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Review & Measurements
d&b audiotechnik 5D

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d&b audiotechnik 5D

With the 5D, d&b audiotechnik presents a new four-channel, 4 x 600 W power amplifier in a 9.5″ format that is predestined for use in fixed installations. With its integrated DSP system, the 5D features the full range of functions also found in d&b's larger models and thereby fits seamlessly into the manufacture's system.

Copy, measurements and images: Anselm Goertz

Due to the use of multimedia applications, fixed install sound reinforcement systems are becoming increasingly sophisticated. This is the case not only when it comes to the complexity of such systems, but also in terms of audio quality as well as operation and networking. Two loudspeakers on the stage or a simple set-up consisting of ceiling loudspeakers are usually no longer sufficient. This is also reflected in d&b audiotechnik's portfolio, which, in addition to large PA systems, also includes a lot of smaller systems designed for use in decentralised applications, for conference rooms, houses of worship and many more. Accordingly, the demands on the matching amplifiers are also increasing. In other words, a big powerful amplifier that is nothing more than simply an amplifier is no longer enough. Today's standard features include numerous channels with different outputs, network control and monitoring of as well as the possibility to feed signals via the network. Additionally, corresponding software is required, which allows users to configure, operate and monitor their units.

All of these features could be found in d&b's amplifiers for some time, however, until now the company's product range only included larger models with 2RU, 19″ cabinets and high output levels. The latest addition to the product family is the slim 1RU, 9.5″ 5D amplifier. Depending on the type of measurement signal, the output is specified as up to 4 × 600 W. The integrated DSP system offers all the functions users are already familiar with from the manufacturer's larger models. In addition, the 5D is d&b's first amplifier that also features a Dante interface. Users therefore no longer need a special audio network bridge for a digital signal feed via the network.

What must a modern amplifier be able to do?

Over the past decades, sound reinforcement amplifiers

The 5D in its long 9.5" enclosure. Thanks to the connector plates, two enclosures can be assembled to form a 19" unit.

have changed significantly. Once enormously heavy power-only amplifiers are now complex loudspeaker management systems that manage the entire system with integrated DSP systems offering nearly endless possibilities with all kinds of digital filters. The same applies to the limiters that protect the speakers. With multiband thermal and peak limiters as well as excursion limitation for the woofers, these offer complex protection functions. Prefabricated and precisely tuned loudspeaker setups ease the operator's work and also increase operational reliability.

The networking of amplifiers has also become standard, as this is the only way to reliably monitor and configure larger systems. In addition to a modern amplifier's "administrative" tasks within a system, the amp's actual core competence still remains amplification. Class D circuits and switching power supplies have also led to a noticeable change here. Amplifiers are now much more compact and, above all, lighter; they can also provide power more in line with demand.

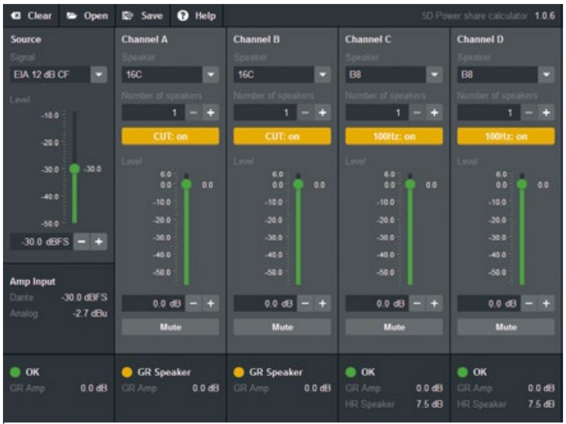
Let us take a look at the 5D at this point: its four channels have identical characteristics and draw their power from one source, the power supply. A look at the data sheet shows interesting values. For the maximum output voltage, the data sheet specifies 120 Vpk. With a sine signal, this would correspond to a power of 900 W at an 8-Ω load. This value, however, is understood to be a short-term peak value. Depending on the signal's crest factor, the maximum average power is significantly lower. A table in the data sheet provides detailed information on this.

For a better understanding of these values, one must first abandon the idea of sine power as the decisive value because music and speech are not sine signals. A sine signal has a ratio of the peak value to the effective value of 1.414 (3 dB). Non-compressed or weakly compressed music or speech signals have a value of 4 (12 dB) or higher. This ratio of the peak value to the effective value or peak to RMS value is called the crest factor. It follows that for the undistorted reproduction of speech or music, an amplifier must be able to deliver high voltages and currents, especially for short periods. If the 5D's 120 Vpk are fully utilised with a 12 dB crest factor signal, this corresponds to an effective voltage of only 30 Vrms and an average power at 8 Ω of 112 W. It is therefore completely sufficient if, for this channel, the power supply unit on average provides 112 W plus any losses in the order of 25 %. Higher reserves must correspondingly only be available for short signal peaks.

Power sharing

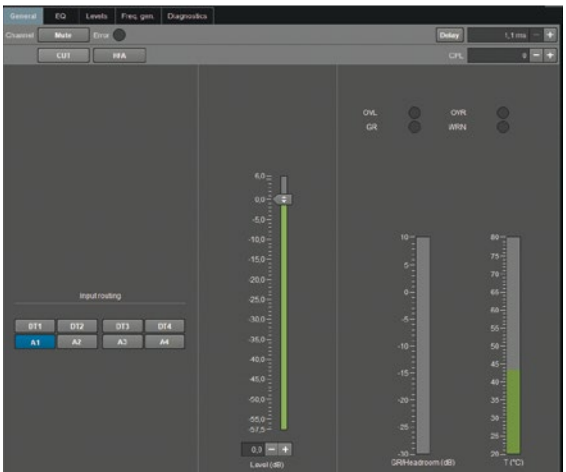
If one considers the power supply unit together with the four channels that draw from one source, then one can make use of so-called power sharing. If all channels are not fully used at the same time, then remaining reserves can be used to provide more power for the other channels. Users can calculate the optimal use of the 5D with power sharing by using the power share calculator, a small software that is available on d&b's homepage. Fig. 1 shows the software's user interface, where users first select the speaker types connected to the four outputs and then enter their number. Standard filters such as cut for the tops or lowpass for the subwoofers are also set here. The example in Fig. 1 shows 16C column loudspeakers for channels 1 and 2 as well as B8 subwoofers for channels 3 and 4. The signal is defined with an ➔

Front view
LEDs on the front panel indicate the most important information such as signal present, gain reduction or overload for the four channels.



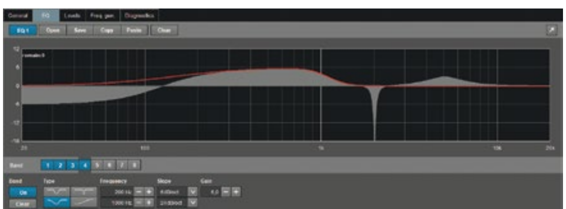
Power share calculator

Fig. 1: The power share calculator is available as an online tool on d&b's homepage. It allows users to quickly and easily calculate at which input level the selected speakers or amplifier are fully loaded. The signal shape can also be selected. Here, the calculation is done for an EIA spectrum and 12 dB crest factor.



General tab

Fig. 2: Overview for an amplifier channel with level meters for input level and for headroom or gain reduction. On the left side, users can select the input signal's routing and can set the level. Mute, delay and standard filters for CPL, CUT and HFA are also set here.



EQ tab

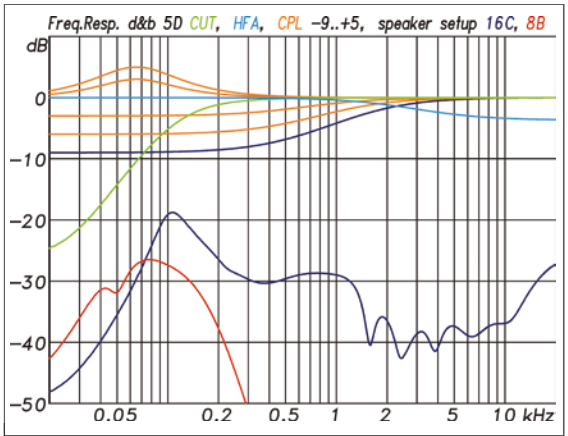
Fig. 3: Every amplifier channel features an eight-fold filter bank with shelf, bell and notch filters. Asymmetrical filters with different rising and falling edges can also be set.

EIA-426B spectrum and a crest factor of 12 dB. Both correspond to a typical music signal. If one now moves the level fader up, for the 16C, the gain reduction that protects the speakers is the first to react. For the B8 subwoofers, on the other hand, the display still shows headroom of 7.5 dB. If one increases the level even further – despite the speaker's gain reduction – or if several speakers are connected in parallel to one channel, the gain reduction amp is also displayed for the respective channel or, as a consequence, also the overload (OVL) display. If the total of four channels overload the power supply unit, the display appears in the field at the very bottom left next to the channels.

The data sheet includes another value of 4 × 37.5 W sine that may also need explanation. This value is defined as "long term" sinus power at an ambient temperature of 40°C. It is therefore a value for extreme conditions where the amplifier with a sine signal remains thermally stable at a high outside temperature and continuous load. For an EIA-426B noise with a crest factor of 12 dB, on the other hand, the data sheet specifies a much higher value of 4 × 600 W at both 8 Ω and 4 Ω – values that at first glance do not match glance. This value is calculated by taking the peak value measured with a 12 dB crest factor signal, dividing it by 1.414 (as one would with a sine signal) and calculating the power based on this. The RMS value is obtained by dividing the peak value by 4. This results in an average power of 75 W per channel, which can be provided over longer periods of time under normal conditions. If the amplifier threatens to overheat due to high outside temperatures, the maximum power can be halved – which would bring us back to the 4 × 37.5 W. What seems contradictory at first glance, does indeed match.

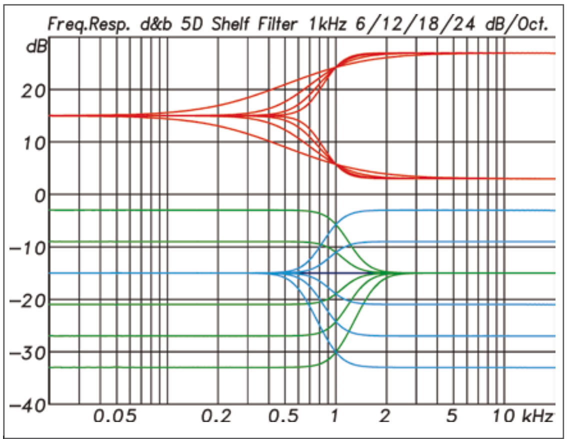
Hardware

Externally, like most modern amplifiers, the 5D is rather unassuming. Aside from to the air inlet, the 9.5" enclosure's small front panel with only 1 RU houses only a few LEDs for power and data as well as a combined mute/error and signal preset/gain reduction/overload LED for each channel. There are no controls on the front as all settings and monitoring are done via the network using the R1 software. The 5D's rear, on the other hand, is densely occupied. In addition to the mains connection and a small fan, the four balanced analogue inputs, the speaker connections, four GPI pins and an error contact can be found here. All connections are designed with Euroblock connectors. An internal 2-port Ethernet switch is included for the two network connections, allowing connections either in a star topology or as daisy chains with other units. Remote control via a network is provided by the OCA/AES70 protocol. In the network, the internal µC and the Dante interface appear with separate MAC addresses and accordingly also receive independent IP addresses.



Speaker set-ups and standard filters

Fig. 4: Top: Standard filter functions LowCUT, coupling (CPL) and HF attenuation. Below: Two examples of speaker setups from the speaker library. Here, for a B8 subwoofer and a 16C column speaker.



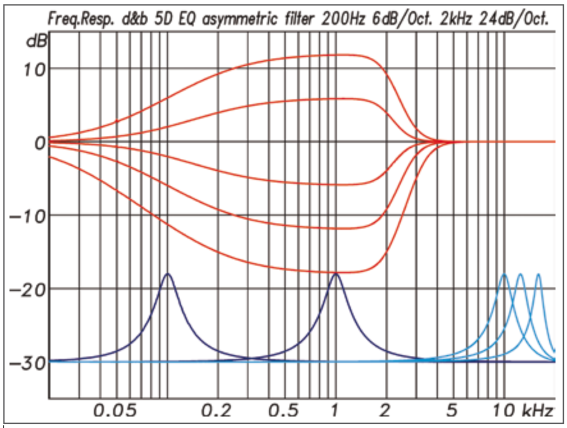
Shelf filter versions

Fig. 5: Four shelf filters versions are available with slopes of 6, 12, 18 and 24 dB/oct. The gain can vary from −18 dB to +12 dB.

The inside of the compact enclosure features two two-channel power amplifier modules, each with their own cooling profile, and a power supply unit that takes up most of the space inside the enclosure and is somewhat hidden under an insulating cover. At the rear, one finds a board with the output filters and below that the DSP system with µC and the peripherals, consisting of ADC, DAC and the Dante interface.

Software

When it comes to amplifiers, as is the case for many other professional audio technology devices, the associated external software is becoming increasingly larger and more important. Devices such as the 5D can only be configured with the help of PC software. In d&b's world, this role is taken on by the R1 software, which is available both for Windows and for macOS operating systems. R1 is suitable for all applications from a single amplifier configuration to large, extended systems. Users also have the option of compiling their own user interfaces and protecting various depths of operation by using passwords. →

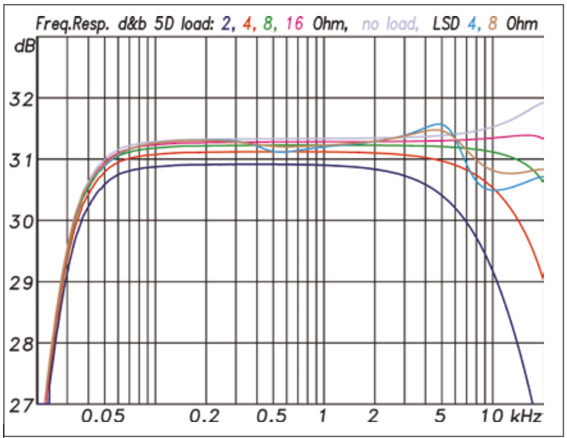


Asymmetric filters

Fig. 6: Top: Asymmetric filters with different slopes for the rising and falling edge. Below: Bell filter with +12 dB and a quality of Q=2. When approaching half the sampling rate, the filter curve is compressed due to the transformation to the digital plane. In contrast to the asymmetrical filters, this is an artefact of digital filters.

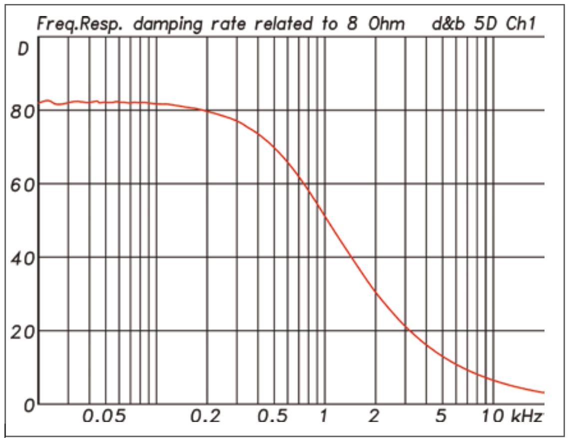
Rear view

The rear with Euroblock connections for the inputs and outputs; the two network connections can also be daisy-chained.



Frequency response

Fig. 7: Frequency responses measured with different loads of 2-, 4-, 8- and 16-Ω, in idle mode exemplary with 4- or 8-Ω rated impedance loudspeakers.



Damping factor

Fig. 8: Damping factor as a function of the frequency related to an 8-Ω load.

A comprehensive description of the R1 software would go too far at this point, so only points regarding the amp's configuration and therefore relevant for the 5D review will be discussed here.

Basically, the software distinguishes between three settings: configuration, tuning and show. In the configuration setting, users can give names to the respective amplifier channels, can assign a channel to a group, and can select speaker setups. In addition to the linear setting, users can always choose the speakers from the d&b range that are to be operated with the respective amplifier. In the tuning section, users will find tabs called General (Fig.. 2), EQ (Fig. 3), Levels, Freq.Gen. and Diagnostics for each amp channel.

The level tab, which is not shown here, displays the level meters for the input level, for headroom or gain reduction as well as the current power values as RMS value and the measured impedance. In the Freq.Gen. tab, users can set test signals with pink noise or as a sine wave, while the Diagnostics tab gives detailed information about source and cause should an error occur.

DSP features

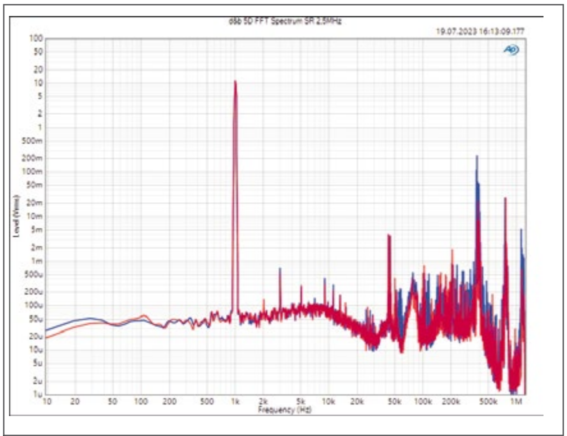
The 5D DSP's task is to take care of the filter functions and limiters as well as the signal routing. Three types of filters can be found. These are prefabricated loudspeaker setups with more or less detailed progression matching the respective model, which users can select but not change. Two examples can be found in the lower part of Fig. 4 for a 16C column loudspeaker and for an 8B subwoofer. In addition, predefined filters for CUT, CPL and HFA are also included. These abbreviations stand for a high-pass filter (CUT) for combining a top with subs, a low-shelf filter (CPL) for compensating the coupling effect in arrays and a high-frequency attenuation (HFA) for using fill systems close to the audience. The three types of filters mentioned are shown in the upper part of Fig. 4.

In addition, the DSP includes an eight-fold filter bank (Fig. 3) for each amp channel, which includes shelf, bell and notch filters. As a special feature, asymmetric filters with different rising and falling edges (Fig. 6) can also be set here. For the shelf filters (Fig. 5), users can select values of 18 and 24 dB/Oct. in addition to the usual slopes of 6 and 12 dB/Oct. The filters' gain range is –18 to +12 dB each, while the quality ranges from Q=0.5 to Q=25. All in all, users have plenty of options to fulfil all needs, even if special filter functions are called for.

When it comes to setting the frequency, values from 20 Hz to 20 kHz are possible. As processing runs at a sample rate of 48 kHz, one needs to note that the filter curves are compressed as they approach half the sample rate (Fig. 6 below). The reason for this is mathematical, as a real function in the continuous time domain is displayed into the infinitely extended frequency domain via the Laplace transformation. In the discrete time frame (after sampling), the Laplace transformation's equivalent is the z-transformation, which maps the time frame's function to the frequency domain from zero to half the sampling rate. This results in the filter curve's compression as it approaches half the sampling rate. In principle, this is not a problem, but rather only a characteristic of digital filters that should be taken into account during their set-up. Unfortunately, the compression is not shown in the EQ curve's graph. It would be nice to see directly what happens.

Measurements

The 5D's measured results start with the amp's frequency responses as a function of the load. Fig. 7 shows the curves for loads of 2, 4, 8 and 16 Ω as well as no-load and two further measurements with the typical impedance behaviour of a 4-Ω and an 8-Ω loudspeaker. The gain when using the analogue inputs is 31 dB. Due to a Class D power amplifier's circuit design with passive low-pass



High frequency signal components

Fig. 9: The output signal's FFT spectrum measured with a sample rate of 2.5 MHz. At 1 kHz, the useful signal can be identified. Remnants of the PWM switching frequency can be found at approximately 384 kHz and the integer multiples.

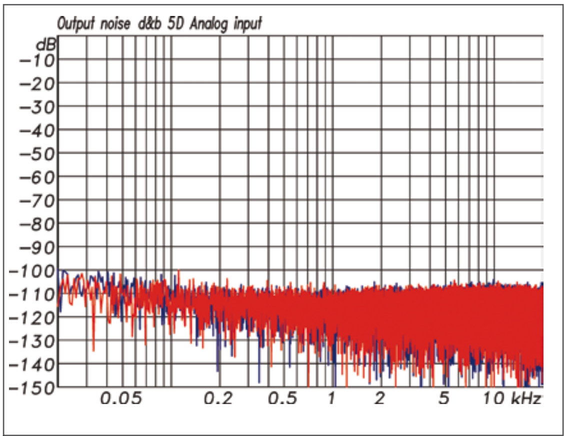


Fig. 10: FFT of the interference signal at the 5D's outputs. The interference level for all four channels is −68 dBu or −70.5 dBu with A-weighting. The maximum output voltage is 120 Vpk. This results in a very good S/N of 111 dB with A-weighting. When using the digital inputs, the result improves by another 3 dB.

filters in the outputs and depending on the load, more or less strong fluctuations occur in the frequency response at the upper end of the transmission range.

The lower the load impedance, the more the curve drops towards high frequencies. As can be seen from the curves in Fig. 7, this only becomes relevant at a 4-Ω load or below. However, real loudspeakers usually have an impedance that increases towards the high frequencies, which again weakens the effect. Measurements with real 4-Ω- and 8-Ω-loudspeaker impedances reflect the loudspeakers' impedance curve to a weak extent. This results in level fluctuations of ±0.5 dB for a 4-Ω loudspeaker, which are negligible in relation to the loudspeaker's frequency response. The amp's latency including the DSP system is a low 1.1 ms.

The measurement of the damping factor (Fig. 8) displays a Class D power amplifier's typical curve. At low frequencies, the result is just above 80 and then drops rapidly with increasing frequency, so that a result of only 8 is reached at 10 kHz. The reason for this are the outputs' low-pass filters, which become noticeable with increasing frequency. However, a high damping factor is especially important at low frequencies, where the loudspeaker requires good control by the amplifier to prevent long decay. The results of approximately 80 measured here are more than sufficient in practice, as cable and contact resistances usually cause even greater resistances on the signal path anyway.

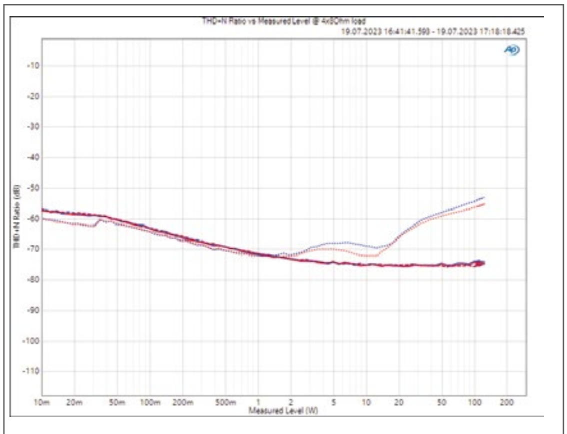
Another measurement for class D amplifiers is the FFT analysis of the output signal with a very high samp- ➔

Inside

Inside view of the 5D: top, the four power amplifiers with their cooling profile; below, the power supply unit is located below the cover.

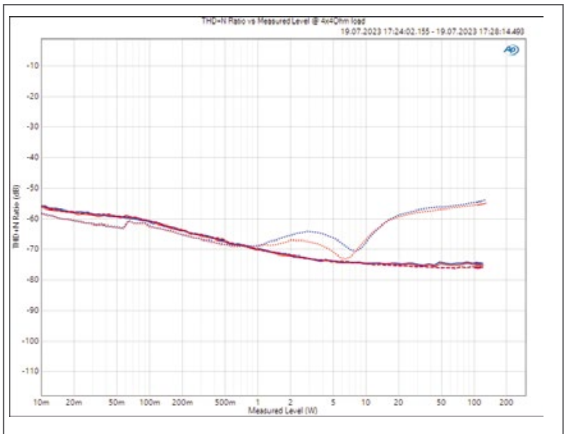
Output filter

Board with the output filters; the DSP board is located below. If one takes a close look, one can identify the ADAU-1466 Sigma DSP from Analog Devices in the shadows.



THD over power at 8 Ω

Fig. 11: Distortions (THD+N) as a function of the output power (x-axis in W) at a 4 × 8-Ω load. Measurements at 100 Hz (– – –), 1 kHz (——) and 6,3 kHz (· · ·).



THD over power at 4 Ω

Fig. 12: Distortions (THD+N) as a function of the output power (x-axis in W) at a 4 × 4-Ω load. Measurements at 100 Hz (– – –), 1 kHz (——) and 6,3 kHz (· · ·).

ling rate. Fig. 9 shows such a measurement for the 5D with a sampling rate of 2.5 MHz. With this type of measurement, both the Class D switching frequency and possible interference within and also outside of the audio frequency range become visible. For the measurement in Fig. 9, a 1 kHz useful signal was also fed in. For this measurement, the useful signal's amplitude at the output was 10 V. The PWM switching frequency at 384 kHz with a voltage of 200 mV and its integer multiples to just below the measurement limit at 1.25 MHz are clearly visible.

All further measurements were carried out with the AUX-0025, a passive low-pass filter to the APX555, as otherwise interference levels and distortion measurements would be disturbed by the high-frequency components in the signal's switching frequency.

The noise level at the 5D's outputs was measured for the analogue signal feed and for the digital feed via the Dante network. Fig. 10 shows the measurement's FFT spectrum with analogue inputs as an example for two of the four channels, which all behave in the same way. The sum level is –68 dBu or –70.5 dBu with A-weighting. The maximum output voltage, on the other hand, is 120 Vpk, resulting in a very good S/N of 111 dB with A-weighting. When using the digital inputs, the value improves by another 3 dB. Interfering mono-frequency components are not visible in the FFT spectrum of the equally distributed white noise displayed in Fig. 10. If one were to connect a loudspeaker with a sensitivity of 95 dB 2.83V/1m to the 5D's outputs, this would result in a noise level of 10 dBA at a distance of 1 m, which should not be critical even under sensitive conditions.

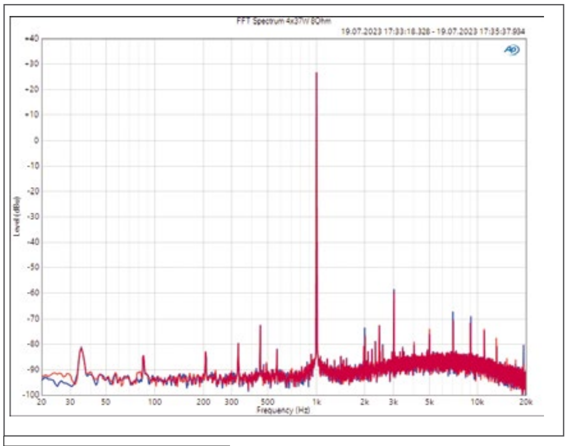
Distortion

The four following measurements examine the 5D's distortion behaviour. Fig. 11 and Fig. 12 show the THD+N values as a function of the output power, measured at frequencies of 100 Hz, 1 kHz and 6.3 kHz for a load of 8 Ω and 4 Ω respectively with simultaneous operation of all four channels. At 100 Hz and 1 kHz, the curves are close together at around –75 dB (=0.017 %). At 6.3 kHz, one can see an increase to approximately –55 dB. The power values achieved with a continuously applied sine signal are approximately 120 W per channel at 8 Ω and at 4 Ω, if all channels are operated simultaneously with this signal.

The distortion for 37.5 W per channel, also measured for 8-Ω and 4-Ω loads, can be found in Fig. 13 and Fig. 14. Although K3 distortions are dominant in both cases, they are more than 80 dB below the fundamental. Distortion components of a higher order drop even further compared to K3 and are somewhat more pronounced for the 4-Ω load.

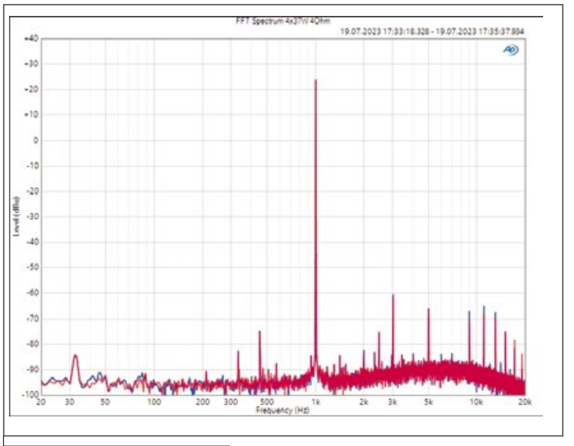
Further THD+N curves displayed in Fig. 15 were measured with a constant level and an output power of 37.5 W per channel each as a function of frequency. The total of four curves show two exemplary channels measured at 8-Ω- and at 4-Ω-loads. At 1 kHz and at 6.3 kHz, the familiar results displayed in Fig. 11 and Fig. 12 for a power of 37 W are again visible.

The final distortion measurement is the DIM (Dynamic Intermodulation Distortion) measurement (Fig. 16), in which a 15 kHz sine wave is superimposed on a steeply sloping 3.15 kHz square wave. The resulting intermodulations are evaluated. This measurement can reveal weaknesses especially when it comes to fast transient signals. The steep edges of the square-wave component are much more demanding on the amplifier than the THD measurement's steady sine wave is. The DIM measurement is therefore very importance when it comes to an amplifier's sonic qualities. As soon as high currents are required, the transient distortions often rise sharply – however this is not the case here. When the limiter kicks in at 0 dBu at 8 Ω or –3 dBu input level (x-axis) at 4 Ω, the re-



FFT spectrum at 8 Ω

Fig. 13: Exemplary distortion spectrum for Ch1 and Ch3 at 4 × 37 W power at a 4 × 8-Ω load. All distortion components are clearly below −80 dB (0.01 %).



FFT spectrum at 4 Ω

Fig. 14: Exemplary distortion spectrum for Ch1 and Ch3 at 4 × 37 W power at a 4 × 4-Ω load.

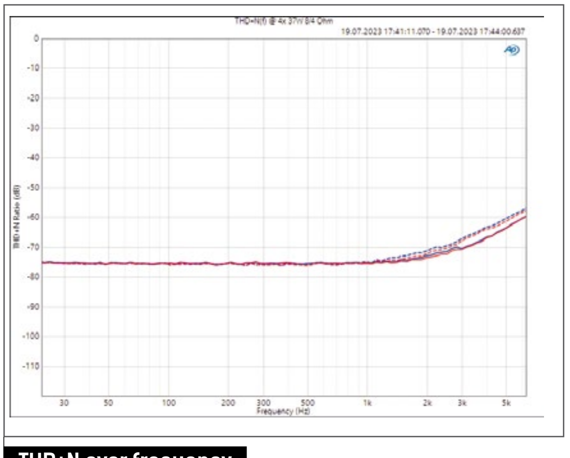
sulting –58 dB at 8 Ω and –56 dB at 4 Ω are in a range typical for Class D power amplifiers.

Performance

The measurement of the 5D's performance was carried out for three loads. All channels with an 8-Ω load, all channels with a 4-Ω load and only one channel with a 4-Ω load. Measurements were made using different signal types with crest factors from 3 dB (sine) to 16 dB (CEA 20 ms burst test). The measurements in detail are:

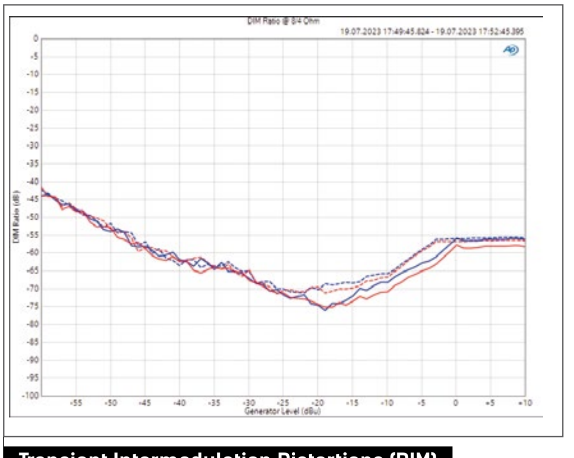
- pulse power for a 1 ms single period of a 1 kHz sine signal
- sine power with a constantly applied 1 kHz sine signal after one second, after ten seconds and after one minute
- power with a constantly applied noise with a crest factor of 12 dB after ten seconds, after one minute and after six minutes
- power with a constantly applied noise with a crest factor of 6 dB after ten seconds, after one minute and after six minutes
- power according to EIAJ measured with a pulsed 1 kHz sine signal with a length of 8 ms every 40 ms. This signal has a crest factor of 10 dB.
- performance according to CEA 2006 with a 1 kHz sine signal whose level jumps by +20 dB for 20 ms every 500 ms. The signal has a crest factor of 16 dB.
- power for a periodically repeating 1 kHz burst with a length of 33 ms, followed by a 66 ms rest phase. This signal has a crest factor of 7.8 dB.
- power for a periodically repeating 40 Hz burst with a length of 825 ms, followed by a 1,650 ms rest phase. This signal also has a crest factor of 7.8 dB.

The evaluation of measurements with sine signals is easy: the effective value is recorded and the power is cal- ➔



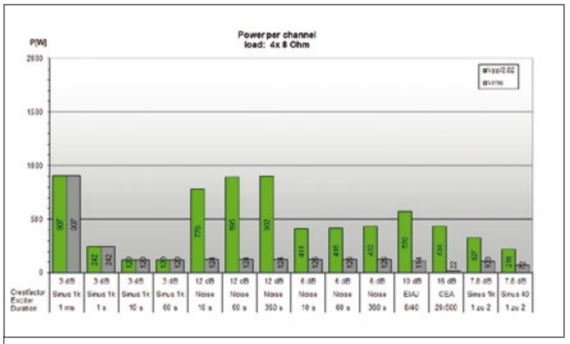
THD+N over frequency

Fig. 15: THD+N measured over frequency each with 4 × 37 W power at a 4 × 8-Ω load (––) and at a 4 × 4-Ω load (- - -) respectively.



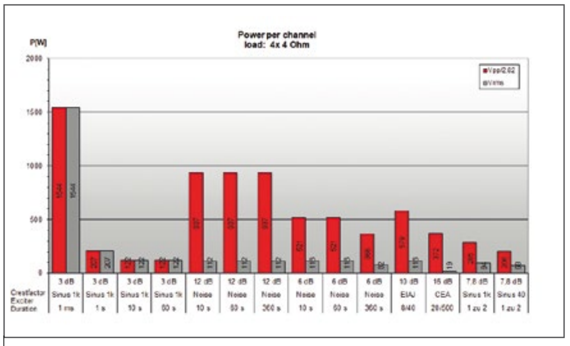
Transient Intermodulation Distortions (DIM)

Fig. 16: Transient intermodulation distortion (DIM100) as a function of the input level measured at a 4 × 8-Ω load (––) and at a 4 × 4-Ω load (- - -).



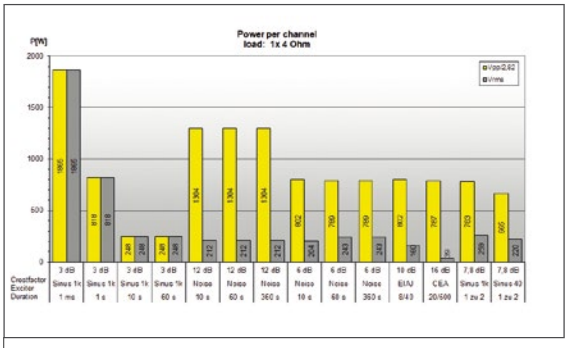
Power for a 4x8 Ω load

Fig. 17: The 5D's power at 8 Ω per channel with simultaneous load of all channels; results for different signal types.



Power for a 4x4 Ω load

Fig. 18: The 5D's power at 4 Ω per channel with simultaneous load of all channels; results for different signal types.



Power for a 1x4 Ω load

Fig. 19: The 5D's power at 4 Ω per channel with load of only one channel; results for different signal types.

culated from it accordingly. The sine wave should not be visibly distorted yet. For the sine burst signals according to EIAJ or CEA, two values can be determined: the short-term RMS during the duration of the burst as well as the overall RMS that also includes the signal pauses. The ratio of the two values is 7 dB for the EIAJ signal and 13 dB for the CEA signal. The crest factor, which describes the ratio of the burst's peak value to the overall effective value, is 3 dB larger in each case and is thus 10 dB and 16 dB respectively. For the burst measurement methods, the overview shows the power (calculated from the burst's short-time effective value) and the overall effective value. A further burst measurement method uses 33 ms long 1 kHz bursts followed by 66 ms long rest phases. Here, the crest factor is 7.8 dB. Based on this measurement and in order to examine an amplifier's capabilities in bass reproduction – where tones are often present for longer periods – the burst's frequency was reduced by a factor of 25 to 40 Hz and the time span was increased by a factor of 25.

Which burst measurement is better or more meaningful cannot be said in general terms. However, when making comparisons, it is important to only juxtapose measurements that are based on the same measurement method.

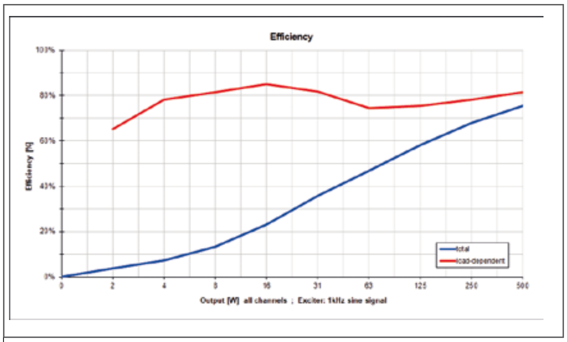
Measurements with noise signals with a crest factor of 12 or 6 dB are somewhat different. The amp is driven to its clip limit with these signals and then permanently loaded. The signal's peak-to-peak value (Vpp) and effective value (Vrms) are measured after ten seconds, after one minute and after six minutes. From this, comparable to the burst measurement, one power value is calculated from the voltage's effective value and one from the peak-to-peak value divided by 2.82. In this way, the values are comparable to those of the burst measurements.

Some benchmarks for the 5D can be derived from the performance graphs. If all channels are loaded simultaneously, with both 8-Ω and 4-Ω loads, an average power of 120 W is available per channel. This applies to sine signals as well as to various noise and burst signals. With different peak power values, a maximum average power – calculated from the voltage's effective value – of approximately 120 W per channel is always achieved. The peak power results show the generous reserves that the 5D has to offer. For the 12 dB noise signal, the ratio of the power's peak to average values is just under eight, corresponding to 8.5 dB. As the power's peak value is calculated here using the voltage's peak-to-peak value (Vpp) divided by 2.82, another 3 dB are added for the power's crest factor. This would bring us close to the test signal's 12 dB. The matter is somewhat different for the 6 dB noise signal. With 8.2 dB, the output power's crest factor is higher than the input signal's 6 dB. Behaviour such as this is normal for signals with low crest factors and is caused by the signal processing of filters and limiters.

If the amplifier is only loaded with one channel, then an average power of just under 250 W is available for this channel. A clever set-up would therefore be, for example, to assign two channels to the subwoofers and two to the tops. This way, sufficient peak reserves would be available for the tops and more average power would available for the subs.

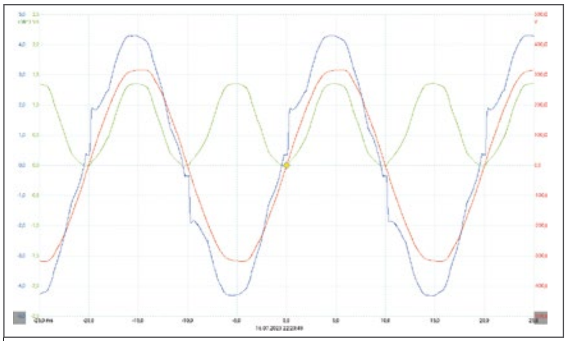
Mains load

The load on the power grid is an issue that should not be neglected, not even when it comes to smaller power am-



Efficiency

Fig. 20: Efficiency as a function of the output power. The blue curve shows the total power, while the red curve displays the load-dependent share without base load. (Inaccuracies may occur at low power levels due to the technology used for this measurement)



Current and voltage curve

Fig. 21: Curves for mains voltage (red), mains current (blue) and the calculated power consumption (green). The distortion in the absorbed current is a very low 7 %, which is equivalent to the amplifier behaving almost like a resistive load on the mains.

plifiers. Important aspects here are efficiency, mains load (keyword power factor) and, especially in the case of continuous operation in fixed installations, also power consumption in idle mode. Two curves showing the amp's efficiency can be found in Fig. 20. The blue curve shows the output power in relation to the total active power drawn from the grid. Together with the base load, this results in rather low efficiency values at low output powers. For the red curve, the output power is only related to the power consumed in addition to the base load.

For the 5D, this results in a good efficiency without base load of approximately 80 %. The base load, in other words the power consumption without signal, is about 50 W and is reduced to less than 5 W in standby mode. Thanks to the "auto-standby" and "auto-wakeup" functions available in the R1 software, the 5D can be operated in a particularly energy-saving way.

The current drawn from the mains should follow the voltage as closely as possible and the amp should therefore act (similar as a real resistor would) as a load for the mains. Deviations are caused by displacement reactive currents (capacitive or inductive) and by distortion reactive currents (harmonic component). The power factor (PF) shows metrologically how well the current curve approximates the voltage curve. The measurement for the 5D at full load can be found in Fig. 21. The blue curve for the current is only slightly distorted compared to the voltage (red curve). The power factor is 0.98, while the distortion (THD) is 7 %. Both values are close to how the ideal for a real load would look like.

The key values for the 5D amp's power consumption are:

- Standby: <5 W
- Idle: 50 W
- max. with 12 dB CF noise: 600 W
- max. with sine signal: 654 W

The results measured here are snapshots and may differ slightly depending on the outside temperature, previous history and signal type. If the amplifier is fully loaded with a 12 dB crest factor signal – which corresponds to an output power of 4 × 120 W – then the power consumption is 600 W.

Summary

With the 5D, d&b audiotechnik is adding a compact four-channel amplifier to its portfolio that is predestined for fixed installations with small and medium power requirements. With a continuous power of 4 × 120 W at 4 Ω or 8 Ω and a simultaneous peak reserve of up to 4 × 900 W, the amp's power is optimally dimensioned so that even signal peaks can be transmitted without distortion. When it comes to its features, the new 5D offers everything one would also expect from d&b's larger amplifiers – and now even more thanks to the addition of a Dante interface. The 5D should hence be the optimal choice for its intended range of operation, perfectly doing its job in relevant system applications, including in d&b soundscape applications. The full system integration into the popular d&b workflow as well as the use on other system platforms thanks to the 5D's plug-ins also underline the integrative system concept.

For the 5D, d&b charges €1,900 net plus VAT. In comparison to d&b's larger amplifier models, the performance offered for this price – both as an amplifier and in all peripheral features – makes the 5D particularly attractive to planners. •