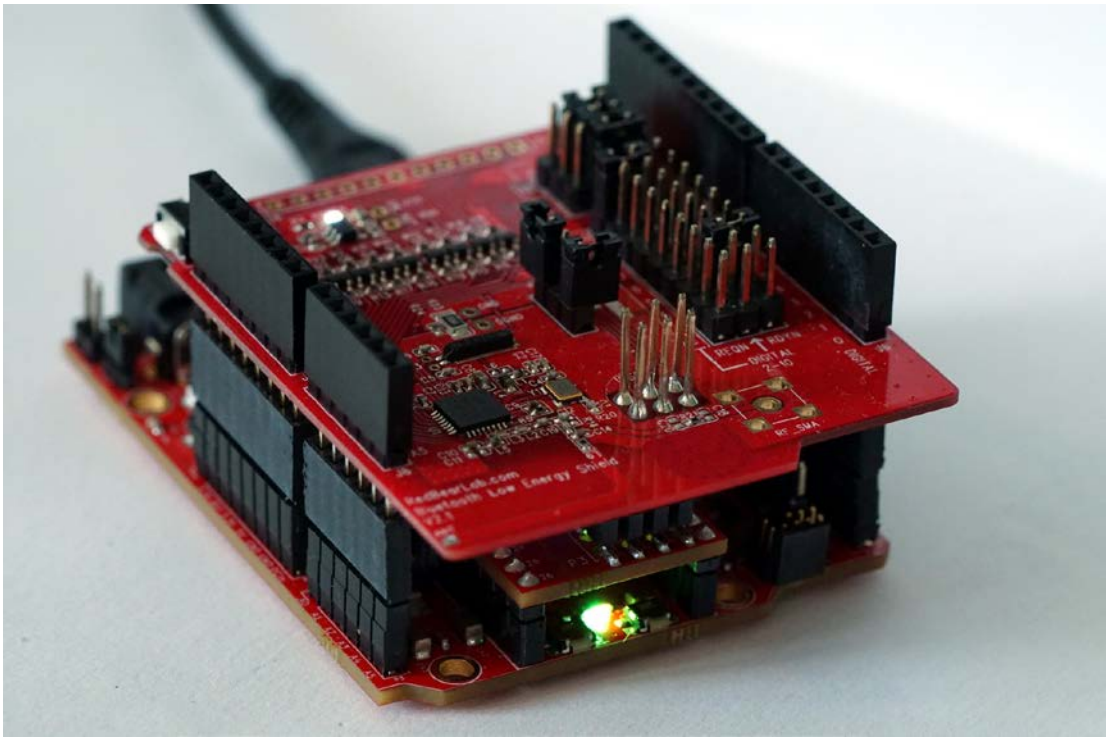
FEEU-UG-2017120001-10

AMBIQ MICRO APOLLO 1 / 2

EVALUATION BOARD

SK-APOLLO-BASE

USER GUIDE



Revision History

Date	Issue
2017-12-04	V1.0, Manuel Schreiner, first version

This document contains 46 pages.

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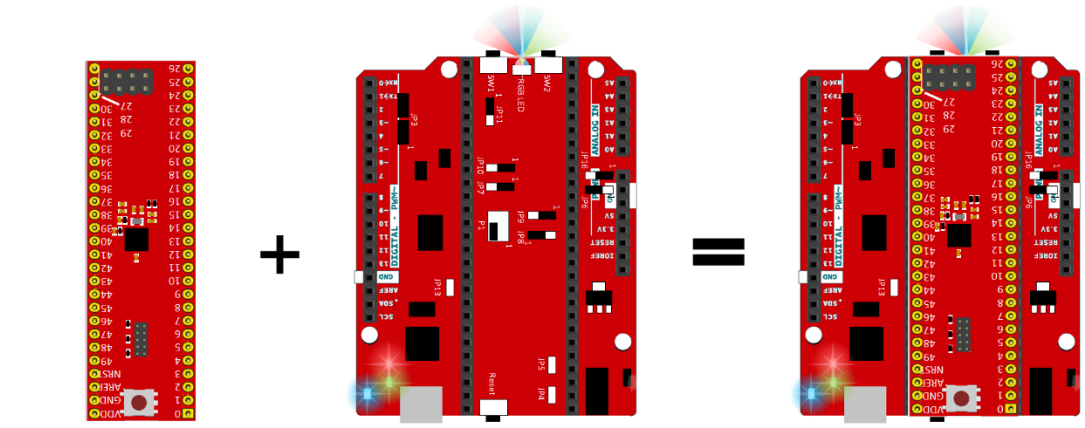


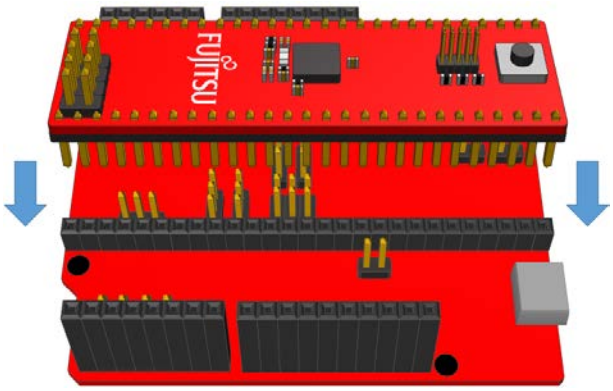
Apollo 1 Breakout: SK-AMAP1-BREAKOUT-V11
Apollo 2 Breakout: SK-AMAP2-BREAKOUT-V11

Baseboard: SK-AMAPOLLO-BASE-V11

Fujitsu Apollo Development Platform

The Fujitsu Apollo Evaluation Platform is compatible with Ambiq Micro Apollo 1 or Apollo 2. The platform consists of two parts: The breakout board and the base board. The breakout boards for Apollo 1 and Apollo 2 are pin-compatible but not totally functional compatibe. Therefore only some jumper settings need adjustment to setup the base board for Apollo 1 or Apollo 2 usage.

Both parts can easily plug together:



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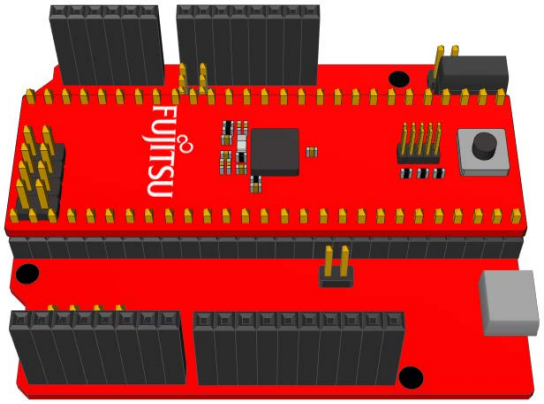
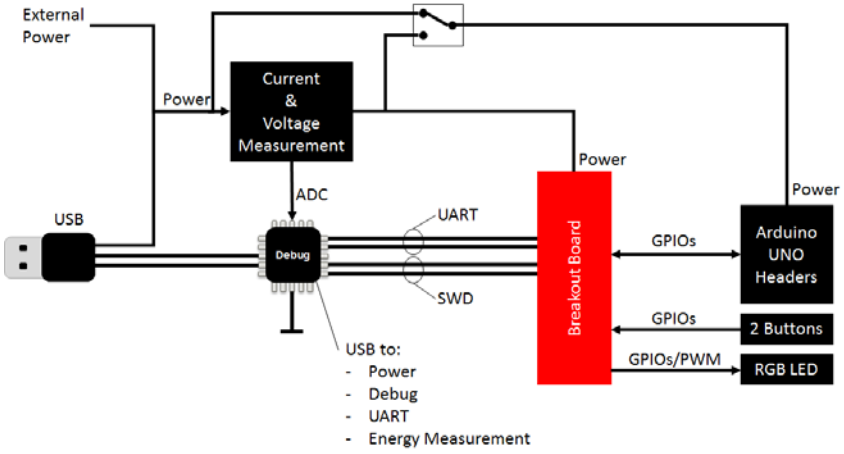
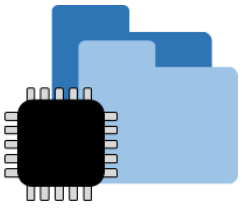




The Fujitsu Apollo Evaluation Platform includes a nano/micro power/energy measurement probe to enable easy power measurement via PC without the need of an expensive multi-meter or power probe. The on-board CMSIS-DAP compatible debugger works driverless with common toolchains like IAR Workbench or ARM/Keil µVision, but is also supported by a free-of-charge toolchain iSystem WinIDEA Open. For additional communication to the PC, the on-board CMSIS-DAP compatible chip “Fujitsu D-Bug” supports USB to UART conversion.

The Fujitsu Evaluation Platform includes additional software examples (based on MCU templates) to the Ambiq Micro’s SDK. It offers MCU Templates as a kind of a common project framework or software framework needed for developers to have an easy start in development with MCUs. Following IDEs are supported:

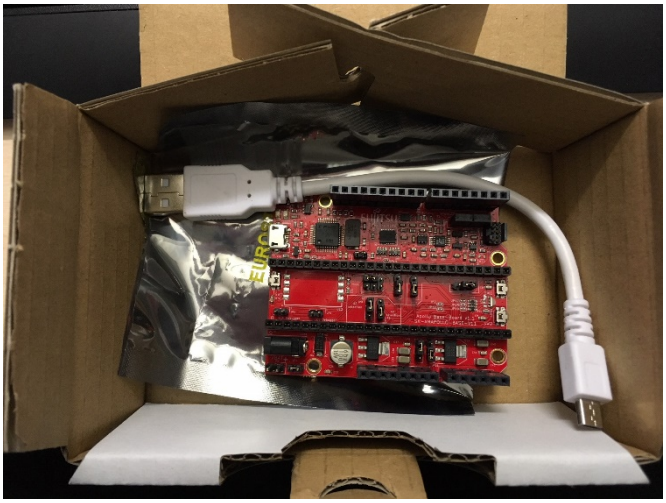


- ARM (Keil µVision)
- Atollic (Atollic TrueStudio)
- Eclipse
- emIDE
- iSYSTEM WinIDEA Open
- IAR (IAR Embedded Workb for ARM Cortex M)
- Makefile (GNU)

1 Introduction SK-APOLLO-BASE

The SK-AMAPOLLO-BASE-V11 evaluation board includes a low-cost evaluation board usable with FEEUs Ambiq Micro Apollo break-out boards SK-AMAP1-BREAKOUT-V11 (Apollo 1) and SK-AMAP2-BREAKOUT-V11 (Apollo 2).

1.1 Scope of delivery



- Apollo base–board SK-AMAPOLLO-BASE-V11 in ESD bag
- USB-Mico cable

Not scope of delivery: SK-AMAP1-BREAKOUT-V11 / SK-AMAP2-BREAKOUT-V11

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1.2 Overview

The SK-APOLLO-BASE is used with Apollo1 or Apollo2 breakout boards (not included). After setting the jumpers for Apollo 1 or Apollo 2 usage the following features of the baseboard can be used:

- Arduino UNO headers
  - 5 Analog pins (or digital pins)
  - 16 digital pins
  - I2C interface
  - SPI interface
- RGB LED
- 2 Buttons
- 1 Reset Button
- USB to Serial Wire Debug (SWD), CMSIS-DAP compatible
- USB to UART
- USB to power measurement

The breakout board itself has an additional “BLE” connector where an external BLE chip can be connected. For Apollo 1 only UART is supported by this connector. For Apollo 2 UART and SPI can be used.

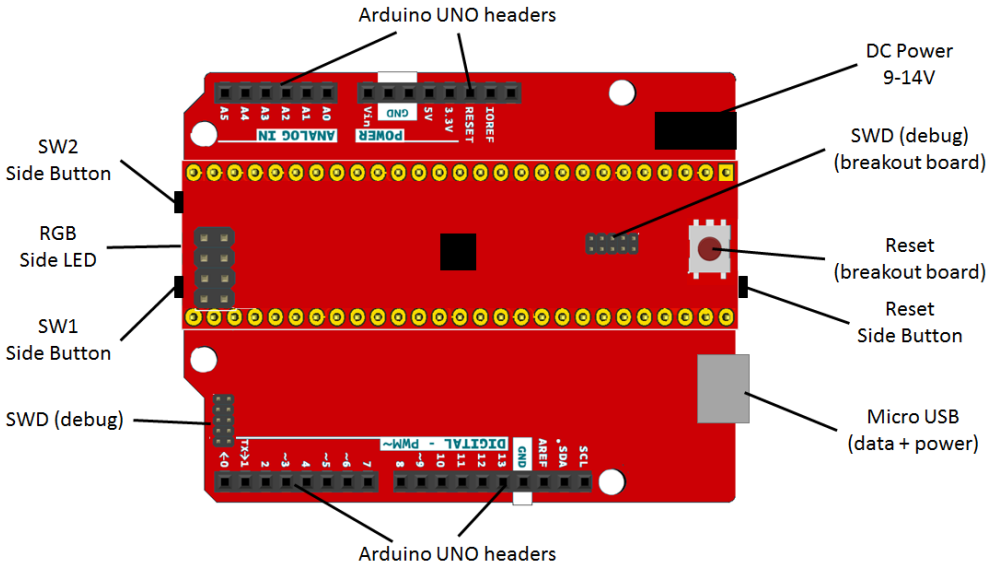


Figure 0-1: Overview EVK-Apollo-Baseboard

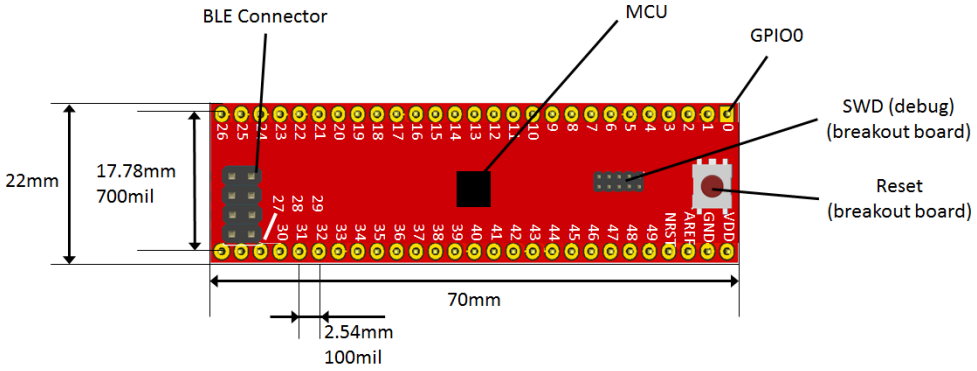


Figure 0-2: Apollo 1 / 2 Breakout-Board

2 Using the Hardware

Following schematic gives a rough overview how the breakout board is connected to the different functionalities:

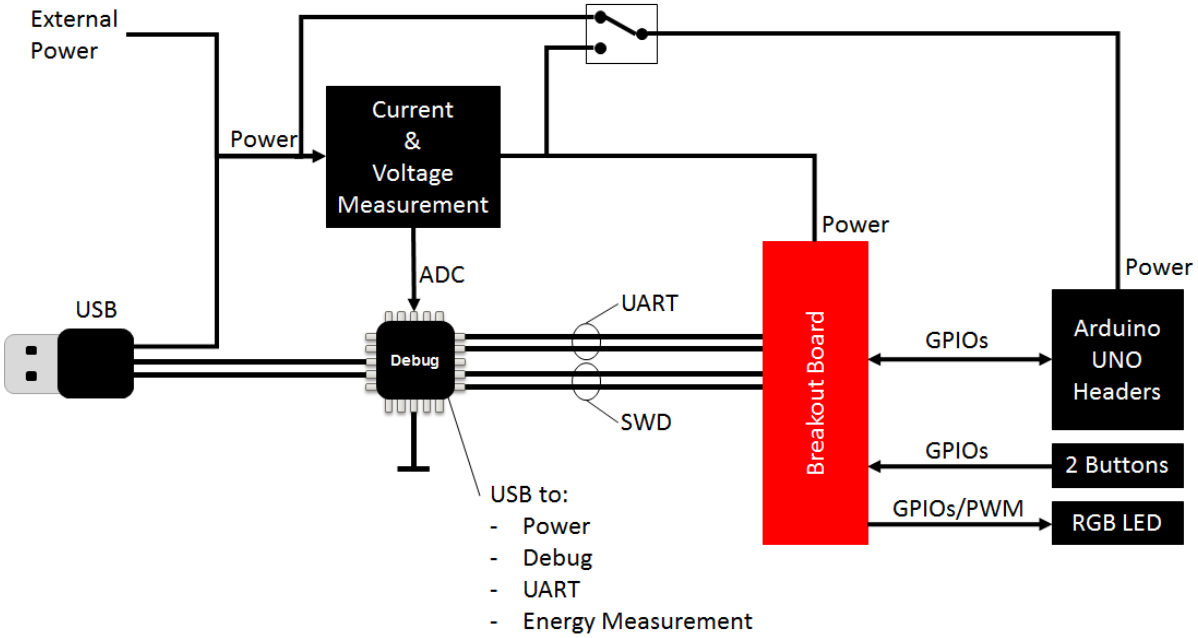
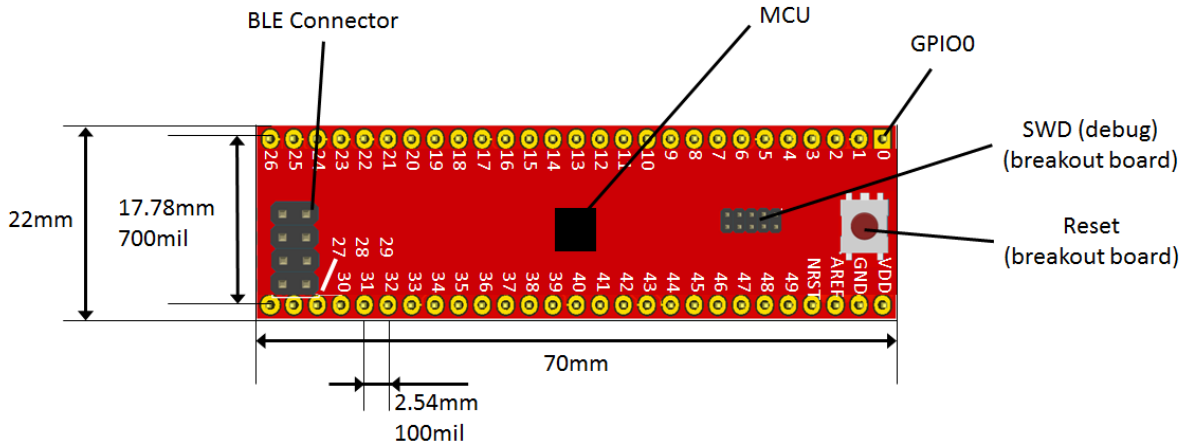


Figure 1-1: FEEU EVK-Apollo-Baseboard Features

2.1 The Breakout-Board



The breakout-board has assembled:

- 2x 27pin 2.54mm header: 50GPIOs, NRST, AREF, GND and VCC
- MCU (Apollo 1 or Apollo 2)
- Inductors for the DC/DC converter
- 32.768 KHz crystal
- ADC filter network
- Reset button
- SWD connector (Debug)

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- BLE connector (Apollo 1 UART only, Apollo 2 UART and SPI)

2.2 Getting started

(1) Check the jumpers as described in 2.1 Jumpers depending of the selected Apollo 1 or Apollo 2 breakout board.

(2) Insert the breakout board with the RESET button in direction of the Power / USB connector.

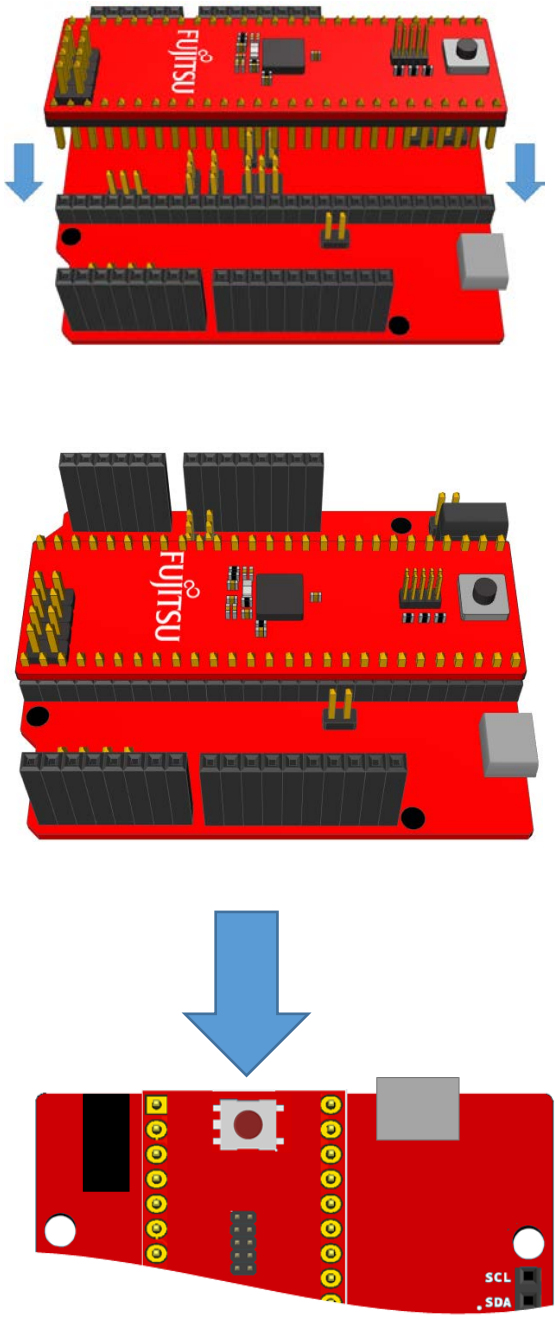

Figure 1-2: Breakout-Board Orientation

(3) Connect your board via the USB connector to power the EVK
   a. LED LD3 (blue) should turn on
   b. After a few seconds LED LD2 should start fading RED

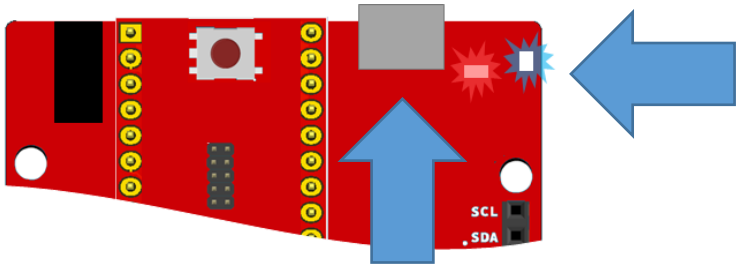

Figure 1-3: USB Connection

(4) Installing Drivers
   a. For Linux no drivers are needed
   b. For OS X no drivers are needed
   c. For Windows 10 no drivers are needed
   d. For Windows XP – 8 please download the driver package from the FEEU website

(5) Installing software (IDE)

   a. iSYSTEM WinIDEA Open (free of charge)
      i. http://www.isystem.com/download/winideaopen
   b. Atollic TrueStudio (free of charge / commercial)
      i. https://atollic.com/resources/download/
   c. IAR Embedded Workbench (commercial)
      i. EWARM 30-day Evaluation Version
         http://supp.iar.com/Download/SW/?item=EWARM-EVAL
      ii. EWARM 32K Kickstart Version
         http://supp.iar.com/Download/SW/?item=EWARM-KS32
   d. Keil µVision / ARM MDK (commercial)
      i. Evaluation Version
         https://www.keil.com/demo/eval/arm.htm

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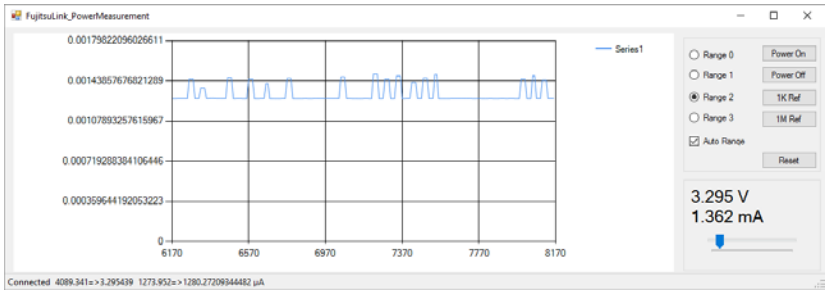
2.3 Power Measurement

2.3.1 On-Board Power Measurement

The on-board debug probe is supporting power measurement. Currently the firmware is still in development and will be supported by the latest ARM MDK / Keil µVison.

The FujitsuLink_PowerMeasurement tool can be used to visualize the power consumption without any DVM required.



2.3.2 Power Measurement via external DVM

Connect an external Multimeter to JP3 pin 2 (+) and 3 (-) to measure the current consumption of the MCU.

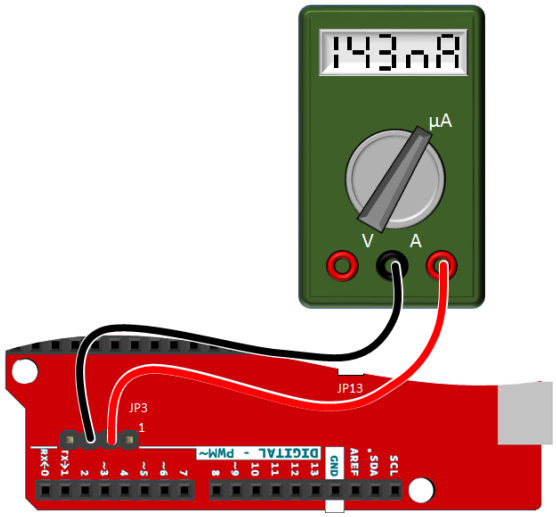


Figure 1-4: External DVM Connection

To measure also the power consumption of components at the Arduino shield, set JP16 to 2-3 position

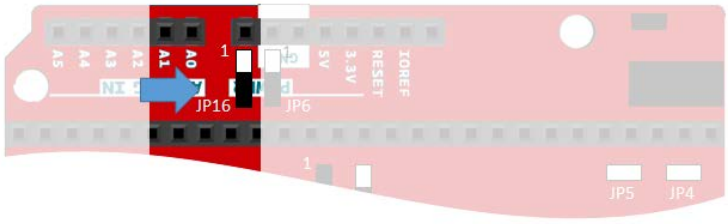


Figure 1-5: Include Arduino-Header in Power Measurement

2.4 USB to Serial

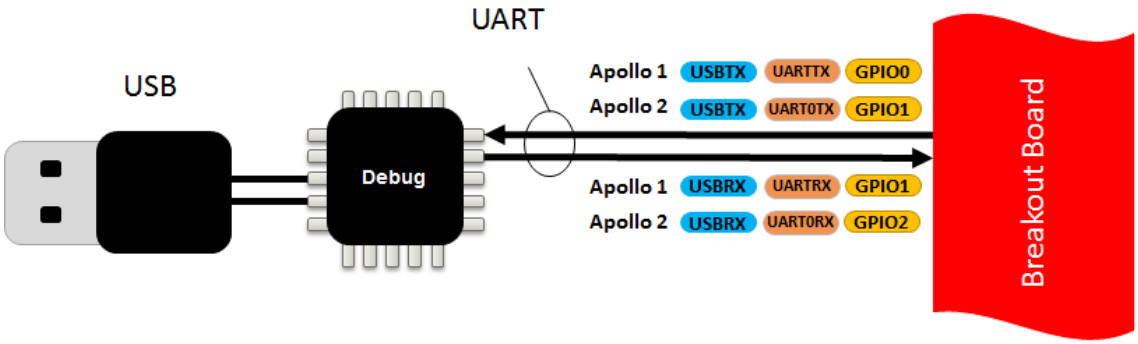


Figure 1-6: USB to UART Converter

To use the USB to serial converter, several serial options are possible. For UART the jumpers JP7 and P1 are used to set the correct usage.

For Apollo 1, JP7 must be 1-2 and P1 2-4:

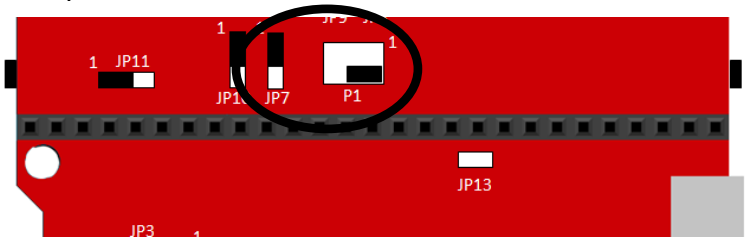


Figure 1-7: Apollo 1 jumper configuration for UART usage

With this jumper selection, GPIO0 is UARTTX and GPIO1 UARTRX.

For Apollo 2, JP7 must be 2-3 and P1 3-4:

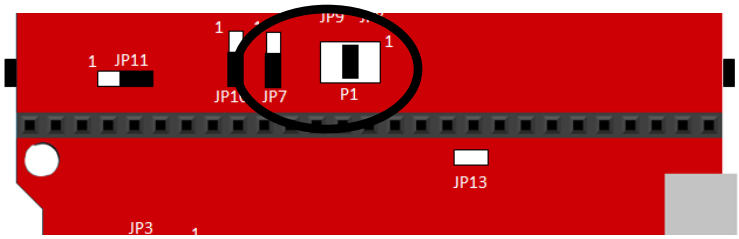


Figure 1-8: Apollo 2 jumper configuration for UART usage

With this jumper selection, GPIO1 is UARTTX and GPIO2 UARTRX.

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Start with the FEEU MCU Temlate for Apollo 1 or Apollo 2. Enable UART FEEU Low-Level-Driver for Apollo in *RTE_Device.h* (in *example**source**config*):

```
#define APOLLOUART_ENABLED 1
#define APOLLOGPIO ENABLED 1
```

Add *apollouart.c* and *apollogpio.c* to your project and include *apollouart.h and apollogpio.h* in you C-file. Following code gives an example how to poll the UART:

```
#include "mcu.h"
#include "apollogpio.h"
#include "apollouart.h"

#ifdef APOLLO2_H
    #define UART UART1
#endif

int main(void)
{
  char c;
#ifdef APOLLO2_H
  ApolloGpio_GpioSelectFunction(PIN_GPIO1,2); //use UART at GPIO1
  ApolloGpio_GpioSelectFunction(PIN_GPIO2,2); //use UART at GPIO2
#else
  ApolloGpio_GpioSelectFunction(PIN_GPIO0,2); //use UART at GPIO0
  ApolloGpio_GpioSelectFunction(PIN_GPIO1,2); //use UART at GPIO1
#endif

  ApolloUart_Init(UART,115200);

  ApolloUart_PutString(“Hello World!\r\n”);
  while(1)
  {
    if (ApolloUart_HasChar(UART))        //button SW1 is pressed
    {
      c = ApolloUart_GetChar(UART);
      ApolloUart_PutChar(UART,c);
    }
  }
}
```

2.5 User Buttons

User buttons are connected as followed:

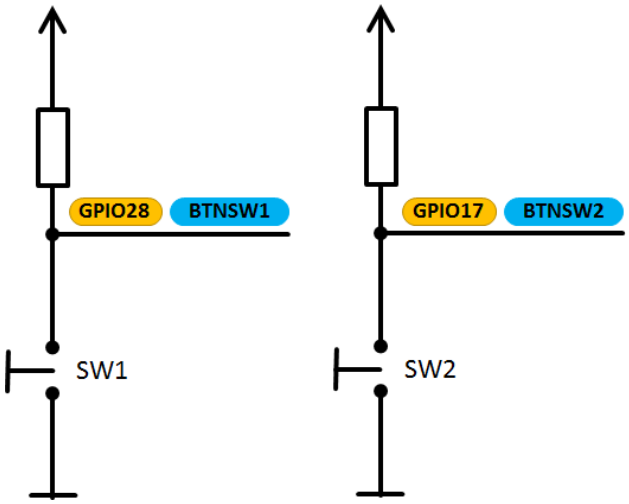

Figure 1-9: Buttons SW1 and SW2 at EVK-Apollo-Base

SW1 connects to GPIO28 and SW2 to GPIO17.

2.5.1 Drive buttons via GPIO

Start with the FEEU MCU Temlate for Apollo 1 or Apollo 2. Enable GPIO FEEU Low-Level-Driver for Apollo in *RTE_Device.h* (in *example**source**config*):

```
#define APOLLOGPIO ENABLED 1
```

Add *apollogpio.c* to your project and include *apollogpio.h* in you C-file. Following code gives an example how to poll the GPIO:

```
#include "mcu.h"
#include "apollogpio.h"

int main(void)
{
  ApolloGpio_GpioInputEnable(PIN_GPIO28,TRUE);    //set GPIO28
                                                  //to input
  ApolloGpio_GpioInputEnable(PIN_GPIO17,TRUE);    //set GPIO17
                                                  //to input

  while(1)
  {
    if (ApolloGpio_GpioIsSet(PIN_GPIO28)) //button SW1 is pressed
    {
      //do the script executing code
    }
  }
`
```

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2.5.2 Drive buttons via IRQ

Start with the FEEU MCU Temlate for Apollo 1 or Apollo 2. Enable GPIO FEEU Low-Level-Driver for Apollo in *RTE_Device.h* (in *example**source**config*):

```
#define APOLLOGPIO ENABLED 1
```

Add *apollogpio.c* to your project and include *apollogpio.h* in you C-file. Following code gives an example how to use GPIOs with callbacks:

```
#include "mcu.h"
#include "apollogpio.h"

static volatile boolean_t bSw1CallbackHappened = FALSE;
void Sw1_Callback(uint8_t u8Gpio)
{
  bSw1CallbackHappened = TRUE;
}

int main(void)
{
  ApolloGpio_RegisterIrq(PIN_GPIO28,
                         GpioFallingEdge,
                         Sw1_Callback);   //set GPIO28 to IRQ usage

  NVIC_ClearPendingIRQ(GPIO_IRQn);        //clear pending flag
  NVIC_EnableIRQ(GPIO_IRQn);              //enable IRQ
  NVIC_SetPriority(GPIO_IRQn,1);          //set priority of IRQ
                                          //smaller value means
                                          //higher priority

  while(1)
  {
    if (bSw1CallbackHappened)           //button SW1 is pressed
    {
      bSw1CallbackHappened = FALSE;
      //do the script executing code
    }
  }
}
```

2.6 RBG LED

The user RGB LED is connected as followed:

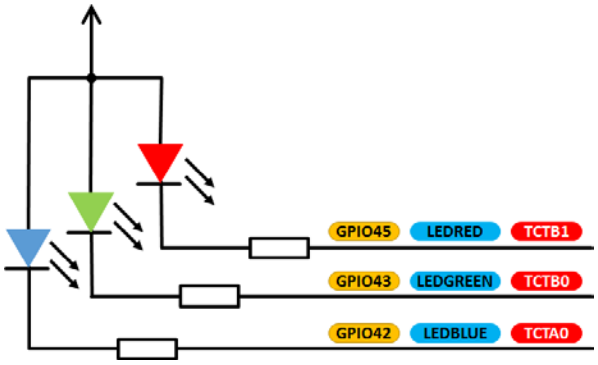

Figure 1-10: RGB LED at EVK-Apollo-Base

Start with the FEEU MCU Temlate for Apollo 1 or Apollo 2. Enable CTIMER FEEU Low-Level-Driver for Apollo in *RTE_Device.h* (in *example\source\config*):

```
#define APOLLOCTIMER_ENABLED 1
#define APOLLOGPIO_ENABLED   1
```

Add *apolloctimer.c* to your project and include *apolloctimer.h* in you C-file. Following code gives an example how to use a PWM to dim a LED:

```
#include "mcu.h"
#include "apollogctimer.h"

int main(void)
{
  ApolloCTimer_PwmInitByGpio(PIN_GPIO42,TRUE);  //set GPIO42
                                                //to PWM
  ApolloCTimer_PwmInitByGpio(PIN_GPIO43,TRUE); //set GPIO43
                                                //to PWM
  ApolloCTimer_PwmInitByGpio(PIN_GPIO46,TRUE); //set GPIO46 to
PWM


  ApolloCTimer_PwmSetDutyByGpio(42,0.5f); //set red LED to
                                          //50% duty cycle
  while(1)
  {
     __NOP();
  }
}
```

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2.7 Arduino Headers

Arduino functions can be used by just selecting the pin in the way ARDUINO_<FUNCTION>. Example:

Function A0: ARDUINO_A0, PIN_GPIO12 (for Apollo 1), PIN_GPIO16 (for Apollo 2)
Function RXD: ARDUINO_D0 or ARDUINO_RXD, PIN_GPIO36
Function SS: ARDUINO_D10, ARDUINO_SS, PIN_GPIO27
Function SDA: ARDUINO_D18, ARDUINO_SDA, PIN_GPIO6

A complete list is attached:

Arduino	**Function**	**Description**	**Apollo 1** Default Function	**Apollo 2** Default Function
NC		not connected		
IOREF		IO reference voltage		
RESET		Reset		
3.3V		3.3V	bold marked:	bold marked:
5V		5V	differences between	differences between
GND		GND	Apollo 1 / Apollo 2	Apollo 1 / Apollo 2
GND		GND		
Vin		Vin		
A0	A0	GPIO or Analogport A0	**GPIO12**/ADC0	**GPIO16**/ADCSE0
A1	A1	GPIO or Analogport A1	**GPIO13/ADC1**	**GPIO34/ADCSE6**
A2	A2	GPIO or Analogport A2	**GPIO14**/ADC2	**GPIO11**/ADCSE2
A3	A3	GPIO or Analogport A3	**GPIO31/ADC6**	**GPIO31/ADCSE3**
A4	A4	GPIO or Analogport A4	GPIO32/**ADC7**	GPIO32/**ADCSE4**
A5	A5	GPIO or Analogport A5	**GPIO30**/ADC5	**GPIO33**/ADCSE5
0/RXD	D0 or RXD	GPIO or UART RXD	GPIO36/**UARTRX**	GPIO36/**UART1RX**
1/TXD	D1 or TXD	GPIO or UART TXD	GPIO35/**UARTTX**	GPIO35/**UART1TX**
2	D2	GPIO or PWM0	GPIO25/TCTA0	GPIO25/TCTA0
3	D3	GPIO or PWM1	GPIO26/TCTB0	GPIO26/TCTB0
4	D4	GPIO or PWM2	GPIO18/TCTA1	GPIO18/TCTA1
5	D5	GPIO or PWM3	GPIO19/TCTB1	GPIO19/TCTB1
6	D6	GPIO or PWM4	GPIO46/TCTA2	GPIO46/TCTA2
7	D7	GPIO or PWM5	GPIO47/TCTB2	GPIO47/TCTB2
8	D8	GPIO or PWM6	GPIO48/TCTA3	GPIO48/TCTA3
9	D9	GPIO or PWM7	GPIO49/TCTB3	GPIO49/TCTB3
10/SS	D10 or SS	GPIO or Chipselect	GPIO27/M1nCE4	GPIO27/M1nCE4
11/MOSI	D11 or MOSI	GPIO or SPI MOSI	GPIO10/M1MOS	GPIO10/M1MOS
12/MISO	D12 or MISO	GPIO or SPI MISO	GPIO9/M1MISO	GPIO9/M1MISO
13/SCK	D13 or SCK	GPIO or SPI SCK	GPIO8/M1SCL	GPIO8/M1SCL
GND		GND		
AREF		Analog Reference		GPIO16
18/SDA	D18 or SDA	GPIO or I2C SDA	GPIO6/M0SDA	GPIO6/M0SDA
19/SCL	D19 or SCL	GPIO or I2C SCL	GPIO5/M0SCL	GPIO5/M0SCL

2.7.1 Using Digital IO

Digital IOs are available as A0…5 and D0..D13 and D18..19. Digital IOs can be also directly addressed by using GPIO0..49.

The Naming is: ARDUINO_A<x>, ARDUINO_D<y> or PIN_GPIO<z>

Start with the FEEU MCU Temlate for Apollo 1 or Apollo 2. Enable GPIO FEEU Low-Level-Driver for Apollo in *RTE_Device.h* (in *example**source**config*):

```
#define APOLLOGPIO ENABLED 1
```

Add *apollogpio.c* to your project and include *apollogpio.h* and *skamapollobase.h* in you C-file. Following code gives an example how to poll the GPIO:

```
#include "mcu.h"
#include "skamapollobase.h"
#include "apollogpio.h"

int main(void)
{
  ApolloGpio_GpioInputEnable(ARDUINO_D0,TRUE);
  ApolloGpio_GpioOutputEnable(ARDUINO_D1,TRUE);
  while(1)
  {
    if (ApolloGpio_GpioIsSet(ARDUINO_D0))
    {
      ApolloGpio_GpioSet(ARDUINO_D1);
    }
    else
    {
      ApolloGpio_GpioClear(ARDUINO_D1);
    }
  }
}
```

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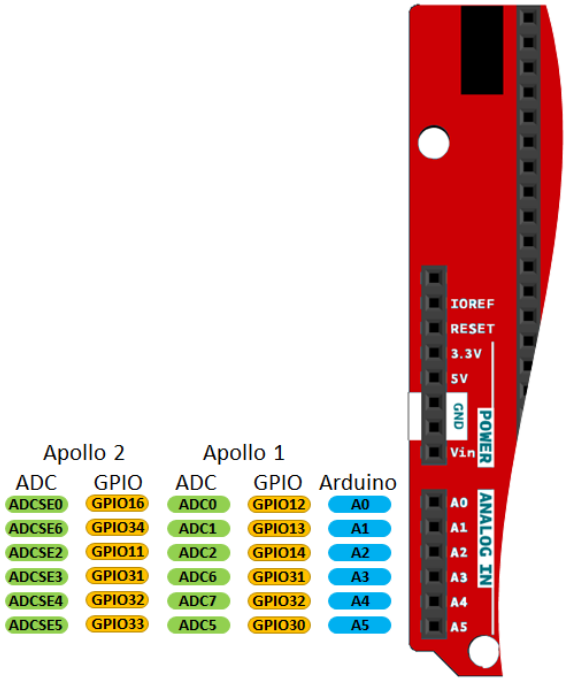
2.7.2 Using ADC



Digital IOs are available as A0…5.

The Naming is: ARDUINO_A<n>

Start with the FEEU MCU Temlate for Apollo 1 or Apollo 2. Enable GPIO FEEU Low-Level-Driver for Apollo in *RTE_Device.h* (in *example**source**config*):

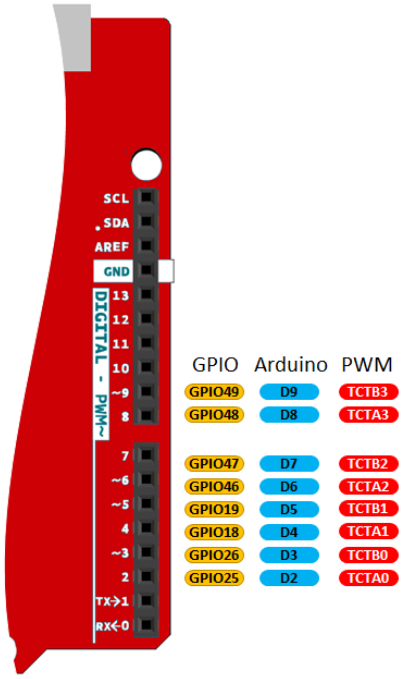
```
#define APOLLOADC_ENABLED 1
#define APOLLOGPIO_ENABLED 1
```

Add *apollogpio.c* and *apolloadc.c* to your project and include *apolloadc.h* and *skamapollobase.h* in you C-file. Following code gives an example how to poll the ADC:

```
#include "mcu.h"
#include "skamapollobase.h"
#include "apolloadc.h"

int main(void)
{
  float32_t f32AdcValue = 0.0f;
  while(1)
  {
    f32AdcValue = ApolloAdc_SimpleReadByPin(ARDUINO_A0);
  }
}
```

2.7.3 Using PWM



Start with the FEEU MCU Temlate for Apollo 1 or Apollo 2. Enable CTIMER FEEU Low-Level-Driver for Apollo in *RTE_Device.h* (in *example**source**config*):

```
#define APOLLOCTIMER_ENABLED 1
#define APOLLOGPIO_ENABLED   1
```

Add *apolloctimer.c* to your project and include *apolloctimer.h* and *skamapollobase.h* in you C-file. Following code gives an example how to use a PWM at D2:

```
#include "mcu.h"
#include "skamapollobase.h"
#include "apollogctimer.h"

int ain(void)
{
  ApolloCTimer_PwmInitByGpio(ARDUINO_D2,TRUE);
  ApolloCTimer_PwmSetDutyByGpio(ARDUINO_D2,0.5f);//set red LED to
                                                 //50% duty cycle
  while(1)
  {
     __NOP();
  }
}
```

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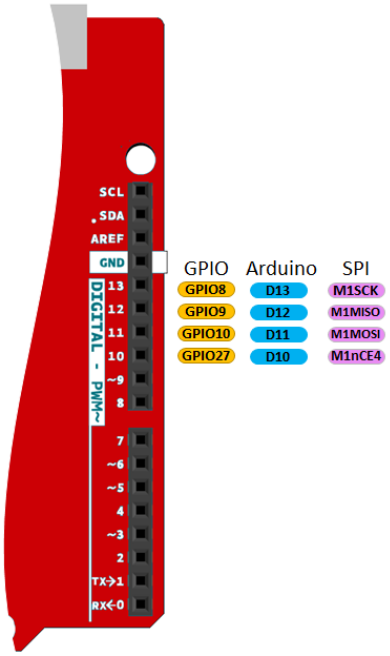
2.7.4 Using SPI



Start with the FEEU MCU Temlate for Apollo 1 or Apollo 2. Enable IOM FEEU Low-Level-Driver for Apollo in *RTE_Device.h* (in *example\source\config*):

```
#define IOMSTR1_ENABLED 1
#define APOLLOGPIO_ENABLED   1
```

Add *apolloiom.c* to your project and include *apolloiom.h* and *skamapollobase.h* in you C-file. Following code gives an example how to use the IOM:

```
#incude "mcu.h"
#include "skamapollobase.h"
#include "apolloiom.h"
#include "apollogpio.h"

const stc_apolloiom_config_t stcIomConfig = {
    IomInterfaceModeSpi, //use SPI mode
    15000000UL,           //frequency
    FALSE,               //SPHA setting
    FALSE,               //SPOL setting
    0,                   //WriteThreshold
    60                   //ReadThreshold
 };

int main(void)
{
  uint8_t b = 0xAA;
  ApolloIOM_Configure(IOMSTR1,&stcIomConfig);
  ApolloIOM_Enable(IOMSTR1);
  ApolloGpio_GpioOutputEnable(ARDUINO_SS,TRUE);

  CLEAR_GPIO(ARDUINO_SS); //set chipselect
  //send one byte
  ApolloIom_SpiWriteByte(IOMSTR1, 0, b, AM_HAL_IOM_RAW);
  //read one byte
  b = ApolloIom_SpiReadByte(IOMSTR1, 0, AM_HAL_IOM_RAW);
  SET_GPIO(ARDUINO_SS); //clear chipselect
  while(1)
  {
     __NOP();
  }
}
```

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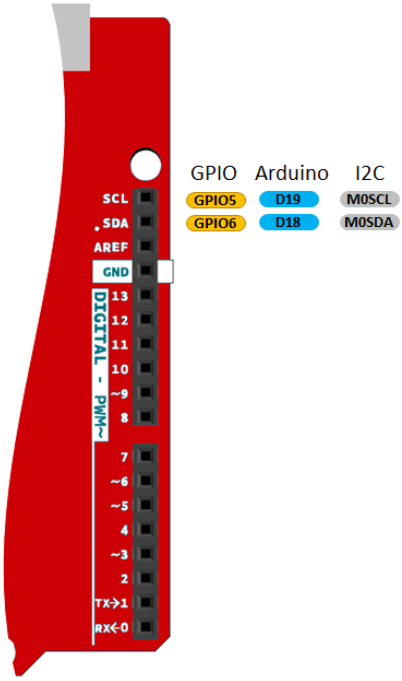
2.7.5 Using I2C



Start with the FEEU MCU Temlate for Apollo 1 or Apollo 2. Enable IOM FEEU Low-Level-Driver for Apollo in *RTE_Device.h* (in *example**source**config*):

```
#define IOMSTR0_ENABLED 1
#define APOLLOGPIO_ENABLED   1
```

Add *apolloiom.c* to your project and include *apolloiom.h* and *skamapollobase.h* in you C-file. Following code gives an example how to use the IOM:

```
#incude "mcu.h"
#include "skamapollobase.h"
#include "apolloiom.h"
#include "apollogpio.h"

const stc_apolloiom_config_t stcIomConfig = {
    IomInterfaceModeI2C, //use SPI mode
    400000UL,            //frequency
    FALSE,               //SPHA setting
    FALSE,               //SPOL setting
    0,                   //WriteThreshold
    60                   //ReadThreshold
 };

int main(void)
{
  uint8_t b = 0xAA;
  ApolloIOM_Configure(IOMSTR1,&stcIomConfig);
  ApolloIOM_Enable(IOMSTR1);
  ApolloGpio_GpioPullupEnable(BOARD_I2C_SCL_PIN,TRUE);
  ApolloGpio_GpioPullupEnable(ARDUINO_SDA,TRUE);
  ApolloGpio_GpioSelectPullup(ARDUINO_SCL,PullUp6K);
  ApolloGpio_GpioSelectPullup(ARDUINO_SDA,PullUp6K);
  ApolloGpio_GpioInputEnable(ARDUINO_SCL,TRUE);
  ApolloGpio_GpioInputEnable(ARDUINO_SDA,TRUE);
  ApolloGpio_GpioSelectFunction(ARDUINO_SCL _PIN,
                                ARDUINO_SCL_FUNC);
  ApolloGpio_GpioSelectFunction(ARDUINO_SDA,
                                ARDUINO_SDA_FUNC);

  // Writing 1 byte data for address 5, register 0x11
  ApolloIom_I2CWriteRegister(IOMSTR1,0x05,0x11,&b,1);

  // Reading 1 byte data for address 5, register 0x11
  ApolloIom_I2CReadRegister(IOMSTR1,0x05,0x11,&b,1);
  while(1)
  {
     __NOP();
  }
}
```

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3 Connectors

Note:

All data and power supply lines connected to this starter kit should be kept as short as possible, with a maximum allowable length of 3m. Shielded cables should be used for data lines. As a rule of thumb, the cable length used when connecting external circuitry to the MCU pin header connectors for example should be less than 20cm. Longer cables may affect EMC performance and cause radio interference.

3.1 Jumpers

Jumper	Description	Default	Options
JP6	Set the power source	2-3	1-2: Power via DC-in 2-3: Power via Debug-USB-Port
JP1	Remove for VBAT usage	closed	Open for VBAT usage
JP10	Arduino A1 Selection	Apollo1: 1-2 Apollo2: 2-3	1-2 GPI013/ADC1 (Apollo) 2-3 GPI037/ADC6 (Apollo 2)
JP10	Arduino A5 Selection	Apollo1: 1-2 Apollo2: 2-3	1-2 GPI030/ADC5 (Apollo) 2-3 GPI033/ADC5 (Apollo 2)
JP12	Solder Jumper, SWDCLK	closed	
JP13	Debugger Program Mode	open	closed: start in USB programming mode
JP14	Solder Jumper, SWO	closed	
JP15	Solder Jumper, Reset	closed	
JP16	Select power delivery Arduino headers	1-2	1-2: Direct via 3.3V 2-3: Include to power measurement
JP17	RGB LED (Red)	closed	
JP18	RGB LED (Red)	closed	
JP19	RGB LED (Red)	closed	
JP2	Solder Jumper, SWDIO	closed	
JP3	Select current probe	1-2,3-4	1-2,3-4: Current probe via shunt 2-3: No current Measurement, no shunt
JP4	Debugger I2C and SPI mode	open	closed in I2C and SPI mode
JP5	Debugger SPI mode	open	closed in SPI mode
JP7	Debugger Apollo 1 / 2 UART mode	Apollo1: 1-2 Apollo2: 2-3	Apollo: 1-2 I2C, UART Apollo 2: 1-2 I2C, SPI-Master Apollo: 2-3 SPI-Slave Apollo 2: 2-3 SPI-Slave, UART
JP8	Arduino A2 Selection	Apollo1: 1-2 Apollo2: 2-3	1-2 GPI014/ADC2 (Apollo) 2-3 GPI011/ADC2 (Apollo 2)
JP9	Arduino A0 Selection	Apollo1: 1-2 Apollo2: 2-3	1-2 GPI012/ADC0 (Apollo) 2-3 GPI016/ADC0 (Apollo 2)
P1	Debugger Apollo 1 / 2 UART mode	Apollo: 2-4 UART Apollo 2: 3-4 UART	Apollo: 3-4 SPI, 2-4 UART Apollo 2: 3-4 SPI-Slave, 3-4 UART, 4-6 SPI-Master

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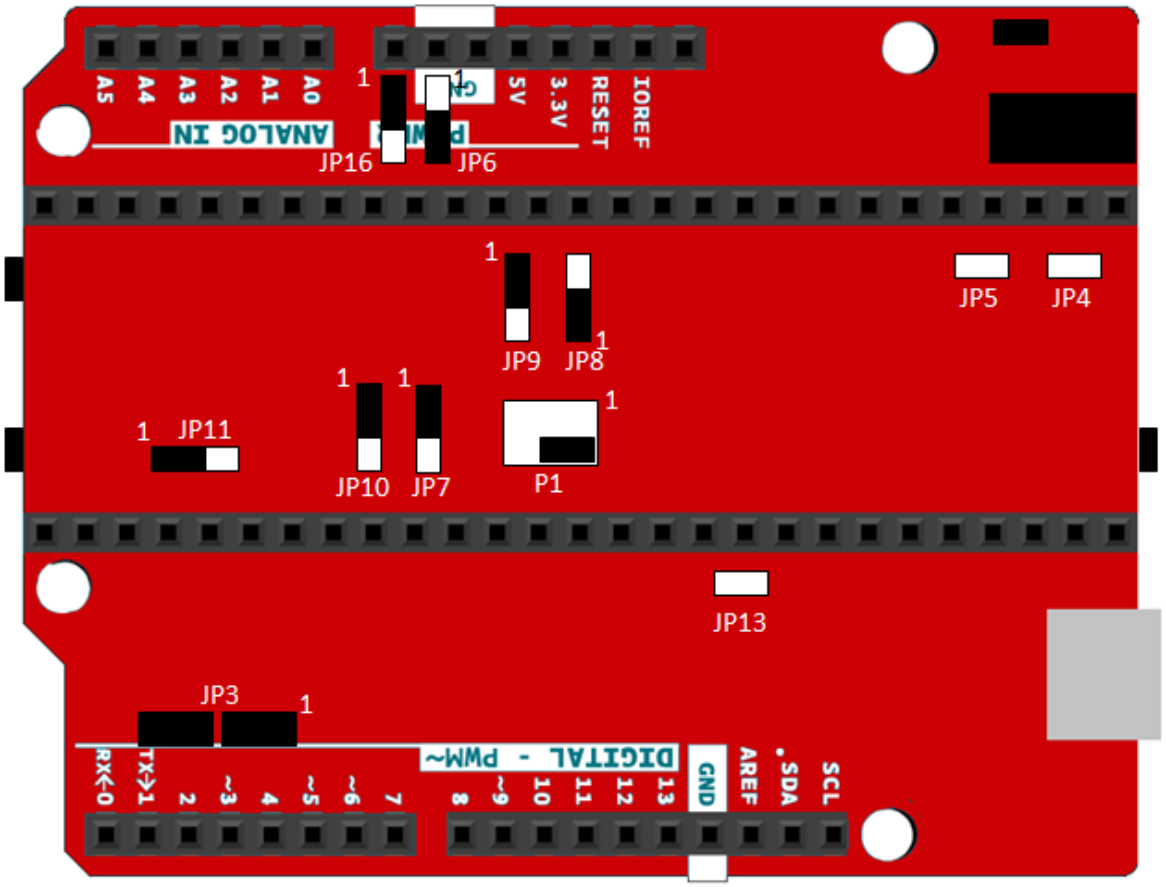
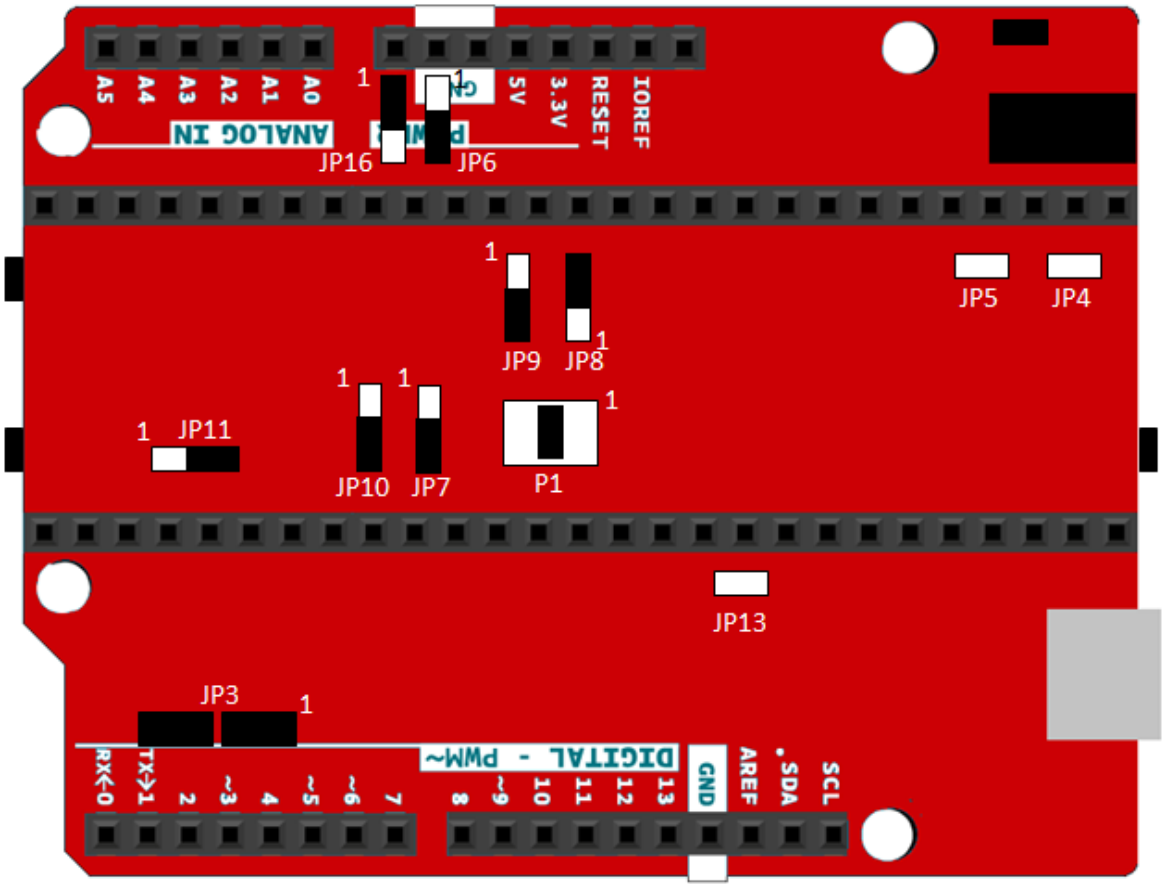
3.1.1 Apollo 1 Jumper Configuration



3.1.2 Apollo 2 Jumper Configuration



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3.2 GPIO Connection

3.2.1 Apollo 1 GPIO Connection

GPIO	Usage	GPIO	Usage
GPIO0	Debugger SCL / SCK / RXD	GPIO37	-
GPIO1	Debugger SDA / MOSI / TXD	GPIO38	-
GPIO2	Debugger MISO	GPIO39	BLE Connector UARTTX
GPIO3	Debugger CS	GPIO40	BLE Connector UARTRX
GPIO4	BLE Connector PWR	GPIO41	Debug - SWO
GPIO5	Arduino pin 19, I2C SCL	GPIO42	RGB LED - Red
GPIO6	Arduino pin 19, I2C SDA	GPIO43	RGB LED - Green
GPIO7	-	GPIO44	BLE Connector
GPIO8	Arduino pin 13, SPI SCK	GPIO45	RGB LED - Blue
GPIO9	Arduino pin 12, SPI MISO	GPIO46	Arduino pin 6
GPIO10	Arduino pin 11, SPI MOSI	GPIO47	Arduino pin 7
GPIO11	-	GPIO48	Arduino pin 8
GPIO12	Arduino A0	GPIO49	Arduino pin 9
GPIO13	Arduino A1		
GPIO14	Arduino A2		
GPIO15	-		
GPIO16	-		
GPIO17	Button SW2		
GPIO18	Arduino pin 4		
GPIO19	Arduino pin 5		
GPIO20	Debug - SWDCLK		
GPIO21	Debug - SWDIO		
GPIO22	-		
GPIO23	BLE Connector		
GPIO24	BLE Connector		
GPIO25	Arduino pin 2		
GPIO26	Arduino pin 3		
GPIO27	Arduino pin 10, SPI CS		
GPIO28	Button SW1		
GPIO29	BLE Connector		
GPIO30	Arduino A5		
GPIO31	Arduino A3		
GPIO32	Arduino A4		
GPIO33	-		
GPIO34	-		
GPIO35	Arduino pin 1, UART TX		
GPIO36	Arduino pin 0, UART RX		

3.2.2 Apollo 2 GPIO Connection

GPIO	Usage	GPIO	Usage
GPIO0	Debugger SCL / SCK	GPIO39	BLE Connector UARTTX/SCK
GPIO1	Debugger SDA / MOSI / RXD	GPIO40	BLE Connector UARTRX/MISO
GPIO2	Debugger MISO / TXD	GPIO41	Debug - SWO
GPIO3	Debugger CS	GPIO42	RGB LED - Red
GPIO4	-	GPIO43	RGB LED - Green
GPIO5	Arduino pin 19, I2C SCL	GPIO44	BLE Connector RTS/MOSI
GPIO6	Arduino pin 19, I2C SDA	GPIO45	RGB LED - Blue
GPIO7	-	GPIO46	Arduino pin 6
GPIO8	Arduino pin 13, SPI SCK	GPIO47	Arduino pin 7
GPIO9	Arduino pin 12, SPI MISO	GPIO48	Arduino pin 8
GPIO10	Arduino pin 11, SPI MOSI	GPIO49	Arduino pin 9
GPIO11	Arduino A2		
GPIO12	-		
GPIO13	-		
GPIO14	-		
GPIO15	-		
GPIO16	Arduino A0		
GPIO17	Button SW2		
GPIO18	Arduino pin 4		
GPIO19	Arduino pin 5		
GPIO20	Debug - SWDCLK		
GPIO21	Debug - SWDIO		
GPIO22	BLE Connector PWR		
GPIO23	BLE Connector		
GPIO24	BLE Connector		
GPIO25	Arduino pin 2		
GPIO26	Arduino pin 3		
GPIO27	Arduino pin 10, SPI CS		
GPIO28	Button SW1		
GPIO29	BLE Connector CTS/CE		
GPIO30	-		
GPIO31	Arduino A3		
GPIO32	Arduino A4		
GPIO33	Arduino A5		
GPIO34	Arduino A1		
GPIO35	Arduino pin 1, UART TX		
GPIO36	Arduino pin 0, UART RX		
GPIO37	-		
GPIO38	-		

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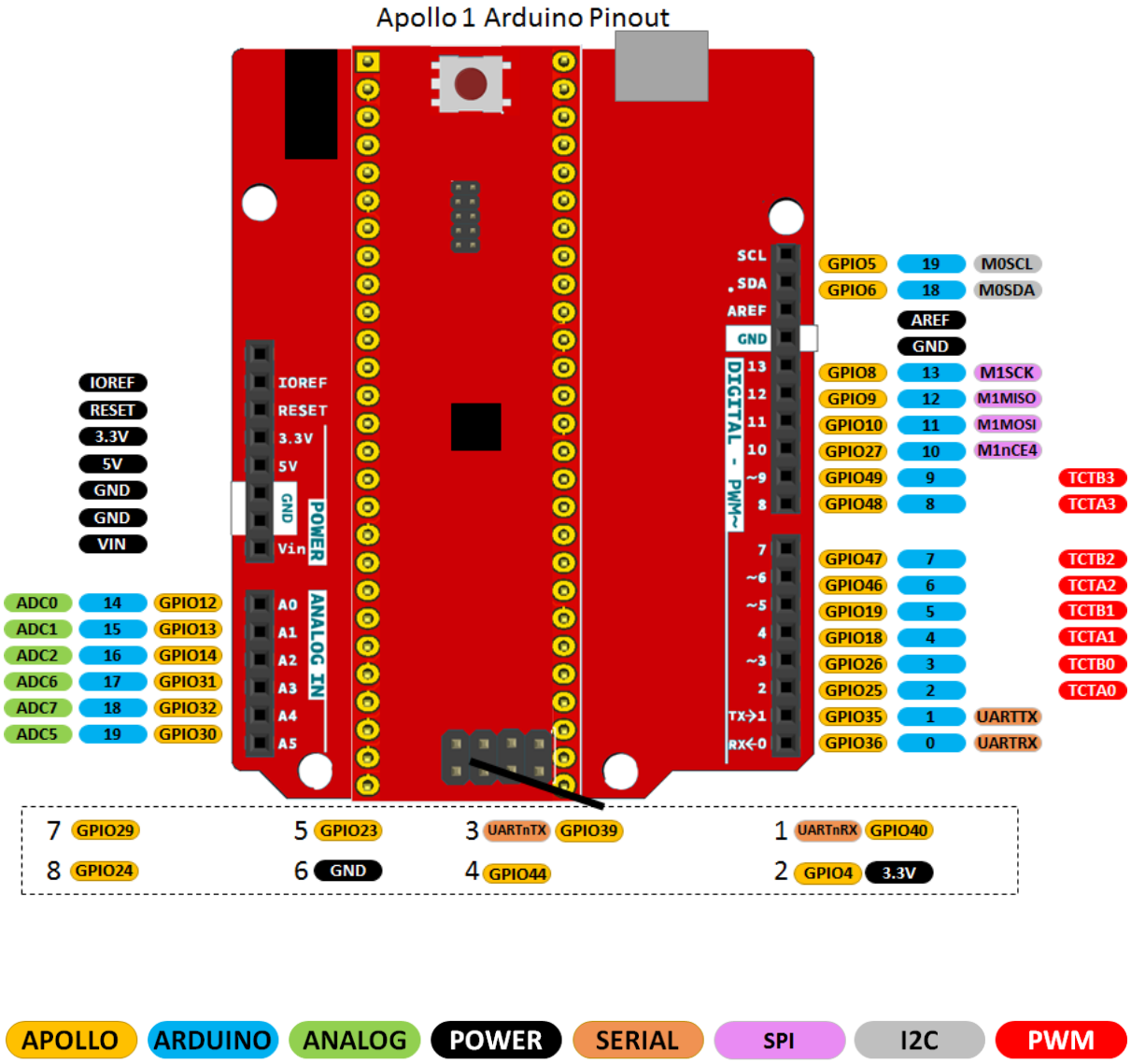
3.3 Arduino Header

3.3.1 Apollo 1 Arduino Header



Arduino	Function	Apollo 1 Default Function	Func 0	Func 1	Func 2	Func 3	Func 7
NC	not connected	bold marked: differences between Apollo 1 / Apollo 2	red marked: default usage				
IOREF	IO reference voltage						
RESET	Reset						
3.3V	3.3V						
5V	5V						
GND	GND						
GND	GND						
Vin	Vin						
A0	GPIO or Analogport A0	**GPIO12**/ADC0	ADC0 [A]	M1nCE0	TCTA0	GPIO12	
A1	GPIO or Analogport A1	**GPIO13/ADC1**	ADC1 [A]	M1nCE1	TCTB0	GPIO13	SWO (O)
A2	GPIO or Analogport A2	**GPIO14**/ADC2	ADC2 [A]	M1nCE2	UARTTX [O]	GPIO14	
A3	GPIO or Analogport A3	**GPIO31/ADC6**	ADC6 [A]	M0nCE4	TCTA3	GPIO31	
A4	GPIO or Analogport A4	GPIO32/**ADC7**	ADC7 [A]	M0nCE5	TCTB3	GPIO32	
A5	GPIO or Analogport A5	**GPIO30**/ADC5	ADC5 [A]	M1nCE7	TCTB2	GPIO30	
0/RXD	GPIO or UART RXD	GPIO36/**UARTRX**		M1nCE1	UARTRX [I]	GPIO36	
1/TXD	GPIO or UART TXD	GPIO35/**UARTTX**		M1nCE0	UARTTX [O]	GPIO35	
2	GPIO or PWM0	GPIO25/TCTA0		M0nCE2	TCTA0	GPIO25	
3	GPIO or PWM1	GPIO26/TCTB0		M0nCE3	TCTB0	GPIO26	
4	GPIO or PWM2	GPIO18/TCTA1	CMPAD1 [A]	M0nCE2	TCTA1	GPIO18	
5	GPIO or PWM3	GPIO19/TCTB1	CMPRF0 [A]	M0nCE3	TCTB1	GPIO19	
6	GPIO or PWM4	GPIO46/TCTA2		M0nCE4	TCTA2	GPIO46	
7	GPIO or PWM5	GPIO47/TCTB2		M0nCE5	TCTB2	GPIO47	
8	GPIO or PWM6	GPIO48/TCTA3		M0nCE6	TCTA3	GPIO48	
9	GPIO or PWM7	GPIO49/TCTB3		M0nCE7	TCTB3	GPIO49	
10/SS	GPIO or Chipselect	GPIO27/M1nCE4		M1nCE4	TCTA1	GPIO27	
11/MOSI	GPIO or SPI MOSI	GPIO10/M1MOS	M1WIR3 [S]	M1MOSI [O]	M0nCE6	GPIO10	
12/MISO	GPIO or SPI MISO	GPIO9/M1MISO	M1SDA [S]	M1MISO [I]	M0nCE5	GPIO9	
13/SCK	GPIO or SPI SCK	GPIO8/M1SCL	M1SCL [S]	M1SCK [O]	M0nCE4	GPIO8	
GND	GND						
AREF	Analog Reference						
18/SDA	GPIO or I2C SDA	GPIO6/M0SDA	M0SDA [S]	M0MISO [I]	UACTS [I]	GPIO6	
19/SCL	GPIO or I2C SCL	GPIO5/M0SCL	M0SCL [S]	M0SCK[O]	UARTS [O]	GPIO5	

IOS	IO Slave	UART1	UART1
IOM0	IO Master 0	UART0	UART0
IOM1	IO Master 1	TCT	Counter/Timers
IOM2	IO Master 2	CLKOUT	Clock output
IOM3	IO Master 3	GPIO	GPIO (* = Power Switch included)
IOM4	IO Master 4	Debug	Debug/Special
IOM5	IO Master 5	LOOPBACK	Loopback
Analog	Analog Modules (ADC, VCOMP)	Audio	Audio

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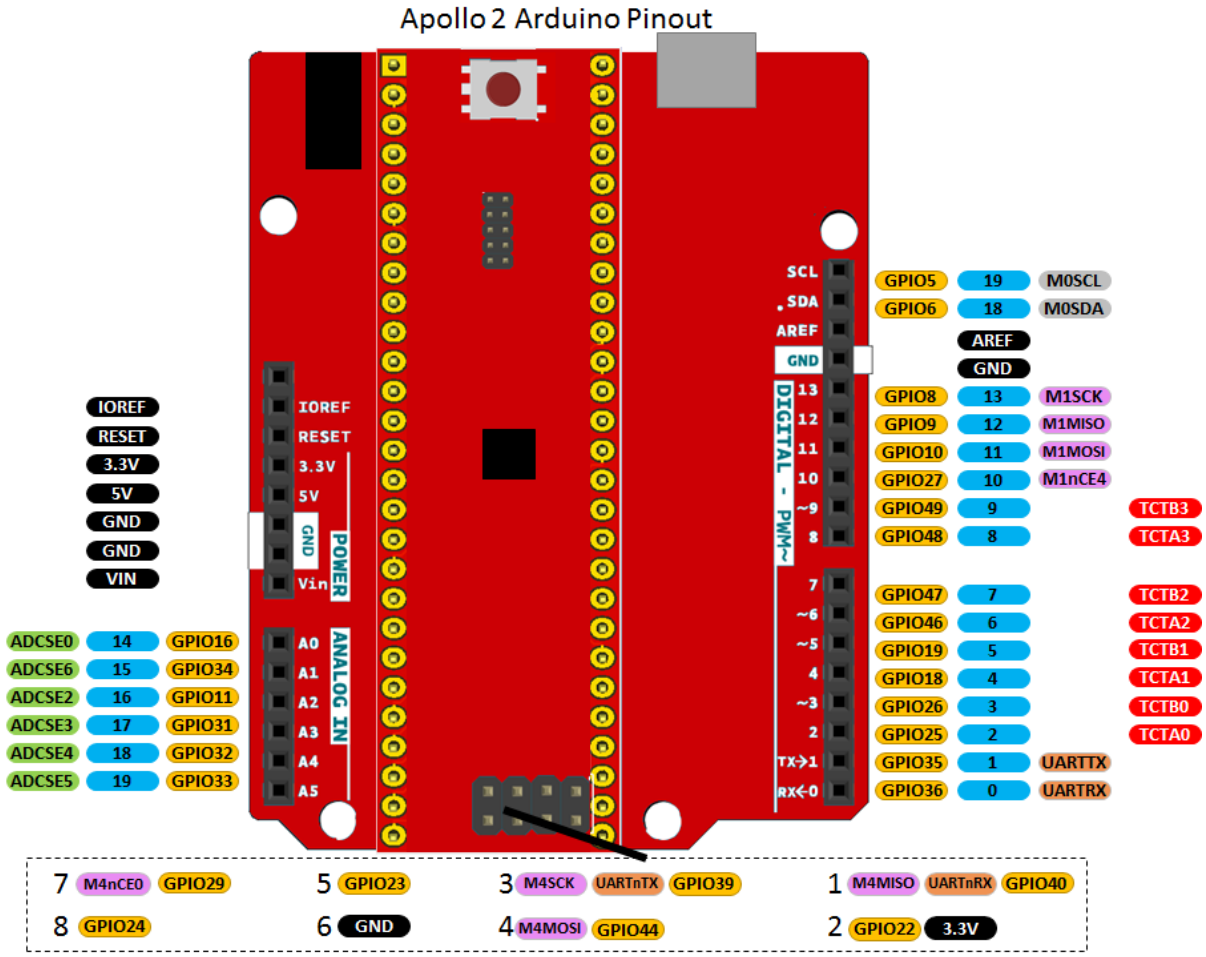
3.3.2 Apollo 2 Arduino Header



APOLLO ARDUINO ANALOG POWER SERIAL SPI I2C PWM

Arduino	Function	Apollo 2 Default Function	Func 0	Func 1	Func 2	Func 3	Func 4	Func 5	Func 6	Func 7
NC	not connected	bold marked: differences between Apollo 1 / Apollo 2	red marked: default usage							
IOREF	IO reference voltage									
RESET	Reset									
3.3V	3.3V									
5V	5V									
GND	GND									
GND	GND									
Vin	Vin									
A0	GPIO or Analogport A0	**GPIO16**/ADCSE0	ADCSE0	M0nCE4	TRIG0	GPIO16	M2nCE3	CMPIN0	UART0TX	UA1RTS
A1	GPIO or Analogport A1	**GPIO34/ADCSE6**	ADCSE6	M0nCE7	M2nCE3	GPIO34	CMPRF2	M3nCE1	M4nCE0	M5nCE2
A2	GPIO or Analogport A2	**GPIO11**/ADCSE2	ADCSE2	M0nCE0	CLKOUT	GPIO11	M2nCE7	UA1CTS	UART0RX	PDM_DATA
A3	GPIO or Analogport A3	**GPIO31/ADCSE3**	ADCSE3	M0nCE4	TCTA3	GPIO31	UART0RX	TCTB1		
A4	GPIO or Analogport A4	GPIO32/**ADCSE4**	ADCSE4	M0nCE5	TCTB3	GPIO32		TCTB1		
A5	GPIO or Analogport A5	**GPIO33**/ADCSE5	ADCSE5	M0nCE6	32KHz_XT	GPIO33		M3nCE7	TCTB1	SWO
0/RXD	GPIO or UART RXD	GPIO36/**UART1RX**	TRIG1	M1nCE1	UART1RX	GPIO36	32KHz_XT	M2nCE0	UA0CTS	M3nCE3
1/TXD	GPIO or UART TXD	GPIO35/**UART1TX**	ADCSE7	M1nCE0	UART1TX	GPIO35	M4nCE6	TCTA1	UA0RTS	M3nCE2
2	GPIO or PWM0	GPIO25/TCTA0	EXTXT	M0nCE2	TCTA0	GPIO25	M2SDA	M2MISO		
3	GPIO or PWM1	GPIO26/TCTB0	EXTLF	M0nCE3	TCTB0	GPIO26	M2nCE0	TCTA1	M5nCE1	M3nCE0
4	GPIO or PWM2	GPIO18/TCTA1	CMPIN1	M0nCE2	TCTA1	GPIO18	M4nCE1	ANATEST2	UART1TX	32KHz_XT
5	GPIO or PWM3	GPIO19/TCTB1	CMPRF0	M0nCE3	TCTB1	GPIO19	TCTA1	ANATEST1	UART1RX	I2S_BCLK
6	GPIO or PWM4	GPIO46/TCTA2	32KHz_XT	M0nCE4	TCTA2	GPIO46	TCTA1	M5nCE4	M4nCE4	SWO
7	GPIO or PWM5	GPIO47/TCTB2	M2nCE5	M0nCE5	TCTB2	GPIO47	M5WIR3	M5MOSI	M4nCE5	
8	GPIO or PWM6	GPIO48/TCTA3	M2nCE6	M0nCE6	TCTA3	GPIO48	M5SCL	M5SCK		
9	GPIO or PWM7	GPIO49/TCTB3	M2nCE7	M0nCE7	TCTB3	GPIO49	M5SDA	M5MISO		
10/SS	GPIO or Chipselect	GPIO27/M1nCE4	EXTHF	M1nCE4	TCTA1	GPIO27	M2SCL	M2SCK		
11/MOSI	GPIO or SPI MOSI	GPIO10/M1MOS	M1WIR3	M1MOSI	M0nCE6	GPIO10	M2nCE6	UA1RTS	M4nCE4	
12/MISO	GPIO or SPI MISO	GPIO9/M1MISO	M1SDA	M1MISO	M0nCE5	GPIO09	M4nCE5		UART1RX	
13/SCK	GPIO or SPI SCK	GPIO8/M1SCL	M1SCL	M1SCK	M0nCE4	GPIO08	M2nCE4		UART1TX	
GND	GND									
AREF	Analog Reference	GPIO16	ADCSE0	M0nCE4	TRIG0	GPIO16	M2nCE3	CMPIN0	UART0TX	UA1RTS
18/SDA	GPIO or I2C SDA	GPIO6/M0SDA	M0SDA	M0MISO	UA0CTS	GPIO06		M1nCE0		I2S _DAT
19/SCL	GPIO or I2C SCL	GPIO5/M0SCL	M0SCL	M0SCK	UA0RTS	GPIO05		EXTHFA		M1nCE2

IOS	IO Slave	UART1	UART1
IOM0	IO Master 0	UART0	UART0
IOM1	IO Master 1	TCT	Counter/Timers
IOM2	IO Master 2	CLKOUT	Clock output
IOM3	IO Master 3	GPIO	GPIO (* = Power Switch included)
IOM4	IO Master 4	Debug	Debug/Special
IOM5	IO Master 5	LOOPBACK	Loopback
Analog	Analog Modules (ADC, VCOMP)	Audio	Audio

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4 Appendix

4.1 Schematics

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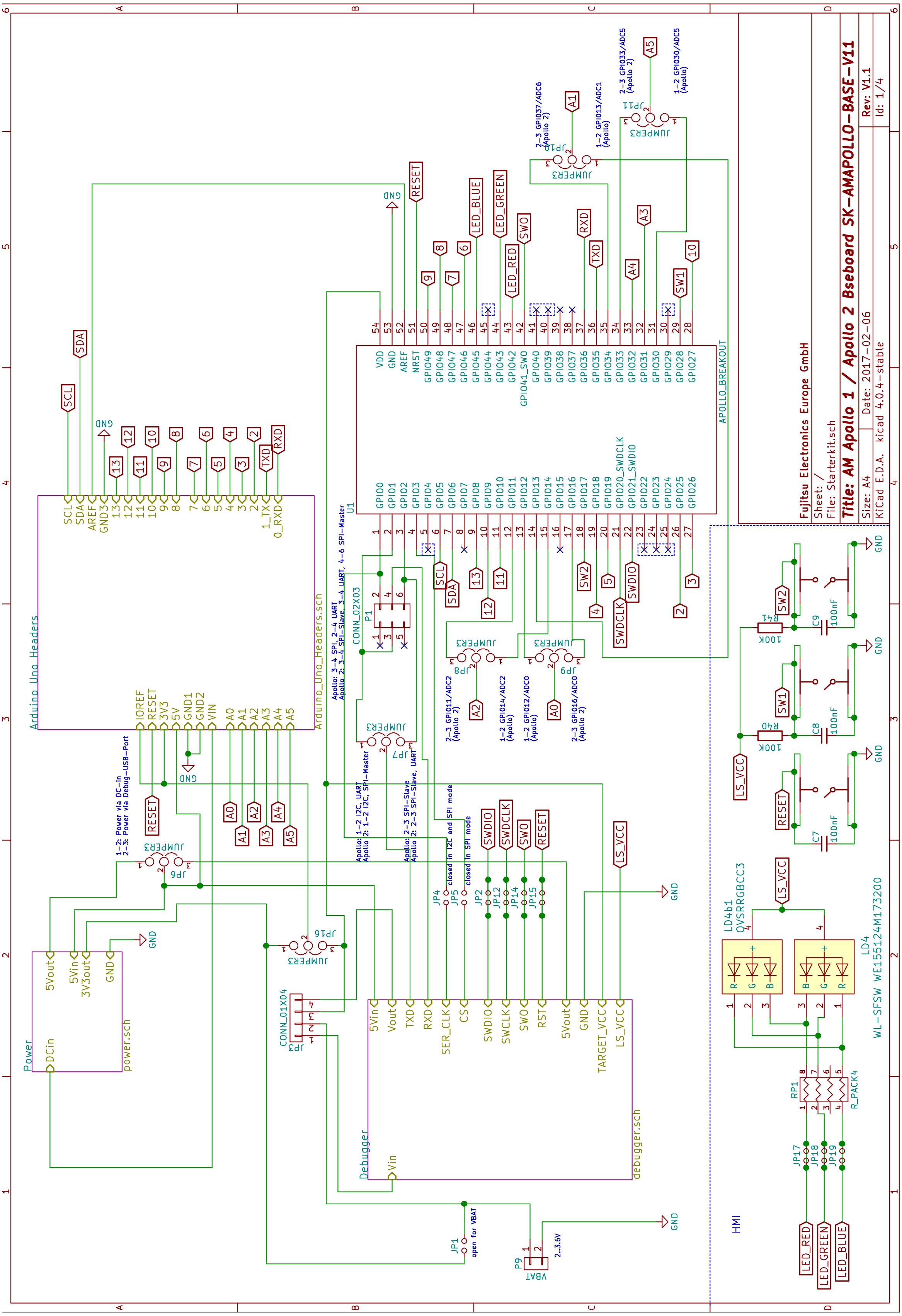
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APOLLO_BREAKOUT
Power
power.sch
Debugger
debugger.sch
HMI

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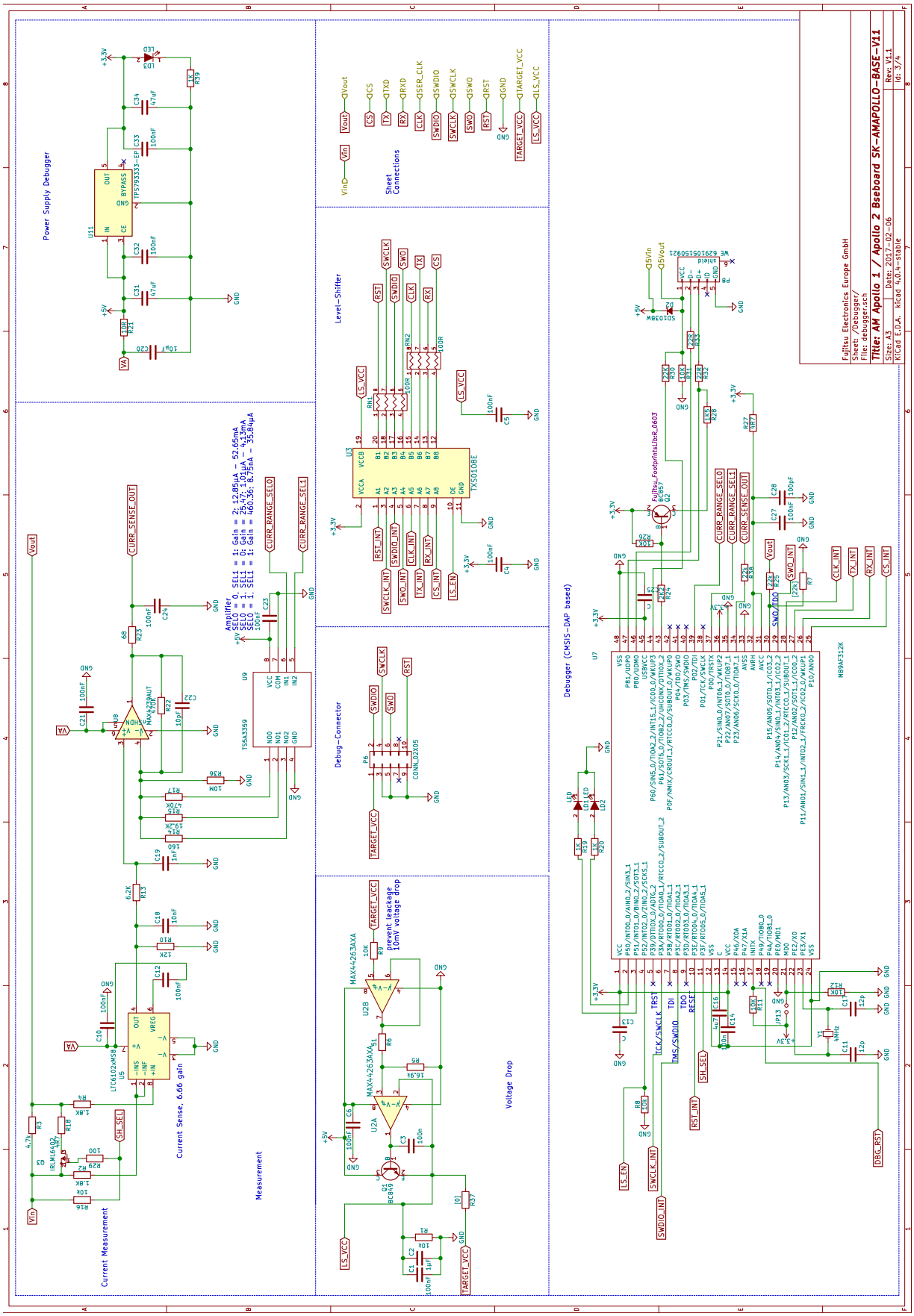
Power Supply Debugger
Sheet Connections
Level-Shifter
Debug-Connector
Voltage Drop
Measurement
Current Measurement
Current Sense, 6.66 gain
Debugger (CMSIS-DAP based)
Fujitsu Electronics Europe GmbH
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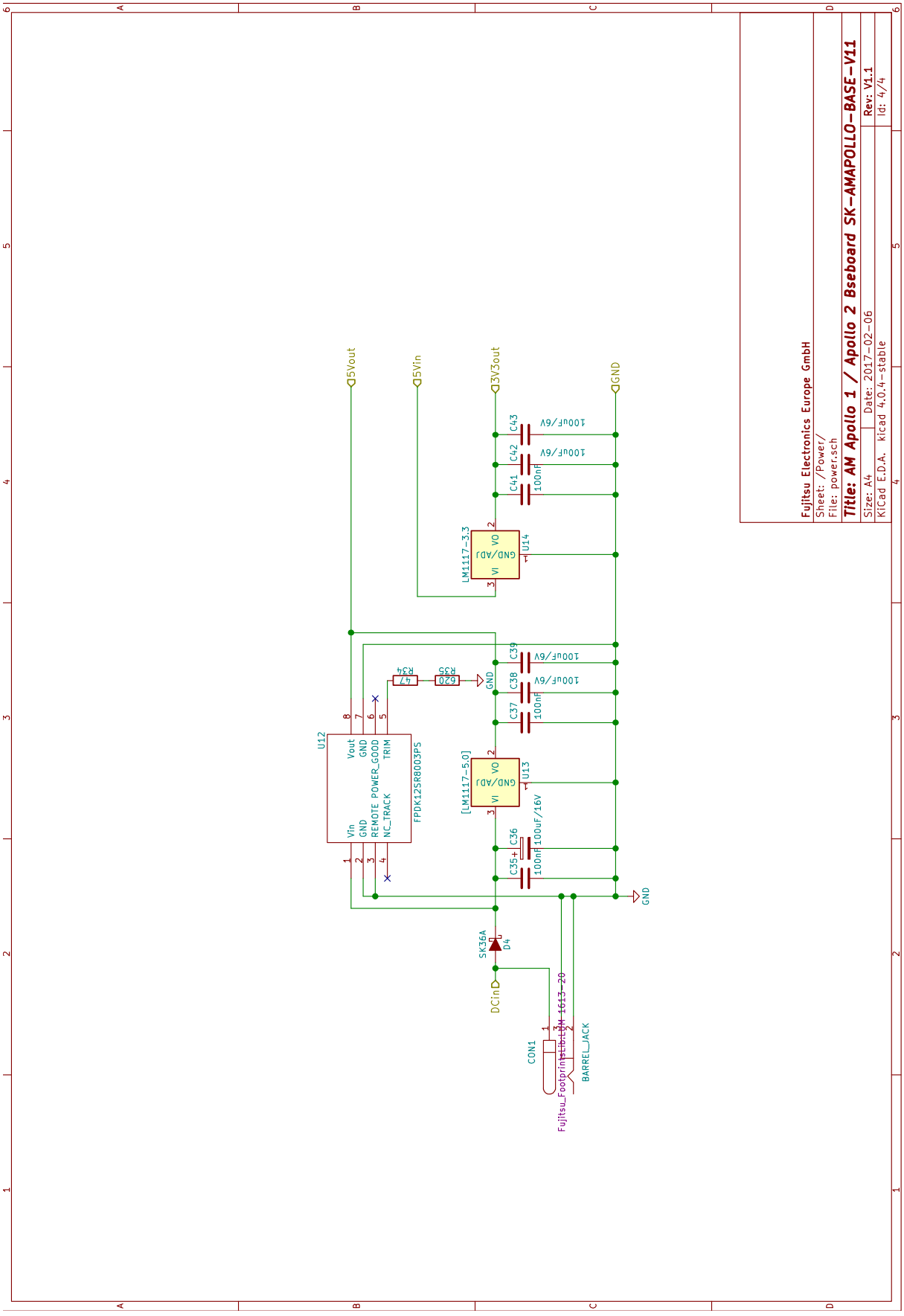
Title: AM Apollo 1 / Apollo 2 Baseboard SK-AMAPOLLO-BASE-V11
Size: A3
Date: 2017-02-06
Rev: V1.1
KiCad E.D.A. kicad 4.0.4-stable
Id: 3/4



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4.2 Figures

4.3 Index

No index entries found.

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5 Information in the WWW

Information about FUJITSU ELECTRONICS EUROPE Products
can be found on the following Internet pages:

http://www.fujitsu.com/feeu

6 Recycling

Gültig für EU-Länder:

Gemäß der Europäischen WEEE-Richtlinie und deren Umsetzung in landesspezifische Gesetze nehmen wir dieses Gerät wieder zurück.

Zur Entsorgung schicken Sie das Gerät bitte an die folgende Adresse:

Fujitsu Electronics Europe GmbH

Warehouse/Disposal

Monzastraße 4a

D-63225 Langen

Valid for European Union Countries:

According to the European WEEE-Directive and its implementation into national laws we take this device back.

For disposal please send the device to the following address:

Fujitsu Electronics Europe GmbH

Warehouse/Disposal

Monzastraße 4a

D-63225 Langen

GERMANY

-- END --

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