ReRAM: The Next NVM is Here
US roadshow
February/March 2023
Who we are

Leading developer of innovative memory technologies
Bringing to market Weebit ReRAM – next-generation NVM\(^{(1)}\) technology

Enabling a new era of intelligent connected devices

Founded: 2015
Located in Israel & France
ASX: WBT

Signed 1st commercial deal
Ongoing discussions / evaluations with additional fabs & customers

World-leading team
50 personnel\(^{(2)}\) (90% engineers/ scientists)

Business model
Product & IP licensing to semiconductor companies & fabs

R&D partner
CEA-Leti, leading micro-electronics research institute

Proven, protected technology
Fully qualified (130nm); >1K wafers to-date; 47 patents & applications

Global NVM Market (US $B)

Source: MarketsandMarkets, December 2022
(1) NVM = Non-Volatile Memory
(2) Includes employees and full-time contractors
World-renowned leadership

**BOARD**

- **Coby Hanoch**  
  CEO  
  Semiconductor veteran; Co-founder of Verisity, VP Sales at Jasper, both acquired by Cadence; CEO of PacketLight

- **David Perlmutter**  
  CHAIRMAN  
  Served as Executive Vice President and General Manager at the Intel Architecture Group and Chief Product Officer of Intel Corporation

- **Dr. Yoav Nissan-Cohen**  
  EXEC. DIRECTOR  
  Received his PhD researching non-volatile memories; Founder and CEO of Tower Semi; Co-Founder of Saifun Semi

- **Atiq Raza**  
  NON-EXEC. DIRECTOR  
  Served as President and COO of Advanced Micro Devices (AMD); Chairman and CEO of RMI

**MANAGEMENT**

- **Ishai Naveh**  
  VP Technology Development  
  Industry veteran, co-founder of Adesto, a pioneer of ReRAM technologies. Leader of NVM tech at Tower Semiconductor

- **Amir Regev**  
  VP R&D  
  Experienced specialist focused on NVM technologies, including Intel, Sandisk, Micron & Marvell

- **Ilan Sever**  
  VP R&D  
  Experienced leader and innovator in the field of memory IP & mixed-signal SoC design from STM, Tower Semi and Dolphin Design

- **Eran Briman**  
  VP Marketing & BD  
  Seasoned technologist turning ideas into business; IP licensing expert from CEVA & Corephotonics (acquired by Samsung)

- **Alla Felder**  
  CFO  
  Senior manager at PWC Israel, active board member of multiple companies in TASE & NASDAQ
Memory at the forefront of global investment in semiconductors

- Geopolitics driving countries to invest locally in semiconductors
  - US CHIPS Act & EU Chips Act to boost new fab construction, advanced R&D in these regions
  - Memory will be over a third of the spending

- Semiconductor companies announce capacity investments over time, mostly in US & EU

<table>
<thead>
<tr>
<th>Country</th>
<th>Announced Fab CapEx:</th>
<th>New Fabs</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSMC</td>
<td>$100B</td>
<td></td>
</tr>
<tr>
<td>Intel</td>
<td>$40B</td>
<td></td>
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<tr>
<td>Samsung</td>
<td>$345B</td>
<td></td>
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<tr>
<td>Micron</td>
<td>$150B</td>
<td></td>
</tr>
</tbody>
</table>

Sources: SIA 2/2022, EE Times, 5/2022; Android Headlines 6/2022, FIERCE Electronics 7/2022 and 8/2022; Brookings.edu 8/2022; Tom’s Hardware 8/2022; WSI 8/2022
<table>
<thead>
<tr>
<th><strong>Weebit ReRAM memory has inherent advantages vs. Flash memory</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3-4x</strong> Lower added wafer cost vs. flash</td>
</tr>
<tr>
<td>✓ 2-mask adder</td>
</tr>
<tr>
<td>✓ Standard materials</td>
</tr>
<tr>
<td><strong>~100x</strong> Faster programming time than flash</td>
</tr>
<tr>
<td>✓ Bit/byte addressable</td>
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(1) Refers to ReRAM cell array

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Weebit is addressing both segments of the Non-Volatile Memory market

- **Embedded memory modules (with ReRAM IP): immediate opportunity**

- **Discrete (stand-alone) memory chips: short/mid-term opportunity**

<table>
<thead>
<tr>
<th><strong>Volatile Memory</strong> (Erased when power removed)</th>
<th>SRAM</th>
<th>DRAM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Non-Volatile Memory (NVM)</strong> (Retained when power removed)</td>
<td>eFlash, ReRAM, MRAM, OTP/MTP</td>
<td>NAND Flash, NOR Flash, ReRAM, MRAM, EEPROM</td>
</tr>
</tbody>
</table>

**Business Model**
- Licensing: License fees + NRE + Royalties
- Product: Sell chips
Embedded ReRAM market segment – approaching the tipping point

The embedded emerging NVM market is expected to reach $3B by 2027\(^1\)

- ReRAM expected to capture 33% market share

This estimate is **solely based on the embedded NVM within the MCU market**

**Does NOT account for:**
- Other target markets apart from embedded MCU market
- Up-front license/use fees
- NRE (non-recurring engineering) fees
- Fab transfer fees
- Revenues from discrete ReRAM products

Source: Yole Emerging Non-Volatile Memory 2022

(1) Yole estimates embedded ReRAM market potential based on size of MCU market, adoption rate of ReRAM within the MCU market and average chip area occupied by ReRAM in the respective year

Foundry-centric IP business model for embedded market

- Foundry offers the IP to customers; collects up-front use fees from customers
- Foundry pays royalties based on % of wafer price

### Weebit Design IP

- **Silicon wafers**
- **Process NRE**
- **Design IP**
- **Process transfer**
- **License fee**
- **Process NRE**
- **License fee**
- **Annual support & maintenance**
- **Use fees**
- **Use fees**
- **Wafer cost (incl. ReRAM)**
- **Royalties**
- **Royalties**
- **ReRAM use fees**

### Foundries

- Intel, GlobalFoundries, Samsung, Skywater Technologies, TSMC and others

### Product Companies

- Apple, AMD, Google, Intel, Nvidia, Samsung and others

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**Discrete market segment opportunity**

The discrete (standalone chips) NVM market is very broad; numerous opportunities for Weebit ReRAM

<table>
<thead>
<tr>
<th>Market</th>
<th>Applications</th>
<th>Opportunity</th>
<th>Weebit Advantages</th>
<th>Timeline</th>
</tr>
</thead>
<tbody>
<tr>
<td>EEPROM(1)</td>
<td>IoT, Medical, A&amp;D</td>
<td>$2B in 2021</td>
<td>✓ Die size</td>
<td>Short-term</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1% CAGR 2021-2027</td>
<td>✓ Cost</td>
<td></td>
</tr>
<tr>
<td>NOR Flash</td>
<td>Consumer, automotive &amp; industrial</td>
<td>$3.5B forecast in 2022</td>
<td>✓ Ultra-low-power operation</td>
<td>Low densities: short-term</td>
</tr>
<tr>
<td></td>
<td></td>
<td>63% growth in 2021</td>
<td>✓ Ultra-low standby current</td>
<td>Med/high densities: mid-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6% CAGR 2021-2027</td>
<td>✓ Die size</td>
<td>term</td>
</tr>
<tr>
<td>NAND Flash</td>
<td>Data storage: on-device or cloud-based</td>
<td>$67B in 2021</td>
<td>✓ Ultra-low power consumption</td>
<td>Multi Gb dies:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6% CAGR 2021-2027</td>
<td>✓ Endurance</td>
<td>longer term</td>
</tr>
<tr>
<td>Storage Class Memory (SCM)</td>
<td>Emerging market filling gap between</td>
<td>~$925m in 2027</td>
<td>✓ Cost</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DRAM &amp; NAND storage</td>
<td></td>
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</table>

**Weebit has various commercial routes to address the discrete market**

- Development / commercialization of own memory chips
- Strategic partnerships with discrete foundries
- Licensing technology to Tier-1 / Tier-2 silicon vendors

Sources:

(1) EEPROM = Electrically erasable programmable read-only memory
Weebit ReRAM addresses a broad range of application requirements

<table>
<thead>
<tr>
<th>Example Applications</th>
<th>Mixed-Signal / Power Mgmt</th>
<th>IoT / MCUs</th>
<th>Edge AI</th>
<th>Automotive</th>
<th>Aerospace &amp; Defense</th>
</tr>
</thead>
<tbody>
<tr>
<td>Back-end-of-line tech for easy analog integration</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Cost-efficiency</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Ultra-low power consumption</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Robustness in high temp / extreme environments</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Scaling advantage at 28nm and below</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>High endurance</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Small footprint to store very large arrays</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
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<tr>
<td>Longevity</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Roadmap to neuromorphic computing</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

Wireless charging; Motor control
Wearables; Smart cards
Security cameras, Industrial
ECUs for sensors & controllers
Flight safety systems; Satellites

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ReRAM adoption is underway in large end markets

Automotive ICs

Weebit ReRAM Advantages vs Flash
- Safety, security, longevity
- Reliable in extreme temps, EMI, vibration, humidity, etc.
- Support fast boot, instant response, frequent OTA updates

Example: Infineon will use ReRAM in its automotive MCUs

Power Management chips (PMICs)
Wireless charging, motor control, and others

Weebit ReRAM Advantages vs Flash
- Embedded flash requires ~10 masks → too expensive
- ReRAM only 2 added masks → cheap to manufacture
- ReRAM: No interference with analog integration (embedded flash too difficult to integrate)

Example: Call phone and laptop chargers

SMart Cards / Mobile payments

Weebit ReRAM Advantages vs Flash
- Embedded flash too expensive to manufacture
- ReRAM most cost-effective NVM
- ReRAM deeply embedded within metal stacks
- MRAM not an option due to EMI
- Ultra-low power, low voltage

Example: Credit cards

Internet of Things (IoT) MCUs

Weebit ReRAM Advantages vs Flash
- Market transition to 22nm and below
- Better cost structure and lower power as market transitions to 22nm and below
- Maximum system integration; flash must be external below 28nm; ReRAM scales below
- External NVM compromises power, speed, security

Example: Wearables, hearing aids, medical devices

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Ultra-low-power MCUs: $7.9 billion by 2027

Automotive semiconductors: $70 billion by 2027

PMICs: $25.5 billion by 2026

Smart card ICs: $3.9 billion by 2027


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Significant recent progress

**NOV 2021**
Raised further A$35m; well funded to 2024

**JUN 2022**
ReRAM IP module fully functional, live demonstration

**OCT 2022**
ReRAM selector can achieve high densities needed for discrete & embedded applications

**OCT 2022**
Final qualification of ReRAM IP module. Industrial-grade temperatures

**NOV 2022**
First production-fab wafers integrating Weebit IP

**JAN 2023**
Taped out first demo chip in advanced 22nm FD-SOI process
Successfully completed ReRAM memory module qualification

Qualification is a key step for every semiconductor product on each new target process

Major milestone using Weebit’s ReRAM memory module produced at CEA-Leti

- Qualified wafers to industry standards
  - Endurance
  - Industrial robustness

- Results driving interest from foundries and customers
  - Repeatability
  - Uniformity
  - Maturity of Weebit’s embedded ReRAM

Commercial Traction

Based on results, Weebit ReRAM is being evaluated by several Tier-1 fabs and customers

Weebit and CEA-Leti are now qualifying ReRAM module at higher temperatures and endurance levels – for advanced applications
SkyWater Technology (Nasdaq:SKYT) – only US-owned pure-play silicon foundry – taking Weebit ReRAM to volume production

- September 2021: Signed agreement
- June 2022: Completed technology transfer to US production fab
- July 2022: Tape-out of memory module
- November 2022: Received 1st wafers from manufacturing
- 1H 2023: Fully qualified memory module
- Customer wafers with Weebit ReRAM in mass production

CEO Coby Hanoch holding a SkyWater wafer 
November 8, 2022

www.skywatertechnology.com/ip-partner-weebit-nano
Selector technology development: key for high-density NVMs

Selector is a strategic R&D effort for Weebit and CEA-Leti

- Enabling high-capacity memory arrays while keeping size and power requirements to a minimum
- Will enable 3D ReRAM in the future

Discrete chips need higher densities than can be achieved with a transistor (1T1R)

- Purpose-built selector (1S1R) enables optimized cell access within a memory array
- Enabling discrete chips while using fab-friendly materials and standard tools

Recent milestone: Weebit ReRAM selector now also suitable for embedded applications

- Opens up new opportunities in areas including AI and automotive

A selector is necessary to scale ReRAM cells

[Graph showing cell area vs. technology node for 1T1R and 1S1R cells]
Taped out Weebit ReRAM demo chip to GF 22nm

Addresses the need for new NVM at one of the industry’s most common process nodes

On-time tape-out of ReRAM IP module in GlobalFoundries’ 22FDX™ FD-SOI (fully depleted silicon on insulator) platform

- FD-SOI: high performance at very low voltage/low leakage; broadly adopted by the industry
- Weebit ReRAM + FD-SOI is ideal for low-power embedded devices

Clear opportunities for NVM at 22nm and below

- Existing embedded flash technology is not a viable option
- Serving various applications including IoT, 5G and AI

Scaling Weebit ReRAM technology to advanced nodes – now targeting sub-22nm

- Weebit is already working on smaller geometries with Tier-1 fabs
- Benefits in terms of memory density

The work Weebit and CEA-Leti are doing to make Weebit ReRAM available on GlobalFoundries’ 22FDX is a welcome development as we continue to expand the ecosystem around this platform. Embedded NVM is a key element of our customers’ designs, but since embedded flash is difficult to scale below 28nm, many customers are looking to NVM solutions such as embedded ReRAM.

“...”

– Mike Hogan, Chief Business Officer
**Weebit is engaged with most top-10 foundries and IDMs**

- In different levels of discussion/evaluation with most of the top fabs
- Expect to sign an agreement with a top fab by mid-year

### Top-10 Foundries*

<table>
<thead>
<tr>
<th>Rank</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TSMC</td>
</tr>
<tr>
<td>2</td>
<td>Samsung</td>
</tr>
<tr>
<td>3</td>
<td>UMC</td>
</tr>
<tr>
<td>4</td>
<td>GlobalFoundries</td>
</tr>
<tr>
<td>5</td>
<td>SMIC</td>
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<tr>
<td>6</td>
<td>Hua Hong (HLMC)</td>
</tr>
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<td>7</td>
<td>PSMC</td>
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<td>8</td>
<td>VIS</td>
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<td>9</td>
<td>Tower</td>
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<td>10</td>
<td>DB HiTek</td>
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</table>

### Top-10 Integrated Device Manufacturers (IDMs)\(^{(1)}\)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Company</th>
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<tbody>
<tr>
<td>1</td>
<td>Samsung</td>
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<tr>
<td>2</td>
<td>Intel</td>
</tr>
<tr>
<td>3</td>
<td>SK Hynix</td>
</tr>
<tr>
<td>4</td>
<td>Micron</td>
</tr>
<tr>
<td>5</td>
<td>Texas Instruments</td>
</tr>
<tr>
<td>6</td>
<td>Western Digital</td>
</tr>
<tr>
<td>7</td>
<td>Infineon</td>
</tr>
<tr>
<td>8</td>
<td>STMicroelectronics</td>
</tr>
<tr>
<td>9</td>
<td>NXP</td>
</tr>
<tr>
<td>10</td>
<td>Analog Devices</td>
</tr>
</tbody>
</table>

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\(^{(1)}\) By 2021 revenue
Weebit ReRAM: Greener non-volatile memory

◆ ReRAM has a lower carbon footprint vs. flash and MRAM
◆ Consumes less electric power than flash
◆ Consumes fewer resources to manufacture than MRAM and flash

◆ No issues with materials scarcity; no rare earth materials
◆ Materials have no contamination risk
◆ Not subject to international conflict

NVM Environmental Impact Examples

<table>
<thead>
<tr>
<th>Resource use, minerals &amp; metals</th>
<th>Water Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>ReRAM Process</td>
<td>-41.6%</td>
</tr>
<tr>
<td>MRAM Process</td>
<td>-53.5%</td>
</tr>
</tbody>
</table>

* Source: Non-Volatile Memory Lifecycle Analysis completed by CEA-Leti Q4 2022
Weebit Nano key targets for 1H23

**SkyWater**
Conclude qualification of embedded ReRAM module

**Fab Partners**
Sign with a Tier-1 fab

**Customers**
Close initial agreements

**Automotive**
Qualify the technology for automotive conditions

**Continue R&D**
Further technical enhancements to the ReRAM cell and selector technologies

**Scaling 22nm**
Continue scaling the technology
Key takeaways

Weebit ReRAM: The Next NVM is Here!

1. The industry needs a new Non-Volatile Memory solution.
2. Weebit ReRAM has unique advantages; is well positioned to replace flash in various markets.
3. Making strong tech progress: 1\textsuperscript{st} wafers from a production fab; qualified based on JEDEC standards.
4. Board & mgmt. have extensive semiconductor commercialisation experience.
5. Weebit is on track to deliver a production solution across a range of high-growth markets.
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