

ZL70103

MICS-Band RF Transceiver

Wireless for Implantable Medical Devices

The ultra-low-power ZL70103 RF transceiver chip supports a MICS-band (Medical Implantable Communication Service band) RF link used exclusively with implantable medical device applications. The chip's unique design allows patient health and device performance data to be monitored, with little impact to the useful battery life of the implanted device.

The ZL70103 is designed for use in implanted medical devices and in external devices such as programmers, monitors, and patient controllers. Utilizing Microsemi's ultra-low-power and RF expertise, the ZL70103 delivers key performance benefits with a high level of integration.

The chip is very flexible and supports two low-power wake-up options. Ultra-low-power operation is achieved using the 2.45-GHz ISM-band wake-up receiver option. Alternatively, a low-power 400-MHz wake-up option is also available. The high level of integration includes a MAC that provides transmit and receive buffers accessed via highly efficient, multibyte, SPI bus transactions. The MAC also provides automatic packet transmission with automatic retransmissions on error detection, thereby achieving a robust and reliable link without involving the application processor.

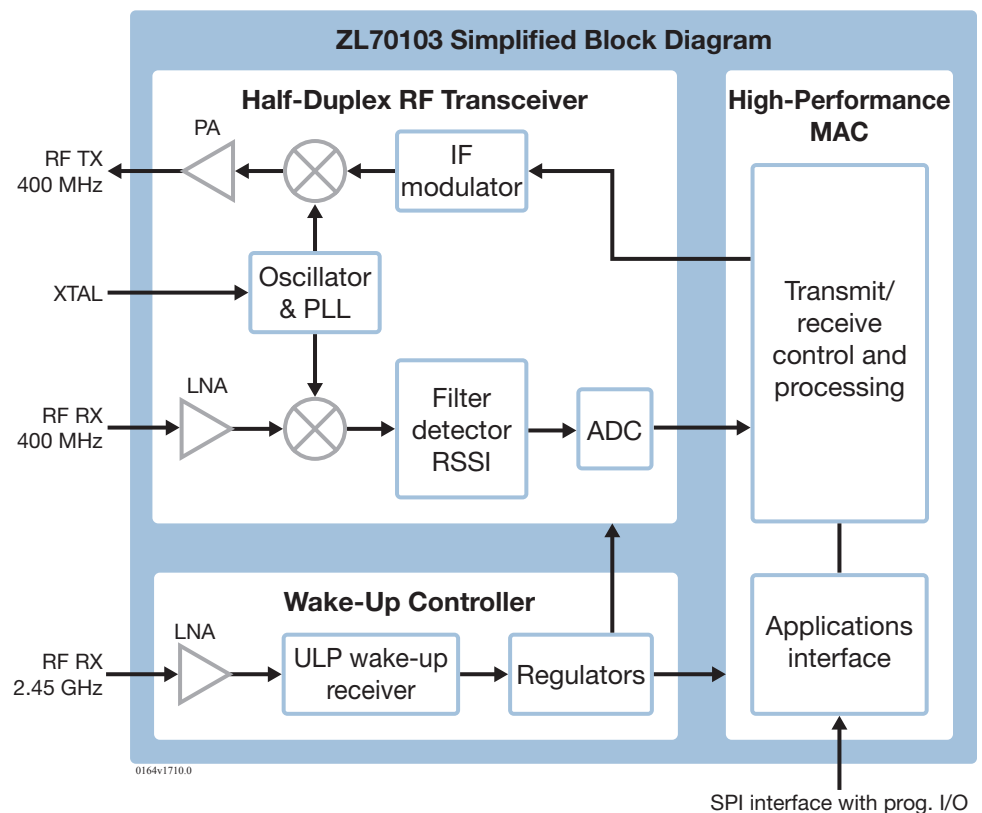
Applications

The ZL70103 is designed to be used with implanted medical devices including:

- Pacemakers
- Implantable cardioverter defibrillators (ICDs)
- Neurostimulators
- Implantable sensors and diagnostic devices
- Drug pumps

Key Features

- Meets performance, power, and size requirements for implanted communication systems
- Operates in the 402-MHz to 405-MHz (ten MICS channels) and 433-MHz to 434-MHz (two ISM channels) frequency bands
- Wide range of high-performance data rates (18.18 kbit/s, 40 kbit/s, 200 kbit/s, or 400 kbit/s raw data rate) allowing users to trade off data rate for sensitivity in a variety of use cases from shallow to deep implants
- Ultralow power consumption that extends battery operating life of implanted devices:
 - ♦ 5 mA average TX/RX current
 - ♦ 290 nA average SLEEP/SNIFF current (1-second external strobe period)
- Highly integrated MAC providing automatic packet transmission with automatic retransmissions on error detection
- Very few external components (three components plus antenna matching)
- Compliant with MedRadio, MICS, FCC, ETSI, and IEC standards



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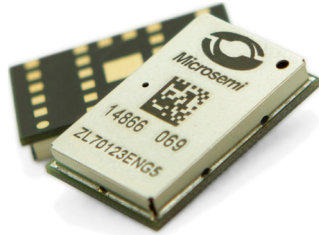
RF Modules for Implantable and External Medical Devices

To provide flexibility and simplified hardware design, the ZL70103 device is available in module format. This allows customers to both evaluate and implement a complete radio solution without having to spend significant engineering resources on RF development.

ZL70123 Base Station Module

The ZL70123 is a complete RF base station module designed to interact with implantable medical devices that are based on the ZL70103, ZL70102, and ZL70101 family of products. The ZL70123 module features:

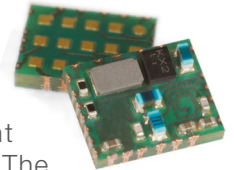
- 400-MHz transceiver with matching network & SAW filter (50 Ω)
- 2.45-GHz wake-up transmitter (50 Ω)
- Provisions for an external log amplifier to support Clear Channel Assessment (CCA)
- Fully shielded package
- Compliant with MedRadio, MICS, FCC, ETSI, and IEC standards
- RoHS compliant
- 18-mm \times 12-mm, 29-pad LGA footprint with a height of 2.95 mm



Please refer to the ZL70123 datasheet for additional information.

ZL70323 Miniaturized Standard Implant Module

The ZL70323 implant module is a small, ready-to-use, RF module providing a complete radio solution for implant applications based on the ZL70103. The ZL70323 module features:



- Integrated 24-MHz reference frequency crystal
- Decoupling capacitors for the supply and built-in regulators
- Separate RF port connections for 400-MHz and 2.45-GHz
 - ◆ Both RF connections have complete matching networks.
 - ◆ The 400-MHz RF port includes a SAW filter to handle blockers.
- 4.5-mm \times 5.5-mm, 15-pad LGA footprint with a height of 1.6 mm
- Implant-grade quality assurance

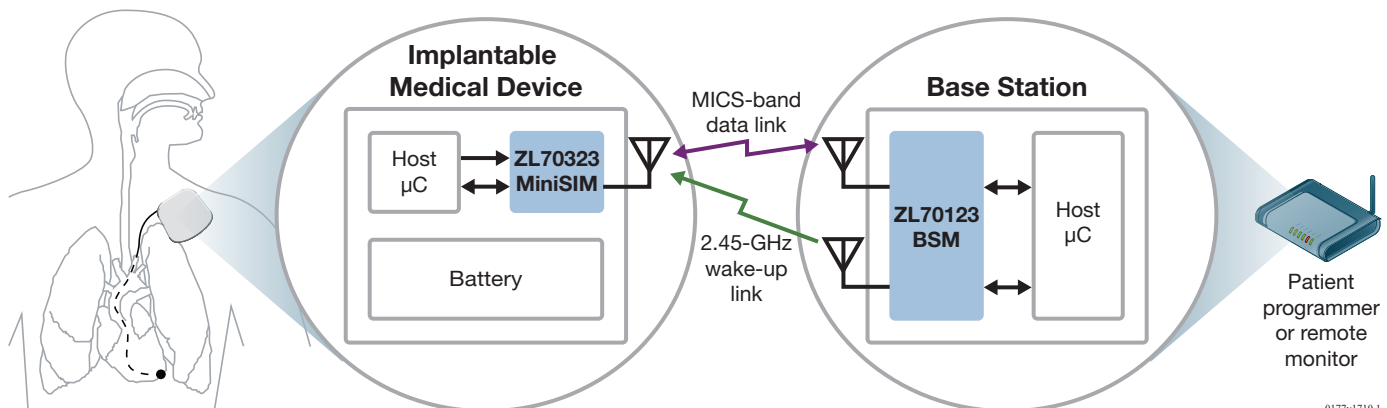
Please refer to the ZL70323 datasheet for additional information.

Implantable Communications Systems

In the surgical and bedside environment, longer operating ranges enhance the implantation procedure for, and remote monitoring capabilities of, implantable medical devices. As shown below, an ultra-low-power RF transceiver in a pacemaker or ICD can wirelessly transmit patient event and device performance data to a base station in the operating room or in the home. In the remote monitor application, data is forwarded over the telephone or internet to a physician's office. If a problem is detected, the patient goes to the hospital where the robust, two-way RF link is used to monitor and adjust device performance under a doctor's supervision. Additionally, when the ZL70103 is used in neurostimulator applications, patient controllers allow users to manage their pain levels on demand.

In order to better support a wide range of use cases, the ZL70103 family of products offers two new raw data rates of 18.18 kbit/s and 40 kbit/s in addition to the data rates of 200 kbit/s and 400 kbit/s used in its predecessor IC (ZL70102). These new data rates provide significantly enhanced link budgets for difficult use cases such as deep implants or longer range applications.

Battery life is a critical performance parameter for implanted devices. The ZL70103 transceiver incorporates a 2.45-GHz wake-up receiver that allows the IC to operate with an average current of 290 nA while sniffing once a second with an external strobe. If a specially coded 2.45-GHz wake-up message is detected while sniffing, the implant is woken up autonomously and starts a MICS-band communication session. Alternative wake-up mechanisms using 400-MHz or direct wake-up are also supported.



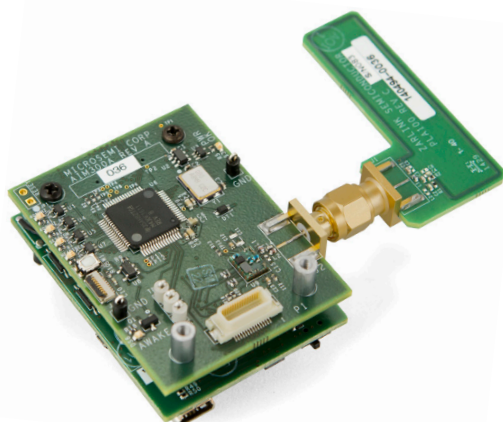
ZL70103 Application Development Kit

The ZL70103 Application Development Kit (ADK) enables rapid evaluation, prototyping, and development of MICS-band medical RF communication systems. The kit combines hardware and software to create an end-to-end MICS-band communication system that demonstrates the ZL70103 RF transceiver's exceptional energy efficiency and robust link features.

The ZL70103 ADK (ZLE70103BADA) is an out-of-the-box solution that includes all hardware and software required to quickly and easily design medical RF communication systems. The kit includes:

- One base station unit
 - ♦ The RF section is based on the ZL70123 base station module, which is included on the Base Station Mezzanine (BSM300A) board.
 - ♦ The application microcontroller allows programming and debugging using a JTAG debug interface.
 - ♦ The dual-band helical antenna (400 MHz and 2.45 GHz) is designed to have an optimal radiation pattern. The SMA connector allows custom antennas to be tested.
 - ♦ The BSM300A board is paired with an ADP100A board (described below), resulting in a complete RF test and evaluation platform for a base station application.
- One implant unit
 - ♦ The RF section is based on the ZL70323 miniaturized standard implant module, which is included on the Application Implant Mezzanine (AIM300A) board.
 - ♦ The application microcontroller allows programming and debugging using a JTAG debug interface.
 - ♦ The dual-band printed loop antenna (400 MHz and 2.45 GHz) is matched to 50 ohms for operation in air. The SMA connector allows custom antennas to be tested.
 - ♦ The AIM300A board is paired with an ADP100A board (described below), resulting in a complete RF test and evaluation platform for an implant application.
- Two Application Development Platform (ADP100A) bridge boards, each including:
 - ♦ A separate communication microcontroller to allow for USB2.0 interface between a PC running the ADK software and the application processor on the mezzanine board.
 - ♦ Battery controller with charger.
 - ♦ Lithium-ion battery to allow stand-alone operation of the Application Implant Mezzanine (AIM300A) board.
 - ♦ Programmable power supply with integrated current/voltage measurement capability.
- One MICS Test Adapter (MTA100A) board that can mount to either mezzanine board to allow for observation and monitoring of key analog and digital signals
- Full documentation
 - ♦ The software download includes the ADK User's Guide, Source Code Overview, and extensive hardware documentation (board schematics, layout, Gerber files, and Bill of Material (BOM)) for all included boards.

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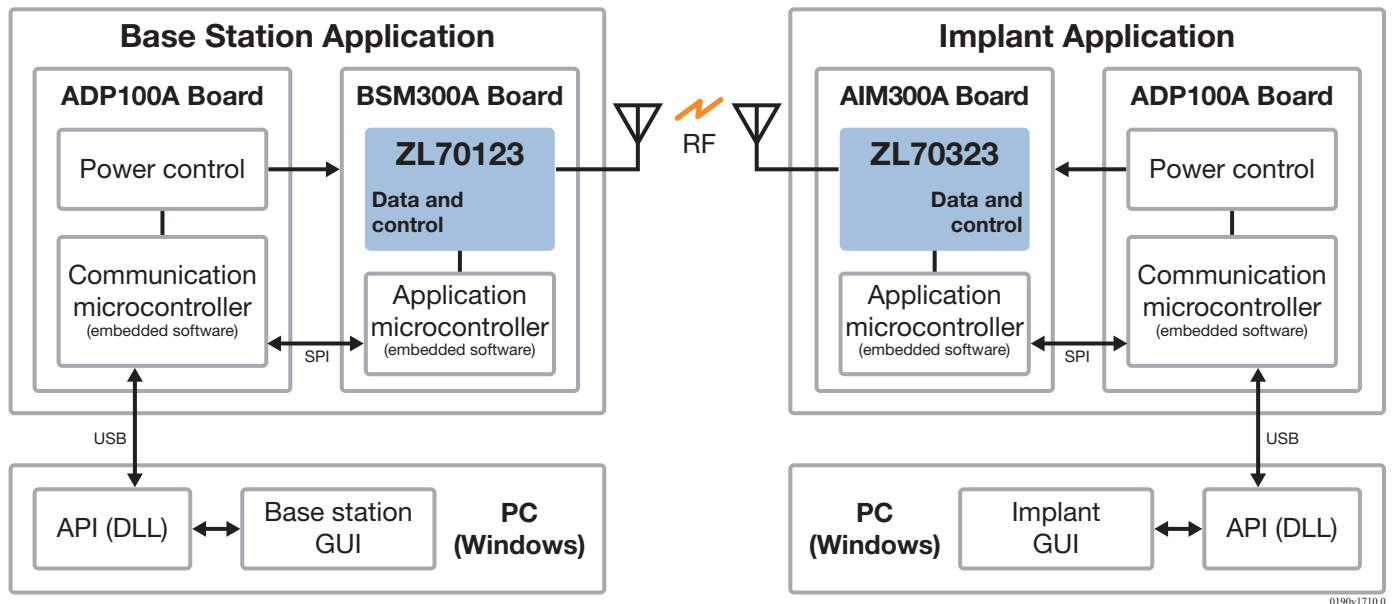
Implant Unit (AIM300A)



Base Station Unit (BSM300A)

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ZL70103 Application Development Kit Block Diagram

ZL70103 Application Development Kit, continued

Using the ZL70103 ADK, customers can quickly create their own custom board designs and use Microsemi software as a starting point for software development for specific ZL70103-enabled MICS-band RF communication systems. All source code is available once an NDA and a Source Code License Agreement (SCLA) are in place.

- GUI software
 - ♦ Windows GUI application that provides a user-friendly visual interface for controlling and demonstrating the performance and capabilities of a ZL70103-enabled RF communication system including all the functionality of the ZL70103, as well as providing access to several system-level tools and ZL70103-specific registers.
 - ♦ Complete source code is available. The code is well commented and is written in Microsoft's C#.
- Windows API (DLL) software
 - ♦ Provides an interface for the ZL70103 ADK GUI over a USB2.0 interface to the base station and implant application processor.
 - ♦ Allows customers to write their own software to control the base station and implant application boards.
 - ♦ Complete source code is available. The code is well commented and is written in C.
- Embedded firmware
 - ♦ Supports all radio functions for base station and implant applications. Most customers port this code to their base station or implant application processor, thereby greatly reducing their development and debug time while taking advantage of a robust set of MICS functions.
 - ♦ Complete source code is available. The code is well commented and is written in C.



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