IC Knowledge LLC, PO Box 20, Georgetown, MA 01833
Web site: www.icknowledge.com email: info@icknowledge.com
Tx: (978) 352 – 7610, Fx: (978) 352 – 3870

IC Knowledge – Adding Processes to our models

I have been receiving a lot of Add Process Request forms recently and most of them have been either incomplete or contained errors. I thought it would be useful to provide more guidance on adding processes.

First off, there are tens of thousands of processes in use in the industry and we can't reflect them all. Process coverage in our models has two main sources:

1. When major companies release a leading edge - platform process we add that to the model. These types of processes from GLOBALFOUNDRIES, Intel, Samsung, SMIC, ST Micro, TSMC, and UMC are the types of processes that TechInsights does teardowns on and there are typically conference papers covering these processes. The tear downs and conference papers provide us with the information to add these processes to the models.
2. Customer requests for us to add processes. When customers request processes, we add them to the model and they are then distributed to all our customers. These processes are typically specialty processes at smaller foundries or run by the larger foundries in smaller volumes.

A few things to be aware of:

1. When you fill out an add processes request form, the resulting process will be released to everyone, it is essential the information on the form be complete and correct. **Please do not guess.** If you don't have the required information, ask your supplier or pay for a teardown.
2. You can ask us for help with a process, but you need to understand there are a lot of things that we can't figure out for you. For example, many processes have a base process and then dozens of optional modules, we have no way of knowing which modules you use, and every module adds cost and they all add different amounts of cost.
3. Suppliers generally do not like our model because it helps you the customer negotiate with them, we can't ask the supplier for process information, they won't provide it to us although they may provide it to you as a customer.
4. There are some suppliers such as XFab that have detailed process information on their web site but even here we need to know what process modules you use.

In summary, our ability to help you add a process is limited. If you submit an incomplete or obviously wrong add process request form to us it will be returned to you. You need to invest the time and resources to correctly and completely fill out the form.

We currently produce five different cost and price models and each model targets specific applications and processes. The following is some more information on the segmentation.

IC Cost and Price Model

This was our first commercial model and still sells the most units. This model is for low power silicon integrated circuits currently in production or due in the next year.

This model is appropriate for microcontrollers, microprocessors, embedded processors, digital signal processors, ASICs, FPGAs, cell phone application processors, NOR Flash and RF front end devices.

The types of processes the model covers are:

- CMOS – the mainstream low voltage/low power IC technology (<20 volts).
- BiCMOS – CMOS with added bipolar devices such as NPNs, PNPs or both. Please note that this is still for low power/low voltage applications (<20 volts). If you say on the add process request that a process is BiCMOS you should be answering yes to either NPN or PNP or both in the bottom section of the sheet, if the process doesn't have either it isn't BiCMOS.
- RFCMOS – CMOS with added feature for RF such as metal-insulator-metal (MIM) capacitors, high value resistors, thick top metal for inductors and additional wells.

Each of these processes have variants, CMOS can be single, dual or triple gate oxide, have various number of metal layers and various numbers of threshold voltages. We must have accurate numbers of gate oxide thicknesses, metal layers and threshold voltages to accurately model these processes. There are also many ways to convert a CMOS process to BiCMOS or RFCMOS and we need to know how this was done to model the process. The add process request sheet has the minimum information set we need to model these processes. Sometimes we have data on how specific companies approach these things and we can looks them up for you but once again please remember there are many thousands of variants and we only have data on a sub set.

The IC Cost and Price Model does not cover high voltage/power (>20 volts) ICs, does not cover discrete devices such as power MOSFETs, IGBTs, Thyristors, Triacs, or diodes. The IC Cost and Price Model does not cover compound semiconductors such as gallium arsenide, gallium nitride or silicon carbide. Processes such as BCD and HVCMOS used for power ICs are not covered in the IC Cost and Price Model. These types of devices will not be added to the IC Cost and Price Model.

We also do not add any processes to the IC Cost and Price Model that are not due to enter production in the next twelve months (those are covered below).

Thee IC Cost and Price Model has some DRAM and NAND coverage but the leading-edge DRAM and NAND processes are better covered in our Strategic Cost and Price Model.

Discreet and Power Products Cost and Price Model

This was the second model we introduced, and it is growing in usage particularly for automotive applications. This model covers discreet devices, high power/voltage ICs (>20 volts) and compound semiconductors.

Examples of discreet devices covered include:

- Power MOSFETs
- IGBTs
- Thyristors
- Triacs
- Power or high voltage Diodes
- Integrated passive devices (IPD)
- MOS Capacitors.

For integrated circuit processes the main examples are:

- BCD – Bipolar/CMOS/DMOS – these processes have CMOS with NPN or PNP or both types of bipolar devices and DMOS devices that provide high voltage/power capability. BCD processes are widely used in automotive and power control ICs. Example of BCD processes are BCDx (where x is a number) from ST Micro and Robert Bosch, PCBx from Polar Fab or LBCx from Texas Instruments.
- HVCMOS – processes that support mode than 20 volts such as display drivers.

Compound semiconductors:

- Gallium Arsenide (GaAs) - ICs and substrates. GaAs is typically used for RF.
- Gallium Nitride (GaN) - ICs, substrates and discrete devices. GaN is used for very high power or RF applications.
- Silicon Carbide (SiC) – primarily discrete devices and substrates. SiC is used for high power and automotive applications.

MEMS Cost and Price Model

This was our third model that we introduced and is the most complex of the three because the products are the most complex. The add process request form does not cover MEMS products because as outlined below they are too complicated and nonstandard. To add MEMS products, you need to engage in an email conversation with us.

MEMS stands for Micro-Electro-Mechanical-System. MEMS are tiny mechanical devices with moving elements fabricated by utilizing semiconductor processing technology. MEMS devices are typically used to either sense something such as pressure or movement or to move something such as a mirror or other mechanical element.

There are three basic approaches to MEMS products and the model covers all three:

1. A single MEMS device in a package. This is common for pressure sensors but can also be used for many other applications, for example a VCSEL (Vertical Cavity Surface Emitting Laser) is often a laser diode with a MEMS structure on it for laser tuning. In the case of VCSELs the substrate is often GaAs and the MEMS Cost and Price Model does support a variety of substrate types beyond silicon.
2. A MEMS device and an IC in the same package, for example Robert Bosch makes accelerometers that are a MEMS devices to sense acceleration and an IC to perform signal conditioning in the same package. The MEMS Cost and Price Model can model up to two MEMS die and up to two IC die in one package to cover these kinds of products. Figure 1 illustrates an example of a MEMS device and figure 2 illustrates a MEMS device and an IC in the same package.

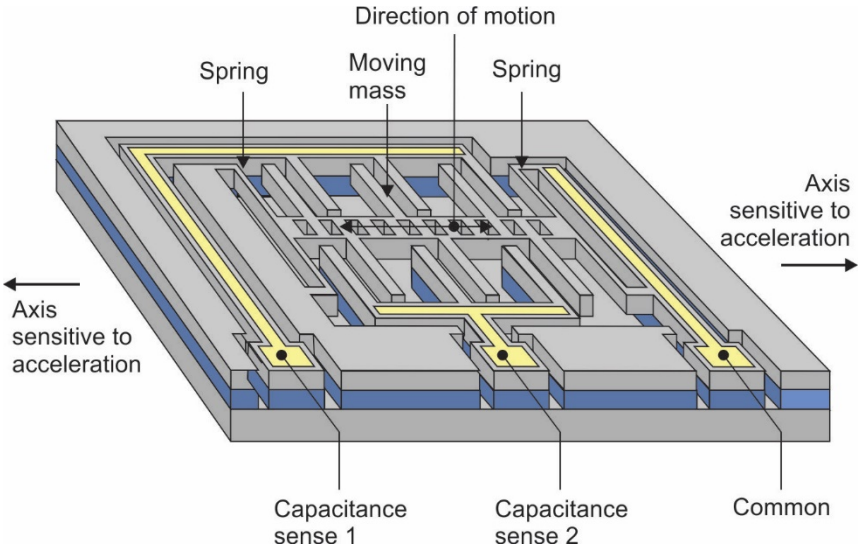

Figure 1. MEMS accelerometer die.

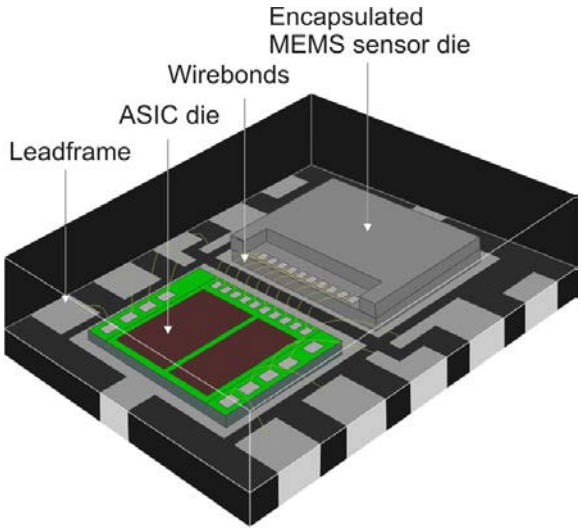

Figure 2. MEMS accelerometer and IC die packaged together as a MEMS product.

3. Integrated MEMS – an integrated MEMS device is an integrated circuit that has a MEMS device fabricated on the same die. For example Texas Instruments digital micro mirror devices are an SRAM IC with the mirror fabricated in the upper metal layers. Analog Devices fabricates accelerometers on top of an IC process and Cavendish Kinetics fabricates RF tuner capacitor arrays on top of an IC process. Integrated MEMS is covered in the MEMS Cost and Price Model in the IC portion of the model because the processes are predominantly an IC process.

The MEMS Cost and Price Model also includes some specialty devices that fit into the MEMS portion of the model such as laser receiver diodes.

Strategic Cost and Price Model

This is our most complex model and has now become or biggest selling model on a dollar basis. The Strategic Cost and Price Model is a state-of-the-art forward-looking wafer only model. The Strategic Cost and Price Model covers 2D and 3D NAND, 3D XPoint, DRAM, Foundry and IDM logic and silicon photonics processes and forward projects into the 2020s. This model is displays more detail and is more customizable than the IC Cost and Price Model. This is the model of choice for materials and equipment companies and is also used by some IDMs and analysts.

Packaging Cost and Price Model

Our newest model this was just released this year. The IC Cost and Price Model, Discrete and Power Products Cost and Price Model and MEMS Cost and Price Models all have packaging cost modules, but they are simple modules based on market surveys and have limited customizability. After many customer requests we built the Packaging Cost and Price Model that is a bottom up model that allows full customization of package configurations. We will eventually integrate a sub set of the Packaging Cost and Price Model capability into the other models, but we need to do that while keeping the other model in their easy to use format.

Update Timing

With five models to maintain we are trying to do model updates every other month for each model. There is considerable overhead involved in opening a model making updates and then closing it again plus getting all of the information together. When you request us to add a process we will add it to the next model update. You can see when the updates are schedule by looking on our web site here: http://www.icknowledge.com/news/newreleases.html

Due to the volume of customer support and add processes request we get we can no longer offer expedited process additions.

Getting Help

Please, please, please read the model manuals before contacting us for support. We are having a difficult time keeping up with all the support requests we get and the majority of them are explained in the manuals.

There are also red dots in the models and if you put your mouse pointer over the red dots a comment field will pop open explain each setting.

Also, please keep in mind that as a cost model customer you are entitled to reasonable email and phone support on how to use the model. Support does not include training you on the basics of semiconductor technology, that is your responsibility. Support also does not include consulting on semiconductor technology or trends, that is available from us as a paid consulting service.