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Answering Un-asked Questions: Patent Disclosures for Analog, Mixed-Signal, and RF Circuit Design

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Obtaining patent protection for inventions related to analog, mixed-signal, and RF circuit design is challenging. Many patent attorneys, agents, and examiners are unfamiliar with circuit design principles. At the same time, most inventors are unfamiliar with the legal requirements and associated best practices that go into drafting a patent application.

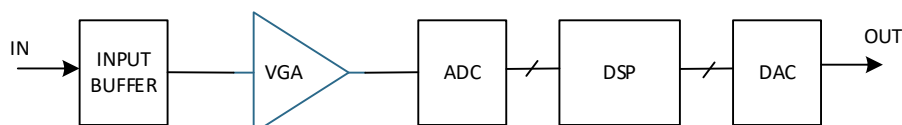
As a result, the patent application may fail to meet legal requirements governing the scope and content of parent applications and/or may limit the scope of patent protection. Although most inventors go to great pains to thoroughly describe the core idea of their invention, what's missing is usually related to the system and environment in which the invention operates.

In this article, I provide a few easy-to-implement suggestions regarding what details should be included in a patent disclosure. Fundamentally, this means writing an invention disclosure that clarifies specific technical details the inventor may not have thought to include and that the patent attorney or agent may not have thought to ask for. With these details in place, however, a patent application is more likely to both meet legal disclosure requirements and result in a strong, assertible patent.

1) Include a system diagram

Even if your invention is directed to a small functional circuit block, it is important to disclose how your invention is connected to the system with which it is designed to interact. A patent directed to a system (e.g., an automobile) may sometimes result in higher damage and royalty payments than a patent directed to a component (e.g., a steering wheel). It is also useful to disclose the system when an inventive aspect of a component provides a positive benefit to a larger system.

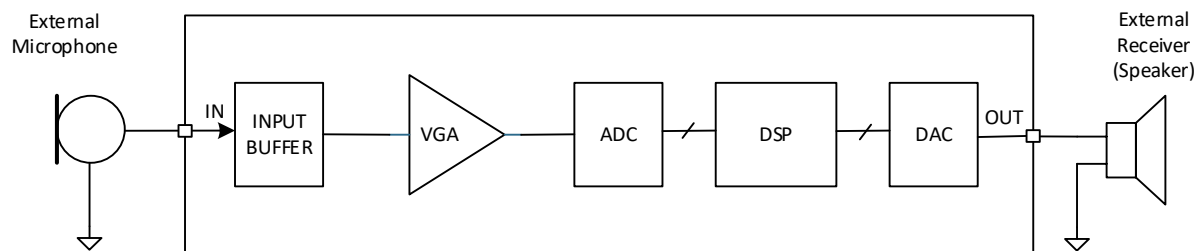
Example: system diagram of a hearing aid



2) Disclose system partitioning

Be sure to disclose the partitioning of your system as it is intended to be sold. For example, if your invention is related to a system that is configured to a motor, antenna, or transducer but does not itself contain a motor, antenna, or transducer, make sure this is disclosed to your patent practitioner. This can be easily shown in the system diagram.

Example: system diagram of a hearing aid showing system partitioning



3) Describe all circuit interfaces

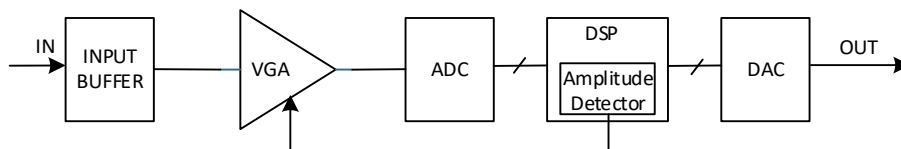
Be sure to clearly account for the sources and loads of each interface of your circuit or system, including signal path and control inputs and outputs, even if these would be well understood by anyone familiar with your technology. This step will ensure that the patent description does not inadvertently omit signal interfaces that would distinguish the invention from what is already known.

4) Explicitly show feedback paths

Be sure to explicitly show feedback paths in your system diagram. Often the existence of a particular feedback path is the distinguishing factor that places a patent application in condition for allowance.

Be sure to disclose digital feedback paths. Unlike analog feedback paths, digital feedback paths are often omitted in circuit diagrams because they can be inconvenient (sometimes impossible) to draw in schematics given the level of abstraction directed to specific digital implementations. If this is the case, a simplified system diagram or signal flow diagram showing the feedback path is still helpful.

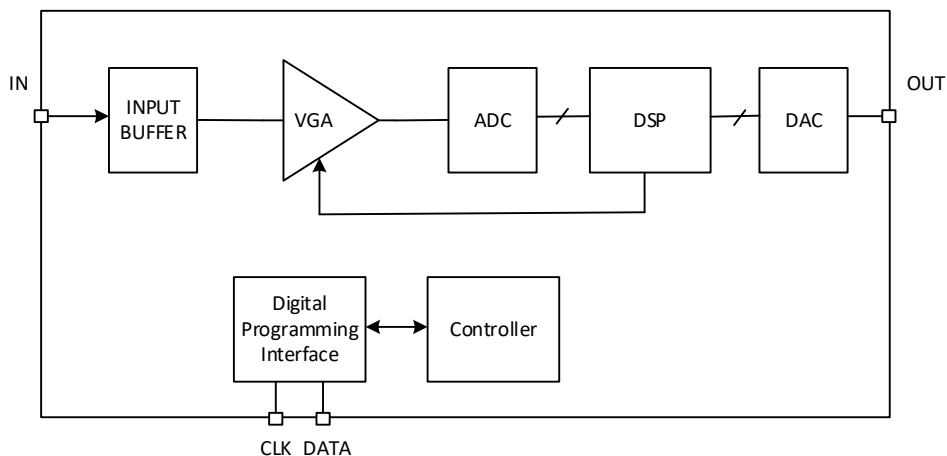
Example: system diagram of a hearing aid showing gain control loop



5) Include an IC block diagram

For integrated circuit designs, it is also a good idea to provide an IC block diagram. Including a chip diagram makes it clear which components are intended to be included on a particular chip, and helps your patent attorney or agent draft claims specifically directed toward integrated circuit implementations.

Example: hearing aid IC diagram



6) Disclose algorithms of digital blocks

When the primary novelty of your design is directed to an analog circuit, it is easy to forget to disclose the operation of digital circuits that interact with the analog blocks. Therefore, it is important to make sure that the operation of these digital circuits is also disclosed.

There are a number of ways that the functionality of a digital block can be disclosed. Simple digital blocks designed to provide control or clock signals can be described with timing diagrams, state transition diagrams, and/or block diagrams.

Alternatives to block diagrams include a written description, pseudocode, or simple list of the steps performed by the calibration block. Regarding physical implementation, it is sufficient to mention that the block may be implemented using digital logic or a programmable processor since it is generally assumed that those in the industry can program a processor or synthesize logic to perform these functions.

For digital processing algorithms, it is important to specify signal path and control inputs and outputs of each digital block just as you would for an analog block.

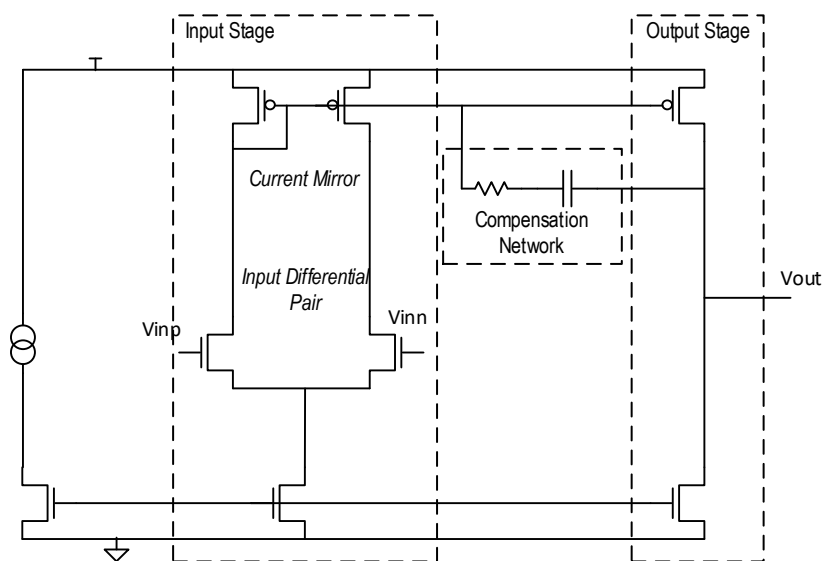
One common problem in invention disclosures is disclosing algorithmic steps without specifying the relationship between each step. For example, a digital algorithm might be succinctly disclosed as including the steps of “digital filtering,” “FFT,” and “threshold comparison,” without specifying on which signal(s) the FFT, digital filtering, and threshold comparison are performed. This lack of detail may easily go undetected by the inventor and other technical experts who assume that each signal path operation in a sequence of signal path operations is performed on the output of the previous step. However, failure to explicitly disclose the relationship between algorithmic steps may pose difficulties when the patent is being examined and asserted.

7) Label key elements of transistor level schematics

The appropriate level of abstraction at which the circuit should be described and claimed depends on the details of the particular invention. As such, it is always important to carefully consider at which level of abstraction you disclose your circuit invention. For example, if you disclose only a low-level transistor level schematic, it will be difficult for the patent attorney or agent to know which aspects of the design are important to claim. On the other hand, if you disclose your circuit at a high level of abstraction, the resulting patent may not properly capture the novelty of the invention.

A compromise between low and high levels of abstraction is to label the blocks of your transistor-level schematic.

Example: labeled block diagram of a two-stage operational amplifier



Conclusion

While there will always be misunderstandings between inventor and patent attorneys in difficult and challenging areas of technology, a well-structured technical disclosure can go a long way to help

ensure that key areas of your invention are well communicated and that your invention is well protected.

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