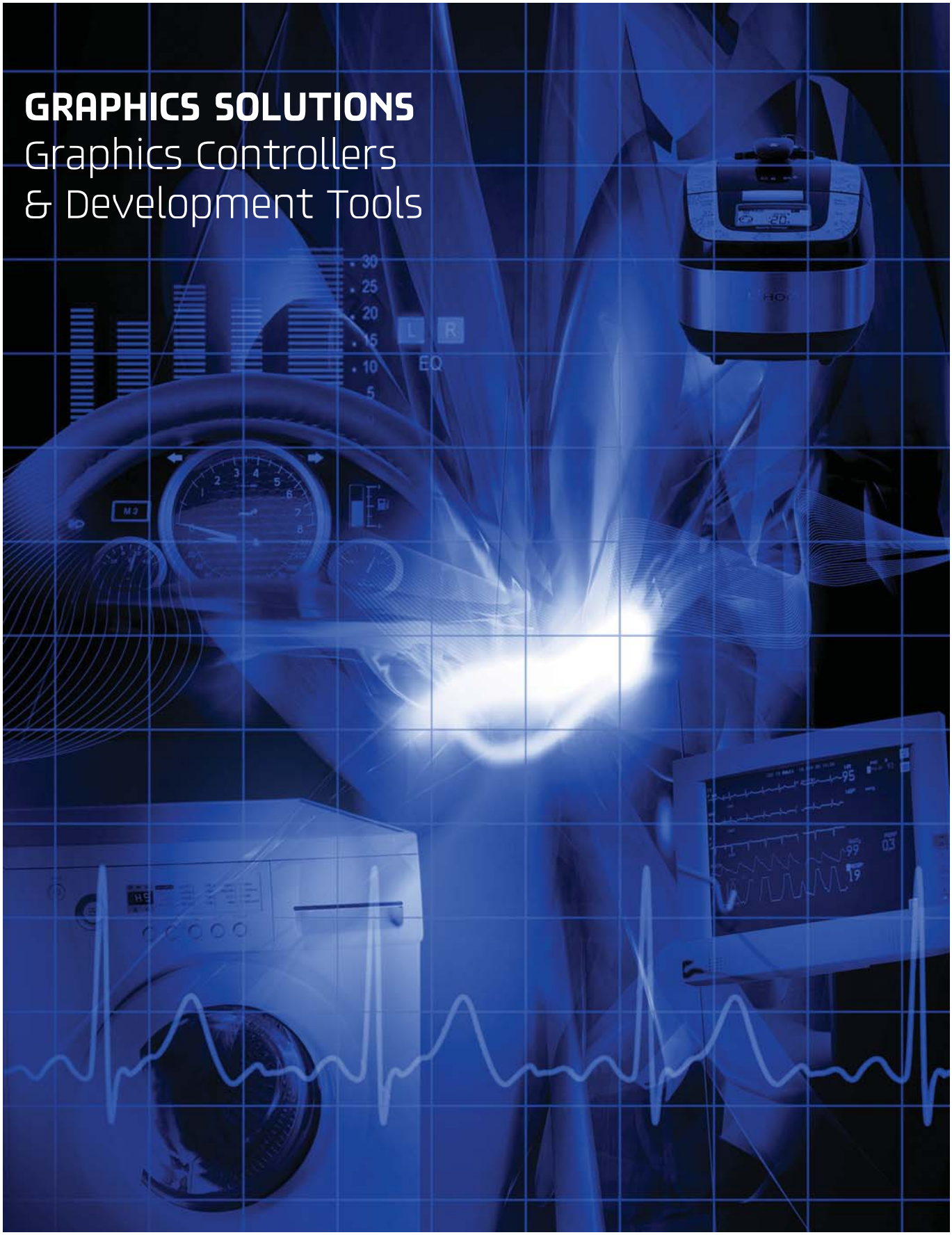
PRODUCT OVERVIEW
GRAPHICS SOLUTIONS

FUJITSU

THE POSSIBILITIES ARE INFINITE



PRODUCT OVERVIEW
GRAPHICS SOLUTIONS

Designed and produced in the UK. Printed on environmentally friendly paper.

This brochure contains references to various Fujitsu Graphics Controller products under their original development code names. Fujitsu does not lay any claim to the unique future use of these code names.

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Introducing Business Unit **GRAPHICS SOLUTIONS**

In October 2006 Fujitsu Microelectronics Europe (FME) created the 'Graphics Competence Center' (GCC) - a new business unit dedicated entirely to graphics solutions. This business unit, with around 35 highly skilled engineers who combine first-rate competence in hardware and software design, application engineering and technical marketing, is located in Munich and maintains close contacts and relationships with European customers to improve the monitoring of market requirements.

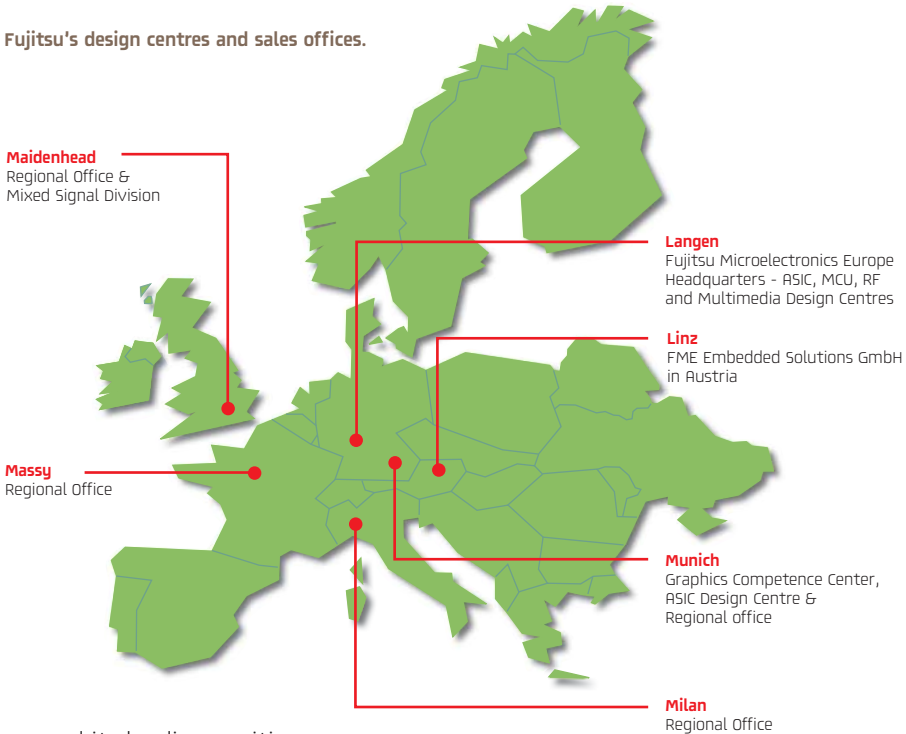
The Graphics Competence Center collaborates closely with Fujitsu in Japan on chip architecture and hardware design, producing the logic and hardware macros for new graphics processing units that are finally delivered as stand-alone GDCs or SoC devices. The development and customisation of software APIs (OpenGL, OpenVG, etc.) and powerful software tools for engineering and debugging, are also a focus of development work done in Munich.

GCC provides expert application support and a constantly updated technical support website (with an RSS service) for fast access to extensive documentation, technical papers and various download packages. Evaluation boards are available for all GDC products from GCC's in-house application specialists who co-operate closely with external hardware and software design and production partners. This helps to shorten our customers' development phase and their time-to-market.

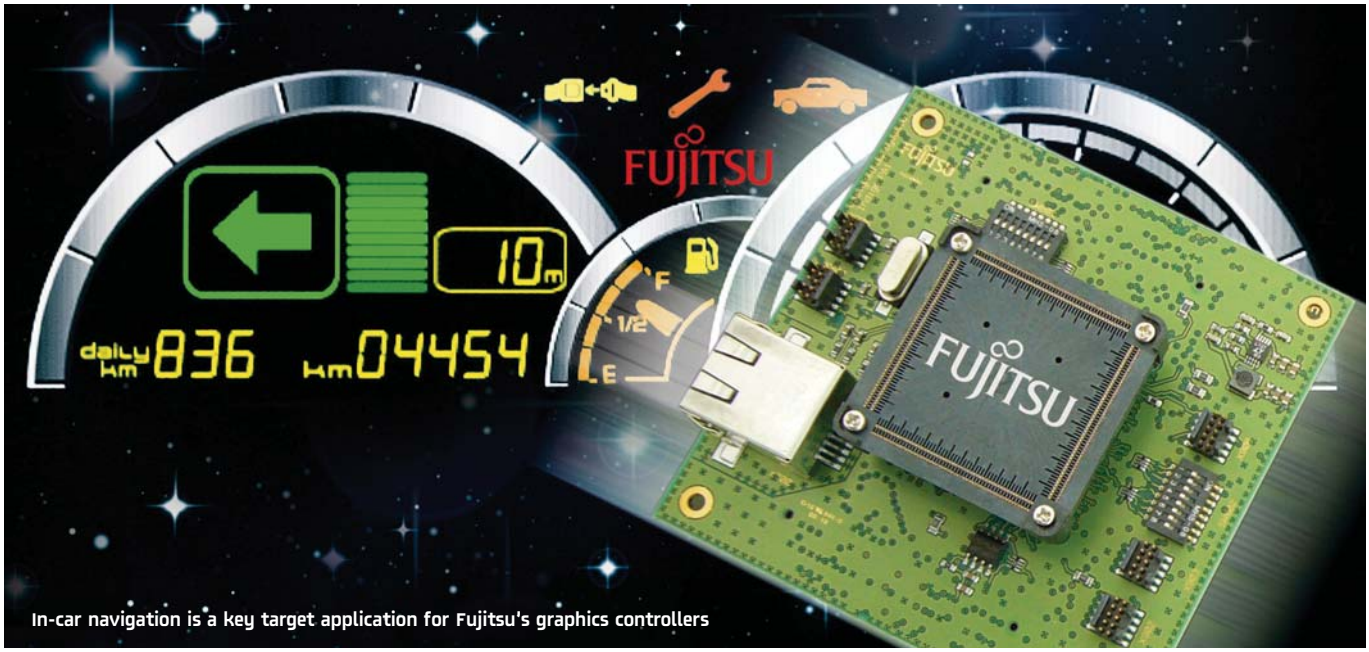
Having a competence center for graphics controllers business close to European customers is a clear advantage for customers and Fujitsu has continued to strengthen and expand its leading position as a semiconductor vendor for embedded graphics applications by investing in new technologies as well as in the Graphic Competence Center, which strives to provide complete graphics solutions including hardware, software, tooling and support.

FME's Business Unit Graphics Solutions is based in Munich and employs 35 specialists, combining hardware and software design, applications engineering and marketing skills

Fujitsu's design centres and sales offices.



Introduction to **GRAPHICS CONTROLLERS**



In-car navigation is a key target application for Fujitsu's graphics controllers

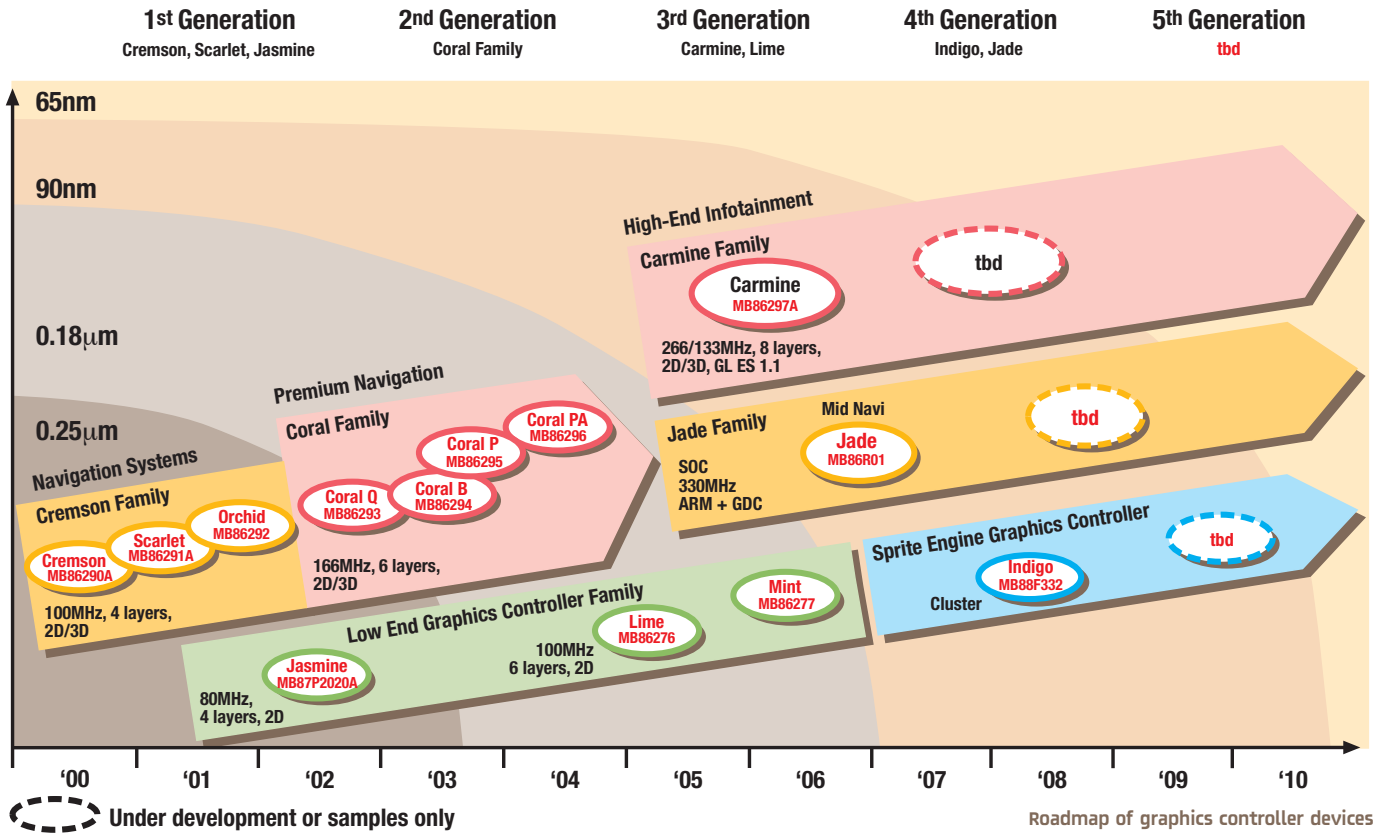
Fujitsu has a solid reputation as a reliable partner and semiconductor vendor and has delivered leading-edge graphics controllers into the embedded market for many years. Graphics controllers from Fujitsu are established in the market as they provide the right combination of the following components:

- A right-sized, flexible feature set
- Low power consumption rates
- High-level quality grades

Fujitsu's graphics controllers drive the displays of most of today's graphics high-end and low-end systems as they have been designed into automotive applications such as navigation systems, dashboard Head-Up Displays (HUDs) and Rear Seat Entertainment (RSE) systems as well as into other application areas, such as marine applications, medical, gaming and industrial fields. The existing product portfolio provides scalable, compatible and cost-effective solutions for almost all embedded graphics and video requirements.

Fujitsu's new graphics controller roadmap contains exciting, leading-edge devices. They have been specified with extensive functionality and high performance characteristics according to OpenGL ES 2.0/OpenVG for dual-view displays with resolutions up to 1280 x 1024 pixels, as well as high integration level SoC derivatives and optimised solutions for low-end and cost-sensitive applications.

Product **ROADMAP**



Roadmap of graphics controller devices

New enhanced graphics controllers are planned as successive products for various kinds of digital audio/video and multimedia applications.

The car navigation application field is a primary focus of Fujitsu's graphic controllers roadmap and will be extended further.

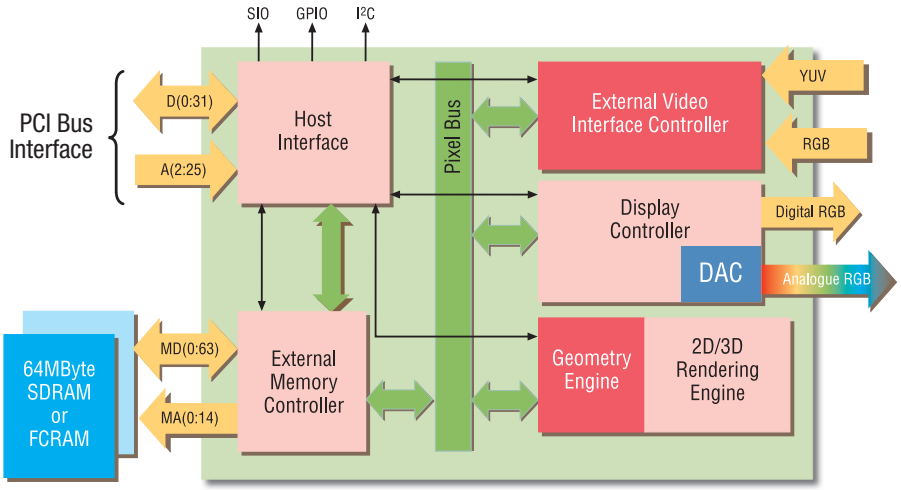
New graphics controllers' support for 3D graphics makes features such as 'bird's-eye view perspective' possible

MB86295 'Coral P' & **MB86296** 'Coral PA'

MB86295 'Coral P' and MB86296 'Coral PA' are enhanced versions of 'Coral B' with a PCI host interface and a new video input controller. Any CPU with a 32-bit PCI V2.1-compliant host interface can be directly connected to 'Coral P/PA'. The devices include both master and slave functions and an internal DMA controller for multi-burst transfers of large quantities of data between all combinations of PCI data space and 'Coral' internal areas.

Additional functions provided by the host interface are general-purpose I/O pins and a serial interface. The external video input of MB86295/6 accepts data conforming to the standards RBT-ITU656, RBT-ITU601, RGB666 and RGB888. This allows video signals of various sources to be displayed together with generated graphics. The video input is capable of accepting TV tuner, DVD player or camera signals in PAL or NTSC video formats. In addition, rendered graphics from any other display controller can be used as video input source.

The video stream is read, modified and written to a video buffer memory completely independent of the display scanning process. Video pictures of diverse resolution and frame frequency rate, in either progressive or interlaced modes, are able to be grabbed, scaled and displayed picture-in-picture. As with 'Coral B', 'Coral P/PA' integrates a new video input up-scaling facility, which now allows a full-screen mode of multimedia pictures at large resolutions



MB86295 block diagram

to be displayed. Both up-scaling and down-scaling can be set independently in horizontal and vertical directions in pixel or line resolutions.

A set of general-purpose I/O pins and a serial interface are also included for simple external resource control.

Key features

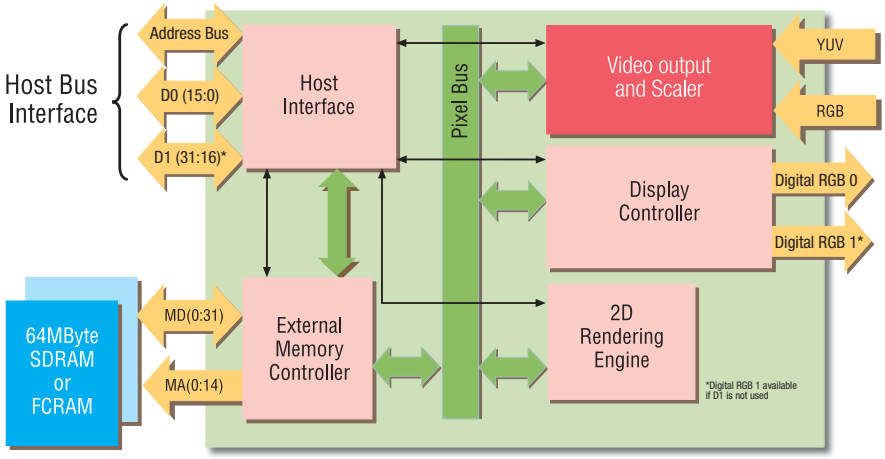
- CMOS 0.18µm technology
- Display resolutions up to 1280 x 768
- 6 layers of overlay display (Windows)
- Alpha plane
- Digital video input (various formats)
- Video scaler (up/down-scaling)
- I²C interface
- Geometry processor
- RGB digital output (8-bit x 3)
- RGB analogue output
- Includes various kinds of 2D/3D graphics acceleration functions
- Built-in alpha-blending, anti-aliasing and chroma-keying
- External SDRAM or FCRAM™ interface @ 133MHz for up to 64MBytes graphic memory
- PCI 32-bit V2.1 host interface
- General-purpose I/O
- Serial interface
- Supply voltage 3.3V (I/O), 1.8V (Internal)
- BGA-256 package
- Temperature range -40 to +85°C

The MB86296 'Coral PA' is a re-designed and feature-expanded version of 'Coral P'. This chip has the following additional features:

- Direct RGB666 video input without conversion to YUV422
- Dual-display feature (independent contents on two connected screens)
- Colour-space conversion method selectable as programmable option
- Brightness, contrast, saturation control for video input
- PCI bandwidth is approximately 70MBytes/s
- New ROM for geometry engine (enhanced functions)
- Pixel-clock delay of display output is programmable
- PCI bus clock can be used as clock input
- Video texture mapping (RGB555 mode)
- Simultaneous up- and down-scaling
- Enhanced pixel clock output
- 100% pin- and function-compatible to 'Coral P'

MB86276 'Lime'

The new graphics controller MB86276 is the perfect choice for 2D-optimised graphics systems based on the 'Coral' family



MB86276 block diagram

MB86276 'Lime' is a low-end extension to the Fujitsu graphics controller family for 2D applications. This chip is based on the 'Coral' family core functions, and optimised for 2D rendering.

The graphics controller, rendering engine and video input unit are taken from the successful 'Coral P/PA' but the floating point co-processor and all 3D-functions have been taken out. Also, the CPU interface is optimised for more CPU connections and the device has some functions to support small footprint graphics applications. MB86296 is 100% binary-compatible to the 'Cremson' and 'Coral' families.

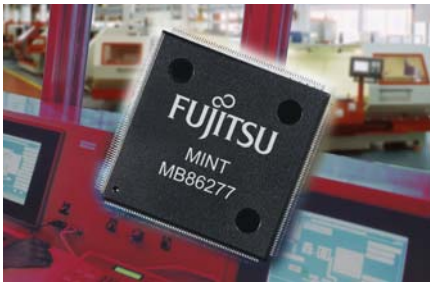
Key features

- CMOS 0.18µm technology
- Display resolutions up to 1280 x 768
- 6 layers of overlay display (Windows)
- Alpha plane
- Digital video input (various formats)
- Video scaler (up/down scaling)
- I²C master/slave interface
- RGB digital output (8-bit x 3)
- Dual-display support (2xRGB666 output)
- Includes various kinds of 2D graphic acceleration functions
- Built-in alpha blending, anti-aliasing and chroma-keying
- External SDRAM or FCRAM™ interface @ 133MHz for up to 64MBytes graphic memory
- Standard host interface for embedded CPUs/MCUs
- (32-bit/16-bit)
- General-purpose I/O
- Serial interface
- Supply voltage 3.3V (I/O), 1.8V (Internal)
- BGA-320 package
- Temperature range -40 to +85°C

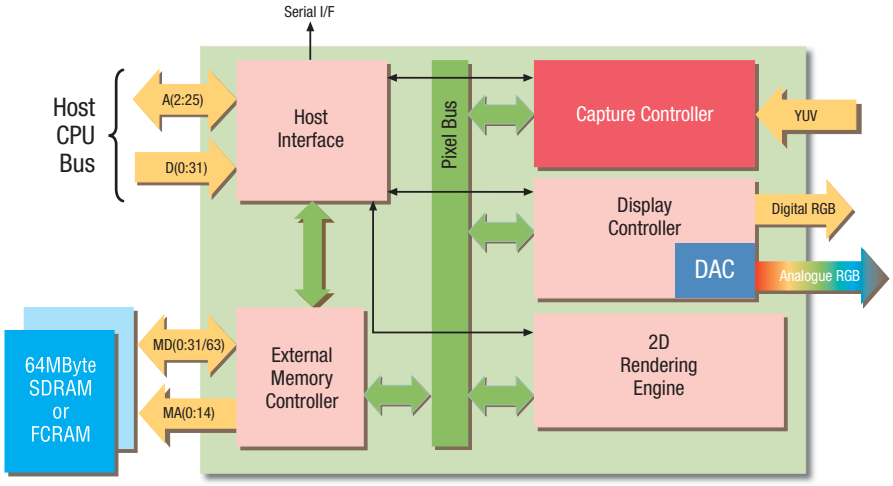
MB86276 Host IF multiplexing modes

Mode 1	HST 32-bit	D(31:16)	RGB out 8/8/8		RGB in 6/6/6		
Mode 2	HST 32-bit	D(31:16)	RGB out 8/8/8		GPIO (4:0)	N/A	Video In (7.0)
Mode 3	HST 16-bit	RGB out 8/8/8		RGB out 6/6/6	GPIO (3)	N/A	Video In (7.0)
Mode 4	HST 16-bit	RGB out 6/6/6	RGB out 6/6/6	N/A	RGB in 6/6/6		

MB86277 'Mint'



The new graphics controller MB86277 is the perfect choice for low-end 2D graphic systems and industrial applications



MB86277 block diagram

Built using CMOS 0.18 µm technology and available in an unleaded LQFP256 package, MB86277 'Mint' is a solid option for various types of low-end 2D graphics applications in the industrial market segment. MB86277 'Mint' operates internally at 100MHz and has a 32-bit MCU interface and a 64/32-bit SDRAM memory interface. The video input unit is capable of accepting TV tuner, DVD player or camera signals in PAL or NTSC video formats (ITU656 format). Interlaced video pictures with various resolutions and frame frequency rates can be grabbed, scaled down and displayed picture-in-picture.

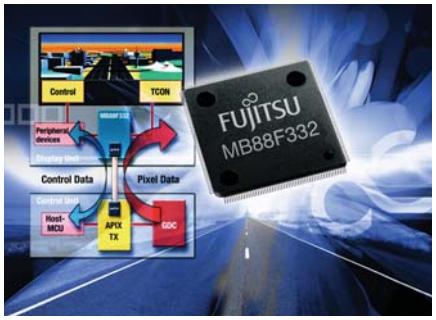
Using the alpha map, the video picture can be blended smoothly together with rendered graphics. The alpha map can be freely assigned to any of the six layers and allows the assignment of 8 bits per pixel, enabling each pixel to be mixed to control transparency to a much more defined degree. In addition, all layers can be blended at a fixed ratio of 256 levels.

To enhance Bit BLT (Bit Block Transfers) operations, this feature can now be combined with alpha-mapping. With this function, any bitmap can be copied from any source location (CPU memory or video memory) and can be copied onto a layer with an independent alpha map. Software routines that make use of this function can greatly improve image quality (for example anti-aliasing over a moving background).

Key features

- CMOS 0.18µm technology
- Internal and memory clock frequency: 100MHz (generated by on-chip PLL)
- Base clock for display clock: 400.9MHz (generated by on-chip PLL)
- Power consumption ‹ 1.0W (estimated)
- Display resolutions typically from 320 x 240 up to 1280 x 768
- 6 layers of overlay display (windows)
- Alpha plane and constant alpha value for each layer
- RGB888 and RGB analogue display output
- Digital video input (ITU656)
- Video input down-scaling
- Rendering engine for 2D graphics acceleration functions
- Texture mapping unit (up to 4096 x 4096)
- Bit BLT Unit for transfers up to 4096 x 4096 surfaces
- Alpha Bit BLT and ROP2 functions
- External 64/32 bit SDRAM interface (100MHz) for graphic memory (up to 64Mbytes)
- Parallel host interface (FR, SH3, SH4, V850, SparcLite, etc.)
- Internal and external DMA support
- I²C interface
- LQFP256 Package
- Temperature range -40 to +85°C

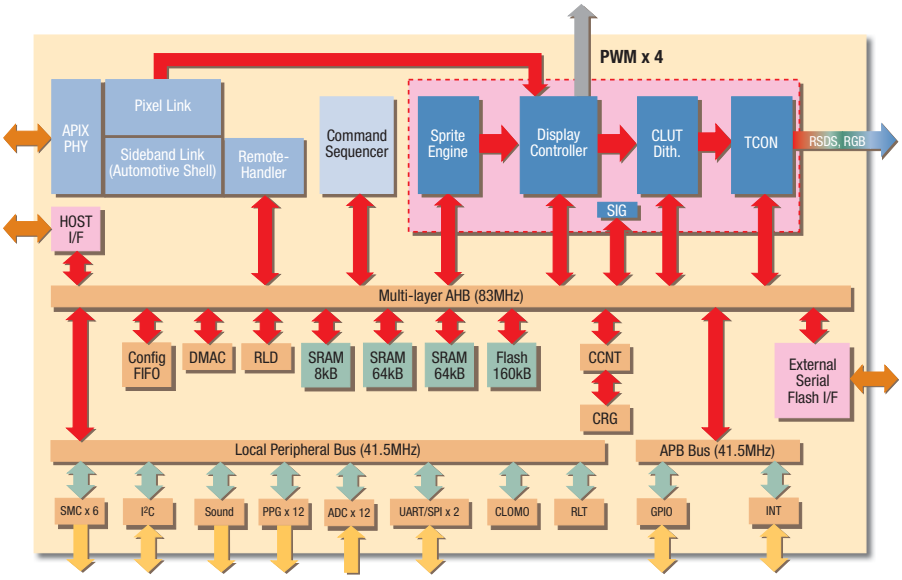
MB88F332 'Indigo'



The new sprite-based graphics controller MB88F332 with APIX® technology

MB88F332 'Indigo' is Fujitsu's first sprite-based Graphics Controller. MB88F332 is a 0.18µm embedded flash CMOS device, which targets automotive application fields, especially state-of-the-art systems, CID (Central Information Display) and RSE (Rear-Seat Entertainment) systems. The need for expensive framebuffer VRAM memory is eleminated as graphics processing is done entirely on a line-based scheme. A suite of 5V MCU peripherals such as SMC (Stepper Motor Controllers), PWMs (Pulse Width Modulators) and ADCs (Analogue-Digital Converters) is integrated to enable the realisation of competitive systems. A new highlight in the MB88F332 'Indigo' device is an implementation of Inova Semiconductor's highspeed APIX® (Automotive/Advanced Pixel Link) interface.

Other features include automatically animated special sprites, which provide a high degree of creativity for optical designs, run-time data decompression (for the expansion of run-length encoded data, such as a company logo used as a splash screen at system start-up time). A built-in data signature calculation feature ensures data integrity as required for strict ASIL (Automotive Safety Integrity Level) level conformance. A programmable, embedded TCON (Timing Controller) unit makes it possible to connect the device directly to almost any TFT (RSDS or TTL) panel.



MB88F332 block diagram

MB88F332 'Indigo' is available in a low-cost LQFP package with an extended temperature range.

Key features

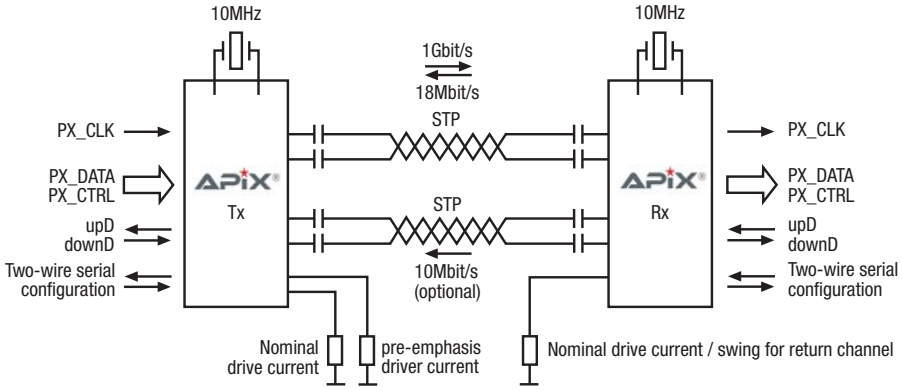
- CMOS 0.18µm technology
- Temperature range -40 to +105°C
- Package: LQFP208
- 83.3MHz system clock
- CPU Interface: Synchronous serial I/F (SPI) or APIX sideband link
- Up to 512 sprites, including 32 special sprites
- 160kB embedded NOR flash ROM
- 128kB+8kB embedded SRAM
- Automatically animated sprites (Command List Auto-Load, Special Sprite Function)
- Line buffer based (no need for external VRAM)
- Maximum display resolution supported: 1280 x 480
- Supports up to 18bpp TFT Panels (RSDS or TTL)
- Embedded TCON (Timing controller)
- APIX RX interface (according to device purchased)
- Pixel link and Sideband link
- Spread spectrum clock modulation (for reduced EMI)
- Signature calculation feature
- Data expansion for RLE (run-length encoded) data

APIX technology

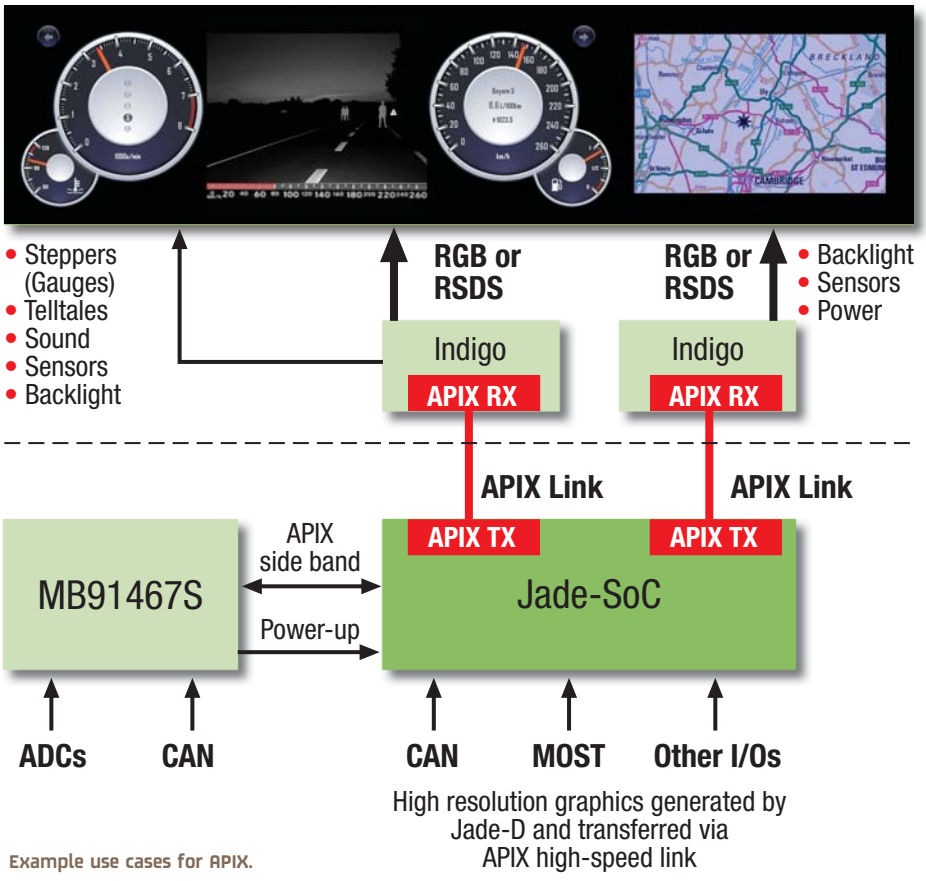
MB88F332 evaluation board

APIX®

Uniquely designed to meet the bandwidth and distance requirements of today's and future automotive connectivity designs, APIX® uses CML-based differential transmission technologies for video data and an independent full duplex bi-directional communication channel. In addition, power can be connected by using just ONE four-wire shielded copper cable in the vehicle. APIX® technology is optimised in terms of EMI by design and well-proven for use in cars. Close collaboration with leading connector and cable manufacturers has resulted in a solid and ruggedised connectivity solution for the automotive market. The combination of adjustable driver characteristics, selectable operating modes (1GBit/s or 500MBit/s) and spread spectrum-clocking enables an optimal combination of minimal EMI, maximum transmission distances and lowest power consumption rates. AShell technology is provided that is a higher level communications protocol to enable easy implementation of secure and error-resistant communication links over the full duplex bi-directional sideband channels. APIX® technology has been adapted by numerous other semiconductor suppliers to provide a broad choice of products and suppliers to the automotive market.



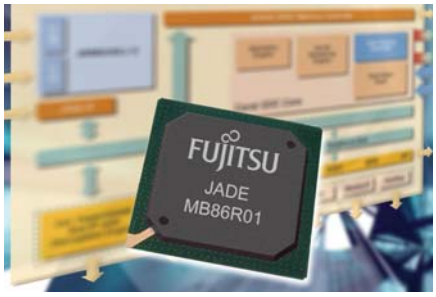
APIX® interface



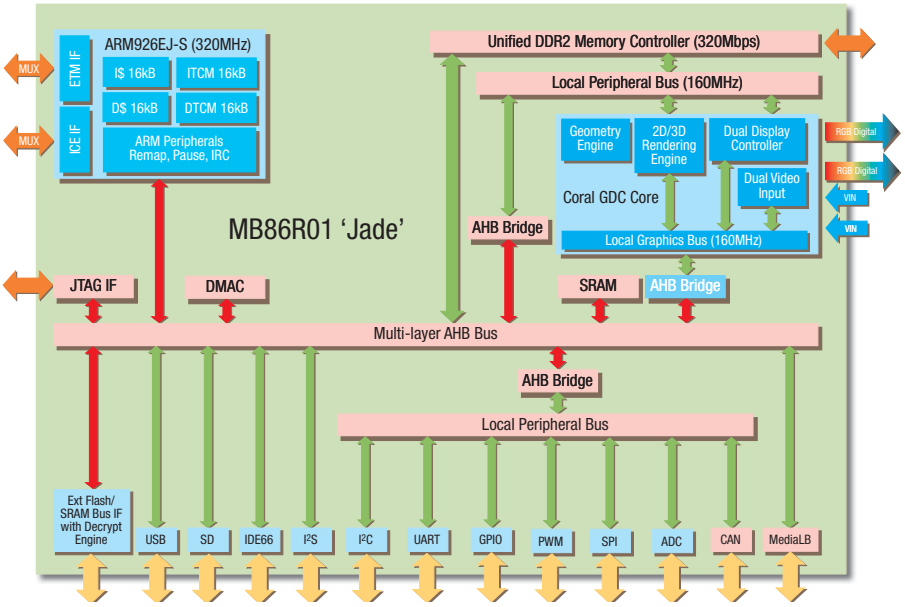
Example use cases for APIX.

inova® Semiconductors

MB86R01 'Jade'



The new System-on-Chip graphics controller MB86R01 is a very versatile device with a large palette of interfaces, offering a wide scope of potential application fields



MB86R01 block diagram

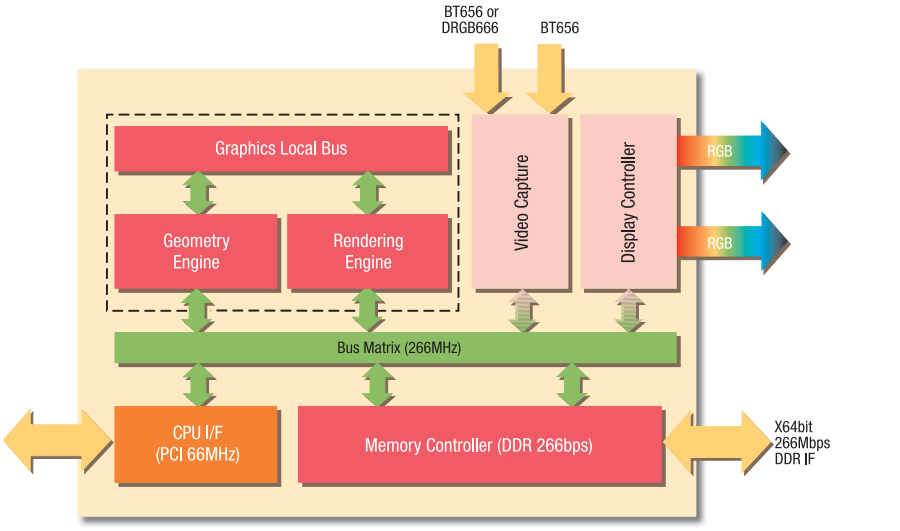
MB86R01 'Jade' is a highly-integrated device for embedded automotive graphics applications. Incorporating an ARM926EJ-S CPU core, together with an enhanced version of the successful 'Coral PA' graphic processor and a number of external interfaces, this 90nm technology device is highly optimised for various types of applications that require outstanding CPU performance in combination with sophisticated 2D/3D graphics features in a compact SoC. Target applications include on-board and mobile navigation systems, graphical dashboard systems, HUD (Head-Up Display) units, rear-seat entertainment systems, Point of Sales terminals and industrial control panels.

Key features

- CMOS 90nm technology
- ARM926EJ-S CPU core (320 MHz) with 16kB instruction and 16kB data cache
- ETM9 and JTAG ICE interface
- Internal/memory frequency: 333MHz
- Display resolutions typically from 320 x 240 up to 1280 x 1024
- 6 layers of overlay display (windows)
- Alpha plane and constant alpha value for each layer
- Dual-display output (2 separate display controllers are integrated supporting RGB8, RGB16 and RGB24)
- Dual-display output (2 separate display controllers are integrated supporting RGB8 and RGB16. One (DISP0) also supports RGB24
- Video scaler (up/down scaling)
- Video: Brightness, contrast, saturation control
- Rendering engine for 2D/3D graphics acceleration functions
- Geometry processor supporting floating point transformations
- Texture mapping unit (up to 4096 x 4096)
- Bit BLT Unit for transfers up to 4096 x 4096 surfaces
- Alpha Bit BLT and ROP2 functions
- External DDR2-SDRAM interface (166MHz) for graphic memory (up to 128MBytes)
- Parallel flash/SRAM host interface
- Parallel ATA interface
- SD card interface
- CAN interface
- Media LB interface
- USB interface (host and function)
- I²C interface
- I²S interface
- UART interface
- SPI
- ADC
- PWM
- GPIO
- BGA-484 Package
- Temperature range -40 to +85°C

MB86297A 'Carmine'

The MB86297A graphics controller is the first device of its kind to be fabricated in 90nm technology



MB86297A block diagram

MB86297A 'Carmine' is a high-end extension to the Fujitsu graphics controller family. This chip carries a brand new graphics core, that delivers 10x more performance than 'Coral PA'. All relevant blocks inside the chip are re-designed and optimised for high-end in-car multimedia applications. 'Carmine' is 100% compatible to OpenGL ES 1.1. All transforming and lighting functions can be executed in hardware.

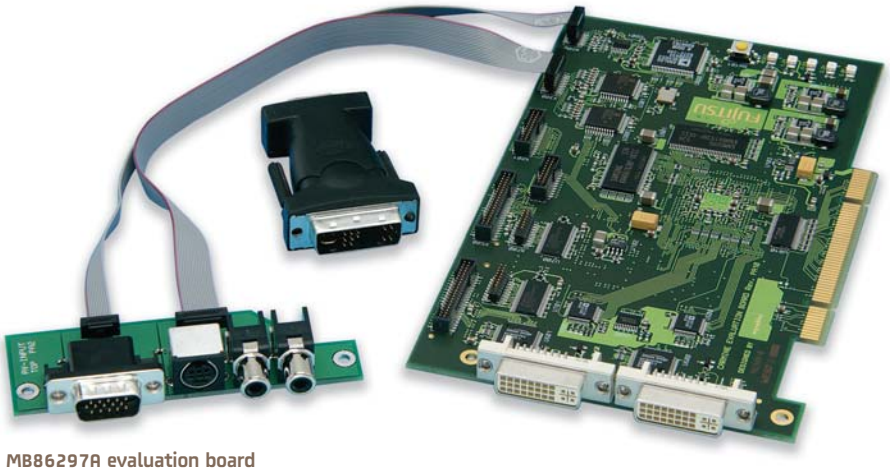
As a new feature, 'Carmine' has two independent display output units. Both can generate individual display timings and resolutions. For each display channel, 8 layers and 4 alpha-planes are available. 'Carmine' also features two independent video input channels - each of them can capture independent YUV and RGB signals.

Key features

- CMOS 90nm technology
- Internal and memory frequency: 266MHz
- Display resolutions up to 1280 x 1024
- 2 x 8 layers of overlay display (windows)
- 2 x 4 alpha planes and constant alpha value for each layer
- Dual-digital video input (various formats)
- Video scaler (up/down scaling)
- Brightness, contrast, saturation control
- Dual-display output
- Rendering engine for 2D/3D graphics acceleration functions
- OpenGL ES 1.1 compatible
- Geometry processor
- External DDR-SDRAM interface @ 266MHz for up to 128MBytes external memory
- PCI66 host interface
- BGA-543 package
- Temperature range -40 to +85°C

Evaluation **BOARDS**

'Indigo' evaluation board is a modular system, that comprises a base board (the evaluation board itself), which offers all the main GDC interfaces, and the push-fit 'EVB Indigo' board, that carries the MB88F332 'Indigo' device itself. The 'Indigo' evaluation board constitutes a powerful development and evaluation platform for the latest graphics controller from Fujitsu. The board offers the following interfaces: DVI, 3 stepper (dual coil) motor controls, a display connector and an interface to the MB88F332 'Indigo' itself (which is mounted on a small separate push-fit board), PWM, GPIO and ADC interfaces.

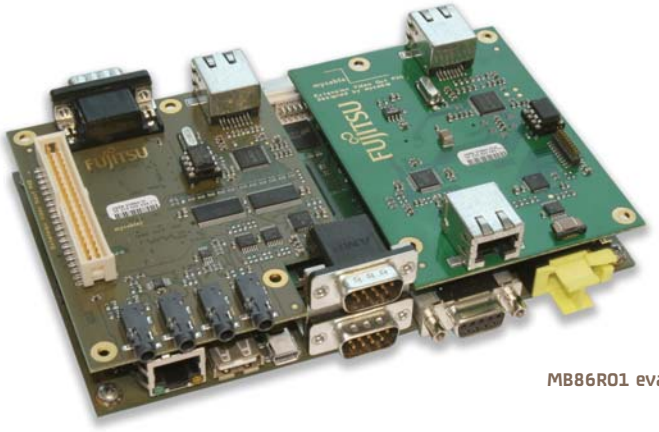


MB86297A evaluation board

MB88F332 evaluation board

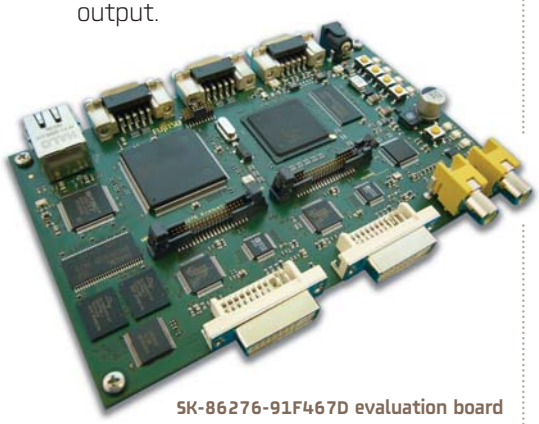
'Carmine' evaluation board is a PCI card and can be used in both an embedded host system or in a PC. Used in a PC together with common IDE tools, it provides a practical evaluation and debugging environment for the MB86297A 'Carmine' device. The driver software makes it possible to develop and execute Windows XP graphic applications on a high performance system. Connectors for video input and output devices have been implemented on the board as separate standard interfaces.

'Jade' evaluation board is a modular system, that comprises a base board (the evaluation board itself), which offers all the main GDC interfaces, the push-fit 'XXS Video' board, which carries the MB86R01 'Jade' device itself and two further extension boards (Video IN and Video OUT). The 'Jade' evaluation board constitutes a powerful, low power consumption development and evaluation platform for the latest graphics controller from Fujitsu.

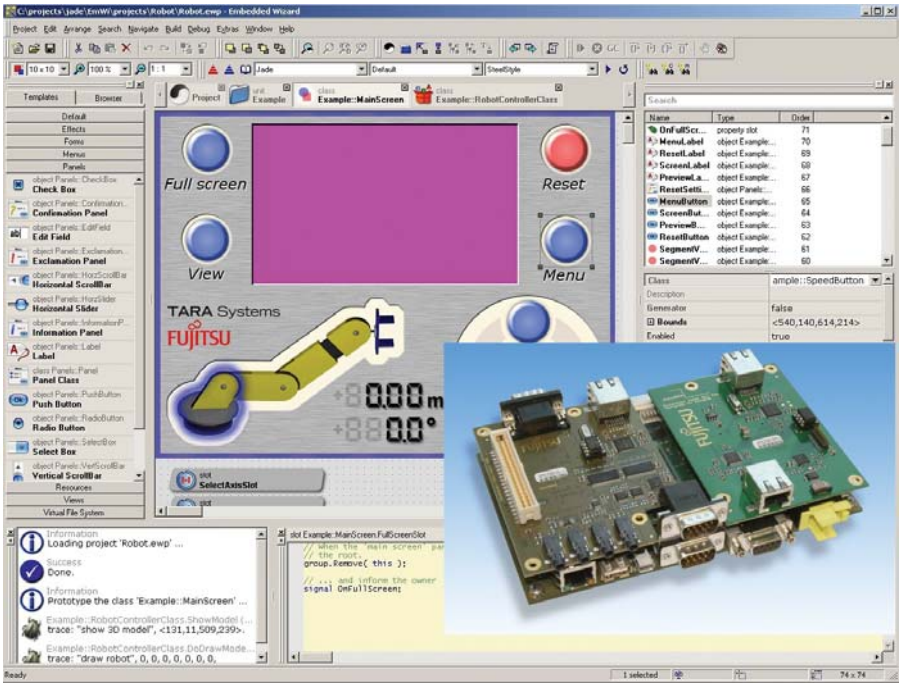


MB86R01 evaluation board

'Lime'/467 evaluation board is a compact system, that incorporates the MB86276 'Lime' graphics controller and the MB91F467D microcontroller. The board offers various interfaces such as CAN, UART, Ethernet, CVBS/S for video input and digital RGB or DVI for dual-display output.

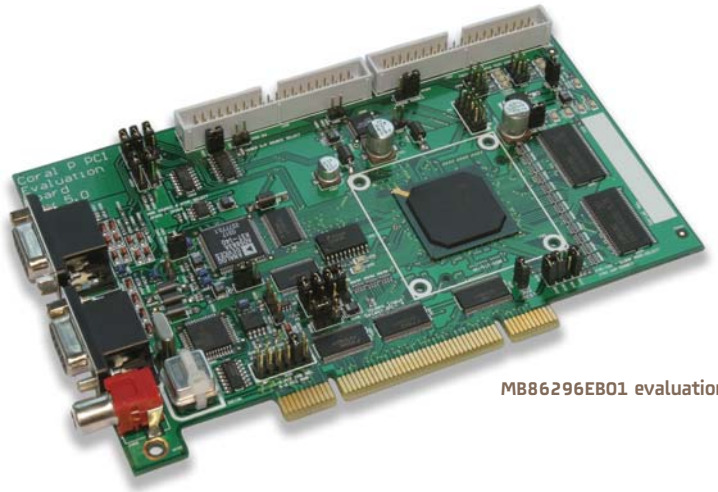


SK-86276-91F467D evaluation board



SK-86R01-EMWI HMI development system

SK-86R01-EMWI development system incorporates the 'Jade' Starterkit SK-86R01 and an evaluation version of TARA Systems' 'EmWi' (Embedded Wizard'), a PC-based tool to simplify and accelerate the development of HMI systems. HMI design, prototyping and automatic code generation are the key advantages of EmWi, which is integrated in an intuitive IDE. The HMI code that is generated can finally be up-loaded and executed on the SK-86R01 'Jade' hardware. Developers therefore have everything at hand to run their custom-designed HMI on an embedded platform very quickly, and they will soon see how simple an HMI design can be made.



MB86296EB01 evaluation board

'Coral' PA evaluation board was designed as a graphics sub-board and needs an additional host system for operation. The Coral PA evaluation board incorporates connectors for video input sources such as CVBS or digital/analogue RGB using standardized RGB connectors to digital or analogue displays.

The host interface is a standard PCI connector, allowing it to connect to an embedded host or a PC-based host, whereby the PC host offers several advantages for practical evaluation and debugging methods.

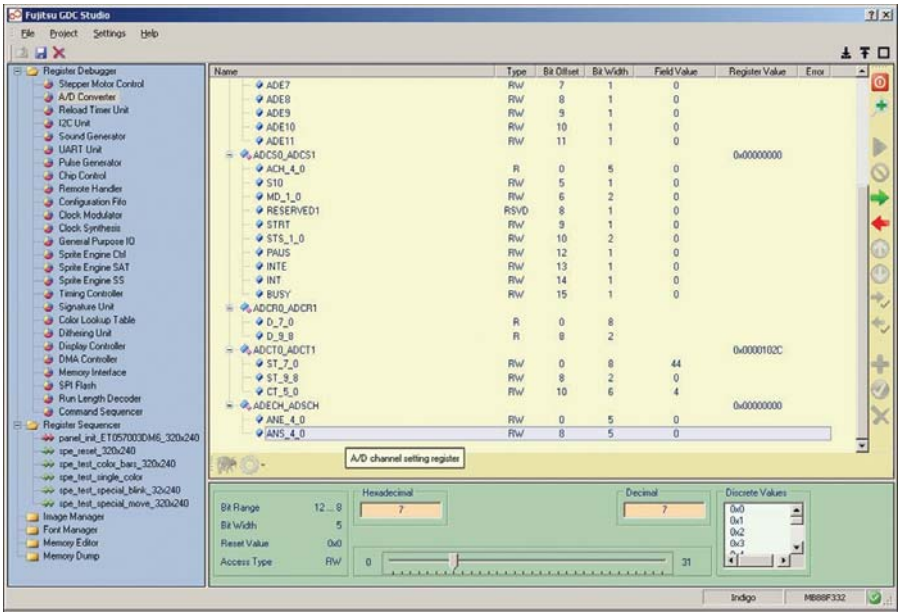
SOFTWARE TOOLS – GDC STUDIO

GDC Studio is a very versatile and powerful tool that can be used for register debugging, sequentially writing to registers, managing images and fonts for an application and for inspecting, dumping and editing RAM and flash memory. A flash programmer is integrated in GDC Studio to round off the picture. The tool is currently only available for MB88F332 'Indigo', but future graphics controllers will also be supported. In its current version, GDC Studio accesses the chip via the Host Interface (SPI). An installation set-up wizard ensures simple installation of the tool and an extensive user manual is provided as an online help, installed with the tool.

Key modules

- Register debugger
- Register sequencer
- Image manager
- Font manager
- RAM and flash memory editor
- On-chip flash support

GDC Studio runs on Windows 2000, Windows XP and Windows Vista (depending on support provided by the 'Aardvark' driver, supplied by a third party company (not part of the delivery scope of GDC Studio). For details about the 'Aardvark' hardware and corresponding driver, please refer to the website of TOTAL PHASE, Inc. http://www.totalphase.com



GDC Studio GUI

Hardware is not included with GDC Studio and not included in the licencing model, which is based on a per-PC locking scheme. Floating licenses are not available for GDC Studio, but volume licenses can be obtained on request to your Fujitsu sales partner.

For more about GDC Studio, please refer to:
http://www.fujitsu.com/emea/services/microelectronics/gdc/swtools/gdc-studio.html

Software **DRIVERS**

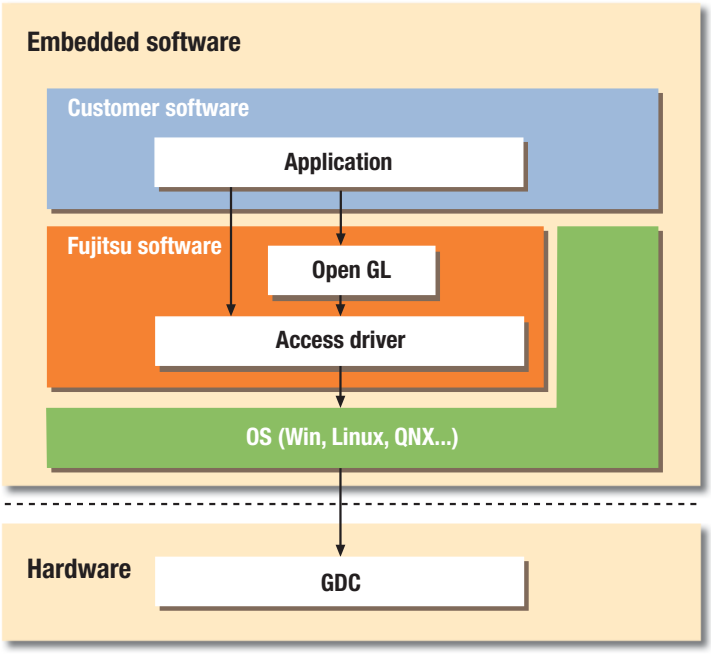
Driver software is needed to provide an interface between the application itself and the underlying hardware. There are three different types of software packages for Fujitsu graphics controllers as described below.

Evaluation software

Evaluation software is used to test the (restricted) functionality of the software stack for an evaluation board. It includes an installation routine for the hardware, examples and brief documentation. The software is supplied as binary code or as a 'basic version' of the source code. Evaluation software is provided 'as-is' i.e. without technical support and is intended for testing and demonstration purposes only.

Basic software

Basic software is used to develop and test the (restricted) functionality of the software stack for a specific graphics controllers for pre-series or prototype production. It includes an installation routine for the hardware, examples and brief documentation. The software is supplied 'as-is' (i.e. without technical support) as binary code or as a 'basic version' of the source code and does not support 3D functionality and texturing.



Software Driver Architecture (example)

Full software

Full software is used to develop and test the (unrestricted) functionality of the software stack for a specific graphics controllers. It includes an installation routine for the hardware, examples and brief documentation. The software is supplied as source code and supports the entire functionality of the software stack, including 3D and texturing. This software is supplied under the terms of a software licence agreement and therefore offers limited technical support. An additional maintenance contract can be offered to provide full technical support.

LEGACY products

MB86290A 'Cremson'

MB86290A 'Cremson' is a 2D/3D graphics controller optimised for applications in car navigation systems and mobile information processing terminals. Offering various sophisticated functions, such as flat or Gouraud shading, bi-linear texture mapping and Z-buffering, 'Cremson' delivers high-speed and superior-performance 3D graphics functionality.

Moreover, anti-aliasing, concaved polygon rendering and fast line draw features are also included, allowing smooth and sophisticated quality rendering. As a result, 'Cremson' performs high-quality rendering operations, with quality similar to leading-edge PC graphics, but with lower power dissipation. 'Cremson' incorporates a 64-bit wide external memory interface, which is driven at the same operating frequency (100MHz) as its internal units to support the large-memory bus bandwidth that is needed to perform the high-performance graphics operations described above. Also, in order to support various kinds of system configurations, Cremson offers a configurable host interface for four types of CPUs (Fujitsu FR30, Hitachi SH3/4 and NEC V832) without the need for external glue logic.

To address the especially complex window configurations of car navigation systems, 'Cremson' offers 4 overlay plane layers. These layers are (from top to bottom): C (console) layer, W (window) layer, M (middle) layer and B (base) layer. Each layer can be rendered in 16-bit/pixel colour (65,536 simultaneous display colours) or rendered in 8-bit indirect colour mode (256 selected out of 262,144 colours). The colour palette can be defined separately for the C layer and B and M layers. A transparent colour option is used to blend the layers directly.

Key modules

- 2D/3D graphics acceleration
- Display up to 1024 x 768
- 4 layers of overlay display
- Configurable CPU interface
- Up to 32MB ext. memory
- RGB analogue output

MB86291A 'Scarlet'

MB86291A 'Scarlet' is an enhanced version of MB86290A 'Cremson', incorporating 2MB embedded SDRAM, video input functions and a geometry processor. The display layers concept, 2D/3D rendering functions and display controller features were inherited from the MB86290A 'Cremson' device.

'Scarlet' is optimised for applications in car navigation systems that require video input features, consumer information processing systems and arcade game applications.

Scarlet has a 2MB, high bandwidth (100MHz) embedded SDRAM. External SDRAM devices are not required for graphics memory. The external video input unit can be used to capture video signals that conform to the standard RBT-ITU656 YUV4:2:2 format. Picture-in-picture functions are supported to display the video image (the W layer is dedicated to that purpose). A flexible video scaler is integrated to make it possible to adjust the dimensions of the video input format.

MB86291A 'Scarlet' incorporates a geometry processor capable of performing numeric calculations for graphics operations. It supports the following functions: Affine conversions, model-view-projections, 3D-clipping operations and others. All drawing functions, display list formats and software functions are compatible to those of the MB86290A 'Cremson' device. An additional RGB digital interface offers flexibility for different display connections.

Key modules

- Embedded 2MB SDRAM
- Geometry processor
- 2D/3D graphics acceleration
- 4 layers of overlay display
- Configurable CPU interface
- Digital video input
- Display output up to 1024 x 768
- Video scaler
- RGB analogue output
- RGB digital output

MB87P2020A 'Jasmine'

MB87P2020A 'Jasmine' is a 2D graphics acceleration chip incorporating 8Mbit of embedded SDRAM, eliminating the need for external memory devices for graphics memory. Its QFP208 package means that MB87P2020A 'Jasmine' is optimised for low-cost, compact automotive and consumer applications where a high level of functionality and system integration is required. The MB87P2020A 'Jasmine' device is optimised to work as a companion chip for Fujitsu's 32-bit MB91F36x family RISC devices.

MB87P2020A 'Jasmine' has a number of features that give designers more flexibility in their application area. Its video input interface was developed to allow the input of several formats (including YUV) and is compatible to a wide range of video decoder chips. A programmable converter matrix (YUV to RGB) allows an application to write YUV format data directly to layers and to convert the data back to RGB for scanning.

In addition, a gamma correction table allows a system designer to adjust the picture characteristics according to the requirements of the display connected in conjunction with an extended colour look-up table that can hold up to 512 entries.

Key modules

- 2D graphic acceleration
- 1MB embedded SDRAM
- 16/32-bit CPU interface
- Digital video input
- RGB analogue output
- RGB digital output
- 4 layers of overlay display

MB86293 'Coral Q' / MB86294 'Coral B'

MB86293 'Coral Q' and MB86294 'Coral B' devices are compatible with host CPU buses including Fujitsu FR, Hitachi SH3 and SH4 and NEC V83 without external glue logic. All devices are binary compatible with previous generation graphics controllers, i.e. the MB86290A 'Cremson', MB86292 'Orchid' and MB86291A 'Scarlet' devices. This helps to speed up development work and saves costs because existing software modules (e.g. a map renderer) and drivers can be used without any modifications.

2D drawing functions have been enhanced by the integration of a line depth display feature, which clearly defines the correct respective level of intersecting map lines. In previous devices, additional software was required to achieve this level of refinement. Enhanced hardware design also provides improvements in pattern line performance. All 'Coral' devices can address up to 64MB of external SDRAM or FCRAM memory at 133MHz and are capable of adjusting picture sizes to optimise the available memory space. All layers can have a colour depth of 8, 16 or 24 bits per pixel and can be changed in position, size and priority. The maximum logical layer size has been increased to 4096 x 4096 pixels.

Key modules

- Geometry processor
- 2D/3D graphics acceleration
- 6 layers of overlay display
- Configurable CPU interface
- Alpha plane
- Display output up to 1024 x 768
- RGB digital output
- Up to 64 MB ext. memory
- CMOS 0.18µm technology

The 'Coral' device family offers an increased internal operating frequency of 166MHz, a 64-bit memory bus, support for six independent layers, advanced alpha-blending features and enhanced video input facilities. The increased internal frequency of 166MHz (400MHz for display dot clocks) enables the rendering engine of the devices to achieve factor of 10 improvements in texture mapping and drawing image quality compared to the previous graphics controller devices. The enhanced bandwidth allows a much greater rate of access for graphics elements and delivers improved scanning functions at higher display resolutions.

Graphics Controllers **COMPARISON TABLES**

Comparison table – devices

Device	MB86290A 'Cremson'	MB86291A 'Scarlet'	MB86292 'Orchid'	MB86293 'Coral Q'
Classification:	**GPU**	**GPU**	**GPU**	**GPU**
Video Output:				
RGB Output: analogue / digital	1/0	1/1	0/1	0/1
Dual display output (multiplexed for 2 displays per output)				
Video Sync signals / TCON signals	• / -	• / -	• / -	• / -
Output TTL / RSDS	• / -	• /	• /	• /
Digital colour output format		24-bit	24-bit	24-bit
Max. Output resolution (typ. @60Hz):				
800 x 600 (SVGA)				
1024 x 480				
1024 x 768 (XGA)	•	•	•	•
1280 x 768 (BrightView)				
1280 x 1024 (SXGA)				
Number of simultaneous display layers (per display output)	4	4	4	6
Layer alpha blending:				
Constant blending for top layer	•	•	•	
Constant blending for all layers				•
Per pixel alpha blending				•
Video Input:				
ITU-R-B.656 (YCbCr422, YUV422)		•	•	
RGB Digital (RGB666)				
Number of inputs (mutliplexed)		1	1	
APIX video link				
Video scaling:				
Upscaling (horizontal / vertical)				
Downscaling (horizontal / vertical)		• / •	• / •	
Rendering:				
2D + 3D primitives	•	•	•	•
Geometry processor		•	•	•
Lighting Engine				
Texture Mapping:				
Max. 256 x 256	•	•	•	
Max. 512 x 512				
Max. 4096 x 4096				•
Video texturing				
Drawing alpha blending:				
Constant blending	•	•	•	•
Per pixel alpha blending				•
Control Interface:				
I²C		1	1	
SIO				
Peripherals				

MB86294 'Coral B'	MB86295 'Coral P'	MB86296 'Coral PA'	MB87P2020A 'Jasmine'	MB86276 'Lime'	MB86277 'Mint'	MB88F332 'Indigo'	MB86297A 'Carmine'	MB86R01 'Jade'
GPU	**GPU**	**GPU**	**GPU**	**GPU**	**GPU**	**GPU**	**GPU**	**SOC**
1/1	1/1	1/1	1/1	0/2	1/1	0/1	0/2	0/2
		•		•			•	•
• / -	• / -	• / -	- / •	• / -	• / -	• / •	• / -	• / -
• / -	• / -	• / -	• / -	• / -	• / -	• / •	• / -	• / -
24-bit	24-bit	24-bit	24-bit	24-bit	24-bit	18-bit	24-bit	24-bit
			•					
						• (1280 x 480)		
•					•			
	•							
		•		•			•	•
6	6	6	4	6	6	512	8	6
•	•	•		•	•	•	•	•
•	•	•		•	•		•	•
•	•	•	•	•	•		•	•
	•	•	•	•	•		•	•
1	1	1	1	1	1		2	2
						1		
• / •	• / •	• / •		• / •	• / •		• / •	• / •
• / •	• / •	• / •		• / •	• / •		• / •	• / •
•	•	•	2D only	2D only	2D only		•	•
•	•	•					•	•
							•	
•								
•	•	•		•	•		•	•
		•					•	•
•	•	•		•	•	•	•	•
•	•	•		•	•		•	•
1	1	1		1	1	1	1	1
	1	1		1		1		
						•		•

Graphics Controllers **COMPARISON TABLES**

Comparison table – devices continued

Device	MB86290A 'Cremson'	MB86291A 'Scarlet'	MB86292 'Orchid'	MB86293 'Coral Q'
Classification:	**GPU**	**GPU**	**GPU**	**GPU**
System:				
Chip core frequency (MHz)	100	100	100	166
CPU Host Interfaces:				
SRAM, non multiplexd, 32 bit buswidth	•	•	•	•
SRAM, non multiplexd,16 bit buswidth				
PCI				
APIX command side band link				
SPI				
I²C				
Integrated CPU				
Package	QFP240	QFP208	QFP256	QFP256
Deviating Temp. Range (Standard: -40 to +85°C)	•	-30 to +85°C	•	•
Embedded RAM, graphic memory (MB)		2		
Embedded ROM memory (MB)				
Max. External video memory (MB):	32		32	64
FCRAM / SDRAM (MHz)	100		133	133
DDR2 (MHz)				
Software / OS Support:				
Graphic API				
Access Library V02 support (Windows XP, Linux, No OS)	•	•	•	•
Access Library V03 support (Windows XP, Linux, No OS)				
OpenGL Support (Windows XP, Linux, No OS)				
GDC-Studio Tool				

Comparison table – tools

Evaluation Board	Description	Device
MB86290EB01	PCI board for PCs (Windows)	MB86290A Cremson
MB86291EB01	PCI board for PCs (Windows)	MB86291A Scarlet
MB86292EB01	PCI board for PCs (Windows)	MB86292 Orchid
MB8629XEB01+MB86293EB01*	Dual PCI board system (Windows)	MB86293 Coral Q
MB8629XEB01+MB86294EB01*	Dual PCI board system (Windows)	MB86294 Coral B
MB86295EB01	PCI board for PCs (Windows)	MB86295 Coral P
MB86296EB02	PCI board for PCs (Windows)	MB86296 Coral PA
MB86296-ADA01	Dual display adapter board	MB86296 Coral PA
MB86297EB01	PCI board for PCs (Windows)	MB86297A Carmine
CREMSON-STARTERKIT-CRM	Sub-board for Cremson Modular Starterkit	MB86290A Cremson
CREMSON-STARTERKIT-ROSE	Sub-board for Cremson Modular Starterkit	MB86291A Scarlet
CREMSON-STARTERKIT-JAS	Sub-board for Cremson Modular Starterkit	MB87P2020A Jasmine

MB86294 'Coral B'	MB86295 'Coral P'	MB86296 'Coral PA'	MB87P2020A 'Jasmine'	MB86276 'Lime'	MB86277 'Mint'	MB88F332 'Indigo'	MB86297A 'Carmine'	MB86R01 'Jade'
GPU	GPU	GPU	GPU	GPU	GPU	GPU	GPU	SOC
166	166	166	64	133	100	80	266	333
•			•	•	•			
			•	•				
	PCI33	PCI33					PCI66	
						•		
						•		
				•				
								ARM
BGA256	BGA256	BGA256	QFP208	BGA320	LQFP256	QFP208	BGA543	BGA484
•	•	•	•	•	•	-40 to +105C	•	•
			1			0.136		
						0.16		
64 133	64 133	64 133		64 100	64 100		128	128
							133	166
			•					
•	•	•		•	•			
		•					•	•
							•	
						•		

Comparison table – tools continued

Evaluation Board	Description	Device
CREMSON-STARTERKIT-LIME	Sub-board for Cremson Modular Starterkit	MB86276 Lime
CREMSON-STARTERKIT-CPU	CPU board for Cremson Modular Starterkit	MB91302 Host CPU
CREMSON-STARTERKITCPU369	CPU board for Cremson Modular Starterkit	MB91369 Host CPU + Debug RAM
STARTERKIT MB91302	CPU board for Cremson Modular Starterkit	MB91302 Host CPU + Debug RAM
SK-91F467D-208PFV	CPU board for Cremson Modular Starterkit	MB91F467D Host CPU + Debug RAM
SK-86276-91F467D	Stand-alone board	MB86276 Lime + MB91F467D Host CPU
SK-86277-91F467D	Stand-alone board	MB86277 Mint + MB91F467D Host CPU
SK-86R01	Jade Evaluation board (4 modules)	MB86R01 Jade
SK-86R01-EMWI	Jade Evaluation board (4 modules) + EMWI Software + LCD	MB86R01 Jade
SK-86R01-TERMINAL	Jade Evaluation board (2 modules)	MB86R01 Jade
SK-88F332	Stand-alone board	MB88F332 Indigo

*** Combination of motherboard (MB8629XEB01) and sub-board (MB86293EB01 or MB86294EB01) - both items must be ordered separately. When ordering, please specify the item according to the 'Evaluation / Development' board name.**

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