

MPC5645S-DEMO-V2

Contents

1 Introduction

The MPC5645S-DEMO-V2 features the MPC5645S 32-bit microcontroller targeting single-chip automotive instrument cluster applications. MPC5645S devices are part of the MPC56xxS family of Power Architecture™-based devices. This family has been designed with an emphasis on providing cost-effective and high quality graphics capabilities to satisfy the increasing market demand for color Thin Film Transistor (TFT) displays within the vehicle cockpit. Traditional cluster functions, such as gauge drive, real time counter, and sound generation are also integrated on each device. The board simplifies the development of applications for the MPC5645S microcontroller by providing the most commonly used external peripherals on a single PCB. Specifically the board features:

- Connections for 2 x SHARP LQ043T1DG01 touch screen LCD TFT panels or LQ043T1DG02 LCD TFT panels (DCU and DCULite)
- General purpose MICTOR connector for connection of your own panels
- Two DVI outputs for connection of desktop TFT LCD panels
- Headphone amplifier and 3.5 mm stereo jacks for sound output from MPC5645S
- Video in port and video ADC supporting composite video connected to the VIU module
- 64 MB of serial flash in two 32 MB chips connected in parallel to QuadSPI ports
- 64 MB of mobile LPDDR memory in two 32 MB chips

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Initial Setup

- 1 x CAN and 1 x LIN serial interfaces with physical interfaces
- USB port for connection to UART or SPI interfaces
- Nexus interfaces on MICTOR connector and JTAG connector and embedded USB debug connection

2 Initial Setup

The MPC5645S-DEMO-V2 comes configured for use with the most common settings. You can change the configuration of the board by configuring jumpers as described below.

NOTE

In all cases remove power from the board before changing any jumper configurations.

2.1 Power supply

The board operates from a +12 V, 1 A supply provided on a barrel jack, centre positive, at P1. The board is protected by a 20 mm cartridge fuse F1 and a value of 1 A is recommended for this. Note that the board includes protection for reverse polarity connection.

The +12 V supply to the board is enabled by switch SW1.

The board generates further voltages from this initial supply. It is recommended that these are always enabled for normal operation but they can be disabled or disconnected by connecting or removing jumpers as follows:

- +5 V switching regulator — Disable fit J40
- +3.3 V switching regulator — Disable fit J35
- +1.8 V switching regulator — Disable fit J36

It is possible to isolate the MCU from its power supplies for measurement purposes or to change the supply voltage by cutting traces on the PCB and providing jumpers to replace the connections.

NOTE

Take extreme care to avoid unintentionally disconnecting the MCU from its power supplies.

Jumper	Description	Cut link
J38	Analog 5 V supply	SH4
J39	MCU stepper motor +5 V supply	SH5
J37	MCU 3V3 supply	SH3

By default the VDDR supply for the MCU is configured to operate from +5 V but this can be changed by cutting a link and connecting a jumper.

Jumper	Description	Cut link
J11 1-2	MCU VDDR operates from +5 V	SH1
J11 2-3	MCU VDDR operates from +3.3 V	

2.2 Oscillator

The MCU operates from an 8 MHz crystal.

A second auxiliary 32 kHz crystal is directly connected to port pins PC14 and PC15. This means that these pins cannot also be used for other functions.

2.3 Reset

The board includes an external low-voltage reset controller that pulls reset on the part when the +5 V regulator drops below approximately 2.6 V. A reset button SW6 is also supplied to force the MCU reset line low. LED D9 will be active when the MCU reset line is active.

2.4 Development tools

Several suppliers provide development and debugging support for the MPC5645S. Freescale provides the CodeWarrior Development Studio, this is a complete integrated Development Environment (IDE) that provides a highly visual and automated framework to accelerate the development of the most complex embedded applications. An evaluation license is available from freescale.com.

2.5 Debug interfaces

There are three debug interfaces available on the board:

- Integrated OSBDM debug interface on J2
- JTAG 14-pin universal debug connector on P1
- Nexus trace debug connector on P3

The USB connector J2 allows connection of the MPC5645S-DEMO-V2 directly to a PC with the CodeWarrior Development Studio for the MPC56xx. The debug software provided with this package recognizes the attached hardware as a development tool and attempts to connect. Depending on the version of the tool in use it may be necessary to select the MPC5645S as the target processor. The MPC5645S-DEMO-V2 does not take any power from the connected USB cable and so the primary 12 V power supply must always be provided even when using the integrated debugger.

The P1 and P3 connectors allow connection of any compatible debugger. Refer to freescale.com for information about suppliers of these debuggers

The choice of a debug interface in use is made using jumper J12. Fit jumpers to J12 to enable the integrated OSBDM debugger.

Header	Description
J12 1-2	Enable the integrated debugger option
12 3-4, 5-6	Enable the integrated debugger to reset the MPC5645S MCU

If using an external debugger then there is an option to place the TDO pin in a known default state. Jumper J8 provides an optional pull-up on the TDO pin.

Header	Description
J8	Provides 10k pull up on JTAG TDO pin

Header J10 is provided to reprogram the integrated MC9S08JM60 device if required.

2.6 Starting up the board

Follow these steps when starting the board:

- Install the required development software include any additional software required for your debugger of choice
- Ensure switch SW1 is in the OFF position. It connects the supplied +12 V power supply from connector P2
- Select the debugger option required using jumpers on J12
- Connect the debugger or USB cable
- If any change has been made to the default power supply cut-links then ensure that a suitable jumper is in place (see section 2.1)
- Apply power to the board by setting SW1 to the ON position.
- If the integrated OSBDM debugger is in use then the host PC recognizes a USB connection and may require new drivers to be installed. Install the required drivers.
- Run your debug software and the MPC5645S MCU will be visible and ready for development

Note that the OSBDM connection requires a delay of 200 ms after reset for correct connection.

3 On-board memory

There are two external memory systems available on the MPC5645S and both are supported on the MPC5645S-DEMO-V2.

- 2 x Micron MT46H16M16LFBF-6 (256 Mb) LPDDR memories providing a 32-bit interface to the MPC5645S for a total of 32 MB of SDRAM
- 2 x Spansion S25FL256P (256 Mb) serial QuadSPI flashes providing a dual QuadSPI serial flash interface to the MPC5645S for a total of 32 MB of serial flash

The LPDDR memory uses the dedicated SDRAM interface on the MPC5645S and requires no GPIO for this function. The serial flash uses 12 GPIO pins.

There is no hardware configuration required to use these on-board memories.

Both memory systems require software configuration before they can be used. See Section 6 for how to obtain example configurations provided by Freescale.

4 Application Configuration

This section includes a description of the interfaces provided on the board and how to configure them.

NOTE

In all cases remove power from the board before changing any jumper configurations or connecting any external hardware.

4.1 LCD TFT panels

The board contains direct connections for two independent TFT panels. These are connected to the DCU and the DCULite interfaces and each provides a choice of three connection possibilities:

- 2 x Sharp LQ043T1DG01 touch screen LCD TFT panels or LQ043T1DG02 LCD TFT panels
- General purpose MICTOR connector for connection of your own panel
- DVI to video monitor

The panels can be configured independently from each other, but only one option should be used at a time for each of the DCU or DCULite.

4.2 Configuring touch screen panels

Fit the Sharp LQ043T1DG01 touch screen panels by connecting the panel FFCs to J42, J44, and J46 for the DCU and J41, J43, J45 for the DCULite.

When using the Sharp LQ043T1DG01 touch screen LCD TFT panels a backlight voltage of +30 V is provided.

4.3 Using an alternate panel

It is possible to connect a different panel to the board by using the general purpose connectors P9 for the DCU and P8 for the DCULite. These are industry-standard 38-pin MICTOR connectors.

4.4 DVI connection

It is also possible to connect the board to external TFT panels via DVI (Digital Video Interface) connectors P10 and P11. To enable the DVI output, configure the DCU or DCULite to a suitable panel format (normally VGA or higher) then connect a jumper at J14 1-2 for the DCU and J14 3-4 for the DCULite. Any timing skew on the panel can be corrected by adjusting the switches at SW5. The status of the connection may be monitored at J14 pin 5 for the DCU or J14 pin 6 for the DCULite; a low signal on these pins indicates a panel has been connected.

NOTE

The default connection on the board assumes that four ADC pins will be used on connectors P8 and P9 for resistive touch screen operation. Since the connector also allows an I2C interface on these pins the factory configuration connects the following pins directly to each other: PC0=PC4=PK10 and PC1=PC5=PK11. If these pins are to be used independently then it is necessary to cut links SH6, SH7, SH9, and SH10.

Table 5. DCU connections on connector P9

Pin no	RGB Digital	RSDS	Pin no	RGB Digital	RSDS
1	R0	RSDS0P	2	B0	RSDS8P
3	R1	RSDS0M	4	B1	RSDS8M
5	R2	RSDS1P	6	B2	RSDS9P
7	R3	RSDS1M	8	B3	RSDS9M
9	R4	RSDS2P	10	B4	RSDS10P
11	R5	RSDS2M	12	B5	RSDS10M
13	R6	RSDS3P	14	B6	RSDS11P
15	R7	RSDS3M	16	B7	RSDS11M
17	G0	RSDS4P	18	+3.3 V	
19	G1	RSDS4M	20	+3.3 V	
21	G2	RSDS5P	22	VSYNC	—
23	G3	RSDS5M	24	HSYNC	—
25	G4	RSDS6P	26	DE/ENABLE	RSDCLKM

Table continues on the next page...

Table 5. DCU connections on connector P9 (continued)

Pin no	RGB Digital	RSDS	Pin no	RGB Digital	RSDS
27	G5	RSDS6M	28	CLK	RSDSCLKP
29	G6	RSDS7P	30	+5 V	
31	G7	RSDS7M	32	+5 V	
33	Y down		34	Y up ¹	
35	X right		36	X left ²	
37	+12 V		38	+12 V	

1. Optional I2C SDA_1 function on PK10 by link at SH10
2. Optional I2C SCK_1 function on PK11 by link at SH9

Table 6. DCULite connections on connector P8

Pin no	RGB Digital	Pin no	RGB Digital
1	R0	2	B0
3	R1	4	B1
5	R2	6	B2
7	R3	8	B3
9	R4	10	B4
11	R5	12	B5
13	R6	14	B6
15	R7	16	B7
17	G0	18	+3.3 V
19	G1	20	+3.3 V
21	G2	22	VSYNC
23	G3	24	HSYNC
25	G4	26	DE/ENABLE
27	G5	28	CLK
29	G6	30	+5 V
31	G7	32	+5 V
33	Y down	34	Y up ¹
35	X right	36	X left ²
37	+12 V	38	+12 V

1. Optional I2C SDA_1 function on PK10 by link at SH7
2. Optional I2C SCK_1 function on PK11 by link at SH6

4.5 Sound

The board contains a Freescale sound codec and headphone amplifier SGTL5000 connected to the MCU. This codec can provide headphone and line out levels from either the I2S or the PWM output of the MCU's Sound Generation Module (SGM).

The choice of output between the PWM and I2S is controlled in software by registers in the SGM. The board is configured such that the I2S DO pin is connected to PB8, and the PWMO pin is connected to PB10. Therefore, for PWM output the software must configure the MCU to use PB10 and for I2S output the software must configure the MCU to use PB8.

The sound output is available to directly connect headphones at connector J30. A line-level output is also provided at connector J34.

4.6 PWM Output

The PWM output is filtered by a 8 kHz low pass 4th order Bessel filter and fed to the left Line-in pin of the SGTL5000. An unfiltered version is fed to the right Line-in pin. This allows comparison of the sound quality of filtered and unfiltered PWM under software control.

4.7 I2S Output

The SGTL5000 codec is configured using I2C_1 on pins PF4 and PF7. Refer to the documentation of the codec for configuration options.

4.8 Video

The board allows connection of two types of video input. Connector J24 allows input of an analogue composite video signal (either PAL or NTSC) and connector P4 allows connection of a digital RGB or YUV bus.

The composite signal conversion is performed by an Analog Devices video DAC ADV7180. This device is configured using I2C_0 on pins PF8 and PF9 and controlled by MCU I/O PM0, PM1, PJ3, and PF2.

MCU port	MCU Function	Comment
PF8	SDA_0	I2C_0 bus
PF9	SCL_0	
PM0	Output pin	Video DAC reset input pin (active low)
PM1	Output pin	Video DAC power down pin (active low)
PF2	Input pin	Video DAC interrupt request pin (active low)

The digital input signals are connected such that the VIU or PDI inputs can be used. Note that I2C_0 is also used as the configuration bus for peripherals connected to this connector.

Table 8. Pinout for P4

Pin no	Signal	Pin no	Signal
1	VIU0 (PK2)	2	PDI0 (PJ4)
3	VIU1 (PK3)	4	PDI1 (PJ5)
5	VIU2 (PK4)	6	PDI2 (PJ6)
7	VIU3 (PK5)	8	PDI3 (PJ7)
9	VIU4 (PK6)	10	PDI4 (PJ8)
11	VIU5 (PL4)	12	PDI5 (PJ9)

Table continues on the next page...

Table 8. Pinout for P4 (continued)

Pin no	Signal	Pin no	Signal
13	VIU6 (PL5)	14	PDI6 (PJ10)
15	VIU7 (PL6)	16	PDI7 (PJ11)
17	VIU8 (PL7)	18	+3.3 V
19	VIU9 (PL8)	20	+3.3 V
21	—	22	PDI_VSYNC (PJ2)
23	—	24	PDI_HSYNC (PJ1)
25	—	26	PDI_DE/ENABLE (PG12)
27	VIU CLK (PJ3)	28	PDI_CLK (PL9)
29	—	30	+5 V
31	—	32	+5 V
33	—	34	SDA_0 (PF8)
35	—	36	SCL_0 (PF9)
37	+12 V	38	+12 V

4.9 CAN Interface

The board implements a physical interface (TJA1041T) on one of the MCU FlexCAN busses: FlexCAN0 is connected to J5.

It is possible to supply the physical interface from an external power supply. The physical interface enable and inhibit signals are brought out to headers to allow connection of additional control signals from the CPU. However, jumper J13 provides simple connections to the STB and EN pins to allow the interface to be operated with the addition of two jumpers.

Connector	Description
J20	Vbat supply for physical interface for FlexCAN0, fit jumper to use on-board +12 V supply
J16 – 1	FlexCAN0 Physical interface INH pin
J16 – 2	FlexCAN0 Physical interface ERR pin
J13 – 1	FlexCAN0 Physical interface WAKE pin
J13 – 4	FlexCAN0 Physical interface EN pin — jumper to pin 2 for pull to +5 V, jumper to pin 6 for software control via PM4
J13 – 5	FlexCAN0 Physical interface STB pin — jumper to pin 3 for pull to +5 V, jumper to pin 6 for software control via PM4

4.10 Serial Boot mode support

FlexCAN0 uses MCU pins PB0 and PB1 for compatibility with serial boot mode support on the MPC5645S. To configure the device to perform FlexCAN serial boot mode place jumpers on J13 pin 2-4 and pin 3-5, then select CAN boot mode by placing jumpers on J23 pin 9-10 (no jumper on J23 pin 11-12).

4.11 LIN Interface

The board implements a physical interface (MCZ33661EF) on one of the MCU LINFlex buses: LINFlex1 is connected to J3. It is possible to pull up the LIN bus from an external power supply.

Connector	Description
J7	Diode and 1k pull up enabled between Vsup and LIN bus

4.12 Serial Boot mode support

See Section 3.6.1 for details.

4.13 USB adapter

There are two options for serial connection to a host computer over USB. The UART function of LINFlex0 can be routed through the integrated OSBDM debug connector at J2 or to a dedicated connector at J1.

- The use of the serial channel on J2 requires suitable software for the OSBDM interface.
- The J1 connector provides a high-speed interface to the MCU via a dedicated USB adapter (FT2232D). The USB adapter supports the USB serial port format and is recognized automatically by a host computer, however, you may need to install drivers to use the port. The drivers are available from <http://www.ftdichip.com/FTDrivers.htm>. Select the drivers that support FT2232D interface IC.

Select the required USB interface by setting jumpers on J17.

Header	USB Port	MCU pin/port
J17 – 1-3	FT2232D BDBUS0	PB3
J17 – 2-4	FT2232D BDBUS1	PB2
J17 – 3-5	OSBDM Rx	PB3
J17 – 4-6	OSBDM Tx	PB2

The USB converter IC has six spare pins on port A. These are available on header J6.

Header	FT2232D Port	MCU pin/port
J6 – 1	ADBUS0	—
J6 – 2	ADBUS4	—
J6 – 3	ADBUS1	—
J6 – 4	ADBUS5	—
J6 – 5	ADBUS2	—
J6 – 6	ADBUS6	—

4.14 Serial Boot mode support

The LinFlex0 (UART) function uses MCU pins PB2 and PB3 for compatibility with serial boot mode support on the MPC5645S. To configure the device to perform LINFlex serial boot mode place jumpers on J23 pin 9-10 and pin 11-12 and J17 pins 1-3 and 2-4.

4.15 Stepper Motor and ADC ports

The board provides two connectors that simplify stepper motor connections to the board. Each port also includes four ADC pins to allow other analog feedback and measurement if required.

These pins may be used as general purpose I/O as required.

Connector pin	Description	Connector pin	Description
P6 — 1	PC10 (ANS10)	P6 — 2	PD4 (M1C0M)
P6 — 3	PL0 (ANS19)	P6 — 4	PD5 (M1C0P)
P6 — 5	GND	P6 — 6	PD6 (M1C1M)
P6 — 7	PD3 (M0C1M)	P6 — 8	PD7 (M1C1P)
P6 — 9	PD2 (M0C1P)	P6 — 10	+5 V
P6 — 11	PD1 (M0C0M)	P6 — 12	PL1 (ANS18)
P6 — 13	PD0 (M0C0P)	P6 — 14	PC11 (ANS11)
P5 — 1	PD11 (M2C1P)	P5 — 2	PL3 (ANS16)
P5 — 3	PD10 (M2C1M)	P5 — 4	PC13 (ANS13)
P5 — 5	PD9 (M2C0P)	P5 — 6	+5 V
P5 — 7	PD8 (M2C0M)	P5 — 8	PD12 (M3C0M)
P5 — 9	GND	P5 — 10	PD13 (M3C0P)
P5 — 11	PC12 (ANS12)	P5 — 12	PD14 (M3C1M)
P5 — 13	PL2 (ANS17)	P5 — 14	PD15 (M3C1P)

4.16 General purpose I/O interfaces

To simplify hardware debug the board provides some basic I/O functions on the remaining unused MCU pins. These pins may be connected to external hardware or jumpered to the on-board functions.

Connector	MCU Port	Hardware function	Recommended function
J32 1-2	PK0	Red LED: anode connected via 100R to +3.3 V	eMIOS[18]
J32 3-4	PF0	Green LED: anode connected via 100R to +3.3 V	eMIOS1[19]
J32 5-6	PF1	Push switch of thumbwheel SW9	EIF8 (SIU interrupt)
J32 7-8	PF3	Push switch of thumbwheel SW8	WKUP10
J32 9-10	PL10	A pin of thumbwheel SW8	eMIOS1[10:11] in quadrature mode
J32 10-12	PL11	B pin of thumbwheel SW8	

Table continues on the next page...

Connector	MCU Port	Hardware function	Recommended function
J32 13-14	PL12	A pin of thumbwheel SW9	eMIOS1[12:13] in quadrature mode
J32 15-16	PL13	B pin of thumbwheel SW9	
J23 1-2	PK7	DIP switch 1	GPIO
J23 3-4	PK8	DIP switch 2	GPIO
J23 5-6	PK9	DIP switch 3	GPIO
J23 7-8	PB4	None	
J23 9-10	PB5	Pull up to 3.3 V	FABM serial boot mode
J23 11-12	PB6	Pull down to GND	ABS serial boot select
J23 13-14	PH4	None	
J23 15-16	PJ12	DIP switch 4	GPIO
J47 1	PE0	None	High drive GPIO / Stepper
J47 3	PE1	None	High drive GPIO / Stepper
J47 5	PE2	None	High drive GPIO / Stepper
J47 7	PE3	None	High drive GPIO / Stepper
J47 9	PE4	None	High drive GPIO / Stepper
J47 11	PE5	None	High drive GPIO / Stepper
J47 13	PE6	None	High drive GPIO / Stepper
J47 15	PE7	None	High drive GPIO / Stepper
J48 1	PC8	None	ADC
J48 3	PC9	None	ADC

5 Index of MCU pin usage

To optimize function and performance most of the MCU I/O pins are pre-configured for specific uses on the board. This table summarizes where the I/O pins are used and for what function.

Table 15. I/O pins

MCU Port	Connected to	Recommended function
PA[0:15]	DCU display connectors	DCU
PB[0:1]	FlexCAN0 Interface	FlexCAN0
PB[2:3]	USB Interface or OSBDM Debug Interface	LINFlex0 (UART mode)
PB[4:6]	J23	GPIO/DPSI/Alternate boot function
PB7	SCK function of Sound codec	SGM (I2S)
PB8	DO function of Sound codec	SGM (I2S)
PB9	FS function of Sound codec	SGM (I2S)
PB10	PWM function of Sound codec	SGM (PWM)
PB11	MCLK function of Sound codec	SGM
PB[12:13]	LINFlex1 Interface	LINFlex1

Table continues on the next page...

Table 15. I/O pins (continued)

MCU Port	Connected to	Recommended function
PC[0:3]	Touch screen for DCU	ADC
PC[4:7]	Touch screen for DCULite	ADC
PC[8:9]	J48	ADC / GPIO
PC[10:11]	P6	ADC / GPIO
PC[12:13]	P5	ADC / GPIO
PC[14:15]	32 kHz crystal	SXOSC (32 kHz oscillator)
PD[0:7]	P6	SMC / SSD / GPIO
PD[8:15]	P5	SMC / SSD / GPIO
PE[0:7]	J47	SMC / SSD / GPIO
PF0	J32 or Green LED	GPIO / eMIOS1[19]
PF1	J32 or thumbwheel switch on SW9	GPIO / EIF[8] / eMIOS1[20]
PF2	Video ADC interrupt	WKUP9 or NMI
PF3	J32 or thumbwheel switch on SW8	GPIO / WKUP10] / eMIOS1[21]
PF4	I2C for sound codec	I2C_1
PF5	I/O for QuadSPI1	QuadSPI
PF6	I/O for QuadSPI1	QuadSPI
PF7	I2C for sound codec	I2C_1
PF[8:9]	I2C for video ADC and video input port	I2C_0
PF[10:15]	Serial flash U18 (QuadSPI0)	QuadSPI
PG[0:11]	DCU display connectors	DCU
PG12	P4 Camera input port	PDI
PH[0:3]	P1 and P3 debug connectors	JTAG
PH4	J23	GPIO / eMIOS1[21]
PJ0	DCULite display connectors	DCULite
PJ[1:2]	P4 Camera input port	VIU/PDI
PJ3	Video clock in on video ADC and camera input port	VIU
PJ[4:11]	P4 camera input port	PDI
PJ12	J23 or DIP switch	GPIO
PJ[13:15]	Serial flash U21 (QuadSPI1)	QuadSPI
PK0	J32 or Red LED	GPIO / eMIOS1[18]
PK1	I/O for QuadSPI1	QuadSPI
PK[2:6]	P4 camera input port	VIU
PK[7:9]	J23 or DIP switch	GPIO / LINFlex2 / SGM (PWM)
PK[10:11]	Optional I2C interface for DCU adapter and DCULite adapter (fit SH6, SH7, SH10, SH11)	
PL[0:1]	P6	ADC / FlexCAN1
PL[2:3]	P5	ADC / eMIOS1[22:23]
PL[4:9]	P4 Camera input port	VIU

Table continues on the next page...

Table 15. I/O pins (continued)


MCU Port	Connected to	Recommended function
PL[10:11]	J32 and thumbwheel encoder	GPIO / eMIOS1[10:11]
PL[12:13]	J32 and thumbwheel encoder	GPIO / eMIOS1[12:13]
PM[0:1]	Reset and power down for video ADC and 10k pull down	
PM2	DCULite display connectors	DCULite
PM3	LIN enable	GPIO
PM4	J13 or FlexCAN0 enable	GPIO
PM[12:13]	DCULite display connectors	DCULite
PN[0:15]	DCULite display connectors	DCULite
PP[0:7]	DCULite display connectors	DCULite

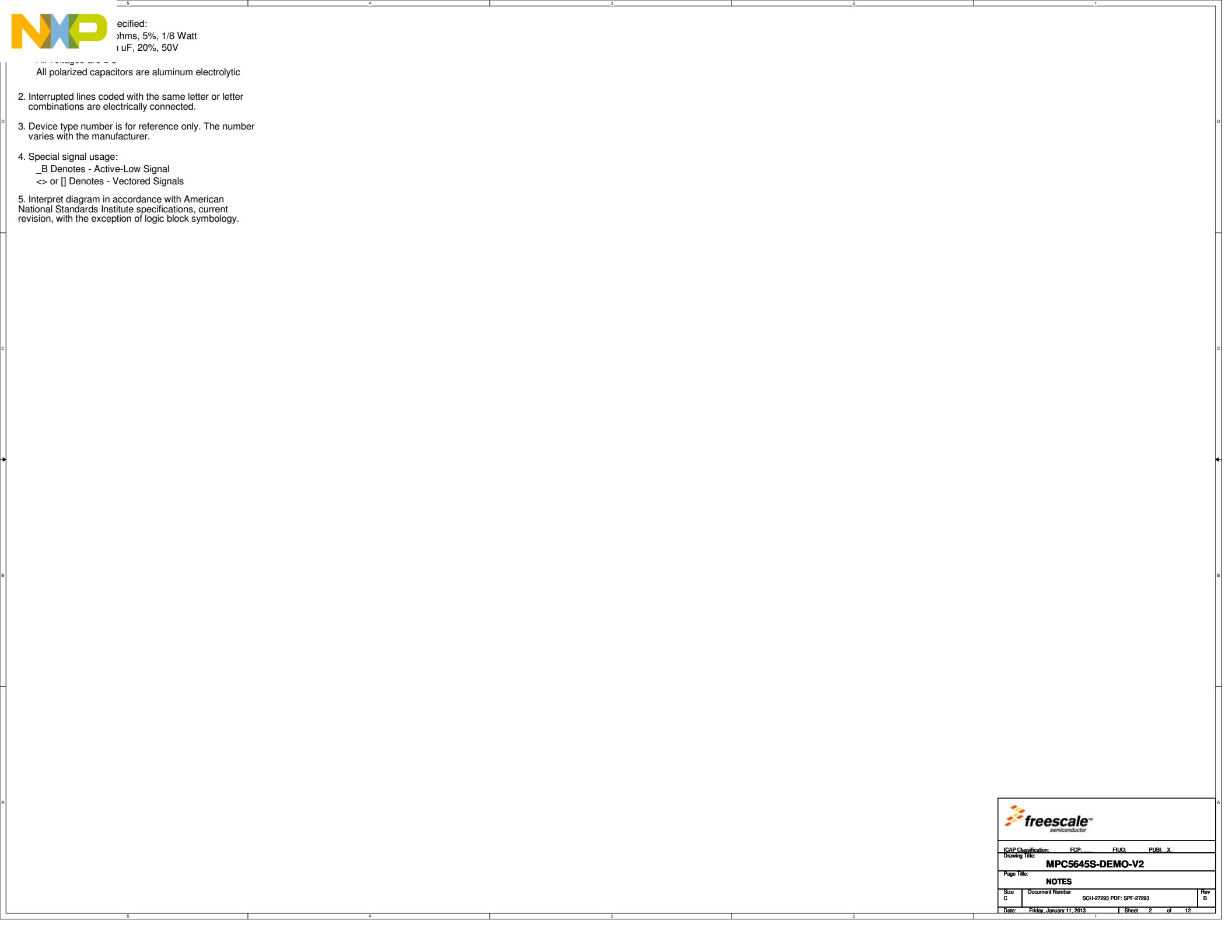
6 Project Examples

Freescale provides CodeWarrior Development Studio projects to assist in the development of software. These software projects initialize the MPC5645S-DEMO-V2 hardware and provide simple examples of how the hardware may be used. See freescale.com for the latest version.

Contents	
History & TOC	
5	Decoupling
6	MPC5645S Peripherals
7	Displays
8	Memory
9	Audio and motors
10	Serial Interface
11	Video Input
12	Debug

Revisions			
Rev	Description	Date	Approved
X1	First production MPC5645S board	05August11	S.McAslan
X2	1. Capacitors C2, C31, C23, C26 changed to higher voltage rating 2.Capacitor C201 moved from VDD_30V to P12V 3.Capacitors C215,C216 added to VDD_30V 4.Capacitors C217,C218, C219,C220 added to DM_VTT_DDR2 power 5.Capacitor C37 added to P12V	18August11	S.McAslan
X3	1.Capacitor C38 & C39 filtering added to USB nets and made as DNP. 2.Net names added before and after FB in power and regulator sections. 3.Differential clock nets suitably appended with _P/_N 4. U14 updated to 344-01142	23August11	S.McAslan
X4	1. Header J31 rotated per Alberto request. 2. IC U4, LIN Transceiver changed from 312-76816 to TMP-WF-15527 (TJA1020T from NXP) 3. Decaps added to U19,U20 and U22	26August11	S.McAslan
X5	1. Pullup resistor added to PF8 (SDA_0), PF9(SCL_0) PF4 (SDA_1) and PF7(SCL_0) and made as DNP 2. Netname between U25 and P11 changed from DCU_* to DCUL_*	30August11	S.McAslan
X6	1. DDR series termination resistor's package changed from 0603 to 0402	05Sep11	S.McAslan
X7	1. DDR series termination resistors RN5 and RN6 package changed to individual 0402 package to aid routing. 2. Capacitor C38 & C39 filtering added to USB nets JM_USB_N/P and made as DNP.	06Sep11	S.McAslan
X8	1. CAN-DB9 pinouts changed to standard connection.	07Sep11	S.McAslan
A	A085 Release	19Sep11	S.McAslan
AX1	A070 Release - J41,J42 connector pin outs reversed R89 removed from U12- pin no 3 R23 value changed from 100ohms to 470ohms U12 - pin 4 is supply changed from 5V_SR to 3.3V_SR - J12 pin 4 is connected with U12- pin 3 (Net name JM_RST_B)	17Nov11 18Nov11	S.McAslan
B	R89(DNP) added at U12- pin no 3, connected to 3.3V_SR MKT part number updated as MPC5645S-DEMO-V2 Board ID, Board Revision are Hard wired. A085 Release	21Nov11 23Nov11 29Nov11 1Dec11	S.McAslan

		Microcontroller Solutions Group 6501 William Cannon Drive West Austin, TX 78752-8689	
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Designer: S.McAslan	Drawing Title: MPC5645S-DEMO-V2	ICAP Classification: FQP:	FLUQ: PUB: X
Drawn by: S.McAslan	TITLE PAGE		
Approved: S.McAslan	Size C	Document Number SCH-27293 PDF: SPF-27293	Rev B
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pecified:
 ohms, 5%, 1/8 Watt
 1 uF, 20%, 50V

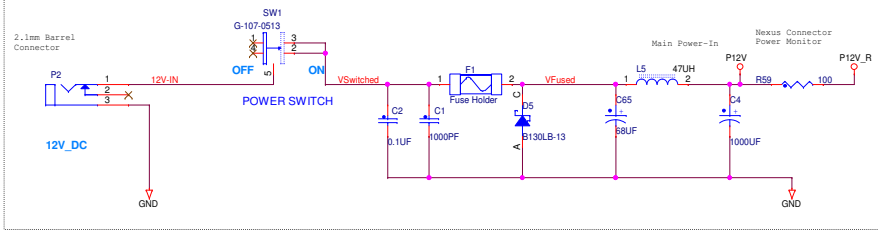
All polarized capacitors are aluminum electrolytic

2. Interrupted lines coded with the same letter or letter combinations are electrically connected.
3. Device type number is for reference only. The number varies with the manufacturer.
4. Special signal usage:
 _B Denotes - Active-Low Signal
 <> or [] Denotes - Vectored Signals
5. Interpret diagram in accordance with American National Standards Institute specifications, current revision, with the exception of logic block symbology.

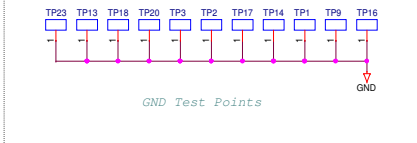
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Page Title: NOTES		
Size C	Document Number SCH-27293 PDF: SPF-27293	Rev B
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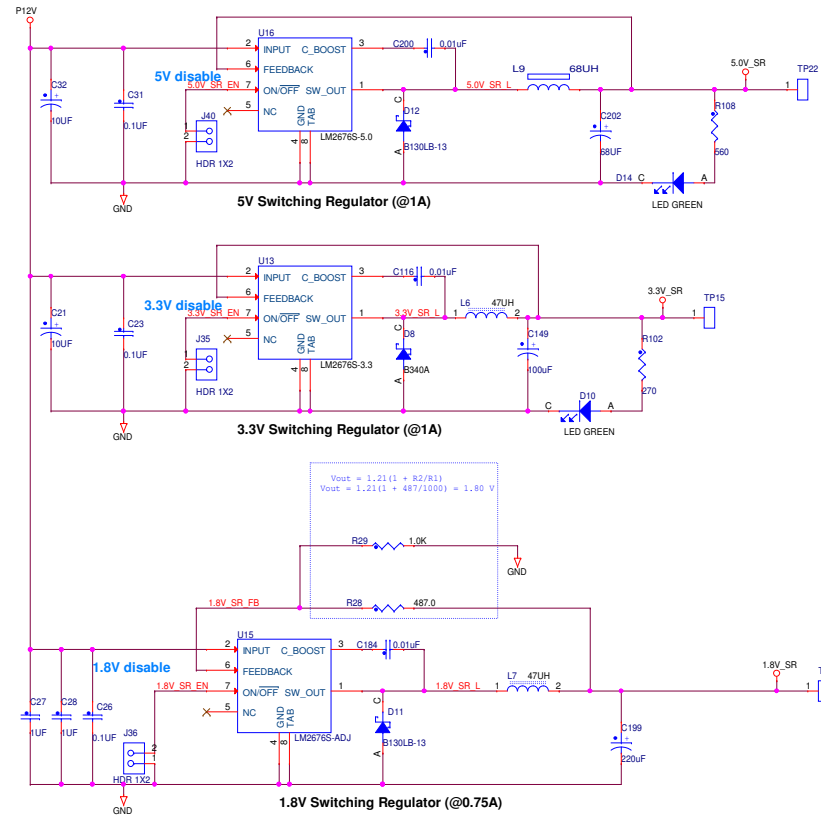
Power supply input and filter



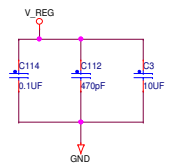
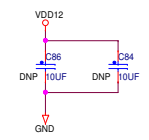
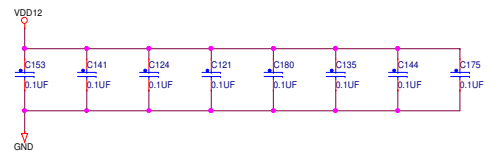
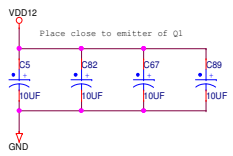
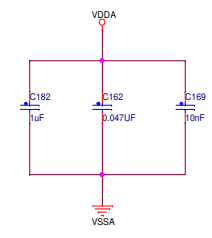
Test and reference points



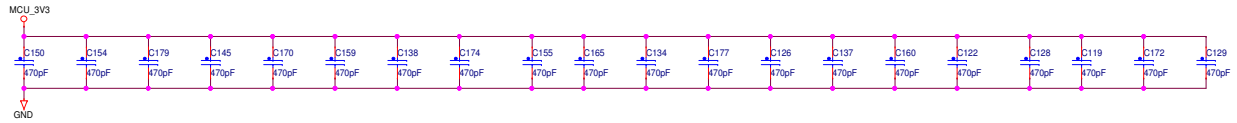
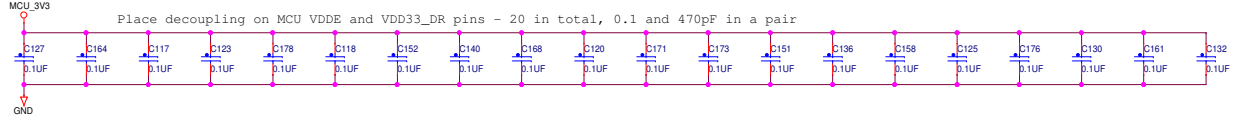
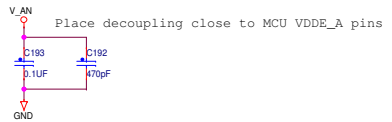
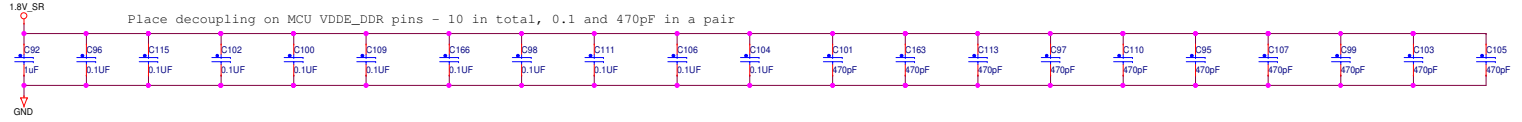
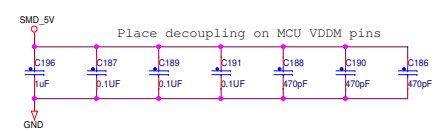
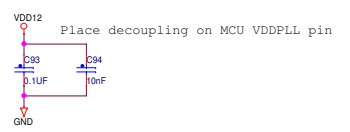
Switching Regulators



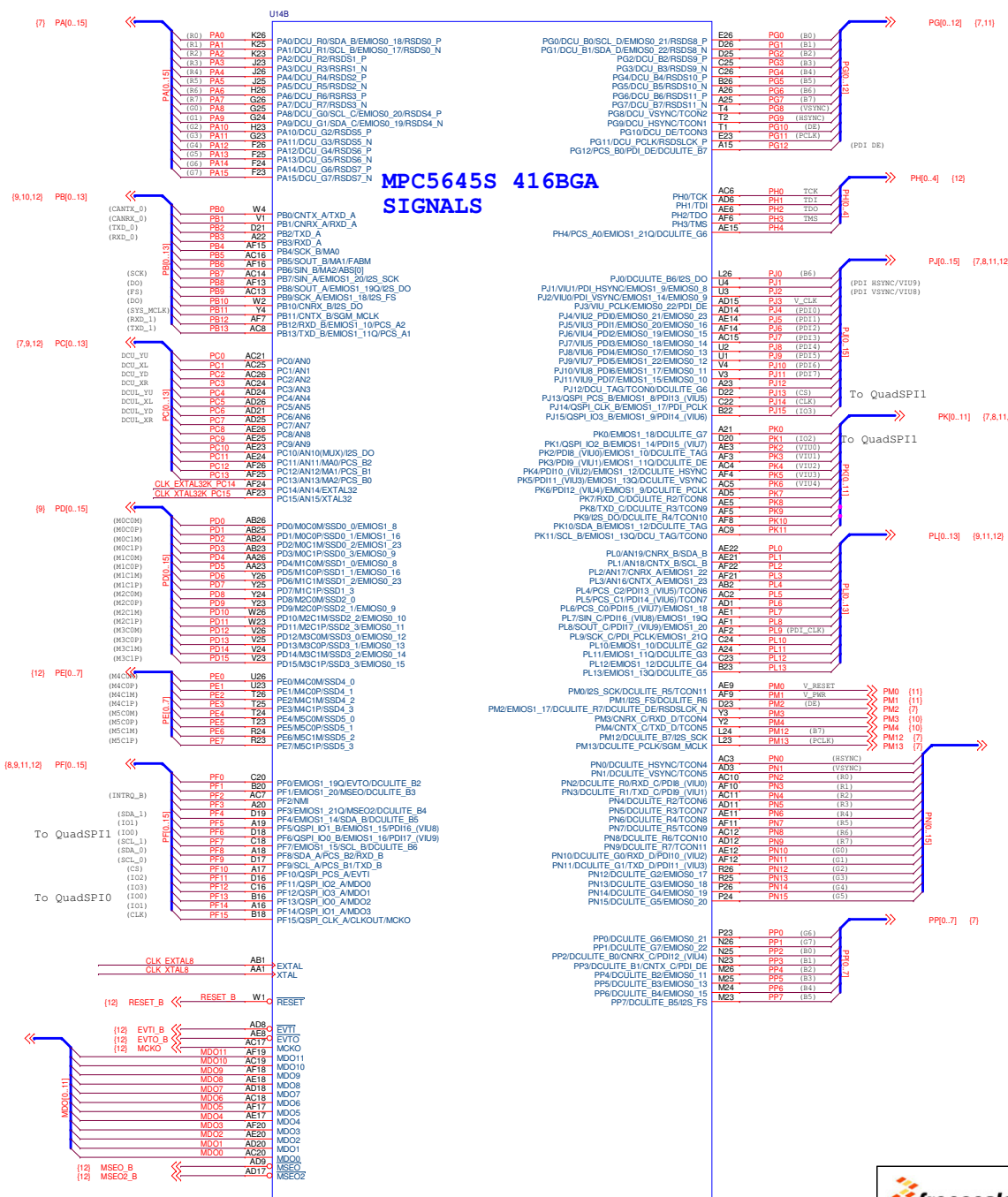
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Page Title: Power Supply			
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Place decoupling on MCU VDDR pin

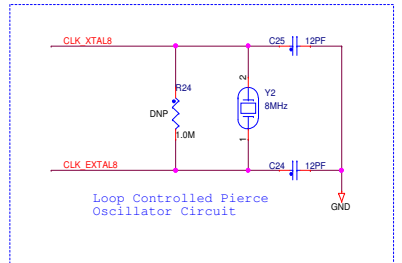
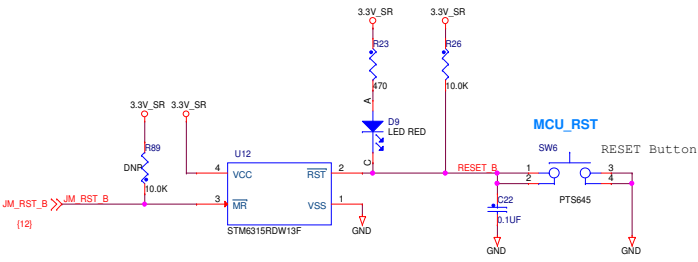
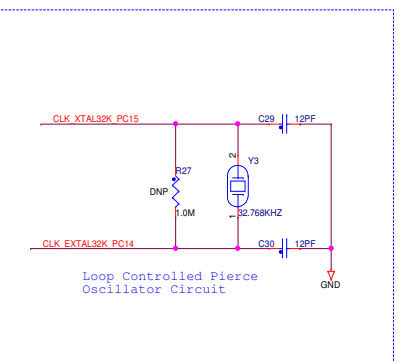


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Page Title: Decoupling	
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MPC5645S 416BGA SIGNALS

Need clock and Reset ccts



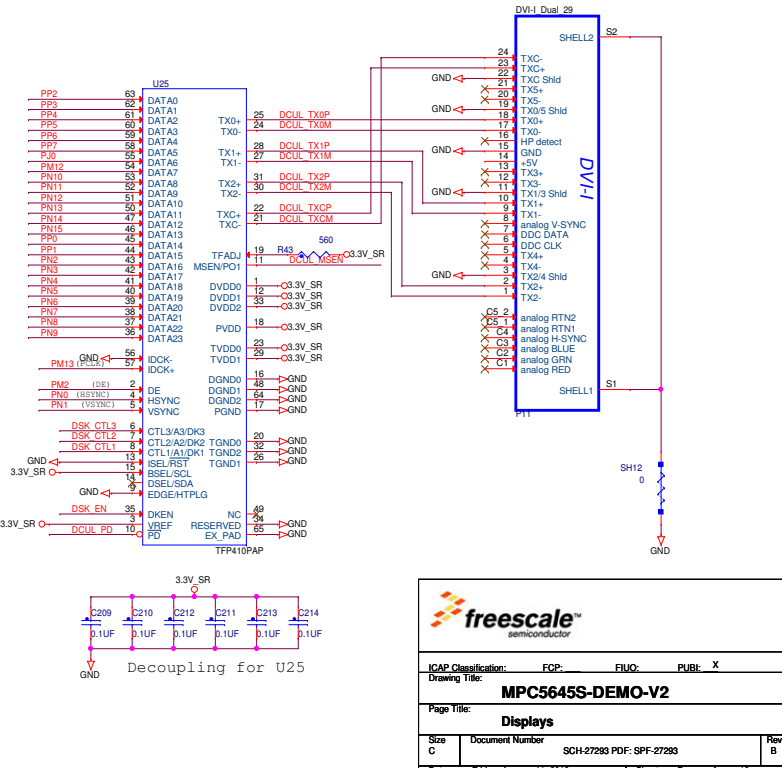
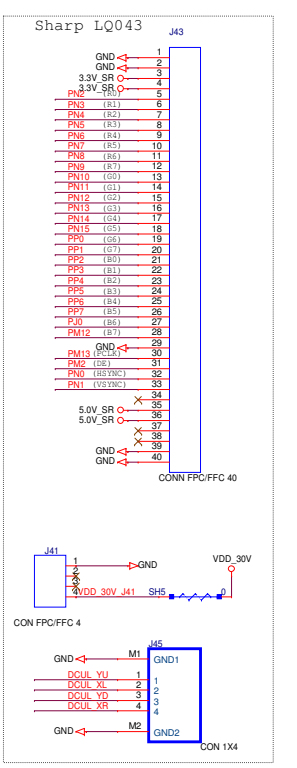
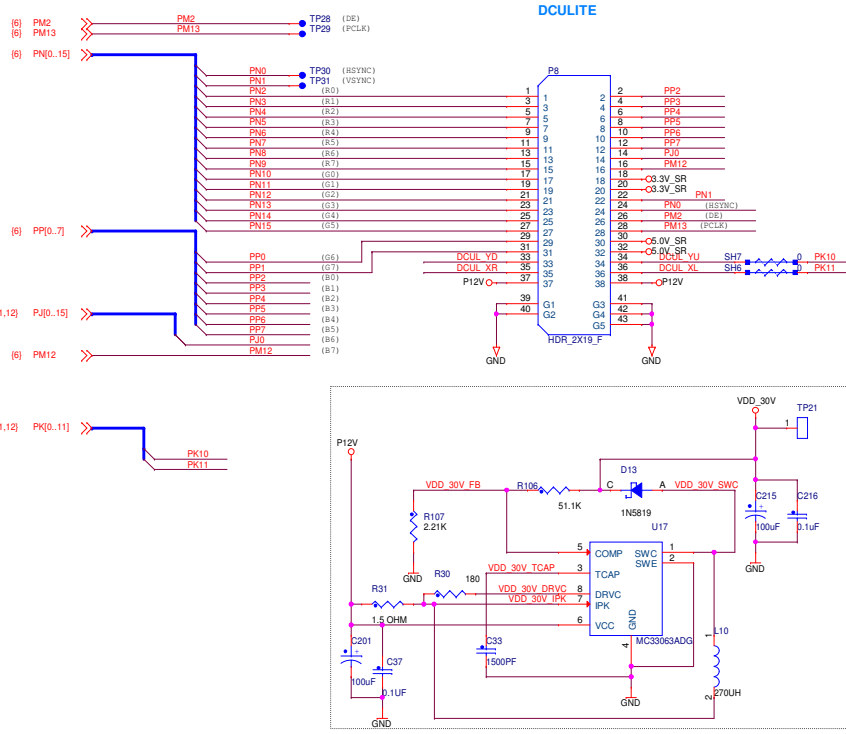
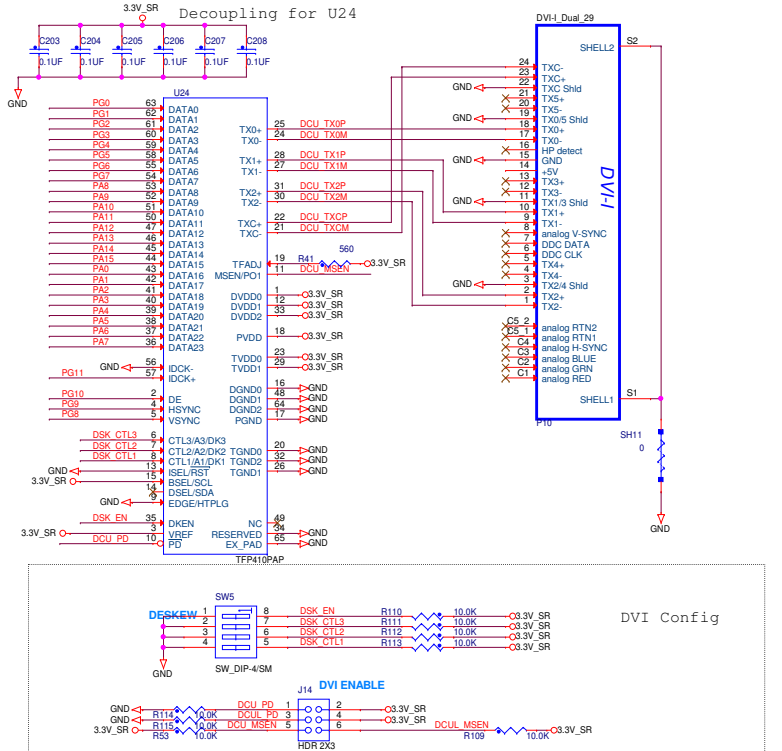
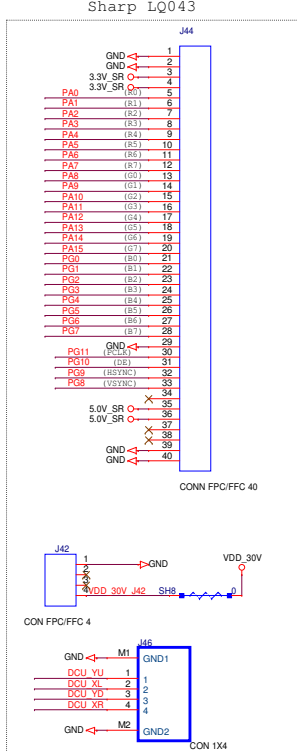
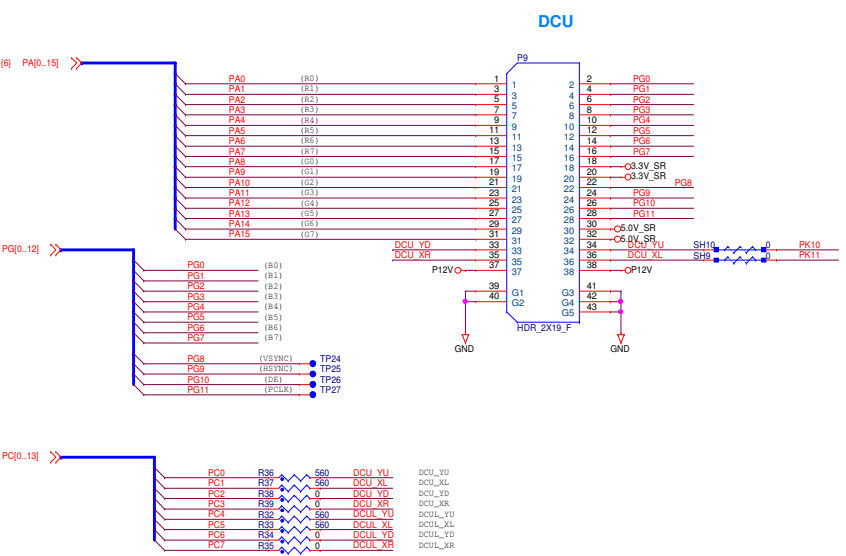
MPC5645S-416BKG

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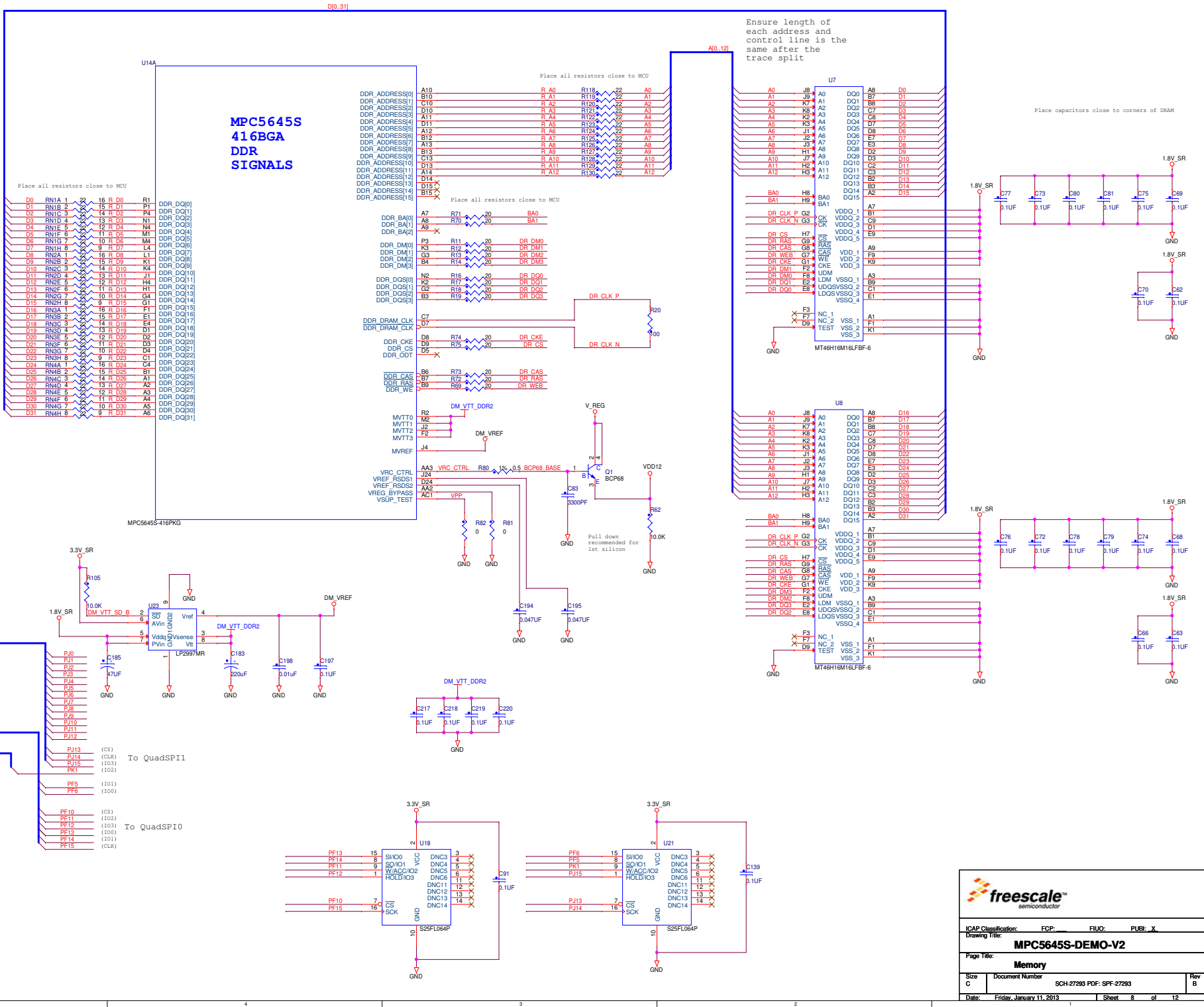
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Page Title: **MCU Peripherals**

Size C	Document Number	Rev B
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ICAP Classification: FCP, EUQ, PUB, X
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 Size C, Document Number SCH-27293 PDF: SPF-27293, Rev B
 Date: Friday, January 11, 2013, Sheet 7 of 12



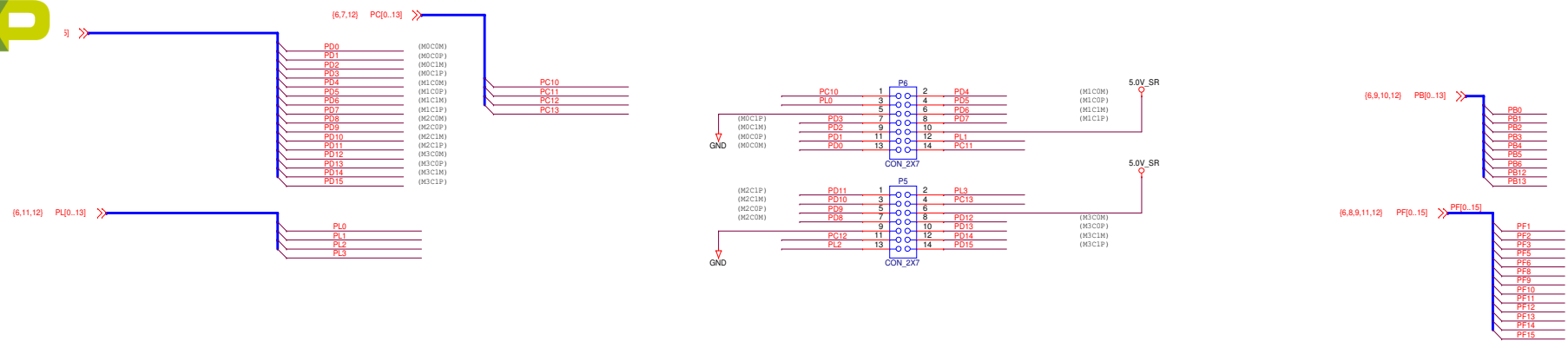
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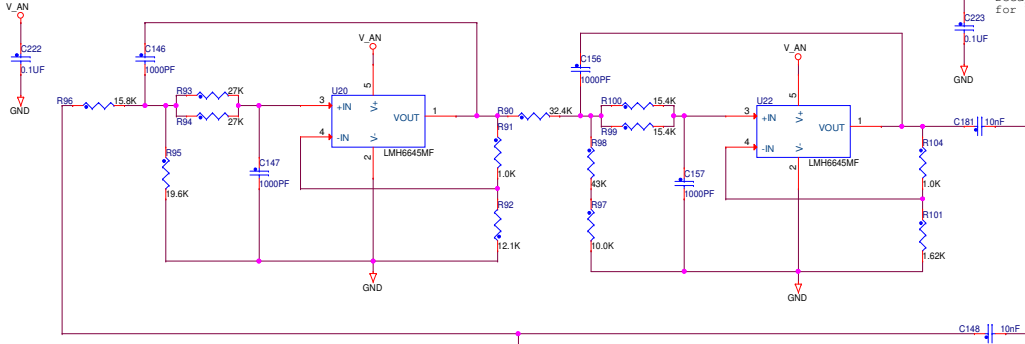
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Size C	Document Number SCH-27293 PDF: SPF-27293	Rev B
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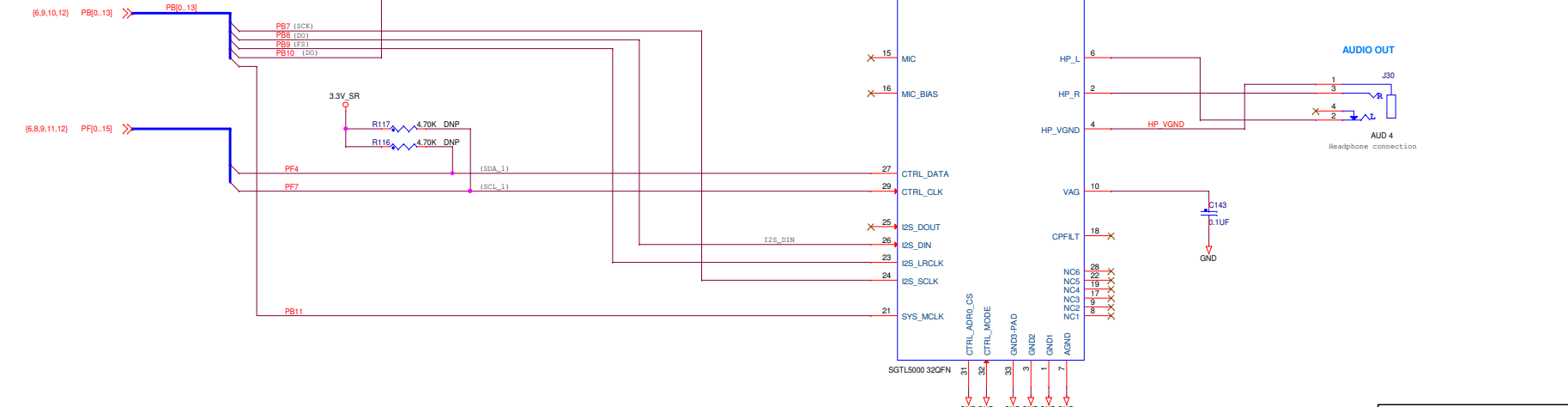
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Decap for U20



Place jack connectors beside each other



External amplifier connection

AUDIO OUT

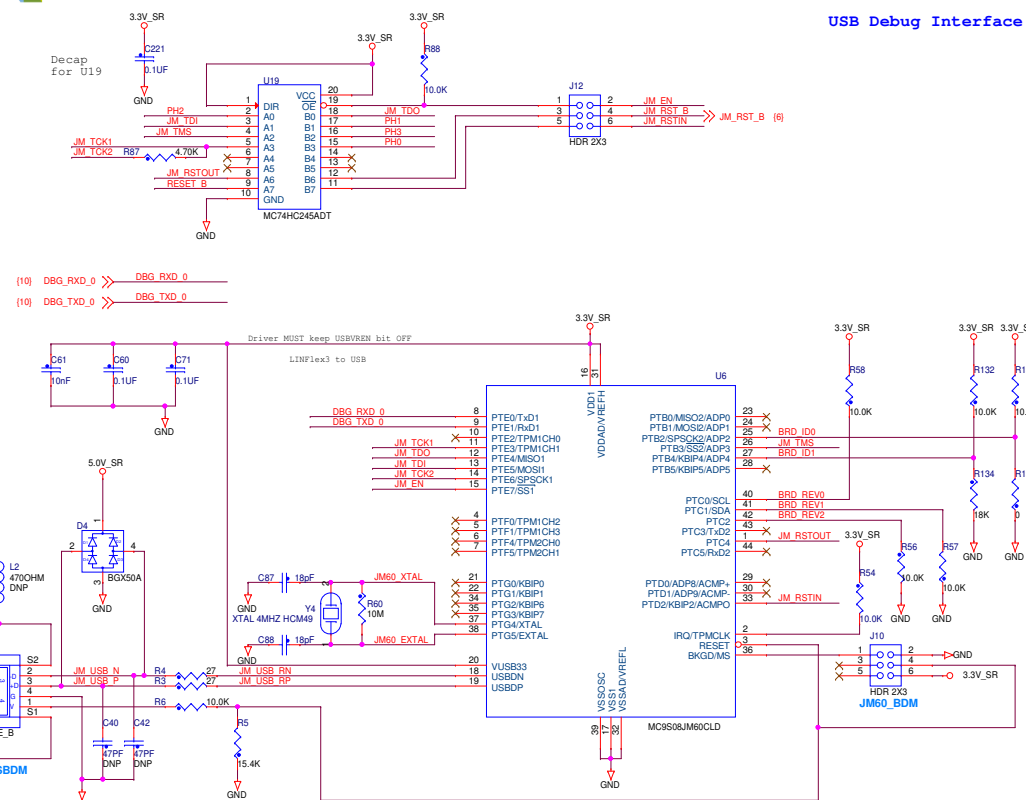
Headphone connection

Star wire grounds to single then connect to plane

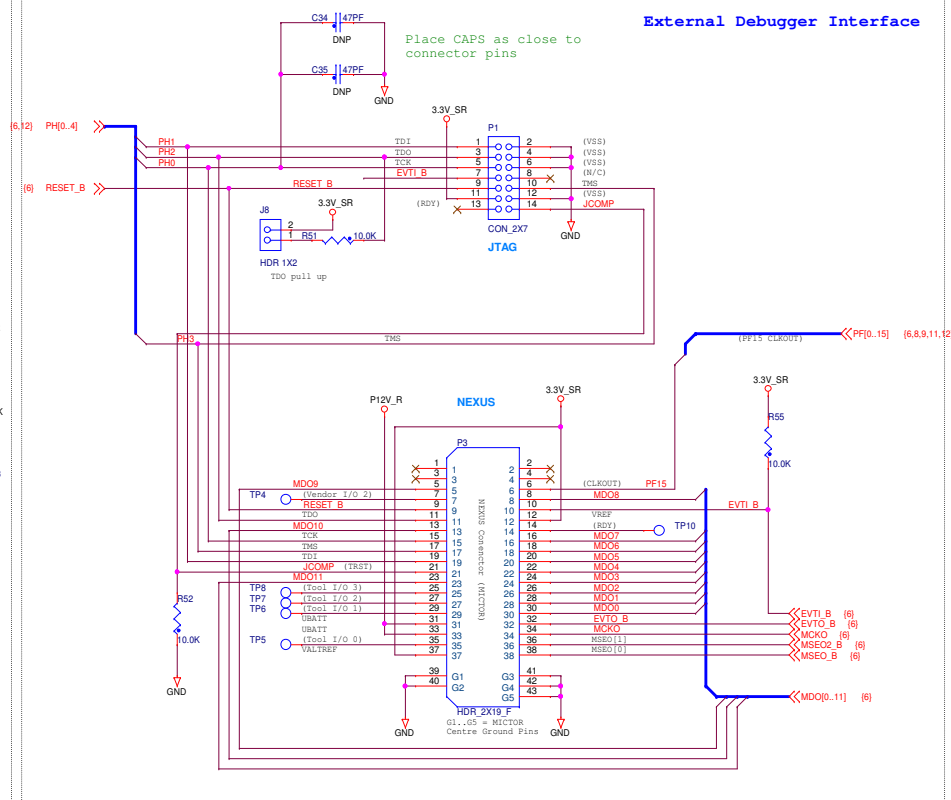
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Size C	Document Number SCH-27293 PDF: SPF-27293
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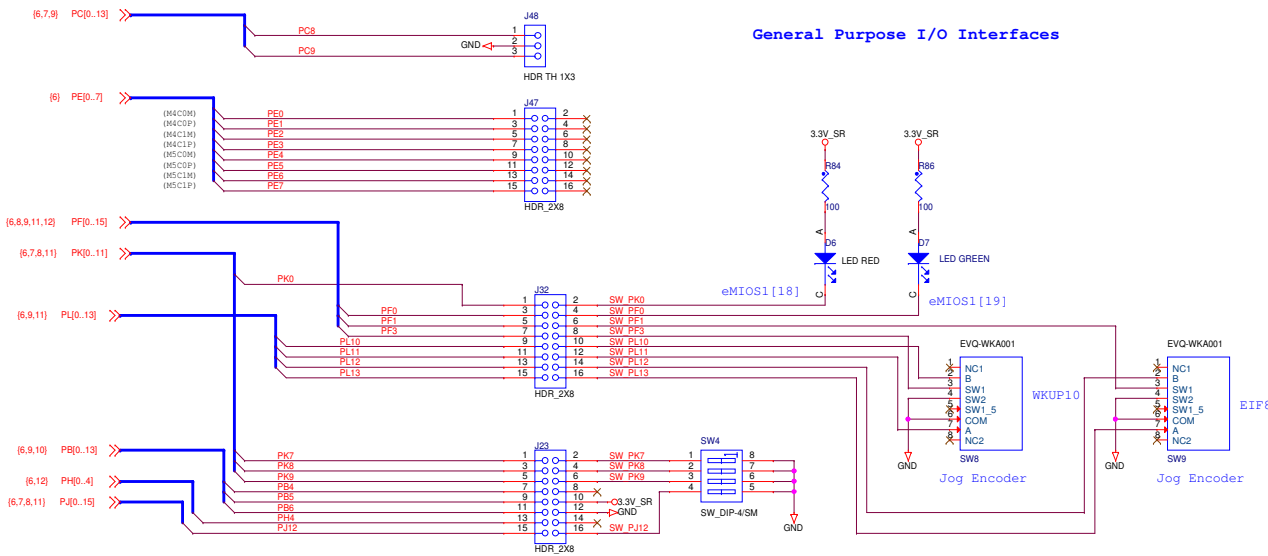
USB Debug Interface



External Debugger Interface



General Purpose I/O Interfaces



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ICAP Classification: FCP: FIUC: PUBI: X

Drawing Title: **MPC5645S-DEMO-V2**

Page Title: **Debug**

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