PRODUCTION PARTNER
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Test report
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Four-channel amplifier with DSP and Dante interface

Powersoft Quattrocanali

The DSP functions, which are already familiar from the Powersoft X Series, are now also available as the lower priced Quattrocanali amplifier series

Copy and measurements: Anselm Goertz | Images: Dieter Stork, Anselm Goertz

PRODUCTION PARTNER APPROVED REVIEW

» ... With the Quattrocanali amplifier series, the renowned Italian amplifier producer Powersoft presents a new series with a focus on fixed installations. ...«

Quattrocanali: As the name, indicates, these Powersoft models are four-channel amplifiers, available in different performance classes from 300 to 1200 W per channel. Three Quattrocanali models will be presented at the ISE 2017 launch: 4804, 2404 and 1204. The first numbers indicate the overall performance, which corresponds to 3 x 300 W, 4 x 600 W or 4 x 1.200 W. The bridge mode of two channels, 2-Ohm operation or 100 V is possible for all models. The primary target group for the series is the installation market, where the models in question will be capable of covering around 95% of all applications. The models are additionally available as pure amplifiers or in a version with DSP and Dante interface (DSP+D). This should be an important aspect, as control rooms with powerful DSP systems are frequently often already present. In such cases, one would not want to buy further DSP power in the amplifiers, which would then be left unused.

Despite the clear focus on the installation market, nothing stands in the way of use in the rental business. The primary difference is the connectors' design: amplifiers for fixed installations are usually equipped with Phoenix terminals while those for mobile use generally rely on XLR and Speakon connections. All other features such as a DSP system and a Dante interface but also remote control and monitoring are equally required in both sectors.

All models from the new series are designed both for the operation of low-resistance loads as well as for 70 V or 100 V systems. The latter is carried out in the direct drive modus without a transformer in the output. Generally, this is possible with a sufficiently high power supply voltage inside the amplifier, if the amplifier is capable of delivering an output voltage of 100 Vrms. Depending on the maximum output voltage, the output limiters have to limit the power to a permitted value, as overload could otherwise be the result. Modern class D circuits with corresponding switch power supplies make both possible, enabling the amplifier to be configured as required via the software.

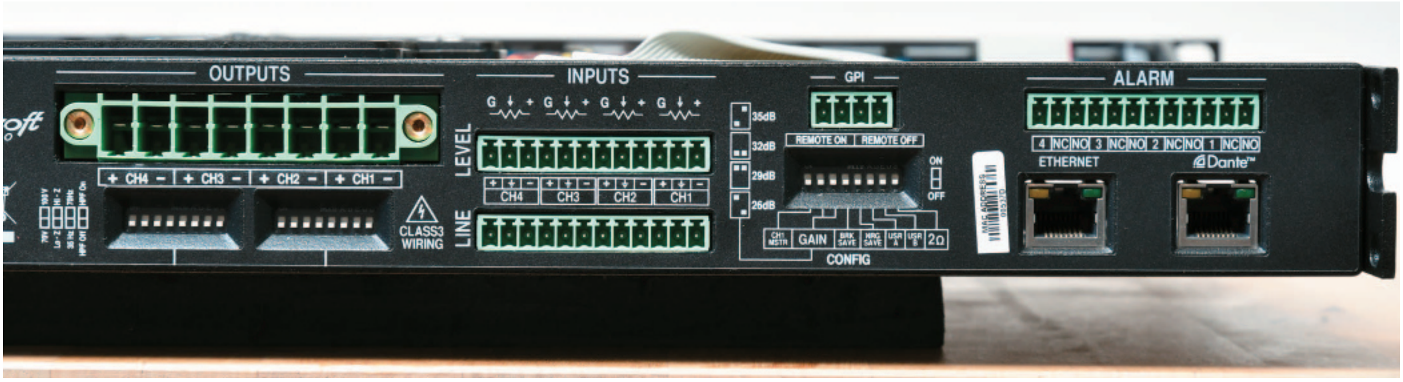
At first glance, the new Quattrocanali amplifiers come in an unobtrusive 1-RU design, which is typical for Powersoft. Only a row of LEDs is visible on the front, which show the relative levels, clip and a possible fault (alarm) for the four channels.

A further LED row delivers information on the amplifier as a whole. Trimmer for the four channels, a button for the standby mode, an amplifier reset and function test are located behind the blend on the front's left side. These functions are particularly important for those models not connected to a network.

On the rear, the amplifier has several rows of Phoenix terminals and a lot of smaller switches to configure the amplifier. All in- and outputs are carried out as Phoenix connectors. Accordingly powerful PC5/8 types were selected for the loudspeaker outputs; for all other connections the usual MC 1.5/12 format was selected. Additionally to the balanced inputs there is a further row of connections, where a 10 kOhm potentiometer can be plugged in to set the level. Via the contacts and the potentiometer, a DC voltage is singularly transmitted as a correcting variable, with the audio signal itself unaffected.

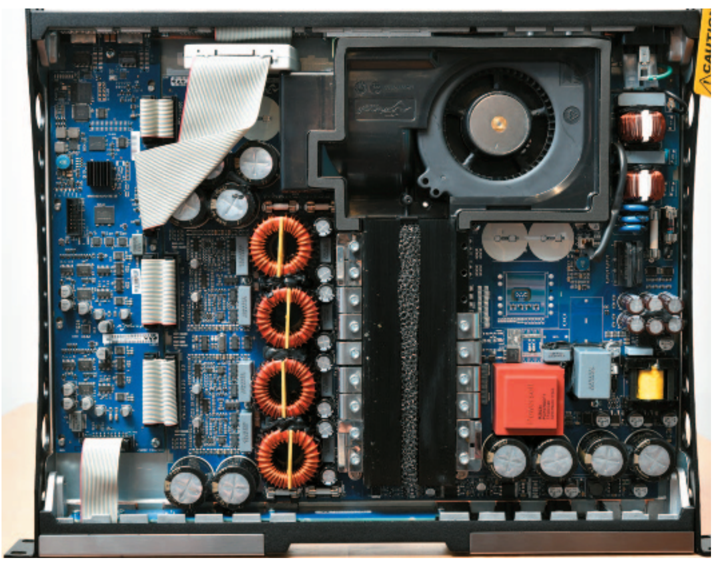
A GPO alarm connection per channel is available to monitor the amplifier. Two versions for alarm contact (open and closed standard) are supported. For all amplifier models the failure of the power supply, overheating, DC voltage at the output but also a short circuit is reported as a fault. Further states of alarm can be activated via the Armonia software for the DSP models – including failure of the pilot signal as well as the excess or underrun of the load impedance's tolerance range.

The settings Low-Z/High-Z and 70 V or 100 V for the High-Z mode are selectable independently for each output via two rows of DIP switches. Additionally, a high-pass filter can be activated and set to 35 or 70 Hz base frequency. The high-pass filters are used in preference in the High-Z modus, thereby preventing an overload of the loudspeakers' transducers due to low-frequency signal components. The settings are independent of the Armonia software and of the optional DSP system in the amplifier. Further DIP switches allow the total amplifier setting to 26, 29, 32 or 35 dB as well as for the 'Energy Save' and 'Breaker Save' functions. After five minutes without an input signal, Energy Save initially switches the output stages off; after 30 minutes it switches to the stand-by mode. Breaker Save halves the maximum power consumed from the power grid and can be used for



Connector panel *with Phoenix terminals for the in- and outputs as well as various other connections*

emergency applications where the amplifier needs to run from a UPS or generator with limited peak current capacity. Possible output is therefore reduced accordingly. Via the switch with the 2-Ohm inscription, users can limit the amplifier's maximum output power to 85 V_{pk} when it is used at low-impedance loads. For the model 1204 presented here, this function is not relevant, as the maximum output voltage in the Low-Z modus is only 80 V_{pk} anyway.

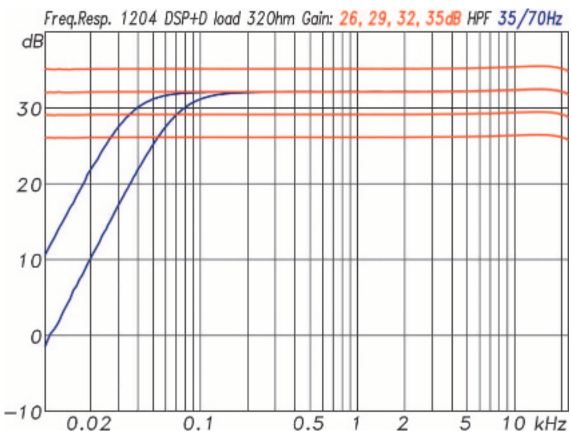


Interior *of the 1204 with DSP system and analogue/digital converter (left), amplifiers (middle) and power supply (right)*

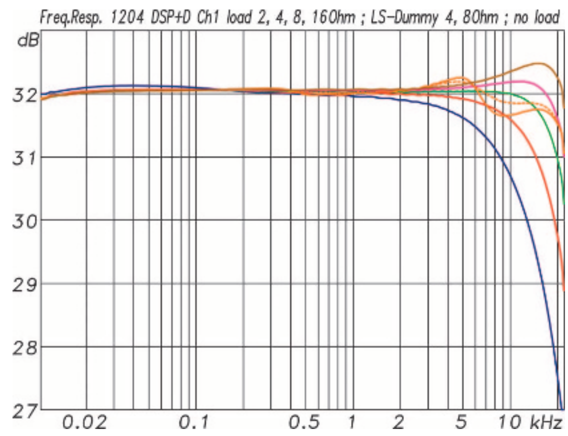
Although not relevant for the actual operation, a brief glance inside the amplifier is interesting. The picture with an opened cover shows the 1204 DSP+D, which was tested. Everything appears very orderly and tidy. The cable connections are limited to a minimum, so that a feeling of reliability is created in visual terms. The cooling channel with a large, flat radial fan, which accomplishes its task relatively noiselessly, is located in the centre. The power supply is located to the right of the cooling channel, which here in the 1204 – as the series' smallest model – is clearly not completely loaded. On the top right next to the rear side and next to fan, one can recognise the filter and two fuses for absolute emergencies, if an internal defect in the power supply should occur. Clearly visible on the left side of the cooling channel are the four amplifiers with their output filters. Directly next to these one can identify the DSP board with the four AKM AK4621 codecs. The codec's stereo DAC is used in parallel operation per amplifier, thereby improving the interference distance by further 3 dB. The same is true for the codecs' ADCs at the analogue inputs. The Dante ultimo interface along with the AKM AK4128 eightfold sample rate converter and the network connection are located at the upper end of the optional DSP board.

Quattrocanali 1204's measurements

Powersoft provided a 1204 model from the Quattrocanali series for the test, with a nominal power of 4 x 300 W at 4 Ohm and 8 Ohm as well as in the High-Z mode. Let us begin our measurements with the frequency responses. Fig. 1 shows the measurements for 26, 29, 32 and 35 dB gain and for 32 dB gain with active 35 Hz or 70 Hz high-pass filter. Both



Frequency response *of the 1204 with high-pass filters at 35 and 70 Hz as well as for the 26, 29, 32 and 35 dB gain settings (Fig. 1)*

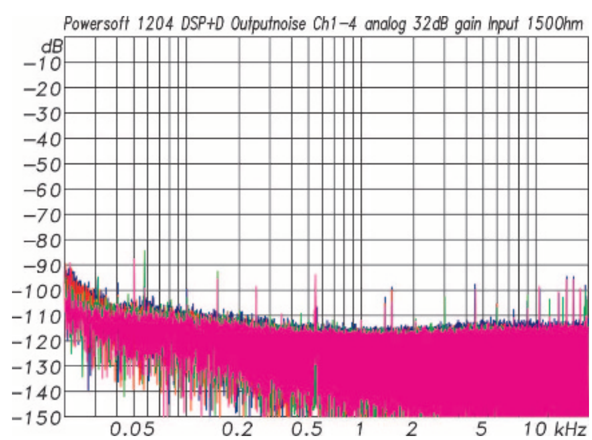


Frequency response *with 2 (blue), 4 (red), 8 (green) and 16 Ohm (pink) load resistances and with 4 (orange) and 8 Ohm (orange dashed) loudspeaker dummy loads respectively (Fig. 2)*

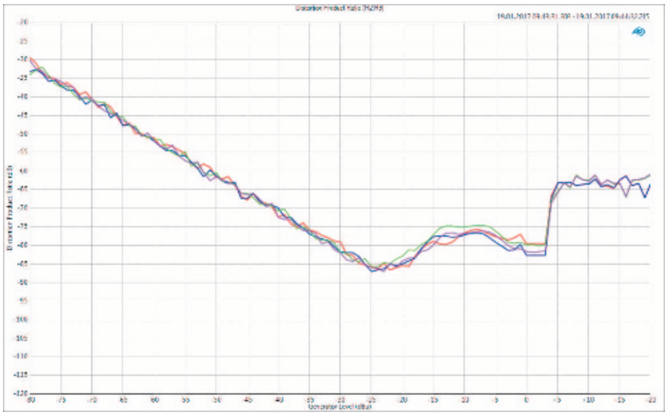
high-pass filters are second order filters with a base frequency at the -3 dB point.

Due to a class D amplifier's wiring concept with passive low-pass filters in the outputs and depending on the load, more or less strong fluctuations occur at the frequency response's upper end. Fig. 2 shows the corresponding measurements for pure ohmic loads at 2, 4, 8 and 16 Ohm as well as with loudspeaker dummies for 4 and 8 Ohm nominal impedance. If one puts the extreme case of 2 Ohm aside, the fluctuations up to 10 kHz remain in a range of up to ±0,4 dB. With a 4 Ohm load, the level at 20 kHz falls by 2 dB. This result too is more than tolerable. If one compared these with the responses using loudspeaker dummies, the high-frequency loss is nearly completely compensated by the loudspeaker-typical strongly increasing impedance towards high frequencies.

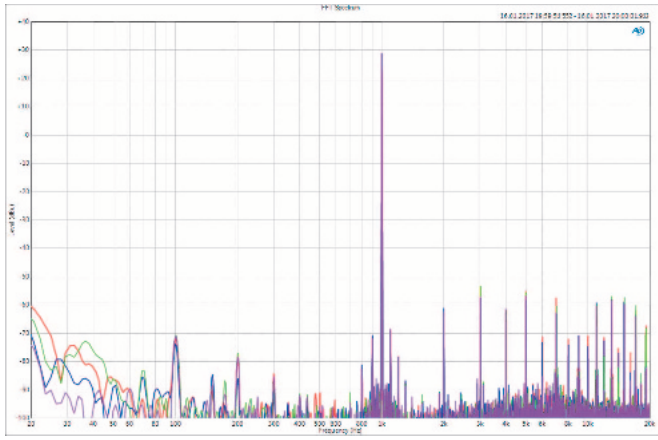
Presented in a different way, one could also define the gain loss in the high frequencies via the amplifier's frequency-dependent internal resistance. If one then relates the source's internal resistance value to the load impedance, this results in the familiar damping factor. At 4 Ohm, this results in 870 for the 1204 at 100 Hz, in 100 at 1 kHz and in 10 at 10 kHz. Important for a high damping factor are especially the low frequencies where the loudspeaker requires a good control by the amplifier so as to prevent too long swinging. In practice, values of 100 for the amplifier are more sufficient, as even larger resistances usually occur on the signal path. If one wants to 'transport' an amplifier's high damping factor to the loudspeaker, one can either rely on an on-board sense line or a kind of anticipatory cable compensation, as is integrated in the 1204 and other amplifiers by Powersoft. However, to prevent instabilities, the method can only be used up to a maximum of 400 Hz.



Interference spectrum *at the 1204' output (CH1 red, CH2 blue, CH3 green, CH4 pink) when using the analogue inputs and 32 dB gain. Overall level -67 dBu and -69 dBu(A). Measured using the digital inputs, the values improve by around 3 dB (Fig. 3)*

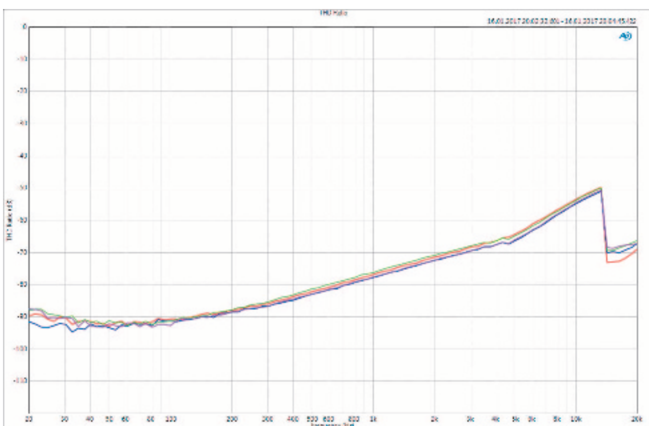


Harmonic distortions (THD) *at 1 kHz and 4 x 4 Ohm load (CH1 red, CH2 blue, CH3 green, CH4 pink) subject to the input level (x-axis, Fig. 4)*

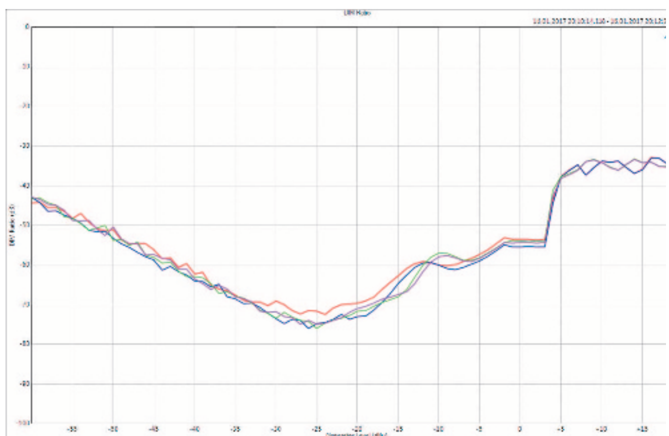


Harmonic distortions (THD+N) *at 1 kHz and 4 x 4 Ohm load (CH1 red, CH2 blue, CH3 green, CH4 purple) for a performance of 4 x 150 W at 4 Ohm (Fig. 5)*

If we have a look at the dynamic range as the next important measurement value, the maximum output voltage should be defined first. This is 80 V_{pk} for the 1204 and (around 37.2 dBu). This compares with the noise level, which is measured at the outputs and was measured once by using the analogue inputs and once with Dante. The analogue inputs were limited with a 200 Ohm resistance. The noise level, which was measured this way, was -67 dBu (unvalued) and -69 dBu (a-valued). After the switch to a digital signal input, the values improved by a further 3 dB. If one uses the A-valued noise level as a basis, the 1204 reached an interference distance of a little above 106 dB analogue and 109 dB respectively for a signal input



Harmonic distortions (THD) *at 4 x 4 Ohm load (CH1 red, CH2 blue, CH3 green, CH4 pink) subject to the frequency for a performance of 4 x 75 W at 4 Ohm (Fig. 6)*



Intermodulation distortions DIM100 *at 4 x 4 Ohm load (CH1 red, CH2 blue, CH3 green, CH4 pink, Fig. 7)* via the Dante network. The corresponding interference spectrums in Fig. 3 show a few small mono-frequency components and in total a slight spectrum increase towards the lower frequencies. According to Powersoft, the cause are the codecs used in the DSP system. The level of the low-frequency interferences is however so small, that it can only be captured in the lab and does not have any meaning in practice.

Distortion

The data sheet indicates distortions of 0.01% and typically lower than 0.05%. In terms of dB this amounts to 60 dB and -66 dB respectively. Fig. 4 shows the corresponding curve for the THD values, which lies below -75 dB for all channels at 4 Ohm until the limiter commences. With the commencement of the limited from an input level of +3 dBu onwards, the values continue to remain just under the -60 dB line. The information from the data sheet is thus fully fulfilled and the limiter too perfectly performs its task.

The spectral composition of the harmonic distortions in Fig. 5 show a slight dominance of the uneven shares with quite a lot of higher-order components, which are admittedly not ideal, however are all too be found at low levels under -80 dB.

When viewed subject to the frequency (Fig. 6), the distortions increase from around -90 dB at 100 Hz with around 6 dB/Oct, so that -53 dB are reached at 10 kHz. Such behaviour can be seen in many devices and is the result of the decreasing efficiency of the negative feedback towards the high frequencies.

The transient intermodulations (Fig. 7) reflect the behaviour already seen in the THD measurement. For low performances very good results of -70 dB and lower are achieved, which towards the higher levels increase to -60 dB and around 6 dB before the clipping limit of -55 dB. The onset of the limiter above +3 dBu input level has a corresponding impact, where the values then lay at -35 dB. The latter is due the signal, which is challenging for the limiter.

DSP, network and Dante

With the Quattrocanali amplifiers, the user has the choice between models with and without a DSP system. The versions with DSP also include a Dante interface as an essential part of their features. The series uses Audinate's Ultimo module, which is ideal for the Quattrocanali amplifiers with its maximum of four channels for the network signal in- and output . Additionally, the Ultimo module is comparatively

Processing: Better in the amp or externally?

DSP systems for signal processing have nowadays become a fixed standard in audio technology – as have the transmission of signals via network. Current DSPs are so powerful, that all functions are available in abundant amounts. For planners and users, the question how the desired functions are to be implemented hardly arises – but rather: where? Centrally inside an audio server in the network or partially decentralised, for example inside the amplifiers? Which solution is the best of course depends on the case at hand. Large installations such as airports or train stations with a lot of loudspeakers and amplifiers of the same type lend themselves to the central editing of controller processing and then distributing the signal to the amplifiers. However, if one is dealing with more complex loudspeaker designs in multi-way systems or with low-resistance and 100 V in mixed applications, the controller processing is mostly better placed in the amplifier. Frequently the functions of a DSP system inside an amplifier are more specific for loudspeakers and thus better suited for the task at hand. For some applications, amplifiers that are 'only' amplifiers are enough. In other cases, one would like to have the controller on board – which also delivers the benefit that controller and amplifier are attuned to one another and the controller has first hand knowledge of what the amplifier is doing.

inexpensive. The only disadvantage is that the Ultimo chip does not enable redundant networking or daisy-chaining.

The Quattrocanali amplifiers' DSP system itself is already familiar from Powersoft's X Series. The same is true for the Armonia software's user interface, which in its current version 2.9.0 has been expanded to allow for the operation of the Quattrocanali models.

The block diagram in Fig. 8 gives a good overview of the general signal routing and the controller's functions. From left to right it gives the choice of the hardware inputs for the four inputs, which are then brought together in a 4 x 4 matrix. This is followed by the input processing with the Advanced EQs and the Speaker EQs. The Advanced EQ – as the name suggests – is equipped with a special 'Raised Cosine' filter type. The subsequent Speaker EQ needs to be seen as a kind of cluster or array EQ. The actual speaker processing with X-Over, limiters and EQs for the individual lines follow in the block 'Ways'. The upstream speaker routing allows users to supply one input channel to several outputs when using active multi-way systems.

For the signal input four analogue inputs or the Dante network are available. Using Audinate's Dante controller software, users can select which of the many available channels are to be connected to the four amplifier inputs. For each of the four inputs, a priority can be independently selected for the Dante network or the analogue inputs. If the preferred signal fails, the alternative is selected. In this setting, the level and delays can be adjusted so that a possible fall back can be carried out without level or delay jump.

The block Speaker EQs contain eight universal IIR filters with the common function, a high- and a low-pass with up to a maximum of eighth order and also a custom FIR filter. The typical use of such a filter with a maximum of 384 taps at 48 kHz sample rate would for example be a beam forming function for line arrays. The custom FID filter in the 'output processing' block also offers 384 taps. Also available here are 16 IIR filter with the known functions as well as a high-pass and a low-pass filter per way.

In addition to the common characteristics such as Butterworth, Linkwitz-Riley and Bessel, linear-phase high and low passes are possible from 400 Hz upwards. With the help of these filter blocks, a typical controller processing for an active loudspeaker's individual ways – including combined amplitude and phase equalisers using the FIR filter – can be set.

Advanced EQ: Raised Cosine

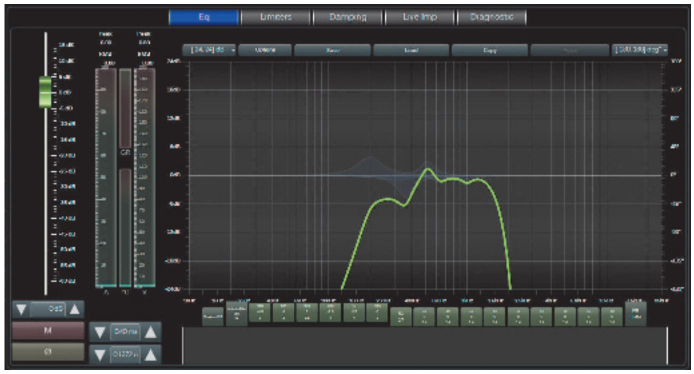
The DSP's Advanced EQ filters are implemented as so-called Raised Cosine filter. Invisible from the outside, a large filter bank is available inside, which divides the whole spectrum into individual small bands, where each band in the level can be set. If all filters are set to 0 dB, nothing happens. A virtually random filter can be created or rather be synthesised from this by reproducing the desired filter curve over the level of the individual bands. How this works exactly primarily depends on the number of frequency bands and thus on the resolution of the frequency rang. In the Powersoft DSP, the distance of the individual filters is 1/10 octave. The necessary processing power for the filter band is constantly at the same level, as all filter bands are always present. For the actual filter design, this process opens many possibilities, which would otherwise be impossible – such as asymmetric filters or shelving filter with nearly any desired steepness. This special Raised Cosine filter bank is available both for all channels of the Quattrocanali amps as well as for the X Series models. Three layers are available in the software, which all include the complete range of functions and can be divided depending on the application. If a layer is already used and blocked in the manufacturer setup, the other two can still be fully used. Internally, all layers will then be invisibly summarised and processed as one filter.

Limiter

A view in the Armonia software's limiter settings shows an abundant selection of five limiters, which can be set to protect the loudspeakers. The amplifier itself features its own limiters, which prevent a clipping or overloading of the amplifier or the power supply. Understandably, the user has no access to these limiters. To protect the loudspeaker, one has to differ between voltage, current and capacity limiters. The voltage limiters act independently of the load. The current limiter measures the actual output current and the capacity limiter calculates the output power based on the voltage and the current.

The effective value (RMS) is the basis for the current limiter; with an average performance value providing the basis for

Block diagram *for the 1204-DSP+D amplifier in the Armonia software (Fig. 8)*



Filter configuration *using the Armonia software. Per output 16 Bi-Quad IIR filter, high- and low-pass filter and customized FIR filter are available respectively (Fig. 9)*

the capacity limiter. Additionally to the threshold value, attack and release times can be set. The voltage limiter however requires a closer look. Here too there is an RMS limiter, which allows the setting of effective values as a base value. In addition there is a peak limiter, which evaluates the output voltage's peak vales in short time constants and – depending on the setting – allows signal peaks to pass for a certain duration. Nevertheless there are always cases in which a certain voltage cannot be crossed – not even for a short time. To achieve this, a clip limiter is available, which intercepts everything above the limit value without a time constant. The limit value is also set as a peak value for the clip limiter. Fig. 10 shows the limiter settings in the Armonia software. The voltage limiters for the RMS value, peak value and the hard clip value are set in the upper row. Below are the settings for the voltage and capacity limiters. When using these two, users must consider that the values need to be appropriately adjusted if several loudspeakers are connected in unison.

Further important functions of the Armonia software are located in the Diagnostic Module. These include a pilot signal generator, a pilot signal detection and two modules for load monitoring. These can identify the connected load's impedance either in broadband with a useful signal or systematically measure with a certain adjustable frequency. In both

Limiter design *of the 1204 with five entities (Fig. 10)*

Diagnostic structure *of the 1204 with pilot signal and load monitoring (Fig. 11)* cases, the upper and lower limit values can be set, resulting in a fault signal if these are exceeded or undercut.

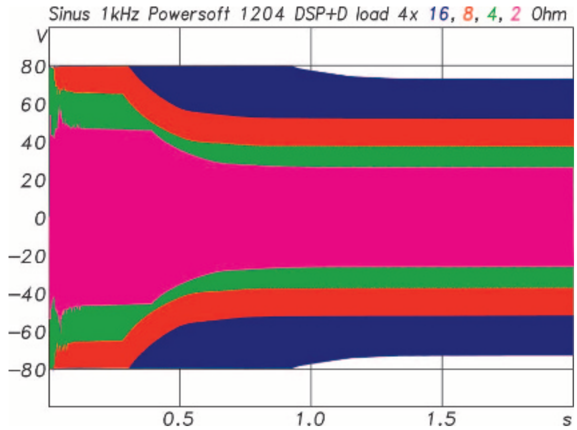
Output power measurements

There are several factors that determine an amplifier's maximum output power. This starts with the maximum output voltage, which is defined by the power supply voltage in the amplifier and by the maximum permissible voltage for the semiconductor in the amplifier. For the Quattrocanali, this value in the 100 V modus is around 150 V_{pk}. Also defined by the semiconductor is the maximum output current, which is specified for the 1204 with 33 A_{pk}. Both values are indicated in the data sheet and could be reached or even surpassed by our measurements with burst signals.

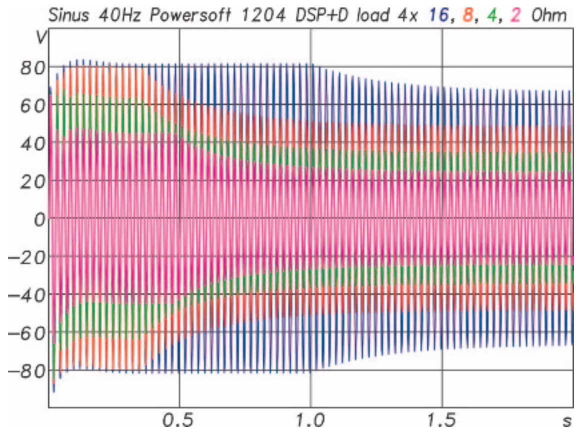
The next question now is: with which voltage and which current can the amplifier deliver at certain loads over which timespan? An extreme is the load with a constant sinusoidal signal parallel on all channels. Depending on the load, the current limit in the amplifiers and/or the power supply will intervene and will reduce the output current. Even if a constant sinusoidal signal is not a typical signal for an amplifier outside of the lab, with these measurements one can nevertheless understand which average power P_{avg} an amplifier is capable of producing in the time course. Average power is often incorrectly described as RMS power, which can be attributed to the calculation as a product based on the RMS voltage and RMS current values.

$$P_{avg} = \frac{1}{T}\int_0^T i(t)\cdot u(t)\,dt = U_{rms}\cdot I_{rms}$$

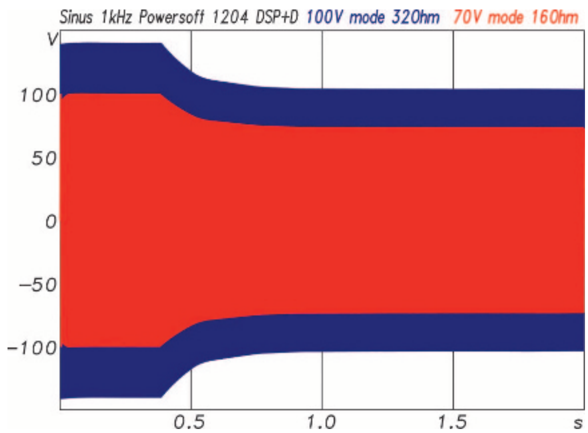
Fig. 12 shows such a measurement with a constant sinusoidal signal of 1 kHz with a simultaneous modulation of all channels with loads of 2, 4, 8 and 16 Ohm. At 4, 8 and 16 Ohm the signal begins with a maximum output voltage of 80 V_{pk}. Depending on the load, this condition remains at 4 Ohm for a few ms up to a 1s for 16 Ohm. After that, the power is limited to 170 W per channel independent of the load. A second identical measurement series was carried out with a 40 Hz sinusoidal (Fig. 13) instead of a 1 kHz sinusoidal signal, which lead to identical results. Especially when considering the application in fixed installation, the behaviour in the 70 V and 100 V modus was also examined. 300 W at 70 V causes a 16 Ohm load and 300 W at 100 V lead to a 32 Ohm load. The results in Fig. 14 show that the nominal voltages of 70 or 100 V are exactly met and accordingly also the power of



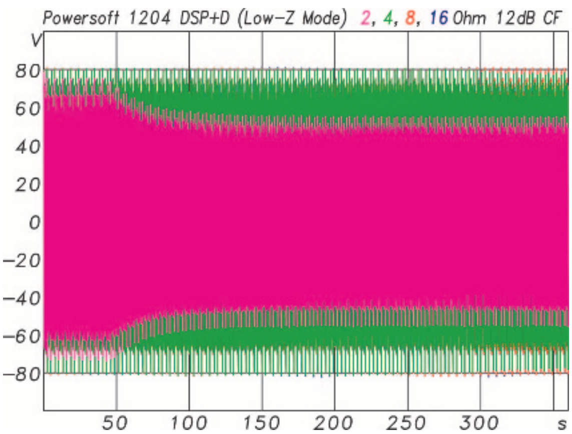
Output signal for a 1 kHz sinusoidal signal *at full capacity and a load of 4 x 2, 4, 8, 16 Ohm (Fig. 12)*



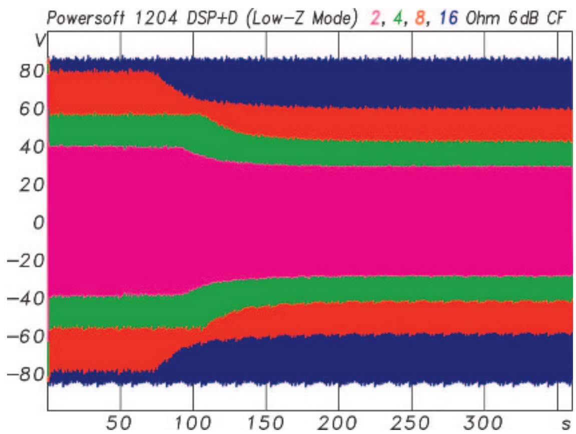
Output signal for a 40 Hz sinusoidal signal *at full capacity and a load of 4 x 2, 4, 8, 16 Ohm (Fig. 13)*



Output signal for a 1 kHz sinusoidal signal *with full capacity in the 70 V modus with 16 Ohm load and in the 100 V modus with 32 Ohm load (Fig. 14)*



Output signal for a EIA426B noise *with 12 dB crest factor at full capacity and a load of 4 x 2, 4, 8, 16 Ohm (Fig. 15)*



Output signal for a EIA426B noise *with 6 dB crest factor at full capacity and a load of 4 x 2, 4, 8, 16 Ohm (Fig. 16)*

300 W in both cases. After around 0.4 s, the limiter also sets in here, leading to a reduction to the familiar 170 W per channel. Basically such a limitation is not a problem, as the speech and music signals have significantly higher crest factors and the limiter for the 170 W average power will thus never intervene. In the EN 54-16 regarding voice alarm control in fire alarm systems, a nominal power with a sinusoidal signal is required for the duration of a minute. The certification for EN 54 voice alarm control is thus not possible.

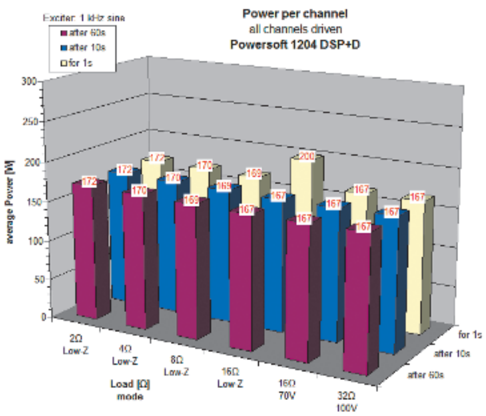
A further measurement series under the present conditions with loads of 2 Ohm to 16 Ohm and in the 70 and 100 V modus respectively were carried out with noise signals according to EIA-426B with 6 dB and 12 dB crest factor. A crest factor of 12 dB can be seen as typical for normal announcements and music. A value of 6 dB however is only reached with extreme compression of the signal. For the 12 dB crest factor signal the 1204's behaviour is displayed in Fig. 15 over a timespan of 360 s. At 4, 8 and 16 Ohm the maximum output voltage of 80 V_{pk} is constant during the whole measurement duration. The effective value or output voltage's RMS value respectively is 20 V. At 4 Ohm this means an average power of 100 W per Channel. At 2 Ohm load, the maximum output voltage after 360 s is still 55 V_{pk}, which corresponds to an average power of around 100 W per channel at 2 Ohm.

This is different for a crest factor of 6 dB in Fig. 16. Here, the full output voltage only remains at the 16-Ohm load. At low load resistance a limiter sets in after 60 s, which limits the average value to values between 105 and 120 W per channel. For both signals with 6 dB and 12 dB crest factors respectively, the 360 s measurement was also carried out in the 100 V modus with a 32-Ohm load. The amplifier delivered a permanently stable output signal for a 12 dB crest factor during this measurement. If the crest factor is reduced to 6 dB, the limiter sets in after 50 s, reducing the output voltage to 93 V_{pk}

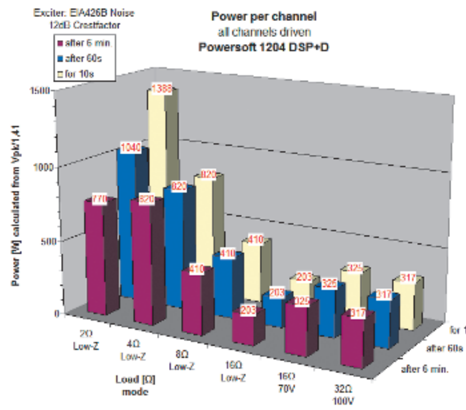
Based on the measurements so far with sinusoidal signals and noise with 6 and 12 dB crest factors, a very good overview of the amplifier's capacity is already possible. The 1204's maximum average power per channel after 60 s is 170 W. Apart from the exception of a 2-Ohm load, signals with a 12 dB crest factor are permanently transmitted with the maximum possible output voltage of 80 V_{pk}; signals with a crest factor of only 6 dB are limited to an average power of 115 W after a little over 60 s.

Results: performance values

The following diagrams give an overview of the performance measurements at all loads and for different time spans between 1 s and 360 s. In order to be able to compare these better, the performance values are always calculated on the basis of the measured voltage peak value divided by 1.414 – thus the way a sinusoidal signal would be calculated. For a



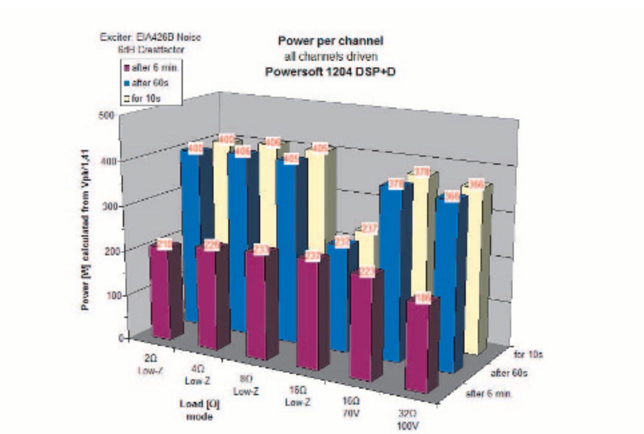
Sinusoidal *power values with simultaneous load of all channels and measurement with a constant sinusoidal signal (Fig. 17)*



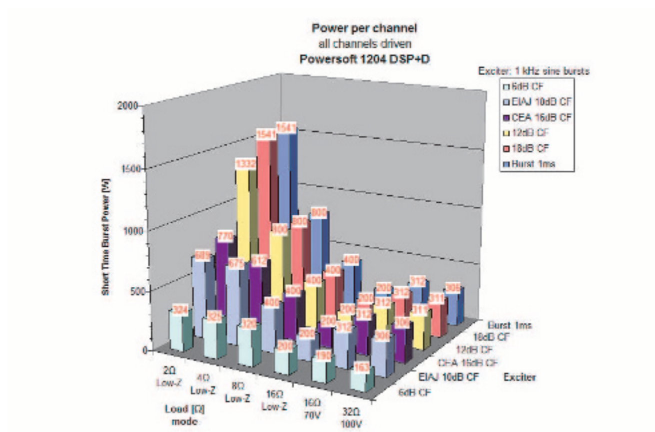
EIA426B *performance values for simultaneous load of all channels and measurement with a 12 dB crest factor noise, performance calculated from peak voltage divided by 1.41 (Fig. 18)*

constant sinusoidal signal with a 3 dB crest factor, the value then also corresponds to the average power P_{avg}. For signals with a crest factor of more than 3 dB, this correlation no longer applies. Nevertheless, the value remains comparable with a sinusoidal measurement. Alternatively, if it were to comply with common measurement methods, power could be easily comparable as peak power.

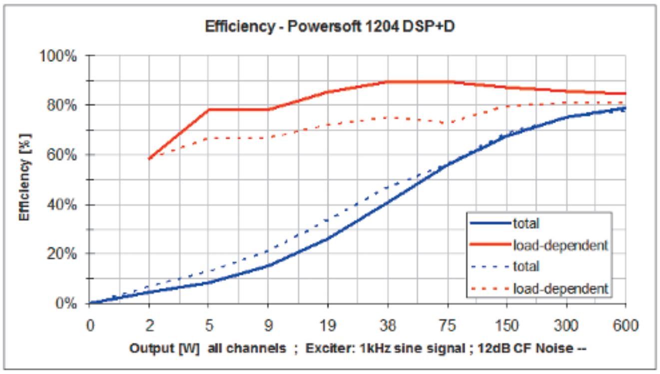
Fig. 17 shows an overview of all measurements with a constant sinusoidal signal for a timespan from 1 s to 60 s. The



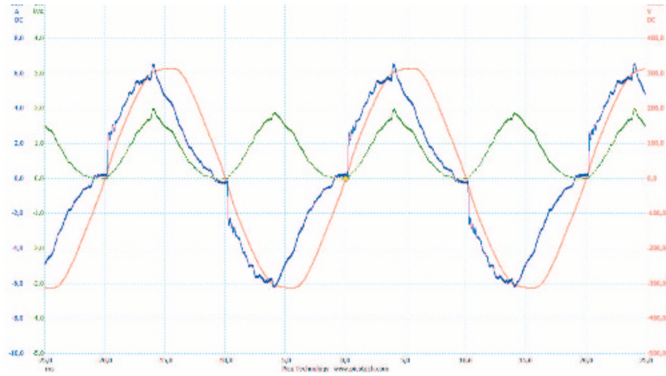
EIA426B *performance values for simultaneous load of all channels and measurement with a 6 dB crest factor noise, performance calculated from peak voltage divided by 1.41 (Fig. 19)*



Burst *performance values for simultaneous load of all channels with sinusoidal and burst signals with different crest factors. Performance as short-term RMD values (Fig. 20)*



Efficiency *of the 1204 in % depending on the output power (x-axis). In red the curve without base load, which indicates a very good amplifier efficiency (Fig. 21)*



Progression *of supply voltage (red), mains voltage (blue) and the calculated power consumption (green) with an RMS value of 835 VA (apparent power) (Fig. 22).)*

maximal power, which was measured this way, is constantly around 170 W per channel. The limitation takes place via the maximum performance of the power supply. For the 12 dB crest factor signal (Fig. 18), the limiting factor – apart from a 2-Ohm operation – is however always the maximum output voltage. Correspondingly, the power increases for each halving of the impedance. Only for the 2-Ohm load a doubling of the 4-Ohm measurement is not fully achieved.

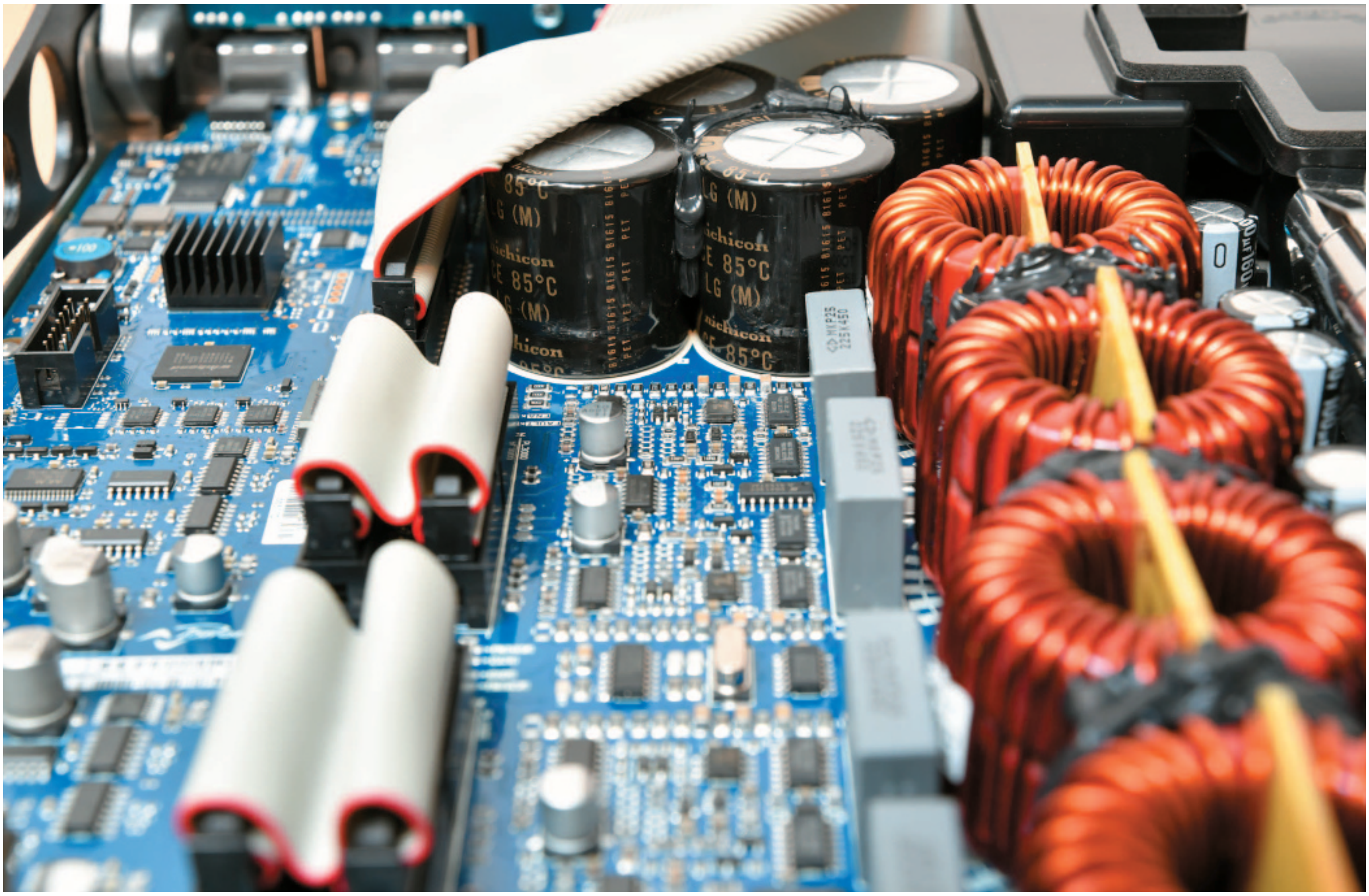
If the crest factor is reduced to 6 dB (Fig. 19), the maximum output voltage is only a limiting factor at 16 Ohm. For all other loads, the average power again becomes the limiting value. Independent of the load apart from the 16-Ohm measurement, this is around 200 W and 115 W after 360 s for the 6 dB crest factor signal in the first 60 s.

Additionally to the performance measurement techniques presented here, there are also a few other methods. The different is mostly the type of measurement signal and especially the crest factor. The desired crest factor for noise signals can be achieved using a targeted clipping of the signal or for burst signals via the burst's duration and level change.

Two typical burst measurement versions are defined according to the CEA standard and EIAJ. The measurement defined according to the EIAJ requirements works with 8 ms long sine bursts, which repeat themselves every 40 ms. This results in a crest factor of 10 dB. If one orients oneself by the CEA-2006-B standard, a measurement with a 20 ms burst is carried out every 500 ms. In contrast to the EIAJ method, the signal is not completely switched of between the bursts her, but only reduced by 20 dB. The crest factor is 16 dB. The performance value of such a measurement is defined for the 8 ms or 20 ms duration of the burst. Burst measurements with a sufficient number of periods in the burst additionally offer the advantage that additionally to the power the harmonic distortions in the signal can also be assessed. Fig. 20 shows the 1204's corresponding measurement results for these two methods. Additionally, there are the values for a single 1 ms burst and for further burst signals with 6, 12 and 18 dB crest factors. These consist of 1 kHz sine bursts with 2 ms long bursts, above which the height of the crest factor is set and repeated every 100 ms.

Network load

The last metrological observation is the power, which is taken from the power grid. The values for the standby and idle modus are very important especially for devices in fixed installations, as continuous operation is an issue and even small power differences can lead to large costs when calculated across an entire year. An energy saving mode can be activated for the Quattrocanalis, which initially sets individual



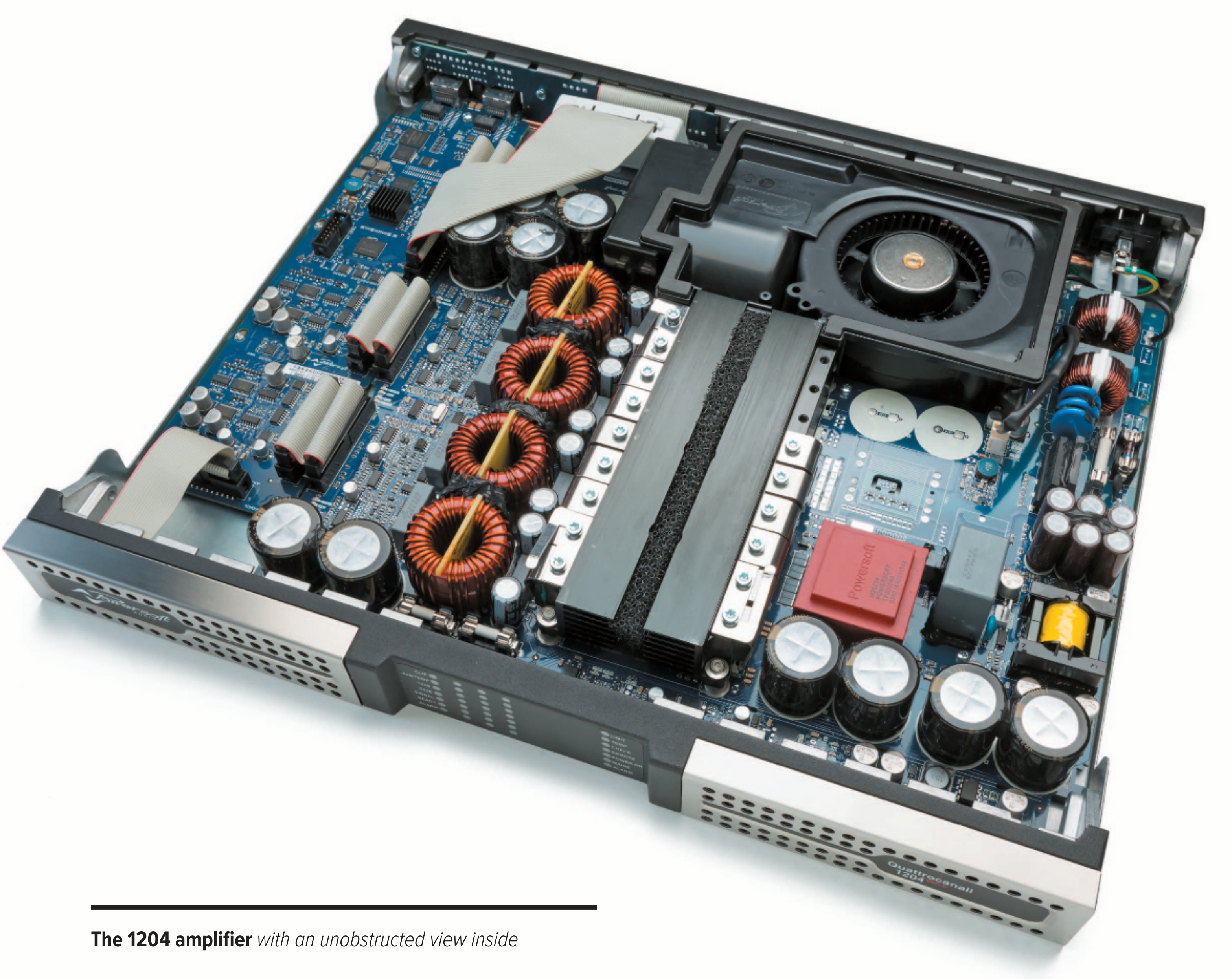
Four amplifier channels *inside the 1204 with output filter (right)*

channels and then the whole amplifier into the standby modus automatically. For this purpose, two power supplies are included: a large one for normal operation and an auxiliary power supply, which allows amplifier control and remote supervision also in standby modus. The following list shows some of the values of power consumption from the power grid for different operating states:

Standby:	17 W
No Signal (Idle):	30–50 W
Max. power 12 dB CF and 4 x 4 Ohm:	770 W
Max. Power Sinus:	761 W

The power consumption is not always consistent in the idle modus. A typical value is 32 W, which can however temporarily increase to 50 W. The second to last value is the power consumption when the amplifier is working at full capacity with a 12 dB crest factor signal. If one reduces the 30 W base load and then sets the remaining 740 W in relation to the output power of 600 W, one received an efficiency of 81%.

The curve in Fig. 21 shows the relationship between the output and consumed power, respectively the efficiency, depending on the output power. The blue curve sets the total consumed power in relation to the output power; the red curve shows the load-dependent proportion without base load. The measurements were carried out with sinusoidal signals (complete lines) and with a 12 dB crest factor noise



The 1204 amplifier *with an unobstructed view inside*

(dotted line). Without base load, the efficiency is between 75% and up to 90% depending on the signal type and load condition: an all-together excellent set of values. .

The Quattrocanali amplifiers' power supplies are equipped with PFC (Power Factor Correction), which secured a low distortion power consumption from the power grid. The goal is to make the amplifier as comparable as possible to a purely ohmic consumer in the network. How successful this is, is illustrated by the power factor (PF). Fig. 22 exemplarily shows curve of the supply voltage (red), the current course (blue) and the calculated current capacity (green). These curves were measured with an output power of 3 x 150 W. The power factor for this measurement was a very good 0.91. However, this is only achieved if the amplifier is working to full capacity. If the limiter sets in after 60 s and reduces the power consumption a little, then the power factor falls to 0.75. An inquiry at Powersoft revealed that the PFC only fully

Overview: Powersoft Quattrocanali 1204 DSP+D

Power 4 Ohm/4 Ch	Sinus 10 s	12 dB CF 60 s	Peak 1 ms
in W per Ch	170	800	800

Noise	dBu	dBu(A)
	–67	–69
Dynamic	dB	dB(A)
	104	106

f[Hz]	20	1 k	20 k
Gain dB	32,1	32	29,7
Phase °	+10	0	–100
HP-Filter	<5 Hz (35/70 opt)		
TP-Filter	21,5 kHz		

f[Hz]	100	1 k	10 k
CTC dB	90	85	45
CMRR dB	65	65	60
DF rel. 4 Ohm	800	110	10

THD(f) 25 % Power [dB]	–91	–77	–54

	Min.	before clipping
THD 1 kHz	–86	–80
DIM100	–75	–55

Power supply	HF switch power supply with PFC 85–275 V AC
Sleep	-
Standby	17 W
No signal	30–50 W
Full power	770 W @ 4 x 4 Ohm at 12 dB CF

Weight in kg	6,8
RRP incl. VAT	1.760,00 €
S.No.	003 000 45
Circuit	Class-D
DSP System	Powersoft Armonia
Remote	Armonia software from 2.9.0

operated from an amplifier output power of 500 W. This is especially true for the smallest model in the series, the 1204., However, this value was only achieved with sinusoidal signals in the lab.

Summary

With the Quattrocanali amplifier series, the renowned Italian amplifier producer Powersoft presents a new series with a focus on fixed installations. With capacities of 4 x 300 W to 4 x 1.200 W and the possibility to drive 100 V systems in direct drive, the Quattrocanali models cover most amplifier tasks in fixed installations. Along with the optional DSP system and Dante interface, even more potential applications arise in signal processing, remote control and monitoring. The DSP system offers the complete range of functions already available in Powersoft's X Series top-of-the-range models and that for a very agreeable extra charge of just 440 € including Dante interface. In the lab, the 1204 DSP+D delivered good to very good results. Convincing are the few distortions, a good interference distance and performance values, which are completely stable. The results for the short-term available peak power are additionally far above the nominal power, thereby allowing the Quattrocanali 1204 to offer a lot of headroom. A special mention should be made of the Armonia software, which is part of the DSP system, and with which users can easily configure the amplifier despite the huge range of functions. Highly pleasing for potential users – in view of the capacities and functions offered – is also the Quattrocanali series' pricing.

A unique feature of the standard version ist that the amplifier does offer Ethernet control for Armonia and 3rd party control. It offers level and mute control and monitoring of the amplifier status.