

**Freescale Semiconductor, Inc.** User's Guide Document Number: TWRK65F180MUG

Rev. 0, 05/2015

# TWR-K65F180M User's Guide

## **1** Introduction

The K65F180M Tower MCU Module (TWR-K65F180M) is a low-cost evaluation, demonstration, and development board, which features the Kinetis 180 MHz K65 low-power MCU. The TWR-K65F180M microcontroller module can operate in stand-alone mode or as part of the Freescale Tower System, a modular development platform that enables rapid prototyping and tool re-use through reconfigurable hardware. Take your design to the next level and begin constructing your Tower System today by visiting <u>freescale.com/tower</u> for additional Tower System microcontroller modules and compatible peripherals.

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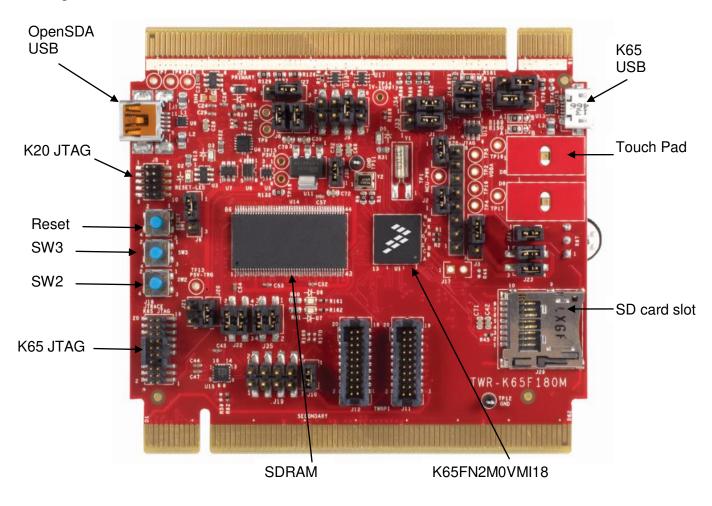


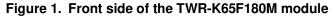


#### 1.1 Features

The following list summarizes the features of the K65F180M Tower MCU boards:

- Tower compatible processor board
- K20 based OPENSDA circuit
- Four user-controlled status LEDs
- Two Capacitive Touch Pads and two mechanical push buttons
- Socket for Tower Plug-in (TWRPI, for instance a sensor board)
- Standalone high speed USB host and device function
- Potentiometer
- SDRAM connection
- MMA8451Q three-axis accelerometer
- Battery holder for 20 mm lithium battery (battery diameter 20 mm, thickness 25 mm)
- Board power select with 3.3 V or 1.8 V MCU operation
- MicroSD card slot
- OpenSDA USB





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Figure 2. Back side of the TWR-K65F180M module

### 1.2 Getting started

You can find a printed version of the Quick Start Guide in the TWR-K65F180M box that contains the list of recommended steps for getting started.

## 2 Contents

The TWR-K65F180M includes:

- TWR-K65F180M for board assembly
- Quick Start Guide
- USB A to mini-B cable for debug interface and power supply
- CR2032 coin cell battery for VBAT power supply
- USB A to micro-B cable for K65FN2M0VMI18 USB interface



## **3 Hardware description**

The TWR-K65F180M is a Tower MCU Module featuring the K65FN2M0VMI18 – an ARM<sup>®</sup> Cortex<sup>®</sup>-M4F based MCU with 2 MB on-chip flash, 256 KB on-chip SRAM, SDRAM controller and dual USB controllers in a 169 pin MAPBGA package. It has a maximum core operating frequency of 180 MHz. It is intended for use in the Freescale Tower System but can operate as a stand-alone module. An on-board debug circuit, OPENSDA, provides the SWD debug interface and power supply input through a single USB mini-AB connector. The following sections describe the hardware in more detail. This figure shows a block diagram for the TWR-K65F180M.

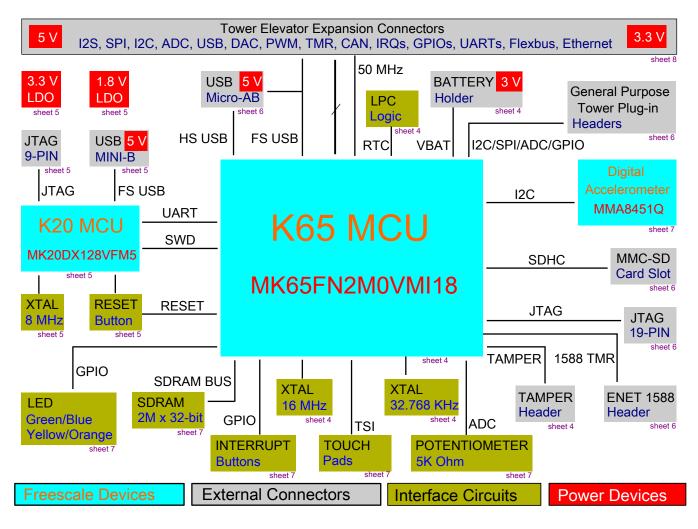


Figure 3. TWR-K65F180M Block Diagram

### 3.1 K65F180M microcontroller

The TWR-K65F180M module features the K65FN2M0VMI18. The K65 microcontroller family is part of the Kinetis portfolio of devices built around an ARM Cortex-M4F core. Refer to the *K65 Family Reference Manual* (document <u>K65P169M180SF5RMV2</u>) for comprehensive information on the K65FN2M0VMI18 device. The key features of K65FN2M0VMI18 are as follows.



Feature	Description
Performance	Up to 180 MHz ARM Cortex-M4 based core with DSP instructions and Single Precision Floating Point unit
Memory and memory expansion	<ul> <li>2 MB program flash memory and 256 KB RAM</li> <li>FlexBus external bus interface and SDRAM controller</li> </ul>
Analog modules	<ul> <li>Two 16-bit SAR ADCs and two 12-bit DACs</li> <li>Four analog comparators (CMP) containing a 6-bit DAC and programmable reference input</li> <li>Voltage reference 1.2 V</li> </ul>
Communication interfaces	<ul> <li>Ethernet controller with MII and RMII interface to external PHY and hardware IEEE 1588 capability</li> <li>USB high-, full-, and low-speed On-the-Go with on-chip high speed transceiver</li> <li>USB full-, low-speed OTG with on-chip transceiver</li> <li>Two CAN, three SPI and four I<sup>2</sup>C modules</li> <li>One low power UART and five standard UARTs</li> <li>Secure Digital Host Controller (SDHC)</li> <li>I2S module</li> </ul>
Security	<ul> <li>Tamper detect and secure storage</li> <li>Hardware random-number generator</li> <li>Supports DES, AES, SHA accelerator (CAU)</li> <li>Multiple levels of embedded flash security</li> </ul>
Timers	<ul> <li>Four periodic interrupt timers</li> <li>16-bit low-power timer</li> <li>Two 16-bit low-power timer PWM modules</li> <li>Two 8-channel motor control / general purpose / PWM timers</li> <li>Two 2-channel quad decoder / general purpose timers</li> <li>Real-time clock</li> </ul>
Human machine interface	<ul> <li>Low-power hardware touch sensor interface (TSI)</li> <li>General-purpose input / output</li> </ul>

#### Table 1. K65FN2M0VMI18 key features

#### 3.2 Clocking

The Kinetis microcontrollers start up from an internal digitally controlled oscillator (DCO). The software can enable one or two external oscillators if required. The external oscillator for the Multipurpose Clock Generator (MCG) module can range from 32.768 kHz up to a 32 MHz crystal or ceramic resonator. The external oscillator for the Real-Time Clock (RTC) module accepts a 32.768 kHz crystal.

Two crystals are provided on-board for clocking the K65F180M device: a 16 MHz crystal as the main oscillator to clock the MCG module and a 32.768 kHz crystal for clocking the RTC module.

#### NOTE

The on-chip HS USB PHY requires a 12, 16, or 24 MHz crystal with the main oscillator on EXTAL0 and XTAL0 pins.

#### 3.3 System power

In standalone operation, the main power source for the TWR-K65F180M is derived from the 5.0 V input from either the USB mini-B connector, J7, or the debugger header, J18, when a shunt is placed on jumper J21. An on-board low-dropout regulator provides either 3.3 V or 1.8 V supply from the 5.0 V



input voltage based on the configuration of jumper J9. See sheet 5 of the *TWR-K65F180M Schematics* (document <u>TWR-K65F180M-SCH</u>) for further details.

When installed into a Tower System, the TWR-K65F180M can be powered from either an on-board power source or from another power source in the assembled Tower System. If both the on-board and off-board power sources are available, the TWR-K65F180M will default to the off-board power source.

The 3.3 V or 1.8 V power supplied to the MCU is routed through a jumper, J1. The jumper shunt can be removed to allow the following:

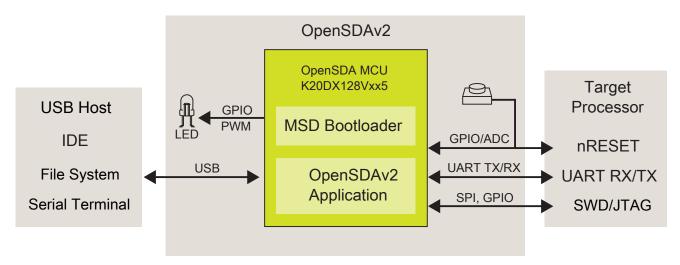
- 1) Alternate MCU supply voltages to be injected.
- 2) Measurement of power consumed by the MCU.

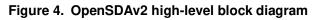
### 3.4 Tamper module (Dryice) and Real-Time Clock supply

The Dryice tamper detection module and the Real-Time Clock (RTC) module on the K65FN2M0VMI18 have two modes of operation: system power up and system power down. During system power down, the tamper detection module and the RTC are powered from the backup power supply (VBAT) and electrically isolated from the rest of the MCU. The TWR-K65F180M provides a battery receptacle for a coin cell battery that can be used as the VBAT supply. The receptacle uses standard 20 mm diameter 3 V lithium coin cell batteries.

### 3.5 Serial and Debug Adapter version 2 (OpenSDAv2)

OpenSDAv2 is a serial and debug adapter circuit which includes an open-source hardware design, an open-source bootloader, and debug interface software. It bridges serial and debug communications between a USB host and an embedded target processor as shown in figure 4. The hardware circuit is based on a Freescale Kinetis K20 family MCU with 128 KB of embedded flash and an integrated USB controller. OpenSDAv2 comes preloaded with the CMSIS-DAP bootloader—an open-source mass storage device (MSD) bootloader—and the CMSIS-DAP interface firmware (also known as the mbed interface), which provides an MSD flash programming interface, a virtual serial port interface, and a CMSIS-DAP debug protocol interface. For more information on the OpenSDAv2 software, see mbed.org and https://github.com/mbedmicro/CMSIS-DAP.







OpenSDAv2 is managed by a Kinetis K20 MCU built on the ARM Cortex-M4 core. The OpenSDAv2 circuit includes a status LED (D3) and a pushbutton (SW1). The pushbutton asserts the Reset signal to the K65 target MCU. It can also be used to place the OpenSDAv2 circuit into bootloader mode. SPI and GPIO signals provide an interface to either the SWD debug port or the K20. Additionally, signal connections are available to implement a UART serial channel. The OpenSDAv2 circuit receives power when the USB connector J7 is plugged into a USB host.

### 3.6 Cortex Debug connector

The Cortex Debug connector is a 20-pin (0.05 inch) connector providing access to the SWD, JTAG, and EzPort signals available on the K65 device. The K65 pin connections to the debug connector (J18) are shown in this table.

Pin	Function	TWR-K65F180M connection
1	VTref	3.3 V MCU supply (MCU_PWR)
2	TMS/SWDIO	PTA3/UART0_RTS_b/FTM0_CH0/JTAG_MS/SWD_DIO
3	GND	GND
4	TCK/SWCLK	PTA0/UART0_CTS_b/FTM0_CH5/JTAG_CLK/SWD_CLK/EZP_CLK
5	GND	GND
6	TDO/SWO	PTA2/UART0_TX/FTM0_CH7/JTAG_DO/TRACE_SWO/EZP_DO
7	Key	_
8	TDI	PTA1/UART0_TX/FTM0_CH6/JTAG_DI/EZP_DI
9	GNDDETECT	PTA4/FTM0_CH1/MS/NMI_b/EZP_CS_b
10	nReset	RESET_b
11	Target Power	5 V supply (via J21)
12	TRACECLK	PTE0/SPI1_PCS1/UART1_TX/SDHC0_D1/TRACE_CLKOUT
13	Target Power	5 V supply (via J21)
14	TRACEDATA[0]	PTE4/SPI1_PCS0/UART3_TX/SDHC0_D3/TRACE_D0
15	GND	GND
16	TRACEDATA[1]	PTE3/SPI1_SIN/UART1_RTS_b/SDHC0_CMD/TRACE_D1
17	GND	GND
18	TRACEDATA[2]	PTE2/SPI1_SCK/UART1_CTS_b/SDHC0_DCLK/TRACE_D2
19	GND	GND
20	TRACEDATA[3]	PTE1/SPI1_SOUT/UART1_RX/SDHC0_D0/TRACE_D3

Table 2. Cortex	C Debug	connector	pinout
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#### NOTE

To avoid conflict with RMII signals, trace signals are routed to the PTE port with unpopulated 0 Ohm resistors to avoid signal conflicts with SDHC.

### 3.7 External Bus Interface – FlexBus

The K65 device features a multi-function external bus interface called the FlexBus interface controller. This is capable of interfacing with slave-only devices. The FlexBus interface is not used directly on the TWR-K65F180M. Instead, a subset of the FlexBus is connected to the Primary Connector so that the external bus can access devices on Tower peripheral modules. See Table 6 "**Error! Reference source not found.**" and sheet 8 of the *TWR-K65F180M Schematics* (document <u>TWR-K65F180M-SCH</u>) for more details.



#### 3.8 SDRAM

The TWR-K65F180M board contains 64 Mb SDRAM (32-bit width) which is connected to the K65 SDRAM controller. The SDRAM signals are multiplexed with Flexbus signals. See the *K65 Family Reference Manual* (document <u>K65P169M180SF5RMV2</u>) "Flexbus signal multiplexing" section and "SDRAM SDR signal multiplexing" section on how to use the Flexbus and SDRAM in multiplexed mode.

### 3.9 Accelerometer

An MMA8451Q digital accelerometer is connected to the K65 MCU through an I<sup>2</sup>C interface (I<sup>2</sup>C0) and two GPIO/IRQ signals (PTE27 and PTE28). See Table 5 "Error! Reference source not found." for connection details.

When using Kinetis Bootloader to update K65 MCU flash firmware with an  $I^2C$  interface, remove the jumpers on J35 so  $I^2C$  communication is not affected by the accelerometer connection. For information on Kinetis Bootloader, see <u>freescale.com/kboot</u>.

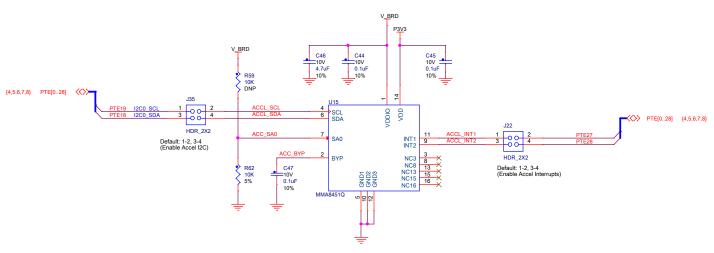


Figure 5. Accelerometer connection

### 3.10 Potentiometer, Pushbuttons, LEDs

The TWR-K65F180M features:

- A potentiometer connected to an ADC input signal (ADC1\_SE16/ADC0\_SE22)
- Two pushbutton switches (SW2 and SW3 connected to PTA4 and PTA10)
- User controllable LEDs connected to GPIO signals
  - Yellow LED D6 connected to PTB4
  - Orange LED D7 connected to PTB5
  - o LED D8 connected to PTA28
  - o LED D9 connected to PTA29



### 3.11 General Purpose Tower Plug-in (TWRPI) socket

The TWR-K65F180M features two sockets (J11 and J12) that can accept a variety of different Tower Plug-in modules featuring sensors, RF transceivers, and more. The General Purpose TWRPI socket provides access to I<sup>2</sup>C, SPI, IRQs, GPIOs, timers, analog conversion signals, TWRPI ID signals, reset, and voltage supplies. The pinout for the TWRPI Socket is defined in the following table.

Left-si	de 2x10 Connector	Right-side 2x10 Connector		
Pin	Description	Pin	Description	
1	5V VCC	1	GND	
2	3.3 V VCC	2	GND	
3	GND	3	I <sup>2</sup> C: SCL	
4	3.3 V VDDA	4	I <sup>2</sup> C: SDA	
5	VSS (Analog GND)	5	GND	
6	VSS (Analog GND)	6	GND	
7	VSS (Analog GND)	7	GND	
8	ADC: Analog 0	8	GND	
9	ADC: Analog 1	9	SPI: MISO	
10	VSS (Analog GND)	10	SPI: MOSI	
11	VSS (Analog GND)	11	SPI: SS	
12	ADC: Analog 2	12	SPI: CLK	
13	VSS (Analog GND)	13	GND	
14	VSS (Analog GND)	14	GND	
15	GND	15	GPIO: GPIO0/IRQ	
16	GND	16	GPIO: GPIO1/IRQ	
17	ADC: TWRPI ID 0	17	GPIO: GPIO2/UART0_RX	
18	ADC: TWRPI ID 1	18	GPIO: GPIO3/ UART0_TX	
19	GND	19	GPIO: GPIO4/ UART0_CTS	
20	Reset	20	GPIO: GPIO5/ UART0_RTS	

#### Table 3. TWRPI socket pin description

#### 3.12 Touch interface

The touch-sensing input (TSI) module of the Kinetis microcontrollers provides capacitive touch-sensing detection with high sensitivity and enhanced robustness. Each TSI pin implements the capacitive measurement of an electrode. There are two individual electrodes on-board the TWR-K65F180M that simulates pushbuttons.



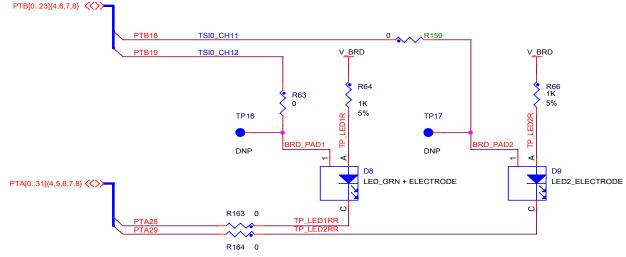


Figure 6. Touch pad circuitry

### 3.13 USB interface

The K65FN2M0VMI18 features a high-, full-, and low-speed USB controller with on-chip HS USB PHY, and a full-, low-speed USB controller with on-chip USB PHY. The TWR-K65F180M board enables the USB to be host or device in standalone mode or with connection to a TWR-SER1 board in a complete tower kit. FS USB controller DP/DM signals can be selectively routed to the MicroUSB connector J15 or the MiniUSB connector J14 on a TWR-SER1 board by changing the 0 ohm resistor to connect either to A or B as shown in the following schematic. This is to help reduce on-board signal stub. The HS USB controller signal DP/DM signals can only be connected to on-board MicroUSB connector J15.

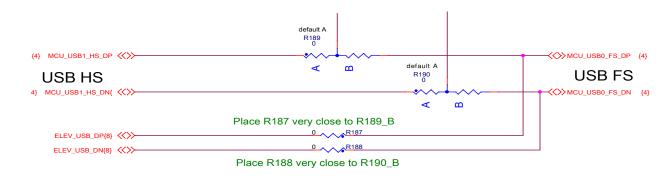


Figure 7. USB signal routing

#### 3.14 Secure digital card slot

A Micro SD card slot is available on the TWR-K65F180M connected to the SD host controller (SDHC) signals of the MCU. This slot will accept standard format SD memory cards. See Table 5 "Error! Reference source not found." for connection details.



### 3.15 Ethernet and 1588

The K65FN2M0VMI18 features a 10/100 Mbps Ethernet MAC with MII and RMII interfaces. The TWR-K65F180M routes RMII interface signals from the K65 MCU to the primary elevator connector which enables a connection to an external Ethernet PHY that can be found on some Tower peripheral modules.

The reason that only RMII instead of MII interface signals are routed out is because there is multiplexing of the Flexbus function on some of the MII signals. Routing only the RMII signals enables Ethernet and Flexbus functions to work at the same time.

When the K65 Ethernet MAC is operating in RMII mode, synchronization of the MCU clock and the 50 MHz RMII transfer clock is important. The MCU input clock must remain in phase with the 50 MHz clock supplied to the external PHY. According to the K65 reference manual, the RMII clock can be selected between EXTAL and ENET\_1588\_CLKIN (PTE26) and because the system oscillator is already connected with 16 MHz to allow HS USB PHY to function, the RMII clock is coming from PTE26 and this signal is connected to CLKIN0 (B24) of the primary elevator.

## 4 Jumper table

There are several jumpers provided for isolation, configuration, and feature selection. See the following table for details.

Jumper	Option	Setting	Description		Description	
J1	MCU power connection	On	Connect V_SUPPLY and V_BRD with MCU_PWR	On		
JI		Off	Disconnect V_SUPPLY and V_BRD with MCU_PWR	OII		
J2	VDD and VDDA connection	On	Connect VDD and VDDA	On		
JZ	VDD and VDDA connection	Off	Disconnect VDD and VDDA	OII		
		1-2	Connect VBAT to on-board 3.3 V supply from V_SUPPLY			
J3	VBAT power selection	2-3	Connect VBAT to the higher voltage between on-board 3.3 V supply or coin cell supply	1-2		
J4	Tamper signal header	2-3	-3 Tamper signal header		Tamper signal header	
J6	RESET button connection	1-2	When powering the OPENSDA MCU, bootloader mode can be selected	1-2		
		2-3	When OPENSDA MCU is not powered, RESET button can be used			
J8	5V power connection	On	Connect P5V_TRG_USB to input of on-board 3.3 V regulator	On		
J0	5V power connection	Off	Disconnect P5V_TRG_USB to on-board 3.3 V regulator	On		
		1-2	V_SUPPLY comes from OPENSDA MCU (K20) USB regulator			
J9	Board power selection	3-4	V_SUPPLY comes from on-board 1.8 V regulator	5-6		
19	Board power selection	5-6	V_SUPPLY comes from on-board 3.3 V regulator	5-0		
		7-8	V_SUPPLY comes from K65 USB regulator			
J10	TWRPI power selection	On	Connect V_BRD to TWRPI connector power	On		
310		OFF	Disconnect V_BRD to TWRPI connector power			

#### Table 4. TWR-K65F180M jumper table



Jumper Option Setting Descripti		Description	Default setting		
14.0		On	Connect PTD8 to USB power enable for MIC2005	On	
J13	USB power enable connection	OFF	Disconnect PTD8 to USB power enable for MIC2005		
14.4	USB over-current flag	On	Connect PTD9 to USB over-current flag for MIC2005	0	
J14	connection	OFF	Disconnect PTD9 to USB over-current flag for MIC2005	On	
116	USB ID connection	1-2	Connect PTD15 to USB ID pin on MicroUSB connector J15	1.0	
J16	USB ID connection	2-3	Connect PTE10 to USB ID pin on MicroUSB connector J15	1-2	
J17	Pulldown connection on	On	Disconnect pull down resistor on CD/DAT3 pin on MicroSD slot	Off	
J17	CD/DAT3 for MicroSD slot	Off	Connect pull down resistor on CD/DAT3 pin on MicroSD slot	Oli	
	MCU reset connection on	On	Connect MCU reset on pin10 of JTAG connector J18	On	
J20	JTAG connector	Off	Disconnect MCU reset on pin10 of JTAG connector J18		
J21	JTAG Power Connection	On	Connect on-board 5V supply to JTAG port (supports powering board from external JTAG probe)	Off	
		Off	Disconnect on-board 5V supply from JTAG port		
J22	Accelerometer INT connection	1-2	Connects INT1 from MMA8451 to PTE27	1-2	
JZZ	Accelerometer INT connection	3-4	Connects INT2 from MMA8451 to PTE28	3-4	
	K65 VREGIN selection	1-2	VREG_IN0 connected with ONBOARD_USB_VBUS		
J23		1-3	VREG_IN1 connected with ONBOARD_USB_VBUS	1-2	
525		2-4	VREG_IN0 connected with ELEV_USB_VBUS	3-4	
		3-4	VREG_IN1 connected with ELEV_USB_VBUS		
J24	Potentiometer connection	On	Connect potentiometer to ADC1_SE16	On	
J24		Off	Disconnect potentiometer to ADC1_SE16	On	
107	7 /RSTOUT connection		MCU reset signal connected to /RSTOUT (A63) on primary elevator	2.2	
J27	/KSTOUT connection	2-3	PTD10 connected to /RSTOUT (A63) on primary elevator	2-3	
100		On	Connect V_BRD to SDRAM chip	0.7	
J30	SDRAM power connection	Off	Disconnect V_BRD to SDRAM chip	On	
J32	SWD clock disconnection	On	Connect SWD_CLK from OPENSDA circuit to K65 MCU to allow debugging using OPENSDA	On	
		OFF	Disconnect SWD_CLK from OPENSDA circuit to K65 MCU to allow J-Link or U-Link debug		
J33	UART2 RX connection	1-2	Connect UART2_RX to elevator	2-3	
555		2-3	Connect UART2_RX to OPENSDA UART RX	2-3	
10.4		1-2	Connect UART2_TX to elevator		
J34	UART2 TX connection	2-3	Connect UART2_TX to OPENSDA UART TX	2-3	
10-	I <sup>2</sup> C connection with	1-2	Connect I <sup>2</sup> C0_SCL with accelerometer SCL	1-2	
J35	accelerometer	3-4	Connect I <sup>2</sup> C0_SDA with accelerometer SDA	3-4	
10.0		1-2	Connect MiniUSB connector (J7) VBUS with U12 pin 1		
J36	USB 5 V power connection	2-3	Connect P5V_ELEV with U12 pin 1	2-3	

#### Table 4. TWR-K65F180M jumper table (continued)



## 5 Input/output connectors and pin usage table

The table below provides details on which K65F180M pins are used to communicate with the TWR-K65F180M sensors, LEDs, switches, and other I/O interfaces.

#### NOTE

Some port pins are used in multiple interfaces on-board and many are potentially connected to off-board resources via the primary and secondary Connectors. You must take care to avoid attempted simultaneous usage of mutually exclusive features.

Feature	Connection	Port Pin	Pin Function
OPENSDA	OPENSDA RX data	PTE17	UART2_RX
USB-to-serial bridge	OPENSDA TX data	PTE16	UART2_TX
	SD clock	PTE2	SDHC0_DCLK
	SD Command	PTE3	SDHC0_CMD
	SD Data0	PTE1	SDHC0_D0
SD Card Slot	SD Data1	PTE0	SDHC0_D1
	SD Data2	PTE5	SDHC0_D2
	SD Data3	PTE4	SDHC0_D3
	SD Card Detect	PTA9	PTA9
	SW2 (NMI)	PTA4	PTA4
Pushbuttons	SW3 (LLWU)	PTA10	PTA10
	SW1 (RESET)	RESET_b	RESET_b
Touch Pads	Touch	PTB18	TSI0_CH11
	Touch	PTB19	TSI0_CH12
	D2 / Orange LED	—	RESET_b
	D5 / YEL/GRN LED	—	Power on
LEDs	D6 / Yellow LED	PTB4	Yellow LED
	D7 / Orange LED	PTB5	Orange LED
	D8	PTA28	D8 Electrode LED
	D9	PTA29	D9 Electrode LED
Potentiometer	Potentiometer (R67)	_	ADC1_SE16/ADC0_SE22
	I <sup>2</sup> C SDA	PTE19	I <sup>2</sup> C0_SDA
Accelerometer	I <sup>2</sup> C SCL	PTE18	I <sup>2</sup> C0_SCL
Accelei Ollielei	IRQ1	PTE27	PTE27
	IRQ2	PTE28	PTE28

#### Table 5. I/O Connectors and Pin Usage Table



	USB VBUS Enable	PTD8	PTD8
High Speed USB	USB Over-current flag	PTD9	PTD9
	USB ID	PTD15 or PTE10	USB1_ID
	ENET 1588 TMR0	PTB2	ENET0_1588_TMR0
ENET 1588	ENET 1588 TMR1	PTB3	ENET0_1588_TMR1
ENET 1500	ENET 1588 TMR2	PTB4	ENET0_1588_TMR2
	ENET 1588 TMR3	PTB5	ENET0_1588_TMR3
RTC	RTC bypass	PTA11	PTA11
	TWRPI AN0 (J11 Pin 8)		ADC0_SE16 / ADC0_SE21
	TWRPI AN1 (J11 Pin 9)		ADC1_DP0 / ADC0_DP3
	TWRPI AN2 (J11 Pin 12)		ADC1_DM0 / ADC0_DM3
	TWRPI ID0 (J7 Pin 17)		ADC0_DP0 / ADC1_DP3
	TWRPI ID1 (J7 Pin 18)		ADC0_DM0 / ADC1_DM3
	TWRPI I <sup>2</sup> C SCL (J12 Pin 3)	PTE19	I <sup>2</sup> C0_SCL
	TWRPI I <sup>2</sup> C SDA (J12 Pin 4)	PTE18	I <sup>2</sup> C0_SDA
	TWRPI SPI MISO (J12 Pin 9)	PTD14	SPI2_SIN
General Purpose TWRPI Socket	TWRPI SPI MOSI (J12 Pin 10)	PTD13	SPI2_SOUT
	TWRPI SPI SS (J12 Pin 11)	PTD15	SPI2_PCS1
	TWRPI SPI CLK (J12 Pin 12)	PTD12	SPI2_SCK
	TWRPI GPIO0 (J12 Pin 15)	PTC14	PTC14
	TWRPI GPIO1 (J12 Pin 16)	PTC15	PTC15
	TWRPI GPIO2 (J12 Pin 17)	PTC16	PTC16
	TWRPI GPIO3 (J12 Pin 18)	PTC17	PTC17
	TWRPI GPIO4 (J12 Pin 19)	PTC18	PTC18
	TWRPI GPIO5 (J12 Pin 20)	PTC19	PTC19

Table 5. I/O Connectors and Pin Usage Table	(continued)
Tuble of le Connectore and Thir Couge Tuble	(continuou)

## 6 Elevator connections

The TWR-K65F180M features two expansion card-edge connectors that interface to Elevator boards in a Tower System: the primary and secondary Elevator connectors. The pinout for the primary Elevator Connector is provided in this table. The values in **bold** are either power or ground.

Pin #	Side B		D:	Side A	
PIN #	Name	Usage	Pin #	Name	Usage
B1	5 V	5.0 V Power	A1	5V	5.0 V Power
B2	GND	Ground	A2	GND	Ground
B3	3.3 V	3.3 V Power	A3	3.3 V	3.3 V Power
B4	ELE_PS_SENSE	Elevator Power Sense	A4	3.3 V	3.3 V Power
B5	GND	Ground	A5	GND	Ground

Table 6. TWR-K65F180M Primary Connector Pinout



SDHC_D3/ B8         PTE2         A7         SCL0         PTE19           B8         SPH_CL3/ SDHC_D3/ B9	B6	GND	Ground	A6	GND	Ground
BY         SHC D3 / SDHC D3 / B8         SPI1_CS1_b         A7         B7           B9         SPIC D3 / SDHC D3 / B9         PTE4         A9         GPI09 / CTS1         PTD1           B9         SPIL CS0_b         PTE3         A10         GPI08 / SDHC_D2 / GPI07 / B10         SDHC_D3 / SDHC_D0 / B11         PTE1         A11         SD WP DET         PTA9           B12         ETH COL          A12         ETH CRS         -           B13         ETH RXER         PTA5         A13         ETH MDC         PTA7           B14         ETH TXEN         PTA15         A15         ETH_RXD2         -           B16         ETH_TXEN         PTA15         A15         ETH_RXD3         -           B16         ETH_TXD0         PTA17         A19         ETH_RXD1         PTA14           B17         ETH_TXD1         PTA17         A19         ETH_RXD0         PTA12           B21         GPI01 / RTS1         PTD0         A21         I2S0 MCLK         PTE1           B22         GPI01 / RTS1         PTD0         A21         I2S0 MCLK         PTE1           B22         GPI01 / RTS1         PTD0         A21         I2S0 MCLK         PTE12 <t< td=""><td></td><td>SDHC_CLK /</td><td></td><td></td><td>001.0</td><td>DTE10</td></t<>		SDHC_CLK /			001.0	DTE10
B8         SPI1_CS1_b          A8         SDAU         PTE16           B9         SPH_CS0_b         PTE4         A9         GPI09/CTS1         PTD1           B10         SPH_CS0_b         PTE3         A10         GPI08/SDHC_D2         PTE5           SDHC_D0/         B11         SPI_MOS0         PTE1         A11         SD_WP_DET         PTA9           B12         ETH_COL          A12         ETH_CRS         -         -           B13         ETH_RXER         PTA5         A13         ETH_MDC         PTA8           B14         ETH_TXEN         PTA15         A15         ETH_MDC         PTA7           B15         ETH_TXER         -         A16         ETH_RXDU         PTA14           B17         ETH_TXD         -         A17         ETH_RXDU         PTA12           B20         ETH_TXD1         PTA16         A20         ETH_RXDU         PTA13           B21         GPI01/RTS1         PTE0         A22         I280_DUT_BCK         PTE1           B22         GPI03         PTE0         A24         I280_TXDU         PTE16           B22         GPI03         PTE0         A22         I280_TXDU<	B7		PIE2	A7	SCLO	PIE19
B8         SPH_C_D3 / B9         PTE4         A9         GPIO9/CTS1         PTD1           B0         SDHC_D3 / B10         SPI1_MOS1         PTE3         A10         GPIO8/SDHC_D2         PTE5           B10         SDHC_CD0 / B11         PTE1         A11         SDWP_DET         PTA9           B12         ETH_COL          A12         ETH_CRS            B13         ETH_TXER         PTA5         A13         ETH_MOC         PTA7           B14         ETH_TXER         PTA5         A13         ETH_MOC         PTA7           B15         ETH_TXER          A16         ETH_RXDX            B16         ETH_TXER          A18         ETH_RXD3            B18         ETH_TXD3          A18         ETH_RXD2            B19         ETH_TXD1         PTA17         A19         ETH_RXD0         PTA13           B22         GPIO2 / SDHC_D1         PTE0         A22         I2S0_DOUT_BCLK         PTE11           B24         CLKN0         PTE26         A24         I2S0_DOUT_BCLK         PTE12           B23         GPIO2 / SDHC_D1         PTE6         A23		SDHC_D3 /			2040	DTE19
B9         SPI1_CS0_b         PTE3         A9         GPIO9/CTS1         PTD1           B10         SP1_MOSI         PTE3         A10         GPIO8/SDHC_D2         PTE5           B11         SDHC_CMD/         PTE1         A11         SDW-D_CT         PTA9           B12         ETH_COL          A12         ETH_CRS            B13         ETH_TXER         PTA5         A13         ETH_MDC         PTA8           B14         ETH_TXER         PTA5         A13         ETH_MDC         PTA7           B15         ETH_TXER         PTA15         A15         ETH_RXCLK            B16         ETH_TXER          A18         ETH_RXD2            B16         ETH_TXD3          A18         ETH_RXD2            B18         ETH_TXD1         PTA17         A19         ETH_RXD0         PTA13           B22         GPIO2/SDHC_D1         PTE0         A22         I2S0_DOUT_ECK         PTE11           B23         GPIO2/SDHC_D1         PTE0         A22         I2S0_DOUT_ECK         PTE11           B24         CLKOUT1         PTC3         A25         I2S0_DOUT_ECK         PTE	B8		—	A8	SDAU	FIEI8
B9         SPI1_CSU_D         A9         GPI09/C1S1         PID1           B10         SPI1_MOSI         PTE3         A10         GPI08/SDHC_D2         PTE5           B11         SDHC_MD7         GPI07/T         GPI07/T         GPI07/T         GPI07/T           B11         SDH_CD07         —         A11         SD_WP_DET         PTA9           B12         ETH_RXER         PTA5         A13         ETH_MCC         —           B13         ETH_RXER         PTA5         A15         ETH_RXDV         PTA7           B16         ETH_TXER         —         A16         ETH_RXDV         PTA14           B17         ETH_RXD3         —         A17         ETH_RXD1         PTA14           B17         ETH_TXD1         PTA17         A19         ETH_RXD1         PTA12           B20         ETH_TXD1         PTA16         A20         ETH_RXD1         PTA13           B21         GPI07/TS1         PTD0         A21         I2S0_DUT_K         PTE12           B23         GPI03         PTE6         A24         I2S0_RXD0         PTE7           B24         CLKIN0         PTE26         A24         I2S0_RXD0         PTE7		SDHC_D3 /				
B10         SPI1_MOSI         PTE3         A10         GPI08/SDHC_D2         PTE5           B11         SDHC_D0 / SDHC_D0 / B12         PTE1         A11         SD_WP_DET         PTA9           B12         ETH_COL          A12         ETH_CRS            B13         ETH_RXER         PTA5         A13         ETH_MOIO         PTA7           B14         ETH_TXEN         PTA5         A15         ETH_RXD4            B16         ETH_TXEN         PTA15         A15         ETH_RXD3         -           B16         ETH_TXD3         -         A17         ETH_RXD3         -           B18         ETH_TXD0         PTA17         A19         ETH_RXD1         PTA12           B20         ETH_TXD1         PTA17         A19         ETH_RXD1         PTA12           B21         GPI01/RTS1         PTD0         A21         I2S0_DOUT_BCLK         PTE6           B22         GPI02/SDHC_D1         PTE0         A22         I2S0_DUT_BCLK         PTE11           B24         CLKIN0         PTE26         A24         I2S0_DUT_BCLK         PTE10           B26         GND         Ground         A26         GND         <	B9			A9	GPIO9 / CTS1	PTD1
BI0         SPI1_MOSI         AI0         GPI08/SDH_DZ         PTES           B11         SDHC_D0/         PTE1         A11         SD_WP_DET         PTA9           B12         ETH_COL          A12         ETH_CRS            B13         ETH_RXER         PTA5         A13         ETH_RXC         PTA5           B14         ETH_TXER         PTA5         A15         ETH_RXCL            B15         ETH_TXER         -         A16         ETH_RXDV         PTA14           B17         ETH_TXER         -         A18         ETH_RXD1         PTA14           B17         ETH_TXD3         -         A17         ETH_RXD1         PTA12           B20         ETH_TXD1         PTA16         A20         ETH_RXD1         PTA13           B21         GPI01/RTS1         PTD0         A21         I2S0_DUT_FS         PTE1           B22         GPI02/SDHC_D1         PTE0         A22         I2S0_DUT_FS         PTE11           B24         CLKINO         PTC2         A25         I2S0_DUT_FS         PTE10           B26         GND         Ground         A26         GND         Ground           B			PTF3			
B11         SPI1_NISO         PTE1         A11         SD_WP_DET         PTA9           B12         ETH_COL          A12         ETH_CRS            B13         ETH_RXER         PTA5         A13         ETH_MDC         PTA8           B14         ETH_TXCLK          A14         ETH_MDC         PTA8           B15         ETH_TXER          A16         ETH_RXDV         PTA14           B17         ETH_TXD3          A17         ETH_RXD3            B18         ETH_TXD2          A18         ETH_RXD1         PTA12           B20         ETH_TXD1         PTA17         A19         ETH_RXD1         PTA12           B21         GPI01/RTS1         PT00         A21         I2S0_MCLK         PTE6           B22         GPIO2/SDHC_D1         PTE0         A22         I2S0_DOUT_ECK         PTE12           B23         GPI03         PT010         A23         I2S0_MOD         PTE12           B23         GPI03         PTC3         A26         GND         Ground           B24         CLKINO         PTC3         A26         GND         Ground	B10		1120	A10		PTE5
B11         SPI1_MISO         A11         SD_WP_DE1         PTA9           B12         ETH_COL          A12         ETH_CRS            B13         ETH_RXER         PTA5         A13         ETH_MDC         PTA8           B14         ETH_TXCLK          A14         ETH_MDC         PTA8           B15         ETH_TXEN         PTA15         A15         ETH_RXCLK            B16         ETH_TXEN         PTA17         A18         ETH_RXD1         PTA14           B17         ETH_TXD2          A18         ETH_RXD1         PTA12           B18         ETH_TXD2          A18         ETH_RXD1         PTA12           B20         ETH_TXD1         PTA16         A20         ETH_RXD1         PTA12           B21         GPI01/RTS1         PTD0         A21         I280_DOUT_BCLK         PTE6           B22         GPI03         PTD10         A23         I280_DOUT_BCLK         PTE7           B24         CLKIN0         PTE26         A24         I280_RXD0         PTE7           B25         CLKOUT1         PTA6         A27         AN3         ADC0_SE16 <t< td=""><td></td><td>—</td><td>PTF1</td><td></td><td></td><td></td></t<>		—	PTF1			
B13         ETH_RXER         PTA5         A13         ETH_MDC         PTA8           B14         ETH_TXCLK          A14         ETH_MDIO         PTA7           B15         ETH_TXEN         PTA15         A15         ETH_RXCLK            B16         ETH_TXEN         PTA15         A15         ETH_RXDV         PTA14           B17         ETH_TXD1          A16         ETH_RXD1         PTA12           B18         ETH_TXD2          A18         ETH_RXD1         PTA12           B19         ETH_TXD1         PTA16         A20         ETH_RXD1         PTA12           B20         ETH_TXD1         PTA16         A20         ETH_RXD0         PTE12           B21         GPI01/RTS1         PTD0         A21         I2S0_DOUT_BCLK         PTE6           B22         GPI03         PTD10         A23         I2S0_DOUT_ECT         PTE7           B24         CLKIN0         PTE6         A24         I2S0_RXD0         PTE7           B25         CLKOUT1         PTC3         A25         I2S0_TXD0         PTE7           B25         CLKOUT1         PT64         A27         AN3         ADC0_SE16						
B14         ETH_TXCLK          A14         ETH_MDIO         PTA7           B15         ETH_TXER         PTA15         A15         ETH_RXCLK            B16         ETH_TXER          A16         ETH_RXDV         PTA14           B17         ETH_TXD3          A17         ETH_RXD2            B18         ETH_TXD1         PTA17         A19         ETH_RXD1         PTA12           B20         ETH_TXD0         PTA16         A20         ETH_RXD0         PTA13           B21         GPI01/RTS1         PTD0         A21         I2S0_DOUT_BCLK         PTE6           B22         GPI02/SDHC_D1         PTE0         A22         I2S0_DOUT_FS         PTE11           B23         GPI03         PTD10         A23         I2S0_RXD0         PTE7           B25         CLKOUT1         PTC3         A26         GND         Ground           B26         GND         Ground         A26         GND         Ground           B27         AN7         PTA6         A27         AN3         ADC1_DOC1           B29         AN5         PTE24         A29         AN1         ADC1_DM0						
B15         ETH_TXEN         PTA15         A15         ETH_RXCLK            B16         ETH_TXER          A16         ETH_RXD3            B17         ETH_TXD2          A17         ETH_RXD3            B18         ETH_TXD2          A18         ETH_RXD2            B19         ETH_TXD1         PTA17         A19         ETH_RXD0         PTA13           B21         GPI01/RTS1         PTD0         A21         I2S0_MCLK         PTE6           B22         GPI02/SDHC_D1         PTE0         A22         I2S0_DOUT_BCLK         PTE12           B23         GPI03         PTD10         A23         I2S0_DOUT_SC         PTE11           B24         CLKIN0         PTE26         A24         I2S0_TXD0         PTE7           B25         CLKOUT1         PTC3         A25         I2S0_TXD0         PTE10           B26         GND         Ground         A26         GND         Ground           B27         AN7         PTA6         A27         AN3         ADC1_DP0           B28         AN6         PTC3         A28         AN2         ADC1_DP0			PTA5			
B16         ETH_TXER         —         A16         ETH_RXDV         PTA14           B17         ETH_TXD3         —         A17         ETH_RXD3         —           B18         ETH_TXD1         PTA17         A19         ETH_RXD1         PTA12           B20         ETH_TXD1         PTA16         A20         ETH_RXD1         PTA12           B21         GPIO1/RTS1         PTD0         A21         I2S0_MCLK         PTE6           B22         GPIO2/SDHC_D1         PTE0         A22         I2S0_DOUT_BCLK         PTE12           B23         GPIO3         PTD10         A23         I2S0_DOUT_FS         PTE11           B24         CLKINO         PTE26         A24         I2S0_RXD0         PTE7           B25         CLKOUT1         PTC3         A25         I2S0_TXD0         PTE10           B26         GND         Ground         A26         GND         Ground           B27         AN7         PTA6         A27         AN3         ADC1_DP0           B28         AN6         PTC3         A28         AN2         ADC1_DP0           B29         AN5         PTE24         A29         AN1         ADC1_DP0						
B17         ETH_TXD3          A17         ETH_RXD3            B18         ETH_TXD1         PTA17         A18         ETH_RXD1         PTA12           B20         ETH_TXD0         PTA16         A20         ETH_RXD0         PTA13           B21         GPIO1/RTS1         PTD0         A21         I2S0_MCLK         PTE6           B22         GPIO2/SDHC_D1         PTE0         A22         I2S0_DOUT_FS         PTE11           B23         GPIO3         PTD10         A23         I2S0_DOUT_FS         PTE11           B24         CLKIN0         PTE26         A24         I2S0_RXD0         PTE7           B25         CLKOUT1         PTC3         A25         I2S0_TXD0         PTE10           B26         GND         Ground         A26         GND         Ground           B27         AN7         PTA6         A27         AN3         ADC0_SE16           B28         AN6         PTC3         A28         AN2         ADC1_DM0           B30         AN4         PTE24         A29         AN1         ADC1_DM0           B31         GND         Ground         A31         GND         Ground			PTA15			
B18         ETH_TXD2         —         A18         ETH_RXD2         —           B19         ETH_TXD1         PTA17         A19         ETH_RXD1         PTA12           B20         ETH_TXD0         PTA16         A20         ETH_RXD0         PTA13           B21         GPIO1/RTS1         PTD0         A21         I2S0_MCLK         PTE6           B22         GPIO2/SDHC_D1         PTE0         A22         I2S0_DOUT_BCLK         PTE12           B23         GPIO3         PTD10         A23         I2S0_DOUT_FS         PTE11           B24         CLKIN0         PTE26         A24         I2S0_TXD0         PTE7           B25         CLKOUT1         PTC3         A25         I2S0_TXD0         PTE10           B26         GND         Ground         A26         GND         Ground           B27         AN7         PTA6         A27         AN3         ADC1_DP0           B29         AN5         PTE24         A29         AN1         ADC1_DP0           B29         AN5         PTE24         A29         AN1         ADC1_DM0           B30         AN4         PTE25         A30         AN0         ADC0_DC_OUT			—		—	PTA14
B19         ETH_TXD1         PTA17         A19         ETH_RXD1         PTA12           B20         ETH_TXD0         PTA16         A20         ETH_RXD0         PTA13           B21         GPI01 / RTS1         PTD0         A21         I2S0_MCLK         PTE6           B22         GPI02 / SDHC_D1         PTE0         A22         I2S0_DOUT_BCK         PTE12           B23         GPI03         PTD10         A23         I2S0_DOUT_FS         PTE11           B24         CLKIN0         PTE26         A24         I2S0_TXD0         PTE7           B25         CLKOUT1         PTC3         A25         I2S0_TXD0         PTE10           B26         GND         Ground         A26         GND         Ground           B27         AN7         PTA6         A27         AN3         ADC0_SE16           B28         AN6         PTE24         A29         AN1         ADC1_DP0           B30         AN4         PTE25         A30         AN0         ADC0_SE16           B31         GND         Ground         A31         GND         Ground           B33         TMR3         PTD6         A33         TMR1         PTB13			—			—
B20         ETH_TXD0         PTA16         A20         ETH_RXD0         PTA13           B21         GPI01 / RTS1         PTD0         A21         I2S0_MCLK         PTE6           B22         GPI02 / SDHC_D1         PTE0         A22         I2S0_DOUT_BCLK         PTE12           B23         GPI03         PTD10         A23         I2S0_DOUT_FS         PTE11           B24         CLKIN0         PTE26         A24         I2S0_RXD0         PTE7           B25         CLKOUT1         PTC3         A25         I2S0_TXD0         PTE10           B26         GND         Ground         A26         GND         Ground           B27         AN7         PTA6         A27         AN3         ADC0_SE16           B28         AN6         PTC3         A28         AN2         ADC1_DP0           B29         AN5         PTE24         A29         AN1         ADC1_DM0           B30         AN4         PTE25         A30         AN0         ADC0_SE16           B33         GND         Ground         A31         GND         Ground           B32         DAC1         DAC1_OUT         A32         DAC0         DAC0_OUT			—			
B21         GPI01/RTS1         PTD0         A21         I2S0_MCLK         PTE6           B22         GPI02/SDHC_D1         PTE0         A22         I2S0_DOUT_BCLK         PTE12           B23         GPI03         PTD10         A23         I2S0_DOUT_SC         PTE12           B24         CLKIN0         PTE26         A24         I2S0_TXD0         PTE7           B25         CLKOUT1         PTC3         A25         I2S0_TXD0         PTE10           B26         GND         Ground         A26         GSO_TXD0         PTE10           B26         GND         Ground         A26         GSO_TXD0         PTE10           B29         AN5         PTE24         A29         AN1         ADC1_DP0           B29         AN5         PTE25         A30         AN0         ADC0_DSE16           B31         GND         Ground         A31         GND         Ground           B32         DAC1         DAC1_OUT         A32         DAC0         DAC0_OUT           B33         TMR3         PTD6         A33         TMR1         PTB13           B34         TMR2         PTD7         A34         TMR0         PTB12						
B22         GPIO2 / SDHC_D1         PTE0         A22         I2S0_DOUT_BCLK         PTE12           B23         GPIO3         PTD10         A23         I2S0_DOUT_FS         PTE11           B24         CLKIN0         PTE26         A24         I2S0_RXD0         PTE7           B25         CLKOUT1         PTC3         A25         I2S0_TXD0         PTE10           B26         GND         Ground         A26         GND         Ground           B27         AN7         PTA6         A27         AN3         ADC0_SE16           B28         AN6         PTC3         A28         AN2         ADC1_DP0           B30         AN4         PTE24         A29         AN1         ADC1_DM0           B30         AN4         PTE25         A30         AN0         ADC0_SE16           B31         GND         Ground         A31         GND         Ground           B34         TMR3         PTD6         A33         TMR1         PTB13           B34         TMR2         PTD7         A34         TMR0         PTB12           B36         3.3 V         3.3 V Power         A36         3.3 V Power           B37         PWM7					=	
B23         GPI03         PTD10         A23         I2S0_DOUT_FS         PTE11           B24         CLKIN0         PTE26         A24         I2S0_RXD0         PTE7           B25         CLKOUT1         PTC3         A25         I2S0_TXD0         PTE10           B26         GND         Ground         A26         GND         Ground           B27         AN7         PTA6         A27         AN3         ADC0_SE16           B28         AN6         PTC3         A28         AN2         ADC1_DP0           B29         AN5         PTE24         A29         AN1         ADC1_DM0           B30         AN4         PTE25         A30         AN0         ADC0_SE16           B31         GND         Ground         A31         GND         Ground           B32         DAC1         DAC1_OUT         A32         DAC0         DAC0_OUT           B33         TMR3         PTD6         A33         TMR1         PTB12           B35         GPI04         PTA28         A35         GPI06         PTA29           B36         3.3 V         3.3 V Power         A36         3.3 V         3.3 V Power           B38						
B24         CLKIN0         PTE26         A24         I2S0_RXD0         PTE7           B25         CLKOUT1         PTC3         A25         I2S0_TXD0         PTE10           B26         GND         Ground         A26         GND         Ground           B27         AN7         PTA6         A27         AN3         ADC0_SE16           B28         AN6         PTC3         A28         AN2         ADC1_DP0           B29         AN5         PTE24         A29         AN1         ADC1_DP0           B30         AN4         PTE25         A30         AN0         ADC0_SE16           B31         GND         Ground         A31         GND         Ground           B32         DAC1         DAC1_OUT         A32         DAC0         DAC0_OUT           B33         TMR3         PTD6         A33         TMR1         PTB13           B34         TMR2         PTD7         A34         TMR0         PTB12           B35         GPI04         PTA28         A35         GPI06         PTA29           B36 <b>3.3 V 3.3 V Power</b> A36 <b>3.3 V 3.3 V Power</b> B36		GPIO2 / SDHC_D1				
B25         CLKOUT1         PTC3         A25         I2S0_TXD0         PTE10           B26         GND         Ground         A26         GND         Ground           B27         AN7         PTA6         A27         AN3         ADC0_SE16           B28         AN6         PTC3         A28         AN2         ADC1_DP0           B29         AN5         PTE24         A29         AN1         ADC1_DM0           B30         AN4         PTE25         A30         AN0         ADC0_SE16           B31         GND         Ground         A31         GND         Ground           B32         DAC1         DAC1_OUT         A32         DAC0         DAC0_OUT           B33         TMR3         PTD6         A33         TMR1         PTB13           B34         TMR2         PTD7         A34         TMR0         PTB12           B35         GPI04         PTA28         A35         GPI06         PTA29           B36         3.3 V         3.3 V Power         A36         3.3 V         3.3 V Power           B37         PWM7         -         A38         PWM2         PTD2           B39         PWM8						
B26         GND         Ground         A26         GND         Ground           B27         AN7         PTA6         A27         AN3         ADC0_SE16           B28         AN6         PTC3         A28         AN2         ADC1_DP0           B29         AN5         PTE24         A29         AN1         ADC1_DM0           B30         AN4         PTE25         A30         AN0         ADC0_SE16           B31         GND         Ground         A31         GND         Ground           B32         DAC1         DAC1_OUT         A32         DAC0         DAC0_OUT           B33         TMR3         PTD6         A33         TMR1         PTB13           B34         TMR2         PTD7         A34         TMR0         PTB12           B35         GPIO4         PTA28         A35         GPIO6         PTA29           B36 <b>3.3 V 3.3 V Power</b> A36 <b>3.3 V 3.3 V Power</b> B37         PWM7         -         A37         PWM3         PTD3           B38         PWM6         -         A38         PWM2         PTD4           B40         PWM4						
B27         AN7         PTA6         A27         AN3         ADC0_SE16           B28         AN6         PTC3         A28         AN2         ADC1_DP0           B29         AN5         PTE24         A29         AN1         ADC1_DP0           B30         AN4         PTE25         A30         AN0         ADC0_SE16           B31         GND         Ground         A31         GND         Ground           B32         DAC1         DAC1_OUT         A32         DAC0         DAC0_OUT           B33         TMR3         PTD6         A33         TMR1         PTB13           B34         TMR2         PTD7         A34         TMR0         PTB12           B35         GPI04         PTA28         A35         GPI06         PTA29           B36 <b>3.3 V 3.3 V Power</b> A36 <b>3.3 V 3.3 V Power</b> B37         PWM7         -         A37         PWM3         PTD2           B38         PWM6         -         A38         PWM2         PTD2           B40         PWM4         PTD4         A40         PWM0         PTD1           B41         CANRX0			PTC3			PTE10
B28         AN6         PTC3         A28         AN2         ADC1_DP0           B29         AN5         PTE24         A29         AN1         ADC1_DM0           B30         AN4         PTE25         A30         AN0         ADC0_SE16           B31         GND         Ground         A31         GND         Ground           B32         DAC1         DAC1_OUT         A32         DAC0         DAC0_OUT           B33         TMR3         PTD6         A33         TMR1         PTB13           B34         TMR2         PTD7         A34         TMR0         PTB12           B35         GPI04         PTA28         A35         GPI06         PTA29           B36         3.3 V         3.3 V Power         A36         3.3 V         3.3 V Power           B37         PWM7         -         A37         PWM3         PTD3           B38         PWM6         -         A38         PWM2         PTD2           B39         PWM4         PTD4         A40         PWM0         PTD0           B41         CANRX0         PTA30         A42         TXD0         PTA1           B42         CANTX0         PTA						
B29         AN5         PTE24         A29         AN1         ADC1_DM0           B30         AN4         PTE25         A30         AN0         ADC0_SE16           B31         GND         Ground         A31         GND         Ground           B32         DAC1         DAC1_OUT         A32         DAC0         DAC0_OUT           B33         TMR3         PTD6         A33         TMR1         PTB13           B34         TMR2         PTD7         A34         TMR0         PTB12           B35         GPIO4         PTA28         A35         GPIO6         PTA29           B36         3.3 V         3.3 V Power         A36         3.3 V         3.3 V Power           B37         PWM7         -         A37         PWM3         PTD3           B38         PWM6         -         A38         PWM2         PTD2           B39         PWM4         PTD4         A40         PWM0         PTD1           B40         PWM4         PTA1         A41         RXD0         PTA1           B42         CANTX0         PTA30         A42         TXD0         PTA2           B43         IWIRE         -						—
B30         AN4         PTE25         A30         AN0         ADC0_SE16           B31         GND         Ground         A31         GND         Ground           B32         DAC1         DAC1_OUT         A32         DAC0         DAC0_OUT           B33         TMR3         PTD6         A33         TMR1         PTB13           B34         TMR2         PTD7         A34         TMR0         PTB12           B35         GPIO4         PTA28         A35         GPIO6         PTA29           B36 <b>3.3 V 3.3 V Power</b> A36 <b>3.3 V 3.3 V Power</b> B37         PWM7         -         A37         PWM3         PTD3           B38         PWM6         -         A38         PWM2         PTD2           B39         PWM4         PTD4         A40         PWM0         PTD1           B40         PWM4         PTA30         A41         RXD0         PTA1           B44         CANRX0         PTA30         A42         TXD0         PTA2           B43         1WIRE         -         A43         RXD1         ELEV_UART_RX           B44         SPI0_MOSI	B28	AN6	PTC3	A28	AN2	
B31         GND         Ground         A31         GND         Ground           B32         DAC1         DAC1_OUT         A32         DAC0         DAC0_OUT           B33         TMR3         PTD6         A33         TMR1         PTB13           B34         TMR2         PTD7         A34         TMR0         PTB12           B35         GPIO4         PTA28         A35         GPIO6         PTA29           B36 <b>3.3 V 3.3 V Power</b> A36 <b>3.3 V 3.3 V Power</b> B37         PWM7         -         A37         PWM3         PTD3           B38         PWM6         -         A38         PWM2         PTD2           B39         PWM5         PTD5         A39         PWM1         PTD1           B40         PWM4         PTD4         A40         PWM0         PTD0           B41         CANRX0         PTA31         A41         RXD0         PTA2           B43         1WIRE         -         A43         RXD1         ELEV_UART_RX           B44         SPI0_MISO         PTD14         A44         TXD1         ELEV_UART_RX           B45         SPI0_MOS						—
B32         DAC1         DAC1_OUT         A32         DAC0         DAC0_OUT           B33         TMR3         PTD6         A33         TMR1         PTB13           B34         TMR2         PTD7         A34         TMR0         PTB12           B35         GPIO4         PTA28         A35         GPIO6         PTA29           B36         3.3 V         3.3 V Power         A36         3.3 V         3.3 V Power           B37         PWM7         —         A37         PWM3         PTD3           B38         PWM6         —         A38         PWM2         PTD2           B39         PWM5         PTD5         A39         PWM0         PTD0           B41         CANRX0         PTA31         A41         RXD0         PTA1           B42         CANTX0         PTA30         A42         TXD0         PTA2           B43         1WIRE         —         A43         RXD1         ELEV_UART_RX           B44         SPI0_MOSI         PTD13         A45         VSS         VSSA           B46         SPI0_CS0_b         PTD11         A46         VDDA         VDDA           B47         SPI0_CLK		AN4	PTE25	A30		ADC0_SE16
B33         TMR3         PTD6         A33         TMR1         PTB13           B34         TMR2         PTD7         A34         TMR0         PTB12           B35         GPIO4         PTA28         A35         GPIO6         PTA29           B36 <b>3.3 V 3.3 V Power</b> A36 <b>3.3 V 3.3 V Power</b> B37         PWM7         —         A37         PWM3         PTD3           B38         PWM6         —         A38         PWM2         PTD2           B39         PWM5         PTD5         A39         PWM0         PTD0           B40         PWM4         PTD4         A40         PWM0         PTD0           B41         CANRX0         PTA31         A41         RXD0         PTA1           B42         CANTX0         PTA30         A42         TXD0         PTA2           B43         1WIRE         —         A43         RXD1         ELEV_UART_RX           B44         SPI0_MOSI         PTD13         A45         VSS         VSSA           B46         SPI0_CS0_b         PTD11         A46         VDDA         VDDA           B47         SPI0_CLK						
B34         TMR2         PTD7         A34         TMR0         PTB12           B35         GPIO4         PTA28         A35         GPIO6         PTA29           B36 <b>3.3 V 3.3 V Power</b> A36 <b>3.3 V 3.3 V Power</b> B37         PWM7         —         A37         PWM3         PTD3           B38         PWM6         —         A38         PWM2         PTD2           B39         PWM5         PTD5         A39         PWM1         PTD1           B40         PWM4         PTD4         A40         PWM0         PTD0           B41         CANRX0         PTA31         A41         RXD0         PTA1           B42         CANTX0         PTA30         A42         TXD0         PTA2           B43         1WIRE         —         A43         RXD1         ELEV_UART_RX           B44         SPI0_MOSI         PTD13         A45         VSS         VSSA           B45         SPI0_MOSI         PTD13         A45         VDDA         VDDA           B46         SPI0_CS0_b         PTD15         A47         CAN1_RX         PTE25           B48         SPI0_CLK						
B35         GPIO4         PTA28         A35         GPIO6         PTA29           B36         3.3 V         3.3 V Power         A36         3.3 V         3.3 V Power           B37         PWM7         -         A37         PWM3         PTD3           B38         PWM6         -         A38         PWM2         PTD2           B39         PWM5         PTD5         A39         PWM1         PTD1           B40         PWM4         PTD4         A40         PWM0         PTD0           B41         CANRX0         PTA31         A41         RXD0         PTA2           B42         CANTX0         PTA30         A42         TXD0         PTA2           B43         1WIRE         -         A43         RXD1         ELEV_UART_RX           B44         SPI0_MOSI         PTD13         A45         VSS         VSSA           B46         SPI0_MOSI         PTD11         A46         VDDA         VDDA           B47         SPI0_CS1_b         PTD15         A47         CAN1_RX         PTE25           B48         SPI0_CLK         PTD12         A48         CAN1_TX         PTE24           B49         GND						
B36         3.3 V         3.3 V Power         A36         3.3 V         3.3 V Power           B37         PWM7         -         A37         PWM3         PTD3           B38         PWM6         -         A38         PWM2         PTD2           B39         PWM5         PTD5         A39         PWM1         PTD1           B40         PWM4         PTD4         A40         PWM0         PTD0           B41         CANRX0         PTA31         A41         RXD0         PTA1           B42         CANTX0         PTA30         A42         TXD0         PTA2           B43         1WIRE         -         A43         RXD1         ELEV_UART_RX           B44         SPI0_MISO         PTD14         A44         TXD1         ELEV_UART_TX           B45         SPI0_MOSI         PTD13         A45         VSS         VSSA           B46         SPI0_CS0_b         PTD15         A47         CAN1_RX         PTE25           B48         SPI0_CLK         PTD12         A48         CAN1_TX         PTE24           B49         GND         Ground         A49         GND         Ground			PTD7			
B37         PWM7         —         A37         PWM3         PTD3           B38         PWM6         —         A38         PWM2         PTD2           B39         PWM5         PTD5         A39         PWM1         PTD1           B40         PWM4         PTD4         A40         PWM0         PTD0           B41         CANRX0         PTA31         A41         RXD0         PTA1           B42         CANTX0         PTA30         A42         TXD0         PTA2           B43         1WIRE         —         A43         RXD1         ELEV_UART_RX           B44         SPI0_MISO         PTD13         A45         VSS         VSSA           B45         SPI0_MOSI         PTD13         A45         VSS         VSSA           B46         SPI0_CS0_b         PTD15         A47         CAN1_RX         PTE25           B48         SPI0_CLK         PTD12         A48         CAN1_TX         PTE24           B49         GND         Ground         A49         GND         Ground						
B38         PWM6         —         A38         PWM2         PTD2           B39         PWM5         PTD5         A39         PWM1         PTD1           B40         PWM4         PTD4         A40         PWM0         PTD0           B41         CANRX0         PTA31         A41         RXD0         PTA1           B42         CANTX0         PTA30         A42         TXD0         PTA2           B43         1WIRE         —         A43         RXD1         ELEV_UART_RX           B44         SPI0_MISO         PTD14         A44         TXD1         ELEV_UART_RX           B45         SPI0_MOSI         PTD13         A45         VSS         VSSA           B46         SPI0_CS0_b         PTD15         A47         CAN1_RX         PTE25           B48         SPI0_CLK         PTD12         A48         CAN1_TX         PTE24           B49         GND         Ground         A49         GND         Ground			3.3 V Power			
B39         PWM5         PTD5         A39         PWM1         PTD1           B40         PWM4         PTD4         A40         PWM0         PTD0           B41         CANRX0         PTA31         A41         RXD0         PTA1           B42         CANTX0         PTA30         A42         TXD0         PTA2           B43         1WIRE          A43         RXD1         ELEV_UART_RX           B44         SPI0_MISO         PTD14         A44         TXD1         ELEV_UART_RX           B45         SPI0_MOSI         PTD13         A45         VSS         VSSA           B46         SPI0_CS0_b         PTD15         A47         CAN1_RX         PTE25           B48         SPI0_CLK         PTD12         A48         CAN1_TX         PTE24           B49         GND         Ground         A49         GND         Ground		PWM7	<u> </u>			
B40         PWM4         PTD4         A40         PWM0         PTD0           B41         CANRX0         PTA31         A41         RXD0         PTA1           B42         CANTX0         PTA30         A42         TXD0         PTA2           B43         1WIRE          A43         RXD1         ELEV_UART_RX           B44         SPI0_MISO         PTD14         A44         TXD1         ELEV_UART_TX           B45         SPI0_MOSI         PTD13         A45         VSS         VSSA           B46         SPI0_CS0_b         PTD11         A46         VDDA         VDDA           B47         SPI0_CS1_b         PTD15         A47         CAN1_RX         PTE25           B48         SPI0_CLK         PTD12         A48         CAN1_TX         PTE24           B49         GND         Ground         A49         GND         Ground			<u> </u>			
B41         CANRX0         PTA31         A41         RXD0         PTA1           B42         CANTX0         PTA30         A42         TXD0         PTA2           B43         1WIRE         -         A43         RXD1         ELEV_UART_RX           B44         SPI0_MISO         PTD14         A44         TXD1         ELEV_UART_TX           B45         SPI0_MOSI         PTD13         A45         VSS         VSSA           B46         SPI0_CS0_b         PTD11         A46         VDDA         VDDA           B47         SPI0_CS1_b         PTD15         A47         CAN1_RX         PTE25           B48         SPI0_CLK         PTD12         A48         CAN1_TX         PTE24           B49         GND         Ground         A49         GND         Ground				A39		
B42         CANTX0         PTA30         A42         TXD0         PTA2           B43         1WIRE         —         A43         RXD1         ELEV_UART_RX           B44         SPI0_MISO         PTD14         A44         TXD1         ELEV_UART_TX           B45         SPI0_MOSI         PTD13         A45         VSS         VSSA           B46         SPI0_CS0_b         PTD11         A46         VDDA         VDDA           B47         SPI0_CS1_b         PTD15         A47         CAN1_RX         PTE25           B48         SPI0_CLK         PTD12         A48         CAN1_TX         PTE24           B49         GND         Ground         A49         GND         Ground						
B43         1WIRE          A43         RXD1         ELEV_UART_RX           B44         SPI0_MISO         PTD14         A44         TXD1         ELEV_UART_TX           B45         SPI0_MOSI         PTD13         A45         VSS         VSSA           B46         SPI0_CS0_b         PTD11         A46         VDDA         VDDA           B47         SPI0_CS1_b         PTD15         A47         CAN1_RX         PTE25           B48         SPI0_CLK         PTD12         A48         CAN1_TX         PTE24           B49         GND         Ground         A49         GND         Ground						
B44         SPI0_MISO         PTD14         A44         TXD1         ELEV_UART_TX           B45         SPI0_MOSI         PTD13         A45         VSS         VSSA           B46         SPI0_CS0_b         PTD11         A46         VDDA         VDDA           B47         SPI0_CS1_b         PTD15         A47         CAN1_RX         PTE25           B48         SPI0_CLK         PTD12         A48         CAN1_TX         PTE24           B49         GND         Ground         A49         GND         Ground			PTA30			
B45         SPI0_MOSI         PTD13         A45         VSS         VSSA           B46         SPI0_CS0_b         PTD11         A46         VDDA         VDDA           B47         SPI0_CS1_b         PTD15         A47         CAN1_RX         PTE25           B48         SPI0_CLK         PTD12         A48         CAN1_TX         PTE24           B49         GND         Ground         A49         GND         Ground		1WIRE	<u> </u>	A43		ELEV_UART_RX
B46         SPI0_CS0_b         PTD11         A46         VDDA         VDDA           B47         SPI0_CS1_b         PTD15         A47         CAN1_RX         PTE25           B48         SPI0_CLK         PTD12         A48         CAN1_TX         PTE24           B49         GND         Ground         A49         GND         Ground		—				
B47         SPI0_CS1_b         PTD15         A47         CAN1_RX         PTE25           B48         SPI0_CLK         PTD12         A48         CAN1_TX         PTE24           B49         GND         Ground         A49         GND         Ground		—				
B48         SPI0_CLK         PTD12         A48         CAN1_TX         PTE24           B49         GND         Ground         A49         GND         Ground				A46		
B49 GND Ground A49 GND Ground						
			PTD12		_	PTE24
	B50	SCL1	PTE19	A50		
B51         SDA1         PTE18         A51         GPIO15         PTA25	B51		PTE18	A51	GPIO15	PTA25
GPIO5 /						
B52 SPI0_HOLD/IO3 PTA10 A52 GPIO16 PTA26	B52	SPI0_HOLD/IO3	PTA10	A52	GPIO16	PTA26

#### Table 6. TWR-K65F180M Primary Connector Pinout (continued)



B53	USB0_DP_PDOWN	—	A53	GPIO17	PTA27
B54	USB0_DM_PDOWN	—	A54	USB0_DM	ELEV_USB_DN
B55	IRQ_H	PTE27	A55	USB0_DP	ELEV_USB_DP
B56	IRQ_G	PTE27	A56	USB0_ID	—
B57	IRQ_F	PTC11	A57	USB0_VBUS	ELEV_USB_VBUS
B58	IRQ_E	PTC11	A58	I2S0_DIN_BCLK	PTE9
B59	IRQ_D	PTC3	A59	I2S0_DIN_FS	PTE8
B60	IRQ_C	PTC3	A60	I2S0_RXD1	PTE8
B61	IRQ_B	PTE28	A61	I2S0_TXD1	PTE9
B62	IRQ_A	PTE28	A62	RSTIN_b	RESET_b
B63	EBI_ALE / EBI_CS1_b	PTD0	A63	RSTOUT_b	Either RESET_b or PTD10
B64	EBI_CS0_b	PTD1	A64	CLKOUT0	PTA6
B65	GND	Ground	A65	GND	Ground
B66	EBI_AD15	PTB18	A66	EBI_AD14	PTC0
B67	EBI_AD16	PTB17	A67	EBI_AD13	PTC1
B68	EBI_AD17	PTB16	A68	EBI_AD12	PTC2
B69	EBI_AD18	PTB11	A69	EBI_AD11	PTC4
B70	EBI_AD19	PTB10	A70	EBI_AD10	PTC5
B71	EBI_R/W_b	PTC11	A71	EBI_AD9	PTC6
B72	EBI_OE_b	PTB19	A72	EBI_AD8	PTC7
B73	EBI_D7	PTB20	A73	EBI_AD7	PTC8
B74	EBI_D6	PTB21	A74	EBI_AD6	PTC9
B75	EBI_D5	PTB22	A75	EBI_AD5	PTC10
B76	EBI_D4	PTB23	A76	EBI_AD4	PTD2
B77	EBI_D3	PTC12	A77	EBI_AD3	PTD3
B78	EBI_D2	PTC13	A78	EBI_AD2	PTD4
B79	EBI_D1	PTC14	A79	EBI_AD1	PTD5
B80	EBI_D0	PTC15	A80	EBI_AD0	PTD6
B81	GND	Ground	A81	GND	Ground
B82	3.3 V	3.3 V Power	A82	3.3 V	3.3 V Power

Table 6. TWR-K65F180M Primary Connector Pinout (continued)

## 7 References

The list below provides references for more information on the Kinetis family, Tower System and the MCU modules. These can be found in the documentation section of <u>freescale.com/TWR-K65F180M</u> or <u>freescale.com/kinetis</u>.

- TWR-K65F180M Quick Start Guide (document <u>TWR-K65F180M-QSG</u>)
- TWR-K65F180M Schematics (document <u>TWR-K65F180M-SCH</u>)
- *K65 Family Data Sheet* (document <u>K65P169M180SF5V2</u>)
- *K65 Family Reference Manual* (document <u>K65P169M180SF5RMV2</u>)
- Kinetis Quick Reference User Guide (document KQRUG)



## 8 Revision history

Revision number	Date	Substantive changes
0	05/2015	Initial release

#### Table 7. Revision history



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