i.MX23 Reference Schematics

Rev. B

Revision History

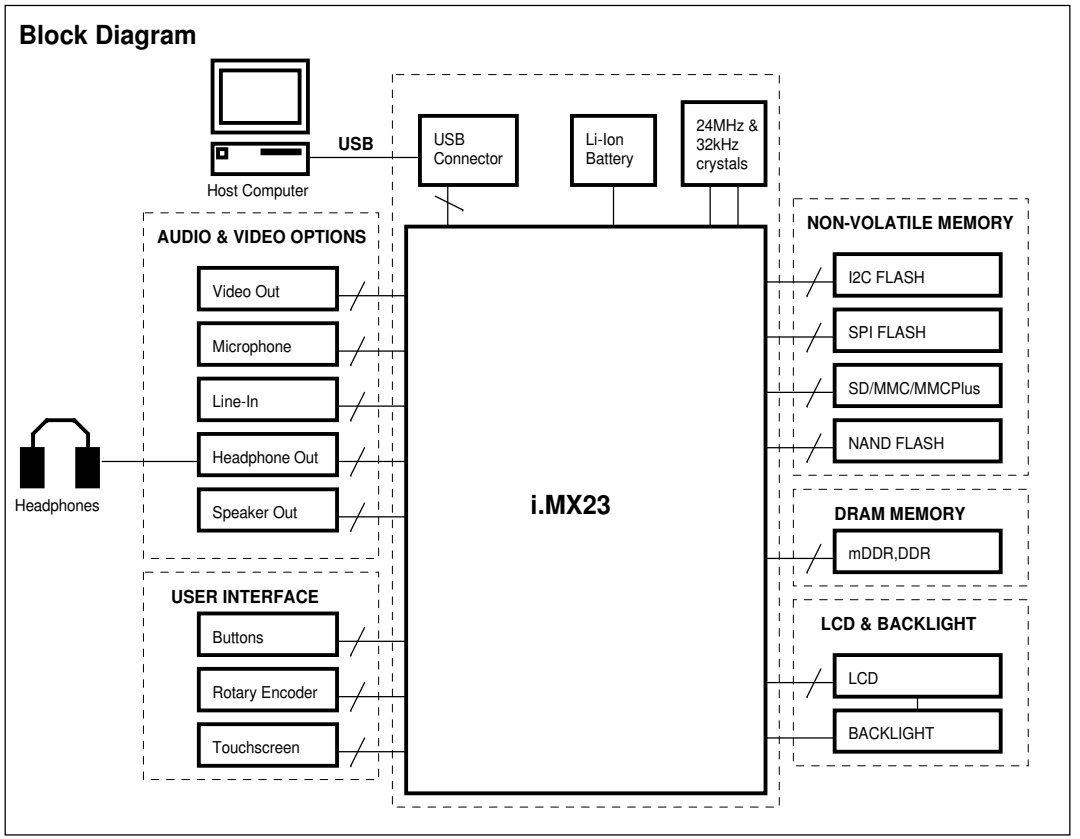
REV. A - 7/1/2009

- Original Release

REV. B - 8/12/2009

- Added 128QFP Package
- Added external speaker amplifier option.

Block Diagram



NOTE: These schematics are subject to change.

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Drawing Title: i.MX23 REFERENCE SCHEMATICS

Page Title: BLOCK DIAGRAM

Size	Document Number	Rev
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Date: Thursday, August 13, 2009 Sheet 1 of 11

i.MX23 EXAMPLE COMPONENTS

DCDC Inductor

For best battery life, the DCDC inductor should have a low DC resistance. The current rating of the inductor should be higher than the measured peak current through the inductor, which will be application-specific. The inductor value is recommended to be between 4.7uH and 15uH.

Note that inductors with a higher DC resistance may be used, but may impact battery life

Reference Designator	Description	Manufacturer	Manufacturer Part Number
L1	15uH, 900mA, 213mOhm RDC	Sumida	CDRH3D28NP-150N
L1	10uH, 690mA, 18mOhm RDC	Panasonic	ELL4LM100M
L1	15uH, 500mA, 520mOhm RDC	Nantong Meda (MEDAFA)	MAH 32-150

DCDC Output Capacitors

The C1, C8, and C14 output capacitors should have an ESR less than 400mOhms. Ceramic capacitors are recommended (Y5V capacitors should not be used for C1, C8, or C14).

Reference Designator	Description	Manufacturer	Manufacturer Part Number
C1,C8,C14	33uF, X5R, 6.3V , Ceramic Capacitor	Murata	GRM32DR60J336ME19L

32kHz Crystal

Reference Designator	Description	Manufacturer	Manufacturer Part Number
Y2	32kHz 20ppm Crystal	Seiko	VT200FA-6PF20PPM
Y2	32kHz 20ppm Crystal	Seiko	SSPT7FA-7PF20PPM

24MHz Crystal

Reference Designator	Description	Manufacturer	Manufacturer Part Number
Y1	24MHz 30ppm Crystal	Jing Feng	24.000MHz Jing Feng Crystal 2x6mm cylinder, +/- 30ppm, CL = 10pF

USB Ferrites and ESD Protection

Reference Designator	Description	Recommended Manufacturer	Manufacturer Part Number
L22	Ferrite, DCR < 100mOhm, 68 ohms @ 100MHz, 1A	Steward	MI0603J680R-10
L50	Ferrite, DCR < 400mOhm, 1500 ohms @ 100MHz, 400mA	Steward	HZ0805D152R-10
D2	ESD Protection Diode	ON Semi.	NZL6V8AXV3T1

Audio Input / Output Ferrites

Reference Designator	Description	Recommended Manufacturer	Manufacturer Part Number
L4, L5, L6, L7, L8, L9, L19, L20, L21	Ferrite, DCR < 400mOhm, 1500 ohms @ 100MHz	Steward	HZ0805D152R-10

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Drawing Title: i.MX23 REFERENCE SCHEMATICS

Page Title: RECOMMENDED COMPONENTS

Size	Document Number	Rev
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i.MX233 169-Pin Package

The i.MX233 should use ceramics + 100 mOhm series resistors or low-ESR tantalums for both the VDD4P2 and the LI-ION BATTERY supplies to prevent a battery charger oscillation issue.

IMPORTANT LAYOUT DESIGN NOTES

1) The crystals should be placed as close as possible to the i.MX233

2) For best USB jitter performance, the VDDXTAL capacitor and the crystal load capacitors should NOT connect to the ground plane near the DRAM bus routing and grounds. These ground connections should preferably be close to the VAG and REFP bypass capacitors.

3) All DCDC input & output capacitors should be located close to the i.MX233

IMPORTANT CRYSTAL DESIGN NOTES

The 24 MHz crystal should be located close to the STMP37XX. Consult crystal manufacturer datasheet for recommended load capacitor values (typically 10-18pF).

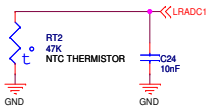
Cload = [(C26*C27) / (C26+C27)] + Cstray

where Cstray = stray PCB capacitance, typically 4 - 6 pF

Note: For Microsoft DRM applications use a 30 ppm crystal.

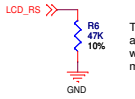
NOTE: The crystal load capacitors C26 and C27, should be resized appropriately when STFM1000 is connected to the crystal circuit. Note that STFM1000 TB2 has 1-2 pF of internal capacitance.

OPTIONAL TEMPERATURE SENSE



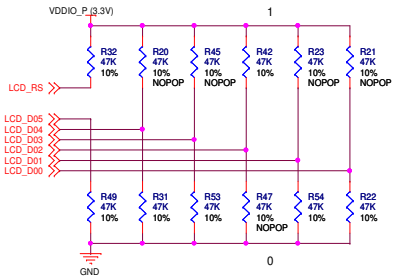
i.MX233 Bootmode Resistor Selection

Option 1: OTP



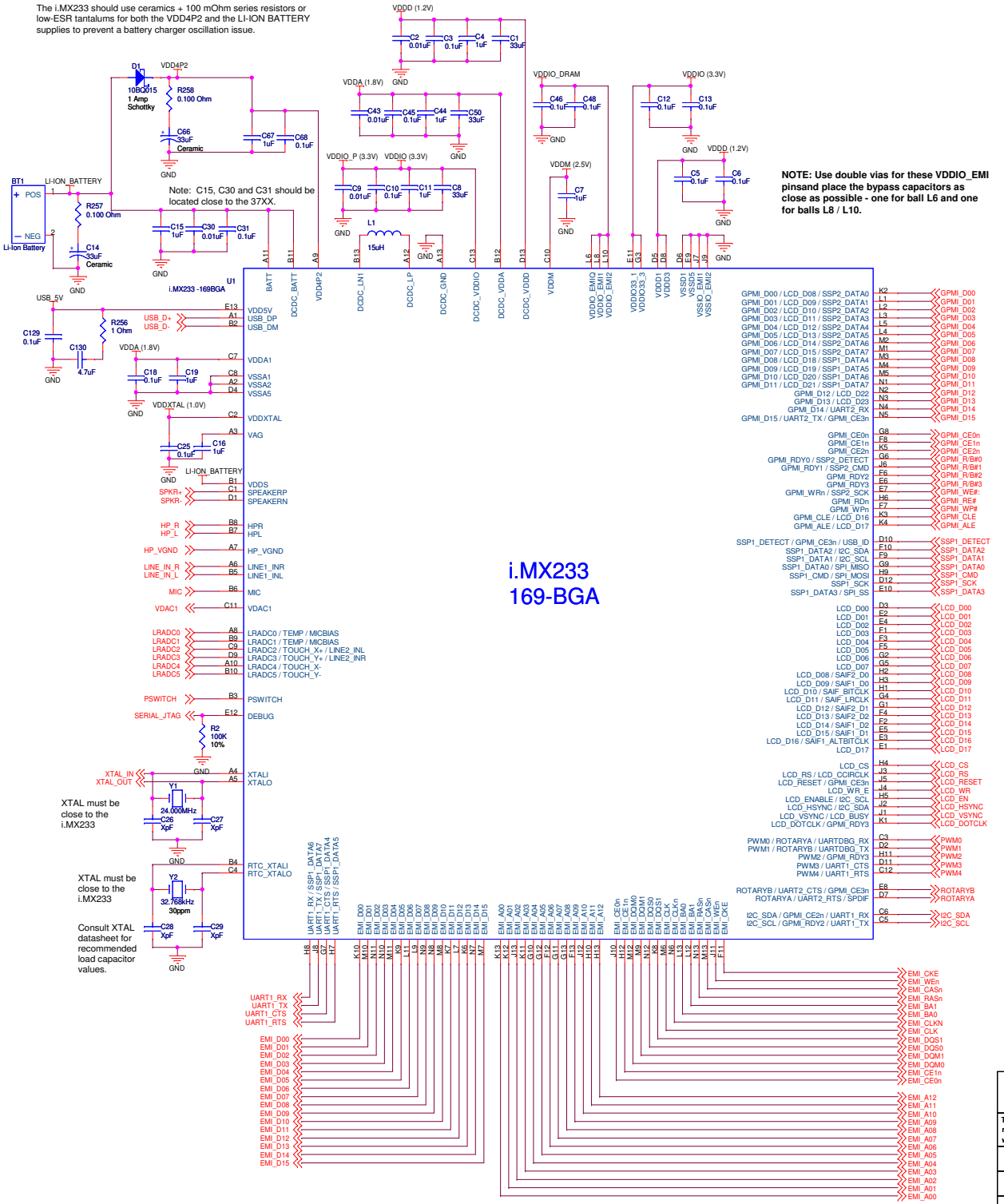
This mode requires that the appropriate boot mode be written into the OTP boot mode register.

Option 2: Resistor



LCD_D05 = ETM Enable Bit:
Low = ETM disabled
High = ETM enabled

BOOT MODE	LCD DATA 03	02	01	00
USB	0	0	0	0
I2C Master	0	0	0	1
SPI Flash 1 Master	0	0	1	0
SPI Flash 2 Master	0	0	1	1
NAND	0	1	0	0
DEBUG	0	1	1	0
SD/MMC 1	1	0	0	1
SD/MMC 2	1	0	1	0



Drawing Title: i.MX23 REFERENCE SCHEMATICS
Page Title: i.MX233 169-BGA
Size: C | Document Number: N/A | Rev: B
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i.MX233 128-Pin LQFP Package

IMPORTANT LAYOUT DESIGN NOTES

1) The crystal should be placed as close as possible to the i.MX233

2) For best USB jitter performance, the VDDXTAL capacitor and the crystal load capacitors should NOT connect to the ground plane near the DRAM bus routing and grounds. These ground connections should preferably be close to the VAG and REFP bypass capacitors.

3) All DCDC input & output capacitors should be located close to the i.MX233

IMPORTANT CRYSTAL DESIGN NOTES

The 24 MHz crystal should be located close to the STMP37XX. Consult crystal manufacturer datasheet for recommended load capacitor values (typically 10-18pF).

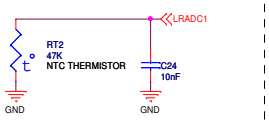
Cload = [(C26*C27) / (C26+C27)] + Cstray

where Cstray = stray PCB capacitance, typically 4 - 6 pF

Note: For Microsoft DRM applications use a 30 ppm crystal.

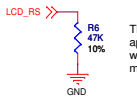
NOTE: The crystal load capacitors C26 and C27, should be resized appropriately when STFM1000 is connected to the crystal circuit. Note that STFM1000 TB2 has 1-2 pF of internal capacitance.

OPTIONAL TEMPERATURE SENSE



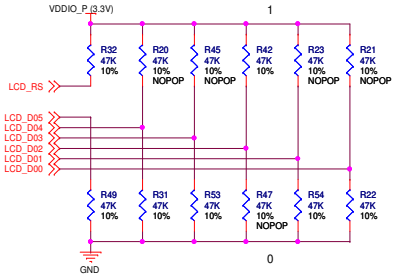
i.MX233 Bootmode Resistor Selection

Option 1: OTP



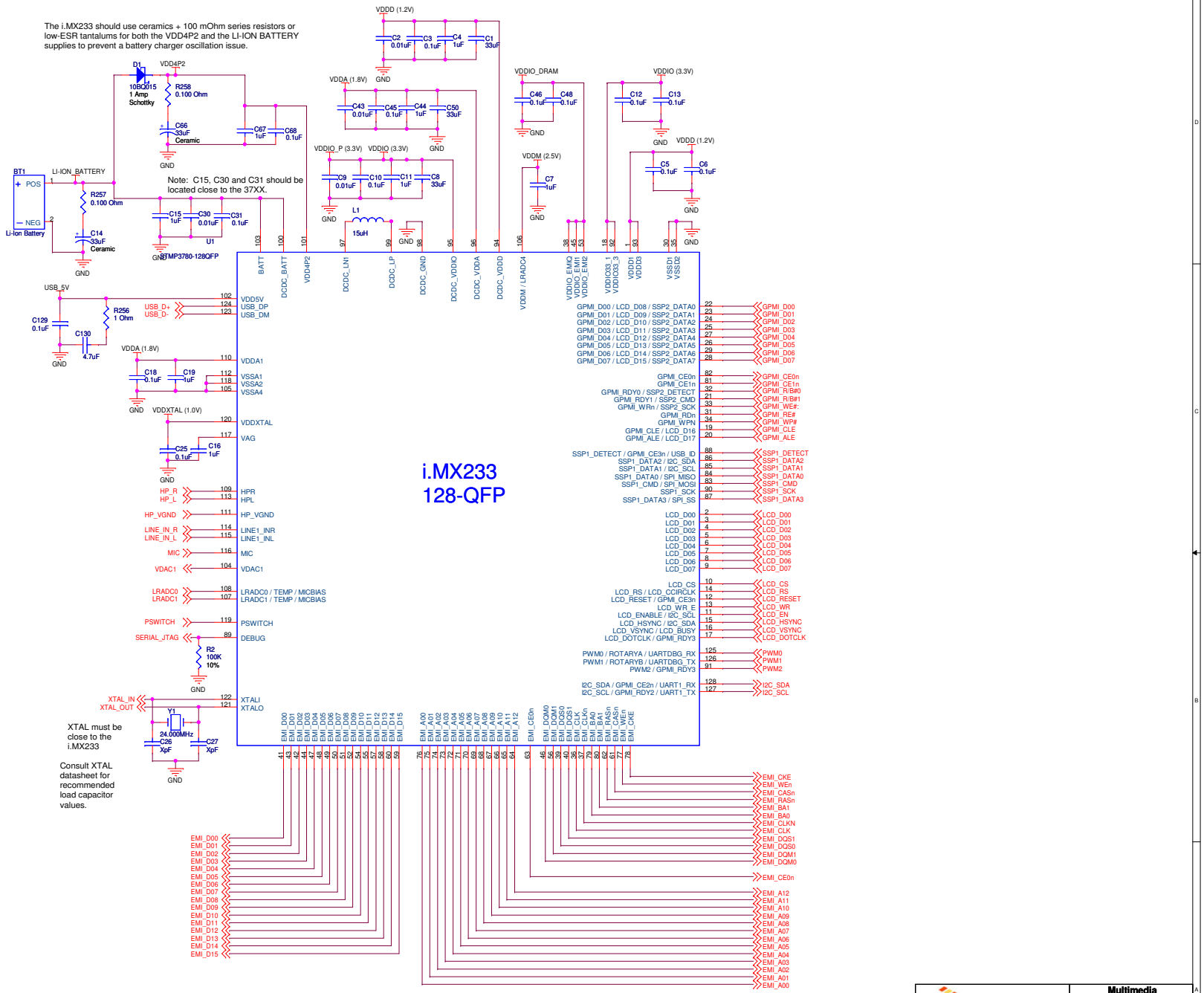
This mode requires that the appropriate boot mode be written into the OTP boot mode register.

Option 2: Resistor



LCD_D05 = ETM Enable Bit:
Low = ETM disabled
High = ETM enabled

BOOT MODE	*LCD DATA* 03	02	01	00
USB	0	0	0	0
I2C Master	0	0	0	1
SPI Flash 1 Master	0	0	1	0
SPI Flash 2 Master	0	0	1	1
NAND	0	1	0	0
DEBUG	0	1	1	0
SD/MMC 1	1	0	0	1
SD/MMC 2	1	0	1	0



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Drawing Title: **i.MX23 REFERENCE SCHEMATICS**

Page Title: **i.MX233 128-QFP**

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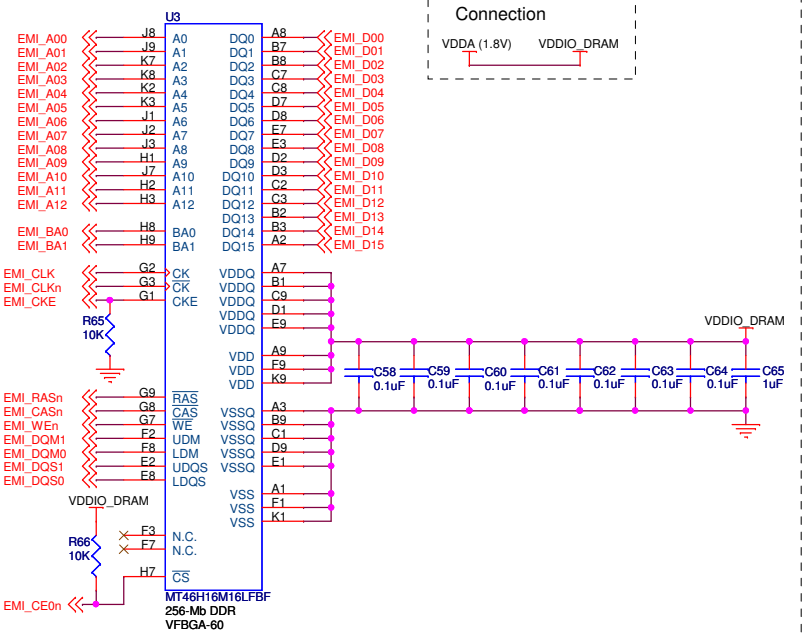
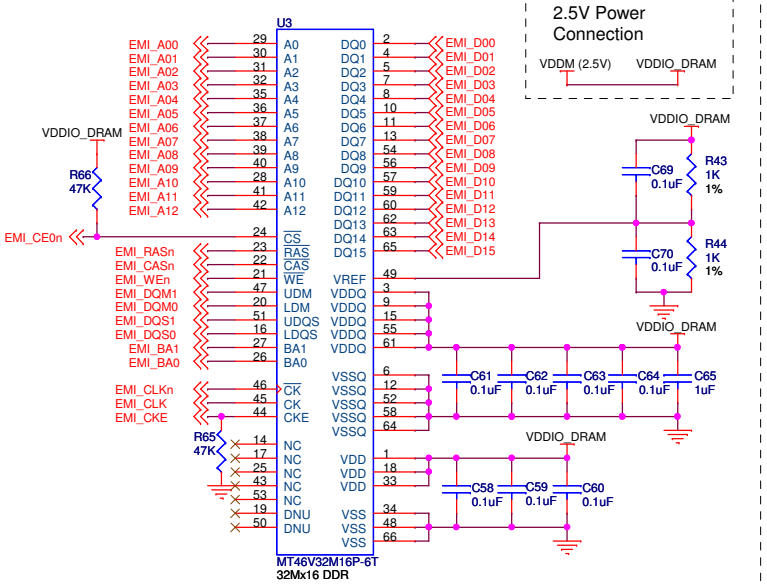
1.8V Mobile DDR



1.8V Power Connection

2.5V DDR



2.5V Power Connection

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Drawing Title: **i.MX23 REFERENCE SCHEMATICS**

Page Title: **DRAM**

Size	Document Number	Rev
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NAND FLASH

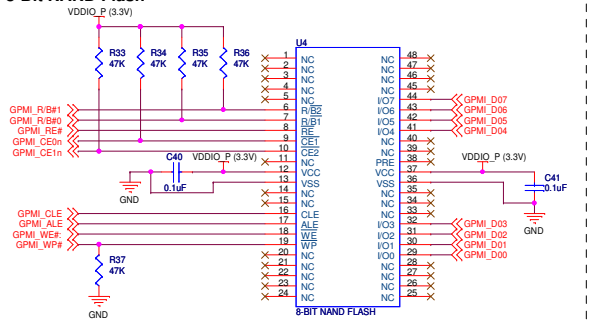
Important Design Notes

1) The WP# pull-down resistor is required to protect the flash memory from inadvertent writes during power transitions.
2) All CE# and R/B# pins require pull up resistors. Note that the i.MX23 has integrated CE# and R/B# pull-up resistors that must be enabled by OTP.
3) The circuits below show dual-CE NAND flash. If using a single-CE NAND flash, change pins 6 and 10 to NO CONNECT.

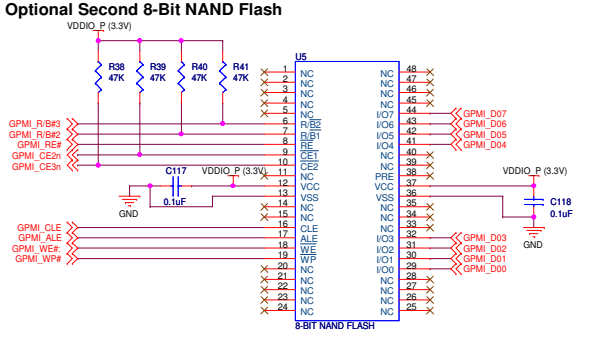
GPMI_CE3n Pin Assignment Options

On Page Net Name	i.MX23 Pin Assignment	
GPMI_CE3n	GPMI_D15	Option 1: BSP Default
GPMI_CE3n	ROTARYB	Option 2
GPMI_CE3n	LCD_RESET	Option 3
GPMI_CE3n	SSP1_DETECT	Option 4

8-Bit NAND Flash



Optional Second 8-Bit NAND Flash



SD/MMC/MMCPlus

SD/MMC/MMCPlus Pin Assignment Options

Option 1: SSP1 (BSP Default Configuration)

On Page Net Name	i.MX23 Pin Assignment
SSP_CMD	SSP1_CMD
SSP_SCK	SSP1_SCK
SSP_DATA0	SSP1_DATA0
SSP_DATA1	SSP1_DATA1
SSP_DATA2	SSP1_DATA2
SSP_DATA3	SSP1_DATA3
SSP_DATA4	GPMI_D08
SSP_DATA5	GPMI_D09
SSP_DATA6	GPMI_D10
SSP_DATA7	GPMI_D11
SSP_DETECT	SSP1_DETECT

Option 2: SSP1 (Alternate Configuration)

On Page Net Name	i.MX23 Pin Assignment
SSP_CMD	SSP1_CMD
SSP_SCK	SSP1_SCK
SSP_DATA0	SSP1_DATA0
SSP_DATA1	SSP1_DATA1
SSP_DATA2	SSP1_DATA2
SSP_DATA3	SSP1_DATA3
SSP_DATA4	UART1_CTS
SSP_DATA5	UART1_RTS
SSP_DATA6	UART1_RX
SSP_DATA7	UART1_TX
SSP_DETECT	SSP1_DETECT

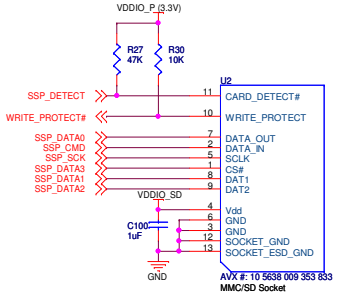
Option 3: SSP2

On Page Net Name	i.MX23 Pin Assignment
SSP_CMD	GPMI_R/B#1
SSP_SCK	GPMI_WE#:
SSP_DATA0	GPMI_D00
SSP_DATA1	GPMI_D01
SSP_DATA2	GPMI_D02
SSP_DATA3	GPMI_D03
SSP_DATA4	GPMI_D04
SSP_DATA5	GPMI_D05
SSP_DATA6	GPMI_D06
SSP_DATA7	GPMI_D07
SSP_DETECT	GPMI_R/B#0

Important Design Notes

1) The SD/MMC socket should have an integrated, normally-open, mechanical CARD DETECT switch.
2) The i.MX23 has integrated pull up resistors for the SD/MMC DATA and CMD signals that must be enabled by setting a register.

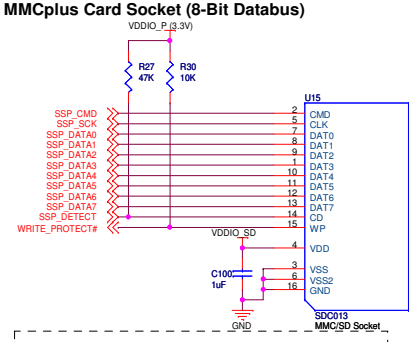
SD / MMC Card Socket (4-Bit Databus)



WRITE_PROTECT# refers to the user-selectable slide switch on SD/MMC cards. This support is optional and can be assigned to any free GPIO pin (not just PWM4).

PWM4 <<>> WRITE_PROTECT#

MMCplus Card Socket (8-Bit Databus)

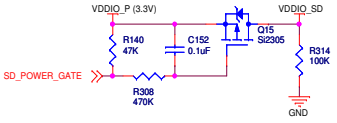


WRITE_PROTECT# refers to the user-selectable slide switch on SD/MMC cards. This support is optional and can be assigned to any free GPIO pin (not just PWM4).

PWM4 <<>> WRITE_PROTECT#

Required Power Switch for Removable SD/MMC Media

This circuitry gates power to the SD/MMC/MMCPlus socket. This ensures reliable operation with some SD/MMC/MMCPlus cards that require large amounts of current at insertion.
At start-up, SD_POWER_GATE is high and VDDIO_SD is unpowered. When CARD_DETECT goes low due to card insertion, firmware will drive SD_POWER_GATE low to connect VDDIO_P to VDDIO_SD. After waiting 30 msec to allow the VDDIO_SD supply to stabilize, the firmware will enable the internal SSP_DATA and SSP_CMD pull-up resistors and begin communicating with the SD/MMC card. When the card is removed and CARD_DETECT goes high, SD_POWER_GATE will be driven high again.

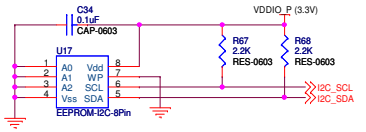


If the application does not need to boot from the SSP port, the SD_POWER_GATE function can be assigned to any free GPIO pin (not just PWM3). However, if the SD/MMC/MMCPlus device is the boot device, SD_POWER_GATE must be driven by the ROM, which supports only 3 OTP-selectable options: PWM0, LCD_DOTCLK, or PWM3.

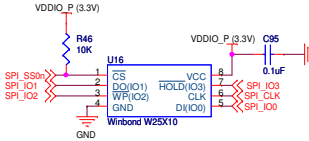
PWM3 <<>> SD_POWER_GATE

I2C EEPROM

Use Microchip 24LCxx-I/P or Equivalent



SPI FLASH



Reference Designator	Description	Manufacturer	Manufacturer Part Number
U16	SPI Flash, 3.0V	Winbond	W25X10

SPI Flash Pin Assignment Options

Option 1: SSP1

On Page Net Name	i.MX23 Pin Assignment
SPI_SS0n	SSP1_DATA3
SPI_CLK	SSP1_SCK
SPI_IO0	SSP1_CMD
SPI_IO1	SSP1_DATA0
SPI_IO2	SSP1_DATA1
SPI_IO3	SSP1_DATA2
SPI_SS1n	SSP1_DATA4
SPI_SS2n	SSP1_DATA5

Option 2: SSP2

On Page Net Name	i.MX23 Pin Assignment
SPI_SS0n	GPMI_D03
SPI_CLK	GPMI_WE#:
SPI_IO0	GPMI_R/B#1
SPI_IO1	GPMI_D00
SPI_IO2	GPMI_D01
SPI_IO3	GPMI_D02
SPI_SS1n	GPMI_D04
SPI_SS2n	GPMI_D05

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Drawing Title: **i.MX23 REFERENCE SCHEMATICS**

Page Title: **NON-VOLATILE MEMORY OPTIONS**

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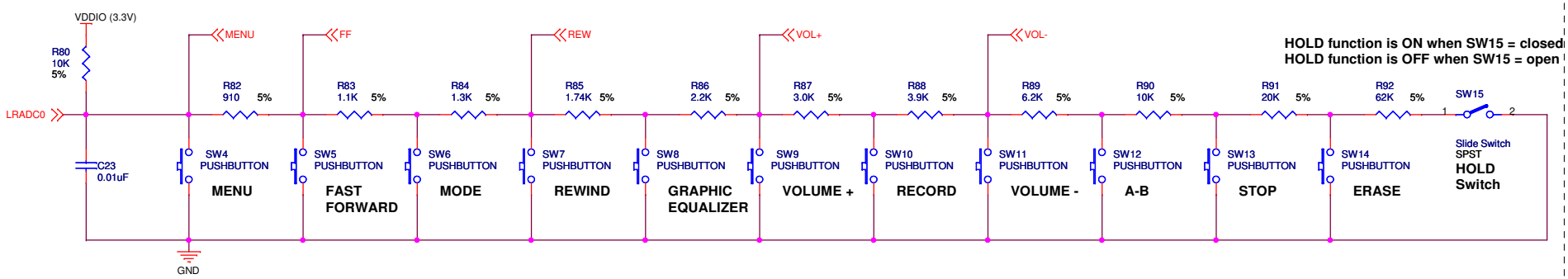
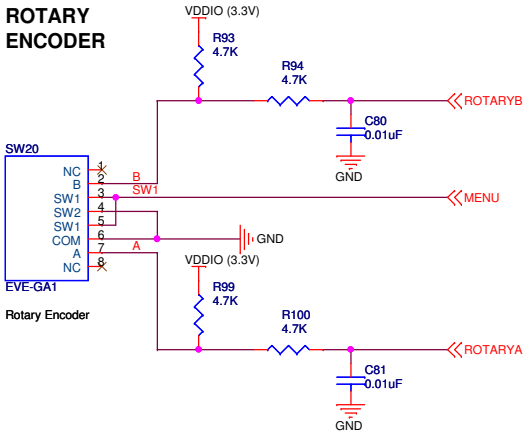
BUTTONS



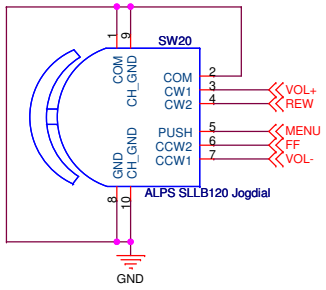
HOLD function is ON when SW15 = closed
HOLD function is OFF when SW15 = open

ROTARY ENCODER



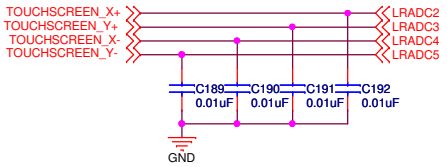
Rotary Encoder

JOG DIAL



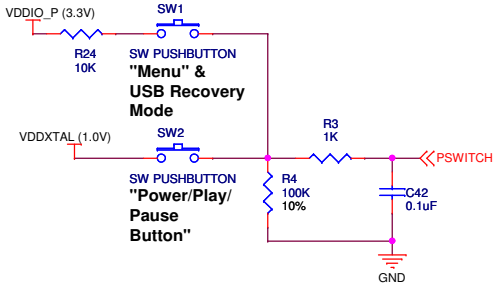
NOTE: The JogDial as shown uses the LRADC resistor network for its internal buttons.

RESISTIVE TOUCHSCREEN / TOUCHPANEL



NOTE: If using a device with an impedance greater than a few kOhms (such as a Touchpanel), the C189-C192 filter capacitors on the LRADC channels may be reduced to 5pF. These smaller capacitors reduce the settling time, which reduces the amount of time the processor must wait to take an accurate reading.
These filter capacitors should be placed close to the i.MX23.

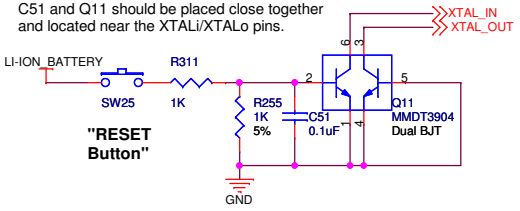
POWER / PLAY / PAUSE & MENU / USB RECOVERY BUTTONS



RESET CIRCUIT

Note: A dual BJT is recommended to provide equal capacitive loading to both XTALi and XTALo. If a single BJT is used on XTALi, the xtal load capacitor values should be adjusted to account for the BJT loading (typically ~5pF).

C51 and Q11 should be placed close together and located near the XTALi/XTALo pins.



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Drawing Title: **i.MX23 REFERENCE SCHEMATICS**

Page Title: **USER INTERFACE**

Size	Document Number	Rev
B	N/A	B

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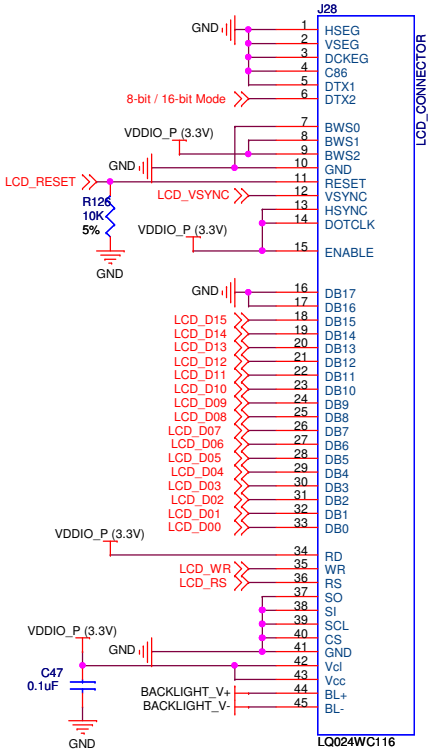
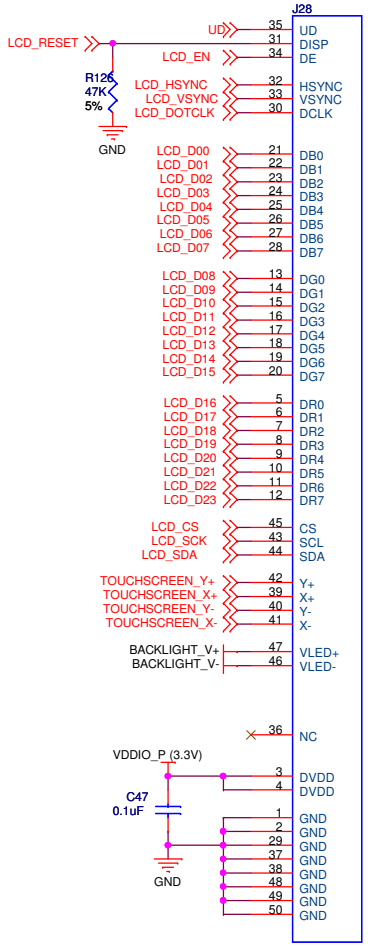
LCD & LED DISPLAY OPTIONS

LCD (8-bit or 16-bit 8080 System Mode)



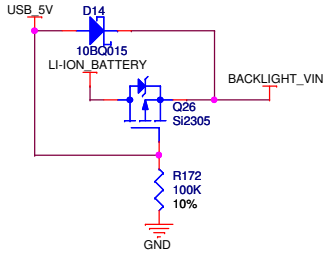
LCD (24-bit DOTCLK Mode)



LCD SPI Interface Pin Assignments

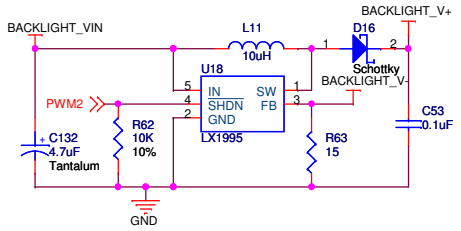
LCD_WR	LCD_SDA
LCD_RS	LCD_SCK
LCD_CS	LCD_CS

Recommended Backlight Power Selection



External Backlight Boost Circuit

Backlight should have 3 or more LEDs in series. If the backlight has fewer than 3 LEDs, the backlight may draw power even if the player is powered off.



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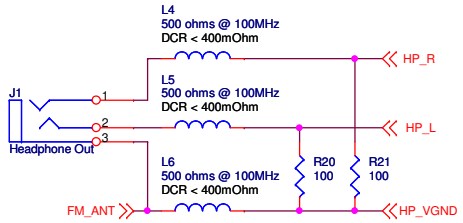
i.MX23 HEADPHONE-OUT OPTIONS

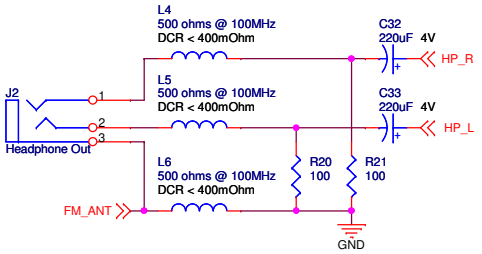
OPTION 1: Direct Drive Headphone Jack (Recommended)

NOTE:
- FM_ANT is the antenna for designs with an FM Tuner
- L4, L5, L6 should be as close as possible to the headphone jack.



OPTION 2: AC-Coupled Headphone Jack

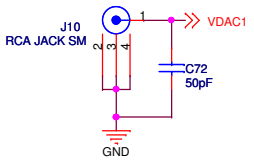
NOTE:
- FM_ANT is the antenna for designs with an FM Tuner
- L4, L5, L6 should be as close as possible to the headphone jack.



i.MX23 VIDEO OUT

Single or Double Termination

The VIDEO_DAC ground should be routed as a star connection to the VAG capacitor.

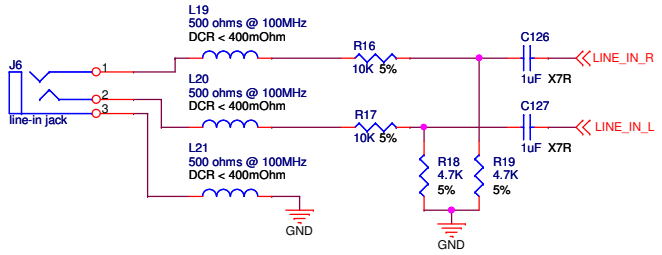


i.MX23 AUDIO-IN OPTIONS

LINE-IN JACK

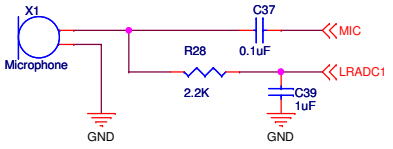
NOTE: The LRADC2 and LRADC3 pins can be configured as an additional LINE IN.

NOTE: For lowest low-frequency distortion, use of X7R 1uF capacitors instead of X5R.



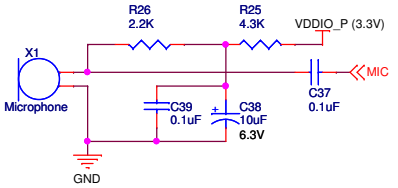
MICROPHONE OPTION 1: LRADC1 bias

Using the LRADC MIC_Bias improves power consumption, since the MIC_Bias can be disabled when not being used.



MICROPHONE OPTION 2: VDDIO bias

For lowest background noise, the VDDIO_P connection to R25 should be routed as a star connection to the 33uF VDDIO_P capacitor. In particular, the VDDIO_P supply for mic bias should be isolated from the VDDIO_P supply for the SD/MMC socket, as SD/MMC card accesses can create supply noise that can show up on the microphone input.

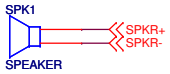


i.MX23 SPEAKER OPTIONS

OPTION 1: Integrated Speaker Amplifier

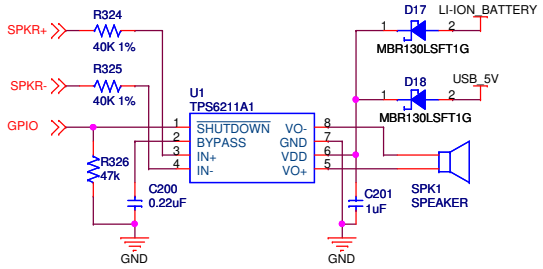
For maximum output power, all speaker power and output pins (VDDS, VSSA5, SPKR+, and SPKR-) should be routed with very wide trace widths to minimize resistive loss.

Recommended speaker impedance is 4 ohms or greater.



IMPORTANT: Because speaker usage causes a large amount of on-chip power dissipation, it is important to understand and follow the guidelines in the "Thermal Conditions" section of the "Characteristics and Specifications" chapter of i.MX23 Reference Manual. If thermal conditions cannot be met, an external speaker amplifier should be used.

OPTION 2: External Speaker Amplifier



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USB 2.0 Connector

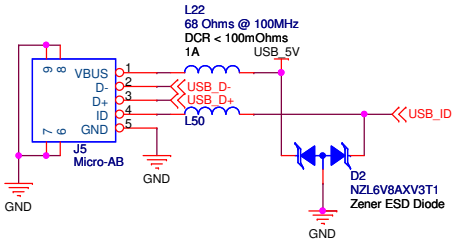
Route USB D+ and D- according to the High Speed USB2.0 Design Guidelines. D+ and D- should have a 90 ohm differential trace impedance and the PCB should have a 20 mil minimum spacing between the USB data lines (D+ and D-) and other signal lines.

In order to maximize ESD immunity, the industrial design plastics should expose the USB Connector as little as possible.

CN1 Pins 6-9 are pins connecting to the USB connector outer shield

The L22 ferrite is recommended for ESD immunity. Note that any ferrite in series with the USB_5V supply should have a low DCR (<100mOhms).

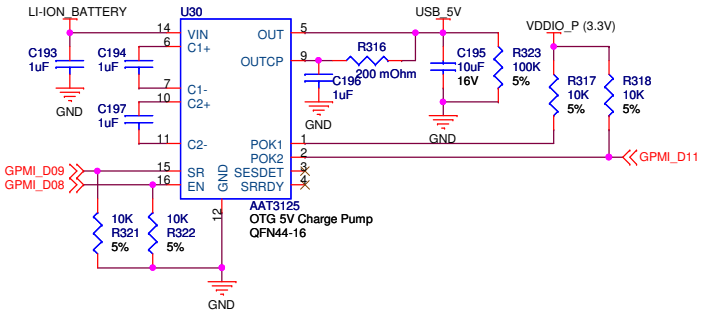
The D2 Zener Diode is strongly recommended to protect the VDD5V pin of the i.MX23 from damaging overvoltage conditions that can result from USB cable attachments or from ESD events.



For applications that support cable-based detection of Host or Device modes.

USB_ID >> <<SSP1_DETECT

OPTIONAL 5V CHARGE PUMP



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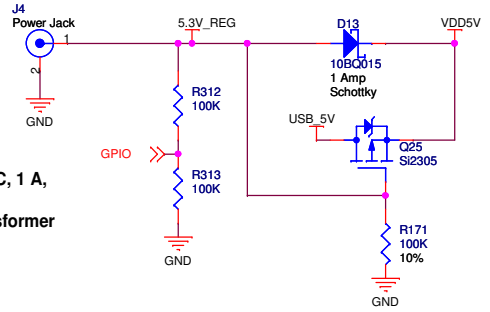
MISC. CIRCUITS

OPTIONAL: Wall Power + USB Power Switch

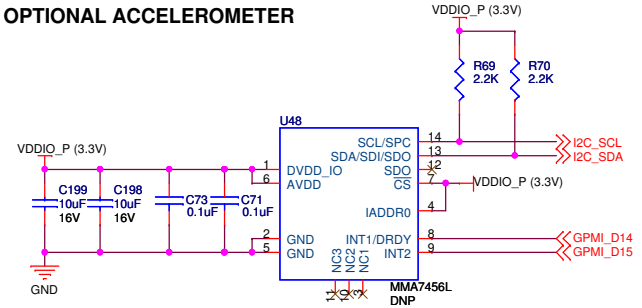
This circuit allows the i.MX23 to power from an external wall power supply. In the case where wall power and USB power are both connected, power will come from the wall power supply. Note that a GPIO and some firmware support may be required to help the i.MX23 differentiate between USB5V and wall power.

To implement this circuit, remove the direct USB_5V connection on the i.MX23 VDD5V pin, and connect the USB_5V line through a FET as shown.

Note that the 5V wall power supply may need to be slightly higher than 5.0V to ensure that it is always higher than the USB_5V supply and thus always supplying power. Use of 5.2V or 5.3V for the wall power supply is ideal.

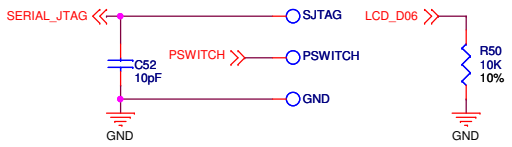


OPTIONAL ACCELEROMETER



OPTIONAL SERIAL JTAG PORT CONNECTIONS

In order to allow debugging on a i.MX23-based device, it is recommended to add 3 testpoints as shown below. In addition, there are other changes that may be required to support debugging:
1) It may also be necessary to add a 10pF capacitor to GND on the SERIAL_JTAG line to reliably debug.
2) The C42 0.1uF capacitor on PSWITCH may need to be moved to the other side of the R3, 1K resistor.



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