Pulse generator 1 Hz—50 MHz

PM 5715

Instruction manual

9499 463 01102 -
930815

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Important

As the instrument is an electrical apparatus, it may be operated only by trained personnel. Maintenance and repairs may also be carried out only by qualified personnel.

Please note

In correspondence concerning this instrument, please quote the type number and serial number as given on the type plate.

Printed in Sweden

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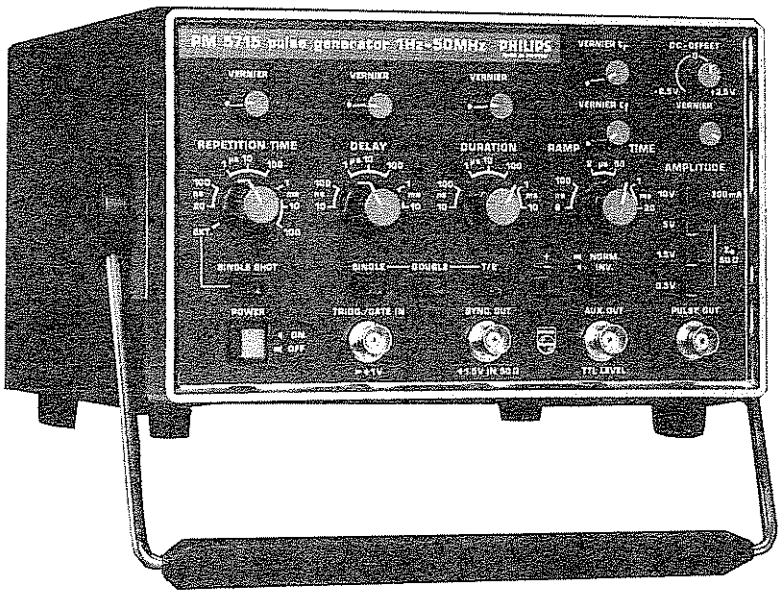

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OPERATING PART

1. Introduction

The PM 5715 generates high-quality pulses at a repetition frequency of 1Hz to 50MHz and rise and falltime being independently and continuously variable between 6ns and 0.5s.
All of the other important pulse parameters, such as pulse delay, duration and amplitude, are also variable within a wide range.
Normal or inverted pulses with positive or negative polarity, double pulse generation and variable d.c. offset are other versatility parameters provided by the PM 5715.
The variable transition time combined with a second TTL matched output make the PM 5715 particularly useful when testing or simulating TTL circuits. Square wave generation and pulse shaping facility extend the range of useful applications.

2. Technical data

Properties expressed in numerical values with statement of tolerances are guaranteed.

Numerical values without tolerances are intended for information purposes only and indicate the properties of an average instrument. The numerical values hold good for the nominal mains voltage.

ELECTRICAL

Internal triggering	
Repetition rate	1Hz...50MHz Variable in 8 ranges with continuous control within the ranges
Jitter	⩽ 0.1% or 50ps whichever is greater
Temperature coefficient	<0.3%/°C
External triggering	
Triggering: input voltage	> +1V to trigger the generator
max. voltage	+12V
frequency input	0...50MHz
impedance	approx. 1kΩ In mode T/2 the pulse duration is determined by the driver input. In mode single or double the delay, and pulse duration are set by front panel controls.
Synchronous gating: input voltage	> +1V to gate the generator
impedance	approx. 1kΩ Gating signal turns generator ''off''. First pulse coincides with trailing edge of the gating pulse.
Delay from trigger (or gate) input to main pulse output with pulse delay set to 10 ns	approx. 50ns
Single shot operation	Single shot facility by means of push-button
Sync. output	Square wave, amplitude +1.5V into 50Ω (+3V open circuit) Source impedance: 50Ω Pulse occurs approx. 40ns ahead of the main pulse with pulse delay set to 10ns.

Pulse delay

Range	10ns...100ms Variable in 7 ranges with continuous control within the ranges
Jitter	⩽ 0.1 % or 50ps whichever is greater
Temperature coefficient	<0.3 %/°C

Pulse duration

Range	10ns...100ms Variable in 7 ranges with continuous control within the ranges
Duty cycle	Approaching 100 % using inverted pulse output (limited only by minimum duration) Greater than 50 % in normal operation
Jitter	⩽0.1 % or 50ps whichever is greater
Temperature coefficient	<0.3 %/°C

Modes of operation

T/2, single pulse or double pulse
Double pulse mode provides "twin" pulses at set delay with simultaneously controlled pulse duration

Auxiliary output

Amplitude +2.5V into 50Ω (+4.5V open circuit)
Source impedance: 50Ω
Pulse occurs approx. 12ns ahead of main pulse
Pulse delay and duration are set with the controls DELAY and DURATION in all operation modes. Provides single pulse or double pulse but not T/2 or inverted pulse.

Main pulse output

Amplitude	0.2V...10V into 50Ω Variable in 4 ranges (10V, 5V, 1.5V and 0.5V) with continuous control within the ranges
Polarity	Positive or negative, normal or inverted
Source impedance	Positive 10V: current source (max. 200mA) Positions 5V, 1.5V and 0.5V: internally terminated with 50Ω
Rise and fall time at 5V and lower positions	⩽6ns...0.5s The transition time remains constant when the main pulse amplitude is varied. Independent continuous control within each of 6 ranges.
Waveform aberration	< ±5 % of set amplitude
Protection	Short and open circuit safe

DC-offset

Continuously variable from +2.5V to −2.5V into 50Ω
Pulse amplitude plus d.c. offset max. ±10V

Main supply
Mains voltage

Switchable ⇄

100V ± 15 %	200V ± 15 %	↑↓ Solderable
115V ± 15 %	230V ± 15 %	
110V	220V	

Voltage selector indicates

Mains frequency 50...400Hz
Power consumption 70VA

Temperature range 0... + 40°C

MECHANICAL

Dimensions Depth 275mm
Width 210mm
Height 130mm

Weight 4kg

3. Accessories

Standard accessories
(supplied with the instrument)

- 1 manual
- 1 mains flex
- 1 fuse 400mA, delayed action
- 1 fuse 800mA, delayed action

Optional accessories
(to be ordered separately)

Termination, 50Ω , 3W	PM 9581
Termination, 50Ω , 1W	PM 9585
Mixing piece, 50Ω	PM 9584
Coaxial cable set, 50Ω	PM 9588*)

*)contains following cables, type RG58A/U with BNC connectors:

	Delay	Length (mm)	Service codenumber
5x	1ns	200	5322 320 10009
4x	2ns	400	5322 320 10011
3x	3ns	600	5322 320 10012
3x	10ns	1980	5322 320 10013

4. Block diagram description

Note: Figures in brackets refer to waveforms shown in Fig. 4—1.

Astable multivibrator

The astable multivibrator generates square wave pulses from which all internal pulses are derived.
Switch REPETITION TIME, SK1, and its vernier, R1, enable adjustment of the repetition time between 1s and 20ns. The multivibrator is inoperative when switch REPETITION TIME is set to position EXT.

Trigger circuit

In the EXT. mode the pulse generator can be triggered by an external signal applied at connector TRIGG./GATE IN, BU1.
The triggering signal is fed to a Schmitt trigger, producing an appropriate signal for the remaining circuits of the generator.
With no triggering signal applied, a single pulse is generated by the Schmitt trigger when push-button switch SINGLE SHOT, SK5, is depressed.
With switch REPETITION TIME set to one of the time positions, the astable multivibrator can be gated by a signal applied at input TRIGG./GATE IN. Bursts of pulses which are synchronized with the gating signal are then obtained.

Gate, sync. amplifier and first pulse shaper

The output of the gate is available at front panel connector SYNC. OUT, BU2. The repetition frequency and the duty cycle of this signal is determined by the astable multivibrator, or, at external operation, by the triggering signal.
The pulse shaper is controlled by the leading edge of the input signal (1) from the gate. The shaper provides a needle pulse (2) which is controlling the delay circuit.

Delay circuit, second pulse shaper and duration circuit

The delay circuit delivers pulses (3) whose width is adjusted with the DELAY control, SK2, and its vernier, R2. The trailing edge of these pulses controls the next pulse shaper which feeds a needle pulse (4) to the duration circuit.
Similar to the delay circuit, the duration circuit produces pulses whose width is set with the DURATION controls, SK3, and its vernier, R3.
In the DOUBLE mode, a needle pulse (5) derived from the leading edge of the delay pulse is gated to the input of the duration circuit. Double pulses are then generated. The output of the duration circuit is available at front panel connector AUX. OUT, BU3.
This signal having a fixed amplitude occurs approximately 12ns ahead of the main signal at front panel connector PULSE OUT, BU4.
Normal or inverted mode of the signal at PULSE OUT can be selected with switch NORMAL/INV.,SK10.

Switch T/2, SK8

When the T/2 switch, SK8, is depressed, the delay and duration circuits are separated from the output stage. The signal (1) produced by the internal multivibrator, or the Schmitt trigger, is fed directly to the output stage. However, the AUX. OUT connector still provides the signal with adjustable delay and duration.
In the EXT. position of switch REPETITION TIME and with switch T/2 depressed, the triggering signal applied at input TRIGG./GATE IN is fed only through the output stage and is available at connector PULSE OUT with the same repetition time and duty cycle as the original signal, but with a rise time, shape, and amplitude in conformance with the specification of the PM 5715.

Ramp generator and output circuit

From switch T/2 the pulses are fed via the differential amplifier to the ramp generator which determinies the transition time of the pulses. The rise and fall times are independently and continuously set with controls RISE, R4 and FALL, R5.
An emitter follower provides a low impedance output to the dual-channel output stage. The polarity switch "+ −" diverts the signal into the positive or negative channel.
In both channels, the amplitude can be continuously controlled with the AMPLITUDE vernier R7.
Next, a resistive network provides attenuation of the signal as set with push-button switches AMPLITUDE, SK11...SK14.
The signal is then fed to the output connector, PULSE OUT, BU4.
A d.c.-offset circuit supplies a positive or negative current to the output line so that baseline shift can be introduced by means of control DC-OFFSET, R6.

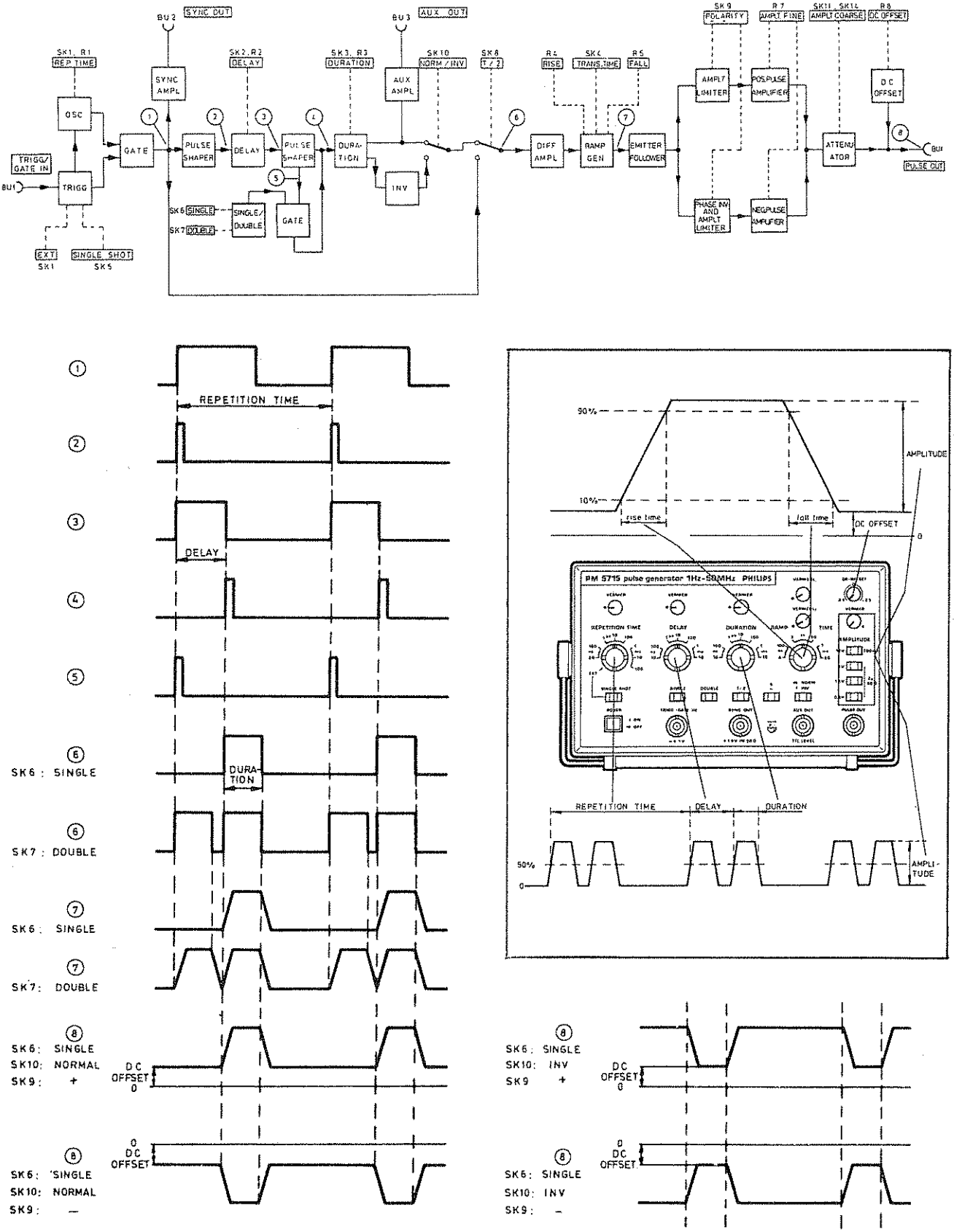

Fig. 4—1. Block diagram

5. Installation

SETTING UP

Always place the instrument so that the air circulation through the airvents in the bottom plate and the top cover is not impeded.
The ambient temperature should be between 0°C and +40°C for operating within the specification.

SAFETY REGULATIONS

Upon delivery, the instrument complies with the required safety regulations. To maintain this condition and to ensure safe operation, it is recommended to follow the instruction below.

BEFORE CONNECTING

Mains voltage

Check whether the instrument is adapted to the nominal mains voltage.

Protection

This instrument is protected according to class I (protective earth) of the IEC 348 or VDE 0411. The mains cable provides earth connection. Outside specially protected rooms, the mains plug must be connected only to sockets with earthed contact.

MAINTENANCE AND REPAIR

Failure and excessive stress

If the instrument is suspected of being unsafe, take it out of operation permanently.
This is the case when the instrument
- shows physical damage
- does not function anyore
- is stressed beyond the tolerable limits (e.g. during storage and transportation)

Dismantling the instrument

When removing covers or other parts by means of tools, live part or terminals could be exposed. Before opening the instrument, disconnect it from all power sources.
If the open live instrument needs calibration, maintenance or a repair, it must be preformed only by trained personnel being aware of the risks. After disconnection from all power sources, the capacitors in the instrument may remain charged for some seconds, observe the circuit diagrams.

Repair, replacing parts

Repair must be made by trained personnel. Ensure that the construction of the instrument is not altered to the detritment of safety. Above all, leakage paths, air gaps and insulation layers must not be reduced.
When replacing, use only original parts. Other spare parts are only acceptable when safety precautions for the instrument are not impaired.

FUSES

For 220V mains voltage, a 400mA fuse with delayed action is used. For 110V, a delayed 800mA fuse is required.
The fuse is available at the rear panel of the generator.
The fuse-holder can be unscrewed for replacement of the fuse.
Only use the specified fuses.

MOUNTING

The instrument may be used in any desired position. Do not position the instrument on any surface which produces or radiates heat, or in direct sunlight.

EARTHING

Before switching on, the instrument must be earthed in conformity with the local safety regulations. The mains cable fixed to the instrument includes a protective conductor, which is connected to the earth contacts of the plug. Thus, when connected to an earthed mains socket the cabinet of the instrument is consequently connected to the protective earth.

WARNING: Connect the mains cable plug only to a socket with protective earth contacts. This protection must not be made ineffective, e.g. by using an extension cable without earth protection!
The circuit earth potential applied to the external contacts of BNC sockets is connected to the cabinet. The external contacts of the BNC sockets must not be used to connect a protective conductor.

MAINS CONNECTION

The instrument must be connected only to an AC supply. Before connecting the instrument to the mains, make sure it is set to the local mains voltage.
Mains connection must be made in accordance with the local safety regulations. This implies that the instrument is connected to mains socket with protective earth contact.

ADJUSTMENT TO THE LOCAL MAINS VOLTAGE

Version /00 to /09 and from version /11

The mains voltage selector SK21 at the rear of the generator can be set to two ranges:

Position	Voltage range	
110V	100...130V	Frequency 50Hz...400Hz
220V	200...260V	

Two other ranges, 85...115V and 170...230V can be achieved by changing the connection of the mains transformer as described in the Service Manual (chapter 10).

For version /10

The instrument can be converted into four mains voltage ranges by changing the wiring of the mains transformer (chapter 10). The selected mains voltage range is indicated on the rear panel according to the table:

Voltage range	Mains voltage indicator (rear)	
85...115V	110V	
100...130V	110V	Frequency 50Hz...400Hz
170...230V	220V	
200...260V	220V	

CONTROLS, INPUT AND OUTPUT CONNECTORS

Control or connector	Designation	Purpose
SK1	REPETITION TIME EXT	Selection of the repetition time in 8 steps Selection of single shot operation or external triggering
R1	VERNIER	Fine control of repetition time, provides overlap between ranges
SK2	DELAY	Selection of delay time in 7 steps
R2	VERNIER	Fine control of delay time, provides overlap between ranges
SK3	DURATION	Selection of pulse duration in 7 steps
R3	VERNIER	Fine control of pulse duration, provides overlap between ranges
SK4	RAMP TIME	Selection of ramp time in 6 ranges
R4	VERNIER t_r	Continuous control of risetime within set range
R5	VERNIER t_f	Continuous control of falltime within set range
R6	DC-OFFSET	Continuous baseline shift from +2.5V to −2.5V
SK11 SK12 SK13 SK14	10V 5V 1.5V 0.5V } AMPLITUDE	Selection of output amplitude
R7	VERNIER	Continuous control of output amplitude. Provides overlap between ranges
SK5	SINGLE SHOT	When SK1 is set to EXT. and no triggering signal is applied to BU1, TRIGG./GATE IN, a single pulse is produced when SK5 is depressed
SK6 SK7	SINGLE DOUBLE }	Selection of single or double pulse
SK8	T/2	Internal operation: Selection of an output pulse train with duty cycle ≈50% External operation: Shaping of applied triggering signal Set delay and duration do not influence
SK9	±	Selection of positive or negative polarity of output pulse
SK10	NORM./INV.	Selection of normal or inverted output pulse
SK15	POWER ON-OFF	Mains switch
BU1	TRIGG./GATE IN	Accepts triggering or gating signals
BU2	SYNC. OUT	Provides synchronizing signal with fixed amplitude (+2.5V into 50Ω) derived from the internal source or triggering signal Typical risetime 10ns, falltime 5ns
BU3	AUX. OUT	Provides auxiliary signal with fixed amplitude +2.5V into 50Ω Typical risetime 10ns, falltime 5ns Variable repetition time, delay and duration No inverted pulses
BU4	PULSE OUT	Provides main pulses
BU21 (rear)		Input connector for mains supply
BU22 (rear)		Earthing clamp
SK21 (rear)		Mains voltage selector

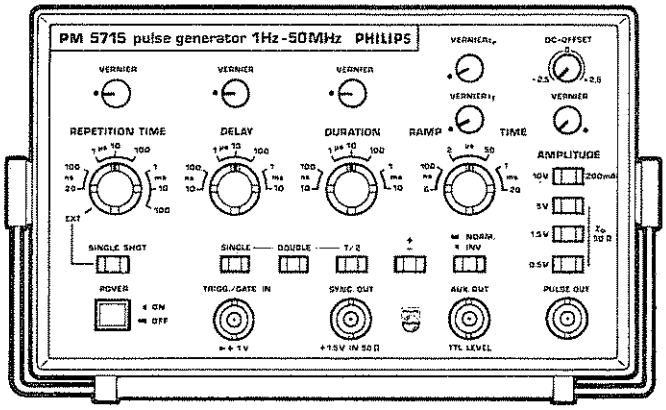

Fig. 5—1. Controls, input/output sockets at the front

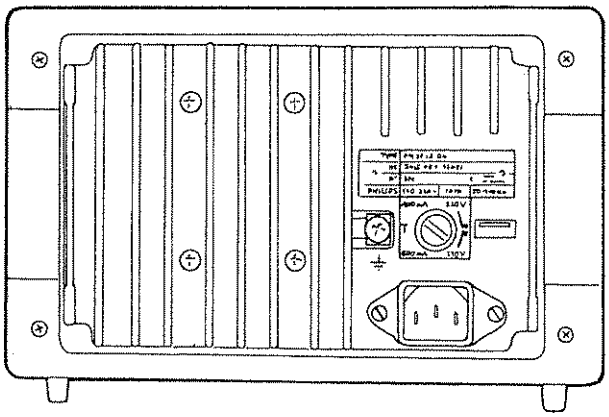

Fig. 5—2. Controls, input/output sockets at the rear, version /00 to /10

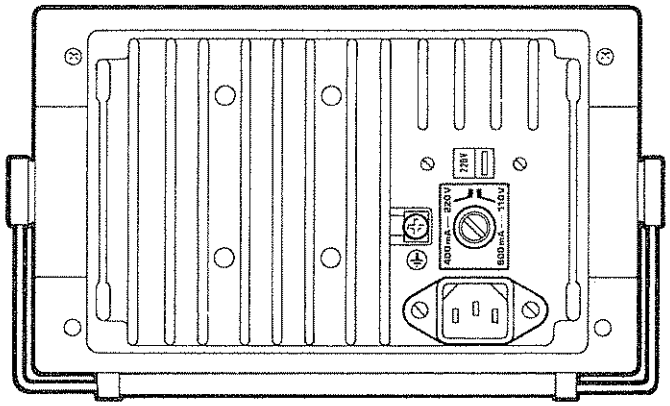

Fig. 5—3. Controls, input/output sockets at the rear, version /11

6. Operation

GENERAL

When exercising the use of the PM 5715 or employing the generator in practical set-ups it is recommended to use the Philips 200ps oscilloscope PM 3400 as displaying unit.
This oscilloscope enables error-free presentation of the 6ns transition time of the PM 5715 and high resolution close-ups of minor pulse details. A conventional oscilloscope with slower rise time can be used, but at the expense of the pulse characteristics.

PULSE OUT OUTPUT, AMPLITUDE CONTROL AND DC OFFSET

The PULSE OUT output can stand open circuit and short circuit conditions. In the lowest amplitude ranges, 0.5V, 1.5V and 5V, the output is internally terminated with 50Ω .
In the 10V range, a current source provides a maximum current output of 200mA. Higher current can be taken out, however at the expense of pulse amplitude.
If the device under test is not determinated with 50Ω , it is recommended to use the Philips 50Ω terminations PM 9581, 3W, or PM 9585, 1W, which are available as optional accessories.
Continuous setting of the pulse amplitude within each of the four ranges is made with the amplitude VERNIER, from 0.2V to 10V.
The DC-OFFSET control provides a baseline shift from +2.5V to −2.5V. The control is mechanically locked in the zero position, thus preventing any offset voltage to be introduced by accident.
The total sum of d.c.-offset and pulse amplitude is maximum 10V.
Consequently, at the highest amplitude position, d.c.-offset is added at the expense of pulse amplitude.

OUTPUTS AUX. OUT AND SYNC. OUT

Output AUX. OUT provides an auxiliary signal at a fixed amplitude of +2.5V into a 50Ω load. A high-ohmic load makes the amplitude increase to maximum +4.5V at open circuit. The AUX. OUT output is always connected to the delay and duration circuits of the generator, even in the T/2 mode, but remains unaffected by the DC-OFFSET control, NORM./INV. and polarity ("+ −") switches.
The typical rise time of the output pulse is 10ns; typical fall time is 5ns. The signal occurs approximately 12ns before the main signal at the PULSE OUT connector and can be fed directly into TTL circuits.
The output SYNC. OUT is connected to the internal square wave multivibrator or, in the EXT. position, to the trigger circuit.
In the internal mode the signal is a square wave with the set repetition time but unaffected by the set delay, duration or other settings. In the EXT. position, the triggering signal determines the repetition time and duty cycle of the SYNC. OUT signal.
This signal occurs approximately 40ns before the main signal at the PULSE OUT connector when the DELAY control is set to 10ns.
The amplitude is fixed to +1.5V into a 50Ω load (+3V open circuit).
Typical rise time is 10ns; typical fall time is 5ns.
The signal can be used to trigger external equipment, e.g. an oscilloscope.

RAMP TIME CONTROL, t_r AND t_f VERNIERS

The ramp time can be set to 6 ranges with continuous and independent control of rise time (vernier t_r) and fall time (vernier t_f) within each of the ranges.
The rise and fall time is defined between the 10% and 90% levels of the total amplitude, see Fig. 6 − 1.
Figure 6 − 2 shows that point A and B are fixed when the rise and fall times are varied. Assuming equal value of rise and fall time, the pulse duration remains constant when the ramp time is changed, or when the amplitude is varied as shown in Fig. 6 − 3.
Figure 6 − 4 shows that the pulse duration decreases when e.g. the rise time exceeds the fall time and the amplitude is kept constant. If the amplitude is also decreased, the pulse duration will increase, as shown in Fig. 6 − 5.

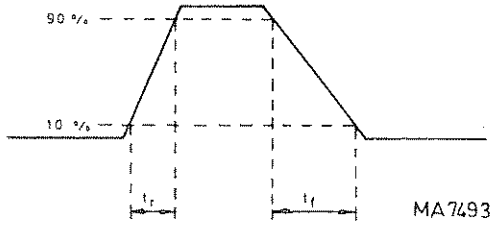

Fig. 6 − 1. Rise and fall time definition

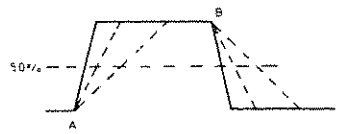

Fig. 6—2. Pulse duration remains constant at equal values of rise and fall time

Fig. 6—3. Pulse duration remains constant when the amplitude is varied at equal values of rise and fall time

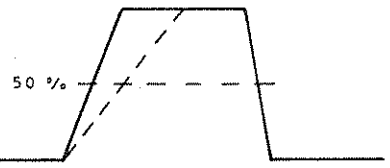

Fig. 6—4. Pulse duration decreases when the rise time exceeds the fall time (or v.v.) at a constant amplitude

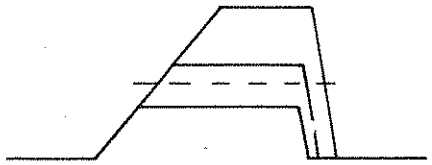

Fig. 6—5. Pulse duration decreases when varying the amplitude at unequal rise and fall time

SINGLE PULSE MODE

Repetition time, pulse delay and duration are defined in Fig. 6—6 which also shows the relationship between these parameters and pulse rise and fall times.

- Set controls REPETITION TIME and DURATION to the desired values
- Set control DELAY to 10ns or to a position required to show the leading edge on the oscilloscope
- Use the SYNC. OUT signal to trigger the oscilloscope
- Select the suitable RAMP TIME range and set the t_r and t_f vernies
- Depress push-button SINGLE
- Select normal or inverted pulses with switch NORM./INV. and pos. or neg. polarity with "+ —"
- Set the AMPLITUDE switches and vernier to required value

Note that when the vernliers of controls REPETITION TIME, DELAY, DURATION and RAMP TIME are set to the white dot, the settings aproximately correspond to the value indicated by the switch knob.
The white dot does not coincide with the extreme position of the vernier, hence providing a small overlap range.

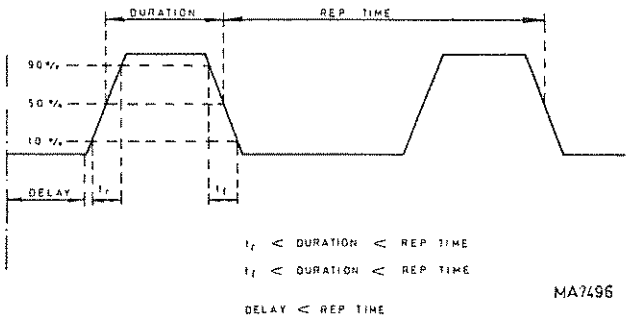

Fig. 6—6. Time setting at single-pulse mode

DOUBLE PULSE MODE

Proceed as with SINGLE pulse mode, but depress button DOUBLE.
Note, however, the relationship between repetition time, pulse delay and pulse duration shown in Fig. 6—7.
Use the DELAY controls to change the spacing between the twin pulses.

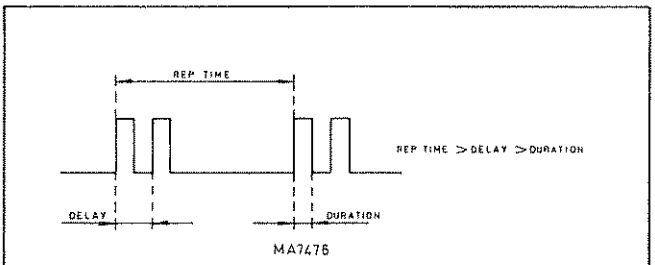

Fig. 6—7. Time setting at double-pulse mode

SQUARE WAVE MODE (T/2)

- Set switch REPETITION TIME to the desired position
- Depress button T/2
- Select positive or negative pulse output

At the PULSE OUT connector a square wave signal is available. Amplitude and d.c.-offset are variable. At the two fastest positions of the REPETITION TIME switch, the duty factor is 50% ± 20%.

Note that the output AUX. OUT provides a signal with the same repetition time but with variable delay and duration (Fig. 6 – 8).

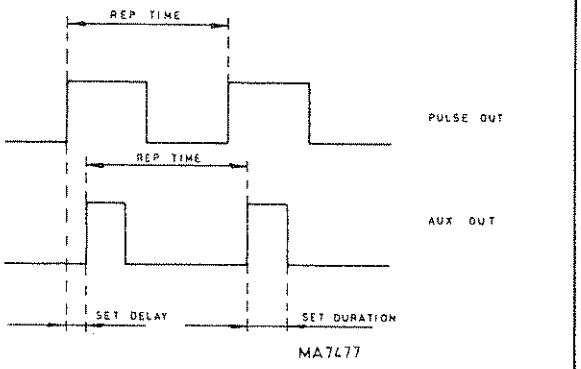

Fig. 6—8. Time setting at T/2-pulse mode

GATED SINGLE OR DOUBLE PULSES

Connect the gating signal to input TRIGG./GATE IN. The amplitude of the gating signal should exceed +1V. Maximum amplitude is +12V.
The positive-going edge of the gating signal turns the generator off. The generator can be gated both in the single and double pulse mode. Select the proper relationship between repetition time, gating pulse duration, internal pulse delay and duration as described in sections RAMP TIME and SINGLE PULSE, and as shown in Fig. 6 – 9 and 6 – 10.

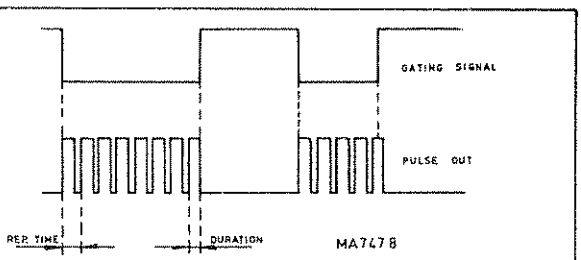

Fig. 6—9. Time setting at gating, single-pulse mode

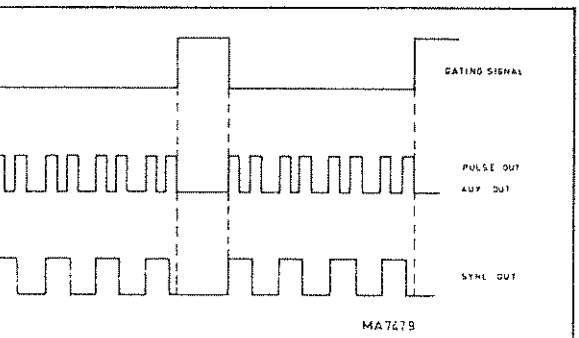

Fig. 6—10. Time setting at gating, double-pulse mode

The gating is synchronous which means that the first pulse coincides with the trailing edge of the gating pulse. The last pulse maintains the set duration even if the gating pulse ends during the pulse.
The overall delay from input TRIGG./GATE IN to output PULSE OUT is approximately 50ns when switch DELAY is set to 10ns.

EXTERNAL TRIGGERING

- Set switch REPETITION TIME to position EXT.
- Connect a triggering signal with amplitude > +1V, (max. +12V) frequency 0-50MHz, to connector TRIGG./GATE IN
  The internal multivibrator is now inoperative
- Depress buttons SINGLE or DOUBLE and set DELAY accordingly (See sections RAMP TIME and SINGLE PULSE)

Outputs PULSE OUT and AUX. OUT provide signals with the same repetition time as the triggering signal but with delay and duration as set with the front panel controls.
The SYNC. OUT output provides a square wave with the same repetition time and duty cycle as the triggering signal.

PULSE SHAPING

- Set switch REPETITION TIME to position EXT.
- Apply the signal to be shaped to input TRIGG./GATE IN (amplitude +1V to +12V)
- Depress button T/2
- Select suitable amplitude, d.c.-offset and positive or negative output

The PULSE OUT connector now provides a signal with the same repetition time and duty cycle as the input signal, but shaped (waveform abberation, transition time) according to the generator's specification (Fig. 6 – 11). Pulse delay and duration can be varied on the signal available at AUX. OUT.

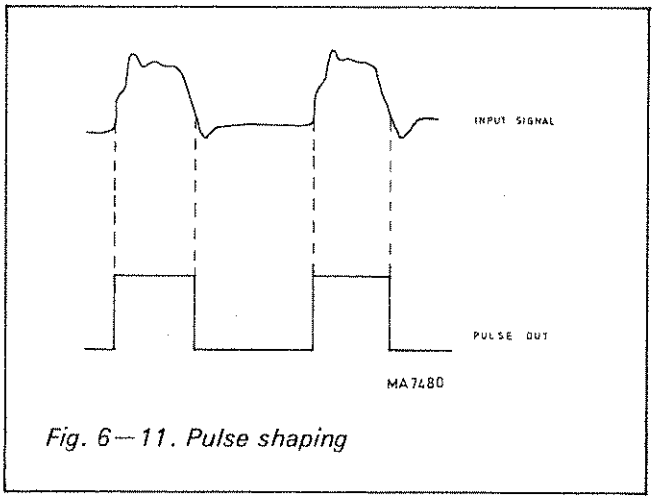

Fig. 6—11. Pulse shaping

SINGLE SHOT

– Set switch REPETITION TIME to position EXT.
– Set DURATION and DELAY to desired values
– Select NORMAL or INVERTED mode, amplitude and d.c.-offset
– Depress the SINGLE SHOT button

One and only one pulse is now generated having a duration as set with the front panel controls.
Electronic switching circuits ensure bounce-free switching.
Outputs SYNC. OUT and AUX. OUT also provide the single pulse (Fig. 6 – 12).
By depressing switch T/2 the delay and duration circuits are disconnected from output PULSE OUT.
The pulse generated remains at PULSE OUT as long as switch SINGLE SHOT is depressed.
The AUX. OUT connector, however, still provides a single pulse whose duration is set with the front panel controls (Fig. 6 – 13).

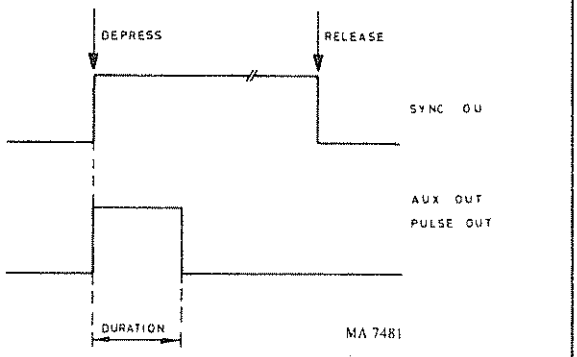

Fig. 6 – 12. Single shot at single-pulse mode

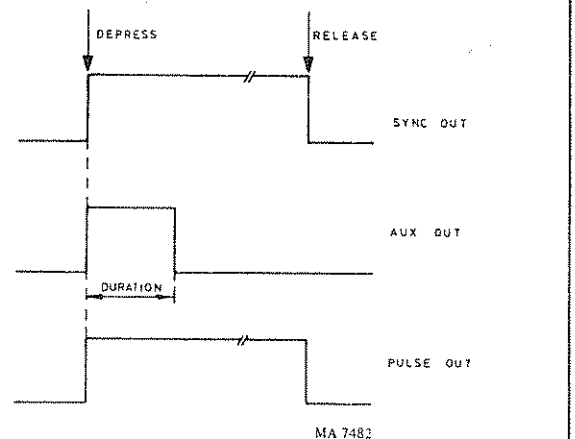

Fig. 6 – 13. Single shot at T/2-pulse mode

DUAL CHANNEL ARRANGEMENT

By combining two PM 5715 a true dual channel generator is achieved.
The one generator can be placed on top of the other to save bench space (Fig. 6 – 14).

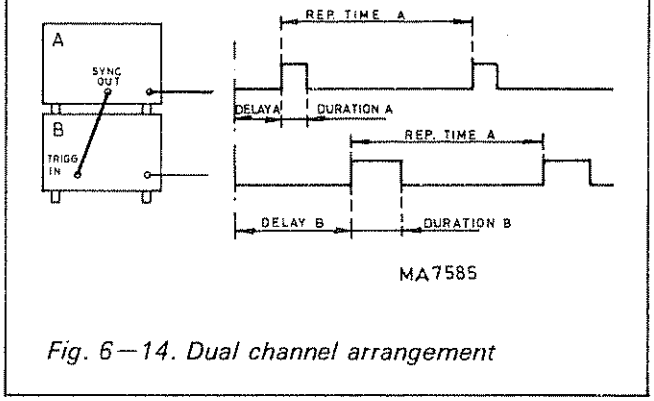

Fig. 6 – 14. Dual channel arrangement

Set the controls of generator A:
REPETITION TIME > DURATION and DELAY
Connect SYNC. OUT of generator A to TRIGG./GATE IN of generator B

Set the controls of generator B:
REPETITION TIME to EXT
Controls DURATION and DELAY to values less than the repetition time of generator A

The delay and duration of the two pulses A and B can be varied independently as well as selection of single or double pulse mode, amplitude, d.c.-offset, normal or inverted mode.
The repetition time is determined by generator A.

MIXING THE OUTPUTS OF TWO GENERATORS

To generate more complex pulse patterns it is feasible to interconnect two PM 5715 and mix their output signals (Fig. 6 – 15).

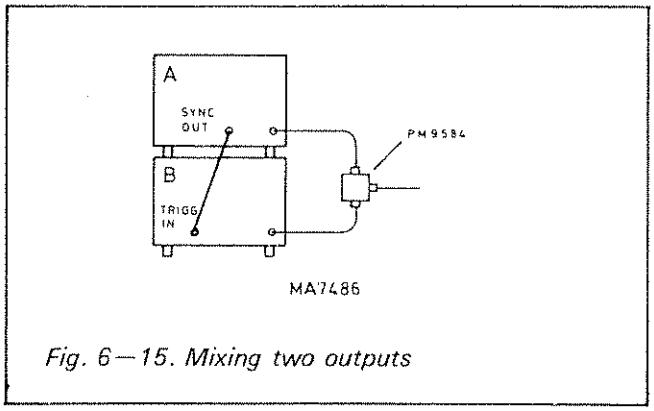

Fig. 6 – 15. Mixing two outputs

The pulse waveform is best preserved by using a resistive 50Ω T-piece, e.g. Philips type PM 9584. One can also mix the outputs via a normal BNC-piece if the pulse distortion can be tolerated.
The cables from the outputs should be of equal length and kept as short as possible.

However, because of the direct connection between the outputs of the generators, some precautions as regards amplitude and duty cycle must be taken to avoid damage to the output stage.
Two alternatives are described below.

Mixing when at least one output is at or below 5V

When at least one of the generators is set to 5V or lower amplitude there is no risk of any damage

Mixing when both outputs exceed 5V

This combination is **NOT** 100% open circuit safe.

If the load is disconnected and the duty cycle exceeds 50% the output transistors dissipate more power than in normal short-circuit conditions. These three rules, therefore, must be followed:

Make sure that the 50Ω load is connected **before** the generators are switched on

Check the time settings so that each generator does not deliver more than 50% duty cycle. Special care must be taken when switching over from NORMAL to INVERTED. A duty cycle of 30% in the NORMAL mode becomes 70% in the INVERTED mode.

Avoid such conditions when pulses overlap eachother. When pulses are of the same polarity, the output stages will be saturated.
Although harmless, this is no real operating condition.
If pulses are of opposite polarity the output currents cancel each other only at the load.