Off</b>	27	35
<b>Normal (22°C)</b>	30	38
<b>Max.</b>	42	50

**DIMENSIONS****Height:** 194 mm (7.6") with feet, 170 mm (6.7") without feet**Width:** 376 mm (14.8")**Depth:** 342 mm (13.5")**Specifications – Multichannel PULSE Type 3560-E****POWER SUPPLY**

Type 2826

**RACK MOUNTING KIT**

WU-0516

**AVAILABLE MODULES**

See "Ordering Information – PULSE Systems 3560-B, 3560-C, 3560-D, 3560-E" on page 23

**POWER REQUIREMENTS****Voltage:** 10 – 32 V DC**Power Consumption:**

When fitted with:

1 × 7536 Controller Module

35 W nominal with 1 input module

140 W nominal with 8 input modules

**Ext. Power Connector:** Neutrik® Powercon 3-pole**Max. No. of Tacho Probes:** 2 in full frame**DIMENSIONS****Height:** 134 mm (5.3") (3 standard rack-mounting units)**Width:** 482.6 mm (19")**Depth:** 300 mm (11.8")**Weight:** 8.7 kg (19 lb.) with Controller Module and 8 Input/Output Modules; 17.5 kg (38.5 lb.) with KQ-0155 and UH-1037

## Specifications – Input Channels, Standard 24-bit and Dyn-X

		Standard 24-bit 7537/37-A/39/39-A, 3038/38-B/39/39-B 3560-B-010/020/030/040			Dyn-X 7538/38-A/40/40-A, 3035 (BNC/BNT) 3040/40-B/41/41-B, 3560-B-110/120/130/140			
Frequency Range		DC to 25.6 kHz						
A/D Conversion		24-bit			2 × 24-bit			
Data Transfer		24-bit 16-bit selectable						
Input Voltage Range		8 ranges: 7.071 mV <sub>peak</sub> to 7.07 V <sub>peak</sub> in 10 dB steps <sup>a</sup> , + 12 V <sub>peak</sub>			1 range: 10 V <sub>peak</sub>			
Input Signal Ground Coupling		Floating or single-ended (grounded to chassis)						
Input Impedance		Direct, Microphone: 1 MΩ    <200 pF CCLD: > 100 kΩ    <200 pF						
Absolute Maximum Input		±35 V <sub>peak</sub> without damage						
High-pass Filters		DC (f <sub>L</sub> = 0)						
		-0.1 dB	-10%	-3 dB	Slope	-10%	-3 dB	Slope
		0.7 Hz high-pass filter	0.15 Hz	0.073 Hz	-20 dB/dec.	0.15 Hz	0.073 Hz	-20 dB/dec.
		7 Hz digital high-pass filter	1.45 Hz	0.707 Hz	-20 dB/dec.	1.45 Hz	0.707 Hz	-20 dB/dec.
		22.4 Hz high-pass filter	14.64 Hz	11.5 Hz	-60 dB/dec.	14.64 Hz	11.5 Hz	-60 dB/dec.
		Intensity filter	23.00 Hz	11.2 Hz	-20 dB/dec.	23.00 Hz	11.2 Hz	-20 dB/dec.
Absolute Amplitude Precision, 1 kHz, 1 V <sub>input</sub>		±0.05 dB, typical ±0.01 dB						
Attenuator Linearity @ 1 kHz		±0.05 dB, typ. ±0.005 dB			-			
Amplitude Linearity (linearity in one range)		0 to 60 dB below full scale			±0.1 dB, typ. ±0.01 dB			±0.05 dB, typ. ±0.01 dB
		60 to 80 dB below full scale			±0.2 dB, typ. ±0.02 dB			±0.05 dB, typ. ±0.01 dB
		80 to 100 dB below full scale			typ. ±0.05 dB			±0.2 dB, typ. ±0.02 dB
		100 to 120 dB below full scale			-			typ. ±0.02 dB
		120 to 140 dB below full scale			-			typ. ±0.02 dB
		140 to 160 dB below full scale			-			typ. ±1 dB
Overall Frequency Response re 1 kHz, lower limit f <sub>L</sub> to upper limit f <sub>U</sub>		DC to max. 25.6 kHz: ±0.1 dB						
Noise: Measured lin. 10 Hz to 25.6 kHz: μV <sub>rms</sub> (input terminated by 50 Ω or less)		Input Range	Guaranteed	Typical	Guaranteed	Typical		
		7.071 mV	<2.5 (<16)	2.2 (<14)	Signal level <316 mV <sub>peak</sub>			
		22.36 mV	<3 (<19)	2.2 (<14)				
		70.71 mV	<4 (<25)	2.5 (<16)	<4 (<25)	3 (<19)		
(Values in parentheses are specified in nV <sub>rms</sub> /√Hz)		223.6 mV	<6 (<38)	5.5 (<35)				
		707.1 mV	<17 (<107)	13 (<82)	Signal level >316 mV <sub>peak</sub>			
		2.236 V	<50 (<313)	33 (<207)				
		7.071 V	<150 (<940)	100 (<625)	<60 (<375)	50 (<313)		
		12 V	<250 (<1570)	150 (<940)				
Spurious-free Dynamic Range (dB) re full scale input (input terminated by 50 Ω or less)		Input Range	Typical		Typical			
		7.071 mV	110 dB		160 dB			
		22.36 mV	110 dB					
		70.71 mV	120 dB					
		223.6 mV	130 dB					
		707.1 mV	130 dB					
		2.236 V	130 dB					
		7.071 V	130 dB					
		12 V	130 dB					
DC Offset re full scale		Guaranteed	Typical	Guaranteed	Typical			
		<-60 dB	-80 dB	<-60 dB	-80 dB			
Harmonic Distortion (all harmonics)		Guaranteed	Typical	Guaranteed	Typical			
		All Ranges		Guaranteed	Typical			
		-80 dB	-100 dB @ 1 kHz	-80 dB	-100 dB @ 1 kHz			

a In rare cases in CCLD mode or when measuring signals with a high DC level in the 7 mV<sub>peak</sub> and 22.36 mV<sub>peak</sub> ranges with 0.7 Hz or 7 Hz high-pass filter settings, an overload might be indicated. If this occurs, increase the input voltage range.

## Specifications – Input Channels, Standard 24-bit and Dyn-X (continued)

		Standard 24-bit 7537/37-A/39/39-A, 3038/38-B/39/39-B 3560-B-010/020/030/040			Dyn-X 7538/38-A/40/40-A, 3035 (BNC/BNT) 3040/40-B/41/41-B, 3560-B-110/120/130/140		
<b>Crosstalk</b> Between any two channels of a module or between any two channels in different modules	<b>Frequency Range</b>	<b>Guaranteed</b>	<b>Typical</b>	<b>Frequency Range</b>	<b>Guaranteed</b>	<b>Typical</b>	
	0 – 25.6 kHz	–100 dB	–140 dB	0 – 25.6 kHz	–100 dB	–140 dB	
<b>Channel-to-Channel Match (same input range)</b>	<b>Guaranteed</b>		<b>Typical</b>	<b>Guaranteed</b>		<b>Typical</b>	
	Maximum Gain Difference		0.2 dB from lower frequency limit, $f_L$ , to upper limit, $f_U$	±0.01 dB	0.1 dB from lower frequency limit, $f_L$ , to upper limit, $f_U$		±0.01 dB
Maximum Phase Difference (within one frame)		1.2° – 0.1° × (f/ $f_L$ ) from $f_L$ to 10 × $f_L$ (not valid for DC setting); 0.2° from 10 × $f_L$ to 1280 Hz (valid for DC setting); 0.1° + 0.1° × (f/1280) from 1280 Hz to 25.6 kHz		1.2° – 0.1° × (f/ $f_L$ ) from $f_L$ to 10 × $f_L$ (not valid for DC setting) 0.2° from 10 × $f_L$ to 6.4 kHz (valid for DC setting) 0.1° + 0.1° × (f/640) from 6.4 kHz to 25.6 kHz			
<b>Channel-to-Channel Match (any input range)</b>	<b>Guaranteed</b>		<b>Typical</b>	-			
	Maximum Gain Difference		0.2 dB from lower frequency limit, $f_L$ , to upper limit, $f_U$				±0.01 dB
Maximum Phase Difference (within one frame)		1.2° – 0.1° × (f/ $f_L$ ) from $f_L$ to 10 × $f_L$ (not valid for DC setting); 0.2° from 10 × $f_L$ to 640 Hz (valid for DC setting); 0.1° + 0.1° × (f/640) from 640 Hz to 6.4 kHz					
<b>Sound Intensity Phase Match (only for using intensity filter)</b>	Complies with IEC 1043 standard Class 1 and ANSI S1.12–1995 Class 1 using Brüel & Kjær Sound Intensity Probes (0.017° @ 50 Hz)						
	<b>Channels Matched</b>	7537, 7539: 4 and 5 3039, 3039B: 5 and 6 3038, 3038B: 5 and 6, 11 and 12			All channels		
		From 2005: All channels					
	<b>Frequency Range</b>	<b>Guaranteed Phase Match</b>	<b>Typical Phase Match</b>	<b>Guaranteed Phase Match</b>	<b>Typical Phase Match</b>		
	50 Hz – 250 Hz	±0.017°	±0.005°	±0.017°	±0.005°		
	250 Hz – 2.5 kHz	0.017° × (f/250)	±0.005°	0.017° × (f/250)	±0.005°		
	2.5 kHz – 6.4 kHz	±0.17°	±0.08°	±0.17°	±0.08°		
<b>Common Mode Rejection</b>	<b>Guaranteed</b>		<b>Typical</b>	<b>Guaranteed</b>		<b>Typical</b>	
	0 – 120 Hz		70 dB	80 dB	70 dB		80 dB
	120 Hz – 1 kHz		55 dB	60 dB	55 dB		60 dB
	1 kHz – 25.6 kHz		30 dB	40 dB	30 dB		40 dB
<b>Absolute Max. Common Mode Voltage</b>	±5 V <sub>peak</sub> without damage						
	±3 V <sub>peak</sub> without clipping						
	If common mode voltage exceeds the max. value, care must be taken to limit the signal ground current in order to prevent damage. Maximum is 100 mA. The instrument will limit the voltage to the stated max. "without damage" common mode value						
<b>Anti-aliasing Filter</b> At least 90 dB attenuation of those frequencies which can cause aliasing	<b>Filter Type</b>	3rd order Butterworth					
	–0.1 dB @	25.6 kHz					
	–3 dB @	100 kHz					
	<b>Slope</b>	–18 dB/octave					
<b>Supply for Microphone Preamplifiers</b>	±14.0 V, 10 mA per channel (max. 20 mA if only 1 to 3 channels used)						
<b>Supply for Microphone Polarization</b>	200 V ±1 V, or 0 V						
<b>Supply for DeltaTron/ICP®/CCLD</b>	4 mA from 24 V source						
	If any DeltaTron/ICP®/CCLD-coupled channel is paralleled with another channel, this must also be DeltaTron/ICP®/CCLD-coupled. Otherwise the signal might be clipped by the paralleled channel						
<b>Tacho Supply (on BNT connectors)</b>	6.5V, max. 100 mA						
<b>Analog Special Functions</b>	<b>Microphone Charge Injection Calibration:</b> All modules with 7-pin LEMO support CIC via dedicated application software and OLE interface <b>Analog Self-test:</b> Functional Check <b>Transducers:</b> Supports IEEE 1451.4 capable transducers with standardised TEDS						
<b>Overload Detection<sup>b</sup></b>	<b>Signal overload</b> <b>CCLD overload:</b> Detection of cable break or short-circuit + detection of CCLD transducer working point fault <b>Microphone preamplifier overload:</b> Detection of microphone preamplifier current consumption too high or too low <b>Common mode voltage overload</b>						

<sup>b</sup> In Direct AC mode, care must be taken when measuring signals with a very high DC component – a DC + AC level exceeding approximately 12 V can be clipped and an overload will **not** be indicated

**Specifications – Charge Input Channels, Dyn-X** (all specifications for transducer capacitance = 1 nF)

		Dyn-X 3035 (TNC Charge Inputs) <sup>a</sup>		
<b>Frequency Range</b>		0.1 Hz to 25.6 kHz		
<b>A/D Conversion</b>		2 × 24-bit		
<b>Data Transfer</b>		24-bit		
<b>Input Range</b>		2 ranges: 10 nC <sub>peak</sub> /1 nC <sub>peak</sub>		
<b>Input Signal Ground Coupling</b>		Floating or single-ended (grounded to chassis)		
<b>Absolute Maximum Input</b>		±300 nC <sub>peak</sub> without damage		
<b>High-pass Filters<sup>b</sup></b>		Not available		
DC (f <sub>L</sub> = 0)				
-10%		-10%	-3 dB	Slope
0.1 Hz high-pass filter		0.1 Hz	0.065 Hz	-40 dB/dec.
1 Hz high-pass filter		1.0 Hz	0.65 Hz	-40 dB/dec.
10 Hz high-pass filter		10.0 Hz	7.88 Hz	-60 dB/dec.
30 Hz high-pass filter		30.0 Hz	23.63 Hz	-40 dB/dec.
<b>Low-pass Filters</b>		-10%	-3 dB	Slope
100 Hz low-pass filter		100 Hz	143 Hz	-40 dB/dec.
1 kHz low-pass filter		1.0 kHz	1.43 kHz	-40 dB/dec.
3 kHz low-pass filter		3.0 kHz	4.31 kHz	-40 dB/dec.
10 kHz low-pass filter		10.0 kHz	14.3 kHz	-40 dB/dec.
30 kHz low-pass filter		30.0 kHz	43.1 kHz	-40 dB/dec.
low-pass filter bypassed		See Anti-aliasing Filter		
<b>Absolute Amplitude Precision, 1 kHz, 1 V<sub>input</sub></b>		±0.05 dB, typ. ±0.01 dB		
<b>Attenuator Linearity @ 1 kHz</b>		±0.05 dB, typ. ±0.005 dB		
<b>Amplitude Linearity (linearity in one range)</b>		±0.05 dB, typ. ±0.01 dB		
0 to 60 dB below full scale		±0.05 dB, typ. ±0.01 dB		
60 to 80 dB below full scale		±0.05 dB, typ. ±0.01 dB		
80 to 100 dB below full scale		±0.2 dB, typ. ±0.02 dB		
100 to 120 dB below full scale		typ. ±0.02 dB		
120 to 140 dB below full scale		typ. ±0.02 dB		
140 to 160 dB below full scale		typ. ±1 dB		
<b>Overall Frequency Response re 1 kHz, lower limit f<sub>L</sub> to upper limit f<sub>U</sub></b>		Min. 0.1 Hz to max. 25.6 kHz: ±0.1 dB, -10% at f <sub>L</sub> and f <sub>U</sub>		
<b>Noise:</b>		<b>Input Range</b>	<b>Signal Level</b>	<b>Guaranteed</b>
<b>Measured lin. 10 Hz to 25.6 kHz:</b> fC <sub>rms</sub> (input terminated by 1 nF)  (Values in parentheses are specified in aC <sub>rms</sub> /√Hz [a = 10 <sup>-18</sup> ])		1 nC	<316 pC <sub>peak</sub>	<5 (<32)
		1 nC	>316 pC <sub>peak</sub>	<15 (<94)
		10 nC	<3160 pC <sub>peak</sub>	<15 (<94)
		10 nC	>3160 pC <sub>peak</sub>	<65 (<407)
<b>Spurious-free Dynamic Range (dB) re full scale input (input terminated by 1 nF)</b>		<b>Input Range</b>	<b>Typical</b>	
		1 nC <sub>peak</sub>	140 dB	
		10 nC <sub>peak</sub>	150 dB	
<b>DC Offset re full scale</b>		Not applicable		
<b>Harmonic Distortion (all harmonics, all ranges)</b>		<b>Guaranteed</b>		<b>Typical</b>
		-80 dB		-100 dB @ 1 kHz
<b>Crosstalk</b> Between any two channels of a module or between any two channels in different modules		<b>Frequency Range</b>	<b>Guaranteed</b>	<b>Typical</b>
		0 – 25.6 kHz	-96 dB	-120 dB
<b>Channel-to-Channel Match (same input range)<sup>b</sup></b>		<b>Guaranteed</b>		<b>Typical</b>
Maximum Gain Difference		0.1 dB from 3 × lower frequency limit, f <sub>L</sub> , to 1/3 upper limit, f <sub>U</sub> 0.8 dB at f <sub>L</sub> , 0.4 dB at f <sub>U</sub>		±0.01 dB
Maximum Phase Difference (within one frame)		0.4° from 10 × f <sub>L</sub> to 0.1 × f <sub>U</sub> 0.2° + 2° × (f/f <sub>U</sub> ) from 0.1 × f <sub>U</sub> to f <sub>U</sub>  For f <sub>L</sub> = 10 Hz or 30 Hz: 1.4° - 0.1° × (f/f <sub>L</sub> ) from f <sub>L</sub> to 10 × f <sub>L</sub> For f <sub>L</sub> = 0.1 Hz or 1 Hz: 5.4° - 0.5° × (f/f <sub>L</sub> ) from f <sub>L</sub> to 10 × f <sub>L</sub>		

**Specifications – Charge Input Channels, Dyn-X (continued)** (all specifications for transducer capacitance = 1 nF)

		Dyn-X 3035 (TNC Charge Inputs) <sup>a</sup>	
Channel-to-Channel Match (any input range) <sup>b</sup>		Guaranteed	Typical
	Maximum Gain Difference	0.2 dB from $3 \times$ lower frequency limit, $f_L$ , to $1/3$ upper limit, $f_U$ 1 dB at $f_L$ , 0.5 dB at $f_U$	$\pm 0.02$ dB
	Maximum Phase Difference (within one frame)	0.4° from $10 \times f_L$ to $0.1 \times f_U$ 0.2° + $2^\circ \times (f/f_U)$ from $0.1 \times f_U$ to $f_U$  For $f_L = 10$ Hz or 30 Hz: $1.4^\circ - 0.1^\circ \times (f/f_L)$ from $f_L$ to $10 \times f_L$ For $f_L = 0.1$ Hz or 1 Hz: $5.4^\circ - 0.5^\circ \times (f/f_L)$ from $f_L$ to $10 \times f_L$	
Common Mode Rejection		Guaranteed	Typical
	0 – 120 Hz	50 dB	55 dB
	120 Hz – 1 kHz	50 dB	55 dB
	1 kHz – 25.6 kHz	40 dB	50 dB
Absolute Max. Common Mode Voltage		$\pm 5 V_{\text{peak}}$ without damage	
		$\pm 3 V_{\text{peak}}$ without clipping	
		If common mode voltage exceeds the max. value, care must be taken to limit the signal ground current in order to prevent damage. Maximum is 100 mA. The instrument will limit the voltage to the stated max. "without damage" common mode value	
Anti-aliasing Filter		Filter Type	
At least 90 dB attenuation of those frequencies which can cause aliasing		3rd order Butterworth	
	–0.1 dB @	25.6 kHz	
	–3 dB @	100 kHz	
	Slope	–18 dB/octave	
Tacho Supply (on BNT connectors)		–	
Analog Special Functions		Analog Self-test: Functional Check	
Overload Detection <sup>c</sup>		Signal overload Common mode voltage overload DC servo out of range	

a. For CCLD and AC inputs see "Specifications – Input Channels, Standard 24-bit and Dyn-X" on page 14

b. For specifications with 0.7, 7 and 22.4 Hz high-pass filters, see the corresponding specifications for BNC/BNT Dyn-X channels

c. **Note:** All overloads in charge mode are indicated as "signal overload"

**Specifications – Input Channels, Types 3109 and 3110**

		3109			3110		
Frequency Range		DC to 25.6 kHz			DC to 25.6 kHz	DC to 204.8 kHz	
A/D Conversion		16-bit			24-bit	16-bit for frequency range > 25.6 kHz	
Data Transfer		16-bit			24-bit 16-bit selectable	16-bit	
Input Voltage Range		7 ranges: $7.071 mV_{\text{peak}}$ to $7.071 V_{\text{peak}}$ in 10 dB steps			8 ranges: $7.071 mV_{\text{peak}}$ to $22.34 V_{\text{peak}}$ in 10 dB steps		
Input Signal Ground Coupling		Floating with $100 \Omega$ to chassis			Floating or single-ended (grounded to chassis)		
Input Impedance		Direct, Microphone: $1 M\Omega    < 200 pF$					
		CCLD: $> 100 k\Omega    < 200 pF$					
Absolute Maximum Input		$\pm 50 V_{\text{peak}}$ ( $\pm 30 V$ DC) without damage			$\pm 35 V_{\text{peak}}$ without damage		
High-pass Filters		DC ( $f_L = 0$ )					
	–0.1 dB	–10%	–3 dB	Slope	–10%	–3 dB	Slope
	0.7 Hz high-pass filter	0.15 Hz	0.073 Hz	–20 dB/dec.	0.15 Hz	0.073 Hz	–20 dB/dec.
	7 Hz digital high-pass filter	1.45 Hz	0.707 Hz	–20 dB/dec.	1.45 Hz	0.707 Hz	–20 dB/dec.
	22.4 Hz high-pass filter	14.64 Hz	11.5 Hz	–60 dB/dec.	14.64 Hz	11.5 Hz	–60 dB/dec.
	Intensity filter	23.00 Hz	11.2 Hz	–20 dB/dec.	23.00 Hz	11.2 Hz	–20 dB/dec.
Absolute Amplitude Precision, 1 kHz, $1 V_{\text{input}}$		$\pm 0.1$ dB			$\pm 0.05$ dB, typ. $\pm 0.005$ dB		
Attenuator Linearity @ 1 kHz		$\pm 0.1$ dB			$\pm 0.05$ dB, typ. $\pm 0.005$ dB		

## Specifications – Input Channels, Types 3109 and 3110 (continued)

	3109		3110					
<b>Amplitude Linearity (linearity in one range)</b>	0 to 40 dB below full scale	±0.1 dB	–					
	40 to 60 dB below full scale	±0.4 dB	–					
	0 to 60 dB below full scale	–	±0.1 dB, typ. ±0.01 dB					
	60 to 80 dB below full scale	±1 dB	±0.2 dB, typ. ±0.02 dB					
	80 to 100 dB below full scale	–	typ. ±0.05 dB					
<b>Overall Frequency Response re 1 kHz, <math>f_L</math> to <math>f_U</math></b>	DC to max. 25.6 kHz ±0.1 dB		DC to max. 204.8 kHz ±0.1 dB, $f_L$ to 25.6 kHz +0.1/–0.2 dB, $f_L$ to 102.4 kHz +0.1/–0.5 dB, $f_L$ to 204.8 kHz					
<b>Noise: <math>\mu V_{rms}</math></b> (input terminated by 50 $\Omega$ or less)  (Values in parentheses are specified in nV/√Hz)	<b>Input Range</b>	<b>Measured lin. 10 Hz to 25.6 kHz</b>	<b>Measured lin. 10 Hz to 25.6 kHz</b>		<b>Measured lin. 10 Hz to 204.8 kHz</b>			
			<b>24-bit ADC</b>		<b>16-bit ADC</b>		<b>16-bit ADC</b>	
		<b>Guaranteed</b>	<b>Guar.</b>	<b>Typ.</b>	<b>Guar.</b>	<b>Typ.</b>	<b>Guar.</b>	<b>Typ.</b>
	7.071 mV	3 (19)	2 (12.5)	1.5 (10)	2 (12.5)	1.5 (10)	6 (13)	4 (9)
	22.36 mV	3 (19)	2 (12.5)	1.5 (10)	2 (12.5)	1.5 (10)	6 (13)	4 (9)
	70.71 mV	5 (32)	2.5 (16)	1.7 (11)	4 (25)	2 (12.5)	10 (22)	6 (13)
	223.6 mV	10 (63)	5 (32)	2.5 (16)	10 (63)	5 (32)	20 (125)	12 (75)
	707.1 mV	31 (194)	10 (63)	5 (32)	31 (194)	16 (113)	60 (375)	30 (188)
	2.236 V	100 (625)	30 (188)	15 (94)	100 (625)	50 (313)	180 (1125)	125 (781)
	7.071 V	316 (1980)	100 (625)	45 (282)	300 (1875)	150 (938)	500 (3125)	400 (2500)
22.4 V	–	300 (1875)	150 (938)	900 (5625)	500 (3125)	1500 (9375)	1200 (7500)	
<b>Spurious-free Dynamic Range (dB) re full scale input</b> (input terminated by 50 $\Omega$ or less)	<b>Input Range</b>	<b>Guaranteed</b>	<b>DC to 25.6 kHz</b>		<b>DC to 204.8 kHz</b>			
			<b>Guaranteed</b>		<b>Typ.</b>		<b>Guaranteed</b>	
			7.071 mV	80 dB or <1 $\mu V$ , whichever is greater	90 dB	95 dB	90 dB	
			22.36 mV		90 dB	110 dB	90 dB	
			70.71 mV		90 dB	120 dB	90 dB	
			223.6 mV		90 dB	120 dB	90 dB	
			707.1 mV		90 dB	120 dB	90 dB	
			2.236 V		90 dB	120 dB	90 dB	
			7.071 V		90 dB	120 dB	90 dB	
22.4 V	–	90 dB	120 dB		90 dB			
<b>DC Offset re full scale</b>	<b>Guaranteed</b>		<b>Guaranteed</b>		<b>Typical</b>			
	<–60 dB		<–60 dB		–80 dB			
<b>Harmonic Distortion (all harmonics)</b>	<b>Guaranteed</b>		<b>DC to 25.6 kHz</b>		<b>DC to 204.8 kHz</b>			
	<b>All Ranges</b>		<b>Guaranteed</b>		<b>Typ.</b>			
	–80 dB or <1 $\mu V$ , whichever is greater		<b>7 mV to 7 V Ranges</b>					
			–90 dB	–96 dB	–75 dB	–90 dB		
			<b>22 V Range</b>					
		–70 dB	–80 dB	–70 dB	–80 dB			
<b>Crosstalk</b> Between any two channels of a module or between any two channels in different modules	<b>Frequency Range</b>	<b>7 mV – 7 V Input Range</b>	<b>Frequency Range</b>	<b>7 mV – 7 V Input Range</b>	<b>22 V Input Range</b>			
	0 – 2 kHz	–100 dB	0 – 2 kHz	–130 dB	–90 dB			
	2 – 12.8 kHz	–85 dB	2 – 12.8 kHz	–120 dB	–90 dB			
	12.8 – 25.6 kHz	–80 dB	12.8 – 25.6 kHz	–110 dB	–90 dB			
			25.6 – 102.4 kHz	–100 dB	–90 dB			
		102.4 – 204.8 kHz	–90 dB	–80 dB				

## Specifications – Input Channels, Types 3109 and 3110 (continued)

	3109		3110		
<b>Channel-to-Channel Match (same input range)</b>	<b>Guaranteed</b>	<b>Typical</b>	<b>Guaranteed</b>	<b>Typical</b>	
	0.2 dB from lower frequency limit, $f_L$ , to upper limit, $f_U$	–	0.1 dB from lower frequency limit, $f_L$ , to upper limit, $f_U$	<0.01 dB	
Maximum Gain Difference					
Maximum Phase Difference (within one frame)	$1.2^\circ - 0.1^\circ \times (f/f_L)$ from $f_L$ to $10 \times f_L$ (not valid for DC setting); 0.2° from $10 \times f_L$ to 1280 Hz (valid for DC setting); $0.1^\circ + 0.1^\circ \times (f/1280)$ from 1280 Hz to 25.6 kHz		$1.2^\circ - 0.1^\circ \times f/f_L$ from $f_L$ to $10 \times f_L$ (~1.1° at $f_L$ and 0.2° at $10 \times f_L$ ) (not valid for DC setting); 0.2° from $10 \times f_L$ to 6400 Hz (valid for DC setting); $0.4^\circ \times f / 6.4 \text{ kHz} - 0.2^\circ$ from 6.4 kHz to 204.8 kHz (~1.4° at 25.6 kHz, 6.2° at 102.4 kHz and 12.6° at 204.8 kHz)		
<b>Channel-to-Channel Match (any input range)</b>	<b>Guaranteed</b>	<b>Typical</b>	<b>Guaranteed</b>	<b>Typical</b>	
	0.2 dB from lower frequency limit, $f_L$ , to upper limit, $f_U$	–	0.1 dB from lower frequency limit, $f_L$ , to upper limit, $f_U$	<0.05 dB	
Maximum Gain Difference					
Maximum Phase Difference (within one frame)	$1.2^\circ - 0.1^\circ \times (f/f_L)$ from $f_L$ to $10 \times f_L$ (not valid for DC setting); 0.2° from $10 \times f_L$ to 640 Hz (valid for DC setting); $0.1^\circ + 0.1^\circ \times (f/640)$ from 640 Hz to 6.4 kHz		$1.2^\circ - 0.1^\circ \times f/f_L$ from $f_L$ to $10 \times f_L$ (~1.1° at $f_L$ and 0.2° at $10 \times f_L$ ) (not valid for DC setting); 0.2° from $10 \times f_L$ to 6400 Hz (valid for DC setting); $0.8^\circ \times f / 6.4 \text{ kHz} - 0.6^\circ$ from 6.4 kHz to 204.8 kHz (~2.6° at 25.6 kHz, 12.2° at 102.4 kHz and 25° at 204.8 kHz)		
<b>Sound Intensity Phase Match (only for using intensity filter)</b>	Complies with IEC 1043 standard Class 1 and ANSI S1.12–1995 Class 1 using Brüel & Kjær Sound Intensity Probes (0.017° @ 50 Hz)				
<b>Channels Matched</b>	3 and 4		1 and 2		
<b>Frequency Range</b>	<b>Guaranteed Phase Match</b>		<b>Guaranteed Phase Match</b>	<b>Typical Phase Match</b>	
50 Hz – 250 Hz	$\pm 0.017^\circ$		$\pm 0.017^\circ$	$\pm 0.005^\circ$	
250 Hz – 2.5 kHz	$0.017^\circ \times (f/250)$		$0.017^\circ \times (f/250)$	$\pm 0.005^\circ$	
2.5 kHz – 6.4 kHz	$\pm 0.17^\circ$		$\pm 0.17^\circ$	$\pm 0.08^\circ$	
<b>Common Mode Rejection</b>	<b>Guaranteed</b>		<b>7 mV – 7 V Input Range</b>		
			<b>Guaranteed</b>	<b>Typical</b>	<b>22 V Input Range</b>
	<b>Typical</b>		<b>Typical</b>		
	0 – 120 Hz	40 dB, 50 dB at DC		70 dB	80 dB
120 Hz – 1 kHz	40 dB		55 dB	60 dB	50 dB
1 kHz – 25.6 kHz			30 dB	40 dB	40 dB
<b>Absolute Max. Common Mode Voltage</b>	$\pm 15 V_{\text{peak}}$ without damage		$\pm 5 V_{\text{peak}}$ without damage		
	$\pm 1.5 V_{\text{peak}}$ without clipping		$\pm 3 V_{\text{peak}}$ without clipping		
	If common mode voltage exceeds the max. value, care must be taken to limit the signal ground current in order to prevent damage. Maximum is 100 mA. The instrument will limit the voltage to the stated max. "without damage" common mode value				
<b>Anti-aliasing Filter</b> At least 90 dB attenuation of those frequencies which can cause aliasing	<b>Filter Type</b>	3rd order Butterworth		<b>Freq. Range <math>\leq 25.6 \text{ kHz}</math></b>	<b>Freq. Range <math>&gt; 25.6 \text{ kHz}</math></b>
	–0.1 dB @	25.6 kHz		25.6 kHz	102.4 kHz
	–3 dB @	100 kHz		100 kHz	400 kHz
	Slope	–18 dB/octave		–18 dB/octave	
<b>Supply for Microphone Preamplifiers</b>	$\pm 15.0 \text{ V}$ , max. 10 mA per channel		$\pm 14.0 \text{ V}$ , max. 20 mA per channel		
<b>Supply for Microphone Polarization</b>	200 V $\pm 1 \text{ V}$ , or 0 V				
<b>Supply for DeltaTron/ICP®/CCLD</b>	4 mA from 24 V source				
<b>Tacho Supply</b> (on BNT connectors)	6.5 V, max. 100 mA				
<b>Analog Special Functions</b>	<b>Microphone Charge Injection Calibration</b> (depending on software support) <b>Analog Self-test:</b> Functional Check <b>Transducers:</b> Supports IEEE 1451.4 capable transducers with standardised TEDS				
<b>Overload Detection</b>	<b>Signal overload</b> <b>CCLD overload:</b> Detection of cable break or short-circuit + detection of CCLD transducer working point fault <b>Microphone preamplifier overload:</b> Detection of microphone preamplifier current consumption too high or too low <b>Common mode voltage overload</b> (Type 3110 only)				

## Specifications – Output Channels, Standard 24-bit and Dyn-X

	Standard 24-bit 7537/37-A/39/39-A		Dyn-X 7538/38-A/40/40-A	
Output Connector	1 × BNC			
Output Coupling	DC			
Signal Ground Coupling	Floating or grounded to chassis			
DA Conversion	24-bit			
DC Offset	≤1 mV @ 25°C and ≤10 mV @ full temperature range (–60 dB re max. output)			
Output Voltage Range	1 μV <sub>peak</sub> – 7 V <sub>peak</sub>			
Output Impedance	50 Ω			
Frequency Range	0 Hz – 25.6 kHz			
Frequency Response re 1 kHz	±0.1 dB, 1 mHz to 25.6 kHz			
Frequency Accuracy	0.0025%			
Waveform	7537, 7537 A	7539, 7539 A	7538, 7538 A	7540, 7540 A
	Sine only	Software determined Arbitrary waveforms up to 2 Msamples	Sine only	Software determined Arbitrary waveforms up to 2 Msamples
Amplitude Linearity @ 1 kHz 0 to 60 dB below full scale 60 to 100 dB below full scale	<b>Typical</b>			
	±0.1 dB			
	±0.2 dB			
Noise μV <sub>rms</sub> (nV/√Hz)	<b>Guaranteed</b>	<b>Typical</b>	<b>Guaranteed</b>	<b>Typical</b>
	<30 (<188)	20 (125)	<30 (<188)	20 (125)
Harmonic and Spurious Distortion Products 0 – 25.6 kHz	< 80 dB re full range output or 1 μV, whichever is greater		< 80 dB re full range output or 1 μV, whichever is greater	
Absolute Amplitude Precision @ 23°C, 1 kHz, 1 V <sub>rms</sub>	<b>Guaranteed</b>		<b>Guaranteed</b>	
	±0.1 dB		±0.1 dB	
Crosstalk between any generator output and any channel on any module 0 – 2 kHz 2 kHz – 25.6 kHz	<b>Guaranteed</b>	<b>Typical</b>	<b>Guaranteed</b>	<b>Typical</b>
	–100 dB	–114 dB	–100 dB	–114 dB
	–85 dB	–110 dB	–85 dB	–110 dB
Common Mode Rejection 1 Hz – 1 kHz	<b>Guaranteed</b>		<b>Guaranteed</b>	
	60 dB		60 dB	
Max. Common Mode Voltage	5 V <sub>peak</sub> , DC – 80 MHz			
	If common mode voltage exceeds the max. value, care must be taken to limit the signal ground current in order to prevent damage. Maximum is 100 mA. The instrument will limit the voltage to the stated max. “without damage” common mode value			
Reconstruction Filter Type Attenuation of mirror frequencies	Sixth order Butterworth			
	>80 dB			

## Specifications – Output Channels, Types 3109 and 3110

	3109	3110	
Output Connector	2 × BNC	1 × BNC	
Output Coupling	DC		
Signal Ground Coupling	Floating or grounded to chassis		
DA Conversion	24-bit		
DC Offset	–	<b>Output Level</b>	<b>DC Offset</b>
		7 mV <sub>peak</sub> – 70 mV <sub>peak</sub>	100 μV
		70 mV <sub>peak</sub> – 700 mV <sub>peak</sub>	100 μV
		700 mV <sub>peak</sub> – 7 V <sub>peak</sub>	1 mV
Output Voltage Range	7 μV <sub>peak</sub> – 7 V <sub>peak</sub>	1 μV <sub>peak</sub> – 7 V <sub>peak</sub>	
Output Impedance	50 Ω		
Frequency Range	0 Hz – 25.6 kHz	0 Hz – 102.4 kHz	
Frequency Response re 1 kHz	±0.1 dB, 1 mHz to 25.6 kHz	±0.1 dB, 1 mHz – 25.6 kHz +0.1/–0.3 dB, 1 mHz – 102.4 kHz Typical: ±0.05 dB	
Frequency Accuracy	0.0025%		
Waveform	Software determined. Arbitrary waveforms up to 2 Msamples		

## Specifications – Output Channels, Types 3109 and 3110 (continued)

		3109	3110				
<b>Amplitude Linearity @ 1 kHz</b>		<b>Guaranteed</b>	<b>Guaranteed</b>		<b>Typical</b>		
	0 to 60 dB below full scale	±0.1 dB	±0.1 dB		±0.05 dB		
	60 to 100 dB below full scale	±0.2 dB	±0.2 dB		±0.1 dB		
	100 to 120 dB below full scale	±0.5 dB	±0.5 dB		±0.2 dB		
	120 to 140 dB below full scale	±1.0 dB	±1.0 dB		±0.5 dB		
<b>Noise</b> $\mu\text{V}_{\text{rms}}$ ( $\text{nV}/\sqrt{\text{Hz}}$ )	<b>Output Level</b>	<b>(10 Hz – 25.6 kHz)</b> <b>Guaranteed</b>	<b>(10 Hz – 25.6 kHz)</b> <b>Guaranteed</b>		<b>(10 Hz – 204.8 kHz)</b> <b>Guaranteed</b>		
			<b>Typ.</b>		<b>Typ.</b>		
	7 $\text{mV}_{\text{peak}}$ – 70 $\text{mV}_{\text{peak}}$	3 (19)	3 (19)	2.5 (16)	15 (34)	9 (20)	
	70 $\text{mV}_{\text{peak}}$ – 700 $\text{mV}_{\text{peak}}$	20 (125)	10 (63)	5 (32)	50 (111)	20 (45)	
	700 $\text{mV}_{\text{peak}}$ – 7 $\text{V}_{\text{peak}}$	200 (1250)	50 (313)	30 (188)	300 (664)	100 (222)	
<b>Harmonic and Spurious Distortion Products</b>	0 – 25.6 kHz	< 80 dB re full range output or 1 $\mu\text{V}$ , whichever is greater	< 80 dB re full range output or 1 $\mu\text{V}$ , whichever is greater, at 10 k $\Omega$ load				
	25.6 – 102.4 kHz	–	< 70 dB re full range output or 1 $\mu\text{V}$ , whichever is greater				
	Typical @ 1 kHz		100 dB re full range output				
<b>Absolute Amplitude Precision</b>		<b>Guaranteed</b>	<b>Guaranteed</b>		<b>Typical</b>		
	@ 23°C, 1 kHz, 1 $\text{V}_{\text{rms}}$	±0.05 dB	±0.05 dB		±0.005 dB		
	@ 1 kHz, 1 mV – 7 $\text{V}_{\text{peak}}$	±0.1 dB	±0.1 dB		±0.05 dB		
<b>Crosstalk</b> between generator output and any channel on any module		<b>Guaranteed</b>	<b>Guaranteed</b>		<b>Typical</b>		
	0 – 2 kHz	–100 dB	–		–		
	2 kHz – 25.6 kHz	–85 dB	–		–		
	0 – 102.4 kHz	–	–120 or better than –90 dB re max. input voltage whichever is greater (worse)		–150 dB		
<b>Common Mode Rejection</b>		<b>Guaranteed</b>	<b>Guaranteed</b>		<b>Typical</b>		
	1 Hz – 1 kHz	50 dB	50 dB		50 dB		
	1 kHz – 25.6 kHz	40 dB	24 dB		30 dB		
	25.6 kHz – 102.4 kHz	–	10 dB		20 dB		
<b>Max. Common Mode Voltage</b>	1 $\text{V}_{\text{peak}}$ , DC – 4 MHz 10 $\text{V}_{\text{peak}}$ , 4 MHz – 80 MHz	5 $\text{V}_{\text{peak}}$ , DC – 80 MHz					
<b>Reconstruction Filter</b>	Type	Seventh order Butterworth	Sixth order Butterworth				
	Attenuation of mirror frequencies	> 80 dB					
<b>Monitor Output</b>	Connectors	2 × BNC					
	Output Level	2.236 $\text{V}_p$ for full scale input in any range, ±0.05 dB					
	Output Impedance	50 $\Omega$					
	Harmonic Distortion	0 – 25.6 kHz: < –90 dB 25.6 kHz – 102.4 kHz: < –80 dB					
	DC Offset (Max.)	None	<b>Input Range</b>	<b>DC Offset (Max.)</b>			
			7.071 mV	150 mV			
			22.36 mV	50 mV			
			70.71 mV	15 mV			
			223.6 mV	5 mV			
			707.1 mV	1.5 mV			
			2.236 V	0.5 mV			
			7.071 V	0.5 mV			
	22.36 V	0.5 mV					
Signal Output	From last amplifier before anti-aliasing filter, but after analog high-pass filters						

**Specifications – Controller Modules Types 7536, 7537, 7537-A, 7538, 7538-A, 7539, 7539-A, 7540, 7540-A and 5-channel PULSE Data Acquisition Units 3560-B-010, -020, -030, -040, -110, -120, -130, -140**

**LAN Interface**

**CONNECTOR**

RJ45 (10baseT/100baseTX) connector complying with IEEE–802.3 100baseX

**PROTOCOL**

TCP/IP

**ACQUISITION PERFORMANCE**

**Data Transfer Rate (No. of Channels × Bandwidth) from Front-end via LAN Interface, per frame:**

16- and 24-bit modules/channels can be mixed  
460 kHz (24-bit data transfer), 700 kHz (16-bit data transfer).

This corresponds approximately to:

Upper Frequency (kHz)	No. of Channels	
	24-bit	16-bit
25.6	18	27
12.8	36	54
6.4	72	96 <sup>a</sup>

a. Theoretically, 108 channels but limited by max. number of channels in one frame

**Note:** For systems containing one or more Type 3030, 3109 or 3032, the performance will be reduced (by approximately one-third) to 400 kHz (16-bit data transfer).

100 MBit LAN can comfortably support a data transfer rate of 1200 to 1400 kHz, so for large systems with multiple frames, Gigabit LAN may be required for both PC card and Ethernet switch

**Data Transfer Rate via WLAN**

Up to 600 kHz (16-bit data transfer) for IEEE 802.11g, 54 MBit connection, dependent on local transmission conditions

**Multiframe Control**

This must only be connected to other BNC Multiframe Control Sockets in Type 7536 or 7537

**Aux**

**AUXILIARY I/O**

**Number of Input Channels:** 12<sup>a</sup>

**Input Connector:** 1 × High density 20-pole D-sub

**Sampling Rate:** 10 samples per second (no internal anti-aliasing filters)

**Input Connections:** Single-ended

**Input Voltage Ranges:** Six input ranges from 0.1 V to 31.6 V in 10 dB steps

**Input Protection:** 50 V

**Input Impedance:** 1 MΩ || < 200 pF

**Precision:**

Range	Precision
31.6 V	±0.5% of reading ±20 mV offset
10 V	±0.5% of reading ±7 mV offset
3.16 V	±0.5% of reading ±7 mV offset
1 V	±0.5% of reading ±4 mV offset
316 mV	±0.5% of reading ±2 mV offset
100 mV	±0.5% of reading ±2 mV offset

**COMPATIBILITY WITH EXISTING TYPE 7536 LAN MODULES**

Type 7536 100 MBit LAN modules, hardware version 12.0 and greater, are compatible and calibrated

Type 7536, hardware version 11.02 and serial number 2352315 – 2352340 of version 12.0, are compatible but need recalibration  
Type 7536, hardware version 11.02, will not function properly without a simple hardware modification (less than 25 units affected). There is a potential for damage if these modules are used for Auxiliary Logging without the modification

**RS–232 Interface**

**RS–232 OUTPUT**

Fulfills EIA–562 (electrical) and EIA–574 (mechanical)

**OUTPUT SUPPLY**

5 V, max. 50 mA

a. 16 input channels (12 currently supported in software) plus 2 output channels which allow simple on/off control

## Ordering Information – PULSE Systems 3560-B, 3560-C, 3560-D, 3560-E

3560-B	3560-C	3560-D	3560-E
<p>Type 3560-B: Compact PULSE  <b>Also includes the following accessories:</b></p> <ul style="list-style-type: none"> <li>ZG-0429: Mains Supply/Battery Charger</li> <li>AN-xxxx: Mains Cable for ZG-0429 (xxxx: country dependent)</li> <li>AO-0546: Power Supply Cable for in-car use</li> </ul>	<p><b>Consists of:</b>                      Type 2827: Portable Data Acquisition Unit  <b>Also includes the following accessories:</b></p> <ul style="list-style-type: none"> <li>ZG-0429: Mains Supply/Battery Charger</li> <li>AN-xxxx: Mains Cable for ZG-0429 (xxxx: country dependent)</li> <li>AO-0546: Power Supply Cable for in-car use</li> <li>DD-0552: Protection Cover</li> <li>DH-0541: Shoulder Strap</li> </ul>	<p><b>Consists of:</b>                      KK-0050: Enclosure incl. Fan Unit                      Type 2826: Power Supply  <b>Also includes the following accessories:</b></p> <ul style="list-style-type: none"> <li>ZG-0430: Mains Supply</li> <li>AN-xxxx: Mains Cable for ZG-0430 (xxxx: country dependent)</li> <li>AQ-0647: DC Supply Cable (Battery to Type 2826)</li> <li>DH-0541: Shoulder Strap</li> </ul>	<p><b>Consists of:</b>                      WU-0516: 19" Rack Mounting Kit                      Type 2826: Power Supply  <b>Also includes the following accessories:</b></p> <ul style="list-style-type: none"> <li>ZG-0434: Mains Supply</li> <li>AN-xxxx: Mains Cable for ZG-0434 (xxxx: country dependent)</li> </ul> <p><b>Requires:</b></p> <ul style="list-style-type: none"> <li>UH-1037: 19" Fan Unit (Height: 1 standard rack-mounting unit)</li> </ul>
<p><b>System Options</b></p> <p>Any PULSE software – see the System Data for PULSE software (BU 0229)</p>			
<p>5-channel PULSE Data Acquisition Units  <b>Standard</b>                      Type 3560-B-010: LEMO                      Type 3560-B-020: BNC                      Type 3560-B-030: LEMO, Generator                      Type 3560-B-040: BNC, Generator  <b>Dyn-X</b>                      Type 3560-B-110: LEMO                      Type 3560-B-120: BNC                      Type 3560-B-130: LEMO, Generator                      Type 3560-B-140: BNC, Generator</p>	<p><b>One Controller Module from:</b>  <b>Standard</b></p> <ul style="list-style-type: none"> <li>Type 7536: Controller Module</li> <li>Type 7537: 5/1-ch. Input/Output Controller Module (LEMO)</li> <li>Type 7537-A: 5/1-ch. Input/Output Controller Module (BNC)</li> <li>Type 7539: 5/1-ch. Input/Output Controller Module with Generator (LEMO)</li> <li>Type 7539-A: 5/1-ch. Input/Output Controller Module with Generator (BNC)</li> </ul> <p><b>Dyn-X</b></p> <ul style="list-style-type: none"> <li>Type 7538: 5/1-ch. Input/Output Controller Module (LEMO)</li> <li>Type 7538-A: 5/1-ch. Input/Output Controller Module (BNC)</li> <li>Type 7540: 5/1-ch. Input/Output Controller Module with Generator (LEMO)</li> <li>Type 7540-A: 5/1-ch. Input/Output Controller Module with Generator (BNC)</li> </ul>		
	<p><b>One Input/Output Module from:</b>  <b>Standard</b></p> <ul style="list-style-type: none"> <li>Type 3038: 12-ch. Input Module</li> <li>Type 3038-B: 12-ch. Input Module</li> <li>Type 3039: 6-ch. Input Module</li> <li>Type 3039-B: 6-ch. Input Module</li> <li>Type 3109: 4/2-ch. Input/Output Module</li> <li>Type 3110: 2/1-ch. Input/Output Module</li> <li>UA-1365: Blank Module</li> </ul> <p><b>Dyn-X</b></p> <ul style="list-style-type: none"> <li>Type 3035: 6-ch. Charge &amp; CCLD Input Module</li> <li>Type 3041: 6-ch. Input Module</li> <li>Type 3041-B: 6-ch. Input Module</li> <li>Type 3040: 12-ch. Input Module</li> <li>Type 3040-B: 12-ch. Input Module</li> <li>UA-1365: Blank Module</li> </ul>	<p><b>Up to Five Input/Output Modules from:</b>  <b>Standard</b></p> <ul style="list-style-type: none"> <li>Type 3038: 12-ch. Input Module</li> <li>Type 3038-B: 12-ch. Input Module</li> <li>Type 3039: 6-ch. Input Module</li> <li>Type 3039-B: 6-ch. Input Module</li> <li>Type 3109: 4/2-ch. Input/Output Module</li> <li>Type 3110: 2/1-ch. Input/Output Module</li> <li>UA-1365: Blank Module</li> </ul> <p><b>Dyn-X</b></p> <ul style="list-style-type: none"> <li>Type 3035: 6-ch. Charge &amp; CCLD Input Module</li> <li>Type 3041: 6-ch. Input Module</li> <li>Type 3041-B: 6-ch. Input Module</li> <li>Type 3040: 12-ch. Input Module</li> <li>Type 3040-B: 12-ch. Input Module</li> <li>UA-1365: Blank Module</li> </ul>	<p><b>Up to Eight Input/Output Modules from:</b>  <b>Standard</b></p> <ul style="list-style-type: none"> <li>Type 3038: 12-ch. Input Module</li> <li>Type 3038-B: 12-ch. Input Module</li> <li>Type 3039: 6-ch. Input Module</li> <li>Type 3039-B: 6-ch. Input Module</li> <li>Type 3109: 4/2-ch. Input/Output Module</li> <li>Type 3110: 2/1-ch. Input/Output Module</li> <li>UA-1365: Blank Module</li> </ul> <p><b>Dyn-X</b></p> <ul style="list-style-type: none"> <li>Type 3035: 6-ch. Charge &amp; CCLD Input Module</li> <li>Type 3041: 6-ch. Input Module</li> <li>Type 3041-B: 6-ch. Input Module</li> <li>Type 3040: 12-ch. Input Module</li> <li>Type 3040-B: 12-ch. Input Module</li> <li>UA-1365: Blank Module</li> </ul>
<p><b>Optional Accessories</b></p>			
<ul style="list-style-type: none"> <li>UA-1689: Handle for Type 3560-B</li> <li>UA-1590: Battery Charger and Holder</li> <li>(2 x) QB-0048: Battery, NiMH DR35</li> <li>AQ-0642: Power Cable between UL-0196 and Type 3560-B</li> <li>AQ-0643: Power Cable between UL-0190 and Type 3560-B</li> </ul> <p><b>Types 3560-B-010, -030, -110, -130</b></p> <ul style="list-style-type: none"> <li>AO-0090: 7-pin LEMO to BNC male (1.2m) for floating ground</li> <li>AO-0091: 7-pin LEMO to BNC female (1.2m) for floating ground</li> <li>JJ-0081: BNC Adaptor, female to female</li> </ul>	<ul style="list-style-type: none"> <li>UA-1590: Battery Charger and Holder</li> <li>(2 x) QB-0048: Battery, NiMH DR35</li> <li>UA-1556: Notebook Mounting Kit</li> <li>UA-1572: 19" Rack Mounting Kit for Type 2827</li> <li>AQ-0642: Power Cable between UL-0196 and Type 3560-C</li> <li>AQ-0643: Power Cable between UL-0190 and Type 3560-C</li> <li>KE-0439: Suitcase for Type 3560-C and PC</li> </ul>	<ul style="list-style-type: none"> <li>AQ-0642: Power Cable between UL-0196 and Type 3560-D</li> <li>AQ-0643: Power Cable between UL-0190 and Type 3560-D</li> <li>AQ-0656: Power Supply Cable with car service plug for 3560-D</li> <li>UA-1556: Notebook Mounting Kit</li> </ul>	<ul style="list-style-type: none"> <li>KQ-0155: 19" Rack Enclosure</li> <li>EA-0540: Air Guide</li> <li>UH-1037: 19" Fan Unit (Height: 1 standard rack-mounting unit)</li> </ul>
<p><b>Services</b></p>			
<ul style="list-style-type: none"> <li>3560-B-CAF: Portable PULSE Accredited Calibration</li> <li>3560-B-CAI: Portable PULSE Accredited Initial Calibration</li> <li>3560-B-CTF: Conformance test of 3560-B with certificate and measured values</li> <li>3560-B-EW1: Extended Warranty for 3560-B, one year extension</li> </ul>	<ul style="list-style-type: none"> <li>3560-C-CAF: Portable PULSE Accredited Calibration</li> <li>3560-C-CAI: Portable PULSE Accredited Initial Calibration</li> <li>3560-C-CTF: Conformance test of 3560-C with certificate and measured values</li> <li>3560-C-EW1: Extended Warranty for 3560-C, one year extension</li> </ul>	<ul style="list-style-type: none"> <li>3560-D-CAF: Portable PULSE Accredited Calibration</li> <li>3560-D-CAI: Portable PULSE Accredited Initial Calibration</li> <li>3560-D-CTF: Conformance test of 3560-D with certificate and measured values</li> <li>3560-D-EW1: Extended Warranty for 3560-D, one year extension</li> </ul>	<ul style="list-style-type: none"> <li>3560-E-CAF: Portable PULSE Accredited Calibration</li> <li>3560-E-CAI: Portable PULSE Accredited Initial Calibration</li> <li>3560-E-CTF: Conformance test of 3560-E with certificate and measured values</li> <li>3560-E-EW1: Extended warranty for 3560-E, one year extension</li> </ul>
<ul style="list-style-type: none"> <li>3560-S11: Installation and Configuration (at Brüel &amp; Kjær)</li> <li>3560-HL1: 3560 Software and Hardware Support. One year of Helpline Support</li> <li>Accredited calibration (CAF), Accredited Initial Calibration (CAI) and Conformance Test (CTF) are also available for individual input/output modules by appending the letters to the type number, for example, 3109-CTF. For further information, please contact your local Brüel &amp; Kjær representative</li> </ul>			

## ACCESSORIES FOR MODULES

7536, 7537, 7538, 7539, 7540, 7537-A, 7538-A, 7539-A, 7540-A	3035, 3038, 3039, 3040, 3041, 3038-B*, 3039-B*, 3040-B*, 3041-B*, 3109, 3110						
<b>ACCESSORIES INCLUDED</b>							
<ul style="list-style-type: none"> <li>AO-1449: LAN Interface Cable crossover with RJ45 (1 m)</li> <li>AO-1451: RS-232 Cable for PULSE Controller Module</li> <li>JJ-0152: BNC T-connector</li> <li>UA-1617: LAN Cable Relief</li> </ul>	<b>Type 3035:</b> <ul style="list-style-type: none"> <li>6 × JP-0162: TNC to 10-32 UNF Plug</li> </ul>						
<b>OPTIONAL ACCESSORIES</b>							
<b>Types 7537, 7538, 7539, 7540 only</b> <ul style="list-style-type: none"> <li>AO-0090: 7-pin LEMO to BNC (1.2m) for Floating GND</li> <li>AO-0091: 7-pin LEMO to BNC female (1.2m) for floating gnd.</li> <li>JJ-0081: BNC Adaptor, female to female</li> </ul> <b>For Auxiliary Parameter Logging</b> <ul style="list-style-type: none"> <li>AO-1472: 37-pin D-sub to Aux I/O</li> <li>AO-0594: 16 BNC Female to 37-pin D-sub</li> <li>AO-0595: 37-pin D-sub converter cable for DATAQ DI-75B</li> </ul>	<ul style="list-style-type: none"> <li>Type 2647: Charge to CCLD Amplifier</li> <li>JP-0145: BNC to 10-32 UNF Plug Adaptor</li> <li>AO-0526: 4-pin Microtech to 3 × BNC Cable</li> <li>3 × BNC to multiplug for triaxial transducers</li> <li>WB-1497: 20 dB Attenuator</li> </ul> <b>Types 3038-B, 3039-B, 3040-B, 3041-B only</b> <ul style="list-style-type: none"> <li>AO-0535: 37-pole D-sub to 6 Microdot for accelerometers</li> <li>AO-0536: 37-pole D-sub to 2 plugs for triaxial accelerometers</li> <li>AO-0602: 37-pole D-sub to 6 × 7-pin LEMO (allows CIC and polarization voltage with Type 3038-B)</li> <li>AO-0603: 37-pole D-sub to 6 × BNC Socket</li> <li>WB-1482: 0/20 dB Attenuator Adaptor for D-Sub connector</li> </ul>						
<p><b>*Note:</b> The following adaptors should not be used with polarization voltage enabled on the B-versions:</p> <table style="width: 100%;"> <tr> <td>AO-0432: 37-pole D-sub to 6 × 3-pin LEMO</td> <td>AO-0562: 37-pole D-sub to STSF/Beamforming Array</td> </tr> <tr> <td>WL-1261: 37-pole D-sub to 6 × 7-pin LEMO</td> <td>WL-1271: 37-pole D-sub to 6 × BNC Socket</td> </tr> <tr> <td>WL-1291: 37-pole D-sub to 6 × BNC Plug</td> <td></td> </tr> </table>		AO-0432: 37-pole D-sub to 6 × 3-pin LEMO	AO-0562: 37-pole D-sub to STSF/Beamforming Array	WL-1261: 37-pole D-sub to 6 × 7-pin LEMO	WL-1271: 37-pole D-sub to 6 × BNC Socket	WL-1291: 37-pole D-sub to 6 × BNC Plug	
AO-0432: 37-pole D-sub to 6 × 3-pin LEMO	AO-0562: 37-pole D-sub to STSF/Beamforming Array						
WL-1261: 37-pole D-sub to 6 × 7-pin LEMO	WL-1271: 37-pole D-sub to 6 × BNC Socket						
WL-1291: 37-pole D-sub to 6 × BNC Plug							

### SOFTWARE

Please refer to the System Data for PULSE software (BU 0229)

### NOTEBOOK PCS<sup>a</sup>

7200-B-xx Dell® Standard Notebook  
 7201-C-xy Dell® High-end Notebook  
 7204-A-xx Crete ROCKY II Plus EX Ruggedized Notebook  
 xx specifies country: DE, DK, ES, FR, GB, IT, RU, SE, US  
 y specifies inclusion of Microsoft® Office Pro: 1 – not included; 2 – included

### TOWER PCS<sup>a</sup>

7202-B-xx Dell® Optiplex GX280 Standard Desktop  
 7203-B-xy Dell® Precision 690 High-end Tower PC  
 xx specifies country: DE, DK, ES, FR, GB, IT, RU, SE, US  
 y specifies inclusion of Microsoft® Office Pro: 1 – not included; 2 – included

### PC ACCESSORIES

UL-0200 Vehicle Adaptor (12 – 32V) for Rocky II+

a. PCs are constantly updated. Contact your local dealer for latest information.

UL-0207-xx Microsoft® Office 2003 Professional Edition  
 UL-0208-xx Microsoft® Office 2003 Small Business Edition  
 UL-0213 17" Flat Panel Display (secondary display for UL-0211)  
 UL-0217 Dell® 19" Flat Panel Display TFT  
 xx specifies country: US (= GB), DE, FR, ES, IT, SE

### PC HARDWARE

AO-1450 LAN Interface Cable with RJ45  
 UL-0167 Netgear® 8-port, 100 MBit Switch  
 UL-0190 Netgear® 5-port, 100 MBit Switch  
 or  
 UL-0229 Netgear® 5-port, 1 GBit Switch

A wide range of Brüel & Kjær Accelerometers, Microphones, Preamplifiers and Sound Intensity Probes is available for use with a Type 3560 system. The system supports IEEE 1451.4 capable transducers with standardised TEDS

See also the PULSE Catalogue (BF 0209) for information on standard system configurations

### TRADEMARKS

Microsoft and Windows are registered trademarks of Microsoft Corporation in the United States and/or other countries · ICP is a registered trademark of PCB Group · MATLAB is a registered trademark of The MathWorks, Inc. · SONY is a registered trademark of Sony Corporation · Intel, Intel InBusiness and Pentium are registered trademarks of Intel Corporation or its subsidiaries in the United States and/or other countries · HP and Omnibook are registered trademarks of Hewlett-Packard Company · Dell and Latitude are registered trademarks of Dell Computer Corporation Neutrik is a registered trademark of the Neutrik Group worldwide · Netgear is a registered trademark of NetGear, Inc.

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

**HEADQUARTERS: DK-2850 Nærum · Denmark · Telephone: +45 4580 0500**  
**Fax: +45 4580 1405 · www.bksv.com · info@bksv.com**

Australia (+61) 2 9889-8888 · Austria (+43) 1 865 74 00 · Brazil (+55) 11 5188-8161  
 Canada (+1) 514 695-8225 · China (+86) 10 680 29906 · Czech Republic (+420) 2 6702 1100  
 Finland (+358) 9-755 950 · France (+33) 1 69 90 71 00 · Germany (+49) 421 17 87 0  
 Hong Kong (+852) 2548 7486 · Hungary (+36) 1 215 83 05 · Ireland (+353) 1 807 4083  
 Italy (+39) 0257 68061 · Japan (+81) 3 5715 1612 · Republic of Korea (+82) 2 3473 0605  
 Netherlands (+31) 318 55 9290 · Norway (+47) 66 77 11 55 · Poland (+48) 22 816 75 56  
 Portugal (+351) 21 4169 040 · Singapore (+65) 377 4512 · Slovak Republic (+421) 25 443 0701  
 Spain (+34) 91 659 0820 · Sweden (+46) 33 225 622 · Switzerland (+41) 44 8807 035  
 Taiwan (+886) 2 2502 7255 · United Kingdom (+44) 14 38 739 000 · USA (+1) 800 332 2040

Local representatives and service organisations worldwide

**Brüel & Kjær** 

