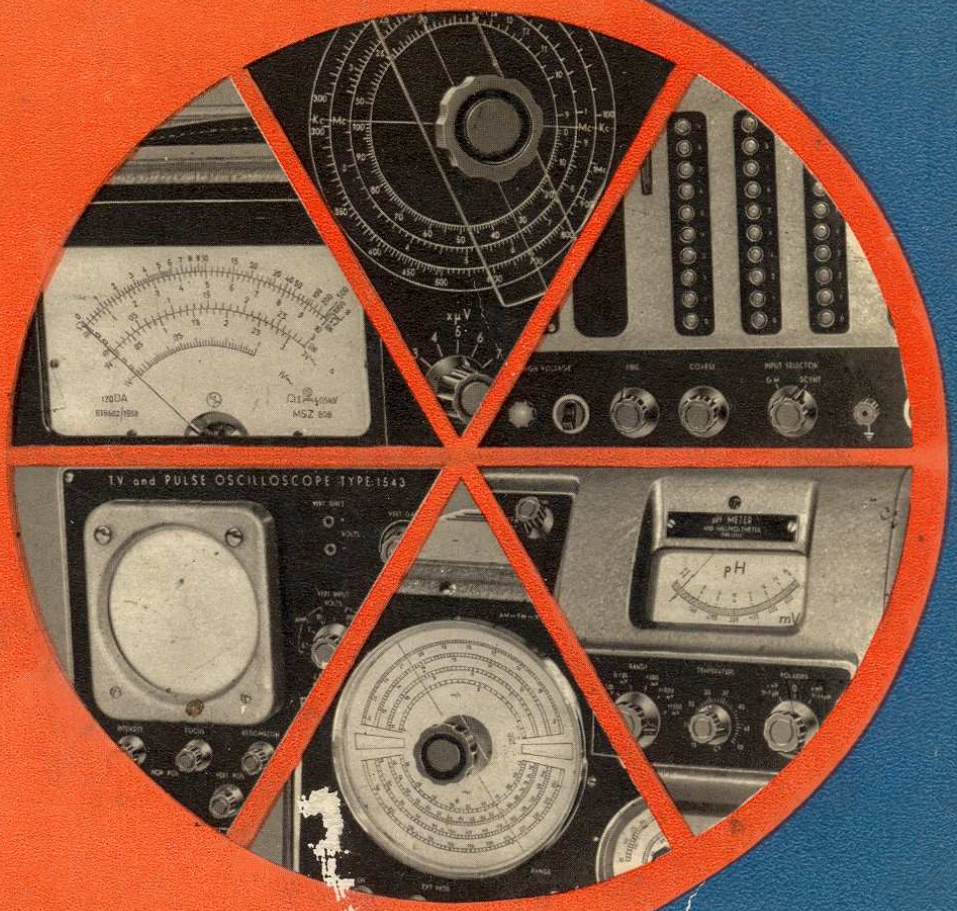


E M G

EMG

ELEKTRONIKUS MÉRŐKÉSZÜLÉKEK GYÁRA

ЗАВОД
ЭЛЕКТРОННЫХ ИЗМЕРИТЕЛЬНЫХ ПРИБОРОВ

WERK FÜR
ELEKTRONISCHE MESS-GERÄTE

WORKS FOR
ELECTRONIC MEASURING GEAR

BUDAPEST

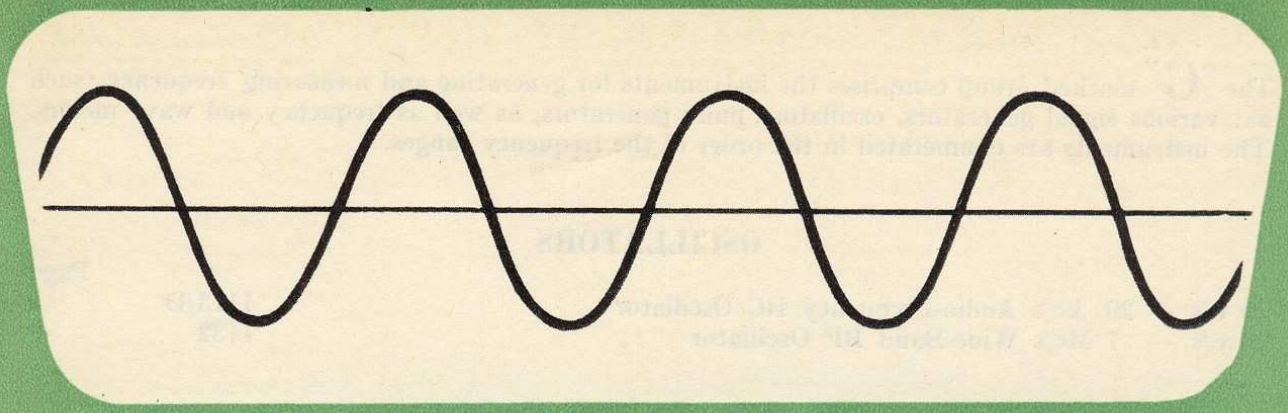
Introduction

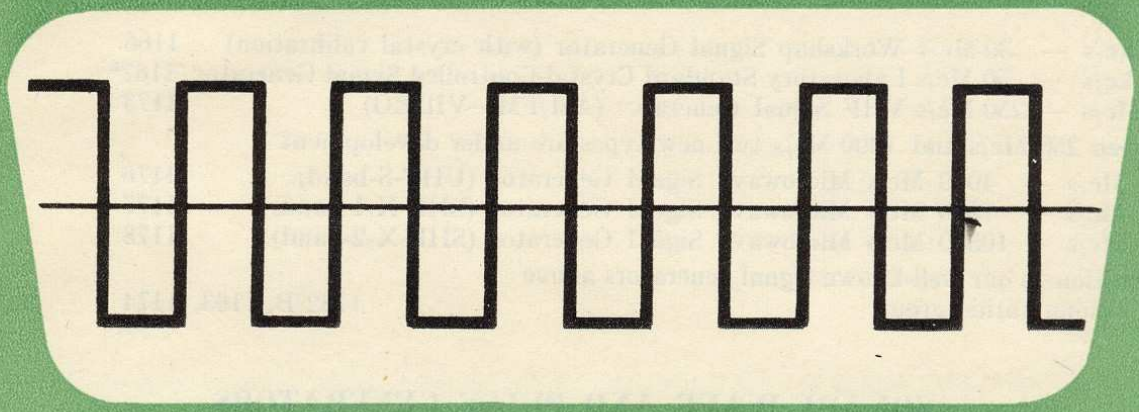
Publication of a new catalogue of products represents as a rule a summary of technical progress made since issuing the previous catalogue.
We are glad to say that we have things to relate in this respect!
Our last catalogue contained a detailed description of our well proved current types and in addition, advance information with short specifications of 21 new types of measuring instruments at that time under development. With one exception we are now manufacturing in series all of these types.
Besides those referred to above, this catalogue also contains 9 types which were not mentioned in our previous catalogue.
A further extension of our development programme is represented by 8 new types of measuring instruments (comprised in group "F") which, after leaving the development stage, will be produced in series in the next future.
Our development programme includes many other types of measuring instruments, in answer to the rapidly increasing demand of industry and research, these however, cannot be mentioned yet.
We wish to add that of our known instruments, 6 types are of an improved design, made up-to-date and available now in the new design, while our other well proved types are supplied in their unchanged form.
Summarizing the above, it can be said that about half of our new production programme described in this new catalogue represents new instruments.

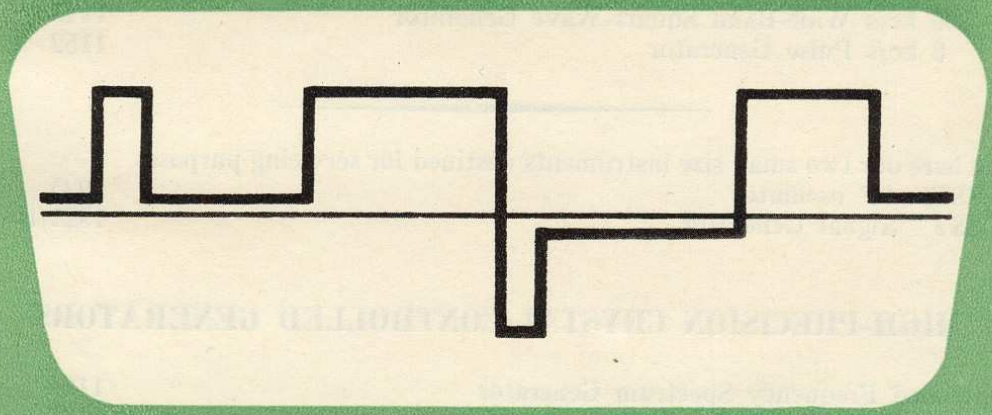
This figure in itself, is a proof of the success of our development work.
The line of our products is divided according to a well proved method into groups marked by letters. The introductory page of the various groups contains the titles of the types found in the group.
To make our measuring instrument types easier to find, this catalogue contains two indexes: one, at the beginning, lists our products in groups of application, the other, at the end of the catalogue, shows them in the order of the type numbers.
There is another fact we wish to mention: the size of this catalogue is more than three times that of the last issue. This is due to the circumstance that the information supplied therein is considerably enlarged in the technical direction; the catalogue contains now detailed descriptions, specifications and diagrams. We trust that this enlargement will contribute considerably to the wide use of our measuring instruments.
In addition to our products this catalogue shows on special colour insets our works and a few details of every-day life, of the designing and producing our products.

TELECOMMUNICATION MEASURING INSTRUMENTS

INSTRUMENTS FOR MEASURING ELECTRICAL QUANTITIES







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GENERATORS
OSCILLATORS
FREQUENCY METERS

The "G" marked group comprises the instruments for generating and measuring frequency, such as: various signal generators, oscillators, pulse generators, as well as frequency and wave meters. The instruments are enumerated in the order of the frequency ranges.

OSCILLATORS

SIGNAL GENERATORS

SQUARE-WAVE AND PULSE GENERATORS

We mention here our two small size instruments destined for servicing purposes

HIGH-PRECISION CRYSTAL-CONTROLLED GENERATORS

TV MEASURING INSTRUMENTS

FREQUENCY METERS

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* Under development (in Group "F"

EMG–1113/D

AUDIO FREQUENCY RC OSCILLATOR

A measuring instrument particularly suitable for testing the frequency response and distortion factor of amplifiers, the frequency fidelity and distortion of loudspeakers and other audio measurements. It can be used for controlling symmetrical and asymmetrical output stages operating with grid current, further for synchronizing oscilloscopes or stroboscopes, as well as for supplying A. C. to measuring bridges. Its high power output (5 W) is particularly advantageous in comparison with other instruments used for similar purposes.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

EMG–1113/D

FUNCTION. The functioning principle of the "Audio Frequency RC Oscillator" is shown in the Block Schematic Diagram below.

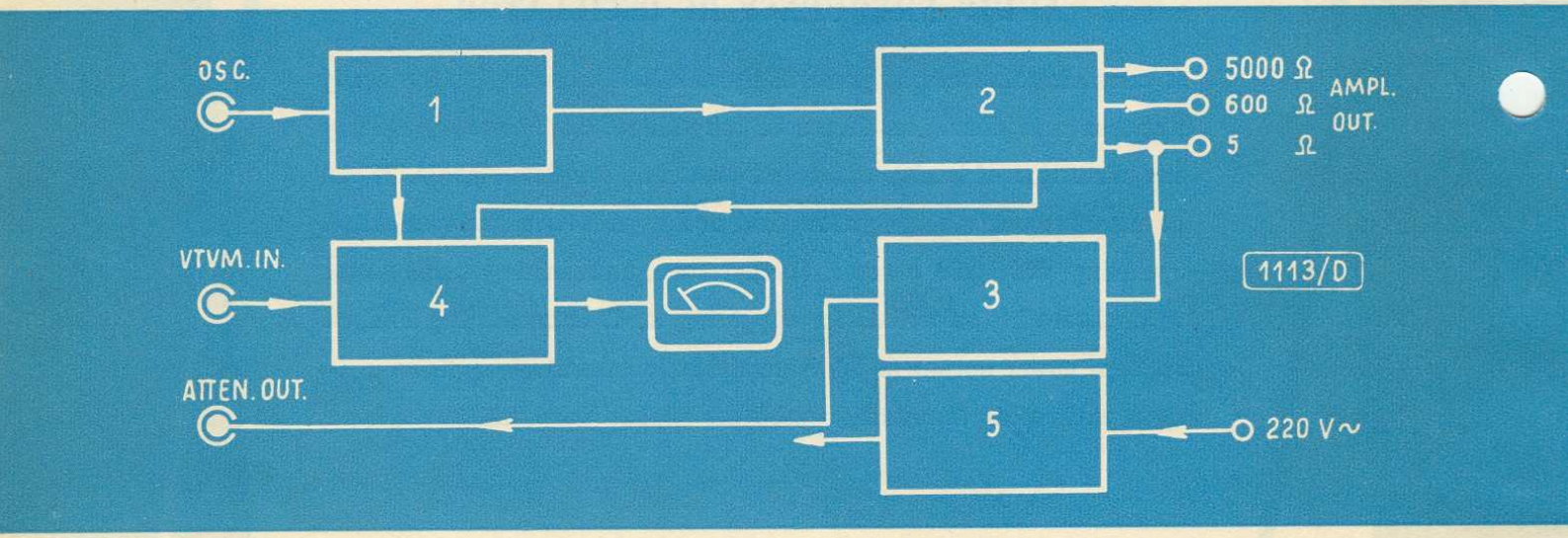
The **oscillator** consists of RC coupled two-stage amplifier with Wien-bridge input system and feedback. The feedback voltage gets through an RC chain back to the grid of the first tube. The adjustment of the required frequency is carried out by means of the variable resistance of the RC chain components. Their values can be varied in such manner that the frequency variation will be in a ratio of 1 : 10. A single frequency corresponds to each value of the variable resistors at which frequency the feedback voltage is in phase with the output voltage. Oscillation sets in at this frequency. The feedback — which has not a constant value — is controlled automatically in balance with amplification. The amplification is subject to the regulation of the feedback. The incandescent lamp connected parallel with the cathode resistor of the first tube is one part of the resistor chain coupled as attenuator. With increasing output voltage the temperature of the incandescent lamp filament and together with it the resistance of the heater filament, the part of the output voltage on it, increases and also the measure of the negative feedback rises and this means the automatic control of amplification.

The sinusoidal voltage produced in the RC oscillator is fed into the power amplifier.

The **power amplifier** consists of a phase-inverter and amplifier stage, following an other amplifier stage with cathode-follower circuit controlling the push-pull output stage.

The design of the circuit admits that non-linear distortions arising at the power amplifier tubes are eliminated by a substantial negative feedback. The feedback applied from a separate coil of the output transformer eliminates the linear and non-linear distortions of the output transformer.

The apparatus has two kinds of output connections :



1. RC oscillator
2. Power amplifier
3. Attenuator
4. V.T. voltmeter
5. Power supply unit

a) Voltage output from the oscillator

b) Power output from the adjustable output transformer having 3 different matchings. Adjustment of the output voltage can be regulated with both kinds of output separately, both coarse or fine.

The **attenuator** is connected to the lowest impedance of the output transformer and its control limits offer a very wide possibility of control. The voltage to be taken from the attenuator is always asymmetrical, otherwise the two higher resistance outputs of the output transformer can be used both in symmetrical and asymmetrical circuit.

The built-in **V. T. voltmeter** can be used for five different measurements viz. in **three** positions for checking the voltage of the various **power outputs,** in **one** position for checking the **voltage output** and finally in another position — as independent V. T. voltmeter — for checking **external input voltages.**

The **power supply** produces current and voltage for the electronic stages with one single high-power rectifier tube. Hum is eliminated by an amply dimensioned filter chain.

Tubes used in this instrument :

EF6—1	UBL21—1	6SN7—2
6SJ7—1	807—2	PV200/600 spec.—1

(The number after the Type-number indicates the number of tubes in use.)

SPECIFICATION

RC OSCILLATOR

FREQUENCY RANGE :
20 c/s—20 kc/s
(in 3 bands)

FREQUENCY BANDS :
20— 200 c/s
200—2000 c/s
2 kc/s— 20 kc/s

FREQUENCY ACCURACY :
$\pm$ 2% or $\pm$ 1 c/s
(whichever is the gerater)
(After warm up and reaching the constant internal temperature).

DISTORTION FACTOR : $\leq$ 0,5%

OUTPUT VOLTAGE :
between 0—5 Volt
continuously adjustable
(by coarse and fine adjustment)

OUTPUT IMPEDANCE :
$<$ 7000 ohm + 0,5 μF

RC OSCILLATOR WITH AF AMPLIFIER

POWER : max. 5 W

FREQUENCY RESPONSE :
(relative to 1 kc/s)
a) at 5 ohms and 600 ohms output
from 20 c/s to 15 kc/s (at 5 W) : $\pm$ 1 dB
from 15 kc/s to 20 kc/s (at 5 W) : $\pm$ 2 dB
b) at 5000 ohms output
from 20 c/s to 5 kc/s (at 5 W) : $\pm$ 1 dB
from 5 kc/s to 15 kc/s (at 5 W) : $\pm$ 2 dB

DISTORTION FACTOR (at nominal load)
a) at 5 ohm and 600 ohm output
from 35 c/s to 15 kc/s (at 5 W) : $\leq$ 1%
from 15 kc/s to 20 kc/s (at 2 W) : $\leq$ 1%
b) at 5000 ohm output
from 35 c/s to 5 kc/s (at 5 W) : $\leq$ 1%

OPTIMUM LOAD (for max. power):

at asymmetrical output: 5,600 and 5000 ohms

at symmetrical output:

2 × 300 ohms

2 × 2500 ohms

OUTPUT ATTENUATOR (resistive)

(only at 5 ohms output): max. 70 dB
(8 stages, each with 10 dB steps)

OUTPUT RESISTANCE

at 0 dB:	50 ohms
at 10 dB:	12,8 ohms
at steps between 20—70 dB:	12,2 ohms

ATTENUATOR ACCURACY: ± 0,3 dB

V. T. VOLTMETER

calibrated in "Volt eff." for sinusoidal signal

MEASURING RANGE: 0—300 Volt
in 6 sub-ranges

UPPER LIMITS OF SUB-RANGES:

1 Volt	0 dB
3 Volt	+ 10 dB
10 Volt	+ 20 dB
30 Volt	+ 30 dB
100 Volt	+ 40 dB
300 Volt	+ 50 dB

(0 dB at 0,775 V, with 1 mW at 600 ohm)

ACCURACY: ± 3% of f.s.d.

FREQUENCY RANGE:
20 c/s—20 Kc/s

FREQUENCY RESPONSE: ± 0,5 dB
(relative to 1kc/s)

SELECTOR SWITCH:

in 5 positions for the following measurements:

1. internal power output at 5 ohms
2. internal power output at 600 ohms
3. internal power output at 5000 ohms
4. internal oscillator output
5. external voltage input

INPUT IMPEDANCE:
about 100 kohms + 2 μF (in series)

BUILT-IN METER: Moving Coil

Accuracy:	1,5
Sensitivity:	100 μA

POWER SUPPLY

Voltage:	110 or 220 Volt
Frequency:	50/60 c/s
Consumption:	about 220 W

OTHER DATA

FINISH:

laquered steel-sheet case with 2 leather carrying handles

DIMENSIONS:

(without knobs and handles)

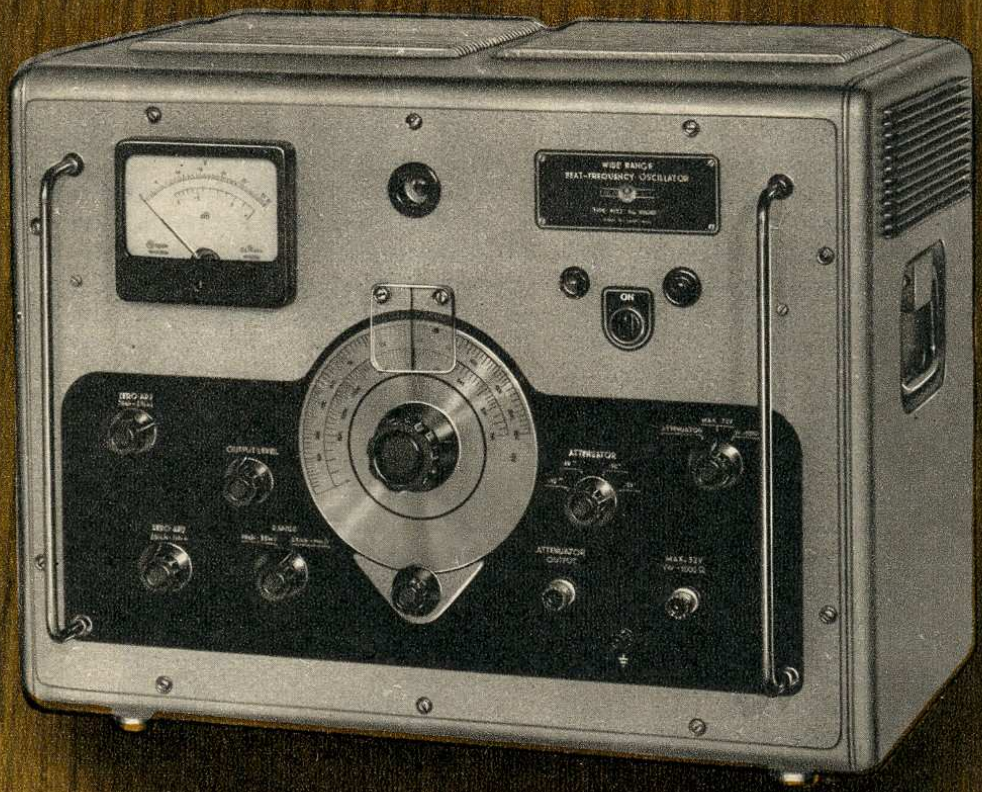
height	315 mm
width	425 mm
depth	235 mm

WEIGHT: 27 kg (approx.)

ACCESSORIES:

1 power cord
2 coaxial screened cables with connector plugs
1 coaxial connector plug

As a result of continued efforts to improve the design of instruments, we reserve the right to change this specification.



EMG–1132

WIDE-BAND BF OSCILLATOR

A laboratory instrument designed for testing audio, radio- and video-frequency amplifiers and for wide-band frequency response measurements.

The advantage of BF oscillators is the wide frequency coverage. The entire frequency range of this instrument is divided in only two bands. The frequency generated in the instrument appears as the difference between the frequencies of one variable and of one fixed oscillator. When changing the frequency ranges, only the plate voltage of the tubes are to be switched over, so that the various troubles resulting from the switching contacts of the tuning circuits are eliminated.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

FUNCTION. The functioning principle of the "Wide-band BF oscillator" is shown in the Block Schematic Diagram below.

The amplification of the signals generated in the variable frequency oscillator is made by a tuned wide-band amplifier stage which at the same time separates the variable oscillator from the mixer-stage. This tuned wide-band amplifier and separating stage supply the higher signal for mixing. The signal of the fixed frequency oscillator gets into the selective amplifier stage supplying the lower signal for mixing. The coupling of the signals produced in the oscillators to the next stage to provide for a good wave shape is always performed inductively. The two oscillators must run together in the 0 position of the frequency scale; this is shown, after appropriate adjustment, by the completely opened position of the magic eye.

The signals of the two independent oscillators are fed after adequate amplifier stages into the mixer stage; the higher signal gets to the control grid of the mixing tube, the lower signal to the cathode circuit of the mixing tube. In consequence of mixing the signal of desired frequency is produced as a difference between the frequencies of the two oscillators. The task of the following filter chain is to eliminate the non-required frequencies produced during mixing. The voltage level of the signal passed here can be regulated and gets then further into the two-stage wide-band amplifier which is a compensated voltage amplifier provided with a negative feedback.

This controls the power amplifier output stage designed in a "cascode" circuit.

The output voltage of the wide-band oscillator is also available through two concentric connectors. A voltage between about 32 V and 3 V appears on the first one, a lower voltage on the second one and this voltage can be reduced through the voltage divider down to 1 mV. The built-in V. T. voltmeter provides facilities for checking the output voltage.

The electronic stages are supplied with current and voltage by three rectifier tubes. After ample filtering two different D. C. Voltages pass to the tubes; the higher serves for feeding the output stage.

Tubes used in this instrument:

ECC 85—1	6 AG 7—3	EF 80—2
OS 51—2	EM 34—1	6H 6—1
5U 4—3		

(The number after the Type-Number indicates the number of tubes in use.)

SPECIFICATION

FREQUENCY RANGE: 20 c/s — 7 Mc/s (in two bands)

FREQ. BANDS: "A": 20 c/s — 25 kc/s
"B": 25 kc/s — 7 Mc/s

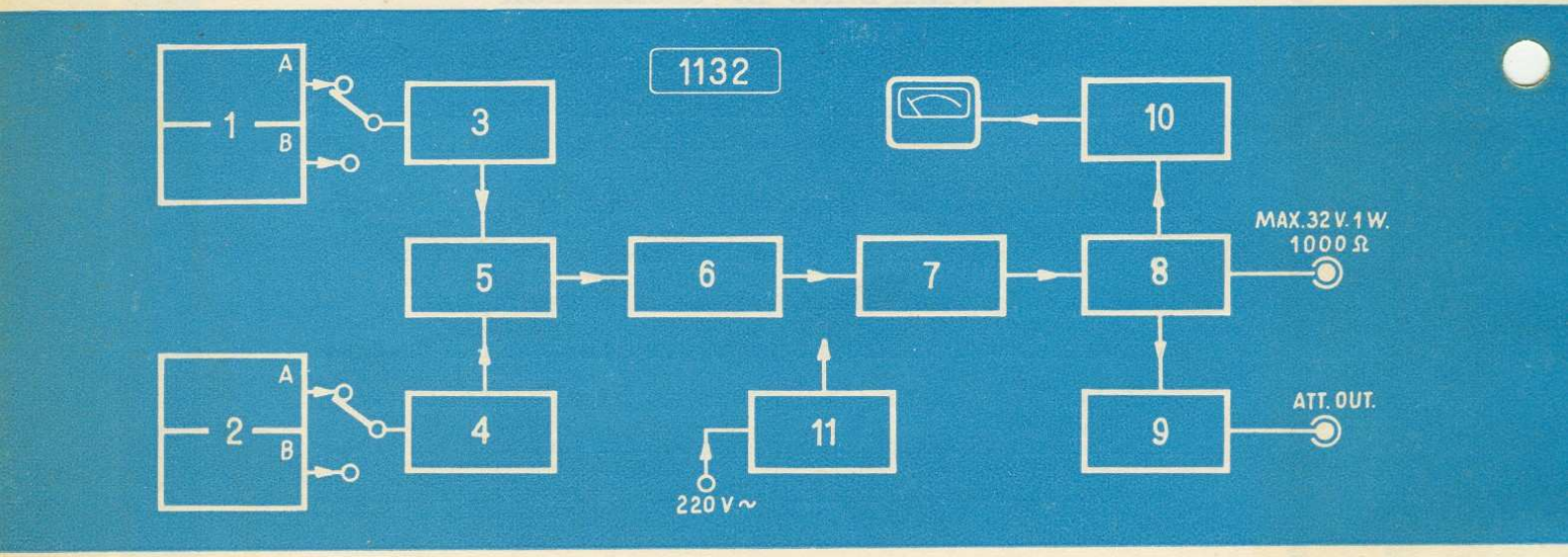
FREQ. ACCURACY: "A" ± (2% + 8 c/s)
"B" ± (2%+3 kc/s)

FREQUENCY STABILITY:
(after reaching const. int. temperature):
"A": ± 10 c/s (for 10 min. duration)
"B": ± 1,5 kc/s (for 10 min. duration)

LINEAR DISTORTION
(Correctly matched directly on coaxial jack):
max. ± 2 dB

OUTPUT VOLTAGE: max. 32 V

OUTPUT POWER: 1 W
(with 1000 ohms load)



1. Variable frequency oscillator
2. Fixed frequency oscillator
3. Wide-band amplifier
4. Selective amplifier
5. Mixer stage
6. Filter
7. Wide-band voltage amplifier
8. Power amplifier
9. Attenuator
10. V. T. voltmeter
11. Power supply unit

EMG–1143

WIDE-BAND SQUARE-WAVE GENERATOR

A laboratory instrument for square-wave testing of wide-band amplifiers, transformers and cables. It is also suitable for square-wave modulation of H. F. oscillators. It can be used to great advantage when testing audio-frequency amplifiers, pulse amplifiers and pulse transformers. The versatile application of the instrument is particularly emphasized by two of its outstanding features : the 1 : 10 000 frequency coverage and the 1 : 1000 voltage coverage.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

FUNCTION: The functioning principle of the "Wide-Band Square-Wave Generator" is shown in the Block Schematic Diagram below.

The square-wave is generated by a cathode-coupled multivibrator which can be switched over to an astable or monostable operation. In astable operation the multivibrator oscillates freely, its frequency can be adjusted by switching over the capacitance values of the cathode circuit capacitor. The cathode-circuit timing capacitor is variable within a wide range in accordance with the required frequency. The speed of triggering is limited — in both directions — only by the cathode-circuit stray capacitance. Hence the significant property of the generator that the rise time and fall time of the square wave are constant, and independent of the frequency. The frequency of the square wave can be asjusted finely also by connecting an external capacitor. In case of external synchronization the freely oscillating multivibrator is directly controlled by the positive or negative pulse. In this case the multivibrator frequency has to be selected so as to be near the frequency of the synchronizing pulse.

In monostable operation the multivibrator does not oscillate freely and swings over only under the action of the sinusoidal external synchronizing signal, passing through the signal cutting and squaring stages. In this case the frequency of the square-wave produced is in accordance with that of the input signal. The differentiated signal voltage of the multivibrator is fed also to separate connecting jacks, so that it can be used as synchronizing signal for other purposes e. g. for oscilloscopes.

The output signal of the multivibrator, controls a cathode-follower power amplifier. By means of the attenuator in the cathode-circuit, the voltage of the output square waves can be adjusted in appropriate steps.

An amply dimensioned power supply unit is provided for all voltage and current needs of the instrument, which furmishes the various positive and negative voltages requested according to the stages of the instrument.

Tubes used in this instrument:

EL 84—4 EZ 80—4

(The number after the Type Number indicates the number of tubes in use.)

SPECIFICATION

FREQUENCY RANGE: 50 c/s — 500 kc/s

ACCURACY: ± 10%

FREQUENCY FINE TUNING:
(with external capacitor) 50 c/s — 500 kc/s

OUTPUT VOLTAGE:
30 mV — 30 V (peak)

ACCURACY: ± 20%

OUTPUT RESISTANCE:
from 30 mV to 3 V 50 ohms
at 10 V 100 ohms
at 30 V 300 ohms

OUTPUT SQUARE WAVE FORM

RISE TIME: (between 10% and 90% points)
between 30 mV and 30 V: max. 70 mμsec

FALL TIME: (between 10% and 90% points)
between 30 mV and 3 V: max. 70 mμsec
10 V and 30 V max. 100 m μsec

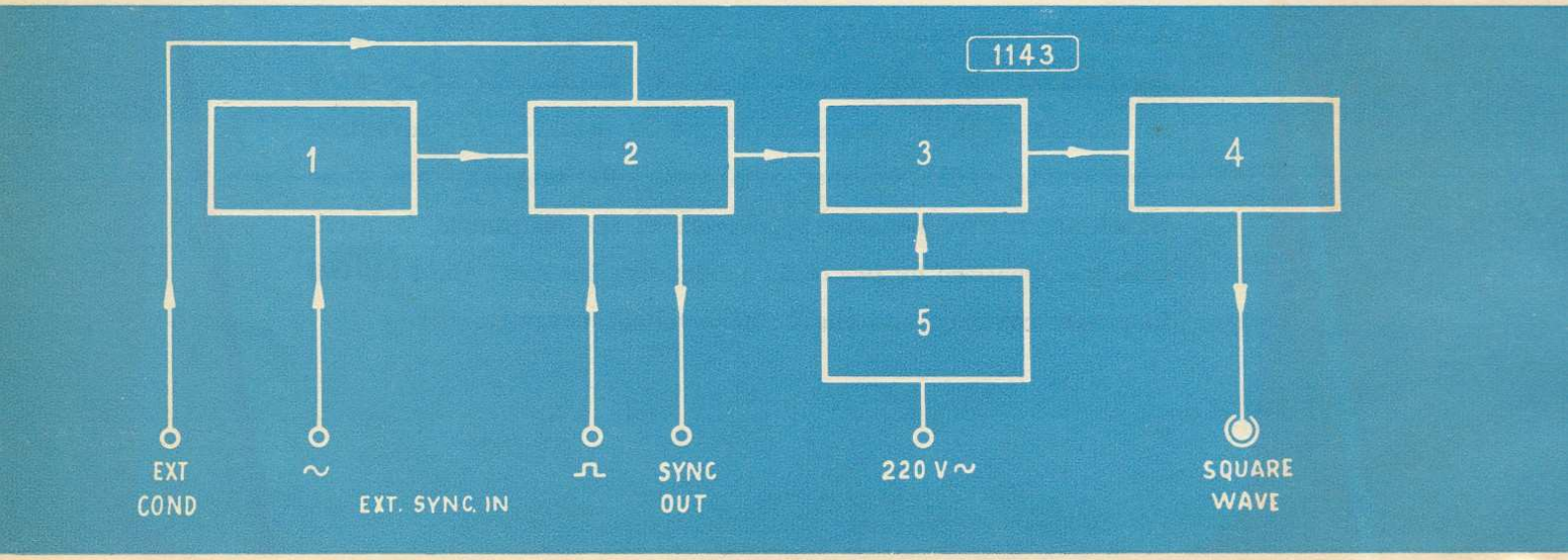
OVERSHOOT: max. 3%

EXTERNAL SYNCHRONIZATION

a) with sinusoidal signal:
Frequency range: 50 c/s to 500 kc/s
External voltage: 25 V to 60 V rms

b) with positive or negative sulse
Frequency range: 50 c/s to 100 kc/s
External voltage: 10 V—100 V (peak)

As a result of continued efforts to improve the design of instruments, we reserve the right to change this specification.



1. Signal cutter and squarer 2. Multivibrator 3. Amplifier 4. Attenuator 5. Power supply unit

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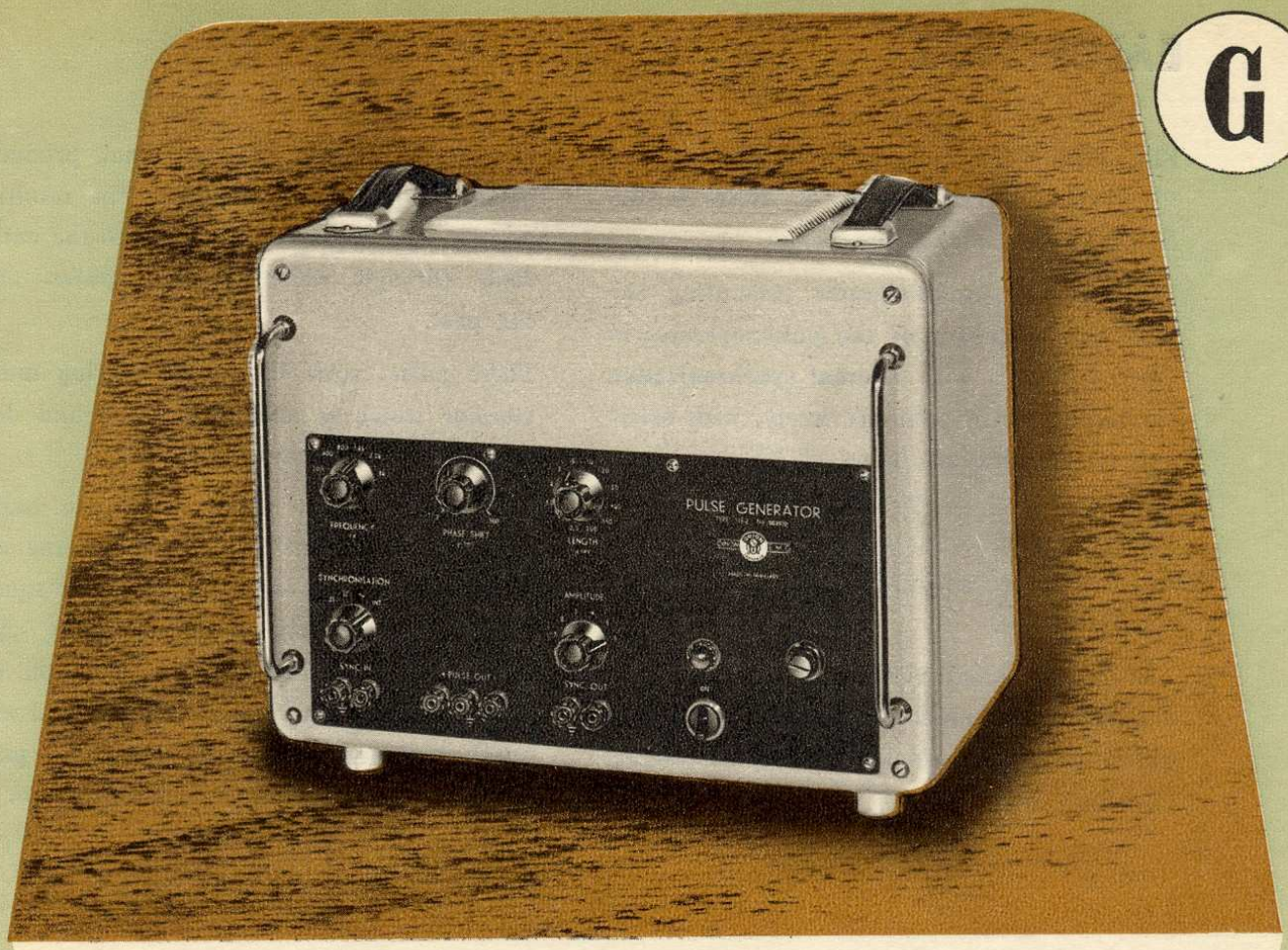


EMG–1152

PULSE GENERATOR

An indispensable laboratory measuring instrument when testing radar systems, microwave multi-channel equipments and pulse amplifiers. The pulse generator is one of the most important instruments of the pulse technique. It can also be used for pulse modulation of H. F. oscillators. Its field of application comprises all measurements where pulses of μsec order are required. The instrument produces true-to-shape pulses in calibrated steps. Pulse frequency, pulse duration and pulse amplitude can be adjusted each separately. Pulse delay can be regulated continuously. The positive and negative output pulses can be used simultaneously.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

EMG–1152

FUNCTION. The functioning principle of the "Pulse Generator" is shown in the Block Schematic Diagram below.

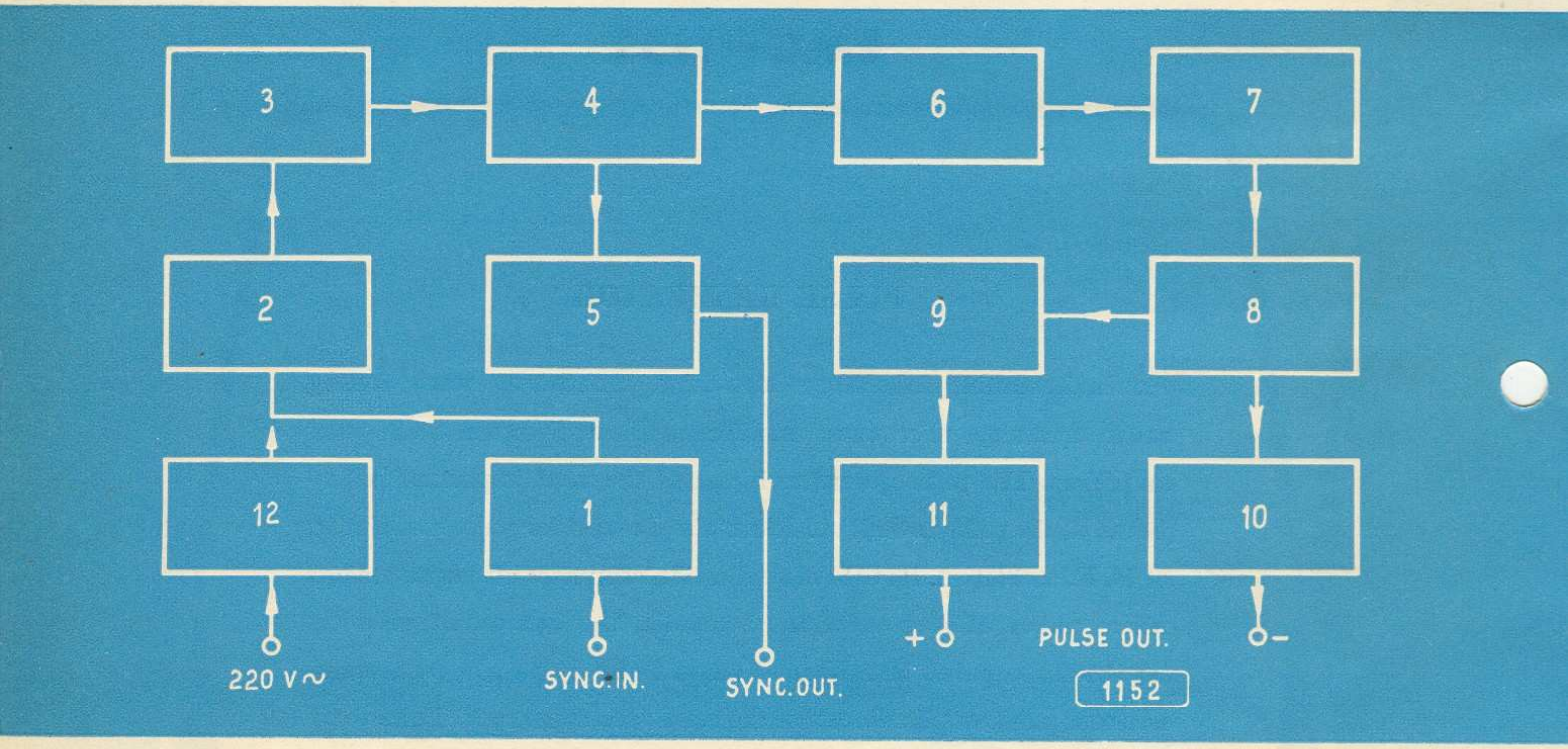
The **frequency multivibrator** generating the repetition frequency of the pulse, operates in two positions : with **internal synchronization** the multivibrator oscillates freely, with **external synchronization,** however, the multivibrator can only be put into operation with a control signal to be coupled from the outside, which is either a sinusoidal or a positive or negative pulse.

The frequency multivibrator is preceded by an **amplifier stage** which amplifies, squares and differentiates the sinusoidal input synchronizing signals.

Differentiating the square signal, produced in the frequency multivibrator, the resulting positive and negative pulses get to the **cutter diode** through which negative pulses only can pass.

These pulses start the **pulse delaying multivibrator** which is cathode coupled and does not oscillate without control.

The square signal produced in the multivibrator carries out two tasks. On the one hand it serves by differentiating the square signal for controlling the synchronous separating stage of the output signals, on the other hand the same signal differentiated with another differentiating link starts the **pulse duration multivibrator.** This multivibrator in



1. Input sync. signal amplifier
2. Pulse repetition frequency multivibrator
3. Cutter diode
4. Pulse delaying multivibrator
5. Output sync. signal separating stage
6. Pulse duration multivibrator
7. Output amplifier
8. First phase-inverter
9. Second phase-inverter
10. First attenuator
11. Second attenuator
12. Power supply unit

itself does not oscillate, being blocked by negative voltage.

The pulse duration multivibrator produces the signal with a duration, adjustable in 12 steps for controlling the **output amplifier** stage.

The fact that the pulse generator supplies both positive and negative signals simultaneously at two separate output connectors, is a great advantage for laboratory measurements. To obtain this, two **phase inverter stages** are connected after the power amplifier stage, these are DC coupled for amplifying true-to-shape signals. The pulse of desired sign, can be taken off the 6 steps attenuator provided on the anode circuit of the corresponding phase inverter stage. The well dimensioned power supply unit is furnishing the positive and negative voltages required, for the instrument stages.

Tubes used in thes instrument :

ECC 40—5	EL 41—4	EL 6—1
AZ 4—1	AZ 21—1	VR 150—1

(The number after the Type-Number, indicates the number of tubes in use.)

SPECIFICATION

PULSE REPETITION FREQENCY :
between 200 c/s and 8 kc/s
in 6 steps

FREQUENCY ACCURACY : ± 10%

POLARITY OF OUTPUT PULSE :
positive and negative
(simultaneously on two separate jacks)

OUTPUT IMPEDANCE
with max. amplitude : about 1,5 kohm
with lower amplitude :
decreasing proportionaly with amplitude

OUTPUT SYNCHRONIZING VOLTAGE :
positive about 20 V_{peak}

EXTERNAL SYNCHRONIZATION :
a) with sinusoidal signal
(between 50 c/s and 8 kc/s)
required external voltage : approx. 25 V_{rms}

b) with positive or negative pulse
(max. up to 8 kc/s)
required external voltage : min. 30 V_{peak}

PULSE DELAY :
between 2 and 300 μsec
(continuously adjustable)

PULSE DURATION :
between 0,5 and 200 μsec
(in 12 steps)

ACCURACY PULSE DURATION :
± 20%

OUTPUT PULSE AMPLITUDE :
between 1,5 V and 75 V_{peak}
(in 6 steps)

PULSE AMPLITUDE ACCURACY : ± 20%

OUTPUT PULSE FORM
Rise or fall time : max. 0,3 μsec
(between 10% and 90% points)

ROOF FALL
a) with max. 200 μsec duration and about 20 kohms load : about 3%

b) with shorter duration and higher load :
negligible

OVERSHOOT : max. 3%

POWER SUPPLY

Voltage :	110, 127, 220 V
Frequency :	50/60 c/s
Consumption :	about 140 W

OTHER DATA

FINISH :

lacquered steel-sheet case with 2 leather carrying handles

DIMENSIONS :

(without knobs and handles)

height	320 mm
width	430 mm
depth	250 mm

WEIGHT : 16 kg

ACCESSORIES :

1 power cord

As a result of continued efforts to improve the design of instruments, we reserve the right to change this specification.

EMG–1166

WORKSHOP SIGNAL GENERATOR

A portable signal generator of up-to-date design and relatively small dimensions, generating H. F. signals of known frequency and voltages. The equipment can be used to equal advantage in workshops, servicing stations and laboratories respectively. Switching over from one frequency band to another and selection of modulation or other ways of operation is carried out by the aid of push-button switches located on the left and right-side of the large-size linear scale. High accuracy of frequency calibration by means of the built-in 1 Mc/s crystal oscillator is a great advantage of the equipment. It is also most suitable for taking selectivity curves, since the accuracy of adjustment of the basic frequency can be greatly increased by using the built-in oscillator of 4 Mc/s.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

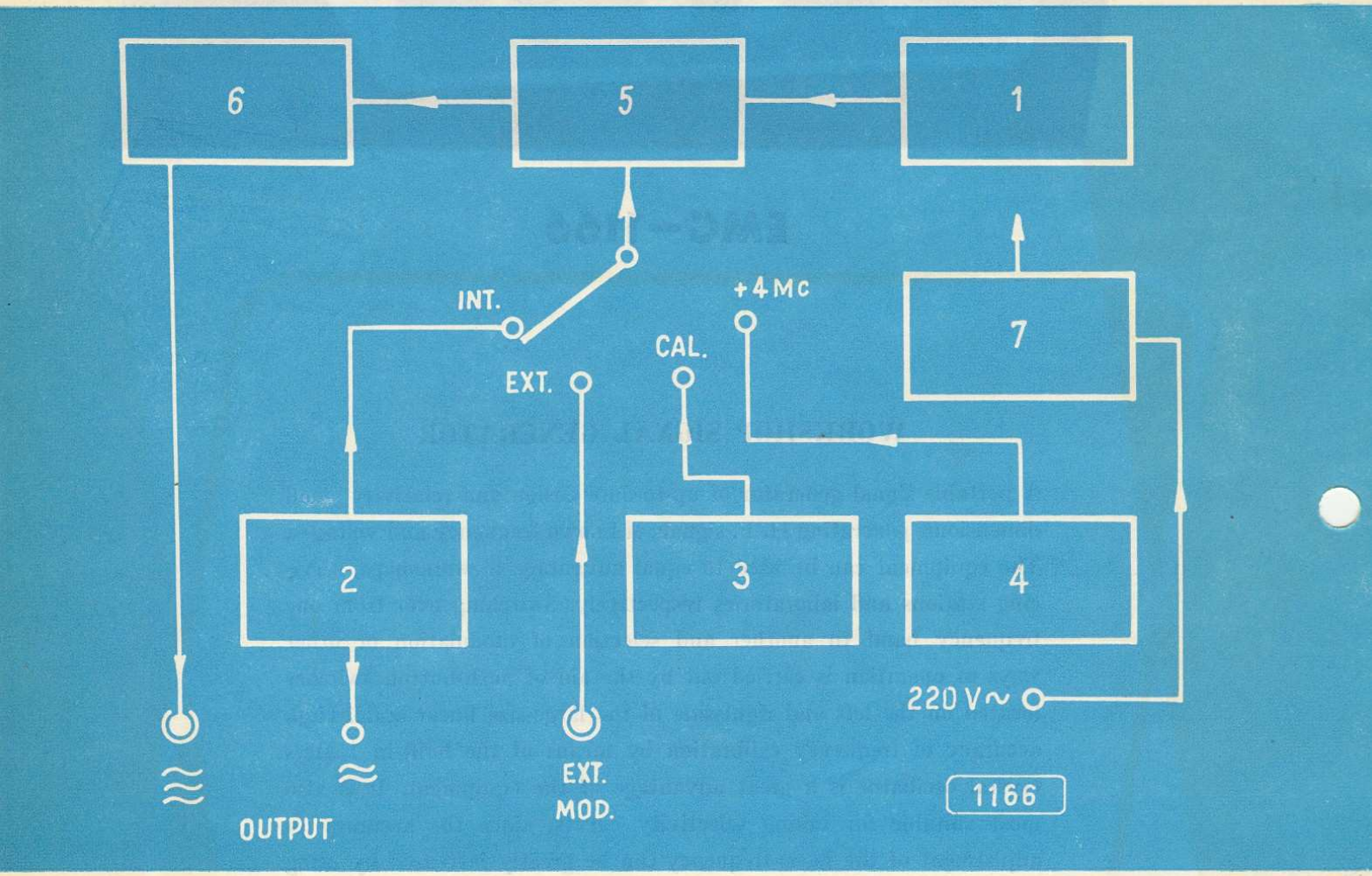
EMG–1166

FUNCTION. The functioning principle of the "Workshop Signal Generator" is shown in the Block Schematic Diagram below.

The instrument consists of several principal units. The most important among them is the LC-coupled **oscillator stage** generating radio-frequency signals. The required frequency can be adjusted by switching over the corresponding group of coils by the push-buttons and by the variable air double capacitor in the tuning circuit. The triode section of a double electron tube operates as an oscillator while the pentode section of the same tube controls the anode potential of the oscillator triode which determines the stability of oscillation and the level of the output voltage. Very careful screening of the oscillator section makes the slight radiation of the instrument practically negligible. The radio-frequency signals can, of course, be modulated by an internal or an external frequency.

Internal modulating frequency (400 c/s) is produced by a separate audio-frequency oscillator, whose signals are also led out separately for other measuring purposes. The audio-frequency oscillator is the triode part of another dual-tube performing two other tasks as well. The pentode section of the same tube is used as a **modulator.**

The **external modulating** frequency is connected to the instrument through a screened coaxial connecting jack and plug respectively. The A. M. radio-frequency, signal modulated



1. RF oscillator
2. AF oscillator
3. Oscillator (4 Mc/s)
4. Crystal oscillator
5. Modulator
6. Attenuator
7. Power supply unit

by the methods described above, after subsequent attenuation in a multi-step **attenuator** (voltage divider), is fed to a screened coaxial connecting jack from which the signal of desired voltage and frequency can be secured through an adequate H. F. cable. The attenuator consists of resistive parts only; its careful design provides for a frequency-independent voltage division. The output voltage can be adjusted in 5 decade steps as well as continuously in coarse and fine adjustment. The ratio of attenuation obtained through the voltage divider can be read directly in μV. The continuous adjuster has a decade graduation, while the step adjuster has five decade steps. By multiplying the values adjusted on the two scales, the output voltage can be easily calculated in μV. In addition to the conventional circuit described before, the measuring instrument includes two electronic sections generally not encountered with traditional signal generators; this circumstance showing a remarkable improvement.
One of these circuits is the **crystal-controlled oscillator** of 1 Mc/s made up by the triode section of the second double tube. It is used for scale calibration in the course of which the frequency scale can be shifted to the left or to the right by means of a calibration screw so that practically an output frequency with an accuracy, reaching nearly that of quartz crystal can, also be adjusted.
Calibration is carried out by the "beat" method in which the difference frequency is made audible in a head-phone permitting easy correction of the frequency scale. After an appropriate switching over the triode section of the above mentioned double-tube will operate as an **oscillator of 4 Mc/s.** On pressing the appropriate push-button the 4 Mc/s can also be produced in combination with the original basic frequency as the **sum or difference of frequencies.**
This circuit and the facility of tuning off by $\pm$ 25 kc/s, permits selecticity curves to be plotted with high accuracy. As shown by the above description the possibility of application of the instrument, at a maximum of exploitability fairly exceeds that of other signal generators of similar dimensions and application and it does so by means of two double-tubes only.
All current circuits of the instrument are fed from a **power supply unit** designed with the usual careful filltering.
Outward radiation of the oscillator is prevented by the H. F. power supply filter circuit attached to the mains input and consisting of several filtering elements, capacitors and chokes.

Tubes used in this instrument:
PCF 82—2 EZ 80—1 VR 105—1

(The figure after the Type-Number shows the number of tubes in use)

SPECIFICATION

FREQUENCY RANGE: 100 Kc/s — 30 Mc/s (in 5 bands)

FREQUENCY BANDS:

100 Kc/s	— 300 Kc/s
300 Kc/s	— 1 Mc/s
1 Mc/s	— 3 Mc/s
3 Mc/s	— 10 Mc/s
10 Mc/s	— 30 Mc/s

FREQUENCY ACCURACY: $\pm$ 1%

FREQUENCY STABILITY:
the drift is less than $\pm$ 0,5%
(for 1 hour, after 30 min. warming-up)

FREQUENCY CHECKING:
with a built-in crystal oscillator of 1 Mc/s

ACCURACY OF FREQUENCY CHECKING: $\pm$ 0,05%

FINE-TUNING OF FREQUENCY:
(for plotting selectivity curves)
the signal of the built-in 4 Mc/s oscillator can be mixed to the output signal of the generator. The 4 Mc/s signal can be tuned off by $\pm$ 25 kc/s

OUTPUT VOLTAGE :

adjustable in steps or continuously between 0,5 μV and 0,1 V

ACCURACY OF OUTPUT VOLTAGE : $\pm$ 3 dB

OUTPUT ATTENUATOR

(resistive) :
adjustable continuosly or in 5 decade steps

OUTPUT IMPEDANCE :

at steps of 1, 10, 100 and 1000 : 10 ohms
at the step of 10 000 : 50 ohms

RADIATION : 3 μV/m

INTERNAL MODULATION

FREQUENCY : 400 c/s

ACCURACY : $\pm$ 5%

MODULATION-DEPTH : 30%

ACCURACY OF MODULATION-DEPTH : $\pm$ 5%

EXTERNAL MODULATION

FREQUENCY RANGE : 30 c/s — 10 Kc/s

FREQUENCY RESPONSE $\pm$ 3 dB

MODULATION-DEPTH : max. 80%

VOLTAGE REQUIREMENT for a 30% modulation-depth : about 2 V

OTHER OUTPUT VOLTAGES
From the MOD. OSCILLATOR,

FREQUENCY : 400 c/s

FREQUENCY ACCURACY : $\pm$ 5%

OUTPUT VOLTAGE :
continuously adjustable between 0 and 5 V

From CRYSTAL OSCILLATOR,

FREQUENCY : 1 Mc/s

FREQUENCY ACCURACY : $\pm$ 0,05%

OUTPUT VOLTAGE : about 25 mV

POWER SUPPLY

Voltage : 110, 127, 220 V
Frequency : 50/60 c/s
Consumption : about 20 W

OTHER DATA

FINISH :

lacquered steel-sheet cabinet with 1 leather carrying handle

DIMENSIONS :

(without knobs and handle)
height 270 mm
width 355 mm
depth 190 mm

WEIGHT : about 14 kg

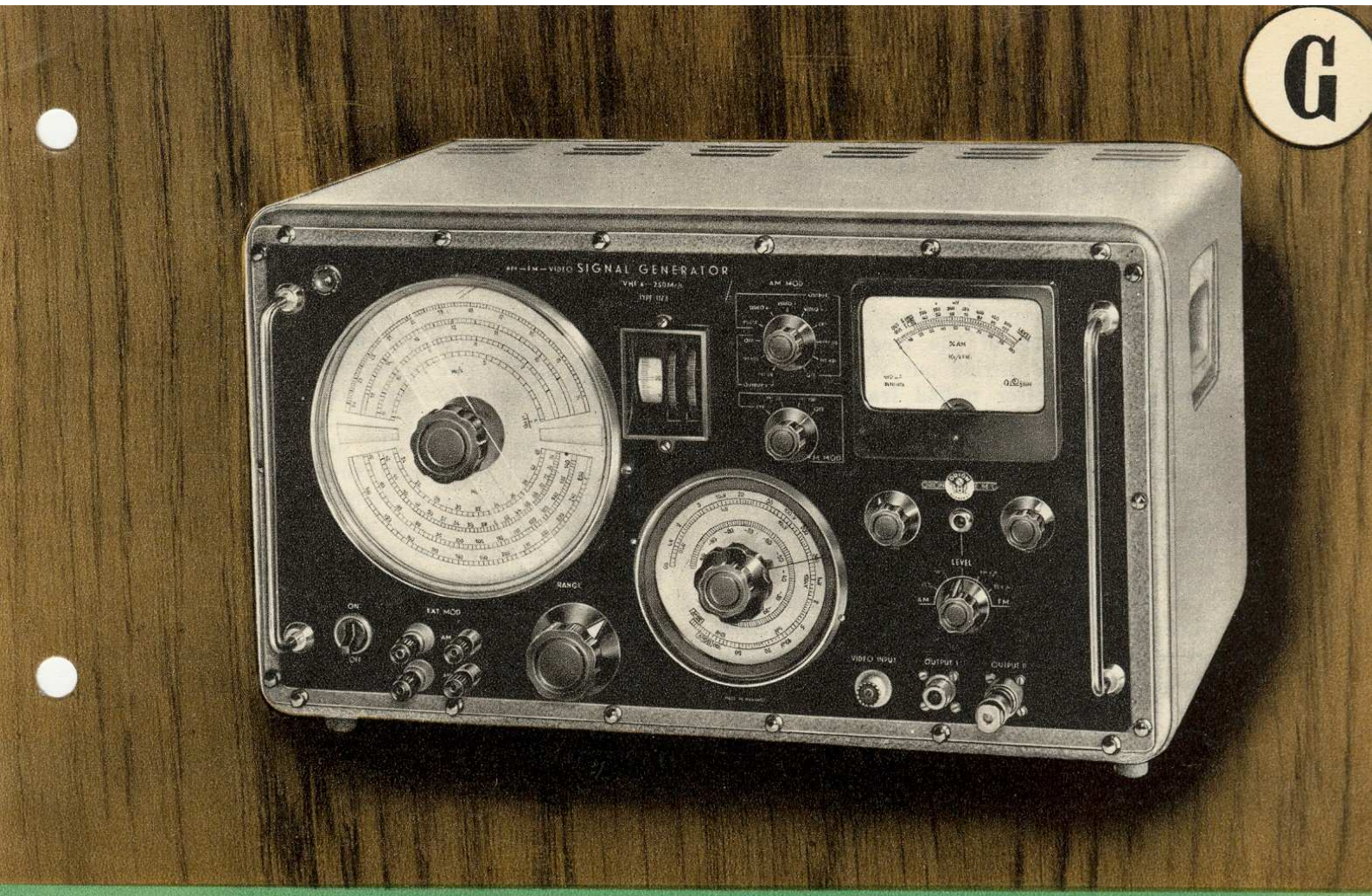
ACCESSORIES :

1 power cord
1 "Am" coaxial connector plug

Accessories supplied with the instrument but charged separately :

EMG 1169—3 Dummy aerial with coaxial cable, with „Am" type connector plug and built-in terminating resistor of 75 ohms.

As a result of continued efforts to improve the design, of instruments, we reserve the right to change this specification.



EMG–1173

VHF SIGNAL GENERATOR (AM/FM-VIDEO)

This measuring instrument is primarily designed for laboratory work, but owing to its versatility, it is practically indispensable in continuous manufacture, too. The instrument can be used for calibrating and measuring the HF- IF- and Demodulator stages of VHF- and TV receivers.

The Video-modulation facilities make testing of the video, synchronous cut-off and time-base stages also possible.

The particular advantage of the apparatus is that it is provided both for positive and negative modulations with resetting of the internal base level.

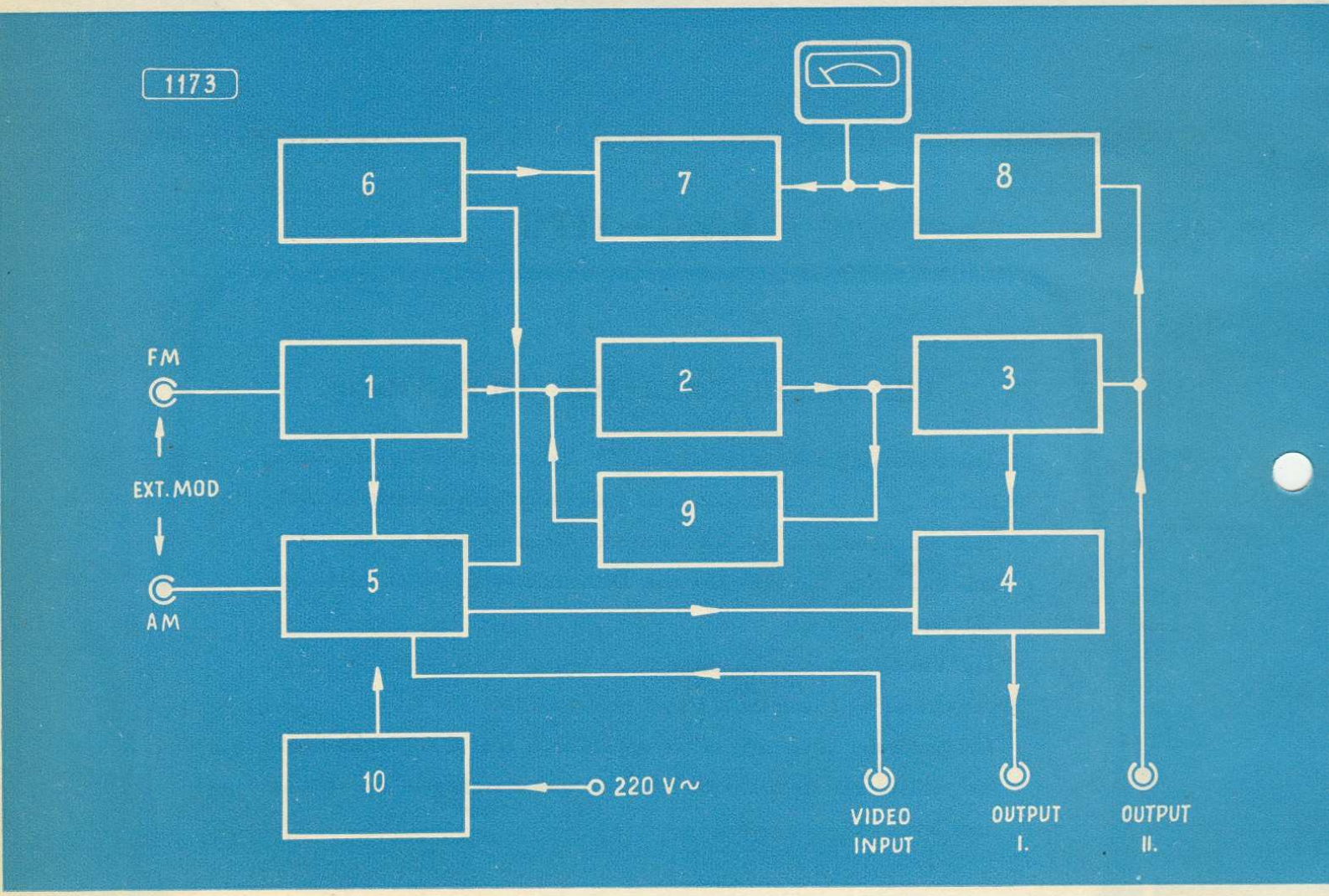
WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

FUNCTION. The functioning principle of the "VHF Signal Generator" is shown in the Block Schematic Diagram below.

The **oscillator** generating the high-frequency signal is working in balanced circuit with a long life double triode, and it is housed along with the frequency modulator in a common cast silumin box.

A **drum system wave selector** provides for the changing of the frequency ranges, while continuous tuning of the frequency of the several ranges is carried out with the aid of a **variable capacitor milled from one block.** The anode voltage of the oscillator tube is adjusted simultaneously with the wave change. The contact switching of the anode voltage operates mechanically so that at connection and later at disconnection, it disconnects before the high-frequency contacts do, so that the disturbing effects which may result from the operation of the wave selector are eliminated. The six contacts of the oscillator get separately through a five-part low-pass LC filter into the cast box as to avoid harmful radiation. Thus the high-frequency signal produced in the oscillator can only get out from the cast box through the divider. All these particularities of the design contribute largely to the stability of the instrument. The high-frequency signal leaves the oscillator through a **piston-system attenuator** and can be utilized both directly and through the modulator unit.

The signal of the oscillator gets from the mobile output coupling loop of the piston through a HF cable to the "T" divider mounted on the modulator cast box. The task of the latter is to divide the HF signal on the one hand to the input of the modulator and on the other to the direct (high-level) output. The circuit has been designed in a manner so as to allow that the 50 ohms cable of the piston be always terminated with the characteristic impedance. External termination has to be provided for by means of the HF cable supplied as an accessory of the instrument since the 50 ohms terminating resistor is already built into it. When using other HF



1. FM amplifier
2. Oscillator and FM modulator
3. Attenuator
4. Modulator
5. Amplifier
6. AF oscillator
7. AF V. T. voltmeter
8. H. F. level measuring stage
9. H. F. level control stage
10. Power supply unit

cables supplied with the measuring instrument the input resistance of the external apparatus under test should be 50 ohms. In case of incorrect (i. e. not 50 ohms) termination or if the output is not terminated, reflection will arise.
The **modulator stage** and the stage serving for the amplification of the audio frequency video and pulse signals are also located in a separate cast silumin box and the circuits used for restoring the base level are also located here.
A silicon diode in the "T" divider is used for level measurements and this involves many advantages. The rectified signal gets through a low-pass filter to the indicating instrument. The voltage values can partly directly shown on the calibrated scale of the meter, on the other hand the appropriate position of the voltage dividing scale of the piston has also to be taken into consideration.
The purpose of the **automatic level control equipment** built into the measuring apparatus is to keep the HF voltage getting to the piston throat at a constant value. This is done by means of the measuring loop, built into the piston throat in a manner that the alternate voltage produced therein gets, after rectification with a germanium diode, through a low-pass filter out from the cast box and onto the control grid of the amplifier tube performing the level control. It is fed from the anode of the same tube onto the differential amplifier. Controlling another tube with the potential difference in relation to the reference signal received from the stabilized anode voltage it automatically controls the anode current of the oscillator and thereby the HF output level.
The level control equipment is adjusted in such manner that it will also control in the other direction the harmful amplitude modulation, occurring together with the frequency modulation and thereby considerably reduces its effect.
Frequency modulation is made through a separate amplifier with two stages and a very strong negative feedback.
Frequency modulation takes place in the oscillator by changing the angle of the current flow. Various possibilities of adjustment are provided to ensure the value of the frequency deviation.
The frequency independent value of the deviation, is provided for by the potentiometer rotating together with the variable tuning capacitor in such manner that it controls, in the several ranges, the audio frequency modulating voltage getting to the input of the FM amplifier in accordance with the FM coverage. The magnitude of the sweep is adjusted at the manufacturing works with the potentiometers getting connected together with the change of the frequency ranges.
The depth of the sweep and of the amplitude modulation is shown by the aid of an **audio-frequency V. T. voltmeter** by the indicating meter. The values can be read off directly from the calibrated scale.
The supply voltages getting into the modulator cast box and the modulating voltages get in through a low-pass filter circuit and they prevent harmful high-frequency in getting out through these lines.
The automatic level control equipment, the audio-frequency oscillator producing the internal modulation signal are located together with the power supply unit in a separate screened part along the rear wall of the apparatus. A Wien—bridge system **audio-frequency oscillator** of very low distortion is used for the internal modulations.
The **power supply unit** consists of 3 principal parts. + 300 V and — 150 V voltages are supplied by separate rectifier and filter units and a separate rectifier unit with a selenium rectifier supplies direct voltage for heating purposes.
The measuring accuracy and stability of the equipment is considerably ensured by the electronic stabilization of the power supply unit and by the rectified and stabilized heating voltages of the oscillator tube and of the first amplifier tube of the automatic level control equipment.

Tubes used in this instrument :

ECC 83—3	EL 84—2	E 88 CC—1
E 180 F—1	EF 80—1	ECC 83—2
PL 81—1	EZ 80—3	VR 105—1
		VR 150—1

(The number after the Type-Number indicates the number of tubes in use.)

SPECIFICATION

FREQUENCY

FREQUENCY RANGE : 4—250 Mc/s (in 8 sub-ranges)

SUB-RANGES :

4 — 7 Mc/s	23,5— 42 Mc/s
6,5—11 Mc/s	41,5— 77 Mc/s
9,5—15 Mc/s	75 —142 Mc/s
14 —24 Mc/s	140 —250 Mc/s

FREQUENCY ACCURACY : ± 1%

RF distortion : max. 10%

OUTPUT VOLTAGES

OUTPUT I. : 0,5 μV—80 mV continuously adjustable

OUTPUT II. : 0,5 μV—400 mV

FREQUENCY RESPONSE : ± 1,5 db

ACCURACY OF DIVIDING : ± 1 dB ± 1 μV

OUTPUT IMPEDANCE : 50 Ohms

MODULATION

INTERNAL AM (OUTPUT I)

MODULATING FREQUENCY :
400 c/s ± 5% and 50 c/s (mains)

MODULATION DEPTH : 0—80%
with two measuring ranges
0—25% and 0—100%
(can be read off on built-in meter)

FM arising with 30% AM :
about 5×10^{-5} with 400 mV output voltage.
Dropping with output voltage.

INTERNAL AM (OUTPUT II)

MODULATING FREQUENCY :
400 c/s ± 5% and 50 c/s (mains)

MODULATION DEPTH : 0—80%
FM arising with 30% AM :
about $\triangle f = 150$ Kc/s

EXTERNAL AM (OUTPUT I)

MODULATING FREQUENCY RANGE :
30 c/s—100 Kc/s

FREQUENCY RESPONSE : ± 5 dB

MODULATION DEPTH : 0—80%
with two measuring ranges
0—25% and 0—100%
(can be read on built-in of meter)

INPUT VOLTAGE REQUIRED :
about 0,1 V/mod%

INPUT IMPEDANCE : 2 Kohms || 2 nF

INTERNAL FM

MODULATING FREQUENCY :
400 c/s ± 5% and 50 c/s (mains)

DEVIATION :
continuously variable between 0—100 Kc/s

MEASUREMENT OF DEVIATION :
with built-in meter in two measuring ranges
0— 25 Kc/s
0—100 Kc/s

HARMONIC DISTORTION
with $\triangle f = 75$ Kc/s : < 5%
AM with $\triangle f = 75$ Kc/s : < 5%
Residual FM :
about 200 c/s (up to 150 Mc/s)

EXTERNAL FM

MODULATING FREQUENCY RANGE :
30 c/s—15 Kc/s

DEVIATION :
continuously variable between 0—100 Kc/s

MEASUREMENT OF DEVIATION :
with built-in meter in two measuring ranges
0—25 Kc/s
0—100 Kc/s

FREQUENCY RESPONSE : ± 1,5 dB

INPUT VOLTAGE : about 0,1 V/kc/s

INPUT IMPEDANCE : 2 kohm || 2 nF

VIDEO MODULATION
(applied only above 20 Mc/s)

POSSIBILITIES OF MODULATION :
pulse mod.
video positive mod.
video negative mod.
video = mod

RESETTING OF BASIC LEVEL :
with video + ve mod. : internal
with video — ve mod. : internal
with video = mod. : external

MODULATING FREQUENCY RANGE
with VIDEO + ve. and VIDEO — ve mod.:
30 c/s—6,5 Mc/s
with VIDEO = and pulse mod.:
0—6,5 Mc/s

AMPLITUDE FREQUENCY CHARACT. :
± 3 dB

MODULATION VOLTAGE REQUIRED :
about 0,05 V/%

PULSE MODULATION :
VIDEO + ve mod.
VIDEO — ve mod.
VIDEO = mod.
} about 0,05 V/%

POWER SUPPLY

Voltage :	110, 127, 220 V
Frequency :	50 c/s
Consumption :	about 140 W

OTHER DATA

FINISH :

lacquered steel-sheet cabinet with 2 metal carrying handles

DIMENSIONS

(without knobs and handles) :

height	340 mm
width	572 mm
depth	317 mm

WEIGHT : about 35 kg

ACCESSORIES :

3 different coaxial screened cables with connector plug "N"
1 coaxial connector plug, "N" with built-in terminating resistor,
1 coaxial connector plug "Am"
1 power cord

As a result of continued efforts to improve the design of instruments, we reserve the right to change this specification.

EMG–1176

MICROWAVE SIGNAL GENERATOR

(UHF—S-band)

An indispensable instrument in the development and maintenance of the microwave equipments for multi-channel telephony, TV relay stations and radar technique ; the instrument operates in one of the most widely used bands, in the 10 cm band.

It is used primarily for laboratory measurements, e. g. for measuring the sensitivity, signal to noise ratio and mixing efficiency of receivers, further with testing the standing wave ratio and impedance of cables and feeder line elements. Owing to its wide frequency range and to the high precision facilities for attenuation and various modulations, it has proved very satisfactory in all fields of microwave measuring technique.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

EMG–1176

FUNCTION: The functioning principle of the "Microwave Signal Generator" is shown in the Block Schematic Diagram below.

The oscillator operates with an external cavity reflex **Klystron.** An "S" plunger, having no contact and being therefore friction- and wear free, is moved for tuning the coaxial cavity. The "S" plunger has many merits in comparison with short-circuiting metallic contact plungers.

a) It does not wear the wall of the cavity resonator so that the geometrical dimensions and the electroplated layers remain unchanged, which is very important for frequency stability and resistance to corrosion.

b) During tuning the contact resistance between cavity and plug does not change.

c) There cannot occur mechanical hysteresis causing inaccuracy in return with short-circuiting metallic contact plungers.

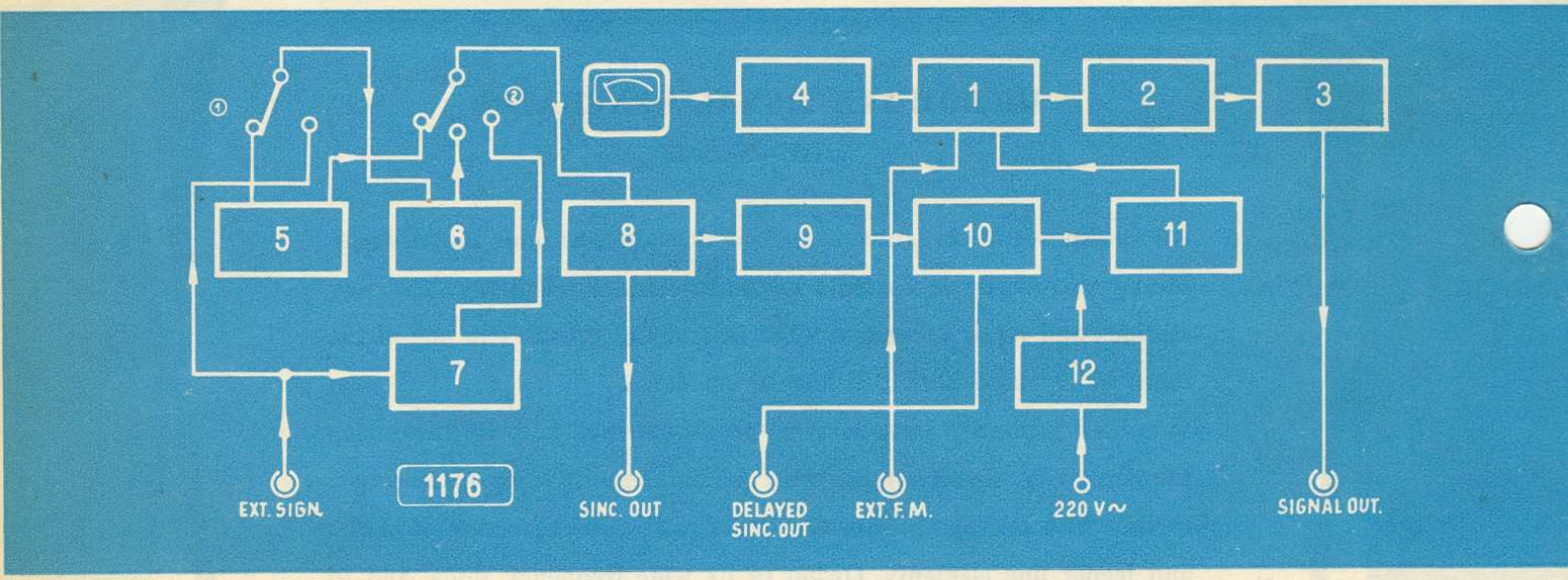
The theoretic length of the **cavity resonator** is $^3/_4$ wave length. The cavity and all other parts important from a microwave viewpoint are combination electroplated (palladium and silver) to reduce losses.

The great transmission of the vernier drive results in an easily read, frequency scale of large dimensions; interpolation between its divisions is possible by the separate scale with hundred graduations. Play is carefully eliminated in the design of vernier drive.

Repeller voltages necessary for covering the relatively wide frequency range, including also changing over of the Klystron mode, are supplied by the **automatic repeller equipment.**

The oscillator is separated from the external load by two attenuators of totally 10 dB. The output impedance is 50 ohms as usual in the "S" frequency range of microwave technique. The mobile output coupling of the microwave power and of the built-in power meter end in two **cut-off attenuators** of identical design, operating with a symmetrical located TE_{11} waveform so that the positively coupled attenuator scale is linear in dB.

The microwave **power meter** compensated for changes of temperature is with regard to its electrical design, a thermistor measuring bridge. The pointer of the attenuator scale is in mechanical connection with the output coupling of the power meter.



1. Klystron oscillator
2. Cut-off attenuator
3. Separating attenuator
4. Power meter
5. Repetitions frequency multivibrator
6. Squaring stage
7. Phase inverter stage
8. Differentiating and separating stage
9. Pulse delaying multivibrator
10. Differentiating and separating stage
11. Mod. stage and pulse duration multivibrator
12. Power supply unit

Four different possibilities of **modulation** are provided for the wide application of the signal generator. These are :

1. internal pulse modulation with several modes of synchronization
2. internal square modulation
3. external pulse modulation
4. frequency modulation

The modulating square and pulse voltages are connected with the accelerating electrode of the reflex Klystron, the frequency modulating voltages with the electrode of the repeller.

1. **Internal pulse modulation.** The repetition frequency of the microwave pulse is produced by a **multivibrator.** The signal produced passes through a differentiating circuit into the **delaying multivibrator** which is cathode-coupled and does not operate without control. The pulses with a length determined by the duration of delay, start the **modulating multivibrator** producing the high-power pulses necessary for the modulation of the Klystron. The modulating multivibrator can be synchronized with three different external signals : with positive pulses directly, with negative pulses through the phase inverter stage and finally with sinusoidal signals controlling the modulating multivibrator through the squaring circuit. The squaring circuit is essentially a cathode-coupled multivibrator which does not oscillate without control.

The microwave pulse can be delayed in relation to the synchronizing pulse, both in case of internal and of external synchronization, within a wide range, delay must, however not exceed 75% of the repetition time of the pulse.

The **output synchronizing pulses** of the instrument are of two kinds :

a) delayed pulses, simultaneously with the microwave pulse,

b) undelayed pulses when starting the frequency multivibrator or the squaring multivibrator.

2. **Internal square modulation.** The modulating multivibrator is controlled through the squaring circuit by the signal of the multivibrator producing the microwave pulse repetition frequency.

3. **External pulse modulation.** The external positive or negative pulse is fed directly into the modulating multivibrator operating then as an independent amplifier stage. There is a possibility for so called inverse modulation with which the microwave oscillator only oscillates in the pauses of the external positive pulse.

4. **Frequency modulation.** This can be either internal or external modulation. Frequency modulation is independent of all other modulations and can therefore be applied simultaneously with any of them.

Tubes used in this instrument :

6 SN 7—7	6 AG 7—1	6 AC 7—3
6 L 6 G—5	5 Z 4—3	5 U 4 G—2
VR 150—1	VR 105—1	K 11—1

(The figure, after the Type-Number indicates the number of tubes in use.)

SPECIFICATION

OSCILLATOR

FREQUENCY RANGE : 1800 — 4000 Mc/s

ACCURACY OF FREQUENCY CALIBRATION : ± 1%

OUTPUT POWER : min. 1 mW

ACCURACY OF POWER METER : ± 2 dB (at —7 dBm)

ATTENUATOR : continuously adjustable between 0 and — 127 dBm

ATTENUATOR ACCURACY : ± 1 dB

OUTPUT IMPEDANCE : 50 ohms (nominal) VSWR below 2

I. INTERNAL PULSE MODULATION

a) **with internal synchronization :**

Pulse repetition frequency :
200 c/s — 6,4 kc/s

Pulse duration (length) :
adjustable between 1 — 10 μsec

Pulse rise and fall time : max. 0,5 μsec
(between the 10% and 90% points)

b) **with external synchronization :**

1. **With positive or negative pulse**

voltage of synchronizing signal :
min. 30 V/peak

pulse repetition frequency :
100 c/s — 10 kc/s

2. **With sinusoidal signal**

voltage of synchronizing signal :
min. 20 V_{rms}

frequency of synchronizing signal :
150 c/s — 10 kc/s

PULSE DELAY

with internal and external synchronization:
adjustable between 3 and 300 μsec

Output synchronizing signals :
1. delayed
2. undelayed

Voltage :
50 — 100 V (peak)

Rise time :
0,5 μsec

II. INTERNAL SQUARE MODULATION

Pulse repetition frequency :
adjustable between 200 c/s and 6,4 kc/s

Rise time : max. 4 μsec

III. EXTERNAL PULSE MODULATION

Voltage :
30 — 100 V (peak)

Polarity :
positive or negative

IV. FREQUENCY MODULATION

1. **Internal modulation**

Modulating frequency :
50 c/s (mains)

Frequency sweep :
adjustable from 0 to approx, 5 Mc/s

2. **External modulation**

Modulating frequency :
50 c/s — 15 kc/s

Voltage necessary for 1 Mc/s deviation :
approx. 0,5 V_{rms}

POWER SUPPLY

Voltage :	110, 127, 220 V
Frequency :	50/60 c/s
Consumption :	about 350 VA

OTHER DATA

FINISH :
lacquered steel-sheet cabinet with 2 built-in handles

DIMENSIONS
(without knobs) :

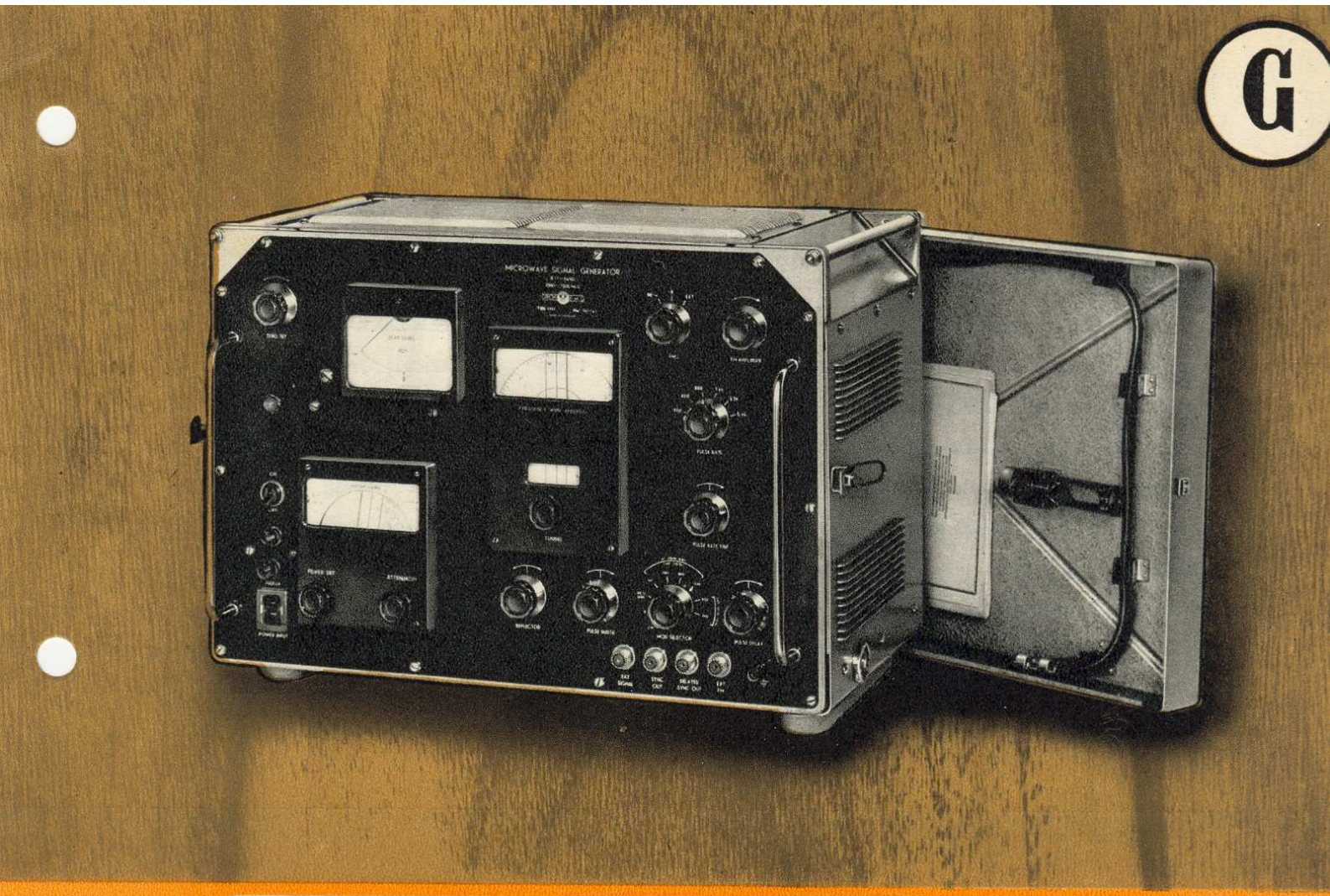
height	430 mm
width	600 mm
depth	385 mm

WEIGHT : about 47 kg

ACCESSORIES :

1 power cord
1 coaxial screened cable with connector plugs "N"
4 "AM" coaxial connector plugs
1 closing lid for instrument case

As a result of continued efforts to improve the design of instrument, we reserve the right to change this specification.



EMG–1177

MICROWAVE SIGNAL GENERATOR

(SHF—X—1-band)

The whole frequency range of microwave telecommunication technique is divided into several bands. This measuring equipment designed as standard current source for various microwave measurements operates in the 6 cm band.

It can be used primarily for measuring the sensitivity, for band-width and noise factor of microwave receivers; for measurements of Q-factor and resonance curves of microwave cavity resonators it can also be used this instrument.

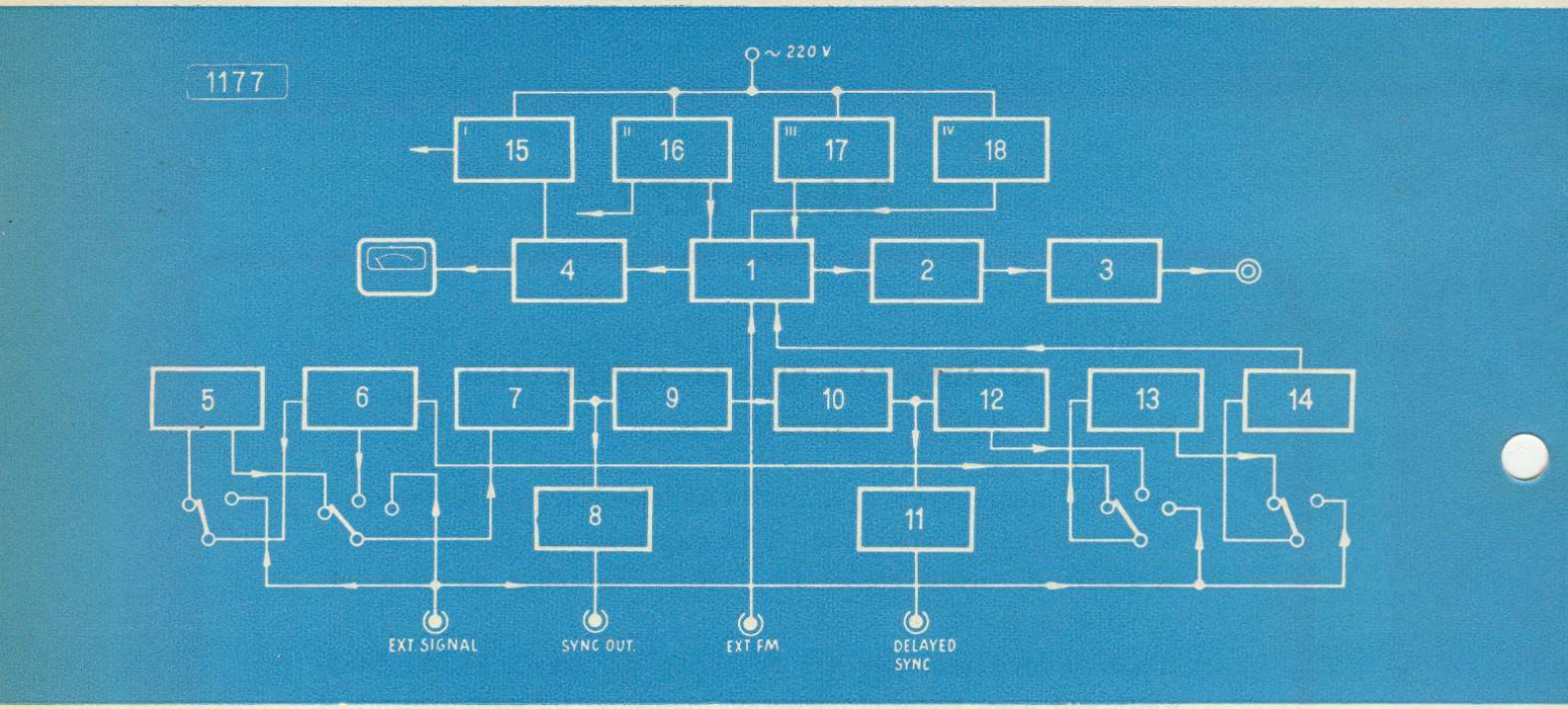
The main microwave measurements for which this signal generator is eminently suitable are: investigation of transmission lines and coupling elements, impedance measurements, S. W. R. measurements, measurement of attenuation of cables and cable connecting elements.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

EMG–1177

FUNCTION: The functioning principle of the "Microwave Signal Generator" is shown in the Block Schematic Diagram below.

The central part of the measuring instrument is the microwave oscillator, operating with a **reflex klystron tube :** the oscillator produces with the external cavity resonator of coaxial design a TEM wave form. The theoretical length of the **cavity resonator** is $^3/_4$ wavelength ; its length is varied for tuning, this is done by moving the so-called "S" plunger. Tuning without metallic contact represents unique advantages. The "S" plunger can be moved very easily between the walls of the cavity resonator so as not to cause friction and wear. It does not wear off the internal walls of high accuracy provided with special electroplating of the cavity resonator so that its main geometrical dimensions and the electroplating remain invaried which guarantees very high frequency stability. Its further advantages are that during tuning, contact resistance between the walls of the cavity resonator and the "S" plunger does not change, so that the accuracy of return is invaried. The powdered iron core disk located behind the "S" plunger eliminates the



1. Klystron oscillator
2. Cut-off attenuator
3. Output coupling unit
4. Power meter
5. Repetitions frequency multivibrator
6. Squaring and phase inverter stage
7. Differentiating circuit and series cutter diode
8. Separating stage
9. Pulse delaying multivibrator
10. Differentiating circuit and series cutter diode
11. Separating stage
12. Pulse duration multivibrator
13. Phase inverter stage
14. Modulator stage
15. Power supply unit I
16. Power supply unit II
17. Power supply unit III
18. Power supply unit IV

cavity resonances behind the plug and provides for terminating with constant impedance. The slots on the mantle of the "S" plunger are designed for eliminating the higher waveforms produced in the cavity resonator.

Sinultaneously with tuning the cavity resonator, repeller voltage must also be changed. The shaft of the voltage adjusting potentiometer is mechanically connected to the shaft, moving the "S" plunger so that the axial displacement of the latter is proportional with the angular displacement of the potentiometer.

The repeller mode is switched over with a sensitive micro-switch. This is necessary since the full very broad frequency band cannot be covered with a single repeller mode, so that at about 5000 Mc/s another repeller mode has to be switched on.

The power generated by the Klystron oscillator passes through two different attenuators following each other to the consumer representing the external load. Connected directly to the external cavity of the Klystron tube is a **cut-off attenuator** operating in TE_{11} waveform ; this is the standard voltage divider of the measuring instrument, its scale being linear and calibrated in dB. A loop made of a special resistor material is used for the output decoupling of the H. F. energy, this provides at the same time for the impedance of the output of the instrument and for its low V. S. W. R. too. The power of the Klystron oscillator is measured by the built-in **thermistor measuring bridge,** With the aid of another output decoupling loop, symmetrical with the output decoupling loop connected to the cut-off attenuator, power of a magnitude identical with the actual output power, is forwarded from the Klystron oscillator to the measuring bridge, for the purposes of measurement. The pointer of the output level in connection with the output decoupling loop of the power meter, so that the consequence of the adjustment is ensured. Measurement is made in one of the bridge-arm with the aid of a bead thermistor and the power can be read on the scale of the indicating instrument located in the diagonal of the measuring bridge. The measuring bridge is heat compensated against the influence of external temperature by means of two disk thermistors.

The wide application of the microwave oscillator is ensured by a **selection of modulation techniques.** The major part of the modulation signals is produced by the pulse generator incorporated with the instrument, external modulation signals can, however, also be introduced. In accordance with its versatile tasks, the **pulse generator** consists of several self-contained parts. The **repetition-frequency multivibrator** has an anode-coupled circuit and operates as a monostable multivibrator. The repetition frequency can be switched over either for starting the delaying multivibrator or for feeding directly into the **squaring or phase inverter stage** which is for its electrical design a cathode-coupled multivibrator with double triode, one of its halves operates as phase inverter.

The **squaring stage** squares, according to the test, either the signal of the frequency multivibrator or the external sinusoidal signal.

The signal of the frequency multivibrator starts the delaying multivibrator after passing through a **differentiating circuit** and a series cutter diode. The task of the differentiating circuit is to provide an appropriately high slope negative signal for the delaying multivibrator. After the differentiating circuit, but still before the delaying multivibrator, the undelayed synchronous signal of positive polarity can be taken off through a separating stage.

The **pulse delaying multivibrator** is generated through the differentiating circuit either by the signal of the frequency multivibrator or by the squared external signal. The signal of the delaying multivibrator starts through a further differentiating circuit and a series cutter diode, the following pulse duration multivibrator. Its task here too is to provide a negative signal with high slope.

After the differentiating circuit, but still before the pulse duration multivibrator the delayed synchronous signal of positive polarity gets through a special **separating stage** onto the appropriate external connector.

The **pulse duration multivibrator** is in its electrical lay-out an anode-coupled monostable multivibrator.

The **phase inverter stage** receives, according to the test, the squared external or internal pulse signal ot the external modulating signal, and inverts their polarity.

The **modulator stage** is connected to the grid of the Klystron tube and supplies to the latter the voltage corresponding to the operation mode desired according to its operation.

The **modulation modes** can be divided into four groups :

1. Internal pulse modulation
2. Internal square modulation
3. External pulse modulation
4. FM modulation (internal or external)

Synchronization is possible in three ways :

1. with positive pulses directly
2. with negative pulses through the phase inverter stage
3. with sinusoidal signals through the squaring circuit.

The **synchronizing pulses** are accessible in two forms also from the outside through the corresponding coaxial connectors.

1. **Undelayed** synchronous signal appearing simultaneously with the signal form of the frequency multivibrator or of the squaring multivibrator.
2. **Delayed** synchronous signal appearing simultaneously with the microwave pulse.

The various electronic stages of the Microwave Signal Generator are provided with current and voltage by four **power supply units** of different design in accordance with their destination, i. e. with the voltages they have to generate. Their common characteristic is that all of them supply stabilized D. C. voltage. Their electronic regulation operates on the principle of the **series regulation** and each of the power supply units contains a regulating tube, a control tube and a stabilizer tube corresponding to the desired power. Power supply unit I. furnishes voltage for the various stages of the pulse generator and operates with a selenium rectifier.

Power supply unit II. provides the modulator stage and operates with a rectifier tube.

Power supply unit III. generates the cavity voltage for the Klystron tube with the aid of two rectifier tubes.

Power supply unit IV. generates the voltage necessary for the repeller of the Klystron and operates with a rectifier tube.

After having described the basic principle of design of the measuring instrument, a few details of construction shall be mentioned, which are very important for the operation and stability of the instrument. The precision-mechanical elements for the tuning are made with a very high mechanical accuracy, so that the return accuracy of frequency adjustment is entirely ensured. Power supply filters have been used for protection against radiation. The internal lay-out of the instrument cabinet also guarantees maximum freedom from radiation. Powdered iron core chokes of special high attenuation were used for the very careful microwave filtering of the various transmission lines supplied with the klystron and repeller.

The connectors comply with the international prescriptions both for microwave and for various other signals in respect of dimensions and of screw threads.

Tubes used in this instrument:

ECC 82—1	ECC 85—7	EL 84—3
EF 80—2	PL 81—5	PY 83—3
EZ 80—2	VR 75—1	VR 105—1
VR 150—1	85 A 2—1	5721/B—1

(The figure after the Type-Number indicates the number of tubes in use.)

EMG–1177

SPECIFICATION

OSCILLATOR

FREQUENCY RANGE: 3800 — 7500 Mc/s

ACCURACY OF FREQUENCY CALIBRATION: ± 1%

FREQUENCY STABILITY (with ± 10% mains voltage fluctuation): better than 0,02%

OUTPUT POWER: min. 1 mV

ACCURACY OF POWER METER: ± 2 dB

ATTENUATOR: continuously adjustable between 0 and —127 dBm

ATTENUATOR ACCURACY: better than ± 1 dB (between —7 and —127 dB)

OUTPUT IMPEDANCE: 50 ohms (nominal) VSWR below 2,5

MODULATION MODES:

internal and external pulse
internal square
internal and external frequency modulation

PULSE AND SQUARE REPETITION FREQUENCY: adjustable between 100 c/s and 8 kc/s

PULSE DURATION (length): adjustable between 1 to 10 μsec

RISE AND FALL TIME (between 10% and 90% points): max. 0,5 μsec

PULSE DELAY: 4 to 300 μsec

SYNCHRONIZATION: internal and external (with positive or negative sinusoidal signal)

VOLTAGE OF SYNCHRONIZING SIGNAL: 25 — 100 V_{rms}

OUTPUT SYNCHRONIZING SIGNALS:
1. delayed
2. undelayed

INTERNAL FREQUENCY MODULATION: 50 c/s (mains)

FREQUENCY DEVIATION: adjustable between 0 to approx. 5 Mc/s

EXTERNAL FREQUENCY MODULATION: the repeller of the Klystron can be modulated through a capacitor

POWER SUPPLY

Voltage:	110, 127, 220 V
Frequency:	50/60 c/s
Consumption:	about 300 VA

OTHER DATA

FINISH: lacquered steel-sheet cabinet with 2 built-in handles

DIMENSIONS (without knobs):

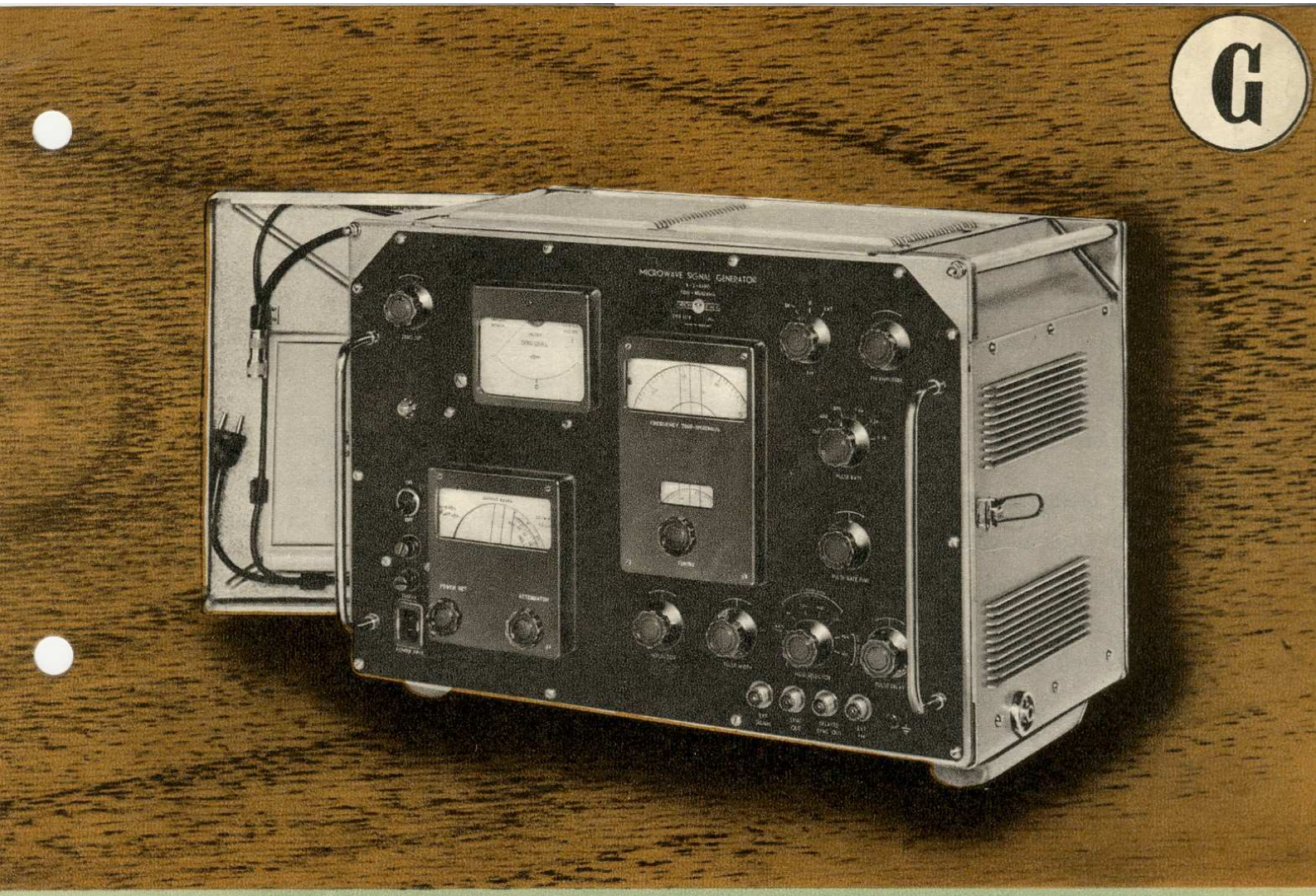
height	430 mm
width	600 mm
depth	385 mm

WEIGHT: about 47 kg

ACCESSORIES.

1 power cord
1 coaxial screened cable with connector plugs „N"
4 coaxial connectors plug "AM"
1 closing lid for instrument case

As a result of continued efforts to improve the design of instruments, we reserve the right to change this specification.



EMG–1178

MICROWAVE SIGNAL GENERATOR

(SHF—X—2 band)

This laboratory measuring instrument operating in the 3-cm microwave band is designed for determining the sensitivity, band-width and noise factor of microwave receivers, but is equally suitable for plotting the Q-factor and resonance characteristics of microwave cavities.

It can be used to advantage as a modulated or unmodulated signal source for measuring the standing-wave ratios or impedances of microwave equipments or self-contained units.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

EMG—1178

FUNCTION. The functioning principle of the "Microwave Signal Generator" is identical with that of the type EMG 1177 so that detailed information will be found in the schematic diagram of the latter type.

The instrument consists of several main sections as self-contained units.

The **oscillator** operates with a reflex Klystron with external cavity connected to the coaxial cavity. Tuning of the cavity resonator is carried out by a so-called "S" plunger eliminating any friction and wear. The repeller voltage is adjusted automatically in each frequency band to the required level. A built-in fan cools the oscillator tube during operation. The frequency of the oscillator can be **modulated** by several different methods. Most of the modulating signals are generated by the built-in **pulse generator ;** external modulation, however, is also possible.

The four modes of modulation are the following:

iuternal pulse, internal spuare-wave
external pulse and frequency modulation.

Calibrated voltages coming from the instrument are divided by a **cut-off attenuator** whose adjustement scale is linear in dB. Output coupling of the H. F. power is carried out by means of a loop made from a special resistance material ensuring at the same time the impedance of the output of the instrument and its low standing-wave ratio.

The incorporated **power meter** operating with thermistor bridges is compensated for changes in temperature and serves to check the output of the signal generator.

The **pulse generator** consists of several self-contained units : the frequency multivibrator generates the pulse repetition frequency which is either used for triggering the delay-multivibrator or is fed directly to the square-wave or phase inverter stage.

Synchronization is possible in three ways : directly with positive pulses, with negative pulses through the phase inverter stage or with sinusoidal signals through the square-wave circuit. The delayed or undelayed synchronization signals produced by the instrument are also accessible from outside.

The voltage and power supply of the signal generator is performed by four separate power supply units independent from each other. The instrument is built with precision-mechanical craftmanship, since the frequency band of instrument demands the highest degree of mechanical precision.

Mention should be made of the **radiation-free** design of the instrument which incorporates, in addition, input filter circuits as well, to ensure a maximum freedom from radiations. Dimensions and finish of the microwave connectors comply with international standard specifications.

Tubes used in this instrument :

ECC 82—1	ECC 85—7	EL 84—3
EF 80—2	PL 81—5	PY 83—3
EZ 80—2	VR 75—1	VR 105—1
VR 150—1	85 A—2	5721/B—1

(The figure after the Type-Number indicates the number of tubes in use.)

SPECIFICATION

OSCILLATOR

FREQUENCY RANGE :
7000 — 10 500 Mc/s

ACCURACY OF FREQUENCY CALIBRATION : ± 1%

FREQUENCY STABILITY
(with ± 10% mains voltage fluctuation) :
better than 0,02%

OUTPUT POWER : min. 1 mW

ACCURACY OF OUTPUT POWER-METER : ± 2 dB

ATTENUATOR :
between 0 — 127 dB
continuously adjustable

ATTENUATOR ACCURACY :
better than ± 1 dB
(between —7 and —127 dB)

OUTPUT IMPEDANCE : 50 ohm (nominal),
VSWR lower than 2,5

MODULATION :

- internal and external pulse
  internal square-wave
  internal and external frequency modulation

PULSE AND SQUARE WAVE

REPETITION FREQUENCY :
adjustable between 100 c/s — 8 kc/s

PULSE WIDTH :
adjustable between 1—10 μsec

RISE AND FALL TIME : max. 0,5 μsec
(between 10% and 90% points)

PULSE DELAY :
4 — 300 μsec

SYNCHRONIZATION :
internal and external
(with positive or negative sinusoidal signals)

VOLTAGE OF SYNCHRONIZING SIGNAL :
25 — 100 V_{rms}

OUTPUT SYNCHRONIZING SIGNALS :
1. delayed
2. undelayed

INTERNAL FREQUENCY MODULATION :
50 c/s
(mains)

FREQUENCY DEVIATION :
from 0 to about 5 Mc/s
continuously adjustable

EXTERNAL FREQUENCY MODULATION:
reflector of the Klystron can be modulated through a capacitor

POWER SUPPLY

Voltage :	110, 127, 220 V
Frequency :	50/60 c/s
Consumption :	about 300 VA

OTHER DATA

FINISH :

lacquered steel-sheet case with 2 built-in handles

DIMENSIONS :

(without knobs) :

height	430 mm
width	600 mm
depth	385 mm

WEIGHT : about 47 kg

ACCESSORIES :

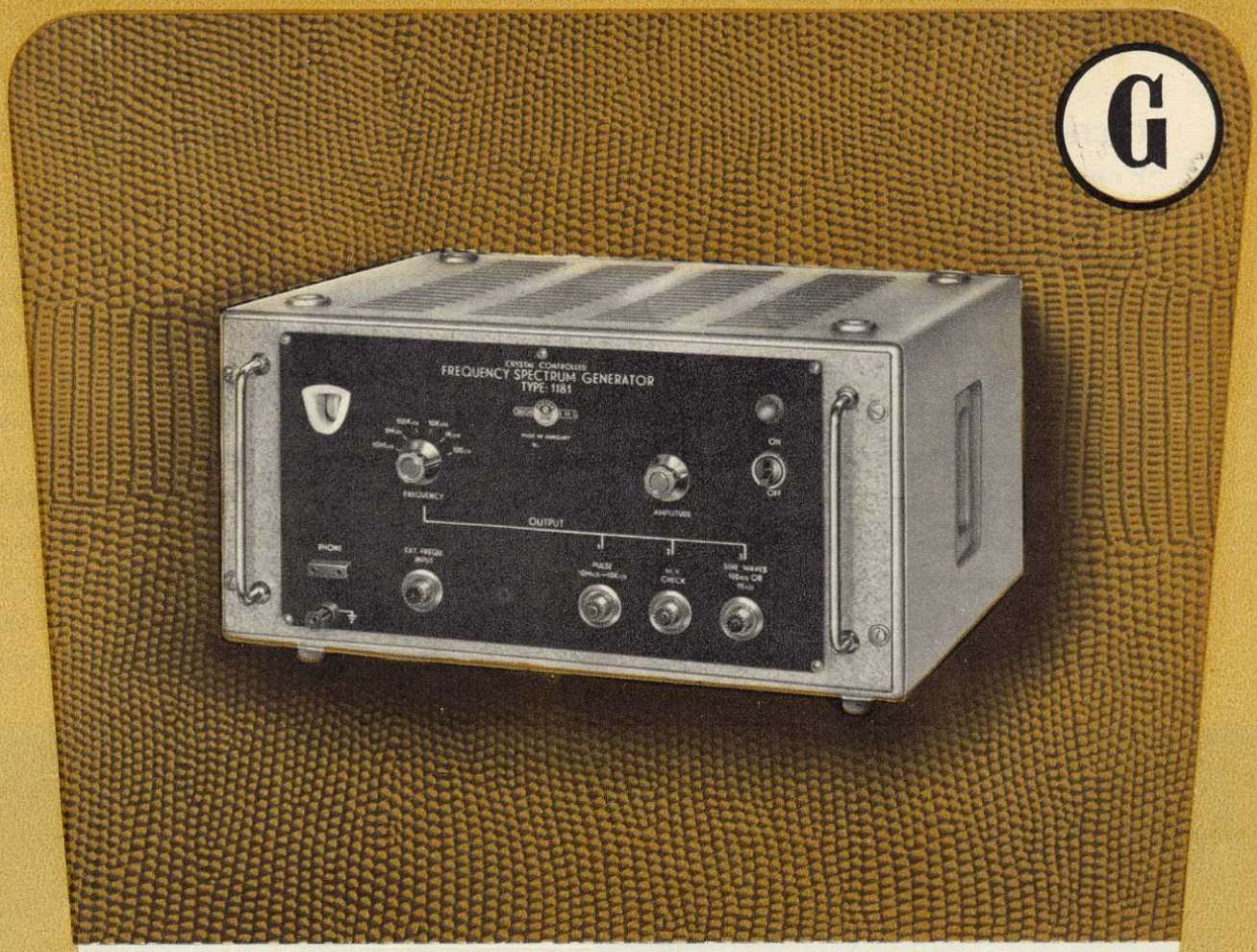
1 power cord

1 coaxial screened cable with connector plug "N"

4 coaxial connector plug "AM"

1 closing lid for instrument case

As a result of continued efforts to improve the design of instruments, we reserve the right to change this specification.



EMG–1181

CRYSTAL–CONTROLLED FREQUENCY SPECTRUM GENERATOR

A generator producing high-accuracy frequencies of **six orders of magnitude** from audio-frequencies to the radio-frequency range. The instrument can be used to equal advantage as an active generator and for passive frequency comparisons as well. As an active generator it produces sinusoidal signals in three frequency bands, needle pulses in three frequency bands and signals of wide frequency-spectrum in four ranges, with a high accuracy corresponding to the incorporated quartz crystal. The instrument is particularly suitable for calibrating and measuring the time-stability of wireless receivers, transmitters, signal generators and wavemeters ; it can be used both in the laboratory research work and in the workshop, wherever a high accuracy of frequency is required.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

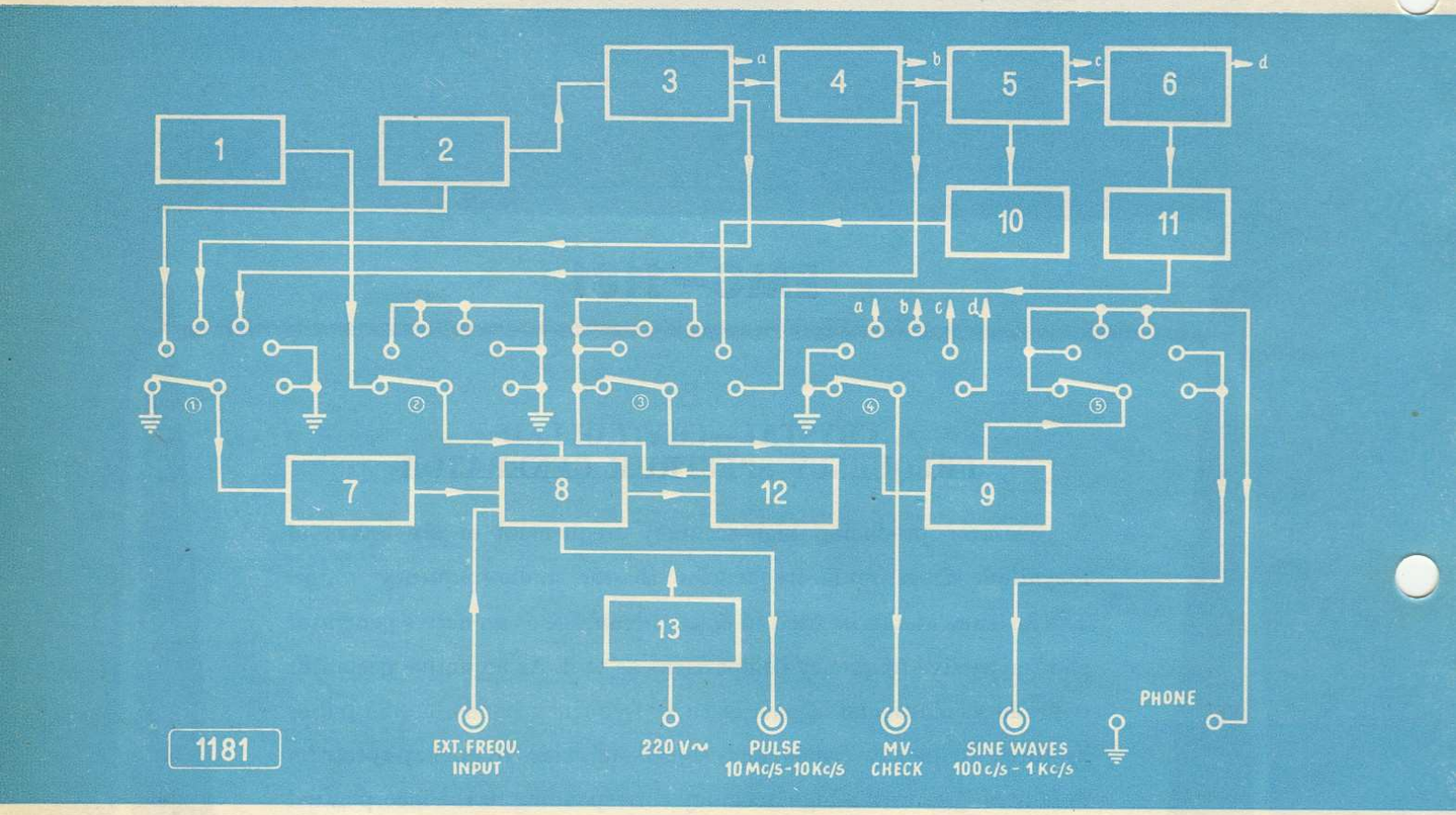
EMG–1181

FUNCTION: The functioning principle of the "Frequency Spectrum Generator" is shown in the Block Schematic Diagram below.

Two self-contained, independent crystal-controlled oscillators form the fundamental part of the spectrum generator. One of the basic frequencies, 1 Mc/s is divided into four lower frequencies with the insertion of four multivibrator-type frequency dividing stages viz.: 100 kc/s, 10 kc/s, 1 kc/s and 0,1 kc/s. The division is decadic in each stage. Adding to this the crystal oscillator, producing 10 Mc/s frequencies, there are totally six orders of magnitude in which high-accuracy fixed frequencies are available.

There will appear always only one frequency or frequency spectrum at the terminals owing to the functional design of the switching system, at the same time the tubes of the other frequency stages are preheated ready for switching, so that they will operate at once on the next frequency change.

By the aid of the mixing stage, incorporated in the instrument and of the interference amplifier coming thereafter, an unknown frequency can be compared with one of the basic frequencies of the generator or with its upper



1. Crystal oscillator (10 Mc/s)
2. Crystal oscillator (1 Mc/s)
3. Frequency-dividing multivibrator (100 kc/s)
4. Frequency-dividing multivibrator (10 kc/s)
5. Frequency-dividing multivibrator (1 kc/s)
6. Frequency-dividing multivibrator (100 c/s)
7. Pulse-shaping stage
8. Mixing stage
9. Interference amplifier
10. Low-pass filter (1 kc/s)
11. Low-pass filter (100 c/s)
12. Band filter (10 kc/s)
13. Power supply unit

harmonic. Such comporative measurements can be carried out in the four upper frequency bands, i. e. 10 Mc/s, 1 Mc/s, 100 kc/s, 10 kc/s. The 10 Mc/s frequency signal is shaped on a diode signal shaper while the 1 Mc/s, 100 kc/s and 10 kc/s frequency signals are shaped through a two stage pulse amplifier and signal shaper into steep-fronted and slow-slope needle pulses. According to the Fourrier analysis, signals of this shape are of the most favourable and uniform distribution along the frequency axis. The shaped signals 10 of Mc/s, 1 Mc/s, 100 kc/s and 10 kc/s are led out from the cathode of the mixing stage to the corresponding coaxial connector. The pulse shaper is essentially a two-stage, so-called sharpening circuit in whose circuit a pulse transformer is used. The self-induction of the transformer and the stray capacitance of the circuit form an oscillating circuit and function owing to the control as a pulse controlled so-called "ringing" oscillator. The self-induction of the pulse transformer located in the second pulse shaping circuit, is lower in order so that the ringing oscillator frequency, developed with this stray capacitance, should be higher than in the preceding stage. In consequence, the spectrum of the needle pulse can be in the higher frequency range also, as wide as possible. The tubes of the pulse-shaping circuit only operate in the 1 Mc/s, 100 kc/s and 10 kc/s positions. The pulse transformers are of an anti-capacitance design taking into consideration that the amplitude of the pulses is a function of the magnitude of the stray capacitances. The differential frequency of the "fx" external frequency to be compared and of the switched-on basic frequency stage or of the harmonics of the latter nearest to the "fx" is raised on the difference amplifier to the appropriate level. Transmission of the amplifying frequency is controlled by a double T link tuned to 10 kc/s and an RC part as low-pass filter. The amplitude of the output signal can be adjusted with a potentiometer. The sinusoidal signals get, after cutting off the harmonics content of the 1 kc/s and 100 c/s multivibrators — which is performed by two low-pass filters — also through the amplifier to the output.

The incorporated magic eye can be used for 0 indication when, at the measurement of signals, they are difficult to detect even with a head-phone.

The correct ratio of division of the frequency-dividing multivibrator has to be checked from time to time. For checking purposes the signals of the multivibrator are fed to a separate coaxial connector. An oscilloscope is used for checking the division ; a Lissajous figure, produced with the 100 c/s and the 50 c/s mains frequency, supplies the necesary information. In case of discrepancy the trimmer capacitors easily accessible for adjustment are used.

The power supply unit supplies voltage and current to the various stages of the instrument. In order to provide for the required high stability, the voltages necessary for the operation of the oscillators and multivibrators have been stabilized.

Tubes used in this instrument :

EF 80—5	ECC 85—4	EF 86—1
ECH 81—1	EM 80—1	EZ 80—1
VR 150—1		

(The figure after the Type-Number indicates the number of tubes in use.)

SPECIFICATION

FREQUENCIES

A) "PULSE" OUTPUT:

shaped sinusoidal signals	10 Mc/s
needle pulses	1 Mc/s
needle pulses	100 kc/s
needle pulses	10 kc/s

B) "MV CHECK" OUTPUT:

unshaped pulses of the frequency-divided multivibrators

100 kc/s
10 kc/s
1 kc/s
100 c/s

C) "SINE WAVES" OUTPUT:

sinusoidal signals	1 kc/s
sinusoidal signals	100 c/s

FREQUENCY ACCURACY: $1 \cdot 10^{-5}$

after reaching thermal equilibrium, i. e. after heating for about 2 hours at 22° C

Temperature coefficient of built-in quartz oscillator between +15 and +60°C:

better than $2 \cdot 10^{-6}$/°C

OUTPUT IMPEDANCE

"PULSE" OUTPUT:

min. 350 ohms

"MV CHECK" OUTPUT:

min. 3 kohms

"SINE WAVES" OUTPUT:

min. 150 ohms

OUTPUT VOLTAGE

"PULSE" OUTPUT:

min. 1 $V_{p\text{-}p}$

"MV CHECK" OUTPUT:

min. 1 $V_{p\text{-}p}$

"SINE WAVES" OUTPUT:
(at 1 kc/s and 100 kc/s):

min. 1 V_{rms}

EXTERNAL FREQUENCY:

INPUT VOLTAGE:

10 mV–10 V

INPUT RESISTANCE:

about 50 kohm || 50 pF

INTERFERENTIAL MARKS

with an internal
1 Mc/s, 100 kc/s, 10 kc/s repetition signal:
up to min. 30 Mc/s
with a 10 Mc/s repetition signal:
up to min. 200 Mc/s

Indication:
with built-in magic eye or
with head-phone

POWER SUPPLY

Voltage:	110, 127, 220 V
Frequency:	50/60 c/s
Consumption:	about 55 W

OTHER DATA

FINISH:

lacquered steel-sheet cabinet with 2 metal carrying handles

DIMENSIONS:
(without knobs and handles):

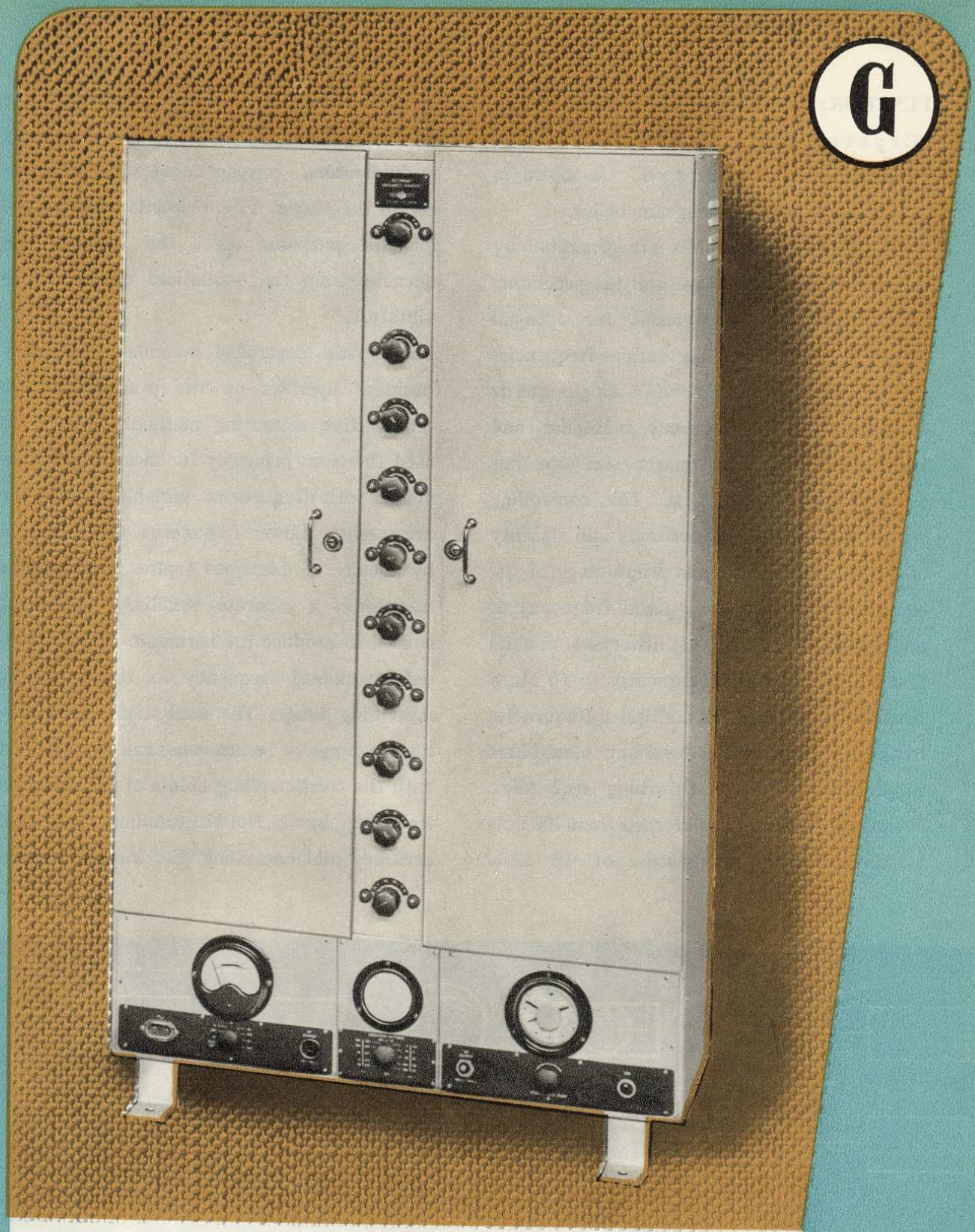
height	245 mm
width	500 mm
depth	400 mm

WEIGHT: about 22 kg

ACCESSORIES:

1 power cord
2 coaxial screened cables, with connector plugs
2 coaxial connector plugs "Am"

As a result of continued efforts to improve the design of instruments, we reserve the right to change this specification.



EMG–1188

CRYSTAL-CONTROLLED SECONDARY FREQUENCY STANDARD

This instrument is a high-precision secondary frequency standard, designed for the generation of radio- and audio-frequencies and is suitable for use in calibrating and checking the frequency in laboratories and in the mass production.

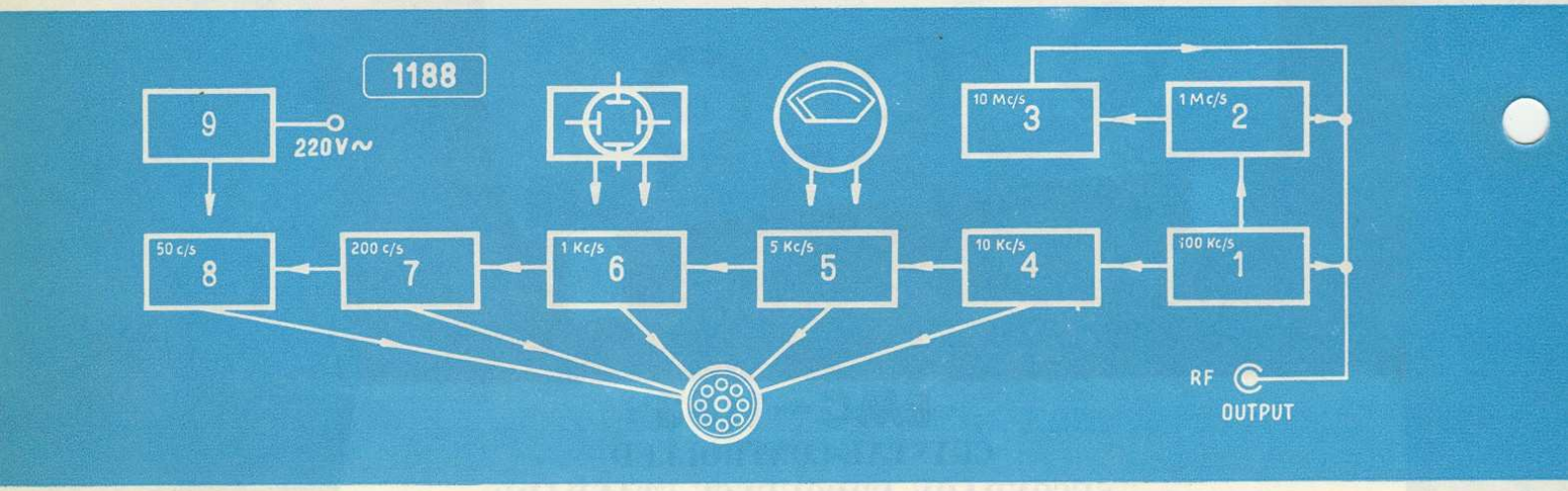
WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

EMG—1188

FUNCTION: The functioning principle of the "Crystal Controlled Secondary Frequency Standard" is shown in the Block Schematic Diagram below.

Eight different frequencies are generated by the equipment. (One stage and his pertaining reserve, has been left vacant for optional subsequent extension.) The various frequencies are produced by means of a single **quartz oscillator** and of **frequency multiplier and attenuator** units. The quartz oscillator has a frequency of 100 kc/s. The controlling crystal provides for the accuracy and stability of frequency. In the appropriate stage of the equipment, the 100 kc/s basic frequency is multiplied by means of distortion circuits first to 1 Mc/s and subsequently to 10 Mc/s. **Amplifier stages** raise the multiplied frequencies to the necessary output level and **band-filters** suppress the undesired disturbing frequencies. Frequency division is performed from 100 kc/s to the necessary frequencies of 10 kc/s, 5 kc/s, 1 kc/s and 200 c/s and finally to 50 c/s. This division is performed by **multivibrators,** corresponding with the number of the stages. Filter circuits dimensioned for this purpose, select the required frequencies from the oscillations of the multivibrators.

The crystal controlled secondary frequency standard operates on the principle of the comparative measuring method. It is to be used therefore primarily for measuring equipments with frequencies variable within the same range. Lower frequencies are measured by means of Lissajous figures; for higher frequencies a separate auxilliary equipment is used to produce the harmonics of the sinusoidal standard frequency in the particular measuring range. The oscillation of the frequency range to be measured can be identified with the corresponding points of the standard frequency band. Notwithstanding their high accuracy and constancy, the frequency stan-



1. 100 c/s crystal oscillator
2. 1 Mc/s frequency multiplier and amplifier
3. 10 Mc/s frequency multiplier and amplifier
4. 10 kc/s frequency multivibrator
5. 5 kc/s frequency multivibrator
6. 1 kc/s frequency multivibrator
7. 200 c/s frequency multivibrator
8. 50 c/s frequency multivibrator
9. Power supply unit

dards produced by the apparatus, secondary standards as they are, require by all means a comparison with some primary standard and a testing on that basis. For that purpose there is a built-in clockwork to be synchron nized with the standard frequency and compared to the astronomic time. As an alternative approach, the oscilloscope can be used to form Lissajous figures easy to compare with the standard frequency. Corrections can be made with the capacitor of the control oscillator.

The frequencies of the control oscillator and the spare control oscillator are also comparable. In order to ensure the stability of operation of the equipment, the necessary direct voltages are supplied by **stabilized power supply,** the heater voltages of the more delicate stages by a **regulating transformer.**

Tubes used in the instrument :

6 AU 6—11	6 AQ 5—8	6 J 6—10
6 SJ 7—2	6 L 6 G—4	PV 200/600-2
2 X 2—2	VR 105—2	3 KP 1—1

(The figure after the Type-Number indicates the number of tubes in use.)

SPECIFICATION

FIXED FREQUENCIENS :

50 c/s, 200 c/s
1 kc/s, 5 kc/s, 10 kc/s, 100 kc/s
1 Mc/s, 10 Mc/s

CONTROL OSCILLATOR

FREQUENCY : 100 kc/s

ACCURACY : 10^{-6}
(adjustable by fine regulation to an external frequency standard)

STABILITY : 2.10^{-6}
(at an ambient temperature of 18 — 22 C°)

TEMPERATURE COEFFICIENT OF QUARTZ CRYSTAL : 5.10^{-7}/C°
(between 20 and 60 C°)

RF OUTPUT VOLTAGE (without load) : min. 3 V

RF OUTPUT RESISTANCE : 150 ohms

AF OUTPUT VOLTAGE (without load) : min. 3 V

AF OUTPUT RESISTANCE : 600 ohms

POWER SUPPLY

Voltage :	110 or 220 V
Frequency :	50/60 c/s
Consumption :	270 W

OTHER DATA

FINISH :
lacquered steel-sheet cabinet with 2 doors

DIMENSIONS :

height	1455 mm
width	850 mm
depth	345 mm

WEIGHT : 105 kg

ACCESSORIES :

1 power cord
1 coaxial screened cable with connector plug

As a result of continued efforts to improve the design of instruments, we reserve the right to change this specification.

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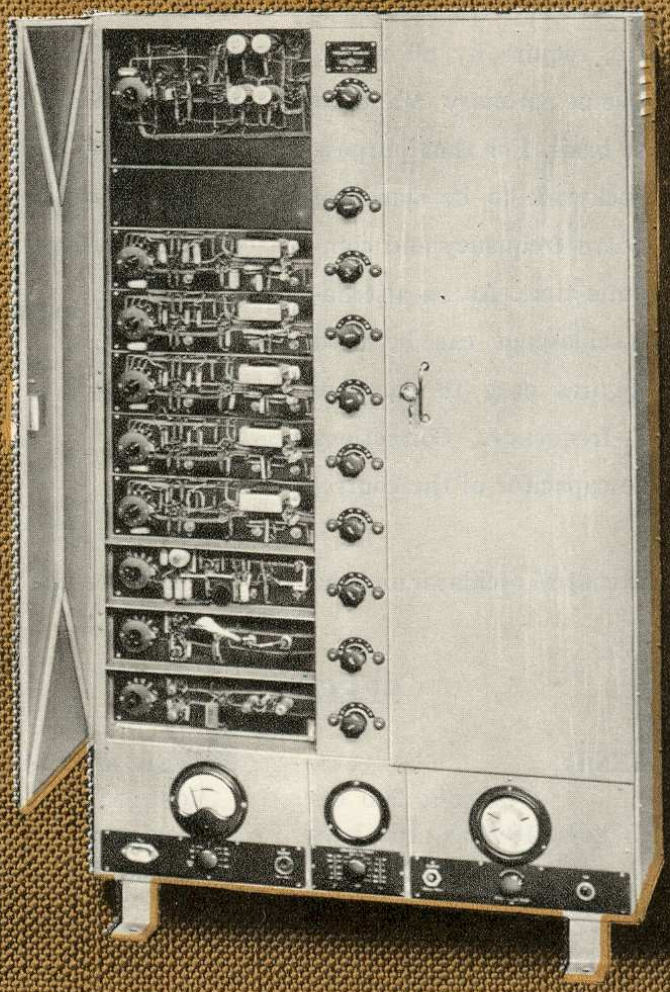


The secondary frequency standard is used for calibrating radio receivers and transmitters, audio-frequency generators and wavemeters wherever radio and audio-frequencies are measured and checked with a high-degree of accuracy.

The entire equipment is housed in an upright cabinet of comparatively little depth, fitted with two locking doors. It includes two fully identical parts, located symmetrically at the right and the left side. With any breakdown, occurring in a stage of the actually operating side, the apparatus can be switched over to the corresponding stage of the reserve side.

The additional facility provided by this arrangement is that production can be carried out without interruption ewen with some defect on one side of equipment.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

EMG–1193

TV SIGNAL AND PATTERN GENERATOR

Since the development of TV engineering an increased demand exists for measuring instruments, to help in the tuning and adjustment problems of the TV receiver independently of the programme. It is well known, that in radio engineering the various signal generators are used for this purpose. By the fact, that at present at least TV programmes are generally much shorter than radio programmes, further that a TV receiver owing to its weight and dimensions, is less conveniently transportable for repair and service, it underlines the importance of this instument. The TV Signal and Pattern Generator permits each significant stage of a TV receiver to be examined in a simple way, since the instrument produces several different signals and patterns each corresponding to standard specifications accepted in international TV engineering.

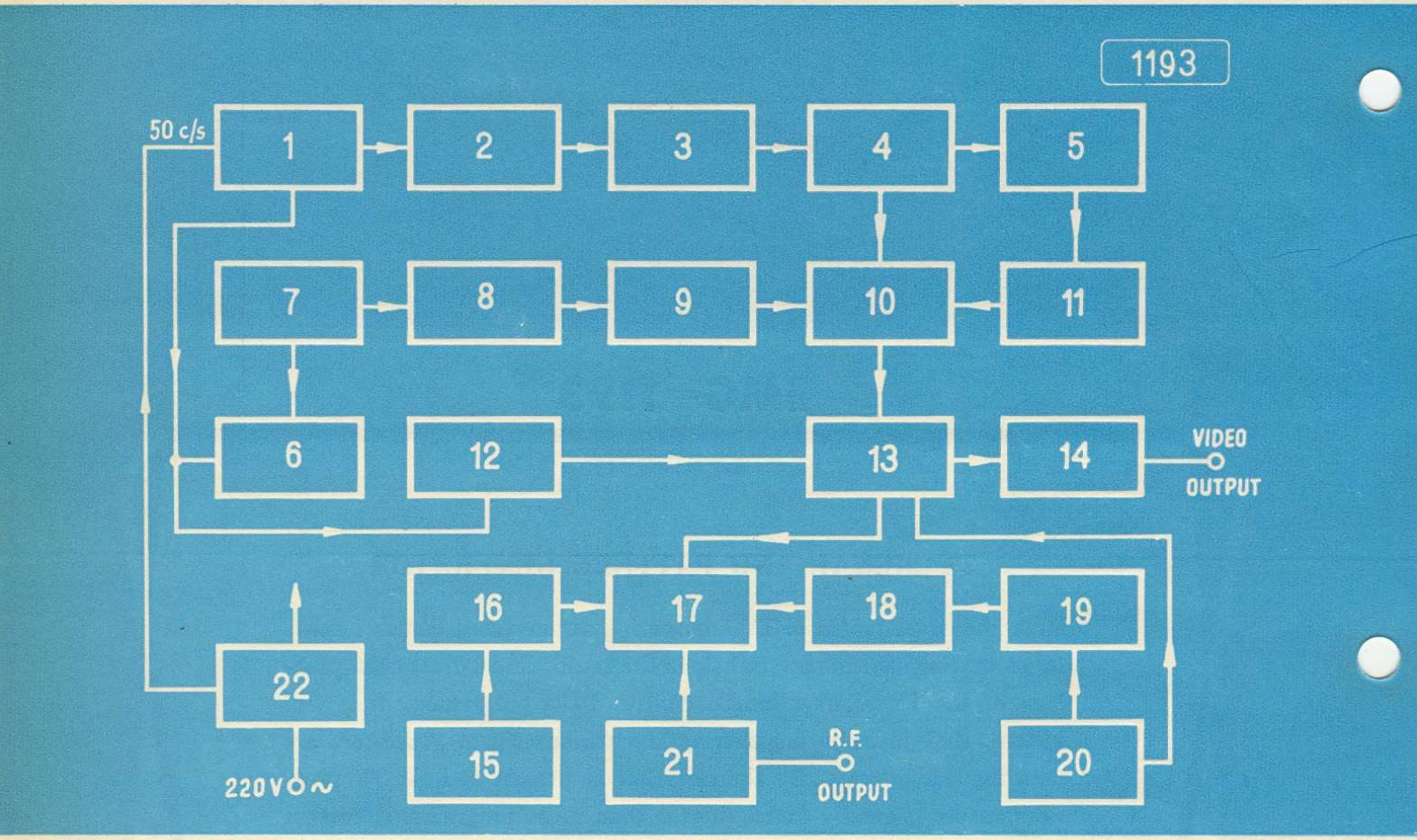
WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

EMG—1193

FUNCTION: The functioning principle of the "TV Signal and Pattern Generator" is shown in the Block Schematic Diagram below.

With the instrument the dimensions, position, sharpness, linearity, etc. of the picture and the intermediate frequency stages of the receiver can be examined. The 5 different patterns produced by the instrument permit the correct operation of the picture stage to be examined. The desired pattern can be selected by means of a switch, at the same time the generators of the not wanted pattern are switched off. The full signal, continuously adjustable at about 1 V, + ve and — ve polarity is led out through capacitor and is accessible on the front panel.

The HF section of the apparatus can be switched over by means of an up-to-date revolving drum to 12 fixed frequencies, corresponding exactly to the image carried frequency channels, prescribed by the **OIRT.** To special order the instrument can be supplied with frequencies corresponding to those pres-



1. Picture synchronizing signal shaper
2. Picture synchronizing signal clipper
3. Picture blackening signal clipper
4. 250 c/s multivibrator
5. 1250 c/s multivibrator
6. Line-synchronizing signal clipper
7. Line frequency oscillator
8. Line blackening signal clipper
9. 78 kc/s multivibrator
10. Picture signal mixer
11. Gradation generator
12. Combined synchronizing signal clipper
13. Sync signal + image signal integrator
14. Phase inverter
15. High-frequency oscillator
16. Cut-off stage
17. Video modulator
18. FM modulator
19. Intercarrier oscillator
20. Audio-frequency oscillator
21. High-frequency attenuator
22. Power supply unit

cribed by the **CCIR** or even in a special design with which the 12 channels are tuned optionally according to OIRT or CCIR. Appart from the 12 positions mentioned above, the revolving drum has three additional positions for producing TV — IF between 16 and 45 Mc/s divided into three ranges with appropriate overlapping and continuously adjustable with a separate variable capacitor.

The symmetrical output resistance ot the HF signal divider is of 240 ohms, aligned to the 240 ohms input resistance of the usual TV receivers. The output attenuator (voltage divider) can be adjusted in three fixed steps. The versatility of the instrument is enhanced by five different modulations achieved in five steps.

The intercarrier frequency is generated with very high accuracy by an oscillator for 5,5 and 6,5 Mc/s and is subsequently FM modulated by a special 1000 c/s oscillator. The latter is necessary for testing the audio IF stage of the TV receiver.

The instrument features in all its stages double tubes, mainly double triodes, thus providing for an economic combination of each stage and each application of the tubes. With the same end in view the double triodes are all of the same type for easy replacement, The total current and voltage supply of the equipment is provided by a **power supply unit** operating with two rectifier tubes. To eliminate mutual interferences, caused by the various stages of the instrument, filtering of each stage is carried out by filter-chains consisting of carefully dimensioned RC-units. The plate voltage for the H. F. oscillators is stabilized by a special stabilizing tube, necessary for frequency stability.

Tubes used in this instrument :
ECC 85—11 ECH 81—1 EZ 80—2
VR 150—1

(The figure after the Type-Number indicates the number of tubes in use.)

SPECIFICATION

TV PICTURE FREQUENCY CHANNELS :

according to OIRT standards

Channel 1	49,75 Mc/s
Channel 2	59,25 Mc/s
Channel 3	77,25 Mc/s
Channel 4	85,25 Mc/s
Channel 5	93,25 Mc/s
Channel 6	175,25 Mc/s
Channel 7	183,25 Mc/s
Channel 8	191,25 Mc/s
Channel 9	199,25 Mc/s
Channel 10	207,25 Mc/s
Channel 11	215,25 Mc/s
Channel 12	223,25 Mc/s

FREQUENCY ACCURACY : ± 1,5%

OUTPUT VOLTAGE :

on channels 1—12 min. 100 mV

OUTPUT ATTENUATOR
(voltage divider) :
adjustable in three steps

ATTENUATION
(voltage division ratios) :
1 : 10, 1 : 100, 1 : 1000

OUTPUT IMPEDANCE :
240 ohms (symmetrical)

TV INTERMEDIATE FREQUENCY :

in three ranges : 16 — 45 Mc/s
continuously adjustable

FREQUENCY ACCURACY : ± 3%

OUTPUT VOLTAGE (TV—IF) :
min. 100 mV

INTERCARRIER FREQUENCIES :
5,5 and 6,5 Mc/s

FREQUENCY ACCURACY : ± 0,1%

VHF INTERMEDIATE FREQUENCY : 10,7 Mc/s

FREQUENCY ACCURACY : ± 0,1%

EMG–1193

LINE FREQUENCY :

(free running oscillator) 15,625 c/s

FREQUENCY ACCURACY : ± 2%

PICTURE FREQUENCY :

50 c/s synchronized from mains

ACCURACY OF LINE AND FRAME SYNCHRONIZING SIGNALS :

± 20% in relation to Standard (no equalizing pulses)

PATTERNS :

1. white field, limited by blackening signals
2. 5 horizontal black-and-white bars of equal width
3. 5 vertical black-and-white bars of equal width
4. combination of 5 horizontal and 5 vertical black-and-white bars (pattern 2 and 3 together)
5. gradation in 5 × 5 light steps
6. 1000 c/s sinusoidal signal AM mod. with 60% depth (without sync. and blanking signals)

VOLTAGE OF VIDEO SIGNALS :

about 1 V peak, continuously adjustable

POLARITY OF VIDEO SIGNAL :

+ or — (led out through capacitor)

FM MODULATION :

in 5 stages

1. no carrier frequency
2. unmodulated
3. 1000 c/s ± 10% △ f = about 75 kc/s
4. FM—IF frequency 1000 c/s ± 10% △ f = about 75 kc/s
5. EXT. MOD. about 0,1 V/kc/s sweep, at 1000 c/s max. input voltage 15 V

MODULATION MODES :

1. picture-carrier frequencies modulated according to patterns
2. intermediate frequencies modulated according to patterns
3. picture-carrier frequencies modulated according to patterns, together with intercarrier frequencies according to FM modulation variations.
4. intermediate frequencies modulated according to patterns, together with intercarrier frequency according to FM modulation variations
5. intercarrier frequencies or VHF intermediate frequency according to FM modulation variations.

POWER SUPPLY

Voltage :	110, 127, 220 V
Frequency :	50/60 c/s
Consumption :	about 80 W

OTHER DATA

FINISH :

lacquered steel-sheet cabinet with carrying handles

DIMENSIONS:

(without knobs and handles) :

height	270 mm
width	360 mm
depth	245 mm

WEIGHT : about 15 kg

ACCESSORIES :

1 power cord

As a result of continued efforts to improve the design of instruments, we reserve the right to change this specification.

EMG–1194

TV SWEEP GENERATOR

A measuring instrument designed for calibrating and checking H. F., I. F. and video stages of television receivers, used to equal advantage in the laboratory and in the workshop. The characteristic curves of the amplifiers and filter circuits under test are plotted on screen of a cathode-ray tube of an external oscilloscope connected to the instrument.

The instrument is suitable for testing two-and four-poles within the frequency range of 100 kc/s to 230 Mc/s. Examination of the response curves is facilitated by the adjustable frequency deviation from 0 to 10 Mc/s. The frequency signals are produced by the built-in crystal-controlled marker generator.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

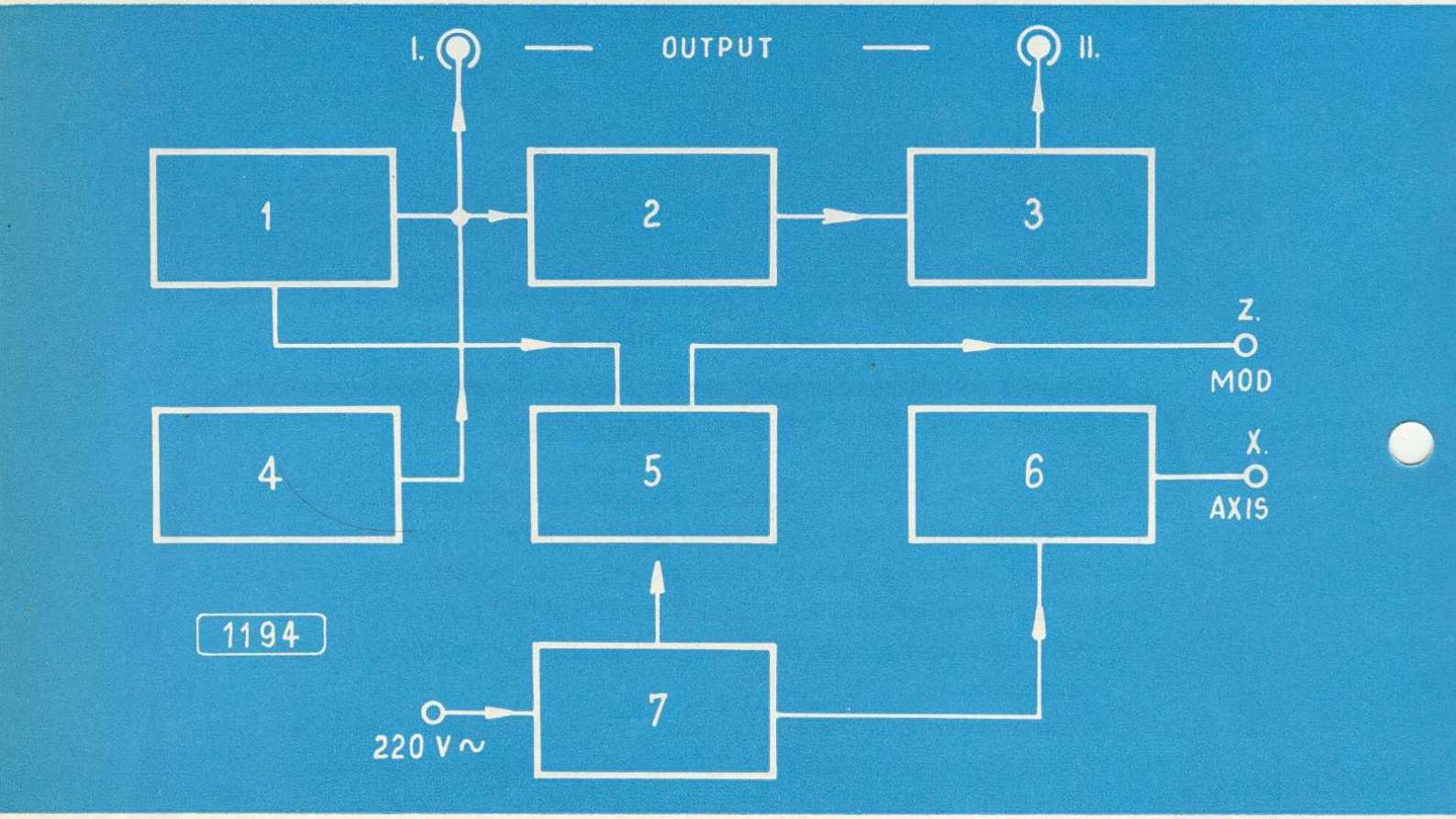
EMG–1194

FUNCTION: The functioning principle of the "TV Sweep Generator" is shown in the Block Schematic Diagram below.

The instrument consists of four principal parts which are very carefully screened against each other.

The tunable **oscillator** producing the basic frequency is frequency-modulated; this is obtained by tuning-off the oscillator circuit coil. The coil is provided with a ferrite core whose permeability also changes with the alteration of premagnetization so that the inductivity of the coil also changes. An iron core yoke is used for changing premagnetization: D.C. and 50 c/s A. C. also are conducted into the coil of the yoke.

The output voltage level of the variable oscillator fluctuates under the frequency deviation. This fluctuation is eliminated by the three-stage **regulating unit** providing for the constant level of the output signal. The third electron tube of this unit performs blanking of the oscillator in the flyback period of the cathode ray. The signals of the variable oscillator appear on the "OUTPUT II" jack. Since the FM oscillator operates in the frequency range of 40 to 230 Mc/s, the signals have to be produced, in the 0 to 40 Mc/s range, by mixing. A **fixed oscillator** tuned to 110 Mc/s is provided for this purpose. One system of a double electron tube produces the oscillation, the other system operates as



1. Variable oscillator
2. Fixed oscillator and mixing stage
3. Cathode-follower stage
4. Output level regulating stage
5. Frequency signal (marker) generator
6. Phase shifter stage
7. Power supply unit

mixer. The signals produced in the 0 to 40 Mc/s frequency range are led out to the connector jack marked "OUTPUT I".

If in the course of measurements carried out with the instrument, frequencies have to be identified, this is done most conveniently with fixed frequency signals (markers). A **crystal controlled signal generator**, incorporated with the instrument and producing signals of 10 Mc/s and 2 Mc/s frequency, serves this purpose. These signals or the harmonics, getting into another mixing stage and being amplified, appear in the form of negative pulses.

The „marker'' points are shown on the screen of the cathode-ray tube in the luminous line in the form of blanks.

Voltage and current are supplied to the various stages of the instrument by the power supply unit. Stabilized DC as reference voltage passes hence also on the regulating tube stabilizing the output level. A further voltage of about 3 V is led out to the front panel. This voltage is used for the oscilloscope connected to the instrument as horizontal deflecting voltage; its phase can be shifted so as to receive with an adequate adjustment an approximately square image on the screen of the cathode-ray tube. In view of the different H. F. signals generated in the instrument its power supply input part is provided with an adequately dimensioned H. F. filter-chain which is stopping any random H. F. signals that might get out onto the power supply.

The DC voltage and filament voltage input circuits of the master oscillater are equally provided with filters to prevent propagation of the harmful H. F. signals. Moreover, the delicate H. F. circuits of the instrument are carefully screened.

On special order two different impedance transformers (BALUN transformers) are supplied with the instrument. These transformers are designed to match the 75 ohms asymmetrical output to the 300 or 240 ohms symmetrical input impedance of TV receivers.

Tubes used in this instrument:

EC 81—1	E 88 CC—1	ECC 85—1
EF 80—1	6 AL 5—1	PL 53—1
PCF 82—1	EZ 81—1	VR 105—1

(The figure after the Type-Number indicates the number of tubes in use.)

EMG—1194

SPECIFICATION

FREQUENCY RANGE : 0 — 230 Mc/s
in 5 bands

FREQUENCY BANDS :

OUTPUT I : (mixed) 0 — 40 Mc/s

OUTPUT II :

40 — 70 Mc/s
70 — 110 Mc/s
110 — 180 Mc/s
180 — 230 Mc/s

(continuously tunable in each band) :

FREQUENCY MODULATION : 50 c/s

FREQUENCY DEVIATION :
between 0 and 10 Mc/s
continuously adjustable

The „0" line :
during half period of the flyback time oscillation of the oscillator is stopped.

OUTPUT VOLTAGE

between 0 and 40 mc/s : 50 MV
between 40 and 230 mc/s : 100 MV

OUTPUT ATTENUATOR :
continuously adjustable up to 80 dB

OUTPUT IMPEDANCE :
75 ohms (asymmetric)

VARIATION OF OUTPUT LEVEL
(with 10 Mc/s max. deviation :
max. 0,1 dB/Mc/s.

FREQUENCY SIGNAL (MARKER) GENERATOR :
quartz crystal controlled

FREQUENCIES :
10 Mc/s or 2 Mc/s

SIGNAL SHAPE :
negative, needle pulse

FORM OF APPEARANCE :
blanking-lighting up; repeated blanking

SIGNAL VOLTAGE :
about 50 V

BAND-WIDTH OF SIGNALS :
about 150 kc/s

TIME-BASE VOLTAGE
(for oscilloscope) :
about 3 V_{rms}/50 c/s
(phase adjustable)

POWER SUPPLY
Voltage : 110, 127, 220 V
Frequency : 50/60 c/s

CONSUMPTION : 150 VA

OTHER DATA

FINISH :

lacquered steel-sheet cabinet with 1 leather carrying handle

DIMENSIONS
(without knobs and handle) :
height 355 mm
width 265 mm
depth 260 mm

WEIGHT : about 10 kg

ACCESSORIES :

1 power cord

1 coaxial screened cable with plugs, without terminating resistor

1 coaxial screened cable with plugs and built-in 75 ohms terminating resistor,

1 coaxial screened cable, with plug on one end

1 measuring cap for Noval tube

Accessories supplied on special order :

EMG—1199—75/300 Balun transformer or
EMG—1199—75/240 Balun transformer

With every transformer
1 coaxial screened cable is supplied.

As a result of continued efforts to improve the design of instruments, we reserve the right to change this specification.

WORKS FOR ELECTRONIC MEASURING GEAR * BUDAPEST

EMG–1195

PORTABLE TV TESTER

The portable TV tester is a light-weight measuring instrument including all devices that may be required for the service testing of TV receivers or for the location of occasional faults in them. The test equipment comprises several main units which ensure, according to the given switching facilities, the various tasks to be carried out. These units are : the oscilloscope, the D. C. and A. C. VT voltmeter (read-off on the oscillator screen), the AM/FM signal gener tor, the pattern generator and the wobbulator.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

EMG–1195

FUNCTION: The functioning principle of the "Portable TV Tester" is shown in the Block Schematic Diagram below.

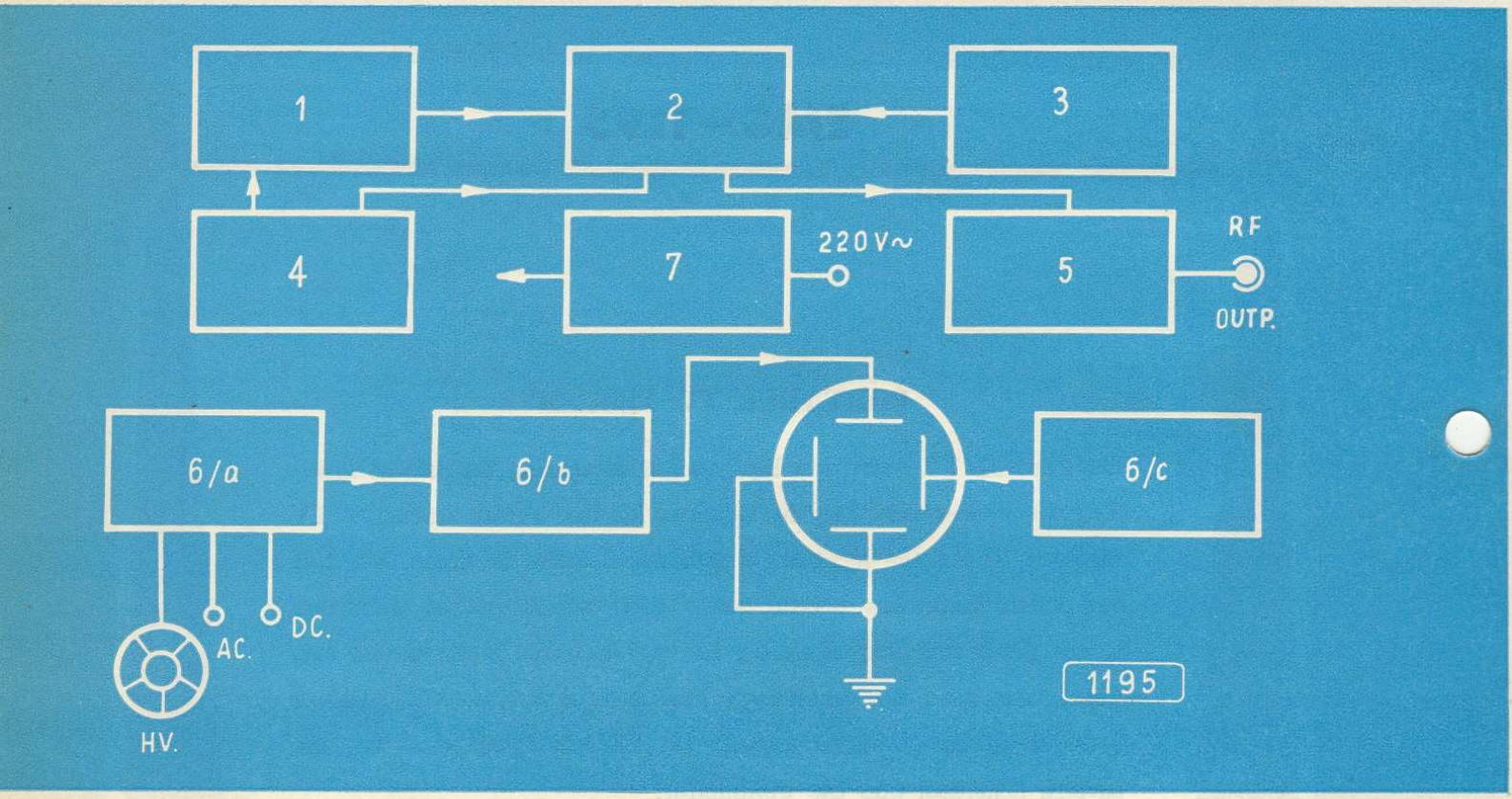
The instruments most important part is the **AM/FM signal generator** with frequency bands covering the entire TV signal range. The frequency accuracy of the signal generator meets all requirements arising in servicing work. Its operation relies upon mixing the frequencies of a constant and a variable oscillator. The high-frequency output voltage is continuously adjustable. With the 1000 c/s frequency of an other incorporated fixed oscillator, the generator signals can be modulated in two ways, either AM or FM.

One swi ching facility permits the equipment to be used as a **wobbulator** with a 50 c/s mains frequency and a frequency sweep f about ± 5 Mc/s.

Another important part of the TV tester is the **pattern generator** which, depending upon the actual switch position, produces five horizontal or five vertical black-and-white bars, without synchronizing signals.

The pattern signals enumerated, which admit of suitable focussing on the screen of the picture tube, are well suited — within the limits of practical requirements — for testing the linearity of the TV-receiver.

The instrument also includes an **oscilloscope**



1. Fixed oscillator with ferrite modulator
2. Mixer- and AM-stage
3. Variable oscillator
4. Modulation signals stage
5. Output H. F. attenuator
6a. Oscilloscope input attenuator
6b. Oscilloscope vertical amplifier
6c. Oscilloscope time-base generator
7. Power supply unit

with an up-to-date cathode-ray tube, 7 cm in diameter, which offers a variety of testing facilities. The frequency range of the oscilloscope vertical amplifier and its linear distortion comply with those of a normal oscilloscope of similar dimensions. The same properties are exhibited by the horizontal amplifier and the time-base generator. The D. C. coupling method of the amplifiers adapts the instrument and its oscilloscope to the testing of D. C. Voltages. The oscilloscope — properly calibrated — can be used either as an A. C. or as a D. C. V. T. voltmeter; moreover, in connection with a suitable measuring head, it can be employed for the testing of **high voltage** up to 30 kV also encountered during the testing of TV receivers.

The **power supply unit** has a separate rectifier tube to feed voltages for the electronic stages and another rectifier tube with selenium rectifier to supply accelerating voltage for the cathode-ray tube. The anode voltage of the oscillators is stabilized so as to keep the frequency on a constant level.

Tubes used in this instrument:

EF 80—3	ECL 82—1	ECC 85—1
EZ 80—1	AZ 41—1	VR 150—1
DG 7/6—1		

(The number after the Type-Number indicates the number of tubes in use.)

SPECIFICATION

AM/FM SIGNAL GENERATOR

FREQUENCY RANGES: 5 — 230 Mc/s (in two bands)

Frequency Band I: 5 — 70 Mc/s

Frequency Band II: 165 — 230 Mc/s

Frequencies of Band I and II are present simultaneously on the output connector

Frequency accuracy: ± 1,5% or 1,5 Mc/s whichever is the greater

Frequency calibration with a quarz crystal oscillator of 10 Mc/s

Output voltage: about 20 mV

AM MODULATION

FREQUENCY: 1000 c/s

MODULATION DEPTH: about 80%

FM MODULATION

FREQUENCY: 1000 c/s

△ f = about 150 kc/s

continuously adjustable

TV-PATTERNS:

5 horizontal black-and-white strips

5 vertical black-and-white strips

WOBBULATOR

FREQUENCY DEVIATION:

about ± 5 Mc/s

△ f = 50 c/s

continuously adjustable

CATHODE-RAY OSCILLOSCOPE

VERTICAL AMPLIFIER

FREQUENCY RANGE:

30 c/s — 100 kc/s

LINEAR DISTORTION: ± 3 dB

(relative to 1 kc/s):

up to 200 kc/s ± 6 dB

SENSITIVITY:

(for A.C. exam.) 100 mV_{rms}/cm

(for D. C. exam.) 3 V/cm

TIME-BASE GENERATOR

FREQUENCY RANGE:

about 20 c/s — 18 kc/s (in 2 bands)

Band I: about 20 — 60 c/s (FRAME)

Band II: about 6 — 18 kc/s (LINE)

VACUUM TUBE VOLTMETER

A. C. MEASURING RANGE:
1, 3, 10, 30, 100, 300 Vpp

MEASURING ACCURACY: ± 15%

D. C. MEASURING RANGE:
5, 15, 50, 150, 500V

MEASURING ACCURACY: ± 15%

WITH H. T. MEASURING HEAD:
up to 30 kV

MEASURING ACCURACY: ± 25%

POWER SUPPLY

Voltage	110, 127, 220 V
Frequency	50/60 c/s
Consumption	65 W

OTHER DATA

FINISH:
lacquered sheet-steel case with carrying handle

DIMENSIONS:
(Without knobs and handle):

height	330 mm
width	430 mm
depth	220 mm

WEIGHT: about 15 kg

ACCESSORIES:

1 power cord

Acccessories delivered on charge extra:

1 EMG 1392 H. V. measuring head with plug (30 kV)

1 EMG 1393—1 Measuring prod for voltage measurement (direct)

1 EMG 1393—2 Measuring prod for voltage measurement (with built-in resistor)

As a result of continued efforts to improve the design of instruments, we reserve the right to change this specification.

VARIOUS EMG SIGNAL GENERATORS

1162/B **1163** **1174**

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

EMG—1162/B WORSKHOP SIGNAL GENERATOR

FUNCTION: As to its electrical design the **RF oscillator** has LC coupling, the variable capacitor of the oscillator circuit has fine adjustment for tuning. The **AF oscillator** generates the 400 c/s frequency required for the modulation of the radio frequency signals, this frequency is accessible in two different voltages, also on a separate jack for audio-frequency measurements. The amplitude-modulated radio-frequency signal is applied through an **attenuator** to the screened coaxial output jacks. The attenuator adjustable in decadic steps provides for frequency independent voltage division. The decimal division of the **continuously adjustable linear scale** and the decadic graduation of the **multi-step attenuator** permits convenient readings of the attenuation rates under test; simple multiplication of the two scale readings will give the value of the output voltage in μV. Radiation of the oscillator is reduced to a practically negligible level by efficient screening of the instrument.

SPECIFICATION

FREQUENCY RANGE: 100 kc/s — 20 Mc/s (in six bands)

FREQUENCY ACCURACY: $\pm$ 2%

OUTPUT VOLTAGE: 1 μV — 0,1 V, continuously adjustable

MODULATION: internal 400 c/s, external 50 — 10 kc/s

EMG—1163 LABORATORY STANDARD SIGNAL GENERATOR

FUNCTION: The **RF oscillator** operates on the feedback principle. Oscillations of the required frequency can be adjusted by switching over the coils of the corresponding wave band and tuning the variable capacitor of the oscillating circuit. The frequency of each band is calibrated. The **AF oscillator** generates two different fixed frequencies. The radio-frequency signals can be modulated in adjustable depth with one of them or with the adjustable frequency of a separate generator. The amplitude-modulated radio-frequency signals appear on two screened coaxial jacks. Careful design of the **attenuator,** consisting of resistive elements only, guarantees a frequency-independent attenuation. A signal having an informative value of about 1 V is available on one of the coaxial jacks. Voltage can be checked with the built-in **V. T. voltmeter;** switching over its indicating instrument, it shows the percentage value of the adjusted modulation depth. The power supply transformer acting as **regulating transformer** eliminates the fluctuations of the mains voltage.

SPECIFICATION

FREQUENCY RANGE: 85 kc/s — 35 Mc/s (in six bands)

FREQUENCY ACCURACY: $\pm$ 1% (up to 30 Mc/s)

OUTPUT VOLTAGE: adjustable between 0,5 μV and 0,1 V

OUTPUT ATTENUATOR: adjustable in 5 decadic steps and continuously

INTERNAL MODULATION: 400 c/s and 1000 c/s

EXTERNAL MODULATION: 30—15000 c/s

EMG—1174 VHF SIGNAL GENERATOR

FUNCTION: The frequency range is divided into three ranges. The **VHF oscillator** is of special design, each range having an independent oscillator tube and tuning capacitor. The variable capacitor consists of three stators independent of each other and of a single common rotor. In accordance with the frequency bands the common rotor passes through the stator plates. The anode voltages of the oscillator tubes are switched on at the same time so that contact trubles resulting from change-over of the oscillating circuit are eliminated. The voltage of the VHF oscillator gets through a capacitive system **attenuator** to the coaxial output jack. Frequency independent voltage division is warranted by the attenuator. The VHF signals can be both **amplitude-** and **pulse-modulated** since the measuring instrument comprises an **AF oscillator** and **pulse generator** for modulation purposes. The latter can also be used independently. Voltage is controlled by the built-in **V. T. voltmeter** whose indicating meter, when changed over, also shows the percentage value of the adjustable modulation depth. The **power supply unit** provides stabilized voltages for all stages. The filament voltages of the VHF oscillator tubes are kept on a constant level by a special regulating transformer.

SPECIFICATION

FREQUENCY RANGE: 20 — 280 Mc/s (in three bands)

FREQUENCY ACCURACY: $\pm$ 2%

OUTPUT VOLTAGE: 1 μV — 10mV

INTERNAL MODULATION (AM): 400 c/s

PULSE MODULATION: 25 c/s — 10 kc/s

EXTERNAL MODULATION: 50 c/s — 15 kc/s

VARIOUS EMG FREQUENCY METERS

1611 1612 1631/B

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

EMG—1611

RF WAVEMETER

A measuring instrument operating by the absorption measuring method, particularly suitable for quick workshop measurements and most easy to handle.

FUNCTION. The rod antenna supplied as accessory is coupled to the input of the measuring instrument. The input radio-frequency signals are fed into the tuning circuit, featuring according to each band, separate RF coils and variable tuning capacitors. According to the absorption principle, the measurement absorbs energy from the tuned circuit to be tested and the tuned circuit of the wavemeter gets, if properly tuned, into resonance with the radiated frequency to be measured. Thereby an a. c. voltage is produced in the tuning circuit of the wavemeter and this a. c. is after rectification indicated by the instrument. The H. F. current is rectified not by an electron tube but by a germanium diode so that no power supply is needed. The scale of the variable tuning capacitor, being frequency calibrated according to the measuring ranges, makes direct reading possible. The linear graduation of the scale serves by the aid of the individually calibrated frequency curves supplied with the instrument for direct reading, which means greater care in reading and at the same time higher accuracy of measurement.

SPECIFICATION

FREQUENCY RANGE:
90 kc/s to 50 Mc/s
(in 6 ranges)

SENSITIVITY
the instrument indicates
min. 0,3 V input voltage

MEASURING ACCURACY:
(with direct reading): ± 2%
(with indirect reading):
up to 25 Mc/s ± 0,25%
above 25 Mc/s ± 0,5%

EMG—1612

VHF FREQUENCY METER (500 Mc/s)

A sensitive measuring instrument suitable for the measurement of frequencies generated in the VHF band of ultra-short waves, also used to advantage for laboratory measurements.

FUNCTION. The resonance of the built-in tuning circuit can be adjusted by changing the length of a single inductance, of the tuning arc. The whole frequency range is divided into four bands which can be changed over, with a low-loss change-over switch. With three wave-bands, fixed capacitors are coupled to the oscillating circuit, the tuning arc alone forms, together with its self-capacitance, the oscillating circuit whose tuning scale is calibrated directly in frequency. For obtaining the tuned circuit coupling as a rule, simple approachment of the instrument will do if the test frequency i.e. the radiated energy is sufficient so that there is no need of direct connection. The resonant position in agreement with the frequency of the tuned circuit to the tested is indicated, after adequate rectification, by the built in meter. A silicone diode is used for rectification so that there is no need for any current supply.

SPECIFICATION

FREQUENCY RANGE:
50 to 500 Mc/s,
i. e. 600 to 60 cm (in 4 ranges)

MEASURING ACCURACY:
up to 400 Mc/s ± 1%
above that ± 2%

EMG—1631/B

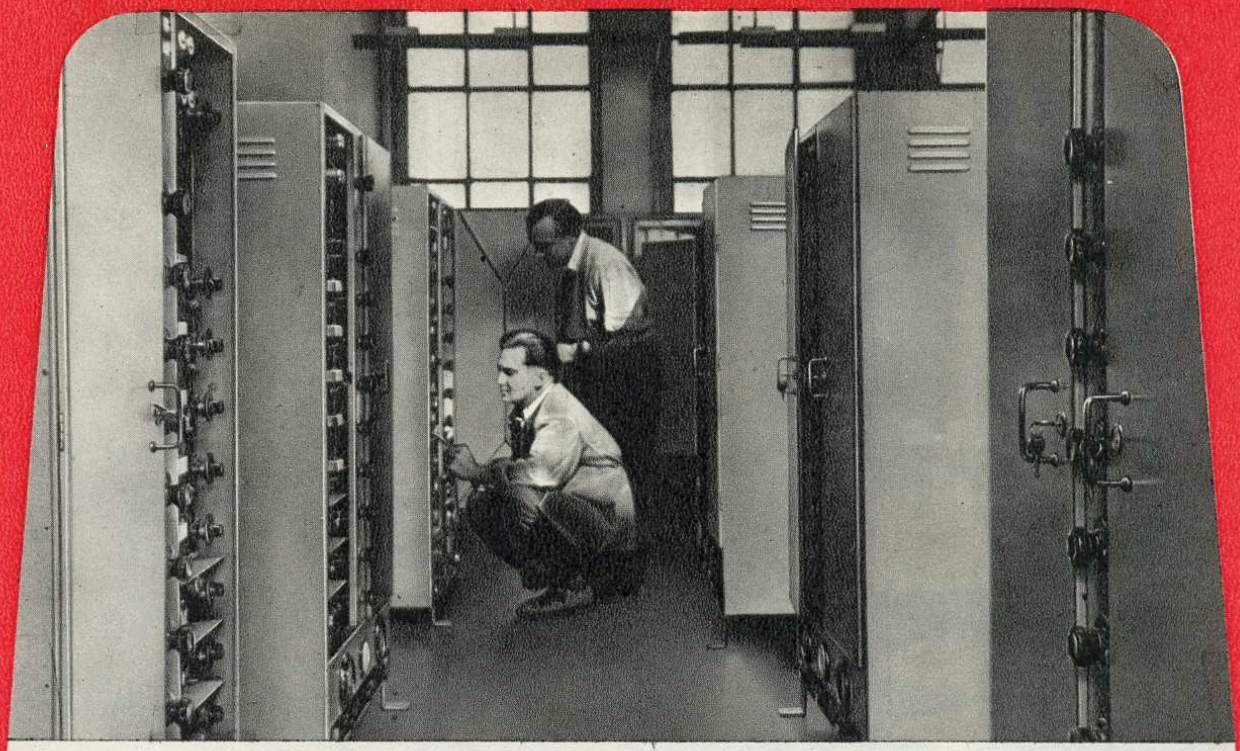
DIRECT-READING FREQENCY METER (100 kc/s)

FUNCTION. The signals to be measured, which may vary within very wide voltage limits, first are fed into the wide band amplifier stage from where they pass through two shaping stage (squaring), the latter also acting as power amplifier. The signals, squared and sufficiently amplified, proceed to the differentiating and pulse counting stage, their mean values being indicated by an instrument calibrated directly in terms of frequency. The various stages are provided by the power supply unit with stabilized anode voltage. The measuring instrument can be calibrated with a 50 c/s A. C. mains frequency or with an external generator.

SPECIFICATION

MEASURING RANGE: 20 c/s — 100 kc/s
(in 7 ranges)

MEASURING ACCURACY: ± 3%



LABORATORY CONTROL
OF FREQUENCY STANDARD EQUIPMENTS

FINAL ADJUSTEMENT
OF WORKSHOP SIGNAL GENERATORS

DETAIL OF DRAFTING ROOM
THE DESIGN DEPARTMENT

CALIBRATION OF MEASURING INSTRUMENTS

0

OSCILLOSCOPES

The "O" marked group comprises oscilloscopes and their auxiliary instruments. Enumeration follows in the order of the upper frequency limit.

SPECIAL OSCILLOSCOPE

AUXILIARY INSTRUMENTS FOR OSCILLOSCOPES

* Under development (in Group „F")

EMG–1535

CATHODE-RAY OSCILLOSCOPE

The oscilloscope represents an indispensable and most important instrument for workshops and laboratories.

This instrument is a considerable step forward in the development of the 3″ dia. cathode-ray oscilloscope used hitherto.

Both amplifiers of the instrument are of a special design and provide the amplification of a wider frequency band with very little distortion. The good phase response of the vertical amplifier enables pulses to be transmitted true-to-shape, the instrument is therefore most suitable for up-to-date pulse measurements e. g. for the alignment of TV receivers.

By appropriate adjustment of the symmetrical output amplifiers Lissajous figures can also be produced with the instrument so that it can be used for frequency measurement and comparison, too.

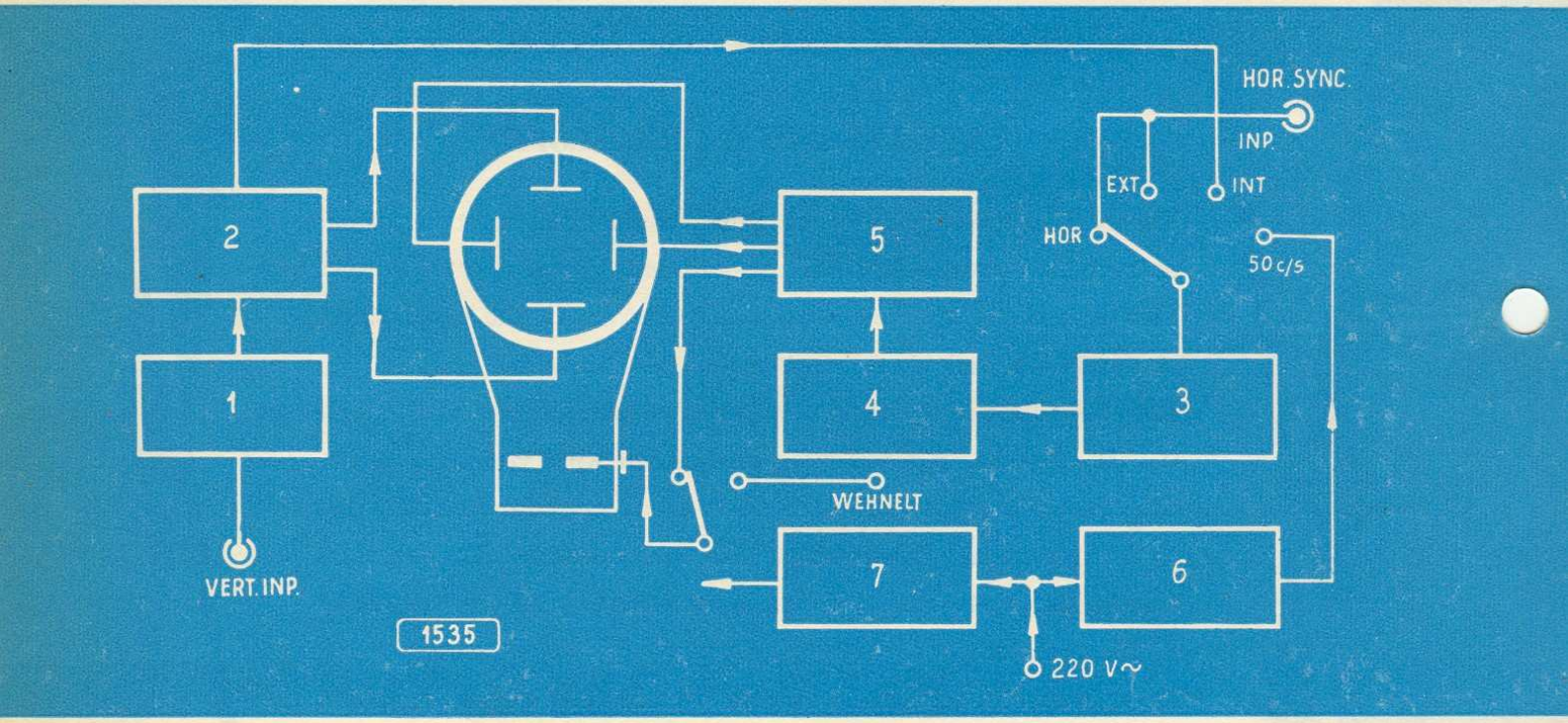
WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

EMG–1535

FUNCTION. The functioning principle of the "Cathode-ray Oscilloscope" is shown in the Block Schematic Diagram below.

The signal voltage under test passes into the 7-steps **attenautor** (voltage divider) coupled before the **vertical amplifier**; this attenuator provides for frequency independent division in all positions. The signal with an amplitude reduced according to the display requested passes from the attenuator to the input of the vertical amplifier. The amplifier is push-pull coupled since the pair of deflecting plates of the cathode-ray tube require symmetrical voltages. The three-stage amplifier is RC coupled and operates with 3 doubles triodes. Wide-band amplification is ensured in the various stages by carefully dimensioned LF and HF frequency compensation. In accordance with the feature of the push-pull circuit the amplifier is indifferent to mains hum. The bias necessary for the amplifier stages are all automatically adjusted.

The signal coupled to the horizontal amplifier passes first into a 5-steps **attenuator** (voltage divider) whose design provides, similarly to the other attenuator, also a frequency independent division. From here the signal gets into the **horizontal amplifier** producing also a symmetrical deflecting voltage for the other deflecting plates of the cathode-ray tube. Though owing to its destination the operating band of the horizontal amplifier is not as broad as that of the vertical amplifier and it is necessarily of different sensitivity and has yet three stages; since it is not in push-pull circuit, the final stage only carries out phase inversion with particular regard to the desired symmetrical output. The horizontal amplifier is also RC coupled and in order to ensure the



1. Input attenuator (vertical)
2. Vertical amplifier
3. Input attenuator (horizontal)
4. Horizontal preamplifier or sync. amplifier
5. Horizontal amplifier or time-base generator
6. Power supply unit
7. High-voltage supply unit

good quality of frequency transmission, low frequency emphases was also used in the first stage.

The full amplification of the horizontal amplifier and therefore the amplitude of the signal shape can be continuously regulated with the aid of a potentiometer provided in the second amplifier stage. It is not only a technical, but also a considerable economic advantage of the instrument that the first stage of the horizontal amplifier operates as synchronous amplifier and its second stage, after switching over, as time-base generator. As new stage a double triode is provided here with one half operating in cathode-follower circuit and the other half as synchronizing diode; the next tube produces in "Phantastron" coupling the saw-tooth shaped oscillations, in 6 overlapping steps, but between the steps the timebase frequencies and the amplitude as well can be regulated continuously with a potentiometer. The last electron tube of the time-base generator operates similarly as in the horizontal amplifier, as phase inverter; it therefore supplies symmetrical deflecting voltages for the corresponding deflecting plates of the cathode-ray tube.

Facilities are provided for three ways of synchronization: internal synchronization, from the vertical amplifier; AC mains synchronization, from the 50 c/s power supply; external synchronization, from some adequate signal generator.

Another considerable advantage of the instrument is the "Limiter"-coupled diode, by means of which synchronization does not depend on the amplitude of the signal so that independently of its magnitude the shape of the display can be well fixed.

As **cathode-ray tube** the well proved 3″ screen diameter type was used. Direct connection is also provided to its deflecting plate pairs whereupon the amplifiers are automatically disconnected so that without the amplifier, external signals between 0 to 30 Mc/s can also be tested if the voltage of the signals under test is so high that there is no need of amplification. Light modulation of the cathode ray is also possible as connection can be made to the Wehnelt cylinder through the built-in capacitor. Very careful screening of the cathode-ray tube is a guarantee against any harmful effect of external magnetic field which may cause disturbances.

By means of the control elements (potentiometers) provided in the circuits of the electrodes of the cathode-ray tube the position of the display on the screen can be displaced both in the vertical and in the horizontal directions. Intensity and sharpness can also be regulated; not only focus but astigmy can also regulated for this purpose so that the intensity of the display can be adjusted in any part of the screen, therefore also on the edge, to full sharpness.

The oscilloscope obtains its full voltage and current supply from two independent supply units. The normal power-supply unit supplies with two rectifier tubes coupled in parallel the DC voltages necessary for the operation of all electronic stages. The high-voltage supply unit supplies with a selenium rectifier the negative high voltage necessary for the cathode-ray tube.

Tubes used in this instrument:

ECC 85—4 EF 80—2 PL 83—1
EZ 80—2 3 KP 1—1

(The number after the Type-Number indicates the number of tubes in use.)

EMG–1535

SPECIFICATION

CATHODE-RAY TUBE

SCREEN DIAMETER : 3″ (75 mm)

ACCLERATION VOLTAGE : approx. 1100 V

COLOUR OF SCREEN : green

VERTICAL AMPLIFIER (Y):

FREQUENCY RANGE :
20 c/s — 1 Mc/s

LINEAR DISTORTION (1 kc/s) : ± 3 dB

SENSITIVITY : 20 mV_{rms}/cm

OVERSHOOT
(with a signal of 0,1 μsec rise time : max. 3%

ROOF FALL
(with 50 c/s square-wave signal) : max. 3%

INPUT ATTENUATOR
voltage division ratios :
1, 3, 10, 30, 100, 300, 1000
input voltage : max. 300 V_{rms}
input impedance : 1 Mohm || 30 pF

HORIZONTAL AMPLIFIER (X)

FREQUENCY RANGE :
20 c/s — 500 kc/s

LINEAR DISTORTION (1 kc/s) : ± 3 dB

SENSITIVITY : 70 mV_{rms}/cm

INPUT ATTENUATOR
voltage division ratios :
1, 10, 30, 100, 300
input impedance : 1 Mohm || 30 pF

AMPLIFICATION
continuously adjustable

TIME-BASE GENERATOR

FREQUENCY RANGE :
20 c/s — 150 kc/s
(adjustable in 6 steps and also continuously)

SYNCHRONIZATION :

1. internal from vertical amplifier
2. 50 c/s mains
3. external, from adequate signal generator

LIGHT MODULATION

INPUT IMPEDANCE :
100 kohms || 30 pF
(max. 1500 V)

POWER SUPPLY

Voltage : 110, 127, 220 V (adjustable)
Frequency : 50/60 c/s
Consumption : about 70 W

OTHER DATA

FINISH :
lacquered steel-sheet case with 1 leather handle

DIMENSIONS
(without knobs and handle) :
height 270 mm
width 205 mm
depth 360 mm

WEIGHT : about 15 kg

ACCESSORIES :
1 power cord
1 coaxial screened cable with connector plugs
1 coaxial plug
1 co-ordinate plate
1 shield

As a result of continued effort to improve the design of instruments, we reserve the right to change this specification.

EMG–1538/B

INDUSTRIAL OSCILLOSCOPE

With measurements for industrial and scientific purposes, where mechanical, optical or other physical phenomena have to be investigated, these must first be converted into electrical voltage changes by means of various transducers, to make them suitable for the examination by the oscilloscope. The resulting voltages being usually so low that an ordinary oscilloscope can hardly identify them, there is need for an oscilloscope of particular sensitivity. The frequency range of the EMG–1538/B oscilloscope has been extended far towards the lower rates to make it particularly suitable for the examination of oscillation phenomena occurring in industry. The upper frequency limit of the instrument, 10 000 c/s, makes it suitable for the investigation of electric switching and of low-frequency acoustic phenomena.

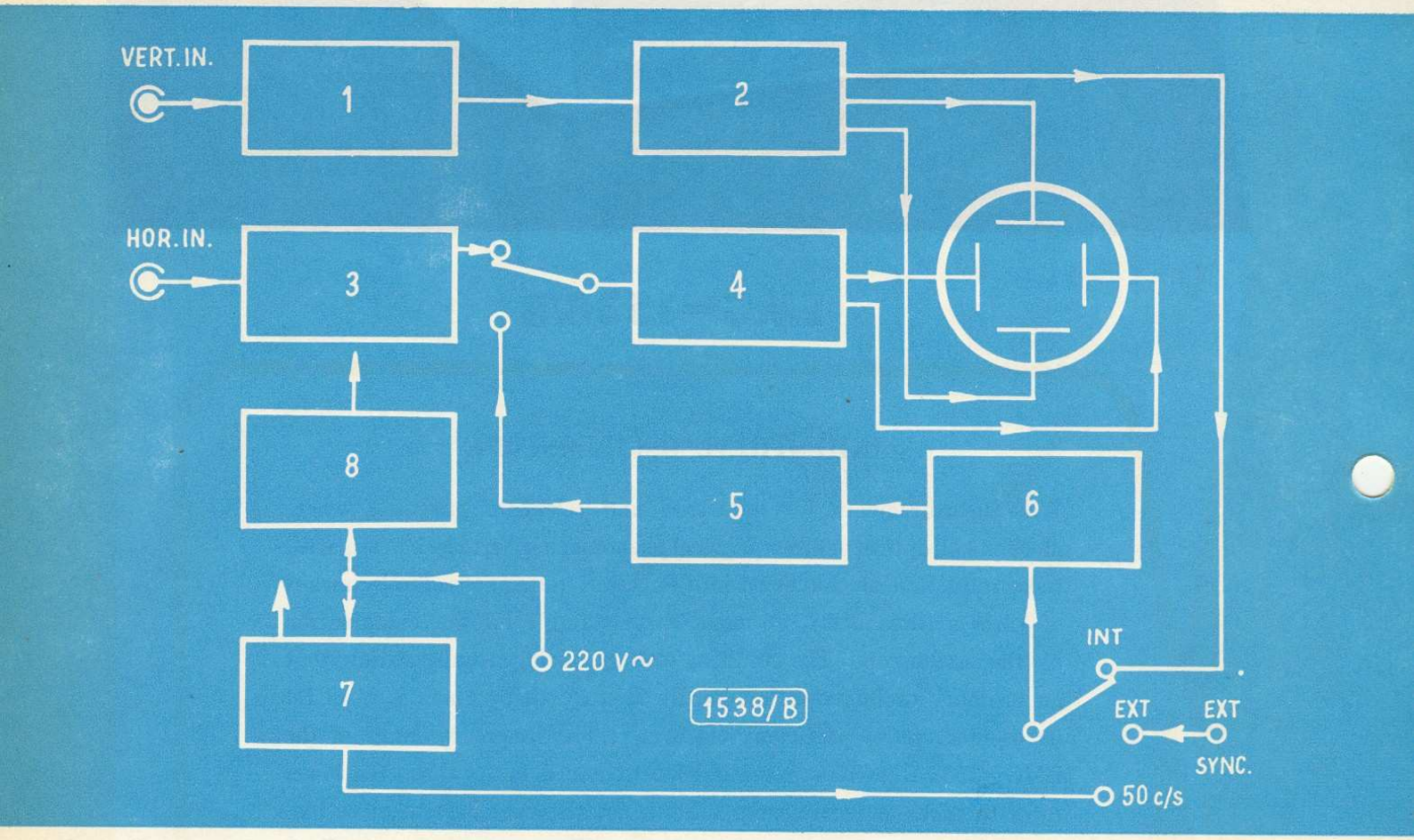
WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

EMG-1538/B

FUNCTION. The functioning principle of the "Industrial Oscilloscope" is shown in the Block Schematic Diagram below.

Two entirely identical but independent amplifiers and both having two push-pull stages, are coupled to each of the **horizontal and vertical** deflecting **plates of the** C. R. T. These lend a considerable stability and make it indifferent to external disturbances. The coupling elements of the amplifiers have been selected, to warrant a high degree of linearity and a transmission nearly free from distortion. The second stage of the amplifiers is connected directly to the corresponding plate pairs of the cathode-ray tube, without intermediate RC networks. The merit of this novel design consists in the facillity of displacing the image spot without consideration of a time constant. The gain of both the horizontal and the vertical amplifiers permits the coarse adjustment in 10 steps by approximately calibrated attenuators and the fine adjustment with a potentiometer.

If the test signal voltage is high enough, not to necessitate the use of the incorporated amplifier, direct connection to the pair of deflection plates of the cathode-ray tube can be established; in this case the amplifier joined to it will necessarily switched off. The supply of an external voltage to the connecting terminal of the Wehnelt-cylinder which is separately terminated through a capacitor, allows a light modulation of the cathode-ray.



1. Vertical input attenuator
2. Vertical amplifier
3. Horizontal input attenuator and preamplifier
4. Horizontal amplifier
5. Time-base generator
6. Synchronous amplifier
7. Power supply unit
8. High-voltage supply unit

The pentode circuit of the **time-base generator** warrants a high measure of linearity, an effect still further increased by the fact that the time-base voltage, amplified in the last stage of the horizontal amplifier, arrives at the cathode-ray tube without the intermediary of an RC network coupling. The frequency of the time-base generator permits of step-by-step adjustment and of continuous fine adjustment. For **synchronization**, three possibilities are provided :

internal, from the vertical amplifier
from the 50 c/s AC. mains
external, from a suitable signal generator.

The extent of synchronization can be set by fine adjustment. When using a Photo-Recorder attachment, time-base operation which is then secured by the film travel, can be dispensed with. In consideration of the photographic exposure, the cathode-ray tube has blue light and a long persistance. Current and voltage for the operation of the entire apparatus are obtained from a power supply rectifier of suitable size, fitted with filter units. A separate rectifier tube furnishes high voltage for the cathode-ray tube, while the other electron tubes obtain the required DC. voltage from another high-efficiency rectifier tube.

For the non-fluctuating operation of the amplifiers, this voltage is stabilized electronically.

Electron tubes used in the instrument :

6 SJ 7—5	6 AC 7—5	6 AU 6 —1	
6 L 6—1	5 Z 5—1	2 X 2—1	
3 KP 2—1	VR 105—1	884—1	

(The number after the Type-Number indicates the number of tubes in use.)

SPECIFICATION

CATHODE-RAY TUBE

Screen diameter : 3'' (7,5 cm)
Accelaration voltage : about 2000 V

VERTICAL AMPLIFIER

FREQUENCY RANGE : 0,1 — 10 000 c/s
LINEAR DISTORTION : (relative to 1 kc/s) ± 3 dB
SENSITIVITY : 3,5 mV_{rms}/4 cm or 10 mV/4 cm
INPUT RESISTANCE : about 100 kohms

HORIZONTAL AMPLIFIER

FREQUENCY RANGE : 0,1 — 10 000 c/s
LINEAR DISTORTION : (relative to 1 kc/s) ± 3 dB
SENSITIVITY : 7 mV_{rms}/5 cm or 20 mV/5 cm
INPUT RESISTANCE : 100 kohms

TIME-BASE GENERATOR

FREQUENCY RANGE : 0,1 — 2000 c/s adjustable in 6 steps and continuously

POWER SUPPLY

Voltage : 110 or 220 V
Frequency : 50/60 c/s
Consumption : about 100 W

OTHER DATA

FINISH :

lacquered steel-sheet case with 2 carrying handles

DIMENSIONS

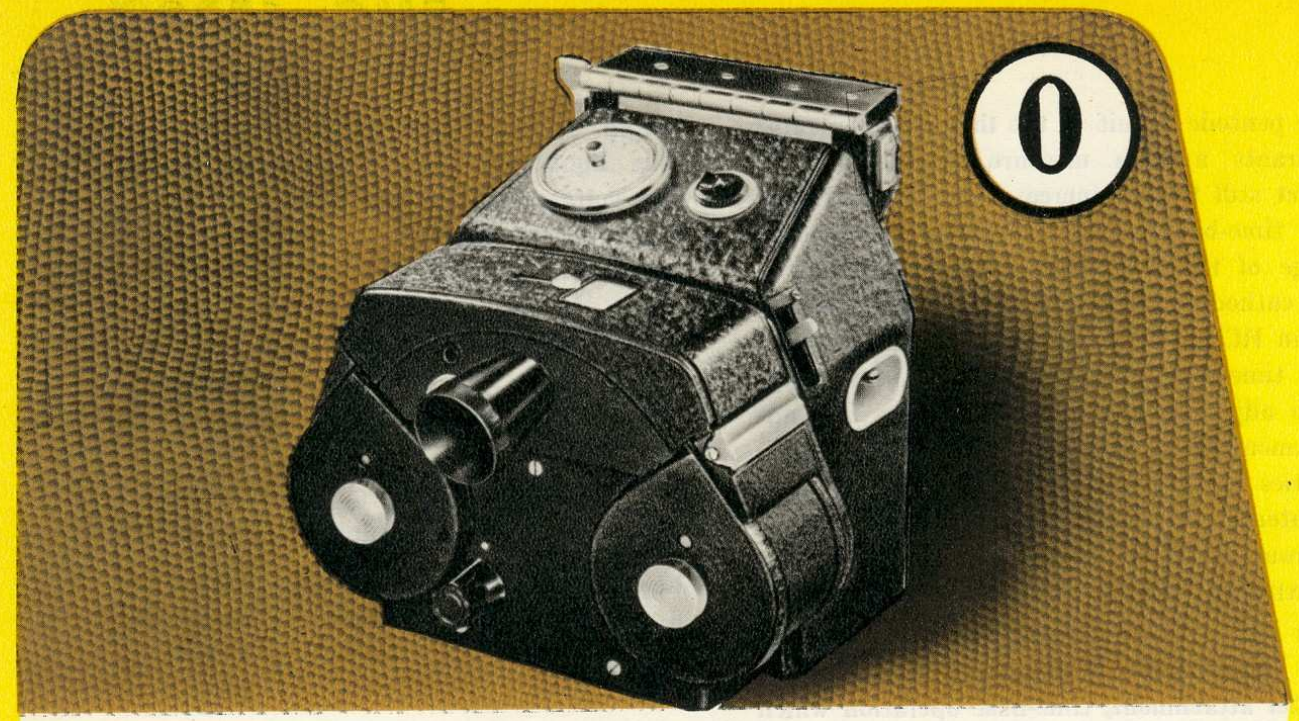
(without knobs and handles) :
height 375 mm
width 285 mm
depth 500 mm

WEIGHT : about 25 kg

ACCESSORIES :

1 power cord
1 coaxial screened cable with connector plug

As a result of continued efforts to improve the design of instruments, we reserve the right to change this specification.



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"PHOTORECORDER" 1578-1

(for use with Industrial Oscilloscope)

It is often impossible to follow by the eyes the quick change of phenomena, displayed on the screen of the cathode-ray tube. Accurate evaluation requires adequate recording of the signals.

The "PHOTORECORDER" will, with the help of a suitable optical equipment, photograph the movement of luminous points on the screen onto a light-sensitive paper tape. The principal parts of the apparatus are the following : the motor (220 V, 50 c/s) driving by means of gear and friction transmissions, the band transport mechanism and the time-base equipment. Three band speeds : 30, 90 and 200 mm/sec and idle running can be adjusted with the change-speed gear. The tape cutting fly-bar cuts off, after the shot, the exposed section of tape, to enable removal of the holder, containing the exposed tape. There are two storing caskets, one for receiving the unexposed tape, the other for receiving maximum 15 m of exposed band. The counter shows the length of the unexposed tape. The time-base equipment fixes, at fixed regular intervals, signals on the tape to enable an unambiguous and easy evaluation of the shots. The time intervals are : 0,2 or 0,1 sec $\pm$ 3%. The illuminating light source of the time-base equipment projects the signals, in groups of five through the optical cylinder on the paper tape, four are short and the fifth a longer one. Suspend and fasten the camera on three button on the shield, mounted on the front panel of the industrial oscilloscope. Use with the equipment a sensitive paper tape, corresponding in size to the 35 mm standard film.

EMG–1543/B

TV AND PULSE OSCILLOSCOPE

A laboratory oscilloscope for the examination of electric phenomena occurring in television and pulse techniques. Its circuit design offers many new measuring possibilities, especially in TV engineering. Particularly outstanding features of the instrument are the true-to-shape transmission of pulses, the special circuits necessary for TV measurements only, in investigating TV pictures, the possibility of expansion the patterns in the horizontal direction, the built-in voltage calibration circuit, the built-in marker generator etc.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

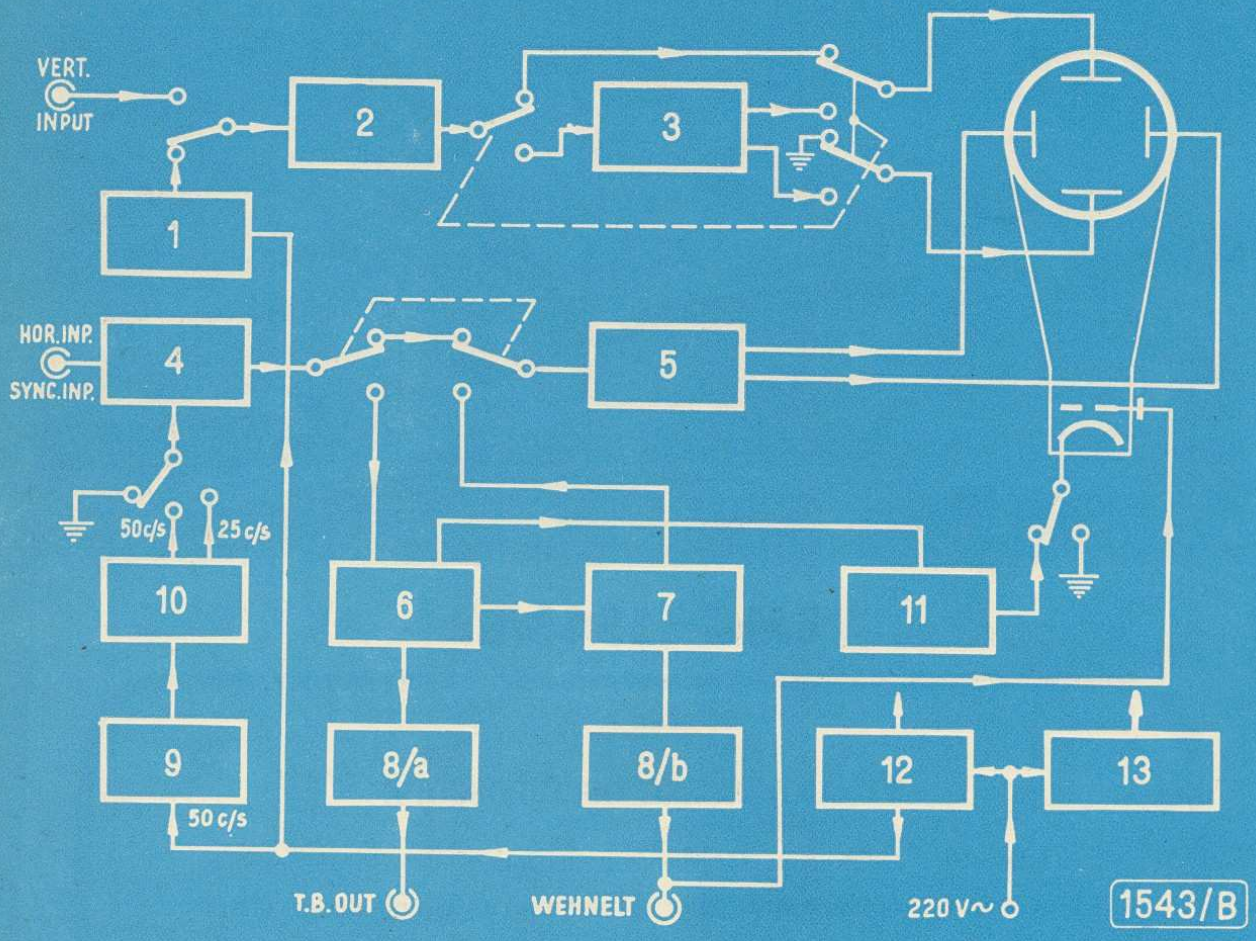
FUNCTION. The functioning principle of the "TV and Pulse Oscilloscope" is shown in the Block Schematic Diagram below.

The **calibration-voltage generator** supplies A. C. voltages of mains frequency and is adjusted by the aid of a five-step voltage divider to the input of the vertical amplifier for comparing the various voltages displayed on the screen of the cathode-ray tube.

The **input attenuator of the vertical amplifier** supplies, within the specified frequency limits input signals of frequency-independent voltage division for the vertical amplifier. The input impedance of the vertical amplifier is independent of the adjusted voltage limit.

The **vertical amplifier** consists of four stages, viz. the input cathode-follower stage, the two-stage amplifier, again a cathode-follower stage and the output stage consisting of two high-power pentodes. The pentodes supply earth-balanced voltages to the pair of vertical deflection plates. The compensation applied in the output stage ensures pulse-transmissions without overshooting and self-oscillation.

The EMG 1396 low-capacitance measuring



1. Calibration voltage generator and voltage divider
2. Input attenuator of vertical amplifier
3. Vertical amplifier
4. Horizontal pre-amplifier and synchronous amplifier
5. Horizontal power amplifier
6. Time-base generator
7. Time expanding circuit
8. Separating stages (8a, 8b).
9. TV line-selecting circuit
10. TV pulse-shaping stage
11. Marker generator
12. Power supply unit
13. High-voltage supply unit

head features passive links only and divides the test voltage in a ratio of 1 : 10 as related to the input of the oscilloscope.

Its application makes possible the investigation of voltage points in circuits, sensitive to external loadings, such as video amplifiers, H. F. oscillators, etc. This is made possible by the low capacitance and high ohmic resistance of the measuring head. For investigating higher voltages, the input terminals can be switched over, directly or by inserting a capacitance. With such switching-over the amplifier will necessarily be switched off from the deflection plate. It is a special advantage for safety that the operation described can be performed, without re-arranging the connecting plugs, with a switch ; there is therefore no danger of accidentally touching the high-tension section.

Direct connection, as well as that established with the insertion of a capacitance, involve a three-stage attenuator furnishing the deflection plate with voltages divided in ratios of 1, 2 and 4. Control of the attenuators is performed with a common switch, i. e. with a single control knob.

Since connections without the amplifier can be made to one vertical plate of the cathode-ray tube only, the deflection obtained will be asymmetrical ; all control elements for dis, placing the pattern on the screen, can however, be operated also under these conditions. This is particularly significant for the investigation of A. C. voltages superposed to D. C. voltages. Deflection plate connections without amplifier should therefore only be used, when high A. C. voltages (of several hundred volts) are to be investigated or where the frequency of the test signal is beyond the upper frequency limit of 10 Mc/s of the amplifier.

With an amplifierless connection to one of the vertical deflection plates of the cathode-ray tube it, is possible to investigate A. C. signals of frequencies up to about 60 Mc/s. It is pertinent to mention that in case of vertical deflection applied without amplification D. C. signals can also be investigated.

If a symmetrical deflection is to be obtained, connections should be made through the amplifier to the vertical deflection plates, to eliminate trapezoidal distortions arising with asymmetrical deflections.

Vertical amplification, i. e. the amplitude of the signal, can be continuously adjusted by means of a potentiometer provided in the cathode circuit of the first tube in cathode-follower connection. The adjustment of both the stepwise voltage divisions and of the gains is practically independent of the frequencies transmitted.

The wide-band transmission of the vertical amplifier is provided for by compensation applied in each stage. These compensations eliminate linear distortion occuring in the ranges of both lower and higher frequencies, thus the frequency transmission of the vertical amplifier is nearly linear over the whole wide range. The total gain of the vertical amplifier is so high that even a very low input voltage is sufficient for the cathode ray to traverse the full width of the screen.

The **horizontal amplifier** also consists of several parts viz. of the input tube which is a double triode in cathode-follower connection and two pre-amplifier stages with pentodes. The output amplification comprises two high-power tubes, one of them acting also as a phase inverter, thus the horizontal deflection plates of the cathode-ray tube also receive symmetrical voltages.

The gains are continuously adjustable and are also practically frequency-independent over the range specified.

When using the horizontal amplifier, the time-base generator is cut out, but when using the time-base generator the first three stages of the horizontal amplifier (without the final stage amplifiers) will act as a **synchronous amplifier.**

The **time-base generator** comprises a bootstrap stage, a discharge pentode and frequency determining capacitors, whose charging is controlled by a multivibrator consisting of two pentodes. The time-base generator may be operated in two different ways viz. free running or triggered. The sweep frequency can be

adjusted in five steps ; the period of running expressed in microseconds, can be easily adjusted to the required value by coarse and fine adjustment. The saw-tooth oscillations of the time-base generator are, after subsequent amplification in the final stage of the horizontal amplifier, fed to the horizontal pair of deflection plates of the cathode-ray tube. It is pertinent to mention here that the patterns appearing on the screen of the cathode-ray tube can be expanded horizontally about threefold by aid of the **time expanding** circuit.

The amplitude of the voltage, furnished by the time-base generator is so large that it can displace the luminous spot along the full screen diameter.

Synchronization can be accomplished in three diferent ways :

internal synchronization from the vertical amplifier

external synchronization from a suitable external signal generator

mains synchronization from the 50 c/s mains. In each case the synchronization can be sensitive to signals in "+" or "—" direction. Amplification of the synchronization signals to the required degree is, after switching over, performed in the first three stages of the horizontal amplifier, acting this time as a **synchronous amplifier.**

A novelty included in the improved design is the **TV circuit** composed of several parts, viz. the TV-line-selector, the squaring stage, the frequency halving multivibrator (50/25 c/s) and the two-stage pulse-shaping amplifier, through which the synchronization signals are conducted to the time-base generator, where they act in conjunction with the TV line-synchronization signals, cut-off and amplified by the synchronous amplifier.

The television circuit permits the desired line or lines to be selected from among the TV video signals. The two, half pictures can be tested alternately by lines of symmetrical position in the half pictures, facilitated by a switch-over device. Finally the two half pictures can be superposed in order, to test the picture interlace.

The LC-coupled **marker generator** produces sinusoidal signals which, fed to the cathode of the cathode-ray tube through a switch, provide for the modulation marks of the time base on the screen with four different time intervals.

For a **cathode-ray tube** the instrument incorporates the latest model with large screen diameter (5″).

No-amplifier connection to one of the vertical deflection plates is possible, as has been mentioned in describing main characteristics of the vertical amplifier.

Connections can be established to the Wehnelt-cylinder of the cathode-ray tube through a built-in capacitor from the outside of the instrument, too. Thus it will be possible to apply external **light modulation** as well. The blanking signal for the cathode-ray, during the flyback period can be secured from the same terminal. The signal voltage of the time-base generator is led out on the terminal situated next to it.

A very careful screening of the cathode-ray tube provides for full protection against the harmful influences of external magnetic fields. The pattern, displayed on the screen of the cathode-ray tube, can be displaced both horizontally and vertically by means of potentiometers provided for the purpose.

Facilities have been provided to adjust independently the beam intensity and the sharpness (focus) on the screen. The astigmatism being adjustable, it will be possible to carry out focussing of the pattern at an optional part, including the edge of the screen.

All currents and voltages required for the oscilloscope are supplied by several rectifier stages, acting as self-contained units within the **power supply unit.** They perform the following functions :

1. supply : H. T. acceleration voltages and H.T. post acceleration voltages for the cathode-ray tube by aid of selenium rectifiers ;

2. supply, Voltages for the final amplification stages of the horizontal and vertical amplifiers by means of two rectifier tubes ;
3. supply : Feed the rest of the electronic stages and regulate the voltages by aid of two additional rectifier tubes, one electronic regulating tube and one stabilizer tube ;
4. supply negative D. C. voltages to the cathode-ray tube and the time-base generator by aid of a separate rectifier tube.

Tubes used in the instrument

ECC	85–6	E 180 F–2	18046–1
PL	36–6	EF 80–2	EL 84–2
PL	83–3	PCC 88–2	6 AL 5–3
EZ	4–4	PCC 88–2	VR 105–2
DG	13–54–1		

(The number after the Type-Number indicates the number of tubes in use.)

SPECIFICATION

CATHODE-RAY TUBE

SCREEN DIAMETER : 5″ (125 mm)
SCREEN COLOUR : green
PERSISTENCE : medium
ACCLERATION VOLTAGE : about 1600 V
POST-ACCLERATION VOLTAGE : about 1600 V

VERTICAL AMPLIFIER (Y)

FREQUENCY RANGE : 3 c/s — 10 Mc/s
LINEAR DISTORTION (at 1 kc/s) : ± 3 dB
SENSITIVITY : 50 mV_{p-p}/cm
OVERSHOOT
with signals of 35 mμsec rise time : max. 3%
with signals of 0,004 rise time : max. 1%
ROOF FALL : max. 2%
(with a square-wave signal of 50 c/s)
INPUT ATTENUATOR (before the amplifier) :
VOLTAGE DIVISION RATIOS : 1, 10, 100
INPUT ATTENUATOR (before the deflection plate)
VOLTAGE DIVISION RATIOS : 1, 2, 4
INPUT IMPEDANCE (without the amplifier) : about 2 Mohms || 40 pF
WITH AMPLIFIER about 1,11 Mohms || 30 pF
WITH LOW-CAPACITANCE MEASURING HEAD : about 11,1 Mohms || 8 pF
CALIBRATION VOLTAGES : (with 50 c/s mains) 0,1, 0,3, 1, 3, 10 V_{p-p}

HORIZONTAL AMPLIFIER (X)

FREQUENCY RANGE : 20 c/s — 1 Mc/s
LINEAR DISTORTION : (at 1 Mc/s) ± 3 dB
SENSITIVITY : 140 mV_{p-p}/cm
INPUT IMPEDANCE (with amplifier) : about 1,11 Mohms || 30 pF

TIME-BASE GENERATOR

adjustable in 5 steps or continuously, with coarse and fine adjustment
SWEEP PERIOD at 10 cm pattern width : 50 000 μsec–2 μsec
(This corresponds to a sweep of 5000 μsec/cm to 0,2 μsec/cm without expanding)
HORIZONTAL EXPANDING : 3 : 1
MINIMUM SWEEP PERIOD at max. expanding related to 10 cm : 660 mμsec
(with max. expanding this corresponds to) : 66 mμsec/cm

SYNCHRONIZATION MODES

(with signals of "+" or "—" direction):

1. internal, from the vertical amplifier (HF, and "+" or "—")
2. mains, 50 c/s or 25 c/s
3. external, from a suitable signal generator

TV CIRCUIT

REPETITION FREQUENCY: 25 and 50 c/s

FALL TIME: 40 msec. — 60 μsec

DELAY: 40 msec.

LIGHT MODULATION

INPUT IMPEDANCE: about 150 kohms || 30 pF

MARKER GENERATOR:

for periods of 10, 1, 0.1 and 0,03 μsec

ACCURACY: ± 5%

POWER SUPPLY UNIT:

Voltage:	110, 127, 220 V
Frequency:	50/60 c/s
Consumption:	about 500 VA

OTHER DATA

FINISH:

lacquered steel-sheet cabinet with 2 carrying handles

DIMENSIONS

(without knobs and handles):

height	430 mm
width	320 mm
depth	660 mm

WEIGHT: about 40 kg

ACCESSORIES:

1 power cord
3 different coaxial screened cables with connector plugs
1 coaxial "Am" connector plugs
1 co-ordinate plate
1 green filter plate
1 shield

Accessory charged separately:

EMG—1396 low capacitance measuring head with screened cable and connector plug

As a result of continued efforts to improve the design of instruments, we reserve the right to change this specification.

EMG–1548

TIME MEASURING OSCILLOSCOPE

The instrument which combines the well-known features of an ordinary oscilloscope and a synchroscope, ranges among the most important measuring instruments of the laboratory for testing pulse technique equipments and radar systems. Used as an ordinary oscilloscope, it is suitable for the investigation of any kind of periodical signal, as a synchroscope, it is equally suitable to that of both periodical and nonperiodical signals. Moreover without regard of the voltage shape, the unit is suitable for the examination of signals that last only for a fraction of the repetition period. As an accurate time measuring device, it renders valuable service in the testing of extremely short pulses. A precisely calibrated time scale reads the pulse periods in terms of microseconds.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

EMG–1548

FUNCTION. The functioning principle of the "Time Measuring Oscilloscope" is shown in the Block Schematic Diagram below. The equipment actually operates in two different connection variants and can be used for measurements accordingly.

Continuous service when used as an ordinary wide-range oscilloscope.

Triggered service when used as pulse and time measuring oscilloscope. In the latter case there are two subvariants :

Operation "A" = undelayed

Operation "R" = delayed

During continuous service

(when using the apparatus as a normal oscilloscope)

the following of the main units are in operation :

Input attenuator (voltage divider)

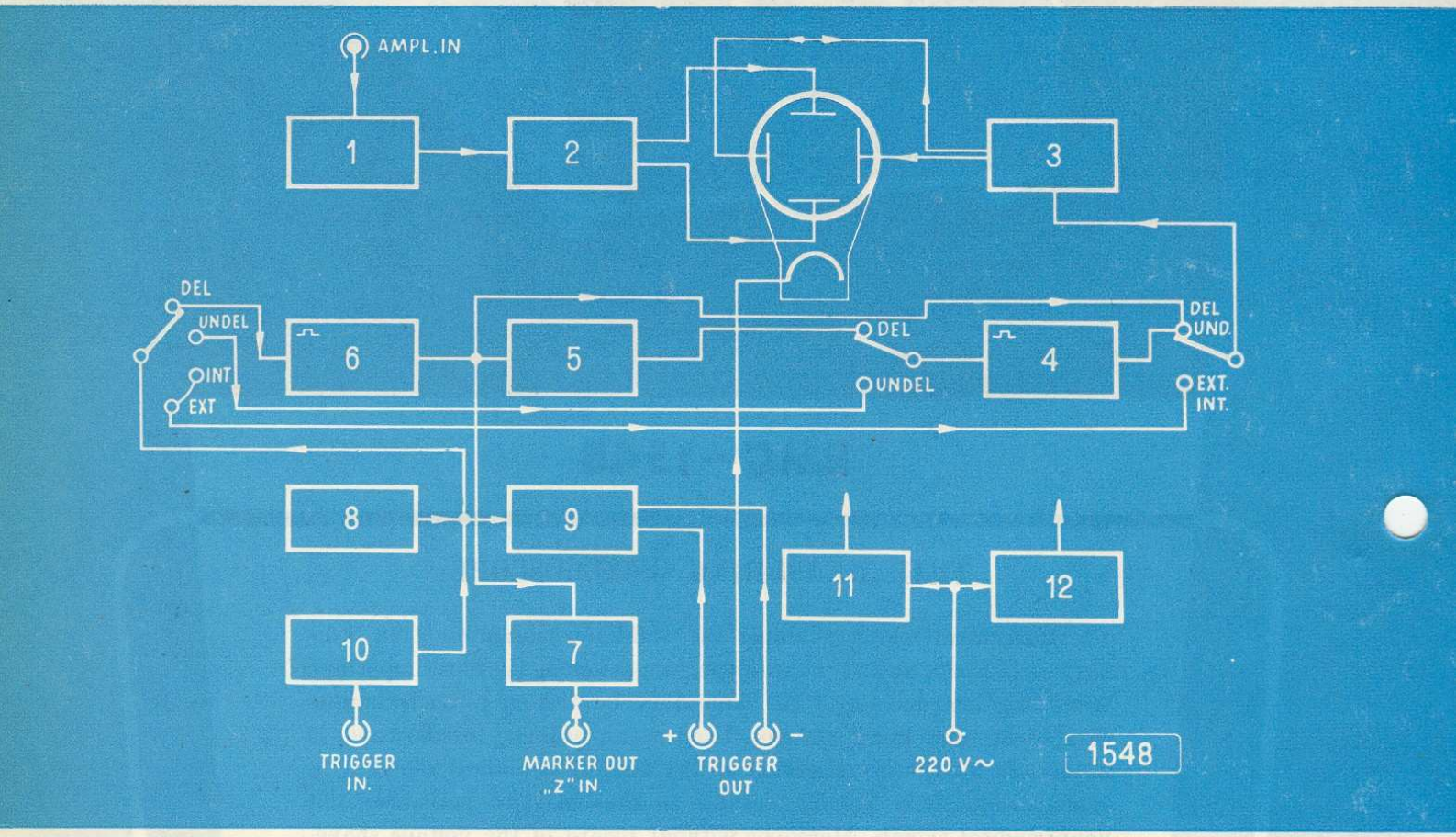
Vertical wide-band amplifier

Time base generator

Cathode-ray tube

Obviously the voltage supplying units are also functioning.

The various stages are working in the system described below :



1. Input attenuator
2. Vertical amplifier
3. Time base generator
4. Sweep generator "R"
5. Prec. delay circuit
6. Sweep generator "A"
7. Marker generator
8. Start signal generator
8. Delay circuit for start signal
10. Start signal or synchronous signal amplifier
11. High-voltage supply unit
12. Power supply unit

The **input attenuator** (voltage divider) has five positions and can be used for testing also signals of great amplitude as it subdivides the incoming signals, irrespective of their frequencies, in the ratios of 1 : 3, 1 : 10, 1 : 30 and transmits them to the input of the vertical amplifier.

The efficiency of the **vertical wide-band amplifier** is so high, that even quite small signals can be tested. It should be specially emphasized that the amplifier is suitable for pulse transmission purposes because of its very short rise-time and the low percentage of roof-fall. The wide-range amplifier is coupled with a balanced output to the vertical plate pair of the cathode-ray tube. Should the input signal be high enough not to require any amplification, then direct connection to the pair of vertical plates of the cathode ray-tube can also be established, in which case the amplifier joined to it in forced coupling will necessarily drop off these points.

A special advantage of the apparatus is, that the vertical deflected voltage is terminated to the front plate through two connecting jacks. In this way the peak voltages of the various signal shapes can be well measured with the vacuum tube voltmeter of great input impedance which can be connected to the said jacks.

The electrical circuit and design of the **time base generator** takes the two types of operation into consideration and can be switched over to **continuous** on **triggered** service. The time base generator is of the self-excitation type, with stepwise and continuously fine adjustable frequency.

The time base signal passes a phase inverter stage and is conducted with balanced connection to the horizontal pair of deflection plates of the cathode-ray tube.

When set to continuous operation, the apparatus can be **synchronized** in two ways : either with an **internal** signal produced by the vertical amplifier or with an **external signal** obtained from the external generator.

The measure of synchronization can be set by continuous adjustment.

In case of **triggered service,** when using the apparatus as a pulse and time measuring oscilloscope, of the main parts of the apparatus with **operation "A"** in addition the following are in operation :

Internal start signal generator
Delay circuit for start signal
Sweep generator "A".

With **operation "R"** in addition the following are also in operation :

Precision delay circuit for measuring time
Sweep generator "R"

The various stages operate in the manner described below.

The **internal start signal generator** is an astable multivibrator with RC-coupling, producing a continuously adjustable start signal within the given frequency limits. If the time base generator is set to **undelayed action** (operation "A") the start signal passes the appropriate switches and reaches the **sweep generator "A"** which, however, can be triggered not only from the internal generator but also from an external one.

In respect of its electrical circuit, the gate generator "A" is a monostable multivibrator producing signals of calibrated lengths in microseconds to be used for various purposes.

One group of the gate signal of 100, 1000, 4500 and 10 000 microseconds determines the decay periods of the signals obtained from the time base generator. The signals of the internal trigger generator allow a continuous adjustment of the delay between 4 and 20 microseconds with the help of the **delay circuit.**

If the time base generator is set to **delayed action** ("R" mode) the 100 and 1000 microseconds signals of the gate generator "A" actuate the **precision delay circuit** which operates in "Boot-strap" circuit. This produces saw-tooth-shaped oscillations by means of which, very short time periods between, 0,05 and 1000 microseconds can be measured with a high degree of accuracy. The signals of the precision delay circuit, regulated by a special **10-turn precision potentiometer,** actuate the **sweep generator "R"** which features a monostable multivibrator. The delayed signals control the **marker generator** so that delayed time signals get, in accordance with the adjustment, to the horizontal pair of deflection plates of the cathode-ray tube. The marker signal device of the apparatus are of particularly great importance in time measurement.

One type of signal is supplied by the **marker generator,** an oscillator in "Transitron" circuit operated by the gate generator "A". The high precision 100 Kc/s signal of the oscillator, properly amplified, arrives as a negative light modulation to the cathode of the cathode-ray tube, in consequence of which the time base line on the screen of the cathode-ray tube is extinguished at intervals of 10 microseconds. The marker signal is also separately lead out to the coaxial connecting terminals on the front plate. Thus it is possible to employ the marker signal with external measuring devices. The same coaxial terminals allow the connecting of the external "Z" modulation of the cathode-ray tube.

In addition to the above blanking marker signals, it is possible by means of the gate generator "A" and of the precision delay circuit, to produce more brightly illuminated marker signals of 100 to 1000 microseconds duration which can be displayed on the screen of the cathode-ray tube.

The cathode-ray tube has a large screen diameter and the high acceleration voltage applied warrants a sharp image of great luminous intensity. Luminous intensity and picture (focus) sharpness can be adjusted separately and regulation of the auxiliary focus in the third grid will further enhance the clarity of the image. The position of the light spot on the screen can be shifted and continuously adjusted both horizontally and vertically. The **high voltage** for the cathode-ray tube is supplied by a separate mains rectifier, while all other stages with electron tubes obtain the required voltage from a separate **power supply unit.**

The **electron tubes** used in the apparatus are:

6 SN 7—11	6 H 6 G—2	6 AG 7—6
6 SJ 7—1	6 L 6 G—1	6 AC 7—2
6 H 6—1	VR 150—1	807—2
2 X 2—2	5 U 4 G—3	5 CP 1—1
6 F 6 G—1		

(The number after the Type-Number indicates the number of tubes in use.)

SPECIFICATION

CATHODE-RAY TUBE

DIAMETER OF SCREEN:
5″ (12,5 cm)

ACCELERATION VOLTAGE:
max. 4000 V

VERTICAL AMPLIFIER

FREQUENCY RANGE:
5 c/s — 8 Mc/s

LINEAR DISTORTION (1 Kc/s): ± 3 dB

RISE AND DECAY TIME:
max. 0,1 μsec

ROOF FALL (with signal of 50 c/s):
max. 5%

OVERSHOOT: max. 3%

TIME BASE GENERATOR

1. CONTINUOU

FREQUENCY RANGE:
20 c/s — 200 kc/s
(adjustable in 9 steps or continuously)

2. TRIGGERED

a) "A" MODE
NON-DELAYED TIME DURATIONS:
5, 10, 25, 100
1000, 4500, 1000 μsec

b) "R" MODE TIME DURATIONS
DELAYED: 5, 10 and 25 μsec or
10 and 25 μsec within 1000 μsec

TRIGGER PULSE GENERATOR

FREQUENCY RANGE:
80 c/s — 2000 c/s
(continuously adjustable)

REQUIRED EXTERNAL TRIGGER SIGNAL:
positive or negative

EXTERNAL TRIGGER VOLTAGE:
min 15 V

OUTPUT START SIGNAL:
positive or negative

VOLTAGE OF OUTPUT START SIGNAL:
appr. 25 V

DELAY CIRCUIT

DELAY OF TRIGGER SIGNAL:
4 -- 20 μsec
(continuously adjustable)

PRECISION DELAY CIRCUIT

RANGE OF TIME MEASUREMENT:
0,05 — 1000 μsec

ACCURACY OF TIME MEASUREMENT:
± 1%

MARKER GENERATOR

a) "R" MODE
BLANKING INTERVALS: 10 μsec ± 5%

b) "A" MODE
with 100 to 1000 μsec running down:
displaceable light signal

POWER SUPPLY

Voltage:	110 or 220 V
Frequency:	50/60 c/s
Consumption:	about 350 W

OTHER DATA

FINISH :

lacquered steel-sheet cabinet with 2 built-in carrying handles

DIMENSIONS

(without knobs and handles) :

height	480 mm
width	360 mm
depth	620 mm

WEIGHT : about 70 kg

ACCESSORIES :

1 power cord
2 coaxial screened cables with connector plugs
3 coaxial connector plugs "Am"
1 co-ordinate plate
1 light shield
4 double plugs for short-circuiting

As a result of conntinued efforts to improve the design of instruments, we reserve the right to change this specification.

EMG–1551

DOUBLE-BEAM OSCILLOSCOPE

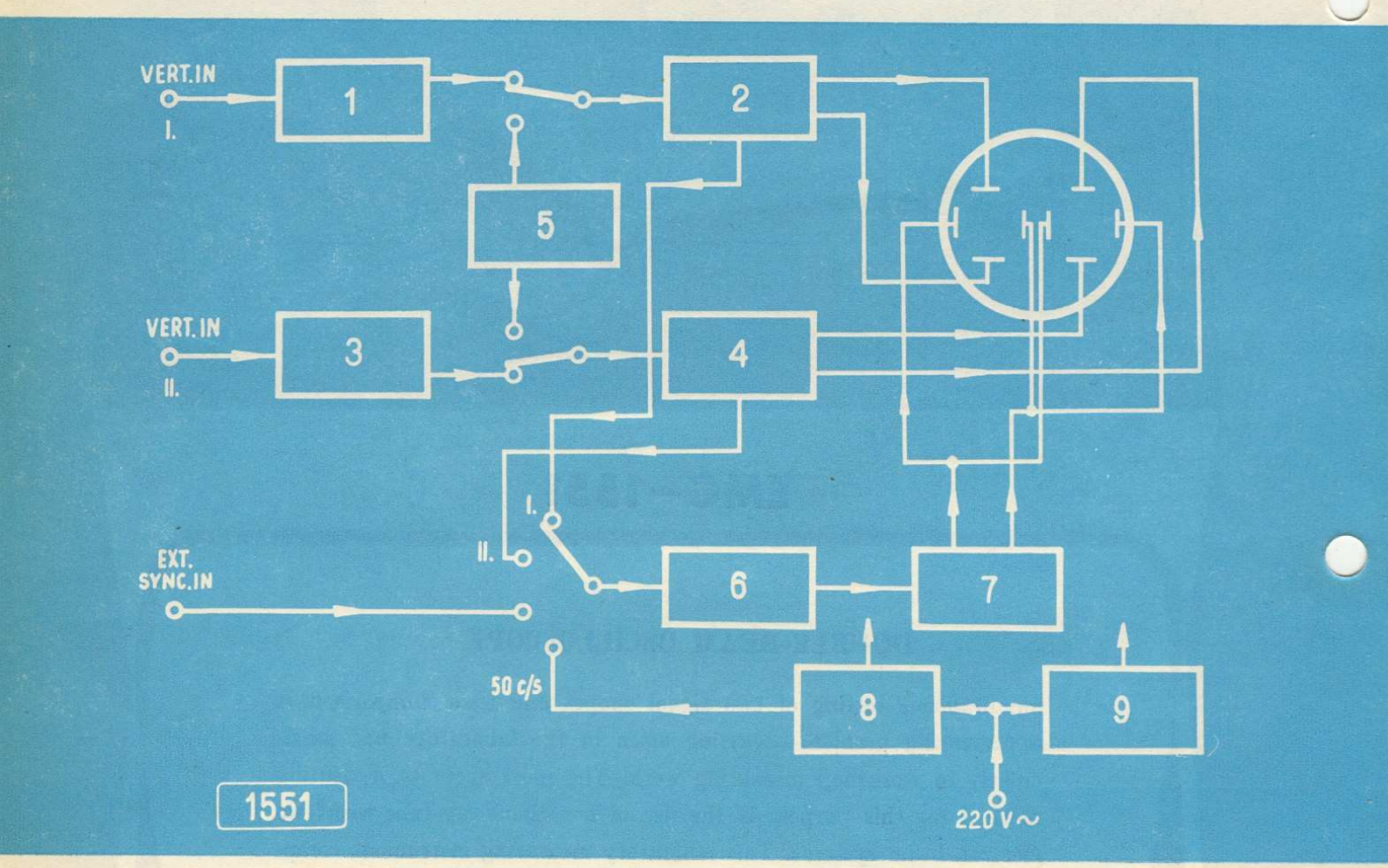
Simultaneous testing of two signal shapes and their comparison, is a measuring problem occurring often in the laboratory but particularly in workshop measuring work. The most accurate measuring method for this purpose is the use of a cathode-ray tube with two electron beam systems. This laboratory measuring instrument complies not only in respect of its circuitry, but also for its internal design and versatile utilization, with the highest technical requirements of the related measuring technique problems.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

FUNCTION. The functioning principle of the "Double-beam Oscilloscope" is shown in the Block Schematic Diagram below.

The cathode-ray tube features two independent electrone-optics and deflecting systems which can be operated independently of each other. Brilliance and sharpness, as well as the position of the spot of light in vertical and horizontal directions can be regulated separately in both systems. The deflecting plate pairs require symmetrical voltages which are supplied by two self-contained and independent amplifiers. The task of the amplifiers is vertical deflection but one of them can also be used as horizontal amplifier, always with the other deflecting system. Connection to the deflecting plate pairs is possible directly or also through a capacitor, so that for indication purposes the instrument can be used even up to 50 Mc/s.

The external voltages under test passe first into the measuring head coupled before the amplifiers; these measuring heads contain one electron tube each coupled as electronic voltage divider and input-cathode-follower respectively. Continuous regulation of the input voltage is carried out in the cathode of the measuring head tube with the aid of a



1. Input cathode-follower stage (Probe I)
2. Broad-band vertical amplifier I
3. Input cathode-follower stage (Probe II)
4. Broad-band vertical amplifier II
5. Calibrating voltage
6. Sync. amplifier and sync. phase inverter stage
7. Time-base generator
8. Power supply unit
9. High-voltage supply unit

potentiometer. The low resistance value of the latter makes for frequency independent regulation. Sensitivity can be adjusted within a very wide range by the use of the electronic input voltage divider. The amplifier stages in the amplifier are separated from each other bycathode-follower stages. The symmetrical voltages required for the deflecting plate pairs are generated by the push-pull output stages following after phase inversion. Phase inversion is made in the cathode circuit of the push-pull output stage. A **calibrating voltage** of 50 c/s frequency can also be coupled to the input of the amplifiers; this voltage can also be adjusted in two steps, according to the sensitivity in two steps. By its help the ratio, between the signal to be tested and the calibrating signal, becomes directly visible on the cathode-ray tube screen and can thus be utilized directly for measuring purposes.

The **time-base generator** has a multivibrator circuit and its frequency can be adjusted in steps and also continuously. Straight line response of the time-base voltage is provided for by the charging coupling stage. The timebase generator can be switched to operation of two ways:

a) the time of running is adjusted for four different durations,

b) for a single running which can be triggered from the outside.

There are three facilities for **synchronization**

a) internal synchronization from one or from the other amplifier

b) external synchronization from an adequate signal generator and

c) synchronization with 50 c/s AC mains frequency.

The synchronous signal gets through an amplifier stage (separator) into the time-base generator so that the reaction of the generator signals is prevented. Measure and phase of synchronization can be regulated.

The **power supply unit** produces two positive anode voltages and one negative for the various stages, also a negative high-voltage for the cathode-ray tube, all with the aid of separate rectifiers. The anode voltage of the more important stages is stabilized.

The internal design of the instrument is based on up-to-date principles: the electronic units operating independently, are built onto separate frames so that mounting is convenient and easy acces to all components is ensured.

Tubes used in this instrument:

6 J	6–2	EF	42–4	ECC	40–2
6 AU	6–2	EL	84–4	EL	6–1
EL	41–2	AZ	4–3	AZ	1–1
V	22/7000–1	VR	150–2	OR	2/100/2–1

(The number after the Type-Number reference indicates the number of tubes in use.)

SPECIFICATION

CATHODE-RAY TUBE:

4″ (10 cm)

ACCELERATING VOLTAGE:

about 1500 V

VERTICAL AMPLIFIERS (both)

FREQUENCY RANGE:

20 c/s — 5 Mc/s

SENSITIVITY:

25 mV_{rms}/cm,
or 70 mV/cm p-p

LINEAR DISTORTION
(with measuring heads)
(relative to 1 kc/s): ± 3 dB

INPUT IMPEDANCE OF
MEASURING HEAD: 2·2 Mohms || 20 pF

TIME-BASE GENERATOR

FREQUENCY RANGE:

15 c/s — 150 kc/s
(in 8 sub-ranges)

SINGLE TRIGGERED RUNNING:
(continuously adjustable):

approx. 5 μsec
25 μsec
100 μsec
1000 μsec

TRIGGERING SIGNAL :
min. 15 V unit pulse

SYNCHRONIZATION :
(adjustable) :

a) to the first vertical amplifier

b) to the second vertical amplifier

c) to external voltage source

d) to mains frequency

(Measure and phase of synchronization are adjustable)

INPUT RESISTANCE OF SYNCHRONIZATION : 1 Mohm

POWER SUPPLY

Voltage :	110, 127, 220 V
Frequency :	50/60 c/s
Consumption :	about 400 W

OTHER DATA

FINISH :
lacquered steel-sheet case with two built-in handles

DIMENSIONS :
(without knobs and handles) :

height	500 mm
width	400 mm
depth	650 mm

WEIGHT : about 60 kg

ACCESSORIES :

1 power cord
2 measuring heads
8 short-circuiting double plugs

As a result of continued efforts to improve the design of instruments, we reserve the right to change this specification.

EMG–1534

CATHODE-RAY OSCILLATOR

A small size instrument which can be used with advantage for audio-frequency measurements both in the workshop and in the laboratory.

EMG–1541/C

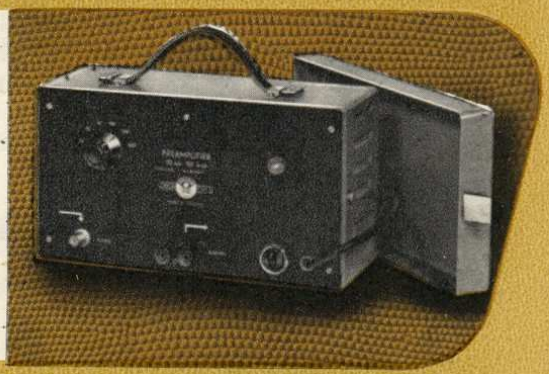
WIDE-RANGE CATHODE-RAY OSCILLOSCOPE

A measuring instrument with high amplification, permitting up to 8 Mc/s a true-to-shape examination of very low amplitude signals with negligible distortion. The screen of the CRT is large, the diameter being 5″ (125 mm).

EMG–1594

LOW-FREQUENCY PRE-AMPLIFIER

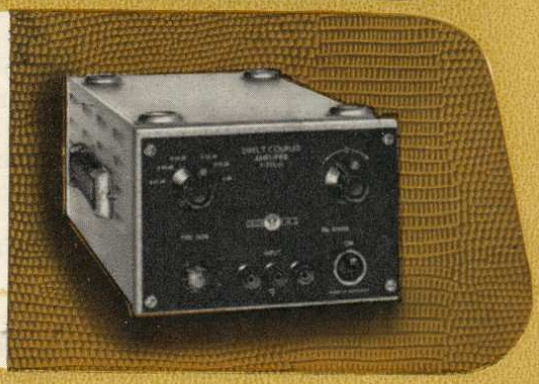
This instrument connected before smaller types of oscilloscopes, will increase its amplification 500 times. Its frequency characteristic is nearly linear. Having a self-contained power supply unit it can be used independently.



EMG–1598

D. C. AMPLIFIER

For use as pre-amplifier of an oscilloscope when testing D. C. changes. Its advantage is that the input and output signals are on an equal level.



WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

EMG—1534 CATHODE-RAY OSCILLOSCOPE (300 kc/s)

FUNCTION. The vertical amplifier and horizontal amplifier are identical in their electrical design. Connection with the amplifiers, is possible directly or through input attenuators (voltage dividers) which can be used within a very wide frequency range. The amplifiers are cathode-follower coupled. The time-base generator is designed as cathode-coupled multivibrator. Frequency can be regulated stepwise and continuously, the amplitude can be adjusted with the input potentiometer of the horizontal amplifier. Three methods of synchronization are provided : internal from the vertical amplifier, from the AC. mains 50 c/s, external from a suitable signal generator. The power supply unit consists of two parts. High voltage required for the supply of the cathode-ray tube is obtained from a separate rectifier tube.

SPECIFICATION

CATHODE-RAY TUBE SCREEN DIAMETER	3″ (7,5 cm)
VERTICAL AMPLIFIER :	20 c/s — 300 kc/s
LINEAR DISTORTION at 1 kc/s :	+ 1—3 dB
SENSITIVITY :	50 mV_{rms}/cm
HORIZONTAL AMPLIFIER :	20 c/s — 300 kc/s
LINEAR DISTORTION at 1 kc/s :	± 3 dB
SENSITIVITY :	65 mV_{rms}/cm
TIME-BASE GENERATOR :	20 c/s — 75 kc/s (5 steps)

EMG—1541/C WIDE-RANGE CATHODE-RAY OSCILLOSCOPE (8 Mc/s)

FUNCTION: The vertical amplifier consists of several main units : the three-stage pre-amplifier is followed by a phase inverter and a push-pull output stage for producing the symmetrical voltages. Before entering the pre-amplifier, the test signal passes a three-stage attenuator. The horizontal amplifier has two stages and also supplies symmetrical voltages. The input voltage passes a two-stage attenuator before reaching the amplifier. The time-base generator consists of a two-tube multivibrator and a charging pentode to produce the saw-tooth oscillations. There are three possibilities for synchronization : internal, from AC mains 50 c/s and external. The mains unit supplies voltages and current for all stages, the negative high voltage for the cathode-ray tube is independently of the preceding rectifiers.

SPECIFICATION

VERTICAL AMPLIFIER :	5 c/s — 8 Mc/s
LINEAR DISTORTION (at 1 kc/s)	+ 1 — 3 dB
SENSITIVITY :	75 mV_{rms}/cm
HORIZONTAL AMPLIFIER :	20 c/s — 500 kc/s
LINEAR DISTORTION (at 1 kc/s) :	± 2 dB
SENSITIVITY :	60 mV_{rms}/cm
TIME-BASE GENERATOR :	20 c/s — 500 kc/s (7 steps)

EMG—1594 LOW FREQUENCY PRE-AMPLIFIER

FUNCTION: From the point of view of electrical design the instrument is a two-stage RC coupled amplifier with pentodes of high mutual conductance. The high negative feedback makes it nearly insensitive to various disturbing influences (e. g. ageing of tubes, etc.) A six-stage attenuator is used for controlling amplification and the gain can be read off directly on the scale of the attenuator.

SPECIFICATION

FREQUENCY RANGE :	20 c/s — 100 kc/s
AMPLIFICATION (GAIN) :	10, 20, 50, 100 and 500-fold
LINEAR DISTORTION :	± 1 dB
INPUT VOLTAGE :	max. 2,5 V
OUTPUT VOLTAGE :	max. 25 V

EMG—1598 D. C. AMPLIFIER

OPERATION: The amplifier is D. C. coupled and consists of three push-pull stages operating with double triodes. Both input and output can be symmetrical or asymmetrical. Positive and negative feedback increase stability. The rectifier operates in voltage doubler circuit and the power supply contains paper insulated capacitors only.

SPECIFICATION

FREQUENCY RANGE :	0 — 20 kc/s
INPUT IMPEDANCE :	2 × 500 komhs
INPUT ATTENUATOR :	0 — 50 dB (6 steps)
ATTENUATION ACCURACY :	± 1,5 dB
LINEAR DISTORTION :	± 2 dB

EMG–9911

CATHODE-RAY ELECTROCARDIOGRAPH

A medical electronic instrument to be used for the continuous examination of the action voltages of the heart or of pulse and cardiac sound signals. Very quick changes of low voltages being involved, it is most expedient to use the cathode-ray tube and up-to date electronic amplification methods for observing them. The signals under test can be seen for a relatively long time on the cathode-ray tube screen in the shape of persistance curves and they can also be photographed with the "PHOTORECORDER" camera.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

FUNCTION: The human body can be taken as a generator of high internal resistance. The action voltages which can be taken off from various points of the body can only be measured with an instrument of particularly high internal resistance ; other instruments will show only a fraction of the original voltage so that false data are obtained by their use. High amplification is required for making visible and fixing the very low voltages and in addition particular care must be paid not only to the input resistance but also to true-to-shape and true-to-phase transmission. Low inertness of the measuring, respectively the indicating system is most important when displaying the voltages, to avoid distortions. The cathode-ray tube is the most convenient device for this purpose. Electronic circuit technique now already enables the detection of processes shorter than the μsec order of magnitude.

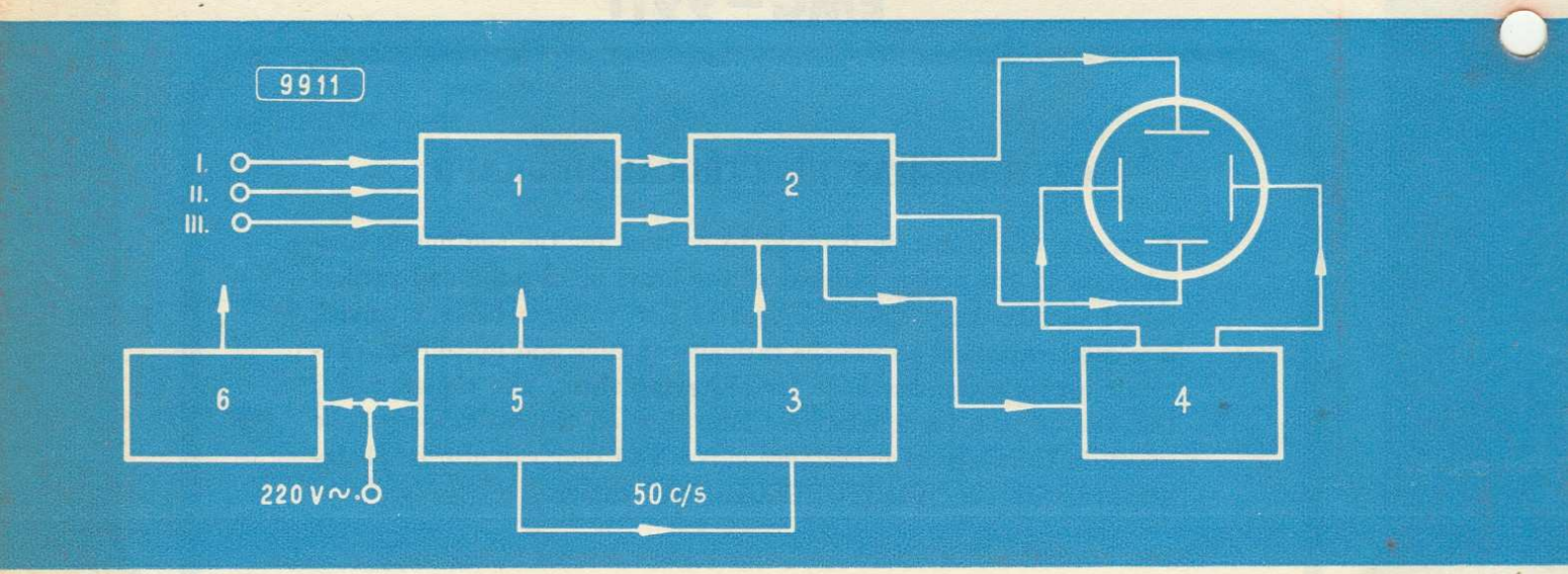
The functioning principle of the "Cathode-ray Electrocardiograph" is shown in the Block Schematic Diagram below.

The electrodes fastened to the body of the patient establish through the patient-cable an electrical connection with the instrument. The outlets can be changed over on the instrument according to the examination under the Enthoven rule. The incoming action voltages are amplified to the desired level by the three-stage **push-pull coupled amplifier** connected to the **vertical**-deflection plate pair of the cathode ray tube. Distortion-free stable operation of amplification is warranted by the full symmetry of the coupling and by the high negative feedback applied. The **time-base generator** supplies the saw-tooth shaped voltage, connected to the horizontal deflecting plates of the cathode-ray tube and controlling the progress in the **horizontal** direction of the illuminating display spot. The position of the display spot can be adjusted with separate control potentiometers. The **power supply unit** supplies an electronically stabilized anode voltage to the amplifier stages of the instrument and 220 V alternating voltage to the "PHOTO-RECORDER". The careful design of the instrument, the screening effect of the external metal case and the efficient magnetic screening of the cathode-ray tube warrant medical examination free of external disturbances.

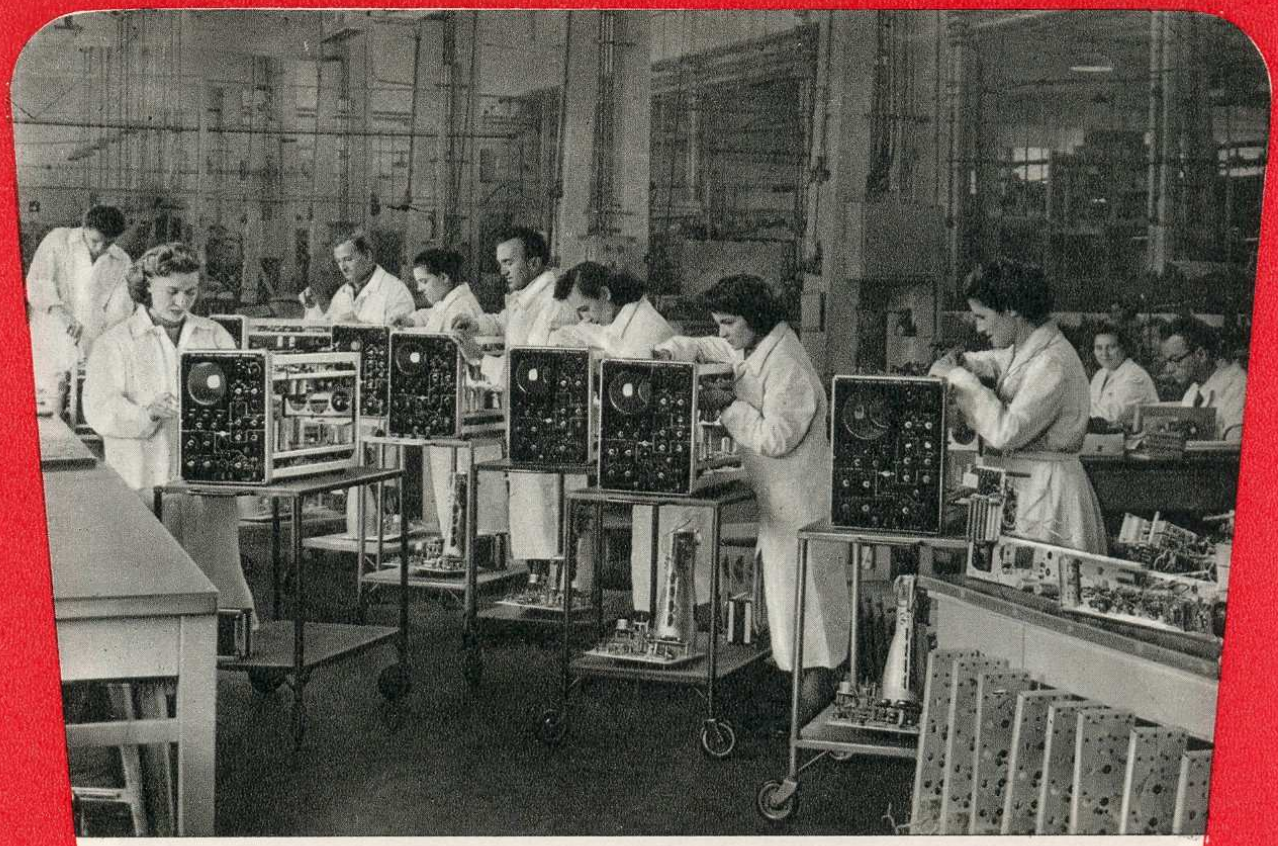
Precise medical appreciation of the examined phenomena requires continuous fixing of the display appearing on the screen, which is also necessary to keep a record for future examination. The „PHOTO-RECORDER" is used for this purpose ; this camera fixes the display on the screen with an adequate optical equipment on a 35 mm light sensitive paper band.

ACCESSORIES :

1 power cord
1 patient-cable and various electrodes with connections



1. Electrode group selecting stage
2. Vertical amplifier
3. Interference compensating stage
4. Time-base generator
5. Power supply unit
6. High-voltage supply unit

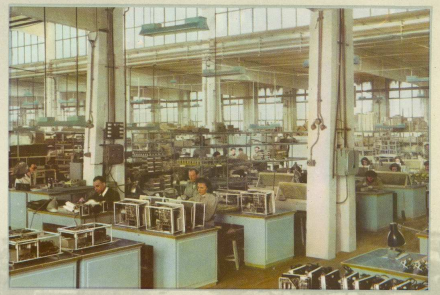


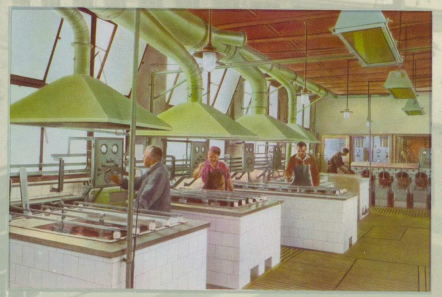
CONTINUOUS ASSEMBLY OF TV OSCILLOSCOPES

CALIBRATION OF TV OSCILLOSCOPES

DETAIL OF TRANSFORMER WINDING SHOP

LABORATORY CONTROL
OF MICROWAVE SIGNAL GENERATOR



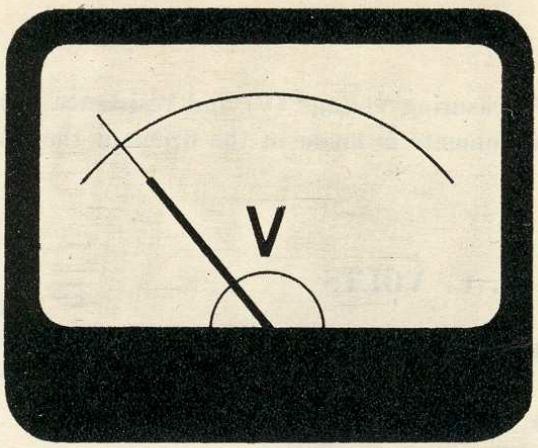


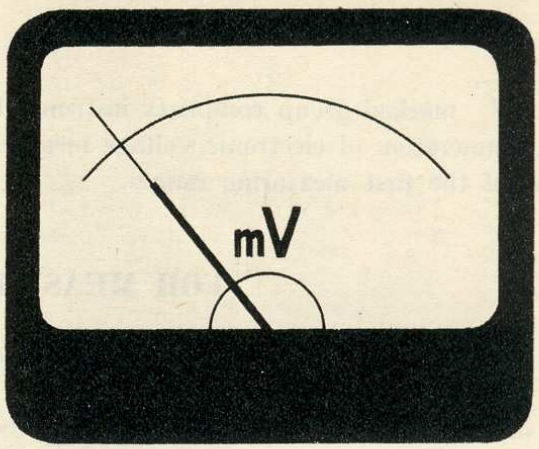
RÉSZLETEK A GYÁR ÉLETÉBŐL

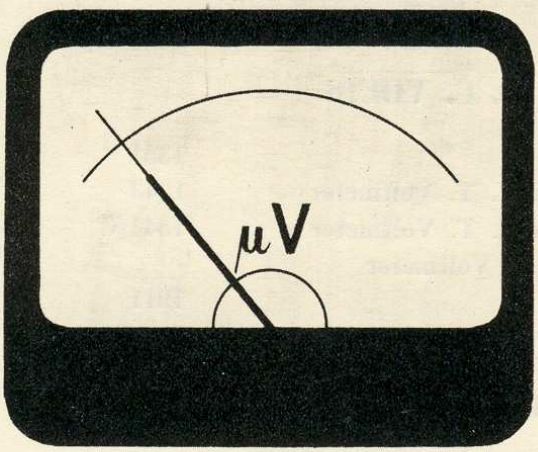
СНИМКИ ИЗ ЖИЗНИ ЗАВОДА

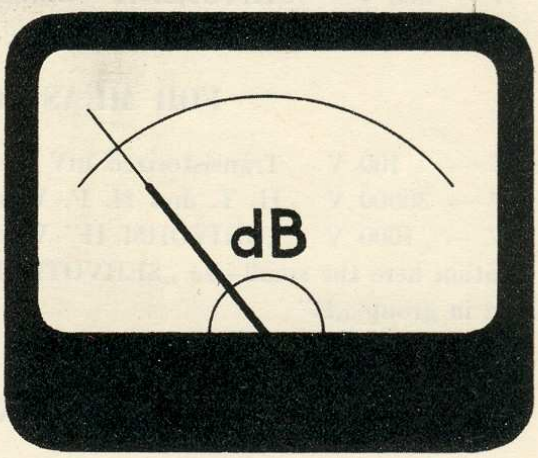
TEILANSICHTEN AUS DEM LEBEN DER FABRIK

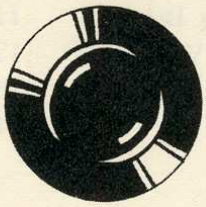
SOME VIEWS OF THE LIFE OF THE FACTORY

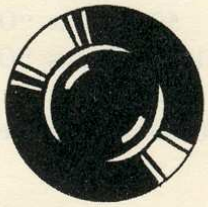












V

VOLTMETERS

OHM METERS

The "V" marked group comprises instruments for measuring voltage (V) and resistance (R). The enumeration of electronic voltage measuring instruments is made in the order of the upper limits of the first measuring ranges.

FOR MEASURING A. C. VOLTS

			Page
300 μV — 100 V	Sensitive V. T. Voltmeter (300 kc/s)	1316	101
30 mV — 100 V	V. T. voltmeter (500 kc/s)	1315/C	99
300 mV — 30 V	Transistorized mV meter (250 Mc/s)	1351	111
1 V — 300 V	H. T. and H. F. Workshop V. T. Voltmeter (200 Mc/s)	1343	107
3 V — 300 V	"ORIVOHM II" Workshop V. T. Voltmeter (25 Mc/s)	1341/C	105

FOR MEASURING D. C. VOLTS

3 mV — 100 V	Transistorized mV meter	1351	111
1 V — 30000 V	H. T. and H. F. Workshop V. T. Voltmeter	1343	107
3 V — 1000 V	„ORIVOHM II" Workshop V. T. Voltmeter	1341/C	105
We mention here the small-size „SERVOTEST" V. T. Voltmeter included in group „E"		1911	151

FOR MEASURING RESISTANCE (R)

0,1 — 1000 mOhms	Milliohmeter Attachment	1411	115
0,5 ohm — 10 Mohms	"ORIPONS" Workshop Measuring Bridge	1432/B	115
0,2 ohm — 1000 Mohms	"ORIVOHM II" Workshop V.T. Voltmeter	1341/C	105
0,2 ohm — 1000 Mohms	H. T. and H. F. Workshop V. T. Voltmeter	1343	107
0,5 Mohm — 100000 Mohms	Megohmmeter	1422	115

In group "V" they are the following

MICROWAVE MEASURING INSTRUMENTS

VSWR Indicator	1318	103
Microwave Power Meter	1382/B	113

EMG–1315/C

VACUUM-TUBE VOLTMETER

This precision voltmeter is a valuable appliance designed in the first place for telecommunication voltage measurement in the audio-frequency range. Within the specified frequency limits it works with remarkably low linear distortion. The instrument can also be used as an indicator up to 1 Mc/s if some concessions can be made with respect to measuring accuracy and to frequency response.

The amplifier may be used as an independent amplifier, with separate input and output coaxial connectors.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

FUNCTION. The functioning principle of the "Vacuum-tube Voltmeter" is shown in the Block Schematic Diagram below.
The input attenuator (voltage divider) is connected to the first amplifier stage in cathode-follower circuit. Additional gain is obtained by a two-stage voltage amplifier, whose design and well balanced coupling elements warrant the linearity of the frequency response.
Mains voltage fluctuations and tube variations are efficiently guarded against, by the considerable negative feedback of the voltage amplifier.
The amplified AC voltage, also passes through another amplifier stage in cathode-follower circuit before it reaches the measuring rectifier of the VT. voltmeter.
The eight-steps **attenuator** is divided in steps of 10 dB each. When used as a measuring amplifier, the instrument is capable to produce a gain of about 100 with the attenuator set to the lowest position.
The output voltage of the measuring amplifier is high enough for the most measuring tasks to be performed.
Voltage and current for the various stages of the equipment are obtained from a properly filtered power supply unit.

Tubes used in this instrument :
6 AC 7—2 6 J 5—2 6 X 5—2

(The number after the Type-Number indicates the number of tubes in use.)

SPECIFICATION

a) VT. VOLTMETER

MEASURING RANGE : 2 mV — 100 V (in 8 ranges)

UPPER LIMITS OF MEASURING RANGES : 30, 100, 300 mV 1, 3, 10, 30, 100 V

MEASURING ACCURACY
(after reaching the constant internal temperature) : ± 3% of f.s.d.

FREQUENCY RANGE : 20 c/s — 500 kc/s

FREQUENCY RESPONSE
(related to 1 kc/s) :
between 25 kc/s and 300 kc/s : ± 2%
below and above
(within the frequency range) : ± 5%

INPUT IMPEDANCE
in the lower four measuring ranges :
about 2 Mohms || 35 pF
in the upper four measuring ranges :
about 1 Mohm || 35 pF

b) **MESURING AMPLIFIER**

Frequency response
(related to 1 kc/s) :
between 25 c/s and 300 kc/s : ± 0,2 dB
below and above
range) : (within the frequency ± 0,5 dB

AMPLIFICATION
(within 30 mV measuring range) :
about 100 x

OUTPUT VOLTAGE : max. 3,5 V_{rms}

OUTPUT IMPEDANCE :
about 700 ohms + 100 nF

POWER SUPPLY

Voltage	110, 220 V
Frequency	50/60 c/s
Consumption	about 25 W

OTHER DATA

FINISH :
lacquered steel-sheet case with leather grip

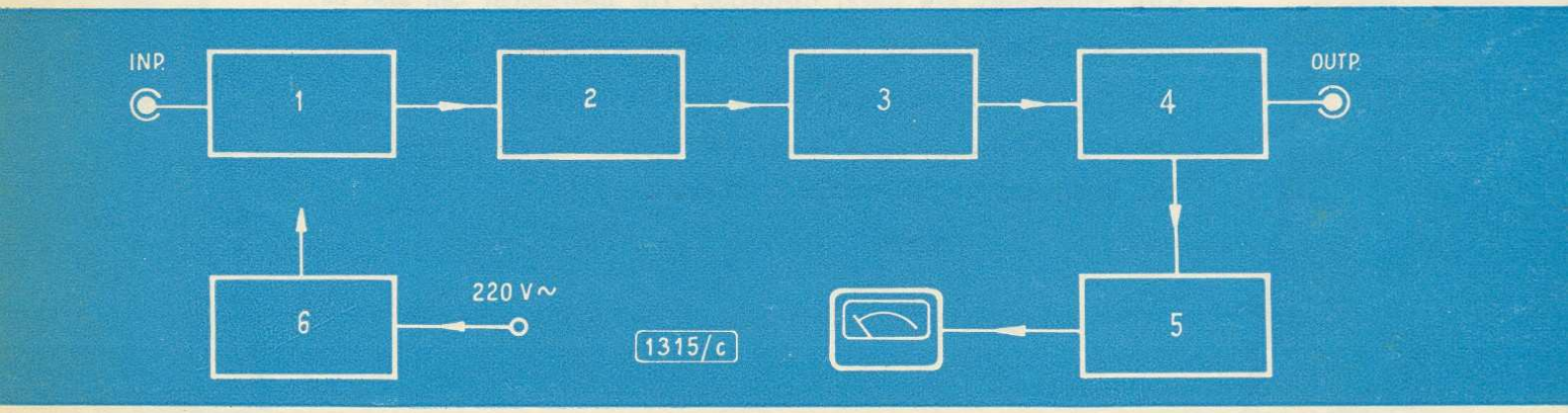
DIMENSIONS
(without knobs and handle) :

height	194 mm
width	240 mm
depth	148 mm

WEIGHT : about 6 kg

ACCESSORIES :
1 coaxial screened cable with connector plugs
1 coaxial "Am" connector plug

As a result of continued efforts to improve the design of instruments we, reserve the right to change this specification.



1. Attenuator
2. Input cathode-follower stage
3. Wide-band voltage amplifier
4. Output cathode-follower stage
5. Measuring rectifier
6. Power supply unit

EMG–1316

SENSITIVE VT VOLTMETER AND MEASURING AMPLIFIER

High-accuracy measuring equipment is needed also in the field of low voltages when measuring the voltage and amplification data of low-frequency amplifiers and apparatus of the transmission technique.

The conventional VT voltmeters register as a rule mV magnitudes while this instrument is measuring in the most sensitive measuring range μV voltages.

Its advantages are : high sensitivity (30 μV can already be read off), a wide upper voltage measuring limit (up to 100 V) and negligible linear distortion. The accuracy of measurements can be improved by the aid of the special voltage calibration arrangement, built into the measuring instrument. The amplifier part of the instrument has very high amplification and low distortion so that it can also be used as laboratory measuring amplifier.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

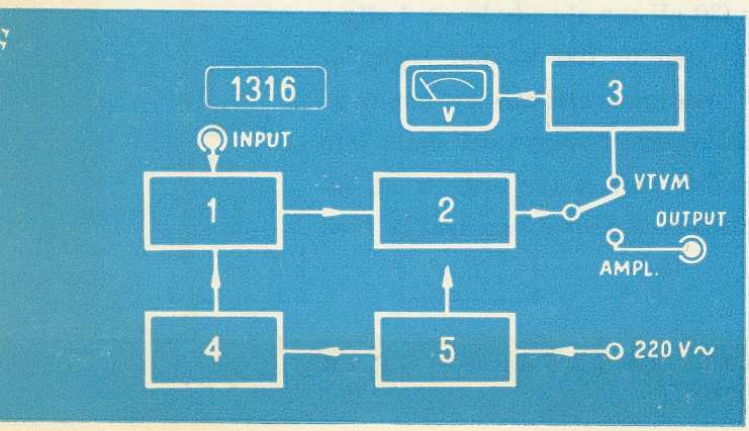
FUNCTION. The functioning principle of the "Sensitive Vacuum Tube Voltmeter" is shown in the Block Schematic Diagram below.

The voltage under test, can be fed in two ways to the grid of the pentode of the input cathode-follower stage. The lower voltages (within the measuring range of 300 μV to 100 mV) get there directly, while the higher voltages (between 300 mV and 100 V) do so through a preliminary voltage divider providing for a 1 : 1000 ratio division. The **attenuator** itself is in the cathode circuit of the cathode-follower stage and serves with six steps for dividing the low voltages. The switches of the two dividers operate on a common shaft, so that they furnish together, attenuation in 12 steps of 10 dB each or voltage divisions for 12 measuring ranges. After the cathode-follower stage the voltage to be measured and already adequately divided is forwarded into an advanced type 4-stage amplifier having very little noise and hum and low distortion. One negative feedback is used for regulating the response of high and low frequencies, the other for regulating the measure of amplification.

The amplifier tubes are not heated with AC voltage but with rectified voltage to ensure the low noise level of the amplifier. Operation of the amplifier tubes under the normal specification data with lower plate and screen grid voltages contribute to noise reduction. The output can be switched over to a coaxial jack which is the output of the measuring amplifier. In the other position of the switch the plate of the power tube is connected with the measuring bridge in whose diagonal an indicating instrument is provided and shows the value of the voltage or attenuation measured. Germanium diodes in the two arms of the bridge designed for rectification of the amplified AC voltages. The measuring instrument has self-calibration.

For high accuracy measurement it is advisable to calibrate the measuring instrument before each measurement series.

All stages are fed with voltage and current by the electronic stabilized **power supply unit.** Stability of the heating voltage is provided for by ferroresonance transformer.



Tubes used in this instrument :

EF 86—5	EL 84—1
VR 105—1	EZ 80—1

(The number after the Type-Number indicates the number of tubes in use.)

SPECIFICATION

A) **AS VT VOLTMETER**

MEASURING RANGE : 30 μV — 100 V (in 12 sub-ranges)

UPPER LIMITS OF MEASURING SUB-RANGES : 300 μV, 1, 3, 10, 30, 100, 300 mV 1, 3, 10, 30, 100 V

ATTENUATOR : —70 dB to +40 dB (in 10 dB steps)

MEASURING ACCURACY (related to 1 kc/s) : $\pm$ 2% (after reaching constant internal temperature)

FREQUENCY RANGE : between 10 c/s and 300 kc/s

FREQUENCY RESPONSE (related to 1 kc/s) $\pm$ 0,5 dB

INPUT IMPEDANCE : 2 Mohms || 40 pF

B) **AS MEASURING AMPLIFIER**

MAX. AMPLIFICATION : about 2000 x

LINEAR DISTORTION (related to 1 kc/s) : $\pm$ 0,5 dB

DISTORTION FACTOR max. 2% (at 2 V_{rms} output voltage)

OUTPUT VOLTAGE : max. 3,5 V_{rms}

OUTPUT RESISTANCE : max. 1000 ohms

POWER SUPPLY

Voltage :	110, 127, 220 V (adjustable)
Frequency :	50/60 c/s
Consumption :	about 75 W

OTHER DATA

FINISH :
lacquered steel-sheet cabinet with 2 metal handles

DIMENSIONS : (without knobs and handles) : height 240 mm, width 500 mm, depth 390 mm

WEIGHT : about 15 kg

ACCESSORIES :
1 power cord
1 coaxial screened cable
1 coaxial connector plug "Am"

As a result of continued efforts to improve the design of instruments, we reserve the right to change this specification.

1. Input cathode-follower stage and attenuator
2. 3-stage amplifier
3. Measuring rectifier
4. Calibrating circuits
5. Stabilized power supply unit

EMG–1318

VSWR INDICATOR AND SELECTIVE AMPLIFIER

(1000 c/s)

A measuring instrument indispensable in the field of microwave laboratory measurements e. g. when matching feeder elements or measuring impedance. In addition it can be used to advantage as an indicator for measuring bridges, fed with a 1 kc/s frequency. This instrument is actually a highly sensitive amplifier, with built-in indicator, for the well known appliance of microwave measurements, for the slotted line.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

FUNCTION: The functioning principle of the "VSWR Indicator" is shown in the Block Schematic Diagram below.
The two main parts of the instrument are the amplifier and the indicator.
The amplifier is highly sensitive and consists of four stages. The input signal passes through a capacitor or matching transformer first to the input attenuator and hence to the pre-amplifier.
In case of VSWR measurements the impedance of the microwave diode performing rectification is matched to the instrument by the input transformer.
Max. 140 dB can be adjusted in eight steps, with the input attenuator. The signal/noise ratio of the input stage is favourably selected.
The selectivity of the instrument is provided for by the double T-filter, operating between two amplifiter stages as negative feedback chain and with the exception of 1000 c/s, attenuates all other frequencies.
From the selective amplifier stage the 1000 c/s signal is lead into the output amplifier; continuous (coarse and fine) adjustment of the amplification is carried out in the grid circuit of the output amplifier.
From the power output amplifier stage the signal passes with cathode-follower coupling to the VT voltmeter. The scale of the instrument shows the standing wave ratio in VSWR.
When using the instrument as VT voltmeter for voltage measurement the linear V and dB calibrated scale of the indicating instrument is read. With the aid of a switch in "—5 dB" position, a higher reading accuracy on the "EXPANDED" scale. In "NORMAL" position the instrument scale is approximately linear, in "EXPANDED VSWR" position it shows an exponential character.

TUBES used in this instrument:

EF 86—3 ECC 82—1 EZ 80—1 VR 150—2

SPECIFICATION

MEASURING RANGE:
0 to 70 VSWR dB (in 8 ranges)
ACCURACY OF STEPS
(10 VSWR — dB): ± 0,2 dB
AMPLIFICATION:
adjustable in 8 steps (between 0 and 140 dB, fine adjustment in each stage)
INPUT VOLTAGE: max. 1 V
INPUT IMPEDANCE:
at the transformer input: about 200 ohms
at the capacitor input: about 200 kohms
FREQUENCY: 1000 c/s ± 2%
BAND-WIDTH
(between the 3 dB points of the frequency curve): 40 c/s ± 20%
SENSITIVITY: 0,1 μV for f. s. d.
NOISE LEVEL < 0,05 μV
(at the most sensitive measuring range)

POWER SUPPLY

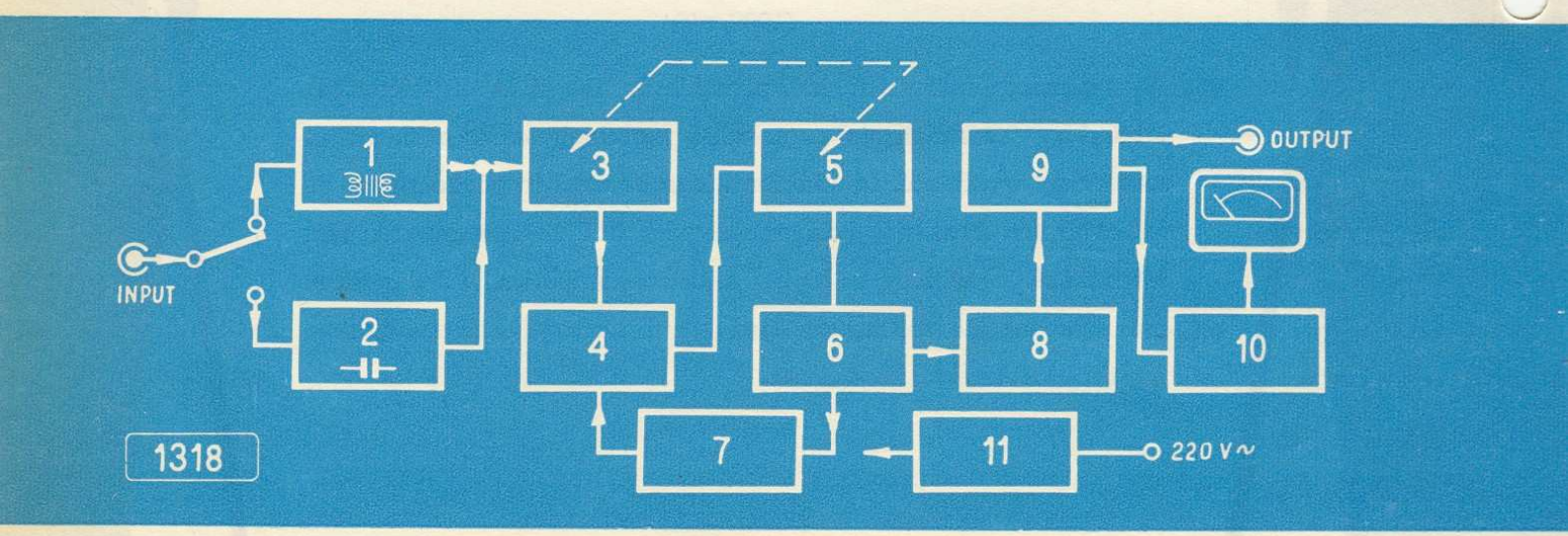
Voltage:	110, 127, 220 V (adjustable)
Frequency:	50/60 c/s
Consumption:	about 40 W

OTHER DATA

FINISH:
lacquered steel-sheet cabinet with 1 leather carrying handle
DIMENSIONS
(without knobs and handle):
height 250 mm width 320 mm depth 220 mm
WEIGHT: about 10 kg

ACCESSORIES:
2 coaxial connector plugs "Am"

As a result of continued efforts to improve the design of instruments, we reserve the right to change this specification.



1. Input transformer
2. Input capacitor
3. Voltage divider 1.
4. Pre-amplifier 1st stage
5. Voltage divider 2
6. Pre-amplifier 2nd stage
7. Double T-link
8. Output amplifier
9. Cathode-follower stage
10. Measuring rectifier
11. Power supply unit

EMG–1341/C

"ORIVOHM II" WORKSHOP VT VOLTMETER

In laboratory measurements and investigations as well as in workshop routine tests, there is frequent need for a handy and dependable VT voltmeter, qualified to take reliable measurements of the occurring DC and AC voltage values or ohmic resistance values with an accuracy to all conceivable requirements.

Owing to its expanded measuring range and its application within wide frequency limits, the "ORIVOHM II" VT voltmeter is excellently suited for laboratory and workshop tasks.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

FUNCTION. The functioning principle of the "ORIVOHM II" Workshop VT Voltmeter is shown in the Block Schematic Diagram below.

The circuit of the VT voltmeter proper, consists of a double triode in bridge circuit; owing to the high input resistance, the power source remains unaffected by the charge from the measuring appliance.

In case of **D. C. measurements**, the test voltage is connected over the input attenuator directly to the bridge circuit.

In case of **A. C. measurements** a double triode acts as measuring rectifier. Measuring errors due to starting current and tube wear are considerably reduced by the compensation circuit applied. The measuring diode, operating on the straight section of its characteristic, secures a considerables linearity of the voltage scale.

The circuit arrangement described, offers the advantage, that only DC voltage will be divided, whether with D. C. or with a A. C. measurement. In consequence there is no delicate compensating of frequency response in the A. C. voltage attenuator.

The measuring appliance can be used as indicator for D. C. fed measuring bridges, with the instrument pointer easily adjustable to mid-position. When measuring A. C. voltages, the measuring instrument can be used as **indicator** up to 75 Mc/s.

For **resistance measurements** the instrument scale is also calibrated in ohms, with 0 at the beginning, 10 in the middle and ∞ at full scale deflection.

The voltage required for resistance measuerment is supplied by a selenium rectifier instead of a dry battery.

Tubes used in this unstrument :

ECC 82—1 EZ 80—1 6 H 6—1

(The number after the Type-Number indicates the number of tubes in use.)

SPECIFICATION

DC MEASURING RANGE: 0 — 1000 V

UPPER LIMITS OF SUB-RANGES :
3, 10, 30, 100, 300, 1000 V

MEASURING ACCURACY : ± 3% of f. s. d.

INPUT RESISTANCE 15 Mohms

AC MESURING RANGE: 0 — 300 V

UPPER LIMITS OF SUB-RANGES :
3, 10, 30, 100, 300 V

MEASURING ACCURACY : ± 5% of f.s.d.

INPUT IMPEDANCE : 1 Mohm || 20 pF

FREQUENCY RANGE : 30 c/s to 25 Mc/s

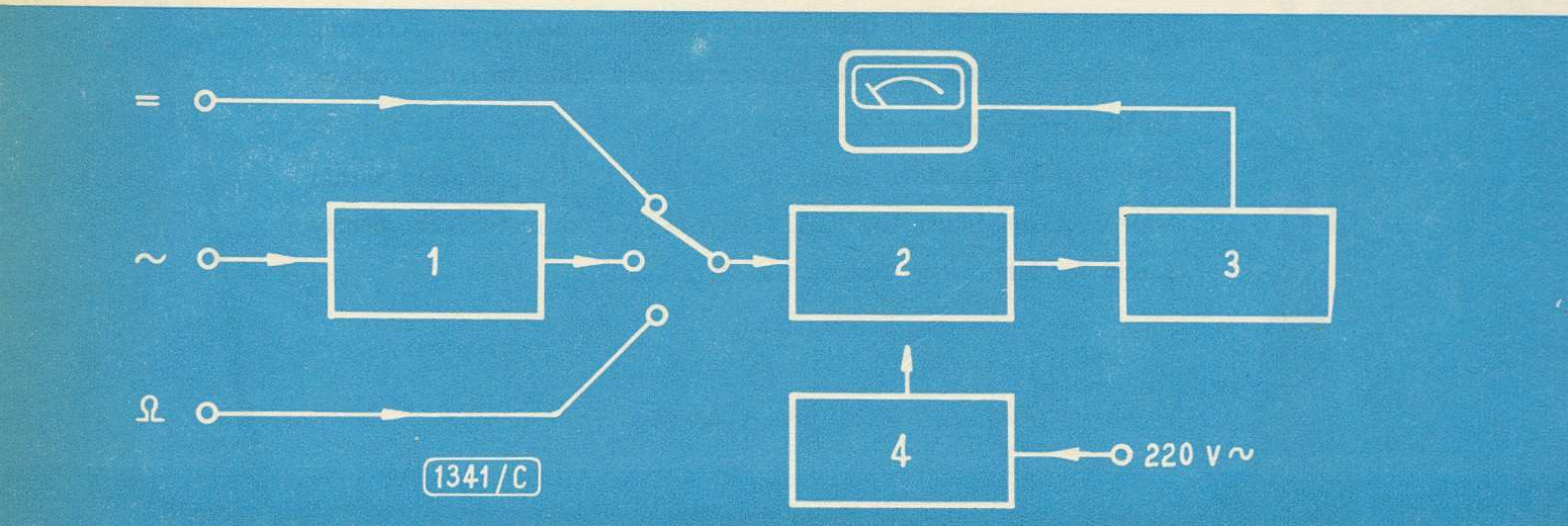
FREQUENCY RESPONSE : ± 0,5 dB

R MEASURING RANGE:
0,2 ohm — 1000 Mohms

UPPER LIMITS OF SUB-RANGES:
1000, 10 000, 100 000 ohms
10, 100, 1000 Mohms

MEASURING ACCURACY
from 100 ohms to 100 kohms : ± 5%
from 100 kohms to 10 Mohms : ± 10%
up to 100 Mohms : ± 20%

POWER SUPPLY
Voltage : 110, 127, 220 V
Frequency : 50/60 c/s
Consumption : about 20 to 25 W



1. Measuring rectifier 2. Voltage divider 3. VT voltmeter bridge 4. Power supply unit

V

EMG–1343

H.T. AND H.F. WORKSHOP VT VOLTMETER

Voltage measurements are needed most frequently in workshop and laboratory measuring work. This VT voltmeter keeps level with the development of H. F. technique, respectively with the extension of the higher frequency limits and with the measurement of higher operating voltages occurring in TV receivers. The instrument is suitable not only for measuring D. C. and A. C. voltages and resistances, but with a special H. F. measuring head, voltages up to 200 Mc/s and with another special H. T. measuring head D. C. voltages can be measured up to 30 kV.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

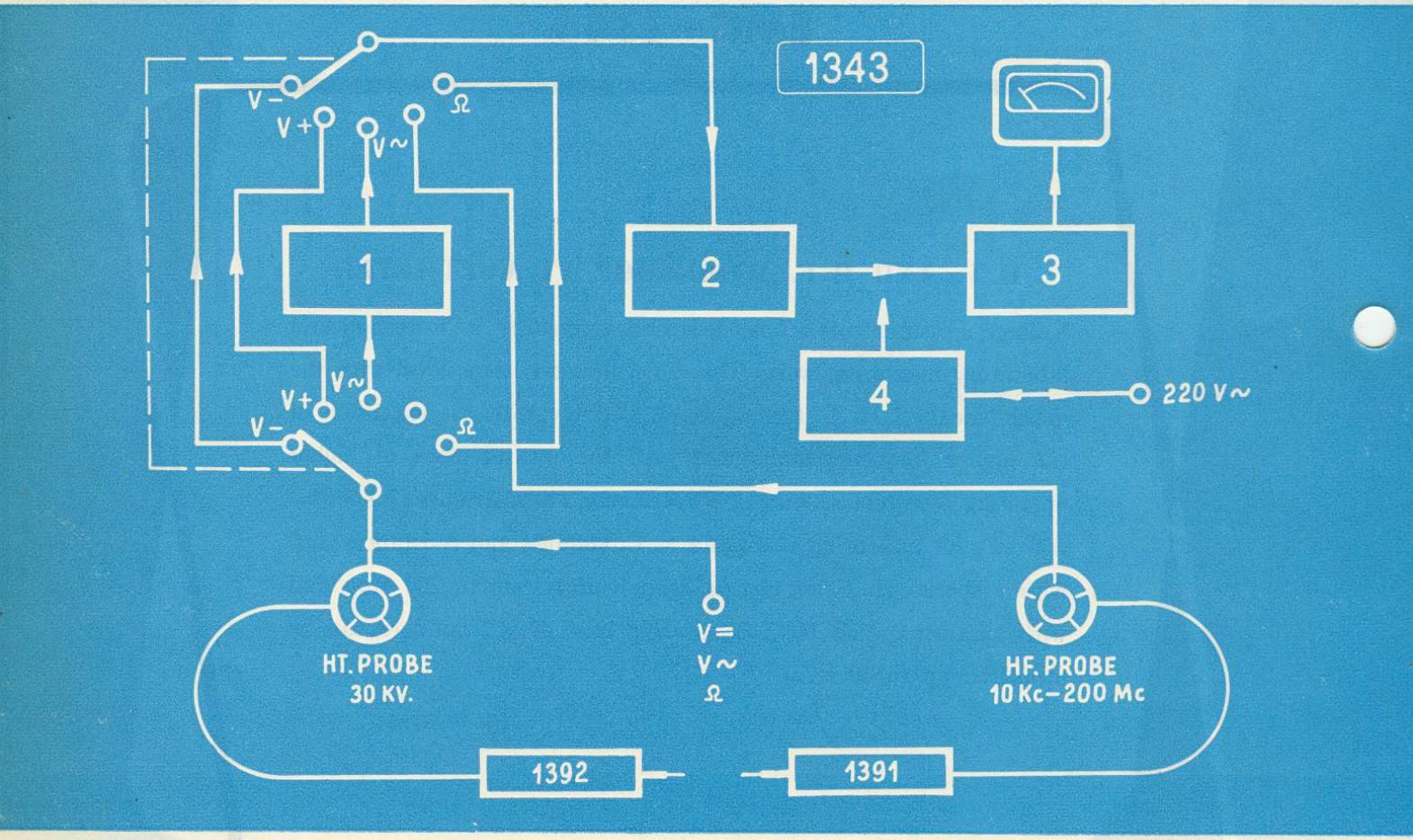
FUNCTION: The functioning principle of the "H. T. and H. F. Workshop VT Voltmeter" is shown in the Block Schematic Diagram below.

One of the advantages of the instrument is, that when measuring without the heads, the test voltage has always to be connected with the same pair of jacks, irrespective whether it is a DC or AC voltage. This means that replugging the source of so much trouble is avoided, since a single rotary switch is used for the selection of the measuring method according to the kind of voltage. The resistance to be tested can be also connected to the above pair of jacks.

The **input attenuator** (voltage divider) is used for selecting the voltage measuring range. Its input resistance (15 Mohms) is so high, that it represents no load of the voltage under test (voltage source).

When measuring **DC voltage** (up to 1000 V) this is connected directly to the input attenuator (voltage divider) to pass from here, after appropriate voltage dividing, to the VT voltmeter, which is a DC amplifier with a bridge circuit and a double triode. The circuit design of the equipment is highly insensitive to measuring errors due to changes and ageing of tubes and of fluctuations in the mains supply. With a mains voltage fluctuation of $\pm 10\%$, there can result even in the most sensitive measuring band only, a measuring deviation of max. $\pm 2\%$, in the other measuring bands the difference is quite negligible. It is known that when measuring DC voltage, the + ve or — ve polarity of the voltage to be measured, has to be taken into consideration. A built-in switch is used for switching over the indicating instrument accordingly, which is a much more convenient solution than to plug over for this purpose. The measurement of **resistance** is also done in the corresponding circuit of DC voltage measurement in a way that the resistance to be tested, figures as one link of the voltage divider and the indicating instrument is in fact only used for measuring the voltage drop accross the resistance. The scale of the instrument is calibrated in ohm values so that there is "0" at the beginning of the scale "10" in the center and "∞" at the end. The measuring voltage of 1 V is produced by selenium rectifier.

There are two possibilities for measuring **AC voltage.** The alternating voltage to be measured is rectified by the built-in diode, if the upper frequency limit is not above 5 Mc/s. A compensating diode is also used in the measuring circuit. The purpose of this diode is the compensation of the starting current



1. Measuring rectifier (built-in)
2. Voltage divider
3. VT voltmeter bridge
4. Power supply unit

and the automatic eliminating of measuring errors resulting from ageing of the electron tube. A great advantage in measuring technique of the VT voltmeter circuit design is that actually always only DC voltage is divided both when measuring DC and AC voltage (taking into account the preceding rectification). This circumstance is significant in two ways. On the one hand there is no need for the very delicate frequency compensation, necessary with AC voltage dividers, on the other hand, the frequency range of the instrument can be raised upwards with relatively simple means of reliable accuracy.

It should be mentioned that the measuring instrument actually measures a peak voltage, the scale of the indicating instruments, however, calibrated for sinusoidal signals in V_{rms}.

Where the upper frequency limit of the signal to be measured is above 5 Mc/s the H. F. measuring head (EMG—1391) has to be used. The instrument can be used as an indicator, completed with a measuring head, up to 700 Mc/s.

Voltage and current for the electronic stages is produced by the **power supply unit** with a single rectifier tube through an adequate filter chain.

Convenient handling and safety in measurement were taken into consideration in the design of the instrument.

The metal cabinet of the instrument must by all means be separately **earthed** through the jack provided for this purpose.

Tubes used in this instrument:

ECC 82—1 EZ 80—1 EA 50—3

(The number after the Type-Number indicates the number of tubes in use.)

SPECIFICATION

DC MEASUREMENT

MEASURING RANGE

(Instrument itself): 20 mV — 1000 V (in 7 sub-ranges)

UPPER LIMITS OF SUB-RANGES: 1, 3, 10, 30, 100, 300, 1000 V

MEASURING ACCURACY: ± 3% of f. s. d.

INPUT RESISTANCE: 15 Mohms (in all ranges)

POLARITY: + ve or — ve adjustable

MEASURING RANGE

(Instrument + H. T. measuring head Type — 1392): 2 V — 30 kV (in 6 sub-ranges)

UPPER LIMITS OF SUB-RANGES: 100, 300, 1000, 3000, 10 000, 30 000 V

MEASURING ACCURACY: ± 10% of f. s. d.

INPUT RESISTANCE: 1500 Mohms (in all ranges)

POLARITY: + ve or — ve adjustable

AC MEASUREMENT

MEASURING RANGE: 100 mV — 300 V (in 6 sub-ranges)

UPPER LIMITS OF SUB-RANGES: 1, 3, 10, 30, 100, 300 V

MEASURING ACCURACY: ±5% fo f. s. d.

MEASUREMENT: peak value of pos, half cycle

CALIBRATION: in RMS value (with sinusoidal shape)

FREQUENCY RANGE

(Instrument itself): 30 c/s — 5 Mc/s

INPUT IMPEDANCE

at 30 c/s:	1 Mohm || 20 pF
at 3 kc/s:	1 Mohm || 20 pF
at 500 kc/s:	500 kOhms || 20 pF
at 5 Mc/s ·	100 kohms || 20 pF

FREQUENCY RANGE

(Instrument + H. T. measuring head Type — 1391): 10 kc/s — 200 Mc/s

INPUT IMPEDANCE

at 100 kc/s:	900 kohms || 5,5 pF
at 1 Mc/s:	650 kohms || 5,5 pF
at 10 Mc/s:	200 kohms || 5,5 pF
at 100 Mc/s:	20 kohms || 5,5 pF
at 200 Mc/s:	5 kohms || 5,5 pF

FREQUENCY RESPONSE

up to 150 Mc/s:	+ 6% of f. s. d.
up to 200 Mc/s:	+ 10% of f. s. d.

RESISTANCE MEASUREMENT

MEASURING RANGE: 0,2 ohm — 1000 Mohms (in 7 sub-ranges)

MEASURING ACCURACY (at the centre of the ranges):

between 100 ohms and 100 kohms: ± 5%
between 100 kohms and 10 Mohms: ± 10%
for other values up to 100 Mohms: ± 20%

POWER SUPPLY

Voltage:	110, 127, 220 V
Frequency:	50/60 c/s
Consumption:	about 25 W

OTHER DATA

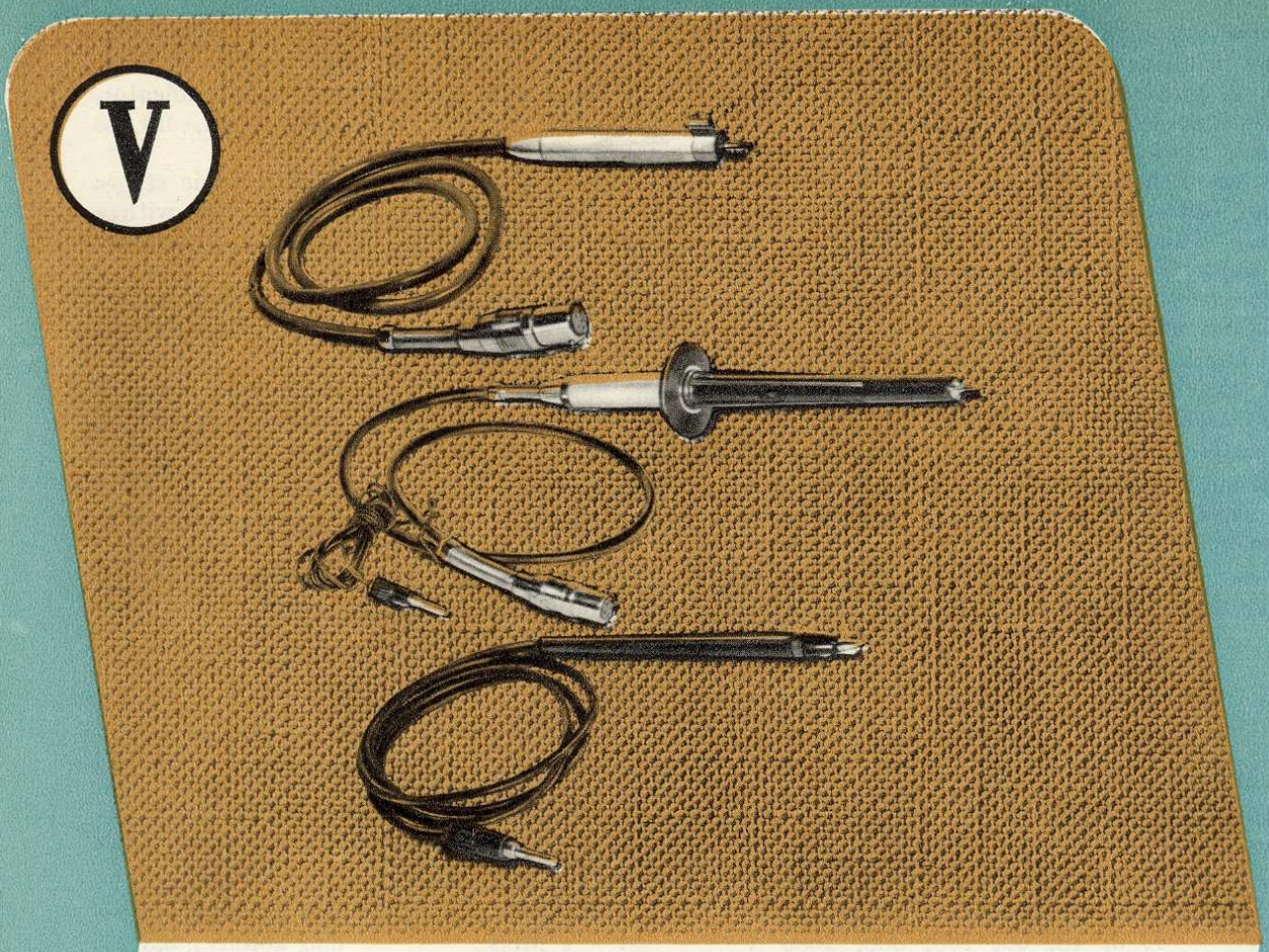
FINISH: lacqueres steel-sheet cabinet with 1 carrying handle

DIMENSIONS: (without knobs and handle): height 235 mm width 180 mm depth 140 mm

WEIGHT: 5 kg

As a result of continued efforts to improve the design of instruments, we reserve the right to change this specification.

V



MEASURING HEADS
FOR THE EMG—1343 VACUUM-TUBE VOLTMETER

EMG—1391 H. F. MEASURING HEAD

By means of this measuring head, H. F. alternating voltage up to a frequency limit of 200 Mc/s can be measured. A special diode, built in the measuring head, performs rectification. The input capacitance of the measuring head is not more than 5,5 pF.

EMG—1392 H. T. MEASURING HEAD

To be used when measuring high alternating voltages (30 kV).

In view of the differences in their use and design the measuring heads are connected separately with the measuring instrument via the respective five-pole plugs of special design.

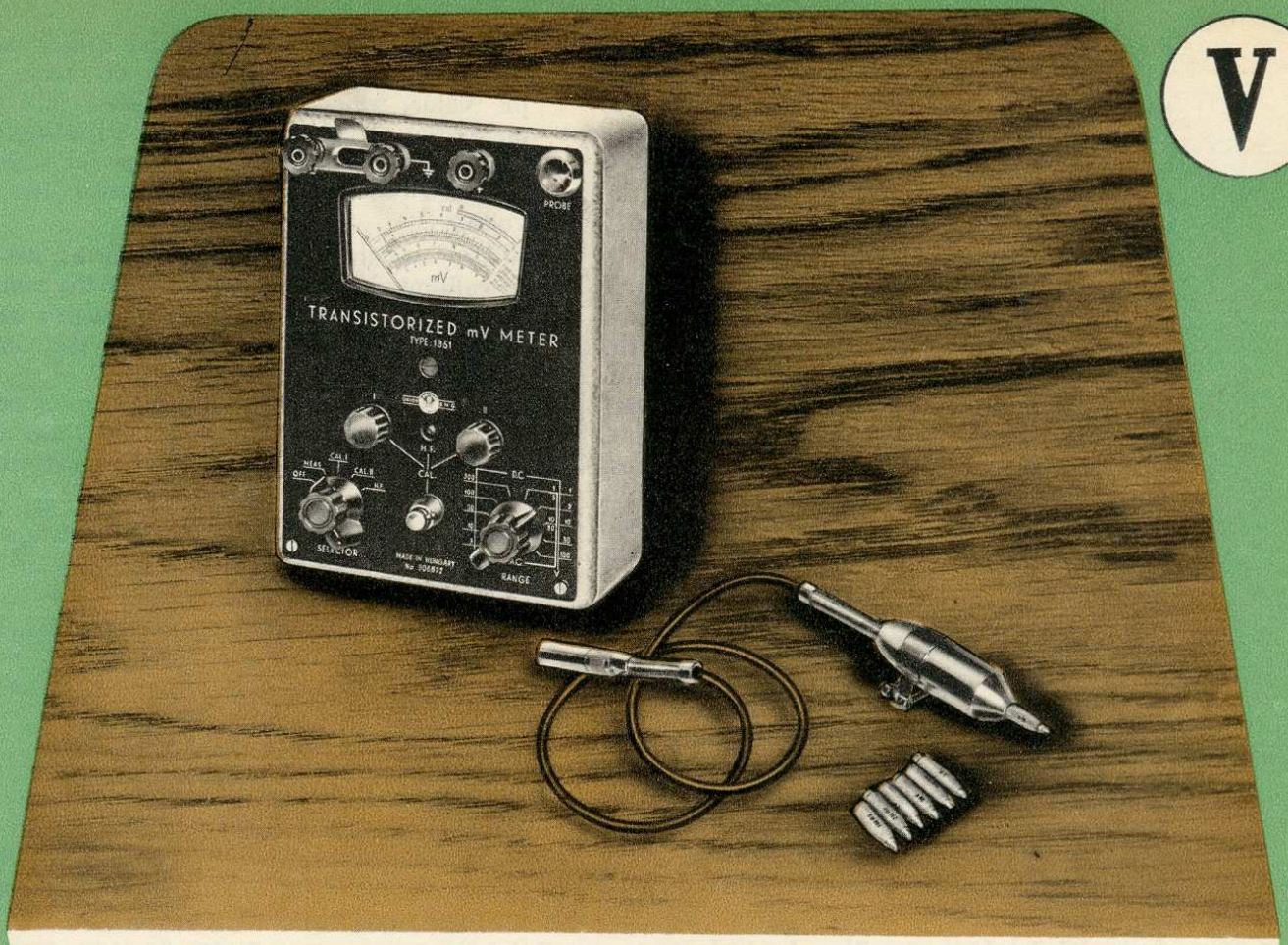
EMG—1393—1 MEASURING ROD for direct connection

EMG—1393—3 MEASURING ROD for connection through a 500 kohms resistor to the VT Voltmeter.

Both measuring rods are provided with fixed measuring cords and banana plugs.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

V



EMG–1351

TRANSISTORIZED mV METER

The unusually small dimensions and the exceptionally low voltage and current demand of transistors has led to a miniaturization of measuring instruments expected by measurement technicians but particularly by servicing men for long time.

The wide measuring range of this mV meter permitting not only measurements of DC voltages but by the aid of the measuring head supplied with it, also measurement of H. F. voltages. This little instrument is the combined result of reduced dimensions and transistorizing.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

FUNCTION. The functioning principle of the "Transistorized mV Meter" is shown in the Block Schematic Diagram below. When measuring **DC voltage** this is directly connected to the input attenuator (voltage divider) provided for the adjustment of the desired measuring range. The basic sensitivity of the measuring system is 3 mV.

In view of the low input voltage under test the DC voltage has to be inverted to AC voltage. This is carried out by means of the DC voltage **inverter** featuring four transistors, two of which operate as **multivibrators** and two, partly parallel connected as AC **chopper.** The AC voltage is measured across the loading resistor connected to one of the emitter electrodes in a square wave signal corresponding to the 1 kc/s frequency of the multivibrator.

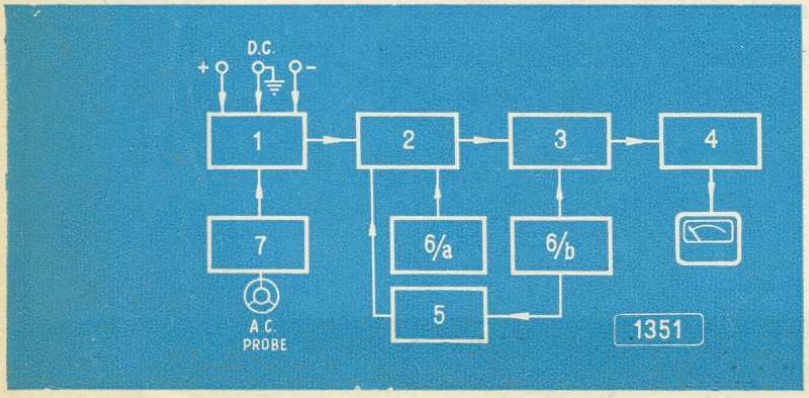
One of the dry batteries at a load of 2,5 mA is provided for the voltage and current supply to the DC voltage inverter (4 transistors). The AC voltage generated in the inverter passes into a three stage **transistor amplifier.** The three stages are exclusively needed for stabilization of the operation. Owing to the operating current load the transistors are sensitive to temperature ; to avoid this they are loaded to no more than 1 to 2 mW instead of the permissible 25 mW.

A special dry battery with a load of no more than 3 mA is used for supplying voltage and current to the transistor amplifier.

The AC voltage coming from the amplifier is rectified by a germanium diode, the DC voltage is indicated by a meter provided in accordance with voltage division with two scales for the DC voltages, one of the scales being graduated in figures of 1 to 10, the other 1 to 3.

The **EMG 1937 H. F. measuring probe** is especially designed for **measuring AC voltages;** the measuring probe operates with two germanium diodes in voltage doubler circuit. The DC voltage of the two charging capacitors passes through a screened cable to the input of the measuring instrument.

The measuring probe provided with germanium diodes has the advantage over the vacuum diodes that it has no starting current and its input capacitance is also lower.



When measuring AC voltages, so called "capacitance dividers", capacitors of very low pF value, which can be screwed into the measuring probe, are used for adjusting the various measuring ranges. A special scale is provided on the indicating meter for AC voltages.

Before measurement, the instrument has to be calibrated in such manner that the voltage of the dry battery should get through a calibrated additional resistance to the input divider of the instrument.

In view of the sensitivity of H. F. measurements the prescriptions concerning the measuring head must be observed strictly. (Screening cap.)

Transistors and diodes used in the instrument :

OC 71—7 DS 160—1 DS 332—2

(The number after the Type-Number indicates the number of tubes in use.)

SPECIFICATION

DC VOLTAGE MEASUREMENT

MEASURING RANGE :
(Instrument itself) 500 μV to 100 V
(in 10 sub-ranges)

UPPER LIMITS OF SUB-RANGES:
3, 10, 30, 100, 300 mV
and 1, 3, 10, 30, 100 V

MEASURING ACCURACY : $\pm$ 5% of f.s.d.

INPUT RESISTANCE : 300 kOhms/V $\pm$ 5%

AC VOLTAGE MEASUREMENT :

MEASURING RANGES
(With measuring probe EMG—1397) :
50 mV — 30 V
(in 5 sub-ranges)

UPPER LIMITS OF SUB-RANGES: 300 mV
1, 3, 10, 30 V

MEASURING ACCURACY : $\pm$ 10%

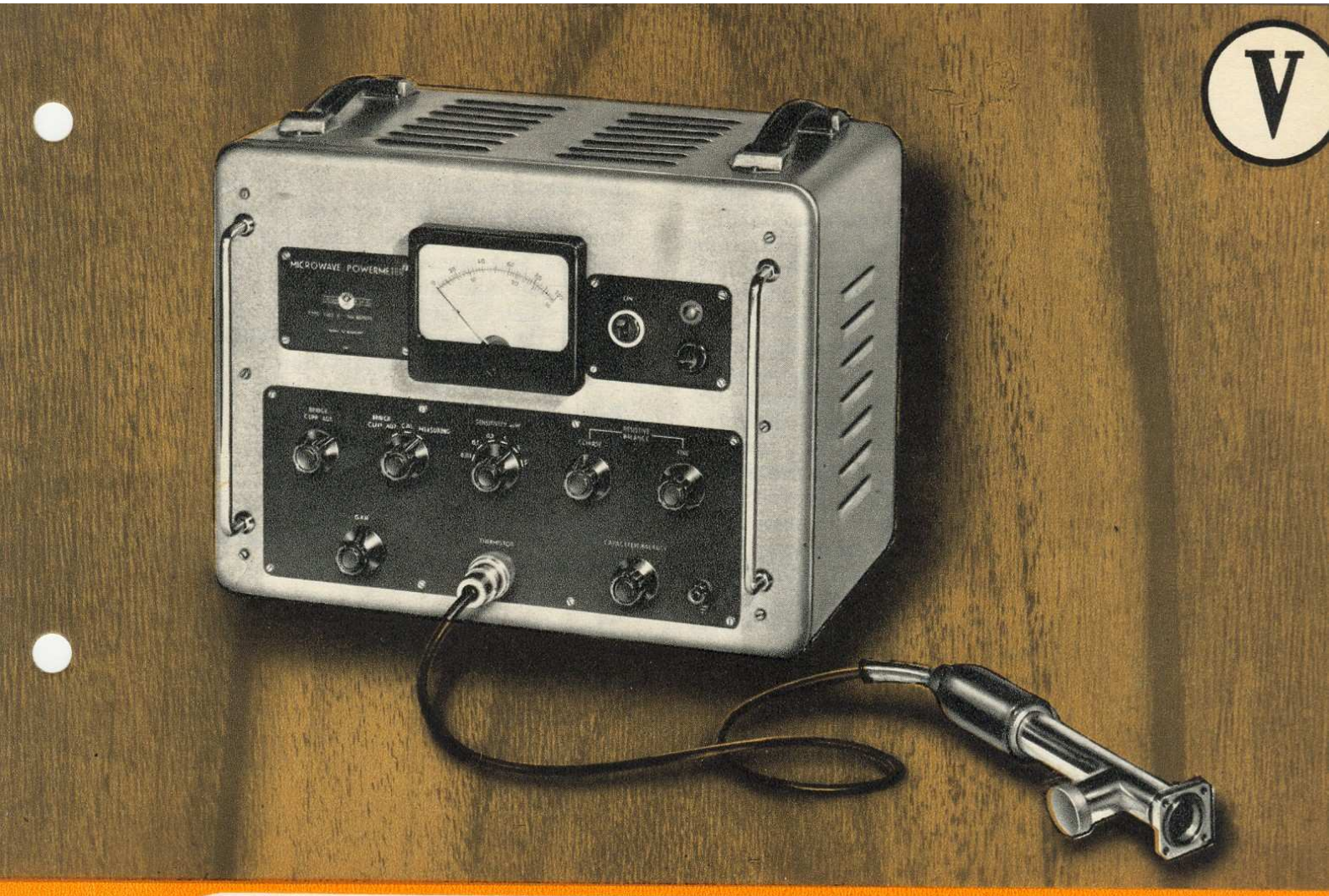
FREQUENCY RANGE

with measuring probe at
300 mV measuring range :
100 kc/s — 250 Mc/s
with measuring ranges above 1 V
3 Mc/s — 250 Mc/s

FREQUENCY RESPONSE

with measuring head for all measuring ranges :
$\pm$ 15% (relative to 10 Mc/s)

1. Input attenuator
2. D. C. voltage inverter
3. Amplifier
4. Measuring rectifier
5. Calibrating circuit
6. Dry batteries
7. Measuring head (for AC voltage)



EMG–1382/B

MICROWAVE POWER METER

The function of this instrument is the measuring of relatively low microwave power at a max. VSWR of 2,0.

It is an indispensable laboratory test equipment when measuring attenuations and measuring the power of H. F. triodes, Klystrons, travelling wave tubes and in general microwave oscillators.

It can also be used to advantage for testing microwave attenuators, dividers, direction couplers and transmission line parts.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

FUNCTION. The functioning principle of the "MICROWAVE POWER METER" is shown in the Block Schematic Diagram below.

The sensing part of the microwave power meter is the **measuring thermistor** which is located in the **measuring head** and acts as one of the arms of the oscillator bridge and regulates the output level of the **oscillator** producing a fixed frequency of 10 kc/s. According to the circuit applied, the measuring thermistor represents, independently of the input microwave power, always the same constant terminal resistance for a feeder. This is absolutely important and necessary for the accurate matching of the measuring transmission line. As to the operating principle, the oscillator and the **oscillator bridge** form a self-compensating thermistor bridge. The microwave power under test reduces the output level of the 10 kc/s fix oscillator and in consequence the balance position adjusted before measurement of the **compensating measuring bridge** is upset. One of the arms of the second measuring bridge is also a thermistor providing for the amplitude sensitivity of the bridge and compensating at the same time the temperature. Voltage resulting from the unbalance of the compensating bridge passes through a divider to the measuring amplifier and then through a measuring rectifier to the indicating meter. The indication of the unbalance of the measuring bridge at the same time indicates the microwave power (in milliwatts) according to the measuring range set.

Calibrated D. C. power is adjusted by the aid of the built-in resistors and corresponding to the various measuring ranges it serves for calibrating the measuring instrument. This calibrated D. C. power is coupled to the measuring thermistor when calibrating the measuring instrument. Now again the same process is repeated as when measuring the microwave power. The full scale deflection of the meter can be adjusted accurately by the aid of the "calibrated power" and by regulating the amplification.

The measuring thermistor und the thermistor for compensating the temperature are accommodated in a common measuring head.
Voltage and current for the circuits of the instrument and keeping them on the same level, which is very important for the reliability of the measurements, is provided for by the stabilized power supply unit.

Tubes used in this instrument :

6 AC 7—3	6 AG 7—1	6 L 6—1
6 SJ 7—1	VR 150—1	5 Z 4—1

(The number after the Type -Number indicates the number of tubes in use.)

SPECIFICATION

FREQUENCY RANGE : 1800 — 4000 Mc/s
(with measuring head supplied with the instrument)
(at VSWR max. 2.)

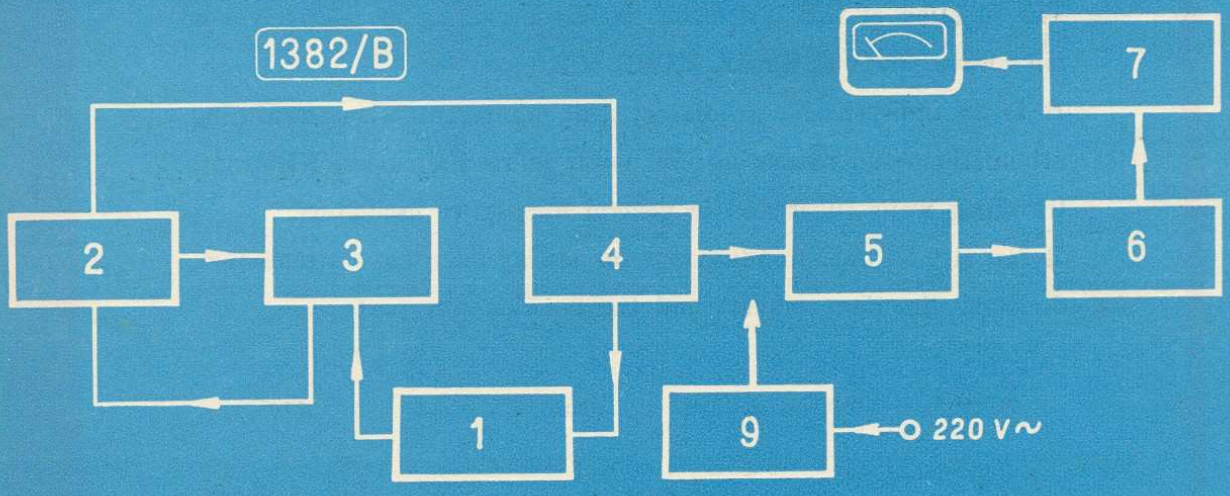
MEASURING RANGES :
0,03, 0,1, 0,3, 1, 3, 5 mW

MEASURING ACCURACY :
(with correct matching) : ± 10 %
Input impedance of measuring head :
47,9 ohms

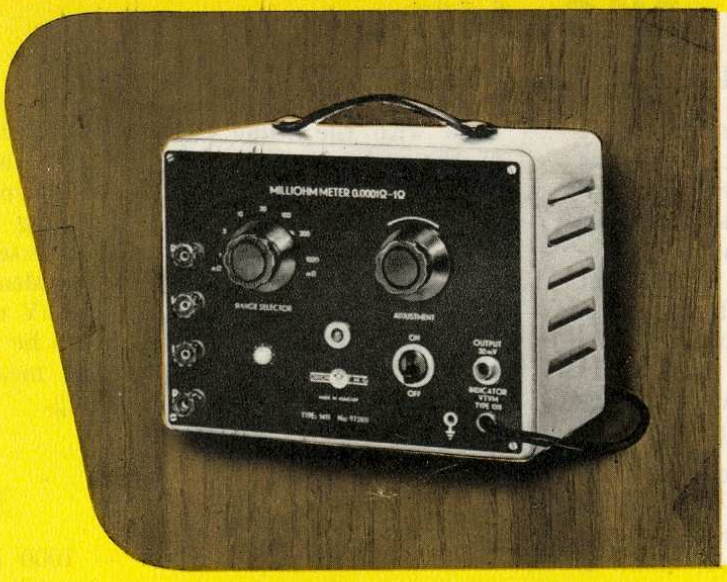
CALIBRATION :
with built-in calibrated circuits

CALIBRATION ACCURACY : ± 2,5%

As a result of continued efforts to improve the design of instruments, we reserve the right to change this specification.



1. Measuring head with thermistors
2. Oscillator
3. Oscillator bridge
4. Compensating bridge
5. Attenuator
6. Measuring amplifier
7. Measuring rectifier
8. Power supply unit



EMG–1411

MILLIOHMMETER ATTACHMENT

A device designed for use in connection with a VT voltmeter for measuring resistances of milliohm order of magnitude.

EMG–1422

MEGOHMMETER

An instrument for measuring high insulation resistances, which can be used to an upper limit of 100 000 Megohms

EMG–1432/B

"ORIPONS" WORKSHOP RC MEASURING BRIDGE

A Wheatstone measuring bridge for workshop measurements of resistance and capacitance.

EMG RESISTANCE MEASURING INSTRUMENT

1411 1422 1432/B

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

EMG–1411

MILLIOHMMETER ATTACHMENT

It is a task, frequently occurring in laboratory research work to measure contact resistances of very low value, of milliohm order of magnitude, eg, between contact surfaces of various switches. A high sensitivity measuring method and a pertinent measuring instrument respectively is necessary for such purposes. The milliohmmeter adapter connected to the EMG 1315/C VT voltmeter is particularly suitable for measuring very low resistance values.

FUNCTION. Resistance measurement is actually based on the measurement of the voltage drop produced on the resistor to be measured. Voltage necessary for the measurement is supplied by a special transformer. 1 A current to be adjusted accurately with the built-in regulator is, led through the resistor under test. The value — measured in millivolts — of the resulting voltage drop is in direct numerical ratio with the value expressed in milliohms of the resistor. The value measured is indicated by the VT voltmeter instrument permanently, on the 30 mV measuring range. The built-in auto-transformer is used for changing over the measuring range. Measuring accuracy is the highest in the 30 mV measuring range. Only resistors which can be loaded with a current of 1 A can be measured, without the danger of overloading.

SPECIFICATION

MEASURING RANGE :

0,1 — 1000 mOhm
(in 7 ranges)

MEASURING ACCURACY :

in the 30 mohm range ± 5%
in other ranges ± 10%

EMG–1422

MEGOHMMETER

A measuring instrument designed for the serial testing of high insulation resistance of the telecommunications and instruments industry.

FUNCTION. A voltage divider, with known resistance values, is connected to the test resistor by the aid of the measuring range switch, receives a stabilized direct voltage from the power supply unit of the instrument. Voltage drop observed on the voltage divider is measured by a bridge-system VT voltmeter. The bridge circuit has the advantage to be considerably insensitive against tube ageing and mains fluctuations. In view of the high resistance values to be measured, the input jacks are protected against changes of measurement caused by moisture content and by leakage currents. The stabilized voltage necessary for operating the measuring instrument and other operating voltages is furnished by the power supply unit.

SPECIFICATION

MEASURING RANGE :

0,5 — 100 000 Mohms
(in 5 ranges)

CALIBRATION ACCURACY :

5% resp. ± 10% (dependent on range)

EMG–1432/B

„ORIPONS" RC WORKSHOP MEASURING BRIDGE

Measurement of resistance (R) and capacitance (C) is the most frequent task in workshops and servicing. The workshop measuring bridge has been designed for this purpose and it can also be used for measuring inductance (L).

FUNCTION: Measurement is made in the well known Wheatstone bridge circuit, the balance of the bridge being indicated by a magic eye. The measuring bridge can be fed with two different voltages : with alternating voltage (50 c/s) from the power supply transformer and with direct voltage produced by the built-in selenium rectifier. With direct voltage feed a mechanical vibrator operates in the grid circuit of the amplifier. Resistance can be measured by the aid of the built-in calibrated resistors, inductance only by using external reference standards. In addition to direct measurement, + 20% and −20% comparative measurement can also be made.

SPECIFICATION

RESISTANCE MEASURING RANGE
(with DC voltage) :

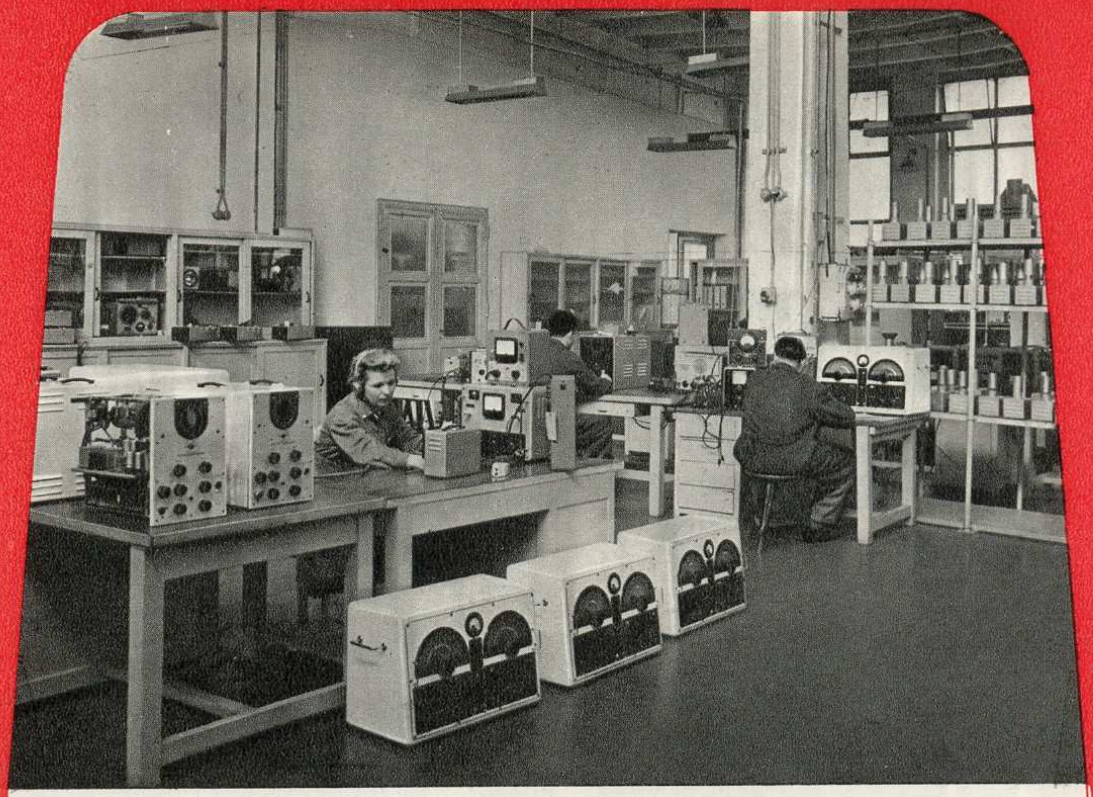
0,5 ohm — 1 Mohm ± 5%

RESISTANCE MEASURING RANGE
(with AC voltage) :

0,5 ohm — 10 Mohms ± 3%

CAPACITANCE MEASURING RANGE
(with AC voltage) :

50 pF — 1000 μF ± 3%

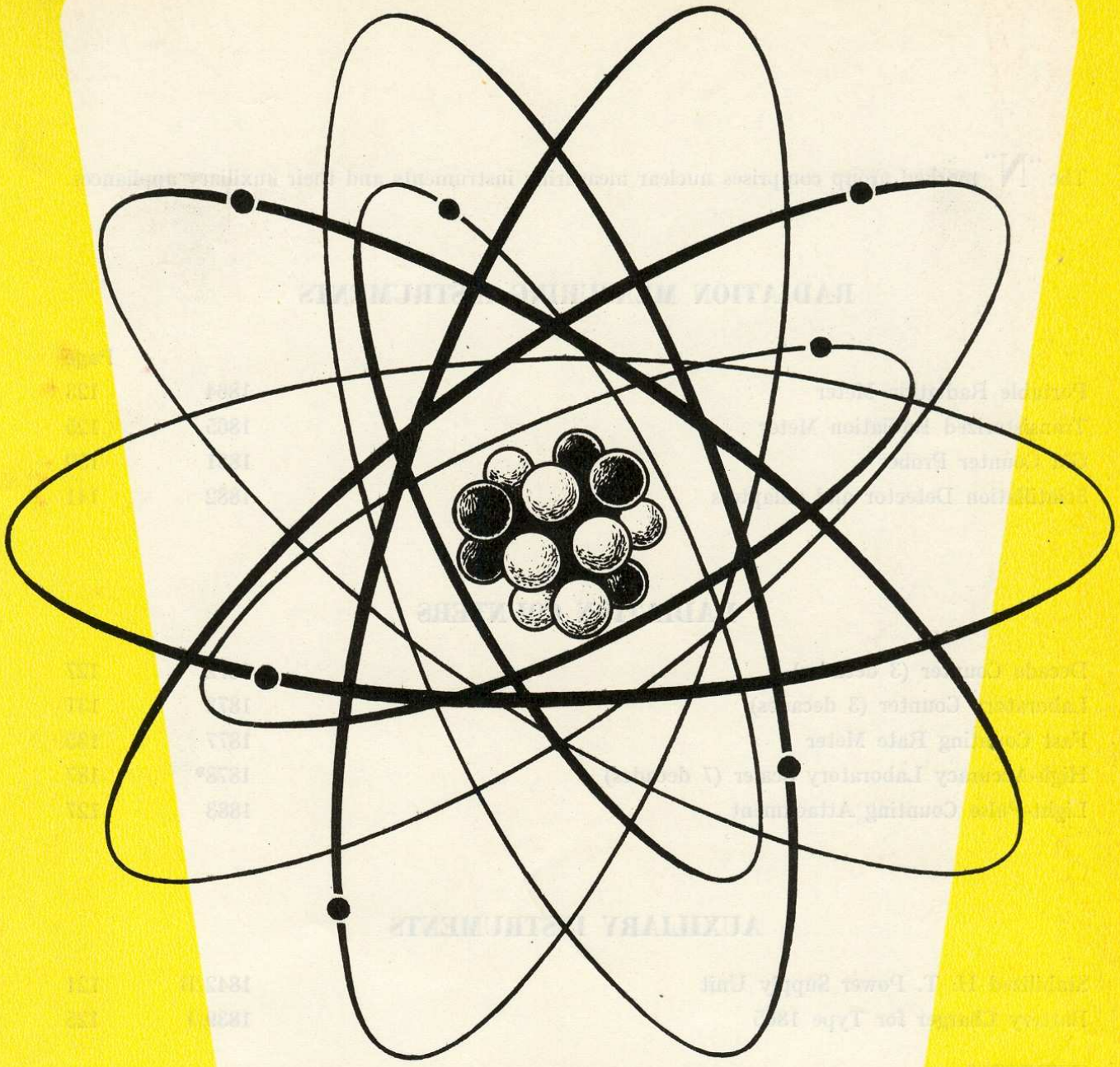


LABORATORY CONTROL
OF PRODUCTION SAMPLES

CONTINUOUS PRODUCTION LINE ASSEMBLY
AND ITS CONTROL

HIGH PERFORMANCE PUNCH PRESS
FOR PRODUCING INSTRUMENT CABINETS

WELDING OF METAL CABINET FRAMES



N

NUCLEAR INSTRUMENTS

The "N" marked group comprises nuclear measuring instruments and their auxiliary appliances.

RADIATION MEASURING INSTRUMENTS

RADIATION COUNTERS

AUXILIARY INSTRUMENTS

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* Under development (in Group „F")

EMG–1842/B

REGULATED STABILIZED H. T. POWER SUPPLY UNIT

When measuring radioactive radiation, there is an absolute need for high voltage supply for the G—M tube and scintillation detectors of very accurately stabilized D. C. current source, which lends itself to fine adjustment also within a wide range, but supplies high voltage independently of the load. This equipment complies with these requirements to a considerable degree. Its stability, the highly accurate adjustability of output voltage and its design and construction in accordance with H. T. standards make it an indispensable auxiliary appliance for every radiological laboratory. "SYSTEM KFKI"

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

FUNCTION. The functioning principle of the "H. T. power supply unit" is shown in the Block Schematic Diagram. The apparatus consists of two main parts: the H. T. section and the fine regulation section.

The aim of electronic regulation of the **H. T. section** is on the one hand compensation of the mains voltage fluctuations, on the other hand to keep the output voltage on a constant level independently of changes of the external load. Electronic regulation operates on the **parallel regulation** principle. The two groups of elements performing regulation and stabilization are:

a) **the regulating tube** coupled parallel with the rectified voltage and obtaining its stabilized reference voltage from a separate rectifier;

b) **the voltage divider** consisting of two links: an ohmic resistor and an electron tube; the latter receives also stabilized voltages for the auxiliary grid and the control grid. For ensuring the accuracy of electronic regulation, the filament voltage of the electron tube, comprised in the voltage divider, is kept on a constant level by a special ferroresonance transformer. A potentiometer is used, with regulation of the grid bias of the control tube, for the **coarse** adjustment of the H. T.

The **fine regulation section** operates with a separate rectifier; electronic regulation operating on the **series regulation** principle is connected after the smothing-filter of the rectifier.

The two voltage sources are connected in series through a pole changer so that the fine regulation can be applied to any part of the high voltage. The full output voltage or the fine regulated voltage is shown, after the necessary switch-over, by the built-in meter.

Tubes used in the instrument:

H. T. section

V 22/7000—1	EZ 80—1	PL 81—1
EF 80—1	VR 150—1	85 A 2—1

Fine regulation section

PY 83—1	EL 84—1
EF 80—1	VR 105—1

(The number after the Type-Number indicates the number of tubes.)

SPECIFICATION

H. T. SECTION

OUTPUT VOLTAGE: 300 — 3000 V

LOAD max. 0,5 mA

OUTPUT VOLTAGE CHANGE
between max. load and noload: 0,3%
measured at max. output voltage

OUTPUT VOLTAGE CHANGES:
within ± 10% fluctuations of the mains
With each 1% change: max. 0,02%
or max. 0,3 V

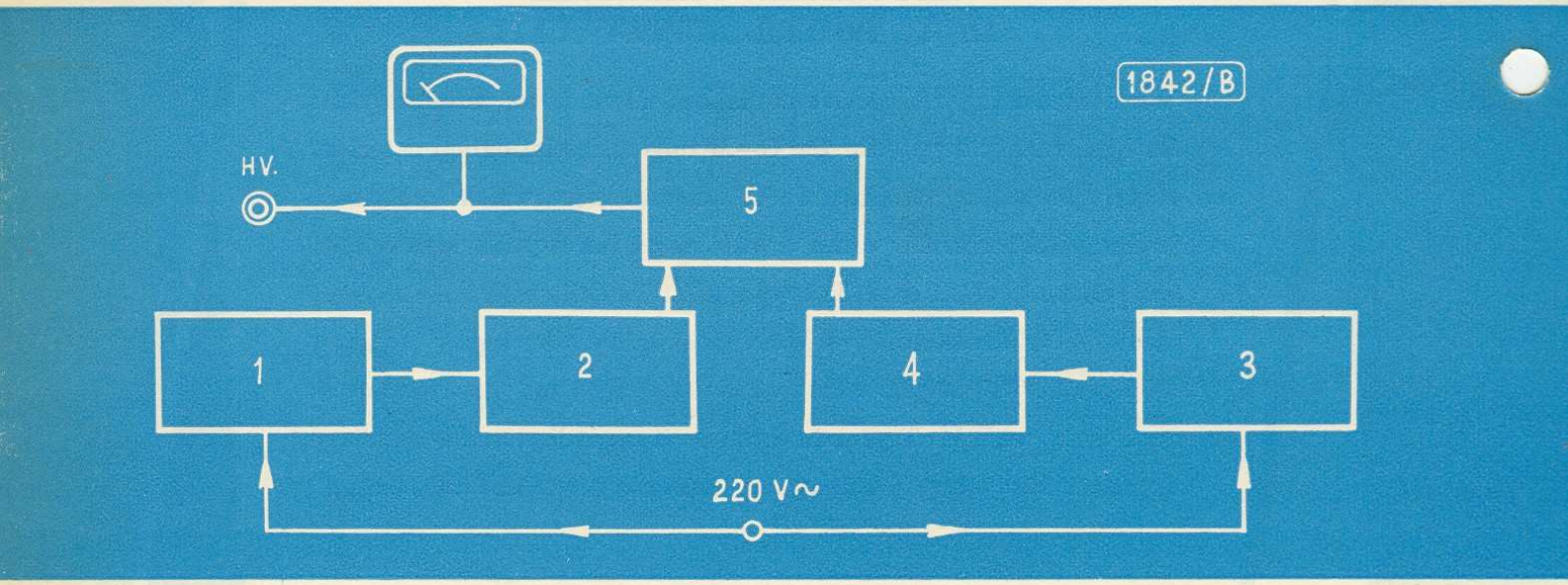
HUM VOLTAGE max. 1 V
(with max. 3000 V and max. 0,5 mA load)

OUTPUT IMPEDANCE:
< 3500 ohms

FINE REGULATION SECTION

OUTPUT VOLTAGE FINE ADJ.: max. 500 V

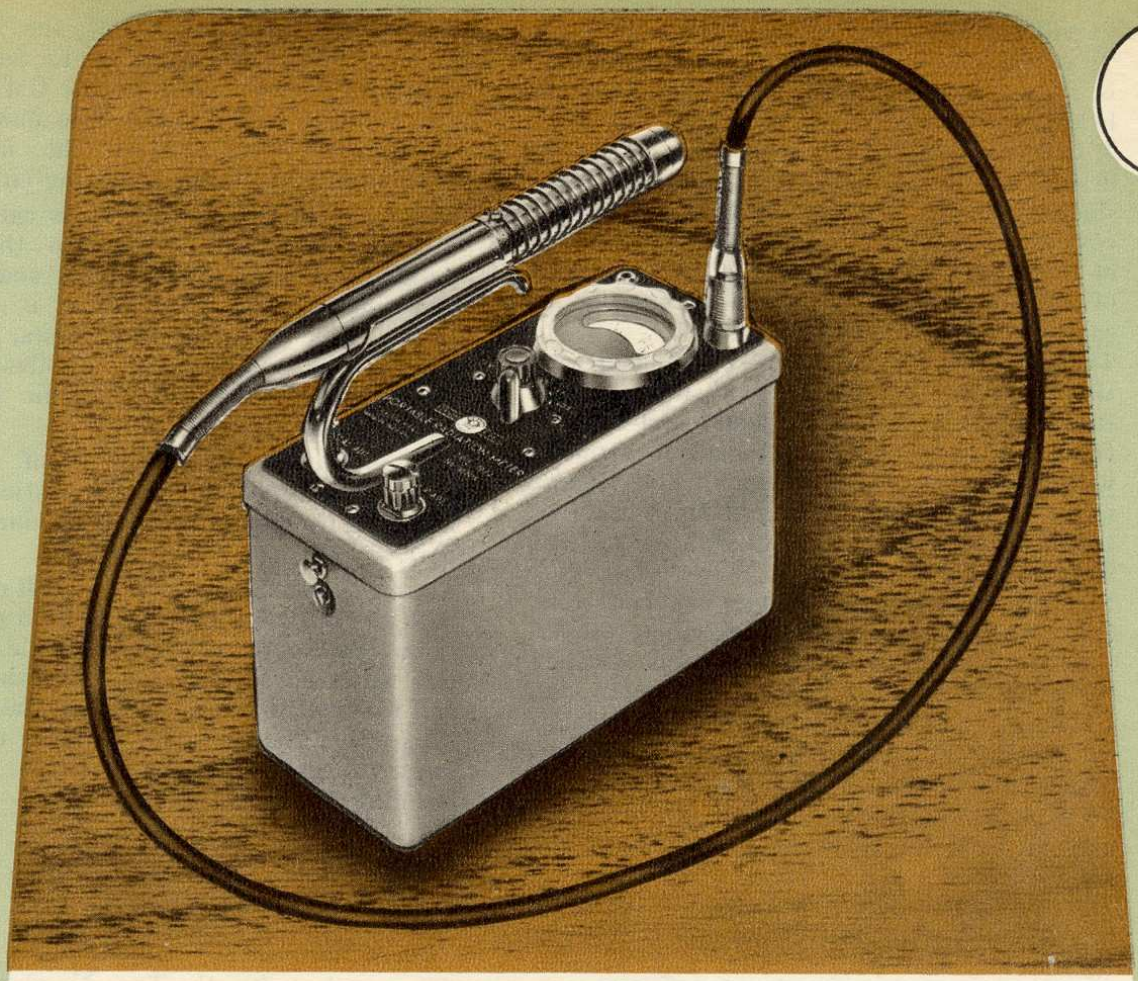
As a result of continued efforts to improve the design of instrument, we reserve the right to change this specification.



H. T. section
1. Power supply rectifier stage
2. Voltage regulating and stabilizing stage

Fine regulation section
3. Power supply rectifier stage
4. Voltage regulating and stabilizing stage

5. Pole changer



EMG–1864

PORTABLE RADIATION METER

This instrument is primarily suitable for measuring Gamma ray radiation, it can also be used with advantage for Beta ray measurements. Its portable design and high sensitivity make the instrument particularly suitable for a quick survey of areas exposed to radiation danger. It is also suitable for other measurements in radiological laboratories, e. g. when using radioactive isotopes for medical or industrial applications.

A special advantage of the instrument is that it enables the tests to be carried out not only by observing visually the built-in indicating meter, but also by listening to the pulses through a headphone connected to the instrument through special sockets, the latter method considerably facilitating observation in case of low frequency pulses.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

FUNCTION. The functioning principle of the "Portable Radiation Meter" is shown in the Block Schematic Diagram below.

A GM tube built-in the probe head of special design serves for detecting radiation. The shielding of the head is fitted with a rotable cover for screening the GM tube. The purpose of this cover is to provide for the separation of Beta radiation from Gamma radiation in case of Gamma measurements.

The probe head (EMG 1881—5) supplied with the radiation meter, carries a standard GM tube organic filled **without end-window.** On special order a probe head can be supplied with a GM tube with end-window and organic fil'ed. This probe head (EMG—1881—6) can be connected to the instrument without any alteration.

H. T. is necessary for feeding the GM tube, this is generated by a H. F. "Blocking" oscillator. The generated A. C. voltage is rectified by a diode then filtered and fed to the GM tube. The voltage generated by the oscillator can be adjusted from outside. The indicating instrument of the Radiation Meter, when switched to the marked position, can also be used for checking the H. T. of the GM tube.

The red mark (lower voltage) on the scale of the indicating instrument refers to the (cylindrical) GM tube without any window, the blue mark (higher voltage) to the GM tube with an end-window.

The operating principle of the Radiation Meter is that the radiation to be detected generates voltage pulses in the GM tube and the numbers falling to the time unit of these voltages are measured by the monostable multivibrator coupled measuring circuit.

One scale of the instrument is calibrated in mR/hour and this applies to the normal design GM tube organic filled and without end-window. The other scale is calibrated in the time unit of the pulses, in their number in relation to minutes and is used with the GM tube organic filled but with an end-window.

The indicating instrument is of a ribbon-suspended type and its operation is not impaired by impact or vibration during transport.

The instrument features a self-calibration with the help of a built-in standard permanent radioactive source; calibration should be carried out with the help of the GM tube without end-window. The radiation of the standard radioactive source serves only for calibration purposes and is so low as to be absolutely harmless for living beings.

Tubes used in this instrument:

1 R 5 T—2 1 S 4 T—1

(The number after the Type-Number indicates the number of tubes in use.)

SPECIFICATION

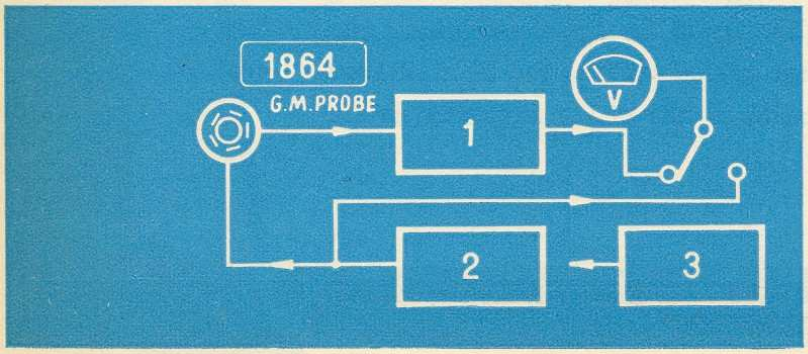
MEASUREMENT OF GAMMA RAYS:
from 0,5 to 2 MeV radiating energy

DETECTION OF BETA RAYS:
0,3 MeV or more radiating energy

MEASURING RANGES: 0,2 2, 20 mR/hour
(1881—5 type GM tube probe)
or:
600, 60000, 60 000 imp/min.
(1881—5 or 1881—6 type GM Tube Probe)

MEASURING ACCURACY:
± 15% of f. s. d.

DRY BATTERIES:
1 pcs Type 45 G (67,5 V)
2 pcs Type 1 D (1,5 V)



OTHER DATA

FINISH:
lacquered steel-sheet case

DIMENSIONS:
height 210 mm
width 220 mm
depth 110 mm

WEIGHT
(without batteries): about 3,2 kg

ACCESSORIES:

1 EMG 1881—5 GM tube probe with GM tube, without end-window organic.

As a result of continuous efforts to improve the design of instruments we, reserve the right to change this specification.

1. H. F. oscillator (blocking oscillator)
2. Measuring circuit (multivibrator)
3. Filament and anode batteries

EMG–1865

TRANSISTORIZED RADIATION METER

A small-size, pocket instrument for the measurement of Gamma radiations and the detection of Beta- and X-ray radiations with wide measuring ranges. The detector is a built-in halogen-filled G—M tube.

EMG–1839/1

BATTERY CHARGER

(for charging button-type accumulators)

The appliance is used primarily for charging the button-batteries used with the EMG 1865 transistorized radiation meter. The charger is built into a plastic case, is shock-proof during operation and can be inserted directly into the wall socket.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

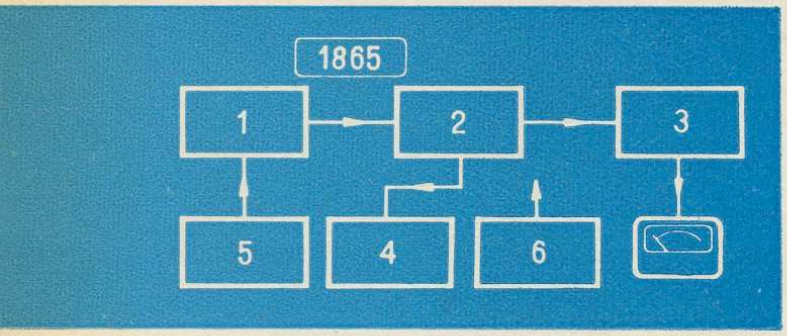
EMG—1865 TRANSISTORIZED RADIATION METER

The operating principle of the instrument is shown in the Block Schematic Diagram below.

The instrument comprises transistors and germanium diodes only, operating in the most up-to-date circuit design. As regards its electrical lay-out the instrument consists of two main sections viz. the measuring circuit and the oscillator circuit producing H. T. for the G—M tube.

The pulses coming from the G—M tube pass to the transistorized amplifier signal shaper stage; for each input pulse only one signal of defined magnitude and duration is favoured, continuous self-oscillation being prevented by diodes. The measuring circuit is fed by the amplifier signal shaping stage. The value of the amount of radiation detected can be read on the scale, calibrated in mR/hour of the built-in indicating meter. The full scale deflection of the meter can be precisely adjusted with potentiometers. Detection of radiation pulses can be made in two different ways: with a built-in indicating instrument and with a built-in neon-lamp which indicates the counts by flashes.

The neon-lamp indicator is also controlled by the signal-shaping stage. The H. T. necessary for the operation is generated by a transistorized, so-called "blocking" oscillator, the voltage received is raised by a voltage-doubling circuit to the necessary level. Glow-lamps are used for the stabilization of the voltage.



Power is supplied by small-size, perfectly enclosed button type accumulator, also accommodated inside the instrument. The instrument is housed in a plastic case of functional shape.

SPECIFICATION

MEASURING RANGE:
0 — 0,5 mR/h
0 — 5 mR/h
0 — 50 mR/h

CALIBRATION: with Co 60

MEASURING ACCURACY:
±15% of f. s. d
(between 10 C° and + 40° C)

G—M TUBE: halogen-filled type-CTC—1

READJUSTMENT OF MEASURING RANGE:
by means of built-in potentiometers

DETECTION OF COUNTS:
with flash lamp

H. T. STABILIZATION:
with glow-lamp

H. T. RECTIFICATION:
with selenium

BATTERIES:
three 1,2 V 150 mA/h
button-type accumulator (DEAC)

As a result of continued efforts to improve the design of instruments, we reserve the right to change this specification.

1. G—M tube (built-in)
2. Amplifier, signal shaper
3. Measuring circuit
4. Flash (radiation pulses) stage
5. H. T. supply unit
6. Batteries

EMG—1839/1 BATTERY CHARGER

(for charging 150 mA/h button-type accumulators)

The charger can be operated on 220 V AC. when using 110 V the charging current drops to half its value so that double of the time is needed for charging.

The circuit design of the changer warrants that the charging current cannot exceed the measure permitted for this type of battery with 220 V 12 mA. The charging current is a function of the power supply voltage, of the frequency and the capacitance of the capacitor used. To secure a shock-proof design of the charger a mechanical construction was chosen allowing that the batteries to be charged be only inserted and taken out after pulling out the plug from the wall socket.

N

EMG–1872

DECADE COUNTER

An electronic measuring instrument designed primarily for counting steep-fronted pulses. Such pulses arrive via the G—M tubes and scintillation detectors to the input of the measuring instrument. The counter is primarily an indispensable measuring appliance of atomic physics laboratories.

EMG–1883

LIGHT PULSE COUNTING ATTACHMENT

An auxiliary appliance to be coupled before the counter in industrial work, e. g. when counting slowly changing phenomena, which are formed into pulses of shape and magnitude for the input circuits of the counter.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

EMG–1872

FUNCTION: The functioning principle of the "Decade Counter" is shown in the Block Schematic Diagram below.

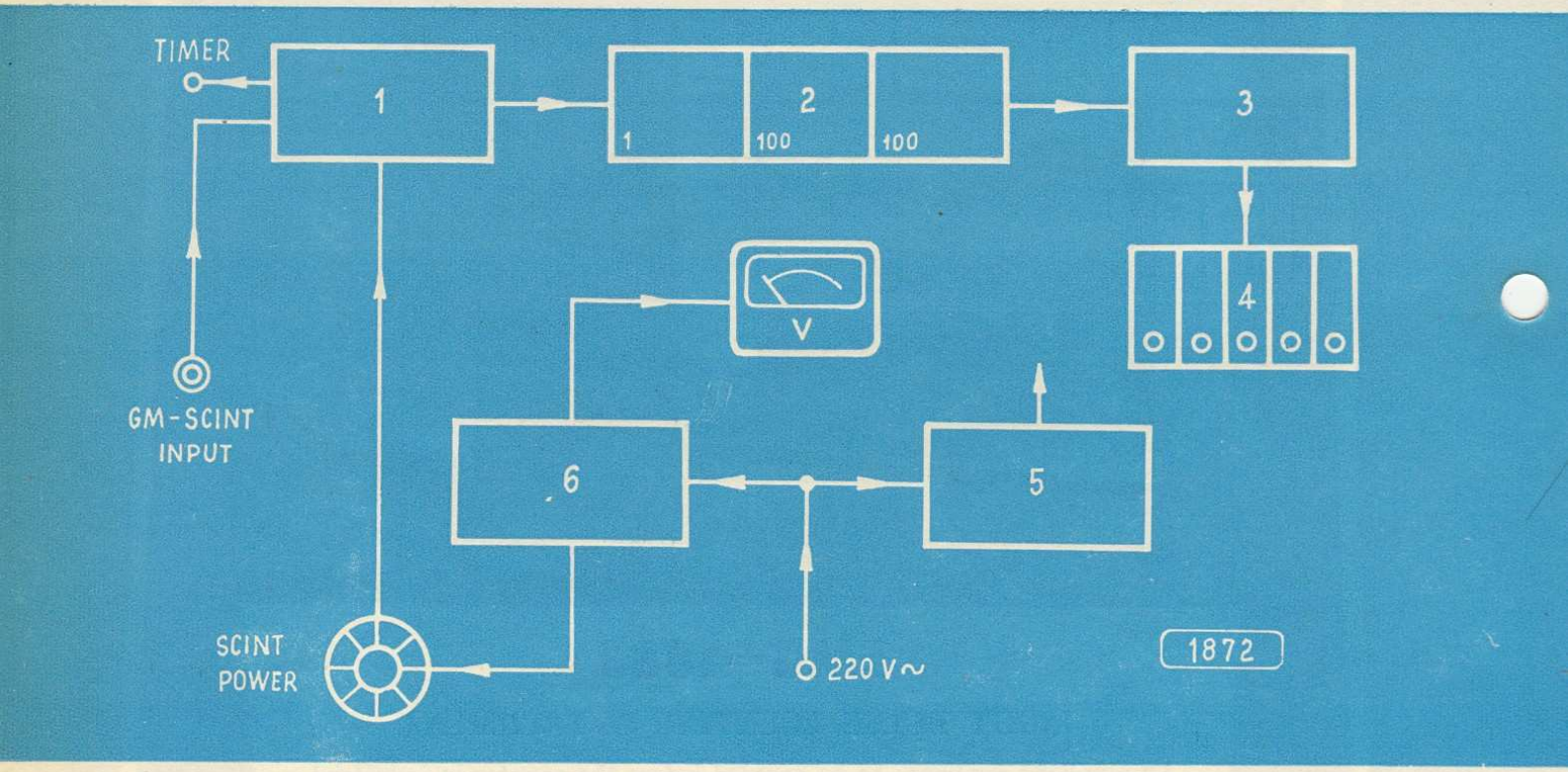
The first part of the counter is the **pulse amplifier** featuring two RC coupled stages. Sensitivity can be continuously adjusted within a very wide range. Thus the instrument already operates on quite low input voltages e. g. 0,1 V, at the same time it can also amplify signals of considerable magnitude e. g. an input voltage of max. 70 V. This mode of regulation permitting an easy elimination from the measurement of all interferences which might disturb the expected results. There are not only further amplification tasks for the second stage of the pulse amplifier but it also forms and partly limits the peak voltage of the signals passing further.

The next stage is the **monostable multivibrator** that has the function to convey to the electronic counting stages signals independent of the magnitude of the input signal, always of the same magnitude and duration. This part is the **pulse divider** featuring three decadic stages and counting in the orders of magnitude of 1, 10 and 100, the incoming and amplified pulses. Each decadic stage consists of 4 bistable multivibrators whose every swing-over is indicated by the series of glow-lamps consisting of 10 units and acting as indicators. The result of counting can be read off the figures beside the illuminated lamps at once and directly without any further counting operation.

Every thousandth pulse, controls the **power stage,** the **electromechanical counter** is located in the circuit of the latter. The counter has 5 digits and operates with 15 figure changes per second. Both counting parts can be brought into "O" position : the electronic decades electrically and the electromechanical counter mechanically.

One of the main parts of the instrument is the **stabilized H. T. power supply unit** generating for the operation of the G—M tube or of the Scintillation Counter, the necessary high voltage of needed stability. The variation of the output high voltage remains even with a power supply fluctuation of $\pm 10\%$ within $\pm 0{,}5\%$, so that it can be considered as practically constant. The value of the output voltage can be changed by coarse and fine regulation within a very wide range and the value adjusted can be read off on the scale of the built-in indicating instrument.

The tubes used in all electronic stages obtain



1. Pulse amplifier
2. Electronic counting stages
3. Power amplifier
4. Electromechanical counter
5. Power supply unit
6. H. T. power supply unit

their voltage and current from the **power supply unit** with two rectifier tubes, the reference voltage of the regulating and control tube of the H. T. section is also supplied by this unit.

The **"Decade Counter"** in addition to counting radioactive particles with the help of the G–M tube or Scintillation Counter can, also be used for measuring **frequency and time;** a time switching clock and a signal generator of suitable frequency range and frequency stability is also necessary for this work.

The counter is suitable not only for measuring radioactive radiation but also for detecting and counting such other electrical or mechanical phenomena whose resultant is a steep-fronted pulse or can be transformed into such pulse.

Tubes used in this instrument :

ECC 85 –13	EF 80–3	EL 84–1
EZ 80–2	PL 81–1	VR 150–1
2 X 2–1	85 A 2–1	

(The number after the Type-Number indicates the number of tubes in use.)

SPECIFICATION

COUNTING SECTION

PULSE AMPLIFIER

INPUT SIGNAL :
min. 0,1 V, max. 70 V
(sensitivity continuously adjustable)

POLARITY OF INPUT SIGNAL :
negative

DETECTORS TO BE CONNECTED :
1. G–M tube
2. Scintillation counter

ELECTRONIC COUNTER

DECADIC DIVISIONS :
in 3 stages

DIVISIONS STAGES :
1, 10, 100 orders of magnitude

RESOLUTION TIME : 5 μsec

ELECTRONIC DECADE STAGES :
can be put into "O" position electrically

ELECTROMECHANICAL COUNTER

5 digits

SPEED OF DIGIT CHANGE : 15/sec

ELECTROMECHANICAL COUNTING MECHANISM :
can be put into "O" position mechanically

FULL COUNTING SPEED

max. 15 000 imp/sec.

COUNTING OPERATION OF THE INSTRUMENT :

a) with external time switch (connected to "Timer" pair of jacks) or

b) can be started and stopped with built-in two-position hand switch

H. T. SECTION

(can be switched off)

OUTPUT VOLTAGE :
between 300 and 2000 V
coarse and fine adjustment

LOAD : max. 0,5 mA

OUTPUT VOLTAGE CHANGE (within $\pm$ 10% fluctuations of mains voltage) : max. $\pm$ 0,5%
(measured at output voltage between 800 and 1500 V)

POWER SUPPLY

Voltage :	110, 127, 220 V
Frequency :	50/60 c/s
Consumption :	about 110 W

OTHER DATA

FINISH :
lacquered steel-sheet case with 2 metal handles

DIMENSIONS (without knob and handle) :

height	280 mm
width	500 mm
depth	380 mm

WEIGHT : about 20 kg

ACCESSORIES :

1 power cord
1 coaxial screened cable with 3 kV connector plug

As a result of continued efforts to improve the design of instruments, we reserve the right to change this specification.

EMG—1883

LIGHT PULSE COUNTING ATTACHMENT

Nuclear counting apparatus may be used not only for counting the number of impacts of radioactive particles, but also, extensively, in industry, particularly for counting physical phenomena, which can be converted into variations of light intensity.

A photocell is used for conversion. In case of rapidly changing phenomena the photocell produces sufficiently steep-fronted pulses which can be applied to the input circuit of the counter.

When, however, slow-changing phenomena have to be counted, e. g. the number of produced pieces in industry, an electronic attachment has to be inserted between the photocell and the nuclear counter in order to convert the variations of light intensity into pulses of a form and size corresponding to the input circuit of the nuclear counting device.

A photocell built into a strong metal case provided with a round light inlet aperture is used for sensing the variations of light intensity. The head of the photocell, equipped with a cable and connector, is connected to the attachment from which it obtains the supply voltage for the photocell through the cable.

Care should be taken that free access of the light rays through the aperture be not obstructed and that assuming the incidence of a parallel beam, a quantitity of light, as large as possible should find its way, free of shadow to the photocell. The variation of the photoemission current, caused on the cathode of the photocell by the variation of the illumination intensity, is applied to the input of a single stage D. C. amplifier. The amplified signal is passed to a Schmitt circuit built-up by a double triode. The variation of current causes the Schmitt circuit to swing over from the normal position and there appears on the anode of the second triode system such steep-fronted negative pulse as is necessary to operate the input of the counter. A germanium diode is provided in the attachment for a moderate shaping of the negative pulse.

When the attachment is used, the high voltage supply unit of the nuclear counter should not be switched on.

Tubes used in this instrument :

EF 80—1 ECC 85—1 EZ 80—1

Photocell Tungsram 223.

SPECIFICATION

COUNTING SPEED : 0 to 100 p/sec

INPUT SIGNAL SHAPE : as desired

OUTPUT SIGNAL SHAPE : steep-fronted pulse

OUTPUT PULSE POLARTIY : negative

OUTPUT PULSE AMPLITUDE : about 1 V

OPERATING VOLTAGE OF PHOTOCELL : adjustable between 40—60 V

CHANGE OF PHOTOCELL CURRENT (necessary for safe operation) : min. 2 μA

POWER SUPPLY

Voltage	110, 127, 220 V
Frequency	50/60 s/c
Consumption	about 15 W

OTHER DATA

FINISH :
lacquered steel-sheet case with leather handle

DIMENSIONS :

height	190 mm
width	210 mm
depth	140 mm

WEIGHT 3,5 kg

ACCESSORIES

1 detector head with photocell coaxial cable fastened to it
1 coaxial screened cable, with 3 kV plugs

As a result of continuous efforts to improve the design of instruments, we reserve the right to change this specification.

EMG–1873

LABORATORY COUNTER

A high-speed decade counter used in laboratories engaged in nuclear and radioactive measurement; the instrument can be adjusted in advance for automatic operation, up to a number of pulses.

"SYSTEM KFKI"

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

EMC–1873

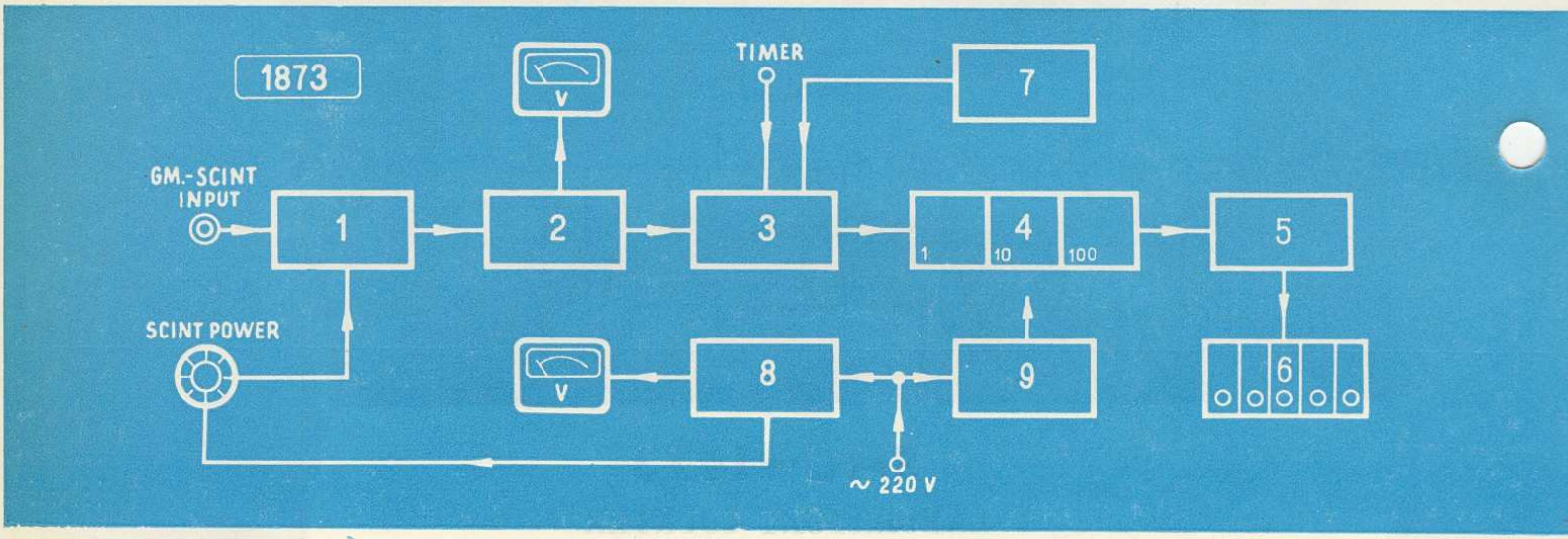
FUNCTION: The functioning principle of the "Laboratory Counter" is shown in the Block Schematic Diagram below.
The measuring instrument is primarily suited for counting pulses coming from nuclear detectors e. g. from G—M tubes or scintillation counters but also for counting pulses from other sources.

The equipment consists of two principal units viz. the counting unit and the H. T. unit. The pulses to be counted first pass into the **pulse amplifier** whose sensitivity is variable within a wide range. Multiple negative feedback improves the stability of amplification. The amplified pulses pass first to the **discriminator,** then the signals in excess of the cut-off voltage adjusted, get to the gate circuit having an open and closed position. The signals traversing the gate circuit control the **electronic counter** featuring three decade stages ; these stages count the single, decimal and centesimal magnitudes ; glow-lamps are used for indicating the figures. Each decade stage consists of four bistable multivibrators.

The five-digit **electromechanical counter,** respectively its amplifying stage, follows after the third decade. Before starting counting, all counting stages have to be set to zero position. The open position of the gate circuit can be adjusted with the aid of the built-in timer for any time between one second and one hour. If the pulses are counted to a definite number, the electromechanical counter should be adjusted in advance to this number ; when reaching this number, cuonting is terminated respectively automatically switched off. The **H. T. section** is used for the high voltage supply of the G—M tube counter or Scintillation counter. The H. T. section compensates by its electronic regulation, the fluctuations of the mains supply voltage and keeps the output voltage on a constant level independently of the change in external load.

Electronic regulation operates on the so-called parallel regulation principle. The elements provided for regulation and stabilization are:

1. the **regulator tube** coupled parallel with the rectified voltage.



1. Pulse amplifier
2. Discriminator
3. Gate circuit
4. Electronic counting stages
5. Power stage
6. Electromechanical counter
7. Timer
8. H. T. power supply unit
9. Power-line supply unit

2. the **voltage divider** consisting of an ohmic resistor and an electron tube; the latter receives also stabilized voltages for the auxiliary grid and control grid, even its heating voltage is regulated by a ferroresonance transformer to a constant value. A potentiometer is used for coarse adjustment of the high voltage by regulating the grid bias of the control tube. Fine regulation is possible for any voltage on the 300 to 3000 V range of the high voltage. The power supply unit connected in series with the H. T. section is used for fine regulation. This will supply a stabilized voltage regulated between 0 and 300 V. The main task of the **power supply unit** is to provide all electronic stage of the instrument with voltage and current. Its operation is based on the principle of **series regulation.**

The high voltage can be switched over either to the G—M tube counter or to the scintillation counter, since separate input terminals are provided for them on the measuring instrument.

Tubes used in this instrument:

ECC 85—13	EL 84—13	EF 80—10
EZ 80—1	PL 84 —1	V 22/7000—1
5 U 3 C—2	VR 150—1	VR 105—2
6 AL 5—15		

(The number after the Type-Number indicates the number of tubes in use.)

SPECIFICATION

OUNTER SECTION

ELECTRONIC COUNTER

DECADIC DIVISIONS:

3 stages

orders of magnitude 1, 10, 100

RESOLUTION TIME:

5 μsec

ELECTROMECHANICAL COUNTER:

with 5 digits

MAX. COUNTING:

up to 100 0 00 000

PULSE AMPLIFIER

INPUT SIGNAL:

min. 5 mV

max. 700 mV

INPUT SIGNAL POLARITY :

negative

AMPLIFICATION:

in 6 steps, adjustable

AMPLIFICATION STEPS:

100, 200, 500 ×

1000, 2000, 5000 ×

OUTPUT VOLTAGE:

max. 70 V

INPUT IMPEDANCE:

220 kohms || 50 pF

RISE TIME:

$\leq$ 0,1 μsec

DISCRIMINATOR

RESOLUTION TIME:

5 μsec

LIMIT VOLTAGE:

between 5 and 70 V

continuously adjustable

DISCRIMINATOR ACCURACY: $\pm$ 0,3 V

TIMER (Gamma—1892)

SWITCHING TIME:

adjustable between 1 sec and 60 min.

EMG—1873

H. T. SECTION

(for feeding G—M tubes or scintillation counters)

(can be switched off)

OUTPUT VOLTAGE:

between 300 and 3000 V continuously adjustable

FINE REGULATION

OF OUTPUT VOLTAGE: max. 300 V

(at any voltage between 300 and 3000 V)

LOAD: max. 0,5 mA

OUTPUT VOLTAGE VARIATION:

(between max. load and noload): 0,3%

(at 3000 V output voltage)

OUTPUT VOLTAGE VARIATION

(between + 10% and — 10% of mains voltage):

with each 1% change:

max. 0,02%

or max. 0,3 V

RIPPLE VOLTAGE max. 1 V

(at max. 3000 V and max. 0,5 mA load)

OUTPUT IMPEDANCE:

3500 ohms

POWER SUPPLY

Voltage:	110, 127, 220 V
Frequency:	50/60 c/s
Consumption:	500 W

OTHER DATA

FINISH:

enamelled steel-sheet cabinet with 2 metal handles

DIMENSIONS

(without knobs and handles):

height	1020 mm
width	550 mm
depth	370 mm

WEIGHT: about 70 kg

ACCESSORIES:

1 coaxial screened cable with 3 kV connecting plug

On special order charged separately:

1 G—M tube EMG—1881—1

As a result of continued efforts to improve the design of instruments, we reserve the right to change this specification.

EMG—1877

FAST COUNTING RATE-METER

A measuring instrument for determining the pulse counts of alfa, beta, gamma and neutron radiation mean values, i. e. pulse counts related to a time unit. An instrument indispensable primarily for laboratories engaged in the industrial and therapeutical application of radioactive isotopes. In nuclear research it can be used for measuring radiation intensity and also for taking the integrated radiation spectrum.

As detector' various G—M counter-probes (EMG—1881) or Scintillation probes (EMG—1882) with the "Scintillator" insert, necessary for measurement, can be connected to the instrument.

Measuring results can be recorded continuously by the aid of the external recorder which can be connected to the measuring instrument.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

EMG–1877

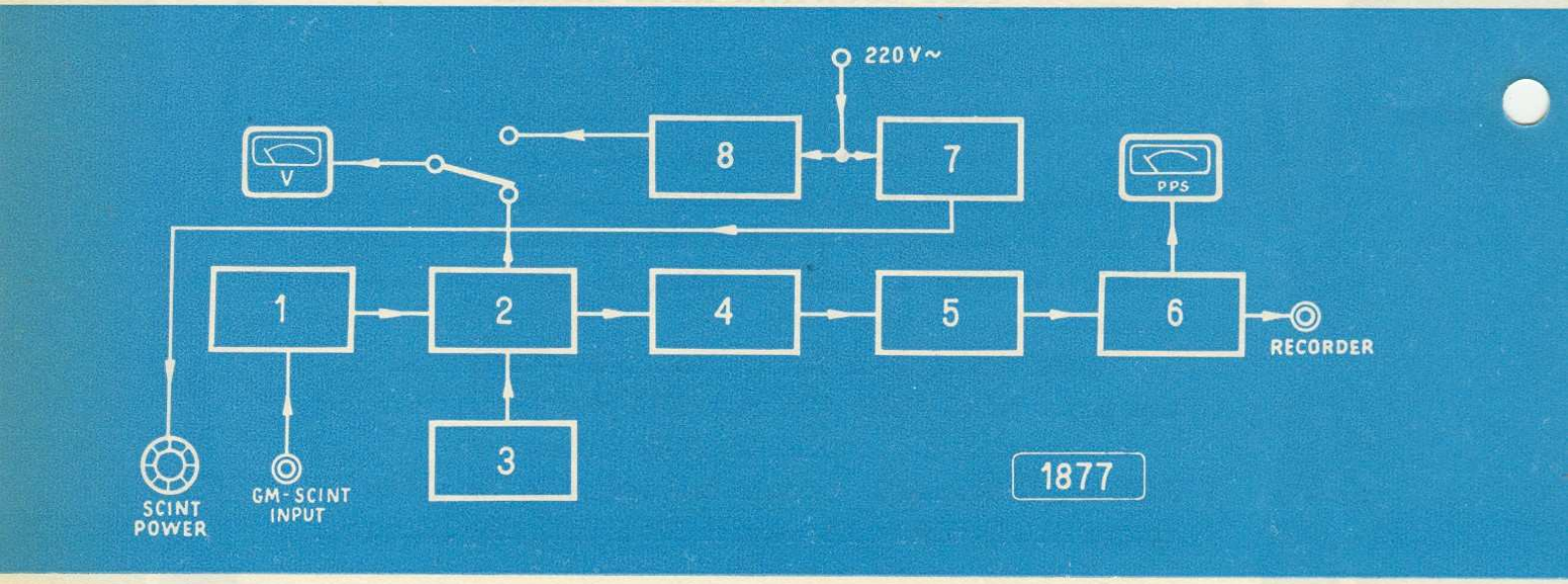
FUNCTION. The functioning principle of the "Fast Counting Rate-Meter" is shown in the Block Schematic Diagram below.

The **pulse amplifier** features three stages. It is characterized by linear response and great band-width. Amplification that is to say, sensitivity of the instrument can be changed continuously within wide limits.

The amplified pulses pass into the **discriminator** stage which is basically a bistable multivibrator, the known Schmitt circuit. The so-called discrimination level of this stage can be adjusted and among the various pulses only signals of such amplitude get through which are above the limit value adjusted. Discrimination voltage is measured by one of the **indicating meters.** (V)

The signals having come through pass into the **paralysing circuit** having the task to adjust the dead time of the instrument to known values. Paralysis times can be adjusted in three stages within very wide limits. This circuit operates according to its electronic design as a multivibrator, that is to say after the effect of the pulse received has ceased, it returns again into its original starting position. Otherwise the operation of the paralysing circuit can also be switched off according to the measurement desired. The next is the **limiter stage** consisting of several parts ; its task is to produce from each pulse a signal of definite amplitude. The signal arrived here passes after amplification and phase inversion to the bistable multivibrator and then to the limiter itself, which is a double triode. The frequency calibrating circuit is located in the cathode of the limiter.

The signal arriving from the limiter passes into the **integrating stage** supplying the input of the **V.T. voltmeter** with a voltage, proportionate with the number of counts during the time unit. The time constants can be adjusted in five steps by switching over adequate capacitors. The voltage amplified by the V. T. voltmeter stage is measured by another **indicating meter** (PPS), whose scale is calibrated in pps so that the measured value can be read off at once. The external



1. Pulse amplifier
2. Discriminator
3. Paralyzing circuit
4. Limiter stage
5. Integrating stage
6. V. T. voltmeter
7. H. T. power supply unit
8. Power supply unit

level recorder can be connected to the same output points.

The separate H. T. unit built into the instrument whose stabilization operates basically on the electronic principle of **"parallel regulation"**, is used for furnishing high voltage to the G—M tube or scintillation counter switch can be connected to the measuring instrument. The purpose of regulation is to compensate the effect of mains voltage fluctuations so that the composite variation in high voltage should be quite negligible, that is to say that the output high voltage should be nearly stable. Several electronic regulating and stabilizing stages were applied for reaching this aim. The value of the high voltage adjusted with the potentiometer can, after switching over, be read off on the scale of the built-in meter measuring also the discrimination voltage. A separate **power supply unit** operating with two rectifier tubes supplies voltage and current to all electronic stages of the measuring instrument.

This part is also electronically regulated and its operation is based on the principle of **"series regulation"**.

It is to stress that no electrolytic capacitors are used in the instrument, filtering being done by the electronic methods, thus paper capacitors only are used, which solution contributes to increase the operating safety. In addition an other AC rectifier also operates in the measuring instrument, this rectifier produces the desired negative voltage for the various grid voltages. The voltage obtained passes through the usual filter chain and is also stabilized.

The power supply unit also provides the reference voltage for the electronic regulation. The measuring instrument is built into a steel cabinet for dimensions corresponding to the rack system. With the rack system that is to say, with a design ensuring the simultaneous use of several measuring instruments, this instrument can be mounted without any difficulty into the rack since its dimensions comply with international customs.

Tubes used in this instrument :

Fast counting rate meter unit

ECC 85—5 EF 80—3 6 AL 5—2

H. T. power supply unit :

2×2—1 PL 81—1 EF 80—1
VR 150—1 85 A 2—1

Power supply unit :

6×4—3 EL 84—2 ECC 83—1
VR 105—1

(The number after the Type-Number indicates the number of tubes in use.)

EMG–1877

SPECIFICATION

COUNTING RATE-METER UNIT

MEASURING RANGE:
0 — 10 000 pps
(in 8 sub-ranges)

MEASURING SUB-RANGES:
3, 10
30, 100
300, 1000
3000, 10000 pps

MEASURING ACCURACY: ± 2%

TIME CONSTANTS:
0,2, 1, 5, 20, 100 sec (adjustable)

PULSE AMPLIFIER

INPUT SIGNAL VOLTAGE:
min. 100 mV
max. 30 V
(sensitivity adjustable)

POLARITY AND SHAPE OF INPUTSIGNAL: negative pulse

DISCRIMINATOR

RESOLUTION TIME: < 2 μsec
(with paralysing circuit switched off)

VOLTAGE RANGE:
continuously adjustable between 5 and 50 V

DISCRIMINATING ACCURACY: ± 1 V

PARALYSING CIRCUIT

PARALISING TIMES:
1000, 100, 5 μsec
(can be switched off)

BUILT-IN METER

ACCURACY CLASS: 1,5

TYPE: moving coil

CONNECTION OF EXTERNAL LEVEL RECORDING INSTRUMENT (RECORDER):
max. 5 mA

H. T. UNIT (can be switched off)
(for supplying G-M TUBES OR SCINTILLATION PROBES)

OUTPUT VOLTAGE:
between 300 and 2000 V
continuously adjustable

LOAD: max. 0,5 mA

OUTPUT VOLTAGE CHANGE
(with ± 10% fluctuation of mains voltage):
max. 0,5%
(Measured between 800 and 1500 V output voltage.)

POWER SUPPLY

Voltage:	110, 127, 220 V
Frequency:	50/60 c/s
Consumption:	about 80

OTHER DATA

FINISH
lacquered steel-sheet case with 2 handles

DIMENSIONS:
(without knobs and handles):

height	225 mm
width	500 mm
depth	400 mm

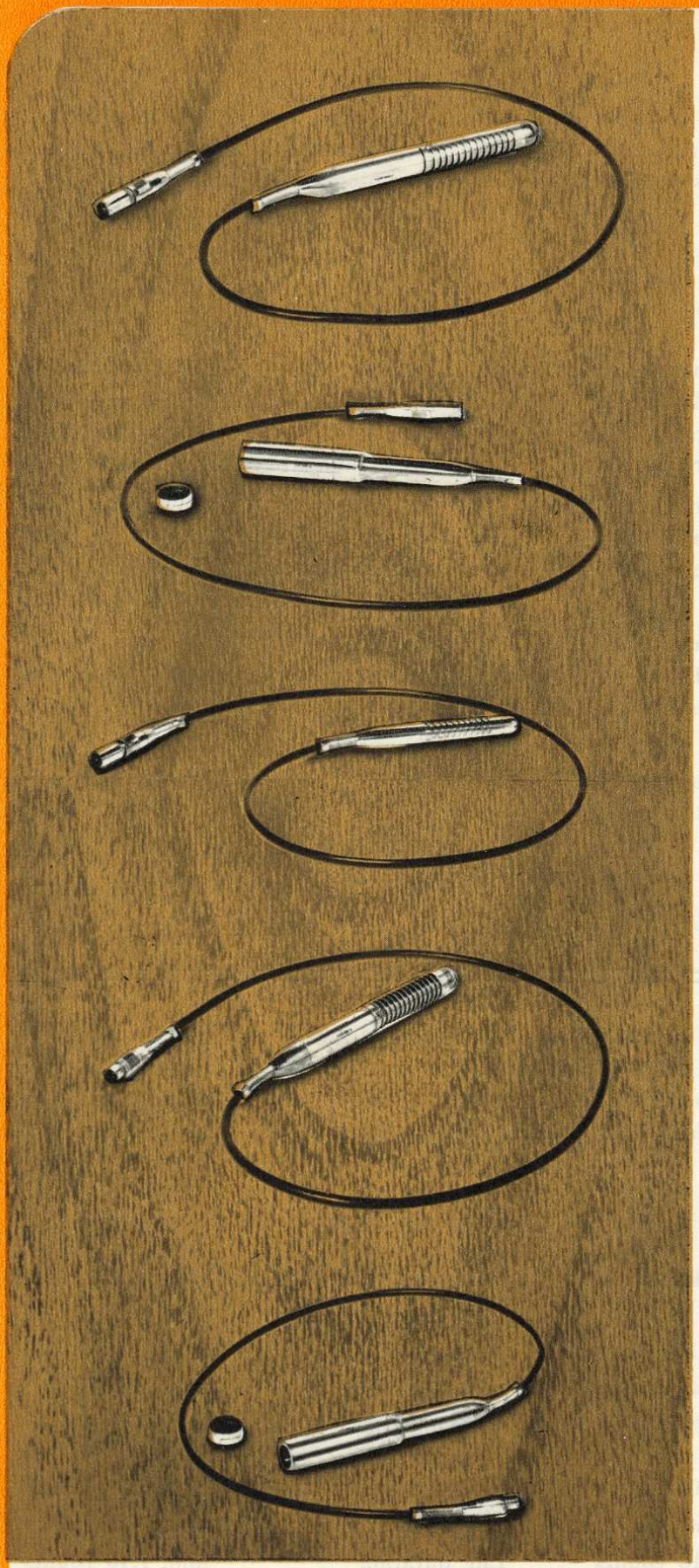
WEIGHT: about 18 kg

ACCESSORIES:

1 power coord
1 coaxial screened cable with 3 kV plug
1 G—M tube with organic filling.

As a result of continued efforts to improve the design of instrument we, reserve the right to change this specification.

WORKS FOR ELECTRONIC MEASURING GEAR * BUDAPEST



N

EMG—1881-1

Organic filled G—M tube without end-window, standard design

EMG—1881-2

Organic filled G—M tube with end-window

EMG—1881-3

Halogen filled G—M tube

EMG—1881-4

Organic filled G—M tube without end-window, standard design

EMG—1881-5

Organic filled G—M tube with end-window.

EMG—1881

G—M COUNTER PROBES

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

EMG—1881

The **probes** made for the various G—M tubes and provided with cable and plug provide for the versatile utilization of nuclear measuring instruments. The plug mounted on the end of the cable is the same with three and two types so that the G—M detector probes can be used with all type EMG nuclear measuring instruments having a G—M tube connector socket suitable for the above special plug

The different types of the G—M detector probes are :

EMG 1881—1 G—M tube probe with fixed coaxial cable and 3 kV plug. The G—M tube is filled with an organic material, has **no end-window** and is of a standard design.

EMG 1881—2 G—M tube probe with fixed coaxial cable and 3 kV plug. The G—M tube is filled with an organic material and features an **end-window.**

EMG—1881—3 G—M tube probe with fixed coaxial cable and 3 kV plug. The G—M tube is of a standard design and is **halogen** filled.

The above three detectors can be used with the following EMG measuring instruments :

1872. Decade counter
1873. Laboratory counter
1877. Fast counting rate-meter.

EMG 1881—5 G—M tube probe with fixed coaxial cable, and 1,5 kV plug. The G—M tube is filled with an organic material and is of a standard design, **without end-window.**

EMG 1881—6 G—M tube probe with fixed coaxial cable and 1,5 kV plug. The G—M tube is of **end-window** design, filled with an organic material.

The above two detectors can be used with the EMG 1864 instrument.

The most important equipment for the detection and measuring of radioactive radiations and for counting radioactive particles is the **Geiger-Müller counter,** in short the G—M tube. The variants in design of this tube serve for different measuring purposes. Some of the G—M tubes are filled with an organic material, others with halogen and they are also made in end-window design.

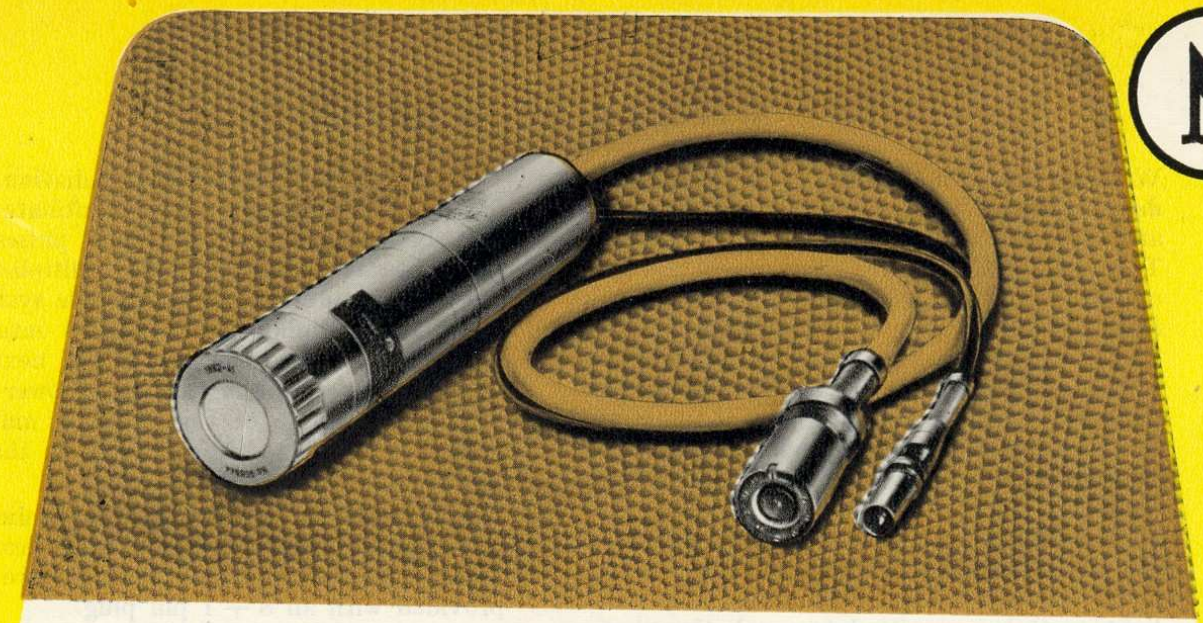
Specification of the G—M tubes used in G—M detector probes :

G—M tube with organic filling, without end-window :

Starting voltage	max. 1100 V
Plateau length	min. 250 V
Plateau slope	max. 7%/100 V
Zero effect (under 5 cm of lead) :	max. 10 p/min
Dead time	max. 150 μsec
Life duration	min. $7{,}10^7$ counts
Insulation resistance	min. 10^{11} ohms
Wall thickness (on sensitive part)	30 to 40 mg/cm^2

G—M tube with organic filling and end-window :

Starting voltage	max. 1250 V
Plateau length	min. 250 V
Plateau slope	max. 7%/100 V
Zero effect (under 5 cm of lead)	max. 10 p/min.
Dead time	max. 150 μsec
Life duration	min. $7{,}10^7$ counts
Insulation resistance	min. 10^{11} ohms
Wall thickness (window-thickness)	4 to 6 mg/cm^2



EMG–1882

SCINTILLATION DETECTOR

A high efficient detector, designed for use in the course of medical or industrial utilization of radioactive radiations and in nuclear research work in connection with EMG radiation measuring and counting equipment, provided with the necessary accessories.

ADAPTERS WITH "SCINTILLATOR" INSERTS

Adapters carrying various "SCINTILLATOR" inserts can be connected to the tube, containing the electronic parts of the "Scintillation Detector" permitting thus the measuring of Alfa, Beta and Gamma radiations.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

EMG–1882

SCINTILLATION DETECTOR

With nuclear measurements a **scintillation detector** is used when a detector, more sensitive and efficient than the G–M tube, is wanted. The cylindrical external tube of the detector offers sufficient protection against disturbances caused by external magnetic fields. The secondary electron multiplier tube (photomultiplier) is elastically fastened within the cylindrical jacket. The internal lay-out of the device provides for light-proof sealing of the photomultiplier against the other parts of the detector.

It is a known fact that the photocathode of the photomultiplier is highly senasitive to the effect of direct light therefore not much light must be permitted to reach the photomultiplier when changing or unscrewing the adapter. Particularly heavy damage occurs if the photomultiplier, in switched-on state with its adapter unscrewed, gets under high voltage.

The photomultiplier being the most important and most sensitive component of the whole equipment, greatest care is of particular importance.

As a result of radioactive radiation, light flashes are produced in the "Scintillator" insert, these pass in the shape of light pulses onto the photocathode of the photomultiplier and are then transformed by the binode system of the photomultiplier and amplified into electrical pulses led to the grid of the next electron tube, operating in cathode-follower coupling. The purpose of this stage is matching with low impedance to the input of the nuclear counter.

Supply voltages for the photomultiplier and the electron tube can be obtained from the nuclear counter, through the multicore cable provided with an 8 + 1 pin plug.

EMG 1872, 1873 and 1877 nuclear counter feature connection facilities to the "Scintillation Detector", i. e. current and voltage supply of the device.

Electron tubes used in the instrument :
ECC 85–1 Photomultiplier FEU 35–1

(The number after the Type-Number indicates the number of tubes in use.)

ADAPTERS WITH „SCINTILLATOR" INSERTS

The "Scintillator" insert is one of the most important part of the „Scintillation Detector." The insert disks are made of anorganic compounds or crystals, or an organic compounds worked onto the substance of other disks or else organic compounds in the substance of plastic disks.

Under the influence of radioactive radiations light flashes are generated in the „Scintillator" inserts, thase flashes get in the shape of light pulses on the photocathode of the photomultiplier of the „Scintillation Detector" and from there adequately amplified onto the nuclear counter.

The inserts are mounted into aluminium sockets determined by the size of the inserts ; to ensure that optical and mechanical connection remains always the same.

Fine pitch screw threads of appropriate design are used for the **mechanical coupling. Optical connection** with the photocathode of the secondary electron tube, is made with particular care since the quality of this connection has a great bearing on the efficiency of detection.

The **optical coupling** consists of several layers : The "Scintillator" insert is sealed e. g. in case of the NaJ crystal by a glass plate and there is a thin layer of silicone oil between the two. There is a plexiglass disk between the glass plate and the photocathode and again a thin silicone oil layer between all layers.

Different "Scintillator" inserts have to be used for the detection of the various radioactive radiations so that the adapters also vary accordingly.

SPECIFICATION

1. **For Alfa radiation counting EMG 1882–11**
   Max. diameter : 108 mm.
   Material of "SCINTILLATOR" : ZnS (Ag) :

2. **For Alfa radiation counting EMG 1882–21**
   Max. diameter : 62 mm.
   Material of "SCINTILLATOR" : ZnS (Ag) :

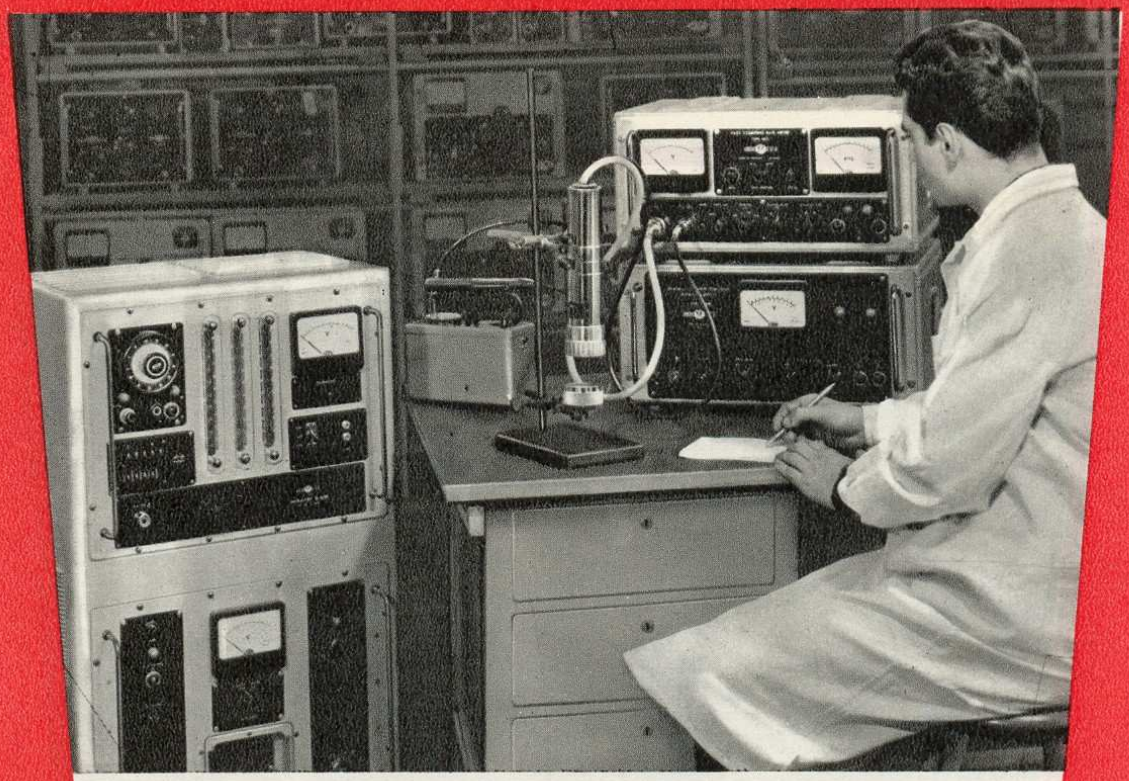
3. **For Beta radiation counting EMG 1882–22**
   Max. diameter : 62 mm.
   Material of "SCINTILLATOR" :
   Terphenyl + PoPoP built into Polyvinyltoluene.

4. **For slow neutron counting EMG 1882–23**
   Max. diameter : 62 mm.
   Material of„ SCINTILLATOR" :
   boric acid + ZnS (Ag) :

5. **For fast neutron counting EMG 1882–31**
   Max. diameter : 62 mm.
   Material of "SCINTILLATOR" :
   Polyvinyltoluene + Terphenyl + PoPoP :

6. **For Gamma radiation counting EMG 1882–41**
   Max. diameter : 62 mm
   Material of "SCINTILLATOR" :
   NaJ (crystal) activated with Thalium.

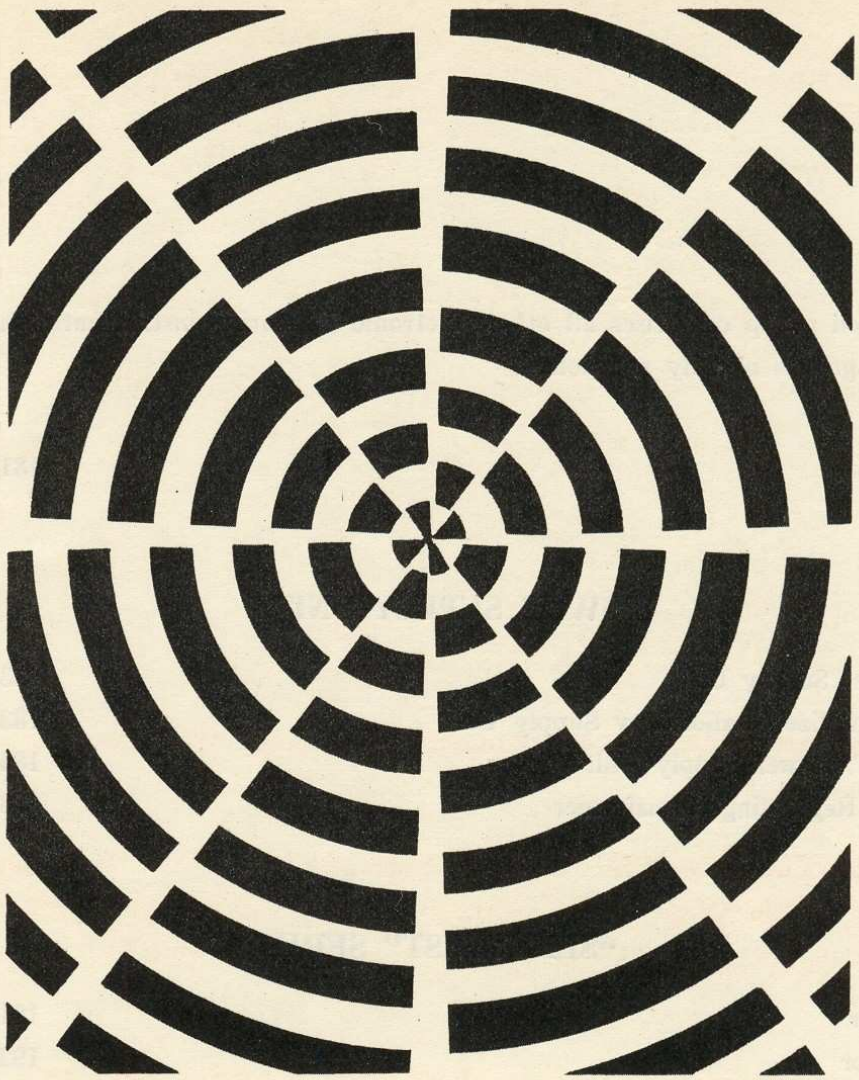
PANEL ASSEMBLY
OF NUCLEAR MEASURING INSTRUMENTS



CONTROL MEASUREMENT
WITH NUCLEAR MEASURING INSTRUMENTS

CHASSIS ASSEMBLY
OF MEASURING INSTRUMENTS

ASSEMBLY OF INSTRUMENT PARTS



E

MISCELLANEOUS ELECTRONIC MEASURING INSTRUMENTS

The "E" marked group comprises all other electronic measuring instruments which do not fit into the other groups already mentioned.

POWER SUPPLY UNITS

"SERVOTEST" SERIES

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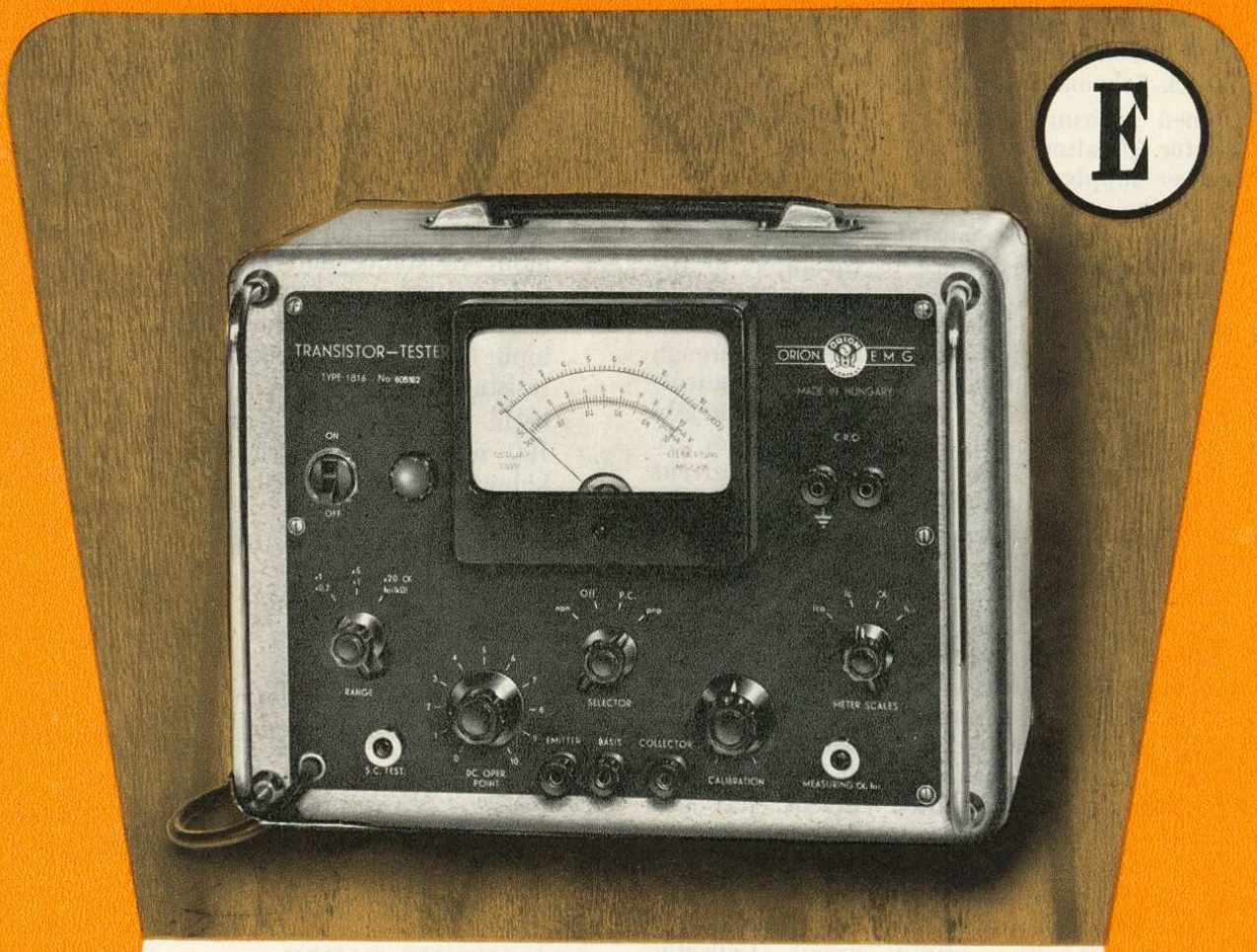
* Under development (in Group „F")



EMG—1816

TRANSISTOR TESTER

An instrument indispensable in workshops and laboratories utilizing transistors for testing the working condition and principal operating data of transistors. It is particularly suitable for measurements in manufacture, for sorting and for continuous workshop measurements as it is very easily handled and its design makes quick measurement possible ; its safety is enhanced by the fact that the built-in indicating instrument — owing to the circuit applied — cannot be deteriorated even in case of wrong handling. The transistor tester measures the current amplification factor (β) of point contact and p-n-p transistors, their collector saturation current (Ic_0^s) and input resistance (h_{11}). When measuring the current amplification factor the operating point can be adjusted and the collector current corresponding to the operating point can also be measured.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

FUNCTION. The functioning principle of the "Transistor Tester" is shown in the Block Schematic Diagram below.

When measuring the current **amplification factor** (β) alternating voltage passes from the power supply unit through a voltage divider into the measuring circuit. This voltage is coupled as from a constant current generator through a high-resistance to the input of the transistor circuit. There is low resistance at the output of the transistor test circuit, the alternating voltage measured there, gets through the measuring amplifier stage to the indicating instrument with a scale calibrated directly in terms of the current amplification factor (β). The transistor tester measures the current amplification factor (β) and collector saturation current (I_{c_0}) with point contact transistors in **earthed base** circuit and with p. n. p. transistors in **earthed emitter** circuit.

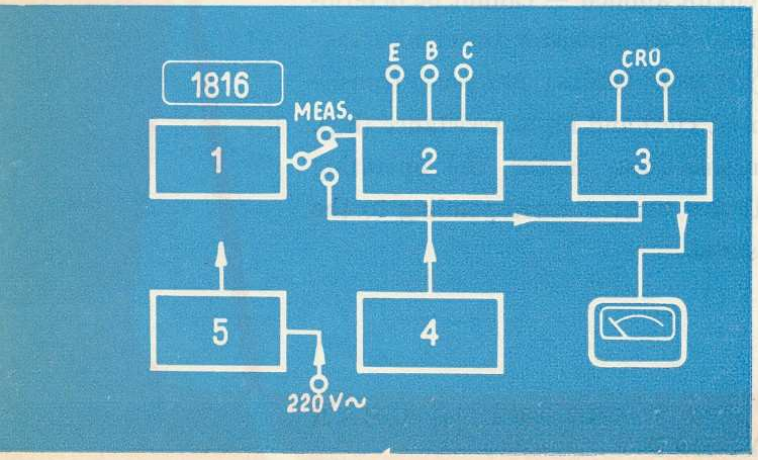
Power supply voltage fluctuation, if any, slightly influences measuring accuracy so that calibration is necessary when measuring. A button has to be pressed for measurement; Calibration can be adjusted with a potentiometer in the end position of the meter pointer. **Measurement of saturation current** (I_{c_0}) is a direct current measurement in such manner that when interrupting the circuit of the input electrode, a current measuring instrument provided with adequate shunts, gets coupled into the output circuit. Collector voltage is with all measurements 4,5 V and is generated by the dry battery built into the instrument.

When measuring **input resistance** (h_{11}) a constant current generator is connected to the input of the transistor. With this measurement the measuring amplifier is coupled with its meter to the input of the transistor circuit. The current being constant the voltage indicated on the scale of the meter is proportionate with the input resistance (h_{11}) and this can be read directly on the scale of the meter.

Tubes used in this instrument:

EF 80—1 EZ 80—1

(The number after the Type-Number indicates the number of tubes in use.)



1. Voltage divider
2. Measuring circuit
3. Measuring amplifier
4. Dry battery
5. Power supply unit

SPECIFICATION

CURRENT AMPLIFICATION FACTOR (β)

MEASURING RANGE:
0 — 200

MEASURING ACCURACY:
with p. n. p. transistors of max. 100 ohms input resistance and min. 200 kohms output resistance): max. ± 4,5%
with p. n. p. transistors of max. 1 kohms input resistance and min. 20 kohms output resistance: max. ± 8%
with point-contact transistors of max. 100 ohms input resistance and min. 10 kohms output resistance: max. ± 8%

COLLECTOR CURRENT (I_{c_0})

MEASURING RANGE: 0 — 1 mA

MEASURING ACCURACY: ± 2%

INPUT RESISTANCE (h_{11})

MEASURING RANGE: 0 — 10 kohms

MEASURING ACCURACY:
with p. n. p. transistors of max. 1 kohm input resistance: max. ± 8%

COLLECTOR CURRENT

MEASURING RANGE: 0 to 10 mA

MEASURING ACCURACY: ± 2%

COLLECTOR VOLTAGE: 4,5 V

LEAKAGE CURRENT:

("Base" electrode current with p. n. p. transistors):
adjustable between 0 and 100 μA

"Emitter" electrode current with point contact transistors: between 0 and 1 mA

Accuracy of adjustment: ± 10%

As a result of continued efforts to improve the design of instruments, we reserve the right to change this specification.

E

EMG–1832/B

REGULATED STABILIZED POWER SUPPLY UNIT

With this equipment the various stages and units of electronic instruments designed for measuring or experimental purposes are quickly and reliably supplied with current. It can be used wherever voltages of a few hundred volts, regulated or unregulated and simultaneously unregulated heater voltage is needed.

EMG–1838

MAINS VOLTAGE REGULATIN TRANSFORMER (220 V)

Accurate observance of the rated value of the power supply voltage is necessary for the correct operation of certain electronic measuring instruments. It is known that power supply voltage will drop under certain circumstances, e. g. in case of peak loads and that it will rise at other times, when the load is dropping. To eliminate this, an apparatus is needed, which will keep the rated power supply voltage automatically on a constant level. This voltage regulating transformer is used for such purposes.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

EMG–1832/B

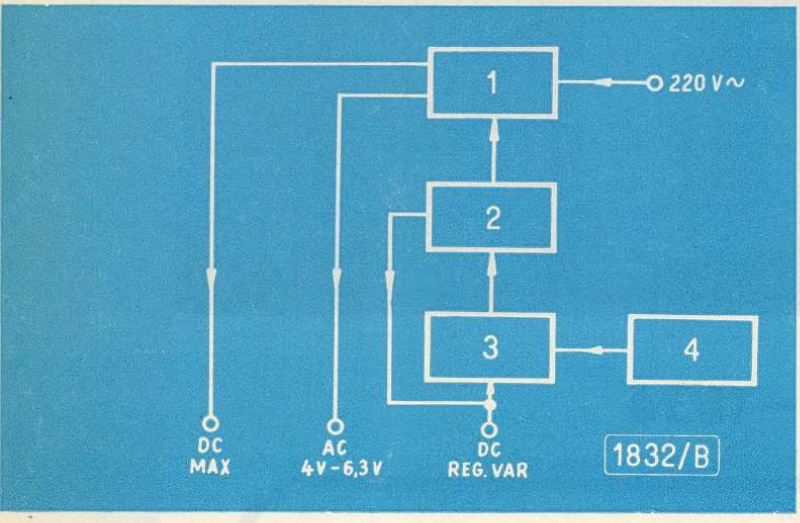
REGULATED STABILIZED POWER SUPPLY UNIT

FUNCTION. AC mains is rectified by two high-power tubes. The unregulated max. DC voltage is led out to a separate jack. Electronic regulation operates on the principle of series regulation. In view of the considerable direct current, power regulation is performed by three high-power parallel-coupled electron tubes. Bias of the three series-coupled regulating tubes is adjusted by the control stage. According to the changes in load, the internal resistance of the tubes and thereby the voltage drop produced on them should become regulated automatically. The regulated voltage, measured on the output jacks, is constant, independently of the load. Cathode voltage of the control stage tube is kept on a constant level by a special stabilizer tube. Coarse and fine adjustment of the regulated voltage is possible with the two potentiometers of the filter chain connected to the output plus and minus points. The apparatus also supplies unregula, ted filament voltage to the 4 V and 6,3 V tubes.

Tubes used in this instrument :

6 AU 6–1 EBL 21–3 VR 105–1
AZ 21–2

(The number after the Type-Number indicates the number of tubes in use.)



SPECIFICATION

REGULATED STABILIZED POWER

DC VOLTAGE : between 150 and 300 V
VARIATION OF VOLTAGE : max. 0,5%
(between no-load and fulload)
VOLTAGE VARIATION : max. 0,5
(with ± 10% mains voltage fluctuation):
DC CURRENT : between 0 and 100 mA
(with max. 0,5% voltage variation)
DC CURRENT : between 0 and 140 mA
(with voltage variation **in excess** of 0,5%)

UNREGULATED (not stabilized)
DC VOLTAGE : about 500 V
DC CURRENT max. 140 mA

UNREGULATED AC VOLTAGE
HEATER VOLTAGE (with max. 5 A) :
4 V ± 10%
6,3 V ± 10%
HUM VOLTAGE
(when earthing the negative point) 0,01 V

POWER SUPPLY
Voltage : 110, 220 V
Frequency : 50/60 c/s
Consumption : about 100 W
(depending on load)

OTHER DATA

FINISH :
lacquerd steel-sheet case with 1 leather handle
DIMENSIONS
(without knobs and handle) :
width 320 mm, height 250 mm, depth 220 mm
WEIGHT : 12,5 kg

As a result of continued efforts to improve the design of instruments, we reserve the right to change this specification.

1. Rectifier and filtering stage
2. Voltage regulating stage
3. Control stage
4. Stabilizing stage

EMG–1838

MAINS VOLTAGE REGULATING TRANSFORMER (220 V)

FUNCTION. Regulation is made basically, according to the so-called ferro-resonance principle, with a saturated iron core transformer whose primary coil corresponds to the AC mains voltage while its secondary coil is tuned by a capacitor to the mains frequency.

A compensating coil is coupled in series with the secondary coil. This circuit design provides a constant voltage regulated to 220 V, almost independent of the AC mains voltage variation.

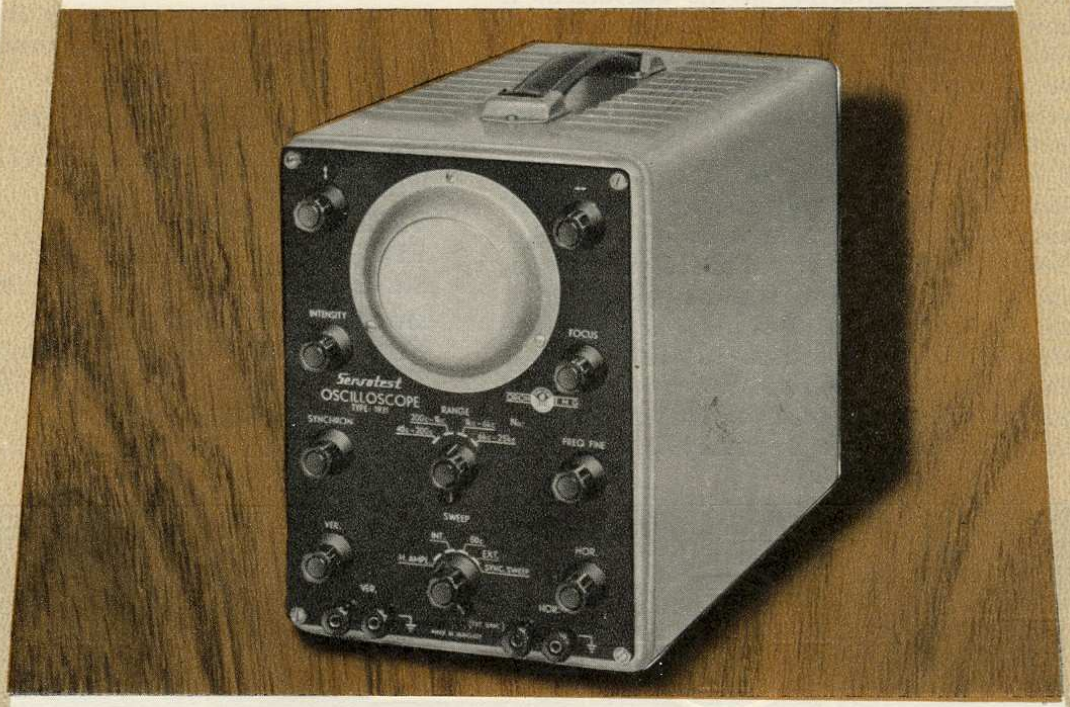
SPECIFICATION

SECONDARY VOLTAGE : 220 V
VOLTAGE VARIATION
with ± 10 mains voltage fluctuation :
max. ± 1%
POWER : max. 60 W

EMG–1911

"SERVOTEST" V. T. VOLTMETER

The V. T. voltmeter is the first measuring instrument in service work and trouble shooting since most of the faults can be determined by voltage measurement. Its high input impedance and wide frequency range makes it suitable for measuring not only at audio-frequencies, but at radio-frequencies as well.



EMG–1931/B

"SERVOTEST" CATHODE-RAY OSCILLOSCOPE

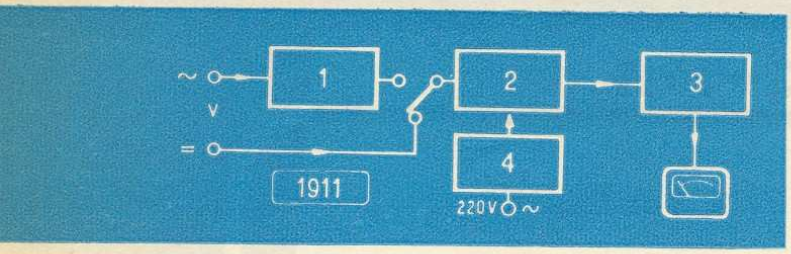
There is great need in service work also of the oscilloscope, one of the most versatile measuring instruments. Its comparatively small size, its reliable rugged design and its satisfactory accuracy of measurement are identical with the other equipments of the "Servotest" equipment series. It is used to particular advantage for measuring audio-frequencies.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

EMG—1911

"SERVOTEST V.T. VOLTMETER

The operating principle of the instrument is shown in the Block Schematic Diagram below. The input circuit of the VT voltmeter is varied according to the DC or AC voltage to be measured. When measuring DC voltage, the voltage under test is fed through the input voltage divider directly to the bridge circuit of the VT voltmeter represented by a double triode. When measuring alternating voltage a double diode performs the rectification and the input voltage divider follows after it. Taking into consideration the preceding rectification, only DC voltage division is made when measuring DC and AC voltage. As indicating instrument the VT voltmeter can be used to advantage even up to 50 Mc/s.



SPECIFICATION

MEASURING RANGE: 0 — 1000 V (in 4 ranges)
MEASUREMENT ACCURACY: DC ± 4%, AC ± 5%
FREQUENCY RANGE: 10 Mc/s (max. up to 200 V)

1. Measuring rectifier
2. Voltage divider
3. V. T. voltmeter bridge
4. Power supply unit

EMG—1931/B

"SERVOTEST" CATHODE-RAY OSCILLOSCOPE

The operating principle of the instrument is shown in the Block Schematic Diagram below. Both amplifiers of the instrument producing the voltages for the vertical and horizontal pairs of deflecting plates are of the same electrical design and work independently of each other. Each is fitted with a double amplifier triode. A potentiometer connected before each amplifier adjusts the input voltage. The focus and intensity of the luminous spot can also be adjusted continuously, and it can be displaced in horizontal and vertical direction. The oscillations of the time-base generator get amplified to the horizontal pair of deflecting plates of the cathode-ray tube. The time-base frequency is adjustable in four steps or continuously. Synchronization is possible with the internal frequency, with the 50 c/s mains frequency or with an external frequency. The power supply unit provides high voltage for the cathode-ray tube with a separate rectifier tube while the rest of the stages obtain the required current and voltage from another rectifier tube.

SPECIFICATION

SCREEN DIAMETER OF CATHODE-RAY TUBE: 3″ (7,5 cm)

VERTICAL AMPLIFIER

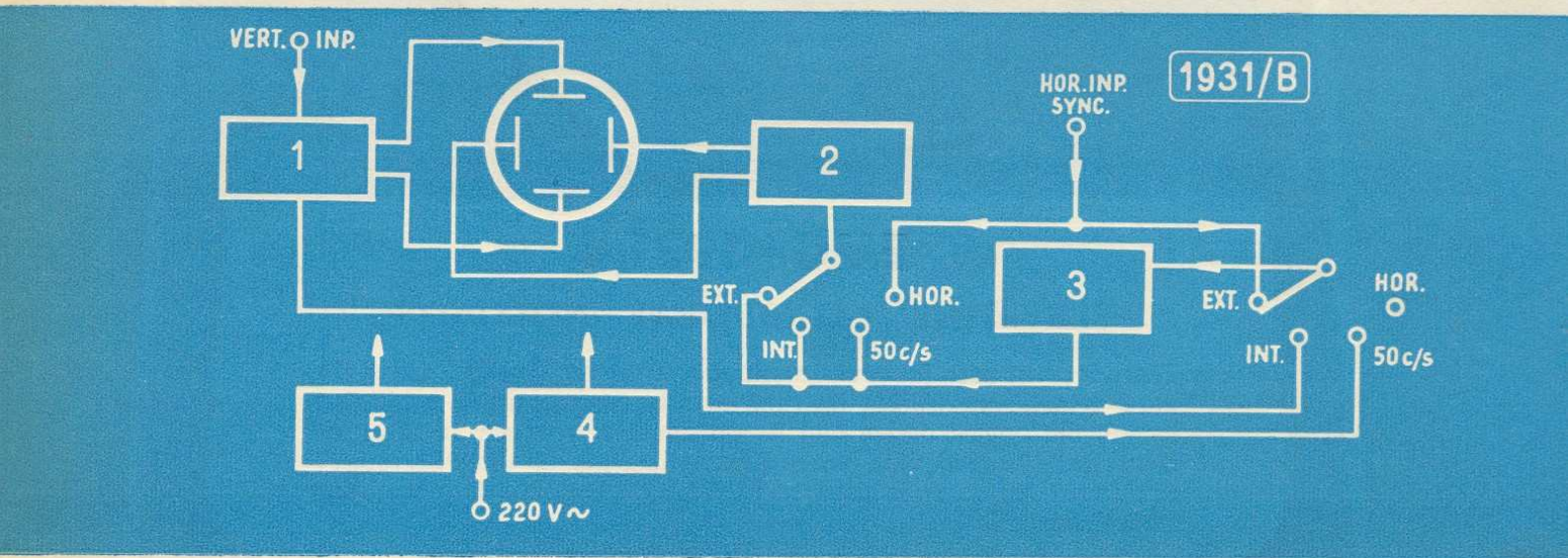
FREQUENCY RANGE: 40 c/s — 100 kc/s
SENSITIVITY: 200 mV_{rms}/cm

HORIZONTAL AMPLIFIER

FREQUENCY RANGE: 40 c/s — 100 kc/s
SENSITIVITY: 250 mV_{rms}/cm

TIME-BASE GENERATOR

FREQUENCY RANGE: 40 c/s — 25 kc/s



1. Vertical amplifier 2. Horizontal amplifier 3. Time-base generator 4. Power supply unit
5. High voltage supply unit

E

EMG–1921/B

"SERVOTEST" SIGNAL GENERATOR

A light portable measuring instrument designed for the generation of H. F. signals for workshop and servicing purposes. They can be modulated by means of the built-in audio-frequency oscillator.

EMG–1925

"SERVOTEST" AF OSCILLATOR

A useful instrument for workshop repair of radio receivers or in radio servicing for the examination of audio-frequency components, receiver units, e. g. amplifier stages.

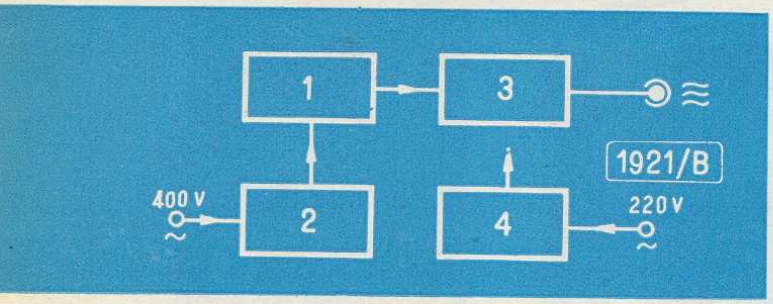
WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

EMG—1921/B "SERVOTEST" SIGNAL GENERATOR

FUNCTION. The RF **oscillator** is LC-coupled, its tuning circuit is arranged in the grid circuit of one half of the double triode, operating as oscillator. The grid resistor in the same circuit consists of two parts; of a constant and of a variable part.
The variable part, a potentiometer, attends to continuous regulation of the radio-frequency output level as one of the links of the output **attenuator,** when the radio-frequency signal passes through the five-stage decade attenuator to the output screened coaxial jack.
The basic oscillations of the RF oscillator can be **modulated** with the 400 c/s audio-frequency signal produced by the other half of the double triode. Internal modulation can also be switched off, where an unmodulated signal is needed for a measurement. The instrument obtains its voltage and current from the built-in power supply unit containing also the necessary filter.

Tubes used in this instrument:
ECC 40—1 6 X 4—1

(The number after the Type-Number indicates the number of tubes in use.)



SPECIFICATION

FREQUENCY RANGE: 100 kc/s — 25 Mc/s
FREQENCY SUB-RANGES:
100 kc/s — 300 kc/s
300 kc/s — 1 Mc/s
1 Mc/s — 3 Mc/s
3 Mc/s — 9 Mc/s
9 Mc/s — 25 Mc/s

FREQUENCY ACCURACY ±3%
Output voltage of RF oscillator:
100 mV ± 50%
(adjustable in 5 steps and continuously)
Accuracy of output attenuator steps: ± 30%

INTERNAL MODULATION: 400 c/s ± 10%

POWER SUPPLY

Voltage:	110, 220 V
Frequency:	50/60 c/s
Consumption:	appr. 20 W

OTHER DATA

FINISH:
lacquered steel-sheet case, with leather handle

DIMENSIONS
(without knob and handle):
height 180 mm, width 236 mm, depth 132 mm

WEIGHT: 5 kg

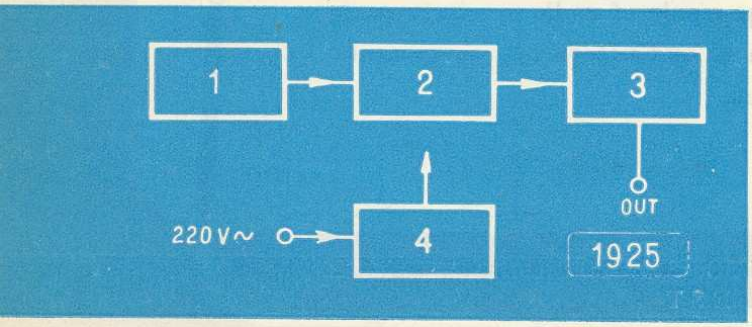
ACCESSORIES:
1 coaxial screened cable with plugs.

1. RF oscillator
2. AF oscillator
3. Attenuator
4. Power supply unit

EMG—1925 "SERVOTEST" AF OSCILLATOR

FUNCTION: The AF oscillator is an **RC coupled oscillator.** in Wien-bridge. The frequency bands can be changed by switching over the resistors inserted in the two arms of the bridge while the double variable capacitor has to be adjusted for fine tuning of the desired frequency.
The oscillator tube is a double triode; amplitude stability is provided for by the incandescent lamp inserted in the cathode circuit of one of the triodes.

Tubes used in this instrument:
ECC 40—1 6 AU 6—1 6 X 4—1



SPECIFICATION

FREQUENCY RANGE: 20 c/s — 20 kc/s (in 3 bands)

FREQUENCY BANDS: 20 c/s — 200 c/s
200 c/s — 2 kc/s
2 kc/s — 20 kc/s

FREQUENCY ACCURACY: ± 5 % or 5 c/s (whichever is the higher)

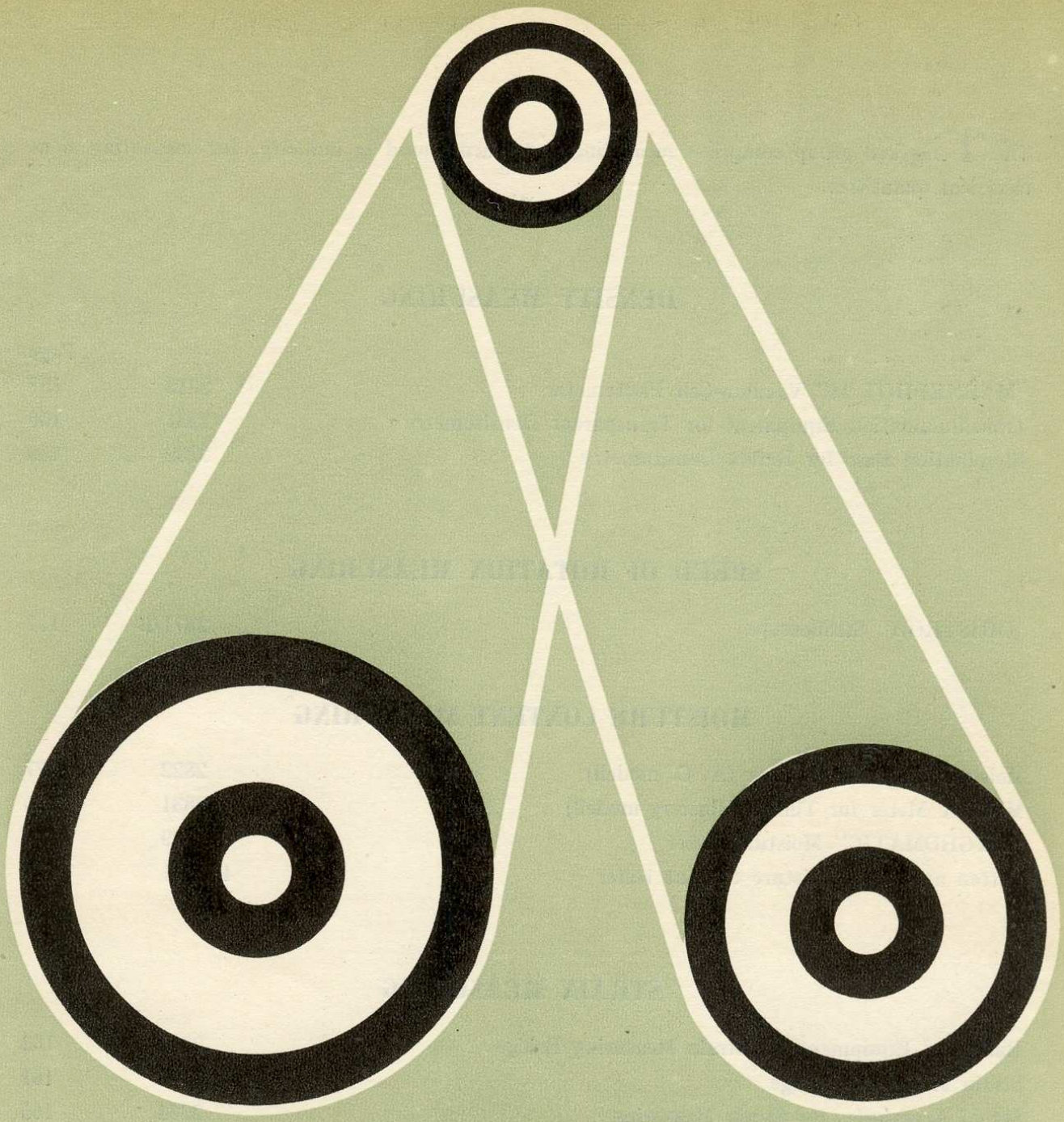
OUTPUT VOLTAGE: min. 5 V

OUTPUT ATTENUATOR: 1 : 10 and 1 : 100 in stage
and continuously adjustable

POWER SUPPLY:

Voltage:	110, 120 V
Frequency:	50/60 c/s
Consumption:	about 20 W

1. RC oscillator
2. Cathode-follower stage
3. Attenuator
4. Power supply unit



I

INDUSTRIAL MEASURING INSTRUMENTS

The "I" marked group comprises measuring instruments used in industry, for measuring non-electrical quantities

DENSITY MEASURING

SPEED OF ROTATION MEASURING

MOISTURE CONTENT MEASURING

STRAIN MEASURING

"pH" MEASURING

I

EMG–2213

"MAGNEPHOT II" VACUUM CELL PHOTOMETER

A test instrument designed for use in the field of industrial and scientific measurements, particularly for measuring and checking various physical processes. With an appropriate complementary equipment it can be used primarily for measurement of optical light density, but also as indicating apparatus for any measuring of industrial process based on the comparison of the traversing or reflected quantity of light, further based on the absorption or diffraction of light.

Its sensitivity increased to threefold, its finish and design (push-buttons) make it the most up-to-date measuring instrument for photometrical measuring tasks.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

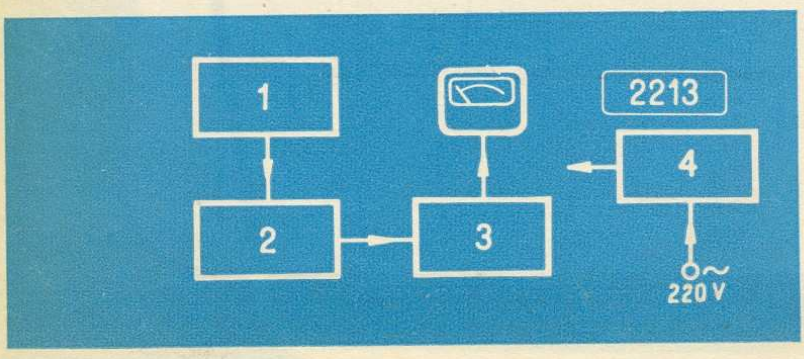
FUNCTION. The functioning principle of the "MAGNEPHOT II" Vacuum Cell Photometer is shown in the Block Schematic Diagram below.

Electronic photometers converts the light to be measured with a photocell into electric current which passes then through an appropriate electronic amplifier onto the calibrated indicating instrument. The use of a D. C. amplifier, for such purpose involving several technical drawbacks, it is most expedient to use the A. C. amplifier. The use of this amplifier is made possible by the patented "MAGNEPHOT" system photocurrent modulation inverting the output voltage of the vacuum photocell into alternating voltage which can be amplified much more safely without disturbing circumstances.

A photocell sensitive to the red colour is built in the measuring head and the calibration of the instrument also refers to this photocell.

The sensitivity of the measuring head is determined by the light quantity incident on the photocell. The measuring head is therefore supplied with 2 light-shutter rings which can be screwed in. The aperture of one of the rings is 6 mm corresponding to the basic sensitivity. This aperture is used when adjusting the μLumen value of the scales with a Tungsten filament standard lamp (2870 K°). Sensitivity can be increased to about double by using the 8,5 mm aperture light-shutter ring.

The measuring head is of v. ry small dimensions and is connected with a multicore cable to the photometer; the electromagnet receives the necessary A. C. for its operation through this cable and the modulated current of the photocell also passes through it onto the first electron tube of the amplifier stage. The magnetic modulation applied means that the electron current leaving the cathode of the photocell under the influence of light is modulated by the A. C. magnetic field of mains frequency (50 c/s), as a result the doubled frequency of the modulating frequency appears on the loading resistor of the photocell. This design eliminates absolutely the interference caused by stray currents produced otherwise in the circuit of the photocell.



The A. C. amplifier used is in fact a selective amplifier tuned to the input signal of 100 c/s. The following phase sensitive rectifier features also a patented circuit.

There are four different scales on the indicating instrument. Two linear scales can be used for percentage measurement of light transmission. Two other scales with logarithmic graduation show the **density** values. They are very simple to read, since only the basic density value shown on the measuring range push-button and the density value indicated on the instrument scale, have to be added, to receive the measured final value.

The measuring instrument obtains its full current supply from the power supply unit.

Tubes used in this instrument:

ECC 85—2 EZ 80—1 TUNGSRAM 223—1

(The number after the Type-Number indicates the number of tubes in use.)

SPECIFICATION

UPPER LIMITS OF LINEAR (percentage) SCALES:

30, 100, 300, 1000,
3000, 10 000, 30 0000 μLumen

LOGARITHMIC (DENSITY) SCALES

MEASURING RANGES:

0—0,6 D,	0,6—1 D
1—1,6 D,	1,6—2 D
2—2,6 D,	2,6—4 D

RELATIVE DENSITY MEASURING ACCURACY
(between D = 0 and 3)
max. 0,03 D or 7% of full scale deflection (whichever the higher)
(at rated A. C. mains voltage and frequency).

POWER SUPPLY

Voltage:	110, 127, 220 V
Frequency:	50 c/s
Consumption:	about 20 W

OTHER DATA

FINISH:
lacquered steel-sheet cabinet with handle

DIMENSIONS:

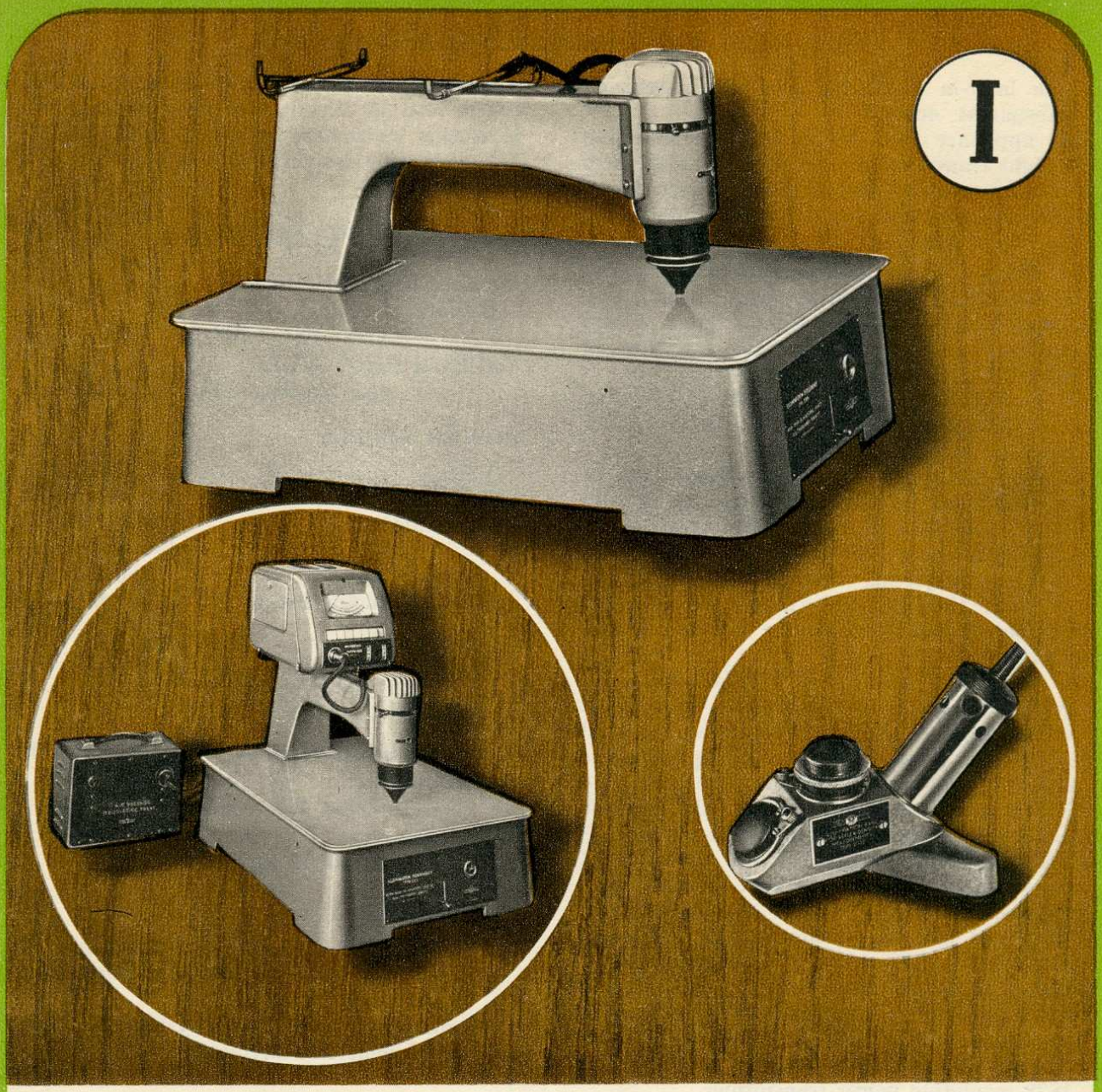
height	185 mm
width	185 mm
depth	315 mm

WEIGHT: about 8 kg

ACCESSORIES:
1 power supply connection cord
1 measuring head with cable
2 light-shutter rings

As a result of continued efforts to improve the design of instruments we reserve the right to change this specification.

1. Measuring head
2. Amplifier (100 c/s)
3. Phase sensitive rectifier
4. Power supply unit



I

EMG–2231 EMG–2232

AUXILIARY EQUIPMENTS FOR DENSITOMETRY

Objective comparison of tonal values of films and prints is an examination frequently occurring in the photographic and printing industries. **Densitometry** is divided into two principal groups :

transparent densitometry, based on the **light-transmitting** property of the test material,

reflex densitometry, based on the **light-reflecting** property of the test material.

Separate appliances are used for the two measuring purposes, these appliances can be operated coupled to the "MAGNEPHOT II" vacuum cell photometer.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

EMG—2231 TRANSPARENT DENSITOMETER

with built-in measuring head for measuring transparent density.

An appliance used for measuring blackening or light transmission. The equipment operates with a traversing ray of light, not within a defined spectrum range, with illumination by white light.

It consists of the following principal parts:

1. **Measuring table** with opaque plate, featuring a measuring aperture of about 3 mm diameter exactly opposite the aperture of the sensing photocell.
2. **Two of fluorescens lighting tubes,** 15 W each, built into the measuring table for transilluminating the opaque plate.
3. **Projector arm with projector head** fixed to it, which can be displaced vertically up and down. A 6 V/30 W incandescent lamp arranged in the focus of the pair of lenses built into the projecting head is used as source of light; the light rays emitted are arranged by the condensor lenses into a parallel light beam.
4. **Measuring head** with "MAGNEPHOT" system photocurrent modulation, with a red colour sensitive photocell, the measuring head is built in permanently exactly opposite the measuring aperture on the opaque plate.
5. **Diaphragm** provided under the opaque plate with a lever operated from outside.

The mechanical design of the Transparent Densitometer enables the "MAGNEPHOT II" photometer coupled to it for densitometry, to be placed onto the holder of the projecting arm specially developed to this purpose.

Stabilized power supply voltage is required for the projecting lamp built in the projecting head and for the "MAGNEPHOT II" photometer; this voltage is supplied by the EMG 1838 regulating power transformer.

By the use of the Transparent Densitometer the incident or traversing light rays can be aligned in parallel or divergently.

The density of the film section transilluminated can be read off directly in density value on the indicating instrument of the "MAGNEPHOT II" measuring instrument.

SPECIFICATION

DIMENSIONS OF FILM
(surface of table):
max. 700 × 700 mm

VACUUM PHOTOCELL:
red sensitive (TUNGSRAM 223)

POWER SUPPLY

Voltage:	110/220 V
Frequency:	50/60 c/s
Consumption:	about 30 W
	(for "F" tubes not stab.)
	about 70 W
	(for photometer and projecting lamp, stab.)

OTHER DATA

FINISH:
lacquer steel-sheet frame and cast iron arm

DIMENSIONS:
600 × 425 × 400 mm

WEIGHT:
about 12 kg

ACCESSORIES:

1 conic inset for parallel light measurements
1 conic inset with lense system for stray light measurements
1 conic inset with lense system for collected light measurements

As a result of continued efforts to improve the design of instruments we, reserve the right to change this specification.

EMG—2232 ILLUMINATION BASE

for measuring reflex density.

An appliance for measuring blackening which operates with a reflected light ray, not within a definite spectrum range, by illumination with white light.

The measurement is based on the property of substances not permeable to light; they absorb one part of the light and reflect the other part.

Reflex densitometry i. e. determination of **blackening** of the test material is carried out with illuminating light falling at 45° onto the plane of the test material and with light reflected at an angle of 45° in relation to the incident ray of light.

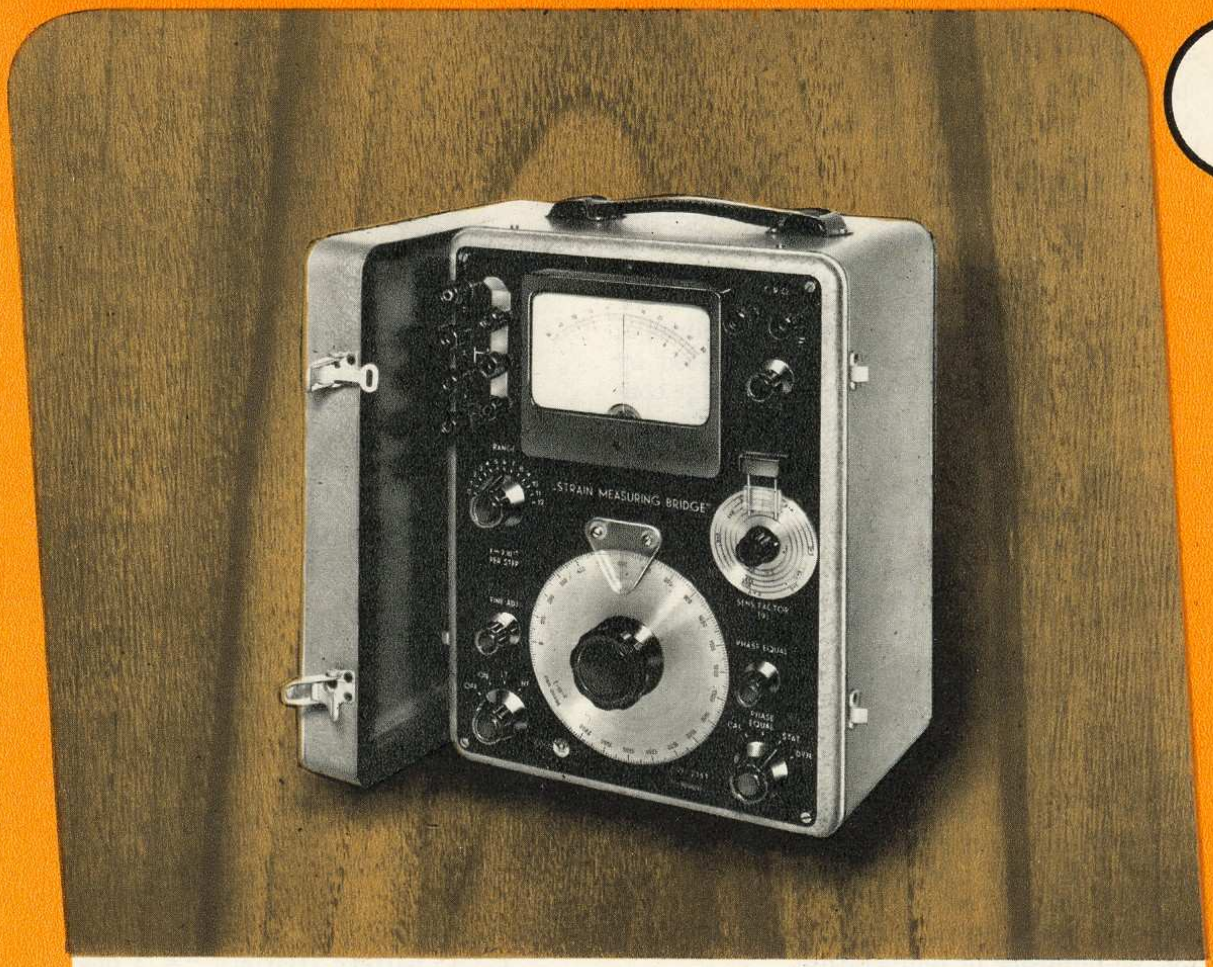
The illuminating stand has to be placed on the test material e. g. on paper.

The illuminating stand is actually used for accurate stabilization of the relative positions of the measuring head and of the source of light.

The measuring surface is approximately circular, its diameter being about 3 mm.

The illumination base can also be used for the determination of the **reflection** of the test material, e. g. with lacquered surfaces, where measurement is made with an illuminating light, falling at 45° onto the plane of the test material and with light, reflected at an angle of 90° in relation to the incident ray of light.

The "MAGNEPHOT II" photometer with its measuring head attachment, containing the red sensitive photocell, is necessary for measuring reflex density.



EMG–2353

STRAIN MEASURING BRIDGE

An instrument designed for the static and dynamic measurement of mechanical deformations, measuring the resistance changes of so-called strain gauges made of a resistance wire, in a very sensitive calibrated measuring bridge system. Highly accurate strain gauges of calibrated value, made of resistance wire are fastened tightly to the body, machine or mechanism for determining the deformation resp. strain. The length of the very thin resistance wire varies in function of the deformation of the test object, this change being measured by the strain measuring bridge with $^{0}/_{00}$ accuracy.

FUNCTION. The functioning principle of the "Strain Measuring Bridge" is shown in the Block Schematic Diagram below. As to its principle design, the strain measuring bridge is an A. C. Wheatstone bridge measuring the changes in resistance of the strain gauges. Under the double bridge system measuring principle applied, the change in resistance produced by the dimensional changes of the strain gauges upsets the balance of one of the Wheatstone bridges, of the „measuring" bridge; the voltage produced here is compensated by another, „calibrating" Wheatstone bridge connected in series with the former bridge and consisting of calibrated measuring arms The mechanical change in dimension effected by the strain gauge can be read off the scale calibrated in specific strain (ε) of the regulating elements after an adequate electronic amplifier and a phase-sensitive rectifier used for sensing the direction of strain. The Wheatstone bridge obtains the current from an L—C system oscillator. Alternating voltage supply to the measuring bridge represents many advantages as against the known direct voltage supply.

In general two gauges, a measuring and a compensating gauge are used with the strain measuring bridge; one of the gauges serves for measuring the deformations and strains, the other for compensating the strain produced by the influence of temperature.

The circuit of the strain measuring bridge is also suitable for the simultaneous use of two or four strain gauges which means a double or fourfold sensitivity of the instrument and also facilitates carrying out special measuring tasks. Static and dynamic deformations can be detected with the strain measuring bridge. The "selector" switch of the strain measuring bridge is used for adjusting.

1. the phase compensation, method
2. calibration of the measuring bridge,
3. the desired static or dynamic measuring system.

The sensitivity factor (g) of the gauge, can be adjusted continuously on the corresponding scale of the strain measuring bridge.

Tubes used in the instrument:
1 T 4—1 1 S 4—T—1

(The number after the Type-Number indicates the number of tubes in use.)

SPECIFICATION

MEASURING RANGE (adjustable)
In the centre position of the measuring range extension switch:
$\pm 12\,^0/_{00}$ i. e.
$\pm 12 \cdot 10^{-3}\ \varepsilon$ (spec. deform.)
In extrem position of measuring range extension switch:
+ or—24 $^0/_{00}$ i. e.
+ or—$24 \cdot 10^{-3}\ \varepsilon$

MEASURING RANGE
in steps of $2\,^0/_{00}$ and further $2\,^0/_{00}$ continuously

MEASURING ACCURACY
(related to the $2\,^0/_{00}$ step or to the full scale of the fine setting): $0{,}01\,^0/_{00}$ i. e. $1 \cdot 10^{-5}$

SENSITIVITY FACTOR (g)
between 1,7 — 2,7
continuously adjustable

OSCILLATOR FREQUENCY:
2 kc/s $\pm$ 10%

BATTERIES
L. T. battery (Battery "A") one 1,2 V
H. T. battery (Battery "B") two 45 V

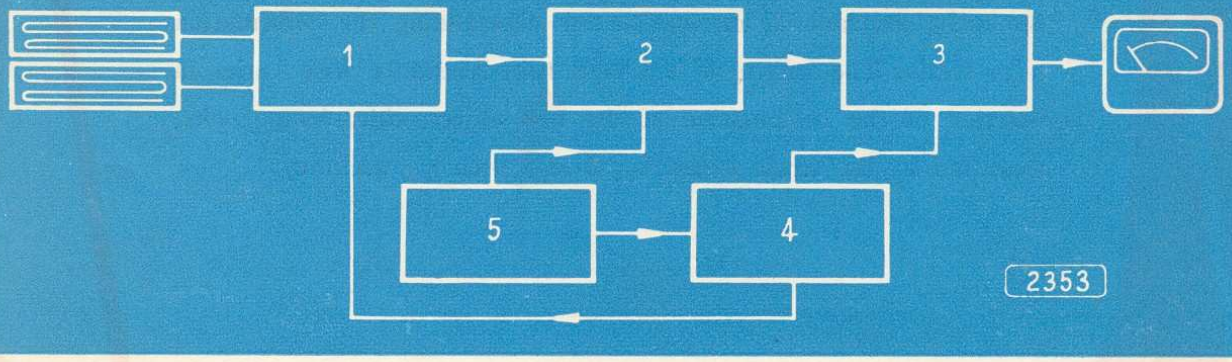
OTHER DATA

FINISH:
lacquered steel-sheet case with 1 leather handle

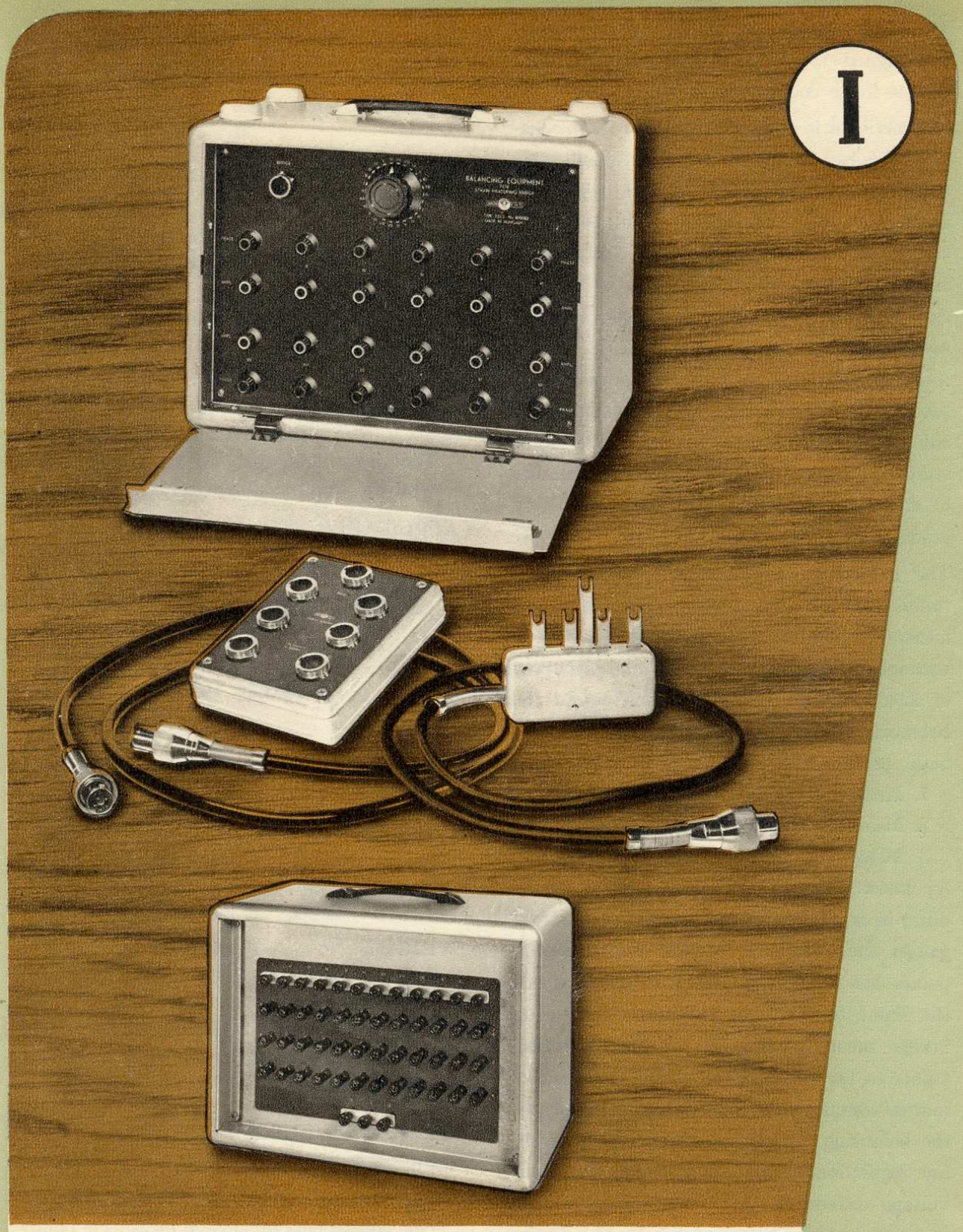
DIMENSIONS
(without knobs and handles):
height 317 mm, width 238 mm,
depth 202 mm

WEIGHT: about 12 kg

As a result of continued efforts to improve the design of instruments, we reserve the right to change this specification.



1. Double (measuring bridge Wheatstone)
2. Amplifier
3. Phase-sensitive rectifier
4. Oscillator (2 kc/s)
5. Dry batteries



EMG–2352

BALANCING EQUIPMENT FOR STRAIN MEASURING BRIDGE

The balancing equipment permits ohmic and capacitive balancing i. e. switching over of twelve measuring points.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

The strain measuring bridge (EMG—2353) is designed for a maximum of four strain gauges to be coupled on directly.

In practice it is often necessary for the mechanical deformation to be measured simultaneously in several points of the test object. To allow for this requirement the balancing equipment enables using a greater number of strain gauges and their insertion in the circuit of the strain measuring bridge. In principle it is sufficient to use a single strain measuring bridge for any number of measuring points. Several balancing equipments can also be used in connection with the same strain measuring bridge, thus the number of measuring points can be increased to any multiple of 12.

The balancing equipment has the merit of rapid and reliable change-over from one measuring point to the other and this is done without influencing the result and accuracy of measuring. As to its electrical design the balancing equipment consists of the following main parts :

1. Measuring voltage converter
2. Measuring point change-over switch
3. Measuring point regulator (1 to 12).

As known, the several strain gauges slightly differ in resistance ; when using several strain gauges the difference between the measuring points has to be eliminated, in other words the input terminals of the strain measuring bridge must be brought, at all measuring points to the same initial state. This task of mutual compensation is performed primarily by the balancing equipment, which includes very fine regulation, capable of equalizing the slight voltage differences. For increased measuring accuracy and sensitivity, each balancing equipment can be used optionally with two or four strain gauge connection. Measurement at several points obviously supposes a larger surface than the normal measurement with two or four strain gauges ; considerable convenience is derived herefrom when using two strain gauges, since any number of gauges between one and twelve can be employed for heat compensation purposes.

SPECIFICATION

MEASURING RANGES

identical with those of the EMG—2353 strain measuring bridge

ERROR CAUSED BY THE BALANCING EQUIPMENT

a) when using 2 strain gauges

$\pm$ 0,002% specific elongation

with a 100 ohms gauge :

max. 2% specific elongation

with a 600 ohms gauge :

$\pm$ 0,0009% specific elongation

b) when using 4 strain gauges

measurement free from error.

The above data apply to use in connection with the strain-measuring bridge EMG-2353

APPLICABLE STRAIN GAUGES

Resistance :

from 100 to 600 ohms

Number of gauges : 2 or 4

OTHER DATA

FINISH :

lacquered steel-sheet case with 1 carrying handle

DIMENSIONS :

height	345 mm
width	430 mm
depth	240 mm

WEIGHT : about 10 kg

ACCESSORIES :

1 connection cable with plug connectors to strain measuring bridge and balancing equipment.

ON SPECIAL ORDER

EMG 2353—2

Distributing box for connection of 5 balancing equipments for several measuring points (with seven 5-pin connection sockets)

EMG—2352—21

Connecting cable, with 5-pin plug connector at both ends, one for each balancing equipment (connection to distributing box)

As a result of continued efforts to improve the design of instruments we, reserve the right to change this specification.

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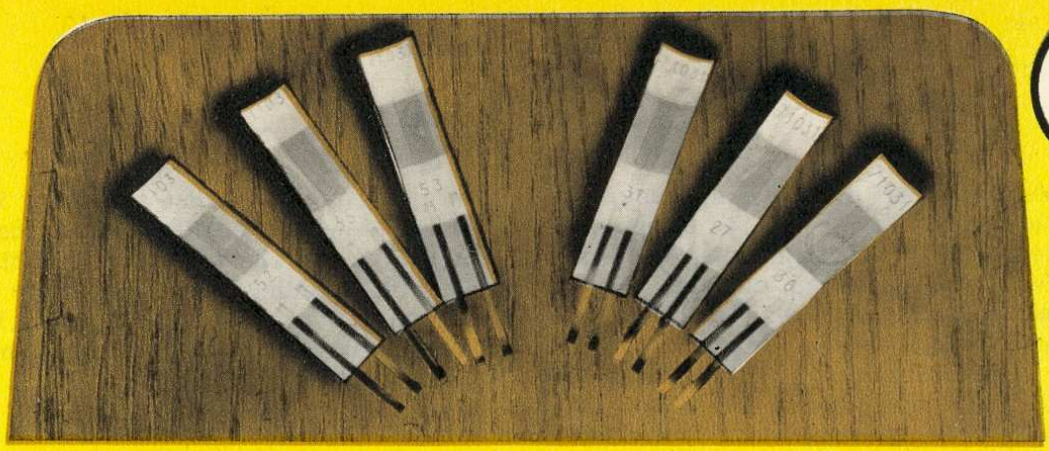
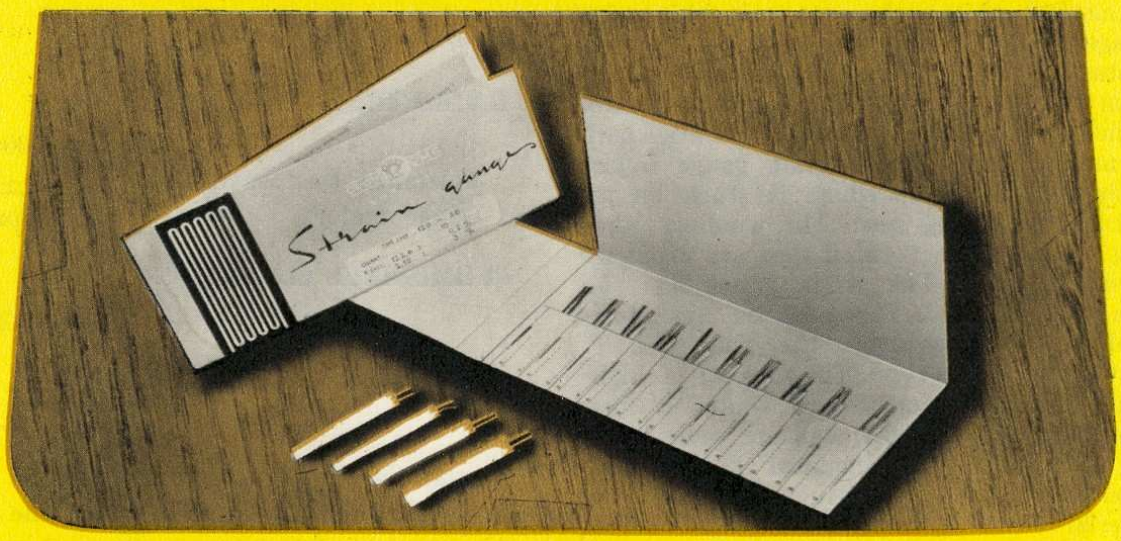




EMG–2359

STRAIN GAUGES

EMG–2358

SET OF ACCESSORIES FOR STRAIN MEASURING

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

EMG–2359

STRAIN GAUGE

To determine the deformation, elongation and mechanical strain that a machine, a machine part or a structural element is likely to suffer during operation, there is a need for **Strain Measuring Bridge** (EMG 2353), and for a set of suitable Strain Gauges. The strain gauge, made from resistance wire, must be fastened to or stuck on the test object. Proportionally with the mechanical deformation of the test object, the extremely thin wire changes its length and consequently its resistance, whose rate is measured by the strain measuring bridge in thousandth parts of the specific deformation. The essential part for measurement of the strain gauge is the resistance wire itself which is stuck on an electrical insulating base. The windings, showing various geometrical shapes, are made by special methods. The strain gauge has the form of a flat grid. This form ensures considerable advantages over other shapes, e. g. the wound-around type. The making of high-precision strain gauges, how simple it may seem, is in fact a highly delicate manufacturing procedure. The mechanical change in the dimensions of the strain gauge depends of the material of the resistance wire used and of the winding method. Besides the resistance value, the most important characteristic of the gauge is the so-called sensitivity factor (g) indicated by the manufacturer on the envelop of the gauges. The value of the g-factor vaires slightly, according to brand and type of gauge. The value corresponding to (g) must be set on the appropriate scale of the strain measuring bridge.

SPECIFICATION

RATED RESISTANCE (R):

120, 350, 600 ohms

Tolerance (per envelope):	± 0,2%
Gauge factor:	approx. 2

PERMISSIBLE CURRENT:

max. 25 mA

PERMISSIBLE TEMPERATURE:

max. 70°C

The strain gauges are packed per 10 pieces in a cartoon envelope, carrying the more important electrical data; each envelope being hermetically sealed in a plastic foil cover.

EMG–2358

SET OF ACCESSORIES FOR STRAIN MEASURING

Proper preparation of strain measuring, means not only putting into service the measuring instrument, (the Strain Measuring Bridge type 2353), but far more correct location of the strain gauges sensing the mechanical deformation, fastening them to the test object, further adequate connection of these strain gauges with the measuring instrument.

Correct preparation of measurements is known to be highly important, for producing the correct measuring results. This statement applies even more to strain measurements. For properly fastening the strain gauges, a few accessories are needed, which are best used in the construction tested and found satisfactory by the manufacturers. The carefully assembled set, supplied by the manufacturers in a portable case specially designed for this object serves this purpose.

The set of accessories for strain measuring consists of the following parts: 1 carrying case with grip und built-in partitions

2358/1	50 g of adhesive in metal box
2358/2	150 g of solvent for the above adhesive, in metal box
2358/3	400 g of toluene
2358/4	400 g of acetone (pur.) in metal box
2358/5	200 g of liquid ammonia
2358/6	4 water colour brushes (number 4)
2358/7	15 m of adhesive tape (width 25 mm)
2358/8	2 sheets of abrasive linen № 60
2358/9	2 sheets of abrasive linen № 220
2358/10	100 g of household cotton wool
2358/11	100 sheets blotting paper (45 × 18 mm)
2358/12	50 paper bakelite strips (45 × 18 mm × 1 mm thick)
2358/13	50 foam rubber strips (45 × 18 mm × 10 mm thick)

Methods, to use the various accessories and adhesives are given in detail in the instructions for use of the strain gauge.

I

EMG–2513

pH–ELECTROMETER

Quick and accurate determination of the acidity or basicity of solutions is a constantly recurring routine in chemical laboratories.

This measuring instrument is designed for the measurement of hydrogen-ion concentration (pH) and for the measurement of electrochemical potentials in mV; it can also be used to advantage for measuring the redox potential and for potentiometric titration.

The measuring instrument can be used, not only for samples measurements but also for continuous pH, checkings since the recording device, necessary for this purpose can be connected to the apparatus.

The "pH-Electrometer" is one of the most important measuring instrument for chemical analysis, for chemical technology as well as for medical, biological and pharmaceutical research work.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

FUNCTION. The functioning principle of the "pH-electrometer" is shown by the Block Schematic Diagram below.
The measuring unit of Hydrogen-ion concentration is the "pH"; acid solutions are characterized by 0 to 7 pH, alkaline solutions by 7 to 14 pH.
The first condition of "pH" meaurement is to create an electrical connection, according to the principle of measurement, between the solution to be measured and the measuring apparatus, this is done by means of the **electrodes.** Two electrodes are necessary for measurement: a reference electrode and a measuring electrode. The **calomel electrode** is the reference electrode, it is connected to the input marked "+" of the measuring apparatus.
The measuring electrode is a **glass electrode** connected to the input marked "—" of the measuring apparatus.
In addition any other electrodes, having the form or other properties suitable for the desired measurement, may also be used; a few designs are represented in the Type 2518/B set of "Accessories for pH measurement".
The pH Meter EMG 2513 measures — according to the nature of the test solution — the D.C. voltage arising between the pair of electrodes. A high input resistance is necessary for load-freee measurement. This is provided partly by the high quality of the insulators, applied on the input terminals and partly by the "electrometer" system circuit of the input stage.
Both tubes of the input stage are pentodes; with the help of the common cathode resistor used, the second tube operates as cathode controlled earthed-grid amplifier and performs phase inversion for the next bridge-circuit amplifier stage in which a double triode is operating. Connected to its output is the built-in indicating instrument, on whose scale both the pH and mV values can be read off directly after the necessary switch-over.
The high negative feedback used in the measuring apparatus considerably increases its stability. Sensitivity can be adjusted according to the temperature of the test solution (between 15 and 50° C).
The mV measurement actually takes place in two ranges (350 mV or 700 mV), similarly to pH measurement; with the help of a compensating voltage the range for mV measurements can be increased by other three sub-ranges to 2200 mV.
Compensating voltage, produced by a germanium diode, is applied to the input of the apparatus via a calibrated potentiometer and a multi-step switch.
Voltage and current is supplied to the measuring instrument by the mains unit; two stabilizer tubes connected in series are provided for the stabilization of the anode voltage.
A further contribution to the stabilization of the measurement is a built-in ferro-resonance transformer stabilizing the filament voltage of the electron tubes.

Tubes used in this instrument:

EF 36—2	ECC 85—1	6 X 4—1
VR 150—1	VR 105—1	

(The number after the Type-Number indicates the number of tubes in use.)

SPECIFICATION

MEASURING RANGES

(for pH measurements): 0—14 pH

SUB-RANGES:

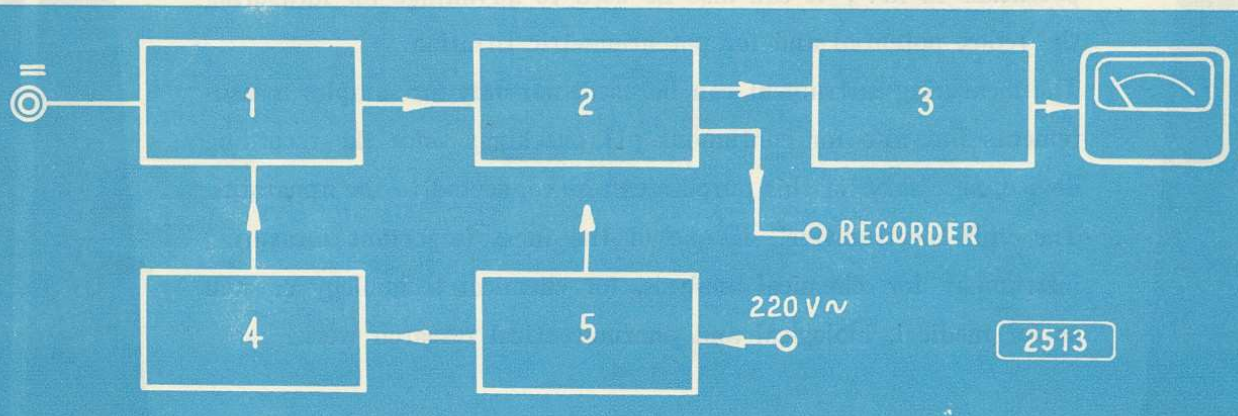
0—7,5 pH; 6,5—14 pH

MEASURING RANGES

(for mV measurements): 0—2200 mV

SUB-RANGES:

0— 350 mV
0— 700 mV
500—1200 mV
1000—1700 mV
1500—2200 mV



1. Input stage
2. Bridge circuit stage
3. Amplifier stage
4. Compensating voltage stage
5. Power supply

ACCURACY

(for pH measurements) : 0,1 pH (with built-in meter)

(Any indicating meter with an internal resistance of 250 ohm can be connected from outside to the measuring apparatus. When using a 0,2 class instrument an accuracy of measurement of 0,05 pH is obtainable)

ACCURACY

(for mV measurements) :

in the measuring range of 0—350 mV : ± 5 mV

in the measuring range of 0—700 mV : ± 10 mV

in any other measuring ranges : ± 10 mV or ± 1% (whichever is the higher)

INPUT RESISTANCE

(for pH measurements) : 10^{10} ohms

TEMPERATURE COMPENSATION : adjustable between 15—50° C

Any recorder can be connected to the measuring instrument : 1 mA—250 ohms

POWER SUPPLY

Voltage :	110, 127 or 220 V
Frequency :	50/60 c/s
Consumption :	about 50 W

OTHER DATA

FINISH :
lacquered steel sheet case

DIMENSIONS :

Height	205 mm
Width	405 mm
Depth	275 mm

WEIGHT : approx. 11 kgs

ACCESSORIES :

1 power cord

As a result of continued efforts to improve the design of instruments, we reserve the right to change this specification.

SET OF ACCESSORIES FOR pH MEASUREMENTS

This set is supplied on special request and comprises the electrodes, buffer solutions, etc. necessary for the measurements.

It consists of the following parts	Type No.
1 metal case with cover and handle with built-in nests for holding accessories	2518—1

Electrodes and cables

2 glass electrodes	2518—21
1 screened glass electrode	2518—22
1 calomel electrode, chargeable	2518—23
1 calomel electrode, charged	2518—24
2 platinum electrodes	2518—25
1 screened special cable, with connecting plugs for screened glass electrode	2518—28
1 screened special cable, with connecting plugs for calomel electrode	2518—29
1 stand with foot, for electrode	2518—3

Glass Accessories

2 test tubes	2518—41
3 small graduated jars	2518—42
3 large graduated jars	2518—43
1 thermometer with protective cap, 0—60° C	2518—48

Chemicals

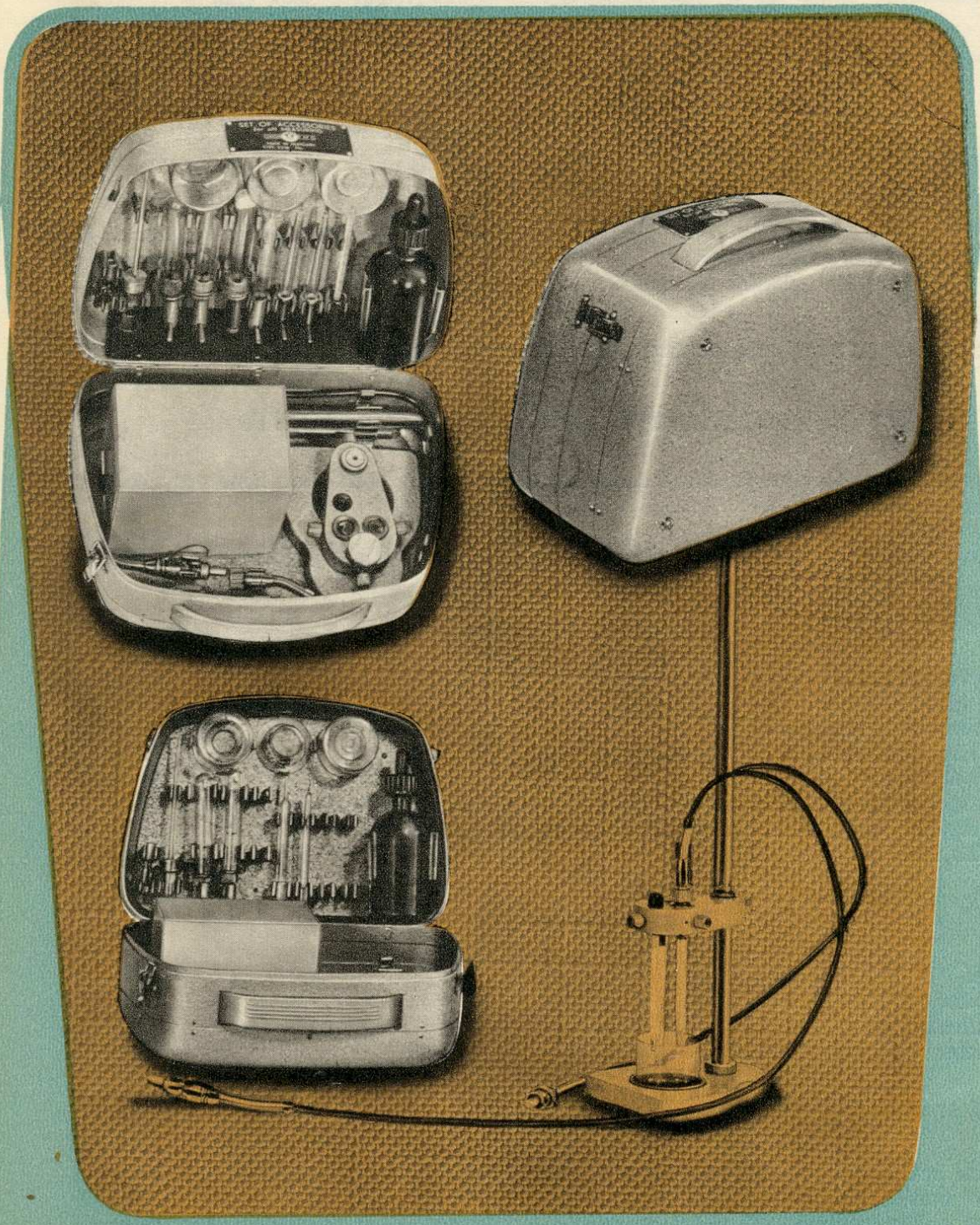
1 250 cu. cm bottle of saturated chloride of potassium solution, with dropper	2518—51
10 ampoul of buffer solution 3,57 pH 5 cu. cm	2518—52
10 ampoul of buffer solution 7 pH 5 cu. cm	2518—53
10 ampoul of buffer solution 12,6 pH 5 cu. cm	2518—54
1 cardboard box for ampoules	2518—59

I

EMG–2518

SET OF ACCESSORIES FOR pH MEASUREMENTS

A set made up in accordance with pH measuring requirements, occurring most frequently in chemical laboratories ; the set contains in an enclosed metal case the most important necessary measuring accessories, electrodes, the appropriate cables, glass accessories and chemicals. The easily portable set of accessories can also be used to advantage by workshop measuring stations.



I

EMG–2829

"HYGROMATIC" MOISTURE METER

Quick and reliable determination of the moisture content of the various cereals is an important measuring problem of agricultural industries engaged in the processing of cereals. Such methods are known for long but none is as simple as the electronic measuring method which determines the relative moisture content of the test materials with reference to the measurement of an electric quantity (C). The "HYGROMATIC" represents an excellent solution of this problem. It is not only suitable for determining the moisture content of cereals but also that of any other granular or powdery material if different electrodes and measuring vessels are used for the different materials. Direct reading in relative moisture per cent on the expanded measuring ranges is a particular advantage provided by the instrument.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

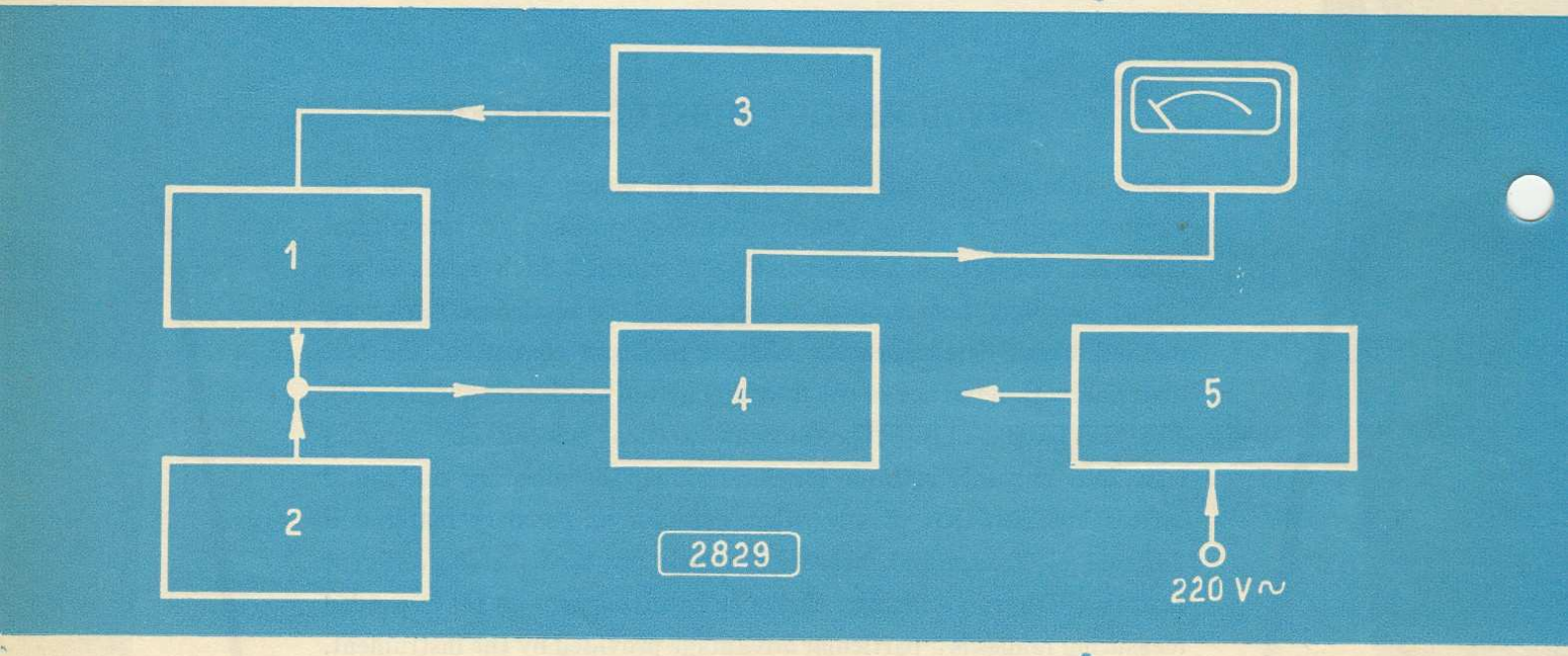
EMG–2829

FUNCTION: The functioning principle of the "HYGROMATIC" is shown in the Block Schematic Diagram below.

Its measuring principle is based on the knowledge that the moisture absorbing materials, the so-called hygroscopic materials, change the dielectric properties with their moisture content. This variation is proportional to the moisture content of the test material. If the material in question is used as dielectric medium of a capacitor specially designed for this purpose, the capacitance will also change with the change of such medium. The variation of the capacitance can be measured in a suitable electronic circuit that is to say the measure of the change can be read on the scale of an indicating meter. The test material as dielectric, changes the capacitance of the measuring capacitor (measuring cylinder), which connected in series with the calibrated capacitor, form a voltage divider. This voltage divider consisting of two capacitors obtains its stabilized voltage from an electron coupled oscillator operating at 2 Mc/s with one half of the double triode. Frequency stability of the oscillator is provided for by the careful compensation of temperature, interference is eliminated by careful screening. The oscillator voltage arising on the voltage divider is divided in proportion to the capacitances of the two capacitors; the voltage drop produced on the measuring capacitor is measured by a VT voltmeter, represented by the other half of the double triode mentioned above.

The various stages of the measuring instrument are supplied with voltage and current by the power supply unit, generating stabilized anode voltage for the double triode. The mains voltage fluctuations are compensated by the power supply transformer, designed as stray transformer ensuring thereby stable measuring results.

It is important for quick and reliable measurements that the entire measuring range of



1. Calibrated capacitor
2. Measuring capacitor
3. Oscillator
4. V. T. voltmeter
5. Power supply unit

the instrument is covered by the basic scale of the indicating meter of the VT voltmeter without any change-over. This feature would permit to determine roughly the range in which fine measurement will be made. The four sub-scales of the instrument are marked on the basic scale and each of the four scales shows — after switching over to the corresponding range — the section marked on the basic scale, expanded to the full length of the arc.

The percentages of relative moisture content occurring in practice for the three most important cereals, are graduated on the expanded measuring range. Special transparent plexiglass scales, duly calibrated with expanded ranges, are provided for wheat, rye and barley ; each of them can conveniently be placed on the main instrument. The manufacturers are permanently developing this method of moisture content determination and are making successively available to industry, measuring cylinders fitting the original "HYGROMATIC" instrument and used for measuring the moisture content of the various materials. Calibrated scales elaborated for these cylinders are supplied with them.

Tubes used in this instrument :
ECC 40—1 6 X 6—1 VR 150—1

(The number after the Type-Number indicates the number of tubes in use.)

SPECIFICATION

MEASURING RANGE :
0 to 30% rel. moisture content

MEASURING BANDS :
for different materials
On bands 3 and 4 :
wheat 8 to 22% rel. m. c.
On bands 3 and 4 :
rye 10 to 23% rel. m. c.
On bands 2, 3 and 4 :
barley 10 to 22% rel. m. c.

MEASURING ACCURACY :
± 0,5% rel. m. c.

POWER SUPPLY

Voltage :	110, 220 V
Frequency :	50/60 c/s
Consumption :	about 20 W

OTHER DATA

FINISH :
lacquered steel-sheet case with leather handle

DIMENSIONS
(without knobs and handle) :

height	260 mm
width	205 mm
depth	145 mm

WEIGHT : about 8 kg

As a result of continued efforts to improve the design of instruments, we reserve the right to change this specification.

EMG—2829-I/MK

Measuring set I.

To be used with the "Hygromatic" moisture meter for wheat, rye and barley. The set consists of the following parts :

1 measuring capacitor
4 filling orifice adapters
3 special scales
1 material filler dish

EMG—2829-II/MK

Measuring set II.

To be used with the "Hygromatic" moisture meter for maize, peas and sunflower. The set consists of the following parts :

1 measuring capacitor
1 filling orifice adapter
3 special scales
1 stirring rod

EMG—2829-III/MK

Measuring set III.

To be used with the "Hygromatic" moisture meter for oats. The set consists of the following parts :

1 measuring capacitor
1 filling orifice adapter
1 special scale

VARIOUS MEASURING SETS
USED WITH THE „HYGROMATIC" MOISTURE METER

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

EMG–2831

MOISTURE METER FOR TIMBER

(battery-modell)

The necessity to determine the moisture content of various wood materials arises not only in places where A. C. mains is available for the operation of the measuring instrument, but also in places, e. g. forests, timber-yards etc. where there is no power supply current. This requirement is satisfied by the battery-modell of "Moisture Meter for Timber" which can be operated anywhere and which permits simple and very quick measurement in the same way as if measurement were made by the use of a measuring instrument supplied from the mains.

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

FUNCTION: The functioning principle of the "Moisture Meter for Timber" is shown in the Block Schematic Diagram below.

The value of resistance, arising between measuring electrodes stuck into the wood material, shows a certain correlation with the water content percentage of the wood. Measurement, which is in fact resistance measurement, is based on this fact. A voltage divider consisting of known resistance values is connected by means of the measuring range change-over switch to the resistance to be measured (wood material). The voltage drop produced on the voltage divider, is measured in three measuring ranges by a bridge-system VT voltmeter. The bridge circuit arrangement and the careful design ensure very considerable stability of measurement.

Owing to the high input resistance of the VT voltmeter the measuring instrument does not load the resistance of the material to be tested. Measuring errors caused by the ageing of tubes are eliminated by the use of the double tube. In consequence of the special circuit arrangement, the calibration adjusted does not change with band-switching. The resistance of the wood material to be measured, extends from a few Kohms to thousands of Mohms nevertheless the percentage value of the relative moisture content can be read directly from the indicating meter. The percentage of relative moisture content is naturally based on the moisture value referring to the dry weight of the wood.

Tube used in this instrument:
DLL 101—1

SPECIFICATION

MEASURING RANGE:
between 7% and 100%
relative moisture content (in 3 ranges)

MEASURING BANDS:
7 — 13% rel. m. c.
14 — 30% rel. m. c.
30 — 100% rel. m. c.

MEASURING ACCURACY
in Band 1:
± 1% rel. m. c.
in Band 2:
± 2% rel. m. c.
in Band 3:
of informative character

OTHER DATA

FINISH:
strong wooden case with cover, with 1 leather handle

DIMENSIONS:

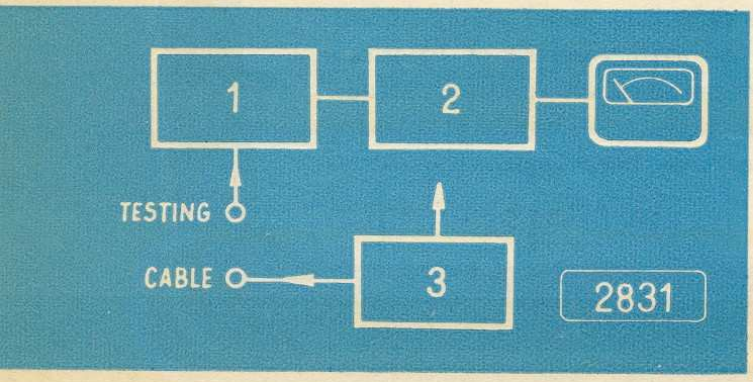
height	288 mm
widht	205 mm
depth	180 mm

WEIGHT
(with batteries):
about 6 kg

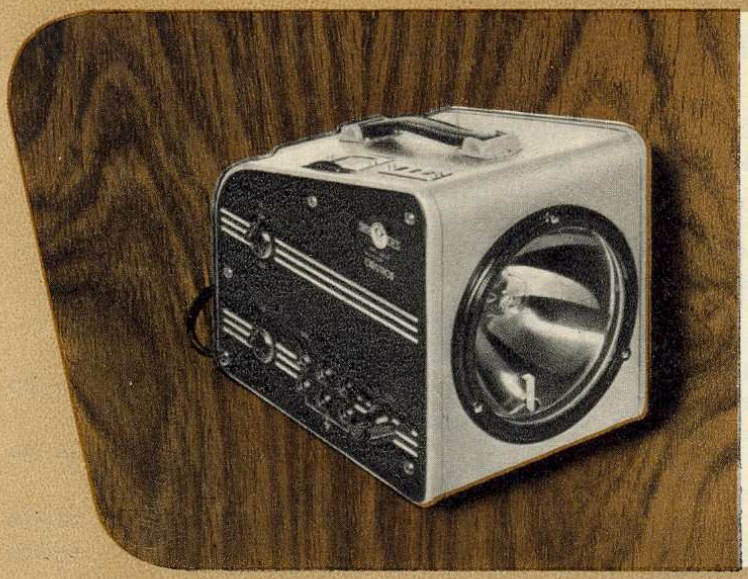
ACCESSORIES:
1 anode battery 67,5 V
1 heating battery 1,5 V
1 DLL 101 tube (special water proof design)
1 hammer head for knock-in knives
4 spare knives
1 connecting cable (with polyethylene insulation)

Other electrodes supplied on special order:
EMG—2831—2 needle electrode with grip
EMG—2831—3 tank electrode
EMG—2821—5 feeler electrode with grip
EMG—2831—6 deeply penetrating electrode with grip

As a result of continued efforts to improve the design of instruments, we reserve the right to change this specification.



1. Voltage divider
2. VT voltmeter bridge
3. Batteries

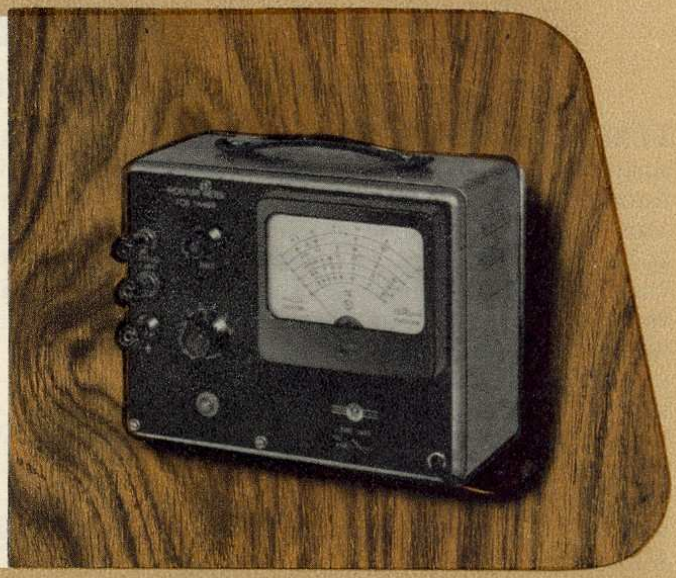


EMG—2371/B "ORISTROB" STROBOSCOPE

A measuring instrument designed for determining, free of load, the rotation speed of machinery elements, motors, transmissions etc. Based fundamentally on the known physical stroboscopic phenomenon.

EMG—2822 MOISTURE METER FOR TIMBER

One of the known methods for determining the moisture content of wood, the so called drying method based on sampling, is very complicated and requires much time. Simple and quick measurement is made possible with this Moisture Meter; by its use the moisture content of all kinds of wood can be read of directly in per cent on the scale of the indicating instrument.



4—02—1/A and 4—02—1/B COTTON AND WOOL MOISTURE CONTENT TESTER AND TANK ELECTRODE

WORKS FOR ELECTRONIC MEASURING GEAR
BUDAPEST

EMG–2371/B

"ORISTROB" STROBOSCOPE

FUNCTION: When a periodically moving object is illuminated with the periodically flashing light of the stroboscope lamp, the rotating or moving object will be seen temporarily at standstill. This phenomena is the basic principle of the measurement. The stroboscope lamp performs, according to a certain repetition frequency flashes of a few μsec duration which are reproduced in the charging circuit. Repetition frequency can be regulated with the pulse passing to the grid of the tube. The pulse generating the flash may come from the built-in multivibrator, from the AC mains (50 c/s) or from an external equipment, the contactor. The basic frequency of the multivibrator can be calibrated in operation with the reed, located below on the rim of the reflector and operating with AC of 50 c/s. The reed appears to be standing at 50 c/s and its harmonics.

SPECIFICATION

SPEEDS MEASURABLE
WITH BASIC FREQUENCY:
600 — 15 000 r. p. m.
WITH MULTIPLE FREQUENCY:
about 100 000 r. p. m.

ACCURACY:
above 750 r. p. m.: ± 2%
below 750 r. p. m.: ± 3%

EMG–2822

MOISTURE METER FOR TIMBER (for AC)

FUNCTION: This instrument measures conductivity variations due to the change of the humidity content of the wood respectively variations of resistance between the points to be measured. There is a certain mathematical correlation between this resistance value and the percentage value of the moisture content of the wood. A voltage divider consisting of known resistance values is connected by means of the voltage range change-over switch to the resistance to be measured between the electrode stuck into the wood material. Voltage drop produced on the voltage divider is measured by a bridge-system VT voltmeter, offering the advantage to be highly insensitive to the ageing of tubes and to mains voltage fluctuations. Two different electrodes are used for measurement, respectively for establishing electrical connection with the wood material to be tested: 1. needle electrode, mounted on a head, complete with grip, 2. blade electrode, mounted on an impact head. A suitable high-insulation cable is used for connecting the electrodes with the measuring instrument.

SPECIFICATION

MEASURING RANGE:
5,5 — 50% rel. moisture c.
(in 6 ranges)

MEASURING ACCURACY:
between 5,5 — 20% rel. m. c.
± 1% rel. moisture c.
between 20 — 30% rel. m. c.
± 2% r. m. c.

EMG–4-02-1/A

COTTON AND WOOL MOISTURE CONTENT TESTER

FUNCTION: Measurement is based on the principle of measuring the resistance of textile materials. It is known that there is a mathematical correlation between moisture content and resistance. Separate scales can therefore be produced after appropriate calibration for the different materials. The scales can be read directly and show the relative moisture content percentage. They are transparent plexiglass scales and can be placed from outside onto the indicating instrument. Special scales calibrated for seven different textile materials are supplied with the instrument. A voltage divider consisting of known resistance values is coupled by means of the measuring range change-over switch to the resistance to be measured on the part of the textile material between the electrodes. The voltage drop produced is measured by a bridge-system VT voltmeter.
Electrodes are provided for measurement, respectively for establishing electrical connection with the textile material under test. The needle electrodes, necessary for measuring baled cotton and cotton wound on bobbin, are standard accessories of the instrument. The electrodes are built into measuring heads and supplied with connecting cables.

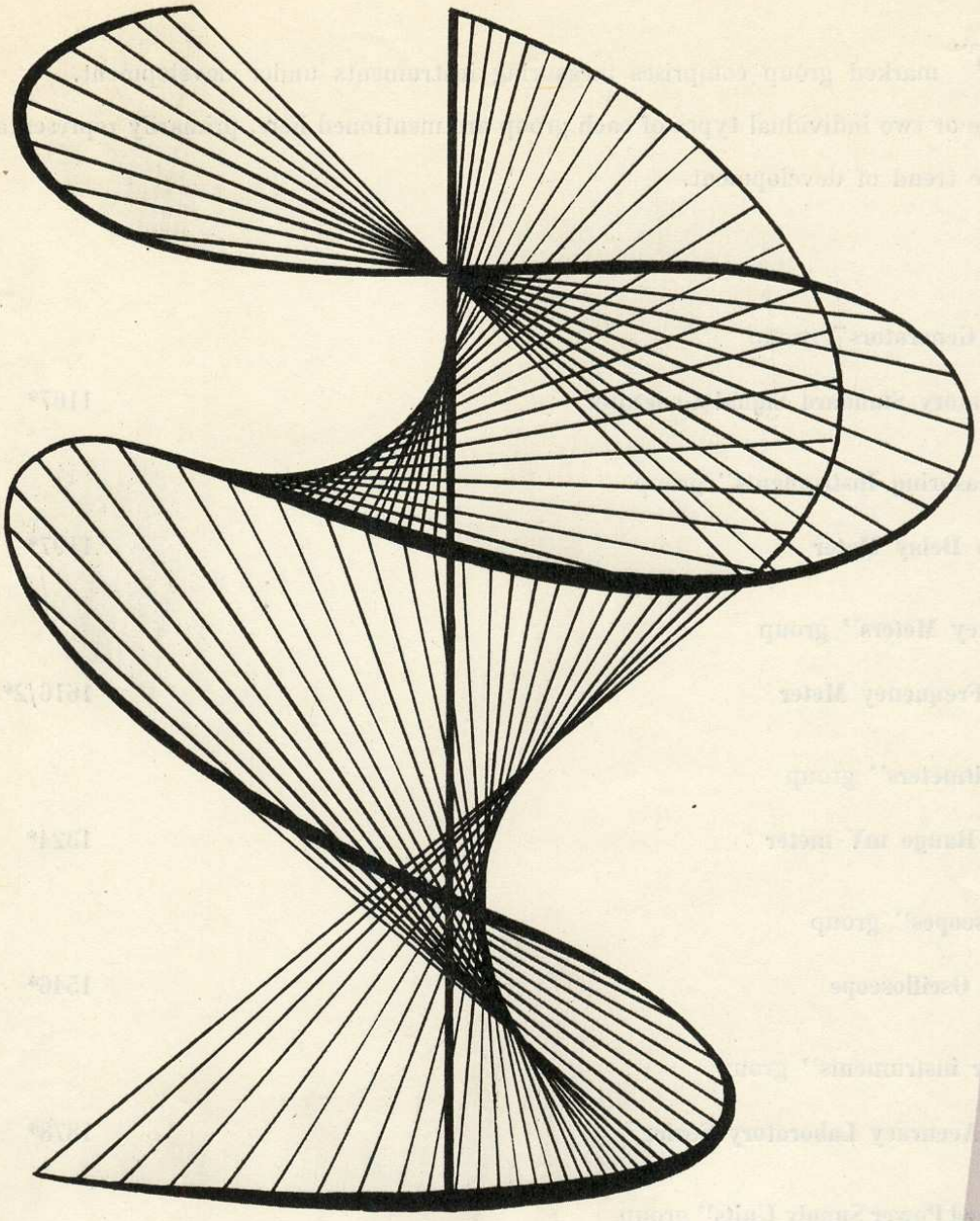
SPECIFICATION

MEASURING RANGE:
between 1 to 30% rel. moisture c.
MEASURING ACCURACY:
± 1% rel. moisture c.

EMG–4-02-1/B

CONTAINER ELECTRODE

This electrode can be supplied separately for measuring cotton and wool in loose state. The capacity of the container is about 50 g of loose textile material.

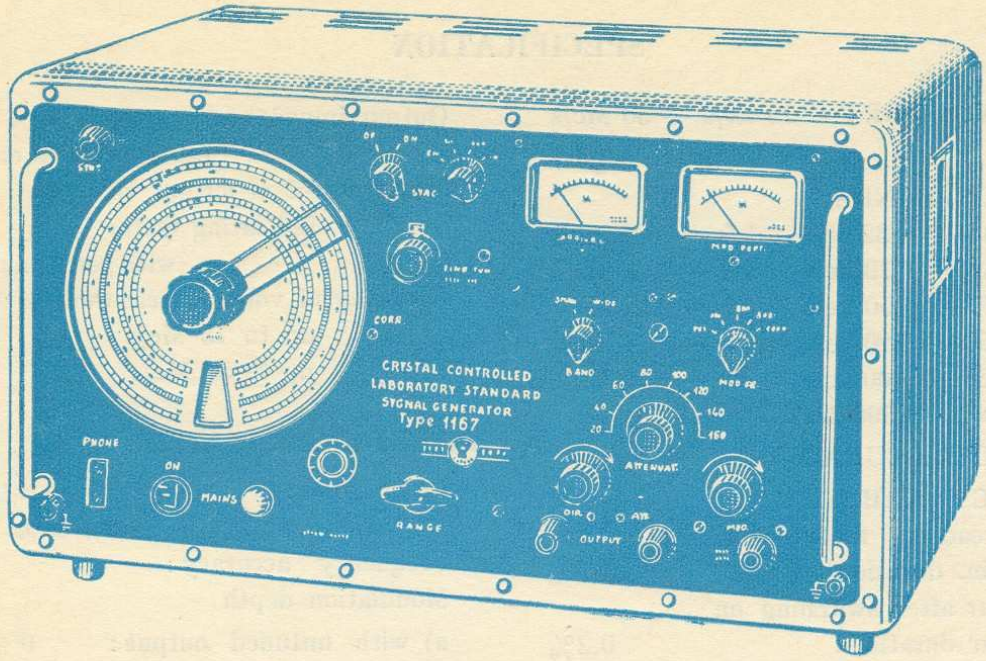


F

MEASURING INSTRUMENTS UNDER DEVELOPMENT

The "F" marked group comprises measuring instruments under development.
Only one or two individual types of each group are mentioned here, primarily representative types from the trend of development.

The data given for these types are tentative and of an informative character therefore without any obligation our part.



EMG–1167*

LABORATORY STANDARD CRYSTAL-CONTROLLED SIGNAL GENERATOR

A highly accurate standard signal generator of most recent design provided with all monitoring and measuring facilities offered at present by the most up-to-date electronic design technique.

The most important part of the instrument is the **master oscillator** operating, with a pentode in a tuned anode circuit feedback. The stability of the oscillator and that of the output level are ensured by a special automatic regulator. The frequency of the master oscillator is checked by the internal **quartz crystal-controlled oscillator,** operating on three selectable fix frequencies with high harmonics content. The **mixing stage** beats the frequencies of the master oscillator and the output of the crystal oscillator, respectively their corresponding harmonics. The crystal oscillator in, **"synchronous" operation** position of the master switch, can be synchronized with its signals as the master oscillator in which case the output frequency is of crystal accuracy. At the same time when operated with amplitude-modulation system, the output signal is absolutely free of any frequency modulation. The signals of the master oscillator can be amplitude-modulated in the modulator stage with the built-in Wien-bridge system RC oscillator. Modulation depths can always be controlled continuously and its percentage value can be read directly on the dial of an indicating instrument.

The modulator dial can be used in two operative modes: with a high impedance **tuned, narrow-band** output and small impedance, **untuned** wide-band output. With the narrow-band operation mode, modulation is provided by the well-known side-band suppression system, while with the wide-band operation mode, all modulation side-bands are recorded but naturally at a lower output level.

The output signal voltage of the signal generator traverses an attenuator circuit, the voltage division produced by the attenuator is independent of the frequency.

The output voltage level of the signal generator is shown by an indicating meter.

The power supply unit is stabilized by electronic methods; owing to the absence of rectifier tubes, current consumption of the instrument is very low indeed, since only germanium rectifiers are used.

Both input lines of the power supply is suppressed by means of H. F. filter circuits.

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* Advance Information

EMG–1167

SPECIFICATION

FREQUENCY RANGE : 15 kc/s — 50 Mc/s (in 11 bands)

FREQUENCY BANDS :

15 — 32 kc/s	1,5 — 3,2 Mc/s
32 — 70 kc/s	3,2 — 7 Mc/s
70 — 150 kc/s	7 — 15 Mc/s
150 — 320 kc/s	15 — 32 Mc/s
320 — 700 kc/s	32 — 50 Mc/s
700 — 1500 kc/s	

FREQUENCY ACCURACY : ± 1%

FREQUENCY STABILITY

a) after reaching thermal balance for 10 min. duration : 0,01%

b) $^1/_2$ hour after switching on for 1 hour duration : 0,2% (up to 10 Mc/s)

FREQUENCY CONTROL

Built-in crystal-controlled oscillator frequencies : 100 kc/s, 1 Mc/s, 10 Mc/s

Frequency accuracy : (between 0 and 60° C) ± 0,02% (related to 20° C)

SYNCHRONIZATION

With the basic frequency of the crystal oscillator and its harmonics

With external frequencies : between 10 kc/s and 50 Mc/s

OUTPUT VOLTAGE

a) with tuned, narrow-band output : between 0,1 μV and 1 V

b) with untuned, wide-band output : between 0,1 μV and 0,5 V

OUTPUT ATTENUATOR : adjustable in 6 steps and continuously

Attenuation steps : 6 × 20 dB

Further attenuation : in cable head 20 or 40 dB

Output impedance : 75 ohms (at terminated cable end)

Measurement of output voltage : indicating meter with germanium diode

Accuracy of voltage measurement :

up to 15 Mc/s ± 5%

up to 50 Mc/s ± 10%

INTERNAL MODULATION

Frequencies : 400, 800, 1000 c/s

Frequency accuracy : ± 3%

Modulation depth

a) with untuned output : 0 — 50%

b) with tuned output : 0 — 100%

as shown by modulation frequency-table according to frequency bands)

EXTERNAL MODULATION

Frequency : 30 c/s — 15 kc/s ± 1 dB

Measurement of modulation depth percentage : indicating meter with germanium diode

FREQUENCY MODULATION

Frequency deviation with 30% AM modulation

up to 30 Mc/s 3×10^{-5}

up to 50 Mc/s 1×10^{-3}

In case of synchronization : no detectable FM modulation

Radiation : < 1 μV/m

Noise level : 40 dB (with 30% modulation)

As a result of continued efforts to improve the design of instruments, we reserve the right to change this specification.

WORKS FOR ELECTRONIC MEASURING GEAR * BUDAPEST

EMG–1546*

H. F. OSCILLOSCOPE

(0 — 25 Mc/s)

A heavy-duty oscilloscope, complying with the most versatile laboratory requirements. The instrument is suited primarily for tests in the field of TV and pulse technique.

Its outstanding features are: very wide frequency coverage, ranging from D.C. to 25 Mc/s, true-to-shape pulse transmission, facilities for expanding the patterns on the screen, a built-in voltage calibration circuit and many other circuit designs for other purposes, hitherto not used in oscilloscopes. Some of the principal units and circuits of the measuring instrument are described as follows:

a) **Vertical amplifier.** It features two stages, each of them being an independent chain-type amplifier. The two stages operate in cascade connection. The input of the amplifier can be switched to both D.C. and A.C. voltages. The input attenuator provides for a frequency-independent voltage division in 5 steps.

b) **Delay dummy line.** The output of the amplifier is connected to the vertical deflection plates of the cathode-ray tube through this dummy line. The dummy line consists of π links and has a delay period of 0,2 μsec.

c) **Calibration voltage.** It is provided by a separate generator utilizing the 50 c/s of the power supply. The signals are of trapezoidal shape. The calibrated voltage can be adjusted by using the appropriate attenuation step.

d) **Multivibrator.** Can be used by two diffe-

* Advance Information

rent modes of operation viz. in triggered and untriggered service. The task of the multivibrator is to control the time-base generator.

e) **Time-base generator.** This generator produces saw-tooth oscillations at intervals controlled by the multivibrator. The speed of sweep can be adjusted within wide limits. The saw-tooth signals have also a special lead-out.

f) **Synchronization.** There are three different possibilities for synchronization viz.: external, internal and mains synchronization in + or — direction.

Amplification of the signals necessary for synchronization is performed in the synchronous amplifier.

g) **Pausing device.** After the saw-tooth signal has completed a cycle the pausing device brings the multivibrator back to its initial position, thus permitting an adequate pause to be kept before the multivibrator resumes operation.

h) **Expander circuit.** The extent of enlargegment can be continuously adjusted up to six times the original image.

j) **Blanking circuit.** This circuit serves for blanking the luminous trace of the cathode-ray tube during the flyback period of the time-base generator.

k) **Cathode-ray tube.** The most up-to-date design has been used, with a long-persistence screen. Beam intensity and sharpness (focus) of image are, of course, separately adjustable, in addition astigmatism as well. The shapness of image can be adjusted at will on any point of the pattern. The cathode-ray tube has been carefully screened against external magnetic stray fields. The internal layout of the instrument is of an advanced conception the component parts beint arranged in a clear and easily accessible manner.

SPECIFICATION

CATHODE-RAY TUBE

SCREEN DIAMETER:	130 mm
COLOUR OF SCREEN:	green
ANODE POTENTIAL:	2000 V
POST ACCELERATION VOLTAGE:	4000 V
USEFUL SCREEN AREA:	105 × 65 mm
TYPE OF CATHODE-RAY-TUBE:	DG 13—54

VERTICAL AMPLIFIER (Y)

FREQUENCY RANGE:	O — 25 Mc/s
LINEAR DISTORTION (at 1 kc/s):	± 3 dB
SENSITIVITY:	0,1 V/cm
RISE TIME:	12 nsec
OVERSHOOT (in case of a pulse with rise time of 10 μsec):	3%
INPUT IMPEDANCE:	10 Mohms || 40 pF
INPUT VOLTAGE:	0,1, 1, 10 V/cm

HORIZONTAL AMPLIFIER (X)

FREQUENCY RANGE:	O. — 5 Mc/s
LINEAR DISTORTION (at 1 kc/s):	± 3 dB
SENSITIVITY:	0,5 V/cm
INPUT IMPEDANCE:	1 Mohm || 50 pF
INPUT VOLTAGE:	0,5, 5, 50 V/cm

TIME-BASE GENERATOR

DEFLECTING SPEED without expanding:	0,02 sec/cm to 0,1 μsec/cm
with expanding:	max. 16 nsec
Horizontal expanding:	max. 6 x

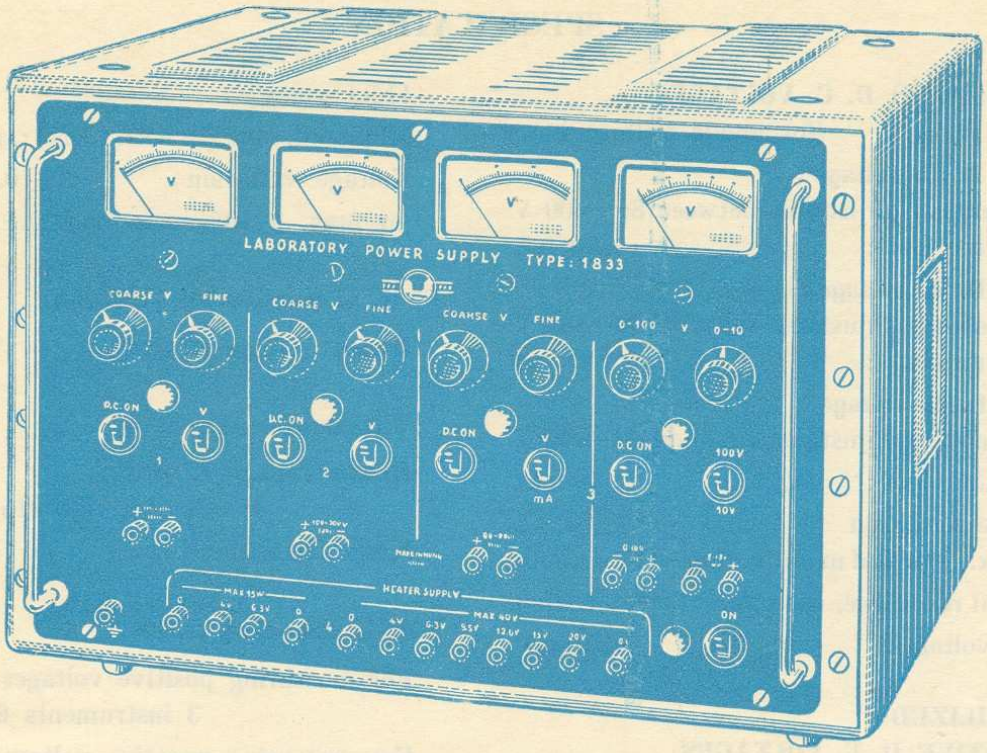
MODES OF SYNCHRONIZATIOV

(with + or — signals):	internal
	mains
	external

LIGHT MODULATION

INPUT IMPEDANCE:	about 0,5 Mohm || 50 pF

As a result of continued efforts to improve the design of instruments, we reserve the right to change this specification.



EMG—1833*

HIGH-POWER LABORATORY STABILIZED VOLTAGE SUPPLY UNIT

The stabilized D.C. voltage supply, furnishing a variety of voltages, is a valuable aid to research and development laboratories and can be used to advantage in workshop measurements as well.

The apparatus supplies three independent D.C. voltages stabilized electronically e. g. for anode and auxiliary-grid voltages, and two different negative voltages for grid biases.

Each unit can be switched of separately on the DC side, a considerable advantage from the operation point of view.

Since the units are not earthed, all of them can be connected in series, thus producing a total value of 3×300 V.

The units being independent of each other, either the + ve or the — ve pole can be earthed separately. Thus the apparatus, or part of it, can be used as a positive or negative voltage supply.

D.C. voltages can be measured with the four built-in meters which can be switched over to measure current.

The electronic stabilization relies in each supply unit on the principle of **serial regulation,** which not only equalizes mains fluctuations, but also keeps the output voltages at a constant level.

Apart from the three supply units, the apparatus comprises a seperate heating transformer supplying commercially available A. C. tubes with heating voltages in two different load groups.

Each mains transformer of the apparatus is complete with a fuse and a selector switch.

The foolproof design of the apparatus ensures exceptionally safe operation, making it particularly suitable for continuous service.

* Advance Information

EMG–1833

SPECIFICATION

A) **STABILIZED D. C. VOLTAGES**
(for anode voltage etc.)

1. Unit. D. C. voltage :
Continuously adjustable between 80—300 V
Maximum load : 100 mA

2. Unit. D. C. voltage :
Continuously adjustable between 80—300 V
Maximum load : 100 mA

3. Unit. D. C. voltage :
Continuously adjustable between 80—300 V
Maximum load : 50 mA
Voltage variation $< \pm 0{,}5\%$
(at max. $\pm 10\%$ of mains voltage fluctuation):
Internal resistance, each unit : about 1 Ohm
Hum voltage : < 10 mV

B) **STABILIZED NEGATIVE D. C. VOLTAGES**
(for grid bias etc.)

1. D. C. VOLTAGE
Continuously adjustable between 0 and —100 Volt
Hum voltage : < 10 mV

2. D. C. VOLTAGE
Continuously adjustable between 0 and —10 dB
Hum voltage : < 1 mV
Maximum load (in both cases) : max. 1 mA
Voltage variation $< \pm 0{,}5$ per cent,
(at. max. $\pm 10\%$ mains voltage fluctuation)

C) **A. C. (for heating purposes)**

Heater voltage 1. group
4 and 6,3 V
Maximum load : 15 W

Heater voltage 2. group
4; 6,3; 9,5; 12,6; 15 and 20 V
Maximum load : 40 W

Built-in indicating meters

For measuring positive voltages :
3 instruments 65 μA each
For measuring negative voltages :
1 instrument 65 μA
Accuracy class of instruments : 1,5
Accuracy of voltage measurements (using the meters above) : $\pm 3\%$ of f.s.d.

As a result of continued efforts to improve the design of instruments, we reserve the right to change this specification.

EMG–1878*

HIGH-ACCURACY LABORATORY SCALER

(7 decade type)

* Advance Information

EMG–1878

A high-accuracy instrument, suitable primarily for counting pulses supplied by nuclear probes and other pulse sources.
Separate units of the complete equipment can be used for various independent measurements, thus the instrument is the most important basic equipment for nuclear or medical research laboratories.

Its design and construction being most up-to-date, the instrument complies with the more severe requirements of a laboratory work. The instrument consists of several self-contained **units** dimensioned so as, to conform with the international standards of the so-called "rack" system.

The units are as follows :

a) **Pulse amplifier** Type 1878—2

A high-gain and high-stability amplifier, remarkable for its exceptional linearity of signal transmission. The differentiating and integrating time constants of the amplifier can be adjusted, thus permitting the most favourable signal-to-noise to be selected for each particular measurement.

Input signal : min. 10 mV
max. 50 V

Facilities for connecting :
1. GM-tube probe
2. Scintillation probe

b) **Discriminator** Type 1878—3

Suited for use in two different modes of operation : differentiating or integrating service. Its resolving time is designed to permit the full counting speed to be utilized.

Channel width :
adjustable between 0 — 20 V
Limiting voltage :
adjustable between 10 — 100 V
Accuracy : ± 0,5 V

c) **Electronic Timer** Type 1878—5

It operates in two different ways adjusted in advance : it counts up to a final number adjusted in advance, in this case it measures the time of counting, or it counts during a preset period, in this case it gives the sum total counted during the preset period.

Time constant :
in decadic steps from 10 — 10 000 seconds
or
Counting (adjustable in advance) :
in 7 decadic steps up to
max. 1 000 000 p/sec

d) **Scaler** Type 1878—6

A scaler of fully electronic design in which the high-speed counting decades operate with vacuum tubes, the rest of the stages with cold-cathode "Dekatron" tubes.

Counting : 7 decades
10, 100, 1000, 10 000, 100 000, 1 000 000

Resolving time :
1 μsec

Max. counting :
1 000 000 p/sec

e) **Counting ratemeter** Type 1878—7

The ratemeter section indicates an average of pulses per unit of time. The time constant can be selected at will so as to suit the particular type of measurement and increase the measuring accuracy.

Speed of counting : 0 — 10 000 p/sec
(in 8 ranges)

Time constants :
0,2, 1, 5, 20, 100 sec.

f) **High-voltage power supply** Type 1878—8

Supplies high voltages for GM tubes or other radiation probes with up-to-date methods of stabilization, making for the stability of voltages required for the measurements.

Output voltage :
continuously adjustable
between 300 and 3000 V

Fine adjustments of output voltage (at optional value between 300 and 3000 V) :
max. 300 V

Load : max. 0,5 mA

Variation of output voltage between maximum load and no-load : 0,3%
(at 3000 V output voltage)

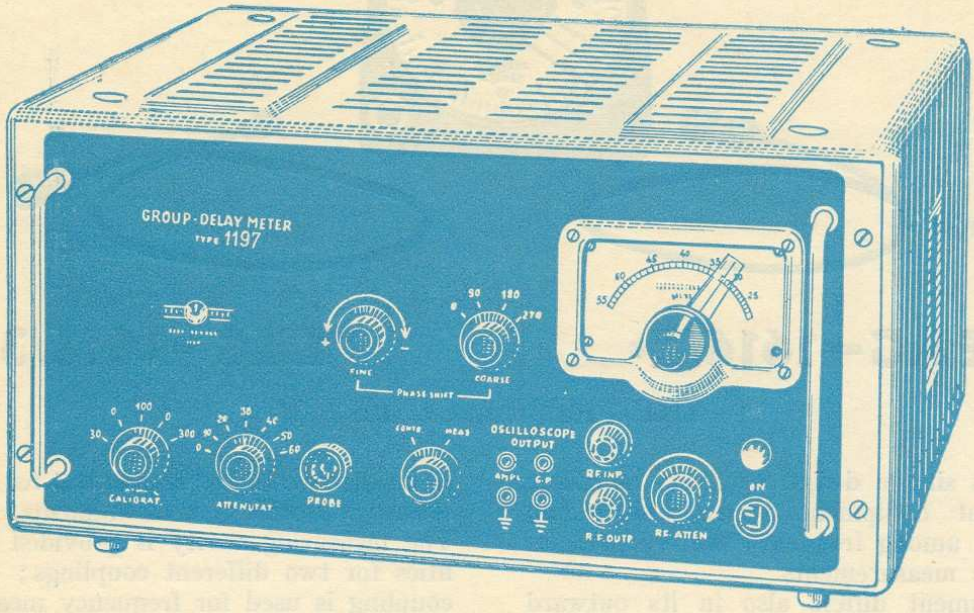
Variations of output voltage (with ± 10% fluctuation of mains voltage, at every variation of 1%) : max. 0,02%
or max. 3 V

Ripple voltage (at max. 3000 V and a load of max. 0,5 mA) : max. 1 V

Output impedance : max. 1500 ohms

As a result of continued efforts to improve the design of instruments, we reserve the right to change this specification.

WORKS FOR ELECTRONIC MEASURING GEAR * BUDAPEST



EMG—1197*

GROUP DELAY METER

Owing to the pulse character of television video signals, amplitude and phase characteristics representing the transmission have to be adjusted together. With television image transmission, side-band suppression may cause considerable phase errors, so that when tuning-in the TV receiver while simultaneously adjusting amplitude and phase characteristics, making concessions to the amplitude response, the phase response has to be set correctly.

The phase transmission properties of a linear system can be determined best by the characteristics of group delay. This laboratory measuring instrument is used for tuning the I. F. stage of TV receivers, further for measuring the characteristics of the group velocity of broad-band amplifiers and filters (passive four-poles) operating within the frequency range of the measuring instrument. The characteristics are plotted by the aid of an external sweep generator, as a function of frequency on the screen of the oscilloscope being connected to the instrument. The equipment measures directly group velocity, on the basis of the lot frequency principle (with the Nyquist method). The built-in "MARKER" signals are used for frequency calibration.

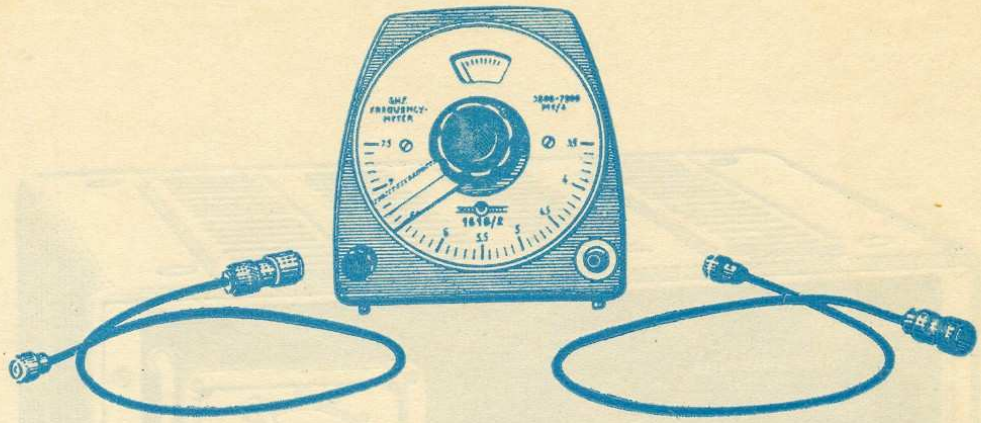
Frequency range :	10 — 50 Mc/s
Amplification :	about 1 x
Frequency characteristics (within 10 Mc/s) :	0,1 dB/Mc/s
RF input signal :	max. 250 mV
Input impedance :	75 ohms
Output impedance :	75 ohms
Output attenuator:	max. 80 dB (continuous)
Modulation depth :	30%
Aux. oscillator frequency :	55 kc/s
Aux. oscillator design :	crystal-controlled
Sensitivity (with 20 mV/cm oscilloscope sensitivity) :	30 mμsec/cm
Measuring limits :	30, 100, 300 mμsec/cm
Measuring heads :	
Internal demodulator :	50 mV — 5 V
External demodulator :	2,5 mV — 1 V
Input preset divider :	1 : 30
Frequencies of marker signals :	between 25 and 50 Mc/s

POWER SUPPLY

Voltage :	110, 127, 220 V
Frequency :	50/60 c/s
Consumption :	about 100 W

As a result of continued efforts to improve the design of instruments, we reserve the right to change this specification.

* Advance Information



EMG–1616/2* EMG–1616/3*

SHF FREQUENCY METER

Due to its simple design and easy handling, the present equipment is an outstanding instrument among frequency meters used for microwawe measurements.
The instrument differs also in its outward appearance radically from the conventional form. The dials scale calibrated in terms of frequencies not only accommodated the tuning and coupling elements but also carries the indicating instrument. Tuning i. e. coverage of the whole frequency range is made with a single control knob fitted with a plexiglass pointer, requiring no bandswitching whatever.
As regards its electrical design the instrument is of the absorption type. This means that adjustment of the resonance point is made by tuning a microwave cavity, while indication of resonance is performed by a built-in small-size indicating meter having an approximately logarithmic scale. Full-scale deflection and sensitivity of the instrument can be adjusted with a potentiometer. Rectification of the measured voltage is made by a silicon diode. The D. C. voltage coming from the diode is led out on the front panel also, thus permitting an external amplifier of higher sensitivity to be connected to the instrument for indicating low-level frequency measurements.
The measuring cavity is provided with facilities for two different couplings; the looser coupling is used for frequency measurements of higher outputs.
All connectors of the instruments are of the internationally known 50-ohms BNC type. Each coupling terminal should be fitted, when off duty, with a terminating plug containing a special iron core and supplied with the instrument as an accessory.
The design and construction of the instrument are patented.

1616/2. Frequency range: 3500 — 7500 Mc/s
1616/3. Frequency range: 7000 — 10500 Mc/s

Power required for indication: min. 1 mV
H. F. rectifier: silicon diode 1 N 23
Built-in indicating meter: moving-coil type
Sensitivity: 50 μA

As a result of continued efforts to improve the design of instruments, we reserve the right to change this specification.

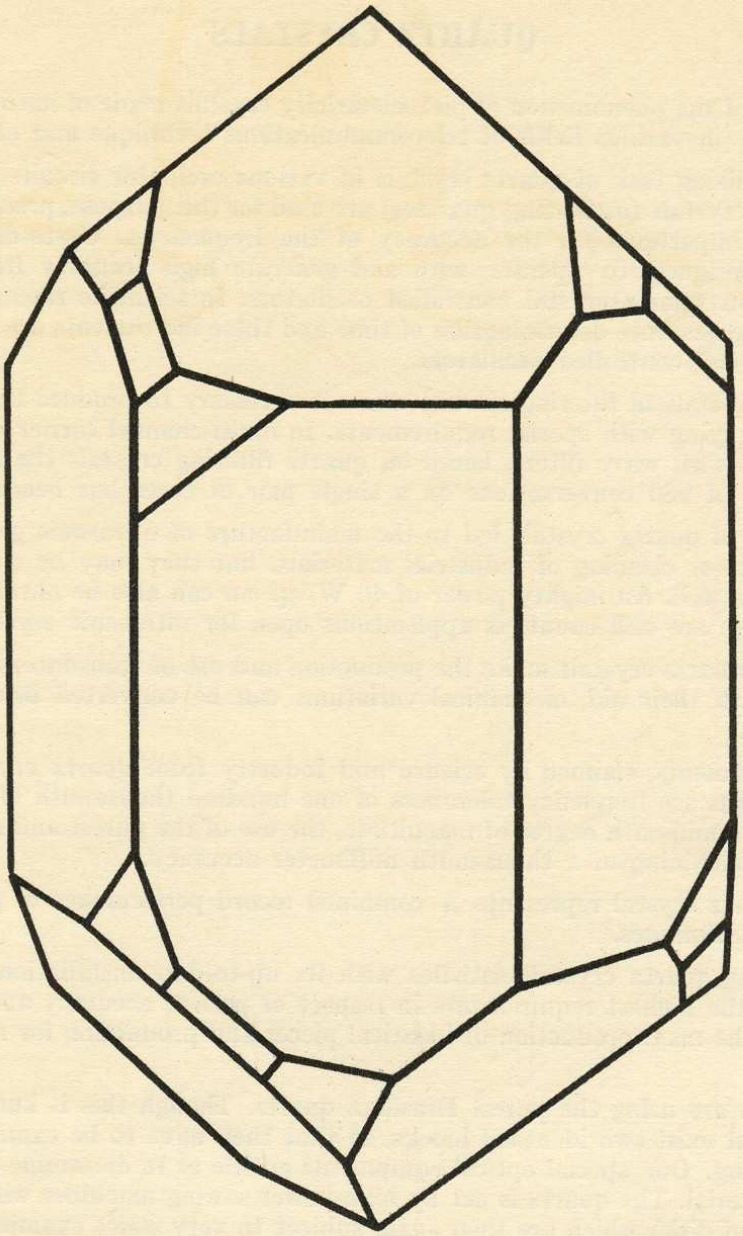
EMG–1324*

WIDE-RANGE HIGH-SENSITIVITY mV METER

A laboratory instrument for H. F. voltage measuring

MEASURING RANGE: 1 mV to 1 V (in 7 ranges)
MEASURING ACCURACY: ± 3% of f. s. d.
FREQUENCY RANGE: 30 c/s — 30 Mc/s
FREQUENCY RESPONSE (at 10 Mc/s): ± 5%

* Advance information



Q

QUARTZ CRYSTALS

EMG

QUARTZ CRYSTALS

Since the discovery of the phenomenon of piezoelectricity crystals made of natural quartz are being used more and more in various fields of telecommunications technique and of applied physics.

The frequency stabilizing task of quartz crystals in various oscillator circuits is well known. The so-called oscillating crystals (oscillating quartzes) are used for this purpose, precision of their manufacture is of crucial importance for the accuracy of the frequencies. Up-to-date telecommunication equipments, designed to operate with and generate high accuracy frequency, are today inconceivable without quartz crystal controlled oscillators. In scientific research work a "quartz clock" is used for the accurate determination of time and these instruments are in fact also nothing else but quartz crystal controlled oscillators.

The use of quartz crystals in filtering circuits made it necessary to produce filtering crystals (filtering quartzes) complying with special requirements. In multi-channel carrier frequency telephone apparatus, equipped with wave filters, based on quartz filtering crystals the simultaneous undisturbed transmission of 960 conversations on a single pair of cores has become possible.

In industry the use of quartz crystals led to the manufacture of ultrasonic generators permitting special material tests or cleaning of industrial materials, but they may be used for medical and chemical purposes as well. An mighty power of 40 W/sq. cm can also be obtained with ultrasonic crystals so that there are still countless applications open for ultrasonic crystals.

Pressure measuring quartz crystals make the production and use of transducers possible for measuring technique ; with their aid, mechanical variations can be converted into easily measurable electrical variations.

The physical requirements, claimed by science and industry from quartz crystals are very high indeed. Such demands are frequency tolerances of one hundred thousandth of magnitude, temperature tolerances of a millionth degree of magnitude, the use of the purest and most carefully selected raw material, machining of a thousandth millimeter accuracy.

The up-to date quartz crystal represents a combined record performance of precision techniques and of measuring techniques.

Our plant, producing quartz crystals satisfies with its up-to-date installation and novel, mostly patented, methods the highest requirements in respect of perfect accuracy and it is in a position to undertake both the mass production of identical pieces and production for meeting special individual wishes.

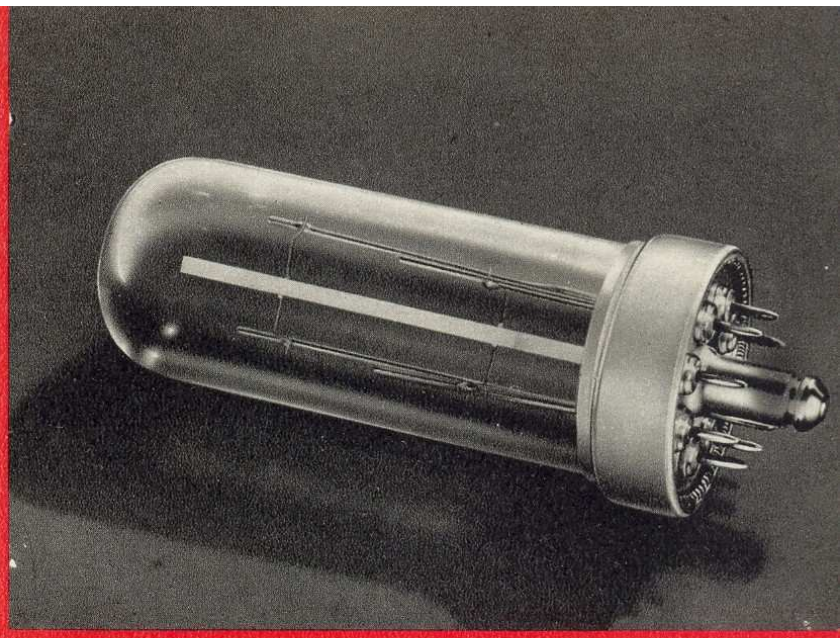
As raw material we are using the purest Brasilian quartz. Though this is known to be a natural mineral, there do not exist two identical blocks, so that they have to be examined most carefully already before cutting. Our special optical equipments enable us to determine the minutest impurities in the raw material. The quartz is cut by high-power sawing machines with diamond cutting edges into plates and disks which are then again subject to very strict examinations for detecting nonuniformity of the material or ingemination. In order to obtain various technical properties required ,e. g. a good temperature factor, the plane of the out must enclose a definite angle with the crystal axes, this is checked with minute accuracy with the aid of an X-ray instrument. This is one of the most important examinations of quartz crystal production. The crystal plates are then ground on optical grinding machines with more than a thousandth millimeter accuracy to their final size. The plane surface is checked with interference rings. The surface layer destroyed during grinding is removed by milling, so that the destroyed layer cannot cause a change in frequency later. As electrode material gold is used exclusively, it is precipitated on up-to-date metal evaporating equipments onto the adequately cleaned crystal plates. This is how the high time stability of the electrode system is warranted.

The rated frequency of the crystal is adjusted in air-conditioned rooms, then after, closing the crystal containers they are made airtight or filled with a neutral dry gas. The always identical level of the finished product quality is warranted by very careful checking examination. After mechanical tests, test for ruggedness and various electric examinations, the recording automatic measuring equipment registers the change of the crystal characteristics as a function of temperature. This is a guarantee for always perfect operation of our crystals within the temperature range indicated.

OSCILLATOR CRYSTAL

QRH

IN HERMETICALLY
SEALED
GLASS BULB
WITH LOCTAL SOCKET



QR OSCILLATOR CRYSTALS

The quartz crystals are manufactured in a wide frequency range in several types and can be used within an operating temperature of up to 24° C $\pm$ 5° for vibrationfree operational conditions. Certain types can also be made in a ruggedized finish (22 c/s—5 g). The most favourable shape and cut of the quartz crystals should be selected for the operation within the frequency range in question. The crystal envelopes are made in a great variety of types of glass, metal or plastic; suspension of the crystal in these containers is undamped, the internal wire terminations are soldered. The sockets providing for the circuit contact of the crystals are adapted to the container. In case of all glass bulbs, the sockets correspond to loctal or noval tube sockets; with metal or plastic cases they have two pins. Great care is taken that our types of quartz crystals comply safely with the data represented in the specification.

QRH 11 OSCILLATOR CRYSTALS

Frequency range: 3,5 to 10 kc/s

Type	Frequency accuracy	Temperature coefficient/C°
QRH 11—11	$1 \cdot 10^{-3}$	$5 \cdot 10^{-6}$
11—12	$1 \cdot 10^{-3}$	$3 \cdot 10^{-6}$
QRH 11—21	$1 \cdot 10^{-4}$	$5 \cdot 10^{-6}$
11—22	$1 \cdot 10^{-4}$	$3 \cdot 10^{-6}$
QRH 11—31	With series capacitor it can be tuned to nominal frequency	$5 \cdot 10^{-6}$
11—32	,,	$3 \cdot 10^{-6}$

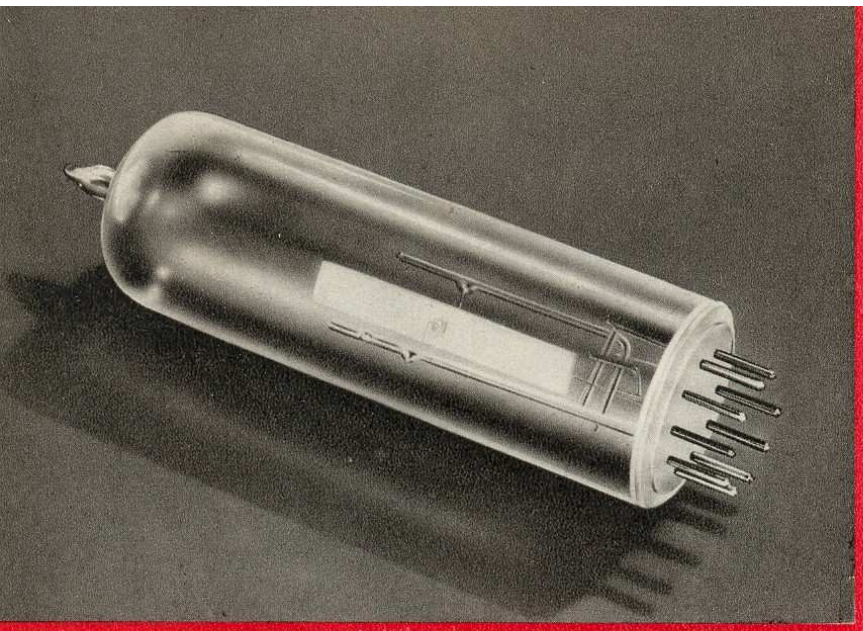
In hermetically sealed glass bulbs with loctal or noval socket.

QRH 12 OSCILLATOR CRYSTALS

Frequency range: 10—20 kc/s

Type	Frequency accuracy	Temperature coefficient/C°
QRH 12—11	$1 \cdot 10^{-3}$	$5 \cdot 10^{-6}$
12—12	$1 \cdot 10^{-3}$	$3 \cdot 10^{-6}$
QRH 12—21	$1 \cdot 10^{-4}$	$5 \cdot 10^{-6}$
12—22	$1 \cdot 10^{-4}$	$3 \cdot 10^{-6}$
QRH 12—31	With series capacitor it can be tuned to nominal frequency	$5 \cdot 10^{-6}$
12—32	,,	$3 \cdot 10^{-6}$

In hermetically sealed glass bulbs with loctal or noval socket.



OSCILLATOR CRYSTAL

QRL

IN HERMETICALLY SEALED GLASS BULB WITH NOVAL SOCKET

QR OSCILLATOR CRYSTALS

QRH 13 OSCILLATOR CRYSTALS

Frequency range : 20—40 kc/s

Type	Frequency accuracy	Temperature coefficient/C°
QRH 13—11	$1 \cdot 10^{-3}$	$9 \cdot 10^{-6}$
QRH 13—21	$1 \cdot 10^{-4}$	$9 \cdot 10^{-6}$
QRH 13—31	With series capacitor it can be tuned to nominal frequency	$9 \cdot 10^{-6}$

In hermetically sealed glass bulbs with loctal or noval socket.

QRL 14 OSCILLATOR CRYSTALS

Frequency range : 40—90 kc/s

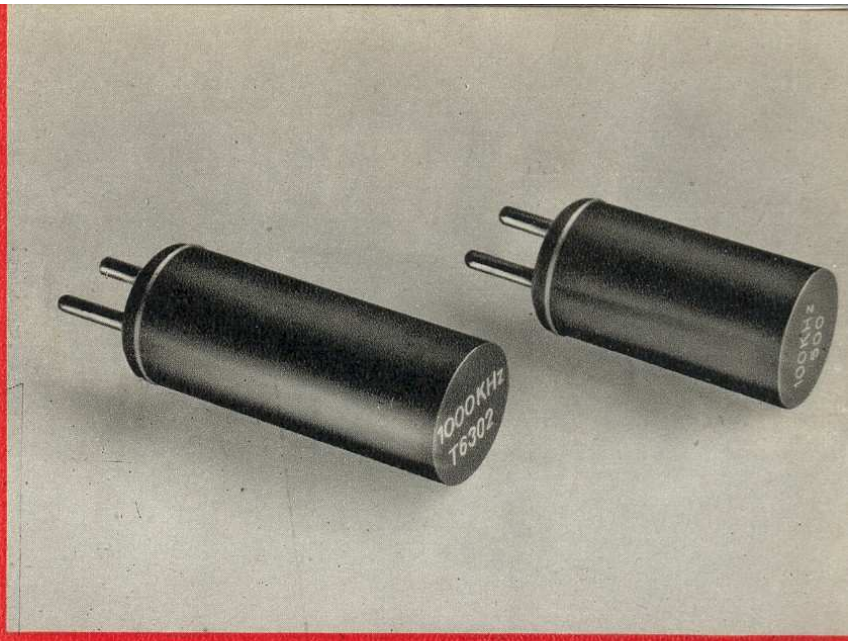
Type	Frequency accuracy	Temperature coefficient/C°
QRL 14—11	$1 \cdot 10^{-3}$	$5 \cdot 10^{-6}$
14—12	$1 \cdot 10^{-3}$	$3 \cdot 10^{-6}$
14—13	$1 \cdot 10^{-3}$	$2 \cdot 10^{-6}$
QRL 14—21	$1 \cdot 10^{-4}$	$5 \cdot 10^{-6}$
14—22	$1 \cdot 10^{-4}$	$3 \cdot 10^{-6}$
14—23	$1 \cdot 10^{-4}$	$2 \cdot 10^{-6}$
QRL 14—31	$5 \cdot 10^{-5}$	$5 \cdot 10^{-6}$
14—32	$5 \cdot 10^{-5}$	$3 \cdot 10^{-6}$
14—33	$5 \cdot 10^{-5}$	$2 \cdot 10^{-6}$
QRL 14—41	$2{,}5 \cdot 10^{-5}$	$5 \cdot 10^{-6}$
14—42	$2{,}5 \cdot 10^{-5}$	$3 \cdot 10^{-6}$
14—43	$2{,}5 \cdot 10^{-5}$	$2 \cdot 10^{-6}$
QRL 14—51	With series capacitor it can be tuned to nominal frequency	$5 \cdot 10^{-6}$
14—52	,,	$3 \cdot 10^{-6}$
14—53	,,	$2 \cdot 10^{-6}$

In hermetically sealed glass bulbs with loctal or noval socket.

OSCILLATOR CRYSTALS

QRV AND QRL

IN BAKELITE CASE
WITH 2 PINS SOCKET



QR OSCILLATOR CRYSTALS

QRL 15 OSCILLATOR CRYSTALS
Frequency range : 90 to 150 kc/s

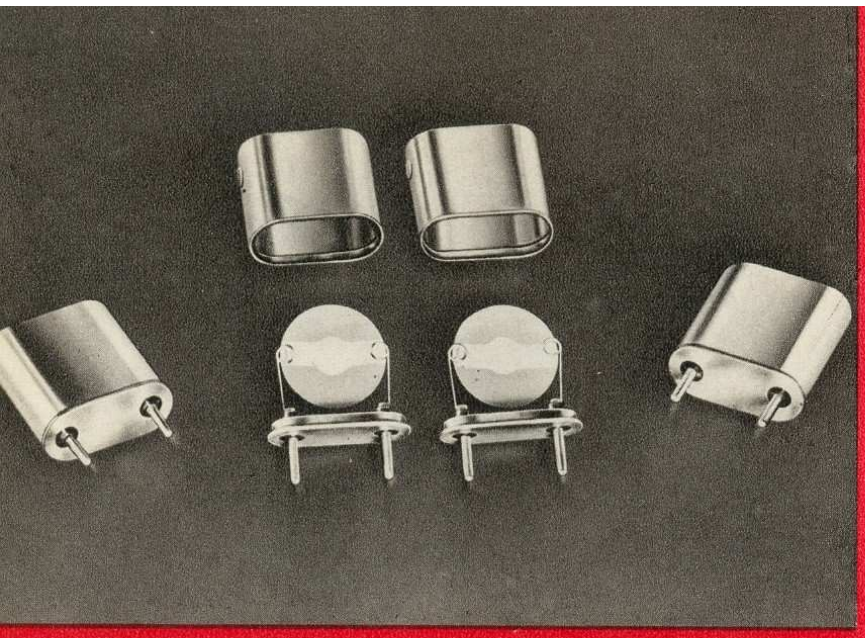
Type		Frequency accuracy	Temperature coefficient/C°
QRL	15—11	$1 \cdot 10^{-3}$	$5 \cdot 10^{-6}$
	15—12	$1 \cdot 10^{-3}$	$3 \cdot 10^{-6}$
	15—13	$1 \cdot 10^{-3}$	$2 \cdot 10^{-6}$
QRL	15—21	$1 \cdot 10^{-4}$	$5 \cdot 10^{-6}$
	15—22	$1 \cdot 10^{-4}$	$3 \cdot 10^{-6}$
	15—23	$1 \cdot 10^{-4}$	$2 \cdot 10^{-6}$
QRL	15—31	$5 \cdot 10^{-5}$	$5 \cdot 10^{-6}$
	15—32	$5 \cdot 10^{-5}$	$3 \cdot 10^{-6}$
	15—33	$5 \cdot 10^{-5}$	$2 \cdot 10^{-6}$
QRL	15—41	$2{,}5 \cdot 10^{-5}$	$5 \cdot 10^{-6}$
	15—42	$2{,}5 \cdot 10^{-5}$	$3 \cdot 10^{-6}$
	15—43	$2{,}5 \cdot 10^{-5}$	$2 \cdot 10^{-6}$
QRL	15—51	With series capacitor it can be tuned to nominal frequency	$5 \cdot 10^{-6}$
	15—52	,,	$3 \cdot 10^{-6}$
	15—53	,,	$2 \cdot 10^{-6}$

In hermetically sealed glass bulbs with loctal or noval socket or in bakelite case with two-pin socket.

QRL 16 OSCILLATOR CRYSTALS
Frequency range : 150 to 300 kc/s

Type		Frequency accuracy	Temperature coefficient/C°
QRL	16—11	$1 \cdot 10^{-3}$	$5 \cdot 10^{-6}$
	16—12	$1 \cdot 10^{-3}$	$3 \cdot 10^{-6}$
QRL	16—21	$1 \cdot 10^{-4}$	$5 \cdot 10^{-6}$
	16—22	$1 \cdot 10^{-4}$	$3 \cdot 10^{-6}$
QRL	16—31	$5 \cdot 10^{-5}$	$5 \cdot 10^{-6}$
	16—32	$5 \cdot 10^{-5}$	$3 \cdot 10^{-6}$
QRL	16—41	$2{,}5 \cdot 10^{-5}$	$5 \cdot 10^{-6}$
	16—42	$2{,}5 \cdot 10^{-5}$	$3 \cdot 10^{-6}$
QRL	16—51	With series capacitor it can be tuned to nominal frequency	$5 \cdot 10^{-6}$
	16—52	,,	$3 \cdot 10^{-6}$

In hermetically sealed glass bulbs with loctal or noval socket or in bakelite case with two-pin socket.



MINIATURE OSCILLATOR CRYSTALS

QRM

IN METAL CASE WITH 2 PINS SOCKET

QRM MINIATURE OSCILLATOR CRYSTALS

QRM 53 MINIATURE OSCILLATOR CRYSTALS

Frequency range : 1000 — 2000 kc/s

Type	Frequency accuracy	Temperature coefficient/C°
QRM 53—11	$1 \cdot 10^{-3}$	$5 \cdot 10^{-6}$
53—12	$1 \cdot 10^{-3}$	$3 \cdot 10^{-6}$
53—13	$1 \cdot 10^{-3}$	$2 \cdot 10^{-6}$
QRM 53—21	$1 \cdot 10^{-4}$	$5 \cdot 10^{-6}$
53—22	$1 \cdot 10^{-4}$	$3 \cdot 10^{-6}$
53—23	$1 \cdot 10^{-4}$	$2 \cdot 10^{-6}$
QRM 53—31	$5 \cdot 10^{-5}$	$5 \cdot 10^{-6}$
53—32	$5 \cdot 10^{-5}$	$3 \cdot 10^{-6}$
53—33	$5 \cdot 10^{-5}$	$2 \cdot 10^{-6}$
QRM 53—41	$2{,}5 \cdot 10^{-5}$	$5 \cdot 10^{-6}$
53—42	$2{,}5 \cdot 10^{-5}$	$3 \cdot 10^{-6}$
53—43	$2{,}5 \cdot 10^{-5}$	$2 \cdot 10^{-6}$

In metal case with two-pin socket.

QRM 54 MINIATURE OSCILLATOR CRYSTALS

Frequency range : 2000 — 8000 kc/s

Type	Freqiuency accuracy	Temperature coefficient/C°
QRM 54—11	$1 \cdot 10^{-3}$	$5 \cdot 10^{-6}$
54—12	$1 \cdot 10^{-3}$	$3 \cdot 10^{-6}$
54—13	$1 \cdot 10^{-3}$	$2 \cdot 10^{-6}$
QRM 54—21	$1 \cdot 10^{-4}$	$5 \cdot 10^{-6}$
54—22	$1 \cdot 10^{-4}$	$3 \cdot 10^{-6}$
54—23	$1 \cdot 10^{-4}$	$2 \cdot 10^{-6}$
QRM 54—31	$5 \cdot 10^{-5}$	$5 \cdot 10^{-6}$
54—32	$5 \cdot 10^{-5}$	$3 \cdot 10^{-6}$
54—33	$5 \cdot 10^{-5}$	$2 \cdot 10^{-6}$
QRM 54—43	$2{,}5 \cdot 10^{-5}$	$2 \cdot 10^{-6}$

In metal case with two-pin socket.

QRM 55 MINIATURE OSCILLATOR CRYSTALS

Frequency range : 8000 — 11000 kc/s

Type	Frequency accuracy	Temperature coefficient/C°
QRM 55—11	$1 \cdot 10^{-3}$	$5 \cdot 10^{-6}$
55—12	$1 \cdot 10^{-3}$	$3 \cdot 10^{-6}$
55—13	$1 \cdot 10^{-3}$	$2 \cdot 10^{-6}$
QRM 55—21	$1 \cdot 10^{-4}$	$5 \cdot 10^{-6}$
55—22	$1 \cdot 10^{-4}$	$3 \cdot 10^{-6}$
55—23	$1 \cdot 10^{-4}$	$2 \cdot 10^{-6}$
QRM 55—31	$5 \cdot 10^{-5}$	$5 \cdot 10^{-6}$
55—32	$5 \cdot 10^{-5}$	$3 \cdot 10^{-6}$
55—33	$5 \cdot 10^{-5}$	$2 \cdot 10^{-6}$
QRM 55—43	$2{,}5 \cdot 10^{-5}$	$2 \cdot 10^{-6}$

In metal case with two-pin socket.

QRM 56 MINIATURE OSCILLATOR CRYSTALS

Frequency range : 11000 — 20000 kc/s

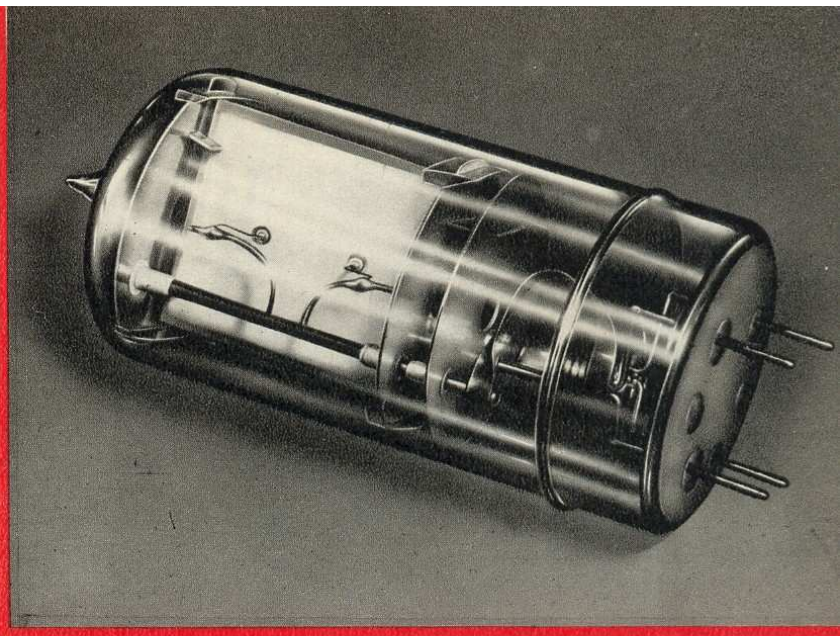
Type	Frequency accuracy	Temperature coefficient/C°
QRM 56—11	$1 \cdot 10^{-3}$	$5 \cdot 10^{-6}$
56—12	$1 \cdot 10^{-3}$	$3 \cdot 10^{-6}$
56—13	$1 \cdot 10^{-3}$	$2 \cdot 10^{-6}$
QRM 56—21	$1 \cdot 10^{-4}$	$5 \cdot 10^{-6}$
56—22	$1 \cdot 10^{-4}$	$3 \cdot 10^{-6}$
56—23	$1 \cdot 10^{-4}$	$2 \cdot 10^{-6}$
QRM 56—31	$5 \cdot 10^{-5}$	$5 \cdot 10^{-6}$
56—32	$5 \cdot 10^{-5}$	$3 \cdot 10^{-6}$
56—33	$5 \cdot 10^{-5}$	$2 \cdot 10^{-6}$
QRM 56—43	$2{,}5 \cdot 10^{-5}$	$2 \cdot 10^{-6}$

In metal case with two-pin socket.

OSCILLATOR CRYSTAL

QG

IN HERMETICALLY SEALED GLASS BULB WITH SPECIAL SOCKET



QG FREQUENCY STANDARD OSCILLATOR CRYSTAL

A special kind of GT cut oscillator crystals is made for normal frequency equipments and frequency standards; these crystals being supplied in glass envelopes with a special socket and may be used without thermostat between wide temperature limits.

QG 61 FREQUENCY STANDARD OSCILLATOR CRYSTAL

Frequency : 100 kc/s

Type	Frequency accuracy	Temperature coefficient/C°
QG 61	$5 \cdot 10^{-6}$ (with 600 pF series capacitance)	$3 \cdot 10^{-7}$

Operating temperature range from + 15° C to + 60° C
In hermetically sealed glass envelope, with special socket.

On special order, other frequency standard oscillator crystals can be supplied, within a frequency range of 80 to 300 kc/s with a temperature coefficient selected to the wish of the customer, under special agreement

QRM MINIATURE OSCILLATOR CRYSTALS

QRM 57 MINIATURE OSCILLATOR CRYSTALS

Frequency range : 20000 — 50000 kc/s

Type	Frequency accuracy	Temperature coefficient/C°
QRM 57—11	$1 \cdot 10^{-3}$	$5 \cdot 10^{-6}$
57—12	$1 \cdot 10^{-3}$	$3 \cdot 10^{-6}$
57—13	$1 \cdot 10^{-3}$	$2 \cdot 10^{-6}$
QRM 57—21	$1 \cdot 10^{-4}$	$5 \cdot 10^{-6}$
57—22	$1 \cdot 10^{-4}$	$3 \cdot 10^{-6}$
57—23	$1 \cdot 10^{-4}$	$2 \cdot 10^{-6}$
QRM 57—31	$5 \cdot 10^{-5}$	$5 \cdot 10^{-6}$
57—32	$5 \cdot 10^{-5}$	$3 \cdot 10^{-6}$
57—33	$5 \cdot 10^{-5}$	$2 \cdot 10^{-6}$
QRM 57—42	$2{,}5 \cdot 10^{-5}$	$3 \cdot 10^{-6}$
57—43	$2{,}5 \cdot 10^{-5}$	$2 \cdot 10^{-6}$

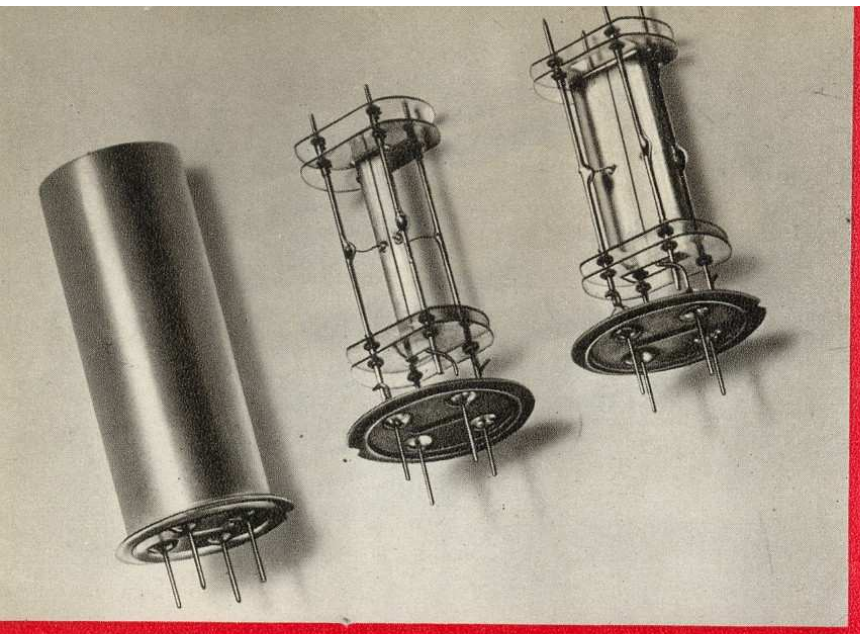
In metal case with two-pin socket.

QRM 58 MINIATURE OSCILLATOR CRYSTALS

Frequency range : 50000 — 75000 kc/s

Type	Frequency accuracy	Temperature coefficient/C°
QRM 58—11	$1 \cdot 10^{-3}$	$5 \cdot 10^{-6}$
58—12	$1 \cdot 10^{-3}$	$3 \cdot 10^{-6}$
58—13	$1 \cdot 10^{-3}$	$2 \cdot 10^{-6}$
QRM 58—21	$1 \cdot 10^{-4}$	$5 \cdot 10^{-6}$
58—22	$1 \cdot 10^{-4}$	$3 \cdot 10^{-6}$
58—23	$1 \cdot 10^{-4}$	$2 \cdot 10^{-6}$
QRM 58—31	$5 \cdot 10^{-5}$	$5 \cdot 10^{-6}$
58—32	$5 \cdot 10^{-5}$	$3 \cdot 10^{-6}$
58—33	$5 \cdot 10^{-5}$	$2 \cdot 10^{-6}$
QRM 58—42	$2{,}5 \cdot 10^{-5}$	$3 \cdot 10^{-6}$
58—43	$2{,}5 \cdot 10^{-5}$	$2 \cdot 10^{-6}$

In metal case with two-pin socket.



FILTER CRYSTALS

QF

INTERNAL DESIGN

QF FILTER CRYSTALS

Filter crystals are always made according to the specification of the customer, since they have to comply with requirements corresponding to filter circuits used in various circuitry.

They are supplied

enclosed in a metal envelope filled with nitrogen, provided with a 4 glass-bead termination; built on a ceramic rack, without case.

On request we shall be pleased to send our customers a questionnaire for filling-in the necessary data.

Continuation from page 195.

QR OSCILLATOR CRYSTALS

QRC 17 OSCILLATOR CRYSTALS

Frequuency range : 300 to 450 kc/s

Type	Frequency accuracy	Temperature coefficient/C°
QRC 17—11	$1 \cdot 10^{-3}$	$5 \cdot 10^{-6}$
17—12	$1 \cdot 10^{-3}$	$3 \cdot 10^{-6}$
QRC 17—21	$1 \cdot 10^{-4}$	$5 \cdot 10^{-6}$
17—22	$1 \cdot 10^{-4}$	$3 \cdot 10^{-6}$
QRC 17—31	$5 \cdot 10^{-5}$	$5 \cdot 10^{-6}$
17—32	$5 \cdot 10^{-5}$	$3 \cdot 10^{-6}$
QRC 17—41	$2{,}5 \cdot 10^{-5}$	$5 \cdot 10^{-6}$
17—42	$2{,}5 \cdot 10^{-5}$	$3 \cdot 10^{-6}$
QRC 17—51	With series capacitor it can be tuned to nominal frequency	$5 \cdot 10^{-6}$
17—52	,,	$3 \cdot 10^{-6}$

In hermetically sealed glass bulbs with loctal or noval socket or in bakelite case with two-pin socket.

QRV 18 OSCILLATOR CRYSTALS

Frequency range : 450 to 900 kc/s

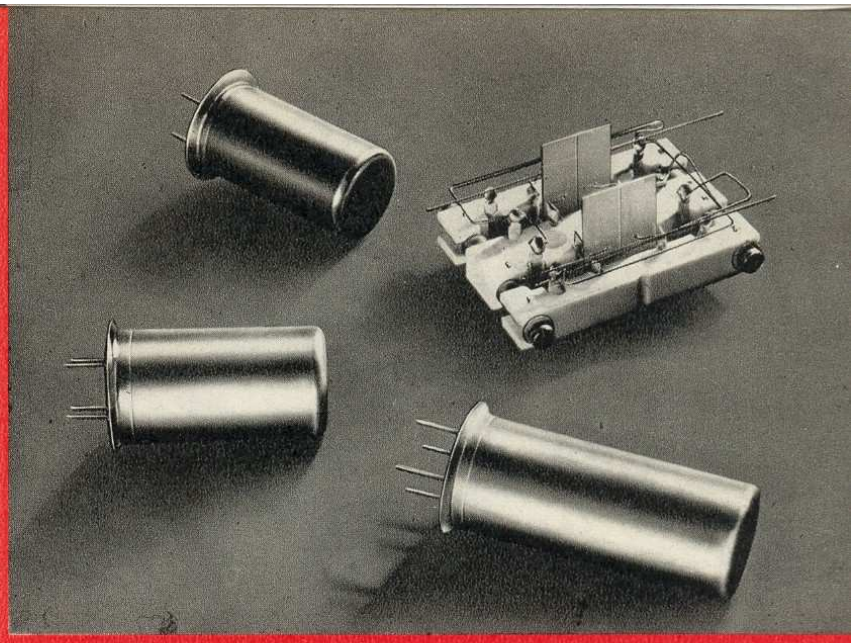
Type	Frequency accuracy	Temperature coefficient/C°
QRV 18—11	$1 \cdot 10^{-3}$	$5 \cdot 10^{-6}$
18—22	$1 \cdot 10^{-3}$	$3 \cdot 10^{-6}$
QRV 18—21	$1 \cdot 10^{-4}$	$5 \cdot 10^{-6}$
18—22	$1 \cdot 10^{-4}$	$3 \cdot 10^{-6}$
QRV 18—31	With series capacitor can be tuned to rated frequency	$5 \cdot 10^{-6}$
18—32	,,	$3 \cdot 10^{-6}$

In hermetically sealed glass bulbs with loctal socket.

FILTER CRYSTALS

QF

IN METAL CYLINDER FILLED WITH NITROGEN WITH SOLDER TERMINALS AND MOUNTED ON CERAMIC STAND



QR OSCILLATOR CRYSTALS

QRV 19 OSCILLATOR CRYSTALS
Frequency range : 900—2000 kc/s

Type	Frequency accuracy	Temperature coefficient/C°
QRV 19—11	$1 \cdot 10^{-3}$	$5 \cdot 10^{-6}$
19—12	$1 \cdot 10^{-3}$	$3 \cdot 10^{-6}$
19—13	$1 \cdot 10^{-3}$	$2 \cdot 10^{-6}$
QRV 19—21	$1 \cdot 10^{-4}$	$5 \cdot 10^{-6}$
19—22	$1 \cdot 10^{-4}$	$3 \cdot 10^{-6}$
19—23	$1 \cdot 10^{-4}$	$2 \cdot 10^{-6}$
QRV 19—31	$5 \cdot 10^{-5}$	$5 \cdot 10^{-6}$
19—32	$5 \cdot 10^{-5}$	$3 \cdot 10^{-6}$
19—33	$5 \cdot 10^{-5}$	$2 \cdot 10^{-6}$
QRV 19—41	$2{,}5 \cdot 10^{-5}$	$5 \cdot 10^{-6}$
19—42	$2{,}5 \cdot 10^{-5}$	$3 \cdot 10^{-6}$
19—43	$2{,}5 \cdot 10^{-5}$	$2 \cdot 10^{-6}$

In hermetically sealed glass bulbs with loctal or noval socket or in bakelite case with two-pin socket.

QRV 22 OSCILLATOR CRYSTALS
Frequency range : 8000 to 11000 kc/s

Type	Frequency accuracy	Temperature coefficient/C°
QRV 22—11	$1 \cdot 10^{-3}$	$5 \cdot 10^{-6}$
22—12	$1 \cdot 10^{-3}$	$3 \cdot 10^{-6}$
22—13	$1 \cdot 10^{-3}$	$2 \cdot 10^{-6}$
QRV 22—21	$1 \cdot 10^{-4}$	$5 \cdot 10^{-6}$
22—22	$1 \cdot 10^{-4}$	$3 \cdot 10^{-6}$
22—23	$1 \cdot 10^{-4}$	$2 \cdot 10^{-6}$
QRV 22—31	$5 \cdot 10^{-5}$	$5 \cdot 10^{-6}$
22—32	$5 \cdot 10^{-5}$	$3 \cdot 10^{-6}$
22—33	$5 \cdot 10^{-5}$	$2 \cdot 10^{-6}$
QRV 22—43	$2{,}5 \cdot 10^{-5}$	$2 \cdot 10^{-6}$

In hermetically sealed glass bulbs with loctal or noval socket or in bakelite case with two-pin socket.

QRV 21 OSCILLATOR CRYSTALS
Frequency range : 2000 to 8000 kc/s

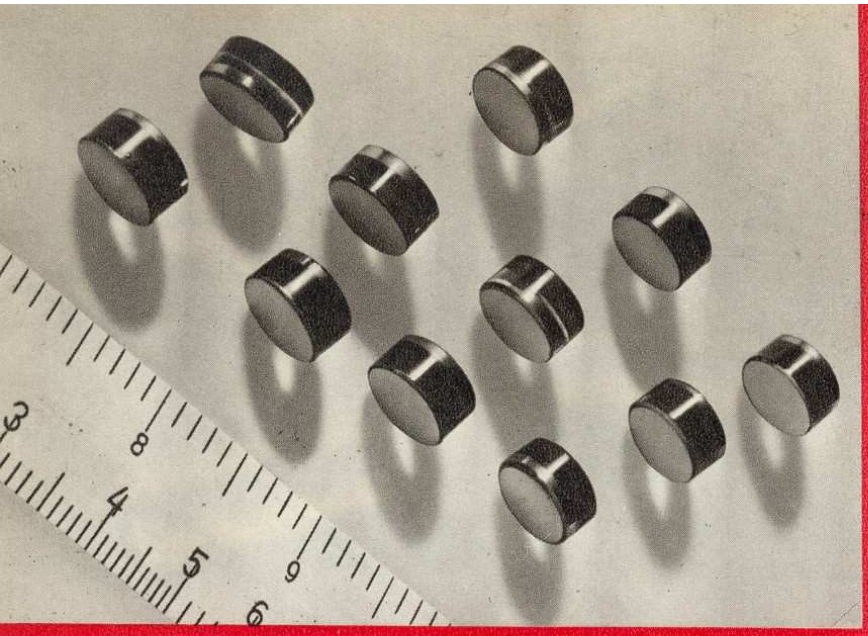
Type	Frequency accuracy	Temperature coefficient/C°
QRV 21—11	$1 \cdot 10^{-3}$	$5 \cdot 10^{-6}$
21—12	$1 \cdot 10^{-3}$	$3 \cdot 10^{-6}$
21—13	$1 \cdot 10^{-3}$	$2 \cdot 10^{-6}$
QRV 21—21	$1 \cdot 10^{-4}$	$5 \cdot 10^{-6}$
21—22	$1 \cdot 10^{-4}$	$3 \cdot 10^{-6}$
21—23	$1 \cdot 10^{-4}$	$2 \cdot 10^{-6}$
QRV 21—31	$5 \cdot 10^{-5}$	$5 \cdot 10^{-6}$
21—32	$5 \cdot 10^{-5}$	$3 \cdot 10^{-6}$
21—33	$5 \cdot 10^{-5}$	$2 \cdot 10^{-6}$
QRV 21—43	$2{,}5 \cdot 10^{-5}$	$2 \cdot 10^{-6}$

In hermetically sealed glass bulbs with loctal or noval socket or in bakelite case with two-pin socket.

QRV 23 OSCILLATOR CRYSTALS
Frequency range : 11000 to 20000 kc/s

Type	Frequency accuracy	Temperature coefficient/C°
QRV 23—11	$1 \cdot 10^{-3}$	$5 \cdot 10^{-6}$
23—12	$1 \cdot 10^{-3}$	$3 \cdot 10^{-6}$
23—13	$1 \cdot 10^{-3}$	$2 \cdot 10^{-6}$
QRV 23—21	$1 \cdot 10^{-4}$	$5 \cdot 10^{-6}$
23—22	$1 \cdot 10^{-4}$	$3 \cdot 10^{-6}$
23—23	$1 \cdot 10^{-4}$	$2 \cdot 10^{-6}$
QRV 23—31	$5 \cdot 10^{-5}$	$5 \cdot 10^{-6}$
23—32	$5 \cdot 10^{-5}$	$3 \cdot 10^{-6}$
23—33	$5 \cdot 10^{-5}$	$2 \cdot 10^{-6}$
QRV 23—43	$2{,}5 \cdot 10^{-5}$	$2 \cdot 10^{-6}$

In hermetically sealed glass bulbs with loctal or noval socket or in bakelite case with two-pin socket.



PRESSURE MEASURING CRYSTALS

QN

WITHOUT SOCKET
WITH GILDED SURFACE

QUARTZ CRYSTALS FOR PRESSURE

Quartz crystals without case, to be used in pressure indicators. The plane surfaces are provided with a gilded conducting coating. The essential dimensions are the diameter and the thickness.

QN QUARTZ CRYSTALS FOR PRESSURE

Type		Diameter in mm	Thickmess in mm
QN	71—11	3—8	2—10
QN	72—11	8—20	2—6
	72—12	8—20	6—12
QN	73—11	20—40	2—5
	73—12	20—40	5—8
	73—13	20—40	8—12

ULTRASONIC QUARTZ CRYSTALS

Crystals designed to supplying a high power — depending of their area — in the ultrasonic range. The characteristic dimension is the diameter. The crystals are made without envelope, for a frequency accuracy of $\pm 2\%$ in general.

QU ULTRASONIC QUARTZ CRYSTALS

Type		Diameter in mm	Frequency kc/s
QU	81—11	10—20	1500— 1400
QU	82—11	20—40	600— 2500
	82—12	20—40	2500— 8000
	82—16	20—40	300— 600
QU	83—11	40—60	600— 1500
	83—12	40—60	1500— 3000
	83—16	40—60	300— 600

ELECTRONIC MEASURING INSTRUMENTS BY TYPE NUMBERS

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ELECTRONIC MEASURING INSTRUMENTS
BY TYPE NUMBERS

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ELECTRONIC MEASURING INSTRUMENTS BY TYPE NUMBERS

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Conclusion

Some general informative data on our products :

Our instruments are in general designed for use on 110/127/220 V, 50 c/s AC.

The cases of our instruments are made of steel sheet whose strength and thickness is in accordance with the instruments dimensions. The finishing coat of the cases is lacquer in grey colour with a hammered surface effect.

Covering and packing of our instruments offers full protection even during long transport.

The component parts used in our instruments are carefully selected ; most of them are our own design and make ; electron tubes and a few other components excepted, everything is made within our works.

Our instruments are always calibrated within a considerably more strict tolerance range than that set out in the specification and this is a most important guarantee of quality.

We reserve the right to discontinue the manufacture of some types described here or to deliver new designs instead of them, should the development of our products or our manufacturing programme require it.

We trust that our readers will find in our technical descriptions full information on the highly developed state of our products and on their essential characteristics. Should you require more detailed data or a more accurate description of any of our measuring instruments, please let us know and we shall be glad to send you the information you want.

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