

# From idea to product in seven steps

## How to turn an electronics product idea into a reality with contract engineering

Eric Funk - Partner, Red Mountain Radio LLC

In this age of cost-cutting, an increasing number of businesses are having design work completed under contract. This is true in the area of circuit design as well.

Hiring an outside contract engineer to perform circuit design work is beneficial when a single project does not justify the cost of hiring a full time engineer, or when

the design work requires a special skill that is not available within your organization.

Dr. Funk is a founding partner with Red Mountain Radio LLC, a firm that specializes in contract radio-frequency (RF) circuit design. In this article, he outlines seven steps to successful product design that have worked time and again for his clients.

### 1. Do Your Market Research

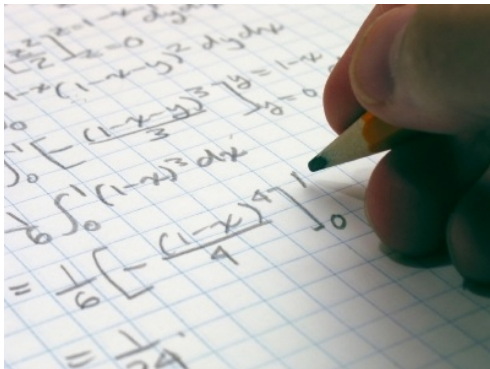


It may seem obvious, but the success of your product will ultimately depend on its marketability. The development process represents a major commitment of time and funds. Avoid back-tracking by first determining the key features that will be required to make your product a success in the marketplace. Don't overlook user interface features that will give you a marketing edge.

Keep in mind that engineers are typically not qualified to offer an expert perspective about the suitability of a product for the marketplace. If you don't have market expertise in-house, there are many dedicated market research firms that can help you with this step.

Likewise, when you do move ahead, it will be important to have reasonably accurate estimates of product volume and recurring cost targets. These estimates and targets should be included in your technical specifications, so make these calculations as a part of your market research effort.

### 2. Determine Technical Feasibility



So, you think that you have the next "killer app." It not only slices and dices, but there isn't anything like it on the market. If your idea sounds too good to be true, it is important to ask if others have tried to develop similar products or solve a similar problem. If so, what challenges have they encountered?

A solid feasibility analysis is an insurance policy for the long term. The positive reinforcement that your organization receives can make this step very rewarding. We encourage all of our clients to complete a feasibility analysis and we are available to help them with aspects of the analysis that involve our area of expertise, radio frequency (RF) design.

It is especially important to make sure that the proposed work is compatible with sound principles of physics and electrical engineering. If the product includes a radio frequency or wireless portion, this aspect can be particularly complex. Complete system products such as a communications link or a radar system, may require a link budget, bit-error-rate analysis, and/or radar cross section calculation. Particularly challenging problems may benefit from computer modeling at this stage.

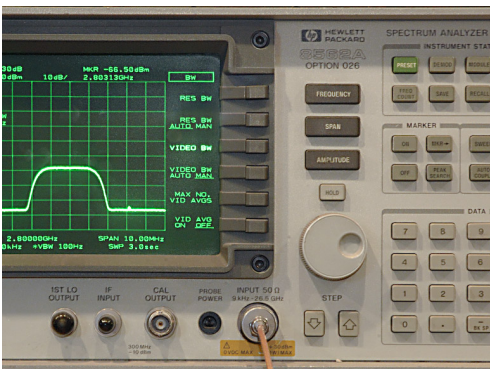


### 3. Evaluate Time and Resources

Once both technical and marketplace feasibility have been established, it is time to move ahead and create a plan for product development. An assessment of the resources that will be required to complete the design is a necessity.

If you are developing a wireless or RF product, the design will typically also include mechanical, packaging, and digital circuitry aspects. Assess the design resources that you have available in-house and consider outsourcing the aspects for which you do not have or do not wish to obtain the expertise. For example, our clients often have digital circuit design capabilities in-house, but seek out our services for the RF portion of their design. We can generally complete an RF design job at a fraction of the cost of hiring a dedicated full-time in-house RF design engineer and obtaining the required test instrumentation.

It is also important to set a realistic time-frame. The performance of wireless and RF circuits in particular tend to be very sensitive to circuit board layout and environment. During the process of integration with mechanical and digital components, the layout will inevitably need to be changed. Preparation for manufacturing can also be very time consuming. As a rule of thumb, expect the whole development effort to take at least three times as long as the time required to develop the individual components.



### 4. Develop Complete Specifications

If you have decided to outsource some or all of your design work, putting the work out for bid will be required. Specifications are your calling card for the job. In my years of doing contract RF design, I've noticed that the quality of the project specifications are the best indicator of future project success. Well written specifications attract highly qualified contract engineers and help ensure an accurate quotation. Poorly written specification will attract bids from poorly qualified vendors.

Expect a high quality contract engineer to critique your specifications and point out conflicts or omissions. Do not trust an engineer who does not give the specifications a serious critique. In the likely event that you do not have your own circuit design expertise in-house, you may consider consulting with an outside engineer solely to develop a complete set of specifications. If you ultimately choose to use the same contract engineer for both writing the specifications and executing the design, it is good form to have the specifications reviewed by a qualified third party.

The following types of specifications are absolutely critical in any circuit design job: recurring cost per unit and (yearly) quantity, input and output port specifications (including protocols, if applicable), circuit board size and form factor, temperature, power supply voltage and current draw. Beware of vendors who bid on your work if any of these specifications are missing.

Lastly, when talking with contract engineers, make sure that you understand how compliance with the specifications will be verified. You may consider a short term lease of the instruments that are required to verify compliance.

## 5. Put the work out for bid

If you have made it this far, your next step is to put the work out for bid.



In all likelihood you will want to execute non-disclosure agreements (NDAs) with your potential vendors. Once an NDA is in place, you may discuss specifications, cost, assignment of rights, and time frame requirements with your potential vendors.

Unless your work is very straightforward, our firm usually responds to a request with a time-and-materials proposal. We provide an estimate of the time and a cost that is not to be exceeded (NTE) without your organization's approval. Since the specified cost is NTE, the cost will be on the high side. If you decide to work with us, a purchase order against a proposal together with the a small deposit (if specified) is usually sufficient for work to begin.

By way of reference, most of the work that we bid on is structured such that we deliver one or two working and tested prototypes of our circuit or component and the associated design files. The design files typically include a schematic, Bill of Materials, board layout files (Gerber format), parts centroid (parts placement information), and processor code (if any). Assistance with integration of the circuit into the overall design and preparation for manufacturing is usually billed on an as-needed basis at our hourly rate beyond the cost of the contract.

## 6. Choose a qualified contract engineer

Carefully evaluate the proposals that you receive. Do the specifications on the proposal agree with your own specifications? Are the proposed cost and time-frame reasonable? Are the payment terms agreeable to your accounting department? Beware of low-ball bids, both in terms of cost and time. Thorough work takes time. Remember the adage that you get what you pay for.



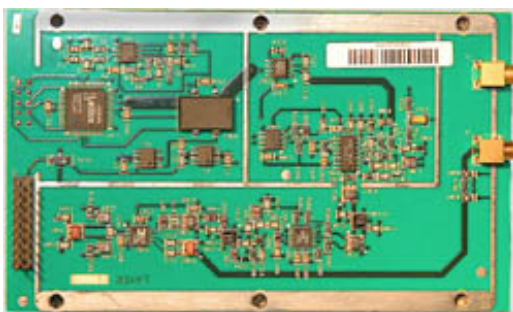
Consider the qualifications of each vendor. Do they have sufficient experience and education to complete the job? When you speak with them do they ask good questions and anticipate details that you might have overlooked?

## 7. Follow through

If you have followed each of the previous steps, this aspect is straight forward. Once you have chosen a contract engineer and ordered work to start (usually by written order), stay in monthly, if not weekly contact to ensure that work is proceeding as scheduled.

At this point, the contract engineer is designing to the specifications within the proposal. The engineer is not responsible for features, functions, or other specification that you may have omitted.

Although, since you have written your specifications carefully and double checked the specifications on the proposal, this is not a problem! If some small changes are required, they should be agreed to in writing (an e-mail is sufficient for small changes) and any additional costs should be acknowledged.



Remember to follow the payment schedule and terms to which you have agreed. The specifications and schedule on the contract or proposal against which you have made a purchase are the bottom line.

Above all, if you have followed the steps above, now is the time to relax and watch your product or design come to fruition.

---

## **Eric Funk**

Eric Funk, Ph. D. is a founding partner of Red Mountain Radio LLC. He has worked in the RF/microwave field as a Research Engineer at the Naval Research Laboratory, a Senior RF Design Engineer, and Principal Investigator at the University of Maryland.

Contact: [eric@redmountianradio.com](mailto:eric@redmountianradio.com), 970-325-2158x12.



## **Red Mountain Radio LLC**

Red Mountain Radio LLC is a Colorado based firm offering professional RF, microwave, optical, and analog contract design services. Our engineers understand the fundamental physics and theory behind radio, radar, and communications, and have the practical work-bench experience required to design market-ready products. [www.RedMountainRadio.com](http://www.RedMountainRadio.com).