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# USER MANUAL

*Starter Kit EFM32TG-STK3300*

0 1 2 3 4

*Feature rich starter kit for evaluation, prototyping and application development for the EFM32TG MCU family with the ARM Cortex-M3 CPU core.*

*Main features;*

- Advanced Energy Monitoring provides real-time visibility into the energy consumption of an application or prototype design.
- On-board debugger with debug out functionality
- 160-segment Energy Micro LCD

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# 1 Introduction

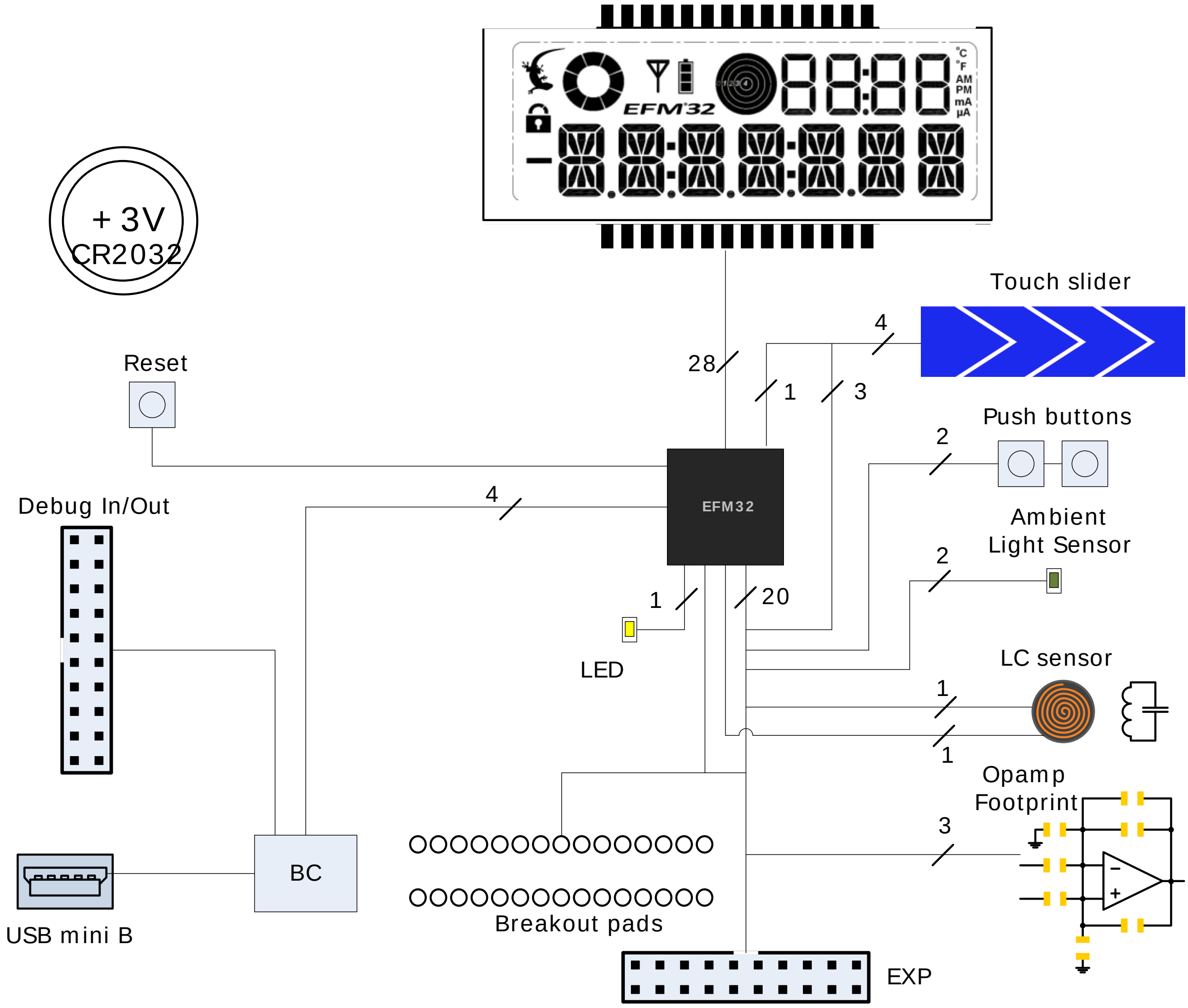
## 1.1 Features

- Advanced Energy Monitoring system for precise current tracking.
- Special hardware configuration for isolation of the MCU power domain.
- Full feature USB debugger with debug out functionality.
- 160 segment Energy Micro LCD.
- 20 pin expansion header.
- Breakout pads for easy access to I/O pins.
- Powered by USB or CR2032 battery.
- 2 user buttons, 1 user LED and a touch slider.
- Ambient Light sensor and inductive-capacitive metal sensor.
- EFM32 Op-amp footprint.
- 32MHz and 32.768kHz crystal oscillators.

# 2 STK block diagram

An overview of the Kit is shown in the block diagram below.

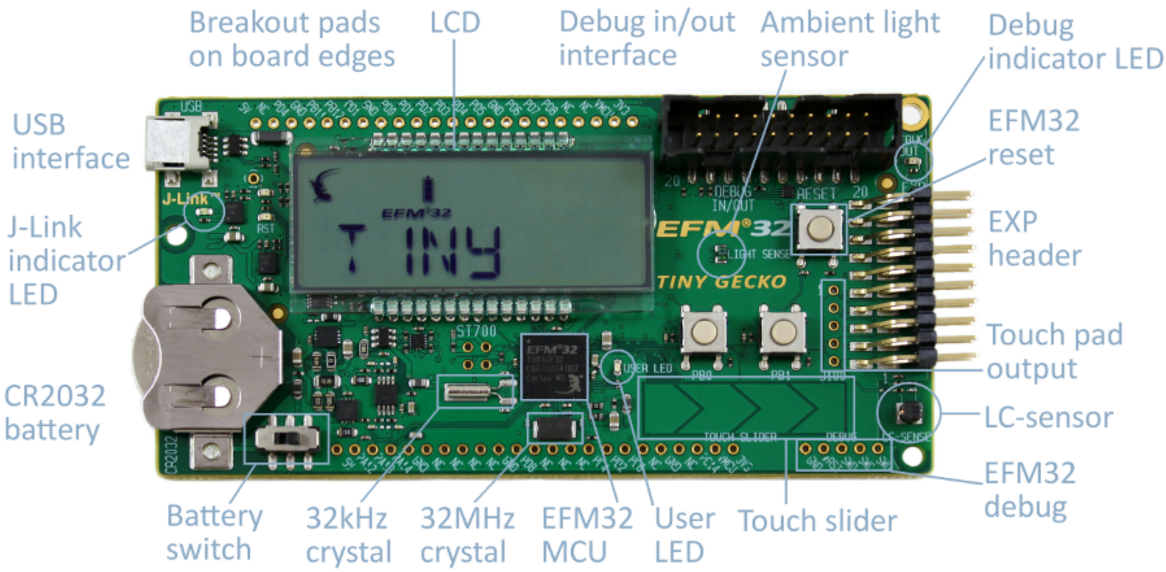
***Figure 2.1. EFM32TG-STK3300 Block Diagram***



# 3 Hardware layout

The layout of the EFM32TG-STK3300 is shown below.

***Figure 3.1. EFM32TG-STK3300 hardware layout***



# 4 Power supply

## 4.1 USB

The EFM32TG-STK3300 can get its power from the USB port. The MCU voltage will be 3.3 volts when USB is connected.

## 4.2 Battery

There is a socket for a 20mm coin cell battery, which can be used to power the kit. When the battery connect switch position is towards the battery, the EFM and its peripherals is powered by the battery. The board controller/AEM is not powered by the battery, so the BSP software support library cannot be used without USB connected. The current consumption while running on battery will be zero since the battery supply is not part of the AEM.

***Note***

Make sure that the battery is inserted with the correct polarity.

# 5 Reset infrastructure

## 5.1 MCU

The primary user reset for the EFM32 MCU is the reset button on the board. This will only reset the EFM32 MCU. The MCU can also be reset by the internal debugger or an external debugger.

## 5.2 Board controller

The board controller can only be reset by pulling and reinserting the USB cable. While on battery power this will not reset the EFM32 MCU.

# 6 Peripherals

The starter kit has a set of peripherals that showcase some of the features of the EFM32TG.

Be aware that most EFM32 I/O routed to peripherals are also routed to the breakout pads. This must be taken into consideration when using the breakout pads for your application.

## 6.1 Pushbuttons

The kit has two user pushbuttons marked PB0 and PB1. They are connected to the EFM32, and are debounced by RC filters with a time constant of 1ms.

## 6.2 LED

There is one LED on the kit marked USER LED. An active high on the respective pin will light the LED.

## 6.3 LCD

A 28-pin Energy Micro LCD display is connected to the EFM32. The LCD has 8 common lines and 20 segment lines. This gives a total of 160 segments in 8-plexed mode. These lines are not shared on the breakout pads. Capacitors for the EFM32TG LCD boost function is also available on the EFM32TG-STK3300.

## 6.4 Touch slider

A touch slider utilizing the capacitive touch capability is available. It is placed under the two push buttons on the kit, above the "TOUCH SLIDER" print.

## 6.5 Ambient Light Sensor

The kit has a light sensitive, transistor type, ambient light sensor connected to the low energy sensor interface of the EFM32TG MCU. The sensor is placed above the push buttons and can be used to sense changes in ambient light levels.

## 6.6 LC Sensor

In the bottom right corner there is an inductive-capacitive sensor for demonstrating the low energy sensor interface. By setting up oscillating currents in the inductor, metal nearby the inductor can be sensed by measuring the oscillation decay time. The effective range is a few millimeters.

## 6.7 Op-Amp Footprint

If the kit is flipped over there is a silk-print model of a typical operational amplifier feedback circuit. The actual operational amplifier is one of the op-amps inside the EFM32. By soldering 0603 sized resistors the EFM32 internal operational amplifier can be evaluated with exact resistor values.

# 7 Advanced Energy Monitor

## 7.1 Usage

The AEM (Advanced Energy Monitor) data is collected by the board controller and can be displayed by the energyAware Profiler, available through Simplicity Studio. By using the energyAware Profiler, current consumption and voltage can be measured and linked to the actual code running on the EFM32 in realtime.

## 7.2 AEM theory of operation

In order to be able to measure currents ranging from 0.1uA to 50mA (114dB dynamic range), two current sense amplifiers are utilized. The amplifiers measure voltage drop over a small series resistor and translates this into a current. Each amplifier is adjusted for current measurement in a specific range. The ranges for the amplifiers overlap and a change between the two occurs when the current is 200uA. To reduce noise, averaging of the samples is performed before the current measurement is presented in the AEM GUI.

During startup of the kit, an automatic calibration of the AEM is performed. This calibration compensates for the offset error in the sense amplifiers.

## 7.3 AEM accuracy and performance

The Advanced Energy Monitor is capable of measuring currents in the range of 0.1uA to 50mA. For currents above 200uA, the AEM is accurate within 0.1mA. When measuring currents below 200uA, the accuracy increases to 1uA. Even though the absolute accuracy is 1uA in the sub 200uA range, the AEM is able to detect changes in the current consumption as small as 100nA The measurement bandwidth of the AEM is 60Hz when measuring currents below 200uA and 120Hz when measuring currents above 200uA. The table below summarizes the accuracy of the two current sense amplifiers in different ranges.

***Table 7.1. AEM accuracy***

| Current range | Low gain amplifier accuracy | High gain amplifier accuracy |
|---|---|---|
| 50mA | 0.1mA | - |
| 1mA | 0.1mA | - |
| 200uA | 0.01mA | 1uA |
| 10uA | - | 0.1uA |
| 1uA | - | 0.1uA |

***Note***

The current measurement will only be correct when powering the EFM32 from USB power. The battery switch should be in the position furthest away from the battery.

# 8 Board controller

The control MCU can act as a board controller (BC). There is a UART connection between the EFM32 and the BC. The connection is made by setting the bc_en line high. The EFM32 can then use the BSP (Board Support Package) library functions to send commands to the BC. When bc_en is low, bc_tx and bc_rx can be used by other applications.

To use the board controller for your application, the Board Support Package must be installed. See the BSP chapter to find out how.

***Note***

The board controller is only available when USB power is connected.

# 9 Board Support Package

The Board Support Package (BSP) is a set of C source and header files that enables easy access to, and control over some board specific features.

Compared to the Energy Micro development kit, the functionality is limited. Unless you need/want some of the functions contained in the BSP, there is really no need to include or use it. The EFM32 in the Starter Kit is fully usable without BSP support, and you can use all peripherals in the efm32lib without the BSP.

The BSP use EFM32 peripheral USART1 (TX pin PD7, RX pin PD6) on baudrate 115200-8-N-1 to communicate with the board controller.

***Note***

The BSP is only functional when the Starter Kit is USB-powered, using these function calls with USB disconnected will give unpredictable results.

## 9.1 Installation location

When installing Simplicity Studio, the BSP will be installed in the user directory, typically in a location such as

```
Win7: C:\Users\[username]\AppData\Roaming\energymicro\boards
```

or something similar (depending on your OS/Windows version). All files in the board support package is prefixed by stk.

## 9.2 Application Programming Interface

To use the BSP, include the Starter Kit header file, like this:

```
#include "stk.h"
```

All functions in the BSP are prefixed with STK_. The main initialization routine is defined as

```
void STK_Init(void);
```

and must be called before any access to the STK-functions. This function call will setup the UART communication channel with a 115800 baud rate. This baud rate depends on the current core clock, so correct clock configuration should be set before calling this function.

```
bool STK_Ready(void);
```

Returns *true* if the board controller is responding. A non-responding board will either return false, or hang (i.e. if the EFM32 is powered by the CR2032 battery cell).

```
float STK_Current(void);
```

Returns instant current usage in milliamperes.

```
float STK_Voltage(void);
```

Returns instant voltage (VMCU) reading in volt.

```
bool STK_EnergyMode(uint8_t em);
```

Informs the board controller about the Energy Mode (sleep mode) we are going into. This information can be used by the board controller to present a richer visual graph for illustrating what the EFM32 is currently doing.

In addition to these main functions, full documentation of the complete API is included in the Doxygen/HTML documentation of the installed package.

## 9.3 Example Applications

Under the EFM32_Gxxx_STK/examples folder in your installation directory, you will find an example program using the BSP, with corresponding project/Makefiles for the supported IDEs.

## 9.4 How to include in your own applications

The easiest way to include the BSP in your application is to base your work on the example application that use the BSP. The following items are recommended for correct configuration:

1. Make sure you define the correct part number (i.e. EFM32TG840F32) as a preprocessor defined symbol
2. Make sure you define the correct part number (i.e. EFM32TG840F32) for your project file
3. Add and include the EFM32_CMSIS-files (startup_efm32.s, system_efm32.c, core_cm3.c) to your project
4. Add and include _all_ BSP package .c-files, with the stk-prefix to your project
5. Configure include paths to point at the CMSIS/CM3/CoreSupport and CMSIS/CM3/DeviceSupport/EnergyMicro/EFM32 directories
6. Configure include paths to point to the EFM32_Gxxx_STK/bsp directory

Make sure you call "STK_Init()" early at startup, and you should be all set.

# 10 Connectors

## 10.1 Breakout pads

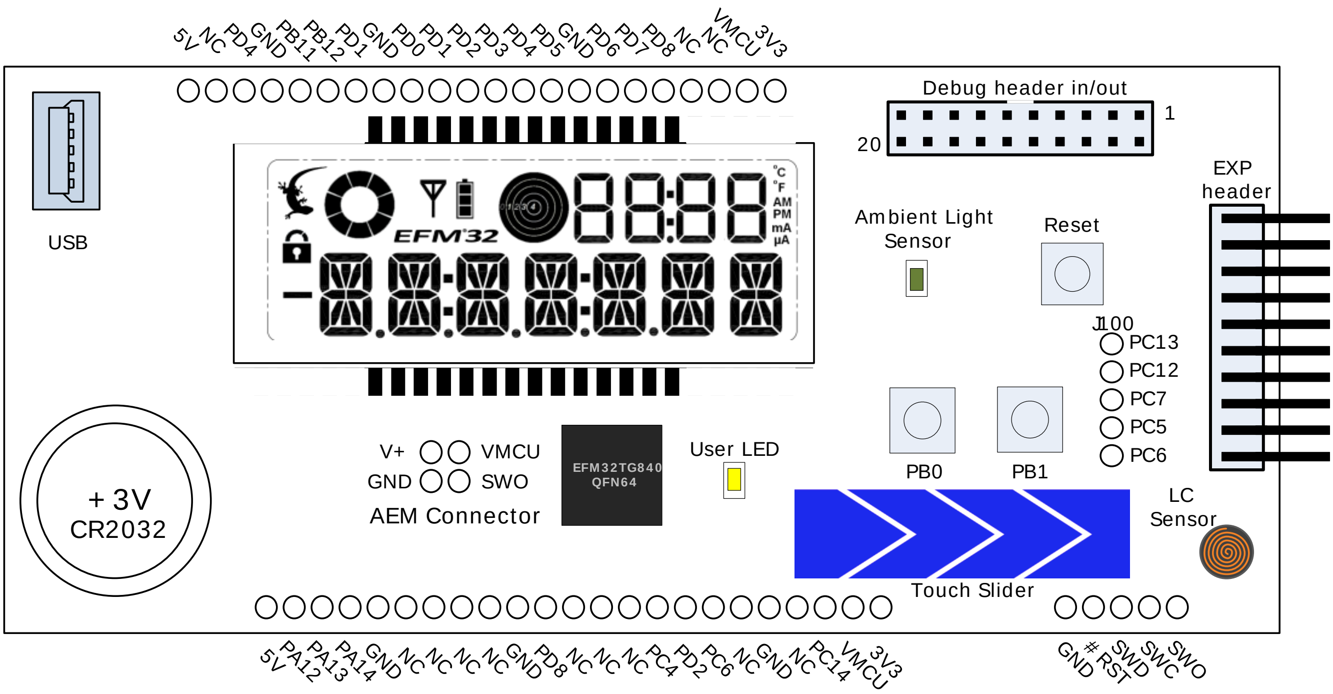
Most I/O except the LCD pins are routed to the breakout pads at the top and bottom edge of the kit. A 2.54mm (100 mil) pitch pin header can be soldered in place on the pads for easier access.

Some of the breakout pads are not connected and therefore marked NC. The position of the connected pins are compatible with the EFM32G Gecko starter kit.

**Note**

Some of the breakout pads are shared by on-board EFM peripherals. The schematic must be consulted to make sure that it is OK to use a shared pin in your application.

***Figure 10.1. Breakout pads and layout diagram***



## 10.2 Expansion header

A 20 pin expansion header can be used to connect plugin boards. This contains a selection of I/O, powers and ground. See the pinout in the table below.

***Table 10.1. Expansion header pinout***

| I/O | # | # | I/O |
|---|---|---|---|
| GND | 1 | 2 | VMCU |
| PC4 | 3 | 4 | PD0 |
| PC5 | 5 | 6 | PD1 |
| PC12 | 7 | 8 | PD2 |
| PC13 | 9 | 10 | PD3 |
| PB11 | 11 | 12 | PD4 |
| PB12 | 13 | 14 | PD5 |
| PD7 | 15 | 16 | PD6 |
| PD8 | 17 | 18 | 5V |
| GND | 19 | 20 | 3V3 |

*Table 10.2. Expansion header pin list*

| EXP header pin number | MCU GPIO pin | Some MCU GPIO pin functions |
|---|---|---|
| 1 | GND | Ground |
| 2 | VMCU | MCU supply voltage |
| 3 | PC4 | OPAMP_P0 #0 / LETIMER_OUT0 #3 / ACMP0_CH4 / LES_CH4 |
| 4 | PD0 | ADC0_CH0 / USART1_TX #1 / OPAMP_OUT2 #1 |
| 5 | PC5 | OPAMP_N0 #0 / LETIMER_OUT1 #3 / ACMP0_CH5 / LES_CH5 #0 |
| 6 | PD1 | ADC0_CH1 / TIMER0_CC0 #3 / USART1_RX #1 / OPAMP_OUT1ALT #4 |
| 7 | PC12 | CMU_CLKOUT0 #1 / ACMP1_CH4 / LES_CH12 #0 |
| 8 | PD2 | ADC0_CH2 / TIMER0_CC1 #3 / USART1_CLK #1 |
| 9 | PC13 | ACMP1_CH5 #0 / TIM1_CC0 #0 / TIM1_CC2 #4 / PCNT0_S0IN #0 / LES_CH13 #0 |
| 10 | PD3 | ADC0_CH3 / OPAMP_N2 #0 / TIM0_CC2 #3 / US1_CS #1 |
| 11 | PB11 | DAC0_OUT0 #0 / OPAMP_OUT0 #0 / TIM1_CC2 #3 / LETIM0_OUT0 #1 |
| 12 | PD4 | ADC0_CH4 / OPAMP_P2 #0 / LEU0_TX #0 |
| 13 | PB12 | DAC0_OUT1 #0 / OPAMP_OUT1 #0 / LETIM0_OUT1 #1 |
| 14 | PD5 | ADC0_CH5 / OPAMP_OUT2 #0 / LEU0_RX #0 |
| 15 | PD7 | ADC0_CH7 / OPAMP_N1 #0 / TIM1_CC1 #4 / I2C0_SCL #1 / LES_ALTEX1 #0 / ACMP1_O #2 |
| 16 | PD6 | ADC0_CH6 / OPAMP_P1 #0 / TIM1_CC0 #4 / I2C0_SDA #1 / LES_ALTEX0 #0 / ACMP0_O #2 |
| 17 | PD8 | CMU_CLKOUT1 #1 |
| 18 | 5V | USB Power |
| 19 | GND | Ground |
| 20 | 3V3 | 3.3V board power |

## 10.3 Debug connector

This connector is used for Debug In and Debug Out (see Debug chapter). The pinout is described in the table.

*Table 10.3. Debug connector pinout*

| Pin number | Function | Note |
|---|---|---|
| 1 | VTARGET | Target voltage on the debugged application. |
| 2 | NC | |
| 3 | /TRST | JTAG tap reset |
| 4 | GND | |
| 5 | TDI | JTAG data in |
| 6 | GND | |
| 7 | TMS/SWDIO | JTAG TMS or Serial Wire data I/O |
| 8 | GND | |
| 9 | TCK | JTAG TCK or Serial Wire clock |
| 10 | GND | |
| 11 | RTCK | JTAG RTCK |
| 12 | GND | |
| 13 | TDO/SWO | JTAG TDO or Serial Wire Output |
| 14 | GND | |
| 15 | /RESET | Target MCU reset |
| 16 | GND | |
| 17 | PD | This pin has a 100k pulldown. |
| 18 | Cable detect | This signal must be pulled to ground by the external debugger or application for cable insertion detection. |
| 19 | PD | This pin has a 100k pulldown. |
| 20 | GND | |

# 11 Debugging

The EFM32TG-STK3300 has an on-board debugger, and it can be used in different ways to debug the EFM32, both on and off kit. Below are descriptions on the different modes. Check the configuration chapter to find out how to change the debug setting.

***Table 11.1. Debug modes***

| Mode | Description |
|---|---|
| Debug MCU | In this mode the on-board debugger is connected to EFM32 on the EFM32TG-STK3300. |
| Debug IN | In this mode the on-board debugger is disconnected, and an external debugger can be connected to debug the EFM32 on the EFM32TG-STK3300. |
| Debug OUT | In this mode the on-board debugger can be used to debug an EFM32 mounted in your own application. |

## 11.1 Debugging during battery operation

When the EFM32 is powered by the battery and the USB is still connected, the on-board debug functionality is available. If the USB power is disconnected the debug controller on the kit will not work. To enable debugging in this mode, connect an external debugger (e.g. another EFM32TG-STK3300) to the debug pads in the bottom right corner of the EFM32TG-STK3300. These pads are connected directly to the EFM32 debug interface.

# 12 Integrated Development Environments

The Energy Micro software packages contains various examples in source form to use with the Starter Kit. The following IDEs are supported.

## 12.1 IAR Embedded Workbench for ARM

An evaluation version of IAR Embedded Workbench for ARM is included on a CD in the EFM32TG-STK3300 package. Check the quick start guide for where to find updates, and IAR's own documentation on how to use it. You will find the IAR project file in the

```
iar
```

subfolder of each project

## 12.2 Rowley Associates - CrossWorks for ARM

See the quick start guide for download details for CrossWorks for ARM. You will find CrossWorks project files in the

```
rowley
```

subfolder of each project.

## 12.3 CodeSourcery - Sourcery G++

See the quick start guide for download details for Sourcery G++. The

```
codesourcery
```

subfolder contains Makefiles for use with the Sourcery G++ development environment.

## 12.4 Keil - MDK-ARM

See the quick start guide for download details for evaluation versions of Keil MDK-ARM. The

```
arm
```

subfolder in each project contains project files for MDK-ARM. Please see the MDK-ARM documentation for usage details.

# 13 energyAware Commander and Upgrades

The *energyAware Commander* is a program that comes with Simplicity Studio. It can perform various kit and EFM32 specific tasks.

## 13.1 eA Commander Operation

This utility gives the ability to program the EFM32, upgrade the kit, lock and unlock devices and more. Some of the features will only work with Energy Micro kits, while other will work with a J-Link debugger connected. Press the "F1" button, or select the "Help->Help" menu item for a full description.

## 13.2 Upgrades

Upgrading the kit is done through Simplicity Studio. The Studio will automatically check for new updates on startup.

You can also use the *energyAware Commander* for manual upgrades. Select the "Kit" icon, use the "Browse" button to select the correct file ending in ".emz", and press the "Install package button".

# 14 Errata

The following sections lists the erratas and known issues for operating the STK. You can read the STK revision on the white label on the back side of the STK. It is in the format "BRD2100, Rev: Axx".

## 14.1 Chip errata

You can use *energyAware Commander* and press the "Connect" button to retrieve EFM32 revision information. Download the chip errata from http://www.energymicro.com for the latest errata updates on your device.

## 14.2 efm32lib Chip Init routine

The efm32lib

```
#include "efm32_chip.h"
CHIP_Init()
```

routine will, as far as possible, enable work arounds for chip erratas to make EFM32 Tiny Gecko devices be as software compatible as possible. In some cases, this can introduce increased current. See the device errata and source code for details.

## 14.3 STK Revision Errata

***Table 14.1. BRD2100 Revision Errata***

| Revision | Problem | Description |
|---|---|---|
| . | . | . |

# 15 Version information

The current version information can be read from Gecko Commander.

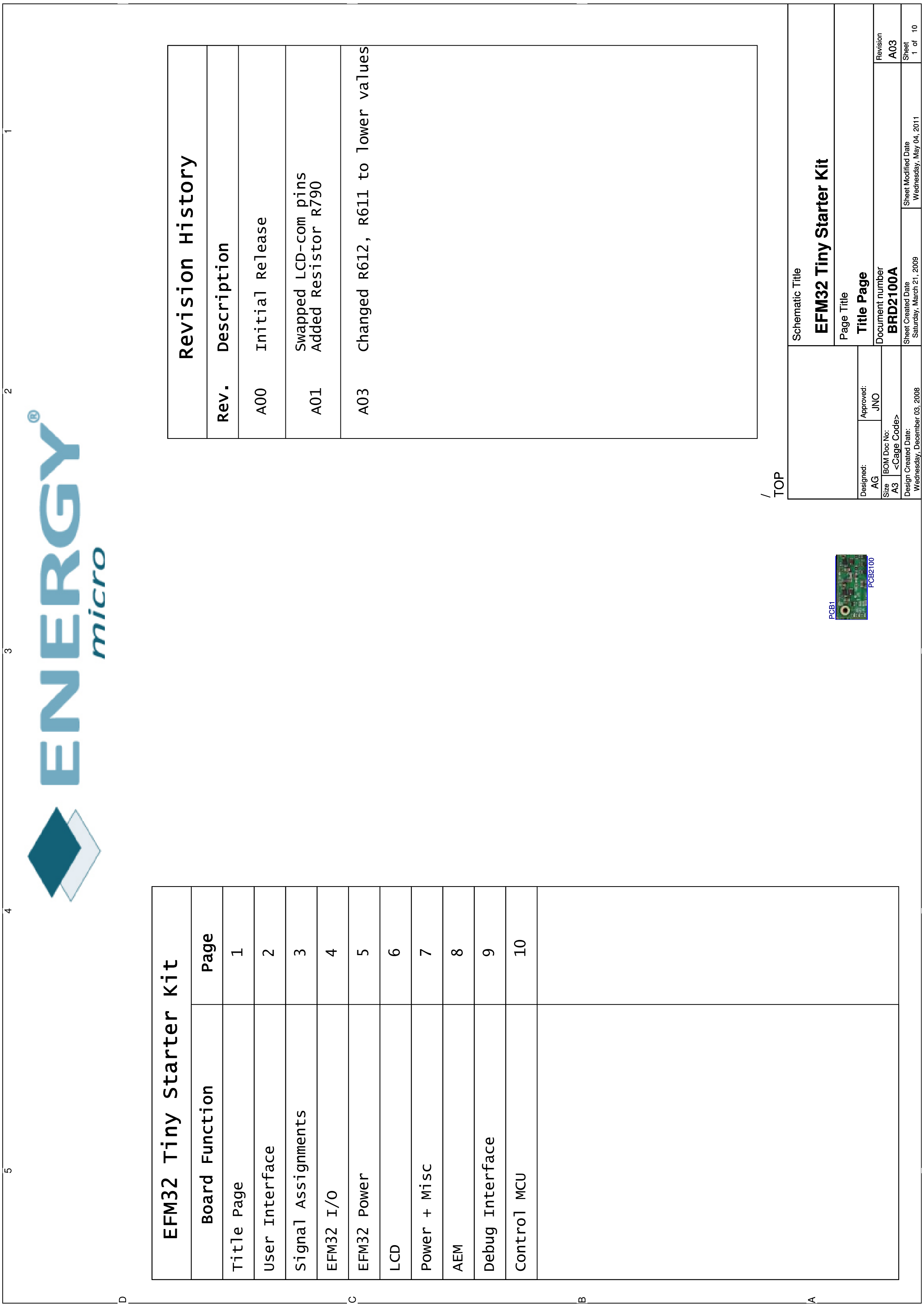
***Table 15.1. Current versions***

| Type | Version | Released |
|---|---|---|
| Firmware revision | 1.5.0 | 13.05.2011 |
| Board | BRD2100A Rev. A03 | 13.05.2011 |

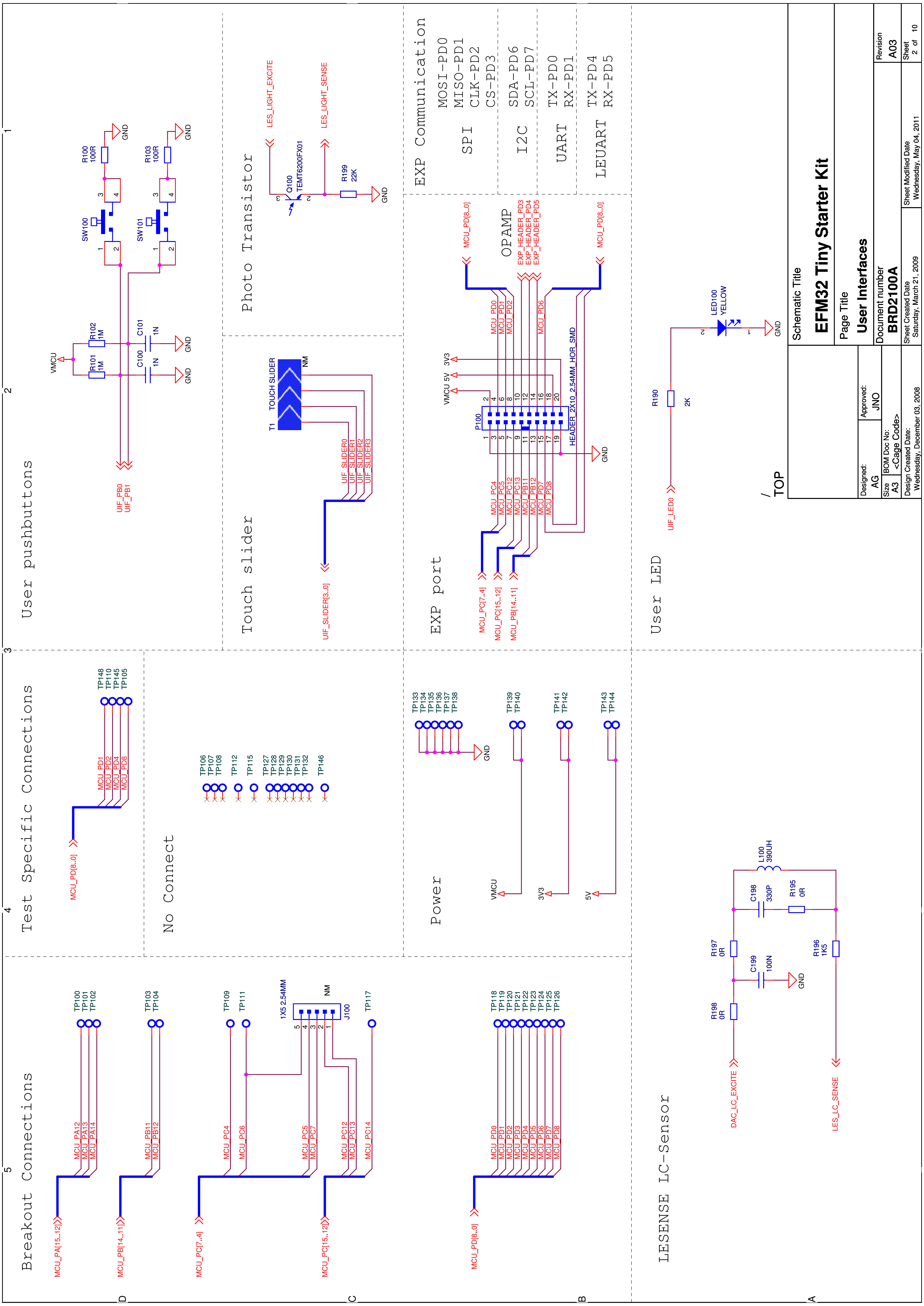
# 16 Schematic

On the next pages you can find the schematic of the board.

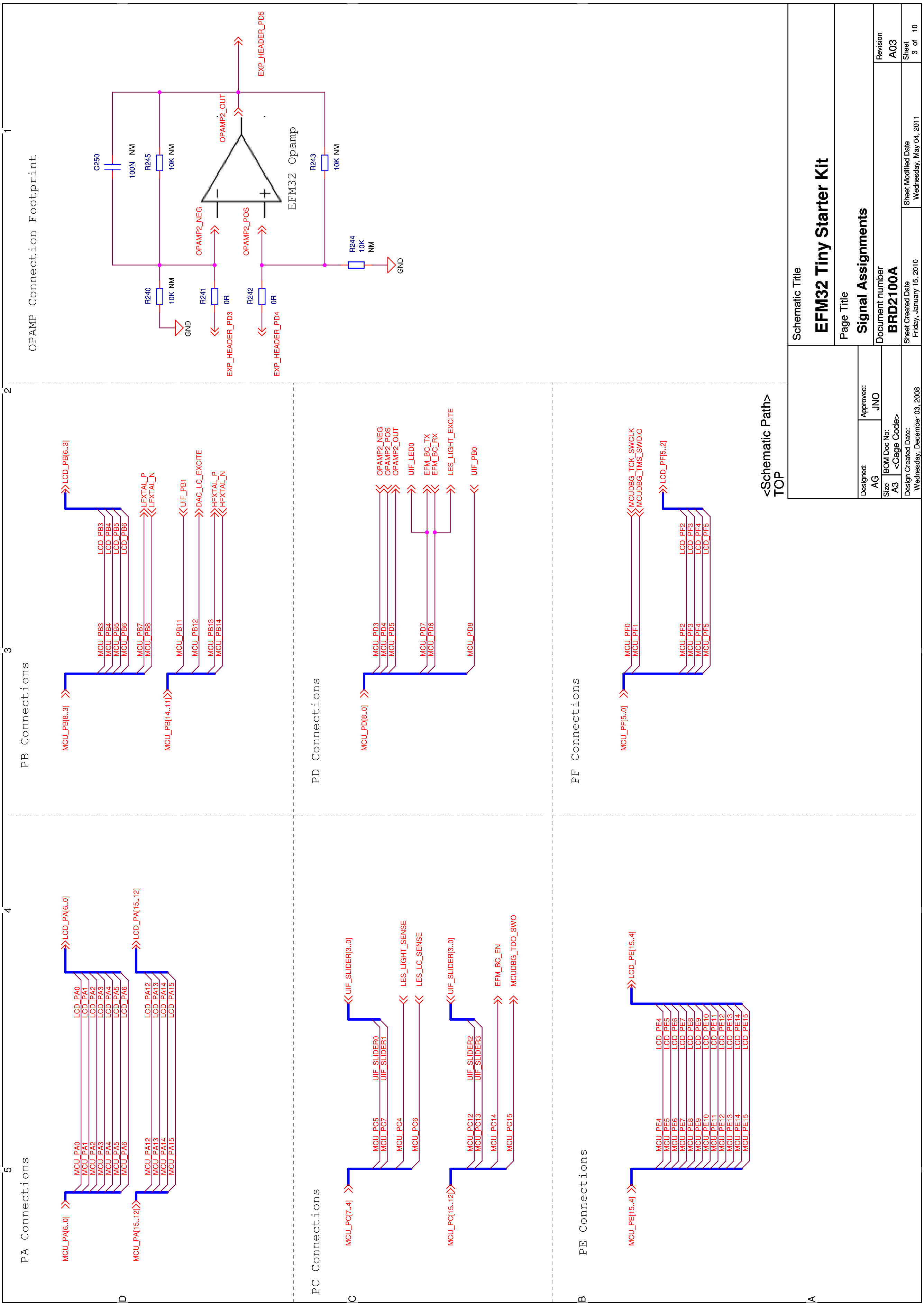
***Figure 16.1. Schematic Page 1***



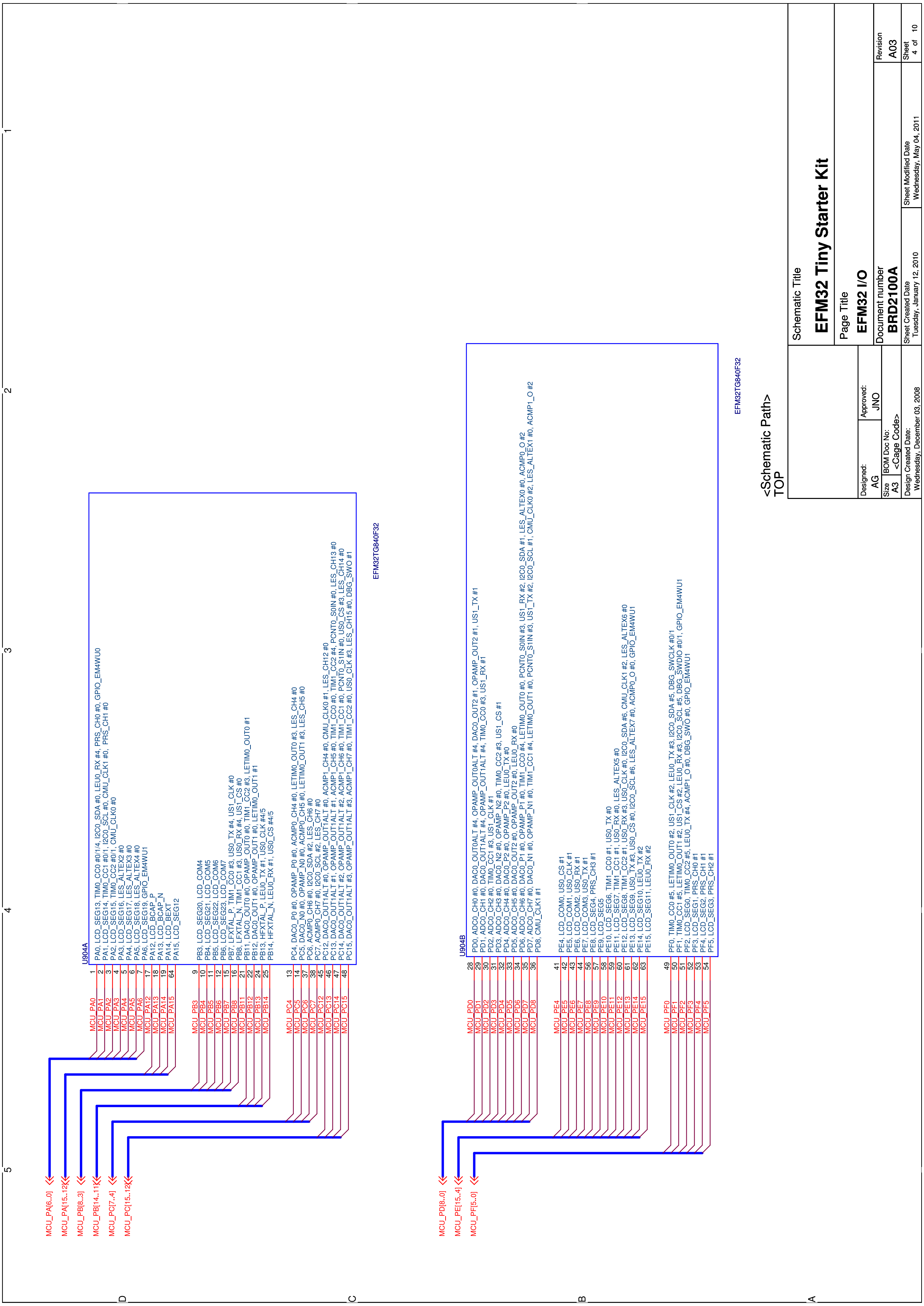
## Figure 16.2. Schematic Page 2



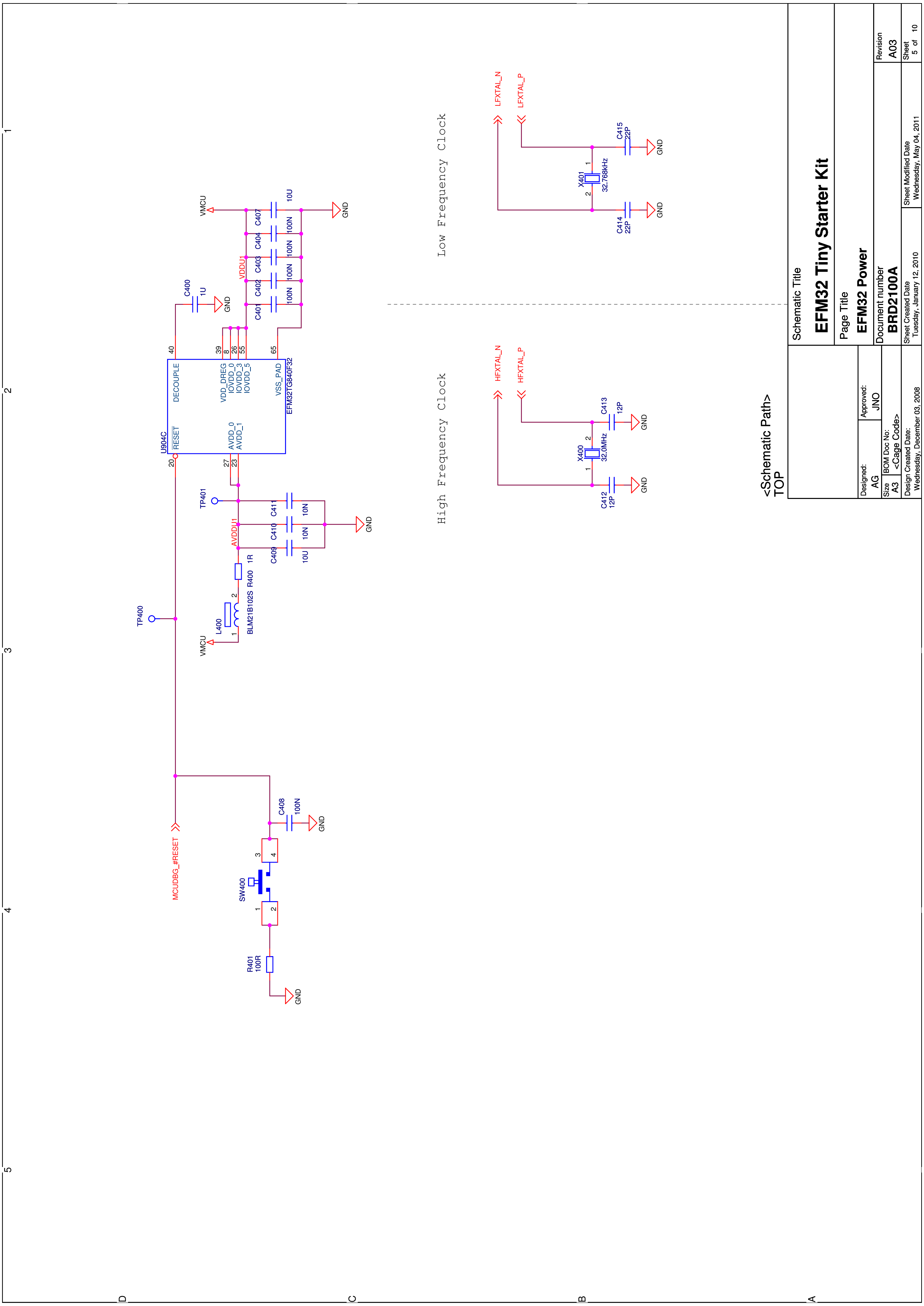
### Figure 16.3. Schematic Page 3



## Figure 16.4. Schematic Page 4



## *Figure 16.5. Schematic Page 5*



### Figure 16.6. Schematic Page 6

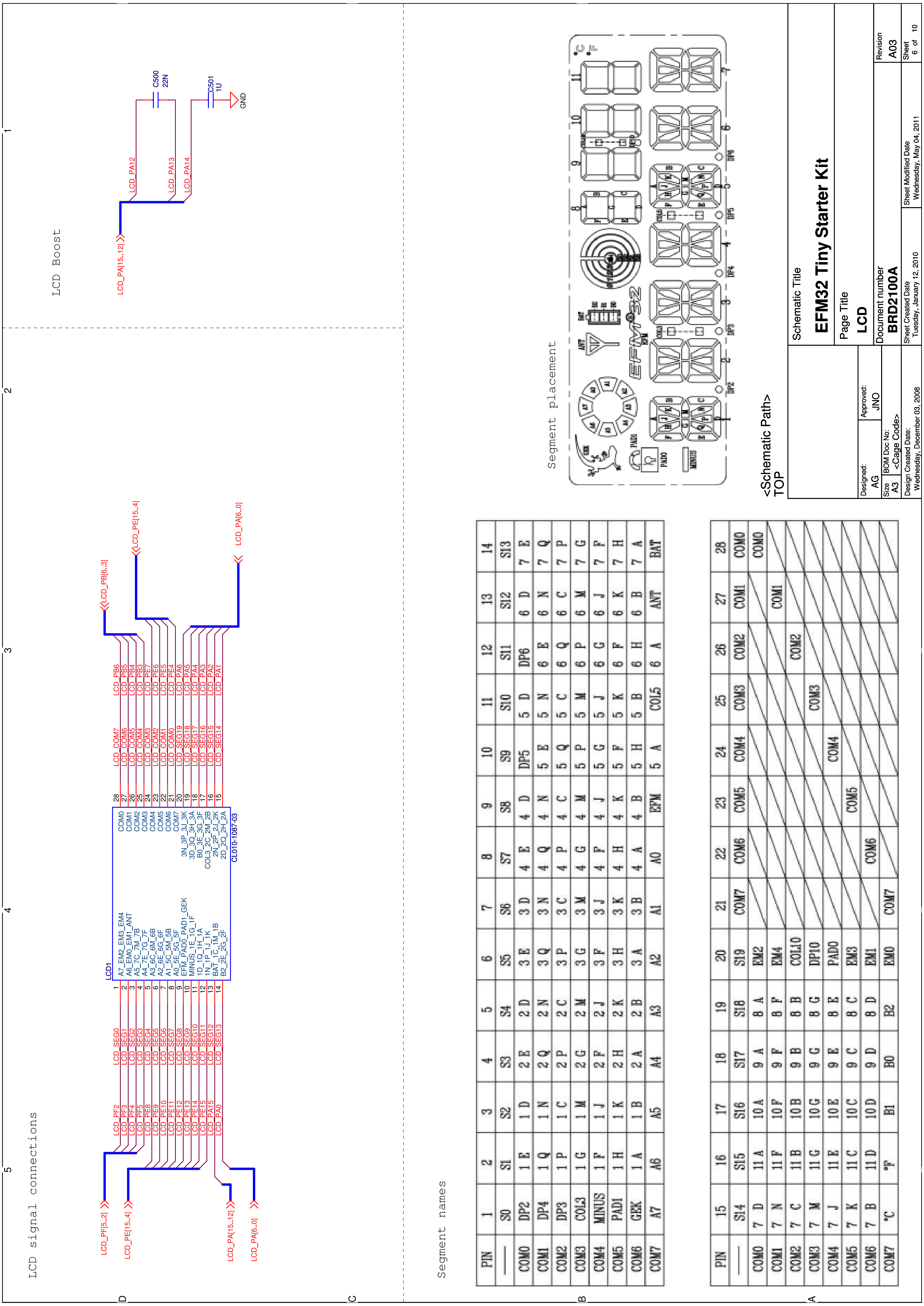
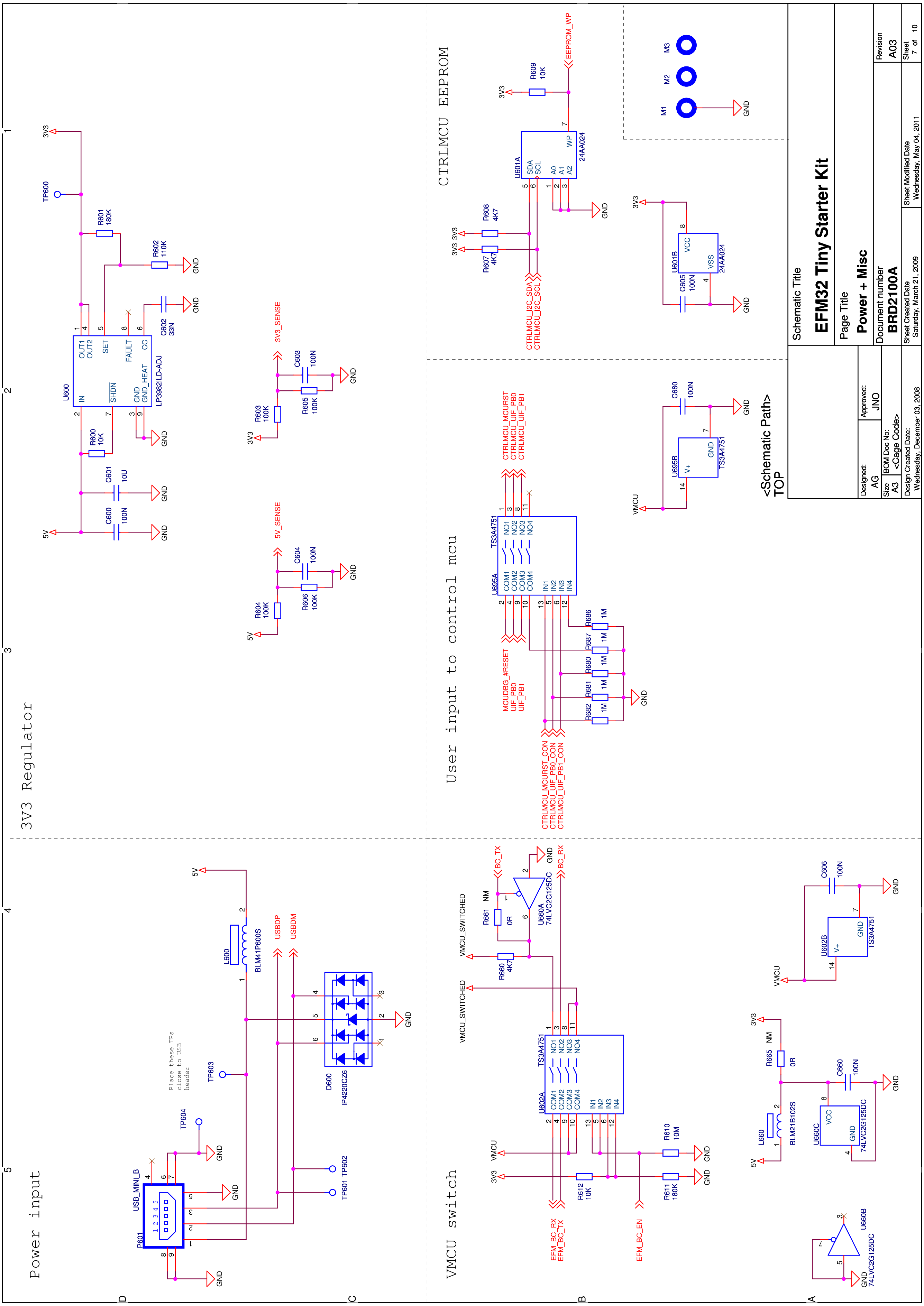


**Figure 16.7. Schematic Page 7**



## Figure 16.8. Schematic Page 8

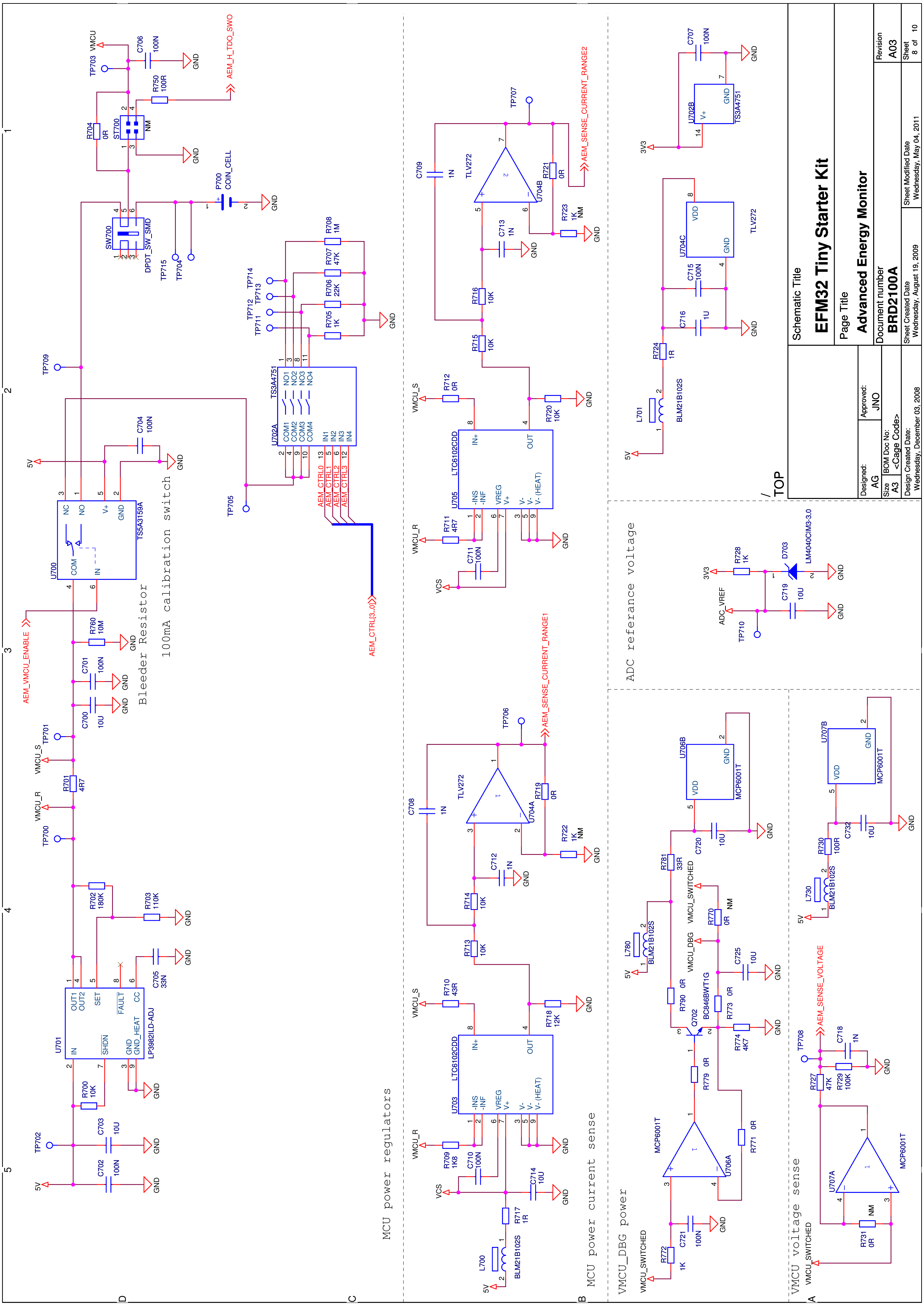
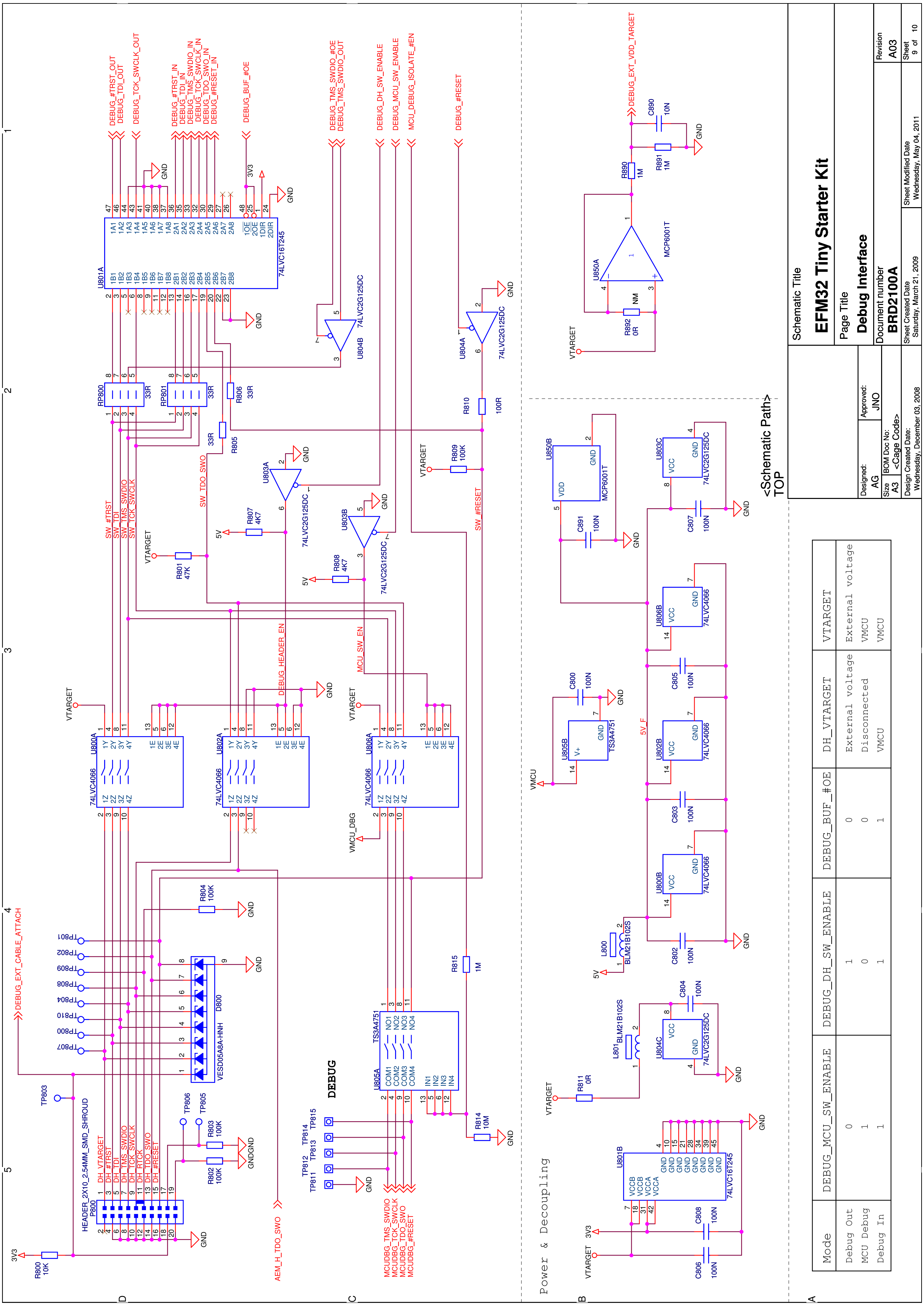
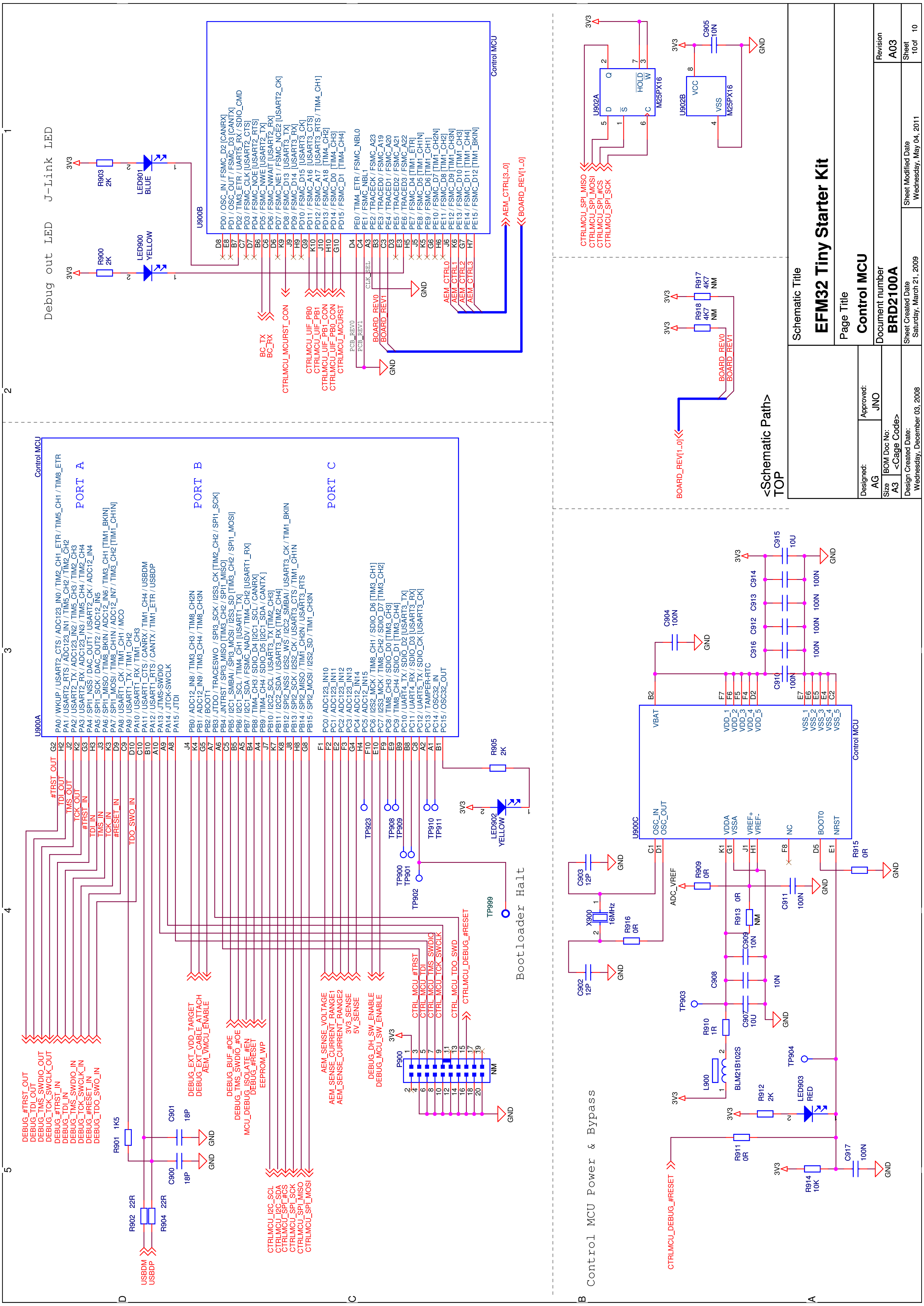


*Figure 16.9. Schematic Page 9*



## *Figure 16.10. Schematic Page 10*



# 17 Assembly Drawing

On the next pages you can find the assembly drawings of the board (not to scale).

*Figure 17.1. Assembly Drawing Page 1*

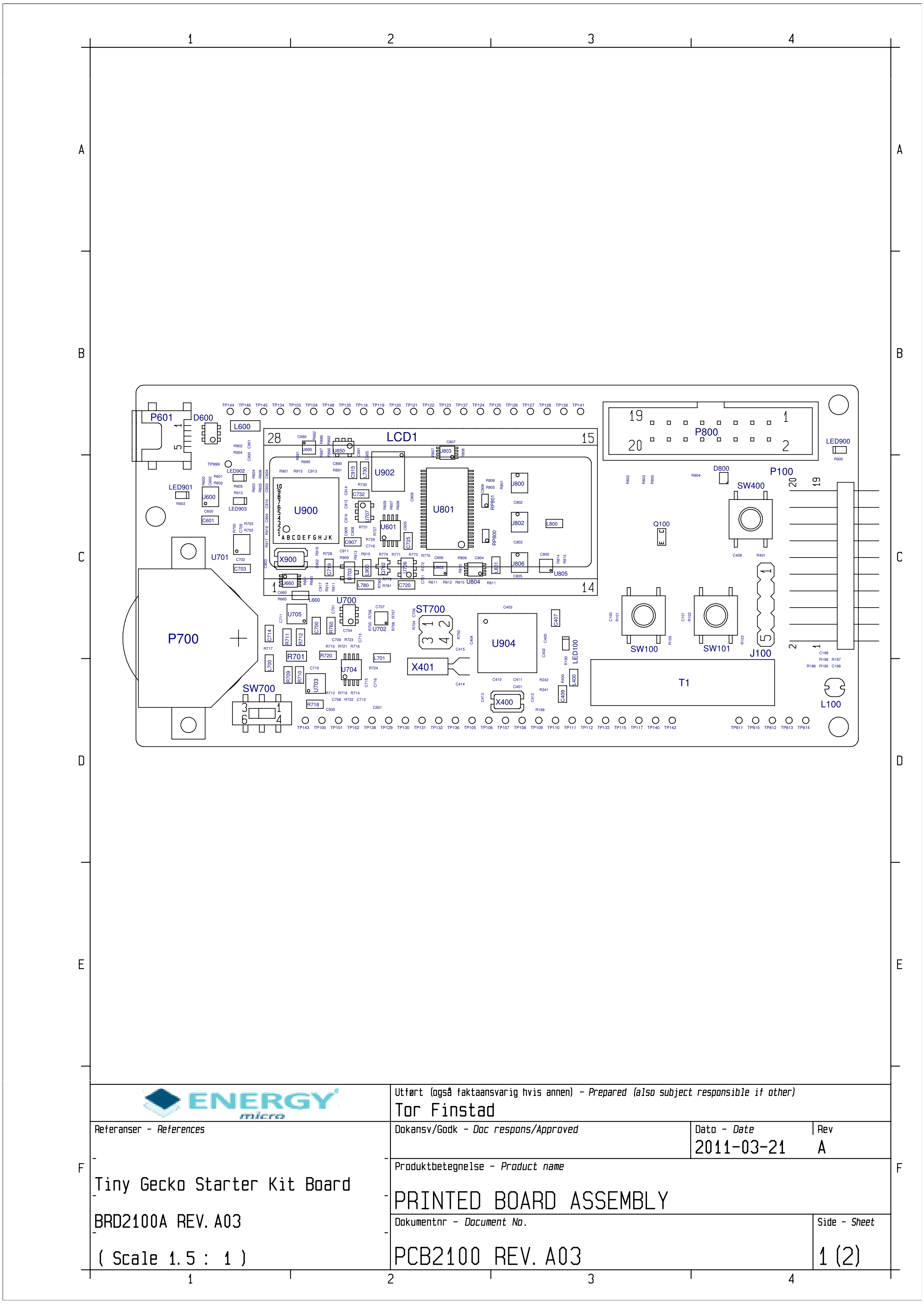
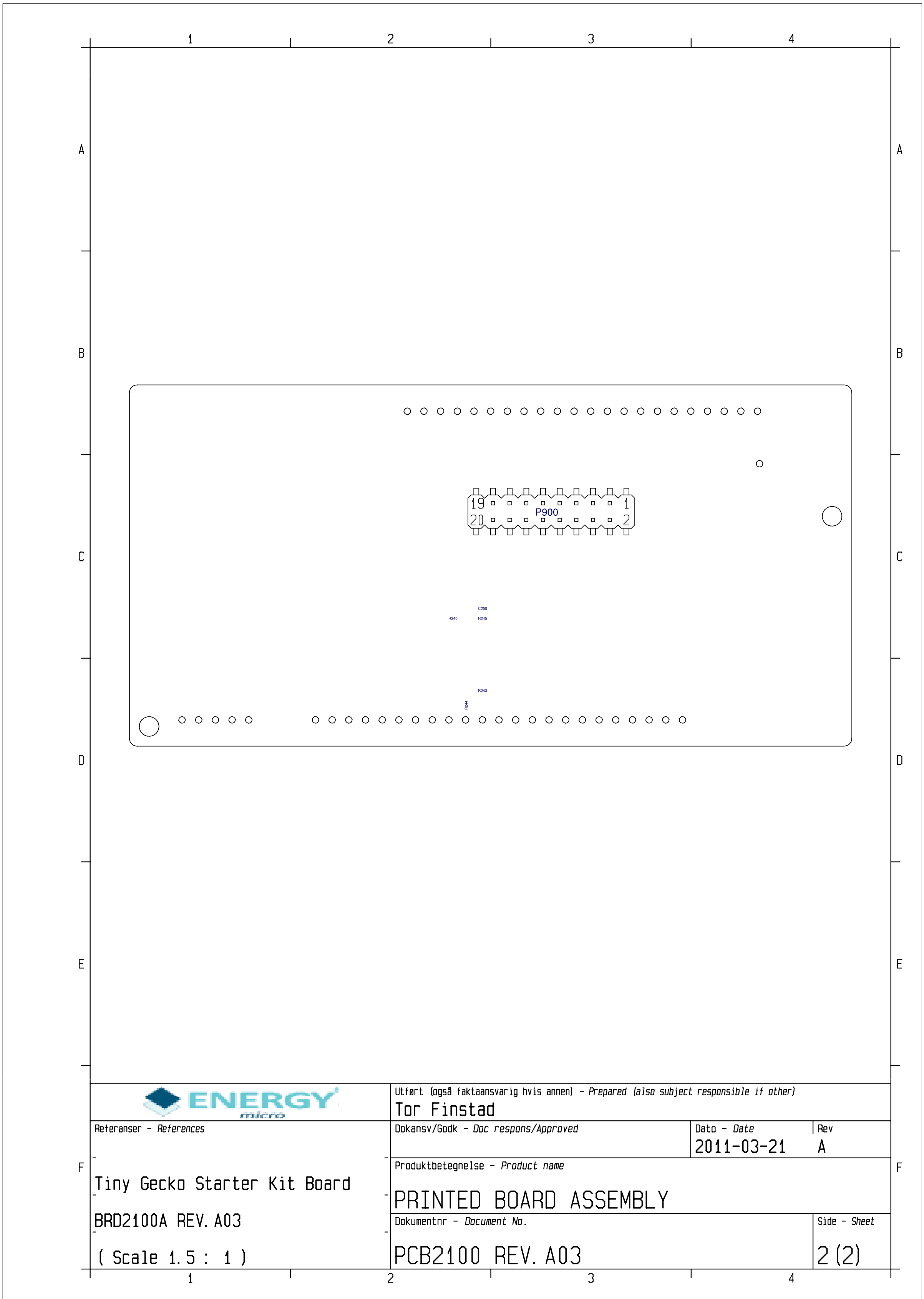


***Figure 17.2. Assembly Drawing Page 2***



# 18 Bill of Materials

On the next pages you can find the Bill of Materials for the board.

### *Table 18.1. Bill of Materials*

| Qty. | Reference | Manufacturer | Manufacturers Part Number |
|---|---|---|---|
| 7 | C100,C101,C708,C709,C712,C713,C718 | Murata | 1N 16V X7R GRM155 |
| 1 | C198 | Murata | 330P 50V C0G GRM155 |
| 39 | C199,C401,C402,C403,C404,C408,C600,C603,... | Murata | 100N 16V X7R GRM155 |
| 3 | C400,C501,C716 | Murata | 1U 10V X5R GRM18 |
| 12 | C407,C409,C601,C700,C703,C714,C719,C720,... | Murata | 10U 10V X5R GRM21 |
| 6 | C410,C411,C890,C905,C908,C909 | Murata | 10N 16V X7R GRM155 |
| 4 | C412,C413,C902,C903 | Murata | 12P 50V C0G GCM155 |
| 2 | C414,C415 | Murata | 22P 50V C0G GCM155 |
| 1 | C500 | Murata | 22N 16V X7R GRM155 |
| 2 | C602,C705 | Murata | 33N 16V X7R GRM155 |
| 2 | C900,C901 | Murata | 18P 50V C0G GCM155 |
| 1 | D600 | NXP Semiconductors | IP4220CZ6,125 |
| 1 | D703 | National | LM4040CIM3-3.0 |
| 1 | D800 | Vishay Semiconductors | VESD05A8A-HNH |
| 1 | LCD1 | Tri-T Co Ltd | CL010-1087-03 |
| 3 | LED100,LED900,LED902 | Everlight | EL-19-21UYC/S530-A2/TR8 |
| 1 | LED901 | Panasonic | LNJ926W8CRA |
| 1 | LED903 | Everlight | 19-21SDRC/S530-A3/TR8 |
| 1 | L100 | Bourns | 390UH SDR0302-391KL |
| 9 | L400,L660,L700,L701,L730,L780,L800,L801,... | Murata | BLM21B102S |
| 1 | L600 | Murata | BLM41P600S |
| 1 | PCB1 | | PCB2100 Rev. A03 |
| 1 | P100 | Taitek | HE2-20G6C394-5R |
| 1 | P601 | Hirose Electric Co Ltd | UX60-MB-5ST |
| 1 | P700 | Keystone | 3002 |
| 1 | P800 | 3M | D2520-6V0C-AR-WE |
| 1 | Q100 | Vishay | TEMT6200FX01A |
| 1 | Q702 | ON Semiconductor | BC846BWT1G |
| 2 | RP800,RP801 | ROHM | MNR04M0APJ330 |
| 6 | R100,R103,R401,R730,R750,R810 | | 100R |
| 11 | R101,R102,R680,R681,R682,R686,R687,R708,... | | 1M |
| 5 | R190,R900,R903,R905,R912 | | 2K |
| 15 | R195,R197,R198,R704,R719,R721,R771,R773,... | | 0R |
| 2 | R196,R901 | | 1K5 |
| 2 | R199,R706 | | 22K |
| 2 | R241,R242 | | 0R |
| 4 | R400,R717,R724,R910 | | 1R |
| 10 | R600,R609,R612,R700,R713,R714,R715,R716,... | | 10K |

| Qty. | Reference | Manufacturer | Manufacturers Part Number |
|---|---|---|---|
| 2 | R601,R702 | | 180K |
| 2 | R602,R703 | | 110K |
| 9 | R603,R604,R605,R606,R729,R802,R803,R804,... | | 100K |
| 6 | R607,R608,R660,R774,R807,R808 | | 4K7 |
| 2 | R610,R814 | | 10M |
| 1 | R611 | | 180K |
| 1 | R701 | Bourns | 4R7 0.1% CRT1206-BY-4R7-ELFTR |
| 3 | R705,R728,R772 | | 1K |
| 3 | R707,R727,R801 | | 47K |
| 1 | R709 | | 1K8 0.1% |
| 1 | R710 | | 43R 0.1% |
| 1 | R711 | | 4R7 0.1% |
| 1 | R712 | | 0R 0.1% |
| 1 | R718 | | 12K 0.1% |
| 1 | R720 | | 10K 0.1% |
| 1 | R760 | | 10M 1% |
| 3 | R781,R805,R806 | | 33R |
| 2 | R902,R904 | | 22R |
| 3 | SW100,SW101,SW400 | Omron Electronics | B3S1000 |
| 1 | SW700 | C&K Components | JS202011SCQN |
| 2 | U600,U701 | National Semiconductor | LP3982ILDX-ADJ |
| 1 | U601 | Microchip | 24AA024-I/MS |
| 4 | U602,U695,U702,U805 | Texas Instruments | TS3A4751RUCR |
| 3 | U660,U803,U804 | NXP | 74LVC2G125DC |
| 1 | U700 | Texas Instruments | TS5A3159ADBVR |
| 2 | U703,U705 | National Semiconductor | LTC6102CDD#PBF |
| 1 | U704 | Texas Instruments | TLV272CDGK |
| 3 | U706,U707,U850 | Microchip Technology | MCP6001T-I/OT |
| 3 | U800,U802,U806 | NXP | 74LVC4066BQ |
| 1 | U801 | Texas Instruments | 74LVC16T245DGG |
| 1 | U902 | Numonyx | M25PX16-VMP6E |
| 1 | U904 | Energy Micro | EFM32TG840 |
| 1 | X400 | NDK | NX5032GA-32.000M |
| 1 | X401 | Golledge | GSWX-26 |
| 1 | X900 | NDK | NX5032GA-16.000000MHZ |

# 19 Document Revision History

## 19.1 Revision 1.00

2011-05-13

Initial revision.

# A Disclaimer and Trademarks

## A.1 Disclaimer

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# Table of Contents

# List of Figures

# List of Tables

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