SK-16FX-48PMC

FUJITSU

freeRTOS

Includes EUROScope lite16FX on-chip debugger
euros
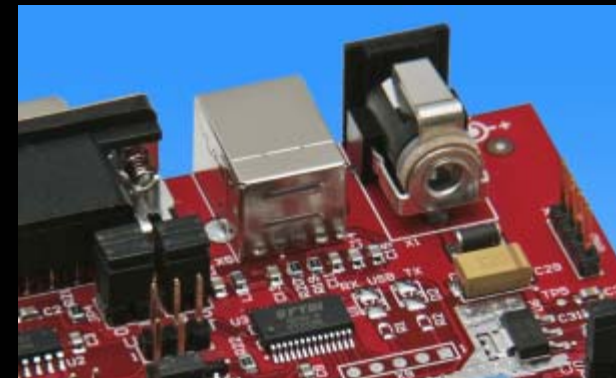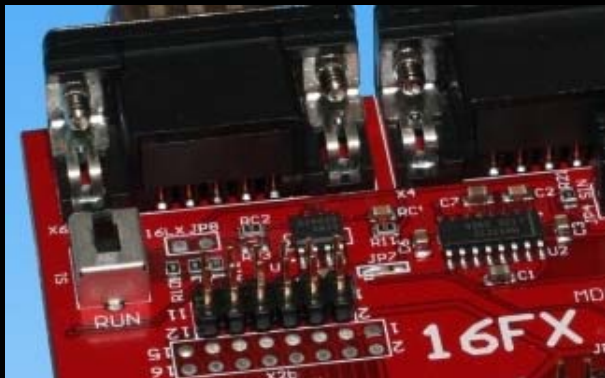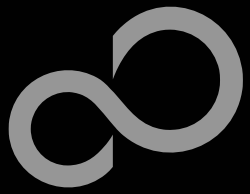
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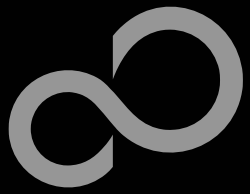
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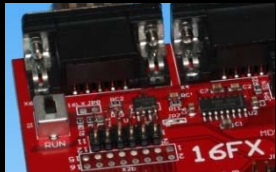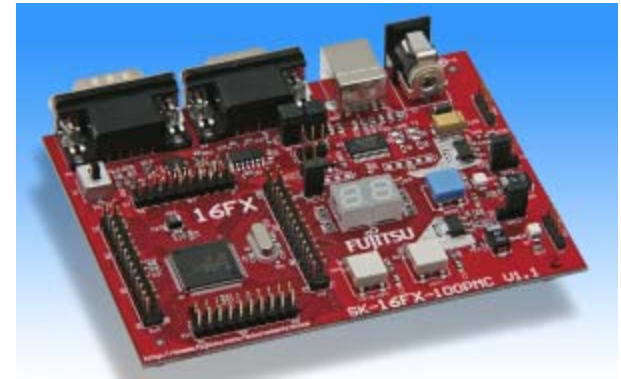
Overview

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  - The hardware
  - The software

- **Try yourself**
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  - Program download
  - New project
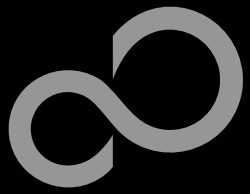 - EUROScope
  - FreeRTOS

- **Optional tools**
- **Contacts**

- **Additional 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

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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)
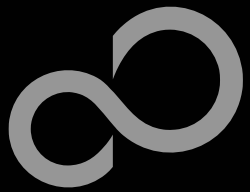- ADC
- External interrupts
- Others
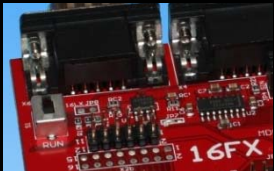
About the SK-16FX-48PMC

∎ **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
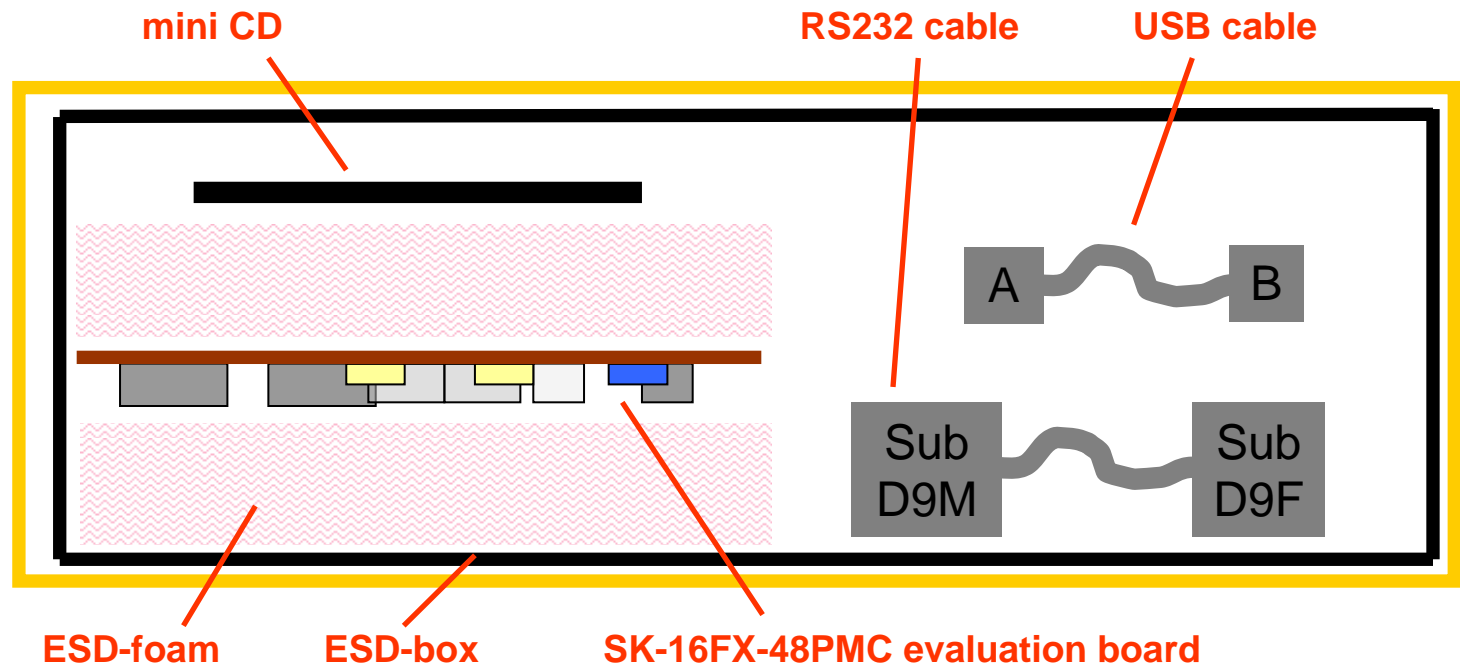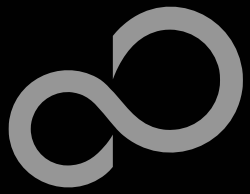- USB power-supply (external power supply possible)
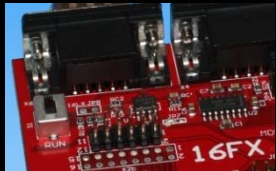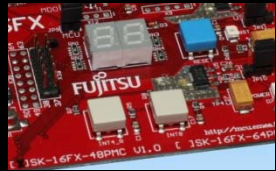
SK-16FX-48PMC content

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
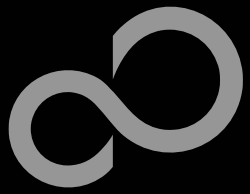- The count direction can be changed by pressing the key buttons
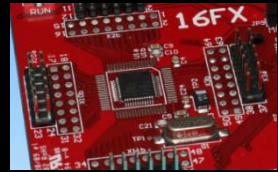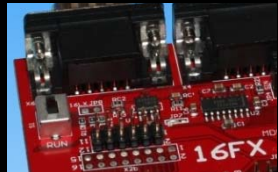
INT1

INT0
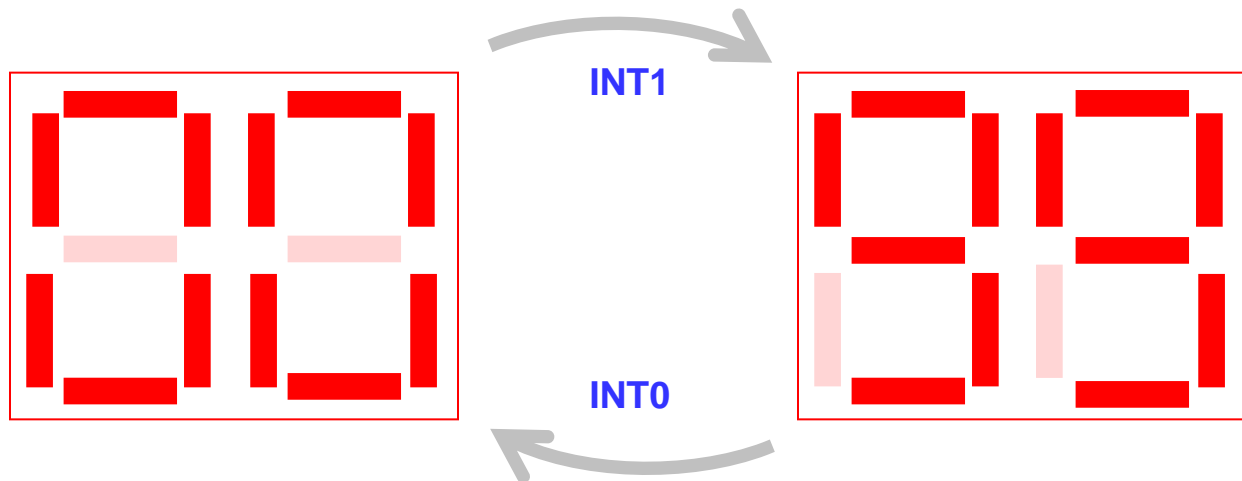
Test it
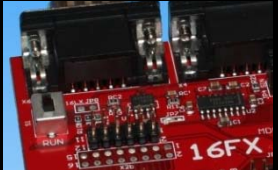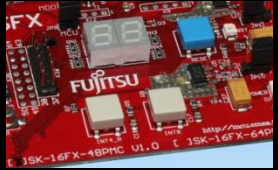
Congratulations!

■ **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
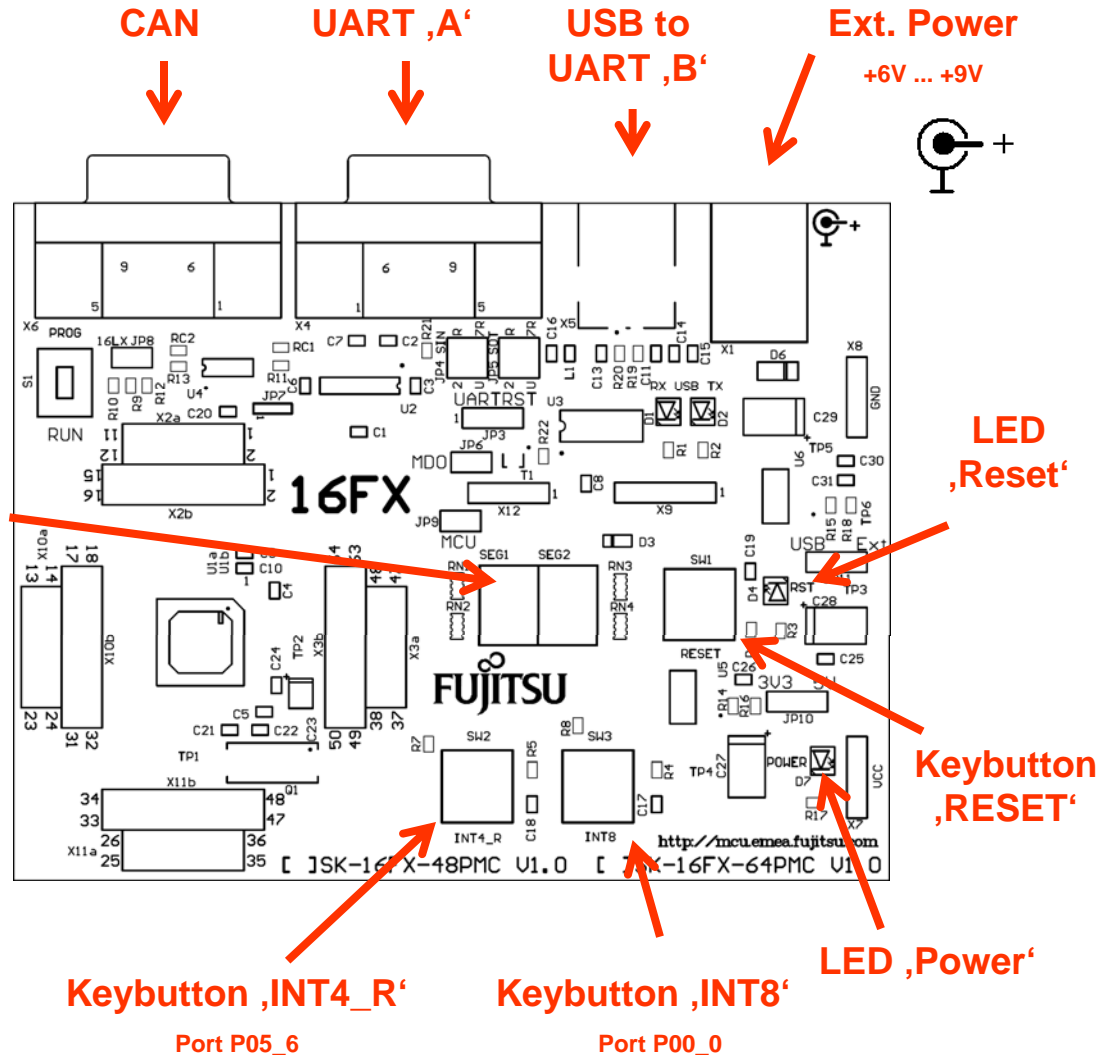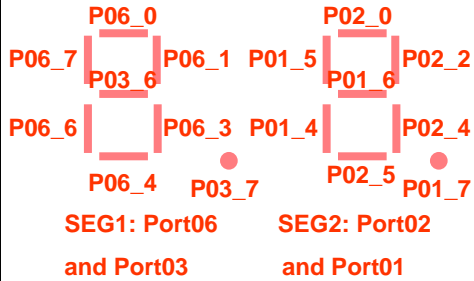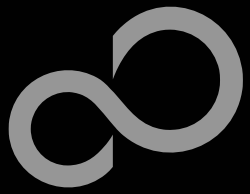- On-chip debugging with EUROScope

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The Hardware

■ **Main features**

CAN

UART ‚A'

USB to UART ‚B'

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

7-Segment Display

P06_0   P02_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

LED ‚Reset'

Keybutton ‚RESET'

Keybutton ‚INT4_R'
Port P05_6

Keybutton ‚INT8'
Port P00_0

LED ‚Power'

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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
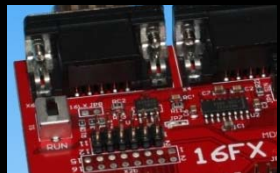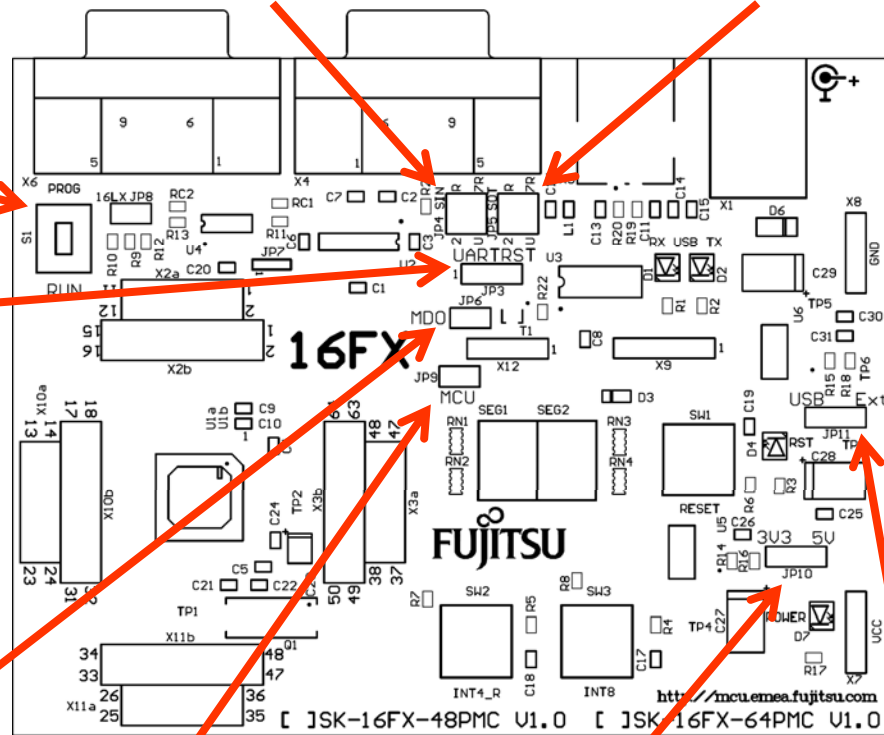
JP9: MCU Vcc

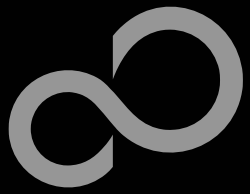This jumper can be used to measure the current consumption of the MCU

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
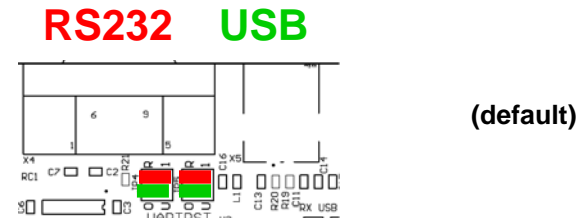
2-3: External supply is used

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**
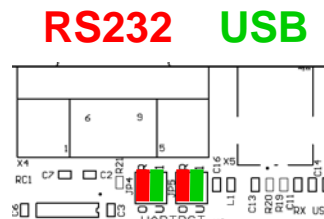
The Hardware

■ 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
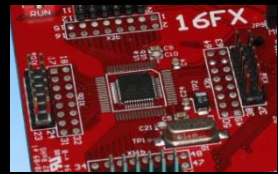
The Hardware

■ **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
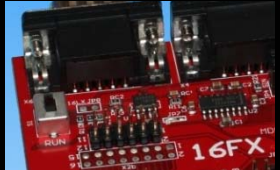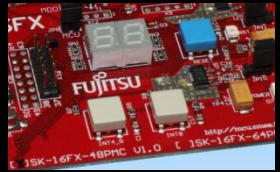
The Software

- **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.

Installation of the USB-driver

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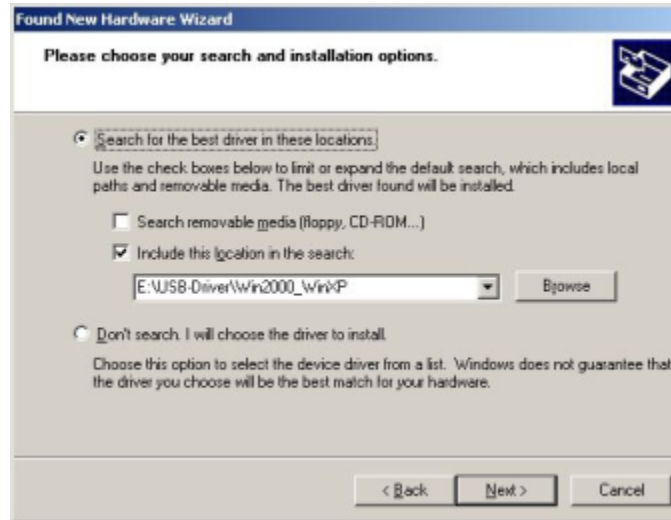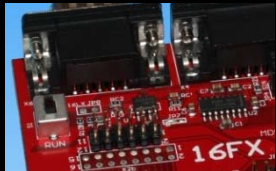
- ● Windows will 'Found New Hardware: SK-16FX-48PMC' and the Hardware Wizard should start automatically
  - • **Note: The installation procedure may differ with different operating systems**

- ● 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'

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

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'

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 Semiconductor Europe - http://emea.fujitsu.com/semiconductor

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)
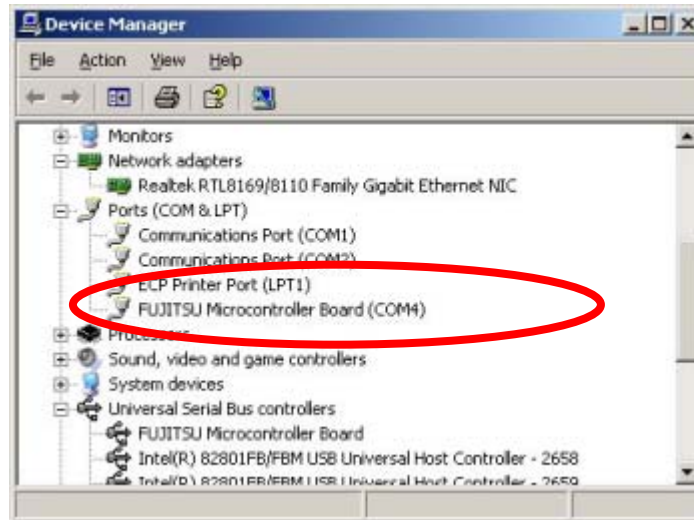
Note:
Currently EUROScope supports only COM1 - COM9.

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

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)

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[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.

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
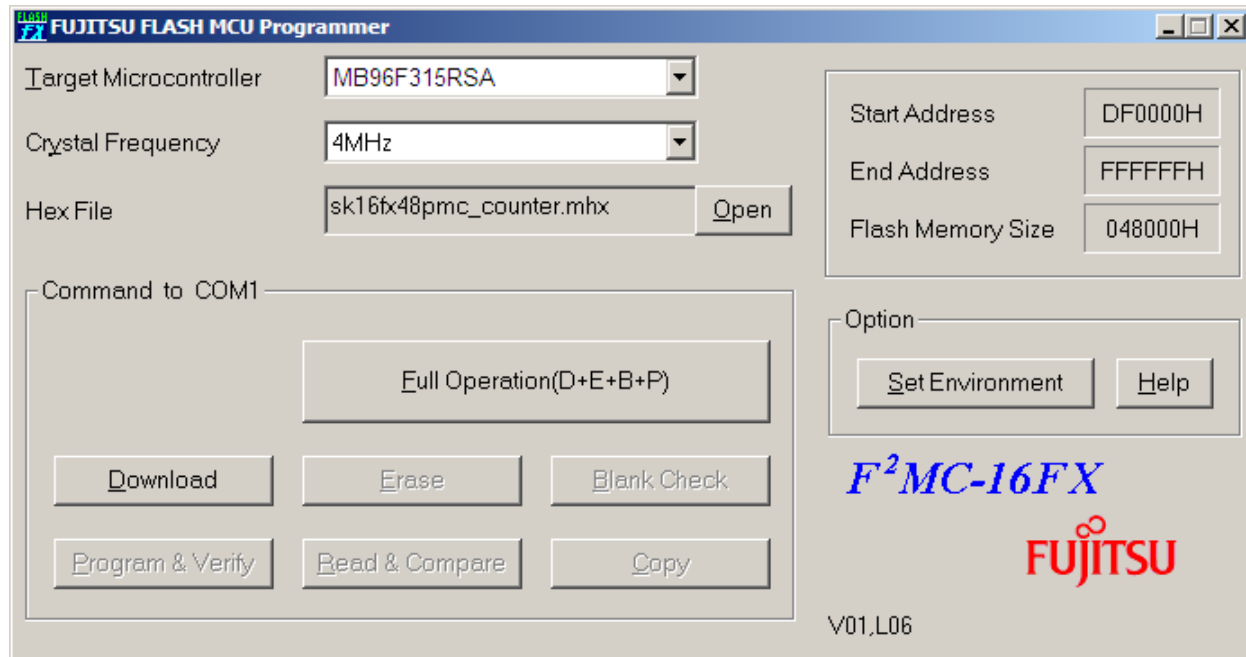
Tools and Software Examples

- **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.
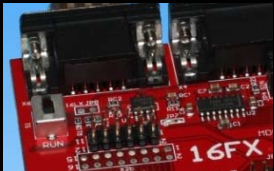
Program Download

■ **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)
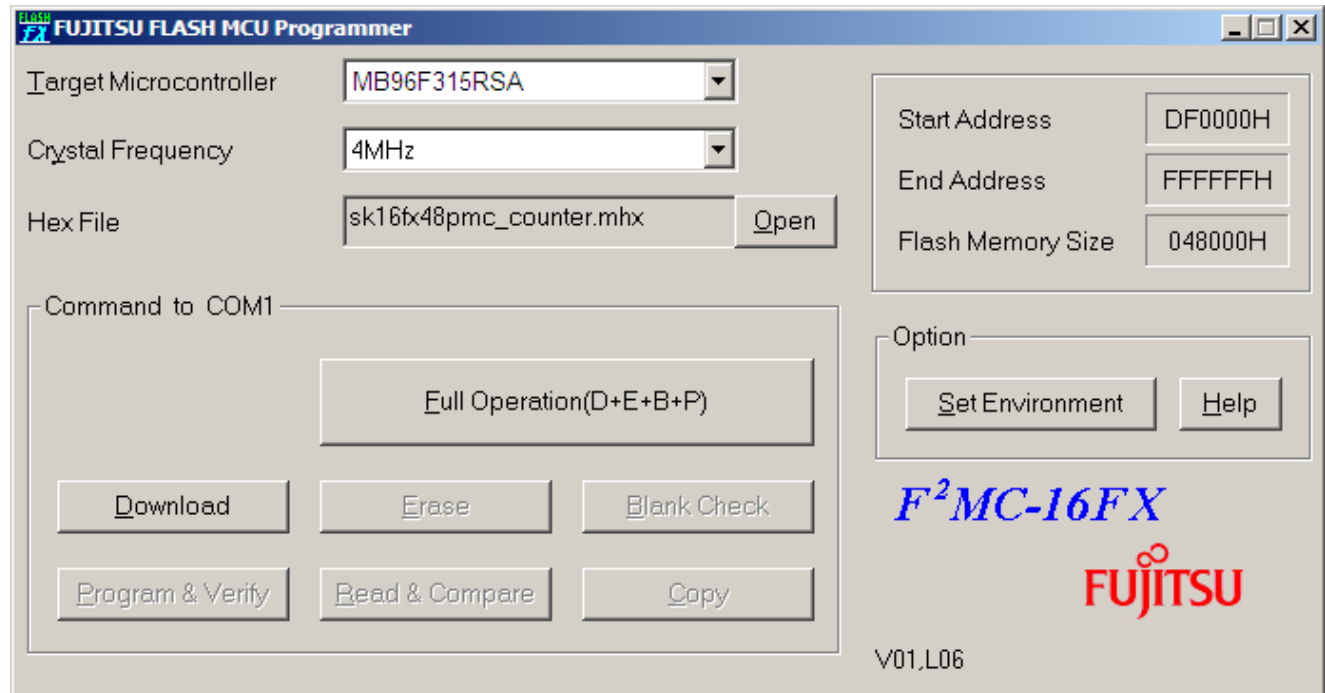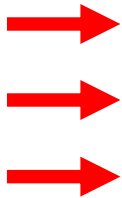
Program Download

- ■ **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'**
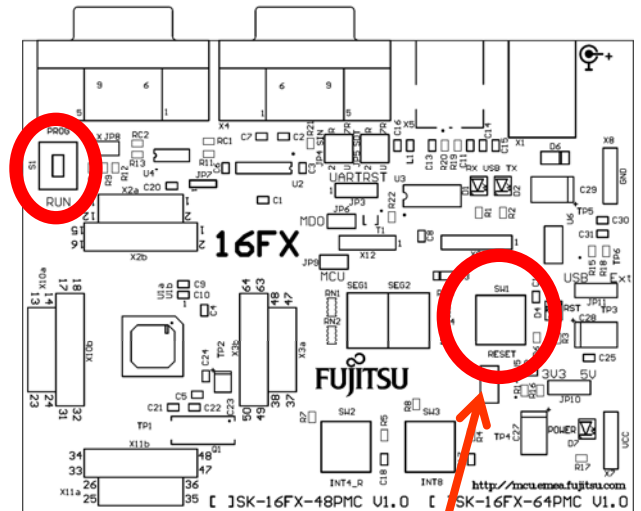
S1: Mode selection

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

Keybutton 'RESET'

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

$F^2MC\text{-}16FX$

V01,L06

4224 / 4224

It ended normally completely

Ok

24

Program Download

■ **Close the MCU Flash programmer**

■ **Set jumper S1 to position ‚RUN'**

■ **Press ‚Reset'**

USB port
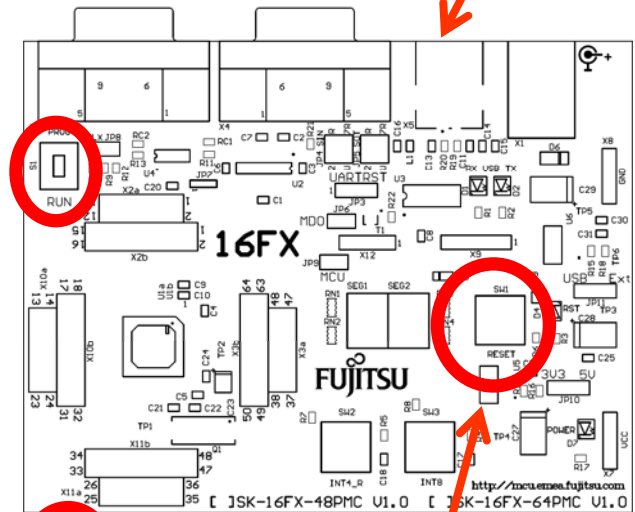
S1: Mode selection

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

F^2MC-16FX

FUJITSU

V01,L06
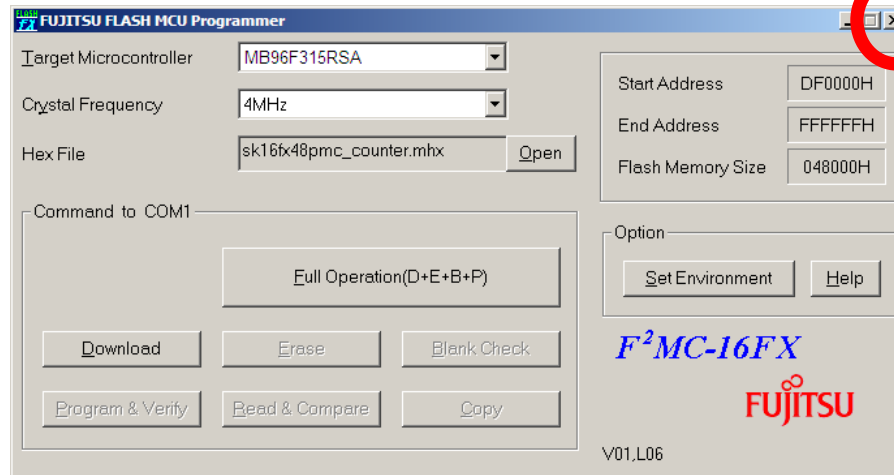
New Project

- **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'
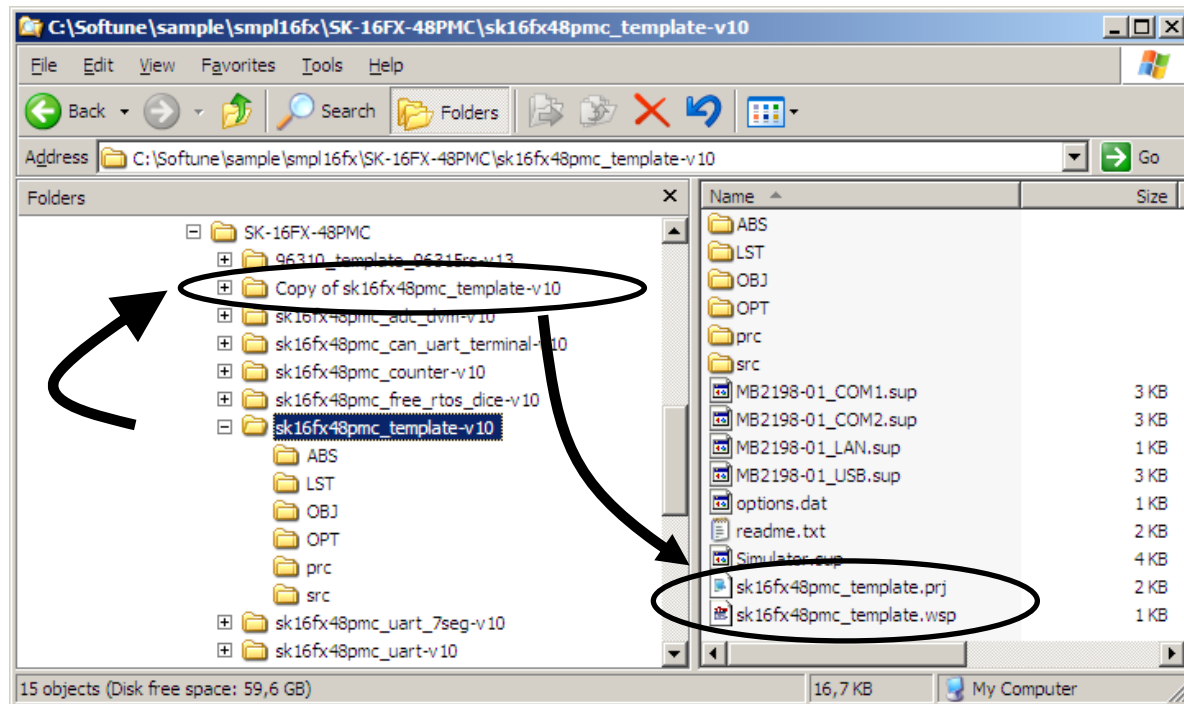
New Project

- **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'
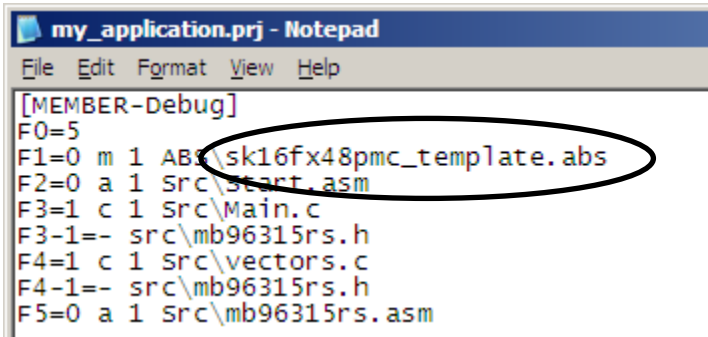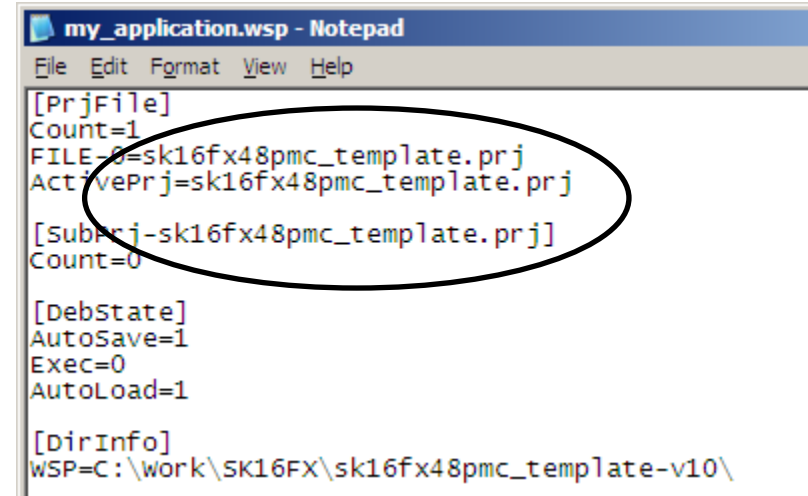
```
my_application.prj - Notepad
File  Edit  Format  View  Help
[MEMBER-Debug]
F0=5
F1=0 m 1 ABS\sk16fx48pmc_template.abs
F2=0 a 1 Src\Start.asm
F3=1 c 1 Src\Main.c
F3-1=- src\mb96315rs.h
F4=1 c 1 Src\vectors.c
F4-1=- src\mb96315rs.h
F5=0 a 1 Src\mb96315rs.asm
```

```
my_application.wsp - Notepad
File  Edit  Format  View  Help
[PrjFile]
Count=1
FILE-0=sk16fx48pmc_template.prj
ActivePrj=sk16fx48pmc_template.prj

[Subprj-sk16fx48pmc_template.prj]
Count=0

[DebState]
AutoSave=1
Exec=0
AutoLoad=1

[DirInfo]
WSP=C:\Work\SK16FX\sk16fx48pmc_template-v10\
```

New Project

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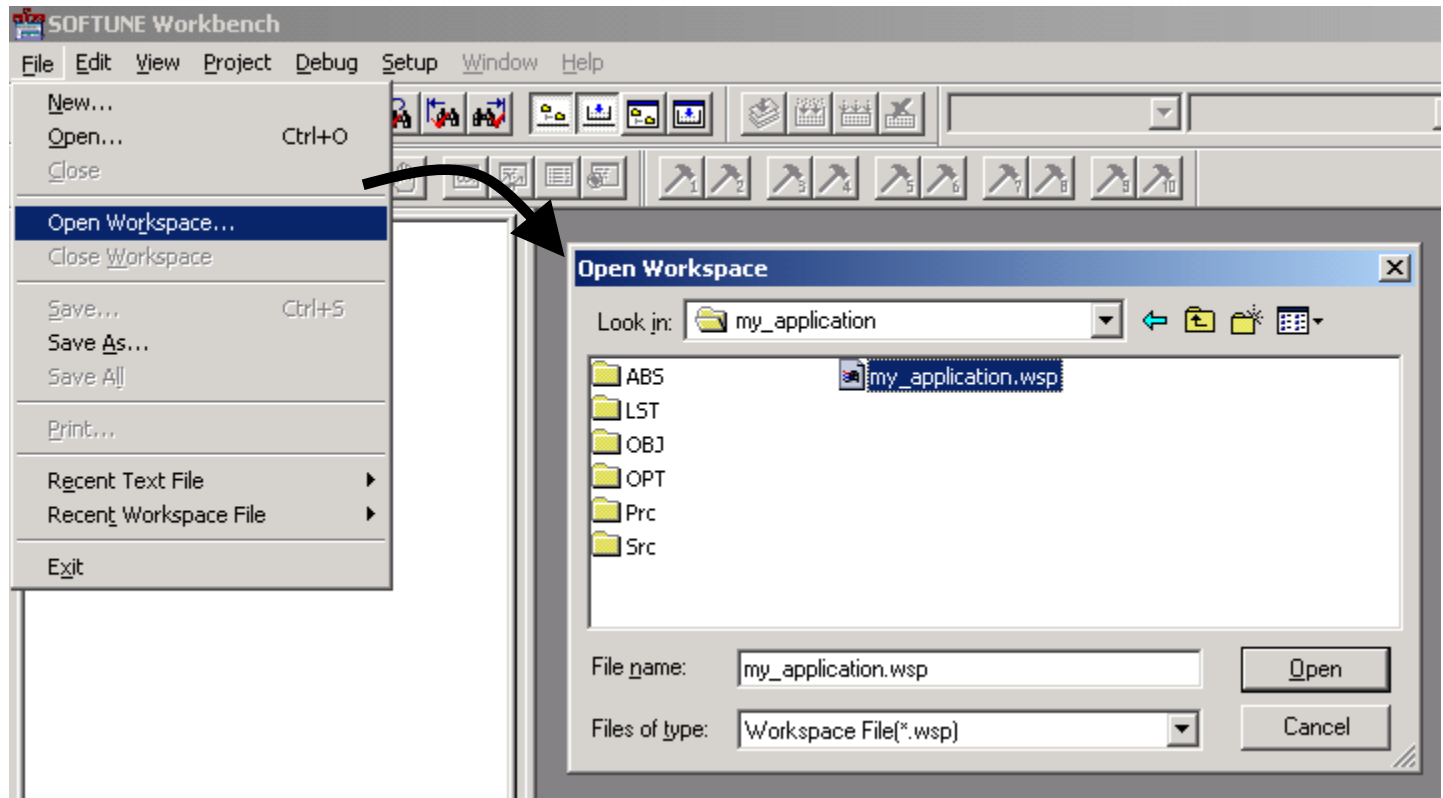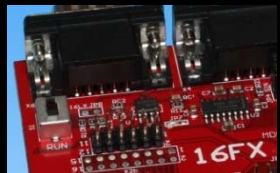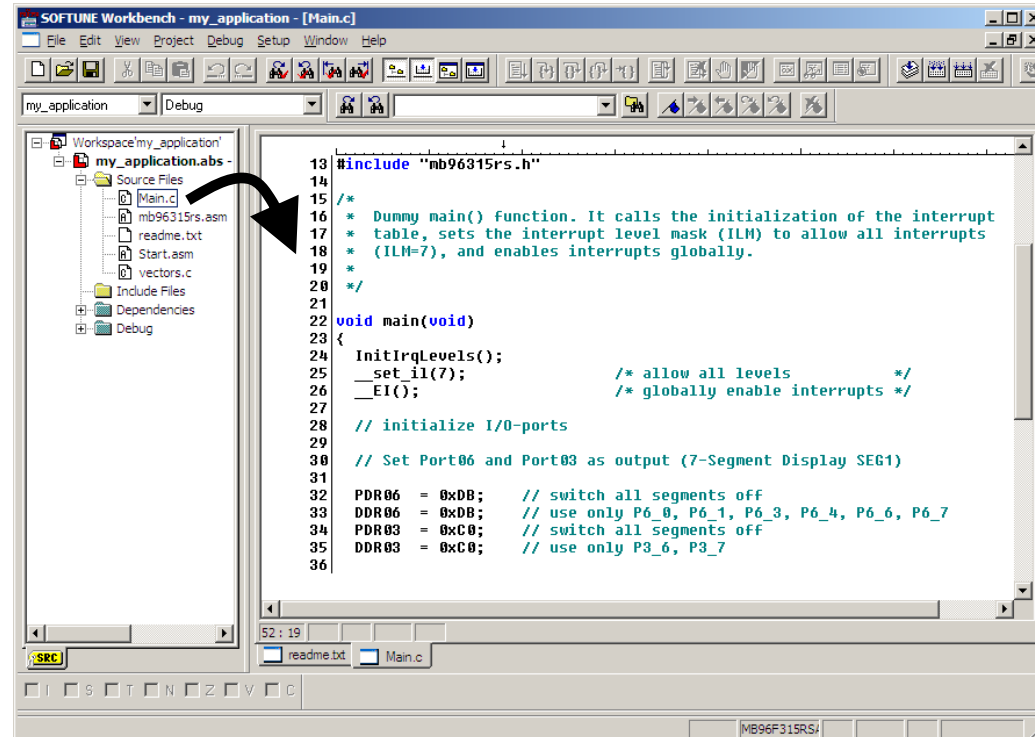
New Project

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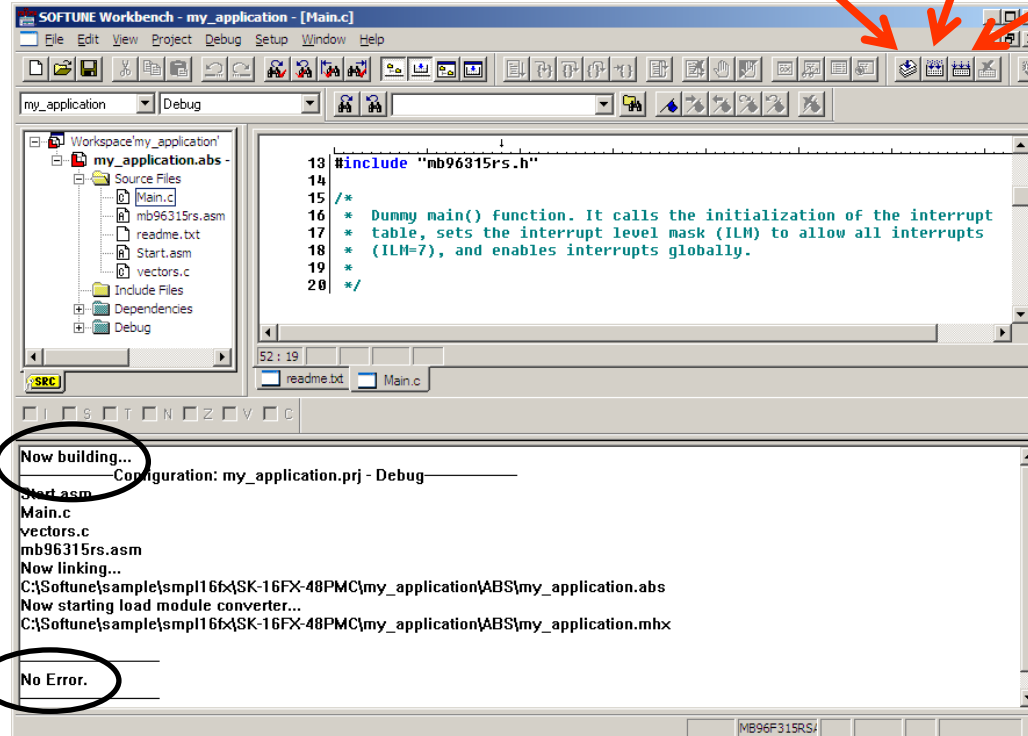 - Vectors.c : Vector table
  - Main.c   : Your application

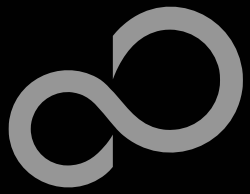# New Project

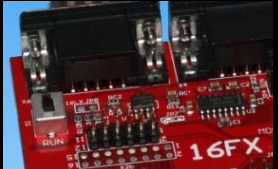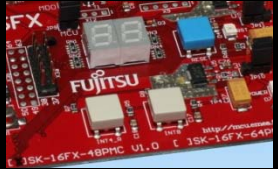- **Compile and build your project**
  - Generates the MHX-file, which can be programmed to the Flash

Compile   Make   Build

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)
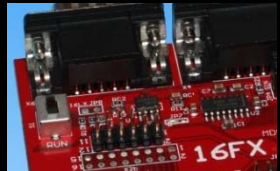- Windows for memory, watch, mixed source code, register
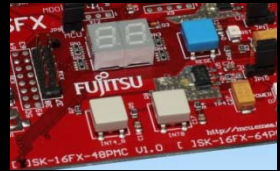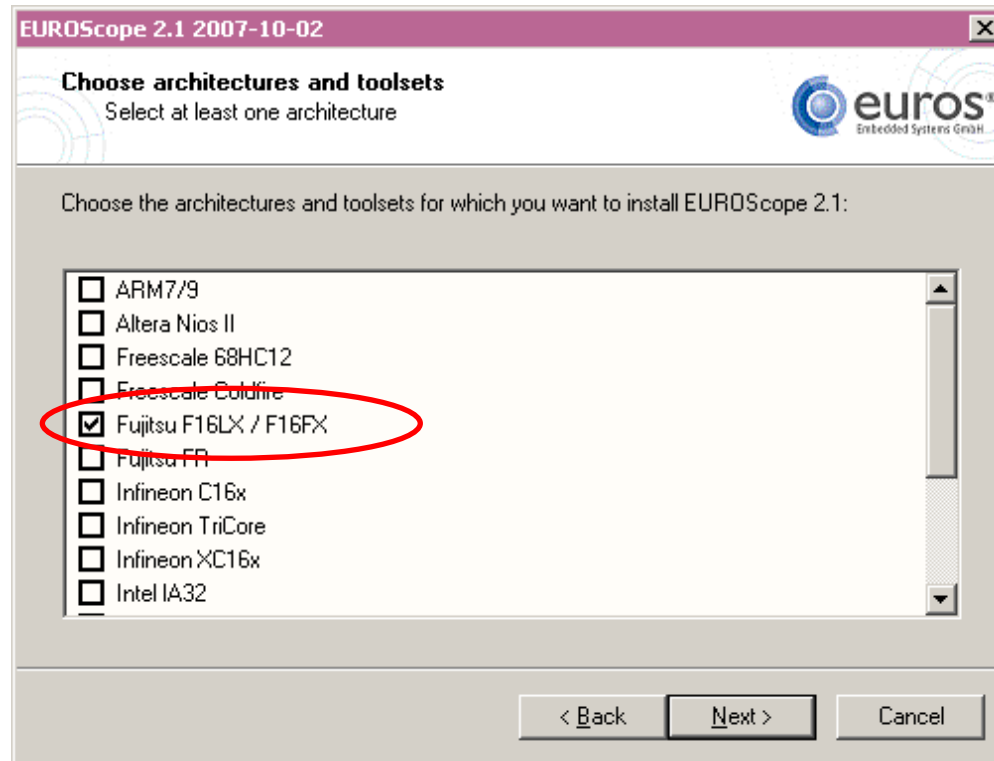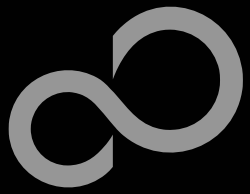- Plug-ins available for operating systems etc.

Includes EUROScope lite16FX on-chip debugger

euros® Embedded Systems GmbH
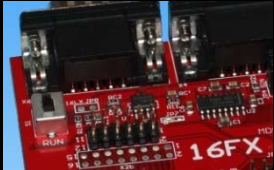
EUROScope lite 16FX Installation

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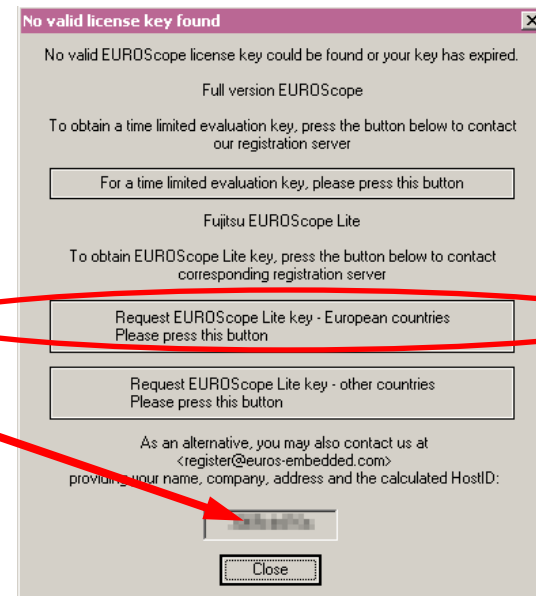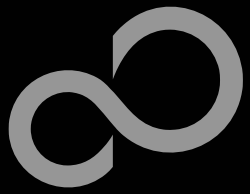 - Choose „Fujitsu F16LX / F16FX" from list

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**
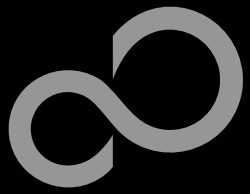 - Default connection: UART2 routed to X5/USB.

- **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
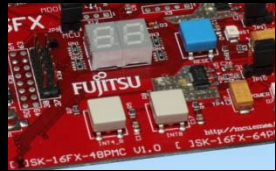
EUROScope lite 16FX Configuration

- **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"

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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...			
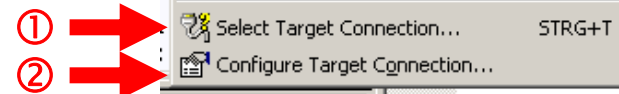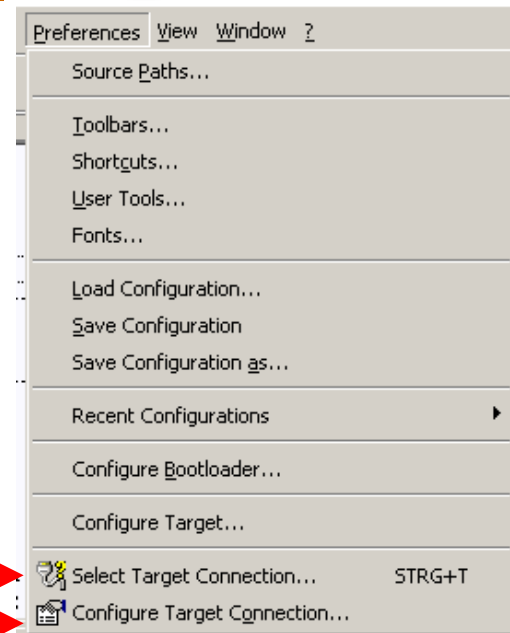
EUROScope lite 16FX
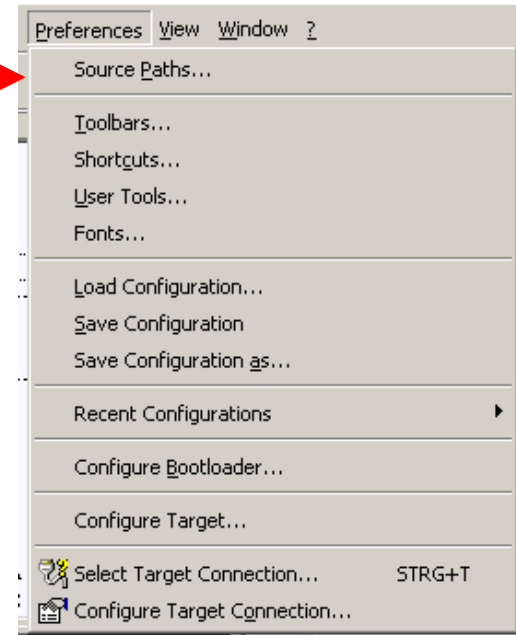# Load ABS file

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

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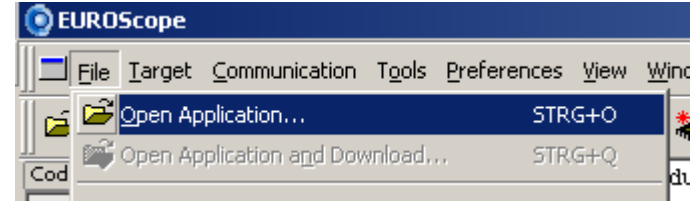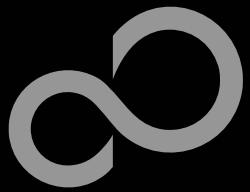
■ **Projects may be compiled on another PC or folder structure than the debug PC**
- Adjust the source path ①
  - Click New (Insert) ②
  - Browse to source folder ③
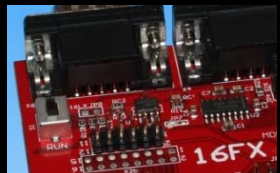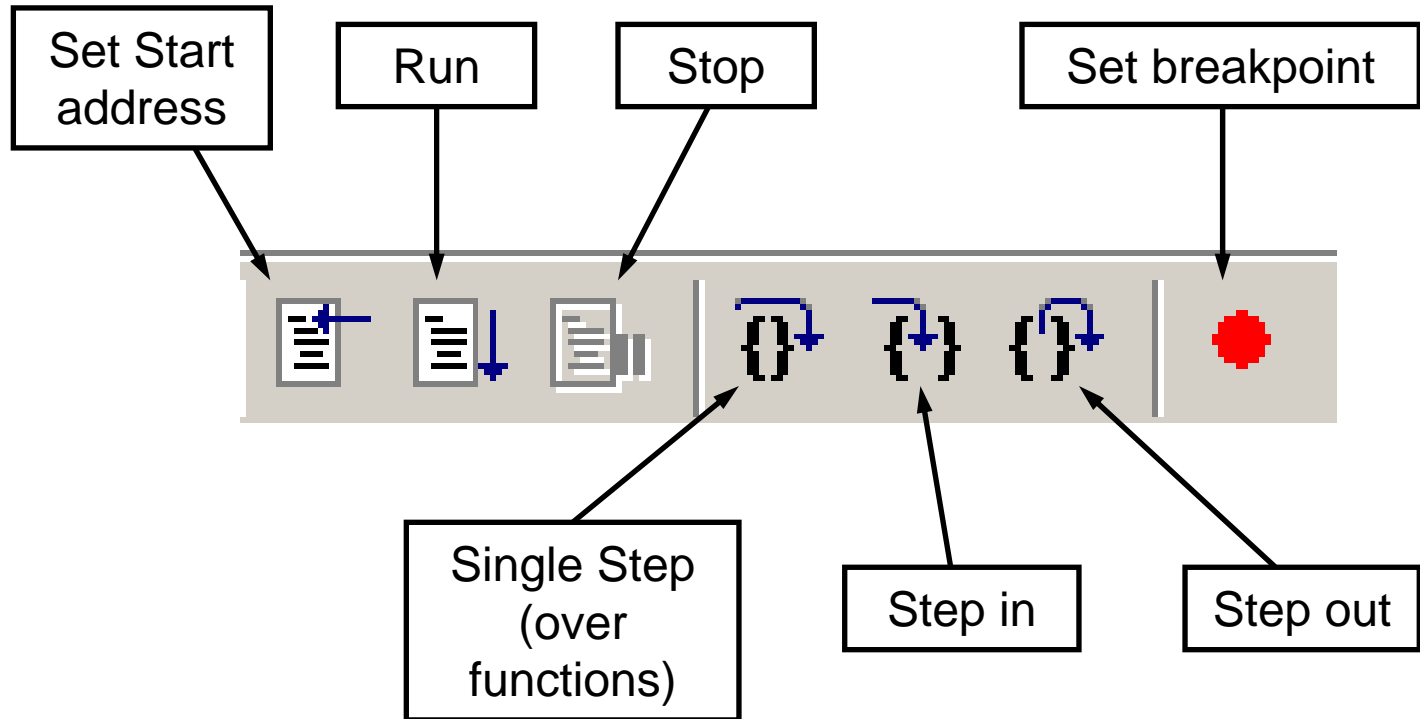   - E.g.: <drive>:\Examples\sk16fx48pmc_counter-v10\Src

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
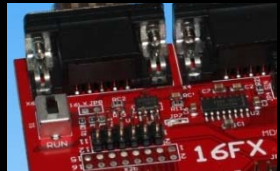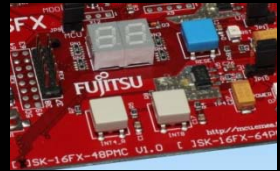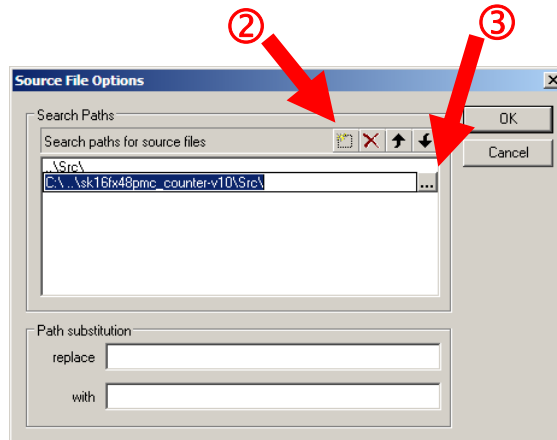
EUROScope lite 16FX Start Debugging

■ **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
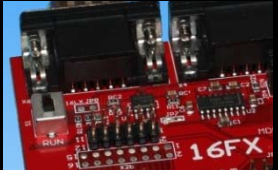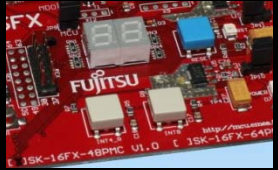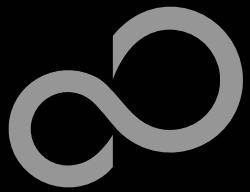
EUROScope lite 16FX Breakpoints

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

Yellow arrow shows actual programm counter

Point indicates breakable source code line

```
131  ⇨  while(1)
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
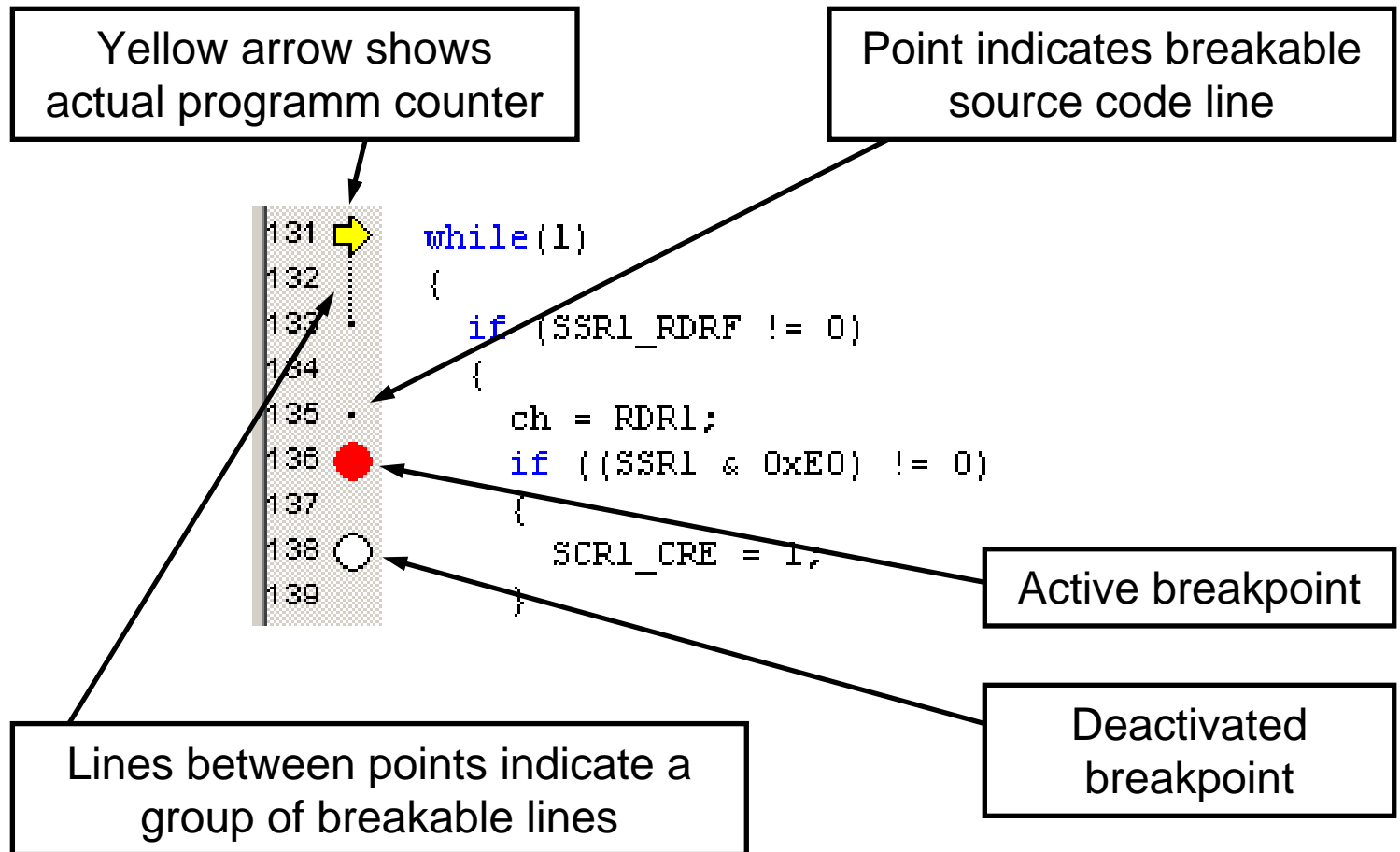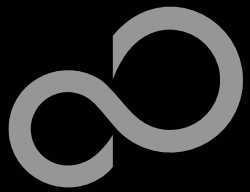
EUROScope lite 16FX Processor Status

- **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**
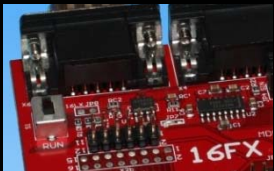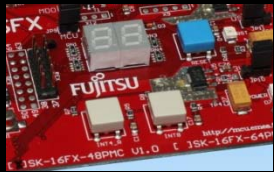
```
Register: unknown register                              ▲ ✕

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
```

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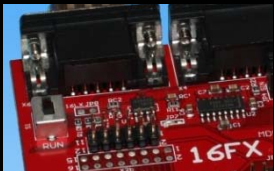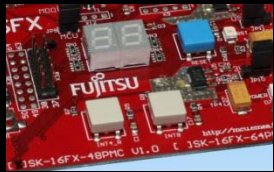
Variable	Value	Type	Storage	Module	Address	Size
cnt1	22 '.'	char	0x2246	main	0x2246	1 byte
cnt2	9 '.'	char	0x2245	main	0x2245	1 byte
cntdir	0 '.'	char	0x2244	main	0x2244	1 byte
delay	40144	unsigned long	0x2240	main	0x2240	4 byte

Local / Global / **Watch** / this
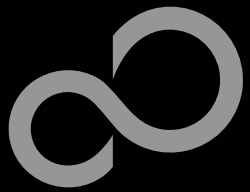
EUROScope lite 16FX Memory View

- **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**
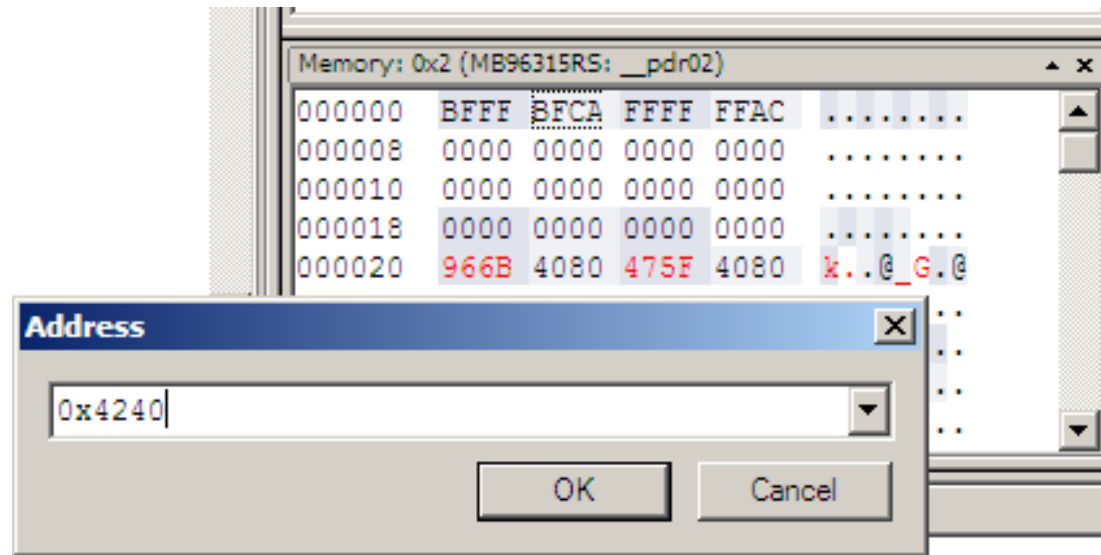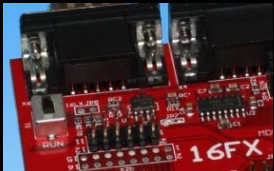
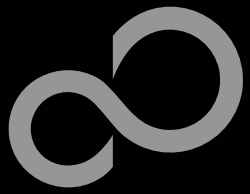# EUROScope lite 16FX Changing/Adding Source Window

■ **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
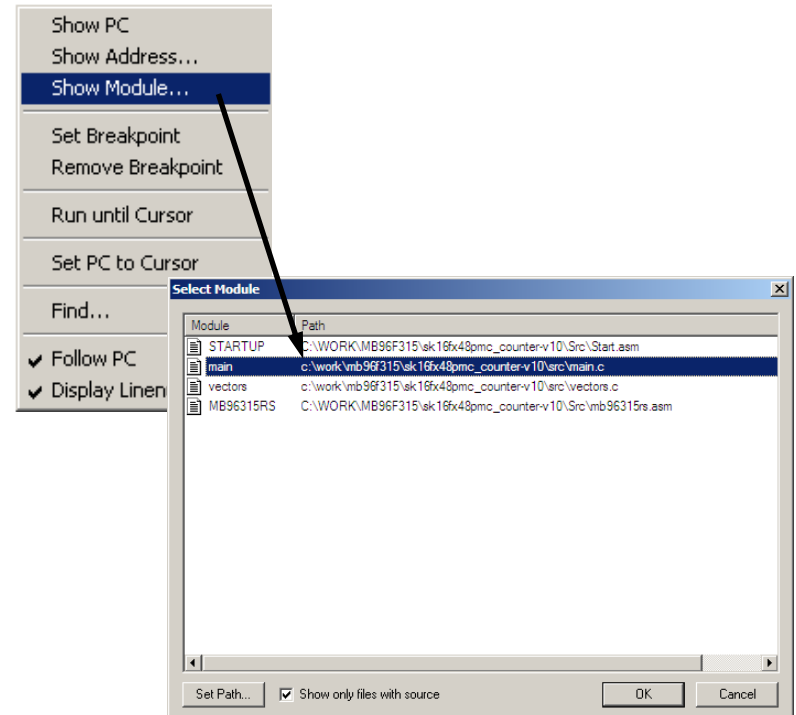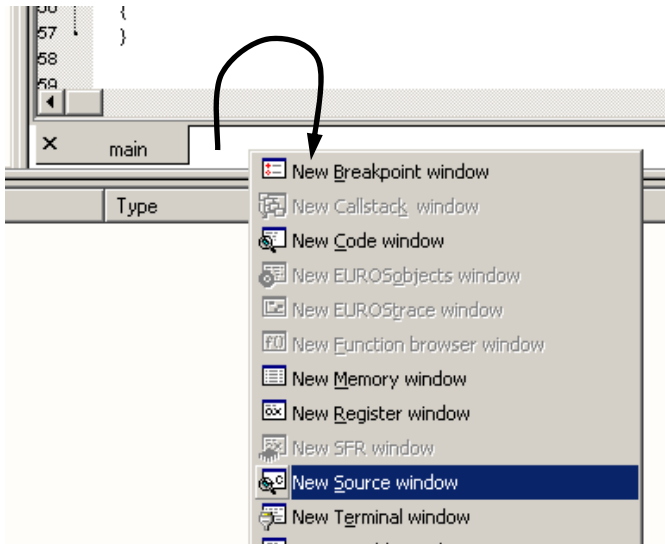
EUROScope lite 16FX Flash Programming

■ **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
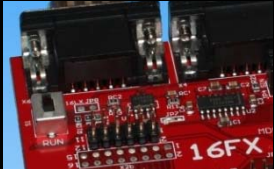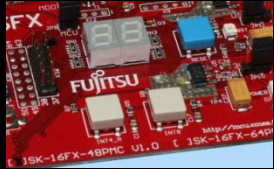
EUROScope lite 16FX
BDM Configuration

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

Flash security unlock keys

BDM Activation
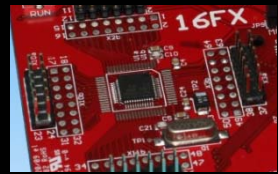
[√] Use EUROScope configuration
[ ] Use MHX file configuration
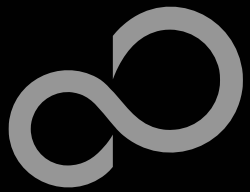
EUROScope lite 16FX
Flash Programming Dialog

■ **Chip erase and Flash programming**

● Click on ‚Done' and reset board after programming

Chip erase (‚all sectors' must be checked)

Flash Programming

Chip	Flash 0 00DF0000h .. 00DF7FFFh 32 KB Unknown (430000ee) internal flash (int)	Erase
	Flash 1 00F80000h .. 00FFFFFFh 512 KB Unknown (430000ee) internal flash (mai)	

Sectors	Flash 1 Sector 0 00F80000h .. 00F8FFFFh 64 KB	☑ all sectors
	Flash 1 Sector 1 00F90000h .. 00F9FFFFh 64 KB	
	Flash 1 Sector 2 00FA0000h .. 00FAFFFFh 64 KB	
	Flash 1 Sector 3 00FB0000h .. 00FBFFFFh 64 KB	
	Flash 1 Sector 4 00FC0000h .. 00FCFFFFh 64 KB	
	Flash 1 Sector 5 00FD0000h .. 00FDFFFFh 64 KB	
	Flash 1 Sector 6 00FE0000h .. 00FEFFFFh 64 KB	
	Flash 1 Sector 7 00FF0000h .. 00FFFFFFh 64 KB	

Browse to MHX file

File | C:\WORK\MB96F315\sk16fx48pmc_counter-v10\ABS\sk16fx48pmc_counter.m | ... | Program

☐ Use this base address: 0x0   ☐ Auto load when programmed

Fill gaps up to 0 bytes with 0xFF ☐ Reconfigure when programmed

Status

Progress

Flash programming

Info | 10 sections from 0xDF0000 to 0xFFFFDE
1: 0xDF0000..0xDF0001
2: 0xDF001C..0xDF001F
3: 0xDF0030..0xDF0037
4: 0xDF0040..0xDF004B

Done

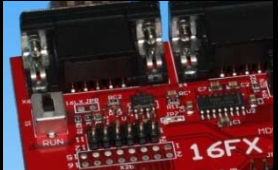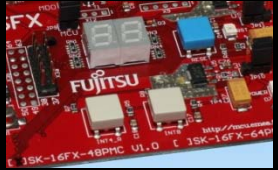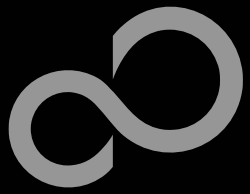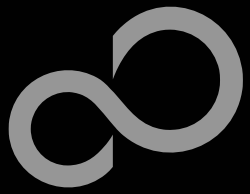# EUROScope lite 16FX Prospect

- **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
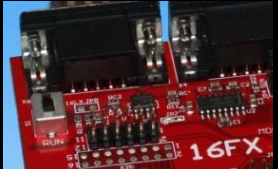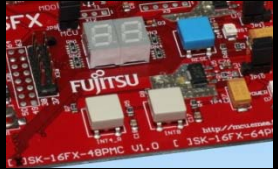 - Autorun after reset
  - No breakpoint predefinition

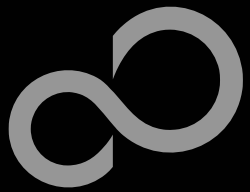- **For more details of „EUROScope lite 16FX"
  please refer to application note:**
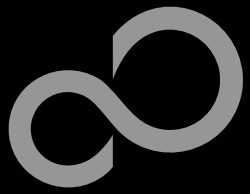 - mcu-an-300235-e-16fx_using_EUROScope

FreeRTOS™

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
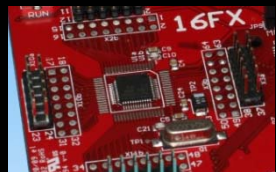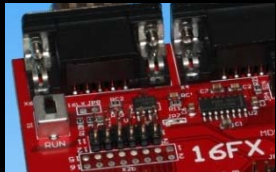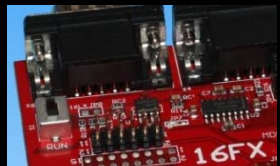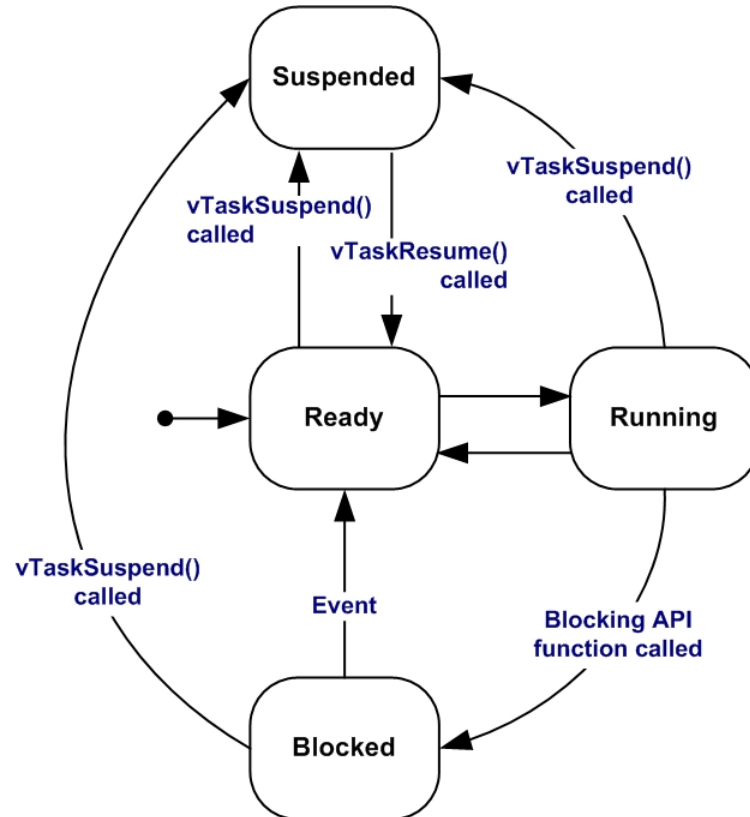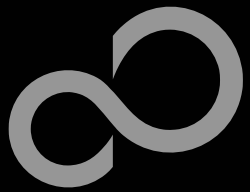
FreeRTOS™ - Tasks

■ Autonomous

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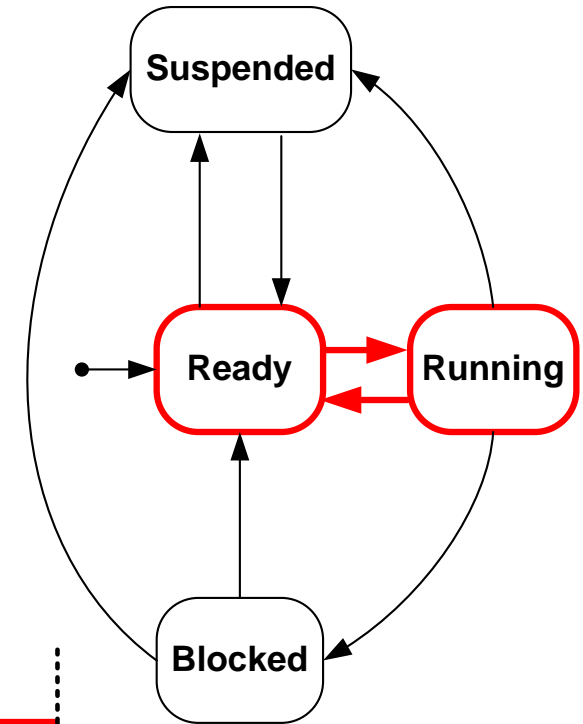

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FreeRTOS™ - Multitasking

- **Prioritised Pre-emptive Multitasking**

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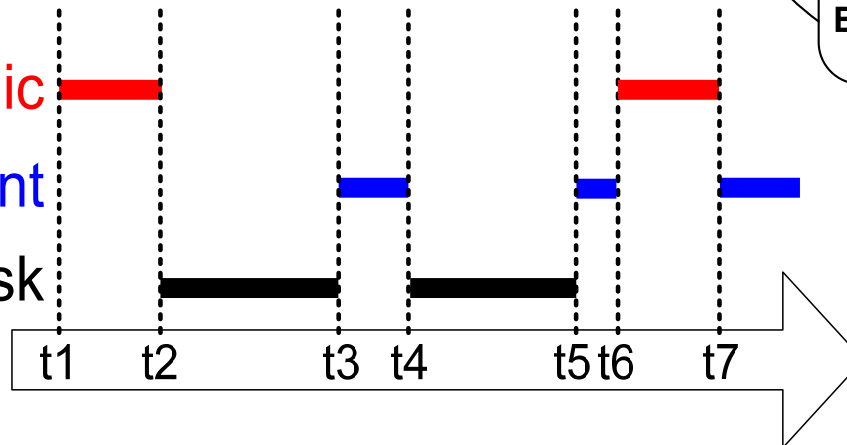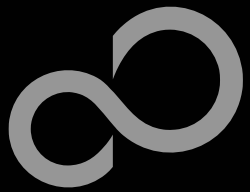

Suspended / Ready / Running / Blocked state diagram

med, periodic
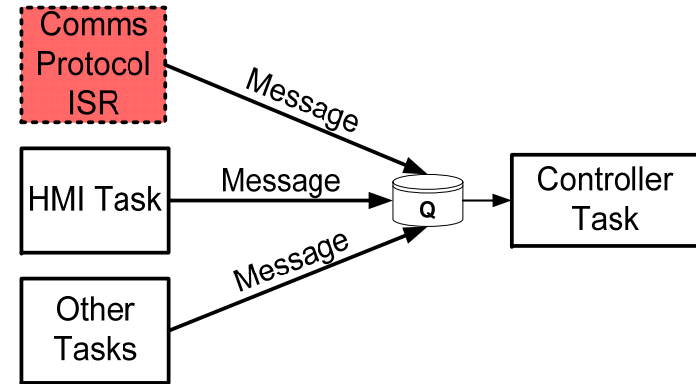
low, event

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 );
    }
}
```
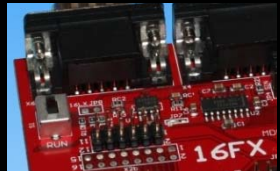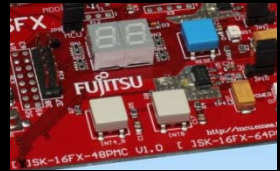
FreeRTOS™ - Mutexes

- **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");
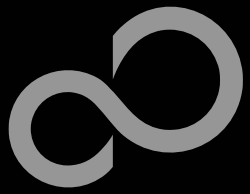
Task 2
xSemaphoreTake()

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
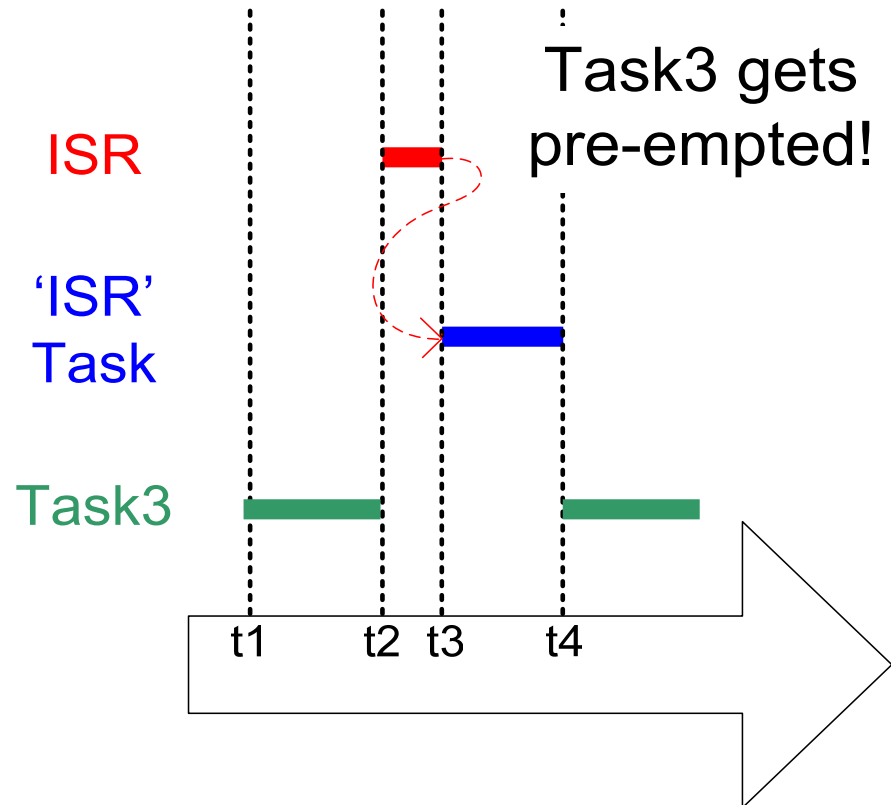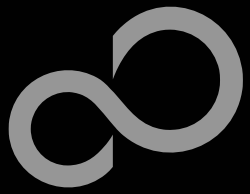
FreeRTOS™ - Binary Semaphores

■ **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. */
  }
}
```
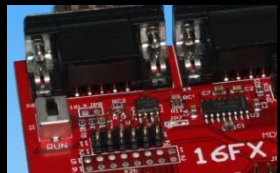
FreeRTOS™

- **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/

USING THE FreeRTOS
REAL TIME KERNEL

FreeRTOS REFERENCE
MANUAL

API Functions and
Configuration Options
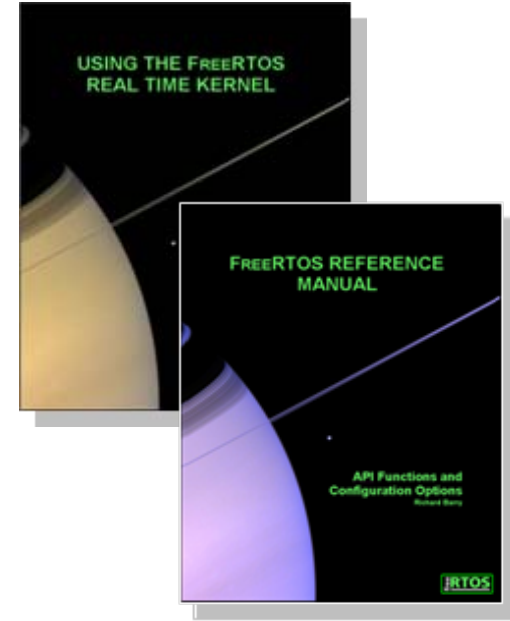
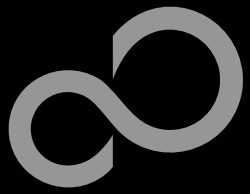- **FreeRTOS™ incl. one example is provided by this starterkit**

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

**58**
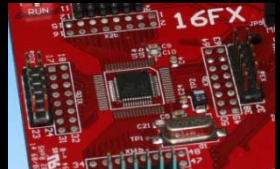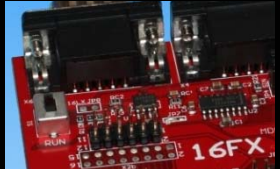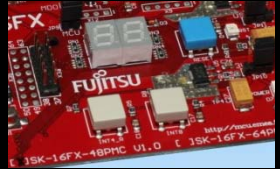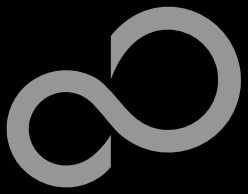
FUJITSU

THE POSSIBILITIES ARE INFINITE

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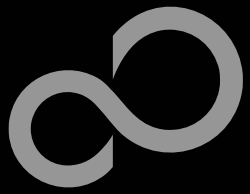
■ **In order to learn more about Fujitsu's microcontrollers**

- 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
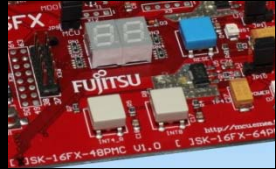
Optional Tools

- **<u>High-end evaluation board</u>**
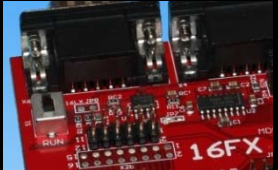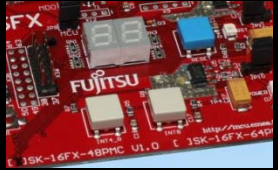 - SK-96310-48PMC (Supports LQFP package M26)

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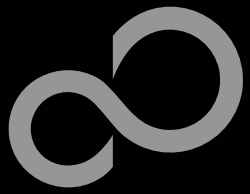 - MB2198-01 + MB2198-500
  - Emulation chip MB96V300B
  - Probe header MB2198-509 for LQFP package M26
    - Socket NQPACK048SD, HQPACK048SD

- **<u>Programmer</u>**
  - Conitec GALEP-4
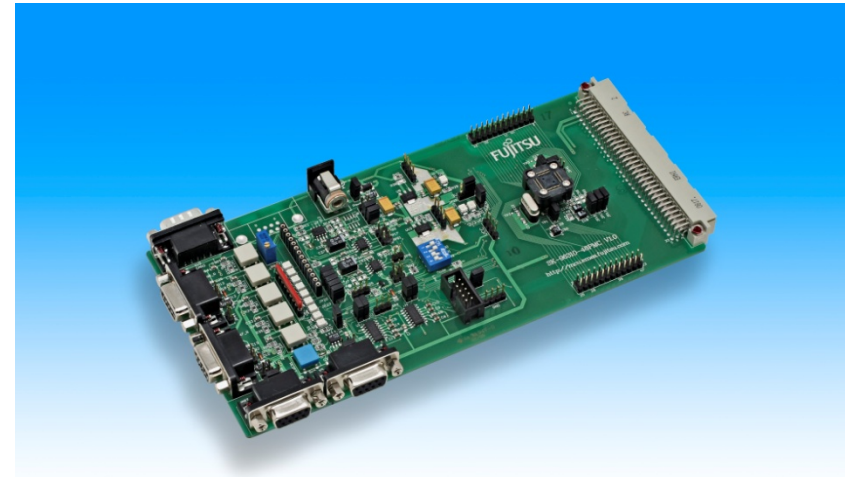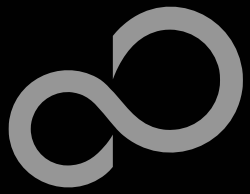
- **<u>Operating systems</u>**

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
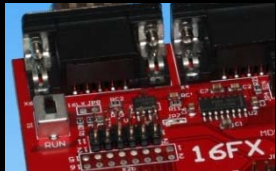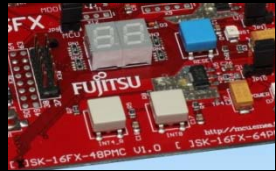- Connector for LC-Display
- Example projects

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)
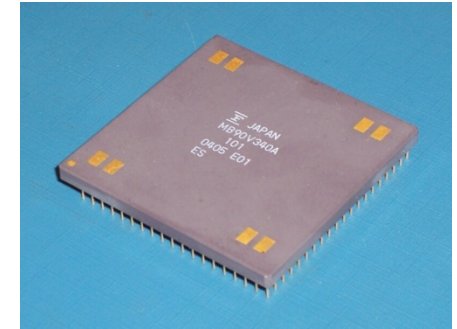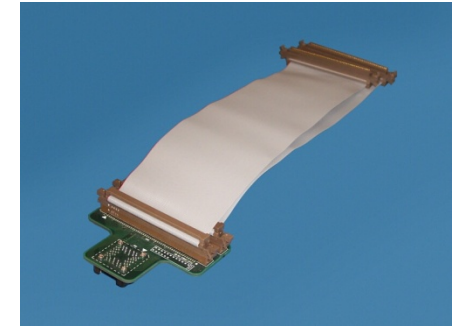- Trace function

Hardware Emulator

- **Emulation chip MB96V300B**
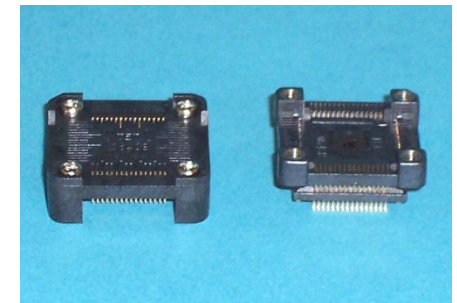 - Superset supports all features of 16FX

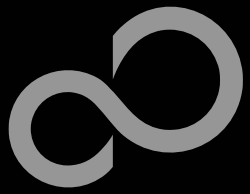- **Probe header**
  - MB2198-509 for LQFP package M26

- **Socket for LQFP package M26**
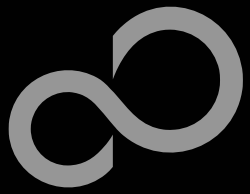 - NQPACK048SD, HQPACK048SD

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

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**
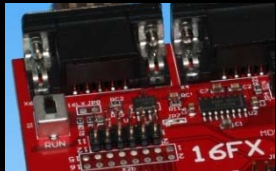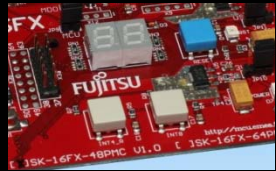 - Small memory footprint for single-chip applications incl. PC viewer
  - www.segger.com

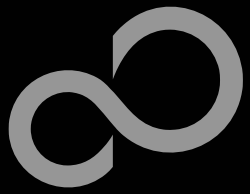- **osCAN (OSEK/VDX)**
  - osCAN (OSEK/VDX) and further networking software CAN, LIN, FlexRay, etc.
  - www.vector-informatik.de

- **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**
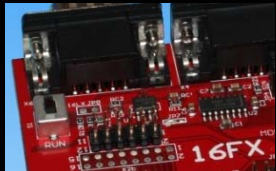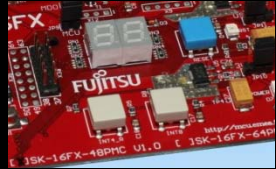
Fujitsu Semiconductor Europe

- **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
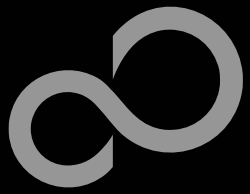 - Tel: (02) 90 45 02 1, Fax: (02) 90 75 00 87
- **United Kingdom**
  - Network House, Norreys Drive, Maidenhead, Berkshire SL6 4FJ
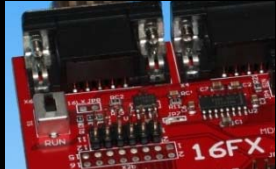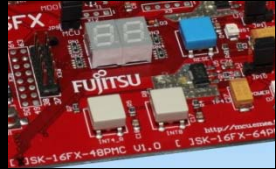 - Tel: (01628) 50 46 00, Fax: (01628) 50 46 66

- **World Wide Web**
  - http://emea.fujitsu.com/semiconductor
  - http://mcu.emea.fujitsu.com
  - Contact: mcu_ticket.FSEU@de.fujitsu.com

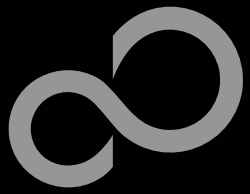# EU-Konformitätserklärung / EU declaration of conformity

 C €

**Hiermit erklären wir, Fujitsu Semiconductor Europe GmbH, Pittlerstrasse 47, 63225 Langen, Germany
dass dieses Board aufgrund seiner Konzipierung und Bauart sowie in den von uns in Verkehr gebrachten
Ausführung(en) den grundlegenden Anforderungen der EU-Richtlinie 2004/108/EC „Elektromagnetische Verträglichkeit"
entspricht. Durch eine Veränderung des Boards (Hard- und/ oder Software) verliert diese Erklärung ihre Gültigkeit!**

**We, Fujitsu Semiconductor Europe GmbH, Pittlerstrasse 47, 63225 Langen, Germany
hereby declare that the design, construction and description circulated by us of this board
complies with the appropriate basic safety and health requirements according to the EU Guideline 2004/108/EC entitled
'Electro-Magnetic Compatibility'. Any changes to the equipment (hardware and/ or software) will render this declaration
invalid!**

Note:

**All data and power supply lines connected to this starter kit should be kept as short as possible, with a maximum
allowable length of 3m. Shielded cables should be used for data lines. As a rule of thumb, the cable length used when
connecting external circuitry to the MCU pin header connectors for example should be less than 20cm. Longer cables
may affect EMC performance and cause radio interference.**

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:
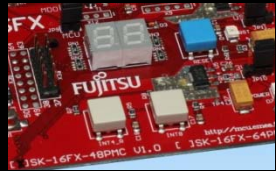
■ **Valid for European Union Countries:**

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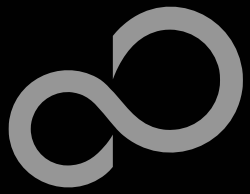- For disposal please send the device to the following address:

Fujitsu Semiconductor Europe GmbH

Warehouse/Disposal

Monzastraße 4a

D-63225 Langen

Fujitsu Semiconductor 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