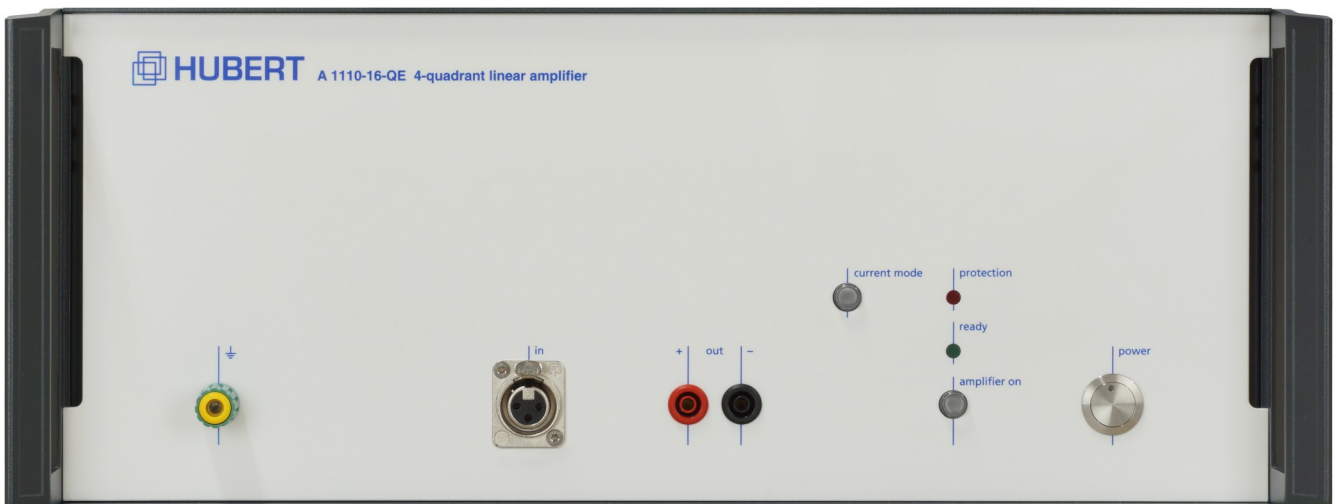




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## Datasheet



# A1110-16-QE

**4-Quadrant Voltage and Current Amplifier  
DC - 1 MHz**



# 1 Product Description

The A1110-16-QE is a linear, extreme-broadband, precision power amplifier designed for all applications which require fast-changing signals with high performance.

The A1110-16-QE can be operated as a voltage amplifier or current amplifier. The current amplifier offers a constant, frequency-invariant output current for inductive loads.

The amplifier is equipped with “auto-commutating” voltage supply. Three bipolar supply voltages are automatically or manually switched individually. The amplifier ensures high sink outputs and is also suitable for operation as active load. Three optional operating voltages per polarity are available for high-voltage/low-current or low-voltage/high-current applications. The voltage switch-over can be implemented optionally as manual or automatic. Especially in case of very low-impedance loads, the operating voltage can be reduced to 1/10 which is associated with a corresponding reduction of the power loss.

Output voltage and output current can be limited and observed on low-impedance signal outputs.

The device is equipped with a temperature-controlled, quietly-running fan. As well as an over-temperature disconnection, a power-loss calculation and an absolute-current monitoring guarantees perfect short-circuit and overload protection.

An interlock offers the possibility of a remote-controlled security system.

The operation is implemented over the operating elements on the front panel and over the USB interface by PC with a graphical user interface.

Please find the latest release of this datasheet on our website:  
[www.drhubert.com](http://www.drhubert.com)



## 2 Features

- 4-quadrant voltage and current amplifier
- Fully configurable and operable by means of the supplied software
- Output voltage max.  $75 V_{\text{peak}}$
- Output current max.  $28 A_{\text{peak}}$
- Output current  $55 A_{\text{peak}} / 500 \text{ ms}$
- Symmetrical input
- Series / parallel input connection in case of higher voltage / current requirements
- USB port as standard (LAN interface optional)
- Auto-commutating voltage supply
- Interlock
- Voltage / current monitor output
- 6 configurable compensation networks for inductive loads in current amplifier mode

## 3 Applications

- General lab applications for research, development and testing
- EMC testing
- Material testing
- MRI
- Component tests
- Plunger coil drives
- Piezo actuation
- Generation of magnetic fields (e.g. with Helmholtz coils)
- Medical engineering
- Laser technology
- Plasma technology



## 4 Control Software

The device includes an application software that ensures fully remote-controlled operation and comprehensive configuration of the amplifier via the USB interface. A trouble-free integration to existing automated test systems is guaranteed by a complete remote command list.

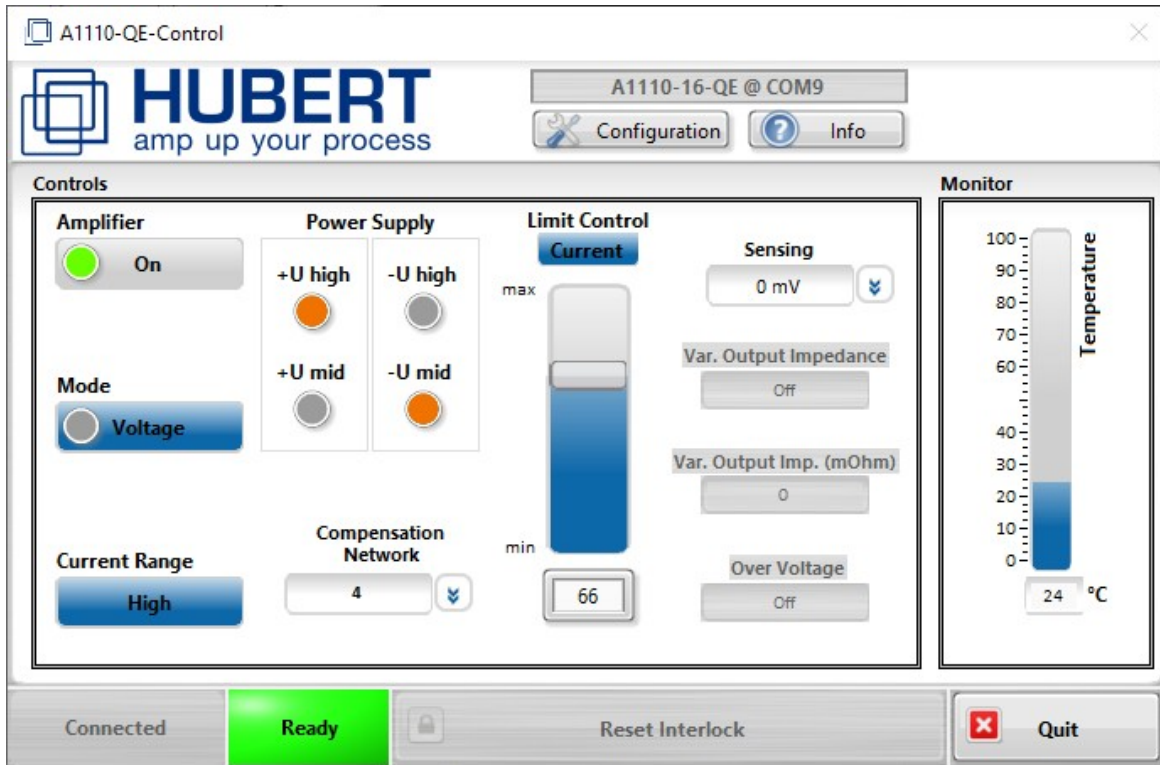


Figure 1: A1110-QE-Control Main Menu

## 5 Pictures



Figure 2: Back panel elements



## 6 Current Amplifier

In current control mode, the A1110-16-QE behaves like a voltage-controlled current source and delivers a nearly frequency-independent constant load current to an inductive load.

The following five compensation networks are equipped ex works.

No	Load	Rc	Cc	Current Range
1	1 Ohm + 500 uH	100 kOhm	10 nF	high
2	0,1 Ohm + 200 uH	68 kOhm	4,7 nF	high
3	1 Ohm + 1mH	150 kOhm	22 nF	high
4	4 Ohm + 1,8 mH	200 kOhm	1 nF	high
5	0,078 R + 88 uH	80 kOhm	6,8 nF	high
6	<i>Reserved for Option-01</i>			

The selection is made by our A1110-QE-Control software. Please also note the corresponding recommended current measuring range.

If none of the above compensation networks is suitable for your application, please order your amplifier with Option-01: Custom Current Amplifier. Our engineers will design a custom compensation network specific for your needs. Up to 6 custom compensation networks are possible as existing ones can be removed.

We would be pleased to assist you in the realization of a compensation network for your application.



## 7 Specifications

The A1110-16-QE is equipped with three operating voltages and the two auto and manual operating modes.

Mode	+operating voltage	-operating voltage
Auto	10 V, 45 V, 90 V	-10 V, -45 V, -90 V
Manual: + Umid	45 V	auto
Manual: + Uhigh	90 V	auto
Manual: - Umid	auto	-45 V
Manual: - Uhigh	auto	-90 V
Manual: + Umid, -Umid	45 V	-45 V
Manual: + Uhigh, -Umid	90 V	-45 V
Manual: + Uhigh, -Uhigh	90 V	-90 V
Manual: + Uhigh, -Uhigh	45 V	-90 V

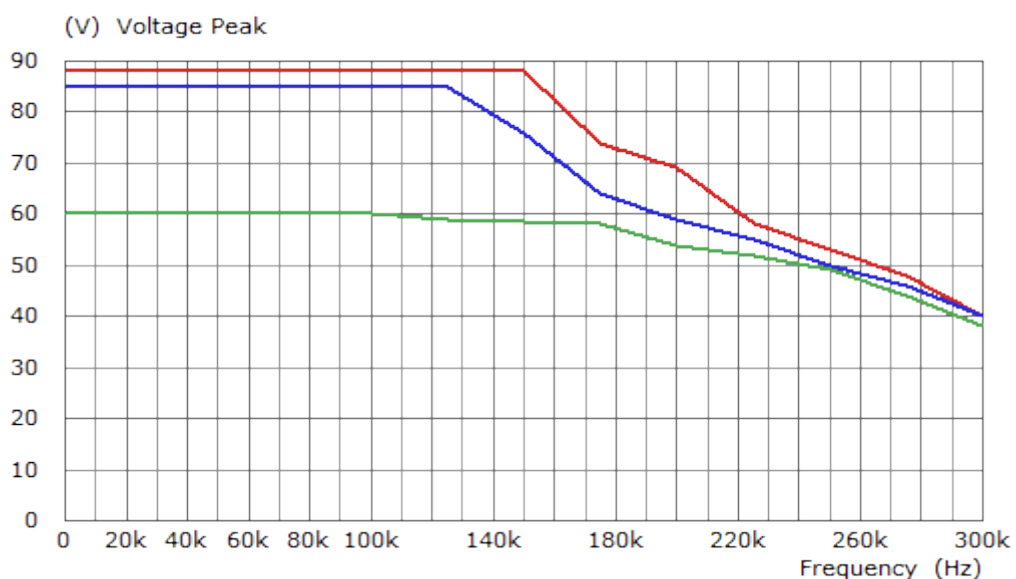
In auto mode the operating voltage is automatically switched on the basis of the signal amplitude. This mode is suitable for real-time applications with DC voltages and sine-wave signals, with which high sink power is required at inductive loads.

### 7.1 Output Voltage vs. Frequency (THD + N < 1%)

Red: @ 8 Ohm

Blue: @ 4 Ohm

Green: @ 2 Ohm



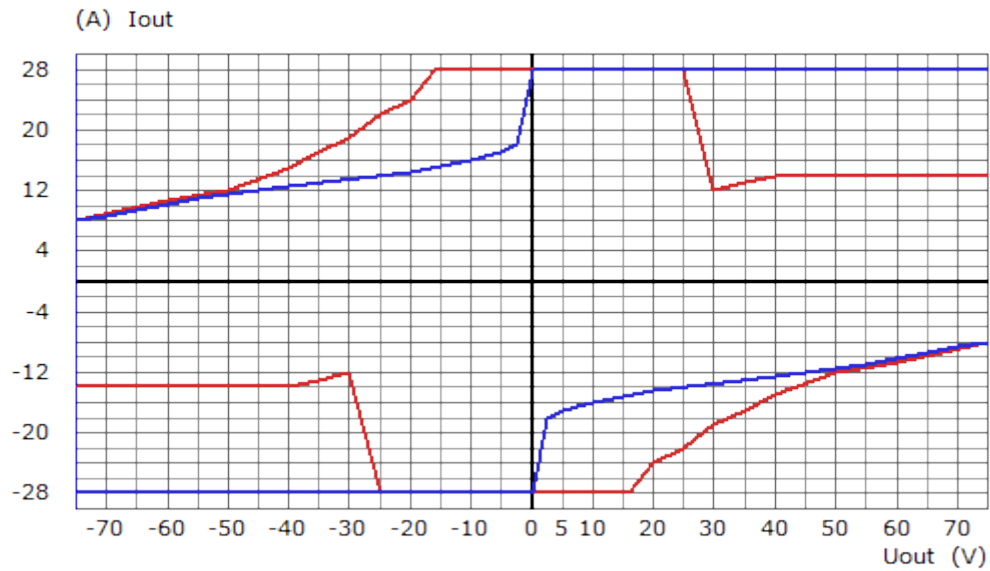


## 7.2 Output Current vs. Output Voltage (THD + N < 1%)

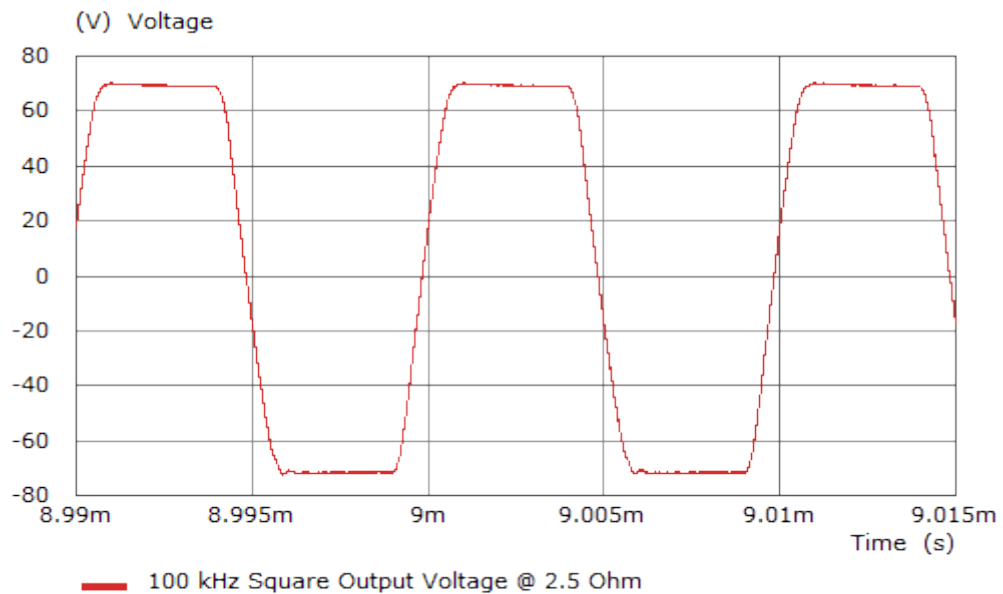
Supply Voltage: Auto

Blue: AC Limit

Red: DC Limit



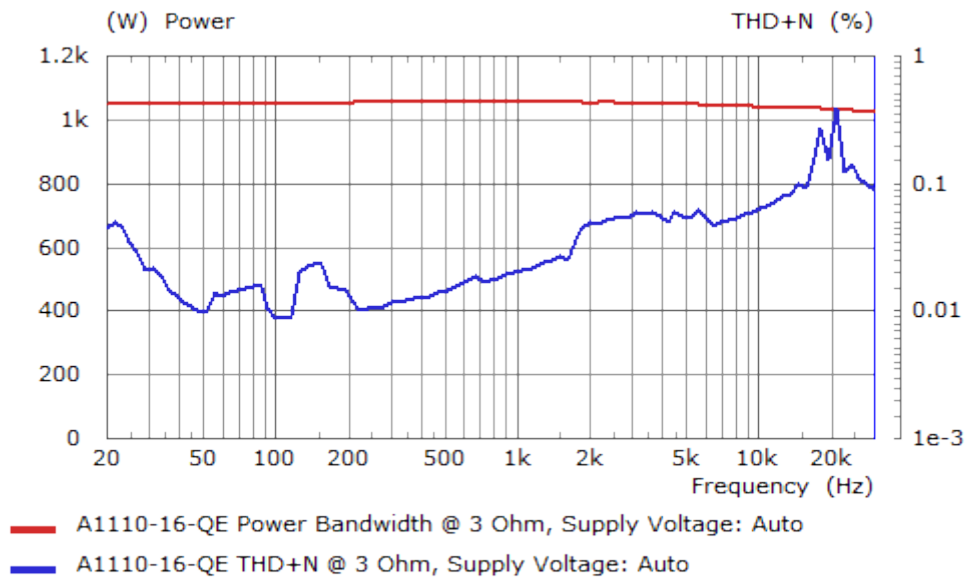
## 7.3 Square Wave at 100 kHz and 2,5 Ohm Load





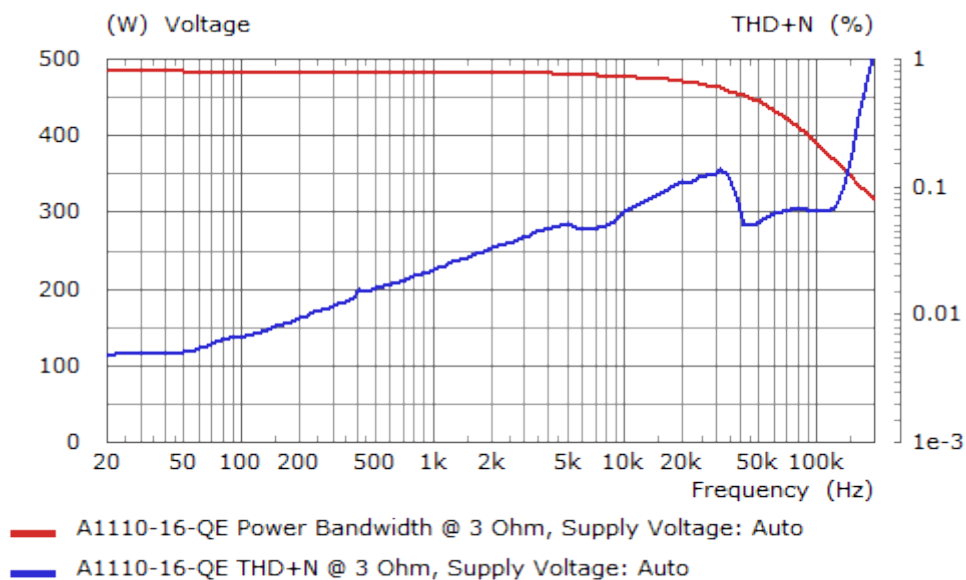
## 7.4 Power Bandwidth at 3 Ohm Load

Input level normalised to max. output level at 30 kHz; THD+N < 1%



## 7.5 Power Bandwidth at 3 Ohm Load

Input level normalized to max. output level at 200 kHz; THD+N < 1%

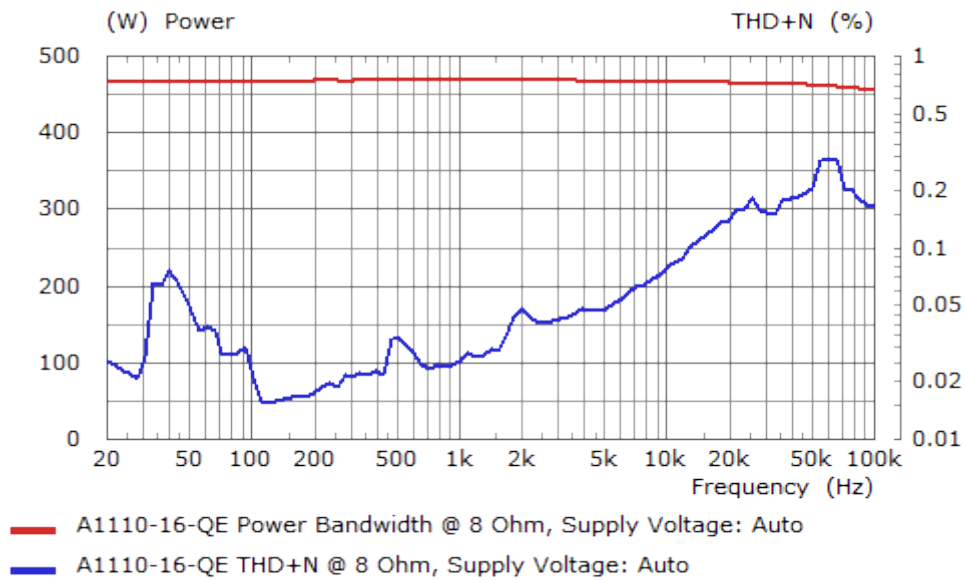




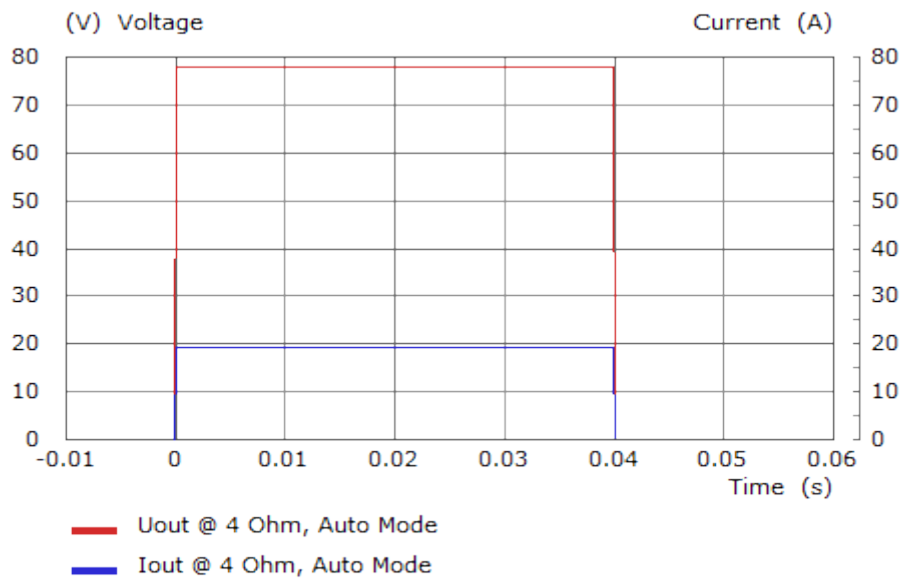


## 7.6 Power Bandwidth at 8 Ohm Load

Input level normalised to max. output level at 100 kHz; THD+N < 1%)

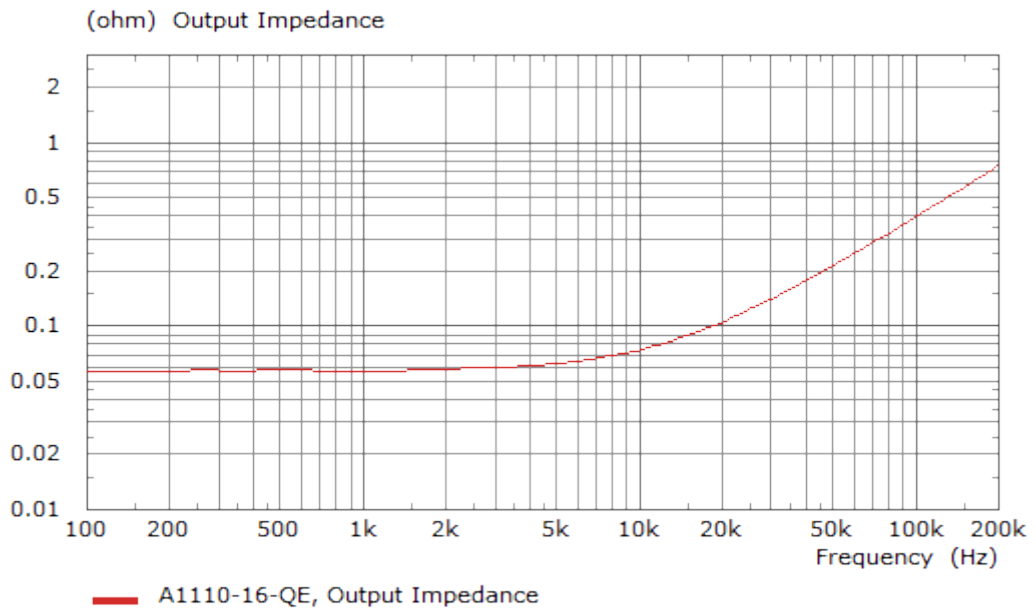


## 7.7 Pulse at 4 Ohm Load





## 7.8 Output Impedance





## 7.9 Specifications

Parameters	Specification	Conditions/Moments
	Controlled Voltage Mode	25° C ambient temperature Continuous operation
<b>Input Impedance</b>	100 kOhm 200 kOhm	unbalanced, 1kHz balanced, 1kHz
<b>Maximum Input Level</b>	20V <sub>pp</sub>	< 1 % THD, 1 kHz, 8 Ohm Load
<b>Common-Mode Rejection Ratio</b>	> 60 dB	Rs= 50 Ohm, 10 Hz – 200 kHz, re +34.5 dBV @ Output
<b>Small Signal Frequency Response</b>		
	DC - 200 kHz	+0, -0.5 dB, 1 W @ 8 Ohm High Voltage Mode
	DC - 1 MHz	+0, -3.0 dB, 1 W @ 8 Ohm High Voltage Mode
<b>Phase response</b>	+0, -5 degrees	10 Hz - 30 kHz
<b>Power Response (continuous)</b>		
8 Ohm Load	400 W 200 W	DC - 100 kHz, < 0.5% THD High Voltage Mode DC – 200 kHz, < 0.5% THD High Voltage Mode
3 Ohm Load	1000 W 800 W 450 W	DC - 30 kHz, < 0.5% THD High Voltage Mode DC - 100 kHz, < 0.5% THD High Voltage Mode DC - 200 kHz, < 1% THD High Voltage Mode
<b>Slew Rate</b>	100 V/uSec	
<b>Residual Noise</b>		
10 Hz - 22 kHz	< 100 uV ( < -80 dBV )	All Voltage Modes Input shorted 8 Ohm Load
10 Hz - 80 kHz	< 125.5 uV ( < -78 dBV )	All Voltage Modes Input shorted 8 Ohm Load
10 Hz - 200 kHz	< 158.5 uV ( < -76 dBV )	All Voltage Modes Input shorted 8 Ohm Load
<b>Signal-to-Noise Ratio</b>		
10 Hz - 22 kHz	< -114.5 dB	re +34.5 dBV, < 1% THD 8 Ohm Load High Voltage Mode
10 Hz - 80 kHz	< -112.5 dB	re +34.5 dBV, < 1% THD 8 Ohm Load High Voltage Mode



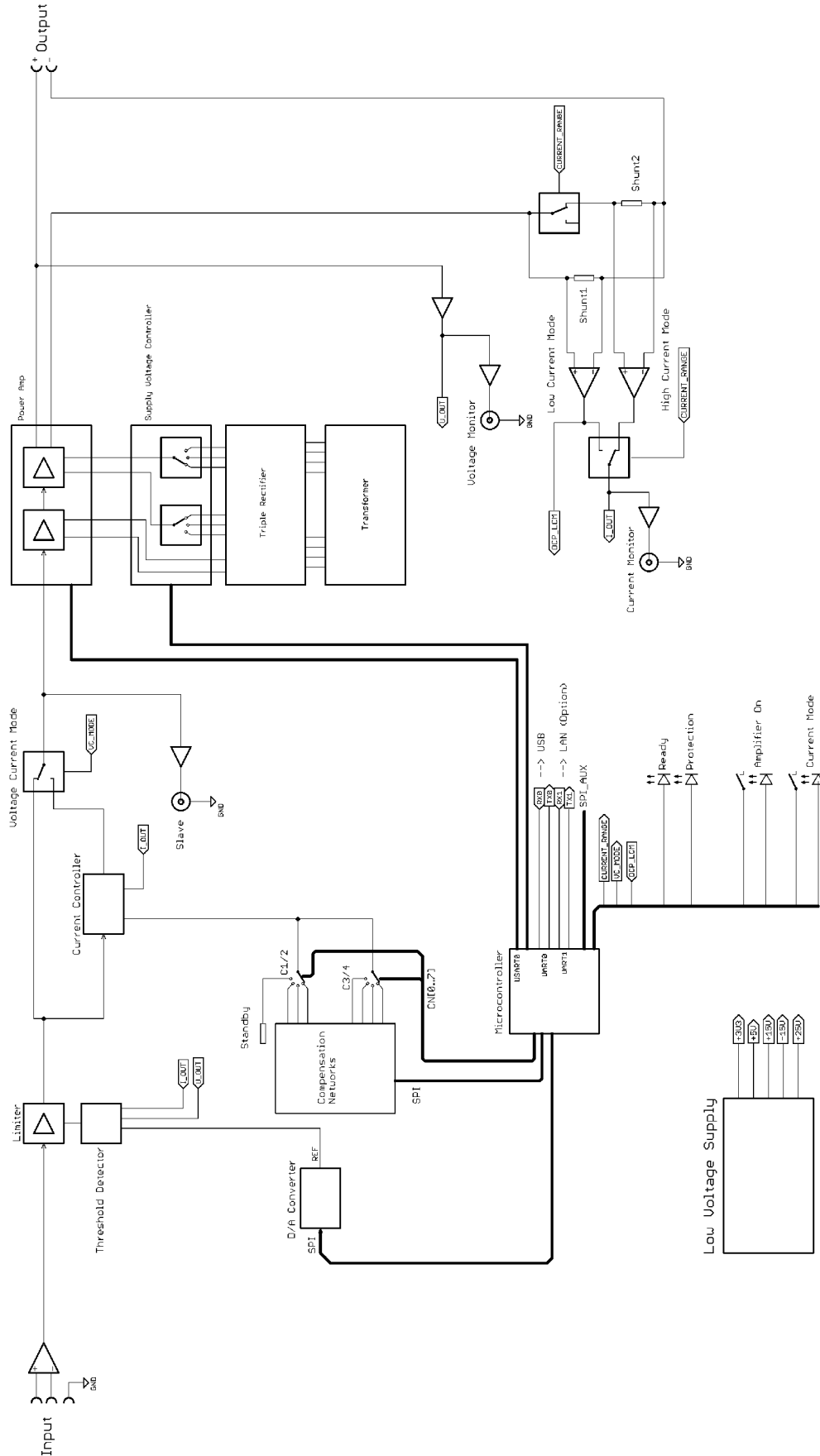
Parameters	Specification	Conditions/Moments
10 Hz – 200 kHz	< -110.5 dB	re +34.5 dBV, < 1% THD 8 Ohm Load High Voltage Mode
<b>THD+N</b>		
10 Hz – 100 kHz	< 0.5 %	800 W @ 3 Ohm; Auto
10 Hz – 100 kHz	< 0.1 %	800 W @ 3 Ohm High Voltage Mode
<b>Output Offset</b>	< 1.0 mV	DC
<b>Output Impedance</b>	< 60 mOhm	@1 kHz; Instrument: HP8751A, Network Analyzer
<b>Power, Pulse, 40ms, 20% Duty Cycle</b>		
Peak output		
4 Ohm	75 V, 19.5 A	> 40 us rise time / > 40 us fall time
4 Ohm	75 V, 18.9 A	> 100 ns rise time / > 100 ns fall time
2.5 Ohm	68 V, 27 A	> 40 us rise time / > 40 us fall time
2.5 Ohm	68 V, 27 A	> 100 ns rise time / > 100 ns fall time
0.5 Ohm	14V, 28 A	> 10 us rise time / > 10 us fall time
0.5 Ohm	14V, 28 A	> 100 ns rise time / > 100 ns fall time
<b>Current, Pulse, 500ms, 5% Duty Cycle, unipolar</b>		
Peak Output		
60 mOhm	+ 55 A	+Umid / -Ulow
60 mOhm	- 55 A	+Ulow / -Umid
<b>Power, Sinus, 100Hz, continuous</b>		
4 Ohm	58 V, 15.5 A, 841 W	< 1 % THD+N; Auto or Uhigh
3 Ohm	56 V, 18.5 A, 1036 W	< 1 % THD+N; Auto or Uhigh
2 Ohm	40 V, 19 A, 760 W	< 1 % THD+N; Auto
1 Ohm	19 V, 19 A, 361 W	< 1 % THD+N; Auto
0.5 Ohm	9.5 V, 19 A, 180.5 W	< 1 % THD+N; Auto
0.06 Ohm	1.15 V, 19 A, 21.85 W	< 1 % THD+N; Auto or Umid
<b>Power, DC</b>		
0.9 Ohm	24 V, 26 A, 624 W	Auto or Umid
0.55 Ohm	13.5 V, 24.5 A, 330 W	Auto or Umid
<b>Sink Power, DC</b>	650 W	Low Voltage Mode; see U/I-Plot
<b>Voltage Monitor</b>	$\pm 100 \text{ mV} \cong 1 \text{ V} \pm 2\%$	
<b>Current Monitor</b>	High Current Range: $\pm 200 \text{ mV} \cong 1 \text{ A} \pm 2.5 \%$	Shunt = 20 mOhm
	Low Current Range: $\pm 1.2 \text{ V} \cong 100 \text{ mA} \pm 1 \%$	Shunt = 2.5 Ohm
<b>Gain</b>		
Controlled Voltage Mode	1 V / 10 V; $\pm 0.1\%$ ( $\pm 0.01\%/^{\circ}\text{C}$ )	Uin / Uout



Parameters	Specification	Conditions/Moments
Controlled Current Mode	High Current Range: 1 V / 3 A	U <sub>in</sub> / I <sub>out</sub>
	Low Current Range: n.a.	unspecified
<b>Physical Characteristics</b>		
AC Power	230 VAC / 50 Hz	
Remote control	USB Ethernet (Option)	
Operating Temperature	10 °C to 55 °C	
Humidity	80% or less	non-condensing
Cooling	Forced air	
Dimensions (W x H x D)	449 x 177 x 585.5 mm	
Weight	Approx. 30 kg	



# 8 Block Diagram





## 9 Product Options

The following product options are available at the time of placing the order. Upgrades of existing devices are not possible.

Article Name	Article Description	Order Number
A1110-16-QE	4-Quadrant Voltage and Current Amplifier	11100070
Option-01: Custom Current Amplifier	Additional compensation network for one specified load. The device is equipped with five general-purpose networks by default.	11101010
Option-02: Internal Current Measurement	High-performance current transformer; Precision DC +/-0.1%; Output BNC bush, galvanically isolated from the amplifier	11101020
Option-03: Ultra Stable Gain	Gain $10 \pm 0,1\%$ ( $\pm 25\text{ppm}/\text{C}^\circ$ ); Offset $\pm 1\text{ mV}$ ( $\pm 25\text{ uV}/\text{C}^\circ$ )	11101030
Option-04: Basic Function Generator	DC, 0.05Hz - 300 kHz, sine, square, triangle; For usage with A1110-E-Control only.	11101040
Option-05: Isolation Amplifier	For potential isolation of input and output	11101050
Option-06: Ethernet Interface	For connection to a computer (RJ45)	11101060
Option-07: Displays for voltage and current	Displays for voltage and current (monitor outputs) in front panel	11101070
Option-08: Sensing	Adjustable voltage drop: 500 mV / 1V / 2V	11101080
Option-09: 100 V Output Voltage	Output Voltage up to $\pm 100\text{ V}$	11101090
Option-12: Adjustable Output Resistance	R: $0\text{ m}\Omega - 200\text{ m}\Omega$ ; Resolution $1\text{ m}\Omega$ ; Accuracy 0.5%	11101120
Option-14: Overvoltage Protection	For protection of amplifier outputs	11101210



## 10 Contact

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## 11 Document History

Revision	Date	Changes
2.0	March 2020	First publication in new layout