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Computerized Quality Control of Loudspeaker Units and Systems

Ortofon P400

Manufacturing Quality Is Not Optional

THE IMPORTANCE OF YIELD

The bottom line of production management is yield. In a highly competitive business environment, each single batch should produce as many "good" units as possible.
If too many units are passed which later prove to be defective, the cost - in terms of money as well as reputation - is very high.
On the other hand, if too many units are rejected during quality control, a manufacturer is supposed to be on the safe side and does not risk his reputation. However, a modest profit is very easily reversed into a break-even situation, or even a loss.

THE COSTS OF HINDSIGHT

For production managers, the Greek letter "π" has a very special meaning, demonstrating the accelerating costs of discovering and replacing defective units at various stages - from the manufacturing line, until the completed product is rejected by the end user.
Assuming that the cost of rejecting a loudspeaker unit right after the assembly is $1, the expense will be more than trebled (π) if the defective unit is not revealed until after it has been packed. Following shipment, the cost of discovering and replacing what should have been a reject in the first place, is trebled once more. (π!)
And so on. What begins as a minor manufacturing defect develops into a significant operating loss at an alarming speed. But the damage to the reputation of the supplier responsible may be even more expensive to repair.

YOUR CUSTOMERS DEMAND QUALITY

Irrespective of whether your customers are end users or manufacturers themselves, they demand quality - in terms of consistency and reliability. And they do not always take your word or reputation as sufficient proof of the quality of your products. Other manufacturers, in particular, also know the "π" factor of repair costs. Because of fierce competition and slim profit margins, they not only conduct increasingly stringent incoming inspection procedures - they also demand documentation of quality from their suppliers.

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P400

Objective Tests Are a Must

OPERATOR INDEPENDENT TESTS

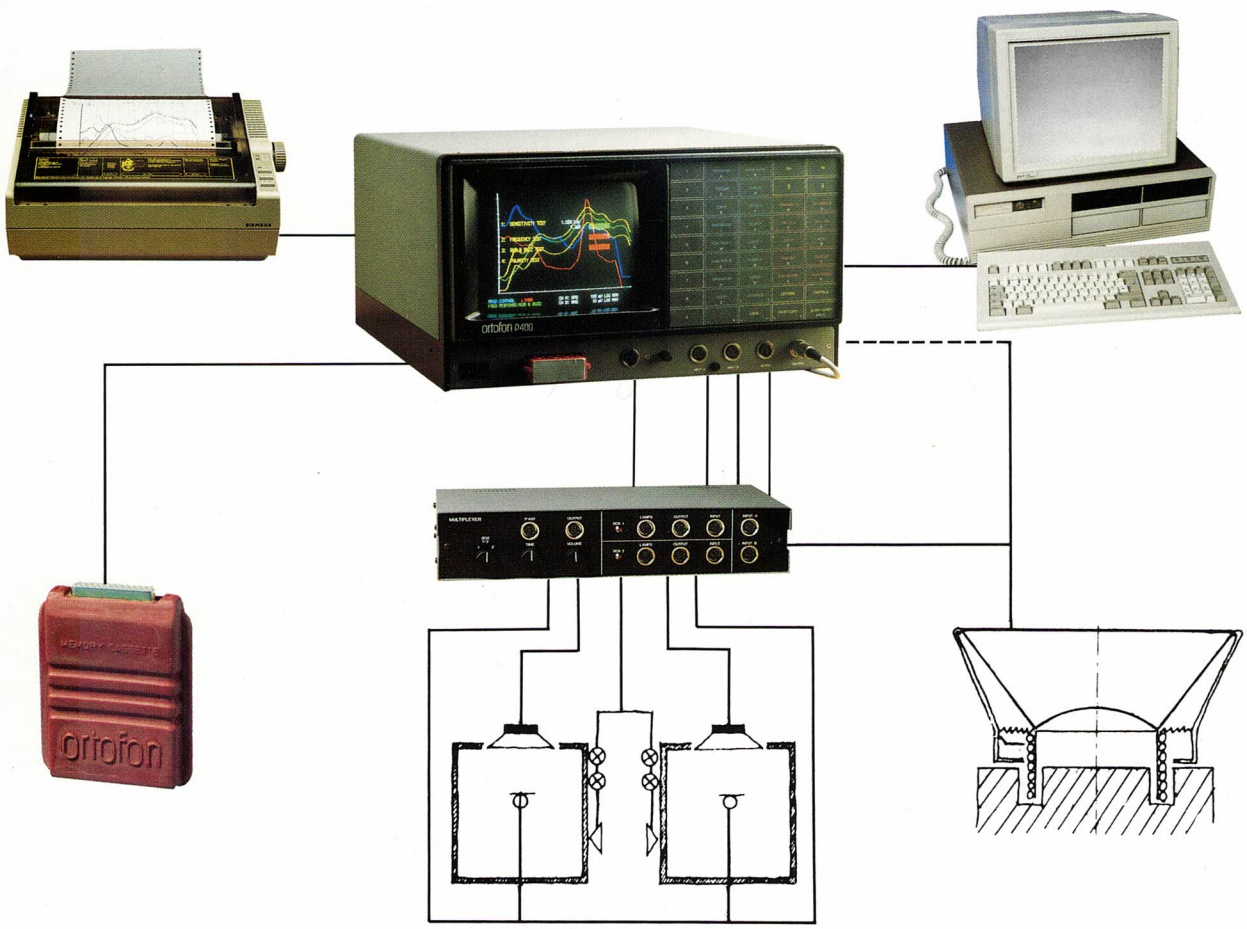
For generations, manufacturers of loudspeaker units and systems have been using a combination of swept sine wave signals and subjective listening to assess the performance of their products.
Although the human ear is an excellent "instrument", in many ways unsurpassed by laboratory equipment, this method is neither fast, economical, repeatable nor objective. Neither does it provide documentation which can be used for sales support or feedback within the organization.
Subjective quality control operators are key people who need months of expensive training, plus motivation and concentration. Furthermore, they are different. And their sensitivity varies throughout the day.
In marginal cases, a product which may be approved by one operator, will be rejected by another - or rejected in the morning, but approved by the end of the day. And a mere common cold is sufficient to change the quality level of an approved production series.

COMPUTERIZED OBJECTIVITY

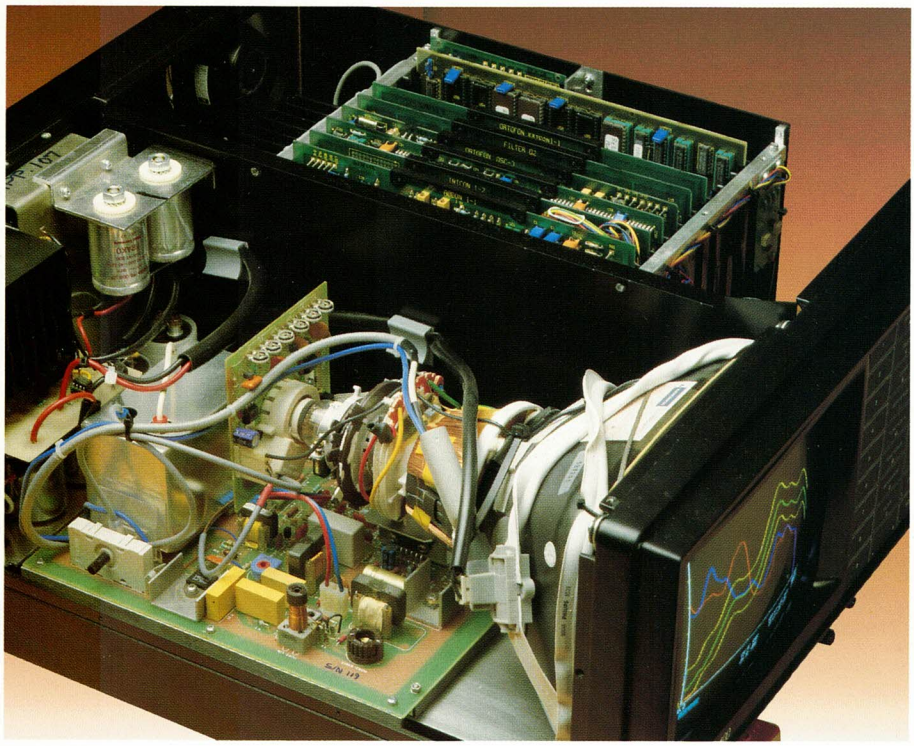
The Ortofon P400 Measuring Computer represents a major technological advancement in the field of loudspeaker testing and quality control.
The P400 features the basic advantages of computerization - repeatability and accuracy. A loudspeaker unit or a complete system can be inspected, evaluated and approved or rejected in a matter of seconds, according to pre-programmed parameters and tolerances.
The results are never influenced by human individuality, fatigue or distraction.

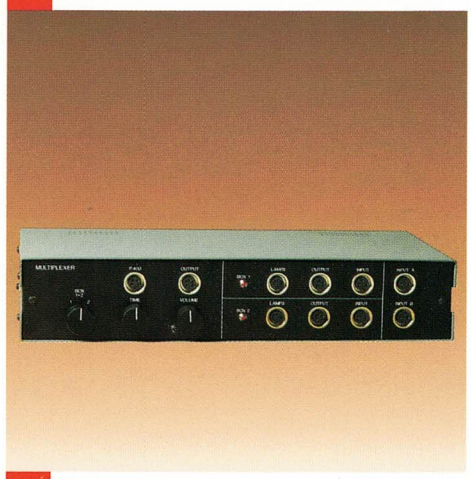
DOCUMENTATION AND STATISTICS

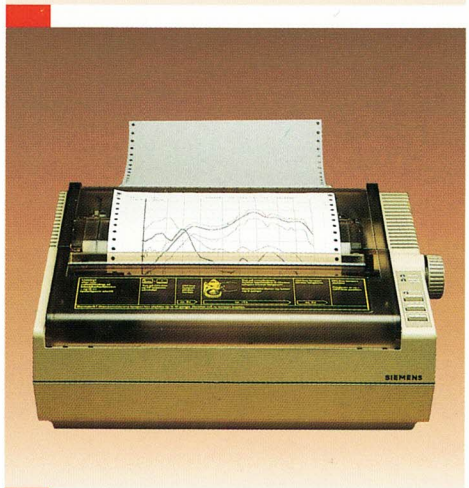
Being a Measuring Computer, the P400 will not only perform quality control procedures. The test results can also be stored and used for documentation and statistics - internally and externally.
Data from various batches may be analyzed and compared, to keep track of yield and tolerances. This makes it easy to study the development of manufacturing quality over a period of time, and provides an early warning system against quality slippage and component problems.



The Ortofon P400 Measuring Computer







THE P400 CONCEPT

Innovative designs and efficient production management, including stringent quality procedures, has made Ortofon one of the world's largest manufacturers of pick-up cartridges in all categories, from budget OEM types to ultra-expensive audiophile models.

Earlier than the competition, Ortofon realized that one way to increase factory throughput and production consistency was to replace conventional testing with computer controlled systems.

Like its in-house predecessors, the P400 Measuring Computer has been designed for intensive use, right on the factory floor. Based on Ortofon's own experience with transducers, plus elaborate consultations with leading loudspeaker manufacturers, the P400 is not a "universal" laboratory instrument.

Conceptually, the Ortofon P400 is a highly specialized tool, created for one task - to determine quickly and accurately whether the product under test is good or bad.

ANALOGUE AND DIGITAL SYNERGY

Being a measuring computer, the P400 does, of course, contain a host of digital functions. But basically, the inspection procedures are performed in the analogue domain, simply because FFT and other digital techniques are not sufficiently advanced for transducer quality control.

The digital circuits of the P400 are employed for signal generation, signal processing, control and storage. These functions are performed in the digital domain, because digital technology eliminates or minimizes problems like temperature drift, maintenance, calibration, and adjustment.

Furthermore, these digital capabilities make the P400 easy to use and provide interfaces to peripheral equipment. A personal computer may be used for remote programming, control and storage of permanent records. Several types of printers may be connected and produce hard copies for documentation of the test results.

This analogue/digital design of the P400 is unique in the market, and the synergy of the two technologies combines speed, accuracy and ease of operation.

FUNCTIONS

The Ortofon P400 Measuring Computer is designed as a computer controlled signal generator and two-channel response analyzer. The instrument can be programmed to perform exact and repeatable tests of the following parameters:

- Frequency response
- Efficiency (sensitivity)
- Rub and buzz
- Electrical phase (polarity)
- Impedance

FEATURES

- Reference limit information can be individually programmed, and the measured data compared to these limits for a GO/NO GO indication.
- Tolerance bands may be generated automatically, from a small number of known, good units.
- Test programmes may be stored and kept in dedicated EE-PROM memory modules. These modules are virtually indestructible and will withstand rugged handling as well as magnetic fields.
- Manual operation (by skilled users), semi-automatic operation (by operators with a few hours of training), or fully automatic operation in a robotized manufacturing environment.
- Interactive operation by means of an IBM (or compatible) PC which also may be employed for storage of data and statistics. The Ortofon P400 application software supports LOTUS 1-2-3, LABTECH NOTEBOOK, ASYST, and many other widely used programmes.

INPUTS, OUTPUTS AND INTERFACES

- Two analogue measuring channels, accepting a very wide range of signal levels, including many types of microphones. Optional power supplies for Brüel & Kjaer condenser microphones.
- Constant voltage/constant current output (high power output optional).
- External filter IN/OUT.
- Keyboard and 5-function operator keybox.
- RS-232C serial interface (optional).
- Special high-speed version of the Siemens PT88 ink-jet printer (optional).
- Multiplexer System P400 (optional) permits control of two test stations from one P400 Measuring Computer. Optical GOOD/REJECT indicators and audible REJECT signal.
- Video printer interface (optional).
- IEEE-488 interface.

Ortofon P400
Key Specifications

MEASURING INPUTS:

Individual channels	2 (A & B)
Full scale sensitivity	10 mV - 100 V
Display dynamic range (log mode)	60 dB
Scale	log/lin
Frequency range	10 Hz - 100 kHz
Detector modes	RMS, DC (log/lin)
Rešolution X/Y (12-bit)	2,000/4,000 points
S/N ratio	> 80 dB

FILTERS (STANDARD):

Individual channels	2 (A & B)
Type	Tracking Constant relative bandwidth
Center frequency	Fundamental to 12th harmonic
Gain (fundamental to 2nd harmonic	0 dB
Gain (3rd to 12th harmonic)	20 dB
S/N ratio (10 Hz - 5 kHz)	> 80 dB

Other filters for special applications are optionally available.

GENERATOR:

Frequency range	5 Hz - 20 kHz Frequency - crystal derived Amplitude - precision voltage reference based
Modes	Sine wave Pulsed sine wave Swept sine wave
Sweep	Hyper-exponential Exponential (optional)
Distortion	< –70 dB, typically
Spuriae	< –70 dB, typically
Attenuator	0 - –84 dB

OUTPUT (CVA3):

CONSTANT VOLTAGE:

max.	10 V_{RMS}
Output impedance	150 mΩ (incl. DIN connector)

CONSTANT CURRENT:

max.	100 mA
Output impedance	> 5 kΩ (10 Hz - 1 kHz,

FREQUENCY COUNTER:

Frequency range	1 Hz - 130 kHz (3½ digit display)

The period of the signal is measured and converted into frequency.

DISPLAY:

Picture tube	10-in. 8-colour CRT
Resolution X/Y	250/250 display points
Y scale (log)	60 dB
X scale (time based)	0.1 - 6,000 sec. full scale
X scale (frequency based)	2 - 5 decades in approx. 1/3 decade steps
X zoom (reversible)	2, 4, 8
Y zoom (reversible)	2, 4, 8, 16
Interfaces	RS-232C (for graphics printer) IEEE-488 (for external controller) RS-232C (for service use)
Controller I/O	IEEE-488 IEC-625 GP-IB HP-IB
Transfer rate	Typically 40 µs/byte (depending on type of controller and length of interface cable)
Graphics printer	Siemens PT88 (modified, optional) via RS-232C interface
Transfer rate	19,200 baud
Plotting time	20 - 80 sec.

GENERAL:

CPU	Motorola 6809 (8-bit)
Total RAM (internal)	103 kb (min.)
Total ROM (internal)	137 kb (min.)
EE-PROM (external)	2, 4 or 8 kb

One test programme requires 2 kb of storage capacity.

Power supply	100 - 120 V, ±10% 220 - 240 V, ±10% 50/60 Hz
Power consumption	250 W
Dimensions: Width	440 mm/17.3 in.
Height	250 mm/9.6 in.
Depth	560 mm/27.5 in.
Shipping weight	35 kg/77 lbs.
Operating temperature	15 - 40 °C/59 - 104 °F
Relative humidity	20 - 80%

Specifications and design are subject to change without notice.

Ortofon P400 Block Diagram