TCP/IP Applications Using the MCF51CN Family—Designer Reference Manual

Device Supported: MCF51CN Microcontrollers

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Chapter 1
Introduction

1.1 Overview

This reference manual describes using the MCF51CN128 reference design hardware to run the following TCP/IP applications:

- SCI/SPI to Ethernet
- Web Server
- Email Client
- FTP Server

All hardware schematics diagram, gerber files, Allegro hardware source files, board pictures, and firmware source codes are available in reference materials. All hardware files and software can be reused to enable directly TCP/IP connectivity in customized applications.

For details about the technical implementation of the reference design main features, refer to the following documents:

- Application note titled *Serial-to-Ethernet Bridge Using MCF51CN Family and FreeRTOS* (document AN3906)
- Application note titled *Web Server Using MCF51CN Family and FreeRTOS* (document AN3928)
- Application note titled *Email Client Using MCF51CN Family and FreeRTOS* (document AN3930)
- Application note titled *FTP Server Using MCF51CN Family and FreeRTOS* (document AN3931)

1.2 Key Features

- Uses Freescale ColdFire V1 Core MCF51CN128 48-pin QFN package running up to 50.33 MHz

- Low cost board in a minimal size of 2.89’’ × 1.55’’. Ethernet Minimal System is 1.15’’ × 1.55’’.
- For the MCF51CN128 reference design hardware, power can be applied to both unused pairs from the RJ45 cable. Therefore, power through the jack is not required. For more details go to Section 2.7.
- The following TCP/IP services are implemented.
  - **DHCP Client Service:**
    - IP dynamic address (DHCP) or static support at runtime
  - **Serial Bridge**
    - A UART or SPI to Ethernet bridge is implemented using the socket approach.
    - Supports client or server implementation that allows connecting two serial bridges using the Internet.
    - An always enabled web page can configure all interfaces and bridge settings. A reset command can be sent through the web page to make settings take effect.
    - The following settings can be changed or shown at runtime through the configuration web page or at compile time:
      - MAC address
      - IP address
      - IP mask address
      - IP gateway address
      - Server address to connect as a client
      - Static or dynamic IP address
      - TCP port to connect or bind to
      - TCP client or server implementation
      - Configuration or bridge implementation
      - UART port
      - UART baudrate
      - UART parity
      - UART number of bits
      - UART number of stop bits

        - UART flow control
        - SPI port
        - SPI baudrate
        - SPI polarity
        - SPI phase
        - SPI master or slave
        - SPI polling or interrupt handling
    - Using hardware and software flow control for the RS232 interface
    - Presence of RS485 transceiver and connector
    - The bridge can be configured through the UART interface using a set of commands explained in Section 4.5
    - For the MCF51CN128 reference design hardware, power can be applied to pin 6 of the UART connector. Therefore, the power jack is not required. Refer to Figure 2-5 for more details.
    - An accelerometer by SPI is on-board to test SPI bridge.

- **HTTP Server Service**
    - Supports HTTP with the following services:
        - HTTP 2.0—Persistent connections or keep-alive sessions
        - SSI—Server side include (SSI) directives
        - AJAX—Used to give the illusion that a web page changes without refreshing it
        - FORMS (POST request)
        - CGI—(POST request) common gateway interface support
        - Tasks status though a web page

- **Email Client Service**
    - Assigned IP is sent via email if the dynamic IP is used.

- **FTP Server Service**
  - Stores information using FAT and then makes it accessible using FTP
  - FTP is mounted over an SD card reader

1.3 Advantages

- The MCF51CN128 is a low cost MCU that can enable Ethernet/TCP/IP connectivity to any embedded design.
- Software source codes are available to directly use in a customer application. It also allows customer changes or customizations.
- Hardware files are provided for free. If a change in hardware is required for a customized design, hardware source files can be edited.
- The MCF51CN128 MCU can obtain power from connectors like the RJ45 and DB9.
- For support enter a service request at, www.freescale.com/support.

1.4 Development Tools

- CodeWarrior V6.2.1 is used to download the software application.
- A proper Ethernet cable must be selected depending on the Ethernet element that is the PC, hub, switch, or router.

1.5 Top and Bottom View of the MCF51CN128 Reference Design Hardware

The following figures describe the top and bottom view of the board. A hardware block diagram is shown in Figure 2-2. For details about components, go to Sections 2.2 and Section 2.3.

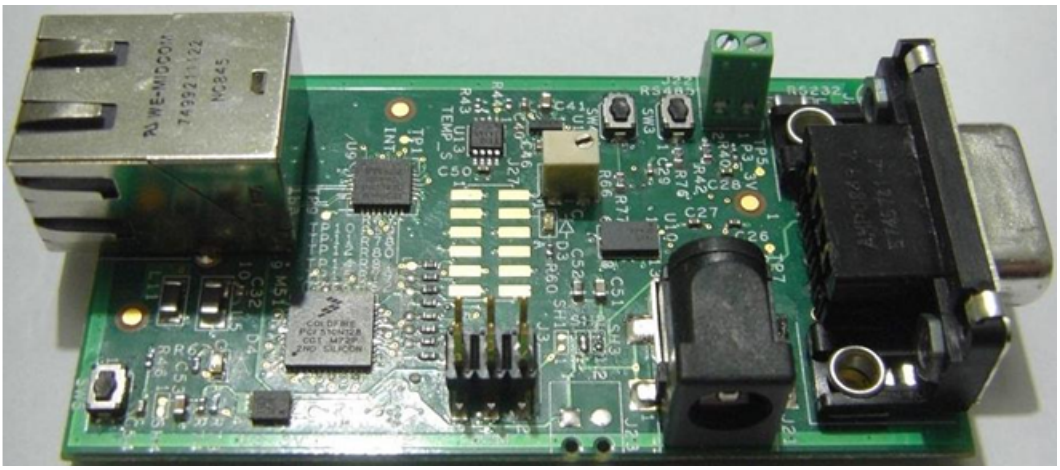


Figure 1-1. Top view of MCF51CN128 reference design hardware

Figure 1-2. Bottom view of MCF51CN128 reference design hardware

1.6 How the MCF51CN128 Reference Design Fits Your System

The following figures show how the system fits into some TPC/IP applications. Specific features are explained in the Section Firmware. The figures show reference design squared by a red box.

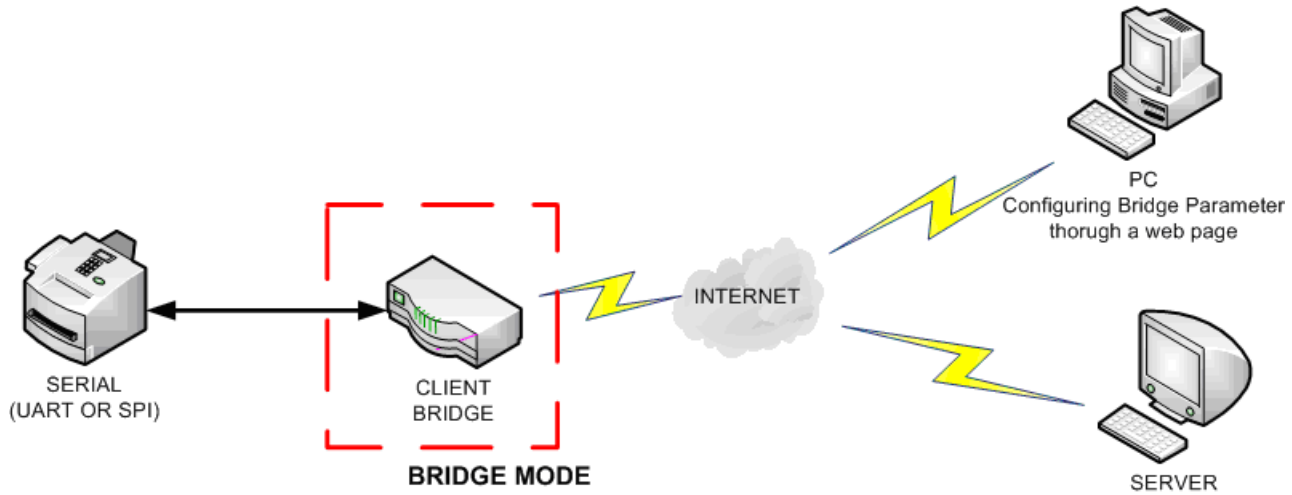


Figure 1-3. Serial bridge in Bridge mode

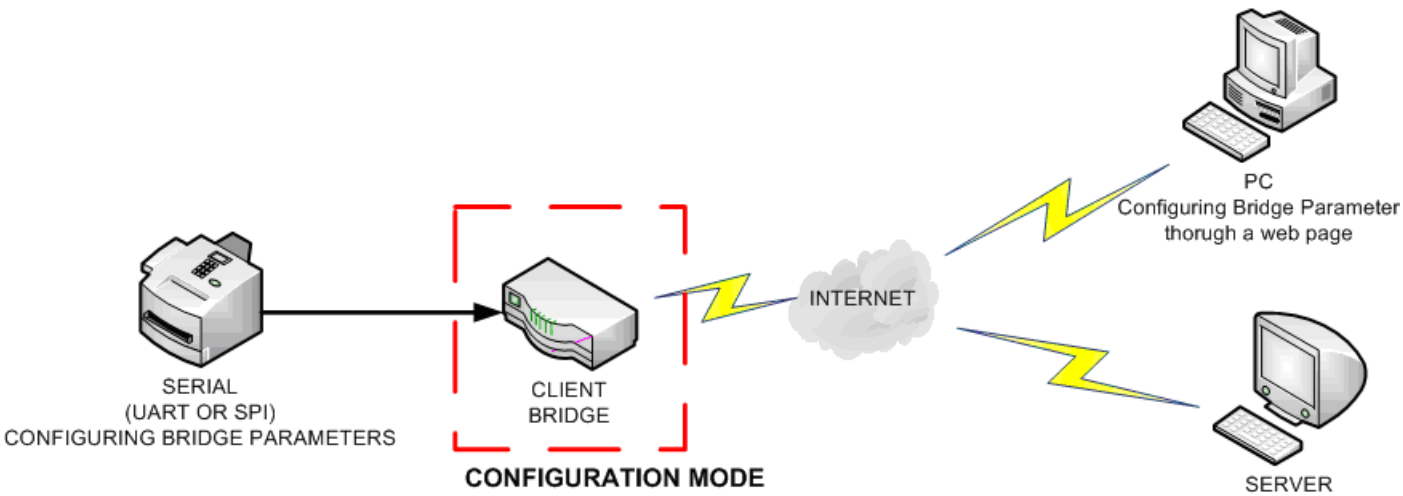


Figure 1-4. Serial bridge in Configuration mode

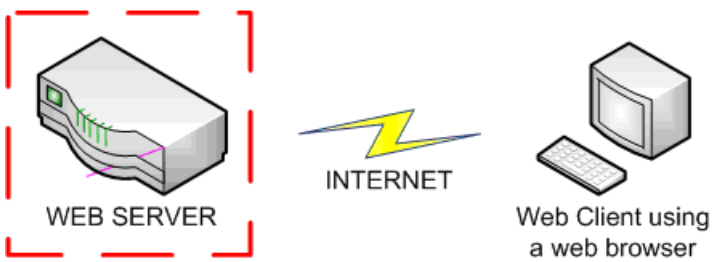


Figure 1-5. Web server implemented at MCF51CN family providing HTTP services, one client at a time

Figure 1-6. Email client connecting to an SMTP server

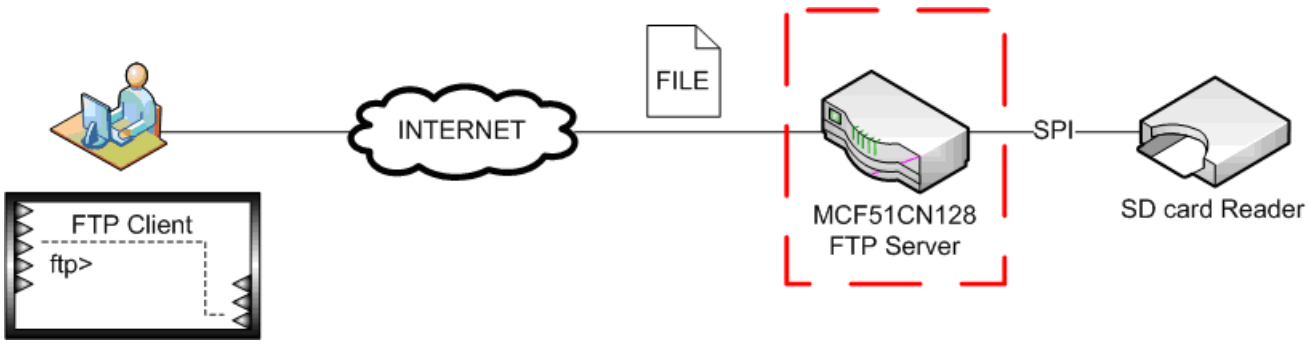


Figure 1-7. FTP server using FAT16 on an SD card

Chapter 2
Hardware Description

2.1 Hardware

The hardware design characteristics are as follows:

1. Show the small-size Ethernet application board using the MCF51CN128 MCU—This area must be programmable, functional, and completely independent. This area is called the **Minimal System** (see Section 2.4).
2. Demonstrate the Minimal System capabilities using sensors and external hardware. This area is called the **Demo System** (see Section 2.4).
3. The Minimal System must be designed in the hardware in such a way that the whole system can work independent of the Demo System. A set of zero—Resistors are provided so the Minimal System can be isolated from the Demo System.
4. Provide the user with customizable hardware—If only the Minimal System is required, layout files from the MCF51CN128 reference design can be edited. Therefore, the Minimal System can be copied to a new hardware project. Only a power source connection is required for the Minimal System.
5. To reuse the Minimal System, the same hardware components must be selected.
6. The Demo System must be able to provide all the serial interfaces for testing the VSCI, IIC, and SPI.
7. The board is able to get power from five sources. See Section 2.7.
8. The board is able to provide all serial signals available to the client through an accessible serial header.

2.2 Minimal System Features

The following is a list of main components in the Minimal system:

- Top view (see Figure 1-1):
  - MCF51CN128 —Uses a 48-pin QFN package to handle all the TCP/IP applications
  - Power LED—Turned on when the power is applied
  - Reset button—Resets the MCF51CN128 processor
  - Customized BDM for programming
  - LDO on-board—Provides regulated 3.3 V. The voltage must be between 3.7 V and 5.5 V.
  - Ethernet PHY 10/100 Mbps
  - RJ45 connector

- Bottom view (see Figure 1-2):
  - A single 25 MHz oscillator crystal—Feeds the MCF51CN128. The MCU then feeds the Ethernet PHY clock.

2.3 Demo System Features

The following is the list of the Demo system main components:

- Top view (see Figure 1-1):
  - Standard 2 × 3 BDM connector
  - Serial header—All serial signals are mapped
  - Temperature sensor by IIC
  - ADC—Using a POT
  - LED—General purpose LED
  - Power can be supplied from:
    - Power jack—5.5 V max
    - Terminal block—5.5 V max
    - Unused DB9 pin for power—5.5 V max
    - Unused Ethernet cable pairs for power—5.5 V max
    - Battery—3.3 V max
  - Accelerometer sensor using SPI

- Two buttons connected to KBI pins
- RS485 output connector
- Female DB9 output connector

- Bottom view (see Figure 1-2):
  - RS485 transceiver
  - RS232 transceiver
  - µSD card connector

2.4 Connection Between Minimal System and Demo System Features

The following figure shows how the MCF51CN128 reference design hardware is divided into a Minimal and Demo system.

A set of zero Ω resistors that connect both these systems are present and visible at the top and bottom layers on the MCF51CN128 reference design hardware. Disconnecting these registers isolate the Minimal system from the Demo system.

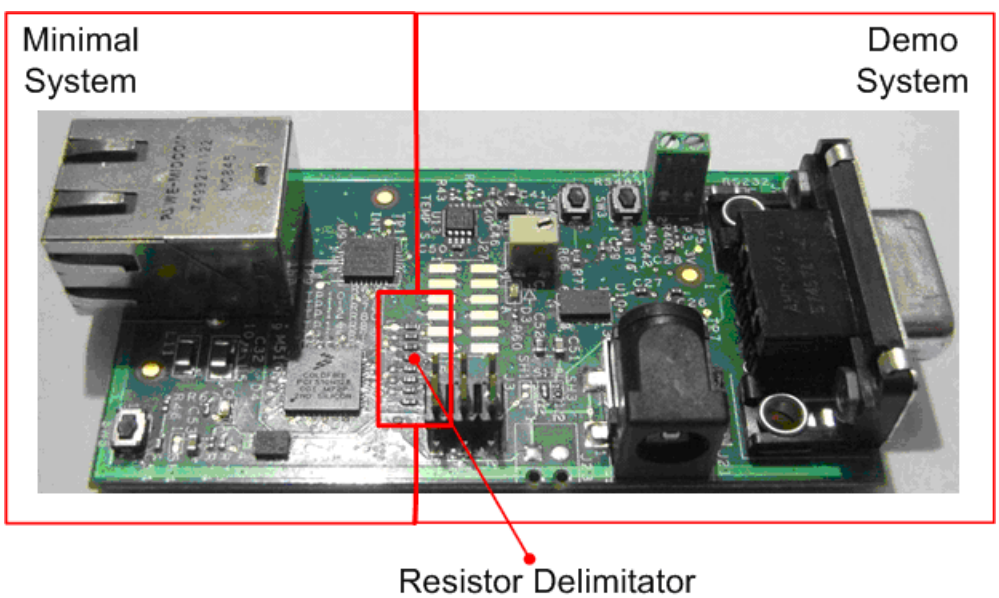


Figure 2-1. Board showing Minimal and Demo system

2.5 Hardware Block Diagram

The following block diagram shows the features of the MCF51CN128 reference design hardware. The components related to the Minimal System are shown in the color blue and the components related to the Demo System are shown in the color green.

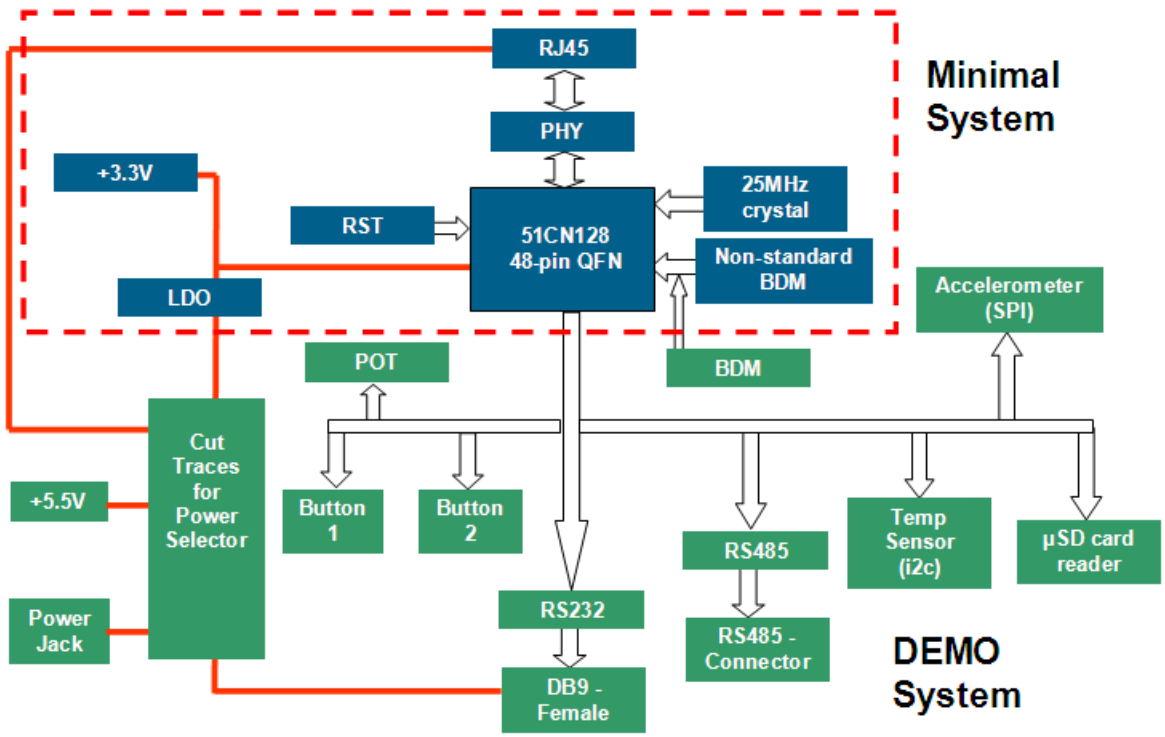


Figure 2-2. MCF51CN128 reference design hardware block diagram

The following figures show the main hardware components on the MCF51CN128 reference design hardware.

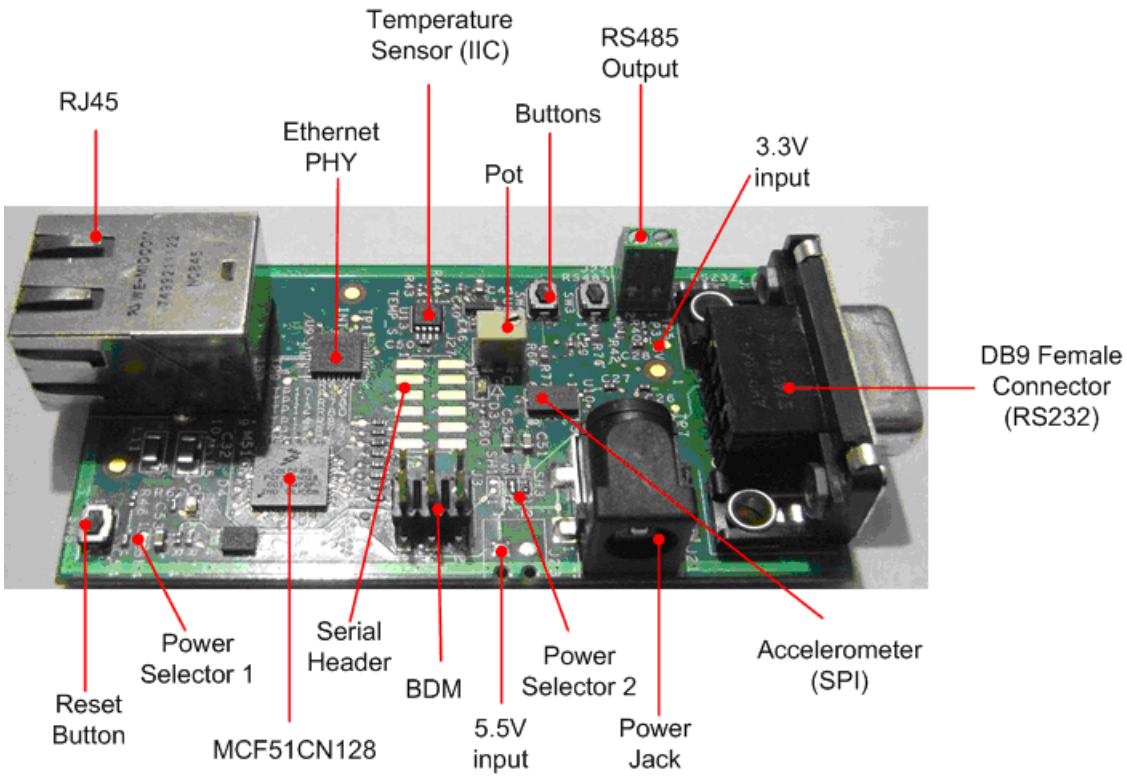


Figure 2-3. MCF51CN128 reference design top view

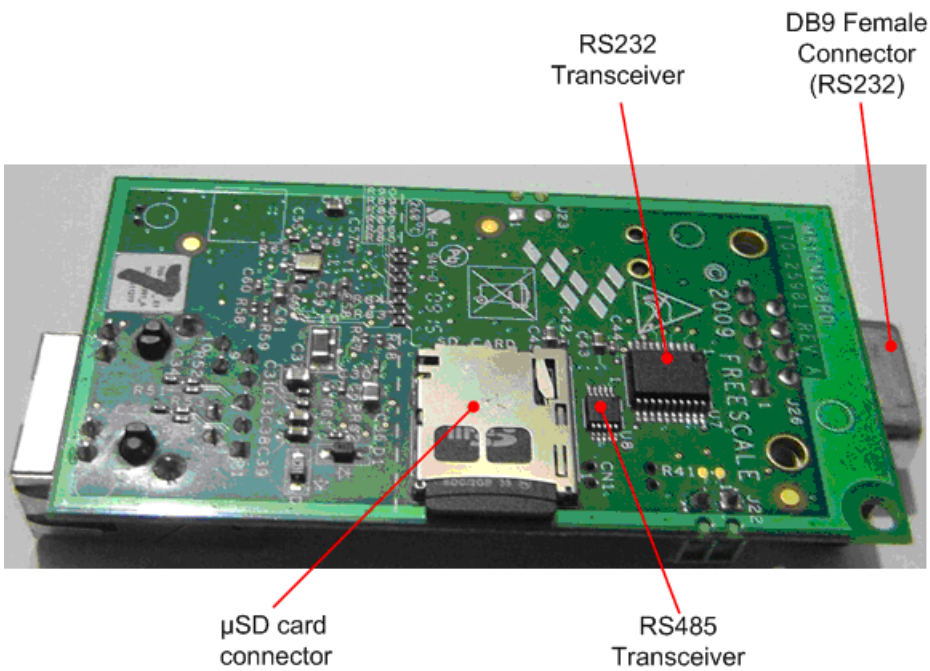


Figure 2-4. MCF51CN128 reference design bottom view

Note

The serial header is not populated in Figure 2-3.

2.6 Pinout Description

The following list shows how all the pins of the MCF51CN128 48-pin QFN are used on the hardware:

Table 2-1. MCF51CN128 reference design hardware pin assignment

	Pin	Name	Func 1	Func 2	Notes
Minimal System	1	VDD1			
	2	VSS1			
	13	VDD2			
	14	VSS2			
	25	VDD3			
	26	VDDA			
	27	VSSA			
	28	VSSA			
	37	VDD4			
	38	VSS4			
	3	PTA0	PHYCLK		
	4	PTA1	MII_MDIO		
	5	PTA2	MII_MDC		
	6	PTA3	MII_RXD3		
	7	PTA4	MII_RXD2		
	8	PTA5	MII_RXD1		
	9	PTA6	MII_RXD0		
	10	PTA7	MII_RX_DV		
	11	PTB0	MII_RX_CLK		
	12	PTB1	MII_RX_ER		
	16	PTB3	MII_TX_CLK		
	17	PTB4	MII_TX_EN		
	18	PTB5	MII_TXD0		
	19	PTB6	MII_TXD1		
	20	PTB7	MII_TXD2		
	21	PTC0	MII_TXD3		
	22	PTC1	MII_COL		
	23	PTC2	MII_CRS		
	39	PTD4	EXTAL		
	40	PTD5	XTAL		

	Pin	Name	Func 1	Func 2	Notes
Shared	24	RESET	PTC3 (RST)		
	41	BKGD	PTD6 (BKGD)		
Demo System	46	PTE3	GPIO (SELECT-OR)		Analog MUX Selector
	42	PTD7	SPSCK2 (ACC)	ADP3 (POT)	Selection by Analog MUX
	43	PTE0	MISO2 (ACC)	GPIO (SD)	
	44	PTE1	MOSI2 (ACC)		
	45	PTE2	SS2 (ACC)	GPIO (LED)	
	15	PTB2	SS1 (SD)		
	30	PTC5	GPIO (CTS)	MOSI1 (SD)	Selection by Analog MUX
	31	PTC6	SCL2 (TEMP)	MISO1 (SD)	
	32	PTC7	SDA2 (TEMP)	SPSCK1 (SD)	
	33	PTD0	TXD1 (RS232)		
	34	PTD1	RXD1 (RS232)		
	35	PTD2	TXD2 (RS485)		
	36	PTD3	RXD2 (RS485)		
	47	PTE4	KBI2P4 (SW2)		
	48	PTE5	KBI2P5 (SW1)		
	29	PTC4	GPIO (RTS)		

2.7 MCF51CN128 Reference Design Board Power Options

The following figure shows the power options for the MCF51CN128 reference design board.

The options are listed below:

- Ethernet—Brown and blue pairs take power. Brown pair (pin 4 and 5) is positive and blue pair (pin 7 and 8) is negative. The voltage drop due to the Ethernet cable length must be considered when carrying power through the RJ45 cable.

Note

This is not power over Ethernet (PoE) but a way to power-up the MCF51CN128 reference design board.

- UART—Pin 6, +5.5 V unregulated power
- Power jack connector (Default Power Source)
- Regulated 3.3 V jack connector

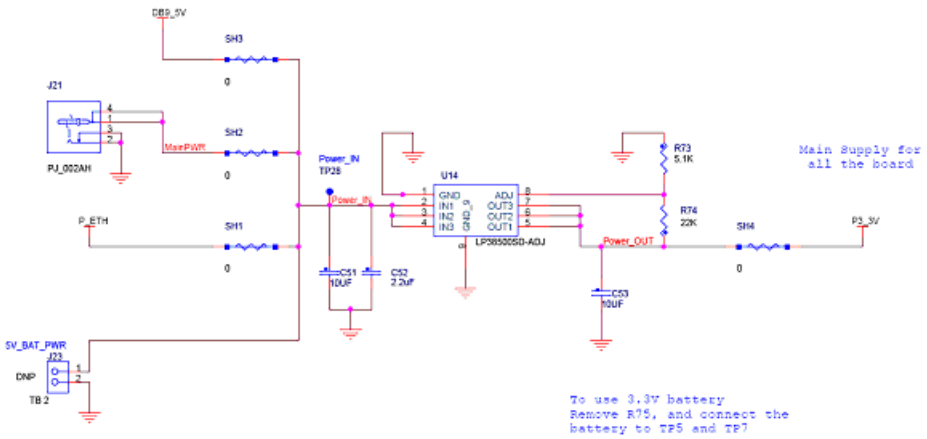


Figure 2-5. MCF51CN128 reference design board power options schematic

2.8 Hardware Considerations

The following list shows all the hardware considerations:

- Due to a reduced number of pins to all the functions required by the Demo System, an analog switch is required to switch between pin functions.
- The following list shows shared functions that must be used exclusively:
  - µSD card reader and I2C (temperature sensor)
  - rs232 hardware signals and second SPI port (accelerometer sensor)
  - Accelerometer sensor and µSD card connector while containing a µSD card.
  - General purpose LED and second SPI port (accelerometer sensor)
  - POT and second SPI port (accelerometer sensor)
- When using the Ethernet cable as the power supply, the length of the cable must be considered due to the voltage drop.

Chapter 3
Firmware Description

3.1 Firmware

The software design characteristics are as follows:

- Use a layered approach to write code so it can be migrated faster to other MCUs like the MCF5225x.
- Write code for the CodeWarrior 6.2.1 compiler.
- Use of existent software—FreeRTOS 5.3.0 as the RTOS and lwIP 1.3.0 as the TCP/IP stack.
- Serial bridge must transmit data between the UART or the SPI to Ethernet.
- UART must support—Software, hardware flow control.
- Bridge parameters must be visible and configurable using a web browser.
- All serial parameters must be configurable without recompiling the code.
- Serial parameters must be configurable through the same serial interface.
- Static and dynamic IP addresses must be available.
- Web server must be able to show files from the µSD card.
- Web server must support persistent-connections.
- Firmware must be able to send an email.
- SD card files must be able to be updated through an FTP session (FTP server).

3.2 Firmware Organization

After reset, the firmware starts in one of the following modes:

- Serial Bridge Mode

- The following services are functional:
  - The selected serial (UART or SPI) to Ethernet bridge
  - Static or dynamic IP address
  - Email client with a dynamic IP address
  - HTTP server without SD card support
  - FAT16 support

- Configuration Mode
  - The following services are functional:
    - The selected serial (UART or SPI) to Ethernet configurator configures serial parameters using predefined serial commands.
    - Static or dynamic IP address
    - Email client with dynamic IP address
    - HTTP server with SD card support
    - FTP Server with SD card support

NOTE

The SD does not work if the SPI configurator is selected.

    - FAT16 support

NOTE

The only difference between the serial bridge and configuration mode is the serial function (bridge or configuration) and the FTP server feature.

Configuration and reset can be requested at any time using a web page.

3.3 Block Diagram

The following figure shows how software is divided into functional pieces and joined together to have a functional reference design software.

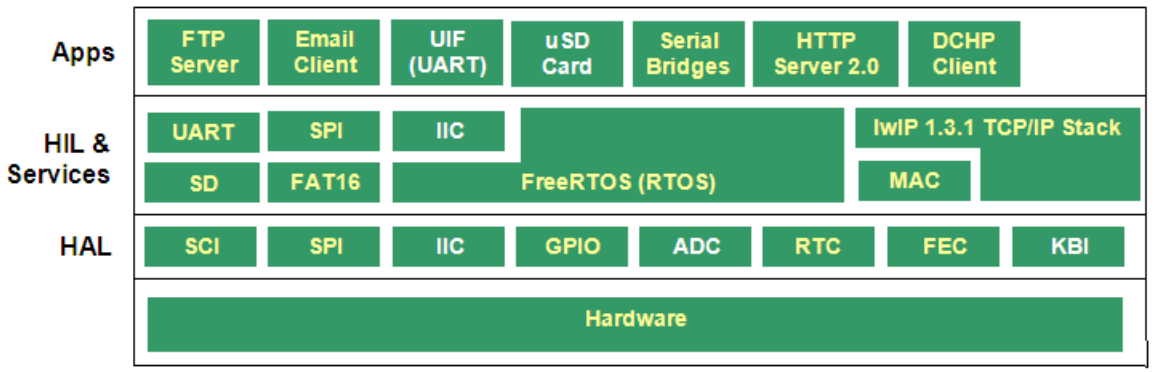


Figure 3-1. MCF51CN128 reference design software

3.4 System Startup

The following table shows all the default parameters after reset. The full table is implemented in file constants.c.

Table 3-1. Default firmware parameters

Ethernet Options	
MAC Address	00:CF:52:35:00:07
IP Address	192.168.1.3
Subnet Mask IP Address	255.255.255.0
Gateway IP Address	192.168.1.1
Server IP Address	192.168.1.81
DHCP	OFF
Serial Bridge Options	
Mode	Configuration Mode
Serial Interface	UART Bridge
Server/Client	Server
Port	1234
UART Options	
UART Port	SCI2
Baudrate	19200
Parity	No Parity
Number of Bits	8 Bits
Stop Bit	1 Stop Bit
Flow Control	Software
SPI Options	
SPI Port	SPI2

Baudrate	1Mbps
Idleness	Idle High
Sample	Middle Sample
Master/Slave	SPI Master
Interrupt/Polling	Polling
Email Options	
Username	lasko.coldfire@yahoo.com
Password	Freescale123
STMP Server	smtp113.plus.mail.mud.yahoo.com
Authentication	YES

3.5 Internal Functionality of Socket Layer

The following figure shows the socket flow from the server and client perspective.

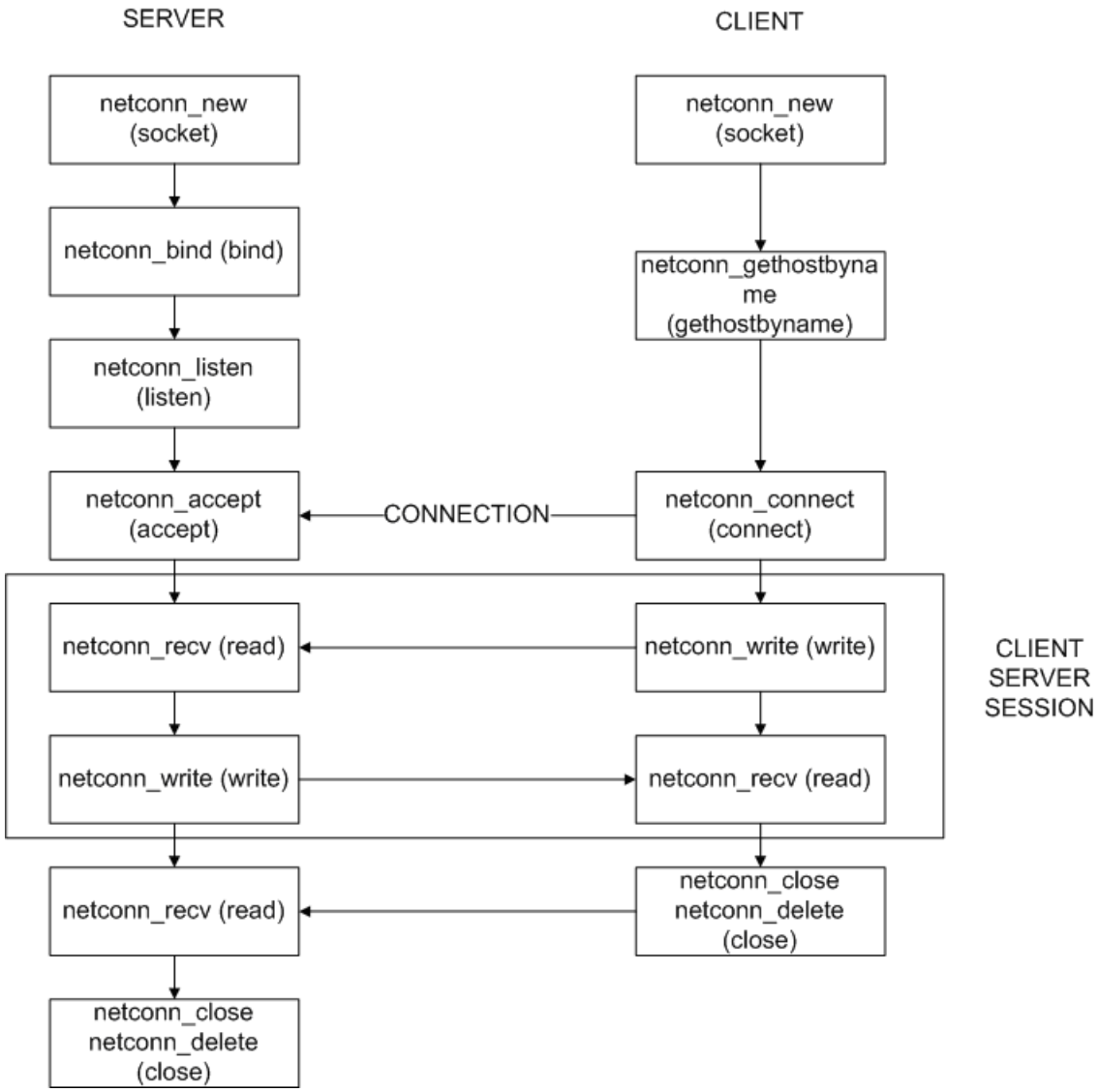


Figure 3-2. Socket flow diagram

Chapter 4
System Setup

4.1 Getting Started

This section describes the using the software and hardware to demonstrate the use of this reference design

4.2 Install Software

This is the process to download firmware to hardware:

- Connect the BDM Multilink or BDM Cyclone PRO to the MCF51CN128 reference design hardware.
- Download software using CodeWarrior 6.2.1v compiler.
- Disconnect the BDM Multilink or BDM Cyclone PRO from the programmed target.

Before downloading the firmware to the MCF51CN128 reference design hardware, the M51CN128RD C-macro must be selected. The file name is m51cn128evb.h.

```
/*****************************************************************************/

/*Warning: only define one of them*/
#define M51CN128RD            /*pins moved to reference design hardware*/
//#define V1_TOWER              /*pins moved to reference design hardware*/
```

Figure 4-1. Selection of the MCF51CN128 reference design hardware

4.3 Hardware Setup

For hardware setup, perform the following steps:

1. The power supply must be between 3.7 and 5.5 V because of regulator limits. To select a different power source, go to .
2. The red LED near the RJ45 connector must be turned on as soon as the power is applied.

4.3.1 HTTP Server Functionality

After running the sample program, the browser must show the following:

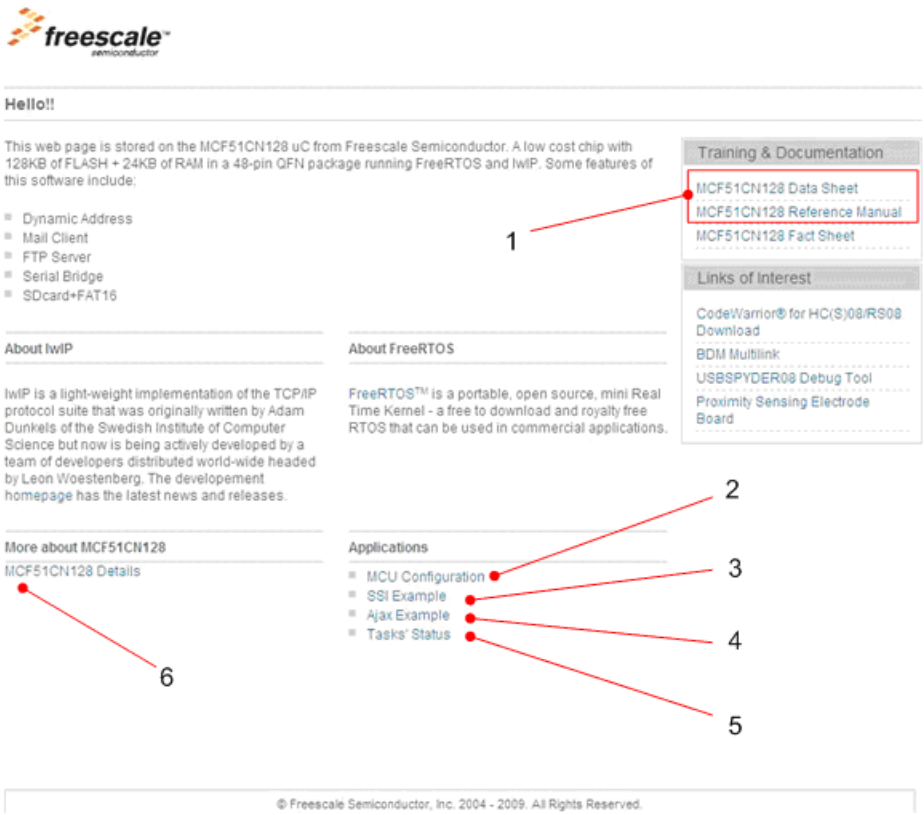


Figure 4-2. Default web page

1. Links to reference manual and data sheets. A connection to the Internet is required.
2. MCU Configuration page
3. SSI Example page
4. AJAX Example page
5. Tasks' Status Example page
6. MCU features

From this default web page, the following pages are available:

If the MCU Configuration link is clicked, or config.shtml is requested from the browser, the following web page shows the parameters that can be changed.

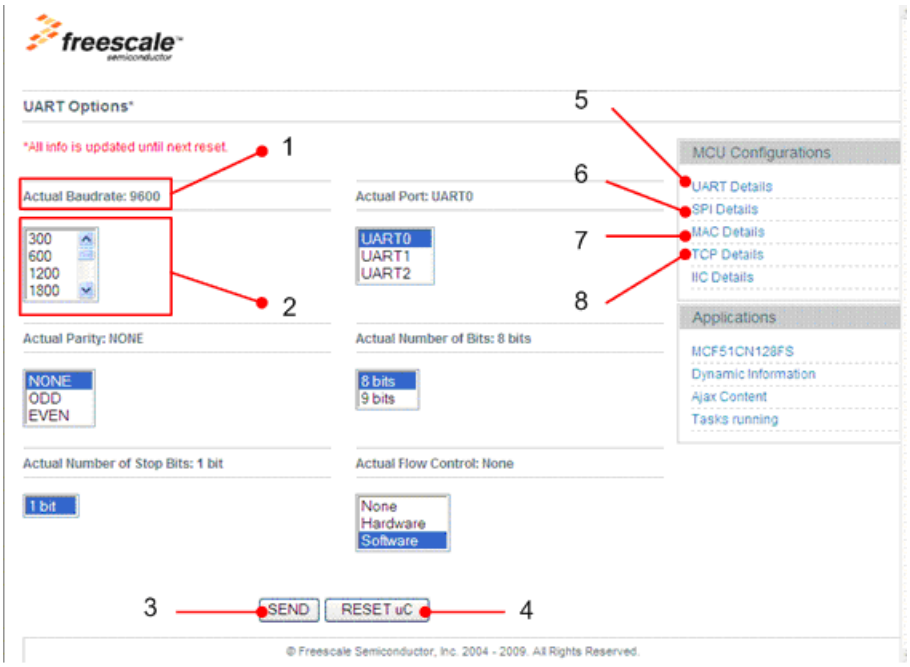


Figure 4-3. Configuration page

1. Actual settings
2. Options to select
3. Send new configuration to the MCU
4. Reset MCU
5. UART configuration
6. SPI configuration
7. MAC configuration
8. TCP configuration

Another application that is available in the web server is an AJAX example. The following figure shows what is shown in the browser when ajax.htm is entered. The application increments only the 8-bit counters and shows them graphically.

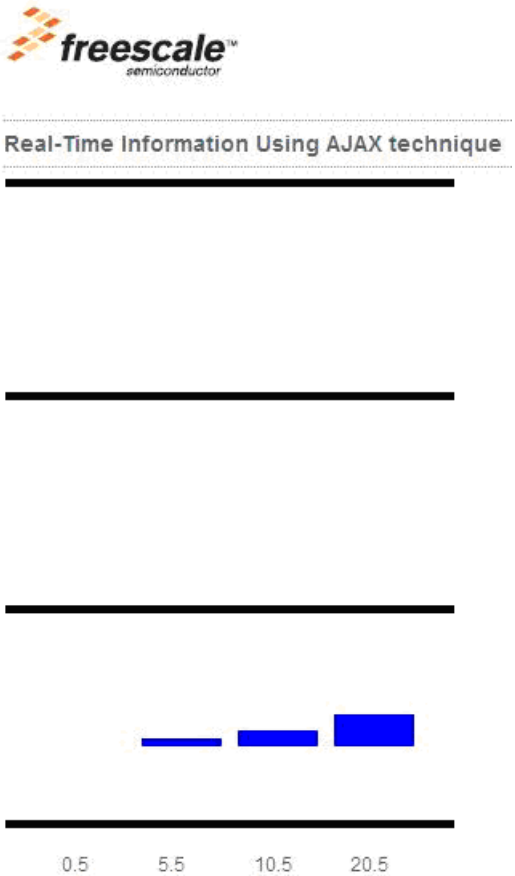


Figure 4-4. An AJAX web page dynamically updated at background

The RTOS tasks' status are displayed showing valuable information like:

- Task name
- Task state
- Amount of stack available for the task, measured in longwords

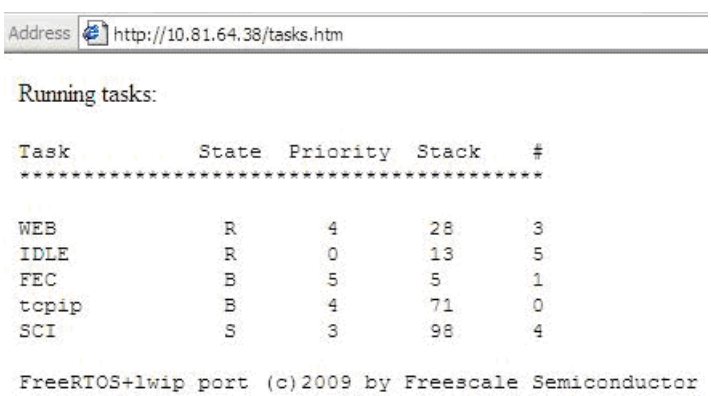


Figure 4-5. Tasks' status on the MCF51CN128

4.3.2 Email Client Functionality

As soon as the firmware gets a valid IP address using DHCP, an email is sent. Email receipt, subject, and content are defined at file dhcp_app.c. Email origin, password, authentication flag, and SMTP server are defined at file constants.c.

The following figure shows a received email sent by the system.

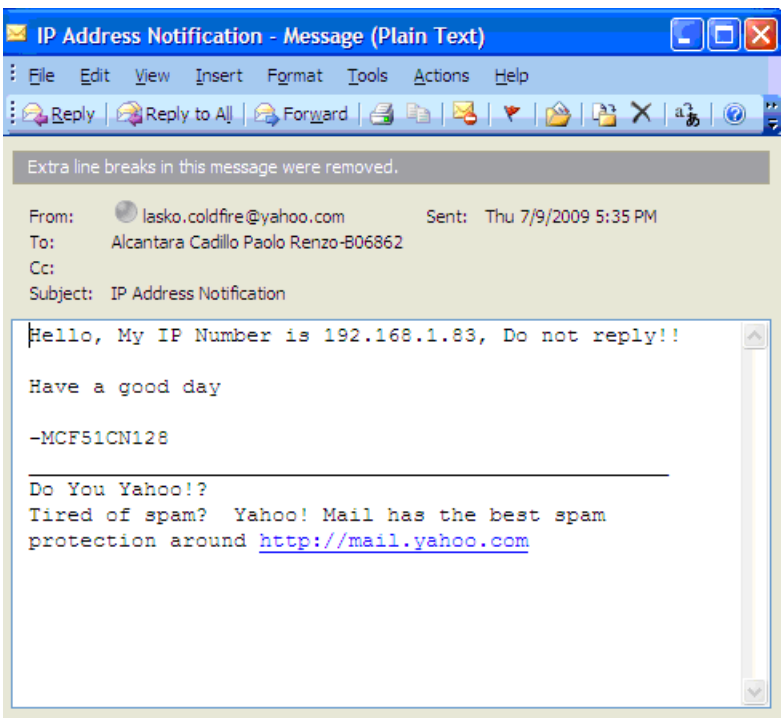


Figure 4-6. Email sent by the MCF51CN128 reference design

The following email client implementation does not deal with encryption. Almost all the actual SMTP servers use secure socket layer (SSL) to correctly sign-in and exchange information over a secure communication protocol. Popular email service providers like Hotmail, Yahoo, or Google accept SSL. File attachments to emails need to be considered in the future.

At the time of testing this software, the following SMTP server is the only one that accepts regular requests without SSL:

smtp113.plus.mail.mud.yahoo.com

The username and password used with the Yahoo email account are stored at constants.c and might not be valid during testing.

4.3.3 FTP Server Functionality

The MCF51CN128 reference design is able to start an FTP server if the following conditions are met:

- Configuration mode is running, not using SPI interface
- A valid µSD card is connected with a valid FAT16 file system

The following table shows the list of interpreted commands implemented when using Microsoft Windows command-line FTP client. They are interpreted because one or more FTP commands are required to run the interpreted command. For example, LS will require PORT and NLST to work.

Table 4-1. Microsoft Windows command-line FTP client implemented commands

FTP client	Description
LS	Displays files
GET [filename]	Copy a file from FTP server to FTP client
PUT [filename]	Copy a file from FTP client to FTP server
DELETE [filename]	Delete a file from FTP server
QUIT	Ends FTP session
HELP	Shows description of FTP commands

The following figure shows an established FTP client session to the FTP server application. A username and password are required to view the files. Later on, the files can be:

- Listed
- Uploaded
- Downloaded
- Deleted

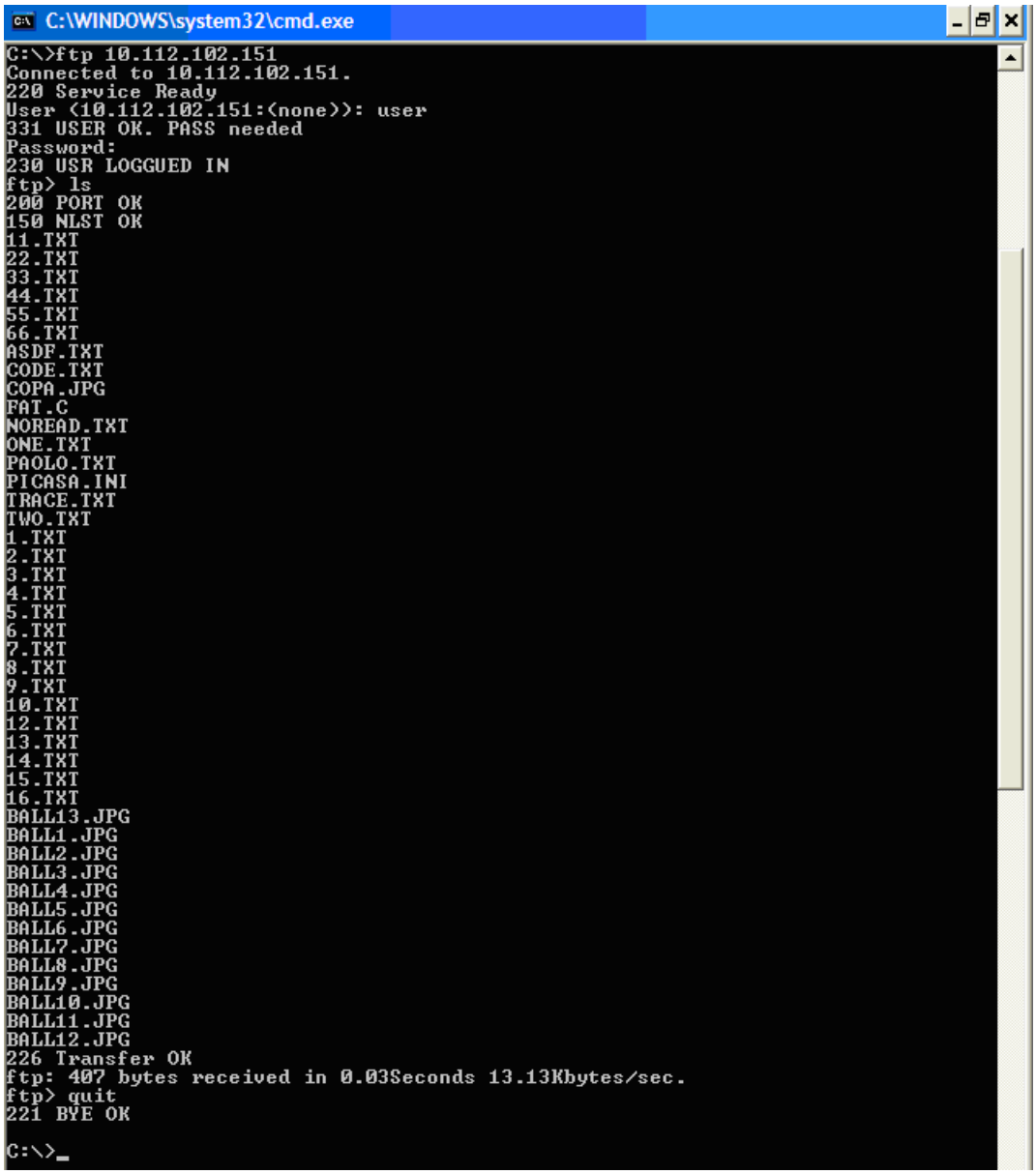


Figure 4-7. Microsoft Windows command-line FTP client with the MCF51CN128

For this implementation the following information is required to log in:

Username: user

Password: Freescale123

FTP server implementation has the following limitations:

- Only allows one client and one transfer at a time.
- FTP server was tested using only Microsoft Windows command-line FTP client.

- If an unimplemented command is received, the FTP client is notified and the FTP session is closed.

For the FAT16 implementation, there are two limitations:

- The name of the file must be up to eight characters and the extension must be up to three characters.
- Current implementation does not work with directories.

4.3.4 Serial Bridge Functionality

The Serial Bridge can work in two modes:

- Configuration mode—Serial interface (UART or SPI) is used to configure the serial bridge. This is the default mode.
- Bridge mode—Characters received at serial interface, are sent to Ethernet and vice verse.

The Ethernet side can be tested using HyperTerminal with the following information:

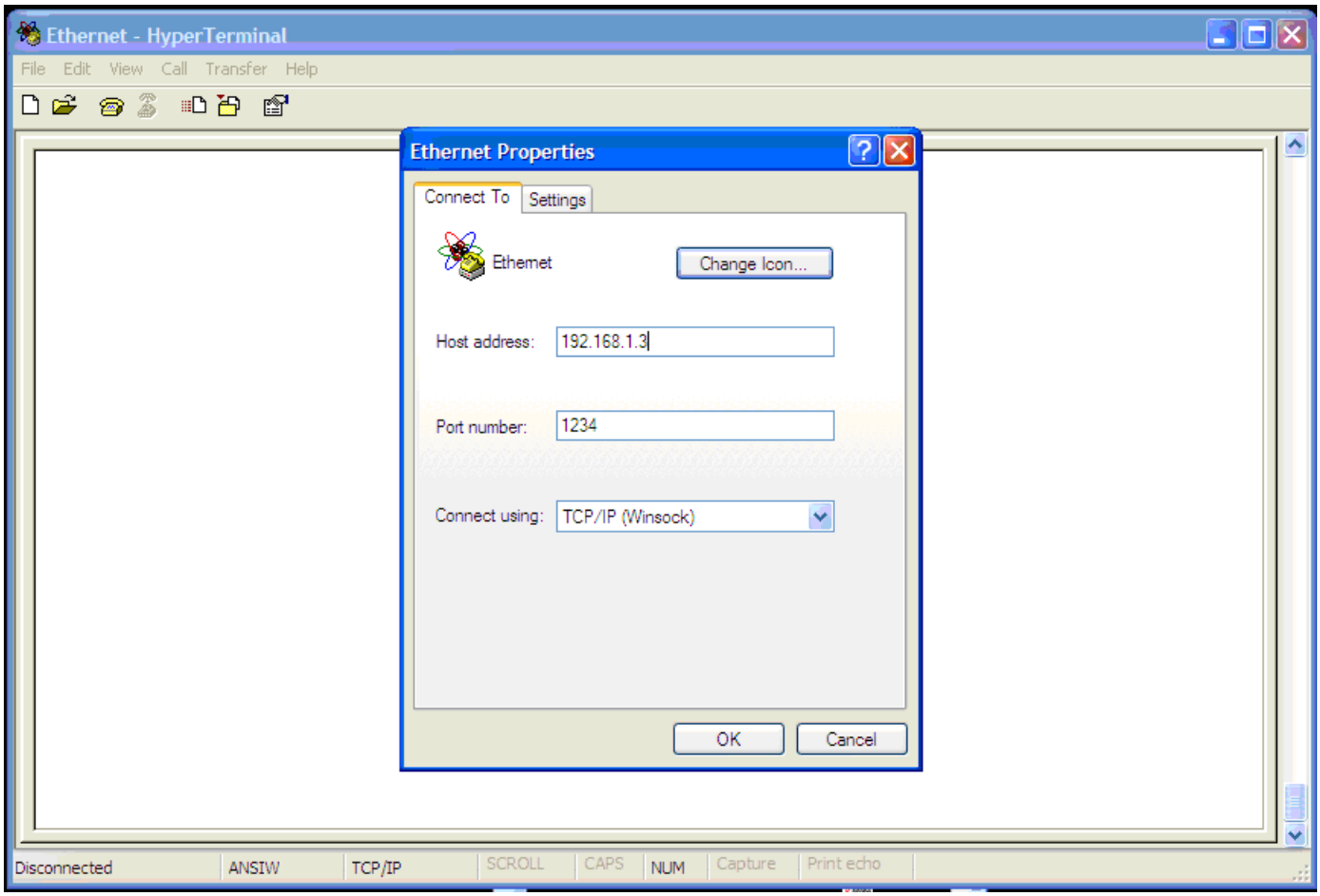


Figure 4-8. Microsoft HyperTerminal settings to test serial bridge

The UART can be tested using a standard serial terminal like HyperTerminal. In this example, the HyperTerminal using TCP/IP (Winsock) works as a TCP client and the firmware as a TCP server. The client must then specify the server's address to get a connection.

For details about default UART or SPI settings, go to Section 4.4 To configure the serial interface, go to Section 4.5

4.4 Principle of Operation

The Serial Bridge works in Configuration and Bridge modes. The Web server interface works at all time, but the serial configuration (UART or SPI) only works in the configuration mode.

The Serial Bridge starts with the following configuration:

Table 4-2. Reference design default parameters

MAC Parameters

MAC Address	00:CF:52:35:00:01
IP Address	192.168.1.3 for static implementation
Mask Address	255.255.255.0
Gateway Address	192.168.1.1
Server Address to Connect to an Address	192.168.1.3
Static or Dynamic Address	Static
TCP Parameters	
TCP Port to Connect to	1234
Client or server implementation	192.168.1.3
Configuration or bridge Implementation	Configuration
UART Parameters	
Port	First Port
Baudrate	19200
Parity	NONE
Number of bits	8
Number of Stop bits	1
Flow Control	SW Flow Control
SPI Parameters	
Port	Second Port
Baudrate	1 Mbps
Polarity	Low
Phase	Middle
Master or Slave	Master
Polling or Interrupt Handling	Polling

4.5 Serial Configuration Commands

In configuration mode, the serial configuration task is enabled. The purpose of this task is to configure all the serial parameters stated in Section1.2 Key Features . Default settings are stated in Table 4-2. The configuration is made through a set of commands that are sent using the UART or SPI interface. These commands are sent from the data terminal equipment (DTE), like a PC to the MCF51CN128 reference design hardware.

Table 4-3, Table 4-4, and Table 4-5 list all available commands. For example, if the board_get_uart_port command is requested, the serial interface must send the packet as shown in Figure 4-9.

For the GET commands, three characters are needed to identify the command. If it is not a valid command, then a single zero byte is returned as an answer. For a valid command, the number of returned characters is equal to:

1 byte for ACK + Number of bytes stated at 2nd byte of requested command.

Table 4-3. Get commands to get bridge parameters

GET Commands			
Command Name	**1st Character—Command ID**	**2nd Character—Number of Parameters**	**3rd Character—SubCommand ID**
board_get_eth_dhcp_auto	0x50	1	0
board_get_bridge_configuration	0x50	1	1
board_get_bridge_tcp_mode	0x50	1	2
board_get_bridge_tcp_server	0x50	1	3
board_get_uart_port	0x50	1	4
board_get_uart_parity	0x50	1	5
board_get_uart_number_of_bits	0x50	1	6
board_get_uart_stop_bits	0x50	1	7
board_get_uart_flow_control	0x50	1	8
board_get_spi_port	0x50	1	9
board_get_spi_polarity	0x50	1	10
board_get_spi_phase	0x50	1	11
board_get_spi_master	0x50	1	12
board_get_spi_interrupt	0x50	1	13
board_get_email_authentication_required	0x50	1	14
board_get_bridge_tcp_port	0x50	2	0
board_get_spi_baud	0x50	2	1
board_get_eth_ip_add	0x50	4	0
board_get_eth_netmask	0x50	4	1
board_get_eth_gateway	0x50	4	2
board_get_eth_server_add	0x50	4	3
board_get_uart_baud	0x50	4	4
board_get_eth_ethaddr	0x50	6	0
board_get_email_username	0x50	6	1
board_get_email_password	0x50	6	2
board_get_email_smtp_server	0x50	6	3

Note

Get functions return the same number of characters of the "Number of Parameters."

For the SET commands, the following number of bytes is required for each command:

3 bytes for all SET commands + Number of bytes stated at 2nd byte of requested command

For a valid command, one is returned, otherwise zero is returned.

Table 4-4. Set commands to change bridge parameters

SET Commands			
Command Name	**1st Character— Command ID**	**2nd Character—Number of Parameters**	**3rd Character—SubCommand ID**
board_set_eth_dhcp_auto	0xA0	1	0
board_set_bridge_configuration	0xA0	1	1
board_set_bridge_tcp_mode	0xA0	1	2
board_set_bridge_tcp_server	0xA0	1	3
board_set_uart_port	0xA0	1	4
board_set_uart_parity	0xA0	1	5
board_set_uart_number_of_bits	0xA0	1	6
board_set_uart_stop_bits	0xA0	1	7
board_set_uart_flow_control	0xA0	1	8
board_set_spi_port	0xA0	1	9
board_set_spi_polarity	0xA0	1	10
board_set_spi_phase	0xA0	1	11
board_set_spi_master	0xA0	1	12
board_set_spi_interrupt	0xA0	1	13
board_set_email_authentication_required	0xA0	1	14
board_set_bridge_tcp_port	0xA0	2	0
board_set_spi_baud	0xA0	2	1
board_set_eth_ip_add	0xA0	4	0
board_set_eth_netmask	0xA0	4	1
board_set_eth_gateway	0xA0	4	2
board_set_eth_server_add	0xA0	4	3
board_set_uart_baud	0xA0	4	4
board_set_eth_ethaddr	0xA0	6	0
board_set_email_username	0xA0	6	1

SET Commands			
Command Name	**1st Character— Command ID**	**2nd Character—Number of Parameters**	**3rd Character—SubCommand ID**
board_set_email_password	0xA0	6	2
board_set_email_smtp_server	0xA0	6	3

Note

Set functions will return zero if the command was correctly executed. If any other number is returned, the command has failed.

Reset command is a single character command, as shown in the following table.

Table 4-5. Get commands to change bridge parameters

RST Command	
Command Name	**1st Character**
Reset the Board	0x88

Note

Reset function returns zero if it was correctly received.

For example, to ask for the serial's port configuration, the following sequence must be sent:

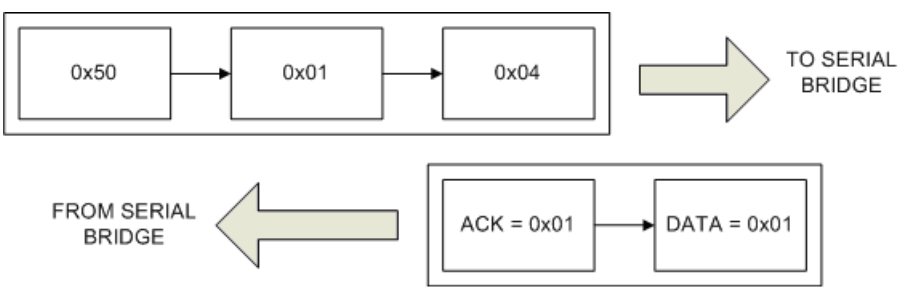


Figure 4-9. Packet visual explanation

The answer from the bridge means it correctly received the command, and the UART port configuration is located at port number 1.

All settings are reloaded as soon as the reset command is requested.

4.6 Support

For any questions regarding this reference design, submit a service request using www.freescale.com/support.

Appendix A

A.1 Additional Files

The following files are included with this reference design in a zip file called DRM114.zip.

- CodeWarrior project containing the firmware—[DRM114SW.zip]
- Bill of materials (BOM)—[BOM-25981_A.xls]
- PDF schematic files—[SPF-25981_A.pdf]
- Hardware source files—[SCH-25981_A.zip]
- Hardware layout file—[LAY-25981_A.zip]
- Gerber files—[GRB-25981_A.zip]

These files are provided free of charge to Freescale users.

Appendix B

B.1 Bill of Materials (BOM)

Item	Subclass Mfr. Name	Number Mfr. Part Number	Description Preferred Status	Qty	Reference
1	CADPart	150-75182	CAP CER 0.1UF 16V 10% X7R 0402	25	C24-C35,C40,C42,C44,C46,C47,C50,C54,C55, C57-C60,C62
	CAL-CHIP	GMC04X7R104K16NT-LF	Alternate		
	KEMET	C0402C104K4RAC	Alternate		
	MURATA	GRM155R71C104KA88D	Alternate		
	PANASONIC	ECJ0EX1C104K	Preferred		
	SKYMOS	CC0402B104K160NT	Alternate		
	TDK	C1005X7R1C104KT	Alternate		
	VENKEL COMPANY	C0402X7R160-104KNE	Alternate		
	VENKEL COMPANY	C0402X7R160-104KNP	Alternate		
	VENKEL COMPANY	C0402X7R160-104KSNE	Alternate		
	WALSIN TECHNOLOGY CORP.	0402B104K160CT	Alternate		
2	CADPart	150-75469	CAP CER 10UF 6.3V 20% X5R 0603	9	C38,C39,C41,C43,C45,C51,C53,C56,C61
	MURATA	GRM188R60J106ME47D	Alternate		
	PANASONIC	ECJ1VB0J106M	Preferred		
	TDK	C1608X5R0J106M	Alternate		
	VENKEL COMPANY	C0603X5R6R3-106MNE	Alternate		
3	CADPart	150-75680	CAP CER 12PF 50V 5% C0G 0402	2	C48,C49
	MURATA	GRM1555C1H120JZ01D	Preferred		
	TDK	C1005C0G1H120J	Alternate		
4	CADPart	150-76330	CAP CER 2.2UF 6.3V 10% X5R 0603	1	C52
	KEMET	C0603C225K9PAC	Alternate		

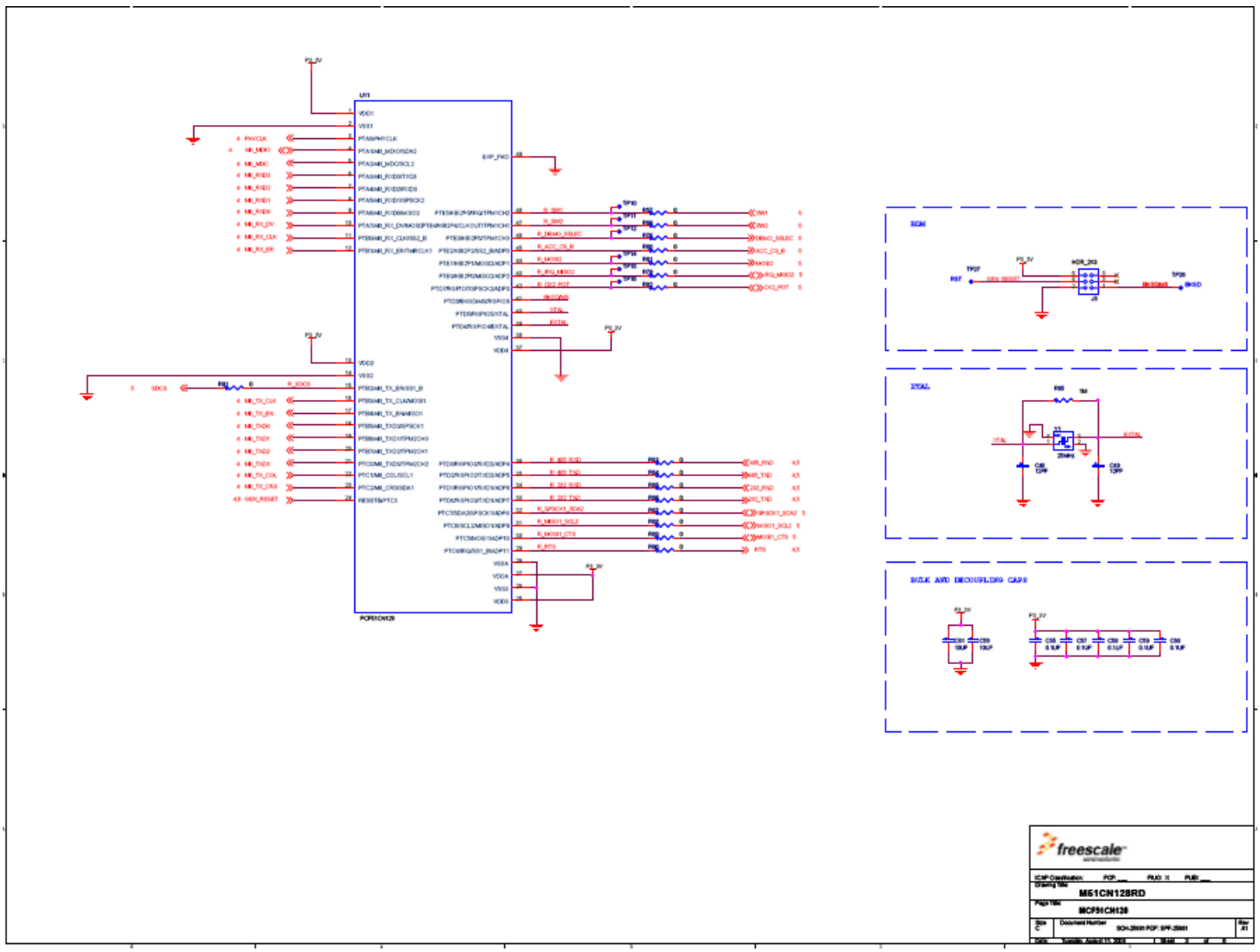
	MURATA	GRM188R60J225KE19D	Alternate		
	PANASONIC	ECJ1VB0J225K	Preferred		
5	CADPart	150-77793	CAP CER 22UF 10V 20% X5R 0805	2	C36,C37
	TAIYO YUDEN	LMK212BJ226MG-T	Preferred		
6	CADPart	180-75073	IND FER BEAD, 68OHM@100MHZ, 3A, 25%, IND_1206, ROHS COMPLIANT	2	L9,L11
	PANASONIC	EXCML32A680U	Preferred		
7	CADPart	180-77336	IND FER BEAD 390 OHM@100MHZ 2A 25% 1206	2	L5,L10
	MURATA	BLM31PG391SN1L	Preferred		
8	CADPart	210-30025	CON 9 DB 0.318 SKT RA SHLD TH 54MIL SP 494H AU	1	J26
	FRAMATOME CONNECTORS INTERNATIONAL	D09S33E4GX00LF	Alternate		
	FRAMATOME CONNECTORS INTERNATIONAL	ID09S33E4GV00LF	Alternate		
	TYCO ELECTRONICS	5747844-5	Alternate		
	TYCO ELECTRONICS	5747844-6	Preferred		
	TYCO ELECTRONICS	5788797-2	Alternate		
9	CADPart	210-30106	CON 1 JACK PWR RA SMT -- NI	1	J21
	CUI STACK	PJ-002AH-SMT	Preferred		
10	CADPart	210-78342	CON 1X2 TB TH 2.54MM SP 335H -- 138L	1	J22
	PHOENIX CONTACT	1725656	Preferred		
11	CADPart	210-79464	CON 13 RJ-45 SHLD RA TH G-Y LEDS 50MIL SP 541H SN 135L	1	P1
	WURTH ELEKTRONIK EISOS GMBH & CO. KG	7499211122	Preferred		
12	CADPart	211-75026-00	HDR 2X3 SMT 100MIL CTR 380H AU	1	J3
	Pinrex Enterprise Co., Ltd	212-92-03 SBEL	Alternate		
	SAMTEC	TSM-103-01-S-DV-P-TR	Preferred		
13	CADPart	211-77244	HDR 2X6 SMT 2.0MM CTR 193H AU	1	J27
	FRAMATOME CONNECTORS INTERNATIONAL	57202-F51-06ALF	Preferred		
14	CADPart	211-77584	CON 8 SD CARD PUSH-PUSH SMT 1.1MM SP 77H AU	1	CN1
	MOLEX	502570-0893	Preferred		
15	CADPart	230-76732	XTAL 25MHZ FIXED -- SMT	1	Y1
	TXC CORP	8Z 25.000	Preferred		
16	CADPart	312-75425	IC THERMOMETER THERMOSTAT DIGITAL 2.7-5.5V UMAX8	1	U13
	MAXIM	DS75U+	Preferred		
17	CADPart	312-75592	IC XCVR RS232 3-5.5V SSOP20 - ROHS COMPLIANT	1	U7
	INTERSIL	ICL3225ECAZ	Preferred		
18	CADPart	312-77977	IC ACCELERATION SENSOR 3-AXIS DIGITAL 2/4/8G 2.4-3.6V LGA14	1	U10
	FREESCALE SEMICONDUCTOR	MMA7455L	Preferred		
19	CADPart	312-78678	IC XCVR RS485/RS422 TX/RX 20MBPS 3.0-5.5V MSOP10	1	U8
	INTERSIL	ISL3176EIUZ	Preferred		
20	CADPart	312-79518	IC XCVR 10/100M EPHY IEEE 802.3u 3.3V QFN32	1	U9
	MICREL	KSZ8041NL	Preferred		
21	CADPart	315-78801	IC LIN VREG LDO FlexCap ADJ 0.6-5V 1.5A 2.7-5.5V LLP8	1	U14
	NATIONAL SEMICONDUCTOR	LP38500SD-ADJ/NOPB	Preferred		
22	CADPart	315-78804	IC LIN SW DUAL SPDT 1.65-5.5V DFN12	1	U12
	ON SEMICONDUCTOR	NLAS3158MNR2G	Preferred		
23	CADPart	344-01039	IC MCU COLDFIRE 32BIT 128K FLASH 24K RAM 1.8-3.6V QFN48	1	U11
	FREESCALE SEMICONDUCTOR	PCF51CN128CGT	Preferred		
24	CADPart	370-76427	LED RED SGL 30MA 0603	2	D3,D4
	LUMEX	SML-LXFM0603SIC-TR	Preferred		
25	CADPart	470-30000	RES MF 1.0M 1/16W 1% 0402	1	R65

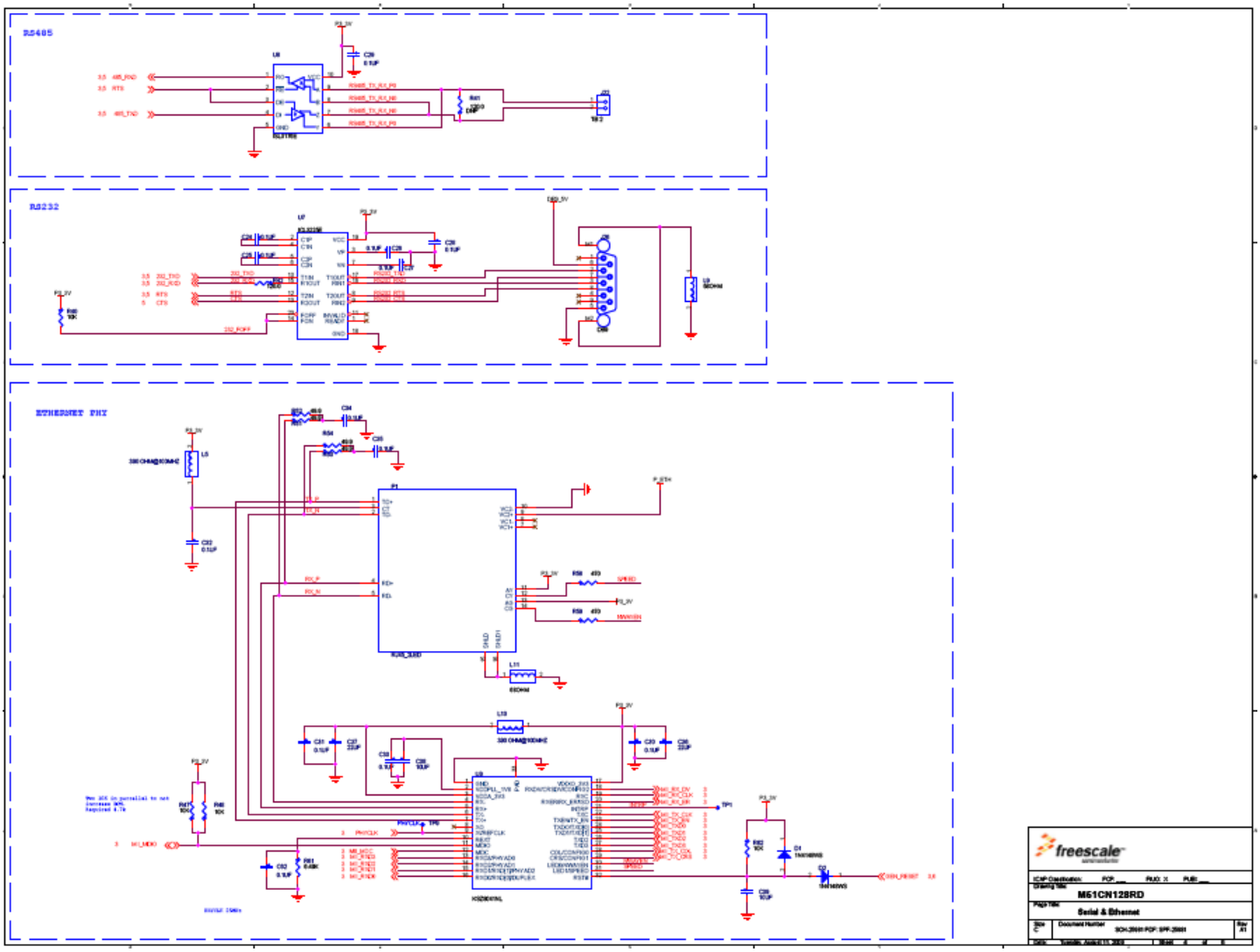
BOURNS	CR0402FX1004GLF	Alternate		
KOA SPEER	RK73H1ETTP1004F	Preferred		
26 CADPart	470-30914	RES MF 5.1K 1/16W 1% 0402	1	R73
KOA SPEER	RK73H1ETTP5101F	Preferred		
27 CADPart	470-30927	RES MF 6.49K 1/16W 1% 0402	1	R61
KOA SPEER	RK73H1ETTP6491F	Preferred		
28 CADPart	470-75360	RES MF 49.9 OHM 1/16W 1% 0402	4	R51-R54
BOURNS	CR0402-FX-49R9GLF	Alternate		
KOA SPEER	RK73H1ETTP49R9F	Preferred		
THYE MING TECH CO LTD	CR02FL6-49R9	Alternate		
VENKEL COMPANY	CR040216W49R9FT	Alternate		
VISHAY INTERTECHNOLOGY	CRCW040249R9FKEB	Alternate		
29 CADPart	470-75394	RES MF ZERO OHM 1/16W 5% 0402	16	R57,R69,R78-R91
BOURNS	CR0402-J/-000GLF	Alternate		
KOA SPEER	RK73Z1ETTP	Alternate		
PANASONIC	ERJ2GE0R00X	Alternate		
ROHM	MCR01MZPJ000	Preferred		
SEI ELECTRONICS INC	RMCF1/16S0.005%R	Alternate		
SKYMOS	RC-0402-0000T	Alternate		
SMEC	RC73JP2ZF	Alternate		
THYE MING TECH CO LTD	CR-02JL6----0R	Alternate		
VENKEL COMPANY	CR0402-16W-000T	Alternate		
VISHAY INTERTECHNOLOGY	CRCW04020000Z0ED	Alternate		
YAGEO AMERICA	RC0402JR-070RL	Alternate		
30 CADPart	470-75557	RES MF 10K 1/16W 5% 0402	7	R40,R43,R44,R46-R48,R62
BOURNS	CR0402-JW-103GLF	Alternate		
KOA SPEER	RK73B1ETTP103J	Alternate		
PANASONIC	ERJ-2GEJ103X	Alternate		
SEI ELECTRONICS INC	RMCF1/16S10K5%R	Alternate		
SMEC	RC73L2Z103JTF	Alternate		
VENKEL COMPANY	CR0402-16W-103JT	Alternate		
VISHAY INTERTECHNOLOGY	CRCW040210K0JNEC	Alternate		
VISHAY INTERTECHNOLOGY	CRCW040210K0JNED	Preferred		
YAGEO AMERICA	RC0402JR-0710KL	Alternate		
31 CADPart	470-75609	RES MF 22K 1/16W 5% 0402	1	R74
BOURNS	CR0402-JW-223GLF	Alternate		
KOA SPEER	RK73B1ETTP223J	Alternate		
PANASONIC	ERJ2GEJ223X	Alternate		
SMEC	RC73L2Z223JTF	Preferred		
VENKEL COMPANY	CR040216W223JT	Alternate		
VISHAY INTERTECHNOLOGY	CRCW040222K0JNEA	Alternate		
YAGEO AMERICA	RC0402JR-0722KL	Alternate		
32 CADPart	470-76449	ZERO OHM CUT TRACE 0402 PADS; NO PART TO ORDER	4	SH1-SH4
33 CADPart	470-76469	RES MF 470 OHM 1/16W 1% 0402	4	R58-R60,R67
THYE MING TECH CO LTD	CR-02FL6--470R	Preferred		
VISHAY INTERTECHNOLOGY	CRCW0402470RFKED	Alternate		
34 CADPart	470-77907	RES MF 120 OHM 1/10W 1% 0603	3	R42,R76,R77
KOA SPEER	RK73H1JTTD1200F	Preferred		
YAGEO AMERICA	RC0603FR-07120RL	Alternate		
35 CADPart	470-78639	RES POT 11 TURN 10K 1/4W 10% SMT	1	R66
BOURNS	3224W-1-103E	Preferred		
36 CADPart	480-75133	DIODE SW 150MA 53V SOD-323	2	D1,D2
DIODES INC	1N4148WS-7-F	Preferred		
37 CADPart	510-75219	TEST PAD 35 MIL ROUND SMT; NO PART TO ORDER	16	TP1,TP4-TP7,TP9-TP12,TP14-TP16,TP26-TP29
38 CADPart	510-76958	SW SPST MOM NO TACT 12V 50MA SMT	3	SW3-SW5
E SWITCH	TL1015BF160QG	Preferred		
39 CADPart	210-78342	CON 1X2 TB TH 2.54MM SP 335H --138L	0	J23
PHOENIX CONTACT	1725656	Preferred		
40 CADPart	470-77907	RES MF 120 OHM 1/10W 1% 0603	0	R41
KOA SPEER	RK73H1JTTD1200F	Preferred		
YAGEO AMERICA	RC0603FR-07120RL	Alternate		

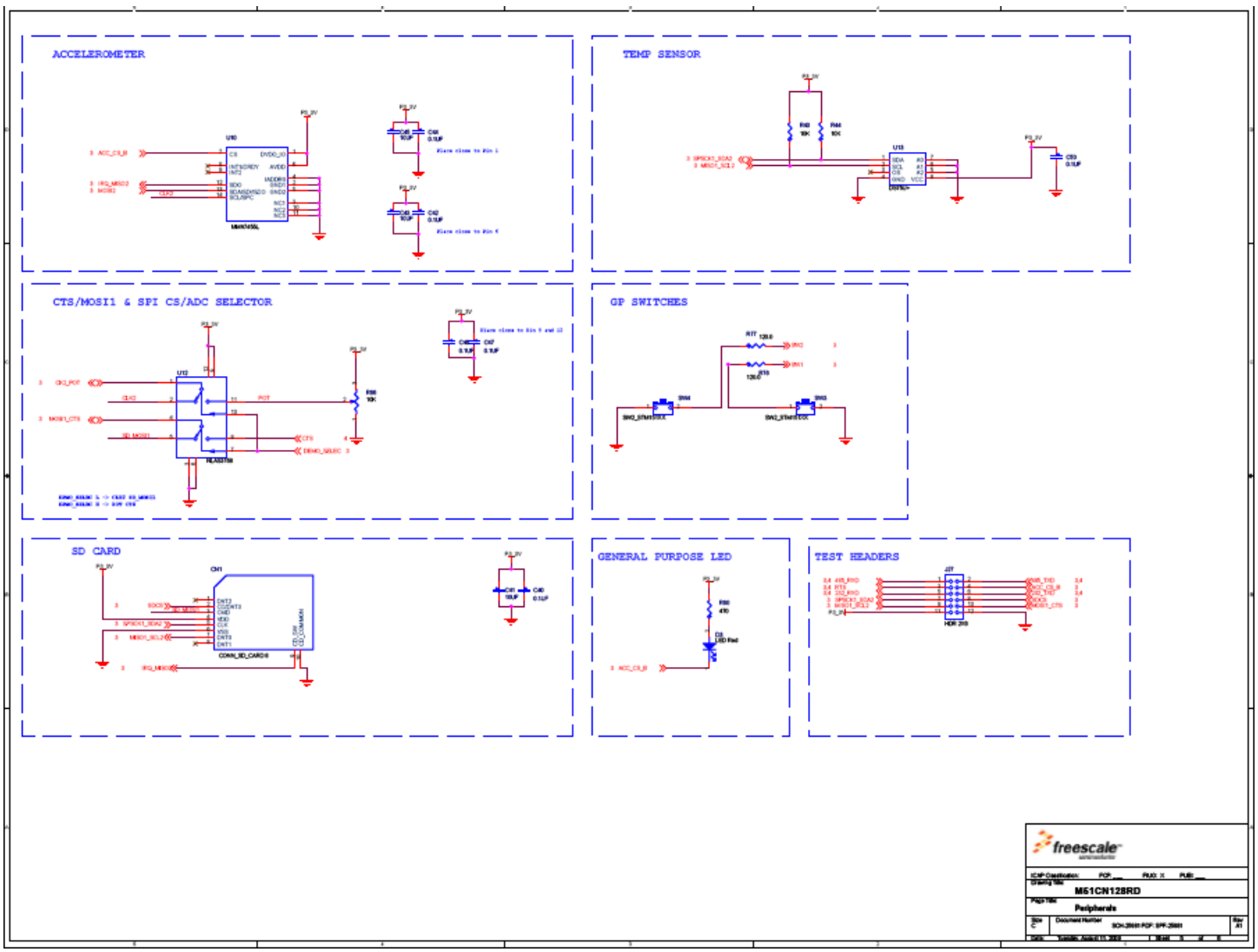
Figure B-1. Manufacturer BOM Report

Appendix C

C.1 Schematics




RS485
RS232
ETHERNET PHY
M51CN128RD
Serial & Ethernet


ACCELEROMETER
TEMP SENSOR
CTS/MOSI1 & SPI CS/ADC SELECTOR
GP SWITCHES
SD CARD
GENERAL PURPOSE LED
TEST HEADERS
freescale
M51CN128RD
Peripherals

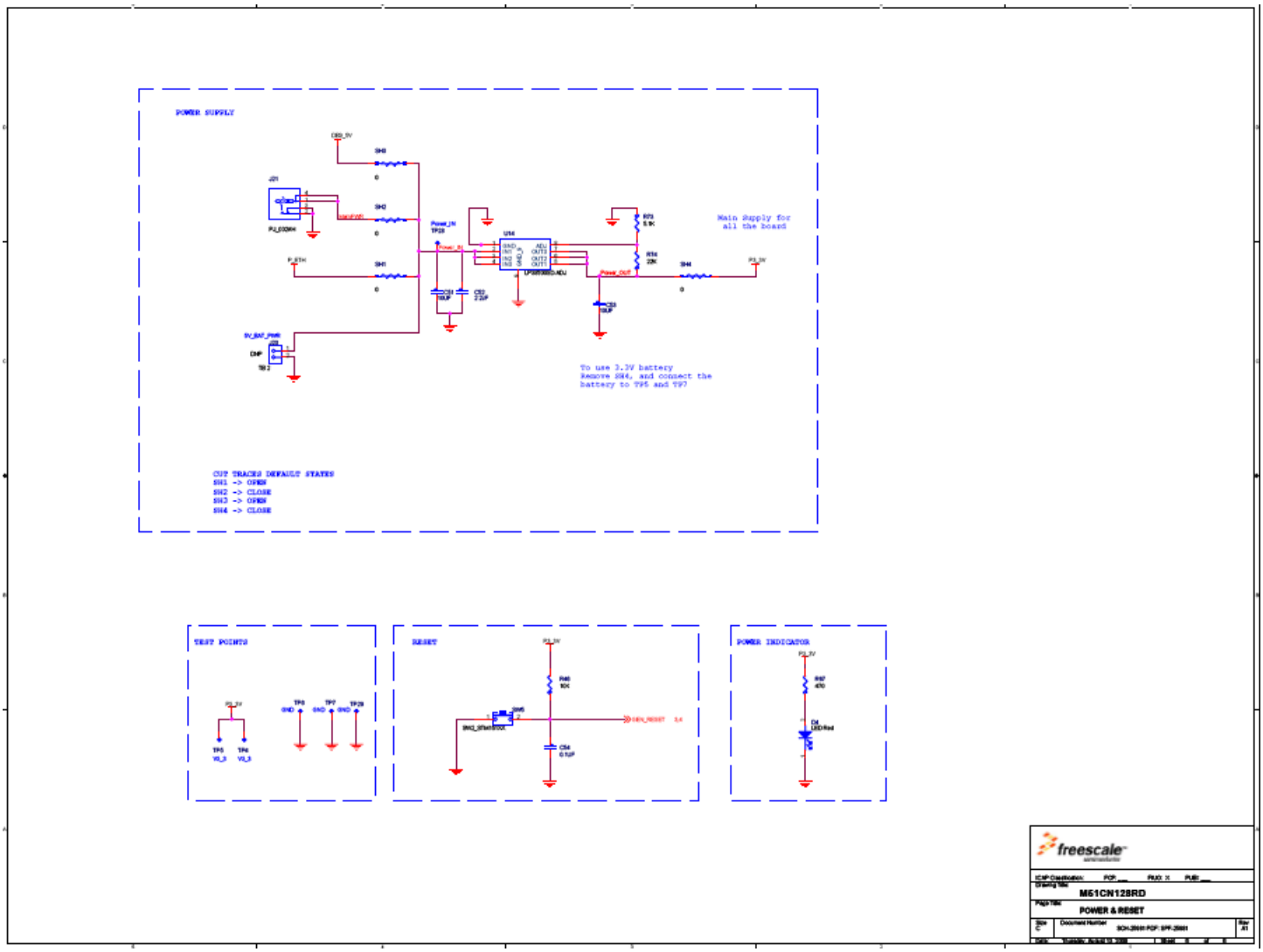


Figure C-1. MCF51CN128 reference design schematics

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