MMstm32F107

Minimodule with ARM microcontroller and Ethernet

User Guide

REV 1.0

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Contents

Introduction

MMstm32F107 is universal minimodule for the STM32F107 microcontrollers from ST Microelectronics. This microcontroller is available in the LQFP100 case which is difficult to solder in prototype and amateur circuits due to the compactness of pins. We have undertaken an attempt at placing it on a board of 36x61mm with a layout of leads which matches the commonly available prototype circuit boards and to EVBmmTm evaluation board. In addition, we have included Ethernet PHY 10/100Mb with RJ45 connector and magnetics, USB connector and socket for microSD memory card. All ports and signals of the microcontroller (except that used for Ethernet PHY) are lead out by means of two-row pin connectors with 0.1' (2.54mm) pitch. This minimodule is not only an adapter but a complete main board for STM32F107 microcontroller. It needs only a connection to the supply voltage and we can start loading 256kBytes of Flash memory. Thanks to built-in bootloader, there is even no programmer necessary. Through integration of the peripherals with the microcontrollers on one board, the application of this module can lead to a shorter design period and facilitate the construction of systems based on ARM microcontrollers, by eliminating the need to design the printed board. The module is supplied with example software.

The **MMstm32F107** minimodule can be also used in didactic laboratories of informatics colleges and universities, and can be also used to build circuits realizing thesis projects.

Features

MMstm32F107 minimodule:

- Complete, ready to use microprocessor system
- Fast ARM STM32F107 microcontroller with up to **90DMIPS** throughput
- Up to 256kB Flash memory and up to 64kB RAM
- Onboard 10/**100Mbps** Ethernet PHY and RJ45 connector with embedded magnetics
- USB mini B connector
- microSD memory card socket
- JTAG/SWD for in system programming and debugging
- Built-in 25MHz system clock resonator
- Built-in 32.768kHz RTC resonator
- Possibility to mount backup battery for RTC
- Onboard LED diodes for indicating Power supply, Ethernet connection status, USB status, and one user LED
- Module supply voltage: 5V
- 2 x 40 terminals with 0.1" (2.54mm) pitch fitting every prototype board
- Small dimensions: 36mm x 61mm
- Available evaluation board and sample applications

1. The module

Block diagram

A block diagram of MMstm32F107 minimodule is shown on the image below:

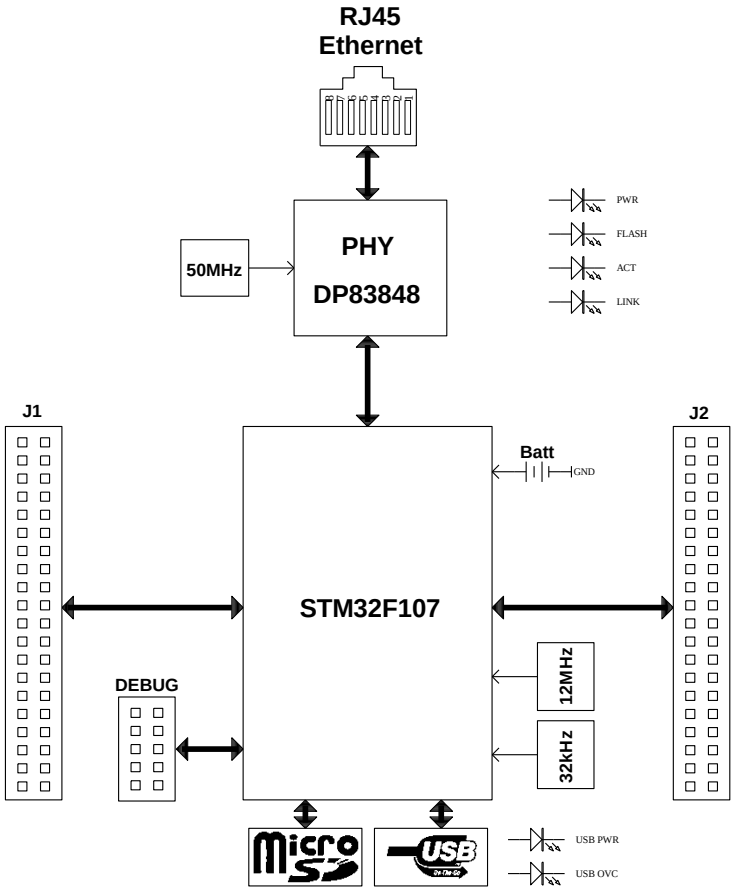
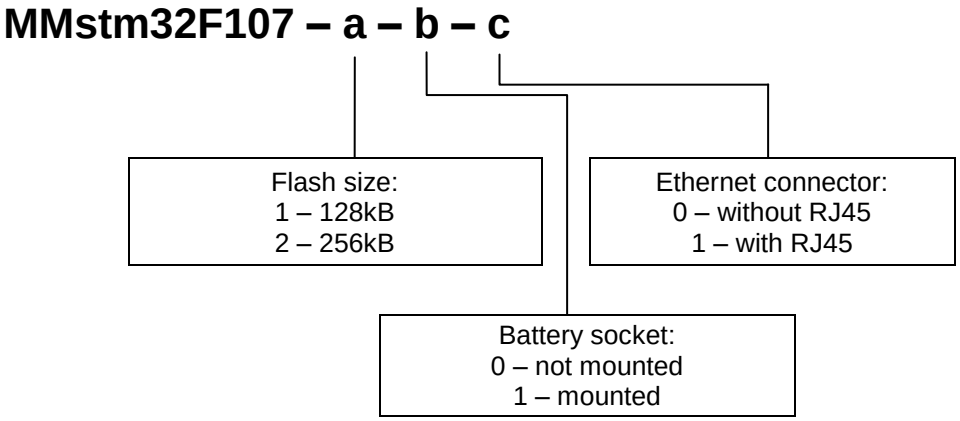


Figure 1 Block diagram of MMstm32F107 minimodule.

Minimodule can be ordered in different configurations with use of selector:



For example: MMstm32F107-2-0-1 – minimodule with 256kB Flash MCU, without battery socket, with RJ45 connector.

Terminals layout

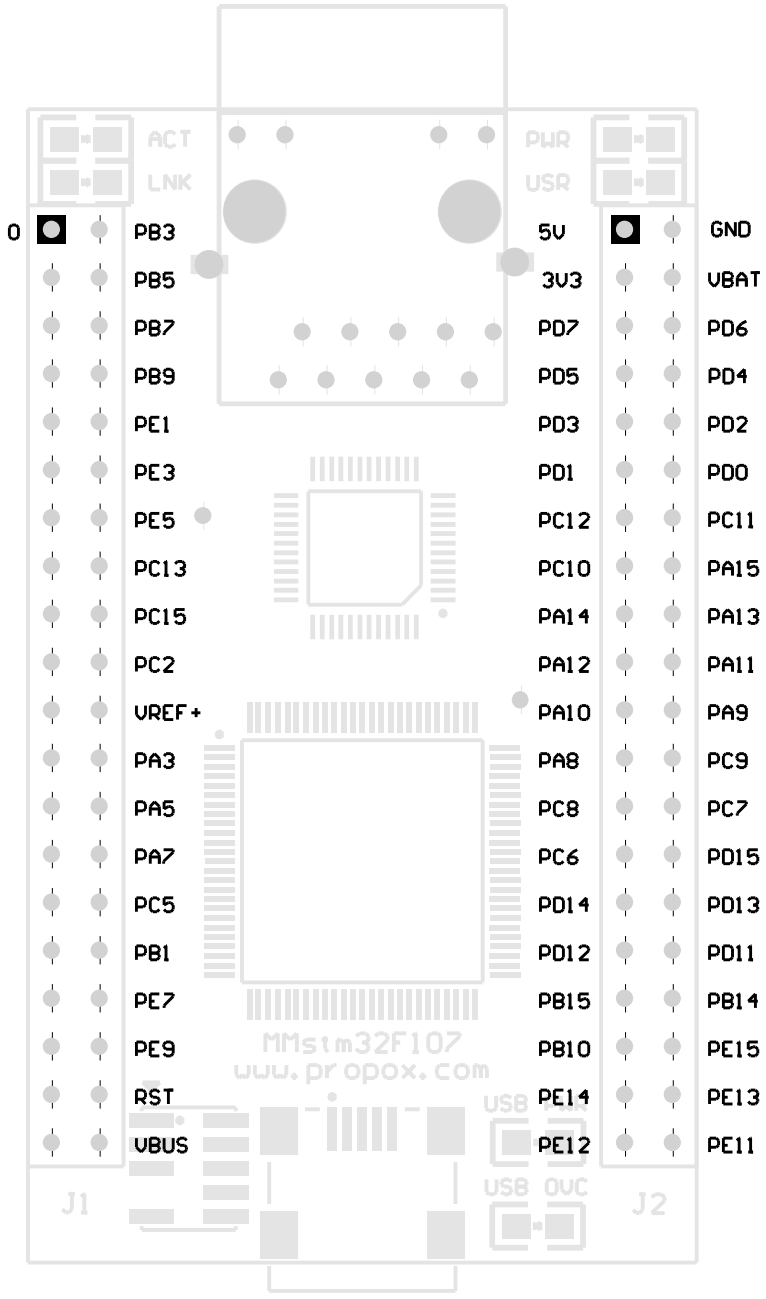


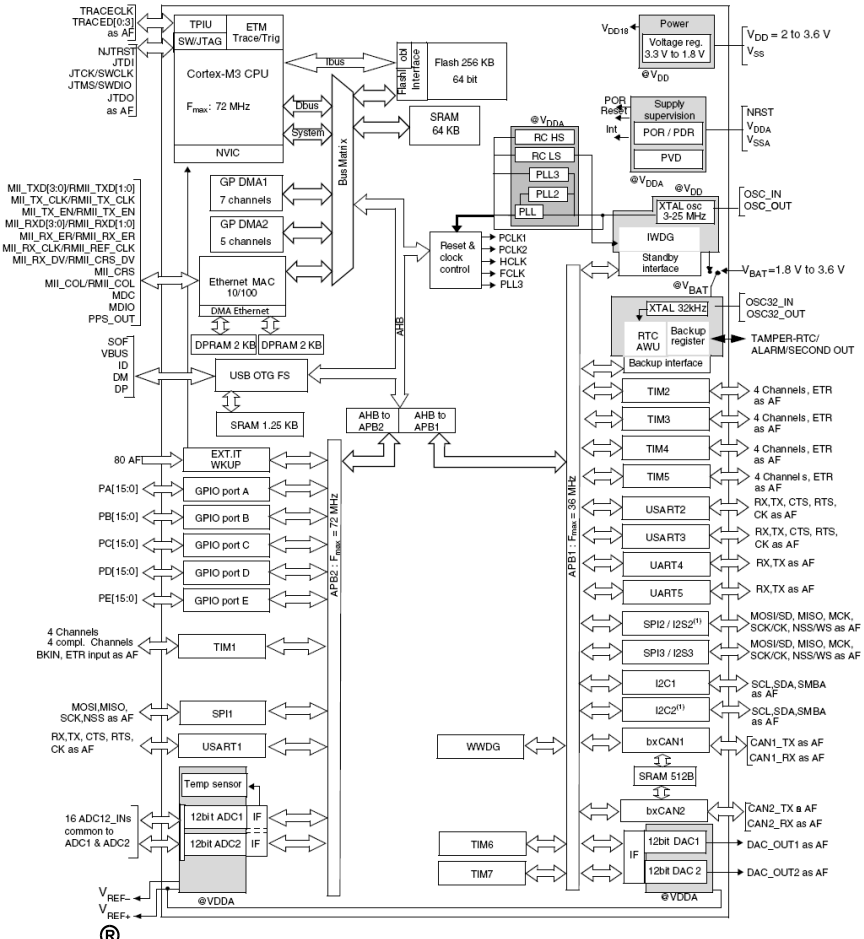
Figure 2 Terminals layout – top view.

Detailed description of ports can be found in microcontroller datasheets.

STM32F107 microcontroller

- 32-bit ARM Cortex-M3 core clocked up to 72MHz
- 128 or 256kB in system programmable FLASH memory
- 48 or 64kB general purpose SRAM memory
- 4kB Ethernet SRAM memory
- 1.25kB USB SRAM memory
- In system programmable via JTAG, SDW, USB, RS232 or CAN
- 12-channel DMA controller
- Up to four 16-bit timers, each with up to 4 IC/OC/PWM or pulse counter
- 1 × 16-bit motor control PWM timer with dead-time generation and emergency stop
- Ethernet MAC
- USB 2.0 device/host/OTG (full speed)
- 2 CAN controller
- 5 UART interfaces
- Two I2C-bus interfaces
- Three SPI interfaces
- I2S interface
- SD/MMC interface
- Two 12-bit AD converters (16 channels)
- Two 12-bit DA converters
- Up to 80 fast I/O ports with 5V tolerance
- Advanced interrupt controller
- Low Power modes
- RTC with battery backup
- Single supply voltage 2.0 - 3.6V
- JTAG and SWD interfaces

More info about STM32F107 can be found at manufacturer site:
http://www.st.com/mcu/devicedocs-STM32F107VC-110.html



Ethernet PHY

Minimodule is equipped with DP83848 Ethernet PHY and RJ45 connector with integrated magnetics.

DP83848 features:

- 10/100 Mb/s operation
- Auto-MDIX
- IEEE 802.3u Auto-Negotiation and Parallel Detection
- IEEE 802.3u ENDEC, 10BASE-T transceivers and filters
- IEEE 802.3u PCS, 100BASE-TX transceivers and filters
- Low power consumption < 270mW typical
- Low power modes
- Optimized for cable length performance far exceeding IEEE specifications

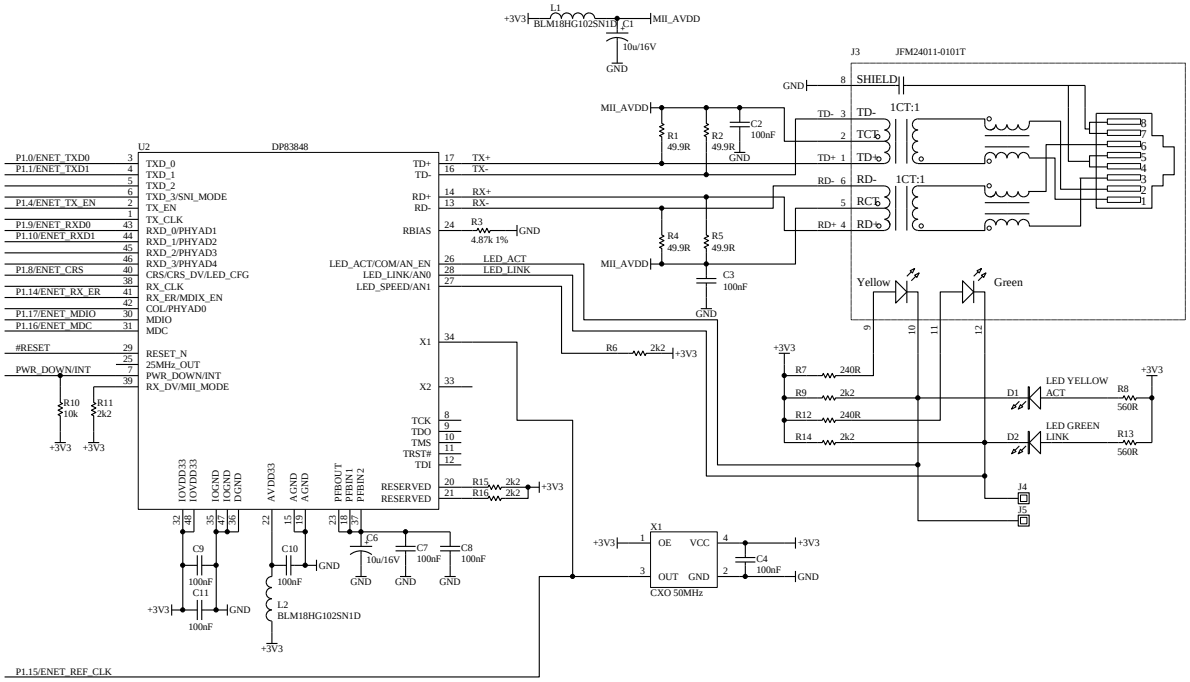


Figure 3 Implementation of Ethernet interface in 32F107.

DP83848 documentation can be found on manufacturer site: http://www.national.com

Module can be also ordered without RJ45 connector, with gold pin connector mounted instead.

USB interface

STM32F107 microcontroller have built-in USB 2.0 full-speed interface, which is capable of working as Host, Device or in OTG mode. Module is equipped with UBS mini B connector, power switching circuit (for Host mode) and LED diodes showing interface's power state.

U5 (STMPS2141STR) is power switch providing voltage supply to USB connector, it is controlled by MSU's PC9 pin (active low). Additionally is has short-circuit protection disconnecting power from USB connector. Fault condition is indicated by low logic level on MCU's PE1 pin and red LED diode "USB OVC". If power switch will not be used, it can be disconnected by desoldering R37 and R38 resistors, what will make PC9 and PE1 pins available to other use.

Thanks to D9 module can be also powered from USB connector. Presence of power supply voltage in USB connector (either from external source or from U5 switch) is signaled by red diode "USB PWR".

Schematics of module's USB circuit is show below.

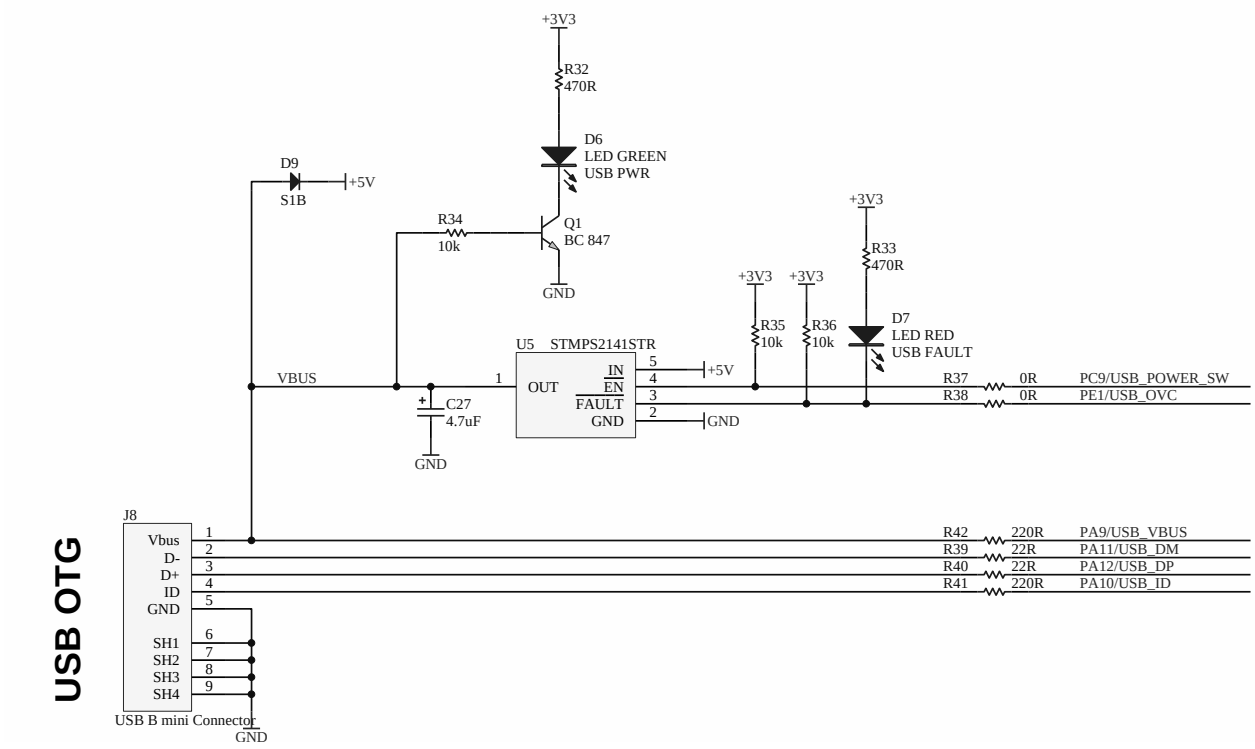


Figure 4 Implementation of USB interface.

CAN interface

MMstm32F107 microcontrollers have on chip two CAN interfaces, compatible with CAN2.0 A and B specifications. To connect MMstm32F107 minimodule to CAN bus additional circuit – CAN bus driver. Example of such circuit is shown below.

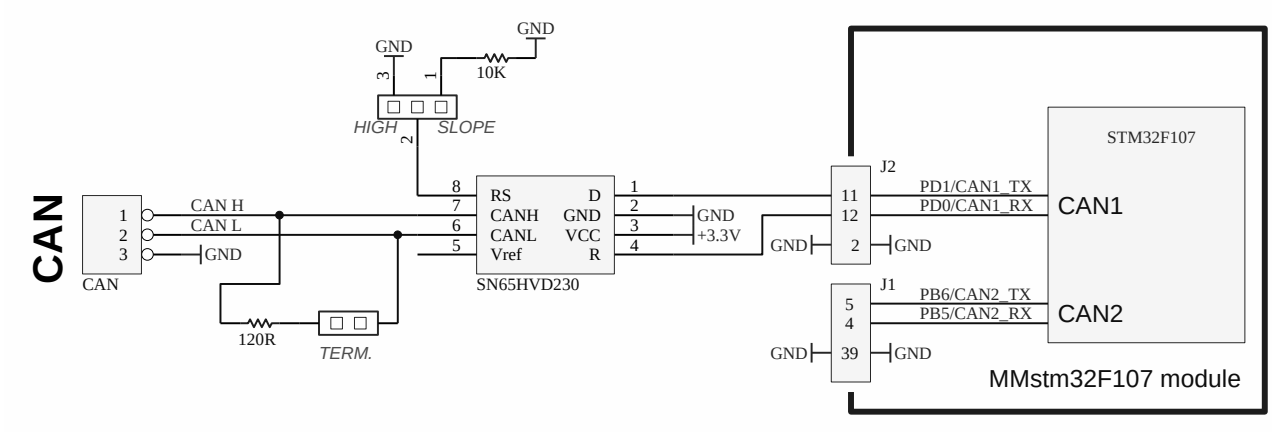


Figure 5 Connection of MMstm32F107 to CAN bus

RS232 interfaces

STM32F107 microcontroller has five USART ports which can be used to connect the minimodule with a PC computer other equipment equipped with a RS-232 port. Such a connection requires a level converter based on a ST3232 or similar IC, connected to the TX and RX lines. Drawings below show example use of USART1 port.

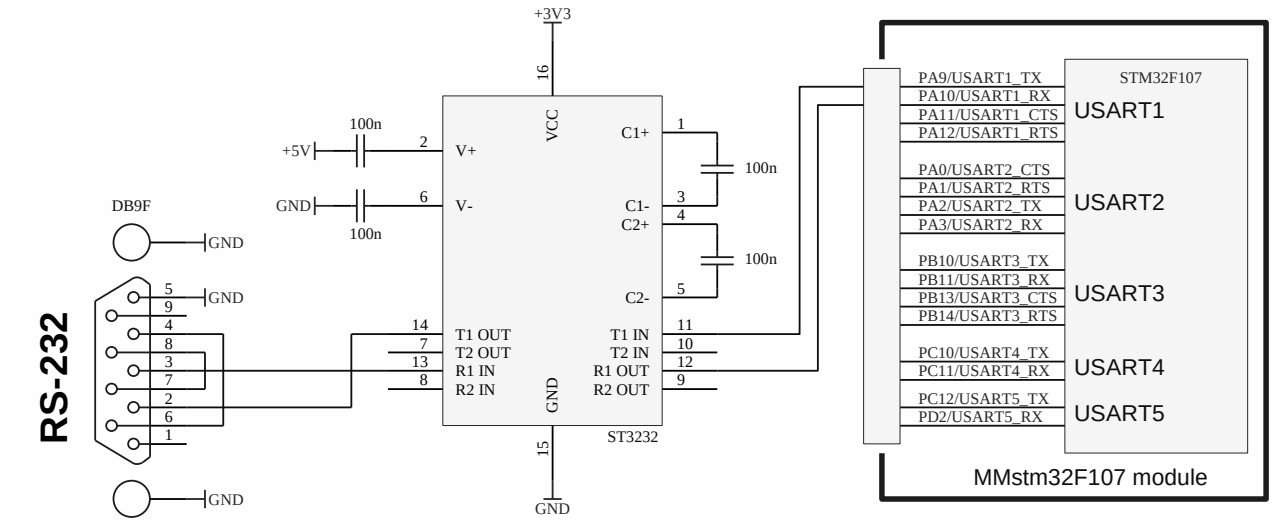


Figure 6 Example of UART0 use as DCE.

microSD memory card socket

Minimodule is equipped with microSD memory card socket, connected to microcontroller's SPI3 port (pins PA4, PC12, PC10, PC11). Additionally , to PE0 is connected signal informing by low logic level that card is present in the socket.

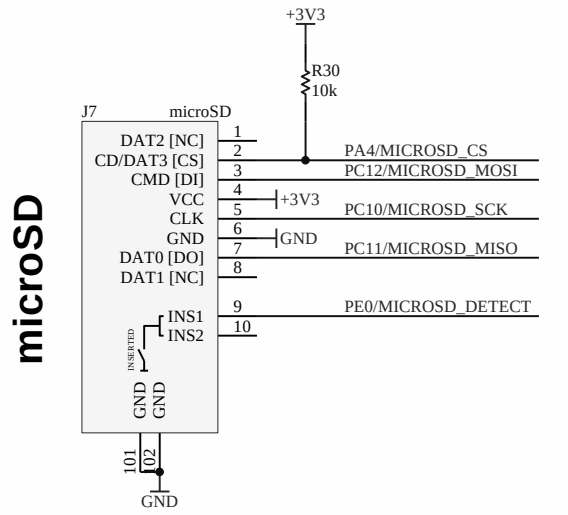


Figure 7 microSD connector.

Cortex Debug connector

Module is equipped with new standard of debugging/programming connector defined by ARM, called „Cortex Debug Connector". It is a 10-pin (2x5) goldpin connector with 1.27mm pitch with small footprint on PCB.

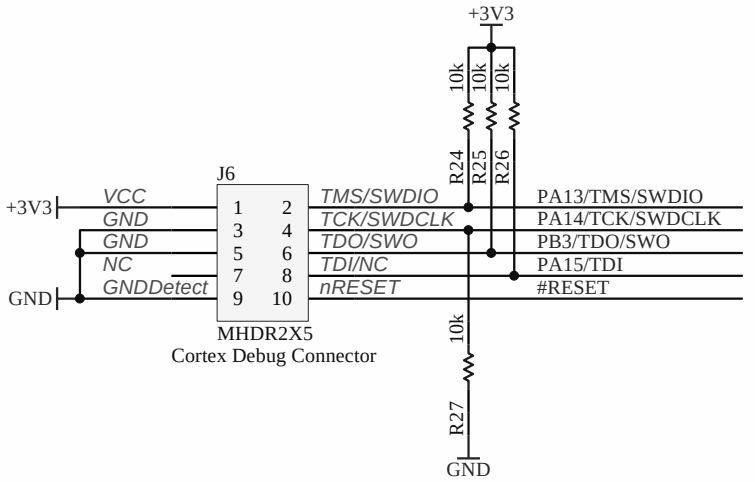


Figure 8 Cortex Debug connector.

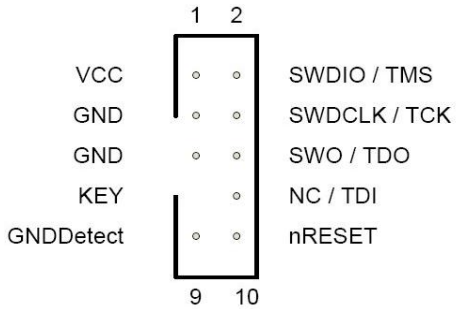


Figure 9 Pinout of Cortex Debug connector.

Power supply

MMstm32F107 module require regulated 5V power supply with output current at least 300mA (when USB Hot function with capability of powering connected devices is not used) or 800mA (if this function is used). Module current draw is depended on many factors: CPU core and buses frequency, used peripherals, Ethernet controller activity, microSD activity etc. There are many possibilities to reduce power consumption thanks to microcontroller and PHY low power modes.

Power supply should be connected to pins 1 (+5V) and 2 (GND) of J2 connector. Module's built in power supply is shown below:

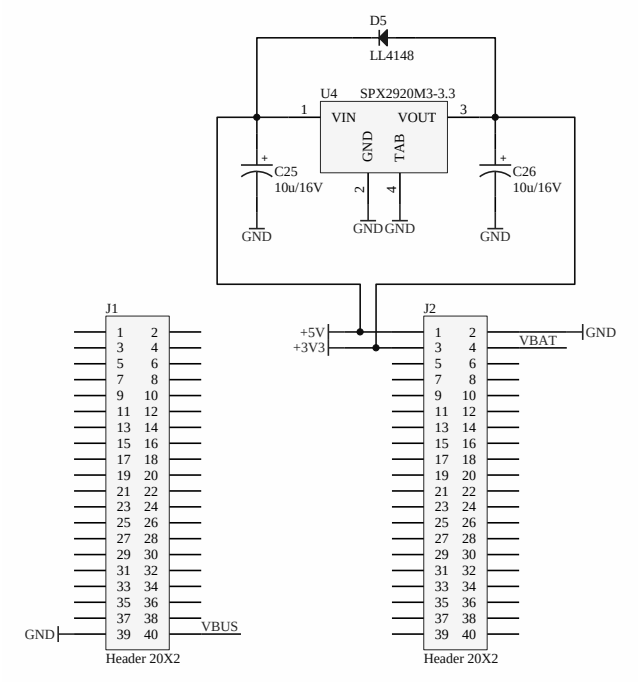


Figure 10 Module's power supply circuit.

Module can be also powered from USB connector – more on this subject in „USB interface" section.

2 Evaluation Board

In order to facilitate the design of equipment using the minimodule, an evaluation board has been prepared. It includes the following elements:

- Connector with all terminals of the minimodule
- Connectors of all peripherals accessible on board
- JTAG connector for in system programming and debugging
- Voltage regulators (+5V and +3,3V)
- Possibility supply with USB Port
- Power switch
- 8 switches and 8 LED diodes
- Buzzer
- 2 potentiometers
- IRDA port
- USB Device and USB Host ports
- Two ports RS232 with LEDs
- Codec Audio
- CAN Interface
- 1-WIRE connector
- SD/MMC card slot
- Alphanumeric LCD connector
- Graphic LCD connector

More info can be found on page:
http://www.propox.com/products/t_183.html

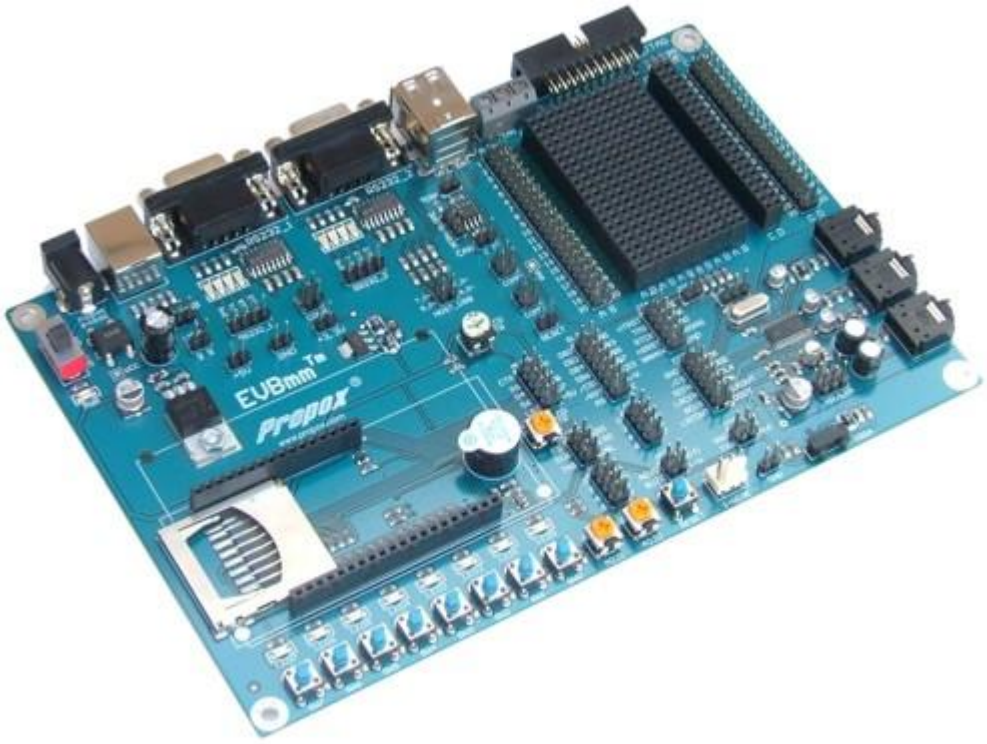


Figure 11 EVBmmTm evaluation board.

3 Example software

MCU manufacturer's site contain many example applications showing how to handle different peripherals: http://www.st.com/mcu/devicedocs-STM32F107VC-110.html

You can find there among others:

- Implementation of RC5 infrared remote control receiver
- ADC handling
- Sample WWW server
- Handling of serial ports, I2C, SPI
- Handling of USB port in Device and OTG modes

Module is delivered with programmed sample application implementing Simple WWW server. Sources of this application can be found on our site:
http://www.propox.com/download/software/demo_MMstm32_eth_lib.zip

To quickly test bought module:

- Connect module to local Ethernet Network, or directly to PC with straight or crossed cable
- Connect module to PC with USB cable to power up module
- Visit www page at address http://192.168.0.8 On this page you can read voltage at ADC input (PC4, J1-29), and control four outputs, to whom you may connect e.g. LED diodes (LED1: PD7, J2-5; LED2: PD13, J2-30; LED3: PD3, J2-9, LED4: PD4, J2-8)

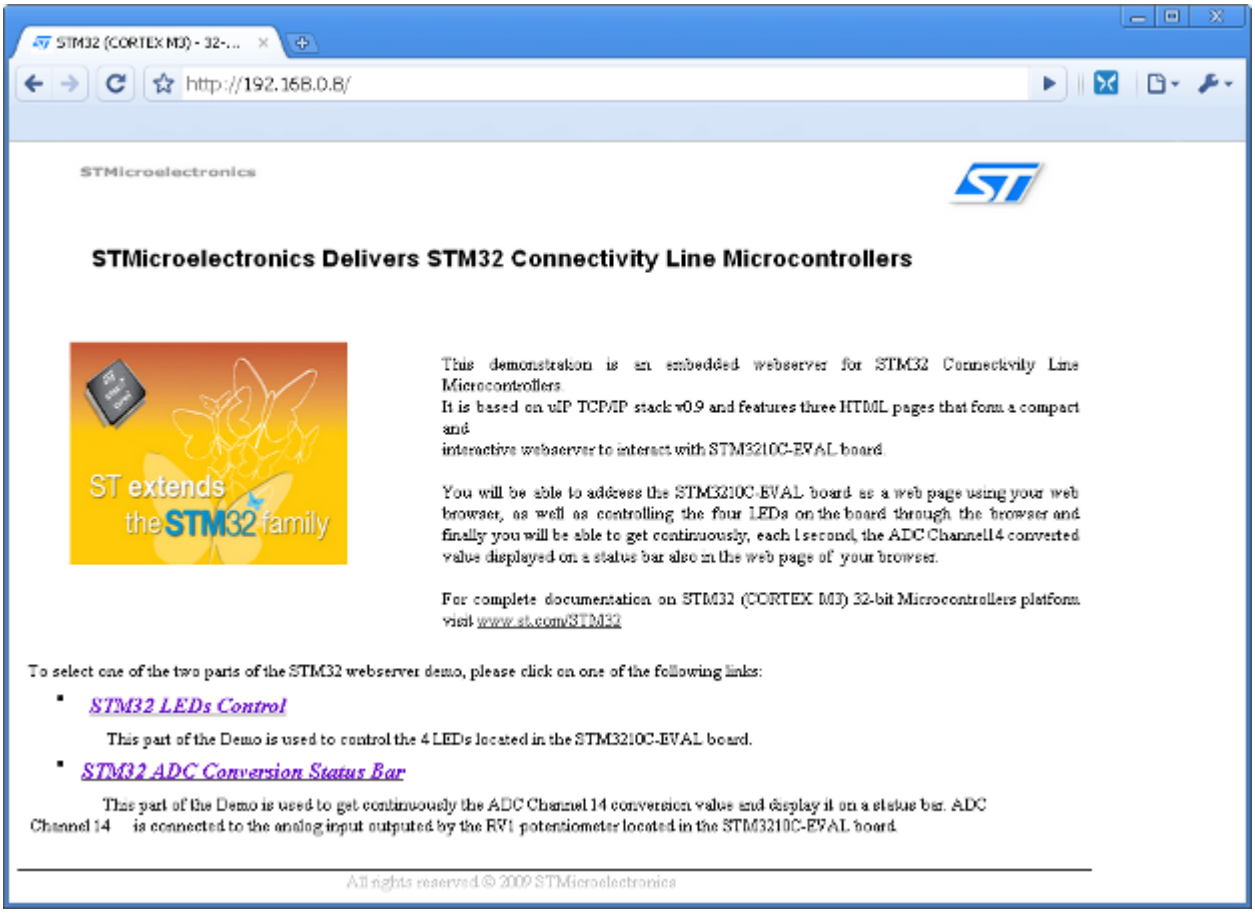


Figure 12 WWW page Server by module.

Programming Flash memory of STM32F107

Flash memory of STM32F107 microcontroller can be programmed in two ways: using JTAG/SWD interface or through bootloader. In this documentation, second method, not requiring any special programming hardware, will be described.

Bootloader program is stored in internal ROM memory and allow to program Flash memory through interfaces: USB, RS232 and CAN. To enable bootloader, during reset BOOT0 pin (connector J1, pin 1) should be connected to high logic level and BOOT1 to low logic level (BOOT1 have pull-down resistor, so it can be left unconnected).

Boot mode selection pins		Boot mode
BOOT1 (PB2)	BOOT0	
X	0	Flash
0	1	ROM (bootloader)
1	1	RAM

Table 1 MCU's boot modes.

Programming through RS232 interface

To program processor through RS232, its USART2 port should be connected to PC using level translator, e.g. shown below:

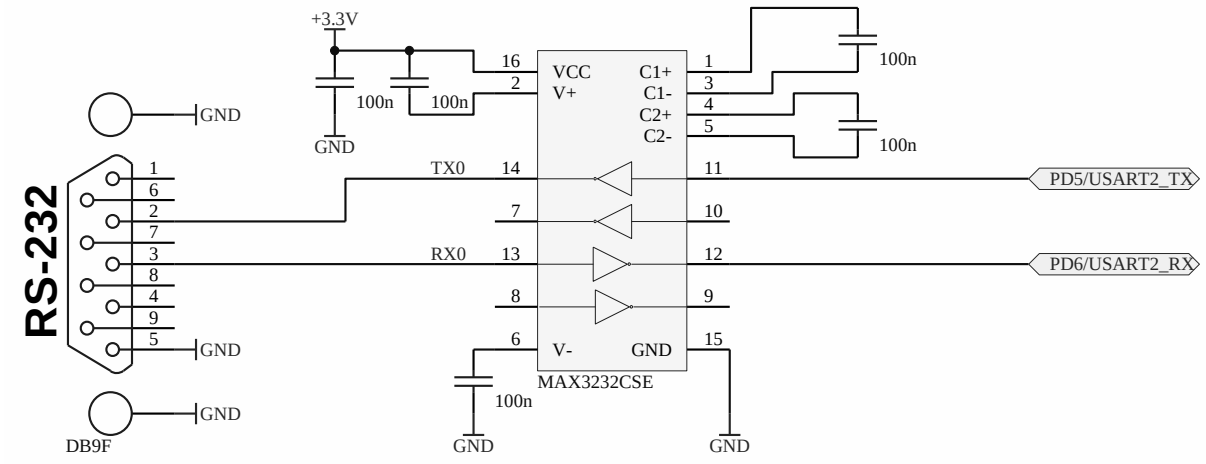


Figure 13 RS232 level translator.

Pins RS of USART1 (PA10) and CAN (PB5) should be connected to steady logic state, USB interface should be not connected.

PC should have installed „Flash Loader Demonstrator" application from ST: http://www.st.com/mcu/download2.php?file=um0462.zip&info=STM32F107VC%20Software%20-%20PC%20&url=http://www.st.com/stonline/products/support/micro/files/um0462.zip

After launching this application (Start -> Programs -> STMicroelectronics -> Flash Loader Demonstrator -> Flash Loader Demo) appropriate COM port should be selected (another options can be left unchanged), then you can three times click "Next" button to go through subsequent windows:

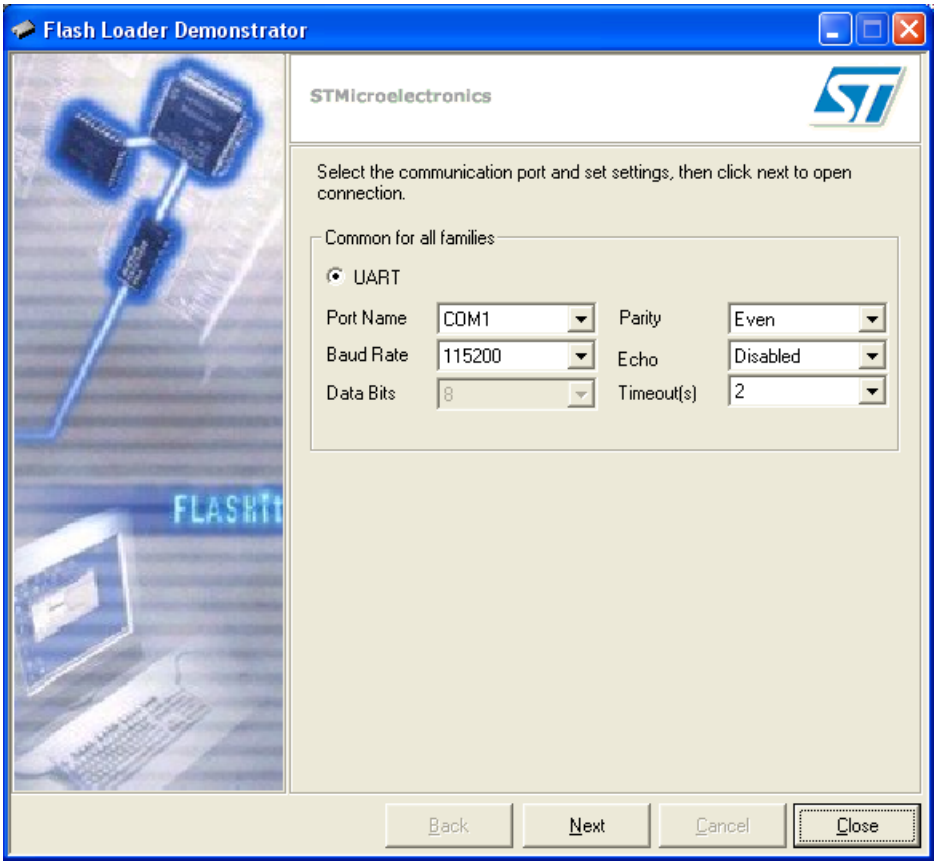


Figure 14 First window of „Flash Loader Demonstrator" application.

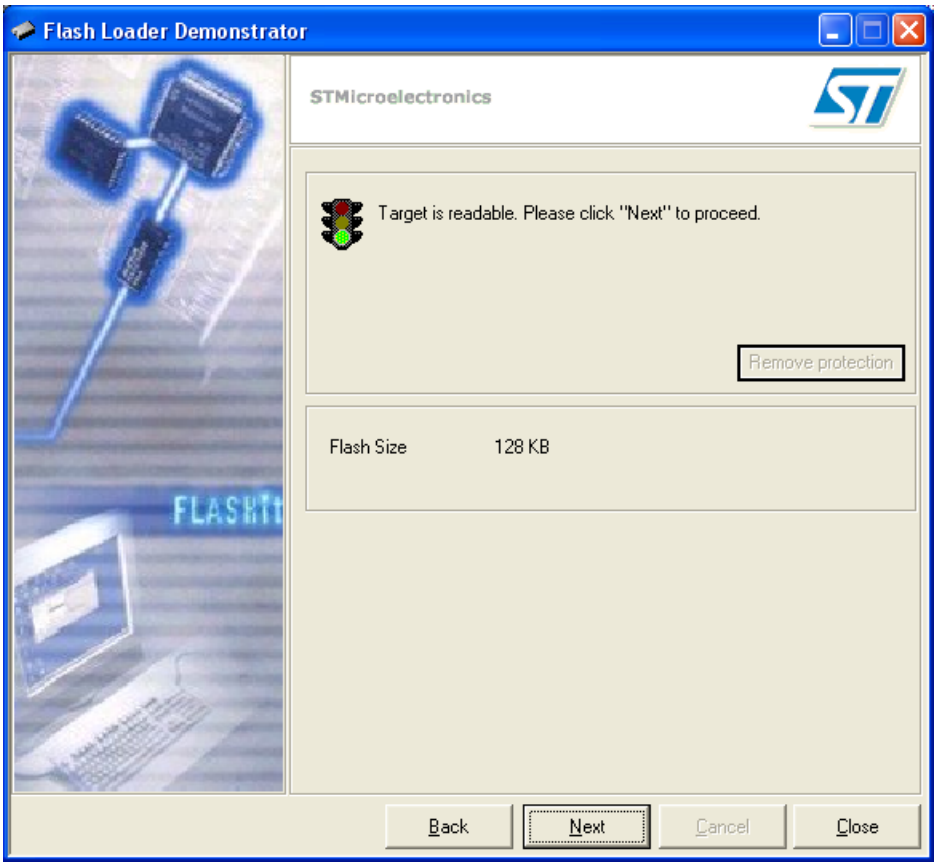


Figure 15 Second window of „Flash Loader Demonstrator" application.

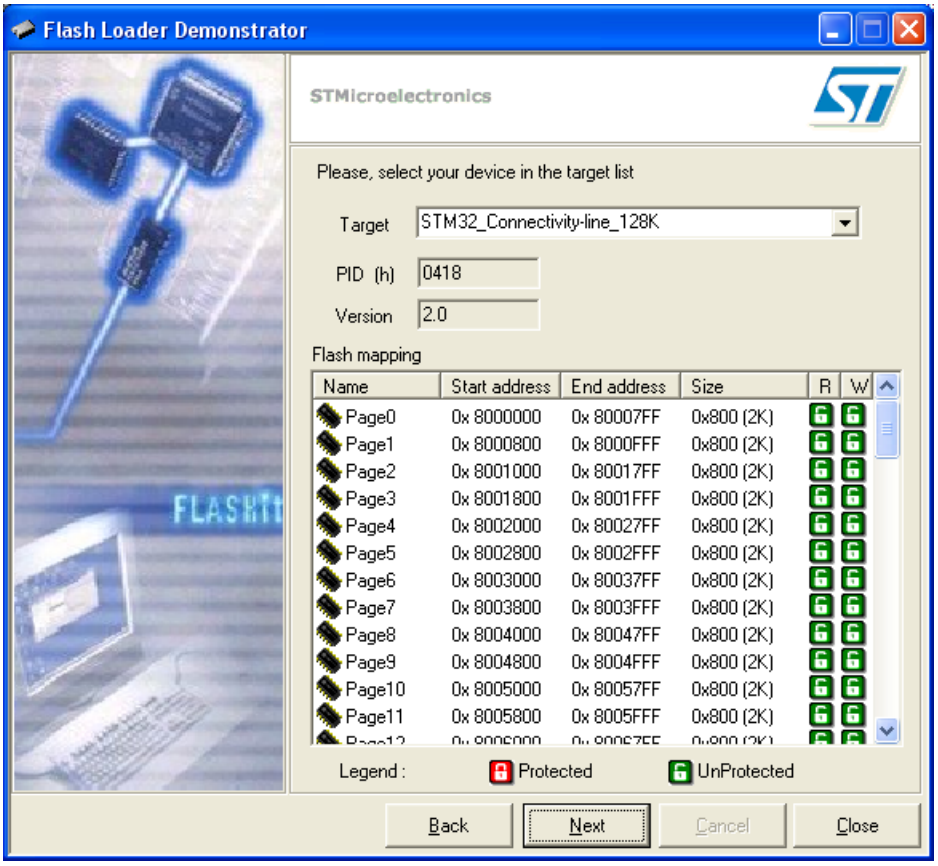


Figure 16 Third window of „Flash Loader Demonstrator" application.

In next window select „Download to device" and choose file to program:

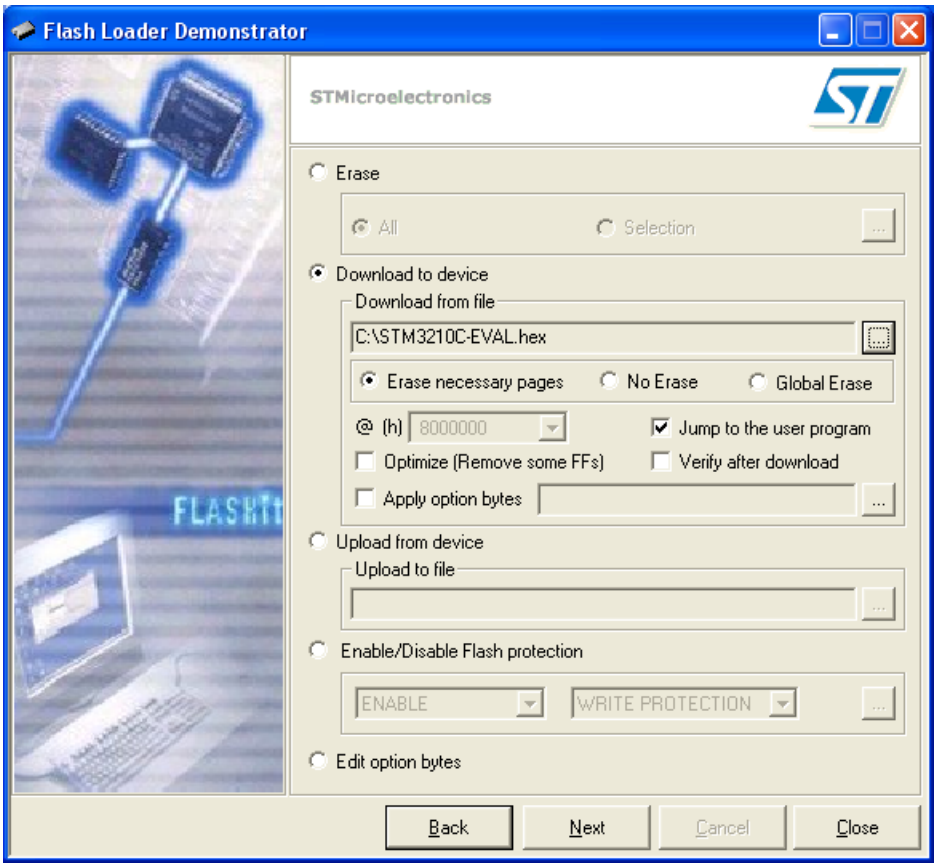


Figure 17 Fourth window of „Flash Loader Demonstrator" application.

After clicking „Next” processor will be programmed:

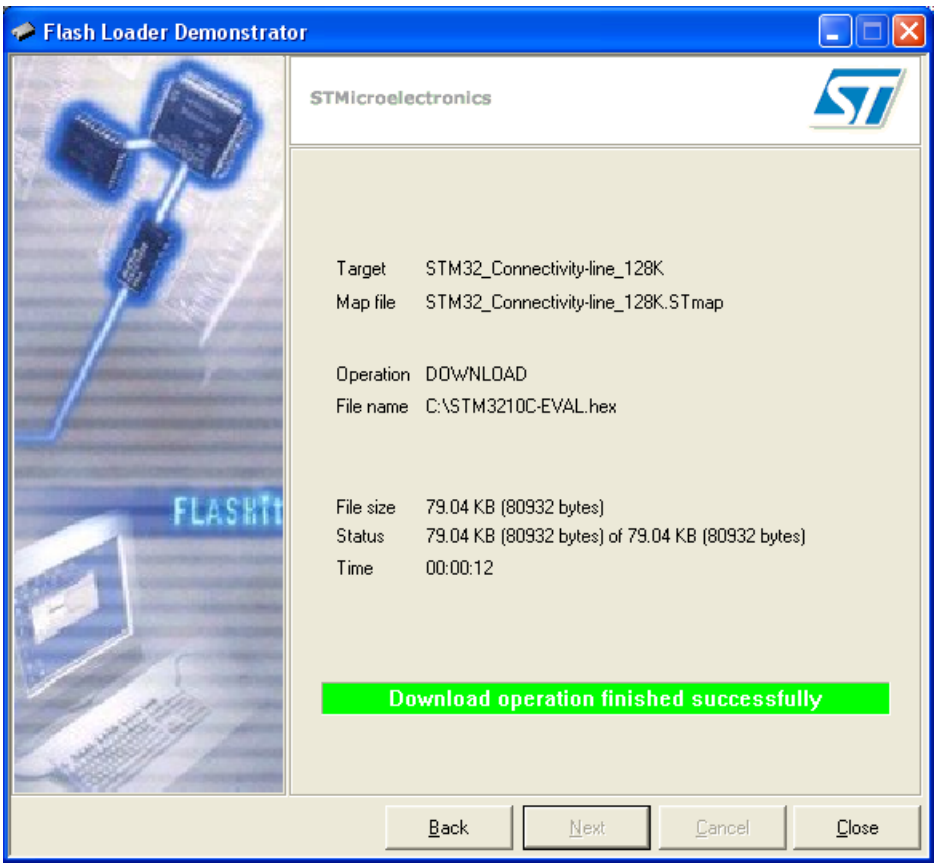


Figure 18 Fifth window of „Flash Loader Demonstrator” application.

Detailed documentation can be found in document:
http://www.st.com/mcu/download2.php?file=13916.pdf&info=STM32F107VC%20Software%20-%20PC%20&url=http://www.st.com/stonline/products/literature/um/13916.pdf

Programming through USB interface

Processor can also be programmed through USB interface. To do this use „DfuSe” application from ST:
http://www.st.com/mcu/download2.php?file=um0412.zip&info=STM32F107VC%20Software%20-%20PC%20&url=http://www.st.com/stonline/products/support/micro/files/um0412.zip

Application documentation:
http://www.st.com/mcu/download2.php?file=13379.pdf&info=STM32F107VC%20Software%20-%20PC%20&url=http://www.st.com/stonline/products/literature/um/13379.pdf

4 Specifications

Microcontroller	STM32F107
Program memory	do 256kB
Data memory	do 64kB
Memory card socket	Micro SD
No. of digital I/O	do 71
No. of analog inputs	do 16
No. of analog outputs	Do 2
Ethernet	10/100 Mb/s Auto-MDIX, onboard RJ45
Power supply	5V
Power consumption	800mA
Dimensions	36x61mm
Weight	ok. 100g
Operating temperature range	0 – 70ºC
Humidity	5 – 95%
Connectors	Double 2x40 header Ethernet RJ45 USB Cortex Debug Connector

5 Technical support

In order to obtain technical assistance please contact support@propox.com . In the request please include the following information:

- number of the module version (e.g. REV 1)
- setting of resistors
- a detailed description of the problem

6 Guarantee

The MMstm32F107 minimodule is covered by a six-month guarantee. All faults and defects not caused by the user will be removed at the Producer's cost. Transportation costs are borne by the buyer.

The Producer takes no responsibility for any damage and defects caused in the course of using the MMstm32F107 module.

7 Assembly drawings

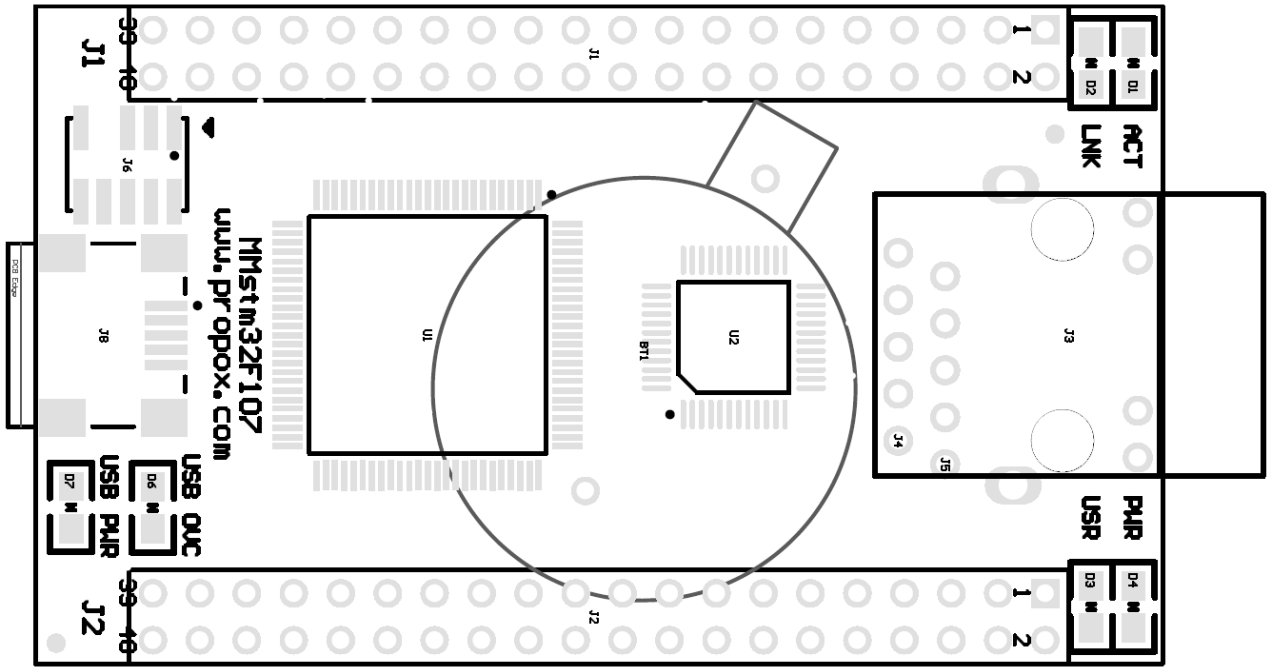


Figure 19 Assembly drawing – top layer.

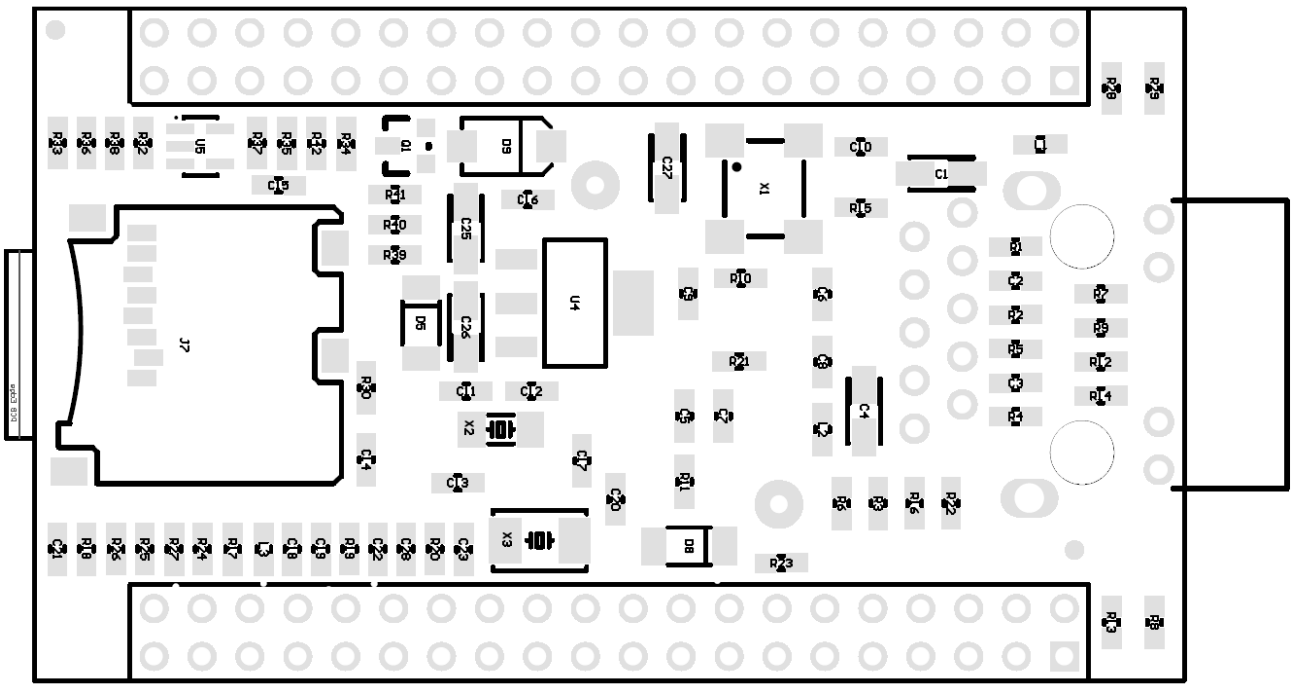


Figure 20 Assembly drawing – bottom layer.

8 Dimensions

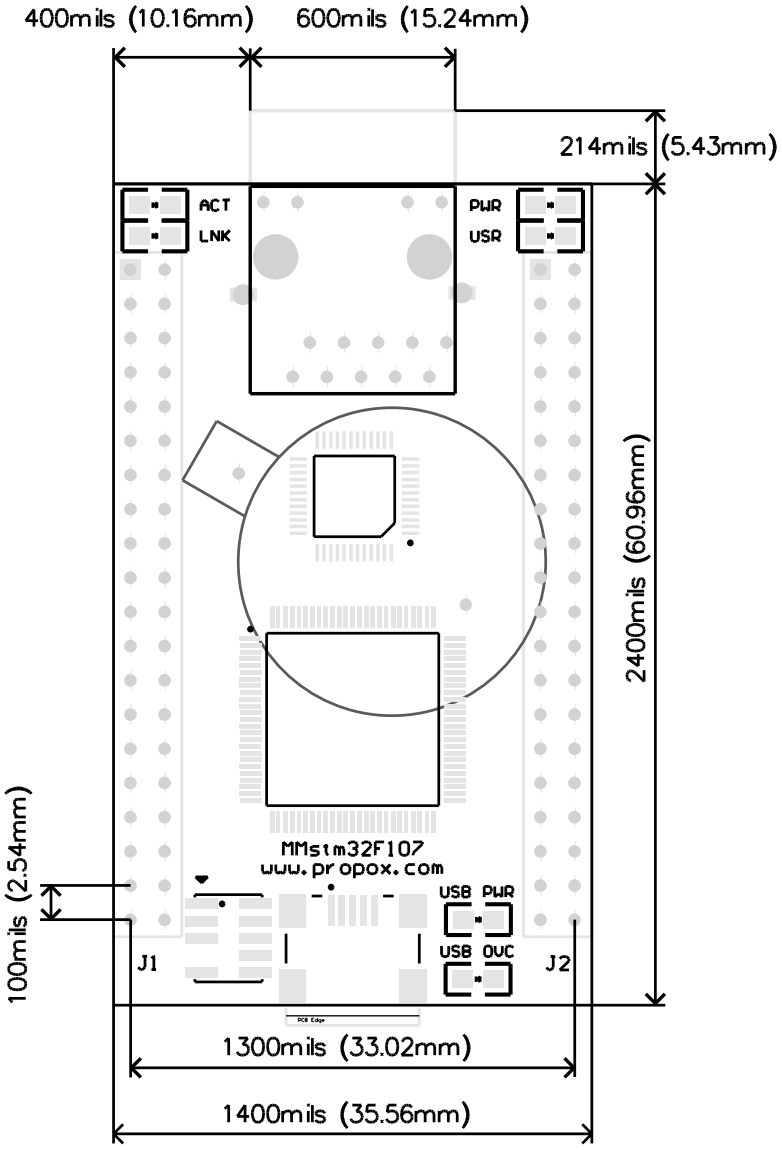
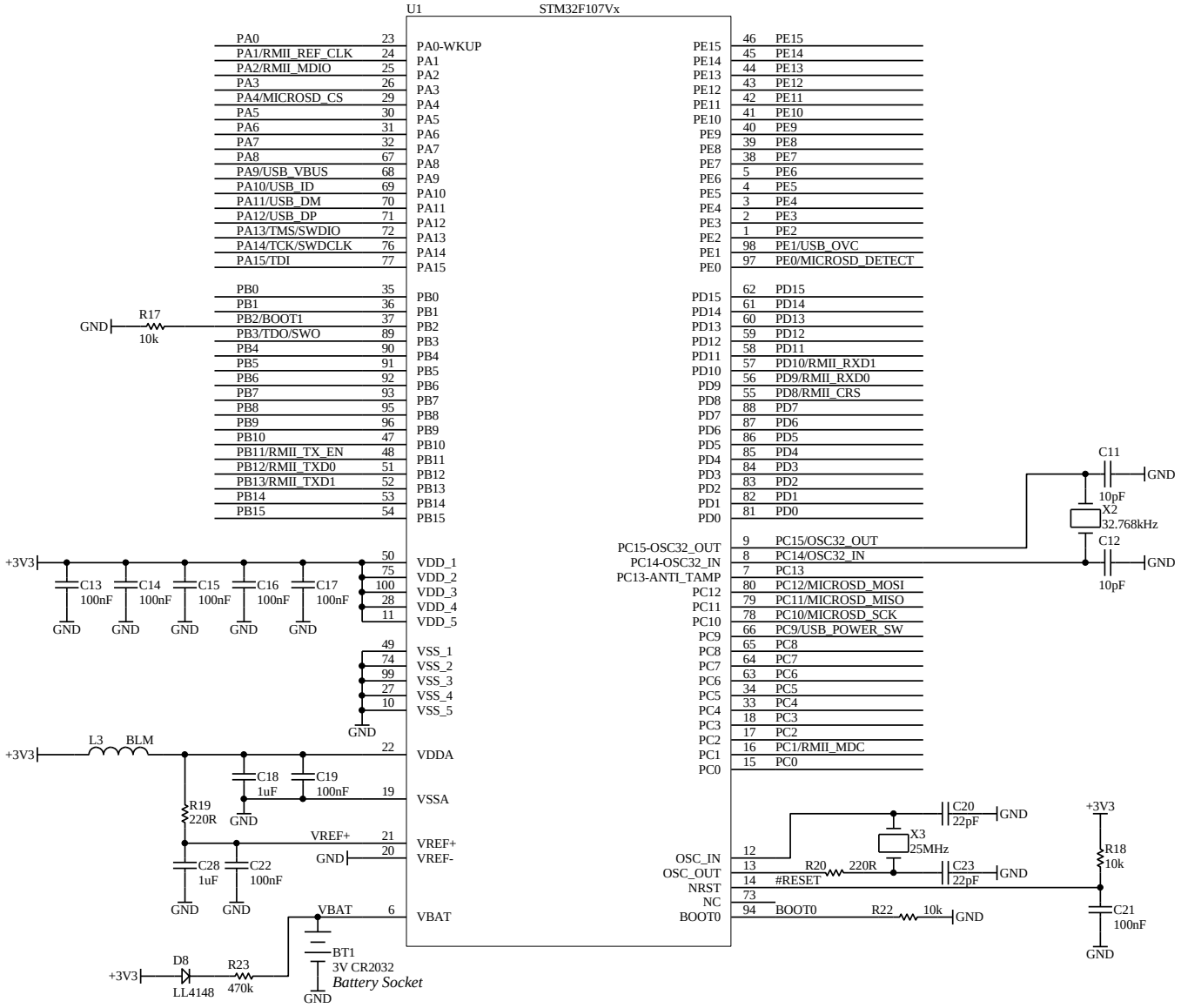
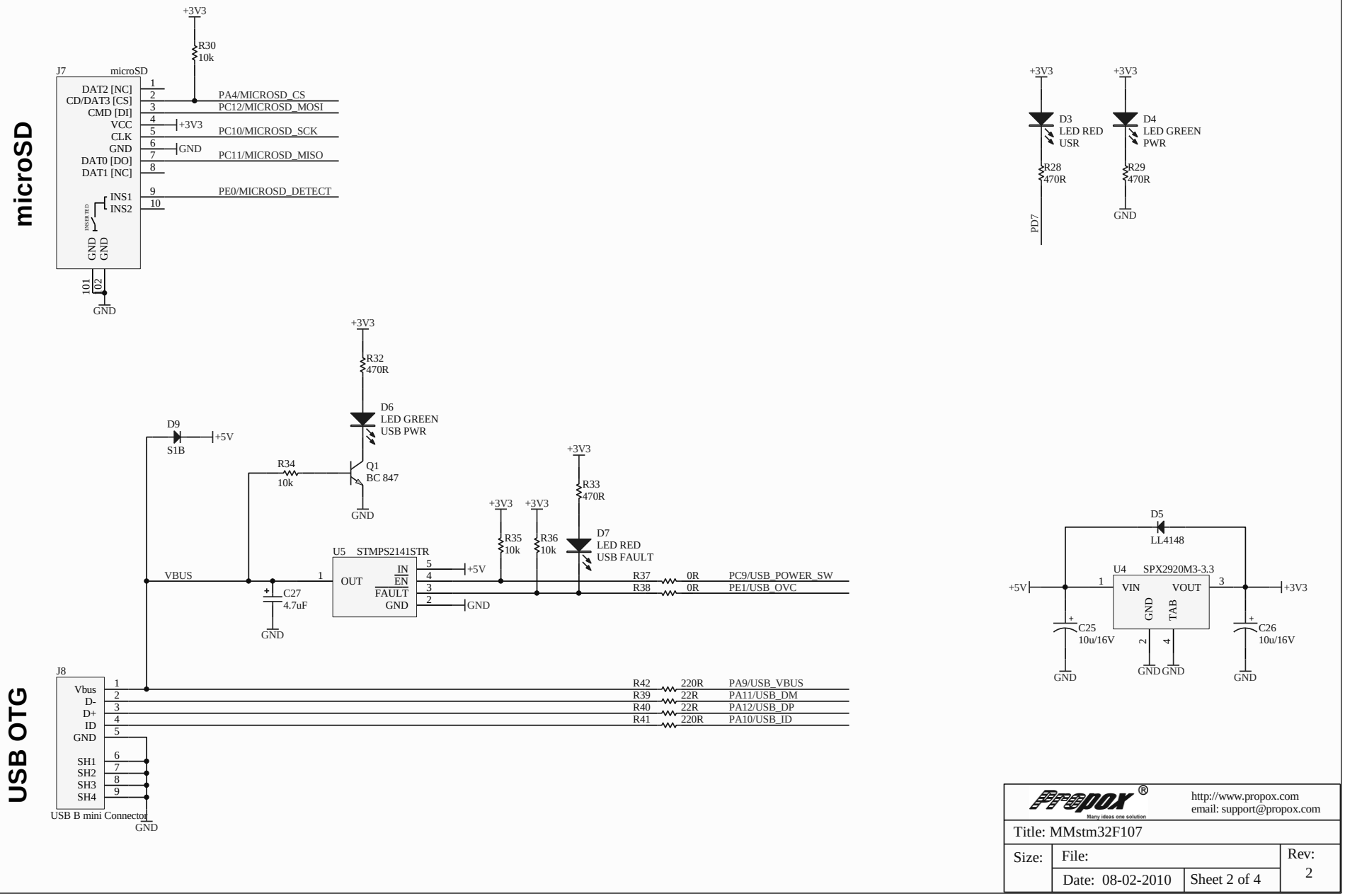


Figure 21 Dimensions – top view.

Figure 22 Dimensions – side view.

9 Schematics


U1
STM32F107Vx
PA0 23
PA1/RMII_REF_CLK 24
PA2/RMII_MDIO 25
PA3 26
PA4/MICROSD_CS 29
PA5 30
PA6 31
PA7 32
PA8 67
PA9/USB_VBUS 68
PA10/USB_ID 69
PA11/USB_DM 70
PA12/USB_DP 71
PA13/TMS/SWDIO 72
PA14/TCK/SWDCLK 76
PA15/TDI 77
PB0 35
PB1 36
PB2/BOOT1 37
PB3/TDO/SWO 89
PB4 90
PB5 91
PB6 92
PB7 93
PB8 95
PB9 96
PB10 47
PB11/RMII_TX_EN 48
PB12/RMII_TXD0 51
PB13/RMII_TXD1 52
PB14 53
PB15 54
PA0-WKUP
PA1
PA2
PA3
PA4
PA5
PA6
PA7
PA8
PA9
PA10
PA11
PA12
PA13
PA14
PA15
PB0
PB1
PB2
PB3
PB4
PB5
PB6
PB7
PB8
PB9
PB10
PB11
PB12
PB13
PB14
PB15
PE15 46
PE14 45
PE13 44
PE12 43
PE11 42
PE10 41
PE9 40
PE8 39
PE7 38
PE6 5
PE5 4
PE4 3
PE3 2
PE2 1
PE1 98
PE0 97
PD15 62
PD14 61
PD13 60
PD12 59
PD11 58
PD10 57
PD9 56
PD8 55
PD7 88
PD6 87
PD5 86
PD4 85
PD3 84
PD2 83
PD1 82
PD0 81
PC15-OSC32_OUT 9
PC14-OSC32_IN 8
PC13-ANTI_TAMP 7
PC12 80
PC11 79
PC10 78
PC9 66
PC8 65
PC7 64
PC6 63
PC5 34
PC4 33
PC3 18
PC2 17
PC1 16
PC0 15
PE15
PE14
PE13
PE12
PE11
PE10
PE9
PE8
PE7
PE6
PE5
PE4
PE3
PE2
PE1/USB_OVC
PE0/MICROSD_DETECT
PD15
PD14
PD13
PD12
PD11
PD10/RMII_RXD1
PD9/RMII_RXD0
PD8/RMII_CRS
PD7
PD6
PD5
PD4
PD3
PD2
PD1
PD0
PC15/OSC32_OUT
PC14/OSC32_IN
PC13
PC12/MICROSD_MOSI
PC11/MICROSD_MISO
PC10/MICROSD_SCK
PC9/USB_POWER_SW
PC8
PC7
PC6
PC5
PC4
PC3
PC2
PC1/RMII_MDC
PC0
R17
10k
GND
+3V3
C13 100nF
C14 100nF
C15 100nF
C16 100nF
C17 100nF
50
75
100
28
11
VDD_1
VDD_2
VDD_3
VDD_4
VDD_5
49
74
99
27
10
VSS_1
VSS_2
VSS_3
VSS_4
VSS_5
L3 BLM
22
VDDA
C18 1uF
C19 100nF
19
VSSA
R19 220R
VREF+ 21
20
VREF+
VREF-
C28 1uF
C22 100nF
VBAT 6
VBAT
BT1
3V CR2032
Battery Socket
D8
LL4148
R23 470k
C11
10pF
X2
32.768kHz
C12
10pF
C20 22pF
X3
25MHz
C23 22pF
R20 220R
OSC_IN 12
OSC_OUT 13
NRST 14
NC 73
BOOT0 94
#RESET
R22 10k
R18 10k
C21 100nF
Many ideas one solution
http://www.propox.com
email: support@propox.com
Title: MMstm32F107
Size:
File:
Date: 08-02-2010
Sheet 1 of 4
Rev: 2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USB OTG
+3V3
R30
10k
J7
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DAT2 [NC]
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GND
DAT0 [DO]
DAT1 [NC]
INS1
INS2
INSERTED
GND
GND
101
102
PA4/MICROSD_CS
PC12/MICROSD_MOSI
PC10/MICROSD_SCK
PC11/MICROSD_MISO
PE0/MICROSD_DETECT
+3V3
GND
D3
LED RED
USR
D4
LED GREEN
PWR
R28
470R
R29
470R
PD7
R32
470R
D6
LED GREEN
USB PWR
D9
S1B
+5V
R34
10k
Q1
BC 847
R33
470R
D7
LED RED
USB FAULT
R35
10k
R36
10k
U5
STMPS2141STR
OUT
IN
EN
FAULT
GND
VBUS
C27
4.7uF
R37
0R
PC9/USB_POWER_SW
R38
0R
PE1/USB_OVC
D5
LL4148
U4
SPX2920M3-3.3
VIN
VOUT
GND
TAB
C25
10u/16V
C26
10u/16V
J8
Vbus
D-
D+
ID
GND
SH1
SH2
SH3
SH4
USB B mini Connector
R42
220R
PA9/USB_VBUS
R39
22R
PA11/USB_DM
R40
22R
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R41
220R
PA10/USB_ID
http://www.propox.com
email: support@propox.com
Title: MMstm32F107
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File:
Date: 08-02-2010
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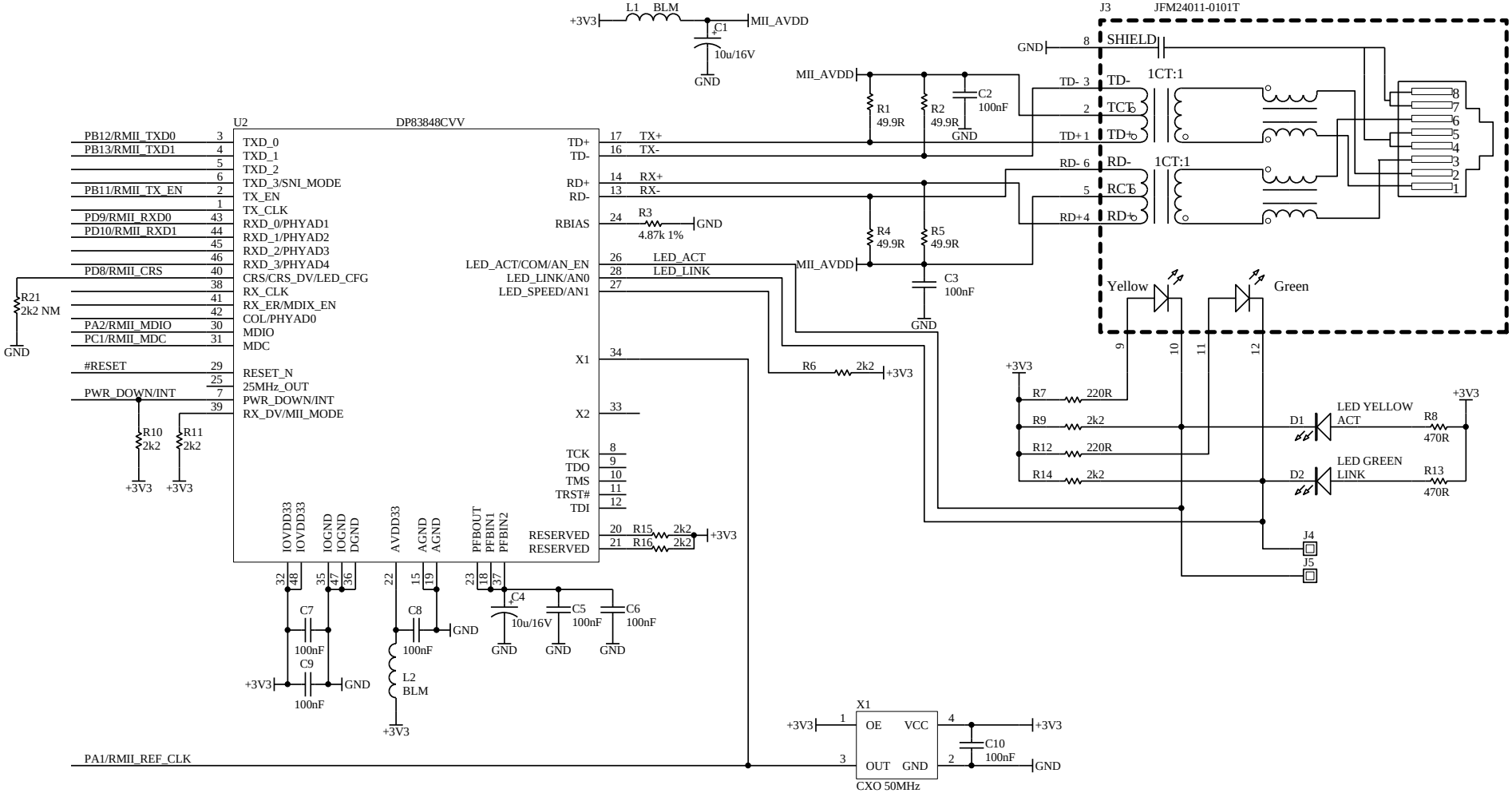
2



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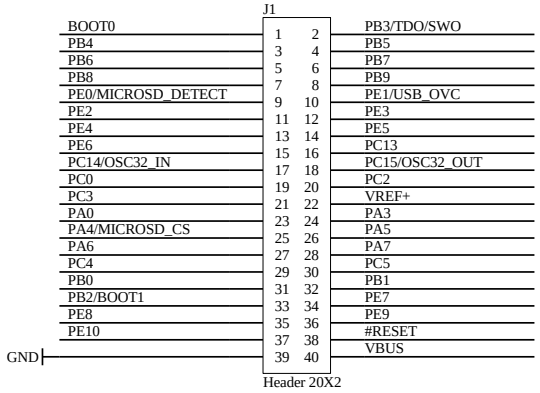
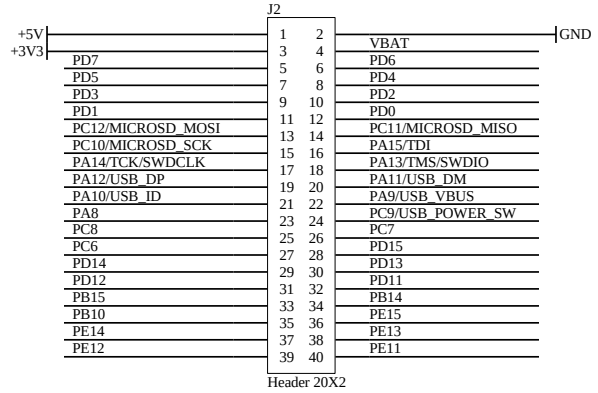
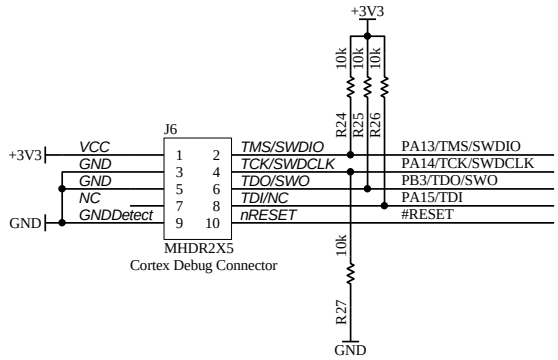
Title: MMstm32F107			
Size:	File:		Rev: 2
	Date: 08-02-2010	Sheet 3 of 4	







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