

# M-PRO2 Series Data Sheet



M-PRO2

# Table of Contents

Product series outline.....	3
Absolute maximum ratings.....	3
Audio specifications.....	4
Input & Output loading.....	5
AC Mains and power loss specification .....	5
Audio measurements.....	6
Frequency response channel (SE).....	6
Total Harmonic Distortion + Noise.....	6
Noise Spectrum .....	7
Intermodulation Distortion (CCIF, TIM).....	7
Cross Talk & Output impedance .....	8
Product connections and LED indicators.....	9
LED Functionality .....	9
LED timing during start-up & shut-down.....	9
Connectors.....	10
Open Collector Outputs.....	12
Fan Control.....	12
Power Up-/Down timing diagram.....	12
Single Ended (SE) & Bridge Tied Load (BTL) configuration .....	13
SE input configuration.....	13
BTL input configuration.....	13
Protection features.....	14
Over current protection .....	14
DC protection .....	14
Over-/under voltage protection .....	14
Mains fuse protection .....	14
Temperature protection.....	14
Sleep Mode.....	14
High frequency protection .....	15
Readouts .....	15
Clip.....	15
Dis read/Protect.....	15
SMPS Limit.....	15
Output voltage .....	15
Output current.....	15
Temp Monitor.....	15
Mechanical Dimensions M-PRO2.....	16
Safety compliance .....	17
Electro Magnetic Compliance.....	17
ESD warning.....	17
Changes .....	17

## Product series outline

The M-PRO module is a true application dedicated “power pack” for the most demanding and powerful professional speaker applications, requiring high-end sonic quality as well as true professional reliability under any condition.

The M-PRO module includes a fully integrated universal mains power supply and 2 high performance Class D amplification stages.

Key features are outlined below:

- Plug'n play integrated power package complete with all readout- and protection features for Professional applications, such as subwoofers, high power monitors and line arrays or small speaker systems. The complete integration secures optimal performance and reliability as well as shortened time to market.
- Fully protected high efficiency UREC™ switch mode power supply with auto selectable mains, enabling hassle free worldwide operation.
- Pascal proprietary UMAC™ Class D optimized amplifier power stages, with leading Power performance specification and market acknowledged audio specifications.
- Complete interface, including extensive readouts and high Auxillary power for the most advanced DSP solutions.
- EMI and Safety compliant design

## Absolute maximum ratings

Symbol	Parameter	Value	Unit
$V_{ACmax}$	Maximum off-line voltage	265	$V_{AC}$
$V_{ACmin}$	Minimum off-line voltage	85	$V_{AC}$
$f_{AC}$	AC Mains frequency range	45 - 65	Hz
$I_{+15Vmax}$	Maximum +15V current draw <sup>1</sup>	150	mA
$I_{-15Vmax}$	Maximum -15V current draw <sup>1</sup>	-150	mA
$I_{+7Vmax}$	Maximum 7V current draw	1000	mA
$V_{in\_p\_max}$	Maximum peak input voltage, all channels	+/-15	$V_p$
$R_{load\ ch1}$	Minimum loudspeaker impedance ch1	4	$\Omega$
$R_{load\ SE}$	Minimum loudspeaker impedance, SE-mode	4	$\Omega$
$R_{load\ BTL}$	Minimum loudspeaker impedance, BTL-mode	8	$\Omega$
$T_a$	Maximum operating ambient temperature	60	$^{\circ}C$

Table 1: Absolute maximum ratings

## Audio specifications

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{outmax\_SE}$	Peak output voltage, SE	$R_L = 8\Omega$ $R_L = 4\Omega$		80		V
$V_{outmax\_BTL}$	Peak output voltage, BTL	$R_L = 8\Omega$		160		V
$I_{outmax\_SE/BTL}$	Peak output current, SE/BTL			21		A
$P_{o\_tot}$	Total module output power (power supply limited)	230VAC 120VAC		1400 1350		W
$P_o$	Output power @ 1% THD+N 1kHz (AES17 filter), SE	$R_L = 8\Omega$ 230VAC 120VAC		400 400		W
$P_o$	Output power @ 1% THD+N 1kHz (AES17 filter), SE	$R_L = 4\Omega$ 230VAC 120VAC		800 800		W
$P_o$	Output power @ 1% THD+N 1kHz (AES17 filter), BTL	$R_L = 8\Omega$ 230VAC 120VAC		1400 1350		W
THD+N	THD+N (AES17 filter)	1kHz, 1W, $R_L = 8\Omega$		0,003		%
$V_{noise\_SE}$	Output idle noise, SE	Unweighted A-weighted		75 55		$\mu V_{RMS}$ $\mu V_{RMS}$
$V_{noise\_BTL}$	Output idle noise, BTL	Unweighted A-weighted		140 110		$\mu V_{RMS}$ $\mu V_{RMS}$
$DR_{SE}$	Dynamic Range, SE	Unweighted A-weighted		118 120		dB dB
$DR_{BTL}$	Dynamic Range, BTL	Unweighted A-weighted		118 120		dB dB
$A_{SE}$	Voltage gain, SE	1kHz		26		dB
$A_{BTL}$	Voltage gain, BTL	1kHz		32		dB
$Z_{o\_SE}$	Absolute output impedance, SE	1kHz		6		m $\Omega$
$IMD_{CCIF\_SE}$	Intermodulation distortion (CCIF), SE	18.0kHz and 19.0kHz $P_o = 10W$ 8 $\Omega$ , 1kHz		0.0008		%
$TIM_{SE}$	Transient Intermodulation distortion (TIM), SE	$P_o = 10W$ 8 $\Omega$		0.002		%

Note 1: All channels loaded with 8 ohm. Maximum total power is limited by the power supply.

Table 2: Audio specifications

## Input & Output loading

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Z <sub>INPUT</sub>	Input impedance	Ch1, Ch2(SE)		1.88		kΩ
Z <sub>L</sub>	Loudspeaker impedance range	Ch1, Ch2(SE)	4		inf	Ω
Z <sub>L</sub>	Loudspeaker impedance range	Ch1, Ch2 (BTL)	8		inf	Ω

Table 3: Input & Output Loading

## AC Mains and power loss specification

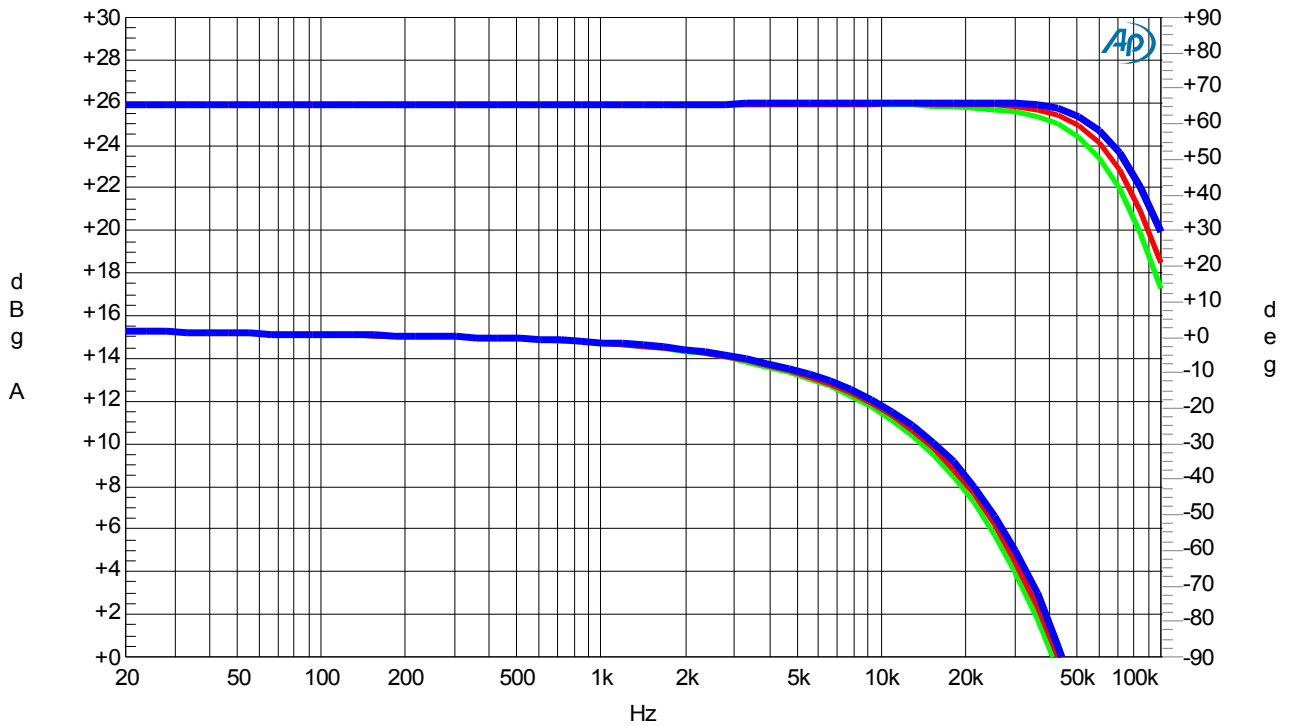
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
P <sub>AC_PN</sub>	AC mains power input, 230V Pink noise, SE	R <sub>L</sub> = 8Ω R <sub>L</sub> = 4Ω R <sub>LBTL</sub> = 8Ω Nominal <sup>1</sup> (RMS output = 1/8 of rated power)		179 335 186		W <sub>RMS</sub>
P <sub>120VAC NS</sub>	AC mains power input No signal applied	Sleep Mode Disable Idle		3 12 23		W <sub>RMS</sub>
P <sub>230VAC NS</sub>	AC mains power input No signal applied	Sleep Mode Disable Idle		6 14 25		W <sub>RMS</sub>
V <sub>AC Range 1</sub>	Operational voltage range 120V <sub>AC</sub>		85		138	V <sub>AC</sub>
V <sub>AC Range 2</sub>	Operational voltage range 230V <sub>AC</sub>		170		265	V <sub>AC</sub>
P <sub>Heat</sub>	Heatsink power dissipation Pink noise	R <sub>L1,2</sub> = 8Ω R <sub>L1,2</sub> = 4Ω R <sub>LBTL</sub> = 8Ω Nominal <sup>1</sup> (RMS output = 1/8 of rated power)		79 135 72		W <sub>RMS</sub>
T <sub>protection</sub>	Temperature @ Thermal limiting			85		°C
T <sub>SD</sub>	Temperature @ Thermal shutdown	Thermal hyst.= 10°C		95		°C

Note 1: "8 Ohm SUB" load is channels loaded in BTL with an 18" driver bandpass subwoofer with a nominal impedance of 8 Ohm. Input signal filtered to 25Hz - 200Hz.

Table 4: AC Mains and power loss specification

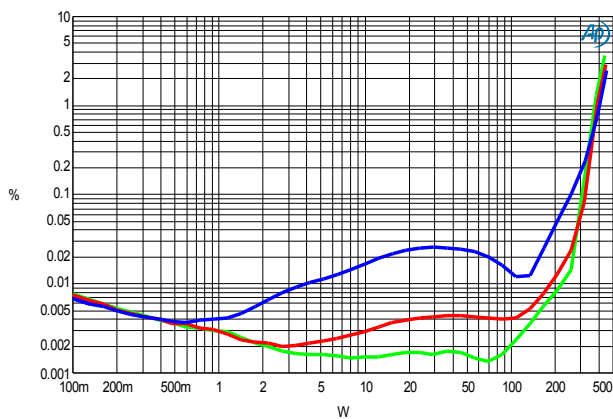
# Audio measurements

## Frequency response channel (SE)

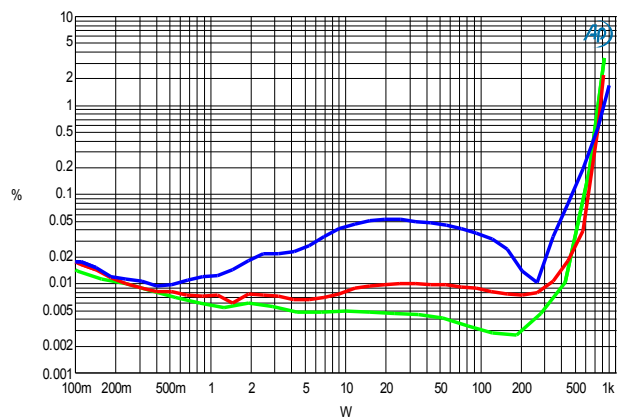


Frequency response, 4Ω (green), 8Ω (red) and open load (blue). Top - amplitude. Bottom - phase

## Total Harmonic Distortion + Noise

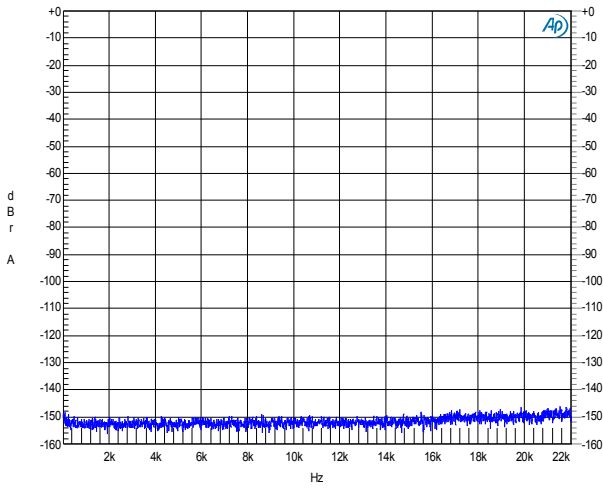


THD+N vs. Po, Channel 2 & 3, 100Hz (green), 1kHz (red), 6,67kHz (blue), 8Ω

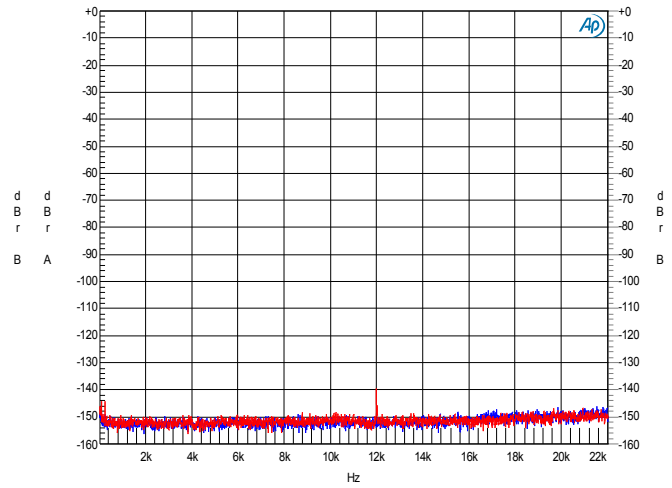


THD+N vs. Po, Channel 2 & 3, 100Hz (green), 1kHz (red), 6,67kHz (blue), 4Ω

## Noise Spectrum

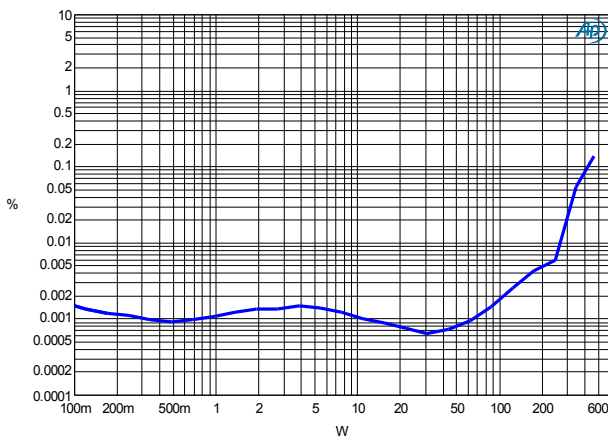


FFT, Channel 1 & 2, BTL, 8 Ohm, Idle

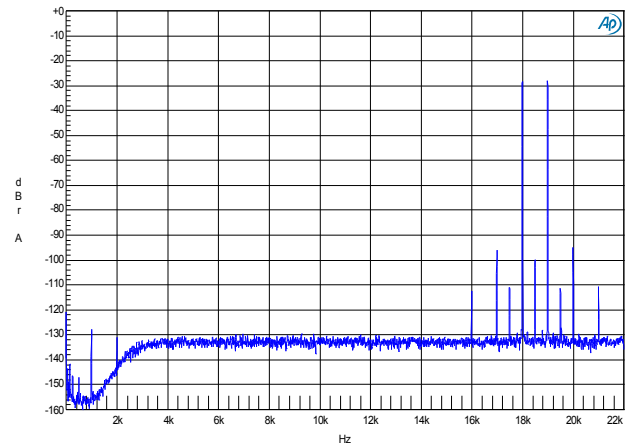


FFT, Channel 1 (Blue) & 2 (Red), SE, 4 Ohm, Idle

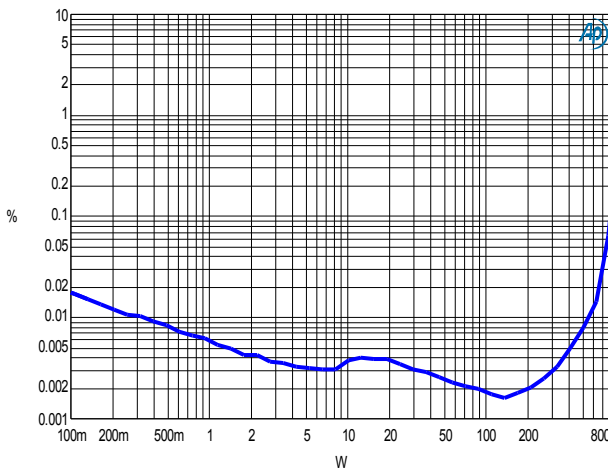
## Intermodulation Distortion (CCIF, TIM)



CCIF vs power  $R_L=4$  ohm, SE,  $f_1=18$ kHz,  $f_2=19$ kHz

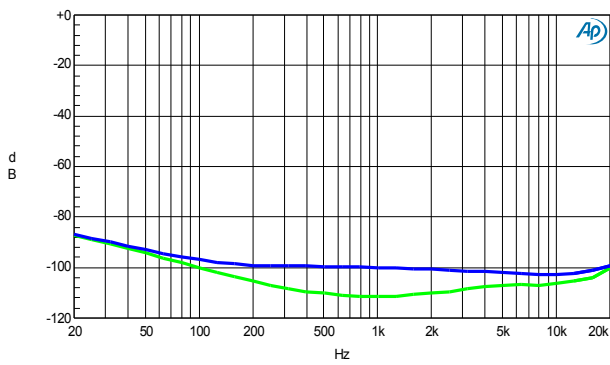


CCIF FFT, SE,  $f_1=18$ kHz,  $f_2=19$ kHz,  $R_L=40$ hm,  $P_0=10$ W.

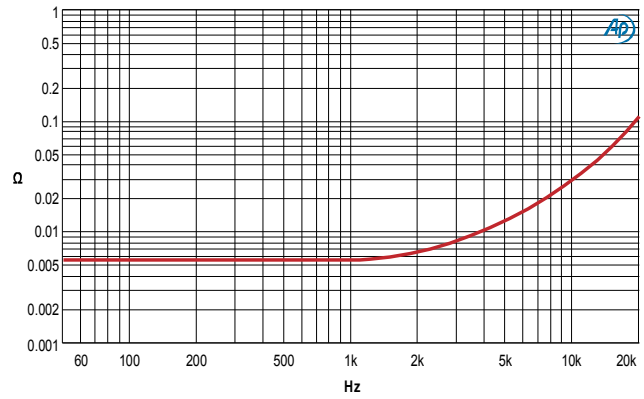


TIM vs. power,  $R_L=4$  Ohm, SE

### Cross Talk & Output impedance



Cross talk, Channel 2,  $P_{o, ch1}=100W$  (green),  
Channel 1,  $P_{o, ch2}=100W$  (blue)



Output impedance, SE,  $I_{out}=1ARMS$

# Product connections and LED indicators

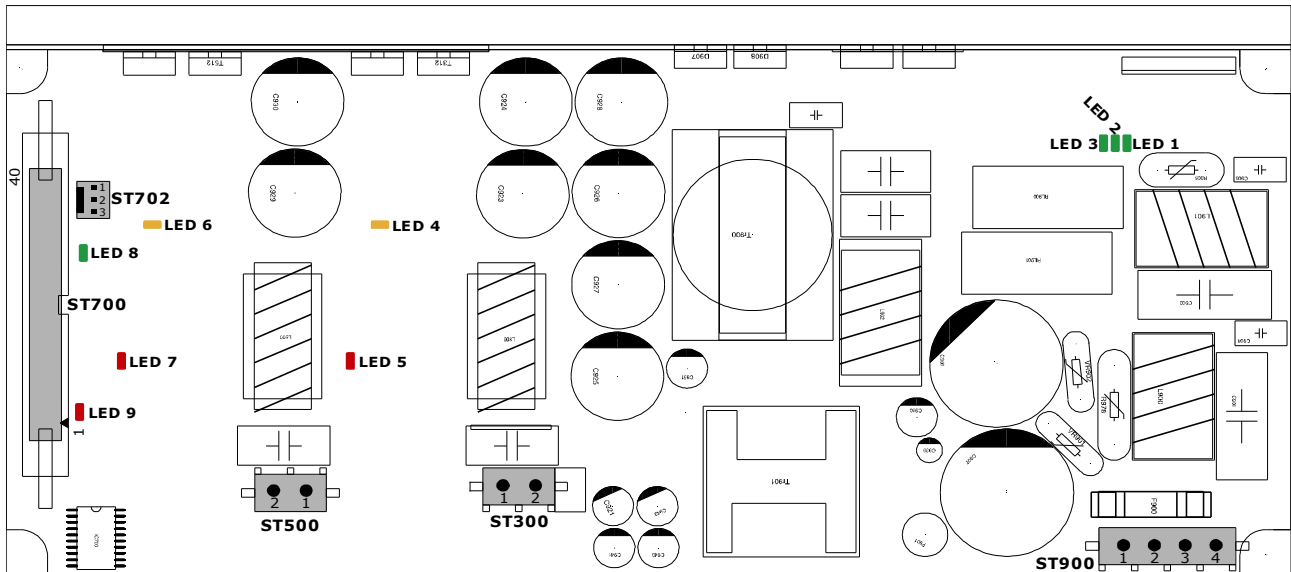


Figure 1: M-PRO23 Connectors and LEDs

## LED Functionality

LED No.	Function	Normal Operation	LED Indication	LED Indication Result
LED 1	Amplifier drive voltage (Mains SMPS ON)	ON	On, Permanent Flashing	Amplifier drive voltage present, SMPS ON Disable (Mute) or Amplifier DC shutdown
LED 2	Relay 1 state	ON		Inrush limiter bypassed
LED 3	Relay 2 state	ON OFF		Mains AC voltage: 120V <sub>AC</sub> Mains AC voltage: 230V <sub>AC</sub>
LED 4	Disable <sub>CH1</sub>	OFF	ON OFF	Channel 1, Disable (Mute) or protection mode Channel 1, Enabled
LED 5	Clip Limiter <sub>CH1</sub>	OFF	ON OFF	Channel 1, Clip limiting Channel 1, Not clipping
LED 6	Disable <sub>CH2</sub>	OFF	ON OFF	Channel 2, Disable (Mute) or protection mode Channel 2, Enabled
LED 7	Clip Limiter <sub>CH2</sub>	OFF	ON OFF	Channel 2, Clip limiting Channel 2, Not clipping
LED 8	Auxiliary 5V	ON	ON OFF	Auxiliary 5V present Auxiliary 5V not present
LED 9	RMS Limiting	OFF	Flashing wo. input Flashing, with input On, Permanent	AC mains 120V/230V detection failed $P_{AC\ Mains} = 1kW$ , periodical RMS limiting $P_{AC\ Mains} > 1kW$ , permanent RMS limiting

Table 5: LED Functionality

## LED timing during start-up & shut-down

During normal start-up and shut-down of the amplifier modules the LED's will show the following timing.

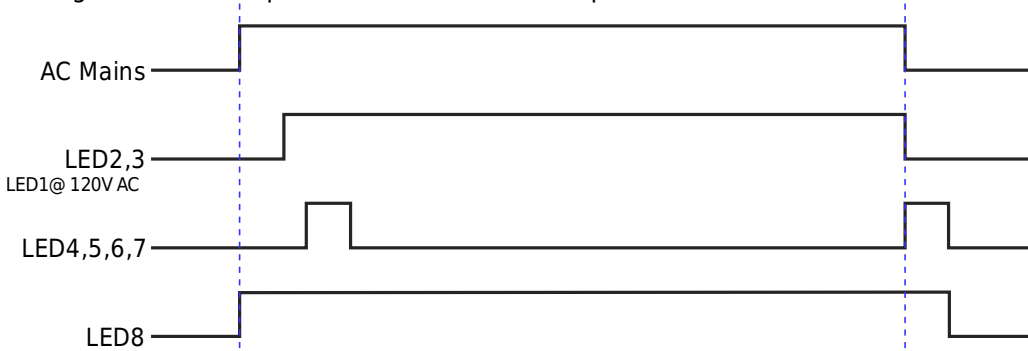


Figure 2: LED timing during start-up and shut-down

## Connectors

<b>AC Mains (ST900)</b>		
<b>Pin No.</b>	<b>Function</b>	<b>Note</b>
Pin 1	AC Live	AC mains Live input
Pin 2	AC Neutral	AC mains Neutral input
Pin 3		No connection
Pin 4	Earth	Earthing of module, electrical contact to heat sink
<b>PCB connector counterpart list:</b>		
Cable connector housing part number: Molex (42021-4A)		
Cable connector pin part number: Molex (42024)		

Table 6: AC Mains (ST900) Connector

<b>Speaker output (ST300)</b>		
<b>Pin No.</b>	<b>Function</b>	<b>Note</b>
Pin 1	+Ch1 <sub>Out</sub>	Amplifier channel 1, Out+
Pin 2	- Ch1 <sub>Out</sub> (GND)	Amplifier channel 1, GND
<b>PCB connector counterpart list:</b>		
Cable connector housing part number: Molex (42021-2A)		
Cable connector pin part number: Molex (42024)		

Table 8: Speaker output (ST300) Connector

<b>Speaker output (ST500)</b>		
<b>Pin No.</b>	<b>Function</b>	<b>Note</b>
Pin 1	- Ch2 <sub>Out</sub> (GND)	Amplifier channel 2, GND
Pin 2	+Ch2 <sub>Out</sub>	Amplifier channel 2, Out+
<b>PCB connector counterpart list:</b>		
Cable connector housing part number: Molex (42021-2A)		
Cable connector pin part number: Molex (42024)		

Table 9: Speaker output (ST500) Connector

<b>Fan output (ST702)</b>		
<b>Pin No.</b>	<b>Function</b>	<b>Note</b>
Pin 1	GND	GND
Pin 2	Fan output	Output for 5V fan
Pin 3	GND	GND
<b>PCB connector counterpart list:</b>		
Cable connector housing part number: Molex (10-11-2033)		
Cable connector crimp pin part number: Molex (9773789)		

Table 10: Fan output (ST702) Connector

<b>Input &amp; Output (ST700)</b>			
<b>Pin No.</b>	<b>Function</b>	<b>Type</b>	<b>Note</b>
Pin 1	Signal Shield	AGND	Connect to analog GND at DSP-board
Pin 2	Signal return Channel 1	Input, SGND	Connect to ch1 signal source GND at DSP-board
Pin 3	Signal input channel 1	Input	4 V peak correspond to full output voltage, 32dB gain
Pin 4	Signal Shield	AGND	Connect to analog GND at DSP-board
Pin 5	Signal return Channel 2	Input, SGND	Connect to ch2 signal source GND at DSP-board
Pin 6	Signal input channel 2	Input	4 V peak correspond to full output voltage, 26dB gain
Pin 7	Signal Shield	AGND	Connect to GND at DSP-board
Pin 8	Not Connected		
Pin 9	Not Connected		
Pin 10	Signal Shield	AGND	Connect to GND at DSP-board
Pin 11	V Out monitor channel 1	Output	+/- 10 V <sub>p</sub> correspond to +/- 160 V on output
Pin 12	V Out monitor channel 2	Output	+/- 10 V <sub>p</sub> correspond to +/- 80 V on output
Pin 13	Not Connected		
Pin 14	I Out monitor channel 1	Output	+/- 10 V <sub>p</sub> correspond to +/- 30 A on output
Pin 15	I Out monitor channel 2	Output	+/- 10 V <sub>p</sub> correspond to +/- 20 A on output
Pin 16	Not Connected		
Pin 17	Temp monitor	Output	0-10 V correspond to 0 - 100 Degrees Celsius
Pin 18	GND (ref +/-15 V)	GND	
Pin 19	GND (ref +/-15 V)	GND	
Pin 20	Clip channel 1	Output, Active low	Open collector <sup>1</sup>
Pin 21	Clip channel 2	Output, Active low	Open collector <sup>1</sup>
Pin 22	Not Connected		
Pin 23	GND (ref +/-15 V)	GND	
Pin 24	Dis read/Protect	Output, Active low	Indicates amp channels switched off. Open collector <sup>1</sup>
Pin 25	GND (ref +/-15 V)	GND	
Pin 26	Disable (Mute)	Input, Active Low	Switches all amp channels off.
Pin 27	Not used (Do not connect)	Floating	Floating
Pin 28	SMPS Limit	Output, Active low	Indication before SMPS limiting Open collector <sup>1</sup>
Pin 29	Temp reduction off	Input, Active Low	Disables soft volume reduction at high temp.
Pin 30	Sleep mode	Input, Active Low	Shuts down all power circuitry - except +7 V
Pin 31	+7 V	Output	Maximum current 1.0 A (available also in sleep mode)
Pin 32	+7 V	Output	Maximum current 1.0 A (available also in sleep mode)
Pin 33	GND (ref +/-15 V)	GND	
Pin 34	GND (ref +/-15 V)	GND	
Pin 35	+15 V	Output	Maximum current 150 mA total on +15V
Pin 36	+15 V	Output	Maximum current 150 mA total on +15V
Pin 37	GND (ref +/-15 V)	GND	
Pin 38	GND (ref +/-15 V)	GND	
Pin 39	-15 V	Output	Maximum current 150 mA total on -15V
Pin 40	-15 V	Output	Maximum current 150 mA total on -15V
<b>PCB connector counterpart list:</b>			
Cable connector housing part number: Greenconn (GPHA220-2002B02A)			

Note 1: All open collector outputs have a 470Ω resistor in series with the open collector.

Table 11: Input & Output (ST700) Connector

## Open Collector Outputs

All collector outputs are implemented as shown on the picture below. The 470Ω resistor is inserted to protect the open collector transistor and the 47pF capacitor has been implemented as EMI filtering.

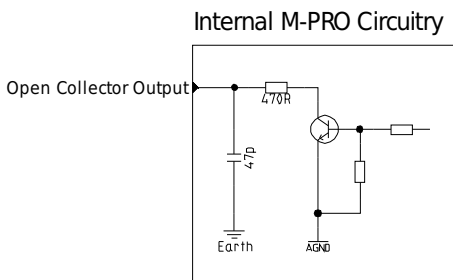


Figure 3.1: Open Collector Output

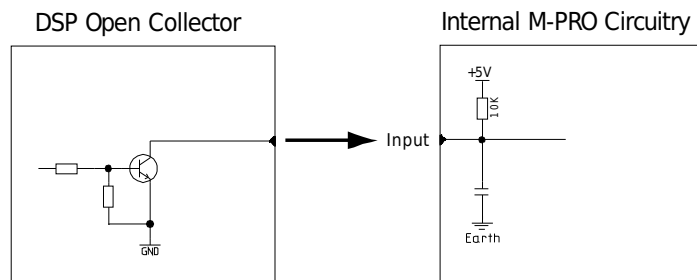


Figure 3.2 Input for open collector control

## Fan Control

The fan control thermal limits can be seen from the table below. The fan control signal can be used for a 5V fan or as a control signal for a 230V<sub>AC</sub> fan.

Fan threshold		
Parameter	T <sub>On</sub> (°C)	T <sub>Off</sub> (°C)
T <sub>Powerstage</sub>	60	40

## Power Up-/Down timing diagram

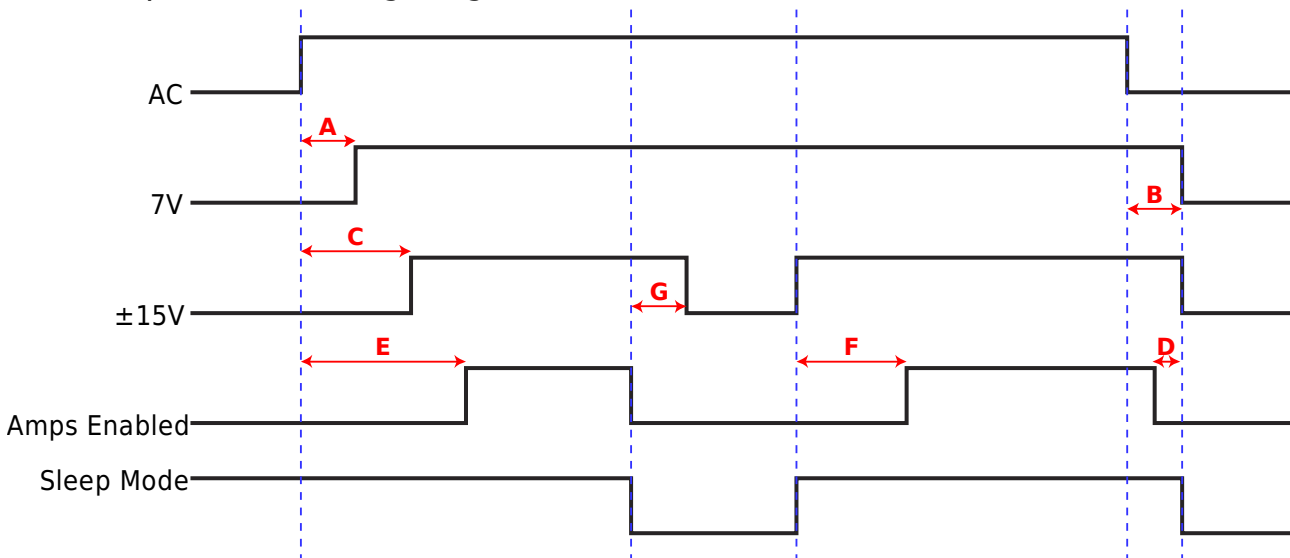


Figure 4: Power Up-/Down timing diagram

Parameter	Time (ms)	Condition
A	140ms	+/-15V and +7V, loaded with DEMO I/O board
B	2000ms	+/-15V and +7V, loaded with DEMO I/O board
C	2400ms	+/-15V and +7V, loaded with DEMO I/O board
D	0ms	+/-15V and +7V, loaded with DEMO I/O board
E	4000ms	+/-15V and +7V, loaded with DEMO I/O board
F	3500ms	+/-15V and +7V, loaded with DEMO I/O board
G	270ms	+/-15V and +7V, loaded with DEMO I/O board

Table 12: Power Up-/Down timing specifications

# Single Ended (SE) & Bridge Tied Load (BTL) configuration

Channel 1 and channel 2 of the M-PRO2 module can be operated in either SE or BTL mode<sup>1</sup>. Please note that output connector ST500 has been rotated 180 degrees, meaning that the output of ST500 has been inverted. This means that for both SE and BTL applications the input signal for channel 2 should be inverted.

## SE input configuration

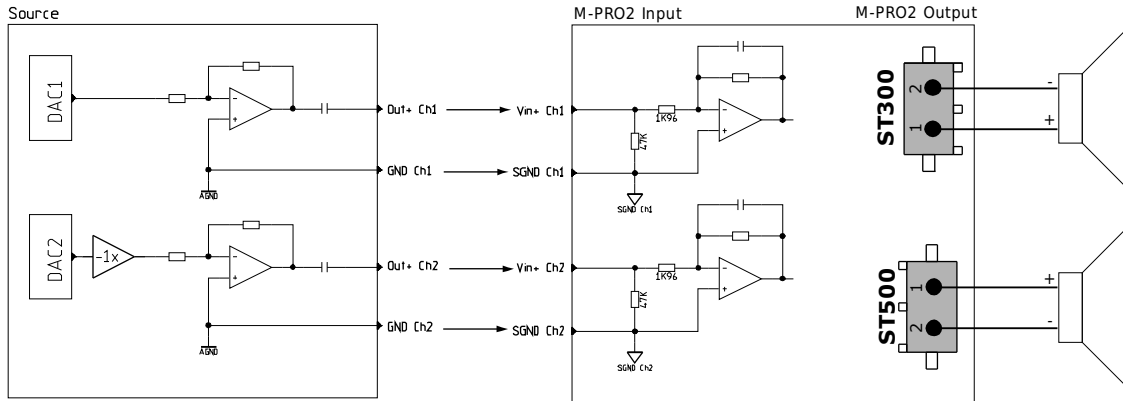


Figure 6: SE input configuration

## BTL input configuration

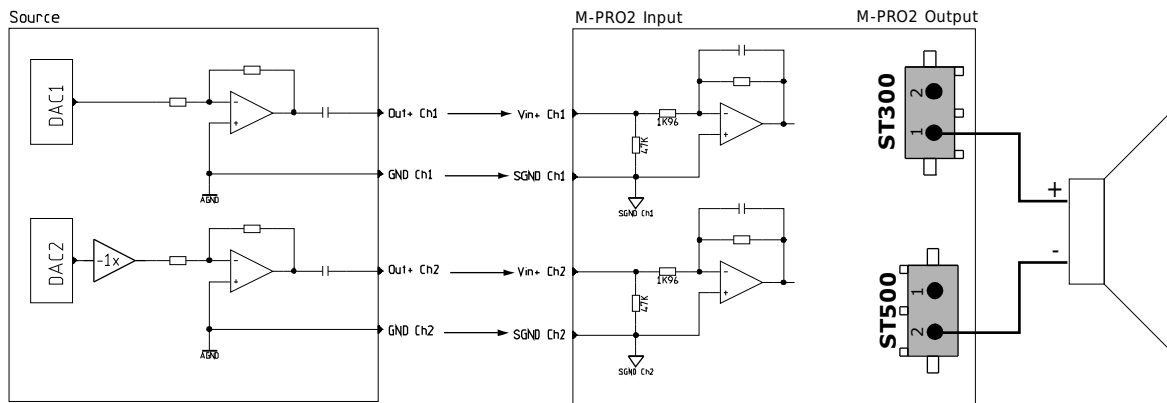


Figure 7: BTL input configuration

Note 1: For amplifier output loading in SE or BTL mode, please refer to Input & Output Loading section.

## Protection features

### Over current protection

All amplifier channels are over current protected on outputs.

Current clipping is engaged when the amplifier channels exceeds its specified peak current output<sup>1</sup>. This can be seen as the output voltage of the amplifier being clipped.

If the current output of an amplifier channel exceeds its specified peak current output e.g in case of a short circuit of the output. In this case the amplifier will be disabled (Muted) for 1000ms and automatically restart.

Note 1: Please see audio specification section.

### DC protection

A built-in DC protection circuit will attenuate any DC signals on the amplifier outputs, either produced by an input signal containing a DC signal or by malfunction of the amplifier.

In case of a signal input containing a DC or due to an amplifier malfunction, where the DC-protection circuit can not sufficiently attenuate an amplifier DC output signal, the amplifier will disable (Mute) and restart 3 times before latching, after which power must be removed in order to power up the product.

### Over-/under voltage protection

Power supply over- and under voltage protection is implemented, which means that the powersupply will enter a protection mode when the operational off-line voltage exceeds or drops below the specified upper and lower operational off-line AC voltages. Exceeding 265V<sub>AC</sub> for a longer period of time might damage the power supply permanently.

### Mains fuse protection

Protection of the mains fuse in the product is implemented such that the RMS current flowing from the AC mains connection, will never exceed the fuse breaking current.

The Mains fuse protection also removes the risk of compromising safety in situations of overload.

The M-PRO2 series module fuse should never be replaced. In the case where a fuse is blown the product should be returned to Pascal, according to Pascal RMA procedures.

### Temperature protection

Temperature protection of powerstages, transformers and heatsinks can be used in two different configurations:

1. Thermal limiter "ON": Limiting is engaged after the powerstage, transformer or heatsink temperature has reached it's specified thermal limiting temperatures. After limiting is engaged, the amplifier will find it's thermal equilibrium.
2. Thermal limiter "OFF": The amplifier disables (Mutes) for a period of time and automatically restarts , after the powerstage, transformer or heat sink temperature have reached the specified thermal start-up temperature.

### Sleep Mode

This function is designed as a special feature for installation purposes.

When the amplifier is put into Sleep Mode, major circuitry parts are powered down, which leads to the low AC mains power input specification of only a few watt.

The +7V supply rail is still active, which enables a possible network/DSP to remotely power up the amplifier again.

## High frequency protection

A high frequency protection is implemented in order to protect filter components from overload.

The high frequency protection algorithm has been implemented to protect the amplifier from excessive HF signals on the the amplifier outputs.

The amplifiers have a full power bandwidth of 20 kHz, which will be allowed for unlimited time, 30kHz full power is allowed for 2 seconds before protection becomes active.

## Readouts

### Clip

When the amplifier output peak voltage or current exceeds the specified values, the amplifier channel will start clipping the Voltage/Current. Clipping indication has been implemented for each amplifier channel.

Clip indication for channel 1 and 2 can be monitored from ST700, Pin 20 and 21.

### Dis read/Protect

The Dis read/protect indication is based on an open collector, indicating if any of the amplifier channels or the power supply is in disable (Mute) or in protect mode. This indicates either an external shutdown or an on-board protection condition. Dis Read/Protect can be monitored from ST700 pin 24.

### SMPS Limit

In order to protect the power supply from overload, a power supply limiter is set.

The SMPS limit indication is based on an open collector and can be monitored from ST700 pin 28. The timing of the SMPS limit engagement can be seen below:

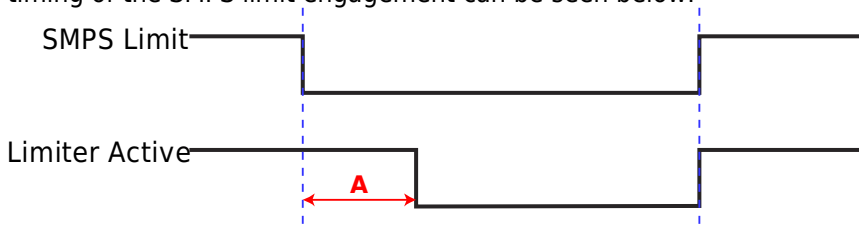


Figure 5: SMPS Limit

A = 1000 ms

### Output voltage

Output voltage is measured on channel 1 and 2 and supplied as a bi-directional sinusoidal voltage output.

Output voltage for channel 1 and 2 can be measured on ST700 pin 11 and 12.

### Output current

Output current is measured on channel 1 and 2 and supplied as a bi-directional sinusoidal voltage output.

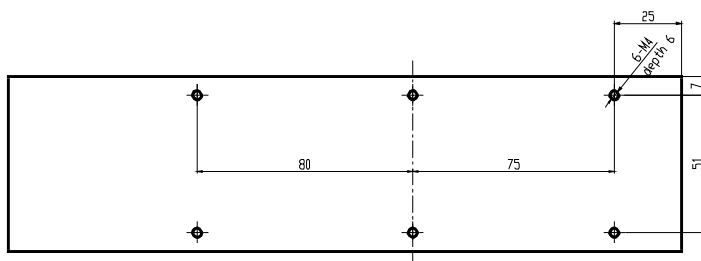
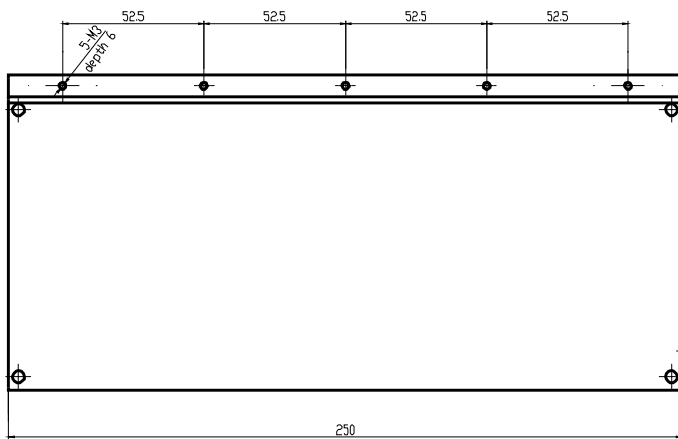
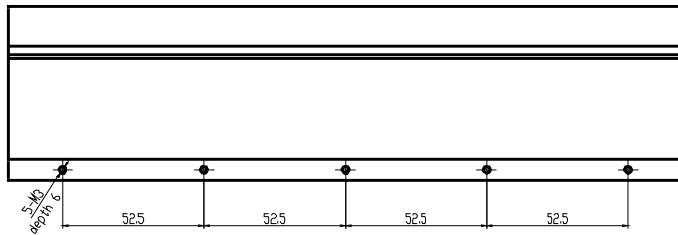
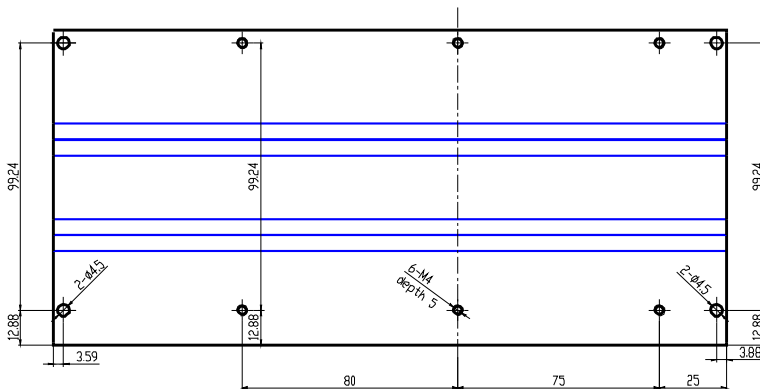
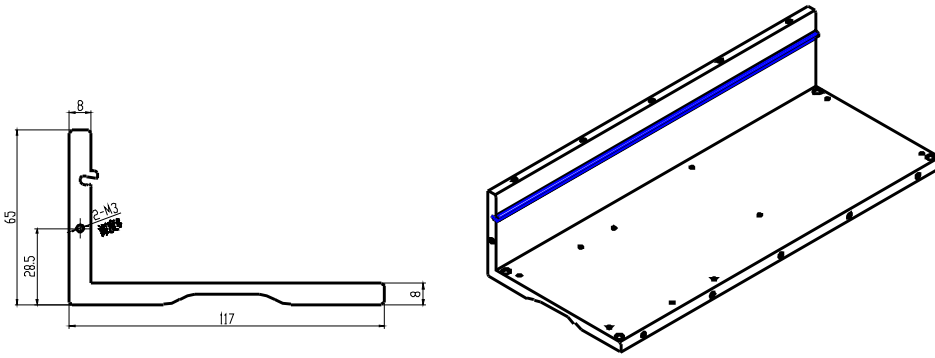
Output current for channel 1 and 2 can be monitored on ST700 pin 14 and 15.

### Temp Monitor

Temperature monitoring is made at several points in the amplifier and power supply. The maximum temperature of any measurement point is provided as the Temp Monitor, which can be monitored on ST700 pin 17.

# Mechanical Dimensions M-PRO2

All dimensions in mm



## Safety compliance

M-PRO2 series modules are all safety tested, according to the following standards:

IEC60065: 2001 (7<sup>th</sup> Edition) + A1: 2005  
EN60065: 2002 + A1:2006  
UL60065: 2003, CSA C22.2 60065-03 + Am 1 (2006)

Test procedure: CB  
M-PRO2 series CB certificate no. available on request.

Product safety category: Class 1 (Earthed equipment)

## Electro Magnetic Compliance

Pascal amplifier modules are EMI compliance tested according to the following standards.

EN55103-1 Emission

EN55103-2 Immunity

EMI verification measurements of the final product, should be carried out in order to secure compliance of the final product.

## ESD warning

In order to retain the right to Pascal warranty on products, precautions on ESD must be taken when handling Pascal products. Handling of Pascal products should comply to the following standards.

IEC 61340-5-2: Protection of electronic devices from electrostatic phenomena. User Guide.  
IEC 61340-5-1: Protection of electronic devices from electrostatic phenomena. General Requirements.  
ANSI/ESD-S20.20-1999: Protection of Electrical and Electronic Parts, Assemblies and Equipment.

## Changes

Pascal Products are continuously undergoing smaller changes to improve the performance or to comply with manufacturing and quality requirements. Therefore specifications in this datasheet, might be subject to change.

For further information

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