



# Munich to Augsburg



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# 1 Route Information

## 1.1 History

The Munich–Augsburg line was built by the Munich–Augsburg Railway Company (Munich–Augsburger Eisenbahn–Gesellschaft) and opened in 1840.

Between 26 June 1965 and 3 October 1965, two pairs of trains per day using Class E 03 locomotives ran at 200 km/h on the line for the 1965 International Transport Exhibition in Munich, taking 26 minutes to complete the run.

In 1977 the 42.7 km long section between Lochhausen and Augsburg–Hochzoll was put into operation with a regular permitted speed of 200 km/h. For the first time in Germany numerous trains could reach this speed in regular commercial operations.

On 10 December 2011 the railway upgrade was opened with an increased speed limit after 13 years of work.

## 1.2 The Route

Travelling west from Munich the line runs through Laim where the route splits and heads west through Pasing and Northbound for Nuremberg via Ingolstadt. Munich S–Bahn Line S3 services run from Munich Underground platforms heading West and follow the line to Augsburg until we reach Mammendorf.

Augsburg has 9 platforms and a large freight yard, plus a freight yard on the other side of the main station area.

## 1.3 Rolling Stock

The Munich S–Bahn Line S3 regularly sees traffic from DBAG Class 423 and Class 440 Electric Multiple units running stopping services for commuters. The other lines see a variety of traffic including ICE 3, Electric Class 101's, Diesel Class 218's and much more.

## 1.4 Focus Time Period

This Train Simulator simulation is based around the present day route in 2012.

## 2 Getting Started

### 2.1 Recommended Minimum Hardware Specification

The Munich to Augsburg 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 AFB Train Power Control

AFB stands for Automatische Fahr- und Bremssteuerung – or loosely translated in to English it means "Automatic Driving and Braking Control"

AFB allows the driver of the locomotive to set the target speed and then the computer in the locomotive will apply the throttle to obtain that speed and then keep applying throttle or brake in order to maintain it. You can almost think of it as a kind of Cruise Control for trains.

The way to use AFB is the same for all AFB equipped locomotives; there are essentially three controls that you will use.



*Figure 1: BR101 Control Desk*

- A – AFB Control Lever
- B – Throttle Control Lever
- C – Train Brake

To operate AFB, simply follow these steps:

1. Set the AFB control to the desired speed. Note on the speedometer a small red triangle “bug” will slide around to the configured speed.
2. Release the brakes and once completely released you should then set the Train Brake to Hold – this is the first notch after release and usually shows up in the Simulator as around 22%. When set to the Hold notch the AFB computer can apply brakes as it needs in order to reduce the speed. If the Train Brake is left in Release it will not be able to apply brakes.
3. Move the throttle control to the desired level of acceleration, at this point the train will begin moving and accelerate to the configured speed.



The image shown to the left indicates that the AFB speed target is set to 50km/h, represented both in digits at the bottom of the speedometer and the presence of the red triangle “bug” on the dial that is currently set at 50km/h.

All speed changes should be managed with the AFB control, simply change the target speed as required and the AFB Computer will apply throttle and brakes appropriately.

If you wish to come out of AFB control and return to manual control, simply set the target speed to 0km/h and then the throttle and brake controllers will return to normal manual functionality.

### 3.1 Key Controls

Function	Keyboard
Increase	Y
Decrease	C

## 4 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.

## 5 PZB Signalling System

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

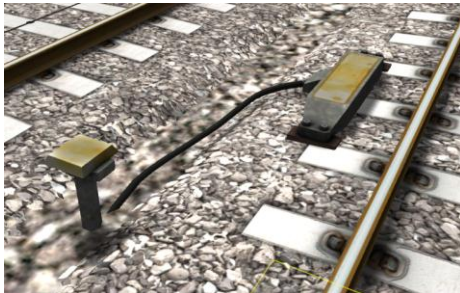
Safe distances between trains are managed conventionally through the use of block-based systems.

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.

### 5.1 PZB Track Interface

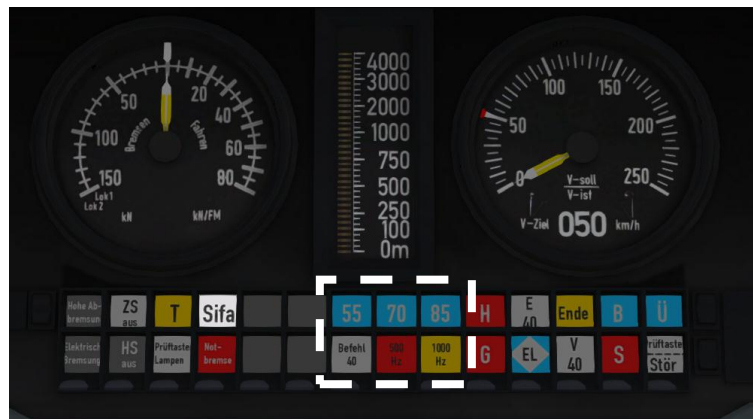


The PZB system incorporates in-cab signalling, this is where the control desk has indicators, alarms and buttons that will react according to the signalling status on the railway. The mechanism by which this works is a series of “balise” magnets placed on the side of the track. An example of one of these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



## 5.2 In-Cab Indicators

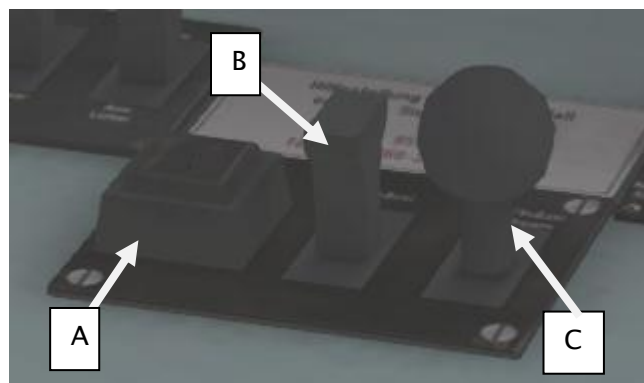
Inside the cab there are lights pertaining to the state of the PZB system as shown in the diagram below:



The white-dashed section shows the lamps related to PZB

## 5.3 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

## 5.4 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 Augsburg 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

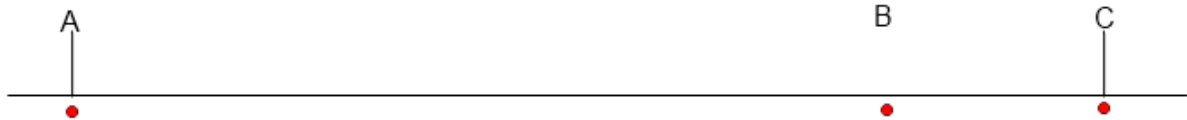
Type U – Lights up the 55 lamp

## 5.5 Key Controls

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

## 5.6 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.

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.



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

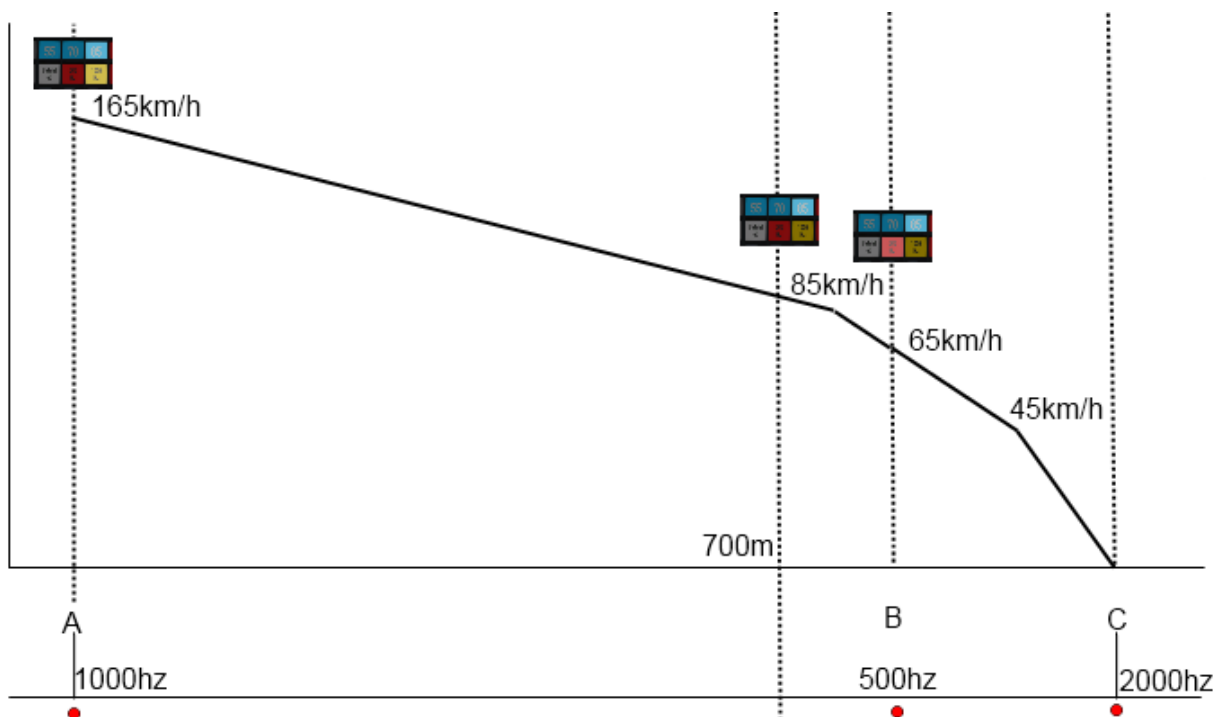
There is an additional state called Restricted Monitoring may engage while you are travelling under the control of either the 1000hz or 500hz magnets. If you travel below 10km/h for more than 15 seconds or you stop completely at any point, the PZB display will start alternating between two of the speed 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.

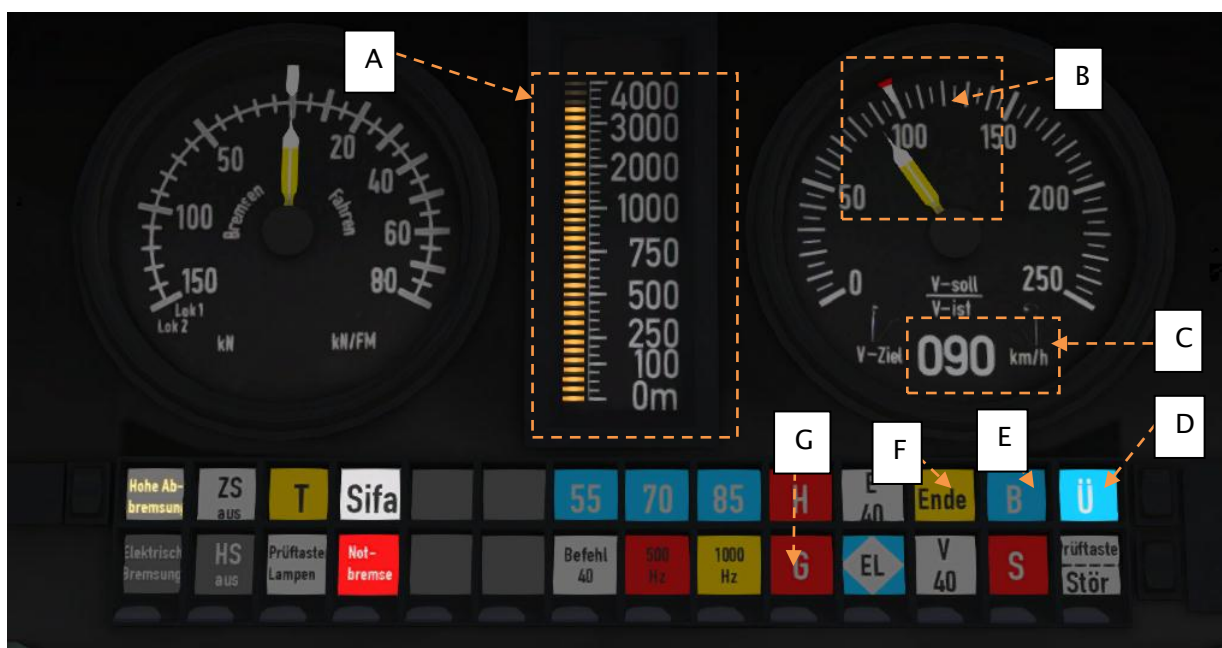


## 6 LZB Signalling System

The restriction of conventional block signalling is the amount of time taken by trains to ensure they can stop from their first notification of a signal at danger. This affects the maximum speed that trains can operate and is in relation to the length of the block. Unfortunately while lengthening blocks can allow trains to run faster it means that fewer trains can run as the gaps between them get progressively longer.

The modern solution to this problem is to change from fixed block signalling to a dynamic sliding block that protects a range in front of the locomotive that is changing as the locomotive moves.

LZB is controlled by a central control station; each one monitors approximately 100 kilometres of line and informs the on-board LZB computer what speed limit is dynamically being imposed on. The following image shows the displays related to LZB functionality on a BR101 locomotive cab dashboard. Note that the displays are standard across all LZB capable locomotives.



In the above example, LZB has been enabled and we can see the following:

- A – Distance to next speed change
- B – Target speed taking in to account LZB speed restrictions
- C – Target speed in digit form
- D – Indicator that LZB mode is enabled
- E – Automatic Brake Intervention enabled if lit
- F – LZB mode terminating if illuminated
- G – Overspeed Indicator





LZB is automatically enabled as you pass one of these LZB posts as shown in the picture on the left.

If PZB is being used then it is automatically disabled and LZB gets switched on automatically.

If your AFB control is set to 0 (disabled) then the LZB system is simply there to instruct you what to do. If AFB is being used then the target speed will be the lowest of your AFB setting and the current LZB speed restriction.

LZB mode will be automatically disabled when the train passes over an LZB termination balise such as the one shown in the picture on the right. If PZB was enabled then it will be switched back on as the LZB system is switched off.

You get an in-cab warning that LZB mode is terminating approximately 1.7km before it actually ends with the “Ende” light illuminating.



## 7 The ICE3M



### 7.1 ICE 3M (Class 406)

The Class 406 ICE 3M is the first in the German high-speed InterCityExpress family of Siemens Valero trains to be used on international revenue services. Operating in and between Germany, France, Belgium and the Netherlands trains reach speeds of up to 330 km/h (205 mph). Train sets consist of two driver cars and 6 intermediate cars, comprising of 1<sup>st</sup> class transformer and converter coaches, a restaurant/bistro and 2<sup>nd</sup> class coaches.

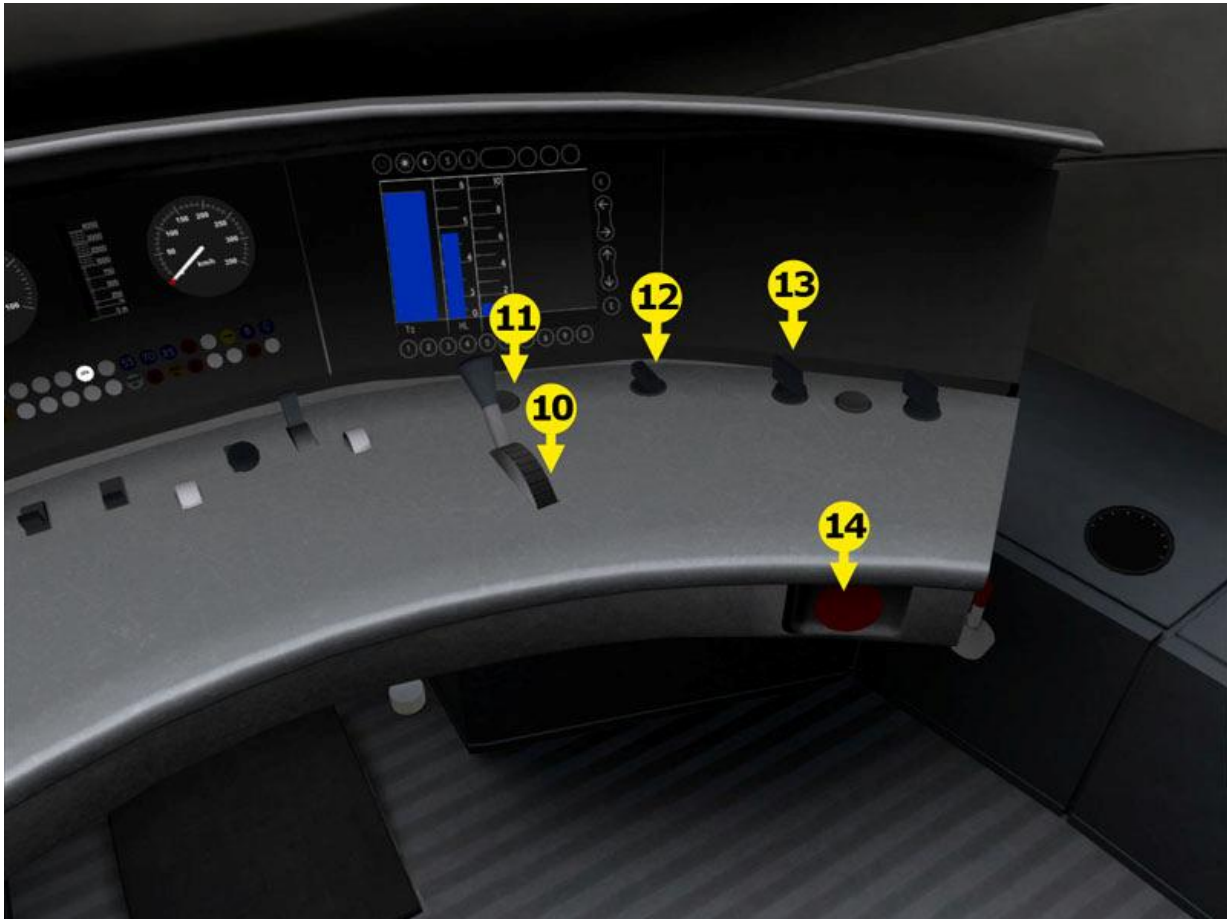
### 7.2 Specifications

Class Number	Class 406
Formation	8-car (2 Driver cars + 6 Carriages)
Wheel Arrangement	Bo'Bo'
Weight Trainset:	435t
Height	12.6ft (3.84m)
Length Driver Cars:	85.76ft (26.14m)
1 <sup>st</sup> Class / 2 <sup>nd</sup> Class / Service :	81.23ft (24.76m)
Trainset:	658.92ft (200.84m) (8 car)
Width	9.68ft (2.95m)
Wheelbase	68.24ft (20.8m)
Power at Rails	AC: 8,000 kW (10,728 hp) , DC: 4,300 kW (5,766 hp)
Tractive Effort	300 kN (67,000 lb)
Design Speed	AC: 330 km/h (205 mph) , DC: 220km/h (136.7 mph)
Maximum Braking Force	4,799 kN (6,436 hp)
Braking Systems	Eddy-current, regenerative braking, disc brakes
Traction Motor Type	Asynchronous 3-phase AC motors
Number of Traction Motors	x16 @ 500kW per motor
Voltages	15 kV 16.7 Hz, 25 KV 50 Hz AC Overhead, 1500V and

### 7.3 Cab Controls



1. Throttle
2. AFB control
3. Reverser
4. Pantograph
5. PZB controls
6. Horn
7. Desk Light
8. Sander
9. Cab Light



- 10. Train Brake
- 11. SIFA Reset
- 12. Wipers
- 13. Lights
- 14. Emergency Brake

## 7.4 Keyboard Guide

Increase / Decrease Throttle	A / D
Increase / Decrease Reverser	W / S
Increase / Decrease Train Brake	' / ;
Increase / Decrease Locomotive Brake	[ / ]
Increase / Decrease Dynamic Brake	. / ,
Increase / Decrease AFB	Y / C
Horn	Space
Open Passenger Doors	T
Request Permission to Pass Signal Ahead	Tab
Request Permission to Pass Signal Behind	Ctrl–Tab
Headlights On / Headlights Off	H / Shift + H
Raise / Lower Pantograph	P
Emergency Brake	Backspace
Wipers Toggle	V
Change state of Junction Ahead / Behind	G / Shift + G
Couple Manually	Ctrl + Shift + C
SIFA Toggle	Shift + Numpad Enter
SIFA Acknowledge	Numpad Enter
LZB Toggle (only needed for Non–LZB routes)	Shift Ctrl Numpad+
PZB Toggle	Ctrl + Numpad Enter
PZB Wachsam / Acknowledge	Page Down
PZB Frei / Release	End
PZB Befehl40 / Override	Del

## 8 The DBAG Class 101



First built in 1996, the 101 is Deutsche Bahn's star locomotive. It is used across most of Germany for express passenger travel. Able to achieve speeds of up to 220 km/h, the 101 is also among the fastest locomotives on the German Network.

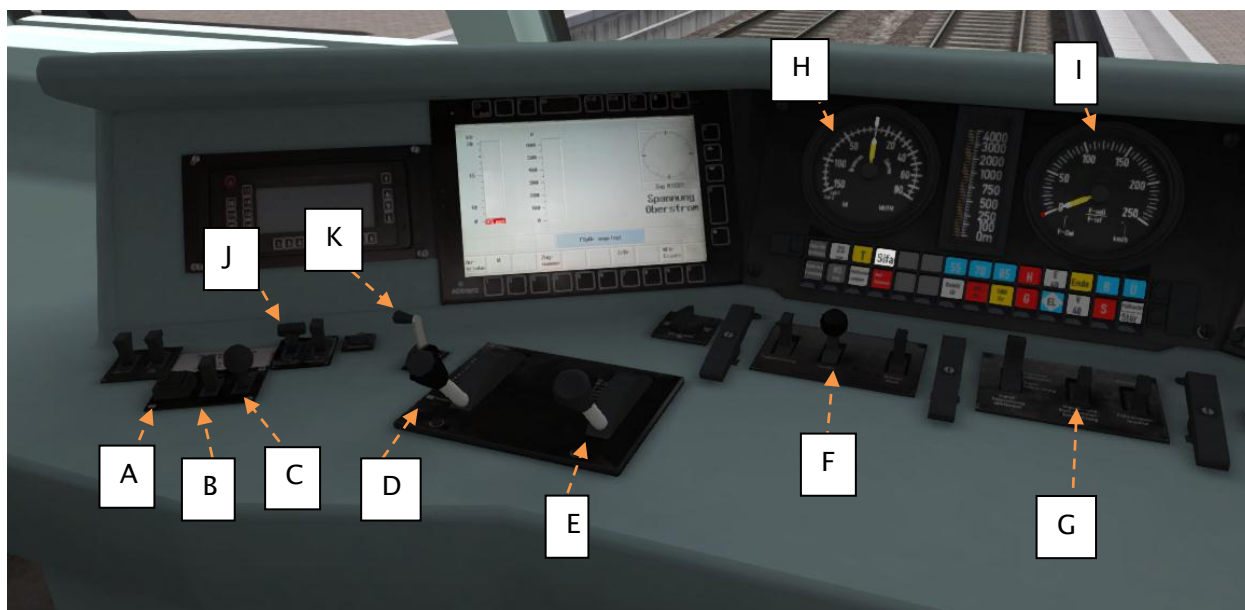
The first 101 was delivered in 1996 and quickly earned a reputation for speed and reliability. The modern body design and many advanced electronic systems make the BR101 a very efficient and economical train. Soon after its introduction, duties were quickly moved to Intercity routes and many InterRegio trains were pulled by this locomotive.

Despite production ending in 1999, the 101 is still at the forefront of reliable and efficient high-speed operations today. This all-purpose locomotive works fast passenger and freight trains alike and it has met the expectations of Deutsche Bahn throughout its service.

### Technical Data

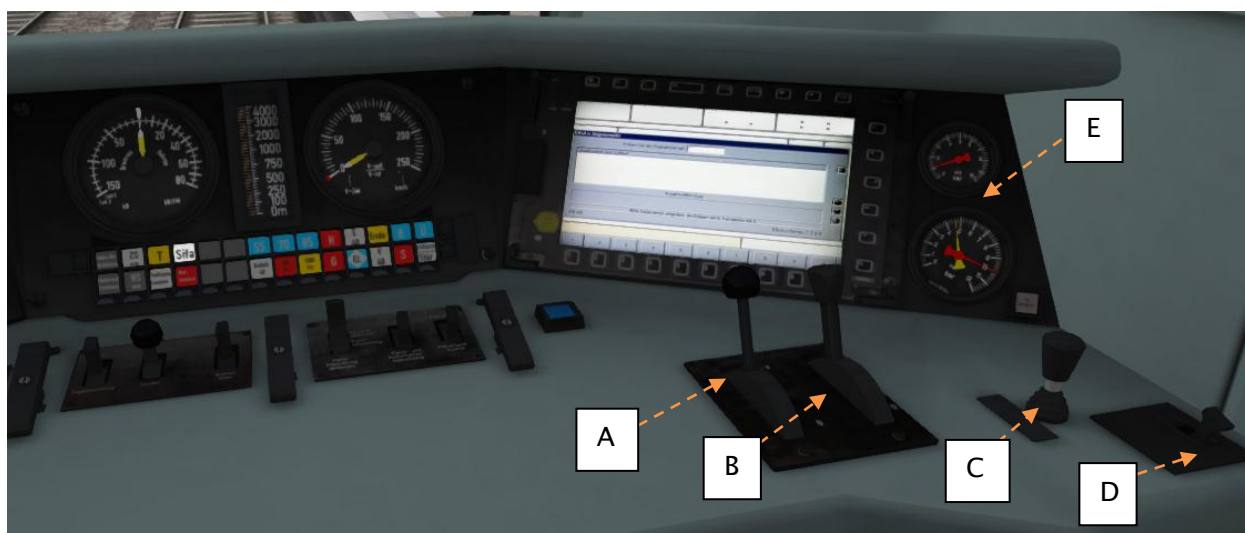
<b>Total Built</b>	145
<b>Weight</b>	87t
<b>Length</b>	62'6" (19.1m)
<b>Engine Power</b>	8,500Hp (6,400kW)
<b>Max Speed</b>	135 mph (220km/h)
<b>Fuel Capacity</b>	N/A

## 8.1 Cab Controls



- A – PZB Befehl40 (Override)
- B – PZB Frei (Release)
- C – PZB Wachsam (Acknowledge)
- D – AFB Control Lever
- E – Throttle Lever
- F – Sander

- G – Headlights
- H – Traction Effort Meter
- I – Speedometer
- J – Pantograph Up/Down
- K – Reverser



- A – Train Brake
- B – Dynamic Brake

- C – Locomotive Brake
- D – Horn
- E – Brake Pressure Dials

## 8.2 Keyboard Guide

Increase / Decrease Throttle	A / D
Increase / Decrease Reverser	W / S
Increase / Decrease Train Brake	' / ;
Increase / Decrease Locomotive Brake	[ / ]
Increase / Decrease Dynamic Brake	. / ,
Increase / Decrease AFB	Y / C
Horn	Space
Open Passenger Doors	T
Request Permission to Pass Signal Ahead	Tab
Request Permission to Pass Signal Behind	Ctrl-Tab
Headlights On / Headlights Off	H / Shift + H
Raise / Lower Pantograph	P
Emergency Brake	Backspace
Wipers Toggle	V
Change state of Junction Ahead / Behind	G / Shift + G
Couple Manually	Ctrl + Shift + C
SIFA Toggle	Shift + Numpad Enter
SIFA Acknowledge	Numpad Enter
LZB Toggle (only needed for Non-LZB routes)	Shift Ctrl Numpad+
PZB Toggle	Ctrl + Numpad Enter
PZB Wachsam / Acknowledge	Page Down
PZB Frei / Release	End
PZB Befehl40 / Override	Del



## The DBAG Class 294

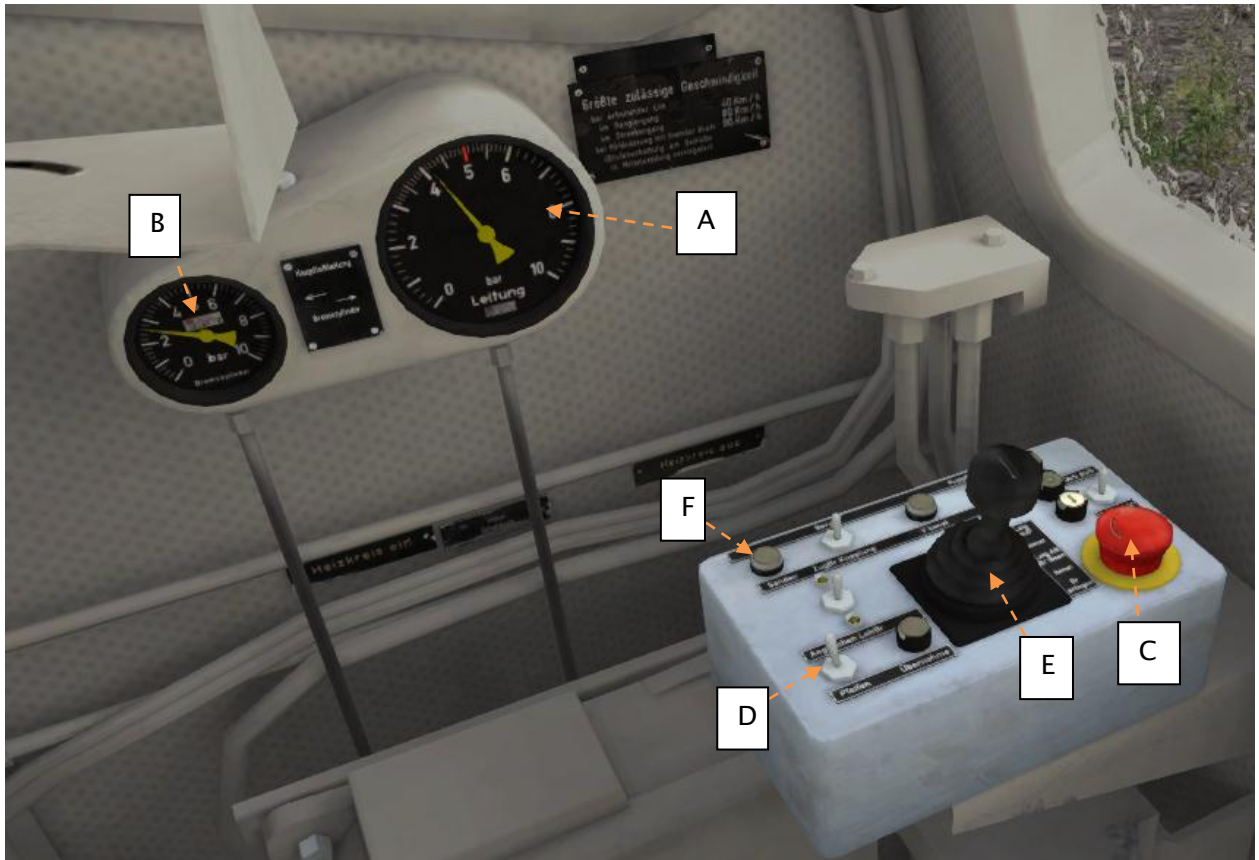


Built between 1966 and 1971, the V90 locomotive is a standard diesel Freight Shunter for Deutsche Bahn. The limited railway traction design provides a locomotive of extreme versatility and reliability. Still going strong today, the newly named Class 294 locomotives can be found all over the network.

### Technical Data

<b>Total Built</b>	511
<b>Weight</b>	78t
<b>Length</b>	45'10" (14m)
<b>Engine Power</b>	1,350Hp (1,007kW)
<b>Max Speed</b>	50 mph (80 km/h)
<b>Fuel Capacity</b>	500gal (2,273L)

### 8.3 Cab Controls



- A – Brake Cylinder Pressure
- B – Main Brake Air Line
- C – Emergency Brake
- D – Horn
- E – Combined Train Brake and Throttle
- F – Sander



- A – PZB Befehl40 (Override)
- B – PZB Frei (Free)
- C – PZB Wachsam (Acknowledge)
- D – Headlights



A - PZB Lamps  
B - Speedometer

## 8.4 Keyboard Guide

Increase / Decrease Throttle	A / D
Increase / Decrease Reverser	W / S
Increase / Decrease Train Brake	' / ;
Increase / Decrease Locomotive Brake	[ / ]
Increase / Decrease Dynamic Brake	. / ,
Horn	Space
Open Passenger Doors	T
Request Permission to Pass Signal Ahead	Tab
Request Permission to Pass Signal Behind	Ctrl–Tab
Headlights On / Headlights Off	H / Shift + H
Emergency Brake	Backspace
Wipers Toggle	V
Change state of Junction Ahead / Behind	G / Shift + G
Couple Manually	Ctrl + Shift + C
PZB Toggle	Ctrl + Numpad Enter
PZB Wachsam / Acknowledge	Page Down
PZB Frei / Release	End
PZB Befehl40 / Override	Del

## 9 Scenarios

### 9.1 Wash and Go

**Time of Day:** 12:00

**Weather:** Clear, Summer

**Loco:** ICE 3M

**Description:** Starting from Laim sidings make your way to the ICE Trainwash and then head in to Munich Station. From there it's fast run west to Augsburg.

### 9.2 Storming in to Munich

**Time of Day:** 20:30

**Weather:** Stormy Rain, Autumn

**Loco:** ICE 3M

**Description:** Take your ICE 3M express train from Augsburg to Munich in some very unpleasant weather.

### 9.3 Westbound Snowy Stopper

**Time of Day:** 07:30

**Weather:** Snow, Winter

**Loco:** BR101

**Description:** A morning timetabled stopping service from Munich to Augsburg. You will be expected to keep to your timetable to complete this scenario successfully!

### 9.4 Pub Crawl to Munich

**Time of Day:** 00:30

**Weather:** Clear, Summer

**Loco:** BR101

**Description:** Having enjoyed too much of the local brews, passengers want to get home to Munich. Hopefully the rowdy crowd won't cause too many problems along the way but stay alert and do your best to get everyone home safely.

### 9.5 Freight Run to Pasing

**Time of Day:** 14:30

**Weather:** Foggy Rain, Summer

**Loco:** BR294

**Description:** Take a heavy freight train from Augsburg yard to Pasing yard. This will require a run-around in Laim Sidings. It's a busy day on the line so expect plenty of traffic and occasionally the odd red light that might hold you up. The rain doesn't help either so be gentle with the controls.

## 9.6 Heightened Security

**Time of Day:** 08:45

**Weather:** Cloudy, Summer

**Loco:** BR101

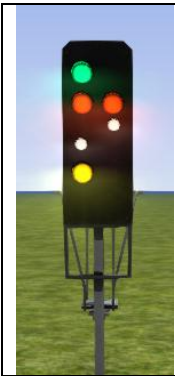

**Description:** An anonymous phone call has been received indicating that there is at least one incendiary device that has been planted on one of the normal S-Bahn trains that run this service. As a result, all normal trains have been taken out of service while they are inspected and a special service is being put on using Class 101's in a top-and-tail configuration. It's going to be a hard day today but we will not let them win – do your best to provide a great service to customers running all stops from Mammendorf to Munich Tief.

## 10 Signalling

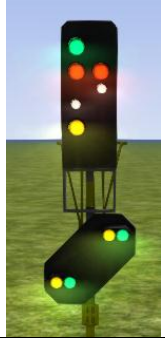
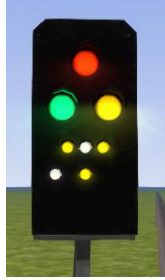
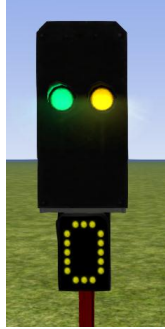

The signalling system employed on German Railways is extremely complex to understand at first; however in reality each signal you encounter will be composed of one or more straight forward signal types to give the final post.

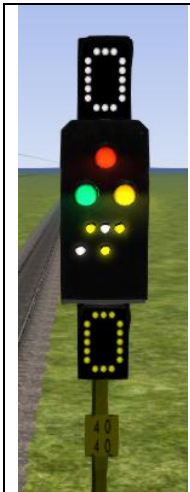
This manual doesn't attempt to cover all the possible signal types and variations, but it should provide sufficient background as to let you work out what each signal post you come across is telling you by explaining the component parts. Note that any signal of a given type that you see should be interpreted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

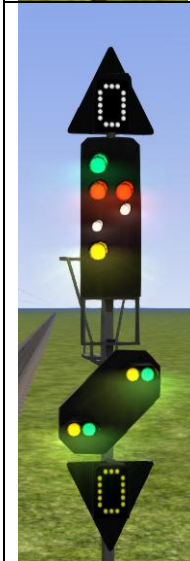


	<p><b>Combined Signal Type: Hp Vr</b></p> <p>This is an example of a combined signal, in this case the example shown is an “Hp Vr” combination. The functions of the individual signal heads are identical to those explained above but they are placed on the same post.</p>
	<p><b>Signal Type: Ks</b></p> <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.</p> <p>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.</p> <p>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>



**Combined Signal Type: Ks Zs3 Zs3v**

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.



**Combined Signal Type: Hp Vr Zs3 Zs3v**


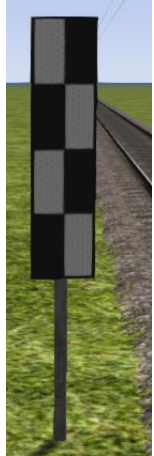


An example of how the signalling can begin to look very complex, however this is simply four signal types combined on to one post. Here you can see:





- permission to enter the next block on the Hp signal,
- indication of the signal state for the next signal on the Vr signal
- speed restriction starting from this signal via the Zs3 at the top
- speed restriction in place from the next signal via the Zs3v at the bottom




**Combined Signal Type: Vr Zs3v**

This signal combination naturally combines the distant Vr signal with the distant speed indication in the Zs3v signal.

	<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 be 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>
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