The Creation of Interoperable Integrated Circuits Using Clean Room Design Practice

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Trademark Notice

Disclaimer

This document was written by an engineer, not an attorney. It is not an offer of legal advice. It should be considered only as a general guide to support the technical efforts of a lawful reverse engineering process that respects the patent, copyright, trademark and trade secrecy rights of others. A licensed intellectual property attorney should be retained before using the clean room design practices described in this document. Comments and suggestions are welcome and should be directed to wadep@silicore.net.

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"Now, as to whether it will fly. As far as the general design factors are concerned, there are no special problems."

Heinrich Dorfman

The Flight of the Phoenix
20th Century Fox Film Corp, 1965

"Freedom is the freedom to say that two plus two make four. If that is granted, all else follows."

Winston Smith

1984
George Orwell

Table of Contents

Document Revision History

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23 FEB 2008 First publication; remove proprietary markings and apply copyright notice allowing unrestricted copying, distribution and display without adaptation.

I. Executive Summary

This document is intended to be used as a guide for practitioners of a clean room design practice used at Silicore Corporation. It uses various ethical and legal methods to create semiconductor chip designs that interoperate with other devices found in the industry. These methods are specifically designed so that the resulting intellectual property works will not infringe on the patent, copyright, trademark or trade secrecy rights of others. The technique is intended to be used in the following situations:

1) *Parts obsolescence due to technical aging.* Original design documents are lost; including drawings, software design tools, technical know-how or fabrication processes.

2) *Parts obsolescence due to a loss of economic vitality.* The original manufacturer quits making a device because of changes in market, market strategy or bankruptcy.

3) *Long lead-times or price gouging.* A sole supplier of a semiconductor or semiconductor IP provides poor service or charges inflated prices.

4) *Quality control.* The original device is of poor quality.

5) *Regulatory compliance.* The internal operation of a device must be understood and inspected. Examples include FDA approved medical devices, HAVA compliant voting machines, weights and measures equipment, casino gaming equipment, stock exchange trading systems and aircraft fly-by-wire control systems.

6) *Improve or better understand proprietary intellectual property rights.* To improve the intellectual property protection of a proprietary device by understanding some of the limitations of intellectual property protection.

7) *Extraction of public domain works.* Extraction of public domain works from a patented invention or a copyrighted document for use in a proprietary design or an industry standard.

8) *Competitive analysis or patent infringement investigation*. Reverse engineering of a competitor's product for marketing purposes or to determine infringement.

9) *Circumvention of US Government Deemed Export Regulations (EAR)*[1]. Semiconductor devices built with US Government funds may require an export license on products shipped abroad or built by foreign nationals. Compliance is an expensive and time consuming process, especially on standard products that are delivered from inventory. The methods described in this document allow the creation of design works that circumvent the EAR or conform to its open source software exemptions.

[1] Ref: EAR 734.3(b)(3)(i) (open software) and 734.7 (published software).

Reasonable Licensing is Preferred

A clean room design is not required if the design works for an original device can be licensed at a reasonable cost and in a form that suits the intended use of the design. In these cases there usually isn't any need to perform the clean room design at all: licensed designs can most often be obtained faster, they cost less, they're more reliable and they allow one to garner know-how through technical support.

Here the term *'reasonable cost'* means that a design works can be licensed at a fee which is substantially less than the cost of reverse engineering. Furthermore, any terms and conditions built into a license agreement may or may not be reasonable to a buyer or licensee. These include:

- Royalty price on fixed (one time) or variable (per piece) basis
- Auditing terms
- Delivery schedule
- Maintenance and technical support
- Quality of the design deliverables
- Goodwill (brand name recognition, etc.)
- Exclusivity
- Bundling with a particular brand of hardware or use with specific software tools
- Export controls (common on works originally paid for with US Gov't. funds)
- Warrantee
- Limitations on liability

The term *'intended use'* applies to the design deliverables. This generally relates to technical issues, such as:

- Requirements for specific software tools / tool chain
- Device limitations such as:
    - Specific brand of integrated circuit (e.g. silicon foundry)
    - Specific brand of logic component (e.g. specific CPU core)
- Open sources for validation purposes
- Ability to make adaptations to the design
- Ownership of derivative works

Both *'reasonable cost'* and *'intended use'* assume that the parties will actually negotiate the terms of the license agreement. In some cases only a standard license agreement is available, and in others the manufacturer may refuse to deal altogether (common among competitors).

Within the semiconductor industry there is also a proclivity to use intellectual property as a blunt instrument of industry control. In many cases this results in an anti-competitive business environment where the rights afforded by copyright and patent law are amassed and bundled together to suppress competition. There can be a fine line between the limited monopoly granted by patent and copyright laws, and those prohibited by anti-trust legislation.

Technical Background

The clean room design practice described in this document can be used to create semiconductor chip alternatives that do not infringe on the intellectual property rights of others. These inexpensive methods can create analog and digital integrated circuit designs using FPGA, ASIC, full custom and discrete circuit topologies.

All semiconductors use a multi-layer mask works for the purpose of fabricating parts. Each 'layer' (or process step) is fabricated by shining an ultraviolet light through a layer of the mask onto a sensitized silicon or gallium arsenide (GaAs) wafer. Sensitizing the wafer allows it to react with photo-sensitive chemicals. This allows the electronic properties of the wafer to be altered, such as when the p-n junctions in transistors and diodes are created in a process known as doping.

At one point in the process metal is deposited (evaporated) onto the surface of the wafer. The surface of the metallization layer is then sensitized and exposed to ultraviolet light through the mask works. A chemical etchant is applied to the surface of the wafer, leaving some of the metal and removing the rest. These steps in this process form the interconnection paths (electrically conductive wires) between the various parts of the chip.

Each step of the process is analogous to printing a photograph from a negative. There, light is shined through a film and onto paper that has been sensitized with photo reactive chemicals. Once the paper is sensitized an image is developed by applying various chemical treatments to it.

In another process called electron beam lithography the various parts of the semiconductor device are sensitized in a vacuum under an electron beam. However, the basic chemical steps for converting a raw silicon or gallium arsenide (GaAs) wafer into a working microchip are similar.

For the purposes of this guide, finished integrated circuits fall into one of four categories. These are called FGPA, ASIC, full custom and discrete circuit devices.

The *FPGA*, or Field Programmable Gate Array, is a generic integrated circuit that is field configurable for a specific application. It uses a standard set of (undifferentiated) gates, analog blocks and interconnections which are supplied by the manufacturer, and are usually offered with a variety of packaging styles, operating temperatures and other attributes. These devices use programmable blocks which are interconnected by programmable interconnection paths. This allows them to be 'programmed' after delivery to the end user.

The *ASIC*, or Application Specific Integrated Circuit, is a generic integrated circuit that is factory programmable for a specific application. Like the FPGA it uses a standard set of (undifferentiated) gates, analog blocks and interconnections which are supplied by the manufacturer. Unlike the FPGA they are not field programmable; instead they are programmed at a silicon foundry by applying a metallization layer that configures it for a particular application. This is done in a two-step manufacturing process where the basic structure is created on the silicon wafer, which is then placed into inventory. At a later date the wafer is removed from storage and interconnection paths are etched onto the chip.

The *full custom device* implements logical and analog building blocks, and interconnection (conduction) paths at a silicon foundry. The physical topology of these devices is not programmable in any way, except through the specific design of the semiconductor structure (although they may include programmable memory elements such as RAM and ROM in the circuit design).

The *discrete circuit* is formed from a plurality of components based on transistors, diodes, chips, electron (vacuum) tubes, electromechanical relays, optical switching elements, resistors, capacitors, inductors and other devices. The physical topology of these circuits is not programmable in any way, except through the specific design of a printed wiring board or discrete wiring matrix (although they may include programmable memory elements such as RAM and ROM in the circuit design).

Regardless of the type of device, the final application is established by a circuit design. This can be expressed in a number of ways, but is commonly done with a special type of software called a Hardware Description Language (HDL). There are a number of these languages used today, with examples being VHDL, Verilog® and System Verilog. Once the hardware description has been created and simulated it is used to program the various functions of the integrated circuit.

Final programming is achieved using processes commonly referred to as '*synthesis*' and '*routing*'. In FPGA and ASIC devices these are software processes that convert a front end design into an electronic circuit as applied to undifferentiated gates and interconnection paths. In full custom devices these are software processes that convert a front end design into the electronic structure of a semiconductor wafer. Discrete circuits use similar software for defining a printed wiring board. Many of the HDL languages are portable, meaning that any given circuit design can be moved from one type of device to another, or from one brand to another[2].

These examples describe only one possible design flow path (sometimes called a 'tool chain' in semiconductor jargon). To make things simple, the clean room design practice assumes that the design works will be created with portable, synthesizable software techniques such as those offered by hardware description languages. This methodology has tremendous technological and economic advantages. For one thing, the final design is 'future-proof', making it virtually immune to future changes in semiconductor technologies. It also makes good business sense for the end customer because a highly competitive reverse auction marketplace is created for chips.

Within the context of clean room design practice the term 'software' refers to machine instructions, including the use of hardware description languages, schematic diagrams and traditional programming languages such as 'C' or VisualBasic®. This may differ somewhat from traditional industry jargon, which often refers to a circuit design, or alternatively a front end design. However, the need for this becomes apparent when we speak in terms of licensing and intellectual property protection. That's because the physical structure of a chip is generally protected under copyright law as a mask work; and software is generally protected as a literary work.

[2] In some cases design structures such as memories are not completely portable, and do require some customization when moving the design to a new device.

Technical Controls Afforded by License Agreements

The manner in which software is provided dictates how useful it is in the final application. This generally involves two key areas: (1) how the software is licensed and (2) in what form it is provided. All software, unless it is in the public domain, can be traded under a license agreement. This involves the granting of certain intellectual property rights that have been lawfully obtained by the licensor in exchange for some consideration. This includes publicly licensed software which usually grants certain rights in exchange for publicly available code adaptations.

Technical controls, such as binary (object) encoding or obfuscated code, can also be applied to software. This uses the synthesized (compiled) form of software that is readable by machines, but not by human beings.

The clean room design practice would not be required if the owner of the original device provided licensed copies of their design at a reasonable cost and in a form that suits the intended use. If this were possible then a potential licensee would prefer this option rather than spend the time and expense needed for a new clean room design. However, the key terms here are *'reasonable cost'* and *'intended use'*. It turns out that most industry standard chips can't be licensed in a way that satisfies both of these requirements. There are a number of reasons for this:

1) The assigned owner of a device (or the intellectual property rights contained therein) will not or cannot license their technology to third parties. Note that in some cases they may be bound by a separate licensing agreement.

2) The assigned owner of a device will not license their technology in such a way that allows inspection of the internal design (trade secrecy protection).

3) The assigned owner of a device will not license their technology in a manner that allows it to be distributed to others (for inspection by an end user).

4) The assigned owner of a device will not license proprietary design tools, manuals or data that are needed to execute or inspect the design.

It should be noted that most public software licenses (e.g. GPL or BSD) will satisfy the requirements of clean room design practice. This is a key feature of public licensing that is well known and understood in the related area of computer systems software. Examples include GNU/Linux™ and Sun/Solaris™.

Technical controls to protect certain trade secrecy rights usually take the form of binary encoded software (a.k.a. object code). This is the output obtained from portable compilers and synthesis tools. For the most part, binary code can't be read by human beings, but it can be de-compiled. However, it is quite difficult to understand the nuances of de-compiled code because manuals,

comments and labels are not visible. For the most part, though, a practitioner must be able to visually inspect the original source code and understand its operation[3].

Open source software is one example that can be inspected before compiling or synthesis. It can be subjected to industry standard V,V&T quality control methods because it can displayed and distributed in an unrestricted way. Often it can be adapted by third parties as well.

It should be noted here that to be useful, design tools must be open as well. This prevents bugs and viruses from being implanted into a compiler or synthesis tool.

[3] Note that it is possible to craft license agreements that allow non-public display within groups. For example, the Help America Vote Act (HAVA) established this ability among a group of election judges. However, this approach is not very practical because: (a) trade secrecy agreements essentially become moot when software is shared by dozens or hundreds of people in multiple countries, and (b) it foments distrust among discriminated classes of end users.

Interoperability Standards

System level chip designs are very time consuming and expensive to develop. One way to alleviate these problems is to create and adopt interoperability standards for System-on-Chip and IP Core interfaces. This allows chip systems to be pieced together from off-the-shelf software components, thereby reducing time-to-market and costs.

For example, the USB port on your computer uses an interoperability standard to define the connectors, cables, power-supply, data interchange protocol and so forth. This establishes a marketplace for hundreds of companies to compete, making USB compatible mice, cameras, scanners, computers, software and so forth. This spreads the development costs of common system components across a number of companies, and means that they are readily available.

The direct analogy in semiconductor design is to create an interoperable, open System-on-Chip (SoC)[4] based on public information, and which allows access to a truly open and unrestricted basis. This allows portable designs to be implemented across a number of silicon and tool vendors.

Silicore Corporation has been at the forefront of this activity with the creation of technologies such as WISHBONE and FIRECRACKER SoC, and the GREYMATTER Network-on-Chip (NoC). Standard open, portable and available WISHBONE and FIRECRACKER SoC interconnections are available in the following interconnection topologies:

- Point-to-point
- Data flow
- Shared bus:
  - ✓ Broadside network (WISHBONE Standard Shared Bus)
  - ✓ Asynchronous ring network (FIRECRACKER)
  - ✓ Synchronous ring network (GREYMATTER)
- Crossbar switch
- Off (inter) chip

Since 1999 WISHBONE has been used by a number of companies and on-line groups (e.g. www.opencores.org). Major companies such as Flextronics, Mentor Graphics, Altium (Nexar) and a surprising number of manufacturers use it for their semiconductor designs. These represent both open and closed (proprietary) semiconductor markets.

[4] There are a number of proprietary SoC on the market. These include AMBA (ARM, Ltd) and CoreConnect™ (IBM). These technologies could also be used in the clean room design practice, but because they are only available under proprietary licensing agreements they do not support many of the advantages offered by publicly licensed or public domain offerings. For example, designs cannot be transferred to third parties until a licensing agreement is obtained. This eliminates many of the solutions provided for V,V&T as well as the competitive open market benefits.

Practitioner Requirements

Participation in the clean room design practice is limited to those who meet a minimum set of qualifications. Those who do are known as a *practitioner*. This reduces the possibility that an interoperable device will infringe on the patent, copyright, trademark or trade secrecy rights of others. A practitioner is qualified if he or she meets the following requirements:

1) The practitioner must be skilled in the art of semiconductor front end design.

   35 U.S.C. 112 - ¶ 1
   "The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention."

2) The practitioner must read and understand this entire document.

3) The practitioner must be capable of finding, reading and understanding all of the case histories in *Case Law Outlines.* This includes the ability to:

   a. Locate case law citations in a law library or an on-line service.
   b. Obtain copies of patents and file wrappers (patent documents).
   c. Search for new project-specific case histories and patent documents.

4) The practitioner must disclose, in writing, any conflict of interest that pertains to a specific project that uses the clean room design practice. This includes, but is not limited to, the terms of any unexpired non-disclosure or non-compete agreements that have been made in relation to products which are similar or identical to an original device or original manual. This disclosure must be made at the beginning of the project, and must be made available to all the other participants in the project.

   A practitioner must recuse themselves from the project if it is felt that his or her involvement will jeopardize the project or resulting work product.

The conflict-of-interest requirement is directed at the trade secrecy rights of others. Problems most often arise when a practitioner has previously agreed to non-disclosure or non-compete terms in an employment or other contract. This may happen if he or she had worked for a company who makes (or has made) a version of the original device.

In some cases a practitioner may have signed a confidential non-disclosure or non-compete agreement (i.e. the agreement itself or even its mere existence is a trade secret). Such agreements may or may not be enforceable given the circumstances of a discovery process in relation to a public trial. However, they still must be disclosed in a manner that does not violate the original agreement.

It should be noted that the process inherently assumes that a practitioner will operate in an honest, forthright and ethical manner. Any cheating, such as the use of illegally obtained documents, is counterproductive to the process because it can lead to an unusable interoperable device or new manual, or can magnify other problems through the doctrine of unclean hands. Historically, conflict of interest problems are not uncommon in these situations:

> *Nimmer on Copyright - 13.03[F][1]*
> [In the case of Computer Associates International, Inc. v. Altai, Inc., 982 F.2d 693 (2d Cir. 1992):] "Defendant hired away one of plaintiff's employees to develop a rival job scheduling program for mainframe computers. In violation of his signed agreement with plaintiff (but without defendants knowledge), that employee took with him the source code for Adapter, which he used to develop a common system interface component, called Oscar 3.4, for defendant's rival software product. Approximately 30 percent of Oscar 3.4 was copied directly from Adapter. Upon learning of its wrongful provenance, defendant locked away the Adapter code; using untainted employees, defendant rewrote the 30 percent of copied code, and salvaged the rest of Oscar 3.4. The resulting product, Oscar 3.5, replaced its forbear and was shipped as a 'free upgrade' to existing customers.
>
> The court readily found infringement as to Oscar 3.4, from which judgment defendant did not pursue an appeal. As to Oscar 3.5, the district court attributed such similarities as existed between it and Adapter to external factors, such as the programs' functionality, and accordingly denied liability. The court of appeals agreed."
>
> *Acuson Corp. v. Aloka Col, Ltd. - 257 Cal.Rptr. 368 (Cal.App. 6 Dist. 1989)*
> "Someone who knowingly uses stolen design for a yet-unreleased product will be liable under trade secret law even though the product is later sold to the public; liability exists because the product was still secret at the time and actual trade secrets were compromised by unethical behavior." (257 Cal.Rptr. 368, [29])
>
> *Lasermaster Corp. v. Sentinel Imaging – 931 F.Supp. 628 (D.Minn. 1996)*
> "Evidence was insufficient to establish that ink jet printer manufacturer's former employee utilized manufacturer's confidential information when he helped competitor reverse engineer computer chip used with manufacturer's printer; manufacturer did not allege that only way for former employee to complete reverse engineering process was to utilize its confidential information, and did not demonstrate that former employee's information regarding contents of chip was crucial to solving competitor's reverse engineering problems." (931 F.Supp. 628, [15])

The Ethics and Legality of Reverse Engineering

Whenever the discussion of reverse engineering arises, the question at the back of everyone's mind is: *is it ethical?* On the one hand using someone else's design seems a bit seedy, but on the other it's a necessary thing because we all build upon the shoulders of others. This and other ethical discussions relating to the imitation of creative works are beyond this guide, and are better left to philosophers like Judge Richard Posner who so eloquently argues the matter in The Little Book of Plagiarism.

When it comes to clean room design practice, a better question is: *am I purloining or destroying the intellectual property rights of others?* This makes it an objective question of law and fact rather than the more subjective question of ethics. This approach will be used in the remainder of this guide.

There are a number of State and Federal statutes, and a large body of case law, that explicitly allows the practice of reverse engineering. These are encompassed under patent, copyright and trade secrecy laws, and include:

- Reverse engineering of copyrighted materials[5]:
    - *Atari Games Corp. v. Nintendo of America - 975 F.2d 832 (Fed. Cir. 1992)*
      "Copyright Act permits individual in rightful possession of copy of work to undertake efforts to understand work's ideas, processes, and methods of operation. 17 U.S.C.A. § 107." (975 F.2d 832, [18])
    - *Hazard – V. Reverse Engineering of Computer Software, §3.22 Generally*
      "Courts are likely to be less sympathetic to the plaintiff in reverse engineering cases where, as in *Atari Games* and *Sega Enterprises*, it appears that the plaintiff has attempted to monopolize a market by making it impossible for others to compete – by inhibiting creative expression. If a competitor cannot enter a particular market simply because it cannot understand the ideas in a particular program, and if it cannot understand such ideas only because it cannot conduct intermediate copying for purposes of reverse engineering, courts are likely to be cautious in disallowing fair-use copying." (p. 3-62)
- Reverse engineering of copyrighted semiconductor mask works is permitted by statute under 17 U.S.C. 906.
- Reverse engineering of copyrighted works under the Digital Millennium Copyright Act (DMCA) is permitted by statute under 17 U.S.C. 1201(f).

[5] Reverse engineering under copyright fair use doctrine is described by Goldstein on Copyright, 3rd Ed. *§7.2.1.4(c): The "reverse engineering" limitation.*

- Reverse engineering of materials protected as trade secret:

    - *Acuson Corp. v. Aloka Col, Ltd. 257 - Cal.Rptr. 368 (Cal.App. 6 Dist. 1989)*
      "Trade secret law does not prohibit lengthy and expensive reverse engineering of objects in the public domain; state law encourages such efforts by giving the competitor who invests substantial resources in reverse engineering the opportunity to hold in legally protected confidence the results of its labor." (257 Cal.Rptr. 368, [26]).

      "Both the original inventor and the reverse engineer may claim protection for their labors. West's Ann.Cal.Civ.Code § 3426.1" (257 Cal.Rptr. 368, [27])

One of the most important requirements of an interoperable device is that it has a good manual. When creating a new manual, what role does the original manual play as a reference tool? Copyright law is quite clear that this practice is perfectly legal and proper so long as the new manual does not use any of the exclusive rights granted to the copyright holder of the original manual. 17 U.S.C. § 106 define four exclusive rights of the copyright holder:

- *Reproduction*: right to reproduce the copyrighted work in copies.
- *Derivative works*: right to prepare derivative works based upon the copyrighted work.
- *Distribution*: right to distribute copies of the copyrighted work to the public by sale or other transfer of ownership, or by rental, lease or lending.
- *Performance and display*: right to perform or display the copyrighted works in public.

Only copies of an original manual that have been lawfully obtained can be used for reverse engineering purposes:

Atari Games Corp. v. Nintendo of America - 975 F.2d 832 (Fed. Cir. 1992)
"Copyright Act permits individual in rightful possession of copy of work to undertake necessary efforts to understand work's ideas, processes, and methods of operation. 17 U.S.C.A. § 107." (975 F.2d 832, [18])

"To invoke fair use exception, individual must possess authorized copy of literary work." 17 U.S.C.A. § 107." (975 F.2d 832, [22])

It should also be noted that only the preparation of a new manual is discussed within the context of this report. It is assumed that the original manual would only be used as a reference tool; it should not be commercially reproduced, distributed or displayed unless permission has first been obtained from the copyright owner.

In some cases a licensing agreement may specifically prohibit reverse engineering. This has been the subject of numerous shrink wrap license agreements which prohibit the activity. However, it should be noted that a license agreement (shrink-wrap, or otherwise) cannot preempt

the Copyright Act by creating any new rights over and above those provided under 17 U.S.C. § 106.

17 U.S.C. § 106. Exclusive rights in copyrighted works

Subject to sections 107 through 122, the owner of copyright under this title has the exclusive rights to do and to authorize any of the following:

(1) to reproduce the copyrighted work in copies or phonorecords;
(2) to prepare derivative works based upon the copyrighted work;
(3) to distribute copies or phonorecords of the copyrighted work to the public by sale or other transfer of ownership, or by rental, lease, or lending;
(4) in the case of literary, musical, dramatic, and choreographic works, pantomimes, and motion pictures and other audiovisual works, to perform the copyrighted work publicly;
(5) in the case of literary, musical, dramatic, and choreographic works, pantomimes, and pictorial, graphic, or sculptural works, including the individual images of a motion picture or other audiovisual work, to display the copyrighted work publicly; and
(6) in the case of sound recordings, to perform the copyrighted work publicly by means of a digital audio transmission.

ProCD, Inc. v. Zeidenberg – 908 F.Supp. 640 (W.D. Wis. 1996)

"In placing shrinkwrap license provision on its software product, producer seeks to prohibit unauthorized copies; prohibit software rental; prohibit reverse engineering and modification to software; limit use of software to one central processing unit; disclaim warranties; and limit liability." (908 F.Supp. 640, [12])

"It is only when contract erects barrier on access to information that under copyright law should be accessible that Copyright Act's preemption provision operates to protect copyright law from individually crafted evaluations of that law. 17 U.S.C.A. § 301" (908 F.Supp. 640, [25])

II. Case Law Outlines

Case law is an important part of clean room design practice. In general, the protection of intellectual property rights is governed by a set of explicit rules which are defined by state and federal statutes. However, in some situations the laws are rather vague and can lead to disputes. Case law provides a vital record as to how these disputes are resolved by the courts, and establishes a set of standard practices which can be followed under similar circumstances by authors, inventors, attorneys, legislators and judges.

The case law outlines in this section were selected because of their relevance to clean room design practice. However, they are intended only as a general guide and should not be used as a substitute for a careful reading of the case itself. Copies of the entire cases can be found in most law libraries and in commercial on-line systems such as Westlaw and Lexis-Nexis. The major cases can also be found on the internet. They are presented here in alphabetical order by name.

Acuson Corporation v. Aloka Co., Ltd

Manufacturer of ultrasonic imaging equipment brought action against competitor for misappropriation of alleged trade secrets. The Superior Court, Santa Clara County of California, enjoined use of the trade secrets by competitor, and competitor appealed. The Court of Appeal reversed stating that: "(1) there can be no trade secrets in product which has been disclosed by sale to the public, and (2) fact that competitor may have disguised its identity when obtaining the machine does not give rise to the misappropriation of trade secrets." 257 Cal.Rptr. 368 (Cal.App. 6 Dist. 1989).

- Public domain information:
    - "Information and goods publicly disclosed cannot be trade secrets." (257 Cal.Rptr. 368, [11])
    - "Desire to protect local industry against competition from the outside cannot be a legitimate goal of state trade secret law." (257 Cal.Rptr. 368, [24])
- Reverse engineering under California Uniform Trade Secrets Act:
    - "Trade secret law does not prohibit lengthy and expensive reverse engineering of objects in the public domain; state law encourages such efforts by giving the competitor who invests substantial resources in reverse engineering the opportunity to hold in legally protected confidence the results of its labor." (257 Cal.Rptr. 368, [26]).
    - "Both the original inventor and the reverse engineer may claim protection for their labors. West's Ann.Cal.Civ.Code § 3426.1" (257 Cal.Rptr. 368, [27])

- Use of stolen trade secrets for products:

    - "Someone who knowingly uses stolen design for a yet-unreleased product will be liable under trade secret law even though the product is later sold to the public; liability exists because the product was still secret at the time and actual trade secrets were compromised by unethical behavior." (257 Cal.Rptr. 368, [29])

Application of Mancy

Patent applicant for a process for producing antibiotic daunorubicin appeals to the Patent Office Board of Appeals, who affirms rejection of Claims 1-5 by Examiner on grounds of obviousness. The US Court of Customs and Patent Appeals reverses, stating the Claims were non-obvious. 499 F.2d 1289 (1974)

- Conditions for obviousness in process claims:

    - "Under statute making unobvious conditions for patentability, neither novel product made by process for which patent is sought, nor novel starting material used in such process can be treated as prior art. 35 U.S.C.A. § 103" (499 F.2d 1289, [2])

Application of Musgrave

Patent Examiner rejects a number of claims for a patent application relating to seismic data collection on grounds that they were non-statutory. The Board of Appeals of the US Patent Office affirms, and The US Court of Customs and Patent Appeals reverses. 431 F.2d 882 (1970)

- Claim preamble interpretation (opinion of Board of Appeals of the US Patent Office):

    - "The preamble of claim 2 refers to 'signals * * * from seismic detection stations' so that 'signals' here could have only the meaning of the output of a device which senses waves transmitted through the earth. Since these signals are not specified to be electrical, mechanical or optical or to denote any other physical state or a material or thing, the sole connotation here would be that 'signals' (i.e. without a modifier) are synonymous with information or data and are an abstraction and intangible." (431 F.2d 882, 886)

- Method claims for both mental and physical steps[6]:

    - "Mere fact that steps involved in method claim are not physical acts applied to physical things does not, for patentability purposes, render claims non-statutory. 35 U.S.C.A. § 101." (431 F.2d 882, [1])

[6] Also see: 'blue-pencil' rule.

- "In considering patentability of process consisting of plurality of steps, question as to whether individual steps are old is immaterial to question of whether combination constitutes statutory 'process.' 35 U.S.C.A. § 101." (431 F.2d 882, [2])

- "We cannot agree with the board that these claims (all the steps of which can be carried out by the disclosed apparatus) are directed to non-statutory processes merely because some or all of the steps therein can also be carried out in or with the aid of the human mind or because it may be necessary for one performing the process to think. All that is necessary, in our view, to make a sequence of operations steps a statutory 'process' within 35 U.S.C. § 101 is that it be in the technological arts so as to be in consonance with the Constitutional purpose to promote the progress of 'useful arts.' Const. Art. 1, sec. 8." (431 F.2d 882, 893)

Application of Prater

Patent applicant appeals the Patent Office decision which rejected all claims for applicant's method for processing (analyzing) conventionally obtained spectrographic data. The US Court of Customs and Patent Appeals affirm in part and reverse in part. 415 F.2d 1393 (1969).

- Claim interpretation in patent applications:

  - "Claims yet unpatented are to be given broadest reasonable interpretation consistent with specifications during examination of patent application, since applicant may then amend his claims, thereby reducing the possibility that, after patent is granted, claims may be interpreted as giving broader coverage than is justified and that thought, in public interest, is deemed to be paramount to applicant's interest, since applicant is not foreclosed from obtaining proper coverage by express claim language. 35 U.S.C.A. §§ 100(b), 101-103, 112." (415 F.2d 1393, [1])

  - "Applicant should not have limitations of specification read into claim at any time before patent is granted, where no express statement of limitations is included in the claim." (415 F.2d 1393, [2])

- With respect to claim 9 and mental processes:

  - "The examiner felt that each of the present process claims can be read on mental calculations with the appropriate mathematics and, as the only physical steps, writing on paper." (415 F.2d 1393, 1398)

  - "However, that is quite another question from the one before us, namely, whether appellants are entitled to claims of the breadth of those they seek here. As already noted, we view appellants' position that they are not seeking patent coverage of any purely mental process or any mental process coupled only with pencil and paper markings, but they are seeking coverage of the operation of a properly

programmed general-purpose digital computer performing their process, as well as that of an analog device of the type disclosed. Appellants feel that they are entitled to a claim of the scope of claim 9 since, *when read in the light of the specification,* claim 9 does not cover a mental process." (415 F.2d 1393, 1403 – footnotes omitted)

- "In our view, appellants would really like us to read a limitation of the specification into the claims, not merely interpret the claims in the light of the specification. When read in the light of the specification, claim 9 does read on a mental process augmented by pencil and paper markings. We find no express limitation in claim 9 which, even when interpreted in the light of the specification, would support the conclusion that the claim is limited to a 'machine process' or 'machine-implemented process.' This is particularly important in this case since the board noted that, in their brief before the board, appellants acknowledged that '[t]hough not practical for most of the needed applications, their method, theoretically, can be practiced by hand." (415 F.2d 1393, 1404)

- "We are not persuaded by any sound reason why, at any time before the patent is granted, an applicant should have the limitations of the specifications read into a claim where no express statement of the limitations is included in the claim." (415 F.2d 1393, 1405)

- "Thus, with respect to claim 9, appellants have not particularly pointed out and distinctly claimed the subject matter which they regard as their invention as required by 35 U.S.C. § 112, it therefore being unnecessary to consider 35 U.S.C. § 101 or its applicability here. Accordingly, the board's decision as to claim 9 is affirmed." (415 F.2d 1393, 1405)

AT&T Corp. v. Excel Communications Inc.

Long distance telephone carrier sues competitor for patent infringement in case involving direct-dialed calling method. US District Court (Delaware) grants summary judgment of invalidity for US Pat. 5,333,184. US Court of Appeals (Fed. Cir.) reversed and remanded. 50 USPQ2d 1447 (1992).

- Patentability of method claims containing mathematical algorithms:

  - "Method claims containing mathematical algorithms need not involve physical transformation or conversion of subject matter from one state into another in order to constitute patentable subject matter under 35 U.S.C. § 101, since 'physical transformation' is merely one example of how mathematical algorithm may bring about useful application, not invariable requirement." (50 USPQ2d 1447, [3])

  - "Whether process claim is directed to mathematical algorithm that is not applied to or limited by physical elements has little, if any, bearing on determining whether claim encompasses statutory subject matter, since mere fact that claimed

invention involves inputting, calculating, outputting, and storing numbers would not render invention nonstatutory subject matter unless its operation does not produce 'useful, concrete, and tangible result." (50 USPQ2d 1447, [4])

Atari Games Corp. v. Nintendo of America, Inc.

Computer game company brought action against competitor for unfair competition, patent infringement, trade secrecy violations and copyright infringement. Competitor filed counterclaims for unfair competition, violations of the Sherman Act and patent infringement. After consolidation of cases, the U.S. Dist. Court, Northern District of California granted preliminary injunction prohibiting competitor's exploitation of competitors copyrighted computer program, and competitor appealed. The Federal Circuit Court of Appeals affirmed, holding that: "(1) company's computer program contained protected expression; (2) company was likely to show that competitor obtained unauthorized copy of program from Copyright Office; (3) company was likely to show that competitor used reverse engineering to exploit company's program; (4) company was likely to demonstrate substantial similarity between its program and competitor's program; and (5) competitor's "unclean hands" precluded it from asserting equitable defense of copyright misuse." 975 F.2d 832 (Fed. Cir. 1992).

- Computer software copyright is protected as a literary works:
    - "Copyright Act's definition of 'literary works' embraces computer programs; as literary works, copyright protection extends to programs and to instructions encoded on silicon chips. 17 U.S.C.A. § 101." (975 F.2d 832, [6])
- Demonstration of reverse engineering practices:
    - "Even for works warranting little copyright protection, verbatim copying is infringement." (975 F.2d 832, [11])
    - "Semiconductor Chip Protection Act which permits limited reverse engineering to reproduce mask work did not apply to competitor's attempts to use reverse engineering on computer game company's computer chip to understand company's security program which prevented use of competitor's games in company's machines; competitor did not reproduce or copy company's mask work, competitor used entirely different chip, and copied program from company's chip. 17 U.S.C.A. § 906." (975 F.2d 832, [16])
    - "Copyright Act permits individual in rightful possession of copy of work to undertake efforts to understand work's ideas, processes, and methods of operation. 17 U.S.C.A. § 107." (975 F.2d 832, [18])
    - "Competitor's use of reverse engineering on chip in rightful possession of competitor which carried computer game company's security program in order to disassemble object code and to understand program's method of functioning was fair use of copyrighted program; however, copying beyond that necessary to

understand program was infringement and competitor could not use reverse engineering as excuse to commercially exploit program. 17 U.S.C.A. § 107." (975 F.2d 832, [24])

- Reverse engineering and *fair use doctrine*, see below: 975 F.2d 832, [19]

- Use of patented encryption mechanism with copyrighted unlocking message (pre-DMCA).

- Copyright misuse.

- Demonstration of the *fair use doctrine*:

  - "When nature of work requires intermediate copying to understand ideas and processes in copyrighted work, that nature supports fair use for intermediate copying; thus, reverse engineering of object code to discern unprotectible ideas in computer program is fair use. 17 U.S.C.A. § 107(2)." (975 F.2d 832, [19])

- Demonstration of *merger doctrine*:

  - "Patent law protects process or method performed by computer program and copyright law protects expression of that process or method; however, if patentable process is embodied inextricably in line-by-line instructions of computer program, process merges with expression and precludes copyright protection. 17 U.S.C.A. § 101 et seq.; 35 U.S.C.A. § 1 et seq." (975 F.2d 832, [8])

  - "To protect processes or methods of operation, creator must look to patent laws; author cannot acquire patent-like protection by putting idea, process, or method of operation in unintelligible format and asserting copyright infringement against those who try to understand that idea, process or method of operation. 17 U.S.C.A. § 102(b)." (975 F.2d 832, [17])

- Demonstration of the *intrinsic and extrinsic tests* for substantial similarity:

  - "The Ninth Circuit uses a two-step analysis to evaluate substantial similarity: First, an 'extrinsic' test is used to determine whether two ideas are substantially similar. This is an objective test which rests upon specific criteria that can be listed and analyzed. Second, an 'intrinsic' test is used to compare forms of expression. This is a subjective test which depends on the response of the ordinary reasonable person." (975 F.2d 832, 844)

- Demonstration of the *abstraction-filtration-comparison test* for copyright infringement:

  - "After separating computer program into manageable components, court must filter unprotectible components of program from protectable expression; court

must filter out as unprotectible ideas, expression necessarily incident to ideas, expression already in public domain, expression dictated by external factors such as computer's mechanical specifications, compatibility with other programs in industry served by program, and expression not original to programmer or author." (975 F.2d 832, [7])

- Demonstration of the *common errors test* for copyright infringement:

    - "In another example, the district court noted that Nintendo modified its 10NES slave chip program in 1987. This modification deleted some instructions from the original 10NES program. Nonetheless the Rabbit program contains instructions equivalent to those deleted from the original 10NES program. These unnecessary instructions strongly suggest that the Rabbit program is substantially similar to the 10NES program." (975 F.2d 832, 845)

Corning Glass Works v. Sumitomo Electric USA, Inc.

Patent assignee brought action against competitor for patent infringement; competitor counter sued seeking declaratory judgment that patents were invalid, unenforceable and not infringed. US District Court for the Southern District of NY, 671 F.Supp 1369, held that competitor had infringed two of three patents at issue, and that they were valid. Competitor appealed, and assignee cross-appealed; Federal Circuit Court of Appeals affirmed, 868 F.2d 1251 (Fed. Cir. 1989).

- Claim interpretation for anticipation of prior art:

    - "Anticipation requires that every limitation of patent claim in issue be disclosed, either expressly or under principles of inherency, in single prior art reference." (868 F.2d 1251, [1])

- Claim interpretation for infringement:

    - "In determination of infringement, words of claim must first be interpreted, and, as properly interpreted, they must be 'read on' accused structure to determine whether each of the limitations recited in claim is present in accused structure." (868 F.2d 1251, [6])

- Limitations of patent claim preamble:

    - "No litmus test can be given with respect to when the introductory words of a claim, the preamble, constitute a statement of purpose for a device or are, in themselves, structural limitations of a claim. To say that a preamble is a limitation if it gives 'meaning to the claim' may merely state the problem rather than lead one to an answer. The effect preamble language should be given can be resolved only on review of the entirety of the patent to gain an understanding of

what the inventors actually invented and intended to encompass by the claim." (868 F.2d 1251, 1257)

Data Gen. v. Grumman Systems Support

Computer manufacturer brought action against a competitor that services its computers for copyright infringement and misappropriation of trade secrets. Competitor filed counterclaims alleging anti-trust violations. The US District Court for The District of MA favored computer manufacturer, 825 F.Supp. 340, and competitor appealed. The Court of Appeals affirmed in part and remanded, 36 F.3d 1147 (1st Cir. 1994).

- Provisions of the Sherman Anti-trust Act:
    - "Sherman Act provision prohibiting contracts in restraint of trade prohibits seller from 'tying' sale of one product to purchase of second product if seller thereby avoids competition on merits of 'tied' product. Sherman Act, § 1, as amended, 15 U.S.C.A. § 1." (36 F.3d 1147, [30])
    - "Monopolist's unilaterial refusal to deal with its competitors, as long as refusal harms competitive process, may constitute prima facie evidence of exclusionary conduct in context of monopolization claim. Sherman Act, § 2, as amended, 15 U.S.C.A. § 2." (36 F.3d 1147, [39])
    - "Computer manufacturer's refusal to provide spare parts, depot repair services, certain documentation, change order kits and schematics to third parties that maintained its computers was not exclusionary conduct in violation of Sherman Act's monopolization provision, absent evidence of any resulting harm to owners of manufacturer's equipment. Sherman Act, § 2, as amended, 15 U.S.C.A. § 2." (36 F.3d 1147, [46])
- Copyright misuse in licensing agreements.

Diamond, Commissioner of Patents and Trademarks v. Diehr et al.

Commissioner of Patents brought action against patent applicant for synthetic rubber curing process. Applicant's claims were rejected by the Patent Office, but this finding was reversed by the Court of Customs and Patent Appeals, 602 F. 2d 982. US Supreme Court affirmed, 450 US 175 (1981); 209 USPQ 1 (Sup. Ct. 1981).

- Summary of the action:
    - Respondents characterized their contribution to the art to reside in the process of constantly measuring the temperature inside the mold and feeding the temperature measurement into a computer that repeatedly recalculates the cure time by use of the mathematical equation and then signals a device to open the press at the proper time. The patent examiner rejected respondents' claims on the ground that

they were drawn to nonstatutory subject matter under 35 U.S.C. § 101, …" (450 US 175, 175)

- "While a mathematical formula, like a law of nature, cannot be the subject of a patent, respondents do not seek to patent a mathematical formula, but instead seek protection for a process of curing synthetic rubber. Although their process employs a well-known mathematical equation, they do not seek to pre-empt the use of that equation, except in conjunction with all of the other steps in their claimed process. A claim drawn to subject matter otherwise statutory does not become non statutory simply because it uses a mathematical formula, computer program, or digital computer. Respondents' claims must be considered as a whole, it being inappropriate to dissect the claims into old and new elements and then to ignore the presence of the old elements in the analysis." (450 US 175, 175)

- "When a claim containing a mathematical formula implements or applies the formula in a structure or process which, when considered as a whole, is performing a function which the patent laws were designed to protect (e.g., transforming or reducing an article to a different state or thing), then the claim satisfies § 101's requirements." (450 US 175, 176)

- Unpatentable under 35 U.S.C. §101:

  - "Excluded from patent protection are laws of nature, natural phenomena, and abstract ideas." (450 US 175, 185)

Ex parte McNabb and Voss

Patent Office Examiner disallows applicants Claims 14-16 for a radiological method to analyze the structure of solid objects. Patent Office Board of Appeals reversed. 127 USPQ 456 (1959)

- Subject matter that has mental steps in addition to physical steps[7]:

  - "Any method or step in a method which can be manually performed and requires use of human eyes for detection or determination of any condition, such as temperature, pressure, time, etc., and/or use of hands for purpose of manipulating, such as turning off or on or regulating a given device in a certain manner or at a certain time, etc., to produce a certain result necessarily involves human mind and hence can be classed as a mental step; such steps, however, are not purely mental or interpretive mental steps and are not the kind which are prohibited by decisions relating to purely mental steps." (127 USPQ 456, [1])

[7] Also see: Moy, § 5:27 Exception for Ministerial Acts.

Feist Publications, Inc. v. Rural Telephone Service Co., Inc.

Telephone directory (white pages) publisher brought action against a telephone company alleging that a compilation of facts delivered as a telephone book is not entitled to copyright protection. The District Court granted summary judgment to telephone company, holding that telephone directories are copyrightable. The Court of Appeals affirmed. US Supreme Court reversed, 499 US 340 (1991).

- Originality is prerequisite for copyright protection:
    - "Article I, § 8, cl. 8, of the Constitution mandates originality as a prerequisite for copyright protection. The constitutional requirement necessitates independent creation plus a modicum of creativity. Since facts do not owe there origin to an act of authorship, they are not original and, thus, are not copyrightable. Although a compilation of facts may possess the requisite originality because the author typically chooses which facts to include, in what order to place them, and how to arrange the data so that readers may use them effectively, copyright protection extends only to those components of the work that are original to the author, not to the facts themselves. This fact/expression dichotomy severely limits the scope of protection in fact-based works." (499 US 340, 340)
- Compilations of facts may be copyrightable:
    - "A compilation is not copyrightable per se, but is copyrightable only if its facts have been 'selected, coordinated, or arranged *in such as way* that the resulting work as a whole constitutes an original work of authorship.' § 101 (emphasis added). Thus, the statute envisions that some ways of selecting, coordinating, and arranging data are not sufficiently original to trigger copyright protection. Even a compilation that is copyrightable receives only limited protection, for the copyright does not extend to the facts contained in the compilation. § 103(b)." (499 US 340, 341)
- Demonstration of the *sweat of the brow test* and *industrious collections test* for copyright infringement:
    - "Lower courts that adopted a 'sweat of the brow' or 'industrious collection' test – which extended a compilation's copyright protection beyond selection and arrangement to the facts themselves – misconstrued the 1909 Act and eschewed the fundamental axiom of copyright law that no one may copyright facts or ideas." (499 US 340, 341)

Gottschalk, Acting Commissioner of Patents v. Benson et al.

Acting Commissioner of Patents brought action against patent applicant on claims rejected by the Patent Office but sustained by the Court of Customs and Patent Appeals, 441 F.2d 682. US Supreme Court reversed, 409 US 63 (1972).

- Summary of the action:

    - "Respondents filed in the Patent Office an application for an invention which was described as being related 'to the processing of data by program and more particularly to the programmed conversion of numerical information' in general purpose computers. (They claimed a method for converting binary-coded decimal (BCD) numerals into pure binary numerals.) The claims were not limited to any particular art or technology, to any particular apparatus or machinery, or to any particular end use. They purported to cover any use of the claimed method in a general-purpose digital computer of any type." (409 US 63, 64)

- US Supreme court reversed and rejected applicant's claims, citing:

    - "Respondents' method for converting numerical information from binary-coded decimal numbers into pure binary numbers, for use in programming conventional general-purpose digital computers is merely a series of mathematical calculations or mental steps and does not constitute a patentable 'process' within the meaning of the Patent Act, 35 U.S.C. § 100 (b). Pp. 64-73." (409 US 63, 63)

    - "It is conceded that one may not patent an idea. But in practical effect that would be the result if the formula for converting BCD numerals to pure binary numerals were patented in this case. The mathematical formula involved here has no substantial practical application except in connection with a digital computer, which means that if the judgment is affirmed, the patent would wholly pre-empt the mathematical formula and in practical effect would be a patent on the algorithm itself." (409 US 63, 72)

    - "It is said that the decision precludes a patent for any program servicing a computer. We do not so hold." (409 US 63, 71)

In Re Abrams

Patent office rejects claims of Armand J. Abrams for an oil prospecting method. US Court of Customs and Patent Appeals affirms, 188 F.2d 165 (1951).

- Judicial review that Claim steps which constitute the invention are purely mental in character.

    - "In truth, the question of whether a step in a process is mental or physical seems to us to be one of fact rather than one of law and so should not be difficult of determination, but opinions sometimes differ even as to facts." (188 F.2d 165, 168)

    - "Citation of authority in support of the principle that claims to mental concepts which constitute the very substance of an alleged invention are not patentable is

unnecessary. It is self-evident that thought is not patentable." (188 F.2d 165, 168)

- Controversial[8] 'rules' for establishing patentability of mental steps claims:
    - "Going further, the brief sets forth as applicable to cases where the claims contain certain so-called mental steps, three suggested 'rules of law' reading:

      1. If all of the steps of a method claim are purely mental in character, the subject matter thereof is not patentable within the meaning of the patent statutes.

      2. If a method claim embodies both positive and physical steps as well as so-called mental steps, yet the alleged novelty or advance over the art resides in one or more of the so-called mental steps, then the claim is considered unpatentable for the same reason that it would be if all the steps were purely mental in character.

      3. If a method claim embodies both positive and physical steps as well as so-called mental steps, yet the novelty or advance over the art resides in one or more of the positive and physical steps and the so-called mental step or steps are incidental parts of the process which are essential to define, qualify or limit its scope, then the claim is patentable and not subject to the objection contained in 1 and 2 above." (188 F.2d 165, 166)

In Re Lowry

Patent and Trademark Office Board of Patent Appeals and Interferences rejects claims in patent application of Edward S. Lowry for a computer memory storage system. US Court of Customs and Patent Appeals reversed, holding that: (1) claims disclosed were not analogous to printed matter, and (2) claims were not disclosed, anticipated, or made obvious by prior art. 32 F.3d 1579 (Fed. Cir. 1994); 32 USPQ.2d 1031.

- Use of printed matter as a claim limitation:
    - "Patent and Trademark Office (PTO) must consider all claim limitations when determining patentability of invention over prior art, and PTO may not disregard claim limitations comprised of printed matter." (32 F.3d 1579, [3])

[8] *Application of Musgrave – 431 F.2d 882 (1970)*
"It remains our view that we need not be encumbered in our reasoning by the 'Rules' of Abrams for the reason that they have never enjoyed the approval of this court." (431 F.2d 882, 889)

"… see Ex parte Egan, 129 USPQ 23 (1960), a case which, incidentally, accepted the Abrams 'Rules' as established law;" (431 F.2d 882, 892)

- "The printed matter cases have no factual relevance where 'the invention as defined by the claims requires that the information be processed not by the mind but by a machine, the computer." (32 F.3d 1579, 1583)

In Re Nuijten

Patent applicant Petrus A.C.M. Nuijten appeals decision of the Board of Patent Appeals and Interferences which rejected claims for a watermark encoding method. The US Court of Appeals affirms in a split decision, stating that: (1) claims required some carrier upon which the information was embedded and (2) claims were not directed to statutory subject matter. 500 F.3d 1346 (Fed. Cir. 2007)

- A *'signal'* is a non-statutory claim element:

  - "The claims on appeal cover transitory electrical and electromagnetic signals propagating through some medium, such as wires, air, or a vacuum. Those types of signals are not encompassed by any of the four enumerated statutory categories: 'process, machine, manufacture, or composition of matter.'" (500 F.3d 1346, 1352).

  - "Claims in patent application for a signal with embedded digital watermark encoded according to a given encoding process were not directed to a patentable process; claim's recitation of a encoding process did not transform a claim covering the signal itself into one covering the process by which that thing was made. 35 U.S.C.A. § 101." (500 F.3d 1346, [6]).

  - "A propagating electromagnetic signal is not a 'machine' as that term is used in statute defining patentable subject matter. 35 U.S.C.A. § 101." (500 F.3d 1346, [8]).

  - "Artificiality is insufficient by itself to render something a 'manufacture' within meaning of statute defining patentable subject matter. 35 U.S.C.A. § 101." (500 F.3d 1346, [9]).

  - "Regardless of how broadly or narrowly one construes a product-by-process claim, it is clear that such claims are always to a product, not a process." (500 F.3d 1346, 1355 – citing *SmithKline Beecham Corp. v. Apotex Corp.*, 439 F.3d 1312 at 1317).

KSR International Co. v. Teleflex Inc. et al.

Exclusive patent licensee brought action against competitor for patent infringement. The US Dist. Court for the Eastern District of MI granted summary judgment for competitor on grounds of obviousness, 298 F.Supp.2d 581. Licensee appealed, and US Court of Appeals for the Federal Circuit reversed, 119 Fed.Appx. 282. The US Supreme Court reversed, and remanded (127 S.Ct.

1727 (2007)).

- Invalidation of patent on the grounds of obviousness.
    - "Patent claiming the combination of elements of prior art is obvious if the improvement is no more that the predictable use of prior art elements according to their established functions. 35 U.S.C.A. § 103" (127 S.Ct. 1727, [1])
    - "Patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art. 35 U.S.C.A. § 103" (127 S.Ct. 1727, [2])
    - "In determining whether subject matter of patent claim is obvious, neither the particular motivation nor the avowed purpose of patentee controls; what matters is the objective reach of the claim. 35 U.S.C.A. § 103" (127 S.Ct. 1727, [3])
    - "Patent's subject matter can be proved obvious by noting that there existed at the time of invention a known problem for which there was an obvious solution encompassed by patent's claims. 35 U.S.C.A. § 103" (127 S.Ct. 1727, [4])
    - "In determining whether patent combining known elements is obvious, question is not whether the combination was obvious to the patentee but whether the combination was obvious to a person with ordinary skill in the art; under correct analysis, any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide reason for combining the elements in the manner claimed. 35 U.S.C.A. § 103" (127 S.Ct. 1727, [5])
- Opinion on the *teaching, suggestion or motivation (TSM) test* for obviousness:
    - "…the TSM test is incompatible with our precedents." (127 S.Ct. 1727, 1741)

Kublan v. Hasbro Toy Division of Hasbro

Independent toy inventor Neil Kublan brought action against toy maker for breach of confidentiality agreement, conversion, fraudulent inducement, and misuse of trade secret. US District Court for the S.D. of New York finds for toy maker, and dismisses complaint. 50 USPQ2d 1539.

- Conversion of intangible property right:
    - "Plaintiff's claim that defendants converted his idea for hand puppet by using it without his consent is not actionable under New York law, since claim is for conversion of idea and design for puppet, not for physical puppet itself, and since New York does not recognize claim for conversion of intangible property right." (50 USPQ2d 1539, [1])

- For purposes of trade secret, patent document places idea into the public domain:

    - "Defendant toy companies are entitled to summary judgment on claim that their manufacture of dinosaur hand puppets constitutes unauthorized use of plaintiff's trade secret, since under New York law, product idea must be novel or original to qualify as trade secret, and since idea for hand-held dinosaur puppet is not novel, in view of several patents for hand-held animal puppets that were on file at time plaintiff submitted his puppet to defendant." (50 USPQ2d 1539, [2])

Lasercomb America, Inc. v. Reynolds

Computer (CAD/CAM) software developer brought action against steel rule die manufacturer's president for copyright infringement and fraud. US District Court for the Middle District of NC found for developer and awarded damages. The Court of Appeals affirmed in part, reversed in part and remanded, 911 F.2d 970 (4th Cir. 1990).

- Copyright misuse [9]:

    - "We are persuaded, however, that a misuse of copyright defense is inherent in the law of copyright just as a misuse of patent defense is inherent in patent law." (911 F.2d 970, 973)

    - "Anticompetitive language in software program developer's licensing agreement amounted to a misuse of copyright by attempting to use copyright to control competition outside computer-assisted die manufacturing so that misuse of license barred recovery for infringement even if misuse was not antitrust violation; agreement forbade licensee from developing or assisting in developing any kind of computer-assisted die-making software." (911 F.2d 970, [3])

    - "Defense of copyright misuse is available even if defendants themselves have not been injured by misuse." (911 F.2d 970, [4])

Microsoft Corporation v. AT&T Corporation

Patent holder for recorded speech process brought action against software manufacturer for infringement on grounds that it was liable for foreign installations of software. The US District Court for the Southern District of NY granted summary judgment of infringement, and manufacturer appealed. The Court of Appeals for the Federal Circuit, 414 F.3d 1366, affirmed. The US Supreme Court reversed, 127 S.Ct. 1746 (2007)

- Does software itself, rather than a copy of software, when combined with other patented elements outside of the United States, constitute infringement?

[9] An excellent historical treatise of copyright misuse begins on p. 972.

- "Generally, no infringement occurs when a patented product is made and sold in another country; however, the Patent Act provides an exception when one 'supplies from the United States' for 'combination' abroad, a patented invention's 'components.' 35 U.S.C.A. § 271 (f)(1)" (127 S.Ct. 1746, [1])

- "A copy of computer software, not the software in the abstract, qualifies as a 'component' within meaning of section of the Patent Act providing that patent infringement occurs when one 'supplies … from the United States,' for 'combination' abroad, a patented invention's 'components.' 35 U.S.C.A. § 271 (f)(1)" (127 S.Ct. 1746, [2])

- "A copy of Windows, not Windows in the abstract, qualifies as a 'component' under § 271(f)." (127 S.Ct. 1746, 1748)

- "A blueprint may contain precise instructions for the construction and combination of the components of a patented device, but it is not itself a combinable component." (127 S.Ct. 1746, 1748)

- "While copying software abroad is indeed easy and inexpensive, the same can be said of other items, such as keys copied from a master." (127 S.Ct. 1746, 1749)

Mitel, Inc. v. Iqtel, Inc.

Manufacturer of telephone call controllers brought action against competitor for copyright infringement. The US District Court for the District of Colorado, 896 F.Supp. 1050, denied manufacturer's motion for preliminary injunction, and manufacturer appealed. The US Court of Appeals affirmed, 124 F.3d 1366 (10th Cir. 1997).

- Reverse engineering of command and control code registers:

  - "Neither numbers of command codes used to program manufacturer's telephone call controllers nor code registers and descriptions were sufficiently original to merit copyright protection, where numbers were arbitrarily chosen and arbitrarily assigned to each function, and registers and descriptions were purely sequential. 17 U.S.C.A. § 102(a) " (124 F.3d 1366, [7])

  - "'Values' created by manufacturer of call controllers, which were assigned to description portion of command codes and were devised to set each function at particular level of operation, were excluded from copyright protection under scenes a faire doctrine, since values were largely dictated by external factors such as hardware compatibility requirements and industry practices." (124 F.3d 1366, [11])

  - "Content of 'values' created by manufacturer of call controllers, which were assigned to description portion of command codes and were devised to set each function at particular level of operation, were sufficiently original to be eligible for copyright protection, because effort required of manufacturer's employees to devise appropriate

values for wide variety of individual functions reflected at least minimal degree of creativity. 17 U.S.C.A. § 102(a)" (124 F.3d 1366, [10])

- Demonstration of the *abstraction-filtration-comparison test* for copyright infringement":

    - "Under abstraction-filtration-comparison analysis, which is used to aid in separating idea from expression and identifying protectable expression, court dissects copyrighted work according to varying levels of abstraction, filters out elements which are not subject to copyright protection, and compares remaining protectable elements with allegedly infringing work." (124 F.3d 1366, [4])

- Demonstration of the *merger doctrine*:

    - "Although element of work may be characterized as method of operation, which is excluded from copyright protection, that element may nevertheless contain expression that is eligible for copyright protection. 17 U.S.C.A. § 102(b)." (124 F.3d 1366, [5])

    - "Under merger doctrine, copyrightable expression is denied protection from infringement because expression is inseparable from or merged with ideas, processes, or discoveries underlying expression." (124 F.3d 1366, [8])

    - "Originality is independent requirement of copyright protection that is not satisfied merely because merger doctrine, which denies protection to copyrightable expression when expression is inseparable from or merged with ideas, processes or discoveries underlying expression, in inapplicable." (124 F.3d 1366, [9])

- Demonstration of the *scenes-a-faire doctrine*:

    - "Under scenes a faire doctrine, expressive elements of work of authorship are not entitled to protection against copyright infringement if they are standard, stock, or common to topic, or if they necessarily follow from common theme or setting." (124 F.3d 1366 [12])

    - "Scenes a faire doctrine excludes from protection against copyright infringement those elements of work that necessarily result from external factors inherent in subject matter of work." (124 F.3d 1366, [13])

    - "In determining whether elements of copyrighted work were excluded from protection under scenes a faire doctrine, district court erred in discussing whether external factors such as market forces and efficiency considerations justified defendant's copying of the element and should have kept its focus upon external factors that dictated plaintiff's selection of elements." (124 F.3d 1366, [14])

    - "We have extended this traditional copyright doctrine to exclude from protection against infringement those elements of a work that necessarily result from external factors inherent in the subject matter of the work. For computer-related applications,

these external factors include hardware standards and mechanical specifications, software standards and compatibility requirements, computer manufacturer design standards, industry programming practices and practices and demands of the industry being serviced." (124 F.3d 1366, 1375)

- Scenes-a-faire doctrine relating to reverse engineering, above: 124 F.3d 1366, [11]

Parker, Acting Commissioner of Patents v. Flook

Acting Commissioner of Patents brought action against patent applicant seeking protection for a method of updating alarm limits in a catalytic process. Applicant's claims were rejected by the Patent Office; reversed by the Court of Customs and Patent Appeals, 559 F.2d 21, 195 USPQ 9 , and reversed by US Supreme Court, 437 US 584, 198 USPQ 193 (1978).

- Use of post-solution applications of mathematical formula in computer programs:
  - "The notion that post-solution activity, no matter how conventional or obvious in itself, can transform an unpatentable principle into a patentable process exalts form over substance. A competent draftsman could attach some form of post-solution activity to almost any mathematical formula: the Pythagorean Theorem would not have been patentable, or partially patentable, because a patent application contained a final step indicating that the formula, when solved, could be usefully applied to existing surveying techniques. The concept of patentable subject matter under § 101 is not 'like a nose of wax which may be turned and twisted in any direction ***.' White v. Dunbar, 119 US 47, 51". (198 USPQ 193, 197).
  - "Identification of limited category of useful, although conventional, post-solution applications of mathematical formula does not make claimed method whose only novel feature is that formula, eligible for patent protection." (198 USPQ 193, [11]).

ProCD, Inc. v. Zeidenberg

Producer of computer software brought action against users for violations of the Copyright Act and Wisconsin Computer Crimes Act. US District Court finds for defendants, 908 F.Supp. 640 (W.D.Wis. 1996).

- Data embedded in software:
  - "Telephone listings compiled in computer software were not entitled to copyright protection." (908 F.Supp. 640, [1])
  - "Feist's result may well serve as a disincentive to companies considering the compilation of factual databases, but Feist struck the 'careful balance' between fact and expression in copyright law by allowing facts to be copied at will in order

to advance the development of science and art. That disincentives might result was not considered important." (908 F.Supp. 640, 647 – footnotes omitted)

- "Although telephone listings compiled in computer software were not protected by federal copyright law, copyright protection attached to software component, which represented original expression and creativity." (908 F.Supp. 640, [2])

- Reverse engineering:

  - "User did not infringe copyrighted computer software that contained uncopyrighted compilation of telephone listings by copying software onto his computer's hard drive to download and access uncopyrightable data; user was entitled to personal use exception to restrictions on copying protected computer software, although downloading was for purpose of offering telephone listings over the internet. 17 U.S.C.A. §§ 117, 501." (908 F.Supp. 640, [3])

- Use of shrinkwrap license agreement:

  - "'Shrinkwrap licenses' are intended to take place of any bargains or agreements between mass market software producers and users, because typical software transaction does not involve bargained agreements concerning use limitations, but purchase made by computer user at retail store or through mail, with little discussion or bargaining between producer and user." (908 F.Supp. 640, [11])

  - "In placing shrinkwrap license provision on its software product, producer seeks to prohibit unauthorized copies; prohibit software rental; prohibit reverse engineering and modifications to software; limit use of software to one central processing unit; disclaim warrantees and limit liability." (908 F.Supp. 640, [12])

  - "Even if provision of Uniform Commercial Code (UCC) governing when additional terms and conflicting forms are binding on merchants applied to sale of computer software to consumers, user agreement or 'shrinkwrap license' included with software was not binding on buyers, where buyers never agreed to it expressly and it never became part of agreement between parties. U.C.C. § 2-207" (908 F.Supp. 640, [18])

  - "The decision on this issue is a close call." (908 F.Supp. 640, 654)

  - Author's note: the line of reasoning taken by the court with respect to shrinkwrap licensing and Uniform Commercial Code (UCC) appears to be a fine one. The sale of this particular software was governed by the UCC, but objections relate to the conduct of the parties with respect to 'offer' and 'acceptance' of terms of sale.

UCC § 2-207[10].

- Preemption of state law by Copyright Act:
    - "It is only when contract erects barrier on access to information that under copyright laws should be accessible that Copyright Act's preemption provision operates to protect copyright law from individually crafted evisions of that law. 17 U.S.C.A. §301" (908 F.Supp. 640, [25])
    - "Copyright Act preempted Wisconsin Computer Crimes Act as it applied to actions of users of copyrighted computer software in distributing uncopyrightable telephone listings contained within the software; telephone listings fell within subject matter of copyright, and producer sought merely to prohibit copying and distribution that it could not prevent under federal copyright law. 17 U.S.C.A. §301; W.S.A. 943.70(2)(a)" (908 F.Supp. 640, [27])
- Preemption of contract terms by Copyright Act:
    - With respect to shrinkwrap license, above: 908 F.Supp. 640, [12]
    - "National Car Rental, Taquino, Trenton and Acorn do show that contract claims are not preempted automatically by federal copyright law. Contracts that are consistent with the copyright law's goals of self-protection should be upheld. Rightful owners should be able to define the limits of permissible copying or modification of their works. It is only when a contract erects a barrier on access to information that under copyright law should be accessible that § 301 operates to protect copyright law from individually crafted evisions of that law." (908 F.Supp. 640, 658 - footnotes omitted)
    - "Plaintiff's license agreement is an attempt to avoid the confines of copyright law and of Feist. Its prohibition on the distribution of public information cannot be

[10] *U.C.C. § 2-207. Additional Terms in Acceptance or Confirmation.*
(1) A definite and seasonable expression of acceptance or a written confirmation which is sent within a reasonable time operates as an acceptance even though it states terms additional to or different from those offered or agreed upon, unless acceptance is expressly made conditional on assent to the additional or different terms.
(2) The additional terms are to be construed as proposals for addition to the contract. Between merchants such terms become part of the contract unless:
- the offer expressly limits acceptance to the terms of the offer;
- they materially alter it; or
- notification of objection to them has already been given or is given within a reasonable time after notice of them is received.

(3) Conduct by both parties which recognizes the existence of a contract is sufficient to establish a contract for sale although the writings of the parties do not otherwise establish a contract. In such case the terms of the particular contract consist of those terms on which the writings of the parties agree, together with any supplementary terms incorporated under any other provisions of this Act.

Source: www.law.cornell.edu/ucc/2/2-207.html on 14 NOV 2007

squared with the purposes of copyright law or with plaintiff's own compilation of data." (908 F.Supp. 640, 659 – footnotes omitted)

Ex parte Read

Patent applicant brings Ex parte action against primary patent examiner who rejected claims for an aircraft ground speed indicator. Patent Office Board of Appeals affirms, 123 USPQ 446 (1943).

- Patent application rejected on grounds of mental act:
    - "Claims to method of determining rate of travel of vehicle are rejected as failing to define true method since they do not define any true manipulative steps except moving one scale relative to another scale; act of correlating the reading of one scale with reading on the other is purely a mental act that cannot be regarded as true manipulative step." (123 USPQ 446, [1])

Rogers v. Koons

Photographer brought suit against sculptor alleging infringement of copyrighted photograph. US District Court for the Southern District of NY, 751 F.Supp. 474, as amended on re-argument 777 F.Supp. 1, held that sculptor infringed. Sculptor appealed, Court of Appeals affirmed, 960 F.2d 301 (2ND Cir. 1992)

- Originality; copyright infringement when affixed medium is different:
    - "Copyright protection extends only to those components of work that are original to creator; fact that whole work is copyrighted does not mean that every element of it is copyrighted; however, quantity of originality needed to be shown is modest. 17 U.S.C.A. § 101 et seq." (960 F.2d 301, [2])
- Demonstration of the *substantial similarity test*:
    - "In determining whether two works of art are substantially similar for purposes of Copyright Act, focus must be on similarity of expression of idea or fact, not on similarity facts, ideas or concepts themselves. 17 U.S.C.A. § 101 et seq." (960 F.2d 301, [6])
    - "No copier may defend act of plagiarism by pointing out how much of copy he has not pirated. 17 U.S.C.A. § 101 et seq." (960 F.2d 301, [7])
- Demonstration of the *fair use doctrine*:
    - "Where original work is factual rather than fictional, scope of fair use doctrine is broader. 17 U.S.C.A. § 107" (960 F.2d 301, [12])

Secure Services Technology, Inc. v. Time and Space Processing, Inc.

Facsimile machine manufacturer brought action against competitor for violation of Trade Secrets Act and copyright infringement. Finding for defendant. 722 F.Supp. 1354 (E.D.Va. 1989)

- Electronic timing waveforms not capable of being copyrighted:
    - "Slight variations in 'handshake protocol,' the stream of binary digits which enable facsimile machines to recognize each other and complete transmission and reception of information, were not capable of being copyrighted; general composition of protocol was dictated by need to communicate with other machines and manufacturer was able to make only minor reordering or variance in signals which did not meet originality requirements for copyright. 17 U.S.C.A. §§ 102, 103" (722 F.Supp. 1354, [2])
    - "Facsimile machine manufacturer could not obtain copyright protection for timing of its implementation of standard handshaking protocol program under which facsimile machines communicated with each other; timing was process by which electronic signals were created, transmitted or received, and as such excluded from copyright under statute. 17 U.S.C.A. § 102(b)" (722 F.Supp. 1354, [3])
- Reverse engineering under the California Uniform Trade Secrets Act:
    - "Manufacturer of facsimile machine could not claim trade secret status under California Uniform Trade Secrets Act for protocols developed to facilitate communication between machines when it failed to take steps to safeguard information as required under the Act. West's Ann.Cal.Civ.Code §§ 3426.1 to 3426.10, 3426.1(d)." (722 F.Supp. 1354, [1])
    - "The Act expressly permits reverse engineering as a method of discovering what would otherwise constitute a trade secret as long as the product was not acquired by improper means." (722 F.Supp. 1354, 1361)
    - "In this case, by selling its machine without reserving proprietary rights, SST effectively disclosed its protocol variations." (722 F.Supp. 1354, 1361)
- Rights governing timing variations from industry standards (CCITT T.30 protocol).
- Distinction between copyright registration and certificate of registration:
    - "Copyright laws make a distinction between copyright registration and receiving from the Copyright Office a certificate of registration. Under the copyright laws, copyright registration is presumed to have occurred from the moment of the owner of the copyrightable materials delivers his application and filing fee to the Copyright Office. 17 U.S.C. § 408(a)." (722 F.Supp. 1354, 1364)
- Demonstration of *US Government rights* in intellectual property agreements.

White Consolidated Industries v. Vega Servo-Control

Machine tool maker brought action against competitor for software patent infringement; competitor counterclaims charging invalidity. District Court, S.D. Michigan, S. Div, 214 USPQ 796 (Dist. Ct 1982), invalidates patent; US Court of Appeals, 713 F.2d 788 (Fed. Cir. 1983), affirms.

- Plaintiff did not disclose trade secreted software that was necessary to enable one to reproduce the invention:
    - "… when a computer program held proprietary by maintaining its processor as a trade secret is the only known way of practicing an invention of which it is an integral part, there has been a failure to disclose the best mode of practicing the invention." (214 USPQ 796, 825)
    - "Best mode requirement is separate and distinct from enabling requirement of Section 112; question of specification's adequacy in this context is not related to question of specification's sufficiency in complying with enabling requirement; if specific computer language was best mode and was not disclosed because it was held as trade secret by inventor, enabling requirement was not met." (214 USPQ 796, [12])
- Element of claim described as 'means' must correspond to a structure described in specifications:
    - "Inventor cannot by mere use of word 'means' appropriate any and all kinds of devices that may perform specified function or any other mechanism or device other than that which is described in patent or that is its mechanical equivalent." (214 USPQ 796, 834)
- Sufficiency of disclosure:
    - "Section 112 requires simply disclosure of invention that would enable persons skilled in pertinent art to practice invention." (214 USPQ 796, [7])
    - "Disclosure is sufficient even if it requires person having established level of knowledge to conduct reasonable amount of experimentation; what amount of experimentation is reasonable is determined in view of invention's nature." (214 USPQ 796, [8])
    - "First paragraph of 35 U.S.C. 112 requires that specification be complete enough to enable one of ordinary skill in art to make and use invention without undue experimentation; prohibition of 'undue' experimentation means that need for minimum amount of experimentation is not fatal; every detail need not appear in specification where skill of art is such that what does appear enables one skilled in

art to make and use invention; specification need to describe conventional nor disclose what skilled already possesses." (214 USPQ 796, [9])

- "Use of product whose composition is trade secret is not violation of enabling requirement of Section 112 per se where product is known to those skilled in art and readily obtainable." (214 USPQ 796, [10])

- A patent is presumed to be valid:
  - "Validity is a question of law." (214 USPQ 796, [4])
  - "While patent is presumed valid, 35 U.S.C. 282, presumption has no independent evidentiary value but only serves to place burden of proof on party who asserts invalidity." (214 USPQ 796, [5])

- Demonstration of the *doctrine of equivalents*:
  - "'To temper unsparing logic and prevent an infringer from stealing the benefit of the invention' a patentee may invoke this doctrine to proceed against the producer of a device 'if it performs substantially the same function in substantially the same way to obtain the same result.'" (214 USPQ 796, 834)

- Demonstration of the *doctrine of file wrapper estoppel*:
  - "Under doctrine of file wrapper estoppel, if file wrapper reveals that the patentee has surrendered claims, or has amended, narrowed or otherwise limited his claims in response to objections of Patent Office, he may not later recapture, through the doctrine of equivalents, what he has given up." (214 USPQ 962 - Index Digest 22.151)

III. Clean Room Design Practice for Interoperable Devices

The clean room design practice is not a recipe or a formula; it's a set of general 'rules of thumb' for creating interoperable devices and new manuals. These rules are gleaned from (and are expressed by) state and federal laws, case law precedents, and a careful observation of the practices of the U.S. Patent and Trademark Office with regard to public domain information.

The process varies on a project-by-project basis, but generally involves two major tasks. The first is a reverse engineering process that: (a) identifies the form, fit and function of an original device and (b) attempts to understand its internal operation. The former is quite easy to do even though it may be quite time consuming. In most cases it involves building a fixture and bench testing the device to understand its various operating modes. The latter is more difficult as the internal operation of microcircuits can sometimes be hard to determine. This involves the study of public domain information such as technical reference manuals, academic papers, patents, internet sources (USEnet News, publicly licensed software, financial news, blogs etc.), the interviews of users, the review of products incorporating the device and so forth. In some cases the device can be peeled, meaning that the integrated circuit dice is removed from its plastic or ceramic package and inspected with optical or electron beam microscopy. However, in most cases the interoperable device does not need to work the same way that the original device does. In almost all cases it is merely sufficient that the two behave in identical ways (at the package pins).

One aspect of the clean room design process is to identify various legal and ethical methods for performing the reverse engineering process. The patent, copyright and trade secrecy laws specifically allow reverse engineering to take place, both to ascertain how something works and as a pro-competitive commercial measure. In some cases the practitioner will discover that an original device uses patented apparatus or processes. In these cases he or she will need to determine if the claims of a patent can be circumvented or licensed from its owner. If neither is possible then the clean room design practice will have succeeded in indentifying specific legal or technological impediments to creating the interoperable device.

The second task in the process is to create a new, original design works for the interoperable device and new manual. This document describes how to do this in a legal and ethical manner. In most cases it involves substantial creative input from the practitioner. By their very nature interoperable microcircuits are not just 'knock-off' copies of an original device; they require a substantial amount of creative effort and hard work to pull off.

In all cases a test fixture for the original and interoperable devices will need to be built. This allows bench testing on a side-by-side basis to determine the compatibility of the new device.

If offensive (exclusive) intellectual property rights are needed then the design works for the interoperable device and the new manual can be protected and retained by the new owner. If only defensive rights are needed then the design will most likely be publicly licensed. Either way, every step of the process should be documented. These records should show the deliberate actions taken to copy the original design in a way that does not infringe the rights of others. All

paperwork should be dated and maintained with the highest ethical and technical standards, and with the assumption that it will eventually be used to defend one's rights in a court of law.

Mask Work, Front End Design and Back End Design

Semiconductors are fabricated from a set of plans called a 'mask work'. These are a set of written instructions (blueprints) that describe the materials and processes needed to make the chip, along with a multi-layer graphic template called a 'mask'. Each 'layer' (or process step) in the chip is fabricated by shining an ultraviolet light through a layer of the mask onto a sensitized silicon or gallium arsenide (GaAs) wafer. Sensitizing the wafer allows it to react with photo-sensitive chemicals. This allows the electronic properties of the wafer to be altered, such as when the p-n junctions in transistors and diodes are created in a process known as doping.

The mask work describes how to fabricate the physical semiconductor chip, but it does not describe its various operating principles. For example, the mask work may completely define how to fabricate a silicon microprocessor chip, but it does not say anything about its functional abilities, such as how to add two binary numbers, how to convert binary into binary coded decimal (BCD) numbers, the operation of its various internal registers and so forth. It might be argued that these abilities could be reconstructed from the mask work, but this is extremely hard to do and is rarely done.

The mask work for a microcircuit is created as part of a design flow (sometimes called a 'tool chain') where the functional operation of the microcircuit is first defined, and then physical operation (in the form of a mask work) is created from this definition. The semiconductor industry broadly differentiates between these two tasks with its own set of jargon. There, the functional operation of a semiconductor is expressed as a *'front end design'*, and its physical embodiment as a *'back end design'*. Precise definitions for these terms (with respect to the clean room design process) is provided in the *Glossary of Terms*.

The *front end design* usually takes the form of a schematic diagram or hardware description language, and defines the functional operation of an electronic device. However, it does not show the physical embodiment of the device. For example, it may show the symbol for a diode, together with some ascribed electrical properties such as current carrying capacity, leakage current and speed, but it does not apply any particular physical significance to it. It does not show the dimensions of the junction, whether it's implemented on a silicon or gallium arsenide (GaAs) substrate, whether it's a bipolar or MOS structure, how it's been doped or whether or not it's a p-n junction or a p-n-p transistor with its base and emitter junctions wired together. Only the diode's functional operation in terms of its electrical properties are defined in the front end design.

This is not to say that a schematic diagram could not enforce some underlying physical structure. For example, the schematic diagram in the instant example could indicate that the diode is to be implemented on a particular silicon substrate using a particular MOS manufacturing process. However, the circuit designer need not have any knowledge of the underlying physical structure of the diode. He or she only needs to be aware of its electrical properties. Thus, any originality

contained in the front end design does not ascribe any particular physical significance to the microcircuit … only its function properties are conveyed [11].

The *back end design* expresses the tangible, physical embodiment of the device in the form of artwork and manufacturing processes. It defines a three-dimensional structure that includes compositions of metals, insulating materials and semiconductors that have been processed to provide carefully defined electrical properties. In general, this is accomplished by defining a limited number of component structures such as transistors, diodes, resistors, capacitors and interconnection wires – each with their own inherent electrical properties. These are then arranged into a composite system which performs the functions described by the front end design.

Front end design and back end design requires a different set of creative inputs. The art of front end design generally relates to the final application of the microcircuit … the system level functions that turn a microcircuit into a desktop computer or a wrist watch. The art of back end design generally relates to the manufacture of the microcircuit itself … the chemical process needed to convert a raw silicon or gallium arsenide (GaAs) wafer into a tangible device. Both arts require a high degree of creativity, albeit with very different set of skills and tools.

This has not always been the case. When integrated circuits were first made in 1959 the distinction between front end design and back end design did not exist. In most cases the same people did both jobs with the same skills and tools. However, there have been great strides in the art of computer aided design (CAD) and computer aided manufacturing (CAM) relating to microcircuits since that time. These have automated each task to the point where different skill sets and tools are needed. This distinction was not produced through serendipity; it was dictated by the need to handle two very different but complementary tasks … those relating to the application design of the microcircuit, and those relating to its manufacturing.

Mask Work Under the Copyright Act

Special provisions are made in the Copyright Act with relation to semiconductor mask works. These are provided under:

- 17 U.S.C. Chapter 9: Protection of Semiconductor Chip Products
- 37 CFR Part 211: Mask Work Protection

Unless direct observation of the silicon or gallium arsenide (GaAs) die is used during a reverse engineering process (in a process often called *peeling*), the mask works copyright is irrelevant to the clean room design practice. That's because the design works for the interoperable device is assumed to take the form of portable software, and which is defined later in this manual as a *CLASS Machine*. This expresses the design as a *literary works* … an entirely different form of expression (form of fixed medium) than a *mask works*.

17 U.S.C. 901(a)(2)(A)- Definition of 'mask work'

[11] The relationship between numerical values and tangible, physical quantities such as electron charge, voltage and current is discussed elsewhere in this manual. See: "A Definition for 'Software Mechanism'."

"a 'mask work' is a series of related images, however fixed or encoded—
(A) having or representing the predetermined, three-dimensional pattern of metallic, insulating, or semiconductor material present or removed from the layers of a semiconductor chip product; and
(B) in which series the relation of the images to one another is that each image has the pattern of the surface of one form of the semiconductor chip product; …"

17 U.S.C. § 101 – Definition of 'literary works'
"'Literary works' are works, other than audiovisual works, expressed in words, numbers, or other verbal or numerical symbols or indicia, regardless of the nature of the material objects, such as books, periodicals, manuscripts, phonorecords, film, tapes, disks, or cards, in which they are embodied."

Atari Games Corp. v. Nintendo of America, Inc. - 975 F.2d 832 (Fed. Cir. 1992)
"Copyright Act's definition of 'literary works' embraces computer programs; as literary works, copyright protection extends to programs and to instructions encoded on silicon chips. 17 U.S.C.A. § 101." (975 F.2d 832, [6])

"Semiconductor Chip Protection Act which permits limited reverse engineering to reproduce mask work did not apply to competitor's attempts to use reverse engineering on computer game company's computer chip to understand company's security program which prevented use of competitor's games in company's machines; competitor did not reproduce or copy company's mask work, competitor used entirely different chip, and copied program from company's chip. 17 U.S.C.A. § 906." (975 F.2d 832, [16])

Moy's Walker on Patents - §5:37 Computer Software as an Article of Manufacture: Printed Matter …
"When claimed as an article, computer software is potentially unpatentable because of the exception to section 101 for printed matter. Computer software can be read by both humans and machines. It is thus potentially analogous to literary expressions that are protected under copyright. The United States patent system polices the boundary primarily through the printer matter exception." (p. 5-137, footnotes omitted).

Copyright protection extends to the expression of an idea, and different expressions of the same idea can be afforded separate but equal copyright protection under the law. The ideas embodied into the semiconductor chip … its mechanism … can be expressed either as a mask work or as a literary work.

17 U.S.C. 902(c) - Subject matter of protection; Mask works
"In no case does the protection under this chapter for a mask work extend to any idea, procedure, process, system, method of operation, concept, principle, or discovery, regardless of the form in which it is described, explained, illustrated or embodied in such work."

17 U.S.C. 102(b) – Subject Matter of Copyright; In general

"In no case does copyright protection for an original work of authorship extend to any idea, procedure, process, system, method of operation, concept, principle, or discovery, regardless of the form in which it is described, explained, illustrated, or embodied in such work."

Atari Games Corp. v. Nintendo of America, Inc. - 975 F.2d 832 (Fed. Cir. 1992).

"To protect processes or methods of operation, creator must look to patent laws; author cannot acquire patent-like protection by putting idea, process, or method of operation in unintelligible format and asserting copyright infringement against those who try to understand that idea, process or method of operation. 17 U.S.C.A. § 102(b)." (975 F.2d 832, [17])

Microcircuits Implemented as Software Design Works

This guide assumes that the design for an interoperable device will take the form of portable software rather than a mask work. This architectural style is defined here as a *CLASS Machine*. There are a number of reasons for taking this approach, but in general it was used in order to address a number of technical concerns as well as some shortcomings in the way mask work is protected under the Copyright Act, especially when FPGA and ASIC chips are involved. The main reasons are:

1) *A CLASS Machine* expresses a microcircuit design as portable software in the form of a hardware description language or schematic diagram. This is done for a number of sound technical and economic reasons:

    a) It facilitates group design practices using interoperable, modular functional blocks known as soft IP cores.

    b) Design service life is extended because IP cores can be moved from one target device to another as better technology becomes available or older technology becomes obsolete.

    c) Reduction in costs and improvement in quality through the creation of a competitive, reverse auction marketplace for semiconductor chips, IP cores and development software.

    d) The facilitation of industry standard Verification, Validation and Test (V,V&T) procedures to insure quality in safety critical and security applications. This builds confidence on the part of buyers and end users through transparency of design, a feature that allows them to independently determine if a device has any bugs, viruses or back door entry points.

2) A *CLASS Machine* does not infringe on a copyrighted *mask work* because the two are different forms of expression for similar electronic systems.

    17 U.S.C. 902(c) - Subject matter of protection; Mask works
    "In no case does the protection under this chapter for a mask work extend to any idea, procedure, process, system, method of operation, concept, principle, or discovery, regardless of the form in which it is described, explained, illustrated or embodied in such work."

    Atari Games Corp. v. Nintendo of America, Inc. - 975 F.2d 832 (Fed. Cir. 1992)
    "Semiconductor Chip Protection Act which permits limited reverse engineering to reproduce mask work did not apply to competitor's attempts to use reverse engineering on computer game company's computer chip to understand company's security program which prevented use of competitor's games in company's machines; competitor did not reproduce or copy company's mask work, competitor used entirely different chip, and copied program from

company's chip. 17 U.S.C.A. § 906." (975 F.2d 832, [16])

3) A *CLASS Machine* clearly differentiates between copyrightable *software* and patentable *software mechanism*. By definition, the *front end design* of a CLASS Machine can be protected as copyrighted expression, but it cannot be patented. Only when it's combined with the physical mechanism present in the *back end design* can it be protected.

The remainder of this section will be dedicated to the nature of software, the nature of software patents, and a detailed definition of the CLASS Machine.

A Definition for 'Software'

Software is defined in this document as *machine instructions*. These can take the form of source code or binary encoded instructions for a general purpose computer, compilation of data, Hardware Description Language (HDL), schematic diagram, state diagram, timing diagram or logical truth table. There are many other definitions that exist in the trade, all of which are assumed to be encompassed by the broad definition of *machine instructions*.

In terms of electronic circuits, one can also approach the problem from the standpoint of conventional wisdom, using the time-tested axiom: *'if it looks like a duck, quacks like a duck and walks like a duck, then it probably is a duck'*. The reader can examine Figure 1 and make up his or her own mind whether the simple reset circuit expressed there is software or not.

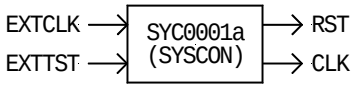
```
-----------------------------------------------------------------
-- Reset generator.
-----------------------------------------------------------------

RST_GENERATOR: process( EXTCLK )
begin

    if( rising_edge(EXTCLK) ) then

        DLY <= ( not(EXTTST) and     DLY  and not(RST) )
            or ( not(EXTTST) and not(DLY) and     RST  );

        RST <= ( not(EXTTST) and not(DLY) and not(RST) );

    end if;

  CLK <= EXTCLK;

end process RST_GENERATOR;
```

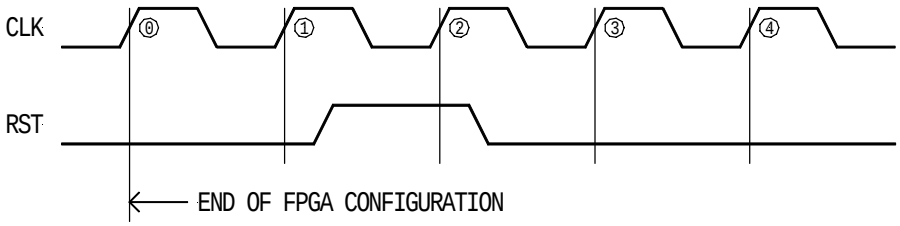
Figure 1. Machine instructions for a System-on-Chip (SoC) reset circuit[12].

Also note that Figure 1 shows machine instructions for a *portable* circuit design. By *portable* it is meant that it can run on a number of machine topologies; there is no underlying mechanism

[12] The example was taken from the 'SYC001a.vhd' … a simple WISHBONE system controller circuit that is portable across FPGA, ASIC, full custom and discrete devices.

either expressed or implied. It describes an information handling process which can be simulated on a general purpose computer, emulated on special purpose hardware, implemented as a circuit using FPGA, ASIC, full custom or discrete circuit topologies, or solved by mental calculation with the only physical assistance being that of a pad and pencil. If implemented as a microcircuit it can be fabricated on a wide variety of physical topologies such as those using silicon or gallium arsenide (GaAs) substrate, bipolar or MOS structures, and geometries of 45 nm, 90 nm or 1 um.





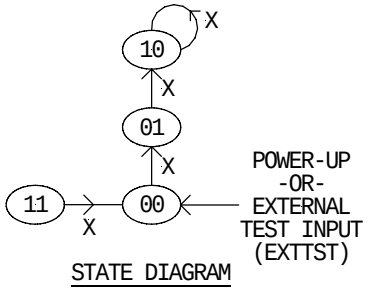
RESET STATE MACHINE:

GENERATES A WISHBONE COMPATIBLE RESET SIGNAL. THIS STATE MACHINE IS USED FOR FPGA WHERE ALL FLIP-FLOP BITS ARE INITIALIZED TO ZERO. THIS CIRCUIT IS KNOWN TO BE COMPATIBLE WITH MOST AGERE, ALTERA AND XILINX FPGAs. SIMULATION WORKS WITH ASICs THAT MEET INITIAL FLIP-FLOP CONDITIONS (AFTER POWER-UP).

INPUTS: TEST
STATES: DLY, RST

STATE MACHINE EQUATIONS:

```
DLY := ( /EXTTST *  DLY * /RST )
     + ( /EXTTST * /DLY *  RST );
RST :=   /EXTTST * /DLY * /RST;
```



STATE DIAGRAM

SHORTHAND NOTATION:

=	COMBINATORIAL OUTPUT
:=	REGISTERED OUTPUT
+	LOGICAL 'OR'
*	LOGICAL 'AND'
/	LOGICAL 'NOT'

Figure 2. Equivalent expression for the behavior of the circuit shown in Figure 1.

Application of Prater - 415 F.2d 1393 (1969).

"The examiner felt that each of the present process claims can be read on mental calculations with the appropriate mathematics and, as the only physical steps, writing on paper." (415 F.2d 1393, 1398)

Software Patentability

Portable circuit designs expressed as software, like the examples shown in Figures 1 and 2, are non statutory subject matter, and are therefore not patentable. While they can certainly be protected under the Copyright Act as a literary works, they do not meet the criteria for a patentable invention under 35 U.S.C. § 101. The major arguments against software patentability is that it is a literary works, it can be interpreted as a formula and that it can be implemented as a mental process.

In 1972 the US Supreme Court expressed an opinion on portable software processes. In Gottschalk v. Benson the Court addressed the patent application for a BCD to binary conversion method, whose claims had been rejected by the Patent Office but sustained by the Court of Customs and Patent Appeals.

> *Gottschalk, Acting Commissioner of Patents v. Benson et al. - 409 US 63 (1972)*
> "It is said that the decision precludes a patent for any program servicing a computer. We do not so hold." (409 US 63, 71)
>
> "It is conceded that one may not patent an idea. But in practical effect that would be the result if the formula for converting BCD numerals to pure binary numerals were patented in this case. The mathematical formula involved here has no substantial practical application except in connection with a digital computer, which means that if the judgment is affirmed, the patent would wholly pre-empt the mathematical formula and in practical effect would be a patent on the algorithm itself." (409 US 63, 72)

In 1981 the US Supreme Court refined its Gottschalk decision by upholding software patent claims in *Diamond v. Diehr*. There, the Court accepted claims for a computer program for a rubber curing process.

> *Diamond, Commissioner of Patents and Trademarks v. Diehr et al. - 450 US 175 (1981)*
> "When a claim containing a mathematical formula implements or applies the formula in a structure or process which, when considered as a whole, is performing a function which the patent laws were designed to protect (e.g., transforming or reducing an article to a different state or thing), then the claim satisfies § 101's requirements." (450 US 175, 176)

The differences between these two cases illustrate one of the basic precepts of software patenting. In *Gottschalk v. Benson* (1972) the Court ruled that software per-se is not patentable if it is merely another expression for a mathematical formula. However, in *Diamond v. Diehr* (1981) the Court clarified its position by stating that software is patentable if it is implemented as an element in a *process* or a *mechanism (apparatus)* that is otherwise allowed under 35 U.S.C. § 101.

These arguments are closely aligned with implementation of *mental processes* (also known as *mental steps* or *mental acts*), which are not patentable in either the United States or Europe. This

has special relevance in the field of information technology because many computing devices perform tasks that can be duplicated by the human mind, and vice-versa. For this reason, software patent claims in the US and PCT systems must rise above some purely abstract mental process and include some minimal physical device.

One of the earliest cases involving mental processes was in *Halliburton v. Walker*[13]. There, the Ninth Circuit Court of Appeals invalidated a patent claiming that the invention was novel only because it claimed a mental process.

> *Halliburton Oil Well Cementing Co. v. Walker* - 146 F.2d 817 (1944)
> "The court held this patent invalid for want of invention, finding that its novelty lay only in the performance of certain mental steps.
>
> This is a method patent. The steps involved are described in the claims by the following descriptive words "determining," "registering," "counting," "observing," "measuring," "comparing," "recording," "computing." There are 9 claims, all of which are in suit. Claim 2, copied below, may be taken as typical:
>
> > '2. The method of determining the unknown location of an obstruction in a well having a string of tubing therein, which consists in creating an acoustical impulse in the annular space between the tubing and the well casing to produce echoes from portions of the tubing string distinguishable from each other and from the echo from the unknown obstruction, observing the lapse of time between the arrival at a predetermined point of the echoes from successive portions of the tubing string to thereby determine the velocity of the pressure wave through the particular well under measurement, and measuring the lapse of time between the creation of the pressure impulse and the arrival at said predetermined point of the echo from the unknown obstruction.'
>
> In substance, Walker's method claimed here consists in setting down three knowns in a simple equation and from them determining or computing an unknown. The three knowns are: (a) the distance from the well head to the tubing catcher (for example); (b) the length of time it takes an echo to return from that obstruction; and (c) the length of time it takes an echo to return from the fluid surface. From these three knowns can then be determined the distance of the fluid surface from the well head.
>
> We think these mental steps, even if novel, are not patentable. Cf. Don Lee, Inc. v. Walker, 9 Cir., 61 F.2d 58. A patent may be obtained only upon an invention of a "new and useful art, machine, manufacture, or composition of matter." 35 U.S.C.A. § 31. As

[13] It should be noted that *Halliburton v. Walker* is probably better known in conjunction with an issue relating to means-plus-function claims. The case considered three U.S. patents assigned to Walker: 2,156,519; 2,209,944 and 2,161,733. The Ninth Circuit Court of Appeals, 146 F.2d 817, held that the '944 patent was not patentable on grounds that it employed mental steps; that the '519 patent was valid and infringed; and that the '733 patent was invalid due to prior art. However, on appeal the U.S. Supreme Court, 329 U.S. 1, reversed the decision of the lower court on the '519 patent, holding it invalid for failure of the claims to make a "full, clear, concise, and exact" description of the invention. The '519 decision is later associated with legislative (statutory) changes for means-plus-function claims in the Patent Act of 1952.

said in Cochrane v. Deener, 94 US 780, 788, 24 L.Ed. 139: "A process is a mode of treatment of certain materials to produce a given result. It is an act, or a series of acts, performed upon the subject-matter to be transformed and reduced to a different state or thing. If new and useful, it is just as patentable as a piece of machinery. In the language of the patent law, it is an art." Cf. also Corning v. Burden, 15 How. 252, 267, 14 L.Ed. 683.

It must be remembered that this is purely a method patent. No apparatus is claimed. Given an apparatus for initiating an impulse wave in a well and a means for differentiating between and for recording echoes returned from obstructions in it, anybody with a rudimentary knowledge of arithmetic will be able to do what Walker claims a monopoly of doing. If his method were patentable it seems to us that the patentee would have a monopoly much broader than would the patentee of a particular apparatus. To sum the matter up, we think that Walker's apparatus patent No. 2,156,519 gives him all the protection his inventive genius entitles him to." (146 F.2d 817, 821)

Within the context of US and European (PCT) patents, the difference between a mental act and a computing mechanism can be found by examining the applicant's specifications and claims, as described by Kutten:

Kutten - §3:15 What is not patentable: Mental steps.
"But the main case constantly cited for the proposition that mental steps are not patentable is *In re Abrams*. The claim dealt with a method of oil prospecting. Boreholes were sealed and the pressure therein reduced. The rates of pressure rise in the boreholes were then compared for anomalies, indicating petroleum deposits.

The PTO examiner rejected the claim as predominantly involving mental steps and his rejection was upheld by the Board of Appeal of the Patent Office. In its ruling, the court bluntly stated that mental steps were not patentable. It said, "Citation of authority in support of the principle that claims to mental concepts which constitute the very substance of an alleged invention are not patentable is unnecessary. It is self-evident that thought is not patentable." The court then went on to state two points:

(1) The question of whether mental steps or physical steps are involved is one of fact and not law; and

(2) The applicant's specifications will be examined as an aid in interpreting the steps of the claim." (p. 3-16, footnotes omitted)

The basis for excluding mental acts from patentability *In re Abrams*, stems from the notion that one cannot infringe on a patent merely by thinking about a protected idea. At first glance this

appears to be a fairly benign concept until one is faced with the alternative: that a software patent could be the ultimate ideological weapon of thought control[14].

> *Moy's Walker on Patents - § 5:26 -- Mental Steps --- Policy Rationales*
> "Yet another policy justification for the mental steps doctrine is the desire to avoid imposing infringement liability upon unassisted human thought. [FN19] The United States Patent and Trademark Office, in particular, has occasionally taken the position that larger public policy concerns prevent the grant of what are essentially ownership interests in human beings through the grant of patent rights. [FN20] According to this line of reasoning, issuance of patent rights in mental thought processes would be intolerable because it has the potential to impose infringement liability on activities that consist solely of the act of thinking." (p. 5-99) [FN19] "See, e.g. Application of Prater, 56 C.C.P.A. 1281, 415 F.2d 1393, 1400 n.20, 162 U.S.P.Q. (BNA) 541, 6 A.L.R. Fed. 134 (1969)." [FN20] "The USPTO has used this general reasoning to justify its position against the grant of patent right in genetically engineered human organisms. See § 5:16."

A similar situation exists in Europe. There, 'programs for computers' are not patentable under statute in the European Patent Convention[15] (*italics* added):

> *52(2) EPC – Patentable Inventions*
> "The following in particular shall not be regarded as inventions within the meaning of paragraph 1 (italics added):
>
> (a) discoveries, scientific theories and mathematical methods;
> (b) aesthetic creations;
> (c) schemes, rules and *methods for performing mental acts*, playing games or doing business, and *programs for computers*;
> (d) presentations of information."

14 George Orwell alludes to this concept in his book 1984, where the main character Winston Smith writes in his diary (Ch. 7): *"Freedom is the freedom to say that two plus two make four. If that is granted, all else follows."*

Orwell's reasoning behind his famous line has been the subject of much conjecture since he wrote the book in 1948. However, the book dealt with the role of information technologies controlled by a totalitarian regime. One could postulate that Orwell feared the relationship between computing technology, as embodied by a binary adder, and the ability to control thought itself by way of the patent process. He completed 1984 at a time when digital computing was being widely characterized in the popular press as an 'electronic brain', and four years after Halliburton Oil Well Cementing v. Walker, 146 F.2d 817 (1944), an early court case involving the invalidation of patent claims because mental steps were used. Similar fears are shared by contemporary thinkers too, such as W. Daniel Hillis:

> "…the true power of the computer is that it is capable of manipulating not just the expression of ideas but also the ideas themselves." (p. XI)
>
> - W. Daniel Hillis, The Pattern on the Stone

15 An overview of software patentability on a country-by-country basis is provided by *Lundberg, §11 Foreign Patent Prosecution (p. 375 – 421).*

EPC 52(2)(c) is often cited on the internet and in the popular press (especially among open source software advocates) as a European ban on software patents. Strictly speaking this is probably true, but a casual reading of the regulation does not provide the whole story.

> *Chartered Institute of Patent Agents - 18A.2.2 Types of computer-related inventions*
> "There are a very wide variety of different types of inventions associated with computer technology. Many arise in connection with computer hardware, for example in the digital electronics associated with the computer processor itself and the associated digital logic, data storage and communications devices and display or printing apparatus. Generally, these inventions present no special difficulties as far as obtaining patent protection is concerned.
>
> However, difficulties arise in obtaining patent protection for inventions embodied as computer programs; in other words where the only difference from the prior art is associated with an instruction program stored as a sequence of binary numbers in a suitable data storage device."

Like the United States, the Europeans do not accept the idea of an 'invention embodied as a computer program.' Instead, they require it be part of a 'technical device'. What appears to have emerged in European case law is that when software is equivalent to a mechanism, it is patentable.

> *Clark et al. - Part A 5. Validity, IV. Not an Invention: 5-235 Schemes and Programmes*
> "In determining whether a patent is for a computer program 'as such', it is the substance, rather than the form of the claims which is important. The mere fact that a computer program is involved in a process or forms part of an apparatus does not necessarily make the invention unpatentable. The fact that a process is implemented by a computer program does not make it unpatentable if it would be patentable if implemented mechanically. What is decisive is whether the claimed invention is new and non-obvious even if it were not implemented by a computer program. The approach now being taken by the Patent Office is that adopted by the court in CFPH." (p. 1150/8 - footnotes omitted)

This leads to an interesting question with regard to software mechanisms: at what point is the computer program itself differentiated from the mechanism which it describes? Again, the Europeans provide guidance on this matter by requiring that a patentable invention have a 'technical effect'.

> *Chartered Institute of Patent Agents -18A.5.2 Methods for performing mental acts.*
> "Interestingly, in support of their appeal, the appellants had compared their invention with a 'fly-by-wire' system which would render the process of flying an aircraft (which can be regarded as a mental act) a technical process having a technical effect. In response to this submission, the board stated that there were fundamental differences between flying an aircraft and programming a computer. In its view, flying an aircraft was a method of controlling a technical process performed by a technical device and was thus fundamentally technical, notwithstanding the fact that mental acts might be

involved. However, programming a computer was, in the board's view, of a basically mental nature. The board could see nothing in automating that process using a computer which could be regarded as a contribution to a field not excluded from patentability." (p. 18A/11)

This precedent suggests that a computer program itself is unpatentable because it is equivalent to a mental act under EPC 52(2), but that the fly-by-wire control system is patentable because it is a technical device with industrial application. Stated another way, the computer program portion of the fly-by-wire control system could not be patented, but that the combination of the computing device and other elements making up an aircraft control system, such as rudders and elevators, is patentable.

> *Moy's Walker on Patents - § 5:27 -- Mental Steps --- Exception for Ministerial Acts*
> "After these decisions, however, the various tribunals began to treat some recitations of mental process steps more favorably. In Ex parte McNabb [FN9] the USPTO's Board of Appeals distinguished between what it called 'purely' or interpretive mental acts and those mental acts that are merely ministerial. The claims at issue there involved a method of 'locating defects in the structure of approximately cylindrical wooden objects such as a tree, a telephone pole and the like.' They stated that a person would read film with a densitometer, plot optical densities, ascertain deviations, and orient the deviations. Despite this human involvement, however, the Board held that the steps were statutory subject matter." (p. 5-102, some footnotes omitted) [FN9] "Ex Parte McNabb and Voss, 127 U.S.P.Q. (BNA) 456, 1960 WL 7646 (Pat. & Trademark Office Bd. App. 1960)"

A Definition for 'Software Mechanism'

Within the context of clean room design practice, a software mechanism is a useful apparatus under the control of a software programmable electronic computing element. If it comprises statutory material then it would be patentable under Title 35 of the US Code.

> *Landis on Mechanics of Patent Claim … - §4:9 Claims to a Computer Program or …*
> "A computer program or software-related invention is an apparatus or process that employs a computer or that is adapted for employing a computer as an operative component of the device or process. In particular, it relates to an invention in computer software, the program that drives the computer to perform a series of steps. The invention lies in the series of steps, not in the program itself." (Landis, Rel. #5, 7/07; p. 4-20)

Various court decisions have led to the conclusion that software claims must be presented as a *process (method)* or a *mechanism (apparatus)* that would be otherwise patentable. This creates some confusion because software (defined here as 'machine instructions') has attributes of both in that it is essentially a machine process for converting one mathematical expression, or one idea, into another.

Landis on Mechanics of Patent Claim … - §7:2 Claiming Different Classes in One Patent
"An apparatus claim covers what a device is, while a method claim covers what a device does." (Landis, Rel. #6, 11/07; p. 7-4)

In all known situations known to this author a *generic software conversion process* is indistinguishable from a *mental process*. In order to distinguish between these two, a *mechanism* for implementing the software conversion process (i.e. a specific computing apparatus) must be defined in order to differentiate it from human thought. This is often referred to as a *software mechanism* or a *software defined mechanism*.

Patentable software mechanisms take two general forms:

1) *Software controlled apparatus.* Software can be used as a generic control element in an apparatus that encompasses other elements that make it statutorily patentable subject matter. For example, an aircraft fly-by-wire control system might include software running on a general purpose computer as a claimed element, but it must claim other physical elements as well. Those other elements must distinguish it from any information process, or its equivalent, which occurs naturally in the human body (augmented in some cases by pencil and paper markings).

2) *Computing apparatus.* Software can be applied to a computing apparatus so long as: (a) it produces tangible results and (b) that equivalent information processes do not occur naturally in the human body. However, within this context it is important to understand that a computing apparatus, by its very nature, involves a process for adding value to information. Thus, in this field of invention 'apparatus' and 'process' at some level of abstraction are inextricably intertwined[16].

   An electronic computing apparatus produces tangible results if it does useful work by adding value to information expressed as a physical quantity; it consumes energy in the form of electricity and expels waste in the form of heat. Information expressed as a physical quantity can include, but is not limited to, electrons measured as voltages or currents which represent discrete binary numbers or analog waveforms. In a computing apparatus these tangible quantities might or might not be physically transformed; but rather, the values they represent are transformed from one state to another.

   AT&T Corp. v. Excel Communications Inc. - 50 USPQ2d 1447 (1992)
   "Method claims containing mathematical algorithms need not involve physical transformation or conversion of subject matter from one state into another in order to constitute patentable subject matter under 35 U.S.C. § 101, since 'physical transformation' is merely one example of how mathematical algorithm may bring about useful application, not invariable requirement." (50 USPQ2d 1447, [3])

   "Whether process claim is directed to mathematical algorithm that is not applied to or limited by physical elements has little, if any, bearing on determining

[16] This is also why general purpose computing apparatus are generally called a 'processor' (or, alternatively, 'microprocessor').

whether claim encompasses statutory subject matter, since mere fact that claimed invention involves inputting, calculating, outputting, and storing numbers would not render invention nonstatutory subject matter unless its operation does not produce 'useful, concrete, and tangible result." (50 USPQ2d 1447, [4])

Application of Musgrave – 431 F.2d 882 (1970)
"Mere fact that steps involved in method claim are not physical acts applied to physical things does not, for patentability purposes, render claims non-statutory. 35 U.S.C.A. § 101" (431 F.2d 882, [1])

In Re Nuijten - 500 F.3d 1346 (Fed. Cir. 2007)
"The claims on appeal cover transitory electrical and electromagnetic signals propagating through some medium, such as wires, air, or a vacuum. Those types of signals are not encompassed by any of the four enumerated statutory categories: 'process, machine, manufacture, or composition of matter.'" (500 F.3d 1346, 1352).

Application of Mancy – 499 F.2d 1289 (1974)
"Under statute making unobvious condition for patentability, neither novel product made by process for which patent is sought, nor novel starting material used in such process can be treated as prior art." (499 F.2d 1289, [2])

The courts have provided neither exact nor unanimous guidance on what does and does not constitute mental steps. What appears to be at issue is that one person should not be able to infringe on another's intellectual property rights merely because that person exists in bodily form, and is given the natural ability to think and reason. Thus, it is assumed in this document that mental steps encompass all information processes or their equivalents, augmented at times by pencil and paper markings, which occur naturally in the human body. This includes the human nervous system, the endocrine system and that which takes place during DNA replication.

In Re Abrams - 188 F.2d 165 (1951).
"Citation of authority in support of the principle that claims to mental concepts which constitute the very substance of an alleged invention are not patentable is unnecessary. It is self-evident that thought is not patentable." (188 F.2d 165, 168)

Diamond v. Diehr et al. - 450 US 175 (1981)
"Excluded from patent protection are laws of nature, natural phenomena, and abstract ideas." (450 US 175, 185)

Landis on Mechanics of Patent Claim … - §1:3 The Statutory Classes
"If a claimed element, particularly in a product claim, is a person, rather than some man-made object, then the claim is invalid as indefinite, because the specification does not disclose a structure corresponding to the claimed function." (Landis, Rel. #6, 11/07; p. 1-4)

The CLASS Machine

The CLASS Machine, or *Configurable Logic Array SuperStructure*, defined below is a precise architectural style used for integrated and discrete electronic systems. Its main purpose is to alleviate patent infringement problems that abound in integrated circuit designs. It does this by clearly differentiating a public domain intellectual property space from a privately held protected space in terms of electronic system patents. This is accomplished by defining two levels of abstraction in electronic circuits:

1) A first level of abstraction where **software** expresses a portable front end design which can be protected under the Copyright Act, but which is non-statutory matter under the Patent Act (i.e. it can't be patented even if it's novel, non-obvious and so forth).

2) A second level of abstraction where a **software mechanism** encompasses a **front end design** in combination with a physical structure for an electronic system; the combined elements forming a patentable invention so long as it meets the requirements provided by 35 U.S.C. § 101 and elsewhere.

Silicore Corporation has abandoned all U.S. and International patent rights to the CLASS Machine as applied under 35 U.S.C. 102(c), and has assigned them to the public domain. Similarly, 'CLASS' and 'CLASS Machine' are former common law trademarks of Silicore Corporation that have been injected into the public domain.

Furthermore, the definition for the CLASS Machine is presented in the form of a patent claim under the pretense that the invention it expresses is believed to exist in the public domain. Prior art which meets the claim specification has been in public use for more than one year prior to the first public disclosure of the CLASS Machine definition, and is therefore unpatentable.

> *35 U.S.C. 102(b) - Conditions for patentability; novelty and loss of right to patent.*
> "A person shall be entitled to a patent unless — … (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of the application for patent in the United States, …"
>
> *Honeywell Inc. v. Sperry Rand Corporation et al. - 180 USPQ 673 (1973)*
> 13.34.13 On February 28, 1956, a conference was held between Thibodeau and McGee (of Ordnance), and Boberg and Hogan (attorneys for IBM), in which it was pointed out by IBM that, if a dedication to the public of the inventions claimed in the ENIAC application because of public use could be shown, the claims being contested in the IBM-Sperry Rand interferences would fall into the public domain." (180 USPQ 673, 719)

It is defined[17] thusly:

> **CLASS Machine**
>
> A **software mechanism** comprising:
>
> a **front end design** for a useful electronic system;
>
> at least one conversion means whereby said **front end design** is adapted to a first executable form and a second executable form;
>
> a first circuit topology being selected from a group consisting of **ASIC**, **FPGA**, **full custom device** and **discrete circuit**;
>
> a second circuit topology being selected from a group consisting of **ASIC**, **FPGA**, **full custom device** and **discrete circuit**;
>
> said first executable form being operable with said first circuit topology, and said second executable form being operable with said second circuit topology;
>
> said first executable form being inoperable with said second circuit topology, and said second executable form being inoperable with said first circuit topology.
>
> Ω

For example, a CLASS Machine comprised by: a front end design defined as a Silicore SLC1657 microcontroller (a computing apparatus in the form of an an 8-bit RISC processor with a Harvard Architecture), is synthesized and routed to run on: (a) a Xilinx Virtex II FPGA, and (b) an Altera FLEX 10KE FPGA.

In another example, a CLASS Machine comprised by: a front end design defined as a Dillon Engineering FFT/IFFT IP Core (a computing apparatus in the form of a Digital Signal Processor (DSP) implemented as a massively parallel butterfly architecture), is synthesized to run on: (a) a Xilinx Virtex II FPGA, and (b) a Xilinx Virtex 5 FPGA.

The CLASS Machine definition assumes that portable design structures are used. These must be available without license restrictions that would prevent the migration of a front end design between a first circuit topology and a second circuit topology. For example, a proprietary microprocessor design might be used which, under terms of its license agreement, could only be used in conjunction with specific software components made by the licensor, or implemented on silicon produced at their foundry. This makes it impossible to move the design from one platform to another, and so is not portable.

An example of a portable design structure available without license restrictions is the WISHBONE System-on-Chip (SoC) Interconnection for Portable IP Cores, Rev. B.2, which is incorporated herein by reference.

[17] **Bold Face** type indicates defined elements in the Glossary.

WISHBONE SoC Interconnection for Portable IP Cores - Rev. B.2, § 1.2
"A further objective of the specification is to create a portable interface that is independent of the underlying semiconductor technology. For example, the interconnect must be capable of working with both FPGA and ASIC hardware target devices." (p. 10)

The objectives of the CLASS Machine assume that software alone can't be patented because it is non-statutory subject matter[18] established under 35 USC § 101 and under a large body of case law precedent. It is patentable only when it is operated as a *software mechanism* or a *software defined mechanism*. Stated another way, software in the abstract can be thought of as a representation of a number, a series of numbers or a mathematical expression. It does not produce a tangible result. Only when it is associated with some physical device or process can it express a tangible quantity, such as a mechanism for producing a series of voltages or currents that represent binary numbers or analog waveforms.

This approach is taken mainly as a defensive measure for open source designs. Other industry segments that develop and use open source software have been plagued by software patent problems, both real and frivolous (e.g. GNU/Linux™ operating system). Since the front end design for a CLASS Machine by definition is expressed as non-statutory elements it cannot be patented and therefore cannot infringe on the patent rights of others. However, it can be freely traded on the internet and elsewhere so long as the terms of its copyright license is met. Furthermore, the definition firmly establishes that the design can be used in both semiconductor and discrete systems. This eliminates liability as a contributory infringer of an integrated circuit patent so long as there are non-infringing uses for the design.

CLASS Machine Examples

This section will provide a detailed CLASS Machine example using the Silicore SLC1657 microprocessor. A copy of the SLC1657 8-Bit RISC uC Core Technical Reference Manual, (available under a public, GPL license) along with its software source codes, is incorporated by reference with this guide. It is an adaptation of an earlier product called the SLC1655, a scaled down version of the same design. That earlier version was completed in 1998 and licensed through Lucent Technologies and others. It embodied a substantial amount of original and creative work, and at that time was the first portable, commercial microprocessor design capable of operating on FPGA parts.

[18] Software as non-statutory subject matter includes: mathematical algorithms, mental steps, printed matter, factual compilations and so forth. See Moy § 5:35.

Diamond, Commissioner of Patents and Trademarks v. Diehr et al. - 450 US 175 (1981)
"Excluded from patent protection are laws of nature, natural phenomena, and abstract ideas." (450 US 175, 185)

In Re Nuijten - 500 F.3d 1346 (Fed. Cir. 2007)
"The claims on appeal cover transitory electrical and electromagnetic signals propagating through some medium, such as wires, air, or a vacuum. Those types of signals are not encompassed by any of the four enumerated statutory categories: 'process, machine, manufacture, or composition of matter.'" (500 F.3d 1346, 1352).

The Silicore SLC1657 microprocessor[19] is written as a soft, portable core in the VHDL hardware description language. This means that the VHDL software language statements that describe it can be implemented (synthesized and routed) on a variety of programmable, application specific and custom semiconductor devices.

Table 1 shows the various CLASS Machine attributes that are present in the SLC1657 microprocessor. There, a portable and synthesizable front end design named TOPLOGIC.VHD is converted to three executable forms of FPGA. Each of these attributes is described in detail in the SLC1657 8-Bit RISC uC Core Technical Reference Manual, as well as by visual inspection of the VHDL source code.

[19] The SLC1657 is software compatible with a 1970's era microprocessor made by General Instrument, and which is now offered as the PIC16C57 made by Microchip Technology, Inc. (Chandler, AZ). However, the internal operation of the SLC1657 is quite likely very different than the offering by Microchip Technology, Inc.

Table 1. Silicore SLC1657 CLASS Machine Example			
CLASS Machine Attribute(s)	**First Executable Form**	**Second Executable Form**	**Third Executable Form**
Front End Design	TOPLOGIC.VHD		
Conversion Means	*Logical File(s):* XSP2EVAL.VHD *Synthesis tool(s):* Protel PeakVHDL *Router tool(s):* Xilinx Alliance	*Logical File(s):* AF10EVAL.VHD *Synthesis tool(s):* Protel PeakVHDL *Router tool(s):* Altera MAX+ II	*Logical File(s):* AGO3EVAL.VHD *Synthesis tool(s):* Protel PeakVHDL *Router tool(s):* Agere Foundry
Circuit Topology	FPGA	FPGA	FPGA
Executable Form	Xilinx Spartan II Configuration Bitstream	Altera FLEX 10KE Configuration Bitstream	Agere ORCA 3L Configuration Bitstream
Notes	Bitstream is not operable with other executable forms. Software at a higher level of abstraction also runs on Microchip PIC16C1657. Example: 1657DEMO.SRC	Bitstream is not operable with other executable forms. Software at a higher level of abstraction also runs on Microchip PIC16C1657. Example: 1657DEMO.SRC	Bitstream is not operable with other executable forms. Software at a higher level of abstraction also runs on Microchip PIC16C1657. Example: 1657DEMO.SRC

CLASS Machine, Non-equivalent Examples

There are a number of other computing apparatus that perform functions which are similar to the SLC1657 microprocessor example cited above, but which do not conform to the specification for a CLASS Machine. These are called *'non-equivalent examples'* within the context of the present discussion.

As an aide to the present discussion, a set of hypothetical claims were created that define both a *front end design* and a *software mechanism* that correspond to the same elements in a SLC1657 CLASS Machine. For the moment we will assume that the core-plus-FPGA combination is patentable subject matter (e.g. they have not been publicly displayed, are novel, non-obvious, etc.). The first independent claim describes a front end design, and the second dependant claim creates a mechanism that conforms to the CLASS Machine definition:

1. A processor comprising:

a reduced instruction set computer (RISC) with a Harvard Architecture including an instruction pipeline respectively allocated to a single instruction thread, the instruction thread capable of transporting 12-bit instruction words from a single-word instruction cache;
a plurality of functional modules controlled by the instruction pipeline, the functional modules including at least one 8-bit input port, at least one 8-bit output port, an 8-bit accumulator register and an arithmetic logic unit (ALU) capable of adding two 8-bit binary numbers;
first, second and third 12-bit machine instruction words directing the control of said functional modules, the instructions being fetched from said cache in sequential order so as to form a useful program, the first instruction causing a first arbitrary binary number to be loaded into said accumulator register, the second instruction causing said ALU to add a second arbitrary binary number located at said input port to said accumulator register and then placing the result back into the accumulator, the third instruction causing the value in said accumulator to be moved to said output port.

2. The processor according to Claim 1 implemented on an FPGA integrated circuit selected from a group consisting of Xilinx Spartan II, Altera FLEX 10KE and Agere ORCA 3L.

A further aide to the present discussion is shown in Figure 3. This is a software program that operates at a level of abstraction above the Turing Machine processor defined by the SLC1657 microcontroller. This program reads an input port (PORT0), moves the value to an accumulator, adds two to that value, and outputs the result to an output port (PORT1) … in this case calculating the mathematical expression '2 + 2 = 4'. The processor running this program conforms to the hypothetical Claim 1 specification, but it does contain elements which conform to Claim 2.

Corning Glass Works v. Sumitomo Electric USA, Inc. - 868 F.2d 1251 (Fed. Cir. 1989)
"Anticipation requires that every limitation of patent claim in issue be disclosed, either expressly or under principles of inherency, in single prior art reference." (868 F.2d 1251, [1])

PROGRAMMING			RESPONSE		
INST. #	SLC1657 INSTRUCTION	PORT0 INPORT	PORT1 OUTPORT	INTERNAL ACCUMULATOR	COMMENTS
0	NOP	0x02	----	----	No Operation
1	MOVI 0x02	0x02	----	0x02	Load ACCUM with 0x02
2	ADD 0x05,A	0x02	----	0x04	Add PORT0 to ACCUM
3	MOVA 0x06	0x02	0x04	0x04	Send result to PORT1

Figure 3. SLC1657 program to perform the operation 2 + 2 = 4.

Now that precise definitions exist for the SLC1657 CLASS Machine example, consider the following examples of computing apparatus that perform similar, non-equivalent functions:

- *Original device.* An original device similar to the SLC1657 CLASS Machine is the PIC16C57 microcontroller made by Microchip Technology, Inc. (Chandler, AZ). That device is anticipated by hypothetical Claim 1, but not by Claim 2 (because it is not implemented on an FPGA device).

  Also note that with respect to the CLASS Machine definition, the Silicore SLC1657 and the Microchip PIC16C57 utilize different front end designs.

- *Assembly Language Simulator*. A simulator for both the Silicore SLC1657 and the Microchip PIC16C57 is the *PIC16 Assembly Language Simulator* made by Parallax, Inc. (Rocklin, CA). It is anticipated by hypothetical Claim 1, but not by Claim 2 (because it is implemented on a general purpose personal computer, and is in all likelihood not implemented on an FPGA device).

- *Emulator.* An emulator for the SLC1657 CLASS Machine is provided by the MPLAB® ICE 2000 made by Microchip Technology, Inc. (Chandler, AZ). It is anticipated by hypothetical Claim 1, but not by Claim 2 (because it is implemented on a general purpose personal computer and/or an identical Microchip PIC16C57, and is in all likelihood not implemented on an FPGA device).

- *Test Bench.* A VHDL test bench (TSTBENCH.VHD) is available for the SLC1657 TOPLOGIC.VHD entity. It is anticipated by hypothetical Claim 1, but not by Claim 2 (because it is implemented on a general purpose personal computer, and is in all

likelihood not implemented on an FPGA device). The test bench operates in conjunction with a VHDL simulator (different than the assembly language simulator mentioned above), and is usually operated in one of two ways:

  - Textual statements that indicate whether the core is functioning as expected[20].

  - Timing waveforms (diagrams). This may include state diagrams or a detailed timing analysis. Graphical, simulated, timing waveforms can also be regarded as a basic input/output system for the core.

- *Truth Tables.* Test vector files (e.g. VECTADDR.TXT) are also available for the SLC1657 core. These exhibit equivalent behavior to the SLC1657 core, but are expressed as a logical truth table instead of VHDL code. This allows the circuit designer to cross-check the behavior defined by the synthesizable VHDL code with a behavioral model that conforms to his or her expectations. Stated another way, the test vectors treat the core as a 'black box' with a transfer function determined by the internal VHDL coding. The truth tables are anticipated by hypothetical Claim 1, but not by Claim 2 (because it is implemented on a general purpose personal computer, and is in all likelihood not implemented on an FPGA device). The truth tables are used in two ways:

  - As a simulation they are used to exercise TOPLOGIC.VHD by stimulating its inputs and verifying its outputs. This is generally done with an ANSI compatible VHDL simulator.

  - As an alternative expression for the TOPLOGIC.VHD entity they define the behavior of the core. In this capacity they can be regarded as an equivalent expression to the VHDL code.

  Note that these truth tables are used in conjunction with the test bench described above. However, they are listed separately because the truth tables define equivalent behavior, but must be run in conjunction with the VHDL test bench.

- *Mental Process Augmented by Pad and Pencil Markings.* Hypothetical Claim 1 can be implemented by a mental processor augmented by pad and pencil markings. This method is not anticipated by Claim 2 because the human mind is not implemented with an FPGA. Figure 4 shows an example that reads an input port (PORT0), moves the value to an accumulator, adds two to that value, and outputs the result to an output port (PORT1) … in this case calculating the mathematical expression '2 + 2 = 4'.

[20] The statements in this example only test the input and output conditions of the core. However, in other examples (such as those using System Verilog), internal logic states of the core can also be tested, resulting in a more robust simulation.

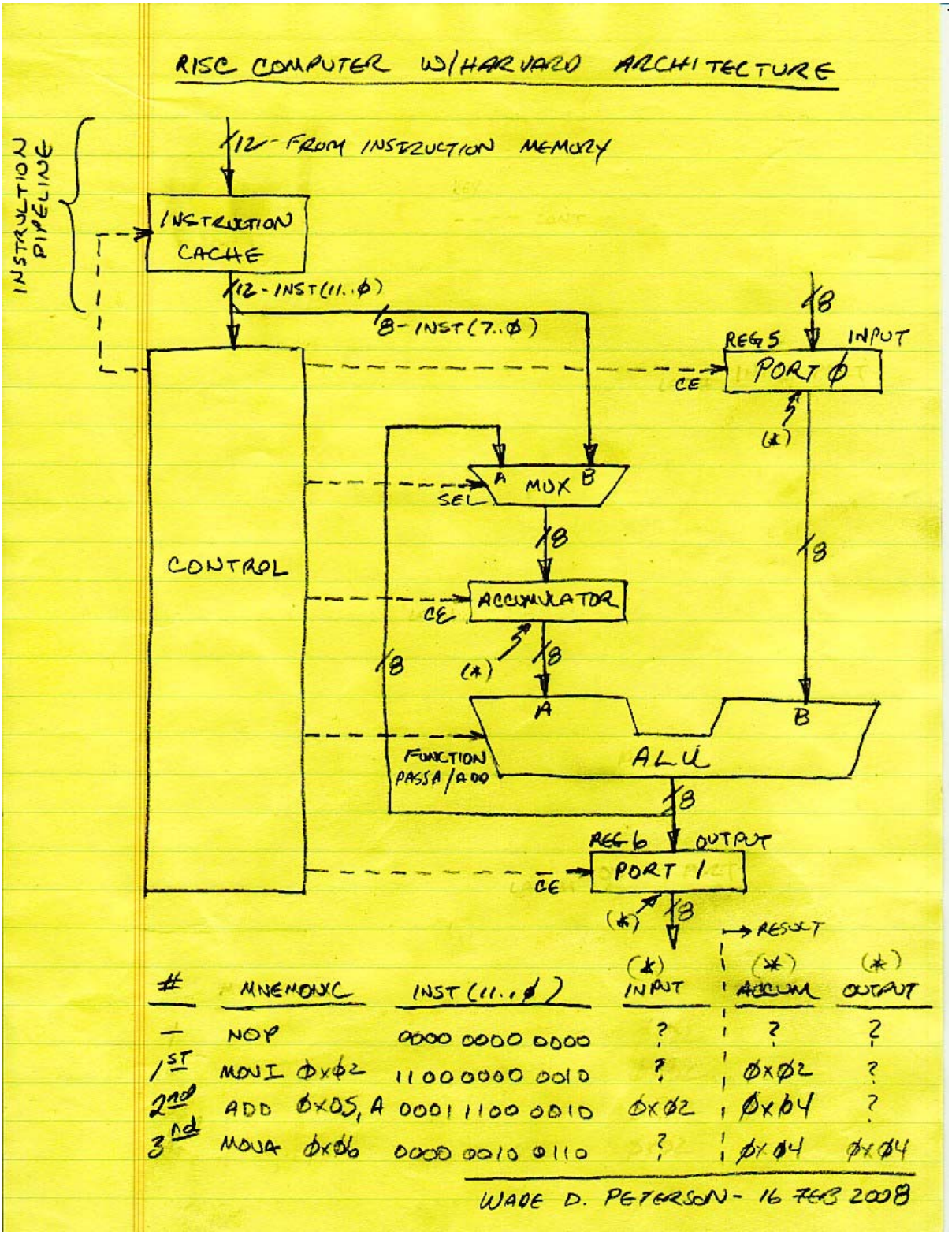


Figure 4. Paper and pencil markings augmenting a mental processor that performs the operation 2 + 2 = 4.

Contributory Infringement

While non-statutory material expressed by a front end design is not patentable, it should not be assumed that it can't infringe on the patent right of others. This possibility occurs under a set of carefully defined conditions known as *contributory infringement*, which are outlined in 35 U.S.C. § 271.

> *35 U.S.C. § 271(c) - Infringement of patent*
> "Whoever offers to sell or sells within the United States or imports into the United States a component of a patented machine, manufacture, combination or composition, or a material or apparatus for use in practicing a patented process, constituting a material part of the invention, knowing the same to be especially made or especially adapted for use in an infringement of such patent, and not a staple article or commodity of commerce suitable for substantial noninfringing use, shall be liable as a contributory infringer."

This same section of the patent code also covers carefully defined situations where contributory infringement occurs outside of the United States. This section was reviewed by the US Supreme Court in 2007 in Microsoft Corporation v. AT&T Corporation. There, a patent holder for a recorded speech process (AT&T) brought action against a software manufacturer (Microsoft) for infringement on grounds that it was liable for foreign installations of its software.

> *Microsoft Corporation v. AT&T Corporation -127 S.Ct. 1746 (2007)*
> "A copy of computer software, not the software in the abstract, qualifies as a 'component' within meaning of section of the Patent Act providing that patent infringement occurs when one 'supplies … from the United States,' for 'combination' abroad, a patented invention's 'components.' 35 U.S.C.A. § 271 (f)(1)" (127 S.Ct. 1746, [2])
>
> "A copy of Windows, not Windows in the abstract, qualifies as a 'component' under § 271(f)." (p. 1748)

Claim Preamble

The hypothetical claims above also demonstrate another problem with patents for software defined mechanisms. That is, that the Applicant may try to over claim their invention by using an overly broad claim preamble. In general, the purpose of the preamble[21] is to define the broad scope of the invention, but not to recite explicit limitations on the claimed invention.

> *Landis - § 2:4 Preamble*
> "Claims should have 'preambles', or introductory statements, the purposes of which are to indicate the statutory class of the claim (often by implication from the words in the preamble) and to name or define the thing that is to be claimed. It defines the field of the invention claimed. Preambles may be quite long or very short, depending on the type of claim one is using, but a shorter preamble is preferred." (p. 2-4)

[21] Also see: *MPEP §2111.02 - Effect of Preamble*

In the hypothetical Claim 1 (above) this might mean changing the preamble from "A *processor* comprising" to "An *integrated circuit device* comprising". At some level of abstraction this may appear to change the scope of the claimed invention from the field of 'all things that process' to 'all things on an integrated circuit'. However, providing a limiting element in the preamble has a number of problems associated with it as well.

> *Corning Glass Works v. Sumitomo Elec. USA, Inc. - 868 F.2d 1251 (Fed. Cir. 1989)*
> "No litmus test can be given with respect to when the introductory words of a claim, the preamble, constitute a statement of purpose for a device or are, in themselves, structural limitations of a claim. To say that a preamble is a limitation if it gives 'meaning to the claim' may merely state the problem rather than lead one to an answer. The effect preamble language should be given can be resolved only on review of the entirety of the patent to gain an understanding of what the inventors actually invented and intended to encompass by the claim." (868 F.2d 1251, [2])

One of the guidelines used to interpret preamble language is called the *'giving life, meaning and vitality' rule*. This gives the claim interpreter at least some hope of determining whether or not the preamble language constitutes a limitation on a claimed invention.

> *Application of Rockwell – 150 F.2d 560 (US CCPA 1945)*
> "The general rule is that the introductory clause of a claim which states only the environment, intended use or purpose of the structure later recited in the claim is not a limitation on the subject matter. This, like most rules, is subject to exception. An examination of the authorities discloses that the exception governs when the introductory clause is that portion of the claim which gives meaning and vitality to it." (*150 F.2d 560, 562*)

The interpretation of claim preamble limitations with such broad scope tends to rest on questions of abstraction, obviousness and the doctrine of equivalents.

> *Application of Musgrave - 431 F.2d 882 (1970)*
> "The preamble of claim 2 refers to 'signals * * * from seismic detection stations' so that 'signals' here could have only the meaning of the output of a device which senses waves transmitted through the earth. Since these signals are not specified to be electrical, mechanical or optical or to denote any other physical state or a material or thing, the sole connotation here would be that 'signals' (i.e. without a modifier) are synonymous with information or data and are an abstraction and intangible." (431 F.2d 882, 886)

Claim Preamble and Tests for Obviousness

The CLASS Machine definition overcomes the aforementioned claim preamble limitations by limiting its scope to the field of all possible 'software mechanisms', and then including a series of specific mechanisms for implementing a front end design in the body of the claim. This is accomplished by specifying a Markush group of equivalent alternatives, consisting of **ASIC**, **FPGA**, **full custom device** and **discrete circuit**. In terms of a *portable* front end design, the first three alternatives are mechanisms based upon single integrated circuit devices, and the final

alternative is a mechanism based upon a plurality of smaller components called a discrete circuit (which may include a subset of integrated circuits).

One skilled in the art of electronic circuit design might argue that each of these alternatives has its own advantages and disadvantages, and thus is patentable on its own merits. For example, the FPGA alternative is field programmable and can be rapidly changed, whereas the ASIC alternative is generally less expensive in large quantities and operates faster. Such combinations would assume that the inventors actually intended to encompass something that is field programmable, cheaper or faster.

In another example the ASIC, FPGA and full custom devices are integrated onto a single chip, whereas the discrete circuit uses a plurality of components. Highly integrated single chip solutions are generally less expensive to fabricate and are more reliable (smaller, and fewer connection points which may fail due to shock or vibration), but multi device solutions are sometimes capable of dissipating more heat (because they have a larger surface area, and therefore run cooler given the same power levels). Such combinations might be patentable so long as the inventors actually intended to encompass something that is less expensive to fabricate, is more reliable or is capable of dissipating more heat.

In these cases the inventor must also disclose the best mode for practicing the invention. If they merely limited the scope of the invention using the preamble, but do not provide any understanding of what they actually invented and intended to encompass by the claim, then it must be assumed that the all of the Markush alternatives within CLASS Machine are equivalent, obvious, and not patentable.

> *KSR International Co. v. Teleflex Inc. et al. – 127 S.Ct. 1727 (2007)*
> "Patent claiming the combination of elements of prior art is obvious if the improvement is no more that the predictable use of prior art elements according to their established functions. 35 U.S.C.A. § 103" (127 S.Ct. 1727, [1])
>
> "In determining whether patent combining known elements is obvious, question is not whether the combination was obvious to the patentee but whether the combination was obvious to a person with ordinary skill in the art; under correct analysis, any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide reason for combining the elements in the manner claimed. 35 U.S.C.A. § 103" (127 S.Ct. 1727, [5])

> *Chiba et al., US Pat. No. 3,818,252 - UNIVERSAL LOGICAL INTEGRATED CIRCUIT*
> "A principal object of the present invention is to provide a universal logical integrated circuit manufacturable at a very low cost. Another object of the invention is to provide a simple and small-size universal logical integrated circuit. Briefly, the universal logical integrated circuit of the present invention uses fixed memory elements on which the memory contents are programmable either permanently or semipermanently, thus making the memory elements possess associative functions." (Col. 2, line 26)

Beaulieu et al., US Pat. No. 3,851,221 - INTEGRATED CIRCUIT PACKAGE
"It is still another object of the invention to provide an integrated circuit package suitable for containing both a processing unit and a memory in integrated circuit form for a data processing system." (Col. 1, line 58)

Mallon, US Pat. No. 3,964,087 - RESISTOR NETWORK FOR INTEGRATED CIRCUIT
"It is a major object of the invention to provide a resistor network package affording greater packaging density, minimizing of electrical lead lengths, minimum conductor length dimensions from the voltage source to the resistors in the package, no requirements for additional sockets, wires or holes in a circuit board, and significant assembly and installation cost reduction." (Col. 1, line 24)

Pastoriza, US Pat. No. 3,978,473 - INTEGRATED-CIRCUIT DIGITAL-TO-ANALOG CONVERTER
"With the development of integrated-circuit (IC) technology, efforts have been made to produce D-A converters in IC form, seeking the benefits of improved reliability, small size, low power consumption, and low production costs." (Col. 1, line 27)

Archey et al., US Pat. No. 3,999,105 - LIQUID ENCAPSULATED INTEGRATED CIRCUIT PACKAGE
"It is the further object of the invention to provide a package for an integrated circuit in which the transfer of heat from the wafer to the exterior of the package is significantly improved. It is yet another object of the invention to provide a semiconductor wafer package constructed to minimize the thermal expansion mismatch stresses between the semiconductor wafer and the carrier for the wafer; which carrier also supports the necessary electrical interconnections between the wafer and the package exterior. It is still another object of the invention to provide a package which is easily constructed and which can be electrically tested at each level of the construction. It is still a further object of the invention to provide a semiconductor package which incorporates semiconductor memory wafers together with the necessary logic functions to provide a complete computer basic system module. It is yet a further object of the invention to provide a basic system module in which the density is maximized and the signal path length is minimized. It is another object of the invention to provide a package which can be easily scaled up or down to provide greater or lesser capacity without losing any of the benefits of the package." (Col. 1, line 50)

Yasuda et al., US Pat. No. 4,042,861 - MOUNTING ARRANGEMENT FOR AN INTEGRATED CIRCUIT UNIT IN AN ELECTRONIC DIGITAL WATCH
"An object of the present invention is to provide a full electronic digital watch movement which is fitted with an IC-block assembly capable of satisfying the afore-mentioned five requirements. [Afore-mentioned five requirements: 1. easiness in manufacture; 2. reliability in operation; 3. capability of providing a large number of connecting terminal

means; 4. small overall dimensions; and 5. easiness in electrical connection of said numerous terminal means with other related and cooperating terminal or other means]. A further object is to provide a watch movement of the above kind which is fitted with an IC-block assembly highly stable against outside mechanical shocks." (Col. 2, line 51 – text in brackets inserted from specification)

Ootsuka et al., US Pat. No. 6,762,444 - SEMICONDUCTOR INTEGRATED CIRCUIT DEVICE AND A METHOD OF MANUFACTURING THE SAME

"A problem associated with a soft error produced due to an alpha ray arises in each memory cell of such a memory. The soft error produced due to the alpha ray is a phenomenon in which an alpha ray contained in external cosmic radiation, or an alpha ray emitted from a radioactive atom contained in a package material for an LSI enters a memory cell and damages or corrupts information stored in the memory cell." (Col. 1, line 24)

"An object of the present invention is to provide a semiconductor integrated circuit device, e.g., a high-performance semiconductor integrated circuit device which reduces a soft error produced in each memory cell of an SRAM." (Col. 2, line 4)

Software and the Equivalency of Expressed Elements

Any given front end design can be expressed as a plurality of equivalent design elements depending upon: (a) the type and brand of target device (e.g. various brands of FPGA), and (b) the operating characteristics of the tools that convert higher level (more abstract) statements into low-level switching and routing devices.

For example, consider the equivalent expressions for a 'NOT' gate and an 'AND' gate in Figure 5, and the 2-input multiplexer shown in Figure 6. In each of these cases a plurality of equivalent Boolean expressions is presented. These may include a VHDL software statement, a schematic diagram showing a transistor arrangement, one or more schematic symbols and a look-up table (which is commonly referred to as a 'LUT' in FPGA nomenclature).

Each of these logical expressions is converted into some underlying mechanism for carrying out the Boolean logic expression. This conversion can be accomplished by means of design entry, software synthesis, placement and routing tools or hand wiring of discrete components. The exact way to carry out each function depends upon the process used and the underlying requirements for implementing them. For example, consider the following example conversions:

- A *first conversion* might create a first transistor topology and a first interconnection structure using a silicon integrated circuit substrate.

- A *second conversion* may create a second transistor topology and a second interconnection structure using a gallium arsenide (GaAs) integrated circuit substrate.

- A *third conversion* may program a bit pattern within a look-up table memory.
- A *fourth conversion* may create discrete gate functions on a printed wiring board.
- A *fifth conversion* may create a structure of mechanical relays and discrete interconnection wires.

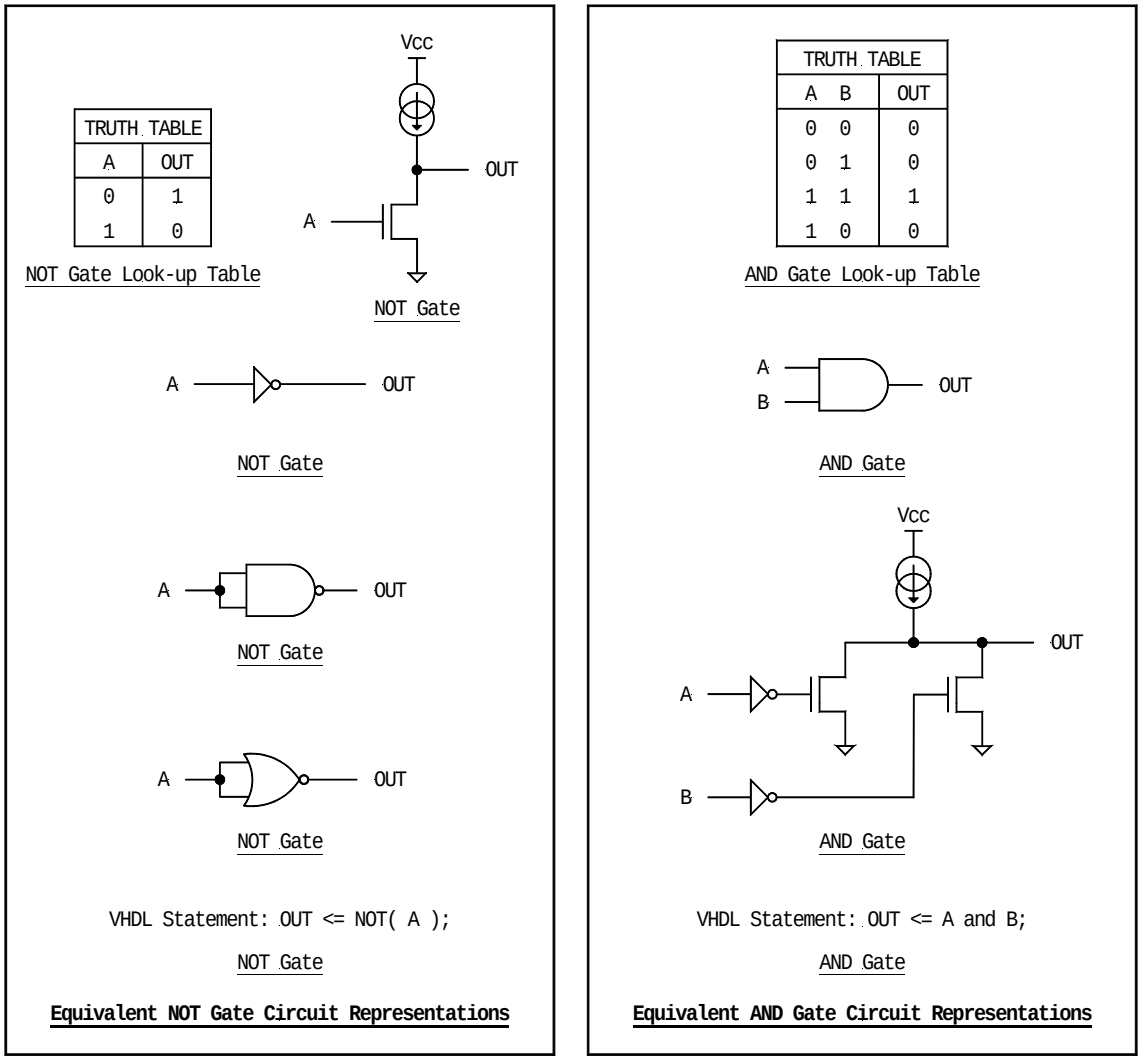


Figure 5. Equivalent expressions for 'NOT' and 'AND' gates.

It should be noted that the equivalency of these methods is limited to their logical function alone. In many cases one particular conversion has distinct advantages over another. Some may provide benefits in terms of speed (the time delay required to carry out the logical function), power consumption, re-programmability, cost, space radiation hardening (for use in satellites, interplanetary probes, etc.) and so forth.

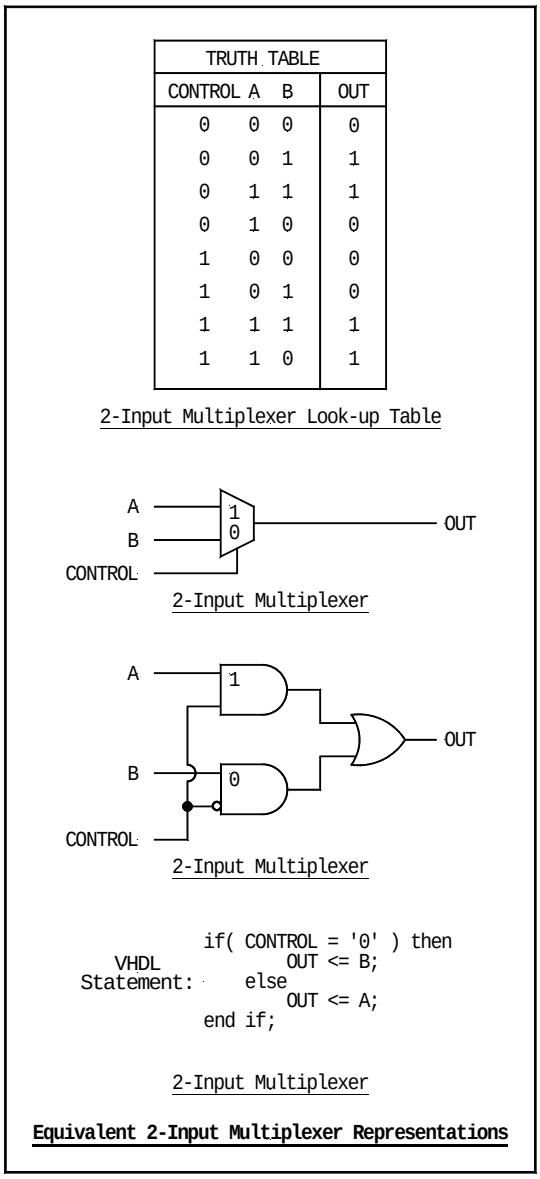


Figure 6. Equivalent expressions for a 2-input multiplexer.

However, from the perspective of the front end design in the CLASS Machine, all of the conversions in this example produce equivalent Boolean logical expressions. In the CLASS Machine definition this conversion made through by process that is expressed as a means-plus-function statement, thusly:

> "at least one conversion means whereby said front end design is adapted to a first executable form and a second executable form;"

Landis on Mechanics of Patent Claim … - §7:2 Claiming Different Classes in One Patent
"An apparatus claim covers what a device is, while a method claim covers what a device does. They are different. Avoid method limits in a product claim, except in the correct way of describing some element for performing a particular function and in a 'whereby' (necessary result of the structure or process claimed) clause. Avoid product limits in a method claim, except where the method involves a workpiece which is being described or the method describes operating some means to act on the workpiece." (Landis, Rel. #6, 11/07; p. 7-5 – footnotes omitted)

In Re Nuijten - 500 F.3d 1346 (Fed. Cir. 2007)
"Regardless of how broadly or narrowly one construes a product-by-process claim, it is clear that such claims are always to a product, not a process." (500 F.3d 1346, 1355 – citing *SmithKline Beecham Corp. v. Apotex Corp.*, 439 F.3d 1312 at 1317).

It should be noted that these examples relate to digital circuits. However, it should be obvious to one skilled in the art that similar equivalences also exist in analog circuits. For example, an operational amplifier can be formed from integrated MOS transistors, discrete bipolar transistors or from vacuum (electron) tube amplifiers. Similarly, a resistor can be expressed as a bulk carbon element, a thin-film element or a semiconductor element.

The conversion means can take the form of a logical file wrapper, a synthesis tool, a router tool[22], a parametric core generator or a mental process augmented by pencil and paper markings. Each of these may operate independently or in combination with one or more of the others (e.g. file-wrapper + synthesis + router). As such, the term 'conversion means' should be interpreted as an adaptive element, regardless of whether it takes the form of a machine, a process or a non-statutory claim element. For example, the conversion means in the SLC1657 example above includes a file wrapper called 'XSP2EVAL.VHD' whose purpose is to logically convert the 'TOPLOGIC.VHD' entity to the Xilinx FPGA, and so more closely resembles a machine. However, the synthesis and router tools involve software batch processes that are used to convert software into an executable form. In either case the purpose of 'conversion means' is to adapt the front end design to an executable form.

WISHBONE SoC Interconnection for Portable IP Cores - Rev. B.2 (Glossary of Terms)
"Wrapper - A circuit element that converts a non-WISHBONE IP Core into a WISHBONE compatible IP Core. For example, consider a 16-byte synchronous memory primitive that is provided by an IC vendor. The memory primitive can be made into a WISHBONE compatible SLAVE by layering a circuit over the memory primitive, thereby creating a WISHBONE compatible SLAVE. A wrapper is analogous to a technique used to convert software written in 'C' to that written in 'C++'." (p. 25)

[22] Specific examples of synthesis and routing software packages are: Quartus II made by Altera Corporation (San Jose, CA – USA), ispLEVER made by Lattice Semiconductor Corporation (Hillsboro, OR – USA) or the Integrated Software Environment (ISE) made by Xilinx Inc. (San Jose, CA – USA). However, it should be noted that many equivalent solutions to these products, or subsets of these products (e.g. synthesis tools), exist elsewhere in the industry.

> "Parametric Core Generator - A software tool used for the generation of IP cores based on input parameters. One example of a parametric core generator is a DSP filter generator. These are programs that create lowpass, bandpass and highpass DSP filters. The parameters for the filter are provided by the user, which causes the program to produce the digital filter as a VHDL or Verilog hardware description. Parametric core generators can also be used create WISHBONE interconnections." (p. 21)

In some cases the software tool used by the 'conversion means' is capable of implementing a plurality of adaptations depending upon some implementation strategy. For example, a Xilinx FPGA that has three-state interconnection paths can implement a multiplexer either as three-state wire-or logic elements or as a Boolean logic expression like the one shown in Figure 6. This selection can be made by way of a manual (programmable) software switch, or some optimization strategy based upon maximum speed or minimum die size.

Other types of equivalency are also possible, and are well known to those skilled in the art of logic design. For example, DeMorgan's laws establish equivalent logical functions based upon intermediate 'AND' or 'OR' gates. When expressed as pseudo-code:

```
not(A and B)  <= IS EQUIVLENT TO =>  not(A) or  not(B)
not(A or  B)  <= IS EQUIVLENT TO =>  not(A) and not(B)
```

The conversion means can equivalently be applied to a mental process augmented by pencil and paper markings (see: *Application of Prater - 415 F.2d 1393, 1398, 1404*). For example, the conversion of a schematic diagram to discrete printed wiring board artwork (ready for fabrication) can be accomplished in this way.

The conversion means also means that in some cases the different Markush alternative selected in the CLASS Machine definition will result in different solutions. The software tools which make up the conversion means may optimize the logical function for a particular type and brand of device, usually with regard to either speed or circuit size.

Another type of conversion equivalency relates to the level of abstraction inherent within the software language. For example, very different VHDL, Verilog and 'C' language statements can represent the same binary adder[23] when synthesized on an FPGA, ASIC, full custom device or discrete circuit. 'C' language statements at a very high level of abstraction can also perform binary addition on general purpose CISC or RISC microprocessors.

Software and the Equivalency of Claimed Elements

The US Patent and Trademark Office has established precedents where a hardware computing apparatus has been equated to a software mechanism. In Thekkath, US Pat. No. 6,604,159 entitled: DATA RELEASE TO REDUCE LATENCY IN ON-CHIP SYSTEM BUS, the USPTO granted twelve claims for an 'on-chip system bus', eleven claims for a 'processing device', three

[23] Synthesizable 'C' compilers for FPGA or ASIC are available. Ref: *Impulse 'C'* by Impulse Accelerated Technologies (Kirkland, WA); SystemC® (IEEE 1666); Venkitakrishnan, US Pat. No. 6,513,145; Sato et al., US Pat. No. 6,467,075.

claims for 'access to a data bus' and two claims for a *'computer program product'*. In this case a single invention used four equivalent claim constructions[24].

> *Thekkath, US Pat. No. 6,604,159*
> "In addition to implementations of the invention using hardware, the invention can also be embodied in an article of manufacture comprised of a computer usable medium configured to store a computer-readable program code. The program code causes the enablement of the functions or fabrication, or both, of the hardware disclosed in this specification. For example, this might be accomplished through the use of general programming languages (e.g., C, C++, and so on), hardware description language (HDL), register transfer languages (RTL), Verilog HDL, VHDL, AHDL (Altera Hardware Description Language), or other programming and/or circuit (i.e., schematic) capture tools available in the art. A book entitled "A Verilog HDL Primer" by J. Bhasker, Star Galaxy Pr., 1997 provides greater detail on Verilog HDL, and is incorporated herein by reference in its entirety for all purposes." (Col. 15, line 33)

Non-statutory Hybrid Inventions

Non-statutory hybrid inventions exist whenever statutory elements 'A' and non-statutory elements 'B' have been combined into an invention in the form of 'AB'[25]. These are generally interpreted in accordance with the novel aspects of the invention. That is, that if the point of novelty of the invention relates to statutory subject matter, then it is allowed. Conversely, if the point of novelty of the invention relates to non-statutory subject matter, then it is not allowed.

> *Moy's Walker on Patents - § 4:79 Hybrid Claim Presentations …*
> The PTO's single-category requirement also impacts the interpretation of claims that include elements of nonstatutory subject matter. Examples of such nonstatutory elements are mathematical formulae, some forms of printed matter, and natural laws. When the PTO confronts such a claim, it will treat the nonstatutory recitation as nonlimiting, and essentially ignore its presence during examination." (p. 4-252, footnotes omitted).

> *Moy's Walker on Patents - §5:62 Blue-pencil rule*
> "In practice, the rule operated by first striking or 'blue-penciling' the non-statutory elements from the patent claim conceptually, and then subjecting the resulting, purified form of the invention to examination for patentability. Under the rule the hybrid invention that the patent claim actually describes is considered to meet the various criteria of patentability only if the purified form of the invention would do so as well. If the purified version fails a particular criterion, in contrast, the actually described invention is considered to also fail." (p. 5-180)

The definition of a **CLASS Machine** is a hybrid claim presentation which incorporates both statutory and non-statutory elements. There, the ***front end design*** ('A') is by definition

[24] Additional examples can also be found in Thekkath US Pat. No. 6,393,500; Thekkath et al. US Pat. No. 6,490,642; Courtright et al. US Pat. No. 6,493,776 and Thekkath et al. US Pat. No. 6,681,283.
[25] See: Moy's Walker on Patents, §§ 5:60 – 5.64 Historical progression of substantive approaches.

composed of non-statutory subject matter in the form of **software**, and the *conversion means for adapting said* ***front end design*** could be statutory or non-statutory depending on the situation. The other elements of the definition ('B') are statutory in nature, as they define well understood physical elements. The resulting ***software mechanism*** ('AB') is patentable so long as it meets the requirements under 35 U.S.C. 102.

In some cases the *conversion means for adapting the* ***front end design*** will be performed by a machine (usually a software package), and in others it might be a mental process augmented by pencil and paper markings. For example, the **CLASS Machine** for the SLC1657 microprocessor implemented on the Xilinx Spartan II **FPGA** used in the example above uses conversion code (e.g. a file wrapper) in conjunction with a conversion process performed by a general purpose computing apparatus[26]. On the other hand the **front end design** for an audio amplifier can be applied to a **discrete circuit** by interpreting a schematic diagram, hand taping a printed wiring board and then use a soldering iron to assemble the components.

> *In re Abrams - 188 F.2d 165 (1951)*[27]
> "Going further, the brief sets forth as applicable to cases where the claims contain certain so-called mental steps, three suggested 'rules of law' reading:
>
> 1. If all of the steps of a method claim are purely mental in character, the subject matter thereof is not patentable within the meaning of the patent statutes.
>
> 2. If a method claim embodies both positive and physical steps as well as so-called mental steps, yet the alleged novelty or advance over the art resides in one or more of the so-called mental steps, then the claim is considered unpatentable for the same reason that it would be if all the steps were purely mental in character.
>
> 3. If a method claim embodies both positive and physical steps as well as so-called mental steps, yet the novelty or advance over the art resides in one or more of the positive and physical steps and the so-called mental step or steps are incidental parts of the process which are essential to define, qualify or limit its scope, then the claim is patentable and not subject to the objection contained in 1 and 2 above." (188 F.2d 165, 166)

[26] There is nothing to prevent one from performing this conversion process manually, either. One could theoretically read the VHDL code, and then program the FPGA bit stream using paper and pencil.

[27] There appears to be some judicial controversy regarding the rules suggested by the Appellant in Abrams.

> *Application of Musgrave – 431 F.2d 882 (1970)*
> "It remains our view that we need not be encumbered in our reasoning by the 'Rules' of Abrams for the reason that they have never enjoyed the approval of this court." (431 F.2d 882, 889)
>
> "… see Ex parte Egan, 129 USPQ 23 (1960), a case which, incidentally, accepted the Abrams 'Rules' as established law;" (431 F.2d 882, 892)

Application of Musgrave - 431 F.2d 882 (1970)
"We cannot agree with the board that these claims (all the steps of which can be carried out by the disclosed apparatus) are directed to non-statutory processes merely because some or all of the steps therein can also be carried out in or with the aid of the human mind or because it may be necessary for one performing the process to think. All that is necessary, in our view, to make a sequence of operations steps a statutory 'process' within 35 U.S.C. § 101 is that it be in the technological arts so as to be in consonance with the Constitutional purpose to promote the progress of 'useful arts.' Const. Art. 1, sec. 8." (431 F.2d 882, 893)

In Re Lowry - 32 F.3d 1579 (Fed. Cir. 1994)
"Patent and Trademark Office (PTO) must consider all claim limitations when determining patentability of invention over prior art, and PTO may not disregard claim limitations comprised of printed matter." (32 F.3d 1579, [3])

"The printed matter cases have no factual relevance where 'the invention as defined by the claims requires that the information be processed not by the mind but by a machine, the computer." (32 F.3d 1579, 1583)

Public Domain Information

The easiest and most common way to gather information about an integrated circuit is to obtain public domain information. This includes an enormous body of publicly available documents that are available in this field of invention. There are plenty of materials around, as integrated circuits represent a fully mature technology. The first transistor was invented in 1949, the first integrated circuit in 1959, and the first VLSI (Very Large Scale Integrated Circuit) in about 1969. Sources of information include:

- Technical reference manuals
  - Examination of command, control and op-codes
- Reverse engineering
  - Operational testing
  - Timing analysis
  - Peeling
- Academic papers
- Trade journal articles
- On-line materials
- Patent documents
  - USPTO / PCT / WIPO patents
  - File wrapper
- Personal interviews (without trade secrecy or non-compete conflicts of interest).

Patent Documents

Patent documents are an excellent source of information about integrated circuit design. They serve two purposes in the clean room design practice: (a) they identify potential infringement problems, and (b) they teach other (non-infringing) ways to perform similar functions.

If an enforceable prior art patent is found (i.e. not expired, not invalidated, etc.) which might cover a new device, then the practitioner must license or ask permission to use the design, design around its claims or find sufficient grounds for invalidation or unenforceability.

Invalidation of a patent involves the identification of new issues which would have prevented patentability by the patent office Examiner. This includes such things as prior art, public use, description in a printed publication or any number of other issues that might have barred the patent. A patent can only be invalidated by the courts, and it is rare that a patent owner will 'throw in the towel' by making public statements disclaiming their patent rights[28]. The USPTO also has formal methods for patent reexamination and submission of prior art under 37 CFR 1.501 (see the MPEP).

These formal methods are beyond the scope of this document, and are better left to the tutelage of an Attorney at Bar. Instead the clean room design practice should, if necessary, focus on building a strong case against *enforceability*. The idea is to build a case so strong that any patent holder or would-be patent holder would not dare to sue for infringement. Or, if they do sue then they would surely loose without much expenditure on the part of the defendant.

Outside of the formal methods describe above, there is really no way to force a patent owner to admit that their patent claims read on prior art in the public domain. The only way to press the issue is for the practitioner to proceed with a new design based upon the patented method, and then wait to get contacted by the patent owner. If that happens, then it's up to the parties to resolve any dispute.

In the United States and elsewhere, an integrated circuit (or any other device for that matter) can't be patented if it does not meet a series of conditions for patentability. These are clearly defined in *35 U.S.C. §102: Conditions for patentability; novelty and loss of right to patent*. This section of the US Code clearly identifies both what is patentable and what is not patentable (and hence, what is freely available in the public domain).

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[28] Disclaiming patent rights can be made by public statements or through an official notice. For an example of an official disclaimer see the last page of: Cranford P. Walker, US Pat. No. 2,156,519.

In some cases, participation in an industry standards organization (ANSI, JEDEC, IEEE etc.) might disclaim one's patent rights. See: Hovenkamp, *Chapter 35 – Intellectual Property and Standards-Setting Organizations*.

> *Hovenkamp – §35.5b. Misrepresentations regarding intellectual property.*
> "In several recent cases, antitrust plaintiffs have alleged that defendants persuaded a standard-setting organization to adopt their proposed standard b misrepresenting its status as intellectual property. This misrepresentation sometimes takes the form of an omission (failing to assert ownership in the standard publicly until after it is adopted), and sometimes the form of an affirmative falsehood (signing a statement indicating that the party has no intellectual property rights in the proposed standard)." (2007 Supplement, p. 35-37)

35 U.S.C.S. § 102 - n9 Lawyer's Edition 2000

"Novelty requirements of 35 U.S.C.S §102(a) and (b) operate in tandem to exclude from consideration for federal patent protection knowledge which is already available to public, and express congressional determination that creation of monopoly in such information would not only serve no useful purpose, but would in fact injure public by removing existing knowledge from public use. Bonito Boats, Inc. v. Thunder Craft Boats, Inc. (1989) 489 US 141, 103 L Ed 2d 118, 109 S Ct 971, 9 USPQ2d 1847."

Thus, if prior art appears to exist on a patent or patent application, and if it was not considered by the patent examiner[29], then it may be possible to build a strong case against enforceability. This situation is not uncommon in the field of integrated circuits given the enormous body of open technology and the maturity of the industry, coupled with the fact that most patent examiners do not investigate public domain materials unless they have been specifically offered by an applicant, and even then they may be ignored.

Another common strategy is to form a case against enforceability by establishing 'guilt by association'. Stated another way, if a similar inventive works (to the one employed in a new device) existed before a patent applicants filing date, then any prosecution against the new device would likewise have to apply to the prior art.

Chisum - §3.02[1][f]

"Because of the symmetry between the tests for infringement and invalidity by anticipation, a patent owner's charge of infringement of a patent by an accused infringer's device is potentially fatal to the patent's validity of the accused infringer establishes that its device is, in fact, prior art."

Corning Glass Works v. Sumitomo Elec. USA, Inc. 868 F.2d 1251 (Fed. Cir. 1989)

"Anticipation requires that every limitation of patent claim in issue be disclosed, either expressly or under principles of inherency, in single prior art reference." (868 F.2d 1251, [1])

"In determination of infringement, words of claim must first be interpreted, and, as properly interpreted, they must be 'read on' accused structure to determine whether each of the limitations recited in claim is present in accused structure." (868 F.2d 1251, [6])

Also, when analyzing a technology, a patent application or an issued patent to see if it meets the conditions for patentability, it is necessary to clearly understand the symmetry between the terms 'anticipation' and 'infringement. Figure 7 shows these terms diagrammatically in terms of their relationship to patent claims.

[29] Note that some patent claims may appear to read on a public domain prior art, but that an examiner may have allowed wording based upon some argument presented during the prosecution of the patent application. Also see: doctrine of file wrapper estopple.

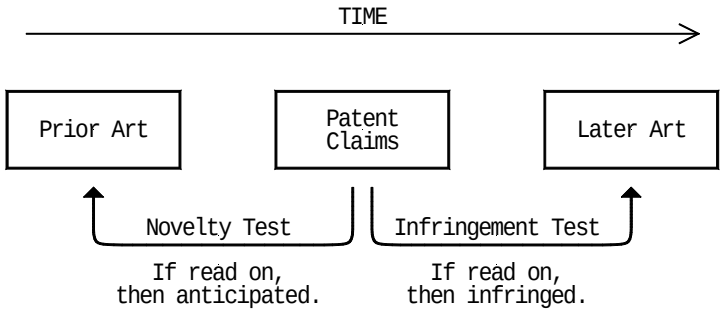

Figure 7. Novelty test and infringement test.

White Consolidated Industries, Inc. v. Vega Servo Control, Inc. - 214 USPQ 796
"As explained by D. Chisum, Patents §3.02[1] (1981): The inquiry as to anticipation is symmetrical with the inquiry as to infringement of a patent. The classic test of anticipation provides: 'that which will infringe, if later, will anticipate, if earlier. Thus a claim fails to meet the novelty requirement if it covers or reads on a product or process found in a single source in the prior art." (214 USPQ 796, 828)

Timing Analysis

Another way to gather information about the operation of an original device is to bench test it. Connect it to a logic analyzer, oscilloscope or other test equipment and exercise its functions to see how the device works. This requires that a test bed (usually a printed circuit board) be created that has the command and control capabilities necessary to operate the device, along with any interface and power supply circuits that may be needed. In most cases the test bed will require some software capability that allows the original device to be exercised. For example, it may need a microprocessor or emulator capable of running test programs downloaded to it.

In most cases an equivalent test bed should be created for the interoperable device as well. This allows both devices … the original and the interoperable part … to be compared on an apples-to-apples basis. Waveforms and other data (facts) obtained in this way are usually not protected by patent, copyright or trade secret.

In Re Nuijten - 500 F.3d 1346 (Fed. Cir. 2007)
"The claims on appeal cover transitory electrical and electromagnetic signals propagating through some medium, such as wires, air, or a vacuum. Those types of signals are not encompassed by any of the four enumerated statutory categories: 'process, machine, manufacture, or composition of matter.'" (500 F.3d 1346, 1352).

Secure Services Tech., Inc. v. Time and Space Proc., Inc. - 722 F.Supp 1354 (1989)
"Facsimile machine manufacturer could not obtain copyright protection for timing of its implementation of standard handshaking protocol program under which facsimile machines communicated with each other; timing was process by which electronic signals were created, transmitted or received, and as such excluded from copyright under statute." (722 F.Supp. 1354, [3])

Feist Publications, Inc. v. Rural Telephone Service Co., Inc. - 499 US 340 (1991)
"Article I, § 8, cl. 8, of the Constitution mandates originality as a prerequisite for copyright protection. The constitutional requirement necessitates independent creation plus a modicum of creativity. Since facts do not owe there origin to an act of authorship, they are not original and, thus, are not copyrightable." (499 US 340, 340)

Acuson Corp. v. Aloka Col, Ltd. 257 - Cal.Rptr. 368 (Cal.App. 6 Dist. 1989)
"Trade secret law does not prohibit lengthy and expensive reverse engineering of objects in the public domain; state law encourages such efforts by giving the competitor who invests substantial resources in reverse engineering the opportunity to hold in legally protected confidence the results of its labor." (257 Cal.Rptr. 368, [26]).

"Both the original inventor and the reverse engineer may claim protection for their labors. West's Ann.Cal.Civ.Code § 3426.1" (257 Cal.Rptr. 368, [27])

Peeling

Integrated circuits can be reverse engineered through a process known as *'peeling'*. This generally involves opening a lawfully obtained integrated circuit, removing it from its outer plastic or ceramic package, and deducing its operation using visual microscopy, electron beam microscopy or chemical analysis such as Auger electron beam microscopy.

Chip peeling is described as a valid reverse analysis technique in *Atari Games Corp. v. Nintendo of America Inc.*, where Atari used it as a method for reading software object code from Nintendo's product. Under appeal, this process was determined to be a legitimate fair use under copyright law.

Atari Games Corp. v. Nintendo of America Inc. - 975 F.2d 832 (Fed. Cir. 1992)
"Atari retrieved this object code from NES security chips in its efforts to reverse engineer the 10NES program. Atari chemically removed layers from Nintendo's chip to reveal the 10NES object code. Through microscopic examination of the 'peeled' chip, Atari engineers transcribed the 10NES object code into a handwritten list of ones and zeros. While these ones and zeros represent the configuration of machine readable software, the ones and zeros convey little, if any, information to the normal unaided observer. Atari then keyed this handwritten copy into a computer. The computer then 'disassembled' the object code or otherwise aided the observer in understanding the program's method or functioning. This 'reverse engineering' process, to the extent untainted by the 10NES copy purloined from the Copyright Office, qualified as a fair use.

The district court assumed that reverse engineering (intermediate copying) was copyright infringement. *Atari Games v. Nintendo of Am.,* Nos. 88-4805, 89-0027, 89-0824, slip op. at 11-13, 1991 WL 57304 (N.D. Cal. Apr. 11, 1991). This court disagrees. Atari did not violate Nintendo's copyright by deprocessing computer chips in Atari's rightful possession. Atari could lawfully deprocess Nintendo's 10NEWS chips to learn their unprotected ideas and processes. This fair use did not give Atari more than the right to understand the 10NES program and to distinguish the protected from the unprotected elements of the 10NES

program. Any copying beyond that necessary to understand the 10NEWS program was infringement. Atari could not use reverse engineering as an excuse to exploit commercially or otherwise misappropriate protected expression." (975 F.2d 832, 844)

It should be noted that the 'purloined copy' of the software referred to in the Atari Court's analysis was a copy deposited at the copyright office as part of the registration process. Atari had obtained a copy of the deposited material by surreptitious means, and so came to court with unclean hands. While this factored into the courts overall ruling, it did not impact its viewpoints on reverse engineering. In general, fair use exception applies only to lawfully obtained copies.

The analysis in *Atari Games* also maintained that peeling is only available as a means for understanding the operation of a semiconductor; it does not convey any right to reproduce a copyrighted semiconductor design for commercial purposes.

Atari Games Corp. v. Nintendo of America Inc. - 975 F.2d 832 (Fed. Cir. 1992)
"The Copyright Act permits an individual in rightful possession of a copy of a work to undertake necessary efforts to understand the work's ideas, processes, and methods of operation.

This permission appears in the fair use exception to copyright exclusivity. Section 107 of the Copyright Act states that 'fair use of a copyrighted work, including such use by reproduction in copies…for purposes such as criticism, comment, news reporting, teaching … scholarship or research' is not infringement. 17 U.S.C. §107. The legislative history of section 107 suggests that the courts should adapt the fair use exception to accommodate new technological innovations." (975 F.2d 832, 842)

This case supports a long established 'quid-pro-quo' that exists under copyright law. That is, exclusive rights are extended to the author in the form of reproduction, adaptation, public display and so forth. In exchange, the author relinquishes all rights to the underlying processes, methods and ideas of his expressive ideas (although they may be separately protected by patent).

Control, Command and Operational Codes

A standard method used in many electronic systems (including semiconductor devices) is to associate a numeric constant with some predefined function. These are often referred to as control, command and operational codes (op-codes). Even though they may be called different things, they are used for the same basic purpose: to use a fixed numeric constant to cause some specific activity in the system. There are two basic forms of these codes used in an instruction set:

- *Complex Instruction Set.* A numeric constant whose entire value must be decoded to yield a significant control function.

  Microprocessors that use these codes are often referred to as CISC processors, or Complex Instruction Set Computers. These have the advantage of being able to encode many instructions into a small number of bits … say 256 codes in an 8-bit instruction

space. Their disadvantage is that each instruction must be decoded, a process which takes time and hardware resources.

- *Reduced Instruction Set.* A numeric constant where each bit or combination of bits has a significant control function.

  Microprocessors that use these codes are often referred to as RISC processors, or Reduced Instruction Set Computers. They have the advantage of running faster and taking less hardware resources than CISC processors because their instructions do not needed to be decoded. Their disadvantage is that fewer instructions can be encoded into any given space … say 32 instructions in a 12-bit instruction space.

For example, in a telephone call controller a command word of 006 might indicate that the controller should configure its serial port to communicate at 4800 baud (an example of a complex instruction). In a microprocessor, an operational code (op-code) of 0x1C0 might cause it to clear a specific internal register (an example of a reduced instruction). In both cases the code is usually associated with a shorthand mnemonic such as 'CLR' for 0x1C0, along with a written description of how it operates.

The replication of these codes is fundamental to clean room design practice. The relevant question here is whether or not they can be used in the interoperable device and the new manual if they were first used in a mask copyrighted (original) device or an original manual. Within the context of this discussion we are considering only the command codes themselves. Sequences of command codes (i.e. software programs) in most cases are copyrightable as a software literary works.

> *Mitel, Inc. v. Iqtel, Inc. – 124 F.3d 1366 (10th Cir. 1997)*
> "Neither numbers of command codes used to program manufacturer's telephone call controller nor code registers and descriptions were sufficiently original to merit copyright protection, where numbers were arbitrarily chosen and arbitrarily assigned to each function, and registers and descriptions were purely sequential. 17 U.S.C.A. 102(a)" (124 F.3d 1366, [7])
>
> "Under merger doctrine, copyrightable expression is denied protection from infringement because expression is inseparable from or merged with ideas, processes, or discoveries underlying expression." (124 F.3d 1366, [8])
>
> "Content of 'values' created by manufacturer of call controllers, which were assigned to description portion of command codes and were devised to set each function at particular level of operation, were sufficiently original to be eligible for copyright protection, because effort required of manufacturer's employees to devise appropriate values for wide variety of individual functions reflected at least minimal degree of creativity. 17 U.S.C.A. 102(a)" (124 F.3d 1366, [10])
>
> "'Values' created by manufacturer of call controllers, which were assigned to description portion of command codes and were devised to set each function at particular level of

operation, were excluded from copyright protection under scenes-a-faire doctrine, since values were largely dictated by external factors such as hardware compatibility requirements and industry practices." (124 F.3d 1366, [11])

"Scenes a faire doctrine excludes from protection against copyright infringement those elements of work that necessarily result from external factors inherent in subject matter of work." (124 F.3d 1366, [13])

If we apply this same reasoning to microprocessor op-codes, then we discover that at some level of abstraction these codes become fundamental to its operation. Merger doctrine firmly establishes that the microprocessor design itself cannot be protected through copyright; in order to prevent their reproduction in interoperable products one must patent the underlying method of operation or its manufacturing process.

With respect to the op-code mnemonics (e.g. CLR, ADD, INCSZ), these are usually considered to be a short-hand notation for the numerical op-code. Often, they are single word abbreviations for the name of a particular function. Assuming that these abbreviations were first used in a copyrighted (original) manual, then are these op-code mnemonics protectable under copyright?

One approach to this question is that if mnemonics were protected under copyright or trademark, then only licensees of the copyright holder could create or enhance third party software and hardware tools. This would effectively attach invention rights to a copyrighted software program or hardware tool. Only licensed parties could write, duplicate, adapt, distribute or publicly display software assembler tools, compilers, emulators, simulators and logic analyzers. All of these related products rely on the same mnemonics for their operation.

Lasercomb America, Inc. v. Reynolds – 911 F.2d 970 (4th Cir. 1990)
"We are persuaded, however, that a misuse of copyright defense is inherent in the law of copyright just as a misuse of patent defense is inherent in patent law." (911 F.2d 970, 973)

"Anticompetitive language in software program developer's licensing agreement amounted to a misuse of copyright by attempting to use copyright to control competition outside computer-assisted die manufacturing so that misuse of license barred recovery for infringement even if misuse was not antitrust violation; agreement forbade licensee from developing or assisting in developing any kind of computer-assisted die-making software." (911 F.2d 970, [3])

This question also extends to the anti-trust laws, which prohibit the tying of one product to the purchase of another. Within the context of the computer arts this practice is generally referred to as *bundling*, which is considered to be anti-competitive.

Data Gen. v. Grumman Systems Support – 36 F.3d 1147 (1st Cir. 1994)
"Sherman Act provision prohibiting contracts in restraint of trade prohibits seller from 'tying' sale of one product to purchase of second product if seller thereby avoids

competition on merits of "tied" product. Sherman Act, Sec. 1 as amended 15 U.S.C.A. 1" (36 F.3d 1147, [30])

The question could also be approached from the standpoint of an alphabetical list which relates the op-code name to its numerical value (i.e. a compilation of facts).

> *Feist Publications, Inc. v. Rural Tele. Serv. Co. – 499 US 340 (US Sup. Ct. 1991)*
> "We conclude that names, towns and telephone numbers copied by Feist were not original to Rural and therefore were not protected by the copyright in Rural's combined white and yellow pages directory. As a constitutional matter, copyright protects only those constituent elements of a work that possess more than a de minimis quantum of creativity. Rural's white pages, limited to the basic subscriber information and arranged alphabetically, fall short of the mark." (499 US 340, 363)

Thus, from the proceeding discussion we can conclude that the op-code mnemonics are not afforded copyright protection[30]. They are nothing more than formal names for the numerical op-code values.

Software

In general, fair use copies of software can be used for reverse engineering (disassembly) purposes, so long as they are lawfully obtained.

> *Hazard - V. Reverse Engineering of Computer Software, §3.22 Generally*
> "Courts are likely to be less sympathetic to the plaintiff in reverse engineering cases where, as in *Atari Games* and *Sega Enterprises*, it appears that the plaintiff has attempted to monopolize a market by making it impossible for others to compete – by inhibiting creative expression. If a competitor cannot enter a particular market simply because it cannot understand the ideas in a particular program, and if it cannot understand such ideas only because it cannot conduct intermediate copying for purposes of reverse engineering, courts are likely to be cautious in disallowing fair-use copying." (p. 3-62)

> *Atari Games Corp. v. Nintendo of America - 975 F.2d 832 (Fed. Cir. 1992)*
> "When nature of work requires intermediate copying to understand ideas and processes in copyrighted work, that nature supports fair use for intermediate copying; thus, reverse engineering of object code to discern unprotectible ideas in computer program is fair use. 17 U.S.C.A. § 107(2)." (975 F.2d 832, [19])

It should be noted that 'shrinkwrap' and 'click-through' software licenses often have provisions that prohibit disassembly or reverse engineering of the code. In these cases the software vendors seem to believe that they have the right to preempt fair use clause of the Copyright Act. For more information, see the related section of this document entitled 'copyright misuse'.

[30] This analysis assumes that the original device is offered for sale to the general public. It may not apply to the rare circumstances where a complete microprocessor or other design works is maintained as a trade secret, and is not made available to the general public.

IV. Clean Room Design Practice for New Manuals

The clean room design practice for new manuals assumes the following conditions apply: (a) the original manual is protected by copyright and a rightful owner exists, (b) that permission to copy all or part of the original manual has not been obtained, (c) that the original manual has been acquired by lawful means and (d) it is a necessary reference tool for the project.

New Manual Must Not Infringe on Original Manual

The new manual must not infringe on the original manual. Under the Copyright Code in 17 U.S.C. 102(a), protection is afforded to an "original works of authorship" [31].

> *Nimmer on Copyright - 13.03[E][1][b]*
> "Specifically, in Feist Publications, Inc. v. Rural Telephone Service Co. [499 US 340 (1991)] the Supreme Court defined the essential element of an infringement claim (along with ownership of a valid copyright) as follows: 'copying of constituent elements of the work that are original.'"

However, the determination of what is original and what is not original can be subjective. Here, the courts have established that one work is thought to have been copied from another if the two are '*substantially similar*'.

> *Nimmer on Copyright - 13.03[A]*
> "Just as copying is an essential element of copyright infringement, so substantial similarity between the plaintiff's and defendant's works is an essential element of actionable copying. 'This means that even where the fact of copying is conceded, no legal consequences will follow from that fact unless the copying is substantial.'"
>
> "The determination of the extent of similarity that will constitute a substantial, and hence infringing, similarity presents one of the most difficult questions in copyright law, and one that is least susceptible of helpful generalizations."
>
> "The problem, then, is one of line drawing. Somewhere between the one extreme of no similarity and other of complete and literal similarity lies the line marking off the boundaries of 'substantial similarity'. Judge Learned Hand has said that this line 'wherever it is drawn will seem arbitrary' and that 'the test for infringement of a copyright is of necessity vague'."
>
> *Rogers v. Koons - 960 F.2d 301 (2ND Cir. 1992)*
> "In determining whether two works of art are substantially similar for purposes of

[31] Is has been widely reported (but not independently confirmed by the author) that IBM Corporation uses a two-person method in their clean room design practice for creating new manuals. There, one person reads aloud a section of an original manual and the other writes down a new expression for it.

Copyright Act, focus must be on similarity of expression of idea or fact, not on similarity facts, ideas or concepts themselves. 17 U.S.C.A. § 101 et seq." (960 F.2d 301, [6])

Because of the subjective nature of '*substantial similarity*' the courts have devised a number of tests by which infringement can be determined. These same tests, which will be described below, are used in the clean room design practice to assure that a new manual is not an act of plagiarism (i.e. it does not infringe upon the original manual).

One of the basic precepts of copyright law is that protection is extended only to an original works of authorship. For this reason an infringement court will generally separate out any works that were not original to the author, such as:

- Ideas, processes, methods of operation and facts
- Merger material
- Public domain information
- Scenes a faire material
- Arbitrary material
- Copyrighted works obtained from others

Rogers v. Koons - 960 F.2d 301 (2ND Cir. 1992)
"Copyright protection extends only to those components of work that are original to creator; fact that whole work is copyrighted does not mean that every element of it is copyrighted; however, quantity of originality needed to be shown is modest. 17 U.S.C.A. § 101 et seq." (960 F.2d 301, [2])

Ideas, Processes, Methods of Operation and Facts

Semiconductor manuals are factual, literary works that express an idea. By their very nature they are used for commercial purposes. By necessity they describe the form, fit and function of a physical device, as well as the operating principles under which they operate. Stated another way, they describe an electronic *system,* created by a chemical *process* for the purpose of executing a logical *procedure* by some *method of operation*. A copyright protects the expression of an idea, but the idea itself is not afforded protection under copyright.

17 U.S.C. 102(b) – Subject Matter of Copyright; In general
"In no case does copyright protection for an original work of authorship extend to any idea, procedure, process, system, method of operation, concept, principle, or discovery, regardless of the form in which it is described, explained, illustrated, or embodied in such work."

Atari Games Corp. v. Nintendo of America, Inc. - 975 F.2d 832 (Fed. Cir. 1992)
"To protect processes or methods of operation, creator must look to patent laws; author cannot acquire patent-like protection by putting idea, process, or method of operation in unintelligible format and asserting copyright infringement against those who try to

understand that idea, process or method of operation. 17 U.S.C.A. § 102(b)." (975 F.2d 832, [17])

Mitel, Inc. v. Iqtel, Inc. – 124 F.3d 1366 (10th Cir. 1997)
"Although element of work may be characterized as method of operation, which is excluded from copyright protection, that element may nevertheless contain expression that is eligible for copyright protection. 17 U.S.C.A. § 102(b)." (124 F.3d 1366, [5])

"Under merger doctrine, copyrightable expression is denied protection from infringement because expression is inseparable from or merged with ideas, processes, or discoveries underlying expression." (124 F.3d 1366, [8])

Examples of *processes* expressed in a semiconductor manual:

- Solder paste application by a stencil print.
- Reflow or infrared solder temperature profile.
- Rework and repair procedures for ball grid array packages.

Nimmer on Copyright - § 2.08[D][1][a]
"As an example, graphs intended to record temperature information have been held not copyrightable." (p. 2-112)

Examples of *facts* contained within a semiconductor manual:

- Operating voltage: 4.75 – 5.25 VDC.
- Maximum power dissipation: 0.12 W
- Voltage input, high (Vih): 2.0 V
- Package type: 313 Pin PBGA Package
- Operating temperature: -40C - +85C
- Thermal characteristics graph (data not copyrightable, but drawing itself probably is).
- Reflow solder temperature.
- Release date: November 2002
- Part number: XYZ-417
- E-mail names and addresses; web site addresses.

X-IT Products, L.L.C. v. Walter Kidde Portable Equipment, Inc. – 155 F.Supp.2d 577
"Copyright protection is denied to so-called "functional" material on product labels or packaging, such as slogans, names, or listing of ingredients or contents. 17 U.S.C.A 102"

Mitel, Inc. v. Iqtel, Inc. – 124 F.3d 1366 (10th Cir. 1997)
"In Toro, the Eight Circuit rejected the copyrightability of a lawn tractor manufacturer's numbering of replacement parts because the numbers were insufficiently original. *Id.* at 1213." (124 F.3d 1366, 1373)

Merger Material

Under *merger doctrine*, copyright protection may be withheld if an idea can only be expressed in a limited number of ways, even if it is an original expression.

> *Nimmer on Copyright - 13.03[B][3]*
> "In what would appear to be a questionable extension of the merger doctrine, the First Circuit held that copyright will be denied to any given form of expression of an idea if the nature of the idea is sufficiently narrow so that 'only a limited number' of forms of expression of the idea are possible. The court acknowledged that, in such circumstances, 'it does not seem accurate to say that any particular form of expression comes from [i.e. is necessarily required by] the subject matter,' but concluded 'it is necessary to say that the subject matter would be appropriated by permitting the copyrighting of its expression. We cannot recognize copyright as a game of chess in which the public can be checkmated'."

> *Mitel, Inc. v. Iqtel, Inc. – 124 F.3d 1366 (10th Cir. 1997)*
> "Under merger doctrine, copyrightable expression is denied protection from infringement because expression is inseparable from or merged with ideas, processes, or discoveries underlying expression." (124 F.3d 1366, [8])
>
> "Originality is independent requirement of copyright protection that is not satisfied merely because merger doctrine, which denies protection to copyrightable expression when expression is inseparable from or merged with ideas, processes or discoveries underlying expression, is inapplicable." (124 F.3d 1366, [9])

Public Domain Information

Many manuals contain information which has been re-used from public domain documents. These portions of the document are not afforded protection under copyright. This includes:

- Works created before there was any copyright law.
- Works that were never copyrighted.

  > *Stim – Patent, Copyright & Trademark, 9th ed.*
  > "Although the use of a copyright notice on copies is no longer required in the U.S. as of March 1, 1989, for many years previous to that, omission of the notice voided copyright protections. A work of authorship published prior to January 1, 1978 without the proper notice of copyright qualified for no copyright protection. A work published between January 1, 1978 and March 1, 1989 without the proper notice of copyright lost its copyright protection unless the work was republished after March 1, 1989. But even then, the old copies remained unprotected unless the work was registered with the U.S. Copyright Office within five years of its original publication." (p. 271)

- Works where copyright has expired.

- Works injected it into the public domain through a declaratory statement.

- Works injected into the public domain by the United States Government.

In general, works of the federal government are in the public domain, and are not afforded copyright protection. Patent documents are considered to be in the public domain except when the applicant has specifically requested copyright protection (as prescribed under statute).

> *Matthew Bender & Co., Inc. v. West Publishing Co. – 158 F.3d 693 (1998)*
> "Works of the federal government are not subject to copyright protection, although they may be included in a compilation. 17 U.S.C.A. 105"
>
> *37 CFR § 1.71(d,e) – Detailed description and specification of the invention.*
> "(d) A copyright or mask work notice may be placed in a design or utility patent application adjacent to copyright and mask work material contained therein. The notice may appear at any appropriate portion of the patent application disclosure. For notices in drawings, see § 1.84(s). The content of the notice must be limited to only those elements provided by law. For example, "© 1983 John Doe" (17 U.S.C. 401) and "*M* John Doe" (17 U.S.C. 909) would be properly limited and, under current statutes, legally sufficient notices of copyright and mask work, respectively. Inclusion of a copyright or mask work notice will be permitted only if the authorization language set forth in paragraph (e) of this section is included at the beginning (preferably as the first paragraph) of the specification.
>
> (e) The authorization shall read as follows: A portion of the disclosure of this patent document contains material which is subject to (copyright or mask work) protection. The (copyright or mask work) owner has not objection to the facsimile reproduction by any one of the patent document or the patent disclosure, as it appears in the Patent and Trademark Office patent file or records, but otherwise reserves all (copyright or mask work) rights whatsoever."
>
> Ref: for an example, see: Xu et al. US Pat. No. 7,065,652 (Col. 1, Line 6).

It should be noted that *publicly licensed* materials are not the same as *public domain* materials (although, they can be). For example, the GNU Free Documentation License is a *public license* defined by the Free Software Foundation. There, works are copyrighted by the original author, but have limitations placed upon the duplication and adaptation of the document. However, the King James version of The Bible is in the public domain because it was a works created before the advent of copyright law.

Scenes-a-faire Material

The *scenes-a-faire* doctrine applies to materials which are unprotectable works because they are obtained from outside of the author's creative sphere of influence. It is closely related to merger doctrine, except it applies to preordained attributes of a work…things that by their very nature cannot be altered.

Mitel, Inc. v. Iqtel, Inc. – 124 F.3d 1366 (10th Cir. 1997)
"'Values' created by manufacturer of call controllers, which were assigned to description portion of command codes and were devised to set each function at particular level of operation, were excluded from copyright protection under scenes a faire doctrine, since values were largely dictated by external factors such as hardware compatibility requirements and industry practices." (124 F.3d 1366, [11])

"Under scenes a faire doctrine, expressive elements of work of authorship are not entitled to protection against copyright infringement if they are standard, stock, or common to topic, or if they necessarily follow from common theme or setting." (124 F.3d 1366 [12])

"Scenes a faire doctrine excludes from protection against copyright infringement those elements of work that necessarily result from external factors inherent in subject matter of work." (124 F.3d 1366, [13])

"In determining whether elements of copyrighted work were excluded from protection under scenes a faire doctrine, district court erred in discussing whether external factors such as market forces and efficiency considerations justified defendant's copying of the element and should have kept its focus upon external factors that dictated plaintiff's selection of elements." (124 F.3d 1366, [14])

In semiconductor manuals scenes-a-faire applies to things such as industry standards. For example, if a particular device adheres to an industry standard interconnection, then the standardized elements would most likely be covered under scenes-a-faire doctrine. The same would apply to de-facto standards (commonly accepted practices) too.

Mitel, Inc. v. Iqtel, Inc. – 124 F.3d 1366 (10th Cir. 1997)
"We have extended this traditional copyright doctrine to exclude from protection against infringement those elements of a work that necessarily result from external factors inherent in the subject matter of the work. For computer-related applications, these external factors include hardware standards and mechanical specifications, software standards and compatibility requirements, computer manufacturer design standards, industry programming practices and practices and demands of the industry being serviced." (124 F.3d 1366, 1375)

A similar situation applies to timing waveforms. For example, two people can connect a logic analyzer to two original integrated circuits and get more-or-less the same waveforms out of them. For more information see the section below on *Timing Analysis*.

Arbitrary Material

Material that is arbitrarily selected is generally not protectable under copyright because it is not original. It should be noted that the meaning of 'arbitrary' is not the same thing as random (although in some cases it might be). In some situations a random choice in itself might be fundamental to a method of operation (such as in casino gaming systems), but in these cases patent protection would most likely apply. Arbitrariness has been used to establish that numbers

such as command codes, part numbers and their descriptions are not original, and are therefore not protectable.

> *Mitel, Inc. v. Iqtel, Inc. – 124 F.3d 1366 (10th Cir. 1997)*
> "Even though the district court discussed originality under section 102(a) and method of operation under section 102(b) together, the court clearly found that Mitel's command codes lack originality. The district court stated that "the numbers constituting the command codes were arbitrarily chosen and arbitrarily assigned to each function". Mitel, 896 F.Supp. at 1055. Relying on Toro Co. v. R&R Prods. Co., 787 F.2d 1208, the court concluded that such arbitrariness was insufficient to sustain a finding of originality.
>
> In Toro, the Eight Circuit rejected the copyrightability of a lawn tractor manufacturer's numbering of replacement parts because the numbers were insufficiently original. *Id.* at 1213." (124 F.3d 1366, 1373)

Copyrighted Works Obtained From Others (Incl. Fair Use)

Many works contain copyrighted passages and other sections which have been obtained from others. This includes:

- Publicly licensed materials (e.g. Wikipedia; GNU Free Documentation License).
- Items included with permission from the original author.
- Passages copied under the fair use exception.

In general, licensed materials (including permissions granted by authors) are outside the scope of this document because they contain provisions which are unique to each situation.

Fair use doctrine allows a number of items to be used without the specific consent of the original author. These were first defined by Congress in Section 107 of the 1976 Copyright Act, albeit with a lack of specificity. Goldstein on Copyright (section 12.1) lists a number of situations where fair use copying is permissible:

- Quotation of excerpts in a review or criticism for purposes of illustration or comment.
- Quotation of short passages in a scholarly or technical work, for illustration or clarification of the author's observations.
- Use in a parody of some of the content of the work parodied.
- Summary of an address or article, with brief quotations, in a news report.
- Reproduction by a library of a portion of a work to replace part of a damaged copy.
- Reproduction by a teacher or student of a small part of a work to illustrate a lesson.

- Reproduction of a work in legislative or judicial proceedings or reports.

- Incidental and fortuitous reproduction, in a newsreel or broadcast, of a work located in the scene of an event being reported.

> *Rogers v. Koons - 960 F.2d 301 (2ND Cir. 1992)*
> "Where original work is factual rather than fictional, scope of fair use doctrine is broader. 17 U.S.C.A. § 107" (960 F.2d 301, [12])

Materials Protected as a Trade Secret

In general, the procedures set forth in this document view materials obtained under a trade secrecy (non-disclosure) agreement as a conflict of interest. They should not be used unless permission is first obtained in writing from the disclosing party.

> *Uniform Trade Secrets Act (1984 Amendments) – Sec. 1(4), Definitions*
> "TRADE SECRET means information, including a formula, pattern, compilation, program, device, method, technique, or process, that:
>
> (i) derives independent economic value, actual or potential, from not being generally known to, and not being readily ascertainable by proper means by, other persons who can obtain economic value from its disclosure or use, and
>
> (ii) is the subject of efforts that are reasonable under the circumstances to maintain its secrecy."

In practice, a trade secret is information which is not disclosed to the general public and which has been afforded the legal protections of a trade secret. When held by two or more parties it must be shared under a non-disclosure agreement which is usually (but not always) executed in writing, and which establishes the rules for disclosing and maintaining the trade secret. Trade secret materials in written or tangible form are usually identified with markings such as '*confidential*', '*proprietary*' or '*trade secret*'. When disclosed orally they are usually identified as a secret at the time of oral disclosure, and followed up by written confirmation. By their very nature trade secrets cannot include anything that:

i. is already in the possession of the receiving party;

ii. is or becomes part of the public knowledge or literature by acts other than those of the receiving party after receiving it;

iii. is rightfully received by the receiving party or its subsidiaries from a third party;

iv. is approved for release by written agreement with the disclosing party;

v. is or becomes available to a third party from the disclosing party on an unrestricted basis; or

vi. is transmitted before the execution date or after the expiration date of the agreement.

In practice, trade secrets are very difficult to keep unless all of the parties adhere to strictly defined and universally understood guidelines contained in a written non-disclosure agreement (NDA). If the parties do not understand the terms of the trade secrecy agreement, or cannot explicitly define what is covered under the terms, then the trade secret will most likely be lost over time through carelessness.

There is a large body of case law precedents involving trade secrets. In *Secure Services Technology v. Time and Space Processing*, 722 F.Supp. 1354, the court examined how the Uniform Trade Secrets Act affected a facsimile machine made by Secure Services Technology (SST), a claimant under the Act.

> *Secure Services Technology v. Time and Space Processing - 722 F.Supp. 1354*
> "Acuson claimed trade secret protection in processes used in its ultrasonic imaging equipment, a non-invasive medical diagnostic tool. Acuson took several precautions to prevent disclosure of these imaging processes: (i) the equipment was sold under a limited license for the internal software, (ii) sales persons and dealers were required to sign confidentiality agreements, and, (iii) internal padlocks were included in the equipment making it more difficult to examine the machinery. Even so, the Acuson court concluded that, while the precautions taken by Acuson were examples of what a manufacturer might do to prevent or inhibit others from reverse engineering its product, these precautions were not adequate under the Act to provide the ultrasonic imaging equipment with trade secret protection. Notwithstanding those precautions, reverse engineering remained an effective means of discovering Acuson's ultrasonic imaging process. Id., 257 Cal. Rptr. at 375-77. The court explained that once a trade secret is disclosed to 'others who are under no obligation to protect the confidentiality of the information, or [is] otherwise publicly disclose[d] …, [the] property right is extinguished.' Id. at 378 (quoting Ruckelshaus v. Monsanto Co., 467 US 986, 1002, 104 S.Ct. 2862, 2872, 81 L.Ed.2d 815 (1984)). The same is true here, as no precautions taken by SST precluded reverse engineering of the protocol variations; SST, through its own carelessness, failed to adequately protect its rights." (722 F.Supp. 1354, 1360 - footnotes omitted)

At issue were modifications of a standard CCITT T.30 facsimile timing protocol (standard) which had been made by SST.

> *Secure Services Technology v. Time and Space Processing - 722 F.Supp. 1354*
> "SST claims that these variations in timing and content, collectively referred to as 'protocol variations', deserve trade secret protection. And because the content variations can be transcribed into alphanumeric form, SST also claims copyright protection.
>
> TSP spent over $800,000 in an apparently successful effort to achieve interoperability with the Ricoh and Valutech machines." (722 F.Supp. 1354, 1358)

To achieve this interoperability, TSP used a protocol analyzer connected to the SST machine in order to examine and adjust their machines handshaking protocol.

> *Secure Services Technology v. Time and Space Processing - 722 F.Supp. 1354*
> "TSP's subsequent successful reverse engineering of the protocol variations to achieve interoperability, therefore, was no less proper. The Act expressly permits reverse engineering as a method of discovering what would otherwise constitute a trade secret as long as the product was not acquired by improper means." (722 F.Supp. 1354, 1361 - footnotes omitted)

Tests for Copyright Infringement

There are a number of tests for copyright infringement. These include (but are not limited to):

- Abstraction-filtration-comparison test
- Common errors test
- Intellectual labor test
- Intrinsic and extrinsic tests for substantial similarity

Abstraction-filtration-comparison Test

The abstraction-filtration-comparison test is a conceptual tool that helps separate idea from expression.

> *Nichols v. Universal Pictures Corp - 45 F.2d 119 (2d Cir. 1930)*
> "Upon any work, and especially upon a play, a great number of patterns of increasing generality will fit equally well, as more and more of the incident is left out. The last may perhaps be no more than the most general statement of what the play is about, and at times might consist only of its title; but there is a point in this series of abstractions where they are no longer protected, since otherwise the playwright could prevent the use of his 'ideas,' to which , apart from their expression, his property is never extended." (45 F.2d 119, 121)

> *Mitel, Inc. v. Iqtel, Inc. 124 F.3d 1366 (10th Cir. 1997)*
> "In recent opinions this court has relied increasingly upon the conceptual framework known as the abstraction-filtration-comparison to aid in separating idea from expression and identifying protectable expression. We utilize this approach as follows:
>
> First, in order to provide a framework for analysis, … a court should dissect the [work] according to its varying levels of generality as provided in the abstractions test.
>
> Second, poised within this framework, the court should examine each level of abstraction in order to filter out those elements of the [work] which are unprotectable.

Filtration should eliminate from comparison the unprotectable elements of ideas, processes, facts, public domain information, merger material, scenes a faire material, and other unprotectable elements suggested by the particular facts of the program under examination.

Third, the court should then compare the remaining protectable elements with the allegedly infringing [work] to determine whether the defendants have misappropriated substantial elements of the plaintiff's [work]." (124 F.3d 1366, 1371)

Common Errors Test

The common errors test establishes whether or not a work is copied based upon the incorporation of errors or omissions.

Nimmer on Copyright – 13.03[C]
"Some copyright proprietors intentionally insert errors into their works in order to verify that the substantial similarity of the work of another is the result of copying from his work. Whether or not such errors are intentionally placed in the plaintiff's work, the courts have regarded the existence of common errors in two similar works as the strongest evidence of copying as a factual matter, sometimes creating at least a *prima facie* case of copying."

Atari Games Corp. v. Nintendo of America, Inc. 975 F.2d 832 (Fed. Cir. 1992)
"Specifically, the district court noted that the Rabbit program incorporates elements of the 10NES program unnecessary for the chip's performance. The 10NES slave chip performs some functions beyond unlocking the NES console. For example, the 10NES slave chip shuts down upon receipt of an erroneous message from a master chip. The Rabbit program too contains this feature. This disabling feature is unnecessary to achieve Atari's stated purpose – unlocking the NES console.

In another example, the district court noted that Nintendo modified its 10NES slave chip program in 1987. This modification deleted some instructions from the original 10NES program. Nonetheless, the Rabbit program contains instructions equivalent to those deleted from the original 10NES program. These unnecessary instructions strongly suggest that the Rabbit program is substantially similar to the 10NES program." (975 F.2d 832, 845)

Intellectual Labor Test

One test of originality is whether or not intellectual labor has been applied to create the work. This answers the question: was the work merely copied verbatim or was there substantial intellectual labor used to create it?

Nimmer on Copyright - §1.08[C]
"In *The Trademark Cases* [100 U.S. 82 (1879)], one of the earliest Supreme Court decisions construing the Copyright Clause, it was stated that writings must constitute "the fruits of intellectual labor." Applying this principle, the Court held that a trademark did not constitute a writing and hence, could not claim copyright protection. The fundamental precept that a work is not a writing unless it contains a modicum of intellectual labor has been followed in subsequent cases, and clearly constitutes an essential constitutional element. Thus, facts in themselves, as distinguished from the form or manner in which such facts are presented, cannot constitute writings. Likewise, blank charts for the recording of facts have been held not to constitute writings. Similarly, simple directions dictated by functional considerations, even if original, do not contain sufficient intellectual labor to constitute writing.

It is important to distinguish between the requirement of originality and the requirement of intellectual labor. Although treated interchangeably by some courts, there would appear to be some distinction between the two concepts. The doctrine of originality stems from the Copyright Clause's use of the term "authors" and refers to independent creation. Intellectual labor, on the other hand, suggests an absolute standard, albeit a highly minimal one, of creativity. Thus, a trademark may be original in the sense that the "author" thereof has not copied from any other source, and yet will not constitute a writing because the intellectual labor expended in its creation is so trivial as to be virtually nonexistent."

The intellectual labor test is similar to '*sweat of the brow'* and *'industrious collection'* tests.

Feist Publications, Inc. v. Rural Telephone Service Co., Inc. - 499 US 340 (1991)
"Lower courts that adopted a 'sweat of the brow' or 'industrious collection' test – which extended a compilation's copyright protection beyond selection and arrangement to the facts themselves – misconstrued the 1909 Act and eschewed the fundamental axiom of copyright law that no one may copyright facts or ideas." (499 US 340, 341)

Intrinsic and Extrinsic Tests for Substantial Similarity

Atari Games Corp. v. Nintendo of America, Inc. - 975 F.2d 832 (Fed. Cir. 1992)
"The Ninth Circuit uses a two-step analysis to evaluate substantial similarity: First, an 'extrinsic' test is used to determine whether two ideas are substantially similar. This is an objective test which rests upon specific criteria that can be listed and analyzed. Second, an 'intrinsic' test is used to compare forms of expression. This is a subjective test which depends on the response of the ordinary reasonable person." (975 F.2d 832, 844)

Copyright Notice

A copyright notice contains the '©' mark plus the author's name and date of publication.

> *Stim – Omission of Copyright Notice.*
> "Although the use of a copyright notice on copies is no longer required in the U.S. as of March 1, 1989, for many years previous to that, omission of the notice voided copyright protections. A work of authorship published prior to January 1, 1978 without the proper notice of copyright qualified for no copyright protection. A work published between January 1, 1978 and March 1, 1989 without the proper notice of copyright lost its copyright protection unless the work was republished after March 1, 1989. But even then, the old copies remained unprotected unless the work was registered with the U.S. Copyright Office within five years of its original publication." (p. 271)

Conditional Statement(s)

A conditional statement may be applied to a copyright notice. These are commonly used to grant consent for some particular activity that would otherwise be prohibited, such as copying or distributing the work. For example, the so-called 'viral licenses' like the General Public License (GPL) use conditional statements to foster the widest possible dissemination of software and other documentation. There, the copyright holder gives their permission to copy, adapt and distribute the work so long others grant similar rights for any contribution that they make to the work.

> *Public Affairs Associates, Inc. v. Admiral Hyman G. Rickover - 284 F.2d 262 (1960)*[32]
> "Copies of the speeches delivered after December 1, 1958 bore this sort of notice: 'Copyright 1958, H.G. Rickover. No permission needed for contemporaneous press use. Above copyright notice to be used if most of speech reprinted.'" (284 F.2d 262, 271)

> *Nimmer on Copyright - § 7.15 The Effect of Surplusage in a Copyright Notice*
> "If a proper copyright notice appears on a work, what effect will be given to an additional statement granting permission to freely copy the work or otherwise exploit it? It has been held that a statement accompanying a proper notice that read 'No permission needed for contemporaneous press use' did not invalidate the copyright and, in any event, served to reserve at least all rights other than 'contemporaneous press use.' Unanswered is the more difficult question as to whether a statement unconditionally granting the right to exercise all rights under the Copyright Act will invalidate the copyright, notwithstanding the presences of a proper copyright notice. There is the further question as to whether a conditional consent is binding upon the copyright owner with respect to such uses as come within the scope of consent. It would seem that such consents (either conditional or unconditional) would, in no event, invalidate the copyright, but that the proprietor would be estopped from

[32] Public Affairs Assocs., Inc. v. Rickover, 284 F.2d 262 (D.C. Cir. 1960), vacated for insufficient record, 369 U.S. 111 (1962).

obtaining a judgment against any person who reasonably relied upon such a statement of consent." (p. 7-146)

Copyright Misuse

A copyright holder is given a number of exclusive rights with respect to their original works under 17 U.S.C. § 106 and elsewhere. They are free to license their works so long as any quid-pro-quo within the license agreement is limited to the exclusive rights obtained under the Copyright Act. Any attempt to establish other rights relating to the copyrighted work, and then to bargain with them in a license agreement, is a form of copyright misuse.

17 U.S.C. § 106 - Exclusive rights in copyrighted works

"Subject to sections 107 through 122, the owner of copyright under this title has the exclusive rights to do and to authorize any of the following:

(1) to reproduce the copyrighted work in copies or phonorecords;

(2) to prepare derivative works based upon the copyrighted work;

(3) to distribute copies or phonorecords of the copyrighted work to the public by sale or other transfer of ownership, or by rental, lease, or lending;

(4) in the case of literary, musical, dramatic, and choreographic works, pantomimes, and motion pictures and other audiovisual works, to perform the copyrighted work publicly;

(5) in the case of literary, musical, dramatic, and choreographic works, pantomimes, and pictorial, graphic, or sculptural works, including the individual images of a motion picture or other audiovisual work, to display the copyrighted work publicly; and

(6) in the case of sound recordings, to perform the copyrighted work publicly by means of a digital audio transmission."

For example, provisions in a license agreement for a book contract would probably not be enforceable if it were to, say, limit the distribution of the book to left handed people or those from the state of Wisconsin. These are not exclusive rights provided under the Copyright Act, and so cannot be used as barter within a license agreement. Similarly, rights established under the fair use doctrine cannot be withheld.

Lasercomb America, Inc. v. Reynolds - 911 F.2d 970 (4th Cir. 1990)[33].

"We are persuaded, however, that a misuse of copyright defense is inherent in the law of copyright just as a misuse of patent defense is inherent in patent law." (911 F.2d 970, 973)

[33] The Lasercomb Court provides an excellent historical treatise of copyright misuse beginning on p. 972

"Anticompetitive language in software program developer's licensing agreement amounted to a misuse of copyright by attempting to use copyright to control competition outside computer-assisted die manufacturing so that misuse of license barred recovery for infringement even if misuse was not antitrust violation; agreement forbade licensee from developing or assisting in developing any kind of computer-assisted die-making software." (911 F.2d 970, [3])

"Defense of copyright misuse is available even if defendants themselves have not been injured by misuse." (911 F.2d 970, [4])

ProCD, Inc. v. Zeidenberg - 908 F.Supp. 640 (W.D.Wis. 1996).
"In placing shrinkwrap license provision on its software product, producer seeks to prohibit unauthorized copies; prohibit software rental; prohibit reverse engineering and modifications to software; limit use of software to one central processing unit; disclaim warrantees and limit liability." (908 F.Supp. 640, [12])

"It is only when contract erects barrier on access to information that under copyright laws should be accessible that Copyright Act's preemption provision operates to protect copyright law from individually crafted evisions of that law. 17 U.S.C.A. §301" (908 F.Supp. 640, [25])

Fraudulent Copyright Notice

Fraudulent copyright claims are a Federal crime.

17 U.S.C. 506(c) - Fraudulent Copyright Notice
Any person who, with fraudulent intent, places on any article a notice of copyright or words of the same purport that such person knows to be false, or who, with fraudulent intent, publicly distributes or imports for public distribution any article bearing such notice or words that such person knows to be false, shall be fined not more than $2,500.

Copyright Notice Example

The following copyright notice appears in the Universe II™ VME-to-PCI Bus Bridge Manual[34] from Tundra Semiconductor Corporation (located in Kanata, Ontario, Canada with sales offices in Mountain View, CA USA):

> Copyright
>
> Copyright © November 2002 Tundra Semiconductor Corporation. All rights reserved. Published in Canada.
>
> This document contains information that is proprietary to Tundra and may be used for non-commercial purposes within your organization in support of Tundra products. No other use or transmission of all or any part of this document is permitted without written permission from Tundra, and must include all copyright and other proprietary notices. Use or transmission of all or any part of this document in violation of any applicable Canadian or other legislation is hereby expressly prohibited.
>
> User obtains no rights in the information or in any product, process, technology or trademark which it includes or describes, and is expressly prohibited from modifying the information or creating derivative works without the express written consent of Tundra.

It contains the following elements:

- *"Copyright © November 2002 Tundra Semiconductor Corporation. All rights reserved. Published in Canada."*

  > *17 U.S.C. § 104(c). Subject matter of copyright; National origin.*
  > "Effect of Berne Convention.— No right or interest in a work eligible for protection under this title may be claimed by virtue of, or in reliance upon, the provisions of the Berne Convention, or the adherence of the United States thereto. Any rights in a work eligible for protection under this title that derive from this title, other Federal or State statutes, or the common law, shall not be expanded or reduced by virtue of, or in reliance upon, the provisions of the Berne Convention, or the adherence of the United States thereto."

- "*This document contains information that is proprietary to Tundra and may be used for non-commercial purposes within your organization in support of Tundra products. No other use or transmission of all or any part of this document is permitted without written permission from Tundra, and must include all copyright and other proprietary notices. Use or transmission of all or any part of this document in violation of any applicable Canadian or other legislation is hereby expressly prohibited.*"

[34] Tundra part number: CA91C142BD; Document Number: 80A3010_MA001_03; Release Date: November 2002. Note that manuals for earlier revisions of the part (e.g. CA91C142) had a different copyright notice.

Atari Games Corp. v. Nintendo of America Inc. - 975 F.2d 832 (Fed. Cir. 1992)
"The Copyright Act permits an individual in rightful possession of a copy of a work to undertake necessary efforts to understand the work's ideas, processes, and methods of operation.

This permission appears in the fair use exception to copyright exclusivity. Section 107 of the Copyright Act states that 'fair use of a copyrighted work, including such use by reproduction in copies…for purposes such as criticism, comment, news reporting, teaching … scholarship or research' is not infringement. 17 U.S.C. §107. The legislative history of section 107 suggests that the courts should adapt the fair use exception to accommodate new technological innovations." (975 F.2d 832, 842)

ProCD, Inc. v. Zeidenberg - 908 F.Supp. 640 (W.D.Wis. 1996).
"It is only when contract erects barrier on access to information that under copyright laws should be accessible that Copyright Act's preemption provision operates to protect copyright law from individually crafted evisions of that law. 17 U.S.C.A. §301" (908 F.Supp. 640, [25])

- *"User obtains no rights in the information or in any product, process, technology or trademark which it includes or describes, and is expressly prohibited from modifying the information or creating derivative works without the express written consent of Tundra."*

17 U.S.C. 102(b) - Subject matter of copyright: In general
"In no case does copyright protection for an original work of authorship extend to any idea, procedure, process, system, method of operation, concept, principle, or discovery, regardless of the form in which it is described, explained, illustrated, or embodied in such work."

Atari Games Corp. v. Nintendo of America, Inc. - 975 F.2d 832 (Fed. Cir. 1992)
"To protect processes or methods of operation, creator must look to patent laws; author cannot acquire patent-like protection by putting idea, process, or method of operation in unintelligible format and asserting copyright infringement against those who try to understand that idea, process or method of operation. 17 U.S.C.A. § 102(b)." (975 F.2d 832, [17])

Mitel, Inc. v. Iqtel, Inc. – 124 F.3d 1366 (10th Cir. 1997)
"Although element of work may be characterized as method of operation, which is excluded from copyright protection, that element may nevertheless contain expression that is eligible for copyright protection. 17 U.S.C.A. § 102(b)." (124 F.3d 1366, [5])

"Under merger doctrine, copyrightable expression is denied protection from infringement because expression is inseparable from or merged with ideas, processes, or discoveries underlying expression." (124 F.3d 1366, [8])

V. Digital Millennium Copyright Act (DCMA) of 1998

The *Digital Millennium Copyright Act (DCMA) of 1998* affords special protections with regard to the copying of materials which contains security features. However, from the standpoint of creating an interoperable device or a new manual, this does not appear to create any special problems for the clean room design practice described in this document.

Note that some Field Programmable Gate Array (FPGA) devices contain security features to prevent unauthorized copying of a device, such as binary encoding or encryption of the configuration bit stream. These measures are designed to protect against verbatim copying of device configuration data. However, this type of copying adds little value to the clean room design practice, which focuses on the creation of interoperable source codes.

> *The Digital Millennium Copyright Act of 1998: US Copyright Office Summary.*
> "Section 103 of the DMCA adds a new chapter 12 to Title 17 of the U.S. Code. New section 1201 implements the obligation to provide adequate and effective protection against circumvention of technical measures used by copyright owners to protect their works.
>
> Section 1201 divides technological measures into two categories: measures that prevent unauthorized access to a copyrighted work and measures that prevent unauthorized copying of a copyrighted work. Making or selling devices or services that are used to circumvent either category of technological measure is prohibited in certain circumstances, described below. As to the act of circumvention in itself, the provision prohibits circumventing the first category of technological measures, but not the second." (p. 4)

> *U.S. v. Elcom Ltd. – 203 F.Supp.2d 1111 (2002)*
> "Congress, in enacting Digital Millennium Copyright Act (DCMA), was concerned with promoting electronic commerce while protecting the rights of copyright owners. 17 U.S.C.A. 1201 (b)(1)(A,C)"
>
> "Through the Digital Millennium Copyright Act (DMCA), Congress sought to prohibit certain efforts to unlawfully circumvent protective technologies, while at the same time preserving users' rights of fair use. 17 U.S.C.A. 1201(b)(1)(A,C)"
>
> "Congress did not prohibit the act of circumvention under the Digital Millennium Copyright Act (DMCA) because it sought to preserve the fair use rights of persons who had lawfully acquired a work. 17 U.S.C.A. 1201(b)(1)(A,C)"

Congress also placed a clause in section 1201 of the DMCA that permits circumvention of copyright protection systems so long as they are used for reverse engineering purposes.

17 U.S.C.A. 1201(f)(1) - Reverse engineering

"Notwithstanding the provisions of subsection (a)(1)(A), a person who has lawfully obtained the right to use a copy of a computer program may circumvent a technological measure that effectively controls access to a particular portion of that program for the sole purpose of identifying and analyzing those elements of the program that are necessary to achieve interoperability of an independently created computer program with other programs, and that have not previously been readily available to the person engaging in the circumvention, to the extent any such acts of identification and analysis do not constitute infringement under this title."

Glossary of Terms [35]

Words and phrases that appear in **bold face** are defined elsewhere in this Glossary of Terms.

ASIC
Acronym for: Application Specific Integrated Circuit. An arbitrary **trade name** for a **semiconductor chip product** as defined under 17 U.S.C. 901(a)(1). The intermediate form of the ASIC is a generic array of logical or analog building blocks, with each block being defined by either a fixed function or a programmable function. The intermediate form of the ASIC is defined by a **back end design**. The final form of the ASIC is customized for a particular use by means of a plurality of conduction paths contained in at least one metallization layer. These paths are used both to configure the programmable function blocks (if present), and to connect the logical or analog building blocks together so that the device performs its useful, intended operation. The configuration of the metallization layer is determined by a **front end design**. Both the intermediate and final forms of the ASIC are produced at a **silicon foundry**. Alternative trade names for ASIC devices are: *gate array*, *standard cell device, macrocell array* and *application specific device*.

Other definitions for *'ASIC'* that exist in the trade[36] include:

> *Lundberg §1.02D - Application Specific Integrated Circuits (ASICs)*
> "One type of integrated circuit that is used in complex digital systems is the ASIC. These circuits are made by arranging and interconnecting small component circuits, known as *standard cells* or *macrocells*, to form a larger circuit. This arrangement and interconnection may be done explicitly or it may be done implicitly aided by ASIC design tools running on a computer workstation.
>
> For an implicitly specified circuit, the designer specifies input terminals and output terminals and then defines a mapping function that translates the input signals to the output signals. This mapping function may be a state diagram or it may appear to be a computer program written in a block-structured language. Based on the mapping

[35] A patent is its own lexographer.

> Chisum, Donald. Chisum on Patents §3.02[1][c], Vol. 1 2007
> Federal Circuit decisions acknowledge that a prior art reference need not use the same language as a patent claim, that is, that anticipation need not be 'ipsissimis verbis.'"
>
> White Consolidated Industries, Inc. v. Vega Servo-Control, Inc. 214 USPQ 796, 834
> "Words of patent are given their ordinary and accustomed meaning unless it appears that inventor used them differently; meaning that inventor gives to his words cannot be made to depend upon subsequent events but should appear with application is filed; ordinary meaning of word must be determined from meaning given word by those skilled in art; however, expert's definition of word is not binding on court."

[36] The definition is provided for informational purposes only, and is not part of the formal definition in this Glossary of Terms.

function, the ASIC design tools generate a simulated macrocell layout and interconnection that will achieve the desired function.

The designer can interactively test and modify this simulated layout either by changing the mapping function or by explicitly changing the interconnection of the macrocells. When the simulation produces acceptable results, the design is complete. The computer files describing the simulated layout are then transferred to the ASIC manufacturer, who translates the design into maskworks and generates the actual integrated circuit. When implicit design techniques are used, the designers of a particular ASIC may not be able to describe the circuitry that performs the function. Thus, it may be difficult for an attorney or agent to describe the circuit in a patent application. One solution to this problem is to include the functional specification of the operation of the ASIC either as a table in the specification or as a software appendix. Another solution is to describe the ASIC using state transition diagrams, timing diagrams, or flowchart diagrams that show the relationship between the input and output signals." (p. 8 – footnotes omitted)

back end design
A tangible, physical embodiment for an electronic circuit expressed as artwork, fabrication drawings, bills of material, composition of matter, manufacturing processes and/or technical reference manuals. A copyrightable works that may also express statutory matter under patent law. A mechanism. Also see: **front end design**.

CLASS Machine
An acronym for *Configurable Logic Array SuperStructure.* It is defined[37] as:

> A **software mechanism** comprising:
>
> a **front end design** for a useful electronic system;
>
> at least one conversion means whereby said **front end design** is adapted to a first executable form and a second executable form;
>
> a first circuit topology being selected from a group consisting of **ASIC**, **FPGA**, **full custom device** and **discrete circuit**;
>
> a second circuit topology being selected from a group consisting of **ASIC**, **FPGA**, **full custom device** and **discrete circuit**;
>
> said first executable form being operable with said first circuit topology, and said second executable form being operable with said second circuit topology;
>
> said first executable form being inoperable with said second circuit topology, and said second executable form being inoperable with said first circuit topology.

clean room design practice
Design practices for creating an original works for an **interoperable device** and a **new manual** which do not infringe on the patent, copyright, trademark or trade secrecy rights incorporated into an **original device** or an **original manual**. The original works: (a) may or may not incorporate public domain materials, (b) does not infringe on the patent rights of others, but such infringement may exist without the knowledge of those creating the design, and (c) may

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[37] Silicore Corporation has abandoned all U.S. and International patent rights to the CLASS Machine as applied under 35 U.S.C. 102(c), and has assigned them to the public domain. Similarly, 'CLASS' and 'CLASS Machine' are former common law trademarks of Silicore Corporation that have been injected into the public domain.

Furthermore, the definition for the CLASS Machine is presented in the form of a patent claim under the pretense that the invention it expresses already exists in the public domain. Prior art which meets the claim specification has been in public use for more than one year prior to the first public disclosure of the CLASS Machine definition, and is therefore unpatentable.

> *35 U.S.C. 102(b) - Conditions for patentability; novelty and loss of right to patent.*
> "A person shall be entitled to a patent unless — … (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of the application for patent in the United States, …"
>
> *Honeywell Inc. v. Sperry Rand Corporation et al. - 180 USPQ 673 (1973)*
> 13.34.13 On February 28, 1956, a conference was held between Thibodeau and McGee (of Ordnance), and Boberg and Hogan (attorneys for IBM), in which it was pointed out by IBM that, if a dedication to the public of the inventions claimed in the ENIAC application because of public use could be shown, the claims being contested in the IBM-Sperry Rand interferences would fall into the public domain." (180 USPQ 673, 719)

incorporate novel, patentable methods which are not present in the **original device**. In terms of trade secrets the design shall not incorporate any **proprietary information** obtained through a non-disclosure agreement or by any illegal or unethical means. In some cases it uses intellectual property that has been protected by others, but permission for doing so must be obtained in writing, and restrictions of use must be clearly identified in writing in the **new manual**. Reasonable due-diligence shall be performed to determine if any form of intellectual property infringement exists, under applicable US law. [Note: within this context the term 'clean room' does not refer to the place where semiconductors are fabricated].

device
An integrated circuit (chip).

discrete circuit
An arbitrary trade name for an electronic circuit made from a plurality of components, and which includes: (a) logical or analog building blocks, and (b) a plurality of conduction paths. The logical or analog building blocks being made from a group largely consisting of: transistor, diode, sub-assemblies incorporated into a **semiconductor chip product** as defined under 17 U.S.C. 901(a)(1), electron (vacuum) tube, electromechanical relay, optical switching element, resistive element, capacitive element and inductive element. The conduction paths are made from a group consisting of: insulated wires, cladding incorporated into a printed wiring board and optical fiber. A **front end design** defines the operation of the discrete circuit, and the **back end design** defines its physical topology. Examples of 'sub-assemblies incorporated into a **semiconductor chip product**' include: the MM74HC00M Quad 2-Input NAND Gate made by Fairchild Semiconductor and the LM741CN operational amplifier made by National Semiconductor.

emulator
An arbitrary trade name for an electronic device or system that mimics the function of another electronic device or system. It is usually implemented as a special purpose hardware element and is used for the purpose of evaluating the performance of another circuit, including the identification of defects therein. A common example is a *microprocessor emulator*, a device which runs the software of a particular microprocessor and mimics its electronic behavior, including the replication of external timing signals (waveforms). Also see: **simulator**.

Other definitions for *'emulator'* that exist in the trade[38] include:

[38] These definitions are provided for informational purposes only, and are not part of the formal definition in this Glossary of Terms.

em·u·late -verb (related form: emulator -noun)
3. Computers. a. to imitate (a particular computer system) by using a software system, often including a microprogram or another computer that enables it to do the same work, run the same programs, etc., as the first. b. to replace (software) with hardware to perform the same task.

From: Dictionary.com Unabridged (v 1.1), based on
Random House Unabridged Dictionary, © Random House, Inc. 2006

emulate .v (related form: emulator .n)
Computer Science. To imitate the function of (another system), as by modifications to hardware or software that allow the imitating system to accept the same data, execute the same programs, and achieve the same results as the imitated system.

From: Dictionary.com Unabridged (v 1.1), based on
The American Heritage® Dictionary of the English Language, 4th Ed.

FPGA
Acronym for: Field Programmable Gate Array. An arbitrary **trade name** for a **semiconductor chip product** as defined under 17 U.S.C. 901(a)(1). The final form of an FPGA is a generic array of logical or analog building blocks, with each block being defined by either a fixed function or a programmable function. It contains a plurality of programmable conduction paths which are used to connect the logical or analog building blocks together. The programmable function blocks and programmable conduction paths are modified by configurable memory cells located on the device. The final form of the FPGA is defined by a **back end design**. The FPGA is customized for a particular use by means of the configurable memory cells, whose programming is determined by a **front end design**. The final form of the FPGA is produced at a **silicon foundry**. The device can be customized for a particular use by programming the configurable memory cells at field locations other than the **silicon foundry**. Alternative trade names for FPGA devices are: *programmable devices*, *complex programmable logic devices (CPLD)*, *programmable array logic (PAL)*, *generic array logic (GAL)* or *field programmable analog arrays* (FPAA).

front end design
The functional operation of an electronic circuit that is expressed as **software**. A copyrightable works that expresses non-statutory matter under patent law, but which may patentable when combined with a **back end design**.

Gottschalk, Acting Commissioner of Patents v. Benson et al. - 409 US 63 (1972).
"Respondents filed in the Patent Office an application for an invention which was described as being related 'to the processing of data by program and more particularly to the programmed conversion of numerical information' in general purpose computers. (They claimed a method for converting binary-coded decimal (BCD) numerals into pure binary numerals.) The claims were not limited to any particular art or technology, to any particular apparatus or machinery, or to any particular end use. They purported to cover

any use of the claimed method in a general-purpose digital computer of any time." (409 US 63, 64)

Microsoft Corporation v. AT&T Corporation - 127 S.Ct. 1746 (2007)
"A blueprint may contain precise instructions for the construction and combination of the components of a patented device, but it is not itself a combinable component." (127 S.Ct. 1746, 1748)

full custom device
An arbitrary trade name for a particular type of **semiconductor chip product** as defined under 17 U.S.C. 901(a)(1). The full custom device implements logical or analog functional blocks at a **silicon foundry** as custom layers of metallic, insulating, or semiconductor material which are deposited or otherwise placed on, or etched away or otherwise removed from, a piece of semiconductor material. The **front end design** defines the operation of the microcircuit, and the **back end design** defines the physical topology of the custom layers. Both are merged together, and can be defined by a **mask work** under 17 U.S.C. 901(a)(2).

interoperable device
A replacement device that is form, fit and function compatible with an **original device**. It must work with appropriate third party products and services which may be obtained in an open market, including (but not limited to) assemblers, compilers, **emulators**, logic analyzers and **simulators**. Some compatibility deviations are permitted so long as they are documented.

IP Core
Acronym for: Intellectual Property Core.

know-how
Knowledge and skill of how to do something. Includes both tangible and intangible information; mere thought.

Honeywell Inc. v. Sperry Rand Corporpation et al. - 180 USPQ 673 (1973)
15.25.1.3 Shortly before the 1956 SR-IBM Agreement was executed, J. Presper Eckert, then a UNIVAC executive, expressed opposition to the agreement. Among other things, Eckert was concerned about the treatment of "some dubious information known as 'know-how' (whatever that is)". Eckert also wrote: "A considerable emphasis has been placed on the value of something known as 'know-how' (presumably this means manufacturing drawings, etc.) to us. I cannot find anyone in Engineering who actually knows how we can use this so-called valuable know-how." (180 USPQ 673, 740)

manual
A technical reference manual, data sheet or other form of literature that expresses the form, fit or function of a **device** or **software**.

mask work(s)
A *mask work* is a series of related images, however fixed or encoded – (A) having or representing the predetermined, three-dimensional pattern of metallic, insulating, or

semiconductor material present or removed from the layers of a semiconductor material present or removed from the layers of a semiconductor chip product; and (B) in which series the relation of the images to one another is that each image has the pattern of the surface of one form of the semiconductor chip product. Ref: 17 U.S.C. 901(a)(2).

mental steps
Any information process, or its equivalent, that occurs naturally in the human body such as might take place in the nervous system, the endocrine system and during DNA replication. The process may be practiced by hand, augmented in some cases by pencil and paper markings. Equivalent to the terms: *mental acts* and *mental processes*.

Supplemental information (for information only – not part of the formal definition):

> Application of Prater – 415 F.2d 1393 (1969)
> "*Purely* mental steps" are considered to be steps which may only be performed in, or with the aide of, the human mind. This is quite in contrast to "*purely* physical steps" which only be performed by physical means, machinery, or apparatus. *Purely* mental steps (e.g., "believing") are quite different from *purely* physical steps (e.g., "heating") in many respects, not the least of which is that the former are much less susceptible to specific definition or delineation. Between the *purely* mental and *purely* physical ends of the spectrum there lies an infinite variety of steps that may be either machine-implemented or performed in, or with the aide of, the human mind (e.g., "comparing" and "determining). In ascertaining whether a particular step is "mental" or "physical," each case must be decided on its own facts, considering all of the surrounding circumstances, to determine which end of the spectrum that step is nearer. It may well be that the step of "comparing" may be "mental" in one process, yet "physical" in another. *Disclosure* of apparatus for performing the process without human intervention may make out a *prima facie* case that the *disclosed* process is not mental and is, therefore, statutory. See Kayton, Patent Protectability of Software: Background and Current Law, in the Law of Software 1968 Proceedings B-25 (1968). Here, of course, the patentability of the *disclosed* process is not the question; but that is not to say that the *claims* delineate a patentable process." (415 F.2d 1393, footnote 22)
>
> "In our view, appellants would really like us to read a limitation of the specification into the claims, not merely interpret the claims in the light of the specification. When read in the light of the specification, claim 9 does read on a mental process augmented by pencil and paper markings. We find no express limitation in claim 9 which, even when interpreted in the light of the specification, would support the conclusion that the claim is limited to a 'machine process' or 'machine-implemented process.' This is particularly important in this case since the board noted that, in their brief before the board, appellants acknowledged that '[t]hough not practical for most of the needed applications, their method, theoretically, can be practiced by hand." (415 F.2d 1393, 1404)
>
> *Parker – The Nervous System*
> "The nervous system actually comprises three systems or components, defined by both anatomy and function. The central nervous system, CNS, is central to the body's

structure and workings. It is composed of the brain and its chief nerve, the spinal cord, which runs along the inside of the backbone (spinal or vertebral column). From the CNS branch 45 pairs of nerves: 12 from the brain and 31 from the cord. As these divide, snake among organs and tissue, and infiltrate every tiny nook and cranny, the form the network of the peripheral nervous system, PNS. The CNS can be viewed as the coordinator and decision-maker, with the PNS sending information as sensory input, and receiving instructions as motor output to muscles and glands. The third component is the autonomic nervous system, ANS. This has some elements located in the CNS and shares some nerves with the PNS; it also has its own nerve chains alongside the spinal cord. Its work is primarily 'automatic' in that it deals with activities such as blood pressure control and heart rate adjustment, of which we are rarely aware." (p. 68)

Parker – The Endocrine System

"The endocrine system is composed of bodies of glandular tissue, such as the thyroid, as well as glands within certain organs, such as the testes, ovaries, and heart. The system uses hormones to control and coordinate body functions in much the same way as the nervous system uses tiny electrical signals. The two systems are integrated in the brain and complement each other, but they tend to work at different speeds. Nerves respond within split seconds but their action soon fades; some hormones have longer-lasting effects and act over hours, weeks and years. Hormones regulate processes such as the breakdown of chemical substances in metabolism, fluid balance and urine production, the body's growth and development, and sexual reproduction. Hormone output from a gland can be influenced by several factors including levels of substances in the blood and input from the nervous system. Since hormones travel in the blood, each hormone reaches every body part. However, the specific molecular shape of each hormone slots only into receptors on its target tissues or organs." (p. 104)

Parker - DNA Replication

"Apart from carrying genetic information in chemically coded form, as its sequence of base pairs, DNA has another key feature. It can make exact copies of itself in a process known as replication. It does this by separation of the two backbone strands and the bases attached to them, at the bonds between the base pairs. Then each strand acts as a template to build a complementary partner strand. (p. 223)

Diamond, Commissioner of Patents and Trademarks v. Diehr et al. - 450 US 175 (1981)

"Excluded from patent protection are laws of nature, natural phenomena, and abstract ideas." (450 US 175, 185)

microcircuit

n. a microelectronic computer circuit incorporated into a chip or semiconductor; a whole system rather than a single component [syn: integrated circuit].

From: Dictionary.com Unabridged (v 1.1), based on WordNet® 3.0, © 2006 by Princeton University.

ministerial
-adj. Of or relating to an act that involves obedience to instructions or laws instead of discretion, judgment, or skill. <the court clerk's ministerial duties include recording judgments on the docket>.

ministerial act
-n. An act performed without the independent exercise of discretion or judgment.

Black's Law Dictionary, 8th Ed.

new manual
An original literary works that describes the form, fit and function of an **interoperable device**.

obfuscated code
Software source code, including but not limited to **open source software**, that is altered in order to make it difficult to read or understand by the human mind. It can be used to prevent reverse engineering or adaptation of open source software. The process of obfuscation can be performed manually or by way of an automated process (such as a compiler or a synthesis tool). Also known as: *shrouded code*.

open source software
Software whose licensing permits the unrestricted display and distribution of source code.

original device
An integrated circuit on which an **interoperable device** is based.

original manual
A **manual** which has been supplied by the manufacturer or assigned owner of an **original device**.

peeling
Reverse engineering of an integrated circuit through the use of mechanical, chemical and microscopic analysis. Generally, this involves direct observation of the circuit dice using visual microscopy, electron beam microscopy or chemical analysis such as Auger electron beam microscopy.

plagiarism
n 1: a piece of writing that has been copied from someone else and is presented as being your own work 2: the act of plagiarizing; taking someone's words or ideas as if they were your own [syn: plagiarization, plagiarisation, piracy]

From: Dictionary.com Unabridged (v 1.1), based on

practitioner
A person who is participating in a project using the **clean room design practice** set forth in this document.

proprietary information
Information that is protected as a trade secret. Also see: **public domain information**.

public domain
Without intellectual property protection in the form of a copyright, patent, trademark or trade secret.

public domain document
A document that is not copyright protected.

public domain information
Information that is not protected as a trade secret. Also see: **proprietary information**.

public license
Privately owned intellectual property rights established by patent, copyright or trademark, which has been made available under the terms of a limited public license such as the General Public License (GPL) or the Berkeley Software Distribution (BSD) license.

recuse
To disqualify or seek to disqualify from participation in a decision on grounds such as prejudice or personal involvement.

The American Heritage Dictionary, 4th Ed.

semiconductor chip product
A *semiconductor chip product* is the final or intermediate form of any product – (A) having two or more layers of metallic, insulating, or semiconductor material, deposited or otherwise placed on, or etched away or otherwise removed from, a piece of semiconductor material in accordance with a predetermined pattern; and (B) intended to perform electronic circuitry functions. (Ref: 17 U.S.C. 901(a)(1)).

silicon foundry
A factory that produces a **semiconductor chip product**.

simulator
An arbitrary trade name for a functional model for an electronic device or system, and which is usually implemented as software on a general purpose computer. Also see: **emulator**; **simulation engine**.

simulation engine
An arbitrary trade name for a **simulator** which has been implemented on special purpose computer hardware that has been especially designed and implemented for that purpose. Also see: **simulator**.

software
Machine instructions expressed in various forms of abstraction, such as: (a) symbolic objects, (b) state diagrams, (c) source code or binary encoded instructions for a general purpose computer organized as a Turing machine or a multi-threaded data processor, (d) schematic diagram, Hardware Description Language (HDL), (e) logical truth table (f) timing diagram, or (g) a compilation of data.

Other definitions for *'software'* that exist in the trade[39] include:

> Software n. Computer Science
> The programs, routines, and symbolic languages that control the functioning of the hardware and direct its operation.
>
> American Heritage Dictionary, 4th Ed.

> Software n : (computer science)
> Written programs or procedures or rules and associated documentation pertaining to the operation of a computer system and that are stored in read/write memory.
>
> From: Dictionary.com Unabridged (v 1.1), based on WordNet ® 1.6, © 1997 Princeton University

> Software
> 1. Vendor-supplied or user-generated programs or groups of programs for a computer or computer system. 2. The detailed instructions for performing a particular operation with a calculator or a computer.
>
> Illustrated Dictionary of Electronics, 3rd Ed.

> Software
> (1) Computer programs, procedures and possibly associated documentation and data pertaining to the operation of a computer system. (2) Computer programs and data. (3) The programs, procedures, rules, and any associated documentation pertaining to the operation of an information processing system. (4) A generic term referring to software objects or a structured set of files. This term can refer to the objects forming the hierarchical structure (software objects), or to the actual files and control files (software files). (5) Computer programs and computer databases. (6) Computer programs, procedures, and associated documentation and data pertaining to the operation of a computer system.
>
> IEEE Authoritative Dictionary, 7th Ed.

[39] These definitions are provided for informational purposes only, and are not part of the formal definition in this Glossary of Terms. Note that some definitions imply a related form of '*software'* called *firmware* … a type of *'software'* that resides in a computer read-only-memory (ROM).

software mechanism
A useful apparatus under the control of a specific **software** programmable electronic computing element. A statutory element which, if novel, would be patentable under 35 U.S.C. Also see: **CLASS Machine**; **front end design**.

trade secret information
Information that is protected under the Uniform Trade Secrets Act or its locally established equivalent.

> *Uniform Trade Secrets Act (1984 Amendments) – Sec. 1(4), Definitions*
> "TRADE SECRET means information, including a formula, pattern, compilation, program, device, method, technique, or process, that:
>
> (i) derives independent economic value, actual or potential, from not being generally known to, and not being readily ascertainable by proper means by, other persons who can obtain economic value from its disclosure or use, and
>
> (ii) is the subject of efforts that are reasonable under the circumstances to maintain its secrecy."

trade name
A trademark or an arbitrary name used in trade[40].

unclean hands
An equitable doctrine; a complainant will be denied relief if he or she has engaged in misconduct (as acting in bad faith) directly relating to the complaint; also, the condition of having engaged in such misconduct and being barred from equitable relief <may not be invoked by a plaintiff with unclean hands —Royal Sch. Labs., Incorporated v. Town of Watertown, 358 Federal Reporter, Second Series 813 (1966). NOTE: Unclean hands on the part of the plaintiff is often pleaded as an affirmative defense by the defendant.

From: Dictionary.com Unabridged (v 1.1), based on
Merriam-Webster's Dictionary of Law, © 1996 Merriam-Webster, Inc.

[40] See: Faber, *§6.3 - Trademarked Materials; Arbitrary Names.*

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