3.4. CHECKING AND ADJUSTING

Introduction

The following information provides the complete checking and adjusting procedure for the PM 3240 oscilloscope. As various control functions are interdependent, a certain order of adjustment is often necessary. The procedure is, therefore, presented in a sequence which is best suited to this order, cross-reference being made to any circuit which may affect a particular adjustment. Before any adjustment or check, the instrument must attain its normal operating temperature. Under average conditions this will be approximately 30 minutes after switching on.

All controls which are mentioned without item numbers are located on the front panel of the oscilloscope.

Recommended test equipment

Digital multimeter, e.g. PHILIPS type PM 2421 or PM 2422A.
Pulse generator, rise-time ⩽ 200 ns, e.g. PHILIPS type PM 5711 or PM 5775/6.
Pulse generator, rise-time ⩽ 1 ns, e.g. Tektronix type 106 or 284.
Constant amplitude signal generator, e.g. Tektronix type 191 or 067.0532.01.
R.C. Standardizer, 1 MOhm//15 pF, e.g. Tektronix type 067.0537.00.
Time-marker generator, e.g. Tektronix type 2901.

3.4.1. Performance check

3.4.1.1. Preliminary control settings

- Set the POWER switch to OFF.
- Connect the instrument to the mains.
- Depress the ALT button of the vertical display mode switch.
- Depress the MAIN TB button of horizontal deflection switch.
- Depress the AUTO button of the trigger mode switch.
- Set the MAIN TIME/DIV switch to .1 ms.
- Set the DEL'D TIME/DIV switch to OFF.
- Set the AMPL switches to .1 V/DIV.
- Set the TIME/DIV and AMPL potentiometers to CAL.
- Set the TB MAGN switch to x1 (push).
- Set the POSITION potentiometers to their mid-positions.
- Turn the INTENS potentiometer fully clockwise.
  Controls not mentioned may remain in any position. For subsequent tests, unless otherwise stated, controls should be left in the same position as in the previous check.
- Set the POWER switch to ON.
- Check that the POWER ON lamp lights up.
- Check that the two time-base lines appear on the screen.
- Check the working of the graticule illumination control.

3.4.1.2. Cathode-ray tube

- Set the INTENS and FOCUS controls for a sharp, well-defined trace.
- Centre both time-base lines, using the POSITION potentiometers.
- Check that the traces run exactly in parallel with the central horizontal graticule line; if necessary, readjust in accordance with section 3.4.2.2.5.

3.4.1.3. Vertical axes

Balance

- Depress the A button of the vertical-display mode switch.
- Depress the 0 button of the AC-0-DC switch.
- Switch the AMPL step attenuator between positions 5 mV/DIV and 10 mV/DIV.
- Check that the trace does not jump. If necessary, readjust the BAL potentiometer on the front panel.
- Repeat for the B channel.

Gain and pulse response

- Depress button A(B) of the horizontal-display mode switch and DC of the AC-0-DC switches.
- Depress the PULL TO INVERT switch incorporated in the channel B POSITION potentiometer.
- Set the AMPL step attenuator to 10 mV/DIV.
- Set the AMPL continuous controls to CAL position.
- Apply a square-wave signal with a maximum rise-time of 1 ns, a peak-to-peak value of exactly 60 mV and a frequency of 1 kHz to input socket A(B).
- Set the MAIN TB switch to a suitable position.
- Obtain a stationary trace with the aid of the LEVEL potentiometer.
- Check that the trace height is 6 divisions. If necessary, adjust the GAIN potentiometer on the front panel.
- Check that the pulse-top is straight within 0,1 DIV.
- Increase the frequency of the input signal successively to 10 kHz, 100 kHz and 1 MHz.
- Check that the pulse-top remains straight within 0,1 DIV. at these frequencies.
- Set the MAIN TIME/DIV switch to .05 µs.
- Pull the TB MAGN control to its x5 position.
- Adjust the LEVEL control for a stable display.
- Check that the rise-time between 10 % and 90 % of the pulse height is $\leqslant$ 7 ns.
- Push the TB MAGN control to its x1 position.

If the pulse response of both channels does not meet the requirements stated above, readjust the vertical amplifiers in accordance with section 3.4.2.3.

Bandwidth

- Depress the A button of the vertical-display mode switch.
- Set the AMPL vernier controls to CAL position.
- Set the AMPL switches of both channels to .1 V/DIV.
- Apply a sine-wave voltage of 800 mV_{p-p}, at 50 kHz to input socket A(B) (trace height 8 divisions).
- Increase the generator frequency to 50 MHz while retaining the amplitude of the input signal at 800 mV_{p-p}.
- Check that the trace height is at least 5,6 divisions.

Common-mode rejection

- Depress button ADD of the vertical-display mode switch.
- Pull the channel B PULL TO INVERT switch, incorporated in the POSITION potentiometer, in order to invert channel B signal.
- Set the AMPL switches to .1 V/DIV.
- Apply a sine-wave voltage simultaneously to sockets A and B.
- Check the rejection rate in accordance with the following table.

Note: Adjust the continuous AMPL control of channel A or channel B for minimum trace height.

Input voltage	Generator frequency	Max. trace height	Rejection factor
2,4 V	100 kHz	0,24 DIV	100
2,4 V	1 MHz	0,24 DIV	100

- Disconnect the input voltage.

Chopped mode

- Depress button CHOP of the vertical-display mode switch.
- Set the MAIN TIME/DIV switch to .2 µs.
- Check that there are two time-base lines displayed which can be shifted in relation to each other using the POSITION controls.

Alternate mode

- Depress the ALT pushbutton of the vertical-display mode switch.
- Set the MAIN TIME/DIV switch to 10 µs.
- Check that there are two time-base lines displayed which can be shifted in relation to each other using the POSITION controls.
- Set the MAIN TIME/DIV switch to .1 s.
- Check that the channels are switched over after every sweep of the sawtooth voltage.

Effective signal delay

- Set the MAIN TIME/DIV switch to .05 µs.
- Pull the TB MAGN control to x5.
- Set the channel A AMPL switch to .5 V.
- Apply a square-wave voltage of approximately 600 mV_{p-p}, repetition frequency approximately 100 kHz, rise-time $\leqslant$ 1 ns, to input socket A.
- Adjust the LEVEL potentiometer to obtain a stable, stationary display.
- Set the channel A AMPL switch to position .1 V.
- Turn the INTENS potentiometer to maximum intensity.
- Check that the effective delay time T is larger than 1 division, see fig. 3.10.

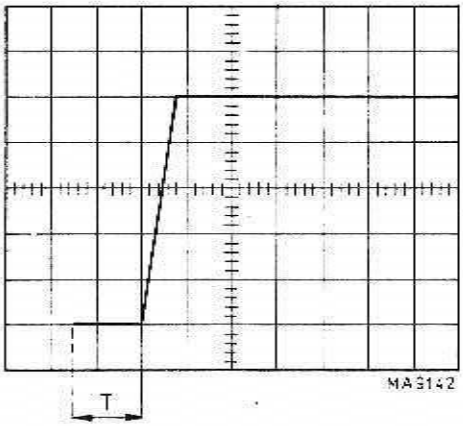

Fig. 3.10. Effective signal delay

Dynamic range and position range

- Set the AMPL switches to .1 V/Div.
- Set the AMPL vernier controls to CAL.
- Apply a sine-wave voltage of 2,4 V, frequency 15 MHz, to input socket A(B).
- Depress button A(B) of the vertical-display mode switch.
- Check that the top and bottom parts of the sinewave can be displayed.
- Check that the displayed sinewave shows no distortion over the whole POSITION range.

3.4.1.4. Main time-base generator

Trigger slope and level

- Depress button A of the vertical-display mode switch.
- Set the channel A AMPL switch to .2 V/DIV.
- Depress the AC button of the channel A AC-0-DC switch.
- Depress the DC button of the main time-base trigger frequency range switch.
- Apply a sinewave signal with an amplitude of 1,6 V to input socket A, frequency approximately 30 kHz.
- Set the MAIN TIME/DIV switch to such a position that a few cycles of the input sinewave are displayed.
- Push the SLOPE switch to its + position.
- Check that the time-base generator starts on the positive-going part of the sinewave and moves upwards when the LEVEL potentiometer is turned clockwise.
- Pull the SLOPE switch to its – position.

– Check that the time-base generator starts on the negative-going part of the sinewave.
– Set the AMPL switch to .1 V/DIV.
– Position the trace in such a way that the bottom half of the signal is displayed.
– Check that it is possible to shift the starting point of the sinewave over 16 divisions, by means of the LEVEL control.
– Push the SLOPE switch to its + position.
– Position the trace in such a way that the top half of the signal is displayed.
– Check that it is possible to shift the starting point of the sinewave over 16 divisions, by means of the LEVEL control.
– Check that the maximum control range of the LEVEL potentiometer does not exceed 32 divisions.

Trigger sensitivity

– Adjust the main time-base LEVEL potentiometer for a stationary display.
– Set the MAIN TIME/DIV switch to such a position that a reasonable number of sinewaves is written on the screen.
– Set the trigger sensitivity in accordance with the table below.

Input Signal	Frequency	Vertical-display mode	MTB trigger mode	MTB trigger frequency range	MTB trigger source	Trace Height/ Volts
YA (BU4)	20 Hz	A	TRIG	DC	A	0,5 div
	10 kHz					0,5 div
	50 MHz					0,5 div
	30 kHz			LF		0,5 div
	30 kHz			HF		1,5 div
	50 MHz					0,5 div
	50 MHz		AUTO			0,5 div
YB (BU5)	20 Hz	B	TRIG	DC	B	0,5 div
	50 MHz					0,5 div
EXT (BU8)	20 Hz		TRIG	DC	EXT	150 mV
	50 MHz					1000 mV

Single-sweep operation

– Set the AMPL switch to .2 V/DIV.
– Set the LEVEL control to mid-range.
– Set the MAIN TIME/DIV switch to .1 s.
– Apply a signal that gives a trace height of approximately 8 divisions to input socket YA.
– Depress the 0 button of the channel A AC-0-DC switch.
– Push the SINGLE button of the trigger-mode controls.
– Check that the NOT TRIG'D lamp lights up.
– Depress button AC of the channel A AC-0-DC switch.
– Check that the trace is written once and that the NOT TRIG'D lamp is extinguished at the start of the sweep.

Triggering at mains frequency

– Depress the AUTO button of the trigger-mode controls.
– Depress the HF button of the trigger frequency range switch.
– Set the MAIN TIME/DIV switch to 5 ms.
– Apply a sinewave signal at mains frequency to input socket A.
– Adjust the AMPL controls of channel A to obtain a trace height of 3 divisions (The triggered display is not stable).
– Depress the MAINS button of the trigger-source controls.
– Check that a stable display can be obtained by means of the LEVEL potentiometer.

Time coefficients

– Apply a time-marker signal to the YA input.
– Check the sweep times at each position of the MTB TIME/DIV switch (cont. control knob in CAL position). The centre 8 time-marker periods must coincide with the centre 8 divisions of the display.
– Check also with the TB MAGN knob in x5 position.

If the requirements stated above are not met, readjust the main time-base generator in accordance with section 3.4.2.5.1.

– Check that the control range of the TIME/DIV continuous control is 1:2,6 to 1:3,5.

3.4.1.5. Delayed time-base generator

Trigger slope and level

– Depress button DEL'D TB of the horizontal-deflection switch.
– Depress button A of the del'd time-base trigger-source controls.
– Set the channel A-AMPL switch to .2 V/DIV.
– Depress the AC button of the channel A AC-0-DC switch.
– Depress the DC button of the delayed time-base-trigger-coupling controls.
– Turn the DELAY TIME multiplier knob fully anti-clockwise.
– Set the MAIN TIME/DIV switch to 20 μs and the DEL'D TIME/DIV switch to 10 μs.
– Apply a sinewave signal with an amplitude of 1,6 V to input socket A, frequency approximately 30 kHz.
– Push the SLOPE switch of the delayed time-base generator to its + position.
– Check that the time-base generator starts on the positive-going part of the sinewave and shifts upwards when the LEVEL potentiometer is turned clockwise.
– Pull the SLOPE switch of the delayed time-base generator to its – position.
– Check that the time-base generator starts on the negative-going part of the sinewave.
– Set the AMPL switch to .1 V/DIV.
– Position the trace in such a way that the bottom half of the signal is displayed.
– Check that it is possible to shift the starting point of the sinewave over 16 divisions by means of the delayed time-base LEVEL control.
– Position the trace in such a way that the top half of the signal is displayed.
– Check that it is possible to shift the starting point of the sinewave over 16 divisions by means of the delayed time-base LEVEL control.
– Check that the maximum control range of the LEVEL potentiometer does not exceed 32 divisions.

Trigger sensitivity

– Depress button DEL'D TB of the horizontal-deflection controls.
– Set the delayed time-base LEVEL potentiometer to obtain a stationary display.
– Set the MAIN TIME/DIV switch one position lower (longer sweep time) than the DEL'D TIME/DIV switch.
– Adjust the DEL'D TIME/DIV switch to such a position that a reasonable number of sinewaves is written on the screen (not for 20 Hz).
– Check the trigger sensitivity in accordance with the table below.

Input signal	Frequency	Vertical-display mode	DTB trigger frequency range	DTB trigger source	Trace Height/Volts
YA (BU4)	20 Hz	A	DC	A	0,5 div
	10 kHz				0,5 div
	50 MHz				0,5 div
	30 kHz		LF		0,5 div
	30 kHz		HF		1,5 div
	50 MHz				0,5 div
YB (BU5)	20 Hz	B	DC	B	0,5 div
	50 MHz				0,5 div
EXT (BU7)	20 Hz		DC	EXT	150 mV
	50 MHz				1000 mV

Time coefficients

– Apply a time-marker signal to the YA input.
– Check the sweep times at each position of the DTB TIME/DIV switch (cont. control knob in CAL position), always keeping the MTB TIME/DIV knob one position lower than the DTB TIME/DIV knob.
The centre 8 time-marker periods must coincide with the centre 8 divisions of the display.
– If necessary, check also with the TB MAGN. knob in x5 position.

If the requirements stated above are not met, readjust the delayed time-base generator in accordance with section 3.4.2.5.3.

– Check that the control range of the TIME/DIV continuous control is 1:2,6 to 1:3,5.

Delay time multiplier

– Depress the MAIN TB button of the horizontal-deflection controls.
– Depress button MAIN TB of the delayed time-base trigger-source controls.
– Set the MAIN TIME/DIV switch to 1 ms and the DEL'D TIME/DIV switch to .1 ms.
– Apply a time-marker signal with a repetition time of 1 ms to input socket A.
– Adjust the LEVEL potentiometer of the main time-base generator for a stable, triggered display.
– Check that the intensity modulation of the delayed time-base is visible.
– Check that the starting point of the delayed time-base (beginning of the intensified portion) can be continuous shifted in relation to the main time-base by rotating the DELAY-TIME controls.
Do not take into account the first and last half-divisions of the trace.

3.4.1.6. *X Deflection*

X Deflection via channel A

– Depress button EXT X DEFL of the horizontal-deflection controls.
– Depress button A of the X deflection selector (m.t.b. trigger source).
– Set the channel A AMPL switch to .5 V/DIV.
– Depress button AC of the channel A AC-0-DC switch.
– Apply a sinewave signal of exactly 3 $V_{p\text{-}p}$, 2 kHz, to input socket A.
– Check that the trace width is approximately 6 divisions.

X Deflection via channel B

– Depress button A of the vertical display-mode switch.
– Set the channel B AMPL switch to .5 V/DIV.
– Depress button AC of the channel B AC-0-DC switch.
– Depress button B of the X deflection selector
– Apply a sinewave voltage of exactly 3 $V_{p\text{-}p}$, 2 kHz, to input socket B.
– Check that the trace width is approximately 6 divisions.

External X deflection

– Depress button EXT of the X deflection selector
– Apply a sinewave voltage of exactly 3 $V_{p\text{-}p}$, frequency approximately 10 kHz, to the EXT input socket.
– Check that the trace width is 6,5 to 10 divisions.

Bandwidth

– Adjust the amplitude of the input signal to obtain a trace width of 6 divisions.
– Increase the frequency of the input signal to 1 MHz.
– Check that the trace width is at least 4,2 divisions.

Phase difference

- Depress the A button of the vertical-display mode switch.
- Depress button EXT X DEFL of the horizontal-deflection controls.
- Set the AMPL switches to .1 mV/DIV.
- Depress button A of the X deflection selector.
- Depress the DC buttons of the AC-0-DC switches.
- Apply a sinewave voltage at a frequency of 10 kHz to input socket A.
- Check that a solid line, at an angle of 45° is displayed.
- Increase the frequency of the input signal to 100 kHz.
- Check that the phase error does not exceed 3°, see fig. 3.11. in which $\frac{B}{A}$ equals the sine of the phase error angle.

X deflection with internal mains voltage

- Depress button MAINS of the X deflection selector.
- Check that the trace width is 8 divisions, ±1,5 div.; If necessary, readjust in accordance with section 3.4.2.5.4.

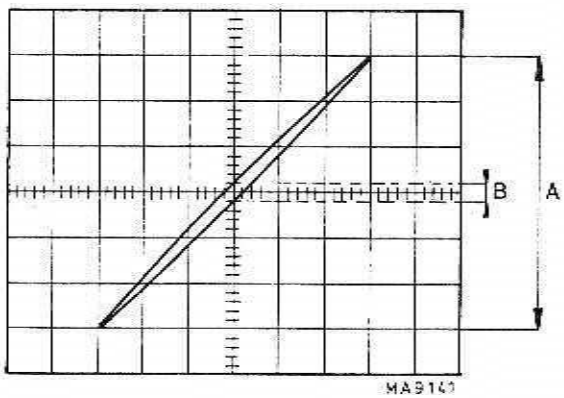

Fig. 3.11. Phase difference in X-Y mode.

3.4.1.7. Mains voltage fluctuations

- Depress button CHOP of the display-mode controls.
- Set the AMPL switches to .5 V/DIV.
- Set the MTB TIME/DIV and the LEVEL knob for a reasonable display.
- Depress buttons AC of the signal-coupling controls.
- Pull the TB MAGN switch to its x5 position.
- Interconnect the CAL sockets and the A and B input sockets.
- Check that neither the trace width nor the trace height changes when the mains voltage is varied between 90 V and 260 V. Also check that the trace brilliance does not change.

3.4.2. Adjusting procedure

3.4.2.1. Preliminary control settings

- Depress the PULL TO INVERT switch incorporated in the channel B.
- Set the POSITION potentiometers to their mid-positions.
- Depress buttons DC of the AC-0-DC switches.
- Rotate the DELAY TIME multiplier knob fully anti-clockwise.
- Depress button MAIN TB of the horizontal-deflection controls.
- Push the TB MAGN control to position x1.
- Depress buttons MAIN TB and AUTO of the trigger-mode controls.
- Set the MAIN TIME/DIV switch to 1 ms and the DEL'D TIME/DIV switch to OFF.
- Set the continuous TIME/DIV controls to CAL.
- Depress buttons DC of the trigger-coupling controls.
- Depress buttons A of the trigger-source controls.

If necessary, first check the power supply, refer to 3.4.2.7.

All adjustment points are indicated in Fig. 3.13 and 3.14.

3.4.2.2. Cathode-ray tube circuit

3.4.2.2.1. Trace rotation

- Depress button A of the vertical-display mode switch.
- Depress button MAIN TB of the horizontal-deflection controls.
- Centre the time-base line, using the POSITION controls.
- Check that the time-base line runs exactly parallel with the horizontal-lines of the graticule; if necessary, readjust TRACE ROT. potentiometer R684

3.4.2.2.2. Brilliance

- No vertical deflection.
- Depress button EXT X DEFL of the horizontal-deflection controls (no horizontal-deflection).
- Turn the INTENS potentiometer 90° from the left-hand stop.
- Check that the dot is barely visible. If necessary, readjust potentiometer R1327

3.4.2.2.3. Brilliance ratio

- Depress button A of the vertical-display mode switch.
- Depress button MAIN TB of the horizontal-deflection controls.
- Turn the DELAY TIME control to its mid-position.
- Set the MAIN TIME/DIV switch to 1 ms and the DEL'D TIME/DIV switch to .2 ms.
- Set the INTENS potentiometer to a position 180° from its anti-clockwise stop.
- Check that the trace of the main time-base generator is just visible over the entire screen and that the portion determined by the delayed time-base generator is brighter. If necessary, readjust the INTENS RATIO potentiometer R1115

3.4.2.2.4. Focus and astigmatism

- Depress button A of the vertical-display mode switch.
- Depress button MAIN TB of the horizontal-deflection controls.
- Set the delayed time-base TIME/DIV switch to OFF.
- Apply a sinewave signal at a frequency of 10 kHz to input socket A.
- Adjust the trace height to 6 divisions, using the AMPL switch and vernier.
- Set the MAIN TIME/DIV switch and the LEVEL potentiometer to such a position that several complete cycles are displayed.
- Set the INTENS potentiometer for normal brilliance.
- Check that a reasonably sharp trace can be obtained with the aid of the FOCUS potentiometer. If necessary, readjust astigmatism potentiometer R1344

3.4.2.2.5. Geometry

- Depress button A of the vertical-display mode switch.
- Depress button MAIN TB of the horizontal-deflection controls.
- Set the DEL'D TIME/DIV switch to OFF.
- Apply a sinewave voltage of 12 $V_{p\text{-}p}$, frequency approximately 10 kHz to input socket A.
- Set the channel A AMPL switch to .1 V/DIV.
- Set the MAIN TIME/DIV switch to .2 ms.
- Check that the displayed vertical lines are straight; if necessary, readjust potentiometer R1346

3.4.2.3. Vertical deflection

3.4.2.3.1. Gain - Channel A

- Depress button A of the vertical-display mode switch.
- Set the AMPL switch to .5 V/DIV.
- Set the AMPL cont. control to CAL.
- Depress button DC of the AC-0-DC switch.
- Apply a square-wave voltage with an amplitude of exactly 3 V to input socket A, frequency approximately 2 kHz.
- Check that trace height is exactly 6 divisions; if necessary, readjust the GAIN preset-potentiometer on the front panel.

– After adjustment, the GAIN preset-potentiometer on the front panel should occupy its mid-position. If necessary, readjust potentiometer R641. (If the setting cannot be reached with R641, change R645.)
– Check that the control range of the AMPL cont. control is at least 1:2,6 to 1:3,5.

3.4.2.3.2. DC Balance - Channel A

– Centre the time-base line, using the POSITION control.
– Check that the time-base line does not jump when the AMPL step attenuator is switched; if necessary, readjust the BAL preset-potentiometer on the front panel.
– Check that the trace does not move if the AMPL continuous control is turned; if necessary readjust R128(A)

3.4.2.3.3. Gain - Channel B

– Depress button B of the vertical-display mode switch.
– Set the AMPL switch to .5 V/DIV.
– Set the AMPL cont. control to CAL.
– Depress button DC of the AC-0-DC switch.
– Apply a square-wave voltage with an amplitude of exactly 3 V to input socket B, frequency approximately 2 kHz.
– Check that the trace height is exactly 6 divisions; if necessary, readjust the GAIN preset-potentiometer on the front panel.
– Check that the control range of the AMPL cont. control is at least 1:2,6 to 1:3,5.

3.4.2.3.4. DC Balance - Channel B

– Centre the time-base line, using the POSITION control.
– Check that the time-base line does not jump when the AMPL step attenuator is switched; if necessary, readjust the BAL preset-potentiometer on the front panel.
– Check that the trace does not move if the AMPL cont. control is turned; if necessary, readjust R128(B)

3.4.2.3.5. Polarity balance - Channel B

– Check that the trace does not jump when the PULL TO INVERT switch, incorporated in the channel B POSITION potentiometer is operated; if necessary, readjust potentiometer R435

3.4.2.3.6. Input attenuators

The input attenuators of both channels are identical. Therefore, only one procedure has been described.

Attenuator - Channel A(B)

– Depress button A(B) of the vertical-display mode switch.
– Set the MAIN TIME/DIV switch to 20 µs.
– Depress button DC of the AC-0-DC switch.
– Apply a square-wave signal, frequency approximately 20 kHz, rise-time $\leqslant$ 200 ns and amplitude as indicated in the table below, to input socket A(B).
– Check that the displayed square-wave is free from overshoot and rounding.

AMPL/DIV switch	Input signal on A(B)	Adjustment	Trace height
5 mV	30 mV	C108	6 div. ±2 %
10 mV	60 mV		6 div. ±2 %
20 mV	120 mV		6 div. ±2 %
50 mV	300 mV	C101	6 div. ±2 %
100 mV	600 mV		6 div. ±2 %
200 mV	1,2 mV		6 div. ±2 %
500 mV	3 V	C109	6 div. ±2 %
1 V	6 V		6 div. ±2 %
2 V	12 V		6 div. ±2 %

Maximum admissible pulse-top error: 2 %.

Input impedance - Channel A(B)

- Apply the voltages mentioned in the table above via an input RC Standardizer of 1 MOhm//15 pF to input socket A(B).
- Check that the displayed square-wave is free of rounding and overshoot; maximum admissible pulse-top error: 2 %; if necessary, readjust in accordance with table below.

AMPL/DIV switch	Standardizer Input	Adjustment	Trace Height
5 mV	30 mV	C107	3 div. ±2 %
10 mV	60 mV		3 div. ±2 %
20 mV	120 mV		3 div. ±2 %
50 mV	300 mV	C102	3 div. ±2 %
100 mV	600 mV		3 div. ±2 %
200 mV	1,2 mV		3 div. ±2 %
500 mV	3 V	C111	3 div. ±2 %
1 V	6 V		3 div. ±2 %
2 V	12 V		3 div. ±2 %

3.4.2.3.7. Square-wave response - Channel B

- Depress button B of the vertical-display mode switch.
- Set the B AMPL switch to 20 mV/DIV.
- Depress the PULL TO INVERT switch incorporated in the channel B POSITION control.
- Set the MAIN TIME/DIV switch to .05 μs.
- Apply a square-wave voltage of approximately 120 $mV_{p\text{-}p}$, rise-time $\leqslant$ 1 ns, repetition frequency approximately 100 kHz.
- Check that the pulse-top is as straight as possible; maximum pulse-top error including ringing and overshoot 0,1 div.

Adjustments

C416 - R442
C603 - R619
C402
C606 - R621
R622
R445

– Also check the square-wave response in positions .1 V (input voltage 600 mV) and .5 V (input voltage 3 V) of the AMPL switch.
– Check also the square-wave response in the PULL TO INVERT B position.

3.4.2.3.8. Square-wave response - Channel A

– Depress button A of the vertical-display mode switch.
– Set the AMPL switch to 20 mV/DIV.
– Apply a square-wave voltage of approximately 120 mV_{p-p}, rise-time $\leqslant$ 1 ns, repetition frequency approximately 100 kHz, to input socket A.
– Check that the pulse-top is as straight as possible; maximum pulse-top error including ringing and overshoot should not exceed 0,1 div.

Adjustments

C316. R432
C301
R345

– Check the square-wave response in positions .1 V (input voltage 600 mV) and .5 V (input voltage 3 V) of the AMPL switch.

3.4.2.4. Triggering

3.4.2.4.1. MAIN TB trigger level and DC balance of X amplifier

– Depress button A of the vertical-display mode switch.
– Depress button MAIN TB of the horizontal-deflection controls.
– Depress button AUTO of the trigger-mode controls.
– Set the MAIN TIME/DIV switch to .5 ms.
– Depress button MAIN TB of the DEL'D TB trigger-source controls.
– Depress button A of the main time-base trigger-source controls.
– Push the TB MAGN switch to position x1.
– Set the X POSITION potentiometer to such a position that the time-base line starts at the extreme left-hand line of the traticule.
– Depress button EXT X DEFL of the horizontal-deflection controls and button EXT of the main time-base trigger-source controls.
– Check that the dot is in the centre of the screen; maximum deviation: 2 divs.
– Centre the dot by means of the X POSITION potentiometer.
– Depress button B of the main time-base trigger-source controls.
– Check that the dot is in the centre of the screen; if necessary, readjust potentiometer R451
– Depress button A of the main time-base trigger-source controls.
– Check that the dot is in the middle of the screen; if necessary, readjust potentiometer R351

3.4.2.5. Horizontal deflection

3.4.2.5.1. Main time-base

Stability

– Depress both 0 buttons of the AC-0-DC switches.
– Depress button MAIN TB of the horizontal-deflection controls.
– Depress button TRIG of the trigger-mode controls.
– Set the DEL'D TIME/DIV switch to OFF.
– Rotate the main time-base LEVEL control fully anti-clockwise.
– Turn STAB potentiometer R873 fully anti-clockwise.
– Check that there is a time-base line written.
– Rotate STAB potentiometer R873 approximately 20° past the point where the time-base line ceases to be displayed.
– Depress button AUTO of the trigger-mode controls.
– Check that there is a time-base line written again.

Time coefficients

As the power supply may affect the sweep times, it must be checked before readjusting the sweep times, refer to 3.4.2.7.

- Depress button A of the vertical-display mode switch.
- Set the AMPL switch to .1 V/DIV.
- Depress button DC of the AC-0-DC switch.
- Depress button MAIN TB of the horizontal-deflection controls.
- Push the TB MAGN switch to position x1.
- Depress button AUTO of the trigger-mode controls
- Set the MAIN TIME/DIV vernier control to CAL.
- Depress button DC of the trigger-coupling controls.
- Depress button A of the trigger-source controls.
- Apply a time-marker signal at a repetition rate of 1 ms to input socket A, amplitude approximately 600 mV.
- Check that the 8 centre periods cover exactly 8 divisions; if necessary, readjust potentiometer R1223
- Pull the TB MAGN switch to position x5.
- Set the time-marker generator to 200 μs.
- Check that the 8 centre cycles cover exactly 8 divisions; if necessary, readjust potentiometer R1209
- Push the TB MAGN control to position x1.
- Set the MAIN TIME/DIV switch to 10 ms.
- Set the time-marker generator to 10 ms.
- Check that the 8 centre cycles cover exactly 8 divisions; if necessary, readjust potentiometer R914
- Check that the control range of the TIME/DIV continuous control is 1:2,6 to 1:3,5.
- Check the remaining positions of the TIME/DIV switch; the centre 8 periods should always cover exactly 8 divisions, ±2,5 %. On the end positions .5 s, .2 s, .1 μs and .05 μs the tolerance is ±3,5 %.
- Also check that the length of the time-base line always exceeds 10 divisions.

3.4.2.5.2. Linearity and horizontal positioning

- Set the MAIN TIME/DIV control to .05 μs.
- Pull the TB MAGN switch to its x5 position.
- Apply a time-marker signal with a pulse repetition frequency of .01 μs to input socket A.
- Check that the 8 centre cycles cover exactly 8 divisions.
- Check also that for the 8 centre cycles a display of 1 cycle/division is obtained; if necessary, readjust trimmer capacitors C1203 and C1208.
- Check that all other cycles have a width of 1 division by shifting the whole train of pulses across the screen. Do not take into account the first and last five cycles.
- Also check that with the X POSITION potentiometer fully anti-clockwise and fully clockwise the beginning and the end of the trace is written within the measuring graticule.

3.4.2.5.3. Delayed time-base

Stability

- Depress button DEL'D TB of the horizontal-deflection controls.
- Depress button A of the delayed time-base trigger-source controls.
- Depress button 0 of the channel A AC-0-DC switches.
- Set the MAIN TIME/DIV switch to .5 ms.
- Set the DEL'D TIME/DIV switch to .2 ms.
- Turn the delayed time-base LEVEL control fully anti-clockwise.
- Turn STAB potentiometer R1064 fully clockwise.
- Check that a time-base line is displayed.
- Rotate STAB potentiometer R1064 approximately 20° beyond the point where the time-base line ceases to be displayed.
- Depress button MAIN TB of the delayed time-base trigger-source controls.
- Check that the time-base line is displayed again.

Time coefficients

- Depress button A of the vertical-display mode switch.
- Set the AMPL switch to .1 V/DIV.
- Depress button DC of the AC-0-DC switch.
- Rotate the DELAY TIME control fully anti-clockwise.
- Depress button DEL'D TB of the horizontal-deflection controls.
- Depress button AUTO of the main time-base trigger-mode controls.
- Depress button A of the delayed time-base trigger-source controls.
- Set the TIME/DIV continuous controls to the CAL positions.
- Apply a time-marker signal at a repetition rate of 1 ms and an amplitude of approximately 600 mV to input socket A.
- Check that the 8 centre periods cover exactly 8 divisions; if necessary, readjust potentiometer R1097
- Check that the control range of the delayed time-base TIME/DIV contin. control is 1:2,6 to 1:3,5.
- Check the remaining positions of the DEL'D TIME/DIV switch.
  Keep the DELAY TIME control fully anti-clockwise during this check, and the MAIN TIME/DIV switch one position lower than the DEL'D TIME/DIV switch. In this way, the delayed time-base can complete an entire sweep.
- Check that the 8 centre periods always cover 8 divisions, ±2,5 % except in the positions .1 μs and .05 μs, where the tolerance is ±3,5 %.
- Check that in all positions of the DEL'D TIME/DIV switch the length of the time-base line exceeds 10 divisions.
- Check that no time-base line is written when the DEL'D TIME/DIV switch occupies the OFF position.

Delay time

- Depress button A of the vertical-display mode switch.
- Depress button DC of the AC-0-DC switches.
- Depress button MAIN TB of the horizontal-deflection controls.
- Depress button AUTO and MAIN TB of the trigger-mode controls.
- Set the DEL'D TIME/DIV switch to 1 μs.
- Set the MAIN TIME/DIV switch to 1 ms.
- Depress button DC of the trigger-coupling controls.
- Depress button A of the trigger-source controls.
- Rotate the TIME/DIV cont. controls to CAL.
- Apply a time-marker signal at a repetition rate of 1 ms.
- Set the LEVEL control of the main time-base for a triggered display.
- Check that the intensity modulation by the delayed time-base is visible over the entire range of the INTENS potentiometer.
- Check that the starting point of the delayed time-base can be continuously shifted along the main time-base line with the aid of the DELAY TIME control. Ignore the first and last half-divisions.

3.4.2.5.4. X Deflection with the mains signal

- Depress button EXT X DEFL of the horizontal-deflection controls.
- Depress button MAINS of the X deflection-source controls.
- Check that the trace width is 10 divisions, ±1 div.; if necessary; readjust potentiometer R1841

3.4.2.6. Calibration unit

- Check the calibration voltage for irregulaties.
- Check that the amplitude of the square-wave voltage is 3 $V_{p\text{-}p}$, ±0.7 %; if necessary, readjust R1906.
- Check that the frequency is 2 kHz ±2 %.
- Check that the CAL current is 6 mA ±1 %.

3.4.2.7. Power supply

Warning: Use an isolating mains transformer when working in the power supply unit. Bear in mind that the main part of this unit is connected direct to the mains. As it is preferred to check the proper function of the power supply with adjustable mains voltage, use of a variable transformer (insulated version) is recommended.

Attention: The power supply unit is provided with a pre-set potentiometer R1834 which controls the d.c. output of the circuit. DO NOT READJUST THIS POTENTIOMETER UNLESS IT IS STRICTLY NECESSARY.
A consequence of readjusting this potentiometer is that all d.c. output voltages change, so that several circuits of the oscilloscope (e.g. time base sweep) must be recalibrated.
In the factory this potentiometer has been adjusted to the nominal value of the +45 V output. This voltage must be +45 V, + or −100 mV.

General

The best way to check the power supply is, when this unit is connected to the normal circuitry of the PM 3240. Provisions have been taken that the unit, after being taken out, remains connected to the instrument.
To facilitate the removal, first disconnect the various connections of the power supply unit.
The supply currents can be measured on each contact of the power supply output connectors. To disconnect one contact of a connector carefully press (twice) the spring at the side of the contact and lift the contact out. Inserting an additional contact provided with a piece of extension wire simplifies current measurement. After replacing the original contact check the spring locking-action to prevent the contact from coming loose later-on.

When the power supply unit is overloaded, the current limitation is actuated. As a result of this, the power supply goes in the "hiccup" mode (2 seconds cycle time approx.). This is caused by, successively, slow charging of the capacitor C1809, starting of the chopper, activation of current limiting transistor TS1808, discharging of the regulator circuit capacitor and so on.
Another reason for the power supply going in the "hiccup" mode is, when the switching transistor TS1807 gets no base current from the regulator circuit. In this case capacitor C1809 is slowly charged until the chopper circuit starts which causes the discharge of the capacitor in a short time, and so on.
If necessary, the power supply unit only, can be checked with the aid of a dummy load, consisting of load resistors and capacitors, see Fig. 3.41.
If a fault is suspected in the power supply, the following procedure may help you to find what is wrong.

NOTE: The power supply must always be loaded with the nominal load.

Required instruments

- Variable mains transformer with isolated windings (e.g. Philips bench model 2422 529 00005 or panel model 2422 529 00006; input 220 V, output 0-248 V/3 A).
- Watt meter (to measure mains power input).
- Oscilloscope (5 MHz bandwidth).
- Resistor 100 Ω, 25 W (5322 115 50015).
- Resistor 22 Ω, 25 W (5322 115 50006).
- Resistor of 1 kΩ and 50 kΩ, 0,5 W.

Checking procedure

In the first part of this procedure the current gain of the switching regulator transistor is checked (and the value of the base resistor R1817).
Then the power supply circuit is checked while the regulating circuit is out of service (switching regulator transistor short-circuited). In this case always check that the voltage across C1809 never exceeds the sum of the voltages across GR1806 and GR1807.
Next the regulating circuit and current limitation is checked.

Proceed as follows:

- Connect the isolating/variable transformer to the mains.
- Connect the power supply unit in series with a 22 ohm, 25 W resistor and via a Watt-meter to the isolating/variable transformer.
- Remove current sensing transistor TS1808.
- Set the variable transformer to 0 volt.
- Switch on the oscilloscope and increase the variable transformer output until the voltage on the power supply reaches 40 V.
- Check that the voltage over C1809 amounts to approx. 56 V (the chopper circuit is not oscillating).

– If this voltage across C1809 does not appear, check the ripple eliminator circuit (TS1801 and TS1802), R1819 and check the chopper circuit on short-circuit.
– Switch-off the instrument.
– After the voltage across C1809 has completely disappeared, switch-on again and check that the voltage across C1809 is present again after approx. 2 seconds.
(The speed of charging depends on the current gain of TS1807 and the value of R1817).

R1817

– Increase the power supply input voltage until the voltage across C1809 amounts to 90 V.
– Connect a 1 kohm (0,5 W) resistor in parallel to C1809.
– The voltage across C1809 must now be 4 V; if not change R1817.
The value of R1817 must be between 25 k ohm - 56 k ohm.
If by changing R1817 the 4 V cannot be reached, TS1807 must be selected.
– Remove the 1 k ohm resistor.

– Adjust the mains input voltage to 40 V.
– Short-circuit emittor-collector of TS1807.
– Start the chopper circuit (TS1804, TS1806) by connecting for a short moment the base of TS1804 via a 50 k ohm (0,5 W) resistor to point 4 of transformer T1802.
– Check the voltage on point 5 of T1802. This must be a square wave of approx. 70 $V_{p\text{-}p}$, frequency approx. 18 kHz.
– The voltage over the 22 ohm series resistor in the mains input must be approx. 1,5 V.
– If the chopper does not oscillate, check the chopper circuit itself.
If the chopper goes in the "hiccup" mode when the 50 k ohm resistor remains connected, check the d.c. output circuits and the circuit connected to points 7 and 8 of T1802.
– Remove the 22 ohm resistor in the mains input.
– Increase the mains input voltage until the voltage over C1809 amounts to 100 V (not higher, otherwise the Z-diodes GR1806 and GR1807 will blow up).
The chopper must start automatically.
– Check the pulse on the base of TS1807.
Adjust with the variable transformer the voltage across C1809 to 90 V; check that this pulse can be varied with R1834. If not check the regulator circuit.
– The power consumption must be 25 W approx.
– Remove the short-circuit across TS1807; check that the pulse on the base of TS1807 changes at this moment.

– Fit current sensing transistor TS1808.
– Check that the chopper circuit cuts out (goes in the "hiccup" mode) when the load of the power supply is increased by approx. 50 %. To this end connect a 200 ohm 25 W resistor to the +45 V output. The current limitation goes "on" when the power output exceeds 30-35 W.
Also when the +45 V output is short-circuited, the power supply goes in the "hiccup" mode.

– Adjust the mains input voltage with the variable transformer to the nominal local voltage.
– If necessary adjust the +45 V output voltage (+ or −100 mV is allowed) with the aid of R1834
– Check again the voltage on point 5 of T1802 with an oscilloscope. The frequency must be 18-22 kHz; check the shape of the chopper voltage (150 $V_{p\text{-}p}$).
– Vary the mains voltage between 90 and 248 V.
Check that the +45 V output remains constant (between + or −200 mV).
Check the 50 % overload current limitation at 248 V.