

NORBIT 2 and 61 SERIES

Solid state
control elements

Data Sheets
March 1974



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NORBIT 2 & 61 SERIES

SOLID STATE CONTROL
ELEMENTS



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MULLARD TECHNICAL HANDBOOK

The data sheets in this booklet are part of the Mullard data handbook system which is made up of three sets of books, each comprising several parts.

Descriptive leaflets and order forms may be obtained from Central Technical Services at the following address:

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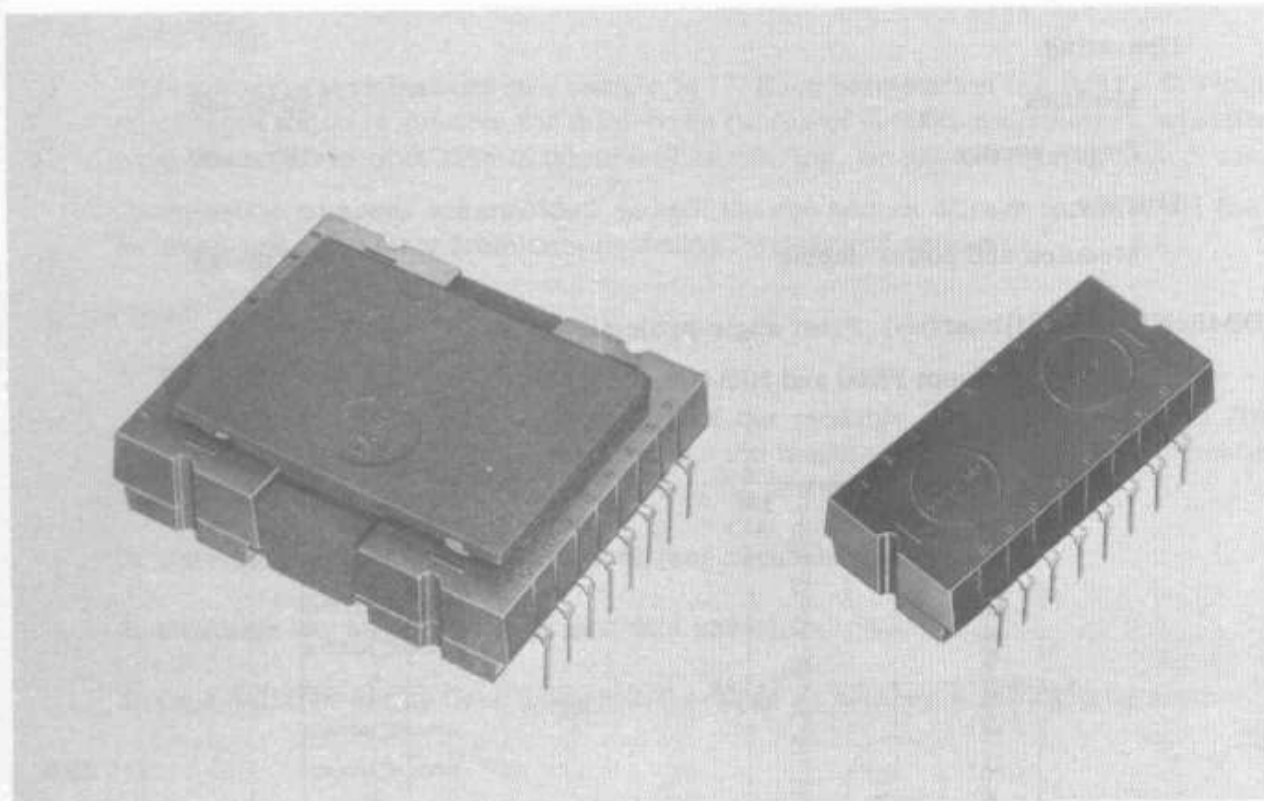
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NORBIT 2 SERIES



INTRODUCTION

Norbit 2 is a series of modules, a power supply unit and mounting accessories, capable of solving industrial control problems. Well established solid state techniques are used and the main features are: -

1. Operation from a single rail, unstabilised 24V_{d.c.} supply.
2. Silicon semiconductors used throughout.
3. Capable of operating up to 10kHz.
4. Encapsulated for protection (except the centre section of the PA60 and HPA60). ←
5. Working temperature range is -10 to +85°C (except PSU61). ←
6. Straightforward interconnection rules to simplify system design.
7. Suitable for wire wrapping, soldering, or printed-wiring board use.
8. Four easy mounting methods.

CLIMATIC CATEGORY (IEC publication 68)

Modules

10/085/56

Power supply

10/060/56

TEMPERATURE RANGE

Operating

Modules

-10 to +85 °C

Power supply

-10 to +60 °C

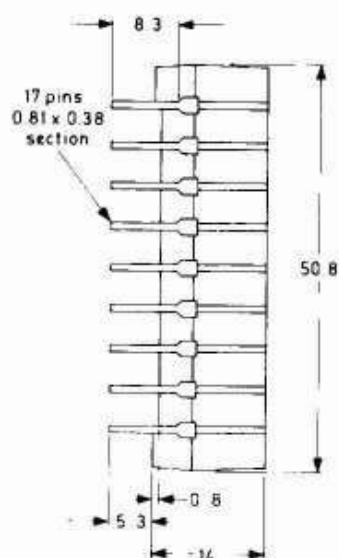
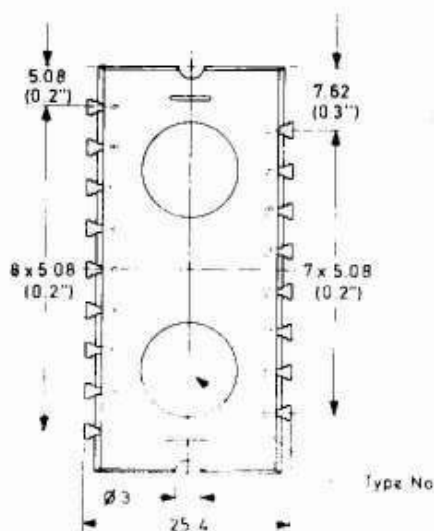
Storage

Modules and power supply

-40 to +85 °C

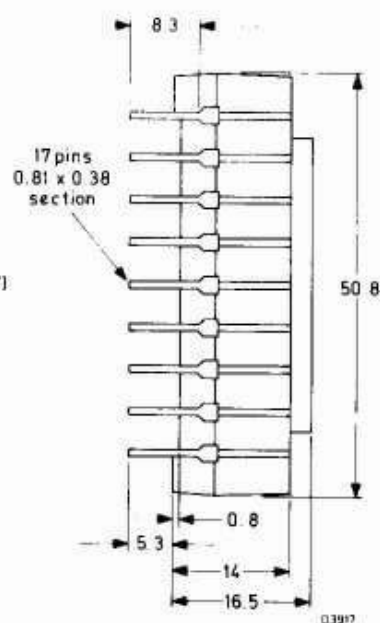
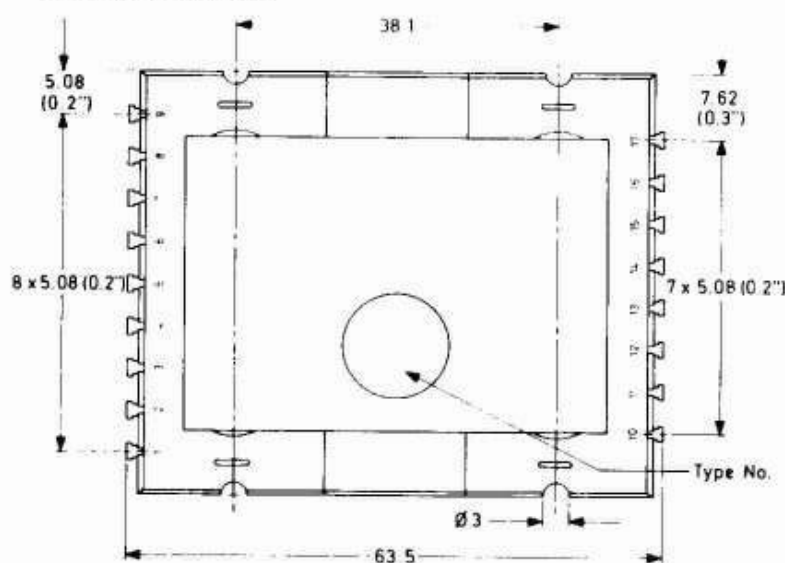
DIMENSIONS (millimetres) First angle projection.

All modules except PA 60 and HPA 60



0.2371

PA 60 and HPA 60



0.3917

For dimensions of accessories see individual data sheets.

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TERMINATIONS

The number of terminations on a module is 17. Each termination is a $0.81 \times 0.38\text{mm}$ section pin which is suitable for mini-wrap (wires of 0.500mm diameter), modified mini-wrap (wires of 0.355mm diameter), soldering, or printed wiring board use.

Termination numbers are moulded on both top and bottom of each module; all connections are accessible from both positions for test and servicing.

MOUNTING

1. By its terminations.

Note: The terminations of each side of the modules are on a 5.08mm (0.2in) pitch but the two rows are staggered and the modules must therefore be mounted on printed-wiring boards using 2.54mm (0.1in) grid.

2. Universal mounting chassis UMC60 (see separate data sheet).
3. Mounting bar MB60 (see separate data sheet).
4. On a suitable flat surface using M2.5 screws or number 4 self tapping screws.

WEIGHT

All modules except PA60 and HPA60	approx. 30	g
PA60 and HPA60	approx. 100	g

TESTS

These modules are designed to meet the following IEC 68 tests: -

1. Cold (functional), test A	-10	$^{\circ}\text{C}$
2. Dry heat (functional), test B (extended to 56 days)	+85	$^{\circ}\text{C}$
3. Long term dampheat, test C	56	days
4. Vibration, test Fb	method A	
5. Temperature cycling, test Na	-40 to +85	$^{\circ}\text{C}$

The modules are also designed to meet the following: -

Shock test	3 blows at 490m/s^2 (50g)
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SYSTEM DESIGN

Terminal connections: These are shown on the individual data sheets. Wherever possible, a consistent pin-layout is provided, to simplify wiring-up.

Loading-drive units

In order to simplify system design, the input requirements and the output capability of the modules are referred to in terms of DRIVE UNITS (d.u.).

A d.u. is an arbitrary unit of loading which takes into account the worst-case condition for correct driving of the circuit and is referred to operation from a $24V_{d.c.} \pm 25\%$ supply source. For example, a module circuit, having an output capability of 6d.u., may be used to drive a number of other circuits with a total of input loading requirements not exceeding 6d.u. All units are designed to tolerate a capacitive loading of 200pF maximum at their outputs (except the 2TG90).

Logic levels

The logic is considered to be positive logic, where the '1' level is more positive than the '0' level.

Logic '0' level is defined throughout the system as being a voltage between 0 and +0.3V.

Logic '1' level will be a positive voltage having a value determined by the loading, but will approach the supply voltage level. This value must always be greater than 11.5V (when the power supply voltage is at a minimum) and the minimum value will rise with any increase in power supply voltage. Therefore, for a system operating from an 18V supply, the '1' level lies between 11.5 and 18V, whereas, for a 30V supply it lies between 14.4 and 30V. Where the loading has been established in d.u., the requirements of voltage levels will automatically be met at all times.

D.C. NOISE IMMUNITY

'0' level immunity

A d.c. voltage of +1V with respect to the common (zero volt) line, applied to any one input (the other inputs floating), will not cause a change in output voltage.

'1' level immunity at $24V \pm 25\%$

A variation of 2V below the minimum '1' input level, will not cause a change in output voltage.

POWER SUPPLY

The modules are designed to operate within the limits of 18 to $30V_{d.c.}$ Currents given in the data sheet are at 30V. If the supply voltage is arranged so it does not exceed a known value, then the current may be reduced proportionately.

ORDERING PROCEDURE

The modules and accessories should be ordered under their appropriate type numbers as given in the individual data sheets.

←

RANGE OF MODULES

Description	Function	Colour	Type number
Twin NOR	Basic logic elements	Black	2NOR60
Quadruple NOR	Basic logic elements	Black	4NOR60
Twin inverter amplifier (or low power output)	High fan-out amplifier (100mA output unit)	Blue	2IA60
Twin low power output	100mA each output	Blue	2LPA60
Medium power output	1A output unit	Blue	PA60
High power output	2.5A output unit	Black	HPA60
Twin input switch filter	Interference suppression	Green	2SF60
Timer	Time delay	Red	TU60
Pulse shaper	Input unit	Green	PS90
Flip-flop	Counter/shift register	Red	FF90
Twin trigger gate	Extends facilities for FF90	Red	2TG90
Grounded load driver	2 input NOR function	Black	GLD60
	Low power grounded load driver		

ACCESSORIES

Description	Function	Type number
Power supply	500mA at 24V _{d.c.} ; 25mA at 100V _{d.c.}	PSU61
Printed wiring board	for mounting a maximum of 8 modules (4 PA60 or HPA60)	PCB60
Mounting chassis	for mounting a maximum of 21 PCB60	MC60 38240
Universal mounting chassis	for mounting a maximum of 6 modules (3 PA60 or HPA60)	UMC60
Mounting bar (1 metre long)	for mounting modules end to end	MB60

For loading table see over.

LOADING TABLE

Module	Each input	Each output
2NOR60	1d. u.	6d. u.
4NOR60	1d. u.	6d. u.
2IA60	2d. u.	20d. u.
2IA60 (as a low power output)	2d. u.	*100mA maximum (30V maximum)
2LPA60	2d. u.	*100mA maximum (30V maximum)
PA60	1d. u.	*1A maximum (30V maximum)
HPA60	1d. u.	*2.5A maximum (30V maximum)
2SF60	100V at 3.3mA	2d. u.
TU60	1d. u.	5d. u.
PS90	1d. u. (see also PS90 data sheet)	6d. u. (see also PS90 data sheet)
FF90	See FF90 data sheet	See FF90 data sheet
2TG90	See 2TG90 data sheet	See 2TG90 data sheet
GLD60	NOR: 1d. u.	6d. u.
	GLD: 2d. u.	See GLD60 data sheet

*These outputs are not suitable for driving the inputs of other modules in this range.

This data sheet should be read in conjunction with
NORBIT 2 Series

DESCRIPTION

A set-reset bistable multivibrator incorporating trigger gates, which may be used for counting, shift registers, etc. Switching is performed by applying signals at the trigger terminals T₁ and T₂ which are controlled by the gates G₁ and G₂ respectively. The trigger terminals may be extended by the addition of external diodes to the ET terminals to provide an OR or inhibit facility. In addition, the circuit may be reset by applying a '1' level to the 'reset' terminal (R) and may be set by applying a '1' level to terminal B₁, via a resistor.

COLOUR

Red

ELECTRICAL DATA

Power supply

Supply voltage, V _P	+24 ± 25%	V _{d.c.}
Supply current to pins 16 and 7	max. 21	mA ←

Input

Logic '0'	0 to +0.3	V
Logic '1'	+(0.24V _P + 7.2) to V _P	V

Loading

The FF90 introduces pulse logic to the NORBIT 2 range and, because of the circuits used, the ability of the driving block to accept current at the '0' level must be considered. This ability to obey the current and timing requirements is expressed simply in terms of 'z.u.'. Normal drive units, i.e., 'd.u.' must still be considered.

The input requirements at the various terminals of the FF90 are given in table 1.

Table 1

Function	Input	d.u. '1' level	z.u. '0' level	Notes
Reset (put Q_1 to '1')	R	1	0	The 'set' and 'reset' inputs may be expanded by using up to 3 suitable diodes at each input. The cathode of each diode must be connected to the input. If the 'set' or 'reset' facilities are used, inputs must be held at '0' (and not left open-circuit) except during the input period.
Set (put Q_2 to '1')	B_1 via 82k Ω resistor (Note 2)	1	0	
Gate	G_1, G_2	2	1	'1' or open-circuit closes gate. '0' opens gate.
Gate	G_1, G_2 via a diode (Notes 1 and 2)	0	1	'1' or open-circuit closes gate. '0' opens gate. The anode of the diode must be connected to the input.
Trigger	T_1, T_2	0	2	Only a negative-going 1/0 edge occurring within 3 μ s provides the required signal. If T_1 and T_2 are interconnected, 4z.u. are required.
Trigger	ET_1, ET_2 via a diode (Notes 1 and 2)	0	2	Only a negative-going 1/0 edge occurring within 3 μ s provides the required signal. If ET_1 and ET_2 are interconnected, 4z.u. are required. The anode of each diode must be connected to the input.

NOTES

1. Suitable diodes are: BAX13 or BAX16.
2. When used, the external diodes and resistor should be mounted as close as possible to the flip-flop.

The loadings in d.u. and z.u. for the units of the NORBIT 2 range are given in table 2 below. The d.u. capability remains exactly as specified in the corresponding data sheets.

Table 2

Unit	d.u. '1' level	z.u. '0' level	Notes
NOR of 2NOR60	6	12	2 inputs must be connected in parallel. Signal must be derived from a chain of units that includes either a PS90, an FF90 or a TU60.
2IA60 as low power output	20	50	Both the inverting and non-inverting connections can be used, but pins 5 and 6 must be interconnected. Signal must be derived from a chain of units that includes either a PS90, an FF90 or a TU60.
NOR of 4NOR60	6	0	No z.u. available. Therefore, these units must not be used to drive the FF90 directly.
LPA60	-	0	
PA60 and HPA60	-	0	
TU60	5	0	
SF60	2	0	
PS90	6	40	
FF90	5	7	

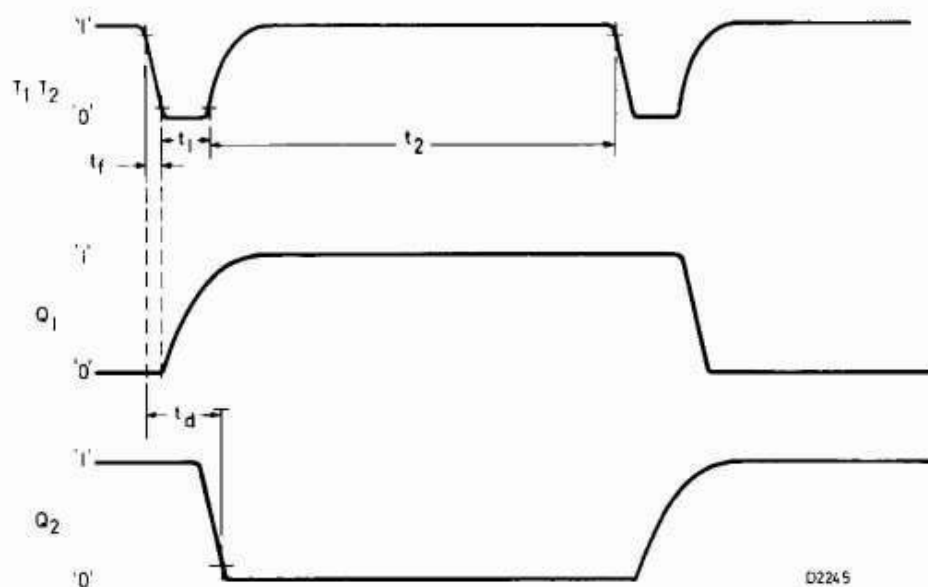
Output

Loading

5 d.u.
and 7 z.u.

Note

Account must be taken of the load imposed by the gates when they are connected to Q_1 or Q_2 terminals.



Operational requirements

The signal at the gate must be present for at least the duration of its recovery time before the triggering edge is applied to T_1 or T_2 . It is permitted to change the gate signal simultaneously with the triggering edge.

Fall time, t_f	max.	3	μs
Pulse duration, t_1	min.	5	μs

Maximum values in kHz for pulse repetition frequency at T terminals, $\frac{1}{t_1 + t_2}$, are given in table 3.

Table 3

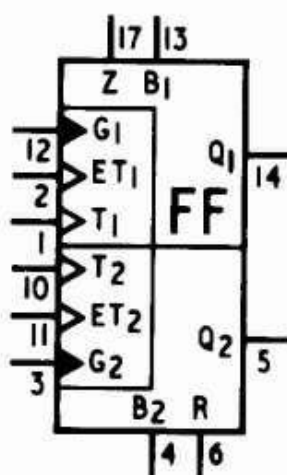
Connection	$t_2 = t_1$	$t_2 = 10t_1$
Flip-flop with input applied to T_1 and T_2 connected together	5.0	7.0
Flip-flop with input to T_1 or T_2 , having ET_1 and ET_2 interconnected and with gate diodes as in table 1	5.0	12.5

Reset (or set) pulse duration	min.	50	μs
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Characteristics

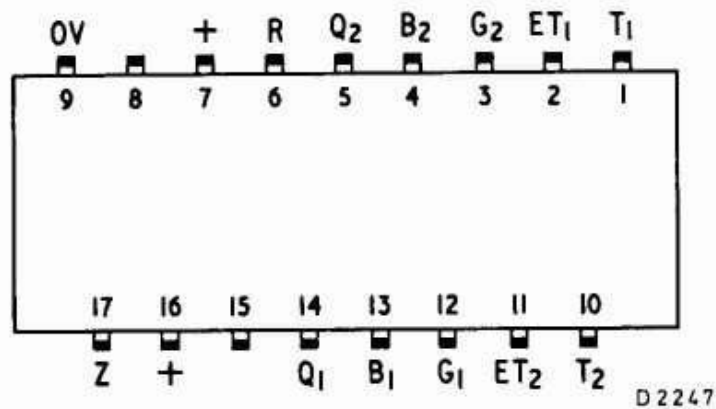
Trigger recovery time, t_2	typ.	73	μs
	max.	99	μs
Gate recovery time			
	gate directly connected	typ.	105 μs
		max.	137 μs
	with gate diodes	typ.	64 μs
Switching delay, t_d			
		max.	77 μs
		typ.	3 μs
	max.	8	μs

DRAWING SYMBOL



D2246

TERMINAL CONNECTIONS

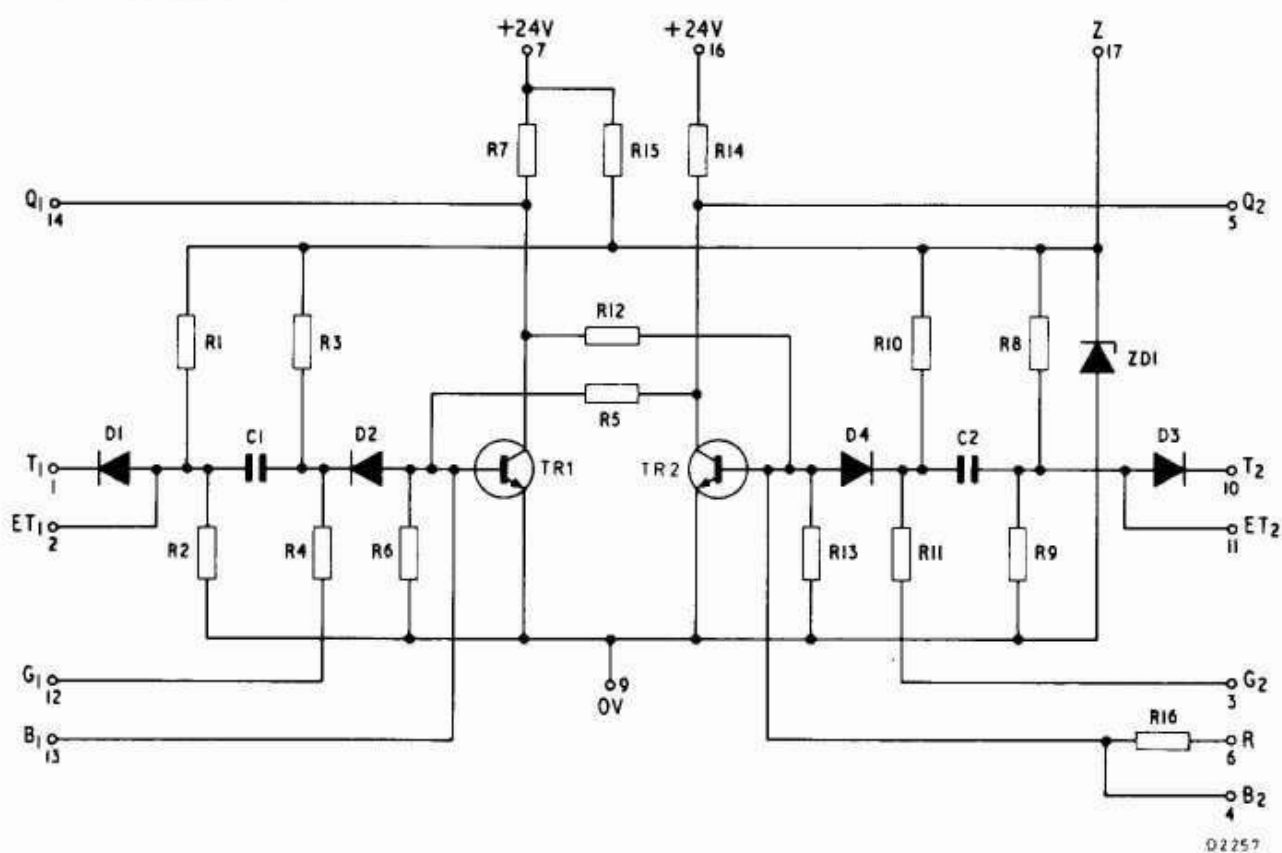


view from underside of module

Terminal No.	Connected to	Terminal No.	Connected to
1	Trigger input (T_1)	10	Trigger input (T_2)
2	Extension trigger input (ET_1)	11	Extension trigger input (ET_2)
3	Gate input (G_2)	12	Gate input (G_1)
4	Transistor TR2 base (B_2)	13	Transistor TR1 base (B_1)
5	Output 2 (Q_2)	14	Output 1 (Q_1)
6	Reset (R)	15	Not connected
7	Positive supply, V_P (connect to pin 16) (+)	16	Positive supply, V_P (connect to pin 7) (+)
8	Not connected	17	Zener diode (Z)*
9	Common supply (0V)		

*CAUTION: With the supplies connected, ensure that pin 16 is not accidentally connected to pin 17 otherwise ZD1 will be damaged.

CIRCUIT DIAGRAM



This data sheet should be read in conjunction with
NORBIT 2 Series

DIMENSIONS

These are in accordance with NORBIT 2 Series outline 2NOR60.

DESCRIPTION

The unit comprises:

1. A 2-input power amplifier for switching d.c. loads with one side connected to ground (GLD).
2. A 2-input NOR gate.
3. A voltage regulator diode (D).
4. A resistor network (R1 and R2).

The above may be used independently, or in combination to produce a monitor circuit for twin channel logic systems with fault display.

COLOUR

Black

ELECTRICAL DATA

Power supply	NOR (supply to pin 6)	GLD	
Supply voltage (d. c.) V_P	$+24 \pm 25\%$	$+24 \pm 25\%$	V
Supply current	max. 4.1	max. $19.1 + I_{load}$	mA
Input			
'0' level	-15* to +0.3	on pin 12 or 13 on pin 4	-4* to +1 0 to 15 V μA
'1' level	$(0.24V_P + 7.2)$ to +70*	on pin 12 or 13 on pin 4	$(0.14V_P + 8.6)$ to +70* $(2.5V_P + 70)$ V μA
Loading per input	1	2	d. u.
*Limiting values. These are absolute operating limits, which must not be exceeded under any conditions.			
Output			
Load capability	6	900 with 3k Ω load connected	d. u.
Minimum load resistance			
driven by signal on pins 12 and 13		75 (notes 1, 2 and 3)	Ω
driven by NOR via D on pin 4 (supply to pins 7 and 16, connect pin 8 to 4, pin 14 to 17, pin 11 to 10, pin 12 or 13 to 0V)		120 (notes 2 and 3)	Ω

For notes see page 2.

ELECTRICAL DATA (contd.)

Auxiliary circuits

Voltage regulator diode

Reference voltage	12	V
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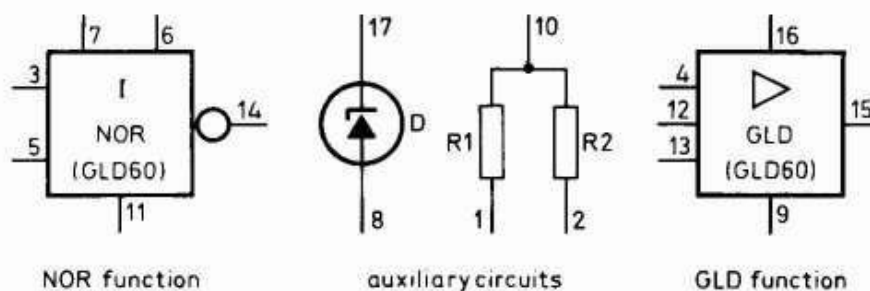
Resistor network

R1	3010	Ω
R2	1500	Ω

NOTES

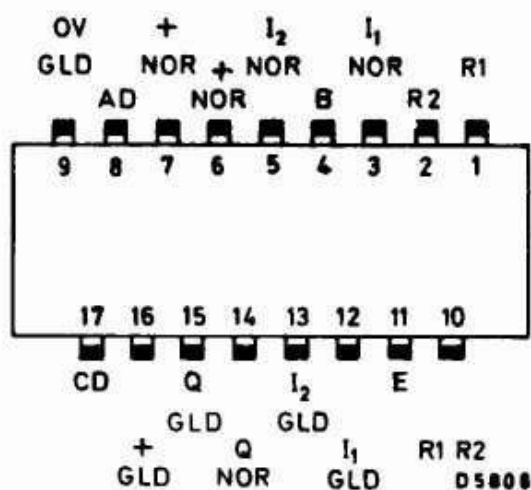
1. Increase by 0.44Ω per deg.C above $T_{amb} = 45^{\circ}\text{C}$, to 86Ω at $T_{amb} = 70^{\circ}\text{C}$.
2. When driving filament lamps, series and bleed resistors must be used.
3. A shunt diode must be used with inductive loads; a suitable diode is BAX12 (cathode to pin 15).

DRAWING SYMBOL



D5807

TERMINAL CONNECTIONS



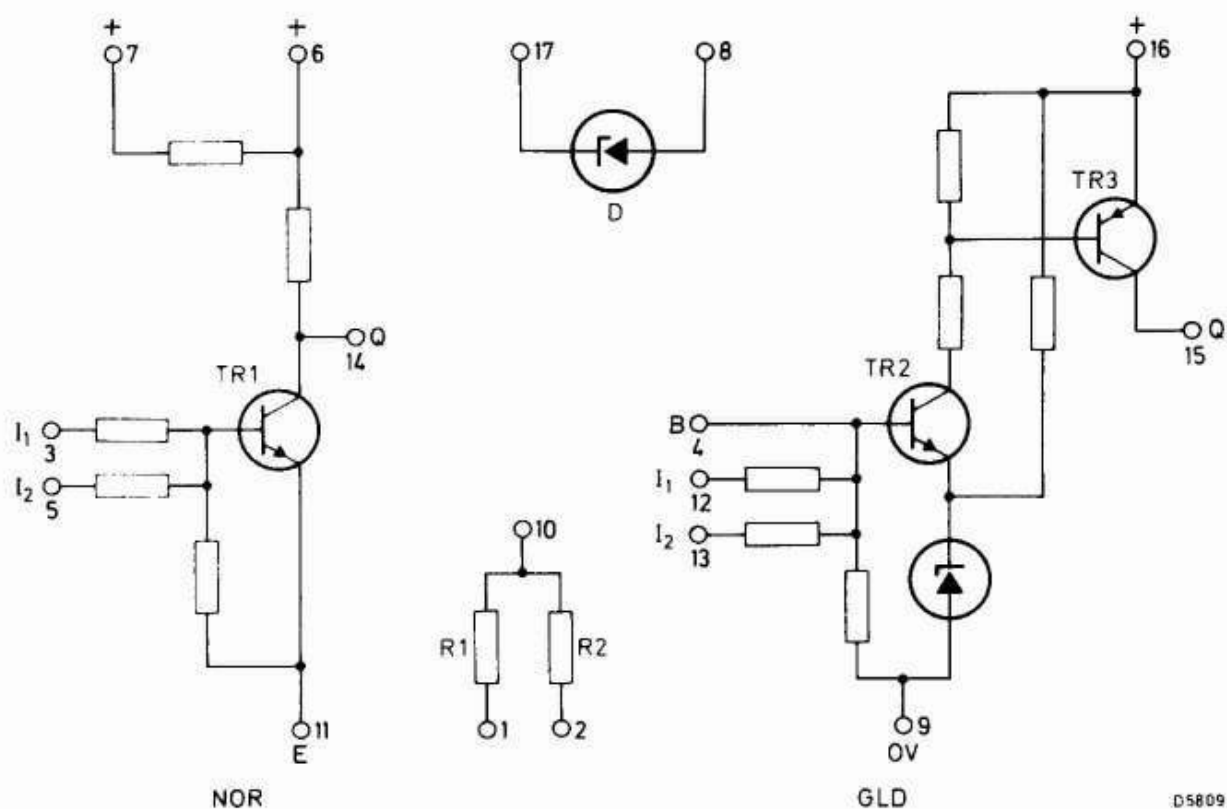
View from underside of module

NORBIT 2 GROUNDED LOAD DRIVER

GLD60

Terminal number	Connected to	Terminal number	Connected to
1	Resistor R1 (R1)	10	Resistors R1 and R2 (R1R2)
2	Resistor R2 (R2)	11	Emitter of TR1 (connect to 0V if used as NOR) (E)
3	Input 1 to NOR (I_1 NOR)	12	Input 1 to GLD (I_1 GLD)
4	Base of TR2 (B)	13	Input 2 to GLD (I_2 GLD)
5	Input 2 to NOR (I_2 NOR)	14	Output of NOR (Q NOR)
6	Positive supply, V_P , to NOR (+ NOR)	15	Output of GLD (Q GLD)
7	Auxiliary supply to NOR (+ NOR)	16	Positive supply, V_P , to GLD (+ GLD)
8	Anode of voltage regulator diode (AD)	17	Cathode of voltage regulator diode (CD)
9	Common supply to GLD (0V GLD)		

CIRCUIT DIAGRAM



D5809