Advantages of Numerical Relay:

1. Compact Size :In the case of electromechanical relay, there is a need for mechanical comparison devices. This amounts for the bulky size of the relay. Then, there is a need for a flag system for activation confirmation of relay.
2. As opposed to this, the numerical relay relies on one system for all approach and use indication on LCD for relay activation, ensuring less space.
3. An important fact to note is that digital protection can be made physically smaller. This is on the account that it needs less panel wiring than equivalent functions implemented using analog tech.
4. Flexibility:Since the numerical relay system relies on software, customized modifications can be made for getting the desired protection features. This saves you the cost of replacing hardware.
5. Reliability: One basic problem with electromechanical relays is that because of larger components and mass interconnection, component non reliability can be an issue. In the case of numerical relays, fewer interconnections ensure reliability.
6. Multiple relay characteristics: The range of operation of traditional models is narrow while numerical relays are diverse and evolution adaptable. This property of multitasking is further strengthened on the account that the numerical system can accommodate different types of relay characteristics.
7. Since, it is possible to provide better compatible protection characteristics, the efficiency improves. This is achieved with the memory save feature in the microprocessor.
8. Communication capacity: Among the most significant advantages of a numerical relays is its ability to cater to digital communication. An interface is added which brings microprocessor based relay property. Substation LAN coupled with fiber optics complete the communication capacity.
9. The property is directly linked to the data history feature of the numerical relay system. Because of data storage systems, the availability of fault data and disturbance record can be made. This helps in finding the nature/magnitude/duration of the fault.
10. Auto reset:It has also been highlighted how the system is flexible. In addition to this, it also has the feature of auto resetting and self-diagnosis.
11. As opposed to numerical relay systems, electromechanical systems do not have the ability to check if normal condition has been attained once activated. The self-diagnose and self-reset features provide less dependence on operating personnel.
12. Related benefits: Apart from the mainstream benefits that have been provided above, there are other ones too. For instance, there is a modular frame in the numerical relay system which allows ease of service.
13. Then the benefit of using microprocessor based relays in the numerical system is that it gives minimum burden on the instrument transformers. The sensitivity of the system is pretty nifty and boasts a high pickup ratio.
14. Based on the information provided above, the end user can clearly see how numerical relay systems would better protect their devices than the conventional ones. The advantageous features highlight why they are a cost effective option.
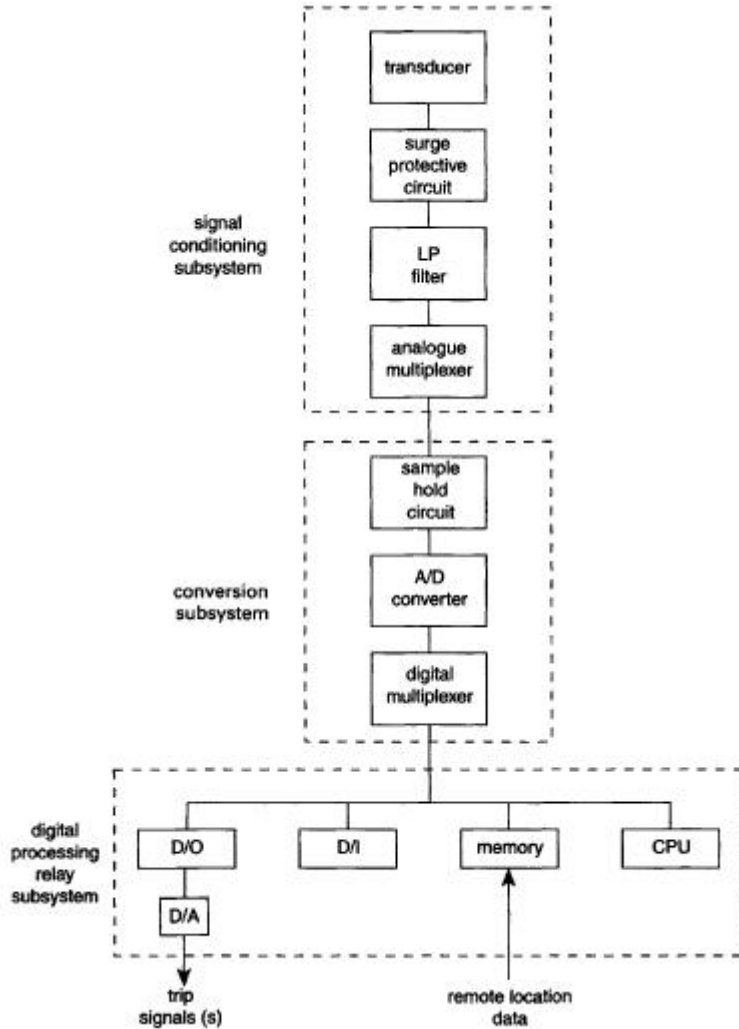
Basic components of a digital relay:
Any digital relay can be thought of as comprising three fundamental sub-systems :
(i) a signal conditioning subsystem
(ii) a conversion subsystem

(iii) a digital processing relay subsystem.

The first two subsystems are generally common to all digital protective schemes, while the third varies according to the application of a particular scheme. Each of the three subsystems is built up of a number of components and circuits, as discussed in detail in the following sections.

signal conditioning subsystem

- transducer
- surge protective circuit
- LP filter
- analogue multiplexer

conversion subsystem

- sample hold circuit
- A/D converter
- digital multiplexer

digital processing relay subsystem

- D/O
- D/I
- memory
- CPU
- D/A

trip signals (s)

remote location data

Signal Conditioning Subsystem:
● Transducers
● Surge Protection Circuits
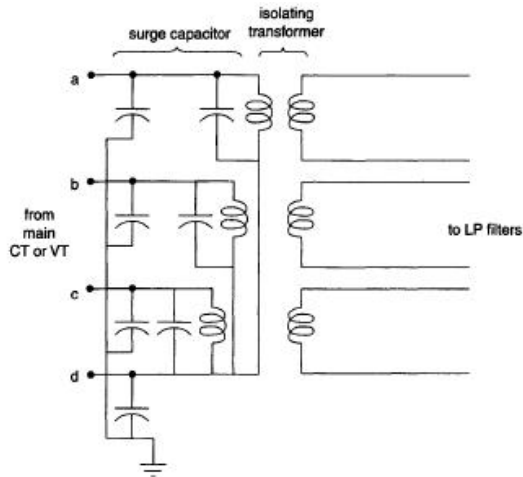
- Analogue filtering : figure shows characteristics of Low pass filter (a) Ideal filter response (b) Practical filter response
- Analogue Multiplexer
- Analog to Digital conversion: Basics of simple digital-to-analogue converter arrangement shown in figure.

clock

4-bit counter

8 4 2 1

digital
output

reset

W₃
W₂
W₁
W₀

comparator,
output = 1 when $V_i \geq V_c$

V_c

D/A converter

−

+

V_i

sample-
hold

analog
input

a

6

5

4

3

2

1

V_i

V_c

counter stops at 0101

quantum levels

1 2 3 4 5 6 7

multiples of clock time step

b