HD audio MICROMEGA

FM10

The FM's heritage

FM10 is the successor to the FM tuner, which was widely recognized as being a best seller in its category due to excellent sound quality and first class reliability. At MICROMEGA we set our heart on developing an FM tuner whose performances would be exceptional while maintaining unbeatable value for money.

The chassis

Made entirely out of metal, the frame's role is to provide a stable base for the FM10's electronic circuits, protecting them from external electromagnetic disturbances and high frequency exposure, which are very common in today's environment. The aluminum front panel adds a special touch to all of the models of this range, providing an impression of elegant soberness, where minimalism and user-friendliness combine harmoniously.
A rotary encoder, driven by the unit's micro-controller, allows adjustment of the reception frequency or quick access to the pre-memorized stations. Six tactile keys allow access to the essential functions and the ergonomic design is intentionally preserved. The blue 10 character dot matrix display, driven by MICROMEGA software, displays all necessary information in real time. When RDS mode is selected, it displays the name of the received station. The aluminum anodized top cover, which comes in either black or silver, matches the front panel perfectly. The brushed effect of the front panel gives the product an unrivalled distinctive touch.

The power supply

Like all tuners, FM10 depends on the user's mains source for its power supply. Unfortunately this source is increasingly subject to interference, especially since the arrival of switching mode power supplies used by computers as well as by numerous other consumer electronics goods, for example TV sets, DVD players, video tape recorders, and satellite devices among others. All these power supplies, even if according to CE standard, they are supposed to prevent any input or output disturbance, emit towards the mains high frequency signals likely to disturb the tuner's reproduction. The effect is more significant the more powerful the model is.
The FM10 uses an R-Core type transformer. These very specific models have very interesting characteristics in terms of mains interference filtering. Contrary to toroidal transformers, which have a very broad bandwidth, R-Core transformers due to the way there are made, have a very narrow bandwidth. This makes them the ideal choice when the current requirement is moderate. FM10 is equipped with a linear power supply made up of several distinct sections in order to avoid the problems of cross talk between the various analog sections, the HF Front end section, the shaping circuits and the audio section. The specific power supply for the HF Front-end provides the necessary current to the HF head, which receives and amplifies the signals coming from the antenna. In addition, linear regulators with high power supply rejection guarantee a perfectly noise-free power supply for all of the section's elements. The other sections take advantage of independent active regulations guaranteeing the best possible signal treatment. To generate the specific voltage required by the FM10's VFD display, a specific winding procedure ensures that the power supply is isolated from this element. Purists know all too well how such problems, if not treated, can have a negative effect on very high quality musical reproduction.

The HF Front end

This module is the heart of all FM tuners and the tuner's reception quality is often directly related to the quality of this vital element. For the FM10, MICROMEGA selected the KST-F724VA which is a Front-end

of Asian origin. This high range element equipped in input with a double-grid FET transistor is particularly powerful. Indeed, compared to models commonly used in other tuners in the FM10's category, this HF Front-end performs much better in terms of the essential requirements for high quality reception. Without going into every detail of the design, some figures are important to point out and justify why we chose this model. The Power Gain is twice as significant as that of the competitor models (32 dB versus 25 dB) and the noise figure is halved (4 dB instead of 8 dB). In addition, the double-grid FET allows what one calls in electronic jargon an AGC (automatic gain control) which consists of adjusting the Front-end input sensitivity to enable the tuner to adapt to different reception levels. In this way, the FM10, by adjusting sensitivity input, adapts to the listener's reception surroundings. If the listener resides in an urban area and has an FM network, it is preferable to set the FM10 to the CABLE position to avoid saturation of the Front-end's input stage. In other situations and particularly when using an antenna or a dipole, we recommend setting the FM10 to the ANTENNA position to profit as much as possible from the very high sensitivity of the reception module, capable of picking up distant stations in optimized conditions with noise reduced to a minimum.

The IF section

At the output of the HF Front-end, the outgoing signal is at 10.7 MHz fixed intermediate frequency. The role of the amplification section with regard to intermediate frequency is to optimize gain in a sharp edge narrow band-width, in order to reject modulation residues from adjacent channels as much as possible. The choice of the band pass filter gauge was a compromise. If it's too narrow, part of the FM band modulation is truncated, resulting in distortion and band limitation after demodulation. If it's too broad, undesirable signals can interfere with the useful ones. Everybody knows, that given the number of FM stations available today, inter-channel spacing fixed in the frequency band plans is not always respected, and particularly in the relay zones. It is the same for the maximum frequency deviation recommended for FM modulation in the band 87.5 - 108 MHz. MICROMEGA opted for a structure on three discrete stages, equipped with Murata high rank input-output impedance adapted ceramic filters. The aim is to obtain a broader total response than the required 150 kHz minimum (FM excursion of +/- 75 kHz), but with a cut off slope extremely steep at the extremities in order to obtain optimal selectivity. The resulting intermediate frequency signals are sent towards the FM10 discriminator's limiter device.

The demodulator and the PLL (Phase Locked Loop)

The FM10's discriminator section and treatment of stereo multiplexing is entrusted to a LA1851 Sanyo circuit, which was chosen for its excellent performances and its numerous functionalities. After limitation of the amplitude of the intermediate frequency FM signals received from the IF section (to remove any trace of parasitic amplitude modulation), the LA1851 carries out demodulation of the multiplexing. This is done by using a quadrature detector featuring an external resonant circuit entirely designed by MICROMEGA. The demodulated signals are directed both towards the RDS decoder without any additional filtering and towards the LA1851 internal stereo multiplexing decoder via a fifth order "anti-birdy" filter, again entirely designed by MICROMEGA with the help of simulation tools.
Its role is to eliminate undesirable high frequency signals and especially the third and upper sub carrier stereo control harmonics, which, if not removed, can cause unwanted "whistling" after the decoding operation. The multiplexing with the sub carrier removed is then decoded by a synchronous demodulator with carrier regeneration ensured by a VCO (Voltage Controlled Oscillator). The LA1851 has a circuit which measures the intensity of the received signal. Via a controlled threshold comparison circuit specific to MICROMEGA, it performs a discrimination of the stations during scanning and memory setting according to the intensity of the collected field. Finally this circuit incorporates mute and mono locking functions which are very useful for stations with poor reception or for scanning stations. During factory

tests, the optimal level of separation for left-right signals is set manually, and is adjusted to 50 dB, a level which is seldom achieved by tuners of this category. In a super-heterodyne receiver, or in other words a frequency translator, the HF Front-end's local oscillator, as well as the tracking filters, must be controlled by a voltage which is representative of the frequency of the selected station. On the FM10's board, this role is played by Sanyo's LC7218 PLL (or phase lock loop circuit), which works together perfectly with the LA1851 demodulator. This synthesis circuit compares the frequency of the HF Front end's local oscillator with the frequency control data transmitted by the main microcontroller. It has its own quartz clock and provides, by means of the loop filter developed by MICROMEGA, the correct voltage to the reception block.

The RDS decoder

This circuit is the Philips SAA6581. It controls the demodulation and preparation of the RDS (Radio System Dated) flow which occupies the top of the FM multiplexing band. Initially it carries out a low-pass input signal filter sent from the discriminator in order to reject undesirable frequency residues over 60 kHz. It delivers a very narrow eighth order band pass filtering (3 kHz) centered on the removed RDS carrier (57 kHz). It regenerates the carrier thanks to its internal PLL and demodulates the carrier removed signal by synchronous demodulation. The RDS modulating bi-phase signal obtained is then decoded in serial binary format with reconstruction of the RDS clock and sent to the microcontroller. The RDS data processing is carried out within the microcontroller by a MICROMEGA algorithm.

The analog stages

The analog stages represent the last link in the chain and their role is vitally important. Indeed, as specialists know, the FM signal contains two control frequencies; one at 38 kHz for the stereo frequency control and the other at 19 kHz for the mono frequency control. If the stereo frequency control is relatively far from the audio band, the mono frequency control isn't. It's situated at the end of the audio band in a zone where perception remains good. Therefore these two frequencies must be cancelled; otherwise a whistling at 19 kHz will seriously disturb the content of the musical message. Fortunately the FM band limits to 15 kHz the band-width of the signal transmitted, and there remains therefore a band-width of 4 kHz to remove the first pilot frequency. In this case stiff slope filters are necessary so MICROMEGA designed 5th order filter elements and had them manufactured.
Once again, MICROMEGA's powerful CAD and simulation tools were able to work wonders, making an invaluable contribution and saving several long weeks of development. Very low noise operational amplifiers are at the heart of these filters and the unity gain buffers provide a perfect interface between the FM10 and other devices connected to it. Finally, a high-speed circuit which detects presence or absence of AC power supply sends the signal to the FM10 to emit DC bursts when switched on or in the event of sudden mains cut off.

The discovery of music

The FM band is a place where you have access to all types of music. The listener is presented with an unprecedented pallet of musical choice and all for the price of a good quality tuner. FM10 makes an excellent choice for it quality musical reproduction, which generates enthusiasm among all those fortunate enough to be the happy owners of one.

TECHNICAL CHARACTERISTICS

Tuning range	87.5 – 108 MHz
Stereo sensitivity	45 µV / 50 dB
Selectivity	60 dB / 300 kHz
Distortion	<0,5%
Bandwidth (±0,5dB)	20 Hz – 15 kHz
Crosstalk	<-50 dB-1 kHz
Output impedance	<600 Ω
Output level	1.5V RMS
RDS decoding	Yes
Preset station memory	50

Power supply

Power consumption	11 W
Fuse	T 160mA / 250V (Slow blow)
	T 315mA / 130V (Slow blow)
Dimensions: (W x D x H mm)	430 x 265 x 69 mm
Weight:	3.0 kg

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