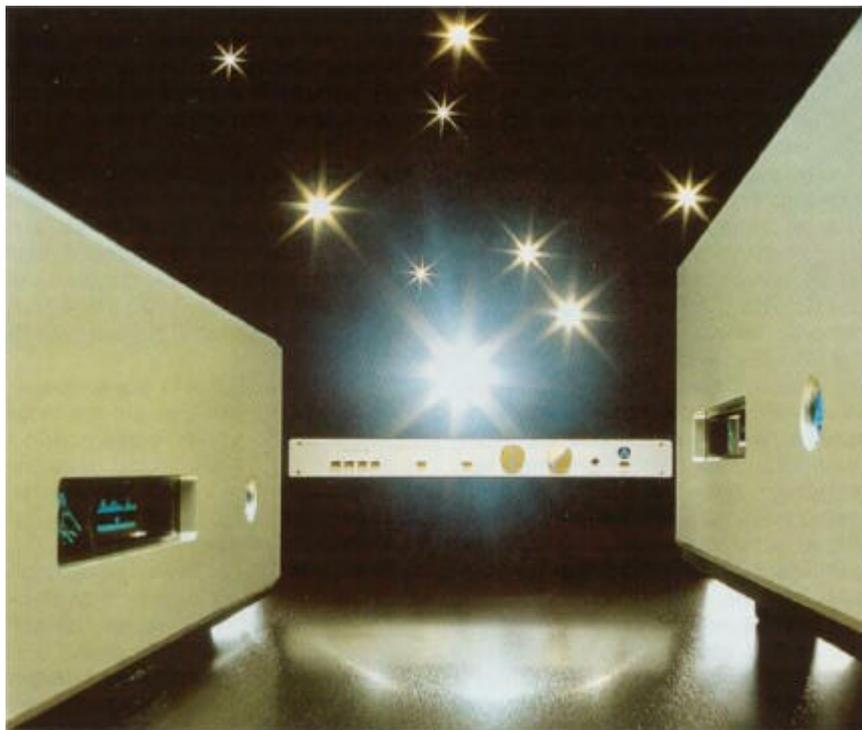


LIKE A SWISS WATCH



As I write this, the Iraqi crisis is worsening, the stock market is plunging, and the world seems to be going to hell in a handbag. So I feel a bit guilty writing about something as comparatively trivial as an extraordinary new preamplifier and power amp, even though they are surely the most glittering technological stars in the firmament of high-end audio.

The village of Wädenswil, near Zurich in Switzerland, is the home of the small plant of FM Acoustics Ltd. From this modest facility comes the most beautiful, precision-crafted, sophisticated and best-sounding preamplifier and power amplifier I have ever heard

FM Acoustics is owned by Manuel Huber, a brilliant and innovative audio and design engineer whose technical expertise is augmented by his deep and abiding love of music. For 17 years, Huber has been making high-precision preamplifiers, power amplifiers, and electronic crossovers for the professional audio industry. Famous as much for their reliability as for their performance, FM Acoustics electronics are in use in recording and broadcast facilities throughout the world.

For the past seven years, Huber has been involved in research and devel-

opment of a totally uncompromised, cost-no-object preamplifier and power amplifier for the high-end audiophile market, his personal "Holy Grail." Huber has now introduced his Resolution Series 611 and 811 amplifiers and 244 preamplifier. These products embody many of his innovative ideas in fabrication (including the use of custom-built, proprietary components) and include many unusual electronic features that contribute to performance, reliability, and protection of the equipment.

I briefly used the 611 amplifier but for some months now have been using the 811 power amplifier and the 244 preamplifier. Most of my comments on the 811 apply equally to the 611

Huber's design philosophy is interesting. He quite rightly points out that amplifier design is a fairly mature technology. Huber feels there is much to be gained by the refinement and proper execution of many aspects of current amplifier designs. Many of these refinements are expensive, either in the basic costs of superior-quality components or in labor-intensive fabrication and testing procedures and techniques. In the pursuit of these refinements and the inclusion of his own

ideas into his 244 preamplifier and 811 power amplifier, Huber has slain many sacred cows and stripped away some of the mythology that has encumbered amplifier design and fabrication for many years

The FM Acoustics 244 preamplifier measures 17 1/2 in. wide, 10 1/2 in. deep, and 13/4 in. in height. Its 4-mm-thick aluminum enclosure is laser-cut and laser-polished to a unique satin finish. The front and back panel lettering is negatively anodized so it can never wear off.

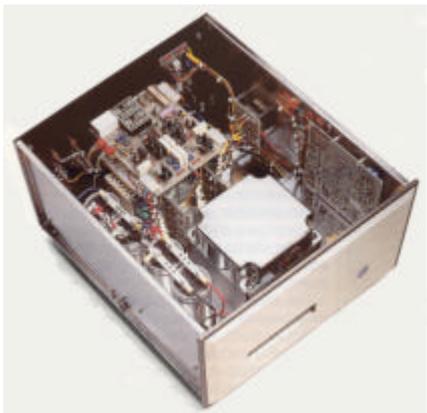
The FM Acoustics 811 Resolution Series power amplifier measures 17 1/4 in wide, 21 in deep, and 9 in. in height, and weighs 115 pounds. Its panels are also laser-polished to match the preamplifier. The front panel has an illuminated power switch and a central display that can indicate fault conditions.

Some expensive high-end amplifiers have separate left and right power supplies. Many even use monoblock construction, making the left and right channels separate amplifiers. The FMA 811, however, is configured as a stereo amplifier on a single chassis. Cost-cutting is not a consideration in the 811, and there are surprising and sound technical reasons, which I will detail next month, why FM Acoustics chose this kind of construction.

To fully describe and convey a true appreciation of the engineering masterpiece that is the FM Acoustics 811 power amplifier would require a great many pages in this journal; if ever a product epitomized the term "built like a Swiss watch," it is this fabulous amplifier. One would have to describe the meticulous and unrelenting attention to every detail of the unit. One would have to cite the use of the finest components and materials, and the ultra-precision fabrication. Above all, one would have to understand the importance of the exhaustive testing (much of it using proprietary procedures) of virtually every component in the FMA 811 amplifier.

A good example of the rigorous testing procedures is the special selection of all transistors used in both the 811 amplifier and 244 preamplifier. The 24 bipolar power transistors used in the 811 are proprietary designs made only for FM Acoustics The 250-V.

*The FM Acoustics Resolution
Series Model 811 amplifier.*



30-A chip is hermetically sealed in a ceramic case. Chip size defines the amount of current the transistor can supply. The average chip on a standard power transistor is around 10 square millimeters, while the FM Acoustics chip is 46 square millimeters. Thus the FM Acoustics chip is about five times larger than a normal transistor, and is also super high speed, about 10 times faster than standard transistors.

All FM Acoustics transistors are tested on a specially modified \$40,000 curve tracer. A certain voltage is set, a certain bias resistance is set, and then the current is turned up and down very slowly, carefully observing the transfer curves for any anomalies. When a transistor is found that fulfills all the desired requirements, the tracer is switched over to the "B1" test side. Other transistors are then tested to try and find one that absolutely matches the first transistor in all parameters, both statically and dynamically. This is all done by hand and is very tedious, time-consuming, and expensive. In the construction of a 244 preamplifier and an 811 power amplifier, as many as several hundred transistors must be tested to come up with the requisite number of matching transistors with identical transfer curves. These matched transistors are used in the positive and negative sides of the amplifier. This ensures that no distortion will be generated—it is actually cancelled within the stage, thus obviating the need for error correction or feedback.

In the 811, all stages are discrete Class A. There is a balanced input stage with a common-mode rejection of 90 db. Then come three voltage-gain stages, in finely tuned steps. Next is a precision predriver stage, the driver stage, and lastly the output **stage**.

All these discrete Class-A stages are cascaded in the 811. Each stage affords optimal performance, and there is no excessive demand on an individual stage. Thus there is always plenty of reserve in each stage:

this also improves long-term stability. With all stages running in Class A, using rail voltages of ± 95 V and quite a bit of bias current, forced-air cooling (via an ultra-quiet fan) is required. This not only provides long-term reliability but also keeps the power transistors in the best temperature range for optimum performance. The fan has two speeds, but in my experience it only goes into its higher speed when very high-level, bass-heavy and long sustained passages of music occur. As a further aid in maintaining optimal temperature range on the power transistors, they are mounted directly on the cooling fins without insulating washers.

It should be noted that the use of matched transistors—all pure Class-A operation, no feedback—and all other features of the 811 amplifier apply equally to the 244 preamp

In many ways, Huber takes a different approach to various aspects of amplifier design as compared to those of most high-end amplifiers. The typical high-end amplifier uses a toroidal transformer in its power supply. For the 811, Huber fabricates his own leaf-type transformer with a capacity of 2,900 VA continuous, and 9 kVA on peak repetitive impulses. Toroidal transformers certainly are preferred to the usual commercial leaf-type transformers which are notorious for their hum, stray fields, and mechanical noises from the stacked leaf plates. But the 811's transformer is another matter altogether. The leaf plates are made of a special high-performance steel (currently supplied only to the Swiss military and FM Acoustics) with a unique, proprietary version of grain-orientation, resulting in extremely low losses and hum, and stray fields that are an order of magnitude lower than those from toroidal transformers. Huber points out that a toroidal transformer of similar capacity to the 811 leaf-type would be inordinately large, very heavy, and difficult to mount safely. Because of manufacturing tolerances inevitable in toroidal transformers

where the metal core joins, there is very strong and directional magnetic radiation. Huber must pay dearly for his special transformers because they must be handmade. Each metal leaf plate is individually welded, so that the resultant stack has immense rigidity and produces no mechanical hum. Proprietary winding techniques are used to complete the transformer, and then a proprietary insulating material is used that can handle 4 000 volts! This careful hand-crafting is obviously quite expensive.

The FM Acoustics 811 power amplifier and 244 preamplifier are the most sophisticated audio amplification equipment that I have ever encountered, and the build quality is breathtaking in its fastidious and meticulous craftsmanship.

There is much cutting-edge technology in these units in respect to such things as special power-supply circuitry and capacitors, the enormous output-current capabilities, an on-board computer that monitors (at 20 times per second) such things as d.c. offsets, high-frequency oscillation, continuous and peak output currents, rail voltage, output voltage, temperature, and bias. There are also new ideas on amplifier/speaker interfaces and myriad other things, to say nothing of the incredible sonic performance of these units. All of these features and capabilities deserve full documentation which I will provide in my next column

The Model 244 preamplifier



JEWELS Or AUDIO ART



Last month in the first part of my review of FM Acoustics' Resolution Series 811 power amplifier and 244 preamplifier. I detailed some of the ultra-precision handcrafting, cost-no-object quality of parts, and proprietary devices and procedures which contribute so heavily to the truly extraordinary sonic accuracy and musicality of these gilt-edged components. The goal of Manuel Huber, the perfection-minded head of FM Acoustics, was to design and build an amp and preamp free from any constraints imposed by time and manufacturing costs. His intent was to redefine and go well beyond the previous state of the art. Many of his ideas and design philosophies fly in the face of conventional wisdom, and almost fanatical attention to every detail, from input to output, was needed to achieve this.

For example, the 811 features a special soft-start surge-protection circuit which limits the in-rush current known to make capacitors age faster. This circuit uses no relays or resistors, and it greatly extends the life of the capacitors. The capacitors used in the 811 are proprietary designs made exclusively for FM Acoustics. Many audio-philies seem to feel that capacitors which resemble 105-mm artillery shells

are indicative of a high-quality power supply. Huber points out that the larger a capacitor is, the higher its inductance and resistance at high frequencies. In addition, a capacitor has a nonlinear electrical series resistance (ESR) with respect to frequency. The FM Acoustics capacitors reduce the ESR by a factor of about five as compared to conventional capacitors. Thus, their ripple current capacity is extremely high. This allows the use of smaller and fewer capacitors, making the ESR lower and far more linear over the entire frequency band.

The 811's 2,900-VA transformer (described last month), proprietary capacitors, and matched pairs of power transistors (with their huge 46-sq.-mm chip area) mounted directly onto the cooling fins are part of the reason it can supply an immense output current. However, it is the 811's unique onboard analog computer which really makes possible its virtually unlimited output current.

The computer measures peak and continuous output current, output voltage, rail voltage bias, temperature and other parameters 20 times per second and compares this data to optimum values stored internally. If you introduce, for example, a very dynamic

signal (but not a short circuit), then the output voltage will on **average** be very high, while the average current will be reasonable—but the peak current will be huge, while the rail voltage remains stable. So here the output current remains absolutely unlimited, producing as much dynamic current as is required by the load. This, of course, requires huge reserves (another reason for the cooling fan), and the amplifier will reproduce precisely what is fed to the input, limited only by what the a.c. power can supply.

If a short-circuit situation develops, peak current is high, continuous current is shooting extremely high, and the rail voltage drops (because it collapses with such great amounts of current). At that moment, the amplifier shuts off before the output stage can be damaged. There is no limiting, compression, or anything similar. The amplifier shuts down, and the front-pane display shows an error message. Another circuit is immediately activated to measure the load impedance 20 times per second. As soon as the short circuit is removed, the amplifier automatically resets and becomes operational. Thus, the amplifier either works perfectly—or shuts off. No negative influence on the audio signal is possible.

The computer also monitors other error conditions. For instance, the 811 is provided with separate positive and negative d.c. sensors on both outputs: if there is any d.c. above 1 V the amplifier switches off and the display shows "**DC Error**" (The computer keeps measuring (20 times per second), and as soon as the d.c. is removed, the amp resumes operation).

The 811 has sensors for high-frequency oscillation that might occur because of ground loops or oscillating equipment. The sensors allow short bursts of high frequencies, like those from tape machine bias, to pass. However, with any continuous oscillation over 20 kHz, the amplifier instantly switches off. It should be noted that in the case of d.c. offset and high-frequency oscillation, the inputs and outputs of the 811 are switched off, as continuous very-high-frequency input into the 811 could destroy it. A proprietary relay with special contact material has 16 parallel contacts, each rated at 2,500 watts, to switch off the amplifier.

FM Acoustics' Manuel Huber set out to exceed the state of the art, regardless of time and production costs.

This relay makes sure that the superb damping provided by the 811 actually gets through to the speakers.

Another feature of the 811 is that it has a star grounding system of super-low impedance, the type used in many professional recording studios. Star grounding is expensive. Every single amplification stage (there are seven in the 811)—every single active device, in fact—must be grounded by a separate wire or connector to the central grounding point. This method, free from ground modulation, guarantees proper grounding, very low impedance and resistance, and no influence of any stage on any other. This is one of the reasons FM Acoustics can make a single-chassis stereo amplifier that equals or surpasses the separation of monoblock amps.

Before it leaves the lab, the 811 goes through elaborate testing. FM Acoustics subjects the 811 to a wide variety of loads and to switchable short-circuit tests. Accurate voltage and current measurements are taken. High-voltage insulation and accurate operating temperature are tested, and the protection circuitry is checked with a d.c. offset generator. Multiple burst measurements are also made. The 811 is run through 599 thermal cycles in a 100-hour burn-in and then subjected to violent vibration on a shaker table for an hour. After this abuse, the entire test procedure is repeated. While FM Acoustics uses many precision tools and devices, many of them proprietary, in the manufacture of the 811, I still have little doubt that there is more labor-intensive handcrafting on the 811 than on any other amplifier.

The FM Acoustics 244 preamplifier, the companion unit for the 811 power amplifier, is built to the same uncompromising level of quality as the 811. The 244 has absolutely zero feedback or feedforward in its circuitry. The proprietary signal-amplification circuitry is encapsulated in plug-in modules, which have discrete Class-A circuitry. As in the 811, all transistors are hand-selected and matched on a curve-tracing instrument. (Around 400 transistors must be checked to find enough matching pairs for one Model 244!) The front panel has push-button switches to select a phono input and three high-level inputs. There is a tape loop, mono/stereo switch, headphone jack, and balance and volume controls. The headphone jack doesn't have the usual 1C headphone amp but uses a discrete Class-A amplifier. Balance and volume controls are sealed, conductive-plastic, multi-wiper potentiometers which are checked to ensure

that they do not deviate by more than 1 dB over a 55-dB range. Another feature of the balance and volume controls is that they are isolated from the gain stages by pure Class-A buffers.

The 244 is available in Version A for moving-coil cartridges, Version B for moving-magnet cartridges, and Version C for purely high-level operation. In Version A, mini switches on the back panel allow for selecting resistance and capacitance for various MC cartridges. As in the 811, the 244 uses a star grounding system, and on the back panel is a ground-lift switch which can be used to check for ground-loop problems.

The bandwidth of the 244 is extremely wide, extending from 2 Hz to 2 MHz! There is said to be no phase shift from 20,Hz to 20 kHz. The output impedance is a very low 10 ohms, allowing the unit to drive several hundred feet of cable without attenuation. Rated distortion on line is an impressive 0.025% THD and on MC phono is 0.03%. Rise- and fall-time is 0.2 μ s with no overshoot. On line, hum, and noise are 90 dB below 0 dBV.

The straightforward specifications of these units are impressive, but although the numbers should be indicative of good sound, in no manner can they prepare you for the stunning musical verisimilitude provided by this gear. After months of intensive auditioning with the most demanding music, there is no doubt in my mind that a new pinnacle of musical performance has been achieved.

No amplification equipment should have a sonic "signature," but many do. Total neutrality, with no euphonious embellishment, is the ideal. The 811 and 244 reproduce *exactly* what is recorded on the source. If distortion and noise are in the recording, they are as faithfully presented as the music. Likewise, there is no alteration to the ambience of the original recording hall or any glamorizing or romanticizing of the musical instruments.

Though specs are often good indicators of sound quality, the 811's and 244's numbers can in no way prepare you for their superb performance

The 811 and 244 are incontestably the best I have ever heard in what I call dynamic expression, the ability to fully reproduce the wide dynamic range of the best CDs with absolute accuracy and to do so without the slightest hint of compression, all throughout the musical spectrum. I heard things on famil-

iar recordings which I had not previously perceived.

On a CD featuring Mitsuko Uchida's monumental performance of Debussy's "Etudes for Piano" (Philips 422212-2), the piano is reproduced as if it were in your listening room, at live playback levels! The dynamics of Uchida's great fortissimo bass chords never sound strained or harsh but simply resound with huge, resonant authority. Her quicksilver runs and trills are totally accurate. Every note is completely articulated, and there's never a trace-of transient blunting.

On a disc of Shostakovich's Eighth Symphony, with Neeme Jarvi and the Scottish National Orchestra (Chandos 8757), the most thrilling music of the third movement—with its relentlessly rapid unison string passages punctuated by high-level tympani strokes, brass fanfares, and snare-drum rolls—is reproduced with stunning accuracy. The unfettered dynamics give the music an exhilarating panache.

John Eargle's landmark recording of Respighi's "Feste Romane" (Delos DCD-3070) is simply unbelievable. The tumultuous outpourings of brass, huge bass drum explosions and accenting tam-tam, fierce high-register strings, and thunderous organ-pedal, counterpoint are reproduced by the FM Acoustics components with simply overwhelming sonority. The demands of dynamic expression on this recording are probably as great as you'll find on any CD and will severely tax even the best audio systems. If your speakers can handle this musical onslaught at realistic levels, the 811 will flawlessly provide the requisite dynamics.

On his dmp label, Tom Jung has produced some of the cleanest, most explosive and demanding recordings on CD. On his *Heat of the Moment* (dmp CD-468), track 5 has just about the most tremendously sonorous piano you'll ever hear. It is deliberately larger than life, for Tom coupled the mike pickup on the piano through a MIDI to a synthesizer, recording subterranean bass frequencies along with huge bass chords from Warren Bernhardt's piano. For the vast, rumbling, ultra-powerful bass, the 811 has the immense reserves of output current needed to reproduce it cleanly.

At \$27,000 for the FM Acoustics 811 power amp and \$6,000 for the 244 preamp, few people are likely to own these simply incomparable jewels of the audio art. But I can tell you that listening to great music through them is on the same level as driving fast cars or indulging in other thrills. So now I've got to fill out my lottery tickets....