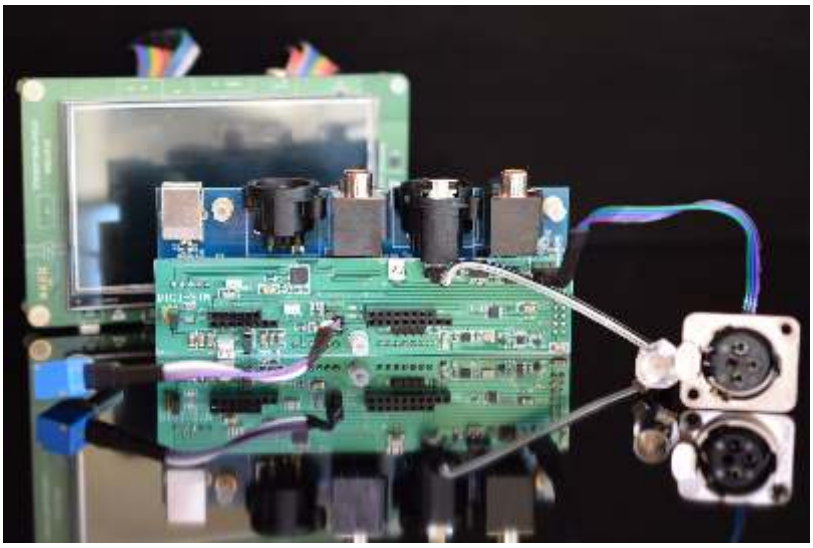
Audio Processing Platform - APP

STM32F7Discovery plus *DIGI-FP* for flexible Digital Audio Processing



- **Audio Processing with *STM32F7 Discovery***
- **Any-to-Any Audio-Interface combination**
- **Sample Rate Conversion (SRC) with HW support**
- **Word-Clock input (BNC, AES11)**
- **Word-Clock output**
- **USB powered**
- **USB-UART, Network Remote Control**
- **Network Audio**
- **SD-Card File Replay**
- **LCD Display, Touchscreen, Rotary Encoder**

Overview

The APP consists of: a) *STM32F7Discovery* [1], b) *miniDSP DIGI-FP* interface board [2] and c) *Lyrebird* Adaptation Module (DIGI-STM) [3].
The DIGI-FP board provides the digital audio-in and -outputs.
The adaptation module acts as interface between DIGI-FP and the STM32Discovery and enhances the system by: USB-UART, Word Clock in- and output, local clock generation.
The power feed is done via the USB-B device input at the DIGI-FP board. It is also possible to power the STM32F7Discovery separately (2x USB power with separation of STM and audio) or the to take the power for the DIGI-FP and adaptation module from the STM (without USB on DIGI-FP, via powered STM).

DIGI-FP

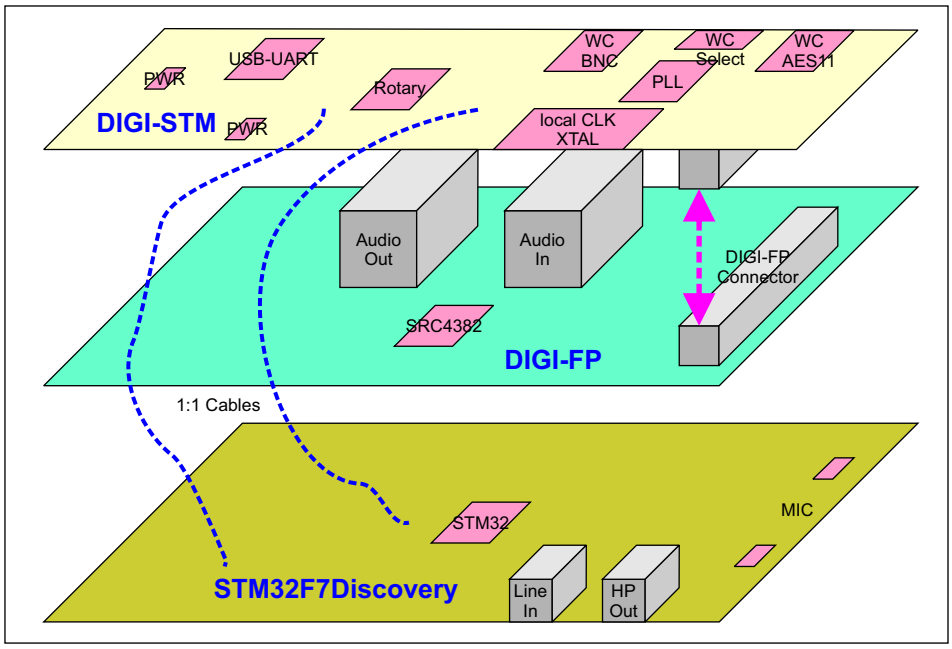
The DIGI-FP board is a module provided by miniDSP and is used without modifications (as plug and play). It uses a SRC chip, TI SRC4382 [4]. The SRC4392 is a pin-compatible version and provides better parameters (SNR: 144dB). This one should be used in future versions.
The DIGI-FP offers three digital inputs: TOSLINK (RX1), S/PDIF (RX2), AES3 (RX3). The inputs are selected as 1-of-4 via the SRC chip. The fourth input is unused.
The board provides as outputs: TOSLINK, S/PDIF, AES3. All outputs are active (no selection needed), but just one should be used.
The DIGI-FP does not provide any further features, e.g. clock generation. It is intended to be used on different miniDSP platforms. Just the USB-B device is provided on a header. The STM-DIGI makes use of it as USB-UART.

Lyrebird DIGI-STM

The STM-DIGI module acts as adapter for the STM32F7Discovery. It provides also additional features such as:

- local clock generation (XTAL)
- Word-Clock in- and outputs (WC) as BNC or AES11
- PLL for the WC recovery and automatic clock selection: Cirrus Logic CS2000 [5]
- USB-UART-Bridge chip Silicon Labs CP2102 [6], which provides also a 500mA 5V-to-3.3V LDO (optional)
- Rotary-Encoder connector as GPIO at STM
- free GPIO-Pins of STM forwarded to header pins

The configuration of the CS2000 and SRC4382 (on DIGI-FP) is done via an I2C bus with STM as master.



- XTAL selection via STM
- PLL-WC selection done automatically via CS2000
- WC type (BNC or AES11) manually (jumper)
- USB-UART chip provides 3.3V 500mA out, it can be wired in order to feed just DIGI-STM, the STM uses a separated 5V feed
- USB 5V for all boards (jumpers)
- 5V to 3.3V via STM, also 3.3V for DIGI-FP and DIGI-STM (optional)
- Rotary-Encoder header, with 3.3V (not for 5V optical, will be fixed in future versions)

Figure 1: system overview

Clock Generation

The orignal approach was to use as the reference clock for the SRC (MCLK, RXCKI is unused) a selection of three clocks: XTAL1 (24.567MHz), XTAL2 (22.5792MHz) and WC (via CS2000). This can be simplified, it should be changed also due to fact that the MEMS XTAL2 has a huge jitter. The XTAL frequencies were chosen as Fs * 512 (the base for 48/96/192 or 44.1/88.2/176.4KHz audio).
The simplification is the following concept:
the CS2000 PLL chip uses just XTAL1 (24.576MHz). The reference for the 44.1KHz audio is generated by a fractional divider in CS2000 (small error, 0.2ppm). The CS2000 is also able to switch automatically in case WC is available or not. Just the selection for the 48 or 44.1KHz audio base clock needs a reconfiguration inside the CS2000. This can be done via the 4 modes in CS2000 (all is pre-configured already, just select a different mode).

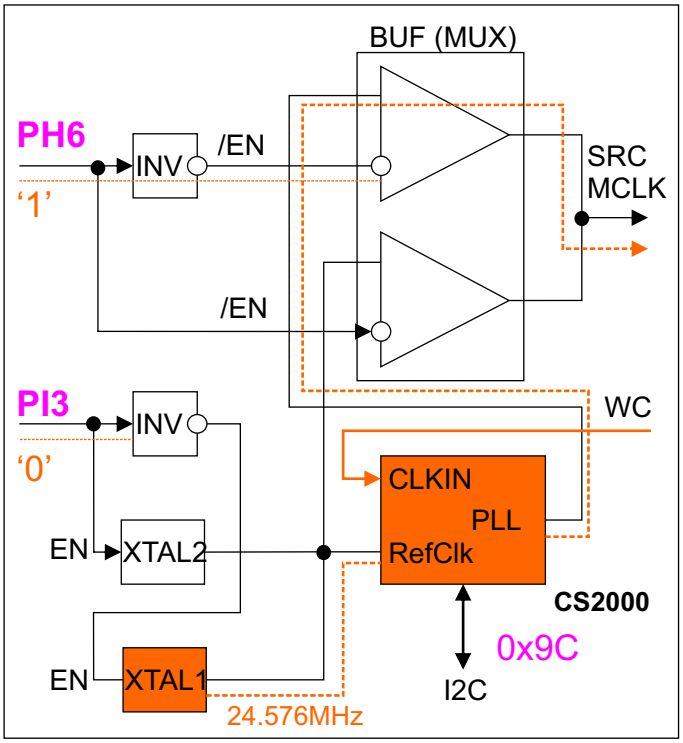


Figure 2: clock generation
(orange: simplified approach)

Word Clock

The WC selection, if BNC or AES11, has to be done manually (set a jumper).

Attention: in the AES11 cable are resistors - do not use a cable without! (an LVDS receiver is used)
The BNC seems to be sensitive: recommendation: a 75R termination resistor connected at BNC or remove the breakout cable if not needed.

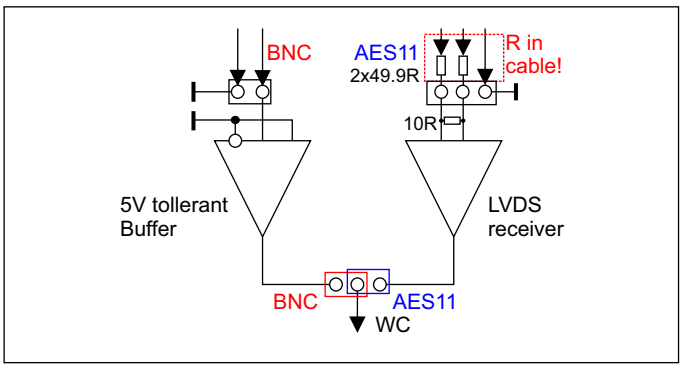
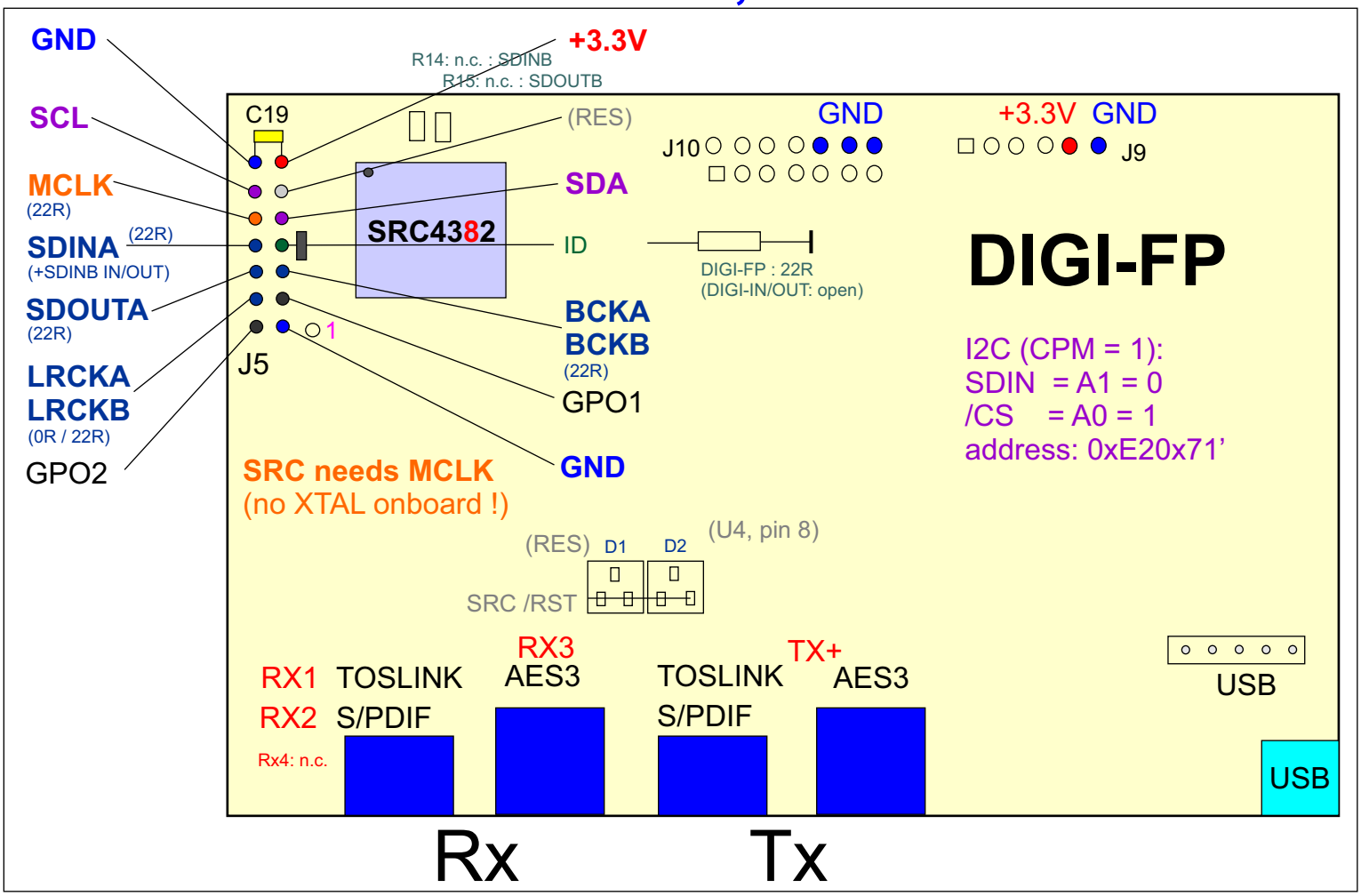


Figure 3: Word Clock (WC) input

Connectors, Headers



CN6

STM32F7Discovery Arduino Headers

1	n.c.	
	3V3/REF	
	NRST	
	3V3 (out)	Power
	5V (in/out)	
	GND	
	GND	
8	VIN	

CN5

1	PA0 SAI2_SD_B (AF10)	SDOUT (I2S)
	PF10 - free GPIO	
	PF9 SAI1_FS_B (AF6)	LRCK
	PF8 SAI1_SCK_B (AF6)	BCK
	PF7 SAI1_MCLK_B (AF6)	GPIO
6	PF6 SAI1_SD_B (AF6)	SDIN

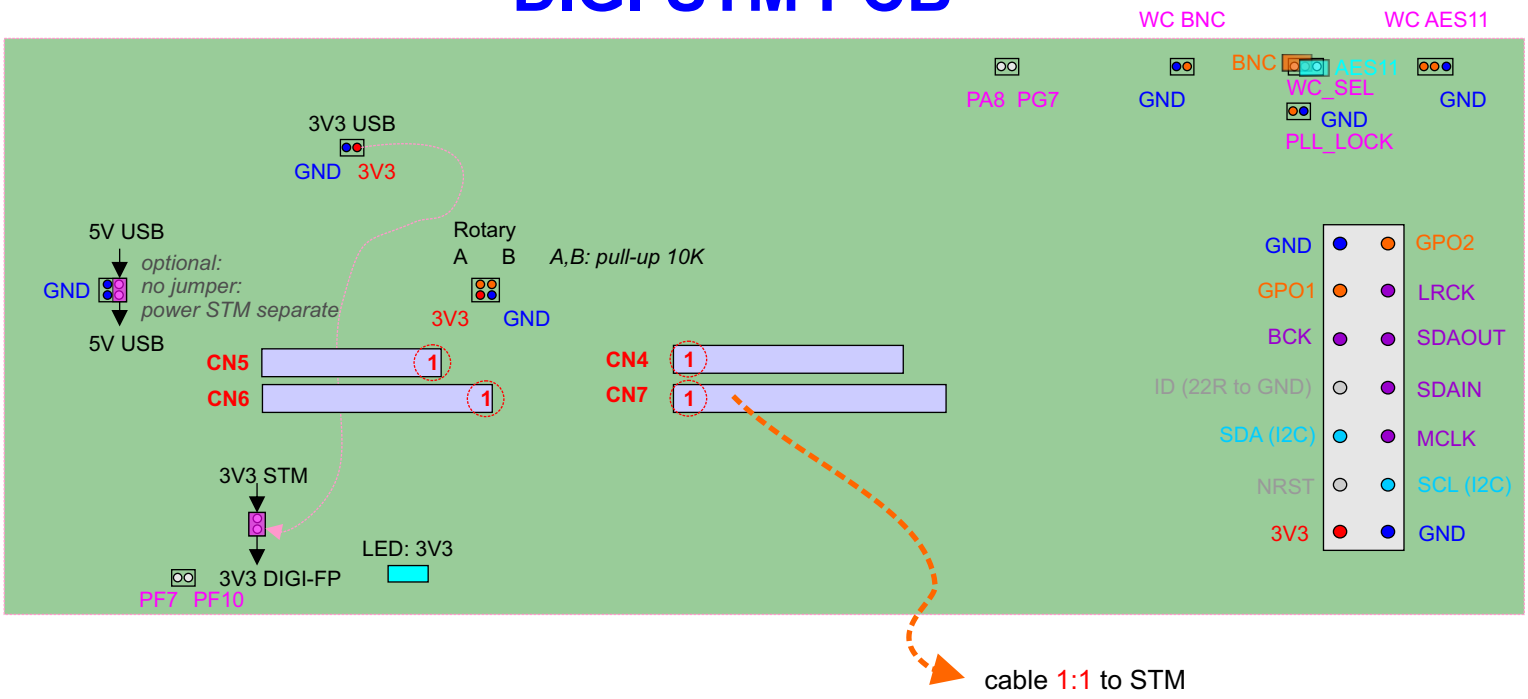
CN7

1	PI2 - Rotary A	Rotary
	PA15 - Rotary B	
	PA8 - free GPIO	
	MOSI	SPI (not used)
	MISO	
	SPI-SCK + LED	
	GND	
	AVDD (out)	
	PB9 SDA	I2C (SRC, CS2000)
10	PB8 SCL	

CN4

1	PC7 - UART6_RX	USB-UART
	PC6 - UART6_TX	
	PG6 - GPO1	SRC STATUS
	PB4 - GPO2	
	PG7 - free GPIO	
	PI0 - SPI2-NSS	SPI (not used)
	PH6 - INT/EXT CLK	CLK_SEL
8	PI3 - XTAL1/XTAL2	

DIGI-STM PCB



Web Links

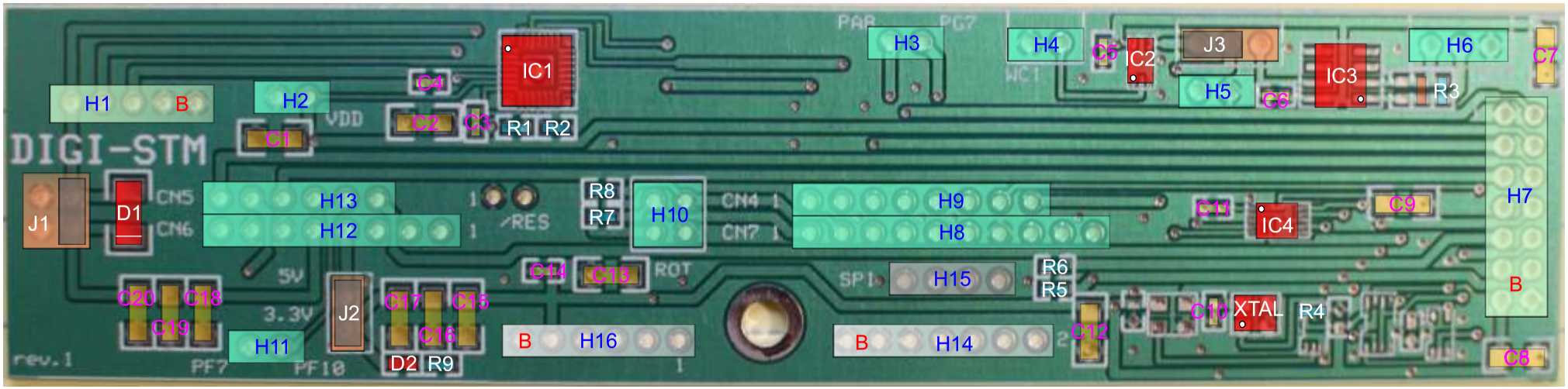
[1] http://www.st.com/web/en/catalog/tools/FM116/SC959/SS1532/LN1848/PF261641?icmp=pf261641_pron_pr-massmarket_jun2015&sc=stm32f7discovery-pr
[2] https://www.minidsp.com/products/opendrc-series/digi-fp
[3] http://www.tjaekel.com/lyrebird/
[4] http://www.ti.com/product/SRC4382?keyMatch=SRC4382&tisearch=Search-EN-Everything
[5] http://www.cirrus.com/en/products/pro/detail/P1125.html
[6] http://www.silabs.com/products/interface/usbtouart/Pages/usb-to-uart-bridge.aspx

Price Estimation

• STM32F7Discovery	USD 50.00
• miniDSP DIGI-FP	USD 45.00
• DIGI-STM	appr. USD 40.00
Total:	**USD 135.00**

tjaekel, 11/2015

DIGI-STM : parts and assembly



Header - solder from bottom side B

Header

IC, active chips IC1 CP2102 IC2 SN74LVC1G125 IC3 DS90LV018A IC4 CS2000 XTAL 24.576MHZ D1 2A/36V D2 LED BLUE 0603

Jumper

Capacitor, 1206, 22..100m

Capacitor, 0603, 0.1.. 1.0m

Resistor, 0603 : R1 4.7K R2 10K R3 10R R4..8 10K R9 100R

optional header - solder from bottom side

optional header

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