

High Efficiency Self Contained Amplifier Module

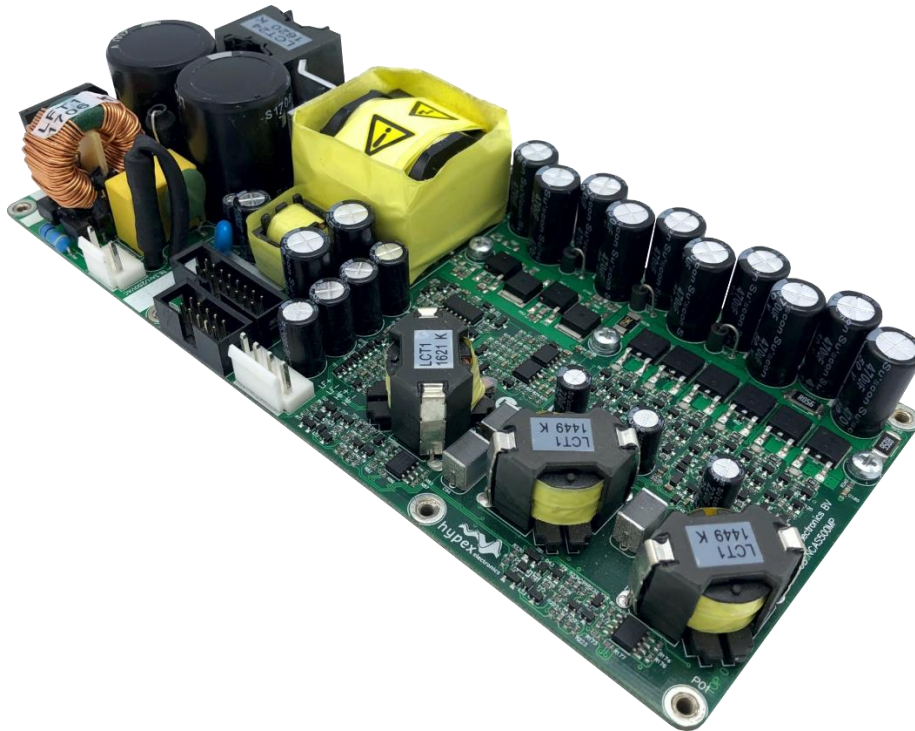


Image is for illustrative purposes only. Please refer to product description.

Highlights

- High efficiency
- Universal mains operation
- Flat, fully load-independent frequency response
- Low output impedance
- Very low, frequency-independent THD
- Very low noise

Features

- Two channel amplifier
- 5W standby SMPS
- Advanced over current protection
- Auto-switching (115/230V)
- Low weight: 415g.
- Compact: 195 x 85 x 40mm

Applications

- Active HiFi speakers
- Active monitoring speakers
- Active PA systems

Introduction

The new NCore Active Speaker (NCAS) modules are specifically designed for application in active speaker design. The modules feature two onboard NCore amplifiers: a full bridge high power channel and a half bridge medium power channel.

The NCAS500MP amplifier module incorporates a low power standby power supply (meets 2013 ERP Lot 6 0.5W requirements), a highly efficient switch mode power supply and a high-performance Class D amplifier in one compact and easily applicable power brick.

Chief distinguishing features are flat frequency response irrespective of load impedance, nearly frequency independent distortion behaviour and very low radiated and conducted EMI. Control is based on a phase shift controlled self-oscillating loop taking feedback only at the speaker output.

For applications requiring a standby mode, a low power standby SMPS also has been integrated into this product. To achieve universal mains input compatibility this SMPS features an automatic input voltage doubler.

Please make sure you always download the latest datasheet from our website.

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1 Safety precautions



This module operates at mains voltage and carries hazardous voltages at accessible parts. These parts may never be exposed to inadvertent touch. Observe extreme care during installation and never touch any part of the unit while it is connected to the mains.

Disconnect the unit from the mains and allow all capacitors to discharge for 10 minutes before handling it.



Attention: Observe precautions for handling electrostatic sensitive devices. This module uses semiconductors that can be damaged by electrostatic discharge (ESD).

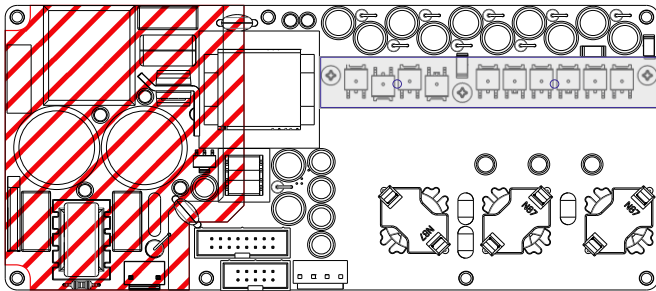
Damage due to inappropriate handling is not covered by warranty.

This product has no user-serviceable parts.



This symbol indicates the presence of hazardous voltages at accessible conductive terminals on the board. Parts that are not highlighted in red may also carry voltages in excess of 80 Vdc!

Warning: To reduce the risk of fire or electric shock, do not expose this apparatus to rain or moisture.

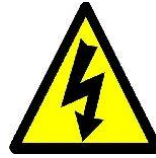


This is a Safety Class 2 device. When mounting the module in an enclosure, a minimum safety distance of 6mm from the module to all possible conducting parts must be ensured to keep compliance with Safety Class 2. All parts highlighted in red carry hazardous voltages. This includes parts on the top and the bottom of the board.

When the module is mounted on a conducting surface, a layer of insulation with a minimum thickness of 0.5mm must be used between the highlighted area, and conducting surface.

When this module is mounted in a tight space there needs to be at least 6mm clearance or a layer of insulation with a minimum thickness of 0.5mm between the top of the transformer and the housing.

1 Précautions de sécurité



Ce module est sous tension secteur et certaines de ses pièces accessibles sont sous une tension dangereuse. Ces pièces doivent dans tous les cas être protégées contre contacts accidentels. Lors de l'installation, une prudence extrême s'impose. Ne jamais toucher les pièces du module quand celui-ci est relié au secteur. Isoler l'appareil du secteur et attendre 10 minutes pour laisser à tous les condensateurs le temps de se décharger avant de le manipuler.



Attention : Respecter les consignes de sécurité pour la manipulation d'appareils sensibles aux courants électrostatiques. Ce module est pourvu de semi-conducteurs qui peuvent être endommagés par les décharges électrostatiques (DES).

Les dommages causés par un usage non approprié sont exclus de la garantie.

Ce produit ne contient aucune pièce devant être entretenue par l'utilisateur.



Ce symbole indique la présence de tensions dangereuses aux broches de raccordement accessibles sur la carte. Les pièces non marquées en rouge peuvent être elles aussi sous une tension supérieure à 80 VCC.

Avertissement: Pour réduire les risques de choc électrique, ne pas exposer cet appareil à la pluie ou l'humidité.

1. Read these instructions.
2. Keep these instructions.
3. Heed all warnings.
4. Follow all instructions.
5. Do not use this apparatus near water.
6. Protect the power cord from being walked on or pinched, particularly at plugs, convenience receptacles, and the point where they exit from the application.
7. Only use attachments/accessories specified or approved by the manufacturer.
8. Unplug this apparatus during lightning storms or when unused for long periods of time.
9. Refer all servicing to qualified service personnel. Servicing is required when the apparatus has been damaged in any way, liquid has been spilled or objects have fallen into the apparatus, the apparatus has been exposed to rain or moisture, does not operate normally or has been dropped.
10. Don't run any cables across the top or the bottom of the module. Apply fixtures to cables to ensure that this is not compromised.
11. Observe a minimum clearance of 6mm with all possible conducting parts (housing etc.).
12. Natural convection should not be impeded by covering the module (apart from the end applications housing).
13. Before using this product, ensure all cables are correctly connected and the power cables are not damaged. If you detect any damage, do not use the product.
14. Changes or modifications not expressly approved by Hypex Electronics will void compliance and therefore the user's authority to operate the equipment.
15. Service or modifications by any person or persons other than by Hypex Electronics authorized personnel voids the warranty.

2 Electrical Specifications

2.1 Power Specifications

Parameter	Conditions	Symbol	Min	Typ	Max	Unit	Note
High Line Input Voltage	-	V _B	200-240Vac ±10%			Vac	1)
Low Line Input Voltage	-	V _{B,FP}	100-120Vac ±10%			Vac	1)
Line Input Frequency	-	f	47		63	Hz	1)
Fuse rating	250Vac, slow blow			6.3		A	2)

Note 1: The unit will automatically switch to the correct line input configuration at start up. Operation beyond these limits may result in irreversible damage.

Note 2: Fuse is soldered on the PCB and is therefore not user replaceable.

2.2 Standby SMPS

The standby power supply is immediately active upon connection to the mains and can therefore be used to power external control circuitry and to operate the PS Enable pin. After disconnection from the mains the standby supply will keep running until the primary capacitors have drained.

Parameter	Conditions	Symbol	Min	Typ	Max	Unit	Note
Output voltage	-	V _{OUT}	4,9	5	5,1	Vdc	
Output current	Continues	I _{OUTMAX}	-	-	1	A	1)
Output current	For ERP compliance	I _{OUTERP}	-	-	40	mA	
External capacitance	-		-	-	4700	µF	
Switching frequency		F _{SW.Stb}	-	65	100	kHz	
Efficiency	Full power	η	74	-	-	%	
Standby power	No load	P _{Stb}	-	-	0.12	W	
Output voltage Ripple		V _{RIPPLE}	-	-	0.1	V	

Note 1: Protected against shorting and overloading, the standby power supply will automatically recover when overcurrent condition is removed.

2.3 Main SMPS

Parameter	Conditions	Symbol	Min	Typ	Max	Unit	Note
Efficiency	Full power	η	90			%	
Idle Losses	230 Vac, 50 Hz	P ₀	-	7.5	-	W	
In-rush current	5Ω In-rush NTC, worst-case	I _{Inrush}			75	A	
Switching frequency		F _{SW}	80	-	120	kHz	
Power consumption	Full power amplifier, 0.5A Vaux, 1A Standby	P _{max}	-	-	650	W	
Output Voltage Vaux	Symmetric power supply	V _{AUX}	±19	±20	±21	Vdc	
Output Current Vaux	Per rail	I _{AUX}	-	-	500	mA	
External capacitance	-		-	-	1000	µF	

2.4 Ncore Amplifier Specifications

Parameter	Conditions	Symbol	Min	Typ	Max	Unit	Note
Max Output Power	Channel 1, 1KHz, THD=1%	$P_{R, 4\Omega}$	-	-	440	W_{rms}	1)
		$P_{R, 8\Omega}$	-	-	400	W_{rms}	1)
	Channel 2, 1KHz, THD=1%	$P_{R, 4\Omega}$	-	-	120	W_{rms}	1)
		$P_{R, 8\Omega}$	-	-	100	W_{rms}	1)
Continuous Output Power	Per channel, 25°C ambient temperature.	$P_{R,cont_CH1}$	-	80	-	W_{rms}	2)
		$P_{R,cont_CH2}$	-	20	-	W_{rms}	2)
Distortion	<10Hz-20kHz AES17 $P_{out} < P_R/2$	THD+N	-	-	0.007	%	3)
	<10Hz-20kHz AES17 $P_{out} = 1W$		-	-	0.005	%	3)
CMRR			-	65	-	dB	
Signal-to-Noise Ratio	Channel 1		-	119	-	dB	
	Channel 2		-	113	-	dB	
Output Noise	Unwtd, <10Hz-20kHz AES17, 0Ω termination	U_N	-	-	60μ	V	
Output Impedance	f<1kHz	Z_{OUT}	-	-	2	mΩ	
	f<20kHz		-	-	10	mΩ	
Power Bandwidth		PBW		20-35k		Hz	4)
Frequency Response	+0/-3dB. All loads.		10	-	50k	Hz	
Voltage Gain Buffered		A_{V_CH1}	31	31.5	32	dB	
		A_{V_CH2}	25	25.5	26	dB	
Voltage Gain Unbuffered		A_{V_CH1}	13	13.5	14	dB	
		A_{V_CH2}	11.5	12	12.5	dB	
Efficiency	Full power	η		92	-	%	
Current Limit.	Hiccup both channels after limiting 40ms	Ch1	-	15	-	A	
		Ch2	-	9	-	A	

Note 1: The stimulus signal is a continuous 1 kHz sine wave. The true rms output voltage is measured across a load resistor and the power is calculated by the formula $\frac{V_{rms}^2}{R_{load}}$. Peak output power is time limited due to thermal properties.

Note 2: Typically this is 1/4 of the peak output power. Apply sufficient cooling.

Note 3: An Audio Precision AES17 20 kHz is used during this measurement.

Note 4: Dielectric losses in the output capacitor limit long term (>30s) full-power bandwidth to 5kHz.

Note 5: The factory default is a buffered input with a gain of 13.5 dB/12.5dB. This can be bypassed as explained in section 2.5 “Input buffer and gain”.

2.5 Ncore Amplifier Audio IO Characteristics

Parameter	Conditions	Symbol	Min	Typ	Max	Unit	Note
Input Impedance	Either input to ground	Z _{IN}		47k		Ω	
Loudspeaker impedance range		Z _L	4	8	-	Ω	

Signal Coupling

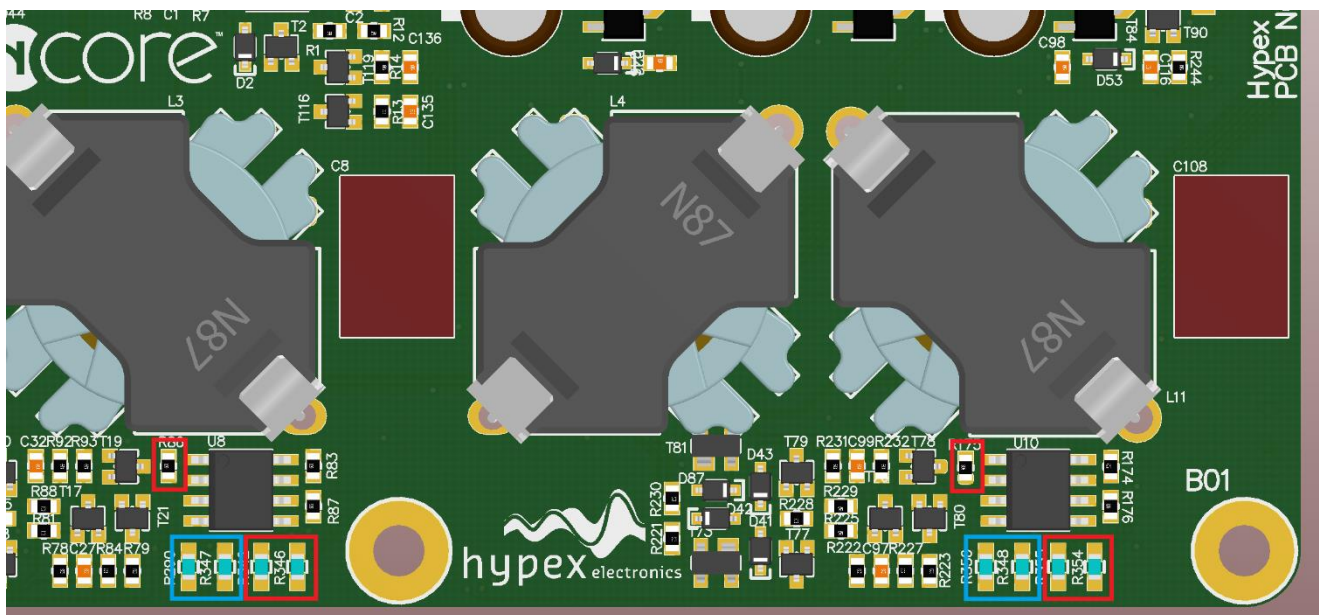
To achieve optimal signal coupling, the audio signal inputs are all DC coupled. One must make sure that the connected application is free of DC offset.

Balanced or unbalanced

All Hypex modules are completely balanced for optimal performance. The modules can be connected to an unbalanced source. To do this correctly, please read our application notes: *'Dealing with legacy pin 1 problems'* and *'Amplifier signal input wiring'*.

Input buffer and gain

This module is equipped with an input buffer. It is possible to bypass the input buffer by removing R86, R175, R342, R346, R354 and R355 and placing a 0 ohm 0603 size resistor on placeholder R290, R347, R354 and R356. Placement of these resistors are shown in the figure below. Furthermore, changing the gain of the module is not supported.



Resistors in the red squares need to be re moved, resistors in the blue squares need to be added for unbuffered operation

Input sensitivity

Below a formula is given to calculate the balanced input signal level for a desired output level. An example is given using P_{RATED} W, Load 4Ω, Gain 25.6

$\frac{\sqrt{P_{RATED} * \Omega_{LOAD}}}{10^{\left(\frac{Gain}{20}\right)}} = Input V_{RMS}$	$V_{RMS} * \sqrt{2} = Input V_{Peak}$	$20 * \log_{10} \left(\frac{V_{RMS}}{0.7746} \right) = Input dBu$
↓	↓	↓
$\frac{\sqrt{400 * 4}}{10^{\left(\frac{25.6}{20}\right)}} = 2.1 V_{RMS}$	$2.1 * \sqrt{2} = 3.0 V_{Peak}$	$20 * \log_{10} \left(\frac{2.1}{0.7746} \right) = 8.7 dBu$

2.6 Timing Specifications

These timing specifications are measured at room temperatures, approximately 21°C, 230Vac.

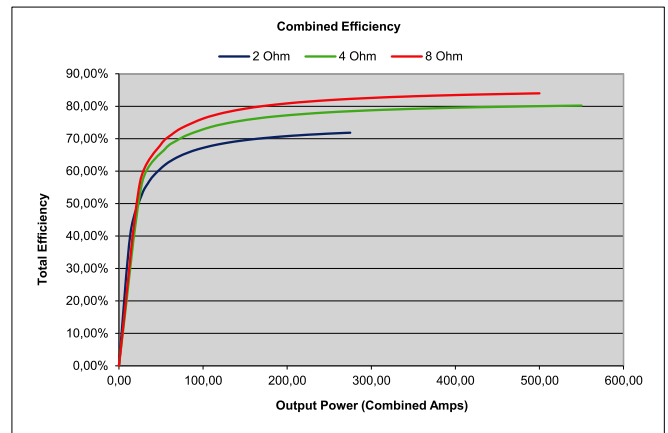
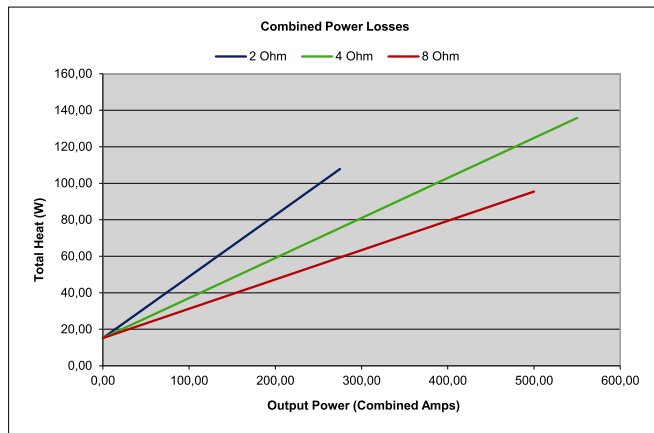
Parameter	Conditions	Min	Typ	Max	Unit	Note
Standby start up delay	Time mains presence, till standby supply is within operational limits		10		ms	
Switching start up delay	Time mains presence, till all power supplies are within operational limits	230V	100	150	ms	
		115V	650	750	ms	
Output delay	Time delay to signal, from moment all power supplies are within operational limits		1500		ms	
Mute delay	Time delay to mute		25		us	
Unmute delay	Time to unmute		120		us	
Shutdown delay	Supply failure or Standby pin		550		us	

3 Environmental Specifications

Parameter	Conditions	Symbol	Min	Typ	Max	Unit	Note
Ambient Temperature	Storage		-25	-	70	°C	
	Operation	T_{amb}	0	-	45	°C	
Heat-sink Temperature		$T_{h,max}$			95	°C	
Humidity	Max 85 percent relative humidity, non-condensing.						



3.1 Heat dissipation

Class D amplifiers’ known high efficiency often leads to a gross underestimation of the cooling required. Please apply adequate cooling to the module to ensure the module operates within specification. The following graphs provide an indication of the heat (in Watts) generated at different output levels. For more information regarding cooling, please refer to our application note “Thermal Design”, available on our website. Defects caused by overheating due to poor thermal management are not covered by warranty.



4 Product Markings

This module has two marking stickers applied.

Model sticker	Identification sticker
<p>Hypex Electronics BV</p> <p>NCAS500MP 100-120~ / 200-240V~ 50-60Hz 630W MAX</p> 	 <p>Hypex Electronics B.V. Kattegat 8, NL-9723JP</p> <p>WK/YR: wyyy H04U002972-0100A12345-0123 NCAS500MP</p>

5 IO Specifications

5.1 Power Supply Enable

By asserting the PS Enable pin of the H-Bus connector the Main-SMPS is enabled. The Standby-SMPS is enabled from the moment that the module is connected to mains. Therefore, the Standby-SMPS can be used to activate the Main-SMPS. When the Main-SMPS is powered up, the amplifiers will be enabled, providing there is no failure and Amplifier Mute is not asserted.

Parameter	Conditions	Symbol	Min	Typ	Max	Unit	Note
SMPS enabled	Logic High level		3,3	-	12	Vdc	¹⁾
SMPS in standby	Logic Low level		-	-	0.8	Vdc	

Note 1: The current (A) drawn can be calculated as follows: $(V_{pin} - 0.7) / 22000$

5.2 Amplifier Mute

By asserting either of the Amplifier Mute pins on the H-Box connector both amplifiers will be muted. This pin may be left unconnected if the mute function is not used.

Parameter	Conditions	Symbol	Min	Typ	Max	Unit	Note
Amplifier mute	Logic High level		3,3	-	12	Vdc	¹⁾
Amplifier un-mute	Logic Low level		-	-	0.8	Vdc	

Note 1: The current (A) drawn can be calculated as follows: $(V_{pin} - 0.7) / 10000$

5.3 DC-Error

If a DC component is present at either of the speaker outputs, the nFatal bus will be pulled down. This triggers the main SMPS to switch off and the DC Error to be activated. To reset the DC Error the module must be disconnected from mains for at least 10 minutes to allow the primary capacitors to drain. A DC Error does not affect the standby SMPS.

Parameter	Conditions	Symbol	Min	Typ	Max	Unit	Note
Collector voltage	Open collector output		-	-	50	V	
Collector current	Open collector output		-	-	100	mA	

5.4 Power Good

The Power Good will be activated if the main SMPS is functioning correctly. If the main SMPS is disabled, the Power Good pin is immediately released.

Parameter	Conditions	Symbol	Min	Typ	Max	Unit	Note
Collector voltage	Open collector output		-	-	50	V	
Collector current	Open collector output		-	-	100	mA	

5.5 Amplifier Clip Indicator

If a clip conditions occurs the Amplifier Clip Indicator pin will be pulled to ground.

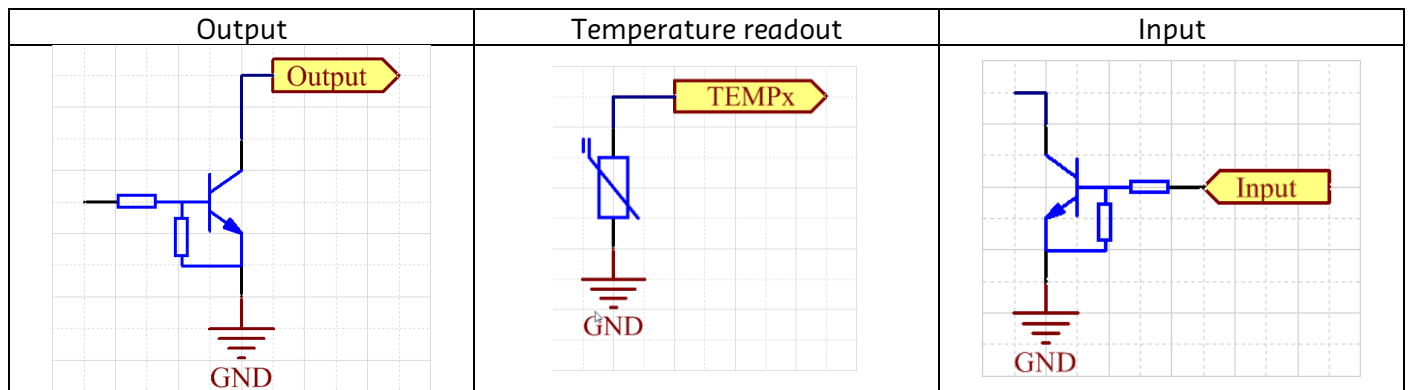
Parameter	Conditions	Symbol	Min	Typ	Max	Unit	Note
Collector voltage	Open collector output		-	-	50	V	
Collector current	Open collector output		-	-	100	mA	

5.6 Temperature Readout

A NTC is placed near the amplifier FET's and can be used to monitor the temperature. The NTC is connected to GND and accessible via the H-Box connector. The characteristics of the NTC are stated in the datasheet of the NTC manufacturer.

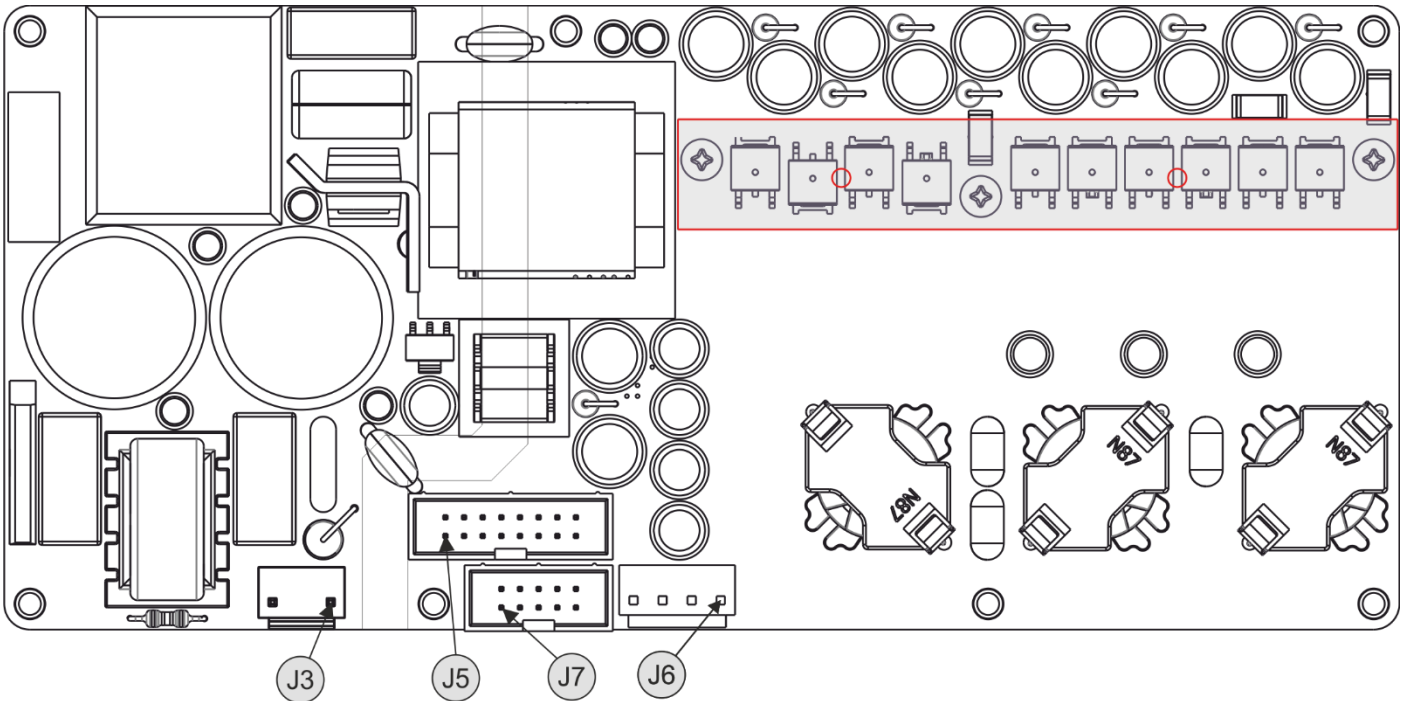
Parameter	Conditions	Symbol	Min	Typ	Max	Unit	Note
Resistor value	100°C - 25°C		0.9	-	10	kΩ	
Permissive Operating Current	25°C				0.31	mA	

NTC type: NCP18XH103J03RB



6 Connector Pinouts

This chapter describes the functional connectors of the amplifier module. A connector not stated in this chapter is only used for production or quality control and must remain unconnected in the end user appliance. The arrows point towards pin1 of the connector, for more information regarding a specific connector, please refer to the corresponding datasheet.



6.1 H-Box connector

Pin	Direction	Function	Remarks
J5.1	Input	CH1 In -	Inverting audio input Channel 1
J5.2	Input	CH1 In +	Non-inverting audio input Channel 1
J5.3	-	CH1 GND	Ground
J5.4	Input	Mute	Amplifier mute (both channels)
J5.5	Output	CH1 Clip	Clip indicator Channel 1
J5.6	Input	CH1 HWAddr	Not connected
J5.7	Output	CH1 ISense(1)	Not connected
J5.8	Output	CH1 Thermal	Temperature readout Channel 1
J5.9	Output	CH2 Thermal	Not connected
J5.10	Output	CH2 ISense(2)	Not connected
J5.11	Input	CH2 HWAddr	Not connected
J5.12	Output	CH2 Clip	Clip indicator Channel 2
J5.13	Input	Mute	Amplifier mute (both channels)
J5.14	-	CH2 GND	Ground
J5.15	Input	CH2 In +	Non-inverting audio input Channel 2
J5.16	Input	CH2 In -	Inverting audio input Channel 2

Connector type equivalent: T821116A1S100CEU

Contact material: Brass, gold flash over nickel

6.2 H-Bus connector

Pin	Direction	Function	Remarks
J7.1	Output	V _{AUX}	Positive auxiliary supply
J7.2	Output	V _{AUX}	Negative auxiliary supply
J7.3	Output	V _{OUT,STANDBY}	Regulated standby supply
J7.4	-	GND	Ground
J7.5	n.c.	SDA (I ² C)	Not connected
J7.6	n.c.	SCL (I ² C)	Not connected
J7.7	Output	DC Error	DC Offset detected, power supply disabled.
J7.8	Output	Power Good	Power supply stable indicator
J7.9	Input	PS Enable	Power supply enable
J7.10	Reserved	Reserved	Not connected

Connector type equivalent: T821116A1S100CEU

Contact material: Brass, gold flash over nickel

6.3 Loudspeaker Connector

Pin	Direction	Function	Remarks
J6.1	-	LS2-	Cold Loudspeaker Output On-board Amp Channel 2
J6.2	Output	LS2+	Hot Loudspeaker Output On-board Amp Channel 2
J6.3	-	LS1-	Cold Loudspeaker Output On-board Amp Channel 1
J6.4	Output	LS1+	Hot Loudspeaker Output On-board Amp Channel 1

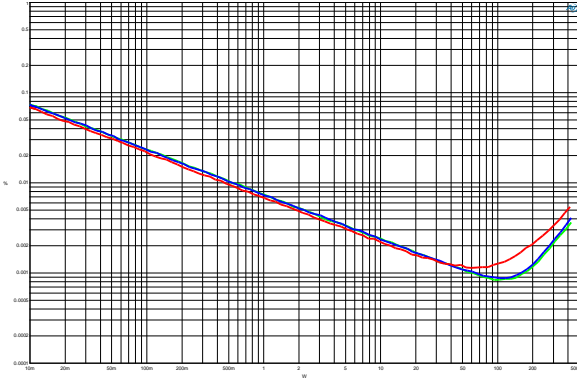
Connector type: B4P-VH(LF)(SN)

6.4 AC Connector Specification

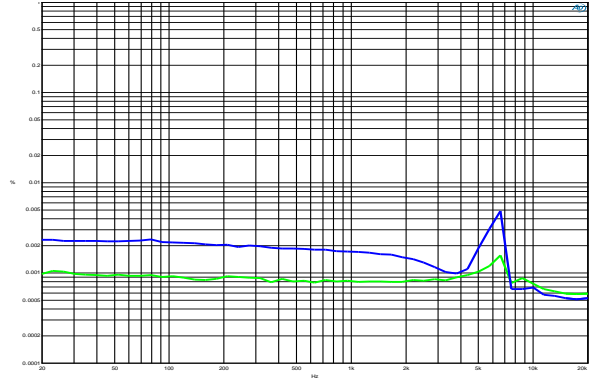
Pin	Direction	Function	Remarks
J3.1	Input	Mains input	Neutral AC
J3.3	Input	Mains input	Phase AC

Connector type: B2P3-VH(LF)(SN)

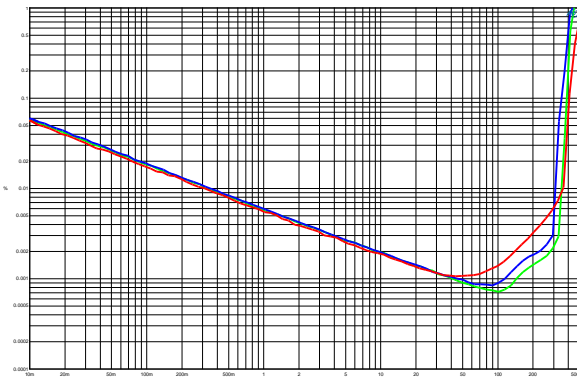
7 Typical Performance Graphs Channel 1



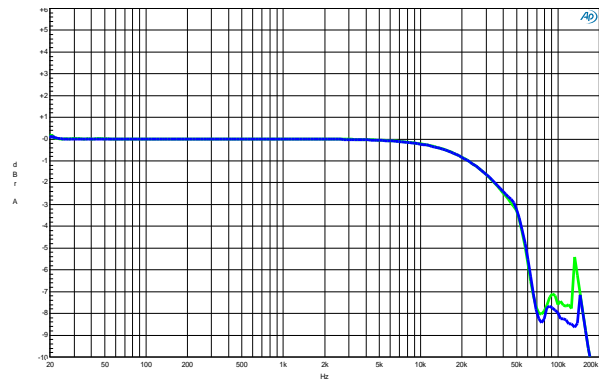
THD+N vs. power at 100Hz (blue), 1kHz (green) and 6kHz (red) (4Ω).



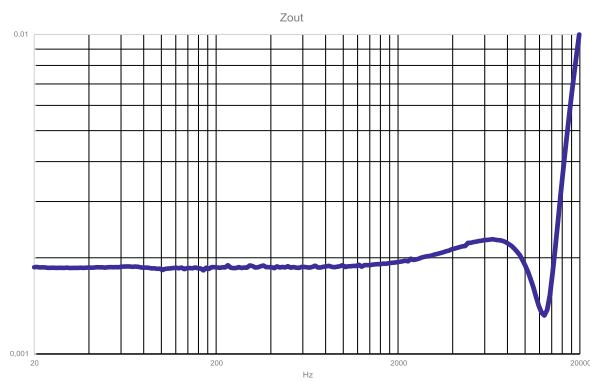
THD+N vs. Frequency at $P_R/2$ in 4Ω (blue) and 8Ω (green).



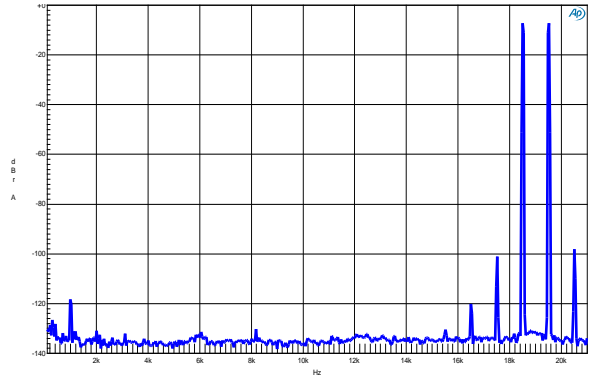
THD+N vs. power at 100Hz (blue), 1kHz (green) and 6kHz (red) (8Ω).



Frequency response in 2Ω (blue) and 4Ω (green).

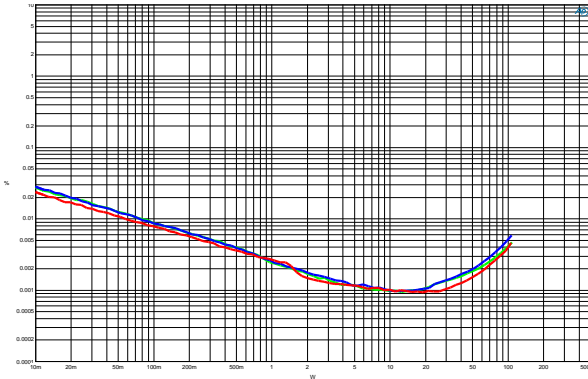


Output impedance

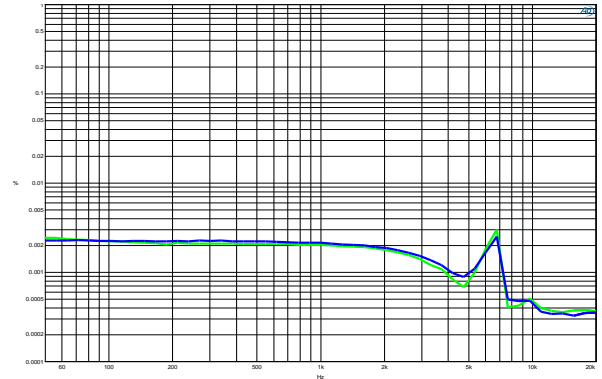


IMD spectrum at 18.5kHz + 19.5kHz, $P_R/2$ in 8Ω (blue).

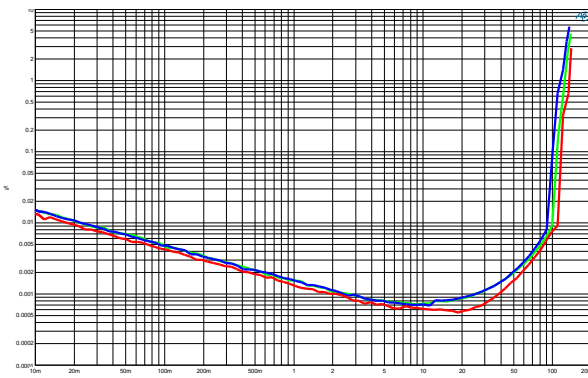
8 Typical Performance Graphs Channel 2



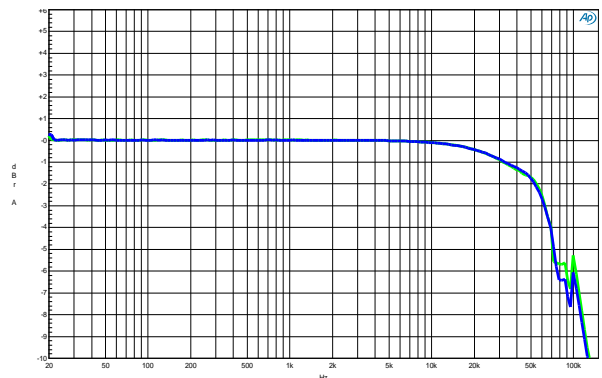
THD+N vs. power at 100Hz (blue), 1kHz (green) and 6kHz (red) (4Ω).



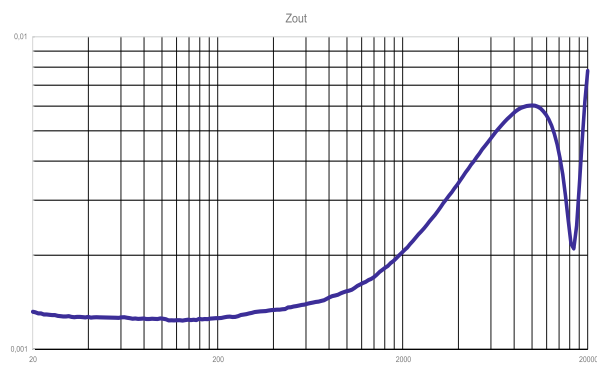
THD+N vs. Frequency at P_R/2 in 4Ω (blue) and 8Ω (green).



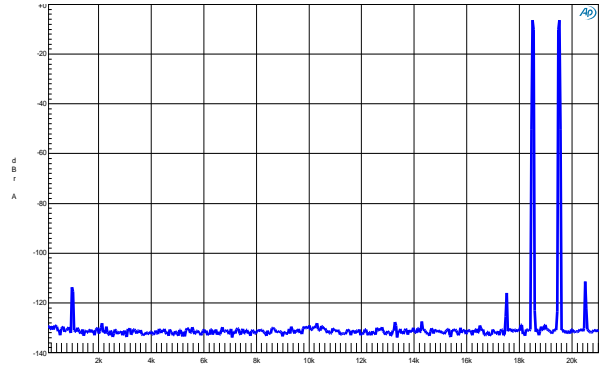
THD+N vs. power at 100Hz (blue), 1kHz (green) and 6kHz (red) (8Ω).



Frequency response in 4Ω (blue) and 8Ω (green).



Output impedance

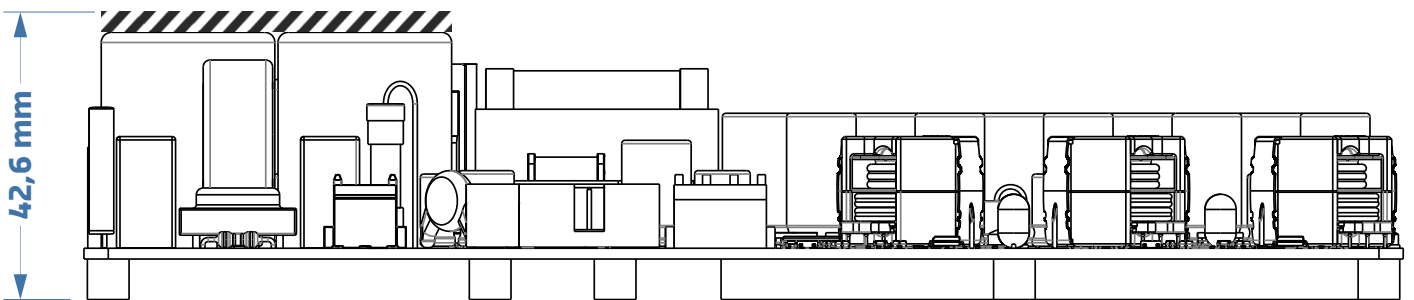
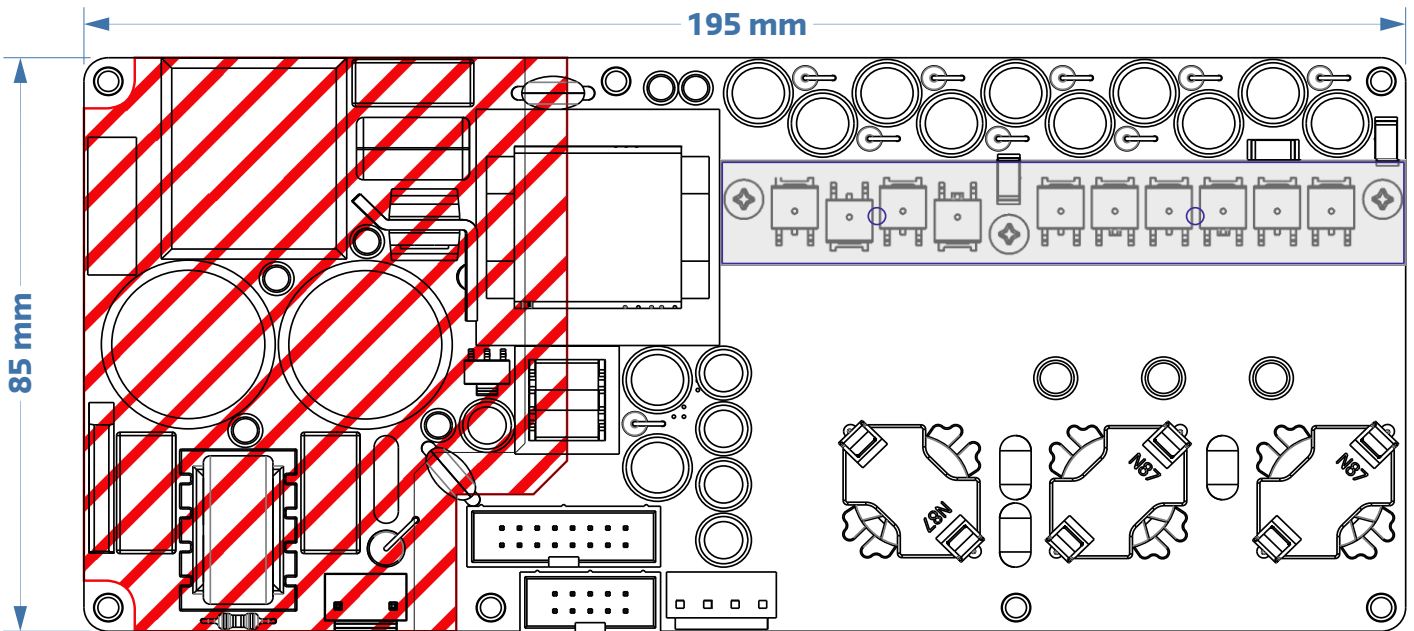


IMD spectrum at 18.5kHz + 19.5kHz, P_R/2 in 8Ω (blue).

9 Dimensions

9.1 Top and side view

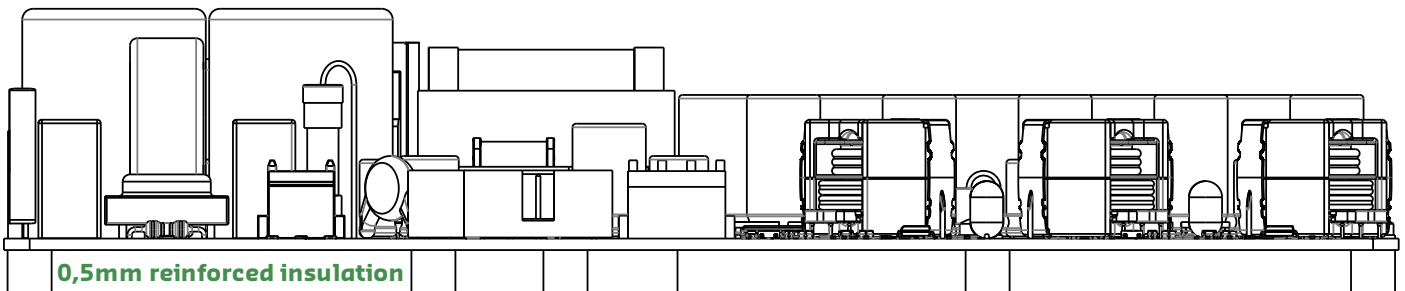
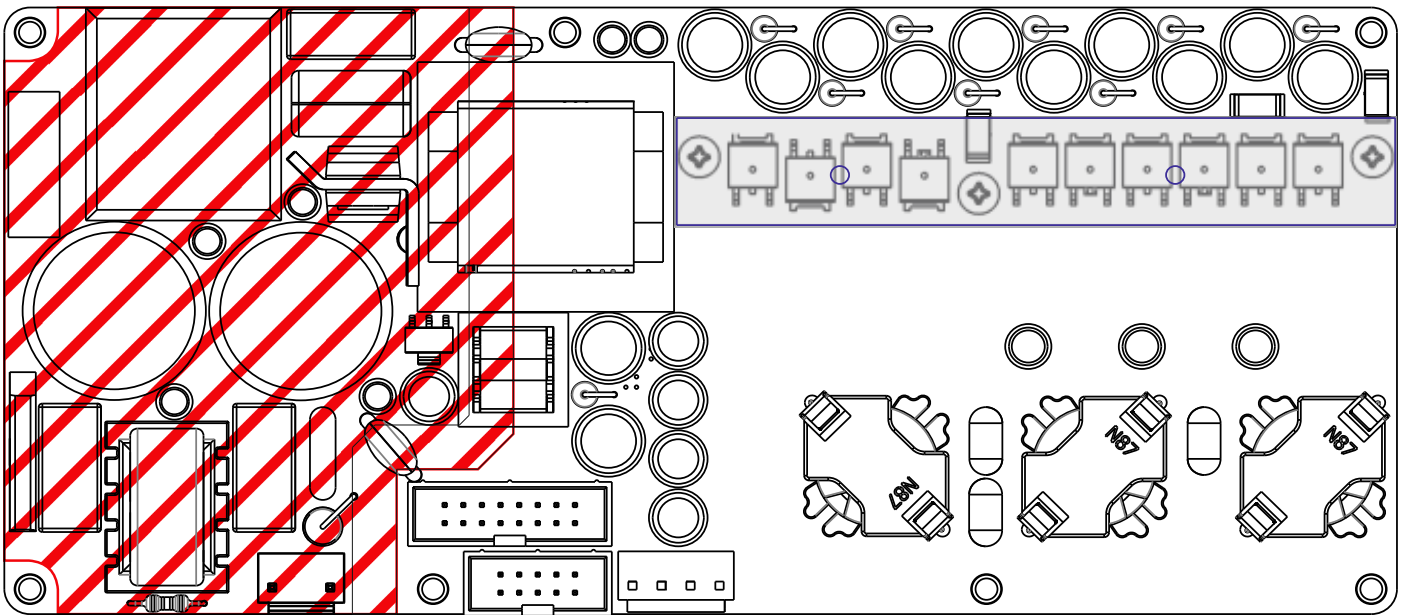
Parameter	Remarks	Symbol	Min	Typ	Max	Unit	Note
Hight			-	42.6	44	mm	
Width			84.6	85	85.4	mm	
Length			194.6	195	195.4	mm	



9.2 Insulation layer

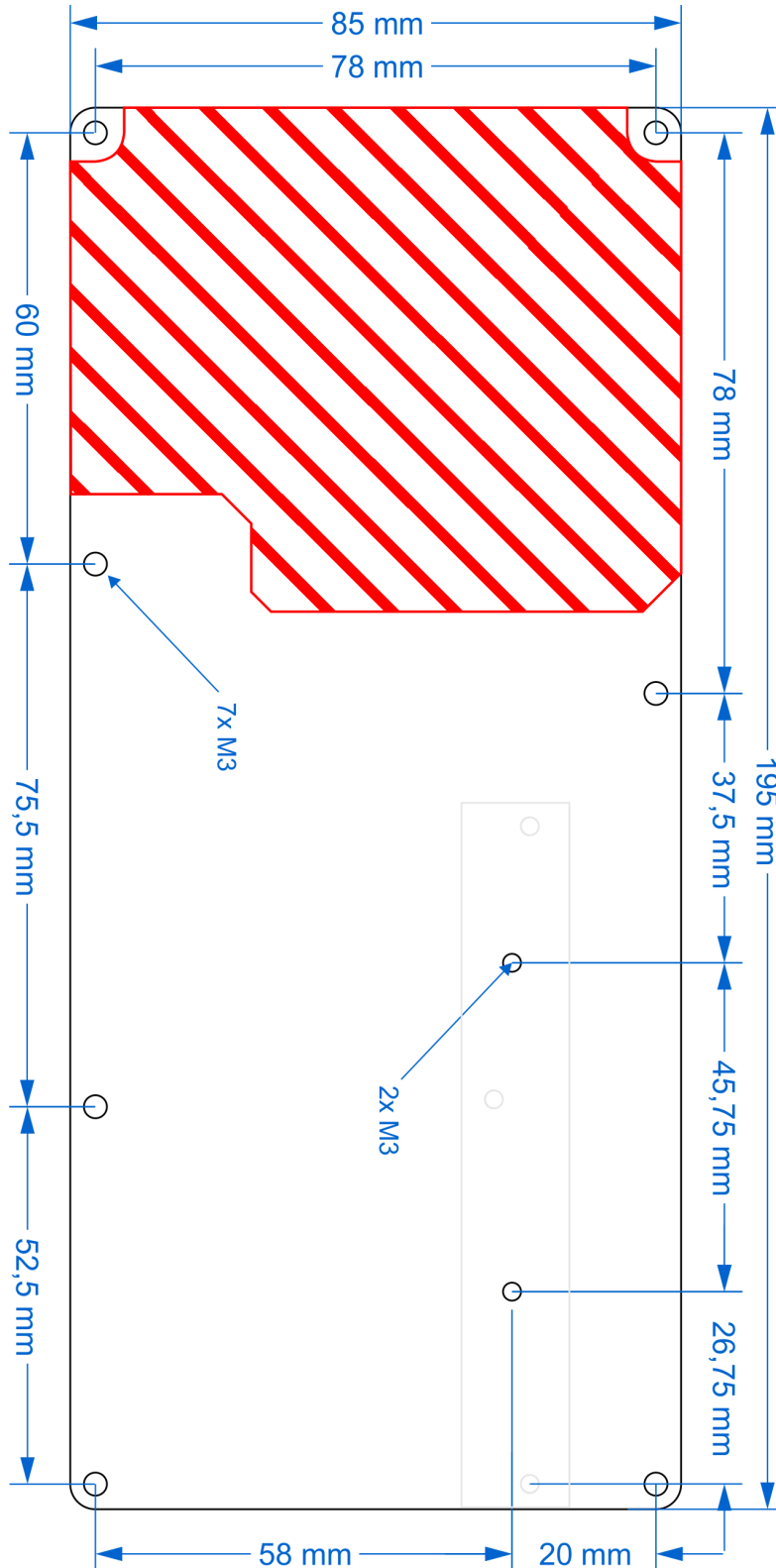
This is a Safety Class 2 device. When mounting the module in an enclosure, a minimum safety distance of 6mm from the module to all possible conducting parts must be ensured to keep compliance with Safety Class 2. All parts highlighted in red carry hazardous voltages. This includes parts on the top and the bottom of the board.

When the module is mounted on a conducting surface, a layer of insulation with a minimum thickness of 0.5mm must be used between the highlighted area, and conducting surface.



9.3 Drill pattern

Maximum allowed protruding depth inside each spacer is 4mm. Spacer threads are M3. All fixture dimensions are subjected to $\pm 0.2\text{mm}$ tolerance.



10 Safety compliance

The NCAS500MP revisions 0100 and higher is safety tested according to the following standards:

- IEC 62368-1:2014 + A11:2017
 - National deviations for CENELEC countries
 - National deviations for USA
 - National deviations for Canada
 - National deviations for New Zealand
 - National deviations for Australia
 - National deviations for Japan

Relevant standards

The NCAS500MP revisions 0100 and higher fulfils the requirements of:

- IEC62368-1:2014 + A11:2017
- UL62368-1:2014 Ed.2
- CSA C22.2#62368-1:2014 Ed.2

Test procedure

- CB scheme IEC62368-1
 - Test laboratory: Intertek SEMKO
 - Ref Certif. No: SE-106803

ETL listing

The NCAS500MP is an ETL listed component for the USA (UL62368-1:2014 Ed. 2) and Canada (CSA C22.2#62368-1:2014 Ed.2).

11 Revisions

Document revision	Module revision	Change log	Date
00	NCAS500MP 00xx	Preliminary version	Jan 2020
01	NCAS500MP 01xx	Document number changed for production version	Sep 2020
02	NCAS500MP 01xx	Updated maximum ambient operating temperature to 45°C Added safety compliance information	Apr 2022

12 Disclaimer

All products, product specifications and data are subject to change without notice to improve reliability, function or design or otherwise.

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