UM2108
User manual

SPC5-CONNECT

Introduction

The SPC5-CONNECT is a programmable USB interface designed to support the most common automotive communication interfaces in a simple tool.

Target applications are ASIC control or communication control and monitoring.

The hardware features, accessible through the Script Engine, make the SPC5-CONNECT a powerful, low cost and easy to use tool for rapid development of small scripts in lab applications.

Please, visit SPC5-CONNECT web site to have further information.

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1 Overview

1.1 General description

The SPC5-CONNECT is an evaluation tool to connect a PC to vehicle interfaces for conventional fieldbus systems. The SPC5-CONNECT device is based on the 32-bit microcontrollers SPC563M64.

The SPC563M64 MCU is a high-performance automotive microcontroller based on the 32-bit Power Architecture®, with up to 1.5 Mbytes of Flash, up to 96 Kbytes of SRAM and a rich set of automotive peripherals.

The board is designed also to help developers evaluate the device peripherals (such as CAN, SCI, LIN) and develop their own applications.

Its design allows full access to CPUs I/O signals, analog channels, Interrupts input and the peripherals such as CAN, UART, JTAG, K-Line, LIN and SPI.

Extension flat cable with 24 pin header connector and DB9 connector, makes it possible to easily connect a daughter board or wrapping board for a specific application.

SPC5-CONNECT (PCs) has been designed to work correctly using Windows platform and no particular hardware requirements are requested.

The SPC5-CONNECT board is also used to evaluate the SPC563M64 silicon.

This user manual provides information on using the SPC5-CONNECT board and its hardware feature.

1.2 Package contents

An SPC5-CONNECT package includes the following items:

- SPC5-CONNECT board;
- Plastic box;
- USB to Mini-USB cable;
- Flat cable with one DB9 connector plus one 24 pin header;
- Mini-CD

1.3 Handling precautions

Please take care to handle the package contents in a manner such as to prevent electrostatic discharge.

1.4 Reference documents

For the development and use of this product the following reference documents have been used and they are also available on CD. See *Table 1*:

Table 1. Reference documents

Reference documents	Description
SPC563M6xL.pdf	32-bit Power Architecture® based MCU for automotive
SPC56 MCU family.pdf	SPC56 MCU family development tools
FT2232D.pdf	FT2232D Dual USB to serial UART/FIFO IC Datasheet
L9616.pdf	High speed CAN Bus transceiver
ST232.pdf	+5V powered multi-channel RS-232 drivers and receivers
L9637.pdf	Monolithic bus driver with ISO 9141 interface
STM6315.pdf	Open drain microprocessor reset
AN107 AdvancedDriverOptions.pdf	Advanced Driver Options for FTDI devices

2 Hardware features

The SPC5-CONNECT board has the following features:

- 18 GPIO's (6 eMIOS);
- 4 ADC channels;
- 2 SPI with 6 CS for DSPI_B and 1 for DSPI_C (shared with GPIO);
- 1 NMI;
- 2 CAN channels (1 ST-L9616 CAN transceiver);
- 1 LIN (with transceiver, multiplexed from SCI);
- 1 UART (with ST-RS232 transceiver, multiplexed from SCI);
- 1 Kline (with ST-L9637D transceiver, multiplexed from SCI);
- 1 USB connection to PC;
- 3 LED (one power-on LED controllable via software);
- 2 LEDs on Tx & RX communication signals;
- 1 reset button with filter and LED indicator;
- Jumper for boot configuration;
- JTAG 14-pin header connector;
- 12 MHz crystal MCU main oscillator;
- 2 Header connectors for easy signals access (flat cable whit connectors included).

Figure 1 shows the view of the placement of components on the top side:

Figure 1. SPC5-CONNECT top side

3 Hardware and software installation

This section describes the minimum system requirements and the procedure for installing the hardware and the control software.

3.1 Minimum system requirements

PC Windows XP or higher with USB port.

3.2 Hardware setup

It is neither necessary to configure your PC, nor to setup the SPC5-CONNECT board. The SPC5-CONNECT has a default configuration as the factory. The default configuration (of the jumpers) is shown in the document reported in the CD "SPC5-CONNECT Configuration top.pdf". The flat cable supplied with the SPC5-CONNECT by default is plugged on P3 header.

3.3 Software setup

3.3.1 USB divers

The drivers are available for most of the Operating Systems and for most of these O.S. two types of driver are available: Virtual COM Port (VCP) drivers and direct (D2XX) drivers. The VCP driver emulates a standard PC serial port longer available that the USB device may be communicated with as a standard RS232 device. The driver D2XX Allows direct access to a USB device via a DLL interface.

To locate the drivers you want to install for a device, select which of the driver types you wish to use (VCP or D2XX) and then locate the appropriate operating systems. With the exception of Windows 98 and Windows ME, all devices are supported in each driver package.

For drivers that enable FTDI devices to work with different operating systems see the FTDI site.

To use SPC5-CONNECT is essential to install the D2XX Direct Driver.

This page contains the D2XX drivers currently available for FTDI devices. Installation guides are available from the Installation Guides page of the Documents section of the FTDI web site for selected operating systems.

D2XX drivers allow direct access to the USB device through a DLL. Application software can access the USB device through a series of DLL function calls. The functions available are listed in the D2XX Programmer's Guide document which is available from the Documents section of the FTDI web site.

3.3.2 SPC5Flasher

SPC5Flasher software application is developed to manage the on-chip SPC56x flash (erasing, programming, verification, reading and checksum function) via SCI, CAN, K-line in the same tool.

The application GUI is an Eclipse based interface that allows the user to connect the tool with the target using a USB dongle and to perform the tool functionalities.

The SPC5-CONNECT is used as interface between SPC5Flasher and target.

SPC5Flasher sends via CAN a plugin that is loaded in the RAM of the target. After the loading of the firmware, it is executed and it is implemented the flasher target side.

3.3.3 SPC5Connect Manager

SPC5-CONNECT firmware is based on a script and an engine. SPC5-CONNECT explorer works only with the default firmware but the user can change the script to execute personalized tasks.

The SPC5-CONNECT Manager is a tool that allows easily to update the script. It allows also to update the engine of the SPC5-CONNECT.

3.3.4 SPC5Connect Explorer

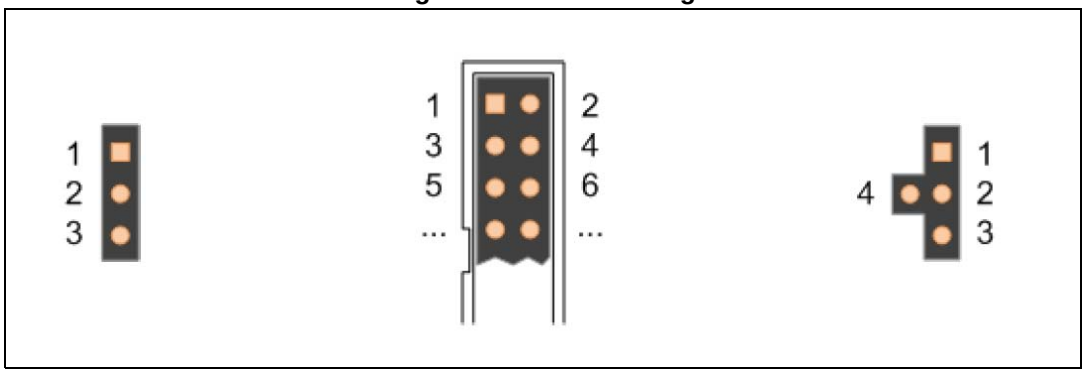
The SPC5-CONNECT Explorer PC Interface allows easy programming of the device together with basic control and monitoring features of target signals.

4 Board pinout (signal description)

4.1 Pin numbering for jumpers and Header connector

Jumpers for the board have a rectangular pad to indicate the position of pin 1. Please, see the examples showed in *Figure 2* for the numbering convention used in this manual for jumper settings.

Figure 2. Pin numbering



4.2 Pinout

In *Figure 3* is shown the pinout of the two expansion connectors (P2 and P3) for use with specific applications.

Figure 3. P2 and P3 connector

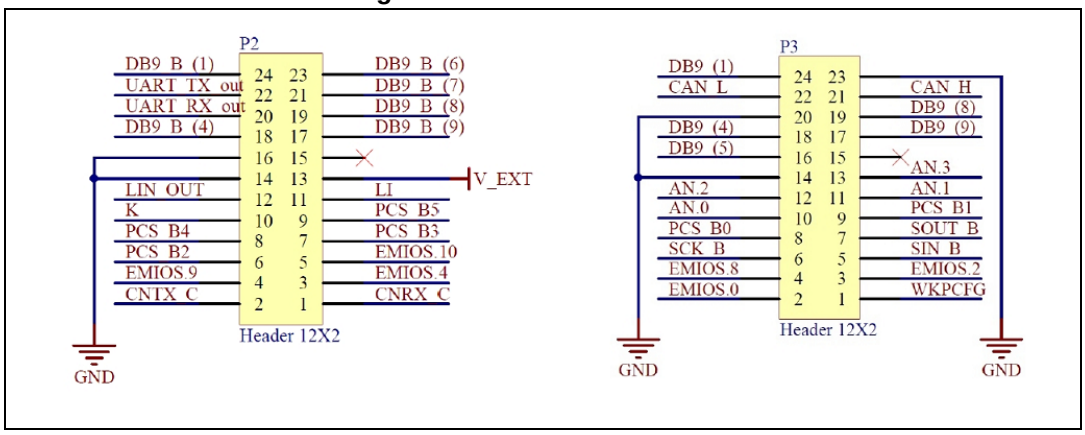


Table 2 and *Table 3* show the correspondence between the P2 and P3 connectors on the PCB and the connectors on the flat cable (7 x 2 header and DB9):

Table 2. Correspondence between P2 connector and flat cable

P2 - Header 12x2 (PCB)		Header 7x2 (flat cable)		DB9 Female (flat cable)	
Pin	**Signal description**	**Pin**	**Signal description**	**Pin**	**Signal description**
1	CANC_RX	1	CANC_RX		
2	CANC_TX	2	CANC_TX		
3	EMIOS.4	3	EMIOS.4		
4	EMIOS.9	4	EMIOS.9		
5	EMIOS.10	5	EMIOS.10		
6	PCS_B2	6	PCS_B2		
7	PCS_B3	7	PCS_B3		
8	PCS_B4	8	PCS_B4		
9	PCS_B5	9	PCS_B5		
10	K_Line	10	K_Line		
11	LI	11	LI		
12	LIN_OUT	12	LIN_OUT		
13	V_EXT	13	V_EXT		
14	GND	14	GND		
15	NC				
16	GND			1	NC
17	NC			2	UART_TX
18	NC			3	UART_RX
19	NC			4	NC
20	UART_RX			5	GND
21	NC			6	NC
22	UART_TX			7	NC
23	NC			8	NC
24	NC			9	NC

Table 3. Correspondence between P3 connector and flat cable

P3 - Header 12x2 (PCB)		Header 7 x2 (flat cable)		DB9 Female (flat cable)	
Pin	**Signal description**	**Pin**	**Signal description**	**Pin**	**Signal description**
1	WKPCFG	1	WKPCFG		
2	EMIOS.0	2	EMIOS.0		
3	EMIOS.2	3	EMIOS.2		
4	EMIOS.8	4	EMIOS.8		

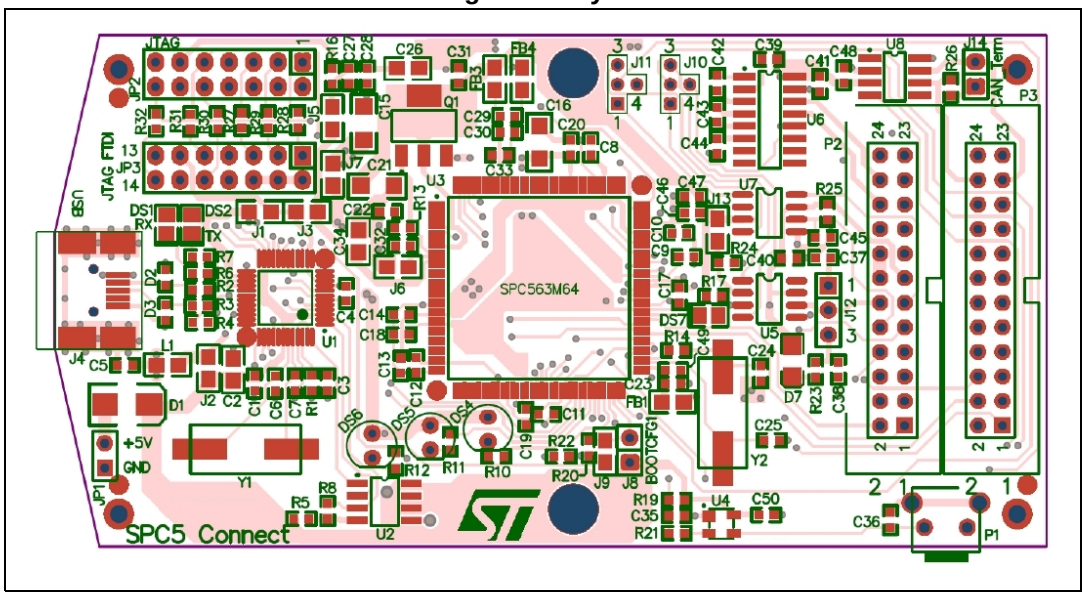
Table 3. Correspondence between P3 connector and flat cable (continued)

P3 - Header 12x2 (PCB)		Header 7 x2 (flat cable)		DB9 Female (flat cable)	
Pin	Signal description	Pin	Signal description	Pin	Signal description
5	SIN_B	5	SIN_B		
6	SCK_B	6	SCK_B		
7	SOUT_B	7	SOUT_B		
8	PCS_B0	8	PCS_B0		
9	PCS_B1	9	PCS_B1		
10	AN.0	10	AN.0		
11	AN.1	11	AN.1		
12	AN.2	12	AN.2		
13	AN.3	13	AN.3		
14	GND	14	GND		
15	NC				
16	NC			1	NC
17	NC			2	CAN L
18	NC			3	GND
19	NC			4	NC
20	GND			5	NC
21	CAN H			6	GND
22	CAN L			7	CAN H
23	GND			8	NC
24	NC			9	NC

4.3 Layout

Figure 4 shows the layout of the board (top side).

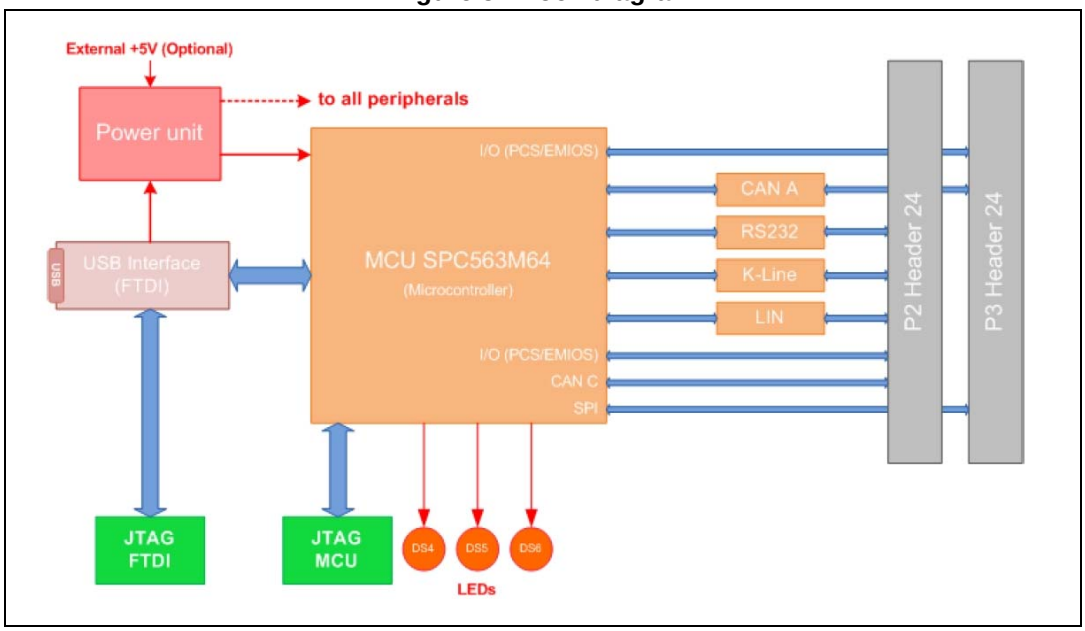
Figure 4. Layout



5 Block diagram

Figure 5 shows a block diagram with the main functions and the interconnections between the main features.

Figure 5. Block diagram



6 Schematic and BOM (Bill of materials)

The CD supplied with the board contains various documents: the circuit diagram refers to the document “ SPC5-CONNECT Schematic_R0.pdf”, while for the BOM you can refer to the document “SPC5-CONNECT BOM_R0.pdf”.

7 Hardware functions and configurations

7.1 System architecture

SPC5-CONNECT is designed in order to allow the use of the communication interfaces independently of each other. The UART, KLINE and LIN interfaces share the same hardware peripheral and therefore only one of them can be active at the same time.

7.2 Power supply

The SPC5-CONNECT is supplied from the USB. The JP1 header connector offers the possibility to supply the +5V directly.

For the location of the jumpers on the PCB see *Figure 1: SPC5-CONNECT top side*. The following jumpers are used to configure the power supply:

Table 4. Supply related jumper

Jumper	Description	Default
J1	Jumper to connect the FTDI-A-bus to the on board Vcc	Close
J2	Jumper to supply the board from the USB +5V	Close
J3	Jumper to connect the FTDI-A-bus to the +3,3V from the SPC563M64 internal regulator (Vrc33)	Open
J5	VCONN, Debug Port Voltage configuration, select the +3,3V from the SPC563M64 internal regulator (Vrc33)	Open (not connected)
J6	VSTBY Power Supply for Standby RAM	Open
J7	Jumper to connect the on board Vcc to the VDDEHx of the SPC563M64 microcontroller	Close

7.3 Boot

The on board SPC563M64 microcontroller can boot from:

- Internal User Flash;
- Serial link (CAN or SCI).

The following jumpers affect the operation of the processor as it initially comes out of the reset state:

Table 5. Reset related components

Jumper	Description	Default
J8	BOOTCFG1 configuration, controls whether the processor boots from internal FLASH or from a serial interface (CAN, SCI)	Open (‘0’) (Int.Flash)
J9	Jumper to connect the BOOTCFG1 pin to the GPIOH0 pin of the FTDI chip for a software control of the Boot configuration	Open

Figure 6 shows the location of the jumpers J8 and J9 on the PCB:

Figure 6. Boot jumpers

7.4 Reset circuit

The RESET circuit uses the STM6315 microprocessor Reset Circuit device.

It performs the asserting of the reset signal whenever the supply voltage drops below a preset value and keeping it asserted until supply voltage has risen above the preset threshold for a minimum period of time (trec). It also provides a manual reset input (MR).

Table 6. Reset related components

Jumper	Description	Default
P1	RESET push button	-
R21	Reset circuit Enable	Close
DS7	Reset Out LED	-

Laterally to case there is a hole to access the button P1. *Figure 7* shows the location of the P1 on the PCB and in the case:

Figure 7. Location of P1 on the PCB

7.5 CAN interface

The ST L9616 high-speed transceiver provides the controller area network (CAN) communication interface through the SPC563M64 CAN_A channel. This serial communication can reach speeds up to 1 Mbps.

The CAN channel is terminated by default with a 120 Ω resistor. User can disconnect this resistor by opening the jumper J14.

For detailed information please refer to datasheet ST L9616.

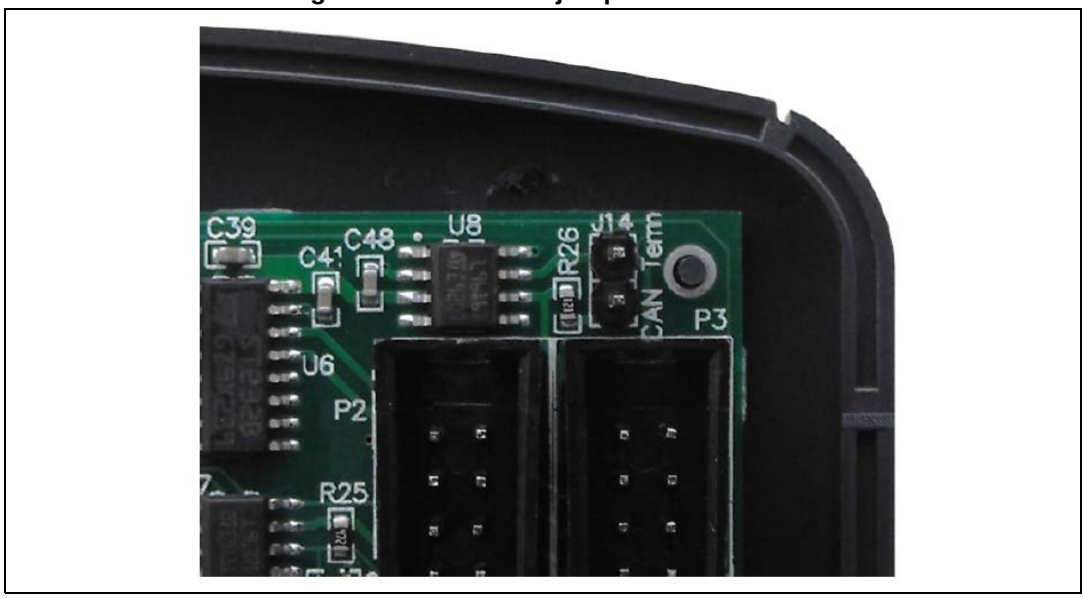
Table 7. CAN related jumpers

Jumper	Description	Default
J14	Jumper to enable the CAN termination 120 Ω resistor	Closed (enabled)

The CAN bus connection is available on the P3 connector. For an easy connection it is also available on the DB9 connector when the flat cable is plugged on P3 header (default configuration).

Figure 8 shows the location of the jumper J14 on the PCB:

Figure 8. Location of jumper J14 on PCB



7.6 UART, LIN and K-LINE interfaces

The UART, LIN and K-Line interfaces share the same hardware peripheral and therefore only one of them can be active at the same time.

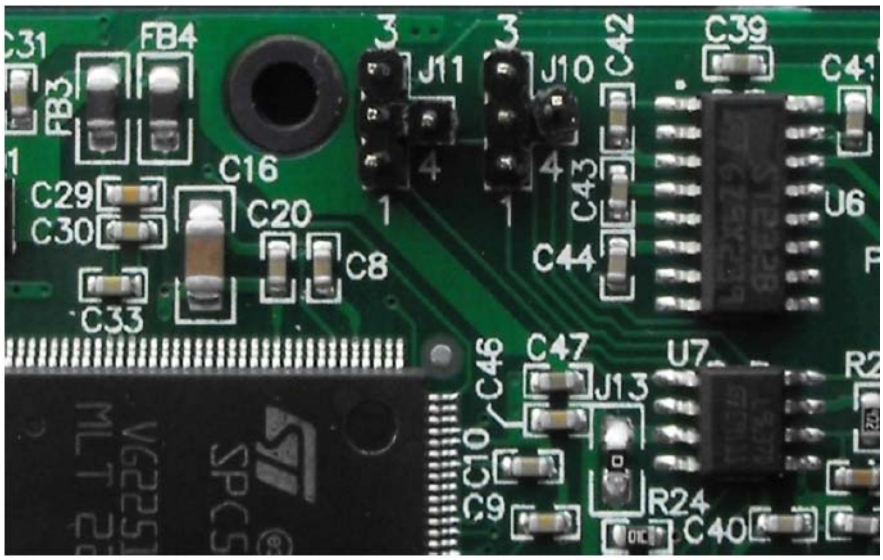
Jumpers J10 and J11 select which interface is connected to the UART_B of the SPC563M64 microcontroller.

Table 8. UART, LIN and K-LINE interfaces jumper selection

Operation mode	TX channel J10 configuration	RX channel J11 configuration
UART	2 - 4 closed (default)	2 - 4 Closed (default)
LIN	2 - 3 closed	2 - 3 Closed
K-Line	2 - 1 closed	2 - 1 Closed

Figure 9 shows the location of the jumpers J10 and J11 on the PCB:

Figure 9. Location of jumpers J10 and J11 on PCB



7.6.1 UART interface

The SPC5-CONNECT board is provided with a standard RS-232 type serial port configured for serial communication with external devices or direct connection to a PC COM port.

For more information please refer to the ST232ABDR datasheet.

The UART connection is available on the P2 connector. For an easy connection it is also available on the DB9 connector when the flat cable is plugged on P2 header.

7.6.2 LIN interface

The SPC5-CONNECT board provides a LIN master type node on the LIN network. Jumper J12 selects the Master or Slave configuration.

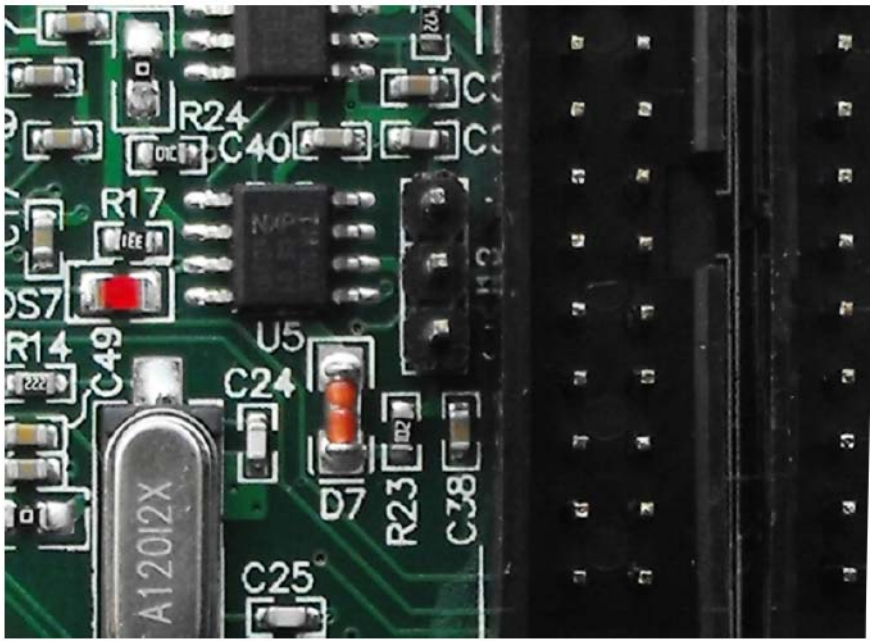
For complete details of transceiver operation refer to datasheet STL9638 datasheet.

Table 9. LIN related jumpers

Jumper	Description	Default
Jumper	Description	Default
J12	Jumper to enable the Master/Slave configuration	2-3 Closed (Master)

Figure 10 shows the location of the jumper J12 on the PCB:

Figure 10. Location of jumper J12 on PCB



The LIN connection is available on the P2 connector. For an easy connection it is also available on the 24 pin connector when the flat cable is plugged on P2 header.

7.6.3 K-Line interface

The ST L9637D transceiver provides the controller Kline communication interface through the SPC563M64 UART_B channel by configuring the J10 and J11 jumpers.

It consists of one single wire shared among nodes with 12V voltage signaling and half duplex communication. Communication protocol uses standard UART 8bit data format. KLINE interface relies on higher protocol solving half duplex communication.

For more information please refer to the ST 9637D datasheet.

The K-Line connection is available on the P2 connector. For an easy connection it is also available on the 24 pin connector when the flat cable is plugged on P2 header.

7.7 LED’s

Three LED’s are connected to the EMIOS14, EMIOS23 and ETPUA1 signals of the SPC563M64 microcontroller.

The first one is programmed as power-on LED.

Table 10. Reset related components

Led	Description	Signal
DS4	Power-on LED / user LED	EMIOS.23 GPIO[202]
DS5	User LED	EMIOS.14 GPIO[193]
DS6	User LED	eTPU_A 1 GPIO[115]

7.8 ADC

Four ADC line of the SPC563, are connected to the P3 connector. For information on the pinout refer to chapter *Section 4: Board pinout (signal description)*.

Table 11. ADC pins

Connector	Description	Pin position
P3	AN.0	10
P3	AN.1	11
P3	AN.2	12
P3	AN.3	13

7.9 NMI

Non-Maskable Interrupt (NMI) makes the input for handling external events that must produce an immediate response, e.g., power down detection.

Table 12. NMI pin

Connector	Signal	Pin position
P3	NMI [WKPCFG - GPIO 213]	1

7.10 SPI (Serial Peripheral Interface)

The Serial Peripheral Interface Bus or SPI bus is a very loose standard for controlling almost any digital electronics that accepts a clocked serial stream of bits. The concept is based on a clock, a “data in”, a “data out”, and a “chip select” for each integrated circuit that has to be controlled.

Table 13. SPI pins

Connector	Signal		Pin position
P3	SIN_B	Serial Data In DSPI_B	5
P3	SCK_B	Serial Clock (output) DSPI_B	6

Table 13. SPI pins (continued)

Connector	Signal		Pin position
P3	SOUT_B	Serial Data Out DSPI_B	7
P3	PCS_B0	Peripheral Chip Select B0	8
P3	PCS_B1	Peripheral Chip Select B1	9
P2	PCS_B2 / SOUT_C	Peripheral Chip Select B2/ Serial Data Out DSPI_C	6
P2	PCS_B3 / SIN_C	Peripheral Chip Select B3/ Serial Data In DSPI_C	7
P2	PCS_B4 / SCK_C	Peripheral Chip Select B4/ Serial Clock (output) DSPI_C	8
P2	PCS_B5 / PCS_C0	Peripheral Chip Select B5/ Peripheral Chip Select C0	9

7.11 GPIO’s

There are 18 General purpose I/O (GPIO's) available on the two connectors. They are shared with other hardware functions.

Table 14. GPIO's pins

Connector	Signal	Pin position	Connector
P2	GPIO[88]	CNRX_C	1
P2	GPIO[87]	CNTX_C	2
P2	GPIO[183]	EMIOS.4	3
P2	GPIO[188]	EMIOS.9	4
P2	GPO[189]	EMIOS.10	5
P2	GPIO[107]	PCS.B2	6
P2	GPIO[108]	PCS.B3	7
P2	GPIO[109]	PCS.B4	8
P2	GPIO[110]	PCS.B5	9
P3	GPIO[213]	NMI	1
P3	GPIO[179]	EMIOS.0	2
P3	GPIO[181]	EMIOS.2	3
P3	GPIO[187]	EMIOS.8	4
P3	GPIO[103]	SIN_B	5
P3	GPIO[102]	SCK_B	6
P3	GPIO[104]	SOUT_B	7
P3	GPIO[105]	PCS.B0	8
P3	GPIO[106]	PCS.B1	9

8 Electrical characteristics

This section contains detailed information on power considerations, maxim and operating ratings.

8.1 Maxim ratings

Table 15. Maxim ratings

Signal	Connector/Jumper	Conditions	Value		Unit
			Min	Max	
+5V external	JP1	J2 = Open	-0,5	+6,0	V
USB_VCC	J4	J2 = Close	-0,5	+5,5	V
V_EXT	P2.13	J2 = Open or Close	-0,3	+40	V

8.2 Operating ratings

Table 16. Operating ratings

Signal	Connector/Jumper	Conditions	Value		Unit
			Min	Max	
+5V external	JP1	J2 = Open	+5,35	+5,6	5,85
USB_VCC	J4	J2 = Close	+4,75	+5	+5,25
V_EXT	P2.13	J2 = Open or Close	+5	+12	+27

8.3 Power consumption

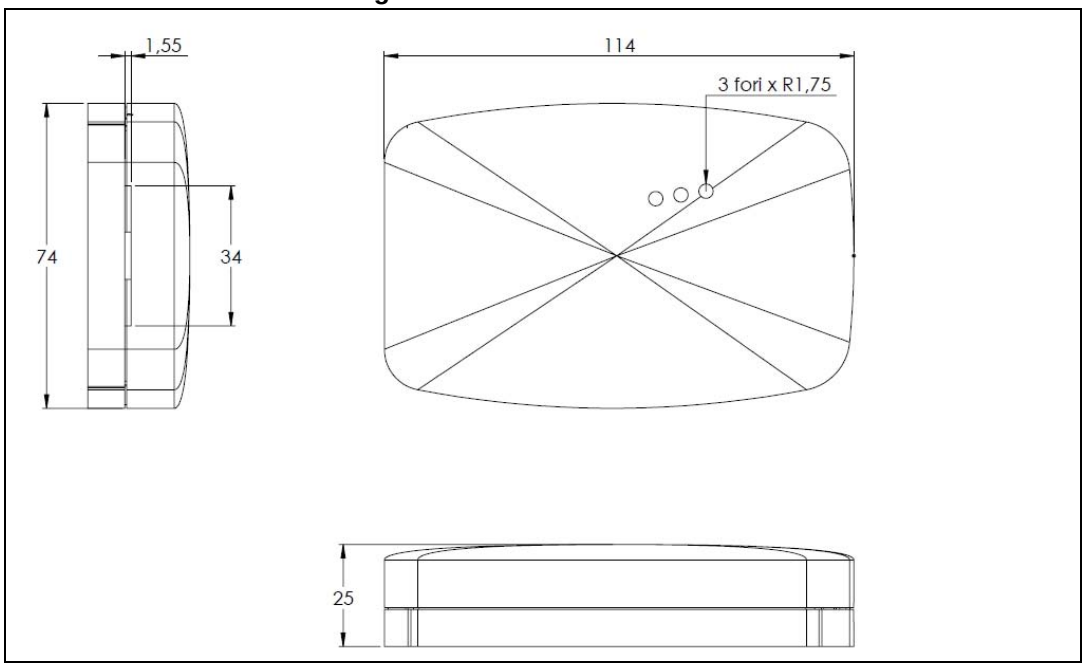
Table 17. Power consumption

Signal	Connector/Jumper	Conditions	Value		Unit	Signal
			Min	Max		
$I_{+5V\ external}$	JP1	J2 = Open and Normal operation	+138	+140	+142	ma
I_{USB_VCC}	J4	J2 = Close and Normal operation	+139	+140	+142	ma
I_{V_EXT}	P2.13	J2 = Open or Close and Normal operation	+1	+3,5	+8	ma

9 Mechanical features

For mechanical details refer to the *Figure 11*.

Figure 11. Mechanical features



10 Qualifications

The product is compliant with Oohs Directive.

According to the WEEE Directive it is suggested not to release the product into the environment.

11 Optional accessories

In this revision of the product are not available optional accessories.

12 Description of the part number

12.1 Ordering from ST

For ordering or additional info on the SPC5-CONNECT, please contact your ST sales and marketing representative or ST distributors.

13 Maintenance

Since there are no mechanical parts or parts that wear out, there are no specific recommendations for the maintenance of the product.

14 Revision history

Table 18. Document revision history

Date	Revision	Changes
17-Oct-2016	1	Initial release.