Freescale Semiconductor, Inc.
User's Guide

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TWR-KM34Z75M Tower Module User's Guide

1. Introduction

The TWR-KM34Z75M microcontroller module is designed to work either in a standalone mode or as a part of the Freescale Tower System development board platform, a modular development platform that enables rapid prototyping and tool re-use through reconfigurable hardware. You can take your design to the next level and begin constructing your Tower System today. For additional Tower System microcontroller modules and compatible peripheral, visit www.freescale.com/tower. For TWR-KM34Z75M specific information and updates, visit www.freescale.com/TWR-KM34Z75M.

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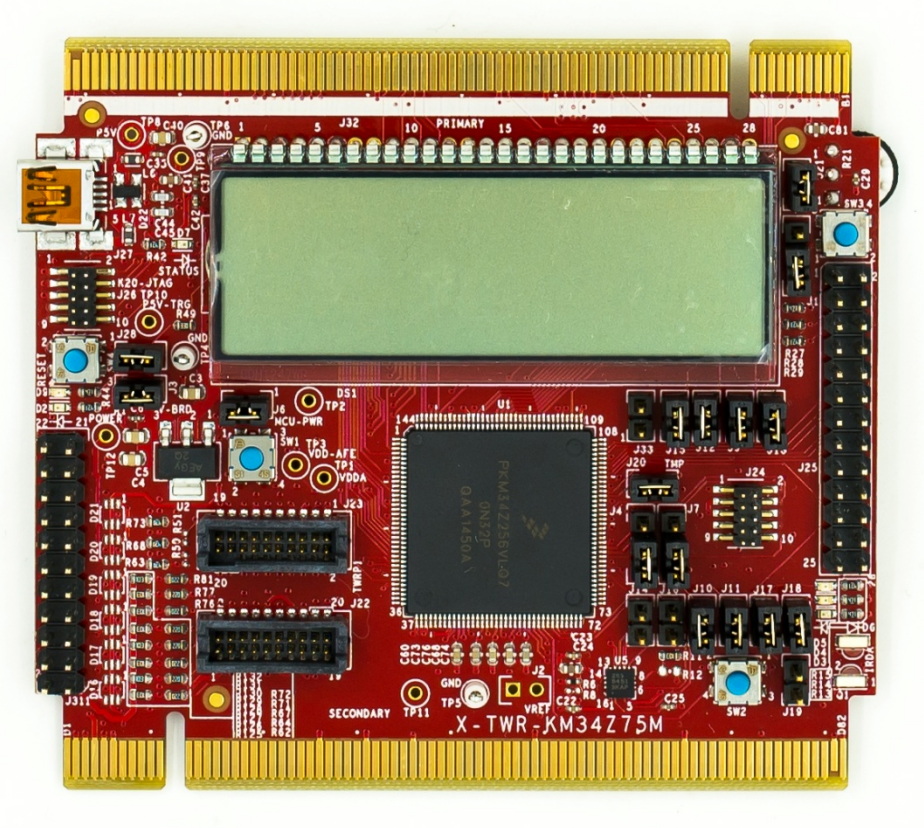

Figure 1. Freescale Tower System development board platform overview

2. Contents

The TWR-KM34Z75M contents include:

- TWR-KM34Z75M board assembly.
- A(M) to MINI B(M) USB cable for debug interface and power or USB to serial interface for TWR-KM34Z75M.
- Quick Start Guide.

3. TWR-KM34Z75M features

- Tower-compatible microcontroller module.
- MKM34Z256VLQ7 MCU (75 MHz, 256 KB Flash, 32 KB RAM, low power, LQFP144 package).
- USB interface with Mini-B USB connector.
- Large 160-seg. glass LCD.
- On-board debug circuit, open source JTAG/SWD (OpenSDA) with virtual serial port.
- Three-axis accelerometer/anti tamper tilt sensor (MMA8451Q).
- Four user-controllable LEDs.
- Two user pushbutton switches for GPIO interrupts.

- One user pushbutton switch for tamper detection.
- One user pushbutton switch for MCU reset.
- Potentiometer.
- Headers for direct GPIO and ADC access.
- External Tamper pins.
- Independent, battery-operated power supply for Real Time Clock (RTC) and tamper detection modules.
- IRDA support.
- NTC temperature sensor.
- General-purpose Tower Plug-in (TWRPI) socket.

4. Get to know the TWR-KM34Z75M

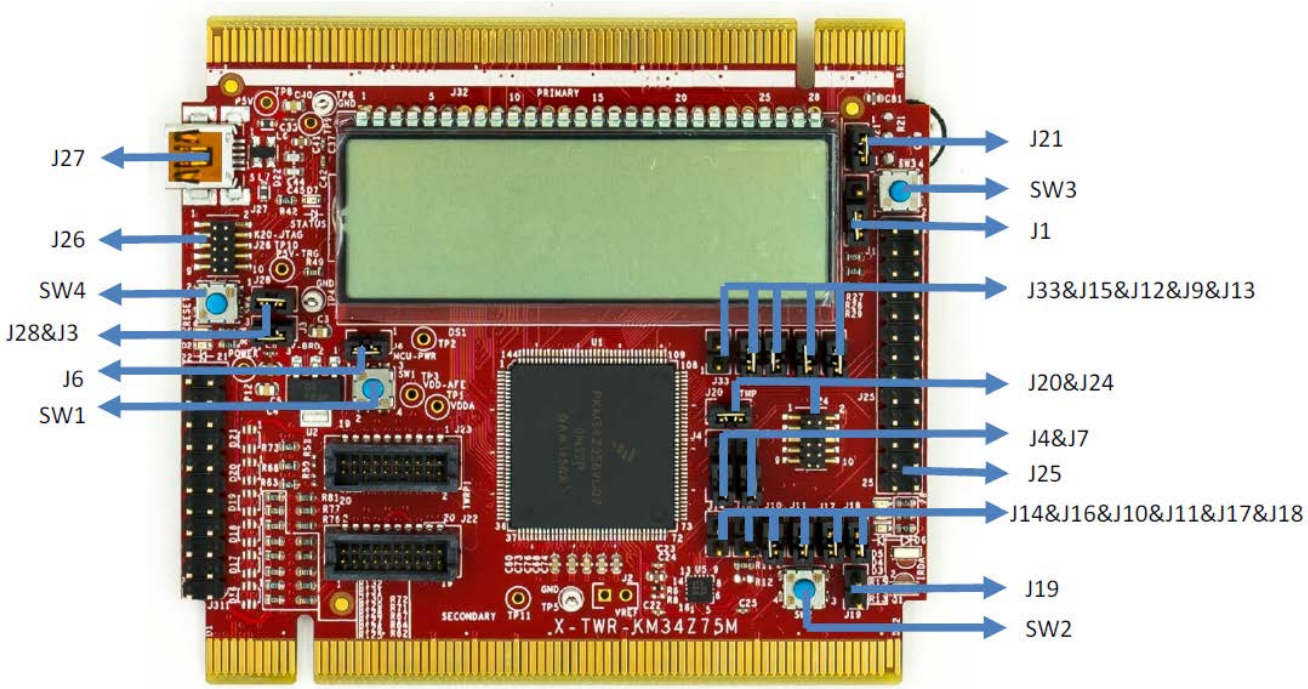

Figure 2. Front side of TWR-KM34Z75M module (TWRPI devices not shown)

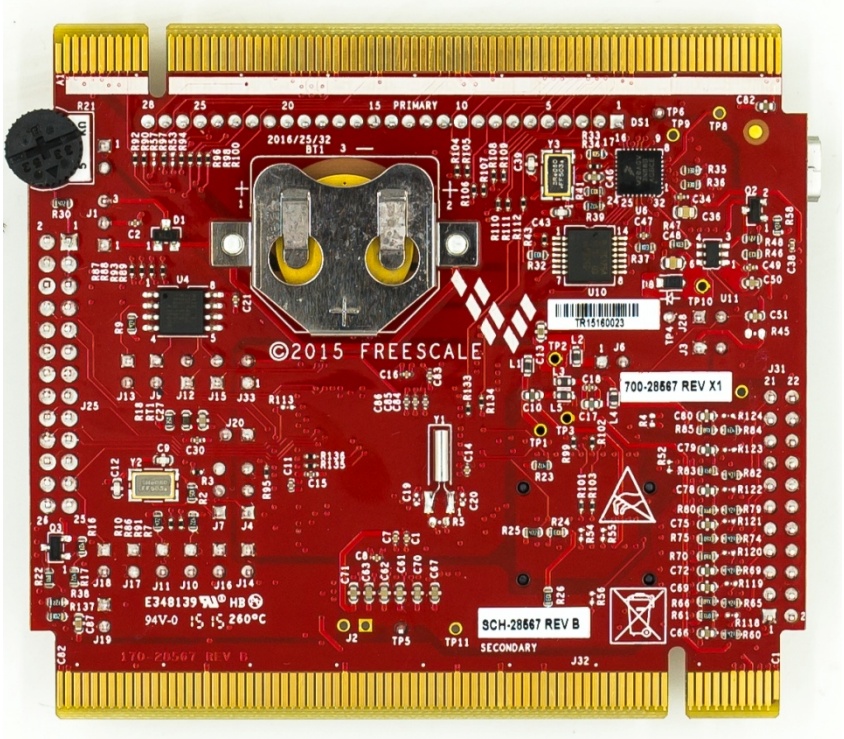

Figure 3. Back side of TWR-KM34Z50M module

5. Hardware description

The TWR-KM34Z75M is a Tower MCU Module featuring the MKM34Z256VLQ7 a Kinetis-M family (metering) microcontroller in a LQFP144 package with Sigma-Delta ADC and tamper detection with a secure real-time clock with independent battery supply. It is intended for use in the Freescale Tower System development board platform but can also operate in a standalone mode. An on-board OpenSDA debug circuit provides a SWD programming interface, USB to serial interface, and power supply input through a single mini-USB connector. An optional on-board sinus waveform generator allows emulating of electricity net signals for software development purposes.

5.1. Tower card block diagram

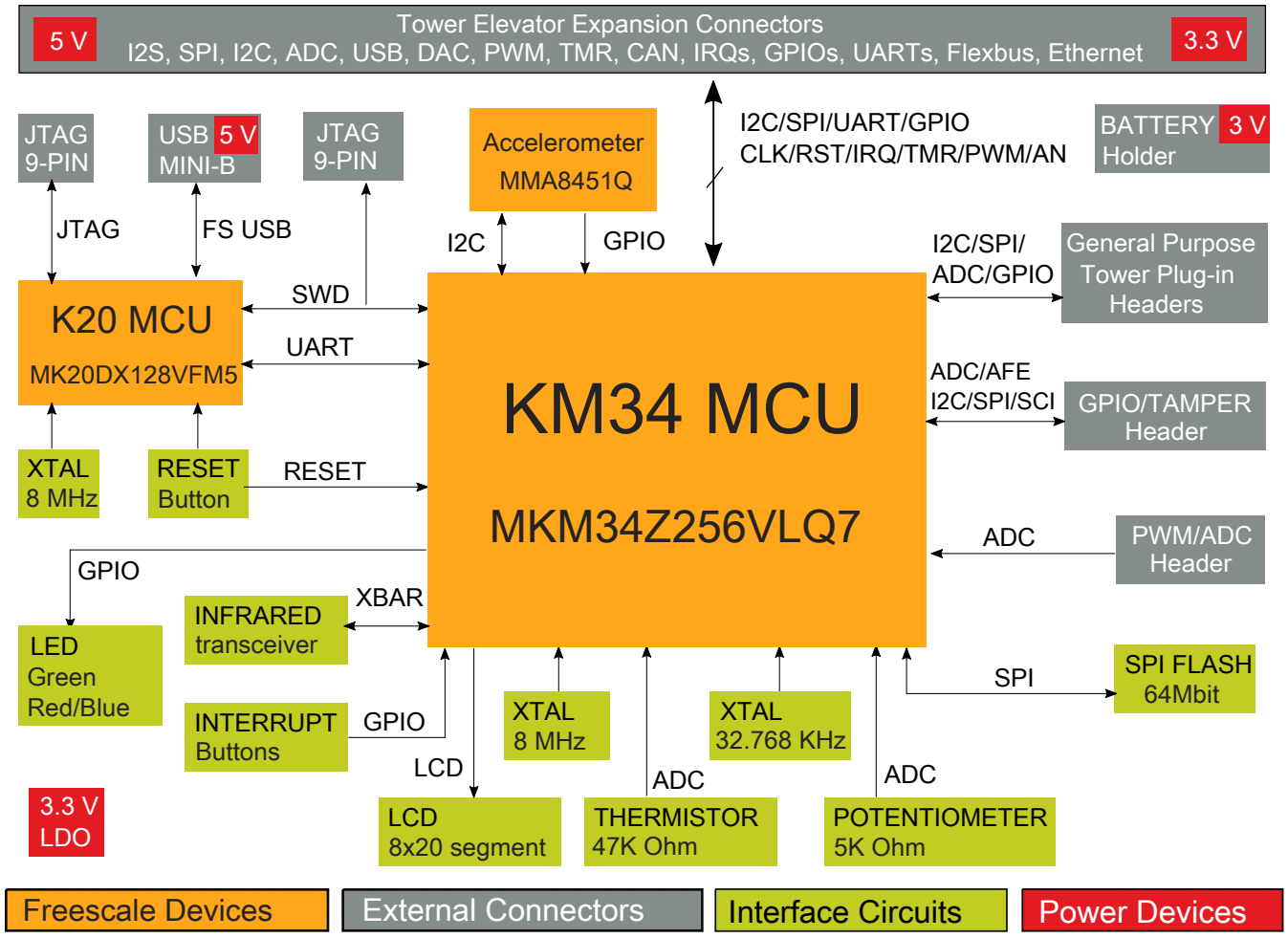

Figure 4. Block Diagram of TWR-KM34Z75M

5.2. Microcontroller

The KM family devices are 32-bit MCUs in 90nm Thin Film Storage (TFS) embedded flash technology. These devices are primarily focused to serve the metering markets for smart single-phase energy meters (EU, India, and China) and two-phase meters (US, Japan).

The KM family targets the EN 50470-1, EN 50470-3, IEC 62053-21, IEC 62053-22, and IEC 62053-23 class of meters.

The KM devices are based on 32-bit ARM Cortex M0+ core with integrated analog front end (AFE). CPU clock rates on these devices can reach up to75 MHz. The KM family of devices includes highly accurate sigma delta (SD) ADC, programmable gain amplifier (PGA), high-precision internal voltage reference, Flash, RAM, phase compensation logic block, and other peripherals. The KM family provides tamper detection and accurate real-time clock on all devices.

5.3. Clocking

The Kinetis-M start up from an internal reference clock = 2MHz core and 1MHz bus clock. The microcontroller can boot in LPBOOT (Low Power Boot) mode, core, and system clk. is then divided by eight.

The CPU software can enable the RTC oscillator connected to (EXTAL0/XTAL0) if desired, or use the second high frequency oscillator connected to (EXTAL1/XTAL1).

The RTC crystal oscillator range is: 31.25 kHz to 39.0625 kHz (typ. 32.768 kHz).

The high frequency crystal oscillator range: 1 to 32 MHz.

Optionally, you can also use two internal clock references (IRC): fast = 4MHz and slow = 32.768 kHz.

You can increase the CPU frequency by using the FLL (DCO) or PLL clock features. In most of the applications, usage of the single 32 kHz external crystal is considered. PLL with a fixed multiplier = x375 is used for clocking the AFE running at ~12.2 MHz. The FLL is used for clocking the CPU core (up to 75 MHz) and the rest of the microcontroller modules.

NOTE

For the best AFE results, usage of the precise external clock is recommended.

5.4. System power

When installed into a Tower System, you can power the TWR-KM34Z75M from either an on-board source or from another source in the assembled Tower System.

In a stand-alone operation, the main power source (5.0 V) for the TWR-KM34Z75M module is derived from either the OpenSDA USB mini-B connector (J14). A low-dropout regulator provides 3.3 V supply voltage from the 5.0 V input voltage.

5.5. iRTC tamper detection and RTC VBAT

The tamper detection module and the Real Time Clock (RTC) module on the MKM34Z256VLQ7 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 microcontroller. The TWR-KM34Z75M provides a battery receptacle for a coin cell battery that is used as the VBAT supply. The receptacle can accept common 20-mm diameter 3 V lithium coin cell batteries.

5.6. Debug interface

There are two debug interface options provided: the on-board OpenSDA circuit and an external ARM JTAG/SWD connector. The ARM-JTAG/SWD connector is a standard 2x5-pin connector providing an external debugger cable with access to the JTAG interface of the MKM34Z256VLQ7. Alternatively, the on-board OSJTAG debug interface is used to access the debug interface of the MKM34Z256VLQ7.

5.7. OpenSDA

An on-board MK20DX128VMF5 based OpenSDA circuit provides a SWD debug interface to the MKM34Z256VLQ7. A standard USB A male to mini-B male cable (provided) is used for debugging via the USB connector (J14). The OpenSDA interface also provides a USB to serial bridge. Drivers for the OpenSDA 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/opensda.

5.8. Title sensor / Accelerometer

MMA8451Q digital accelerometer is connected to the MKM34Z256VLQ7 MCU through an I2C interface (I2C0) and GPIO signals.

5.9. Potentiometer, temp sensor, push buttons, and LEDs

The TWR-KM34Z75M also features:

- A potentiometer connected to an ADC input signal (PTF1/ADC0_SE8).
- Temperature sensor (NTC) connected to an ADC input signal (PTF2/ADC0_SE9).
- Two pushbutton switches (SW1 and SW2 connected to PTA4 and PTD1, respectively).
- IRDA interface through PTL2, PTD0.
- Three user-controllable LEDs connected to GPIO signals:
  - Green LED (D3) to PTJ3.
  - Red LED (D4) to PTJ4.
  - Orange LED (D5) to PTD0.

5.10. USB to Serial interface

The on-board K20 OpenSDA circuit supports the USB to Serial port emulation through the USB CDC Serial Class device.

This means whenever the Tower card is connected to the computer USB port, the board is recognized as a new virtual COM port (COM5 or COM6 in the most of the cases). You can connect the embedded application running on KM34 device and see the output on the PC running the serial terminal application.

6. TWR-KM34Z575M jumper options and headers

The following is a list of all the jumper options on the TWR-KM34Z75M, the default installed jumper settings are indicated in Table 1 by **BOLD** text.

Table 1. Jumpers and Switch options

Option	Jumper	Setting	Description
MCU power connection	J1	**1-2**	Connect VBAT to on-board 3.3 V supply
		2-3	Connect VBAT to the higher voltage between MCU supply (MCU_PWR) or VBAT
SPI NOR flash	J9	**ON**	Connect MCU SPI signal to NOR flash
		OFF	Disconnect MCU SPI signal to NOR flash
	J12	**ON**	Connect MCU SPI signal to NOR flash
		OFF	Disconnect MCU SPI signal to NOR flash
	J13	**ON**	Connect MCU SPI signal to NOR flash
		OFF	Disconnect MCU SPI signal to NOR flash
	J15	**ON**	Connect MCU SPI signal to NOR flash
		OFF	Disconnect MCU SPI signal to NOR flash
Orange LED drive	J17	**ON**	Connect MCU GPIO to drive orange LED
		OFF	Disconnect MCU GPIO to drive orange LED
IRDA transmit	J18	**ON**	Connect MCU IRDA transmit signal
		OFF	Disconnect MCU IRDA transmit signal
IRDA receive	J19	**ON**	Connect MCU IRDA receive signal
		OFF	Disconnect MCU IRDA receive signal
MCU_PWR selection	J3	**ON**	MCU powered from V_BRD 3.3V on board reg.
		OFF	MCU can be supplied by ext. Voltage connected to J6 - pin 1
Analog power enable	J7	**ON**	Connect Analog voltages to V_BRD
		OFF	external VDDA can be applied
Pot. enable	J21	**ON**	Connect PTF1/ADC0_SE8 to pot. R21
		OFF	Disconnect PTF1/ADC0_SE8 to pot. R21
Temp. sensor enable	J9	**ON**	Connect PTF0/AD7 to temp. sensor
		OFF	Disconnect PTF0/AD7 to temp. sensor
OpenSDA Reset enabled	J28	**ON**	KM34 Reset input driven by K20 OpenSDA
		OFF	KM34 Reset input isolated from OpenSDA
8M Crystal	J4	**1-2**	Connect MCU EXTAL PIN to crystal
		2-3	Connect MCU EXTAL PIN to external clock
	J7	**1-2**	Connect MCU XTAL PIN to crystal
		2-3	Connect MCU XTAL pin to GND

The GPIO Header J25, in Table 2, contains tamper pins, CLK out check signal, and most of the peripheral interface BUS pins such as SPI, I2C, and SCI. AFE external modulator signals are also available on this header, to interface the customized board with the external AFE modulator. Most of the pins are used normally as GPIO.

The header J31 in Table 3 is the Analog Inputs / Generator out header contains the auxiliary signal generator input interface, analog inputs of SD, and SAR ADCs. The generator signals are generated outside and connected to J31, which are converted into ADC signals and simulate the meter current and voltage waveform inputs.

Table 2. GPIO Header (J25) signal connections

MCU Signal	J25 PIN		MCU Signal
SW3 (Tamper switch)	1	2	SW3 to TAMPER0 (when closed)
SW3 (Tamper switch)	3	4	SW3 to TAMPER1(when closed)
SW3 (Tamper switch)	5	6	SW3 to TAMPER2(when closed)
V_BRD	7	8	PTK5/UART1_RX
PTK6/UART1_TX	9	10	GND
PTL0/I2C0_SDA	11	12	PTK7/I2C0_SCL
PTF6/SPI1_MOSI	13	14	PTF5/SPI1_MISO
PTF4/SPI1_SCK	15	16	PTF3/SPI1_PCS0
PTD0/CMP0_IN0	17	18	PTF7/CLKOUT
PTL1/XBAR0_IN10	19	20	PTG0/QTMR0_TMR1/LPTMR0_ALT3
PTK4/AFE_CLK	21	22	PTK2/UART0_TX/ADC0_SE14
PTL2/XBAR0_OUT10	23	24	PTK3/UART0_RX/ADC0_SE15
VSSA	25	26	GND

Table 3. Analog Inputs / Generator out (J31)

MCU signal	J31 PIN		MCU signal
EXT_PWM0	1	2	EXT_SD_ADP0
VSSA_AFE	3	4	EXT_SD_ADM0
EXT_PWM1	5	6	EXT_SD_ADP1
VSSA_AFE	7	8	EXT_SD_ADM1
EXT_PWM2	9	10	EXT_SD_ADP2
VSSA_AFE	11	12	EXT_SD_ADM2
EXT_PWM3	13	14	EXT_SD_ADP3
VSSA_AFE	15	16	EXT_SD_ADM3
EXT_PWM4	17	18	EXT_SAR_AD0
EXT_PWM5	19	20	EXT_SAR_AD1
EXT_PWM6	21	22	EXT_SAR_AD2

6.1. General-purpose Tower plug-in (TWRPI) socket

The TWR-KM34Z75M features a socket (J22 and J23) that can accept a variety of different Tower plug-in modules featuring sensors, RF transceivers, and other peripherals. The General-Purpose TWRPI socket provides access to I2C, SPI, IRQs, GPIOs, timers, analog conversion signals, TWRPI ID signals, reset, and voltage supplies. The pin-out for the TWRPI Socket is defined in Table 4.

Table 4. General Purpose TWRPI socket pinout

J22	
Pin	**Description**
1	5 V VCC
2	3.3 V VCC
3	GND
4	3.3 V 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

J23	
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	UART: UART_RX or GPIO: GPIO2
18	UART: UART_TX or GPIO: GPIO3
19	UART: UART_CTS or GPIO: GPIO4/Timer
20	UART: UART_RTS or GPIO: GPIO5/Timer

7. Reference documents

For more information on the Kinetis family, Tower System, and MCU Modules, see the following documents. These can be found in the documentation section of http://www.freescale.com/TWR-KM34Z75M or http://www.freescale.com/kinetis.

- TWR-KM34Z75M-SCH: Schematics (document TWR-KM34Z75M-SCH)
- TWR-KM34Z75M-PWB: Design Package (document TWR-KM34Z75M-PWB)
- KM34P144M75SF0RM: Reference Manual (document KM34P144M75SF0RM)
- Tower Configuration Tool (document TOWER_CONFIG_TOOL)
- Tower Mechanical Drawing (document 900-76126_TWR-MECHDRW)

8. Revision history

Table 5. Revision history

Revision number	Date	Substantive changes
1	06/2015	Update to make the call-outs in Figure 2 fully visible
0	06/2015	Initial release

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