Winning with Specialty and Intelligence

ABB’s Application Solutions for Rail Transit Industry
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Rail Transit Industry Overview

ABB’s Application Solutions for Rail Transit Industry

Typical Cases
Rail Transit Industry Overview
Type of rail transit

Railway
Passenger dedicated line
Maglev railway
Metro light rail
Inter-city railway
As the advanced industry of "One Belt One Road" construction, rail transit will be constructed in three strategic directions, Eurasian High-speed Rail, Central Asia Railway and Trans-Asian Railway, with total length exceeding 30 thousand km.

During "The Thirteenth Five-Year Plan" period, the railway investment scale will reach RMB 350 million to 380 million, and the new railway line of 30 thousand km will be constructed, including about 11 thousand km of high-speed rail.

By the end of 2015, 116 urban rail transit lines had been completed and operated in 26 cities of China, with the total operation length reaching 3612 km. Up to 2020, the total mileage of rail transit in 50 cities of China will reach more than 7000 km.
For the electrical load of the station, the power supply is led from the regional substation.

- Voltage classes: 110kV, 35kV, 10 (6) kV, 380/220V, etc.

The regional substation and distribution station is set in the load concentration area, such as railway hub station, large and super-huge passenger station, switchyard, etc.

- 10kV substation and distribution station provides power line and power continuous line for the automatic block.

- A substation and distribution station is located at the interval of 40km -60km on average.

- It is distributed at the interval of 2-10km with the capacity of about 3-30 kVA at each station.

- The power supply is led from 10kV continuous power transmission line and self-closed line

- Load type: class I load for communication, signal, safety control equipments, and class II load for internal camera, etc.
ABB’s Comprehensive Solutions for Rail Transit

- Electric power telecontrol solution
- Signal power supply panel solution

Substation and distribution station
- MV and LV distribution solution
- DC panel solution

Station
- MV and LV distribution solution
- Intelligent power distribution monitoring system
- Intelligent control system
- Railway integrated earthing solution

Locomotive
- Electric locomotive power distribution solution
- Internal combustion locomotive power distribution solution

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ABB’s Power Distribution Solution for Rail Transit
MV and LV low-voltage distribution system

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ABB’s Power Distribution Solution for Rail Transit
Providing robust power for rail transit

Safe
Reliable
Intelligent
Flexible

Rated current insert block
ABB’s Power Distribution Solution for Rail Transit
iVD4 - On-line monitoring, changing "passive repair" to "active monitoring"

Based on highly safety and reliability
- Fully motor drive system, including circuit breaker truck and earthing switch, keeps people away from hazardous area
- Constructed on basis of VD4 circuit breaker, an MV mainstream product of ABB, to guarantee and extend the reliability of VD4 product.

With intelligence at the core
- TRM temperature rise real time on-line monitoring system
- ICM circuit breaker parameters monitoring system

With environment protection as orientation
- 100% recyclable PT materials
- Low-toxicity and low-pollution trivalent chromium electroplating technology
- Low Smoke and Zero Halogen secondary lead
ABB’s Power Distribution Solution for Rail Transit

iVD4 - Remote expert system, positive repair and maintenance based on condition

Consumer-service staff

Power distribution network

ABB product expert group
ABB’s Power Distribution Solution for Rail Transit
Emax 2 easily realizes load management and improves system efficiency.

Emax 2 can be easily integrated into the power telecontrol system of railway, to realize main functions to the railway LV power distribution system, such as remote control, telemetering, remote signalling and dispatching management, etc.

- Wide connectivity, integrated with all automation systems perfectly
- Brand-new Ekip series electronic tripper, provided with advanced electric power quality management function, for continuous monitoring and analysis of power quality.
- Large-size color touch screen brings more visual operation
- Direct programming from DOC to Ekip Connect, guarantying precise protection action
ABB’s Power Distribution Solution for Rail Transit
M series LV switchgear cabinet: MDmax ST

Reduced investment and purchase cost
- The width of MCC cabinet is only 600, reducing the occupied area and also the manufacturing cost.
- Added with 1.5U unit drawer, the arrangement becomes more compact, reducing the number of cabinets.
- With drawer type structure, 36 circuits can be assembled in maximum.
- The cabinet dimension is reduced by 20% in comparison with the traditional cabinet

Safety in use and simplicity
- Top cap of horizontal bus area is dismountable
- Perfect drawer type electrical operation circuit solution
- Drawer position switchover, not lowering the level of protection
- With the lead screw feed mechanism adopted, it is easy to operate
- High level of protection and high separation type

Durable in use
- The skeleton is treated by aluminum-coated zinc plate double-fold technology
- Uniform technological requirements and quality authentication requirements
ABB’s Power Distribution Solution for Rail Transit
LMAX LV compact busway - ensuring power safety and efficient transmission

Sandwich conductor structure

Aluminum magnesium alloy enclosure

Single bolt connector

Unique misphase-proof device

Reliable insulating materials

Safe and reliable tapping unit

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ABB’s Power Distribution Solution for Rail Transit Motor protection solution – Fully guaranteeing the efficient operation of motor

Railway requirements
A large number of power equipments exist in the railway station, such as fire-fighting equipment, escalator, water supply and drainage and sewage treatment equipments. The thorough protection and flexible control for these loads could ensure the normal operation of railway.

Direct starting
- Moulded case circuit breaker Tmax XT
- Contactor AX
- Thermal relay TA
- Motor control unit UMC100

Star-delta starting
- Moulded case circuit breaker Tmax XT
- Contactor AX
- Universal control and protection switch CPX

Soft starting
- Moulded case circuit breaker Tmax XT
- Contactor AX
- Contactor AX
- Contactor AX
- Soft starter PSTX

Variable frequency starting
- Disconnecter fuse OS
- Disconnecter fuse OS
- Contact AX
- Contact AX
- Frequency converter
ABB’s Power Distribution Solution for Rail Transit
Comprehensively promoting power quality, and maintaining voltage stability and clean electric energy

- RCR reactive power compensation solution
- DYNACOMP real-time dynamic reactive power compensator
- PQF active dynamic filter

Improve power factor, maintain voltage stability and eliminate harmonic pollution
ABB’s Power Distribution Solution for Rail Transit
RCR reactive power compensation solution

- Reduced active loss and less energy consumed
- Capable of suppressing ultraharmonics
- Effective restriction on switching-in rush current
- Higher power distribution equipment utilization rate
- Higher power system stability
ABB’s Power Distribution Solution for Rail Transit
DYNACOMP® Real-time dynamic compensation solution

- Ultra-fast power factor compensation
- Reduced voltage drop and voltage flicker
- No instantaneous current in the switching process, having no impact on the power grid
- Modular and compact design
- Advanced Modbus bus communication is adopted
- The switching step ranges from 50 to 400 kVAR
- CAN bus control for up to 32 stations
- Partial absorption of harmonic
- Power grid detection including harmonic

- Clause 6.0.2 of TB 10016-2006 Code for design of energy-saving of railway engineering: After compensation, the average power factor of traction substation at the primary side shall not be lower than 0.9. When the requirements cannot be met, the dynamic reactive power compensation equipment shall be equipped.
- Clause 7.1.6-3: For the system with large power factor fluctuation, the dynamic reactive power compensation equipment may be adopted.
ABB’s Power Distribution Solution for Rail Transit

PQF active dynamic filter

Harmonic source:
- The harmonics generated by rectifier set of traction locomotive at MV side are coupled at the side of 400V through transformer
- The illumination lamps have rectification parts which input harmonics to the grid when in operation
- The air-conditioner and elevator, etc. are driven by frequency converter, which may cause harmonic pollution while saving energy.

Harmonic hazards:
- Increased loss of transformer and electric equipment
- Serious heating of cables, easy to cause electrical fire
- Protective action of circuit breaker may be triggered, causing power failure and even the train delay.
- Weak current system, such as communication system, may be interrupted, affecting the operation safety of train

PQF active dynamic filter:
- Capable of filtering 20 types of harmonic waves simultaneously
- Filtering efficiency higher than 97%
- Closed-loop controlling technology, with higher accuracy
- Reactive compensation function
- Interphase equilibrium function

- Clause 11.2.13 of TB 10020-2009 Code for design of high-speed rail: The traction power supply shall reduce the impact of negative sequence and harmonics on the power system.
- Clause 15.1.21 of GB50157-2013 Code for design of metro: Harmonics treatment measures shall be taken for LV power distribution system.
- Clause 8.1.3 of GB50490-2009 Technical specification for urban rail transit: The power supply system harmonic content injected to the public grid system shall not exceed the allowable range.
ABB’s Power Distribution Solution for Rail Transit

Lightning protection solution – comprehensive lightning protection, ensuring complete safety

**Railway requirements**

In the event of lightning strike, the lightning discharge triggers the lightning electromagnetic impulse overvoltage and overcurrent to damage the communication signaling equipment and network communication equipment in the station by conduction and sensing after going through the power supply system, communication signal transmission channel, earthing system and building direct lightning protection system, leading to great loss and directly threatening the normal safety of railway consequently.

**External lightning protection of building**

Including lightning rod, downlead and earthing system, etc., mainly used for protection against direct lightning

- OPR lightning rod
- Downlead
- Lightning protection earthing body
- Circular earthing body

**Lightning protection of distribution line**

Including protection level I, II and III, mainly used for protection against inductive thunder and transient overvoltage

- Lightning protection device

**Lightning protection of signal system**

Including lightning protection against communication system, telephone system, fire-fighting system and security system.
People gather and goods are stacked at the passenger station. Once the fire breaks out, heavy casualties and property loss as well as adverse impact may be easily caused.

The electrical line is widely distributed at each corner and operates around the clock. Short circuit, overload, line aging, etc. are liable to cause electrical fire.

- Clause 13.2.3 of JGJ_16-2008 Code for Electrical Design for Civil Building classifies the protected object of automatic fire alarm system at large railway passenger station and above as class I.
- Clause 13.12.1 of JGJ_16-2008 Code for Electrical Design for Civil Building specifies, the distribution lines of building with protected object class I of automatic fire alarm system shall be equipped with fire-proofing residual current operated alarm system.
ABB’s Power Distribution Solution for Rail Transit
EFPS electrical fire monitoring system – preventing fire effectively

The system can monitor 6300 points and 100 areas simultaneously in maximum.
ABB’s Power Distribution Solution for Rail Transit
EFPS electrical fire monitoring system – preventing fire effectively

- Traces and monitors important indicators that can cause electrical fire in real time, to avoid fire occurrence
- Timely positioning fault locations to help trouble shooting and power recovery as soon as possible
- Functions of site monitoring and remote management
- Integrated centralized management to fully improve the monitoring efficiency of electrical fire
ABB’s Power Distribution Solution for Rail Transit

Power telecontrol box type substation

- Box type substation overview
  - 10kV gas insulated switchgear
  - Dry type transformer
  - LV switchgear
  - UPS power supply
  - Mounting position reserved for RTU device

Wiring diagram for primary power source of power telecontrol box type substation

connected with box type substation at up direction

connected with box type substation at down direction
ABB’s Power Distribution Solution for Rail Transit
Power telecontrol box type substation
ABB’s Power Distribution Solution for Rail Transit
Power telecontrol box type substation

Tmax XT+MOD

- The core part of ring main unit includes an SFG load switch, featuring simply structure, small size, mature supporting facilities, easy installation, etc., which is particularly applicable to the box-type substation.
- XT circuit breaker, with MOD electric operating mechanism, is mounted at the LV side:
  - Low cost, stable performance, high reliability, not affected by voltage fluctuation, long service life
  - Significantly reduced MOD impact power consumption, greatly lower than similar products, to the benefit of energy saving and increased service life of electric operation and circuit breaker simultaneously.
  - Quick opening and closing, available for fast power recovery and providing reliable assurance for the power supply of high-speed rail
  - Coordinated with intermediate relay (KO), the function "remote automatic reset" can be realized.
- EMplus collects AC power parameters of circuit, such as current, voltage, power factor, harmonic value, etc., in order to monitor the system remotely.

Tmax+MOS

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ABB’s Power Distribution Solution for Rail Transit
Signal power supply panel solution

- AC/DC miniature circuit breaker, providing specialized protection
- Tmax XT moulded case circuit breaker of incoming line circuit better coordinates with S200 circuit breaker of outgoing line circuit, providing selective protection

AC380V/220V

UPS

- DC 24V DC power supply
- microcomputer detection power supply
- CTC/TDCS power supply
- Switch indication power supply
- Reserve power supply for voltage stabilization
- Microcomputer interlocking power supply
- Relay power supply
- Track circuit power

Supply module AC/AC

Supply module AC/DC

AC380V AC switch machine power supply

DC220V DC switch machine power supply
ABB’s Power Distribution Solution for Rail Transit

DC panel solution

- Insulation monitor CM - IWN – AC, providing specialized protection
- Integrated signal/auxiliary combination contact in S200MDC miniature circuit breaker can provide fault and switching signals of circuit breaker, and it only occupies half modulus (8.8 mm), saving space of cabinet; in addition, an auxiliary contact is mounted at the bottom, not occupying the space of cabinet.
- S200MDC miniature circuit breaker is specially designed with respect to the DC load and can serve more safely
ABB's PSCADA for Rail Transit
Requirements of relevant standards and specifications

- Clause 6.2.3 of TB 10008-2006 Code for design of railway electric power: remote terminal units shall be mounted at following locations: 1. 10kV distribution station, substation of 35 kV and above. 2. Section switch of important power supply line, such as continuous transmission line, automatic blocking line, etc. 3. Important substations of 35/0.4kV and 10/0.4kV. 4. Important LV power supply equipment closely related to train working.

- Clause 12.5.1 of TB 10020-2009 Code for design of high-speed rail (trial): The electric power telecontrol shall serve as one part of railway power supply dispatching system and mainly function as remote control, telemetering, remote signaling and dispatching management, etc. for the railway power supply system. Clause 12.5.2: The electric power telecontrol shall monitor and manage HV electrical equipment, AC/DC operational power supply of substation and distribution station and HV, LV electrical equipment closely related to train working.

- Clause 7.1.5 of TB 10016-2006 Code for design of energy-saving of railway engineering: Telecontrol technology shall be adopted for the power supply network. When conditions of investment and network, etc. are not met, the design shall allow for telecontrol technology conditions.

- Clause 15.6.1 of Code for design of metro: The power supply system for metro shall be equipped with PSCADA. Clause 15.6.6: The functions of PSCADA shall meet the unattended operation requirements of substation.

- Clause 8.1.6 of GB50490-2009 Technical specifications for urban rail transit: The power supply system shall realize remote monitoring through PSCADA.
ABB's PSCADA for Rail Transit
Network topology

MIS layer system

Switch 1

General switch

Switch 2

100M/bps optical fiber ring network

Chart printer

Workstation I

Workstation II

Working machine

Server

Intelligent equipment

Substation 1#

Substation 2#

Substation n#
ABB's PSCADA for Rail Transit
Deployment diagram of intelligent components

- **Management layer**
- **Communication layer**
- **Equipment layer**

**TCP/IP**
- Monitoring host - slave
- Monitoring host - slave
- Superior monitoring

**Ethernet switch**

**Communication manager**
- Generator controller
- Temperature controller of transformer
- EPS/UPS
- Other instruments

**PMC91F**
- EMplus
- EM 400T
- REF541

**Protection and control equipment**
- Tmax XT
- Emax 2
- Tmax XT
- PSTX

**Equipment layer**
- EPS/UPS
- Other instruments

**Power instrument**
- Emax 2
- Emax 2
- Emax 2
- Emax 2

**Distributed area**
- EQ B
- EQ C

**Office area**
- EQ B
- EQ C

**Commercial area**
- EQ B
- EQ C

**Equipment area**
- EQ B
- EQ C

**Metering instrument**
- PSTX
- M101/M102
- M101/M102
- M101/M102
ABB's PSCADA for Rail Transit
Promoting power management and realizing energy saving and emission reduction

Management improvement
Cost reduction

- Information resources sharing to promote the dispatching management of rail transit.
- Varied authority management for personnel with different identities to realize unattended operation of power distribution room and reduce the human cost by about 10%.

Power improvement
Faults reduction

- Further improves the safety and reliability of power system, lowers the power system fault rate by about 30% and reduces the power failure accidents by 30%-40%
- Reduces the operator’s probability of improper emergency handling.

Scientific utilization
Energy saving and emission reduction

- Excavates energy consumption data deeply, and works out energy-saving measures in accordance with corresponding standard or expert model
- Grasps specific conditions of power consumption and optimizes operation mode to reach the energy-saving target of 5%-15%.
ABB’s Intelligent Control Solution for Rail Transit
Requirements of relevant standards and specifications

- Clause 12.7.1-6 of TB 10020-2009 Code for design of high-speed rail (trial): Power saving measures shall be taken into account for lighting design. In the day time, the natural light shall be fully utilized; direct lighting shall be applied for general space; the lighting lamps for large-area sites, such as waiting hall, ticket hall, pull-in hall and canopy, etc. shall be controlled in grouping; an intelligent lighting control system shall be applied for large station building and above.

- Clause 7.3.9-4 of TB 10016-2006 Code for design of energy-saving of railway engineering: An intelligent lighting control system shall be installed for building, platform of large station and above.

- Clause 8.3.2-4 of GB 50226-2007 Code for design of railway passenger station buildings: The lighting for waiting hall, ticket hall, distributed hall, passenger tunnel, platform bridge, luggage and package consigning & claim hall and package warehouse, etc. shall be equipped with no less than two types of control modes with average illuminance, and an intelligent lighting control system shall be applied for super-huge, large station.
ABB’s Intelligent Control Solution for Rail Transit

Main functions

- Lighting control (switch and dimming)
- Electric curtain, roller blind, curtain and electric window control
- Air-conditioning and fan coil control
- Exhaust equipment control
- Water drainage and elevator equipment monitoring
- Audio-visual equipment control
- Fire-fighting linkage monitoring
- Centralized monitoring and control

User’s benefit

- Automatic control and convenient for management
- Energy saving
- Comfortable riding and working environment
ABB’s Intelligent Control Solution for Rail Transit

Control area and control content

Aisle, public washroom
Control of lights, exhaust air, fan coil and emergency lighting

Parking lot, underground garage, underground traffic hub and tunnel

Public area – window/curtain wall

Hall/waiting hall/platform
Control of lights, fan coil, exhaust fan, electric curtain, skylight and emergency lighting

Façade and landscape lighting

Monitoring subsystem
Monitoring of elevator, immersible pump, sewage pump, etc. to report to the central monitoring system in real time

Current detection
Monitoring of numerous lighting circuits; the system will directly alarm in the event of lamp faults or circuit tripping.

Central control system
Centralized monitoring of equipment in the area
Controllable interface of touch screen
Record and display incident and fault information
Statistics of appliance on-off times, turn-on time, etc.
Automatic alarm for circuit tripping

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ABB’s Intelligent Control Solution for Rail Transit

Control area – lobby, waiting hall, platform

06:00 Ready mode
- The system automatically switches on 1/3 lamps and fan coils to get ready

06:30 Operation mode
- Passengers enter the waiting hall and the system switches on all lamps and fan coils

23:30 Cleaning mode
- After all passengers get on the train, the system automatically switches off 2/3 lamps and fan coils for cleaning

Light sensing
- When the natural lighting is sufficient, the system will switch off most lighting circuits to save the lighting energy.

Fire-fighting linkage
- In the event of fire alarm, the forced switching-on function for lighting at public area will be enabled to start the emergency lighting control.
ABB’s Intelligent Control Solution for Rail Transit Control area - aisle, public washroom

- Control of lighting and air-conditioning as per light
  When the lighting is sufficient, the system will automatically switch off the lighting circuits of the station platform. When it becomes dark, the system will automatically switch on corresponding lighting circuits.

- Control of lighting and air-conditioning as per time
  The system switches on and off lighting circuits and air-conditioning equipment as per the set time table.

- System components detection function
  The system detects the line faults through line detection components and then alarms automatically.

- Circuit monitoring function
  The circuit monitoring function guarantees the light source faults on any circuit will be automatically displayed on the central control unit.
ABB’s Intelligent Control Solution for Rail Transit Control area – Façade and landscape lighting

- **Light sensing/timing control**
  When the natural lighting becomes dark, the light sensor will switch on most floodlights. The light sensor switches off part of floodlights through timing, e.g., 11:00 p.m., except for a few basic lights, and switches off the remaining lights when the day breaks.

- **Centralized control**
  On important holidays and festivals, the system switches on landscape lighting through centralized control software and lighting combinations with different scenarios as per different holidays to create special atmosphere.
ABB’s Intelligent Control Solution for Rail Transit
Centralized control system

- Centralized monitoring and control with touch screen
  Monitors and controls lighting, electric window, air-conditioner, etc., in each area of the station through touch screen and graphical interface

- Timing and metering
  Detects on-off times of each appliance and lighting circuit and service life of electrical equipments and lamps, to remind the maintenance personnel of stocking up to replace the lamps to be scrapped Light source and various electrical equipments

- Monitors circuit state and records incidents for the convenience of management
  Automatic alarm for circuit tripping and lamp light source faults, guarantying the most efficient and reliable operation of station control system
ABB’s Intelligent Control Solution for Rail Transit

Advantages

- Centralized control - to the benefit of management and linkage of other systems
- Decentralized control - easy to adjust timely as required
- Light sensing – making use of natural light to fully save energy
- Fire-fighting linkage – improving safety and reducing personnel costs
19 stations are set on the whole line.

i-bus® intelligent control system meets requirements of intelligent use and management under different operation modes through centralized control, site panel control, timing control, light sensing control and fire-fighting linkage, etc., and brings better economic benefit to metro users.
### ABB’s Solutions for Rail Transit

**Integrated earthing solution for railway**

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper-plated round steel</td>
<td>(Downlead; horizontal earthing object)</td>
</tr>
<tr>
<td>Copper-plated steel earthing rod</td>
<td>(Vertical earthing electrode)</td>
</tr>
<tr>
<td>FurseCEM conductive earthing polymeric materials</td>
<td>(Physical resistance-reducing agent)</td>
</tr>
<tr>
<td>FurseWELD exothermic welding</td>
<td></td>
</tr>
</tbody>
</table>

- **Good conductivity**
- **Strong tensile capacity**
- **Effective corrosion prevention**
- **Good burglar resistance**
- **Strong corrosion resistance**
- **Compact size and convenient implementing**
- **Meeting requirements of any length**
- **Effectively reducing the earthing resistance**
- **Small inductance and high discharge capacity**
- **Hardened after buried in earth, not easy to be drained**
- **Pollution-free, not corroding the earthing pole**
- **High conductivity**
- **Stable performance in four seasons**
- **Mountable under both dry and wet conditions**
- **Current-carrying capability of welding point is as same as the conductor**
- **Melting contact, creating permanent connection**
- **Strong corrosion resistance**
- **Easy and safe operation**

### Advantages:

- **ABB Furse earthing system** provides a complete application solution, including link-up earth wire, earthing device, earthing connection line and accessories, etc.
- **Features of long service life**, **high reliability**, **convenient construction** and **free maintenance**, reducing the hidden dangers of earthing grid to realize the safe operation of railway.
ABB’s LV Locomotive Application Solution

Electric locomotive power distribution solution

- Main drive system
- Auxiliary drive system
- The locomotive heating and thermoelectricity guarantee system
- Locomotive lighting system

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ABB’s LV Locomotive Application Solution
Wires and cables management – Adaptaflex series

Product series include: line penetration hose, pipe joint and relevant accessories.
There are 37 types of hoses, meeting cables connection requirements at each part of locomotive; joint includes straight form, 45° bend, 90° bend, and type T, Y, V, and PG system, metric system, NPT system, etc. of thread specifications are equipped.

Advantages: Low smoke and non-toxicity, level of protection reaching IP68, good flexibility, very high impact resistance, very good flame resistance, simple, convenient installation, stable chemical properties, wide adaptive temperature range (from -65°C to 350°C).

With complete certification, Adaptaflex products are widely used for locomotive manufacturing, enjoying very high reputation in the rail transit industry.
## Typical Cases

### Railway
- Qinghai-Tibet Railway
- Wuhan-Guangzhou Passenger Special Line
- Beijing-Tianjin Railway
- Dazhou-Chengdu Railway
- Chengdu-Chongqing Railway
- Beijing-Jiulong Railway
- Baoji-Chengdu Railway
- Longyan-Xiamen Railway
- Wenzhou-Fuzhou Railway
- Naqu section of Qinghai-Tibet Railway
- Beijing high-speed train section

### Metro/light rail
- Beijing Metro
- Shanghai Metro
- Guangzhou Metro
- Shenzhen Metro
- Nanjing Metro
- Wuhan Metro
- Ningbo Metro
- Tianjin Metro
- Xi’an Metro
- Hangzhou Metro
- Chongqing Light Rail
- Chengdu Metro
- Dalian Metro
- Wuxi Metro

### Railway station
- Kunming South Railway Station
- Tianjin Station
- Qingdao Station
- Beijing South Railway Station
- Qingdao Station

### Locomotive
- CNR Dalian Locomotive Co., Ltd.
- CNR Datong Locomotive Factory
- CSR Zhuzhou Locomotive Co., Ltd.
- CSR Ziyang Locomotive Factory
- CSR Qingdao Sifang Locomotive Co., Ltd.
- CSR Nanjing Puzhen Locomotive Factory
- CSR Chengdu Locomotive Factory
- Changchun Railway Vehicles Co., Ltd.
- Alstom Transit Equipment Co., Ltd.
- Jiangsu Changzhou Bombardier Traction System Co., Ltd.
- Bombardier Sifang (Qingdao) Transportation Ltd.
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