ECE Senior Design Product Life Cycle Report
For

Scalable Regulated Three Phase Power Rectifier

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Design and Development Phase

It is important that the development of the design and end product be carried out with the needs of potential customers in mind. The purpose of the system design will ultimately be to release the product to the customer’s full satisfaction. At this stage however, the customer focus is primarily potential investors and proprietors for the product, including those from the engineering and the business worlds to establish funding and a solid foundation to begin work. The customer support focus is to propose the project in great detail and structured planning such that the potential investors will desire to be a part of the process. Direct and immediate concerns of the customer will be focused on the proposed work including the overall design specifications, the necessity for such a product in the marketplace, and economic constraints that are present to ensure that such an endeavor will be worthwhile.

This particular product design is based on a previous design as outlined by Dr. Richard Wall and Dr. Herb Hess that has been upgraded and improved to conform to modern technology and available resources. Research prior to design development includes the full understanding of the original paper pertaining to this design and of the actual design itself. From this research, it has been determined that the new design consists of the following components: Microchip PIC16C74B processor & PICDEM2 development board, Enerpro FCOAUX60 gate firing circuit board, comparator circuit for zero crossing detection, Azonics LCD, Entry Keypad, Teccor Silicon Controlled Rectifiers, and SCR snubbing protection circuits. The chosen components and design configuration is based on the best possible method for the most successful product. This stage is very important to ensure that every important characteristic of the original design is applied and implemented towards the new product design. The design choices made during this initial stage will set the tone for the overall product lifecycle and form the basis for any changes or future product support issues to come. Product revenue maximization issues include mainly the choice of design
components for minimal overall system cost and overall reliability, as well as some minor advertising or recognition that the product will be in the introductory phase and on the market in the near future.

**Introductory Phase**

The customer base will change to focus on actual end users and consumers seeking a product of this type. The primary customers of the Three Phase Rectifier product will be those dealing with any type of application where a three phase DC output voltage must be obtained from a three phase AC power source. There are several customer applications involved with this particular phase, including those throughout the electric power utility industry and with any other field associated with related electrical distribution. Another specific customer application includes users of three phase DC electric motors, as well as almost any DC engineering application where the primary source of power is a three phase AC line. Their primary needs and concerns include discussion and notification of system functions and features, as well as any inaccuracies that may be present that would need to be incorporated into a particular design application.

One of the most important areas of customer support during this phase includes the need for a system user manual that provides useful information regarding the basic operation of the system as a whole, all individual features and functions, overall system specifications and performance characteristics, and any inaccuracies within the system or potential sources of error of any kind that may be potentially problematic and needs to be addressed. A concise explanation of how each individual component plays a role in the system as a whole is useful information to most customers to aid in gaining a better understanding of how their new product physically functions and how this can be applied to their specific application. Schematic diagrams of internal circuitry and an explanation of the features of the software component are also useful tools in familiarizing the customer with the product.

Another very important concern with the customer is safety. Because the system is designed to operate with high voltage and high current levels, every precaution necessary must be taken to
ensure the full safety of not only the direct consumer, but of any other potential users or environmental situations that will exist. Advertising of the product to inform potential customers is a primary method in which the consumer base can be expanded and product revenue can be maximized, as well as continued work to keep production, customer support, and further development costs at a minimum. Initially, costs will be greater during this phase due to component availability and cost, but will start to become less expensive as the technology further develops. The overall life cycle of the product is determined by the amount of advertising and production effort put into this stage to ensure a quality product, leading to a firm customer base.

**Active Phase**

During this stage of the Three Phase Rectifier’s lifecycle, it will be fully functional and in the hands of the consumer. The consumer base remains virtually unchanged from the introductory phase and the continued input from these customers is important in eliminating any initial problems that may arise as the product remains on the market. This recognition of customer feedback and input is the major focus of customer support. By this point, most of the initial problems with relation to the original design and prototype testing will have been worked out and provisions will have been made to ensure that the mass produced product has been as streamlined as possible and produced at the highest quality but lowest cost possible, to maximize product revenue. If all components and upgrades could also be purchased in a bulk quantity during this phase that lowers the overall individual component costs but yet still can all be completely used in manufacturing would also contribute to increased product revenue.

It is predicted that the competition will start to notice this product’s technology and minor changes and upgrades may be necessary to ensure notoriety and uniqueness in the marketplace as well as consumer satisfaction. This initial product satisfaction illustrates the primary needs and concerns of the customer that will continue to be addressed. Support costs will be based on how many product problems do arise at this stage of the lifecycle and also based on what type of repairs
or upgrades need to be fulfilled, such as component types or subsystem replacements. The design choices made within the active phase will determine whether the product life cycle will be extended as long as possible or whether the system will perish in the near future.

**Functionally Stable Phase**

Now that the product has been successfully launched and has been on the market for a while and has been applied to numerous specific customer applications, the customer focus remains on faithful users from previous phases as well as those who may be new to the product. It is in this phase of the product’s life that several support and maintenance issues that have been previously raised need to continue to be taken care of, as well as any more foreseeable conflicts to come. A major potential customer support issue would be the potential failure of a component or subsystem within the main system (such as a SCR or microcontroller failure/problem) that would need to be repaired or replaced within the lifetime of the product, as in the active phase. These potential problems should be getting increasingly smaller by this point, but the availability of replacement components or systems, as well as the availability of individual engineers or technicians to carry out any necessary modification or upgrades would directly affect product support costs, as will the frequency and difficulty of these potential problems or failures. These issues directly affect support costs and therefore overall product revenue as well.

Because system problems and failures should be at a minimum by this stage, product revenue should be gaining towards a maximum. Advertising costs can be decreased due to current product popularity, as can initial repair costs. A key to the overall success and popularity of the product is to not only to note every outlined problem or issue but to fully utilize every bit of feedback obtained from the end user at this phase and apply these concepts to the overall maintenance and customer support plan. The design choices made based on this customer interaction will directly affect the length to which the product’s lifecycle will be. At the completion of this stage, most
significant setbacks and customer complaints will have been dealt with and the product will be at its
most beneficial and error free state for the customer.

**Maturity Phase**

When the designed product reaches this stage in its lifecycle, it will have been on the market
for an extended period of time and the majority of problems will have already occurred and been
addressed as necessary. With this phase may come the growth of the market for similar competing
products that could potentially draw from the original product consumer base. To minimize this
effect, customer support will continue to be a primary focus of the product and will be the ultimate
determination of the overall product life cycle to keep faithful customers satisfied. Spending on
component upgrades and overall customer support will still occur, but at a minimum cost in the life
cycle due to knowledge gained in the previous stages. This will contribute to maximizing product
revenue as will the decreased focus on advertising spending. The design choices associated with the
maturity phase focus mainly on customer support, which is the ultimate determinant of the length of
the product life cycle at this point. A satisfied customer and consumer base will provide for greater
revenue through multiple purchases. Because other similar competing products will exist at this
time, it is important to keep the customer base satisfied that was established in the introdutory,
active, and functionally stable phases.

**Retirement Phase**

As with any product or system design, its useful lifecycle will come to an end at some point
in time in the future since its conception. This particular product is based on a previous design that
was created eight years previous and is now currently obsolete, and the prediction is that this will
occur again in a similar lifecycle time frame. This is due mainly to the discontinuation and
unavailability of certain individual components within the design, as well as the discovery of newer
technologies that could be applied to the design to increase accuracy and precision more so than ever
before. The customer base focus will remain the same as the previous life cycle stage but customer
support will gradually decline and be eliminated within this phase as components and subsystems reach obsolescence and can no longer be feasibly obtained from both an engineering and economic standpoint. Needs and problems faced by the customer in this situation include the need to find a separate but similar product to the current one near the end of its life. This would be a great opportunity for the company at hand to develop a new replacement system.

The product life cycle will unfortunately come to an end when the components incorporated into the design can no longer be purchased or maintained. Design choices and changes will be at a minimum during this final stage, which will lead to the end of the product lifecycle. Although these choices and the funding allocated for them will be at a minimum, it is predicted that the maximizing of product revenue will prove to be a major challenge as demand for the product may be constantly dropping. Once support and demand for the system can no longer be provided to the level in which is necessary for customer satisfaction and full product functionality and reliability will the product be discontinued and retired.

The six phases of a product’s life cycle involve many changes and adaptations that must take place to remain competitive in the market and popular with consumers. These changes must be constantly made to survive in a marketplace full of consumers seeking the highest quality product possible. It is the responsibility of the designer to not only initially design a product, but to provide continued support and provisions for whatever problems may arise throughout the product’s lifetime. If carried our successfully, revenue will be maximized and a solid consumer base will be established. This has been previously illustrated and can be used to contribute to product success in the modern marketplace.