Electronic Supplies for Piezomechanics:
Technical Data
## Content

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### Switcher Amplifier RVC 200/30

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<tr>
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<td>0 V / +200 V, 30 A</td>
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### Analogue High Power / High Voltage Amplifiers

<table>
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<td>LE 430/015</td>
<td>0 V / +430 V, 150 mA</td>
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<td>0 V / +500 V, 2000 mA</td>
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### Switcher Amplifier RVC 500/15

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<tr>
<th>Model</th>
<th>Voltage Range</th>
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<tbody>
<tr>
<td>RVC 500/15</td>
<td>0 V / +500 V, 15 A</td>
<td>20</td>
</tr>
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### Switcher Amplifier RVC 1000/7

<table>
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<tbody>
<tr>
<td>RVC 1000/7</td>
<td>0 V / +1000 V, 7 A</td>
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### High Voltage Pulse Switches

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<th>Model</th>
<th>Voltage Range</th>
<th>Current</th>
<th>Page</th>
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</thead>
<tbody>
<tr>
<td>HPV 200</td>
<td>0 V / 200 V, up to 400 A</td>
<td></td>
<td>22</td>
</tr>
<tr>
<td>HPV 500</td>
<td>0 V / 500 V, up to 200 A</td>
<td></td>
<td>23</td>
</tr>
<tr>
<td>HPV 1000</td>
<td>0 V / 1000 V, up to 100 A</td>
<td></td>
<td>23</td>
</tr>
</tbody>
</table>

### PCI-based High Voltage D/A-Converters

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### Accessories

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</tbody>
</table>
Analog Amplifiers SVR

Low voltage/high voltage types available
Lowest noise levels
Semibipolar operation
for enhanced actuator stroke/force generation

SVR 150/1 (single channel)
SVR 150/3 (3 independent channels)

Voltage range:
–30 V thru +150 V (semibipolar)

Manual setting of DC-Offset
(superimposed to external signal)

Variable attenuation

---

Input:

**Signal:** +/-5 V (+/-10 V with attenuation)
**Impedance:** 5 kOhms
**Connector:** BNC

Output:

**Connector:** BNC
**Voltage total:** –30 V thru +150 V
**DC-Offset range:** –30 V thru +150 V
**Gain:** 30 (without attenuation)
**Max. current:** 60 mA
**Noise:** 0.3 mVpp (for 4.7 µFarad load)
**Display:** LCD

Dimensions W x D x H (mm):
- Single channel: 165 x 200 x 65
- 3-channels: 260 x 320 x 155

Weight:
- Single channel: 1.75 kg
- 3-channels: 4.7 kg

---

Additional features of 3 channel SVR 150/3 amplifier:

Monitor BNC output per channel:
shows 1:1000 piezo voltage

LC-Display per channel
SVR 200/1 (single channel)
SVR 200/3 (3 independent channels)

Voltage range:
–50 V thru +200 V

Manual setting of DC-Offset
(superimposed to external signal)

Variable attenuation

Input:
Signal:  +/–5 V (+/–10 V with attenuation)
Impedance:  5 kOhms
Connector:  BNC

Output:
Connector:  BNC
Voltage total:  –50 V thru +200 V
DC-Offset range:  –50 V thru +200 V
Gain:  40 (without attenuation)
Max. current:  45 mA
Noise:  1 mVpp (for 4 µFarad load)
Display:  LCD
Dimensions W x D x H (mm):
single channel:  165 x 200 x 65
3-channels:  260 x 320 x 155
Weight:
single channel:  1.75 kg
3-channels:  4.7 kg

Additional features of 3 channel SVR 200/3 amplifier:
Monitor BNC output per channel:
shows 1:1000 piezo voltage
LC-Display per channel
SVR 500/1 (single channel)
SVR 500/3 (3 independent channels)

Voltage range:
–100 V thru +500 V

Manual setting of DC-Offset
(superimposed to external signal)
Variable attenuation

Input:

Signal: +/-5 V (+/-10 V with attenuation)
Impedance: 5 kOhms
Connector: BNC

Output:

Connector: BNC
Voltage total: –100 V thru +500 V
DC-Offset range: –100 V thru +500 V
Gain: 100 (without attenuation)
Max. current: 15 mA
Noise: 1 mVpp (for 1 µFarad load)
Display: LCD
Dimensions W x D x H (mm):
single channel: 165 x 200 x 65
3-channels: 260 x 320 x 155
Weight:
single channel: 1.75 kg
3-channels: 4.7 kg

Additional features of 3 channel SVR 500/3 amplifier:

Monitor BNC output per channel:
shows 1:1000 piezo voltage
LC-Display per channel
SVR 1000/1 (single channel)
SVR 1000/3 (3 independent channels)

Voltage range:
−200 V thru +1000 V

Manual setting of DC-Offset
(superimposed to external signal)
Variable attenuation

Input:
Signal:  +/–5 V (+/–10 V with attenuation)
Impedance:  5 kOhms
Connector:  BNC

Output:
Connector:  Lemo OS.250
Voltage total:  –200 V thru +1000 V
DC-Offset range:  –200 V thru +1000 V
Gain:  200 (without attenuation)
Max. current:  8 mA
Noise:  approx. 1 mVpp
(for 0.47 µFarad load)
Display:  LCD
Dimensions W x D x H (mm):
single channel:  165 x 200 x 65
3-channels:  260 x 320 x 155
Weight:
single channel:  1.75 kg
3-channels:  4.7 kg

Additional features of
3 channel SVR 1000/3 amplifier:
Monitor BNC output per channel:
shows 1:1000 piezo voltage
LC-Display per channel
For operation of piezo bimorphs
Bipolar stacks
Shear elements
Other symmetric voltage activation

SVR 150bip/1 (single channel)
SVR 150bip/3 (3 independent channels)

Voltage range:
−150 V thru +150 V

Manual setting of DC-Offset
(superimposed to external signal)

Additional features of
3 channel SVR 150bip/3 amplifier:
Monitor BNC output per channel:
shows 1:1000 piezo voltage
LC-Display per channel

Input:
Signal: +/- 5 V (+/- 10 V with attenuation)
Impedance: 5 kOhms
Connector: BNC

Output:
Connector: BNC
Voltage total: −150 V thru +150 V
DC-Offset range: −150 V thru +150 V
Gain: 30 (without attenuation)
Max. current: 30 mA
Noise: 0.3 mVpp (for 4.7 µFard load)
Display: LCD
Dimensions W x D x H (mm):
single channel: 165 x 200 x 65
3-channels: 260 x 320 x 155
Weight:
single channel: 1.75 kg
3-channels: 4.7 kg
SVR 350 bip/1 (single channel)
SVR 350 bip/3 (3 independent channels)

Voltage range:
-350 V thru +350 V
Manual setting of DC-Offset
(superimposed to external signal)
Variable attenuation

Input:
Signal: +/–5 V (+/–10 V with attenuation)
Impedance: 5 kOhms
Connector: BNC

Output:
Connector: BNC
Voltage total: –350 V thru +350 V
DC-Offset range: –350 V thru +350 V
Gain: 70 (without attenuation)
Max. current: 15 mA
Noise: 1 mVpp (for 1 µFarad load)
Display: LCD
Dimensions W x D x H (mm):
single channel: 165 x 200 x 65
3-channels: 260 x 320 x 155
Weight:
single channel: 1.75 kg
3-channels: 4.7 kg

Additional features of 3 channel SVR 350 bip/3 amplifier:
Monitor BNC output per channel:
shows 1:1000 piezo voltage
LC-Display per channel
Unipolar devices for voltages +150 V and +200 V
Increased current output for increased dynamics
Lowest noise levels

**LE 150/025 (single channel)**

Voltage range:
0 V/+150 V

Manual setting of DC-Offset
(superscribed to external signal)
Variable attenuation

**Input:**
- Signal: +/-5 V (+/-10 V with attenuation)
- Impedance: 5 kOhms
- Connector: BNC

**Output:**
- Connector: BNC
- Voltage total: 0 V thru +150 V
- DC-Offset range: 0 V thru +150 V
- Gain: 30 (without attenuation)
- Peak current: 250 mA (for 200 msec)
- Average current: 70 mA
- Noise: 5 mVpp (for 4.7 µFarad load)
- Display: LCD
- Dimensions W x D x H (mm): 260 x 320 x 155
- Weight: 4.6 kg
LE 150/100 EBW

Voltage range:
0 V/+150 V

Manual setting of DC-Offset
(superimposed to external signal)

Variable attenuation
70 kHz bandwidth (-3 dB)

Input:

Signal:  +/-5 V (+/-10 V with attenuation)
Impedance:  5 kOhms
Connector:  BNC

Output:

Connector:  BNC
Voltage total:  0 V thru +150 V
DC-Offset range:  0 V thru +150 V
Gain:  30 (without attenuation)
Peak current:  1200 mA
Average current:  350 mA
Noise:  20 mVpp (for 4.7 µFarad load)
Display:  LCD
Dimensions W x D x H (mm):
260 x 320 x 165
Weight:  6.8 kg
LE 150/200 (single channel)

Voltage range:
0 V/+150 V

Manual setting of DC-Offset
(superimposed to external signal)
Variable attenuation

Input:
Signal: +/-5 V (+/-10 V with attenuation)
Impedance: 5 kOhms
Connector: BNC

Output:
Connector: BNC
Voltage total: 0 V thru +150 V
DC-Offset range: 0 V thru +150 V
Gain: 30 (without attenuation)
Peak current: 2000 mA
Average current: 350 mA
Noise: 20 mVpp (for 4.7 µFarad load)
Display: LCD
Dimensions W x D x H (mm):
(single channel): 340 x 380 x 180
Weight:
(single channel): 9 kg

Modular concept:
Up to three independent channels can be integrated into one cabinet.
Ordering code:
LE 150/200-2: double channel device
LE 150/200-3: triple channel device
LE 200/070 EBW

Voltage range:
0 V/+200 V

Manual setting of DC-Offset
(superimposed to external signal)

Variable attenuation
70 kHz bandwidth (-3 dB)

Input:
Signal: +/−5 V (+/−10 V with attenuation)
Impedance: 5 kOhms
Connector: BNC

Output:
Connector: BNC
Voltage total: 0 V thru +200 V
DC-Offset range: 0 V thru +200 V
Gain: 40 (without attenuation)
Peak current: 700 mA
Average current: 250 mA
Noise: 20 mVpp (for 4.7 µFarad load)
Display: LCD
Dimensions W x D x H (mm):
320 x 260 x 165
Weight: 7 kg
LE 200/150 EBW (single channel)

Voltage range:
0 V/+200 V

Manual setting of DC-Offset
(superimposed to external signal)
Variable attenuation
70 kHz bandwidth (-3 dB)

Input:
Signal:  +/–5 V (+/–10 V with attenuation)
Impedance:  5 kOhms
Connector:  BNC

Output:
Connector:  BNC
Voltage total:  0 V thru +200 V
DC-Offset range:  0 V thru +200 V
Gain:  40 (without attenuation)
Peak current:  1500 mA
Average current:  500 mA
Noise:  20 mVpp (for 4.7 µFarad load)
Display:  LCD
Dimensions W x D x H (mm):
(single channel):  380 x 340 x 180
Weight:
(single channel):  9 kg

Modular concept:
Up to three independent channels can be integrated into one cabinet.
Ordering code:  LE 200/150-2: (2 channels)
               LE 200/150-3: (3 channels)
**LE 200/500**

**Voltage range:**
0 V/+200 V

**Manual setting of DC-Offset**
(superimposed to external signal)

**Variable attenuation**

**For high capacitance actuators > 2 µF**

---

**Input:**

**Signal:**  +/-5 V (+/-10 V with attenuation)

**Impedance:**  5 kOhms

**Connector:**  high current bunch type or coaxial systems on request::

Ask PIEZOMECHANIK for details

---

**Output:**

**Connector:**  BNC

**Voltage total:**  0 V thru +200 V

**DC-Offset range:**  0 V thru +200 V

**Gain:**  40 (without attenuation)

**Peak current:**  5 A

**Average current:**  1800 mA

**Noise:**  50 mVpp (for 10 µFarad load)

**Display:**  LCD

**Dimensions W x D x H (mm):**
440 x 370 x 230

**Weight:**  15 kg

---

![Graph](image-url)
High Power Switching Amplifier
RCV 200 V/30 A

Voltage range 0 V/+200 V
Manual setting of DC offset
(superimposed to external signal)
Variable attenuation
For capacitive loads > 50 µF typically

Input:
Signal: +/- 5 V (+/- 10 V with attenuation)
Impedance: 5 kOhms
Connector: BNC

Output:
Connector: High current bunch type or coaxial systems on request:
Ask PIEZOMECHNIK for details
Voltage total: 0 V thru +200 V
DC-Offset range: 0 V thru +200 V
Gain: 40 (without attenuation)
Peak current: 30 A
Average reactive current: 10 A
Noise: > 1 V (depends on load)
Display: LCD
Dimensions W x D x H (mm):
(simple channel): 370 x 440 x 230
Weight: 15 kg
Analog High Voltage Amplifiers LE

LE 430/015 (single channel)

Voltage range:
0 V/+430 V

Manual setting of DC-Offset
(superimposed to external signal)

Variable attenuation

Diagram:

Input:

Signal: +/-5 V (+/-10 V with attenuation)
Impedance: 5 kOhms
Connector: BNC

Output:

Connector: BNC
Voltage total: 0 V thru +430 V
DC-Offset range: 0 V thru +430 V
Gain: 86 (without attenuation)
Peak current: 150 mA (for 200 msec)
Average current: 30 mA
Noise: 10 mVpp (for 2.2 µFarad load)
Display: LCD
Dimensions W x D x H (mm):
260 x 320 x 155
Weight: 4.6 kg
Bipolar amplifier LE 350 bip / 050 (single channel)

Amplifier optimized for the operation of bipolar stacks PST 350bip without the risk of overvoltage and depoling

Voltage range:
+/-350 V

Manual setting of DC-Offset (superimposed to external signal)
Variable attenuation

Input:
Signal: +/–3.5 V (+/–10 V with attenuation)
Impedance: 1 kOhm
Connector: BNC

Output:
Connector: Lemo 0S.250
Voltage total: –350 V thru +350 V
DC-Offset range: –350 V thru +350 V
Gain: 100 (without attenuation)
Peak current: 500 mA (for 200 msec)
Average current: 180 mA
Noise: 100 mVpp (for 2 µFarad load)
Display: LCD
Dimensions W x D x H (mm):
260 x 380 x 205
Weight: 8.5 kg
LE 500/200

Voltage range:
0 V/+500 V

Manual setting of DC-Offset
(superimposed to external signal)

Variable attenuation

For high capacitance actuators > 1 μF

Input:
Signal: +/-5 V (+/-10 V with attenuation)
Impedance: 1 kOhm
Connector: BNC

Output:
Connector: High current bunch type or coaxial systems on request:
Ask PIEZOMECHNIK for details
Voltage total: 0 V thru +500 V
DC-Offset range: 0 V thru +500 V
Gain: 100
Peak current: 2 A
Average current: 700 mA
Noise: 50 mV for 2 μF load
Display: LCD
Dimensions W x D x H (mm): 440 x 370 x 230
Weight: 8.5 kg
High Power Switching Amplifier
RCV 500/15 (single channel)

Voltage range:
0 V/+500 V

Manual setting of DC-Offset
(superimposed to external signal)
Variable attenuation
For capacitive loads > 5 µF typically

Input:
Signal: +/- 5 V (+/-10 V with attenuation)
Impedance: 1 kOhm
Connector: BNC

Output:
Connector: High current bunch type or coaxial systems on request:
Ask PIEZOMECHNIK for details
Voltage total: 0 V thru +500 V
DC-Offset range: 0 V thru +500 V
Gain: 100
Peak current: 15 A
Average reactive current: 5 A
Noise: > 1V f(depends on load)
Display: LCD
Dimensions W x D x H (mm):
440 x 370 x 230
Weight: 15 kg
High power switching amplifier
RCV 1000/7 (single channel)

Voltage range:
0 V/+1000 V

Manual setting of DC-Offset
(superimposed to external signal)
Variable attenuation

Input:
Signal: +/-5 V (+/-10 V with attenuation)
Impedance: 1 kOhm
Connector: BNC

Output:
Connector: Lemo 0S.250
Voltage total: 0 V thru +1000 V
DC-Offset range: 0 V thru +1000 V
Gain: 200 (without attenuation)
Peak current: 7 A
Average current: 2.2 A
Noise, switching ripple:
up to 2 Vpp
(depending on actuator’s capacitance)
Display: LCD
Dimensions W x D x H (mm):
360 x 440 x 225
Weight: 20 kg

- Image of the high power switching amplifier RCV 1000/7 (single channel).
- Graph showing the voltage range and bandwidth of the amplifier.
- Technical specifications listed in the document.
High Voltage Pulser HVP

Applications:
- Acoustical, hydraulic, mechanical shock generation
- Material testing
- High g – testing (up to > $10^4 \text{ g}$)
- µsec-precise mechanical pulse trigger

Caution:
Your actuator system must be specially designed to withstand intense mechanical shocks.
Standard stacks (even preloaded ones) can be immediately destroyed, when naively operated with the power pulsers HVP.

Ask PIEZOMECHANIK

Operating principle of the HV-pulsers HVP
A high voltage capacitor is used as the electrical power reservoir.
It is charged to a distinct high voltage level by a permanently operating power supply.

Upon a trigger pulse, the charging switch releases a high current peak towards the piezo actuator capacitance. A serial resistor $R_{CH}$ acts as current limiter.
By this technique current pulses up to several hundreds of Amperes can be generated.

The electrical rise time (RC-time coefficient) is defined by the PZT actuator capacitance $C$ and the resistor $R_{CH}$.

Discharging of the PZT-actuator is done in a similar way towards ground. The discharge current limiter $R_{DCH}$ defines the discharge time constant.

Piezomechanik’s HVP switches are able to provide electrical peak powers up to 100 kW. Higher ratings on request.
The achievable repetition rate is defined by the power supply’s charging power and is about 40 W standard. Higher power ratings for higher repetition rates are offered on request.

Example:
The electrical RC rise time for a HVP 1000/10 pulser (1000 V, 10 A peak, $R = 100 \text{ Ohms}$) together with a 1 µF-actuator is 100 µsec.
Mechanical rise/fall of piezo actuators

The mechanical elongation rise-time of a piezo actuator is limited by the elastic properties of the actuator material and the geometrical dimensions of the actuator.

It is the result of the sound velocity within the PZT stack defining the propagation time of an elastic deformation transient.

The main consequence is that even the shortest electrical pulses cannot produce short actuator pulses below a distinct limit.

The minimum reaction time $T_{\text{react}}$ (mechanical rise time of actuator) is

$$T_{\text{react}} \approx \frac{1}{3} T_{\text{res}}$$

with $T_{\text{react}}$ is the period time of actuator’s self-resonance.

---

Technical data

Input signal:

- > 3 V charge
- < 0.4 V discharge
- Impedance 100 Ohm
- Connector BNC

Variable voltage setting within above ranges by front potentiometer

Set voltage is represented by a 3-digit front LC-Display

Order code e.g. for a max. +500V/100 A pulser:

HVP 500/100

Average power: 40 W

(Notice: Average power defines the repetition rate of pulses, depending further on actuators capacitance)

Connector types:

Depends on voltage and current ratings

Bunch type or coaxial systems on request:

Ask PIEZOMECHANIK for details

Dimensions WxDxH (mm): 265x260x165

Weight: 3.5 kg

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Output:

Max. voltage ranges: Peak current ratings

<table>
<thead>
<tr>
<th>Model</th>
<th>Voltage Range</th>
<th>Peak Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVP 200</td>
<td>0 V / +200 V</td>
<td>100 / 200 / 400</td>
</tr>
<tr>
<td>HVP 500</td>
<td>0 V / +500 V</td>
<td>50 / 100 / 200</td>
</tr>
<tr>
<td>HVP 1000</td>
<td>0 V / +1000 V</td>
<td>20 / 50 / 100</td>
</tr>
</tbody>
</table>

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Fig: Typical reaction of a piezo actuator upon application of a short electrical pulse leading to the equivalent actuator’s stroke with some mechanical over-shooting and residual resonant ringing.
PCI-based High Voltage D/A Converters

The PC plug in cards generate high voltage outputs for the direct operation of piezo actuators. This solution of computer assisted piezoooperation is space and cost saving compared to alternatives using external D/A converters and analog amplifiers. Speed and reliability of data handling is superior to data management via interfaces. The PC-AHV cards are available as single and triple channel devices for voltage levels up to 500 V.

The supplied software runs under Windows 95/98/ME/NT/2000/XP.

DLLs are available for

- Microsoft C++6.0
- Microsoft Visual Basic 6.0
- Borland Delphi 5.0
- Borland C-Builder 4.0

General data

- PCI-Bus
- 8 bit data bus
- Voltage resolution: 14 bit for unipolar output, 13 bit for bipolar output
- Width 1 slot
- PC board dimensions

Technical Data

PC-AHV +150/1 single channel
Output voltage: 0 V thru +150 V
Max. peak current: 75 mA
Max. average current: 25 mA
Resolution: 14 bit
Noise: 5 mV
Output connector: BNC. Adapters to LEMO 00 250 and 0S250 available.

PC-AHV +150bp/1 single channel
Bipolar output voltage: –150 V thru +150 V
Max. peak current: 50 mA
Max. average current: 15 mA
Resolution: 13 bit
Noise: 5 mV
Output connector: BNC. Adapters to LEMO 00 250 and 0S250 available.

PC-AHV +150/3 triple channel
Output voltage: 0 V thru +150 V
Max. peak current: 75 mA/channel
Max. average current: 25 mA (total for 3 channels)
Resolution: 14 bit
Noise: 5 mV
Output connector: BNC. Adapters to LEMO 00 250 and 0S250 available.

PC-AHV 150bp/3 triple channel
Bipolar output voltage: –150 V thru +150 V
Max. peak current: 50 mA/channel
Max. average current: 15 mA (total for 3 channels)
Resolution: 13 bit
Noise: 5 mV
Output connector: BNC. Adapters to LEMO 00 250 and 0S250 available.

PC-AHV +500/1 single channel
Output voltage: 0 V thru +500 V
Max. peak current: 15 mA
Max. average current: 5 mA
Resolution: 14 bit
Noise: 5 mV
Output connector: LEMO 0S250 (other LEMO types on request), adapter to BNC available.

PC-AHV +500/3 triple channel
Output voltage: 0 V thru +500 V
Max. peak current: 15 mA/channel
Max. average current: 5 mA (total for 3 channels)
Resolution: 14 bit
Noise: 5 mV
Output connector: LEMO 0S250 (other LEMO types on request), adapter to BNC available.
PIEZOMECHANIK supplies a wide range of connecting systems, adaptors, extension cable to make the installation and compatibility of components as easy as possible.

When a complete actuator/amplifier system is ordered, the actuators will be equipped with the plugs corresponding the amplifier’s connector. Further adaptors are available for the combination of different connector systems.

Adaptors:

<table>
<thead>
<tr>
<th>Plug</th>
<th>coupler</th>
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<tbody>
<tr>
<td>BNC</td>
<td>LEMOSA 00.250 (low voltage systems)</td>
</tr>
<tr>
<td>BNC</td>
<td>LEMOSA 0S.250 (high voltage systems)</td>
</tr>
<tr>
<td>LEMOSA 00.250</td>
<td>BNC</td>
</tr>
<tr>
<td>LEMOSA 0S.250</td>
<td>BNC</td>
</tr>
</tbody>
</table>

Coaxial cable RG 178 with plug – one end blunt, length 1.5 m standard, other lengths on request

| LEMOSA plug 00.250 |
| LEMOSA plug 0S.250 |
| BNC               |

Extension cables with plug and coupling end, length standard 2 m, other lengths on request

| LEMOSA 00.250 system |
| LEMOSA 0S.250 system |

Extension cables combining different connector systems e.g. BNC-LEMOSA on request.