

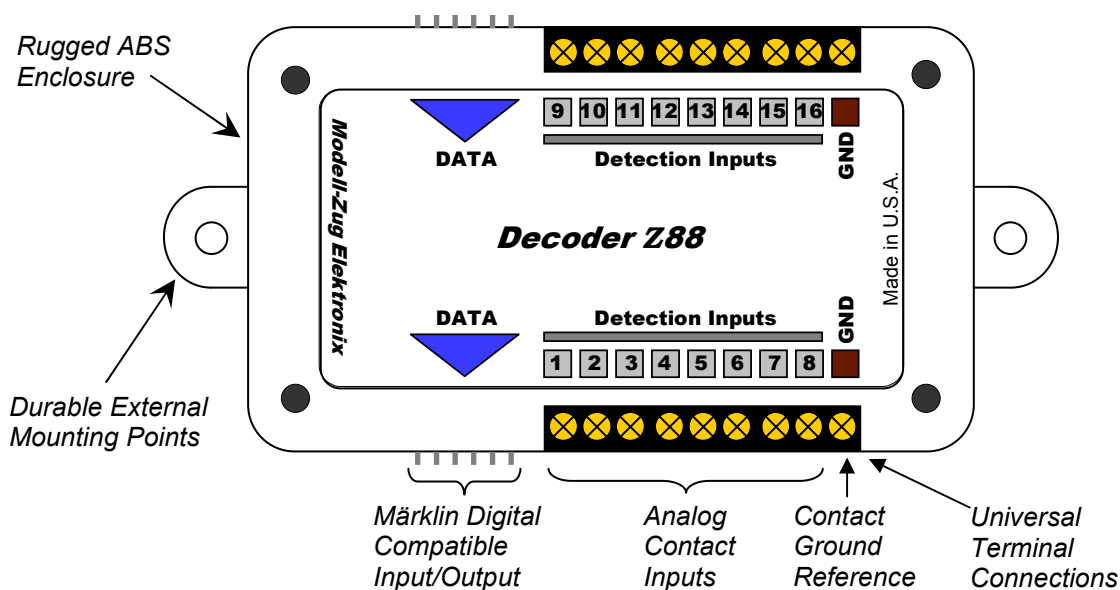


## Decoder Z88

### 1. Introduction

Thank you for purchasing this *Modell-Zug Elektronik* product. The *Decoder Z88* plays an important role in model railroad automation by supplying real-time feedback of layout operations to the digital control system. The *Decoder Z88* performs this task by constantly monitoring the status of various analog contact generators installed around the layout, such as contact tracks, circuit tracks, or reed contacts. The decoder converts these contact positions into digital data that is transmitted to an interface unit in the digital control system. It is at this point that the contact data can be used by the control system to activate preprogrammed layout functions in response to the current status of the layout and relative train positions. This process allows for truly automatic layout control, where train movements can determine their own future routes as well as that of others. Moreover, functions are combined and reused *easily* within and between programmed routes, without the complicated wiring normally associated with a fully automated analog layout. The *Decoder Z88* has been designed to provide maximum compatibility with the Märklin Digital system Memory and Interface units and the Uhlenbrock Intellibox. Please study the following manual in its entirety to gain full utility and enjoyment from this *Modell-Zug Elektronik* product.

### 2. Overview of Features



#### ***Mechanical Specifications***

Dimensions: W 5.37 in.; D 2.63 in.; H 1.26 in. (inc. mounting flanges)  
Weight: 4 oz.

#### ***Electrical Specifications***

Power Consumption: 5mW max.  
Input Voltage Range: 0V to +5V typ.; ±30V max.  
Input Current: -50uA max. (Logic Low)  
I/O Data Type: 10kHz TTL Binary Data Format

### 3. Operating the Decoder Z88

#### **MZE** 3.1 Installation & Connection to the Digital System

The *Decoder Z88* is connected to the digital system through any compatible interface unit including the Märklin Digital Memory, Interface, Central Control-I, or the Uhlenbrock Digital Intellibox. The *Decoder Z88* is connected to the interface unit by a special six-conductor ribbon cable included with the decoder. This cable supports all of the digital communication between the decoder and interface unit in addition to supplying power to the decoder, so that no external power connections are required. Multiple decoders may be connected in sequence to one interface unit by connecting the data output port of the last decoder to the data input port of the next decoder and so forth until the interface unit is reached. The total number of decoders that can be connected together depends on which interface unit is being used. The Uhlenbrock Intellibox and Märklin Interface each provide support for 31 decoders, while the Central Control-I supports four, and the Memory unit supports three. The *Decoder Z88* does not contain an address coding switch, such as those in digital accessory decoders. Instead, the output data is automatically assigned to a given decoder based on its physical position relative to the interface unit. Data from the decoder closest to the interface unit is read first, and is therefore always designated as Decoder #1. The following procedure explains how to properly connect the *Decoder Z88* to the digital system:

- 1) Be sure that all power to the layout is switched OFF. Using the cable supplied with the *Decoder Z88*, connect the decoder to the interface unit or another decoder as shown in Figure 1 below. Be sure to orient the cable connectors so that the ribbon cable points **downward** at both ends.
- 2) When securing the cable, **be careful** to avoid routing multiple ribbon cables together or near any other digital cabling such as digital track power wires, Booster cables, or controller interconnect extension cables. Also avoid making sharp bends or folds in the cable that may crush or break the conductors inside. Any of these situations may lead to interference of the digital signals and improper operation.

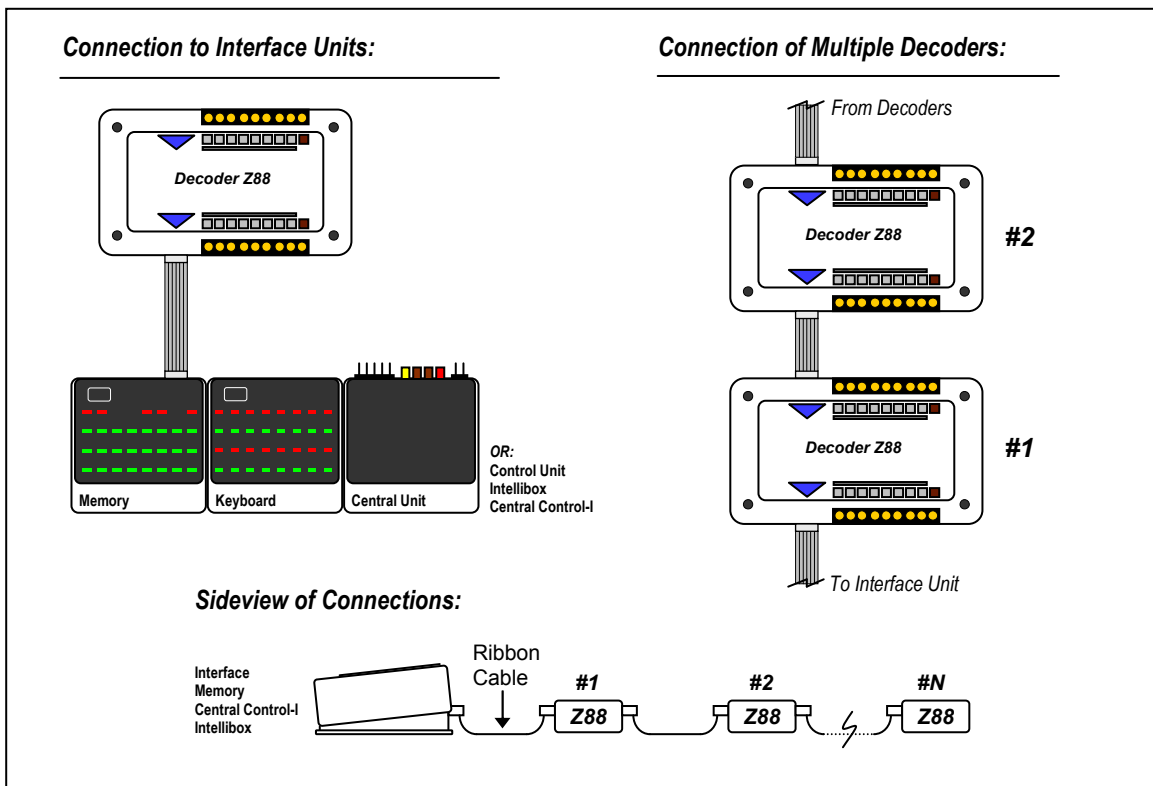


Figure 1. Connections to the Digital System

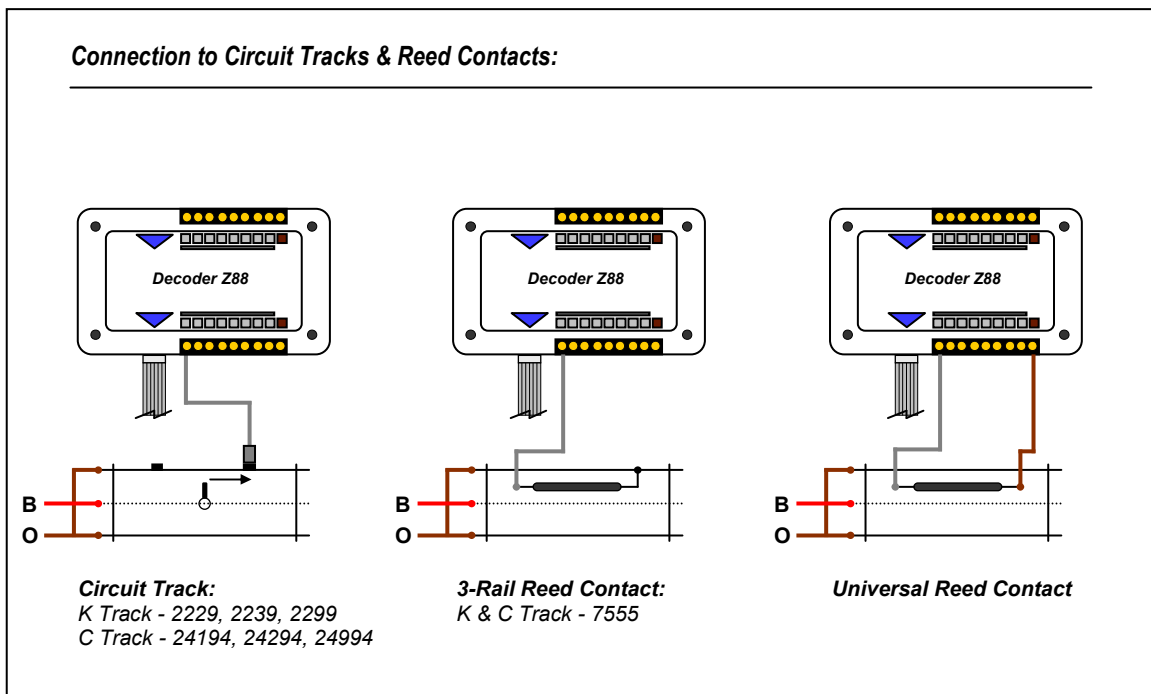


### 3.2 Connecting Contact Generators

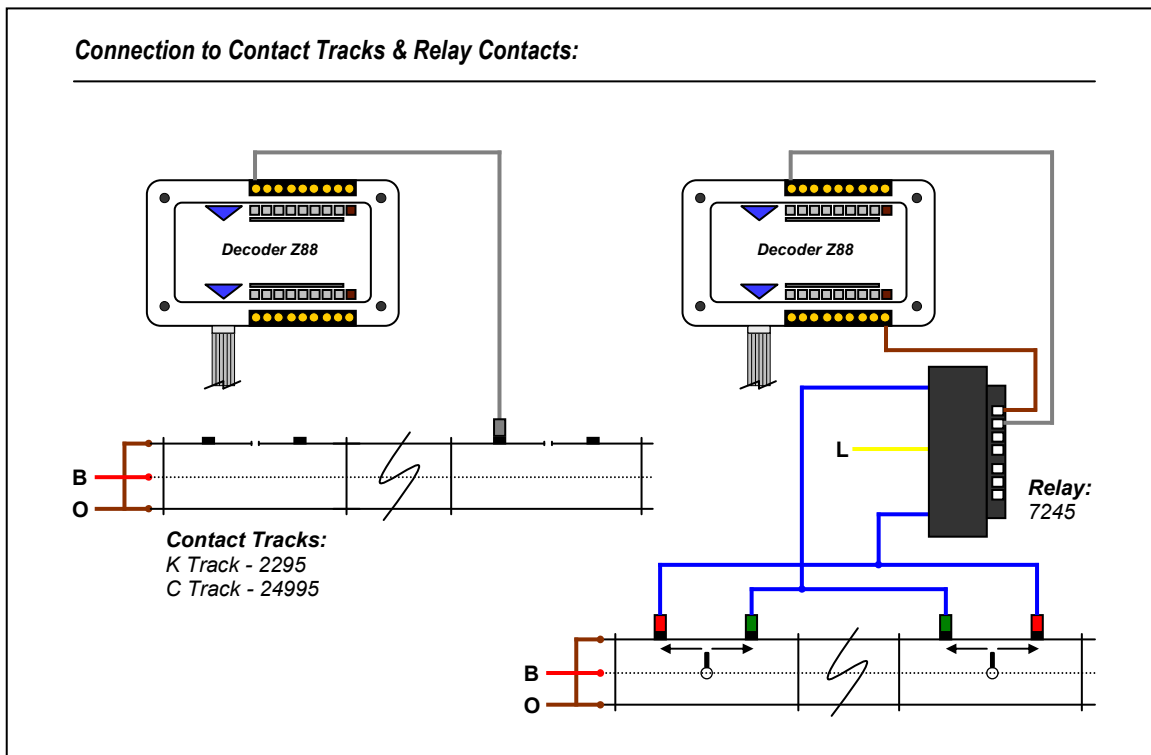
The *Decoder Z88* detection inputs can be activated by any one of several different analog contact generators according to the application. These contact generators may be push-button or toggle switches, contact tracks, circuit tracks, reed switches, relay contacts, etc. A detection input on the *Decoder Z88* is triggered when one of these devices connects the decoder input to the digital system ground, either momentarily or continuously. This event is then “digitized” by the decoder and transmitted to the digital control system through the interface unit. The digital control system may respond to the contact closure in a variety of ways, depending on how the PC control software or the Memory unit has been programmed by the user.

It is important to note that the detection inputs of the decoder have different meaning when used with the Memory unit instead of the Interface, Central Control-I, or Intellibox. When used with the computer interface units, the decoder inputs 1-16 all function similarly and may be assigned different tasks within the PC control software. When connected to the Memory however, the assignment of the decoder inputs relative to the Memory routes is fixed. The decoder connected closest to the Memory controls routes A1-A8, the second decoder controls B1-B8, and the third controls C1-C8. The functionality of the detection inputs differs in that only inputs 1-8 of each decoder will “Set” or activate Memory routes A1-A8, B1-B8, or C1-C8. Inputs 9-16 of each decoder will “Reset” or release the corresponding Memory routes triggered by decoder inputs 1-8, respectively. This function is generally intended for use with the interlocked operating mode of the Memory, where a route must be released before another route that intersects it may be activated. However, this feature is also used with the Memory’s non-interlocked operating mode to determine track occupation within a route. For example, if decoder Input#9 were continuously grounded through a train’s wheels on a contact track, a ground contact on Input#1 will be ignored and the corresponding Memory route will not be activated until Input#9 is released. In this case, other routes (intersecting or not) may be activated if their release inputs are not grounded, since the Memory is in the non-interlocked mode. The following steps and diagrams describe the various contact generator connections to the *Decoder Z88*:

- 1) Be sure that all power to the layout is switched OFF. Connect a circuit track, contact track, relay contact, etc. to the decoder input which corresponds to the route you want to control, as shown in Figure 2 below.
- 2) To connect a universal reed contact to the decoder, the auxiliary ground terminals on either side of the decoder may be used as a ground reference, see Figures 2 & 3. Do **NOT** connect ground return wires from other accessories such as lamps, motors, etc. to these reference terminals, they are **not** intended for high-current use.



**Figure 2. Momentary Contact Generator Connections**



**Figure 3. Continuous Contact Generator Connections**



### 3.3 Sample Applications

The simplicity and flexibility of the digital feedback decoder provide seemingly unlimited applications in the automated model railroad. The ability to instantly activate various combinations of layout functions digitally, without the need for complex analog logic wiring, is by far the biggest advantage. Densely populated layout areas such as stations and yards are easily controlled with a minimum of components. The digital feedback function also allows for increased operational safety on mainlines in multi-train automated layouts. The following examples present the most common uses of the *Decoder Z88*, an automated staging yard and an automated mainline block system. While the functionality of these examples is very straightforward, the operating principles may be easily adopted to more elaborate applications.

#### 3.3.1. Automated Staging Yard:

The staging yard serves as a storage and interchange area for train consists that are used frequently. This area is often placed in a concealed section of the layout so that its operations are hidden from observers, and may be used to create the illusion of greater traveling distances on the layout. A train can enter the staging area and be held there, while other trains are interchanged back and forth between the yard and mainline. This process is easily automated with the digital feedback decoder and digital accessory decoders.

Since a staging yard may be constructed in either a visible or hidden area on the layout, two examples are provided in Figures 4a and 4b below. The first example utilizes the Märklin semaphore or color light signals to switch power to the insulated track sections while adding realistic visual signaling. These turnouts and signals each require their own digital accessory decoders, such as the *MZE Decoder Z83/84* or Märklin k83. The second example takes advantage of the lack of signals in a hidden layout area to reduce the number of components needed. Here, a single *MZE Decoder Z83/84* simplifies the operations by allowing simultaneous turnout and track power control.

In each case, the sequence of events is similar and the specific route programming steps are listed within the figures. It is required that each train has a pickup shoe on the locomotive only, and that at least one track is vacant. The routes are activated by locomotive pickup shoes passing over the circuit tracks C1-C3, which are connected to

the *Decoder Z88* detection inputs 1-3, respectively. A train entering the yard on track G1, for example, will trigger circuit track C1 and activate input 1 on the *Decoder Z88*. This event initiates the set of switching commands stored in Route 1 of the Memory or PC program. In both examples, Route 1 brings Train#1 to a stop on track G1, switches the turnout positions W1-W4, and starts Train#2 on track G2. A similar sequence occurs when Train#2 returns to the staging yard and Route 2 is activated: Trains#2 stops, the turnouts switch, and Train#3 starts. The entire cycle repeats when Train#1 is started again by Train#3 and circuit track C3.

The operational simplicity is improved in the second example (Figure 4b) due to the absence of signals and the use of the *Decoder Z83/84* to control all of the turnouts and track power switching. Each insulated track section is controlled in parallel with a turnout position that is unique to train movement on that track. In this example, when turnout W1 is commanded to “straight,” track power is also automatically applied to the insulated section S1 through the *Z83/84*’s internal relay contacts. When turnout W1 is commanded to change to “branch,” track power to S1 is immediately switched off. The insulated sections S2 and S3 are powered in a similar way. This method requires less programming steps and accessory decoders, and requires no external relays.

It is important to emphasize that, in both examples, the first programming step of any route stops the train in motion and the last step starts the next train. This programming structure should always be followed in any application to prevent potential misoperation.

### **3.3.2. Automated Block System:**

Block systems and signals are used on the prototype to prevent train collisions and derailments, as well as to automate train movements. On the model railroad too, block systems provide additional safety when several trains are to be operated simultaneously. The idea behind the block system is simple: The trackage is divided into logical sections or blocks, which are each controlled by a signal. When a train enters a given block, the entry signal is set to “Stop” and any other train that approaches this block is forced to stop until the first train has passed through. This establishes a safe running distance between the trains.

Extremely realistic block operations can be reproduced using the *Decoder Z88* along with the *MZE Brake Module* and a digital accessory decoder. These components may be assembled to form the simple block system shown in Figure 5 below. This block system contains four blocks that allow for the automation of three trains, as one block must always remain free. Just as in the previous examples, activation of the *Decoder Z88* detection inputs is accomplished using circuit tracks C1-C4. When each circuit track is triggered, the entry signal for that block is set to “Stop” and the entry signal of the previous block is set to “Go.” In this way, only one train is in motion at any given time, moving into the newly cleared block. For example, when a loco pickup shoe passes over circuit track C1, signal S1 will be set to Red and S4 to Green. This starts the train at signal S4 and allows it to proceed only as far as S1, where it will stop before entering Block#1. Coincidentally, the train that triggered this event by passing over circuit track C1 will also stop at signal S2, which was previously set by the train in Block#2. This sequence continues with C4 being activated next, then C3, and finally C2. Once the block signal S1 is set to Go by circuit track C2, the cycle will repeat when the train passes over circuit track C1 again.

Eventhough it is possible to power each block section using the built-in contacts of the Märklin signals, the four *MZE Brake Modules* have been added to provide gradual starting and stopping of each train at the block signals. These modules are designed for use with high-efficiency propulsion locos containing Märklin 6090, 60901, or “mfx” decoder boards. The train movement at each *Brake Module* is controlled through three isolated track sections called Transition, Brake, and Stop sections. When the loco passes through the Transition section and enters the Brake section, the module signals the loco decoder to come to a gradual stop in front of the signal. The Stop section is an added safety mechanism for trains with long braking delay and/or high speed settings that may not fully stop in the braking area and attempt to overrun the signal. Unlike the conventional Märklin signals where the track power is simply switched Off, the *Brake Module* supplies power to the loco’s auxilliary functions (headlights and F1-F4) when the train is stopped. The Brake Module is also equipped with an auxilliary switch output that can be used to control Viessmann or Märklin color light block signals (without external relays). The *Brake Module* inputs are set through a digital accessory decoder, such as the *MZE Decoder Z83/84* or Märklin k83.

To further enhance the realism of this block system, a delay may be inserted between the signal switching within each route program. This creates a less automated, less regimented appearance to the block operations. Since this system is controlled digitally, a delay is easy to implement. When using an interface with a PC, a suitable delay can be placed between the switching command statements in the control software. If a Memory unit is used instead, a set of artificial switching commands to a non-existent turnout (256 for example) may be entered repeatedly to generate a delay between the signal settings of each route (refer to the Memory instructions for details).

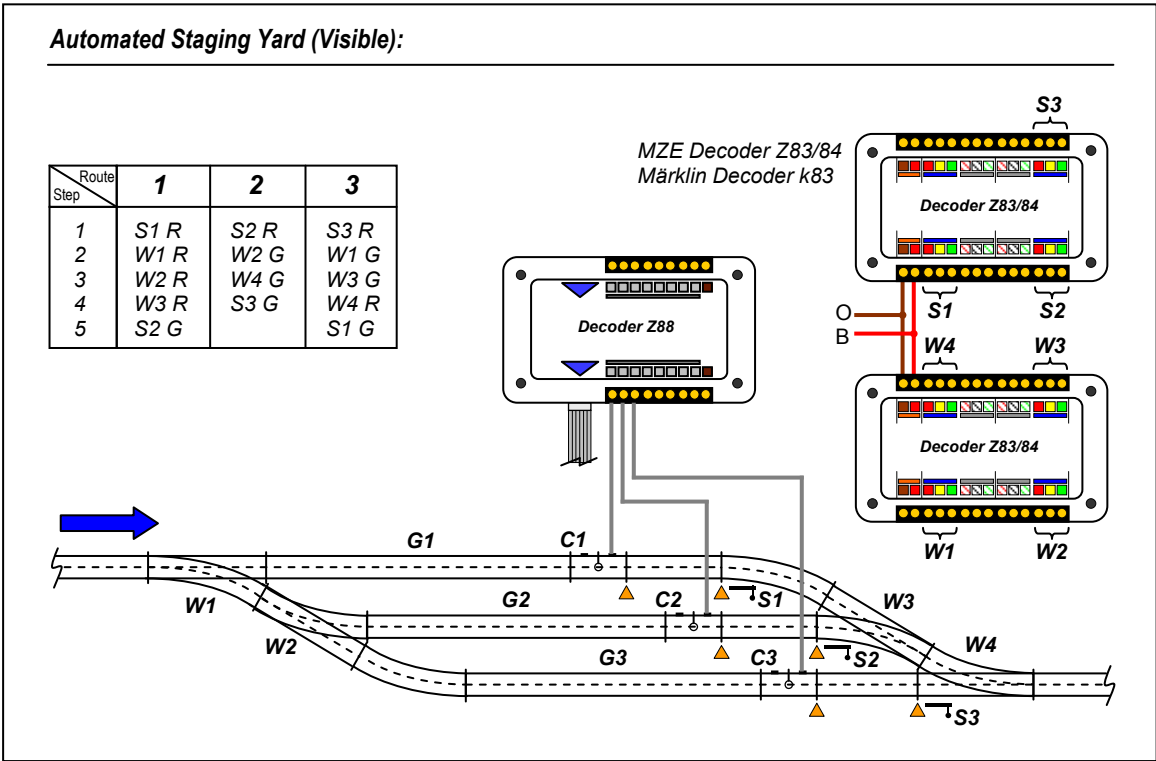


Figure 4a. Staging Yard w/ Signals in Visible Layout Area

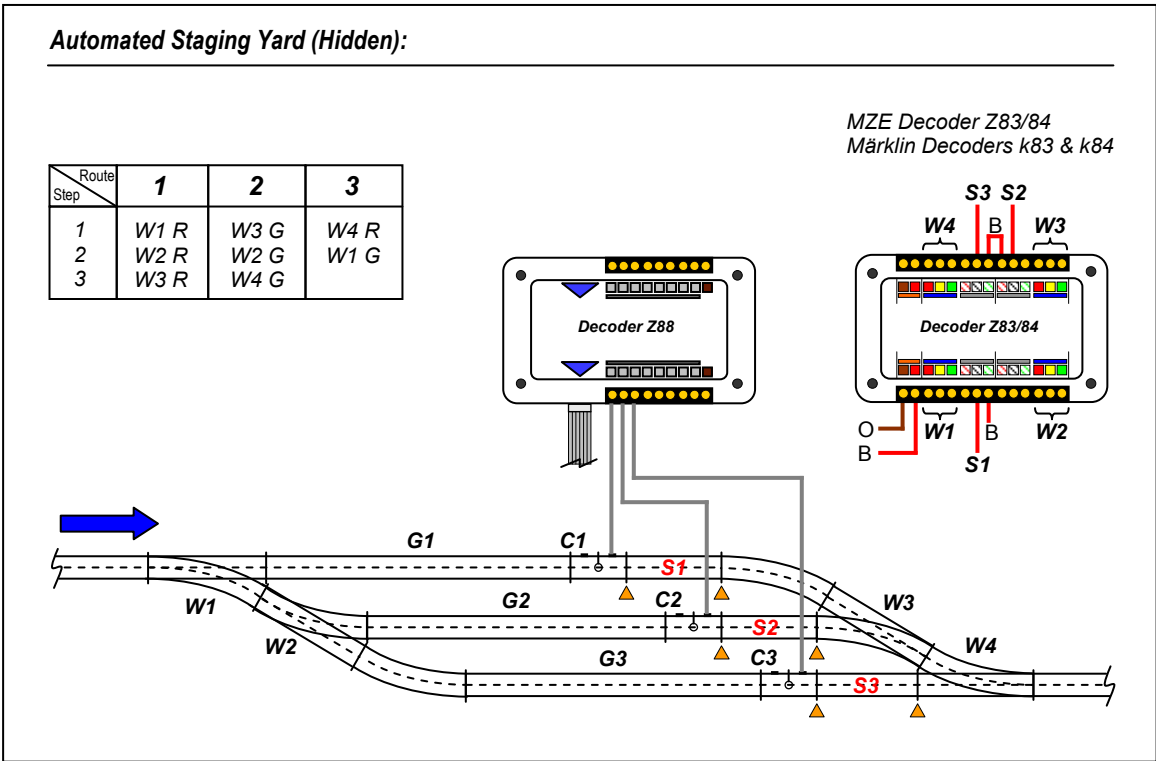


Figure 4b. Staging Yard w/o Signals in Hidden Layout Area

Automated Block System:

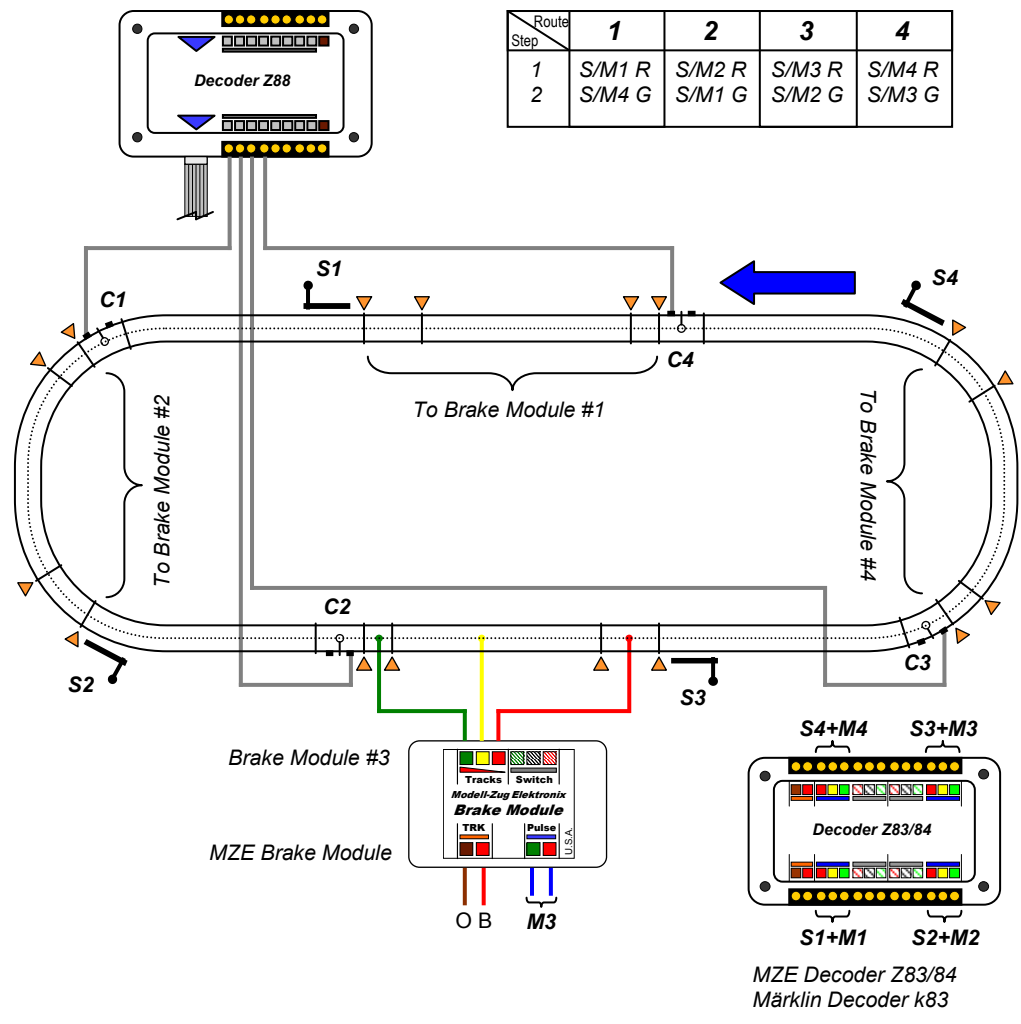


Figure 5. Automated Block System w/ Signals & Brake Modules