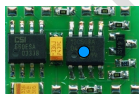


FCS-Module

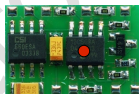
FCS-1

Item no. 54-01016
Emergency vehicle light



FCS-2

Item no. 54-01026
Vehicle module



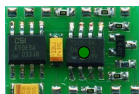
FCS-3

Item no. 54-01036
Bus module



FCS-4

Item no. 54-01046
Emergency vehicle module



FCS-L

Item no. 54-01096
Lighting module



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1. Getting started

This manual applies to the following FCS modules compatible to the Faller** Car System, so for:

- FCS-1 "Emergency vehicle light"
- FCS-2 "Vehicle module"
- FCS-3 "Bus module"
- FCS-4 "Emergency vehicle module"
- FCS-L "Lighting module"

Provided there are no other details given for particular sections, the information given applies to all modules.

How to use this manual

This manual gives step-by-step instructions for safe and correct fitting and connecting of the 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 module to another person, please pass on the manual with it.

Intended use

The FCS modules are designed to be operated according to the instructions in this manual in model building, especially in vehicles compatible to the Faller** Car-System. Any other use is inappropriate and invalidates any guarantees.

The FCS modules should not be mounted by children under the age of 14.

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

Checking the package contents

Please make sure that your package contains:

	Module	Additional components	manual*
FCS-1	1	---	1
FCS-2	1	2 resistors 10 Ω 1 resistor 10 k Ω 1 light sensitive resistor 1 diode 1N4148 1 transistor BC 327 1 reed contact 1 dim switch DS-1	1
FCS-3	1	1 resistor 10 k Ω 1 diode 1N4148 1 transistor BC 327 1 reed contact	1
FCS-4	1	1 resistor 10 k Ω 1 diode 1N4148 2 transistors BC 327 1 loudspeaker	1
FCS-L	1	1 diode 1N4148	1
* CD (containing the manual and further information)			

Required materials

For mounting and connecting 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, a wire stripper and a pair of tweezers

- electronic tin solder (0.5 mm diameter)
- connecting wire, e.g. enamelled copper wire
- LEDs for the vehicle's lighting. Depending on the vehicle's size and construction you can use for example the following:
 - SMD LEDs type 0402, 0603, 0805 oder 1206 or
 - wired LEDs 1,8 mm
- when connecting white LEDs as front lights to the modules FCS-1, FCS-3 or FCS-4: 2 series resistors with 100 Ω

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. Keep the soldering tip clean so the heat of the soldering iron is applied to the solder point effectively.
- 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.
- 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 wire 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.
- The joint should be held still for about 5 seconds after soldering.
- To make a good soldering joint you should 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.
- After soldering check (preferably with a magnifying glass) tracks for accidental solder bridges and short circuits. This would cause faulty operation or, in the worst case, permanent 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 modules are particularly designed for the use in vehicles compatible to the Faller** car system. The modules FCS-1 to FCS-4 are used in vehicles run with two accumulator batteries, the module FCS-L in vehicles with one accumulator battery or, when reducing the module's input voltage, in vehicles run with two accumulator batteries, as well.

4.1. Voltage supply

The accumulator batteries mounted as a standard in the vehicles are sufficient for the voltage supply.

FCS-1 to FCS-4

The voltage of 2,4 V that is provided by the vehicle accumulator batteries, is doubled by the module. This enables white and blue LEDs to be connected, which normally need a voltage of more than 2,4 V.

FCS-L

The circuit regulates the input voltage to a constant current of approx. 25 mA so that the appropriate voltage for the operation of the LEDs is applied at the module's output.

4.2. Possible connections

The modules FCS-1 to FCS-4 have 6 connections each, controlled by specific software stored in the IC on the PCB. Depending on the specification of the different versions, LEDs, dim switch, loudspeaker, reed contacts and / or the vehicle's motor can be connected. It is not necessary to connect all outputs of the module.

The FCS-L has an output for the connection of red and white LEDs.

	FCS-1	FCS-2	FCS-3	FCS-4	FCS-L
Front lights (white LEDs)	+	+	+	+	+
Back lights (red LEDs)	+	+	+	+	+
Brake lights	-	+	+	+	-
Dim switch DS-1	-	+	-	-	-
Flashing lights (blue or orange LEDs)	+ (5)	-	-	+ (2)	-
Warning lights (yellow LEDs)	-	-	+	-	-
Siren (loudspeaker)	-	-	-	+	-
Motor / acceleration delay	-	+	+	+	-
Motor / braking delay	-	+	+	-	-

Front lights

All modules offer the possibility to connect white LEDs as front lights.



When connecting white LEDs as front lights to the modules FCS-1, FCS-3 and FCS-4 you have to mount additional series resistors (recommended value: 100 Ω)!

Back lights and brake lights

It is possible to connect red LEDs as back lights to all modules. With the FCS-1 the red LEDs can be connected directly to the vehicle's accumulator battery, they do not have to be controlled by the module. With the FCS-2 to FCS-4 the red LEDs of back lights are switched brighter when stopping. When connecting an additional reed contact to the FCS-2 or FCS-3 (in order to realise a braking delay) the LED will be switched brighter during the whole brake application.

Dim switch (FCS-2 only)

Depending on the ambient lighting, the lighting of the vehicle is switched on and off via a light sensitive switch. The sensitivity of the switch is set via a trimpot.

Flashing lights (FCS-1 and FCS-4)

The FCS-1 has 5 outputs, the FCS-4 two outputs for the connection of orange or blue LEDs as flashing lights.

Warning lights (FCS-3 only)

There are two outputs for the connection in series of LEDs as warning lights on the right and the left side. The function is adapted to the use in (urban) busses. It is not possible to switch the warning lights when the vehicle is turning.

Siren (FCS-4 only)

The output for the loudspeaker is switched on and off in short intervals while the vehicle is in motion and generates the typical signal.

Motor control / acceleration delay (FCS-2 to FCS-4)

After starting, the motor voltage will be increased gradually, so the vehicles starts gently.

Motor control / braking delay (FCS-2 and FCS-3)

When mounting an additional reed contact into the vehicle it is possible to realise a braking delay. When crossing the stop with the first reed contact the motor voltage is reduced and the vehicle brakes. After crossing the stop with the second reed contact the vehicles stops. During the brake application the braking lights are switched brighter.

4.3. Modes of operation

FCS-1 "Emergency vehicle light"

According to the connection of the circuit's input, the LEDs connected to the five outputs are controlled by two different programmes:

Programme 1 "Double flashlight": The LEDs flash twice each and then go out for a short time. The LEDs connected to two of the five outputs double flash alternately. The other three outputs generate an asynchronous double flash which is interrupted by different intervals.

Programme 2 "Alternating flashlight": Two of the five outputs generate an alternating flash, two others, an alternating double flash. The LED connected to the fifth output flashes with a frequency of its own which is not synchronized to the frequency of the other outputs.

FCS-2 "Vehicle module"

If the vehicle does not receive the signal to drive on for a longer time, all lights connected to the module are switched off (current saving mode).

FCS-3 "Bus module"

When the bus halts more than 10 seconds at a stop, the module interprets the stop as bus stop. The LEDs for the flash light are switched to "warning light" until the drive on signal, but max. up to one minute. If the bus does not receive the signal to drive on during one minute, the flashing lights and the back lights are switched off (current saving mode). While starting after a halt at the bus stop the flash lights on the left are switched on for a short time.

At stops where flash lighting is not desired (e.g. at traffic lights or priority roads), the bus should get the signal to drive on in less than 10 seconds. After such a (short) stop the flash lights on the left are not switched on.

FCS-4 "Emergency vehicle module"

While the vehicle is in motion the flashing lights double flash and the siren is in operation with short breaks. When crossing a stop the back lights are switched brighter for a short time as braking lights and the siren is switched off (provided the reed contact which is in the vehicle is connected to the module). As long as the vehicle is in operation the flashing lights are switched on.

5. Technical specifications

5.1. FCS-1 to FCS-4

Supply voltage	2 - 3 Volt d.c. voltage
Current consumption (without connected loads)	approx. 2 mA
Max. total current	40 mA
Total number of outputs Max. current per output FCS-4 only: output for loudspeaker	max. 6 (depending on the version) 10 mA 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 PCB	approx. 12 x 18 x 2.1 mm
Weight of PCB	approx. 0.7 g

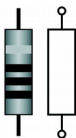
5.2. FCS-L

Supply voltage - vehicles with one battery - vehicles with two batteries	0,9 – 1,8 Volt d.c. voltage 1,6 – 2,5 Volt d.c. voltage
Current consumption	ca. 25 mA (independent of the voltage applied)
Total number of outputs Max. current per output	1 25 mA
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 PCB	approx. 4,2 x 7,4 x 1.7 mm
Weight of PCB	approx. 0.1 g

6. Special features of the additional components

Depending on the specification of the modules, different additional external components have to be connected. These have the following special features:

Resistors



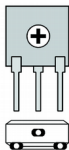
Resistors reduce current. Their mounting orientation is of no importance. The value of resistors for smaller power ratings is indicated through colour rings. Every colour stands for another figure. Carbon film resistors have 4 colour rings. The 4th ring (given in brackets here) indicates the tolerance of the resistor (gold = 5 %).

Value	Colour rings
10 Ω	brown - black - black (gold)
10 k Ω	brown - black - orange (gold)

Light sensitive resistors

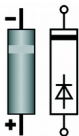
Light sensitive resistors change their value depending on the ambient lighting. As a rule types are used which value decrease with increasing light intensity. Their mounting orientation is of no importance.

Trimm-potentiometers



Trimm-potentiometers (abrv. "trimm-pots") are resistors which allow the value of resistance to be varied and that way to be adapted to the particular demands. In the middle they have a small slot into which a small screwdriver can be put in order to vary the value of resistance. The maximum value is printed on the housing.

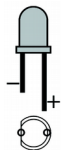
Diodes



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. The diode type is printed on the package.

Diodes must be mounted in a given direction. The negative end is marked with a ring.

Light emitting diodes (LEDs)



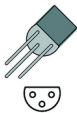
When operated in the forward direction the LEDs light. They are available in several different versions (differing in colour, size, form, luminosity, maximum current, voltage limits).

The cathode (-) has to be connected to the neagtive voltage. With wired LEDs the longer wire is the anode (+). With SMD versions the cathode (-) is marked (bevelled edge, colour marking or similar).

Light emitting diodes should always be connected via a series resistor which limits the current and prevents failure. With circuits designed for the connection of LEDs the series resistors are often integrated on the circuit board.

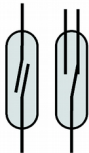
Transistors

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) have a package in form of a half cylinder (SOT-package). The three pins of bipolar transistors (e.g. BC types) are called basis, emitter and collector (abbreviated with the letters B, E, C in the circuit diagram).

Reed contacts (SRK)



Depending on their version reed contacts fulfill the task of a closer or a change-over switch. They respond to a magnetic field, thus making possible contactless switching operations.

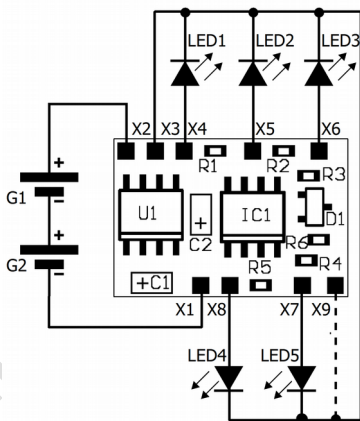
They consist of a glass bulb filled with a preductive gas. Sealed in the glass bulb are two or three reeds made of a magnetic material.

When bending the legs of the glass bulb they can be easily damaged through mechanical strain.

7. Mounting

7.1. Mounting the FCS-1

Open the housing of the vehicle. Locate the position for the module..



Connections FCS-1

Connection to the supply voltage

X1	"-" of the batteries
X2	"+" of the batteries

⚠ Caution: The module should not be connected the wrong way round. Otherwise it will be damaged when put into operation!

Connection of the LEDs for the flashlights

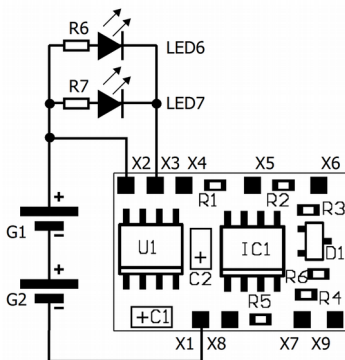
Connect the anodes (+) of the LEDs to the soldering points X4 to X8 and the cathodes (-) to the soldering point X3. Note the different functions of the outputs. Additional series resistors are not necessary for the operation of the LEDs for the flashlights.

When you want to run program 2 ("Alternating flashlight") you have to make a connection between the soldering points X9 and X3. Otherwise the program 1 ("Double flashlight") is performed.

		Programm 1 "Double flashlight"	Programm 2 "Alternating flashlight"
X3		Voltage output (-) of the circuit	Voltage output (-) of the circuit
X4	LED1	Double flashlight	Alternating double flashlight
X5	LED2	Double flashlight	
X6	LED3	Alternating double flashlight	Alternating flashlight
X7	LED4		
X8	LED5	Double flashlight	Flashlight
X9		Input of the circuit → open	Input of the circuit → connected to X3

Connection of the LEDs for the front light

You may connect up to two white LEDs for the front lighting to the module.



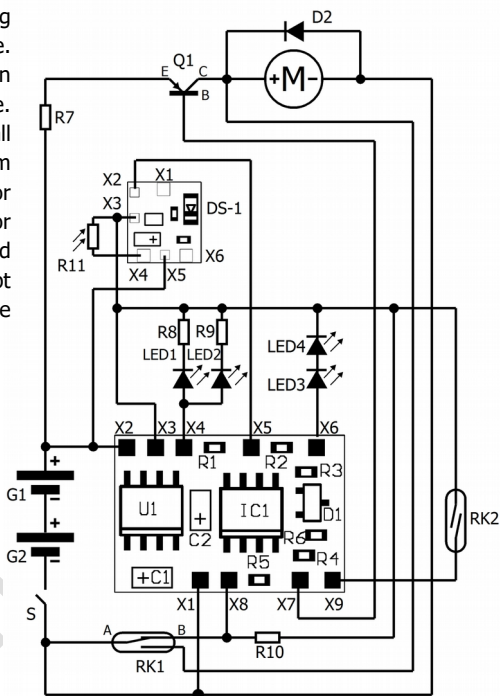
X2	LED6* LED7* R6* R7*	White LEDs for front lighting Series resistors for LED6 and LED7
X3		Voltage output (-) of the circuit

* Not supplied.

⚠ Caution: The LEDs for the front lighting must be operated via series resistors (recommended value: 100 Ω). Otherwise the connected LEDs are damaged and the circuit may not work as intended.

7.2. Mounting the FCS-2

Open the housing of the vehicle. Locate the position for the module. Disconnect all connections from the accumulator batteries, the motor and the mounted reed contact except for the wire to the charging contact.



Connections FCS-2

In many vehicles the resistor R7 shown in the connection diagram is mounted into the lead-in wire to the motor. The resistor has to be connected to the plus pole of the accumulator batteries if not yet mounted that way. If there is no resistor, R7 is not applicable.

X1	"-" of the batteries
X2	"+" of the batteries
X3	Voltage output (-) of the circuit
X4	Front lighting (LED1 and LED2)
X5	Light sensitive switch
X6	Braking / reversing lights (LED3 and LED4)
X7	Motor control
X8	Existing reed contact
X9	Secondary reed contact


External Components

D2 (1N4148)	Additional diode
G1, G2	Existing batteries
LED1*, LED2*	White LEDs for front lighting
LED3*, LED4*	Red LEDs for braking and reversing lights
DS-1	Dim switch
M	Motor
Q1 (BC 327)	Additional Transistor
R7	Existing resistor
R8, R9 (10 Ω)	Series resistors for LED1 and LED2
R10 (10 k Ω)	Additional resistor
R11	Light sensitive resistor
RK1	Existing reed contact
RK2	Secondary reed contact
S	Existing switch

* Not supplied.

Connection to the supply voltage

Connect the connecting point X2 to the plus pole of the accumulator batteries and the minus pole of the accumulator batteries to the existing switch S of the vehicle. Connect the second pole of the switch to the connecting point X1.

 **Caution:** The module should not be connected the wrong way round. Otherwise it will be damaged when put into operation!


Connection of the existing reed contact

The existing reed contact has three connecting points, one at side A and two at side B. Connect the connecting point at side A to the connecting point X1 and the existing switch S.

In order to check which one of the two connecting points of side B you have to connect to the module, connect temporarily the plus pole of the motor to the plus pole of the accumulator batteries and the minus pole of the motor to one of the two connecting points at side B of the reed contact. If the motor does **not** run with this connection, you have to connect this connecting point to the plus pole of the motor and the other connecting point of the reed contact, together with the enclosed resistor R10 (10 k Ω to X8. If the motor runs with this connection, you have to make the connections the other way round. Connect the second side of the resistor R10 to the connecting point X3.

Connection of an additional reed contact

If the vehicle is intended to stop abruptly, the connecting point X9 is not connected and you can skip this section. In order to brake the vehicle gently, an additional reed contact has to be connected, which should be mounted as far as possible in the front of the vehicle. Connect the enclosed reed contact to the connecting points X3 and X9.

 **Caution:** Reed contacts are sensitive to stress. Therefore be careful when bending the legs in order not to destroy the glass bulb!

Connection of the motor

Connect the enclosed diode 1N4148 to the connections of the motor. Observe the polarity of the diode. Then connect the minus pole of the motor to the switch switching the minus pole of the accumulator batteries and to the connecting point X1. Next connect the collector (C) of the enclosed transistor BC 327 to the plus pole of the motor, the basis (B) to the connecting point X7 and the emitter (E) to the resistor R7. If there is no resistor R7, connect the emitter directly to the plus pole of the accumulator batteries.

Connection of the dim switch

Connect the connecting points X2, X3 and X5 of the dimming switch to the connecting points X5, X3 and X2 of the FCS-2.

Next connect the enclosed light depending resistor to the connecting points X3 and X4 of the Dim switch. The light sensitive resistor has to be placed that way it is exposed to the ambient lighting when the housing of the vehicle is closed.

Connection of the LEDs for the front and back lights

The two LEDs for the front lights have to be connected in parallel, i.e. the anodes (+) of the LEDs both have to be connected to X4. Connect the two cathodes (-) to the resistors R8 and R9 (10 Ω). Connect the disconnected ends of the resistors to the connecting point X3.

The two LEDs for the stop and back lights have to be connected in series, i.e. the anode (+) of the one LED has to be connected to the cathode (-) of the other LED. Connect the disconnected anode (+) to connecting point X6 and the disconnected cathode (-) to connecting point X3. Additional series resistors are not necessary for the operation of the LEDs for the stop and back lights.

Setting the sensitivity of the light

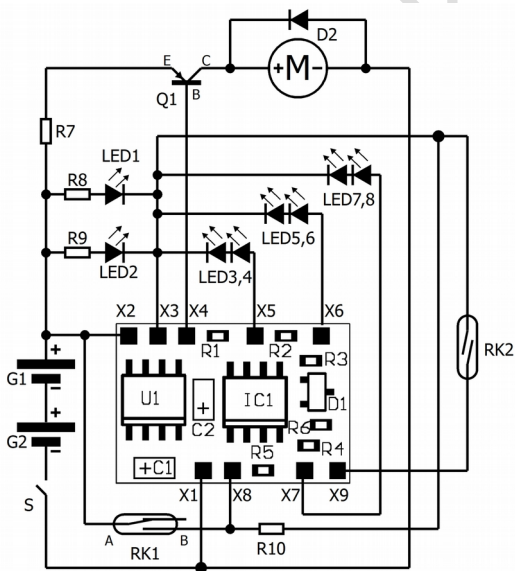
Before closing the housing of the vehicle, you should set the sensitivity of the dim switch to the desired lighting conditions. First set the trim pot to mid-position and change the sensitivity as far as necessary. The circuit requires 3 or 4 seconds to react.

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7.3. Mounting the FCS-3

Open the housing of the vehicle. Locate the position for the module. Disconnect all connections from the accumulator batteries, the motor and the mounted reed contact except for the wire to the charging contact.

Connections FCS-3



In many vehicles the resistor R7 shown in the connection diagram is mounted into the lead-in wire to the motor. The resistor has to be connected to the plus pole of the accumulator batteries if not yet mounted that way. If there is no resistor, R7 is not applicable.

X1	"-" of the batteries
X2	"+" of the batteries / LED1 and LED4
X3	Voltage output (-) of the circuit
X4	Motor control
X5	Right indicator (LED3 and LED4)
X6	Braking / reversing lights (LED5 and LED6)
X7	Left indicator (LED7 and LED8)
X8	Existing reed contact
X9	Additional reed contact


External Components

D2 (1N4148)	Additional diode
G1, G2	Existing batteries
LED1*, LED2*	White LEDs for front lighting
LED3*, LED4*	Yellow LEDs for the right indicator
LED5*, LED6*	Red LEDs for braking and reversing lights
LED7*, LED8*	Yellow LEDs for left indicator
M	Motor
Q1 (BC 327)	Additional Transistor
R7	Existing resistor
R8*, R9*	Additional resistors for LED1 and LED2
R10 (10 k Ω)	Additional resistor
RK1	Existing reed contact
RK2	Additional reed contact
S	Existing switch

* Not supplied.

Connection to the supply voltage

Connect the connecting point X2 to the plus pole of the accumulator batteries and the minus pole of the accumulator batteries to the existing switch S of the vehicle. Connect the second pole of the switch to the connecting point X1.

 **Caution:** The module should not be connected the wrong way round. Otherwise it will be damaged when put into operation!


Connection of the existing reed contact

The existing reed contact has three connecting points, one at side A and two at side B. Connect the connecting point at side A to the connecting point X2 and the plus pole of the accumulator battery.

In order to check which one of the two connecting points of side B you have to connect to the module, connect temporarily the minus pole of the motor to the minus pole of the accumulator battery and the plus pole of the motor to one of the two connecting points at side B of the reed contact. If the motor does **not** run with this connection, you have to connect this connecting point to the connecting point X8 and the enclosed resistor R10. If the motor runs with this connection, you have to connect the other connecting point to the connecting point X8 and the enclosed resistor R10. Finally disconnect the temporary connections of the motor. Connect the second side of the resistor R10 to the connecting point X3.

Connection of an additional reed contact

If the vehicle is intended to stop abruptly, the connecting point X9 is not connected and you can skip this section. In order to brake the vehicle gently, an additional reed contact has to be connected, which should be mounted as far as possible in the front of the vehicle. Connect the enclosed reed contact to the connecting points X3 and X9.

 **Caution:** Reed contacts are sensitive to stress. Therefore be careful when bending the legs in order not to destroy the glass bulb!

Connection of the motor

Connect the enclosed diode 1N4148 to the connections of the motor. Observe the polarity of the diode. Then connect the minus pole of the motor to the switch switching the minus pole of the accumulator batteries and to the connecting point X1. Next connect the collector (C) of the enclosed transistor BC 327 to the plus pole of the motor, the basis (B) to the connecting point X4 and the emitter (E) to the resistor R7. If there is no resistor R7, connect the emitter directly to the plus pole of the accumulator battery.

Connection of the LEDs for the flash lights

The two LEDs for the flash lights on the left or the right have to be connected in series, i.e. the anode (+) of the one LED has to be connected to the cathode (-) of the other LED. Next connect the disconnected anode (+) with connecting point X5 (flash lights on the right) or X7 (flash lights on the left) and the disconnected cathode (-) with connecting point X3. Additional series resistors are not necessary for the operation of the LEDs for the flash lights.


Connection of the LEDs for the stop and back lights

The two LEDs for the stop and back lights have to be connected in series, i.e. the anode (+) of the one LED has to be connected to the cathode (-) of the other LED. Next connect the disconnected anode (+) with connecting point X6 and the disconnected cathode (-) with connecting point X3. Additional series resistors are not necessary for the operation of the LEDs for the stop and back lights.

Connection of the LEDs for the front light

You may connect up to two white LEDs for the front lighting to the voltage output of the module. These LEDs are not controlled by the stored software. They light as soon as the module is connected to the power supply.

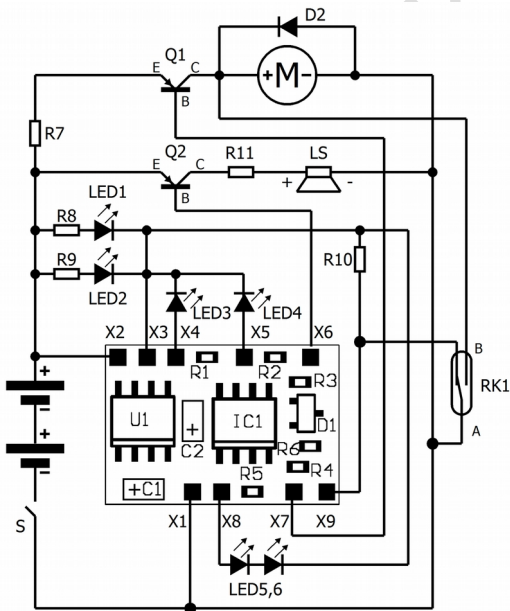
Connect the anodes (+) of the LEDs to the soldering point X2 and the cathodes (-) to the soldering point X3.

 **Caution:** The LEDs for the front lighting must be operated via series resistors (recommended value: 100 Ω). Otherwise the connected LEDs are damaged and the circuit may not work as intended.

7.4. Mounting the FCS-4

Open the housing of the vehicle. Locate the position for the module. Disconnect all connections from the accumulator batteries, the motor and the mounted reed contact except for the wire to the charging contact.

Connections FCS-4



In many vehicles the resistor R7 shown in the connection diagram is mounted into the lead-in wire to the motor. The resistor has to be connected to the plus pole of the accumulator batteries if not yet mounted that way. If there is no resistor, R7 is not applicable.

X1	"-" of the batteries
X2	"+" of the batteries / LED1 and LED2
X3	Voltage output (-) of the circuit
X4	Flashing light 1 (LED3)
X5	Flashing light 2 (LED4)
X6	Siren
X7	Motor control
X8	Braking / reversing lights (LED5 and LED6)
X9	Existing reed contact


External Components

D2 (1N4148)	Additional diode
G1, G2	Existing batteries
LED1*, LED2*	White LEDs for front lighting
LED3*, LED4*	Blue LEDs for flashing lights
LED5*, LED6*	Red LEDs for braking and reversing lights
M	Motor
Q1, Q2 (BC 327)	Additional transistors
LS	Loud speaker
R7	Existing resistor
R8*, R9*	Additional resistors for LED1 and LED2
R10 (10 k Ω)	Additional resistor
R11*	Additional resistor, if necessary
RK1	Existing reed contact
S	Existing switch

* Not supplied.

Connection to the supply voltage

Connect the connecting point X2 to the plus pole of the accumulator batteries and the minus pole of the accumulator batteries to the existing switch S of the vehicle. Connect the second pole of the switch to the connecting point X1.

 **Caution:** The module should not be connected the wrong way round. Otherwise it will be damaged when put into operation!

Connection of the existing reed contact

The existing reed contact has three connecting points, one at side A and two at side B. Connect the connecting point at side A to the connecting point X1 and the existing switch S.

In order to check which one of the two connecting points of side B you have to connect to the module, connect temporarily the plus pole of the motor to the plus pole of the accumulator batteries and the minus pole of the motor to one of the two connecting points at side B of the reed contact. If the motor does **not** run with this connection, you have to connect this connecting point to the plus pole of the motor and the other connecting point of the reed contact with the connecting point X9 and the enclosed resistor R10. If the motor runs with this connection, you have to make the connections the other way round. Connect the second side of the resistor R10 to the connecting point X3.

Connection of the motor

Connect the enclosed diode 1N4148 to the connections of the motor. Observe the polarity of the diode. Then connect the minus pole of the motor to the switch switching the minus pole of the accumulator batteries and to the connecting point X1. Next connect the collector (C) of the enclosed transistor BC 327 to the plus pole of the motor, the basis (B) to the connecting point X7 and the emitter (E) to the resistor R7. If there is no resistor R7, connect the emitter directly to the plus pole of the accumulator batteries.

Connection of the LEDs for the flashing lights

Connect the anodes (+) of the two LEDs for the flashing lights to the connecting points X4 and X5. Connect the cathodes (-) of the LEDs both to the connecting point X3. Additional series resistors are not necessary for the operation of the LEDs for the flashing lights.

Connection of the LEDs for the stop and back lights

The two LEDs for the stop and back lights have to be connected in series, i.e. the anode (+) of the one LED has to be connected to the cathode (-) of the other LED. Next connect the disconnected anode (+) with connecting point X8 and the disconnected cathode (-) with connecting point X3. Additional series resistors are not necessary for the operation of the LEDs for the stop and back lights.

Connection of the loudspeaker


First connect the basis (B) of the enclosed transistor BC 327 to the connecting point X6, the emitter (E) to the plus pole of the accumulator batteries and the collector (C) to the plus pole of the loudspeaker. Next connect the minus pole of the loudspeaker to the connecting point X1. If the polarity of the loudspeaker is not given, you may connect it anyway.

You can reduce the sound volume of the loudspeaker by mounting a resistor between the collector of the transistor and the plus pole of the loudspeaker. The resistor should have a value of 10 to 100 Ω .

Connection of the diodes for the front light

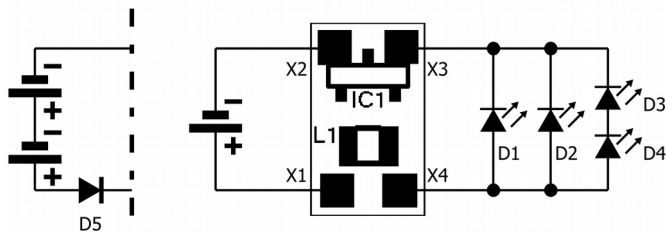
You may connect up to two white LEDs for the front lighting to the voltage output of the module. These LEDs are not controlled by the stored software. They light as soon as the module is connected to the power supply.

Connect the anodes (+) of the LEDs to the soldering point X2 and the cathodes (-) to the soldering point X3.

 **Caution:** The LEDs for the front lighting must be operated via series resistors (recommended value: 100 Ω). Otherwise the connected LEDs are damaged and the circuit may not work as intended.

7.5. Mounting the FCS-L

Open the housing of the vehicle. Locate the position for the module.




Connections FCS-L

D1, D2	LED, white (not supplied)
D3, D4	LED, red (not supplied)
D5	if required, e.g. diode 1N4148
X1	connection to "+" of the accumulator batteries
X2	connection to "-" of the accumulator batteries
X3	connection to the cathode side of the LEDs (-)
X4	connection to the anode side of the LEDs (+)

Connection to the supply voltage

The module is designed for connecting to a supply voltage of 0,9 to 1,8 V (= one accumulator battery). If it is connected to a higher supply voltage of 1,6 bis 2,5 V (= two accumulator batteries) you have to reduce the input voltage by mounting a diode (e.g. 1N4148) in the lead-in wire.

Connect the soldering point X1 to the positive pole and the soldering point X2 to the negative pole of the accumulator batteries.

 **Caution:** The module should not be connected the wrong way round. Otherwise it will be damaged when put into operation!

Connection of the diodes

Connect the LEDs' anodes (+) and cathodes (-), as in the connectioning diagram, to the soldering points X3 and X4. The module is a constant-current source, therefore the mounting of additional series resistors is not necessary.

8. Check list for troubleshooting

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



Disconnect the system from the mains immediately!

Possible cause: The connections to the power supply are connected the wrong round. → Check the connection. In this case the module is probably damaged irreparably.

- The LEDs do not light / flash.

Possible cause: The LEDs are connected the wrong round. → Check the connections.

Possible cause: The power supply is interrupted. → Check the connections.

- **FCS-L:** After applying the supply voltage the LEDs flash quickly and then go out.

Possible cause: The supply voltage is higher than 1,8 V. → Reduce the input voltage, for instance by mounting a diode in the lead-in wire from the power supply to the module.

- **FCS-L:** The red or the white LEDs light brighter than the others.

Possible cause: The burning voltage of the red and the white LEDs differs considerably. → Connect a series resistor (value from 1 to 20 Ω) to the LEDs that light brighter.

- **FCS-2 to -4:** The vehicle does not drive.

Possible cause: The wrong connecting point at side B of the existing reed contact was used. → Check the connection.

- **FCS-2 to -4:** The vehicle drives backwards.

Possible cause: The connections of the motor are connected reverse. → Check the connections.

▪ **FCS-4:** The siren does not work.

Possible cause: The connections of the transistor are reversed.

→ Check the connections.

Possible cause: The power supply is interrupted. → Check the connections.

Possible cause: The vehicle halts at a stop. This is no a fault. The siren is switched off while the vehicle is halting.

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 50 % of the sales price 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.

9. 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.

10. 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.

11. 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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