Reading Datasheets

- A datasheet is a document describes a product, helps you determine if it fits your need, and helps you understand how to make it work.
- If you are a design engineer, you will spend a lot of time reading datasheets.
- It is a skill that honed over many years. At first, its daunting.
- If the datasheet is not too long, print it out. Use a highlighter, make notes in the margins, put stickie labels in important sections.
- If you have the time (51min), see: https://www.analog.com/en/education/education-library/webcasts/how-to-read-datasheet.html

Reading Datasheets

The IC designer who writes the first draft of a data sheet wants to emphasize the genius of his or her creation. The marketing manager wants to stress competitive advantages of the product while soft-peddling any drawbacks. The test engineer wants to minimize the time and cost of production testing, and tries to remove all maxima and minima from the table of characteristics, instead replacing them with "typical" values. Corporation lawyers want to make certain that potential (mis)users of the device have no grounds for suing the Corporation. Corporate communications wants the document shrunk from 60 pages to four. And applications engineers (ahem!) want the data sheet so clear and simple that even a software engineer can understand it and they can sleep away their afternoons without the applications inquiry phone ringing. The final product is a compromise, and not always as helpful as it could be. And because data sheets are always produced in a hurry when the product is ready for release they always have some mistakes.
James Bryant, Analog Devices

Reading Datasheets

- To start, know what specifications are important to your design. If you haven't first done your system-level design, shame on you. Go back. Then you will understand what specifications are important.
- Use parametric searching to find the parts they may meet your criterion.
- Stay away from "bleeding-edge" parts that only have preliminary data, only web datasheets, say "contact the factory", "not recommended for new designs", or are very recent Rev A datasheets.
- Check the date of the datasheet, its revision number and see if there are any errata for the part.
- If the part is really old, say a LM741 (circa 1963!), are there more recent parts available that are cheaper, faster, smaller, higher-performance and more available?

Reading Datasheets

- Use recommended operating conditions to make your decisions about suitability.
- Worse case limits are the numbers to stay from if you want a reliable design.
- Worst case numbers represent the widest extent of testing. Beyond these numbers you are likely to damage the part. This damage may not be catastrophic but could manifest its self as flakiness, or a slow degradation.
- Watch out for power supply startup and shutdown conditions as these may exceed worse case values.

Reading Datasheets

- Recommended Operating Conditions: design with these in mind.
- Note carefully the conditions under which component values are determined.
- Read the small print, the super-scripted values, notes at the bottom of the page, in short, everything.
- Don't expect typical values to hold. These are not tested values and are not guaranteed.
- Typical is typical only to whoever wrote the datasheet. Your application may be atypical!
- Min/Max values are not necessarily tested either. They are statistically arrived at but you can be pretty confident in using them.

Reading Datasheets

- Be careful what package your are ordering.
- Note carefully temperature data and what your power dissipation is expected to be.
- Thermal analysis is just like ohms law. Add up the $^{\circ}C/Watt$ from die to ambient. At room temperature, your die will be much warmer than room temperature. $70\,^{\circ}C$
- Are you operating in commercial range ($0 - 70\,^{\circ}C$) or military ($-40\,^{\circ}C$ to $125\,^{\circ}C$)?
- Note that some pin functions have different pin numbers in different packages!

Reading Datasheets

- App notes or example circuits are great sources of information.
- Evaluation boards are expensive, but get the data package for them and examine their schematics and part choices.
- Application notes help you understand what to do with unused pins, decoupling capacitors, input and output pin terminations, etc.
- Remember that equivalent circuits or simplified schematics for ICs are not what you should necessary expect, but are there to give you some insight as to how they operate.
- Min, max and typ table don't disclose behavior of a device under non-standard operating conditions.
- Spice macro models, are generally simplified for fast execution and are not intended for detailed analyses or non-standard operation. Complex Spice models used by the circuits designers are rarely published because they would provide competitors with too many insights.) - *James Bryant, Analog Devices*
- Some vendors offer both symbols and footprints for popular schematic and PCB tools.