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# Koala EVM User Manual

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## Revision History

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# 1 Introduction

This document describes the Clarinox Koala EVM and how to access each peripheral attached to the STM32F407IGT6 or STM32F429II microcontroller.

## 1.1 Purpose

The purpose of this document is providing the end user with detail about the hardware configuration and layout of the Koala EVM.

This document will explain the hardware of the Koala EVM and provide a description of the peripherals, signals and hardware configurations when used with the STM32F4xx microcontroller.

# 2 Features

The Koala EVM base board comes with the following features:

- STM32F407IGT6 microcontroller with 1 MB of Flash memory, 192 KB of SRAM or STM32F429II microcontroller with 2 MB of Flash memory, 256 KB of SRAM
- On-board ST-LINK with selection jumpers for programming the Clarinox Wireless Module Interface (WMI) module or on-board STM32F4xx microcontroller
- Board power supply: through USB or from an external 5V supply
- USB OTG connector
- Ethernet interface
- DCMI camera interface
- FSMC for LCD with touch screen
- CAN bus port
- USB to Serial UART bridge for debug output
- COM8 100 pin connector for Texas Instruments Wilink6/Wilink7/Wilink8 wireless modules, with 32.768 KHz slow clock oscillator and 3.3V/1.8V level translation for digital interfacing.
- WMI connectors for development with Clarinox wireless modules.

Optional Accessories for the Koala EVM:

- 8 – 14 Bit digital camera module, (type OV9655 1.3MP or similar supported)
- 16 bit parallel LCD module (2.4" 320x240 touch screen display)
- WiLink-8 wireless COM8 module
- USB micro cable for On the Go peripheral
- USB Mini cable for USB-Serial peripheral

### 3 Specification Data Sheet

<b>Koala EVM</b>		
	Chipset	STM32F407IG
	Flash memory	1 MB
	SRAM	192 KB
	Clock	168 MHz
	Current draw (no wireless module connected)	160 mA @5V
	Current draw (TI WL18xx, BT Scanning)	200 mA @5V
	Current draw (TI WL18xx, BT Communications)	210 mA @5V
<b>Koala EVM Pro</b>		
	Chipset	STM32F429II
	Flash Memory	2 MB
	SRAM	256 KB
	Clock Frequency	180 MHz
	Current draw (no wireless module connected)	160 mA @5V
	Current draw (TI WL18xx, BT Idle)	190 mA @5V
	Current draw (TI WL18xx, WLAN idle)	250 mA @5V
	Current draw (TI WL18xx, WLAN scanning)	310 mA @5V
	Current draw (TI WL18xx, WLAN connected)	320 mA @5V
<b>Common Specifications</b>		
	Supported Development Tool Chains	IAR EWARM Keil MDK
	Supported RTOS	uC/OS-III ThreadX FreeRTOS Nucleus*
	Operating Voltage	5 Volts
	Power Supply	USB External 5V
	Operating temperature (ambient)	-40 to +85 °C
	Storage Temperature	-40 to +105 °C
	Supported Wireless modules (COM8 connector)	TI Wilink6/Wilink7/Wilink8
	COM8 voltage supply	3.3v, 1.8v
<b>Peripheral Specifications</b>		
	DCMI camera interface bus width	8-14 Bit
	Camera resolution	1M or 2M Pixel
	LCD interface bus width	16 Bit
	LCD parallel interface	FSMC/6800/8080
	LCD resolution	320 x 240 Pixel
	USB serial max data rate	921600 baud

Table 1: Specifications and Data Sheet

## 4 Hardware and Layout

### 4.1 Block diagram

The Koala EVM is designed around the STM32F407IGT6 microcontroller.

The figure illustrates the connections between the microcontroller and its peripherals.

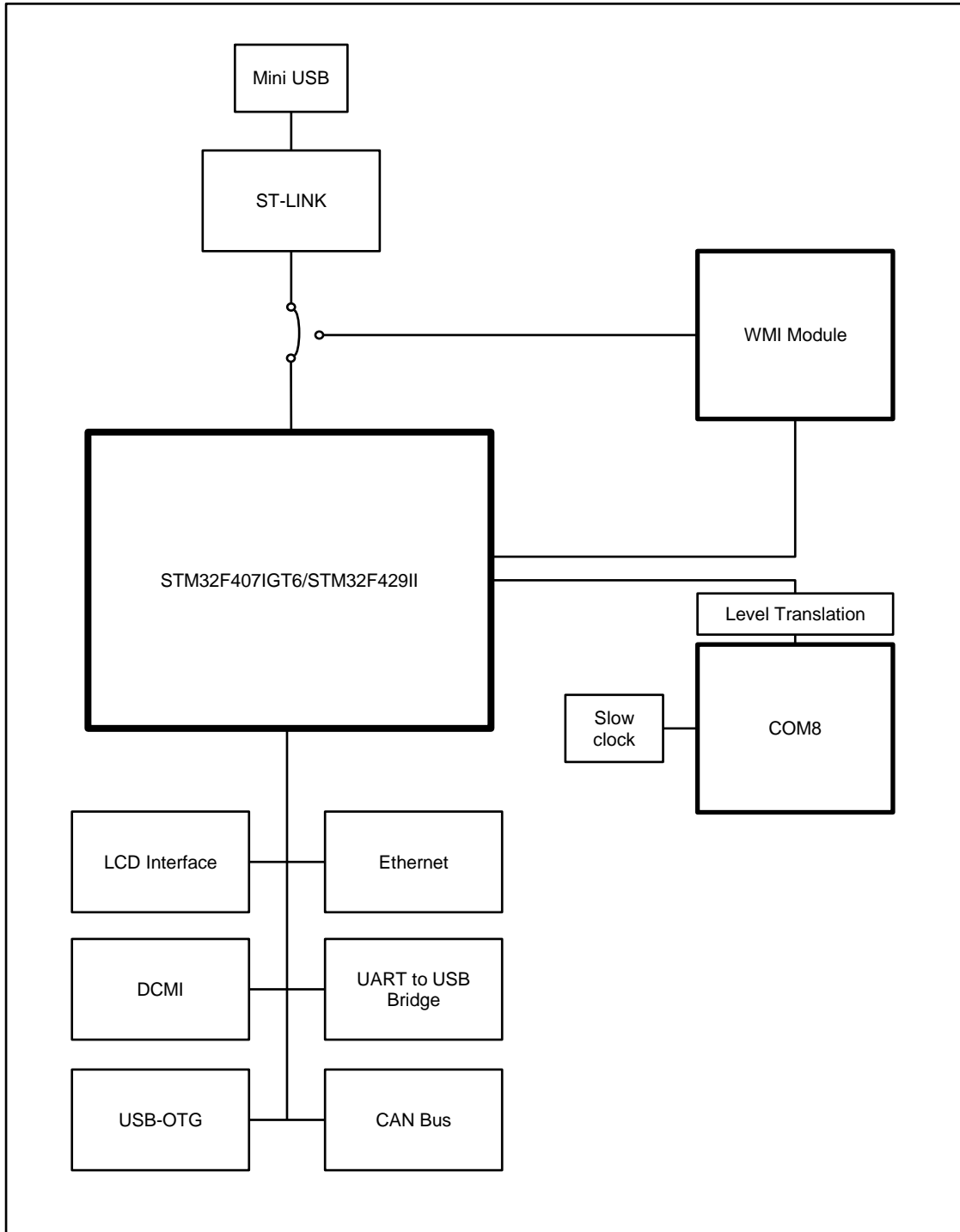


Figure 1: Koala EVM Block Diagram

## 4.2 Layout

The diagram below helps locate each feature on the Koala EVM.

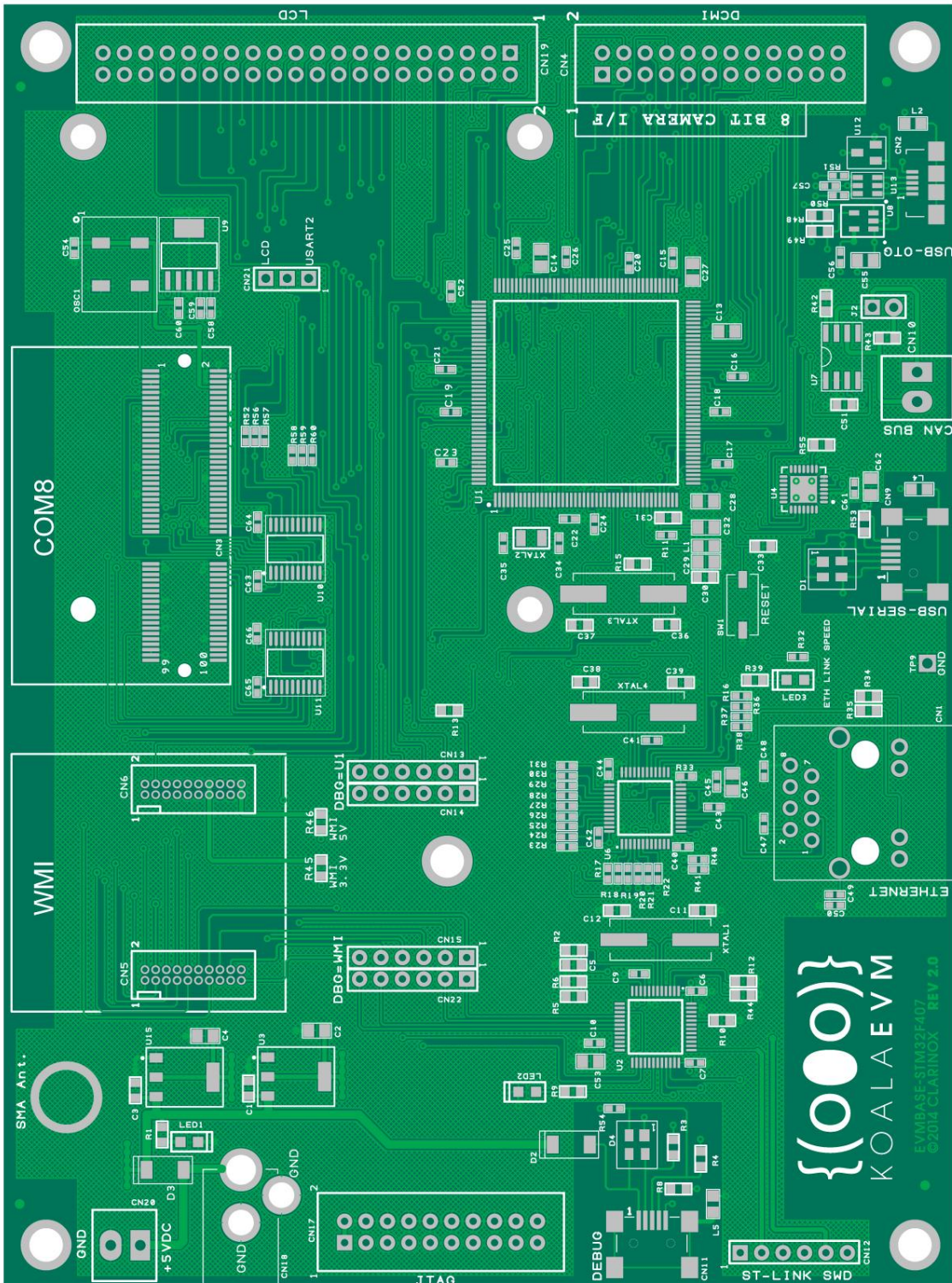


Figure 2: Koala EVM Hardware Layout

## 5 Components

### 5.1 LED Indicators

Below is a description of on board LEDs and their function

Designator	Description
LED1	Lights up to indicate when board is powered on
LED2	ST-LINK, Lights depending on program/ debug activity
LED3	Ethernet link speed indicator, see datasheet of Ethernet PHY (DP83848I).

**Table 2: Koala EVM LED Indicators**

### 5.2 Reset

The EVM includes a user reset button for resetting the KoalaEVM STM32F4xx microcontroller. This button is designated as SW1.

### 5.3 Oscillators

The following Oscillators are required for operation of the board.

#### 5.3.1.1 Crystals for main microcontroller (STM32F4xx)

XTAL3 – 24MHz crystal for system clock, 8 MHz is suitable for most applications but DCMI and USB-OTG require a clock of 24MHz; this should be generated from the system clock MCO

XTAL2 – 32.768 KHz crystal, Sleep/standby clock (Slow clock)

#### 5.3.1.2 Peripherals

OSC1 – 32.768 KHz clock generator for COM8 modules slow clock.

XTAL1 – 8MHz crystal, system clock for ST-LINK MCU (STM32F103)

XTAL4 – 25MHz crystal, for Ethernet physical layer

### 5.4 Voltage Level Translation

All SDIO data lines require pull up resistors except for SDIO\_D3, which is pulled up internally by the attached Wi-Fi module TI WiLink-8 module. Based on the pull up requirements of the module, a suitable level translator must be used to keep logic thresholds.

TI TXS010x pulls up each line. On the SDIO\_D3 this forms an effective parallel with the internal pull up of the wireless module. This keeps the SDIO\_D3 line at the same levels as the other lines and satisfies the pull up requirement of the SDIO interface.



## 6 Extension Interfaces

### 6.1 Pin out of extension headers

Below are the pin designations of the extension headers which require a specific pin configuration for their function. Be sure to observe grooves or markings on the board when connecting to these headers.

#### 6.1.1 WMI connectors

WMI-A (CN5)	
Pin	Function
1	USART6_RTS
2	USART6_TX
3	USART6_RX
4	USART6_CTS
5	USART2_TX
6	USART2_RX
7	USART3_RTS
8	USART3_TX
9	USART3_RX
10	USART3_CTS
11	I2C2_SCL
12	I2C2_SDA
13	I2C2_SMBA
14	WMI1_TDI
15	WMI1_TDO
16	WMI1_TMS
17	WMI1_TCK
18	WMI1_NSRST
19	WMI1_JNRST
20	NC

Table 3: WMI-A connector pin out

WMI-B (CN6)	
Pin	Function
1	SDIO_D0
2	SDIO_D1
3	SDIO_D2
4	SDIO_D3
5	SDIO_CMD
6	SDIO_CLK
7	SPI3_NSS
8	NC
9	NC
10	NC
11	NC
12	NC
13	3.3v
14	3.3v
15	GND
16	GND
17	GND
18	GND
19	5v
20	5v

Table 4: WMI-B connector pin out

#### 6.1.2 DCMI Camera Connector (CN4)

Pin	Function
1	3.3v
2	GND
3	I2C2_SCL
4	I2C2_SDA
5	DCMI_VSYNK
6	DCMI_HSYNK
7	DCMI_PIXCLK
8	DCMI_XCLK
9	DCMI_D7
10	DCMI_D6
11	DCMI_D5
12	DCMI_D4

Table 5: DCMI connector pin outs

Pin	Function
13	DCMI_D3
14	DCMI_D2
15	DCMI_D1
16	DCMI_D0
17	NC
18	NC
19	DCMI_D9
20	DCMI_D8
21	DCMI_D11
22	DCMI_D10
23	DCMI_D13
24	DCMI_D12

### 6.1.3 LCD connector (CN19)

Pin	Function
1	GND
2	FSMC_D0
3	3.3v
4	FSMC_D1
5	NC
6	FSMC_D2
7	FSMC_RS
8	FSMC_D3
9	FSMC_NWE
10	FSMC_D4
11	FSMC_NE
12	FSMC_D5
13	FSMC_D8
14	FSMC_D6
15	FSMC_D9
16	FSMC_D7
17	FSMC_D10
18	SPI2_SCK
19	FSMC_D11
20	SPI2_NSS

Pin	Function
21	FSMC_D2
22	SPI2_MOSI
23	FSMC_D13
24	TOUCH_BUSY
25	FSMC_D14
26	SPI2_MISO
27	FSMC_D15
28	TOUCH_PIRQ
29	FSMC_NOE
30	NC
31	RESET
32	NC
33	NC
34	NC
35	EXTLCD_BL
36	NC
37	3.3v
38	3.3v
39	GND
40	GND

\*NC is not connected or unused pins

Table 6: LCD connector pin outs

## 6.2 Connector information

The table below provides details about the connectors on the board.

Reference	Functionality	Description
CN1	Ethernet	Wired network interface
CN2	USB	USB On The Go (Micro connector socket)
CN3	COM8	100 pin connector for wireless module
CN4	DCMI	Camera header
CN5	WMI	WMI-A connector (including Bluetooth, USART, DEBUG)
CN6	WMI	WMI-B connector (including SDIO, Power)
CN9	USB	USB to USART bridge (Mini USB connector)
CN10	CAN	Link to separate CAN bus
CN11	ST-LINK	USB debug/programming Mini connector, USB power supply
CN12	ST-LINK	ST-LINK SWD header, see section 6
CN13	ST-LINK	ST-LINK Program/debug, see section 6
CN14	ST-LINK	ST-LINK Program/debug, see section 6
CN15	ST-LINK	ST-LINK Program/debug, see section 6
CN17	JTAG	JTAG for programming STM32F4xx MCU
CN18	POWER	Power jack external supply (5v)
CN19	FSMC	Interface for LCD and SPI for touch screen
CN20	POWER	Connector for 5v external power supply
CN21	Jumper	LCD/USART2 select, short Pin 2-3 for LCD, see Start-Up manual
CN22	ST-LINK	ST-LINK Program/debug, see section 6

Table 7: Summary of on board connectors and interfaces

## 7 Embedded ST-LINK programmer

The ST-LINK programming and debugging tool is integrated on the EVM board. The embedded ST-LINK can be used in different ways according to the jumper states (as shown in the diagram):

- Program/debug the STM32F407IGT6/ STM32F429II MCU on board
- Program/debug the MCU on external module connected to the WMI header

For more details about ST-LINK, see documentation from STMicroelectronics.

Jumper configurations:

Jumpers on pins	Function
CN13-CN14	Debug to STM32F4xx microcontroller
CN15-CN22	Debug to WMI module
Off	No ST-LINK debug support

**Table 8: Jumper configurations for on board debugger / programmer**

See sub-sections below for details about jumper installation.

### 7.1 Programming on board STM32F407IGT6/ STM32F429II

Jumpers between CN13 and CN14 pins – Select STM32F407/ STM32F429 MCU to program/debug



### 7.2 Programming WMI module MCU

Jumpers between CN15 and CN22 pins – Select WMI module to program/debug



### 7.3 Programming support disabled

No jumpers connected – ST-LINK Support disabled



## 7.4 ST-LINK headers

Below are details of the ST-LINK signals on the board.

### 7.4.1 Details of ST-LINK Pins

Pin	Signal
1	TDO
2	TDI
3	TMS
4	TCK
5	NRST
6	JNRST

**Table 9: Signals in debug connectors CN13, CN14, CN15 and CN22**

Table:

Connector	Description
CN13	U1: STM32F4xx microcontroller
CN14	ST-LINK
CN15	WMI module
CN22	ST-LINK

**Table 10: Connector designations**

These headers are used for programming the STM32F407/429 (Pro only) or WMI microcontrollers with JTAG. See start-up manual, WMI modules manual or STMicroelectronics documentation for more details.

## 7.5 SWD

The SWD header is provided only for initial programming of the ST-LINK firmware to the board (STM32F103). This is usually not required as the STM32F103 already contains the firmware for USB debug and programming and can be updated via USB with the ST-LINK upgrade application. The SWD header cannot be used for programming any other device.

SWD connector (CN12)

Pin	CN12	Designation
1	VDD_TARGET	VDD from application
2	SWCLK	SWD clock
3	GND	Ground
4	SWDIO	SWD data input/output
5	NRST	RESET of target MCU
6	SWO	Reserved

**Table 11: SWD connector pin outs**

## 8 Operating Specifications

Below are the ratings of the Koala EVM under normal operation.\*

Specification	Value	Unit
Voltage supply	5	V
Current draw (no module connected)	160	mA
Current draw (Bluetooth in use)	250	mA
Current draw (Wi-Fi in use)	340	mA
Operating temperature (ambient)	-40 to +85	°C
Storage temperature	-40 to +105	°C

\*Note: ratings measured without camera or LCD peripherals connected. Actual current usage may vary depending on software.

**Table 12: Operating Specifications**

## 9 Tips and Tricks

### USB-Serial Peripheral

Functionality of the USB Serial port peripheral requires a PC driver for the on board USB-UART chip (Silicon Labs CP210x USB to UART Bridge).

### ST-Link programmer selection with single jumper

Jumpers can be inserted between each pin in the ST-Link headers, except for the 4<sup>th</sup> position for both the WMI module and the on board STM32F4xx. The ST-Link programming target can then be selected by inserting a jumper in the 4<sup>th</sup> position for either the module or the microcontroller. This is shown in the figures below.

Enable programming WMI module (STM32F407/STM32F429 not programmed)



Enable programming STM32F407/STM32F429 (WMI module not programmed)



By arranging the jumpers in this configuration, it disables the JTAG clock signal, making it only operable for the device with all jumpers.

### Resetting WMI modules with Koala EVM reset button

Under the above jumper configuration, pushing the on board reset button will reset both the WMI module and the STM32F407/STM32F429 microcontroller.

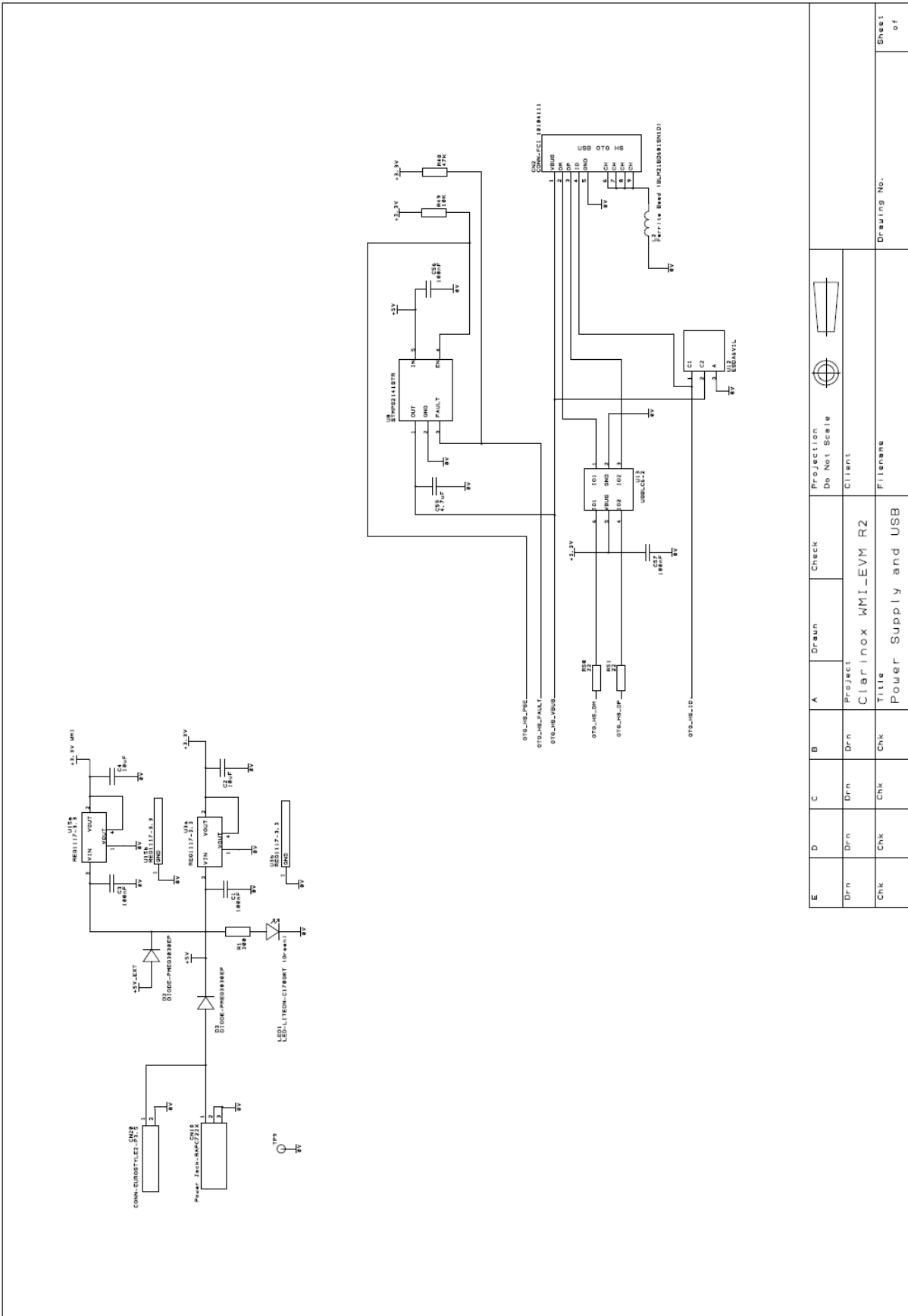








# 10.4 Power Supply and USB-OTG peripheral



	A	B	C	D	E	Check	Projection	Sheet
	Drawn	Drn	Drn	Drn	Drn	Client	Do Not Scale	of
	Project Clarinox WMI-EVM R2					Client		
	Title Power Supply and USB					File Name	Drawing No.	Sheet

# 10.5 ST-LINK programmer

