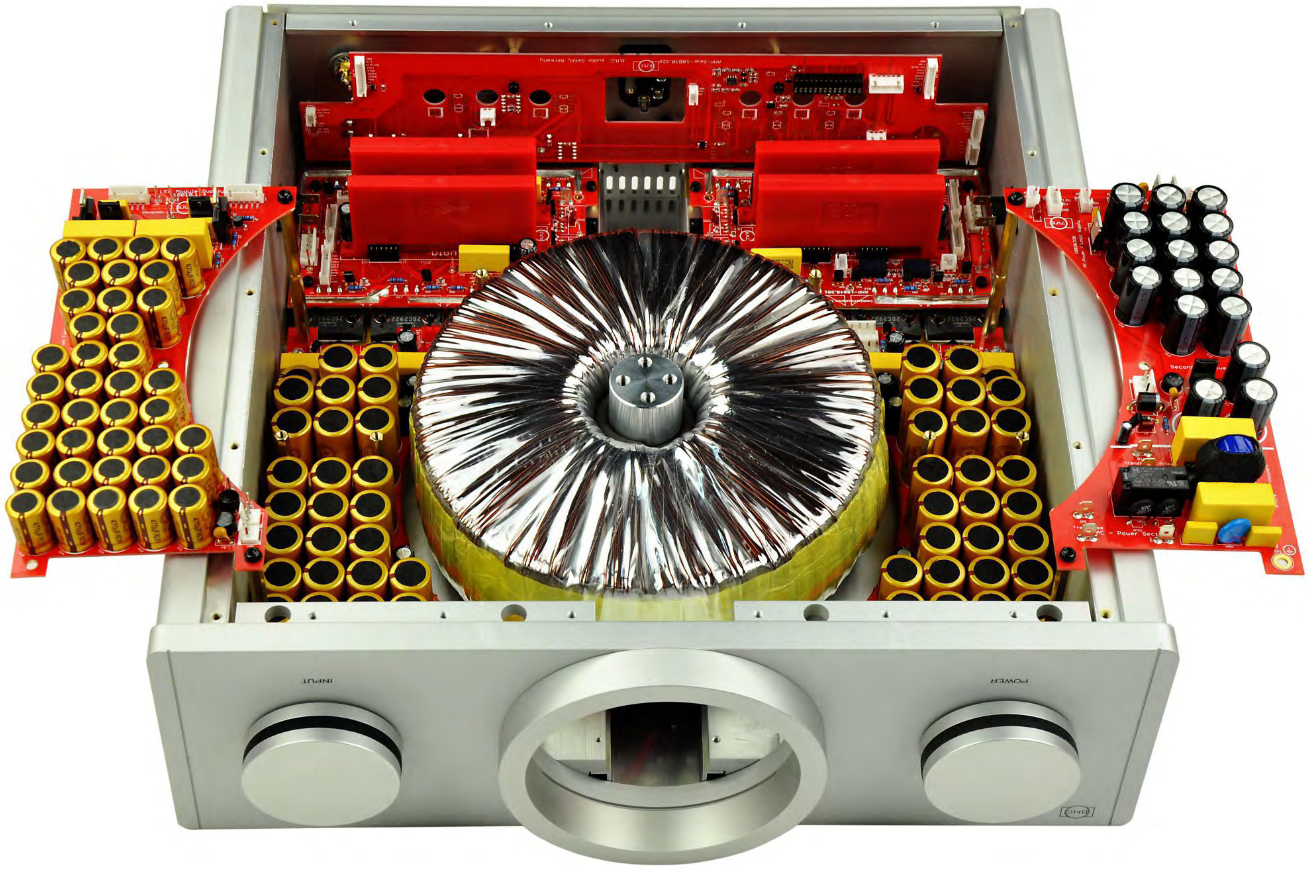


AMPLIFICATION REDEFINED

CI DIGM LEF

Extraordinary features of B.M.C. amplifiers

Perfect measurement results obtained with traditional measurement methods usually are not enough to impress the human ear. This is why standard transistor amplifiers often have to face criticism regarding their lack of natural music reproduction. And tube amplifiers have their own audible fingerprint as well. So, to build an amplifier that does not manipulate the music played, a couple of innovations were needed, innovations so much different from traditional circuits that even engineers have to look twice to figure them out.

CI, DIGM and LEF are our own, original developments that lead to a new experience of music perception when combined and consistently executed.

CI (Current Injection):

Low-impedance signal input that lets the original current of the signal source flow through the amplifier circuit until it reaches the desired speaker output voltage.

DIGM (Discrete Intelligent Gain Management):

Only at the level of the speaker output voltage, the gain is precisely adjusted to the desired volume. This prevents any signal attenuation as well as unnecessary amplification. Less amplification = less distortion and less noise = more natural musical quality.

LEF (Load Effect Free):

The LEF output stage adjusts the output voltage to the load (here: the speaker). The signal transistor, which is crucial to the sound, is separated from driving the load to prevent distortion in the first place. LEF allows single ended operation even with high power output. Sound quality trumps traditional Class A because of the natural absence of distortion.

Over-all negative feedback becomes obsolete:
The concept and natural absence of distortion of B.M.C. amplifiers allows for the abandonment of dubious over-all negative feedback. CI input and DIGM would not be possible without the distortion-free LEF output stage and the abandonment of negative feedback it makes possible.

Although power supplies have nothing to do with the actual amplifier circuits, they definitely matter in determining whether amplifiers are able to live up to their full potential.

Stabilized 2kW power supply:

A 2 kilowatt toroidal transformer provides a solid foundation for a very powerful, dynamic and stable energy supply. Storage in a whole battery of custom-made balanced current capacitors is the basis of extraordinary musical performance and transparency. There is an innovative electronic stabilization circuit especially for the power unit, which filters power supply ripple and other interferences out of the supply voltage, and thereby ensures great background silence and dynamic stability.

Result:

The impact of an amplifier that was systematically designed for the single purpose of music playback can not only be experienced by listening, but as well be seen in the perfect measurement results. Still, what matters in the end is that music comes alive as much as possible. A truly neutral sounding amplifier without a unique character is difficult to imagine. It is this lack of characteristics that makes it so hard to describe, because at times it can be brutally dynamic, or finely detailed, or raw and edgy, or tantalisingly and seducingly beautiful, detailed and at the same time rounded in its spacial representation... Ultimately this results in an unheard-of permeability for music, whatever characteristics it may have.

Technical features of the B.M.C. amplifiers in detail

CI: Using the orginal current of the signal source:

The original current that the signal source injects into the low-impedance CI input flows through the amplifier circuit, and the resulting signal voltage is only defined by the termination at its end. This means that the same electrons that were injected into the input can be found at the output. This is also what sets our circuit apart from traditional voltage amplifiers, because none of the original electrons reaches the output through a FET input and through a bipolar input. The CI input uses the original signal until it reaches the output voltage whereas voltage inputs just create a copy of the signal. The termination can be a simple resistor or a resistor network as in the DIGM.
The CI input's low impedance presents rather tough challenges to the source device's output. Of course all B.M.C. devices are appropriately designed to optimally drive the CI input, thereby enabling the best playback possible. Any other combinations may produce a worse sound while using the CI input than while using the standard XLR input, due to the lack of ability to provide the required current, resulting in tonal disadvantages. Studio devices and premium high-end devices with adequately dimensioned discretely designed balanced output circuits should not have any problems with this, but only the combination with B.M.C. source units will complete a chain of devices that feature the same concept of circuits.

DIGM:

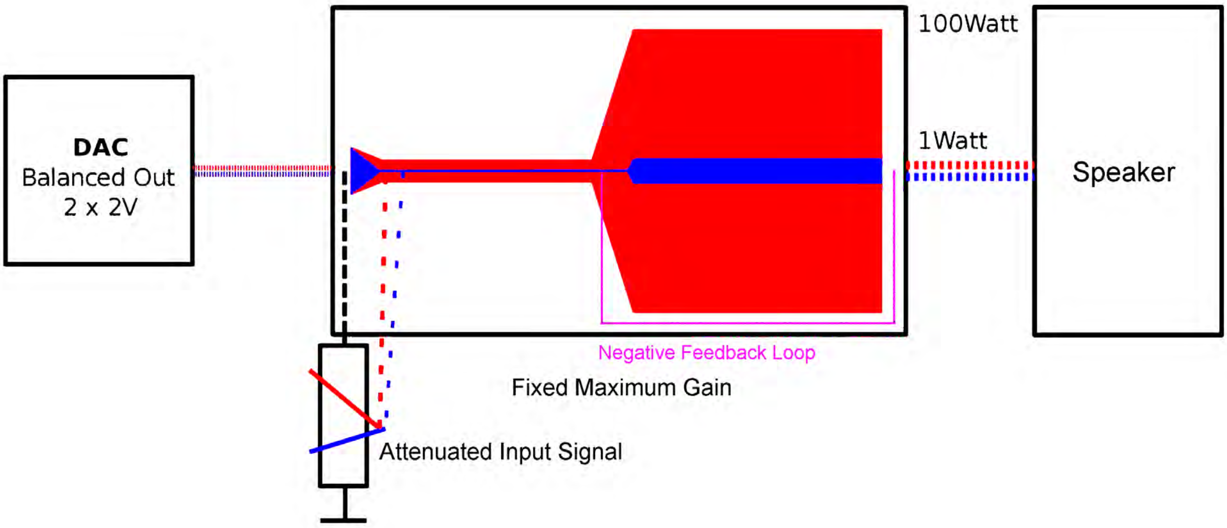
Via bipolar transistors DIGM switches precise resistors in different combinations for matching the desired amplifier gain. This way, the input current is turned into the kind of voltage that corresponds to the required speaker output voltage and is adjustable in steps of 1db. Since integrated CMOS digital potentiometers cannot be used here because of high requirements on current and voltage strength, a circuit was especially tailored to meet these demands and implemented in SMD equipped modules. There is no signal attenuation at all or superfluous amplification, because precise adjustment of the gain to the wanted volume only takes place at the level of speaker output voltage. Less amplification = less distortion and less noise = more natural musical quality. DIGM thus replaces a traditional volume control.

A quick comparison: The constant, very high amplification of traditional amplifiers is so inflated, that in those very rarely occurring cases even weak signals can be adjusted to the maximum output power. In other words, traditional amplifiers have an extremely high fixed gain that is (almost) never needed in practice and would, with a full input signal, result in pitiless clipping. Even when the volume is turned down, this maximum amplification is always there. What happens is this: The input signal is attenuated to such an extent that the output is reduced to the wanted level despite the over-amplification. This attenuation of the input signal is necessary even when maximum output is asked for in connection with a standardized input level. At moderate volume levels the input signal is attenuated to one hundredth or less. Does it really make any sense to reduce an obtained signal level so far that the output stage can only provide a suitable volume by over-amplification? Does it really make any sense to expend all this effort to amplify an MC signal from, let's say, 0.5 mV to 4 V, only to again reduce it to 40 mV, then amplify it again to 2 V, just to get 1 Watt with a 4 Ohm speaker in the end?

Our innovative technology provides a more intelligent solution.

Traditional signal attenuation via potentiometers, constant high amplification

[Always maximum gain | Input signal is attenuated]

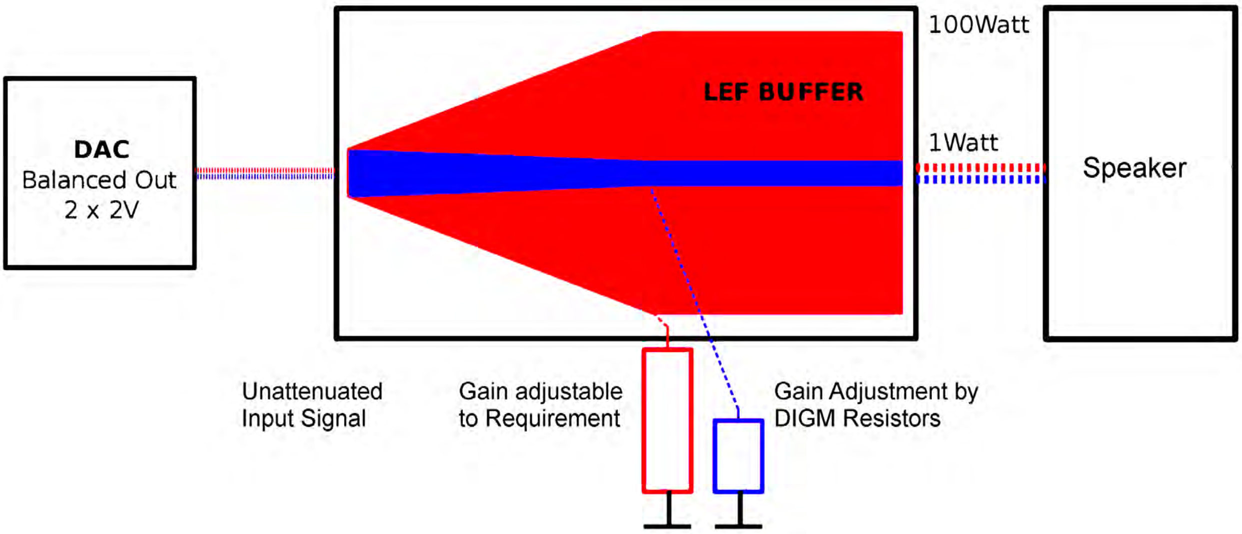


Red = High volume: The input signal is reduced from 4V to less than 1V, then amplified about 30 times.
Blue = Low volume: The input signal is reduced from 4V to less than 100mV, then amplified about 30 times.

Back to the DIGM: In contrast to traditional amplifiers DIGM does not mess with the input signal. It adjusts gain, up to the rarely needed over-amplification, but also down into the range well below 1:1, which means that the gain is precisely adjusted to the wanted volume.

DIGM volume setting via adjusted amplification

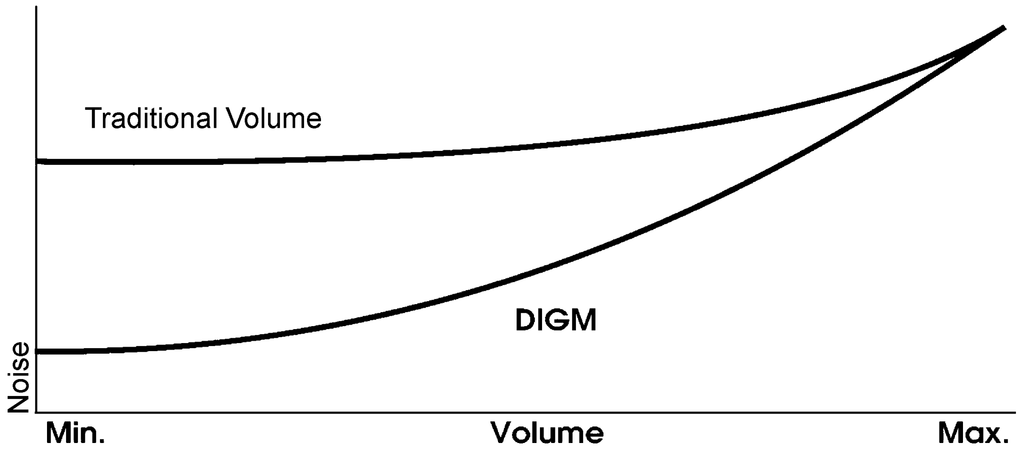
[Input signal is not attenuated | Only actually required amplification | Gain adjustment through DIGM resistors]



Red = High volume: The unattenuated input signal of 4V is amplified about 7 times.
Blue = Low volume: The unattenuated input signal of 4V is amplified about 0.7 times.

Since there is only an adaptation to the load after the gain is adjusted to the output voltage, no noise is further amplified. Traditional amplifiers reduce noise from the source when they lower the level, but the noise of the output stage remains widely constant. DIGM on the other hand allows for a reduction of amplification when the volume is lowered, thus decreasing noise from the source as well as noise of the amplifier.

Comparison: Noise level with traditional volume adjustment and DIGM



With the integrated B.M.C AMP volume adjustment through the DIGM circuit can either be triggered by the remote control or the volume control on the front panel. With the B.M.C. power amplifiers volume adjustment is triggered through an optical connection to the DAC1, use the remote control of the DAC1 or the volume control on its front panel.

LEF:
After the necessary speaker output voltage is produced, the output circuit is responsible for the task of adjustment to the load, in this case the speaker. The LEF circuit is so special, because the signal transistor determining the sound quality does not have to handle the load (and therefore prevents distortions). Hence the name LEF = Load Effect Free.
Furthermore, the part of the circuit which generates most of the current is not determining the sound quality. This revolutionary separation of voltage and current output makes possible a completely smooth drive of phase rotating loads, such as speakers. Single-ended Class A operation, even with high output, is not a problem for this circuit. The natural absence of distortion brings about a quality which is clearly beyond Class A, so that the intended waiver of over-all negative feedback does not result in measurement disadvantages but in tonal advantages.
LEF is extraordinary, that is why the traditional categories Class A or Class AB do not fit here. The level of efficiency corresponds to Class AB. An adequate description of the circuit would be: balanced cascoded single-ended Class A with separate current sources.

Step by step:
In Class A operation transistors operate in the middle, relatively linear range of transistor characteristics and there is no momentum of shift between the positive and negative half-wave. Single-ended Class A dynamically goes beyond that, by having a single transistor process the positive and negative half-wave. Cascoded single-ended Class A goes far beyond that, by having the cascode transistor taking the voltage variation off the signal transistor, which now is able to operate within a very small range of its voltage (V_{ce}) characteristic, thus producing a lot less distortions.
All these circuits have the downside of a low level of efficiency and feedback on the voltage amplifying stage. This produces substantially more thermic output (= heat) than electric power output. However, a low level of efficiency in the output of preamplifiers is acceptable, so sometimes (but rarely) cascoded single-ended Class A circuits are used, both with transistors and tubes.
In the output of power amplifiers the waste of energy of a cascoded single-ended Class A circuit is by itself hardly acceptable. In addition, these output stages, like all traditional amplifiers, modulate the output current (I_c) through the sound-quality -determining transistors; this modulation acts back to the input of this stage, leading to further distortions.
LEF uses a cascoded single-ended Class A circuit for the signal transistor responsible for sound quality, because there is no better circuit for an output stage, as far as dynamic performance is

concerned. For one thing, the cascode frees the signal transistor from the voltage swing, and for another thing, this makes the LEF so special, it is also relieved from the current (I_c) swing, which is necessary to drive the load. Again, hence the name LEF = Load Effect Free. Due to this concept inherent relief the signal transistor determining sound quality has such little variation of (V_{ce}) and (I_c) to do that almost no distortions whatsoever can be produced.
Similar to the cascode, the sound quality of the current sources is secondary. The current relief is carried out by high-impedance power current sources, in this way potential errors are overruled by the low-impedance signal transistor. The symmetrical circuit eliminates remaining residuals of even-numbered harmonics, which is especially important for single-ended circuits.

Over-all negative feedback becomes obsolete:

Over-all negative feedback is a popular way to reduce distortions. If distortions are already at a minimum without over-all negative feedback, this feedback obviously becomes obsolete. Even more: Over-all negative feedback sadly does not work as it is supposed to ideally, because if it worked perfectly, all amplifiers with over-all negative feedback - Class A, Class AB, tube amplifiers an even digital amplifiers - would sound the same or at least very similar. They are supposed to sound very similar or the same because the feedback signal is always compared to the original input signal in the input of differential amplifiers. Thus, all amplifiers ought to sound like the original input signal. However, the distinguishable differences between various amplifiers are so obvious that this alone is proof, that over-all negative feedback does not work properly. There is always a time offset between original signal and feedback signal. Over-all negative feedback rarely works with the actually required open-loop phasing of 0°, especially in IC operational amplifiers it operates across most of the audible range with a phase rotation of 90°, or the phasing even changes within the audible range. On top of that, there are feedback factors of variable size in connection with the various frequencies, because most of the times feedback is a hundred times as strong at 100Hz as it is at 10kHz. Can you really expect a homogeneous and coherent sound from that?

Phase deviations above the audible range are usually even stronger and approximate positive feedback. This causes a certain stress in the high frequency range that people ordinarily associate with transistor- or digital sound, though it really is the sound of over-all negative feedback. There are some circuit tricks to minimize this high-frequency-range edge but they work at the expense of sound transparency and openness. Plus, the load affects the feedback signal, thus it would actually be necessary to adjust the compensation of the feedback loop to the respective load. As the music-signal is not a simple and constant signal, the load is allways changing and makes an adjustment compromise-ridden. Thus over-all negative feedback for an audio circuit is indeed not as unproblematic as it may appear at first glance.
Structurally, over-all negative feedback needs voltage gain way beyond the desired amplification. Voltage gain in tube devices is pretty expensive, so over-all negative feedback is used economically. In contrast, the cost of one or two additional amplification stages in OpAmp-ICs are negligible, so excessive amplification and, accordingly, strong feedback can be found here. It may be true that tubes do not offer strict neutrality, but their tonal popularity certainly is an indicator of advantages in comparison to operational amplifier designs. The allegedly neutral transistor sound of traditional circuits also is not neutral at all; it is alterating in another way, occasionally at an even higher expense of musical quality.

The development of our B.M.C. amplifiers, which has happened in several individual steps and has extended for over a decade, has shown eventually that over-all negative feedback cannot only be easily omitted because the listening experience and the measurement results were absolutely satisfying, but also because in a consistent chain of CI with DIGM and LEF over-all negative feedback would not work. There is not even an option to smuggle in just a tiny bit of over-all negative feedback.
Furthermore, over-all negative feedback has never been able to resolve the following dilemma: With complex loads, which speakers naturally are, over-all negative feedback falls short when the voltage is zero but the flowing of a current is still required. LEF, on the other hand, features two “authorities” with clearly distinct assignments: The LEF signal transistor defines the output voltage while the current servo exclusively works to provide the necessary output current.

The power supply does not have anything to do with the actual amplifier circuit, but has the sole purpose of supplying the amplifier with the necessary energy without contributing any character of its own. This is why the concept and design of the power supply is so very important to the ultimate result offered by the amplifier.

Stabilized 2kW power supply:

A 2kW toroidal transformer is the solid base for a very powerful, dynamic and stable energy supply.
Extraordinary musical expansion and transparency are accomplished by storage in a whole battery of custom-made Balanced Current capacitors. These exceptional capacitors have the ability to support tonal precision as well as acoustic splendor, and they have a higher degree of purification when confronted with power interferences. However, in contrast to preceding filters they do not achieve this at expense of dynamics, quite the opposite is the case. An innovative stabilization circuit, even in the power unit, filters remaining power supply ripple and other disturbances out of the supply voltage and keeps it constant even under changing load conditions. The circuit is designed to have low impedance across the full frequency range, so it does not restrict dynamics or interfere tonally with the audible range.
The extremely sophisticated, stable, clean and so far unique combination of 2kW toroidal transformer, complete equipping with custom-made Balanced Current capacitors and electronic stabilization for the whole amplifier constitutes the foundation for profound quietness and unrestrained vitality. This way, explosive dynamics and energy, as well as fine details and magnificent tones can evolve from a pitch-black background.

Tonal relevance of the technical features:

As elaborate, big and heavy it may be, the power supply serves a single tonally relevant purpose, namely allowing the actual amplifier to perform its task under optimal conditions. Substantial independence from the form of the grid on any given day is one of its more subtle qualities. The LEF circuit makes possible an amplifier without over-all negative feedback that can unfold a more natural sound than an amplifier that is pretty much self-absorbed. Only the LEF output stage without over-all negative feedback enables the forming of a consistent signal chain with the CI Current Injection input, which handles the original input signal until reaching the speaker output voltage, and the lossless volume adjustment by way of gain adjustment via DIGM. All these special features stand out due to their ability of not standing in the way of musical playback. Music is allowed to express all its vitality: All the nuanced details and all the seducingly beautiful colours of tones come alive, as well as their counterparts at the other end of the spectrum, mercilessly attacking and stimulating, irrepressible and furious. Space unfolds convincingly in coherence and representation of details.

Music is meant to enchant, so let us give it a chance to work its magic.