

**TABLE OF CONTENTS**

2	Block Diagram
3	Power Nets
4	MKL28Z512VLL7 (100LQFP)
5	OpenSDA
6	Peripherals
7	External Connectors
8	Elevator Connectors

**Revisions**

Rev	Description	Date	Approved
X1	Initial	9/29/2014	
X2	Update	12/17/2014	
A	Release	1/13/2015	
B	1. change KL28 footprint 2. 32.768Khz connect to EXTAL 3. EMV_IO pin pull up 4. add jumper for opensDA signals 5. remove USB DM DP capacitors. 6. add jumper for VREFH	6/15/2015	
B1	1. Change PKL28 into MKL28 2. add pull-up resistor to UART_TX	1/7/2016	
B2	1.Change 74LVC125 footprint	1/27/2016	
B3	1.Change 74LVC125 and MKL28 part	3/16/2016	
B4	1.Change 74LVC125 part reference	5/5/2016	

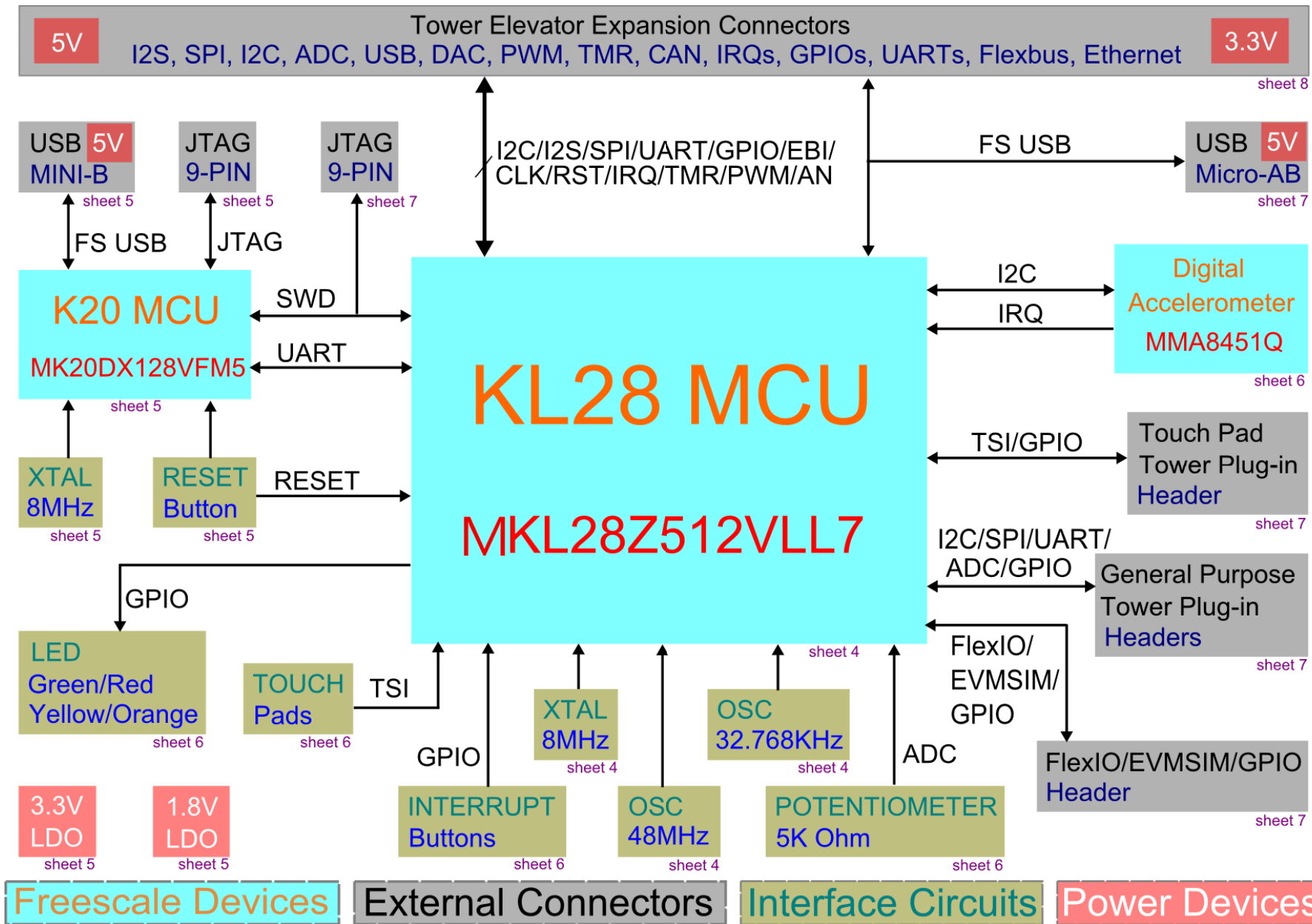
# TWR-KL28Z72M

- Unless Otherwise Specified:  
All resistors are in ohms  
All capacitors are in uF  
All voltages are DC
- Interrupted lines coded with the same letter or letter combinations are electrically connected.

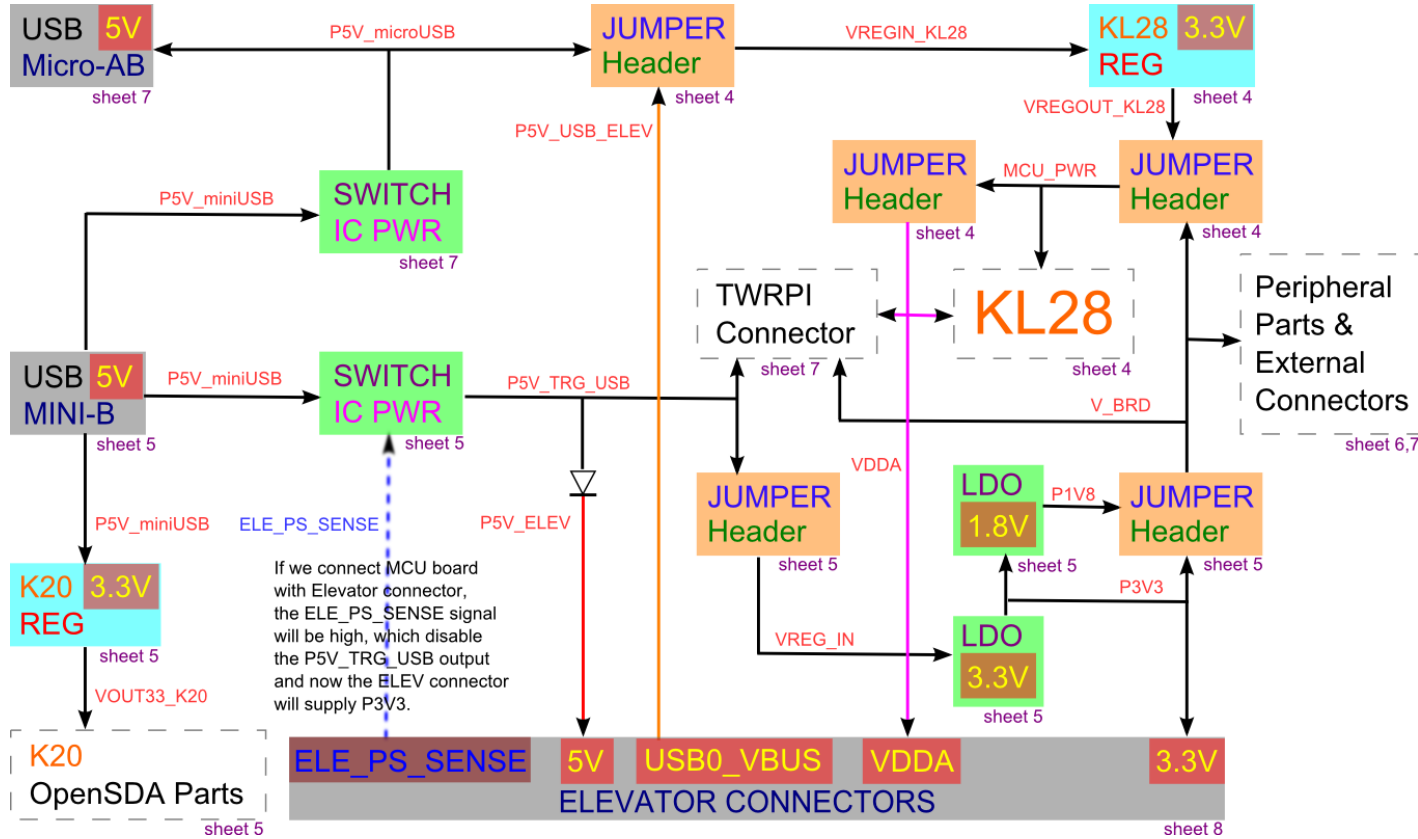
- Device type number is for reference only. The number varies with the manufacturer.
- Special signal usage:  
\_B Denotes - Active-Low Signal  
<> or [] Denotes - Vectored Signals
- Interpret diagram in accordance with American National Standards Institute specifications, current revision, with the exception of logic block symbology.

		<b>Microcontroller Solutions Group</b> 6501 William Cannon Drive West Austin, TX 78752-8689	
<small>This document contains information proprietary to Freescale Semiconductor and shall not be used for engineering design, procurement or manufacture in whole or in part without the express written permission of Freescale Semiconductor.</small>			
Designer: Qiao Jun		ICAP Classification: FQP: FUC: X PUB:	
Drawing Title: Qiao Jun		<b>TWR-KL28Z72M</b>	
Drawn by: Qiao Jun		<b>TABLE OF CONTENTS</b>	
Approved: Y.H.Cheng	Size C	Document Number SCH-28400 PDF: SPF-28400	Rev B4
Date: Thursday, May 05, 2016		Sheet 1 of 8	

# Block Diagram



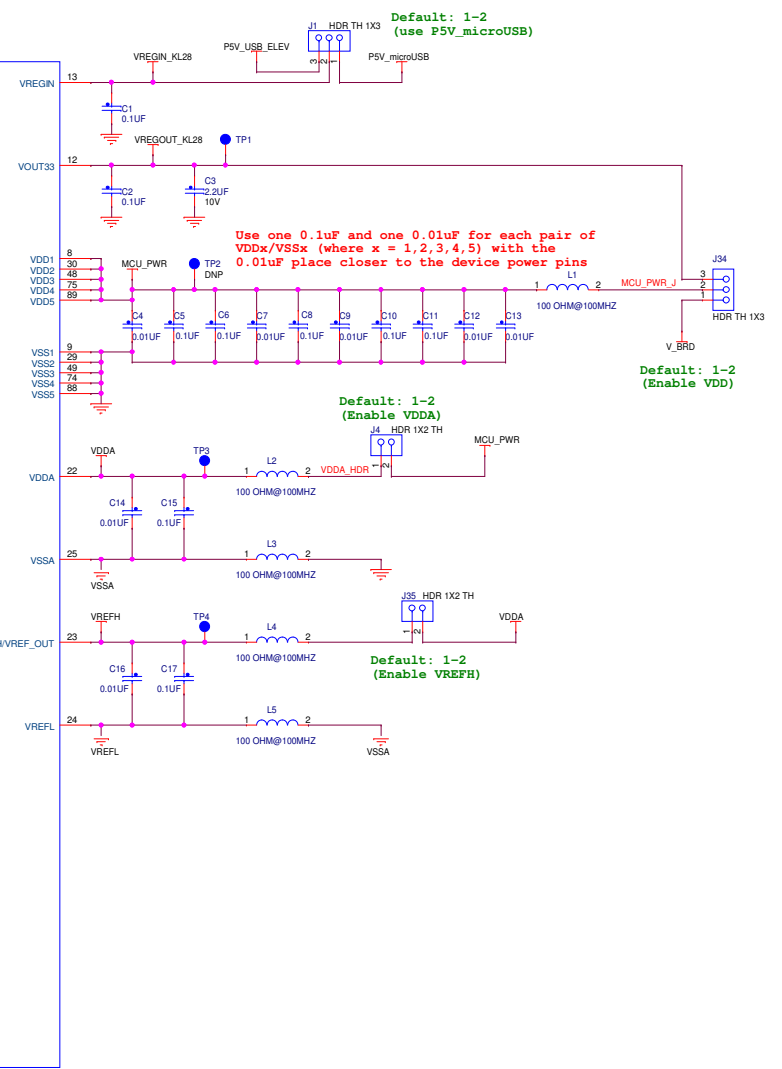
# Power Nets



NET	VOLTAGE	DESCRIPTION
P5V_miniUSB	5V	Primary input power. Filtered from miniUSB connector.
P5V_microUSB	5V	Secondary input power. Filtered from microUSB connector.
P5V_ELEV	5V	Third input power from primary elevator connector.
P5V_USB_ELEV	5V	USB power from primary elevator connector.
P5V_TRG_USB	5V	Output from USB power switch, which is controlled by the K20's VTRG_EN and elevator's ELE_PS_SENSE.
VREG_IN	5V	Output from jumper header, to select P5V_TRG_USB. Also could be supplied externally via header pin.
P3V3	3.3V	Output from LDO or from/to the Elevator connector.
P1V8	1.8V	Output from LDO.
VOUT33_K20	3.3V	Output from the K20 internal regulator.
VREGIN_KL28	5V	Output from jumper header to select P5V_microUSB, P5V_USB_ELEV.
VREGOUT_KL28	3.3V	Output from the KL28 internal regulator.
V_BRD	3.3V or 1.8V	Output from jumper header, to select 1.8V, 3.3V. Also could be supplied externally via header pins.
MCU_PWR	3.3V or 1.8V	Output from jumper header, to select V_BRD, VREGOUT_KL28. Also could be supplied externally via header pin.
VDDA	3.3V or 1.8V	Output from jumper header to select MCU_PWR. Also could be supplied externally via header pin.
VREFH	3.3V	Upper reference voltage for ADC on the MCU. Filtered from VDDA.
VREFL	0V	Lower reference voltage for ADC on the MCU. Filtered from VSSA.
VSSA	0V	VSSA power for MCU and analog circuits. Filtered from GND.
GND	0V	Digital Ground.

KL28

(5,7) SWD_CLK_TGTMUX0	OpenSDA SWD_CLK	34	PTA0/SWD_CLK/TS0_CH1/LP2C0_CTS/TPM0_CH5/LP2C0_SDA5
(5) UART0_RX	OpenSDA UART_TX	35	PTA1/TS0_CH2/LUART0_RX/TPM2_CH0
(5) UART0_TX	OpenSDA UART_RX	36	PTA2/TS0_CH3/LUART0_TX/TPM2_CH1
(5,7) SWD_DIO_TGTMUX0	OpenSDA SWD_DIO	37	PTA3/SWD_DIO/TS0_CH4/LP2C1_SCL/TPM0_CH0/LUART0_RTS
(6,7) PTA4/MISO/TS0_CH5	Push Button_TWRPI GPIO Electrode0	38	PTA4/LWU_P9/TS0_CH5/LP2C1_SDA/TPM0_CH1/NMIO
(8) I2S0_TX_SCLK	elevator I2S0_DOUT_SCK	39	PTA6/USB_CLK/TPM1_CH2/LP2C2_HREQ/I2S0_TX_BCLK
(8) PTA5	elevator RSTIN	40	PTA6/TPM0_CH3
(8) PTA7	elevator RSTOUT	41	PTA7/LPSP2_PCS3/TPM0_CH4/LP2C2_SDA5
(8) I2S0_TXD0	elevator I2S0_DOUT0	42	PTA13/TPM1_CH0/LP2C2_SCL/I2S0_TXD0
(8) I2S0_TX_FS	elevator I2S0_DOUT_WS	43	PTA13/LWU_P4/TPM1_CH1/LP2C2_SDA/I2S0_TX_FS
(8) PTA14	elevator I2S0_DN0	45	PTA14/LPSP0_PCS0/LUART0_TX/LP2C2_SCL/I2S0_RX_BCLK/I2S0_TXD0
(8) I2S0_RXD0	LED	44	PTA15/LPSP0_SCK/LUART0_RX/I2S0_RXD0
(8) PTA16	elevator I2S0_MCLK	46	PTA16/LPSP0_SOUT/LUART0_CTS/I2S0_RX_FS/I2S0_RXD0
(8) I2S0_MCLK	elevator I2S0_MCLK	50	PTA17/ADC0_SE22/LPSP0_SIN/LUART0_RTS/I2S0_MCLK
(4) EXTALD	microUSB Flag	51	PTA18/EXTAL/LUART1_RX/TPM2_CLKIN
(4) XTAL0	microUSB ID	52	PTA19/XTAL/LUART1_TX/TPM1_CLKIN/LP1MTR0_ALT1/LP1MTR1_ALT1
(5,7) RST_TGTMUX0_B	PTA20/RESET/LP2C0_SCL5/TPM2_CLKIN	52	
(7,8) PTB0/TS0_CH0/FX00_D8	elevator EBI_AD8_TWRPI GPIO Electrode1_FlexIO/EVMSIMGPIO header pin9	53	PTB0/LWU_P5/ADC0_SE1/TS0_CH0/LP2C0_SCL/TPM1_CH0/FX00_D8
(7,8) PTB1/TS0_CH1/FX00_D9	elevator EBI_AD9_TWRPI GPIO Electrode2_FlexIO/EVMSIMGPIO header pin10	54	PTB1/ADC0_SE1/TS0_CH1/LP2C0_SDA/TPM1_CH1/FX00_D9
(7,8) PTB2/TS0_CH2/FX00_D10	elevator EBI_AD10_TWRPI GPIO Electrode3_FlexIO/EVMSIMGPIO header pin11	55	PTB2/ADC0_SE2/TS0_CH2/LP2C0_SCL/TPM2_CH0/LUART0_RTS/FX00_D10
(7,8) PTB3/TS0_CH3/FX00_D11	elevator EBI_AD11_TWRPI GPIO Electrode4_FlexIO/EVMSIMGPIO header pin12	56	PTB3/ADC0_SE1/TS0_CH3/LP2C0_SDA/TPM2_CH1/LPSP1_PCS3/LUART0_CTS/FX00_D11
(8) PTB7	elevator GPIO4	57	PTB7/LPSP1_PCS1
(7,8) PTB8/FX00_D12	elevator EBI_AD12_FlexIO/EVMSIMGPIO header pin13	58	PTB8/LPSP1_PCS0/FX00_D12
(7,8) PTB9/FX00_D13	elevator EBI_AD13_FlexIO/EVMSIMGPIO header pin14	59	PTB9/LPSP1_SCK/FX00_D13
(7,8) PTB10/FX00_D14	elevator EBI_AD14_FlexIO/EVMSIMGPIO header pin15	60	PTB10/LPSP1_PCS0/FX00_D14
(7,8) PTB11/FX00_D15	elevator EBI_AD16_TWRPI GPIO Electrode5_FlexIO/EVMSIMGPIO header pin17	62	PTB11/LPSP1_SCK/TPM2_CLKIN/FX00_D15
(7,8) PTB16/TS0_CH0/FX00_D16	elevator EBI_RS0_TWRPI GPIO Electrode7_FlexIO/EVMSIMGPIO header pin19	64	PTB17/TS0_CH10/LPSP1_SIN/LUART0_TX/TPM1_CLKIN/LPSP2_PCS3/FX00_D17
(7,8) PTB17/TS0_CH10/FX00_D17	microUSB Flag_TWRPI GPIO Electrode8_FlexIO/EVMSIMGPIO header pin20	65	PTB18/TS0_CH11/TPM2_CH0/I2S0_TX_BCLK/LP2C1_HREQ/FX00_D18
(7,8) PTB18/TS0_CH11/FX00_D18	elevator SPI1_CS0_TWRPI SPI_SS	66	PTB19/TS0_CH12/TPM2_CH1/I2S0_TX_FS/LPSP2_PCS3/FX00_D19
(7) PTB19/TS0_CH12/FX00_D19	elevator SPI1_CLK_TWRPI SPI_CLK	67	PTB20/LPSP2_PCS0/CMPO_OUT
(7,8) SPI2_CS0	elevator SPI1_MISO_TWRPI SPI_MISO	68	PTB21/LPSP2_SCK/CMPI_OUT
(7,8) SPI2_CS1	elevator SPI1_MISO_TWRPI SPI_MISO	69	PTB23/LPSP2_SIN
(6,7) PTC0/TS0_CH13	Touch Pad_TWRPI GPIO Electrode9	70	PTC0/ADC0_SE14/TS0_CH13/LPSP2_PCS1/USB_SOF_OUT/CMPO_OUT/I2S0_TXD0
(4,7) PTC1/SPI0_CS0	TWRPI GPIO Electrode10	71	PTC1/LWU_P19/ADC0_SE1/TS0_CH14/LP2C1_SCL/LUART1_RTS/TPM0_CH0/I2S0_TXD0
(6,7) PTC2/TS0_CH15	Touch Pad_TWRPI GPIO Electrode11	72	PTC2/ADC0_SE11/CMPI_IN0/TS0_CH15/LP2C1_SDA/LUART1_CTS/TPM0_CH1/I2S0_TX_FS
(8) CLKOUT	elevator CLKOUT0	73	PTC3/LWU_P7/CMPI_IN1/LPSP0_PCS1/LUART1_RX/TPM0_CH2/CLKOUT/I2S0_TX_BCLK
(8) PTC5	elevator IRO_B	76	PTC4/LWU_P8/LPSP0_PCS0/LUART1_TX/TPM0_CH3/I2S0_MCLK/CMPI_OUT
(6,8) PTC5	accelerometer IRO_elevator IRO_D	77	PTC5/LWU_P9/LPSP0_SCK/LPTM0_ALT2/LPTM1_ALT2/I2S0_RXD0/CMPO_OUT
(7) PTC7	FlexIO/EVMSIMGPIO header pin21	79	PTC6/LWU_P10/CMPO_IN0/LPSP0_SOUT/I2S0_RX_BCLK/I2S0_MCLK
(7,8) PTC8/I2C0_SCL/FX00_D21	elevator I2C0_SCL_TWRPI I2C_SCL_FlexIO/EVMSIMGPIO header pin22	80	PTC7/CMPO_IN1/LPSP0_SIN/USB_SOF_OUT/I2S0_RX_FS/FX00_D20
(7,8) PTC8/I2C0_SDA/FX00_D22	elevator I2C0_SDA_TWRPI I2C_SDA_FlexIO/EVMSIMGPIO header pin23	81	PTC8/CMPO_IN2/LP2C0_SCL/TPM0_CH4/I2C0_MCLK/FX00_D21
(6,7) PTC10/PC1_SCL/FX00_D23	accelerometer I2C_FlexIO/EVMSIMGPIO header pin24	82	PTC9/CMPO_IN3/LP2C0_SDA/TPM0_CH4/I2C0_RX_BCLK/FX00_D22
(8) I2C1_SDA	accelerometer I2C	84	PTC10/LP2C1_SCL/I2S0_RX_FS/FX00_D23
(7,8) PTC12	elevator GPIO8_TWRPI GPIO_GPIOI0	84	PTC11/LWU_P11/LP2C1_SDA/I2S0_RXD0
(7,8) PTC13	elevator GPIO7_TWRPI GPIO_GPIOI0	85	PTC12/LP2C1_SCL/TPM0_CLKIN
(7,8) PTC14/EVMSIM0_CLK	elevator GPIO2_FlexIO/EVMSIMGPIO header pin27	86	PTC13/LP2C1_SDA/TPM1_CLKIN
(7,8) PTC15/EVMSIM0_RST	elevator GPIO5_FlexIO/EVMSIMGPIO header pin28	87	PTC14/EVMSIM0_CLK
(7,8) PTC16/EVMSIM0_VCCEN	elevator IRO_H_FlexIO/EVMSIMGPIO header pin29	90	PTC15/EVMSIM0_RST
(6,7) PTC17/EVMSIM0_IO	LED_FlexIO/EVMSIMGPIO header pin30	91	PTC16/EVMSIM0_VCCEN
(6,7) PTC18/EVMSIM0_PD	LED_FlexIO/EVMSIMGPIO header pin31	92	PTC17/EVMSIM0_IO/LPSP0_PCS3
			PTC18/EVMSIM0_PD/LPSP2_PCS2
(7,8) PTD0/FX00_D0	elevator EBI_AD0_FlexIO/EVMSIMGPIO header pin1	93	PTD0/LWU_P12/LPSP0_PCS0/LUART2_RTS/TPM0_CH0/FX00_D0
(7,8) PTD1/FX00_D1	elevator EBI_AD1_FlexIO/EVMSIMGPIO header pin2	94	PTD1/ADC0_SE8/LPSP0_SCK/LUART2_CTS/TPM0_CH1/FX00_D1
(7,8) PTD2/FX00_D2	elevator EBI_AD2_FlexIO/EVMSIMGPIO header pin3	95	PTD2/LWU_P13/LPSP0_SOUT/LUART2_RX/TPM0_CH2/FX00_D2
(7,8) PTD3/FX00_D3	elevator EBI_AD3_FlexIO/EVMSIMGPIO header pin4	96	PTD3/LPSP0_SIN/LUART2_TX/TPM0_CH3/FX00_D3
(7,8) PTD4/FX00_D4	elevator EBI_AD4_FlexIO/EVMSIMGPIO header pin5	97	PTD4/LWU_P14/LPSP1_PCS0/LUART2_RX/TPM0_CH4/LUART0_RTS/FX00_D4
(7,8) PTD5/FX00_D5	elevator EBI_AD5_FlexIO/EVMSIMGPIO header pin6	98	PTD5/ADC0_SE8/LPSP1_SCK/LUART2_TX/TPM0_CH5/LUART0_CTS/FX00_D5
(7,8) PTD6/FX00_D6	elevator EBI_AD6_FlexIO/EVMSIMGPIO header pin7	99	PTD6/LWU_P19/ADC0_SE1/LPSP1_SOUT/LUART0_RX/FX00_D6
(7,8) PTD7/FX00_D7	elevator EBI_AD7_FlexIO/EVMSIMGPIO header pin8	100	PTD7/LPSP1_SIN/LUART0_TX/FX00_D7
(7,8) PTE0/ADC0_SE16	elevator GPIO8_SDA_TWRPI ADC_analog0	1	PTD8/RTC_CLKOUT/ADC0_SE16/LPSP1_SIN/LUART1_TX/CMPO_OUT/LP2C1_SDA
(8) SPI1_SCK	elevator SPI0_MISO	2	PTD9/LWU_P10/ADC0_SE17/LPSP1_SOUT/LUART1_RX/LP2C1_SCL
(8) SPI1_SIN	elevator SPI0_MISO	3	PTD10/LWU_P11/ADC0_SE18/LPSP1_SIN/LUART1_CTS/LP2C1_SDA5
(8) SPI1_CS0	elevator SPI0_CS0	4	PTD11/ADC0_SE19/LPSP1_SIN/LUART1_RTS/LP2C1_SCL5
(8) SPI1_CS1	elevator SPI0_CS1	5	PTD12/LWU_P20/LPSP1_PCS0
(8) PTE6	Push Button	7	PTD13/LPSP1_PCS1
(7,8) PTE16/UART2_TX	elevator UART1_TX_TWRPI UART_TX/GPIO3	14	PTD14/LWU_P16/LPSP1_PCS2/I2S0_MCLK/USB_SOF_OUT
(7,8) PTE17/UART2_RX	elevator UART1_RX_TWRPI UART_RX/GPIO2	15	PTD15/ADC0_DP1/ADC0_SE1/LPSP0_PCS0/LUART2_TX/TPM0_CLKIN/LPSP1_PCS3/FX00_D0
(7,8) PTE18/UART2_CTS_B	elevator UART1_CTS/GPIO3_TWRPI UART_CTS/GPIO4	16	PTD16/LWU_P19/ADC0_SE15/ADC0_SE15/LPSP0_SCK/LUART2_RX/TPM1_CLKIN/LP1MTR0_ALT3/LP1MTR1_ALT3/FX00_D1
(7,8) PTE19/UART2_RTS_B	elevator UART1_RTS/GPIO1_TWRPI UART_RTS/GPIO5	17	PTD18/LWU_P20/ADC0_DP2/ADC0_SE2/LPSP0_SOUT/LUART2_CTS/LP2C0_SDA/FX00_D2
(7,8) ADC0_DP0/ADC0_SE0	elevator AN2_TWRPI ADC_ID (General Purpose)	18	PTD19/ADC0_DP0/ADC0_SE0/LPSP0_SIN/LUART2_RTS/LP2C0_SCL/FX00_D3
(7,8) ADC0_DP0/ADC0_SE0	elevator AN2_TWRPI ADC_ID (General Purpose)	19	PTD20/ADC0_DP0/ADC0_SE0/LPSP2_SCK/TPM1_CH0/LUART0_TX/FX00_D4
(7,8) ADC0_DP0/ADC0_SE0	elevator AN2_TWRPI ADC_ID (General Purpose)	20	PTD21/ADC0_DP0/ADC0_SE0/LPSP2_SOUT/TPM1_CH1/LUART0_RX/FX00_D5
(7,8) ADC0_DP0/ADC0_SE0	elevator AN2_TWRPI ADC_ID (General Purpose)	21	PTD22/ADC0_DP0/ADC0_SE0/LPSP2_SIN/TPM2_CH0/LUART2_TX/FX00_D6
(7,8) ADC0_DP0/ADC0_SE0	elevator AN2_TWRPI ADC_ID (General Purpose)	22	PTD23/ADC0_DP0/ADC0_SE0/LPSP2_SCK/TPM1_CH0/LUART2_RX/FX00_D7
(7,8) ADC0_DP0/ADC0_SE0	elevator AN2_TWRPI ADC_ID (General Purpose)	23	PTD24/ADC0_SE20/EVMSIM0_IO/TPM0_CH0/LP2C0_SCL
(7) PTE24/ADC0_SE20	microUSB detect_TWRPI ADC_analog1	31	PTD25/LWU_P20/ADC0_SE21/EVMSIM0_P0/TPM0_CH1/LP2C0_SDA
(4) USB_CLKIN	48MHz OSC	36	PTD28/RTC_CLKOUT/TPM0_CH5/LP2C0_SCL/USB_CLKIN
(8) ADC0_SE6	potentiometer	26	PTD29/CMPI_IN5/CMPO_IN5/ADC0_SE48/EVMSIM0_CLK/TPM0_CH2/TPM0_CLKIN
(8) TPM0_CS0	elevator TPM0	27	PTD30/ADC0_OUT/CMPI_IN5/ADC0_SE23/CMPO_IN5/EVMSIM0_RST/TPM0_CH3/TPM1_CLKIN
(8) TPM0_CH4	elevator PWM0	28	PTD31/EVMSIM0_VCCEN/TPM0_CH4/TPM2_CLKIN/LP2C0_HREQ
(7) KL28_USB0_DP	KL28_USB0_DP	10	USB0_DP
(7) KL28_USB0_DM	KL28_USB0_DM	11	USB0_DM



32.768 kHz Oscillator

8MHz Crystal

48MHz Oscillator

**freescale**

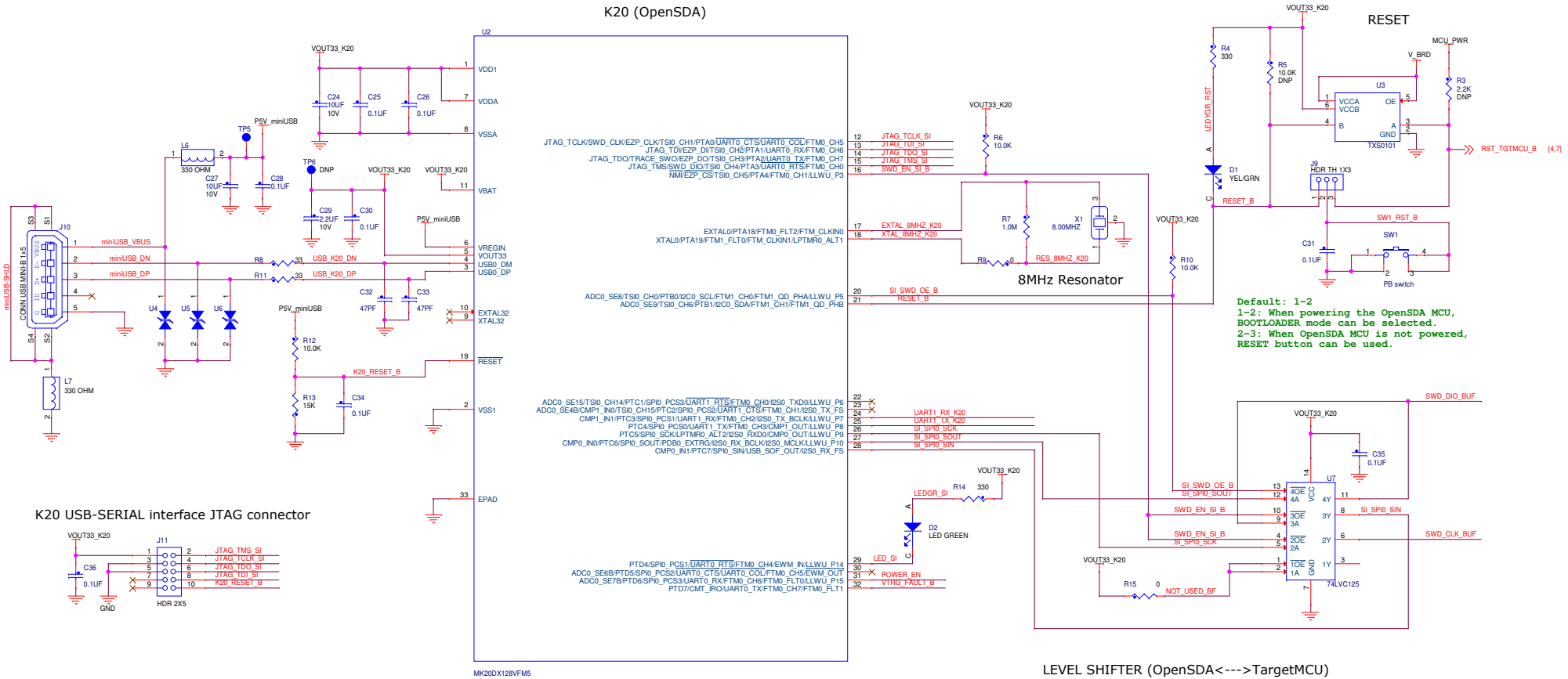
ICAP Classification: FCP: FIUC: X PUB: \_\_\_\_\_  
 Drawing Title: **TWR-KL28Z72M**

Page Title: **MKL28Z512VLL7 (100LQFP)**

Size C	Document Number SCH-28400 PDF: SPF-284000	Rev B4
--------	-------------------------------------------	--------

Date: Thursday, May 05, 2016 Sheet 4 of 8

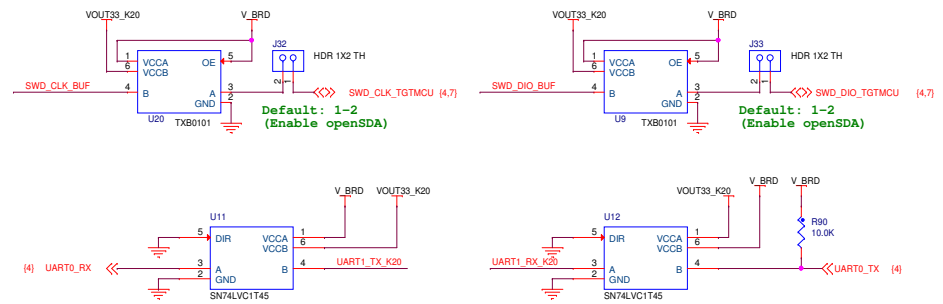
# K20 (OpenSDA)



**RESET**

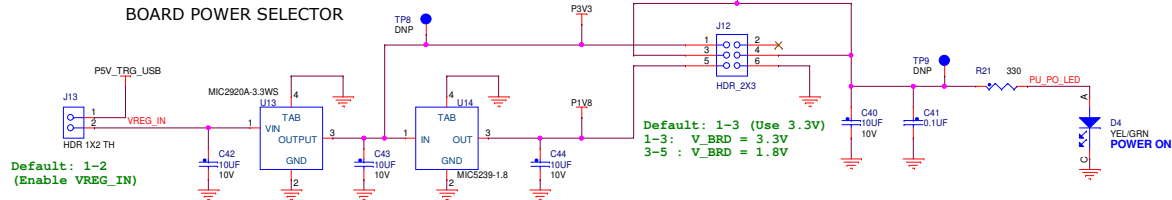
Default: 1-2  
1-2: When powering the OpenSDA MCU, BOOTLOADER mode can be selected.  
2-3: When OpenSDA MCU is not powered, RESET button can be used.

## LEVEL SHIFTER (OpenSDA<-->TargetMCU)

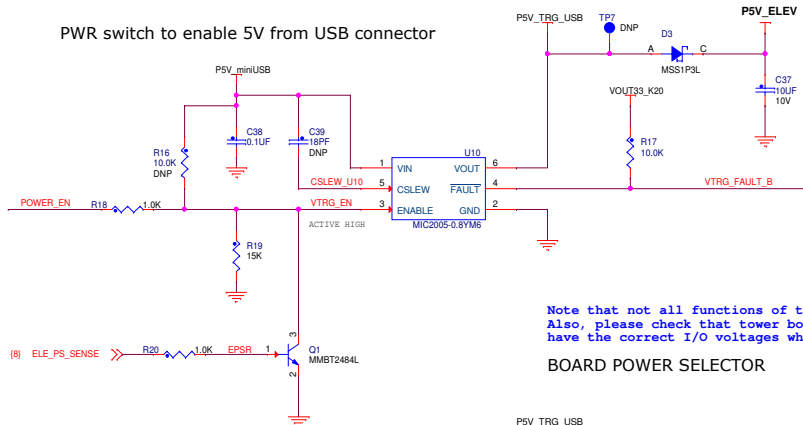


Note that not all functions of the board will operate at 1.8V. Also, please check that tower boards used with this board have the correct I/O voltages when this board is set to 1.8V.

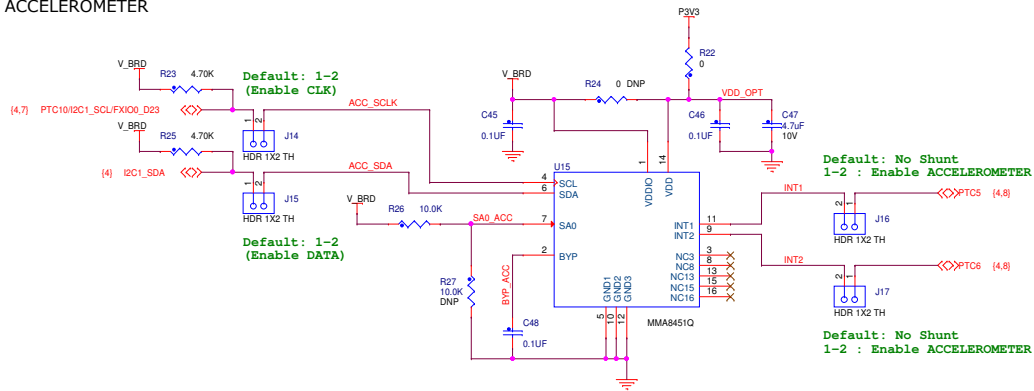
## BOARD POWER SELECTOR



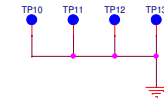
## PWR switch to enable 5V from USB connector



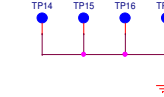
### ACCELEROMETER



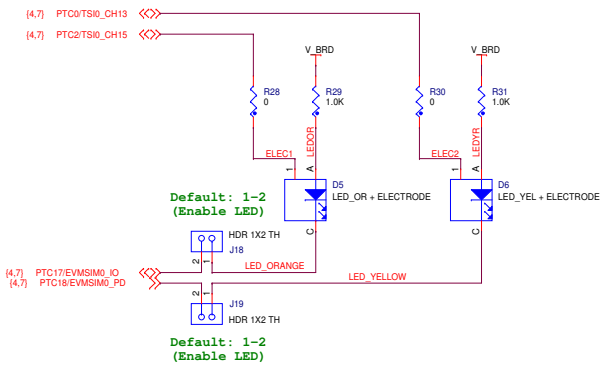
### GND LOOP TEST PADS



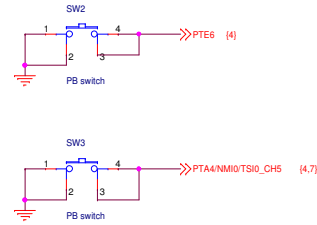
### GND LOOP TEST LOOPS



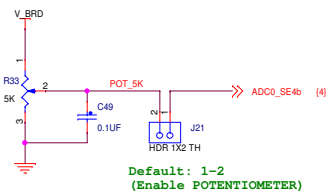
### TOUCH ELECTRODES WITH LEDs



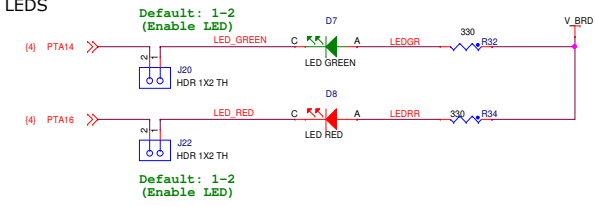
### PUSH BUTTON



### POTENTIOMETER



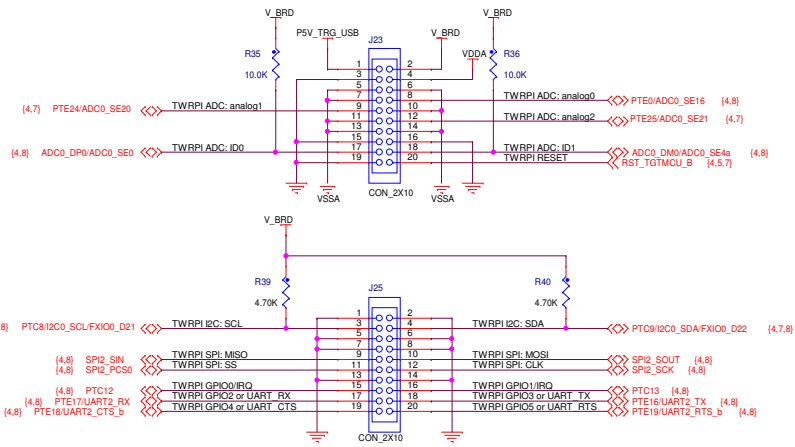
### LEDS



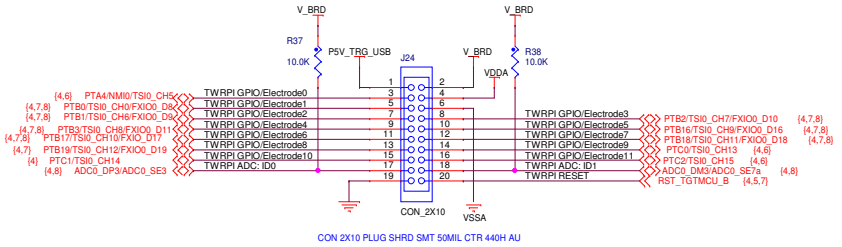
ICAP Classification: FCP: FUC: X PUB:	
Drawing Title: <b>TWR-KL28Z72M</b>	
Page Title: <b>PERIPHERALS</b>	
Size C	Document Number SCH-28400 PDF: SPF-28400
Date: Thursday, May 05, 2016	Sheet 6 of 8

Note: The TWRPI connectors are powered by V\_BRD which may be 1.8V or 3.3V.  
 Not all TWRPI boards will work at 1.8V.  
 Check that the TWRPI board will work at 1.8V before using it when this board is set for 1.8V.

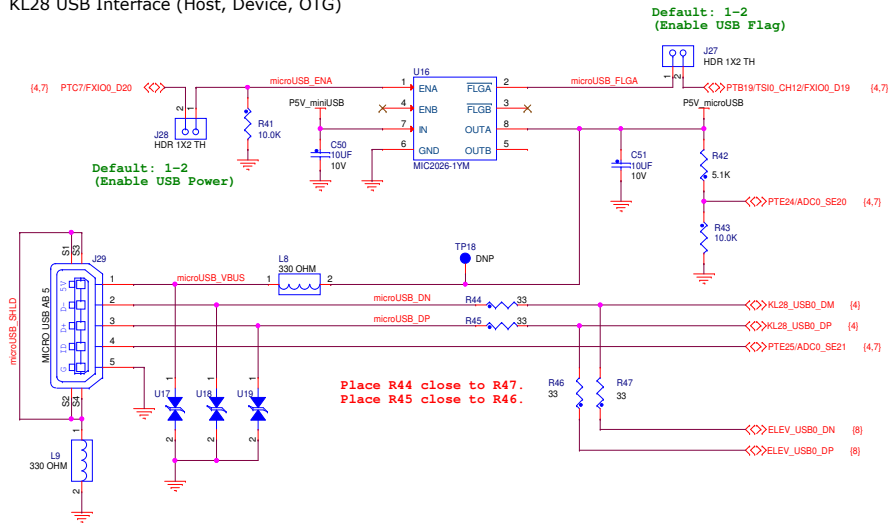
### GENERAL PURPOSE TWRPI



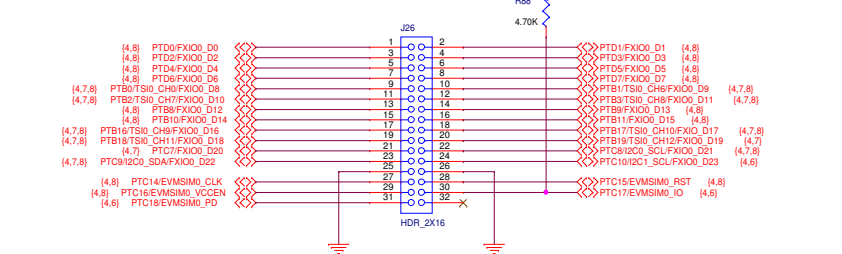
### TOUCH PAD TWRPI



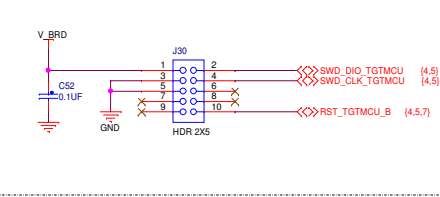
### KL28 USB Interface (Host, Device, OTG)



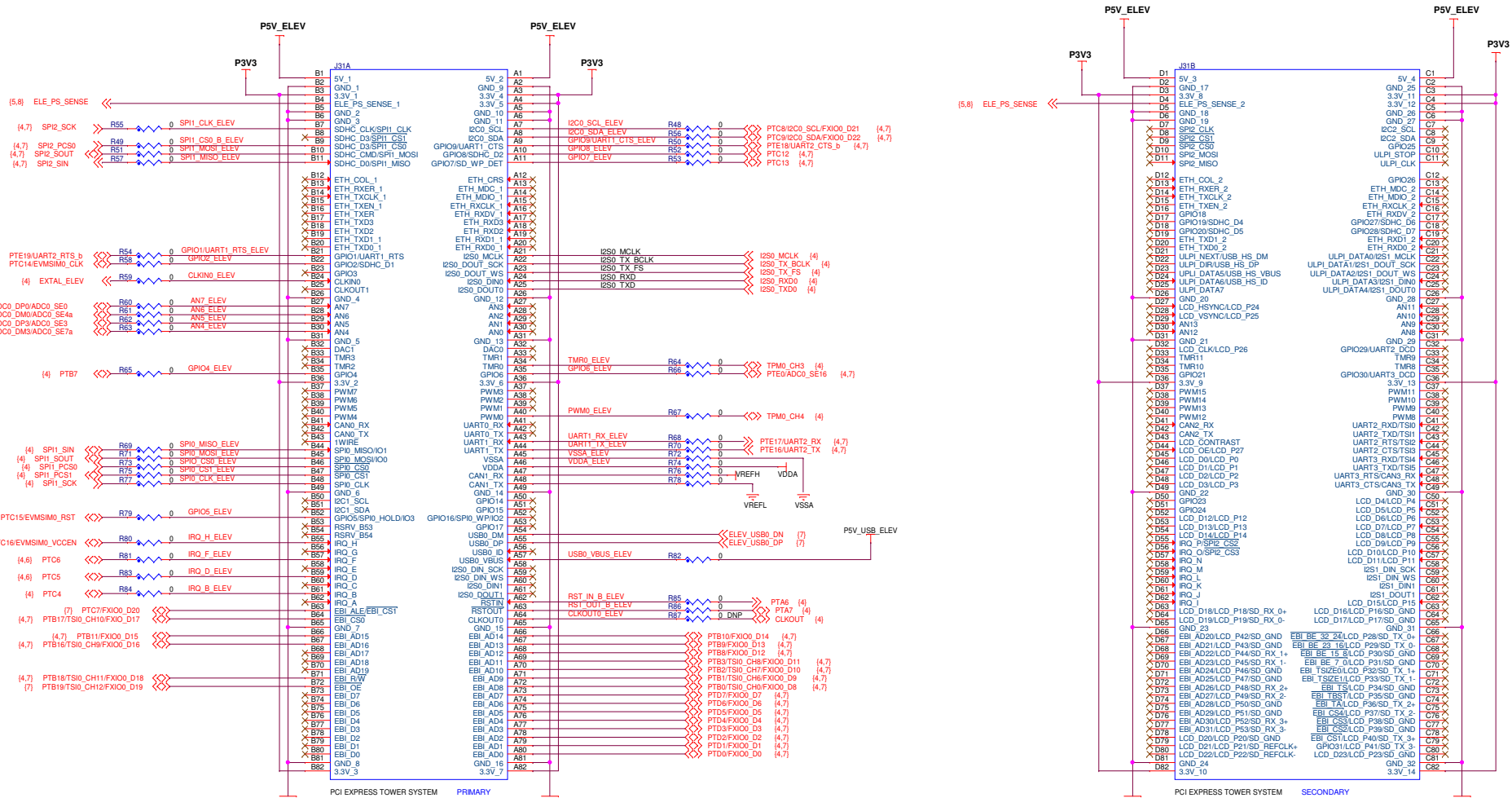
### FlexIO/EVMSIM/GPIO HDR



### KL28 SWD CONNECTOR



# ELEVATOR CONNECTOR



Place C53 and C54 close to primary elevator.



ICAP Classification: FCP: FIUC: X PUBL:	
Drawing Title: <b>TWR-KL28Z72M</b>	
Page Title: <b>ELEVATOR CONNECTORS</b>	
Size C	Document Number SCH-28400 PDF: SPF-28400
Date: Thursday, May 05, 2016	Rev B4