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Advancements in technology and the challenges posed to electrical testing of Protective Relays and Controls

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Presenter: Eric Beckman, PE– Vice President, Operations – NFS

Authors: Eric Beckman, PE, Ryan Matthews, EIT, Tyler DeBey, EIT, Bibek Karki, MSEE, Kushal Gandhi, MSEE

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Outline

- Introduction
- Electromagnetic Era
- Modern Era
- Bridging the Gap
- Conclusion

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Introduction

- Advancements in technology in protective relays and controls have created a different set of challenges to the industry
- Better protection schemes, but more complicated
- Asking more out of field engineers and engineering technicians

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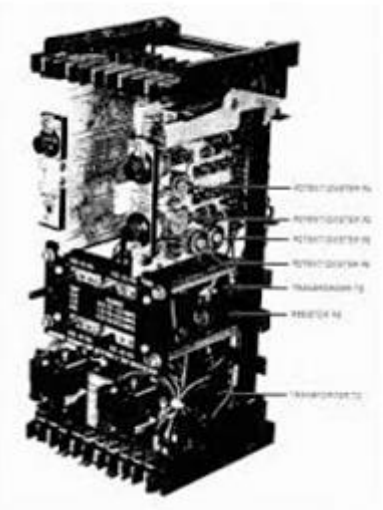
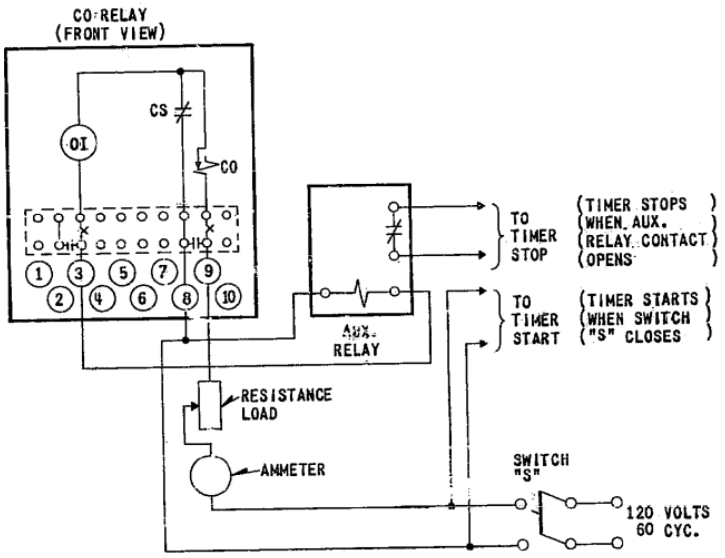
Electromagnetic Era

- Induction disc technology
- Single relay for each element
- Component testing



Electromagnetic Era

- Limited number of manufacturer's
- Single function relay testing with simplified schematics and no logic.



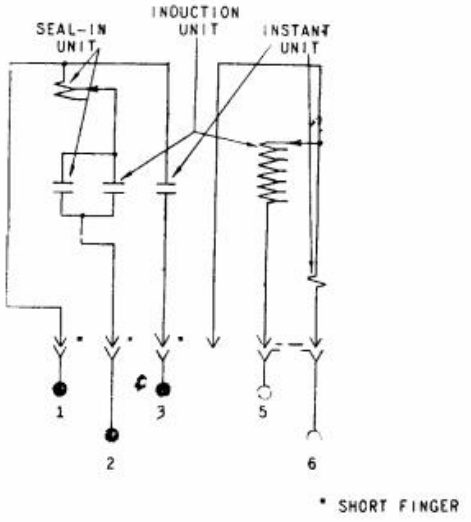


Fig. 13 Internal Connections for Type IAC53B Relay (Front View)

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Electromagnetic Era

- Logic in the function of wiring and controls
- Intent of design engineer for protection scheme seen in wiring/schematics.

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Electromagnetic Era

- Test equipment manufacturer's were limited
- Less competition in test equipment market, more durable equipment.

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Modern Era

- Electromechanical gave way to solid state
- Solid state served as a temporary bridge to the modern style of relays we have today.

Modern Era

- Microprocessor based relays
- Computers interaction
- Communication
- Digital logic based schemes

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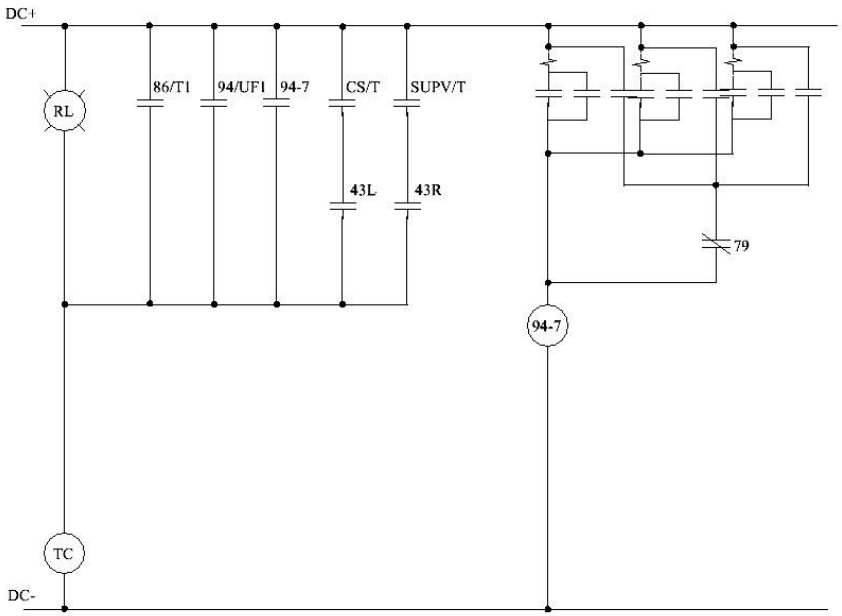
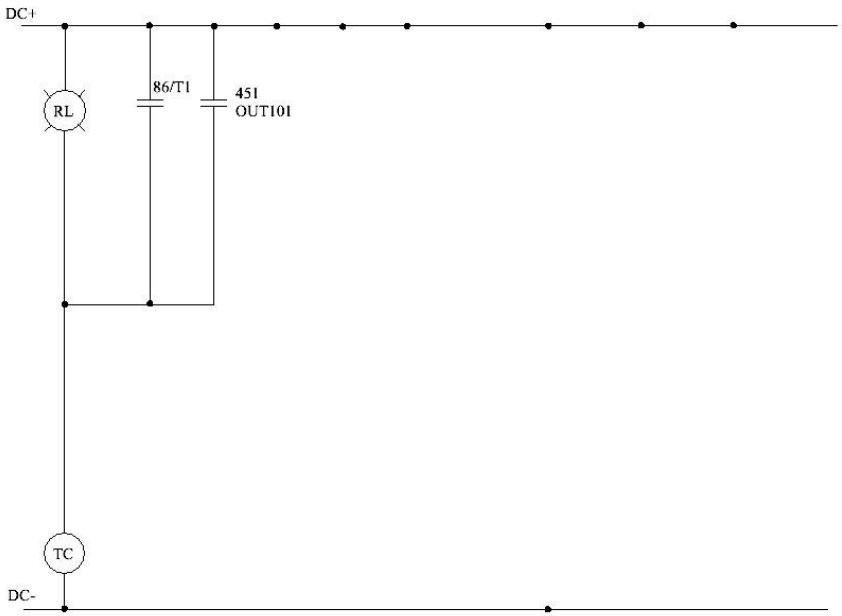
Modern Era

Schematic to Black Box

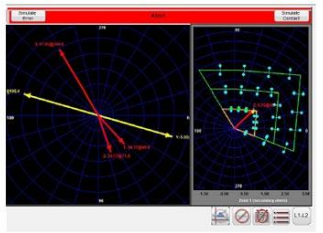


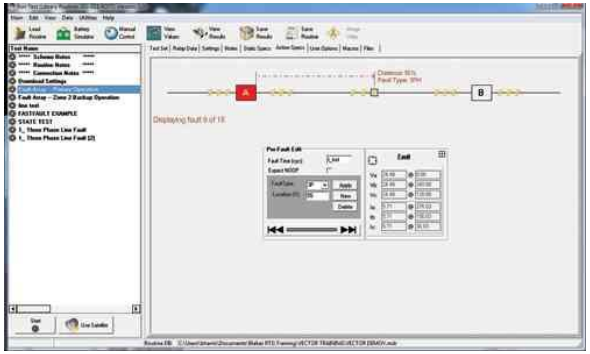


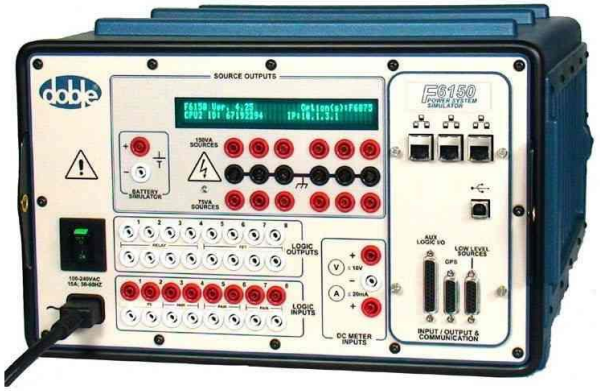
Modern Era

- Advancements in test equipment
- Automation of test equipment
- Data management software

RTMS
Relay Test & Management Software







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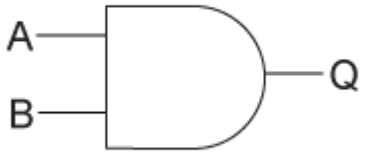
Modern Era

- Technology advancements have lead to requiring more skilled and educated professionals.
- Require more than just power background
- Understanding of software, communications, and digital logic.



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Impact

- Yesterday
  - A separate device was used for each function
  - Equipment was typically overbuilt
  - Few Environmental Concerns
  - Controls were wired and utilized coils and contacts
  - Most technological advances occurred over long periods
- Today
  - Multifunction Microprocessors
  - Cost have driven equipment to limited durability
  - Environmental Concerns drive many decisions
  - Advanced communications and digital technology
  - Technology is changing almost daily

Impact

- Requirement of high level of expertise
- Improperly commissioned systems
- Test equipment quality
- Interface of multiple type of software and firmware.

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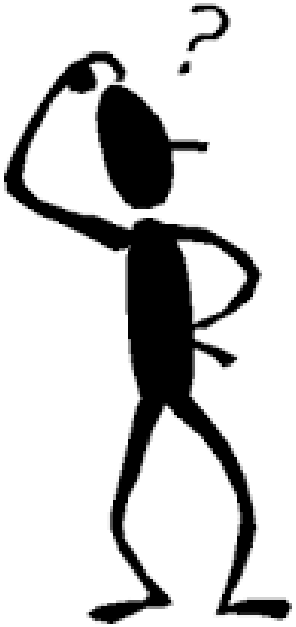
Impact - Scenario

- Commissioning a new relay for a distribution substation.
- Upload settings to relay
  - Incorrect model specified in relay settings
  - Incorrect firmware in relay
- Test relay
  - Notice outputs enabled are not wired up
  - Automated test set communication fails

Impact – Scenario (continued)

- Automated relay setup
  - New test plan, errors in calculation or execution of element testing.
- Test relay logic
  - Logic element reference in equation yet not enabled
  - CT and PT ratios not correct
- Test communication
  - Communication to RTU fails

Impact – Result



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Bridging The Gap

- Higher education system
- Minimum requirements for engineering deliverables
  - Logic diagrams
  - Operational notes
- More investment in training

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Bridging The Gap

- Replacing the aging workforce
  - Estimated 60% of the current workforce will be gone by 2020
- How do we make power engineering field “cool” again?
- Commitment to the industry as a whole

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Conclusion

- Engineering errors
- Test equipment errors
- Software errors
- Installation errors
- Who is going to ensure there are zero mistakes when the switch is turned on??

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Questions

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