

# *Series E6 Shinkansen*



**East Japan Railway Company**

**Transport and rolling stock DEPT**

**Rolling stock technology center**

**Hitoshi Shiraishi**

# Outline of JR East

---



# ◆ Outline of JR East

***JR EAST, a passenger railway company,  
is the largest railway company in JAPAN***

Network: 7,512.6km

No. of Passengers: 16.8 million/day

No. of Trains: 12,784/day

No. of Employees: 59,370

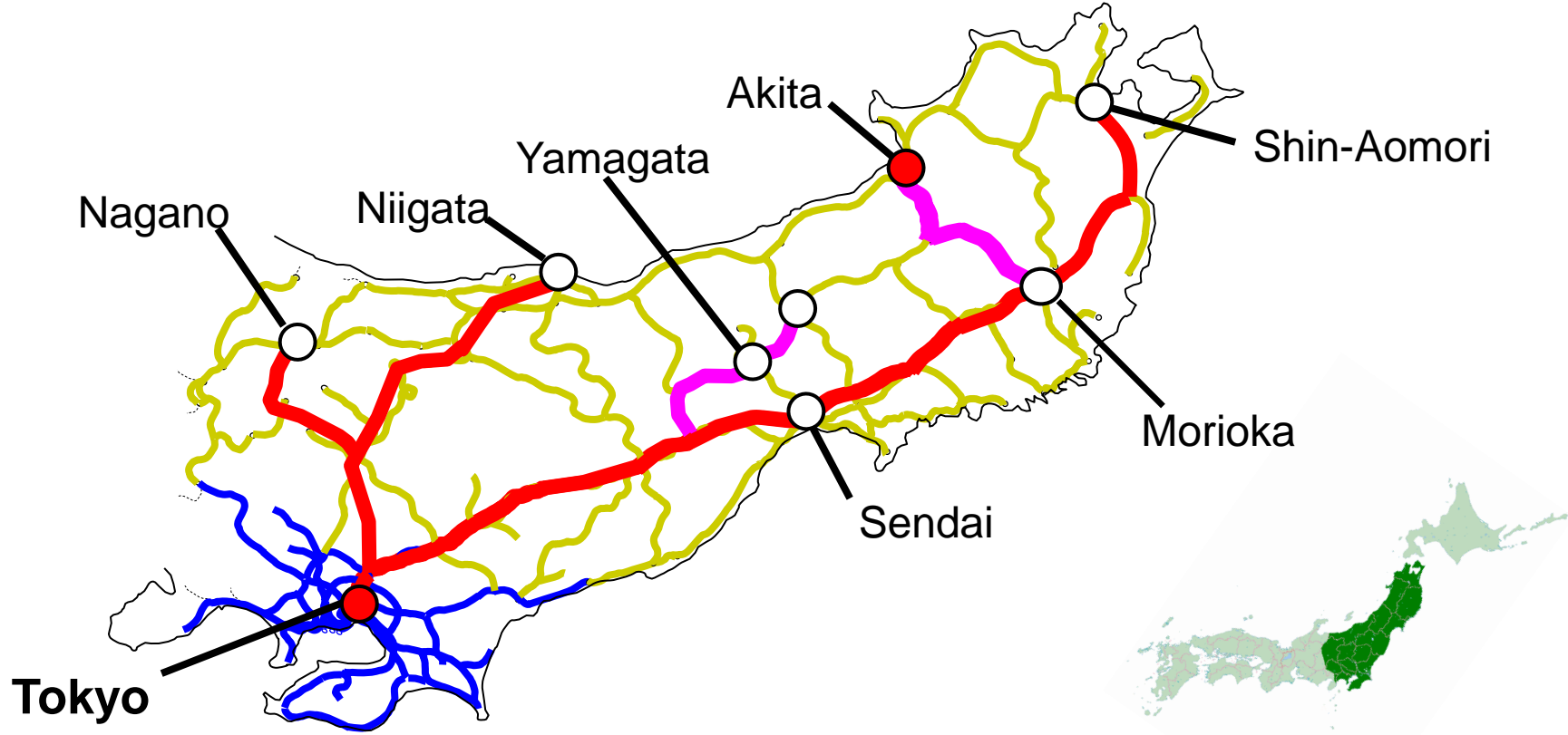
No. of Rolling stock: 13,469



\*Numbers are as of FY ended March 31, 2013



# ◆ Network of JR East



		Network	Gauge	Power supply	Max Speed
High speed network	Dedicated lines	1134.7 km	Standard (1435mm)	AC 25kv 50Hz	320km/h
	Gauge-converted conventional lines for through service	275.6 km		AC 20kv 50Hz	130km/h on electrified
Tokyo urban network		2536.2 km	Narrow (1067mm)	DC 1.5kv / AC 20kv 50Hz or Non-electrified	100km/h on non-electrified
Local network		3566.1 km			

# ◆ Rolling stock of JR East

Shinkansen “EMU\*1”

Number of rolling stock : 1,290



“EMU\*1” for conventional lines  
Number of rolling stock: 11,063



“DMU\*2” for conventional lines  
Number of rolling stock: 519



Others

Passenger coach:141, Locomotives:104

Steam locomotives:3, Freight cars:349



\*1 EMU: Electric multiple unit

\*2 DMU: Diesel multiple unit

\*Numbers are as of FY ended March 31 , 2013

# Shinkansen of JR East

---



# ◆ Types of Shinkansen

## Standard

•For longer trips



320km/h



275km/h

## Large capacity “Double decker”

•Large capacity for commuting



240km/h

## Through service

•For through service  
with coupling/uncoupling functions



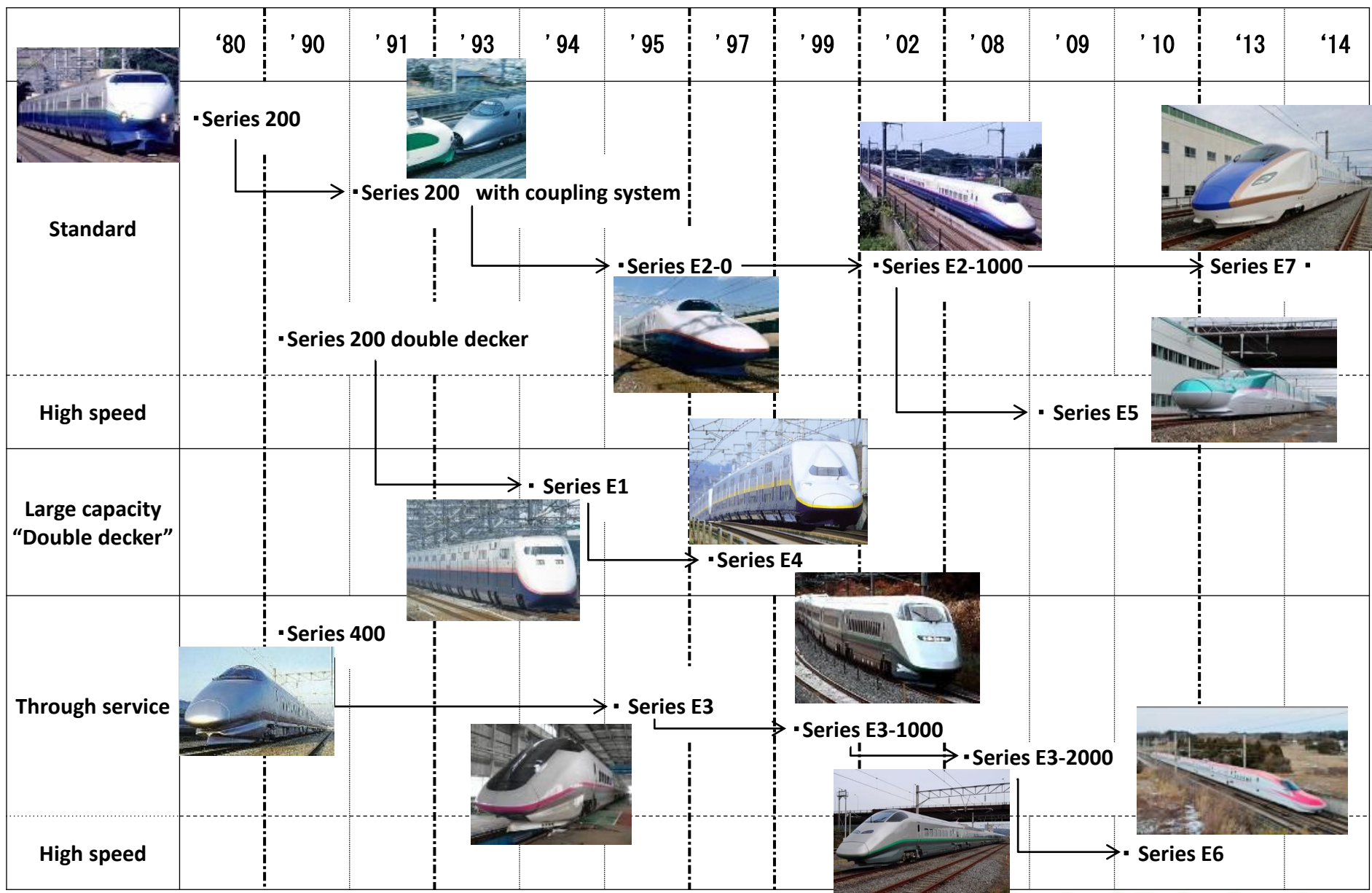
320km/h



275km/h

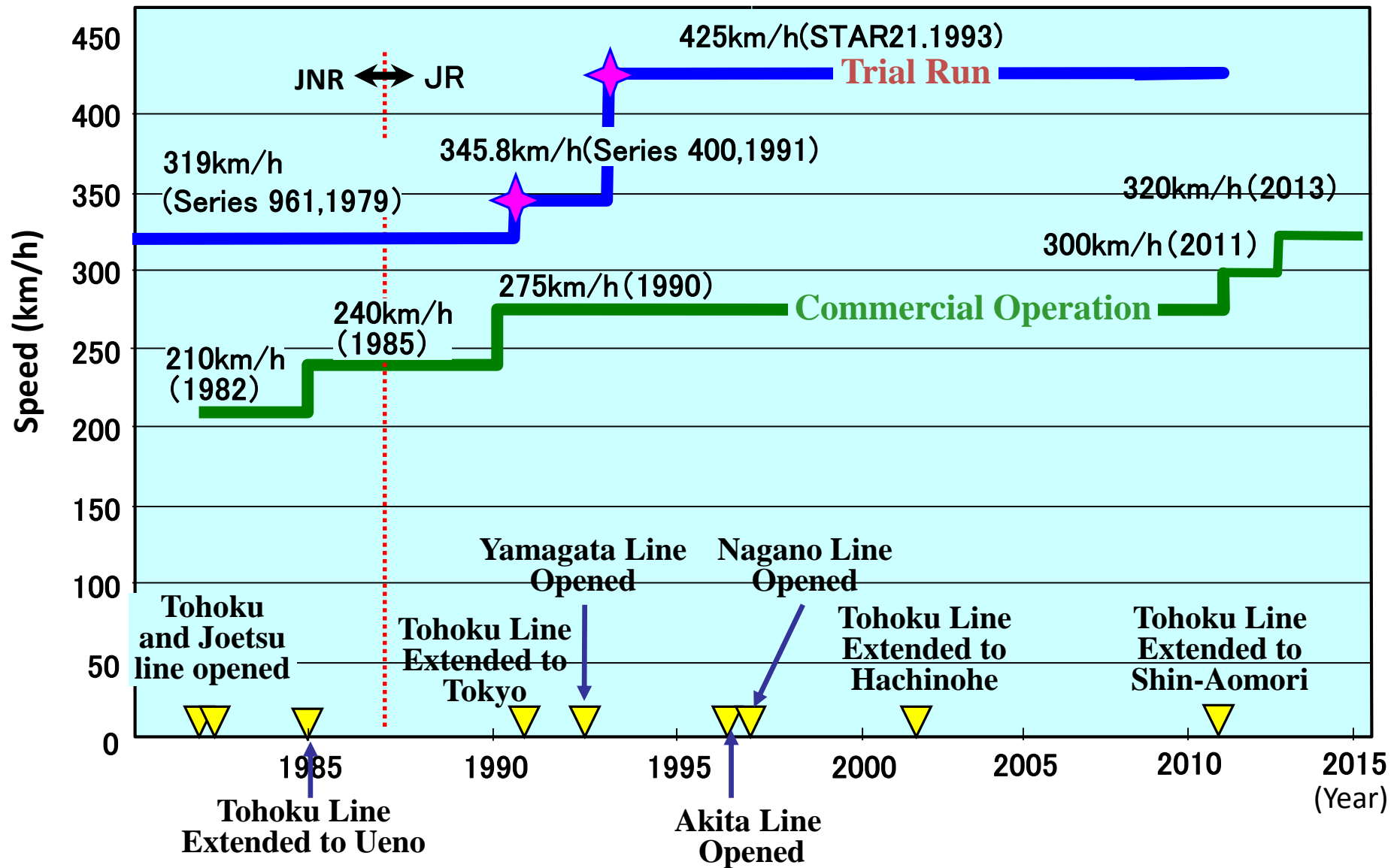


# History





# ◆ History of Speed Improvement










# Series E6 Shinkansen

---



# ◆ Main specification

									
Train	Basic trainset : 5M2T								
Max operation speed	Dedicated line : 320km/h				Conventional line sections: 130km/h				
Car type	E611-0/Mc	E628-0/T	E625-0/M	E625-100/M	E627-0/M	E629-0/T	E621-0/Mc		
Passenger seating capacity	22	34	60	60	68	60	32		
	Total capacity : 336 First class :22 Ordinary class : 314								
Weight	45.1 t	44.4 t	41.7 t	41.8 t	42.1 t	44.2 t	43.4t		
	Total : 302.7t								
Car body	Length	23,075mm	20,500mm					23,075mm	
		Total : 148,650m							
	Width	2,945mm							
	Height	3,650mm	4,490mm	3,650mm			4,490mm	3,650mm	
	Bogie center distance	14,150mm							
	Structure	Aluminum alloy airtight shell							
Bogies	Gauge	1,435mm							
	Type	Bolsterless : Active suspension system, Tilting system							
	Wheel base	2,500mm							
	Wheel diameter	860mm							
	Drive system	Parallel cardan system							



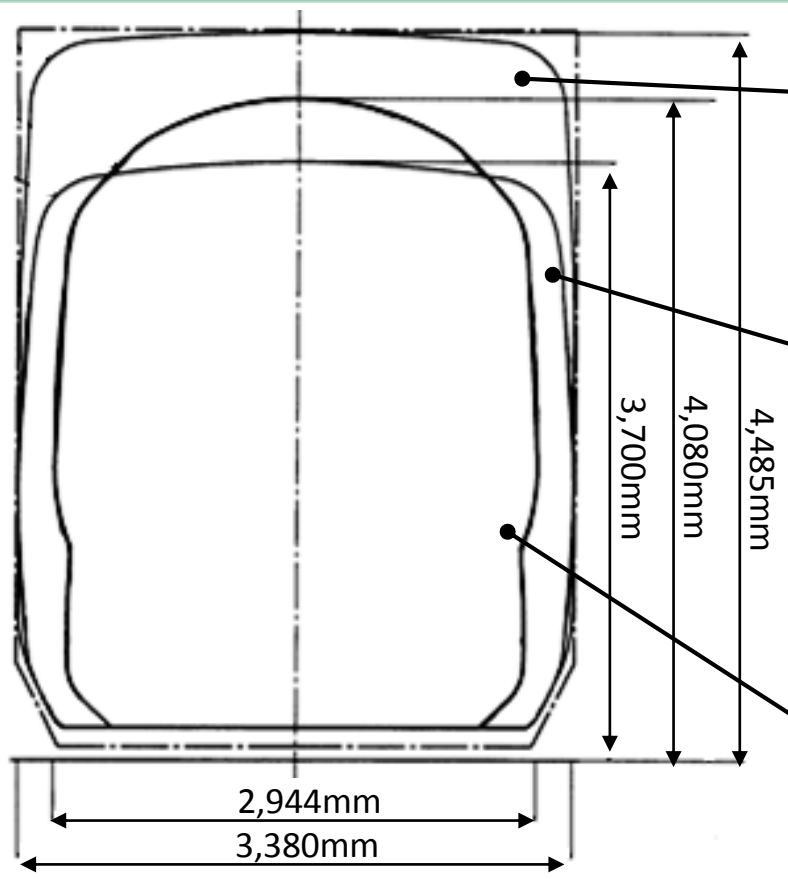
# ◆ Main specification



Electric system	Dedicated line : AC 50Hz 25,000V Conventional line sections: AC 50Hz 20,000V
Current collection	Single-arm pantograph : Raised by spring force, lowered by pneumatic pressure
Power control system	VVVF inverter control
Traction motor	Induction motor : Continuous rated output : 300kW
Brake system	Electric command air brakes with regenerative braking
Air conditioning equipment	Central system ; Cooling 54.66kW Hearing 32kW
Safety device	Dedicated line ; DS-ATC : Automatic train control pattern system + RS-ATC : Radio ATC Conventional line ; ATS-P : Automatic train stop - pattern type
Train radio	Dedicated line ; LCX radio + yard protection radio Conventional line sections; ; Train radio + Train protection radio

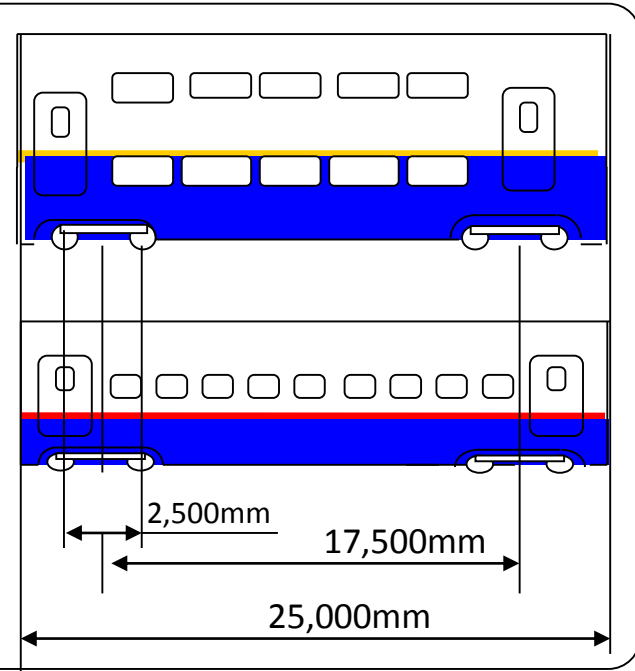


# ◆ Car body size



**Double Decker Series E4**

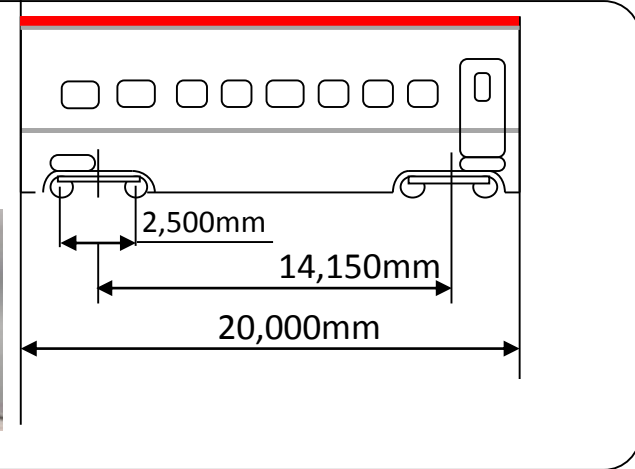
**Standard Series E2**



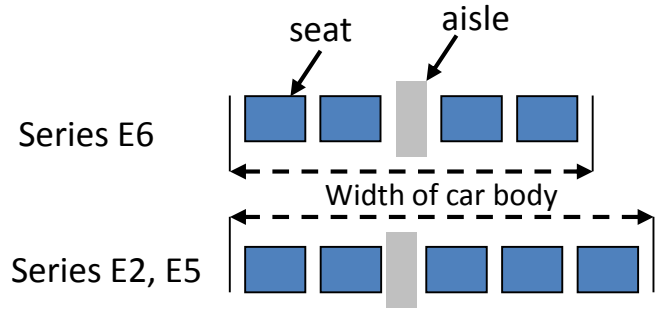
**Through service Series E6**

door

platform step on the doors



## Seat arrangement in Ordinary Car



# ◆ Passenger cabins

## First class



- Lights for reading
- Electric leg rests
- Adjustable head rests

## Ordinary class



- Adjustable head rests

	First class	Ordinary class
Seat pitch	1,160mm	980mm
Height of seats	1,170mm	1.150mm
Width of seats	465mm	450mm



# ◆ Passenger cabins - Barrier-free -

- Able to use with motorized wheel chairs
- Able to wash pouch for ostomy



Barrier-free restroom



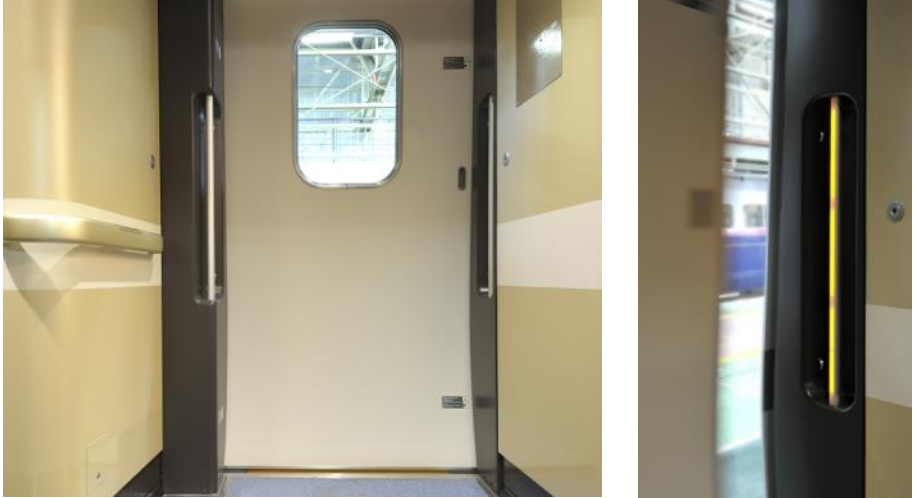
Motorized wheel chairs



System for ostomy



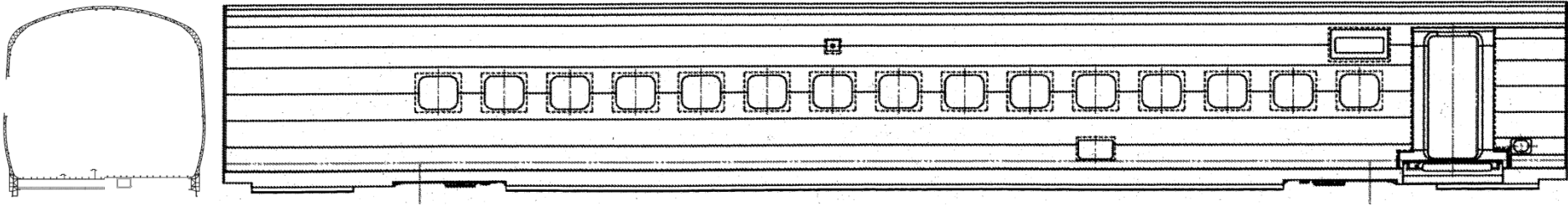
Large annunciator with full-color LEDs



Grab handle with blinking lights when open/close

# ◆ Car body construction

- Structure : Aluminum alloy, Double skin panel, Airtight shell
- Airtight load : 8.2kPa



## Obstacle deflector and snowplow

### Scenario

Mass :100kg  
Height 250mm



V=320km/h

Force :18.2t



V=240km/h



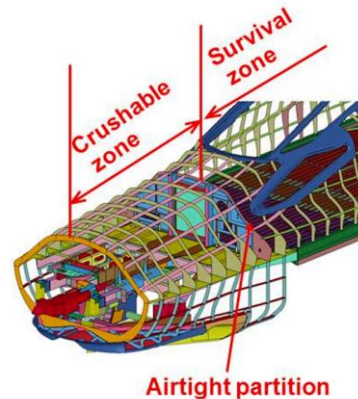
## Crashworthiness design

### Scenario

40 ton truck



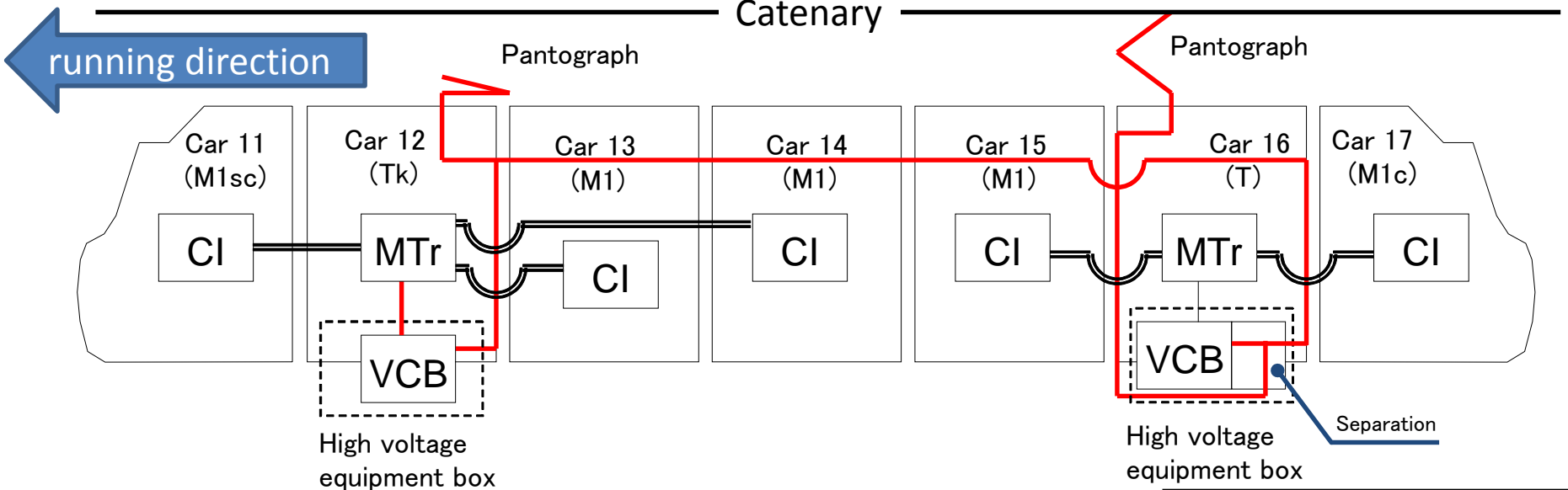
V=70 km/h





# ◆ Train performances

- Traction motor : Induction motor 300kW × 20 = 6,000kW
- Control system : VVVF inverter control
- Acceleration : 0.474m/s<sup>2</sup>, 25,000V/50Hz  
0.556m/s<sup>2</sup>, 20,000V/50Hz
- Balancing speed: 360km/h, Open section, 3‰ 25,000V/50Hz  
Over 120km/h, Open section, 25‰ 20,000V/50Hz



— Ultra – high voltage wiring : AC 25,000V/20,000V 50Hz

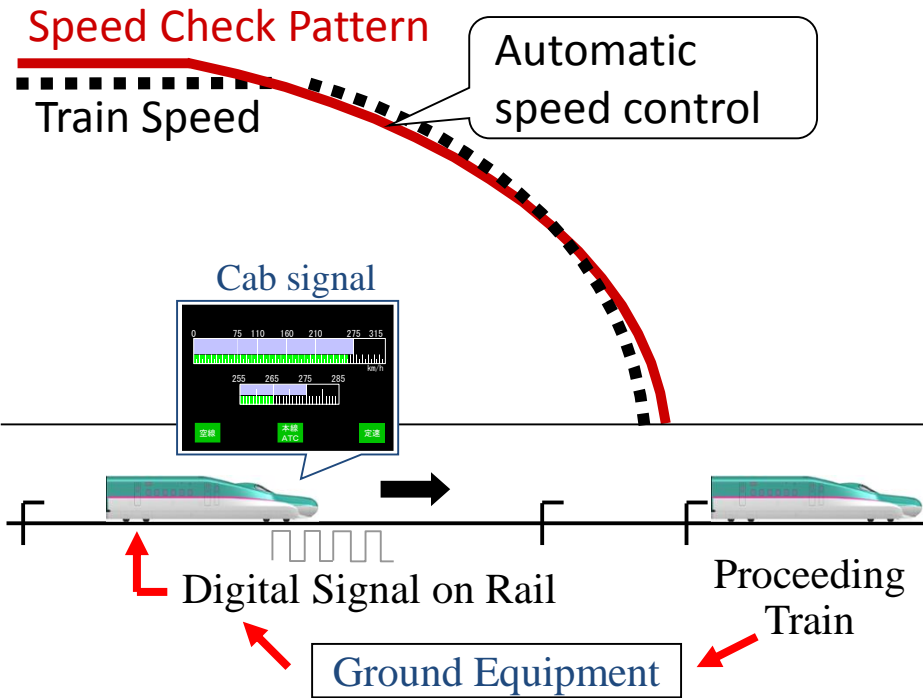
══ MTr secondary wiring : AC 1,500V 50Hz

CI : Converter/Inverter  
MTr : Main transformer  
VCB : Vacuum circuit breaker



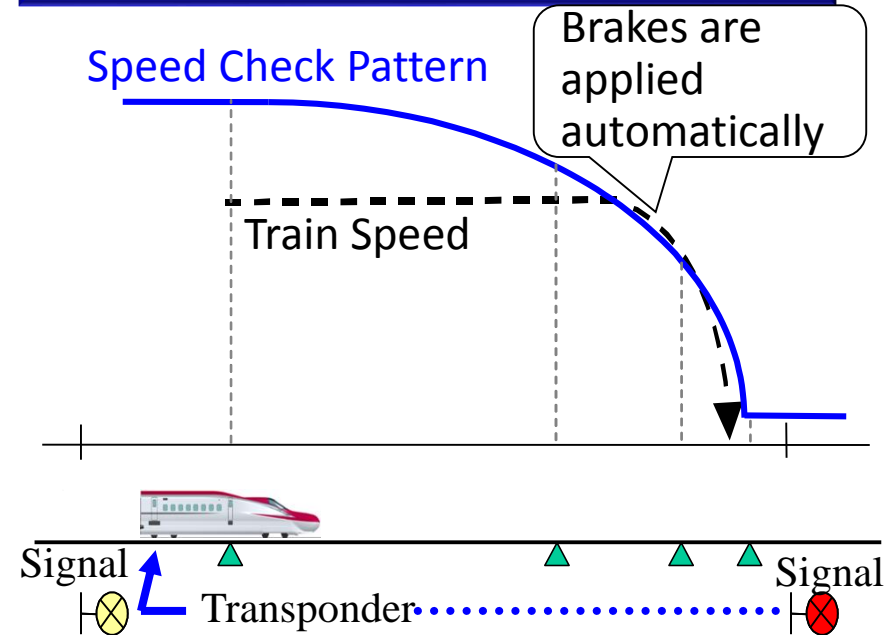
# ◆ Safety device

## Digital-ATC (Dedicated line)



- Ground equipment provides cab signals through rail.
- Ground equipment provides stop location in real time based on location of proceeding train.

## ATS-P : Automatic Train Stop P-type (Conventional line)



- Transponder provides wayside signal.
- Transponder provides data about distance to wayside stop signal.



# ◆ Air conditioning equipment

- Compact air conditioning unit both forced ventilation system and air conditioning

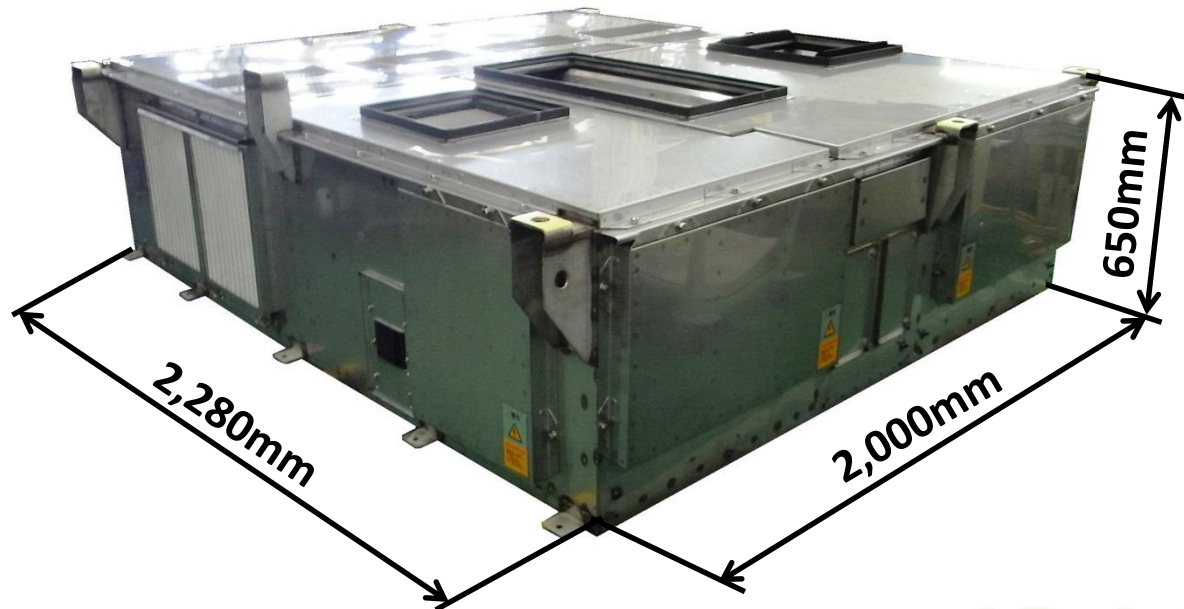
Power source : AC 400V/50Hz

Cooling : 54.66kW

Heating : 32kW

Ventilation volume : 17m<sup>3</sup>/min

Pressure variation in cabin : Under 0.8kPa/4s



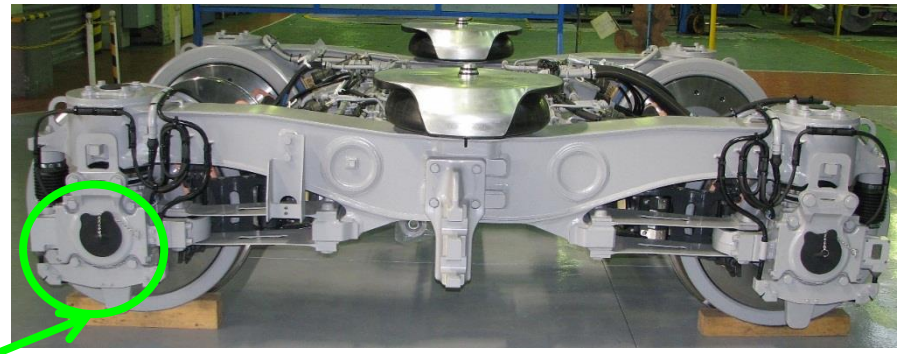
# ◆ Running gear

- Active suspension for good riding comfort
- Air suspension tilting system for good riding comfort on the curve
- Stability on dedicated line at high speed and curving performance on conventional line

### Driving bogie



### Trailer bogie



**Oil lubricating journal bearing + Induction-hardened axle**

### Break gear



Driving bogie	Trailer bogie
Wheel - break disk	Wheel - brake disk + One axle - brake disk

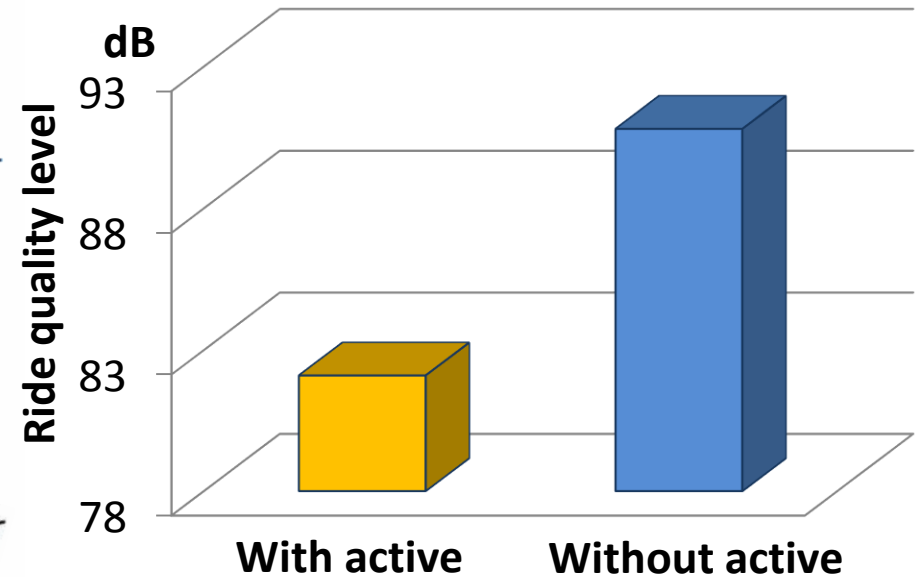
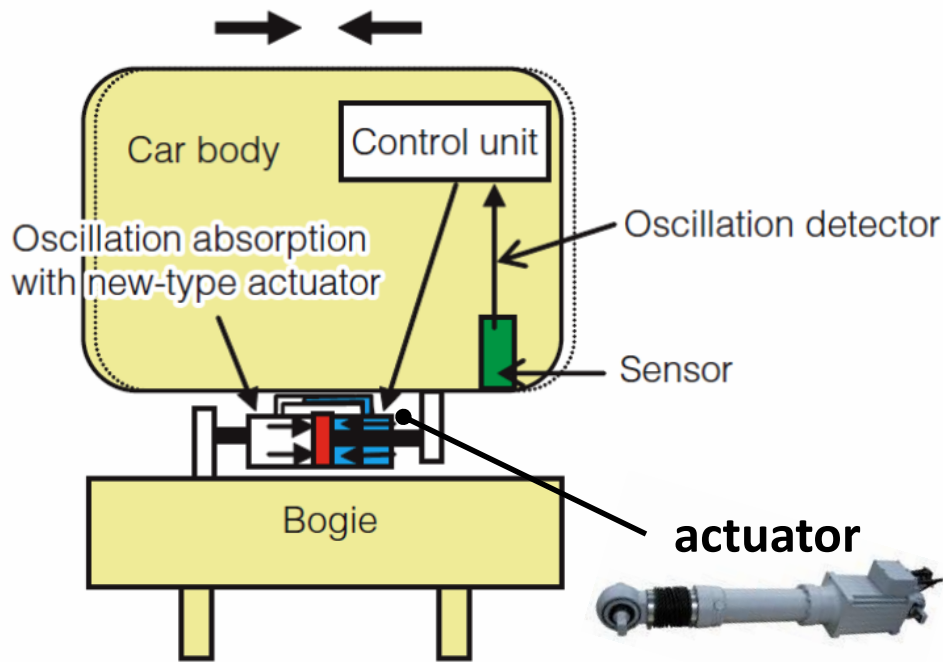
**Minimum brake distance : About 4,000m from 320km/h on emergency brake**



# ◆ Active suspension

- Detect the oscillation of car body by sensor
- Absorb the lateral oscillation by actuator

Operation speed : Over 100km/h, Dedicated line  
Over 50km/h, Conventional line



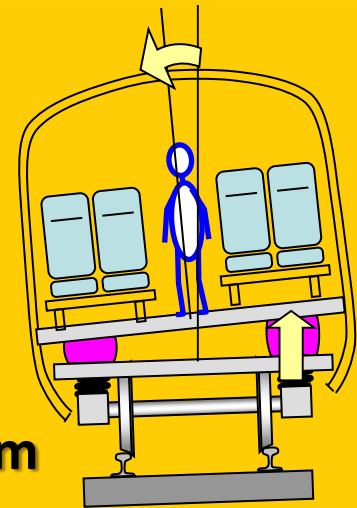
# ◆ Curving performance

## Tilting System

- On dedicated line, by using air suspension tilting system, curving performance is improved.
- Air suspension tilting has advantage in cost and maintenance.

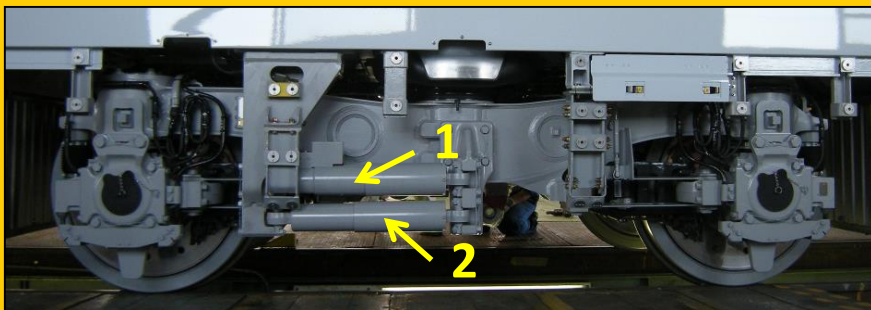
Maximum inclination angle : 1.5 degree.

Steady lateral acceleration : under  $0.9\text{m/s}^2$  R4000, C 155mm



## Yaw dumper switching system

- On conventional lines, by switching off one dumper, the load to the track can be reduced.



Dedicated line : Yaw dumper 1+2

Conventional Line : Yaw dumper 2

Radius : m	Speed : km/h
$400 \leq R < 450$	90
$500 \leq R < 600$	100
$600 \leq R < 700$	110
$R \geq 1000$	130

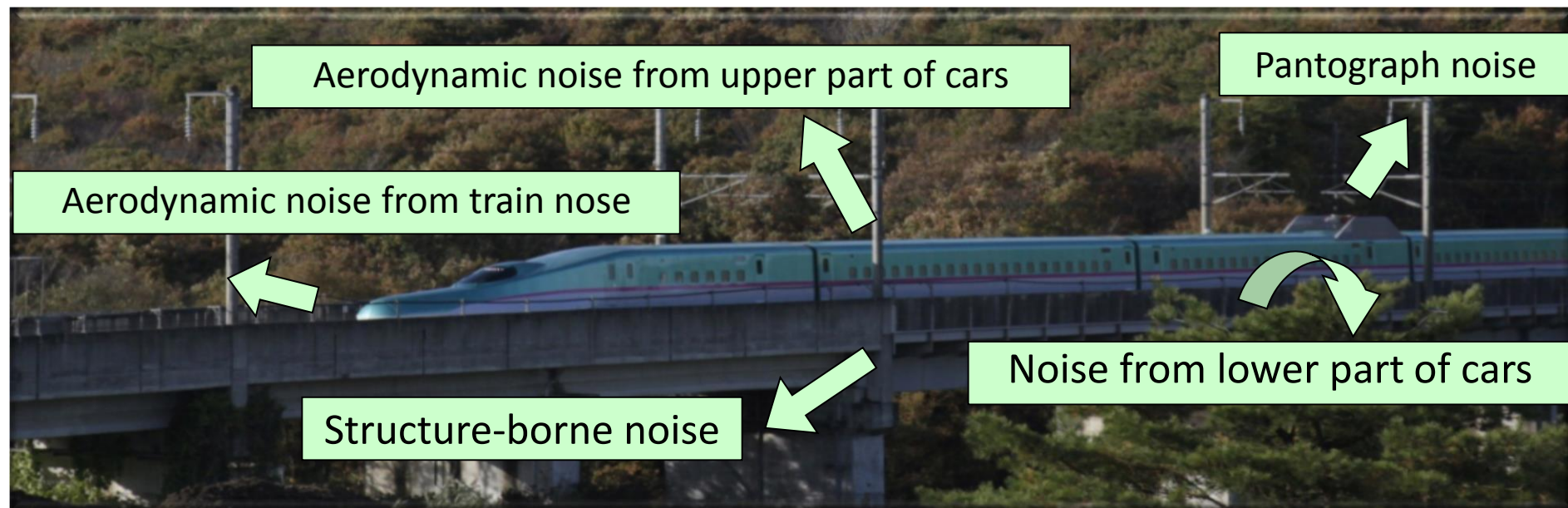


# ◆ Noise reduction

## ***Noise Reduction :***

***Noise generated by a brand new 320 km/h railcar, E5,E6  
= Noise generated by a previous 275 km/h railcar, E2***

## **Noise sources**



# ◆ Noise reduction

Aerodynamic noise from upper part : Circumferential diaphragm

Aerodynamic noise from train nose : Snowplow fins

Noise from lower part : Bogie cover

Shroud panels with sound-absorbing panel



Snowplow fins



Bogie Cover



Case of Series E5  
dedicated bullet  
train



Circumferential  
diaphragm



Shroud panels with  
sound-absorbing panel

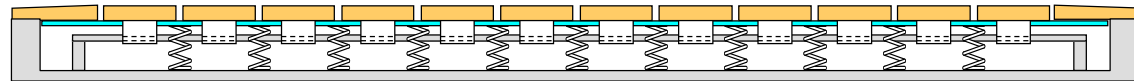
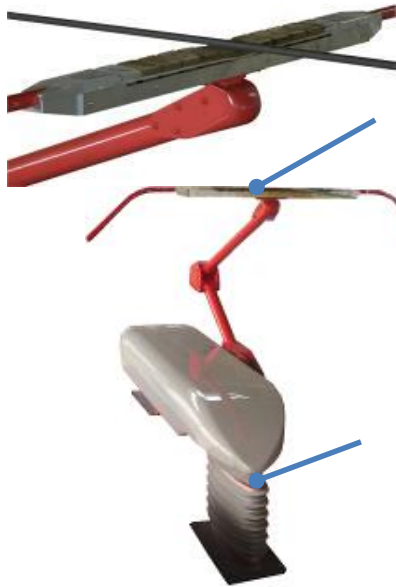
We have developed suitable aerodynamic shapes to achieve the stringent noise standards of Japan within limitations such as small body.





# ◆ Noise reduction

**Pantograph noise : One pantograph power collect  
Pantograph wit multi-segmented contact strip  
Low noise insulator  
Insulation panel**



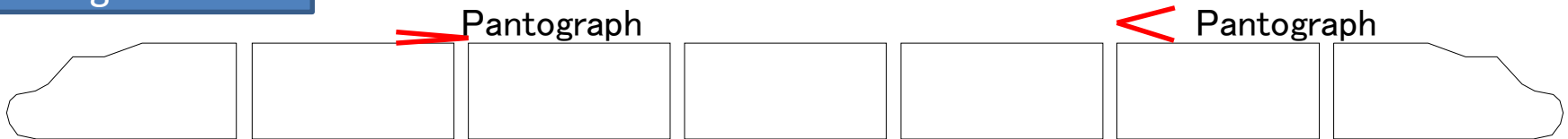
multi-segmented contact strip

Low noise insulator



Case of Series E5 dedicated bullet train

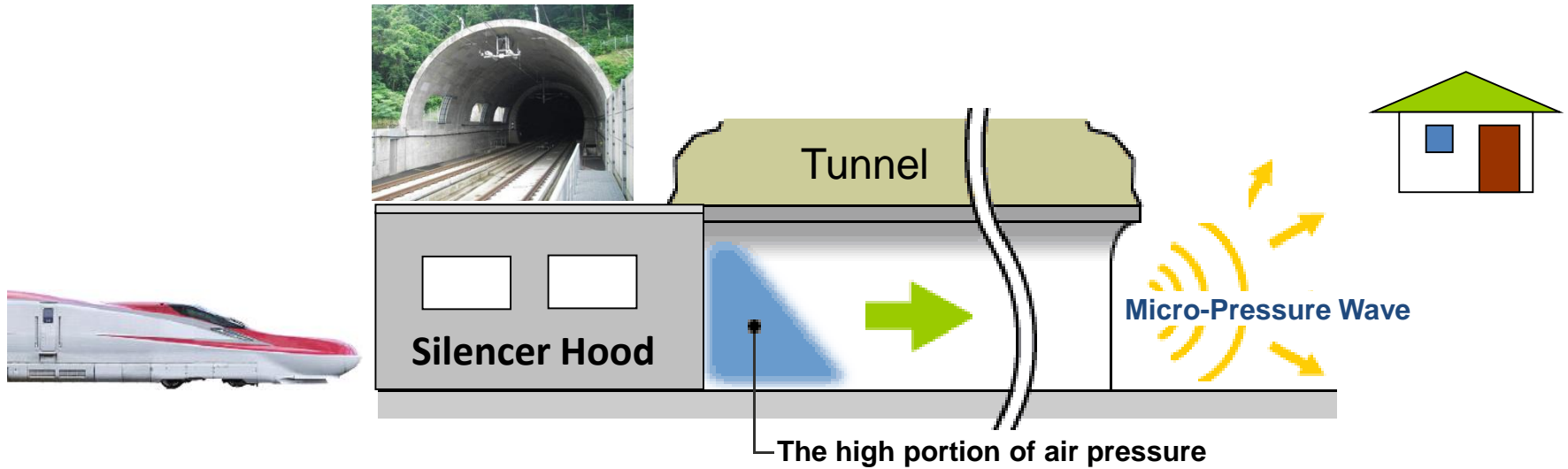
Pantograph and insulation panel



One pantograph power collect

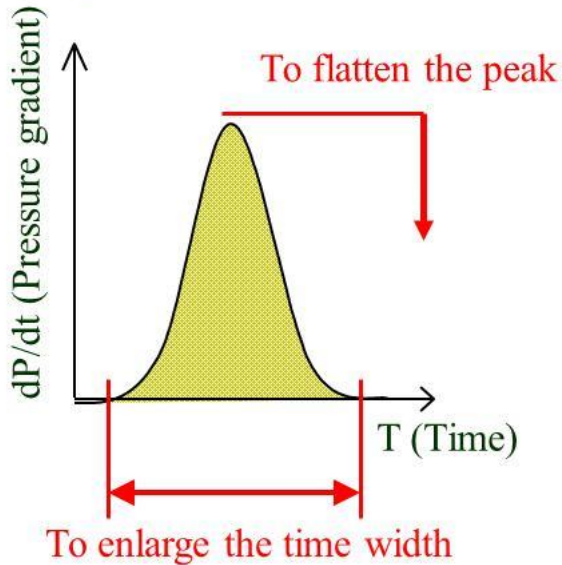


# ◆ Micro-presser wave reduction



## “Long nose shape” for reduction of Micro-Pressure Wave

### Objective of Measures



<p><b>【Series E6】</b>                      Length of nose: 13m                      Cross-section: 9.34m<sup>2</sup></p>	
<p><b>【Series E3】</b>                      Length of nose: 6m                      Cross-section: 10.29m<sup>2</sup></p>	
<p><b>【Series E5】</b>                      Length of nose: 15m                      Cross-section: 10.8m<sup>2</sup></p>	

# ◆ Provisions for snow

In winter, there is a lot of snow in the Akita district.

- Heaters around bogie section
- Removing snow of bogie and bogie covers at Morioka station



## Heaters



  See from this angle



With heater



Without heater

## Removing snow at Morioka station



MAX 8 minutes



# ◆ Summary

- ◆ JR EAST has three types of Shinkansen trains.
- ◆ The Series E6 is “Through service type”, began its commercial service between Tokyo and Akita in March 2013.
- ◆ Operation speed of Series E6 is 320km/h on dedicated line and 130km/h on conventional line sections.
- ◆ Series E6 is a vehicle with many state-of-the-art technologies for noise reduction and passengers’ riding comfort.



A blurred image of a high-speed train, likely a Shinkansen, moving from left to right. The train is white with a red stripe along the top. The background is a blurred landscape, suggesting high speed.

**Thank you for  
your kind attention!**