Electric Locomotives

Reference List

SIEMENS

efficient rail solutions

Contents

Introduction

From the world's first electric locomotive ...

...to the present peak of technological development, Siemens Transportation Systems has placed many successful locomotives on the track. In 1879, Werner von Siemens presented the world's first electric locomotive at the Berlin Industrial Exhibition.

Since then, millions of rail passengers have traveled with us in comfort – maybe unaware of it – but always with the confidence that they would reach their destinations safely. Siemens technology has always been a guarantee for utmost reliability and punctuality.

It's no surprise, therefore, that the EuroSprinter® test unit for the new locomotive generation bears the name "Werner von Siemens".

In the freight sector as well, the name Siemens has always enjoyed a solid reputation. Highly specialized engineering, made-to-measure performance, and the right traction power for your specific transport needs.

A point of emphasis in the past years has been the continuous development of the EuroSprinter family. We have built over 3,000 locomotives in the past 20 years – either alone or in cooperation with our partners. You will find an overview of our achievements on the following pages.

103

Electric Locomotive 103
for German Rail (DB AG)

The class 103.1 locomotive is a development of the 103.0 high-speed locomotive introduced for the first time at the International Transport Exhibition in Munich in 1965.

The reason for German Rail's ordering this vehicle was the planned introduction in 1971 of the "InterCity" network – a system of trains traveling regularly every two hours at a maximum speed of 200 kph.

Scope of application
The class was primarily used for InterCity and TEE operations. It provided highest-quality passenger train traction until the introduction of the ICE at DB AG. Following the introduction of the one-hour service intervals and the second car class in IC operations, its enormous power with respect to the longer and heavier trains was fully leveraged. Under this load and with monthly mileages of more than 40,000 km, it provided impressive evidence of the quality of Siemens electronics.

Technical features
The class 103 is a six-axle high-speed locomotive (200 kph) with a self-supporting underframe and top-mounted hoods. It features fully suspended series traction motors with rubber-ring cardan drive and rheostatic brake with a short-time power of 9600 kW. The locomotive is especially designed for high-speed passenger operations.

Benefits
Until their replacement by the ICE, these locomotives were the fastest and most powerful traction units with the highest mileage. They mark a highlight in classical series-wound motor technology.

Type		**103**
Year		1970–1974
Wheel arrangement		Co'Co'
Power system		15 kV/16.7 Hz
Continuous rating at wheel	[kW]	7080
Starting tractive effort	[kN]	312
Maximum speed	[kph]	200
Weight	[t]	117
Track gauge	[mm]	1435
Numbers built		145

111

Electric Locomotive 111
for German Rail (DB AG)

In October 1973, Siemens AG and what today is its locomotive plant in Munich-Allach were awarded the contract to develop the new four-axle class 111 locomotives.

Scope of application
This class is designed for hauling passenger trains in urban and mainline networks, as well as for high-speed freight trains in the German Rail network at speeds up to 160 kph. Some of the locomotives were specially refitted in 1979 with push-pull control for the integrated rapid transit network in the Rhine-Ruhr region.
Since the introduction of double-deck regional passenger trains at DB AG, they have a large share in high-level regional transportation.

Technical features
This locomotive type marks the transition from DB AG's standard locomotives of the 1950s to the advanced locomotive constructions of modern design. Compared with its predecessors, the class 111 provided for the first time:
- an ergonomically optimized DB AG standard driver's console
- direct air intake of the traction motor fans
- advanced bogies with extensive lateral decoupling of carbody and wheelset.

The locomotives of this class are the last units with conventional technology (AC commutator traction motor) that were purchased by DB AG at that time.

Type	**111**
Year	1974–1984
Wheel arrangement	Bo'Bo'
Power system	15 kV/16.7 Hz
Continuous rating at wheel [kW]	3620
Starting tractive effort [kN]	274
Maximum speed [kph]	160
Weight [t]	84
Track gauge [mm]	1435
Numbers built	227

Benefits
The locomotives feature multiple-running control and are therefore suitable for double-heading and push-pull operation.

120.1

Electric Locomotive 120.1
for German Rail (DB AG)

In November 1984, German Rail ordered the first 60 class 120.1 universal locomotives from the German rail industry, a development of the 120.0 prototype unit.

Scope of application
The locomotives are used as universal units to provide traction for high-speed passenger trains at speeds up to 200 kph as well as traction for heavy-duty freight trains.

Technical features
The 120.1 is the first high-performance production locomotive with three-phase traction technology and asynchronous traction motors for DB AG. The three-phase drive technology, the advanced lightweight construction and the bogies that are an advanced version of those used in the class 111 permit the universal use of locomotives with a continuous rating of 5600 kW.

Benefits
Due to the different uses to which they can be put, the class 120.1 locomotives achieve a work load factor which still remains unequaled.

Due to their three-phase asynchronous motors, the locomotives are largely independent of the operational limitations associated with classic commutator motors.

The lower mass in comparison to commutator traction motors has a beneficial effect on the running performance of the bogies, which is a key aspect for a universal locomotive with a maximum speed of 200 kph.

Type	**120.1**
Year	1987–1988
Wheel arrangement	Bo'Bo'
Power system	15 kV/16.7 Hz
Continuous rating at wheel [kW]	5600
Starting tractive effort [kN]	290
Maximum speed [kph]	200
Weight [t]	84
Track gauge [mm]	1435
Numbers built	60

ES 64 P

High-Performance Universal Locomotive
EuroSprinter ES 64 P (Class 127)

Using the experience gained with the class 120.1 locomotive of German Rail, the S 252 of Spanish National Railways (RENFE) and the LE 5600 of Portuguese Railways (CP), Siemens AG and former Krauss-Maffei built a prototype locomotive – the EuroSprinter – in 1992 at their own expense in order to test new components and environment-friendly materials.

Scope of application
The locomotive was designed as a universal vehicle for heavy-duty freight as well as for fast passenger trains. A first-generation EuroSprinter by design, the prototype provides a platform for the testing of key second-generation components.

Technical features
In the test vehicle, for example, a water-cooled power converter and silicone liquid as coolant for the transformer were used for the very first time. The new SIBAS® 32 microprocessor control unit was also subjected to extensive tests in the EuroSprinter, and auxiliary inverters with IGBTs were used. The use of innovative high-speed bogies with disc brakes on a fully-suspended braking shaft has prepared the ground for the second generation of the EuroSprinter, e.g. the Rh 1016/1116 of ÖBB.

Benefits
The EuroSprinter, which German Rail designates as class 127, was able to give a convincing demonstration of its performance capability under extreme conditions during demonstrations in Norway, Sweden, and Switzerland. On August 6, 1993, the EuroSprinter set a world speed record of 310 kph for three-phase locomotives.

Thanks to its modular structure, it can be used as a basis for production vehicles built to match different service requirements and conditions of the European railways.

At present, the unit is in service in the locomotive pool of Siemens Dispolok GmbH and is rented to railway operators with a full service and maintenance package.

Type		ES 64 P
Year		1992
Wheel arrangement		Bo'Bo'
Power system		15 kV/16.7 Hz
Continuous rating at wheel	[kW]	6400
Starting tractive effort	[kN]	300
Maximum speed	[kph]	230
Weight	[t]	86
Track gauge	[mm]	1435
Numbers built		1

152

Electric Locomotive 152
for German Rail (DB AG)

In 1995, German Rail (DB AG) awarded a supply contract for 170 freight locomotives to Siemens Transportation Systems.

The units were delivered to DB AG over a period between 1997 and 2001. They are based on the EuroSprinter family and are thus the first models of the second generation.

Scope of application
The class 152 is primarily used in heavy-duty freight operations and replaces the six-axle class 150 locomotives.

Technical features
It provides a power of 6400 kW in a 15 kV/16.7 Hz system with individual axle control. As a development compared to the first-generation EuroSprinter locomotives, it has bogies with disc brakes as a standard feature.

Benefits
When awarding the contract, DB AG placed great value on the guarantee of high reliability and availability with low life-cycle costs.

Owing to its modular construction, the class 152 can be converted into a universal and multi-system locomotive with minimum modification effort.

Type	**152**
Year	1997–2001
Wheel arrangement	Bo'Bo'
Power system	15 kV/16.7 Hz
Continuous rating at wheel [kW]	6400
Starting tractive effort [kN]	300
Maximum speed [kph]	140
Weight [t]	88
Track gauge [mm]	1435
Numbers built	195

182

Electric Locomotive 182
for German Rail (DB AG)

The class 182 high-performance locomotives are members of the second generation EuroSprinter family, the development of which started with the class 152 freight locomotive for German Rail.

Scope of application
These multi-system units are able to run not only on 15 kV/16.7 Hz but also on 25 kV/50 Hz electrified lines.

Technical features
The electrical section of the vehicle comprises proven Siemens components, such as the SIBAS 32 control unit, water-cooled GTO traction converters and air-cooled auxiliary inverters. The high-performance traction drive with separate brake disc shaft provides minimized unsprung masses, optimized running dynamics and low maintenance requirements.

Benefits
The multi-system locomotives are among the most powerful and fastest four-axle production locomotives. Performance, speed range, running and braking technology incorporate today's top technology.

Special attention was paid to the aerodynamic exterior design of the locomotive as well as to the ergonomic design of the driver's cab.

For heavy freight trains and fast passenger trains alike, the class 182 is a universal solution to meet highest demands in today's high-performance traction applications.

Type	**182**
Year	2001
Wheel arrangement	Bo'Bo'
Power system	15 kV/16.7 Hz, 25 kV/50 Hz
Continuous rating at wheel [kW]	6400
Starting tractive effort [kN]	300
Maximum speed [kph]	230
Weight [t]	86
Track gauge [mm]	1435
Numbers built	25

189

Electric Locomotive 189
for German Rail (DB AG)

In 1999, German Rail (DB AG) ordered 100 class 189 four-system locomotives for freight operations. These were developed directly from the class 152.

Scope of application
The locomotives are designed for use in pan-European freight operations. They are not only able to operate in AC systems with 15 kV/16.7 Hz and 25 kV/50 Hz but also in DC systems with 1.5 kV and 3 kV.

Technical features
The class 189 provides individual axle control and achieves a maximum speed of 140 kph. In AC operation, they have a rated power of 6400 kW, with ratings of 6000 kW for a 3 kV system and 4200 kW for a 1.5 kV system. In AC systems, the DC link voltage is generated by four-quadrant choppers. In DC systems, the overhead line voltage is fed directly to the DC link. The use of water-cooled IGBT traction inverters marks the transition to the third generation of the EuroSprinter family. The controls of the class 189 locomotive are designed in conformance with the other vehicles German Rail plans to use for its cross border services. In compliance with the scope of application of a freight locomotive, the bogies are equipped with nose-suspended drives and disc brakes.

Benefits
This locomotive type will be provided with all the equipment required for operation in the other European countries. The locomotives will be prepared for certification in Germany, Austria, Hungary, Switzerland, Denmark, Sweden, Norway, Italy, France, the Netherlands, Luxembourg, Belgium, Poland, the Czech Republic, and the Slovak Republic.

Type	**189**
Year	2003–2005
Wheel arrangement	Bo'Bo'
Power system	15 kV AC/16.7 Hz, 25 kV AC/50 Hz, 3 kV DC, 1.5 kV DC
Continuous rating at wheel [kW]	AC 6400, DC 3 kV 6000, DC 1.5 kV 4200
Starting tractive effort [kN]	300
Maximum speed [kph]	140
Weight [t]	86
Track gauge [mm]	1435
Numbers built	100

EA 3000

Electric Locomotive EA 3000
for Danish State Railways (DSB)

After having completed electrification of the first routes in March 1986, Danish State Railways (DSB) started operations with 10 class EA 3000 locomotives. The EA 3000 locomotives were developed and built by a consortium with BBC. Based on the positive experience gained with the first range of vehicles, DSB took up an option for 12 more vehicles with slight improvements over the first model.

Scope of application
The EA 3000 are equally suited for freight and intercity service, as well as for regional traffic.

Technical features
Locomotive for 25 kV AC/50 Hz operation based on the class 120 of German Rail.

Benefits
Due to push-pull technology and double-heading control, this class of locomotives lends itself to especially universal and versatile operations, also for regional trains with control car.

Type	EA 3000	EA 3000
Year	1986	1992–1993
Wheel arrangement	Bo'Bo'	Bo'Bo'
Power system	25 kV/50 Hz	25 kV/50 Hz
Continuous rating at wheel [kW]	4000	4000
Starting tractive effort [kN]	260	260 (300*)
Maximum speed [kph]	160 (175)	160 (175)
Weight [t]	80	80
Track gauge [mm]	1435	1435
Numbers built	10	12

* Maximum value for starting in tunnels

EG 3100

High-Performance Locomotive EG 3100
for Danish State Railways (DSB)

In 1997, Danish State Railways placed an order with Siemens Transportation Systems for 13 high-performance locomotives for cross-border operations.

Scope of application
The six-axle locomotives are used on the land link that was completed in 2000 and connects Sweden to Germany via Denmark. A six-axle vehicle with increased friction mass is required to pull 2,000-ton trains with only one locomotive across the transition ramps between tunnel sections and sea bridges.

Technical features
The EG 3100 is designed to operate in 25 kV/50 Hz as well as 15 kV/16.7 Hz systems and for the train protection systems used in Sweden, Germany, and Denmark and is a member of the second-generation EuroSprinter family. The electrical part of this locomotive features extensively service-proven components such as the SIBAS 32 traction control system, water-cooled traction converters, air-cooled inverters for auxiliary equipment, and nose-suspended drives with wheel-mounted brake disks.

Due to the modular construction of the EuroSprinter family, it was possible to built a six-axle locomotive on the basis of the class 152 with minor modifications.

Benefits
The redundant and proven design of the drive concept guarantees a high degree of reliability and low maintenance requirements.

The adhesion mass of 129 tons provides sufficient traction for 2,000-ton trains on ramps with a 15.6 ‰ grade in all weather conditions.

The certification in Germany, Denmark, and Sweden is the basis for fast pan-European freight operations between Central Europe and Scandinavia.

Type	**EG 3100**
Year	1998–2000
Wheel arrangement	Co'Co'
Power system	15 kV/16.7 Hz, 25 kV/50 Hz
Continuous rating at wheel [kW]	6500
Starting tractive effort [kN]	400
Maximum speed [kph]	140
Weight [t]	129
Track gauge [mm]	1435
Numbers built	13

H 560

Electric Locomotive H 560
for Greek State Railways (OSE)

In early 1996, Greek State Railways (OSE) placed an order with Siemens as the general contractor to build 6 high-performance locomotives. These are the first electric locomotives in Greece.

In late 1997, a follow-up order was signed for another 24 locomotives. These units will be built in cooperation with Hellenic Shipyards in Athens under the leadership of Siemens Transportation Systems.

Scope of application
The multi-system locomotives are used to establish a link with the European railway network on the route from Thessaloniki to the border with former Yugoslavia. They are suitable for both passenger and freight operations.

Technical features
The locomotives are based on the first generation of the EuroSprinter family already seeing service in Germany, Spain, and Portugal.

Benefits
The use of standardized and sophisticated modules allowed a short delivery time of only 17 months, from receipt of the order to completion. The design-to-weight policy and a strict weight management led to a previously unequaled weight of 80 metric tons in this performance class.

Type		H 560
Year		1996–1997, 2000–2002
Wheel arrangement		Bo'Bo'
Power system		25 kV/50 Hz
Continuous rating at wheel	[kW]	5000
Starting tractive effort	[kN]	300
Maximum speed	[kph]	200
Weight	[t]	80
Track gauge	[mm]	1435
Numbers built		6+24

E 402 B

Electric Locomotive E 402 B
for Italian State Railways (FS)

In the course of modernizing its long-distance passenger service, Italian State Railways (FS) placed an order with Ansaldo Trasporti to develop type E 402 units. In addition to the vehicles of the first E 402 A generation, the E 402 B series was developed. Siemens Transportation Systems supplied the electrical components.

Scope of application
The E 402 B are universal locomotives which are also used in the 25 kV high-speed network of FS.

Technical features
For the first time, converters with high-purity water cooling, SIBAS 32 microprocessor control, and a highly integrated transformer were used in Italy. In addition to this, the E 402 B is Italy's first multi-system locomotive.

Benefits
The class E 402 B contributes greatly to increasing the efficiency and environmental compatibility thanks to the use of advanced Siemens components. Due to its multi-system capability, it will pave the way for high-speed operation on 25 kV and, at the same time, keep open the possibility of using such vehicles on existing routes.

Type		E 402 B
Year		1996–1998
Wheel arrangement		Bo'Bo'
Power system		25 kV AC/50 Hz, 3 kV DC, 1.5 kV DC
Continuous rating at wheel	[kW]	5600
Starting tractive effort	[kN]	280
Maximum speed	[kph]	220
Weight	[t]	87
Track gauge	[mm]	1435
Numbers built		30+50

1012

Electric Locomotive 1012
for Austrian Federal Railways (ÖBB)

The class 1012 locomotive was initially designed for use as a high-speed locomotive and a replacement of the class 1044. Today, the three locomotives based in Innsbruck are used to haul trains on the "rolling highway".

Scope of application
The class 1012 locomotive is a universal vehicle for fast passenger and freight services.

Technical features
Whereas the top speed of 230 kph fulfills the requirements of modern rail travel, the power output of 6.4 MW ensures fast running even on grades.

Benefits
Austria's railway network is characterized by a varied mixture of tight curves, long straight stretches, and steep grades.

ÖBB's class 1012 universal locomotive was specifically designed to meet the conditions of operation on these routes.

Type	**1012**
Year	1996
Wheel arrangement	Bo'Bo'
Power system	15 kV/16.7 Hz
Continuous rating at wheel [kW]	6400
Starting tractive effort [kN]	280
Maximum speed [kph]	230
Weight [t]	83
Track gauge [mm]	1435
Numbers built	3

1014/1114

Electric Locomotive 1014/1114

for Austrian Federal Railways (ÖBB)

These locomotives were designed as so-called lightweight units. Optionally, they can be ballasted with six tons. It is planned to replace the locomotives of this type with class 1116 vehicles by 2005 at the latest.

Scope of application

The 1014 dual-frequency locomotive was the first universal unit to permit passenger and freight services between Austria, Hungary, the Czech Republic, and the Slovak Republic without requiring the usual change of locomotives at the border. These locomotives were primarily designed for fast passenger service with lightweight trains.

Technical features

The design of this dual-frequency lightweight vehicle allows the same locomotive to be used with a weight of either 66 or 74 metric tons. The necessary modifications can be made at any time with little effort.

Benefits

Owing to its high speed, the 66-ton version – class 1114 – is ideally suited for fast passenger service. The 74-ton 1014 model is characterized by a higher tractive effort, thus making it suitable for freight traffic as well.

Type	1014	1114
Year	1993–1994	1993–1994
Wheel arrangement	Bo'Bo'	Bo'Bo'
Power system	15 kV/16.7 Hz, 25 kV/50 Hz	15 kV/16.7 Hz, 25 kV/50 Hz
Continuous rating at wheel [kW]	3000	3000
Starting tractive effort [kN]	210	190
Maximum speed [kph]	160	160
Weight [t]	74	66
Track gauge [mm]	1435	1435
Numbers built	16	2

1016/1116

Electric Locomotives Rh 1016, Rh 1116

for Austrian Federal Railways (ÖBB)

In 1997, Austrian Federal Railways ordered four-axle class 1016 and 1116 high-performance locomotives, representing the second EuroSprinter generation, from Siemens AG Austria.

Scope of application

The class 1016 locomotive is designed to operate on 15 kV/16.7 Hz electrified lines in Austria and Germany. The 1116 version is additionally equipped to permit operation on 25 kV/50 Hz lines in countries such as Hungary.

Technical features

The electrical part of the locomotive uses service-proven components from Siemens Transportation Systems, such as the SIBAS 32 traction control system, water-cooled GTO traction converters, and air-cooled auxiliary equipment converters. The high-powered drive with brake disc mounted on a separate shaft is distinguished by minimized unsprung masses, optimum running dynamics, and low maintenance requirement.

Benefits

The locomotives with advanced running and braking technology incorporate the latest technology.

Special attention was devoted to the aerodynamic exterior and the ergonomic design of the driver's cab.

Whether it is hauling heavy-duty freight or fast passenger trains, the Rh 1016/1116 meets the highest expectations for advanced high-performance traction.

Type	1016	1116
Year	1999	1999
Wheel arrangement	Bo'Bo'	Bo'Bo'
Power system	15 kV/16.7 Hz	15 kV/16.7 Hz, 25 kV/50 Hz
Continuous rating at wheel [kW]	6400	6400
Starting tractive effort [kN]	300	300
Maximum speed [kph]	230	230
Weight [t]	86	86
Track gauge [mm]	1435	1435
Numbers built	50	350

1044

Electric Locomotive 1044

for Austrian Federal Railways (ÖBB)

The class 1044 universal locomotive has been in service with ÖBB since 1974. It is used for both passenger and freight traffic. Up to 1994, a total of 187 locomotives had been delivered.

Scope of application
This locomotive type is used for lightweight and heavy-duty passenger and freight operations, primarily on mountain routes.

Technical features
This class is a thyristor-controlled universal locomotive with continuous traction control.

Benefits
Due to their high traction rating and continuous traction control, these units are ideally suited for operations on steep-grade mountain routes.

Type		1044
Year		1974–1995
Wheel arrangement		Bo'Bo'
Power system		15 kV/16.7 Hz
Continuous rating at wheel	[kW]	5150
Starting tractive effort	[kN]	337/300*
Maximum speed	[kph]	160
Weight	[t]	84
Track gauge	[mm]	1435
Numbers built		216

*from version 1044.201 onwards

1063

Electric Locomotive 1063

for Austrian Federal Railways (ÖBB)

Right up into the 1970s, ÖBB mainly operated diesel humping locomotives as well as older electric mainline locomotives for yard work. In the case of the class 1063, ÖBB ordered for the very first time five prototype locomotives which were specifically designed as electric yard locomotives.

Scope of application
The two-system locomotives are also capable of passing through railway stations on the borders with Hungary, the Czech Republic, and the Slovak Republic.

Technical features
The maximum speed is 100 kph with a continuous power of 2000 kW.

Benefits
The three-phase drive system enables maximum wear-free and cost-effective starting tractive efforts even in the lowest speed range as are required for heavy-duty yard operations.

After successful service of the prototypes, ÖBB ordered 45 more locomotives.

Type	**1063**
Year	1983–1991
Wheel arrangement	Bo'Bo'
Power system	15 kV/16.7 Hz, 25 kV/50 Hz
Continuous rating at wheel [kW]	1600
Starting tractive effort [kN]	260
Maximum speed [kph]	100
Weight [t]	82
Track gauge [mm]	1435
Numbers built	50

1064

Electric Locomotive 1064

for Austrian Federal Railways (ÖBB)

In 1975, ÖBB planned the construction of two large classification yards in Vienna and Villach. For this purpose, it ordered 10 six-axle heavy-duty electric humping locomotives. These have been in use since 1994.

Scope of application
The locomotive is especially suitable for heavy-duty humping.

Technical feature
The electrical equipment of the 1064 unit is, for the most part, the same as that of the class 1063. To meet the increased requirements for tractive effort, the locomotive has six axles with a Co'Co' wheel arrangement.

Benefits
The high starting tractive effort that is required for humping is provided in a wear-free and cost-effective manner by the three-phase drive system. A special feature of the locomotives is their suitability for fully-automatic humping. During this operation, the locomotive is automatically controlled by a process computer and moves at an exact, preset speed.

Type	**1064**
Year	1984–1990
Wheel arrangement	Co'Co'
Power system	15 kV/16.7 Hz
Continuous rating at wheel [kW]	1600
Starting tractive effort [kN]	370
Maximum speed [kph]	80
Weight [t]	112
Track gauge [mm]	1435
Numbers built	10

1163

Electric Locomotive 1163
for Austrian Federal Railways (ÖBB)

In view of the great success of its class 1063 unit, ÖBB decided to build a follow-up locomotive – the class 1163.

Scope of application
Since the summer of 1995, these locomotives have been used for heavy-duty yard work and light-duty line service in Vienna and Salzburg.

Technical features
Based on the 1063 unit, the locomotives incorporate several improvements in their appearance and electrical system.

Benefits
In order to match the rising speeds in freight traffic, the maximum speed was specified at 120 kph.

The three-phase drive system avoids the thermal problems of conventional commutator traction motors and ensures both high speeds and high tractive effort in the lower speed range without wear.

Type	**1163**
Year	1993–1995
Wheel arrangement	Bo'Bo'
Power system	15 kV/16.7 Hz
Continuous rating at wheel [kW]	1600
Starting tractive effort [kN]	260
Maximum speed [kph]	120
Weight [t]	80
Track gauge [mm]	1435
Numbers built	20

1822

Electric Locomotive 1822

for Austrian Federal Railways (ÖBB)

Created for political reasons, the class 1822 was intended to solve the transport problem over the Brenner Pass. The five Innsbruck-based locomotives of this type were initially designed to haul freight trains in double-heading configuration, but now they are being used individually and preferably for passenger service on the Innsbruck–Linz route.

Scope of application
The class 1822 two-system mainline locomotive was specially developed for hauling freight over the Alps and is thus also called the "Brenner Unit".

Technical features
To ensure smooth Alpine crossings with heavy-duty freight trains, the locomotives were equipped for double-heading, but with only one cab manned.

Benefits
It can operate in the German and Austrian AC power systems, as well as in the Italian DC power system, thus eliminating the need for time-consuming locomotive changes at borders. During the design phase of this innovative vehicle, particular importance was placed on an extremely lightweight construction and ease of maintenance.

Type	**1822**
Year	1991–1992
Wheel arrangement	Bo'Bo'
Power system	15 kV AC/16.7 Hz, 3 kV DC
Continuous rating at wheel [kW]	4300
Starting tractive effort [kN]	280
Maximum speed [kph]	140
Weight [t]	82
Track gauge [mm]	1435
Numbers built	5

Electric Locomotive LE 5600
for Portuguese Railways (CP)

In December 1990, Portuguese Railways (CP) commissioned a consortium – headed by Siemens Transportation Systems – to design and supply 30 universal locomotives which were then delivered on schedule between 1993 and 1995. Siemens' partners were Sorefame and Siemens SA Portugal, as well as today's Siemens locomotive plant in Munich-Allach.

Scope of application
The LE 5600 is suitable for heavy-duty freight traffic, as well as for rapid passenger service.

Technical features
With the advent of this high-performance locomotive, CP entered the era of modern three-phase AC technology. As a first-generation EuroSprinter model, it is largely similar to the broad-gauge S 252 for RENFE, except for minor modifications. According to its scope of application, the LE 5600 is a single-system locomotive for 25 kV/50 Hz.

Benefits
Its reliable engineering and economic use of energy makes the unit extremely popular with CP's maintenance departments, whereas the train drivers fully appreciate the ergonomic design of the cab console.

With a speed of 224 kph, the LE 5600 holds the Portuguese record for high speed.

Type		LE 5600
Year		1993–1995
Wheel arrangement		Bo'Bo'
Power system		25 kV/50 Hz
Continuous rating at wheel	[kW]	5600
Starting tractive effort	[kN]	300
Maximum speed	[kph]	220
Weight	[t]	87
Track gauge	[mm]	1668
Numbers built		30

S 252

Electric Locomotive S 252
for Spanish National Railways (RENFE)

In March 1989, a consortium led by Siemens Transportation Systems won the order to supply 75 high-performance universal locomotives. Siemens was responsible for the electrical part and today's Siemens locomotive plant in Munich-Allach for the mechanical part. The first 15 locomotives were completely manufactured in Germany.

Scope of application
They are now in service on the new standard-gauge route between Madrid and Seville which was inaugurated in April 1992. They are mainly used for hauling the variable-gauge Talgo trains between Madrid and Cordoba or between Madrid and Seville. Operations on this electrified 25 kV/50 Hz route requires a multi-system equipment due to the terminus electrification with 3 kV.

Technical features
The locomotives are equipped with a three-phase drive system and asynchronous traction motors. Based on the class 120 of German Rail, this is the first multi-system high-performance universal unit with 5.6 MW power. The converters use GTO thyristor converters with freon bath cooling. The bogies have been further developed to provide the lateral dynamics for the fast curve running of tilting trains through the use of a pendulum suspension of the traction motors. The carbody is even suitable for use on exchangeable bogies with 1435 mm and 1668 mm gauge.

Benefits
After having been commissioned in 1992, the locomotives successfully demonstrated their high reliability and availability as well as their low maintenance costs. The good running characteristics of these locomotives in conjunction with the low forces acting on the track were verified during trials carried out by German Rail (DB AG) on the Madrid–Seville line. As a universal multi-system locomotive, the S 252 represents the first generation of the EuroSprinter family.

Type	S 252
Year	1992–1993
Wheel arrangement	Bo'Bo'
Power system	25 kV AC/50 Hz, 3 kV DC
Continuous rating at wheel [kW]	5600
Starting tractive effort [kN]	300
Maximum speed [kph]	220
Weight [t]	89
Track gauge [mm]	1435
Numbers built	15

S 252

Electric Locomotive S 252
for Spanish National Railways (RENFE)

Spanish National Railways purchased broad-gauge locomotives that were essentially of the same construction as the 15 locomotives running on the Madrid–Seville line. Of the 60 broad-gauge locomotives, 15 were built by CAF and 45 by GATSA under license. The units were commissioned in the years between 1993 and 1996.

Scope of application
The locomotives are being used for interregional passenger and freight services throughout the electrified broad-gauge network in Spain, running exclusively on a voltage of 3 kV DC. Their main area of operations, however, is in the triangle between the cities of Madrid, Barcelona, and Valencia.

Technical features
The locomotives use three-phase drive technology and asynchronous traction motors. With the exception of the broad-gauge bogies, the vehicles are largely of the same construction as their standard gauge counterparts.

Benefits
The three-phase traction technology used for the first time in the RENFE class 252 unit has proved to be a complete success. The work load factor of the locomotives is correspondingly high. The distance traveled monthly by the entire fleet totals 1.5 million kilometers, with some locomotives clocking over 34,000 km per month. The suitability of the units for broad and standard gauge, multiple power systems and universal use make this concept a pioneering approach for the development of a European locomotive. The S 252 represents the first generation of the EuroSprinter family.

Type	S 252	S 252
Year	1993–1996	1993–1996
Wheel arrangement	Bo'Bo'	Bo'Bo'
Power system	25 kV AC/50 Hz, 3 kV DC	3 kV DC
Continuous rating at wheel [kW]	5600	5600
Starting tractive effort [kN]	300	300
Maximum speed [kph]	220	220
Weight [t]	89	87
Track gauge [mm]	1668	1668
Numbers built	15	45

1047

High-Performance Locomotive 1047
for Hungarian State Railways (MAV)

In September 2001, Hungarian State Railways (MAV) ordered 10 four-axle high-performance locomotives of type 1047 from Siemens Transportation Systems. They correspond to the type ES 64U2 and are therefore almost identical with the locomotive class 1116 of ÖBB.

Scope of application
The high-performance universal locomotives represent the second generation of the EuroSprinter and are suitable for passenger and freight operations.

Technical features
Based on the class 1116 for Austrian Federal Railways, these locomotives provide not only a traction system for the Hungarian voltage (25 kV AC/50 Hz) but are also suited for the Austrian and the German network (15 kV AC/16.7 Hz). They integrate the automatic train control systems EVM 120 for Hungary and Indusi for Germany and Austria. They are among today's most powerful and fastest four-axle production locomotives. With respect to power, speed range, running and braking technology, they represent the state of the art.

Benefits
Fully suspended disk brakes and traction motors provide superior running dynamics. The units are already certified for unlimited use in Austria, Hungary, and Germany. The possibility to retrofit additional automatic train control systems provides even more options. This makes these units the perfect traction solution for the increasing amount of East-West traffic in the context of the Eastern expansion of the European Union.

The modular construction of the double-system locomotive made it possible to deliver the units within the very short period of only 7 months.

Type	**1047**
Year	2002
Wheel arrangement	Bo'Bo'
Power system	15 kV/16.7 Hz, 25 kV/50 Hz
Continuous rating at wheel [kW]	6400
Starting tractive effort [kN]	300
Maximum speed [kph]	230
Weight [t]	86
Track gauge [mm]	1435
Numbers built	10

1047

High-Performance Locomotive 1047

for Raab-Oedenburg-Ebenfurt Railways (ROeEE)

Together with Hungarian State Railways (MAV), Raab-Oedenburg-Ebenfurt Railways (ROeEE) ordered five four-axle high-performance locomotives of the type 1047 in September 2001.

Scope of application
Representing the second generation of the EuroSprinter, the high-performance universal locomotives are suitable for fast passenger as well as freight operations.

Technical features
Based on the class 1116 for Austrian Federal Railways, these locomotives have a traction system for the Hungarian voltage (25 kV AC/50 Hz) as well as for the Austrian and the German power system (15 kV AC/16.7 Hz). They integrate the automatic train control systems EVM 120 for Hungary and Indusi for Germany and Austria.

Benefits
The modular construction of the high-speed locomotives result in relatively short delivery times: The double-system units could be delivered after only 8 months.

Type	**1047**
Year	2002
Wheel arrangement	Bo'Bo'
Power system	15 kV/16.7 Hz, 25 kV/50 Hz
Continuous rating at wheel [kW]	6400
Starting tractive effort [kN]	300
Maximum speed [kph]	230
Weight [t]	86
Track gauge [mm]	1435
Numbers built	5

8K

Electric Locomotive 8K
for China Railways (CR)

In spring 1985, the 50 Hz project group, a consortium of German, French, Swiss, and Belgian locomotive manufacturers, was awarded the contract to supply 300 four-axle locomotives.

Scope of application
These freight units, equipped with only one driver's cab and usually coupled for double-heading, are used mainly to link the coal mining regions of Shanxi province in the north of China with the sea port of Qinhuangdao in the Gulf of Liao-Dong.

Technical features
The freight locomotives are designed with double-heading capability. For this contract, Siemens scope of supply included the main transformers, traction motors, and auxiliary motors.

Benefits
The first locomotive was delivered only 21 months after the contract was signed, while the last one was handed over to the customer just 12 months later.

Type		8K
Year		1986–1988
Wheel arrangement		Bo'Bo'
Power system		25 kV/50 Hz
Continuous rating at wheel	[kW]	3200
Starting tractive effort	[kN]	314
Maximum speed	[kph]	100
Weight	[t]	92
Track gauge	[mm]	1435
Numbers built		300

DJ1

Electric Double Locomotive DJ1
for China Railways (CR)

In 1997, a financing agreement was signed between the Ministry of Railways and the Chinese government to secure a technology transfer contract with Siemens AG. Siemens built the first 3 double locomotives in Austria and the remaining 17 locomotives in the context of the joint venture with the Chinese locomotive plant ZELW (Zhuzhou Electric Locomotives Works) in Zhuzhou.

Scope of application
The 20 three-phase double electric-freight locomotives are used for heavy-duty freight operations on the mountainous Baoji-Chengdu line that is electrified with 25 kV/50 Hz.

Technical features
These locomotives represent the second-generation EuroSprinter family. They use proven components of locomotives that were already supplied to various European railways, such as water-cooled GTO inverters and SIBAS 32 microcomputer control systems.

Benefits
The two individual units of the locomotive consist are of identical construction and may also be operated separately.

Through optional ballasting, these locomotives which provide an especially high tractive effort can be adapted to even more demanding traction applications.

Type		DJ1
Year		2000–2001
Wheel arrangement		2(Bo'Bo')
Power system		25 kV/50 Hz
Continuous rating at wheel	[kW]	2x3200
Starting tractive effort	[kN]	700 (760)
Maximum speed	[kph]	120
Weight	[t]	2x92 (100)
Track gauge	[mm]	1435
Numbers built		20

8100

Electric Locomotive 8100
for Korean National Railroad (KNR)

In November 1995, Siemens AG and former Daewoo Heavy Industries Ltd. agreed to build 2 prototype locomotives for the Korean National Railroad (KNR). In March 2002, Siemens Transportation Systems won the contract to build 10 more locomotives of type 8100.

Scope of application
The prototypes are suitable for heavy-duty freight traffic as well as for passenger transport.

Technical features
The units are based on the class 152 for German Rail (DB AG), thus representing the second-generation EuroSprinter locomotives. This is one of the first locomotives orders for Korea for three-phase asynchronous technology. In conformance with the Korean railway system, the locomotives are equipped with automatic AAR center couplers.

Benefits
The two engines form the basis for a new series of electric locomotives and are designed to replace the existing DC locomotives of KNR.

As a result of the successful test phase with the prototypes, Korean National Railroad exercised an option for 10 additional locomotives of this type.

Type	**8100**
Year	1998
Wheel arrangement	Bo'Bo'
Power system	25 kV/60 Hz
Continuous rating at wheel [kW]	5200
Starting tractive effort [kN]	330
Maximum speed [kph]	140
Weight [t]	88
Track gauge [mm]	1435
Numbers built	2 (+10)

7E

Electric Locomotive 7E
for South African Railways (SAR)

When South Africa decided that in future new and upgraded routes would only be electrified with 25 kV AC/50 Hz voltage, South African Railways (SAR) ordered an initial series of 100 six-axle AC locomotives in spring 1976. These class 7E electric units were designed to operate on the Ermelo–Richards Bay line which was inaugurated in 1978. A Siemens-led consortium won the order, with the mechanical part of the vehicle being built by the South African rolling stock manufacturer Union Carriage & Wagon (UCW) in Nigel.

Scope of application
These locomotives are used in heavy-duty coal and ore transport.

Technical features
The 7E is a six-axle locomotive for operation in AC power systems.

Benefits
While the first locomotives were being delivered, the consortium received a follow-up order for 65 more class 7E locomotives.

Type		7E
Year		1978–1983
Wheel arrangement		Co'Co'
Power system		25 kV/50 Hz
Continuous rating at wheel	[kW]	2925
Starting tractive effort	[kN]	450
Maximum speed	[kph]	100
Weight	[t]	124
Track gauge	[mm]	1065
Numbers built		165

8E

Electric Locomotive 8E
for South African Railways (SAR)

After Italy and Russia, SAR operates the longest electrified railway network using 3 kV DC. SAR ordered 100 class 8E four-axle yard locomotives in summer 1980. The consortium led by Siemens AG comprised BBC and – for the mechanical construction – Union Carriage & Wagon (UCW).

Scope of application
The class 8E is used as yard locomotive in the switchyards of major urban areas in South Africa.

Technical features
This locomotive is a heavy four-axle yard engine. The electrical equipment for these first African locomotive fitted with DC choppers was supplied in cooperation with BBC under the leadership of Siemens.

Benefits
The convincing concept resulted in the delivery of 7 more locomotives of the same design to two South African mining companies.

Type		8E
Year		1983–1984
Wheel arrangement		Bo'Bo'
Power system		3 kV DC
Continuous rating at wheel	[kW]	686
Starting tractive effort	[kN]	287
Maximum speed	[kph]	75
Weight	[t]	82
Track gauge	[mm]	1065
Numbers built		107

14E

Electric Locomotive 14E

for South African Railways (Spoornet)

The class 14E locomotive was ordered for the Cape gauge by the former South African Railways (SAR), today known as Spoornet. It was one of the first railroads in the world to introduce an extremely advanced and powerful locomotive featuring three-phase traction technology. The 50 Hz project group headed by Siemens was again given the order to supply the first three locomotives. The follow-up order for 10 more class 14E1 locomotives was placed directly with Siemens. The vehicle part was supplied by SLM and UCW.

Scope of application
The locomotives are mainly used for container transport between the two port cities of Cape Town and Durban and the city of Johannesburg approximately 1,500 km and 600 km away, respectively.

Technical features
The Cape gauge locomotive that uses three-phase drive technology can be used both on lines with 3 kV power supply and in 25 kV AC/50 Hz power systems.

Benefits
Thanks to their two-system capability, the 14E unit can work on old lines and the new lines, which considerably increases its scope of application.

Especially with respect to the restricted space conditions in narrow-gauge locomotives commutator-less three-phase traction motors offer advantages in terms of continuous tractive effort.

Type	14E	14E1
Year	1990	1994
Wheel arrangement	Bo'Bo'	Bo'Bo'
Power system	25 kV/50 Hz, 3 kV DC	25 kV/50 Hz, 3 kV DC
Continuous rating at wheel [kW]	4000	4000
Starting tractive effort [kN]	290	369
Maximum speed [kph]	160	130
Weight [t]	93	98
Track gauge [mm]	1065	1065
Numbers built	3	10

ICE 1

401 Power Car for ICE 1 High-Speed Trains
for German Rail (DB AG)

Between 1990 and 1992, DB AG initially purchased 60 high-speed electric trainsets from the German railway industry. They were intended for fast InterCity Express service on the new high-speed routes. The class 401 power cars are based on the knowledge gained with the IC Experimental and the class 120 locomotive.

Scope of application
The trains and the associated 401 power cars are designed for InterCity Express high-speed service on the new lines of DB AG.

Technical features
The power cars have an optimized aerodynamic design for operations on high-speed lines with many tunnels. The driver's cabs are pressurized and air-conditioned. The drives use fully-suspended three-phase asynchronous traction motors and fully-suspended disk brakes.

Benefits
In the international comparison, the 401 power cars achieve exceptionally high annual mileages. Powerful but lightweight three-phase traction motors ensure traction with minimum track wear for the comfortable high-speed trains comprising 11 to 14 intermediate cars.

Type		ICE 1
Year		1990–1992
Wheel arrangement		Bo'Bo'
Power system		15 kV/16.7 Hz
Continuous rating at wheel	[kW]	4800
Starting tractive effort	[kN]	200
Maximum speed	[kph]	280
Weight	[t]	77
Track gauge	[mm]	1435
Numbers built		120

ICE 2

402 Power Car for ICE 2 High-Speed Trains

for German Rail (DB AG)

The ET 402 ICE power cars were built between 1995 and 1997. They were ordered by DB Reise & Touristik and are largely identical to the 401 class power cars.

Scope of application

As the class 401 power cars, the 402 power cars are designed to provide traction for ICE trains on the new lines of DB AG. They are primarily designed for operation in a half-train consist comprising 1 power car, as many as 6 intermediate cars, and a driving trailer.

Technical features

The class 402 power car for the ICE 2 is a continuation of the ICE series in terms of appearance, overall dimensions, external contours and electrical equipment. A noticeable feature of this second generation is the fully-automatic end coupler arranged behind an electropneumatically-operated nose section.

Benefits

This power car is designed for operation in a half-train consist (1 power car, 6 intermediate cars, and a driving trailer) or in a full trainset (two half trains coupled together). It can run on all DB AG routes with 15 kV/16.7 Hz as well as on certain SBB and ÖBB lines.

By coupling two half-trains together, it is possible to fully utilize the route capacities on main lines while preserving the option to serve less frequented secondary lines more cost-effectively with a half-train.

Type		ICE 2
Year		1995–1997
Wheel arrangement		Bo'Bo'
Power system		15 kV/16.7 Hz
Continuous rating at wheel	[kW]	4800
Starting tractive effort	[kN]	200
Maximum speed	[kph]	280
Weight	[t]	78
Track gauge	[mm]	1435
Numbers built		48

TAV

High-Speed Power Car Talgo TAV

Continuing a partnership that has grown over decades from the development and production of lightweight high-speed traction units for light, permanently coupled trains complete with tilting system and radial steering wheelsets with idler wheels, Patentes Talgo SA placed an order with Siemens for the mechanical part of a prototype power car for high-speed rail service. Siemens developed and built the body for this power car and designed the overall layout. The excellent test results led to a production order of 2+16 power cars for the new Madrid–Barcelona line.

Scope of application
The prototype was used to test the Talgo trains at speeds well over 330 kph. The production power cars will provide traction for Talgo trains in scheduled service with 12 intermediate cars between Madrid and Barcelona.

Technical features
Particular emphasis was placed on lightweight construction in anticipation of the passive safety requirements in the European interoperability standard TS I. A second point of developmental emphasis was an aerodynamic design specially catering to the demands regarding minimum sensitivity to crosswinds, reduced buoyancy and good aeroacoustics particularly for tunnel passage.

Benefits
Thanks to the modular platform of the EuroSprinter locomotives, it was also possible to adopt basic body construction principles from the EuroSprinter family in order to meet the distinctive specifications for this power car.

Type		TAV
Year		1999
Wheel arrangement		Bo'Bo'
Power system		25 kV/50 Hz
Continuous rating at wheel	[kW]	4000
Maximum speed	[kph]	> 330
Weight	[t]	< 68
Track gauge	[mm]	1435
Numbers built		2+16

Dual-Mode Locomotive DM 30 AC

for Long Island Rail Road (LIRR) New York, USA

In cooperation with its American partner (EMD), Siemens is supplying the American market with the most advanced passenger rail locomotive, the DM 30 AC, featuring three-phase AC propulsion technology. The customer is Long Island Rail Road (LIRR) which is part of the Metropolitan Transit Authority (MTA) and is the largest commuter rail company in the U.S.

Scope of application
The locomotives are designed for commuter service in the metropolitan New York area.

Technical features
The locomotives use PWM inverters with proven evaporation-bath cooling technology and SIBAS 32 microprocessor control system.

Benefits
A marked decrease in noise and a substantial increase in fuel economy compared to the previously used locomotives set new standards in terms of ecofriendliness in comparison to the previously used units. In addition, the dual-mode DM 30 AC is capable of operating alternatively on the third rail (650 V) as an electric locomotive. This mode also allows the unit in operate in tunnels leading into New York City.

Type		DM 30 AC
Year		1997–1998
Wheel arrangement		Bo'Bo'
Diesel engine rating	[kW/hp]	2237/3000
Continuous rating in 650 V DC mode	[kW]	2150
Starting tractive effort	[kN]	360
Maximum speed	[kph]	161
Weight	[t]	128
Track gauge	[mm]	1435
Numbers built		23

Dual-Mode Locomotive Class 38

for South African Railways (Spoornet)

In mid-1990, South African Railways (Spoornet) awarded a Siemens-led consortium the largest order ever placed by a railway company for dual-mode locomotives.

Scope of application
As dual-mode or hybrid locomotives, the class 38 units are especially suited for combined yard and freight service within the same roundtrip.

Technical features
The locomotives for the narrow Cape gauge (1067 mm) are designed to operate on 3 kV DC systems as well as in diesel mode.

Benefits
The design as dual-mode locomotive eliminates the otherwise necessary switching of locomotives when changing from electrified to non-electrified line sections. This makes railway operations faster, more economical, and more efficient.

Type		Class 38
Year		1992–1994
Wheel arrangement		Bo'Bo'
Diesel engine rating	[kW]	780
Continuous rating in 650 V DC mode	[kW]	1500
Starting tractive effort	[kN]	260/181
Maximum speed	[kph]	100
Weight	[t]	74
Track gauge	[mm]	1067
Numbers built		50

ED 1600

Dual-Mode Locomotive ED 1600
for RAG Bahn- und Hafenbetriebe, Germany

In cooperation with the Bahn- und Hafenbetriebe of Ruhrkohle AG (RAG), two older dual-system locomotives built to operate on line voltage and battery voltage were converted into dual-mode locomotives (overhead line/diesel engine).

Scope of application
The locomotives are assigned to heavy-duty line and transfer operations.

Technical features
They are worked primarily in two and even three shifts, hauling loads that weigh as much as 2,900 tons. In addition, performance studies have shown that these units are capable of traveling at a speed of 60 kph with a trailing load of 2,000 tons, as well as at 80 kph with a trailing load of 1,000 tons.

Benefits
The purpose of this conversion was to increase the tractive power in electric mode from 720 kW to 1600 kW within the same weight and volume restrictions, as well as to install an additional, powerful diesel-alternator set.

Type		ED 1600
Year		1992
Wheel arrangement		Bo'Bo'
Diesel engine rating	[kW]	560
Continuous rating in 15 kV/16.7 Hz mode	[kW]	1600
Continuous rating in diesel-electric mode	[kW]	425
Starting tractive effort	[kN]	360
Maximum speed	[kph]	50
Weight	[t]	88
Numbers built		2

Literature

If you would like to know more about our electric locomotives and power cars for high-speed trains, please write to the following address and request the corresponding order number:

Siemens AG
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Product brochures

High-Performance Electric Locomotives for Austrian Federal Railways, TAURUS Class 1016/1116
Order No.: A19100-V600-B431-V2-7600

High-Performance Electric Locomotives for Danish State Railways, EG 3100
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Offprints

Heavy Freight Double Locomotives for the Chinese Railways
Order No.: A19100-V600-B255-X-7600

Electric Locomotives for Korean National Railroad
Order No.: A19100-V600-B236-X-7600

The electrical equipment for the Long Island Rail Road's DM 30 AC dual-mode Locomotive
Order No.: A19100-V600-B192-X-7600

Technical Information

Class 1016 and 1116 High-Performance Locomotives for Austrian Federal Railways (ÖBB)
Order No.: A19100-V600-B183-V2-7600

Class EG 3100 High-Performance Locomotive for Danish State Railways (DSB)
Order No.: A19100-V600-B187-V1-7600

General-Purpose Locomotive "HellasSprinter" for Greek Railways (OSE)
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Heavy Freight Double Locomotive DJ1 for Chinese Railways (CR)
Order No.: A19100-V600-B452-X-7600

Class 1047 High-Performance Locomotive for the Hungarian State Railway (MAV)
Order No.: A19100-V600-B250-X-7600

Class 1047 High-Performance Locomotive for the regional railway Raab-Oedenburg-Ebenfurter Eisenbahn (ROeEE)
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