Replacing the Cypress CY62137FV18LL MoBL SRAM with Everspin’s MR1A16AxMA35 MRAM

EVERSPIN MRAM MEMORY
Everspin is the worldwide leader in designing, manufacturing, and commercially shipping discrete Magnetoresistive RAM (MRAM) into markets and applications where data persistence and integrity, low latency, and security are paramount.

RELIABLE SUPPLY
Everspin is a long term, reliable manufacturer of MRAM products and operates a fabrication facility in Chandler, Arizona.

OVERVIEW
The Everspin 2Mb MRAM M1A16AxMA35 can operate with the Cypress 2Mb SRAM CY62137FV18LL slower timing, but also allows the system designer to take advantage of MRAM’s faster random access cycle time. The Everspin 2Mb MRAM M1A16Axxx35 is available in 48-BGA.

BENEFITS OF MR1A16AxMA35
Upgrading to Everspin MRAM provides many benefits over Cypress SRAM:
- Faster Random Access Operation Times
- High Reliability and Data Retention
- Unlimited Read/Write Endurance
- No Wear-out Concern
- Competitive Pricing
- Stable Manufacturing Supply Chain
- Standard BGA package

GENERAL CONSIDERATIONS FOR REPLACING SRAM WITH MRAM
Everspin Toggle technology magnetic RAM (MRAM) is essentially non-volatile SRAM. Replacing SRAM with MRAM in any application adds non-volatility without compromise of performance or function. Replacing a volatile SRAM with MRAM will provide instant 20-year data retention without the overhead of storing data to a non-volatile cell or the expense and space of a battery backup power source.
CONSIDERATIONS FOR REPLACING CYPRESS CY62137FV18LL (128k x 16) MoBL SRAM with EVERSPIN MR1A16AxMA35 (128k x 16) MRAM

Designers considering a replacement of CY62137FV18LL with MR1A16AxMA35 need to consider differences in package size and timing. Everspin MR1A16AxMA35 has a different operating voltage range from 3.0V to 3.6V, with a typical of 3.3V.

Table 1 – Overview: CY62137FV18LL-45BVx vs. MR1A16AxMA35

<table>
<thead>
<tr>
<th>Parameter</th>
<th>CY62137FV18LL</th>
<th>MR1A16AxMA35</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package</td>
<td>48 Ball VFBGA</td>
<td>48 Ball BGA</td>
</tr>
<tr>
<td>Size and Height</td>
<td>6 × 8 × 1.0 mm</td>
<td>10 x 10 x 1.35 mm</td>
</tr>
<tr>
<td>Pinout / Footprint</td>
<td>See Figure 2 and Table 4 below</td>
<td>Per JEDEC J-STD-020D.1</td>
</tr>
<tr>
<td>Solder Profile</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Firmware / Timing</td>
<td>0ns Address Hold Time</td>
<td>12ns Minimum Address Hold Time. See Figure 7 below</td>
</tr>
</tbody>
</table>

Figure 1 – Pinout/Footprint Comparison and Considerations

48 BALL BGA
Replacing the Cypress CY62137FV18LL MoBL SRAM with Everspin’s MR1A16AxMA35 MRAM

Table 2 – Pin Function Comparison

<table>
<thead>
<tr>
<th>Ball #</th>
<th>Cypress</th>
<th>Everspin</th>
<th>Everspin Definition</th>
<th>Everspin Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>D3</td>
<td>NC</td>
<td>A15</td>
<td>Address Input</td>
<td></td>
</tr>
<tr>
<td>H5</td>
<td>A11</td>
<td>Vdd</td>
<td>Power Supply</td>
<td></td>
</tr>
<tr>
<td>H6</td>
<td>NC</td>
<td>DC</td>
<td>Do Not Connect</td>
<td>This pin is used for test. Prefer to float. If driven, must be pulled to VIL.</td>
</tr>
</tbody>
</table>

PACKAGE COMPATIBILITY

The Everspin Technologies 48 Ball BGA package is a close-fit with the corresponding Cypress equivalent. However, see figure 4 and 6 to understand the package dimension differences between the Cypress and Everspin FBGA packages. Make special note of the package dimension differences requiring different mechanical “Keep out” areas for these packages. Please refer to the current datasheet for details.

Figure 2 – EVERSPIN Package Outline 10x10mm 48-BGA
Replacing the Cypress CY62137FV18LL MoBL SRAM with Everspin’s MR1A16AxMA35 MRAM

OTHER REPLACEMENT DESIGN CONSIDERATIONS

MRAM ADDRESS HOLD TIME

The Address Hold Time (Everspin Write Recovery Time, tWHAX) for the M1A16AxMA35 is a minimum of 12ns compared to 0ns minimum for CY62137FV18LL.

Figure 7 – 12ns Minimum for Address Hold Time for MR1A16Ax35
Due to its persistence, there is no power monitoring requirement for the Everspin MRAM as is the case with the SRAM. Hence initiating or monitoring Hardware Stores, Re-stores and associated software routines are unnecessary and can be eliminated.

**SIMPLIFIED POWER CYCLING**

When power is removed from the MRAM, data remains valid over 20 years’ time and across the temperature range. This feature, unique to MRAM, allows for Duty Cycle Power control enabling the user to reduce their overall power consumption without concern of wear-out or lost data.

Due to its persistence, there is no power monitoring requirement for the Everspin MRAM as is the case with the SRAM. Hence initiating or monitoring Hardware Stores, Re-stores and associated software routines are unnecessary and can be eliminated.

The MRAM is protected from write operations whenever VDD is less than VWI. As soon as VDD exceeds VDD(min), there is a startup time of 2 ms before read or write operations can start. This time allows memory power supplies to stabilize.

The E and W control signals should track VDD on power up to VDD-0.2 V or VIH (whichever is lower) and remain high for the startup time. In most systems, this means that these signals should be pulled up with a resistor so that a signal remains high if the driving signal is Hi-Z during power up. Any logic that drives E and W should hold the signals high with a power-on reset signal for longer than the startup time. During power loss or brownout where VDD goes below VWI, writes are protected, and a startup time must be observed when power returns above VDD(min).

**MRAM POWER-UP SEQUENCING**

Both MRAM and SRAM will operate from different power supply ranges. Both MRAM and SRAM have similar active operating currents, however, the “Start-up” time for the MRAM is 2ms vs. 55ns for the SRAM. Proper decoupling capacitors should be used to assure reliable operation. The power loss/startup sequence for the MRAM is shown below:
SUMMARY
Replacing a CY62137FV18LL with Everspin’s M1A16AxMA35 2Mb MRAM is a straight-forward process. These devices are close to a drop-in replacement with some consideration of pinout, timing and power supply details shown in the application note.
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Everspin Technologies, Inc.

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