

The *Resolution Series*®

Linear-Phase Electronic Crossover



- ♪ Truly unique 36 dB/octave electronic crossover
- ♪ Unmatched accuracy & reproduction, far superior to any other crossover whatever type and make
- ♪ Perfect step response with absolute freedom of overshoot and ringing
- ♪ 90dB attenuation = reduced inter-modulation distortion of speakers
- ♪ Lower distortion of drivers thanks to reduced diaphragm excursion
- ♪ No speaker lobing irregularities thanks to perfect in-phase response
- ♪ Discrete balanced Class A input featuring a CMRR of >90dB
- ♪ Proprietary Linear-Phase filters
- ♪ No IC's, hybrids, op-amps, or transformers anywhere in the audio path
- ♪ Possibility of separate crossover frequencies for low-pass and high-pass
- ♪ Pure discrete "enhanced Class A" circuitry throughout; no feedback, no feedforward
- ♪ Massive improvements of multi-way systems are now possible simply by replacing the existing crossovers
- ♪ Ultra-precise crossover frequencies are easily adjusted via plug-in modules on frontpanel
- ♪ Automatic muting of all outputs during crossover module change
- ♪ The superb discrete Class A balanced output buffers sense the load and automatically optimize the interface to any load, be it balanced, pseudo-balanced or unbalanced
- ♪ The outputs drive longest cables, including high capacitance and inductance with absolute stability
- ♪ Up to +27dBu (50V_{pp}) output capability and 10dB channel gain allow very high output drive voltages
Result = superb signal to noise ratio of system
- ♪ Delayed turn-on circuitry avoids switch-on transients, thumps and instability
- ♪ Groundlift feature; ground problems, hum and noise are avoided

Usual electronic crossovers use the same primitive textbook circuitry. The standard circuits, IC's technology and filter curves used in these do not allow optimal performance with quality audio systems.

The FM 330 Series of Linear-Phase Electronic Crossovers offer an exiting new and entirely different approach. Crossover technology takes a giant step forward with the result that, by simply exchanging the electronic crossovers, truly dramatic improvement of existing systems is achieved.

- **FM 333:** 3-Way Mono Linear-Phase Electronic Crossover
- **FM 334:** 4-Way Mono Linear-Phase Electronic Crossover

FEATURES

The *Resolution Series*® crossovers are singular in many respects and offer a multitude of features not found in any other electronic crossover:

- FM ACOUSTICS' proprietary Linear-Phase technology is employed. This guarantees absolute freedom of overshoot and no ringing. In combination with a linear attenuation of 36dB/octave and perfect in-phase response, the phase problems and lobing irregularities of speaker systems (that are due to anomalies of typical electronic crossovers) are gone. Simply by exchanging the crossover, massive improvement in any active speaker systems' performance is experienced.
- The *Resolution Series*® crossovers employ FM ACOUSTICS' exclusive discrete Class A balanced input stage that features a CMRR of >90dB (the Common Mode Rejection Ratio is the measurement of the quality of balancing). This contrasts with other "high end" makes typically achieving only 40 - 60 dB. And such a disappointing result is not even guaranteed for these units.
Unbalanced signals are automatically converted to balanced right at the input.
- A delayed turn-on circuitry avoids switch-on thumps and instability. 10 seconds after switch-on, the unit has completely stabilized and all outputs are connected without thumps or transients.
- Separate crossover modules for each Low Pass (LP) and High Pass (HP) filter allow fine tuning to the individual transducer's optimal frequency band. It is also possible to spread or overlap frequency bands with unparalleled accuracy which is an advantage for certain speakers that show peaks or valleys in the crossover region.
- The crossover modules are easily exchangeable from the front panel.
- The true symmetrical balanced output line drivers use FM ACOUSTICS' exclusive discrete enhanced

Class A circuits and can drive hundreds of meters of cable with absolute stability. Even when connecting highly capacitive or inductive loads there is absolutely no distortion nor any level change or instability! Any type of input stage connected to the 330 series is accepted.

- Each output buffer has additional gain. Together with the max. output voltage capability of +27dBu (50V^{PP}), this allows running the audio lines between crossover and amplifiers at higher voltages than usually possible. The results: better signal to noise ratio, less interference and higher dynamics of the overall audio system.
- 25 High-Pass and 25 Low-Pass crossover modules in the range from 63Hz to 16kHz are available as standard but FM ACOUSTICS produces any specific crossover frequency to customer request.

Standard crossover frequencies are:

63 Hz	250 Hz	1000 Hz	4000 Hz
80 Hz	315 Hz	1250 Hz	5000 Hz
100 Hz	400 Hz	1600 Hz	6300 Hz
125 Hz	500 Hz	2000 Hz	8000 Hz
160 Hz	630 Hz	2500 Hz	10'000 Hz
200 Hz	800 Hz	3150 Hz	12'500 Hz
			16'000 Hz

- Standard crossover frequencies of the filter sections can be within the following ranges:

FM 333:

Low to mid crossover frequency: 60Hz - 1600Hz*
Mid to high crossover frequency: 600Hz - 16 kHz*

FM 334:

Low to low-mid crossover frequency: 60Hz - 1600 Hz*
Low-mid to high-mid crossover frequency: 160Hz-3000 Hz*
High-mid to high crossover frequency: 600Hz - 16 kHz*

* If other frequencies are required, internal filter modules that cover other ranges can be installed on special order.

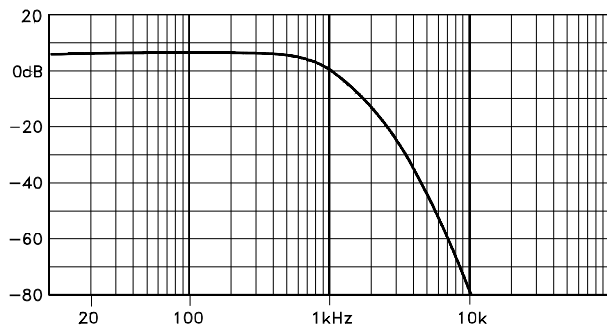


Fig. 1: FM 330 36dB/Octave Linear-Phase Crossover

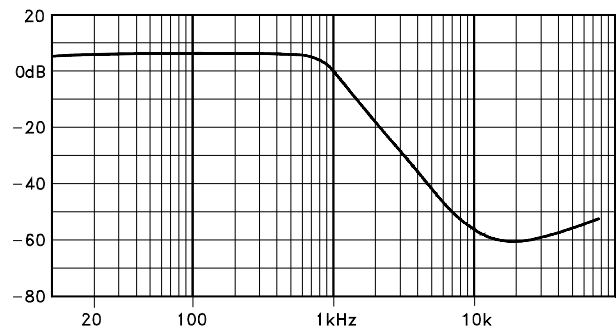


Fig. 2 Widely used 18dB/Octave Crossover

Attenuation curves of the FM 330 series (Fig. 1) in comparison with those of a popular "high quality" crossover (Fig. 2). The higher attenuation of the FM 330 at the critical frequencies results in remarkably lower distortion and intermodulation. The headroom is considerably increased and at the same time drivers have lower distortion (at the same SPL).

The *Resolution Series*® Linear-Phase Crossovers achieve their extraordinary reproduction standard by combining proprietary filters having an attenuation curve that follows a Gaussian function.

They feature a number of special characteristics.

Attenuation and diaphragm excursion

Drivers only perform adequately within a limited bandwidth. Signals out of this range must be attenuated as much as possible so another driver better suited for this frequency range can reproduce these frequencies. The electrical bandwidth supplied to a driver must always be considerably narrower than its mechanical limits would theoretically allow.

A unique advantage of FM ACOUSTICS Linear-Phase technology is the attenuation characteristics of its Linear-Phase filters, which provide complete attenuation (to -90 dB (see Fig. 1). This results in absolutely singular performance, which is understandable when comparing above Fig. 1 with Fig. 2 which shows the attenuation curve of a typical crossover.

As can be seen, with usual filters the response of a driver is not attenuated any further once the typical stop-band damping has been reached. At this point standard crossovers suddenly stop attenuating. Above a few kHz the signal level fed to the low frequency driver actually increases! The low frequency driver is thus supplied with too much high-frequency signal. The result is coloured reproduction in the stop-band.

This, of course, results in additional distortion, intermodulation distortion, lobing irregularities, non-uniform diaphragm excursion etc.

A similar situation exists with the HP filter. As the low frequency attenuation of standard crossovers is worse

than that of the FM 330 Series, the HF driver has to handle larger levels of low frequency signal: this requires a much higher diaphragm excursion. The relation of Sound Pressure Level increase to diaphragm excursion is exponential, so with a standard crossover the HF driver reaches its physical limits much more quickly. The result is higher distortion and intermodulation, lower power handling and less headroom.

When using the *Resolution Series*® crossovers the reduced diaphragm excursion and freedom from overshoot results in astounding improvements. With the *Resolution Series*® crossovers, drivers can actually handle considerably higher signal levels which results in reduced distortion and intermodulation at a given SPL (Sound Pressure Level) or a considerable increase in achievable SPL at the same distortion level.

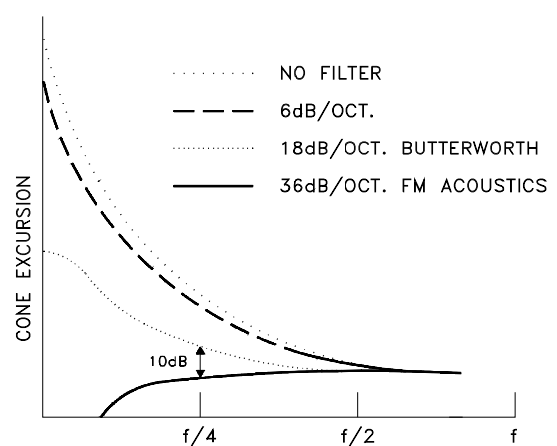


Fig. 3: Voice-coil/cone excursion in relation to frequency for three standard filter circuits and the *Resolution Series*® Linear-Phase Crossovers. With the FM 330 Series the diaphragm excursion is reduced by 10dB(!) at 1/4th of the normalized frequency compared with an "industry standard" 18dB/octave crossover. This obviously results in considerably lower driver distortion and intermodulation.

FM ACOUSTICS unique Linear-Phase filters guarantee **perfect blending** of drivers - the phase accuracy at the crossover point is guaranteed to be better than 2° - absolutely unique in electronic crossover technology. In combination with complete attenuation (down to -90 dB!) this guarantees optimal damping of unwanted frequencies and therefore ultimate performance of the individual drivers. The resulting reduction in distortion yields dramatically increased transparency and resolution.

By replacing existing crossovers with 330 Series Linear Phase Crossovers massive improvement of audio systems are possible.

Additional Features:

- The discrete circuitry uses over 100 hand-selected transistors which are additionally subjected to FM ACOUSTICS' proprietary listening-test procedure. A large number of transistors (between 40% and 95%, depending on batch) must be rejected, meaning that between 400 to over 1000 transistors have to be selected before a single unit can be manufactured! Each individual semiconductor is subjected to these tests. Only perfectly matching semiconductors are used. These are operated in their most linear drive-mode. Error correction and feedback circuitry can thus be avoided.

Similar selection procedures are used for selection of other components such as capacitors which are selected down to 0.1%! These very time consuming component selections (imagine the time required to find matching <0,1 % tolerance capacitors), the standard being 20% in part explain the cost of the crossovers.

The final result: a phenomenal reproduction that vastly improves the sound of bi-amplified, tri-amplified and quad-amplified audio systems.

- For each frequency band there is a separate OUTPUT LEVEL control.

Available in 3 Versions

- FM 333 Series: monophonic 3-way crossover
- FM 334 Series: monophonic 4-way crossover

A *Resolution Series*® crossover will not be subject to obsolescence thanks to its modular technology. Future breakthroughs can be incorporated readily by simply replacing the corresponding module (a 10 minute affair), the crossover can be kept at the forefront of technology and performance.

Apart from the new balancing technology pioneered in the FM 222 and FM 266 the *Resolution Series*® crossovers contain further specialities:

- The *Resolution Series*® crossovers feature FM ACOUSTICS' unique 36 dB/octave linear phase filters. These provide the best performance in **all** systems, thanks to the unique phase linearisation, even if the crossovers that it is replaced with uses a different filter slope (say 12 or 18dB/oct.) thanks to the FM 330's unique phase linearisation.
- For specific applications provision is made inside the unit to include special filters (e.g., high-pass filters against very low frequencies, linear-phase low-pass filters against unwanted ultrasonic frequencies, etc.). Standard Infra- and Ultrasonic filter settings are 1Hz and 60 kHz. On special request they can be set anywhere between 1Hz - 100Hz (HP) and between 10kHz - 100 kHz (LP). If you have special requirements, you are welcome to communicate with our engineering staff who will support you in devising the correct solution for your specific application.
- The truly balanced outputs have sensor circuits that automatically recognize if a balanced, a pseudo-balanced or an unbalanced load is connected. The crossovers automatically optimize the interface to any type of load, be it true balanced, pseudo-balanced or unbalanced, feature *unique* to the *Resolution Series*® crossovers.
- The output has a drive capability of up to +27dB(!) (50V^{PP}). This allows to run considerably higher signal levels than usual. This way a better signal to noise ratio of the complete audio system is achieved.
- The *Resolution Series*® crossovers work optimally with **all** types of input and output circuitry be it of unbalanced, pseudo-balanced or true balanced design.
- With the *Resolution Series*® performance variations and matching problems between balanced and unbalanced equipment are a thing of the past.

For easy frequency module exchange, a tool is available optionally (order type "ACC-22009").

The *Resolution Series*® crossovers are totally transparent and guarantee an incomparably pristine reproduction with **any** system and **any** driver combination. By replacing electronic crossovers of existing audio systems with an FM 330 Series Crossover, truly astounding system improvements can be realized.

SPECIFICATIONS

Specifications are often misused, misunderstood, or utilized only to sell a product instead of indicating its actual performance capabilities. "Typical" specifications will not tell you much about the true value of a certain component. Only **guaranteed minimum** specifications as indicated below, together with carefully controlled listening tests will provide accurate and useful information. Please observe these distinctions if you make comparisons with other products' specification sheets.

All specifications are guaranteed minimum figures for every single *Resolution Series*® crossover.

Filter slope:	low-pass and high-pass: perfect 36 dB/octave, linear-phase	Output:	electronically balanced, discrete enhanced Class A circuitry. Drives balanced as well as unbalanced loads including very long cable runs (>100m) and multiple paralleled inputs.
Bandwidth:	standard: 1Hz to 60 kHz, high-pass internally adjustable from 1Hz to 100 Hz, low-pass internally adjustable from 10 kHz to 100 kHz	Max. output level:	+27 dBu (50V ^{pp}) into 4,7 kOhm balanced load
Phase accuracy at crossover:	better than 2°	Recommended load impedance:	> 600 Ohm
Step response:	perfect, no overshoot or ringing	Distortion:	over full frequency range (including stop band!): 0,005% at 1 V out. Spectral analyses shows no trace of high order harmonics at all
Gain:	continuously variable between +12 dB and -70 dB	Mains voltage:	switchable 115 V / 230 V
Delay time:	depending on frequency; 10 times better than Blauert and Laws criteria for group delay audibility	Max. long-term mains overvoltage:	120% V ^{nominal}
Rise time:	LF channel: dependent on crossover frequency All other channels: 0,5µsec (also depending on input filters)	Power consumption:	15 W
Hum and noise:	better than -115 dB below full output 20 Hz - 20 kHz	Operating temperature:	-20°C to +40°C
Input:	electronically balanced discrete Class A circuitry, floating ground, non-inverting or inverting, perfect performance with balanced or unbalanced sources. Unbalanced sources are automatically balanced right at the input	Operating humidity:	long-term: 0 - 85% short-term: 0 - 95% non-condensing; continuous high humidity may somewhat shorten lifetime of certain components
Input impedance:	40 kOhm from balanced as well as unbalanced sources; impedance is linear over full frequency range	Average lifetime expectancy:	34 years (at 25°C ambient, 10 h per day, 365 days per year)
Input CMRR (Common Mode Rejection Ratio):	typically 90dB, better than 80dB at 50 Hz, even better at other frequencies.	Front panel:	5mm brushed champagne aluminium, letters anodized so they can never wear off, dust-proof level controls with dB calibrated scales. POWER switch and mains indicator. Front accessible crossover modules - individual for each frequency band.
Max. input level:	+20 dBu (22V ^{pp})		

Back panel: Hand-brushed champagne aluminium, lettering anodized so it can never wear off. Chassis connected to mains earth. Groundlift feature.

Input connectors: Female XLR 3-pin

Output connectors: Male XLR 3-pin

Burn-in at factory: minimal 200 hours, 1000 thermal cycles

Vibration test at factory: minimal 1 hour, 50'000 vibration cycles

Spare parts availability: minimum 10 years; guaranteed availability of 99.8% of all parts ex stock at all times.

FM 333:
446 mm w / 300 mm d
44,4 mm h / with feet: 57,4 mm h

FM 334:
446 mm w / 300 mm d
44,4 mm h / with feet: 57,4 mm h

Weight: 8 kg net / 10 kg packed

Applications: high accuracy 2-, 3- and 4-way amplification (multi-way domestic installations) and a variety of professional/laboratory and industrial applications.

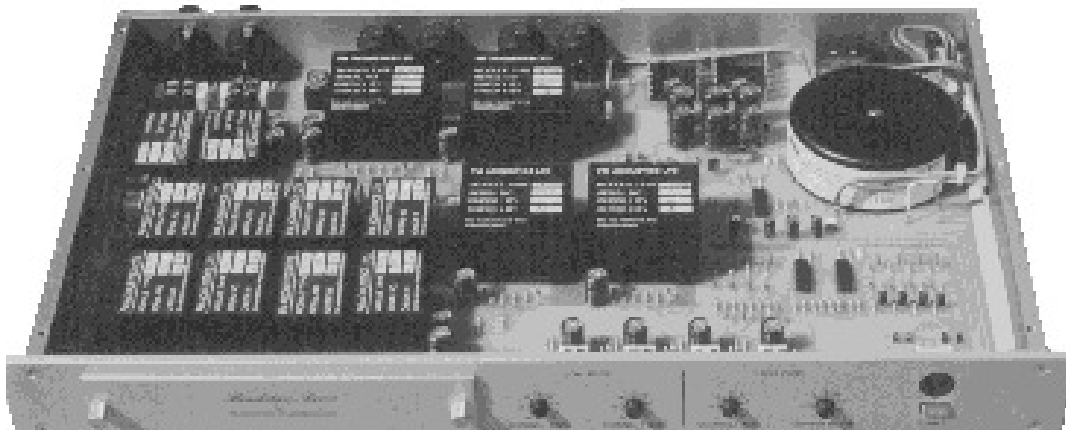
IEC, DIN and MIL (military) standards of components used:

IEC 115-1
IEC 68:55/155/56
IEC 68:55/085/56
IEC 68: 55/200/56
IEC 68: 40/100/56

DIN 384-4
DIN 40040
DIN 40046
DIN 41332 Type IIA
DIN 4406
DIN 44112
DIN 44356
DIN 45910 Part 1201
DIN 45921-107

MIL STD 202,
Method 103
MIL STD-202,
Method 106
MIL STD-202,
Method 301
MIL-R-10509
MIL-R-11804/2B/G
MIL-R-22097
MIL-R-22684
MIL-R-23285
MIL-R-45204, Type II
MIL-R-55182
MIL-S-23190
R.I.N.A.Nr. 5/206/85

"You've never heard it so good!"



FM ACOUSTICS LTD.
Gewerbstrasse 16
CH-8132 Egg bei Zürich / Switzerland
Telephone : ..41/44/725 77 77
Facsimile: ..41/44/725 77 90
<http://www.fmacoustics.com>

S.E.& O. excepted Copyright: FM ACOUSTICS LTD., April 26, 2013
\\data\ds_330

Due to continuous research on existing products, FM ACOUSTICS LTD. reserves the right to change specifications without further notice.