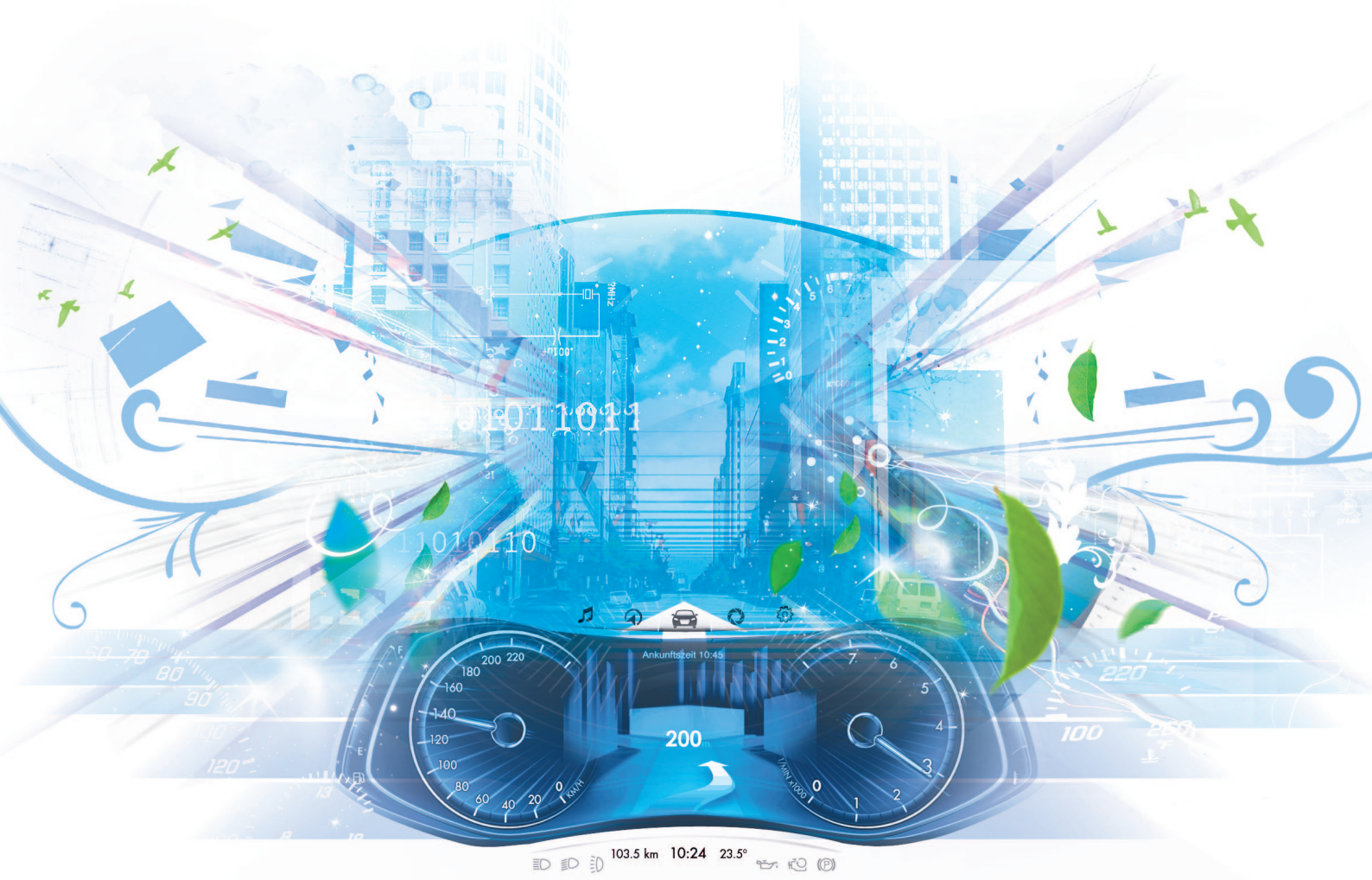
Microcontroller solutions for

# Instrument Cluster




Renesas Electronics
www.renesas.eu

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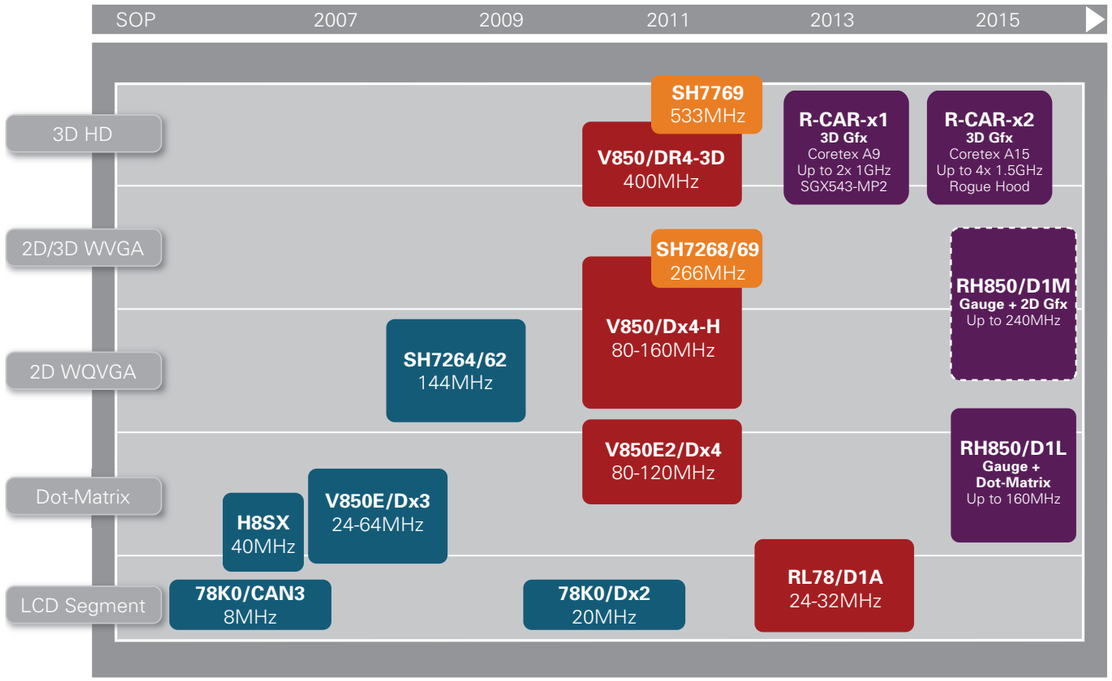
# Instrument Cluster Solutions

D series is a well established microcontroller series in the market - tailored for dashboard applications.
The ongoing success is obvious: more than every second car on the road is built with a Renesas Dashboard MCU.
You can rely on Renesas' expertise and the ultimate quality we stand for. No matter what your design entails, we can help make it reality.

## MCU Roadmap for Cluster Applications




## Graphics Competence

**Large variety of graphics products** for navigation, HMI and dashboard
**Cooperation with leading IP suppliers** such as IMG, TES, many more
**Best embedded 3D** through full support of OpenGL standards at highest performance
**Large pool of graphics IPs** providing you the best fitting IPs for any application
**Own development of graphics IPs** enducing optimum automotive features
**Own development of graphics drivers** thoroughly adapted to automotive needs
**Full tool chain for graphics s/w development,** from content to final code generation

# 32-bit Cluster MCU: RH850/D1x & R-Car

## Next Generation – a quick Preview!

RH850/D1x will be the next-generation cluster MCU family, significantly improving features and performance compared to V850/Dx4:

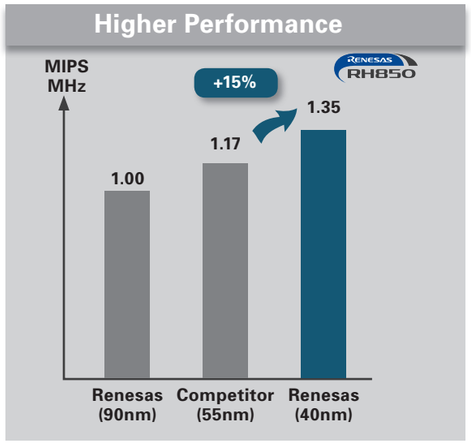
- > Higher CPU performance
- > Increased memory size (Flash, iRAM, vRAM)
- > Improved safety and security concept
- > Drastically reduced power consumption
- > Software compatible with V850/Dx4.

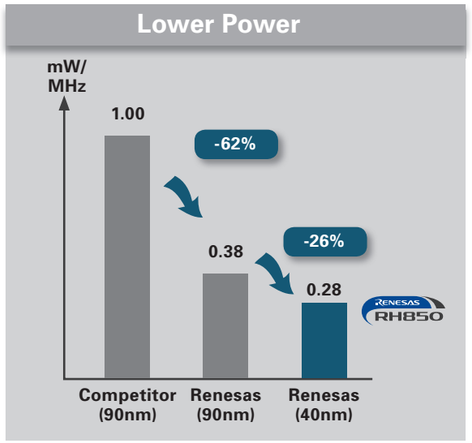
### Priority on Graphics

- > Up to 27x higher graphics performance
- > Warping and JPEG/RLE decompression fully in hardware
- > Dedicated vRAM saving features (sprite engine, compression support, RAM wrapper)
- > Increased memory bandwidth (external Flash & RAM)
- > Enhanced RGL graphics libraries
- > OpenVG 1.1 & HMI tool support
- > Option for 3D / OpenGL-ES 2.0 under planning

## RH850 – Renesas' New Microcontroller Generation for Automotive

The next cluster controller family D1x is utilizing Renesas' embedded 40nm Flash technology that delivers low power consumption and high performance. High-speed flash access and reduced operating power as well as reduced stand-by power consumption contribute to reduce fuel consumption and helps minimize overall power consumption of automobiles. Each mA saved translates into 0.3 mg less $CO_2$. Thus we get a bit closer to the realization of environment-friendly vehicles and smart cars.



# 32-bit Cluster MCU: V850/Dx4

Renesas' Dx4 family is the right choice to meet today's requirements for a wide range of TFT displays: from QVGA and lower resolutions to HUXGA.

The Dx4 controllers are designed to support both the classical dashboard features, such as stepper motors, sound and LCD segment drivers, and 2D graphic animation.

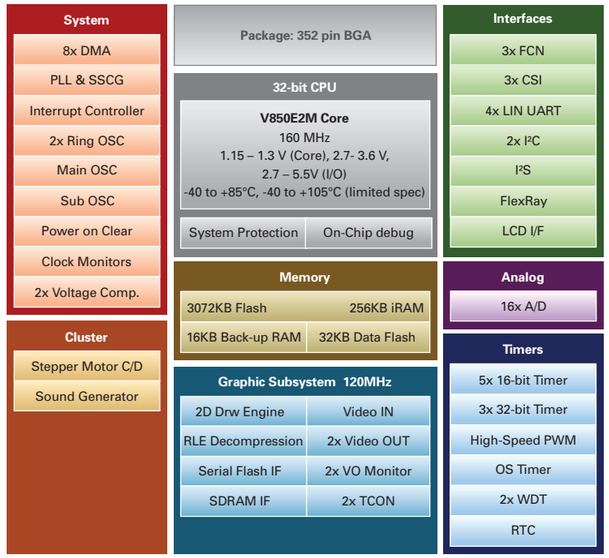
## Benefits

| | |
|---|---|
| **One CPU core for the complete Series**<br>Same powerful V850E2 core independent from operating frequency | **One architecture**<br>for the complete product range offers full flexibility even for different performance classes |
| **Common basic peripheral set**<br>Timers / A/D converter / communication interfaces identical | **One standard base software**<br>package supports all devices within Dx4 |
| **System Protection Function**<br>Memory Protection Unit plus System Register Protection / Timing Supervision / Peripheral Protection | **Real protection**<br>of different application parts within one micro which enable best support for development and failure analysis |
| **Embedded 2D Drawing**<br>Color TFT direct drive from QVGA to WVGA | **2 in 1 solution**<br>enables cost-effective approach from low-end to very high-end with optimized graphic performances |
| **Enhanced communication interfaces**<br>CAN with 64 message bufferFlexRay based on mature Bosch IP with 8kB message buffer | **Support of all automotive standard interfaces**<br>with maximum performance and reduced CPU interruption |

## Key Features

- Up to 6 stepper motors for traditional clusters incl. automatic zero point detection
- LCD segment driver – up to 6 times multiplexing for large segment count
- Sound playback from simple tone to stereo I2S
- Embedded 2D drawing engine
- Up to 2 independent video outputs
- Integrated digital camera/video input interface
- PCB cost benefit with QFP package & integrated Video RAM for low-end TFT
- Flexible video RAM interface for high-end applications

## Dx4-H block diagram

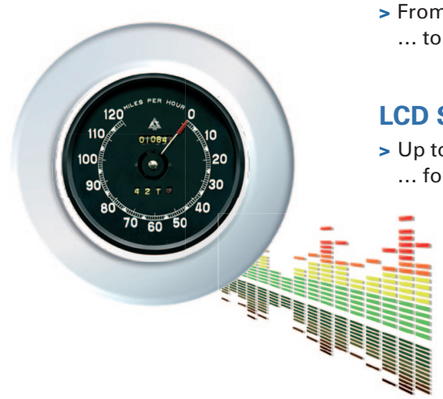



# What you can expect from V850/Dx4

## Core Dashboard Functionality

### Intelligent Stepper Motor Unit

- Coprocessor for driving stepper motors
- Programmable motor characteristics
- Modelling physical behaviour
- Automatic zero point detection
- Electrical drive of all typical motors



### Sound Playback

- From simple tone … to stereo I²S

### LCD Segment Drivers

- Up to 6 times multiplexing … for large segment count

## Design for Functional Safety

### CPU Protection

MPU, Peripherals, execution time

### Debug Protection

Authorised debugging only

### Memory Supervision

Error corrective ECC

### Logic Protection

Soft Error hardening

### System Protection

All system masters access control

### Video Monitoring

Output content check

### Clock Monitoring

All clocks controlled

### Supply Monitoring

Power supply control

## Design for minimum electromagnetic interference with the car

### Spread Spectrum Clocks

SSCG PLLs

### Slew Rate Controlled I/O

Buffers drive a controllable energy

### Pinout EMI Optimised

Integrated memories

### EMI evaluation

Measurement of final products



### Low Energy Clock Trees

Chip design controlled

### On-Chip Capacitances

Filter chip noise

### Low Impedance On-Chip Power Mesh

Chip design controlled

### EMI Design Guidance

ECU design support

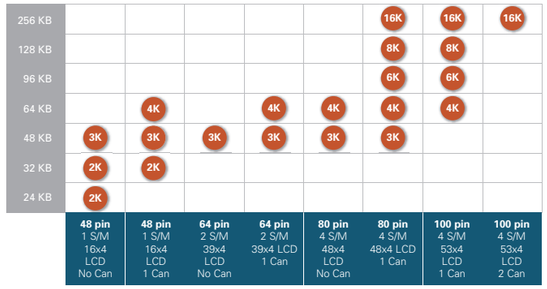
# 16-bit Cluster MCU: RL78/D1A

RL78/D1A as an optimized solution for the BRICs and low-end dashboard markets. It's outstanding features are the ultra low power consumption and the wide variation of products designed to help reduce system cost as external components such as EEPROM, on-chip oscillator or watch-dog are not needed any more.

## Highlights

- Ultra Low Power
- High performance CPU (1.27 DMIPS/MHz)
- Wide memory & package scalability
- High integration enabling system cost reduction
- Global top class of Flash quality
  Data Flash with 1.000.000 W/E cycles (target)
- Integrated safety feature support
- Wide operation voltage of 2.7 to 5.5V

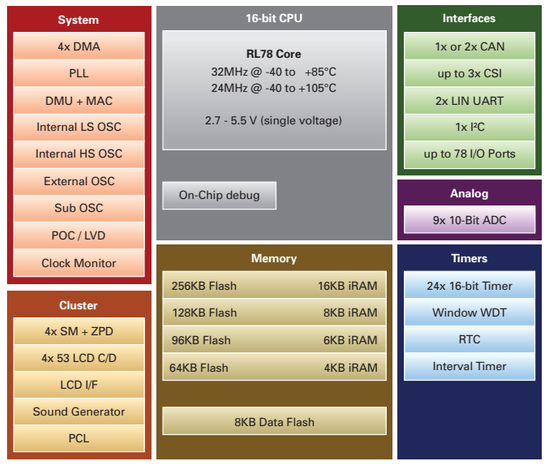
## RL78/D1A line-up




## Key Features

- Sound generator module
- Stepper-motor controller incl. ZPD function
- Real time clock module incl. clock correction
- LCD segment controller
- Support of dashboard specific standby-mode, watch-mode
- Dedicated dashboard specific DMAC trigger configuration
- Autonomous ADC based power-fail function

## RL78/D1A block diagram




# Device Overview

| Device | | Memory | | | Interfaces | | | | | | | | Other Peripherals | | | | | Miscellaneous Information | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nickname | Partnumber | Flash (kB) | iRAM (kB) | Video RAM (kB) | CAN | FlexRay | MLB | Ethernet | UART | CSI | I²C | I²S | 8/16/32-bit Timer Ch. | Stepper Motor C/D | ADC | Graphics Support | Other | CPU Core | CPU Frequ. | Pin/Package | Power Supply |
| V850E2 DJ4 | μPD70F3522 | 256 | 24 | - | 3 | - | - | - | 2 | 3 | 2 | - | 92 | 6 | 16 x 12 bit | 96 x 6 LCD C/D LCF I/F | RTC, Sound gen. | V850E2 | 80 MHz | 144 QFP | 3.0 - 5.5 V |
| | μPD70F3523 | 512 | 48 | | | | | | | | | | | | | | | | | | |
| | μPD70F3524 | 1024 | 96 | | | | | | | | | 1 | | | | | | | 120 MHz | | |
| | μPD70F3525 | 2048 | 192 | | | | | | | | | | | | | | | | | | |
| | μPD70F3526 | 3072 | 256 | | | | | | | | | | | | | | | | | | |
| V850E2 DK4-H | μPD70F3529 | 2048 | 96 | 592 | 3 | - | - | - | 2 | 2 | 2 | 1 | 52 | 4 | 12 x 12bit | 2D Gfx 1 Video OUT serial Flash I/F | RTC, Sound gen. | | 80 MHz | 176 QFP | 3.0 - 5.5V |
| V850E2 DN4-H | μPD70F3532 | 3072 | 256 | - | 3 | 1 | - | - | 4 | 3 | 2 | 1 | 92 | 6 | 16 x 12 bit | 2D Gfx 2 Video OUT 1 Video IN serial Flash I/F SDRAM I/F | LCD I/F, RTC, Sound gen. | | 160 MHz | 352 BGA | 3.0 - 5.5V (I/O) 1.1 - 1.3V (CPU) |
| V850E2 DP4-H | μPD70F3535 | 3072 | 256 | 3MB | 3 | 1 | - | - | 4 | 3 | 2 | 1 | 92 | 6 | 16 x 12 bit | 2D Gfx, 2 Video OUT 1 Video IN serial Flash I/F | LCD I/F, RTC, Sound gen. | | 160 MHz | 408 BGA | 3.0 - 5.5V (I/O) 1.1 - 1.3V (CPU) |
| | μPD70F3536 | 3072 | 256 | 5MB | | | | | | | | | | | | | | | | | |
| | μPD70F3537 | 3072 | 256 | 8MB | | | | | | | | | | | | | | | | | |
| RL78 D1A | R5F10CGB | 24 | 2 | - | - | - | - | - | 1 | 2 | 1 | - | 24 | 1 | 5 x 10bit | 4 x 27 LCD C/D | RTC, Sound gen. | RL78 | 32 MHz | 48 QFP | 2.7...5.5V |
| | R5F10CGC | 32 | | | | | | | | | | | | | | | | | | | |
| | R5F10CGD | 48 | 3 | | | | | | | | | | | | | | | | | | |
| | R5F10CLD | 48 | 3 | - | - | - | - | - | 2 | 2 | 1 | - | 24 | 2 | 5 x 10bit | 4 x 39 LCD C/D | RTC, Sound gen. | | 32 MHz | 64 QFP | 2.7...5.5V |
| | R5F10CMD | 48 | 3 | - | - | - | - | - | 2 | 2 | 1 | - | 24 | 4 | 8 x 10bit | 4 x 48 LCD C/D | RTC, Sound gen. | | 32 MHz | 80 QFP | 2.7...5.5V |
| | R5F10CME | 64 | 4 | | | | | | | | | | | | | | | | | | |
| | R5F10DGC | 32 | 2 | - | 1 | - | - | - | 1 | 2 | 1 | - | 24 | 1 | 5 x 10bit | 4 x 27 LCD C/D | RTC, Sound gen. | | 32 MHz | 48 QFP | 2.7...5.5V |
| | R5F10DGD | 48 | 3 | | | | | | | | | | | | | | | | | | |
| | R5F10DGE | 64 | 4 | | | | | | | | | | | | | | | | | | |
| | R5F10DLD | 48 | 3 | - | 1 | - | - | - | 2 | 2 | 1 | - | 24 | 2 | 5 x 10bit | 4 x 39 LCD C/D | RTC, Sound gen. | | 32 MHz | 64 QFP | 2.7...5.5V |
| | R5F10DLE | 64 | 4 | | | | | | | | | | | | | | | | | | |
| | R5F10DMD | 48 | 3 | - | 1 | - | - | - | 2 | 2 | 1 | - | 24 | 4 | 8 x 10bit | 4 x 48 LCD C/D | RTC, Sound gen. | | 32 MHz | 80 QFP | 2.7...5.5V |
| | R5F10DME | 64 | 4 | | | | | | | | | | | | | | | | | | |
| | R5F10DMF | 96 | 6 | | | | | | | | | | | | | | | | | | |
| | R5F10DMG | 128 | 8 | | | | | | | | | | | | | | | | | | |
| | R5F10DMJ | 256 | 16 | | | | | | | | | | | | | | | | | | |
| | R5F10DPE | 64 | 4 | - | 1 | - | - | - | 2 | 2 | 1 | - | 24 | 4 | 9 x 10bit | 4 x 53 LCD C/D | RTC, Sound gen. | | 32 MHz | 100 QFP | 2.7...5.5V |
| | R5F10DPF | 96 | 6 | | | | | | | | | | | | | | | | | | |
| | R5F10DPG | 128 | 8 | | | | | | | | | | | | | | | | | | |
| | R5F10TPJ | 256 | 16 | | | | | | | | | | | | | | | | | | |
| | R5F10DPJ | 256 | 16 | | 2 | | | | | | | | | | | | | | | | |

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