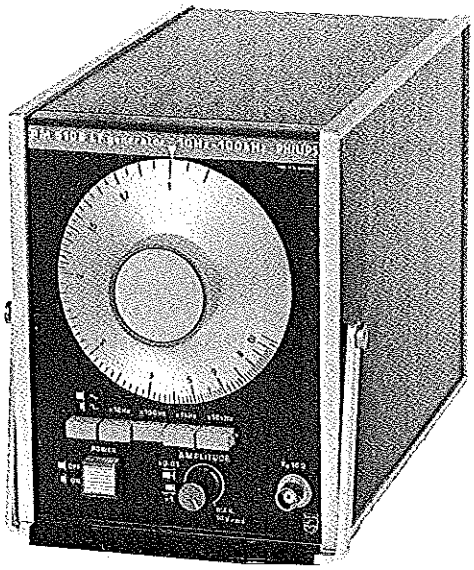
P 45.1

PHILIPS



INSTRUCTION MANUAL
ANLEITUNG
HANDLEIDING
NOTICE D'EMPLOI ET D'ENTRETIEN

L.F.-GENERATOR
N.F. GENERATOR
L.F. GENERATOR
GENERATEUR DE B.F.

PM 5106

(9452 051 06..1)

9499 450 06978

751101/2/04/05

1. Généralités

1.1. INTRODUCTION

Le générateur de basse fréquence PM 5106 fournit des signaux sinusoïdaux et rectangulaires dans la gamme de fréquence de 10 Hz à 100 kHz. La tension de sortie est continuellement réglée; de plus, une atténuation de 40 dB est possible à l'aide d'un interrupteur à tirette.
Cet appareil, du fait de son fonctionnement simple, est très utile à des fins d'étude et d'entretien.

1.2. CARACTERISTIQUES TECHNIQUES

Seules les valeurs exprimées en valeurs numériques et avec tolérance sont garanties, à condition cependant qu'un temps de chauffage de 30 minutes ait été observé.
Les fautes relatives sont données en pourcents des valeurs réglées à moins qu'indiquées différemment.

Modes	: sinusoïdal et rectangulaire.
Fréquence	
Gammes	: 10 Hz à 100 kHz, dans 4 gammes se chevauchant
Limite d'erreur	: ± 5 % ± 1 Hz.
Coefficient de température	: $< 5.10^{-4}/^{o}C$, dans la gamme +5 à +45 ^{o}C.
Dérive à long terme, mesurée pendant 7 heures après une durée de chauffage de 30 minutes	: < 0,1 % de 10 Hz à 1 kHz. < 0,15 % de 1 kHz à 100 kHz.
Mode sinusoïdal	
Tension de circuit ouvert	: 0 à 10 V_{eff}
Atténuation	0 à 60 dB continuellement réglable 0 et 40 dB supplémentaire avec interrupteurs à tirette
Réponse de fréquence (fréquence de référence 1 kHz)	: ± 2 %
Déviation de tension secteur	: < 1 %
Variation de la tension de sortie due à la température	: $< 3.10^{-3}/^{o}C$, négatif.
Facteur de distorsion	: < 1 %, voir Fig. 1
Composante continue	: < 50 mV à 10 kHz < 1 mV typique
Rapport signal/bruit	> 60 dB

1.3. ACCESSOIRES

1 Câble secteur
1 Notice d'emploi et d'entretien.
1 Fusible 0,315 à action différée pour 115 V
1 Label de fusible

1.4. DESCRIPTION DU SCHEMA SYNOPTIQUE (Fig. 3)

La fréquence du générateur est déterminée par le pont de Wien monté dans le circuit de contreréaction de l'amplificateur. Cet oscillateur produit une tension sinusoïdale à faible distorsion, et une amplitude et une fréquence stables.
La fréquence, de 10 Hz à 100 kHz, peut être sélectionnée en quatre échelons décimaux avec le bouton-poussoir 871. Dans chaque gamme, la fréquence est continuellement variable à l'aide de l'échelle 601.
La conversion d'un signal sinusoïdal en signal rectangulaire se fait avec le bouton-poussoir " ▬∿/▬⊓⊔ " de l'unité 871.
En mode " ∿ ", le signal de sortie de l'oscillateur est appliqué par l'intermédiaire du potentiomètre continu AMPLITUDE (614) à l'amplificateur de sortie, lequel amplifie ce signal comme requis et le conduit à la douille BNC Z_0 10 Ω (807). En mode " ⊓⊔ ", un limiteur d'amplitude est connecté entre l'oscillateur et le potentiomètre AMPLITUDE.
L'alimentation produit des tensions continues stabilisées.

2. Mode d'emploi

2.1. INSTALLATION

2.1.1. Position

L'appareil peut être utilisé dans toutes les positions. Il peut également être placé sur l'étrier support.

2.1.2. Adaptation à la tension secteur locale

L'appareil sort de l'usine réglé sur 220 V alternatif. Avant de brancher l'appareil sur 115 V, interchanger les connexions du primaire du transformateur secteur.
- Déposer la plaque supérieure (voir chapitre 3.2.1.)
- Interchanger les connexions du transformateur en conséquence selon la figure 4.
- Modifier l'indication à l'arrière de l'appareil de sorte à indiquer la tension secteur locale.
- Poser à nouveau la plaque supérieure.

2.1.3. Mise à la terre

L'appareil doit être mis à la terre selon les règles de sécurité locale. Le câble secteur compris à la livraison présente un fil de terre, lequel est connecté au contact de terre de la fiche. Si l'appareil est connecté à la douille secteur avec ergots de terre, le boîtier est automatiquement mis à la terre.
La borne ⊥ (805) est reliée intérieurement au châssis; cette borne ne peut en aucun cas être utilisée comme point de raccordement pour une sécurité de terre.
Le contact extérieur du connecteur BNC "LOW Z_0" est connecté à la terre de l'appareil.

2.2.3. Commande de tension de sortie

La tension de sortie peut être continuellement commandée avec le potentiomètre "AMPLITUDE". De pl
une atténuation de 40 dB est possible avec un interrupteur à tirette ⊣ x0,01/ ⊣ x1 (814).

2.3. SERVICE

Avant de procéder au remplacement des composants, déclencher l'appareil. Après remplacement il peut s'avérer nécessaire de rajuster l'appareil (voir chapitre 3.4. CONTROLES ET REGLAGES). Pour l'accès aux composants, voir paragraphe 3.2.

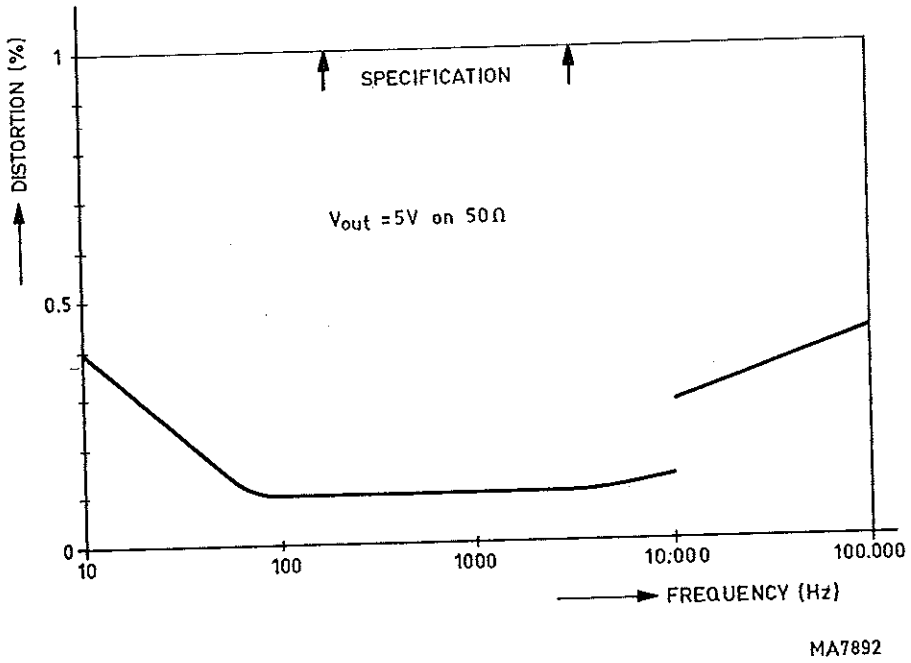

DISTORTION (%)
1
0.5
0
SPECIFICATION
Vout =5V on 50Ω
10
100
1000
10.000
100.000
FREQUENCY (Hz)
MA7892

Fig. 1

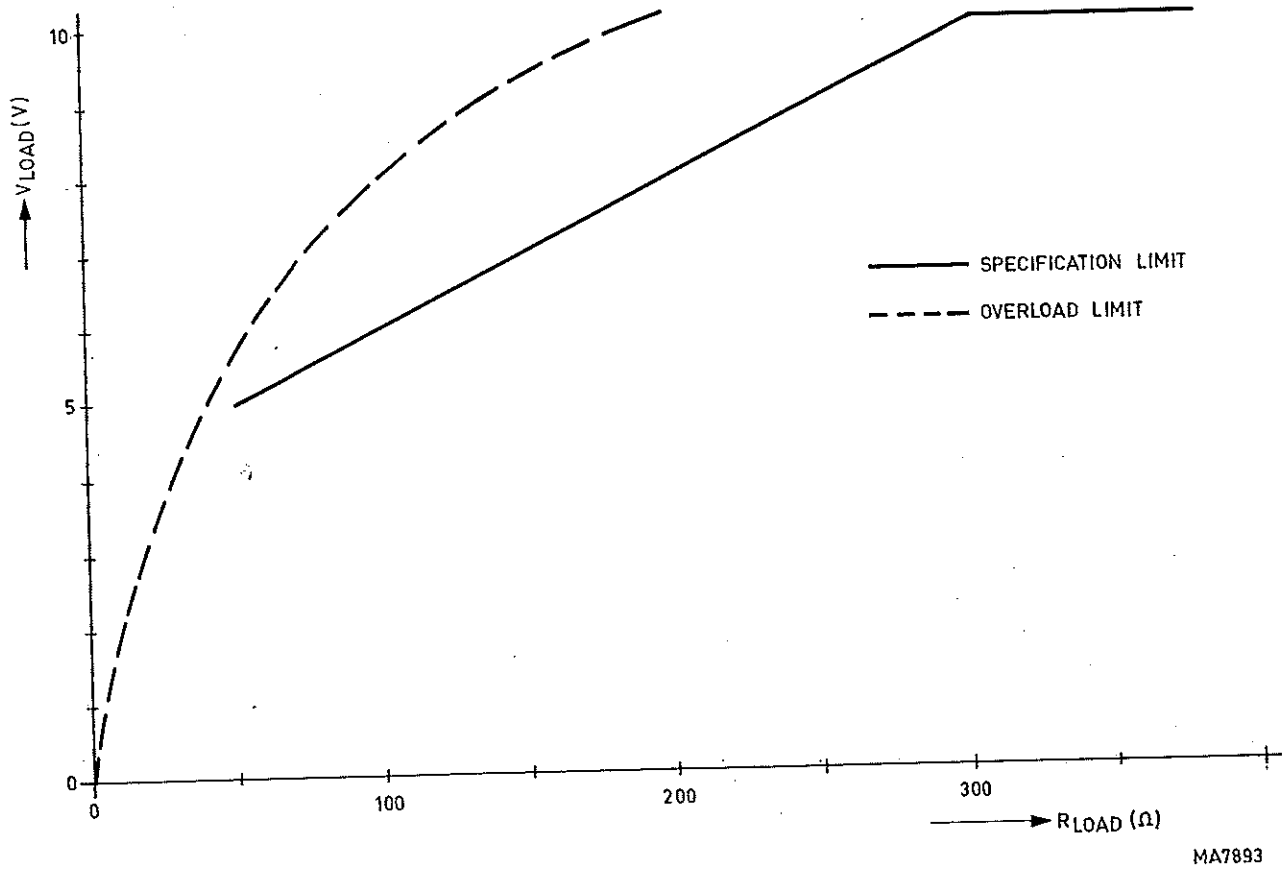

VLOAD (V)
10
5
0
0
100
200
300
RLOAD (Ω)
SPECIFICATION LIMIT
OVERLOAD LIMIT
MA7893

Fig. 2

CONTENTS

TABLE DES MATIERES

1. General information

1.1. INTRODUCTION

The LF generator PM 5106 supplies sine- and square-wave signals in the frequency range 10 Hz to 100 kHz. The output voltage can be adjusted continuously; additional a 40 dB attenuation may be set by means of a pull switch.
This instrument is, owing to its simple operation, very suitable for instruction and service purposes.

1.2. TECHNICAL DATA

Properties expressed in numerical values with statement of tolerances are guaranteed provided the instrument has been warmed-up during 30 minutes. If not indicated differently, the relative faults are given in percents of the adjusted values.

Operating modes	Sine and square wave
Frequency	
Range	10 Hz - 100 kHz, in four overlapping subranges
Setting-error limits	$\pm 5\ \% \pm 1$ Hz
Temperature coefficient	$< 5.10^{-4}/^{o}C$, in range +5...+45 ^{o}C
Long term drift, measured during 7 hours after a warming-up period of 30 minutes	< 0.1 % from 10 Hz up to 1 kHz < 0.15 % from 1 kHz up to 100 kHz
Mode "SINE WAVE"	
Open-circuit voltage	0...10 V_{rms}
Attenuation	0 ... 60 dB continuously 0 and 40 dB additional, with pull switch in amplitude control
Frequency response (referred to 1 kHz)	± 2 %
Mains voltage dependence	< 1 %
Temperature coefficient output voltage	$< 3.10^{-3}/^{o}C$, negative
Distortion factor	< 1 %, see Fig. 1.
d.c.-offset voltage	< 50 mV at 10 kHz < 1 mV typical
Signal-to-noise ratio	> 60 dB
Mode "SQUARE WAVE"	
Open-circuit voltage	0...20 V_{p-p}
Attenuation	0 ... 60 dB continuously 0 and 40 dB additional, with pull switch on amplitude control
Frequency response (referred to 1 kHz)	± 0.5 %

1.4. DESCRIPTION OF THE BLOCK DIAGRAM (Fig. 3)

The frequency determining unit of the generator is the WIEN BRIDGE in the feedback circuit of the AMPLIFIER. This oscillator generates a sine-wave voltage with little distortion and stable frequency and amplitude.

The frequency, from 10 Hz to 100 kHz, can be selected in four decimal steps with push-button unit 871. In each range the frequency is continuously variable by means of dial 601.

Changing-over from sine-wave to square-wave signal is effected with push-button " ▬∿/▬⊓⊔ " of push-button unit 871.

In the "∿" mode, the output signal of the oscillator is applied, via control AMPLITUDE (614) to the output amplifier which amplifies this signal to the required value and carries it to BNC socket Zo 10 Ω (807). In the "⊓⊔" mode a clipper is connected between oscillator and AMPLITUDE control.

The power supply provides stabilized d.c. voltages.

2. Directions for use

2.1. INSTALLATION

2.1.1. Position

The instrument may be used in any position. The instrument can be used in sloping position after the tilting bracket at the bottom has been hinged out.

2.1.2. Adjusting to the local mains voltage

The instrument has been adjusted by the factory to a mains voltage of 220 V a.c.

Before connecting the instrument to 115 V the connections at the primary side of the mains transformer must be interchanged:

- Remove the top plate (see chapter 3.2.1.)
- Resolder the tappings on the transformer in accordance with the connection diagram for the various voltages (see Fig. 4).
- Change the indication plate at the rear to match the relevant mains voltage.
- Fit the top plate.

2.1.3. Earthing

The instrument must be earthed in conformity with the local safety regulations. The supplied mains cable contains an earth core which is connected to the earth contact of the plug. If the instrument is connected to a mains socket with earth contacts, the cabinet is automatically earthed. ⊥ Socket (805) is internally connected to the cabinet; this socket should on no account be used as a connection point for a protective-earth lead! The outer contact of the BNC-socket "LOW Zo" is connected to the signal earth of the instrument.

The circuit earth is connected direct to the signal-earth socket ⏚ (806) and, moreover, to the (earthed) cabinet via 100 nF capacitor 501.

The signal-earth socket ⏚ (806) is connected to cabinet socket ⊥ (805) by means of a shorting plug (horizontal position). As a consequence, undesired external interferences at the signal-earth socket (806) cannot influence the function of the instrument.

2.3. SERVICE

Switch off the instrument before you start replacing parts. After replacing parts, it might be necessary to readjust the instrument according to paragraph 3.4. CHECKING AND ADJUSTING.
For accessibility of the individual parts, see paragraph 3.2.

Note: In case of breakdowns, the assistance of the PHILIPS Service organisation can always be called upon.
Whenever the instrument is to be forwarded to a PHILIPS Service Center for repair, the following should be observed:

- Provide the instrument with a label bearing full name and address of the sender.
  Indicate as completely as possible the symptoms of the fault.
- Carefully pack the instrument in the original packing, or, if this is no longer available, in a wooden crate.
- Forward the instrument to the address provided by your local PHILIPS representative.

3. Service data

3.1. CIRCUIT DESCRIPTION

3.1.1. Oscillator (Figs. 7 and 18)

The l.f. generator comprises an RC oscillator. The sine-wave voltage produced by the RC oscillator is applied to the output voltage divider, either directly or via a clipper. In the latter case a square-wave signal with a mark space ratio of 1:1 will be available on socket LOW Z_0.

The oscillator consists of a frequency-determining Wien four-pole with equal branches and a stabilized amplifier, free from phase shift.
The resonant frequency of the Wien four pole can be calculated from the following formula:

$$f_o = \frac{1}{2 \pi RC}$$

At this frequency the input and output voltage of the Wien four pole are in phase. The amplitude of the output voltage is three times smaller than that of the input voltage. This means that, in order to comply with the oscillation condition, the phase shift of the amplifier should be 0^o and its gain factor should be 3.

The frequency range (in steps of one decade) are obtained by selecting with push-button unit 871 different capacitors from the range 501 up to 513.
A tandem potentiometer 601 is used for fine control of the frequency within the selected range.
Potentiometer 605 and the capacitors 516 and 513 serve for calibration.

The amplifier has a high degree of negative feedback, so that its gain is reduced to a factor 3.
The gain factor can be adjusted by means of potentiometer 610. The resistance setting of this potentiometer is the shunt resistance in the feedback circuit. N.T.C. resistor 607 provides the series resistance; as a result of this the feedback will depend on the amplitude. If, for exemple, the output voltage of the amplifier increases, the current through the feedback network 607//514 in series with the resistance setting of 610 also changes. The increased feedback current causes a temperature rise of the N.T.C. resistor, so that its ohmic value will be reduced. Consequently the feedback voltage increases, so that the output voltage will be reduced. Capacitor 514 serves for phase compensation and with potentiometer 610 the feedback is adjusted to such a degree that the oscillator starts when the instrument is switched on.

3.3. SURVEY OF ADJUSTING ELEMENTS AND AUXILIARY EQUIPMENT

Adjustment	Adjusting element	Measuring value	Measuring instrument	Example	Chapter	Fig.
Current consumption	-	I_{rms} = 68 mA ±10 %	Ammeter	PM 2403	3.4.1.	-
Supply voltages	Resistor 620/UNIT C	-20 V ±1 %	Digital voltmeter	PM 2411	3.4.2.	17
	Resistor 609/UNIT C	+20 V ±1 %				
- Ripple	-	< 5 V_{pp}	Oscilloscope	PM 3231	3.4.2.	-
d.c. voltage for oscillator	-	-16,3 V ±2,5 %	Digital voltmeter	PM 2421	3.4.2.	-
Frequency of output voltage	Potentiometer 605/UNIT A	10 Hz ±10 %				14
	Trimmer 513/UNIT A Trimmer 516/UNIT A	100 Hz...100 kHz ±2 %	Counter	PM 6620	3.4.3.	14
- Waveform	-	-	Oscilloscope	PM 3231	3.4.3.	-
Oscillator output voltage						
- Amplitude of sine-wave voltage	Potentiometer 610/UNIT A	2 V ±1 %	Digital voltmeter	PM 2441	3.4.4.	14
						14
- Duty cycle of square-wave voltage	Potentiometer 621/UNIT A Capacitor 623/UNIT A	0,5 ±5 %	Oscilloscope	PM 3231	3.4.4.	14
- Amplitude of square-wave voltage	-	4 V_{pp} $^{+5\ \%}_{-4\ \%}$	Oscilloscope	PM 3231	3.4.4.	-
Output voltage					3.4.5.	-
- Ripple	Resistor 605/UNIT B	< 2,5 %	Oscilloscope	PM 3231	3.4.5.1.	16
- Overshoot	Trimmer 502/UNIT B	< 2,5 %	Oscilloscope	PM 3231	3.4.5.1.	13
- Amplitude of sine-wave voltage	Resistor 602	10 V ±5 %/0,1 V - 4 %	Digital voltmeter	PM 2421	3.4.5.2.	16
- d.c. part	Capacitor 506/UNIT B	< 10 mV	Multimeter	PM 2403	3.4.5.2.	16
- frequency response sine-wave	-	±1,5 %	Digital voltmeter	PM 2421	3.4.5.3.	-
- frequency response square-wave	-	±0,5 %	Oscilloscope	PM 3231	3.4.5.3.	-
- Distortion factor	-	≤ 0,4 % at 1 kHz ≤ 0,8 % at 10 Hz and 100 kHz	Distortion meter	Hp 331A	3.4.5.4.	-
- Rise and fall time	Trimmer 502/UNIT B	≤ 0,25 µs	Oscilloscope	PM 3231	3.4.5.5.	13
- Droop	-	≤ 0,8 %	Oscilloscope	PM 3231	3.4.5.6.	-
- Stability	-	Waveform	Oscilloscope	PM 3231	3.4.5.7.	-

3.4. CHECKING AND ADJUSTING

Tolerances given in this chapter apply in case of newly adjusted instruments and may differ from those given in chapter 1.2. TECHNICAL DATA.

The adjusting elements, their location and function are mentioned in chapter 3.3.

The instrument may only be adjusted after a warming-up period of at least 1 hour at an ambient temperature of (25 ± 3) °C.

If not duly indicated:

- the voltage levels refer to signal earth
- the rms-voltages represent the a.c. voltages.

The signal-earth socket ⏚ (806) must be connected with cabinet socket ⊥ (805) by means of the shorting plug.

3.4.1. Current consumption

- Connect the instrument to the mains via an ammeter
- Switch on the instrument; the indicator lamp in push-button POWER (812) must light.
- Set push-button 871 to position ∼ and 1 kHz.
- Set the frequency dial to 1
- Measure the current consumption, nominal value at 220 V mains, 50 Hz: I_{rms} = 68 mA ±10 %

TABLE I

Switch 871 to position:	Frequency dial to: 1	2	2,5	4	7	9	10
x 10 Hz	,9 ... 11 Hz ≙ 90,9 ... 111 ms	18,7 ... 21,3 Hz ≙ 47 ... 53,5 ms	23,6 ... 26,4 Hz ≙ 37,9 ... 42,37 ms	38,1 ... 41,9 Hz ≙ 23,8 ... 26,25 ms	67,2 ... 72,8 Hz ≙ 13,74 ... 14,9 ms	86,6 ... 93,4 Hz ≙ 10,71 ... 11,55 ms	96,3 ... 103,7 Hz ≙ 9,64 ... 10,38 ms
x 100 Hz	97 ... 103 Hz ≙ 9,71 ... 10,31 ms	194 ... 206 Hz ≙ 4,854 ... 5,156 ms	242,5 ... 257,5 Hz ≙ 3,883 ... 4,124 ms	388 ... 412 Hz ≙ 2,427 ... 2,577 ms	679 ... 721 Hz ≙ 1,387 ... 1,473 ms	873 ... 927 Hz ≙ 1,079 ... 1,145 ms	970 ... 1030 Hz ≙ 0,971 ... 1,031 ms
x 1 kHz	0,97 ... 1,03 kHz	1,94 ... 2,06 kHz	2,425 ... 2,575 kHz	3,88 ... 4,12 kHz	6,79 ... 7,21 kHz	8,73 ... 9,27 kHz	9,7 ... 10,3 kHz
x 10 kHz	9,7 ... 10,3 kHz	19,4 ... 20,6 kHz	24,25 ... 25,75 kHz	38,8 ... 41,2 kHz	67,9 ... 72,1 kHz	87,3 ... 92,7 kHz	97 ... 103 kHz

3.4.4. Output voltage of the oscillator

- Push-button 871 to ∿ and x 100 Hz
- Set the frequency dial to 10
- Turn potentiometer AMPLITUDE (614) fully anti-clockwise
- Check the oscillator voltage at contact 7/UNIT A with a high-ohmic a.c.-voltmeter (R_i > 1 MΩ), nominal value: 2 V ± 20 mV; if necessary adjust with potentiometer 610/UNIT A
- Set push-button 871 to ⊓⊔ and x 1 kHz
- Set the frequency dial to 2
- Check the duty cycle of the square-wave voltage (positive pulse duration with respect to the period duration) at contact 7/UNIT A, nominal value: 0.475 ... 0.525; if necessary adjust with potentiometer 621/UNIT A
- Set push-button 871 to position ⊓⊔ and x 10 kHz
- Set frequency dial to 10
- Check the duty cycle, nominal value: 0.475 ... 0.525; if necessary adjust with potentiometer 621/UNIT A
- Set push-button 871 to position ⊓⊔ and x 1 kHz
- Set the frequency dial to 2
- Check the duty cycle, nominal value: 0.475 ... 0.525; if necessary change the value of capacitor 523/UNIT A and repeat the whole procedure of the duty cycle.
- Check the amplitude of the square-wave voltage at contact 7/UNIT A, nominal value: V_{pp} = 4 V, permissible tolerance: +200 mV, -400 mV

3.4.5. Output voltage

3.4.5.1. Ripple and overshoot

- Set push-button 871 to ⊓⊔ and x 10 kHz
- Set the frequency dial to 10
- Set control AMPLITUDE (614) to MAX
- Check the ripple of the droop at output Z_0 10 Ω (807), permissible value: < 2,5 %; if necessary change the value of resistor 605/UNIT B
- Check the preshoot at output Z_0 10 Ω, permissible value: < 2,5 %; if necessary adjust with trimmer 502/UNIT B