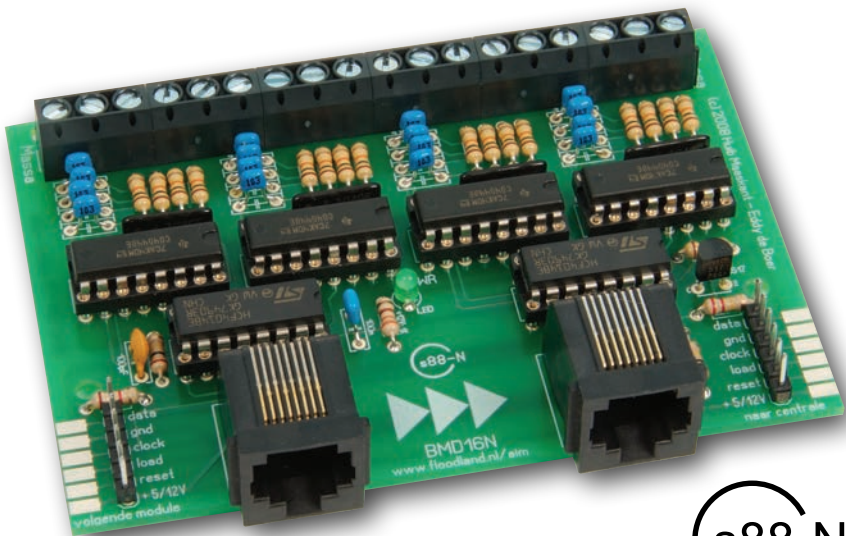# BMD16N

version 1.2

Feedback decoder with 16 contacts for the S88-bus

Compatible with a.o. Märklin Digital, Uhlenbrock
Intellibox, Fleischmann Twin-Center and LDT HSI-88

Compatible with the s88-N standard

For ground detection, reed contacts, contact tracks, etc.
at digital model railroads in all scales

# The BMD16N

**All computer controlled model railroads need a good system providing feedback from the track. The BMD16N was especially designed to provide this feedback reliably and affordably. The BMD16N is fully compatible with the widespread S88-bus and the new s88-N standard.**

## Sturdy screw terminals

The BMD16N is fitted with practical screw terminals. You do not need to fiddle around with expensive model railroad plugs anymore. The connections are easily made and are highly reliable.

## Universal standard

The BMD16N can be connected to your system via normal S88 cables or via UTP network cables. Network cables are cheaper and provide better protection from electrical interference. The cables can be much longer than normal S88 cables. The BMD16N is fully compatible with the s88-N standard, It can be connected directly to any equipment bearing the s88-N logo.

## Reduced risk of feedback errors

The BMD16N is equipped with an improved reset circuit. This feature plus the use of network cables will reduce the chance of false feedbacks from your layout.

## Connect other decoders sideways

If mount several BMD16Ns and/or BMD16N-SDs right next to each other, you will need only a simple print connector or just a few wires to connect the decoders. You do not need any cables between the decoders. This will save you wiring, space and money.

## Attractive kit

The BMD16N is an easy to assemble alternative to similar decoders and kits on the market. The BMD16N is cheaper than feedback decoders from model railroad manufacturers. The professionally made circuit board can be assemble by virtually anybody and the components are available just about everywhere.

Attention:
The connectors on the BMD16N are not normal network plugs. Never connect the decoder to a PC or any other network device!

# Feedback and train detection

The BMD16N has 16 contacts that are activated when you connect them to the ground terminal of your digital system. This is the case in many situations. For example when you have a 3-rail layout and you are using ground detection for occupancy detection. Or when you are using reed contacts or special contact tracks. The BMD16N also offers you the possibility to create a layout plan track control that drives the software on your PC. The switches are connected to the BMD16N and the actions are passed to the system via the S88-bus.

## Ground detection

Using a technique best described as 'ground detection' is the most reliable way of creating track occupancy detection with 3-rail layouts. Creating detection sections is very easy with Märklin K-track. Normally both rails are used for ground and the centre studs for power. When you use only one rail for ground, the other becomes available for train detection.

The free rail is divided into sections with plastic rail joiners (e.g. Roco or Fleischmann). The sections can be as long or as short as you want. Each section will act as an occupancy detector and is connected to another input of the BMD16N.

Normally the free rail will not be connected to anything except the decoder. The section is flagged as being 'free'. When a locomotive or a car is in the section, its wheels will connect both rails. The free rail is now connected to ground and the section is flagged 'occupied'. On turnouts you should always connect both tracks to ground and not use detection. Small locomotives might else stall on the turnout.

## Alternatives

Creating detection sections is a bit more complex with C-track, because you will have to cut all the connections between the rails. If you do not want to do that, you can always settle for current detection with the BMD16N-SD. The drawback is that only rolling stock with a pick-up shoe will be detected. Other alternatives are reed contacts and contact tracks. However they are not as reliable as ground detection or current detection.

## The parts

You can order the parts from Conrad (www.conrad.com) or Reichelt (www.reichelt.de). Or buy them from your local electronics' shop.

| Count | Description | Conrad | Reichelt |
|---|---|---|---|
| 1 | resistor 330 Ohm | 1417730 | 1/4W 330 |
| 17 | resistor 10 kilo Ohm | 1417697 | 1/4W 10K |
| 2 | resistor 100 kilo Ohm | 1417735 | 1/4W 100K |
| 1 | resistor 220 kilo Ohm | 1417665 | 1/4W 220K |
| 4 | resistor network 4 x 100K | 416053 | SIL 5-4 100K |
| 16 | capacitor 10nF | 453323 | KERKO 10N |
| 1 | capacitor 100nF | 453358 | KERKO 100N |
| 1 | LED 3 mm green | 184713 | LED 3MM GN |
| 1 | transistor BC517 (or BCX38C) | 563341 | BC 517 |
| 6 | 16 pin IC-socket[1] | 189529 | GS 16 |
| 4 | IC 4044 | 172871 | MOS 4044 |
| 2 | IC 4014 | 172707 | MOS 4014 |
| 6 | 3-pole screw terminal | 731891 | AKL 101-03 |
| 1 | connector strip | 741119 | SL 1X36G 2,54 |
| 2 | RJ45 western connector | 716148 | MEBP 8-8S |

[1] Only needed if you want to mount the ICs in sockets.

## Assembling the decoder

You do not have to be a soldering virtuoso to put the BMD16N together, but it is good to have at least some experience. Use a small soldering iron and thin solder with a resin core. Never ever use flux or another soldering agent. Heat the spot with the soldering iron and then apply the solder. The joint is ready when the solder forms a tiny mountain (instead of a blob). Cut away the excess leg after the joint has cooled down.

## Suggestions

Resistor are cheaper when you buy them in a package of a 100 pieces. The resistors of 100 kilo Ω are listed as a package of 100 pieces. If you are assembling more than one decoder, be sure not to order too many resistors by mistake. Another option to save money is to leave out the IC sockets and to solder the ICs directly onto the board.
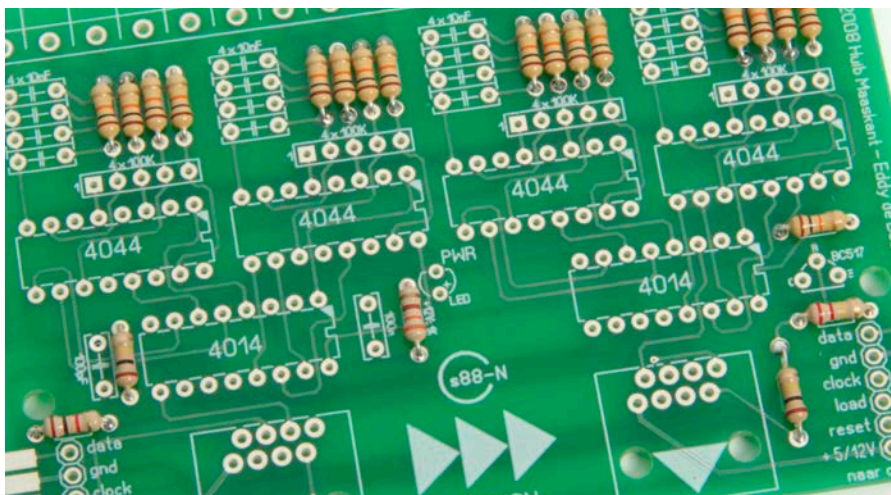
# Assembly

The circuit board has a white print on the component side. The print will tell you exactly where each component has to go. The lowest parts are put in first, the highest parts last. This order makes it easy to flip the board over and solder the parts without the need of holding them into place.

## 1. Resistors

The decoder has several resistors from different values. Resistors are indicated by a small rectangle with a number in it. For example, a rectangle with '330' indicates a 330 Ohm resistor. The colour code on the resistors denotes the value. The direction of assembly is not important as long as the legs are in the right holes. Please note: if you plan to connect the decoder to +12 Volt, you should replace the 330 Ω resistor by a 1 kilo Ω one.

Used values:

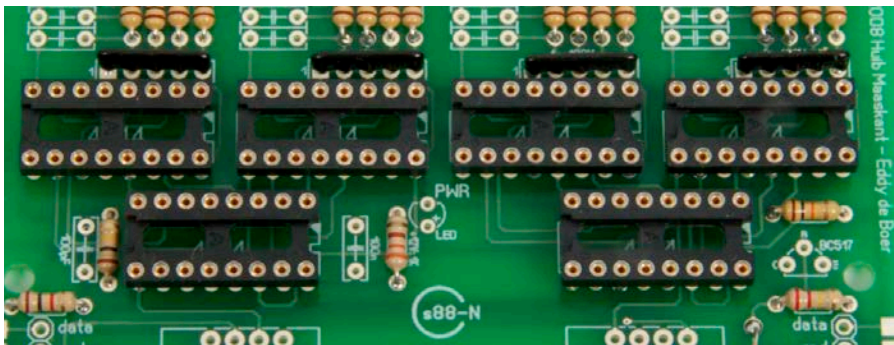| | | |
|---|---|---|
| 330 | 330 Ω | orange-orange-brown |
| 10k | 10 kilo Ω | brown-black-orange |
| 100k | 100 kilo Ω | brown-black-yellow |
| 220k | 220 kilo Ω | red-red-yellow |



## 2. Resistor networks

Part of the resistors come 'pre-packaged' as a resistor network of four resistors. The small black trips have five pins, of which one is a common connection. This pin is indicated with a dot and should go into the hole marked with '1'. Or in other words: it should point to the left.
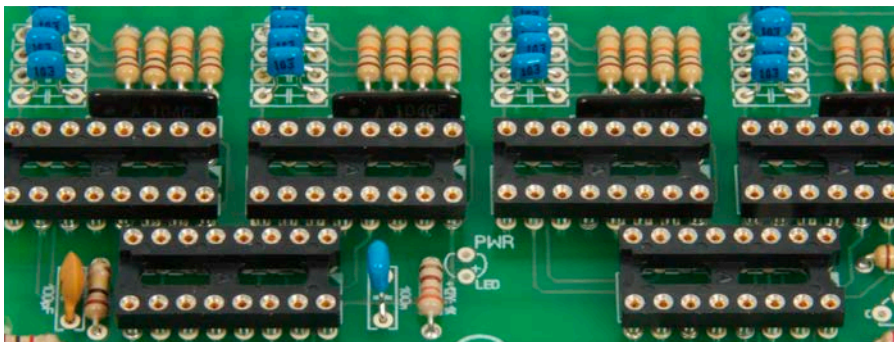
## 3. IC sockets

The IC sockets have a notch on one side. The notch indicates where pin 1 of the IC goes later. When mounting the IC sockets the notch of the socket should be on the same side as the notch in the white print.
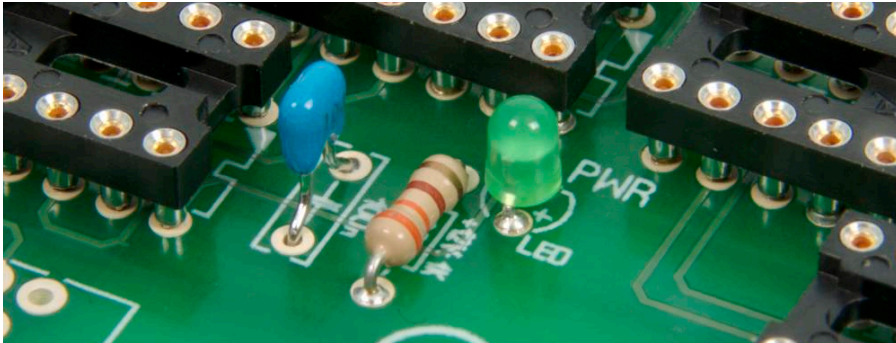


## 4. Capacitors

The decoder has 16 capacitors of 10nF (marked 103) and 1 of 100 nF (marked 104). The capacitors are indicated by rectangles with '10nF' and '100n' next to it. The direction of assembly is not important.
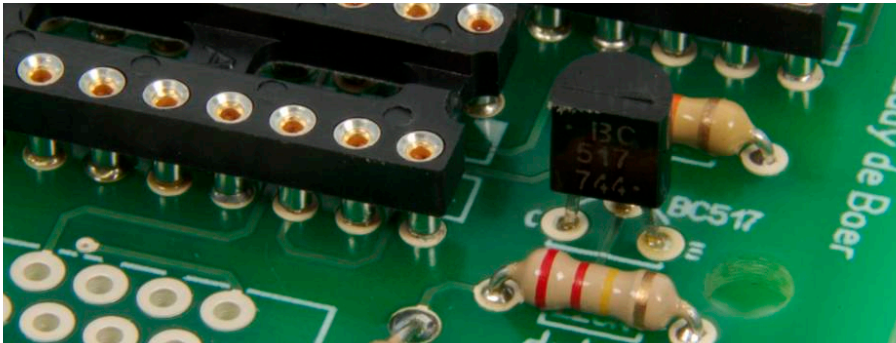
## 5. LED

The LED comes in the middle of the board. The longer leg should be in the hole marked with '+'.



## 6. Transistor

A semicircle with 'BC517' marks the place of the transistor. The flat side of the transistor should point to the bottom of the board.
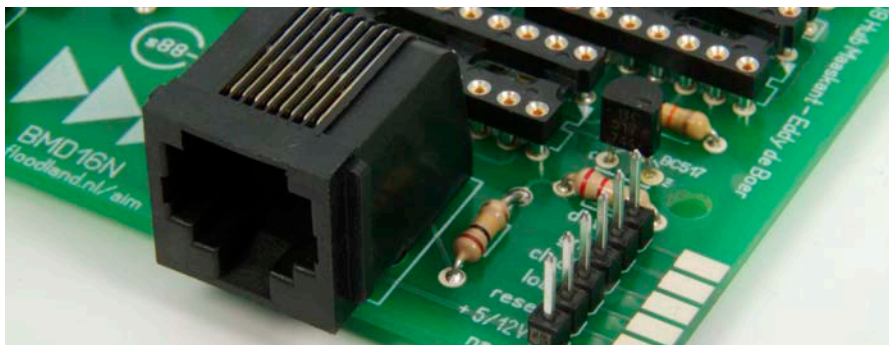


## 7. Screw connectors

The screw connectors come in blocks with three contacts. The sides have slits. First click the connectors together to form one long row and then solder them to the board.

## 8. S88-bus connectors

Cut two pieces with six contacts from the long strip connector if needed. The location of the two strips is clearly marked on the board. You can leave out these connectors if you only plan to use network cables.
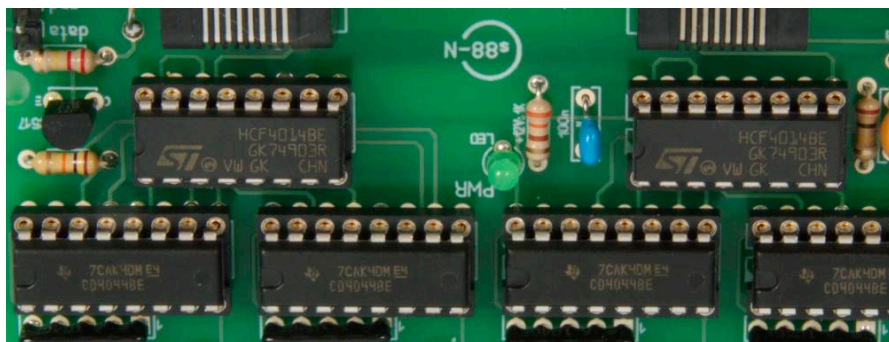
## 9. RJ-45 connectors

The connectors should firmly click into the holes. You can leave out the connectors if you plan on only using the standard S88 cables.

## 10. ICs

You can now press the ICs very gently into the sockets. The text below the socket tells you which IC goes where. The right direction is critical. A notch or dot indicates pin 1 of the IC. This side should correspond with the notch of the IC socket. Please note that all ICs are pointing in the same direction!



## Final check

Congratulations, your board is now ready. Please review your assembly carefully. Are all components in the right place? Are the ICs and the transistor mounted in the right direction? Are all joints soldered correctly and are there no short-circuits? If everything checks out fine, you can connect the BMD16N to your system.

## Revisions

The circuit board might have been updated since the pictures of this manual were taken. Your board might look slightly different from the one in the manual. Please place your components according to the markings on your board wherever they differ from the ones in the pictures.
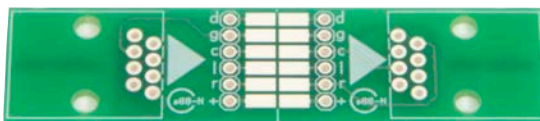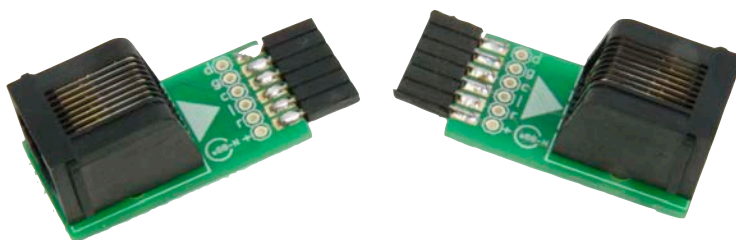
# Connecting your BMD16N

## Connecting to a central unit

The first BMD16N is connected to the S88 data bus on your central unit. The cable is connected to the decoder on the side labelled 'richting centrale'. When your decoder is connected correctly, the green LED will come on.
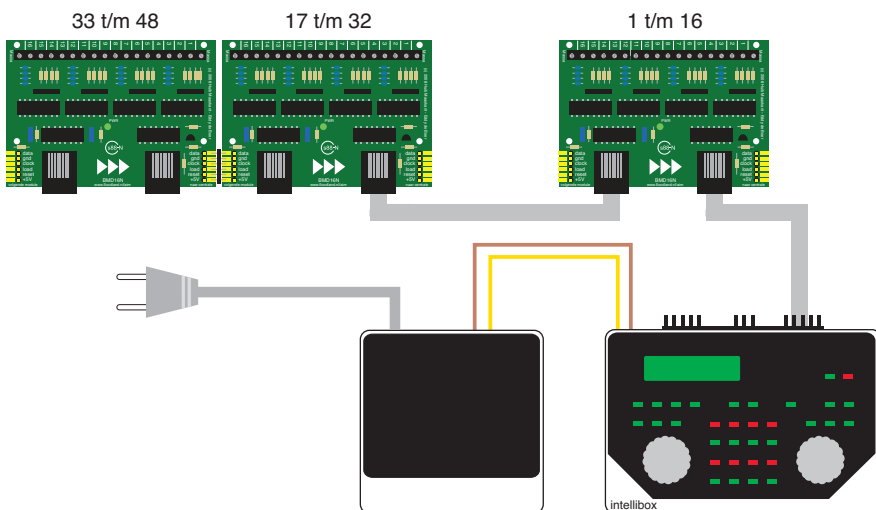


It is recommended to use the s88-N adapter (sold separately). This small adapter changes the standard S88 connection on your central unit into a s88-N connection. Instead of a normal S88 cable, you can now use a reliable and inexpensive network cable to connect your first decoder.

# More decoders

Successive decoders are connected in a chain by preferably a normal network cable (NOT a cross cable). Or else using a standard S88 cable. You can use the s88-N adapter to make decoders with only a standard S88 connection s88-N compatible. This allows you to wire your entire chain of feedback decoders with network cables.
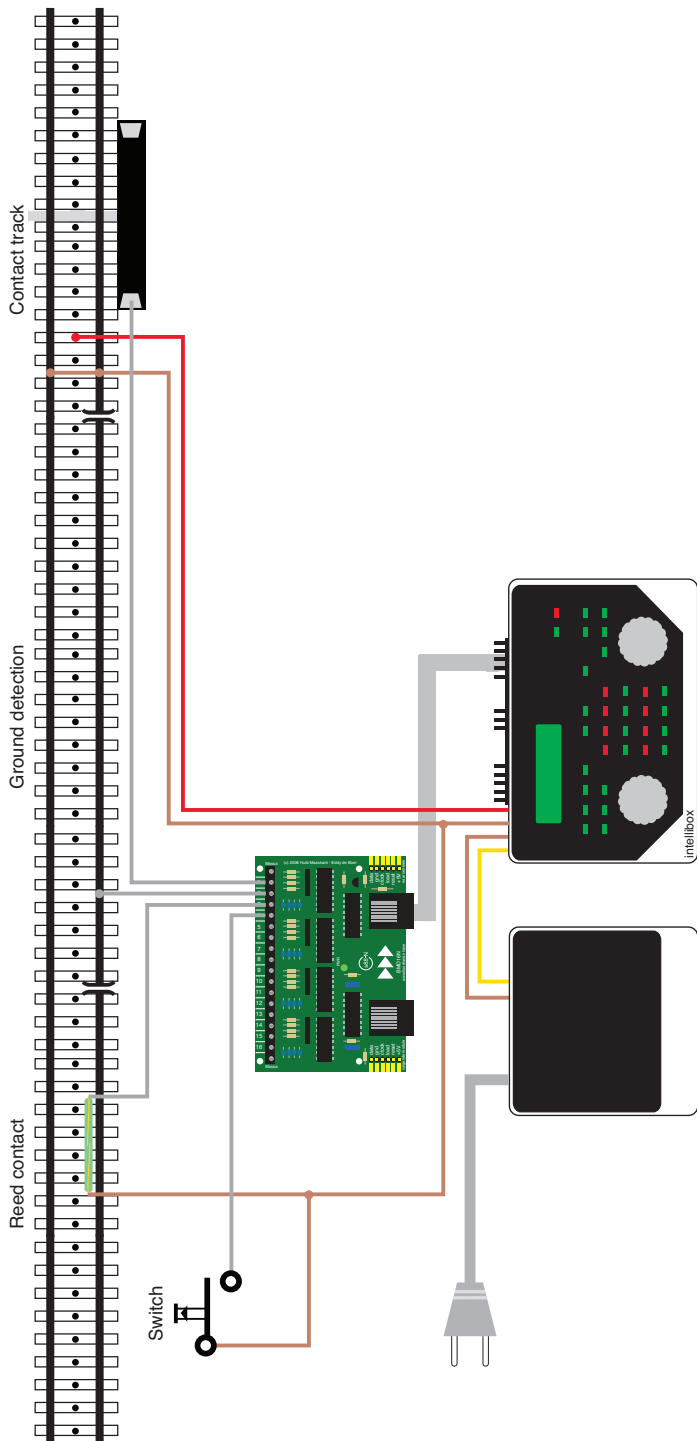
The arrows on the decoder indicate the direction of the data flow. The order of the decoders determines how the contacts are numbered. The first decoder has contacts 1 to 16, the second one 17 to 32, and so on. The BMD16N can be combined with other brands of decoders in any order. With most central units you can connect up to 31 decoders with 16 contacts to the S88 data bus.



# Connecting contacts

The BMD16N has 16 contacts that change their state when they are connected to the ground terminal of your digital system. If you have a 3-rail layout, you will want to use the BMD16N to detect your trains via ground detection. This is by far the most reliable form of train detection for Märklin layouts.

You can also settle for reed contacts or special contact tracks. However they are not as reliable as ground detection and you cannot use them to detect a car that was left behind. Finally you can connect switches to the BMD16N, e.g. in a layout plan track control or as an emergency stop switch in combination with your software. You can use any type of relay or switch, as long as it switches to ground.

Contact track

Ground detection

Reed contact

Switch

intellibox

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