

Freespace® Reference Design with Bluetooth® RF

Hillcrest Labs' patented Freespace motion solution interfaces with low-cost, commercially available MEMS accelerometers and gyroscopes to sense motion in three dimensions and precisely translate movements to control a cursor for use in pointing remote controls and computer peripherals. The solution also enables motion control and tracking for use in immersive video game systems, gestural interfaces and many more applications. This reference design incorporates a complete six-axis Freespace motion solution integrated with Bluetooth RF. To simplify evaluation, the reference kit includes a remote control packaged in a small form factor. The removable Freespace Sensor Module includes the Freespace MotionEngine and microprocessor together with MEMS inertial sensors and supports prototyping with other form factors.

Core Motion Sensing Features

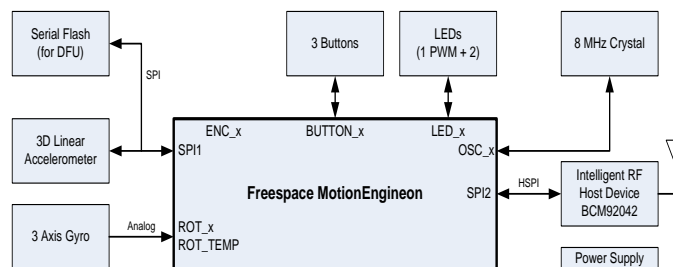
- Produces accurate, low-latency X-Y pointer data for use by a host to control cursor motion
- Produces linear acceleration (mm/s²) and angular velocity (mrad/s)
- Produces angular position (quaternion)
- Provides six-axis sensor configuration
- Includes an embedded processor

Advanced Motion Processing Features

- Orientation compensation – Compensates for tilt by translating motion from the body frame of reference to the user frame of reference
- Button motion suppression – Compensates for inadvertent movement caused by button and scroll events
- Adaptive tremor removal – Cancels the effects of unintended motion caused by user tremor
- Power management – Performs wake-on-motion and on-table detection

Host Interface Features

- Includes Bluetooth RF at 2.4 GHz
- Pairs easily to host device
- Supports multiple simultaneous devices
- Produces HCOMM (Hillcrest Communication Protocol) USB HID reports



Module Block Diagram

User Interface Features

- Includes 3 configurable buttons
- Includes 1 programmable PWM LED
- Includes 2 programmable on/off LEDs
- Supports up to 9 buttons and scroll wheel when used as a module
- Produces mouse button events, keyboard events and consumer page events
- Provides low battery indication

General Features

- Plastic enclosure with removable module
- Powered by 2 AAA batteries (included)
- On/off power switch located on bottom
- Intelligent, automatic power management
- Upgradeable device firmware
- Supported by Hillcrest's Freespace MotionStudio
- Supported by Hillcrest's libfreespace open source library

Applications

- Remote controls
- Computer mice
- Wireless presenter
- Mobile handsets
- Game controllers
- Head trackers
- Virtual reality systems
- Robotics



FSRK-BT-1 as a Remote Control

General Specifications	Value
Dimensions (length x width x height)	4.7" x 1.2" x 0.7" 118 x 29 x 18 mm
Weight (with batteries)	52 grams (1.8 oz)
Operating Temperature Range	0°C to 50°C
Storage Temperature Range	-30°C to 70°C
Latency (motion to HID report)	20 milliseconds
Supply Voltage	1.8 V to 3.6 V
Supply Current @3.0V (active)	40 mA
Supply Current @3.0V (sleep)	0.15 mA

Performance Specifications	Value
Overall	
Update Rate	125 Hz
Bandwidth (-3 dB point)	40 Hz
Pointer	
Sensitivity	35 mickeys / °
Biased Angle Error	< 2° typical
Unbiased Angle Error	< 1° typical
Ripple	1 mickey typical
Hysteresis (>12°/s motion)	3%
Drift	< 100 mickeys / hr
Tremor Cancellation	70%
Linear Acceleration	
Range	± 2 g
Bias (zero-g offset)	< 100 mg
Sensitivity Accuracy	2%
Non-linearity (% full-scale)	3%
Resolution	< 5 mg
Angular Velocity	
Range	± 500 °/s
Bias (zero-rate offset)	< 0.5 °/s
Sensitivity Accuracy	3%
Non-linearity (% full-scale)	1%
Resolution	0.5 °/s
Angular Position	
Range	Any orientation
Bias	< 5°
Resolution	< 0.3°

Hillcrest Laboratories (a.k.a. Hillcrest Labs) sells products to enable a new class of motion and interactive applications. Hillcrest Labs offers its Freespace motion technology as a turnkey solution for motion sensing, motion control, and motion tracking applications including in-air pointing remote controls, motion-sensing game controllers, wireless presenters, mobile handsets, and gesture recognition systems. Freespace motion technology is also used in Hillcrest's Loop™ pointer, a direct-to-consumer in-air mouse for TV that lets users control an on-screen cursor with a flick of the wrist and navigate the Web or their home media content on TV. Hillcrest's products have received numerous awards and recognitions including two CES Innovations Awards, PC World's 100 Best Products and Greatest Tech Designs, ECN's Reader's Choice Tech, Popular Mechanics' Editors Choice, and others.

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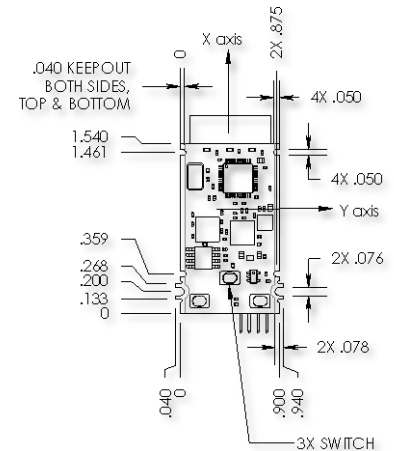
Bluetooth® Host

The FSRK-BT-1 includes a Bluetooth device that works with any standard Bluetooth host device. A Bluetooth adapter is required for use with host devices that do not have Bluetooth. Hillcrest recommends:

- Belkin Mini Bluetooth Adapter (F8T016)
- D-Link DBT-120

Module

The FSRK-BT-1 includes a plastic enclosure that holds the module and 2 AAA batteries. The module can be removed from the plastic enclosure and embedded in a custom prototype to demonstrate Freespace motion sensing with Bluetooth RF. The module supports all features of the processor including 9 buttons and a scroll wheel. Test points on the module allow prototyping access to the processor signals. See the detailed engineering documents.



Additional Information

Product information, white papers, and tools are available at <http://www.hillcrestlabs.com/freespace>

Patent Protection

Hillcrest Labs has a worldwide portfolio of over 200 patents and patents pending including foundational patents for Freespace motion technology and the HōME® application creation platform.

This product is a reference kit intended only for evaluation in a research and development environment, not for use in a residential environment. It has not been tested for compliance with FCC or CE EMC regulations regarding interference with radio frequency energy. It might cause harmful interference with radio communications. The user assumes responsibility for any interference caused by this device.