

Create for the Future

Safety and Stability in Railway Transportation

KYOSAN

ELECTRONIC INTERLOCKING SYSTEM

K5D



KYOSAN ELECTRIC MFG.CO.,LTD.

<https://www.kyosan.co.jp>

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ELECTRONIC INTERLOCKING (EI) SYSTEM "K5D"

30 years' history with over 2,000 stations

Thirty years have past since the electronic interlocking system was first developed and put to practical use, followed by various enhancements made to the system. The critical technologies incorporated in the electronic interlocking system include electronic circuits, programs, interlocking technology, a transmission circuit, and field equipment interfaces. The remarkable advances made in LSI (RISC) technology with regard to electronic circuits, along with much higher transmission speeds in recent years have helped make many variations and/or various system configurations of electronic interlocking systems possible.


Along with the advancement of basic technology, electronic interlocking systems are required to evolve, in addition to the role of ensuring operation even in areas with a high volume of train traffic and high-quality safety performance. Kyosan developed a new electronic interlocking system which is named "K5D" so as to meet these demands and participate actively in future generation.

Basic information of "K5D"


External view



Electronic terminal sub-rack	
Interface	ET-NET, Relay
Input/Output	32 I/Os per 1 PIO board
Temperature [°C]	-20 ~ +70
Humidity [%]	95 and less (no condensation)
Operating voltage	DC24V±10%



Logic sub-rack	
Interface	ET-NET, Ethernet
CPU	32bit Fail-safe CPU
Temperature [°C]	-20 ~ +70
Humidity [%]	95 and less (no condensation)
Operating voltage	DC24V±10%



Features of "K5D"

The interlocking system is a plant that governs safe, smooth operation of trains in a station or depot area controlling all varieties of signaling equipment installed in the area, such as point machines, track circuits, signals, etc., by electrical/electronic means.

The next generation electronic interlocking system is designed based on the following key features.

1. High-Quality Safety & Redundancy

The logic unit of the next generation electronic interlocking system secures the high safety by comparing calculation results of two 32-bit CPUs in the logic card. In addition, the logic unit and its peripherals are all duplicated for redundancy in order to maintain high system availability. The new system conform to requirements for Safety Integrity Level 4 of international standards IEC 62278.

2. Visualized Designing

A specially provided software tool (Logic Data Compiler: LDC) facilitates the design of the interlocking logic, which can be programmable as an image of relay circuit diagrams.

3. Enhanced Scalability

Modular versatile remote electronic terminals allow easy expansion of the system.

4. Variety in Monitoring

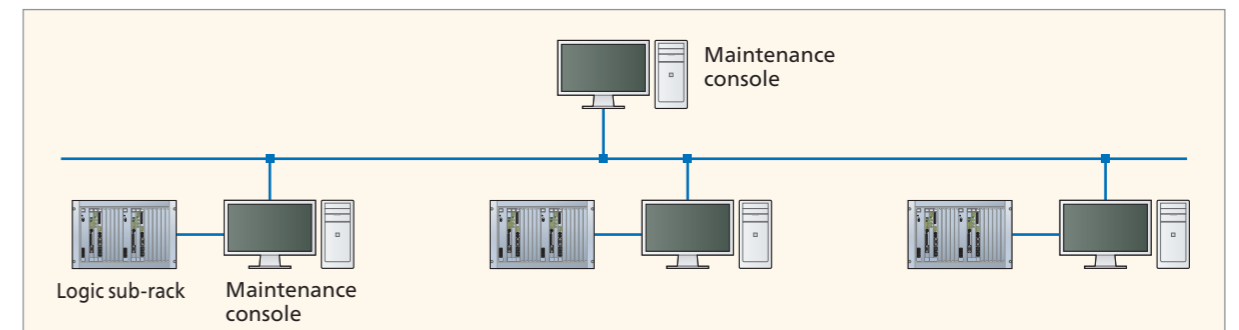
The system console enables comprehensive maintenance of the interlocking system through a variety of graphical monitoring functions.

5. Compliance with EMC standards

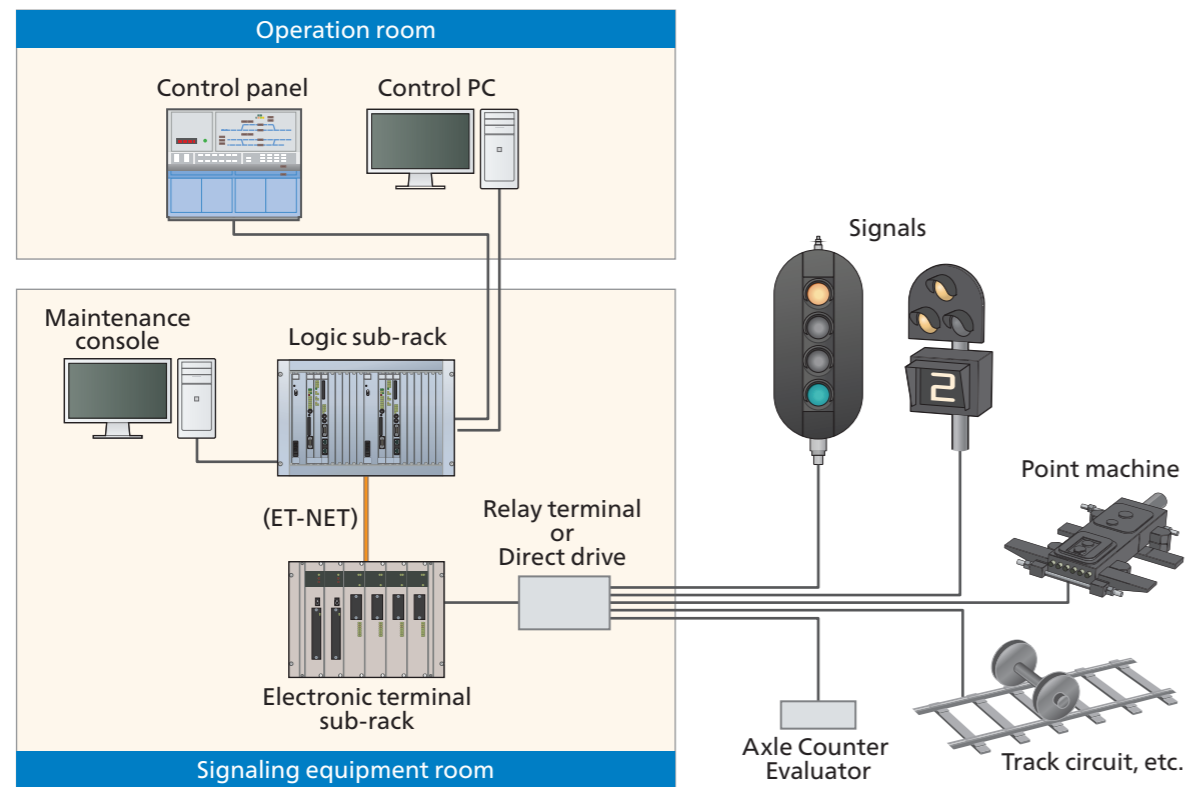
Our interlocking system has been designed and manufactured based on a wealth of experience in delivering products to overseas markets, and has passed the EMC test items to comply with the IEC61000 and EN50141 series.

6. User-Friendly Maintainability

Wire harness is available for internal wiring and it reduces maintenance and replacement works. Maintenance console has function to monitor other station's status through the network. The centralized supervision enables quick response in case of emergency.



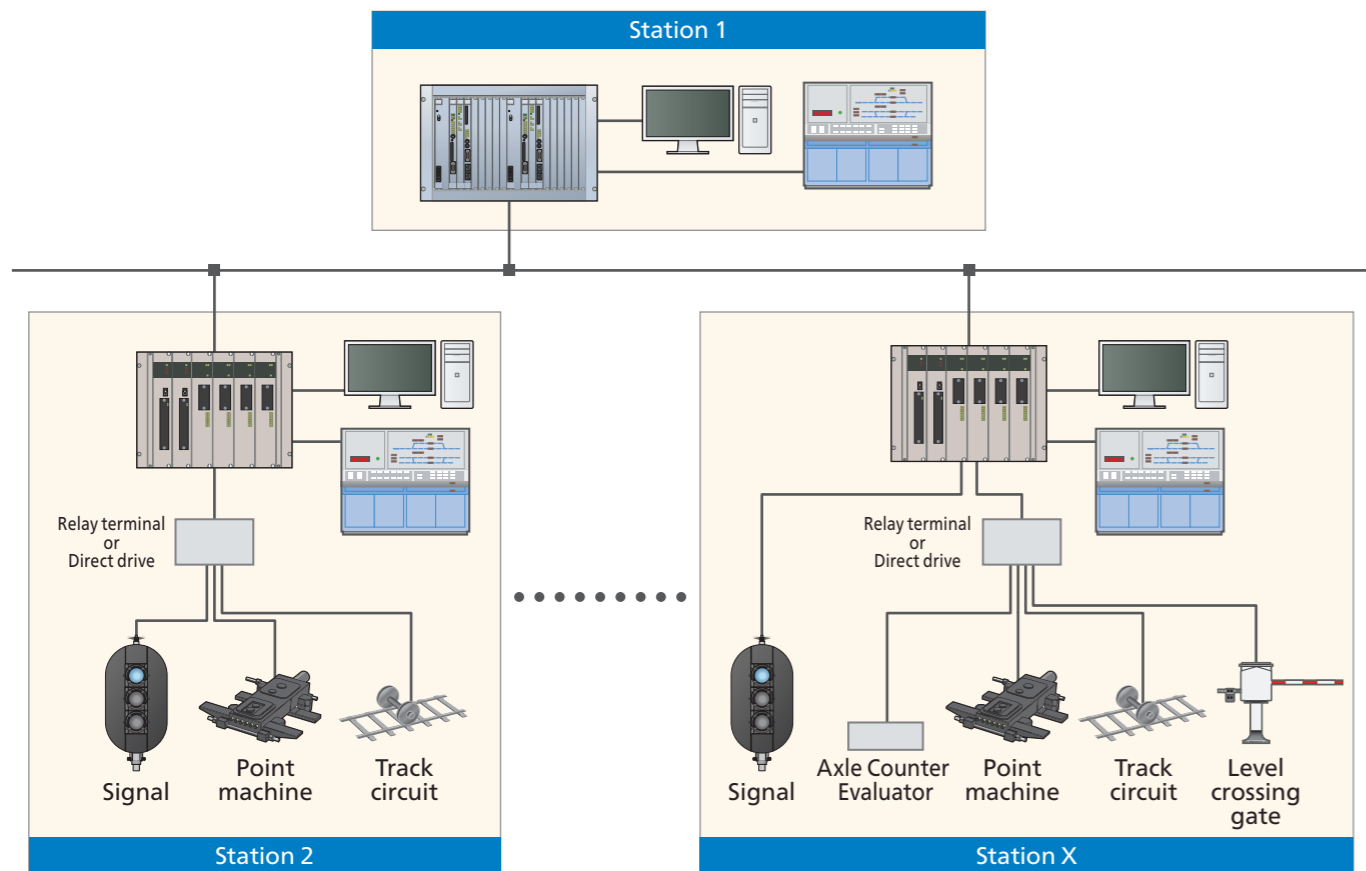
System configuration diagram (for single station)



Descriptions of the System configuration diagrams of "K5D"

- Either Control hardware is available Control Panel type or Control PC type for "K5D".
- "K5D" is connectable with Centralized traffic control system (CTC), Automatic train supervision system (ATS) and other signaling system via Ethernet.
- ET-NET between Logic sub-rack and Electronic terminal sub-rack is exclusive line for transmitting/receiving each equipment's information of the station.
- The Logic sub-rack is able to control multi stations, and realize the configuration similar to single station's one.
- The Electronic terminal sub-rack connects with signaling field gears (e.g. Signals, Point machines, Track circuits, Level crossings, etc.) directly by using dedicated drive cards or via relay terminals.

System configuration diagram (Centralized)



Designing of "K5D"

A. Flexibility attained by using IC card

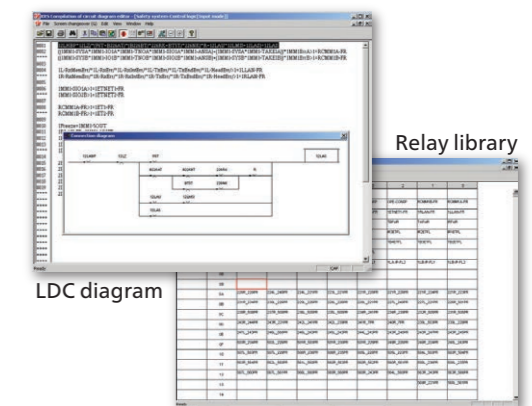
The software of the next generation electronic interlocking system consists of two layers. One is the basic software (firmware) that manages the safe operation of the system stored in a ROM. The other is application software that executes station-specific interlocking logic that is programmed using the LDC and loaded by means of an IC card. New installation or modification of the interlocking logic is easily accomplished by exchanging the IC card.



CPU unit & IC card

B. LDC (Logic Data Compiler)

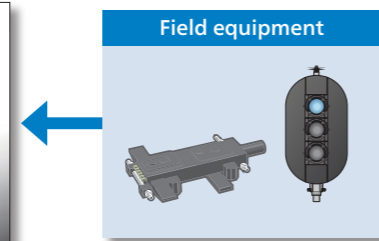
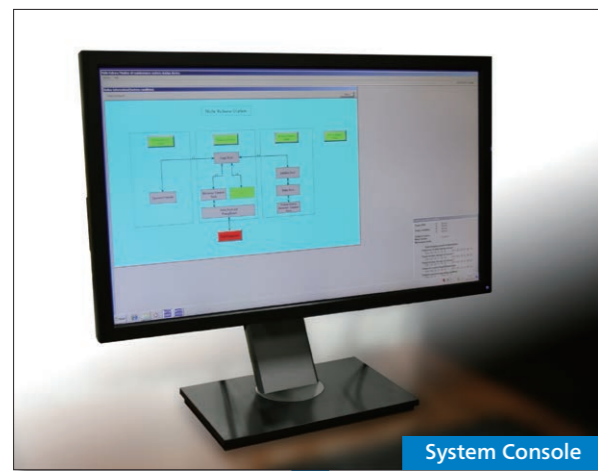
The LDC is a software design tool that allows the designer to create the interlocking logic on a Boolean logic basis, which is easily interchangeable with relay circuit diagrams as to logic expression. In addition, the LDC is outfitted with an automatic data comparison feature that identifies modified portions of the logic on the display for easy verification of the modified design.



System monitor of "K5D"

Maintenance Console

The system console has a variety of different real-time displays, including track map, relay status, timing charts of relay operation, relay circuit diagram, and system status. In addition, operation and failure events are automatically recorded in the system's memory for a predetermined period of time, and can be reported via the display or a printer, providing an easy means for data analysis and troubleshooting.

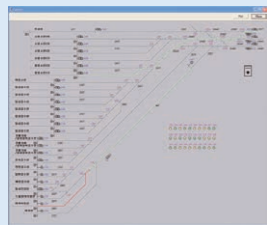


Operations of each element of the system, including logical relays and field equipment, are recorded in chronological order.

Screen display

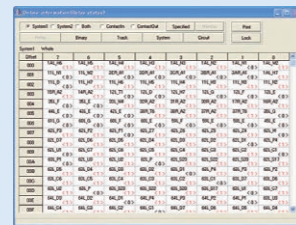
The system console displays various system statuses via comprehensive graphical images.

Track map



Displays track status over the entire depot area.

Relay status



Shows concurrent operation status of the logical relays.

System status



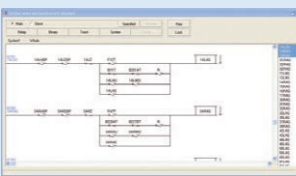
Indicates healthy status of each block configuring the system.

Timing chart

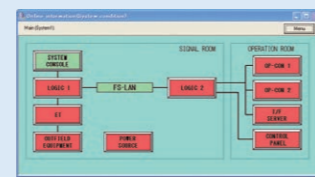


Indicates operating sequence of the logical relays in a timing chart image.

Relay circuit diagram



Describes programmed interlocking logic in relay circuit diagrams.

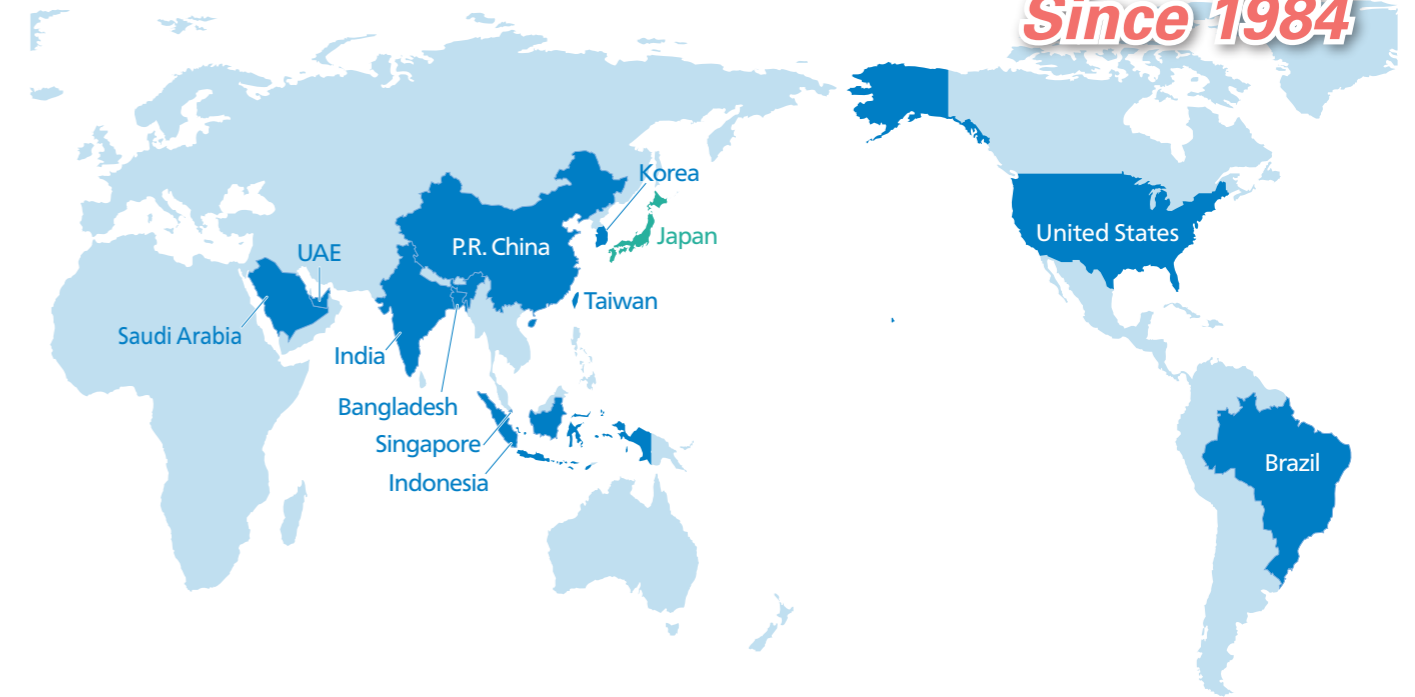


Failed portions are highlighted in red. When the red part is pressed, a message will appear with the solution.

Track record of Kyosan's interlocking system

Implemented at over 2,000 stations worldwide!

Since 1984



Major Supply list

Japan	Public Railways	Tokyo Metropolitan Bureau of Transportation	Overseas	USA	Greater Orlando Aviation Authority	
		Transportation Bureau, City of Nagoya			Hillsborough County Aviation Authority	
		Kobe City Transportation Bureau			Hartsfield-Jackson Atlanta International Airport	
		Transportation Bureau City of Sendai			Miami-Dade Aviation Department	
	JR	East Japan Railway Company		India	Indian Railways	
		West Japan Railway Company			HYDERABAD METRO RAIL LIMITED	
		Central Japan Railway Company			Korea	Korea Railroad corp
		Hokkaido Railway Company				POSCO Engineering & Construction Co., Ltd.
		Kyushu Railway Company				Gwangju Metropolitan Rapid Transit Corporation
		Japan Freight Railway Company				Busan Transportation Corporation
	Private Railways	Tokyo Metro Co., Ltd		P. R. China	Incheon International Airport corporation	
		TOKYU CORPORATION			China State Railway Group Co., Ltd.	
Odakyu Electric Railway Co., Ltd.		Airport Authority Hong Kong				
Keio Corporation		Singapore	Harbin Metro Group Co., Ltd.			
SAGAMI RAILWAY Co., Ltd.			Macao Light Rapid Transit Corporation, Limited			
Nagoya Railroad Co.,Ltd.		UAE	Singapore	Land Transport Authority		
Osaka Metro Co.,Ltd.			Changi Airport Group			
Kintetsu Railway Co.,Ltd.		Taiwan	Dubai Civil Aviation Authority			
HANSHIN ELECTRIC RAILWAY CO.,LTD.			Taiwan Railways Administration			
Keihan Electric Railway Co.,Ltd.			"Taoyuan International Airport Office			
Metropolitan Intercity Railway Company			Civil Aeronautics Administration, MOTC R.O.C"			
Ibara Railway Company		Saudi Arabia	Taiwan High Speed Rail Corporation			
Keisei Electric Railway Co., Ltd.	Saudi Aramco					
SEMBOKU RAPID RAILWAY CO.,LTD.	Indonesia	Directorate General of Railways				
	Bangladesh	Bangladesh Railway				
	Brazil	Brazil CSP Steel Plant Complex				