



### Embedded Ethernet web client based on the STR91x

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#### Introduction

This document describes the functioning of the STEVAL-PCC008V1 demonstration board with an embedded Ethernet web client system which is based on ST's STR91xFAW ARM966E-S™ 16/32-bit Flash MCU with Ethernet microcontroller. This system is designed for viewing/monitoring jpeg images taken from an HTTP web server or from an IP camera present on the network. The images are displayed on the TFT present on the board, thus enabling surveillance. This system needs to be plugged into the network to access jpeg images from the HTTP web server or from the IP camera. This system is compatible with web servers which do not require support for secure socket layer (SSL) and it uses specific programmed requests to capture images from specific web servers.

The system uses a 2.4" TFT for displaying the images captured from the network. The captured jpeg images are displayed on the TFT by converting them into bitmap through a jpeg decompression algorithm. A six-button keypad is provided for navigating through the menus. The availability of the micro-SD card on the board helps in handling large quantities of data from the network.

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# 1 Getting started

## 1.1 Package

The embedded Ethernet web client based on the STR91x system package includes the following items:

- Hardware content
  - Demonstration board equipped with a TFT, micro-SD card, and keypad
- Firmware
  - Already programmed in the system
  - Object files of the firmware
  - Pictures/images
  - Set of images to work with the web server (as an example)
- Documentation:
  - User manual (this document)

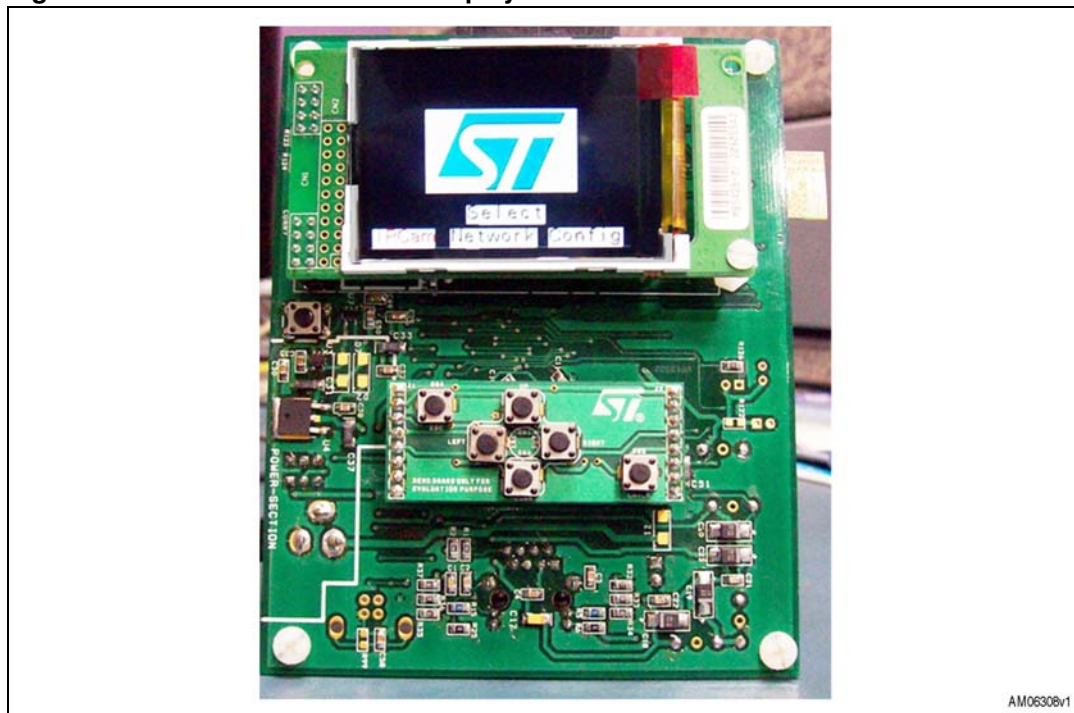
## 1.2 Hardware setup

### 1.2.1 Web client with local display

The board will display the images taken from the network.

To use this mode, jumper J19 present on the board should be in position 2-3. Please refer to [Table 1](#).

**Figure 1. Web client with local display**



## 1.2.2 Jumper settings

The jumper configurations are listed in the table below. Jumper JP19 is used to make the system work either as "Web Client with local display" or as "Web Client with remote display".

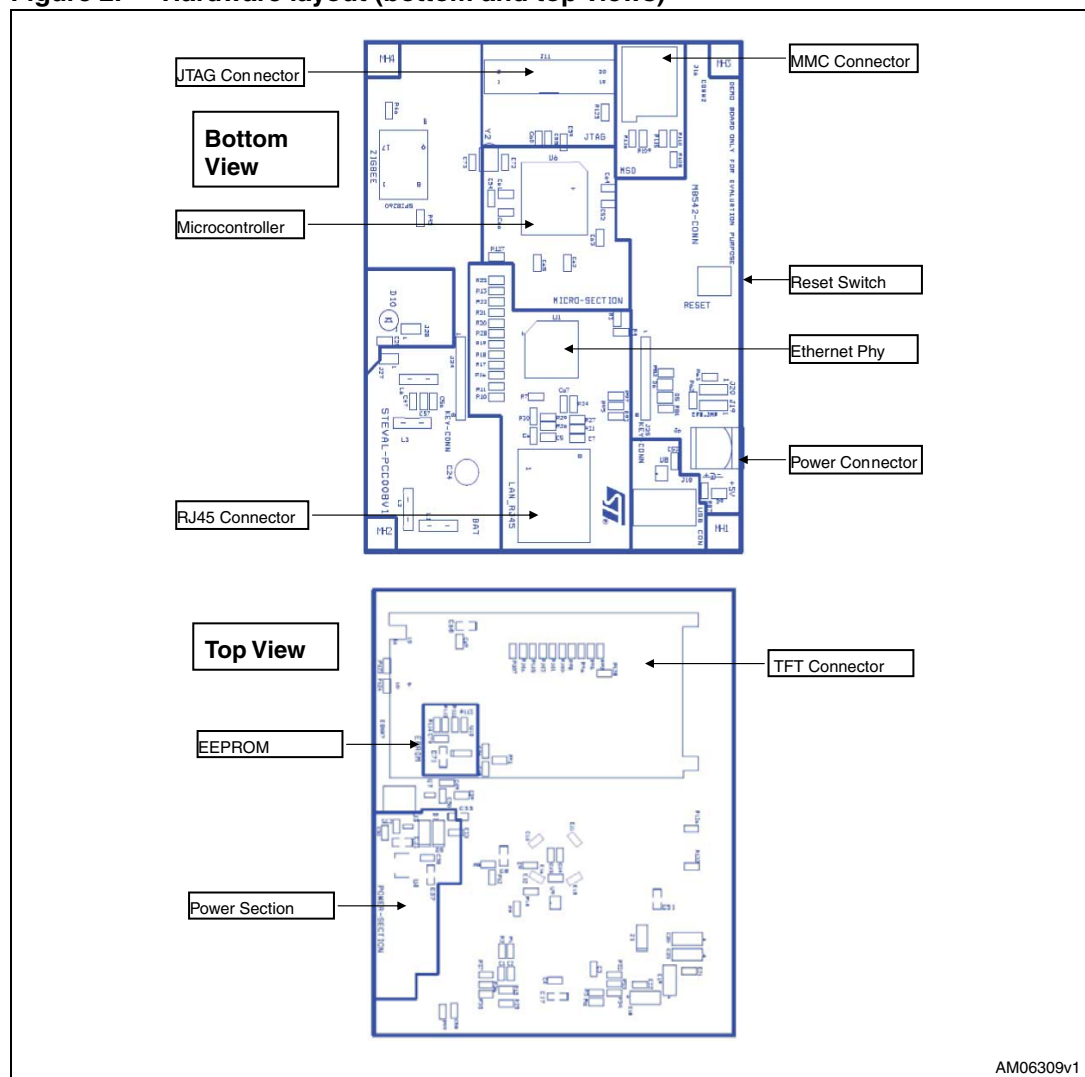
**Table 1. Jumper settings**

Jumper	Jumper position	Function
JP19	2-3	Web client with local display
JP19	1-2	Not used

## 1.2.3 Hardware layout

The system is built around STMicroelectronics' ARM® core-based STR912FAW44X6 in a 128-pin LQFP128 package. [Figure 2](#) shows the layout of different sections of the board.

**Figure 2. Hardware layout (bottom and top views)**



## 1.3 Network setup

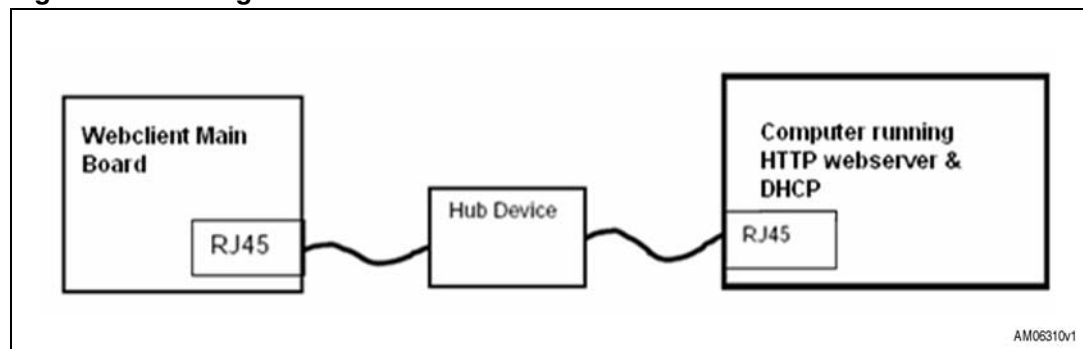
The system needs to be plugged into a network. The network can be accessed in either of the following ways:

- Setting up a local network
- Using an existing network (provided it doesn't restrict external devices).

### 1.3.1 Setting up a local network

The configuration shown in [Figure 3](#) is used to set up the network locally. The designed system supports DHCP protocol which enables the hardware to obtain an IP address automatically from the network. When a network is set up locally, a DHCP server needs to be run on a machine connected to the network. Free DHCP servers can be downloaded from the internet. The system doesn't work on a static IP address.

**Figure 3. Setting local network**



### 1.3.2 Using an existing network

When using an existing network, the system needs to be plugged into the network through the DHCP port. Please check network settings to verify that the network allows connecting such devices.

## 1.4 HTTP web server setup

### 1.4.1 Using a "Techlogica" HTTP web server

To test the functionality of the board, the user can use any web servers. For example, a freeware "Techlogica" HTTP web server can be installed on a machine in the network. This web server is freely available from the internet. After installing the server, the user needs to load images in the web server directory. Some images are provided to the users for testing, but users can use their own images. Before loading the images, verify the following items:

1. The user should store jpeg images in the web server directory. The demonstration unit only supports a maximum of 30 images
2. The size of the image must be 320 x 240 pixels. If not, the image will not be displayed on the TFT. The users can edit the image using any image editor and format to the required size

3. These images should be given names as advised below:  
Name the images starting from 31.jpeg, 32.jpeg, ..... 60.jpeg. In network mode, the demonstration unit requests these images one by one. If the user wishes to add one file (for example IMAGE.jpeg), first delete any file from the list (for example 40.jpeg), then rename IMAGE.jpeg to 40.jpeg which allows the user to display that image on the TFT.  
After the images are saved in the server folder, the server needs to be run in LAN server mode through the interface provided by the server.

**Figure 4. "Techlogica" HTTP web server interface**



### 1.4.2 IPCAM board setup

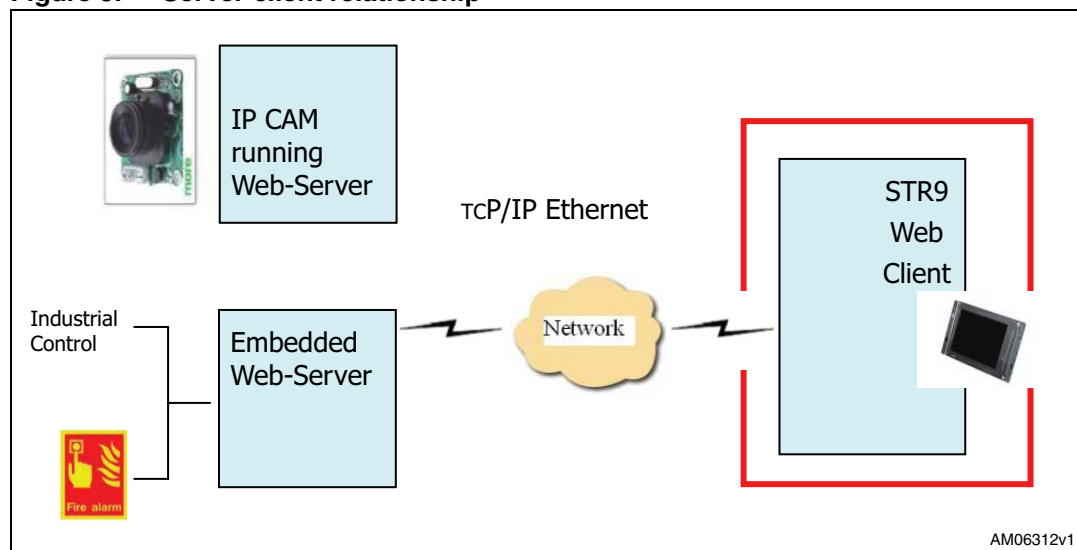
To capture images from the IPCAM system, the user should set the static IP address to that of the IP-CAM board.

## 2 System overview

### 2.1 Server client general description

The system is based on the web server-client relationship as shown in [Figure 5](#). The web server system connects to the network by opening up a connection and listening on it. Any web client system can connect to that port on which the server is listening. This web server can be dedicated for any application. For example, it may be taking data from a camera or it may have images already saved in it or also in industrial applications, process control information can be available on the Ethernet network. This information can be taken by the web client and displayed on the TFT display available on the board.

**Figure 5. Server-client relationship**

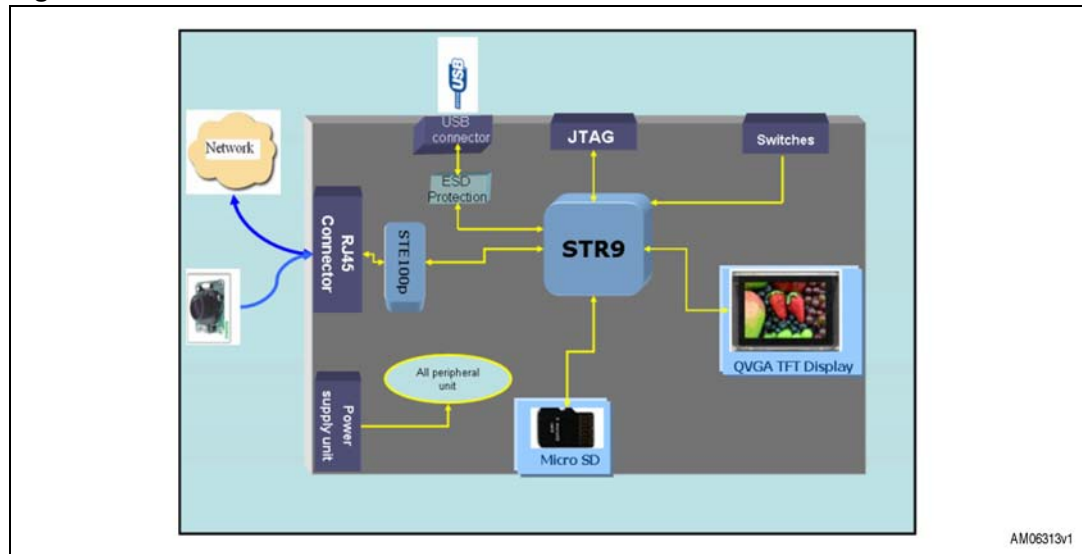


### 2.2 System architecture description

The system works as a web client on the STR9 microcontroller. The system can work with web servers capable of providing jpeg images. The system accesses jpeg images from the web server and displays them on the TFT for viewing/monitoring.

The system can request images from all web servers which don't provide support for secure socket layer communication (SSL). These images are saved on a micro-SD card from where they are decoded and displayed on the TFT through a jpeg decompression algorithm. The system is capable of saving IP addresses of the web servers in non-volatile memory. The user can change these addresses using the keypad.



**Figure 6. Web-client architecture**

The individual parts of the system are described in the following sections.

### 2.2.1 STR9 microcontroller

The system is based on the STR912FAW44X6 microcontroller. The STR9 is a 16/32-bit 96 MHz ARM9E-based MCU having a RISC core, 5-stage pipeline, and tightly coupled memories. The STR912FAW44X6 has 512 kbytes of main Flash and 96 kbytes of SRAM. It has many communication interfaces. For more details refer to <http://www.st.com/mcu/inchtml-pages-str9.html>.

*Note:* The STR9 has two SPI channels. In the demonstration board one SPI is allocated to U2, where a ZigBee® module can be put, while another SPI is shared between the micro-SD card and the TFT display.

### 2.2.2 E-STE100P - single port fast Ethernet transceiver

The E-STE100P, also referred to as the STEPHY1, is a high-performance fast Ethernet physical layer interface for 10BASE-T and 100BASE-TX applications. It was designed with advanced CMOS technology to provide a media independent interface (MII) for easy attachment to 10/100 media access controllers (MAC) and a physical media interface for 100BASE-TX and 10BASE-T. For more details refer to <http://www.st.com/stonline/products/families/communication/wireline/ethernet/ethernet.htm>.

### 2.2.3 TFT: MB542B (AM-240320L8TNQW00H)

The TFT module is based on the TFT from Ampire Co. The resolution of this TFT is QVGA (320 x 240) resolution. It is diagonally 2.4" in size. The TFT has an amorphous, transmissive, normally white display format. It has one backlight with 4 ultra-bright white LEDs.

It has real 262 K color display and supports 5-6-5 and 6-6-6 RGB mode. We are using the 5-6-5 RGB mode means it takes 5, 6, 5 most significant bits for red, green and blue respectively to form one pixel of data. The internal TFT controller is ILI9320. The TFT internal RAM capacity is 172,800 bytes to display direct data. Please refer to the detailed datasheet of the TFT for further details.

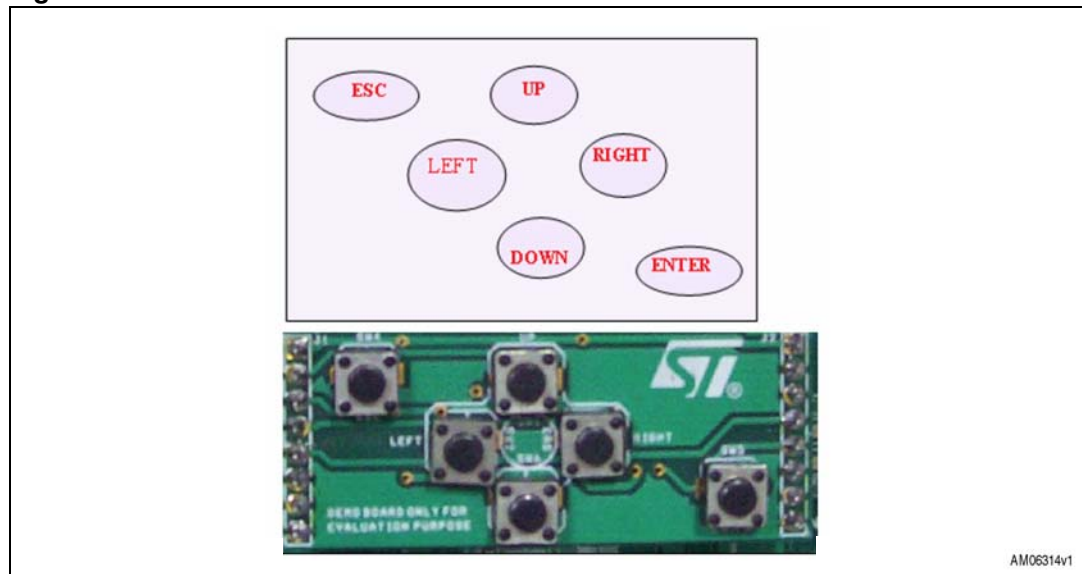
### 2.2.4 Power supply unit

The onboard supply unit contains the low drop fixed positive voltage regulator LD1117D33TR to generate 3.3 V and ultra-low drop voltage regulator LDS3985M18R to generate 1.8 V. This 1.8 V supply is needed for the STR9 microcontroller.

### 2.2.5 User interface section

A set of 6 keys is provided for the user interface section in order to select the options on the TFT.

**Figure 7. User interface**



## 3 Running the system

### 3.1 Powering up

The web client system works on a 5 V power supply. An adapter capable of supplying 5 V, 500 mA can be used.

1. When the system working as "Web client with local display" is powered up, a menu will be displayed on the TFT as shown in [Figure 1](#). Three buttons appear on the menu:
  - IPCAM: This button is used if the user wants to monitor images from the IP camera plugged in the network
  - Network: This button is used if the user wants to monitor images from the LAN server present on the network
  - Config: This button is selected to configure the IP address of the HTTP web server and the IP camera address.

Before going to either IPCAM or network mode please make sure that the IP address of both the HTTP web server and the IPCAM are correct. Through displayed instructions the user can navigate the menu and change IP addresses.

*Note:* The HTTP web server address is the address of the machine where the HTTP server is installed.

The IPCAM address is 10.199.131.2.

2. As mentioned earlier, 6 keys are available for user interface. Once the board is powered on, the TFT displays the message below.

**Figure 8. Initial display**



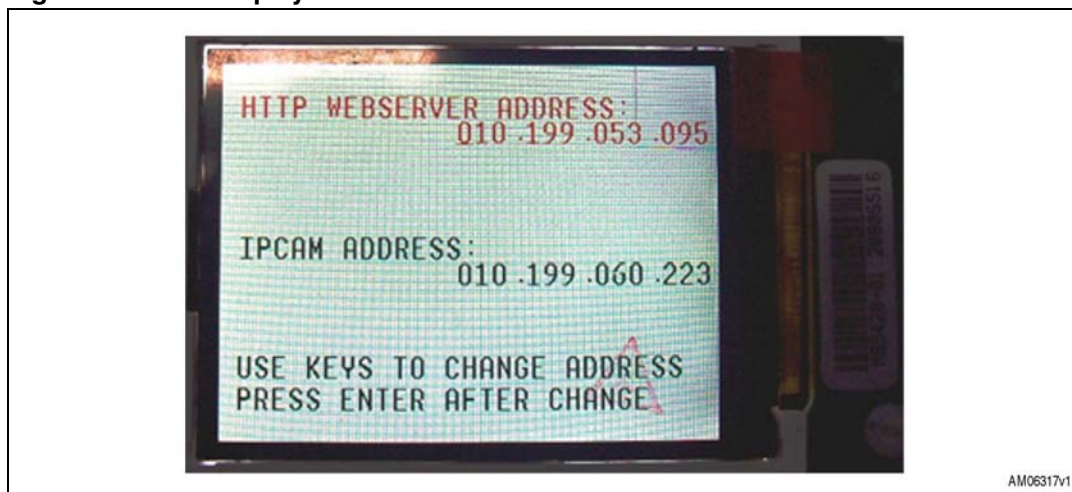
3. The LEFT and RIGHT keys are used to navigate between three buttons (IPCam, network and config). During navigation the button will be highlighted in red. Use the ENTER key to select the button.
4. With the help of the configuration menu, the user can configure the IP address of the servers to which it wants to connect. For example, the user can change the address of the HTTP server to connect to other servers.

Figure 9. TFT display 2



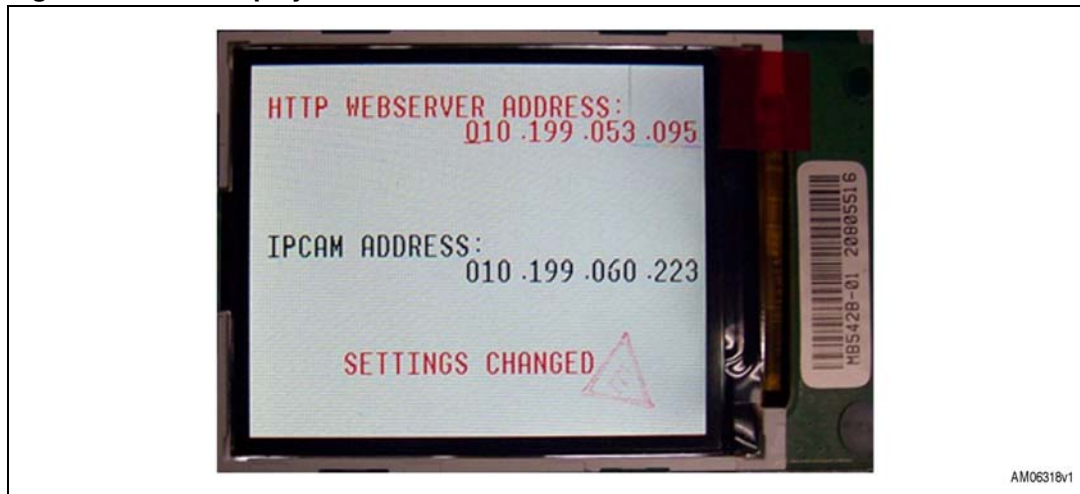
5. When the Enter button is pressed, the TFT displays the message below. By default HTTP WEBSERVER ADDRESS is selected. Use UP and DOWN to change the digits and the LEFT and RIGHT keys to navigate between the digits.

Figure 10. TFT display 3



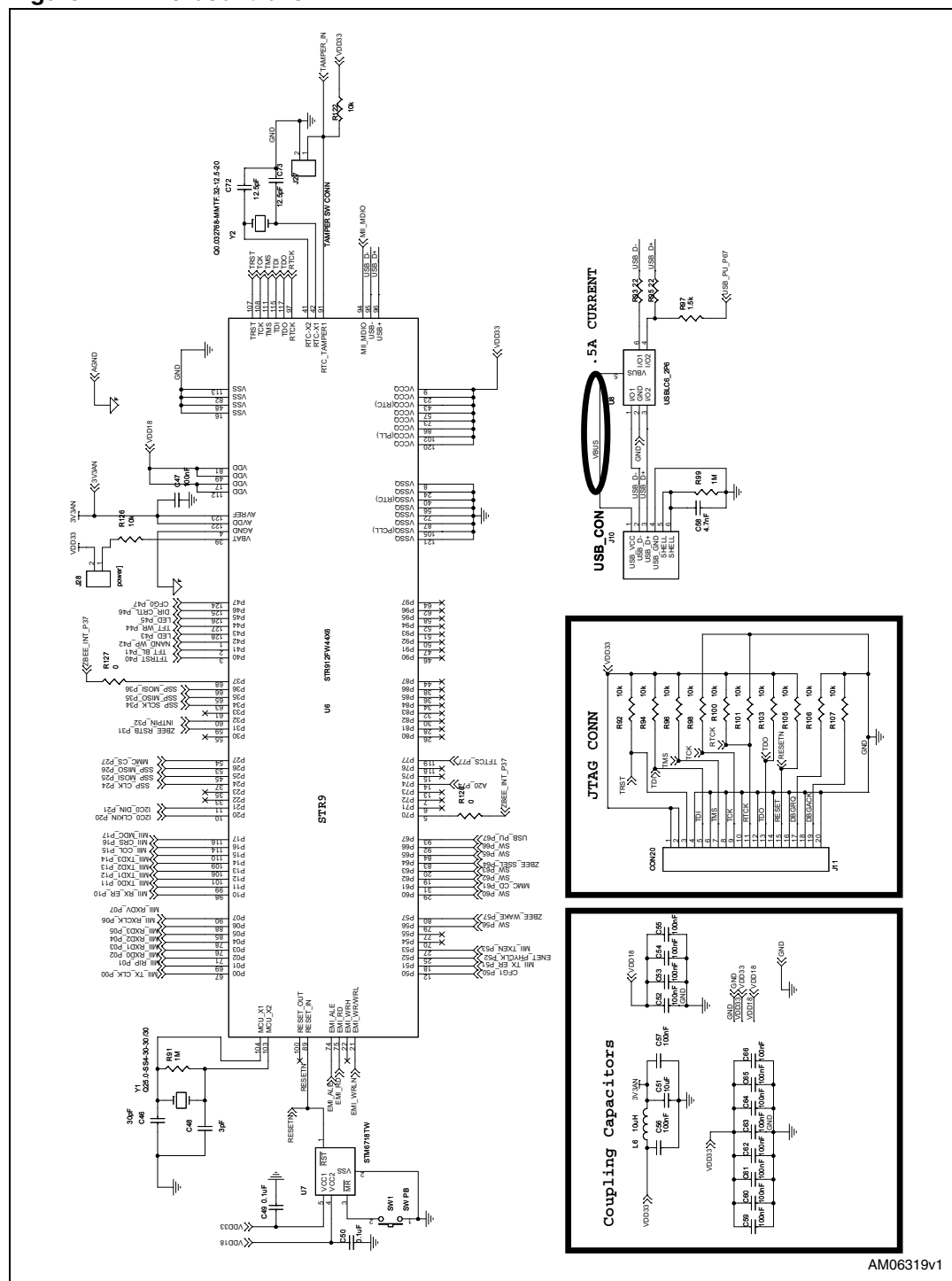
6. Press Enter once the IP address is set.

Figure 11. TFT display 4



7. Use the ESC key to go back to the previous menu. Once the IP address is set, connect the board to the network. Press the appropriate button to capture the images from the server and they will be displayed on the TFT.

**Figure 12. Microcontroller**



### Figure 13. Ethernet

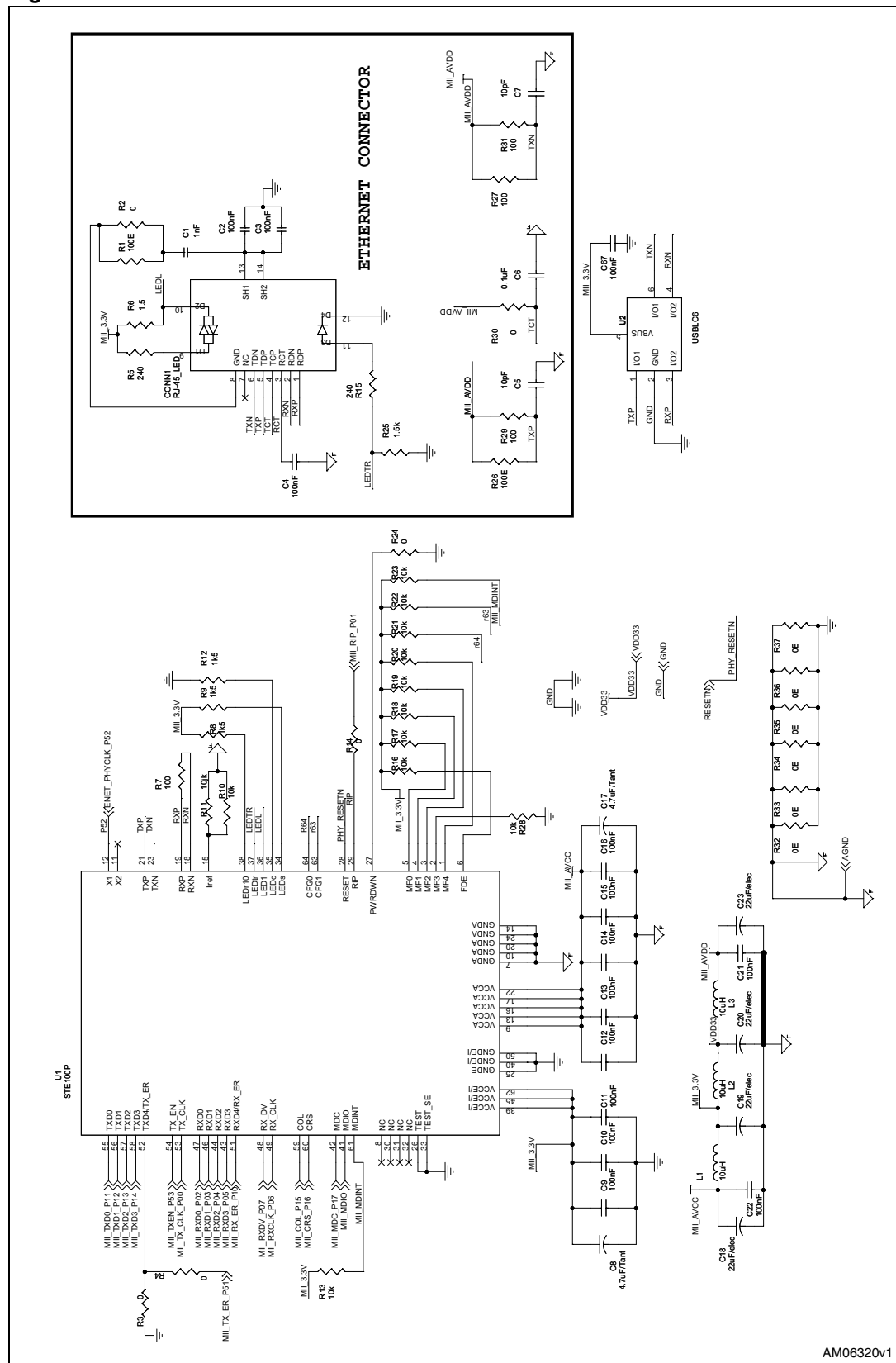
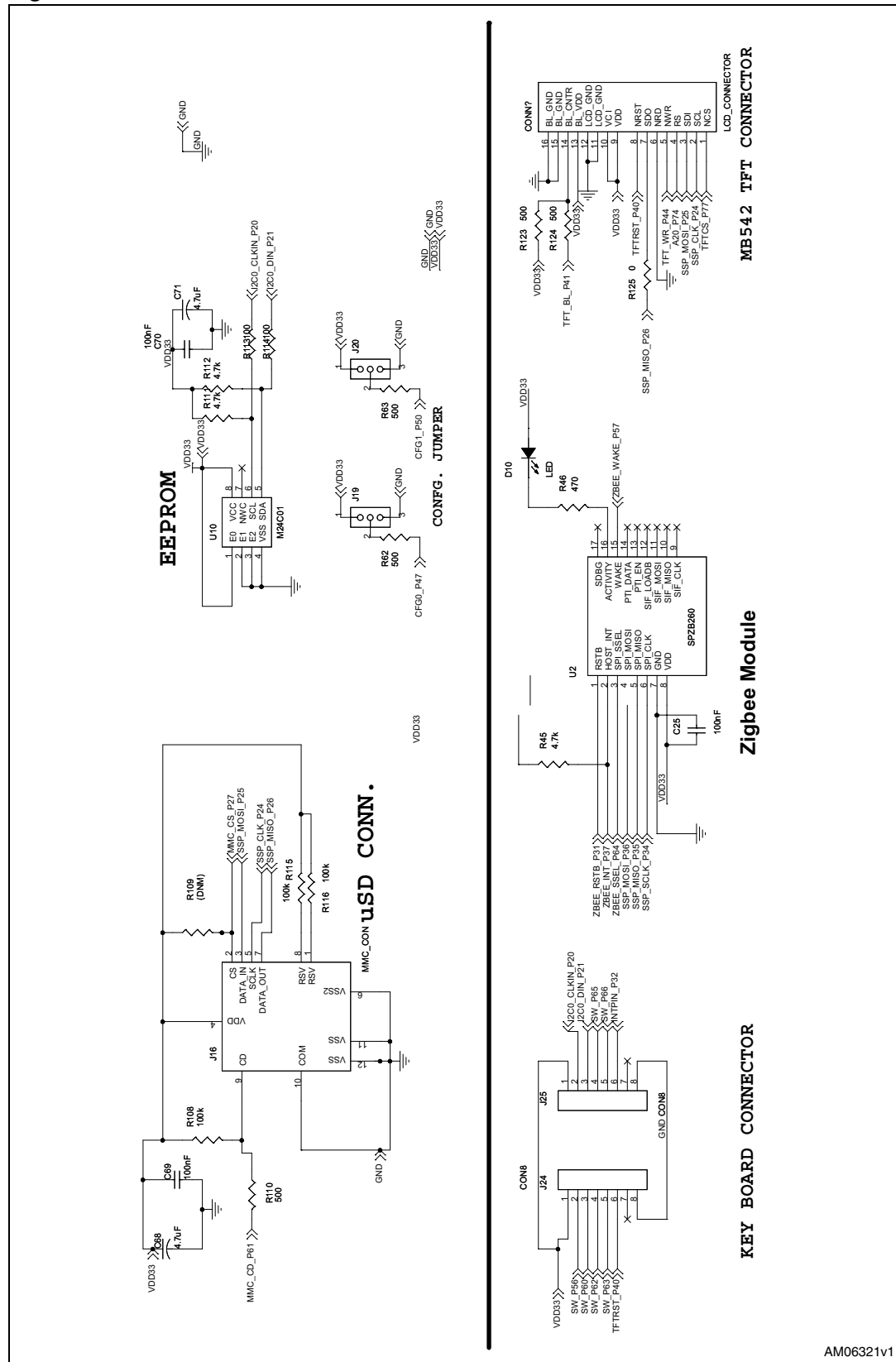


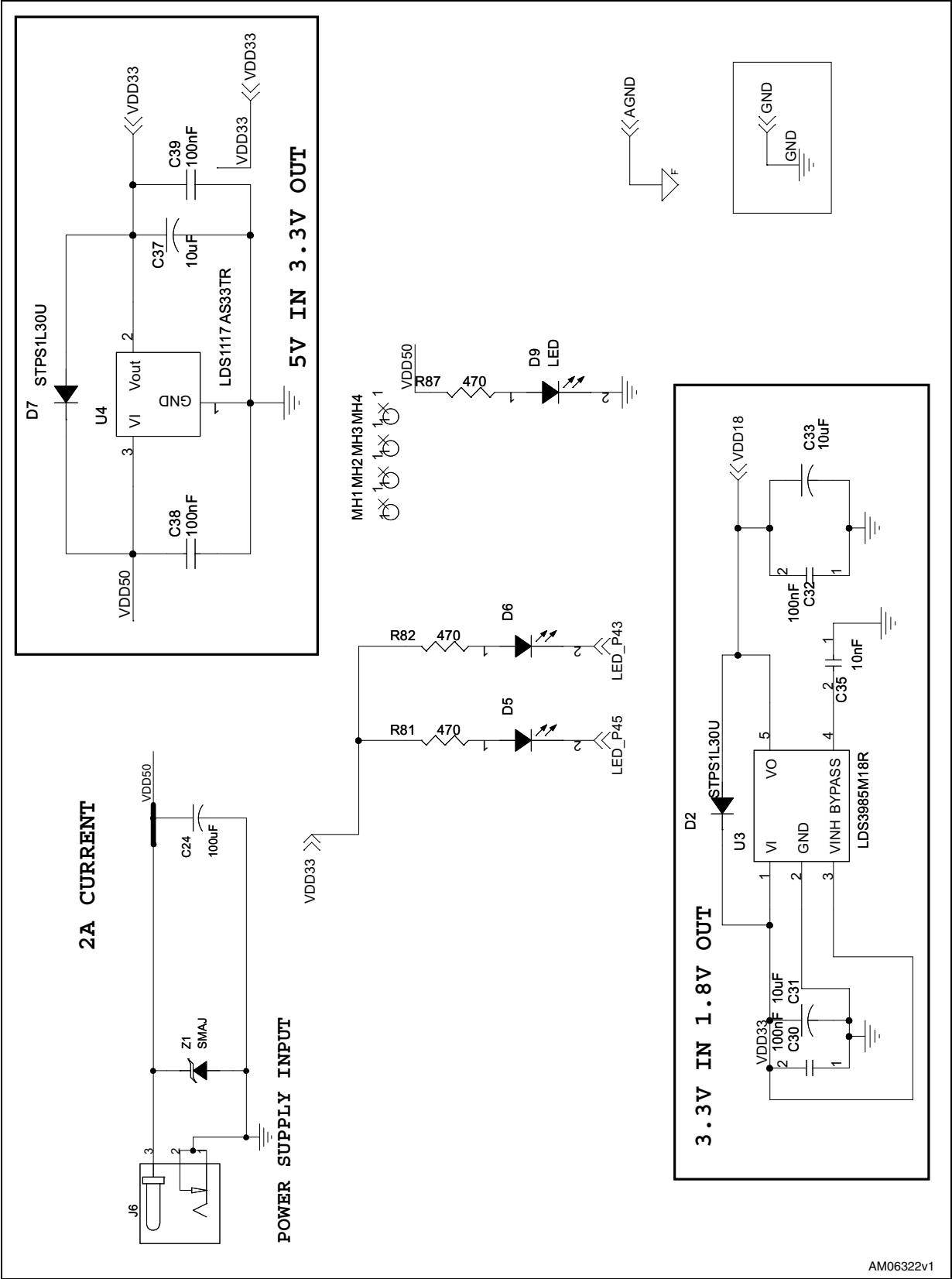
Figure 14. Connectors



AM06321v1



Figure 15. Power management





## 5 Bill of material

Table 2. STEVAL-PCC008V1 main board : BOM

Category	Reference designator	Comp. descr.	Package	Manuf.	Manufacturer's ordering code / orderable part number or equivalent	Suppl.	Supplier ordering code
ST devices	U1	Ethernet PHY	TQFP64 10x10 mm	STMicroelectronics	E-STE100P		
	U3	LDS3985M18R ultra-low drop noise voltage regulator	SOT23-5L	STMicroelectronics	LDS3985M18R		
	U4	LD1117AS33TR low drop voltage regulator	DPAK	STMicroelectronics	LD1117AS33TR		
	U6	ARM966E-S™ 16/32-bit Flash MCU with Ethernet, USB, CAN, AC motor control, 4 timers, ADC, RTC, DMA	LQFP128	STMicroelectronics	STR912FAW44X6		
	U7	STM6718TW ultra-low voltage supervisors	SOT23-5 (WY)	STMicroelectronics	STM6718TWWY6F		
	U8	USBLC6_2P6 very low capacitance ESD protection	SOT23-6L	STMicroelectronics	USBLC6-2P6		
ST devices	U9	Very low capacitance ESD protection	SOT23-6L	STMicroelectronics	USBLC6-2SC6		
	U10	EEPROM	SO8 (150 mil)	STMicroelectronics	M24C01-WMN6TP		
	D2,D7	STPS1L30U (low drop power Schottky rectifier)	SMB	STMicroelectronics	STPS1L30U		
	Z1	Transil™	SMB	STMicroelectronics	SMAJ6.0A-TR		
Crystal and oscillator	Y1	Quartz crystal 25 MHz	11.35 mmx4.35 mm, SS4	Jauch	Q25.0-SS4-30-30/30		
	Y2	Tuning fork crystal 32 kHz	2.0 mmx 6.0 mm	Jauch	Q 0,032768-MMTF32-12,5-20		1

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Bill of material

**Table 2. STEVAL-PCC008V1 main board : BOM (continued)**

Category	Reference designator	Comp. descr.	Package	Manuf.	Manufacturer's ordering code / orderable part number or equivalent	Suppl.	Supplier ordering code
Connectors and jumpers	CONN1	RJ45 with magnetics and G/YLED	PCB mountable, right angle, through-hole	TYCO	5-6605758-4	RS components	Part# 6154412
	J6	Power jack 2.5 mm	Socket, DC power, 2.5 mm, right angle, locking type	Protectron	PDCJ01-08		
	J10	Standard USB B-Type connector	PCB mountable, right angle, through-hole	Any			
Connectors and jumpers	J11	JTAG connector	Box header, right angle, 20way, 2x10-pin, 2.54 mm x 2.54 mm pitch	Protectron	P9604-20-15-1		
	J16	micro-SD connector	SMD	Proconn Technology	MSPN09-D0-1002		
	J19,J20	CON3	1x3-pin, header 2.54 mm x 2.54 mm pitch	Any			
	J24,J25	CON8	1x8-pin, 2.54 mm x 2.54 mm pitch	Any			
	J27, J28	CON2	1x2-pin, 2.54 mm x 2.54 mm pitch	Any			
	CONN2	TFT LCD_CONNECTOR	2x8-pin socket, 2.54 mm x 2.54 mm pitch	Any			



Table 2. STEVAL-PCC008V1 main board : BOM (continued)

Category	Reference designator	Comp. descr.	Package	Manuf.	Manufacturer's ordering code / orderable part number or equivalent	Suppl.	Supplier ordering code
LEDs	D5,D6,D9	LED	SMD0805	Any			
	C5,C7	10 pF	SMD0805	Any			
	C72,C73	12.5 pF	SMD0805	Any			
	C46,C48	30 pF	SMD0805	Any			
	C1	1 nF	SMD0805	Any			
	C58	4.7 nF	SMD0805	Any			
Capacitors	C35	10 nF	SMD0805	Any			
	C2,C3,C4,C6,C9, C10,C11,C12, C13,C14,C15, C16,C21,C22, C25,C30,C32, C38,C39,C47, C49,C50,C52, C53,C54,C55, C56,C57,C59, C60,C61,C62, C63,C64,C65, C66,C67,C69, C70	100 nF	SMD0805	Any			
	C8,C17,C68,C71	4.7 µF/tantalum	EIA 3528-21/ size A	Any			
	C31,C33,C37, C51	10 µF/tantalum	EIA 3528-21/ size A	Any			
	C18,C19,C20, C23	22 µF/tantalum	EIA 3528-21/ size B	Any			
	C24	100 µF	ELC (bulk radial)	Any			

**Table 2. STEVAL-PCC008V1 main board : BOM (continued)**

Category	Reference designator	Comp. descr.	Package	Manuf.	Manufacturer's ordering code / orderable part number or equivalent	Suppl.	Supplier ordering code
Resistors	R1,R7,R26,R27,R29,R31,R113,R114	100 $\Omega$	SMD0805	Any			
	R2,R3,R4,R14,R24,R30,R32,R33,R34,R35,R36,R37,R125,R127,R128	0	SMD0805	Any			
	R5,R15	240 $\Omega$	SMD0805	Any			
	R6,R8,R9,R12,R25,R97	1.5 k $\Omega$	SMD0805	Any			
Resistors	R10,R11,R13,R16,R17,R18,R19,R20,R21,R22,R23,R28,R92,R94,R96,R98,R100,R101,R103,R105,R106,R107,R122,R126	10 k $\Omega$	SMD0805	Any			
	R62,R63,R110,R123,R124	500 $\Omega$	SMD0805	Any			
	R46,R81,R82,R87	470 $\Omega$	SMD0805	Any			
	R91,R99	1 M $\Omega$	SMD0805	Any			
	R93,R95	22 $\Omega$	SMD0805	Any			
	R109	DNM	SMD0805	Any			
	R45,R111,R112	4.7 k $\Omega$	SMD0805	Any			
	R115,R116,R108	100 k $\Omega$	SMD0805	Any			

**Table 2. STEVAL-PCC008V1 main board : BOM (continued)**

Category	Reference designator	Comp. descr.	Package	Manuf.	Manufacturer's ordering code / orderable part number or equivalent	Suppl.	Supplier ordering code
Others	L1,L2,L3,L6	10 $\mu$ H	Through-hole	Any			
	SW1	Reset switch	(6mm x 6mm ) push-button, through-hole, 4-pin				1
		TFT: 320 x 240	TFT module, MB542B using Ampire TFT	Ampire	AM-240320L8TNQW00H		
		micro-SD Card	micro-SD	Any			

**Note:** *Not mounted: R4, D10,J28,J27,U8,J10,U2,R125,R109,Y2,C72,C73,Z1,U9*  
*The term equivalent has been used where the exact part number from the mentioned vendor may not have been used.*

**Table 3. STEVAL-PCC008V1: daughterboard: BOM**

Category	Reference Designator	Component Description	Package	Manufacturer	Manufacturer's ordering code / Orderable Part Number or Equivalent	Supplier	Supplier Ordering Code
Switches	SW1, SW2, SW3, SW4, SW5, SW6	SWITCH, TACTILE, SPNO, Through-hole	6.00 mm x 6.00 mm, 2-pin	C&K components	PTS645SL70TR LFS	Digi-Key	CKN9110CT-ND
Connectors and jumpers	J1, J2	Sockets, 1x8 pin	Sockets, 1x8-pin, 2.54 mm pitch	Protectron	P9401-08-21		
Capacitors	C1,C2,C3,C4, C5,C6	100 nF	SMD0805	Any			
Resistors	R1,R2,R3,R4,R5,R6	10 k $\Omega$	SMD0805	Any			

## 6 Revision history

**Table 4. Document revision history**

Date	Revision	Changes
05-Jul-2010	1	Initial release.



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