Healthcare Analog Front End (AFE) Reference Platform

Target Applications

- Multi-parameter patient monitors
- Digital stethoscopes
- Glucometers
- Blood pressure monitors
- Anesthesia units
- Electrocardiographs
- Activity monitors
- Heart rate monitors
- Defibrillators
- Plethysmographs

Overview

The Freescale Healthcare AFE reference platform integrates a full set of solutions for portable medical and personal healthcare applications. It offers product development solutions for portable electrocardiographs, heart rate monitors, pulse oximeters, glucose monitors, blood pressure monitors, spirometers and Doppler ultrasound stethoscopes.

The Healthcare AFE reference platform is based on the highly integrated Kinetis K50 MCU family, which includes a complete set of analog peripherals, including transimpedance amplifiers and general-purpose amplifiers. This advanced integration allows for improved measurement accuracy and a reduction in board size and bill of materials. Precision analog components from Linear Technology™ are included to provide greater design flexibility.
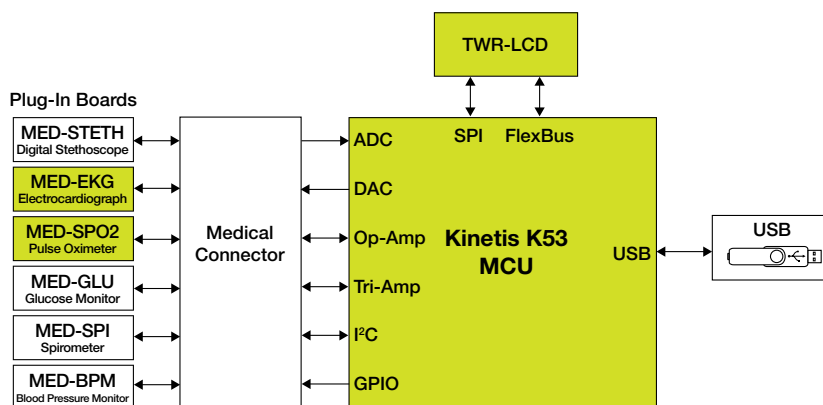
Application Development

The Healthcare AFE reference platform was developed using the Kinetis K53 MCU, featuring an ARM® Cortex™-M4 core embedded in the ready-to-develop Tower System hardware platform. This combination makes the Healthcare AFE reference platform an accurate, rapid prototyping solution for portable medical application design.

The Healthcare AFE reference platform includes six healthcare-specific plug-in boards with reusable software and hardware, providing developers with fast prototyping tools that reduce time to market and allow for greater focus on product key differentiators.

Healthcare Analog Front End (AFE) Reference Design

Plug-In Boards

MED-STETH — Digital Stethoscope
MED-EKG — Electrocardiograph
MED-SPO2 — Pulse Oximeter
MED-GLU — Glucose Monitor
MED-SPI — Spirometer
MED-BPM — Blood Pressure Monitor

Medical Connector

TWR-LCD
SPI   FlexBus
ADC
DAC
Op-Amp   Kinetis K53 MCU
Tri-Amp
I²C
GPIO
USB
USB

Freescale Technology

Healthcare AFE Reference Platform Contents

- TWR-K53N512 Kinetis embedded control board

- TWR-SER serial communications board

- TWR-LCD

- TWR-ELEV

- MED-EKG electrocardiograph development board with and without Linear Technology analog components

- MED-SPO2 pulse oximeter development board with and without Linear Technology analog components

- MED-GLU glucose meter development board with and without Linear Technology analog components

- MED-BPM blood pressure monitor development board with and without Linear Technology analog components

- MED-SPI spirometer development board

- MED-STETH ultrasound stethoscope development board

- EKG cables

- Pulse oximetry finger sensor

- BPM pneumatic kit and arm cuff

- Ultrasound transducer and speaker

- Spirometry mouthpiece

- Blood glucose test strips

Price/Availability

The Healthcare AFE reference platform will not be available for sale. Please contact your local Freescale sales person for a demonstration and access to the reference platform. All application notes, schematics and source code are available at **freescale.com/healthcareAFE**.

Kinetis K53 Measurement Engine Overview

Module	Description	Features
ADC	16-bit sucessive approximation analog-to-digital converter (ADC)	• Up to 16-bit resolution • Up to four pairs of differential and 24 single-ended external analog inputs • Hardware average • Temperature sensor • Selectable voltage reference • Self-calibration mode • Programable gain amplifier up to x64 gain
DAC	12-bit low-power general-purpose digital-to-analog converter (DAC)	• On-chip programmable reference generator output • 16-word data buffer supported with configurable watermark • DMA support
Op-Amp	CMOS single supply, low-input offset voltage, low-input offset and bias current amplifier	• Programmable voltage gain • Low-input offset voltage and current • Low-input bias current • Low current consumption
Tri-Amp	CMOS single supply, low-input offset voltage, low-input offset and bias current amplifier	• On-chip generation of bias voltages • Low-input offset voltage and current • Low-input bias current • Low current consumption
VREF	Reference voltage supply that can be trimmed in 0.5 mV	• Programmable trim register with 0.5 mV steps • Programmable buffer mode selection • 1.2 V output at room temperature • Dedicated output pin, VREF_OUT
PDB	Provides controllable delays to the hardware trigger inputs of ADCs and/or generates the interval triggers to DACs	• Up to 15 trigger input sources and one software trigger source • Up to eight configurable PDB channels for ADC hardware trigger • Up to eight DAC interval triggers • Up to eight pulse outputs
CMP	Provides a circuit for comparing two analog input voltages	• Operational over the entire supply range • Programmable hysteresis control • Selectable interrupt on rising edge, falling edge or both edges of the comparator output • Selectable inversion of comparator output • DMA transfer support

Healthcare Plug-In Board Summary

Board	Description	Applications
MED-EKG	MED-EKG is an auxiliary board in the development of solutions oriented toward electrocardiography and heart rate monitoring. This board allows designers to speed the development of medical devices based on electrocardiography, providing a scalable solution that can be adjusted to the final product needs.	• Heart rate monitors • Electrocardiographs • Defibrillators • Multi-parameter patient monitors
MED-SPO2	MED-SPO2 is a pulse oximetry solution development board ideal for designing applications requiring an SpO2 measurement or beats per minute (bpm) determination using non invasive procedures. This board is reduced in size and includes most of the required components for pulse oximetry determination.	• Pulse oximeters • Anesthesia units • Optical heart rate monitors • Multi-parameter patient monitors
MED-GLU	MED-GLU is a single-board glucometer solution. This board is reduced in size and enables developers with tools to ease the design of medical or industrial solutions based on glucometry. This board can be used together with the Tower System, offering a complete suite of solutions including serial communications and LCD screens.	• Blood glucose meters
MED-BPM	MED-BPM is a development board which eases and accelerates the design of blood pressure monitor applications. It includes isolation circuitry for an air pump and escape valve and is designed for operation with 3–3.3 V	• Blood pressure monitors • Multi-parameter patient monitors
MED-SPI	MED-SPI is a development board which demonstrates the basic implementation of a spirometer solution. It includes a MPXV7025DP differential pressure sensor that facilitates the measurement of the air flow and allows the calculation of lung capacity measurement.	• Spirometers • Anesthesia units
MED-STETH	MED-STETH implements a stethoscope solution based on the use of ultrasonic waves. This board is auxiliary in the design of applications using ultrasound in the detection of heart rate such as digital stethoscopes or fetal heart rate monitors.	• Digital stethoscope • Fetal heart rate monitors

For more information, visit freescale.com/healthcareAFE