

# MUNICH TO GARMISCH-PARTENKIRCHEN



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## 1 Route Information

### 1.1 History

The Munich to Garmisch-Partenkirchen railway is located in the southern part of the German state of Bavaria. The line is one of the oldest in Germany, part of which was opened as far back as 1854.

The early sections of the line from Munich via Pasing, and onto Planegg were opened on the 21<sup>st</sup> May 1854. During this time the section between Munich and Pasing was also duplicated to be shared with the Munich-Garmisch Railway Company.

Throughout 1854, work continued on the line, reaching Gauting on the 16<sup>th</sup> July of the same year, then onto Mühlthal by the 16<sup>th</sup> September, and finally reaching Starnberg on the 28<sup>th</sup> November 1854.

Over the years sections of the current route were independently built to service local industry in and around the towns of Weilheim, Tutzing, Murnau and Partenkirchen.

These sections were upgraded and merged over the years, and on the 20<sup>th</sup> February 1925 an electric hauled train completed the first full run from Munich Main Station all the way to Garmisch-Partenkirchen in southern Bavaria.

### 1.2 The Route

The route is mainly single-track, and electrified throughout. There are 25 stations located along its length.

Travelling west from Munich the line runs through Pasing and then Southbound to the twin town of Garmisch-Partenkirchen in the Alps, near the border with Austria. The Munich S-Bahn Line S6 service runs from Munich heading Southbound to Tutzing where the S-Bahn service terminates on this route.

### 1.3 Rolling Stock

The route is served by the DBAG Class 426 EMU, which is operated by DB Regio. This does not stop at the S-Bahn stations in the first half of the route.

### 1.4 Focus Time Period

This Train Simulator simulation is based around the present day route in 2014.

## 2 Getting Started

### 2.1 Recommended Minimum Hardware Specification

The Munich to Garmisch-Partenkirchen route is highly detailed and feature-rich and incorporates detailed night lighting and will benefit from a higher PC specification.

- Windows XP with latest service pack installed / Windows Vista / Windows 7 / Windows 8
- Processor: 2.8 GHz Core 2 Duo (3.2 GHz Core 2 Duo recommended), AMD Athlon MP
- RAM - 2.0GB
- GFX - 512 MB with Pixel Shader 3.0 (AGP PCIe only)
- SFX - Direct X 9.0c compatible

### 3 SIFA

SIFA is short for Sicherheitsfahrschaltung or “Safety Driving Switch”.

The SIFA vigilance alerter is disabled at startup, but can be activated or deactivated by pressing ‘Shift+Enter(Numpad)’. While activated the SIFA light on the cab dashboard is normally switched off. While the train is moving the driver is required to confirm an alarm every 30 seconds.

When the 30 second alarm is triggered the SIFA light on the cab dashboard will illuminate, after an additional 4 seconds an audible alert will sound. After a further 2.5 seconds the emergency brake will be applied. This can be avoided by acknowledging the alarm at any stage by pressing the ‘Enter(Numpad)’ key.

## 4 PZB Signalling System

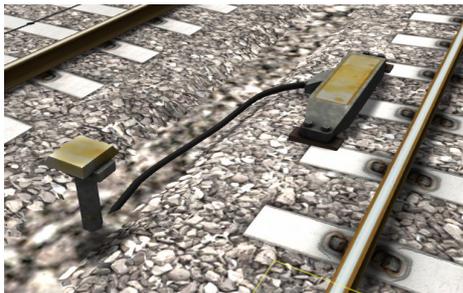
PZB stands for Punktförmige Zugbeeinflussung, loosely translated to English this means “Spotwise Train Control”.

Safe distances between trains are managed conventionally through the use of block-based systems. A given line is broken up in to a series of blocks, and trains are permitted (via green or yellow) signals to enter a block. While a train is present in a block the signal permitting entry is set to red, preventing any more trains to enter.

As railways have developed, more complex control systems and in-cab signalling have been implemented to improve the safety of the railways and to ensure that drivers are fully aware of what is happening around them by requiring them to react in certain ways according to what is happening.

PZB is a complex system and requires that you understand the varying speed limits and the requirement to respond promptly to the signalling system.

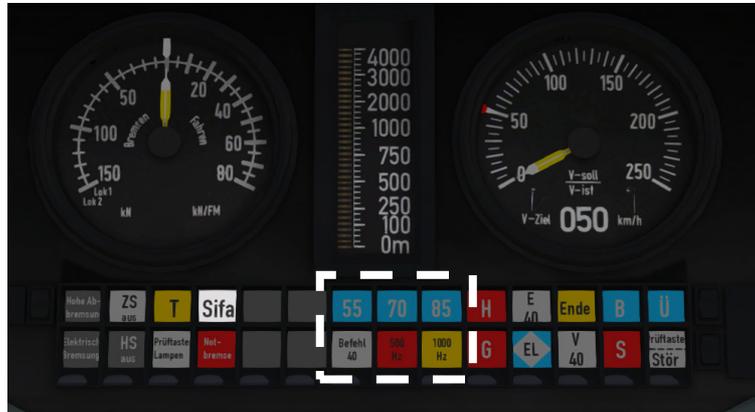
### 4.1 PZB Track Interface



The PZB system incorporates in-cab signalling, this is where the control desk has indicators, alarms and buttons that will react according to the signalling status on the railway. The mechanism by which this works is a series of “balise” magnets placed on the side of the track. An example of one of these magnets is shown in the image on the left.

## 4.2 In-Cab Indicators

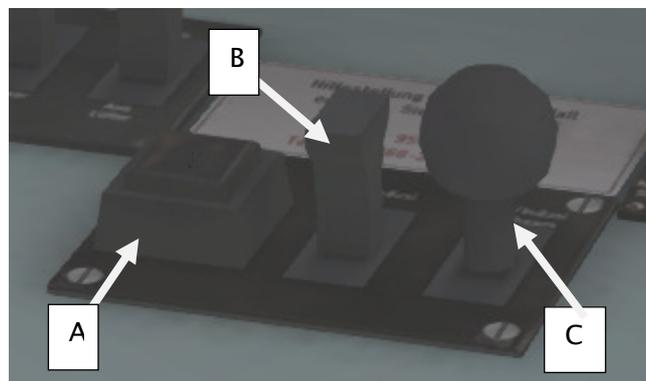
Inside the cab there are lights pertaining to the state of the PZB system as shown in the diagram below:



The white-dashed section shows the lamps related to PZB

## 4.3 Cab Controls

There are also three controls on the cab desk that you will need to use in order to interact with the PZB system.



PZB controls on the Cab Desk of a BR101

These three controls, to the left of the control desk on the BR101, are named as follows:

- A – German: Befehl40 / English: PZB Override
- B – German: PZB Frei / English: PZB Release
- C – German: PZB Wachsam / English: PZB Acknowledge

#### 4.4 Train Types

The type of train you are driving is important to understanding how PZB actually works and impacts on the speed limits that are imposed while PZB is monitoring your train.

There are three types of train that PZB deals with:

- Type O (Obere) - Passenger trains
- Type M (Mittlere) – Faster Freight Trains
- Type U (Untere) – Slow / Heavy Freight Trains

The implementation of PZB within locomotives supplied with the Munich Garmisch route automatically determines the correct type of train based on the train type configuration in the scenario. Once PZB is active you can see this in the PZB lamps as follows:

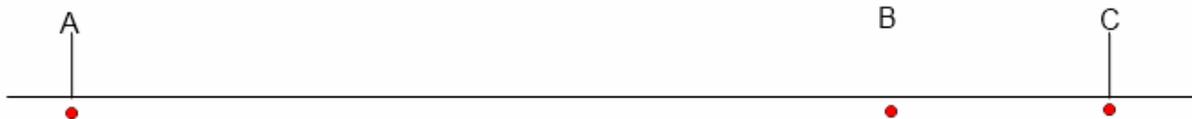
- Type O – Lights up the 85 lamp
- Type M – Lights up the 70 lamp
- Type U – Lights up the 55 lamp

#### 4.5 Key Controls

Function	Keyboard
Activate/Deactivate	Ctrl+Enter(Numpad)
Acknowledge	Page Down
Release	End
Override	Del

#### 4.6 Example

For this example we are driving a passenger train, which is a Type O service; the speed limits indicated in this example are therefore specific to that kind of service and will be different for other types of service.



There are three primary points noted in the diagram above:

- A – The distant signal, usually some 1.2km from the hazard (such as a converging junction)
- B – A point usually about 250m before the guarding signal
- C – The guarding signal, normally placed around 200m before the hazard.

## Train Simulator – Munich to Garmisch–Partenkirchen

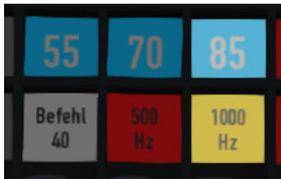
Let's take a look at what happens in this simple example as you begin on the left hand side of the image above and progress along the track until you get to the guarding signal on the right. We'll assume that in this case there is a converging junction set against us and therefore the guarding signal is at a stop indication.



As you approach point A, the Distant Signal will show a Yellow indication to let you know that the signal it is reflecting (at C) is at red indicating danger.

You will also notice that there is a magnet next to this signal. This is called a 1000hz magnet.

As the signal is at anything other than a green indication the magnet will be energised and the PZB system on-board the train will therefore sense its presence. As the train passes over the 1000hz magnet the driver has up to 4 seconds in which to press the PZB Wachsam / PZB Acknowledge key (Page Down). If the driver fails to do this the PZB system will apply emergency brakes to stop the train.



Note that there is no alert in the cab that we have passed over the 1000hz magnet, the driver is expected to be aware that they have passed a distant signal and react accordingly. Once the PZB Wachsam / Acknowledge control is pressed the display will update to indicate that the locomotive is now in a monitored state. As we are a Type O train, the 85 lamp is lit and the 1000hz lamp lights up.

As we pass the 1000hz magnet we must not be exceeding 165km/h, regardless of the line speed. If we are then there is a good change we will not be able to fully stop before the signal at point C and therefore the PZB system will apply emergency brakes.

We now have 23 seconds in which to decrease our speed to 85km/h. If after 23 seconds we are exceeding this speed then the PZB system will apply emergency brakes.

We now continue on towards the guarded signal at no greater than 85km/h.

After 700 meters, the 1000hz lamp will go out and we will no longer be monitored. Now the driver can make a decision based on what they can see. Can you see the guarded signal and is it still at a danger indication?

If it is then we continue slowing down to stop. If the signal is now showing a clear aspect because the hazard has cleared the driver has the option to release the locomotive from monitoring and they will then be permitted to return directly to line speed. Press the PZB Frei / Release button to do this *before* the train reaches point B or further restrictions are put in place.

Caution: Be careful to ensure that you only release when the signal is clear; if you release and the signal is not clear when you reach Point B the system will assume that you are incapable of safely driving the locomotive and will apply the emergency brakes.

Assuming the signal is still at danger and we haven't released from monitoring, we will then reach Point B. At Point B there is another track magnet; the 500hz magnet.

## Train Simulator – Munich to Garmisch–Partenkirchen



As we pass the 500hz magnet we must have slowed down to 65km/h or else we might not be able to stop in time for the signal and the emergency brakes will be applied. There is no need to acknowledge the 500hz magnet. At this point, the PZB lamps on the control desk will change to light up the 500hz lamp, indicating the restriction we're now in.

After passing the 500hz magnet we must now decelerate to 45km/h within 153 meters.

Having slowed down to 45km/h, we can draw up safely to the red signal and stop.

If the signal changes to a clear aspect while we are approaching the signal then we must continue with the 45km/h speed limit as we are still being monitored. It is not possible to release (PZB Frei) from monitoring while under a 500hz restriction. This restriction will continue for 250 meters, taking you past the guard signal, after which you will be able to return to line speed. This is the primary reason for releasing from monitoring before Point B (if and only if the signal is seen to be clear), otherwise you would be tied to running past the clear signal at the much reduced speed limit for an extra 250 meters instead of being able to return to normal line speed earlier.

If you pull up to the signal and stop because it is still red you may seek to obtain permission from the controller to pass it at danger. If you need to pass a signal that is still showing a red aspect then you will need to use the Befehl40 (Override) key to do so as you approach the red signal.

At Point C the guard signal has the third and final type of magnet, a 2000hz magnet. This magnet will *always* stop the train if passed and is used to stop trains that pass the signal while it is at danger. Pressing and holding Befehl40 (Override) key *stops* the PZB system from reacting to the 2000hz magnet. Once the 2000hz magnet is detected, the Befehl40 lamp comes on and you will then be restricted to a speed limit of 40km/h. You should remain at this speed until either you have travelled for 2km, or you have passed a signal showing a clear aspect. Once either of these conditions pass you can press PZB Frei to release from monitoring and return to line speed.

**Alternately Flashing PZB Indicators**

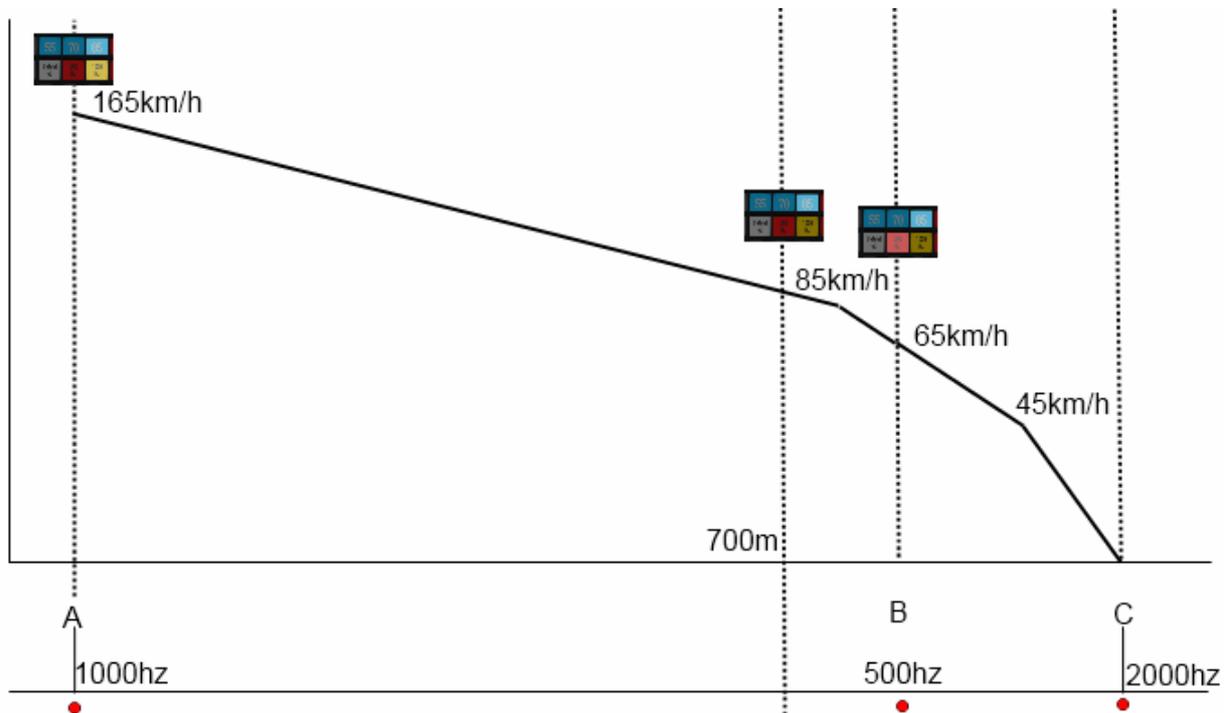
There is an additional state called Restricted Monitoring may engage while you are travelling under the control of either the 1000hz or 500hz magnets. If you travel below 10km/h for more than 15 seconds or you stop completely at any point, the PZB display will start alternating between two of the speed lamps such as the 70 and 85 lamps, to indicate that restricted monitoring is now in place. Under these circumstances the speed limits to be imposed are reduced further. Full details about speed limits for all types of trains in both normal and restrictive monitoring are below.

**PZB Speed Restrictions by Train Type**

Type of Train	Normal Monitoring		Restrictive Monitoring	
	1000hz	500hz	1000hz	500hz
<b>O (Obere)</b>	165km/h -> 85km/h In 23 seconds	65km/h -> 45km/h In 153 meters	45km/h constant	45km/h -> 25km/h in 153 meters
<b>M (Mittlere)</b>	125km/h -> 75km/h in 26 seconds	50km/h -> 35km/h In 153 meters	45km/h constant	25km/h constant
<b>U (Untere)</b>	105km/h -> 55km/h In 34 seconds	40km/h -> 25km/h In 153 meters	45km/h constant	25km/h constant

**Example Run Graph**

Here’s a graphical layout of what happened in our example run, indicating the magnets, speed limits and what you would expect to see in the PZB indicator lamps.



## 5 The DB BR426 EMU

### 5.1 DB BR426 - Background

The BR426 is a high powered, light weight vehicle for short to medium distance services. The 426 is almost identical to the 425, however the 426 is a two car train-set, whereas the 425 is a four car train-set. Built by a consortium of Siemens, Bombardier and DWA, they are operated by DB Regio.

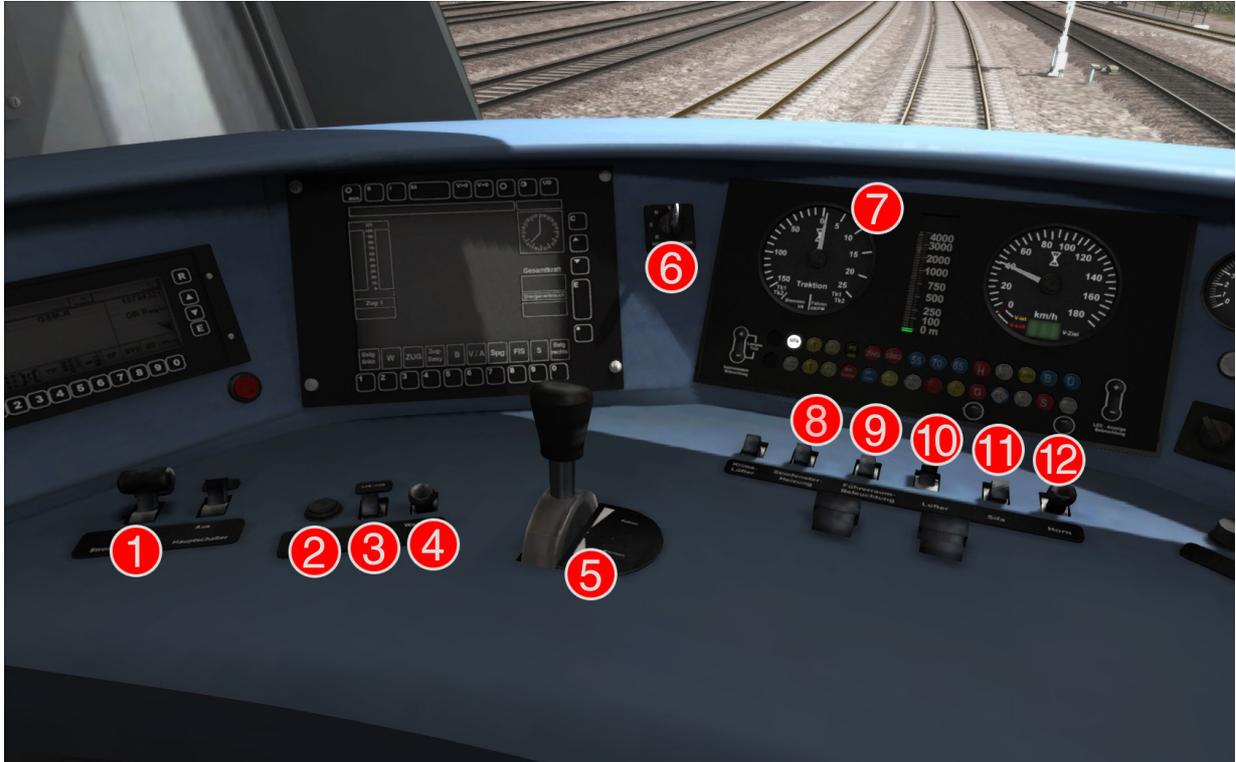
### 7.2 Design & Specification

<b>Builder</b>	<b>Bombardier, Siemens and DWA</b>
<b>Locomotive Weight</b>	63.2 tonnes
<b>Vehicle Power</b>	1575 Hp (1,175kW)
<b>Top Speed</b>	99 MPH (160km/h)
<b>Brake Types</b>	Air brake



## 6 Driving the DB BR426

### 6.1 Cab Controls and image



## Train Simulator - Munich to Garmisch-Partenkirchen

1	Pantograph Up/Down	(P)	9	Sander	(X)
2	PZB Befehl40 (Override)	(DELETE)	10	Headlights	(H)
3	PZB Frei (Release)	(END)	11	Sifa Reset	(NUM PAD ENTER)
4	PZB Wachsam (Acknowledge)	(PAGE DOWN)	12	Horn	(SPACE)
5	Throttle and Brake Lever	(A/D)	13	Speedometer	
6	Reverser	(W/S)	14	Wipers	(V)
7	Traction Effort Meter		15	Brake Pressure Dials	
8	Cab Light	(L)	16	Emergency Brake	(BACKSPACE)

## 7 Scenarios

### 7.1 Training: DB BR426

**Description:** Learn to drive the DB BR 426 using expert controls.

You will be driving the DB BR426. The controls will be explained, then you will be instructed through some basic operations and signalling. Don't worry! All will be explained at a comfortable pace.

### 7.2 Approaching the Alps

**Date:** 3rd July 2014

**Weather:** Cloudy, Summer

**Description:** Today you will be running an express passenger down to Murnau in the form of a BR426. With a busy line ahead of you, it is important you arrive on time.

Today you will be taking this BR426 service down to Murnau. You are due for an 1132 departure here at Munich. You will have some time there to grab lunch before running the return trip later on today. Weather conditions are looking pretty clear, but still, take care.

### 7.3 Weekend of Skiing Ahead

**Date:** 3rd December 2013

**Weather:** Snowing, Winter

**Description:** With weather conditions becoming worse, and fog thickening, you need to take a service down to Garmisch-Partenkirchen without impacting the timetable.

Today you are charged with a service to Garmisch-Partenkirchen. Weather conditions are looking pretty rough, with fog thickening, so take care.

### 7.4 Early City Run

**Date:** 1st April 2014

**Weather:** Cloudy, Spring

**Description:** With sunrise approaching, take this BR426 EMU on a passenger service to Munich. The lines are quiet, but the platforms are full of eager people travelling to work.

There is nothing better than an Early City Run. Quiet lines, but eager commuters. Take this service up to the city. The schedule involves 6 stops on the way.

### 7.5 Afternoon by the Lake

**Date:** 24th March 2014

**Weather:** Cloudy, Spring

**Description:** What a lovely day to spend by the lake. Take this passenger service in the form of a BR426 up to Starnberg, where our commuters are looking to spend the day.

Today's duties will have you running this 1307 passenger service to Starnberg. You are due to terminate there at 1414. Hopefully the weather stays nice so your passengers get a lovely view of the lake. Seems like lots of them have picnic baskets ready!

## 7.6 Stormy Night

**Date:** 5th January 2014

**Weather:** Stormy, Winter

**Description:** The heavens have opened! This is not going to be an easy shift. Take this BR426 EMU on a challenging run to Tutzing.

Forecast shows that this storm is not going to clear until the morning. The show must go on though, so today you are in charge of a service to Tutzing. Please take care and look after the passengers.

## 7.7 Commute to Work

**Date** 15th October 2013

**Weather:** Cloudy Showers, Autumn

**Description:** Take Take this BR426 on a light passenger service from Munich-Pasing down to Weilheim(Oberbay). You will only be making three passenger stops today.

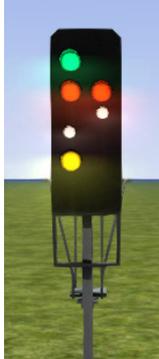
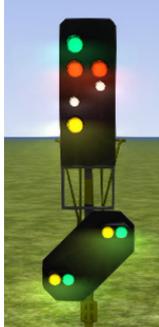
Morning driver, you only have a few stops to make today, but the platforms are looking busy due to commuters travelling to work. You are due to depart at 0739. Try to keep to your timetable.

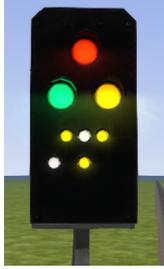
## 8 Signalling

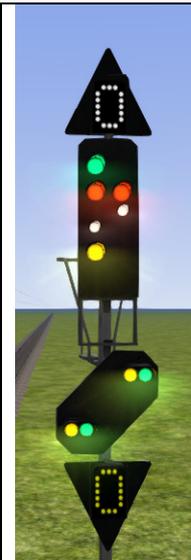
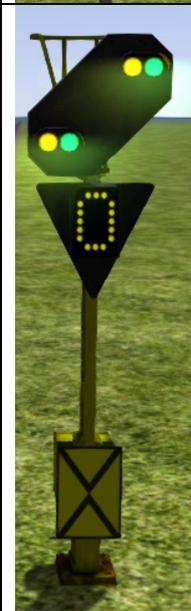
The signalling system employed on German Railways is extremely complex to understand at first; however in reality each signal you encounter will be composed of one or more straight forward signal types to give the final post.

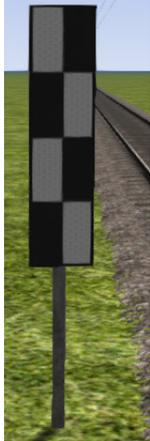
This manual doesn't attempt to cover all the possible signal types and variations, but it should provide sufficient background as to let you work out what each signal post you come across is telling you by explaining the component parts. Note that any signal of a given type that you see should be interpreted the same whether it is on a post, on the ground, on a gantry or in any other position.

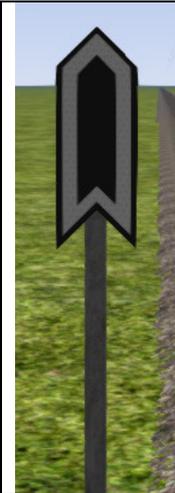
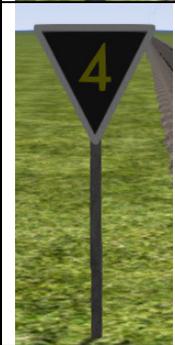
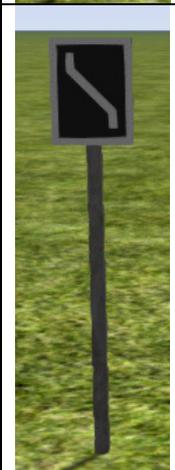
Note that in the examples below, the image shows the signal with all lights on so that you can clearly see where they are. The description of the signal describes the various combinations of lights and what they mean when lit. The small code before the description is the technical name by which that combination of lights is known.

	<p><b>Signal Type: Hp</b></p> <p>This is signal protects entry to a block.</p> <p>Hp0 – Red, Stop - do not proceed          Hp1 - Green: Clear to proceed          Hp2 – Yellow and Green: Caution, Proceed at 40km/h          Sh 1 – Red and Double White: Shunting permitted</p>
	<p><b>Signal Type: Vr</b></p> <p>Vr signals are distant signal types and indicate to you what you should expect the <i>next</i> active signal to be showing.</p> <p>Vr0 – Two Yellow – Caution, expect stop          Vr1 – Two Green – Expect Clear          Vr2 – Green/Yellow – Expect Caution with 40km/h restriction</p> <p>Note the “X” post board at the bottom, any signal which has this board is indicating that the signal is to be interpreted as a Distant signal.</p>
	<p><b>Combined Signal Type: Hp Vr</b></p> <p>This is an example of a combined signal, in this case the example shown is an “Hp Vr” combination. The functions of the individual signal heads are identical to those explained above but they are placed on the same post.</p>

	<p><b>Signal Type: Ks</b></p> <p>A newer signal type than the Hp signal but the function of it is the same.</p> <p>Hp0 – Single Red – Stop, do not proceed.          Ks2 – Single Yellow – Caution, expect next signal at Danger          Ks1 – Single Green – Proceed at line speed          Ks1 Flashing – Proceed and expect speed reduction at next signal          Hp0 + Sh1 – Single Red + Two small white – Shunting permitted</p>
	<p><b>Combined Signal Type: Ks Zs3v</b></p> <p>The Ks distant signal in this combination functions as normal. Zs3v signals are distant speed indicators. That is, you can expect the speed to change as indicated at the <i>next</i> signal. The indicator should be multiplied by 10 to get the speed restriction in km/h, for example, if the Zs3v indicator shows a “3” this means that the speed restriction will be 30km/h at the next signal.</p> <p>The Zs3v signals are clearly identified by being <i>yellow</i> and placed <i>under</i> the signal. Note that fixed speed limits are often indicated with a yellow-backed triangle board rather than an LED signal as shown here. See the example Zs3v speed board below.</p>
	<p><b>Combined Signal Type: Ks Zs3</b></p> <p>Similar to the Zs3v signals, a Zs3 signal differs in that it is indicating the speed limit imposed by <i>this</i> signal. While travelling down the line you could reasonably expect to see a Ks Zs3v indicating 30km/h at the next signal, and then the next signal would be a Ks Zs3 indicating 30km/h starts at this signal.</p> <p>The Zs3 signals are clearly identified by being <i>white</i> and placed <i>above</i> the signal. Note that fixed speed limits are often indicated with a white-backed triangle board rather than an LED signal as shown here. See the example Zs3 speed board below.</p>
	<p><b>Combined Signal Type: Ks Zs3 Zs3v</b></p> <p>Combining the signals shown previously, this will show you the speed limit imposed as of the section you are about to enter as well as the speed limit of the next section, allowing you adjust your speed through the section accordingly.</p>

	<p><b>Combined Signal Type: Hp Vr Zs3 Zs3v</b></p> <p>An example of how the signalling can begin to look very complex, however this is simply four signal types combined on to one post. Here you can see:</p> <ul style="list-style-type: none"> <li>• permission to enter the next block on the Hp signal,</li> <li>• indication of the signal state for the next signal on the Vr signal</li> <li>• speed restriction starting from this signal via the Zs3 at the top</li> <li>• speed restriction in place from the next signal via the Zs3v at the bottom</li> </ul>
	<p><b>Combined Signal Type: Vr Zs3v</b></p> <p>This signal combination naturally combines the distant Vr signal with the distant speed indication in the Zs3v signal.</p>
	<p><b>Signal Type: Hp Shunt</b></p> <p>This very simple signal will often be found as a ground frame or on a small post and is frequently used in yards and sidings. It has two indications:</p> <p>Two Red lights – Stop, do not proceed Two White Lights - Proceed</p>

	<p><b>Post Type: Ne4 Chessboard</b></p> <p>The Ne4 Chessboard is used to tell you that a signal that would normally be at this position has been placed in an alternative location, this could be further away from the track or on the other side of the track.</p> <p>The Ne4 board is always located where the signal would normally expected to be positioned.</p>
	<p><b>Post Type: Lf6 Advance Warning Speed Post</b></p> <p>This speed post provides advance warning that a speed limit change is going to take place. In the example shown, the speed will soon be changing to 40km/h. Following an Lf6 you can expect an Lf7 to mark the start of the new speed limit.</p>
	<p><b>Post Type: Lf7 Speed Post</b></p> <p>This speed post marks the beginning of a change in speed limit. The example indicated marks the beginning of a 40km/h speed limit and you should not be exceeding this speed as you pass the post.</p>
	<p><b>Post Type: Arrow Indicator</b></p> <p>Where there might be confusion about which track a sign is associated with, a small arrow is placed to indicate which line the information applies to. In this example the Lf7 speed restriction applies to the track on the left of the post.</p>

	<p><b>Post Type: Zs10 End of Speed Restriction</b></p> <p>This post indicates the end of a speed restriction started by a Zs3.</p>
	<p><b>Post Type: Zs3 Speed Post</b></p> <p>New speed limit takes effect immediately from this point. Shows one white number indicating the tenth the speed allowed from this point. This is normally used in conjunction with main signals. Permanent speed restrictions are instead indicated using Lf type signs.</p>
	<p><b>Post Type: Zs3v Distant Speed Post</b></p> <p>Shows one yellow number indicating the tenth of the speed allowed from the point where the following Zs3 signal is found. This plate is normally used in conjunction with distant (e.g. Vr) signals.</p>
	<p><b>Post Type: Zs6 Wrong Line Post</b></p> <p>This track change display plate is used to indicate that wrong line running (left hand) is to be used from this signal. It is only used in combination with main signals and only on lines where wrong line working is frequent.</p>