SK-16FX-48PMC

Overview

2

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics   All Rights Reserved.© Fujitsu Limited 2009

Warranty and Disclaimer

- The use of the deliverables (e.g. software, application examples, target boards, evaluation boards, starter kits, schematics, engineering samples of IC's etc.) is subject to the conditions of Fujitsu Microelectronics Europe GmbH ("FME") as set out in (i) the terms of the License Agreement and/or the Sale and Purchase Agreement under which agreements the Product has been delivered, (ii) the technical descriptions and (iii) all accompanying written materials.

- Please note that the deliverables are intended for and must only be used in an evaluation laboratory environment.

- The software deliverables are provided without charge and therefore provided on an as-is basis. The software deliverables are to be used exclusively in connection with FME products.

- Regarding hardware deliverables, FME warrants that they will be free from defects in material and workmanship under use and service as specified in the accompanying written materials for a duration of 1 year from the date of receipt by the customer.

- Should a hardware deliverable turn out to be defect, FME's entire liability and the customer's exclusive remedy shall be, at FME´s sole discretion, either return of the purchase price and the license fee, or replacement of the hardware deliverable or parts thereof, if the deliverable is returned to FME in original packing and without further defects resulting from the customer's use or the transport. However, this warranty is excluded if the defect has resulted from an accident not attributable to FME, or abuse or misapplication attributable to the customer or any other third party not relating to FME or to unauthorised decompiling and/or reverse engineering and/or disassembling.

- FME does not warrant that the deliverables does not infringe any third party intellectual property right (IPR). In the event that the deliverables infringe a third party IPR it is the sole responsibility of the customer to obtain necessary licenses to continue the usage of the deliverable.

- In the event the software deliverables include the use of open source components, the provisions of the governing open source license agreement shall apply with respect to such software deliverables.

- To the maximum extent permitted by applicable law FME disclaims all other warranties, whether express or implied, in particular, but not limited to, warranties of merchantability and fitness for a particular purpose for which the deliverables are not designated.

- To the maximum extent permitted by applicable law, FME's liability is restricted to intention and gross negligence. FME is not liable for consequential damages.

- Should one of the above stipulations be or become invalid and/or unenforceable, the remaining stipulations shall stay in full effect.

- The contents of this document are subject to change without a prior notice, thus contact FME about the latest one.

About the SK-16FX-48PMC

- **The SK-16FX-48PMC includes a low-cost evaluation board based on the Fujitsu 16FX microcontroller MB96310 Series**

- **The MB96310 Series includes the following features:**

  - Up to 160 KByte Flash Memory
  - Up to 8 KByte RAM
  - Up to 1 CAN controller 2.0B
  - Up to 3 LIN-USART interfaces
  - Timers (ICUs, OCUs, PPGs, others)
  - ADC
  - External interrupts
  - Others

About the SK-16FX-48PMC

■ **Features of the SK-16FX-48PMC (EUROScope) board:**

- Microcontroller MB96F315RSA
- 1x UART-Transceiver (SUB-D9 connector)
- 1x USB to serial converter (Type-B connector)
- 1x High-speed CAN-Transceiver (SUB-D9 connector)
- 2x LED-Display (7-Segment)
- 2x 'User'-buttons
- 1x 'Reset'-button, 'Reset'-LED
- All 48 pins routed to pin-header
- On-board 5V and 3V voltage regulators, 'Power'-LED
- USB power-supply (external power supply possible)

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics
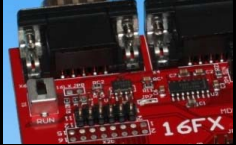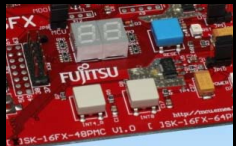
SK-16FX-48PMC content

■ **The SK-16FX-48PMC contains**
- SK-16FX-48PMC evaluation board with MB96F315RSA
- USB cable, RS232 cable
- Mini CD
  - Documentation, USB driver, Softune Workbench, Examples
  - „EUROScope lite 16FX"
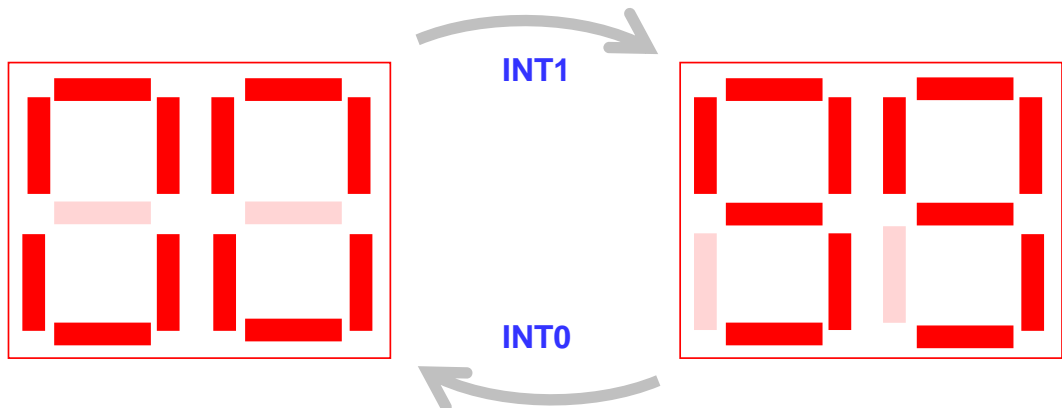
mini CD   RS232 cable   USB cable

A   B

Sub D9M   Sub D9F

ESD-foam   ESD-box   SK-16FX-48PMC evaluation board
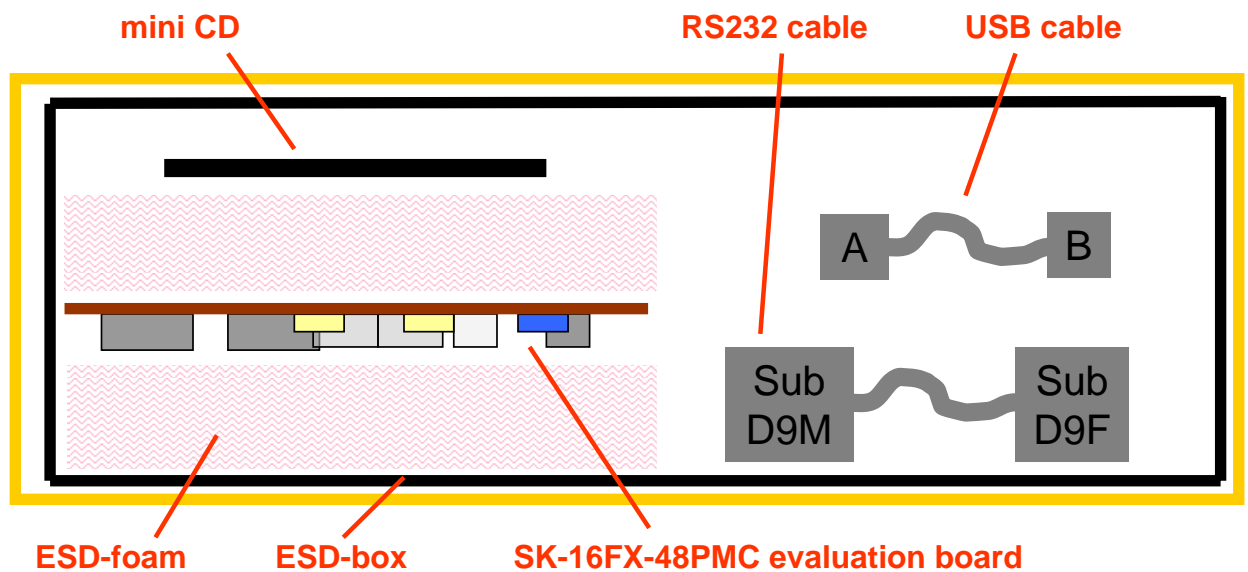
Test it

■ **The microcontroller on the SK-16FX-48PMC is already preprogrammed with a simple application.**

- Connect the USB cable to your PC and the SK-16FX-48PMC
- Install the USB driver from the CD
- Press the ‚Reset'- Button
- The SK-16FX-48PMC will automatically start counting
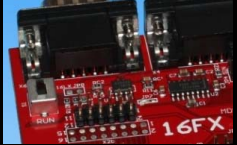- The count direction can be changed by pressing the key buttons

INT1

INT0

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics   All Rights Reserved.© Fujitsu Limited 2009
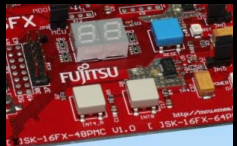
Test it
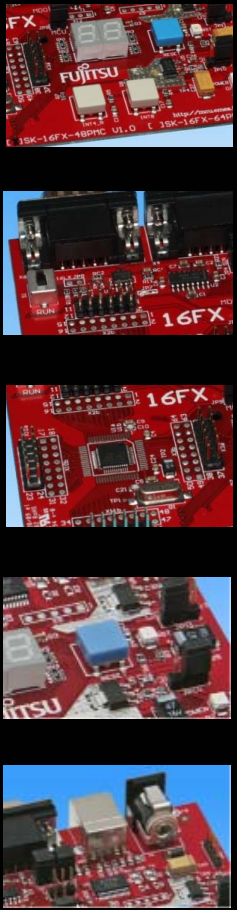
Congratulations!

- **You finished successfully the first test**

- **Now you will get more details about the SK-16FX-48PMC**
- **You will learn more about**
  - The on-board features
  - How to program the Flash
  - How to start your own application
  - On-chip debugging with EUROScope

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics

The Hardware

■ **Main features**

CAN

UART ,A'

USB to UART ,B'

Ext. Power
+6V ... +9V

7-Segment Display

P06_0

P06_7   P06_1   P01_5   P02_2
P03_6   P01_6

P06_6   P06_3   P01_4   P02_4

P06_4   P03_7   P02_5   P01_7

SEG1: Port06   SEG2: Port02
and Port03   and Port01

P02_0

LED ,Reset'

Keybutton ,RESET'

Keybutton ,INT4_R'
Port P05_6

Keybutton ,INT8'
Port P00_0

LED ,Power'

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics
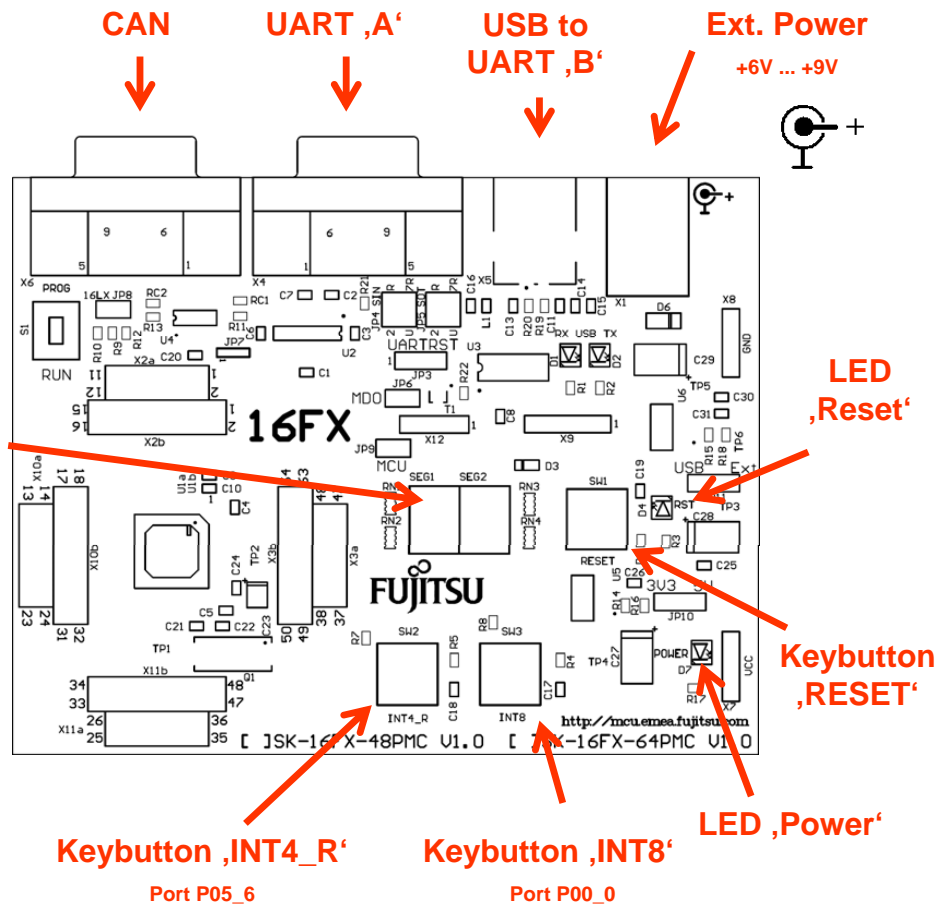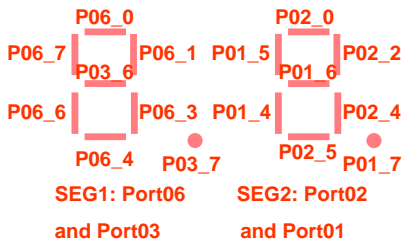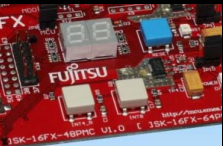
The Hardware

- **The jumpers**

JP4: UART RX select

R-7R: UART7_R=UART'A' / U-2: UART2=UART'B' (USB)

R-2: UART2=UART'A' / U-7R: UART7_R=UART'B' (USB)

JP5: UART TX select

R-7R: UART7_R=UART'A' / U-2: UART2=UART'B' (USB)

R-2: UART2=UART'A' / U-7R: UART7_R=UART'B' (USB)

S1: Mode selection

PROG: Select the program-mode

RUN: Select the run-mode

JP3: DTR-Reset

Set the jumper to 1-2 to connect the DTR-Signal of the UART connector to the microcontroller reset-pin.

Set the jumper to 2-3 to connect the DTR-Signal of the USB connector to the microcontroller reset-pin.

Some terminal-programs, e.g. Fujitsu's Skwizard, allow to reset the evaluation board by using the DTR-Signal.

JP6: MD0 selection

Close this jumper to control the MD0 level by the RTS signal of the USB interface
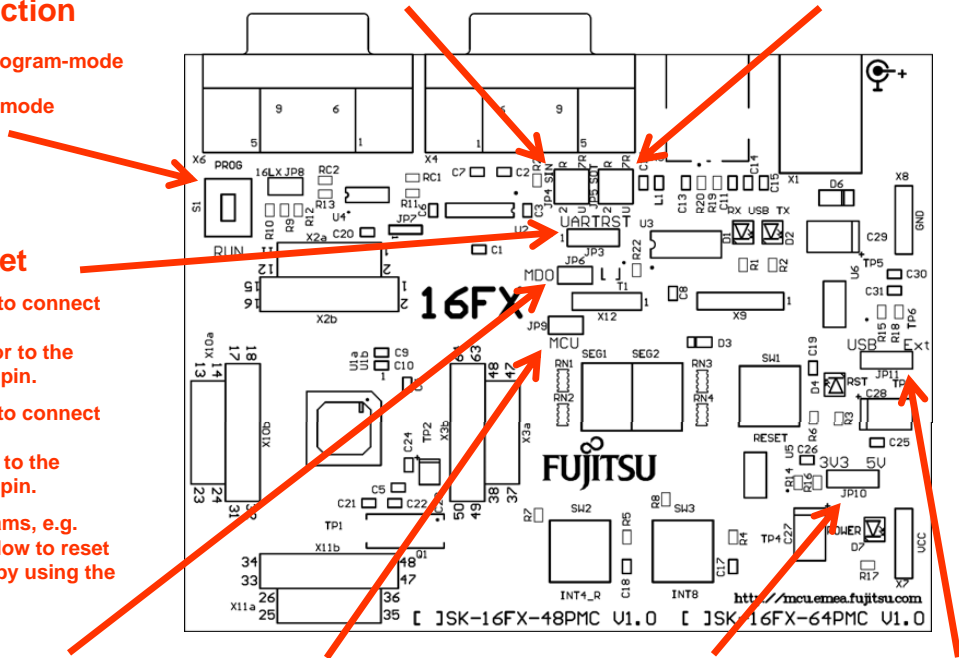
JP9: MCU Vcc

This jumper can be used to measure the current consumption of the MCU

JP10: 5V / 3.3V

1-2: 5V supply is used

2-3: 3.3V supply is used

JP11: Power Supply

1-2: USB supply is used

2-3: External supply is used

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics

The Hardware

■ **JP4, JP5 : UART selection**

- ● UART2 and UART7_R of the microcontroller can be used together with a typical RS232 SUB-D9 connector and a serial/USB converter
- ● The jumpers JP4 and JP5 routes the channel to the connector

- ● UART2 = USB-connector (X5), UART7_R = Sub-D9 (X4) (default)
  - • Setting of Jumper JP4 and JP5: U-2 / R-7R

RS232   USB

(default)
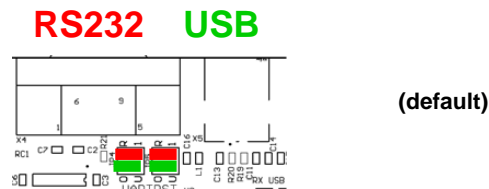
- ● UART2 = Sub-D9 (X4), UART7_R = USB-connector (X5)
  - • Setting of Jumper JP4 and JP5: U-7R / R-2

RS232   USB
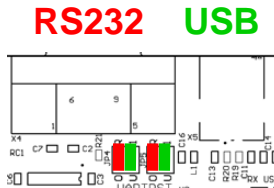
The Hardware

■ **The microcontroller pins**

Pin	Pin-name	SK-16FX-48PMC
1	AVss	GND
2	AVRH	MCUVCC / VCC
3	P06_3 / AN3 / PPG3	SEG1-C
4	P06_4 / AN4 / PPG4	SEG1-D
5	P06_6 / AN6 / PPG6	SEG1-E
6	P06_7 / AN7 / PPG7	SEG1-F
7	P05_0 / AN8 / SIN2 / INT_3R1	UART2 (RXD)
8	P05_1 / AN9 / SOT2	UART2 (TXD)
9	P05_2 / AN10 / SCK2	
10	P05_4 / AN12 / TOT3 / INT2_R	
11	P05_6 / AN14 / INT4_R	Key button 'INT4_R'
12	P07_0 / AN16 / INT0 / NMI	
13	P04_0	
14	P04_1	
15	MD2	GND (w/ JP8 to VCC)
16	MD1	VCC
17	MD0	Mode-Switch S1

Pin	Pin-name	SK-16FX-48PMC
18	P00_0 / INT8 / SCK7_R / TTG8_R	Key button 'INT8'
19	P00_1 / INT9 / SOT7_R / TTG9_R	UART7_R (TXD)
20	P00_2 / INT10 / SIN7_R	UART7_R (RXD)
21	P00_4 / INT12 / SOT8_R / PPG8_R	
22	P00_5/ INT13 / SIN8_R / PPG9_R	
23	P00_3 / INT11 / SCK8_R	
24	P01_0 / CKOT1 / TIN1 / TTG16_R	
25	P01_1 / CKOTX1 / TOT1 / TTG17_R	
26	P01_4 / PPG16_R	SEG2-E
27	P01_5 / SIN2_R / INT7_R / PPG17_R	SEG2-F
28	P01_6 / SOT2_R / PPG18_R	SEG2-G
29	P01_7 / SCK2_R / PPG19_R	SEG2-DP
30	P02_0 / PPG12 / CKOT1_R	SEG2-A
31	P02_2 / PPG14 / CKOT0_R	SEG2-B
32	P02_4 / IN0 / TTG8 / TTG0	SEG2-C
33	RSTX	Key Button 'Reset'
34	X1	4 MHz Crystal

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics   All Rights Reserved.© Fujitsu Limited 2009
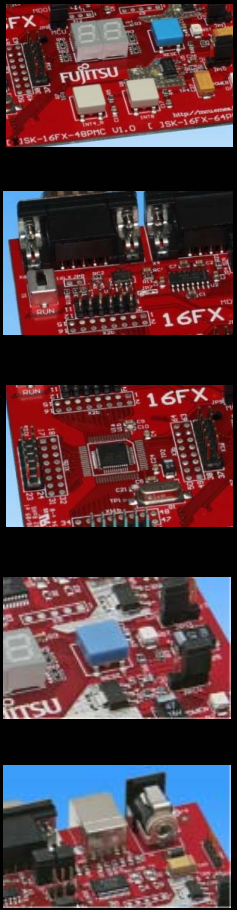
The Hardware

■ **The microcontroller pins (cont'd)**

Pin	Pin-name	SK-16FX-48PMC
35	X0	4 MHz Crystal
36	Vss	GND
37	Vcc	MCUVCC / VCC
38	C	'C' Capacitors
39	P02_5 / IN1 / TTG1 / TTG9 / ADTG_R	SEG2-D
40	P03_0 / IN4 / TTG4 / TTG12 / TOT0_R	
41	P03_1 / IN5 / TOT2_R	
42	P03_2 / INT10_R / RX2	CAN2 (RX)
43	P03_3 / TX2	CAN2 (TX)
44	P03_6 / OUT6	SEG1-G
45	P03_7 / OUT7	SEG1-DP
46	P06_0 / AN0 / PPG0	SEG1-A
47	P06_1 /AN1 / PPG1	SEG1-B
48	AVcc	MCUVCC / VCC

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics
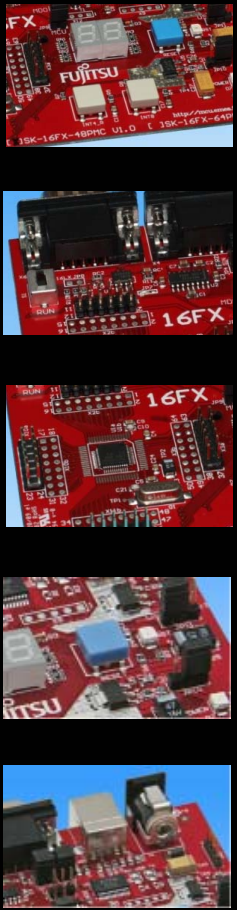
The Software

- **The SK-16FX-48PMC CD includes the following software:**
  - Softune Workbench (development platform for Fujitsu microcontroller)
  - MCU Flash programming tool and SKwizard terminal program
  - USB driver for on board USB-to-RS232 converter
  - On-chip debugger "EUROScope lite 16FX"
  - Software examples for the SK-16FX-48PMC

- **Additionally you can order the latest „Fujitsu MICROS DVD"**
  - Includes documentation & software for all Fujitsu microcontrollers
  - Please contact your local distributor
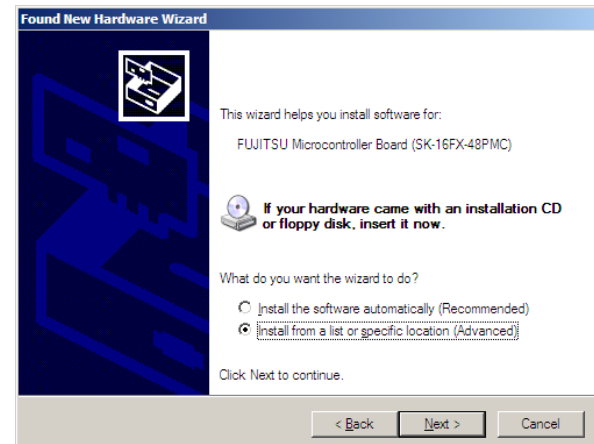
- **Please check our dedicated microcontroller website**

  ## http://mcu.emea.fujitsu.com

  - for updates of the Flash programmer tool, utilities and examples
  - for data sheets, hardware manuals, application notes, etc.
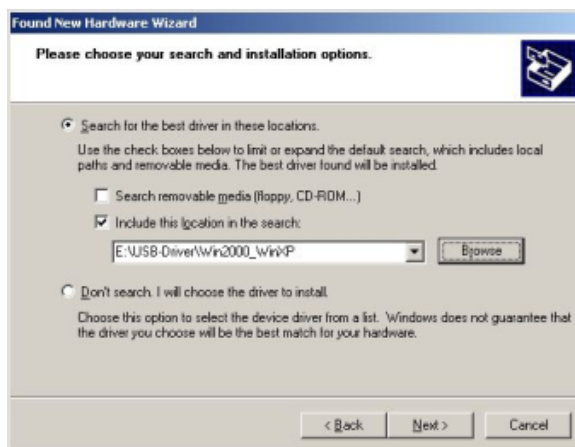
14

Installation of the USB-driver

■ **Connect the SK-16FX-48PMC to your PC's USB port**
- ● Windows will 'Found New Hardware: SK-16FX-48PMC' and the Hardware Wizard should start automatically
  - • **Note: The installation procedure may differ with different operating systems**

- ● Do not connect to Windows Update to search for software
- ● Select 'Install from a list or specific location (Advanced)'
- ● Within next windows select 'Search for the best driver' and browse on the CD to the folder 'drive:\USB-Driver\Win2000_WinXP'
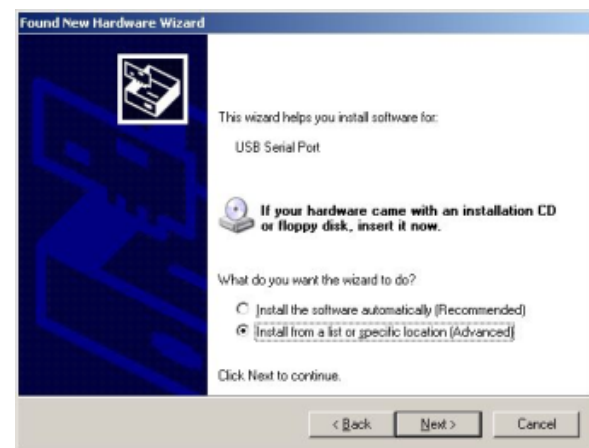
15

Installation of the USB-driver

- 'Continue anyway' although the Windows Logo test may not be passed
- Windows completes the installation by copying some files
- 'Finish' will close the window

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics   All Rights Reserved.© Fujitsu Limited 2009
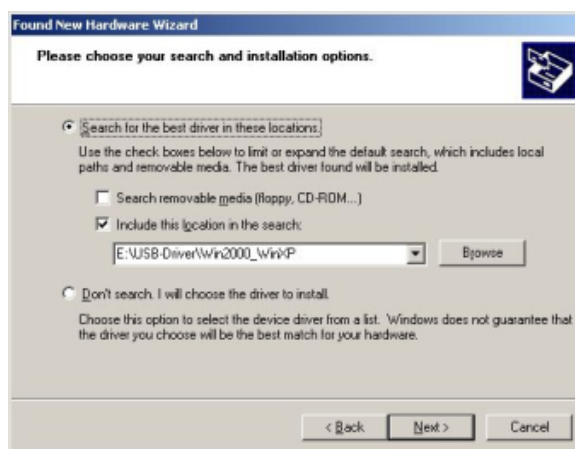
Installation of the USB-driver

- Again Windows will 'Found New Hardware: USB Serial Port' and the Hardware Wizard should start automatically
  - **Note: The installation procedure may differ with different operating systems**

- Do not connect to Windows Update to search for software
- Select 'Install from a list or specific location (Advanced)'
- Within next windows select 'Search for the best driver' and browse on the CD to the folder 'drive:\USB-Driver\Win2000_WinXP'

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics

Installation of the USB-driver

- 'Continue anyway' although the Windows Logo test may not be passed
- Windows completes the installation by copying some files

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics   All Rights Reserved.© Fujitsu Limited 2009

Installation of the USB-driver

■ **Start the Device Manager of the Windows Control Panel**
  ● START -> Settings -> Control Panel
  ● Control Panel -> System -> Hardware -> Device Manager

■ **Check 'Ports' for the assigned virtual COM-port number**
  ● FUJITSU Microcontroller board (e.g.: COM4)
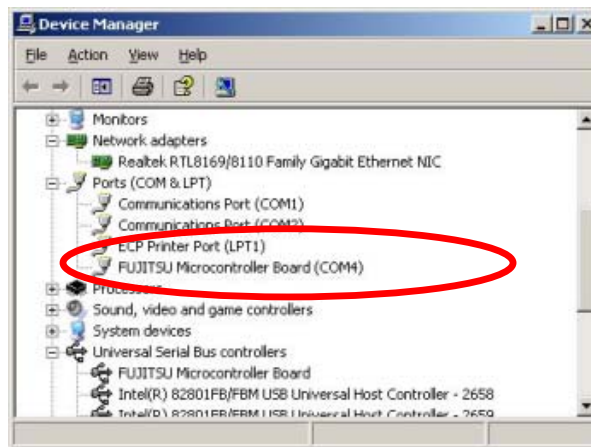
Note:
Currently EUROScope supports only COM1 - COM9.

If the assigned virtual COM-port is greater than COM9 then please re-assign it manually by help of the device manager within the Windows control panel / system.

■ **Ready!**
  ● The SK-16FX-48PMC can be powered via USB (default, JP11)
  ● Depending on JP4 and JP5 one UART is connected to USB

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics   All Rights Reserved.© Fujitsu Limited 2009

The Development Software

■ **Softune Workbench**

- Free of charge (only registration is required)
- Windows based development platform for all 16-bit microcontrollers
- Includes: Editor, C-compiler, assembler, linker, core simulator
- Supports optional hardware emulator
- Requires 'administration' or 'power user' rights on the PC
- Registration[1]
  - https://mcu.emea.fujitsu.com/cusreg/htm/cusreg_form.htm
  - Receive your password for Softune Workbench by email
  - Receive your license file for EUROScope by email

- Start installation
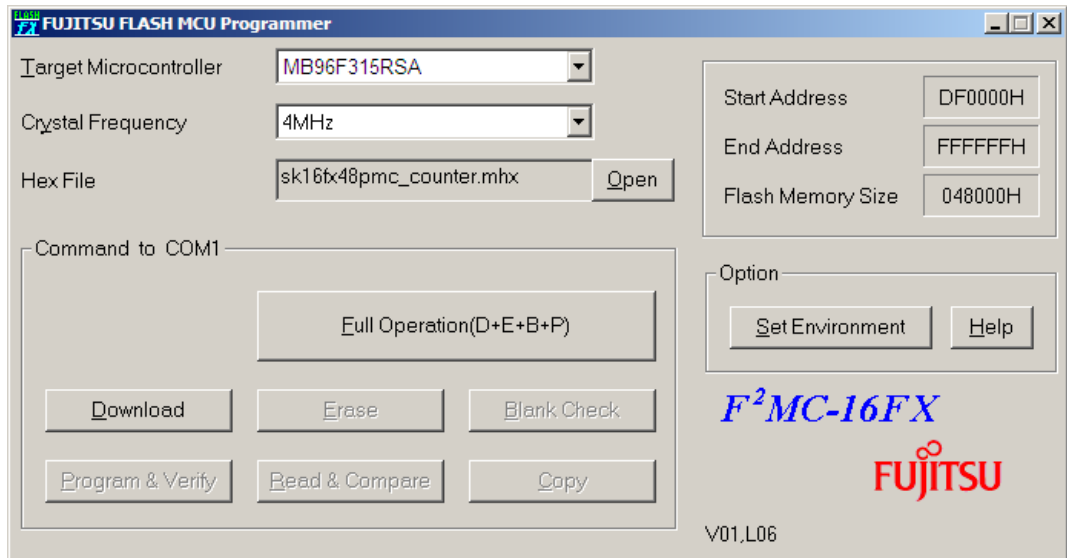 - Enter password and choose destination folder (e.g. c:\Softune16)

---

[1] Note: If you want to use EUROScope please install and run it first and note down the Host ID (MAC address) of your PC system. This ID is needed to be filled out in the registration form to obtain a license key.

20

The FLASH Programmer

■ **MCU Flash programmer**

- Free of charge, no registration required
- Windows based programming tool for all 16-bit Fujitsu microcontroller
- Uses PC serial port COMx (incl. virtual COM port: USB-to-RS232)
- Start installation

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics　　　　All Rights Reserved.© Fujitsu Limited 2009

Tools and Software Examples

- **SKwizard**
  - Free of charge terminal program
  - Start installation
- **Following examples are provided with SK-16FX-48PMC:**
  - sk16fx48pmc_adc_dvm
    - Digital Voltage Meter based on the A/D-converter
  - sk16fx48pmc_can_uart_terminal
    - Simple CAN example controlled by UART7_R
  - sk16fx48pmc_counter
    - Counts from 0 to 99 on the 7-segment Display
  - sk16fx48pmc_template
    - ‚Empty' project as base for user applications
  - sk16fx48pmc_uart
    - UART example using UART7_R
  - sk16fx48pmc_uart_7seg
    - Displays UART Characters on the 7-segment Display

Note:
Do not connect other than EUROScope to UART2 (default: X5/USB).
All examples are prepared to be used with EUROScope and UART2 is reserved for this debugger.

Program Download

■ **Start the Fujitsu MCU Flash programmer**

■ **Select the target microcontroller (MB96F315RSA)**

■ **Select the crystal frequency (4 MHz)**

■ **Choose the software example from the example 'ABS'-folder**
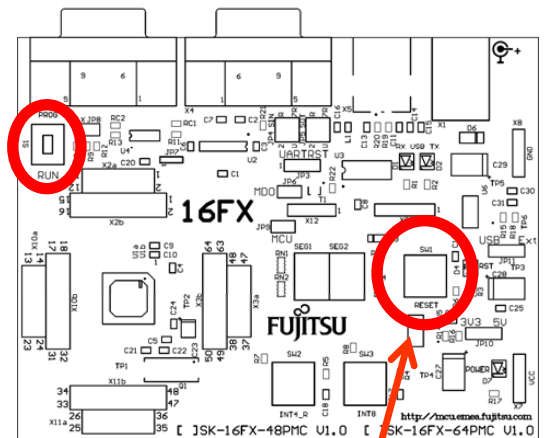(e.g. D:\Examples\sk16fx48pmc_counter-v10\ABS\sk16fx48pmc_counter.mhx)

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics   All Rights Reserved.© Fujitsu Limited 2009
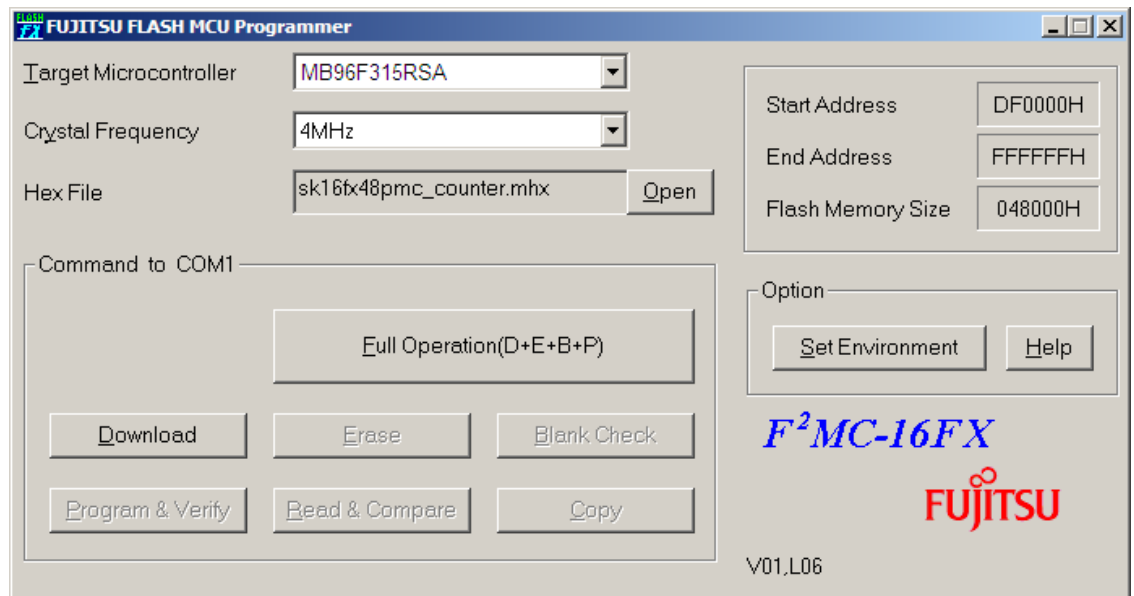
Program Download

- **Connect to the PC**
  - RS232 or USB can be used
  - Select COM port ('Set Environment')
- **Set jumper S1 to position 'Prog'**
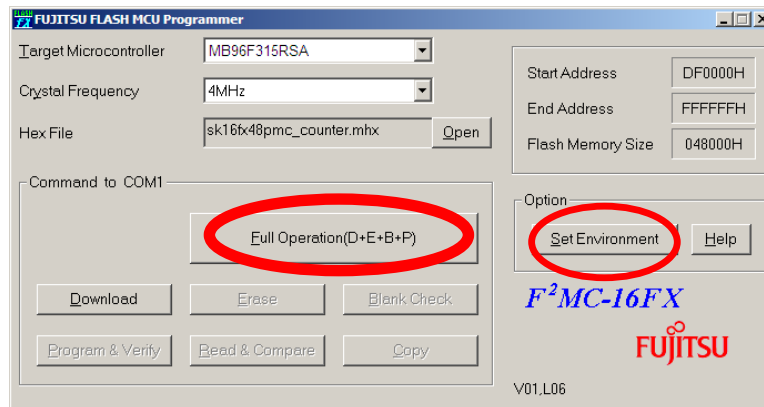- **Press 'Reset'**
- **Start 'Full operation'**

S1: Mode selection

Prog: Set switch to position 'Prog' in order to select the program-mode

RS232   USB port
(see chapter Jumper seetings)

Keybutton 'RESET'

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics

All Rights Reserved.© Fujitsu Limited 2009
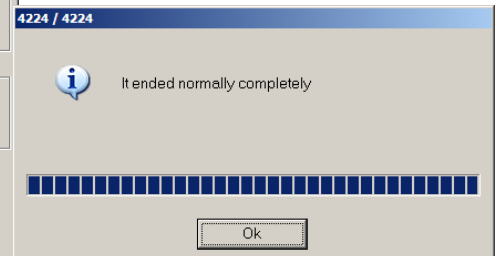
Program Download

- **Close the MCU Flash programmer**
- **Set jumper S1 to position ‚RUN'**
- **Press ‚Reset'**

USB port
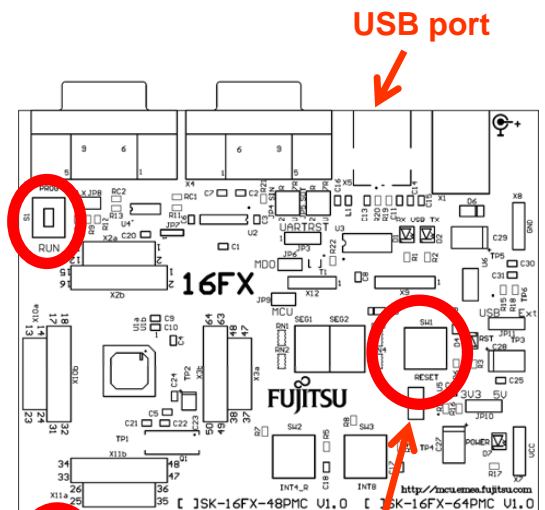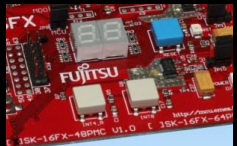
S1: Mode selection

Prog: Set switch to position ‚RUN' in order to select the RUN-mode
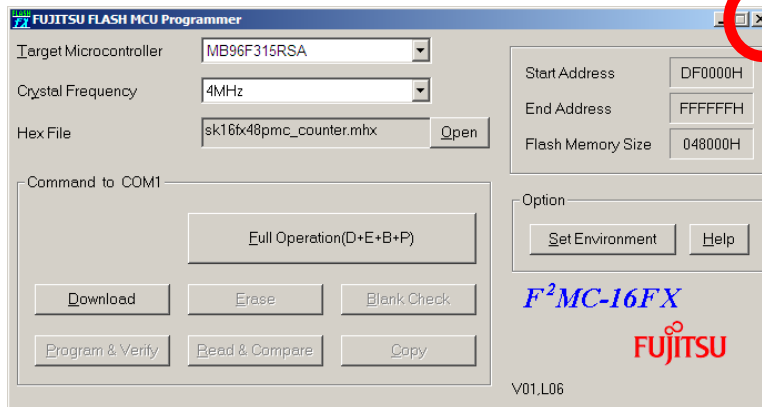
Keybutton ‚RESET'

Close the Flash programmer

FUJITSU FLASH MCU Programmer

Target Microcontroller MB96F315RSA
Crystal Frequency 4MHz
Hex File sk16fx48pmc_counter.mhx Open

Start Address DF0000H
End Address FFFFFFH
Flash Memory Size 048000H

Command to COM1

Full Operation(D+E+B+P)

Download Erase Blank Check

Program & Verify Read & Compare Copy

Option

Set Environment Help

F²MC-16FX

FUJITSU

V01,L06

New Project

- **In order to start a new user project use the template project**
  - This project includes the startup code, header files, and vector table
- **Copy the folder 'Template' within the example folder**
  - Rename 'Copy of sk16fx48pmc_template-v10' to 'my_application'

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics   All Rights Reserved.© Fujitsu Limited 2009
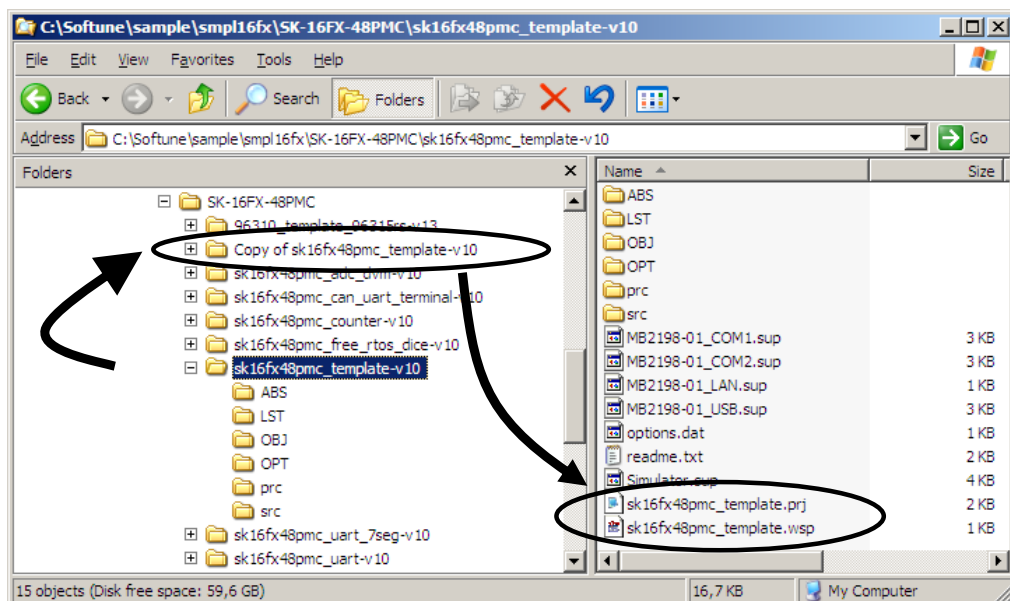
New Project

- **Enter 'my_application'-folder**
  - Rename 'template.prj' into 'my_application.prj'
  - Rename 'template.wsp' into 'my_application.wsp'
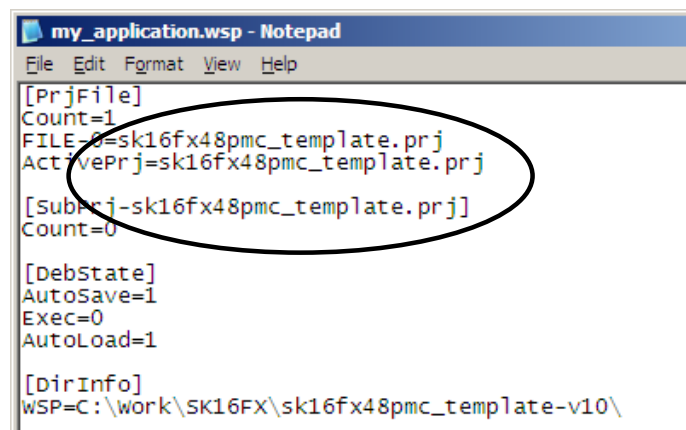- **Edit 'my_application.prj'**
  - rename 'sk16fx48pmc_template' -> 'my_application'
- **Edit 'my_application.wsp'**
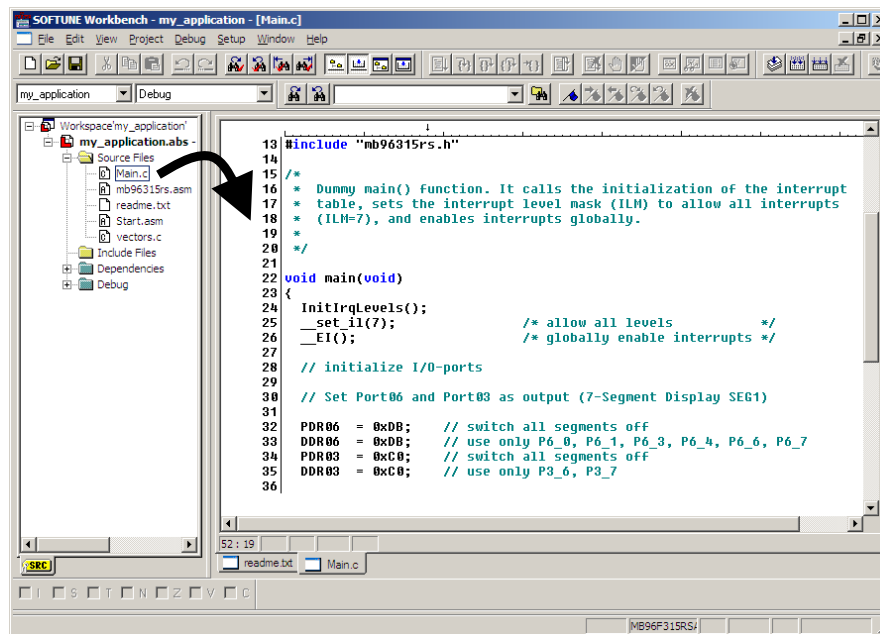 - rename 'sk16fx48pmc_template' -> 'my_application'
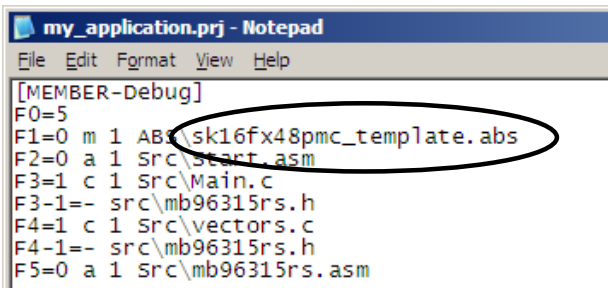
New Project

■ **Start Softune Workbench and open your project**
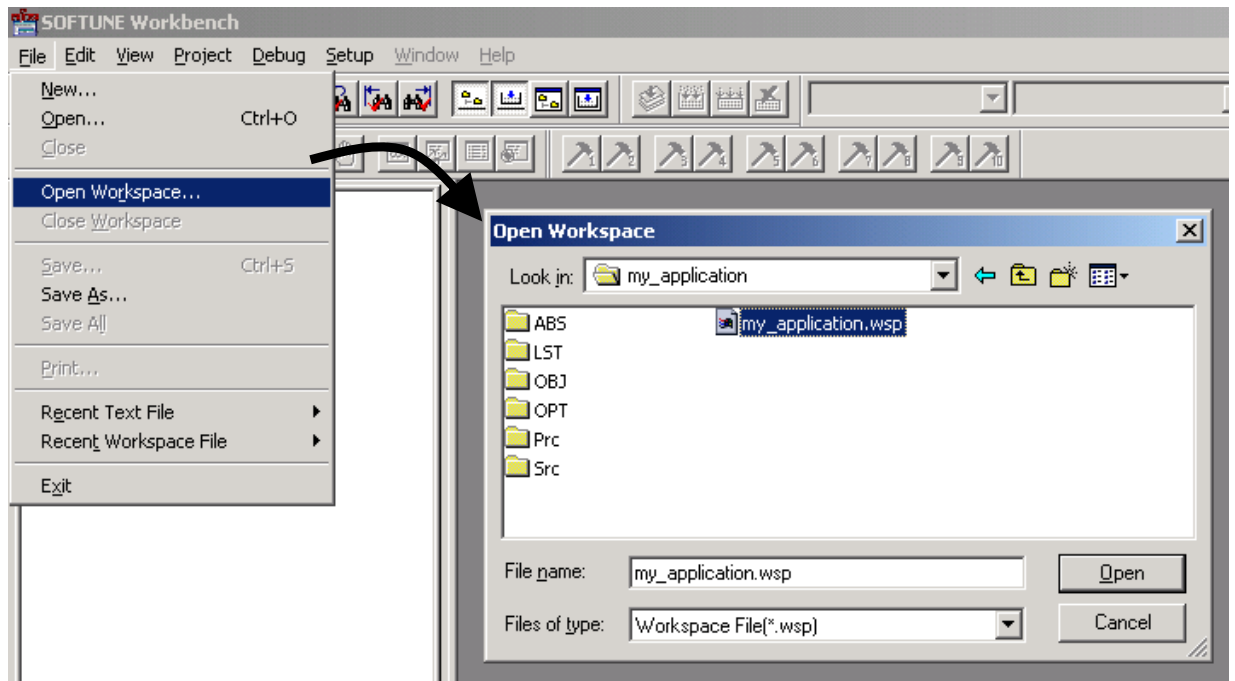
New Project

■ **Write your application code**
- `Start.asm` : Startup code
- `Vectors.c` : Vector table
- `Main.c`   : Your application

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics   All Rights Reserved.© Fujitsu Limited 2009

New Project

■ **Compile and build your project**
  ● Generates the MHX-file, which can be programmed to the Flash

Compile   Make   Build

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics   All Rights Reserved.© Fujitsu Limited 2009
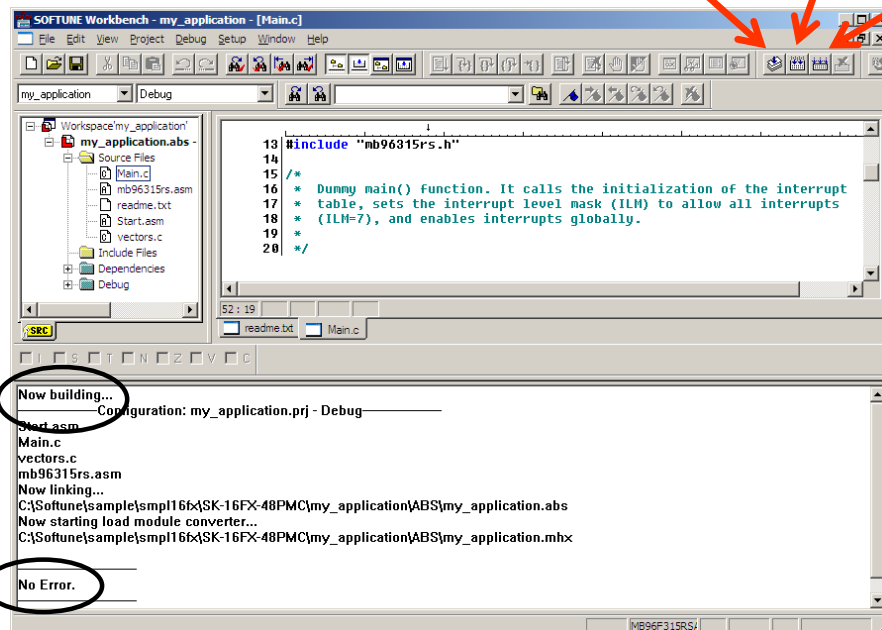
New Project
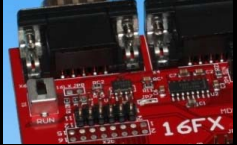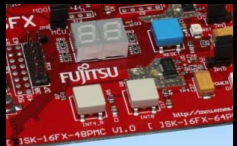
Congratulations!

■ **You have finished your first project**

- ● Please see our application note
  '16FX Getting Started'
  for a more detailed introduction.

EUROScope lite 16FX

- **„EUROScope lite 16FX" source-level debugger**
  - On-chip debugging for 16FX microcontroller
  - No kernel linkage / upload required
  - Breakpoints
  - Single step debugging (step, step-in, step-out)
  - Windows for memory, watch, mixed source code, register
  - Plug-ins available for operating systems etc.

Includes EUROScope lite16FX on-chip debugger

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics

EUROScope lite 16FX Installation

- **Installation of „EUROScope lite 16FX"**
  - Start „EUROScope lite 16FX" for installation
  - Choose „Fujitsu F16LX / F16FX" from list

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics   All Rights Reserved.© Fujitsu Limited 2009
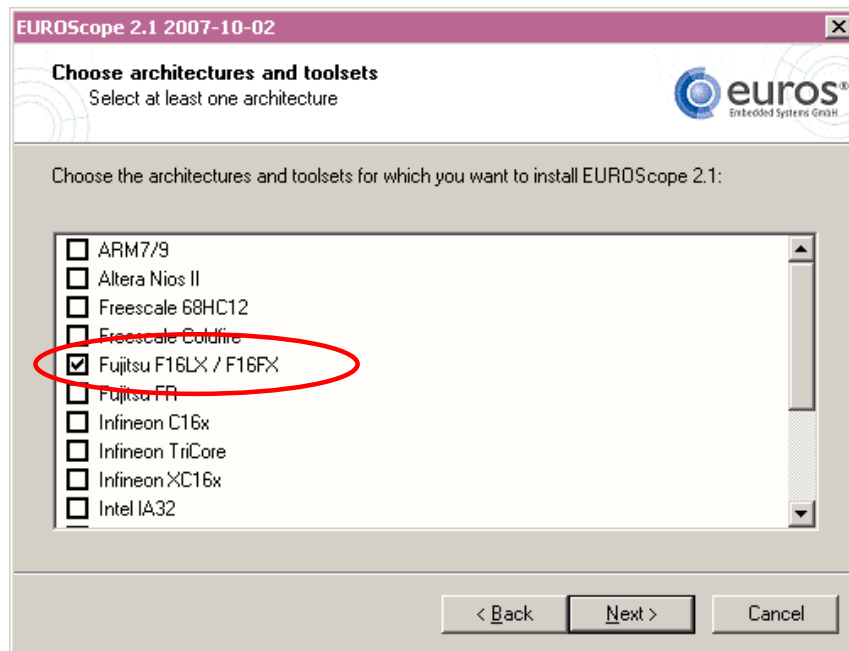
EUROScope lite 16FX Installation

- **License for „EUROScope lite 16FX"**
  - Run EUROScope.exe
    - Copy Host ID (MAC address) of your PC system
    - Request Lite key at
      https://mcu.emea.fujitsu.com/cusreg/htm/cusreg_form.htm
    - Receive license key file from company EUROS by email
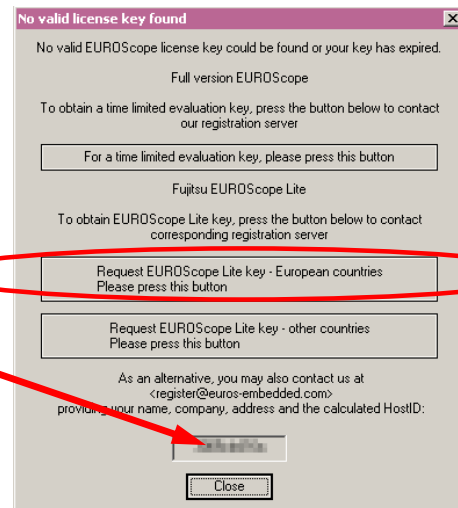   - Copy license key file (*euros-license.key*) to your local installation path

Host ID of your PC system

No valid license key found

No valid EUROScope license key could be found or your key has expired.

Full version EUROScope

To obtain a time limited evaluation key, press the button below to contact our registration server

For a time limited evaluation key, please press this button

Fujitsu EUROScope Lite

To obtain EUROScope Lite key, press the button below to contact corresponding registration server

Request EUROScope Lite key - European countries
Please press this button

Request EUROScope Lite key - other countries
Please press this button

As an alternative, you may also contact us at
<register@euros-embedded.com>
providing your name, company, address and the calculated HostID:

Close

EUROScope lite 16FX
Project preparation

■ **All examples within this package are already prepared for the use with EUROScope**

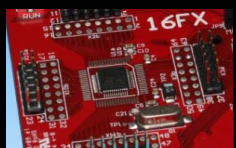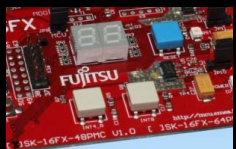- Default connection: UART2 routed to X5/USB.

■ **In case of new projects or project modifications**

- Use Softune Workbench
- Setup the Background Debugging area
  - See *Start.asm* (V1.28), chapter 4.18 (Enable Background Debugging Mode) and chapter 5.9 (Debug Address Specification)
    - See always the latest 'sk16fx48pmc_template' example
- Built your application project with Softune Workbench
  - Loadmodule (*.abs) format is required for debugging

■ **Download your project (*.mhx) to the board**

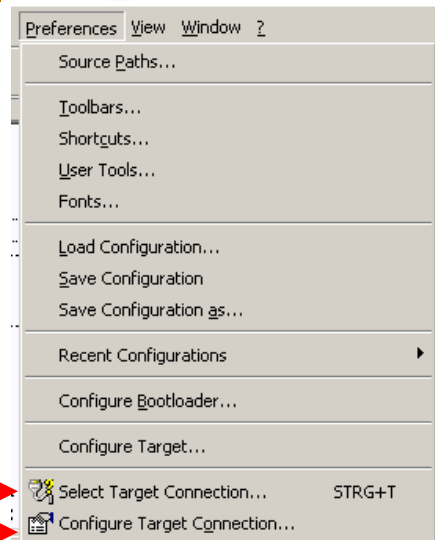- Use the Fujitsu MCU Flash programmer

EUROScope lite 16FX Configuration

- **Start EUROScope**
- **Ensure the following settings**
  - Select Target Connection ①
    - Choose Fujitsu 16FXBootROM (RS232)
  - Configure Target Connection ②
    - Choose the COM port of the Debug-UART (Default: UART2 routed to X5/USB)
    - Choose the baudrate used in the Debug Address Specification of the *Start.asm* file (Default: 115200)
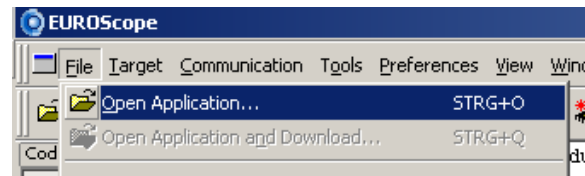   - Choose „asynchronous communication" and „Int/Ext vector mode"

euros®
Embedded Systems GmbH

Preferences View Window ?

Source Paths...

Toolbars...
Shortcuts...
User Tools...
Fonts...

Load Configuration...
Save Configuration
Save Configuration as...

Recent Configurations ▶

Configure Bootloader...

Configure Target...

① Select Target Connection...   STRG+T
② Configure Target Connection...

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics   All Rights Reserved.© Fujitsu Limited 2009

EUROScope lite 16FX
Load ABS file

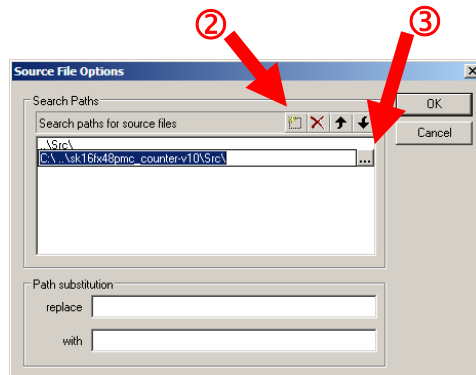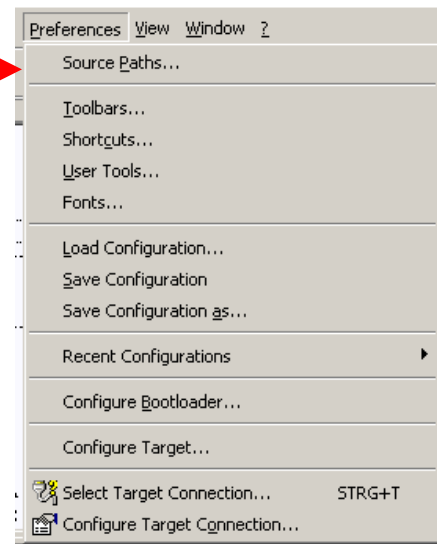■ **Load the *abs* file of your project**
  ● File / Open Application ...

    E.g.: <drive>:\Examples\sk16fx48pmc_counter-v10\ABS\sk16fx48pmc_counter.abs

■ **Projects may be compiled on another PC or folder structure than the debug PC**
  ● Adjust the source path ①
    • Click New (Insert) ②
    • Browse to source folder ③
   • E.g.: <drive>:\Examples\sk16fx48pmc_counter-v10\Src

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics   All Rights Reserved.© Fujitsu Limited 2009

EUROScope lite 16FX
Connect to device

- **Start communication (*Communication –> Open*)**
- **Press reset button**
- **Communication is established, if code in the assembly and source code window is visible**
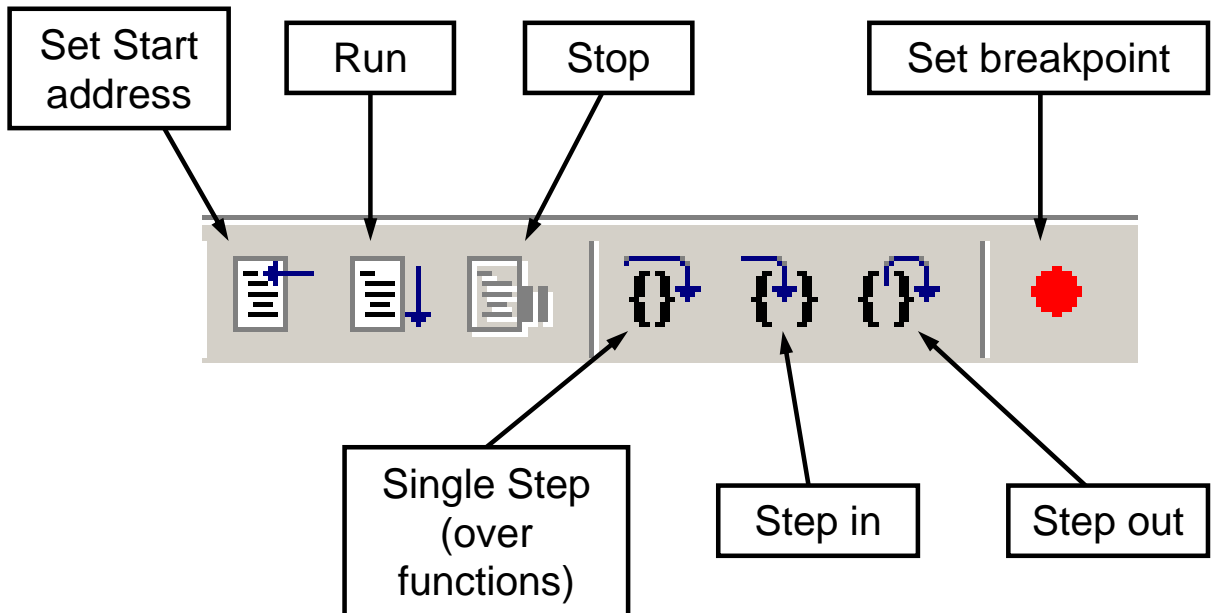
Assembly window

Source code window
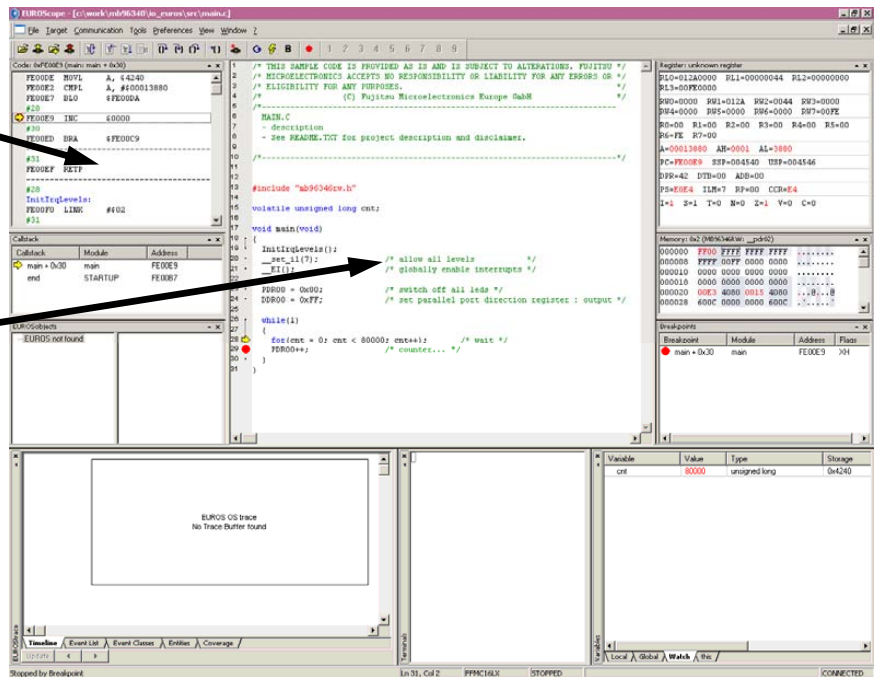
EUROScope lite 16FX
Start Debugging

■ **Initialize target and run until main function**

●

■ **Use menu bar for debugging**

Set Start address	Run	Stop		Set breakpoint

Single Step (over functions)

Step in

Step out

EUROScope lite 16FX Breakpoints
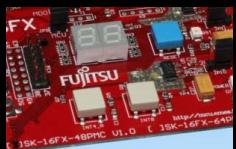
■ **Set a breakpoint**
- ● Double-click to desired line
  - • ‚C' code source: selectables lines are marked by small dot in front
  - • ‚Assembly' window: all lines with an instruction can hold a breakpoint
  - • Some lines in source code window are grouped. When setting a breakpoint all grouped lines getting the red filled circle, but this is treated as only one breakpoint

■ **Activate/deactivate breakpoints**
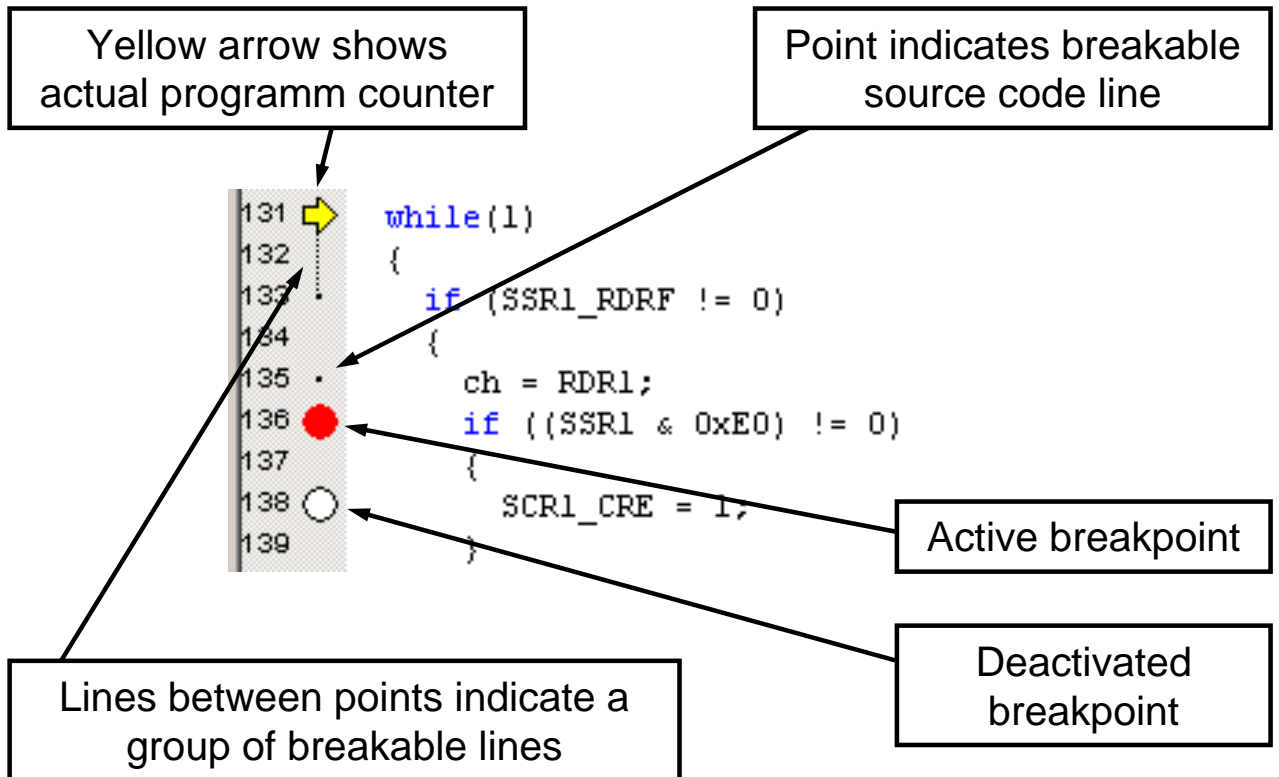- ● Single-click to breakpoint

■ **Delete breakpoint**
- ● Double-click to breakpoint until red filled (or white filled) circel disappears

EUROScope lite 16FX Breakpoints

■ **Short explanation of EUROScope source code window**

Yellow arrow shows actual programm counter

Point indicates breakable source code line

```
131    while(l)
132    {
133        if (SSR1_RDRF != 0)
134        {
135            ch = RDR1;
136            if ((SSR1 & 0xE0) != 0)
137            {
138                SCR1_CRE = 1;
139            }
```

Active breakpoint

Deactivated breakpoint

Lines between points indicate a group of breakable lines

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics

EUROScope lite 16FX Processor Status

- **Processor window provides most important registers**
- **All processor flags are shown individually**
- **All values can be changed**
- **Window is updated on any stop or break of the application**
- **Changes in values are displayed in red due to prior update**

```
Register: unknown register                              ▲ ✕
RL0=01CC0000   RL1=00F80004   RL2=00020000
RL3=00F80000
RW0=0000   RW1=01CC   RW2=0004   RW3=00F8
RW4=0000   RW5=0002   RW6=0000   RW7=00F8
R0=00   R1=00   R2=02   R3=00   R4=00   R5=00
R6=F8   R7=00
A=00660066   AH=0066   AL=0066
PC=F80169   SSP=00253E   USP=002544
DPR=22   DTB=00   ADB=00
PS=E0E5   ILM=7   RP=00   CCR=E5
I=1   S=1   T=0   N=0   Z=1   V=0   C=1   TBR=0000
```

EUROScope lite 16FX
Variable Window

- **Local**
  - Local variables are automatically collected in view „Local"
- **Watch**
  - All local and up to 8 global variables can be added individually to the 'Watch' window
- **Variables are updated on any stop or break of the application**
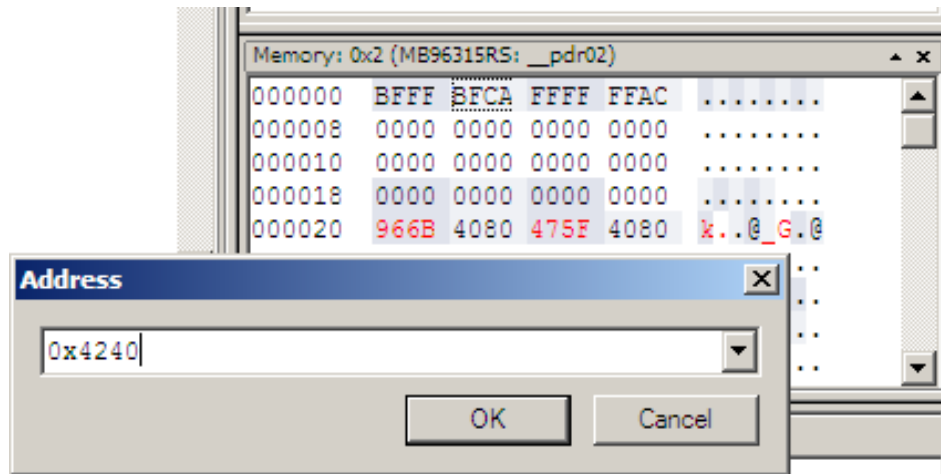- **Changed values are displayed in red**
- **Variable values can be changed in 'value' entry**

Variable	Value	Type	Storage	Module	Address	Size
cnt1	22 '.'	char	0x2246	main	0x2246	1 byte
cnt2	9 '.'	char	0x2245	main	0x2245	1 byte
cntdir	0 '.'	char	0x2244	main	0x2244	1 byte
delay	40144	unsigned long	0x2240	main	0x2240	4 byte

Local Global **Watch** this

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics

EUROScope lite 16FX
Memory View

- **Memory view is updated on every stop or break**
- **Value change is displayed in red due to prior update**
- **Memory content can be changed**
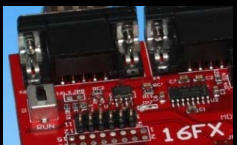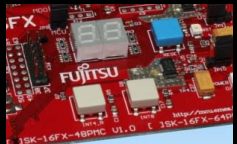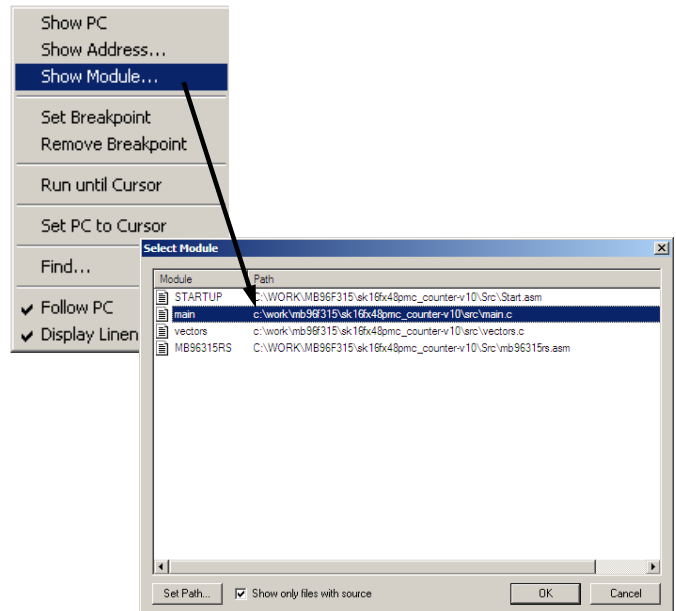- **Memory can be filled with a user byte and size**


```
Memory: 0x2 (MB96315RS: __pdr02)                    ▲ ×
000000   BFFF  BFCA  FFFF  FFAC   ........          ▲
000008   0000  0000  0000  0000   ........
000010   0000  0000  0000  0000   ........
000018   0000  0000  0000  0000   ........
000020   966B  4080  475F  4080   k..@_G.@
```

Address   ×

0x4240   ▼

OK   Cancel

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics   All Rights Reserved.© Fujitsu Limited 2009
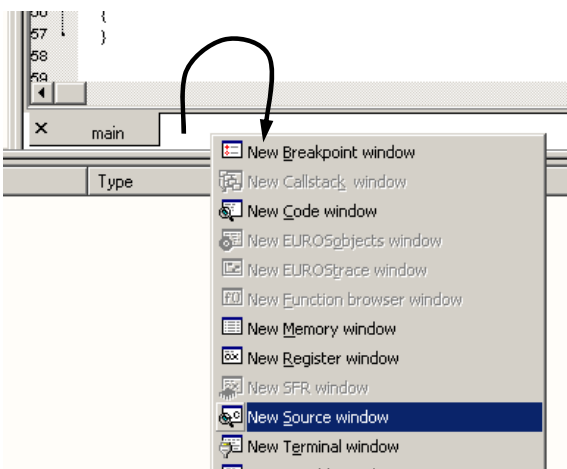
EUROScope lite 16FX Changing/Adding Source Window

■ **New source module window**

- Go in window tab area and right-button click
- Choose „New Source window"

■ **Change source window**

- Get menu by right-mouse-button-click in the source window
- Choose „Show Module..."
- Browse to Module File

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics   All Rights Reserved.© Fujitsu Limited 2009

EUROScope lite 16FX
Flash Programming

- ■ **Flash programming is available via the Flash button:**
  - ● BDM configuration can be set before programming
  - ● Chip erase is supported
  - ● Flash programming is supported
  - ● User has to press reset button after Flash programming
  - ● Fujitsu Flash programming kernels are reused

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics
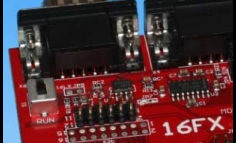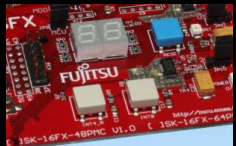
EUROScope lite 16FX
BDM Configuration

- **Background debugging mode configuration**
- **Flash security unlock**
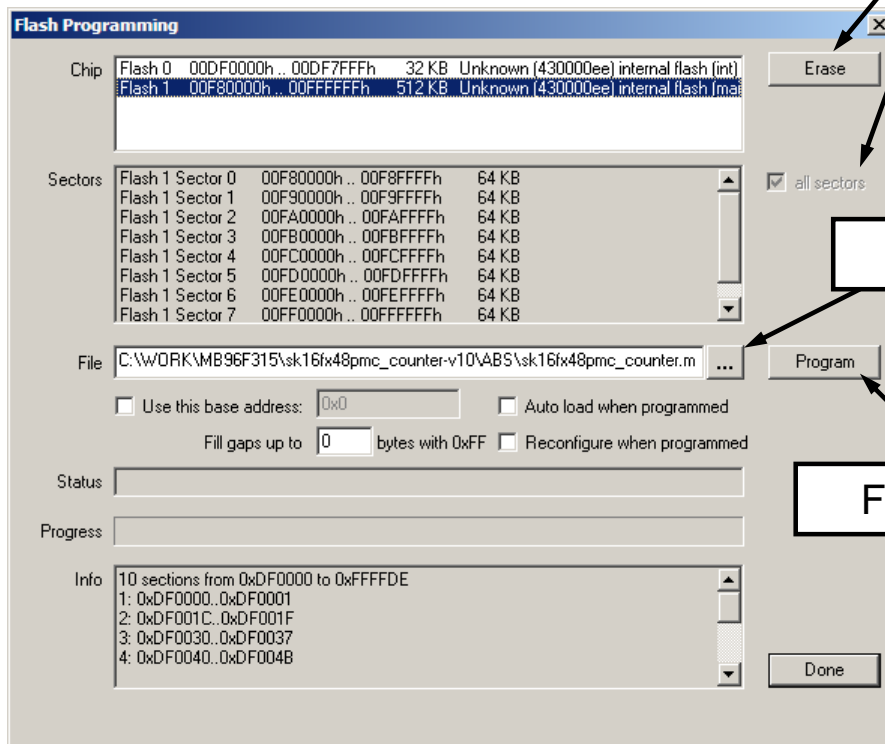

Flash security unlock keys

BDM Activation

[√] Use EUROScope configuration
[ ] Use MHX file configuration

EUROScope lite 16FX
Flash Programming Dialog

■ **Chip erase and Flash programming**
  ● Click on ‚Done' and reset board
    after programming

Chip erase
(‚all sectors' must be
checked)

Browse to MHX file

Flash programming

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics

EUROScope lite 16FX Prospect

■ **All SK-16FX-48PMC examples are configured as follows:**
- UART2 for debugging
- UART7_R may be used by the application
- Asynchronous communication
- 115200 Bits/s
- Autorun after reset
- No breakpoint predefinition

■ **For more details of „EUROScope lite 16FX"**
please refer to application note:
- mcu-an-300235-e-16fx_using_EUROScope

FreeRTOS™
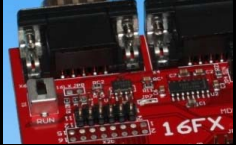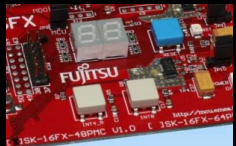
Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics

FreeRTOS™

- **The most widely used open source real-time operating system for embedded microcontrollers**
- **It has the performance, quality and stability of a commercial product**
- **It is available through a very liberal distribution and licensing model which allows users to obtain and develop software with almost no restrictions**
- **Optional commercially licensed and supported versions are available through WITTENSTEIN**
- **Features:**
    - Designed specifically for microcontrollers
    - Powerful trace macros
    - Stack overflow protection
    - No restrictions on priority assignment
    - Safety certified version available – proving robustness
    - Tasks, co-routines, queues, binary semaphores, counting semaphores, recursive semaphores, mutexes, interrupt interaction primitives
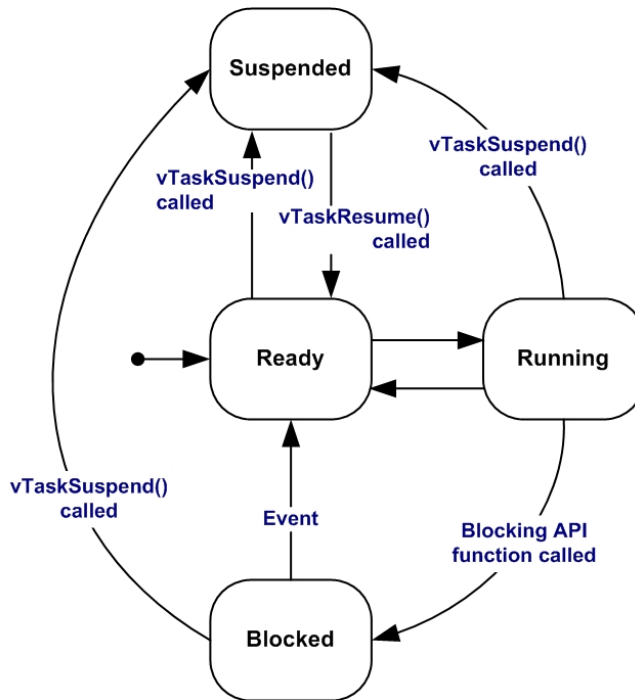
Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics

FreeRTOS™ - Tasks

- **Autonomous**
  - No knowledge of scheduler activity
  - A sequential process
  - Running on a 'virtual processor'
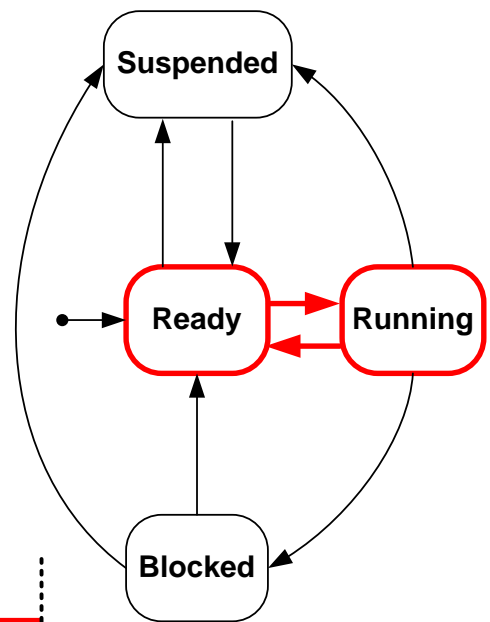 - Prioritised

FreeRTOS^{TM} - Multitasking

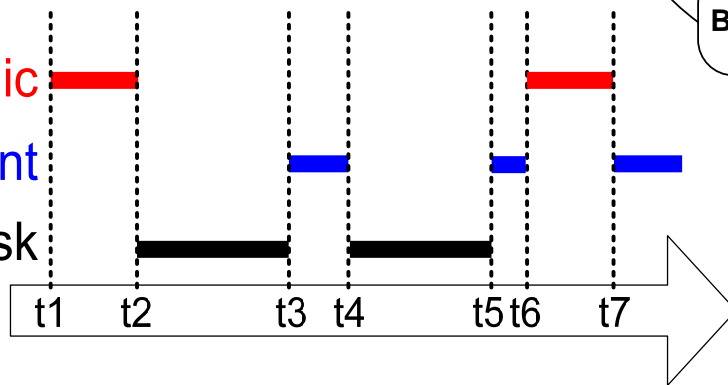■ **Prioritised Pre-emptive Multitasking**

```
void aTask( void * pvParameters )
{
  for( ;; )
  {
    /* Task processing goes here. */
  }
  vTaskDelete( NULL );
}
```
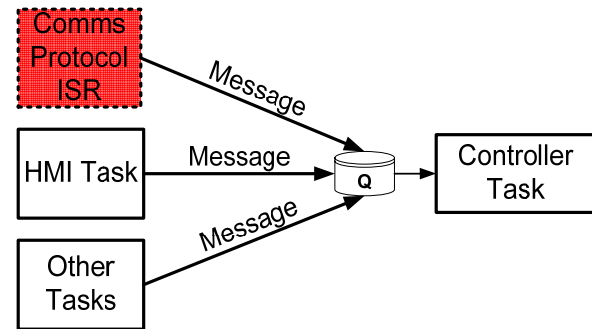

med, periodic

low, event

Idle task

t1 t2   t3 t4   t5 t6   t7

FreeRTOS™ - Queues

- **To be useful tasks must be able to communicate with each other**


```
xQueueHandle xQueue; // Declare the queue

void vTask1( void *Param )
{
char cValueToWrite = 10;

    xQueue = xQueueCreate( 10, sizeof( char ) ); // Create queue

    for( ;; )  {
        xQueueSendToBack( xQueue, &cValueToWrite, 10 );
    }
}
/*-----------------------------------------------------------*/
void vTask2( void *Param )
{
char cValueToReceive;

    for( ;; ) {
        xQueueReceive( xQueue, &cValueToReceive, 10 );
    }
}
```
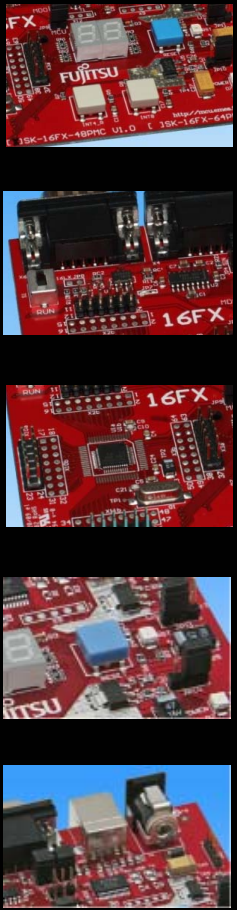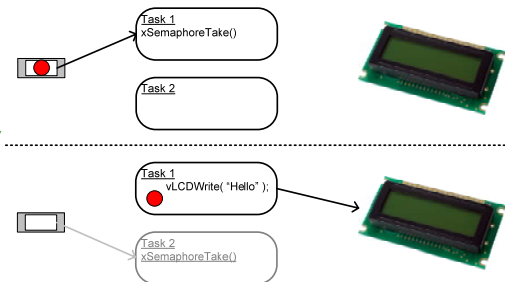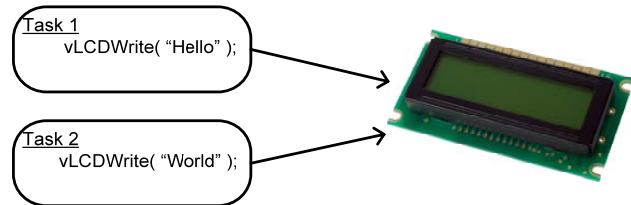
Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics   All Rights Reserved.© Fujitsu Limited 2009

FreeRTOS™ - Mutexes

- **What happens when two tasks attempt to access the same resource?**

Task 1
vLCDWrite("Hello");

Task 2
vLCDWrite("World");

```
void vTask1( void * pvParameters )
{
  for( ;; )
  {
    /* Need access, get semaphore. */
    xSemaphoreTake( xSemaphore, BLOCK_FOREVER );

    vLCDWrite( "Hello" ); /* Access resource */

    /* Must remember to return semaphore. */
    vSemaphoreGive( xSemaphore );
  }
}

/**********************************************/

void vTask2( void * pvParameters )
{
  for( ;; )
  {
    xSemaphoreTake( xSemaphore, BLOCK_FOREVER );

    vLCDWrite( "World" ); /* Access resource */

    vSemaphoreGive( xSemaphore );
  }
}
```
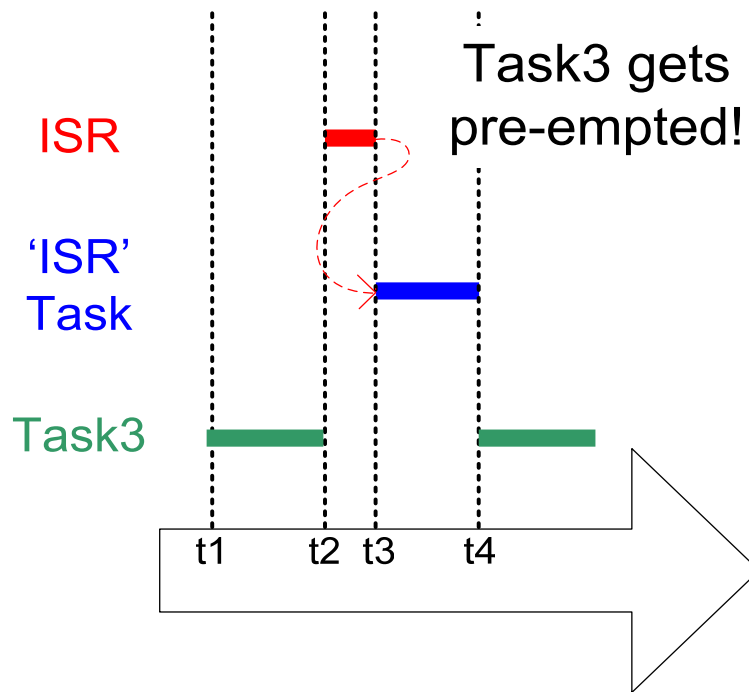
Task 1
xSemaphoreTake()

Task 2

Task 1
vLCDWrite("Hello");

Task 2
xSemaphoreTake()

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics

FreeRTOS™ - Synchronisation

- **Tasks provide a convenient mechanism for processing asynchronous events**
- **Semaphores can be used to implement "Deferred Interrupt Handling"**

Task3 gets
pre-empted!

ISR

'ISR' Task

Task3

t1   t2 t3   t4

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics   All Rights Reserved.© Fujitsu Limited 2009
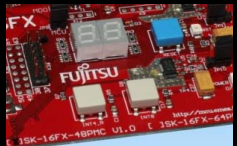
FreeRTOS™ - Binary Semaphores

- The ISR only 'gives' the semaphore
- The task only 'takes' the semaphore

```c
void vAnISR( void )
{
  xSemaphoreGiveFromISR( xSemaphore );
}

/**********************************************/

void vTask2( void * pvParameters )
{
  for( ;; )
  {
    xSemaphoreTake( xSemaphore, portMAX_DELAY );

    /* Processing done here. */
  }
}
```

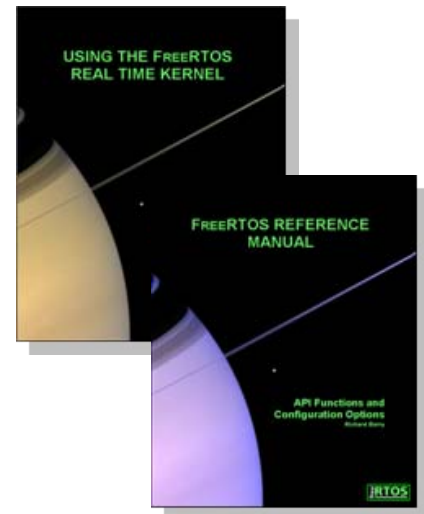Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics

FreeRTOS™

■ **FreeRTOS™ - Operating System**

- mini Real Time Kernel
- open source
- royalty free (also in commercial applications)
- Free support by an active user community
- http://www.freertos.org/

■ **FreeRTOS™ incl. one example is provided by this starterkit**

- sk16fx48pmc_free_rtos_dice-v10
  - Two 7-segment displays are simulating two virtual dices

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics
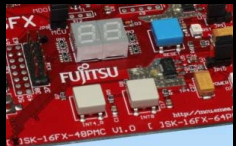
FUJITSU

THE POSSIBILITIES ARE INFINITE

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics

Further Steps

■ **In order to learn more about Fujitsu's microcontrollers**

- Visit our microcontroller website
  - http://mcu.emea.fujitsu.com
    - http://mcu.emea.fujitsu.com/mcu_product/detail/MB96F315RSAPMC.htm
- See our application notes
  - http://mcu.emea.fujitsu.com/mcu_product/mcu_all_appnotes.htm
- See our software examples
  - http://mcu.emea.fujitsu.com/mcu_product/mcu_all_software.htm

■ **Contact your local distributor …**

- for individual support
- to register for our monthly 16FX seminar
- to order the latest 'Fujitsu Micros DVD' containing all information regarding Fujitsu's 8-bit, 16-bit, and 32-bit microcontrollers

Optional Tools

■ **High-end evaluation board**
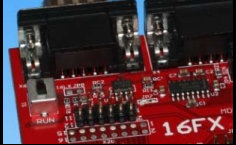- SK-96310-48PMC (Supports LQFP package M26)

■ **Hardware emulator**
- MB2198-01 + MB2198-500
- Emulation chip MB96V300B
- Probe header MB2198-509 for LQFP package M26
  - Socket NQPACK048SD, HQPACK048SD

■ **Programmer**
- Conitec GALEP-4

■ **Operating systems**

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics   All Rights Reserved.© Fujitsu Limited 2009
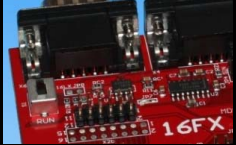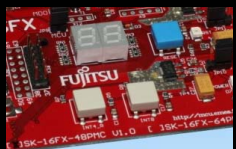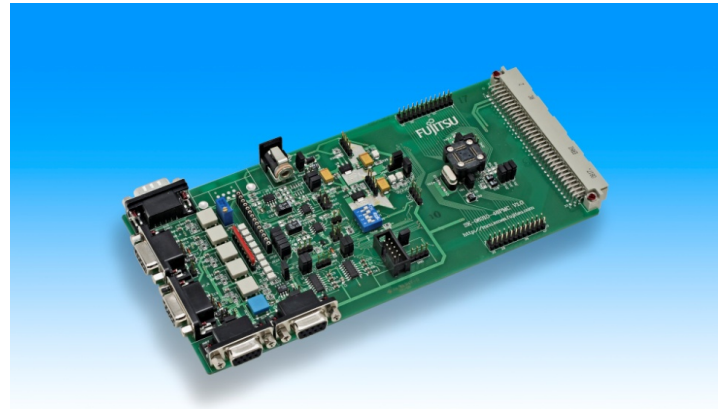
Evaluation Board

■ **SK-96310-48PMC V1.0**

- Evaluation board for MB96310 Series (for LQFP package M05/M26)
- Emulator target board
- Access to all on-chip peripherals
- 2x UART
- 1x CAN
- 2x LIN
- 8x 'User'-LEDs
- 5x 'User'-Buttons
- Flash-Kit connector
- Connector for LC-Display
- Example projects

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics

Hardware Emulator

■ **In-Circuit emulator for F2MC-16FX**

- Main unit (MB2198-01), Adapter (MB2198-500), V-Chip (MB96V300B)
- USB, LAN, and RS232 communication interface
- Connected to target system via Fujitsu probe cable
- High speed operating frequency
- 2052 code / 4 data event breakpoints
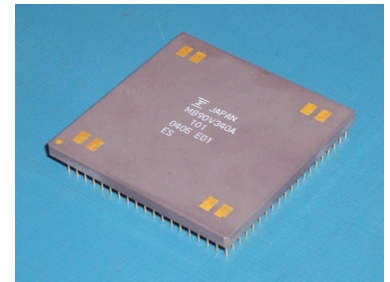- Sequential breakpoints (4 conditions / 3 levels)
- Trace function

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics   All Rights Reserved.© Fujitsu Limited 2009
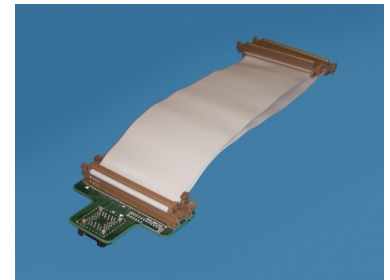
Hardware Emulator

■ **Emulation chip MB96V300B**
  ● Superset supports all features of 16FX

■ **Probe header**
  ● MB2198-509 for LQFP package M26

■ **Socket for LQFP package M26**
  ● NQPACK048SD, HQPACK048SD

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics   All Rights Reserved.© Fujitsu Limited 2009
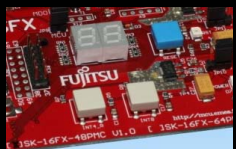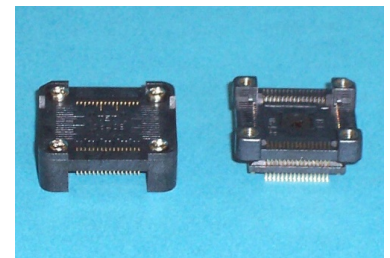
Programmer

■ **GALEP-4 / GALEP-5**

- Supports parallel programming
- Supports serial synchronous and asynchronous programming
- Optional programming cable for serial synchronous programming
- Allows programming in volume production
- www.conitec.com

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics

Operating Systems

- **ProOSEK®**
  - Real-time operating system, OSEK/VDX
  - www.elektrobit.com
- **EUROS**
  - RTOS including TCP/IP, IrDA, IDE, CAN-Bus, CANopen, Profibus, etc.
  - www.euros-embedded.com
- **RTA-OSEK**
  - Realogy Real-Time Architect (RTA) ,OSEK, incl. timing analysis tool
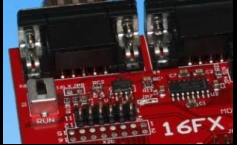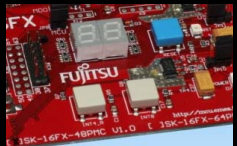 - www.etasgroup.com
- **embOS**
  - Small memory footprint for single-chip applications incl. PC viewer
  - www.segger.com
- **osCAN (OSEK/VDX)**
  - osCAN (OSEK/VDX) and further networking software CAN, LIN, FlexRay, etc.
  - www.vector-informatik.de
- **FreeRTOS**
  - Free and open source mini Real Time Scheduler
  - www.FreeRTOS.org

Contacts - Distribution

■ **European distributors**

■ **ATeG - Anatec AG**	**www.anatec.ch**
■ **ATeG - Anatronic S.A.**	**www.anatronic.com**
■ **ATeG - Ineltek GmbH**	**www.ineltek.com**
■ **EBV Elektronik GmbH**	**www.ebv.com**
■ **Glyn GmbH & Co. KG**	**www.glyn.de** , **www.glyn.ch**
■ **Malpassi srl**	**www.malpassi.it**
■ **Melchioni Electronica SpA**	**www.melchioni.it**
■ **PN Electronics**	**www.pne.fr**
■ **Rutronik**	**www.rutronik.com**
■ **Sagitrón**	**www.sagitron.es/english.htm**

Fujitsu Microelectronics Europe - http://emea.fujitsu.com/microelectronics   All Rights Reserved.© Fujitsu Limited 2009

Fujitsu Microelectronics Europe

Germany (Headquarters)
- Pittlerstrasse 47, D-63225 Langen
- Tel: (0 61 03) 69 00, Fax: (0 61 03) 69 01 22

France
- 2-12 Chemin des Femmes, F-91300 Massy
- Tel: (01) 64 47 97 07, Fax: (01) 64 47 97 01

Italy
- Palazzo Pitagora – Milano 3 City, Via Ludovico il Moro 4B, I-20080 Basiglio, Milano
- Tel: (02) 90 45 02 1, Fax: (02) 90 75 00 87

United Kingdom
- Network House, Norreys Drive, Maidenhead, Berkshire SL6 4FJ
- Tel: (01628) 50 46 00, Fax: (01628) 50 46 66

World Wide Web
- http://emea.fujitsu.com/microelectronics
- http://mcu.emea.fujitsu.com
- Contact: micro_info@fme.fujitsu.com

Recycling

■ **Gültig für EU-Länder:**
- Gemäß der Europäischen WEEE-Richtlinie und deren Umsetzung in landesspezifische Gesetze nehmen wir dieses Gerät wieder zurück.
- Zur Entsorgung schicken Sie das Gerät bitte an die folgende Adresse:

■ **Valid for European Union Countries:**
- According to the European WEEE-Directive and its implementation into national laws we take this device back.
- For disposal please send the device to the following address:

Fujitsu Microelectronics Europe GmbH
Warehouse/Disposal
Monzastraße 4a
D-63225 Langen

Fujitsu Microelectronics Europe

- **'SK-16FX-48PMC'-CD Link-List**
  - Software
    - Softune Workbench
    - EUROScope lite 16FX
    - MCU Flash programmer
    - SKwizard
  - Software Examples
    - sk16fx48pmc_adc_dvm
    - sk16fx48pmc_can_uart_terminal
    - sk16fx48pmc_counter
    - sk16fx48pmc_template
    - sk16fx48pmc_uart
    - sk16fx48pmc_free_rtos_dice
    - sk16fx48pmc_uart_7seg
  - Documents
    - Schematic 'SK-16FX-48PMC'
    - Data sheet MB96310 Series
    - Hardware manual 16FX Family
    - AppNote '16FX Hardware Setup'
    - AppNote '16FX Getting Started'
    - Customer Information 16FX
    - EUROScope Reference Manual
    - AppNote ‚EUROScope'
    - Customer Information of ‚EUROScope' limitations