Fujitsu FlexRay Solutions

FUJITSU

From System Support to Silicon

2nd FlexRay Product Day, Böblingen Dec 1st, 2005
Content

- Fujitsu FlexRay Roadmap
- FlexRay Development Platforms
- FlexRay ASSP Solution
- FlexRay MCU
- Software, Tools, Cooperation
Fujitsu FlexRay Roadmap

- **Step 1**: FlexRay PreBeta2 IP since 2004
- **Step 2**: FPGA Prototype Board since Feb’05
- **Step 3**: Stand alone FlexRay Controller 09 / 2005
- **Step 4**: MCU with integrated FlexRay 2006

FPGA & First Silicon provide Protocol Version 2.1!
Development Platforms

- **FlexRay Evaluation Kit**
  - FPGA-based Solution
  - Presented at Embedded World 2005 in February
  - For first steps; getting familiar with FlexRay Protocol
  - For quick project startup

- **FlexRay Starter Kit**
  - Based on first Silicon for ERAY
  - Features new 32-bit family MB91F460

available
FPGA-based FlexRay - Concept -

Host Processor
- External bus IF (32 bit non mux)
- MCU Starter Kit (with MB91369)
- Interrupts, ports, spare pins

Protocol Representation
- FlexRay Evaluation Board
- FlexRay PCB
- PHY PCB
- PL-Modules
- Plug in PCBs

Data Link Layer
Physical Layer

FlexRay Bus
FLEXRAY-FPGA-EVA-KIT-369

- FPGA-based *FlexRay Evaluation Kit* available on stock @FME
  - Order Code: FLEXRAY-FPGA-EVA-KIT-369

- Contents
  - Host Processor Board
    - 32-bit MCU MB91F369
    - Onboard Monitor Debugger
  - FlexRay Main & Daughter Board
    - FPGA-based ERAY IP core featuring protocol Version 2.1
    - Plug in sockets for physical layer modules
  - Software
    - Driver for FlexRay interface as library
    - Example software
  - Tools
    - DECOMSYS::DESIGNER trial version (30 days free usage)
    - FlexConfig from TZM (‘light’ version)
    - Softune Workbench on Micros CD 3.6
Application Examples

- **Basic FlexRay Communication**
  - 2 FlexRay nodes configured to send frames on each channel
  - 16-bit counter embedded to each frame send in static slot

- **CAN FlexRay Gateway**
  - Each nodes acts as a gateway that collects CAN messages and sends these as frames in static slots on the FlexRay bus; - or vice a versa

- **Keyboard/LCD Demo**
  - User enters data from the keyboard which is transmitted as frame in static slot
  - Data is displayed on LCD
MB88121 Daughter Board

Migration Support FPGA -> ASSP

- Plugs into Evaluation kit
- Mode selection for host I/F
- Level shift for Physical Layer
- Supports 16-bit non-mux host interface
SK-91F467-FLEXRAY

- Starter Kit to support new MB91F460 series
- MB88121 as FlexRay I/F

3 x CAN I/F, 3 x LINUART, Ext. Bus I/F
First ERAY Silicon

MB88121

Fujitsu first to present Silicon for FlexRay™ based on ERAY core

Available since Sept. 2005

- Supports FlexRay Protocol V2.1
- Parallel host interface
- DMA support
- 64 pin LQFP with 0.5 pin pitch
- Internal PLL

Fujitsu Microelectronics Europe - www.fme.fujitsu.com
MB88121 Concept

- **Stand alone FlexRay Protocol device**
  - Emulates the data link layer
  - For existing applications that need to communicate via FlexRay
  - Substitute for lack of suitable embedded solutions in short time frame
    - For 16- and 32-bit processors

![Diagram of MB88121 concept with connections to other microcontrollers and FPGA]

- MB88121 Protocol Version 2.0/2.1
- TX/RX Channel A
- TX/RX Channel B
- Physical Layer
- Host I/F
- Other MCU
  - ARM *
  - Fujitsu FR 32-bit)
  - Fujitsu 16 FX
- * Under consideration
MB88121 Features

- **First Silicon features Protocol Version 2.0 & 2.1**
  - PreBeta2 release of IP core as basis for design
  - Update with final IP release in early 2006 foreseen

- **Package QFP64**
  - 0.5 pin pitch / 10 x 10 mm (M0

- **Single Supply Voltage**

- **Clock**
  - 4/5/8/10 MHz quartz
  - Square wave input 40 MHz or 80 MHz (for test purposes)

- **Parallel Host Interfaces**
  - 32-bit multiplexed Mode
  - 16-bit multiplexed & non-multiplexed Mode
  - 8-bit multiplexed & non-multiplexed Mode

- **Serial Host Interface**
  - SPI

- **First samples available since 9/2005**
Parallel Host Interface

16-bit non-multiplexed Mode

Host CPU

A[10:0]
D[15:0]
RD
WR
CS
RDY
INT

FlexRay ASSP

A[10:0]
D[15:0]
RD
WR
CS
RDY*
INT

MD[2:0]
C
RST

* shared function with DMA Request

Physical Layer A/B

or square wave input

Reset

I/F Mode Select
MB88121 Schedules

- **MB88121**
  - First Silicon with ERAY core in the market
  - Features protocol Specification 2.0
    - PreBeta2update release

- **MB88121A**
  - Protocol Specification 2.1
    - Beta release
  - DMA support for host interface

- **MB88121B**
  - Certified IP with Protocol Specification 2.1
    - Beta2 update
  - Enhanced host interface options i.e SPI (tbd)
FlexRay MCU

Single Chip Solution

with

Embedded FlexRay Controller
# MB91460 Line-up

<table>
<thead>
<tr>
<th>Infotainment</th>
<th>Body</th>
<th>Dashboard</th>
</tr>
</thead>
<tbody>
<tr>
<td>MB91V460 Rev. B</td>
<td>MB91V460 Rev. A</td>
<td>MB91V460 Rev. A</td>
</tr>
<tr>
<td>CAN, SMC, FlexRay, MediaLB</td>
<td>CAN, SMC,</td>
<td>CAN, SMC,</td>
</tr>
</tbody>
</table>

## FlexRay

- **MB91F467DA**
  - 1 MB / 64 KB
  - CAN x 2 / SMC x 6
  - 208 Pins
- **MB91F467BA**
  - 1 MB / 64 KB
  - CAN x 4 / PPG x 16
  - 144 Pins
- **MB91F467DA**
  - 1 MB / 64 KB
  - CAN x 2 / SMC x 6
  - 208 Pins

## Superset Devices

- **MB91F467XA**
  - 1 MB / 64 KB
  - CAN x 2 (3) / FlexRay
  - 176 Pins
- **MB91F467RA**
  - 1 MB / 80 KB
  - CAN x 2 / MediaLB
  - 176 Pins
- **MB91F467BA**
  - 1 MB / 64 KB
  - CAN x 4 / PPG x 16
  - 144 Pins
- **MB91F465DA**
  - 1 MB / 64 KB
  - CAN x 2 / SMC x 6
  - 208 Pins

## Derivatives

- **MB91F465XA**
  - 512 KB / 32 KB
  - CAN / FlexRay
  - 176 Pins
- **MB91F465RA**
  - 512 KB / 40 KB
  - CAN / MediaLB
  - 176 Pins
- **MB91465BA**
  - 512 KB / 32 KB
  - CAN / PPG
  - 144 Pins
- **MB91465DA**
  - 512 KB / 32 KB
  - CAN / SMC
  - 208 Pins

## Notes

- **MB91V460**
  - CAN, SMC, ...
  - FlexRay, MediaLB
- **EVA Devices**
  - “Umbrella Devices”
- **Superset Devices**
- **Derivatives**
  - Flash / ROM / ROMless
MB91F467DA - Dashboard

FR70 CPU
0.18 um
100 MHz

EDSU/MPU

Clock modulation
Clock Control
Clock Supervisor
Power Control
Subclock 32 kHz

Int. Control

Watchdog

Bit Search

RAM 32KB

Harvard Bus Converter

DMA (5 ch)

Pre-fetch 8KB Cache

FLASH
1 MB

RAM 32KB

EXT. I/F incl. SDRAM support

26-bit addr, 32-bit data

CAN x 3
32 msg

SMC x 6

RTC

U/Dcnt x 2

Sound

Alarm x 1

PFM

ICU x 8

OCU x 4

PPG x 12

I²C x 3

R-Timer x 8

LIN-USART x 5

CAN x 3
32 msg

RTC

Ext. Int x 14

GPIO

10Bit ADC x 24

Available since 11/2005

Fujitsu Microelectronics Europe - www.fme.fujitsu.com
MB91F467XA
- Superset Device FlexRay -

5V single supply

Clock Modulation
Clock Module
PLL
Power Control
Sub Clock

Int. Control
EDSU/MPU

FR70 CPU
0.18 um

Watchdog

Bit Search
RAM 32KB

Prefetch 8KB

FLASH
1 MB

RAM 16KB

Boot ROM 4KB

Harvard Bus Converter

DMA (5 ch)

Ext. Bus I/F

Address, Data, Control

FRT x 4

ICU x 4

OCU x 2

PWM x 12

I2C x 2

PFM

LIN x 4

CAN x 2 (3)
32 / 128 buffers per channel

FlexRay
(2 channels)

RTC

Ext. Int. x 8

GPIO

Alarm x 2

2 LIN-USART + FIFO

Fujitsu Microelectronics Europe - www.fme.fujitsu.com

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Target application i.e. Driver Assistant Systems available in 2H'06
## Communication Software

<table>
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<tr>
<th>Application</th>
<th>FlexRay COMMSTACK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating system</td>
<td>Provides the services for application, access via FTCOM</td>
</tr>
<tr>
<td>OSEKTime/FTCOM core &amp; generated code</td>
<td></td>
</tr>
<tr>
<td>Driver</td>
<td>Provides access to registers and memory</td>
</tr>
<tr>
<td>FlexRay Abstraction Layer (FHAL)</td>
<td>Abstraction of CPU i.e. endianess, data structures</td>
</tr>
<tr>
<td>Hardware Abstraction Layer (HAL)</td>
<td></td>
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</table>

Available with any Fujitsu Development Platform
Fujitsu’s Cooperation - FlexRay Partnerships -

- Collaboration with leading Tools and Software suppliers provides the best solution for your FlexRay application

**Physical Layer**

- **FlexRay Silicon**
  - FUTJITSU
  - MB88121
  - MB91F465XA

- **Software**
  - 3SOFT
  - TimeCore

- **Tools**
  - COMMSSTACK
  - BUSDOCTOR
  - DESIGNER
  - DECOMSYS
  - DEComsys
  - FlexConfig

- **FlexRay-FPGA-Eva-Kit-369**
- **SK-91F467-FLEXRAY**

**austriamicrosystems**

- AS8221

**TZM**

- FlexPL-Moduls

**vector**

- DENoe/FlexRay