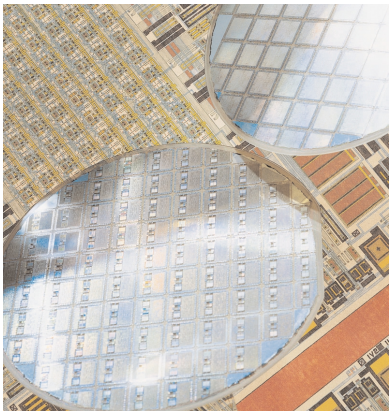
MOTOROLA
intelligence everywhere™

digital dna™

ANALOG ICs

INTEGRATED SOLUTIONS

TECHNOLOGY



WHY USE MOTOROLA'S *SMARTMOS*™ PRODUCTS?

Motorola ***SMARTMOS***™ process is unique because it combines these features:

- NVM
- iLDMOS
- High current metal
- High voltage
- Engineered matching
- Noise immunity
- Tailored for harsh environments
- Inductive load switching and immunity to interference
- Engineered energy capability and robustness
- Good selection of devices with a wide range of features
- 105 V Capability

SMARTMOS™ is the best process for the embedded world.

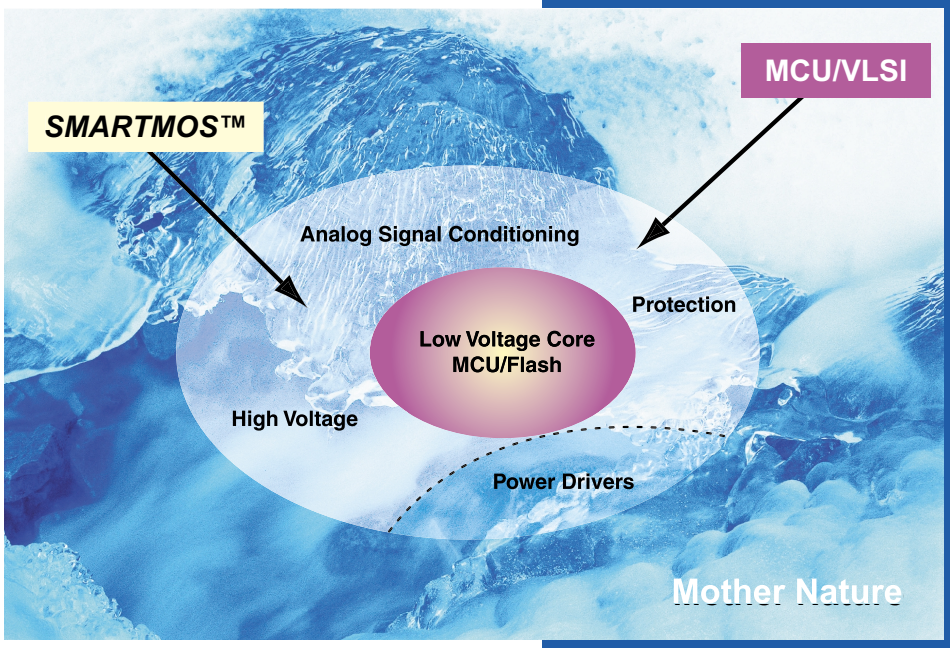
While today's high density CMOS processes have vast amounts of processing power, they cannot directly interact with most real world systems. In embedded systems these real world signals still need to get to the processor and loads need to be driven. In addition, processors need to be provided clean power and protected from the harsh electrical environment found in the outside world.

ICs using ***SMARTMOS***™ are ideally suited to all these tasks. ***SMARTMOS***™ is a combinational CMOS process that integrates precision analog, power devices and logic. Embedded systems designers can eliminate dozens of components and combine all those functions into a single cost-effective IC including functions of voltage regulation, power MOSFETs, input signal conditioning, transient protection, system diagnostics and control.

SMARTMOS™ in combination with HDTMOS discrete FETs for very high currents make up Motorola's predominant process technologies which combine precision analog high voltage, high current power capabilities and high speed CMOS in a single package.

Motorola's Analog ICs using these technologies are:

- Highly Capable - Providing full flexibility of integration
- Robust - Developed for applications demanding a high level of environmental tolerance, found in automotive and industrial applications.
- Cost-Effective - Appropriately balanced analog, power and CMOS logic (***SMARTMOS***™) capabilities providing cost-effective solutions
- Innovatively Packaged - Motorola's innovative multi-die packaging options exploit strengths of both ***SMARTMOS***™ and HDTMOS to offer reduced cost and space.
- Constantly Improving - Motorola has supplied over 1 billion Automotive ***SMARTMOS***™ ICs since 1991. We are currently shipping products in our 6th technology generation.



SMARTMOS™ surrounds your delicate components with real world - capable analog / power interfaces.

Power

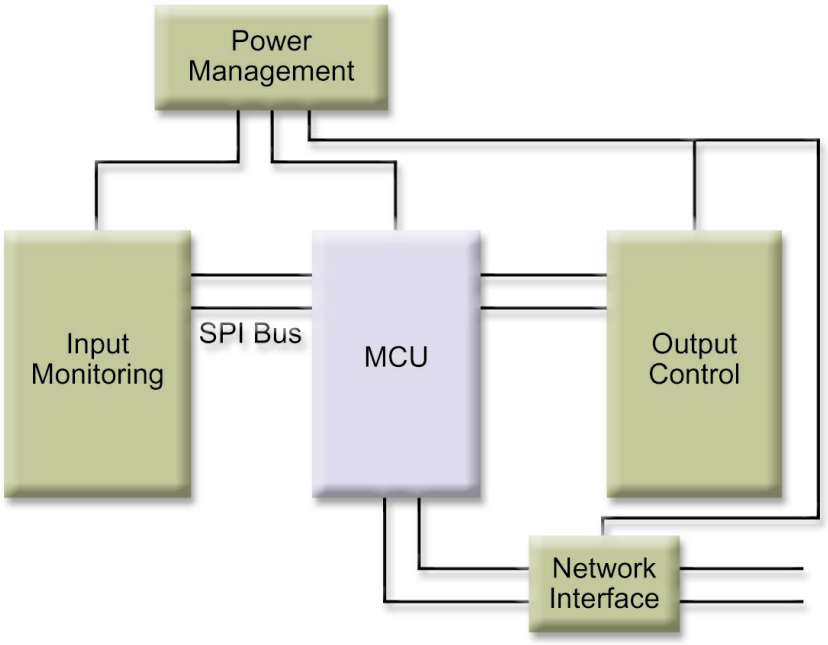
SMARTMOS™ is precision analog, high-speed CMOS, and high voltage power combined into a single IC process! This robust process allows for optimal integration of a wide variety of mixed signal analog features, yielding best-in-class solutions for our customers.

Power is an increasingly in demand component of a mixed signal system. Motorola's ***SMARTMOS***™ technology provides excellent integration capabilities for low and medium power levels. In addition our expertise in control technology allows products to be scaled for many applications. For high power systems, advances in multi-die manufacturing technology allow the cost effectiveness of power HDTMOS devices to be combined with the advanced integration and control capability of ***SMARTMOS***™. These processes allow the customer to receive cost-effective, single-package solutions that decrease their system cost and time-to-market.

Motorola Analog ICs are designed to communicate with their host MCUs as well as enable network communication.

We combine these building blocks into many different ICs which fall into five broad categories:

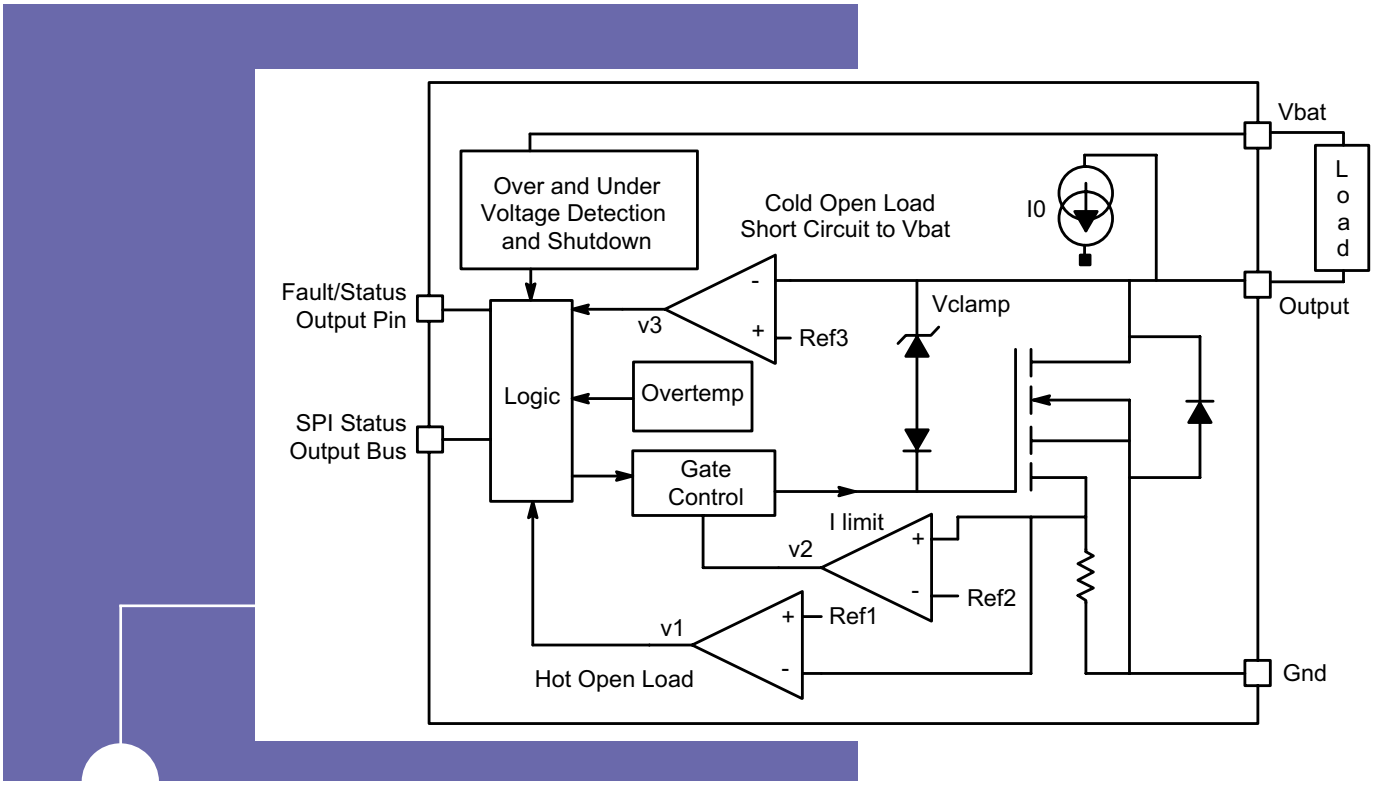
- Power ICs
- Communication
- Power Management
- Safety/Sensors
- Special Functions



- SPI interface allows MCU to control and communicate with ***SMARTMOS***™ ICs
- Built-in diagnostics protect the device and communicate status to the MCU
- Physical interfaces enable the system to communicate reliably over a network
- Non-volatile memory allows setting of unique data and calibration information via the network

Communicating

Protecting

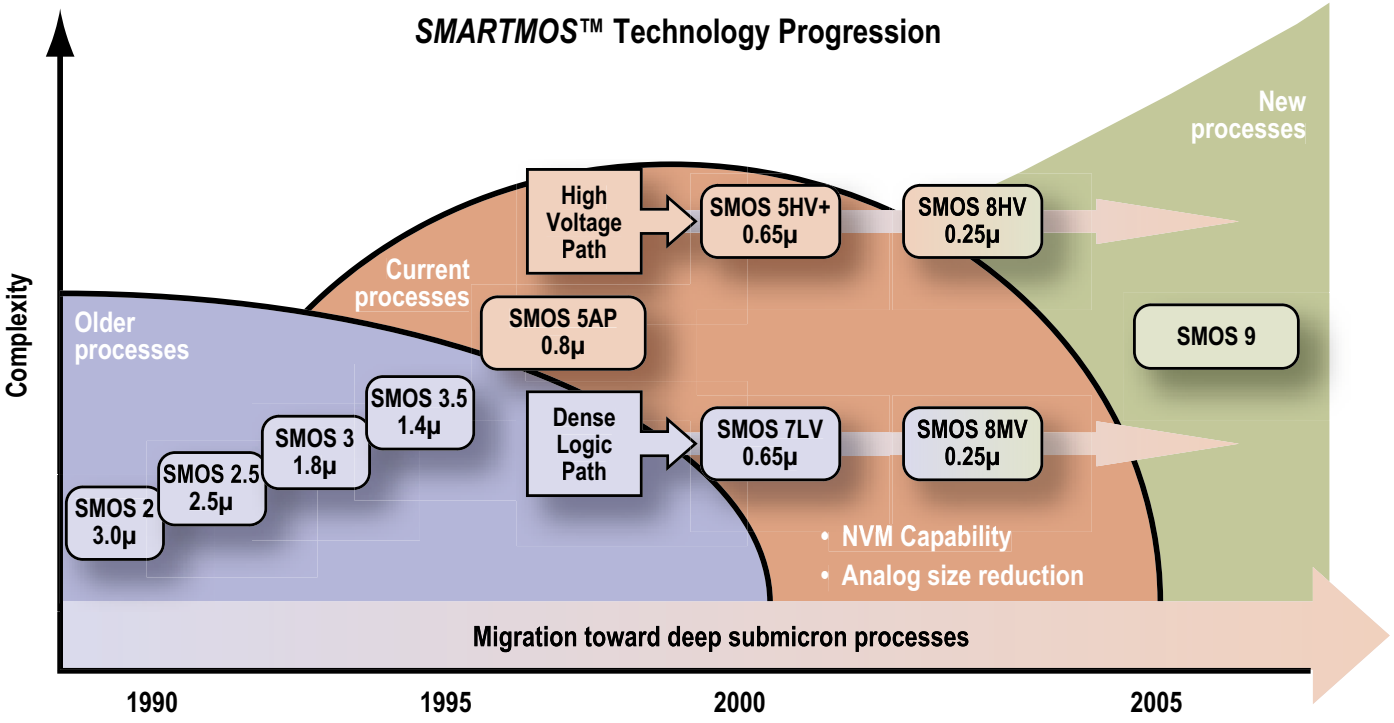


***SMARTMOS*™ PROTECTION FEATURES:**

- Over-current detection or shutdown, with auto-retry
- Open load detection with outputs, ON or OFF
- Output current limiting
- Detection of shorts to ground or supply, with auto-retry
- Over-temperature detection or shutdown, with auto-retry
- Current and voltage waveshaping for radiated RFI reduction
- 2000 V / 200 V (human body model/machine model) ESD (all pins)
- Full diagnostics and status reporting

Most of the products in production today use the ***SMARTMOS***™ 3 process. Today's workhorse process for new designs is ***SMARTMOS***™ 5 AP built on a 0.8 micron double metal CMOS flow that can handle 60 V I/0. Devices featuring thousands of gates, voltage regulators, and multiple power FETs with on chip diagnostics are typically built with this process. In addition a 105 V extension is available for new 42 V system designs.

For devices requiring higher logic density Motorola has ***SMARTMOS***™ 7 LV, a 0.35 micron ***SMARTMOS***™ flow with 45V I/O that makes devices with 100 k gates practical. Both processes have a large variety of devices available to the designer including MOS and bipolar transistors and diodes, several flavors of MOS power devices, non-volatile memory for trim and personalization, and passive components. The next generation of both of these processes will be introduced soon which will allow even greater levels of integration and features.



Our ***SMARTMOS***™ integrated circuit products feature a rich set of mixed-signal building blocks including A/D and D/A converters, rail-to-rail op amps, comparators, charge pumps and gate drives, voltage regulators, precision references, digital logic, and non-volatile memory. For driving loads we have power MOSFET devices with inductive energy clamps, independent thermal management, short circuit protection, and diagnostic load sensing.

Controlling

A-D (8- & 10-Bit)

Oscillator
Crystal, Internal

9-Bit D-A
Guaranteed Monotonic

Op Amps
Rail-to-Rail

Charge Pump
Internal - External

Comparators

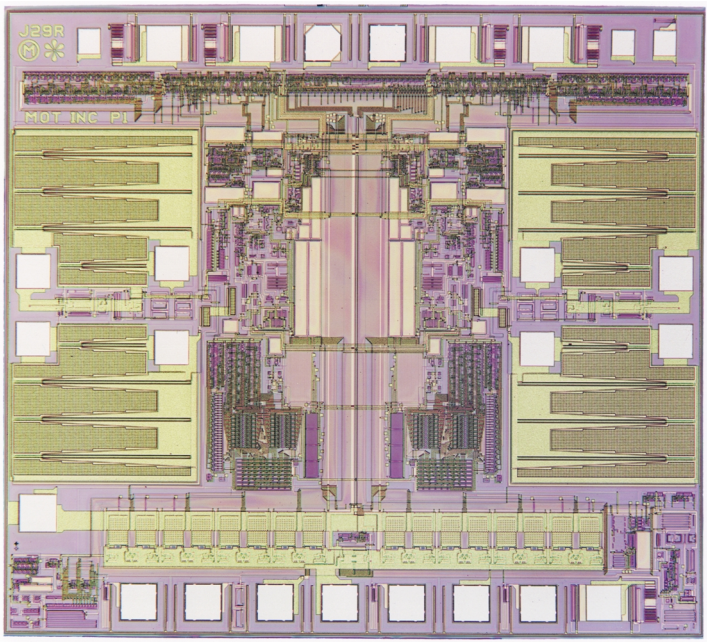
Switched Cap
Filters, Gain Stages

Precision References

Voltage Regulators
MCU Supplies, 5.0 V, 3.3 V, 2.6 V, Etc.

Non-Volatile Memory

Analog MOS
To 20 V or 60 V



High-Speed CMOS

Power MOSFETs

Inductive Energy Clamps

Independent Thermal Management
Shutdown at 165 ±15°C

Load Sensing
- Shorted Load
- Open Load
- Pintel Movement
- Load Resistance
- Inductance

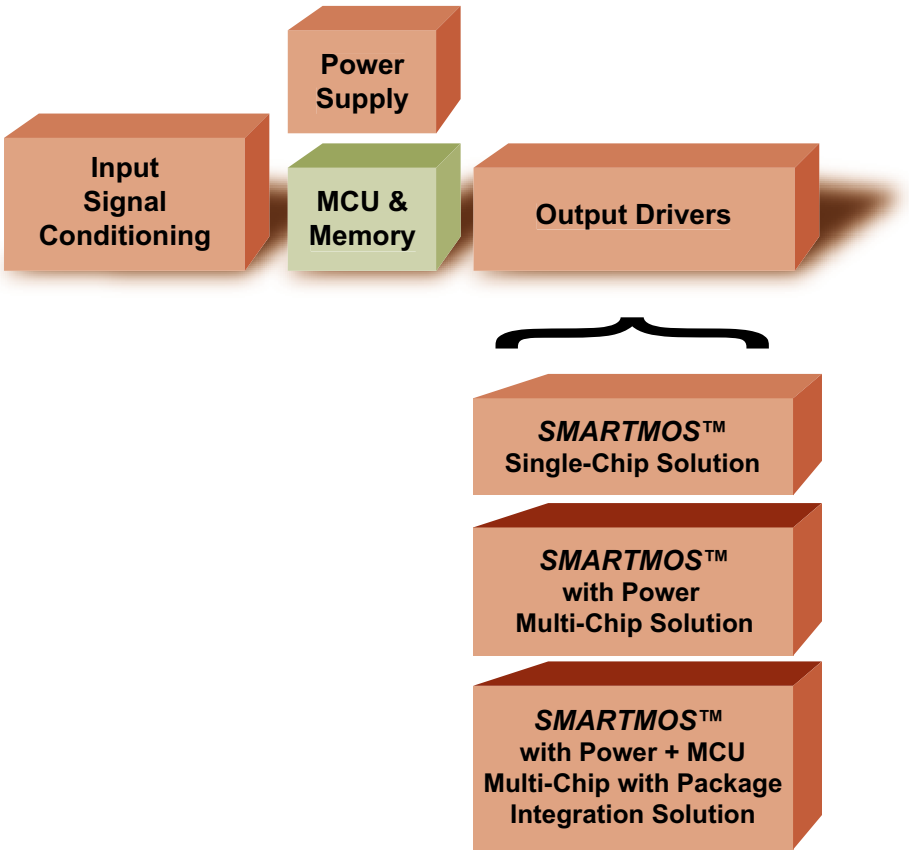
Every MCU requires analog support, power supply supervisory functions, input signal conditioning (de-bounce and serial I/O support analog-to-digital conversion) and output power drivers.

SMARTMOS™ ICs excel at communicating with MCUs and networks.

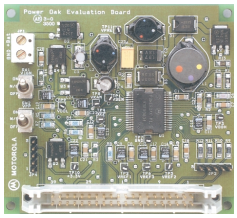
SMARTMOS™ is the best IC technology to control electrical loads and to measure inputs.

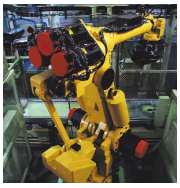
SMARTMOS™ ICs protect delicate VLSI MCU and memory ICs.

SMARTMOS™ products are the ideal technology complement for MCU based systems!



The Analog Products Division of Motorola has a long history serving the commercial and automotive marketplace, and a vast experience with the automotive industry's quality requirements / expectations. We achieved QS9000 certification status in July'98, and we use AEC-Q100 as the basis for our product stress test qualifications (products introduced prior to July'98, may have limited qualification or other data available). Data may be available on a fee-for-service basis.





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