6-150W Railway

MORNSUN DC/DC Converter

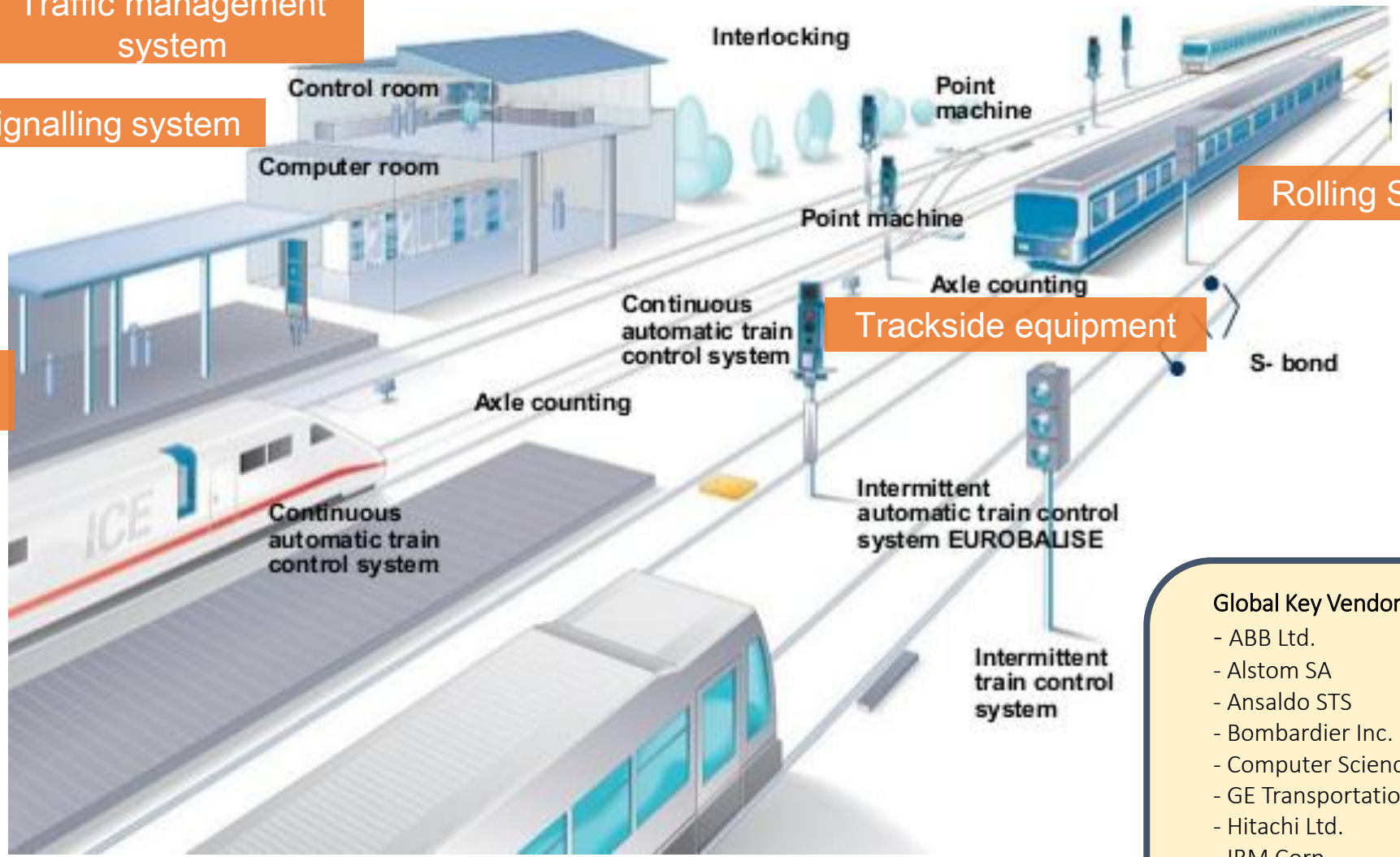
for Railway application

Railway system

Traffic management system

Signalling system

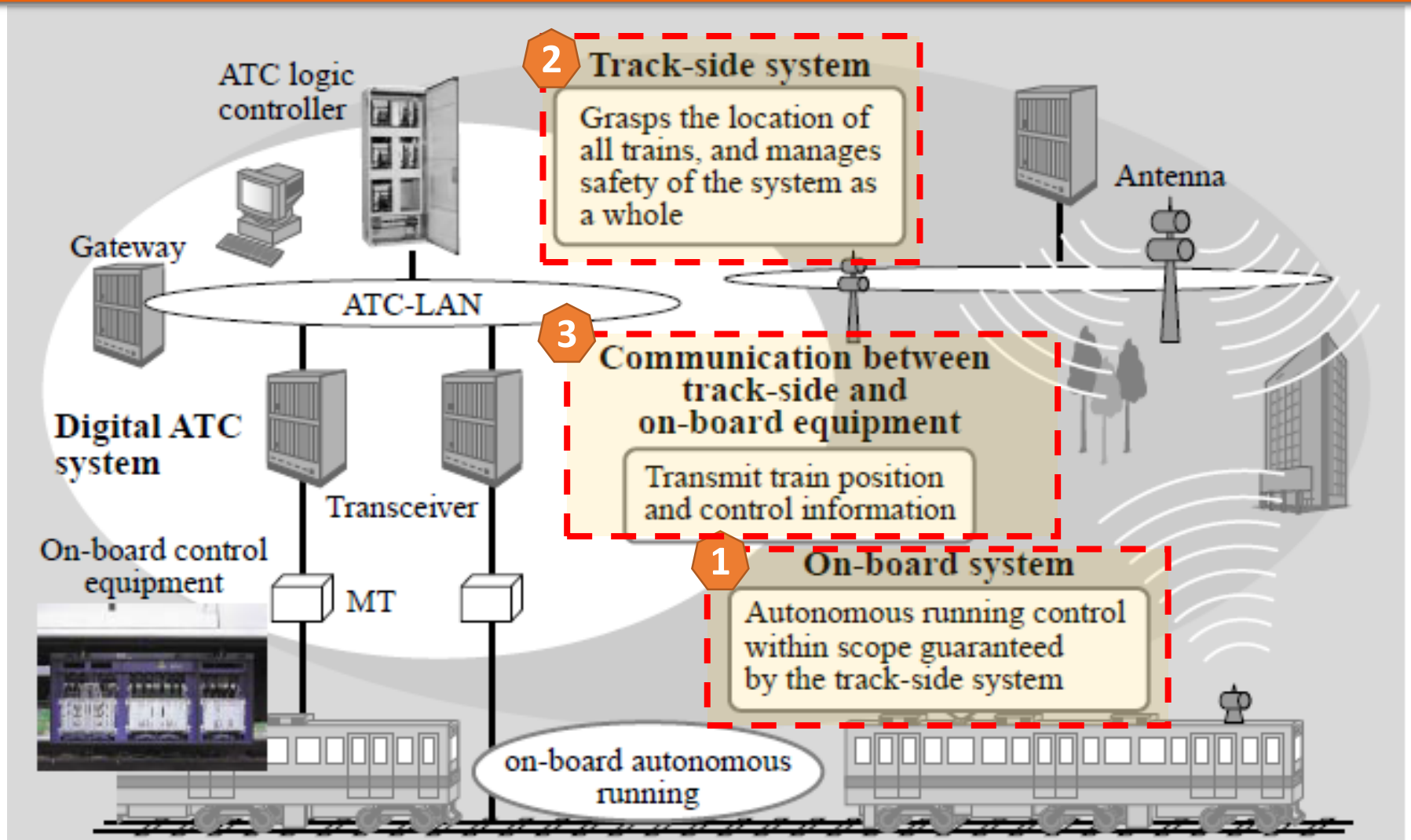
Station Facilities



Global Key Vendors of Railway Management System

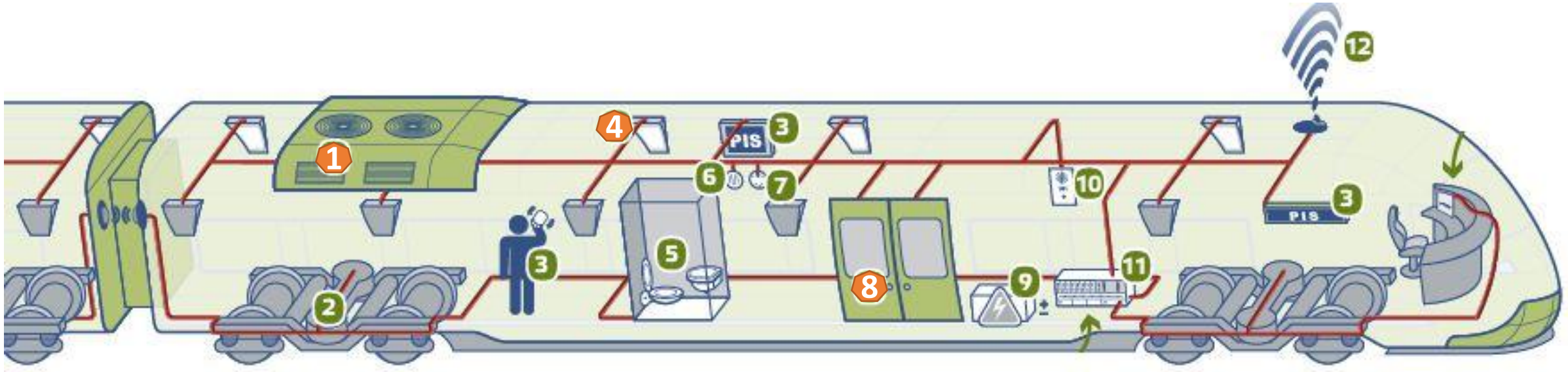
- ABB Ltd.
- Alstom SA
- Ansaldo STS
- Bombardier Inc.
- Computer Sciences Corp.
- GE Transportation
- Hitachi Ltd.
- IBM Corp.
- Indra Sistemas SA
- Siemens AG

DC/DC Converter in railway equipment



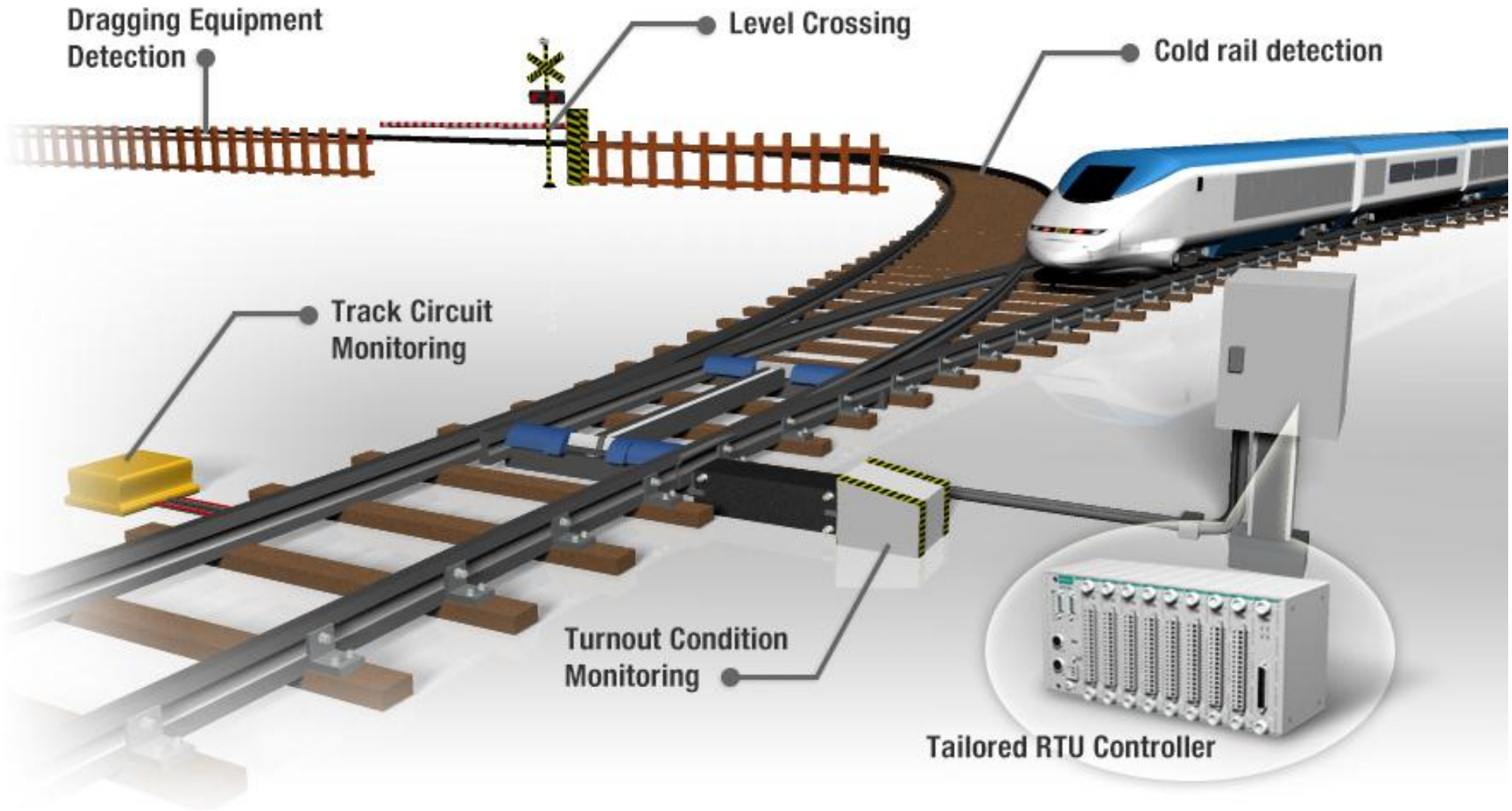
ATC: automatic train control
MT: matching transformer

1. DC/DC Converter in rolling stock *on-board electronic equipment*

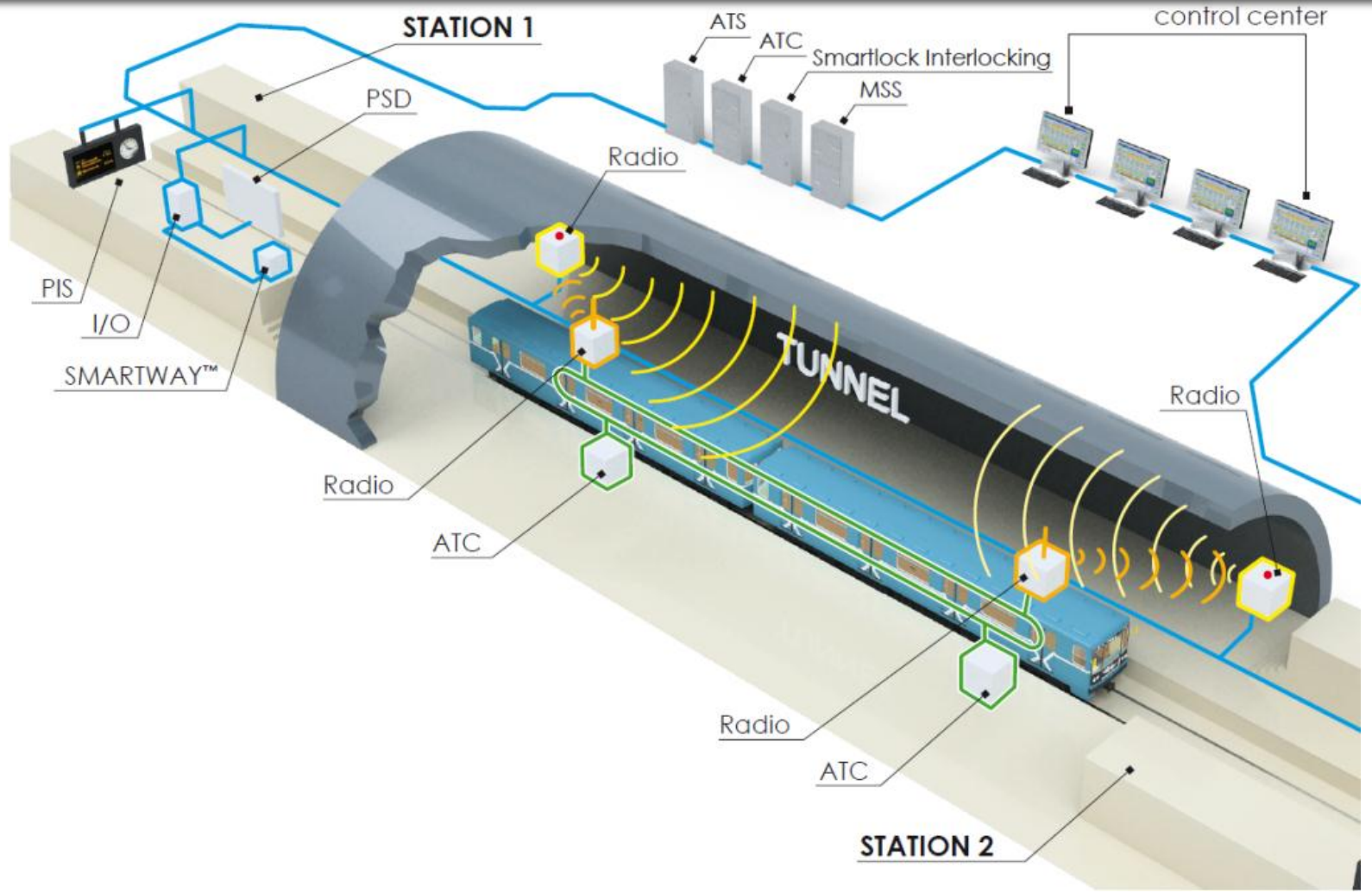


1 Air conditioning/ventilation
2 Bearing temperature (SIL-2)
2 Speed measurement (SIL-2)
2 Brakes
2 Traction
3 Passenger information
4 Lights
5 Water tanks
6 Audio announcements
7 Video surveillance
8 Doors
9 Batteries
10 Emergency communications
11 Data protection (black box)
12 Train-to-wayside communications

2. DC/DC Converter in railway *trackside electronic equipment*



3. DC/DC Converter in railway *communication systems*



Signalling and communication Systems	ATC(Automatic train control)	ATS(Automatic train stop)	Auxiliary Power Supply system	Air conditioning system	Video surveillance

Requirements of electrical and electronic equipment in railway application

Comply with the Standard

The one most frequently cited in design specifications is European Norm EN50155 (IEC571), "Electronic Equipment Used on Rolling Stock Equipment." In the U.K. the standard that applies is RIA12, "General Specification for Protection of Traction and Rolling Stock Equipment from Transients and Surges in DC Control Systems," developed by the Railway Industries Association (RIA).

What are the requirements for vehicle power supply

Nominal Input	Permanent Input Range	Transients	
		Low(0.1s)	High(1s)
(V_N)	0.7(V_N)–1.25(V_N)	0.6(V_N)	1.4(V_N)
24V	17–30V	14V	34V
36V	25–45V	22V	61V
48V	34–60V	29V	67V
72V	50–90V	43V	101V
96V	67–120V	58V	135V
110V	77–137V	66V	154V

Table 1: Input Specifications for EN50155

1. Operating Voltage Ranges

Table 1 lists the nominal input voltages (VN) provided by power sources used for railway applications.

Equipment powered directly from batteries with no voltage stabilizing device must function properly with input voltages that range from 0.7(VN) to 1.25(VN) during normal operation.

The equipment must also withstand input voltage drops of 0.6(VN) for 100ms and overvoltage surges of 1.4(VN) for one second that may occur during startup.

MORNSUN railway DC/DC Converter

6-20W URB1D-R3 series offers input voltage of 40-160VDC, compatible with vehicle battery of 72VDC, 96VDC, 110VDC.

50-150W URF1D series offers input voltage range of 66-160VDC,compatible with vehicle battery of 96VDC, 110VDC.

What are the requirements for vehicle power supply

2. Shock and vibration

Railway vehicles are subject to shock and vibration owing to the nature of railway operational environment. Therefore, random shock and vibration tests are required for the installation of electronic equipment.

MORNSUN railway power converter R3 series fully meet the requirements of Class B, Category 1 Body mounted (EN61371: 2010) for wide voltage input range.

3. Isolation

Isolation is one of effective methods to prevent fault diffusion and plays an important role in vehicle electronic equipment. Equipment's dielectric test is closely relate to vehicle battery voltage. Relevant requirements are Table 2.

Given that vehicle battery is uncertain, it may cause float charge. 110V battery float to 125V or low-voltage transformer over 125V. In this situation, 1500VAC isolation is recommended to meet transient over-voltage.

MORNSUN 6-20W URB1D-R3 series railway power converter offering 1500VAC/2250VDC isolation and 50-150W URF1D series offering 3000VDC are the good choices.

Vehicle battery voltage	Isolation
24V	500VAC/50Hz/1min
48V	500VAC/50Hz/1min
72-125V	1000VAC/50Hz/1min
125V-315V	1500VAC/50Hz/1min

Table 2: Relationship between vehicle battery voltage and Isolation

What are the requirements for vehicle power supply

4. Surge Protection

The RIA12 standard specifies that equipment must withstand a 20ms overvoltage surge 3.5 times greater than the nominal input voltage. For each of the standard input voltages, the maximum input surges are Table 3,

To meet this standard, a suppression circuit must be used with the DC-DC converter. Since the source impedance of this overvoltage pulse is 0.2Ω. Assuming that the rated battery voltage is 110VDC, a single clamp components (clamp voltage: 160VDC) for protection is difficult to absorb about a maximum of 2475J energy (=2475J). Specialized circuits or power supply are recommended.

MORNSUN auxiliary filters adopt conduction power device to form an active clamp circuit helping the transient surge voltage clamp to the withstanding range of railway power converter. Take an example, EMC filter FC-CX3D offers input voltage range of 66VDC-160VDC, maximum 100W output power and maximum 165VDC clamping voltage, and provides high efficiency up to 98% with active clamp circuit, patent protection.

V_N	$3.5(V_N)$
24V	84V
36V	126V
48V	168V
72V	252V
96V	336V
110V	385V

Table 3: Relationship between input voltage and input surge

5. Temperature and humidity

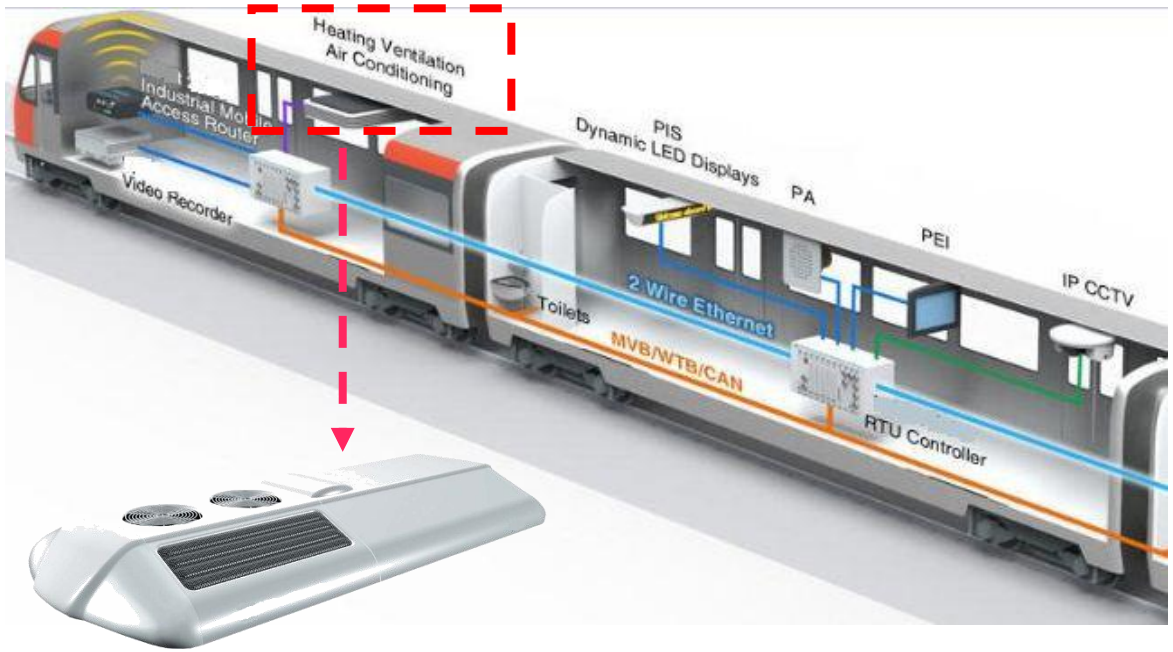
Operating temperatures are divided into four classes according to the severity of the environment, as shown in Table 4. When designing the power supply, it is necessary to consider over-temperature during start-up, indicated in the third column.

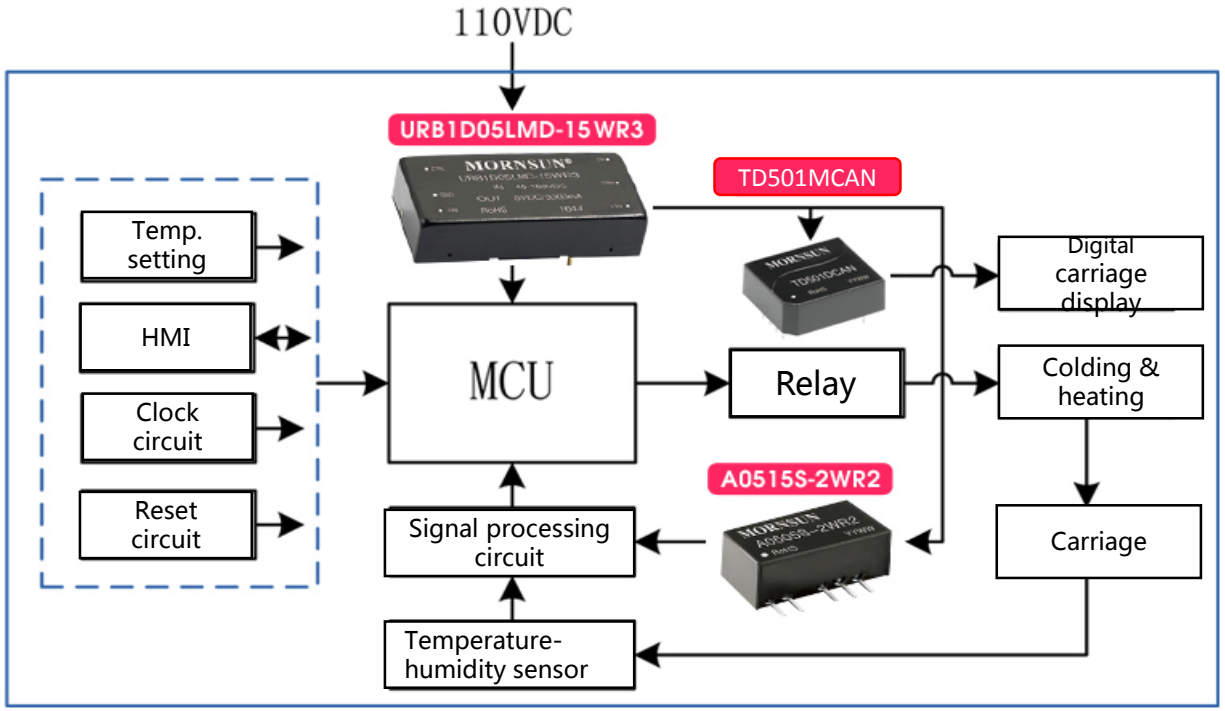
MORNSUN railway power converter is monitored with high quality from design and manufacture with a strict quality control system and passes the railway reliability tests.

Class	Column 1	Column 2	Column 3	Column 4
	Ambient temperature outside vehicle (EN 50125-1, Table 2, Column 1) °C	Internal cubicle temperature °C	Internal cubicle overtemperature during 10 min °C	Air temperature surrounding the printed board assembly °C
T1	-25 +40	-25 +55	+15	-25 +70
T2	-40 +35	-40 +55	+15	-40 +70
T3	-25 +45	-25 +70	+15	-25 +85
TX	-40 +50	-40 +70	+15	-40 +85

Table 4: Operating Temperature Ranges in railway application

On-board system---DC/DC Converter in Air Conditioning control(HVAC controller)





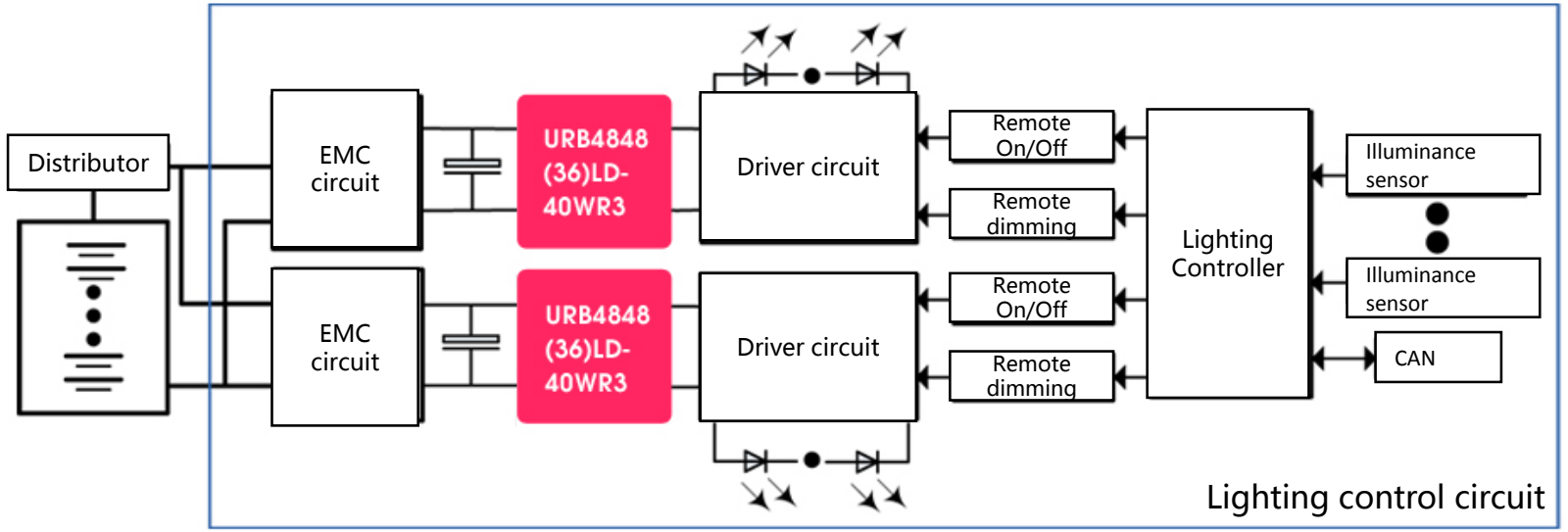
URB1D05LMD-15WR3

- Ultra wide input voltage range of 40-160VDC
- Enhanced isolation, isolation voltage: 2250VDC
- Operating temperature range: -40℃ to +85℃
- Input Under-voltage Protection, Output short circuit, over-current, over–voltage protection

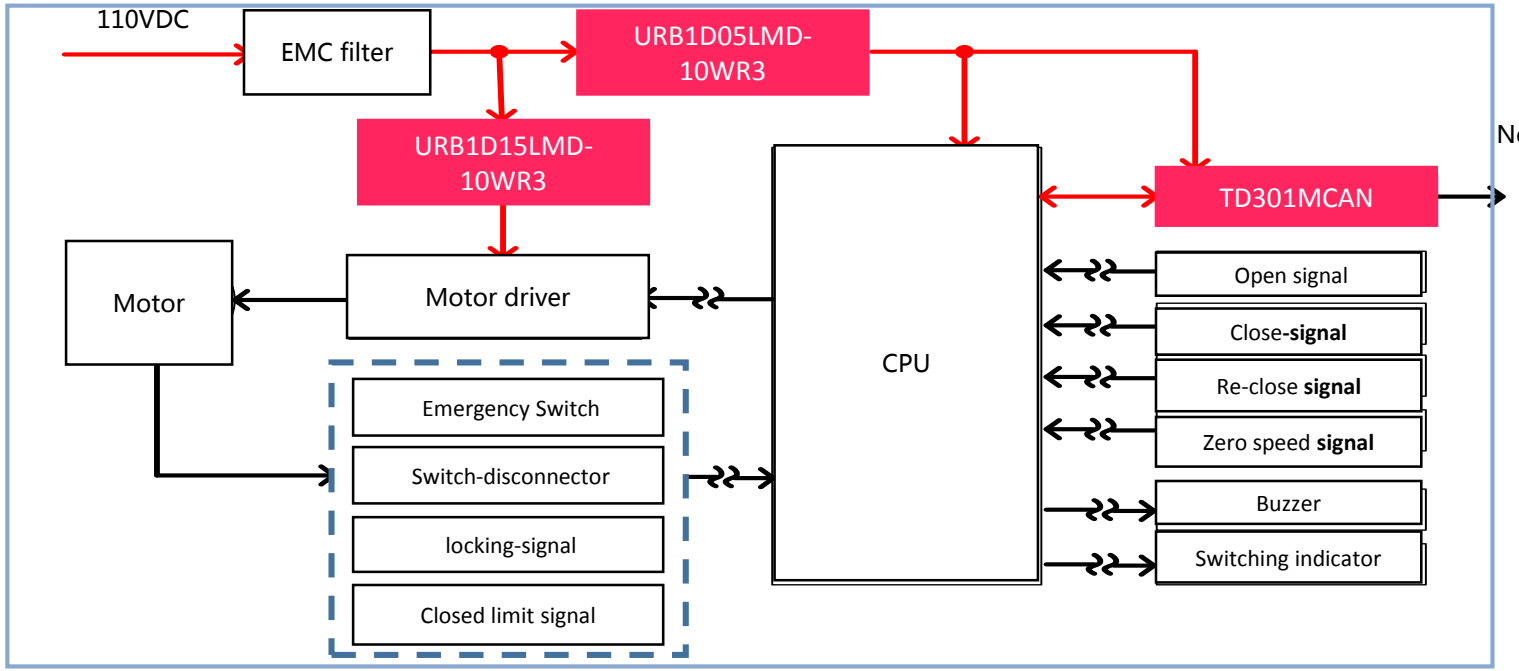
- ✓ EMI meets EN50121-3-2, without external Components
- ✓ Meets requirements of railway standard EN50155
- ✓ IEC60950, UL60950, EN60950 approval(pending)
- ✓ Reverse voltage protection available with A2S(Chassis mounting) or A4S(35mm DIN-Rail mounting)

On-board system---DC/DC Converter in **LED Lighting System**

LED lighting to illuminate railway carriage ceilings, walls, steps, toilets and vestibules

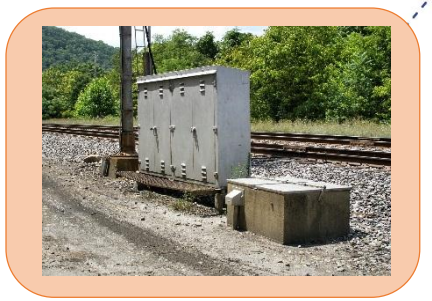


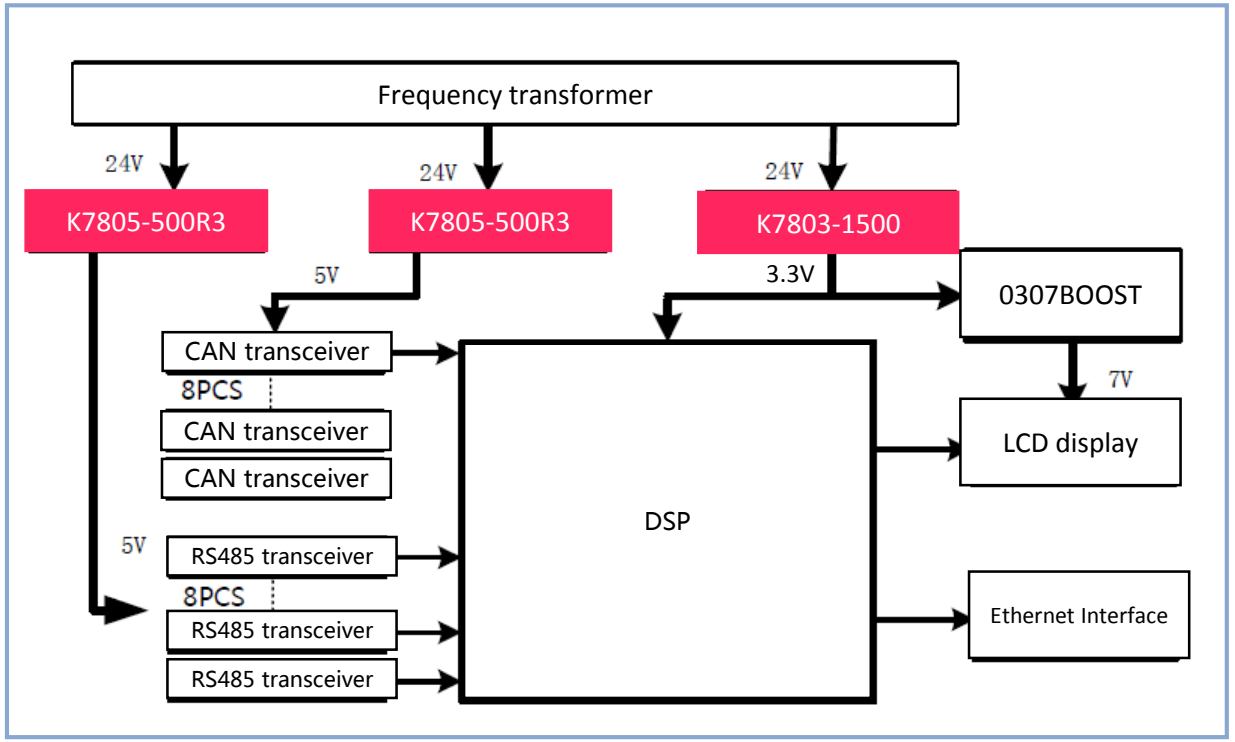
On-board system---DC/DC Converter in **Sliding plug door control**



Trackside electrical equipment --DC/DC Converter in track monitoring system

Track Monitoring System (STS) provides a complete detection package for monitoring the most prevalent hazardous railway conditions.
The STS combines critical rail-mounted sensor technology with an advanced control system which monitors all systems and broadcasts customized warnings over a local radio channel or by wireless modem.





Mornsun DC/DC converter for railway application

6-150W DC/DC converter meet EN50155

Series	Power(W)	Input voltage range(V)	Output voltage(V)	Isolation Voltage(V)
URB1D_YMD-6WR3	5	40-160VDC(110VDC)	5/12/15/24	2250VDC
URB1D_LMD-10WR3	10	40-160VDC(110VDC)	3.3/5/12/15/24	2250VDC
URB1D_LMD-15WR3	15	40-160VDC(110VDC)	3.3/05/12/15/24	2250VDC
URB1D_LMD-20WR3	20	40-160VDC(110VDC)	3.3/5/12/15/24	2250VDC
URB1D_LD-20WR3	20	40-160VDC(110VDC)	3.3/05/12/15/24	2250VDC
URF1D_QB-50W	50	66-160VDC(110VDC)	5/12/15/24	3000VDC
URF1D_QB-75W	75	66-160VDC(110VDC)	5/12/15/24	3000VDC
URF1D_QB-100W	100	66-160VDC(110VDC)	12/15/24	3000VDC
URF1D_HB-150W	150	66-160VDC(110VDC)	12/15/24	3000VDC

- ✓ EMI meets EN50121-3-2, without external Components
- ✓ Meets requirements of railway standard EN50155
- ✓ IEC60950, UL60950, EN60950 approval(pending)
- ✓ Reverse voltage protection available with A2S(Chassis mounting) or A4S(35mm DIN-Rail mounting)

2:1/4:1 wide input R3 series

Series	Power(W)	Input voltage range(V)	Output voltage(V)	Isolation Voltage(V)
VRB_YMD-6WR3	6	9-18/18-36/36-75	3.3/5/9/12/15/24	1500VDC
VRB_YMD-10WR3	10	18-36	5/12/15/24	1500VDC
VRB_LD-15WR3	15	18-36/36-75	5/12/15/24	1500VDC
VRB_LD-20WR3	20	18-36/36-75	3.3/5/9/12/15/24	1500VDC
VRB_LD-30WR3	30	18-36/36-75	3.3/5/9/12/15/24	1500VDC
URB_YMD-6WR3	6	9-36/18-72	3.3/5/9/12/15/24	1500VDC
URB_YMD-10WR3	10	9-36/18-72	3.3/5/9/12/15/24	1500VDC
URB_LD-20WR3	20	9-36/18-72	3.3/5/9/12/15/24	1500VDC
URB_LD-30WR3	30	9-36/18-72	3.3/5/9/12/15/24	1500VDC
K78-500R3		4.75-36	03/05/12/15/24	non-isolated
K78-1000R3		6-36	05/12/15/24	non-isolated

20W Product Parameter Comparison *data from datasheet

	MORNSUN	TRACO	RECOM	Synqor
Series	URB1D_LMD-20WR3	TEN 20WIR	RP20-FR	RQ68xxxQMXxx
Dimension	50.8*25.4*11.8(mm)	50.8*25.4*10.2(mm)	25.4*25.4*10.2(mm)	(60.60 x 39.01 x 12.70 mm (1/4-brick pin-out)
Power	20W	20W	20W	26.4W
Input voltage (V)	40-160	9-36/18-75/43-160	9-36/18-75/43-160	12-155
Output voltage(V)	3.3/5/12/15/24	3.3/5/12/15/±12/±15	3.3/5/12/15/±12/±15	5/12/15/24
Output current(mA)	Depend on output	Depend on output	Depend on output	Depend on output
Efficiency	80%~86%	85-89%	85-89%	84%~86%
Operating Temp.	–40℃ to +85℃ (with derating)	–40℃ to +85℃ (with derating)	-40℃ to +79℃ without derating -40℃ to +101℃ with derating	-40°C~+110°C (derating from 85℃)
Isolation Capacitance	2200pF typ..	3000 pF max.	3000pF max.	1000pF
Ripple & Noise	100mVp-p max	100 mVp-p typ.	100mVp-p	150mVp-p max
Isolation voltage	2250 VDC for 60s	2250 VDC for 60s	2250 VDC for 60s	3000VDC
Short-circuit protection	Continuous, self-recovery	indefinite (automatic recovery	continuous, automatic recovery	yes
Certified	IEC60950, UL60950, EN60950 EN50155, pending	UL/cUL 60950-1, IEC/EN 60950-1, EN 50155	EN50155 ,UL60950, CSA C22.2 No.601.1 Certified	UL 60950-1 CAN/CSA C22.2 No. 60950-1 EN 60950-1 EN45545-2 R24/R25 Compliant
Application	Railway	Railway	Railway	Railway

For more information please visit

www.mornsun-power.com