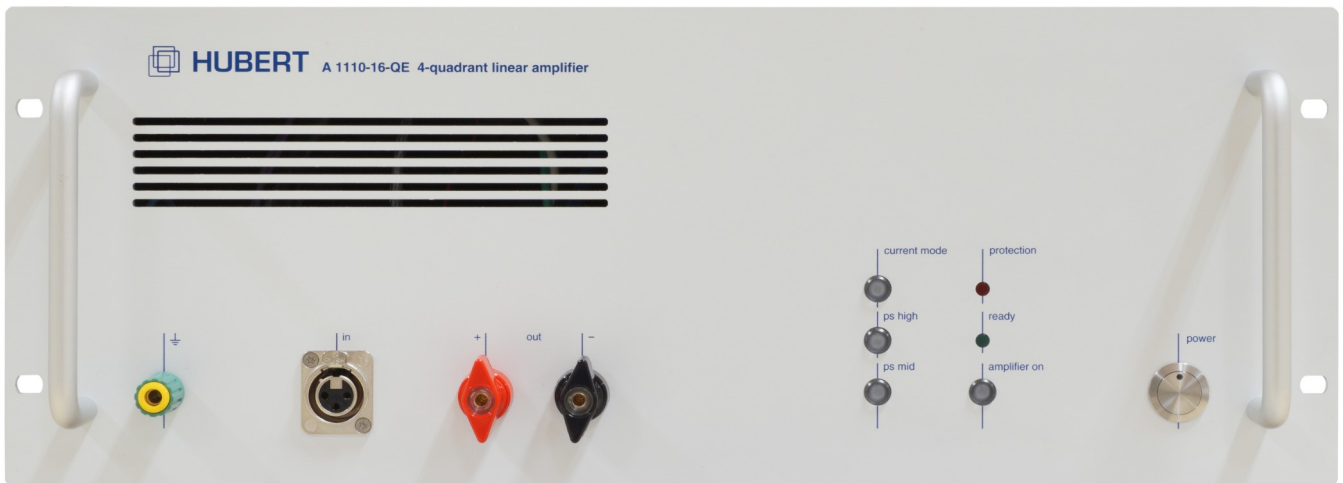


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Datasheet



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.

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 monitor outputs.

The device is equipped with a temperature-controlled, quietly-running fan. 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 device can be operated by using elements on the front panel. Additionally the device can be controlled with the supplied A1110 Control Software via an USB connection.

The device's functionality can even be extended by several product options.

Please find the latest release of this datasheet on our website:
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
- Up to 6 configurable compensation networks for inductive loads in current amplifier mode. Five general-purpose networks are onboard per default.
- Prepared for rack mounting

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.

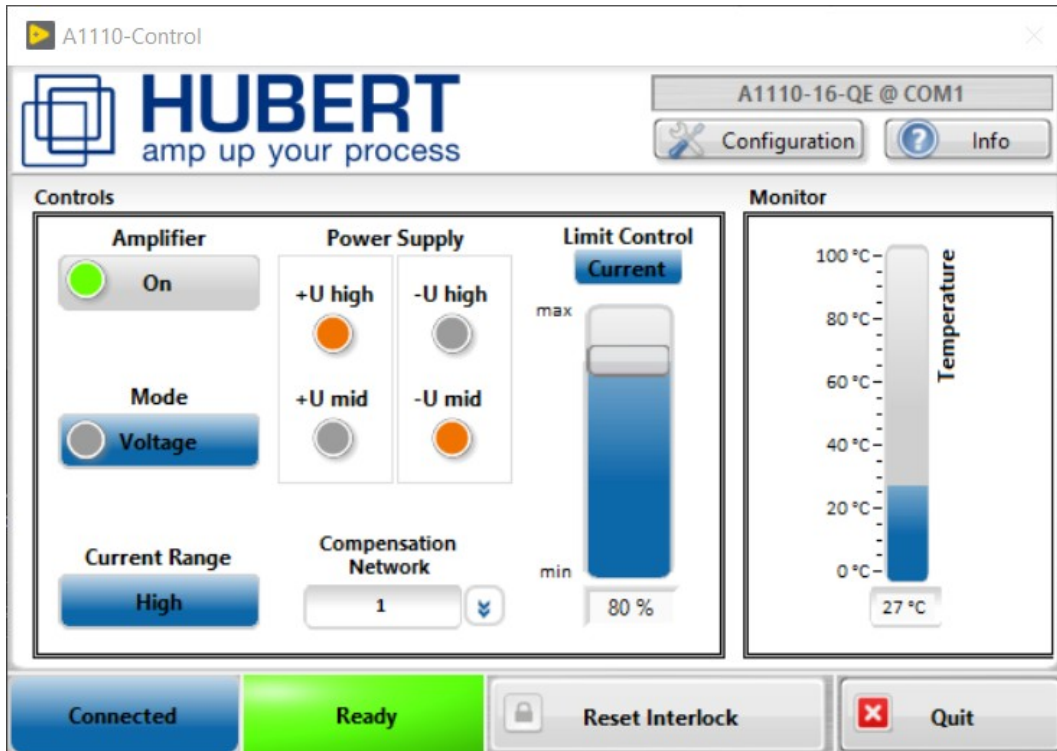


Figure 1: A1110-Control Main Menu

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>			

Table 1: Compensation Network

The selection is made by our A1110-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

Parameters	Specification	Conditions/Moments
	Controlled Voltage Mode	25° C ambient temperature Continuous operation
Input Impedance	100 kOhm 200 kOhm	unbalanced, 1kHz balanced, 1kHz
Maximum Input Level	20V _{pp}	< 1 % THD, 1 kHz, 8 Ohm Load
Common-Mode Rejection Ratio	> 60 dB	R _s = 50 Ohm, 10 Hz – 200 kHz, re +34.5 dBV @ Output
Small Signal Frequency Response		
	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
Phase response	+0, -5 degrees	10 Hz - 30 kHz
Power Response (continuous)		
8 Ohm Load	400 W	DC - 100 kHz, < 0.5% THD High Voltage Mode
	200 W	DC - 200 kHz, < 0.5% THD High Voltage Mode
3 Ohm Load	1000 W	DC - 30 kHz, < 0.5% THD High Voltage Mode
	800 W	DC - 100 kHz, < 0.5% THD High Voltage Mode
	450 W	DC - 200 kHz, < 1% THD High Voltage Mode
Slew Rate	100 V/uSec	
Residual Noise		
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
Signal-to-Noise Ratio		
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
THD+N		
10 Hz – 100 kHz	< 0.5 %	800 W @ 3 Ohm; Auto
10 Hz – 100 kHz	< 0.1 %	800 W @ 3 Ohm High Voltage Mode
Output Offset	< 1.0 mV	DC
Output Impedance	< 60 mOhm	@1 kHz; Instrument: HP8751A, Network Analyzer
Power, Pulse, 40ms, 20% Duty Cycle		
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
Current, Pulse, 500ms, 5% Duty Cycle, unipolar		
Peak Output		
60 mOhm	+ 55 A	+Umid / -Ulow
60 mOhm	- 55 A	+Ulow / -Umid
Power, Sinus, 100Hz, continuous		
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
Power, DC		
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
Sink Power, DC	650 W	Low Voltage Mode; see U/I-Plot
Voltage Monitor	$\pm 100 \text{ mV} \cong 1 \text{ V} \pm 0.5\%$	
Current Monitor	High Current Range: $\pm 200 \text{ mV} \cong 1 \text{ A} \pm 1 \%$ Low Current Range: $\pm 1 \text{ V} \cong 100 \text{ mA} \pm 1 \%$	Shunt = 10 mOhm Shunt = 2.5 Ohm
Gain		
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 Low Current Range: n.a.	U _{in} / I _{out} unspecified
Physical Characteristics		
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)	450 x 198 x 676 mm	
Weight	Approx. 30 kg	

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

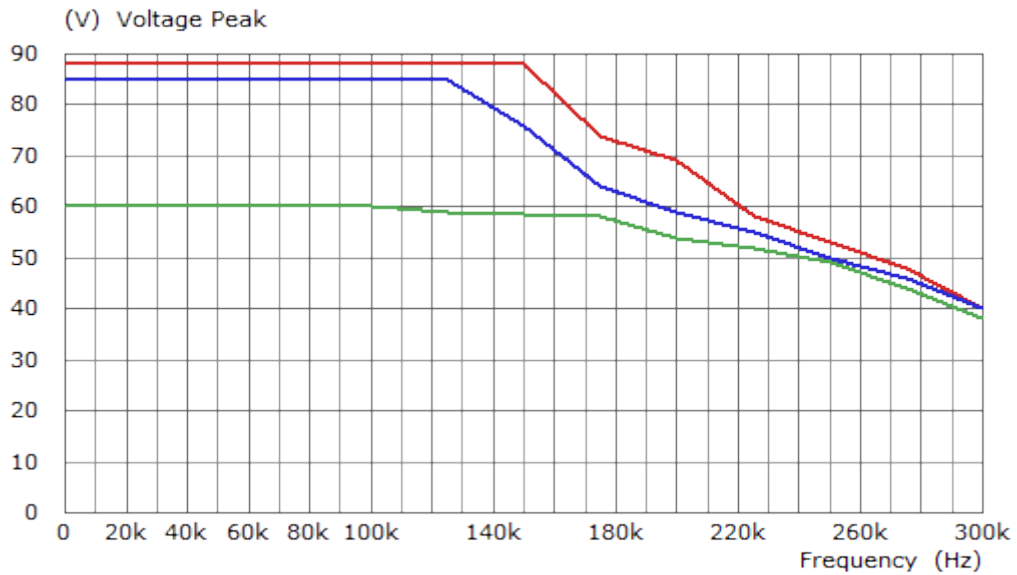
Mode	+Operating Voltage	-Operating Voltage
Auto	10 V, 45 V, 90 V	-10 V, -45 V, -90 V
Manual: + U _{mid}	45 V	auto
Manual: + U _{high}	90 V	auto
Manual: - U _{mid}	auto	-45 V
Manual: - U _{high}	auto	-90 V
Manual: + U _{mid} , -U _{mid}	45 V	-45 V
Manual: + U _{high} , -U _{mid}	90 V	-45 V
Manual: + U _{high} , -U _{high}	90 V	-90 V
Manual: + U _{mid} , -U _{high}	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.



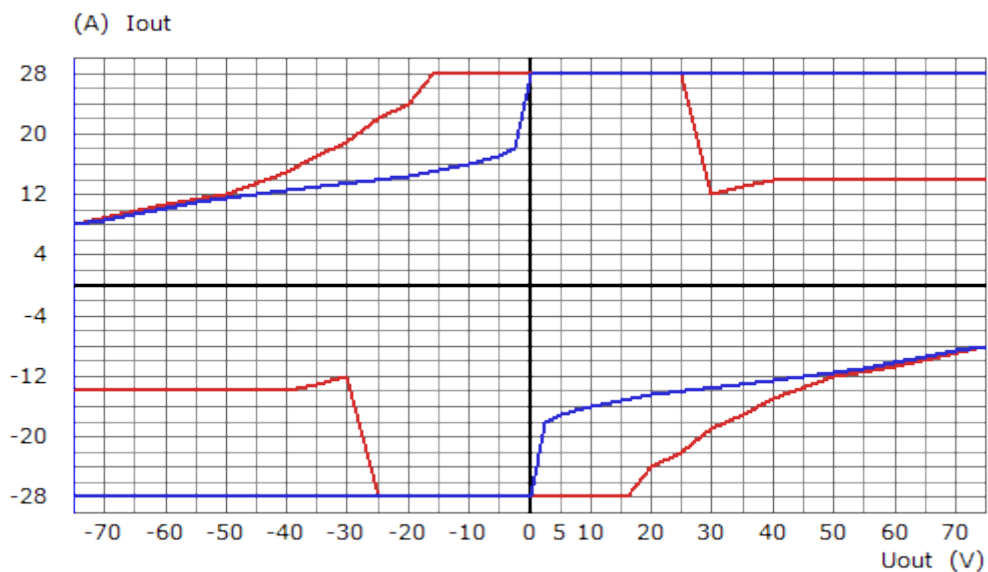
7.1 Output Voltage vs. Frequency (THD + N < 1%)

Red: @ 8 Ohm
Blue: @ 4 Ohm
Green: @ 2 Ohm

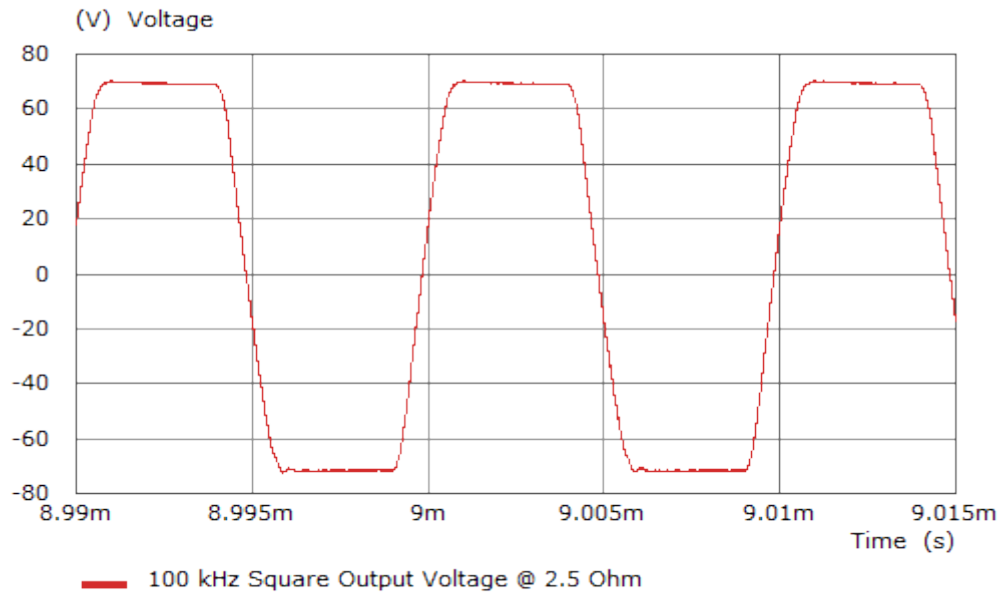


7.2 Output Current vs. Output Voltage (THD + N < 1%)

Supply Voltage: Auto
Blue: AC Limit
Red: DC Limit

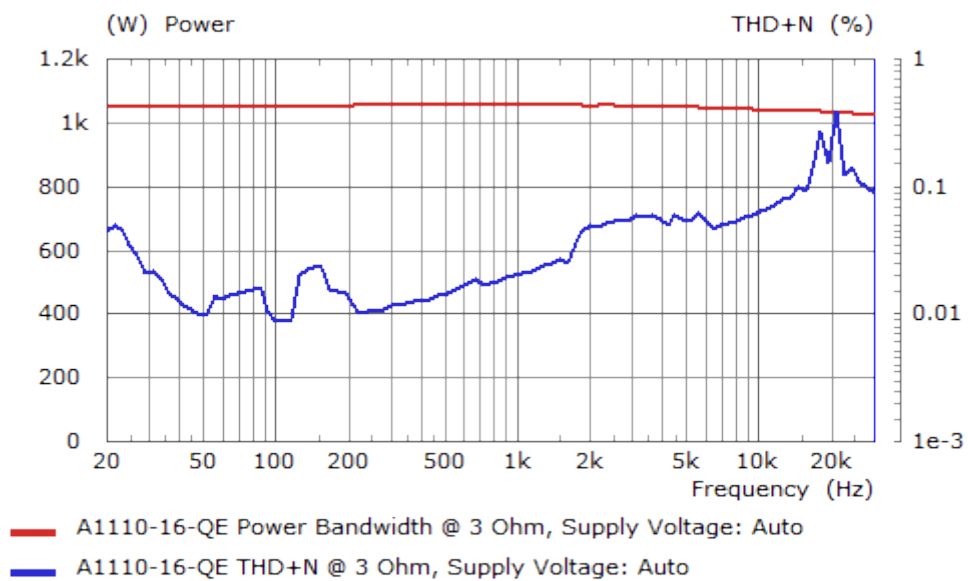


7.3 Square Wave at 100 kHz and 2,5 Ohm Load



7.4 Power Bandwidth at 3 Ohm Load

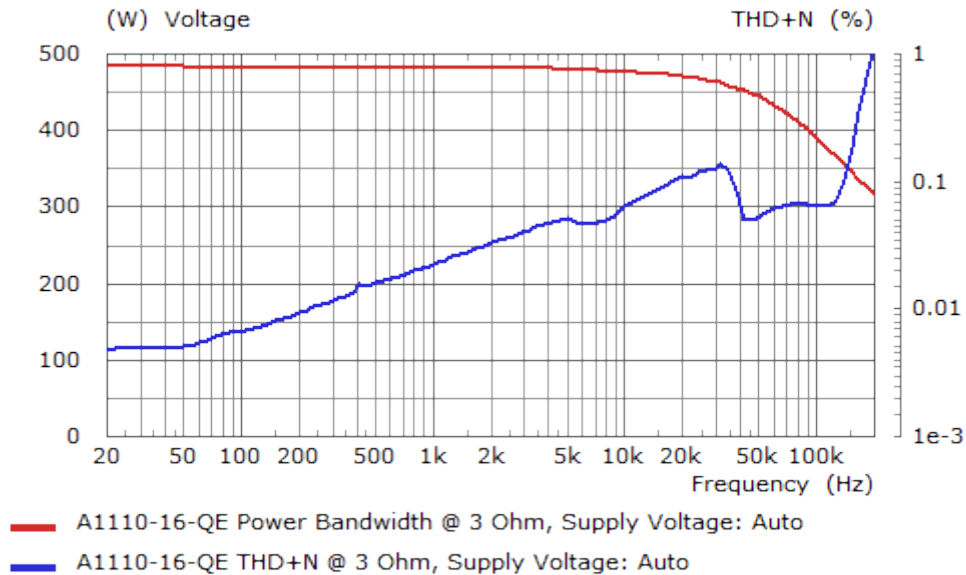
Input level normalised to max. output level at 30 kHz; THD+N < 1%





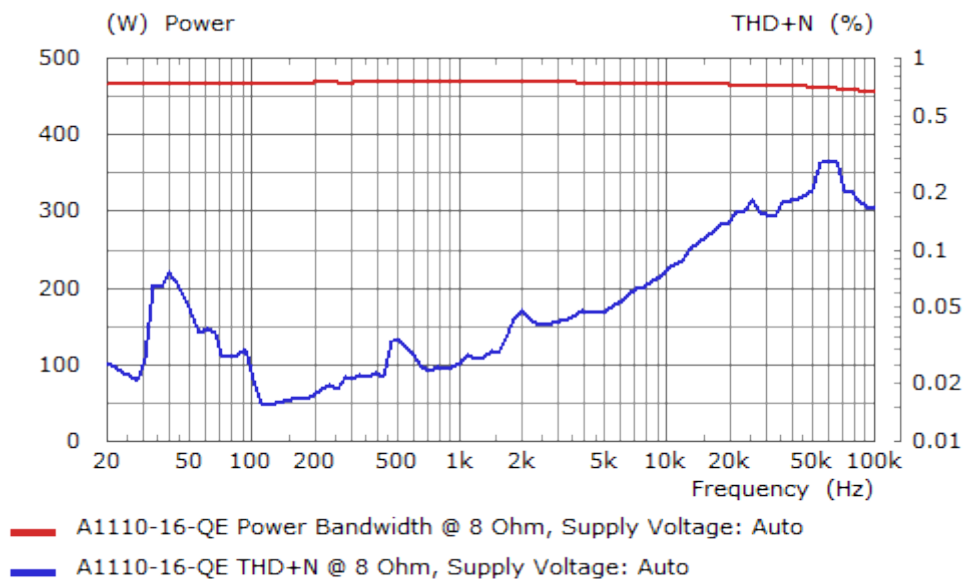
7.5 Power Bandwidth at 3 Ohm Load

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



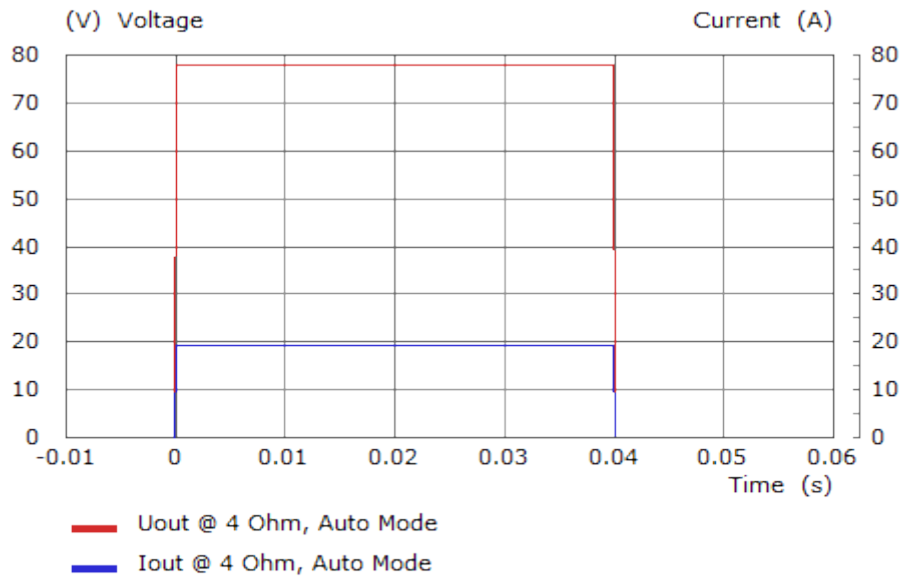
7.6 Power Bandwidth at 8 Ohm Load

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

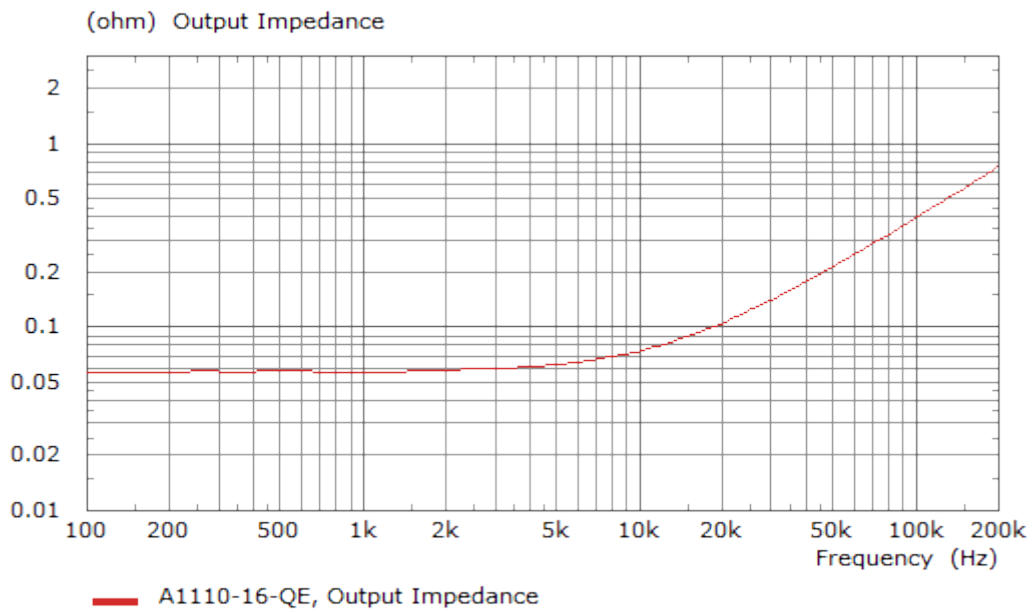




7.7 Pulse at 4 Ohm Load

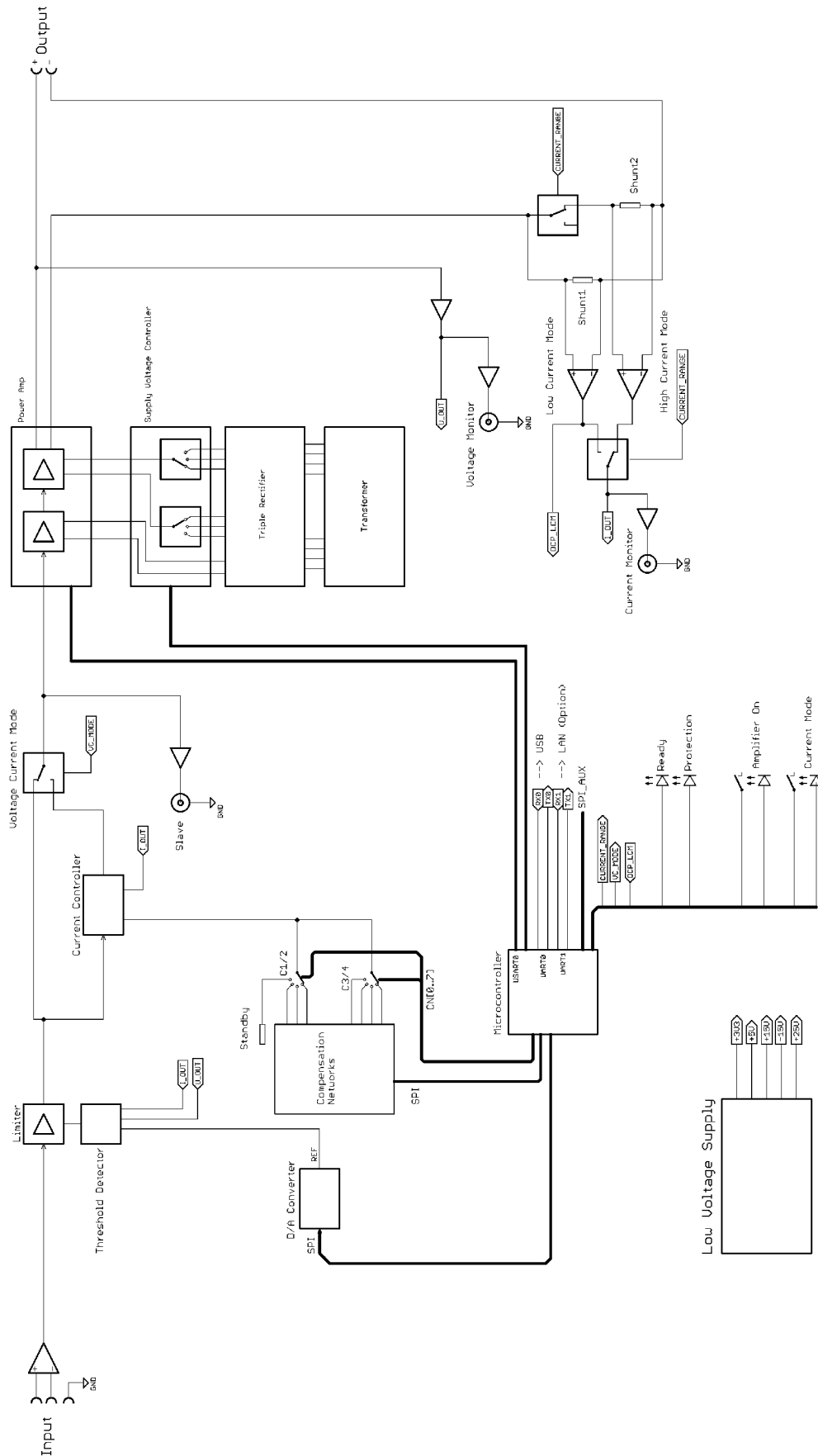


7.8 Output Impedance





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
A1110-16-QE	4-Quadrant Voltage and Current Amplifier
Option: Custom Current Amplifier	Additional compensation network for one specified load. The device is equipped with five general-purpose networks by default.
Option: Basic Function Generator	DC, 0.05Hz - 300 kHz, sine, square, triangle; For usage with A1110-E-Control only.
Option: 1-Channel Isolation Amplifier (*)	For potential isolation of input and output
Option: Ethernet Interface	For connection to a computer (RJ45)
Option: Displays for voltage and current (*)	Displays for voltage and current (monitor outputs) in front panel
Option: Sensing	Adjustable voltage drop: 500 mV / 1V / 2V
Option: Internal Current Measurement	High-performance current transformer; Precision DC +/-0.1%; Output BNC bush, galvanically isolated from the amplifier
Option: Adjustable Output Resistance	R: 0 m Ω – 200 m Ω ; Resolution 1 m Ω ; Accuracy 0.5%
Option: 3-Channel Isolation Amplifier (*)	For potential isolation of input and output
Option: Overvoltage Protection	For protection of amplifier outputs

(*) Choose one of these options per device.



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11 Document History

Revision	Date	Changes
2.0	March 2020	First publication in new layout
2.1	July 2020	Change Low-Current-Monitor Gain Correction of some measurement tolerances
2.2 (starting with SN: 20902587)	August 2020	Option-02 is now Option-10 for this device
2.3	November 2020	Option-09 moved to a separate model: A1110-16-QE-100
3.0	April 2021	New housing
3.1	May 2022	Options renamed