TWR-K60D100M Tower Module

User's Manual

Rev. 1.1

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Revision History

Revision	Date	Changes
1.0	Jun 1, 2011	Initial Release for PWA 700-27291 Rev B
1.1	Aug 28, 2011	Fixed hyperlink in Section 1.4

1 TWR-K60D100M and TWR-K60D100M-KIT Overview

The TWR-K60D100M is a Tower Controller Module compatible with the Freescale Tower System. It can function as a stand-alone, low-cost platform for the evaluation of the Kinetis K10, K20 and K60 family of microcontroller (MCU) devices. The TWR-K60D100M features the Kinetis K60 low-power microcontroller based on the ARM® Cortex™-M4 architecture with USB 2.0 full-speed OTG controller and 10/100 Mbps Ethernet MAC.

The TWR-K60D100M is available as a stand-alone product or as a kit (TWR-K60D100M-KIT) with the Tower Elevator Modules (TWR-ELEV) and the Tower Serial Module (TWR-SER). The TWR-K60D100M can also be combined with other Freescale Tower peripheral modules to create development platforms for a wide variety of applications. Figure 1 provides an overview of the Freescale Tower System.

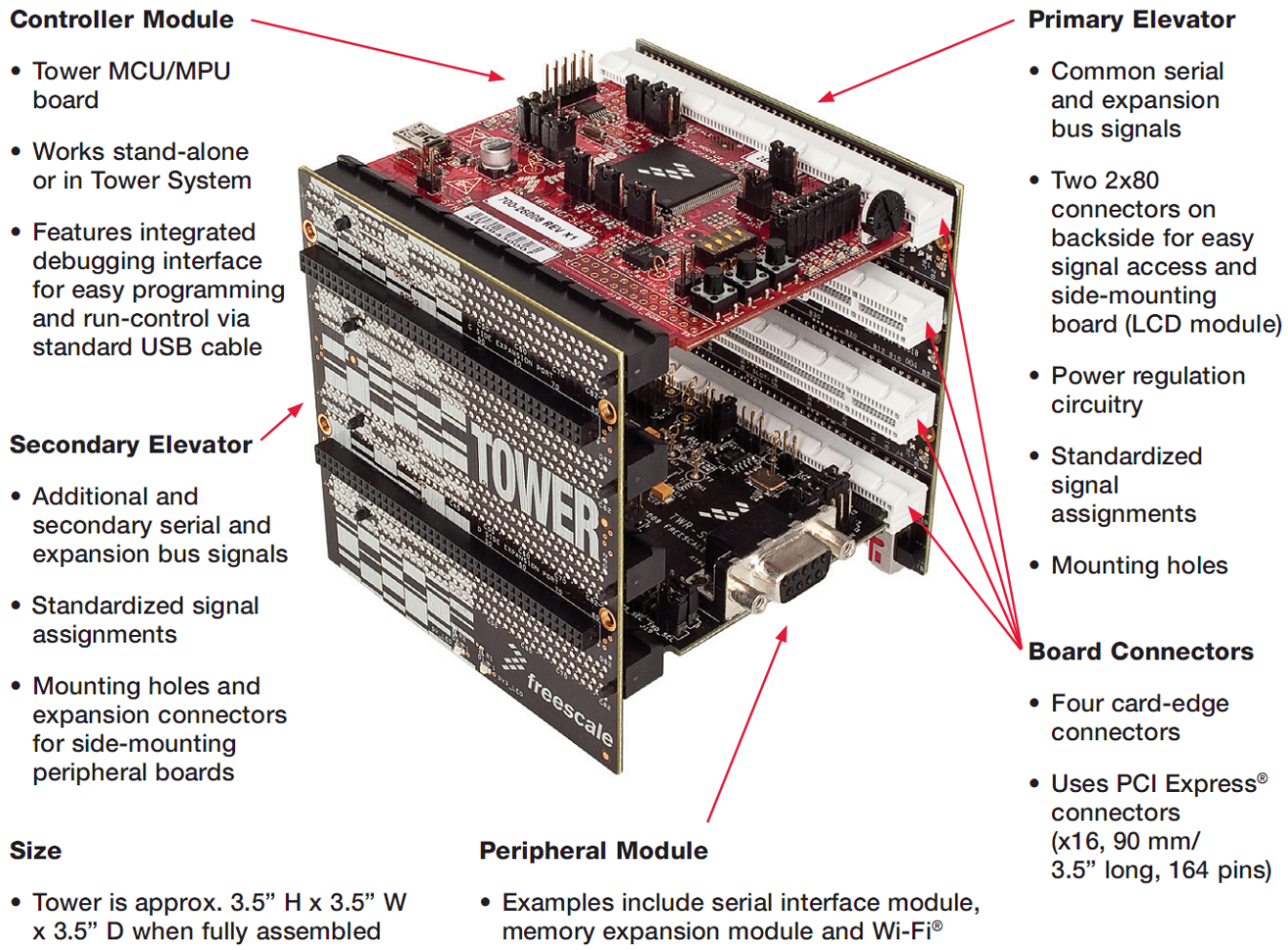

Figure 1. Freescale Tower System Overview

1.1 Contents

The TWR-K60D100M contents include:

- TWR-K60D100M board assembly
- 3ft USB cable
- CR 2025 Coin Cell Battery

- Quick Start Guide

The TWR-K60D100M-KIT contains:

- TWR-K60D100M MCU module
- TWR-ELEV – Primary and Secondary Elevator Modules
- TWR-SER – Serial module including USB host/device/OTG, Ethernet, CAN, RS232 and RS485

1.2 Features

Figure 2 and Figure 3 show the TWR-K60D100M with some of the key features called out. The following list summarizes the features of the TWR-K60D100M Tower MCU Module:

- Tower compatible microcontroller module
- MK60DN512VMD10: K60DN512 in a 144 MAPBGA with 100MHz operation
- Touch Tower Plug-in Socket
- General purpose Tower Plug-in (TWRPI) socket
- On-board JTAG debug circuit (OSJTAG) with virtual serial port
- Three axis accelerometer (MMA78451Q)
- Four (4) user-controllable LEDs
- Four (4) capacitive touch pads
- Two (2) user pushbutton switches
- Potentiometer
- Battery Holder for 20mm lithium battery (e.g. 2032, 2025)
- SD Card slot
- 3.3V or 1.8V operation
- Isolation for low power measurements

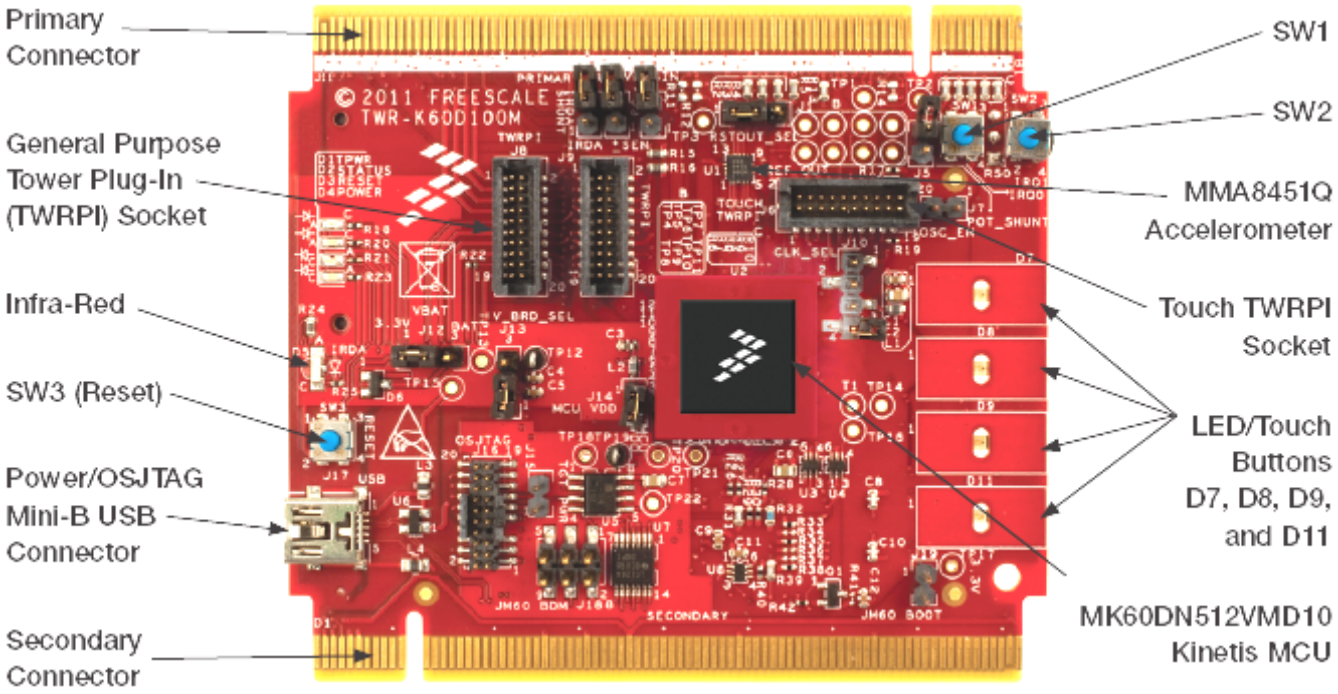

Figure 2. Callouts on front side of the TWR-K60D100M

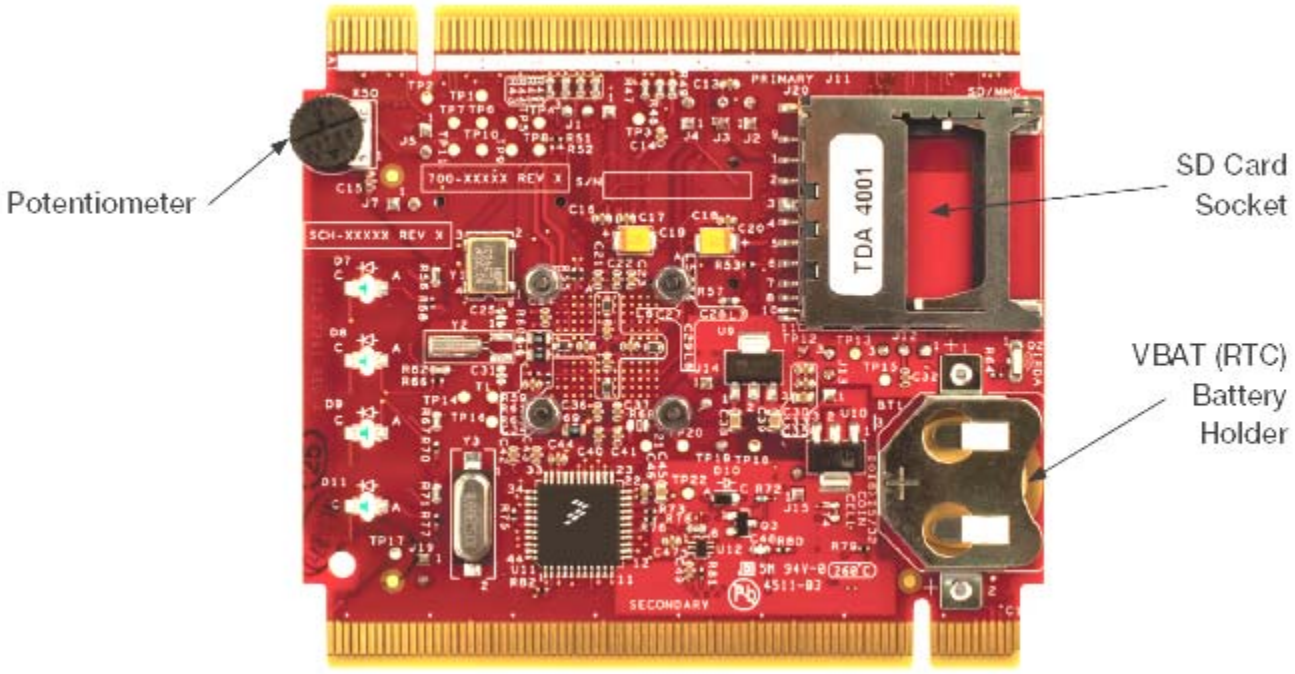

Figure 3. Callouts on back side of the TWR-K60D100M

1.3 Getting Started

Follow the Quick Start Guide found printed in the TWR-K60D100M box or on the web for the list of recommended steps for getting started. There are also lab walk-through guides available on the tool support page for the TWR-K60D100M: http://www.freescale.com/TWR-K60D100M.

1.4 Reference Documents

The documents listed below should be referenced for more information on the Kinetis family, Tower System, and MCU Modules. These can be found in the documentation section of http://www.freescale.com/TWR-K60D100M or http://freescale.com/kinetis.

- *TWR-K60D100M-QSG: Quick Start Guide*
- *TWR-K60D100M-SCH: Schematics*
- *TWR-K60D100M-PWA: Design Package*
- *K60 Family Product Brief*
- *K60 Family Reference Manual*
- *Kinetis Quick Reference User Guide (QRUG)*
- *Tower Configuration Tool*

2 Hardware Description

The TWR-K60D100M is a Tower Controller Module featuring the MK60DN512VMD10—an ARM Cortex-M4 based microcontroller with USB 2.0 full-speed OTG controllers, Ethernet, and Encryption in a 144 MAPBGA package with a maximum core operating frequency of 100MHz. It is intended for use in the Freescale Tower System but can operate stand-alone. An on-board debug circuit, OSJTAG, provides a JTAG debug interface and a power supply input through a single USB mini-AB connector. Figure 4 shows a block diagram of the TWR-K60D100M. The following sections describe the hardware in more detail.

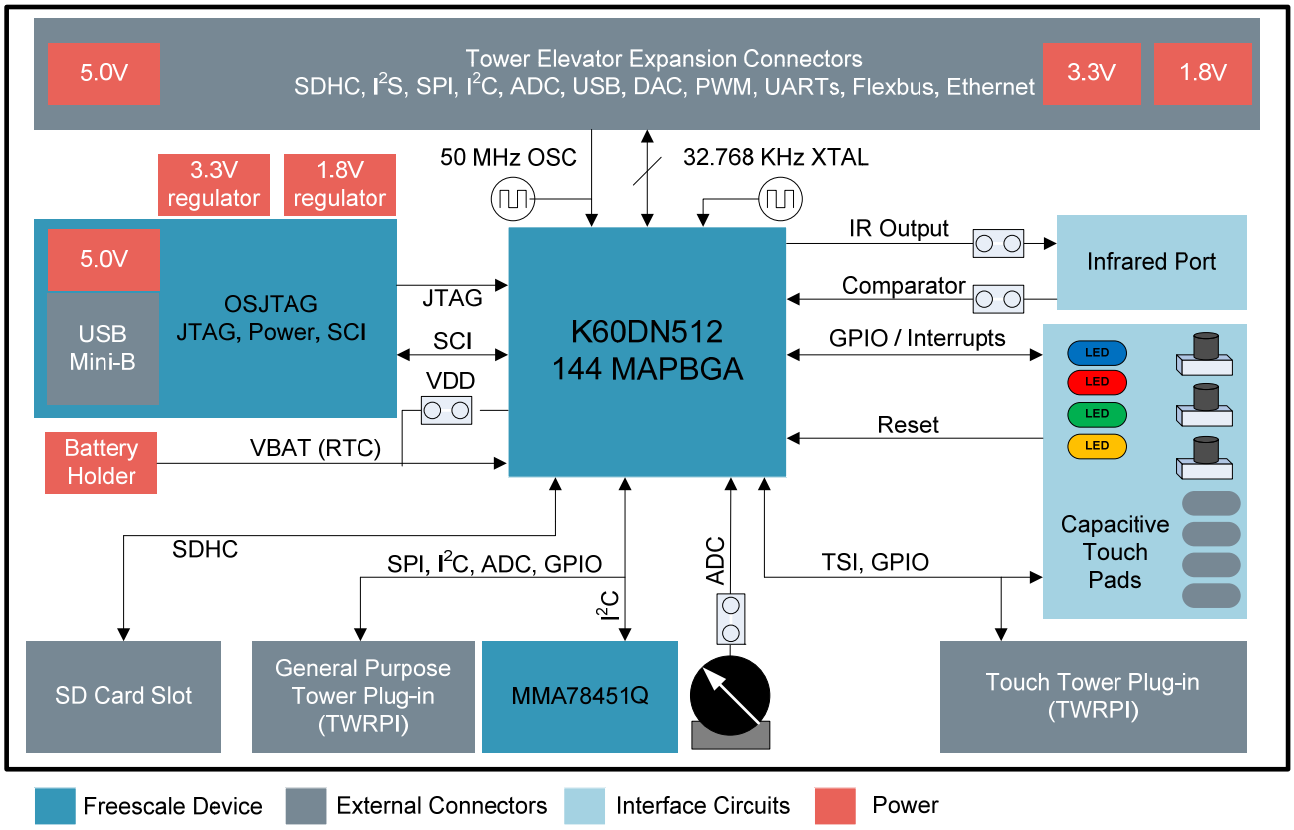

Figure 4. TWR-K60D100M Block Diagram

2.1 K60DN512 Microcontroller

The TWR-K60D100M module features the MK60DN512VMD10. The K60 microcontroller family is part of the Kinetis portfolio of devices built around an ARM Cortex-M4 core. Refer to the *K60 Family Product Brief* and the *K60 Family Reference Manual* for comprehensive information on the MK60DN512VMD10 device. The key features are listed here:

- 32-bit ARM Cortex-M4 core with DSP instructions
- 100MHz maximum core operating frequency
- 144 MAPBGA, 13mm x 13mm, 1.0mm pitch package
- 1.71V – 3.6V operating voltage input range
- 512 Kbytes of program flash, 128 Kbytes of static RAM
- External bus interface
- Power management controller with 10 different power modes
- Multi-purpose clock generator with PLL and FLL operation modes
- 16-bit SAR ADC, 12-bit DAC
- High-speed analog comparator with 6-bit DAC
- Programmable voltage reference
- USB full-speed/low-speed OTG/Host/Device controller with device charge detect
- 10/100 Mbps Ethernet MAC
- SPI, I^2C (w/ SMBUS support), UART (w/ ISO7816 and IrDA), CAN, I^2S
- SD Host Controller (SDHC)

- GPIO with pin interrupt support, DMA request capability, digital glitch filtering
- Capacitive touch sensing inputs (TSI)
- Debug interfaces: JTAG, cJTAG, SWD
- Trace: TPIU, FPB, DWT, ITM, ETM, ETB

2.2 Clocking

The Kinetis MCUs start up from an internal digitally controlled oscillator (DCO). Software can enable one or two external oscillators if desired. 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.

The EXTAL pin of the main external oscillator can also be driven directly from an external clock source. The TWR-K60D100M features a 50 MHz on-board clock oscillator as seen in sheet 4 of the schematics. However, when the K60 Ethernet MAC is operating in RMII mode, synchronization of the MCU input clock and the 50 MHz RMII transfer clock is important. In this mode, the MCU input clock must be kept in phase with the 50 MHz clock supplied to the external PHY. Therefore, the TWR-K60D100M provides the option (see description for J6 in Table 5) to select the clock input to the MCU from 1) the on-board 50MHz source or 2) an external clock from the CLKIN0 pin on the Primary Connector 3) route CLKIN0 from TWR-SER 50 MHz to ENET_1588_CLKIN. When the K60 is operating in Ethernet RMII mode, the Tower peripheral module implementing the RMII PHY device should drive a 50 MHz clock on the CLKIN0 signal that is kept in phase with the clock supplied to the RMII PHY. Refer to section 2.10 “Ethernet” for more information.

2.3 System Power

In stand-alone operation, the main power source for the TWR-K60D100M module is derived from the 5.0V input from either the USB mini-B connector, J17, or the debug header, J16, when a shunt is placed on jumper J15. Low-dropout regulators provide either a 3.3V or 1.8V supply from the 5.0V input voltage via J13. Refer to sheet 5 of the TWR-K60D100M schematics for more details.

When installed into a Tower System, the TWR-K60D100M can be powered from either an on-board source or from another source in the assembled Tower System. If both the on-board and off-board sources are available, the TWR-K60D100M will default to the off-board source.

The V_BRD power supplied to the MCU is routed through a jumper, J14. The jumper shunt can be removed to allow for either 1) alternate MCU supply voltages to be injected or 2) the measurement of power consumed by the MCU.

2.3.1 RTC VBAT

The Real Time Clock (RTC) module on the K60 has two modes of operation, system power-up and system power-down. During system power-down, the RTC is powered from the backup power supply, VBAT. The TWR-K60D100M provides a battery holder for a coin cell battery that can be used as the VBAT supply. The holder can accept common 20mm diameter 3V lithium coin cell batteries (e.g. 2032, 2025). Refer to the description of J12 in Table 5 “TWR-K60D100M Jumper Table” for more information.

Additionally, the RTC_WAKEUP signal from the K60 was connected to the JM60 to demonstrate the feature where the RTC can set an alarm and assert the RTC_WAKEUP signal to external circuitry so the external circuitry can apply MCU VDD.

2.4 Debug Interface

There are two debug interface options provided: the on-board OSJTAG circuit and an external Cortex Debug+ETM connector.

2.4.1 OSJTAG

An on-board MC9S08JM60 based Open Source JTAG (OSJTAG) circuit provides a JTAG debug interface to the K60D100M. A standard USB A male to Mini-B male cable (provided) can be used for debugging via the USB connector, J16. The OSJTAG interface also provides a USB to serial bridge. Drivers for the OSJTAG interface are provided in the *P&E Micro OSBDM/OSJTAG Tower Toolkit.* These drivers and more utilities can be found online at http://www.pemicro.com/osbdm.

Note: The port pins connected to the OSJTAG USB-to-serial bridge (PTD6 and PTD7) are also connected to the infrared interface. Refer to Table 6 “I/O Connectors and Pin Usage Table” and Table 5 “TWR-K60D100M Jumper Table” for more information.

2.4.2 Cortex Debug+ETM Connector

The Cortex Debug+ETM connector is a 20-pin (0.05") connector providing access to the SWD, SWV, JTAG, cJTAG, EzPort and ETM trace (4-bit) signals available on the K60 device. The pinout and K60 pin connections to the debug connector, J16, is shown in Table 1.

Table 1. Cortex Debug+ETM Connector Pinout

Pin	Function	TWR-K60D100M Connection
1	VTref	3.3V MCU supply (P3V3_MCU)
2	TMS / SWDIO	PTA3/SCI0_RTS_b/FTM0_CH0/JTAG_MS/SWD_DIO
3	GND	GND
4	TCK / SWCLK	PTA0/SCI0_CTS_b/FTM0_CH5/JTAG_CLK/SWD_CLK/EZP_CLK
5	GND	GND
6	TDO / SWO	PTA2/SCI0_TX/FTM0_CH7/JTAG_DO/TRACE_SWO/EZP_DO
7	Key	—
8	TDI	PTA1/SCI0_RX/FTM0_CH6/JTAG_DI/EZP_DI
9	GNDDetect	PTA4/FTM0_CH1/MS/NMI_b/EZP_CS_b
10	nRESET	RESET_b
11	Target Power	5V supply (via J12)
12	TRACECLK	PTA6/FTM0_CH3/TRACE_CLKOUT
13	Target Power	5V supply (via J12)
14	TRACEDATA[0]	PTA10/FTM2_CH0/FTM2_QD_PHA/TRACE_D0
15	GND	GND
16	TRACEDATA[1]	PTA9/FTM1_CH1/FTM1_QD_PHB/TRACE_D1
17	GND	GND
18	TRACEDATA[2]	PTA8/FTM1_CH0/FTM1_QD_PHA/TRACE_D2

Pin	Function	TWR-K60D100M Connection
19	GND	GND
20	TRACEDATA[3]	PTA7/FTM0_CH4/TRACE_D3

Note: Many of the trace signals connected to the debug connector are also connected elsewhere on the TWR-K60D100M. Refer to Table 6 "I/O Connectors and Pin Usage Table" and Table 7 "TWR-K60D100M Primary Connector Pinout" for more information.

2.5 Infrared Port

An infrared transmit and receive interface is implemented as shown in Figure 5 below. The CMT_IRO pin directly drives an infrared diode. The receiver uses an infrared phototransistor connected to an on-chip analog comparator through a low-pass filter. Internal to the K60 device, the output of the analog comparator can be routed to a UART module for easier processing of the incoming data stream.

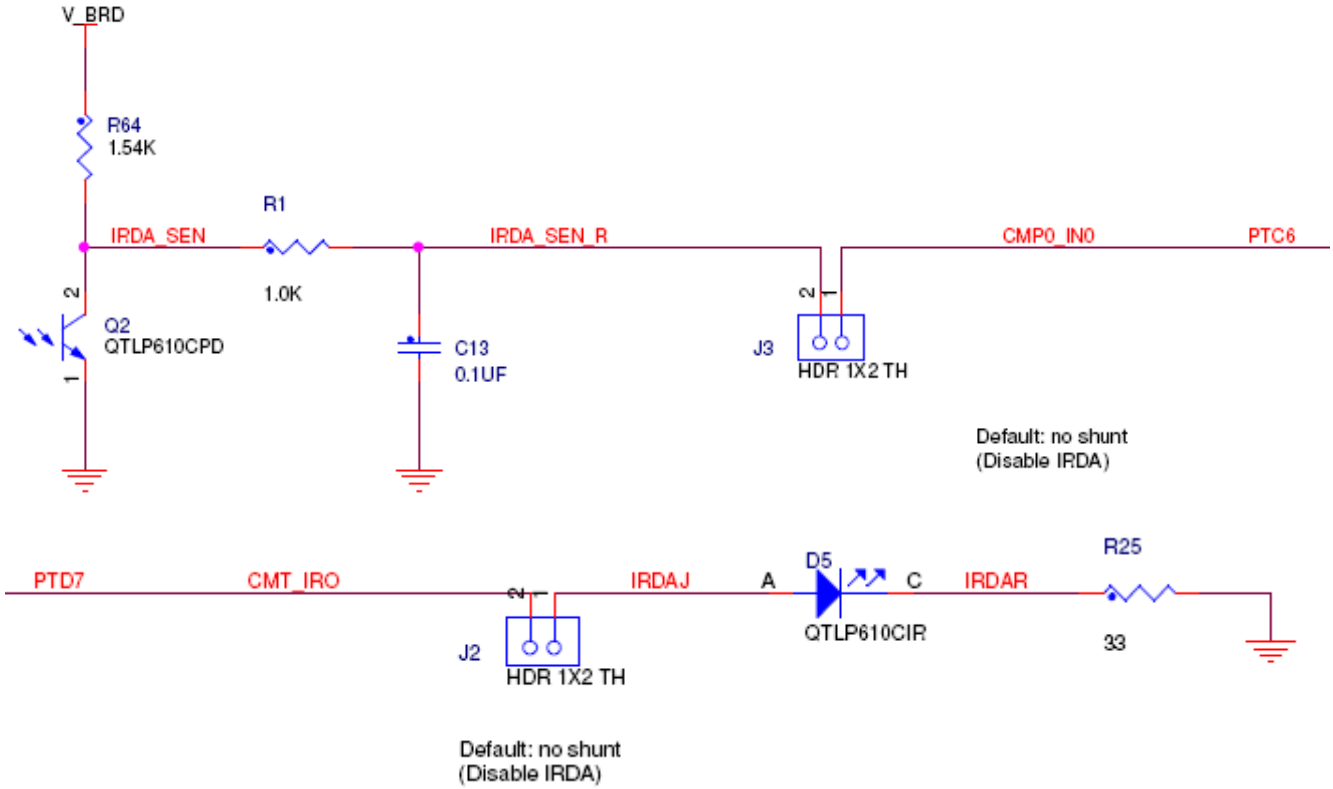

Figure 5. Infrared Port Implementation

2.6 Accelerometer

An MMA78451Q digital accelerometer is connected to the K60 MCU through an I2C interface and a GPIO/IRQ signal. Refer to Table 6 "I/O Connectors and Pin Usage Table" for connection details.

2.7 Potentiometer, Push buttons, LEDs

The TWR-K60D100M features two pushbutton switches connected to GPIO/interrupt signals, one push button connected to the master reset signal, four capacitive touch pad electrodes, four user-controllable LEDs, and a potentiometer connected to an ADC input signal. Refer to Table 6 "I/O

Connectors and Pin Usage Table" for information about which port pins are connected to these features.

2.8 General Purpose Tower Plug-in (TWRPI) Socket

The TWR-K60D100M features a socket 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 I2C, SPI, IRQs, GPIOs, timers, analog conversion signals, TWRPI ID signals, reset, and voltage supplies. The pinout for the TWRPI Socket is defined in Table 2.

Refer to Table 6 "I/O Connectors and Pin Usage Table" for the specific K60 pin connections to the General Purpose TWRPI socket.

Table 2. General Purpose TWRPI socket pinout

Left-side 2x10 Connector

Pin	Description
1	5V VCC
2	3.3 V VCC
3	GND
4	3.3V VDDA
5	VSS (Analog GND)
6	VSS (Analog GND)
7	VSS (Analog GND)
8	ADC: Analog 0
9	ADC: Analog 1
10	VSS (Analog GND)
11	VSS (Analog GND)
12	ADC: Analog 2
13	VSS (Analog GND)
14	VSS (Analog GND)
15	GND
16	GND
17	ADC: TWRPI ID 0
18	ADC: TWRPI ID 1
19	GND
20	Reset

Right-side 2x10 Connector

Pin	Description
1	GND
2	GND
3	I2C: SCL
4	I2C: SDA
5	GND
6	GND
7	GND
8	GND
9	SPI: MISO
10	SPI: MOSI
11	SPI: SS
12	SPI: CLK
13	GND
14	GND
15	GPIO: GPIO0/IRQ
16	GPIO: GPIO1/IRQ
17	GPIO: GPIO2
18	GPIO: GPIO3
19	GPIO: GPIO4/Timer
20	GPIO: GPIO5/Timer

2.9 Touch Interface

The touch sensing input (TSI) module of the Kinetis MCUs provides capacitive touch sensing detection with high sensitivity and enhanced robustness. Each TSI pin implements the capacitive measurement of an electrode.

The TWR-K60D100M provides two methods for evaluating the TSI module. There are four individual electrodes on-board the TWR-K60D100M that simulate push buttons. Additionally, twelve TSI signals are connected to a Touch Tower Plug-in (TWRPI) socket that can accept Touch TWRPI daughter cards that may feature keypads, rotary dials, sliders, etc.

The pinout for the Touch TWRPI socket is defined in Table 3. Refer to Table 6 “I/O Connectors and Pin Usage Table” for the specific K60 pin connections to the Touch TWRPI socket.

Table 3. Touch TWRPI socket pinout

Pin	Description
1	5V VCC
2	3.3 V VCC
3	Electrode 0
4	3.3V VDDA
5	Electrode 1
6	VSS (Analog GND)
7	Electrode 2
8	Electrode 3
9	Electrode 4
10	Electrode 5
11	Electrode 6
12	Electrode 7
13	Electrode 8
14	Electrode 9
15	Electrode 10
16	Electrode 11
17	ADC: TWRPI ID 0
18	ADC: TWRPI ID 1
19	GND
20	Reset

2.10 Ethernet

The K60D100M features a 10/100 Mbps Ethernet MAC with MII and RMII interfaces. The TWR-K60D100M routes the RMII interface signals from the K60 MCU to the Primary Connector, allowing the connection to an external Ethernet PHY device on a Tower peripheral module.

When the K60 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 be kept in phase with the 50 MHz clock supplied to the external PHY. Therefore, the TWR-K60D100M provides the option (see description for J10 in Table 5) to clock the MCU from an external clock from the CLKIN0 pin on the Primary Connector. The Tower peripheral module implementing the RMII PHY device should drive a 50 MHz clock on the CLKIN0 pin that is kept in phase with the clock supplied to the RMII PHY.

The TWR-SER module that comes as part of the TWR-K60D100M-KIT provides a 10/100 Ethernet PHY that can operate in either MII or RMII mode. By default the PHY is boot strapped to operate in MII mode; therefore jumper configuration changes may be required. In addition to that, the TWR-K60D100M also allows the option to route CLKIN0 from the TWR-SER 50 MHz to the ENET_1588_CLKIN. Table 4 shows the settings for proper interoperability between the Ethernet interface on the TWR-SER and the TWR-K60D100M.

Table 4. Ethernet operation jumper settings

Tower Module	Jumper	Setting
TWR-K60D100M	J10	2-3
TWR-SER	J2	3-4
TWR-SER	J3	2-3
TWR-SER	J12	9-10

2.11 USB

The K60D100M features a USB full-speed/low-speed OTG/Host/Device controller with built-in transceiver. The TWR-K60D100M routes the USB D+ and D- signals from the K60 MCU to the Primary Connector, allowing the connection to external USB connectors or additional circuitry on a Tower peripheral module.

The TWR-SER module included as part of the TWR-K60D100M-KIT provides a USB OTG/Host/Device interface with a mini-AB USB connector. There are many configuration options that can be selected to evaluate different USB modes of operation. By default, the TWR-SER is configured for USB Device operation.

The following jumper configuration options allow the TWR-K60N512 to utilize the TWR-SER USB interface in Device mode using a single USB cable for the entire Kit:

TWR-SER:
J3: position 2-3 [provides 50MHz to TWR-K60N512]
J10: position 2-3 [power for Tower System from USB connector on Serial board]
J16: position 3-4 [get 5V from USB cable]

TWR-K60D100M:
J4: ON [5V from TWR-SER to K60 VREGIN]
J10: position 2-3 [receive 50MHz from TWR-SER]

Please refer to the documentation included with the TWR-SER for more information on the configuration options.

2.12 Secure Digital Card Slot

A Secure Digital (SD) card slot is available on the TWR-K60D100M connected to the SD Host Controller (SDHC) signals of the K60 MCU. This slot will accept SD memory cards as well as Secure Digital Input Output (SDIO) cards. Refer to Table 6 “I/O Connectors and Pin Usage Table” for the SDHC signal connection details.

2.13 External Bus Interface – FlexBus

The K60 device features a multi-function external bus interface called the FlexBus interface controller capable of interfacing to slave-only devices. The FlexBus interface is not used directly on the TWR-K60D100M. Instead, a subset of the FlexBus is connected to the Primary Connector so that the external bus can access devices on Tower peripheral modules. Refer to Table 7 “TWR-K60D100M Primary Connector Pinout” and sheet 8 of the TWR-K60D100M schematics for more details.

3 Jumper Table

There are several jumpers on the TWR-K60D100M that provide configuration selection and signal isolation. Refer to the following table for details. The default installed jumper settings are shown in bold with asterisks.

Table 5. TWR-K60D100M Jumper Table

Jumper	Option	Setting	Description
J1	Drive RSTOUT Selection	***1-2***	Use PTE27 to drive RSTOUT
		2-3	Use PTB8 to drive RSTOUT
J2	Infrared Transmitter Connection	ON	Connect PTD7/CMT_IRO/UART0_TX to IR Transmitter (D5)
		OFF	Disconnect PTD7/CMT_IRO/UART0_TX from IR Transmitter (D5)
J4	USB VREGIN Power Connection	***ON***	Connect USB0_VBUS from Primary Elevator (A57) to VREGIN
		OFF	Disconnect VREGIN from Primary Elevator
J5	Potentiometer Connection	***ON***	Connect potentiometer to ADC1_DM1
		OFF	Disconnect potentiometer from ADC1_DM1
J7	Oscillator Selection	ON	Disable on-board oscillator
		OFF	Enable on-board oscillator
J10	Clock Input Source Selection	***1-2***	Connect main EXTAL to on-board 50 MHz clock
		2-3	Connect EXTAL to CLKIN0 signal on Primary Elevator (B24)
		3-4	Connect CLKIN0 signal on Primary Elevator (B24) to ENET_CLKIN
J14	MCU Power Connection	***1-2***	Connect on-board 3.3V or 1.8V (V_BRD) supply to MCU
		2-3	Isolate MCU from power supply (allows for external supply or power measurements)
J12	VBAT Power Selection	***1-2***	Connect VBAT to on-board 3.3V or 1.8V supply
		2-3	Connect VBAT to the higher voltage between MCU supply (MCU_PWR) or coin-cell supply (VBATD)
J18	OSJTAG Mode Selection	ON	OSJTAG bootloader mode (OSJTAG firmware reprogramming)
		OFF	Debugger mode
J15	JTAG Power Connection	ON	Connect on-board 5V supply to JTAG port (supports powering board from external JTAG probe)
		OFF	Disconnect on-board 5V supply from JTAG port

4 Input/Output Connectors and Pin Usage Table

The following table provides details on which K60D100M pins are using to communicate with the LEDs, switches, and other I/O interfaces onboard the TWR-K60D100M.

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. Take care to avoid attempted simultaneous usage of mutually exclusive features.

Table 6. I/O Connectors and Pin Usage Table

Feature	Connection	Port Pin	Pin Function
OSJTAG USB-to-serial Bridge	OSJTAG Bridge RX Data	PTE9	UART5_RX
	OSJTAG Bridge TX Data	PTE8	UART5_TX
SD Card Slot	SD Clock	PTE2	SDHC0_DCLK
	SD Command	PTE3	SDHC0_CMD
	SD Data0	PTE1	SDHC0_D0
	SD Data1	PTE0	SDHC0_D1
	SD Data2	PTE5	SDHC0_D2
	SD Data3	PTE4	SDHC0_D3
	SD Card Detect	PTE28	PTE28
	SD Write Protect	PTE27	PTE27
Infrared Port	IR Transmit	PTD7	CMT_IRO
	IR Receive	PTC6	CMP0_IN0
Pushbuttons	SW1 (IRQ0)	PTA19	PTA19
	SW2 (IRQ1)	PTE26	PTE26
	SW3 (RESET)	RESET_b	RESET_b
Touch Pads	E1 / Touch	PTA4	TSI0_CH5
	E2 / Touch	PTB3	TSI0_CH8
	E3 / Touch	PTB2	TSI0_CH7
	E4 / Touch	PTB16	TSI0_CH9
LEDs	E1 / Orange LED	PTA11	PTA11
	E2 / Yellow LED	PTA28	PTA28
	E3 / Green LED	PTA29	PTA29
	E4 / Blue LED	PTA10	PTA10
Potentiometer	Potentiometer (R71)	—	ADC1_DM1
Accelerometer	I2C SDA	PTD9	I2C0_SDA
	I2C SCL	PTD8	I2C0_SCL
	IRQ	PTD10	PTD10
General Purpose TWRPI Socket	TWRPI AN0 (J4 Pin 8)	—	ADC0_DP0/ADC1_DP3
	TWRPI AN1 (J4 Pin 9)	—	ADC0_DM0/ADC1_DM3
	TWRPI AN2 (J4 Pin 12)	—	ADC1_DP0/ADC0_DP3
	TWRPI ID0 (J4 Pin 17)	—	ADC0_DP1
	TWRPI ID1 (J4 Pin 18)	—	ADC0_DM1
	TWRPI I2C SCL (J5 Pin 3)	PTD8	I2C0_SCL
	TWRPI I2C SDA (J5 Pin 4)	PTD9	I2C0_SDA
	TWRPI SPI MISO (J5 Pin 9)	PTD14	SPI2_SIN
	TWRPI SPI MOSI (J5 Pin 10)	PTD13	SPI2_SOUT

Feature	Connection	Port Pin	Pin Function
	TWRPI SPI SS (J5 Pin 11)	PTD15	SPI2_PCS0
	TWRPI SPI CLK (J5 Pin 12)	PTD12	SPI2_SCK
	TWRPI GPIO0 (J5 Pin 15)	PTD10	PTD10
	TWRPI GPIO1 (J5 Pin 16)	PTB8	PTB8
	TWRPI GPIO2 (J5 Pin 17)	PTB9	PTB9
	TWRPI GPIO3 (J5 Pin 18)	PTA19	PTA19
	TWRPI GPIO4 (J5 Pin 19)	PTE26	PTE26
Touch Pad TWRPI Socket	Electrode 0 (J3 Pin 3)	PTB0	TSI0_CH0
	Electrode 1 (J3 Pin 5)	PTB1	TSI0_CH6
	Electrode 2 (J3 Pin 7)	PTB2	TSI0_CH7
	Electrode 3 (J3 Pin 8)	PTB3	TSI0_CH8
	Electrode 4 (J3 Pin 9)	PTC0	TSI0_CH13
	Electrode 5 (J3 Pin 10)	PTC1	TSI0_CH14
	Electrode 6 (J3 Pin 11)	PTC2	TSI0_CH15
	Electrode 7 (J3 Pin 12)	PTA4	TSI0_CH5
	Electrode 8 (J3 Pin 13)	PTB16	TSI0_CH9
	Electrode 9 (J3 Pin 14)	PTB17	TSI0_CH10
	Electrode 10 (J3 Pin 15)	PTB18	TSI0_CH11
	Electrode 11 (J3 Pin 16)	PTB19	TSI0_CH12
	TWRPI ID0 (J3 Pin 17)	—	ADC1_DP1
	TWRPI ID1 (J3 Pin 18)	—	ADC1_SE16

5 Tower Elevator Connections

The TWR-K60D100M features two expansion card-edge connectors that interface to the Primary and Secondary Elevator boards in a Tower system. The Primary Connector (comprised of sides A and B) is utilized by the TWR-K60D100M while the Secondary Connector (comprised of sides C and D) only makes connections to the GND pins. Table 7 provides the pinout for the Primary Connector.

Table 7. TWR-K60D100M Primary Connector Pinout

Pin #	Side B		Pin #	Side A	
	Name	Usage		Name	Usage
B1	**5V**	**5.0V Power**	A1	**5V**	**5.0V Power**
B2	**GND**	**Ground**	A2	**GND**	**Ground**
B3	**3.3V**	**3.3V Power**	A3	**3.3V**	**3.3V Power**
B4	ELE_PS_SENSE	Elevator Power Sense	A4	**3.3V**	**3.3V Power**
B5	**GND**	**Ground**	A5	**GND**	**Ground**
B6	**GND**	**Ground**	A6	**GND**	**Ground**
B7	SDHC_CLK / SPI1_CLK	PTE2	A7	SCL0	PTD8
B8	SDHC_D3 / SPI1_CS1_b		A8	SDA0	PTD9
B9	SDHC_D3 / SPI1_CS0_b	PTE4	A9	GPIO9 / CTS1	PTC19
B10	SDHC_CMD / SPI1_MOSI	PTE1	A10	GPIO8 / SDHC_D2	PTE5
B11	SDHC_D0 / SPI1_MISO	PTE3	A11	GPIO7 / SD_WP_DET	PTE27

Pin #	Side B		Pin #	Side A	
	Name	Usage		Name	Usage
B12	ETH_COL		A12	ETH_CRS	
B13	ETH_RXER	PTA5	A13	ETH_MDC	PTB1
B14	ETH_TXCLK		A14	ETH_MDIO	PTB0
B15	ETH_TXEN	PTA15	A15	ETH_RXCLK	
B16	ETH_TXER		A16	ETH_RXDV	PTA14
B17	ETH_TXD3		A17	ETH_RXD3	
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	PTC18	A21	SSI_MCLK	PTE6
B22	GPIO2 / SDHC_D1	PTE0	A22	SSI_BCLK	PTE12
B23	GPIO3	PTE28	A23	SSI_FS	PTE11
B24	CLKIN0	PTA18	A24	SSI_RXD	PTE7
B25	CLKOUT1	PTE26	A25	SSI_TXD	PTE10
B26	**GND**	**Ground**	A26	**GND**	**Ground**
B27	AN7	PTB7	A27	AN3	PGA0_DP/ADC0_DP0/ADC1_DP3
B28	AN6	PTB6	A28	AN2	PGA0_DM/ADC0_DM0/ADC1_DM3
B29	AN5	PTB5	A29	AN1	PGA1_DP/ADC1_DP0/ADC0_DP3
B30	AN4	PTB4	A30	AN0	PGA1_DM/ADC1_DM0/ADC0_DM3
B31	**GND**	**Ground**	A31	**GND**	**Ground**
B32	DAC1	DAC1_OUT	A32	DAC0	DAC0_OUT
B33	TMR3		A33	TMR1	PTA9
B34	TMR2	PTD6	A34	TMR0	PTA8
B35	GPIO4	PTB8	A35	GPIO6	PTB9
B36	**3.3V**	**3.3V Power**	A36	**3.3V**	**3.3V Power**
B37	PWM7	PTA2	A37	PWM3	PTA6
B38	PWM6	PTA1	A38	PWM2	PTC3
B39	PWM5	PTD5	A39	PWM1	PTC2
B40	PWM4	PTA7	A40	PWM0	PTC1
B41	CANRX0	PTE25	A41	RXD0	PTE25
B42	CANTX0	PTE24	A42	TXD0	PTE24
B43	1WIRE		A43	RXD1	PTC16
B44	SPI0_MISO	PTD14	A44	TXD1	PTC17
B45	SPI0_MOSI	PTD13	A45	VSS	VSSA
B46	SPI0_CS0_b	PTD11	A46	VDDA	VDDA
B47	SPI0_CS1_b	PTD15	A47	VREFA1	VREFH
B48	SPI0_CLK	PTD12	A48	VREFA2	VREFL
B49	**GND**	**Ground**	A49	GND	Ground
B50	SCL1	PTD8	A50	GPIO14	
B51	SDA1	PTD9	A51	GPIO15	
B52	GPIO5 / SD_CARD_DET	PTE28	A52	GPIO16	
B53	USB0_DP_PDOWN		A53	GPIO17	
B54	USB0_DM_PDOWN		A54	USB0_DM	USB0_DM
B55	IRQ_H	PTA24	A55	USB0_DP	USB0_DP
B56	IRQ_G	PTA24	A56	USB0_ID	
B57	IRQ_F	PTA25	A57	USB0_VBUS	VREGIN
B58	IRQ_E	PTA25	A58	TMR7	
B59	IRQ_D	PTA26	A59	TMR6	

Pin #	Side B		Pin #	Side A	
	Name	Usage		Name	Usage
B60	IRQ_C	PTA26	A60	TMR5	
B61	IRQ_B	PTA27	A61	TMR4	
B62	IRQ_A	PTA27	A62	RSTIN_b	RESET_b
B63	EBI_ALE / EBI_CS1_b	PTD0	A63	RSTOUT_b	RESET_b
B64	EBI_CS0_b	PTD1	A64	CLKOUT0	PTC3
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	**3.3V**	**3.3V Power**	A82	**3.3V**	**3.3V Power**