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T&M news

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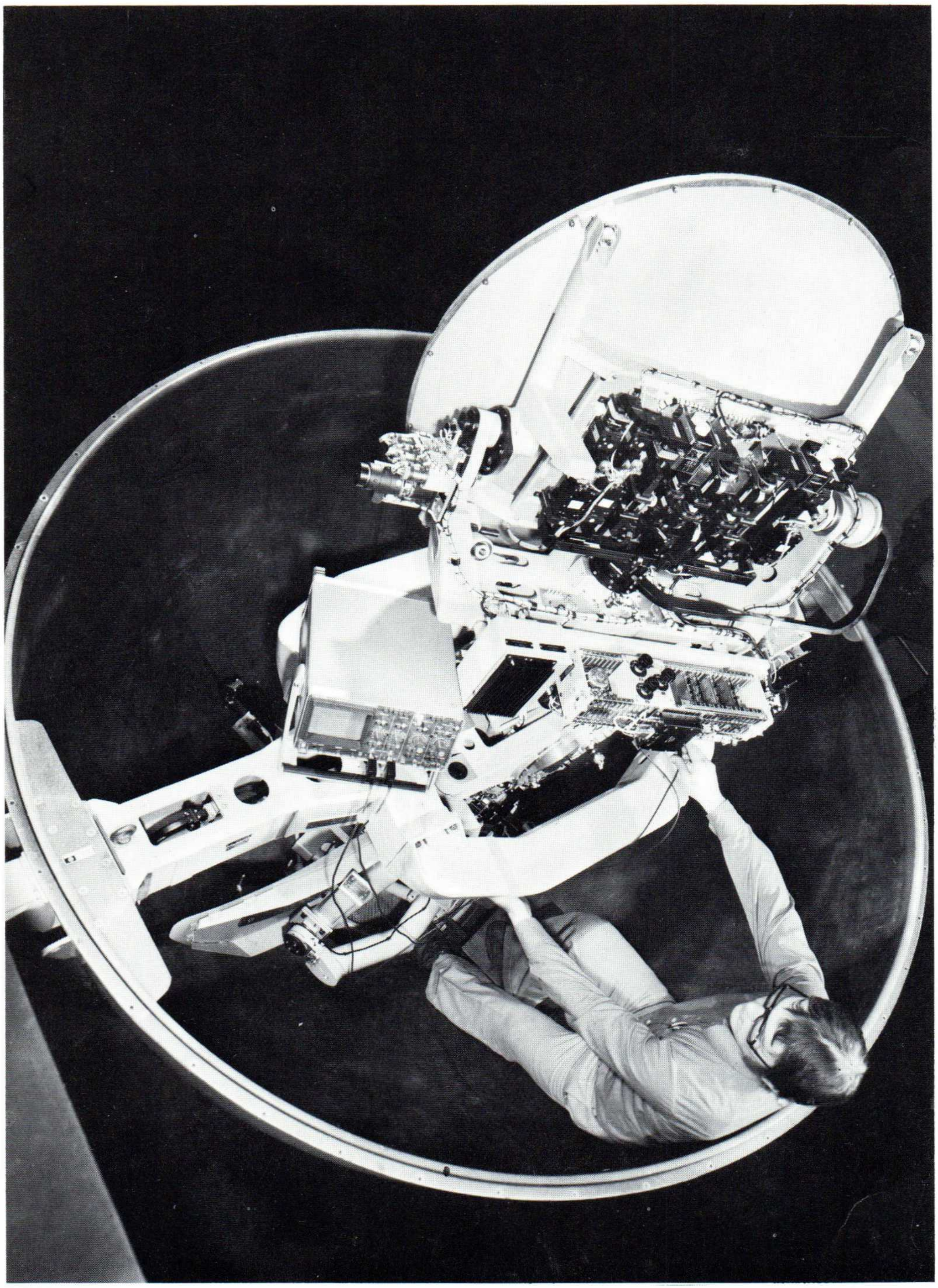
In this issue
Most of the articles are devoted to the new oscilloscope PM 3260.



Design innovation marks new 120 MHz oscilloscope

A new lightweight Philips portable HF oscilloscope, the PM 3260, has just been released at the I.E.E.E. International Exhibition in New York, and will shortly be shown at the Paris "Salon de Composants" and the Hannover Messe.

Thanks to the use of advanced hybrid integrated circuitry, a new CRT and a low-dissipation transformerless power supply, the PM 3260 combines outstanding performance with first-rate reliability and serviceability.

A bandwidth of 120 MHz at 5 mV sensitivity, two separate vertical channels, main and delayed time bases, very extensive X-Y and X-Y//Y facilities; a big screen with 8 x 10 real centimetre divisions and an unusually high light yield, even for very fast signals with a very low repetition rate - all packed into an instrument weighing hardly more than 9 kg. Furthermore you'll really be impressed by the thought that has gone into the arrangement of the controls on the front plate to give an instrument which is **comfortable** to use **quickly** and **accurately.** There's such a lot of news in the new PM 3260 that we're devoting most of this issue to it!

continued on page 2

T&M news

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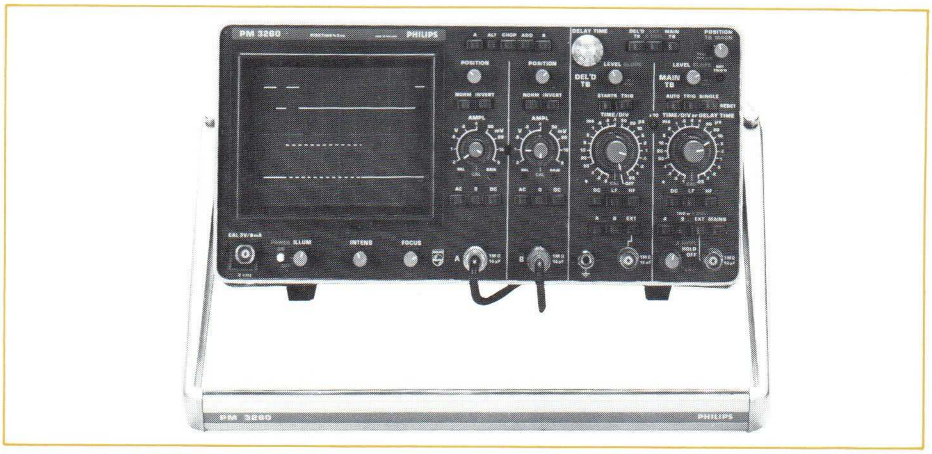


Design innovation marks new 120 MHz oscilloscope

(continued from front page)

Tailor-made for both laboratory and field work
In addition to the specifications which make the instrument more than adequate for use as a general-purpose laboratory oscilloscope, special attention has been paid to the typical requirements of development, production-testing and field-service work in the telecommunications and data-processing industries.
The above-mentioned high writing rate of the CRT is a case in point. Other features include sensitivity, highly reliable triggering for signal rates up to more than 200 MHz, a wide trigger-source selection range for both main and delayed time base and extensive X-Y facilities (we may mention in particular the possibility of sweeping both vertical channels with the same external horizontal signal).
Although (as we shall see in greater detail below) the PM 3260 is super-portable, this has by no means been achieved at the expense of the accuracy and reliability demanded of a good laboratory instrument. This emerges clearly from the big screen, good vertical sensitivity and stability, extensive algebraic combination facilities for the vertical signals, availability of connectors for active probes, high time base accuracy, etc.

Portability
Since important fields of application of the new oscilloscope involve portable use in one's own works or in the field, special attention has been paid in the design of the instrument to ensure not only real portability (even in rather constricted spaces) but also all-round usability in all possible positions of the scope and at all possible viewing angles as far as the user is concerned.
By paying constant attention to weight during the development, we have succeeded in achieving the revolutionarily low weight (at the given bandwidth) of a little more than 9 kg (20 lb), which is about 15% lower than that of comparable instruments. This low weight has been achieved by the use of new techniques in both mechanical and electronic fields. The special points of the design are described in greater detail in a separate article on page 4.
As regards the electronics, great savings were made by use of a new type of power supply with drastically limited weight and internal dissipation and by extensive use of special new monolithic integrated circuits in hybrid thin-film technology, and special miniature transistors at points where integration gave problems. These IC's will also be described in a separate article (page 6).

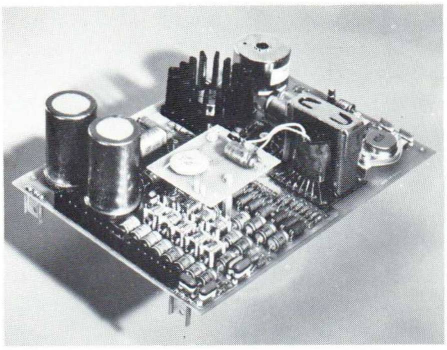
New CRT
Many of the revolutionary features of the PM 3260 were made possible by use of a new 20-kV Philips cathode-ray tube which combines a large screen and very high writing rate with minimum length. Among other things, this has made it possible to reduce the length of the instrument considerably which means that it's portable **without** giving you a permanently raised shoulder. This new CRT will be described in more detail in a separate article on page 5.

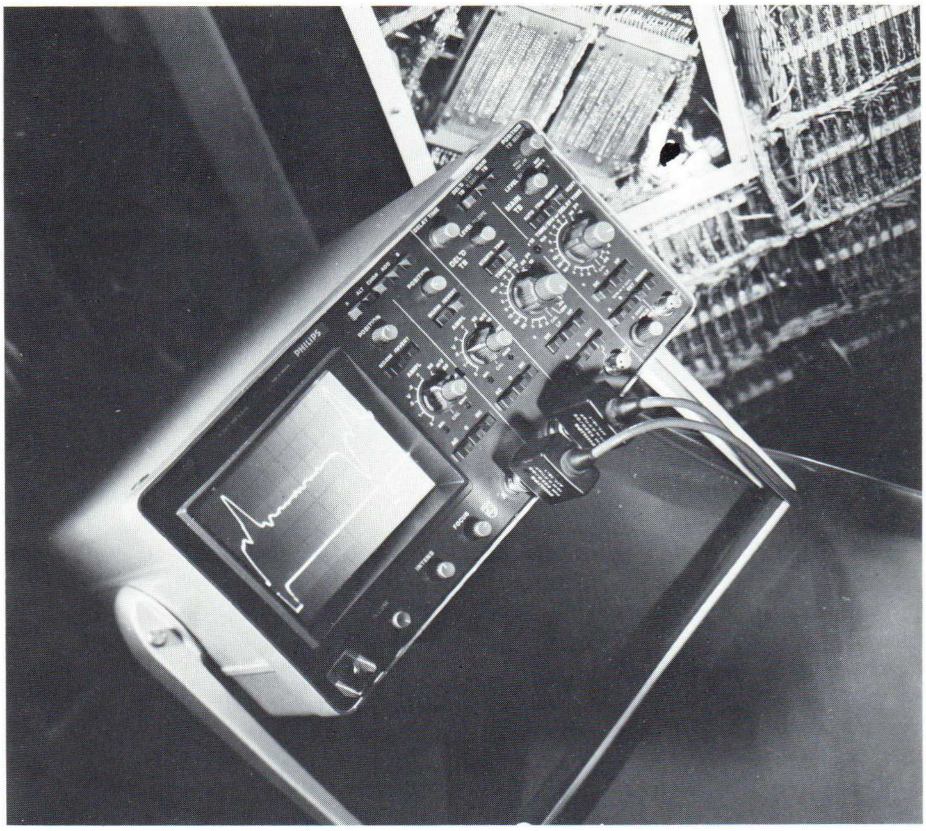
One function, one control
Like earlier Philips HF oscilloscopes with two time bases, the PM 3260 still follows the principle of separate controls for each time base. Although the reduction in the volume of the instrument meant that appreciably less room was available on the front plate for fitting in all the controls, we resisted the temptation to combine the controls of the two time bases in a double-knob system because intensive investigation at the Institute for Perception Research, Eindhoven, showed that measurements involving use of the second time base could be performed appreciably faster and with fewer errors using the system with separate knobs.
The same principle was also followed in the design of the push-buttons.
Push-buttons are never used to control more than one function. We may mention in this connection that the buttons have been given a special shape with levelled corners which makes it practically impossible to push in two buttons at the same time, see photo on page 4.

Extra width for comfortable operation
If we had really tried, we could have squeezed the controls together even more, thus saving an extra couple of

centimetres in width - but we didn't. After all, the weight is minimum despite the slightly greater width; and by giving that little bit extra in width we have made it possible to space the knobs by that distance which ergonomic research has shown makes for optimum operation.

New power supply
The PM 3260 has no mains transformer. Instead it uses a switching circuit of a type already proven for some years in the Philips range of power supplies. This type of design not only saves a lot of iron, thus making a large





contribution to the weight reduction mentioned before but also has an inherently low power consumption, obviating the need for a cooling fan and filter. This made it possible to use a completely closed cabinet for the oscilloscope electronics, keeping dust and dirt out and ensuring a remarkably short recovery time when an instrument is brought e.g. from a wintry car trunk into a room where temperature and humidity are both much higher. This disables most oscilloscopes for almost an hour, whereas the PM 3260 is guaranteed fully operative within fifteen minutes.
The very low total consumption of 45 W for the 120 MHz PM 3260 is also an important advantage when a battery pack has to be used, ensuring a reasonable operating time even at this high bandwidth. Had the PM 3260 been equipped with a conventional power supply, the consumption would have been around 80 W, almost double the actual value.
A third point in favor of the new power circuit is the high input flexibility. The scope accepts any line voltage and any line frequency between 90 and 250 V, 46 and 440 Hz, without any need for adjustment.

Easy maintenance, easy calibration
Several novel features in the PM 3260 make it a very easy instrument to service. Solid-state switching is used for all front panel controls so that the location of the controls could be planned physically on an ergonomic basis without reference to the electronics behind them. Most functions have their own plug-in cable harness, which permits switches and push-button sets and/or their associated printed-circuit-board (pcb) electronics to be checked independently. This solid state switching technique also means that the front panel controls could be designed or chosen for maximum electrical and mechanical reliability and that the internal wiring of the instrument is greatly simplified. The internal design is such that all units are very easily accessible and can be removed in seconds. Components are on the accessible side of the pcb's only.
Compared with discrete electronics, the use of hybrid thin film circuits yields advantages with regard to the number of adjustment points. For example, a vertical amplifier would normally require some 30 adjusting points. The circuitry used in the PM 3260 only needs about one third of this number, permitting really fast recalibration. In addition, the high stability of the circuitry about doubles the length of time that can pass between recalibrations.
The following articles will deal with the salient features of the PM 3260 in greater details.

BRIEF SPECIFICATION

Y-axis
Bandwidth
DC - 120 MHz at full sensitivity.
Input impedance
1 MΩ//15 pF.
Display modes
Channel A only, normal and inverted.
Channel B only, normal and inverted.
Alternate.
Chopped at approx. 1 MHz.
Added.
Deflection coefficients
2V/division . . . 5 mV/division, 1-2-5 sequence.
X-axis
Main time base
Time coefficients
1 s/div... 50 ns/div. 1-2-5 sequence.
Uncalibrated continuous control between steps.
x10 magnifier extends max. sweep rate to 5 ns/div.
Modes
Auto - Triggered - Single shot.
Trigger source
Channel A, channel B, external or mains.
Delayed time base
Time coefficients
0.5 s/div... 50 ns/div., 1-2-5 sequence
Uncalibrated continuous control between steps.
x10 magnifier extends max. sweep rate to 5 ns/div.
Modes
Starts: directly starting, after selected delay interval.
Trig: triggered by delayed time base trigger Circuit after selected delay interval.
Trigger source
Channel A; channel B, or external.
CRT
Philips D14 - 240; 20 kV PDA tube; GH (P31) phosphor.
Screen
8 x 10 divisions, each 1 cm, internal graticule.
Supply
100 - 240 V ± 10%; 46 - 440 Hz without switching.
Dimensions and weight
Height 15.4 cm
Width 31.6 cm
Depth 41.0 cm (excluding handle, front cover and feet).
Weight 9 Kg (20 lb) approx.

For further information, please check reply card ①

Designing a new portable oscilloscope

It takes a lot of brain-work - and a lot of team-work - to pack a 120 MHz oscilloscope into a 9-kg (20 lb) package measuring no more than 15 x 32 x 41 cm, which can be accurately and comfortably operated under a wide variety of conditions. A few of the points involved are discussed in this article.

The basic design requirements for the PM 3260 were reliability, compactness and portability; but it was stipulated that the compactness should not be achieved at the cost of ease of operation or serviceability.

Portability

In order to realize the predicate „portable'' as fully as possible, the frame of the oscilloscope is made of light metal, and many ergonomic aspects have been taken into consideration. For example, the form and dimensions of the handle have been chosen with respect to the external dimensions of the instrument so that e.g. the oscilloscope can be carried upstairs without problems. By making the front and rear castings of magnesium alloy, and taking care at all stages of the design work to ensure that the wall thickness was kept to a minimum, we were able to realize considerable savings in weight: the front casting only weighs 280 grammes, and the rear wall 390 grammes.

The solidly constructed handle is a help not only for carrying the instrument but also for placing it on a bench or other working surface in the most convenient position. The handle can be set in a number of different positions, which can be used as "standup" settings. These settings have been chosen so that the instrument can be viewed from the most convenient angle(s).

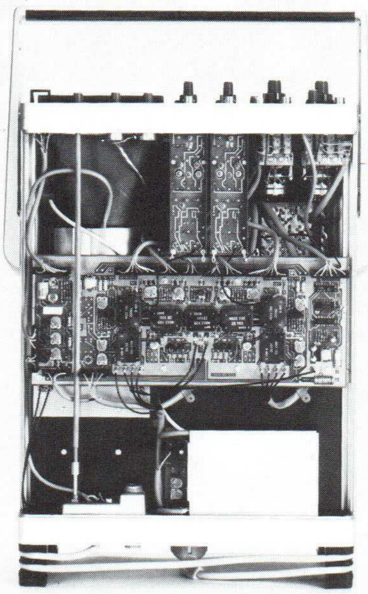
In order to make it easier to carry the oscilloscope with a fixed mains cable, provisions have been made for winding the cable round the rear supports of the instrument; most common types of mains plugs can be clamped in the recesses provided for this purpose in the rear panel.

Finish

Until recently, the outer wall of most all T & M instruments was made of "skin plate" (sheet metal with a plastic layer bonded on to it). However, the exterior of the PM 3260 is painted with scratch-proof Nextel lacquer, giving it an attractive, matt look. Use of a lacquer finish makes it much easier to supply the oscilloscope in other colours if desired.

Serviceability

Various measures have been taken to make the PM 3260 as serviceable as possible. For example, the number of electronic units has been kept to a minimum, and these units can be quickly and simply mounted in the housing. The latter is built up of a front casting and rear casting connected by extruded profiles, and a separate box for the power supply. The rear cover can be removed by unscrewing two screws, revealing the mains switch, mains filter and power-supply unit, which have intentionally been kept separate from the rest of the controls. It may be noted that the power-supply unit can be serviced outside the instrument, without interrupting the operation of the latter.



Thanks to the use of quick-fasteners, the top and bottom covers can be removed easily and quickly, exposing the printed-circuit boards and other vital parts. Most of these parts (including the printed-circuit boards) can be replaced in minutes, since all the electrical connections are realized with plugs, and the units are simply mounted (by clearly visible means!) in the instrument.

Cooling

The heat-radiating surface of the instrument has been chosen in such a way with respect to the contents that the heat generated by the various units can be led off naturally, making forced cooling unnecessary.

Cooling louvres and apertures have been avoided as far as possible, and where present are fully in accordance with the relevant IEC standards.

Controls

On the control panel, the various functions (horizontal and vertical parts, specific tube functions) are logically arranged and separated where possible. The input connectors are kept as low as possible, so that the cables don't get in your way, and the most widely used main time-base controls are placed on the far right.

Moreover, the form and dimensions of the push-buttons have been carefully chosen to reduce the chance of simultaneously depressing two buttons to a minimum.

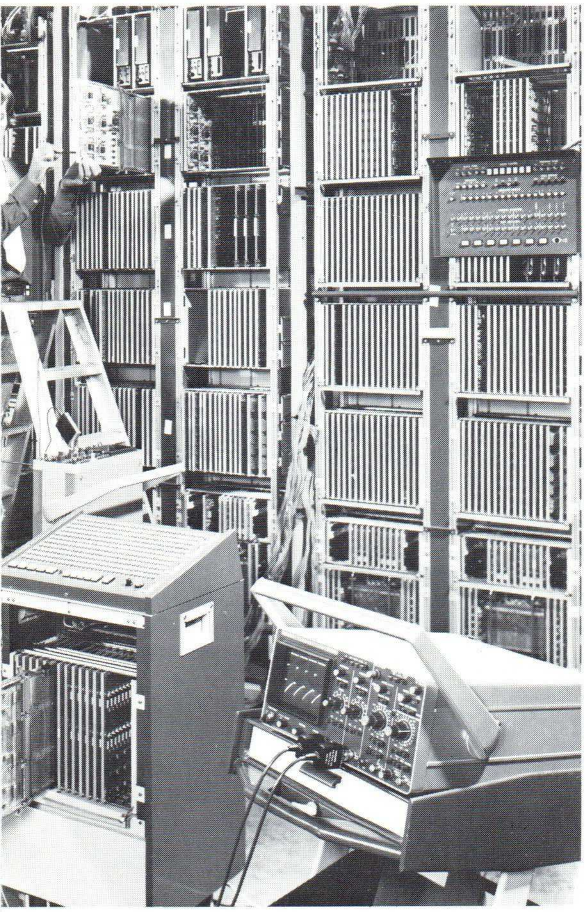
Photography facilities

The trace on the screen can be photographed in two different ways:

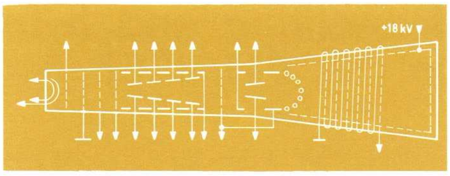
— by means of a hand-held Polaroid camera (type PM 9380), which can be rapidly and simply positioned by placing its lens shield around the bezel;

this solution has the advantage that when photos are not being taken, there is no camera around to get in the way of the controls.
— with an oscilloscope camera from the Steinheil series, mounted on the threaded holes provided just under the bezel.
The **protective cover** over the front panel, which can be locked and unlocked by a simple twist of the wrist, serves not only to protect the controls on the front panel but also to carry the various accessories (probes, etc.) required.

Team-work
Close cooperation between T & M's Development Department, Philips' Concern Industrial Design Department and the Institute for Perception Research of Eindhoven's Technical High School led, after the scrapping of many provisional designs, to an instrument which ergonomically and functionally is really outstanding.
It's a pleasure to have been in a team which designed an instrument which turned out to be such a technical beauty.

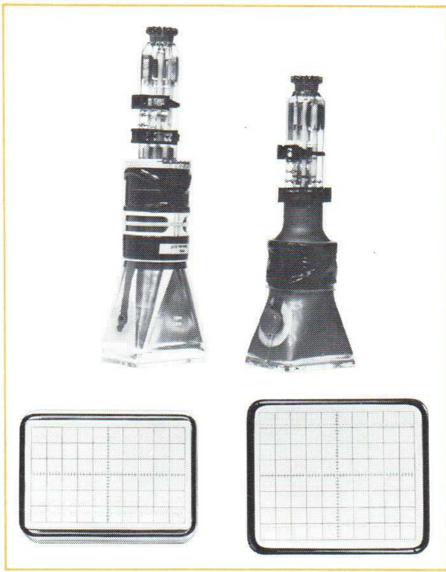


New 20 kV cathode-ray tube



The combination of a very high acceleration voltage segmented vertical deflection plates, a special domed mesh after the deflection system and the big (8 x 10 cm) aluminized screen give a brighter, bigger display with an exceptionally high writing speed from a tube which is much shorter than normal.

The new cathode-ray tube for the PM 3260 oscilloscope has a rectangular bulb with an 8x10 cm viewing area, and has been specially designed to meet the requirements of a wide-band portable oscilloscope.
These requirements can be summarized as follows: high light output to ensure a photographic writing speed that is compatible with the bandwidth of the instrument, and facilitate the visual observation of repetitive signals with a low repetition rate, high deflection sensitivity to reduce the power requirement for the vertical and horizontal deflection signal amplifiers, adequate high-frequency response of the vertical deflection system and a good line width. Moreover, in the interest of compactness the tube should be short.
In order to obtain a high light output, post-deflection accelleration (PDA) has of course been used, with a final voltage of 20 kV. The aluminized screen is of the well known P_{31} (GH) type, the spectral energy distribution of which is well matched to the spectral sensitivity of the human eye while the photographic writing speed is high.
The flat mesh used in previous tube types is replaced by a domed mesh in the PDA system. This structure is manufactured by pressing a fine electroformed mesh (mechanically supported by a ring) into the desired shape.
This type of PDA system gives expansion of the horizontal as well as of the vertical deflection of the electron beam, thus rendering the tube electron-optically equivalent to one with a considerably larger deflection-plate screen distance. Use of a domed mesh has thus made it possible to improve the deflection sensitivity without increasing the length of the tube.
The bandwidth of an oscilloscope is in general mainly determined by the capacitive load presented to the output stage of the deflection signal amplifier, and by transit-time effects. Both these limitations can, to a great extend, be overcome by subdividing the vertical deflection plates into several sections that are interconnected by a filter network. In the present CRT each of the vertical deflection plates consists of four sections which are all brought to the neck of the tube. The filter network is connected outside the tube, permitting final adjustments to be made if necessary.
Apart from the requirements imposed by the bandwidth, the accuracy of the display has also received considerable attention. For a parallax-free reading, the screen is provided with an internal graticule. The horizontal deflection direction can be aligned with respect to the graticule lines by means of a rotation coil. An additional coil system can produce a magnetic quadrupole field which allows any orthagonality error to be eliminated. Moreover, the electron gun is provided with a geometry-control electrode, the potential of which can be adjusted to minimise pin-cushion or barrel distortion of the pattern.



The bigger screen and shorter length clearly illustrate progress in the development of cathode-ray tubes.

Monolithic and hybrid integrated circuits in the PM 3260 oscilloscope

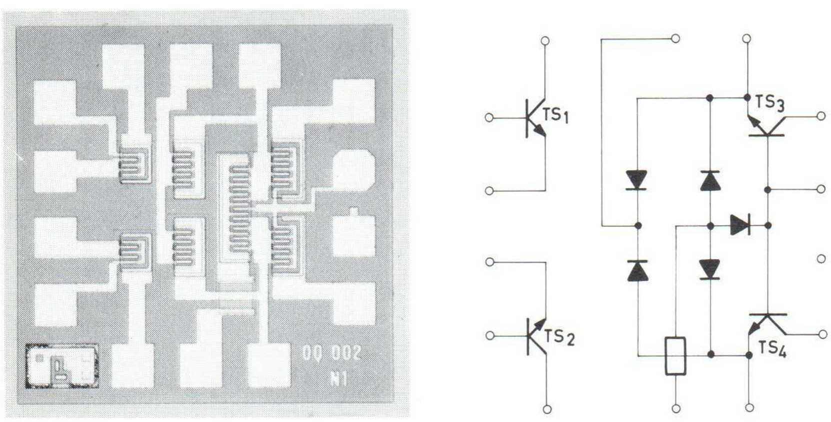
If you want to design a light-weight portable oscilloscope with specifications normally only met with in laboratory instruments, combined with extra-rugged construction to withstand the rough conditions encountered in mobile service applications, it is an obvious idea to think of using solid-state high-density electronics.

Monolithic integrated circuits (MIC's)
The PM 3260 is in fact equipped with specially developed monolithic integrated circuits (MIC's) mounted on thin-film modules. These new circuits were designed by the T & M predevelopment team in close collaboration with the Special Solid-state Product group of Philips Elcoma division.
The oscilloscope contains as many as 17 of these new IC's, covering nearly all the main functions of the instrument. Before going into detail about the specific circuits used in the PM 3260, it is instructive to give some considerations about IC applications in oscilloscopes in general.
First, let's look at the advantages of monolithic IC's in oscilloscopes
- excellent LF pulse response
- first-class HF performance
- high stability, common-base operation
- the number of oscilloscope alignments can be strongly reduced
- high CMRR
- high density
- high reliability

However, monolithic IC's incorporating resistors and capacitors will be relatively inflexible as regards gain and applications as these components introduce poor tolerance and limited range.

In the integrated circuits designed for the PM 3260, therefore, the resistors and capacitors were brought outside the MIC. Integrated thin-film circuitry has been used for the resistors, while the capacitors are miniature multilayer components. This guarantees very small, reproducible dimensions and all the good points of the MIC's themselves are preserved.

Hybrid integrated circuits
The solution described above, of combining monolithics with thin-film integrated resistors and discrete capacitors in fact gives what is known as **hybrid integrated circuits.** Although the price of thin-film circuitry is a bit higher than that of printed-circuit boards with discrete components, the performance and reliability of thin-film circuits are incomparable.



Note:
- short distance between TS_1 and TS_2 (giving optimum thermal coupling)
- ultra-short distance between TS_3 and TS_4, ensuring stable common base operation
- well balanced lay-out (giving good differential behaviour and optimum CMRR)
- cross-under resistor shown in the circuit is not critical as regards HF operation

Fig. 1. One of the MIC's widely used in the PM 3260 (the OQ 002).

Resistors made by thin-film techniques have properties comparable with the best discrete metal-film resistors - but with much smaller dimensions. Dissipations up to 100 mW/mm^2 are possible. The high component density (up to 10 elements per cm^2) gives on the one hand the desired compact (low-weight) circuitry and on the other hand short, well-defined distances between the different elements (definition of conductor and resistor pattern 5 μm), which has high-frequency advantages.

Thin-film technology
The thin-film technique used was developed by Philips Elcoma division. The production process may be described briefly as follows. A lay-out drawing to a scale of 20:1 is made of the electronic circuit. Two polyester masks are made, one for the conductor pattern and one for the resistor pattern. These masks are photographically reduced 20 times. The ceramic substrate used is very pure Al_2O_3 (Aluminium oxide) with a coating of NiCr (Nickel Chromium) resistor film and Ni (Nickel) conductor film on top of that.
After treatment with photoresist, exposure through the conductor mask opens the future conductor pattern. To lower the specific resistance of the conductor tracks and also to serve later as a mask, some layers of gold are electrochemically deposited. (The Ni layer serves as electrode). In the next step the photoresist and the Ni (not covered by gold) are etched away. Another photoresist is then applied over the circuit. This second mask determines the places where NiCr is to remain. The rest of the NiCr is again removed by etching. Fig. 2 shows the different process steps in the creation of a resistor.
The last step before encapsulation is the screening of solder paste and the mounting of discrete components by a reflow soldering technique.

An example from the PM 3260
The substrate and components of one of the thin-film hybrid IC's used in the PM 3260 are shown in fig. 3. In this specific circuit, 27 resistors are incorporated on a substrate measuring 17 x 24 mm. MIC's, transistors, capacitors and terminals are fixed on this substrate by a reflow soldering technique. After pretesting, the circuit is encapsulated to meet stringent quality specifications. Final DC and functional HF testing completes the process.

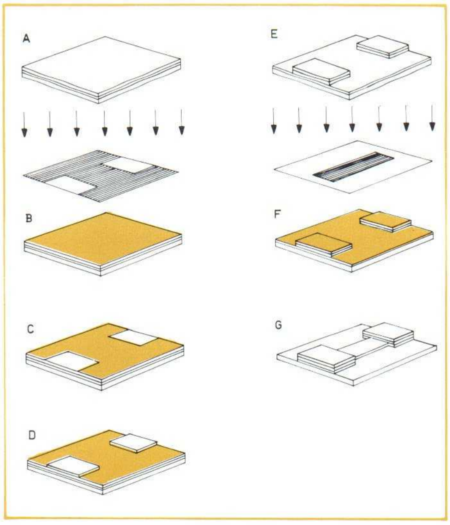


Fig. 2. The different steps in the production of a thin-film substrate.

a. NiCr and Ni deposited.

b. Exposure of photoresist through photographic mask (track pattern).

c. Exposed photo.

d. Electrochemical growth of Au on Ni.

e. Removal of photoresist and Ni (except Au regions).

f. New layer of photoresist and exposure through second (resistor) mask.

g. After development of photoresist, etching of NiCr.

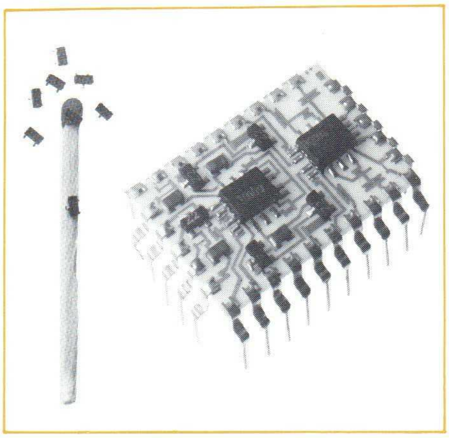


Fig. 3. Substrate and components.

A modern version of a classic instrument

AC milivoltmeters PM 2454 B

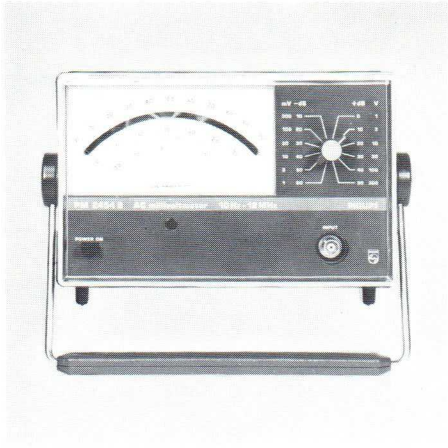
Most electronic engineers have some feeling of nostalgie for a measuring instruments they used long ago at the start of their career or even during their student days - an instrument, though bulky, was handy to use and never failed to work accurately (as we remember it now). This feeling is a mixture of "instruments like that aren't built any more nowadays" and "oh! for the days of our youth . . ."

Instruments that awaken such reveries when you find them still in use are the "classics".

But even "classics" have a limited life; and even before an instrument has reached the limits of its utility, marketing economic or technological reasons will make it necessary to develop and launch a successor. This is how a classical instrument like GM 6012 had to be replaced by the PM 2454 several years ago, while the PM 2454 is now being upgraded to the PM 2454 B.

This new instrument still has many of the good features of the GM 6012. Above all quality and reliability "translated" to meet 1974 requirements. And new features have been added, such as extended bandwidth, full floating input and an output for recording purposes. Every thing is packed into a new-style cabinet with the usual supersimple controls and a display which is even a little bit more accurate than before.

Today it's as up to date as it can be; 15 to 20 years from now, you may well hear people saying: "Look, they're still using the good old PM 2454 B over there boy, does that take you back . . . . .



Technical data of the PM 2454 B

Measuring ranges:
1 mV scale to 300 V in 12 ranges.
—80 dB to +52 dB on dB scale
Accuracy in the various frequency ranges:

40 Hz - 400 kHz	Accuracy 1% of reading ± 1% fsd
10 Hz - 40 Hz	Accuracy 3% of reading ± 1% fsd
400 kHz - 2 MHz	Accuracy 2% of reading ± 1% fsd
6 MHz - 12 MHz	Accuracy 4% of reading ± 3% fsd

Predeflection
3% in most sensitive range.
90-day stability: 0,1%
Influence of mains voltage:
10% mains voltage variation gives a change of <0.1% in the reading.
Temperature coeff.:
0,1%/°C between 0 and 45°C.
Overload:
Protected up to 300 V on all ranges.
Floating input:
Inpedance Lo-housing 1 G Ω/1,4 nF
CMR:
140 dB at 1 kHz in most sensitive range.
DC output:
1 V at full scale deflection output resistance 1 kΩ.
Supply:
90 110 128 200 220 238 V ± 10% frequency 48-62 Hz.
DC 4-6 V (150 mA at 5 V)

For further information, please check reply card ②

Czech stamp depicts Philips TV test pattern

The test pattern of the Philips colour/monochrome generator PM 5544 has been chosen to illustrate a stamp which commemorates the 20th anniversary of the Czechoslovakian TV authority. It is this signal that viewers now see on their screens and it has been started in monochrome prior to the introduction of colour transmissions. The pattern was also recently introduced by both the BBC and IBA in the UK, which joins Australia, Austria, Belgium, Denmark, Holland, Hong Kong, Hungary, Ireland, Spain, Thailand, Sweden, Norway and Yugoslavia - a list which is steadily growing longer.

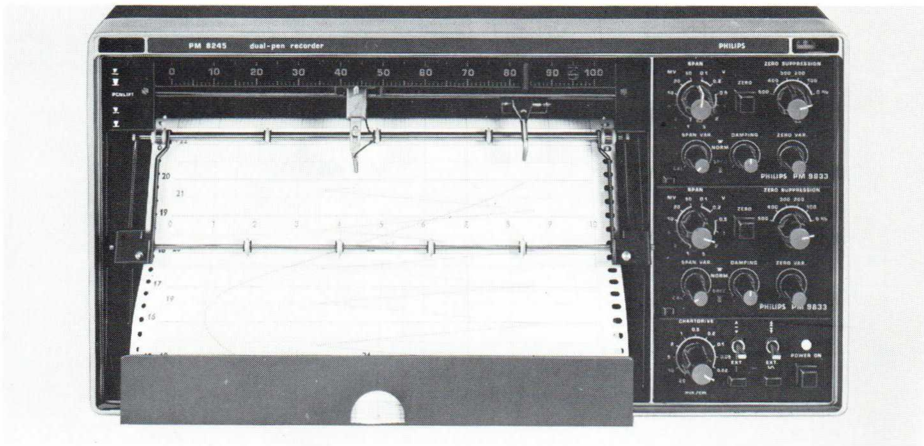
A versatile signal for monochrome and colour

The success of the Philips generator is indicated by the increasing number of countries that are using this test pattern, the information content of which is high but easily decipherable, for both colour and monochrome.

The PM 5544 is therefore ideal for countries who already have, or are planning, colour transmissions, such as Czechoslovakia. The instrument sets high standards for receivers since every significant defect will show up immediately, in one form or the other, directly on the TV set screen.

Two versatile chart recorders

Single-line and double-line versions



Input flexibility is the outstanding feature of the two new multipurpose chart recorders PM 8240 and PM 8245. Both offer a choice of input modules and both are members of the same family of laboratory recorders as the recently introduced multipoint recorder PM 8235. Input modules are interchangeable between all three recorders. In this way, maximum application flexibility is obtained with minimum stocking.
Three types of plug-in input modules are available for all instruments in the range. These are a single-range, a six-range and a universal module. The first two modules themselves accept plug-in printed-circuit range cards which can be changed to suit the application or the range of values being measured.

Measuring different parameters

The single-range module can be equipped with any range card for measurement of mV, resistance thermometers or thermocouples, the latter having cold-junction compensation.
The six-range module takes up to six different range cards; it can be remotely programmed by using the connector at the rear of the instrument. This unit can occupy one channel only on the double-line recorder.
The universal module is calibrated in 12 steps from 1 mV to 5 V with a non-calibrated control that extends the full-range sensitivity to 0.3 mV. Zero suppression is calibrated and variable to 500%, thereby greatly extending the range of application of the instruments.

High-accuracy instruments

All three instruments in the family offer an accuracy of 0.25% and a reproducibility of 0.1%. Response time for the recorders is fast - 0.3 sec for f.s.d. Inputs are floating and guarded.
The chart is driven by a "mains triggered" stepper motor and has a range of speeds, in both forward and reverse direction, from 3 cm/hour to 6 000 cm/hour. Speeds are selected in 11 steps in a 1:2:5 sequence; the manual transport "fast forward" and "fast reverse" (1.5 m/min) is switch activated. There is remote control for forward/stop/reverse, chart speed and servo-motor stand-by.
All three instruments have the same basic electronic and mechanical design and use the same convenient Z-fold paper system, which provides the user with a recorded chart in handy bookform. Chart width is 250 mm and information is easy to find along the 20 m length of chart.

Writing system

The two new recorders use a glass-tip writing system that provides clean, smudge-free traces at the highest recording speeds. The pens use transparant disposable ink cartridges with an ink capacity of 3 cc. Pen lift is controlled electrically and can be initiated by remote control or from the recorder. On the dual-line instrument, each pen can be lifted independently.
The introduction of these two new instruments to complement the 12-channel PM 8235 recorder enables Philips to offer science and industry a versatile range of equipment in which much has been standardized to simplify operation and maintenance.

Technical data of the PM 8240/45

Accuracy:	0.25% fsd
Dead band:	0.1 % fsd
Drift:	$<0.25\ \mu V/^{\circ}C$
Max. sensitivity:	1 mV (cal)
Input impedance:	2 MΩ
Source impedance:	max. 100 kΩ
Dimensions:	445 mm width 450 mm depth incl. rear cover 222 mm height (5E)
Weight:	20 kg (PM 8240) 25 kg (PM 8245)

For further information, please check reply card ③

First picture in South Africa

The first powerful television signals in South Africa are being broadcast from Pretoria as part of the buildup towards the TV network.
The picture being transmitted is the test pattern PM 5544 generator with the letters SABC/SAUK and the words "toets - testing". It is another significant step towards television - due to be launched in 1976. The SABC today called them "running up" testspart of the process of installing transmitters. Similar tests are to be carried out on all other major transmitters.
The SABC believes the test are of little public interest, however the picture can be received at Channel 5 - the frequency allocated to Pretoria.
The Pretoria transmitter covers an area bounded roughly by Warmbaths, Rustenburg, Bronkhorstspruit and the Reef.

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