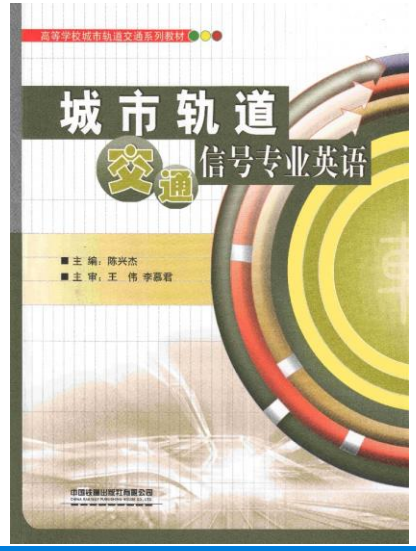
CHAPTER 3
Interlocking

- Can Li @ 12#503A
- lic@jsnu.edu.cn
- https://sslic.cn/speci_eng



Unit 13 Computer Interlocking

- Introduction
- Computer Interlocking Development Requirements
- Take Two Squares Two Systems
- Fully Electronic
- Modular
- Hardware Configuration
- Software Constitutes
- Achieve the Basic Functions and Special Interlocking Function
- Conclusion

Introduction

- England from 1984 started to develop computer-based interlocking system, *at present, as the core railway transportation safety control system, replacing the original 6502 Electric (interlocking)*, but with the large scale development of computer interlocking system also exposed more and more problem.
  - Since many computer-based interlocking systems retains nearly 30% of the relay circuit, complex structure, large area, multi-wire, solder joints, this cause high failure rate, anti-interference ability is weak, while interlocking software *out of the intellectual property protection considerations*, is completely closed, for interlocking software correctness, security, not in-depth control.
  - Software testing is only limited to functional testing, black box testing, and the test cannot be exhaustive range of functions.

13.1 Development Requirements

- To ensure that rail transport leaps and bounds, give full play to the railway signal factories, engineering units, specialized construction units, electrical service maintenance units role *in ensuring the basic security conditions*, based on the computer-based interlocking system allows multi-level units become widely participate to achieve an open interlock devices. Computer interlocking system of the ideal state is:
  - complete factory production.
  - completely standardized design.
  - most simplified construction site.
  - most simplified acceptance mode.
  - most simplified maintenance approach.
  - most simplified maintenance tools.
  - easiest secondary development that free secondary development.
  - complete device parameter monitoring function.
  - meet railway traffic automation interface functions.

13.2 Take Two Squares Two Systems

- UK's current computer interlocking systems are: hot standby, two out of three and two by two to take two systems.
  - Hot Standby system problem exists Dual switch, *switch failure would have serious consequences for the risk*, shielded redundant technology to take two of the three systems, although the possibility of dangerous output is extremely small, but there cannot be downtime problems, therefore this year the main technological transformation and new railway lines have given priority to take two squares two systems, two by two computer interlocking system is also taking future trends.

13.3 Fully Electronic

- As manufacturing technology continues to improve, the electronic unit to get the vigorous development of electronic unit with small, powerful features, facilitate networking, remote management and remote diagnostics.
- Thus, with the Ministry of Science and continues to progress, to get rid of the relay, using fully electronic computer interlocking will be a trend. Show as below Fig. 13.1.

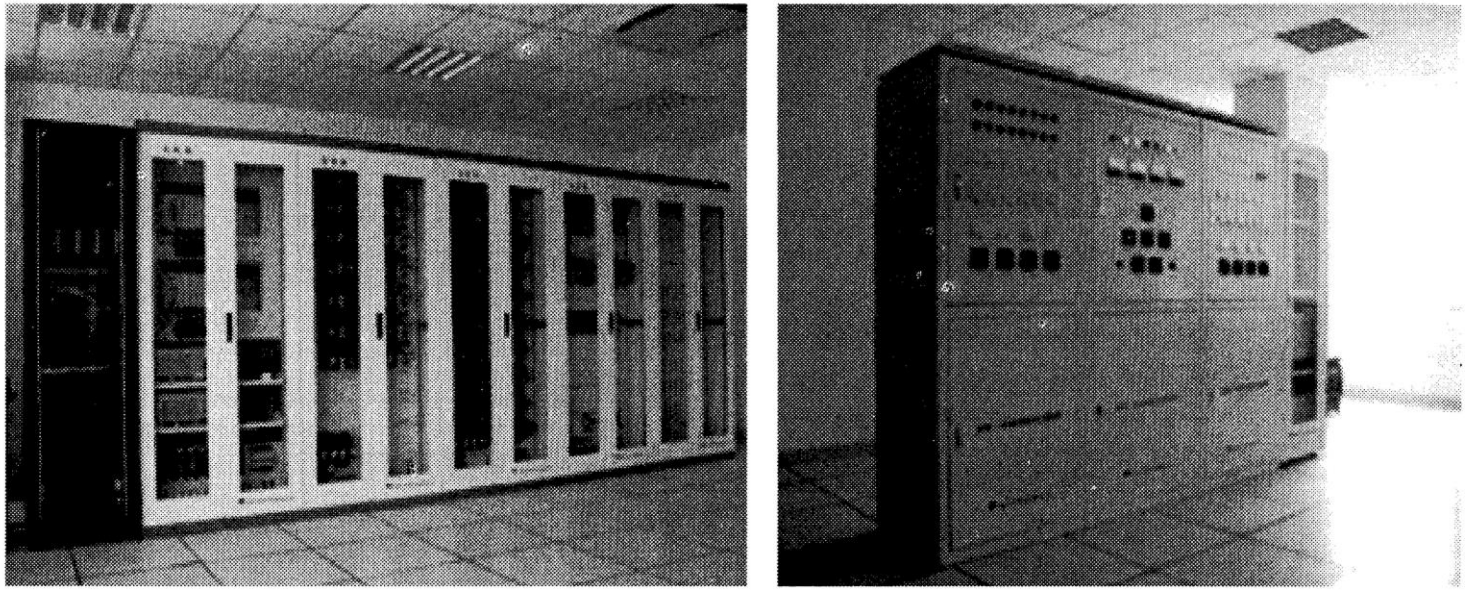


Fig. 13. 1 Computer interlocking device

13.4 Modular

- For ease of use and maintenance, computer interlocking should move towards modular, functional direction to achieve the module line replacement, saving the system maintenance time.

13.5 Hardware Configuration

- Fully electronic interlocking modular computer system using industrial control technology, *the abolition of all 6502 relay module* is in direct control of the outdoor unit switch machines, signals machines, track circuits, in a clear, comprehensive fault diagnosis and fault indication and all modules supporting hot-swappable capabilities.

- Cabinet wiring with plug-in cable directly corresponding nose plate will minimize the amount of construction, and the use of direct replacement module and the first maintenance after analyzing ways will achieve "fool" the construction and maintenance.

13.6 Software Constitutes

- Interlocking Software should break the current computer interlocking system interlock seclusion other barriers to achieve an open source code level, and its "messaging" and "module assembled" interlocking ideas and original 6502 15 network cable and Puzzles designed in a way similar to the implementation of modular,
  - trained technical personnel should be able to cope with any new station interlocking software design and debugging,
  - testing to ensure early detection can minimize and resolve software in a variety of potential security risks,
  - computer-aided design system refers to the user input station plan and set the necessary parameters, (so that) you can automatically generate interlock programs and data to minimize human error (Fig. 13.2).

13.6 Software Constitutes

- 联锁软件应打破当前计算机联锁系统联锁隔离等障碍，达到开源代码级别，其“消息传递”和“模块组装”的联锁思路与原6502的15条网络线及拼图（模块）的设计方式均类似于模块化的实现。训练有素的技术人员应该能够应对任何新车站联锁软件的设计和调试； 通过测试来确保最大限度地减少早期检测和解决软件中各种潜在的安全风险；计算机辅助设计系统是指用户输入车站配线图并设置必要的参数，可以自动生成联锁程序和数据，从而最大限度地减少人为失误。

13.6 Software Constitutes

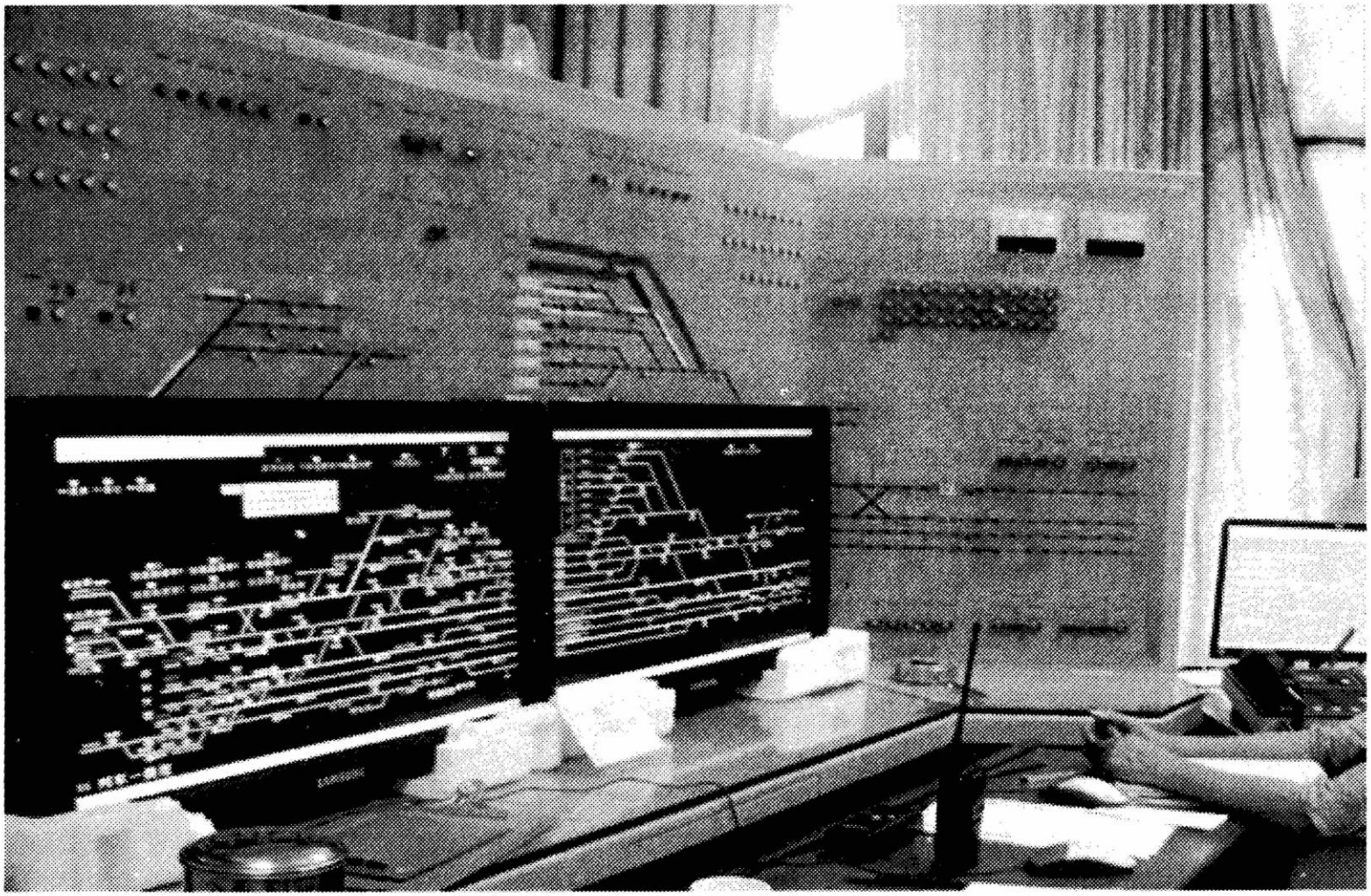


Fig. 13. 2 Monitoring interface

13.7 Achieve the Basic Functions and Special Interlocking Function

- Achieve progress *on the road turnout*, signal and track circuit interlock properly to ensure correct and train running into the road safety. To meet all of the interlock function 6502, the main features include:
  - handle all stations train route, shunting into the road and roundabout approach. Equipment failure can be handled in the boot and boot into the path of total lockdown.
  - the end is always handled two ways. Shunting into the road at once handled by a few basic approach consisting grow way; can also be handled by one segment.
  - signals belonging to the hostile approach, cannot open. Only checked into the path of all track sections idle, all the relevant switch position is correct and has been locked in position, according to investigate and correct the hostile relations, the signal to open.
  - having a signal normally closed function, special off function to prevent automatic repeat function open signals and artificial repeat open feature.
  - with approach automatically unlock, halfway back to unlock, unlock cancellation approach, labor and trouble unlocking unlock approach into the road.
  - having separate operation functions turnout.

13.7 Achieve the Basic Functions and Special Interlocking Function

- According to the special requirements of stations to achieve special interlocking relationships, such as:
  - single hook slide release function,
  - stock Road middle Chucha feature non shunting into the road,
  - continuing into the road,
  - local control station or turnouts and clinical linkages interval occlusion.

13.8 The flexible System Configuration Function

- Fully electronic interlocking modular computer system using three-layer structure, the upper PC; upper layer via a communication network and the second interlocking machine communication; third layer is 10 module execution units.

- According selection of different composition interlocking machine can achieve hot standby interlock fault tolerant computer or three takes two interlocking squares two computers or take two interlocking computer systems.

13.9 Conclusion

- Full computer control of railway signal interlocking system is a new generation of interlock devices, 有如下特点:
  - systems to computer control technology as the core,
  - power electronic switching technology based on the use of electronic means,
  - the use of computer communications, automatic detection and other advanced technologies, to achieve full electronic control computer of the railway signal interlocking equipment,
  - small, powerful, easy networking, for
    - railway automation,
    - information technology to provide basic information,
    - remote management and remote diagnostics,
    - railway signaling professional development.

13.9 Conclusion

- 全计算机控制铁路信号联锁系统是新一代联锁装置，主要特点如下：系统以计算机控制技术为核心；使用电子方式的电力电子开关技术；利用计算机通信、自动检测等先进技术，实现铁路信号联锁设备的全电子控制计算机；体积小、功能强大，易于组网，可促进铁路自动化，提供基础信息的信息技术、远程管理与远程诊断以及铁路信号的专业发展。

Homework

- Page 108
  - 1
  - 2
  - 3
  - 4: (1)