24-Bit Delta Sigma ADC Product Series

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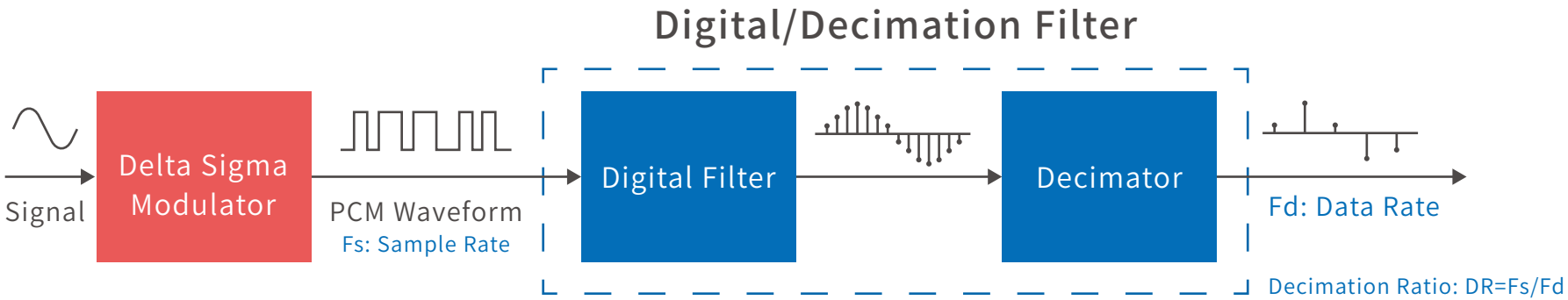
HOLTEK SEMICONDUCTOR INC.

24-Bit Delta Sigma ADC Characteristics

The Delta Sigma ADC (A/D Converter) has the features of high accuracy and low noise. As sensor products become more and more abundant in the terminal market of health measurement, industrial control and other areas, such as weighing products, temperature measurement products, blood glucose meters, body fat scales, temperature/pressure transmitters, etc., the market demand for Delta Sigma ADC is continuously increasing.

Nowadays, the Delta Sigma ADC is a very common architecture in high-resolution applications. It consists of two primary parts, the Delta Sigma Modulator and Digital/Decimation Filter, as shown in the following figure.



The Delta Sigma ADC has the following advantage and disadvantage:

Advantage

High Resolution: The Delta Sigma ADC uses an oversampling technique to continuously sample signals multiple times over a period of time and then calculates the average output. This enables a high resolution and is ideal for applications with high-accuracy measurement of continuous signals.

Disadvantage

Longer Delay: The Delta Sigma ADC architecture includes a digital filter which requires a longer settling time for analog signal sudden changes or channel switching. This makes the Delta Sigma ADC more suitable for DC-almost signal measurements or applications with slow signal changes.

Three 24-Bit Delta Sigma ADC Product Series

Holtek is a leading manufacturer of professional microcontroller IC design with a wide range of product categories, including 8-bit and 32-bit microcontroller IC and peripherals. Since its establishment in 1998, the Company has been continuously committed to the research and development and technical innovation, looking forward to providing the most competitive products and solutions for customers.

Holtek provides the following three series of 24-Bit Delta Sigma ADC IC products:

- 24-Bit Delta Sigma ADC **Peripheral Series**
- 24-Bit Delta Sigma ADC **Flash MCU Series**
- 24-Bit Delta Sigma ADC **Health Care SoC MCU Series**

Professional Technical Service

In order to provide customers with more comprehensive services, Holtek established the solution company BEST HEALTH ELECTRONICS INC in 2017.

Best Health has professionals to provide technical support, market trending and competitive solutions as well as to solve various difficult problems in production for customers, accelerating their move to mass production and achieving rapid market launch of their terminal products.

Best Health's technical service scope covers the body composition, temperature, blood pressure, blood glucose and blood oxygen measurements and other application fields.

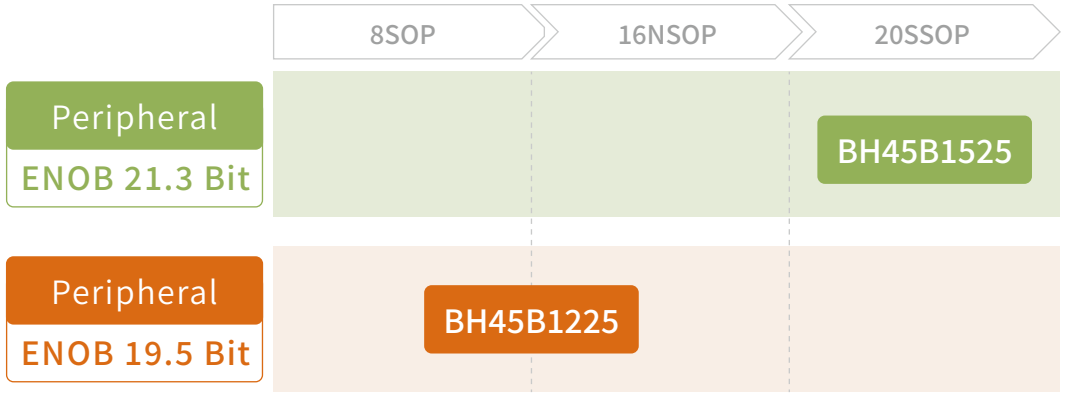
BEST HEALTH [Best Health Website]

24-Bit Delta Sigma ADC Peripheral Series

Main Features

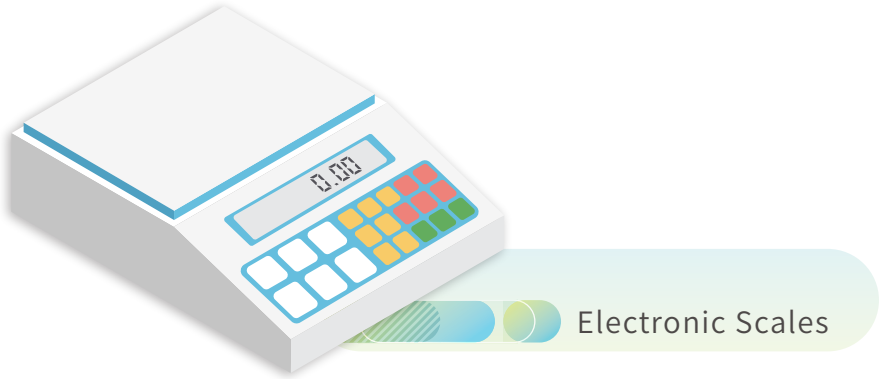
Holtek's 24-Bit Delta Sigma ADC Peripheral Series includes multiple input channels and a programmable gain amplifier (PGA), and is specially designed for applications that interface differentially to analog signals. This series has the benefits of low noise and high accuracy, which can improve the measurement function of various high-accuracy sensor applications. Communication with external MCUs or devices is implemented through an internal I^2C or SPI interface. The low power feature also enables this series for battery powered applications.

Figure 1 shows the product lineup of this series, with which customers can preliminarily select the desired IC according to their product requirements.

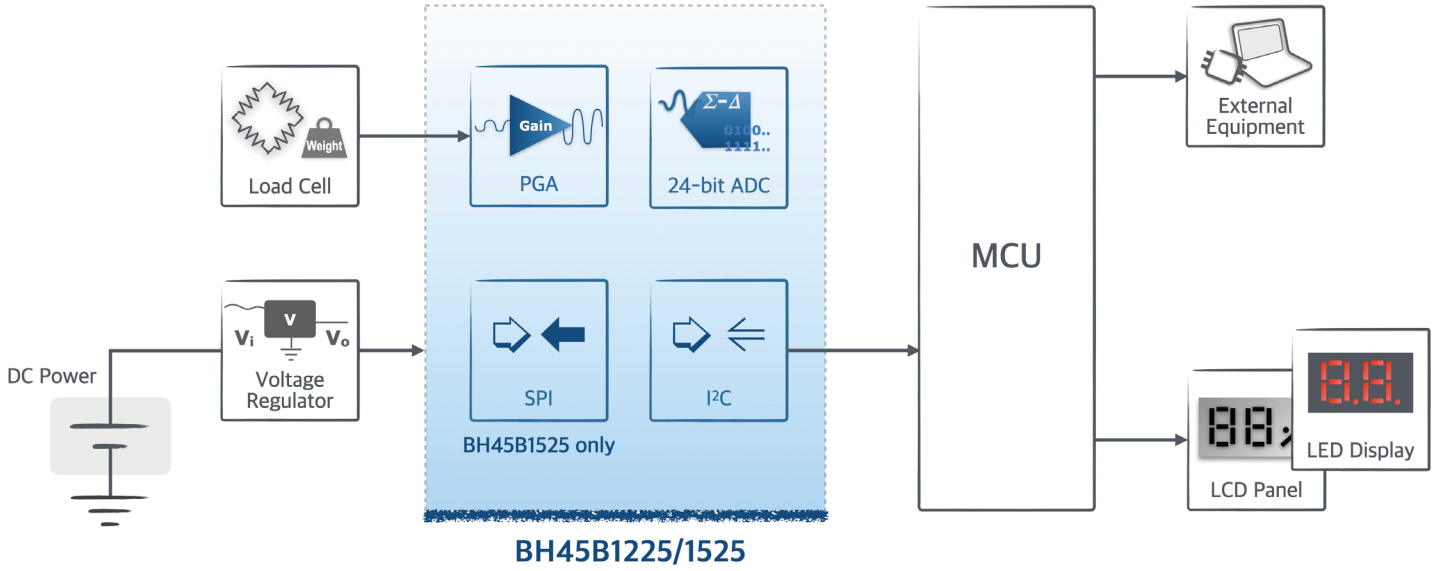


▲ Figure 1: 24-Bit Delta Sigma ADC Peripheral Series Lineup

Applications



Weighing Product Application Block Diagram



Product Selection

24-Bit A/D Peripheral

Part No.	Max. Freq.	VDD	ADC	ENOB	Data Rate	PGA	Interface	Package
BH45B1225	4.91MHz	2.4V~5.5V	24-bit×4	19.5	5Hz~1.6kHz	1~128	I^2C×1	8SOP, 16NSOP
BH45B1525	4.91MHz	2.7V~5.5V	24-bit×4	21.3	10Hz~1.28kHz	1~128	SPI×1, I^2C×1	20SSOP
Note: Test Conditions of ENOB are PGA Gain = 64, Data Rate = 10Hz, and Vref=1.65V.								

Please refer to the official website for product selection information.

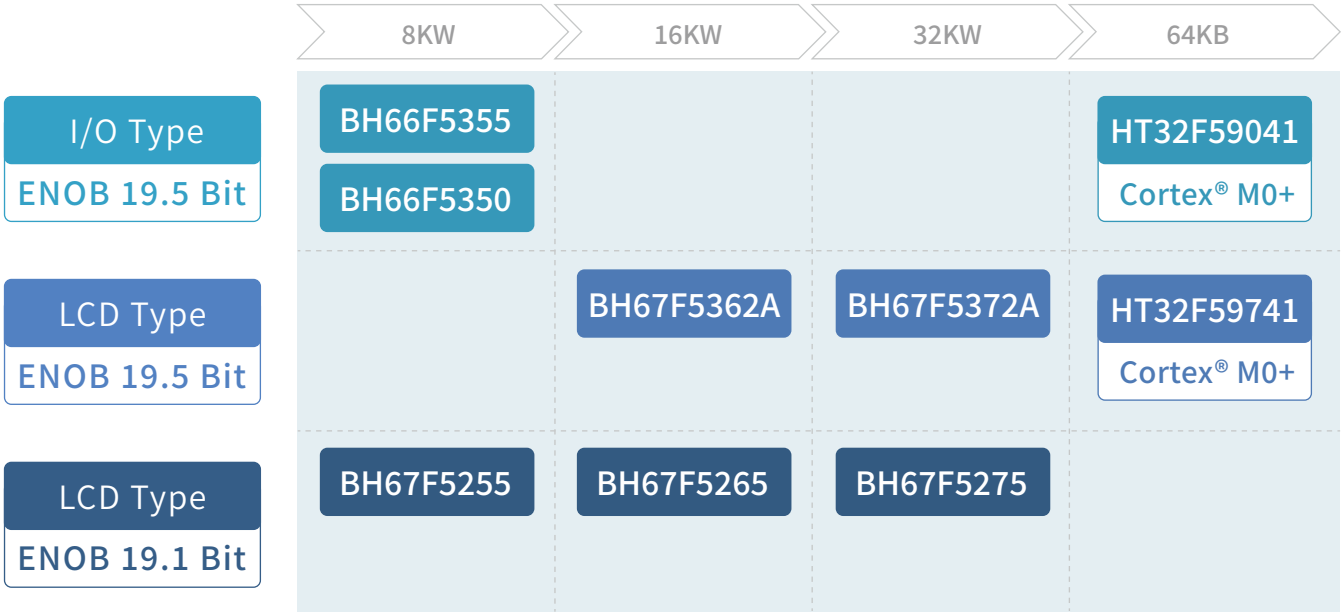
24-Bit Delta Sigma ADC Flash MCU Series

Main Features

Holtek's 24-Bit Delta Sigma ADC Flash MCU Series includes 8-Bit Flash MCUs and Cortex® M0+ Flash MCUs. This series includes a multi-channel 24-Bit Delta Sigma ADC with the features of low noise and high accuracy.

Analog features include a programmable gain amplifier (PGA). Multiple and extremely flexible Timer Modules provide timing, pulse generation and PWM generation functions. Communication with external hardware is catered for by including fully integrated SPI, I^2C or UART interface functions. The integrated LDO can provide power for the MCU and external devices. Protective features such as an internal Watchdog Timer, Low Voltage Reset and Low Voltage Detector coupled with excellent noise immunity and ESD protection ensure that reliable operation is maintained in hostile electrical environments.

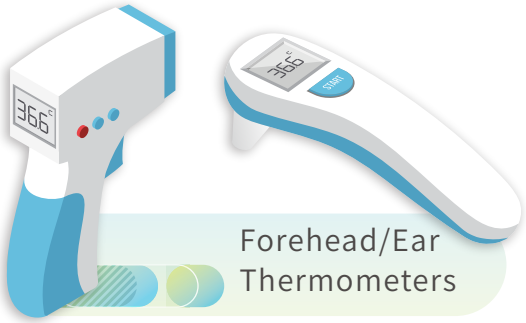
Figure 2 shows the product lineup of this series and customers can make a preliminary selection with the table.



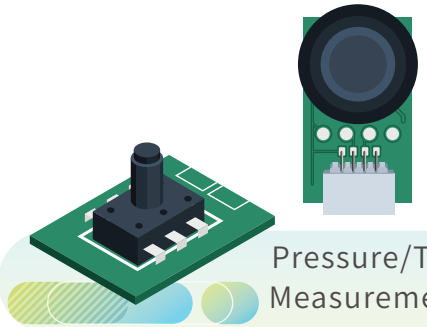
▲ Figure 2: 24-Bit Delta Sigma ADC Flash MCU Series Lineup

Applications

Pressure/Temperature Transmitters

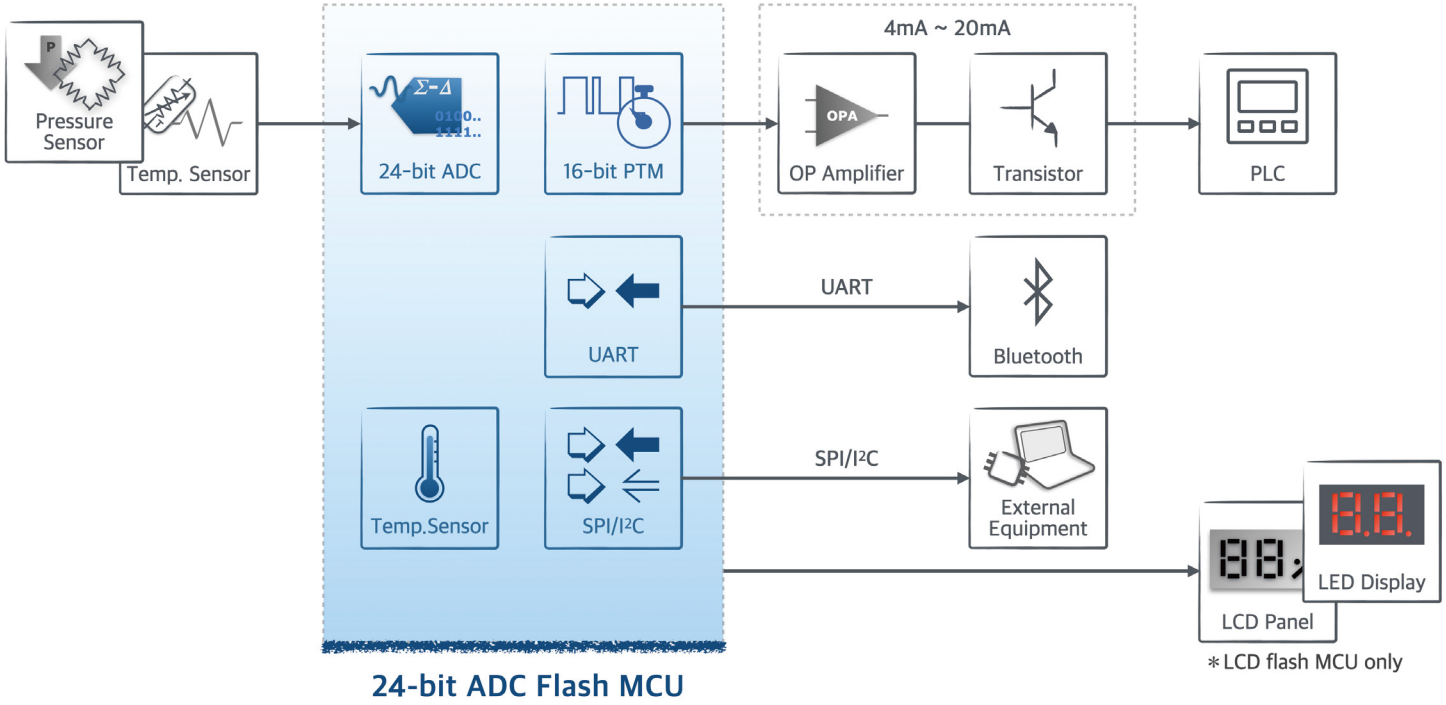


Forehead/Ear Thermometers



Pressure/Temperature Measurement Modules

Application Block Diagram



Product Selection

32-Bit M0+ 24-Bit A/D MCU

Part No.	Max. Freq.	VDD	Flash	SRAM	ADC		Timer	RTC	Interface	Others	Max. I/O	Package
HT32F59041	20MHz	2.5V~5.5V	64KB	8KB	SAR ADC 1Msps 12-bit×12	Delta Sigma ADC 24-bit×4	BFTM×2, PWM×2 GPTM×1, MCTM×1	√	USART×1, UART×2 SPI×1, I²C×1	CRC, DIV	30	48LQFP

32-Bit M0+ 24-Bit A/D LCD MCU

Part No.	Max. Freq.	VDD	Flash	SRAM	ADC		Timer	RTC	USB	LCD	Interface	Others	Max. I/O	Package
HT32F59741	60MHz	1.65V~3.6V	64KB	8KB	SAR ADC 1Msps 12-bit×10	Delta Sigma ADC 24-bit×4	BFTM×2, PWM×2 GPTM×1	√	√	29×4~25×8	USART×1, UART×2 SPI×2, I²C×2	CRC, DIV SCI	53	64/80LQFP

Note:
BFTM: Basic Function Timer
GPTM: General Purpose Timer
QSPI: Quad serial peripheral interface
SCI: Smart Card Interface
AES: Advanced Encryption Standard
SCTM: Single Channel Timer
MCTM: Motor Control Timer
SLED: Strip LED Controller
LEDC: LED controller
PWM: Pulse Width Modulation
USB: 2.0 Full Speed device
DIV: Hardware Divider
EBI: External Bus Interface for NOR Flash/SRAM/LCD

24-Bit A/D Flash MCU

Part No.	Max. Freq.	VDD	Program Memory	Data Memory	Data EEPROM	Stack	IAP	I/O	Timer	ADC	ENOB	Temp. Sensor	CMP	OPA	Interface	Package
BH66F5350	12MHz	2.2V~5.5V	8K×16	512×8	128×8	8	√	13	10-bit CTM×1 16-bit PTM×1	24-bit×4	19.5	±0.2°C	—	2	UART/SPI/I²C×1	24SSOP 28SSOP
BH66F5355	12MHz	2.2V~5.5V	8K×16	512×8	512×8	8	—	10	10-bit CTM×1 16-bit PTM×1	24-bit×4	19.5	±0.2°C	—	2	UART×1 SPI/I²C×1	24QFN 24SSOP

24-Bit A/D LCD Flash MCU

Part No.	Max. Freq.	VDD	Program Memory	Data Memory	Data EEPROM	MDU	Stack	IAP	I/O	Timer	ADC	ENOB	LCD	OPA	RTC	Interface	Package
BH67F5362A*	16MHz	1.8V~5.5V	16K×16	2048×8	1024×8	√	16	√	45	10-bit PTM×6 16-bit PTM×2 16-bit STM×3	12-bit×14 24-bit×4	— 19.5	36×4 34×6 32×8	—	√	UART×2 SPI/I²C×1	64LQFP
BH67F5372A*	16MHz	1.8V~5.5V	32K×16	3072×8	2048×8	√	16	√	45	10-bit PTM×6 16-bit PTM×2 16-bit STM×3	12-bit×14 24-bit×4	— 19.5	36×4 34×6 32×8	—	√	UART×3 SPI/I²C×1	64LQFP
BH67F5255	8MHz	2.2V~5.5V	8K×16	512×8	512×8	—	16	√	30	10-bit PTM×2 16-bit STM×1	24-bit×4	19.1	24×4 22×6	2	—	UART×1 SPI/I²C×1	32QFN 48LQFP
BH67F5265	16MHz	2.2V~5.5V	16K×16	1024×8	1024×8	√	16	√	43	10-bit PTM×3 16-bit STM×1	24-bit×6	19.1	30×4 28×6 26×8	2	√	UART×1 SPI×1 SPI/I²C×1	32QFN 48/64LQFP
BH67F5275	16MHz	2.2V~5.5V	32K×16	2048×8	2048×8	√	16	√	57	10-bit ATM×1 10-bit PTM×3 16-bit STM×1	24-bit×6	19.1	44×4 42×6 40×8	2	√	UART×1 SPI×1 SPI/I²C×1	32QFN 48/64LQFP 80LQFP

* Under development, available in 3Q, 2025
Note: Test Conditions of ENOB are PGA Gain = 64, Data Rate = 10Hz and V_{REF}=1.65V.

Please refer to the official website for product selection information.

Development Tools

HT32 24-Bit A/D LCD MCU Development Board

The BMHB4008 is a development board for the HT32F59741, which is a 32-bit high performance and low power consumption MCU based around an Arm® Cortex®-M0+ processor core. The 32-bit MCU has abundant resources and fast CPU execution speed, which can implement more complex functions, and is especially suitable for high-grade measurement products, such as blood pressure meters, instruments, industrial controls, etc.

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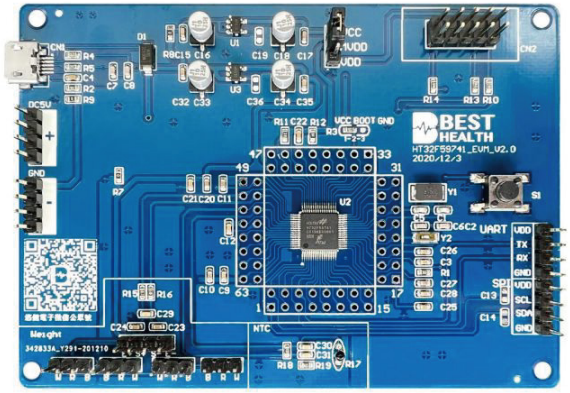
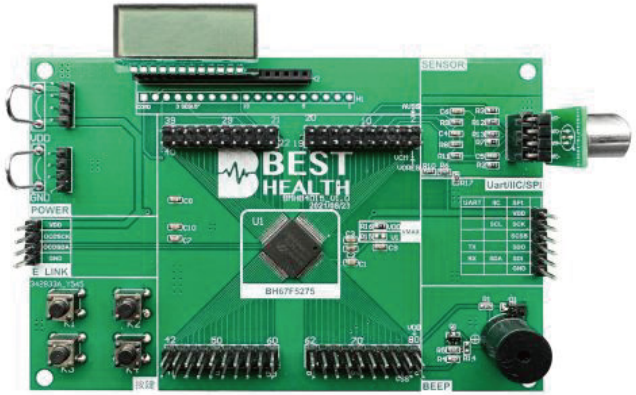


HT8 24-Bit A/D LCD MCU Development Board

The BMHB4015 is a development board for the BH67F5275, which includes a high-resolution high-efficiency Delta Sigma ADC and an integrated LCD driver. It is suitable for use in high-accuracy measurement products.

Purchase from Best Modules Website

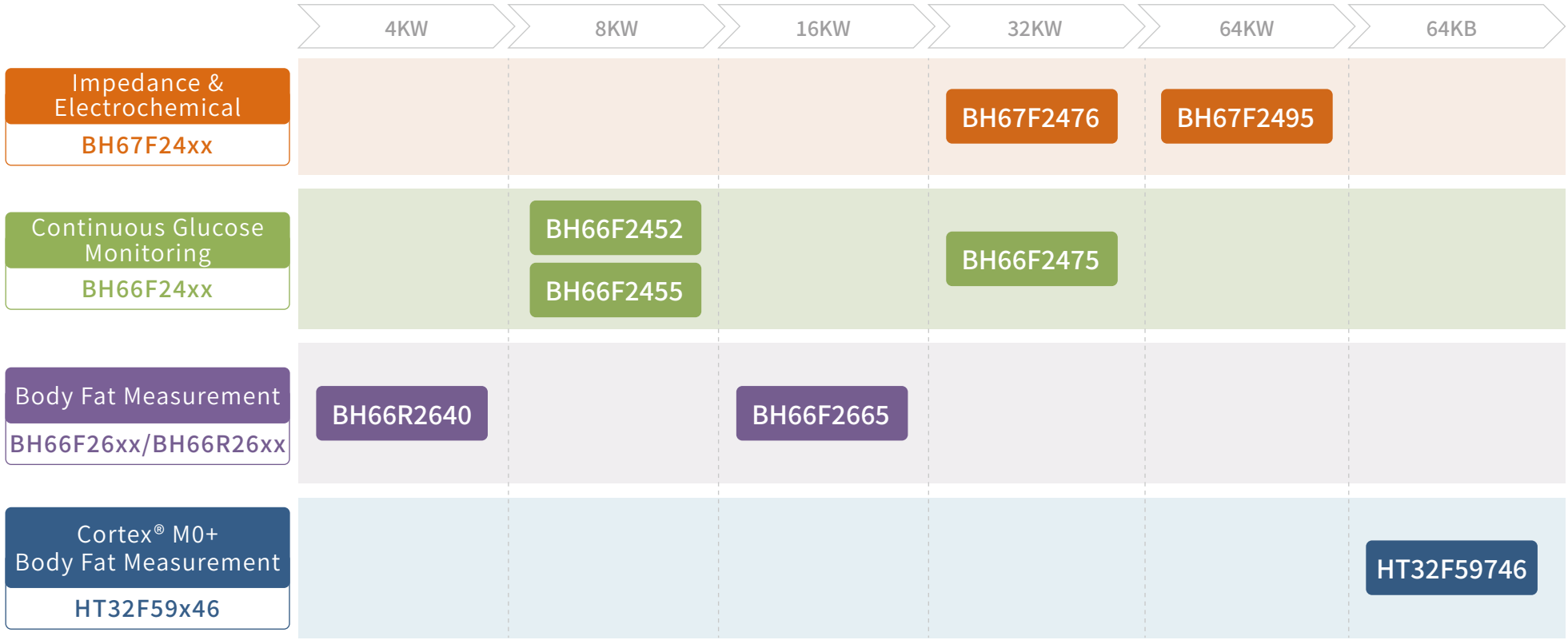


24-Bit Delta Sigma ADC Health Care SoC MCU Series

Main Features

Holtek's Health Care SoC MCU Series covers 8-Bit and 32-Bit SoC MCUs which include a multi-channel 24-Bit Delta Sigma ADC. Inheriting the analog features of the Holtek 24-Bit Delta Sigma ADC Flash MCU Series, this series also includes different AFE circuits in order to be embedded into applications such as blood glucose meters (BGM & CGM) and body fat scales.

Figure 3 shows the lineup of this series, facilitating customers for preliminary product selection.



▲ Figure 3: Health Care SoC MCU Series Lineup

Applications

Glucose Meters (BGM)

Continuous Glucose Monitoring(CGM)

Body Fat Scales

Product Selection

Impedance & Electrochemical LCD Flash MCU

Part No.	Max. Freq.	VDD	Program Memory	Data Memory	Data EEPROM	MDU	Stack	IAP	I/O	Timer	ADC	ENOB	LCD	RTC	OPA	Phase Detect	USB	Interface	Package
BH67F2476	16MHz	2.2V~5.5V	32K×16	2048×8	2048×8	—	16	√	49	10-bit PTM×2 16-bit STM×1 10-bit ATM×1	24-bit ×10	19.1	36×4 34×6 32×8	√	2	√	—	UART×2 SPI/I²C×1	64LQFP 80LQFP
BH67F2495	16MHz	2.2V~5.5V	64K×16	4096×8	4096×8	√	16	√	49	10-bit PTM×2 16-bit STM×1 10-bit ATM×1	24-bit ×10	19.1	36×4 34×6 32×8	√	2	√	√	UART×2 SPI/I²C×1	64LQFP 80LQFP

Note: Test Conditions of ENOB are PGA Gain = 64, Data Rate = 10Hz, and V_{REF} = 1.65V.

Continuous Glucose Monitoring Flash MCU

Part No.	Max. Freq.	Input Voltage	Voltage Pump	Program Memory	Data Memory	Data EEPROM	Stack	IAP	I/O	Timer	ADC	OPA	Interface	Package
BH66F2452*	4MHz	0.85V~2.5V	√	8K×16	512×8	512×8	16	√	9	10-bit CTM×1 16-bit PTM×1	24-bit ×2	3	UART×1 SPI×1	24QFN

* Under development, available in 3Q, 2025

Part No.	Max. Freq.	VDD	Program Memory	Data Memory	Data EEPROM	MDU	Stack	IAP	I/O	Timer	ADC	OPA	CMP	Interface	Package
BH66F2455*	4MHz	2.2V~5.5V	8K×16	512×8	512×8	—	16	√	9	10-bit CTM×1 16-bit PTM×1	24-bit ×2	3	—	UART×1 SPI×1	16/24QFN
BH66F2475	16MHz	2.2V~5.5V	32K×16	2048×8	2048×8	√	16	√	9	10-bit CTM×2 16-bit PTM×1	24-bit ×2	3	√	UART×1 SPI×1	16/24QFN

* Under development, available in 3Q, 2025

Please refer to the official website for product selection information.

Product Selection

Body Fat Measurement Cortex®-M0+ 32-Bit Flash MCU

Part No.	Max. Freq.	VDD	Flash	SRAM	I/O	RTC	Timer	LCD	ADC	Electrode	Phase Detect	Interface	Package
HT32F59746*	60MHz	2.2V~3.6V	64KB	8KB	51	√	BFTM×2, PWM×2 GPTM×1	29×4 27×6 25×8	12-bit×4 / 24-bit×4	8	√	USART×1 UART×2, SPI×2 I²C×2, SCI×1	80LQFP

* Under development, available in 3Q, 2025

Body Fat Measurement Flash MCU

Part No.	Max. Freq.	VDD	Program Memory	Data Memory	Data EEPROM	Stack	I/O	IAP	Timer	ADC	RTC	Electrode	Phase Detect	Interface	Package
BH66F2665	8MHz	2.2V~5.5V	16K×16	1024×8	1024×8	16	26	√	10-bit CTM×1 10-bit STM×1	24-bit ×6	√	8	√	UART×1 SPI/I²C×1	24/32QFN 48LQFP

Body Fat Measurement DFE OTP MCU

Part No.	Max. Freq.	VDD	Program Memory	Data Memory	Stack	I/O	Timer	ADC	Electrode	Phase Detect	Interface	Package
BH66R2640	8MHz	2.2V~5.5V	4K×16	512×8	12	15	10-bit CTM×1	24-bit ×4	4	√	UART×1 SPI/I²Cx1	24SSOP 32QFN

Please refer to the official website for product selection information.

Development Tools

HT8 BGM Glucose Meter MCU Development Board

The BMHB2012 is a development board of the BH67F2495, which is suitable for use in products such as glucose meters, blood glucose and blood pressure 2-in-1 monitors, hemoglobin meters, etc.

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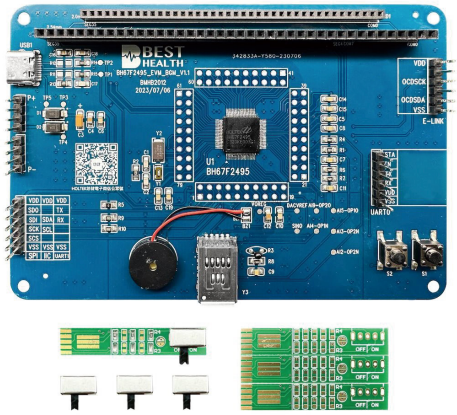
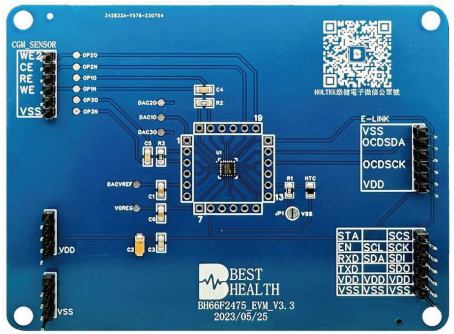


Development Tools

HT8 CGM Glucose Meter MCU Development Board

The BMHB2008 is a development board of the BH66F2475, which provides a multi-channel 24-bit Delta Sigma A/D converter and a continuous glucose monitoring AFE. It is suitable for use in CGM glucose meters.



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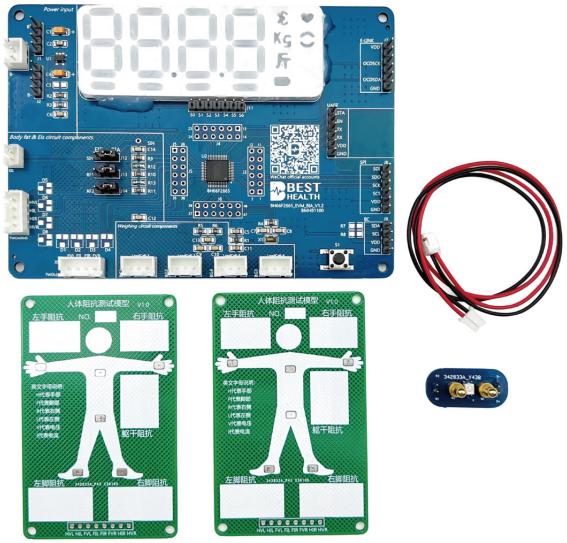
HT8 Body Fat Measurement MCU Development Board

The BMHB1100 is a development board of the BH66F2665, which provides a multi-channel 24-bit Delta Sigma A/D converter and a body fat measurement AFE. It is suitable for use in eight-electrode body fat scales.



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Development Resources

Online Debug Adaptor

The e-Link is an online debug adaptor for Holtek's OCDS architecture Flash MCUs. Together with the HT-IDE3000 software it allows users to program and debug programs on their target boards. It provides debug operations such as single step, full speed, stop, breakpoints during the debug process.

Hardware：e-Link
Software：HT-IDE3000

Programmer

The e-WriterPro can be used as a programming tool for all of Holtek MCUs, supports both online and offline programming modes and can also be used for small to medium volume production purposes.

Hardware：e-WriterPro
Software：HOPE3000

Reference Files

24-Bit Delta Sigma ADC PCB Layout Guide

This article provides some 24-bit ADC PCB layout notes to assist designers to appropriately layout the PCB to obtain accurate measurement results.

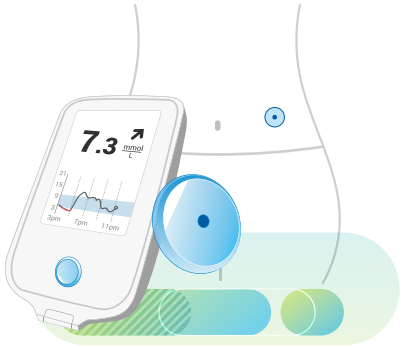
HT8 MCU 24-Bit Delta Sigma A/D Converter Application Note

This article takes an HT8 MCU as an example to introduce the usage of the Delta Sigma ADC.

Application Solutions

CGM Continuous Glucose Monitor

The Holtek CGM solution uses an AFE MCU specifically designed for continuous glucose monitoring applications. The AFE MCU includes a multi-channel 24-bit Delta Sigma A/D converter and a continuous glucose monitoring circuit, which includes operational amplifiers and 12-bit D/A converters. The MCU requires only a small amount of peripheral circuits to implement 2/3/4-electrode continuous glucose monitoring. The MCU also provides an SPI/UART interface.

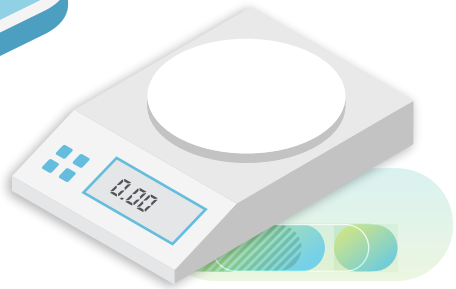


High Accuracy Blood Glucose Meter

The Holtek high accuracy blood glucose meter solution uses an MCU that supports HCT measurement. For blood glucose meters, the MCU integrates several related functions, including an internal reference voltage generator, an internal LDO, a 24-bit Delta Sigma A/D converter, 12-bit D/A converters, operational amplifiers and an LCD driver, etc. It requires a small amount of peripheral components to use for blood glucose meters.

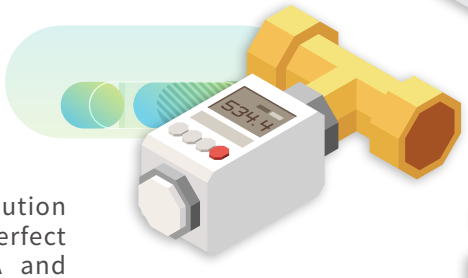
Touch Key Kitchen Scale

Holtek has released an LCD type MCU which can be applied for use in LCD/LED touch kitchen scale products. This solution has the advantages of high functional integration, low cost and so on. With the integrated 24-bit ADC, LCD/LED Driver and Touch Key functions, this solution can help users to rapidly develop all the functions required by high-accuracy touch kitchen scale products.



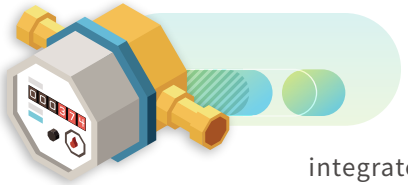
Temperature Transmitter

The Holtek temperature transmitter (4~20mA) uses a measurement dedicated MCU, which reduces the solution cost on the basis of ensuring perfect functions. The integrated LDO, OPA and 12-bit DAC facilitate the construction of constant voltage/constant current circuits to drive the sensor. The 24-bit Delta Sigma ADC is used to accurately sample the sensor signals. The 16-bit PTM can generate a high-resolution PWM signal for 4~20mA current transmission. Using this MCU solution only requires a very simple peripheral circuit.



Pressure Transmitter

The Holtek pressure transmitter (4~20mA) uses a measurement dedicated MCU, which reduces the solution cost on the basis of ensuring perfect functions. The integrated LDO, OPA and 12-bit DAC facilitate the construction of constant voltage/constant current circuits to drive the sensor. The 24-bit Delta Sigma ADC is used to accurately sample the sensor signals. The 16-bit PTM can generate a high-resolution PWM signal for 4~20mA current transmission. Using this MCU solution only requires a very simple peripheral circuit.



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