fischertechnik

Additional Programs for the Electronics Module Part No. 152063

Contents:

1.1 Additional Programs for the Electronics Module

For fans of digital technology, these additional functions are provided in the fischertechnik Electronics Module (part no. 152063) and can be selected using the DIP switches. The added features are not described in the booklets, as they are designed as additional projects after the construction of the models contained in the PROFI Electronics kit (part no. 524326).

As with the programs described in the booklet, the setting of the DIP switches only becomes effective after a short disruption of the supply voltage (i.e. switch it off and on again).

The special functions include; AND logic gate, OR logic gate, XOR logic gate, D flip-flop with reset, JK (RS) flip-flop, monostable, threshold and differential switch (analog comparator), binary or BCD counter, dual programmable frequency divider, as well as lighting effects and frequency generator.

The following is a description of these additional functions.

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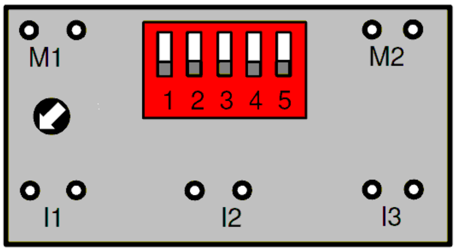
1.2 Wiring of the inputs and outputs

For additional programs, with up to 4 outputs and up to six inputs, the I/O numbering is from left to right as shown below:

Outputs			
M1		M2	
O1	O2	O3	O4



Inputs					
I1		I2		I3	
E1	E2	E3	E4	E5	E6

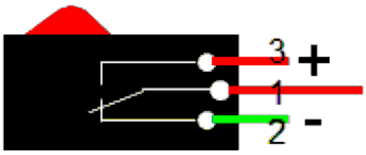
Examples: O2 = right socket of M1
O3 = left socket of M2
E1 = left socket of I1
E6 = right socket of I3

The inputs with the prefix "I" correspond to the normal inputs, they can (depending on the selected program) handle both analog and digital signals. In an unconnected or "open" condition, they are inactive (= 0).

The inputs with the prefix "E" are the additional inputs. The odd numbered "E" inputs have a pull-up resistor, these inputs are normally in the "1" state and can be changed to the "0" state by connecting to "-" (ground or 0V). The even numbered "E" inputs have a pull-down resistor, these inputs are normally in the "0" state and can be changed to the "1" state by connecting to "+" (positive or 9V supply).

You can connect any output (O1 to O4) of an Electronics module to any "E" input directly. As the Electronics module's output always has a defined output level (0V or 9V), this satisfies the input requirement without the need for additional components or connections.

When connecting pushbuttons to "E" inputs, it is recommended that the following circuit is used:



to +9V supply
to "E" input
to 0V supply

By using this method of wiring, a "-" is connected to the "E" input when the button is not pressed and a "+" is connected to the "E" input when the button is pressed.

Other electronic devices (e.g. phototransistors) can be connected, but please note the following:

- For E2, E4, E6 inputs: connect the red connection of the phototransistor to "+" and the other terminal of the phototransistor at the respective "E" input.
- For E1, E3, E5 inputs: connect the red connection of the phototransistor to the "E" input and the other terminal of the phototransistor to "-".
- NPN transistors may be directly connected between E1, E3, E5 and "-". To connect an NPN transistor between "-" and E2, E4 or E6, a pull-up resistance[1] is required for the correct operation.

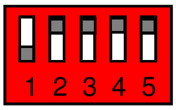
Due to debouncing and the scanning interval of the electronic module, a 15ms signal delay may occur. Note the inputs are scanned at 100Hz (100 times per second).

[1] In the models merry-go-round and sliding door with contact switch an NPN transistor input is connected to the Electronics Module. Instead of the LED used in the "touch switch" circuit in the booklet, a second resistor (a pull-up resistor) is used. The transistors T1 and T2 are connected in, what is called, a "Darlington pair" configuration. When the contact switch is "open", both transistors T1 and T2 are "off" and 9V is connected to the input via the "pull-up resistor". A "1" state will then appear at the input. When the switch is touched a small amount of current flows to the base of T1 which is amplified by the "Darlington pair", turning T2 on and connecting 0V to the input. A "0" state then appears at the input.

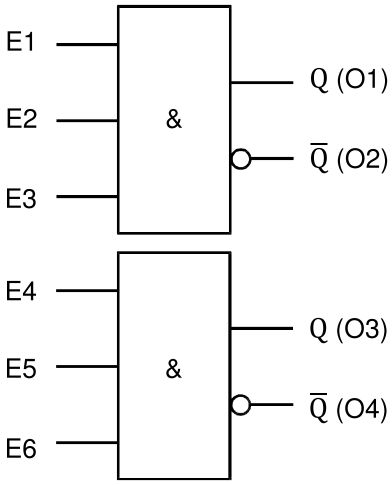
1.3 Additional programs for digital technology

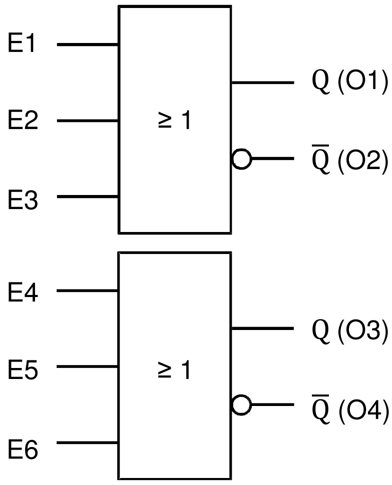
1.3.1 AND / OR logic gate

DIP - Switch Position



AND Logic Gate 2 x 3 inputs	**OR Logic Gate** 2 x 3 inputs
Pot left (counterclockwise)	Pot right (clockwise)





Truth Table - AND Logic Gate					**Truth Table - OR Logic Gate**				
E1	E2	E3	O1	O2	E1	E2	E3	O1	O2
E4	E5	E6	O3	O4	E4	E5	E6	O3	O4
0	0	0	0	1	0	0	0	0	1
1	0	0	0	1	1	0	0	1	0
0	1	0	0	1	0	1	0	1	0
1	1	0	0	1	1	1	0	1	0
0	0	1	0	1	0	0	1	1	0
1	0	1	0	1	1	0	1	1	0
0	1	1	0	1	0	1	1	1	0
1	1	1	1	0	1	1	1	1	0

Legend: 0 = 0V, 1 = 9V

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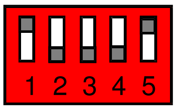
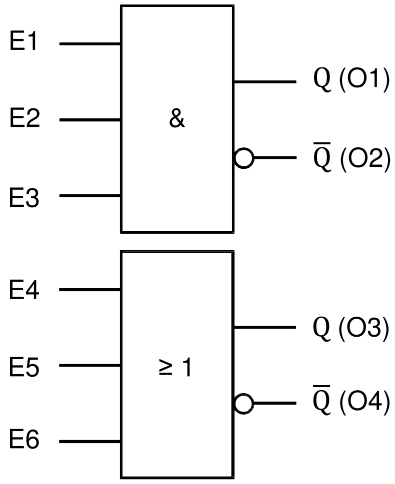
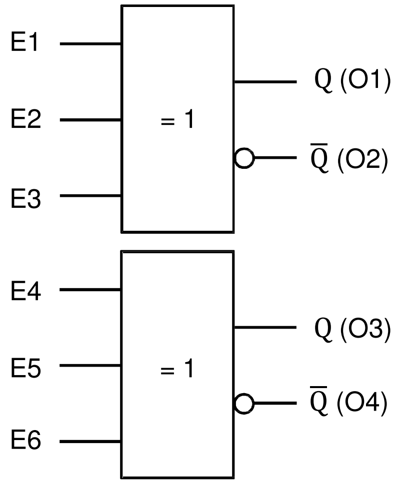
1.3.2 XOR Logic Gate

DIP - Switch Position	
	
AND / OR Logic Gates 3 Inputs	**XOR Logic Gate** 2 x 3 Inputs
Pot left (counterclockwise)	Pot right (clockwise)
	

Truth Table - AND Logic Gate

E1	E2	E3	O1	O2
0	0	0	0	1
1	0	0	0	1
0	1	0	0	1
1	1	0	0	1
0	0	1	0	1
1	0	1	0	1
0	1	1	0	1
1	1	1	1	0

Truth Table - XOR Logic Gate

E1	E2	E3	O1	O2
E4	E5	E6	O3	O4
0	0	0	0	1
1	0	0	1	0
0	1	0	1	0
1	1	0	0	1
0	0	1	1	0
1	0	1	0	1
0	1	1	0	1
1	1	1	1	0

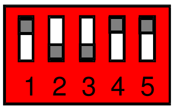
Truth Table - OR Logic Gate

E4	E5	E6	O3	O4
0	0	0	0	1
1	0	0	1	0
0	1	0	1	0
1	1	0	1	0
0	0	1	1	0
1	0	1	1	0
0	1	1	1	0
1	1	1	1	0

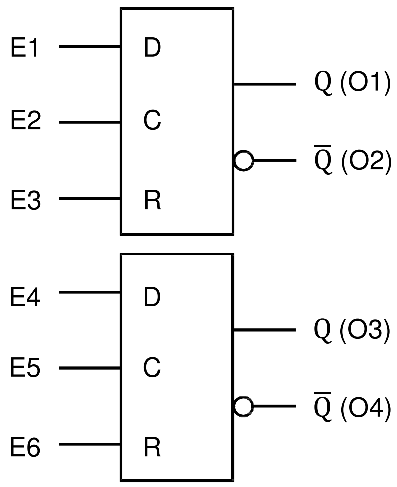
Legend: 0 = 0V, 1 = 9V

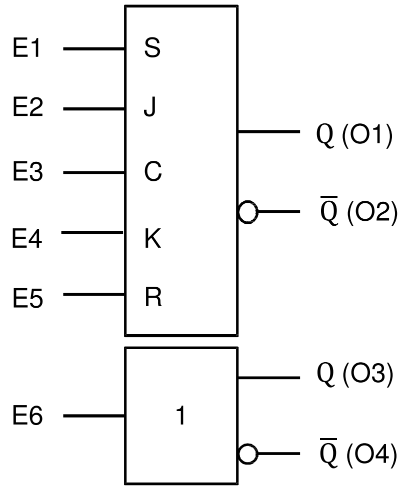
1.3.3 D Flip-flop with Reset, JK-(RS) Flip-flop and NOT Logic Gate (inverter)

DIP - Switch Position



D Flip-flop with Reset 2x 3 inputs	**JK (RS) Flip-flop and NOT Logic Gate**
Pot left (counterclockwise)	Pot right (clockwise)





E1 / E2 = D
E2 / E5 = CLOCK
E3 / E6 = RESET

E1 = SET
E2 = J
E3 = CLOCK
E4 = K
E5 = RESET

Truth Table - D Flip-flop

E1 E4	E2 E5	E3 E6	O1 O3	O2 O4
0	↑	0	0	1
1	↑	0	1	0
X	X	1	0	1

Legend: 0 = 0V, 1 = 9V, ↑ = Transition 0V to 9V, X = Don't Care

Truth Table - JK (RS) Flip-flop

E1	E2	E3	E4	E5	O1	O2
0	0	↑	0	0	-	-
1	X	X	X	0	1	0
0	X	X	X	1	0	1
1	X	X	X	1	-	-
0	1	↑	0	0	1	0
0	0	↑	1	0	0	1
0	1	↑	1	0	O2[1]	O1[1]

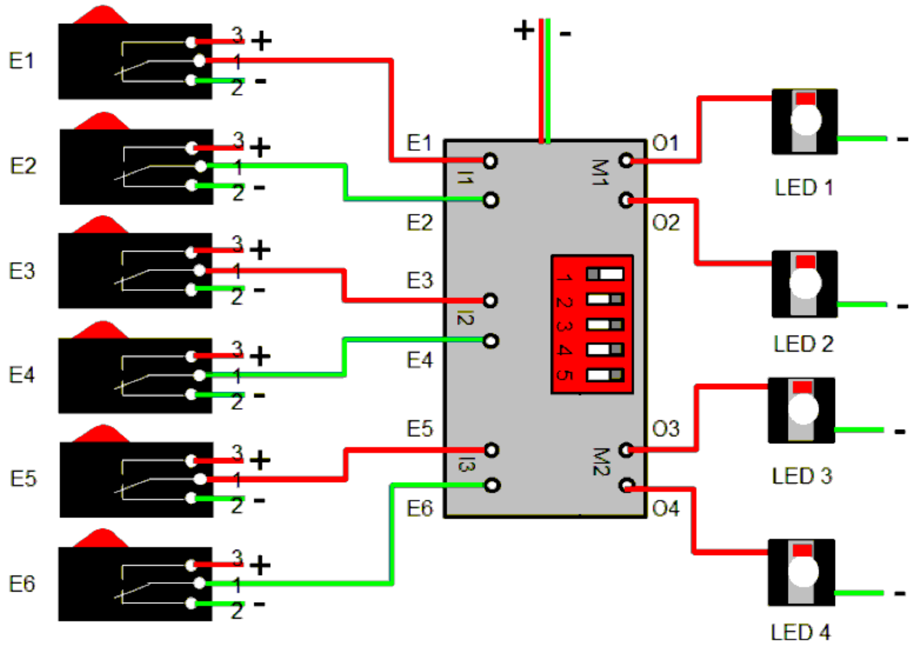
Legend: 0 = 0V, 1 = 9V, ↑ = Transition 0V to 9V, X = Don't Care, - = No State Change
[1] E2 and E4 = 1:toggles O1 and O2, changes from 0 to 1 and vise-a-versa

Truth Table – NOT Gate (inverter)

E6	O3	O4
0	1	0
1	0	1

Legend: 0 = 0V, 1 = 9V

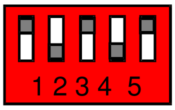
1.3.4 Test circuit - OR / AND / XOR / NOT logic gate D flip-flop / JK (RS) flip-flop



Set the DIP Switch position and Pot according to the program required.

1.3.5 Monostable or One Shot

DIP - Switch Position



Set Running Time Potentiometer adjustable

I1 (E1/E2) = retriggerable input, that is, the running time is restarted at each pulse (edge-triggered, i.e. responding to a 0V → 9V transition)
I2 (E3/E4) = not retriggerable, that is, the running time must elapse before a new time can start. (edge triggered, i.e. responding to a 0V → 9V transition)
E5 = Logic input for time duration (see table below)
E6 = Logic input for time duration
Pot = Fine adjustment of time duration

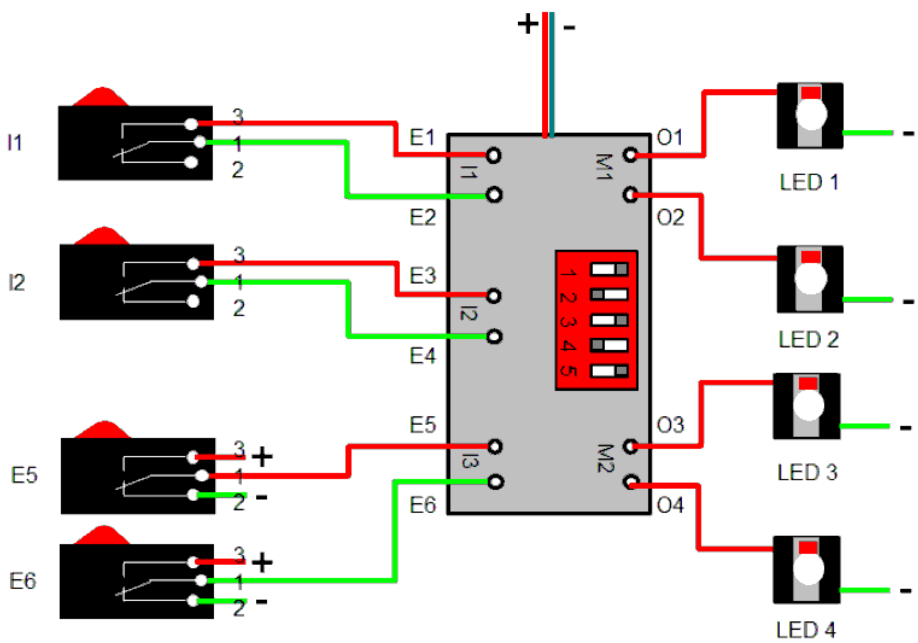
O1 = 9V output for running time duration
O2 = O1 inverted
O3/O4 = flashes alternately during the time interval (O1 = 9V)

I1 and I2 can also be triggered via phototransistors. For connection see 1.4.1 Threshold and differential switch (analog comparator)

Function Table - Monostable Running Time		
E5	E6	Time
0	0	0.1 – 1 Seconds
1	0	1 – 10 Seconds
0	1	10 – 100 Seconds
1	1	1 – 10 Minutes

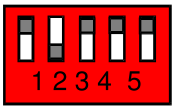
Legend: 0 = 0V, 1 = 9V

1.3.6 Test Circuit - Monostable

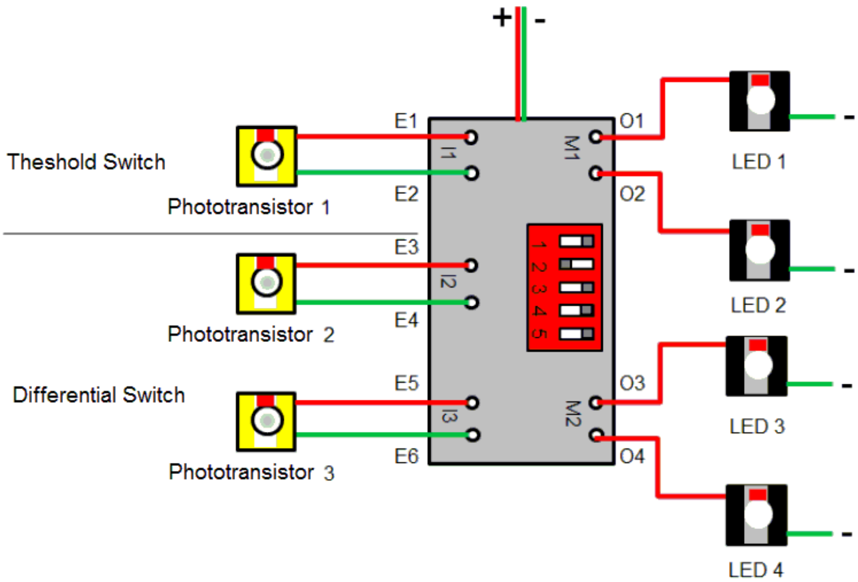


1.4 Other Functions

1.4.1 Threshold and differential switch (analog comparator)

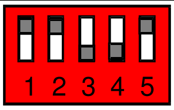
DIP - Switch Position 	
Threshold Switch I1 = Phototransistor 1 Pot = Set point adjustment O1 = 9V, when E2 exceeds the set point set by the potentiometer O2 = O1 inverted Application: adjust of light barrier	**Differential Switch** I2 = Phototransistor 2 I3 = Phototransistor 3 Pot = Hysteresis adjustment (Sensitivity) O3 = 9V, when I2 is greater than I3 O4 = O3 inverted Application: Orientation of solar cells

1.4.2 Test Circuit - Threshold and differential switch



1.4.3 Binary or BCD Counter

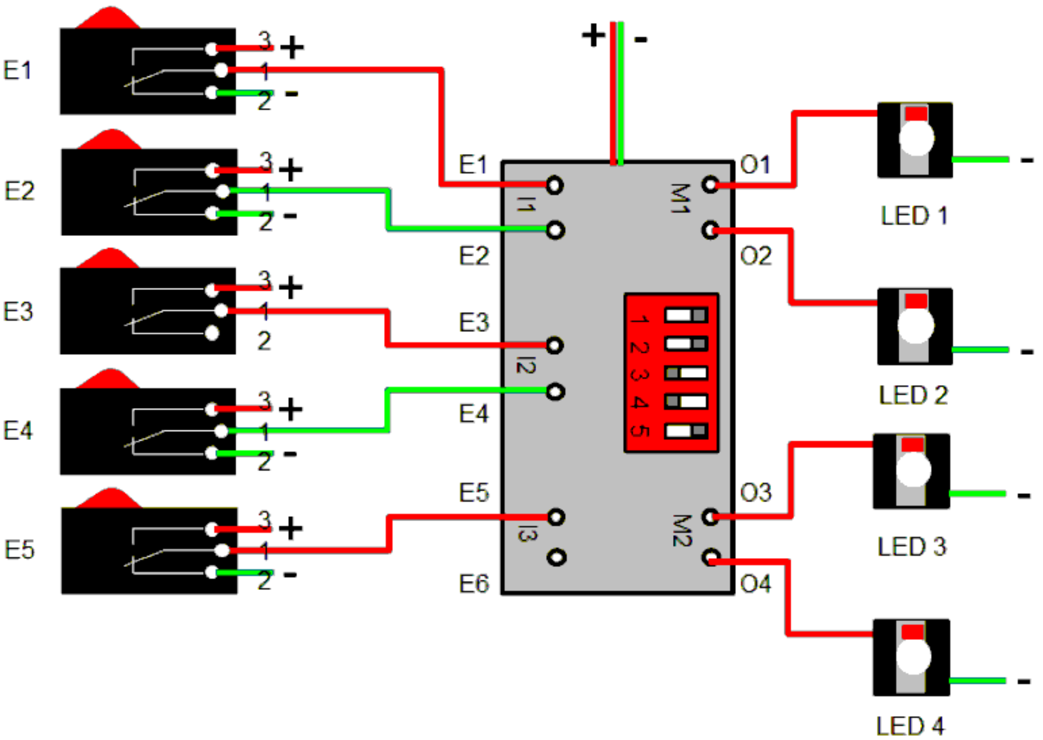
DIP - Switch Position



E1 = Clock input. Each 0V → 9V transition adds one count
E2 = Count Direction:
9V = Count Up
0V = Count Down
E3 = Counter Enable. At 9V the counter operates
E4 = Reset input. At 9V, the counter is set to 0 (independent of all other inputs)
E5 = Count Range:
9V = 0 to 15 (binary)
0V = 0 to 9 (BCD – Binary Coded Decimal)

O1 = Counter output, Bit 0 = O1
O2 = Counter output, Bit 1 = O2
O3 = Counter output, Bit 2 = O3
O4 = Counter output, Bit 3 = O4

1.4.4 Test Circuit – Binary or BCD Counter



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1.4.5 Dual programmable frequency divider

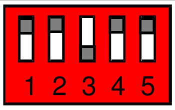
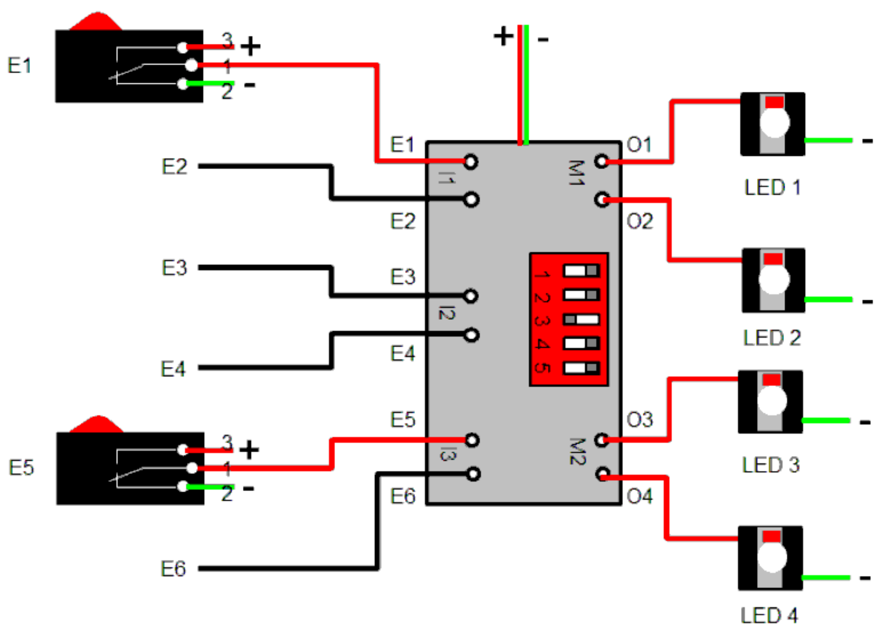
DIP - Switch Position	
E1 =	Input Channel 1
E 2/E3 =	Divisor Selection Channel 1
E5 =	Input Channel 2
E4/E6 =	Divisor Selection Channel 2
Pot left =	(counterclockwise) debouncing on
Pot right =	(clockwise) debouncing off, frequencies can be processed up to 500 Hz. Example: Encoder motor, connect the pulse output (black line) to the input of each channel.
O1 =	Output Channel 1
O2 =	O1 / 2
O3 =	Output Channel 2
O4 =	O3 / 2

Table – Frequency Divisor

Channel 1		Frequency Divisor
E2	E3	
Channel 2		
E4	E6	
0	0	16
1	0	12
0	1	5
1	1	3

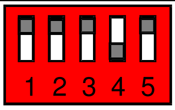
Legend: 0 = 0V, 1 = 9V

1.4.6 Test Circuit - Dual programmable frequency divider



1.4.7 Lighting Effects / Frequency Generator

DIP - Switch Position



E1 / E2 / E3 = Selection of type of light effect. These inputs are checked continuously. i.e. the switches may be changed at any time.
Pot = speed of light effect or frequency 0–50Hz (O1)

O1 = LED 1
O2 = LED 2
O3 = LED 3
O4 = LED 4

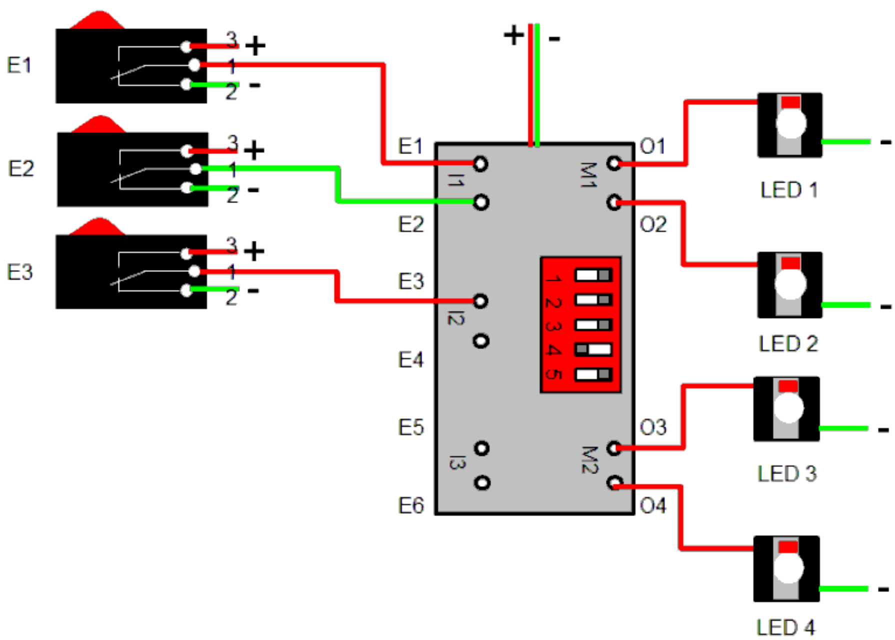
The lighting effects can be changed at any time without restarting the Electronics Module.

Table - Lighting Effects / Frequency Generator

E1	E2	E3	Lighting Effect
0	0	0	4 independent Flashing Lights
1	0	0	2 Independent Alternate Flashing Lights
0	1	0	4 Blue-Light Flasher
1	1	0	Light Chaser
0	0	1	Construction Site Chaser
1	0	1	Flickering Fire
0	1	1	Navigation Lights
1	1	1	0–50Hz Frequency Output (O1 only)

Legend: 0 = 0V, 1 = 9V

1.4.8 Test Circuit - Lighting Effects / Frequency Generator



1.5 Transistor Test

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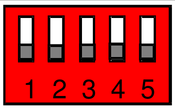
<tr><td>DIP – Switch Position</td><td></td></tr>
<tr><td colspan="2">E2 = Input to Transistor
S1 = Start Test

The transistor is OK, if the LED on the Electronic module after pressing S1 shows a short flash.</td></tr>
</table>

1.5.1 Test Circuit – Transistor Test