



FCS-3

**Busmodul
für Faller* Car-System**

**Bus module compatible
to the Faller* Car-System**

**Module pour autobus
du Faller* Car-System**

**Busmodule voor
het Faller* Car System**

Art.-Nr. 22-01-071-3

Anleitung

Manual

Mode d'emploi

Handleiding



Table of contents

How to use this manual	19
Intended use	20
Safety instructions	20
EMC declaration	22
Summary of operation	23
Technical specifications / Circuit Diagram(Fig. 1)	24
Checking the package contents	25
Required tools and materials	25
Safe and correct soldering	26
Special features of the additional components	27
Mounting the FCS-3	28
FAQ	31
Manufacturer's note	31
Certification	31
Conditional warranty	32
Connections (Fig. 2)	II
(Page II in the centre of this handbook is removeable.)	

How to use this manual

If you have no specialist technical training, this manual gives step-by-step instructions for safe and correct fitting of the module, and operation. Before you start, we advise you to read the whole manual, particularly the chapter on safety instructions and the FAQ chapter. 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 on to another person, please pass on the manual with it.

Intended use



Caution:

Integrated circuits 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.

The module can be used according to the specifications of this manual in a vehicle compatible to the Faller* Car-System. The stored software is designed for controlling a bus in scheduled services.

The module is not suitable for children under the age of 14.

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

Any other use is inappropriate and invalidates any guarantees.

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,
- connecting the circuit to another voltage than specified,
- impermissibly high humidity,
- 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.

- Mounting the module 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 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 module.

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.

EMC declaration

This product is developed in accordance with the European standards EN 55014 and EN 50082-1, tested corresponding to the EC - directive 89/336/EEG (EMVG of 09/11/1992, electromagnetic tolerance) and meets legal requirements.

To guarantee the electromagnetic tolerance you must take the following precautions:

- Make no changes to the original parts and accurately follow the instructions, circuit diagram and connections diagrams included with this manual.
- Use only original spare parts if you have to repair module.

Summary of operation

The module is particularly designed for the use in vehicles compatible to the Faller* car system, that are run with two accumulator batteries. It has six in- and outputs for the connection of LEDs, motor and reed contacts. Additional white LEDs for the front lighting can be connected to the additional output. It is not necessary to use all light-outputs. The in- and outputs are controlled from the software stored in the IC. The software is designed for controlling a bus in scheduled services.

The voltage of 2,4 V that is provided by the vehicle accumulator batteries, is doubled by the module. This enables white LEDs to be connected, which normally need a voltage of more than 2,4 V. Red and yellow LEDs may be connected directly via series resistors to the accumulator batteries, provided they are not to be controlled by the software.

Front lighting

Additional to the six in- and outputs controlled by the software there can be connected up to two additional white LEDs for the front lighting to the additional output. These LEDs are not controlled by the software and light as soon as the module is supplied with voltage.

N.B. In contrast to the LEDs connected to the outputs controlled by the software these should be connected via series resistors. Otherwise the connected LEDs are damaged and the circuit may not work as intended.

Back lighting

It is possible to connect two red LEDs to one output of the module for the back and stop lights. While breaking and some seconds after stopping, the back lights are switched brighter.

Flashing lights

The LEDs for the flashing lights on the right and the left can be switched in series from two outputs of the module. Switching on or off the flash lights while the vehicle is turning right or left is not possible.

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 at 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.

Driving of the motor

The reed contact that is in the vehicle, and the additional reed contact should be connected to the module. The module then influences the motor: After a stop it starts gently. When crossing the stop with the first reed contact the vehicle brakes gently and finally stops when crossing the stop with the second reed contact. If the reed contacts are not connected to the module, controlling the back lights and the flash lights at a stop is not possible.

Technical specifications

Supply voltage	2 to 3 Volt D.C.
Current consumption (without connected loads)	approx. 4 mA
Max. total current	80 mA
Max. current per output	20 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	approx. 12 x 18 x 2,1 mm
Weight	approx. 0,5 g

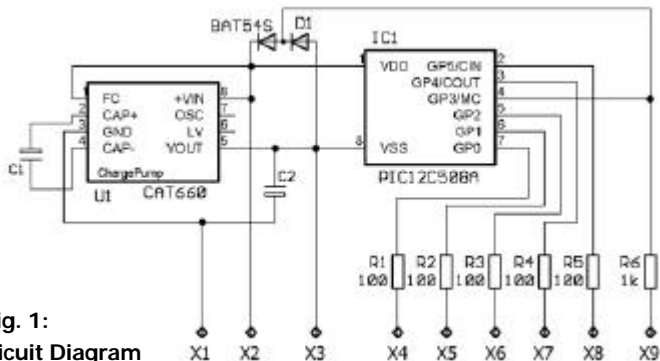


Fig. 1:
Circuit Diagram

Checking the package contents

Check the contents of the package for completeness after unpacking:

- one module,
- additional components: one resistor 10 k Ω , one diode 1N4148, one transistor BC 327, one reed-contact,
- one manual.

Required tools and materials

Make sure you have the following tools and materials ready for use:

- an electronic soldering iron (max. 30 Watt) with a fine tip,
- a soldering iron stand,
- a tip-cleaning sponge and a heat-resistant mat,
- a small side cutter and wire stripper,
- a pair of tweezers,
- tin solder (0,5 mm. diameter),
- enamelled copper wire or thin connecting wire,
- LEDs for the lights,
- if necessary: series resistors for the front lights.

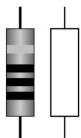
Safe and correct soldering

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**. If you have had training in soldering you can skip this chapter.

- 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.

Special features of the additional components



Resistors

Resistors reduce current. Their mounting orientation is of no importance. The value of resistors for smaller power ratings (under 5 W) is indicated through colour rings. Every colour stands for another figure. The added resistor has a value of 10 k Ω (colour rings brown - black – orange – gold).



Diodes

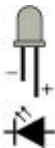
Diodes allow the current to pass through in one direction only (forward direction). The diode type is printed on the body.

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



Transistors

Transistors are current amplifiers which convert low signals into stronger ones. They have three contacts. As they are polarized, they have to be mounted in a certain direction. Die BC-Types have a housing in form of a half cylinder (SOT-housing). The three connecting points are called basis (B), collector (C) and emitter (E).



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 longer lead of wired LEDs is always the anode (positive pole). With SMD-LEDs the cathode normally is shown by a mark on the housing.

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.



Reed contacts

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 protective 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.

Mounting the FCS-3

Preparation

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 lead-in wire to the charging contact. Follow the connection diagram fig. 2 (page 11 in the centre of this handbook) and the special features of the additional components.

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 battery if not yet mounted that way. If there is no resistor, R7 is not applicable.

Connection to the supply voltage

Connect the connecting point X2 to the plus pole of the accumulator battery and the minus pole of the accumulator battery 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 destroyed 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 the additional reed contact

The additional reed contact has to be mounted as far as possible in 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 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.

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.

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. Follow the connection diagram fig. 2!

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 light, which are connected to the voltage output must be operated via series resistors! Otherwise the connected LEDs are damaged and the circuit may not work as intended.

Computation of the series resistors for the front light LEDs

In order to spare the accumulator batteries it is recommended to restrict the input of the LEDs for the front lighting to approx. 10 mA. This guarantees as well a sufficient brightness. In this case you can determine the series resistor from the following formula:

$$R = (U_B - U_F) / I = (4,8 - U_F) / 0,01$$

R: necessary series resistor [Ohm]

U_B : voltage at the voltage output of the circuit [V]

U_F : forward voltage of the LED [V]


I: Current through the LED [A]

Example for a LED with $U_F = 4$ V:

$$R = (4,8 - 4,0) / 0,01 = 80 \text{ Ohm}$$

As the calculated value in this example does not correspond to a commercial resistor we choose the next lower value, that means a resistor of 68 Ohm. The input of the LED then is ca. 12. mA.

FAQ

- 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.
- The vehicle does not drive.
Possible cause: The wrong connecting point at side B of the existing reed contact was used. → Check the connection.
- The vehicle drives backwards.
Possible cause: The connections of the motor are connected reverse. → Check the connections.

If you cannot find the problem, please return the module for repair (address on the cover page).

Manufacturer's note

According to DIN VDE 0869, the person who assembles and/or mounts a circuit in its' casing is the manufacturer of the product. If he sells the product to another person he is responsible for passing on all the relevant papers and his name and address.

Certification

This product conforms with the EC- directive 89/336/EWG on electromagnetic radiation and is therefore CE certified.

Conditions of warranty

This product is guaranteed for two years. The warranty includes the correction of faults which can be proved to be due to material failure or factory flaw. We guarantee the function of the parts according to the parameters in not mounted state as well as the adherence to the technical specifications of the circuit when assembled and connected according to the manual.

Other claims are excluded. By law, we are not responsible for damages or secondary damages in connection with this product. We retain the right to repair, make improvements, supply spare parts or return the purchase price.

The following invalidate the warranty:

- using an unsuitable soldering iron, solder containing liquid acids or similar,
- if damage is caused by not following the instructions in this manual or the connection diagram(s)
- if the module has been altered and repair attempts have failed,
- if arbitrary changes in the circuit are made,
- if additional components are added which are not described in the manual,
- if the copper tracks or soldering eyes are damaged,
- if damage occurs due to an overload of the module,
- if connected to a incorrect voltage or current,
- if damaged by other persons,
- if damaged by faulty operation or if damaged by careless use or abuse,
- if damaged by touching components before electrostatic discharging of the hands.

* "**Faller**" is a registered and protected trade mark of Gebrueder Faller GmbH, Guetenbach, Germany.

Connection Table

X1	Connection to „-“ of the accumulator batteries
X2	Connection to „+“ of the accumulator batteries / front lighting
X3	Voltage output (-) of the circuit
X4	Motor control
X5	Right indicator
X6	Braking and reversing lights
X7	Left indicator
X8	Existing reed contact
X9	Secondary reed contact

External Components

D2	Additional Diode (1N4148)
G1, G2	Existing chargeable 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	Additional Transistor (BC 327)
R7	Existing resistor
R8*, R9*	Additional resistors for LED1 and LED2
R10	Additional resistor 10 k Ω
RK1	Existing reed contact
RK2	Additional reed-contact
S	Existing switch

* Not supplied.

Aktuelle Informationen und Tipps:

Information and tips:

Informations et conseils:

Actuele informatie en tips:

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

Garantie und Service:

Warranty and service:

Garantie et service:

Garantie en service:

Tams Elektronik GmbH

Rupsteinstraße 10

D-30625 Hannover

fon: +49 (0)511 / 55 60 60

fax: +49 (0)511 / 55 61 61

e-mail: modellbahn@tams-online.de