



## Semiconductor Solutions

Automotive Applications

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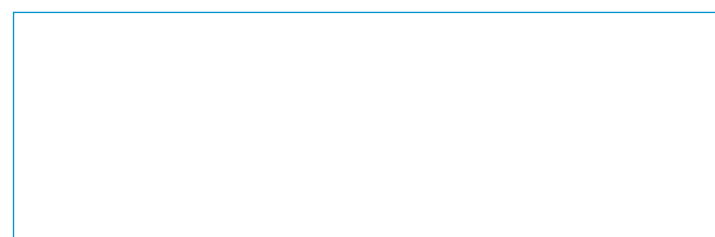
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# Semiconductor Solutions

## for Automotive Applications

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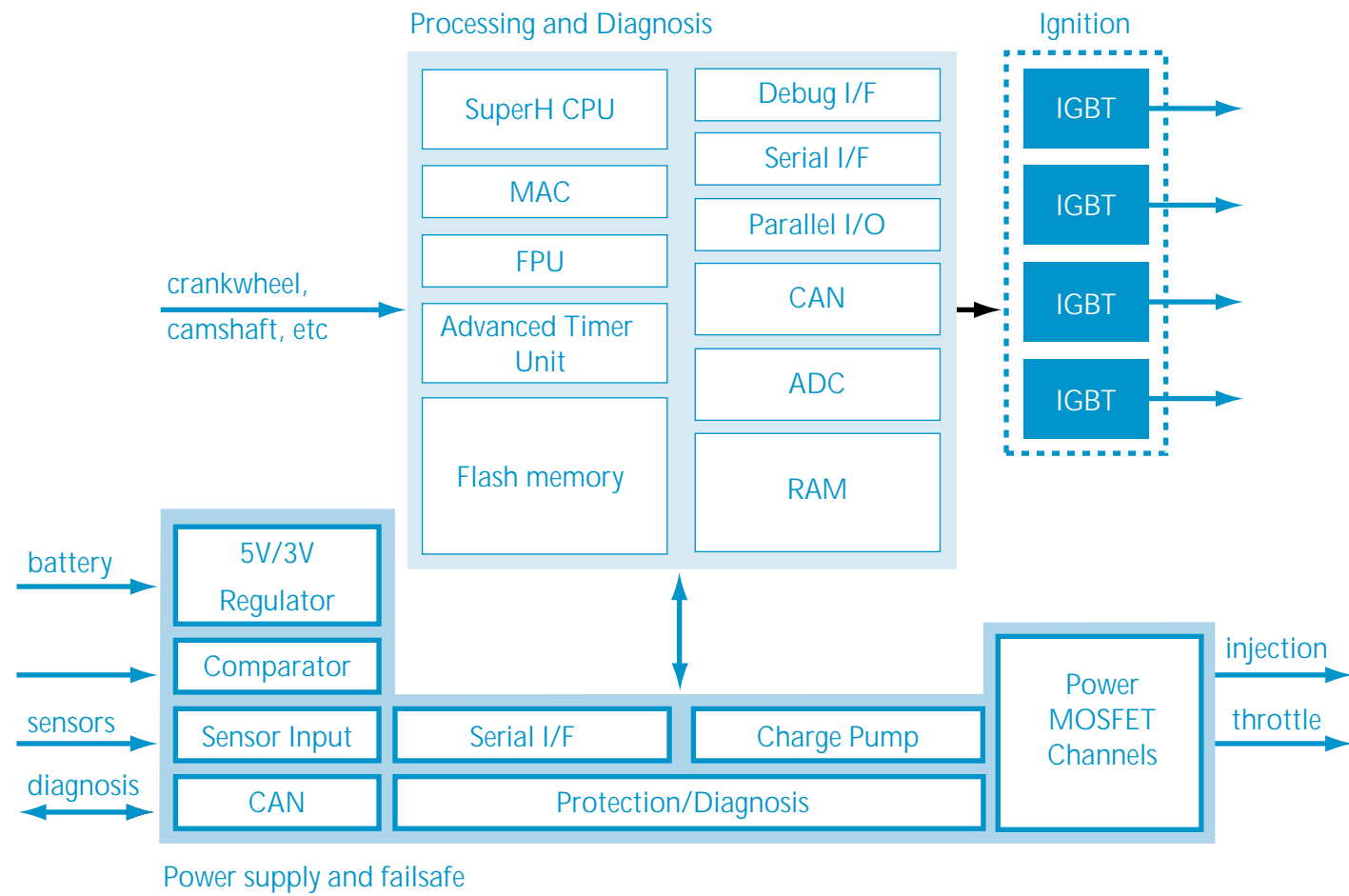
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*To provide world  
leading system  
solutions in focused  
areas, exceeding  
customers'  
expectations in  
technology, quality,  
support and service,  
thus ensuring  
ROI and a win-win  
customer relationship.*

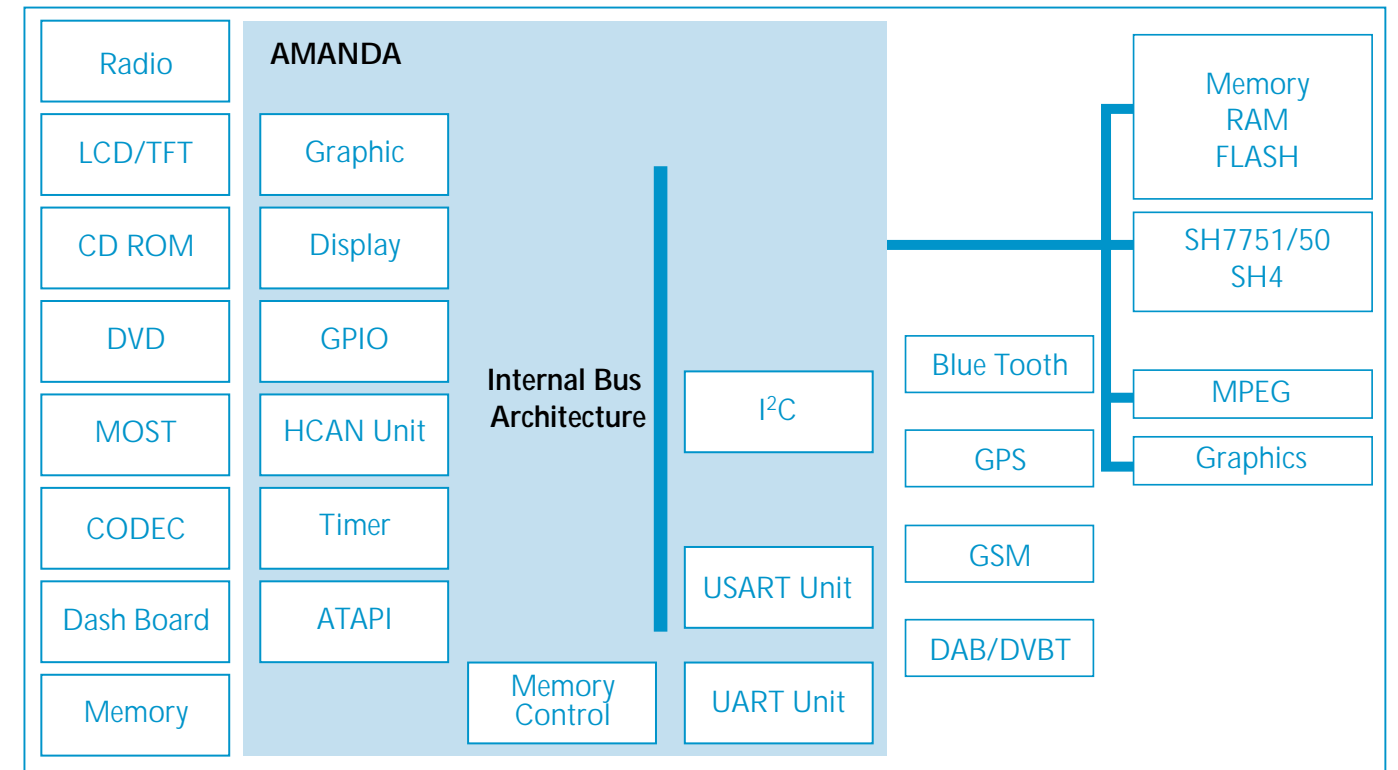
System solution with Hitachi Semiconductor



■ Why choose Hitachi?

- | Flash: leading on-chip flash technology
- | Long experience in automotive powertrain applications
- | Long term commitment to support automotive market
- | Leading technology, excellent products, clear roadmap
- | Experts to support products and applications in Europe
- | Development tools and calibration tools from Hitachi
- | Strong 3rd party support
- | Hitachi solutions have been chosen by leading automotive companies

System solution with Hitachi Semiconductor



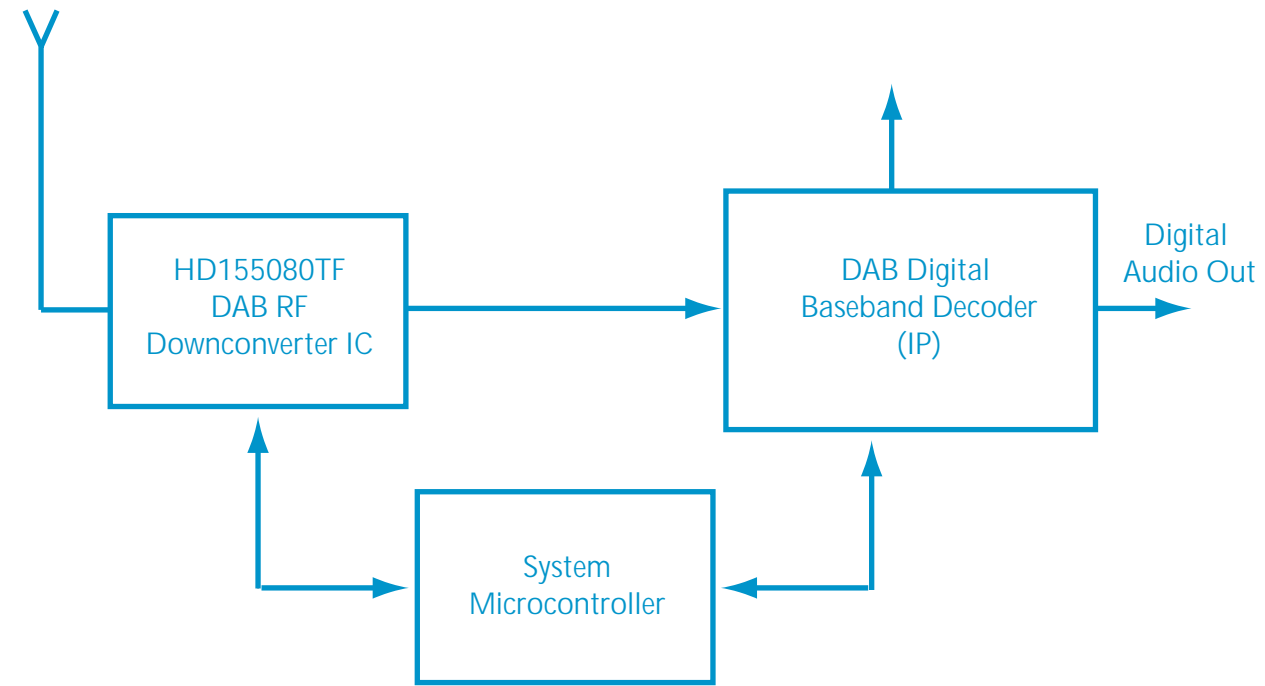
■ Why choose Hitachi?

- | SuperH has market-leading performance
- | SuperH is complemented by a range of Companion chips and leading-edge ASIC technology
- | SuperH is the premier platform for Windows™ CE systems, including AutoPC

*"Hitachi: has gained market dominance in automotive GPS navigation systems by being the supplier of the device of choice for many OEMs."*

source: Dataquest

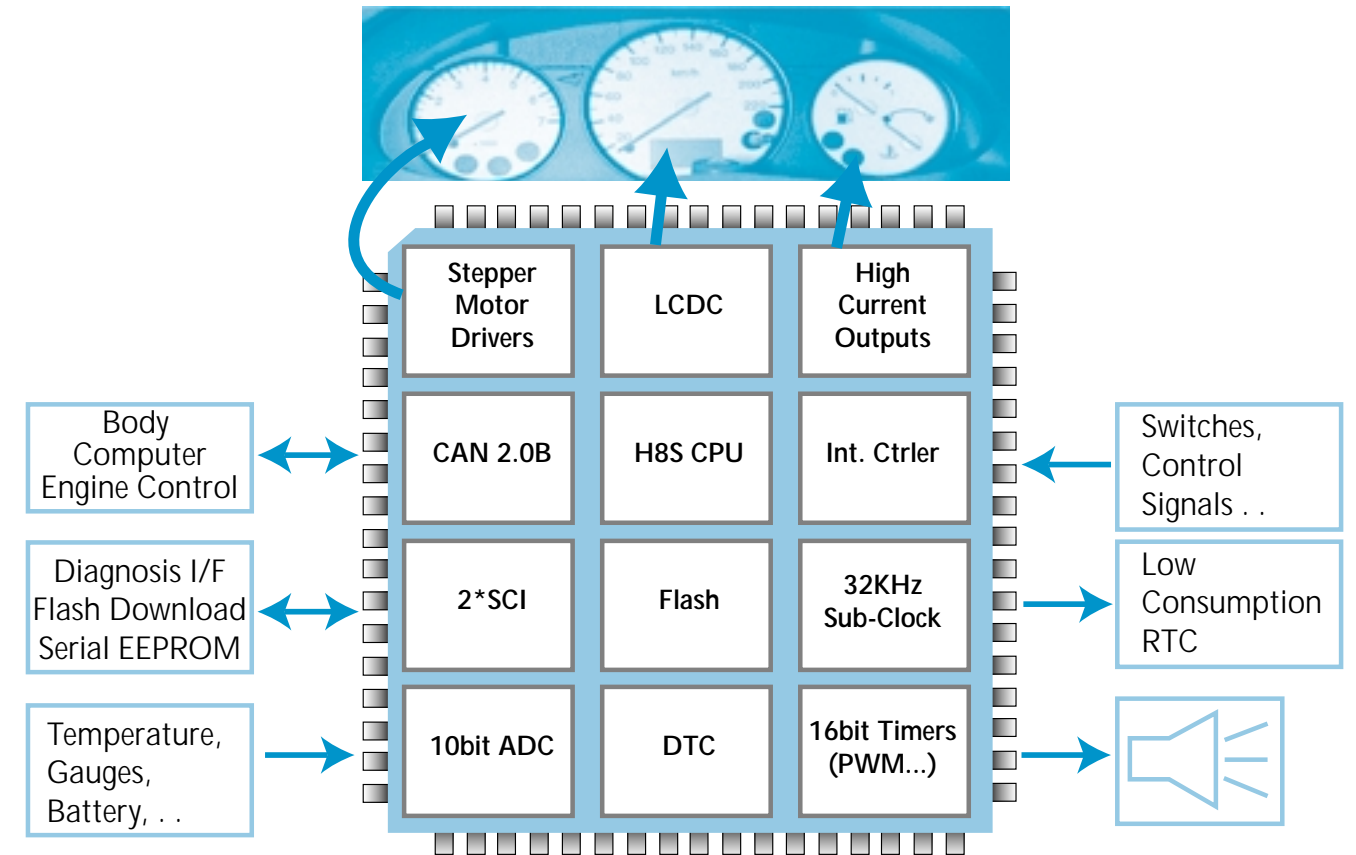
System solution with Hitachi Semiconductor



■ Why choose Hitachi?

- | High integration of digital and RF functions reduce system costs and space requirement
- | Leading-edge process technology for BICMOS and CMOS

System solution with Hitachi Semiconductors



■ Why choose Hitachi?

- | High CPU performance and upward compatibility from all H8
- | Low power consumption
- | Special chip design to achieve low EMI
- | Large on-chip Flash memory
- | High integration - single chip solutions

## Hitachi Microcontrollers - The Solution for Automotive Application

Hitachi microcontrollers have been used in automotive applications since the first days electronics were used in cars, starting with 8-bit CPU cores. Today, the line up includes low cost 8-bit as well as high performance 32-bit RISC microcontrollers and processors.

High level language supporting CPU architectures with upwardly compatible products are Hitachi traditional features.

Hitachi's commitment to support the automotive market has been recognised by the market and also expressed by the NEXUS group : "(Hitachi) represent large market share for MCU's in automotive powertrain. Technology leader for 16-bit/32-bit MCUs. Long term automotive focus."

Today, Hitachi microcontrollers are used in

- | dashboards,
- | climate control systems,
- | ABS and traction control systems,
- | airbags,
- | engine and automatic gearbox systems
- | Car Information Systems, including navigation, DAB and mobile phones.

CPU road map to reduce cost of ownership

Hitachi's product development always has customers' system costs and customers' competitiveness in mind.

One of the design rules to achieve this is software upward compatibility. Examples are the upward

compatibility from H8/300L to H8/300(H) and further to H8S, Hitachi's latest 16-bit CISC CPU development and the upwardly compatible SuperH RISC CPU cores.

The SuperH family now offers an upwards compatible 32/64 bit RISC engines (20 ... 1000 MIPS) combined with high code density comparable to 16-bit MCUs.

On the other hand, latest RISC CPU technology is available to the benefit of the customer - high performance at low costs, high power efficiency and optimum memory usage.

At on-chip peripheral level, compatibility of modules is given from low-end 8-bit to high-end 32-bit where applicable. Thus reducing the time to rewrite low level software drivers.

### 32-bit RISC microcontrollers and microprocessors for automotive applications

32-bit performance is required in a number of automotive applications.

#### Powertrain

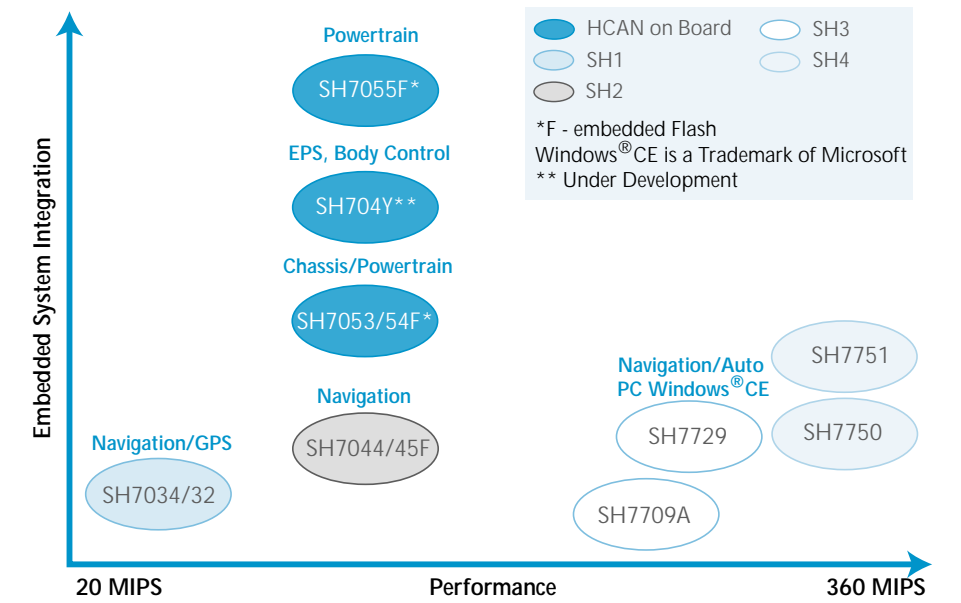
SH7055F with 512 KB on-chip Flash, based on SH2 CPU core, 40 MHz, 52 Dhrystone MIPS, is Hitachi's latest microcontrollers for the powertrain.

#### Car Information Systems

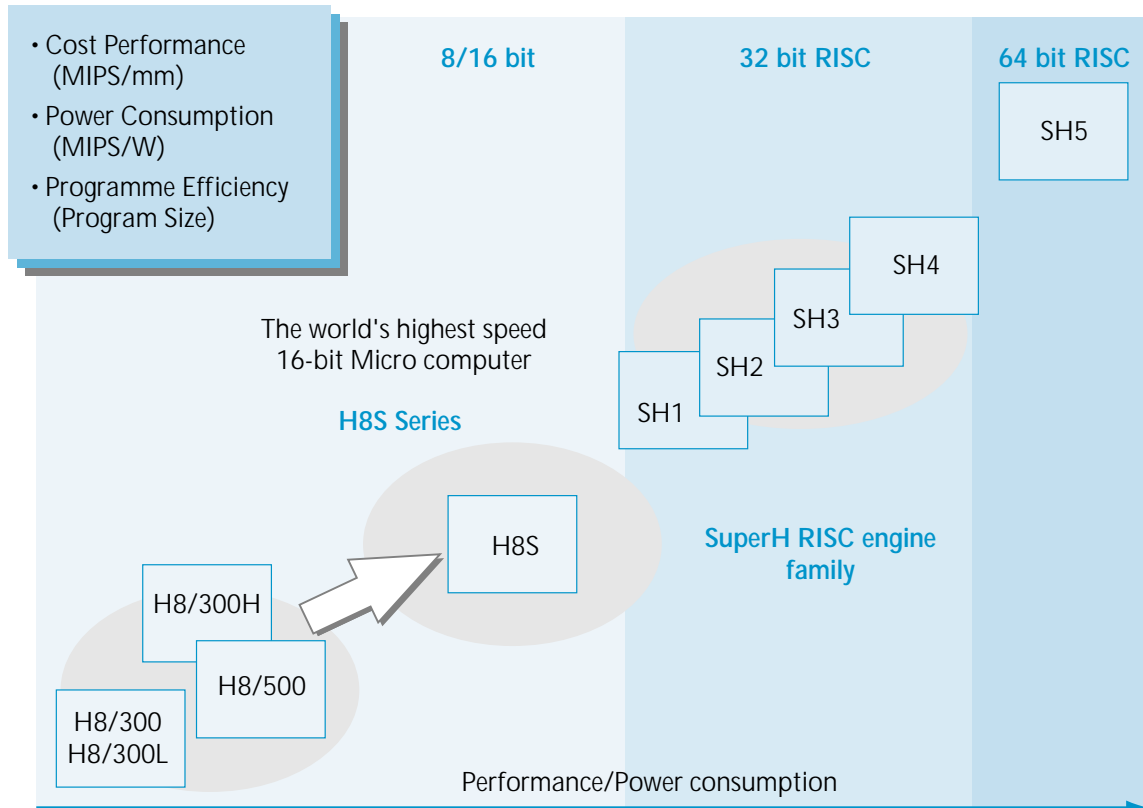
Hitachi's strong position in car information systems is reflected by the wide range of SuperH devices for applications such as DAB, mobile phone, and SuperH processors based on SH3 and SH4 cores.

#### AutoPC

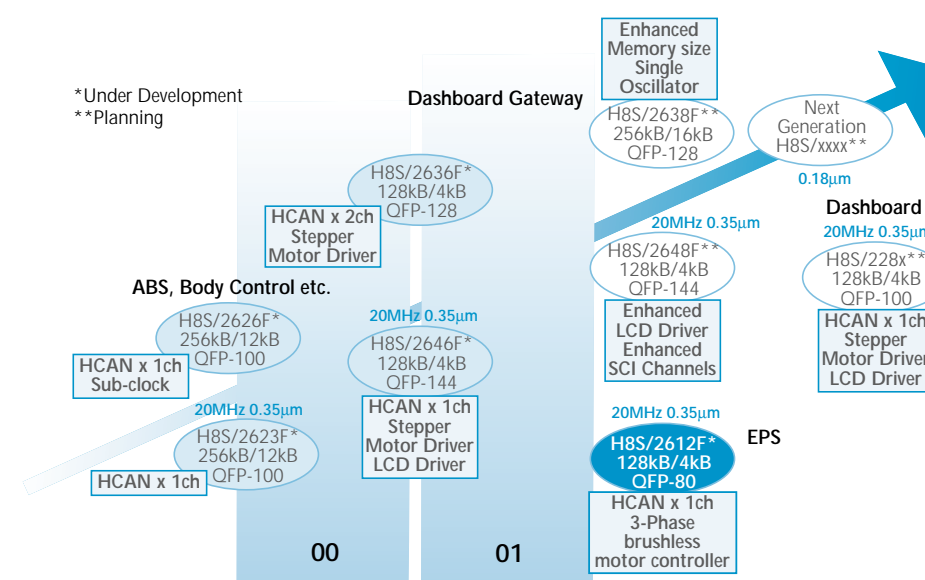
SH3 has been used as a reference CPU core by Microsoft for AutoPC development platforms. SH4 has been the first device for the 2nd generation AutoPC.



32-bit RISC SupeH for Automotive



Microcontroller Roadmap



H8S/26xx-series for Automotive Body applications

### H8S 16-bit CISC microcontrollers with on-chip CAN

A number of automotive applications such as airbags, dashboards, climate control systems currently based on 8-bit microcontrollers run out of steam.

Hitachi addresses an upgrade path from 8-bit microcontrollers with its 16-bit microcontrollers series H8S. H8/300 based applications can easily migrate to this upwardly compatible CPU.

Some of these H8S microcontrollers are equipped with CAN. All of the automotive microcontrollers are available with on-chip Flash.

### Wide Temperature Range

All products are offered in the appropriate temperature ranges to support the target application requirement (-40°C to 85°C, 105°C, 125°C).

## F-ZTAT Flash on-chip Microcontrollers

Several years ago, Hitachi recognised the importance of providing its customers a fast and flexible solution for updating or re-programming their code on-chip of microcontrollers in their systems-on-board programming.

Hitachi's technology is called F-ZTAT, following the well established ZTAT technology.

Today, about 30 microcontrollers are in mass production at Hitachi with on-chip Flash memory. They vary in memory size from 32 kbyte up to 512 kbyte. It covers 8-bit and 16-bit H8-series microcontrollers as well as 32-bit SuperH microcontrollers.

130 Mpcs of embedded Flash devices were shipped by end '99 in total, 6.8 Mpcs out of these for powertrain

applications

### Line up of F-ZTAT microcontrollers

Hitachi's Flash memory has evolved in time with processors and process enhancements. The first microcontrollers with on-chip Flash were 8-bit and 16-bit devices, in 0.8  $\mu\text{m}$  technology, using hot electron injection technology and NOR cell layout.

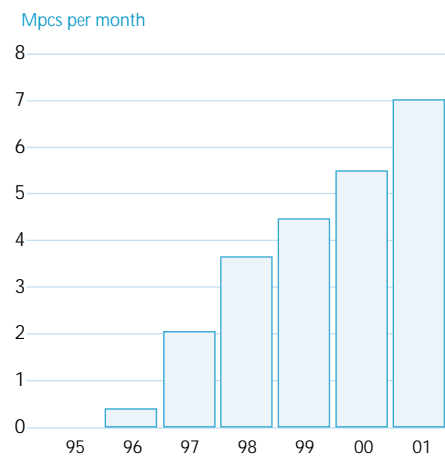
The latest devices are manufactured in 0.35  $\mu\text{m}$  using electron tunnelling. This technology has been applied also in 0.5  $\mu\text{m}$  products. The cell layout in both technologies has been enhanced and is a modified NOR cell.

For example the SH7055F in 0.35  $\mu\text{m}$  has currently one of the worlds largest

on-chip Flash memory with 512 kbyte.

### Single supply voltage for programming and execution

0.5  $\mu\text{m}$  and 0.35  $\mu\text{m}$  based microcontrollers run from external 5 V or 3.3V respectively, and use the same supply voltage terminal and voltage level for programming and erasing.



Shipment of microcontroller with embedded Flash

### Flash memory block structure

The on-chip Flash memory is organised in blocks of varying sizes. Each block defines an atomic unit for erase operations. Blocks can be erased individually to allow for selective re-programming.

### On-board programming

This is supported by two modes on every F-ZTAT microcontroller :

- | Boot mode
- | User mode

The boot mode supports in-system programming of blank - unprogrammed - devices. It is also useful for simple and total reprogramming of devices in the system. It can be protected against external attacks (auto erase function) for security reasons.

The user mode operation is totally under control of the user's system. For example, the following can be individually set :

- | communication protocol
- | communication link - serial, parallel, CAN, debug interface
- | storage of user kernel - stored in on-chip Flash or external system

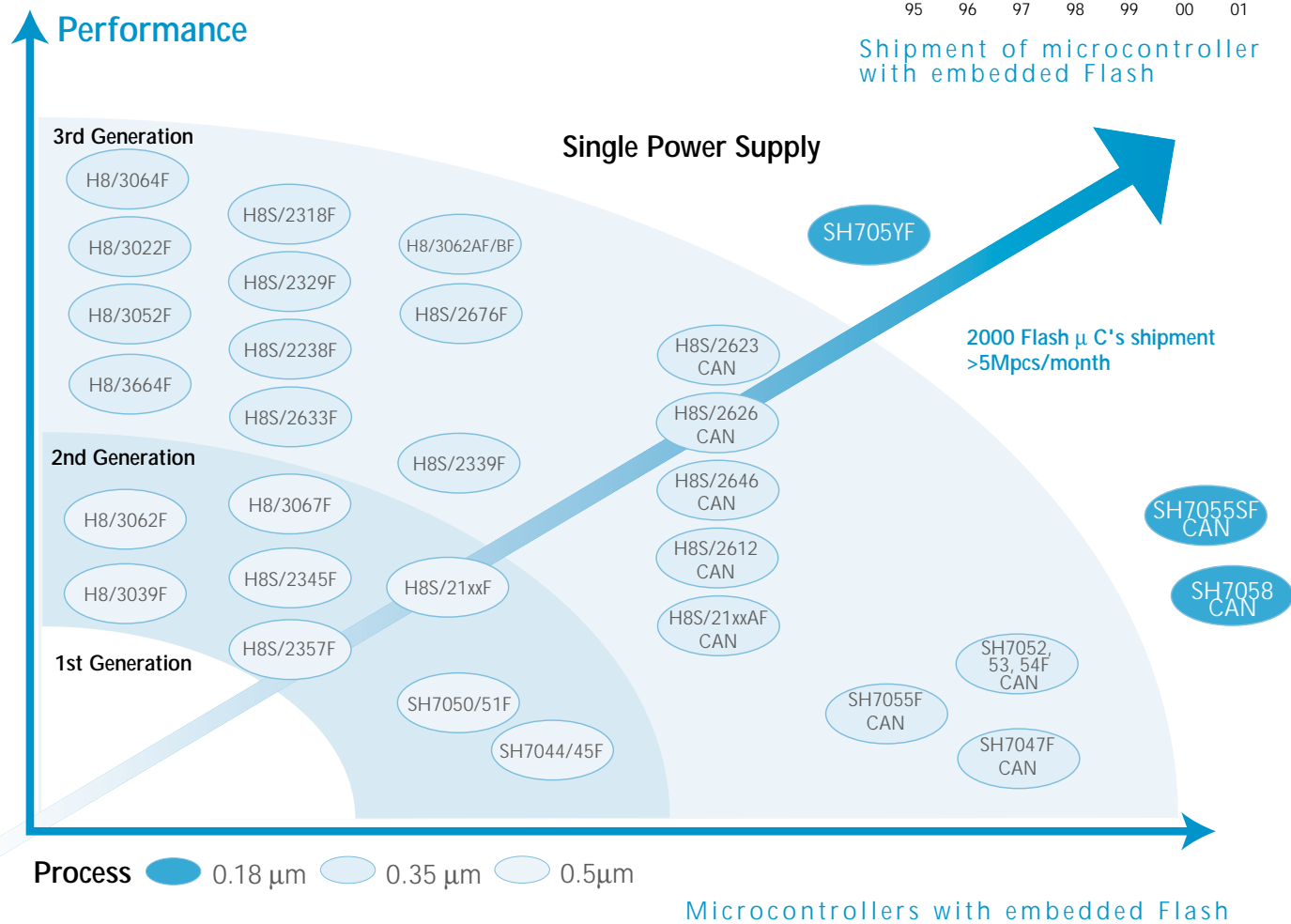
### Special feature for in-system debugging and calibration

SH7055F supports a special mode at which any of the 4 kbyte blocks of Flash memory can be mapped to RAM.

This allows fast write operations to be performed by code which would normally have to access the Flash without changing the destination address.

### Programming support by Hitachi development environment

Hitachi provides programming software and hardware to ease the set up of devices. Thus the user can quickly get started with Hitachi's F-ZTAT devices.



SH7055F block organisation

## EMC - Low Noise Products for Automotive

Hitachi's foundation for improvement of EMC is measurement, simulation and support from EMC-experts in Japan and EMC-support-engineers World Wide.

Low EME of microcontroller products is a significant feature to enable low cost electronic systems. Hitachi's H8S and SuperH series products are examples how this can be successfully achieved.

The requirements of the automotive related customers tends to speed up controllers with lower electromagnetic emission.

To hit this requirement Hitachi established an EMC-organisation of LSI-designers and EMC-experts for LSI-level, system level and simulation.

The test and design centre was built up for measurement and simulation of emissions.

### Measurement

An EMC-test-board was developed and produced by Hitachi for every semiconductor. This EMC-test-board is the foundation for the measurement of all kinds of emission, and the relating factors.

Hitachi applies the following three EMC evaluation methods to achieve compliance with the major areas and address the different behaviour's:

- | Vcc/Gnd fluctuation (RF current/voltage)
- | TEM Cell (SAE method) (near field emission)
- | Micro Anechoic Chamber (far field emission)
- | VDE-test method Emission relating factors:
  - | Circuit design (LSI)
  - | PCB-design
  - | Cable-Connection.

The result of the measurement often requires a new design of the EMC-test-board. This circulation continues until the result of emission is better than before.

### Simulation

The prediction of the emission by the advanced 3D field solver "AERIAL" reduces the counts of EMC-test-board hardware-design-cycles, because many interesting changes could be faster made and simulated in software.

Simulation - Parts:

- frequency spectrum of
  - | cable connections
  - | semiconductors
- Vcc/Gnd fluctuation
  - | current operating
  - | simultaneous switching noise

A fast time to EMC-solutions with simulation method is possible.

### 20 dB improvement

For example the H8S/2128F offers a noise reduction of 20 dB (at FM band) and a possible doubling of performance in comparison to an old system.

Points of noise reduction were:

- | isolated CPU from peripheral bus
- | static CPU
- | enhanced module stop function
- | gating clock
- | internal step-down circuit of power supply system.
- | internal PLL
- | isolated power supply of CPU and Peripheral
- | optimised pin allocation
- | multiply Vcc/Gnd connection
- | powerful ports with low emission

### Environment

The environment of the semiconductor is also considered by the design- and test-team.

- | Power-Ground Planes
- | system connections
- | placement of components
- | decoupling capacities
- | PCB-design of crystal oscillator connection

### Support

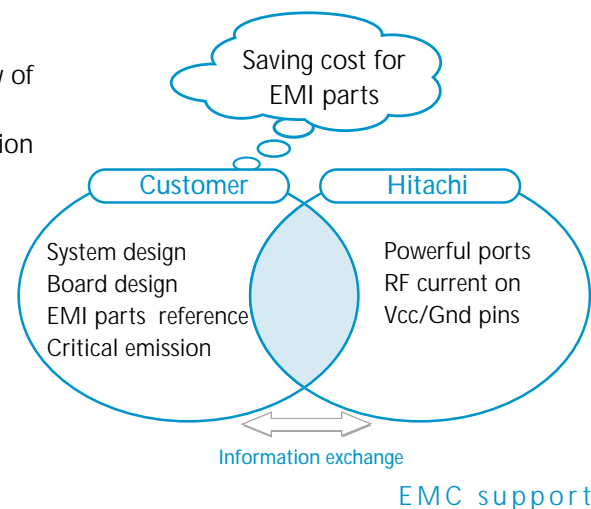
The presentation of semiconductors with low emission is the result of Hitachi's strong experience in:

- | measurement
- | software simulation
- | environment checking

All our experience helps the customers from the beginning of a new system, to minimise the emission.

Hitachi EMC Support:

- | system design
- | board design
- | EMI parts reference
- | critical emission



## H8S/2636F - 16-Bit Microcontroller with CAN 2.0B

H8S/2636 is a high performance 16-bit microcontroller with two CAN 2.0B channels. Large integrated memories (128K Flash) and powerful peripherals make this device ideal for many automotive applications like dashboards, body controller electronic power steering (EPAS), suspension control, electronic clutch, electronic air pressure management (ECAM), and much more. The device is manufactured in Hitachi's advanced 0.35um process, allowing to integrate a high performance CPU (8 MIPS Dhrystone), large memories and sophisticated peripherals in a cost effective way.

### Features:

- | H8S 16/32-bit CPU comprising 8 general purpose registers, 32-bit wide. The architecture provides for efficient execution of "C" code, provides a minimum instruction cycle time of 50ns (at 20MHz) and 16MB memory space. It also has a built-in Multiply-Accumulate-Unit (MAC), which supports digital-signal-processing applications with a 200ns MAC.
- | Hitachi HCAN module, providing full CAN 2.0B compliance with, for each of the two channels, 15 transmit/receive buffers and local acceptance filtering for one additional receive-only buffer. Data rates up to 1Mbit/s, priority sorting mechanism against priority inversion and extended data and remote frames with 29 bit identifiers are supported.
- | 128Kbyte of on-chip, high-speed Flash memory, partitioned into several different size blocks (from 1KB to 32KB).
- | 4Kbyte of on-chip, high-speed RAM.
- | Data Transfer Controller (DTC), which provides a flexible pseudo-Direct-Memory-Access (DMA) function, available for all on-chip peripherals and any on-chip or off-chip memories. The DTC can handle all data transfer tasks, so that

almost 100% of the CPU performance can be used for calculations.

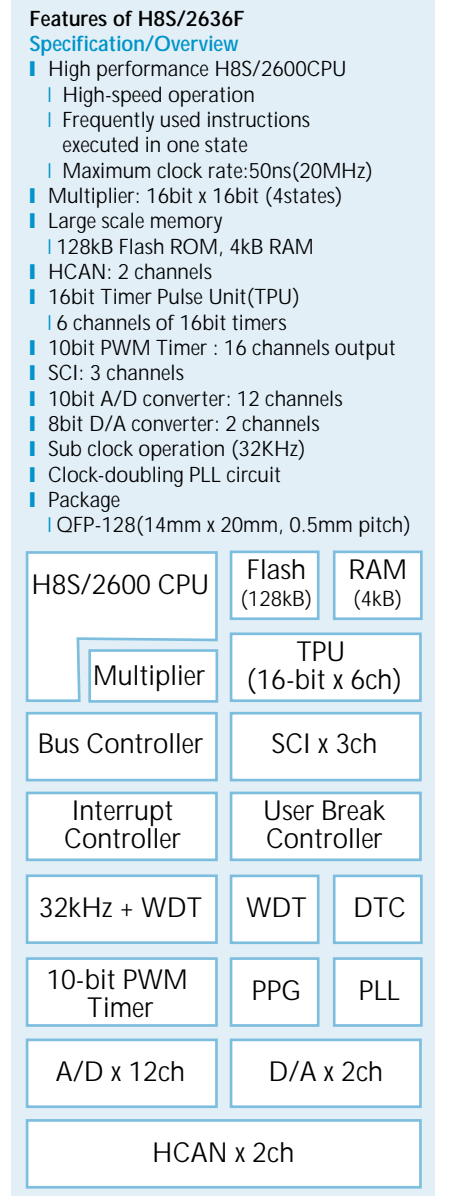
- | 16 channel 10-bit PWM timer with high current output to directly drive up to four stepper motors.
- | Six channel 16-bit timer pulse unit (TPU) with 16 input capture/output compare registers.
- | Programmable Pulse Generator (PPG) to drive 4x4 real time outputs. Together with the TPU and the DTC, the PPG can provide autonomous stepper motor control (for example) with very little CPU intervention.
- | Three Serial Communication Interfaces (SCI), which can operate in synchronous or asynchronous mode.
- | 12 channel 10-bit Analog-to-Digital Converter (ADC) with a minimum conversion time of 11us.
- | Two channel 8-bit Digital-to-Analog Converter.
- | 72 IO pins and 12 input only pins
- | Interrupt controller supporting seven external interrupt pins and 55 internal interrupt sources. Eight programmable priority levels.
- | Several low power modes, including sub-clock function (32KHz) allowing to reach below 1mA power consumption while CPU and a timebase still running.
- | PLL clock generation.
- | 128 pin plastic QFP package available in several extended temperature ranges up to 85°C.

### Numerous measures are implemented to reduce radiation

3V core power supply (integrated step down circuit), PLL clock generation, reduced output buffer sizes to limit slew rates, on-chip capacitors, separate on-chip busses and many more improvements reduce radiation by about 20dB compared with similar designs without these measures.

Hitachi also provides a full tool chain to speed up development

- | Evaluation boards
- | Emulators
- | Modern, highly optimizing C-Compiler under Windows GUI
- | High performance debugger HDI running under Windows 95 and NT
- | MakeApp software which allows to generate initialisation code and driver routines in "C" source code with a few simple mouse strokes. (available end 2000)



H8S/2636 block diagram

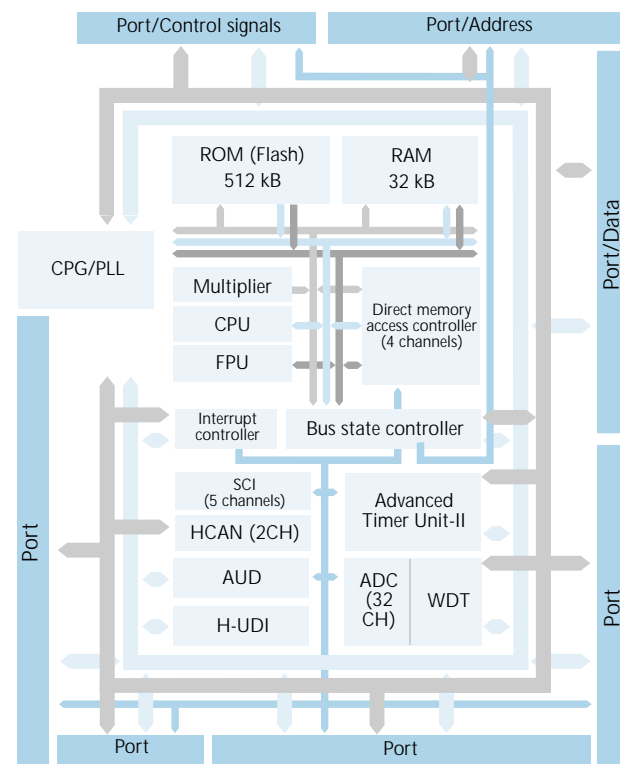
## SH7055F - 32-bit RISC Microcontroller for Powertrain

SH7055F is an application specific standard product, targeting automotive powertrain applications. It provides also the solution for high performance automotive and industrial systems which require large on-chip memory and two CAN interfaces. The device is manufactured using Hitachi's 0.35µm technology. 3.3V power supply for memory and core reduces EME and provides low power operation. 5 V power supply for I/O (analogue and digital) ensures compatibility with existing technologies and guarantees high accuracy of AD converter.

### Features

- SH2 CPU
  - | SuperH CPU with hardware multiply and accumulate unit.
  - | 52 Dhrystone MIPS at 40 MHz CPU clock. Most instructions are executed in a single cycle.
  - | 62 16-bit instructions for minimum code size.
- FPU
  - | Single precision floating point unit (IEEE754)
- 512 KB on-chip Flash
  - | Single supply voltage : 3.3V for execution and programming. Access in a single cycle.
  - | 16 segments ( 4 KB, 32 KB, 64 KB) support independent write/erase of program and data areas. Calibration support by Flash emulation in RAM. Built in boot program is provided for initial chip programming. User specific programming is done using user program mode.
- 32 KB on-chip RAM
  - | 32-bit access in single cycle at 40 MHz.
- Advanced Timer Unit - II
  - | 2nd generation of powerful timer unit with dedicated functions for ignition, injection and crankshaft treatment. 40 independent timer/counter channels with 65 input/output.

- Advanced Pulse Controller
  - Two channels Compare Match Timer
  - 32 channels 10-bit AD Converter with three independent sample & holdcircuits. 32 conversion result registers and DMAC support reduces the CPU overhead. Conversion time is 13µs.
  - Two channels CAN interfaces with each 15 transmit/receive buffers, 1 receive only buffer with local acceptance mask filter.
    - | Flexible configuration for transmit scheme, either by priority or by message buffer number.
    - | Flexible configuration of bus connection, either one CAN interface with 32 buffers or two separate modules on separate busses.
- Five channels SCI
  - | JTAG compliant bus interface (H-UDI) support CPU bypass mode and CPU interrupt mode.
- AUD acts as special form of DMAC with modes for fast trace and debugging.
- User Break Controller (UBC) enables user to set break conditions
- Interrupt controller with 16 priority levels. 117 interrupt vectors
- Watchdog Timer
- Clock Pulse Generator with built in frequency quadrupling
- 149 I/Os
- Low power modes
  - | Sleep, hardware and software standby
- Packaging
  - | QFP-256, 0,5 mm pin pitch
  - | PBGA-256, 1,27 mm pin pitch
  - | Flip Chip
- Power consumption typ 600 mW
- Operating ambient temperature specifications
  - | -40°C to 105°C
  - | -40°C to 125°C



SH7055F block diagram

### Development tools

Hitachi provides the complete set of tools :

- | Evaluation board
- | Emulator
- | Calibration tool
- | C compiler
- | Software simulator
- | MakeApp (Coding tool)
- | Operating system OSEK
- | JDS-box (JTAG-, H-UDI support)

A number of 3rd party tools are also available.



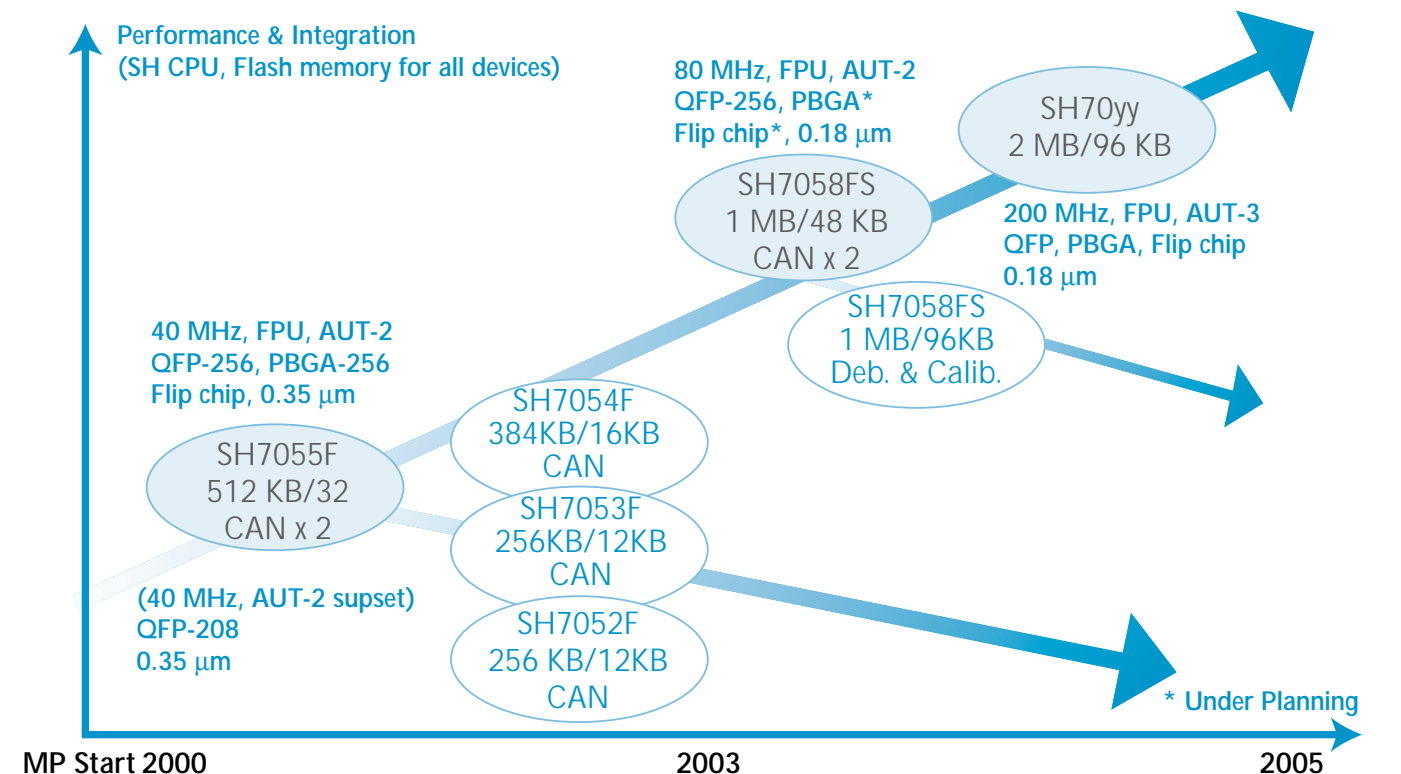
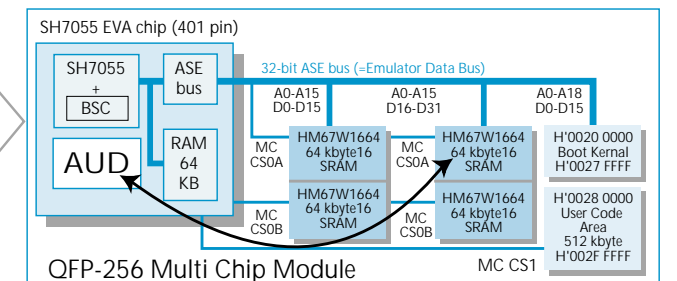
### Roadmap

SH7055F is one member of ASSPs for automotive powertrain applications with a roadmap to your future.

### Calibration Tool for SH7055F

The calibration of engine management or gearbox parameters is becoming a more and more complex task. Hitachi has recognised this and is offering its SH7055 customers a special solution. The solution consists of an MCM (Multi Chip Module) which

incorporates an SH7055 bond-out chip (as it is also used in emulators), 1 Mbyte external Flash and 512 kbyte RAM memory. This allows the complete emulation of the 512 kbyte SH7055 Flash memory in RAM and hence very quick modification of parameters via the on-chip AUD debugging module (no CPU impact). This chip is supported by an external interface board which is converting the AUD protocol into either CCP (CAN calibration protocol) or EPP (fast parallel) protocol. This interface board is designed for mounting inside the customers ECU.



SH705x for Powertrain

## SuperH™ Products for CIS

### SuperH™ for CIS

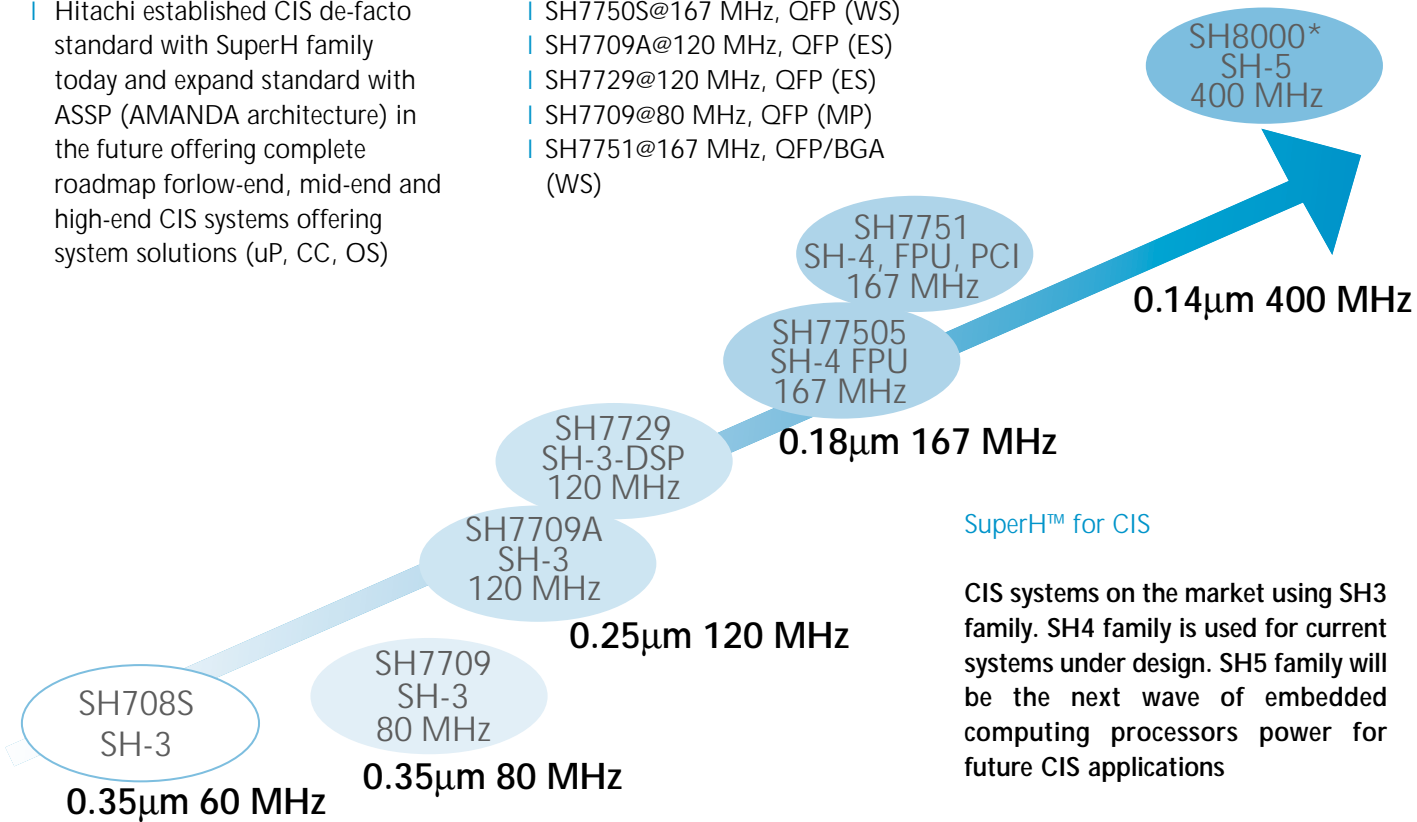
Hitachi is investing in new technologies for ITS applications

- Hitachi is the CIS market leader with 70% market share Worldwide\*  
\*source Dataquest 1998

- Hitachi established CIS de-facto standard with SuperH family today and expand standard with ASSP (AMANDA architecture) in the future offering complete roadmap for low-end, mid-end and high-end CIS systems offering system solutions (uP, CC, OS)

### SuperH products for CIS

- SH7709, SH7709A, SH7729, SH7750, SH7751
- Potential Candidates: SH7727, SH7706
- WTR/I-Spec Status:
  - SH7750@167 MHz, QFP (MP)
  - SH7750S@167 MHz, QFP (WS)
  - SH7709A@120 MHz, QFP (ES)
  - SH7729@120 MHz, QFP (ES)
  - SH7709@80 MHz, QFP (MP)
  - SH7751@167 MHz, QFP/BGA (WS)



### SuperH™ for CIS

CIS systems on the market using SH3 family. SH4 family is used for current systems under design. SH5 family will be the next wave of embedded computing processors power for future CIS applications

### Operating Systems

Hitachi's SuperH embedded microprocessor family is supported by major Operating System vendors. Many SuperH embedded processor devices are, for example, supported by WindRiver (VxWorks and PSOS), Microsoft (Windows®CE), Accelerated Technology (Nucleus), Microware (OS-9), QNX, Lineo (Linux), LynuxWorks (LynxOS, Linux) and many others more. The support includes device specific driver availability, board support packages for many reference platforms, as well

as the availability of application software such as speech recognition, www browsers, Java Virtual Machines, multimedia plug-in's such as MP-3 decoder software, and many others more.

The Operating System software makes efficient use of the SuperH family's specific and quite often unique features, e.g. the DSP unit of the SH-3-DSP, the Floating-Point Unit of the SH-4, or the SIMD approach of the SH-5.

## AMANDA Advanced Multimedia And Navigation Display Accelerator

This device is a companion to the Hitachi's SH RISC processor family. It is aimed at the Car Information System market and combines multiple functions needed in this type of applications. These features include a high performance graphics engine, video input and communication peripherals. The advanced architecture offers an optimised system solution for the different data streams routed through AMANDA (Graphic Data, Audio, GPIO's, Serial IF's). The clear separation of geometric operations (handled by the SuperH CPU) and rendering operations (handled by the graphic module of AMANDA) has also resulted in improved system bus utilisation.

### Features

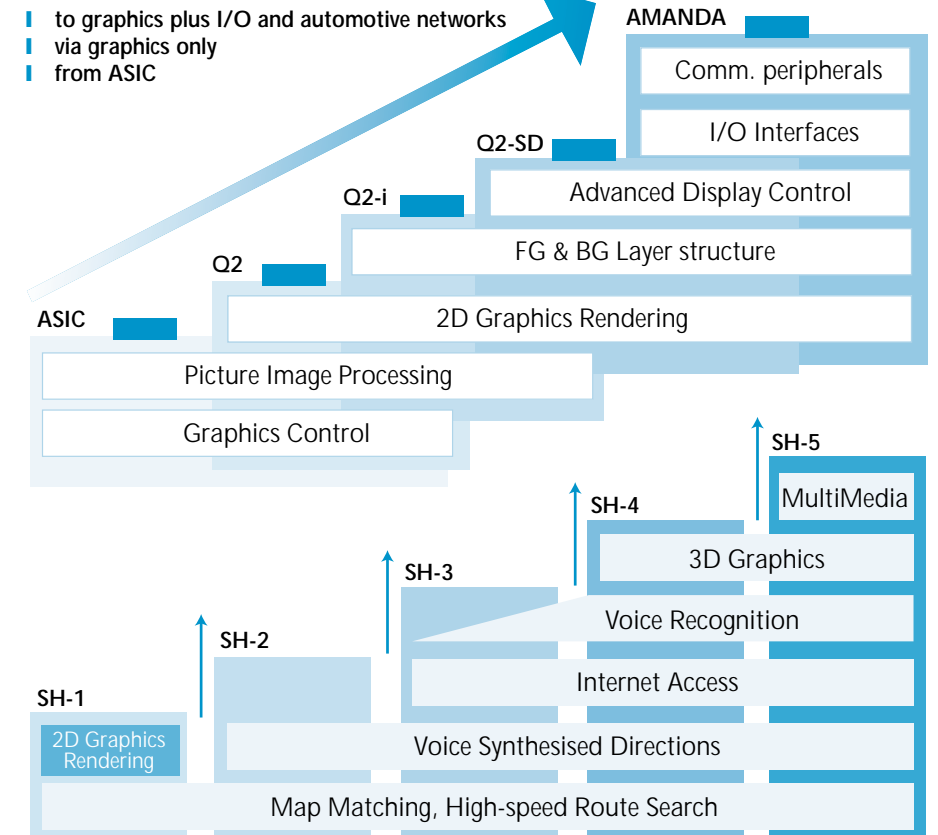
- SH-4 MPX interface
- The 32-bit MPX bus will operate up to 100 MHz
- Supports up to 128 MBytes SDRAM
- Advanced internal bus architecture
- Graphics-engine/ rendering unit
- Video input unit
- Display output unit
- Interrupt controller
- I<sup>2</sup>C
- Compatible interface
- High speed MPEG2 interface
- CAN supports CAN specification 2.0A and 2.0B (active):
- UART /USART
- ATAPI/ATA-3
- GPIO
- Timers

- PLL clock generation
- Power management
- JTAG
- Operating voltage  
The device will use 1.5V for internal digital logic and 3.3V for I/O and analogue modules. This device will conform to automotive specifications including a temperature range of -40 to 85oC
- Package  
The device will be packaged in a TBGA352.

## SuperH™ & AMANDA



Hitachi enters the logical way in CIS integration:



Evolution of the MMI for Car Navigation

## DAB - Single Chip for RF

The HD 155080TF was developed for Digital Audio Broadcast systems and integrates most of the functions to receive and down convert a DAB RF signal for further base band processing. The HD 155080TF incorporates an L-band LNA with AGC and bias circuitry, a Band III LNA with associated AGC, together with all mixers and amplifiers necessary to form a receiver for L-band (1450MHz-1492MHz) and band 2/3 and synthesiser settings can be

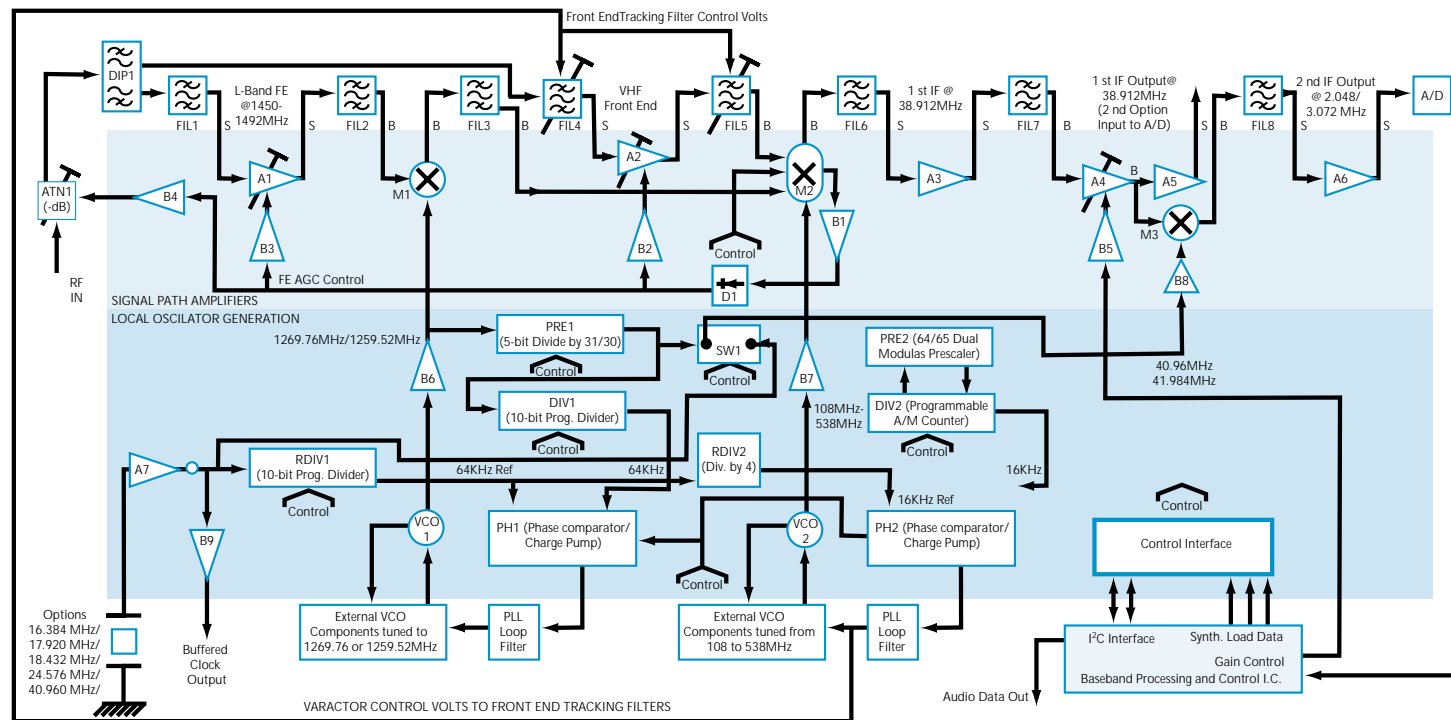
controlled via the I<sup>2</sup>C bus interface.

All functional blocks on the HD155080TF can be switched off separately via the I<sup>2</sup>C interface to enable power saving, reducing the power consumption to an absolute minimum.

The HD 155080TF is fabricated using a 0.6m double-polysilicon Bi-CMOS process reception (70-500MHz). Moreover the HD 155080TF includes all

synthesiser and digital dividers needed on-chip and therefore reduces the amount for external components to an absolute minimum.

Three different IF output frequencies (2.048MHz, 3.072MHz and 38.912MHz) to cover different baseband concepts are provided by the HD 155080TF. The HD 155080TF functions.



### Features

- L Band LNA (A1) with front-end AGC
- Band III LNA (A2) with AGC
- On-chip mixers M1-M3
- On-chip VCO's
- On-chip reference and tuning synthesiser
- Integrated Local Oscillators
- Five external crystal clock options
- Reference clock input
- Master clock output
- I<sup>2</sup>C bus control
- Highly Integrated one chip RF DAB Solution
- Wide Operating Frequency range
  - | L Band :1450 ~ 1492MHz
  - | Band 2/3 : 70MHz ~ 500MHz
  - | 1st IF : 38.912MHz
  - | 2nd IF : 2.048MHz or 3.072MHz
- Operating supply voltage : 2.7V ~ 3.6V
- Low power consumption
- Operating temperature range: -40 ~ +85°C
- 64 PIN SMD Thin Quad Flat Package (TQFP)

## Power-MOSFET for Automotive Applications

### Power MOSFET 7th Generation

With the introduction of the D6- and D7-series Hitachi started a new age of RDS (on) performance. Using 0.8 μm and 0.5 μm technology and more than double of the cell density for D6 results in 40 million cells/in<sup>2</sup> and for D7 in 8 million cells/in<sup>2</sup> in comparison.

The D6 and 7-Series utilises the Trench cell structure to achieve high density. With this technology Hitachi can offer a 3.5 mOhm device in TO-3P or a 7 m Ohm device in LDKPAK (TO-220 without flange).

Hitachi general switching MOSFETs use the vertical structure and are generally known as D-Series. Now Hitachi is introducing super low RDS (on) devices for ABS, Electric Power Steering and high voltage breakdown devices for Direct Injection.

### Customer benefits

- Super low RDS (on) (2.7 mOhms, 40V)
- Optimized gate drive voltages
- Very high avalanche capability
- Breakdown voltages from 20V to 1500V
- High ESD destruction capability
- Broad line up of P channel devices
- More than 30 different packages

### Avalanche Capability- A commitment to rugged automotive environment

Power MOSFETs can be destroyed by the surge voltage generated from the load inductance and from parasitic inductance. Hitachi guaranteed values for repetitive avalanche energy level and its temperature characteristics belong to the highest world-wide.

### Target applications

- ABS and traction control
- Electric power steering and other electrical systems replacing hydraulic
- Engine control - direct injection
- Temperature range -40 to ~175°C for limited time

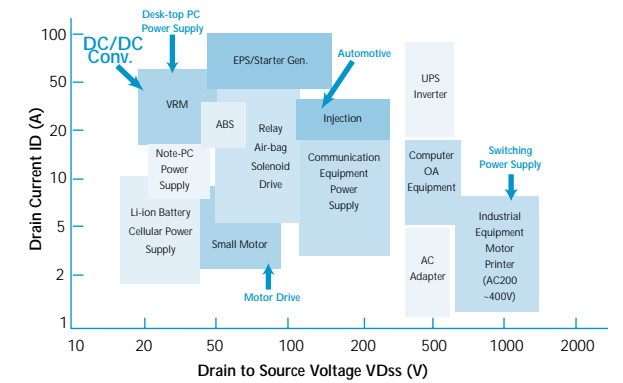
### Major Characteristics of Low RDS (on) D6 and D7 Power MOSFET

Main Application Area: EPS, EPAS, EHPAS

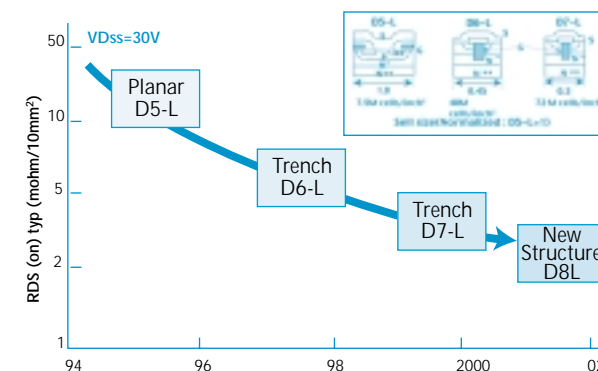
Package	Type No.	Proc.	V <sub>DSS</sub> (V)	V <sub>GS</sub> (V)	I <sub>D</sub> (A)	P <sub>ch</sub> (W)	RDS (on) m				C <sub>iss</sub> (pF)	Q <sub>g</sub> (nC)	Schedule	
							V <sub>GS</sub> =10V		V <sub>GS</sub> =4V				WS	MP
LDPAK	25K3134	D6	30	±20	75	100	4	5	5.5	8.5	6800	130	OK	OK
	25K3070	D6	40	±20	75	100	4.5	5.8	6.5	10	6800	150	OK	OK
	25K3379	D6	40	±20	85	110	3.8	4.8	5.5	8.5	9500	170	OK	OK
	H7N0401LD	D7	40	±20	95	200	2.7	3.5	4	6	TBD	TBD	00/03	00/3Q
TO-220	25K3135	D6	60	±20	75	100	6	7.5	8	12	7100	125	OK	OK
	25K3421	D6	30	±20	85	110	3.1	3.9	4.5	7	9200	TBD	OK	00/3Q
	25K3418	D6	60	±20	85	110	4.3	5.5	6	9	9200	TBD	OK	00/3Q
	25K3069	D6	37	±20	75	100	6	7.5	8	12	7100	125	OK	OK



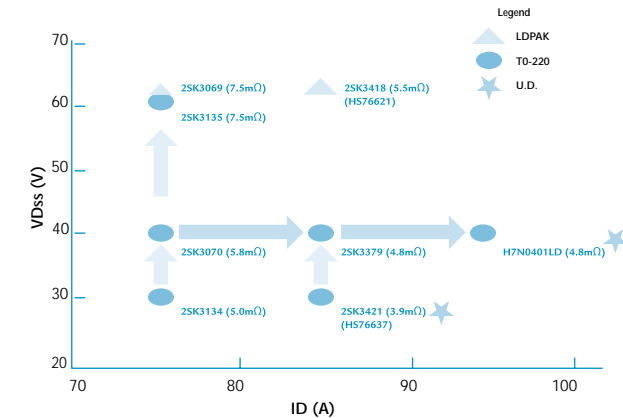
### Application Map for Power MOSFET



### On-Resistance Transition (30V)



### Evolution of Low Ron & High Current D6 and D7 MOSFET



## IGBT - for Ignition Systems

Hitachi has developed IGBT technology for several years to meet the harsh environment in automotive applications. IGBT product features have been trimmed to meet the requirements of applications such as electronic vehicles (motor drive) and ignition systems. Ignition systems require particularly low saturation voltage which has been achieved using 2.0  $\mu\text{m}$  technology.

### Key Features

- | Low tolerance clamping voltage
- | Low on saturation voltage
- | Low threshold voltage for direct microcontroller drive (logic level drive)
- | 175°C -55 ~ +175°C

### Ignition IGBTs

Current	Voltage	Internal R	Partname
20A	360V	75 $\Omega$ , 20k $\Omega$	GN3620ZR4LD, LS, LM
14A	400V	75 $\Omega$ , 20k $\Omega$	GN4014ZR4LD, LS, LM
14A	400V	none	GN4014Z4LD, LS, LM

### P/N reading

i.e. G N 36 20 Z R 4F LD

