

Manual

# Light Computer

Item no. 53-02015 - 53-02236



For all kits and ready-built modules  
of the LC series

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## 1. Getting started

### How to use this manual

This manual gives step-by-step instructions for safe and correct assembly of the kit and fitting and connecting of the ready-built module, and operation. Before you start, we advise you to read the whole manual, particularly the chapter on safety instructions and the checklist for trouble shooting. You will then know where to take care and how to prevent mistakes which take a lot of effort to correct.

Keep this manual safely so that you can solve problems in the future. If you pass the kit or the ready-built module on to another person, please pass on the manual with it.

### Intended use

The LC modules are designed to be operated according to the instructions in this manual in model building, especially with model railways. Any other use is inappropriate and invalidates any guarantees.

The LC modules should not be assembled or mounted by children under the age of 14.

Reading, understanding and following the instructions in this manual are mandatory for the user.



#### Caution:

The LC modules contain integrated circuits. These are very sensitive to static electricity. Do not touch components without first discharging yourself. Touching a radiator or other grounded metal part will discharge you.

## Checking the package contents

Please make sure that your package contains:

- one kit, containing the components listed in the parts list (page 19) and one PCB or
- one ready-built module,
- two socket terminal strips (1 x 3-pole, 1 x 5-pole),
- additionally with LC-module 16: one dim switch and one light sensitive resistor;
- a CD (containing the manual and further information).

## Required materials

For assembling the kit you need:

- an electronic soldering iron (max. 30 Watt) or a regulated soldering iron with a fine tip and a soldering iron stand,
- a tip-cleaning sponge,
- a heat-resistant mat,
- a small side cutter and wire stripper,
- as necessary a pair of tweezers and long nose pliers,
- electronic tin solder (0,5 mm. diameter).

In order to connect the module you need wire. Recommended diameters:  $\geq 0,05 \text{ mm}^2$  for all connections.

You can connect small light bulbs or LEDs (via series resistors) to the 5 outputs of the LC module. Light bulbs, LEDs and series resistors are not included in the package. For further information on the maximum number of bulbs or LEDs to be connected to one output see section 7.

In addition, you possibly need for the following versions of the LC-modules:

- LC-module 16: For the connection of accessories with a current consumption of more than 100 mA to output 1: a monostable relay 1xUm 12 V (e.g. item-no. 84-61010-01) and a protective diode 1N400x,  $x \geq 1$ .
- LC-module 18: a loudspeaker (recommended impedance  $\geq 32$  Ohm, e.g. item no. 70-03121-01).

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## 2. Safety instructions

### **Mechanical hazards**

Cut wires can have sharp ends and can cause serious injuries. Watch out for sharp edges when you pick up the PCB.

Visibly damaged parts can cause unpredictable danger. Do not use damaged parts: recycle and replace them with new ones.

### **Electrical hazards**

- Touching powered, live components,
- touching conducting components which are live due to malfunction,
- short circuits and connecting the circuit to another voltage than specified,
- impermissibly high humidity and condensation build up

can cause serious injury due to electrical shock. Take the following precautions to prevent this danger:

- Never perform wiring on a powered module.
- Assembling and mounting the kit should only be done in closed, clean, dry rooms. Beware of humidity.
- Only use low power for this module as described in this manual and only use certified transformers.
- Connect transformers and soldering irons only in approved mains sockets installed by an authorised electrician.
- Observe cable diameter requirements.
- After condensation build up, allow a minimum of 2 hours for dispersion.
- Use only original spare parts if you have to repair the kit or the ready-built module.

## Fire risk

Touching flammable material with a hot soldering iron can cause fire, which can result in injury or death through burns or suffocation. Connect your soldering iron or soldering station only when actually needed. Always keep the soldering iron away from inflammable materials. Use a suitable soldering iron stand. Never leave a hot soldering iron or station unattended.

## Thermal danger

A hot soldering iron or liquid solder accidentally touching your skin can cause skin burns. As a precaution:

- use a heat-resistant mat during soldering,
- always put the hot soldering iron in the soldering iron stand,
- point the soldering iron tip carefully when soldering, and
- remove liquid solder with a thick wet rag or wet sponge from the soldering tip.

## Dangerous environments

A working area that is too small or cramped is unsuitable and can cause accidents, fires and injury. Prevent this by working in a clean, dry room with enough freedom of movement.

## Other dangers

Children can cause any of the accidents mentioned above because they are inattentive and not responsible enough. Children under the age of 14 should not be allowed to work with this kit or the ready-built module.



### Caution:

Little children can swallow small components with sharp edges, with fatal results! Do not allow components to reach small children.

In schools, training centres, clubs and workshops, assembly must be supervised by qualified personnel.

In industrial institutions, health and safety regulations applying to electronic work must be adhered to.

### 3. Safe and correct soldering



#### **Caution:**

Incorrect soldering can cause dangers through fires and heat. Avoid these dangers by reading and following the directions given in the chapter **Safety instructions**.

- Use a small soldering iron with max. 30 Watt or a regulated soldering iron.
- Only use electronic tin solder with flux.
- When soldering electronic circuits never use soldering-water or soldering grease. They contain acids that can corrode components and copper tracks.
- Insert the component connecting pins into the PCB's holes as far as possible without force. The components should be close to the PCB's surface.
- Observe correct polarity orientation of the parts before soldering.
- Solder quickly: holding the iron on the joints longer than necessary can destroy components and can damage copper tracks or soldering eyes.
- Apply the soldering tip to the soldering spot in such a way that the part and the soldering eye are heated at the same time. Simultaneously add solder (not too much). As soon as the solder becomes liquid take it away. Hold the soldering tip at the spot for a few seconds so that the solder flows into the joint, then remove the soldering iron.
- Do not move the component for about 5 seconds after soldering.

- To make a good soldering joint you must use a clean and unoxidised soldering tip. Clean the soldering tip with a damp piece of cloth, a damp sponge or a piece of silicon cloth.
- Cut the wires after soldering directly above the soldering joint with a side cutter.
- After placing the parts, please double check for correct polarity. Check the PCB tracks for solder bridges and short circuits created by accident. This would cause faulty operation or, in the worst case, damage. You can remove excess solder by putting a clean soldering tip on the spot. The solder will become liquid again and flow from the soldering spot to the soldering tip.

## 4. Operation overview

The Light Computer is controlled by a micro controller. The program stored in the micro controller controls the five outputs of the module. Sequence and timing are different with the various versions.

The LC module has a switching input (JP2) which has effects on the program sequence with some versions. Depending on the version and the input connected to earth or not

- the program finishes after one cycle or is repeated endlessly;
- the one or the other version of the program will be displayed.

**LC-1 "Advertising light 1":** The five outputs are switched on one after the other, blink together three times and are switched off afterwards. If the input JP2 is switched to earth, the light sequence switches off after the completion of the program. If the input remains open, the program repeats continuously.

**LC-2 "Advertising light 2":** The five outputs are switched on and off one after the other (running light sequences) and afterwards are switched on commonly for approx. 3 seconds. If the input JP2 is switched to earth, the light sequence switches off after the completion of the program. If the input remains open, the program repeats continuously.

**LC-3 "Advertising light 3":** At the start the five outputs are briefly switched on and off apparently without any system and afterwards are switched on commonly for approx. 3 seconds. If the input JP2 is switched to earth, the light sequence switches off after the completion of the program. If the input remains open, the program repeats continuously.

**LC-4 "Building site flasher":** At the five outputs a running light sequence is created. If the input JP2 is switched to earth, the light sequence switches off after the completion of the program. If the input remains open, the program repeats continuously.

**LC-5 "Flickering flame":** At the five outputs an irregular light pattern is created. If red and yellow bulbs are connected, the appearance of a flickering flame results. If the input JP2 is switched to earth, the light sequence switches off. If the input remains open, the program repeats continuously.

**LC-6 "Welding light":** At each of the five outputs short and strong light impulses are created, interrupted by breaks at irregular intervals. Please note: The breaks can last for several minutes! The patterns are different at all outputs, which allows you to connect several "work places". The effect is most realistic when blue LEDs are connected to the outputs. If the input JP2 is switched to earth, the light sequence is interrupted. If the input remains open, the program repeats continuously.

**LC-7 "Traffic light control":** Traffic light control for a complete intersection. Outputs 1 and 2 are red and green for direction A, outputs 4 and 5 are red and green for direction B. Output 3 is the amber for both and overlaps with red when changing to green, as common e.g. in Germany, Great Britain, Austria, Hungary, Switzerland, Poland, Lithuania, Norway and Sweden. If the input JP2 is switched to earth, the traffic lights switch to flashing amber and simulate a traffic light out of order, as common e.g. in Germany, Austria, Hungary, Switzerland and Poland. If the input remains open, the traffic lights operate continuously.

**LC-8 "Advertising light 4":** Fusion of the advertising lights 1 to 3, coming on one after the other. If the input JP2 is switched to earth, the light sequence switches off after the completion of the active part of the program. If the input JP2 is switched to earth, the light sequence is interrupted. If the input remains opens, the program is repeated constantly.

**LC-9 "Ignition module for gas lamps":** If the input JP2 is given a short electric pulse (earth), the gas lamps start to flicker and grow brighter gradually. Every ignition process is slightly different. After approx. 5 seconds the gas lamps reach their maximum brightness. During operation, the lamps flicker now and then at different times (variations of gas pressure). After the switch-off impulse, (when the input JP2 is given a short electric pulse) all lamps shine on with moderate brightness and go off completely in approx. 1.5 seconds.

**LC-10 "Fluorescent tube simulator:** If the input JP2 is given a short electric pulse (earth), the different fluorescent tubes flicker for a moment before all of them light one after the other - just like the real thing. The turning on pattern is a little different for each. If the input JP2 is switched to earth shortly, the light switches off. When the input is switched to earth permanently, a defective tube is simulated on output 1. This tube flickers at irregular intervals, at times brightening quickly, at times slowly.

**LC-11 "Occupied house":** Two different programs are available. Program 1, "Home", starts if the input JP2 is switched to earth, Program 2, "Office", if the input remains opens. The programs take approximately 15 minutes and are repeated after a short pause.

Program 1: First the light in the kitchen (output 1) goes on for a while, followed a bit later by the living room (output 2). Output 3 is assigned for connecting a blue light bulb (the TV set), which flickers like a television picture. Some time later the light in the kitchen switches off, and goes on again once during the program flow. The light in the bathroom (output 4)

goes on for a short time at irregular intervals. By the end of the program the lights in the bedroom (output 5) and in the bathroom go on for some time, the bulbs connected to outputs 2 and 3 switch off.

Program 2: In the entrance-hall (output 1) the light goes on for a short time at irregular intervals. The offices (or the flats in a multiple family dwelling) are connected to the outputs 2 to 5. The lights in the offices go on one after the other, but only after the light in the entrance hall has previously been switched on. By the end of the program the lights in the offices switch off one after the other and each time the light in the entrance hall goes on for a short time.

**LC-12 "Fairground attraction illumination":** Each of the 5 outputs can control several connected light bulbs, which form different patterns: they flash in changing sequences, form running lights, flicker irregularly etc. The input JP2 has no function in this version.

**LC-13 "Candlelight simulator":** After switching on the module the "candles" start to flicker - just like the real thing. At irregular intervals they brighten and dim. The input JP2 has no function in this version.

**LC-14 "Signal tower box light":** The 5 outputs switch at random the connected bulbs or LEDs. These light for a while and simulate the activities in a signal tower box. If the input JP2 is switched to earth, the light sequence is interrupted. If the input remains open, the program repeats continuously.

**LC-15 "Emergency vehicle light":** The bulbs / LEDs connected to the 5 outputs make 2 short flashes and then go off for a short time. The breaks between the double flashes are of varying duration for the five outputs. This way the characteristic light pattern for modern emergency vehicles is created. If the input JP2 is switched to earth, the light sequence is interrupted. If the input remains open, the program repeats continuously.

**LC-16 "Dim switch for street lamps":** The input JP2 is switched on and off automatically via a light sensitive switch. The sensitivity of the switch is set via a trimpot.

Four outputs are designed for the connection of street lamps. The street lamps are getting brighter gradually after being switched on and obtain their maximum brightness after about one minute. Additional accessories (e.g. house lightings) which are intended to be switched depending on the ambient lighting can be connected to output 1 via a relay.

The circuit responds to changes of the ambient lighting with a delay of some seconds. While the street lamps are getting brighter after being switched on and some seconds after being switched off, the circuit does not respond to changes of the ambient lighting.

**LC-17 "Speed trap":** The output 1 controls the speed trap, which flashes at irregular intervals (from approx. 3 to 25 seconds). The outputs 2 to 5 are assigned for connecting the flash lights of police cars. The outputs 2 and 3 produce an asynchronous double flashing light (for modern police cars), the outputs 4 and 5 an asynchronous flashing light (for older police cars). The input JP2 has no function in this version.

Tip: The effect of the light patterns is most realistic when a white LED with high luminosity is connected to the output 5, blue LEDs are connected to the outputs 2 and 3 and small blue bulbs to the outputs 4 and 5.

**LC-18 "Vehicle lighting":** Via the switching input JP2 you can set the following programs: "moving vehicle" (with the input open) or "standing vehicle" (with the input switched to earth).

Assignment of the outputs:

- 1: Flashing lights on the left
- 2: Flashing lights on the right
- 3: Interior light (standing vehicle) or horn (moving vehicle)
- 4: Front lights
- 5: Back lights / brake lights

In the program "moving vehicle": The front and back lights are always switched on. It is possible to connect a loudspeaker as a horn (not included) to output 3, the volume can be reduced by connecting a series resistor (approx.  $10\ \Omega$  to  $1\ \text{k}\Omega$ ). The flashing lights on the left and the right, the horn and the stop lights are switched on and off at random. After the stop lights having been lighted the flasher is switched on, afterwards the stop lights and a little bit later the flasher are switched off.

In the program "standing vehicle": The front and back lights are switched on most of the time. Now and again the flashing lights on the left and the right, the warning flasher and the interior light are switched on. After the interior light having been lighted the front and back lights and then the interior light are switched off. Afterwards all lights are switched off for a period.

**LC-19 "Paparazzi flash":** The photographer's flash lights are connected to the five outputs of the module. They flash at random independently from each other. At irregular intervals flashlight thunderstorms break when all flashlights are used nearly simultaneously and several times close together. Using white LEDs creates a very realistic effect. The input JP2 has no function in this version.

**LC-20 "Roadworks vehicle":** The module's five outputs control the lighting of a complete roadworks vehicle including a trailer. Assignment of the outputs:

- 1: Lane indication arrow of the trailer  
(gets slowly brighter and then darker)
- 2: Flash lights of the trailer
- 3 and 4: Warning flasher of the service vehicle
- 5: Double flash light

The input JP2 has no function in this version.

**LC-21 "Funfair flow effect lighting 1":** The 5 outputs generate a light flow sequence. After the first run through the output 5 stays on, after the second run through the output 4, and so on, so that after 5 cycles all connected lamps or LEDs are switched on. With the cycles 6 to 10 the outputs are switched off in reverse order. If the input JP2 is switched to earth, the light sequence switches off after the completion of the active part of the program. If the input remains open, the program is repeated constantly.

**LC-22 "Funfair flow effect lighting 2":** The five outputs generate a light flow sequence. After being switched off, the outputs continue to glow for a short time. In the first cycle one output stays on and one continues to glow, in the second run through two outputs stay on and two continue to glow and finally, in the third cycle three outputs stay on and two continue to glow. If the input JP2 is switched to earth, the light sequence switches off after the completion of the active part of the program. If the input remains open, the program is repeated constantly.

**LC-23 "Funfair flow effect lighting 3":** The five outputs generate a running light sequence, which changes the running direction at random. If the input JP2 is switched to earth, the light sequence switches off after the completion of the active part of the program. If the input remains open, the program is repeated constantly.

## 5. Technical specifications

Supply voltage	10 – 18 Volt a.c. or d.c. voltage
Current consumption (without connected devices) approx.	20 mA
Max. total current	500 mA
Number of outputs	5
Max. current per output	100 mA
Number of switching inputs	1
Protected to	IP 00
Ambient temperature in use	0 ... +60 °C
Ambient temperature in storage	-10 ... +80 °C
Comparative humidity allowed	max. 85 %
Dimensions of the PCB (approx.)	25 x 30 mm
Weight of the circuit (approx.)	3 g

## 6. Assembling the kit

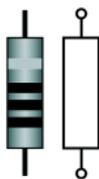
You can skip this part if you have purchased a ready-built module.

### Preparation

Put the sorted components in front of you on your workbench.

The separate electronic components have the following special features you should take into account in assembling:

## Resistors



Resistors reduce current.

The value of resistors for smaller power ratings is indicated through colour rings. Every colour stands for another figure.

Carbon film resistors have 4 colour rings. The 4th ring (given in brackets here) indicates the tolerance of the resistor (gold = 5 %).

Value:

1 k $\Omega$

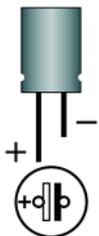
10 k $\Omega$

Colour rings:

brown - black - red (gold)

brown - black - orange (gold)

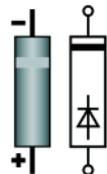
## Electrolytic capacitors



Electrolytic capacitors are often used to store energy. In contrast to ceramic capacitors they are polarized. The value is given on the package.

Electrolytic capacitors are available with different voltage sustaining capabilities. Using an electrolytic capacitor with a voltage sustaining capability higher than required is always possible.

## Diodes and Zener diodes



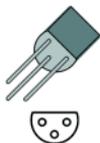
Diodes allow the current to pass through in one direction only (forward direction), simultaneously the voltage is reduced by 0,3 to 0,8 V. Exceeding of the limit voltage always will destroy the diode, and allow current to flow in the reverse direction.

Zener diodes are used for limiting voltages. In contrast to "normal" diodes they are not destroyed when the limit voltage is exceeded.

The diode type is printed on the package.

## Transistors

Transistors are current amplifiers which convert low signals into stronger ones. There are several types in different package forms available. The type designation is printed on the component.



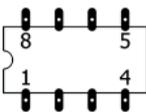
Transistors for a low power rating (e.g. BC types, BS types) have a package in form of a half cylinder (SOT-package).

The three pins of bipolar transistors (e.g. BC, BD and BT types) are called basis, emitter and collector (abbreviated with the letters B, E, C in the circuit diagram).

## Integrated circuits (ICs)



Depending on the type, ICs fulfil various tasks. The most common housing form is the so-called "DIL"-housing, from which 4, 6, 8, 14, 16, 18 or more "legs" (pins) are arranged along the long sides.

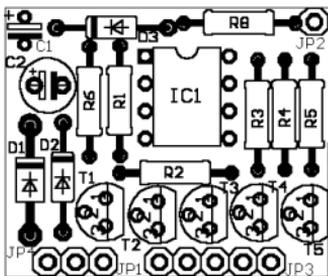


ICs are sensitive to damage during soldering (heat, electrostatic charging). For that reason in the place of the ICs IC sockets are soldered in, in which the ICs are inserted later.

## Microcontrollers

Microcontrollers are ICs, which are individually programmed for the particular application. The programmed controller are only available from the manufacturer of the circuit belonging to it.

## PCB layout and parts list



Resistors	R1 - R5	10 k $\Omega$
	R6, R8	1 k $\Omega$
Diodes	D1	1N400x, x=2...7
	D3	1N4148
Zener diode	D2	ZD 5,1 V
Electrolytic capacitors	C1, C2	100 $\mu$ F/25 V
Transistors	T1 - T5	BC547B
Micro-controller	IC1	12F508A-I/P
IC-socket	IC-1	8-pole
Solder pins	JP2	1-pole
	JP1 / JP4	3-pole
	JP3	5-pole

LC-16 only:

Dim switch	DS-1
Light sensitive resistor	R11

## Assembly

Proceed according to the order given in the list below. First solder the components on the solder side of the PCB and then cut the excess wires with the side cutter. Follow the instructions on soldering in section 3.

**⚠ Caution:** Several components have to be mounted according to their polarity. When soldering these components the wrong way round, they can be damaged when you connect the power. In the worst case the whole circuit can be damaged. At the best, a wrongly connected part will not function.

1.	Resistors	Mounting orientation of no importance.
2.	Diodes, Zener diodes	Observe the polarity! The negative end of the diodes is marked with a ring. This is shown in the PCB layout.
3.	IC socket	Mount the socket that way, the marking on the socket shows in the same direction as the marking on the PCB board.
4.	Electrolytic capacitors	Observe the polarity! One of the two leads (the shorter one) is marked with a minus sign.
5.	Transistors	Observe the polarity! The cross section of transistors for a low power rating in SOT-packages is shown in the PCB layout.
6.	Solder pins	
7.	IC	Insert the IC into the soldered socket. Do not touch the IC without first discharging yourself by touching a radiator or other grounded metal parts. Do not bend the "legs" when inserting it into the socket. Check that the markings on the PCB, the socket and the IC show to the same direction.

### Performing a visual check

Perform a visual check after the assembly of the module and remove faults if necessary:

- Remove all loose parts, wire ends or drops of solder from the PCB. Remove all sharp wire ends.
- Check that solder contacts which are close to each other are not unintentionally connected to each other. Risk of short circuit!
- Check that all components are polarised correctly.

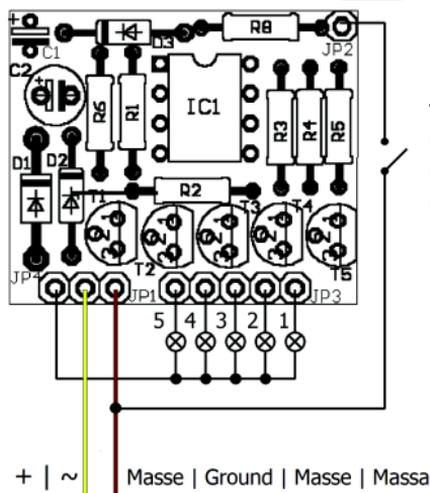
When you have remedied all faults, go on to the next part.

## 7. Connecting the LC module

Connect the power supply, the light bulbs, LEDs or other accessories and if necessary switches or push-buttons, according to the following list and connecting diagrams, to the LC module. Follow the appended instructions below as well.

For the connection of the cables (except JP2) you find socket terminal strips included in the package. You can plug them onto the pin strips on the PCB and can remove them any time.

JP1	Power supply (10-18 V) Check the polarity when connecting the module to d.c. voltage. With a.c. voltage the polarity is of no importance.	3-pole
JP4	Return conductor for the outputs 1 to 5	
JP2	Switching input	1-pole
JP3	Outputs 1 to 5   Max. current per output: 100 mA	5-pole



Taster | Schalter  
 Push button | Switch  
 Bouton | Interrupteur  
 Drukknop | Schakelaar

## Use of the switching input JP2

According to the version you can control the program flow or choose one of two different program variants via the switching input JP2. According to the version and to the intended mode of operation you can use switches, push-buttons or fixed solder connections. With some versions JP2 has no function.

LC version	Function of JP2
LC-12, LC-13, LC-17, LC-19, LC-20	No effects on the program flow.
LC-1, LC-2, LC-3, LC-4, LC-5, LC-6, LC-8, LC-14, LC-15, LC-21, LC-22, LC-23	JP2 open → endless repeat. JP2 is connected to earth* → The cycle will be ended after the end of the program.
LC-7	JP2 open → standard operation. JP2 is connected to earth* → Traffic lights switch to flashing amber.
LC-9	JP2 is connected to earth for a short time (e.g. by the switching impulse of a push-button) → program will be started / finished.
LC-10	JP2 is connected to earth for a short time (e.g. by the switching impulse of a push-button) → program will be started / finished. JP2 is connected to earth → defective fluorescent tube at output 5.
LC-11	JP2 connected to earth → "Home". JP2 open → "Office".
LC-16	JP2 designed for the connection of a dim switch.
LC-18	JP2 connected to earth → "standing vehicle". JP2 open → "moving vehicle".
* e.g. by closing a switch	

## Connecting light bulbs

As a rule you can connect one or two bulbs to one output. Bulbs are not polarized. Connect one side to the output, the other to the return conductor.

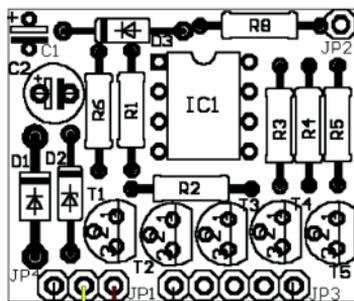
 **Caution:** The maximum current of 100 mA per output should not be exceeded. In this case the output would be damaged. For that reason strictly uphold the specification of the current consumption (given in mA) on the bulb's socket or its packaging.

## Connecting LEDs

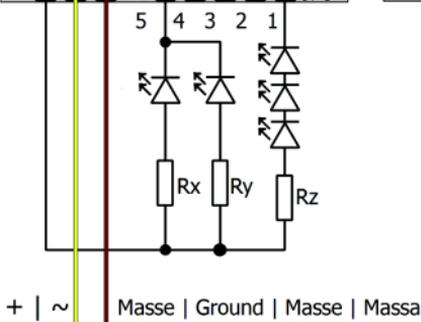
You can connect several LEDs in parallel or serial (in series) to one output (see following sections). Which version fits better depends amongst others from the mounting situation.

LEDs are polarized. Connect the cathode (-) to the output and the anode (+) to the return conductor. With wired versions the anode (+) has the longer "leg", with SMD versions the cathode (-) is marked (e.g. by a reamed corner or a paint mark).

 **Caution:** LEDs always have to be connected via a series resistor, otherwise they will be damaged when put into operation. Advice concerning choosing a series resistor → "Parallel / Serial connection of LEDs".



Rx	Vorwiderstand
Ry	Series resistor
Rz	Résistance
	Voorschakelweerstand



## Parallel connection of LEDs

With a parallel connection each LED has to be connected via it's own series resistor to the output. The total current at the output results from summing up the current of each single LED.

The current consumption of one LED depends on the value of the series resistor. The higher the value, the lower is the current and the more LEDs can be connected to one output. But, the LEDs light the darker, the higher you choose the series resistor's value.

**⚠ Caution:** The maximum current of 100 mA per output should not be exceeded. In this case the output would be damaged.

### Examples for parallel connection of LEDs:

Power supply	Series resistors	Current per LED	max. number of LEDs per output
transformer (~)   12 V	1,5 kOhm	10 mA	10
transformer (~)   12 V	820 Ohm	20 mA	5
transformer (~)   15-16 V	2,2 kOhm	10 mA	10
transformer (~)   15-16 V	1 kOhm	20 mA	5
transformer (~)   18 V	2,7 kOhm	10 mA	10
transformer (~)   18 V	1,2 kOhm	20 mA	5

The calculation of the series resistors is based on the following formula:

$$\text{series resistor [kOhm]} = \text{power supply [V]} / \text{current [mA]}$$

Note: The operating voltage with a.c. transformers is approx. 1,4 times the nominal voltage given on the transformer. With d.c. power packs the operating voltage corresponds to the given nominal voltage.

### Serial connection of LEDs

With a serial connection all LEDs have to be connected (in series) via one series resistor to the output. The current consumption of the LEDs depends on the value of the series resistor. The higher the value, the lower is the current. But, the LEDs are dimmer, the higher you choose the series resistor's value.

The number of LEDs you can connect in series depends on the transformer's nominal voltage and the colour of the LEDs. When connecting too many LEDs, the voltage is not sufficient and the LEDs do not light.

**Examples for serial connection of LEDs:**

Nominal voltage transformer ( $\sim$ )* <sup>1</sup>	Operating voltage * <sup>1</sup> appr.	Forward voltage of the LED* <sup>2</sup>	Max. number of LEDs* <sup>3</sup> per output
12 V	17 V	2 V	7
		4 V	3
16 V	22 V	2 V	10
		4 V	4
18 V	25 V	2 V	11
		4 V	5

\*<sup>1</sup> Nominal voltage and operating voltage: The operating voltage with a.c. transformers is approx. 1,4 times the nominal voltage given on the transformer. With d.c. power packs the operating voltage corresponds to the given nominal voltage.

\*<sup>2</sup> The forward voltage of white and blue LEDs is approx. 4 V, differing coloured LEDs approx. 2 V.

\*<sup>3</sup> Tolerance and / or voltage fluctuations in practice often cause the calculated operating voltage not being available. For that reason it is recommended to connect one LED less than possible in theory.

Calculate the necessary series resistor as follows:

$$\text{nec. } R_V [\text{Ohm}] = (U_B [\text{V}] - U_F [\text{V}] \times n_{\text{LED}}) / (I_F [\text{mA}] \times 0,001)$$

$U_B$  = operating voltage |  $U_F$  = forward voltage of the LED

$n_{\text{LED}}$  = number of LEDs |  $I_F$  = current with max. luminance

Example: Connection of 2 blue and 3 red LEDs with using a 18 V a.c. transformer. Designated current: 20 mA:

$$\text{nec. } R_V = (25 \text{ V} - 4 \text{ V} \times 2 - 2 \text{ V} \times 3) / (20 \text{ mA} \times 0,001) = 550 \text{ Ohm}$$

We choose the next resistor's value which is provided as a standard, which means a resistor of 560 Ohm. If using a resistor with a higher value the current of the LEDs would be reduced and the LEDs would light less brightly.

**Tip: Connecting many LEDs to one LC module**

If you want to connect a great number of LEDs to one LC module (e.g. with advertising lights or funfair lights), best connect them as follows:

Connect so many LEDs in series as possible with the available operating voltage. When using an a.c. transformer of 18 V you can connect 7 white or blue or 11 different coloured LEDs in series. Reduce the current by using a series resistor as far as the LEDs' brightness still matches your ideas.

Connect further "chains" of LEDs switched in series in parallel to the same output. Take care not to exceed the max. current of 100 mA. When limiting the current of each single "chain" to 10 mA, you can connect 10 chains in parallel to one output.

You can do the same with the other 4 outputs. Based on our example you can connect:

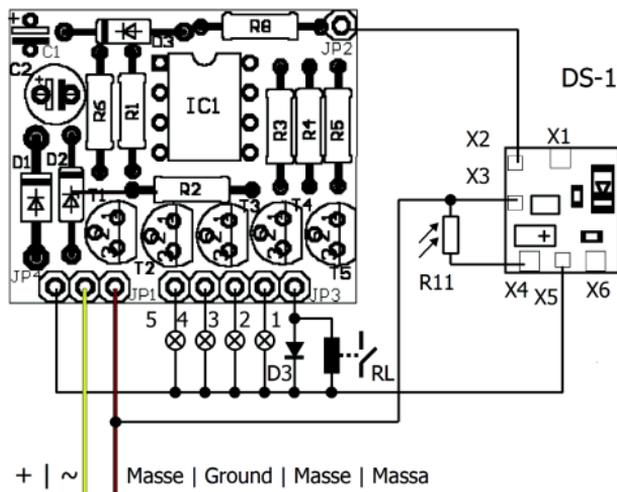
$5 \times 10 \times 7 = 350$  white or blue LEDs or

$5 \times 10 \times 11 = 550$  different coloured LEDs to one module!

## 8. Connecting the LC-16

### Connecting the dim switch (LC-16)

Connect the dim switch and the light sensitive resistor according to the connection diagram. The light sensitive resistor has to be placed that way it is exposed to the ambient light. In order to set the sensitivity of the dim first set the trim pot to mid-position and change the sensitivity as far as necessary. The circuit requires 3 or 4 seconds to react.



RL	Relay
D3	Diode, 1N400x, x = 2...7
DS-1	Dim switch
R11	Light depending resistor
Ausgang 1	Additional accessories
Ausgang 2-5	Street lamps

### Connecting an additional load (LC-16)

With the LC-16 the output 1 is designed for the connection of additional accessories (e.g. houses' lightings), to be switched on via the dim switch commonly with the street lamps connected to the outputs 2 to 5. Accessories with a current consumption of max. 100 mA can be connected directly, accessories with a higher current consumption have to be connected via a monostable relay 1xUm 12 V (e.g. item no. 84-61010-01) and a diode (see connection diagram).

## 9. Check list for troubleshooting

- Parts are getting too hot and/or start to smoke.



Disconnect the system from the mains immediately!

Possible cause: one or more components are soldered incorrectly.  
→ In case you have mounted the module from a kit, perform a visual check (→ section 6.) and if necessary, remedy the faults. Otherwise send in the module for repair.

- The lamps connected to the module do not light.

Possible cause: one or more components are soldered incorrectly.  
→ Perform a visual check.

Possible cause: A switch connected to the module is closed. → Check the position of switches.

Possible cause: The bulbs or LEDs are defective. → Check the bulbs / LEDs.

Possible cause: The LEDs are connected falsely polarized. → Check the LEDs' polarity.

Possible cause: One or more outputs have been damaged due to overload. → Send in the module for repair.

Possible cause: With a serial connection too many LEDs have been switched in series. → Decrease the number of LEDs or increase the voltage supply.

**Hotline:** If problems with your module occur, our hotline is pleased to help you (mail address on the last page).

**Repairs:** You can send in a defective module for repair (address on the last page). In case of guarantee the repair is free of charge for you. With damages not covered by guarantee, the maximum fee for the repair is the difference between the price for the ready-built module and the kit according to our valid price list. We reserve the right to reject the repairing of a module when the repair is impossible for technical or economic reasons.

Please do not send in modules for repair charged to us. In case of warranty we will reimburse the forwarding expenses up to the flat rate we charge according to our valid price list for the delivery of the product. With repairs not covered by guarantee you have to bear the expenses for sending back and forth.

## 10. Guarantee bond

For this product we issue voluntarily a guarantee of 2 years from the date of purchase by the first customer, but in maximum 3 years after the end of series production. The first customer is the consumer first purchasing the product from us, a dealer or another natural or juristic person reselling or mounting the product on the basis of self-employment. The guarantee exists supplementary to the legal warranty of merchantability due to the consumer by the seller.

The warranty includes the free correction of faults which can be proved to be due to material failure or factory flaw. With kits we guarantee the completeness and quality of the components as well as the function of the parts according to the parameters in not mounted state. We guarantee the adherence to the technical specifications when the kit has been assembled and the ready-built circuit connected according to the manual and when start and mode of operation follow the instructions.

We retain the right to repair, make improvements, to deliver spares or to return the purchase price. Other claims are excluded. Claims for secondary damages or product liability consist only according to legal requirements.

Condition for this guarantee to be valid, is the adherence to the manual. In addition, the guarantee claim is excluded in the following cases:

- if arbitrary changes in the circuit are made,
- if repair attempts have failed with a ready-built module or device,
- if damaged by other persons,
- if damaged by faulty operation or by careless use or abuse.

## 11. EU declaration of conformity

 This product conforms with the EC-directives mentioned below and is therefore CE certified.

2004/108/EG on electromagnetic. Underlying standards: EN 55014-1 and EN 61000-6-3. To guarantee the electromagnetic tolerance in operation you must take the following precautions:

- Connect the transformer only to an approved mains socket installed by an authorised electrician.
- Make no changes to the original parts and accurately follow the instructions, connection diagrams and PCB layout included with this manual.
- Use only original spare parts for repairs.

2011/65/EG on the restriction of the use of certain hazardous substances in electrical and electronic equipment (ROHS). Underlying standard: EN 50581.

## 12. Declarations conforming to the WEEE directive



This product conforms with the EC-directive 2012/19/EG on waste electrical and electronic equipment (WEEE).

Don't dispose of this product in the house refuse, bring it to the next recycling bay.

Information and tips:

<http://www.tams-online.de>

Warranty and service:

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