SIGNALING SYSTEM FOR HIGH SPEED RAIL

December 2011

THE NIPPON SIGNAL CO., LTD.

A3-105

Table of Contents

Designed	Checked	Approved
M.Takahashi	H.Ogihara	H.Ogihara

1. Company Introduction

Founded	1928
Headquarter	Tokyo, Japan
President and COO	Yohei Furuhata
Capital	US$ 82,482,000 *
Annual sales	US$ 1,005,605,000 *
Employees	3,079
Main Business Field	- Railway Signaling Systems - AFC Systems - Traffic Information Systems - Information Systems
Major Overseas Projects	- Taiwan High Speed Rail (Signal) -Chennai Metro (AFC) -etc..

*At the rate of ¥83 to US$1, the approximate exchange rate at March 31, 2011.

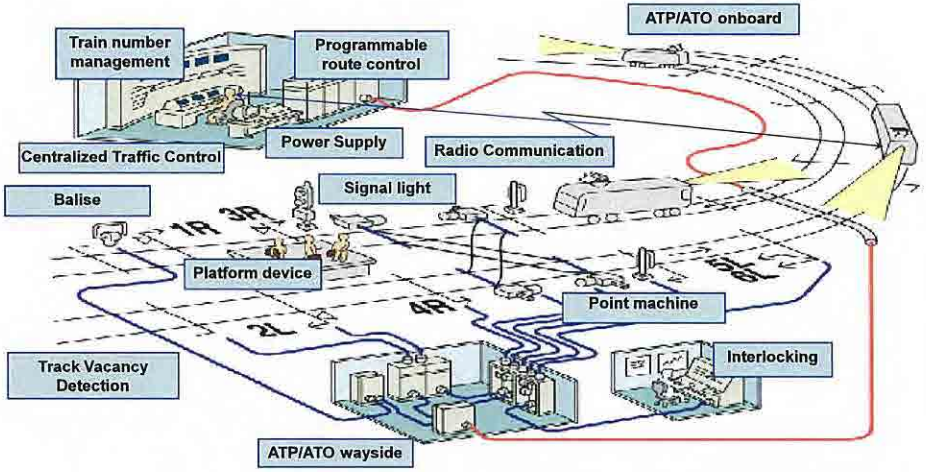
Headquarter

Kuki Plant

Utsunomiya Plant

1. Company Introduction

Nippon Signal Total Signaling System



1. Company Introduction

日本信号 THE NIPPON SIGNAL CO., LTD.

Domestic Activity:

Nippon Signal technology is widely used in Japan

- Shinkansen
- Main line
- Metro / Subway
- Monorail
- LRT

1. Company Introduction

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Overseas Activity: Taiwan High Speed Rail

- Commercial operation since 2007
- Based on Japanese High Speed Rail Technology
- Nippon Signal contributes to its successful operation by advanced Signaling technology.

1. Company Introduction

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Overseas Activity: Others

Beijing Subway line 15

Dubai monorail

Beijing Subway line 13

Chongqing monorail

1. Company Introduction

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Activity in India: Chennai Metro

- Awarded on AFC contract in March 2011
- Commercial operation to be started from 2014
- First Japanese contractor in India for AFC project

2. Signaling Technology for HSR

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2.1 General

Safe and reliable operation at 300km/h (83m/sec)

Fatal accident record is ZERO

Average Delay per train is shorter than 1 minute

2. Signaling Technology for HSR

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2.2 Overview

Signaling system is mainly composed of the following sub-systems.

- Traffic Control/Management System
- Electronic Interlocking system
- Digital ATC system with cab signal
- Track Vacancy Detection system by digital coded ATC signal

2. Signaling Technology for HSR

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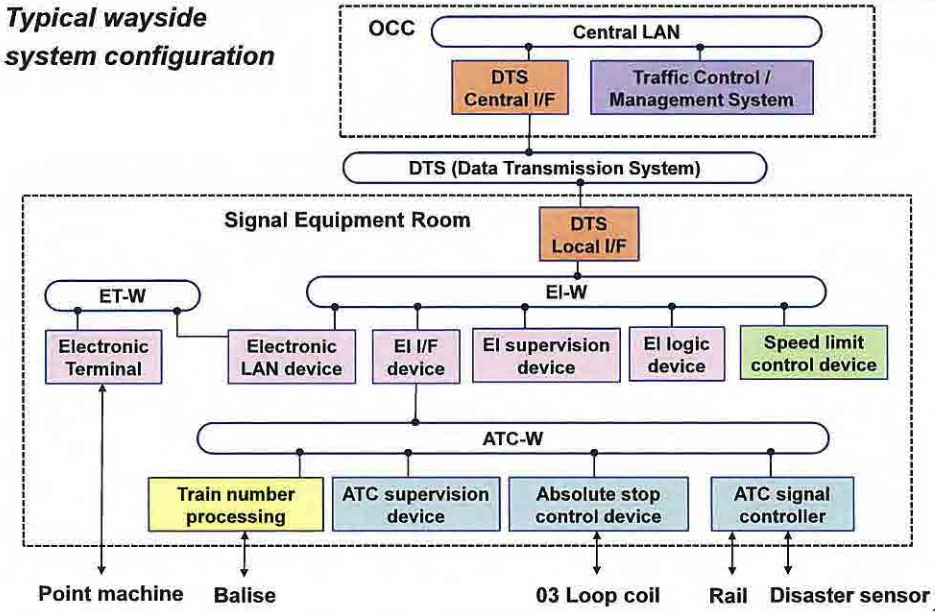
Typical wayside system configuration



2. Signaling Technology for HSR

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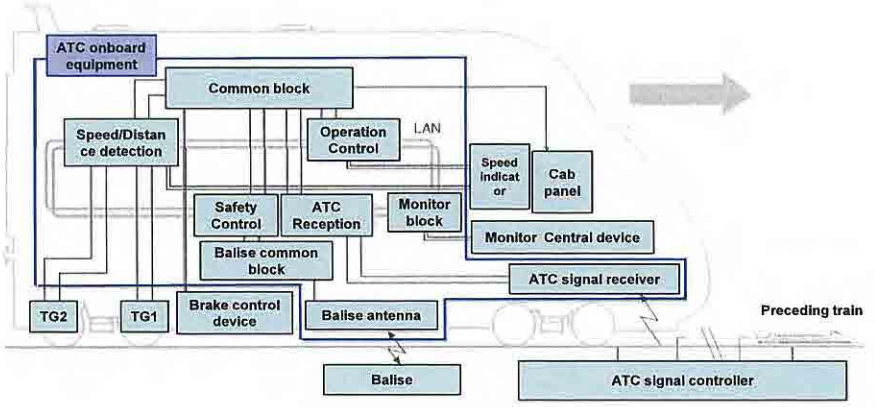
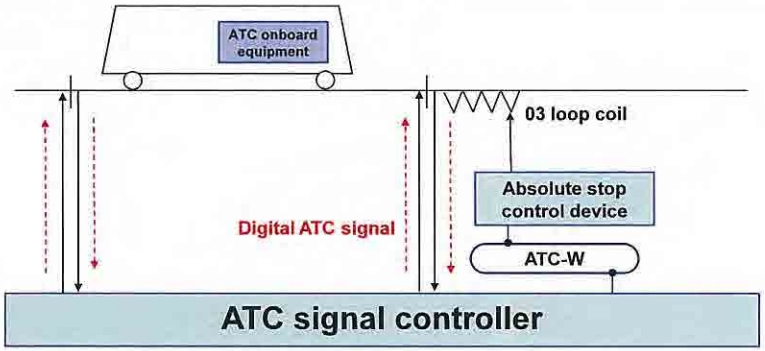
Typical onboard system configuration



2.3 Automatic Train Control



Process:

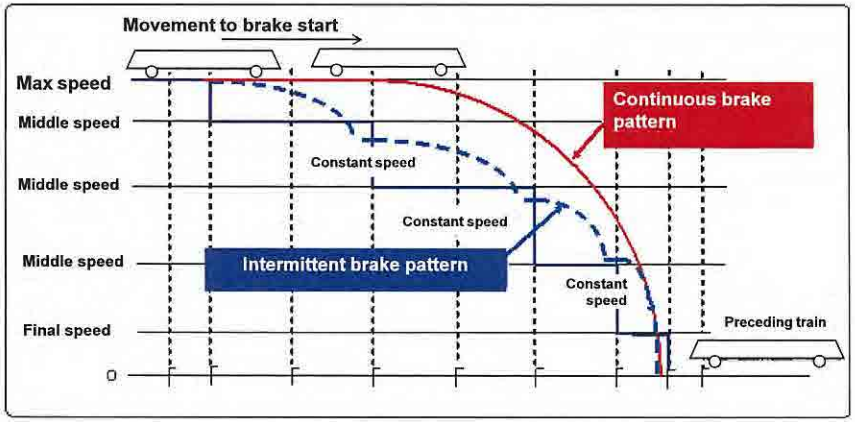
1. Track Vacancy Detection by a change in the ATC signal level
2. Generation of stopping point information by ATC signal controller
3. Transmission of stopping point information by ATC signal controller
4. Creation of speed check pattern by ATC onboard equipment
5. Brake control if train speed over the speed check pattern
   *03 loop coil is used for absolute stop

2.4 Traffic Control/Management system

- **Monitor**
  - Train tracing
  - Delays
  - Equipment
- **Control**
  - Automatic
  - Manual
  - Schedule control
- **Record**
  - Train operation
  - Failure record
  - Logging of operation
  - Record of actual operation
  - System availability

2.3 Automatic Train Control

Continuous brake pattern method is adopted



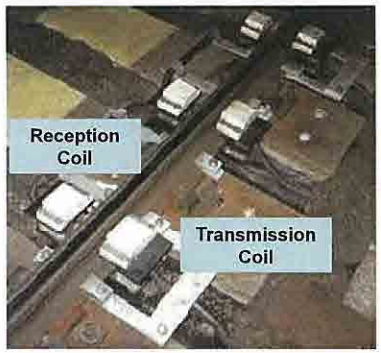
2.5 Others – Disaster Warning System

- Earthquake Warning System
- Environmental Monitoring System
  - Wind speed and direction measurement
  - Rainfall measurement
  - Water level measurement
  - Landslide Detection System
  - Rock fall Detection System

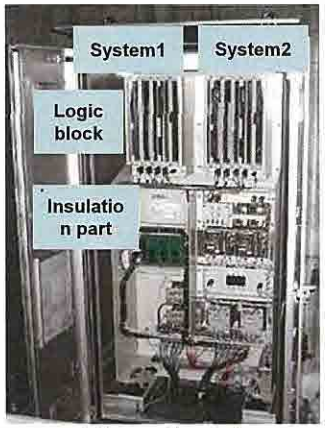
Wind speed and direction measurement

2.5 Others – Digital Axle Counter

Digital Axle Counter is used for Shinkansen as substitute safety system



Axle detector



Axle counting device

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http://www.signal.co.jp/

Kawasaki

Technical Introductions of Kawasaki's High Speed EMU Trains

16 December 2011

Kawasaki

1. Company Profiles and Products

Kawasaki

1.1 Company Profiles

Established:	October 15, 1896
Capital:	USD $1,254 million (as of March 31, 2011)
Net Sales:	USD $14.8 billion (FY ending March 31, 2011)
Employees:	32,706 (as of March 31, 2011)

Kawasaki

2. Record of High Speed Train Production

Kawasaki

2.1 Chronicle of Shinkansen Development

Kawasaki's involvement in development of all Shinkansen trains

Kawasaki supplied 3,407 cars as of 30 November 2011.

Kawasaki

2.2 Taiwan High Speed Rail Series 700T

Train Consist:	9 Motor cars plus 3 Trailer Cars
Electric Power Supply:	AC 25,000 V (60 Hz)
Max. operating speed:	300 km/h
Propulsion system:	IGBT Inverter Control
Traction motor:	285 kW x 4 x 9 cars, 3-phase Induction Motors
Dimension:	25,000 mm(L) x 3,380 mm(W) x 3,650 mm(H)
Delivery:	FY2004-2005
Supplied Q'ty by Kawasaki:	360 vehicles
Fire Safety Standard:	BS6853 Ib (Material, Fire Barrier, etc.)

Kawasaki

2.3 Ministry of Railway, China CRH2

Train Consist:	4 Motor Cars plus 4 Trailer Cars
Electric Power Supply:	AC 25,000 V (50 Hz)
Max. operating speed:	200 km/h
Powering:	IGBT Inverter Control
Braking:	Re-generating & Friction Brakes Blending
Traction motor:	300 kW x 4 x 4 cars, 3-phase Induction Motors
Dimension:	25,000mm(L) x 3,380mm(W) x 3,700mm(H)
Floor height:	1,300 mm
Delivery:	FY2006-2007
Supplied Q'ty by Kawasaki:	480 vehicles

Kawasaki

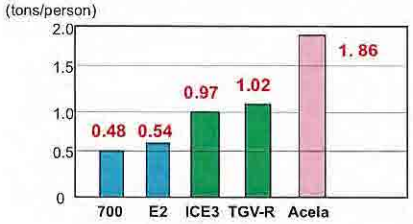
3. Features of Shinkansen Trains

Kawasaki

3.1 Light Weight Design (1)

Weight Comparison of High Speed Trains

Series		700	E2-1000	ICE 3	TGV-R	Acela
Train Weight [A]	(tons)	638	443	409	383	566
Train Length	(m)	405	251	200	200	203
Train Weight / m	(tons/m)	1.58	1.76	2.05	1.91	2.79
Passenger Capacity [B]	(persons)	1323	814	422	377	304
Train Weight / Passenger [A/B]	(tons/person)	0.48	0.54	0.97	1.02	1.86
Max. Axle Load	(tons)	11.3	12.9	16.0	17.0	23.0



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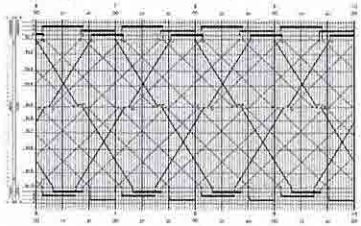
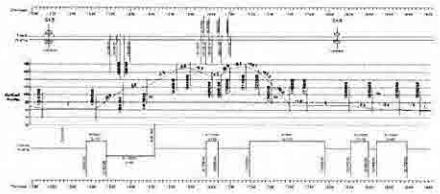
3.1 Light Weight Design (2)

Computer Simulation to substantiate the effect of Light Weight HSR Train.

- Comparison: **Axle Load 14 ton & 17 ton** with same running curve
- Line Length: 330 km
  (Equivalent to high speed section of Taiwan High Speed Rail)
- Train operation: 1 express + 1 local per hour/16 hours per day





Result (Effect of weight difference only)

- Reduction of Power Consumption = 10%
- Reduction of Greenhouse Gas Emission = 16,000 ton/year
  (at CO2 emission rate of 0.56 ton/MWh)

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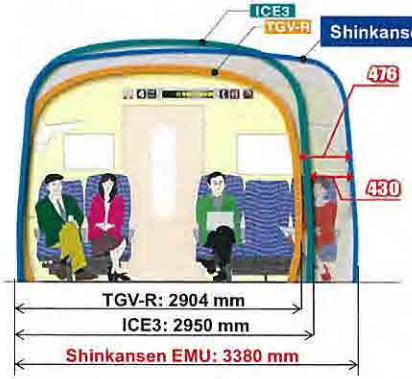
3.1 Light Weight Design (3)

Wide-body Design Contributes to Weight / Capacity Ratio.



Standard Class	Seat pitch (mm)	Aisle width (mm)
Series 300,700 (*)	1040	570・600
Series E3,E2 (*)	980	550・600
TGV-D	920	450
TGV-R	900	450
ICE3	920	554

Note
(*) Rotation seat

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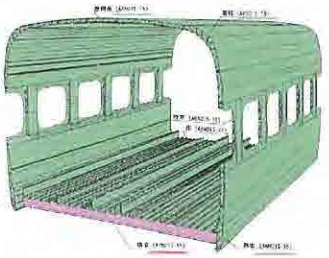
3.1 Light Weight Design (4)



Carbody – Aluminum Double Skin

Bolster-less Bogie

Lightweight train contributes not only to energy saving but also to reduced noise and vibration. It also reduces track maintenance needs.

Skin Thickness: Minimum 2.0mm

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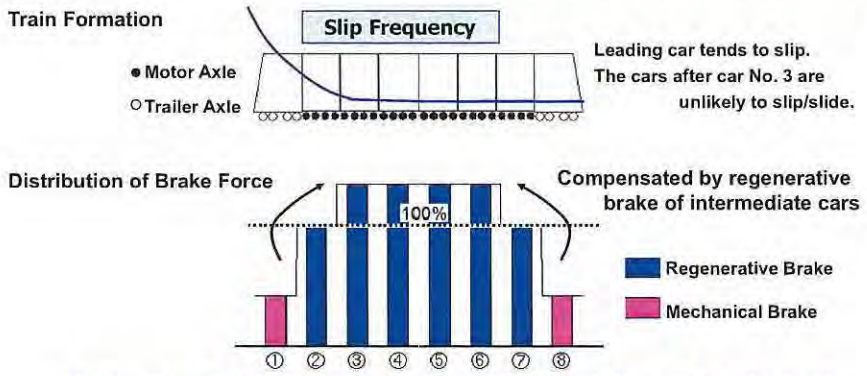
3.2 Efficient Regenerative Brake System

1) High Ratio of Motor Cars in a Train
2) Both Ends are Trailer Cars

→ **Stable and Efficient Regenerative Brake Under Rainy Conditions**



Reduction of Total Power Consumption and Wear of Brake Pad

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3.3 Total System Safety

Series	Japanese HSR	ICE3	TGV-R	Acela
Train Weight / Passenger (tons / person)	0.48-0.54	0.97	1.02	1.86
Required Compression Load (tons)	Japanese Standard 100tons	UIC 200tons		49CFR Tier II 360tons (Coach) 945tons(Power Car)
Track	Fully Dedicated Track	High Speed Section-Dedicated Track Low speed Section-Conventional Track		Conventional Track

Safety in high speed rail operation is of paramount importance and can be ensured through the total system design including sophisticated signaling system and other wayside systems.

↓

Total System Approach Realizes safe high-speed rail.

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4. Kawasaki's Original High Speed Train

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4.1 efSET – Proposed Model

efSET=
environmentally friendly Super Express Train

Proven Shinkansen Technology
+ Requirements of the Country

The principle design development of efSET is completed.

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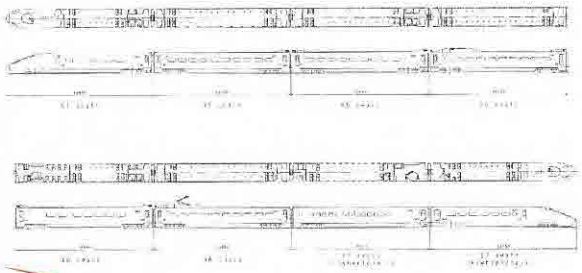
4.2 efSET – Main Specifications

Item	Value
Max. Service Speed	350 km/h
Motor/Truck Ratio	6M2T
Total Traction Power	9,720 kW
Seated Passengers	575
Width	3,380 mm
Train Length	200,000 mm
Train Weight (Empty)	400 t
Max. Axle Weight	14.5 t



Wide Interior

Light Weight

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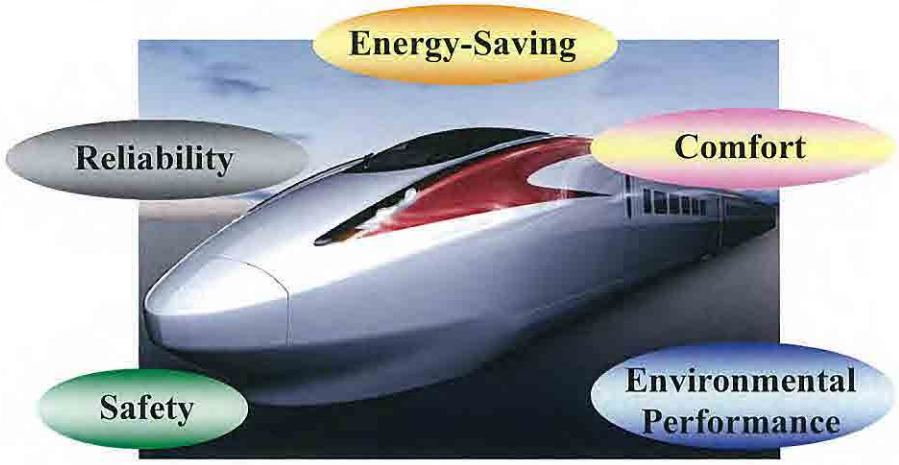
4.3 efSET – Design Concept



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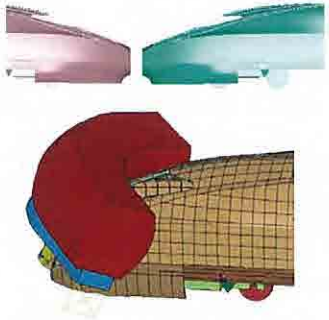
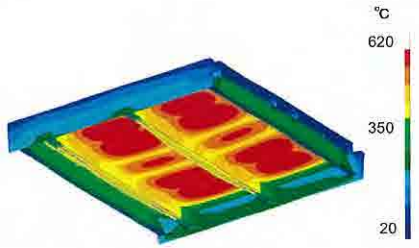
4.4 efSET – Safety

Through operation into conventional line may be required.

⇒ Consideration of Collision and Fire.



Collision Simulation EN15227



Thermal Analysis

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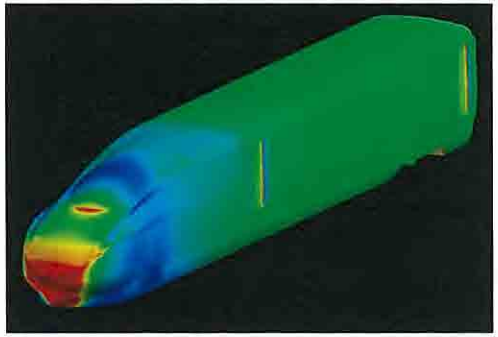
4.5 efSET – Energy Saving

Light Weight Design

Optimum Use of Regenerative Brake

Low Running Resistance(Aerodynamic Design)



Aerodynamic Commotion Simulation (CFD)

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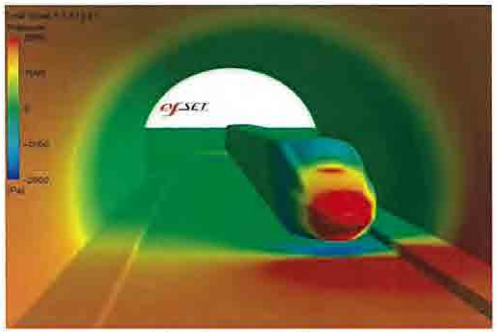
4.6 efSET – Environmental Performance

Low Noise Emission

Low Vibration to the surrounding Area

Low Micro Pressure effect



Micro Pressure Effect

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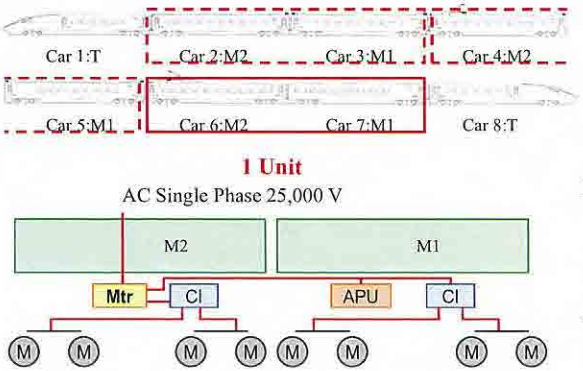
4.7 efSET – Reliability

Application of Service Proven Technologies

Multi-unit system (2 cars = 1 unit) ensures system redundancy

⇒Possible to continue operation even if one unit fails



T* : Trailer Car

M* : Motor Car

Mtr : Main Transformer

M : Traction Motor

CI : Converter/Inverter

APU : Auxiliary Power Unit

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4.8 efSET – Comfort

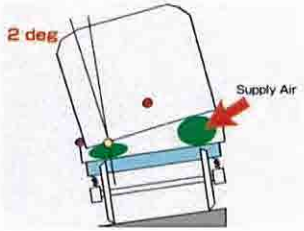
Good Ride Quality

Good Air - tightness

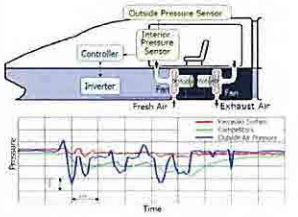
Quiet Salon

Welcoming Design

Full Active Suspension



Carbody Tilting System



Continuous Ventilation

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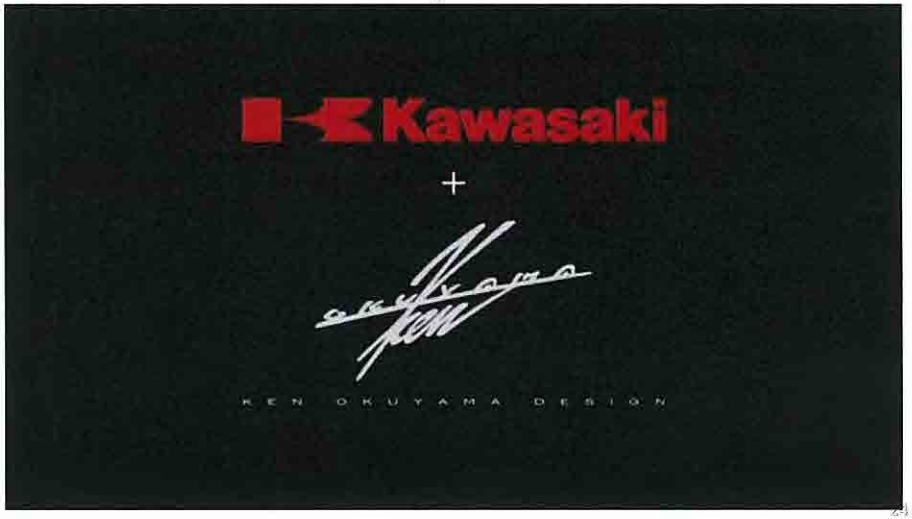
4.9 efSET – Design

Collaboration with Ken Okuyama



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Thank You Very Much for Your Attention