GLOBALFOUNDRIES®

130 nm · 55LPx · 22FDX® · 40LP · 28SLP

eMRAM · eFlash · SIP · Embedded Memory

Embedded Memory: eMRAM, eFlash, SIP
Versatile and Reliable

Highlights

- eMRAM: Versatile and Fast
  + High endurance (>10E6 cycles)
  + >10 years of data retention
  + Read latency (down to 15ns)
  + Low energy (1 pJ/bit)
  + Write latency (down to 40ns/page)
  + Automotive Grade 1 capable (in development)
  + Code, data storage
  + Co-developed with Everspin® Technologies

- eFlash: High reliability
  + Endurance (up to 200K Cycles)
  + Data retention (up to 25 years)
  + Low read latency (down to 10ns)
  + Full Automotive Grade 1 and 0
  + SST SuperFlash® technology

- SIP Flash: Fast time-to-market
  + Logic + QSPI NOR Flash*
  + Multiple package (BGA, QFN)
  + Turn-key from GF

- Complete services and supply chain support
  + Advanced packaging and test solutions, including 2.5D and 3D products
  + Regularly scheduled MPWs

Supplied by memory makers

Production-ready, cost-effective memory solutions for general purpose MCUs, IoT, automotive, industrial, and consumer applications

GLOBALFOUNDRIES' technology platforms from 130nm to 22nm offer a wide variety of embedded memory solutions to address the emerging markets. These include embedded magneto-resistive RAM (eMRAM), embedded Flash (eFlash) and System In Package (SIP Flash) to address the requirements of broad market segments.

GLOBALFOUNDRIES' **eMRAM** offering, with its low power consumption, makes it ideal for the MCU and IoT markets, and its fast access speed and high memory capacity makes it suitable for compute and storage markets. **eFlash** solutions, along with RF and analog enablement and comprehensive IP, are optimized for specific applications such as wearables, IoT, automotive, industrial, and consumer. **SIP Flash** is a flexible and cost-effective package based solution for low cost, high capacity memory requirements and delivers the fastest time to market.

GF Embedded Memory Offerings

	eMRAM	eFlash	SIP Flash
Key Applications	General purpose MCUs, IoT, wearables, automotive, server, compute	Automotive, PMIC, analog controllers, industrial, smart cards, MCUs, wearables	Home security, health and fitness, wearables, sensor hubs
Key Features	• Versatile (memory for both code and compute) • Fully integrated • Write speed • Endurance • Low power operation	• Data retention • Power efficient • Low read latency • Harsh environment	• High capacity • Memory price • Faster time to market
GF Products	22FDX® + eMRAM	• 130 BCD/BCDL + ESF1 • 55LPx/ULP + ESF3 • 40LP + ESF3 • 28SLP + ESF3	28SLP + off-the-shelf NOR Flash 22FDX® + off-the-shelf NOR Flash

| GF eNVM (nm)	130	55	40	28	22	14/12
eMRAM					●	**In Development**
eFLASH	●	●	●	○		
SIP Flash	IP	IP	IP	●	●	

● *Available*   ○ *Prototype available*   **IP** *IP available*

eMRAM Memory

Versatile: code storage and compute operation on the same chip

Key Features

- Versatile embedded memory in FD-SOI
- Energy efficient
- Fast write enables OTA updates
- Fast system wake-up
- No static leakage through eMRAM bitcell
- Fully integrated embedded memory solution with 22FDX® technology extensions
- Ideal for IoT, storage and compute applications
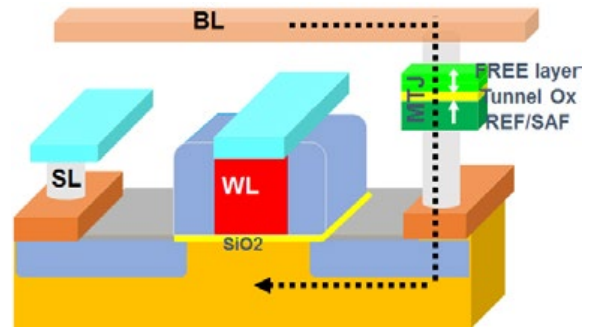
eMRAM Bit Cell

22FDX® Platform and eMRAM Specifications

| Device	4 Core Vt's (FBB, RBB & eLVT), 2 I/O Vt's @ 1.2V/1.5V/1.8V, Passives, LDMOS (3.3V/5.0V/6.5V)	
Memories (SRAM)	HP, HD, ULL, TP, DP	
Libraries	Low power/Performance/Dense/Low leakage	
Extensions	ULP (0.4V), ULL, RF/mmWave, eMRAM, Automotive	
Macros	Macro#1 (Flash-like)	Macro#2 (SRAM-like)
Interface	eFlash-like	SRAM-like
Bit Cell Configuration	1T-1MTJ	2T-2MTJ
Access Time (R/W)	25ns/200ns	15ns/40ns
Retention	>10yr	>10yr
Endurance	>1M Cycles	1M Cycles
Energy (pJ/bit)	1	1
Max. Temp. Grade expected	Ind/Auto G1*	Ind/Auto G1*
Solder Reflow	Yes	Yes
Mask Layer Adder	4	4
Node	22nm	22nm
PDK	V1.3 available to begin design	
MPW Shuttle	Quarterly	

Planned

Key eMRAM Applications

IoT

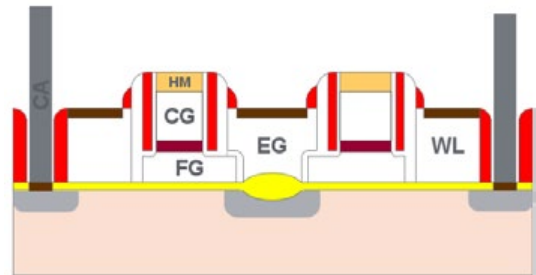
Automotive ADAS
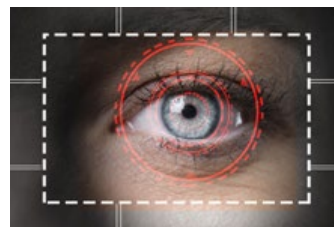
Vision Processing

Storage

eFlash Memory

Reliable: proven in automotive environments

Key Features

- MBytes of on-chip embedded memory
- Combo with RF, BCD and BCDlite analog
- 15+ off-the-shelf macros
- Full eFlash turnkey support from GLOBALFOUNDRIES
- Ideal for industrial and Automotive Grade 1/0 MCUs

eFlash Bit Cell

Platform and eFlash Specifications

Features	40nm	55nm	130nm
Core Device	1.1V CMOS Baseline Process (with overdrive)	1.2V CMOS Baseline Process	5V CMOS Baseline Process
I/O Device	1.8/2.5/3.3V (with overdrive and underdrive)	1.8/2.5/3.3V (with overdrive and underdrive)	5V
Other Devices	5V	5V EDMOS, APMOM, MIM, RF, HRES	1.5V LP CMOS, HRES, Zener Diode, MIM
HV Power Device	N/A	N/A	BCDlite: 10, 12, 16, 20, 24, 30V N/PLDMOS BCD: 10-30, 40, 60, 85V N/PLDMOS
Standard Cells	1.1V Standard Cell Libraries	0.9V, 1.2V Standard Cell Libraries	1.5V
eFlash	SST ESF 3rd generation	SST ESF 3rd generation	SST ESF 1st generation
OTP	Anti-fuse	Anti-fuse	Neobit
SRAM	Dense SP – $0.242\mu m^2$ Performance SP – $0.303\mu m^2$ Dense DP 8T – $0.477\mu m^2$	Dense SP – $0.425\mu m^2$ Performance SP – $0.502\mu m^2$ Dense DP 8T – $0.789\mu m^2$	Dense SP – $2.43\mu m^2$ Dense DP 8T – $5.75\mu m^2$
eFuse	Yes	Yes	Yes
Memory Compilers	SP/DP SRAM, ROM, 1PRF,2PRF	SP/DP-SRAM, 2PRF, 1PRF, ROM	SP/DP SRAM, ROM, 1PRF, 2PRF
Platform	LP	LPx, ULP	BCDlite, BCD
Write time	10μs/10ms	10μs/10ms	30μs(Byte)/30ms
Read time	10ns	12.5ns	30ns
Endurance	200K	200K	10K
Retention	20 years	25 years	10 years
RF	Yes	Yes	N/A
Grade	Auto Grade 1*	Auto Grade 1	BCDlite – Auto Grade 1* BCD – Auto Grade 0*
Target Application	Automotive, smart card, industrial, drones	IoT, low end radars, analog, wearables, general purpose	Intelligent PMICs, audio amplifier, motor control, single chip analog controller

Contact GF for latest availability

Key eFlash Applications
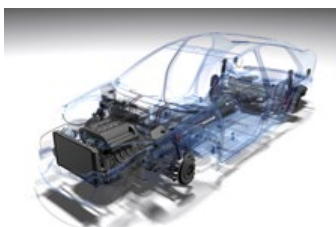
Automotive Drivetrain
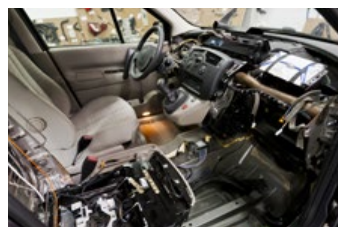
Auto body electronics
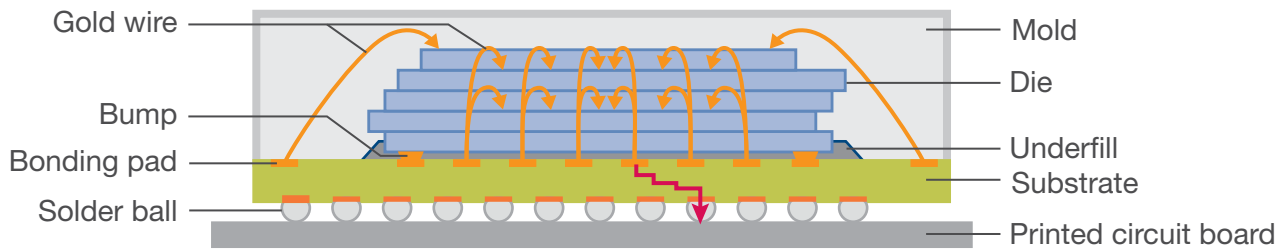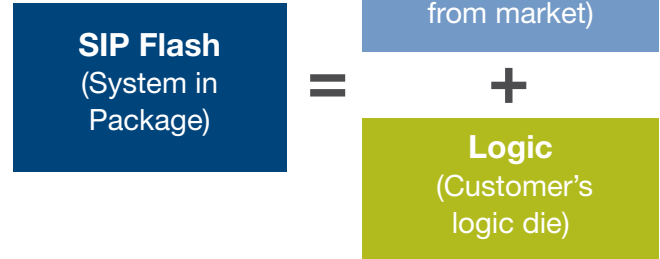

Iot/Wearables

Battery Management

SIP Flash

Fast time-to-market with qualified off-the-shelf NOR flash memory*

* Flash die procured from memory makers

Key Features

- Low cost, low risk and fast time-to-market with proven technology
- High performance NVM interface (QSPI and Flash DDR)
- Enabling small form factor and heterogeneous die stack
- Allows up to 8 dies for QSPI, 4 dies for Hyper/Xccela)
- GF IP allows bundling of I/O and associated delay line block to meet the SDR/DDR data rates
- Ideal for consumer, wearables, AR/VR

SIP Flash (System in Package) **=** **Memory** (Off the shelf from market) **+** **Logic** (Customer's logic die)

Example of a stacked 5-die SIP configuration

SIP Flash Performance

	SIP Flash QSPI (single channel)	SIP using Flash QSPI (dual channel)	SIP using Flash QSPI (quad channel)	SIP using HyperFlash™/ XccelaFlash™ (single channel)
RD Access time	8ns	8ns	8ns	5ns ~ 6.5ns
I/O Width	x4	x4	x4	x8
Max. Bandwidth	66MBps	133MBps	266MBps	333MBps ~ 400MBps

™: HyperFlash owned by Cypress Semiconductor, XccelaFlash owned by Micron Technology

Key SIP Flash Applications

Sensor Hub

eMPU

Voice Recognition

AR/VR

GLOBALFOUNDRIES®

2600 Great America Way, Santa Clara, CA 95054 USA
Tel: +1 408-462-3900   globalfoundries.com/contact-us