

PERFORMANCE CHECK **4**

PERFORMANCE CHECK

CONTENTS

4.0 Performance check.....	4-1
4.1 General information.....	4-1
4.2 Recommended test and calibration equipment.....	4-2
4.3 Preliminary settings.....	4-2
4.4 Checking procedure.....	4-3

4.0 PERFORMANCE CHECK

4.1 GENERAL INFORMATION

WARNING: Before switching-on, ensure that the instrument has been installed in accordance with the Installation Instructions outlined in chapter 3.0 of the Operating Manual.

This procedure is intended to:

- check the instrument's main specification points.
- be used for incoming inspection to determine the acceptability of newly purchased instruments and/or recently recalibrated instruments.
- check the necessity of recalibration after the specified recalibration intervals.

NOTE: The procedure does not check every facet of the instruments calibration; rather, it is concerned primarily with those parts of the instrument which are essential to measurement accuracy and correct operation. Removing the instrument covers is not necessary to perform this procedure. All checks are made from the outside of the instrument.

If the test is started within a short period after switching-on, bear in mind that steps may be out of specification, due to insufficient warming-up time.

Warming-up time under average conditions is 30 minutes.

The performance checks are made with a stable, well-focussed, low-intensity display. Unless otherwise noted, adjust the intensity and trigger-level controls as needed.

NOTES:

- * At the start of every check, the controls always occupy the preliminary settings AUTO SET position, unless otherwise stated.
- * The input voltage has to be supplied to the channel A input; unless otherwise stated.
Unless otherwise stated, the switches TIME/DIV, OFFSET A and B, X-POSITION, TRACE INTENS and TEXT INTENS must be put in such a position that a good read-out of the phenomena of interest is obtained.
- * Tolerances given are for the instrument under test and do not include test equipment error.
- * The input impedance of 50 ohm of the oscilloscope under test is correct if the generator types are used that are given in chapter 13.1 "Recommended test and calibration equipment".
If you use other types of calibration equipment, this may cause problems.
- * For some checks, we make use of service routines. If you want additional information concerning these service routines refer to chapter 11 "Trouble shooting".
- * In some checks in this chapter channel B is mentioned between brackets behind channel A. It is advised to perform the channel A checks first. After that the checks for channel B can be done.

4.2 RECOMMENDED TEST AND CALIBRATION EQUIPMENT

A complete list of all material necessary for both this performance check and also the adjusting procedure is given in chapter 9.2 in this manual.

4.3 PRELIMINARY SETTINGS

- Switch the oscilloscope on.
- Check that all the LED's in the front panel are on for 1 sec. during the power up routine of the instrument's microprocessor.
- Press AUTO.
- Check that after adjustment of TEXT INTENS and TRACE INTENS the read-out information and a horizontal line become visible at the CRT-screen.

4.4 CHECKING PROCEDURE

A. POWER SUPPLY

IMPORTANT

The measurements of the power supply must be done with LIFE VOLTAGES. Therefore it is strongly advised to use a variable mains transformer with isolated primary and secondary windings. Nevertheless, these tests must only be done by a QUALIFIED TECHNICIAN who is aware of the danger involved.

A.1 SUBJECT

Mains voltage range.

TEST EQUIPMENT

Variable mains voltage transformer (and digital multimeter)

SETTINGS

- Connect the oscilloscope (switched off) to the output of the variable mains voltage transformer. If the transformer has no output voltage read-out, you must connect the digital multimeter (a.c. voltage range) to the outputs of the transformer.
- Connect the variable mains transformer to the mains and adjust the output voltage.

REQUIREMENTS

- Check that the oscilloscope starts up normally when switched-on at any voltage in the range 90...264 V (a.c.). Preferred check points are 110, 220 and 240 V (a.c.).

MEASURING RESULTS

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SETTINGS

- Switch the oscilloscope on at a mains voltage between 90...264 V (a.c.).
- Connect the input of Ch. A with the CAL voltage.
- Press AUTO.
- Adjust AMPL/DIV of Ch. A, TIME/DIV and other controls to a well-defined display of the CAL output voltage.

REQUIREMENTS

- Check that the display stays stable over the mains voltage range 90...264 V (a.c.).

MEASURING RESULTS

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- Switch the oscilloscope off and disconnect the variable transformer from the mains.

A.2 SUBJECT

Mains voltage current.

TEST EQUIPMENT

Variable mains voltage transformer and digital multimeter.

SETTINGS

- Connect the oscilloscope to the variable mains transformer. In one of the mains conductors of the oscilloscope the digital multimeter (a.c. current range) must be present.
- Connect the transformer to the mains and switch the oscilloscope on. Graticule illumination must be on.

REQUIREMENTS

- Measure the current drain of the oscilloscope according to the table below (approximate rms value):

Mains voltage:	Current:
110 V (a.c.)	1,5 A
220 V (a.c.)	0,9 A
240 V (a.c.)	0,85 A

MEASURING RESULTS

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Disconnect the variable mains transformer from the mains and connect the oscilloscope directly to the mains voltage.

B. C.R.T. DISPLAY SECTION

SUBJECT	Trace distortion.
TEST EQUIPMENT	L.f. sine-wave generator.
SETTINGS	<ul style="list-style-type: none"> - Press AUTO. - Shift the Ch. A trace in the vertical mid of the screen.
REQUIREMENTS	<ul style="list-style-type: none"> - Check that the Ch. A trace is exactly in parallel with the horizontal graticule lines. - If not correct this with the screwdriver control TRACE ROT. - Shift the Ch. A trace upwards and downwards and check if the deviation from the straight line does not exceed 0,1 div measured outside the central 8x10 div.
MEASURING RESULTS	.....
SETTINGS	<ul style="list-style-type: none"> - Press AUTO. - Apply a 200 kHz/1,6 V (pp) sine wave voltage to the Ch. A input socket. - Adjust the generator's output voltage to 8 div vertical deflection. - Select vertical display of Ch. A and B - Shift the Ch. A and Ch. B display in the vertical mid of the screen. - Select in the DISPLAY section A versus B display and switch register Ø on.
REQUIREMENTS	<ul style="list-style-type: none"> - Check that a vertical line of 8 div is displayed. - Shift this line to the left and the right by means of X-POSITION and check if the deviation from the straight line does not exceed 0,1 div outside the central 8x10 div.
MEASURING RESULTS	.....

SETTINGS	- Shift the vertical line in the horizontal mid of the screen.
REQUIREMENTS	- Check that the angle between the vertical graticule lines and the displayed line does not exceed 0,5 degree. This equals a horizontal deviation of 0,1 div max between top and bottom of the line.
MEASURING RESULTS	.....

C. VERTICAL DEFLECTION

C.1	SUBJECT	Vertical deflection coefficients Ch. A (B).
	TEST EQUIPMENT	Calibrated sq. wave generator adjusted via internal switch (behind left-hand side panel) to deliver a calibrated d.c. voltage.
	SETTINGS	<ul style="list-style-type: none"> - Press AUTO. - Select channel A (B) for vertical display. - Position the time base line on one of the lower graticule lines. - Apply a 2V calibrated d.c. voltage (into 1 M.ohm) to input A (B). Halves into 50 ohm. - Check for a vertical displacement of the time base line of 5 div + or - 1,5% (+ or - 10% in EYE PAT mode) if the input signal is applied.
	MEASURING RESULTS	.....
	SETTINGS AND REQUIREMENTS	<ul style="list-style-type: none"> - Change the channel A (B) AMPL/DIV setting into respectively 100 mV, 50 mV and so on according to the table below. - Position the time base line without input signal on one of the lower graticule lines. - Apply a calibrated d.c. voltage of respectively 1 V, 0,5 V and so on according to the table below. - Check for a vertical displacement of 5 div + or - 1,5 % (+ or - 10% in EYE PAT mode) if the input signal is applied. <p>Note: the above measuring method is chosen because the instrument can not trigger on the 1 kHz calibrated sq.wave signal. The vertical channels however are d.c. coupled.</p>

Generator voltage	AMPL/DIV setting	Requirement			Measuring results
		Displacement	Accuracy		
			Normal	EYE PAT	
1 V	100 mV	5 div.	+/-1,5%	+/-10%	
.5 V	50 mV	5 div.	+/-1,5%	+/-	
.2 V	20 mV	5 div.	+/-1,5%	+/-	
.1 V	10 mV	5 div.	+/-1,5%	+/-	
50 mV	5 mV	5 div.	+/-1,5%	+/-	
20 mV	2 mV	5 div.	+/-1,5%	-	
10 mV	1 mV	5 div.	+/-1,5%	-	

- Disconnect the input signal.

C.2 SUBJECT

Variable gain control.

TEST EQUIPMENT

Calibrated sq.wave generator in d.c. range.

SETTINGS

- Press AUTO.
- Select channel A (B) for vertical display.
- Turn the VARIABLE control out of the CAL position to 100 mV/div.
- Position the time base line on one of the lower graticule lines.
- Apply a calibrated d.c. voltage of 1V (into 1 M.ohm) to input A (B). This voltage halves into 50 ohm.

REQUIREMENT

- Check for a vertical displacement of the time base line of 5 div (+ or - 3%) if the input signal is applied.

MEASURING RESULT

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SETTINGS AND REQUIREMENTS

- Turn the VARIABLE control maximally out of the CAL position.
- Disconnect the input signal.
- Position the time base line on the bottom graticule line.
- Apply the signal again and check for a vertical deflection of 7,5 div minimal.

MEASURING RESULT

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IMPORTANT

Switch the calibrated sq. wave generator back from d.c. to 1kHz with the internal switch. This is not necessary if another PM3340 oscilloscope needs to be checked.

C.3	SUBJECT	DC-offset range.
	TEST EQUIPMENT	L.f. sine-wave generator.
	SETTINGS	<ul style="list-style-type: none">- Press AUTO.- Select channel A (B) for vertical display.- Apply a sine wave signal of 1,6 V/200 kHz to the channel A (B) input.- Adjust the generator to an amplitude of 8 div.
	REQUIREMENT	<ul style="list-style-type: none">- Check that it is possible to adjust the OFFSET control so that the sine-wave can be shifted outside the graticule.
	MEASURING RESULT	.....
C.4	SUBJECT	Vertical dynamic range Ch. A (B)
	TEST EQUIPMENT	Constant amplitude sine-wave generator.
	SETTINGS	<ul style="list-style-type: none">- Apply a sine-wave of 200 MHz/800 mV (pp) to the Ch. A (B) input.- Press AUTO.- Readjust the output signal of the generator so that 4 div are displayed.- Select 100 mV/div with the Ch. A (B) AMPL/DIV control so that 8 div signal are displayed on the screen.
	REQUIREMENTS	<ul style="list-style-type: none">- Check that the displayed sine-wave is free from distortion.
	MEASURING RESULTS	.....

C.5	SUBJECT	Common mode rejection ratio (CMRR).
	TEST EQUIPMENT	Constant amplitude sine-wave generators SG503, SG504 and a power splitter with 2 exactly identical output cables. SG503 is used to measure CMRR at 100 MHz; SG504 is used to measure at 500 MHz.
	SETTINGS	<ul style="list-style-type: none"> - Connect the SG503 (SG504) generator to the power splitter. - Connect the outputs of the power splitter via exactly identical coax cables with the channel A and B input sockets. - Adjust the SG503 (SG504) generator frequency to 100 MHz (500 MHz) and its output voltage to approximately 1V. - Press AUTO. - Adjust the generator's output voltage to a deflection of 8 div via ch. A and B. - Select ch. A INVERT and ADD mode. - Adjust the VARIABLE control of ch. A or B to minimal signal amplitude on the screen.
	REQUIREMENT	- Signal amplitude displayed on screen must be equal or smaller than 0,2 div (0,8 div).
	MEASURING RESULTS	.....

C.6	SUBJECT	Pulse response.
	TEST EQUIPMENT	Pulse generator with rise-time ≤ 70 ps.
	SETTINGS	<ul style="list-style-type: none"> - Apply the fast-rising pulse to the channel A (B) input. - Press AUTO. - Adjust the AMPL/DIV control so that the pulse amplitude is as high as possible within the graticule. - Adjust the TIME/DIV control to 1 us. - Adjust LEVEL so that display starts at leading edge of pulse. - Select TIME/DIV: 1 ns. - EXPAND the time base settings via the MAGN/DELAY menu and keep the leading edge of the pulse within the graticule by adjustment of the DELAY value. - Press LOCK.

- Measure the rise time with the CURSOR/ANALYSE menu via the selections MEASURE, TIME and RISE. The cursors must be positioned at beginning and end of the rising slope. For the RISE LIMIT 10%/90% must be selected.
- Press WRITE.

REQUIREMENT

The rise-time measured on the screen must be 189 ps or less. This value takes into account the rise-times of generator and oscilloscope.

MEASURING RESULT

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C.7

SUBJECT

Base line instability.

TEST EQUIPMENT

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SETTINGS

- Press AUTO without input signals.
- Select Ch. A and B for vertical display.
- Position the A and B lines in the vertical mid of the screen with OFFSET A and B.
- Select function ADD.

REQUIREMENTS

- Check that the line that should be in the vertical mid of the screen does not have a displacement of more than 0,3 div. from the vertical mid of the graticule.

MEASURING RESULTS

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SETTINGS

- Switch channel A and B on.
- Switch up and down through the range 5 ... 200mV of the Ch. A and B AMPL/DIV control. This happens if you keep the knob fixed in one of its two switching positions.

REQUIREMENTS

- Check that the Ch. A and B lines do not jump more than 0,4 div.

MEASURING RESULTS

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SETTINGS	<ul style="list-style-type: none"> - Switch channel A and B on. - Switch the softkey functions "A-INVERT" and "B-INVERT" repeatedly on and off.
REQUIREMENTS	<ul style="list-style-type: none"> - Check that the Ch. A and B lines do not jump more than 0,5 div.
MEASURING RESULTS	.....

SETTINGS	<ul style="list-style-type: none"> - Switch channel A and B on - Turn the controls VARIABLE gain Ch. A and B repeatedly between their extreme positions.
REQUIREMENTS	<ul style="list-style-type: none"> - Check that the Ch. A and B line do not move more than 0,25 div.
MEASURING RESULTS

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C.8	SUBJECT	Average function.
	TEST EQUIPMENT	Constant amplitude sine-wave generator SG503 and 1.f. sine-wave generator.
	SETTINGS	<ul style="list-style-type: none"> - Press AUTO. - Apply a 1.f. sine-wave of 100 kHz/1,2 V (pp) to the Ch. A input. - Adjust generator amplitude to 6 div. - Apply a h.f. sine-wave of 250 MHz/0,2 V (pp) from the constant amplitude generator to the Ch. B input socket. This is the artificial noise signal. - Ch. B input sensitivity must be 200 mV/div - Select ADD mode for vertical display. The display now shows the 100 kHz/6 div sinewave with much 245 MHz "noise" superimposed.

REQUIREMENTS

- Select via vertical MODE and PROCESSING the AVERAGE mode. Now you can select the value "C" between 2...64. The higher C is choosen, the cleaner the display becomes: the noise is eliminated. A high C value has the disadvantage that the correction action lasts longer

MEASURING RESULTS

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D. HORIZONTAL DEFLECTION

D.1	SUBJECT	Deflection coefficients time base.
	TEST EQUIPMENT	Time marker generator.
	SETTINGS	<ul style="list-style-type: none"> - Press AUTO. - Apply the output signal of the time marker generator to input Ch. A.
	REQUIREMENTS	<ul style="list-style-type: none"> - Check the TIME/DIV coefficient errors according to the table below. This must be measured across the central 8 horizontal divisions.

Time markers(pp) pulse frequency	time base setting .../div	Max. coefficient error	Measuring results
20 us	20 us	+or- 3%	.....
10 us	10 us	+or- 3%	.....
5 us	5 us	+or- 3%	.....
2 us	2 us	+or- 3%	.....
1 us	1 us	+or- 3%	.....
500 ns	0,5 us	+or- 3%	.....
200 ns	0,2 us	+or- 3%	.....
100 ns	0,1 us	+or- 3%	.....
50 ns	50 ns	+or- 3%	.....
20 ns	20 ns	+or- 3%	.....
10 ns	10 ns	+or- 3%	.....
5 ns	5 ns	+or- 3%	.....
2 ns	2 ns	+or- 3%	.....
1 ns	1 ns	+or- 3%	.....

- Remove the input signal.

D.2 SUBJECT Trigger sensitivities.

TEST EQUIPMENT Constant sine-wave generator SG503.

SETTINGS

- Apply the output voltage of the generator to input A of the oscilloscope.
- Adjust the output voltage to 250 kHz/10 mV.
- Press AUTO.
- Select TRIGGER MODE TRIGG'ED and HIGH SENS.
- The trigger sensitivities can be checked according to the table below. The trigger source is identical to the input to which the generator is applied.

The trigger sensitivity is sufficient if the signal on the screen is refreshed constantly (compare the memory mode LOCK where this is not done). During the now following test steps adjustment of TIME/DIV may be necessary. Also small LEVEL adjustments may be necessary to obtain a triggered signal.

SETTINGS, REQUIREMENTS AND RESULTS

generator output	scope input, sensitivity, mode	requirement, result
250 kHz/10 mV	A, HIGH, TRIGG'ED	triggered signal:
250 kHz/10 mV	B, HIGH, TRIGG'ED	triggered signal:
250 kHz/10 mV	EXT, HIGH, TRIGG'ED	triggered "line":
250 kHz/100 mV	A, LOW, TRIGG'ED	triggered signal:
250 kHz/100 mV	B, LOW, TRIGG'ED	triggered signal:
250 kHz/100 mV	EXT, LOW, TRIGG'ED	triggered "line":
200 MHz/20 mV	A, HIGH, COUNTDOWN	triggered signal:

TEST EQUIPMENT Constant sine-wave generator SG504 and
frequency doubler HP11721A.

SETTINGS

- Connect the generator's output head to the input of the frequency-doubler. For a good functioning of the frequency doubler it is necessary to drive it with a generator voltage higher then 2 V. The correct input voltages for the oscilloscope can be made with attenuator pieces of good quality between frequency-doubler output and scope input and by varying the generator voltage between 2 and 5,5 Volt. Combinations of 2 attenuators are possible.
- The trigger mode must be COUNTDOWN because the sensitivity checks are in the range 0,5...2 GHz.
- Check the trigger sensitivities according to the table below (readjust TIME/DIV if necessary for a good display):

SETTINGS, REQUIREMENTS AND RESULTS

Generator output	Doubler output	scope input sensitivity	requirement, results
245 MHz	20 mV	A, HIGH	triggered signal,
0.9 GHz *	25 mV *	A, HIGH	triggered signal,
0,9 GHz *	25 mV *	B, HIGH	triggered signal,
1 GHz *	50 mV *	A, LOW	triggered signal,
1 GHz *	50 mV *	B, LOW	triggered signal,

*) Adjust the output voltage at 245 MHz to respectively 20, 25 or 50 mV. Then turn the frequency up to 1 GHz.

SETTINGS

- Apply the output signal of frequency doubler via the necessary attenuators to a power splitter. The splitter's output signals are applied to respectively input A and input EXT.
- Select channel A for vertical display.
- Select EXT as trigger source.
- Select trigger modes COUNTDOWN and SENS HIGH (SENS LOW).
- Adjust the generator signal via the channel A display to an amplitude of 25 mV (50 mV) at a generator frequency of 245 MHz. Increase the generator frequency then to 900 MHz (1000 MHz).

REQUIREMENT

- Check for a stable triggered display via channel A.

MEASURING RESULT

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d.3

SUBJECT

Trigger mode switching.

TEST EQUIPMENT

Constant sine-wave generator SG 503.

SETTINGS

- Apply a 140MHz sine-wave of 1V to ch. A.
- Press AUTO SET.
- Vary the generator frequency in the range 140 ... 170 ... 140 MHz.

REQUIREMENT

- Check via the front panel LED's that the trigger mode changes from TRIGGER to COUNT DOWN at 160MHz (typical value).
- Check that the trigger mode changes from COUNTDOWN to TRIGGER at 150 MHz (typical).

MEASURING RESULT

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E. CURSORS

SUBJECT	Time cursor accuracy.
TEST EQUIPMENT	Time marker generator.
SETTINGS	<ul style="list-style-type: none"> - Apply 20 us time marker signal to the Ch. A input. - Press AUTO. - Select a suitable AMPL/DIV position for Ch. A. - Select 20 us/div for the time base. - Press LOCK. - Press CURSOR/ANALYZE and softkey ON. - Select REG Ø/ch. A for 1st and 2nd cursor - Position the 1st CURSOR and the 2nd CURSOR so that they cover a distance of 8 time marker intervals.
REQUIREMENTS	Check for a time cursor read-out of 160 us + or - 0,5 us.
MEASURING RESULTS	.....
SETTINGS	- Select WRITE again.

F. CALIBRATION VOLTAGE

SUBJECT	Calibration voltage accuracy.
TEST EQUIPMENT	Digital multimeter adjusted to the d.c. voltage range
SETTINGS	Connect the digital multimeter to the CALibration output socket.
REQUIREMENTS	Check for a voltage read out of 1000 mV (+or- 10 mV).
MEASURING RESULTS	.....

G. PLOT OUTPUT

SUBJECT	Accuracy of vertical and horizontal plot output voltages.
TEST EQUIPMENT	Digital multimeter and l.f. sq.wave generator.
SETTINGS	<ul style="list-style-type: none">- Plug the plot cable into the DIN plot output socket at the rear of the instrument.- Apply a sq.wave signal of 10 kHz/1,2 V (pp) to input A and B.- Press AUTO.- Select 200 mV/div for Ch. A and B.- Position the two sq.wave signals in the vertical mid of the screen with OFFSET A and B.- Increase the generator's output voltage so that the displayed signal is 6 divisions.- Select TIME/DIV: 10us.- Select 100 mV/div for Ch. A and B.- Select A versus B via the DISPLAY mode and switch register RØ on.- Select 20 ms/DT via the menus SAVE/PLOT, SELECT and ANALOG.- Press softkey RETURN two times and then ANALOG so that the oscilloscope starts the plot action. This can be seen because the dot moves from left to right in the bottom of the screen.
REQUIREMENTS	<ul style="list-style-type: none">- Measure with the digital multimeter (d.c. voltage range) the maximum voltage at the vertical plot output (red banana plug, black is mass). This voltage must be 1000 mV + or - 30 mV.- Measure with the digital multimeter (d.c. voltage range) the maximum voltage at the horizontal plot output (blue banana plug, black is mass). This voltage must be 1000 mV + or - 30 mV.
MEASURING RESULTS	.....