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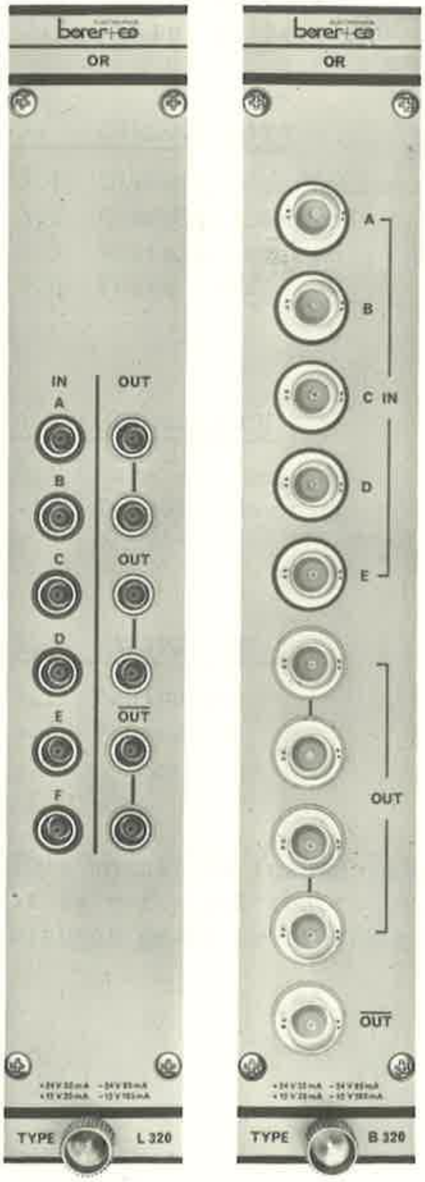
DATA MANUAL

for

OR GATE
L/B 320



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The 300 Series of logic modules is built to the AEC-NIM specifications and most models can be supplied with either 50 ohm BNC connectors or with 50 ohm LEMO 00250 connectors. (Indicated by B or L in front of the type number).

The necessary supply voltages and the respective currents drawn are engraved on the front panel.

For proper and reliable operation the unit should be operated in a sufficiently well ventilated rack to maintain the useful temperature range of +5°C to +60°C.

1.1 Function

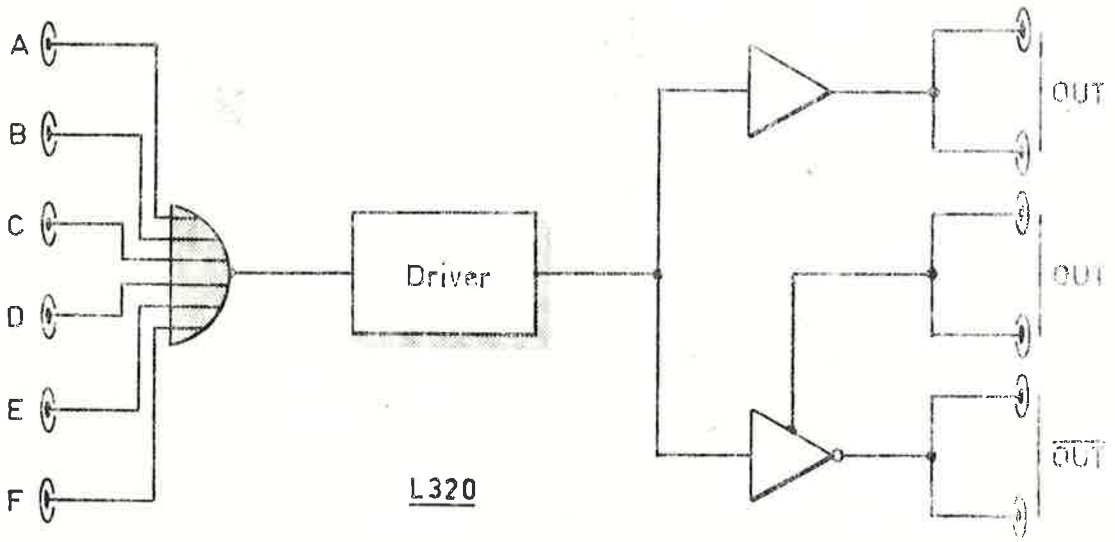
The OR-GATE Type 320 is a versatile module that, in addition to performing a straight-forward OR function, may also be used as a 2 to 6 fold (L320) or 2 to 5 fold (B320) coincidence with 1 to 5 fold (L320) or 1 to 4 fold (L320) anti-function for complementary outputs. Also it may be used as a pulse generator, a fan-out unit and, in combination with a second unit, as a set-reset flip-flop.

The Type L320 has six independant inputs, two dual outputs and one complementary dual output.

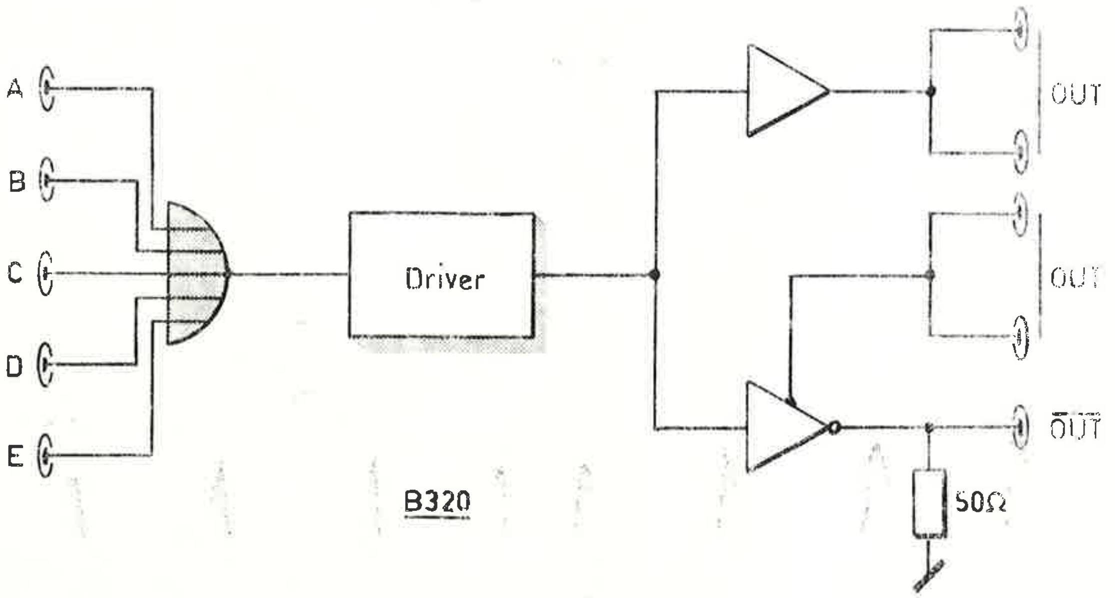
The Type B320 has five independant inputs, two dual outputs and a single complementary output.

The circuit is directly-coupled throughout and is capable of handling rates from dc up to more than 150MHz.

1.2 Block Diagrams



L320



B320

1.3 Specifications

INPUT	Impedance	50 ohms ±2 %
	Reflections	10 %, max. for t_r = 1,5 ns
	Voltage	-700mV, typically (logical 1) -200mV, -4mA max for output = 0 -600mV, -12mA min for output = 1
	Overload	±5V absolute maximum dc ±50V for 100ns maximum
	Width	2,5 ns, min. (measured at 600mV level on 800mV pulse) to dc
	Rate	150MHz, min.
OUTPUT	Impedance	High, current source, 16mA per output. Unused outputs must be terminated.
	Rise time	2,0 ns, max.
	Fall time	2,2 ns, max.
	Width	Equal to inputs ±1 ns
	Propagation delay	5,5 ns ±0,5 ns
POWER CONSUMPTION	+24V -24V +12V -12V	30mA 35mA 30mA 105mA
TEMPERATURE RANGE		+5°C to +60°C
DIMENSIONS		Single width AEC/NIM module
COLOUR CODE	Module Input Output	Green Green Yellow

2.1 Applications

The Type 320 OR-GATE is primarily intended for fast logic processing but may, by cross-coupling between its various front-panel connectors or in conjunction with a second module, also function as a pulse generator or a set-reset flip-flop.

Its 50 ohm inputs and outputs are designed to handle standard NIM pulses and it is suitable for pulse rates in excess of 150MHz.

OR-function: An output occurs if one or more inputs are at logical 1.

L320

$$OUT = OR = A + B + C + D + E + F$$

$$\overline{OUT} = NOR = \overline{A + B + C + D + E + F}$$

B320

$$OUT = OR = A + B + C + D + E$$

$$\overline{OUT} = NOR = \overline{A + B + C + D + E}$$

AND-function: An output occurs at the complementary output if all the connected inputs are at logical 0.

L320

$$\overline{OUT} = AND = \overline{A} \times \overline{B} \times \overline{C} \times \overline{D} \times \overline{E} \times \overline{F}$$

$$OUT = NAND = \overline{\overline{A} \times \overline{B} \times \overline{C} \times \overline{D} \times \overline{E} \times \overline{F}}$$

B320

$$\overline{OUT} = AND = \overline{A} \times \overline{B} \times \overline{C} \times \overline{D} \times \overline{E}$$

$$OUT = NAND = \overline{\overline{A} \times \overline{B} \times \overline{C} \times \overline{D} \times \overline{E}}$$

Anti-function is obtained by using one of the inputs with logical 1.

Set-reset flip-flop : This is accomplished by connecting the complementary output ($\overline{OUT}$) to an input of a second OR-gate 320 and the $\overline{OUT}$ of this second unit to an input of the first unit. A logical pulse at an input of either unit will cause a change of state.

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Pulse generator : Recurrent pulses of 50 % duty cycle may be obtained from the logic outputs (OUT) by connecting the complementary output ($\overline{OUT}$), via a delay cable, to one of the inputs. The frequency obtained is given by:

$$f = \frac{1}{(13 \pm 1{,}5)\ \text{ns} + \text{twice external delay in ns}}\ \text{GHz}$$

$$\text{width} = (6 \pm 0{,}75)\ \text{ns} + \text{external delay in ns}$$

The maximum obtainable frequency is approximately 70MHz and minimum pulse width is about 7 ns. The pulse generator may be gated by applying a logic signal to one of the spare inputs.

2.2 Colour coding

The 300 Series of modules use the colour code given below for ease of identification during assembly in a system. The modules are colour coded by the fixing screws and the connectors by a coloured ring.

Module code	BLACK	Discriminators and shaping modules
	GREEN	Logic modules; AND, OR, etc.
	RED	Linear modules
	GOLD	Gating modules
	BLUE	Interface modules, scalers, ADC, etc.
Connector code	GREEN	Overload protected inputs
	YELLOW	Unused outputs must be terminated
	RED	Non-Standard signal outputs
	NEUTRAL	All others

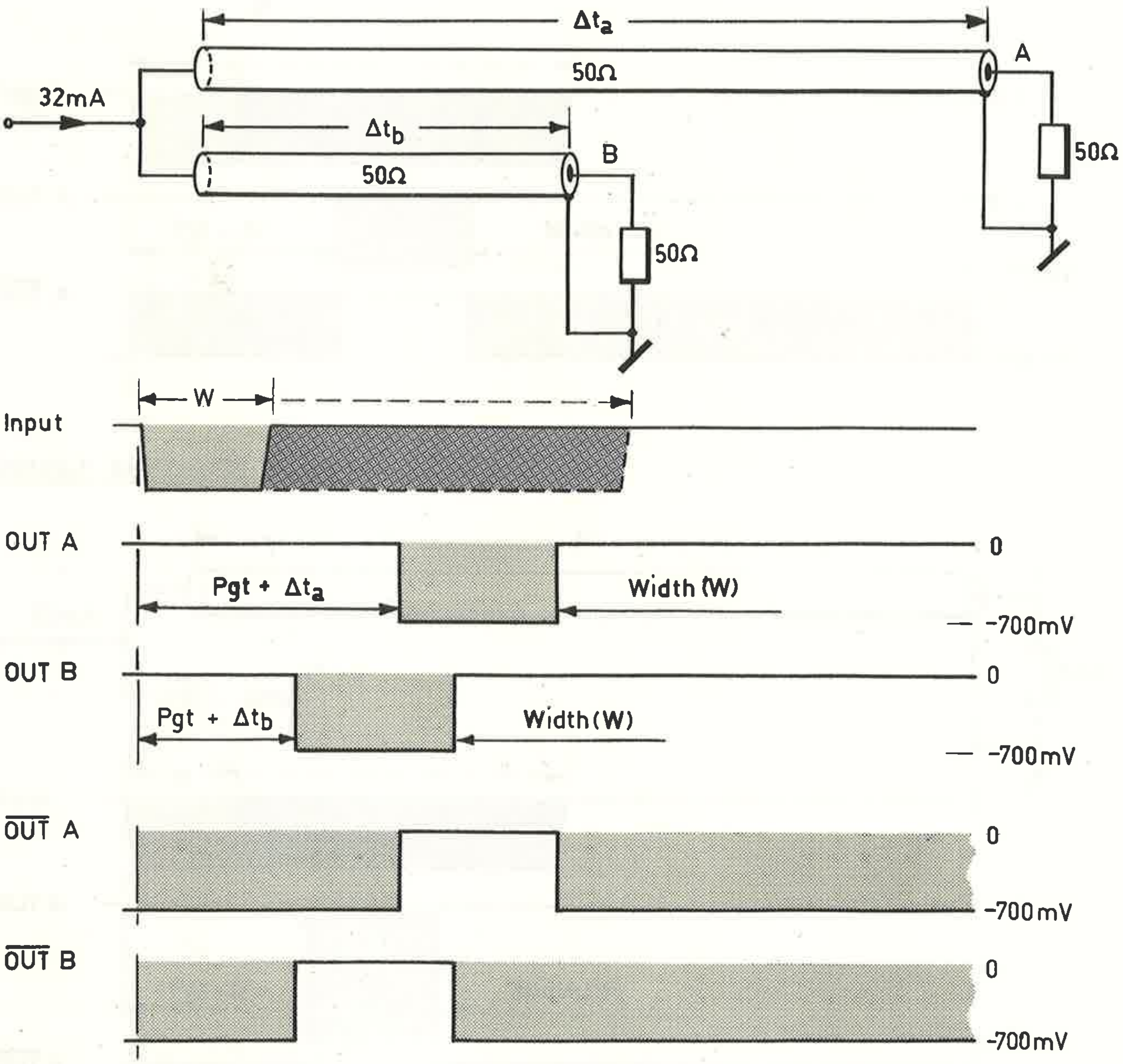
2.3 Inputs

The two versions of the OR-gate 320 are manufactured with either six inputs (Type L320) or five inputs (Type B320), all being internally matched to 50 ohm cables. They are designed to operate with standard NIM pulses.

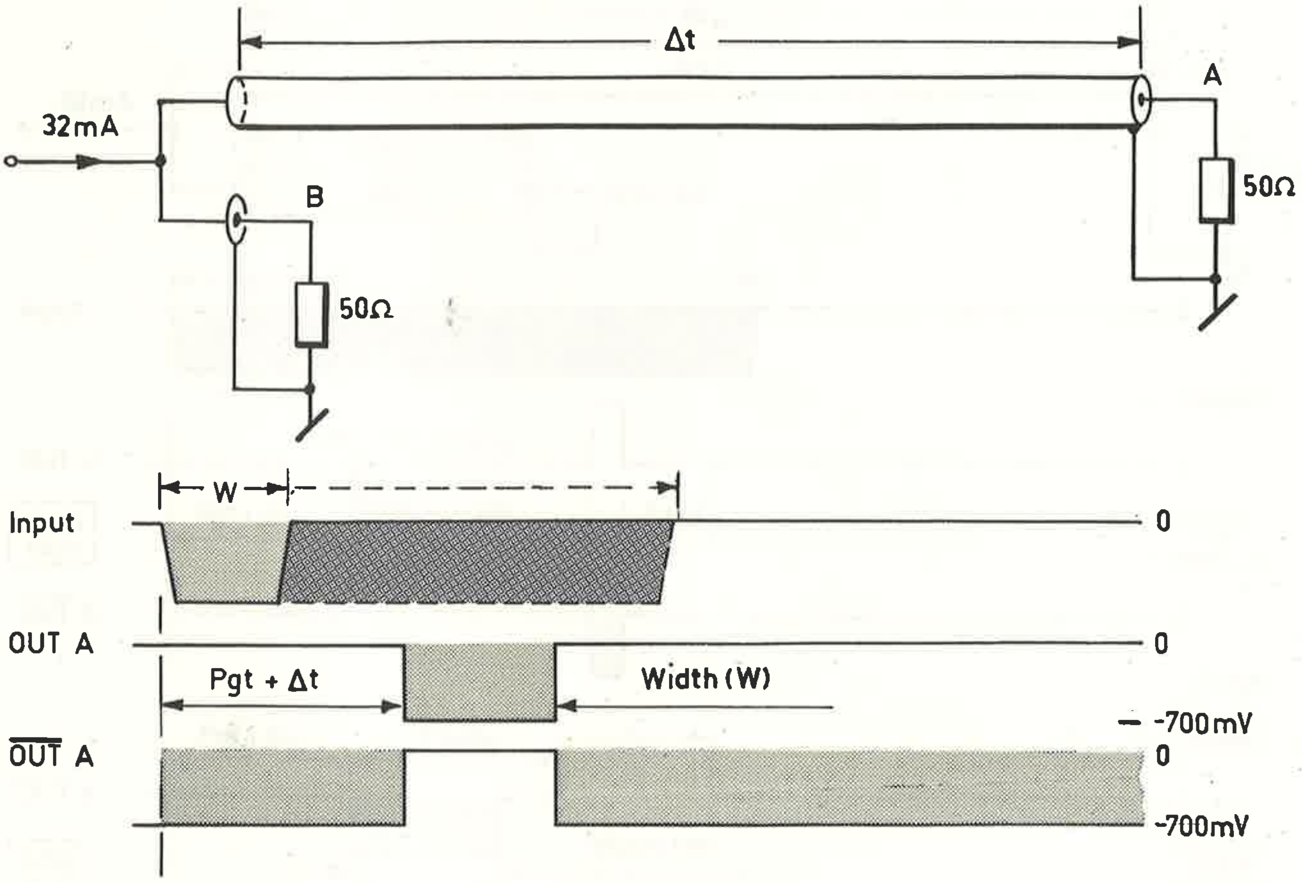
2.4 Outputs

The Type L320 has two dual standard outputs and one dual complementary output. The B320, whilst having two dual standard outputs has only a single complementary output. All outputs are driven by 32mA current sources and at each dual output the two connectors are wired in parallel. In the case of the single complementary output from the B320, an internally wired 50 ohm pseudo-load is included to ensure the correct operation of the output amplifier. Each dual output has associated limiting diodes included to eliminate the need to terminate unused amplifiers. Some applications of the use of the dual outputs are illustrated below.

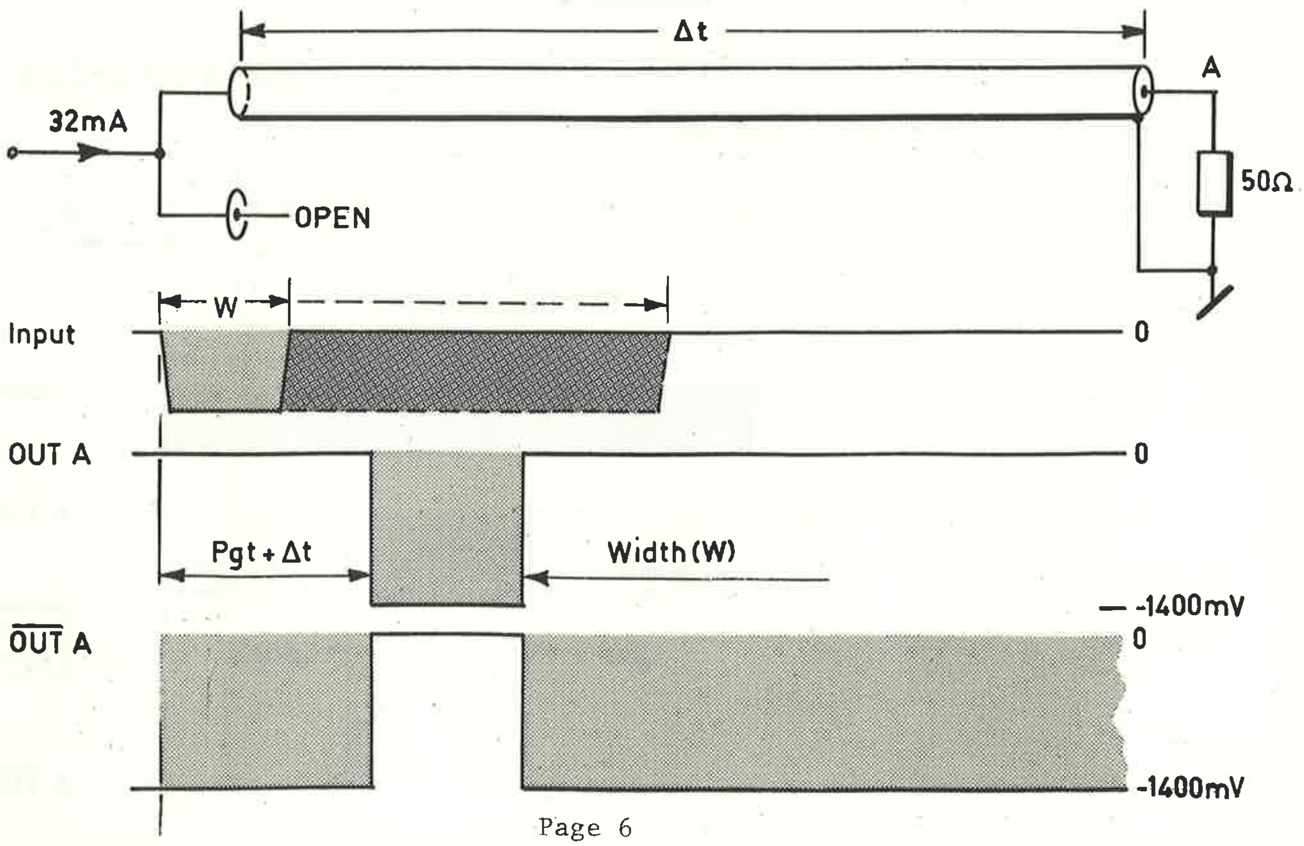
TWO INDEPENDENT STANDARD SIGNAL OUTPUTS INTO 50Ω LOADS



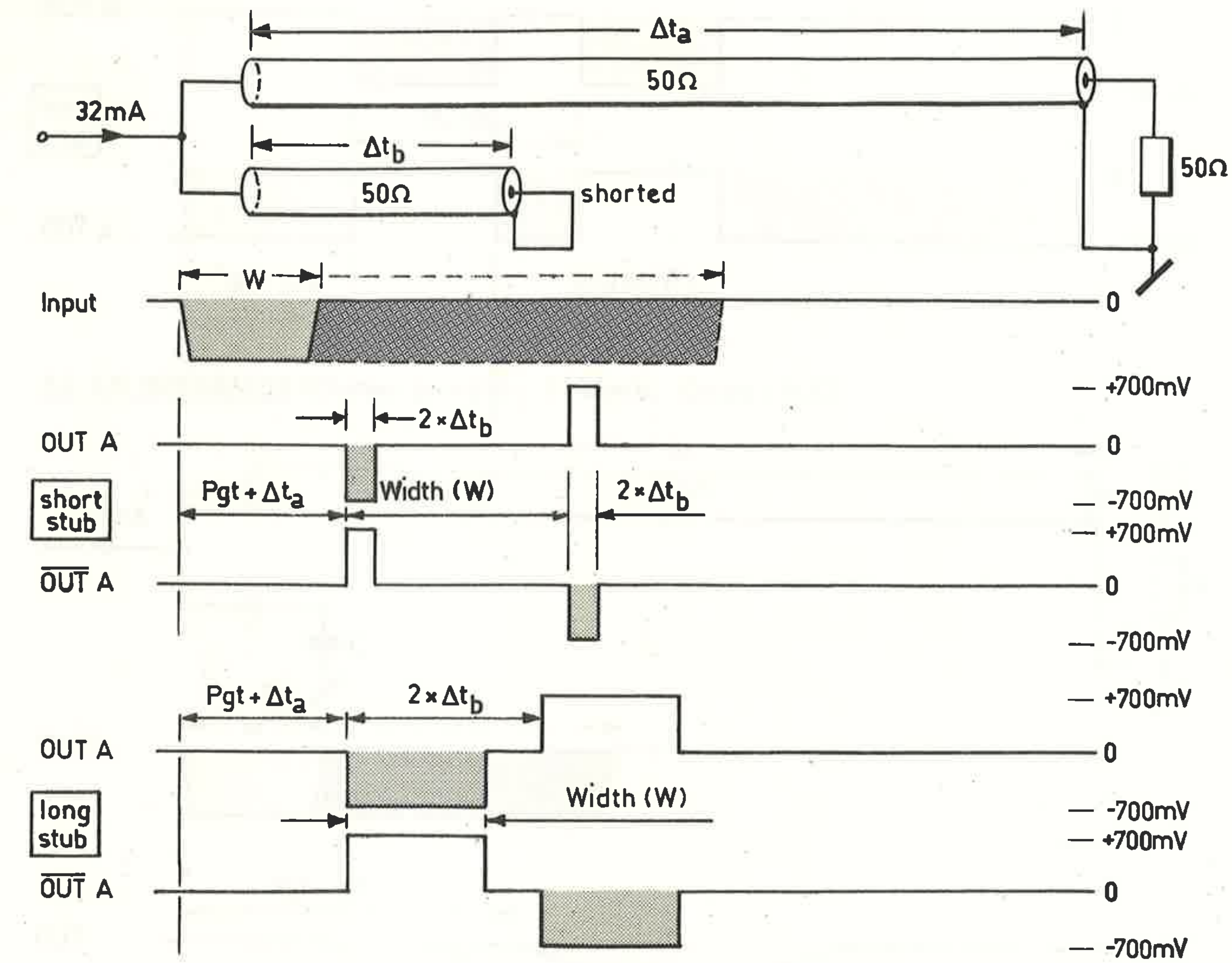
SINGLE OUTPUT INTO 50Ω LOAD. Unused outlet must be terminated



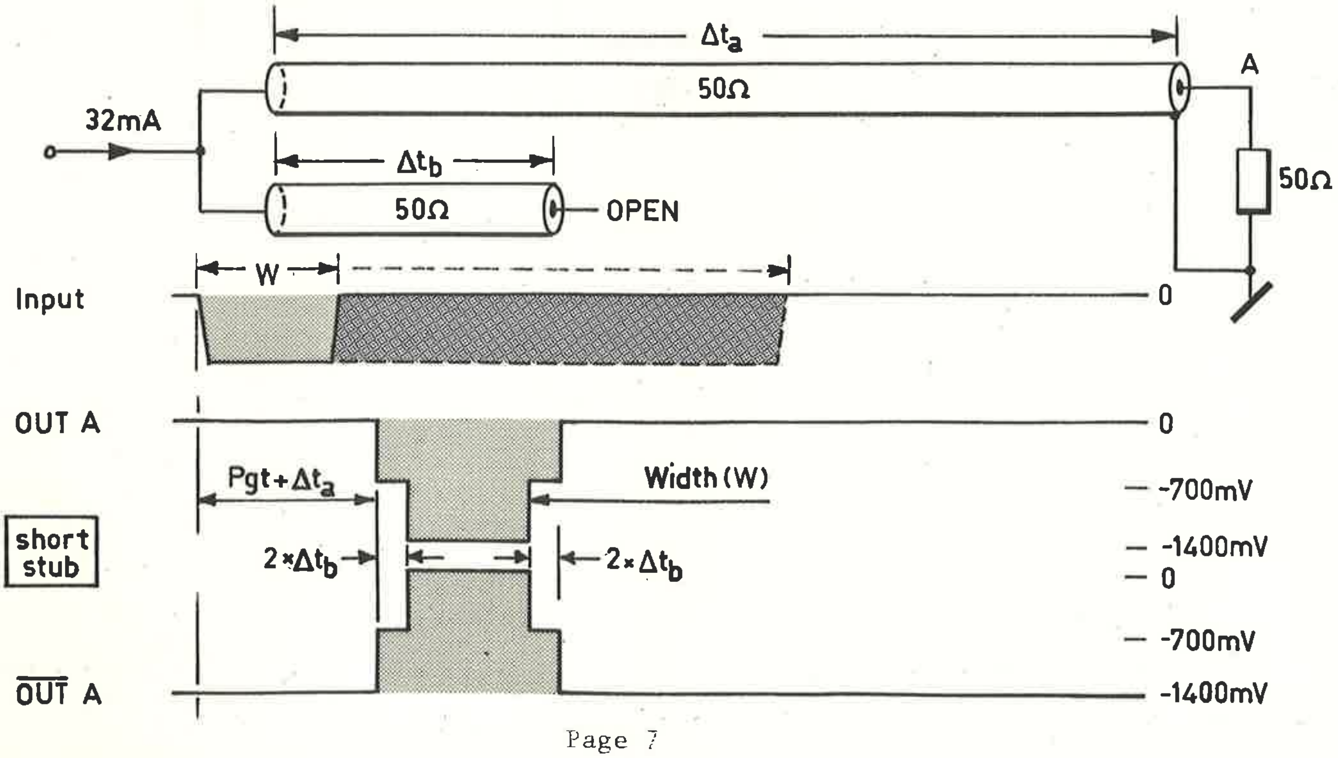
DOUBLE AMPLITUDE OUTPUT



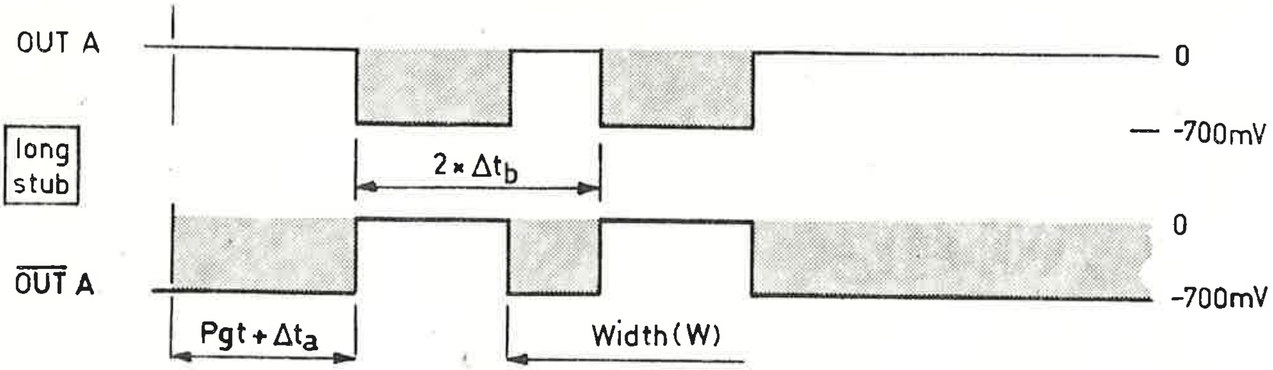
STUB-CLIPPED OUTPUT (SHORTED STUB)



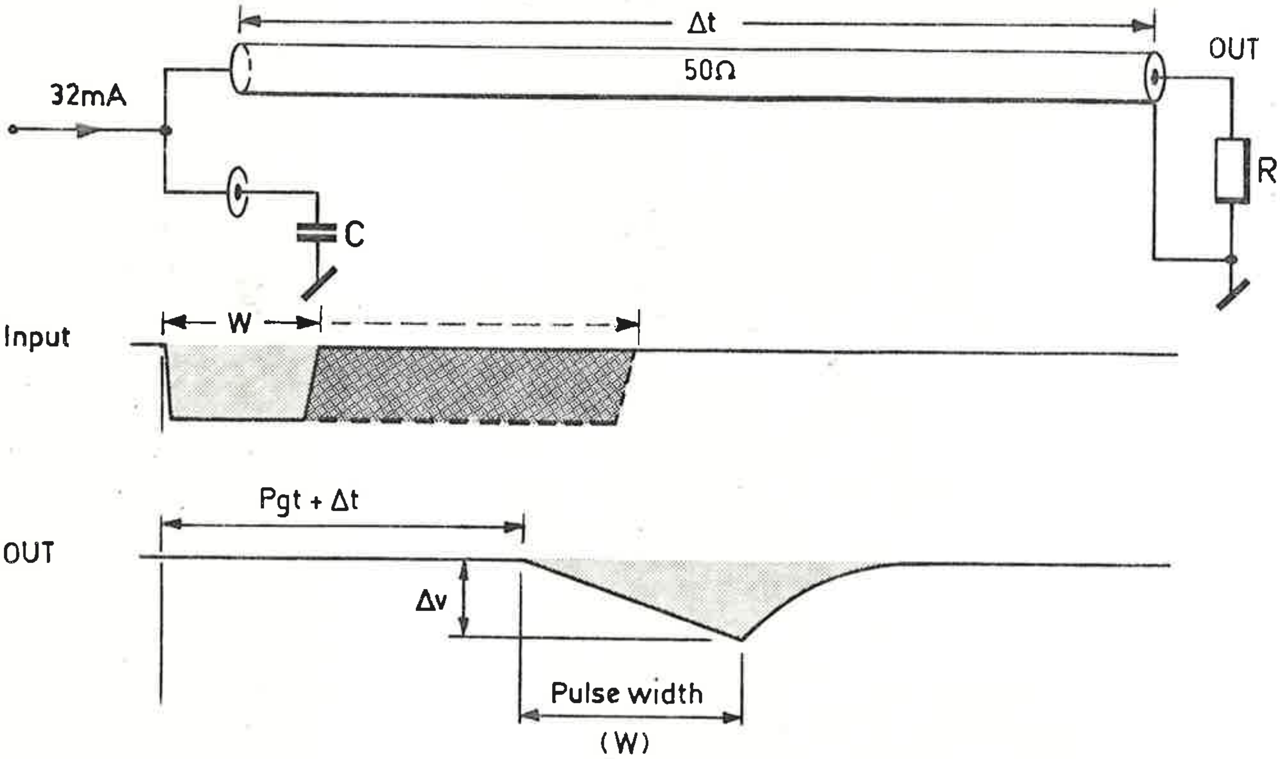
STUB-CLIPPED OUTPUT (OPEN STUB)



STUB-CLIPPED OUTPUT (OPEN STUB) continued

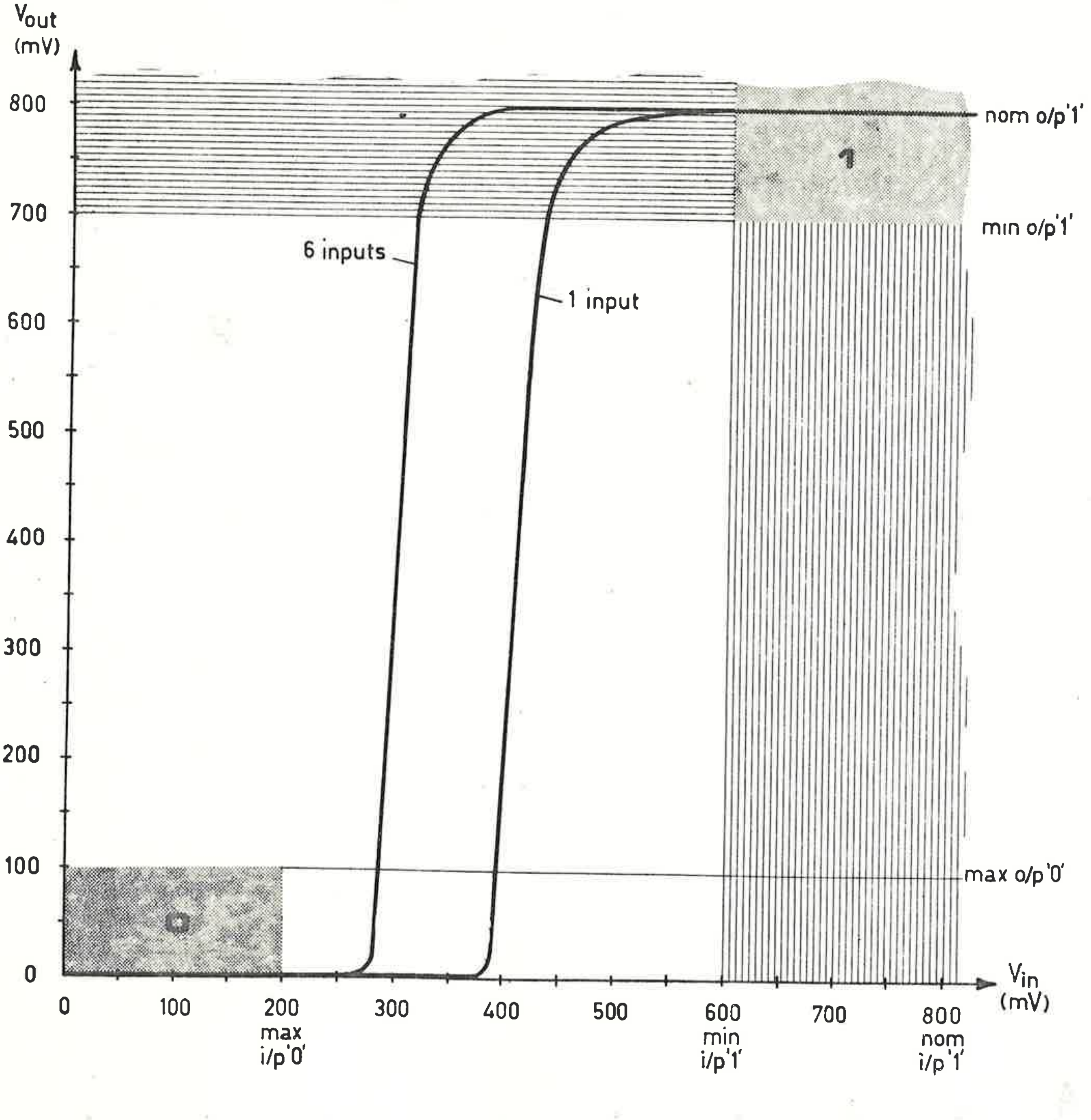


AS AN INTEGRATOR (Charge: $\Delta v \sim I\frac{\Delta t}{C}$; I = 32mA, Decay = R.C)



2.5 Transfer characteristic

The input - output characteristic is illustrated diagrammatically below. As can be seen, the output level stays lower than the minimum output "0" (-100mV) up to a value exceeding the maximum input "0" (-200mV) and the full output "1" (-700mV) is obtained before the minimum input "1" level is reached (-600mV).



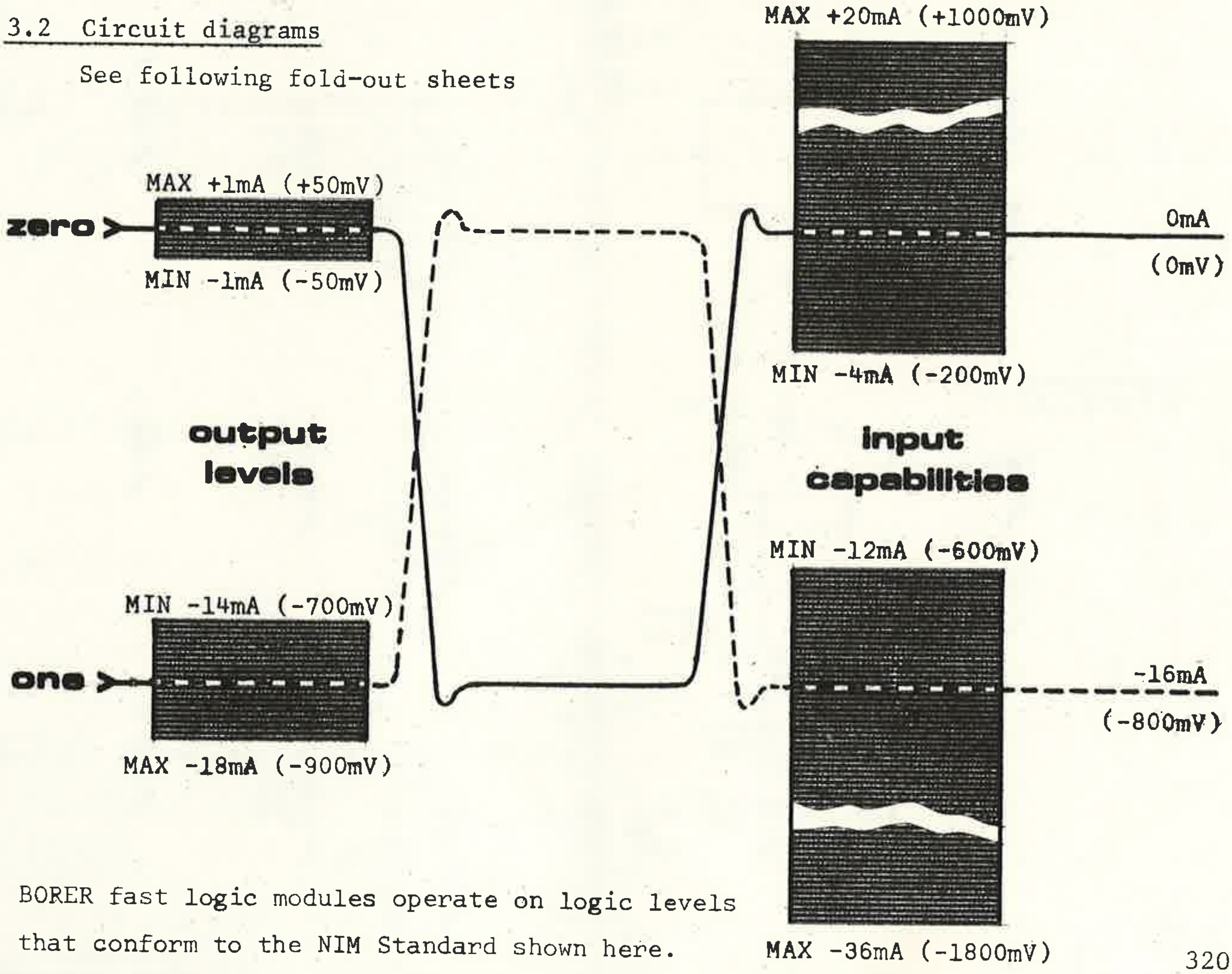
3.1 Circuit description

A negative voltage (pulse or dc) of sufficient amplitude introduced through, for example, input A will transfer the current from transistor Q_7 to Q_1 via the normally reverse - biased diode D_4. This in turn causes a negative voltage excursion of approximately 0,8V at the collector of Q_7. The following transistor Q_8 inverts and roughly doubles the amplitude of the signal. A buffering action is performed by the cascaded emitter-followers Q_9 and Q_{10}. The emitters of Q_{11} and Q_{12} are normally held at a voltage just slightly more negative than the emitter of Q_{10} and hence the bases of Q_{11} and Q_{12}. The positive going signal appearing at the emitter of Q_{10} drives Q_{11} and Q_{12} into a heavily conducting state so that current may be drawn through the load and the emitter resistors. The final transistor Q_{13} inverts the signal once more to provide the complementary output.

When signals are applied simultaneously to more than one input, the same amount of current is drawn away from Q_7 so that a signal of consistant amplitude will drive the output circuits providing one or more inputs are present. The diode between the emitters of the input transistors and Q_7 are normally reverse biased by about 300mV. This provides the required input threshold whilst also giving effective isolation between the inputs.

3.2 Circuit diagrams

See following fold-out sheets



BORER fast logic modules operate on logic levels that conform to the NIM Standard shown here.

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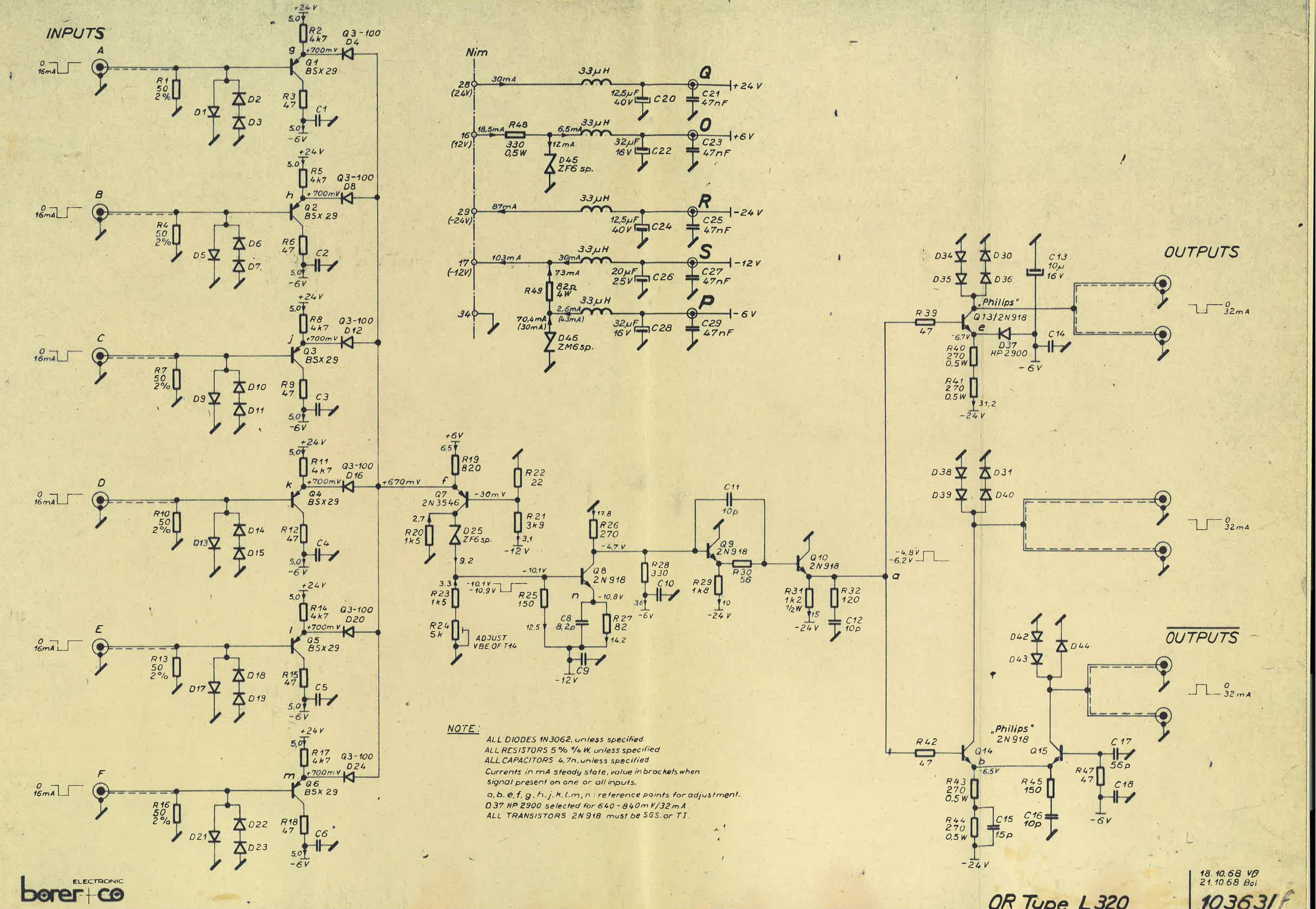
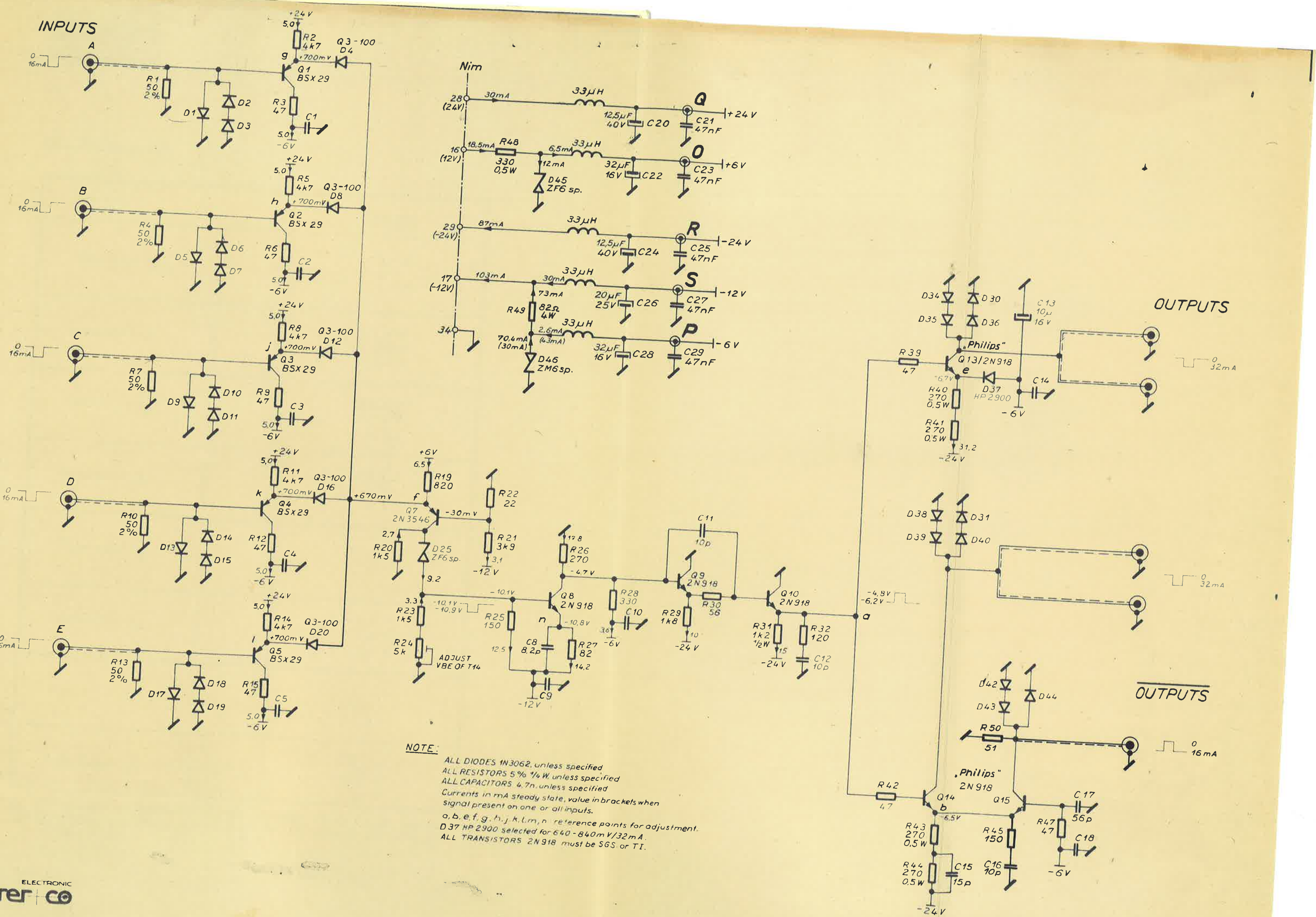


NOTE:

ALL DIODES 1N3062, unless specified
ALL RESISTORS 5% 1/4 W, unless specified
ALL CAPACITORS 4,7n, unless specified
Currents in mA steady state, value in brackets when signal present on one or all inputs.
a, b, e, f, g, h, j, k, l, m, n : reference points for adjustment.
D37 HP 2900 selected for 640-840mV/32mA
ALL TRANSISTORS 2N918 must be SGS. or TI.



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Currents in mA steady state, value in brackets when signal present on one or all inputs.
a, b, e, f, g, h, j, k, l, m, n reference points for adjustment.
D 37 HP 2900 selected for 640 - 840 mV/32 mA.
ALL TRANSISTORS 2N 918 must be SGS or TI.

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3.3 Voltage levels

Position		Voltage
Transistor Q_{1-6}	e b c	+ 0,7 V 0 - 5,7 V
Transistor Q_7	e b c	+ 0,67V - 0,05V - 4,2 V
Transistor Q_8	e b c	-10,8 V -10,1 V - 4,7 V
Transistor Q_9	e b c	- 5,3 V - 4,7 V 0
Transistor Q_{10}	e b c	- 6,0 V - 5,2 V 0
Transistor Q_{11}	e b c	- 6,7 V - 6,2 V - 0,5 V
Transistor Q_{12}	e b c	- 6,5 V - 6,2 V - 0,5 V
Transistor Q_{13}	e b c	- 6,5 V - 6,1 V - 1,5 V

Comparison measurements should be taken using a high quality instrument having a sensitivity of at least 20,000 ohms/V. All voltages are relative to the 0V line.

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3.4 Parts list

Ref.	Description	Remarks
R_1	50 ohms ± 2 % 0,125w	Metal film, AT
R_2	4,7 kohms ± 5 % 0,25w	
R_3	47 ohms ± 5 % 0,25w	
R_4	50 ohms ± 2 % 0,125w	Metal film, AT
R_5	4,7 kohms ± 5 % 0,25w	
R_6	47 ohms ± 5 % 0,25w	
R_7	50 ohms ± 2 % 0,125w	Metal film, AT
R_8	4,7 kohms ± 5 % 0,25w	
R_9	47 ohms ± 5 % 0,25w	
R_{10}	50 ohms ± 2 % 0,125w	Metal film, AT
R_{11}	4,7 kohms ± 5 % 0,25w	
R_{12}	47 ohms ± 5 % 0,25w	
R_{13}	50 ohms ± 2 % 0,125w	Metal film, AT
R_{14}	4,7 kohms ± 5 % 0,25w	
R_{15}	47 ohms ± 5 % 0,25w	
* R_{16}	50 ohms ± 2 % 0,125w	Metal film, AT
* R_{17}	4,7 kohms ± 5 % 0,25w	
* R_{18}	47 ohms ± 5 % 0,25w	
R_{19}	820 ohms ± 5 % 0,25w	
R_{20}	1,5 kohms ± 5 % 0,25w	
R_{21}	3,9 kohms ± 5 % 0,25w	
R_{22}	22 ohms ± 5 % 0,25w	
R_{23}	1,5 kohms ± 5 % 0,25w	
R_{24}	5 kohms p'meter 0,75w	Contelec Type 311
R_{25}	150 ohms ± 5 % 0,25w	
R_{26}	270 ohms ± 5 % 0,25w	
R_{27}	82 ohms ± 5 % 0,25w	
R_{28}	330 ohms ± 5 % 0,25w	

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3.4 Parts list (cont.)

Ref.	Description	Remarks
R_{29}	1,8 kohms ± 5 % 0,25w	
R_{30}	56 ohms ± 5 % 0,25w	
R_{31}	1,2 kohms ± 5 % 0,5w	
R_{32}	120 ohms ± 5 % 0,25w	
R_{39}	47 ohms ± 5 % 0,25w	
R_{40}	270 ohms ± 5 % 0,5w	
R_{41}	270 ohms ± 5 % 0,5w	
R_{42}	47 ohms ± 5 % 0,25w	
R_{43}	270 ohms ± 5 % 0,5w	
R_{44}	270 ohms ± 5 % 0,5w	
R_{45}	56 ohms ± 5 % 0,25w	
R_{47}	47 ohms ± 5 % 0,25w	
R_{48}	330 ohms ± 5 % 0,5w	
R_{49}	82 ohms ± 5 % 4w	
** R_{50}	51 ohms ± 2 %	Metal film
C_{1-6}	4,7 nF ceramic	LCC DCX-706 (C_{1-5} in B320)
C_8	8,2 pF	Philips 2222.625.08828
C_9	4,7 nF ceramic	LCC DCX-706
C_{10}	4,7 nF ceramic	LCC DCX-706
C_{11}	10 pF ± 10%	Erie 835/VSE
C_{12}	10 pF ± 10%	Erie 835/VSE
C_{13}	10 uF 16V electrolytic	Philips 2222.101.14169
C_{14}	4,7 nF ceramic	LCC DCX-706
C_{15}	15 pF ± 10%	Erie 835/VSE
C_{16}	10 pF ± 10%	Erie 835/VSE
C_{17}	56 pF ± 10%	Erie 835/VSE
C_{18}	4,7 nF ceramic	LCC DCX-706

3.4 Parts list (cont.)

Ref.	Description	Remarks
C_{20}	12,5 uF 40V electrolytic	Philips C428 AR/G
C_{21}	47 nF ceramic	LCC DCY-712
C_{22}	32 uF 16V electrolytic	Philips C428 AR/E
C_{23}	47 nF ceramic	LCC DCY-712
C_{24}	12,5 uF 40V electrolytic	Philips C428 AR/G
C_{25}	47 nF ceramic	LCC DCY-712
C_{26}	20 uF 25V electrolytic	Philips C428 AR/F
C_{27}	47 nF ceramic	LCC DCY-712
C_{28}	32 uF 16V electrolytic	Philips C428 AR/E
C_{29}	47 nF ceramic	LCC DCY-712
L_{1-5}	33 uH	Philips ML 00339
Q_{1-6}	BSX 29	
Q_{7}	2N 3546	
Q_{8-13}	2N 918	S.G.S.-Fairchild or Texas Inst.
D_{1-3}	1N3062	
D_{4}	Q3-100	
D_{5-7}	1N3062	
D_{8}	Q3-100	
D_{9-11}	1N3062	
D_{12}	Q3-100	
D_{13-15}	1N3062	
D_{16}	Q3-100	
D_{17-19}	1N3062	

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3.4 Parts list (cont.)

Ref.	Description	Remarks
D20	Q3-100	
* D21-23	1N3062	
* D24	Q3-100	
D25	ZF6	Selected to 3 %
D30,31	1N3062	
D34-36	1N3062	
D37	HP2900	Selected for Vf=640-840mV at 32mA
D38-40	1N3062	
D42-44	1N3062	
D45	ZF6	Selected to 3 %
D46	ZM6	Specially selected

* Type L320 only

** Type B320 only

4.1 Care and service

Under all normal conditions of service no routine maintenance should be necessary. Periodic inspections for accumulations of dust with a visual examination for the continued mechanical soundness of the module may usefully be carried out after at least each year of operation. Ensure that no sharp tools or foreign particles come into contact with the printed circuit board.

4.2 Trouble shooting

Catastrophic component failures are the only likely sources of malfunction in the module. The defective part should be quickly identified by comparisons with the table of voltage levels given earlier. Only replacement parts conforming to the description given in the parts list should be substituted.

5.1 Equipment required

Power supply	$\pm$12V, $\pm$24V 200mA	(Standard NIM-Bin preferred)
Mercury relay pulse generator		
Six-way split		
Pulse generator,	E-H Laboratories	Type 122 or equivalent
Sampling oscilloscope,	Tektronix	Type 661 or equivalent
Voltmeter,	Hewlett Packard	Type 412A or equivalent
Clip-on mA meter,	Hewlett Packard	Type 428A or equivalent
Dummy loads		

5.2 Procedure

1. Set variable resistor R_{24} to its maximum resistance (clockwise)
2. Outputs must be matched
3. Nothing should be connected to the inputs except where noted
4. Connect module to power supply, switch on and check currents drawn against specification.

Initial adjustments

5. Set voltmeter to -1V range and connect the earthy terminal to the -6V line. Measure the voltage at the emitter and base of Q_{12}. Adjust R_{24} to bring the Vbe of Q_{12} to 300mV. Check also the Vbe of Q_{13} to ensure that this is between 200 and 450mV. Measure any dc present at the logic outputs; 0,5mV is acceptable.
6. Measure the voltage across R_{27}; it should be between 1,1 and 1,3V.
7. Check the reverse (threshold) voltages across D_4, D_8, D_{12}, D_{16}, D_{20} and D_{24} (L320 only) by measuring the voltages at the emitter Q_7 and the emitters of Q_{1-6} (Q_{1-5} B320). This should be 300mV.

Pulse tests

1. Connect the sampling oscilloscope to one of the outputs and feed an 800mV, 20 ns pulse from the MRPG to each input sequentially. A 700mV output pulse should result which is virtually independant of the input channel being activated.
2. Leave one input activated and check all outputs for acceptable pulse shapes.
3. Continue feeding one input and check whether output current levels are between 15 and 17mA. Overshoot should not exceed 15 % for logic outputs and should be no more than 18 % for the complementary signal.

4.1 Care and service

Under all normal conditions of service no routine maintenance should be necessary. Periodic inspections for accumulations of dust with a visual examination for the continued mechanical soundness of the module may usefully be carried out after at least each year of operation. Ensure that no sharp tools or foreign particles come into contact with the printed circuit board.

4.2 Trouble shooting

Catastrophic component failures are the only likely sources of malfunction in the module. The defective part should be quickly identified by comparisons with the table of voltage levels given earlier. Only replacement parts conforming to the description given in the parts list should be substituted.

4. Apply a 550mV signal to each input in turn and check that all outputs reach the logical "1" band (700mV min.) and that the complementary output(s) reach the logical "0" band (100mV max.).

5. Apply a 200mV, 20 ns pulse, simultaneously to all inputs. Outputs must remain below 20mV (spikes). If any instabily is noted, remove C8 and check again.

6. Compare the output rise and fall time against the specification by injecting an 300mV, 20 ns pulse into one of the inputs.

7. Output width should be checked by applying an 800mV, 10 ns pulse to one of the inputs. Output width should equal input width (FWHM) +1,3 -0,7 ns for all outputs.

8. Check the minimum input width using an 800mV signal 2,5 ns wide at its 12mA level. All the outputs should reach the logical "1" band and the complementary output(s) should reach the logical "0" band.

9. For the rate test use "single" input pulses from the E-H Pulse generator of 800mV amplitude and 2,5 ns wide at the 12mA level. Set the repetition rate to 150MHz. Ensure that all logic outputs reach the logical "1" band and the complementary output(s) reach the logical "0" band. The level between pulses should stay in the "0" band for logic outputs and in the "1" band for the complement.

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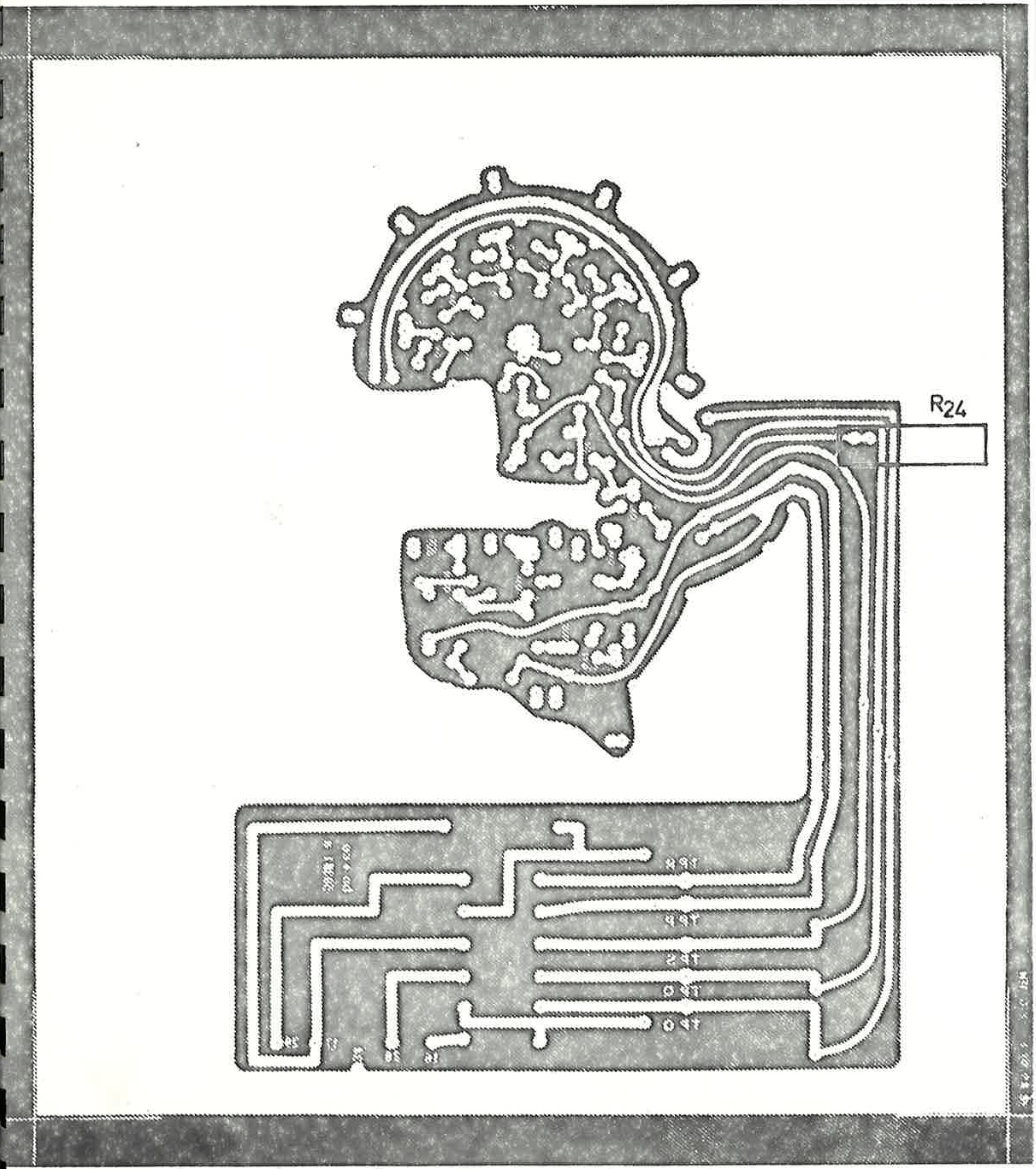

Position of R_{24} viewed from component side