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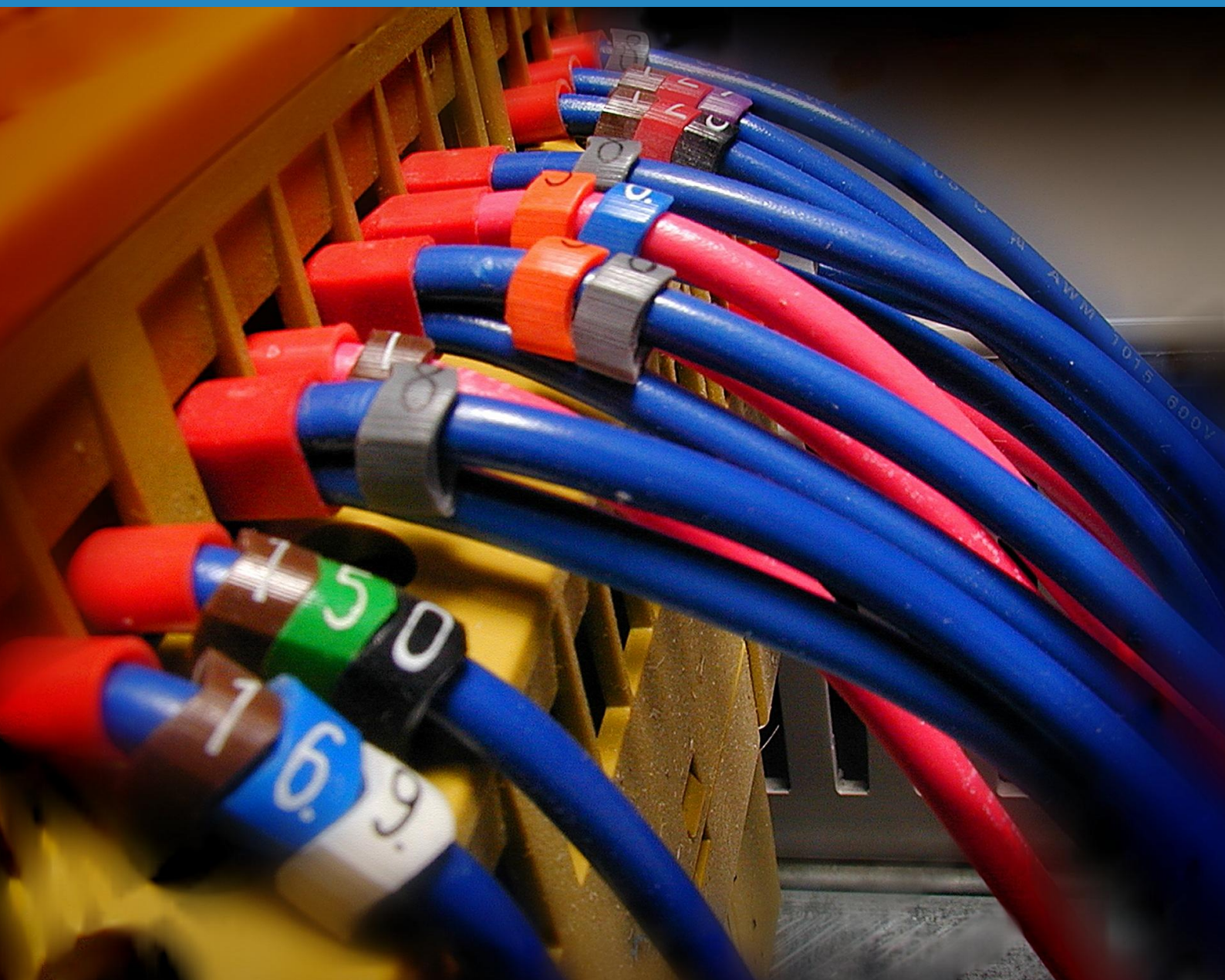
Safety control systems: Some essential considerations



Safety matters

According to the latest HSE reports, each year 1 in 100 000 workers dies in a workplace accident. Another more serious figure – 1 in 125 workers will suffer a major injury that will keep him away from work for a week or longer. With almost 3 million people employed in the UK manufacturing sector alone, the impact of unreliable safety systems is obvious.

Industrial automation has raised production rates to a whole new level – machines are now bigger and faster than ever before. Subsequently, the health and safety risks associated with any automated manufacturing process have risen too.

Increasing integrity and reliability of safety systems have been promoted in European law with the migration from EN954-1 to the latest SIL and Pl standards: ENISO13849 and IEC/EN62061.

Safety control systems – requirements and types

For machine builders and owners, the ideal safety system architecture must conform with the minimum industry standards (*see figure 1*) whilst allowing safe machine operation and not preventing operators from efficient production. The systems should be subject to a Lifecycle Cost Analysis as well as a Benefit-to-Cost Ratio Analysis.

Many component manufacturers have, over the recent past, developed products specifically for use in safety-integrated systems. This report presents four typical safety system architectures, outlines their advantages and disadvantages and cites the approximate cost (per unit) for each.

Figure 1. Major safety system equipment requirements – EN954-1

The following automation manufacturers are amongst the leading producers of safety control equipment:

- PILZ Safety
- Siemens
- GuardMaster (part of Rockwell Automation)
- SICK
- Schmersal

By their nature, machine safety systems are a bespoke element of most control applications and are tailored to meet safe machine operation requirements. Consequently engineers need flexibility in the product suite they choose in order to meet the varying demands of individual machines.

Selecting safety components for inclusion in a safety system is subject to the same rigours as any design engineering exercise. They must, obviously, be fit for purpose and satisfy the technical (or safety integrity) demands of an application and be cost competitive. (Safety is probably one of the areas where cost is the lower priority of the two). Technical and product support are as always in the mix.

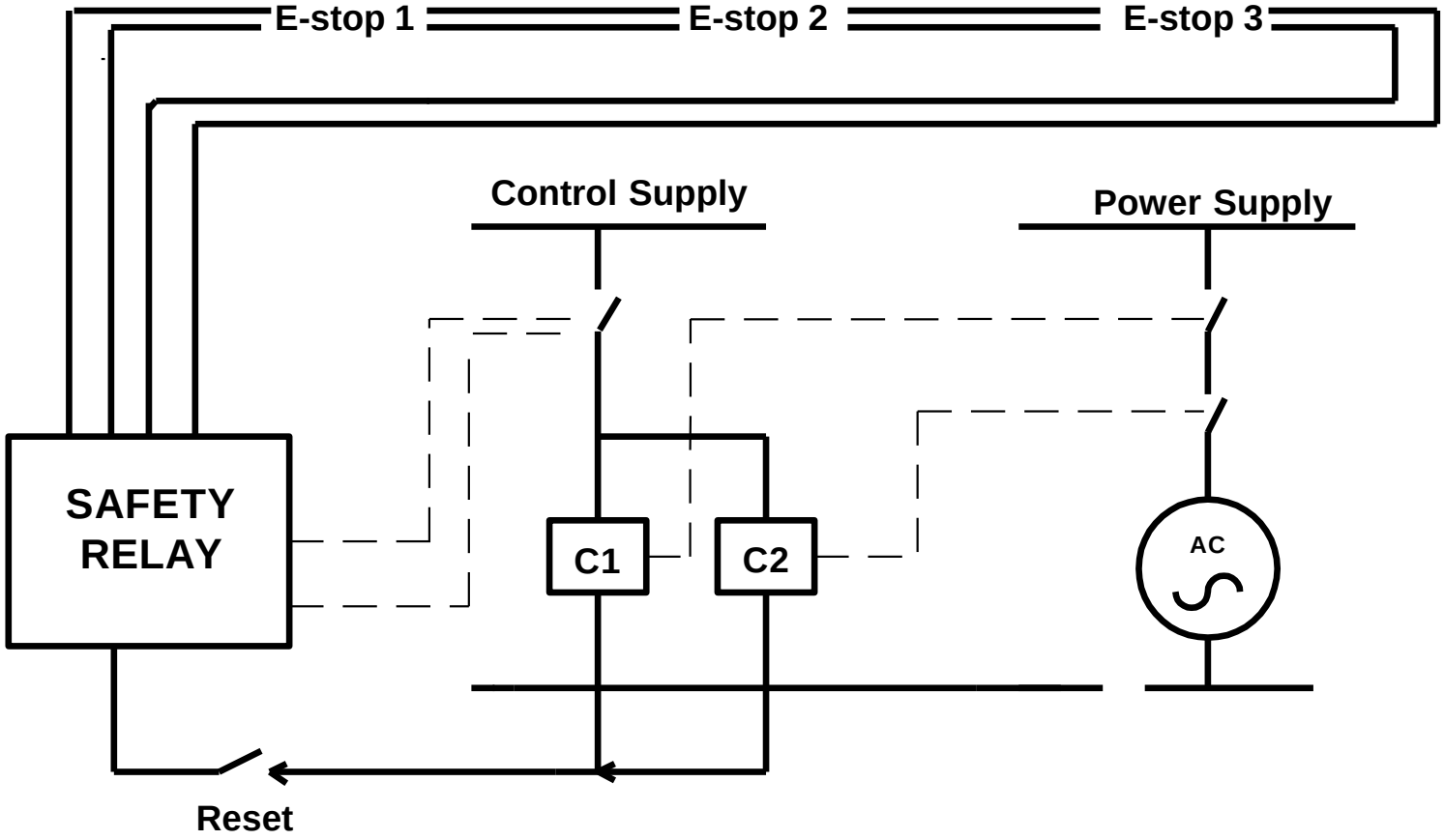


Figure 2. Safety Control system employing safety relays

Safety Relays

- All Emergency Stop buttons wired in series(with dual channels for redundancy)
- Dual contactors used for redundancy.
- Reset circuit monitors contactors before allowing reset to occur

Advantages of safety relays	**Disadvantages of safety relays**
Cheap compared to other alternatives	Wiring can be complex on big systems.
Simple	Difficult to commission and fault find when the system is down.
No software programming required	Complete rewiring is required if changes need to be made later.

Typical price per unit*: £100 - £300

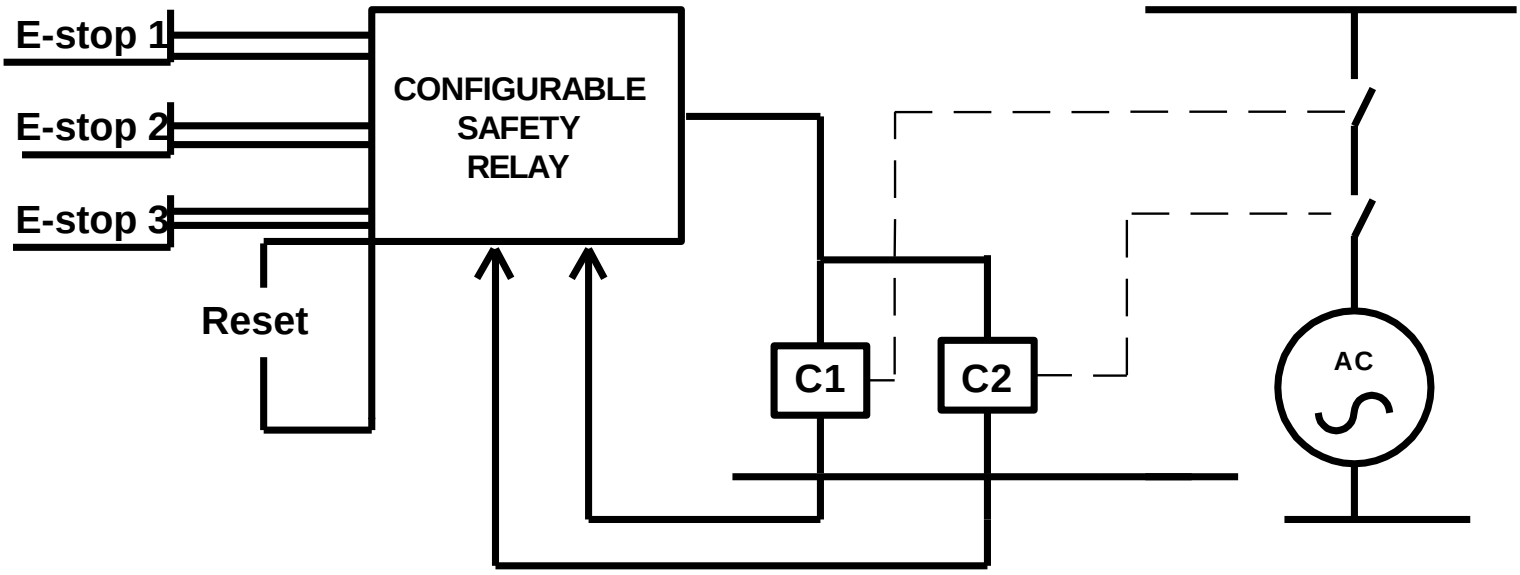


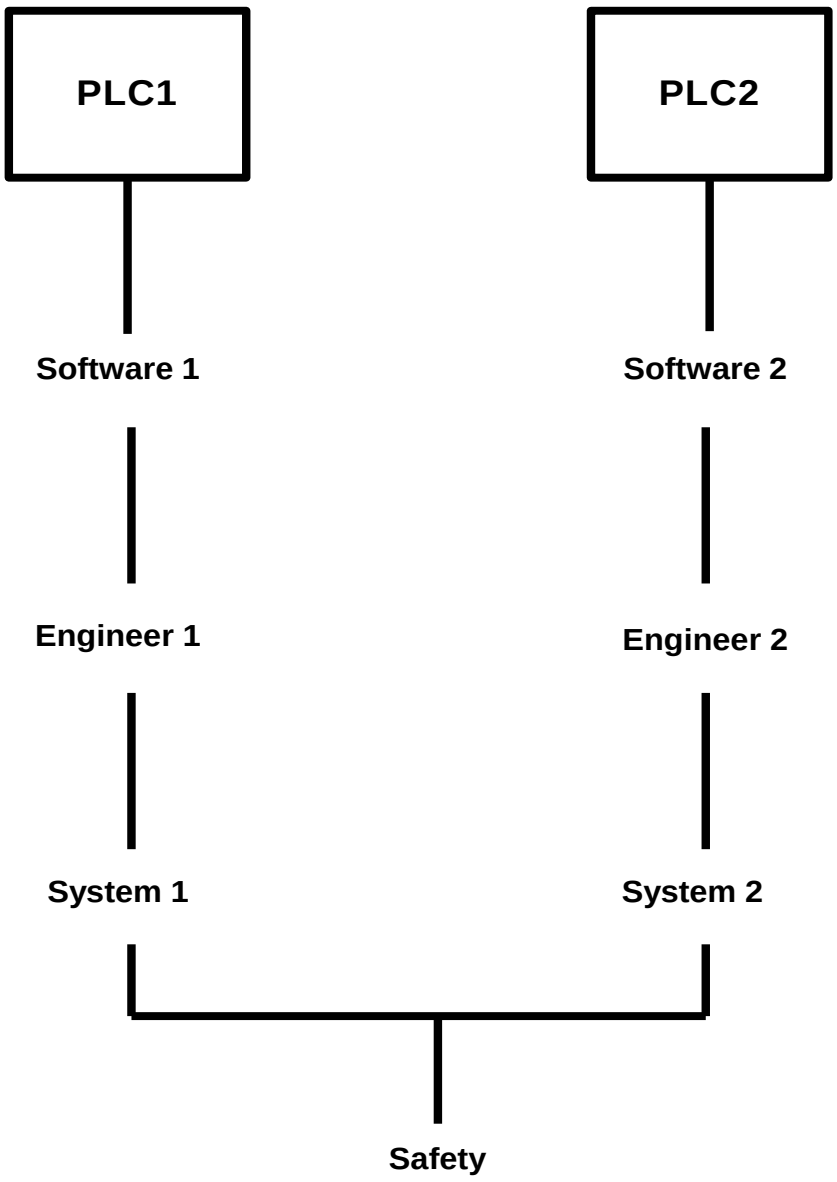
Figure 3. Safety Control system employing configurable safety relays

Configurable safety relays

- Components are wired individually making testing easier
- Still using dual contactors for redundancy
- Reset point is programmable in the software, in this case

Advantages of configurable safety relays	**Disadvantages of configurable safety relays**
Configurable/Flexible	More expensive if used on small systems
Easy to fault find	Need for a PC and software to program
Cheaper on large system due to saving on test time.	-
Easier to change	-

Typical price per unit*: £300 - £1000



A typical arrangement for PLC controllers used in critical applications is to configure a redundant pair, often with "hot-swap" functionality. The redundant controller is used to support a safe and orderly shutdown in the event the primary controller fails.

Arranging multiple controllers and meeting the demand of a safety/critical application using standard PLCs involves cross coupling additional, dedicated I/O from each PLC to monitor their individual conditions and initiate the “hot swap” routine in the event of a unit failure. In a nutshell this often proves to be a complex and time-consuming arrangement to design and implement.

Hence, designing safety systems with standard controllers at the core requires extended engineering time, hardware, and build time to implement the safety section of an application.

Rockwell, Siemens and other major PLC manufacturers offer equipment specifically designed for these critical applications which, whilst carrying higher hardware costs, reduce the costs of design, hardware and build activities and provide a certified solution to the application engineer.

Figure 4. Safety Control system employing redundant PLC arrangement

Redundant PLC systems

- Both systems must compare exactly at all times while running
- Only really used in high spec environments such as pharmaceuticals or nuclear reactors.
- This arrangement is far too expensive for most applications.
- Very difficult to commission and fault find
- Very expensive safety system
- This arrangement was only applicable prior to safety PLCs being made available.

Typical price for 2 parallel systems*: From £10000

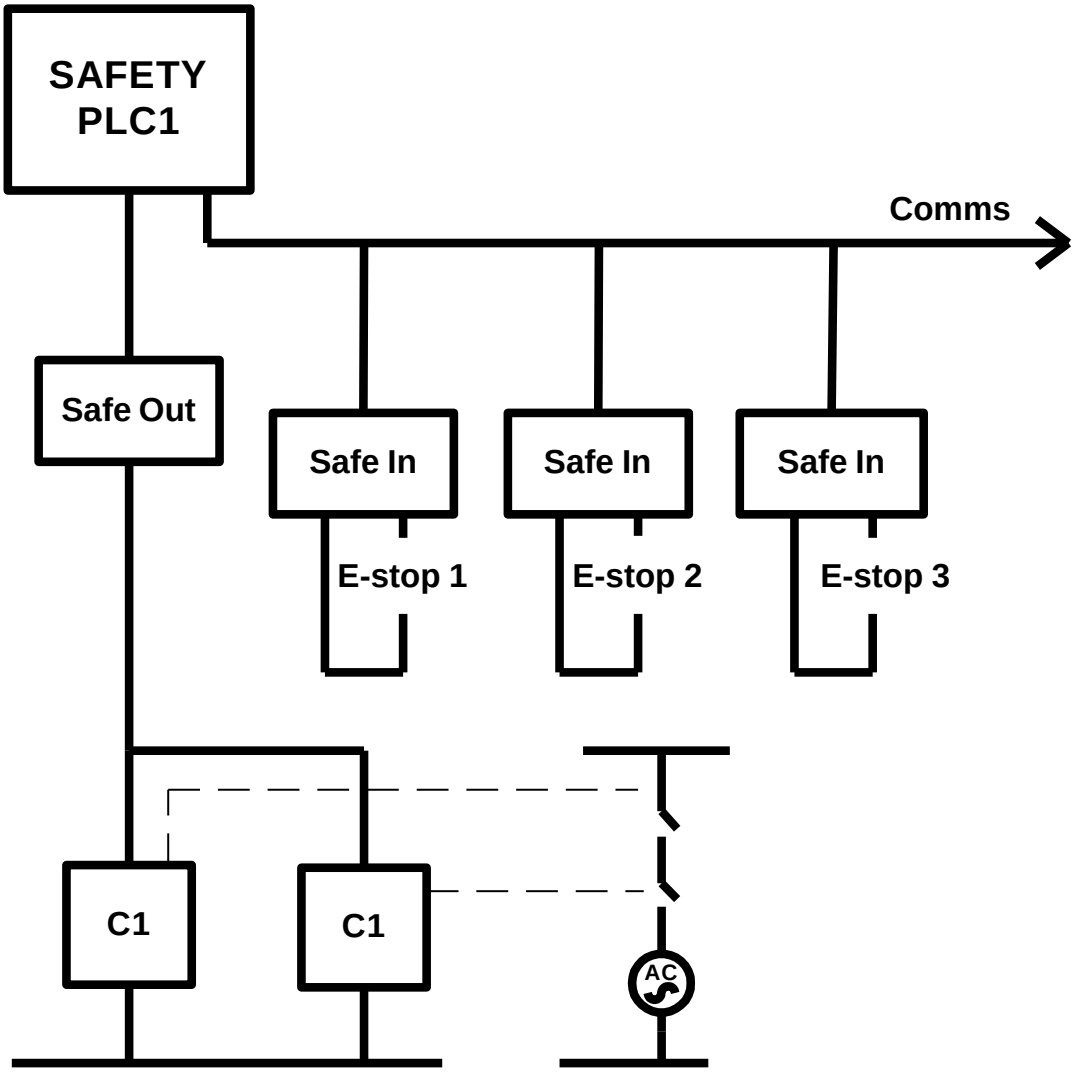


Figure 5. Safety Control system employing Safety PLC

Safety PLCs

- Specific code for safety applications is written in addition to the normal PLC code.
- Safe I/O modules can be centralised or remote.
- At present, safety PLC technology is more readily available

Advantages of Safety PLCs	**Disadvantages of Safety PLCs**
Very Flexible	More difficult to program
Perfect solution for large machines	Expensive software required
Easy to expand later	Understanding of PLC code is required/ Highly trained engineers required

Typical price per unit*: From £2000

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*** Please, note that all prices cited do not include software design costs and/or engineering costs.**

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