ADVANCED AND EVER ADVANCING MITSUBISHI ELECTRIC

MITSUBISHI

ELEVATOR

Series

GPM-III

USA

SERIES GPM-III

Utilizes Advanced Technologies to Succeed

At Mitsubishi Electric, we produce the most technologically innovative elevators in the world. They benefit from our constantly evolving technology and our years of accumulated experience. Our elevators continue to establish benchmarks for quality in the industry, and consistently set new standards for performance and reliability. The Series GPM-III elevators exhibit this philosophy in every detail of design and concept.

Higher Speeds

As buildings grow taller, the need for faster elevators becomes more pressing. To meet the market's demands, Mitsubishi Electric produced the world's fastest passenger elevators as verified by the Guinness Book of Records. Series GPM-III is available for elevators with rated speed of 200 fpm and higher to cover a wide range of applications.

Futuristic Key Technologies

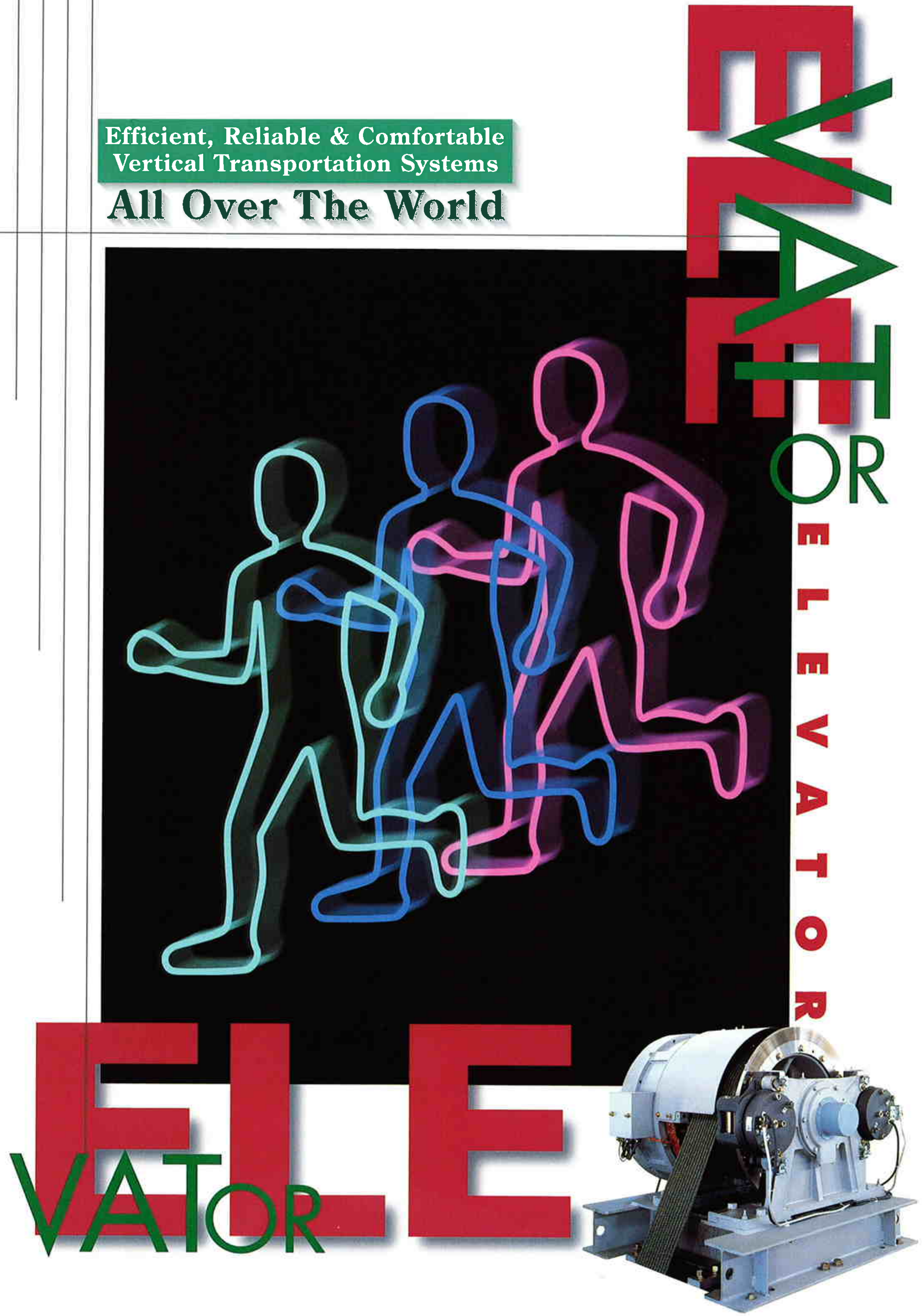
Series GPM-III elevators use advances in core technology to realize optimum performance and operation efficiency. The advances include new gearless traction machines which utilize the PM (permanent magnet) motor*, VVVF (variable voltage, variable frequency) Inverters, AI (artificial intelligence), and Data Network Systems.
*PM motor is applied to elevators with rated speed of 400 fpm and higher.

Intelligent Door System

An advanced RISC (Reduced Instruction Set Computer) microprocessor and VVVF inverters also control the elevator doors. This intelligent system detects the actual door load conditions at each floor and automatically adjusts the door speed and torque to suit. The result is stable, sensitive door opening and closing.

Variety of Features and Functions

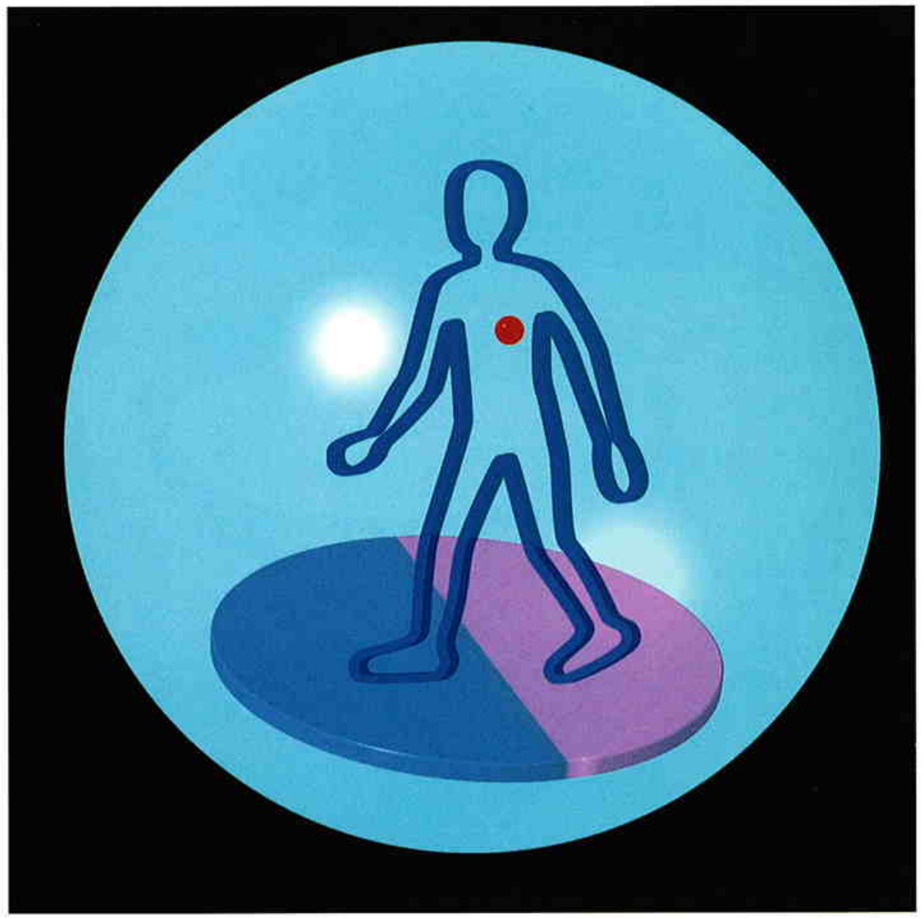
A wide variety of both standard and optional features and functions is available with Series GPM-III, to improve passenger safety and comfort and to simplify building management.



Traction Machine with PM Motor

Delivers Optimal Performance

PM motor is applied to elevators with rated speed of 400 fpm and higher.



Pioneered by Mitsubishi
Mitsubishi Electric presents another world first: a new type of gearless traction machine for high-speed elevators with a PM motor. This unique application of PM motor and double disk-brake system to the elevator traction machine enables several improvements—including higher efficiency, greater comfort, and miniaturization.

Improved Efficiency and Response
Because it does not require an exciting current, the PM motor delivers higher efficiency and quicker response compared to conventional motors. Furthermore, the PM motor maintains this level of efficiency regardless of the number of poles.

A More Comfortable Ride
The PM motor makes it possible to suppress harmonic noise to a level below that of conventional induction motors. Furthermore, the PM motor features a quick response time since it requires no exciting current. Again, the reduced noise and vibration translates into a more comfortable ride for passengers.

Miniaturization
Traction machines with PM motors are smaller and more compact compared to those with conventional induction motors. The PM motor allows for a multi-pole arrangement and the result is a more compact machine. At the same time, the unit's height is reduced by the application of a double disk-brake system.

VVVF Inverter Drive

Share a Ride in Comfort

Unique to Mitsubishi
Mitsubishi Electric was the first in the world to develop successfully VVVF inverter control technology for high speed elevators. We also introduced inverters throughout the entire line-up—from low- to super high-speed ranges. Recent advances have led to even further improvements in operation.

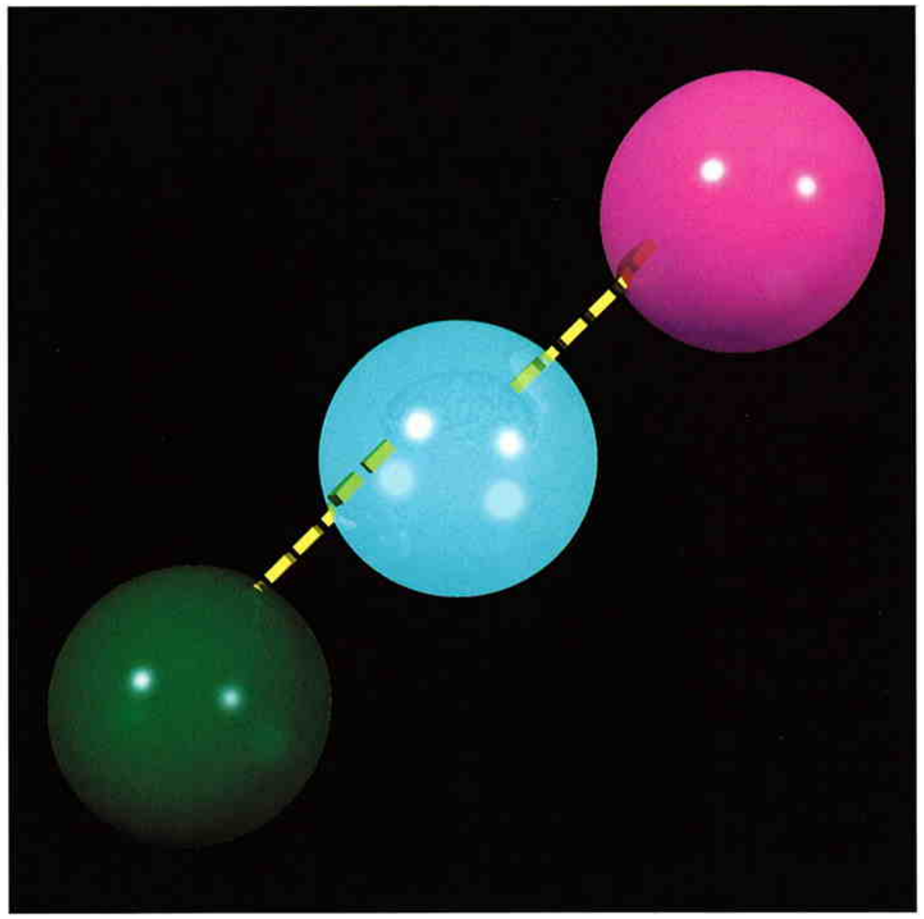
Precise, Effective Speed Control
Mitsubishi VVVF inverters make the ride much smoother by precisely adjusting speed control with voltage and frequency regulation. The inverters also include the latest low-noise modules to make the ride even quieter.

Practical Application
Mitsubishi Electric has already installed the world's fastest VVVF inverter-controlled passenger elevators in the Landmark Tower in Yokohama, Japan. These elevators provide a quiet, comfortable ride as well as large savings in energy.

Even More Advances
Series GPM-III elevators use further advances to control the motor speed. Utilizing the latest in semiconductor technology, Mitsubishi has incorporated on a single System LSI device, several control systems and our all new high speed digital signal processor.

AI Supervisory Control

Incorporates Advanced Artificial Intelligence



Mitsubishi Technology
Using its original Expert System and fuzzy-logic technology, Mitsubishi Electric has developed a supervisory system that improves operation efficiency and increases user satisfaction.

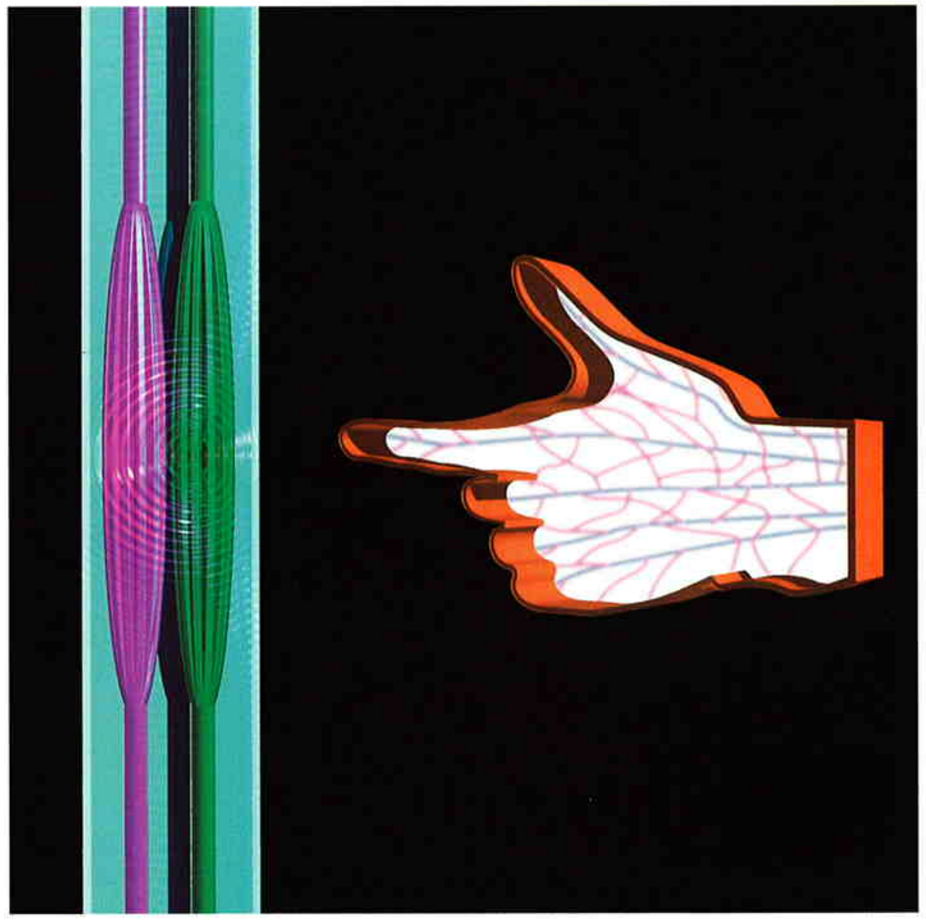
Analytical Decision Process
Series GPM-III elevators use specially designed AI supervisory systems: the AI-21 for two-to-four car and the AI-2100N for three-to-eight car elevator systems. Logical, qualitative judgments are made using traffic databases stored in the system.

Greater Passenger Satisfaction
The AI system evaluates the psychological waiting time for users and factors it into the decision process when responding to hall calls. This Mitsubishi-pioneered technology provides optimum service and user satisfaction by eliminating the irritation felt while waiting for a car on any floor of the building.

Improved Carrying Efficiency
The AI-2100N system utilizes neural networks and car allocation tuning to improve carrying efficiency during peak periods, i.e., morning, lunchtime, and evening rush hours. Details can be found on page 8.

Data Network System

Distributed Microprocessors Enhance the Human-Elevator Interface



A Proficient Network
The Data Network System uses microprocessors distributed throughout the elevator configuration for more flexible control of the overall system. Each microprocessor is specially designed for thought-processing, thus greatly enhancing the "Human-Elevator Interface."

Highly Reliable and Efficient System
Each microprocessor is connected via a serial transmission line to ensure higher reliability and efficiency. The system also shares diagnostic programs among the microprocessors and incorporates backup systems to further enhance reliability and passenger safety.

Increased Flexibility
The distribution of data network microprocessors simplifies modification to features or operation of the system, allowing the system to evolve with the changing needs of the building and its tenants.

Advanced AI Supervisory Control

Mitsubishi's AI Supervisory Control is the key factor in creating an ideal elevator system with optimum user service. Two basic systems are available, and between them they offer a wide range of special functions to suit the needs of any type of building.

AI-21 System

This system is designed for small or medium size buildings with two to four cars in the elevator group.

AI-2100N System

This system is designed for larger buildings with three to eight cars in the elevator group. It suits buildings with dynamic traffic conditions throughout the day and peak carrying times.

Expert System and Fuzzy Logic

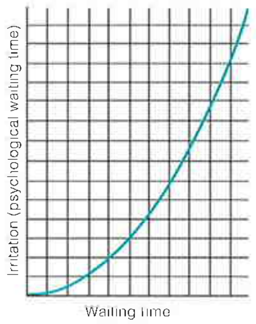
The brain of the AI Supervisory Control employs an intelligent Expert System that utilizes the practical knowledge and experience of elevator group control experts. This information is stored in the system's memory as a 'Knowledge Database.' Drawing from this database, various traffic conditions are monitored and analyzed applying IF-THEN decision rules to maximize the effectiveness of each elevator operation. Mitsubishi Electric has applied fuzzy logic in a manner that enables the elevator control system to make decisions using fragmentary and fuzzy intelligence concepts. For example, using its 'intelligence' and 'common sense,' the system can determine whether or not potential car assignments will result in longer waiting times for calls in the near future or cause elevator congestion. The assessment results are applied to determine the car assignments in order to improve overall service.

Main function	AI-21	AI-2100N
Expert System and Fuzzy Logic	Ⓢ	Ⓢ
Psychological Waiting Time Evaluation	Ⓢ	Ⓢ
Strategic Overall Assignment	Ⓢ	Ⓢ
Immediate Prediction Indication	—	Ⓞ
Car Travel Time Evaluation	Ⓢ	Ⓢ
Learning Function	—	Ⓢ
Distinction of Traffic Flow with Neural Networks	—	Ⓢ
Car Allocation Tuning	—	Ⓢ

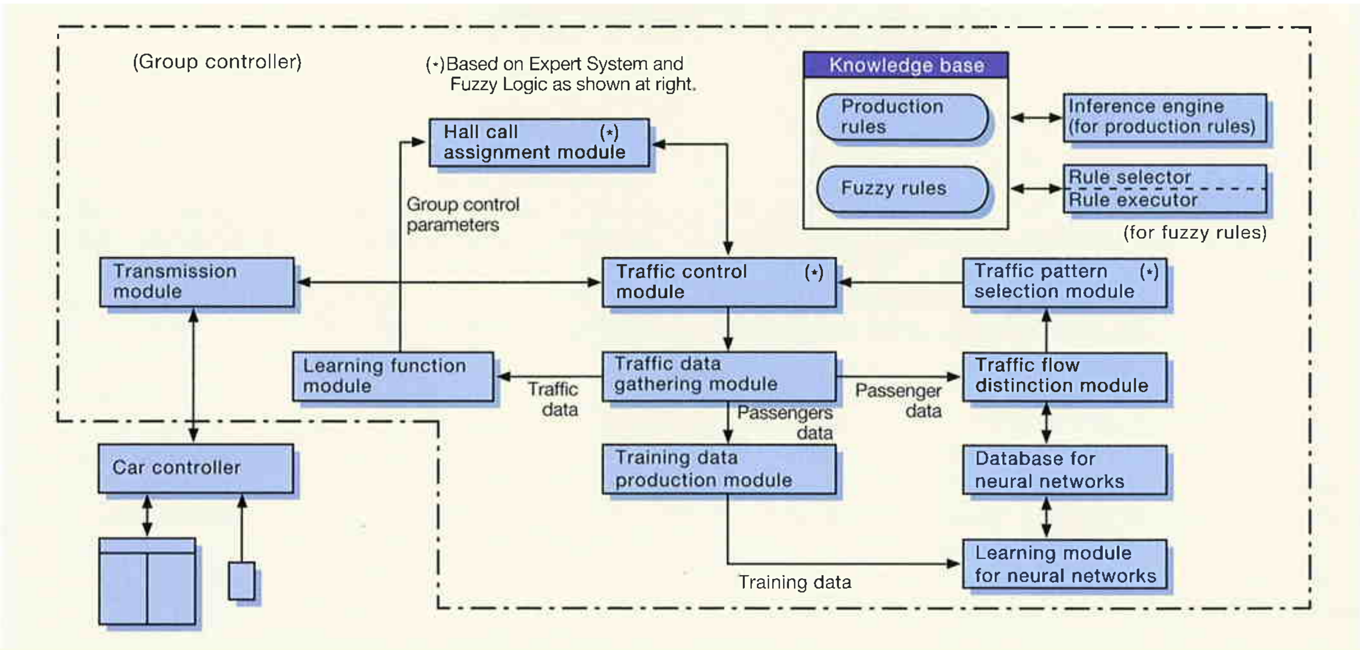
Ⓢ: Standard Ⓞ: Option

Psychological Waiting Time Evaluation

This evaluation function is Mitsubishi Electric technology that originates from the psychological thought patterns of a passenger waiting for an elevator: the irritation of a passenger waiting for elevator arrival is proportional to the square of the actual waiting time. Elevator assignments to hall calls are performed on the basis of evaluation results. In addition to forecasted waiting time, such factors as probability of being bypassed for a hall call, probable time required for traveling after car assignment, current car load and many others are applied in the evaluation function owing to its coefficient diversity. Car assignments to hall calls are made as a sum of all factors. (Evaluation factors vary in accordance with the basic system chosen, type of hall display, and other design parameters.)



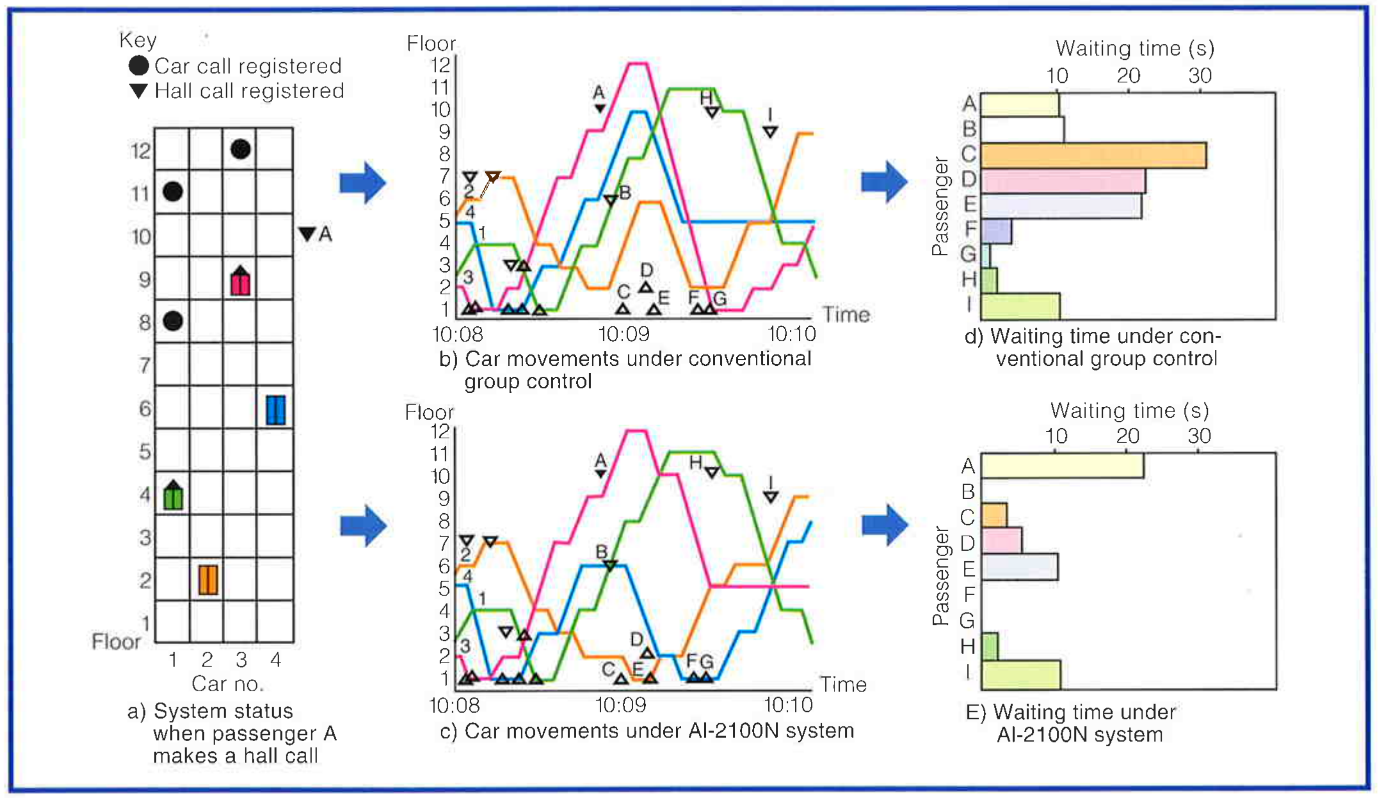
Relationship between Waiting Time and Irritation



Configuration of AI-2100N System

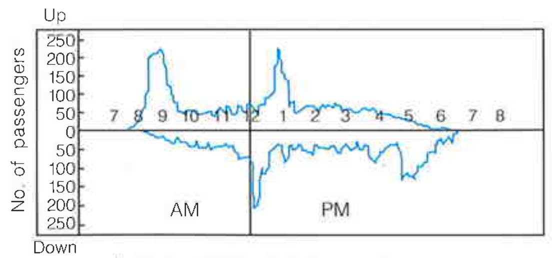
Strategic Overall Assignment

Combining all of the building traffic conditions, the system forecasts where future service will be needed and assigns cars accordingly. This greatly reduces the average overall waiting time and provides optimum service to passengers throughout the building. Consider a simulated traffic situation involving a four-car elevator system (figure shown below). When passenger A registers a down hall call on the 10th floor, a conventional system would assess that the No. 4 car is most appropriate and assign it to service the call. However, this would cause three cars to be concentrated in the upper zone and might reduce service to the lower zone.
The AI-2100N reviews the situation, taking into consideration that if the No. 4 or No. 2 car is assigned to service the 10th floor, that the concentration of cars in the upper zone leaves service to the lower zone inadequate. The system's evaluation function then determines the No. 3 car to be the most suitable and assigns it to the 10th floor call. Thus the overall waiting time for passengers throughout the building is substantially reduced, even though the passenger making the down call on the 10th floor waits a little longer than if the No. 4 or No. 2 car would have been assigned. Once all car and hall calls have been serviced, the system forecasts where the next likely calls for service will arise and accordingly assigns the cars so that the waiting time for future passengers is also reduced. (Strategic Overall Spotting)



Car Travel Time Evaluation

The system assigns each car to hall calls taking into consideration the number of registered car calls (as one evaluation factor), thus minimizing car travel time required after assignment.



Traffic fluctuation in one day (example)

Learning Function

The system learns the daily patterns of a building's traffic flow: incoming/outgoing traffic, lunchtime and interfloor traffic, and others. Distinctive data are stored and then applied to analyses using a statistical method. This determines the most suitable parameters in car assignments to hall calls, thus further enhancing total performance.

Immediate Prediction Indication

Once a passenger has registered a hall call, the ideal car to respond is selected, and the hall lantern lights and a chime sounds once to indicate which door will open. As the car approaches, the lantern begins to flash and the chime sounds twice. This system provides a highly reliable prediction of car arrival and reduces passenger irritation.

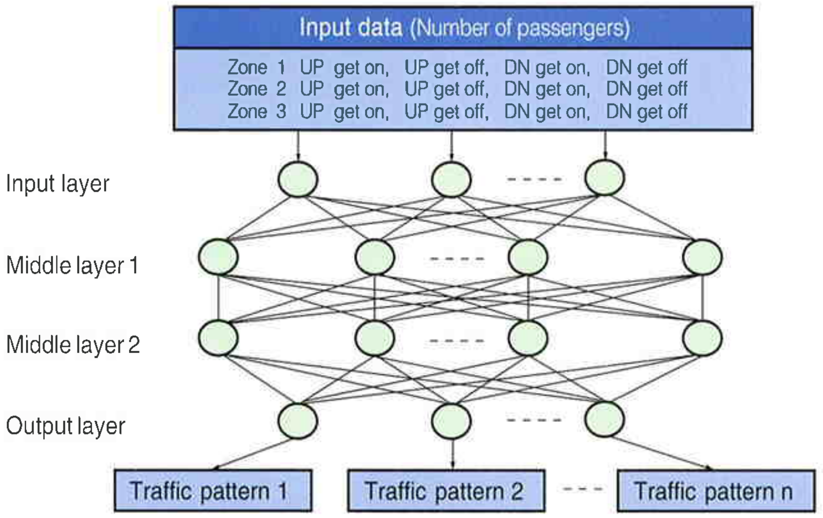
Enhanced Service with the Neural Network (for AI-2100N System)

Distinction of Traffic Flow with Neural Networks

The operation pattern of an elevator group, accompanied by car allocation and parking functions is one of the major elements that impact how efficiently an elevator supervisory system operates. The system must be able to recognize and respond to daily traffic fluctuations during peak periods such as morning up peak, lunchtime and evening down peak. The AI-2100N system utilizes neural networks to recognize with precision the distinctive patterns of traffic flows in real time. Traffic flows in each zone are distinguished by the number of boarding and exiting passengers (estimated by measuring the change in car load) at each floor. A learning module adopted in this system records such traffic patterns, and uses them to provide an optimum operating pattern that is constantly being updated and revised to respond more efficiently to constantly changing traffic flows.

Car Allocation Tuning

The AI-2100N system applies a refined algorithm to improve the average waiting times at each floor in the building. This algorithm controls the number of elevator cars allocated to or parked at the crowded floors during peak periods in incoming, outgoing and lunchtime traffic. It considers a multitude of situations including all aspects of elevator service, elevator operations, degree of traffic density or flows, etc. The tuning process is described as follows:
Step 1: The initial number of cars is set at the starting of crowding.
Step 2: Data is gathered at each elevator operation.
Step 3: And then, the initial allocation number is increased or decreased "tuned" according to the fuzzy rules as shown below.
The chart at center below shows a simulation result of car allocation tuning to the main floor for incoming traffic.



Configuration of Neural Network

Tuning Rule - Increase of car allocation

IF (No cars park at the main floor for extended length, and no tendency to decrease this situation.)
and (Cars with doors closed park at the upper floors sometimes, and no tendency to decrease this situation.)
and (Car parking time at the main floor is short, and no tendency to increase this situation.)
THEN (Car allocation number to the main floor will be increased by one.)

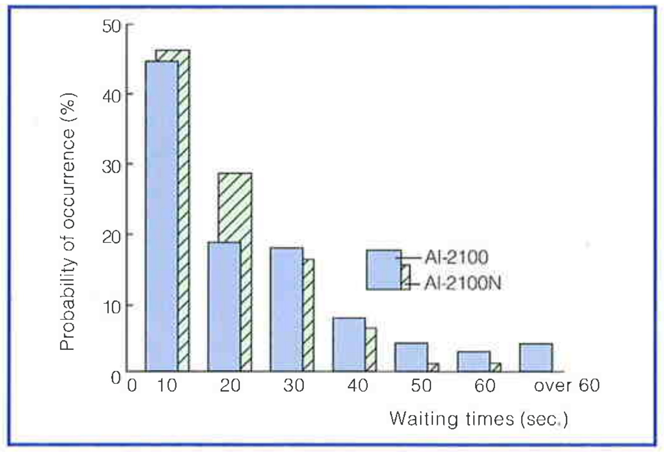
Tuning Rule - Decrease of car allocation

IF (No cars park at the main floor for fewer times, and no tendency to increase this situation.)
and (Cars with doors closed park at the upper floors for fewer times, and no tendency to increase this situation..)
and (Car parking time at the main floor is long, and no tendency to decrease this situation.)
THEN (Car allocation number to the main floor will be reduced by one.)

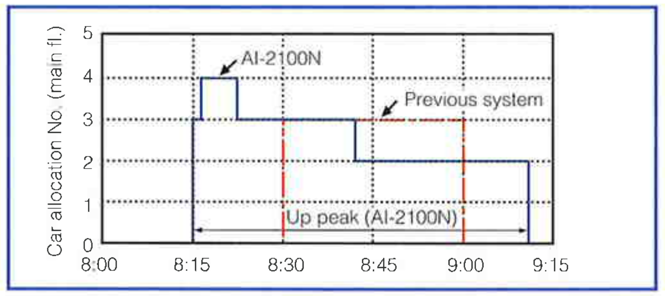
An Example of Fuzzy Rules for Tuning

● Average waiting times	Shortened by 10%.
● Long wait rates (of 60sec. or more)	Reduced by 20%.

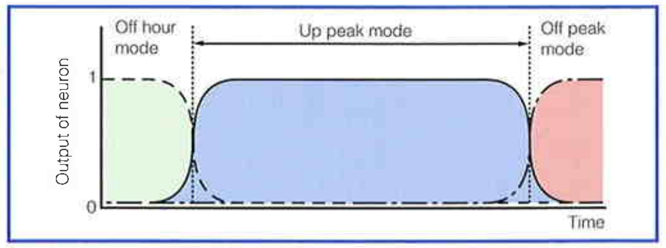
(Note) Compared with previous system (AI-2100)



Simulation Result of Waiting-Time Distribution



Simulation Result of Tuning



An Example of Pattern Selection Modes

Special Functions for Comfort, Convenience and Safety

Feature	Description	AI-21	AI-2100N
■ OPERATIONAL FEATURES			
Safe landing (SFL)	If there is a malfunction and the elevator stops between floors, the controller performs a diagnostic check before moving the elevator to the nearest floor.	Ⓢ	Ⓢ
Next landing (NXL)	If the elevator doors cannot open fully at the destination floor for any reason, the doors will close and the elevator will proceed to the next floor.	Ⓢ	Ⓢ
Continuity of service (COS)	A car experiencing trouble is automatically withdrawn from group operation to protect overall group performance.	Ⓢ	Ⓢ
Automatic bypass (ABP)	A fully loaded car will bypass hall calls in order to maintain maximum operating efficiency.	Ⓢ	Ⓢ
Overload holding stop (OLH)	A buzzer rings to indicate the car is overloaded.	Ⓢ	Ⓢ
Automatic hall call registration (FSAT)	If one car cannot carry all waiting passengers due to full load, another car is automatically dispatched for the remainder.	Ⓢ	Ⓢ
False call cancelling — Automatic (FCC-A)	If the number of car calls registered does not correspond to the car load, all calls are canceled to avoid unnecessary stops.	Ⓢ	Ⓢ
Car light/fan shut off — Automatic (CLO-A/CFO-A)	If there is no call within a preset time period, the car light/fan is automatically shut off to conserve energy.	Ⓢ	Ⓢ
Backup operation for group control microprocessor (GCBK)*	The backup function installed in the system prevents the loss of group control due to failure of a microprocessor or transmission line.	Ⓢ	Ⓢ
■ SERVICE FEATURES			
Car call erase (FCC-P)	If the wrong floor button is pressed, it can be canceled by pressing the same button again quickly.	◎	◎
Hall call erase (FHC-P)	If the hall call button is pressed accidentally, it can be canceled by pressing the button again quickly.	◎	◎
Remote-control car stop (RCS)	With a key switch or MELMOS instruction, a car can be called to a specified floor (on completion of service) and automatically withdrawn from service.	◎	◎
Secret call service (SCS-B)	Car buttons can be locked and accessed only by entering a secret code in the car operating panel.	◎	◎
Non-service to specific floor — Car button type (NS-CB)	Service to specified floors can be restricted by locking out car buttons from the car operating panel.	◎	◎
Swing service (SWSV)	A car can be isolated from the group for special or VIP service.	◎	◎
Floor lockout (NS)	Service to specified floors can be restricted by use of switch, activated manually, by internal time clock or from MELMOS instruction.	◎	◎
Return operation (RET)	A car can be called to a specified floor for independent use using a key switch installed in the supervisory panel or MELMOS instruction.	◎	◎
Independent service (IND)	A car can be isolated from group service and used without interruption using the override switch in the car operating panel.	Ⓢ	Ⓢ

Feature	Description	AI-21	AI-2100N
■ GROUP CONTROL FEATURES			
System backup (BKUP)*	A dual system is installed in the group controller to prevent the loss of group control function if a group control microprocessor fails.	—	Ⓢ
Group control self-diagnosis (GCS)*	Elevator group performance is constantly monitored. Excessive waiting times or other abnormalities are automatically detected and flagged for maintenance personnel.	—	Ⓢ
Peak traffic control (PTC)*	To alleviate temporary traffic congestion, cars are automatically assigned (in preferential order) to floors with the heaviest traffic.	Ⓢ	Ⓢ
Strategic overall spotting (SOHS)*	Please see page 7 for detailed description.	Ⓢ	Ⓢ
Learning function (TLF)*	Please see page 7 for detailed description.	—	Ⓢ
Intense up peak (IUP)*	To improve carrying efficiency, the elevator bank is divided into two groups of cars during peak periods to serve upper and lower floors respectively.	—	Ⓞ
Up peak service (UPS)*	Controls the timing and distribution of cars assigned to meet traffic demand during increased upward service.	Ⓞ	Ⓞ
Down peak service (DPS)*	Controls the timing and distribution of cars assigned to meet traffic demand during increased downward service.	Ⓞ	Ⓞ
Forced floor stop (FFS)	Each car in the elevator bank will stop at a specified floor on every trip — without being called.	Ⓞ	Ⓞ
Main floor parking (MFP)	An available car will park at the main floor with the doors open.	Ⓞ	Ⓞ
Special floor priority service (SFPS)*	Provides preferential car service to a specified floor (e.g., VIP rooms) when a hall call is made at that floor.	Ⓞ	Ⓞ
Closest-car priority service (CNPS)*	With a bank of elevators, the car in the elevator shaft closest to the call button pressed will respond preferentially.	Ⓞ	Ⓞ
Light-load car priority service (UCPS)*	When traffic is light, empty or light-load cars will be given priority over full cars to minimize passengers' travel time.	Ⓞ	Ⓞ
Congested-floor service (CFS)*	The system monitors the degree of traffic density or flow in the building and automatically assigns cars to the most crowded floors to alleviate traffic congestion quickly.	Ⓞ	Ⓞ
Bank-separation operation (BSO)*	The hall buttons can be divided into groups, for independent group control to serve special needs or different floors.	Ⓞ	Ⓞ
Lunchtime service (LTS)*	Car assignment can be adjusted to favor canteen or restaurant floors to accommodate high demand during lunchtime.	Ⓞ	Ⓞ
Main floor changeover operation (TFS)	The designated main floor can be changed by manual switch or time-clock operation to suit buildings with alternating main floors.	Ⓞ	Ⓞ
Destination-oriented car allocation (DOAS)*	The destination floor buttons are installed at the main floor lobby and the system assigns cars corresponding to a group of destination calls registered in the morning rush hours. The service floors of each car are indicated in the elevator lobby.	—	Ⓞ
■ FEATURES FOR COMFORT AND CONVENIENCE			
Door sensor self-diagnosis (DODA)	If a non-contact door sensor fails, the system will automatically determine the timing of door closing to maintain elevator service.	Ⓢ	Ⓢ
Automatic door speed control (DSAC)	The system monitors the actual door load conditions at each floor and automatically adjusts the door speed and torque accordingly.	Ⓢ	Ⓢ
Automatic door-open time adjustment (DOT)	Door opening times are automatically adjusted according to whether the stop was called from the floor or the car.	Ⓢ	Ⓢ
Door load detector (DLD)	If the doors cannot open or close properly, the door direction is reversed.	Ⓢ	Ⓢ
Safety door edge (SDE) on both sides	This sensitive mechanical door edge detects passengers or objects upon contact during door closing.	Ⓢ	Ⓢ
Safety ray (SR)	Two infrared-light beams cover the full width of the door as it opens or closes to detect passengers or objects.	Ⓢ	Ⓢ
Ultrasonic door sensor (USDS)	Sound waves are used to scan a 3D area near the open doors to detect passengers boarding or obstructions.	Ⓞ	Ⓞ
Electronic doorman (EDM)	Used with Safety ray or Multi-beam door sensor to monitor passengers boarding and exiting, and uses that information to keep door-open time to a minimum.	Ⓢ	Ⓢ
Multi-beam door sensor (MBS)	This innovative device offers the dual protection of electronic and mechanical detection. Multiple infrared-light beams are mounted into the safety door edges and cover the full width of the door as it opens or closes to detect passengers or objects. (Can not be combined with SR.)	Ⓞ	Ⓞ

Feature	*Description*	*AI-21*	*AI-2100N*
■ SIGNAL AND DISPLAY FEATURES			
Door Open / Close response (DOR / DCR)	Door open / close buttons illuminate to indicate that they have been activated.	Ⓢ	Ⓢ
EL car information display (MCID)	An integrated display to indicate preset messages and time, as well as car position/direction can be installed in the car operating panel.	◎	◎
Immediate prediction indication (AIL)*	Please see page 7 for a detailed description.	—	◎
Second car prediction (TCP)*	During peak hours when lobbies are crowded, while the first car is loading, the next car to serve that floor will be indicated by illuminated hall lantern.	—	◎
Attentive announcement (AAN-B)	A synthesized voice instructs passengers in the case where normal operation is interrupted. (English only)	Ⓢ	Ⓢ
Voice guidance system (AAN-G)	A synthesized voice instructs passengers on the current status, floor number, etc. (English only)	◎	◎
Interphone (ITP)	Intercom allows two-way communication between passengers and building personnel.	◎	◎
■ EMERGENCY OPERATIONS AND FEATURES			
Operation by emergency power source — A utomatic/Manual (OEPS)	In a power failure, preset cars are automatically called to a specified floor in sequence using the building's emergency power source. Once all cars have arrived at the floor, the designated elevators can operate normally.	◎	◎
Fireman's emergency operation (FE)	During a fire, when the fireman's switch is activated, all calls are canceled and the designated car returns immediately to a specified floor. To facilitate rescue, the car responds only to car calls.	Ⓢ	Ⓢ
Supervisory panel (WP)	This panel monitors elevator operations and controls emergency operations from the building's control room, etc. Position indicators and direction lights are also available.	◎	◎
Mitsubishi elevator monitoring and control system (MELMOS)	This system uses an industrial personal computer to monitor the elevator operations and conditions, and to provide operation commands as necessary.	◎	◎

Notes 1. Ⓢ = Standard ◎ = Optional — = Not applicable
2. * = Not available for Selective Collective operation.