



MED-EKG

User Manual

Rev. 1.0

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1 Overview

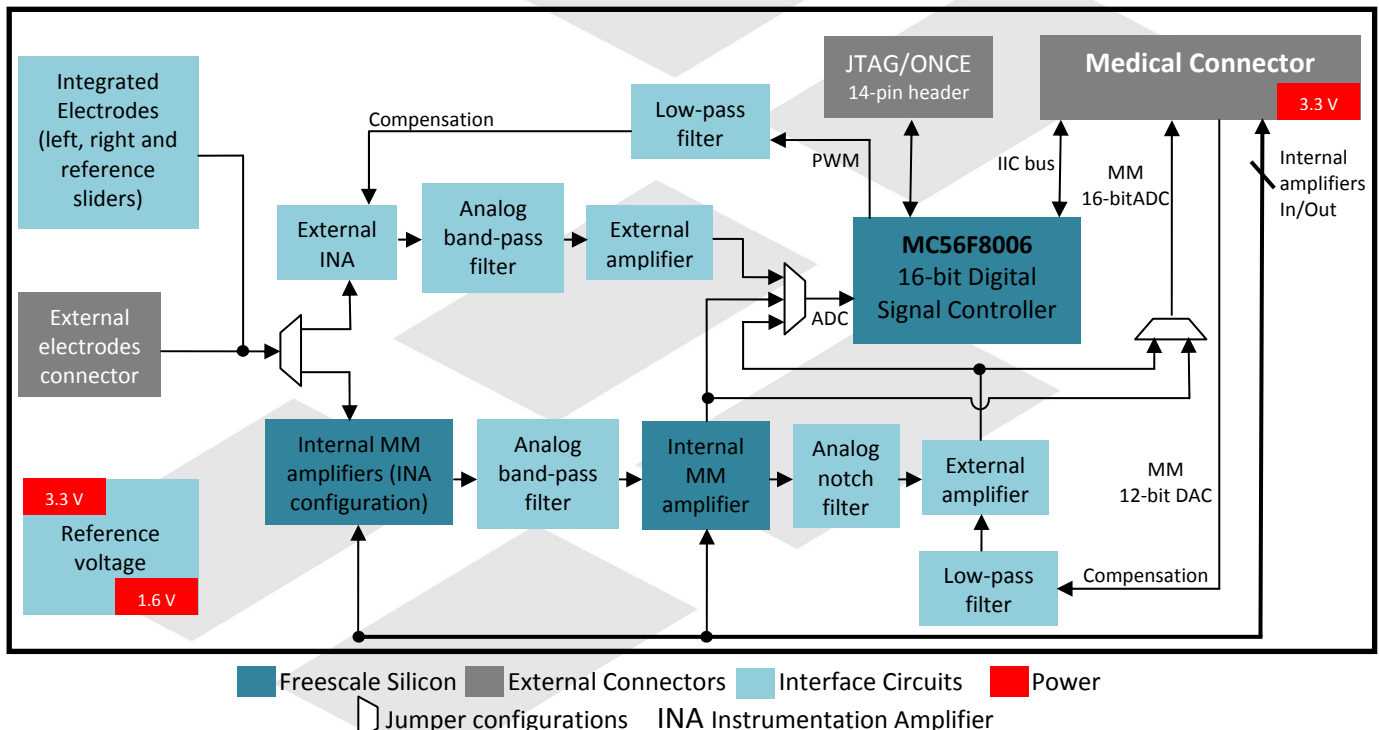
The Medical EKG Module (MED-EKG) is a low cost development board that allows users to rapidly prototype electrocardiogram (EKG/ECG) applications. Users can choose to develop EKG/ECG applications using the external analog components or by using the Flexis MM microcontroller’s on-chip analog modules or a mixture of both. MED-EKG is designed to work with the TWR-MCF51MM module and TWR-S08MM128 module. The EKG/ECG software demonstration and step-by-step lab guide is available in the both the Tower System TWR-MCF51MM-KIT and TWR-S08MM128-KIT or from www.freescale.com

NOTE: TWR-MCF51MM-KIT features the 32-bit MCF51MM256 microcontroller and the TWR-S08MM128-KIT features the 8-bit MC9S08MM128 microcontroller. Peripherals between these two 32-bit and 8-bit MCUs are either identical or compatible; they are called the Flexis devices.

The following list summarizes the features of the MED-EKG board:

- Freescale Tower System compliant and small form factor
- External connector to TWR-S08MM128 and TWR-MCF51MM MCU modules
- Includes the MC56F8006 DSC used for signal conditioning
- Electrodes embedded in development board for easy EKG signal detection using fingertips
- Open connector for any type of EKG electrodes for additional precision
- JTAG-ONCE connector for DSC programming
- Different jumper configurations to allow various signal conditions
- Low power

Figure 1. MED-EKG Block Diagram



2 Reference Documents

The documents listed below are available online. Refer to www.freescale.com/tower or www.freescale.com/medical for the latest revisions of these documents.

- MED-EKG Schematics
- Quick Start Guide for TWR-S08MM128
- Quick Start Guide for TWR-MCF51MM
- TWR-MCF51MM-KIT and TWR-S08MM128-KIT Labs

3 Hardware Features

This section provides more details about the features and functionality of the MED-EKG.

3.1 System Power

The MED-EKG is powered by the default trough connector J1, but can be also powered by the JTAG-ONCE port. Do not apply both power sources at the same time.

NOTE: Power switch is controlled by the MCF51MM256 or MC9S08MM128 pin PTE7 from the corresponding Tower System MCU module. To turn on the MED-EKG module in your software, make sure to set PTE7 pin to output low (active low). To turn off, set PTE7 to output high. This has already been done in the MED-EKG demonstration software in the TWR-MCF51MM-KIT or TWR-S08MM128-KIT.

3.2 Debug Interface

The included DSC is factory programmed with firmware for digital filtering (a band-pass filter and a notch filter), however it can be reprogrammed using an external JTAG-ONCE interface (USB-TAP) for user specific applications. It can be connected on header J10.

3.3 Medical Connector

Header J1 (2x10 pins) of MED-EKG provides connectivity with either the TWR-MCF51MM or the TWR-S08MM128 board through the medical connector. It allows the use of internal OPAMPs, TRIAMPs, ADC and DAC of Flexis MM 32-bit or 8-bit microcontrollers to implement the requirement of signal conditioning. Pin 3 and 4 can also be used to send DSC filtered data to the target Tower MCU. Table 1 shows the signal present in each pin of medical connector. Please refer to TWR-MCF51MM-KIT or the TWR-S08MM128-KIT LAB1 MED-EKG DEMO for instructions on assembling with the Tower System.

MED-EKG Signal	Pin		MED-EKG Signal
VDD(3.3V)	1	2	GND
ECG_IIC_SDA	3	4	ECG_IIC_SCL
MM_AdcEcgSignal	5	6	GND
MM_AdcBaseline	7	8	MMDac
OUT1	9	10	OUT2

INP1-	11	12	INP2-
INP1+	13	14	INP2+
VINP1	15	16	VINP2
VINN1	17	18	VINN2
TRIOUT1	19	20	TRIOUT2

Table 1. Medical Connector 2x10 Pin Header Connections

3.4 Mechanical Form Factor

The MED-EKG is intended to be used as an expansion of the TWR-S08MM128 and TWR-MCF51MM boards. It's designed for the Freescale Tower System and complies with the electrical and mechanical specifications that are described in *Freescale Tower Electromechanical Specification*.

3.5 External Electrodes Connector

The external electrodes connector is labeled as J12 on the MED-EKG module. This connection yields less noise and provides the best way to prototype your EKG application instead of using the on-board sliders contact. The user can connect a 3 lead cable (2 electrodes and 1 ground) via J12 header and use external electrodes. Freescale does not provide this lead due to regulations in different countries. The user has to purchase it separately. This board was tested with Welch Allyn ECG Lead Wires for Atlas Monitor, 3-lead AHA. Figure 2 shows a connection example with external electrodes.

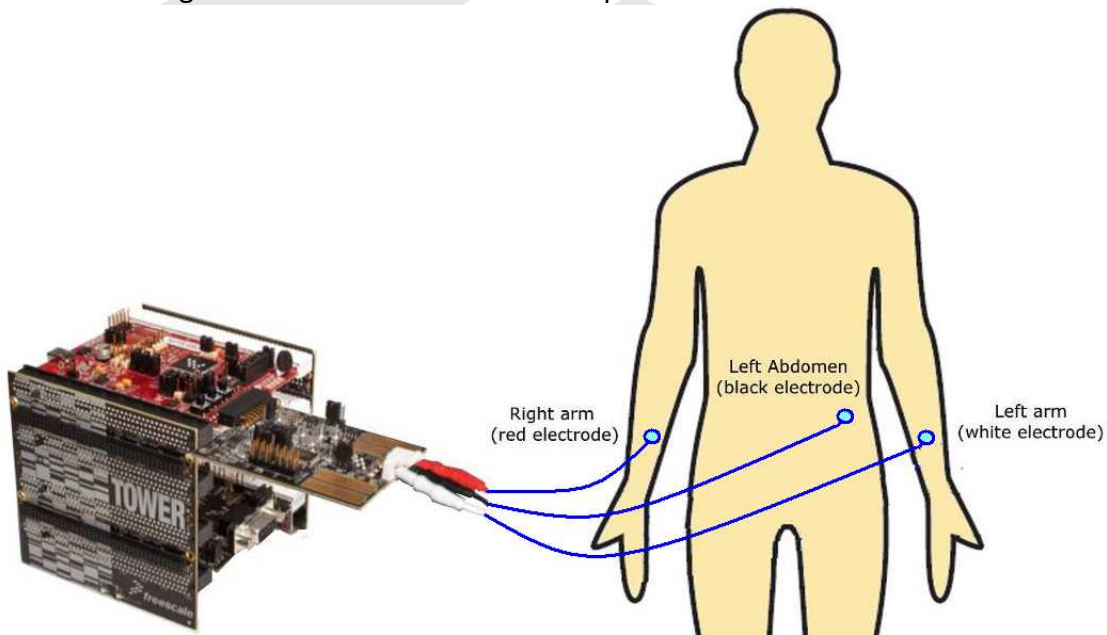


Figure 2. External Electrodes Connection Example

3.6 Slider Electrodes

The on-board slider electrodes are used when external electrodes are not available. The user can place their fingers as is shown in Figure 3. Since the contact is not as secure as the external electrodes leads, you must avoid any small movement to reduce input noise. See TWR-MCF51MM-KIT or TWR-S08MM128-KIT LAB1 guide for tips.

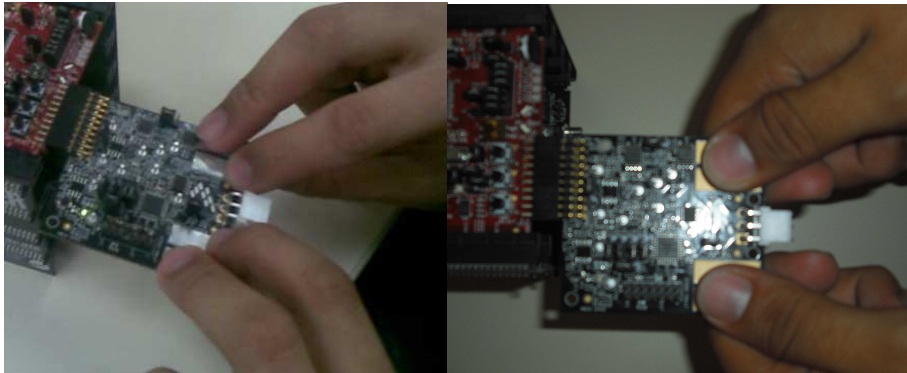


Figure 3. Fingertips Collocation on Slider Electrodes

4 Jumper Table

There are several jumpers provided for configuration and connection selection. Refer to Table 2 for details. The default installed jumper settings are shown in **bold**.

Jumper	Option	Setting	Description
J1	Medical board connector	open	Connection with TWR-S08MM128 or TWR-MCF51MM boards
J2	Connection of MM OPAMP2 INP2-	1-2	Directly to Vref1.6V
		2-3	Trough R12 to OUT2
J3	Right electrode gain (must be the same as J4)	1-2	Gain is 100x
		2-3	Gain is 10x
J4	Left electrode gain (must be the same as J3)	1-2	Gain is 100x
		2-3	Gain is 10x
J5	Enabling R17 connection	open	R17 connection is open
		shunt	R17 is connected to Vref1.6V
J6	Right electrode connection (must be the same as J7)	1-2	Right electrode is connected to external INA input
		2-3	Right electrode is connected to MM internal amplifiers
J7	Left electrode connection (must be the same as J6)	1-2	Left electrode is connected to external INA input
		2-3	Left electrode is connected to MM internal amplifiers
J8	ADC input to DSC	1-2	DSC is feed from internal MM amplifiers output
		2-3	DSC is feed from signal selected in J9

J9	Signal selector jumper	1-2	Selected signal is the external INA circuit
		2-3	Selected signal is the output of internal amplifier OUT2
J10	JTAG-ONCE header	open	It is used to program the DSC
J11	Reference electrodes selector	1-2	Reference electrodes are connected to ground
		2-3	Reference electrodes are connected to Vref1.6V
J12	External electrodes connector	open	It is used to connect external electrodes

Table 2. MED-EKG Jumper Table

NOTE: When J3 and J4 are set to 100x, you must use external electrodes via J12 instead of using the on-board slider contacts. On-board slider contacts yield more noise due to the unsecure connection with fingers. Noise in the first stage of instrumentation with higher amplification can easily results with saturated output so you won't be able to see the EKG output in the final amplification stage.

NOTE: MEG-EKG by default is configured to use the Flexis MM on-chip analogs. The option that uses external INA is not functional by default.

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