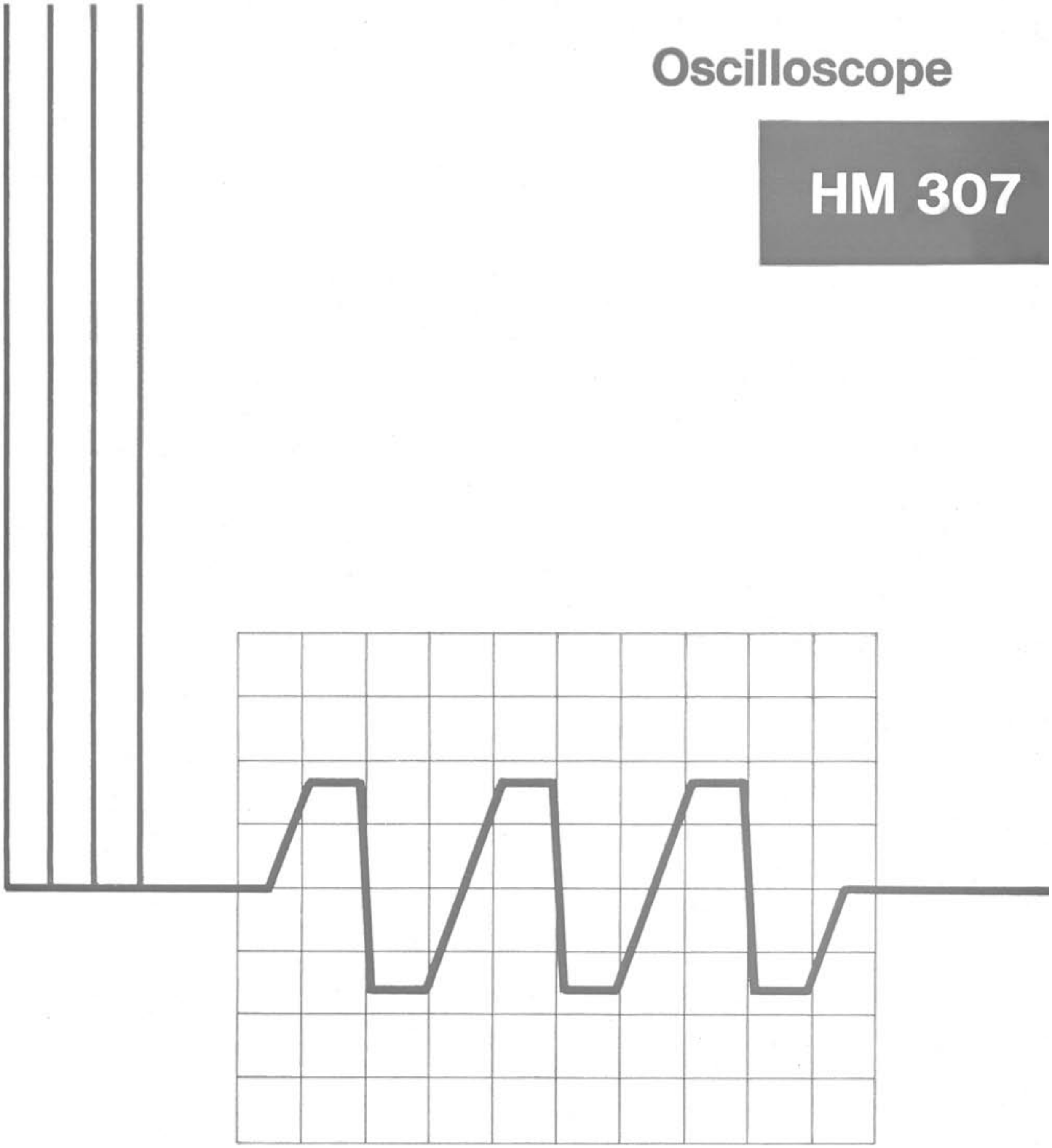
MANUAL

Oscilloscope

HM 307



HAMEG MESSTECHNIK

OSCILLOSCOPE HM 307–4

Specification

Vertical Deflection (Y)

Bandwidth: DC to 10MHz (-3dB),
DC to 15MHz (-6dB).
Risetime: approx. 35ns.
Overshoot: max. 1%.
Deflection coefficients: 12 calibr. steps, 5mV/cm to 20V/cm in 1-2-5 sequence.
Accuracy better than ±5%.
Input impedance: 1MΩ II 25pF.
Input coupling: DC-AC-GD.
Input voltage: max. 500V (DC + peak AC).

Timebase

Time coefficients: 18 calibrated steps, 0.5μs/cm to 0.2s/cm in 1-2-5 sequence, with variable control uncalibr. to 0.2μs/cm.
Accuracy better than ±5% (in cal. position).
Normal length of baseline: approx. 7cm.

Trigger System
Source: internal or external.
Slope: positive or negative.
Modes: manual trigger level control, Automatic Triggering (AT).
Sensitivity: 3mm (2Hz to 30MHz).
external: 0.5-5V, AC only.

Horizontal Deflection (X)

Bandwidth: 1Hz to 1MHz (-3dB).
Deflection coefficient: approx. 0.75V/cm.
Input impedance: approx. 1MΩ II 25pF.

Component Tester

Test voltage: max. 8.6Vrms (open circuit).
Test current: max. 28mA rms (shorted).
Test frequency: 50 resp. 60Hz.
Test circuit grounded to chassis.

General Information

Cathode-ray tube: C 312 P1, 7cm dia.
Accelerating potential: approx. 2kV.
Built-in square-wave generator 1kHz for probe alignment (0.2V ±1%).
Electronic regulation for all important supply voltages incl. high voltage.
Mains voltages: 110, 127, 220, 237V AC.
Maximum mains fluctuation: ±10%.
Mains frequency: 50 to 60Hz.
Power consumption: approx. 27W.
Weight: approx. 3.7kg.
Dimensions: 114x212x280mm.
Finish: dark grey.
With handle and tilt stand.
Accessories incl.: Manual, a pair of tester leads (red and black).

Subject to change.

- **LPS-Triggering**
- **Component Tester**
- **Bandwidth DC to 10MHz**
- **Timebase 0.2μs-0.2s/cm**

The HM307 is a **compact light weight** single trace **oscilloscope** which has been specially designed to meet the requirements of both the service technician and advanced amateur. The sweep circuit employs the **LPS trigger technique** developed by HAMEG. This new technique gives the instrument outstanding trigger performance far beyond the bandwidth of the vertical amplifier. All important supply voltages are regulated. A principal feature of the HM307, which will soon make it an indispensable instrument for servicing, is the **built-in component tester**. This allows both passive and active components to be tested while still in-circuit and therefore makes servicing more efficient and cost effective.
As with all HAMEG instruments the front panel has been designed for easy operation with all controls clearly identified. The robust mechanical construction with the carrying handle on the side and the low profile case make it **an ideal service instrument**.

Accessories optional
Probe x1; Attenuator Probes x10, x100; various Test Cables; Demodulating Probe; Carrying Case; etc.

General

The technique offered by the **HM307** has been achieved by the use of monolithic integrated circuits and discrete semiconductors. The **low profile case** satisfies the requirements for field service. The internal design of the instrument with the majority of the circuit situated on one printed circuit board and the mechanical construction afford **greater serviceability**. The 7cm CRT gives an effective display area of approx. 6x7cm and is complimented by a graticule scaled in cm divisions. The manual attached to each instrument gives full technical details. As with most electron tubes, the CRT develops X-rays. With the HM307 the dose equivalent rate falls **far below the maximum permissible value of 36pA/kg**.

Vertical Deflection

The measuring amplifier of the HM307 is provided with a diode protected FET input. The measuring amplitude is determined by the **12-step frequency compensated input attenuator**. A monolithic integrated circuit is used for the first amplifier stage primarily to considerably reduce the drift of the amplifier. Therefore, there is **no need for drift compensation**. The input attenuator and the input stages are one subassembled unit and easy to replace. The bandwidth depends mainly on the final stage. The specified value refers to -3dB (70% of 40mm). If **scaled down displays** are acceptable, then signals of **much higher frequencies** can be displayed. The phase delay distortions which mainly occur in the final stage are compensated by several RC networks.

Timebase

The trigger and sweep circuit of the HM307 uses the new **LPS technique** designed by HAMEG. A principal benefit of this technique is the **stable and reliable triggering up to 30MHz**. This is achieved by the use of monolithic integrated circuits. Unlike past methods of triggering the trigger signal is fed to a **voltage comparator with TTL output**. The voltage jump is used as a triggering edge for logic control. The core of the sweep circuitry is a dual data flip-flop controlling the charging circuit, the unblanking, and the triggering, considering the switching state of the automatic sensor. When the trigger level control is turned to **"AT" position** (Automatic Triggering) **a baseline** in the absence of an input signal **will be continuously displayed**. The unblanking for the CRT is controlled by a voltage-proof **opto-coupler**.

Miscellaneous

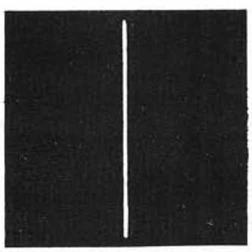
All important **supply voltages are regulated**. The high voltage of 2000V for the CRT is generated by a voltage quadrupler circuit. The HM307 is set for 240V ac. For other mains voltages two soldered jumper connections on the power transformer must be changed. A **built-in 1kHz square-wave generator** is provided for probe alignment and may also be used to check the calibration of the Y-amplifier. Using an attenuator probe X10 the height of the displayed signal is 4cm at 5mV/cm sensitivity.

Tester Operation

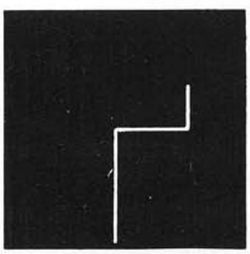
The change-over from oscilloscope operation to **component tester** is achieved by actuating the "GD" push button. The result of the test is displayed on the screen. The displayed maximum values of height and width are constant. The limits of test voltage and short-circuit current are max. 8.6V rms max. 28mA rms respectively. Therefore, general purpose components cannot be damaged by the tester. Beside discrete components the tester can also check semiconductors **in-circuit**. For trouble-shooting of complex circuits it is possible to locate faults by comparison with other devices.

During the test operation it is not necessary to change the oscilloscope settings. Therefore, after release of the "GD" push button oscilloscope operation can be continued immediately.

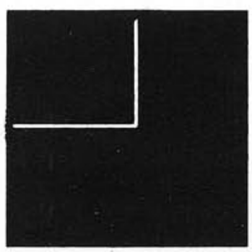
Examples of test displays



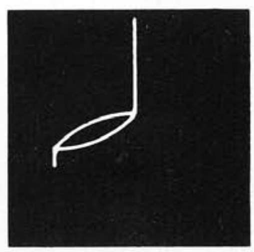
Short-circuit



Z-diode below 8 volts



Transistor base-collector



Transistor base-emitter paralleled to 1μF + 680Ω

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This frequency compensated attenuator probe should be used when the circuit under test is a high impedance source or the signal voltage exceeds 100 Vpp. It should be noted that the probe reduces the input voltage by a factor of 10. The probe can be connected to the test circuit by a removable sprung hook, and an integral ground lead with an insulated crocodile clip.

Specification

Attenuation x 10. Bandwidth DC - 100 MHz. Risetime 3.5 ns. Max. input voltage 600 V (DC + peak AC). Input impedance 10 Megohm. Input capacitance 10.3 - 13.6 pF. Compensation range 10 - 60 pF. Cable length 1.5 m.
Accessories supplied: Sprung Hook, Trimming Tool.

HZ 30 Oscilloscope Probe x 10

The HZ 35 is a straight through probe without attenuation and therefore allows the full sensitivity of the oscilloscope to be used. Due to the probe capacity it is only recommended for use with relatively low impedance and low frequency sources. This probe is connected to the test circuit by a sprung hook and integral ground lead with an insulated crocodile clip.

Specification

Bandwidth DC - 10 MHz. Max. input voltage 600 V (DC + peak AC). Input resistance equal to the oscilloscope resistance. Input capacitance 47 pF + oscilloscope input capacitance. Cable length 1.5 m.
Accessories supplied: Sprung Hook, BNC Adapter.

HZ 35 Oscilloscope Probe x 1

The HZ 36 is a switchable probe offering both x 10 and x 1 operation. In the x 10 mode the characteristics are the same as the HZ 30. In the x 1 position the cable capacity will act as a load on a high impedance source, however the maximum sensitivity of the oscilloscope can be fully utilized. The reference position enables a ground reference level to be set. In this mode the oscilloscope input is grounded.

Specification

Attenuation x 10 same as HZ 30 spec. x 1 operation: Bandwidth DC - 10 MHz. Max. input voltage 600 V (DC + peak AC). Input resistance equal to the oscilloscope resistance. Input capacitance is 40 pF + oscilloscope input capacitance. Reference position: probe tip grounded via 9 Megohm, oscilloscope input grounded. Cable length 1.5 m.
Accessories supplied: Sprung Hook, Trimming Tool, BNC Adapter, Insulating Tip, IC Tip.

HZ 36 Switchable Probe x 10/x 1

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For the measurement of voltages between 500 V and 1500 V it is essential to use the HZ 37 x 100 attenuator probe. It should be noted that if voltages greater than 600 V are applied to the HZ 30, HZ 36 and HZ 38 probes then serious damage to the probes and the oscilloscope input will occur. When using the HZ 37 the input voltage to the oscilloscope is reduced by a factor of 100.

Specification

Attenuation x 100. Bandwidth DC-50 MHz. Risetime 7 ns. Max. input voltage 1500 V (DC + peak AC). Input resistance 9.1 Megohm. Input capacitance approx. 4.6 pF. Compensation range 12 - 48 pF. Cable length 1.5 m.

Accessories supplied: Sprung Hook, Trimming Tool, BNC Adapter, Insulating Tip, IC Tip.

HZ 37 Oscilloscope Probe x 100

The HZ 38 is a x 10 attenuator probe which has been specially designed for the investigation of relatively high frequency signals. As the risetime of the probe is added geometrically to that of the oscilloscope it should not be greater than 20% of the oscilloscope risetime. The HZ 38 is recommended for use with instruments quoting a bandwidth of 40 MHz or more, as the effective bandwidth of the oscilloscope will not suffer reduction by the probe.

Specification

Attenuation x 10. Bandwidth DC-200 MHz. Risetime 1.7 ns. Max. input voltage 500 V (DC + peak AC). Input resistance 10 Megohm. Input capacitance approx. 13 pF. Compensation range 12 - 48 pF. Cable length 1.5 m.

Accessories supplied: Sprunk Hook, BNC Adapter, 2 Ground Leads.

HZ 38 Oscilloscope Probe x 10

The HZ 39 Demodulator Probe is particularly suitable for the display of the AM content of RF signals, and as a detector for swept-frequency voltages. The main circuit component is a peak to peak rectifier with a capacitor input. For RF suppression the output signal is derived via a low-pass filter. For correct operation the probe must be terminated by 1 Megohm (oscilloscope input resistance with DC coupling). If AC coupling has to be used then a separate 1 Megohm resistor will be required to achieve the neccessary DC bias voltage for the diodes.

Specification

Bandwidth approx. 35 kHz to 250 MHz. RF input voltage range 0.25 Vrms to 40 Vrms. Max. input voltage 200 V (DC + peak AC). Output polarity positive. Cable length 1.5 m.

Accessories supplied: Sprung Hook, BNC Adapter.

HZ 39 Demodulator Probe

This adapter is designed to meet applications where it is neccessary to connect 4 mm plugs to an instrument with a BNC input socket. The HZ 20 is solidly constructed and versatile incorporating a BNC male plug to dual 4 mm binding post. The binding post mounting can be rotated so that the adapter can be positioned to avoid obstructing front panel controls.

Specification

Dimensions (mm) length 42, width 35, depth 18. Standard BNC male plug. Two 4 mm binding posts 19 mm between centres. Maximum input voltage 500 V (DC + peak AC).

HZ 20 Adapter Binding Posts to BNC

The HZ 22 is a 50 ohm through termination with a BNC female socket to receive the test cable and a BNC male plug for connection to the oscilloscope. This termination should be used to terminate signal generators and koax-cables which have a 50 ohm characteristic impedance. For correct operation the termination must be connected directly to the oscilloscope input, otherwise the test signals, irrespective of its fundamental shape, will be deformed. The termination should also be used for the accurate measurement of high frequency sine wave signals (to avoid standing waves). The HZ 22 should not be employed when a compensated attenuator probe is used.

Specification

Dimensions (mm): 14 x 20 x 62. Max. load 2 W. Max. voltage 10 Vrms.

HZ 22 50 ohm Through-Termination

When setting the frequency compensation of an oscilloscope input attenuator with a 1 Megohm input resistance a screened x2 input attenuator must be used. The HZ 23 is a compact attenuator with a BNC male plug for connection to the oscilloscope vertical input, and a BNC female socket for connection to the coaxial cable from the oscilloscope calibrator. In series with the centre connections of the plug and socket is a 1 Megohm resistor paralled by a ceramic trimmer capacitor. The trimmer can be adjusted to equal the input capacitance of the oscilloscope, then the impedance of the HZ 23 is equal to the specified input impedance of the oscilloscope under test.

Specification

Dimensions (mm) 62 x 21 x 15. Fixed resistor 1 Megohm. Capacitance compensating range 12 - 48 pF. Max. voltage 250 V (DC + peak AC).

HZ 23 Input Attenuator x2

The HZ 32 coaxial test cable is designed to facilitate connection between an oscilloscope and instruments with 4 mm sockets. However, this combination of BNC- 4 mm can be used for many other applications. For example when investigating AF signals from a high impedance source the possibility of hum pick-up and crosstalk is greatly reduced as the signal input 4 mm plug is completely screened. Both the BNC and 4 mm signal plug have anti-kink mouldings while the 4 mm earth lead is fine stranded wire, to minimize the risk of the cable breaking.

Specification

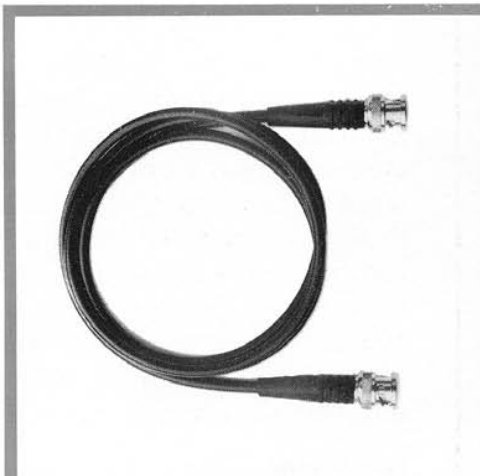
Cable length 1.15 m. Cable capacitance 120 pF. Characteristic impedance 50 ohm. Max. voltage 500 V (DC + peak AC).

HZ 32 Test Cable BNC- 4 mm

The HZ 34 is a coaxial test cable terminated with BNC male plugs at each end. Today the BNC connection system is the most widely used type in the commercial electronics field, and the HZ 34 gives the user a test cable with specified characteristics. To minimize the possibility of cable breakage both BNC plugs are protected by anti-kink mouldings.

Specification

Cable length 1.2 m. Cable capacitance 126 pF. Characteristic impedance 50 ohm. Max. voltage 500 V (DC + peak AC).



HZ 34 Test Cable BNC - BNC

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When the oscilloscope is used for field service applications the HZ 43 carrying case will prove to be invaluable, as it has been designed to protect the instrument and provide storage for accessories and tools. The carrying case is manufactured from hard wearing material, the base of the case has a thick shock absorbing lining which protects the instrument against rough handling. One side of the case has a compartment which can be used to carry accessories, tools and spares. Dimensions for the carrying case are 260 x 210 x 460 mm, while the compartments measurements are 260 x 210 x 50 mm. The instrument handle is used for carrying minimizing the stresses applied to the carrying case.

Suitable for HM 312, HM 412 and HM 512 oscilloscopes. Special model for HM 812 oscilloscope on request.

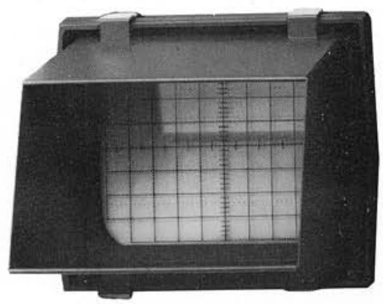
HZ 43 Carrying Case

The HZ 44 Carrying Case has been specially designed for the smaller instruments in the HAMEG range, though of course it may be used for other instruments of a similar size. It also contains a compartment which can be used for accessories and tools. The case is manufactured from a hard wearing material. A leather shoulder strap, with a protective pad, is fixed to the case, this is particularly advantageous if other equipment has to be carried. Ventilation holes are provided in the case so that instruments with a maximum consumption of 30 Watts can be operated in the case. Overall dimensions are approx. 300 x 125 x 300 mm, accessory compartment approx. 120 x 40 x 280 mm.

Suitable for HM 307, HZ 62 and HZ 64 instruments.

HZ 44 Carrying Case

Under high ambient light conditions it may be found that the contrast of the display is diminished, also problems can sometimes be caused by unwanted reflections on the graticule. In most cases the HZ 47 Viewing Hood will overcome these problems as it shields the display area, substantially increasing the contrast, and decreasing the possibility of reflections. The HZ 47 has four sprung clips which easily locate into slots on the oscilloscope bezel.



HZ 47 Viewing Hood

Suitable for HM 312, HM 412, HM 512 and HM 812 oscilloscopes.

General Information

The HM307 is an oscilloscope, which has been specially designed to meet the needs of the Service Technician and amateur, who may not be fully experienced with the application of this type of instrument. All the front panel controls and connectors are clearly identified and logically arranged so that after a short period of time the operator will be completely familiar with the oscilloscope. However, it is recommended that even experienced users should read the following instructions thoroughly, as they include important information concerning the operation of the instrument.

The front panel is subdivided into three sections which correspond to the main functions of the instrument. Immediately below the CRT is a section which contains a combined mains on/off switch and intensity control, the focus control is also located in this section. The vertical amplifier controls together with the component tester input sockets are located in the section to the right of the CRT. The next section incorporates the timebase and trigger controls together with the horizontal position control. The detailed design of the HM307 is such that even incorrect operation should not cause serious damage. All push buttons control only minor functions. However, it is recommended that before operating the instrument all push buttons are in the ''out'' position, after this the required mode of operation will determine which buttons should be depressed. For a better understanding of these Operating Instructions the front panel picture at the end of the manual can be unfolded for reference alongside the text.

The HM307 will accept all signals in the range from DC (direct voltage) to at least 10MHz. For sine-wave voltages the upper frequency limit will be as high as 20-25MHz. However, in this higher frequency range the vertical display height on the CRT is limited to between 10-20mm. In addition, problems of time resolution will also arise. For example, with a 10MHz signal and the timebase set at the fastest speed (0.2μs/cm), one cycle will be displayed every 5mm. The accuracy for indicated values in both the horizontal and vertical axis is ±5%. Therefore, all values to be measured can be determined relatively accurately. However, it should be remembered that from approx. 3MHz upwards the measuring error will increase as a result of loss of gain. At 7MHz this reduction is approx. 10%. Thus, approximately 11% should be added to the measured voltage at this frequency.

The chassis and case of the instrument are directly connected to the earth contact of the power plug and thus to the non-fused earth conductor of the mains supply. Under certain conditions 50Hz disturbing voltages can occur in the measuring circuit due to inter-connection with other mains powered instruments. This can be avoided by using a protective isolating transformer between the mains outlet and the power plug of the HM307. If an isolating transformer is not used the instrument must only be connected to an earth mains socket outlet complying with the appropriate safety requirements. In accordance with standard safety regulations, the earth wire must not be disconnected.

If a protective isolating transformer is used for the display of signals with high zero potential, it should be noted that these voltages are also connected to the case of the oscilloscope. Voltages up to 40V are not normally dangerous. Higher voltages, however, involve a shock hazard. In this case, special safety measures must be taken and must be supervised by qualified personnel.

Long term reliability has been ensured by using solid state circuitry throughout the instrument. However, the heat generated within the unit is extremely low. However, in common with all technically advanced instruments it is recommended that the main characteristics of the HM307 should be periodically checked using the Test Instructions at the end of this manual.

To obtain the maximum life from the cathode-ray tube, the minimum intensity necessary for the measurement being undertaken, and the ambient light conditions, should be used. Particular care is required when a single spot is being displayed as a very high intensity setting may damage the fluorescent screen of the CRT. In addition, switching the oscilloscope off and on at short intervals stresses the cathode of the CRT and should therefore be avoided.

Attention! In spite of the CRT's shielding with Mumetal, influences on the horizontal trace position caused by the earth's magnetic field cannot always be avoided. Hard shocks during transport may also cause a slight rotation of the CRT, in both cases, a centred trace on the graticule will not align exactly with the horizontal centre line. Location of the cause and the required correction to the CRT position are described in the Service Instructions.

Warranty

Before being shipped, each instrument must pass a quality control test of 10 hours. Invariably every early failure can be detected by means of intermittent operation during this test. Nevertheless, a component may fail only after a longer period of operation. Therefore, all HAMEG instruments are covered by a one year warranty against faulty components or workmanship, provided that no modifications have been made to the instrument. It is strongly recommended that if the instrument has to be dispatched by rail or post that the original packing is used. We regret that transportation damage due to poor packing is not covered by the above warranty.

Operating Conditions

Admissible ambient temperature range during operation: +10 °C to +40 °C. Admissible ambient temperature range for storage or transportation: −40 °C to +70 °C.
If condensed water exists in the instrument it should not be operated before acclimatization is achieved. In some cases (an extremely cold oscilloscope) about 2 hours should be allowed before putting the instrument into operation. The instrument should be placed in a clean and dry room. In other words, it is recommended that the instrument should not be used in explosive, corrosive, dusty, or moist environments. The instrument may be operated in any position, however, the convection cooling must not be impaired. Therefore, when the instrument is in continuous operation it should be used in the horizontal position preferably on its tilt stand.

First-Time Operation

On delivery the instrument is set to operate on 240V AC mains voltage. Other voltages may be set by changing the tappings on the mains transformer. The mains fuse has to match the selected mains voltage and if necessary should be replaced. The method of mains voltage change-over and the specified type of the mains fuse are described in the Service Instructions.

To obtain a display, all push buttons should be in the "out" position before commencing to use the instrument, also all blue coloured controls should be set in the fully anti-clockwise position, "Variable" control in "C" and "Level" control in "AT" position.
The markers on the grey knob caps should be set in the vertical position (mid-range).

The instrument is switched on by rotating the "Intens." control, located below the CRT, clockwise. An LED indicates that the instrument is on. If a trace is not visible after a short warm-up time of one minute it is possible that the "Intens." control needs to be increased (rotate clockwise) or the sweep generator is not triggered. Also, the "Y-Pos." control may be incorrectly set. All knobs and switches should again be checked to ensure that the correct positions have been selected. Moreover, particular attention should be paid to the "Level" control. In the absence of an input signal the baseline will only be displayed if this control is in the fully anti-clockwise and locked position "AT" (Automatic Triggering). If only a spot appears (Caution! The CRT phosphor could be damaged under this condition.) probably the push button for "Hor. ext." is depressed. If this is so, it should be released. Now, the baseline should appear and the "Intens." control should be adjusted for average brightness, while optimum sharpness is obtained by adjusting the "Focus" control. At the same time the push button marked "GD" should be depressed. In this position the input to the vertical amplifier is shorted preventing the introduction of unwanted signals. It should be noted that in the "GD" position any signal applied to the vertical input is not shorted, therefore preventing damage to the circuit under investigation.

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Type of Signal Voltage

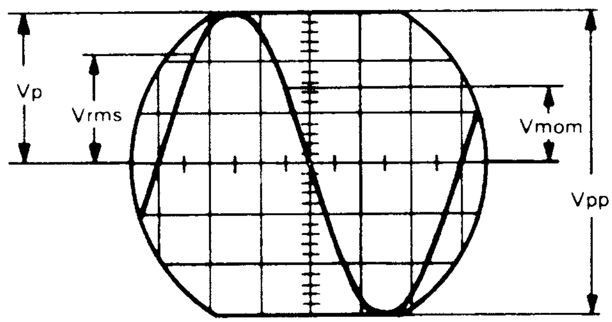
Any signal whose frequency spectrum is below 10MHz can be displayed on the HM307. The display of simple electrical processes such as sinusoidal RF and AF signals or 50Hz ripple voltages poses no problems. However, when square or pulse shaped signals are displayed it must be remembered that their harmonic content must also be transmitted. Therefore, when displaying this type of signal the bandwidth of the vertical amplifier must be considerably higher than the repetition frequency of the signal. An accurate evaluation of such signals with the HM307 is therefore only possible with signals up to a maximum of 1 MHz repetition rate. Greater problems can occur when composite signals are to be displayed, especially if they do not contain any suitable level components at the repetition frequency which can be used for triggering. This occurs, for example, with burst signals. To obtain a reliably triggered display in this case, it may be necessary to use the timebase fine control. Television video signals are relatively easy to trigger at line frequency. However, when investigating signals at frame frequency, the "Level" control should be used with extreme care to find the correct trigger point, it may also be necessary to use the timebase variable control.

For optional operation as an AC or DC voltage amplifier, the vertical amplifier is provided with an "AC/DC" push button. The DC range should only be used if the acquisition of the DC voltage content of the signal is absolutely necessary. However, when investigating very low-frequency pulses, disturbing ramp-offs may occur with AC coupling. In this case, if the signal voltage is not superimposed on a high DC voltage level, DC coupling (push button depressed) is to be preferred. In other cases, a capacitor of adequate capacitance, to block the DC level, must be connected before the input to the vertical amplifier (with DC coupling). This capacitor must have a sufficiently high breakdown voltage. DC voltages are always measured in the "DC" position. DC operation is also recommended for the display of logic and pulse signals, particularly if the duty cycle permanently changes during operation. Otherwise the display will move up and down with any change.

Amplitude Measurements

In general electrical engineering, alternating voltage data normally refer to effective values (rms = root-mean-square value). It is therefore important to remember that the signal magnitudes and voltage designations in oscilloscope measurements always refer to the peak-to-peak voltage (Vpp). The latter corresponds to the real potential difference between the most positive and most negative points of a signal wave-form.

If a sinusoidal wave-form displayed on the oscilloscope screen is to be converted to its effective (rms) value, the resulting peak-to-peak value must be divided by $2 \times \sqrt{2} = 2.83$. Conversely, it should be observed that sinusoidal voltages indicated in Veff (Vrms) have 2.83 times the potential difference in Vpp. The relationship between the different voltage magnitudes can be seen from the following figure.



Voltage values of a sine curve
Vrms = effective value; Vp = simple peak or crest value
Vpp = peak-to-peak value; Vmom = momentary value

The minimum signal voltage required on the vertical input for a display of 1 cm amplitude is 5mVpp. However, smaller signals can be displayed. The deflection coefficients on the input attenuator, designated by "Y-AMPL.", are indicated in mV/cm or V/cm. The magnitude of the applied voltage is ascertained by multiplying the selected deflection coefficient by the display amplitude in cm. If an attenuator probe X10 is used, a further multiplication by 10 is required. With direct connection to the Y input signals up to 120Vpp may be displayed. If the applied signal is superimposed on a DC (direct voltage) level the total value (DC + peak value of the alternating voltage) of the signal on the input must not exceed ±500V. The same limit applies to normal attenuator probes X10, the attenuation ratio of which allows signal voltages up to approximately 1,000Vpp to be evaluated. Voltages up to approximately 3,000Vpp may be measured by using the HAMEG type HZ37 high voltage probe which has an attenuation ratio of 100:1. If a normal X10 probe is used to measure higher voltages there is the risk that the compensation trimmer bridging the attenuator series resistor will break down, causing damage to the vertical input circuit of the oscilloscope. However, if for example only the residual ripple of a high voltage signal is to be displayed on the oscilloscope, a normal X10 probe is sufficient. It is important to remember that in this case an appropriate high voltage capacitor (approx. 22-68nF) must be connected in series with the input tip of the probe.

Time Measurements

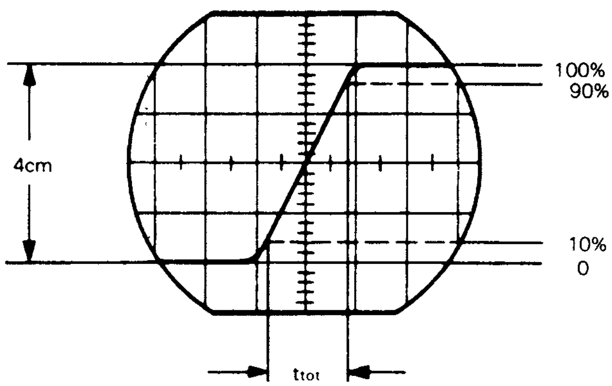
Generally all signals to be displayed are periodically repeating processes and can also be designated as periods. The number of periods per second is the recurrence frequency or repetition rate of the signal. One or more signal periods or even part of a period, may be shown as a function of the adjustment of the "TIMEBASE" switch. Its time coefficients are indicated in ms/cm and µs/cm. Accordingly, the dial is subdivided into two sectors. The duration of a signal period or portion of the wave-form is ascertained by multiplying the relevant time (in cm) by the time coefficient selected on the "TIMEBASE" switch. The time fine control marked "Variable" must be in its calibrated position for accurate measurement (control fully anti-clockwise, arrow pointing to the left).

The timebase sweep speed can be increased by a factor of at least 2.5 by rotating the "Variable" control fully clockwise. In this case it should be remembered that the ascertained time values have to be divided by 2.5 to 3.

When investigating pulse or square wave-forms the critical feature is the risetime of the voltage step. To ensure that transients, ramp-offs, and bandwidth limits do not unduly influence the measuring accuracy, the risetime is generally measured between 10% and 90% of the vertical pulse height. When possible the amplifier controls should be adjusted so that the pulse is precisely aligned with two horizontal graticule lines preferably 4cm apart, as shown in the accompanying figure. The risetime is given by the product of the horizontal distance in cm between the 10% and 90% points, and the time coefficient setting. If the variable on the timebase has been used, this product must be divided by 2.5 to 3. The fall time of a pulse can also be measured by using this method. When very fast risetimes are being measured, the risetime of the oscilloscope amplifier has to be deducted from the measured time value geometrically. The risetime of the signal can be calculated using the following formula:

$$t_r = \sqrt{t_{tot}^2 - t_{osc}^2}$$

In this formula t_{tot} is the total measured risetime, and t_{osc} is the risetime of the oscilloscope amplifier (approx. 35ns). If t_{tot} is greater than 250ns, then t_{tot} can be taken as the risetime of the pulse, and calculation using the above formula is unnecessary. The optimum vertical display position and the interrelation of the risetime measuring range to the complete signal amplitude are shown in the following figure.



Connection of the Test Signal

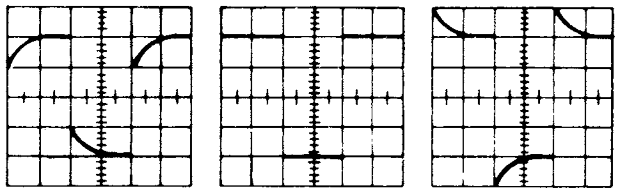
The signal to be displayed should be fed to the vertical input of the oscilloscope by means of a screened test cable, such as the HZ32 or HZ34, or by a X10 attenuator probe. The use of screened cables with high impedance circuits is only recommended for relatively low frequencies (up to approx. 50kHz). For higher frequencies, and when the signal source is of low impedance, a cable of matched characteristic impedance (usually 50Ω) is recommended. In addition, and particularly when investigating square and pulse wave-forms a resistor equal to the characteristic impedance of the cable must also be connected to the cable at the vertical input of the oscilloscope. When using a 50Ω cable such as the HZ34, a 50Ω through-termination HZ22 is available from HAMEG. When investigating square or pulse wave-forms with fast risetimes, transient phenomena on both the edge and top of the signal may become visible if the correct termination is not used. It must be remembered that the 50Ω through-termination will only dissipate a maximum of 2 watts. If a X10 attenuator probe (i. e. HZ30) is used, no termination is necessary. In this case, the connecting cable is matched directly to the high-impedance input of the oscilloscope. With attenuator probes, even high--internal-impedance sources are only slightly loaded (by approx. 10MΩ//11pF). Therefore, when the voltage loss due to the attenuation of a probe can be compensated by a higher sensitivity setting on the HM307, the probe should always be used. Additionally, the series impedance of the probe also provides a certain degree of protection for the input of the oscilloscope amplifier. It should be noted that all attenuator probes must be compensated in conjunction with the oscilloscope amplifier in use.

It is important to remember that for the display of small signal voltages the position of the ground point on the test circuit can be critical. It should always be located as close as possible to the measuring point, if this is not done serious signal deformation may result from any vagabond currents through the ground leads or test chassis parts. This also applies to ground leads of attenuator probes which ideally should be as short and as thick as possible.

If after connecting the test signal the trace disappears from the display area, this may be caused by the test signal's amplitude being too great for the sensitivity set on the vertical amplifier i. e. the amplifier is overscanned. In this case, the "Y-AMPL." switch should be turned anti-clockwise, until the vertical deflection is only 3-5cm. For signal amplitudes greater than 120Vpp a X10 probe should always be used. If after connecting the signal the intensity of the trace is low, it is possible that the period of the test signal is substantially lower than the value set on the "TIMEBASE" switch. In this case the control should be turned anti-clockwise to a corresponding slower time coefficient.

Probe Adjustment

For the undistorted display of signals when using an attenuator probe the probe must be compensated to match the input impedance of the vertical amplifier. This can be easily achieved as the HM307 has a built-in square-wave generator with a repetition frequency of approx. 1kHz and an output voltage of 0.2Vpp ±1%. The method employed to achieve compensation is as follows. The probe tip is connected to the "Calibrator" output, marked with a square-wave, located in the vertical amplifier section of the instrument. Adjust the probe trimmer using the trimming tool supplied, and set the top of the wave--form according to the centre figure.



incorrect correct incorrect

The "TIMEBASE" switch should be in the "0.2ms/cm" position. If the "Y-AMPL." switch is set to "5mV/cm", the display will have a height of 4cm (X10 probe). Since an attenuator probe is constantly subjected to considerable stresses, the compensation should be checked frequently.

Trigger and Timebase

Timebase operation is particularly important in obtaining a satisfactory stable display. If the "Level" control is in the "AT" position (control fully anti--clockwise), the sweep generator will be triggered automatically. In this position a baseline will be visible even in the absence of a signal voltage. In this automatic trigger mode practically all uncomplicated, periodically recurring signals above 30Hz repetition frequency can be displayed in a stable locked-in condition. Operation of the timebase is then restricted mainly to adjusting the time coefficient setting.

To obtain a stable display, the timebase must be triggered synchronously with the applied signal. Triggering can be initiated by the signal itself or by a different, externally applied voltage, which must also be in synchronism. External triggering is selected by depressing the push button marked "Trigg. ext.", the external triggering signal should be applied to the input marked "Inp. ext.". Triggering can be selected from either the rising or falling edge of the applied signal by using the push button marked "+/—", in the out position triggering is from the rising edge, or positive-going slope, of the trigger signal.

As already described, uncomplicated signals may be triggered automatically, i. e. without manual operation of the "Level" control. The repetition rate may also vary in such cases. However, if the pulse duty factor of a square signal changes drastically, and a part of this square-wave deforms to a needle pulse, the operation of the "Level" control may well become necessary. With composite signals, the trigger facility is dependent on the occurence of certain periodically recurring levels. The "Level" adjustment of these signals will require care. If no triggering point can be found on complex signals even after repeated and careful adjustment of the "Level" control, it may be possible to obtain a stable display by adjusting the timebase "Variable" control. Sometimes it can also be advantageous to leave the "Level" control in the "AT" position and to use only the "Variable" control.

All coefficient settings on the "TIMEBASE" switch are calibrated when the "Variable" control is set in the "C" position (control fully anti-clockwise). With the "Variable" control in the right hand stop position the sweep rate is increased by a factor of at least 2.5, this factor is not precisely calibrated. However, a maximum sweep speed of approx. 0.2µs/cm is obtained when the "TIMEBASE" switch is set at 0.5µs/cm. The choice of the optimum time coefficient depends on the repetition rate of the signal being measured. The number of cycles displayed will increase with an increase of the time coefficient.

X-Y operation can be achieved by depressing the push button marked "Hor. ext.", and connecting the horizontal (X) signal to the "Inp. ext." socket. The horizontal amplifier is AC coupled, with a sensitivity of approximately 0.75V/cm. A 10:1 attenuator probe (e. g. HZ30) is required if an input voltage of more than 5Vpp is applied to the horizontal amplifier.

Component Tester

With the help of this built-in tester, semiconductors, capacitors, inductors and resistors can be very easily tested. Also, integrated circuits may be checked to a certain extent. The test-result is displayed on the screen of the oscilloscope. The component under test can be either in or out of a circuit. However, when the component under test is situated in highly complex circuitry the test result may not always be clear, this is due to the effects of the other components, and stray capacitances, in the test circuit. This problem may be overcome by comparing the result obtained from the circuit under test with the results obtained from a similar circuit which is known to be fully operative.

The component tester facility is selected by depressing the "GD" switch on the HM307. In this mode the only controls which function are the "Intens.", "Focus", "X-POS." and "Y-POS." controls. To use the tester only two leads with 4mm banana plugs are required, these are connected to the sockets marked "CT". If necessary these may be obtained from HAMEG under the designation type HZ56. It is also possible to insert the component directly into the component tester sockets. When a component is being tested in circuit it should be disconnected from earth and any power supply (as the test circuitry of the HM307 is already connected to the safety earth). If this is not done then damage could be caused, also incorrect results may be obtained.

When semiconductor devices are tested several variations of indication are possible. However, the main characteristic displayed during these tests is the voltage-dependent knee caused by the junction changing from the conducting to the non-conducting state or vice versa. Three different types of test are possible on transistors as follows: base-emitter, base-collector, emitter-collector.

Normally diodes display the same characteristic as base-emitter junctions (see Test Patterns). The test applied to the transistor junction is non-destructive, as the test voltage applied to this device is limited to a few volts. Difficulty may be experienced if a transistor junction has a breakdown voltage which is higher than the voltage applied by the component tester, for example with high voltage diodes or zener diodes with a breakdown voltage above 8 volts. However, it will normally be found that with a defect there are major differences within the circuitry under test, which give a definite indication of the faulty component.

The component tester can also be used for testing capacitors and inductors. In this mode an elliptical display is obtained as the voltage and current are not in phase, the ellipse will be more or less inclined with a different width is dependent upon the value of the component under test. Capacitors with values between 10nF and 100nF can still be evaluated with the tester. A more precise measurement can be obtained by comparing the result obtained with that obtained for a known value of capacitance.

When testing resistors, the current and voltage have the same phase. Therefore, the test results are displayed on the screen by a straight line which will be inclined from the horizontal depending upon the value of the resistor. Using the component tester an approximate evaluation for resistors up to 50kΩ is possible. The determination of the actual value of the conponent will come with experience, or by direct comparison with a component of known value.

A vertical line is displayed if the component under test has a short-circuit. Conversely a horizontal line is displayed if the component under test is open circuit, or the input to the tester is disconnected.

Maintenance

Within the context of maintenance of the instrument, it is recommended that some of the important features and characteristics of the HM307 are periodically checked. The following Test Instructions indicate only those tests, which can be performed without the use of expensive ancillary instruments.

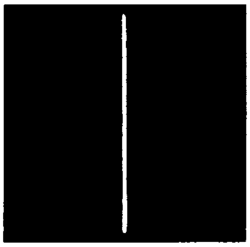
For more exacting tests the HAMEG Oscilloscope Calibrator HZ62 is available. This instrument can be used to check the performance of many commercially available oscilloscopes. The HZ62 is also recommended for the maintenance of large numbers of oscilloscopes.

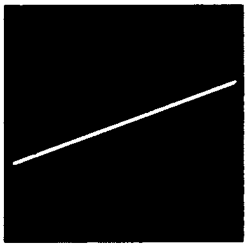
Accessories

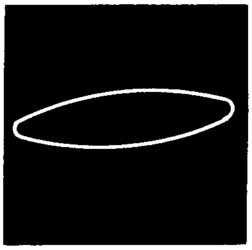
Each HAMEG oscilloscope is supplied with an instruction manual only. However, a wide range of accessories which include test cables and probes are available and should be ordered according to the particular application.

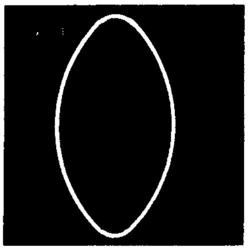
TEST PATTERNS

Single Components

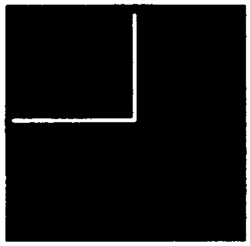

Short circuit

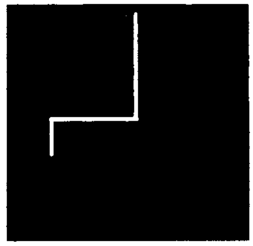

Resistor 510Ω

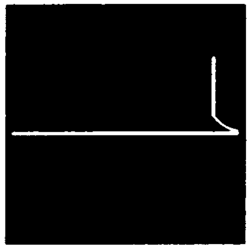

Mains transformer prim.

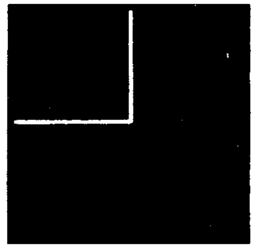

Capacitor 33μF

Single Transistors

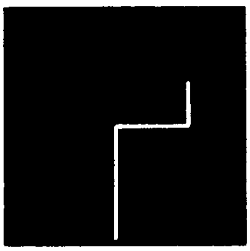

Junction B-C

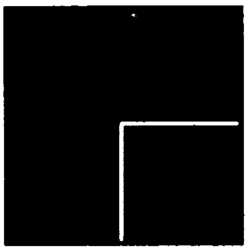

Junction B-E

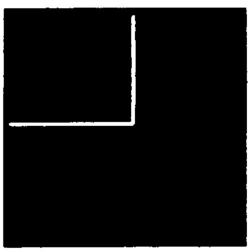

Junction E-C

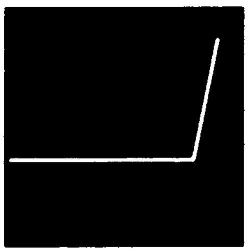

FET

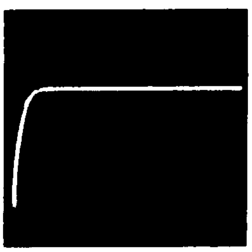
Single Diodes

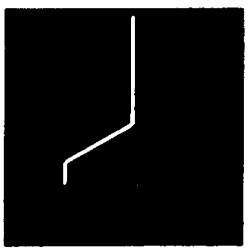

Z-diode under 8V


Z-diode beyond 12V

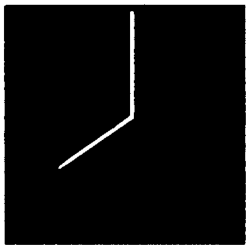

Silicon diode

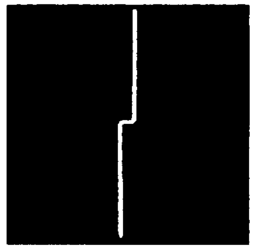

Germanium diode

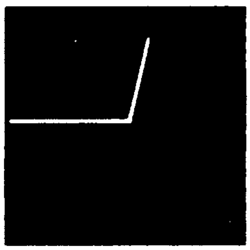

Rectifier

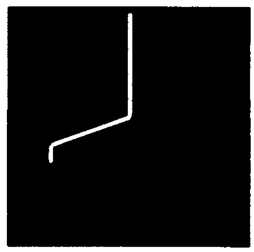

Thyristor G + A together

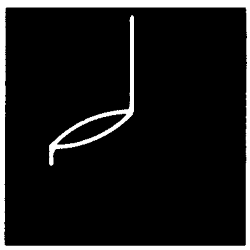
In-circuit Semiconductors

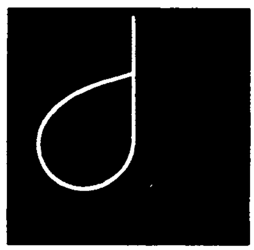

Diode paralleled by 680Ω


2Diodes antiparallel


Diode in series with 51Ω


B-E paralled by 680Ω


B-E with 1μF + 680Ω


Si-diode with 10μF

SHORT INSTRUCTIONS FOR HM 307-3

First Time Operation

Connect instrument to mains supply. Switch on power switch at the "**Intens.**" control. Light emitting diode indicates operating condition. Case and chassis of instrument are connected to ***Safety Earth*** contact of power plug.

No button is depressed; "**Level**" control is set to "**AT**" (Automatic Triggering).

Adjust medium brightness with "**Intens.**" control, adjust trace to graticule centre with controls "**X-Pos.**" and "**Y-Pos.**". Then focus trace.

Measuring

Connect test signal to "**Y-Input**" connector.

Adjust attenuator probe with built-in square-wave ***calibrator***.

Input coupling to be switched to "**AC**" or "**DC**".
With button "**GD**" depressed, the Y-amplifier input is short circuited, and the instrument is also switched for tester operation.

Adjust required display height of signal with "**Y-AMPL.**" switch.

Select sweep rate with "**TIMEBASE**" switch.
Time measurement with "**Variable**" control at left stop ("**C**").

Trigger complicated signals if necessary with "**Level**" and possibly the "**Variable**" control.

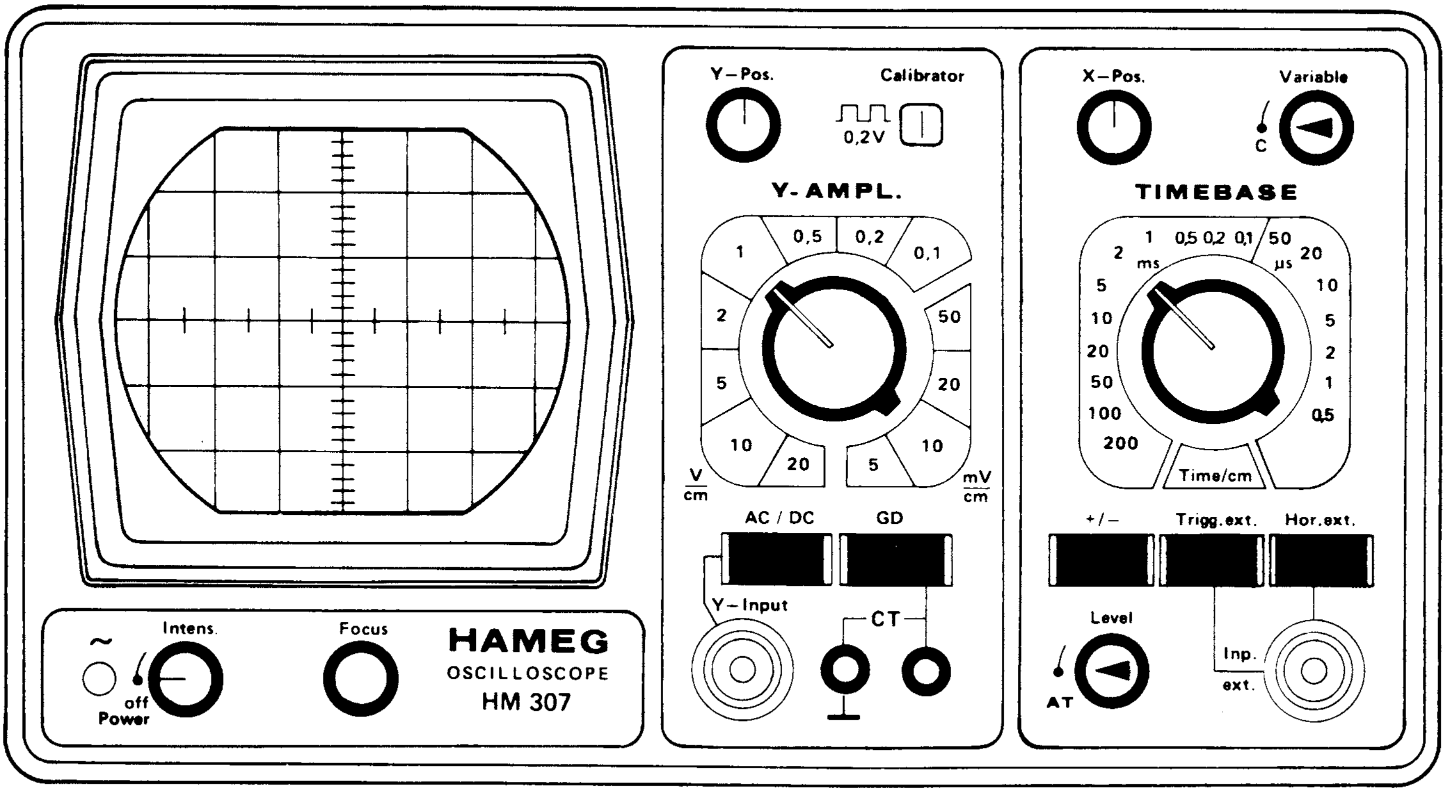
Slope selection with button "**+/—**".

For ext. triggering, signal (0.5 ...5Vpp) to "**Inp. ext.**" connector; button "**Trigg. ext.**" depressed.

Ext. horizontal deflection (X-Y operation) with button "**Hor. ext.**"; X-signal to "**Inp. ext.**" connector.

For tester operation depress button "**GD**", connect test cables to the "**CT**" (Component Tester) sockets.

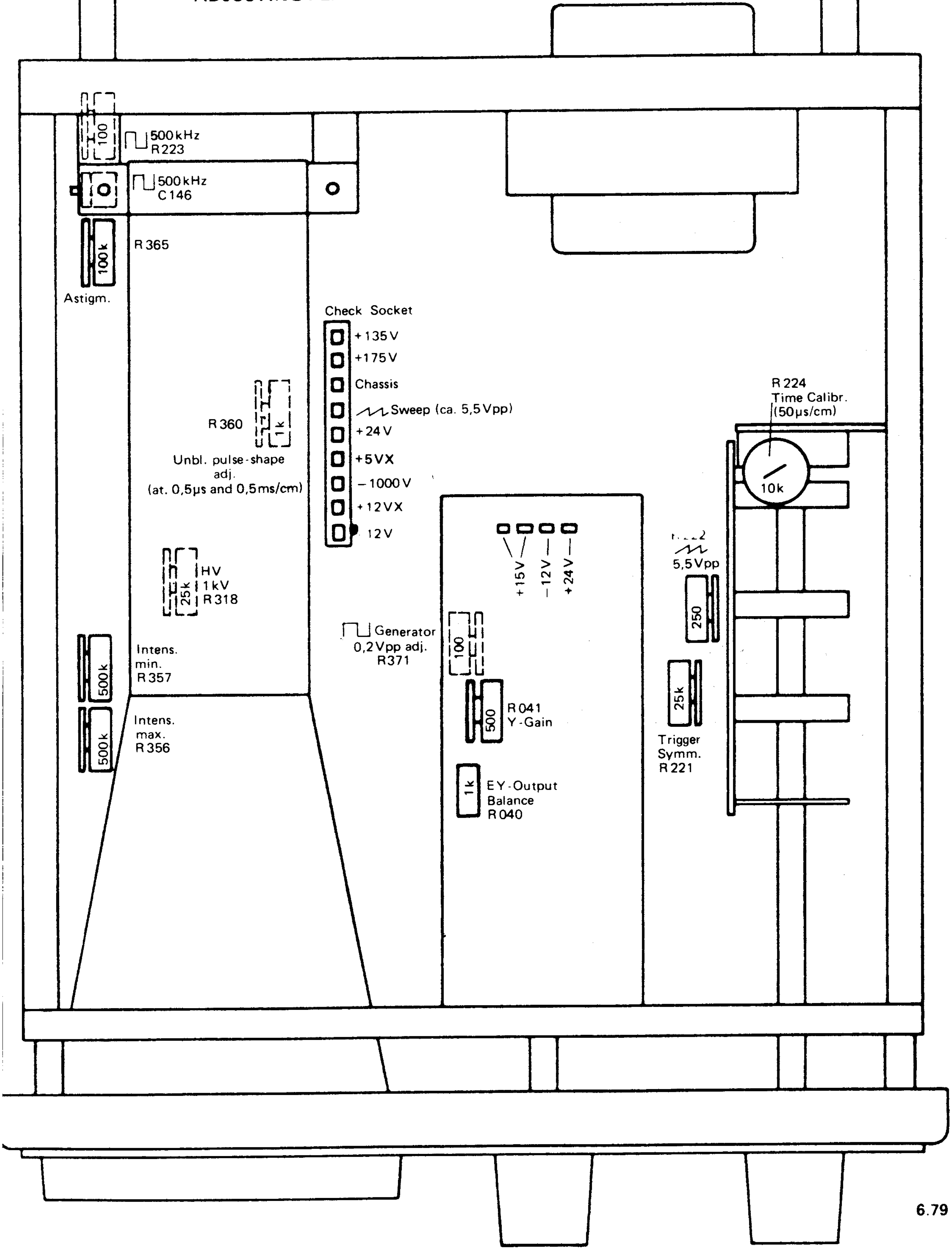
With ***in-circuit*** tests, de-energize and disconnect device under test.



Y–Pos.
Calibrator
0,2V
Y-AMPL.
1
0,5
0,2
0,1
2
50
5
20
10
20
5
10
V/cm
mV/cm
AC / DC
GD
Y–Input
CT
X–Pos.
Variable
C
TIMEBASE
2
1
ms
0,5 0,2 0,1
50
µs
20
5
10
10
5
20
2
50
1
100
0,5
200
Time/cm
+/–
Trigg.ext.
Hor.ext.
Level
AT
Inp.
ext.
Intens.
Focus
off
Power
HAMEG
OSCILLOSCOPE
HM 307

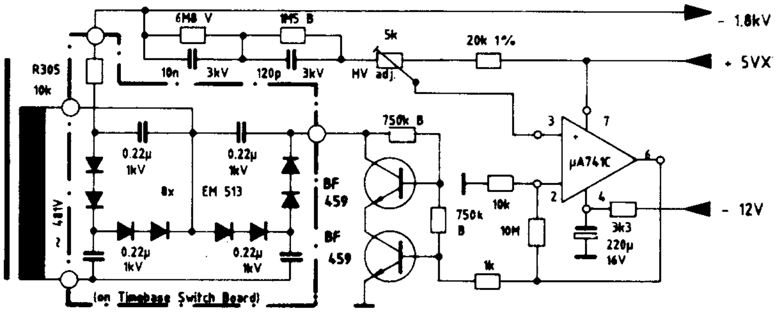
FRONT VIEW

ADJUSTING PLAN HM 307-3

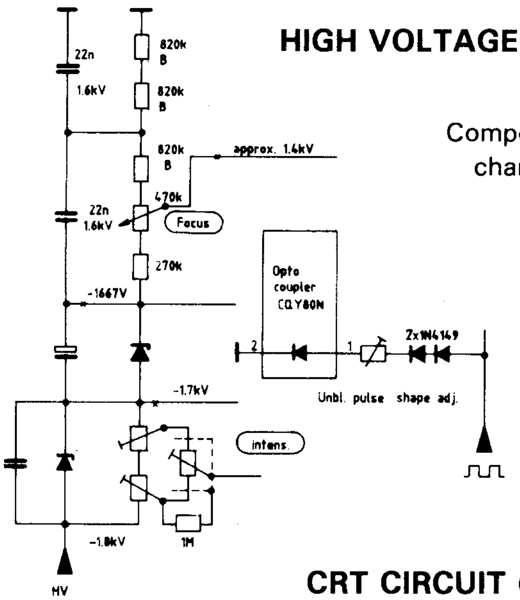


MANUAL CHANGE INFORMATION HM307-4 (30.10.81)

For better display brightness, the type of the CRT (now **C 312 P1**) and the level of the high voltage (now **−1700V** on the CRT's cathode) have been changed. To obtain this improvement some other correctional measures are necessary, as specified below.



HIGH VOLTAGE GENERATION AND REGULATION



Components without value data are not changed (see HM307-3 diagrams).

CRT CIRCUIT (partially)

CHANGE	DESCRIPTION
Diagram: **Y-FINAL AMPLIFIER**	
R192 (1k2 is dropped)	**R192: 1k5** (new)
C145 (110pF is dropped)	**C145: 68pF** (new)
Diagram: **TIMEBASE SWITCH UNIT**	**2 Diodes 1N4149** in series between +24VX and T-Variable (rd). Anode to +24VX, cathode to T-Variable (rd). Now C128 0.1µF from T-Variable (rd) to base T106.
Diagram: **Y-PREAMPLIFIER**	
R037 (680Ω is dropped)	**R037: 1kΩ** (new)

General

These Test Instructions are intended as an aid for checking the most important functions and characteristics of the HM307 at regular intervals without the need for expensive test equipment. Any corrections and adjustments that are required inside the instrument, resulting from such tests, are described in the Service Instructions. This work should, however, only be carried out by properly qualified personnel. As with first time operation, care should be taken that all knobs with arrows are set to their calibrated position (''Level'' control to ''AT'' position). None of the push buttons should be depressed. Please note that the operating voltage on the cathode-ray tube is approximately 1 kV.

This high voltage potential is on the CRT socket, and on the horizontal PCB underneath the CRT. It is recommended that the oscilloscope is switched on approx. 15 minutes before the following tests are carried out.

Cathode-Ray Tube: Brightness and Focus

Normally, the CRT of the HM307 has good brightness. Any reduction on the latter can only be judged visually. A certain loss of sharpness at the edges is unavoidable, this is due to the manufacturing process of the CRT. However, decreased brightness may be the result of reduced high voltage. This is easily recognized by the greatly increased sensitivity of the oscilloscope amplifier. The control range for maximum and minimum brightness must be such that the beam just disappears before reaching the left-hand stop of the ''Intens.'' control, while with the control at the right-hand stop the focus is just about acceptable. The fly-back must on no account be visible. It should be noted that with wide variations in brightness, re-focusing is always necessary. Moreover, with maximum brightness, no ''pumping'' of the display must occur. The latter phenomenon means that the high voltage stabilization is faulty. The R-trimmers for high-voltage, minimum and maximum intensity are only accessible from inside the instrument (see Adjusting Plan).

Astigmatism Check

It should be checked that horizontal and vertical sharpness of the display are equally focused. This is best seen by displaying a high frequency square-wave signal (approx. 1 MHz). Another method is to check the shape of the spot. This can be achieved with the Y-input switched off (position ''GD'') and the ''Hor. ext.'' push button depressed. The focus control is then turned to and fro around the optimum focusing point. The shape of the luminous spot, whether round or oval, must stay the same to the right and left of the optimum focusing point. An R-trimmer of 100kΩ(see Adjusting Plan) is provided inside the instrument for the correction of astigmatism (vertical sharpness).

Symmetry and Drift of the Vertical Amplifier

A check of the Y-Symmetry is possible by means of the control range of the ''Y-Pos.'' control. A sine-wave signal of 10-100kHz is applied to the Y-Input. When the ''Y-Pos.'' control is then turned fully in both directions from stop to stop with a display height of approx. 6cm, the upper and lower visible portions should be approximately equal. Differences of up to 1 cm are still permissible (signal coupling set to ''AC''). Possible faults and correction of the symmetry are described in the Service Instructions. Checking the drift is relatively simple. Fifteen minutes after switching on the instrument, set the deflected beam (time axis) exactly on the horizontal centre line of the graticule. The beam position must not change by more than 5mm during the following hour. Larger deviations generally result from different characteristics of the two FET's in the input to the Y-Amplifier. To some extent, fluctuations in drift are caused by offset current on the gate. The drift is too high, if the vertical trace position drifts by more than 0.5mm on turning the ''Y-AMPL.'' switch through all twelve steps. Sometimes such affects occur only after long periods of operation. Further information can be found in the Service Instructions.

Calibration of the Vertical Amplifier

A square-wave voltage of 200mVpp is present at the calibrator output located in the vertical amplifier section of the HM307. This signal has a tolerance of 1%. If a direct connection is made between the calibrator output and the input of the vertical amplifier, the displayed signal in the 50mV/cm position should be 4cm high. Deviations of maximum 1mm (2.5%) are permissible. If a probe (10:1) is connected between the calibrator output and Y-Input, the same display height should result in the 5mV/cm position. If deviations greater than 1mm are measured then it should be investigated first, whether the cause lies within the amplifier or in the amplitude of the square-wave signal. On occasions it is possible that the probe is faulty or incorrectly compensated. If necessary, the vertical amplifier can be calibrated with an accurately known DC voltage (DC input coupling). The trace position should then vary in accordance with the deflection coefficient set. Adjustment of the measuring amplifier sensitivity or the calibrator voltage is only possible from within the instrument. According to experience, this is rarely necessary.

Transmission Performance of the Vertical Amplifier

The transient response can only be checked with the aid a square-wave generator with a fast risetime (max. 5ns). The test cable must be terminated at the vertical input of the oscilloscope with a resistor equal to the characteristic impedance of the cable. Checks should be made at 50Hz, 500Hz, 5kHz, 50kHz, and 500kHz. In so doing, the square pulses must have a flat top without ramp-off, spikes and glitches; no overshoot is permitted especially at 500kHz and a display height of 4cm. At the same time, the front corner of the pulse must not be rounded. It is recommended that these checks are carried out with the deflection coefficient set at 5mV/cm with DC input coupling. In general, no great changes occur after the instrument has left the factory, and therefore the application of this test is left to the user's discretion.

Certainly the quality of the transmission performance is not only dependent on the vertical amplifier. The input attenuator, located in the front of the amplifier, is frequency-compensated for each step. Even small capacitive changes can reduce the transmission performance. Faults of this kind are as a rule most easily detected with a square-wave signal of low repetition rate (e. g. 1kHz). If a suitable generator with max. output of 40Vpp is available, it is advisable to check at regular intervals the deflection coefficients on all positions of the input attenuator and readjust them as necessary. Adjustment should be carried out in accordance with the Service Instructions. A compensated 2:1 series attenuator is then necessary, too, and this must also be matched to the input impedance of the oscilloscope. This attenuator can be made-up locally or ordered from HAMEG under the Type No. HZ23 (see accessory data). It is important that this attenuator is screened. For local manufacture, the electrical components required are a 1MΩ ±1% resistor, and, in parallel with it, a trimmer 3-15pF in parallel with approx. 20pF. One side of this parallel circuit is connected directly to the input connector of the vertical amplifier while the other side is connected to the test cable from the generator. The test cable should preferably be a low-capacitance coaxial cable. The series attenuator must be matched to the input impedance of the oscilloscope in the 5mV/cm position (DC input coupling; square tops exactly horizontal; no ramp-off is permitted). This is achieved by adjusting the C-trimmer. The shape of the square-wave should be the same for each input attenuator position.

Triggering Checks

The trigger threshold is important as it determines the display height from which a signal will be stably displayed. It should be approx. 3mm for the HM307. An increased trigger sensitivity creates the risk of response to the noise level in the trigger circuit itself. This can produce dephased double images. Alteration of the trigger threshold is only possible from inside the instrument. Checks can be made with any sine-wave voltage between 50Hz and 1MHz. The "Level" control can therefore be in the "AT" position. Then it should be ascertained whether the same trigger sensitivity is also present with the "Level" control in manual operation. On depressing the "+/−" push button, the trigger polarity changes from the positive-going to the negative-going edge of the trigger signal. The HM 307 should trigger on sinusoidal signals up to 30MHz at a display height of approximately 5mm.

Sweep.

Before checking the timebase, it should be ascertained that the trace length is approximately 7cm. If not, it must be corrected by adjusting the R-trimmer designated Sweep Amplitude. This adjustment should be made with the "TIMEBASE" switch in a mid-range position (i. e. 50µs/cm).

If no exact marker is available for checking the timebase time coefficients, a precisely calibrated sine-wave generator may be used. Its frequency tolerance should not be greater than ±1%. The time values of the HM307 are given as being ±5%, but as a rule these are considerably better. For the simultaneous checking of timebase linearity at least 7 oscillations, i. e. 1 cycle every cm, should always be displayed. For exact determination set the peak on the first marker or cycle peak exactly behind the first vertical graticule line using the "X-Pos." control. Deviation tendencies can be noted after several marker or cycle peaks. The following table shows which frequencies are required for the particular timebase ranges. It should be noted that the timebase "Variable" control should be in the fully anti-clockwise position ("C").

200ms/cm —	5Hz	200µs/cm —	5kHz
100ms/cm —	10Hz	100µs/cm —	10kHz
50ms/cm —	20Hz	50µs/cm —	20kHz
20ms/cm —	50Hz	20µs/cm —	50kHz
10ms/cm —	100Hz	10µs/cm —	100kHz
5ms/cm —	200Hz	5µs/cm —	200kHz
2ms/cm —	500Hz	2µs/cm —	500kHz
1ms/cm —	1kHz	1µs/cm —	1MHz
0.5ms/cm —	2kHz	0.5µs/cm —	2MHz

The 20 and 10ms/cm ranges can be checked very precisely with mains frequency (50Hz). On the 20ms/cm range one cycle will be displayed every cm, while on 10ms/cm it will be every 2cm.

It is recommended that an oscilloscope calibrator (HAMEG Type HZ62) is acquired, if the timebase is to be checked on a number of oscilloscopes on a regular routine basis. This instrument employs a quartz marker, providing peak pulses at 1cm intervals for each timebase range. It should be noted that on triggering such pulses the "Level" control must be used.

Miscellaneous

If a regulating mains transformer is available, the characteristics on mains voltage fluctuations should be checked between ±10% of the set rated voltage. Under these fluctuations no variations should show up on the CRT, either in the Y or the X direction.

For checking the performance of the component tester the button "GD" must be depressed. In this mode a 5-6cm long horizontal line must be visible on the screen. When both sockets, designated with "CT", are shorted, a vertical line will be displayed. Corrections are not possible. Wide deviations indicate that a fault condition exists.

The last four voltages are electronically stabilized. Only the —1000V voltage is adjustable. The variation of the fixed voltages greater than ±5% from the nominal value indicates a fault. These voltages are measured on the check socket with reference to ground on the main board (see Adjusting Plan). Measurements of the high voltage may only be accomplished by the use of a sufficient highly resistive voltmeter (≥10MΩ). You must make absolutely sure that the electric strength of the voltmeter is sufficiently high. For the correction of the high voltage there is a variable resistor of 25kΩ mounted under the CRT. It is recommended to check the ripple and also the interaction from other possible sources. Excessive values might be very often the reason for incomprehensible faults. The maximum ratings are specified on the circuit diagrams. For the measurement of the high voltage ripple you need a probe capable to withstand 1000V (e.g. X100 probe HZ37). But also a normal probe X10 is sufficient with a capacitor (10... 20nF 1000V) connected in series to the probe tip.

Maximum and Minimum Brightness

Two variable resistors of 500kΩ each, located under the CRT shield, are used for these adjustments (see Adjusting Plan). They may only be touched by a properly insulating screwdriver (Caution! High voltage.). The adjustments must possibly be repeated because the functions of both variable resistors are dependent on each other. Correct adjustment is performed when the trace can be blanked while "Hor. ext." push button is depressed and, in addition, the requirements described in the Test Instructions will be met.

Astigmatism Correction

The ratio of vertical and horizontal sharpness can be adjusted by the variable resistor of 100kΩ, located near to the CRT socket (see Adjusting Plan). As a precaution however, the voltage for the vertical deflecting plates (approx. +85V) should be checked before, because this voltage will affect the astigmatism control. While the adjustment is accomplished (with depressed button "Hor. ext."), the "Focus" control knob has to be repeatly turned to and fro until the shape of the luminous spot, wether round or oval, will stay the same to the right and left of the optimum focusing. The interaction of focus adjustment and astigmatism correction should be noted. After this adjustment, a square-wave signal should be displayed and be verified once more in accordance with the Test Instructions. The final adjustment has always to be the "Focus" control.

Trouble-Shooting the Instrument

For this job, there will be needed at least an isolating variable mains transformer (protection classification II), a signal generator, an adequate precise multimeter, and, if possible, an oscilloscope. This last item is required for complex faults which can be traced by the display of signal or noise voltages. As noted before, the stabilized high voltage and the supply voltage for the final stages (approx. 300V) are highly dangerous. Therefore it is recommended to use totally insulated extended probe tips when trouble-shooting the instrument. Incidental touches with dangerous voltage potentials are then unlikely. Of course, these instructions can not thoroughly cover all kinds of faults. Some common-sense will certainly be required when a complex fault has to be investigated.

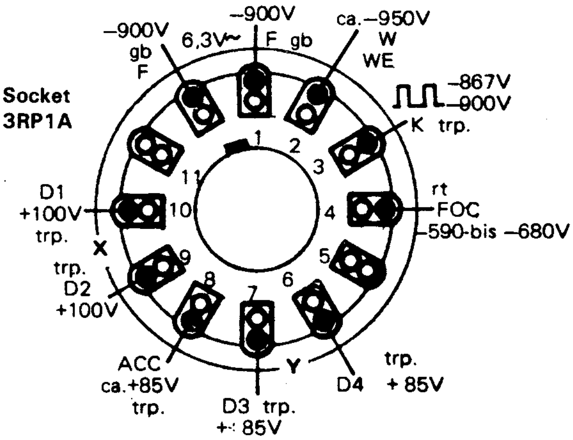
If the instrument fails completely the first and most important step will be to measure the deflecting plate voltages of the CRT. In almost any case, the faulty section can be located. The sections represent:

1. Vertical deflection.
2. Horizontal deflection.
3. CRT circuit.
4. Power supply.

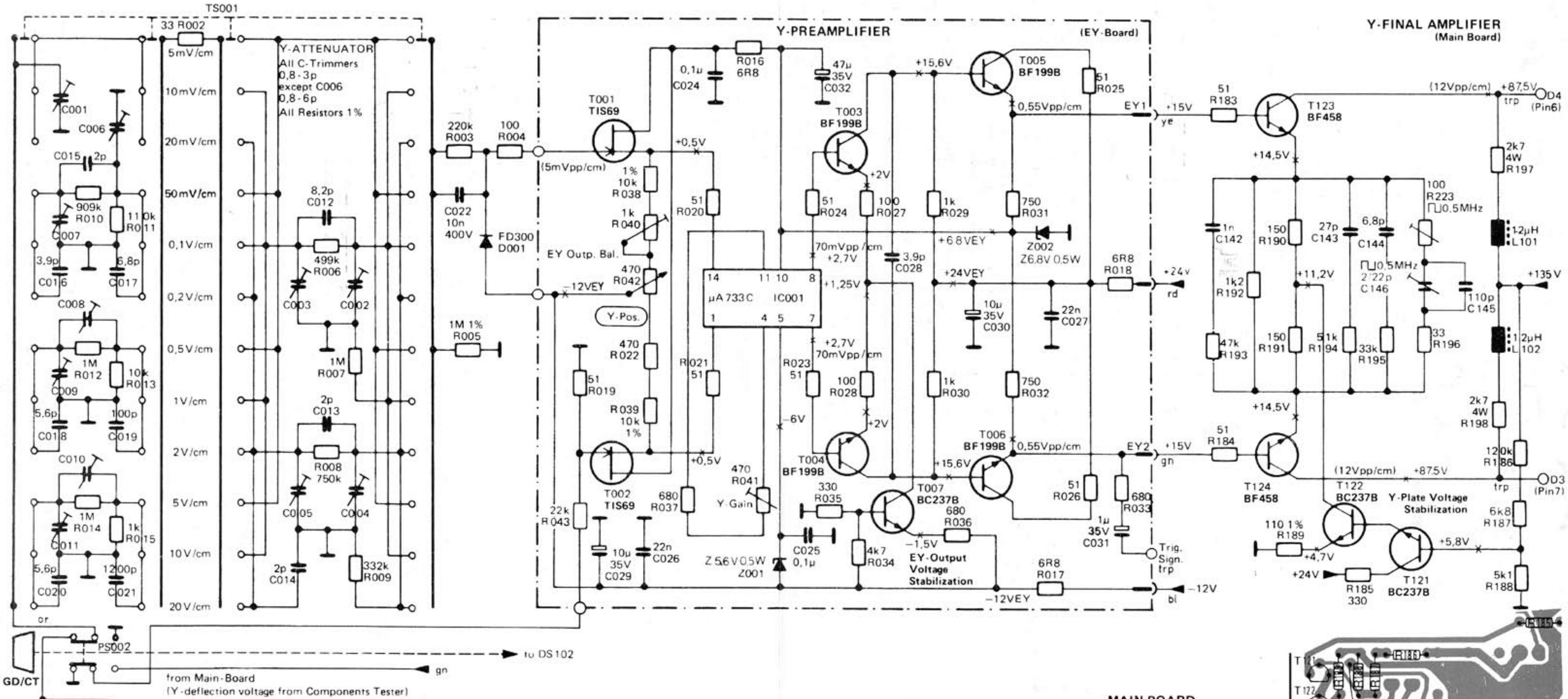
While the measurement takes place the position controls of both deflection devices must be in mid--position. When the deflection devices are operating properly the separate voltages of each plate pair are almost equal then (Y = 81-89V and X = 95-105V). If the separate voltages of a plate pair are very different the associated circuit must be faulty. An absent trace in spite of correct plate voltages means a fault in the CRT circuit. Missing deflecting plate voltages is probably caused by a defect in the power supply.

HAMEG

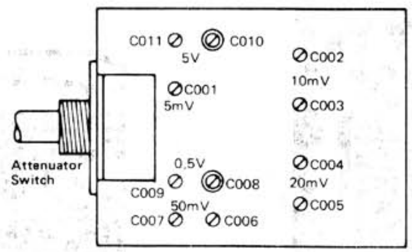
Socket
3RP1A



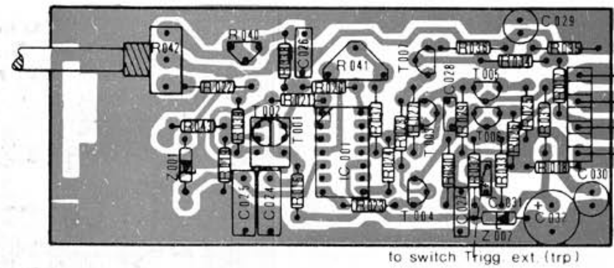
Y-INPUT, ATTENUATOR, Y-PREAMPLIFIER, TRIGGER PICK-OFF AND Y-FINAL AMPLIFIER UNIT



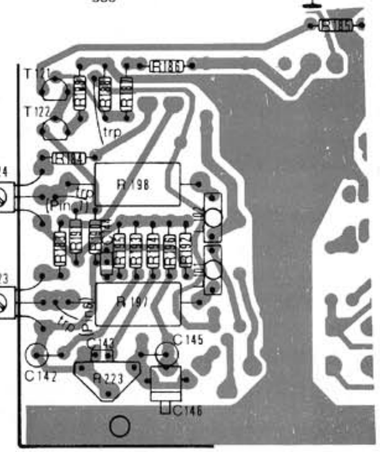
ADJUSTING LOCATIONS ATTENUATOR



COMPONENT LOCATIONS EY-BOARD



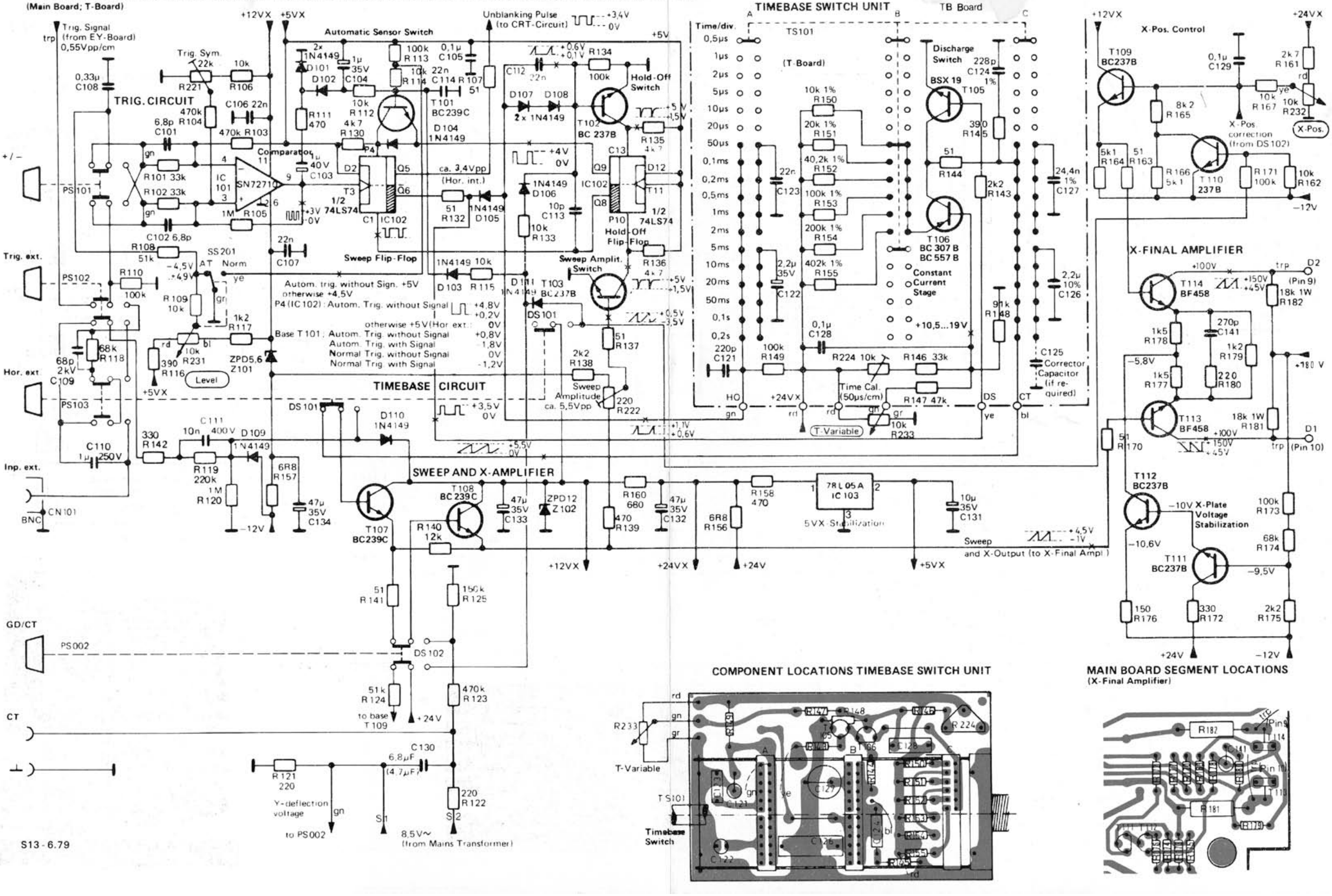
MAIN BOARD SEGMENT LOCATIONS
Y-Final Amplifier



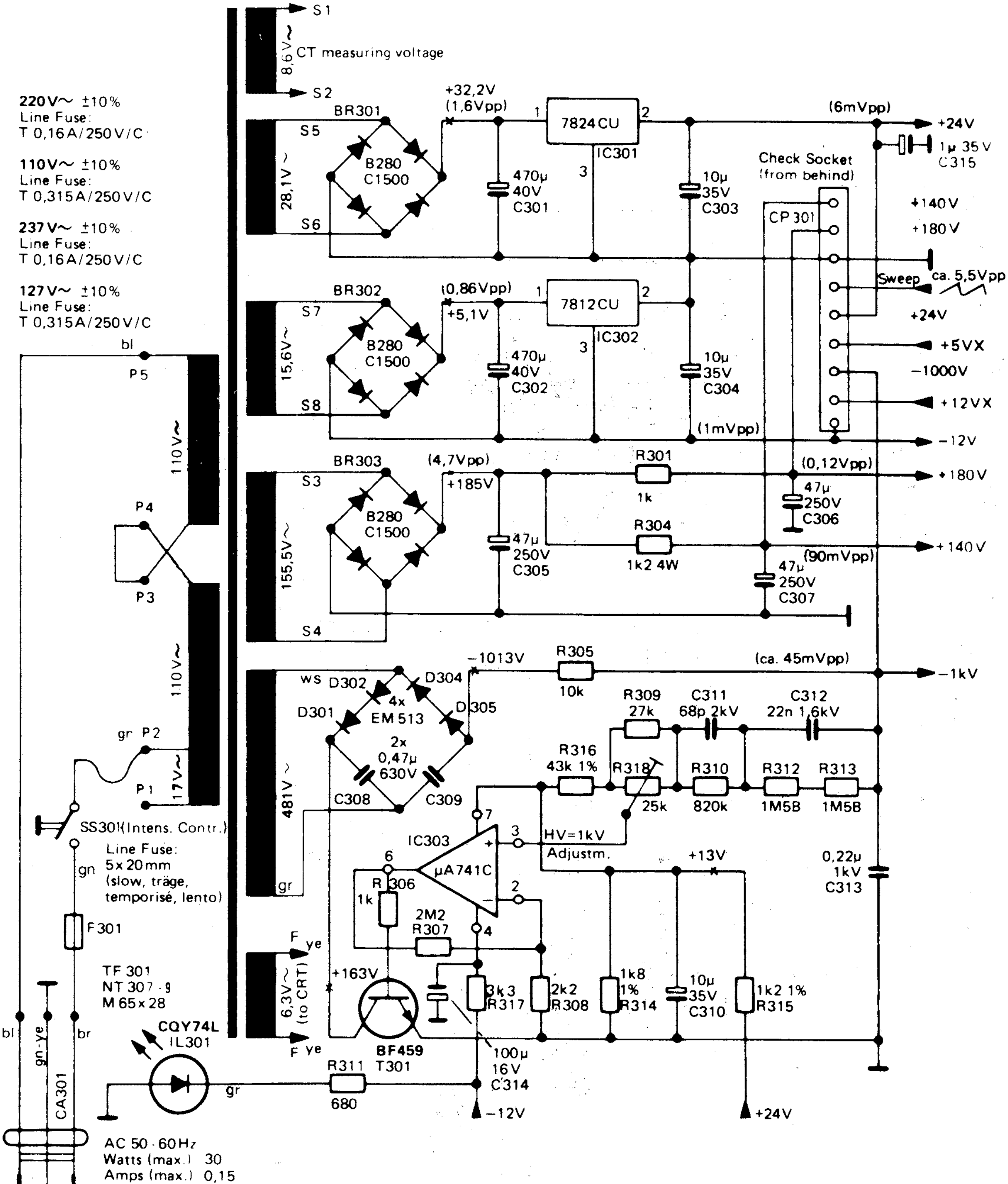
S12-6.79

TIMEBASE AND TRIGGER CIRCUIT, TIMEBASE SWITCH, SWEEP AND X-AMPLIFIER, X-FINAL AMPLIFIER

(Main Board; T-Board)



S13-6.79



CT measuring voltage
8,6V~
S1
S2
220V~ ±10%
Line Fuse:
T 0,16A/250V/C
110V~ ±10%
Line Fuse:
T 0,315A/250V/C
237V~ ±10%
Line Fuse:
T 0,16A/250V/C
127V~ ±10%
Line Fuse:
T 0,315A/250V/C
BR301
S5
28,1V~
S6
B280 C1500
+32,2V (1,6Vpp)
470µ 40V C301
7824CU
IC301
10µ 35V C303
(6mVpp)
+24V
1µ 35V C315
Check Socket (from behind)
CP 301
+140V
+180V
Sweep
ca. 5,5Vpp
+24V
+5VX
−1000V
+12VX
−12V
BR302
S7
15,6V~
S8
(0,86Vpp)
+5,1V
470µ 40V C302
7812CU
IC302
10µ 35V C304
(1mVpp)
BR303
S3
155,5V~
S4
(4,7Vpp)
+185V
47µ 250V C305
R301 1k
R304 1k2 4W
(0,12Vpp)
47µ 250V C306
+180V
+140V
(90mVpp)
47µ 250V C307
bl
P5
110V~
P4
P3
110V~
gr P2
P1
17V~
WS
D302
D304
D301
D305
4x EM513
2x 0,47µ 630V
C308
C309
481V~
gr
−1013V
R305 10k
(ca. 45mVpp)
−1kV
R309 27k
C311 68p 2kV
C312 22n 1,6kV
R316 43k 1%
R318 25k
R310 820k
R312 1M5B
R313 1M5B
IC303
µA741C
HV=1kV Adjustm.
+13V
0,22µ 1kV C313
R306 1k
2M2 R307
3k3 R317
2k2 R308
1k8 1% R314
10µ 35V C310
1k2 1% R315
F ye
6,3V~ (to CRT)
+163V
BF459 T301
100µ 16V C314
−12V
+24V
SS301 (Intens. Contr.)
Line Fuse: 5x20mm (slow, träge, temporisé, lento)
gn
F301
TF 301 NT 307-9 M 65x28
CQY74L IL301
gr
R311 680
bl
gn-ye
br
CA301
AC 50-60Hz
Watts (max.) 30
Amps (max.) 0,15

HAMEG

West Germany **G.m.b.H.**
Kelsterbacher Str. 15-19 — 6 FRANKFURT/M. 71
Tel. (0611) 676017-19 — Telex 0413866

HAMEG

France **S.A.R.L.**
5-9, avenue de la République - 94800 VILLEJUIF
Tél. 678.09.98 - Télex 270705 - (Region Paris)

HAMEG

España **IBERICA S.A.**
Villarroel 172-174 — BARCELONA-36
Tel. 230.15.97

HAMEG

United Kingdom **LTD**
74-78 Collingdon Street — LUTON, LU1 1RX
Tel. (0582) 413.174 — Telex 825.484

HAMEG

U.S.A. **INC.**
88-90 Harbor Road — PORT WASHINGTON
N. Y. 11050
Tel. 516.883.3837 — TWX 510.223.0889