KEYNOTE: Reducing the risk of supply chain problems by use of FPGAs

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Supply Chain Problems

Massive shortage of Integrated Circuits for nearly all applications

Multifactorial causes:

- **Slow market in 2019 and even low forecast for 2020 especially from car manufacturers lead to low inventory and investments**
- **Due to corona crisis more and more people work at home and need PC equipment and internet infrastructure**
- **Consequently, big growing demand for PC, Mobile Phone and Internet access applications in 2020 due to corona crisis**
- **Fast growing semiconductor demand for electric cars in 2020 and 2021**
- **Similar causes for supply shortage of basic products for semiconductor fabs**

RESULT: Massive allocation and shortage of nearly all chips.

High Vulnerability of Electronic Industry

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Even small PCBs need more than 100 components.

Bigger PCBs and those populated on both sides quickly reach more than 1000 components.

It must be distinguished between components which can be replaced by similar components or components from another manufacturer.

This is true for most of the capacitors and resistors.

<u>Normally all ICs are single source components!</u>

RESULT: PCB cannot be manufactured even if one chip is missing.

Using the right Chip package

Most of the semiconductor chips come in different packages.

Even if the chip is available in one or more of the possible packages, only in case the package is matching the footprint on the PCB you can solder it on the PCB.

In some but rare cases it is possible to use a compatible footprint for different packages on the PCB.

To reduce shortage risks it is advisable to select the most popular package which is in stock at several distributors.

ADVISE: Use available components having only one package option.

Reducing Chip Count

In many cases it is possible to reduce chip count by using higher integrated components. This is often used for memories where you can e.g. replace several memories by one.

A very good strategy is to use FPGAs to integrate several smaller functions into one FPGA. Even microcontrollers and some peripherals are combinable into one FPGA.

ADVISE: Use higher integration.

Side Strategy: Reducing Power

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Already now the EU-legislation restricts power consumption of special electronic functions. Even stand by power of electronic equipment is already restricted by law.

By the so called "green deal" of the EU and the increasing efforts to reduce CO_2 footprint one should already design electronics with the lowest power consumption possible.

On the next slides you see a simple example by using FPGAs to rise power efficiency.

Scenario A: Traditional microcontroller design

Scenario B: FPGA with integrated microcontroller

Traditional Microcontroller Design

Pros:

Fully programmable by e.g. C-Language.

Many sizes and SOCs from different suppliers available.

Many different instruction sets (e.g. ARM, 80xx, MIPS, RISC-V…)

Many different performance categories from 4-bit to 64-bit

Cons:

Real time data processing is difficult.

Interrupts and exceptions need clock frequencies designed for worst case operation. (Significantly higher than for normal operation)

Massive overhead from Opcode Fetch. (10-100% depending on used instruction)

RESULT: Easy to use but high power due to high clock frequencies.

FPGA with Microcontroller

Pros:

Microcontroller only needs to perform control and supervisory functions.

No high interrupt load, only low performance needed.

Main data processing task is done by FPGA circuitry.

FPGA circuitry can run even without clock or using low clock frequency by sophisticated pipelining and data processing specially designed for the application.

Cons:

Two different design domains: C and HDL. (New design methods show that high-level languages can be used to generate the HDL as well.)

RESULT: Lower power and lower EMI by using low clock frequencies.

Reducing Chip Stock Risk

The risk of allocation can also be reduced by using the same components for a variety of end products.

As already explained: Only use one package of the chips

FPGAs can help to concentrate on only a small set of them for many products.

For those components selected as “standard FPGA components” storage reach should be at least 6 months. One should not use a just in time supply because these supply chains are very likely to broke.

Adapting storage reach to lead time of components.

Summary

- Massive shortage and allocation for nearly all semiconductor chips partly due to corona crisis.
- Massive impact for electronic industry because of single source chips and high component count on most PCBs.
- Reducing risk by only using chips with one package option.
- Reducing risk and power by using FPGAs to split control and data processing circuitries.
- Use the same FPGAs for a family of end products.
- Use storage at a high level and adapt it to lead times. Don’t use just in time production.

Thank you for your attention!

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