NTI

Minirator MR1 & Minilyzer ML1

The Swiss army knives (well, almost) of audio

The MR1 generator, or Minirator, and the ML1 analyser, or Minilyzer, are handheld. They're completely autonomous, using LR6 1.5 V batteries, which are widely available. A built-in pocket clip is included along with XLR and phono audio connectors. The Minirator is notable for its connector that folds out, like something you'd find on a Swiss army knife.

knife.

range. It generates sinusoidal signals and square waves, white noise, pink noise and a special signal used for speaker phase testing. Thus it offers an entire range of signals that are perfectly adapted to audio testing. Signal amplitude varies between a mic level and a studio line level, i.e., between –76 dBu (a weak level, corresponding to about 130 µV) and + 6 dBu, or about 1.6 V.

third harmonic, at 15 kHz, will be distributed; the others fall outside the passband. The rise time here is limited to a twentieth of a microsecond. Consequently, the square wave generator can't be used to measure an amplifier's rise time—better to use a pair of transistors and do it yourself. Moreover, the shape of the square waves clearly betrays its digital origins. But this is an important tool because it of-

The MR1 source

The Minirator audio generator works in the 20 Hz to 20 kHz frequency

How does one evaluate a sound system or console, or learn about its limitations or performance levels, or simply verify that everything is working properly? Using measuring instruments is a good method, so long as they're practical, not too bulky and, if possible, inexpensive.
Considerations such as these have led Neutrik Test Instruments to design these mini-tools.

Everything is controlled via buttons and LCD displays. You can even change the units—the level changes automatically to match the reading. + 6 dBu doesn't correspond exactly to 1.6 V!

The sinusoidal signal is pure. The distortion rate is very low: NTI says it's less than 0.025% at maximum output level. This rate rises at low levels, primarily as a result of background noise, since according to NTI the rate of distortion + noise is less than 0.18%.

Digital signal generation is linked to a discrete variation in frequency. The MR1 generates the 31 ISO frequencies (or close) with third-octave distribution.

The square waves also benefit from the same frequency series, but limited to 5 kHz. In effect, audio digital generation limits the spectrum to 20 kHz. For our signal, only the

1. ***The balanced output connector opens up like a knife blade. The 1 pin, for the earth, longer than the others, which are gold-plated.***

2. ***The MR1's LCD display indicates the signal type, the frequency and the level. Yo use the buttons to access the parameters.***

fers a relatively wide spectrum, and by monitoring the square wave in a multiamp system you can detect any problems that might exist.

The sinusoidal signals can be used to measure passband or level. Keep in mind that if you're testing a system with speakers, the generator transmits a signal of the same amplitude at every frequency, even treble (say goodbye to your tweeters!).

All in all, the generator's level stability is perfect, which can't be said of every low-distortion oscillator, and this makes it an effective tool for measuring distortion.

The polarity test signal is an unba-

lanced signal intended for use with the analyser, whose polarity tester was designed on the basis of this signal. It's a straight-front signal, with high-order harmonics. Since its fundamental is at 20 Hz, all system transducers are evaluated.
Pink and white noise are used for real-time analyses or sliding frequency tests. The first uses third-octave filtering, i.e., at a constant relative bandwidth; and the second uses constant bandwidth filtering, as in standard FFT (fast Fourier transform) analysers.
Pink noise registers a drop to 3 dB per spectral content octave when the frequency rises.
The final signal scans the spectrum from one end to the other. In other words, it passes automatically from one frequency to the next after emitting a start tone at 315 Hz or 1 kHz. A range of increment options is available, from 50 ms (very fast) to five seconds. This allows you to estimate frequency response using a simple sonometre. Once again, watch out for high frequencies: the level is just as high as at low frequencies and treble radio frequencies.
The scan process is looped. To stop it, you have to change the signal. We would have preferred a manual start, so as to have just enough time to get ready without wasting time waiting for the next cycle.
The tonality is used to provide synchronization with an external device, such as the ML1, which can distinguish between the start tonality and the tonality in the scan signal.
The output pin 1 on the XLR connector is silver-plated and longer than the others (the earth is connected before the signal); the others are gold-plated. The 2 is the hotpoint—this is important, in terms of the polarity test in any case. For a sine signal, which changes polarity with each half-cycle, the 2 pin sometimes generates a positive cycle and sometimes a negative one; the 3 does this as well, but in phase opposition.
The operating manual provides a sinusoidal explanation of the signal polarity.
The controls consist of three buttons and the display screen; each effect is instantaneously displayed on the output. You can switch from one parameter to another with the touch of a button; a blinking light on the screen indicates the accessible parameter.

The ML1 analyser

The ML1 includes a large LCD display. There are four direction keys and an Enter key along with the Start and Escape keys—a handy holdover from computer keyboards.
The analyser includes a toolbox that is both complete and practical. Incredibly; it boasts an absolute and relative voltmetre / noisemetre, a frequency metre, a distortion metre, a VU metre and peak metre, a polarity tester, a balance tester, a time and frequency recorder, a third-octave analyser and finally an oscilloscope. Phew! It's truly a mobile laboratory.
Well, we shouldn't go too far: it's not intended to replace an analyser in the lab. Instead, it's for use in the field—it provides installers with a powerful and irreplaceable diagnostic tool.

3 . ***A clip attaches the Minirator to your pocket. The RCA connector provides an unbalanced output. The texts are laser-engraved.***

4 . ***The small connector next to the ML1's battery compartmen loads the ML1 programme, either from another ML1 or from a computer.***

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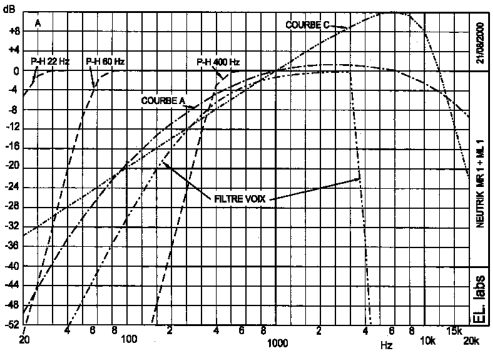
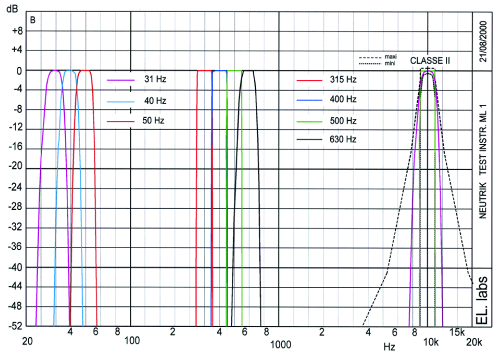
NTI

The level

The screen displays the level in the unit measurement of your choice, and also indicates the frequency and the balance (at the point on the XLR connector producing the highest level).
At bottom, an analogue scale locates the signal on a 100 dB range (or from 0 to 1 V). There's an option that allows you to measure the relative level; the reference voltage is stored instantaneously and the display indicates a decibel reading, a ratio or a percentage greater or less than 100. The reference voltage value is displayed in small characters.



A.



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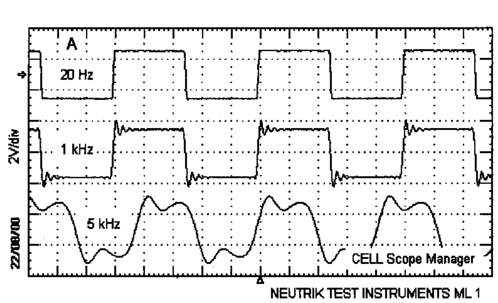

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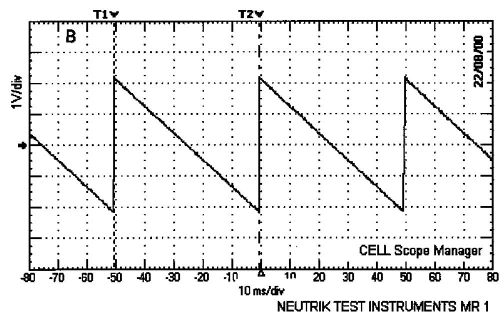


D.

A. Frequency responses for the ML1's built-in filters. The Minirator acts as a source. We have three weighting curves and three highpass curves; the latter eliminate excessively low frequencies that could interfere with the measurement.

B. Frequency responses for the ML1's seven third-octave analyser filters. Some (though not all) of the filters are extremely straight. This is the result of the DSP's synthesis of these filters and the approximations imposed by this technology, if you don't want to have an array of processors. Their dynamic is over 30 dB greater than what is shown here. On the right, we have transposed the response from two of the filters and added templates that correspond to Class II filters. No problems: all requirements are met.

C. The square waves change in shape with the frequency: the higher the frequency, the fewer the harmonics. At 5 kHz, only the 3 harmonic remains.

D. These sweeps are used for the polarity test: the straight front is positive if you're in phase, negative when out of phase. The DSP stores this information intelligently.

Distortion

The ML1's distortion metre is entirely automatic: you feed in a voltage and it figures everything out on its own. It automatically adjusts to match the fundamental and displays the latter along with the total level, from which it calculates total harmonic distortion plus noise*. Here too, various units of measurement are available, including the traditional percentage with an indication in dB, two readings in terms of 100% or 0 dB of the voltage RMS value.

VU metre / peak metre

The dual level indicator provides two analogue, linear readings: a VU-type reading, with ballistics that correspond to those of the well-known needle indicators, and/or a peak metre-type reading, including appliances that are much faster, with control and display instruments that are purely electronic.

The 0 dB (the reference value for each instrument) adjusts accordingly, and the maximum value is stored twice. A segment remains for about a second after the level drop; in addition, the highest level attained is stored permanently. This enables you to detect any saturation of a digital device.

Polarity

Even when used together, the MR1 and ML1 are no replacement for polarity testers, which boast an acoustic generator that's lacking here.

You can't test the polarity of a microphone directly. The signal that's generated has a fundamental frequency of 20 Hz, but a full spectrum isn't necessary for proper operation.

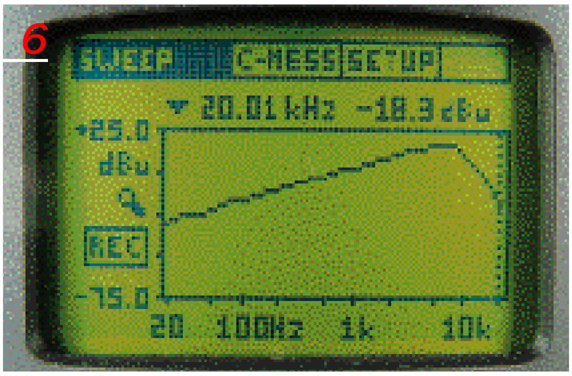
The ML1 receives the signal in sweeps: electrical on its RCA and XLR inputs (when testing the polarity of an electrical device) and acoustic on a microphone (for the speakers).

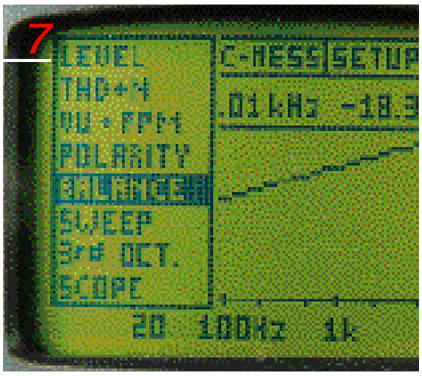
The internal processor has enormous calculating power: no fewer than four methods are available. If the result generated by the ML1 with one method seems dubious, you can move on to the next method until you get a reliable result. The result is clearly indicated with the words Out of Phase or In Phase.

Balance

This time you measure the relative amplitude of the incoming signals on the two XLR connector inputs. If one is greater, the ML1 tells you so. The display indicates the disparity as a percentage or in a voltage ratio.

This measurement is used for analogue output circuits and allows you to check whether an output voltage is balanced or unbalanced.





5 . *NTI installs all the ML1's connectors on a single side. Here we have the acoustic input on the mike and the balanced and unbalanced inputs on two other sockets; you can also connect a headset.*

6 . *In scan mode, the analyser screen shows the frequency response for one of the filters. The MR1 was used as a generator, followed by the ML1.*

7 . *Use the menu to select a function from among those available. With some programmes you can make two selections.*

Scanning

Now we come to data storage. Two scans are available, a frequency scan and a time scan. The frequency scan is activated automatically with the scanned signal generated by the MR1. The frequency and the level at the input are measured and displayed, so you get a direct readout on the screen of the frequency response curve for the system you're testing.

You can't just feed any old thing into the ML1. It recognizes stable, broken and increasing frequencies. The second scan mode is time-based. The ML1 can store a maximum of 1600 pieces of data over a period lasting between 60 seconds and 100 hours. Several settings are stored, including frequency, distortion and level. You can choose to display any one of them, but all are stored and can be recalled later. This system reveals problems that arise intermittently, e.g., activation of the thermal circuit breaker on an overloaded amplifier, or problems relating to non-linearity. Several parameters are recorded simultaneously so that you can detect a problem before you've identified its origin. A level drop may be accompanied by an increase in distortion. All that's missing is an automatic tone start, such as for plotting a curve with a test disk: vinyl or compact disc, etc.

Third-octave analyser

With third-octave analysis, you can quickly monitor the operation of an equalizer or any non-linear frequency circuit, such as a filter.

If you connect a measuring microphone and its preamplifier upstream, you can detect any non-linear responses in an installation and resolve them with a graphic equalizer.

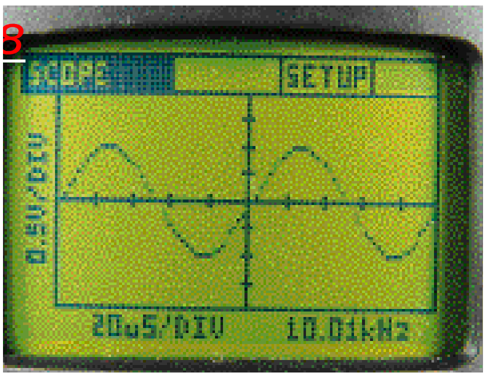
You adjust its time factor, the scales and the total level, although the latter is only present in the form of an analogue bar; a memory would be useful if it's impossible to apply an overlong signal to the circuit you're measuring. The recorder and analyser have a cursor that provides a digital readout of the value for the parameter being displayed; once the recording process is complete, you'll have plenty of time to analyse the data.

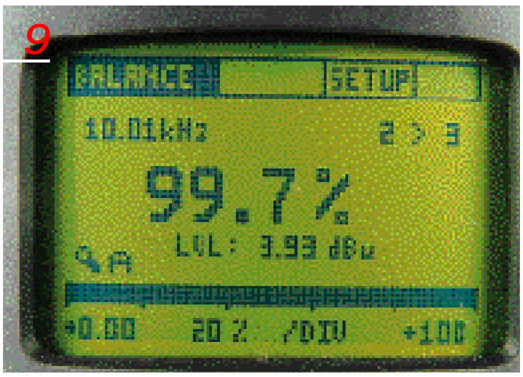
If the batteries die, you won't lose your data—they're stored in flash memory.

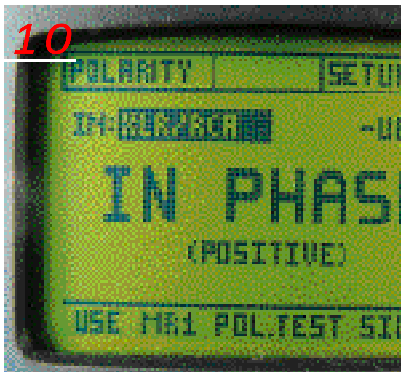
8 . *No buttons for this oscilloscope: it adjusts its time base and vertical scale on its own.*

9 . *Using the phono input, you get a perfect imbalance, as the 99.7% indicates.*

10 . *We are in phase. We used the electrical input here rather than the microphone input.*







11. *The decibels given here are relative; the reference level is indicated below. This shows the frequency and the input type. An analogue scale at the bottom expresses the value.*

12. *In addition to distortion, the ML1 indicates the level and frequency and whether the input is balanced or unbalanced.*

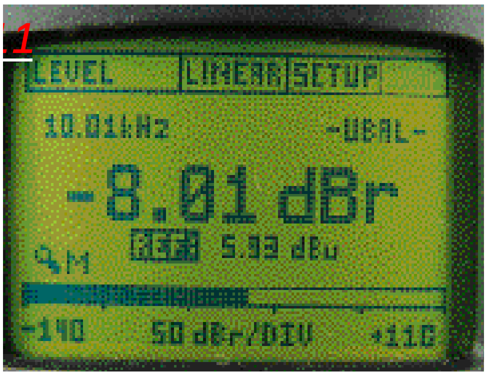
13. *The third-octave analyser screen: here we see the spectrum for a square wave. The cursor automatically goes to the fundamental, for which the level is displayed. The vertical scale is 100 dB, but the value shown has a resolution of 0.1 dB. You can also move the cursor in order to analyse each component.*

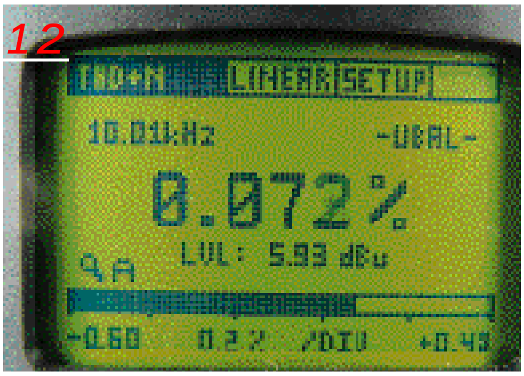
a musical signal and will connect the output accordingly. The output level does not depend on the input level. Since plenty of people will find a tool like this helpful, NTI has installed four user memories that store all the parameters associated with each type of measurement.

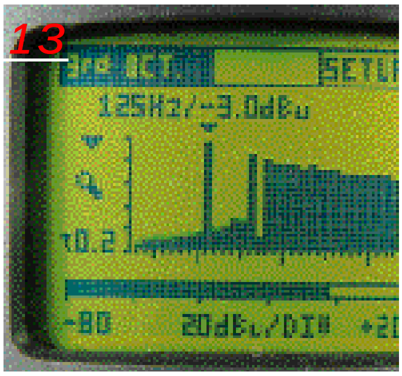
Engineering

Both devices are digital, with a sampling frequency of 48 kHz. The generator is based on a programmable channel everything through a computer.

The components are surface-mounted, with all connectors included. NTI has streamlined the manufacturing process and is using some novel ideas, such as helicoid contact springs for activating the MR1's rotating output connector. Servicing the device isn't too complicated if you're equipped to handle surface work, since everything is accessible. The internal power feed uses converters that provide positive and







Oscilloscope

Finally, the device serves as an oscilloscope. Designed for audio use, it has the corresponding passband (20 kHz) and a display resolution linked to that of the screen. It's possible to detect major incidents but not small transients that may stray in on a sine wave. The main thing is to know the tool's limits. You can incorporate an array of filters into the measuring equipment, including high-pass filters, two weighting filters and a filter for voice passband. A 3.5-mm jack output generates a signal when music is present. The internal processor can recognize circuit. Signal synthesis is completely digital, by means of a table of values, and an 18-bit AKM converter puts analogue signals within your reach as well. Powerful though it is, the DSP uses little energy and includes a microcontroller to monitor consumption. There's a flash memory for storing data. The gain is monitored by a relay as well as by a digitally controlled pot. You can modify the DSP's programming as the software evolves through a connector that's accessible via the battery cover. With this you can transfer the programme from one ML1 to a more recent version, or negative voltage, using the power supplied by two or three 1.5 V batteries.

Handling

Needless to say, we tested the instrument, on a mixing console in particular. We have to point out that, even though they have some pretty powerful features, these devices are by no means intended to replace laboratory-testing equipment. It's essential that you be aware of their limitations, or at least the fact that the passband is limited to 20 kHz. The maximum permissible input vol-

MEASUREMENTS AND TESTS

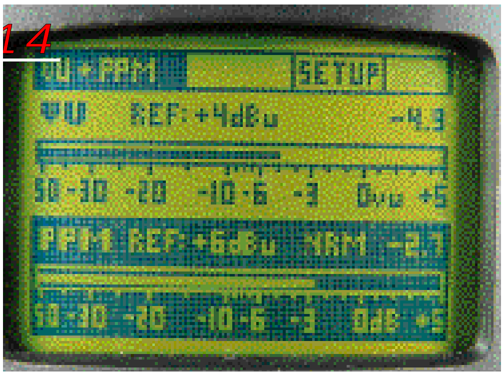
MR1

Square sine wave, 20 Hz/20 kHz scanning, white noise, pink noise, polarity
Frequency: 20 Hz – 20 kHz, 31 frequencies
Sine level: -76 – +6 dBu in increments of 2 dBu, or 0.13 mV – 1.6 V in increments of 23%
Distortion: typically 0.025% at + 6 dBu
Accuracy: ± 0.5 dB ± 1 unit of measurement
Output impedance: 200 E
Dimensions: 140 x 74 x 25 mm
Weight: 170 g with batteries

ML1

Level: dBu, dBV and RMS value. Accuracy: 0.5%. Resolution: up to three digits in dB, four digits in volts.
Frequency: 10 Hz – 20 kHz. Resolution: up to four digits. Accuracy: better than ± 0.1%
Relative harmonic content: Measuring BP: 20 Hz – 20 kHz. Residual distortion: 0.005%
Third-octave analyser: IEC 1260, Class II
Input voltage: -95 – +20 dBu balanced or 14 µV at 7.75 V
Display: Graphic LCD, 60 x 100 pixels
Dimensions and weight: 163 x 86 x 42 mm, 300 g with batteries

tage on the analyser is + 20 dBu, or 7.75 V, on its balanced input, and half that (+ 14 dBu, or 3.8 V) on its phono plug (RCA). A mixing console can generate + 28 dBu, so you have to add an external 10 or 20 dB volume equalizer if you want to assess the console's maximum capacity. The tool is made for use in the field, i.e., for practical testing on devices that aren't necessarily working at high performance. Moreover, the ML1's input impedance is lower than that of a standard measuring tool, so don't

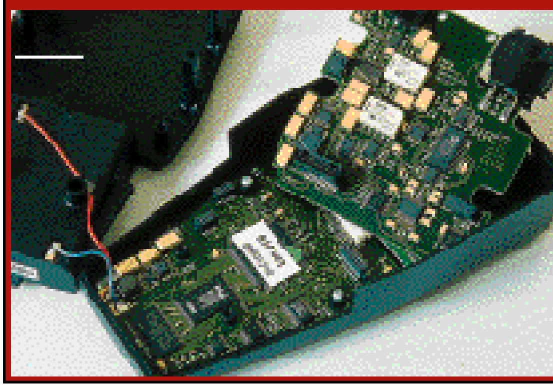


14. *The screen serves as a VU metre and peak metre. The scales can be adjusted. The maximum values are stored on the right; here, –4.9 and –2.7.*

be surprised if you get readings that differ by a few tenths of a dB—the result of a non-null source impedance. The digital display is somewhat misleading in that it highlights differences in level to a greater extent than the needle on an analogue device would do. It may display a difference of a few percentage points even though no difference can be heard—something to keep in mind at all times! Once you've chosen a function, the analyser's myriad automated controls allow you to keep both hands free for your tinkering and, if you're low on light, to illuminate the screen. The MR1 generator and the ML1 analyser complement each other perfectly, despite a difference in frequency at the low end of the spectrum where the generator doesn't conform to the ISO distribution for reasons of synthesis and quartz. The generator's output impedance is 200 E on the phono plug as well as on the XLR in balanced mode, and 100 in unbalanced mode. The maximum output voltage is 6 dBu when the impedance load is high and + 3.6 dBu on 600 W—the value you get on the balanced output. You should avoid using the balanced output in unbalanced mode with a link between 3 and 2; otherwise you may multiply the harmonic distortion rate by a factor of ten! This harmonic distortion rate, measured with the ML1, is approximately 0.02% on almost the entire band; it climbs to 0.080% at 10 kHz. Here, you measure the S/N ratio plus noise. We like the third-octave analyser, which has a number of filters (curves) so straight as to make an analogue filter designer blanch (the curve was plotted from a certain number of points that begin to cluster as you approach the horizontal—it wasn't drawn with a ruler!).
The dynamic range of the display is 100 dB, while that of the measurements is 114 dB. By using the zoom you can detect very low levels without saturating the filter. It's also possible to get a general idea of a background noise spectrum when a signal is present…it's up to you to decipher it. The actual background noise on the millivoltmetre is 60 µV or - 82 dBu open input; this changes to 9 µV or - 99 dBu closed input on 600 E If you want to work with the unbalanced input, you'll want to short-circuit terminals 1 and 3 on the XLR connector; this will give you a dozen or so microvolts of background noise instead of 95. The ML1 input can take a top voltage of + 20.8 dBu in balanced mode and – 6 in unbalanced mode, both on the XLR connector and on the phono. These voltages correspond to 8.4 and 4.8 V respectively. The input impedance is 18.9 kE on the phono plug, 19.5 kE on the two XLR terminals in unbalanced mode and 39 kE in balanced mode. If you measure the sources with a high output impedance, you may get readings that differ from those of your millivoltmetre. Don't blame the millivoltmetre—the explanation may lie with the ML1. Whenever you measure a physical size, you disturb it. This is a golden rule that you should always remember—it may help explain certain anomalies! We've included an illustration of some waveforms taken from the generator output. We traced the curves for the internal filters, weighting and high-pass. You'll also find the curves for some filters on the third-octave analyser for a 52 dB

ACCURACY AND RESOLUTION

Accuracy provides a measure of how much confidence you can place in the result. It identifies the range of values in which the measured dimension falls. For example, a reading of 1 V that is accurate to 1% indicates that the voltage is between 1.01 V and 0.99 V. The resolution indicates the increment between two consecutive values. For example, a resolution of three digits corresponds to a three-digit reading of an object's dimension, but this reading cannot be very exact. A value expressed in dB with a resolution to three digits indicates that the final digit may vary by plus or minus one unit. For example, 31.3 dBu may correspond to a voltage of between 31.2 and 31.4 dBu. There is no guarantee as to the true value of the final digit.
Accuracy and resolution have cumulative effects… And by the way, do you really need to have such accurate readings all the time???



15. *There's a lot of technology packed into this tiny housing. The DSP is hidden behind the label. The automatic gain and input control elements plug into the plate on top.*

spectrum. Some of the filters are quite narrow, and not all of the responses are the same, as you can see on the ML1 display showing a sine input from the MR1. All of these curves broadly meet the requirements for Class II devices such as this one (per NTI). Notice the very high dynamic for this analyser—it's a true investigative tool.

Conclusions

To begin with, there's the price. If you look around for a generator with distortion equal to that of the MR1, you'll find that it will cost you double the price, without providing square waves or noise, and moreover it will have to be plugged into the grid. As for the ML1 analyser, it costs less than a small distortion metre but provides more functions, especially adapted for use in audio. The third-octave analyser is remarkable, the recorders are practical, the phase tester is uncommonly simple. In terms of the quality/price ratio, on a scale of one to five we'd give it at least a 10! On one of our devices we discovered an unimportant power supply defect that we hadn't even suspected beforehand! With the multiple display screens you can check several parameters at the same time without having to negotiate the menu.

Of course, we could complain about a number of things—but can one really complain that a device doesn't offer a function for which it wasn't designed? Absolutely not. It has its limitations, such as a passband that stops quickly at 20 kHz and a low-resolution screen (the settings are recorded in tenths of a dB, but each screen element takes about 3 dB, less if you change the scale). The important thing is to know its limitations and to keep them in mind while you use the device. Take care nonetheless if you're not in the habit of using equipment like this—as we said before, it's possible to make it tell you just about anything! If from time to time you want to display the distortion, as you could do on a laboratory distortion metre, just ask for the spectrum—that provides another way of displaying the phenomenon. Don't wait—order one now…

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Distortion plus noise:
Distortion measurement techniques include background noise and elements that arise from distortion (harmonics). The technique consists of eliminating the fundamental with a highly selective filter, and then measuring what remains. The background noise originates in noise generated by the device itself. This noise is distributed all along the measured spectrum, sometimes with spikes at frequencies connected to that of the mains. High-level distortion measurements do not reflect noise to any notable degree; by contrast, background noise becomes more significant as the audio signal level drops.