

3-1 GENERAL

3-2 This section gives some general notes on the operation of the 8013B together with operating instructions for each of the operating modes:

NORM operating mode
RZ operating mode
EXT WIDTH operating mode

Full setting up instructions are given for normal internal trigger mode followed by any changes required in the control settings for the following modes. For ease of operation the instructions will refer to Figure 3-1 which shows the controls identified by a reference number in

a circle. The same reference numbers are used in the text when each control is mentioned. The control settings shown in Figure 3-1 are the same as the initial settings given for normal internal trigger mode.

3-3 OUTPUT FORMATS

3-4 The 8013B has two pulse outputs: one with positive (17) and one with negative (18) output polarity. The normal/complement output formats can be changed using the NORM/COMPL switch (19). Thus logic convention can be changed without having to re-adjust any of the pulse parameters.

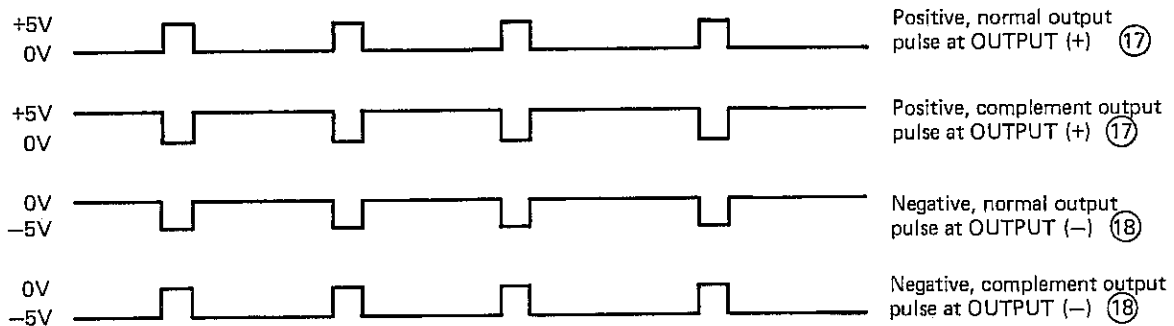


Figure 3-2. Normal/Complement Outputs

3-5 Normal/Complement pulse switching can be used to provide duty cycles of up to 100%.

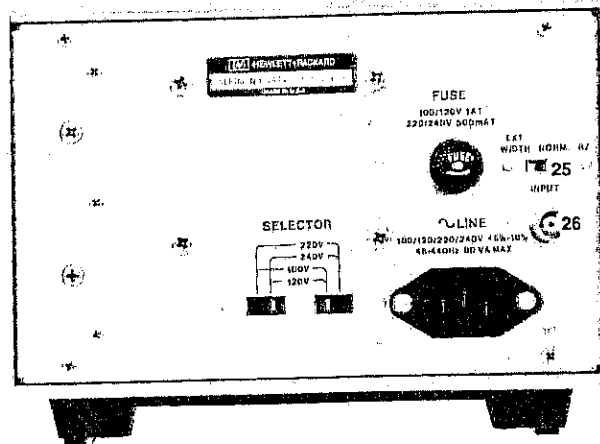
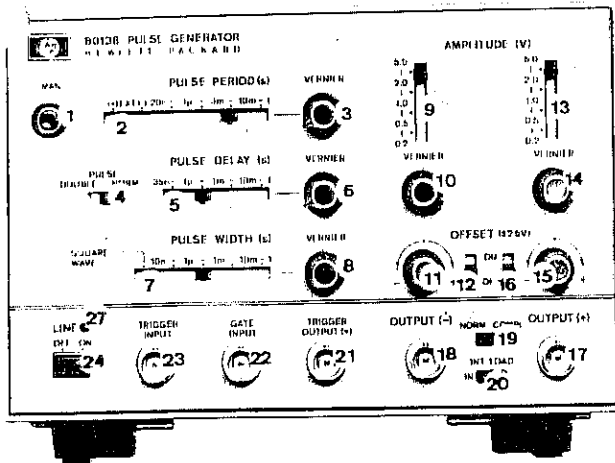
3-6 INTERNAL 50 OHM LOAD

3-7 The internal 50 ohm load of the 8013B can be switched in or out using the INT LOAD switch (20). This makes impedance matching to the circuit under test much easier and also provides a maximum pulse amplitude of $\pm 10V$ with the load switched out.

Note, however, that the DC offset is automatically switched off when the INT LOAD is switched out.

3-8 CONTROL LAYOUT

3-9 The front panel of the 8013B has been carefully designed to provide a logical layout of the controls; horizontal controls for pulse timing parameters, vertical controls for pulse amplitude parameters. Thus a particular pulse can be set up extremely easily and quickly. Also, the pulse period, delay and width controls are designed in such a way that incompatible pulse settings will be noticed immediately (see Figure 3-3).



- ① MAN pushbutton: push to generate single pulses when the RATE switch is set to EXT(+) or EXT(-).
- ② RATE switch: for selecting the range of pulse rate.
- ③ Rate VERNIER: for continuous adjustment of the repetition rate within the range selected on the RATE switch. Clockwise rotation increases the pulse period (i.e. reduced the rate). In the RZ and EXT WIDTH modes the RATE controls define the frequency of trigger output pulses only.
- ④ PULSE DOUBLE/NORMAL switch: in the DOUBLE PULSE position the 8013B delivers two pulses for every trigger pulse — one pulse in phase with the trigger output and one delayed by the amount set on the PULSE DELAY controls. DOUBLE PULSE is not available in the EXT WIDTH mode and is automatically inhibited if selected. In the NORMAL position, for each trigger pulse, the 8013B delivers, from each output, one pulse which is delayed on the trigger pulse by the amount set on the PULSE DELAY controls.
- ⑤ PULSE DELAY switch: for selecting the range of pulse delay with respect to trigger in all modes except SQUARE and EXT WIDTH.
- ⑥ Pulse delay VERNIER: for continuous adjustment of pulse delay within the range selected on the PULSE DELAY switch. Clockwise rotation increases the delay.
- ⑦ PULSE WIDTH switch: for selecting the range of the pulse width required in all modes except SQUARE and EXT WIDTH.
- ⑧ Pulse width VERNIER: for continuous adjustment of pulse width within the range set on the PULSE WIDTH switch.
- ⑨ AMPLITUDE (V) switch: for selecting range of negative (-) output pulse voltage.
- ⑩ AMPLITUDE VERNIER: for continuous adjustment of negative (-) output voltage within the range selected on the AMPLITUDE switch. Clockwise rotation increases the output amplitude.
- ⑪ OFFSET (V) vernier: for adjustment of baseline of pulse OUTPUT (-) over the range of +2.5V to -2.5V.
- ⑫ OFFSET (V) switch: for enabling/disabling the offset VERNIER (-). In the OFF position, the baseline of the pulse OUTPUT (-) is zero volts.
- ⑬ AMPLITUDE (V) switch: for selecting range of positive (+) output pulse voltage.
- ⑭ AMPLITUDE VERNIER: for continuous adjustment of positive (+) output voltage within the range selected on the AMPLITUDE switch. Clockwise rotation increases the output amplitude.
- ⑮ OFFSET (V) vernier: for adjustment of baseline of pulse OUTPUT (+) over the range of +2.5V to -2.5V.
- ⑯ OFFSET (V) switch: for enabling/disabling the offset VERNIER (+). In the OFF position, the baseline of the pulse OUTPUT (+) is zero volts.
- ⑰ OUTPUT (+) connector: BNC connector.
- ⑱ OUTPUT (-) connector: BNC connector.
- ⑲ NORM/COMPL switch: NORM/COMPL reverses the duty cycle of the output; what was the normal output becomes the complement and vice versa.
- ⑳ INT LOAD switch: switches the internal 50 ohm load either IN or OUT. With load OUT, max. amplitude is doubled to 10V.
- ㉑ TRIGGER OUTPUT connector: BNC connector supplies positive trigger output. Trigger output is not related to the input in EXT WIDTH and RZ modes.
- ㉒ GATE INPUT connector: BNC connector to which gate pulses are applied. The pulse output and trigger output are synchronous to the gate signal.
- ㉓ TRIGGER INPUT connector: BNC connector to which trigger pulses are applied when the RATE switch is set to EXT(-) or EXT(+).
- ㉔ LINE ON-OFF switch: press-for-on-press-for-off switch.
- ㉕ EXT WIDTH, NORM, RZ switch: NORM position enables synchronous pulse and trigger output. With rate switch set to EXT+ and this switch set to RZ (delay trigger) or EXT WIDTH (width trigger) the trigger output is asynchronous to signals applied to the INPUT connector.
- ㉖ INPUT connector: BNC connector to which RZ or EXT WIDTH trigger pulses are applied. Input disabled when rate switch is set to an internal range.
- ㉗ LINE lamp: glows when LINE ON/OFF switch is ON.

Figure 3--1. 8013B Front and rear panels — Control identification diagram

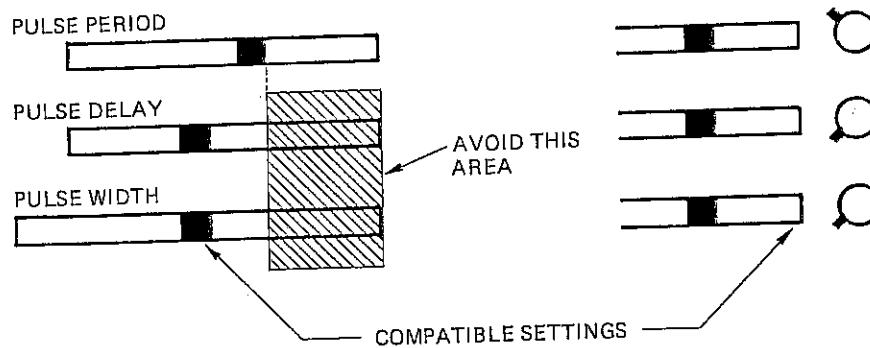


Figure 3-3. Positioning of Controls

3-10 Compatible pulse settings are guaranteed as long as the pulse delay and pulse width controls are either set to the left of the pulse period control or; if set vertically below the period control, that the delay and width verniers are set counter clockwise of the period vernier.

3-11 NORM OPERATING MODE

3-12 There are six ways of operating in the normal mode:

Internal trigger — the repetition rate is determined by the internal rate generator which is internally triggered.

External trigger — the rate generator is disabled and an external signal is used as the trigger source.

Manual trigger — one pulse is produced each time the MAN button is pressed.

Square wave — in each of the above modes a square wave output can be selected (pulse width = pulse period / 2) instead of the variable pulse width output.

Gating — Each of the outputs obtained above (except square wave) can be gated using an external input.

Double pulse — this mode can be selected with any of the above outputs (except square wave). Two pulses are produced for each trigger pulse.

All output pulses are preceded by a trigger pulse at the TRIGGER output connector (21). In square wave mode the delay between the trigger output and the pulse outputs is fixed at 25 ± 8 ns, but in other modes the delay can be varied using the PULSE DELAY (5) and VERNIER (6) controls.

3-13 Internal Trigger

3-14 In this mode the 8013B requires no external signal to produce an output signal. Rate, delay, width, amplitudes etc. are all adjustable from the front panel controls. The initial control settings (also shown in Figure 3-1) are given to assist someone unfamiliar with the operation of the 8013B. The positive and negative pulse outputs (17) and (18) and the TRIGGER OUTPUT (21) should be connected to an oscilloscope using a 50 ohm system (as shown in Figure 3-4). The oscilloscope (an HP 180C mainframe with 1801A and 1821A plug-ins) should be set with the sweep time at $20 \mu\text{s}/\text{div}$ and the sensitivity at $2\text{V}/\text{div}$.

- PULSE PERIOD ② .1m-10m
- VERNIER ③ CCW
- PULSE DOUBLE/NORM ④ NORM
- PULSE DELAY ⑤ 1μ-.1m
- VERNIER ⑥ CCW
- PULSE WIDTH ⑦ 1μ-.1m
- VERNIER ⑧ Center
- AMPLITUDE ⑨ 2.0-5.0
- VERNIER ⑩ CW
- OFFSET VERNIER ⑪ Center
- OFFSET SWITCH ⑫ ON
- AMPLITUDE ⑬ 2.0-5.0
- VERNIER ⑭ CW
- OFFSET VERNIER ⑮ Center
- OFFSET SWITCH ⑯ ON
- NORM/COMPL ⑰ NORM
- INT LOAD ⑱ IN
- Mode selector ⑳ NORM
- LINE ㉔ ON

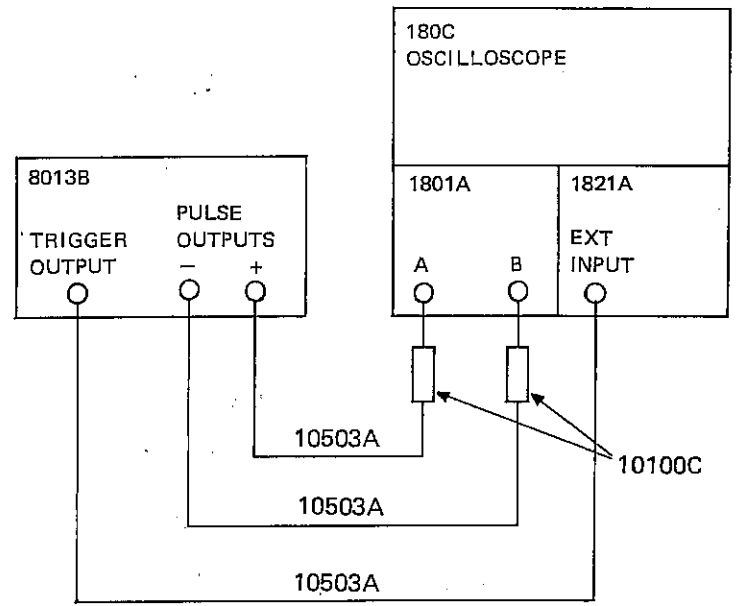


Figure 3-4. Initial control settings and test equipment

3-15 The circuits and controls involved in normal internal trigger mode are shown in Figure 3-5.

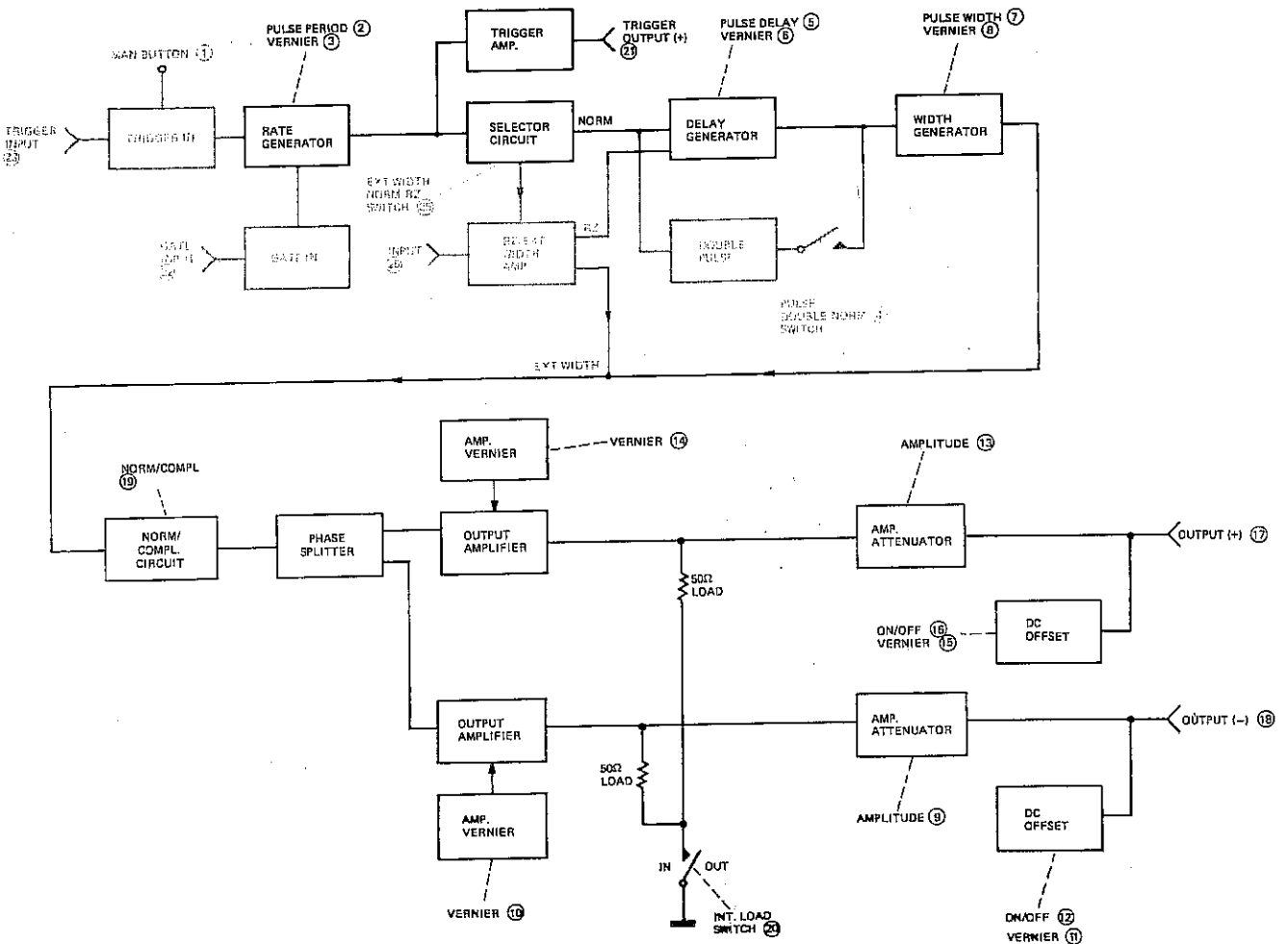


Figure 3-5. Normal internal trigger mode - block diagram

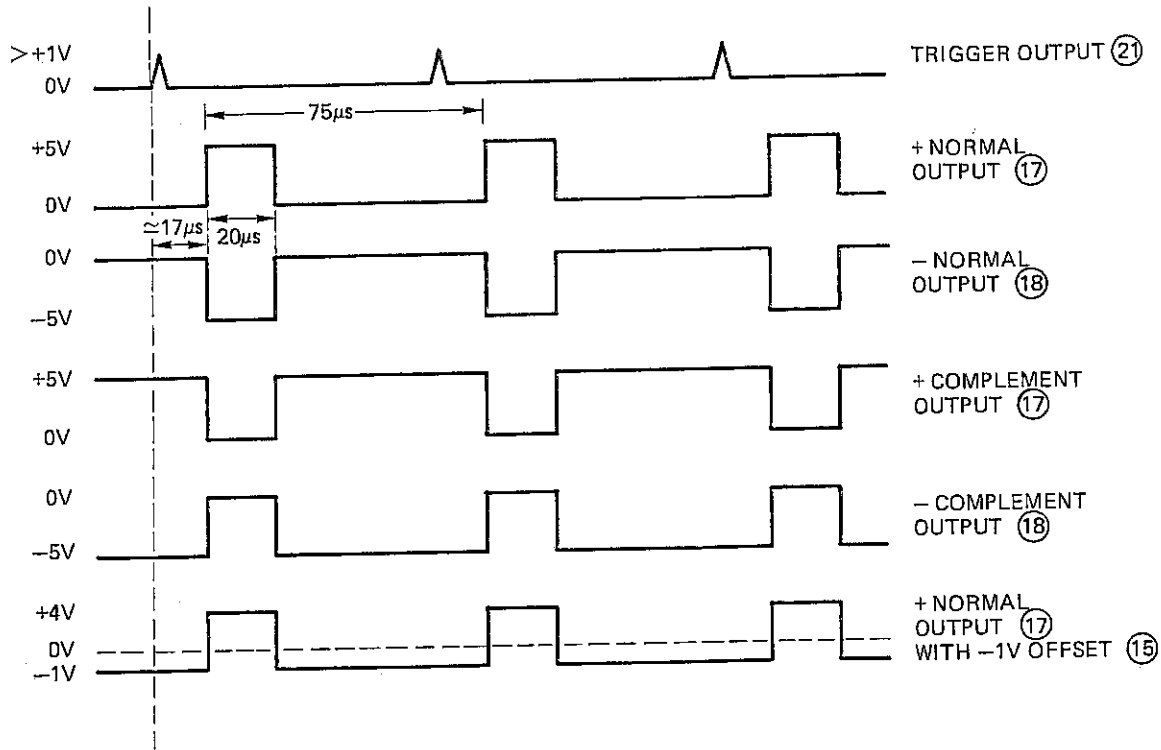


Figure 3-6. Output pulses in normal internal trigger mode

3-16 The output pulses should appear at the pulse OUTPUT (+) (17) and pulse OUTPUT (-) (18) as shown in Figure 3-6 according to the setting of the NORM/COMPL switch (19) and the OFFSET verniers (11) and (15)

3-17 If the INT LOAD switch (20) is set to OUT, the internal 50 ohm loads on each of the output amplifiers are switched out and the amplitude of the output pulses doubles (this can only be done if the 8013B has an external 50 ohm load). All other pulse parameters remain the same.

3-18 External Trigger

3-19 In this mode the repetition rate generator is disabled and each trigger pulse is produced by an

external signal which is applied at the TRIGGER INPUT connector (23). The input signal can be a sinewave of $> 1.7V$ p-p (about zero) or pulses $> 0.8V$ amplitude (positive or negative) and at least 7ns wide. The amplitude must not exceed $\pm 7V$.

a. Set the PULSE PERIOD control (2) to EXT (+) to trigger on the positive going slope of the input or to EXT(-) to trigger on the negative going slope.

b. The pulse delay, width, amplitude, etc. are determined by the front panel controls and can be left at the same settings as for normal internal trigger mode.

3-20 The circuits and controls involved in normal external trigger mode are shown in Figure 3-7.

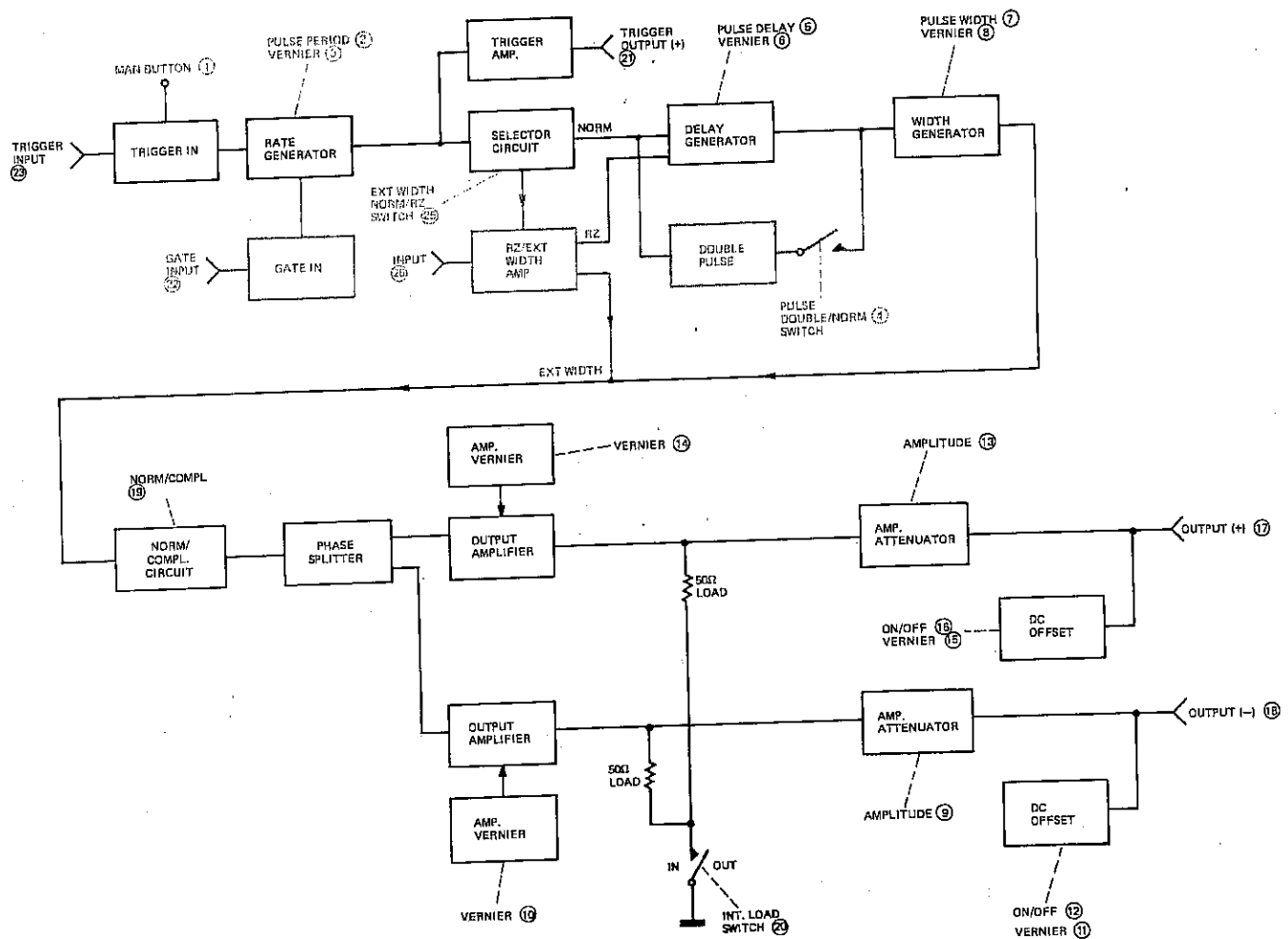


Figure 3-7. Normal external trigger mode – Block diagram

3-21 The output pulses should appear at the TRIGGER OUTPUT (21) and OUTPUT (+) (17) connectors as shown in Figure 3-8, according to the applied trigger and the setting of the PULSE PERIOD control (2) (either EXT+ or EXT-).

3-22 The output pulse parameters and formats can be varied using the controls shown in Figure 3-7.

3-23 Manual Trigger

3-24 In this mode the repetition rate generator is again disabled and each trigger pulse is produced by pressing the MAN button (1) once.

a. Set the PULSE PERIOD control (2) to either EXT(+) or EXT(-).

b. The pulse delay, width, amplitude etc. are determined by the front panel controls and can be left at the same settings as for normal internal trigger mode.

c. Press the MAN button (1) once for each output pulse.

3-25 The circuits and controls involved in normal manual trigger operation are shown in Figure 3-9.

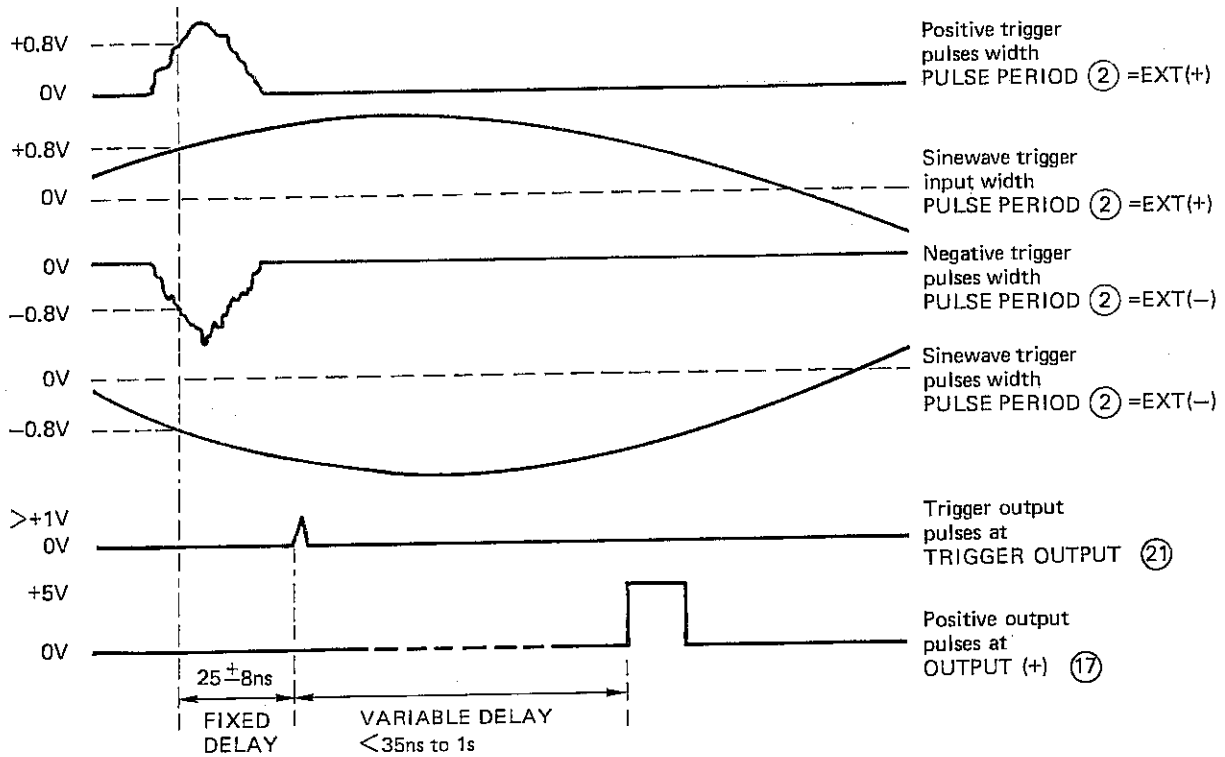


Figure 3-8. Output pulses in normal external trigger mode

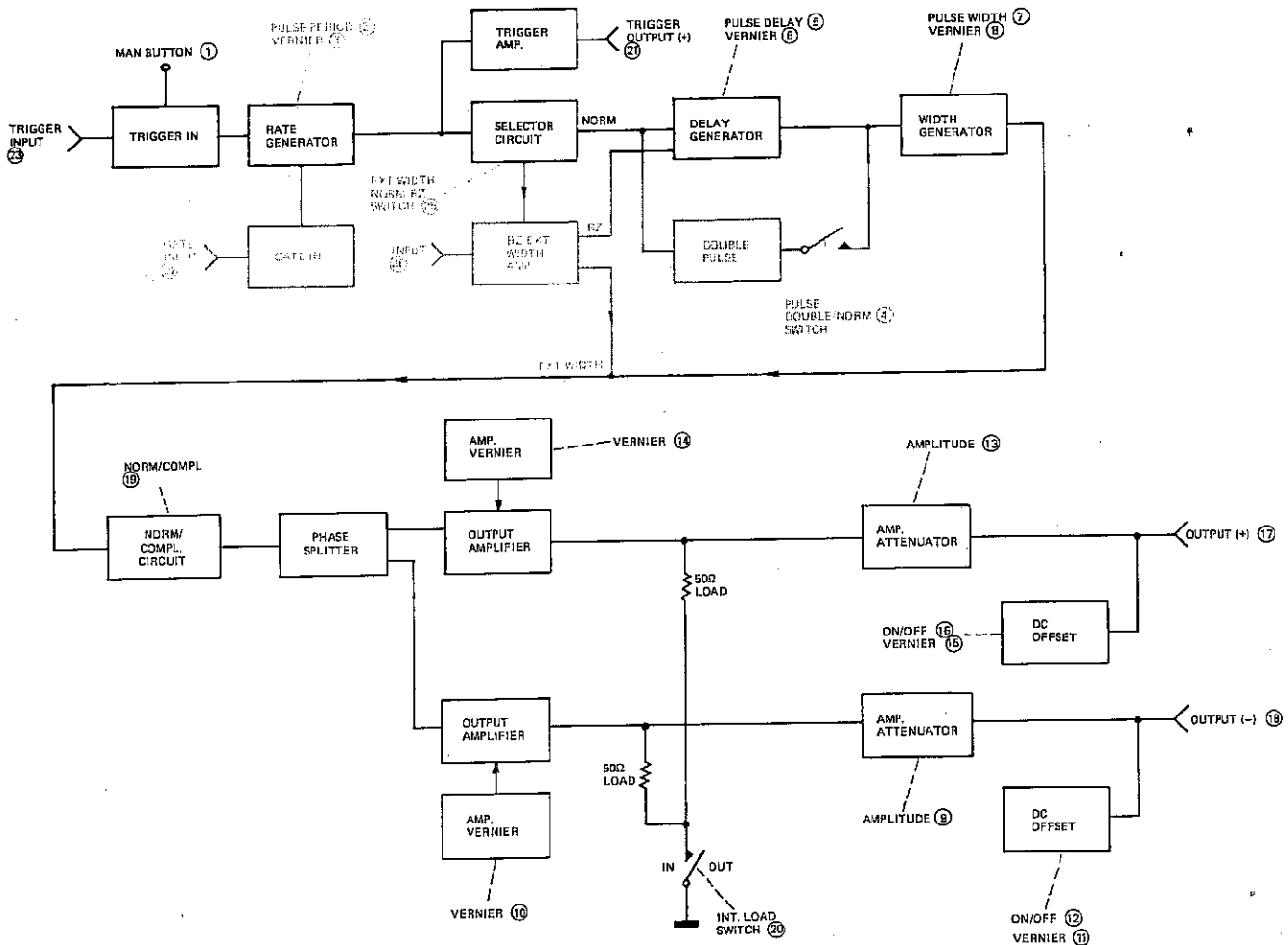


Figure 3-9. Normal manual trigger mode - block diagramm

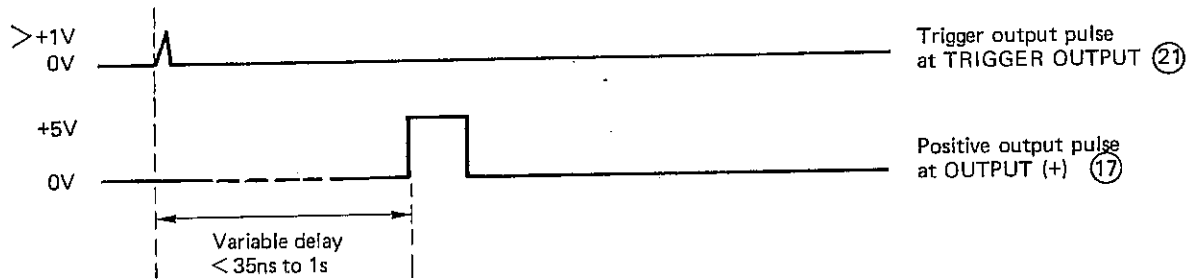


Figure 3-10. Output pulses in normal manual trigger mode

3-26 The output pulses should appear at the TRIGGER OUTPUT (21) and OUTPUT (+) (17) connectors as shown in Figure 3-10.

3-27 The output pulse parameters and formats can be varied using the controls shown in Figure 3-9.

3-28 Square Wave Mode

3-29 In this mode the pulse width is exactly half the pulse period (50% duty cycle). Pulse period, delay amplitude etc. can still be varied using the front panel controls. A square wave output can be selected in any of the preceding operating modes; the following points must, however, be remembered.

- a. Output pulse has 50% duty cycle.
- b. Output pulse rate is half that of the rate generator (or input trigger pulse).
- c. The delay between input trigger pulse and square wave output is fixed.

d. The output pulse is symmetrical above and below the offset level.

e. Square wave output cannot be gated.

3-30 The square wave output can be produced as follows:

a. Set the PULSE PERIOD control (2) to an internal range (as in normal internal trigger mode) or to EXT and apply external trigger pulses at the TRIGGER INPUT connector (23) in order to determine the repetition rate of the output pulses.

b. Set the PULSE WIDTH control (7) to SQUARE WAVE.

c. Set the amplitude etc. of the output pulses as for normal internal trigger mode.

3-31 The circuits and controls involved in square wave mode are shown in Figure 3-11.

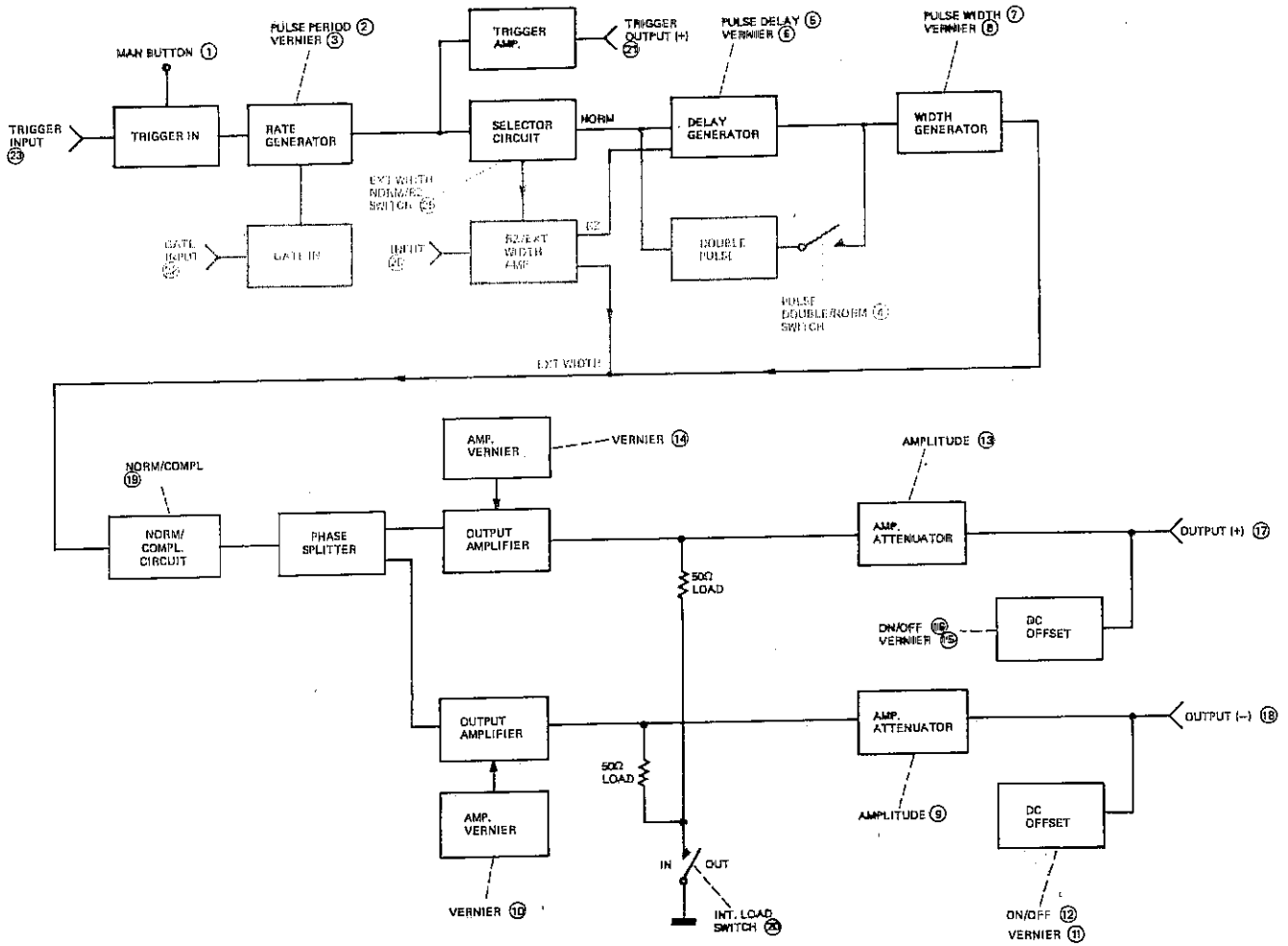


Figure 3-11. Normal square wave mode -- block diagram

3-32 The output pulses should appear at the OUTPUT (+) connector (17) as shown in figure 3-12.

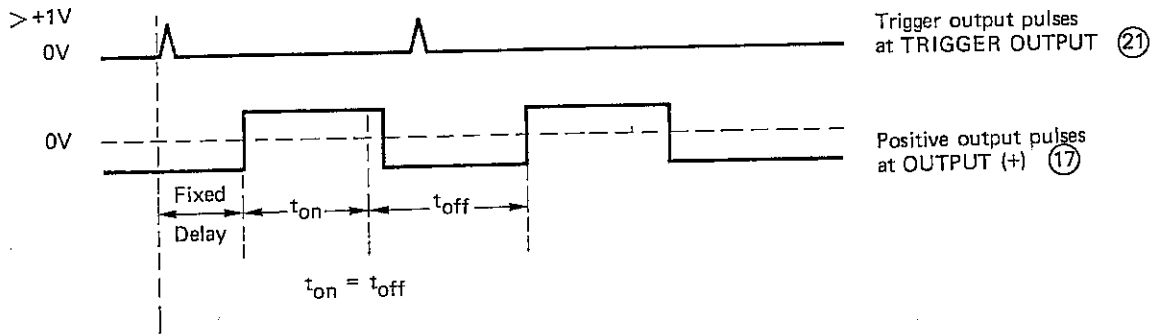


Figure 3-12. Output pulses in square wave mode

3-33 The output pulse can be switched to negative or normal or complement and the offset and amplitude can be varied.

to enable the rate generator — input voltage $> +1.5V$ or resistor $> 1K\Omega$ from gate input to ground.

3-34 Gating Mode

to disable the rate generator — input voltage $< +0.8V$ or resistor $< 160\Omega$ from gate input to ground.

3-35 The output pulses obtained in any of the preceding operating modes can be gated by applying an appropriate pulse to the GATE INPUT (22). If square wave mode is gated, the level of the pulse baseline after the gate has closed depends on the number of pulses during the gate 'on' time (see figure 3-15). The gate input must meet the following requirements:

The gate input is TTL compatible and the input voltage must not exceed $\pm 5V$.

3-36 The circuits and controls involved in gate mode are shown in Figure 3-13.

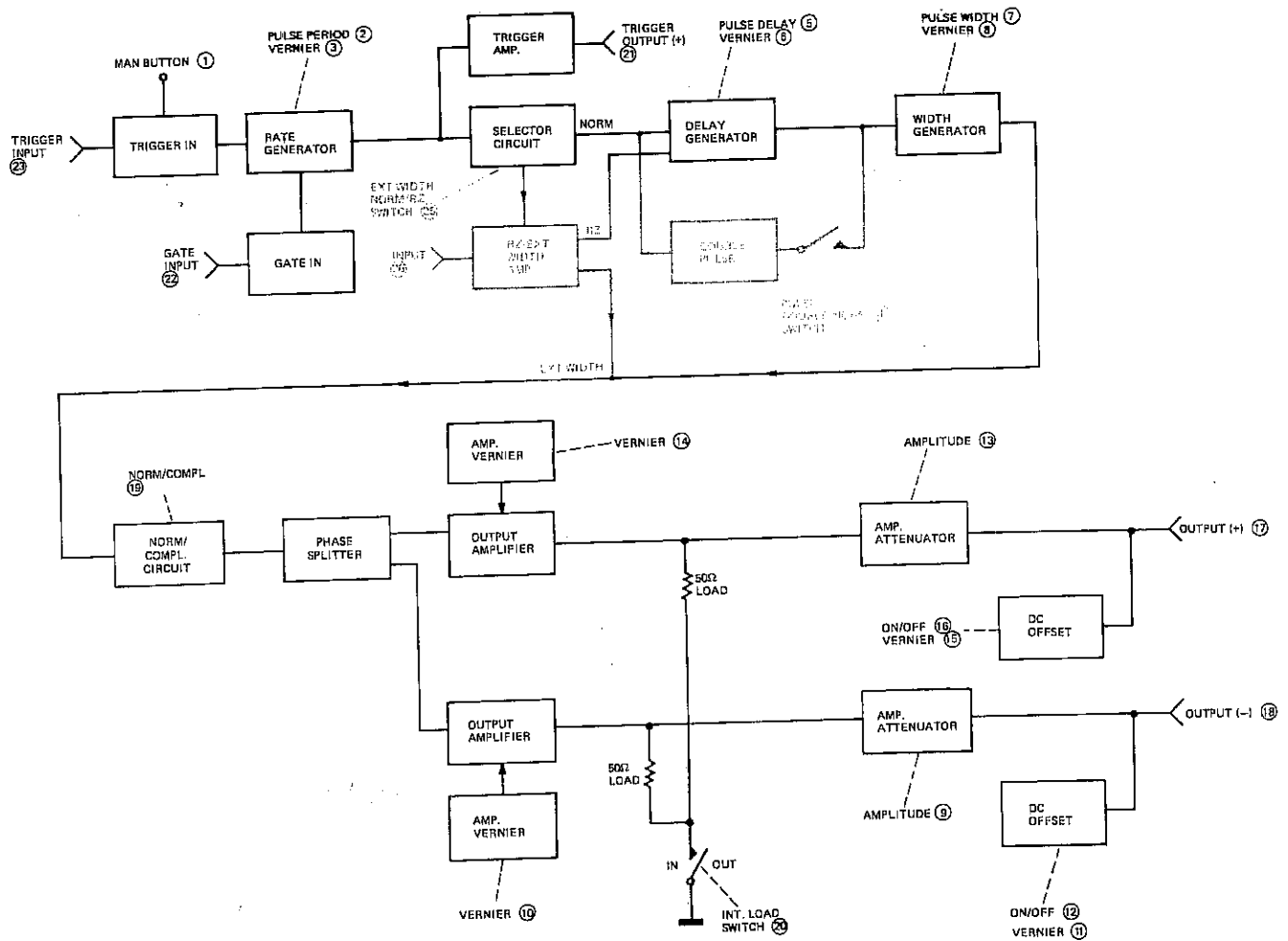


Figure 3-13. Normal gate mode — block diagram

3-37 The output pulses should appear at the TRIGGER OUTPUT (21) and OUTPUT (+) (17) connectors as shown in Figure 3-14.

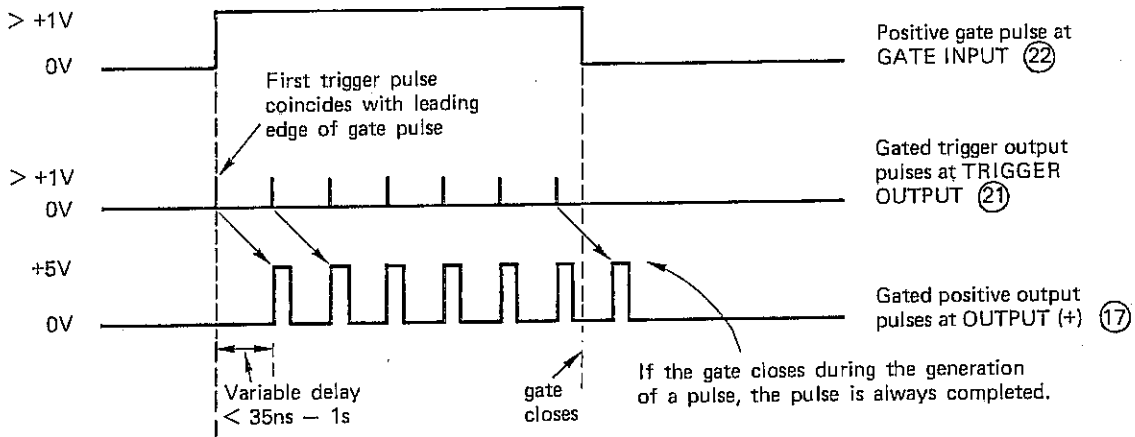


Figure 3-14. Output pulses in gate mode

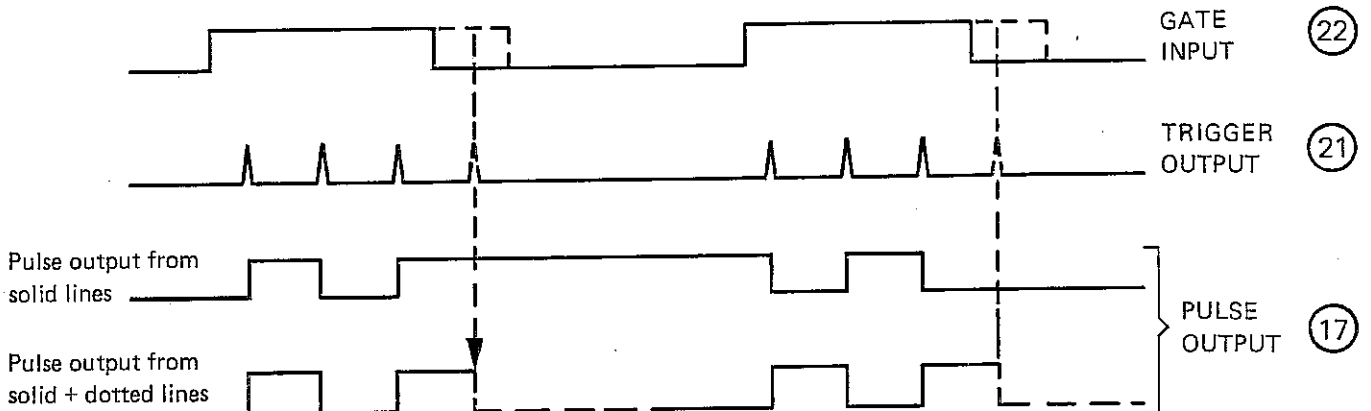


Figure 3-15. Gated output in square wave mode

3-38 RZ MODE

3-39 In RZ mode external pulses, applied to the INPUT connector (26) on the 8013B rear panel, trigger the delay generator directly (see figure 3-16) and the shape of the output pulses is determined by the out-

put amplifiers. The output pulses cannot be gated and are independent of the pulses at the TRIGGER OUTPUT connector (21).

3-40 The circuits and controls involved in RZ mode are shown in figure 3-16.

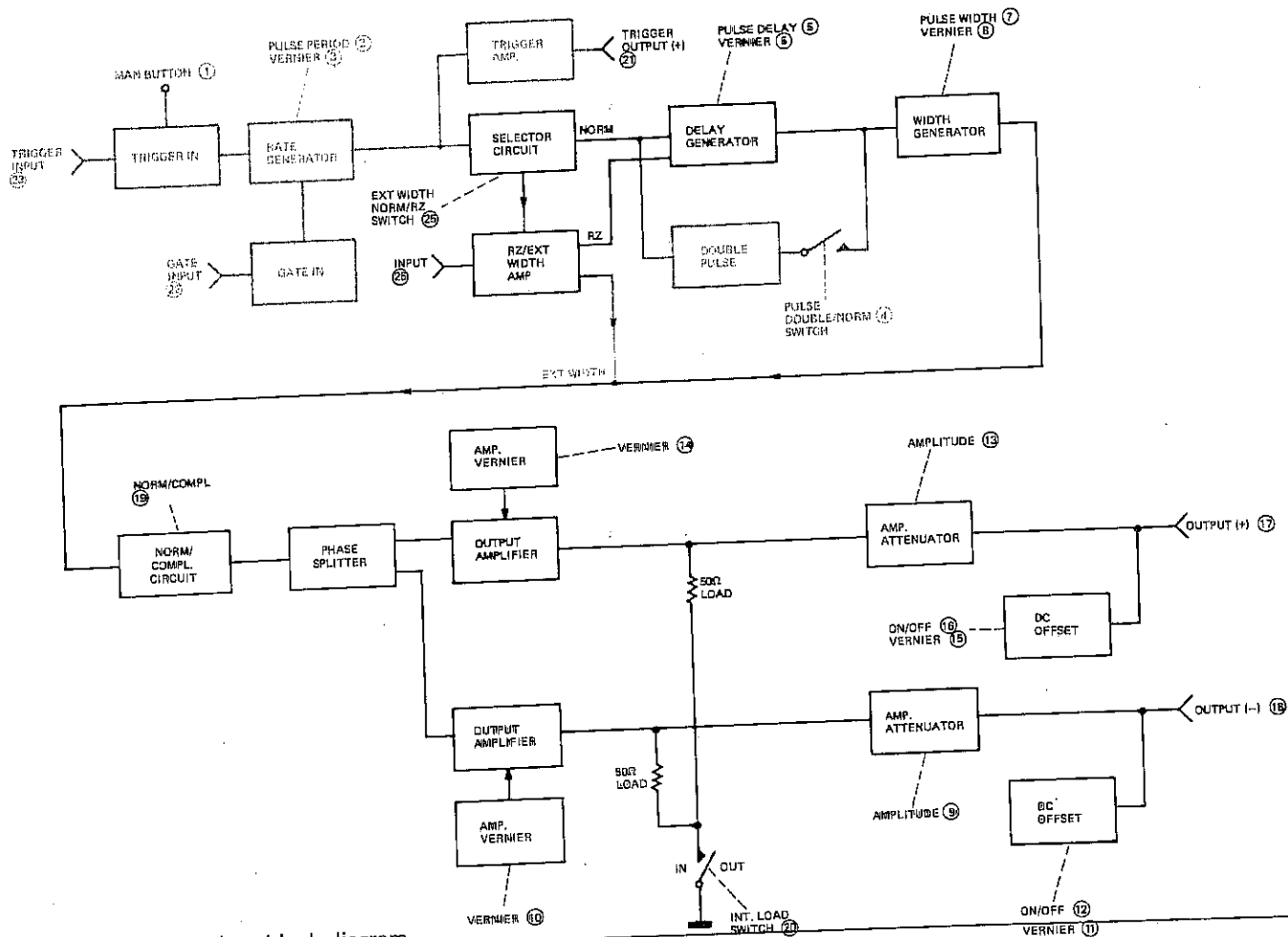


Figure 3-16. RZ mode - block diagram

3-41 The RZ input signal must be $> +1V$ to a maximum of $\pm 5V$ in amplitude and must be at least 7ns wide.

3-42 The procedure for obtaining an output in RZ mode is as follows:

a. Connect the external signal to the INPUT connector (26) on the rear panel of the 8013B.

b. Set the Mode Selector switch (25) to RZ.

c. Set the pulse delay, width, amplitude, offset and output format as required.

3-43 The output pulses should appear at the OUTPUT (+) connector (17) as shown in Figure 3-17.

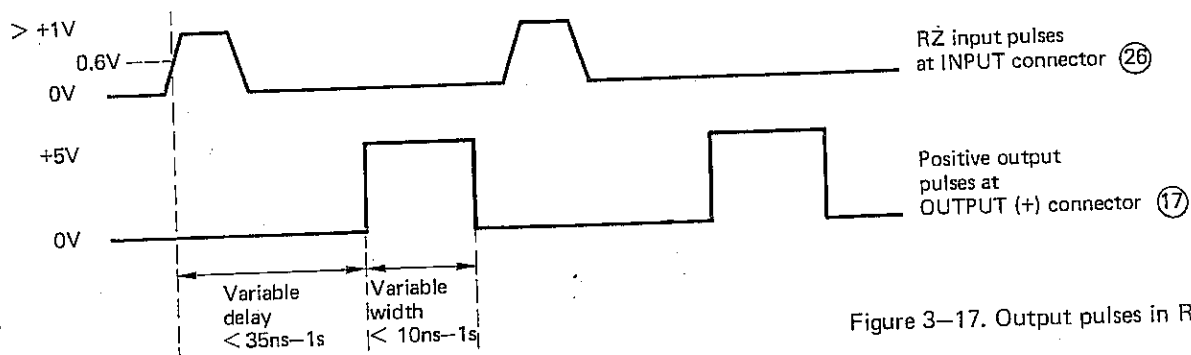


Figure 3-17. Output pulses in RZ mode

3-44 DOUBLE PULSE Mode

3-45 In this mode, the 8013B delivers two output pulses for each trigger pulse. One pulse is in phase with the TRIGGER OUTPUT (21); the other pulse is delayed by the time set on the PULSE DELAY controls (5) and (6).

3-46 Double pulse output can be selected in any of the preceding operating modes except square wave. Double pulse output is produced as follows:

a. Set the PULSE DOUBLE/NORM switch (4) to DOUBLE.

b. The remaining pulse parameters and output format can be set as required.

3-47 The circuits and controls involved in double pulse mode are shown in Figure 3-18.

3-48 The trigger and output pulses should appear at the TRIGGER OUTPUT (21) and OUTPUT (+) (17) connectors as shown in Figure 3-19.

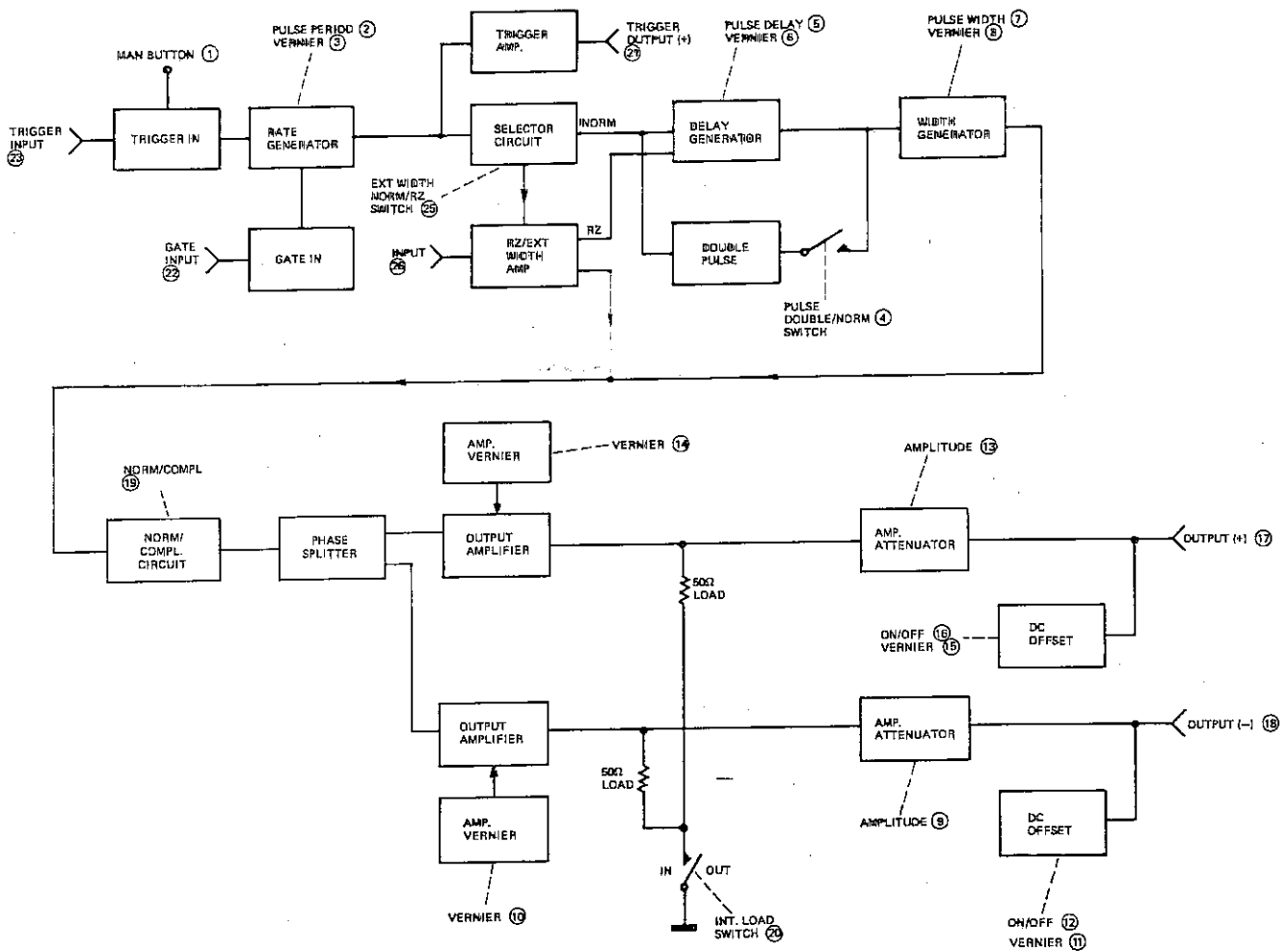


Figure 3-18. Double pulse mode — block diagram

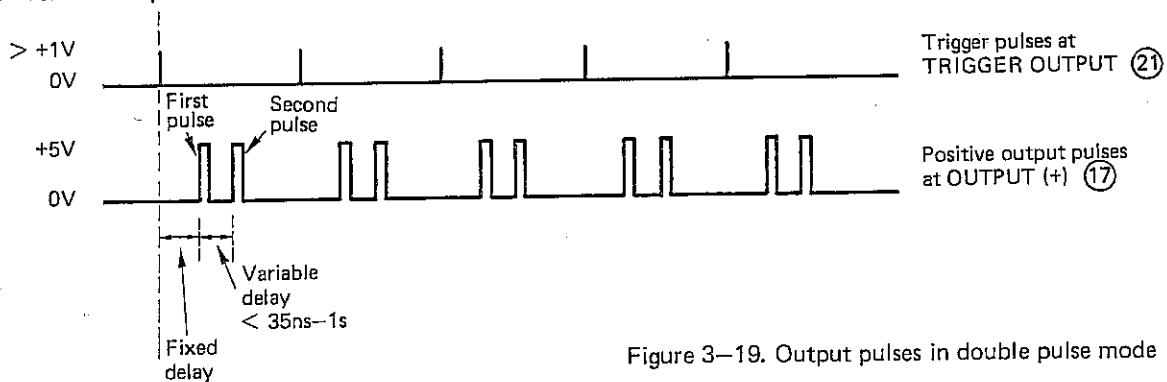


Figure 3-19. Output pulses in double pulse mode

3-49 EXTERNAL WIDTH MODE

3-50 In this mode, external pulses, applied to the INPUT connector (26) on the rear panel, are routed directly to the output amplifiers which are caused to change state at the threshold level of the input signal. Thus the pulse output is a shaped version of the input. It is also independent of the TRIGGER OUTPUT (21).

The external width input signal must be $> +1V$ to a maximum of $\pm 5V$ in amplitude and must be at least 7ns wide.

3-51 The circuits and controls involved in external width mode are shown in Figure 3-20.

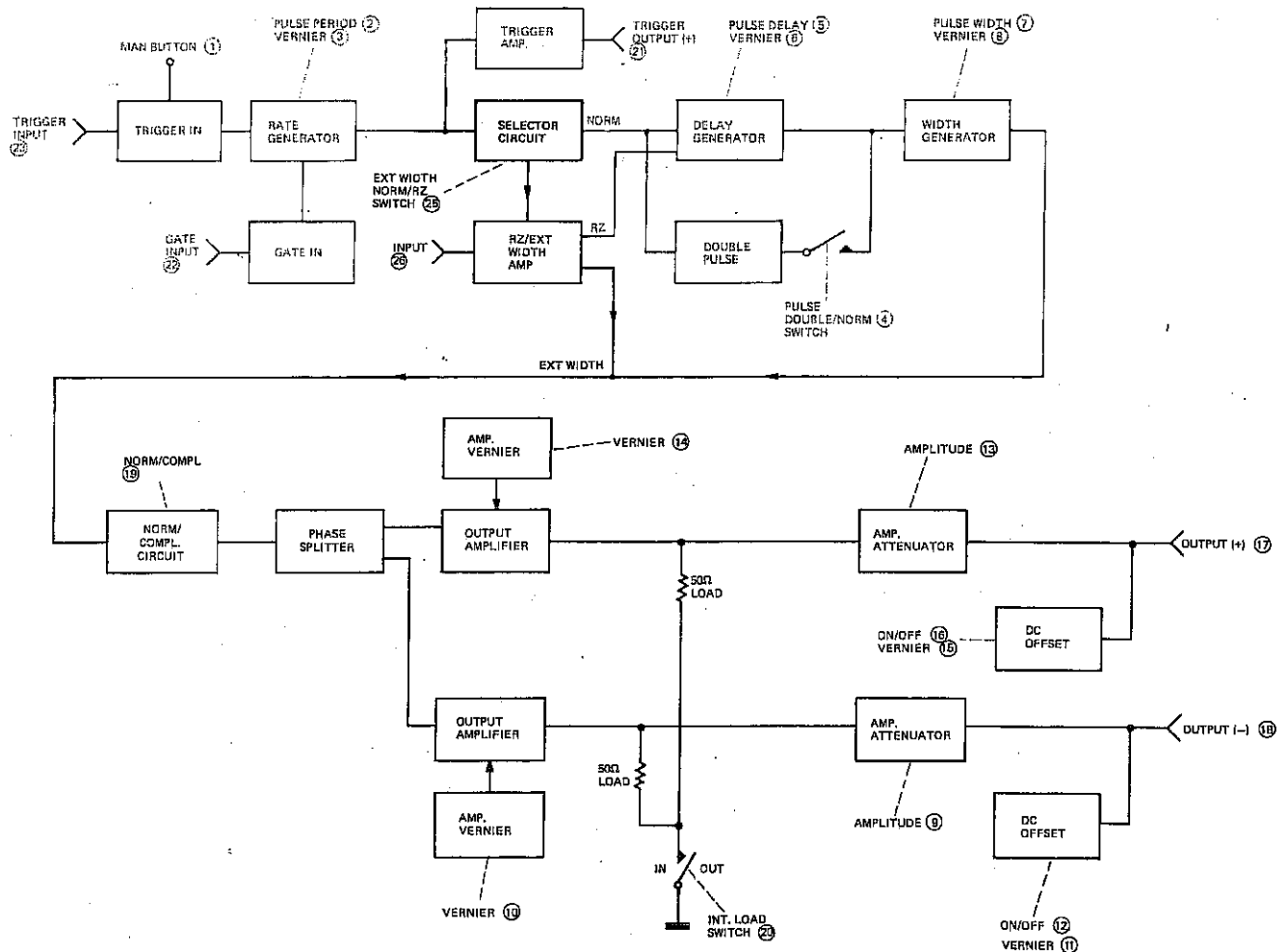


Figure 3-20. External Width mode – block diagram

3-52 The procedure for obtaining an output in external width mode is as follows:

- Connect the external signal to the INPUT connector (26) on the rear panel of the 8013B.
- Set the Mode Selector switch (25) to EXT WIDTH.

c. Set the pulse amplitude and output format as required.

3-53 The output pulses should appear at the OUTPUT (+) connector (17) as shown in Figure 3-21.