Automotive Solutions for Instrument Clusters

Spansion FCR4 Cluster System on Chip Family

Spansion’s FCR4 cluster family of devices has been designed to offer an innovative, scalable solution for hybrid clusters, which combine traditional meters and graphical displays. With embedded flash, the FCR4 microcontrollers (MCUs) and system-on-chip (SoCs) can serve as single-chip solutions or operate as companion chips for other devices to build high performance systems for virtual/free programmable clusters.

FCR4 devices offer a powerful architecture based on the ARM® Cortex™ R4 core and Spansion’s 2D graphics engine. The products include the required safety and security features, allowing for low power consumption and meeting automotive quality standards.

**KEY FEATURES**

**High Performance/High Memory Content**
- ARM Cortex R4, 8KB D-Cache, 8KB I-Cache
- 32-Bit ARMv7 architecture
- 205 DMIPS
- Up to 2MB Internal Flash
- Up to 64KB Internal EEFlash (Data Flash)
- Up to 208KB Internal RAM with ECC

**Connectivity (depending on device)**
- CAN, LIN-USART, SPI, I2C, I2S
- Up to six Stepper Motor Control (SMC) outputs
- HS-SPI (memory mapped access)
- External Bus I/F
- MediaLB (connection to MOST Transceiver)
- APIX® 1.0 Transmitter

**Graphics**
- 2D Graphics Engine SDL
- 1MB Embedded VRAM
- Max Resolution: 1024 pixel hor. x 1024 pixel ver.
- 4 Display Layer plus Alpha blending layer
- Display Controller/TCON
- Max. Pixel clock of 40MHz
- Bit Blitter
- Signature Unit
- Command Sequencer
- TTL and RSDS Output
- Dithering for Display with low color resolution

**Safety Features/Security Features**
- Multiple Memory Production Units (MPU)
- Peripheral Protection Units (PPU)
- Timing Protection Unit (TPU)
- Cyclic Redundancy Checks (CRC of Flash, Cache and RAM)
- Watchdog
- Flash-, Debug- and Test-Security
- Secure Hardware Extension (SHE) for ‘Atlas-L’ and ‘Titan’
  - Self-contained secure area
  - Random Number generator
  - Secure repository for cryptographic keys
  - AES encryption/decryption block

**Other Feature**
- Up/Down Counters
- Programmable Pulse Generators
- Analog-to-Digital Converters
- Sound Generator
- Free Running/Reload Timers
- Input Capture Units, Output Compare units

**Low Power**
- Switchable Power Domains
- Retention RAM
- Flexible Clock Control

**Debugging/Testing**
- ARM Coresight Debug and Trace
- Debugging via JTAG Interface
- Boundary Scan

**Characteristics**
- 5V capable IOs
- Ta: -40°C to +105°C
- Package: LQFP-176
MB9EF226

‘Titan’ is designed as a single chip solution for hybrid automotive instrument clusters and other display applications. It contains support for up to six traditional gauges as well as the 2D graphics engine (SDL) to drive a graphical display. It contains sufficient Flash, RAM and VRAM for this purpose. ‘Titan’ also includes the Secure Hardware Extension (SHE) and a MediaLB interface to connect to a MOST bus and is delivered in a LQFP-176 package. For more details see the block diagram.

TARGET APPLICATIONS

Single chip solution for automotive hybrid instrument clusters and other display applications for displays up to VGA resolution.

MB9DF126

As the successor of the well known MB91460 MCUs, ‘Atlas’ can be used as a standalone general purpose MCU and for instrument clusters driving up to six SMCs or in combination with other devices to support more complex clusters. ‘Atlas’ basically contains the same features as ‘Titan’ except the IRIS-SDL engine, VRAM, MediaLB and SHE, but adds an external bus interface, which aims to connect external parallel interface memories or an external Interface Controller, like the FlexRay controller MB88121. ‘Atlas’ also includes an APIX TX from Inova Semiconductor - all in a LQFP-176 package. ‘Atlas’ can also be used in Applications, where high CPU performance is needed in combination with fast memory access (eg. Quad SPI Flash, parallel NOR Flash) and automotive connectivity (eg. CAN, LIN, APIX).

TARGET APPLICATIONS

Single chips for automotive instrument clusters with up to six stepping motors, companion chip for high end graphics SoCs for virtual instrument clusters and general purpose high performance CAN MCU. Character recognition where the application software is running on ‘Atlas’ and reference data is stored in external parallel NOR or Quad SPI Flash. ‘Atlas’ can run AUTOSAR and delivers the results to the central information display (CID) in a vehicle.
**MB9DF125**

‘Atlas-L’ is a smaller version of the ‘Atlas’ with less embedded Flash memory, a reduced number of Interface and no APIX, but includes the Secure Hardware Extension (SHE).

‘Atlas-L’ can be used as a standalone general purpose MCU, for instrument clusters driving up to six SMCs or as a companion chip for high end graphics SoCs for instrument clusters. It is also available in a LQFP-176 package.

**TARGET APPLICATIONS**

Single chips for automotive instrument clusters with up to six stepping motors and general purpose high performance CAN MCU, where also hardware security can be used to protect the hardware and ensure secure communication with other units.

**SDL PIXEL ENGINE DETAILS**

- Re-configurable concept (functionality can be selected for blit or display)
- Optimized for memory saving
- Freely configurable pixel formats (packed 1,2,4,8,16, 24, 32 bpp)
- Color palettes
- Run-length decoding
- Single pass rendering of blit sequence operations (no temporary buffers)
- Bitmap decompression with clipping on the fly (no need to store decompressed bitmap)
- One pass combinations of various operations (no need to store intermediate results)
- Multiple blend operations in one pass (no need to store intermediate results)
- Supported blend modes (constant + alpha, pre-multiplied)
- Typical applications: Rotation, flip, scaling and blending of compressed bitmaps, alpha blending

**TARGET APPLICATIONS FOR FCR4**

- Automotive instrument cluster with hardware security
- Combination of mechanical instruments with graphical displays
- Application where a small to medium size graphical display is used and an MCU with internal Flash, RAM and VRAM is needed
- Companion chip to graphic controller in automotive applications. The FCR4 device runs AUTOSAR and is connected to the automotive network (e.g. CAN, APIX, MOST)
- Character recognition, where the FCR4 device provides the results to the Central Information Display of the vehicle
- Additional applications where AUTOSAR is needed such as a charger for electric vehicles
Spansion, in conjunction with its partners, offer the required ecosystem for the FCR4 MCUs and SoCs.

**BOARD SUPPORT PACKAGE (BSP) SOFTWARE**
- Header files, low level libraries, software examples, template project
- AUTOSAR V3.1, V4.0 MCAL Package
- Complete AUTOSAR via ecosystem partners
- EPROM emulation library
- APIX remote handler
- AUTOSAR Cry SHE library
  - Simple API (similar to OpenVG)
  - Nearly all hardware features are supported
- IRIS graphics driver library
  - Authoring tools for HMI design via partners
- Supports
  - IAR workbench compiler
  - GHS Multi 5 compiler

**DEVELOPMENT TOOLS (COMPILER, DEBUGGER)**
- Standard tools (compiler, debugger) from well known 3rd parties
- Standard JTAG debugger hardware and trace support from well known 3rd parties
- Ecosystem partners:
  - IAR SYSTEMS
  - Green Hills Software
  - Lauterbach
  - iSystem

**EVALUATION BOARDS**
- Modular Starter Kit
  - Base board per device
    (e.g. SK-MB9DF120-001) with debug/trace connections/flash interface
  - Starter kit use trace chip of each device
    (QFP240 or QFP296, package depending on device)
  - On demand bundles with Segger J-LINK programming/debug adapter
  - Universal IO Extension Board (ADA-FCR4-MULII0-001) with more connectivity
- Trace adaptor per device
  (e.g. EMA-MB9DF120-001)
- A new ‘ready-to-use’ reference board for Titan is available: ‘SK-MB9EF26-DISP-001’
  - QVGA TFT display with backlight
  - SD-Card Interface
  - Ethernet
  - On-board high speed serial flash memory, on-board I2S stereo audio codec

**SPANSION SOC WIZARD**
- Fast bring-up of the hardware
- Embedded flash programmer

Additional information is available at: www.spansion.com/FCR4