NXP Semiconductors
User's Guide

Document identifier: TWRKM35Z75MUG
Rev. 0, 05/2020

TWR-KM35Z75M Tower Module

Contents

Chapter 1
TWR-KM35Z75M

The TWR-KM35Z75M MCU module is designed to work either in a stand-alone mode or as a part of the 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 building your Tower System today by visiting www.nxp.com/Tower for additional Tower System MCU modules and compatible peripherals. For TWR-KM35Z75M specific information and updates, visit www. nxp .com/TWR-KM35Z75M

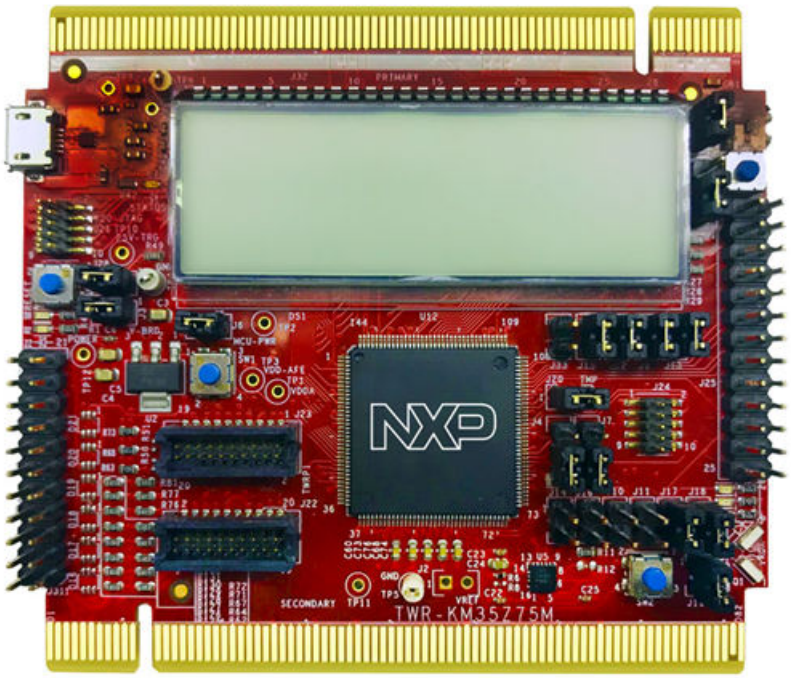

Figure 1. Tower System overview

Chapter 2
TWR-KM35Z75M features

- Tower System-compatible MCU module
- MKM35Z512VLQ7 MCU (75 MHz, 512 KB Flash, 64 KB RAM, low power, LQFP144 package)
- USB interface with Micro-B USB connector
- Large 160-segment glass LCD
- On-board debug circuit: open-source SWD (OpenSDA) with virtual serial port
- Three-axis accelerometer/anti-tamper tilt sensor (MMA8451Q)
- Three user-controllable LEDs
- Two user push-button switches for GPIO interrupts
- One user push-button switch for tamper detection
- One user push-button 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

Chapter 3
Getting to know the TWR-KM35Z75M module

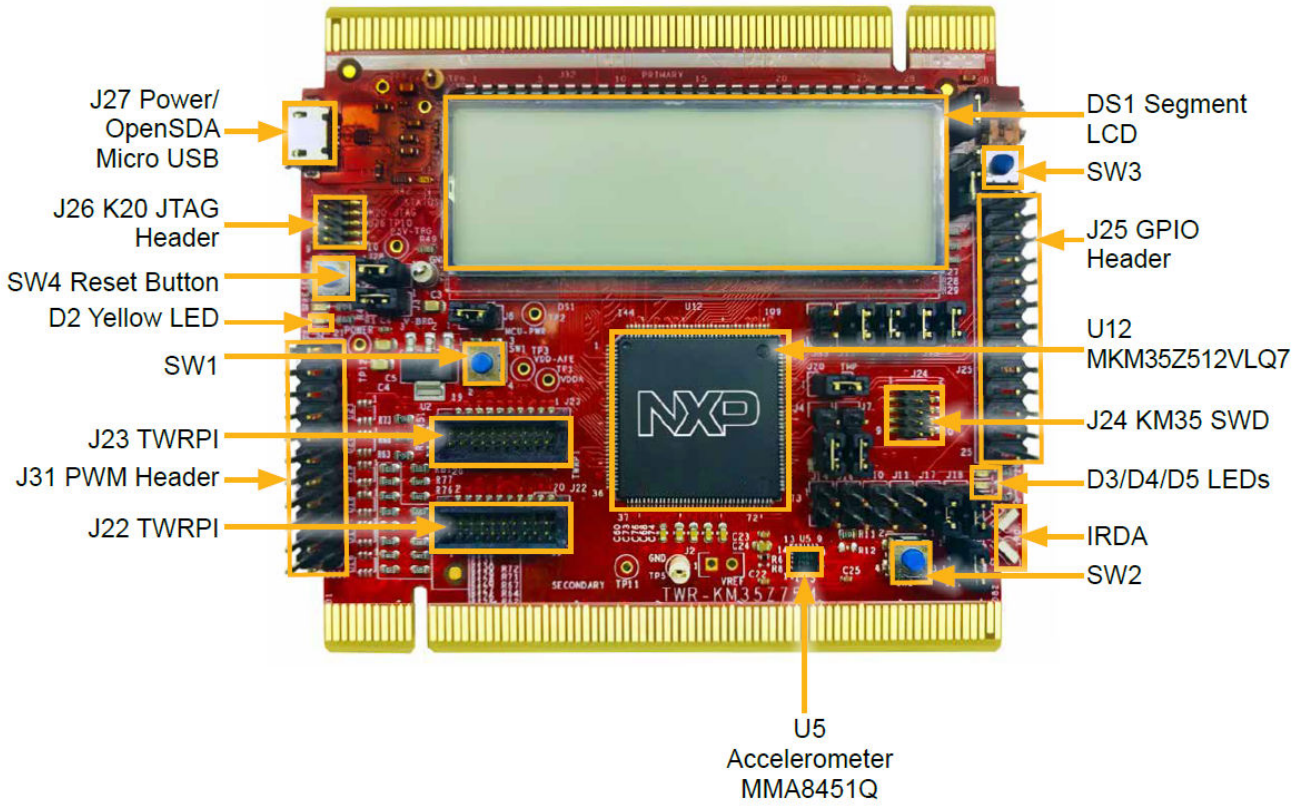

Figure 2. Front side of the TWR-KM35Z75M module

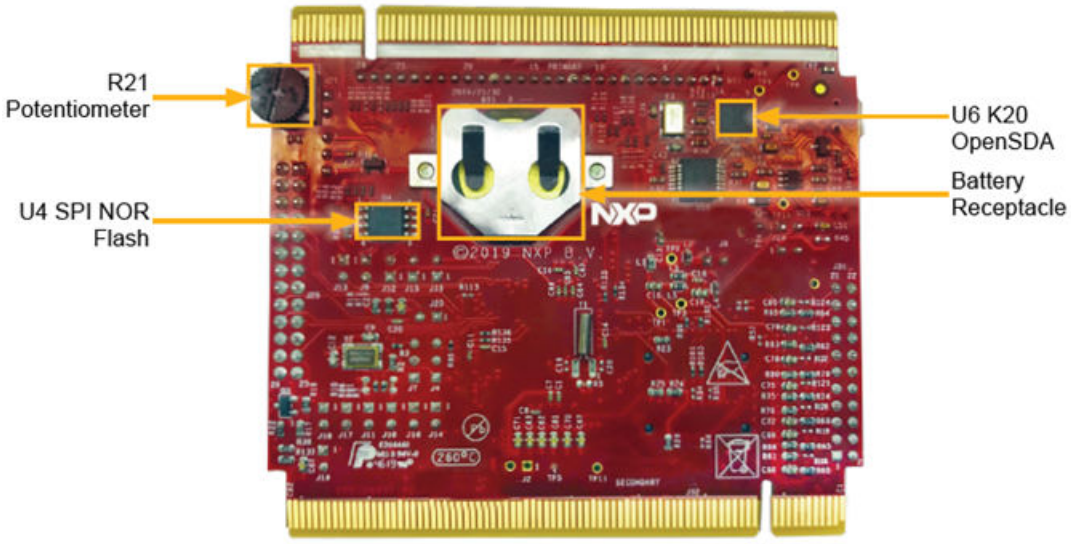

Figure 3. Back side of the TWR-KM35Z50M module

Chapter 4
Reference documents

See the documents listed below for more information on the Kinetis family, the Tower System, and the MCU modules. The following resources are in the documentation section at http://www.nxp.com/TWR-KM35Z75M:

- TWR-KM35Z75M-SCH: schematics
- TWR-KM35Z75M-PWA: design package
- MKM35Z512VLQ7RM: reference manual

NOTE

Some documents may be temporarily unavailable at the time this document is released.

Chapter 5
Hardware description

The TWR-KM35Z75M is a Tower System MCU module featuring the MKM35Z512VLQ7, a Kinetis-M family (metering) MCU in a LQFP144 package with a sigma-delta ADC and tamper detection with a secure real-time clock with an independent battery supply. It is intended for use in the NXP Tower System, but it can also operate on its own. An on-board OpenSDA debug circuit provides SWD programming interface, USB to serial interface, and power supply input through a single micro-USB connector. An optional on-board sinus waveform generator allows to emulate the electricity net signals for software development purposes.

5.1 Tower System card block diagram

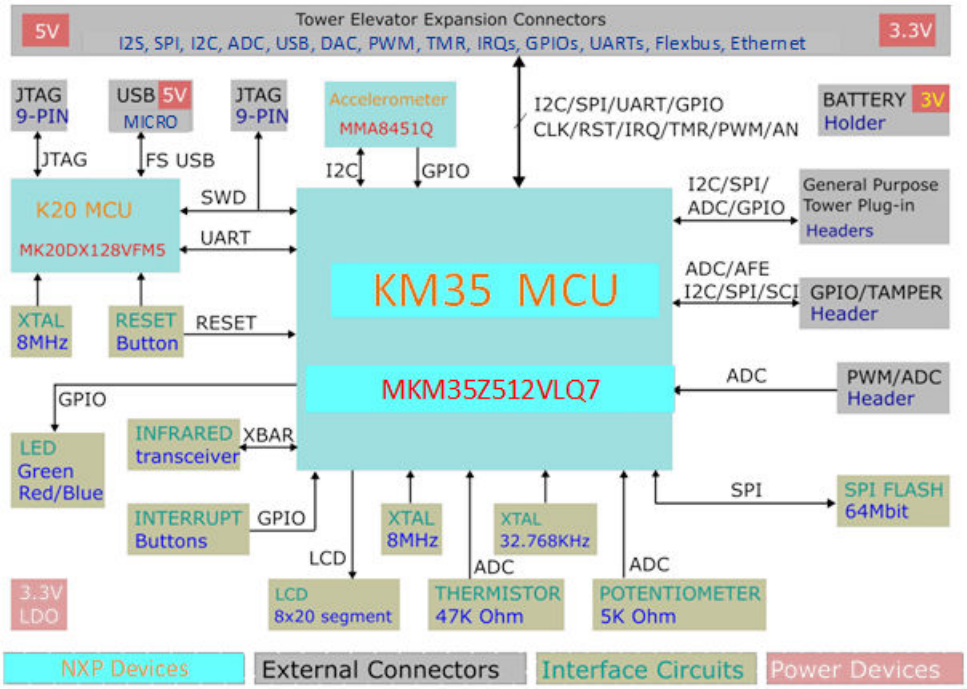

Figure 4. TWR-KM35Z75M block diagram

5.2 MCU

The KM family devices are 32-bit MCUs in 90-nm a 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 classes of meters. The KM devices are based on a 32-bit Arm® Cortex®-M0+ core with an integrated Analog Front End (AFE). The CPU clock rates on these devices can reach up to 75 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

Kinetis-M starts up from an internal reference clock (2-MHz core and 1-MHz bus clock). The MCU can boot in the LPBOOT (Low Power Boot) mode. The core and system clocks are then divided by 8. The CPU software can enable the RTC oscillator connected to EXTAL0/XTAL0, or the second high-frequency oscillator connected to EXTAL1/XTAL1 can be used.

The RTC crystal oscillator range is from 31.25 KHz to 39.0625 KHz (typically 32.768 KHz). The high-frequency crystal oscillator ranges from 1 MHz to 32 MHz. Optionally, two internal clock references (IRC) can be used (fast = 4 MHz and slow = 32.768 KHz).

The CPU frequency can be increased using the FLL (DCO) or PLL clock features. In most of the application, the single 32-KHz external crystal is used. The PLL with a fixed multiplier = x375 can be used to clock the AFE running at ~12.2 MHz. The FLL can be used to clock the CPU core (up to 75 MHz) and the rest of the MCU modules.

NOTE

For the best AFE results, use a precise external clock.

5.4 System power

When installed into the Tower System, the TWR-KM35Z75M can be powered from either an on-board source or from another source in the assembled Tower System.

In stand-alone operation, the main power source (5.0 V) for the TWR-KM35Z75M module is derived from the OpenSDA USB micro-B connector (J27). 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 MKM35Z512VLQ7 have two modes of operation: system power-up and system power-down. During the 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-KM35Z75M module provides a battery receptacle for a coin-cell battery that can be used as the VBAT supply. The receptacle accepts 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 the external ARM-SWD connector. The ARM-SWD connector is a standard 2x5-pin connector which provides an external debugger cable with access to the SWD interface of the MKM35Z512VLQ7.

5.7 OpenSDA

An on-board MK20DX128VMF5-based OpenSDA circuit provides a SWD debug interface to the MKM35Z512VLQ7. A standard USB-A male to micro-B male cable (provided) can be used for debugging via the USB connector (J27). The OpenSDA interface also provides a USB-to-serial bridge.

5.8 Tilt sensor/accelerometer

The MMA8451Q digital accelerometer is connected to the MKM35Z512VLQ7 MCU through the I^2C interface (I2C0) and GPIO signals.

5.9 Potentiometer, temperature sensor, push-buttons, and LEDs

The TWR-KM35Z75M also features:

- Potentiometer connected to the ADC input signal (PTF1/ADC0_SE8).
- Temperature sensor (NTC) connected to the ADC input signal (PTF2/ADC0_SE9)
- Two push-button switches (SW1 and SW2, connected to PTA4 and PTD1, respectively)
- IRDA interface through PTL2 and 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.

Whenever the Tower System module is connected to the computer USB port, the board is recognized as a new virtual COM port. You can connect to the embedded application running on the KM35 device and see the output on the PC running the serial terminal application.

Chapter 6
TWR-KM35Z575M jumper options and headers

The following is a list of all the jumper options on the TWR-KM35Z75M. The default installed jumper settings are indicated in Table 1 by the **BOLD** text.

Table 1. Jumpers and switch options

Option	Jumper	Setting	Description
MCU power connection	J1	**2-1**	Connect VBAT to on-board 3.3 V supply
		3-2	Connect VBAT to the higher voltage between MCU supply (MCU_PWR) or VBAT
	J9	**ON**	Connect MCU SPI signal to NOR flash
		OFF	Disconnect MCU SPI signal to NOR flash
SPI 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
	J17	**ON**	Connect MCU GPIO to drive orange LED
		OFF	Disconnect MCU GPIO to drive orange LED
Orange LED drive	J18	**ON**	Connect MCU IRDA transmit signal
		OFF	Disconnect MCU IRDA transmit signal
IRDA transmit	J19	**ON**	Connect MCU IRDA receive signal
		OFF	Disconnect MCU IRDA receive signal

Table continues on the next page...

Table 1. Jumpers and switch options (continued)

IRDA receive	J3	**ON**	MCU powered from V_BRD 3.3 V on board reg.
		OFF	MCU can be supplied by ext. Voltage connected to J6 - pin 1
MCU_PWR selection	J6	**ON**	Connect Analog voltages to V_BRD
		OFF	external VDDA can be applied
Analog power enable	J21	**ON**	Connect PTF1/ADC0_SE8 to pot. R21
		OFF	Disconnect PTF1/ADC0_SE8 to pot. R21
Pot. enable	J20	**ON**	Connect PTF0/ADC0_SE9 to temp. sensor
		OFF	Disconnect PTF0/ADC0_SE9 to temp. sensor
Temp. sensor enable	J28	**ON**	KM35 Reset input driven by K20 OpenSDA
		OFF	KM35 Reset input isolated from OpenSDA
OpenSDA Reset enabled	J4	**2-Jan**	Connect MCU EXTAL pin to crystal
		3-Feb	Connect MCU EXTAL pin to external clock
8M Crystal	J7	**2-Jan**	Connect MCU XTAL pin to crystal
		3-Feb	Connect MCU XTAL pin to GND

The GPIO Header J25 (Table 2) contains tamper pins, CLK out check signal, and most of the peripheral interface BUS pins such as SPI, I^2C, and SCI. The AFE external modulator signals are also available on this header so that the customized board with the external AFE modulator can be interfaced. Most of the pins can be used normally as GPIO.

Header J31 (Table 3) is the analog inputs/generator-out. The header contains the auxiliary signal generator input interface and analog inputs of the SD and SAR ADCs. The generator signals can be generated outside, connected to J31, and then converted into the ADC signals which 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)

Table continues on the next page...

Table 2. GPIO header (J25) signal connections (continued)

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-KM35Z75M features a socket (J22 and J23) which can accept a variety of different TWRPI modules such as sensors, RF transceivers, and other peripherals. The general-purpose TWRPI socket provides access to I^2C, SPI, IRQs, GPIOs, timers, analog conversion signals, TWRPI ID signals, reset, and voltage supplies. The pinout for the TWRPI socket is listed in Table 4.

Table 4. General-purpose TWRPI socket pinout

J22		J23	
Pin	**Description**	**Pin**	**Description**
1	5 V VCC	1	GND
2	3.3 V VCC	2	GND
3	GND	3	I^2C: SCL
4	3.3 V VDDA	4	I^2C: 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	UART: UART_RX or GPIO: GPIO2
18	ADC: TWRPI ID 1	18	UART: UART_TX or GPIO: GPIO3
19	GND	19	UART: UART_CTS or GPIO: GPIO4/Timer
20	Reset	20	UART: UART_RTS or GPIO: GPIO5/Timer

How To Reach Us

Home Page:

nxp.com

Web Support:

nxp.com/support

For more information, please visit: http://www.nxp.com

For sales office addresses, please send an email to: salesaddresses@nxp.com

Date of release: 05/2020

Document identifier: TWRKM35Z75MUG

arm