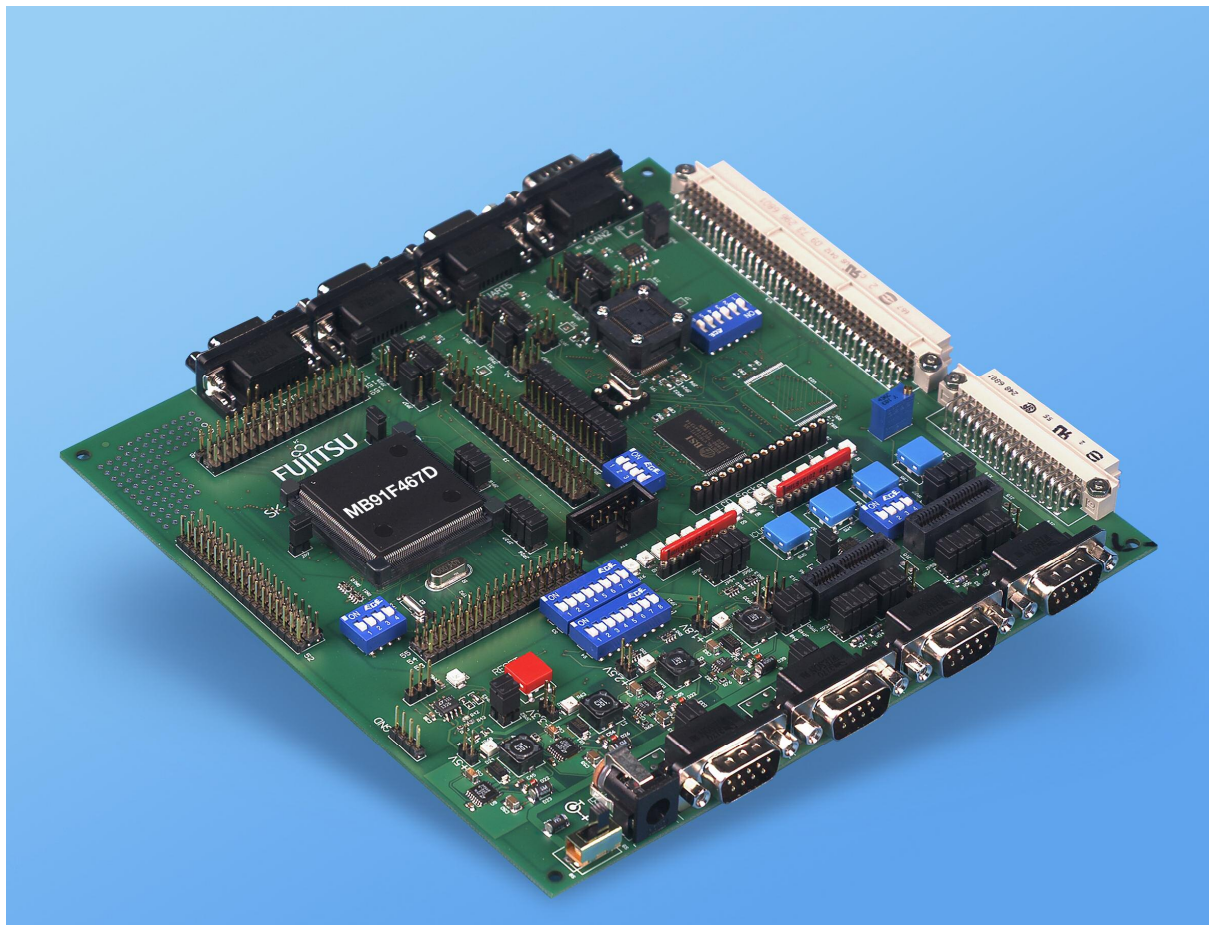


MB88121 SERIES MB91460 SERIES STARTER KIT SK-91F467-FLEXRAY

USER GUIDE



Revision History

| Date | Issue |
|------------|--|
| 22/11/2005 | V1.0, MSt, first official version |
| 01/06/2006 | V1.1, MSt SK-91F467D-208PFV information removed, Getting started chapter changed to new Monitor debugger version |
| | |

This document contains 73 pages.

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1 Introduction

1.1 Abstract

The SK-91F467-FLEXRAY is a multifunctional development board for the FUJITSU FlexRay communication controller MB88121 and the 32-bit Flash microcontroller MB91F467DA. It can be used stand alone for software development and testing or together with monitor-debugger software.

The board allows the designer immediately to start with the software and system development, before his own final target system is available.

1.2 Features

- Supports 32-bit Flash microcontroller MB91F467D
- Supports FlexRay CC MB88121
- 9-12V (2000mA) unregulated external DC power supply
- 5V, 3.3V, 2.5V and 1.8V on-board switching regulators with power status-LEDs
- Triple supply monitor to watch 5V, 3.3V and selectable 2.5V or 1.8V
- On-board Memory:
 - 32Mbit (4MByte) SRAM
- It is possible to connect the FlexRay CC in different ways to the MCU
 - 16 bit non multiplexed / multiplexed bus
 - 8 bit non multiplexed / multiplexed bus
 - SPI communication
- All microcontroller resources available for evaluation
- All microcontroller pins routed to pin header
- In-Circuit serial Flash programming
- Three selectable RS-232 or LIN UART-interfaces
- Three High-Speed CAN interfaces
- Two FlexRay channels (Ch-A, Ch-B)
 - FlexRay physical layer RS-485 available
 - FlexRay physical layer driver module from TSM (FT1080) connectable
- 16 User LEDs
 - optional: alphanumeric standard LC-Display connectable
- Reset button, Reset-LED
- 4 User buttons, one 8 bit MCU port can be connected to DIP switches
- External bus interface routed to 96pin and 48pin DIN 41612 (VG) connectors

**This board must only be used for test applications
in an evaluation laboratory environment.**

1.3 General Description

The SK-91F467-FLEXRAY supports the FUJITSU 32-bit Flash microcontroller MB91F467D and the FUJITSU FlexRay stand alone communication controller MB88121.

The Starter Kit can be used as a stand-alone development platform, or if a MCU socket is soldered instead of the Flash MCU MB91F467D, with the emulation system MB91V460 adapter board (MB2198-300) and 208 pin probe cable board (PB-91467D-NLS-208PFV).

This User Guide is describing PCB version V1.1. The PCB version is printed at the TOP side of the starter kit close to MB91F467D MCU [U1].

1.3.1 On Board Memory

The starter kit includes 32MBit (4MByte) SRAM memory on board. The SRAM can be used with 5V, or with 3.3V external bus supply voltage.

1.3.2 MCU Clocks

The board is supplied with a 4MHz crystal as the main oscillation clock for the MCU. Using the internal PLL of the MCU, internal clock rates up to 100MHz can be achieved. The MCU sub clock is connected to a 32.768 kHz crystal.

1.3.3 MCU Operating Mode

The operating mode of the microcontroller can be selected with the Dip-switch S5.

1.3.4 FlexRay CC Clock

The FlexRay CC clock is operated by a 10MHz crystal mounted in a socket. By removing the 10MHz crystal it is also possible to use an external clock oscillator.

1.3.5 FlexRay CC-MCU Connection

The FlexRay CC (MB88121) is connected to the MCU via external bus. It is possible to use it in 8 bit / 16 bit multiplexed, 8 bit / 16 bit non multiplexed or SPI communication-mode (dependent from revision of MB88121). With jumper or switches the user can change between the different modes.

1.3.6 External Bus interface Connectors

Via DIN 41612 VG96ABC and VG48ABC connectors (external bus interface of the MCU), it is possible to connect the FlexRay FPGA Board to the Starter Kit and use the FPGA as FlexRay communication controller. It is also possible to connect other devices e.g. user applications or Fujitsu graphic device sub boards.

1.3.7 FlexRay Physical Layer

The connection to the physical layer of the FlexRay bus with 9-pin D-Sub connectors (X2 and X6) is realized with RS485 transceiver, or it is also possible to deselect the RS485 transceiver and use pluggable physical layer driver module from TZM (FT1080) instead.

1.3.8 CAN Bus

Three high-speed CAN-transceivers (PCA82C250) are available to connect all available on-chip CAN-controllers to 9-pin D-Sub connectors (X9, X10 and X11). The transceivers provides differential transmit and receive capability between CAN-controller and CAN-bus.

1.3.9 RS-232 and LIN

RS-232 and LIN signals are shared on the 9-pin D-Sub connectors (X1, X4 and X8). It can be selected, if RS-232 or LIN will be used.

Three separate RS-232 transceivers and three separate LIN transceivers are available, to connect the on-chip USARTs to the 9-pin D-Sub connectors.

The RS-232 transceivers generate the adequate RS-232 levels for receive (RXD) and transmit (TXD) lines. The RTS signal can be shortcut to CTS using jumpers (some PC software needs this connection, when a 1:1 cable is used).

Either the DTR line or the RTS line of X1, X4 or X8 connectors can be selected to generate a system reset.

The LIN transceivers (TLE6259) generate the adequate levels to drive the bus line in LIN-systems for automotive and industrial applications.

1.3.10 MCU Pins

All 208 pins of the microcontroller are connected to the edge connectors J1, J2, J3 and J4 and are directly available to the user.

1.3.11 User Buttons

There are four push buttons on board, which can be connected to input-ports of the microcontroller. Some ports may support additional functions like external interrupts (INT0, INT1 and INT2) and trigger for the Reload Timer or Input-Capture (TIN0 / ICU0). One additional button is reserved as System-Reset-button to reset the MCU and the FLEXRAY CC simultaneously, but it is possible to disconnect the RST-ports with JP52 or JP54.

It is possible to connect with Dip-switch S3 eight port input switches at S4 to the MCU port P26_D0 – P26_D7. All eight ports can be switched separately to use e.g. only four ports as input.

1.3.12 User LEDs and optional LCD

Sixteen user-LEDs are connected via two pull-down resistor networks to port P25_D0 - P25_D7 and to port P16_D0 - P16_D7. Parallel to the LEDs on port P25, the connector J6 can be used to connect a standard alphanumeric display. The resistor networks RN2 and RN3 can be removed, to free the ports.

1.3.13 Power Supply

The four on-board step-down switching regulators allow the user to connect an unregulated DC input voltage between +9V to +12V (max. 2000mA) to the starter-kit. The switching regulators provide the voltages of 5V (3A), 3.3V (3A), 2.5V (1,5A) and 1.8V (1,5A) on the starter kit. These voltages give also the possibility, to connect an optional graphic-controller starter kit to the board. The switching regulators are short circuit protected and provide a thermal shutdown.

If the SK-91F467-FLEXRAY starter-kit is connected to the Fujitsu FlexRay FPGA-board it is possible, that the power supply for the SK-91F467-FLEXRAY will be provided by the FPGA-board and a power supply connection to the SK-91F467-FLEXRAY is not needed. For that case the pins 14B, 15B and 16B of DIN 41612 VG48ABC connector X14 are used as voltage input behind the SK-91F467-FLEXRAY on-board power switch, so that the power switch on the FPGA board switches the whole system.

2 Installation

Remove the board carefully from the shipping carton.

First check if there are any damages before power on the starter kit.

To supply the starter kit, use the delivered In-Plug AC-DC Adapter (UPA 2000). Select the AC plug adapter suitable for your country power sockets



Figure 2-1: AC plug adapter

and insert this adapter into the connection terminal on the AC-DC adapter.

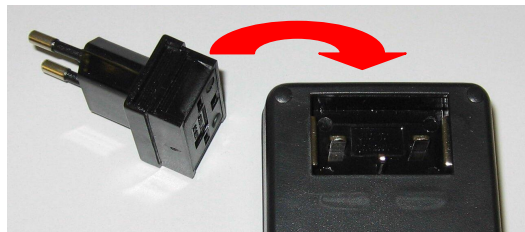


Figure 2-2: AC plug adapter selection

Check the selected output DC voltage of the AC-DC In-Plug adapter at the voltage selection key. It should be 9V! Change the output voltage only in a powered-down condition!



Figure 2-3: DC voltage selection

Select the low voltage adapter suitable to the power connector X5 at the SK-91F467-FLEXRAY and plug it to the connecting socket in the right orientation (+ connected to shield and GND connected to centre pin).

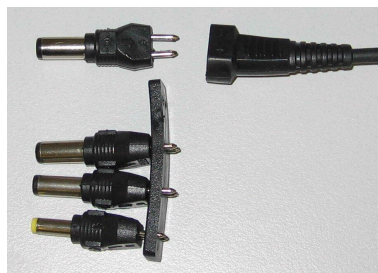


Figure 2-4: Low voltage adapter selection

Now connect the DC low voltage adapter to the Starter kit and plug in the In-Plug Power Supply to a power socket. The SK-91F467-FLEXRAY can be turned on with the on board power switch S8 (or S9).

For the power supply of the SK-91F467-FLEXRAY a DC input voltage of 9V – 12V is recommended. The positive voltage (+) must be connected to the shield, and ground (GND) must be connected to the centre of the connector X5!

After power-on of the SK-91F467-FLEXRAY, the four red power-on LEDs D24 (5V), D30 (3.3V), D34 (2.5V) and D40 (1.8V) should be light. The reset LED D18 should be off.

Additionally the LED D2 and D4 should be on. The starter kit is delivered with programmed Softune Workbench Monitor Debugger in internal Flash of MB91F467D series. The monitor debugger is checking also the external SRAM access at CS1. In case of successful access to external SRAM the LED D2 and D4 are ON. In case of failed access LED D1 and D4 are set to ON.

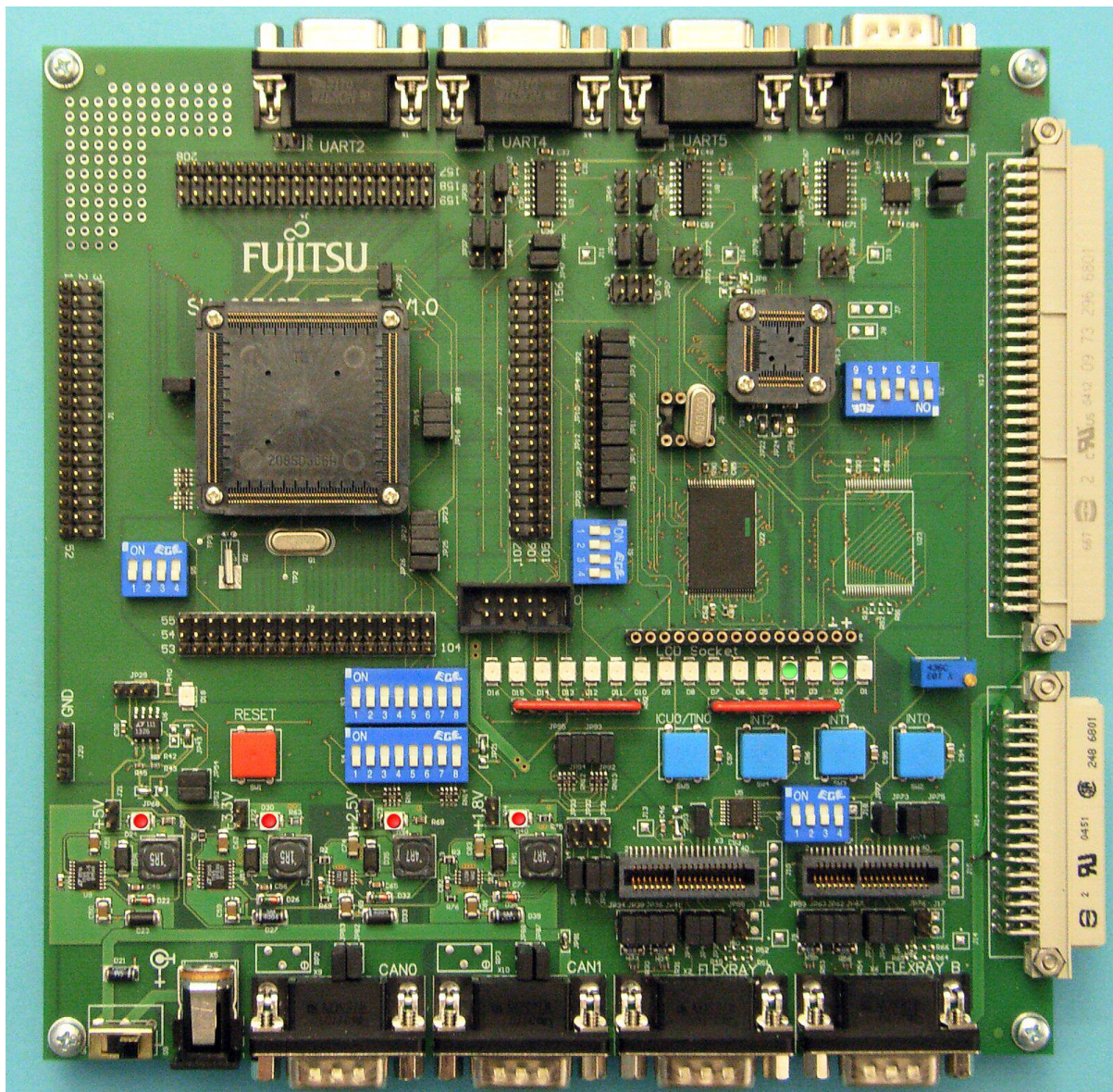


Figure 2-5: Starter kit status after power on

2.1 Jumper Settings

The following table lists all jumpers including its default setting and location on the starter kit. The default jumper setting is described for 16 bit non multiplexed bus communication between MCU and FlexRay CC.

| Jumper | Description / Function | Type | Default | Layout Coordinates | Schematic Page |
|--------|-------------------------------|---------------------|---------|--------------------|----------------|
| JP1 | ASSP A10 / INT2 | Jumper 3 pin | 1-2 | G 7 | 1 / 3 |
| JP2 | ASSP A9 / INT3 | Jumper 3 pin | 1-2 | G 7 | 1 / 3 |
| JP3 | ASSP A5 / SCK | Jumper 3 pin | 1-2 | G 8 | 1 / 3 |
| JP4 | ASSP A4 / SDI | Jumper 3 pin | 1-2 | G 8 | 1 / 3 |
| JP5 | ASSP A3 / SDO | Jumper 3 pin | 1-2 | G 8 | 1 / 3 |
| JP6 | ASSP BCLK – MCU MCLKI | Solder Jumper 2 pad | Closed | K 9 | 1 / 3 |
| JP7 | ASSP – MCU A0 connection | Jumper 2 pin | Closed | B 8 | 1 / 3 |
| JP8 | ASSPVcc 5V / 3.3V | Solder Jumper 3 pad | 1-2 | J 6 | 1 / 3 |
| JP9 | ASSPVcc1 ASSPVcc / 3.3V | Solder Jumper 3 pad | 1-2 | J 6 | 1 / 3 |
| JP10 | ASSP D10 / MDS2 | Jumper 3 pin | 1-2 | G 8 | 1 / 3 |
| JP11 | ASSP D9 / MDS1 | Jumper 3 pin | 1-2 | G 9 | 1 / 3 |
| JP12 | ASSP D8 / MDS0 | Jumper 3 pin | 1-2 | G 9 | 1 / 3 |
| JP13 | ASSP C-Pin – 1.8V | Solder Jumper 2 pad | Closed | K 8 | 1 / 3 |
| JP14 | ASSP D5 / INT2 | Jumper 3 pin | 1-2 | G 9 | 1 / 3 |
| JP15 | MCUVcc - AVcc | Jumper 2 pin | Closed | E 9 | 1 / 3 |
| JP16 | AVcc - AVRH | Jumper 2 pin | Closed | E 9 | 1 / 3 |
| JP17 | ASSP D4 / INT3 | Jumper 3 pin | 1-2 | G 10 | 1 / 3 |
| JP18 | GND - AVss | Jumper 2 pin | Closed | E 8 | 1 / 3 |
| JP19 | ASSP CS CSX3 / CSX6 | Jumper 3 pin | 1-2 | G 10 | 1 / 3 |
| JP20 | ASSP ALE / INT2 | Jumper 3 pin | 1-2 | G 10 | 1 / 3 |
| JP21 | VDD35 MCUVcc / 3.3V | Solder Jumper 3 pad | 1-2 | F 15 | 1 / 3 |
| JP22 | ASSP BGT – 1.8V | Solder Jumper 2 pad | Closed | J 9 | 1 / 3 |
| JP23 | MCUVcc – HVDD5 | Jumper 2 pin | Closed | E 10 | 1 / 3 |
| JP24 | ASSP MT - GND | Solder Jumper 2 pad | Closed | K 9 | 1 / 3 |
| JP25 | MCUVcc – VDD5R | Jumper 2 pin | Closed | E 11 | 1 / 3 |
| JP26 | Vcc - MCUVcc | Jumper 2 pin | Closed | E 11 | 1 / 3 |
| JP27 | MCUVcc – VDD5 | Jumper 2 pin | Closed | E 11 | 1 / 3 |
| JP28 | GND – HVSS5 | Jumper 2 pin | Closed | E 6 | 1 / 3 |
| JP29 | DTR select DTR / /DTR | Jumper 3 pin | Open | B 14 | 2 / 3 |
| JP30 | UART2 RTS - CTS | Jumper 2 pin | Open | D 3 | 2 / 3 |
| JP31 | FlexRay nSTB – P18_6 | Jumper 2 pin | Open | G 16 | 2 / 3 |
| JP32 | FlexRay WAKE – P18_5 | Jumper 2 pin | Open | G 16 | 2 / 3 |
| JP33 | FlexRay EN – P18_4 | Jumper 2 pin | Open | G 16 | 2 / 3 |
| JP34 | FlexRay CHA RS485 Termination | Jumper 2 pin | Closed | H 18 | 2 / 3 |
| JP35 | FlexRay RxD_A | Jumper 2 pin | Closed | J 18 | 2 / 3 |
| JP36 | FlexRay CHA RS485 Termination | Jumper 2 pin | Closed | H 18 | 2 / 3 |
| JP37 | UART2 RxD RS232 / LIN | Jumper 3 pin | 2-3 | F 5 | 2 / 3 |
| JP38 | FlexRay CHA RS485 - BM | Jumper 2 pin | Closed | H 18 | 2 / 3 |
| JP39 | UART2 DTR / RTS | Jumper 3 pin | Open | F 4 | 2 / 3 |
| JP40 | FlexRay TxEN_A | Jumper 2 pin | Closed | J 18 | 2 / 3 |
| JP41 | FlexRay CHA RS485 - BP | Jumper 2 pin | Closed | H 18 | 2 / 3 |
| JP42 | Watch 1.8V | Solder Jumper 2 pad | Open | B 15 | 2 / 3 |
| JP43 | Watch 2.5V | Solder Jumper 2 pad | Closed | B 15 | 2 / 3 |
| JP44 | UART2 TxD RS232 / LIN | Jumper 3 pin | 2-3 | F 5 | 2 / 3 |
| JP45 | FlexRay TxD_A | Jumper 2 pin | Closed | H 18 | 2 / 3 |
| JP46 | UART2 RS232 / LIN | Jumper 3 pin | 2-3 | F 4 | 2 / 3 |
| JP47 | UART2 LIN Enable | Jumper 2 pin | Closed | G 6 | 2 / 3 |
| JP48 | FlexRay CHA EN | Jumper 2 pin | Closed | G 17 | 2 / 3 |
| JP49 | FlexRay CHA WAKE | Jumper 2 pin | Closed | G 17 | 2 / 3 |
| JP50 | FlexRay CHA nSTB | Jumper 2 pin | Closed | G 17 | 2 / 3 |
| JP51 | UART2 LIN Master Yes / No | Jumper 2 pin | Closed | G 5 | 2 / 3 |
| JP52 | RESET - ASSP RST | Jumper 2 pin | Closed | B 16 | 2 / 3 |
| JP53 | VccPL 5V / 3.3V | Solder Jumper 3 pad | 1-2 | H 16 | 2 / 3 |
| JP54 | RESET - MCU RST | Jumper 2 pin | Closed | B 15 | 2 / 3 |

| Jumper | Description / Function | Type | Default | Layout Coordinates | Schematic Page |
|--------|-------------------------------|---------------------|---------|--------------------|----------------|
| JP55 | FlexRay CHA nERR – P14_4 | Jumper 2 pin | Open | J 18 | 2 / 3 |
| JP56 | FlexRay CHA VBat | Jumper 2 pin | Closed | J 16 | 2 / 3 |
| JP57 | UARTX RST Select | Jumper 6 pin | Open | H 6 | 2 / 3 |
| JP58 | UART4 RTS - CTS | Jumper 2 pin | Closed | F 3 | 2 / 3 |
| JP59 | FlexRay CHB RS485 Termination | Jumper 2 pin | Closed | K 18 | 2 / 3 |
| JP60 | UART4 RxD RS232 / LIN | Jumper 3 pin | 1-2 | H 5 | 2 / 3 |
| JP61 | FlexRay RxD_B | Jumper 2 pin | Closed | L 18 | 2 / 3 |
| JP62 | FlexRay CHB RS485 Termination | Jumper 2 pin | Closed | K 18 | 2 / 3 |
| JP63 | FlexRay CHB RS485 - BM | Jumper 2 pin | Closed | K 18 | 2 / 3 |
| JP64 | UART4 DTR / RTS | Jumper 3 pin | Open | H 4 | 2 / 3 |
| JP65 | UART4 TxD RS232 / LIN | Jumper 3 pin | 1-2 | H 5 | 2 / 3 |
| JP66 | FlexRay TxEN_B | Jumper 2 pin | Closed | L 18 | 2 / 3 |
| JP67 | FlexRay CHB RS485 - BP | Jumper 2 pin | Closed | K 18 | 2 / 3 |
| JP68 | Vcc 5V / 3.3V | Solder Jumper 3 pad | 1-2 | B 16 | 2 / 3 |
| JP69 | UART4 RS232 / LIN | Jumper 3 pin | 1-2 | H 4 | 2 / 3 |
| JP70 | FlexRay TxD_B | Jumper 2 pin | Closed | L 18 | 2 / 3 |
| JP71 | UART4 LIN Enable | Jumper 2 pin | Open | H 6 | 2 / 3 |
| JP72 | UART4 LIN Master Yes / No | Jumper 2 pin | Open | H 6 | 2 / 3 |
| JP73 | FlexRay CHB EN | Jumper 2 pin | Closed | L 16 | 2 / 3 |
| JP74 | FlexRay CHB WAKE | Jumper 2 pin | Closed | L 16 | 2 / 3 |
| JP75 | FlexRay CHB nSTB | Jumper 2 pin | Closed | L 16 | 2 / 3 |
| JP76 | FlexRay CHB nERR – P14_7 | Jumper 2 pin | Open | L 18 | 2 / 3 |
| JP77 | FlexRay CHB VBat | Jumper 2 pin | Closed | L 16 | 2 / 3 |
| JP78 | UART5 RTS - CTS | Jumper 2 pin | Closed | H 3 | 2 / 3 |
| JP79 | UART5 RxD RS232 / LIN | Jumper 3 pin | 1-2 | J 5 | 2 / 3 |
| JP80 | UART5 DTR / RTS | Jumper 3 pin | Open | J 4 | 2 / 3 |
| JP81 | UART5 TxD RS232 / LIN | Jumper 3 pin | 1-2 | K 5 | 2 / 3 |
| JP82 | CAN0 RxD | Jumper 2 pin | Closed | D 19 | 2 / 3 |
| JP83 | CAN0 TxD | Jumper 2 pin | Closed | D 19 | 2 / 3 |
| JP84 | UART5 RS232 / LIN | Jumper 3 pin | 1-2 | K 4 | 2 / 3 |
| JP85 | UART5 LIN Enable | Jumper 2 pin | Open | K 6 | 2 / 3 |
| JP86 | UART5 LIN Master Yes / No | Jumper 2 pin | Open | K 6 | 2 / 3 |
| JP87 | CAN1 RxD | Jumper 2 pin | Closed | G 19 | 2 / 3 |
| JP88 | CAN1 TxD | Jumper 2 pin | Closed | F 19 | 2 / 3 |
| JP89 | CAN2 RxD | Jumper 2 pin | Closed | M 4 | 2 / 3 |
| JP90 | CAN2 TxD | Jumper 2 pin | Closed | M 4 | 2 / 3 |
| JP91 | Vin – Ext Voltage | Solder Jumper 2 pad | Closed | G 18 | 3 / 3 |
| JP92 | INT0 | Jumper 2 pin | Closed | G 15 | 3 / 3 |
| JP93 | INT1 | Jumper 2 pin | Closed | G 15 | 3 / 3 |
| JP94 | INT2 | Jumper 2 pin | Closed | G 15 | 3 / 3 |
| JP95 | ICU0/TIN0 | Jumper 2 pin | Closed | G 15 | 3 / 3 |
| JP96 | Direct RESET | Solder Jumper 3 pad | 1-2 | A 14 | 2 / 3 |
| JP97 | VCC1V8 to X14B2 | Solder Jumper 2 pad | Closed | H 16 | 3 / 3 |

Table 2-1: Jumper settings

2.2 Jumper Location

The following picture shows the silk plot of the starter kit with marked default jumper settings.

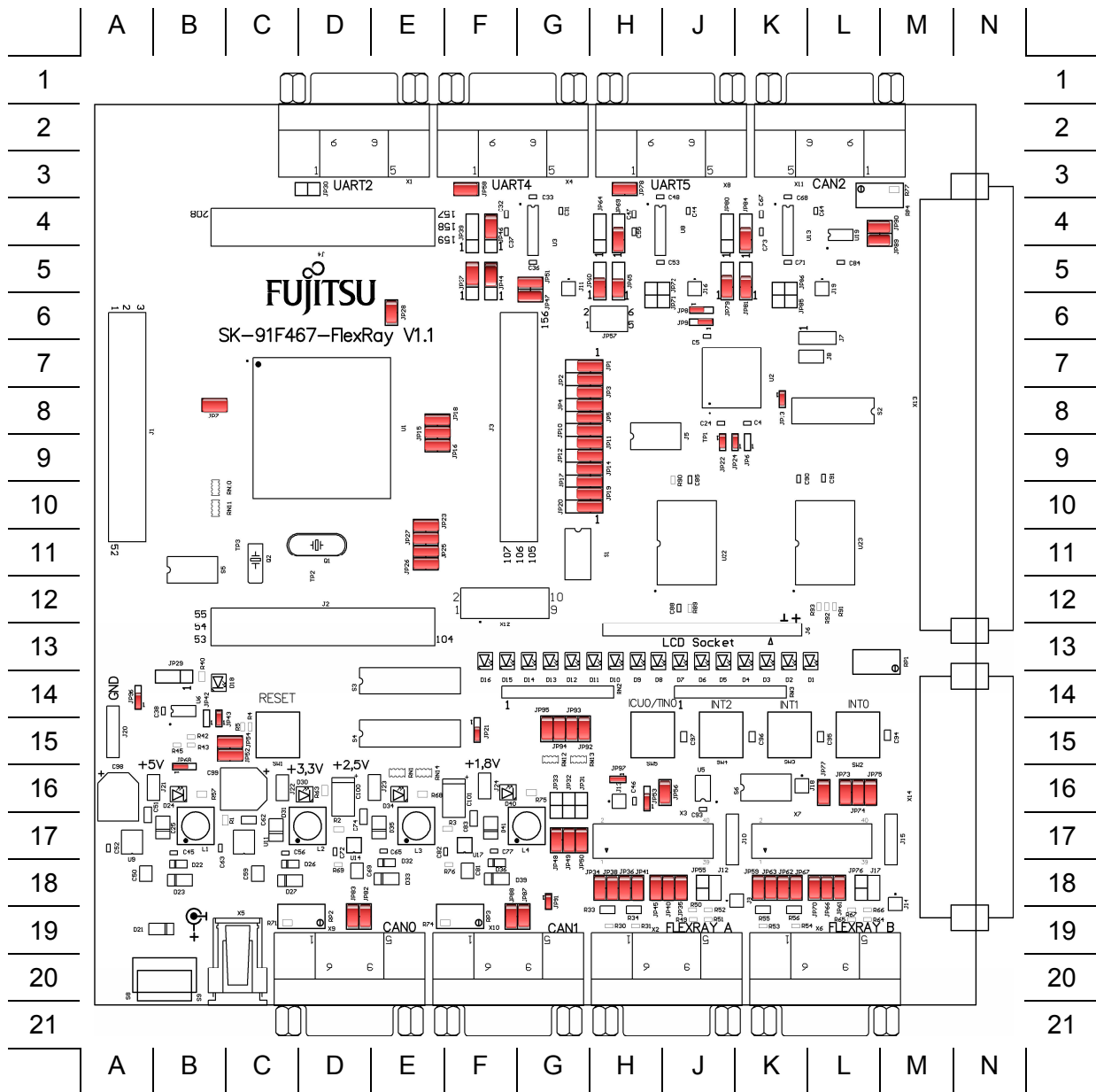


Figure 2-6: Default Jumper Settings

2.3 Software Installation

2.3.1 Installation of Softune Workbench

Fujitsu supplies a full working 32bit development environment with the “SK-91F467-FLEXRAY” starter kit called Softune Workbench V6. The Softune Workbench also supports a monitor debugger which is pre-programmed into the internal Flash memory of the “SK-91F467-FLEXRAY”. To develop own software and to work with the Monitor Debugger of the “SK-91F467-FLEXRAY” the Softune Workbench development environment must be installed first. Follow the instructions for successful installation of the Softune Workbench.

- 1) Before starting the installation setup ensure that you are logged in with administrator or power user permissions, otherwise the Softune installation will fail! Be aware that Softune does not support multi-user support. Therefore install- and user login must be the same.
- 2) Browse on the starter kit CD-ROM into the directory Software\SWBInstall and start the setup.exe

You can also start the installation using a browser by opening the index.html of the CD-ROM. Use the link “Software\Softune Workbench\” in the left side frame.
- 3) Follow the installation instructions
- 4) For the default installation path it is recommended to use c:\Softune32
- 5) After the installation is finished, Softune Workbench for FR can be started via the Windows “Start” menu



Figure 2-7: Softune Workbench start menu location

- 6) When Softune Workbench is started the following window will be shown

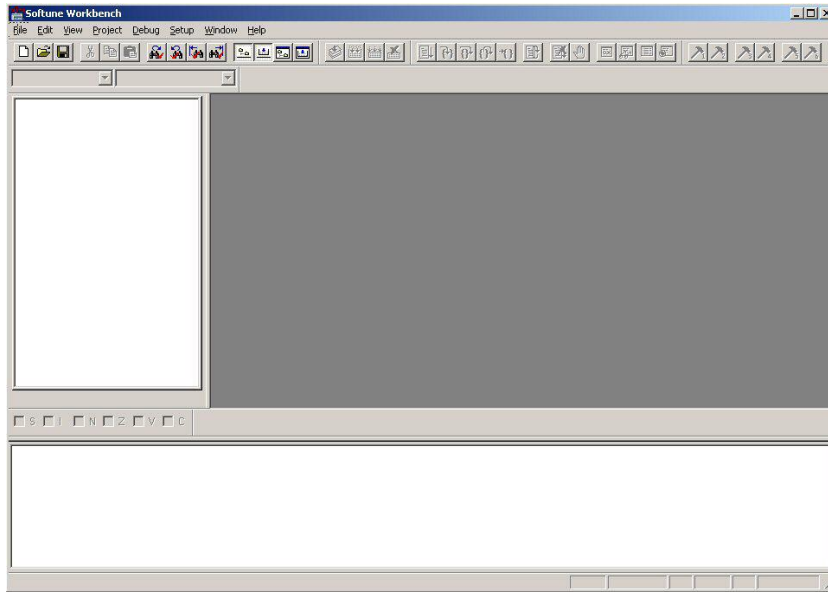


Figure 2-8: Softune Workbench V6 IDE

3 Jumpers and Switches

This chapter describes all jumpers and switches that can be modified on the starter kit. The default setting is shown with a grey shaded area.

3.1 MCU Operating-Mode (S5)

The DIP-switch S5 is used to set the operating mode of the MCU. Ensure that the mode pin settings correspond to the operation-mode of the application. For more detailed information please check the Hardware-Manual of the microcontroller.

| DIP switch | Setting | Logical value |
|-----------------|-------------|---------------|
| S5/1 (MD0) | ON (closed) | 1 (high) |
| | OFF (open) | 0 (low) |
| S5/2 (MD1) | ON (closed) | 1 (high) |
| | OFF (open) | 0 (low) |
| S5/3 (MD2) | ON (closed) | 1 (high) |
| | OFF (open) | 0 (low) |
| S5/4 (Not used) | ON (closed) | Not connected |
| | OFF (open) | Not connected |
| Default: grey | | |

Table 3-1: MCU Operating Mode

By default, the “Single Chip Run-Mode” of MB91F467DA is selected.

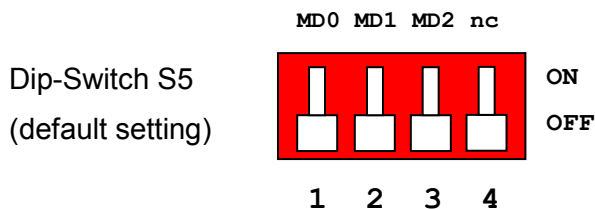


Figure 3-1: MCU Mode Switch

3.2 FlexRay CC Operating-Mode (S2)

The DIP-switch S2 is used to set the operating mode of the FlexRay communication controller. Ensure that the mode pin settings correspond to the operation-mode of the application. For more detailed information please check the Hardware-Manual of the FlexRay CC.

| DIP switch | Setting | Logical value |
|---------------|-------------|---------------|
| S2/1 (MD0) | ON (closed) | 0 (low) |
| | OFF (open) | 1 (high) |
| S2/2 (MD1) | ON (closed) | 0 (low) |
| | OFF (open) | 1 (high) |
| S2/3 (MD2) | ON (closed) | 0 (low) |
| | OFF (open) | 1 (high) |
| S2/4 (MDE0) | ON (closed) | 0 (low) |
| | OFF (open) | 1 (high) |
| S2/5 (MDE1) | ON (closed) | 0 (low) |
| | OFF (open) | 1 (high) |
| S2/6 (MDE2) | ON (closed) | 0 (low) |
| | OFF (open) | 1 (high) |
| Default: grey | | |

Table 3-2: FlexRay CC Operating Mode

By default, the “16-bit non multiplexed mode” is selected.

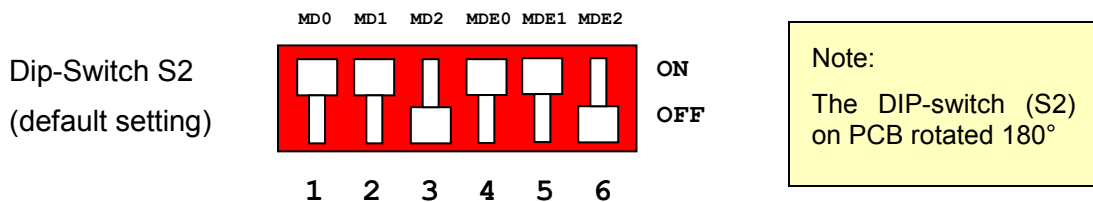


Figure 3-2: FlexRay CC Mode Switch

3.3 FlexRay CC SPI Settings (S1)

The DIP-switch S1 is used to set the FlexRay CC SPI settings, if the FlexRay CC is selected to communicate with the MCU over SPI. For more detailed information please check the Hardware-Manual of the FlexRay CC.

Note:
The DIP-switch (S1) is connected to the FlexRay CC in case the jumpers setting are set to SPI communication mode. Please refer to chapter 3.5 MCU-FlexRay CC Connection.

| DIP switch | Setting | Logical value |
|-----------------|-------------|---------------|
| S1/1 (MDS0) | ON (closed) | 0 (low) |
| | OFF (open) | 1 (high) |
| S1/2 (MDS1) | ON (closed) | 0 (low) |
| | OFF (open) | 1 (high) |
| S1/3 (MDS2) | ON (closed) | 0 (low) |
| | OFF (open) | 1 (high) |
| S1/4 (Not used) | ON (closed) | Not connected |
| | OFF (open) | Not connected |
| Default: grey | | |

Table 3-3: FlexRay CC SPI Settings

The SPI function is not yet supported by MB88121!

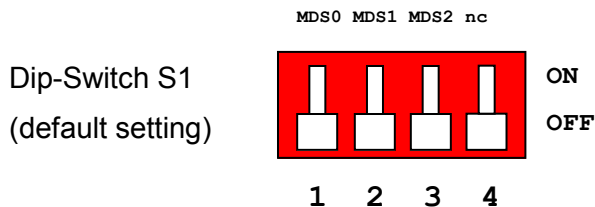


Figure 3-3: FlexRay CC SPI-Mode Switch

3.4 Power Supply

There are four on-board switching regulators to provide the voltages 5V, 3.3V, 2.5V and 1.8V on the starter-kit. With the power ON/OFF-switch S8 or S9 (S9 is a soldering option to use a different switch), the main input voltage from DC-connector X5 will be connected to the VIN voltage of the board. The VIN voltage supplies the switching regulators and the VBat voltage of the FlexRay physical layer driver modules from TZM (FT1080), if they are connected to X3 and X7.

| Switch | Setting | Description |
|---------------|-----------|-------------|
| S8 or S9 | ON (1-2) | Power ON |
| | OFF (2-3) | Power OFF |
| Default: grey | | |

Table 3-4: Power Switch

With JP91 the pins B14, B15 and B16 of the external bus interface connector X14 can be connected to the VIN voltage, so that it is possible to supply the board from an external connected board e.g. the Fujitsu FlexRay FPGA board.

There is a triple supply monitor on-board, which monitors three of the four DC output voltages and generates a system reset, in case with wrong levels of the on board voltages. 5V and 3.3V are always monitored and the third monitored voltage can be selected with the solder jumpers JP42 and JP43.

With JP68 it is possible to select the whole board supply voltage Vcc to 5V or 3.3V

| Jumper | Setting | Description |
|---------------|-------------|--|
| JP91 | ON (closed) | Vin connected to X14 pins B14, B15 and B16 |
| | OFF (open) | Vin not connected to X14 pins B14, B15 and B16 |
| JP42 | ON (closed) | Vcc1V8 connected to supply monitor |
| | OFF (open) | Vcc1V8 not connected to supply monitor |
| JP43 | ON (closed) | Vcc2V5 connected to supply monitor |
| | OFF (open) | Vcc2V5 not connected to supply monitor |
| JP68 | 1-2 | Vcc is connected to 5V |
| | 2-3 | Vcc is connected to 3.3V |
| Default: grey | | |

Table 3-5: Power supply configurations

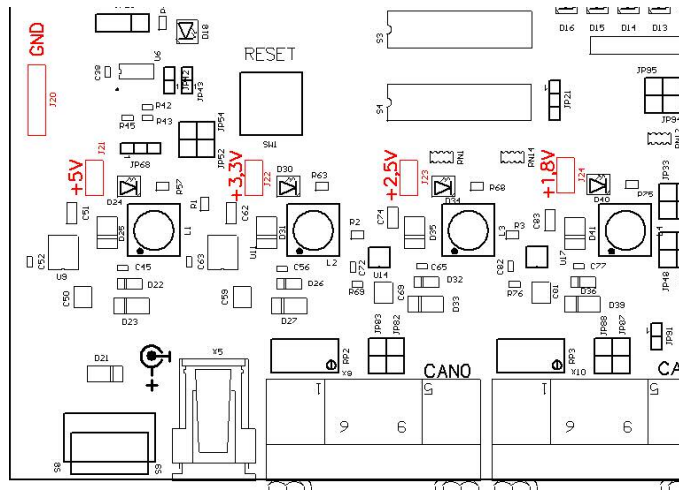


Figure 3-4: Voltage Test Points

| Regulator | Test point | Voltage |
|-----------|------------|---------|
| U9 | J21 | +5V |
| U11 | J22 | +3.3V |
| U14 | J23 | +2.5V |
| U17 | J24 | +1.8V |
| - | J20 | GND |

Table 3-6: Voltage Test Points

3.4.1 MCU Power Supply Voltage

- JP21** With this jumper it is possible to connect the MCU external bus interface supply VDD35 to 3.3V. The MCU MB91460 series supports the function to supply the MCU with 5V so that the normal I/O ports work with 5V and supply the external bus interface with 3.3V.
- JP23** This jumper is used to connect the HVDD5 supply to MCUVcc. The HVDD5 is the MCU supply voltage for the high current ports.
- JP25** This jumper is used to connect the VDD5R MCU supply pins to MCUVcc
- JP26** This jumper is used to connect the Vcc voltage to MCUVcc.
- JP27** This jumper is used to connect the VDD5 MCU supply pins to MCUVcc
- JP28** This jumper is used to connect the HVSS5 MCU pins to GND. HVSS5 are the GND pins for the high current ports.

Note:

JP23, JP25, JP26, JP27 and JP28 can be used for measurements of power consumption of the MCU.

| Jumper | Setting | Description |
|--------|-------------|-------------------------------|
| JP21 | 1-2 | VDD35 connected to MCUVcc |
| | 2-3 | VDD35 connected to 3.3V |
| JP23 | ON (closed) | HVDD5 connected to MCUVcc |
| | OFF (open) | HVDD5 not connected to MCUVcc |
| JP25 | ON (closed) | VDD5R connected to MCUVcc |
| | OFF (open) | VDD5R not connected to MCUVcc |
| JP26 | ON (closed) | MCUVcc connected to Vcc |
| | OFF (open) | MCUVcc not connected to Vcc |
| JP27 | ON (closed) | VDD5 connected to MCUVcc |
| | OFF (open) | VDD5 not connected to MCUVcc |
| JP28 | ON (closed) | HVSS5 connected to GND |
| | OFF (open) | HVSS5 not connected to GND |

Default: grey

Table 3-7: MCU Power Supply SK-91F467-FLEXRAY

3.4.2 MCU Analogue Power Supply Voltage

The power supply as well as the reference voltage for the A/D-converter can be provided internally or externally.

- JP15** Connects power supply AVcc of the A/D converter to MCUVcc
- JP16** Connects high reference voltage AVRH of the A/D converter to AVcc
- JP18** Connects AVss of the A/D converter to GND

| Jumper | Setting | Description |
|---------------|-------------|--|
| JP15 | ON (closed) | AVcc is connected to MCUVcc |
| | OFF (open) | AVcc is disconnected |
| JP16 | ON (closed) | AVRH is connected to AVcc |
| | OFF (open) | AVRH defined by resistor network ^{*1} |
| JP18 | ON (closed) | AVss is connected to GND |
| | OFF (open) | AVss is disconnected |
| Default: grey | | |

^{*1}By default the resistor network (R10 and R13) is not assembled on the board

Table 3-8: MCU ADC Supply

Note:
If JP15 or JP18 are open, the user has to supply an adequate analogue voltage supply (AVcc and AVss) to the A/D-converter.
If JP16 is open, the potential divider comprising resistors R10 and R13 define AVRH.

3.4.3 FlexRay CC Power Supply Voltage at SK-91F467-FLEXRAY

- JP8** Connects 5V or 3.3V voltage supply to ASSPVcc
- JP9** Connects 3.3V or ASSPVcc to ASSP voltage supply pin Vcc1 (3.3V by default)
- JP13** Connects ASSP C-pin to 1.8V voltage supply
- JP22** Connects ASSP pin 8 to 1.8V voltage supply
- JP24** Connects ASSP pin 9 to GND

| Jumper | Setting | Description |
|---------------|-------------|------------------------------------|
| JP8 | 1-2 | 5V connected to ASSPVcc |
| | 2-3 | 3.3V connected to ASSPVcc |
| JP9 | 1-2 | 3.3V connected to ASSP Vcc1 pin |
| | 2-3 | ASSPVcc connected to ASSP Vcc1 pin |
| JP13 | ON (closed) | 1.8V connected to ASSP C-pin |
| | OFF (open) | 1.8V not connected to ASSP C-pin |
| JP22 | ON (closed) | 1.8V connected to ASSP pin 8 |
| | OFF (open) | 1.8V not connected to ASSP pin 8 |
| JP24 | ON (closed) | GND connected to ASSP pin 9 |
| | OFF (open) | GND not connected to ASSP pin 9 |
| Default: grey | | |

Table 3-9: FlexRay CC Supply

3.5 MCU-FlexRay CC Connection at SK-91F467-FLEXRAY

The FlexRay communication controller MB88121 provides different communication modes to a microcontroller. The MB88121 has different pin functions in its communication modes. Therefore it is possible to connect the CC in different ways to the MCU, to evaluate the different communication modes.

- JP1** Connects MCU INT6 or MCU A10 to CC pin 35 (INT2 / A10)
- JP2** Connects MCU INT7 or MCU A9 to CC pin 36 (INT3 / A9)
- JP3** Connects MCU A5 or MCU SCK6 to CC pin 40 (SCK / A5)
- JP4** Connects MCU A4 or MCU SOT6 to CC pin 41 (SDI / A4)
- JP5** Connects MCU A3 or MCU SIN6 to CC pin 42 (SDO / A3)
- JP7** Connects MCU A0 with CC A0
- JP10** Connects MCU D26 or CC SPI-mode switch S1-3 (MDS2) to CC pin 53 (AD10 / D10 / AD2 / D2 / MDS2)
- JP11** Connects MCU D25 or CC SPI-mode switch S1-2 (MDS1) to CC pin 54 (AD9 / D9 / AD1 / D1 / MDS1)
- JP12** Connects MCU D24 or CC SPI-mode switch S1-1 (MDS0) to CC pin 55 (AD8 / D8 / AD0 / D0 / MDS0)
- JP14** Connects MCU D21 or MCU INT6 to CC pin 58 (AD5 / INT2)
- JP17** Connects MCU D20 or MCU INT7 to CC pin 59 (AD4 / INT3)
- JP19** Connects MCU CSX3 or MCU CSX6 to CC pin 19 (CS)
- JP20** Connects MCU INT6 or MCU ASX to CC pin 22 (ALE / INT2)

Note:

For more information about the FlexRay CC modes and the different pin functions, please refer to MB88121 documentation.

| Jumper | Setting | Description |
|--------|-------------|------------------------------------|
| JP1 | 1-2 | MCU INT6 connected to CC INT2 |
| | 2-3 | MCU A10 connected to CC A10 |
| JP2 | 1-2 | MCU INT7 connected to CC INT3 |
| | 2-3 | MCU A9 connected to CC A9 |
| JP3 | 1-2 | MCU A5 connected to CC A5 |
| | 2-3 | MCU SCK6 connected to CC SCK |
| JP4 | 1-2 | MCU A4 connected to CC A4 |
| | 2-3 | MCU SOT6 connected to CC SDI |
| JP5 | 1-2 | MCU A3 connected to CC A3 |
| | 2-3 | MCU SIN6 connected to CC SDO |
| JP7 | ON (closed) | MCU A0 is connected to CC A0 |
| | OFF (open) | MCU A0 is not connected to CC A0 |
| JP10 | 1-2 | MCU D26 connected to CC AD2 / AD10 |

| Jumper | Setting | Description |
|---------------|---------|--|
| | 2-3 | CC SPI-mode switch S1-3 connected to CC MDS2 |
| JP11 | 1-2 | MCU D25 connected to CC AD1 / AD9 |
| | 2-3 | CC SPI-mode switch S1-2 connected to CC MDS1 |
| JP12 | 1-2 | MCU D24 connected to CC AD0 / AD8 |
| | 2-3 | CC SPI-mode switch S1-1 connected to CC MDS0 |
| JP14 | 1-2 | MCU D21 connected to CC AD5 |
| | 2-3 | MCU INT6 connected to CC INT2 |
| JP17 | 1-2 | MCU D20 connected to CC AD4 |
| | 2-3 | MCU INT7 connected to CC INT3 |
| JP19 | 1-2 | MCU CSX3 connected to CC CS |
| | 2-3 | MCU CSX6 connected to CC CS |
| JP20 | 1-2 | MCU INT6 connected to CC INT2 |
| | 2-3 | MCU ASX connected to CC ALE |
| Default: grey | | |

Table 3-10: MCU-FlexRay CC Connection

3.6 FlexRay Physical Layer

The SK-91F467-FLEXRAY provides different FlexRay physical layer communication. The default setting is for RS-485 physical layer communication (on board). To test the original FlexRay physical layer transceiver, it is possible to deselect the RS-485 transceiver and plug in FlexRay physical layer driver module from TZM (FT1080). With the TZM (FT1080) modules the user has the possibility to evaluate transceiver chips from different vendors quite easy.

Note:

Disconnect the RS-485 physical layer transceiver signals before plugging in the FT1080 modules to X3 and X7.

3.6.1 Channel A

- JP35** Connects FlexRay channel A RxD to RS-485 transceiver (FT1080 must not be plugged in X3!)
- JP40** Connects FlexRay channel A TxEN to RS-485 transceiver (FT1080 must not be plugged in X3!)
- JP45** Connects FlexRay channel A TxD to RS-485 transceiver (FT1080 must not be plugged in X3!)
- JP38** Connects FlexRay channel A RS-485 transceiver output B to Sub-D-9 connector (X2)
- JP41** Connects FlexRay channel A RS-485 transceiver output A to Sub-D-9 connector (X2)
- JP34, JP36** Connects RS-485 termination network to signal lines at FlexRay channel A
- JP48** Connects FT1080 module CH-A EN to configuration switch S6

- JP49** Connects FT1080 module CH-A WAKE to configuration switch S6
- JP50** Connects FT1080 module CH-A nSTB to configuration switch S6
- JP55** Connects FT1080 module CH-A nERR to MCU port P14_4
- JP53** Selects VccPL (supply voltage of CH-A and CH-B FT1080 modules) 3.3V or 5V
- JP56** Connects FT1080 module CH-A VBat to VBat (input voltage of the starter kit)

| Jumper | Setting | Description |
|---------------|-------------|---|
| JP35 | ON (closed) | TXDA connected to RS-485 transceiver |
| | OFF (open) | TXDA not connected to RS-485 transceiver |
| JP40 | ON (closed) | TXENA connected to RS-485 transceiver |
| | OFF (open) | TXENA not connected to RS-485 transceiver |
| JP45 | ON (closed) | RXDA connected to RS-485 transceiver |
| | OFF (open) | RXDA not connected to RS-485 transceiver |
| JP38 | ON (closed) | CH-A RS-485 output B connected to X2 |
| | OFF (open) | CH-A RS-485 output B not connected to X2 |
| JP41 | ON (closed) | CH-A RS-485 output A connected to X2 |
| | OFF (open) | CH-A RS-485 output A not connected to X2 |
| JP34, JP36 | ON (closed) | Line termination connected to CH-A RS-485 |
| | OFF (open) | Line termination not connected to CH-A RS-485 |
| JP48 | ON (closed) | CH-A FT1080 EN connected to S6 |
| | OFF (open) | CH-A FT1080 EN connected to S6 |
| JP49 | ON (closed) | CH-A FT1080 WAKE connected to S6 |
| | OFF (open) | CH-A FT1080 WAKE connected to S6 |
| JP50 | ON (closed) | CH-A FT1080 nSTB connected to S6 |
| | OFF (open) | CH-A FT1080 nSTB connected to S6 |
| JP55 | ON (closed) | CH-A FT1080 nERR connected to MCU P14_4 |
| | OFF (open) | CH-A FT1080 nERR not connected to MCU P14_4 |
| JP53 | 1-2 | Vcc 5V is connected to VccPL |
| | 2-3 | Vcc 3.3V is connected to VccPL |
| JP56 | ON (closed) | VBat is connected to FT1080 CH-A |
| | OFF (open) | VBat is not connected to FT1080 CH-A |
| Default: grey | | |

Table 3-11: FlexRay CH-A Configuration

3.6.2 Channel B

- JP61** Connects FlexRay channel B RxD to RS-485 transceiver (FT1080 must not be plugged in X7!)
- JP66** Connects FlexRay channel B TxEN to RS-485 transceiver (FT1080 must not be plugged in X7!)
- JP70** Connects FlexRay channel B TxD to RS-485 transceiver (FT1080 must not be plugged in X7!)

- JP63** Connects FlexRay channel B RS-485 transceiver output B to Sub-D-9 connector (X6)
- JP67** Connects FlexRay channel B RS-485 transceiver output A to Sub-D-9 connector (X6)
- JP59, JP62** Connects RS-485 termination network to signal lines at FlexRay channel B
- JP73** Connects FT1080 module CH-B EN to configuration switch S6
- JP74** Connects FT1080 module CH-B WAKE to configuration switch S6
- JP75** Connects FT1080 module CH-B nSTB to configuration switch S6
- JP76** Connects FT1080 module CH-B nERR to MCU port P14_7
- JP77** Connects FT1080 module CH-B VBat to VBat (input voltage of the starter kit)

| Jumper | Setting | Description |
|---------------|-------------|---|
| JP61 | ON (closed) | TXDB connected to RS-485 transceiver |
| | OFF (open) | TXDB not connected to RS-485 transceiver |
| JP66 | ON (closed) | TXENB connected to RS-485 transceiver |
| | OFF (open) | TXENB not connected to RS-485 transceiver |
| JP70 | ON (closed) | RXDB connected to RS-485 transceiver |
| | OFF (open) | RXDB not connected to RS-485 transceiver |
| JP63 | ON (closed) | CH-B RS-485 output B connected to X6 |
| | OFF (open) | CH-B RS-485 output B not connected to X6 |
| JP67 | ON (closed) | CH-B RS-485 output A connected to X6 |
| | OFF (open) | CH-B RS-485 output A not connected to X6 |
| JP59, JP62 | ON (closed) | Line termination connected to CH-B RS-485 |
| | OFF (open) | Line termination not connected to CH-B RS-485 |
| JP73 | ON (closed) | CH-B FT1080 EN connected to S6 |
| | OFF (open) | CH-B FT1080 EN connected to S6 |
| JP74 | ON (closed) | CH-B FT1080 WAKE connected to S6 |
| | OFF (open) | CH-B FT1080 WAKE connected to S6 |
| JP75 | ON (closed) | CH-B FT1080 nSTB connected to S6 |
| | OFF (open) | CH-B FT1080 nSTB connected to S6 |
| JP76 | ON (closed) | CH-B FT1080 nERR connected to MCU P14_7 |
| | OFF (open) | CH-B FT1080 nERR not connected to MCU P14_7 |
| JP77 | ON (closed) | VBat is connected to FT1080 CH-B |
| | OFF (open) | VBat is not connected to FT1080 CH-B |
| Default: grey | | |

Table 3-12: FlexRay CH-B Configuration

3.6.3 FT1080 Control Settings (S6)

The DIP switch S6 is used to set EN, WAKE and nSTB signals of the FlexRay physical layer driver modules from TZM (FT1080). The control signals can also be connected with jumper to the MCU to give the possibility to set them via user software. Both modules (FT1080) will be set simultaneously, if JP48-JP50 and JP73-JP75 are closed.

| DIP switch | Setting | Logical value |
|-----------------|-------------|---------------|
| S6/1 (EN) | ON (closed) | 0 (low) |
| | OFF (open) | 1 (high) |
| S6/2 (WAKE) | ON (closed) | 0 (low) |
| | OFF (open) | 1 (high) |
| S6/3 (nSTB) | ON (closed) | 0 (low) |
| | OFF (open) | 1 (high) |
| S6/4 (Not used) | ON (closed) | Not connected |
| | OFF (open) | Not connected |
| Default: grey | | |

Table 3-13: FT1080 Control Settings

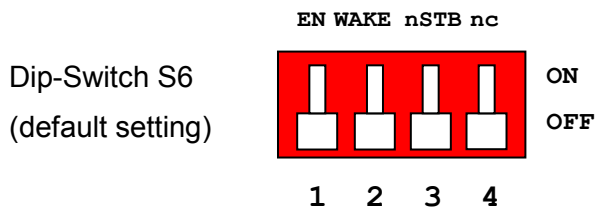


Figure 3-5: FT1080 Control Switch

JP31 Connects nSTB signal of FT1080 modules to MCU port 18_6

JP32 Connects WAKE signal of FT1080 modules to MCU port 18_5

JP33 Connects EN signal of FT1080 modules to MCU port 18_4

| Jumper | Setting | Description |
|---------------|-------------|--------------------------------------|
| JP31 | ON (closed) | nSTB is connected to MCU P18_6 |
| | OFF (open) | No connection to the microcontroller |
| JP32 | ON (closed) | WAKE is connected to MCU P18_5 |
| | OFF (open) | No connection to the microcontroller |
| JP33 | ON (closed) | EN is connected to MCU P18_4 |
| | OFF (open) | No connection to the microcontroller |
| Default: grey | | |

Table 3-14: FT1080 Connection to MCU

3.7 CAN0 – CAN2

Three high-speed CAN-transceivers (PCA82C250) are on-board to connect all available on-chip CAN to 9-pin D-Sub connectors (X9, X10 and X11).

JP82 Connects MCU RX0 to CAN transceiver U15

JP83 Connects MCU TX0 to CAN transceiver U15

JP87 Connects MCU RX1 to CAN transceiver U18

JP88 Connects MCU TX1 to CAN transceiver U18

JP89 Connects MCU RX2 to CAN transceiver U19

JP90 Connects MCU TX2 to CAN transceiver U19

| Jumper | Setting | Description |
|---------------|-------------|--------------------------------------|
| JP82 | ON (closed) | CAN0 RxD connected to MCU |
| | OFF (open) | No connection to the microcontroller |
| JP83 | ON (closed) | CAN0 TxD connected to MCU |
| | OFF (open) | No connection to the microcontroller |
| JP87 | ON (closed) | CAN1 RxD connected to MCU |
| | OFF (open) | No connection to the microcontroller |
| JP88 | ON (closed) | CAN1 TxD connected to MCU |
| | OFF (open) | No connection to the microcontroller |
| JP89 | ON (closed) | CAN2 RxD connected to MCU |
| | OFF (open) | No connection to the microcontroller |
| JP90 | ON (closed) | CAN2 TxD connected to MCU |
| | OFF (open) | No connection to the microcontroller |
| Default: grey | | |

Table 3-15: CAN-MCU connection

3.8 LIN / RS-232 UART

There are three UART connectors X1, X4 and X8 (9-pin D-Sub) on-board, which can be used for RS-232 or LIN communication (to get information in detail about pin usage, please refer to chapter 4.2 UART / LIN Connector (X1, X4, X8)). The LIN transceiver needs to be configured as LIN-master or LIN-slave.

3.8.1 UART 2

UART2 (connector X1) is selected as LIN master at default setting.

JP37 Select, if SIN2 is connected to RS-232- or LIN-transceiver

JP44 Select, if SOT2 is connected to RS-232- or LIN-transceiver

JP46 Select, if RS-232- or LIN-transceiver is connected to X1 pin2 (shared pin)

JP30 Some terminal programs needs a connection between CTS and RTS

JP39 Selects, if DTR or RTS will be used for system reset generation

JP47 Enables the LIN transceiver

JP51 Selects, if UART2 will be LIN master or LIN slave

Note:
UART2 has to be selected with JP57, to generates a system reset

| Jumper | Setting | Description |
|---------------|-------------|--|
| JP37 | 1-2 | MCU SIN2 connected to RS-232 transceiver |
| | 2-3 | MCU SIN2 connected to LIN transceiver |
| JP44 | 1-2 | MCU SOT2 connected to RS-232 transceiver |
| | 2-3 | MCU SOT2 connected to LIN transceiver |
| JP46 | 1-2 | X1 pin2 is connected to RS-232 transceiver |
| | 2-3 | X1 pin2 is connected to LIN transceiver |
| JP30 | ON (closed) | RTS and CTS is connected at connector X1 |
| | OFF (open) | RTS and CTS is not connected at connector X1 |
| JP39 | 1-2 | DTR can be used for system reset |
| | 2-3 | RTS can be used for system reset |
| JP47 | ON (closed) | LIN transceiver is enabled |
| | OFF (open) | LIN transceiver is not enabled |
| JP51 | ON (closed) | LIN master mode |
| | OFF (open) | LIN slave mode |
| Default: grey | | |

Table 3-16: UART2 Settings

3.8.2 UART 4 (Flash programming)

UART4 (connector X4) is selected as RS-232 at default setting. UART4 is also used to write user software into the Flash of the MCU.

JP60 Select, if SIN4 is connected to RS-232- or LIN-transceiver

JP65 Select, if SOT4 is connected to RS-232- or LIN-transceiver

JP69 Select, if RS-232- or LIN-transceiver is connected to X4 pin2 (shared pin)

JP58 Some terminal programs needs a connection between CTS and RTS

JP64 Selects, if DTR or RTS will be used for system reset generation

JP71 Enables the LIN transceiver

JP72 Selects, if UART4 will be LIN master or LIN slave

Note:

UART4 has to be selected with JP57, to generates a system reset

| Jumper | Setting | Description |
|---------------|-------------|--|
| JP60 | 1-2 | MCU SIN4 connected to RS-232 transceiver |
| | 2-3 | MCU SIN4 connected to LIN transceiver |
| JP65 | 1-2 | MCU SOT4 connected to RS-232 transceiver |
| | 2-3 | MCU SOT4 connected to LIN transceiver |
| JP69 | 1-2 | X4 pin2 is connected to RS-232 transceiver |
| | 2-3 | X4 pin2 is connected to LIN transceiver |
| JP58 | ON (closed) | RTS and CTS is connected at connector X4 |
| | OFF (open) | RTS and CTS is not connected at connector X4 |
| JP64 | 1-2 | DTR can be used for system reset |
| | 2-3 | RTS can be used for system reset |
| JP71 | ON (closed) | LIN transceiver is enabled |
| | OFF (open) | LIN transceiver is not enabled |
| JP72 | ON (closed) | LIN master mode |
| | OFF (open) | LIN slave mode |
| Default: grey | | |

Table 3-17: UART4 Settings

Note:

UART4 is used as serial interface for Softune Workbench Monitor Debugger. Jumper J58 must be closed.

3.8.3 UART 5

UART5 (connector X8) is selected as RS-232 at default setting.

JP79 Select, if SIN5 is connected to RS-232- or LIN-transceiver

JP81 Select, if SOT5 is connected to RS-232- or LIN-transceiver

JP84 Select, if RS-232- or LIN-transceiver is connected to X8 pin2 (shared pin)

JP78 Some terminal programs needs a connection between CTS and RTS

JP80 Selects, if DTR or RTS will be used for system reset generation

JP85 Enables the LIN transceiver

JP86 Selects, if UART5 will be LIN master or LIN slave

Note:
UART5 has to be selected with JP57, to generates a system reset

| Jumper | Setting | Description |
|---------------|-------------|--|
| JP79 | 1-2 | MCU SIN4 connected to RS-232 transceiver |
| | 2-3 | MCU SIN4 connected to LIN transceiver |
| JP81 | 1-2 | MCU SOT4 connected to RS-232 transceiver |
| | 2-3 | MCU SOT4 connected to LIN transceiver |
| JP84 | 1-2 | X4 pin2 is connected to RS-232 transceiver |
| | 2-3 | X4 pin2 is connected to LIN transceiver |
| JP78 | ON (closed) | RTS and CTS is connected at connector X4 |
| | OFF (open) | RTS and CTS is not connected at connector X4 |
| JP80 | 1-2 | DTR can be used for system reset |
| | 2-3 | RTS can be used for system reset |
| JP85 | ON (closed) | LIN transceiver is enabled |
| | OFF (open) | LIN transceiver is not enabled |
| JP86 | ON (closed) | LIN master mode |
| | OFF (open) | LIN slave mode |
| Default: grey | | |

Table 3-18: UART5 Settings

3.9 User Push Buttons INT0, INT1, INT2 and ICU0/TIN0

There are four user push buttons on the starter kit, which can be connected to the microcontroller.

JP92 – JP95 Connects the user push buttons (SW2 – SW5) to the microcontroller

| Jumper | Setting | Description |
|---------------|-------------|--|
| JP92 (SW2) | ON (closed) | Button INT0 is connected to the microcontroller |
| | OFF (open) | No connection to the microcontroller |
| JP93 (SW3) | ON (closed) | Button INT1 is connected to the microcontroller |
| | OFF (open) | No connection to the microcontroller |
| JP94 (SW4) | ON (closed) | Button INT2 is connected to the microcontroller |
| | OFF (open) | No connection to the microcontroller |
| JP95 (SW5) | ON (closed) | Button ICU0/TIN0 is connected to the microcontroller |
| | OFF (open) | No connection to the microcontroller |
| Default: grey | | |

Table 3-19: User Push Buttons

3.10 User DIP Switch 8 Bit (S4)

There is an 8 bit user-DIP-switch on-board, which can be connected to one MCU port (P26), Connecting High- or Low level to the pins. S3, also an 8 bit DIP-switch, dis-/connect the eight channels of S4 to the MCU pins. In case of other usage of these pins, open S3 switch accordingly.

| DIP switch | Setting | Logical value |
|---------------|-------------|---------------|
| S4/1 - 8 | ON (closed) | 0 (low) |
| | OFF (open) | 1 (high) |
| Default: grey | | |

Table 3-20: S4 Values

Note:
DIP-switch S3 is used to connect DIP-switch S4 to the MCU port pins at port P26.

| DIP switch | Setting | Description |
|---------------|-------------|--------------------------------------|
| S3/1 - 8 | ON (closed) | S4/1-8 connected to MCU port P26_0-7 |
| | OFF (open) | No connection to the microcontroller |
| Default: grey | | |

Table 3-21: S3 Settings

3.11 Reset Generation

A system reset can be generated in different ways. The first possibility is to press the user reset push button (SW1). Secondly the supply monitor will generate a reset if an unusual voltage is detected and third a reset is raised if a UART that does a reset is selected.

If a system reset is done, it will be displayed by the red reset LED (D18).

The system reset will do a simultaneous reset of the microcontroller and the FlexRay communication controller. The MCU and / or the FlexRay CC can be disconnected from the system reset signal with two jumpers.

The Reset push button can be used in two modes:

- no delay of Reset
- press Reset button 2s

The selection is done by solder Jumper JP96.

JP52 Connects the FlexRay CC to the system reset signal (SK91F467-FLEXRAY)

JP54 Connects the MCU to the system reset signal

| Jumper | Setting | Description |
|---------------|-------------|--|
| JP52 | ON (closed) | Reset is connected to FlexRay CC RST |
| | OFF (open) | No connection to the FlexRay CC |
| JP54 | ON (closed) | Reset is connected to MCU INITX |
| | OFF (open) | No connection to the MCU |
| JP96 | 1-2 | Reset is generated when SW1 is pressed |
| | 2-3 | Reset is generated after SW1 is pressed 2s |
| Default: grey | | |

Table 3-22: Reset Connections

The triple supply monitor on-board has the possibility to watch 5V, 3.3V and the third voltage is user configurable 2.5V or 1.8V. If any voltage has a failure, a system reset will be done.

JP42 Monitoring of 1.8V supply voltage

JP43 Monitoring of 2.5V supply voltage

| Jumper | Setting | Description |
|---------------|-------------|--|
| JP42 | ON (closed) | Vcc1V8 connected to supply monitor |
| | OFF (open) | Vcc1V8 not connected to supply monitor |
| JP43 | ON (closed) | Vcc2V5 connected to supply monitor |
| | OFF (open) | Vcc2V5 not connected to supply monitor |
| Default: grey | | |

Table 3-23: Supply Monitor Settings

By default 2.5V supply will be monitored.

The system reset also can be done via any UART. Therefore the user has the possibility to select one of the three on-board UARTs.

JP57 Select which UART should do the system reset

JP29 The polarity of the DTR/RTS signal can be inverted by this jumper. Remove the jumper to disable the UART reset function

| Jumper | Setting | Description |
|--------|---------|--|
| JP57 | 1-2 | Reset will be done via UART2 |
| | 3-4 | Reset will be done via UART4 |
| | 5-6 | Reset will be done via UART5 |
| JP29 | 1-2 | No polarity inversion for the DTR/RTS signal |
| | 2-3 | Polarity inversion for the DTR/RTS signal |

Table 3-24: Reset UART Selection

By default the UART reset is disabled.

Note:

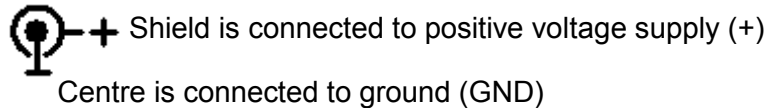
During normal operation, the reset LED should be off!

If the reset LED is steadily on, check the power supply voltages and the settings for the reset generation by UART.

4 Connectors

4.1 Power Connector (X5)

The following figure shows the power connection jack of the starter kit. This connector is used to connect an external unregulated DC power supply voltage (9V-12V DC recommended 2000mA).



Table

Figure 4-1: Power Connector

4.2 UART / LIN Connector (X1, X4, X8)

Three 9-pin D-Sub female connectors are used for the serial interfaces LIN/UART2, LIN/UART4 and LIN/UART5.

Take care, that the RS232 as well as the LIN signals are shared at the connectors and have to be selected by jumpers (see chapter 3.8).

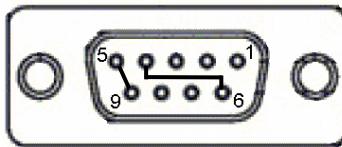


Figure 4-2: UART Connector

| Pin Number | Pin Signal | Description |
|------------|------------|---|
| 1 | +VBat | Power from LIN bus |
| 2 | TXD | RS-232 transmit output |
| | LIN | Bi-directional LIN-interface |
| 3 | RXD | RS-232 receive input |
| 4 | DTR | Connected to DSR (pin 6) |
| 5 | GND | Ground normally used for RS232 connection |
| 6 | DSR | Connected to DTR (pin 4) |
| 7 | RTS | Can be connected with CTS by jumper |
| 8 | CTS | Can be connected with RTS by jumper |
| 9 | LGND | Ground normally used for LIN connection |
| Shield | GND | Ground |

Table 4-1: UART Connector Signals

Note:
Please use 1:1 cable for RS232 PC-connection.

4.3 CAN Connector (X9, X10, X11)

Three 9-pin D-Sub male connectors are used for the CAN interfaces CAN0, CAN1 and CAN2.

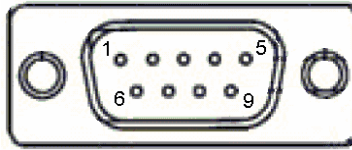


Figure 4-3: CAN Connector

| Pin Number | Pin Signal | Description |
|------------|------------|-------------------------------------|
| 1 | NC | Not used |
| 2 | CANL | LOW-level CAN voltage input/output |
| 3 | GND | Ground |
| 4 | NC | Not used |
| 5 | NC | Not used |
| 6 | NC | Not used |
| 7 | CANH | HIGH-level CAN voltage input/output |
| 8 | NC | Not used |
| 9 | NC | Not used |
| Shield | GND | Ground |

Table 4-2: CAN Connector Signals

4.4 FlexRay Connector (X2, X6)

Two 9-pin D-Sub male connectors are used for the two FlexRay channels A and B. As default RS-485 is used at SK-91F467-FLEXRAY.

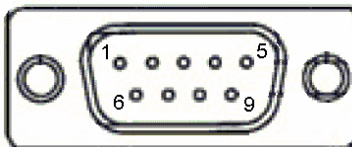


Figure 4-4: FlexRay Connector

| Pin Number | Pin Signal | Description |
|------------|------------|--|
| 1 | NC | Not used |
| 2 | BM | Bus line Minus |
| 3 | GND | Ground |
| 4 | NC | Not used |
| 5 | User | Connected to optional pin head (CH-A: J9; CH-B: J14) |
| 6 | NC | Not used |
| 7 | BP | Bus line Plus |
| 8 | NC | Not used |
| 9 | NC | Not used |
| Shield | Shield | Connected to shield of FT1080 modules |

Table 4-3: FlexRay Connector Signals

4.5 FlexRay Physical Layer Module Connector (X3, X7)

To use the FlexRay physical layer driver module from TZM (FT1080) there are two special connectors on board of SK-91F467-FLEXRAY, both for FlexRay channels A and B, to insert the modules. If the modules FT1080 should be used, it is necessary to disable the RS-485 driver modules (see chapter 3.6).

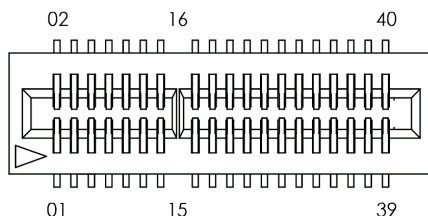


Figure 4-5: FlexRay Physical Layer Connector

| Pin Number | Pin Signal | Description |
|------------|------------|---|
| 1 | SGND | Signal Ground |
| 2 | Shield | FlexRay bus shield (filtered) |
| 3 | NC | Not used |
| 4 | BM | Bus line Minus |
| 5 | NC | Not used |
| 6 | BP | Bus line Plus |
| 7 | EN | Mode control input |
| 8 | NC | Not used |
| 9 | WAKE | Local wakeup |
| 10 | NC | Not used |
| 11 | nSTB | Mode control input |
| 12 | NC | Not used |
| 13 | BGE | Bus guardian enable |
| 14 | NC | Not used |
| 15 | No Pin | Coded |
| 16 | No Pin | Coded |
| 17 | TxD | Transmission data input |
| 18 | Ubuffer | Transmitter supply voltage buffering |
| 19 | TxEN | Transmission data enable |
| 20 | GND | Ground |
| 21 | RxD | Receive data output |
| 22 | VIO | I/O supply voltage |
| 23 | RxEN | Receive data enable output (not used) |
| 24 | GND | Ground |
| 25 | INH2 | Inhibit switch floating in standby / sleep mode |
| 26 | Vcc | Supply voltage |
| 27 | INH1 | Inhibit switch floating in sleep mode |
| 28 | GND | Ground |
| 29 | nERR | Error indication |
| 30 | VBat | Battery supply voltage |
| 31 | NC | Not used |
| 32 | GND | Ground |
| 33 | NC | Not used |
| 34 | nCS | ID-EEPROM SPI-nCS (connected to optional pin header) |
| 35 | NC | Not used |
| 36 | SDI | ID-EEPROM SPI data in (connected to optional pin header) |
| 37 | TRXD0 | Star (connected to optional pin header) |
| 38 | SDO | ID-EEPROM SPI data out (connected to optional pin header) |
| 39 | TRXD1 | Star (connected to optional pin header) |
| 40 | SCK | ID-EEPROM SPI clock (connected to optional pin header) |

Table 4-4: FlexRay Physical Layer Modules

4.6 USER-LEDs and optional LC-Display (D1-D16, J6)

There are sixteen user LEDs on-board, D1-D8 connected to MCU port P25 and D9-D16 connected to MCU port P16. To disconnect the LEDs from the MCU, it is possible to remove RN3 (D1-D8 at port P25) and RN2 (D9-D16 at port P16).

It is also possible to connect a standard LCD module with backlight to connector J6. With the potentiometer RP1 the contrast of the LCD can be adjusted.

| Pin | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 16 | 15 |
|------|-------|-------|-------|-------|----|---|---|-------|-------|-------|-------|----|-----|-----|------|------|
| LCD | DB7 | DB6 | DB5 | DB4 | - | - | - | - | E | R/W | RS | VO | Vcc | GND | LED- | LED+ |
| LED | D8 | D7 | D6 | D5 | | | | D4 | D3 | D2 | D1 | | | | | |
| Port | P25_7 | P25_6 | P25_5 | P25_4 | | | | P25_3 | P25_2 | P25_1 | P25_0 | | | | | |
| MCU | 187 | 186 | 185 | 184 | | | | 181 | 180 | 179 | 178 | | | | | |

Table 4-5: LED/LCD Signals

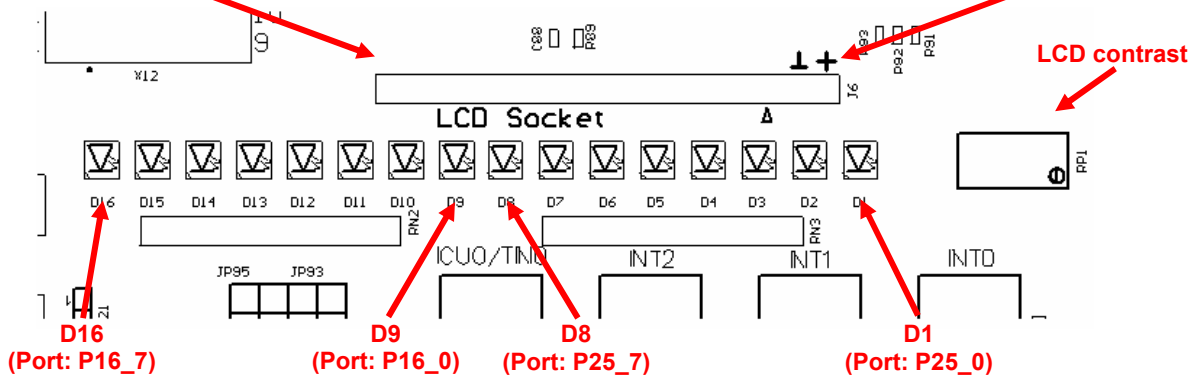


Figure 4-6: User LEDs / LCD

4.7 In-Circuit-Programming Connector (X12)

There is a Flash-programming socket on the starter kit which makes it possible to program the Flash MCU with a special programming adapter. Mode pins and reset signal is also available at this connector.

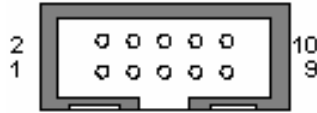


Figure 4-7: In Circuit Programming Connector

| Pin Number | Pin Signal | Description |
|------------|------------|----------------------|
| 1 | NC | Not used |
| 2 | NC | Not used |
| 3 | MD0 | MCU mode-pin 0 |
| 4 | MD2 | MCU mode-pin 2 |
| 5 | INITX | MCU reset signal |
| 6 | SIN4 | UART4 receive data |
| 7 | SOT4 | UART4 transmit data |
| 8 | SCK4 | UART4 clock |
| 9 | VCC | Board supply voltage |
| 10 | GND | Ground |

Table 4-6: In-Circuit Programming Connector

4.8 MCU Pin Connectors (J1-J4)

All MCU pins are directly connected to the four pin header around the MCU. The last two pins of the pin header J1, J2, J3 and J4 are unused (see PCB overprint).

| Connector | MCU Pins |
|-----------|----------|
| J1 | 1-52 |
| J2 | 53-104 |
| J3 | 105-156 |
| J4 | 157-208 |

Table 4-7: MCU Pin Connectors

On the PCB, the corresponding pin numbers of the MCU are written next to the connector pins.

4.9 External Bus Connectors (X13, X14)

4.9.1 VG96ABC DIN 41612 (X13)

| Pin | Name | MCU-P. | Pin | Name | MCU-P. | Pin | Name | MCU-P. |
|-----|-------|--------|-----|-------|--------|-----|-------|--------|
| A1 | 2.5 V | - | B1 | 2.5 V | - | C1 | 2.5 V | - |
| A2 | 3.3V | - | B2 | 3.3V | - | C2 | 3.3V | - |
| A3 | 5.0 V | - | B3 | 5.0 V | - | C3 | 5.0 V | - |
| A4 | GND | - | B4 | GND | - | C4 | GND | - |
| A5 | D0 | 192 | B5 | D1 | 193 | C5 | D2 | 194 |
| A6 | D3 | 195 | B6 | D4 | 196 | C6 | D5 | 197 |
| A7 | D6 | 198 | B7 | D7 | 199 | C7 | D8 | 200 |
| A8 | D9 | 201 | B8 | D10 | 202 | C8 | D11 | 203 |
| A9 | D12 | 204 | B9 | D13 | 205 | C9 | D14 | 206 |
| A10 | D15 | 207 | B10 | D16 | 2 | C10 | D17 | 3 |
| A11 | D18 | 4 | B11 | D19 | 5 | C11 | D20 | 6 |
| A12 | D21 | 7 | B12 | D22 | 8 | C12 | D23 | 9 |
| A13 | D24 | 10 | B13 | D25 | 11 | C13 | D26 | 12 |
| A14 | D27 | 13 | B14 | D28 | 14 | C14 | D29 | 15 |
| A15 | D30 | 16 | B15 | D31 | 17 | C15 | GND | - |
| A16 | GND | - | B16 | GND | - | C16 | GND | - |
| A17 | A0 | 18 | B17 | A1 | 19 | C17 | A2 | 20 |
| A18 | A3 | 21 | B18 | A4 | 22 | C18 | A5 | 23 |
| A19 | A6 | 24 | B19 | A7 | 25 | C19 | A8 | 28 |
| A20 | A9 | 29 | B20 | A10 | 30 | C20 | A11 | 31 |
| A21 | A12 | 32 | B21 | A13 | 33 | C21 | A14 | 34 |
| A22 | A15 | 35 | B22 | A16 | 36 | C22 | A17 | 37 |
| A23 | A18 | 38 | B23 | A19 | 39 | C23 | A20 | 40 |
| A24 | A21 | 41 | B24 | A22 | 42 | C24 | A23 | 43 |
| A25 | A24 | 44 | B25 | A25 | 45 | C25 | NC | - |
| A26 | NC | - | B26 | NC | - | C26 | NC | - |
| A27 | NC | - | B27 | NC | - | C27 | GND | - |
| A28 | P27_0 | 158 | B28 | P27_1 | 159 | C28 | P27_2 | 160 |
| A29 | P27_3 | 161 | B29 | P27_4 | 164 | C29 | P27_5 | 165 |
| A30 | P27_6 | 166 | B30 | P27_7 | 167 | C30 | GND | - |
| A31 | 2.5V | - | B31 | 2.5V | - | C31 | NC | - |
| A32 | GND | - | B32 | GND | - | C32 | GND | - |

Table 4-8. VG96 (X13) Signals

Note:

The pin numbers of the VG connectors refer to the male connectors that plugs into the starter kit. Please see chapter 5 to find the right orientation.

4.9.2 VG48ABC DIN 41612 (X14)

| Pin | Name | MCU-P. |
|-----|--------|--------|
| A1 | CSX0 | 56 |
| A2 | CSX2 | 58 |
| A3 | NC | - |
| A4 | CSX6 | 60 |
| A5 | BGRNTX | 51 |
| A6 | RDX | 50 |
| A7 | WRX1 | 47 |
| A8 | WRX3 | 49 |
| A9 | NC | - |
| A10 | DREQ0 | 189 |
| A11 | DEOP0 | 191 |
| A12 | INT12 | 97 |
| A13 | INT13 | 98 |
| A14 | SIN5 | 109 |
| A15 | GND | - |
| A16 | INITX | 73 |

| Pin | Name | MCU-P. |
|-----|------|--------|
| B1 | GND | - |
| B2 | 1.8V | - |
| B3 | GND | - |
| B4 | 1.8V | - |
| B5 | GND | - |
| B6 | NC | - |
| B7 | NC | - |
| B8 | NC | - |
| B9 | NC | - |
| B10 | NC | - |
| B11 | NC | - |
| B12 | NC | - |
| B13 | NC | - |
| B14 | Vin | - |
| B15 | Vin | - |
| B16 | Vin | - |

| Pin | Name | MCU-P. |
|-----|--------|--------|
| C1 | CSX1 | 57 |
| C2 | CSX3 | 59 |
| C3 | NC | - |
| C4 | RDY | 55 |
| C5 | BRQ | 54 |
| C6 | WRX0 | 46 |
| C7 | WRX2 | 48 |
| C8 | ASX | 62 |
| C9 | MCLKO | 65 |
| C10 | DACKX0 | 190 |
| C11 | NC | - |
| C12 | SDA0 | 99 |
| C13 | SCL0 | 100 |
| C14 | SOT5 | 110 |
| C15 | SCK5 | 111 |
| C16 | GND | - |

Table 4-9: VG48 (X14) Signals

Note:

The pin numbers of the VG connectors refer to the male connectors that plugs into the starter kit. Please see chapter 5 to find the right orientation.

4.9.3 Distance between VG-Connectors

To connect own applications to the starter-kit the following figure shows the distance between the VG DIN 41612 connectors.

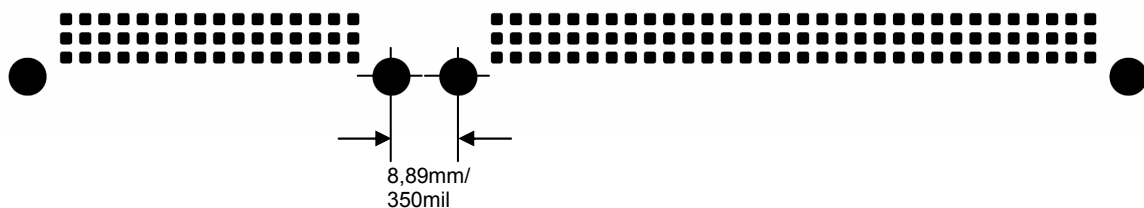


Figure 4-8: Layout of DIN VG Connectors

5 Getting Started

Make sure Softune Workbench for FR is installed on your PC and the “SK-91F467-FLEXRAY” or “SK-91F467D-208PFV” is ready to use (power-on (X5), serial connection (UART4) to COM port of the PC). Refer to Chapter 2 Installation for details on the hardware and software installation.

5.1 Introduction to Softune Workbench

Start Softune Workbench. Select <File> <Open Workspace> to load the first example “SK-91F467-FLEXRAY_test.wsp”. All examples can be found in the folder \software\examples on the starter kit CD-ROM. It is recommended to copy this folder to the local hard-drive. In the project tree on the left side, you can open the “source”-folder which contains the source-files registered to this project. A double-click on one of the files will invoke the built-in editor, which supports syntax-highlighting, tags and various other functions.

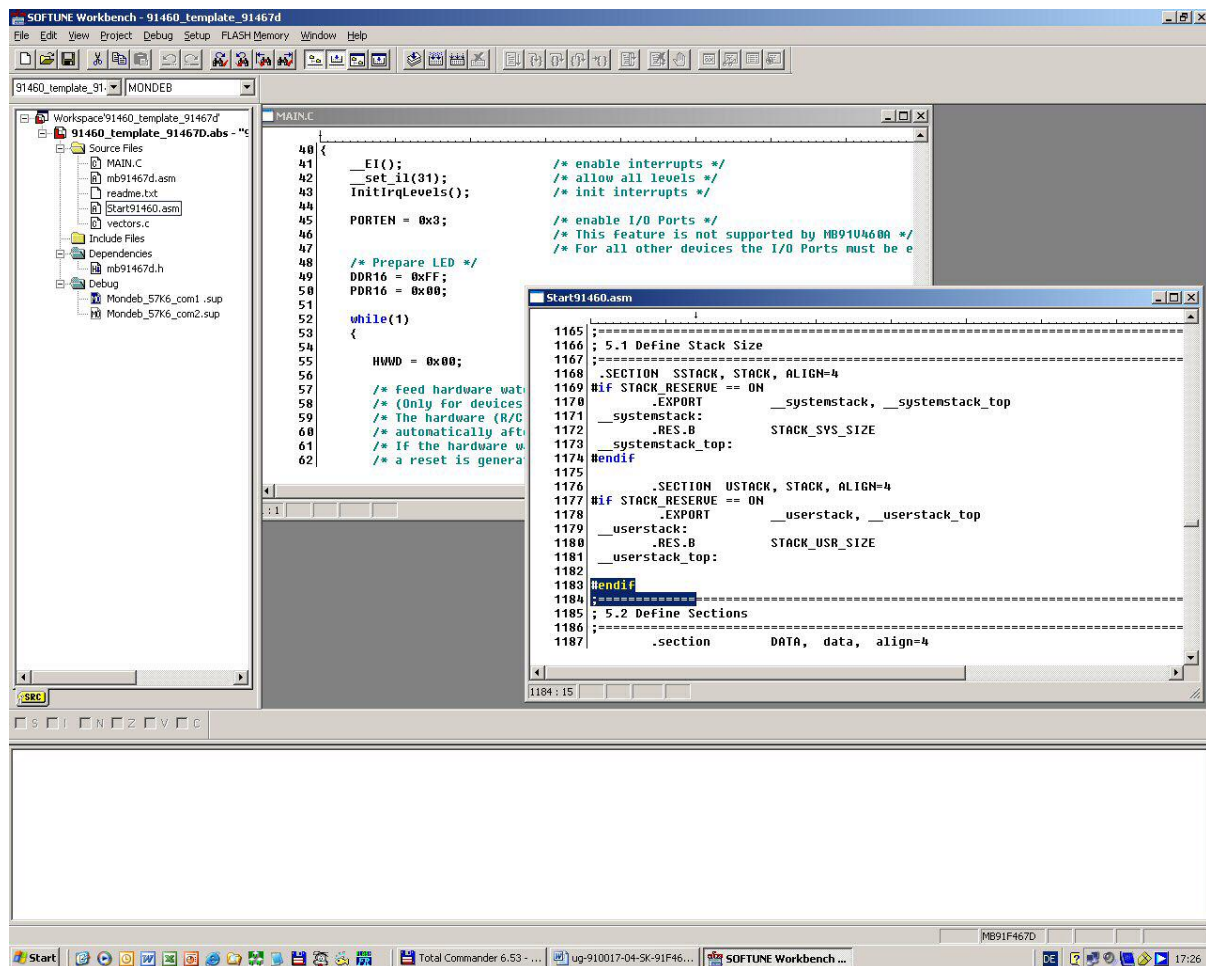


Figure 5-1: Softune Workbench main window

Note:

You may customize the editor by a right-click on the editor window.

Whenever you modify the source-files, you have to re-compile and link the related files to produce a valid load module (ABS-file). This is done using the MAKE-function. MAKE invokes the assembler, C-compiler and linker for FR whenever necessary (only modified files will be re-compiled).

If you wish to re-compile the entire project regardless of any changes, you can use the BUILD-function. To check for syntax-errors on a specific source-file, use the COMPILE/ASSEMBLE function.

These three functions are available on the button-bar or from the main menu (Project – Compile / Make / Build / Abort).



Click on MAKE or BUILD. Messages from the individual language tools will be fed into the output window at the bottom of the main screen. If the tool chain (C-compiler → Assembler → Linker) was completed successfully, the message “No Error” will appear.

If you get any errors during compilation, an appropriate message will be generated. Try this with a simple syntax-error (e.g. delete a semicolon “;” from the end of a C-line) and click on MAKE again. You will now see a message like this:

```

Now Making...
-----Configuration: Starterkit91302_Test.prj - Debug-----
main.c
*** C:\SK-91F467-FLEXRAY\SK-91F467-FLEXRAY_Test\Src\main.c(81) E4065B: expected a ";"
*** C:\SK-91F467-FLEXRAY\SK-91F467-FLEXRAY_Test\Src\main.c(104) W1012B: warning: parsing
restarts here after previous syntax error
1 error detected in the compilation of
"C:\SK-91F467-FLEXRAY\SK-91F467-FLEXRAY_Test\Src\main.c".
-----
Error detected.
-----

```

To locate the position in the source-file, where the error has occurred, double-click on the message. The editor will open the appropriate source-file, indicating the error highlighted in red, depending on the customise settings of the editor. Correct the error and re-compile the project as explained above.

If more errors occurred, you can go through the error list step by step using the menu “Edit – Top/Previous/Next/Bottom Error” or using the appropriate buttons which have the same functions:



Note:
To get on-line help about a specific error, select the error message and press F1. In many cases, you can get some useful hints how to solve the problem. Of course, you can also use the HELP-menu anytime during development or debugging.

5.2 Project Start-up

In order to allow a quick and smooth project start-up Fujitsu Microelectronics Europe supplies a template project as a reference. The easiest way to start a new project is to make a copy of the template project and use this copy as a start-up. The template includes the latest start91460.asm file, MCU header file, IRQ table, basic linker and C-Compiler settings.

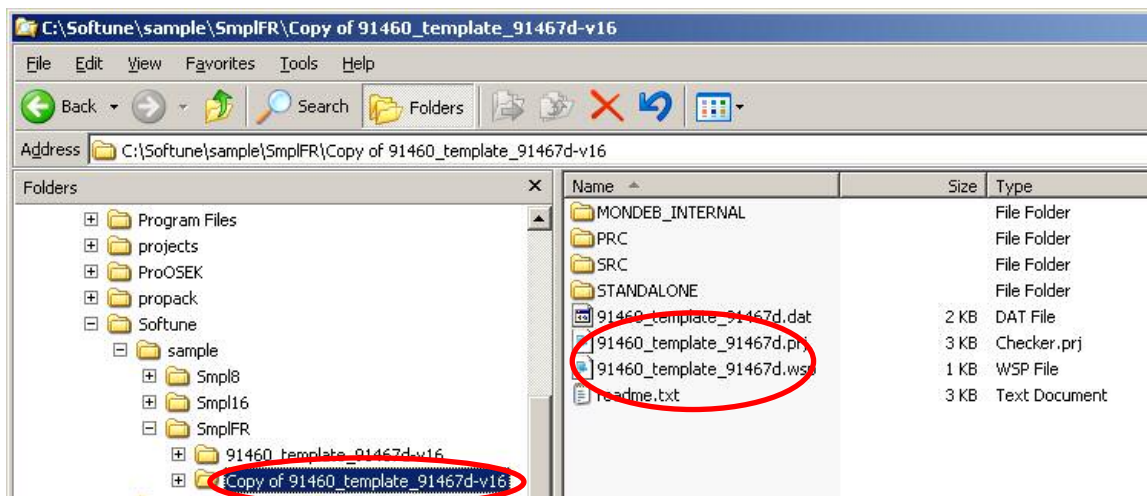
Note:

In any case the settings done in the template must be checked and have to be adjusted to the specific needs and settings of the final application. The template is providing an example for building up a new project.

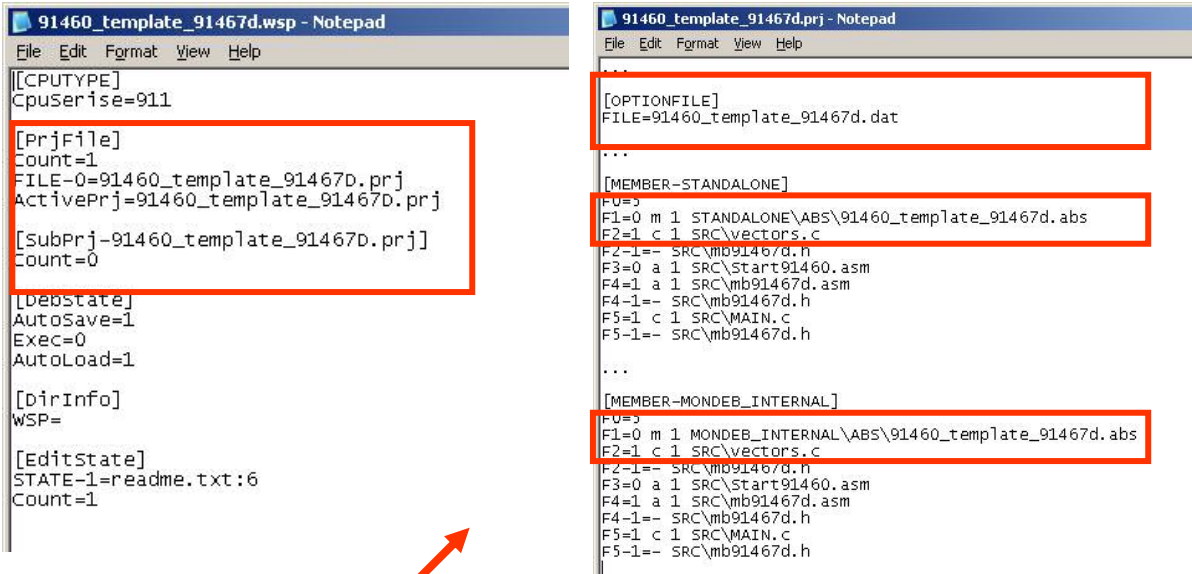
THIS SAMPLE CODE IS PROVIDED AS IS AND IS SUBJECT TO ALTERATIONS. FUJITSU MICROELECTRONICS ACCEPTS NO RESPONSIBILITY OR LIABILITY FOR ANY ERRORS OR/ELIGIBILITY FOR ANY PURPOSES. (C) Fujitsu Microelectronics Europe GmbH

5.2.1 Create a New Project:

1. In order to start a new user-project use the “**91460_template_91467d**” project
2. **Copy** the folder **91460_template_91467d** and **rename** the folder to e.g. **my_application**



3. **Enter the folder “my_application”**
Rename “91460_template_91467d.prj” into “my_application.prj”
Rename “91460_template_91467d” into “my_application.wsp”
4. **Edit “my_application.prj”**
Rename “91460_template_91467d” -> “my_application”
5. **Edit “my_application.wsp”**
Rename “91460_template_91467d” -> “my_application”



Rename "91460_template_91467d" into "my_application"

6. Start Softune Workbench and open your project

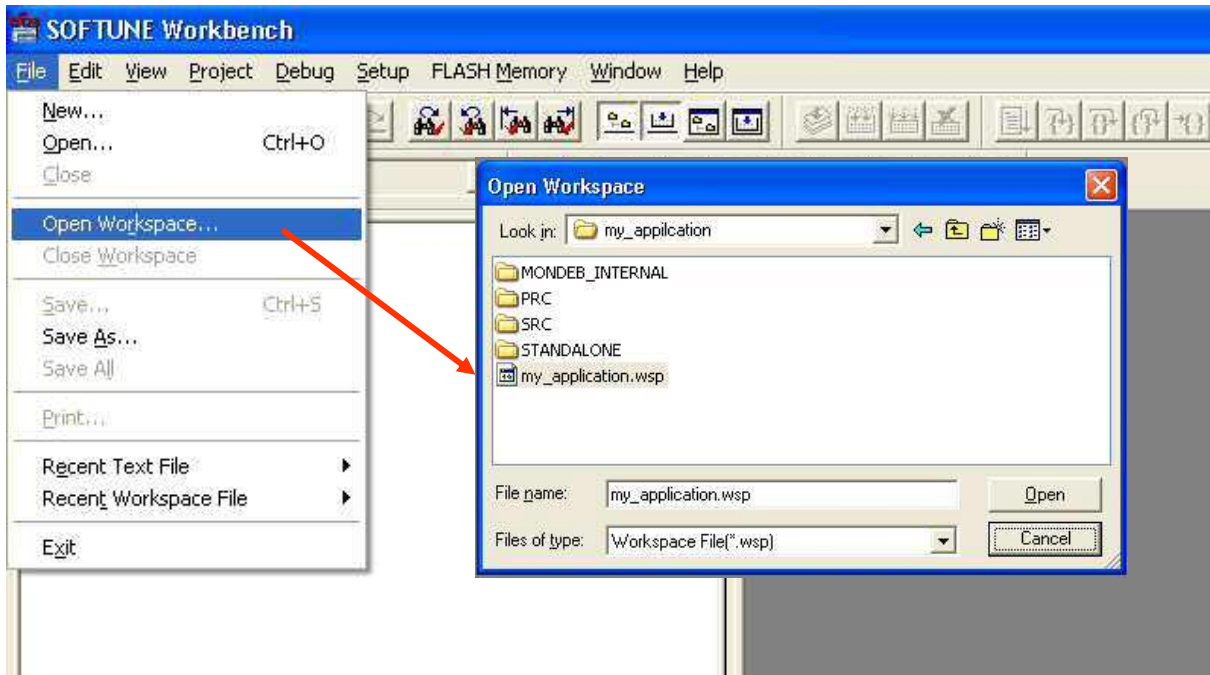


Figure 5-2: Open Softune Workbench workspace (*.wsp)

7) Select Active Configuration "MONDEB_DEBUG"

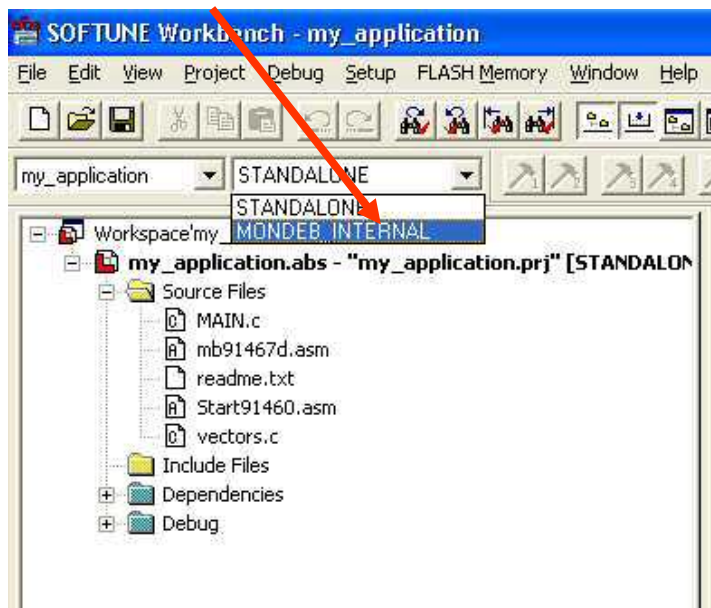


Figure 5-3: Project configuration selection

5.2.2 Use Active Configuration MONDEB_INTERNAL

With this selection the project is linked to be used with the Softune Workbench monitor debugger. Corresponding linker settings are done for the memory map in order to avoid overwriting of the sections which are used by the monitor debugger. The code is linked in this configuration for external SRAM, otherwise it is not possible to debug code with the Softune Workbench monitor debugger. The monitor

Note:

Always check the memory map of the linker settings and ensure that this memory map is suitable for the application and target system in use. Additionally the .mp1 file should be checked to ensure correct settings.

7. Check MCU settings in the module **start91460.asm**. Be careful regarding any modifications. If the peripheral clock speed is modified it can happen that the communication between Softune Workbench and monitor debugger is lost. In the module start91460.asm some basic MCU settings are done and some initial data copy transfers are performed for specific data sections e.g. INIT. Check module **vectors.c** if any interrupts are used for proper vector table set-up.
8. Write application code in the module **main.c** or add any other module to the project.
9. Write and modify source code and settings corresponding to the needs of the application. Finally use "Make", or "Build" to compile and link the project. The generated output files can be found in the sub-folder MONDEB_INTERNAL of the project folder. The *.mhx file (Motorola S-Record) is located in the ABS sub-folder.

Note:
Always check the memory map of the linker settings and ensure that this memory map is suitable for the application and target system in use. Additionally the *.mp1 file should be checked to ensure correct settings..

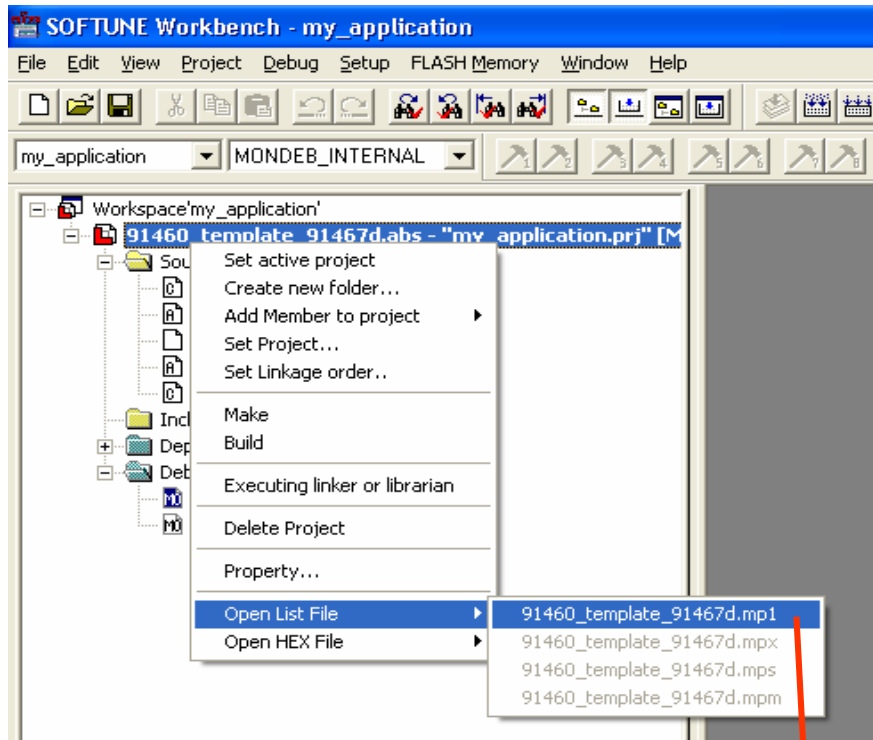


Figure 5-4: Open Softune Workbench Linker mapping file

Check linker mapping list in the*.mp1 file by right-click on “my_application.abs”, Open List File, *.mp1.

```

45 ■FR/FR80 Family SOFTUNE Linker Mapping List
46
47 S_Addr. -E_Addr.   Size      Section Type A1      Sec.(Top 81)
48 00029000-00029003 00000004  DATA  P RW-- 04 REL  DATA
49 00029004-000293FF 000003FC  STACK  P RW-- 04 REL  SSTACK
50 00029004-.....    00000000  DATA  P RW-- 04 REL  INIT
51 00029400-00029401 00000002  STACK  P RW-- 04 REL  USTACK
52 00840000-00840307 00000308  CODE   P R-XI 02 REL  CODE
53 00840308-00840707 00000400  CONST  P R--I 04 REL  INTVECT
54 00840308-.....    00000000  CONST  P R--I 04 REL  CONST
55 00840308-.....    00000000  DATA  P R--- 04 REL  #INIT
56 008F4000-008F4223 00000224  CODE   P R-XI 04 REL  CODE_START
    
```

Figure 5-5: Softune Workbench Linker Mapping

Start Softune Monitor Debugger via the “Debug” Command

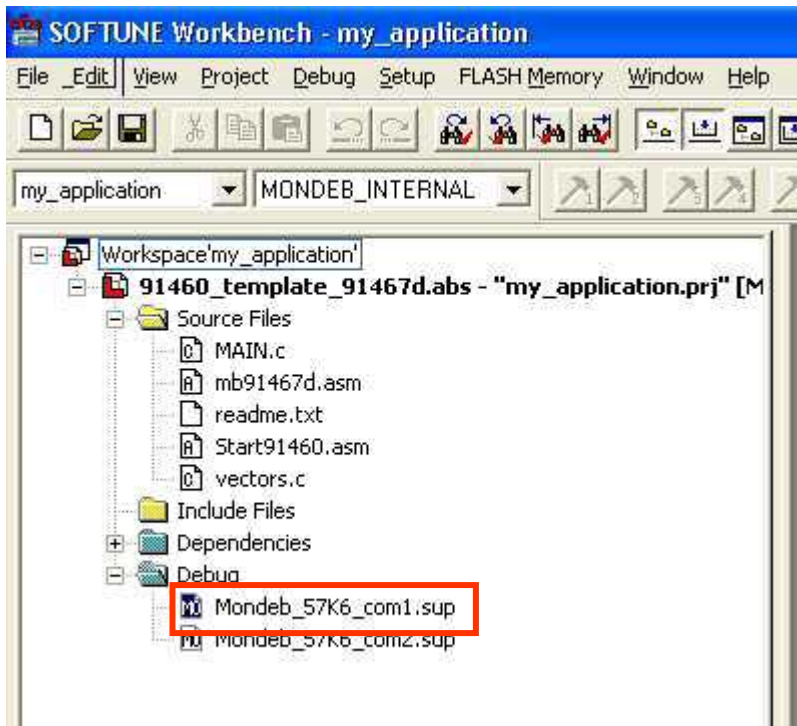


Figure 5-6: Start Softune Workbench Monitor Debugger

10. After the project is built and debugged successfully switch to the active configuration **STANDALONE**

5.2.3 Use Active configuration STANDALONE

11. With this selection the project is linked to work in internal flash memory. This configuration will not work with the Softune Workbench monitor debugger. In this configuration the code is linked to work in internal Flash memory, only.
12. Use **“Make”**, or **“Build”** to compile and link the project for internal Flash memory. The generated output files can be found in the sub-folder STANDALONE of the project folder. The *.mhx file (Motorola S-Record) is located in the ABS sub-folder.

Note:

Always check the memory map of the linker settings and ensure that this memory map is suitable for the application and target system in use. Additionally the *.mp1 file should be checked to ensure correct settings.

13. Program the generated *.mhx file (Motorola S-Record) with the Flash programming utility into the internal Flash. See Chapter 6.1 “Programming the internal Flash Memory” for more details.

Note:

It is not possible to use the Softune Workbench monitor debugger with this configuration because no code can be debugged which is located in internal Flash. Also this configuration does not support special debugger settings, which are disabled for this configuration.

5.3 Softune Workbench Monitor Debugger

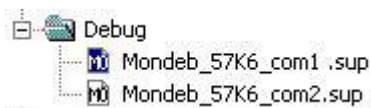
5.3.1 General Description

Whenever you have created a valid load module successfully, you can switch from the development mode to the debugging mode of Softune Workbench.

Basically, there are 3 types of debugging systems supported :

1. The software simulator: This type of debugger is always present and does not require any special hardware extensions. The simulator will cover the FR-core features, but no peripheral functions. Therefore, you can use the simulator to verify program flow, check for dynamic errors, look at the generated assembler code , etc. .
2. The monitor debugger: This debugger type requires an evaluation board like the “SK-91F467-FLEXRAY” connected to one of the COM-ports of your PC. Therefore, make sure the evaluation board connected and powered-up as described before. Explanations in this manual refer to the monitor debugger only.
3. The emulator debugger: The in-circuit-emulator (ICE) is a system, which allows a connection to any target system using a probe-cable. The appropriate system for the MB91F467DA series is the MB2198-01 system. More information about this system can be found on Fujitsu's website.

Which debugger is used for the actual project can be configured in the project tree as shown below or in the “Project – Setup Project – Debug” menu. The current selection is blue marked (icon):



The default settings for the monitor debugger are: **COM-Port 1, 57K6 baud, 8N1**. If you wish to change the COM-port, please right-click on the “Mondeb_57K6_com1.sup” entry and select change.

Note:

If you change the baud rate or use a different crystal frequency, you have to change the UART-settings in the debugging kernel source project, re-compile and flash the new kernel to your “SK-91F467-xxx” board first. The project can be found in Software\SWBMonitorDebugger. All settings are done in the module u_io.asm.

If these settings are correct, start your debugging session:

Make sure you have connected the “SK-91F467-xxx” starter kit and your monitor-kernel is stored in the internal flash memory of the MB91F467DA series at the starter kit. Then power up and reset the starter kit. Check the following configurations:

1) Correct CPU Mode selection (DIP-Switch S5)

After Power on the Monitor debugger indicates via the 8 user-LEDs the current status. The following status indications exist. Ensure that the CPU is working in normal RUN Mode (DIP-Switch S5 **position all OFF**)

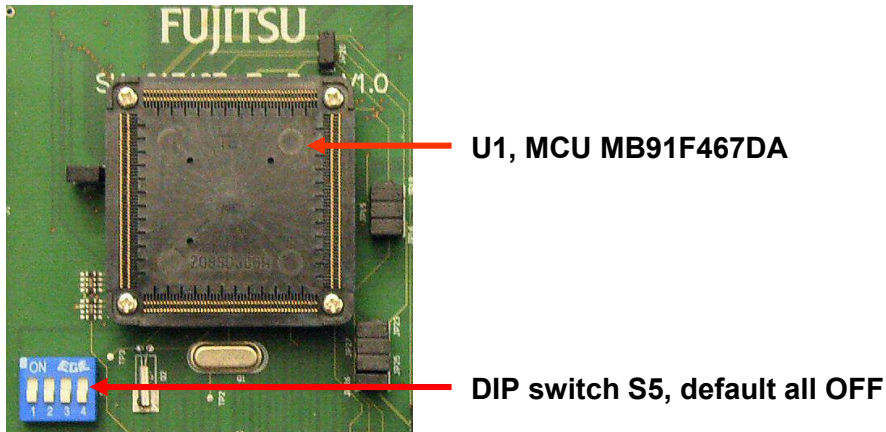


Figure 5-7: MB91F467D and mode pin DIP switch

2) Correct start-up of the monitor debugger

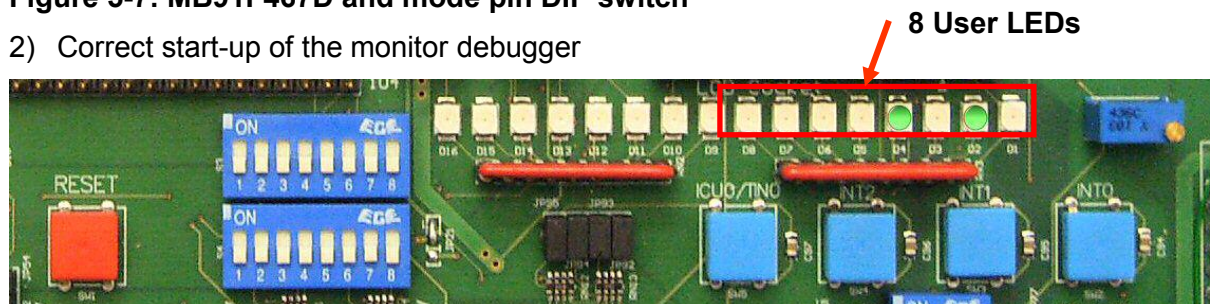


Figure 5-8: Reset button and user LED

Reset

In case of any other status indication push the reset button or check chapter 6.6.1 for detailed information.

Start the debugger by double clicking the “Mondeb_57K6_com1.sup” entry in the project/debug tree - or by using “Debug – Start Debug” from the menu. You should see a progress bar indicating the download process.

If no process is indicated an error message will occur (“e.g. Invalid communication status”). Double-check the settings again as explained above. Also make sure the evaluation-board is powered on, ready to use and the RS232-cable is connected properly. Also see the troubleshooting section in the appendix.

After starting the debugger, the source window will be opened which contains locate-arrows for each (possible) source-line, the original source-code,

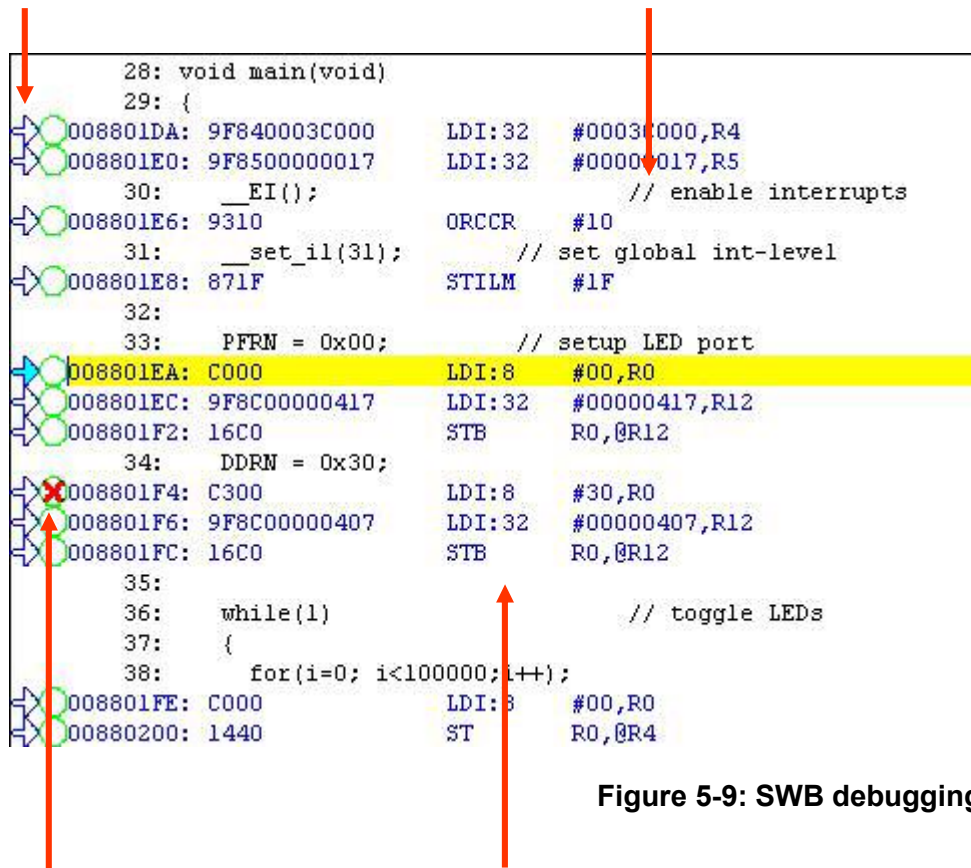


Figure 5-9: SWB debugging window

Breakpoint-indicators and the assembler code (in “mixed view”). The current program position will be indicated by a yellow line. Use right-click in the source window to configure the view (add/remove control characters, View Mixed source code, Breakpoint ...)

Note:
You can choose “mixed view” from the context menu (right-click) to display source and assembly code at the same time. The command “go to current” will take you to the active code line!

5.3.2 Basic Debugger Features



GO: Executes the program continuously from the memory location pointed to by the current program counter (PC) until a termination factor occurs.



STEP IN: Executes the program stepwise according to the listing in the source window (steps in C- or ASM). Note that interrupts are disabled during step execution !



STEP OVER: Executes the program stepwise except call-instructions (which will be executed until return). Interrupts are not disabled during a continuous CALL...RETURN execution.



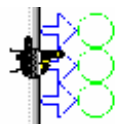
STEP OUT: Executes the program continuously to the parent function (until RETURN). Interrupts are enabled. Note, that debug information is required for this function.



EXECUTE UNTIL CURSOR: Automatically sets a breakpoint at the actual cursor position and executes continuously until this breakpoint, which will be deleted afterwards.

Each valid code line in a debugger window automatically has a locator (blue arrow) and a breakpoint-option (circle). Note that some C-lines may not be displayed with locators and breakpoints, because the compiler has created “optimized” assembler-code. Select “mixed view” in order to check the compiler output.

Instead of single-steps, you may also use the arrows to directly execute your program until a certain line of your source-code :





ABORT: Forcibly terminates execution. This button is not fully supported by the monitor debugger and may cause malfunction if used to abort “continuous operation” of the MCU.

This command button can only be used to abort single code line operations

Example: `for(k=DELAY_CONSTANT; k>0; k--);`

Use the **button INT0** on the “SK-91F467-xxx” for **ABORT** function.





To **ABORT** continuous execution on the “SK-91F467-xxx” starter kit, you have to use the **INT0 button** on the “SK-91F467-xxx” starter kit.

5.4 Advanced Monitor Debugger Features



TOGGLE BREAKPOINT: Sets or deletes breakpoint at the current source line:

To set or delete a breakpoint, click the circles at the beginning of a source-line.

A  indicates an active breakpoint. Hit “Run continuously”  to execute code until reaching this line. A list of all breakpoints can be found under the “Debug – Breakpoint” menu. 255 Software-Breakpoints (using TRAP replacement) are possible.

Note:

To set breakpoints at positions which are currently not visible (e.g. because the source window of that module is not open), you can also enter a symbolic label directly in the “Breakpoint” menu. Example: Enter “main” in the address-field and confirm. The new breakpoint will automatically be assigned to the address of the “main()”-function.



REGISTER WINDOW: Displays the CPU-register window. Updated registers appear in red. *Setup* in context menu defines which Registers should be displayed.



WATCH WINDOW: Displays the current variables to „watch“. Double-click on any variable in your code then specify *watch* in context menu to add to watch window. All listed variables in a watch window can be displayed in any number format. Use *Edit* to directly change the contents.



MEMORY WINDOW: Displays memory areas in various formats defined by *Setup* (context menu). Changing of address/data is possible when debugger is not executing.

The memory window can be very helpful to check the registers or the frame memory of the connected graphic controller !



DISASSEMBLER: Disassembles the content of the code memory beginning from actual PC position and displays the result in a separate window. Individual assembler-lines can be changed using the „inline assemble“-function.

DEBUG - STACK: Displays the current stack contents in terms of function calls. Parameters, if any, are displayed in brackets.

DEBUG - VECTOR: Reads out and displays the actual interrupt-vector table. Use the „jump“ function to display any code areas pointed to by an interrupt vector (e.g. interrupt service routines used in your program).

DEBUG - CALL: This function can be used to „call“ any routine defined in your code when the debugger is on hold.

DEBUG – LOAD TARGET FILE: Starts a new download of the current load module (ABS file). Usually this function will be executed automatically after starting the debugger (defined in debug settings ; see „Project-Setup-Debug“). However, this function can be useful to re-initialize the debugger for the current debug session.

VIEW - SYMBOL: This function displays all (global) symbols of the current project. Information about the type (char, integer etc.) and the location (address in RAM or register) can be shown using „detail“.

VIEW - LOCAL: Similar to View-Symbol, but only local variables of the current function are shown.

VIEW - COMMAND: From this window, the debugger can be controlled using a command line input. All GUI functions are available as individual commands.

Example:

Run continuously

Step

Examine PDRG

Set break main

Dump/Halfword 0x2000000..0x20000FF

Shortcuts to complex commands can be defined (“alias”) and parameter strings can be substituted by variables.

Example: mydump = Dump/Halfword 2000000..20000ff

A set of commands can be combined to a “macro”. Aliases and macros can be defined using the command window context menu.

Example: restart: set register PC=2000000
 set break main
 Run continuously

In order to document or save debugging details such as memory contents, all outputs fed to the command console can be written to a file (“logging”).

A whole “program” of commands (incl. flow control) can be written to a PRC-file and executed. Procedure-files are simple text-files with the extension “.PRC” and can be created by the Softune Workbench editor or any other text editor. To execute a procedure-file, use the command window menu or the “file-open” menu during debugging.

Note:

Procedure-files can be very helpful to configure the debug-environment automatically, perform automated tests (e.g. when a new C-module has to be tested) or to enhance basic emulator functions such as breakpoints. Using a procedure file, breakpoints can be defined dynamically depending on program conditions. See the “Command Reference Manual” (on-line help) for detailed information about the available command and parameter syntax. Some procedure files exist already included in the example project directory.

5.5 Memory Configuration for User Applications

Valid load module files can only be achieved if the language tool configuration is appropriate. The most convenient way to create owns a project is to copy the provided Template-Projects from the example-directory and use it as “blank sheet”.

If the Softune Monitor debugger is being used the following memory areas are reserved by the monitor debugger and must not be used by the application.

| Memory Map of Softune Workbench Monitor debugger | | | |
|---|-----------------|-----------------------------|-----------------|
| 91460_mondeb_uart4-v11 | | | |
| Memory Type | Used for | Area(s) | Sections |
| Internal CPU Data RAM | Stack, Data | 0x28000 - 0x28FFF | STACK, DATA |
| Internal Flash Memory of MB91F467DA series | Debug Kernel | 0x000F:0000- 0x000F:FFFF | CODE, CONST |
| | Vector Table | 0x0F:FC00- 0x0F:FFFF | INTVECT |
| <p>Note: Be aware that the memory map may depend on the debugger version and any modifications of the debugger made by the user.</p> | | | |

Table 5-1: Memory map of Monitor debugger 91460_mondeb_uart4-v11

| | |
|--|---------------------------|
| <p>Note: The following chip select areas are used by the Softune monitor debugger and must not be used or overlap with other chip select areas:</p> | |
| CS1 – SRAM | 0x0080.0000 - 0x009F.FFFF |

Always check the Linker Settings (“Project – Setup Project – Linker – Disposition”) to make sure the following memory map is applied according to the project configuration:

| Recommended linker settings for “SK-91F467-xxx” starter kits <u>for debugging</u> | | | |
|---|-------------------------------|-------------------------|-------------------|
| Memory Type | Used for | Area(s) | Sections |
| Data RAM, | Variables, Stack | 0x029000 - 0x02FFFF | DATA, INIT, STACK |
| External SRAM 1MB | Code, Const, IRQ Vector Table | 0x00840000 - 0x0094FFFF | CODE, CONST |

Table 5-2: Linker Settings for MB91F467DA Monitor Debugger configuration

Note:
In any case all settings must be checked and corrected corresponding to specific application requirements. Also check settings in the start91467.asm initialisation file! Use the linker mapping list (e.g. *.mp1 file) to check the final memory allocation.

The following chip select areas are used by the Softune monitor debugger and must not be used or overlap with other chip select areas:

CS1 – SRAM 0x0080.0000 - 0x009F.FFFF

Checklist for project configuration:

- **Make sure, the correct Target MCU (“Project – Setup Project - MCU” menu) MB91F467D is selected.**
- **Use the correct linker settings as outlined above depending on your target MCU and the target area (embedded flash or external RAM).**
- **Use the provided templates to make sure the sections are located correctly.**
- **Always check the *.mp1 file (use right mouse click on top *.abs file in the project window of Softune Workbench and select “open list file”) to see the used sections and address areas!**
- **The following Chip select areas are used by the Softune monitor debugger and must not be used or overlap with other chip select areas:**

CS1 – SRAM 0x0080.0000 - 0x009F.FFFF

Note:
Be aware that the Softune Workbench monitor debugger is only able to debug code which is located in RAM! It is not possible to debug code located in Flash memory!

6 Flash Programming

6.1 Programming internal Flash of MB91F467DA series

To program the Monitor debugger or any other Application into the internal Flash memory of MB91F467DA series following steps must be taken.

- 1) To install the Flash Programming utility on the PC the following steps must be taken
 - a. Browse to the folder “Software\FlashProgramming” of the starter kit CD-ROM and execute the FME_FR_Flashprogrammer_v3_7.exe file. The default installation folder is: C:\Softune6\Utility\
 - b. Start Flash Programming tool by double click flash.exe within the installed folder: C:\Softune6\Utility\FME_FlashProgrammer_v3_7\flashprg.exe
- 2) Open the Flash programming Utility by double click the flashprg.exe file
- 3) Select CPU type, COM Port, baud rate, Hex File as shown in the following figure
 - a. Device Type: MB91F467D
 - b. Com port: 1
 - c. Baudrate: 38400
 - d. Hex File: MonDeb91467D.mhx

Use button “Browse” and browse to
c:\..\Software\MonitorDebugger\ MonDeb91467D.mhx

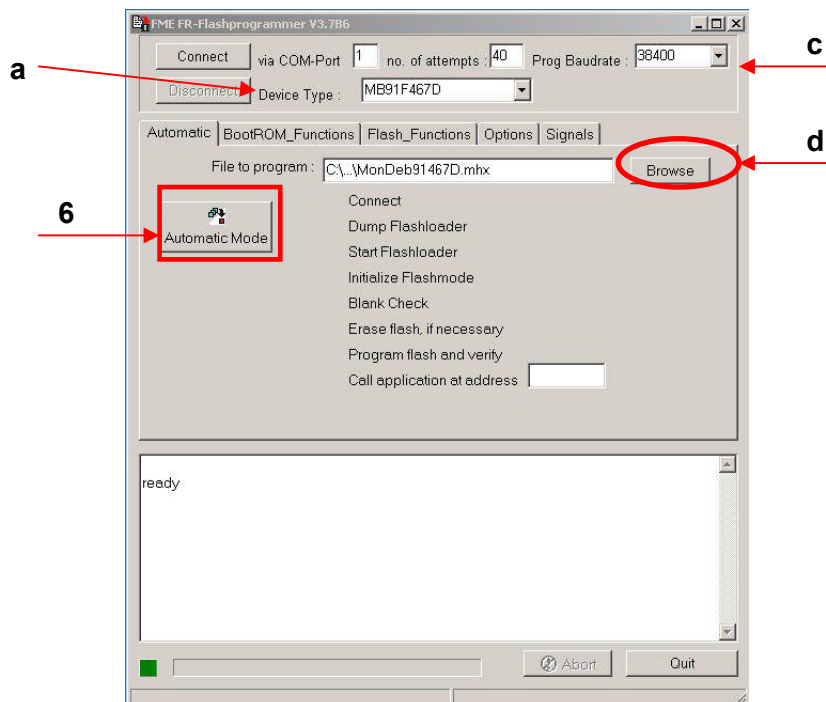


Figure 6-1: FME FR-Flash Programmer for MB91F467D series

- 4) Connect starter kit and PC with a RS232 cable. MB91F467 is using UART4 interface for serial Flash Programming.
- 5) Power-off the board or assert and hold RESET
- 6) Press "Automatic" button to start automatic Flash Programming

Using the "Automatic" button the Programming steps are automatically proceed by the Flash Programmer Utility.

- 7) Power-on the board or release RESET to start Flash Programming

After pressing the "Automatic" button release the RESET button or power on the starter kit in order to start boot Rom execution of MB91F467DA series.

All steps are proceed automatically, download the Flash Programming routine, 'blank check', Flash erase if necessary and Programming the Application.

Following is displayed in the message window in case of successful programming:

```
Sending start characters...
Connection OK.
Filesize=8192 (0x2000)
bincommand:
write
writing 8192 bytes...
  received checksum = 4426 (0x114A)
  calculated checksum = 4426 (0x114A)
OK - checksums match
write finished.
Sending Baudrate Information:
  received checksum = 114 (0x0072)
  calculated checksum = 114 (0x0072)
OK - checksums match
write byte finished.
Baudrate set (write byte) finished.
calling address 0x030000
bincommand:
"call"
call initiated - waiting for returnvalue...
returnvalue = 254
searching for flash-loader...
Flash mode activated (">" received)
Checking...
Blank Check finished
Chip erase in process...
```

```
CAUTION : DO NOT INTERRUPT OR CUT OFF POWER DURING ERASE !!!  
Chip-erase successful  
Sending download command  
loading and programming...  
00148000: Security Address not programmed, use Prog Word!  
00148004: Security Address not programmed, use Prog Word!  
00148006: Security Address not programmed, use Prog Word!  
001448008: Security Address not programmed, use Prog Word!  
0014800C: Security Address not programmed, use Prog Word!  
0014800E: Security Address not programmed, use Prog Word!  
Download and programming completed  
Automode finished.  
COM port closed  
automatically disconnect
```

Figure 6-2: FME Flash Programmer output message window

As shown in the message window the Security address is not programmed in Automatic programming process. This is done for security reason to avoid the activation of the Security function by accident.

- 8) After successful programming assert Reset or Power-off / On the board in order to start the programmed application.

Note 1:

The MB91F467DA series is checking the serial UART4 interface for valid string to enter Flash programming mode. For details about boot sequence refer to Hardware Manual of MB91460 series.

Note 2:

Be aware of Security Features of MB91F467DA series. Check Documentation of MB91460 series for detailed information!

7 Trouble shooting

| Problem | Solution |
|--|--|
| Starter kit does not power-on correctly. Some or all of the power LEDs (D24, D30, D34, and D40) do not lit up. | Check voltage supply and jumpers : <ul style="list-style-type: none"> * The voltage on DC-Power plug should be in the range of 9-12V. The plug should have + on shield and – on the centre. The power supply should be able to supply at least 500mA. To support both, the “SK-91F467D-208PFV” and a graphic sub-board the supply should be able to supply 1500mA. * The LEDs should light up after switching on the board. Use a multimeter to see whether 5V,3.3V, 2.5V and 1.8V are present on the Vcc/GND test measurement points J21, J22, J23 and J24. * Check jumper positions according to chapter 2.1 * Remove all user extensions of the starter kit |
| Starter kit stays in reset. LED D18 (Reset indicator) lights up permanently. | <ul style="list-style-type: none"> * LED D18 (Reset) should flash. If D18 lights up permanently, the voltage is too low - Increase the voltage supply and check available supply current to solve the problem. * Remove all user extensions on the board to avoid any shortcuts or leakage current! |
| The communication from Softune Workbench to the evaluation board fails (Communication errors) | <ul style="list-style-type: none"> * Make sure your COM-port number and the baud rate settings are correct (see debugger introduction). The default COM-port is 1 and the default baud rate is 57K6Baud. * Make sure no other programs are using the same COM-port on your PC. Close all other applications (e.g. Flash programmer utilities, terminals etc.) * Check if RTS/CTS is closed on the CPU module (check jumper JP58, 60, 65 are closed). * Use only a RS232 extension 1:1 cable |
| The windows of the debugger are empty. | <ul style="list-style-type: none"> * This is due to wrong (maybe old) file path information. Closing all windows in the debugger and re-open should fix the problem. |
| When trying to program the application to the embedded flash, the programmer stops at first address with “loading error” ! | <ul style="list-style-type: none"> * You are probably trying to program a program to the flash which is linked for the external RAM area. Check for details the linker memory map and the linker output mapping file *.mp1 file. |
| Hardware units such as LEDs, user buttons, UART are not working. | <ul style="list-style-type: none"> * Make sure you have enabled these units on the evaluation board using the appropriate jumpers. See the provided examples and the hardware manual for information on how to control the peripherals. |
| LCD at parallel LCD port does not work | <ul style="list-style-type: none"> * Adjust the potentiometer RP1 to adjust contrast of LCD. Remove resistor network RN3 |
| Graphic sub-board does not work | Check power supply 9-12V/1500mA. Reduce external bus clock frequency |

Table 7-1: Trouble shooting

8 Silk-Plot of the Board

8.1 Top Side

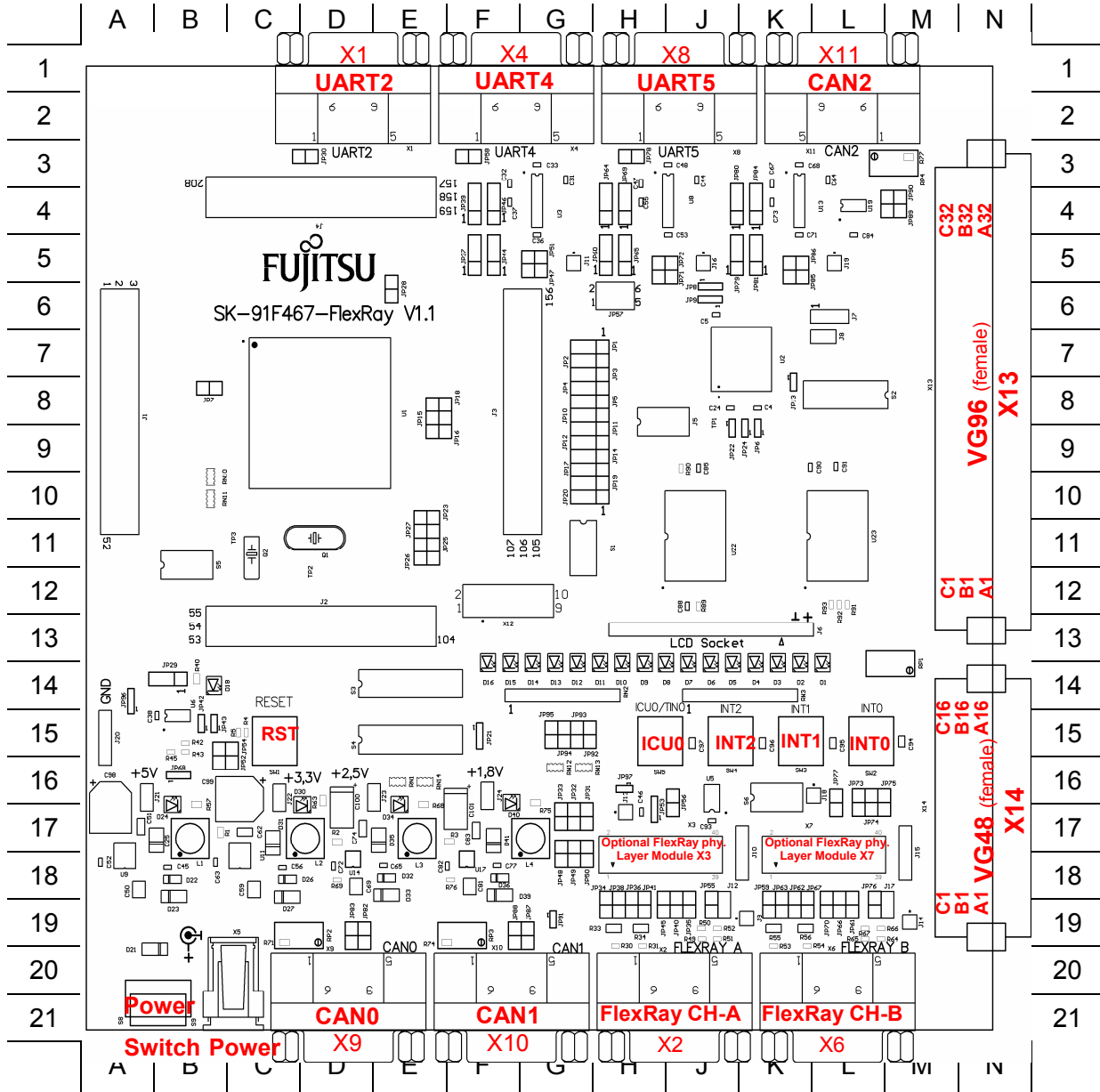


Figure 8-1: Board Layout (Top Side)

8.2 Bottom Side

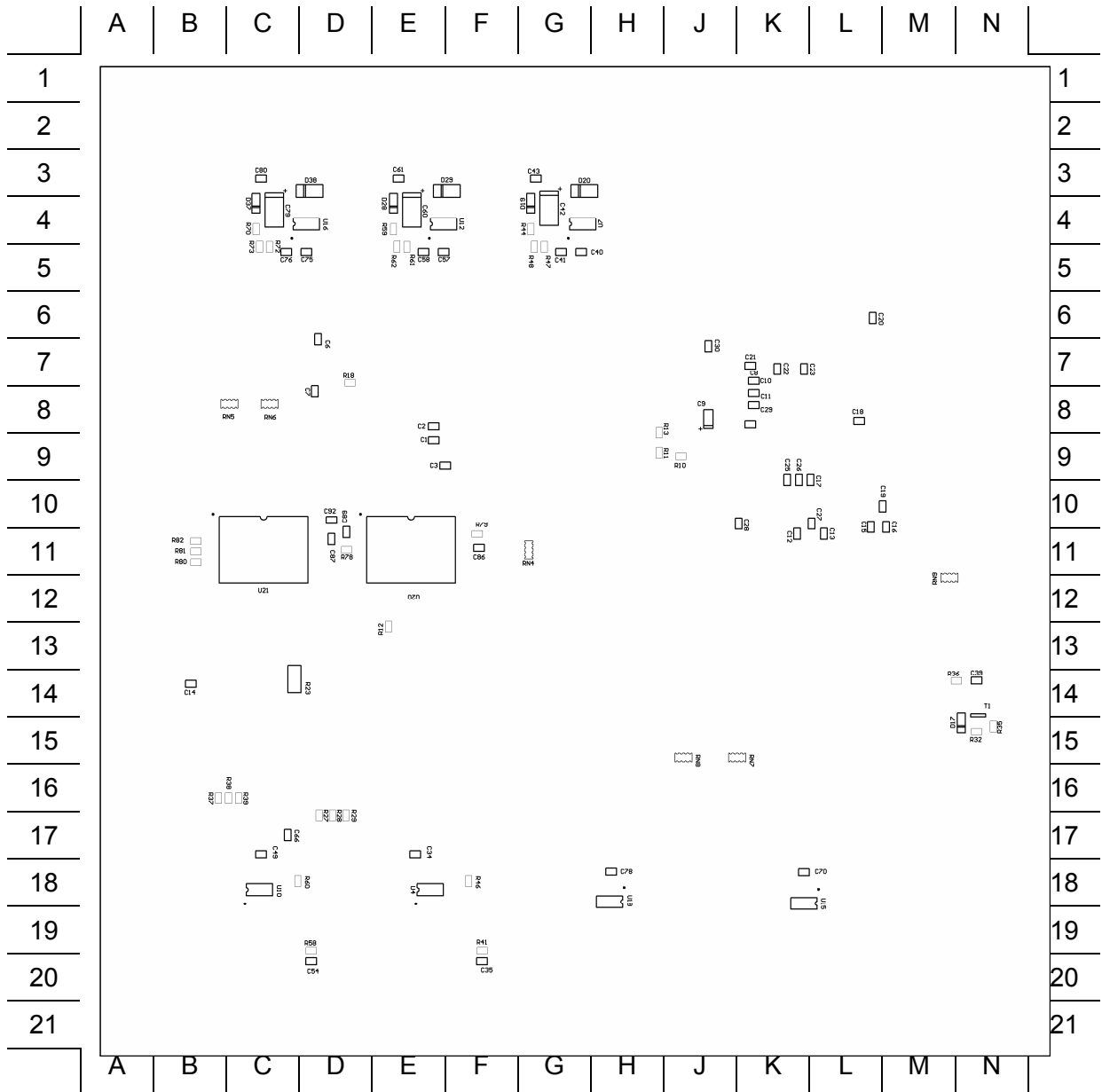


Figure 8-2: Board Layout (Bottom Side)

9 PCB History

9.1 SK-91F467-FLEXRAY V1.0

| Part | Problem | Fixed |
|------|--|-------|
| U20 | Wrong UB/LB connection (WRX2 and WRX3 has to be connected) | V1.1 |
| X14 | Connect 1.8V supply not directly to X14 (add jumper) | V1.1 |
| U6 | Additionally pull-up resistors for MCU and ASSP reset line | V1.1 |
| U6 | Reset button connection (SW1), add further option to activate reset directly when pressing SW1. Actually, SW1 must be pressed 2s to activate reset. (add solder jumper to select one option) | V1.1 |
| U9 | Add C=220uF/16F between Vcc5V and GND | V1.1 |
| U11 | Add C=220uF/16F between Vcc3V3 and GND | V1.1 |
| U14 | Add C=100uF/16F between Vcc2V5 and GND | V1.1 |
| U17 | Add C=100uF/16F between Vcc1V8 and GND | V1.1 |
| | | |
| | | |

Table 9-1: History PCB V1.0

9.2 SK-91F467-FLEXRAY V1.1

| Part | Problem | Fixed |
|------|---------|-------|
| | | |
| | | |
| | | |

Table 9-2: History PCB V1.1

10 Appendix

10.1 Related Products

- SK-91460-MAIN Evaluation main board for MB91460 Series
- SK-91460-91F467D-208PFV MCU-board incl. MB91F467DA for SK-91460-MAIN
- SK-91F467D-208PFV Evaluation board with MB91F467DA
- SK-91F467-FLEXRAY Evaluation board with MB91F467DA and MB88121A
- ADA-91V460-91F467D Conversion adapter MB91V460 to MB91F467D

- MB2198-01 Emulator debugger main unit
- MB2198-10 DSU cable
- MB2198-300 Adapter board for MB91V460 emulation chip (BGA-660P)
- MB91V460 Emulation chip of MB91460 Series
- PB-91467D-208PFV Probe cable for MB91F467DA target system
(Recommended for SK-91F467D-208PFV)
- PB-91467D-NLS-208PFV Probe cable for MB91F467DA target system
(Recommended for SK-91F467-FLEXRAY)
- NQPACK208SD Socket for package FPT-208P-M01 and FPT-208P-M04
Tokyo Eletech Corp. www.tetc.co.jp/e_tet.htm
- HQPACK208SD306H Header for FPT-208P-M01 e.g.: MB91F467D
- YQPACK208SD Joint connector extension for NQPACK208SD
- YQSOCKET208SDN Joint connector socket for NQPACK208SD

- MB91F467DA Flash chip of MB91460 Series
- MB88121A FlexRay Communication Controller

10.2 Information on the WWW

Information about FUJITSU MICROELECTRONICS Products can be found on the following Internet pages:

Microcontrollers (8-, 16- and 32bit), Graphics Controllers
Datasheets and Hardware Manuals, Support Tools (Hard- and Software)

<http://www.fme.gsdc.de/gsd.htm>

Automotive products: MCU, Graphic display controller, MPEG en/decoder, gyro sensors

<http://www.fujitsu.com/emea/services/industries/automotive/>

Linear Products: Power Management, A/D and D/A Converters

<http://www.fujitsu.com/emea/services/microelectronics/linears/>

Media Products: SAW filters, acoustic resonators and VCOs

<http://www.fujitsu.com/emea/services/microelectronics/saw/>

For more information about FUJITSU MICROELECTRONICS

<http://emea.fujitsu.com/microelectronics>

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10.5 Abbreviations

| | |
|-------|---|
| ADC | Analogue Digital Converter |
| ASSP | Application Specific Standard Product |
| CAN | Controller Area Network |
| CC | Communication Controller |
| CS | Chip Select |
| FME | Fujitsu Microelectronics Europe GmbH |
| FPGA | Field Programmable Gate Array |
| GDC | Graphical Display Controller |
| LB | Lower Byte |
| LIN | Local Interconnect Network |
| MCU | Microcontroller Unit |
| PCB | Printed Circuit Board |
| SRAM | Static Random Access Memory |
| TZM | Transferzentrum Mikroelektronik |
| UART | Universal Asynchronous Receiver Transmitter |
| UB | Upper Byte |
| UG | User Guide |
| USART | Universal Synchronous Asynchronous Receiver Transmitter |

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