



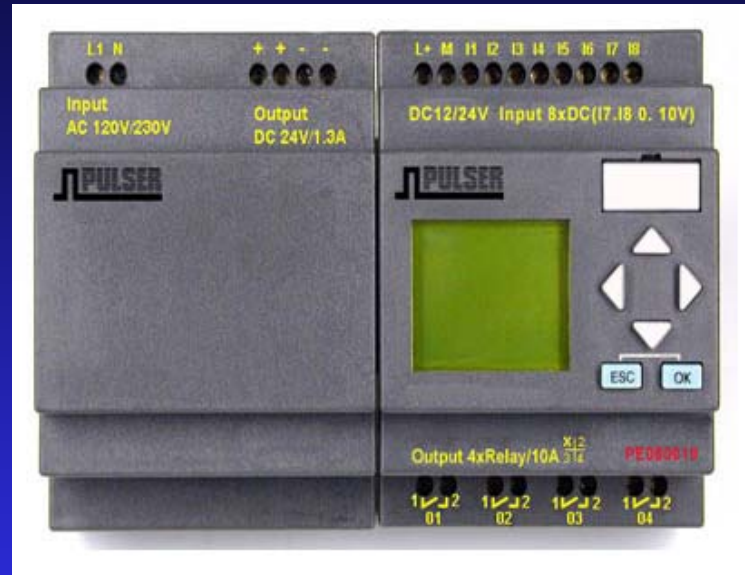
PLC in modern vessels

Are you aware of the risks?

HMA CONCEPT 800
Integrated marine automation



PLC in modern vessels



Are you aware of the risks?



PLC

- Have become extremely popular in the past 10-15 years
- Low price starting at 100 USD up to 10 000 USD
- Large capacity , from a few signals < some thousand signals
- Easy programming
- Easy modification
- Cheap indication on screens compared to lamps
- Easy to copy SW
- Available anywere any time

What is a PLC?

- PLC - Programmable Logic Controller
- Sizes covering some I/O to several hundred signals
- Storing the program in RAM or non volatile flash memory
- Hundreds and types and brands
- Many different programming languages
- Different types of program handling (offline – online)
- Different methods for parameter handling (RAM – Flash)
- A large variety of communication protocols available
- Programmed through a PC or Laptop most common today
- Prices from 1000 NOK

Common PLC storage areas?

Bootstrap Loader area

Contains a small SW for loading of firmware

Firmware area

Contains the operating system, where basic SW and libraries are stored. The functions of the SW depends upon the Firmware.

Application SW area

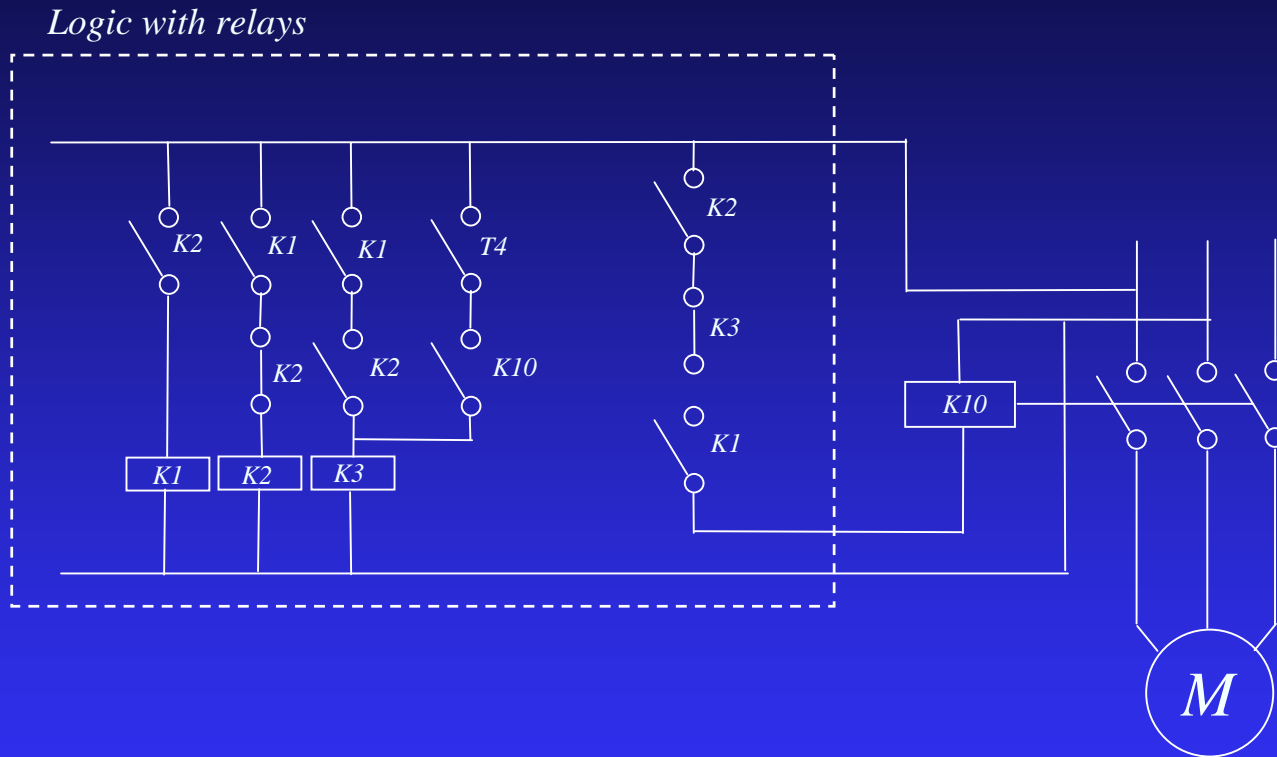
Contains the Software for the specific application

Parameters area

Contains changable parameters for the application SW

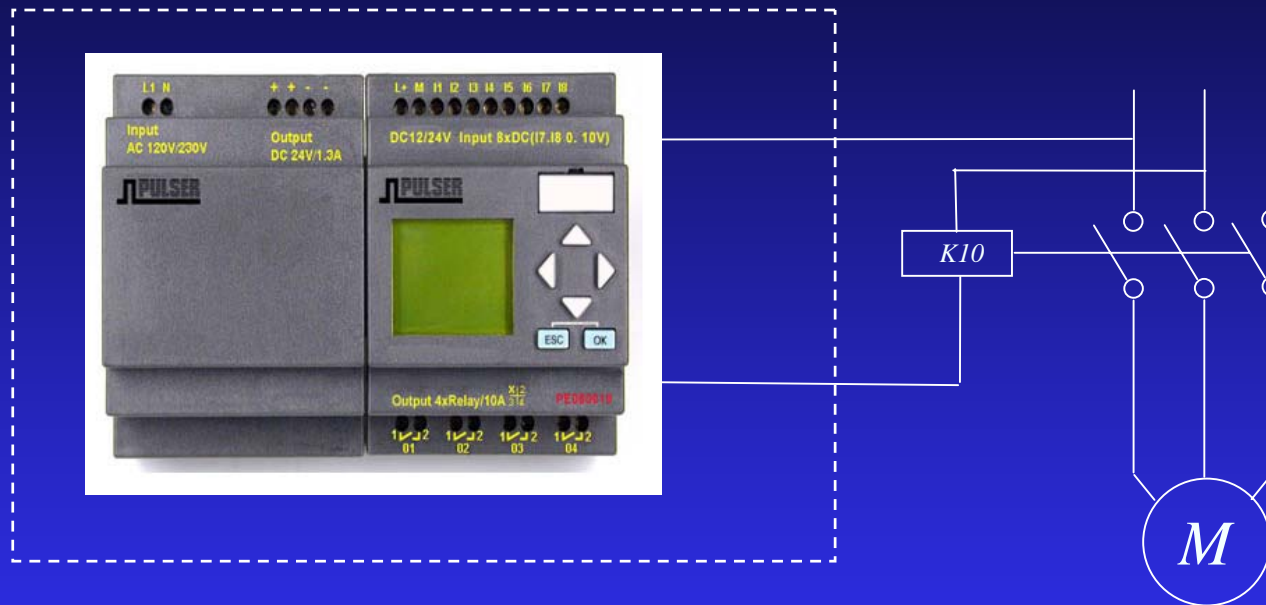
PROM	Bootstrap Loader
EEPROM / RAM	Firmware
EEPROM / RAM	Application SW
EEPROM / RAM	Parameters

The total Difference



ANY ELECTRICIAN CAN REPEARE THIS CONNECTION

PLC Control



A PLC FAILURE MAY BE WERY DIFFICULT TO REPAIR

Consequences

What are the consequences in the following cases:

1. PLC stall (hang)
2. PLC breakdown
3. PLC reboot (internal watchdog)
4. PLC logical SW bug

Remedies

What are the remedies in the following cases:

1. PLC stall (hang) – Reset by the crew
2. PLC breakdown - Replacement
3. PLC reboot (internal watchdog) – Probably not noticed
4. PLC logical SW bug – In some cases simple, but in other cases impossible

Remedies - PLC Stall

Reasons:

1. Poor application SW (programming)
2. Poor PLC Firmware
3. Poor PLC Hardware
4. All the above

In any case, this is a critical failure, which needs to be rectified.

But to day, in most cases this is solved byt the crew with a ??????

You guessed correct

A RESET

Remedies - PLC Bug

How can you detect a bug?

You may try to provoke the bug but:

If the PLC have some timers, and some combinatorial logic, this may show to be impossible.

Is there al LOG available?

If there is some trace after this action in some event log, you will get some important clew

But probably no log is available.

Availability

What is the consequences of a PLC stop?

Normally most ship owners prepare for a component failure during the DP2 FMEA

What is forgotten? **The time it takes to repair the failure.**

Remember this vessel is probably offhire during this failure:

- Due to a component failure necessary for safe DP2 operation – (out of DP2)
 - Due to a important component failure in the cargo handling system
- Cargo handling is often not a concern, as it is not a part of the FMEA

Do you have the answers?

- How many microprocessors or PLC's are installed on the vessel?
- How many different types/brands are installed.
- What vital equipment onboard depend on a working microprocessor or a functional program?
- Is it guaranteed that a unit which have been programmed and passed a number of tests will do the job it have been programmed to do?
- If it is powered from a UPS, will it withstand a UPS failure after 5 years in operation?
- Does it contain a battery? If so, how often should the battery be replaced?
- If so what happens to the application SW after a battery failure?
- If so, what happens to the adjustable parameters (if any) after a battery failure?
- How does the unit it act when it is re-booted?
- Does the unit contain a FLASH memory?
- If so, what is the lifetime of this memory?
- What actions should be taken if a unit has to be re-booted?

Break down - replacement

- Is there a spare unit in the store?
- Is it possible to get a replacement unit within a reasonable time when needed?
- Is the firmware and HW in the spare unit compatible with the application SW?
- Is it loaded with the latest revision of application SW?
- Is this unit the same for a number of components? (DG1,2,3,4...)
- Are any parameters changed?
- Is the application SW stored onboard?
- Is there a compatible PC for running this SW?
- Is the necessary PC SW for uploading the application SW available or installed?
- Does this PC run a compatible operating system for the tool SW?
- Is the appropriate cable for this connection present?



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Change Modification

- Du you have the necessary SW for modification of the SW?
- Are you 100% sure that you have the correct SW version in your possession?
- Can you download the actual SW from the unit?
- Are there any parameters that may be lost during SW upload?
- If so, do you have a list of updated parameters?
- Are some of the crew trained to do a modification?
- Is there some kind of log for changes available?



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Maintenance and support

- For how long period will it be possible to purchase a compatible replacement unit?
- What are the consequences if you need to upgrade to a newer unit?
- Will you need the support from the supplier to do this job?
- Is the supplier still available, and do the supplier still have your resent application SW and the correct version?
- Dos the supplier have track on all changes made on this particular unit?

PLC Failure Story 1



This vessel faced a 4 week offhire when the PLC controlling the Main Engine and clutch failed.

The company who delivered the system were not available.

The PLC type was obsolete.

No SW were stored on board, and no PC to load SW was available.

PLC Failure Story 2



This ferry had it all.
RP propulsion,
Separated engine rooms
Backup levers in the ECR
Backup governors
Redundant control
Etc.

Passengers, cars, trucks and trains were stuck for hours due to a failure.
Guess where?

IN A PLC CONTROLLING THE BOW GATE

Who have thought of that? As it had nothing to do with the propulsion.

Minimum PLC requirements

- Limit the number of PLC's
- Limit the types-brands of PLC's
- Keep spare units onboard
- Require Latest SW to be stored onboard
- Keep necessary tools for uploading SW
- Keep track of battery replasement
- Requiere a revision log and parameter log
- Quality requierements to the supplier
- Update HW regularly, or check availability
- Do not accept rebooting as a solution



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