Technical Innovation for
Your Safety and Easy Life

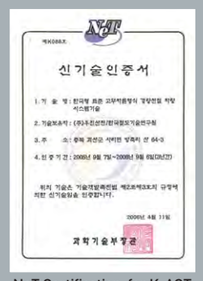
With the World's largest and Exclusive Factory for LRV

WOOJIN Industrial Systems CO., Ltd.

A Corporation for Quality and Environment!
A Corporation for New Technology and Future!

ISO9001

ISO14001



NeT Certification for K-AGT

Quality Certification for PSD

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Busan Subway Line No. 4 | Rubber Tired Light Rail Vehicle




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Special point

Features

This rubber tired AGT is the 1st automated unmanned operation LRV in Korea.
It has been developed on the basis of the standard specifications for LRV issued by M.O.C.T.
This automated unmanned operation LRV is to be operated under no driver and no attendant's boarding,
and has been proven its excellent safety and punctuality with serving the revenue operation more than 10 years.
Applying a side lateral riding guideway to the rubber tired bogie, this LRV is protected against derailment
and proud of a green transportation system with low vibration, low noise and excellent driving performance.

Progress Status

Oct. 2005	Supply contract of E&M System for Busan Subway Line 4 (Vehicle, Signal, Communication, Maintenance facility, Rigid power rail, PSD, System Engineering)
Nov. 2005	Start of vehicle basic design and detail design
Jul. 2006	Establishment of vehicle exterior & interior design (Designed by DSH)
Sep. 2006	Approval of vehicle drawings and technical documents
Apr. 2007	Completion of the prototype vehicle (MC, M3 car)
May. 2008	Completion of 1st train among 17 trains
Sep. 2008	Completion of the first configuration's 5,000km preliminary progress
Oct. 2010	Depot test and the main line test drive
Dec. 2010	Starting the revenue service of Busan Metro line No. 4 (Minam ~ Anpyeong)

Advantages of Rubber Tired LRT

■ Automated unmanned operation
- Ensuring safety and punctuality
- Reducing operation cost by decreased manpower

■ Lightened vehicle
- Reducing construction cost
- Providing excellent load distribution
- Improving energy efficiency
- Providing effective vehicle size suitable for transportation demand

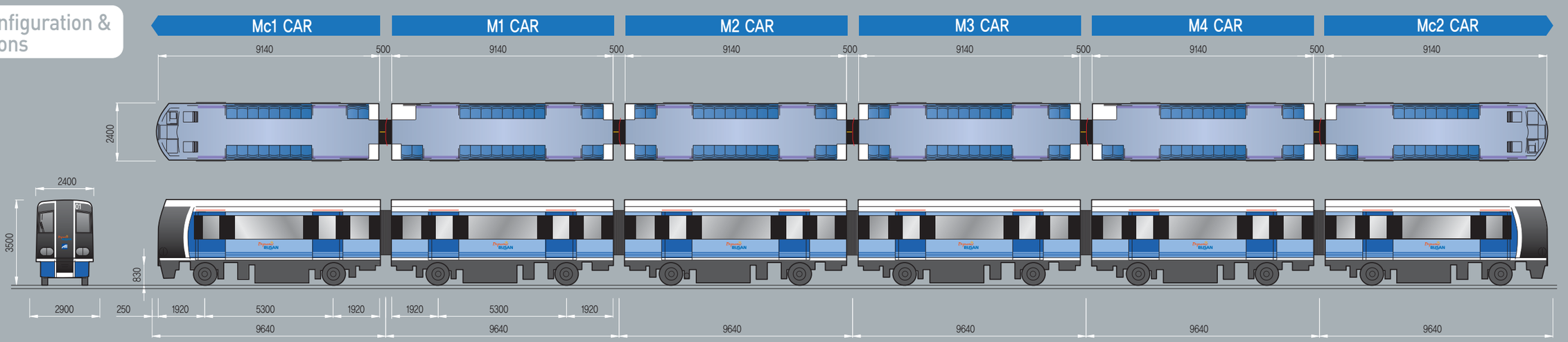
■ No derailment risk
- Ensuring safety by left & right guide rail

■ Rubber Tired Bogie
- Low vibration & noise (less than 75dB)
- Excellent curving capability (30m)
- Excellent climbing capability (58‰)
- Applicable in complicated downtown area

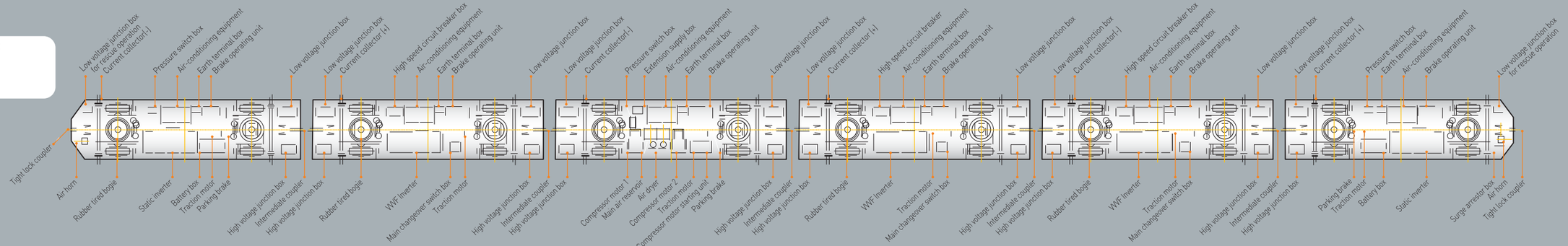
Train Configuration & Specification

This LRV consists of 6 cars for 1 train.
Arrangement and specifications of main equipments are as below.

Train Configuration & Dimensions



Arrangement of Equipments



Specifications of Vehicle and Equipments

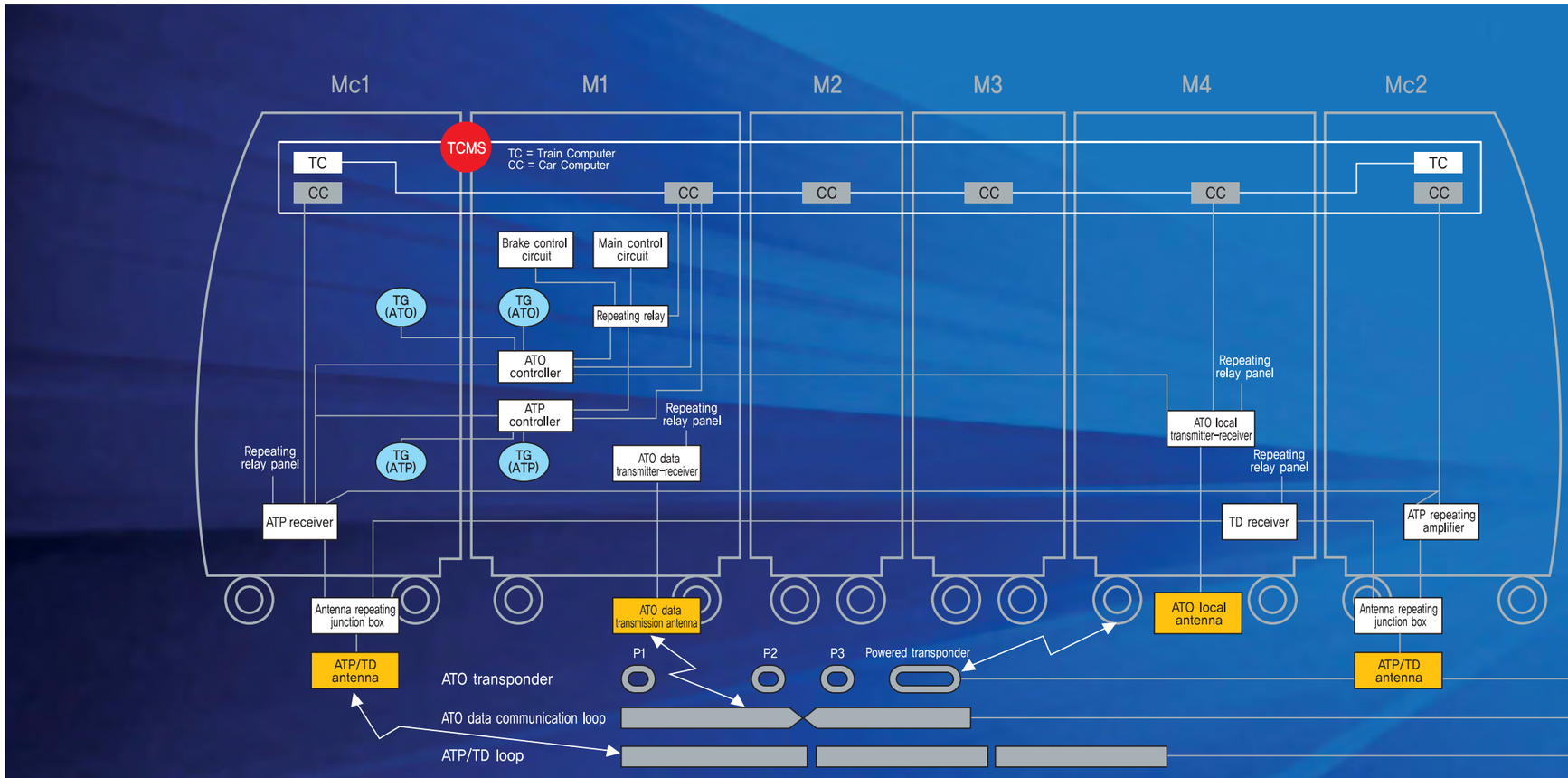
Vehicle		Mc1	M1	M2	M3	M4	Mc2
Vehicle type		Rubber Tired AGT LRV					
Train formation		6 cars/train					
Weight	Tare	72ton					
	Full	108ton					
Passenger capacity [Max.]		52(86)	52(82)	54(84)	54(84)	52(82)	52(86)
Seats		18	22	24	24	22	18
Standings		34(68)	30(60)	30(60)	30(60)	30(60)	34(68)
Guideway		Side lateral riding					
Power supply		750V DC, 3rd rail (Side lateral riding)					
Train operation		Automated unmanned operation by ATP/ATO					

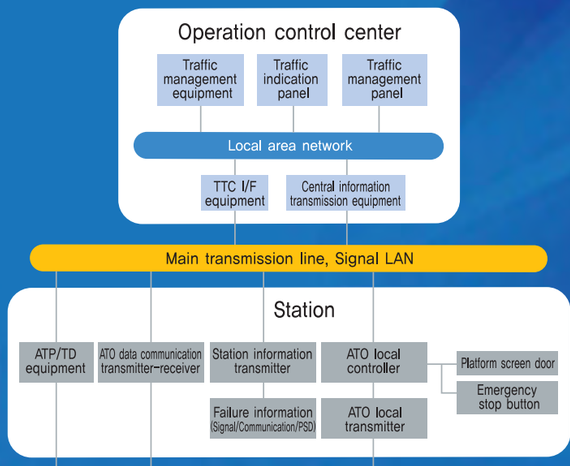
Bogie	Rubber tired single axle bogie
Wheel	Tubeless tire with internal aluminum wheel
Propulsion Control System	Voltage typed PWM IGBT Inverter, 3 phase 550V AC
Traction Motor	3 phase squirrel type induction motor (110kW, 550V, 1800rpm)
Static Inverter	2 Level IGBT Inverter, 70kVA
TCMS	32 bit micro-processor control
Brake System	Regenerative + pneumatic brake by electrical command
Compressor motor	Oilless piston type (528ℓ/min)
Battery	Ni-Cd alkaline battery, 50Ah

Air conditioner	Direct jet type (18,000 kcal/hr)
Heater	220V AC, Automated control, 7kW/car
Side door	Electrical door engine, Outside sliding type
ATO	ATO on-board equipment, ATO transponder
ATP	Digital code communication type
TD(Train detector)	Check-in & check-out type, Redundancy
TR(Train radio)	Induction wireless type (ATO DATA transmitter)
LCD indicator	15" LCD, XGO mode (1024 x 768)
LED indicator	Φ3, 6 rows, 220V AC

Automated Unmanned Operation System

This system is composed of Automatic Train Operation (ATO), Automatic Train Protection (ATP), Train Detector (TD), Train Radio (ATO Data communication system), Train Control & Monitoring System (TCMS), etc. Information about speed control, train detection, train traffic, station, etc. is transmitted from the wayside to on-board signal antenna, and each signal system transmits such information to on-board ATO controller. Then, the ATO controller performs the automated unmanned operation.





Safety System for Automated Unmanned Operation

01 Redundancy
- Redundancy of main equipments
- Back-up when failure

02 Emergency Communication
- Communication between passenger and OCC

03 Emergency Stop
- Failure of main equipment
- Detection of obstacle on track
- Operation of emergency alarm
- Operation of emergency stop button by passenger

04 Emergency Alarm
- Side door unintentionally opened
- Vehicles' uncoupled (Power rail breaks its voltage automatically)

05 Remote Control
- Departure prohibition of vehicle
- Temporary speed of vehicle
- Reset for main equipment failure of vehicle
- Re-departure of vehicle

Exterior & Interior Design

Outside

Exterior is designed to show an image of "sea, sailing boat, and wave" which symbolizes Busan, a seaside city.

■ Appearance

- Symbolizing Busan and showing an image of "sea, sailing boat, and wave"
- Advanced design of curved surface window

■ Carbody

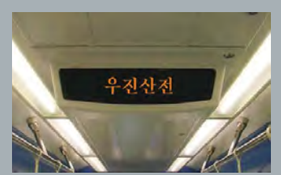
- Double-skin body structure of high intensified and lightened aluminum alloy(AL6005A)

■ Exterior Color

- Symbolizing colors of sail(white) and sea(blue)
- Showing an image of waves through three blue lines at side

Interior

Interior is designed with the consideration that the number one priority is the safety and convenience of passengers.



■ Passenger Space

- Large size and single unit windows for passenger's wide visibility
- Curved stanchion for grace appearance and convenience
- Divided seats for comfortable separation of passengers
- Widened gangway for large space
- Convenient multi space for wheelchair and baby carriage, etc

◆ Interior Color

- Symbolizing color of Line No. 4
- Harmonizing with exterior colors

◆ Interior Materials

- Seats & interior panel of self-extinguishing and low smoke material in accordance with domestic/international safety standards

■ Emergency Driving Console

- Advanced design in consideration of automated unmanned operation for passenger's wide visibility
- Compact driving console equipped with necessary equipments for emergency operation

■ Service Equipments for Passenger

- LED & LCD typed passenger information display system
- Emergency interphone, monitoring camera, fire detection equipment, emergency exhausting fan, etc. for coping with emergency situation during automated unmanned operation

Main Equipment

All core equipments are digitally integrated resulting lighter weight, hence being perfect match with Rubber Tired LRV, AGT

Rubber Tired Bogie

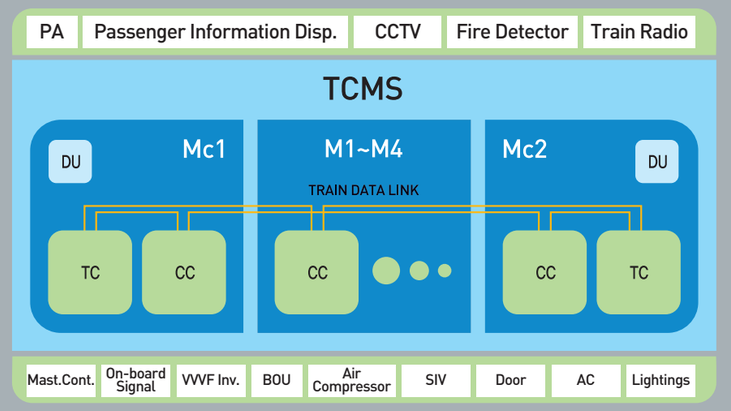
- Type of bogie : Single axle bogie
- Type of wheel : Rubber tire injected with nitrogen gas
- Type of tire : internal secondary aluminum wheel replacing traditional tube
- Guidance wheel and switching wheel : Light urethane
- Suspensions : 1st suspension - rubber tire, 2nd suspension - air spring
- Guideway : Riding of compulsory side rail with 4 guidance wheels

VVVF Inverter

- Type : IGBT VVVF Inverter
- Input voltage : 750V DC
- Output voltage : 550V AC, 3-phase
- Control Device : IGBT (Insulated Gate Bipolar Transistor)
- Control method : 1C1M
  - PWM control (2-leveled signal voltage control)
  - Automatic Acceleration and Deceleration with VVVF Inverter for both propulsion and energy regeneration process control

Train Control and Monitoring System (TCMS)

- TCMS has functions as follows
  - Real-time monitoring of all information necessary for train operation
  - System integration and automatic response while train operates automatically
  - Maintenance support with recording of operation and inspection log



Static Inverter

- Type : IGBT Inverter
- Input voltage : 750V DC
- Output voltage : 380V AC / 100V DC
- Control method : Inverter constant voltage regulation
- Power Rating : 70kVA

Traction Motor

- Model : KST-110
- Type : 4 pole 3phase squirrel cage induction motor
- Cooling method : Natural cooling
- Output Rating : 110kW

Current Collector

- 3rd rail (Side lateral riding)
- Operating method : Spring tension
- Uplift force : 6±1kgf

Brake Operating Unit (BOU)

- Pneumatic brake module
  - Brake control unit + Air reservoir + Operating valves
- Model : YJ36M
- Brake method
  - Regenerative + Pneumatic brake by electrical command (28 levels for each controls)
- Features
  - Brake force monitoring
  - Automatic conversion at detecting the shortage of brake force (Service brake → Emergency brake → Preventive brake)

Compressor Motor (CM)

- Air supply system
  - Compressor + Dryer + Reservoir + Starting unit + Pressure switch box etc.
- Type : JRC-5FA, Oilless & low noise piston type
- Discharge : 528ℓ/min
- Max. Pressure : 10bar
- Output Rating : 5.5kW
- Input voltage : 3-phase 380V AC

Wake-up Power Supply Unit (WPU)

- Input voltage : 750V DC
- Output Rating : 100V DC, 8.6A
- Utility facto : more than 80%
- Features : At power rail powering, automated unmanned system starts automatically by remote control