

The background of the slide is decorated with numerous 3D cubes. Some cubes are arranged in straight lines, while others are scattered randomly. The cubes are rendered in a light gray, wireframe style, giving them a three-dimensional appearance.

# ememory

**Leading NVM IP Provider**

Embedded Wisely, Embedded Widely

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eMemory is a leading developer of embedded non-volatile memory (eNVM) technologies and provides the semiconductor industry's most comprehensive platform of eNVM intellectual property (IP) products, services and solutions. eMemory licenses its proprietary technology to semiconductor foundries, integrated device manufacturers (IDMs) and fabless design houses around the world.

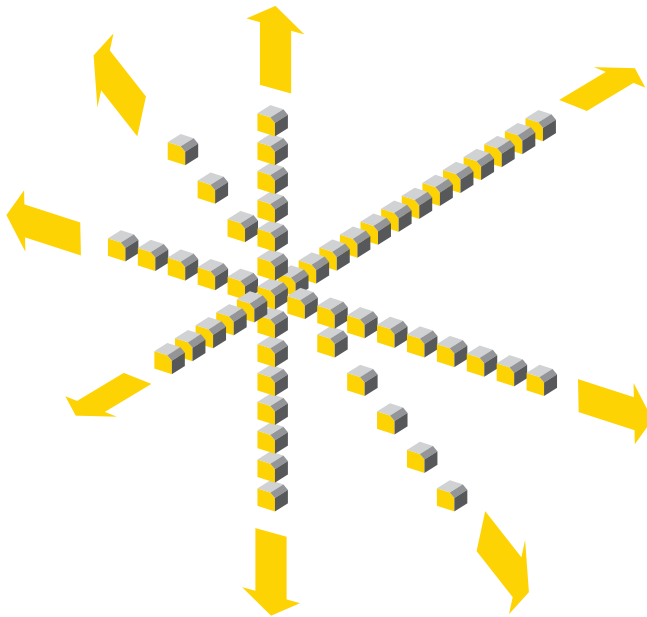
**Facts**

Founded: 2000  
Chairman: Charles Hsu Ph.D.  
President: Rick Shen Ph.D.  
Location: Hsinchu, Taiwan  
Capitalization: USD 25 Million  
Technologies: NeoBit, NeoFuse, NeoEE, NeoFlash, NeoMTP  
Customers: 1000+

# Embedded Wisely, Embedded Widely

eMemory's embedded non-volatile memory is the industry's most widely adopted eNVM IP available.

eMemory  
2



## **Widest availability**

- Silicon-proven at 22 major foundries
- Over 320 qualified processes (and growing)

## **Widest application**

- OTP, PMTP, MTP, EEPROM, Flash
- Successfully embedded in more than 30 major types of chips
- IP behind over 100 unique applications

## **Widest selection**

- Support for logic, mixed-signal, RF, high voltage, BCD, SiGe, automotive and low-power processes
- Process nodes from 0.5um to 7nm

## **Widest utilization**

- Over 1200 customers and 1100 IPs in use today
- Adopted by more than 11 of the world's top IDMs
- Deployed in consumer, industrial, and automotive grade products








- Foundry
- IDM
- Fabless

	Taiwan	China	Korea	Japan	North America	Europe	Others
Foundry	5	7	3	3	1	2	1
IDM	0	0	0	8	2	1	0
Fabless	264	496	66	51	226	111	50










# Technologies and Products

eMemory's eNVM products have helped IDMs and fabless design houses to improve the functionality of their integrated circuits (ICs), reduce total system cost, and raise the overall competitiveness of their products.

**eMemory's proprietary technologies include NeoFuse, NeoBit, NeoEE, NeoMTP, and NeoFlash.**

<b>NeoFuse™</b> NeoFuse is an antifuse solution offering reliable, secure and high yield embedded OTP/PMTP function for advanced technology node.	<b>Features:</b> <ul style="list-style-type: none"><li>– No additional masking layer required.</li><li>– Suitable for 125°C application, high reliability</li><li>– Low process dependency, easily port to derivative process</li><li>– Destructive programming, data irreversible for security</li><li>– Cell redundancy plus program repair for extremely high yield</li></ul>	
<b>NeoBit™</b> NeoBit is a programmable logic device offering the industry's most silicon-proven path to embedded OTP/PMTP function.	<b>Features:</b> <ul style="list-style-type: none"><li>– Industry's most widely embedded NVM device.</li><li>– No additional masking layer required.</li><li>– Suitable for all logic-derivative CMOS technologies.</li><li>– Hot electron injection programmable.</li></ul>	
<b>NeoEE™</b> NeoEE is a single-poly embedded memory device offering the industry's lowest implementation cost upto 100K program/erase cycles with low to medium densities (< 16K bits).	<b>Features:</b> <ul style="list-style-type: none"><li>– Industry's smallest logic process-based NVM device with 100K endurance.</li><li>– No additional masking layer required.</li><li>– Suitable for logic-derivative CMOS technologies.</li><li>– Easy way to integrate Flash or EEPROM into IC designs.</li></ul>	
<b>NeoMTP™</b> NeoMTP is a single-poly embedded memory device offering the industry's lowest implementation cost at 1K program/erase cycles with medium to high densities. (16K~512K bits).	<b>Features:</b> <ul style="list-style-type: none"><li>– No additional masking layer required for logic process.</li><li>– Suitable for all logic-derivative CMOS technologies.</li><li>– Easy way to integrate with Flash or EEPROM into IC designs.</li><li>– NOR type operation (hot electron program/FN erasing)</li><li>– High Read speed (20~40ns)</li></ul>	
<b>NeoFlash™</b> NeoFlash is a single-poly embedded NVM device offering outstanding endurance properties, able to achieve over 10K program/erase cycles with high density (> 16K bits).	<b>Features:</b> <ul style="list-style-type: none"><li>– Industry's most cost-effective logic process-based NVM device with 10K endurance at high density (&gt; 16Kbits).</li><li>– Only 2~3 extra masking layers required.</li><li>– Easiest porting to all logic-derivative CMOS technologies for embedded flash.</li><li>– Industry's best cost structure and potential at advanced process nodes.</li></ul>	

Products

OTP				
<p><b>NeoFuse HR</b></p> <p><i>OTP HR is a highly reliable, one-time programmable memory solution that serves as a low cost, replacement for traditional metal-and-poly fuses.</i></p> <p><b>Typical Applications:</b></p> <ul style="list-style-type: none"><li>– Trimming</li><li>– ID Setting</li><li>– Function Selection</li><li>– Encryption</li><li>– Parameter Setting</li></ul> <p><b>Quick Review:</b></p> <ul style="list-style-type: none"><li>– Process nodes: 110/65/55/40/28/16/10/7nm</li><li>– Up to 512K bits</li></ul>	<p><b>NeoBit HD</b></p> <p><i>OTP HD is a high density one-time programmable memory solution and low process dependence.</i></p> <p><b>Typical Applications:</b></p> <ul style="list-style-type: none"><li>- Code Storage</li><li>- Parameter Setting</li><li>- ID Setting</li><li>- Encryption</li><li>- ROM Replacement</li></ul> <p><b>Quick Review:</b></p> <ul style="list-style-type: none"><li>– Process nodes: 0.5/0.35/0.25/0.18/ 0.16/ 0.13/0.11um/65/55nm</li><li>– 4K to 512K bits</li></ul>	<p><b>NeoBit HR</b></p> <p><i>OTP HR is a highly reliable, one-time programmable memory solution that serves as a low cost, small-sized and traditional metal-and-poly fuses.</i></p> <p><b>Typical Applications:</b></p> <ul style="list-style-type: none"><li>– Trimming</li><li>– ID Setting</li><li>– Function Selection</li><li>– Encryption</li><li>– Parameter Setting</li></ul> <p><b>Quick Review:</b></p> <ul style="list-style-type: none"><li>– Process nodes:0.5/0.35/ 0.25/0.18/0.16/0.13/0.11um /90/80/55nm</li><li>– Up to 4K bits</li></ul>	<p><b>NeoBit ULP</b></p> <p><i>OTP ULP is an ultra low-power, one-time programmable memory solution ideally suited to the low-power, low-voltage memory requirements of RFIC chips.</i></p> <p><b>Typical Applications:</b></p> <ul style="list-style-type: none"><li>– Code Storage</li><li>– Encryption</li></ul> <p><b>Quick Review:</b></p> <ul style="list-style-type: none"><li>– Process nodes:0.35/0.25/0.18um</li><li>– 512 to 4K bits</li></ul>	<p><b>NeoBit GHD</b></p> <p><i>OTP GHD has the same advantages and cell structure of NeoBit HD, but with a smaller OTP size, lower masking layer, and shorter FAB cycle time, all thanks to eMemory's unique "Green Technology".</i></p> <p><b>Typical Applications:</b></p> <ul style="list-style-type: none"><li>– Code Storage</li><li>– Parameter Setting</li><li>– ROM Replacement</li></ul> <p><b>Quick Review:</b></p> <ul style="list-style-type: none"><li>– Process nodes: 0.18/0.153um</li><li>– 4K to 16M bits</li><li>– Shorter FAB cycle time</li><li>– Small cell size: 0.8um<sup>2</sup></li></ul>
				
PMTP	MTP		Flash	
<p><b>NeoBit HR</b></p> <p><i>Pseudo-MTP (PMTP) HR is a high reliability multi-time programmable embedded memory with limited endurance and full logic process compatibility, using a two cell per bit structure to create ultra high yields.</i></p> <p><b>Typical Applications:</b></p> <ul style="list-style-type: none"><li>– Trimming</li><li>– Parameter Setting</li><li>– ID Setting</li><li>– Encryption</li></ul> <p><b>Quick Review:</b></p> <ul style="list-style-type: none"><li>– Process nodes:0.25/0.18/ 0.15/0.13/0.11um</li><li>– Up to 4K bits</li></ul>	<p><b>NeoEE HE</b></p> <p><i>MTP HE is a high endurance flash memory technology and offers endurance upto100K program/erase at a maximum density of 16K bits.MTP HE is built on logic process technology.</i></p> <p><b>Typical Applications:</b></p> <ul style="list-style-type: none"><li>– Encryption</li><li>– Parameter Setting</li><li>– ID Setting</li><li>– Pairing</li></ul> <p><b>Quick Review:</b></p> <ul style="list-style-type: none"><li>– Process nodes:0.3/0.18/0.153/0.13/</li><li>– Up to 16K bits</li></ul>	<p><b>NeoMTP HD</b></p> <p><i>MTP HD is a high density flash memory technology and offers density up to 512k bits and endurance of 1K program/erase. MTP HD is built on logic, HV and BCD process technology.</i></p> <p><b>Typical Applications:</b></p> <ul style="list-style-type: none"><li>– Code Storage</li><li>– Parameter Setting</li></ul> <p><b>Quick Review:</b></p> <ul style="list-style-type: none"><li>– Process nodes:0.18/0.153/0.13/0.11um /80/55nm</li><li>– 16K to 512K bits</li></ul>	<p><b>NeoFlash HD</b></p> <p><i>Flash HD is a high density full-features, embedded flash memory-system-on-a-chip (SoC) applications such as MCUs, DSPs, cellular communications, smart cards, DVDs, and speech/voice ICs.</i></p> <p><b>Typical Applications:</b></p> <ul style="list-style-type: none"><li>– Code Storage</li><li>– Parameter Setting</li></ul> <p><b>Quick Review:</b></p> <ul style="list-style-type: none"><li>– Process nodes: 0.18/0.16/0.13/0.11um</li><li>– 16K to 2M bits</li></ul>	
				

# Services and Support

eMemory's highly capable IP design/service team offers prompt, high-quality technical support, design and engineering services as it meets customers' various NVM IP needs.

## Technology Development and Porting

*eMemory provides five NVM IP technologies, NeoFuse, NeoBit, NeoEE, NeoMTP and NeoFlash. All five technologies can be easily ported across different fabs, process nodes and derivative processes. eMemory supports these technologies with the industry's largest and most experienced technology development service team. This team includes process, device, testing and PE engineers, who have successfully developed/ported processes for foundries and fabless design houses.*

### Foundry Side

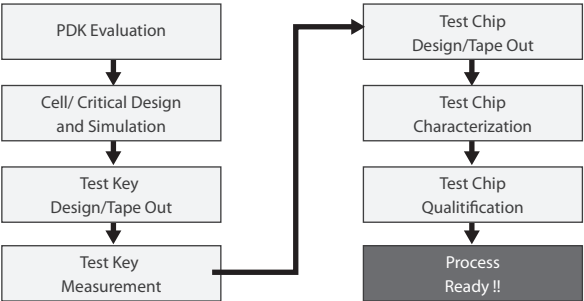
- NeoBit technology at 21 foundries and 10 IDMs
- NeoFuse technology at 10 foundries
- NeoEE technology at 9 foundries
- NeoMTP technology at 8 foundries and 1 IDMs
- NeoFlash technology at 2 foundries and 3 IDMs

With 320+ process platforms in operation today, eMemory offers foundry partners access to a sizable and constantly expanding customer base.

### Fabless Design House Side

In addition to an extensive range of pre-existing IP products, eMemory provides customized eNVM development services to meet any special technology or process node requirements of fabless design house customers.

### New Process Development Flow



## IP/Product Engineering

*With a wealth of successful design experience and strong testing support capabilities, eMemory can efficiently resolve customer issues during product design, testing, and production stages.*

### Design Engineering Consulting

For the design phase, eMemory provides customers with complete design kits including documentation on IP usage and features, along with necessary files for design simulation and layout placement and routing (P&R) in a customer's design workflow. Detailed application guidelines and test methodologies are also available in the design kits for customer's reference.

### Product Engineering Consulting

All eMemory IP meets strict characterization and qualification testing standards for IP performance and reliability. eMemory delivers design kits containing the proposed testing workflow and test conditions to customers at an early stage for reference. In addition, eMemory provides professional consultation during the design, test, and mass production stages.

### Easily Accessible Support Resources

To effectively resolve customer issues from design to mass production, eMemory offers customers convenient access to downloadable data sheets, comprehensive IP information, design-related documentation, and IP merge application, which can serve as a 7-24 inquiry platform for resolving customer requirements.

### Service items from design to mass production

NVM IP Introduction
SPEC Discussion
Process Node Suggestion/ Set Up
Proposing Optimized Solution
Customized Design
Provide IP Simulation Model
Testing Flow Suggestion
IP Merge Flow
Testing Issue Analysis
Production Issue Analysis
Special System Spec Supporting
Engineering Consulting for End-system



## NeoROM™

*The NeoROM Service converts NeoBit/NeoFlash IP to mask ROM-like characteristics for customers requiring efficient product-level testing and inventory management when products move into mass production.*



### What is NeoROM?

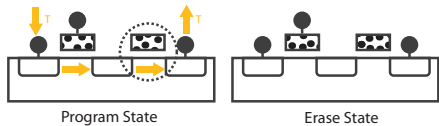
NeoROM is fully compatible with logic or logic-derivative processes, requiring no additional masking or extra process steps. NeoROM does not change the standard CMOS process, and, thus, results in no additional process costs. Process simplicity and flexibility not only make NeoROM

extremely robust, but also deliver higher fabrication yields. NeoROM minimizes the time required during testing by as much as 90%.

### Technical Principles

NeoBit converts to NeoROM with one poly mask change. The conversion process is simple and cost-effective. Customers do not require secondary IC certification for the same chip size.

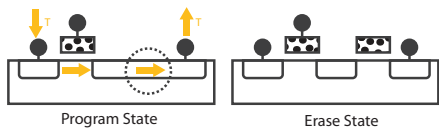
#### NeoBit Methodology



#### Feature:

1. Fast Time-to-Market
2. Design Flexibility
3. No Inventory

#### NeoROM Methodology

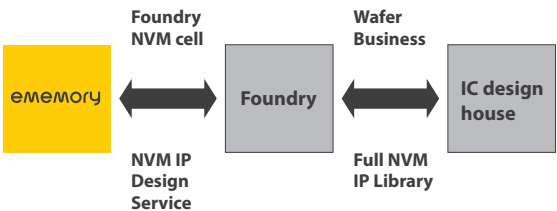


#### Feature:

1. Fast Time-to-Market
2. Revise Poly Only
3. Low Testing Cost
4. No Code Program Cost

## NVM IP Design Service with Foundry Proprietary Technology

eMemory provides NVM IP design service using foundry's proprietary NVM cell. Base on sufficient NVM IP design experience and over 1 million 8 inch wafer shipment per year from customer side, eMemory has set up a fluent flow to co-work with IC design house for customizing OTP/MTP/Flash IP and helping customer's IC got better benefit from NVM IP. Now eMemory starts to provide NVM IP design service for foundry proprietary NVM technology, and will help foundry partners get more wafer business by extending NVM IP types and quantity.



## iService™

eMemory iService™ is an online tool that provides customers with 24/7 access to proprietary technical documentation. Customers can log-in to download technical documents, and request design kits.

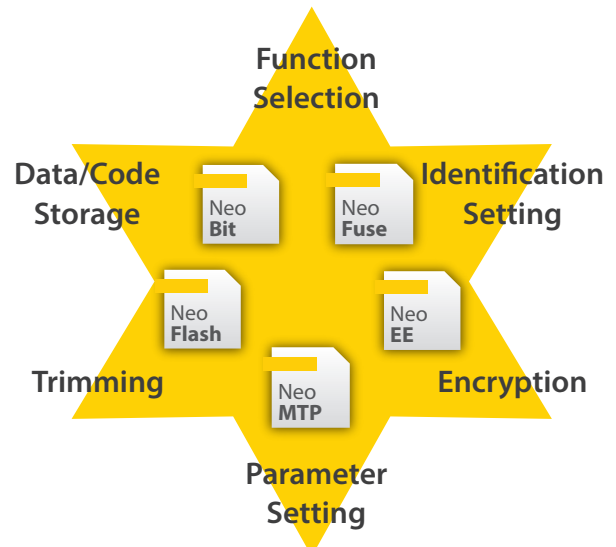


# eNVM Applications

Since the introduction of eMemory's eNVM in the year 2000, over six major applications have found favor with fabless design houses, and have been widely adopted in no less than 30 major types of ICs.

## Application by Function

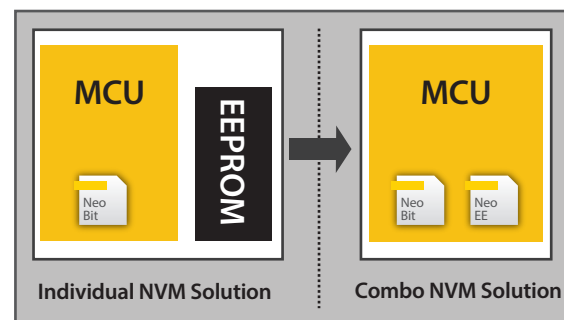
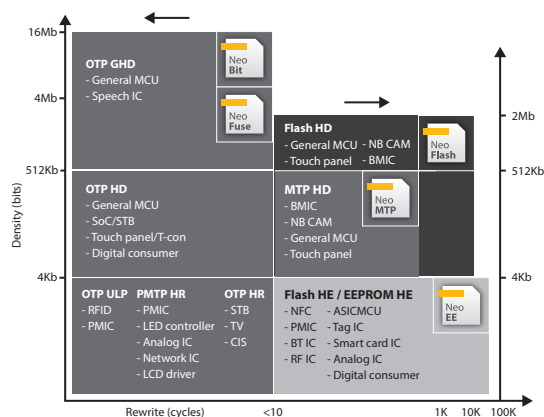
There are six major applications of eNVM by function. To date, eMemory products have been applied in more than 100 unique applications based on these six application types. eMemory's embedded NVM family including OTP, MTP, and Flash that can be fabricated concurrently with logic circuit fabrication without extra mask or very few additional masks. eMemory's technology has been widely adopted in electronic devices for consumer electronics and industrial applications to achieve various functions.



For controller ICs such as MCU, embedded OTP or MTP are commonly used for **data/code storage**. Nevertheless, embedded NVM can also be applied in extensive applications which go beyond just code storage. To reduce the impact of process shift and stress from packaging on analog ICs performance, few-bit embedded OTP or MTP such as NeoBit and NeoEE is adopted to store various parameters for **setting, trimming** or **function selection** such as gamma factor in LCD driver ICs to optimize product performance or improve production management and logistics tracking. Embedded Logic NVM has also been seen in security-sensitive applications, such as digital rights protection applications and smart cards for **encryption** and **identification setting**.

The demand of density and endurance varies with target markets; adopting the most appropriate eNVM solution is important to the product. Being the leading eNVM company, eMemory's five technologies including OTP and MTP solutions can help customer to find the most suitable solution instead of high performance but over SPEC solution to achieve cost-effectiveness.

Due to the capability to provide multiple logic NVM solutions, eMemory can offer not only individual OTP or MTP solution but also the "Hybrid solution" which integrates OTP and MTP in one single chip while reducing dimension by sharing common OTP/MTP circuits. "Hybrid solution" can provide the most versatile and cost effective package for MCU customers to replace eFlash.



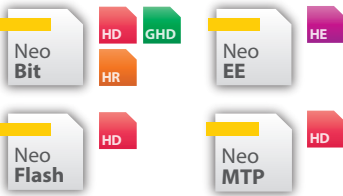
## Application by Chip Type

There are ten major types of ICs that use eNVM for advanced functionality, improved operation, and reduced cost.

### Touch Panel Controller

NVM is commonly used for F/W code storage and configuration setting to meet various display size and module stacking structure. Some unique gesture, face suppression and the others also could be programmed in F/W to make differentiation.

#### Recommended Products:



### Image Signal Processor

The properties of image sensors, including CCD and CMOS devices, may deviate from idealized values or need to set special parameters depending on the particular manufacturing process, which in turn may affect final image quality. For this reason, NVM finds use in recording the actual values of a given image sensor, which can then be utilized in trimming the deviation or optimizing image quality in a system. NVM can also record the location of defective pixels in an image sensor to allow compensation. Meanwhile, the image processing algorithms corresponding to different mechanism actuator such as VCM, Piezo, and stepping motor are also stored in MCU/DSP.

#### Recommended Products:



### LCD TV Controller

When data is transmitted through HDMI, NVM is required to store the HDCP key used complete the HDCP-compliant secure transmission. NVM is also used to store information on the video formats supported by the HDMI receiver. Moreover, many circuit properties, like the analog interface in an LCD TV controller, should be measured and their values stored for trimming, another area where NVM finds use, allowing for fine-tuned performance.

#### Recommended Products:



### LED Management IC

Because the brightness of LED arrays varies with ambient temperatures and operating times, NVM is required to record data on changes in brightness levels for use in dynamically stabilizing these levels. In addition, compensations for deviations in LED controller IC properties caused by a process shift can use trimming parameters stored in NVM.

#### Recommended Products:



### Fingerprint

eMemory's eNVMs are widely used by capacitive & optical fingerprint sensor IC. The main purpose is for trimming and ID storage. Now, eMemory also provide HD OTP & MTP for algorithm & fingerprint template storage, to meet match-in-sensor SoC application requirement in the future. eMemory's NeoFuse OTP can also provide RNG (Random number generator) & PUF (physical unclonable function) for security design in fingerprint sensor.

#### Recommended Products:



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## LCD Driver

Embedded NVM provides the programmability and flexibility necessary to enable liquid crystal gamma curve tuning, over-driving (OD) schemes, common voltage settings, and ID coding from within the TFT LCD driver IC.

### Recommended Products:



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## MEMS Controller

Embedded NVM can be used to record sensor parameters of MEMS Controller chips at FT or system adjustment stages, record values for circuit properties, and trim sensor and circuit resolutions at both the CP and FT stages.

### Recommended Products:



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## RFIC

An RFIC chip features extremely low power consumption and low-voltage operation, requiring dedicated memory for data storage and processing. Ultra low-power eNVM does not reduce the total system size. It also ensures that additional power is not needed to support the memory needs of the chip.

### Recommended Products:



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## MCU

Conventionally MCUs require a dedicated memory, such as ROM, for three storing software programs, as a data storage unit in the MCU system, or as circuit logic. Embedded NVM allows these three functions to be integrated within the MCU chip, reducing total system cost and increasing production flexibility.

### Recommended Products:



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## Power Management IC (PMIC)

Embedded NVM eliminates the area penalty and cumbersome programming challenges of traditional poly or metal fuses that require physical destruction. Embedded NVM efficiently regulates and fine-tunes power levels for precise and accurate voltage management.

### Recommended Products:



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## STB Controller

Digital TV signals need to be decoded by a STB before they can be fully displayed. As analog circuit properties in an STB system may deviate from expected values due to process shifts, the deviation can be recorded in NVM for use in trimming. In addition, to ensure data security and privacy, NVM can be used for encryption key storage.

### Recommended Products:

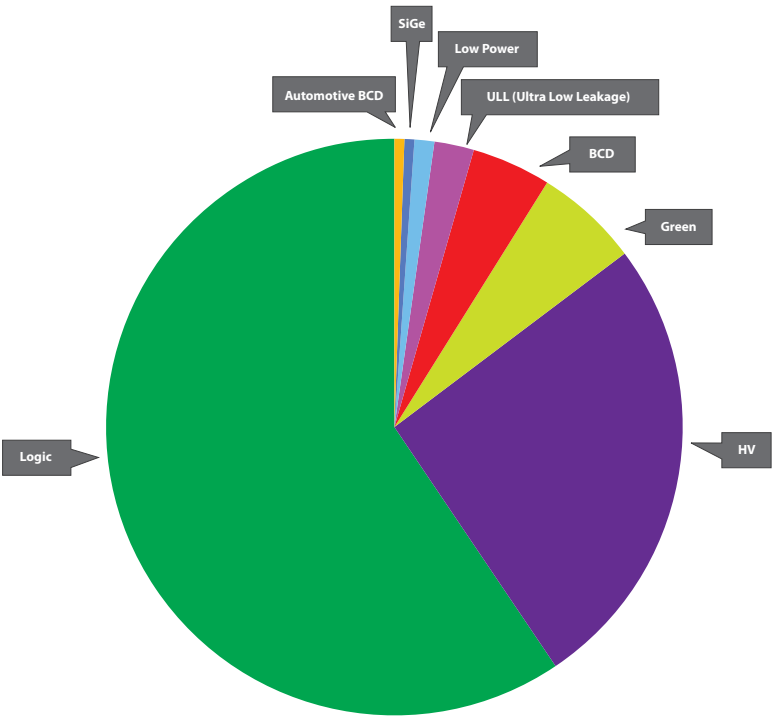


Technology type	NeoFuse	NeoBit					NeoEE	NeoMTP	NeoFlash
Memory type	OTP	OTP				PMTP	Flash/ EEPROM	MTP	Flash
Family type	HR	HD	HR	ULP	GHD	HR	HE	HD	HD
Standard process	Y	Y	Y	Y		Y	Y	Y	Y
Green Process					Y		Y	Y	
Extra masking layer	0	0	0	0	0	0	0	0	2~3
Compatibility with logic process	Y	Y	Y	Y	Y	Y	Y	Y	Y
SPICE model aligned to logic	Y	Y	Y	Y	Y	Y	Y	Y	Y
Wafer processing cost	Standard logical process cost	Standard logical process cost	Standard logical process cost	Standard logical process cost	~30% lower than standard logical process cost	Standard logical process cost	Standard process cost	Standard process cost	22% lower than stack gate embedded flash process cost
Process Dependence	Low	Low	Low	Low	Middle	Low	Low	Low	Middle
Technology development time	6 months	6 months	6 months	6 months	9 months	6 months	1 yr	1 yr	1.5 yrs
In-system programming	Y	Y	Y	Y	Y	Y	Y	Y	Y
Erasability	NO	Y (by UV)	Y (by UV)	Y (by UV)	Y (by UV)	Y (by UV)	Y (electrical)	Y (electrical)	Y (electrical)
Time to market	Good	Good	Good	Good	Good	Good	Good	Good	Good
Rapid porting on foundries/ processes	Y	Y	Y	Y	Y	Y	Y	Y	Y
Endurance	1	1	1	1	1	1~10	100K	1K	10K
Consumer grade	Y	Y	Y	Y	Y	Y	Y	Y	Y
Industry grade	Y	Y	Y			Y	Y	Y	Y
Automotive grade	Y		Y				Y		
Porting process type	Logic process (from 0.18um to advanced node)	Logic process (from 0.5um to advanced node, with 5V or 3.3V or 2.5V I/O device)					Logic process (from 0.18um to advanced node)	Logic process (from 0.18um to advanced node)	Logic process (from 0.5um to advanced node)
	High voltage/OLED	High voltage process					High voltage process	High voltage process	High voltage process
	BCD process	BCD process					BCD process	BCD process	BCD process
	Low power/ Ultra low power	Low power/Ultra low power					Low power process	Low power process	Low power process
	CIS Process	Automotive process					Automotive process		
	High Performance Mobile(HPM)	SiGe process					SOI process		
	DRAM								
	eFlash process								
	FinFET process								

**eMemory Process Platform**

eMemory’s core technologies - NeoFuse, NeoBit, NeoEE, NeoMTP and NeoFlash - are being widely built in to more than 320 process nodes in various foundry and IDM companies for processes ranging from 0.5um to 7nm. eMemory’s core technologies support CMOS-based logic processes and derivative processes, including mixed-signal, RF, high-voltage, BCD, SiGe and low-power processes. You can easily find eMemory NVM solutions for various process platforms to suit your particular design needs.

**Process types of eMemory NVM IP distribution**



Process type		Definition
HV		Logic process with high voltage device
Logic		General purpose CMOS logic process
BCD		Bipolar/ CMOS logic/ DMOS process
Automotive BCD		Automotive grade BCD process
Green		Proprietary 0.18um logical process of eMemory
SiGe		Silicon Germanium BiCMOS process
ULL/ LowPower		Low leakage CMOS logic process



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**eMemory**

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