



Flash Memory Summit

ReRAM's Development Path Towards Commercialization

Amir Regev

VP Technology Development at Weebit Nano

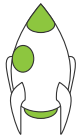
August 3rd, 2022



- Weebit overview
- ReRAM module
- Initial qual results
- Summary

Who is Weebit Nano?

Leading developer of innovative next-gen memory technology – Weebit ReRAM – for the global semiconductor industry



Founded: 2015

Israel & France 50 personnel*
(90% engineers/scientists)



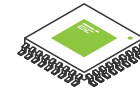
R&D Partner: Leti

Leveraging years of research
experience in NVM



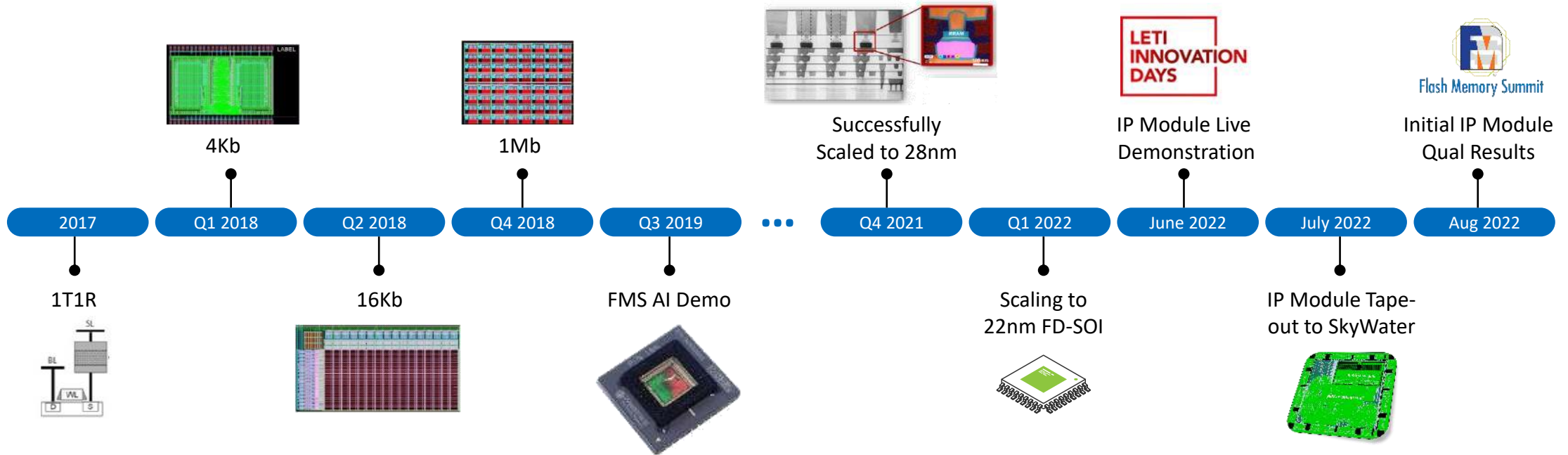
Current Business Model:

IP licensing to semiconductor
companies & fabs



Silicon-Proven Technology

Mbit arrays avail @ 28-130nm
Volume production 2023

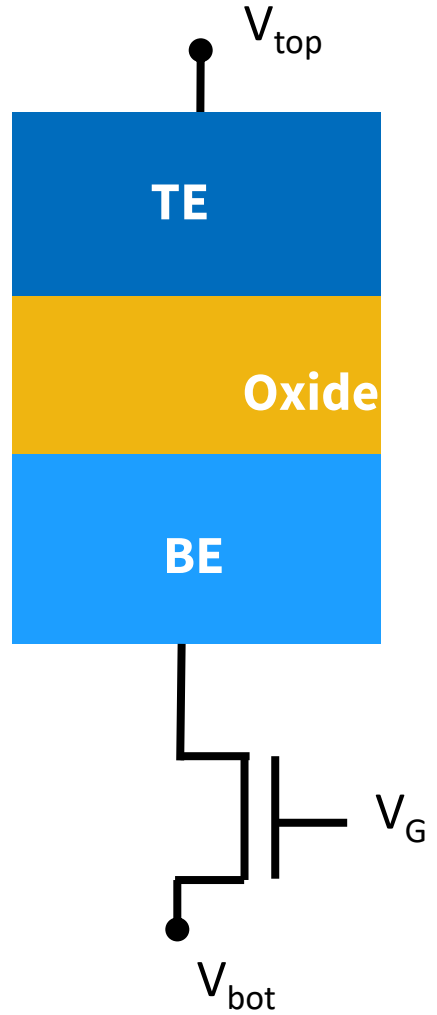


*Includes employees and permanent contractors.

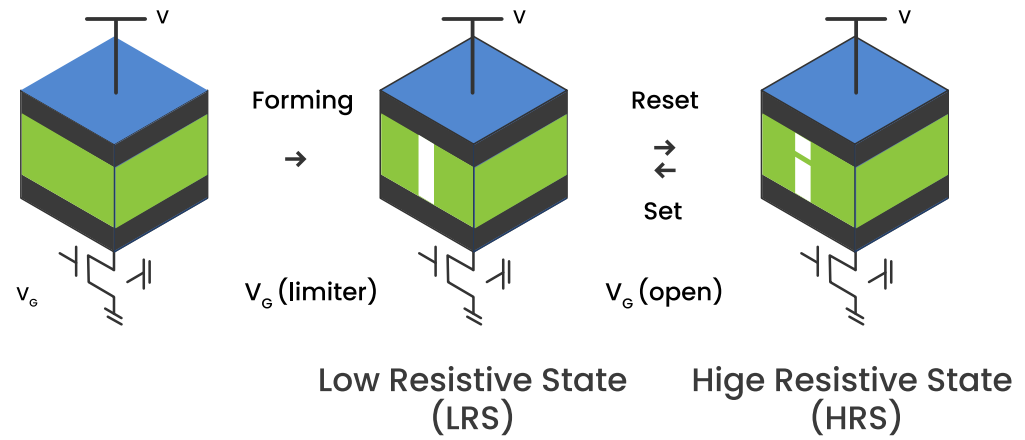
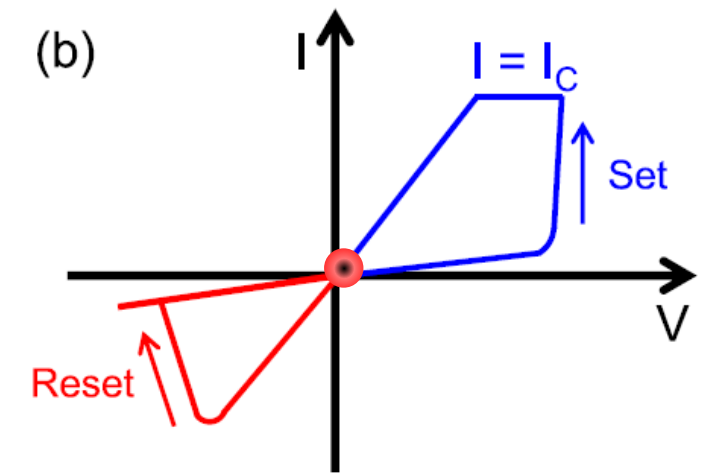
ReRAM Basic Operation



Flash Memory Summit



- SET (Program) – HRS → LRS
- RESET (Erase) – LRS → HRS

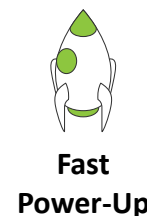




MCU/IoT: A Natural Fit for ReRAM Integration

- **Billions of Battery-operated Edge Devices**
 - By 2026*: 55B connected devices worldwide;
73 ZB of data generated from connected IoT devices
- **Name of the game: System Integration**
 - Flash stuck at 28nm
- **Embedded ReRAM has significant advantages over external NOR flash**
 - Power: eliminate external memory interfaces
 - Speed: Avoid data fetching from external memory
 - Cost: Cut expensive SRAM or external flash
 - Reliable: Handles higher temps; built for longevity
 - Endurance: Enables new use-cases
 - Secure: Instantiated on-chip, difficult to hack

Requirements

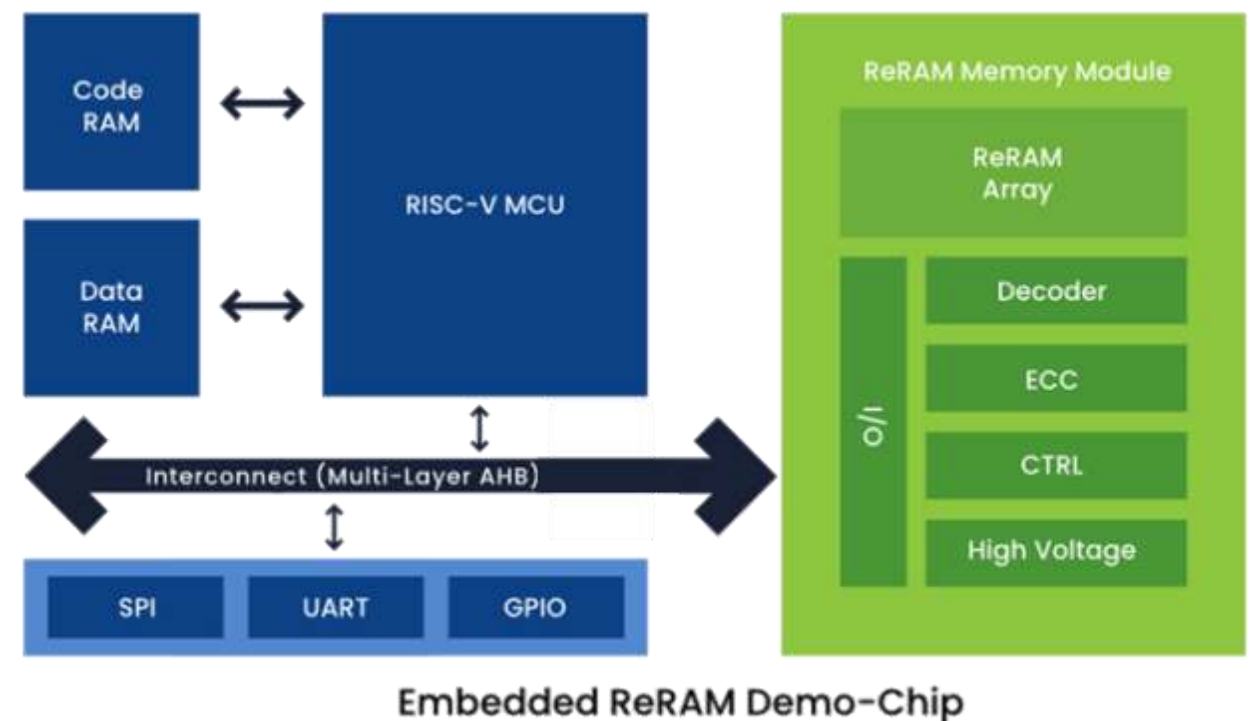


* Source: IDC Research 2021



Weebit ReRAM Module Design in Qualification

- Integrating a ReRAM array in a complete module in 130nm technology
- Module includes
 - All analog circuitry
 - Smart algorithms (read, set/reset, forming)
 - Control logic and data manipulation
 - Redundancy, ECC
- The ReRAM module is further integrated into a complete subsystem
 - Based on a RISC-V processor
- Silicon is fully functional, now undergoing Characterization & Qualification



ReRAM Qualification Process

- Weebit is now qualifying its 1st ReRAM module
- Qualification process (unlike technology demonstration) requires meeting industry standards (JEDEC, AEC, MIL) to show technology maturity

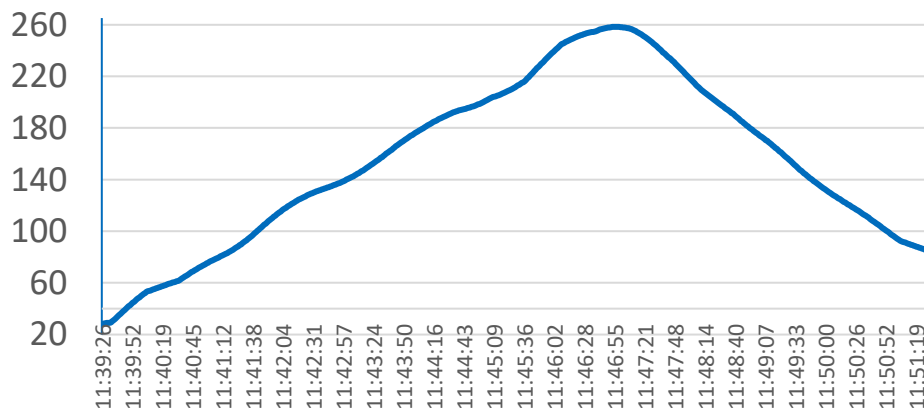
Stress	Test Item	Reference	Stress Conditions	Test Conditions / Acceptance Criteria	Sample Size	Comments
NVCE	Endurance	JESD22-A117 JEDEC 47	25°C and 85°C V=Vcc max	Datasheet Spec/ 0 Fails	3 Lots/ 77 units	Test all the array bits to 100% Max spec
UCHTDR	Data Retention	JESD22- A117 JESD47	Tstress – 125°C	1000 hrs/ 0 Fail	3 Lots/ 77 units	Readout at 25°C and 85°C
PCHTDR	Post Cycle Data Retention	JESD22- A117	Tstress = 125°C 100% spec	10 hrs/ 0 Fail	3 Lots/ 39 units	Readout at 25°C and 85°C
SMT	SMT Reflow	ESD22 - A113	Tc 260 °C	3 cycles/ 0 fails	3 Lots/ 25 units	Pb-Free Assembly Profile



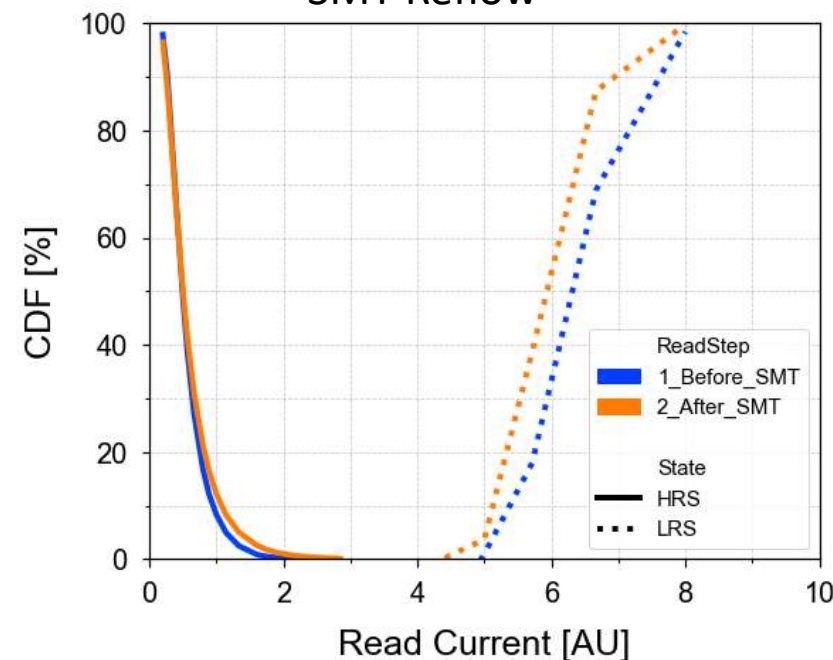
SMT Reflow Results (Memory Module)

- The main challenge of any new technology is demonstrating thermal stability
- SMT reflow cycles (up to 260°C) are a good indication for data retention
- Results: Showing high thermal stability performance
 - 3 consecutive SMT reflow cycles
 - 1st lot, 25 units, passed with zero failures

Soldering Reflow Profile



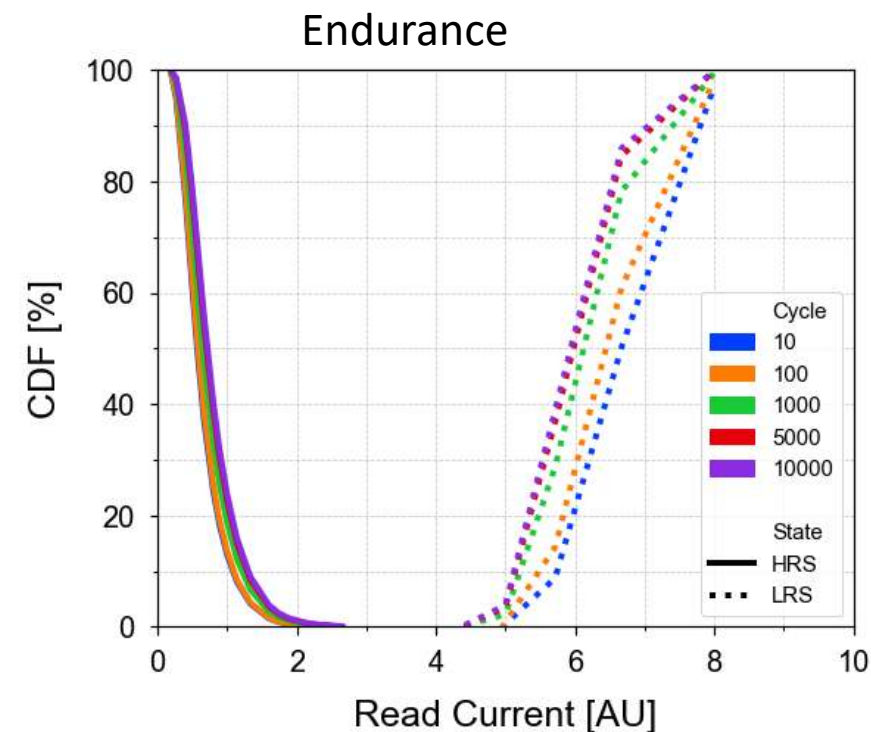
SMT Reflow





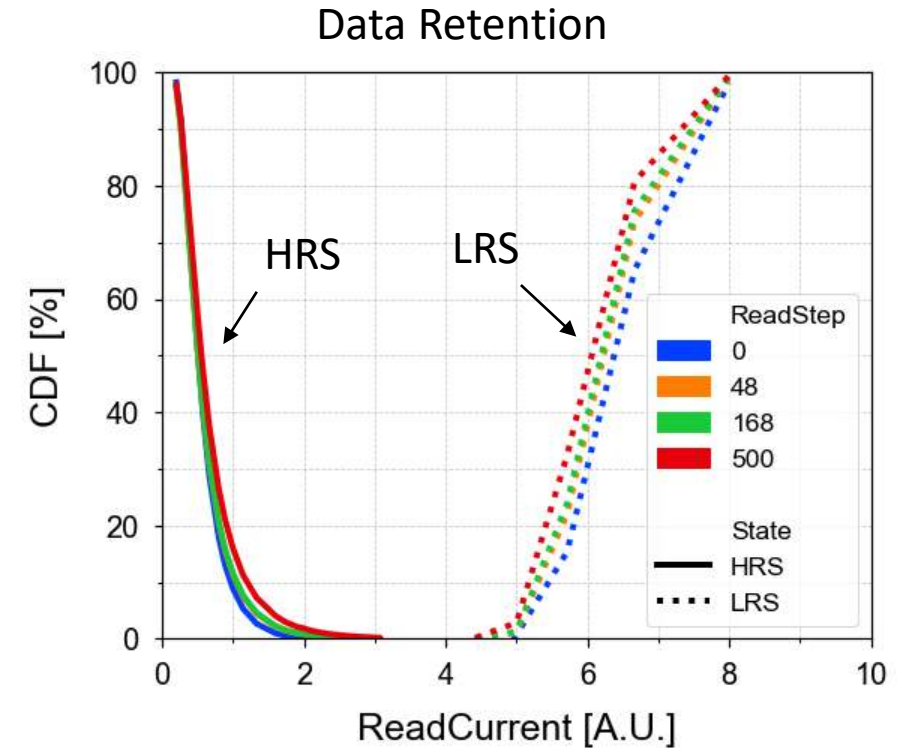
Non-Volatile Cycling Endurance - NVCE

- Sample size – 77 units
- Test sequence – alternating CHBD pattern and monitoring each cycle for errors
- Results – passed 10K cycles with no failures
- Endurance testing continues



Memory Module Data Retention

- High temp bake for data retention
 - Bake at 130°C (accelerated conditions) to predict 10 years operation at hot temperature
- 1st lot, 77 units, passed with zero failures*
 - Also showing stability after first few hours bake
- Retention after endurance cycles:
 - Passed zero failures after 10K cycles, 168h@130°C



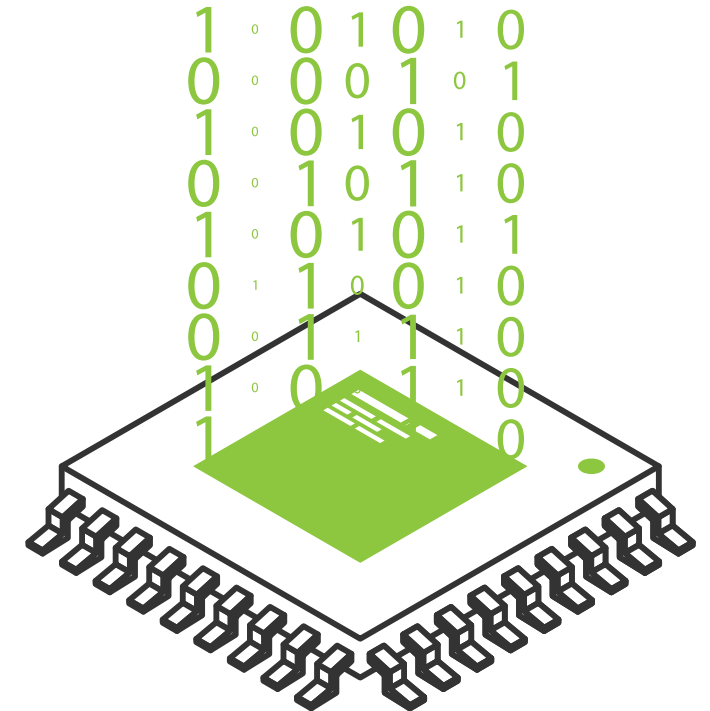
* Currently 500h, final RO 1000h.

Conclusions



- Weebit has functional ReRAM modules under qualification now
- Successful initial qualification results:
 - Showing good data retention before and after cycling
 - Endurance test showing good results up to spec, extended cycling characterization on-going
 - High temp stability is demonstrated by passing 3x SMT

Come & see
our live ReRAM Demos
at **Booth #639**





Thank You!



Read more on www.weebit-nano.com