White Paper

MoBL™: The New Mobile SRAM

Introduction

Communication is the key to modern society. People would like to be connected wherever they are, regardless of what they are doing. This, in turn, has caused the rapid expansion of the use of wireless communication devices, which give the user the freedom to communicate and exchange ideas from anywhere. Most mobile communication units take the form of pagers, cellular phones, advanced PDAs, etc.

This white paper covers cellular phones and the memory inside those phones.

Cell Phone

A simple block diagram of a typical cellular phone is shown in *Figure 1*.

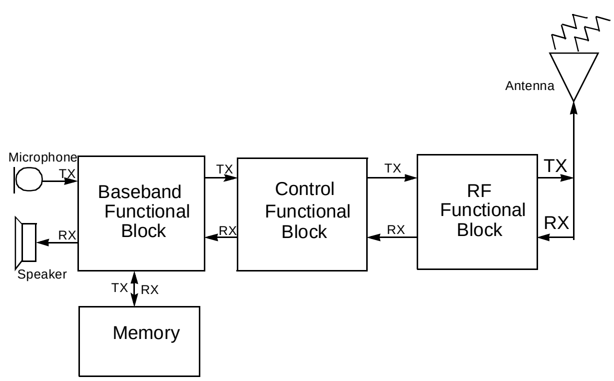

Figure 1. Block Diagram of a Cellular Phone

The primary components of a cell phone are the RF unit, DSP for control, ASIC for baseband processing, and memory. The memory size will vary depending on the kind of cell phone and the feature set of the cell phone. Most digital phones use a significant amount of memory. The memory could be embedded into the signal processor or reside in an external Flash, PROM, or an SRAM.

The SRAM memory in the cell phone is primarily used to store frequently accessed data and temporary variables generated by the ASIC. As the features in the cell phones expand, the memory size also increases. Newer phones will have 4 Mb or more of SRAM memory.

More Details

Power is one of the primary concerns for cell phone designers. Cell phones run off of a battery, which is typically a Li-Ion or a Ni-CD cell with an Amp-Hr rating of 600 mAhr. These have limited power capacity, which forces a designer to use the lowest-power components on the cell phone.

Figure 2 shows the relation between talk time and the SRAM power consumption on a cell phone

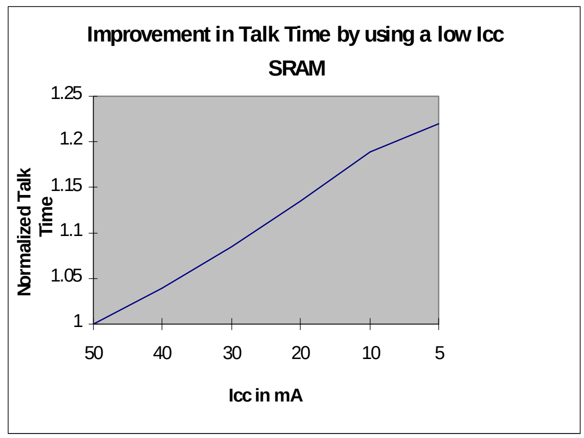

Figure 2. Cell Phone Power Graph

As a simplified example consider a phone using a typical 1-Meg Slow SRAM.

Assume that the cell phone uses a 600-mAhr battery and assume that the talk time is 150 minutes (2.5 hrs).

Using these values we can compute the average I_{CC} of the cell phone. The average I_{CC} = 600 mAhr/2.5 hrs = 240 mA.

Assuming the I_{CC} of the typical 2-Mb SRAM when operating to be approximately 60 mA and the SRAM to be selected 50% of the time, the SRAM takes about 12.5% (30 mA/240 mA) of the total power budget of the cell phone!

12.5% is a significant portion of the power budget and will affect the talk time of the cell phone. Cypress's MoBL family addresses this need by providing an extremely low current SRAM.

Now, let's evaluate the same cell phone that now uses Cypress's 2-Mb MoBL SRAM. This consumes 10 mA of I_{CC} when in the active mode. With the identical assumptions, the percentage of power use by the SRAM is dropped to 4.16% (10 mA/240 mA). The savings of 8.34% (12.5% – 4.16%), or 125 minutes is added to the talk time.

Device Accesses

Typical SRAM accesses in a cellular phone occur as shown in *Figure 3*.

One technique to save power is to have the memory controller place the SRAM in a standby mode when it is not accessing the device, i.e., if there are long periods of inactivity. More power saving can be achieved if the SRAM is placed in a data retention mode by lowering the supply voltage. This would allow an additional power saving of more than 90%. Switch to

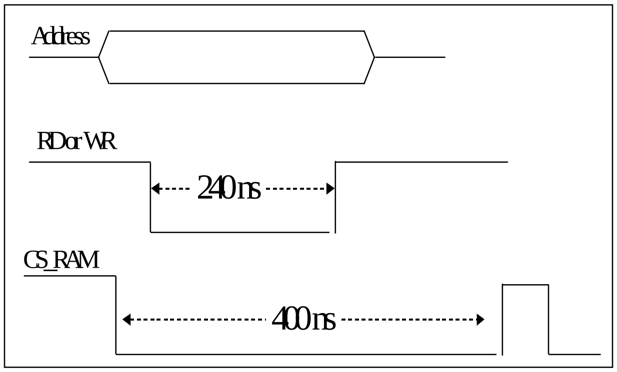

Figure 3. Typical Cell Phone Memory Access During Active Operation

and from data retention mode takes a small amount of time, but the power saving is significant. This requires a SRAM memory with a low data retention voltage.

Space

Space is also a big concern. As mobile devices become more and more prevalent, convenience becomes an important factor. This forces designers to use smaller and smaller devices. MicroBGA has become the SRAM package of choice due to its incredibly small form factor.

MoBL™

Cypress has recognized the importance of power and size and has introduced the MoBL (More Battery Life) family of SRAMs. These SRAMs have unique features that make them ideally suited for mobile applications.

First, MoBL has been designed to operate under a wide voltage range.The reason for this is to lower the overall system power and allow for seamless voltage migration. The V_{CC} of the SRAM in many cases is dictated by an ASIC on the processing engine of the system. ASIC and processor voltages are migrating downwards as ASIC technology migrates from 3.3V to 2.7V to 2.5V and so on. This ultimately can reduce the SRAM power by 99%. The operating range of the MoBL extends from 1.8V to 3.6V, so the same device operates under this range with a minor degradation in the access time.

MoBL is also designed to operate with a very low I_{CC} in order to save system power. The I_{CC} for a 2M MoBL device at 3.6V is typically 10 mA. This is accomplished through a unique patented design technique that reduces power by 70–90% when compared to standard SRAMs used today. MoBL also has a very small standby current. This is important when the SRAM is deselected, but still draws power to maintain internal data. The standby current is 10 µA at 3.6V and 2 µA at 1.8V. A third feature that MoBL offers is a low data retention voltage; the MoBL devices have a data retention all the way down to 1.0V.

Figure 4 shows T_{AA} Vs I_{CC} for the 2M MoBL device. *Figure 5* shows Taa vs. V_{CC} for the 2M MoBL device. As seen in these graphs the I_{CC} is lowered as the access time and cycle time is increased.

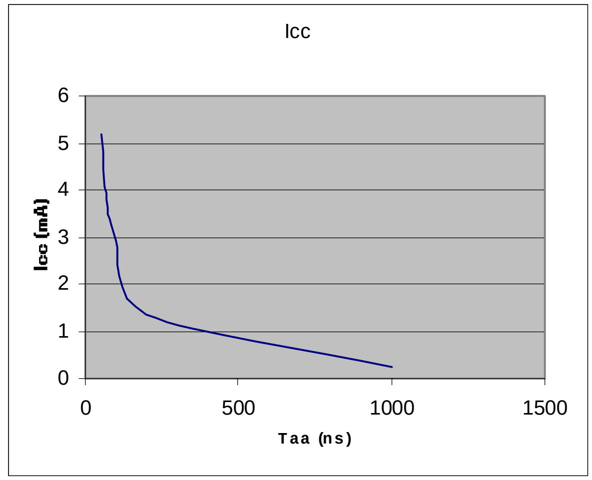

Figure 4. I_{CC} Vs T_{AA} for MoBL 2M Device

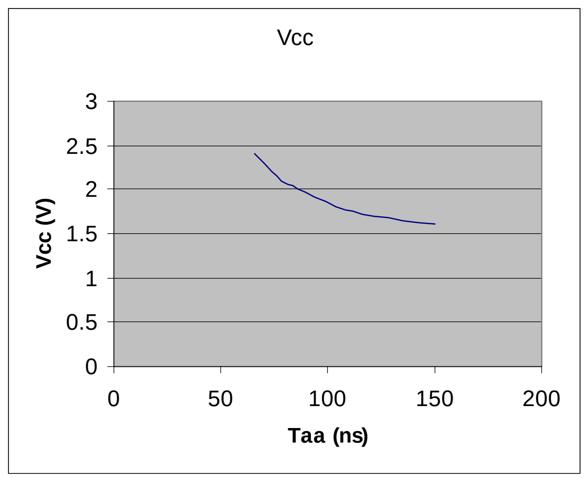

Figure 5. V_{CC} Vs T_{AA} for MoBL 2M Device

Cell Phone Power Saving

Let us compare the power consumption of a normal slow SRAM against the MoBL SRAM. To do this, let us assume a cellular phone using a normal 2M slow SRAM and a 2M MoBL SRAM. If the access on this SRAM is as shown in *Figure 3*, a normal SRAM I_{CC} variation would be as shown in *Figure 6(a)*. The I_{CC} variation of the MoBL SRAM is shown in *Figure 6(b)*.

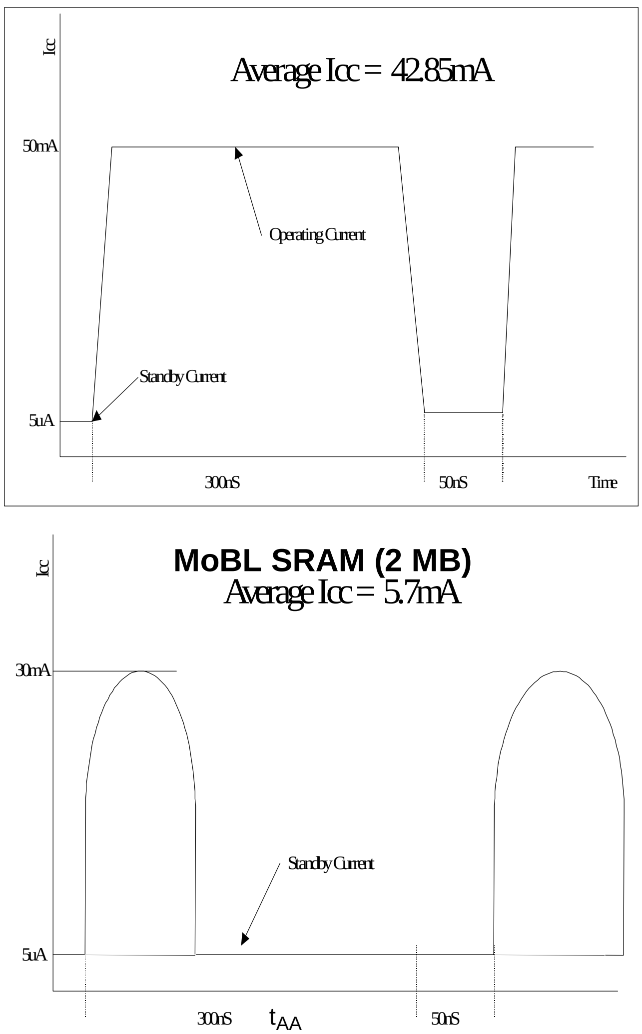

Figure 6. (a) I_{CC} for Existing Slow SRAM
(b) I_{CC} for MoBL SRAM

As seen from this, we have an 80% saving in power when we use a MoBL device over a normal slow SRAM device.

Board Space

Use of microBGA saves significant board area. *Figure 7* compares the board space saved by using the space saving microBGA package over existing packages. As can be seen, microBGA can yield a 85% space savings over other surface mount technologies.

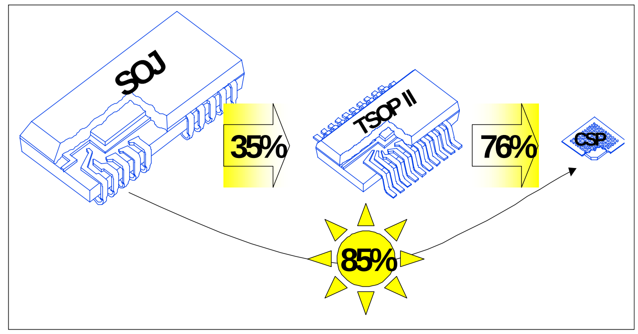

Figure 7. Space Saving Using FBGA

MoBL: The Family

Table 1 gives the part numbers of all the devices in the MoBL family.

Table 1. MoBL Product Offerings

Part #	Density	Configuration	Package	Feature
CY62138V	2M	128K x 8	FBGA	
CY62136V	2M	128K x 8	FBGA & TSOPII	
CY62137V	2M	128K x 8	FBGA & TSOPII	Byte Enable Power down
CY62148V	2M	128K x 8	FBGA, SOIC & TSOPII	
CY62146V	2M	128K x 8	FBGA & TSOPII	
CY62147V	2M	128K x 8	FBGA & TSOPII	Byte Enable Power down

Conclusion

MoBL SRAMs offer several advantages over traditional SRAMs. This should make the MoBL a perfect fit for most wireless/mobile applications. MoBL benefits include:

1. World’s lowest I_{CC} by far.
2. World’s fastest access time at low V_{CC} (100 ns @ 1.8V).
3. Wide operating voltage range (3.6–1.8V) for a single device.
4. All MoBL devices are offered in the Industrial temp range.
5. Low data retention voltage (Vdr = 1.0V) for power savings and simplified battery interface.
6. Space savings by using the microBGA package.