ZL70321 MICS-Band RF Standard Implant Module (SIM)

Features

- Complete MICS-Band[1] RF Telemetry Radio Solution
- Implantable Radio Module Designed to Enable Simple Development of Implantable Medical Devices
- Implant-Grade Quality Assurance
- Integrated High-Performance Antenna Matching, SAW Filter, and Antenna Tuning Circuitry
- Compact Design and Small Size Suitable for Implants
- Fully Shielded Package
- Integrated Reference Frequency Crystal and Decoupling Capacitors
- Designed to Meet Regulatory Requirements (FDA, FCC, ETSI, and IEC)

Applications

- Implantable Medical Devices
  - Cardiac Rhythm Management
  - Neurostimulators
  - Drug Delivery, Sensors, and Diagnostics

Description

The ZL70321 implantable radio module implements all RF-related functions needed to deploy the implantable node in a MICS-band RF telemetry system. The integrated antenna tuning circuit allows the module to be used with a wide range of implantable antennas (nominal antenna impedance is 100+j150Ω). Figure 1 shows the module's major functions:

- ZL70102-based MICS-band RF transceiver with an integrated matching network, SAW filters for suppression of unwanted blockers, and antenna tuning.
- 2.45-GHz wake-up receiver matching network.
- Integrated 24-MHz reference frequency crystal.
- Decoupling capacitors.

Ordering Information

ZL70321MNJ 43-pad LGA

Please refer to "Package Overview" on page 4-6 for details.

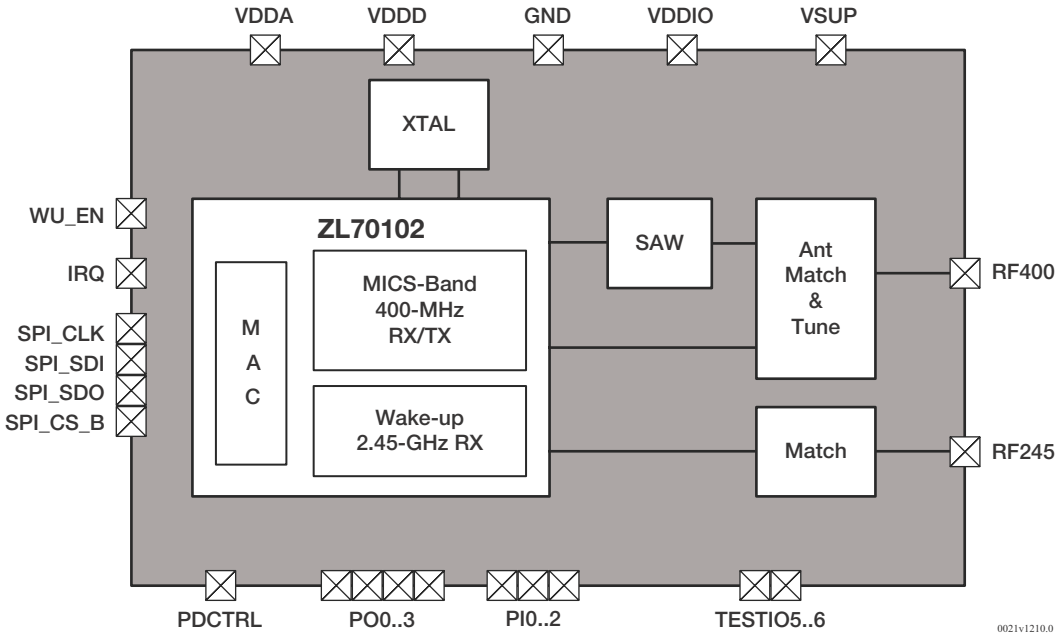

Figure 1 • **ZL70321 Block Diagram**

1 *MICS is a subset of MedRadio.*

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1 – Product Description

The ZL70321 implantable radio module is a high-performance, easy-to-use RF module based on the ZL70102 MICS-band transceiver IC. The module is small and is designed to provide good performance while consuming very little power.

The ZL70321 RF module integrates all the circuitry and functionality required to deploy a complete radio solution for implantable applications. This allows the circuit complexity to be reduced to placing one single package on your implantable application board.

Please refer to Table 1-1 below for all documents related to the ZL70102 family of products. These documents can be found on Microsemi's website or by contacting Microsemi's CMPG sales for more information.

***Table 1-1* • Related Documentation**

Product	Document(s)	Description
ZL70102 MICS-Band RF Transceiver	ZL70102 Datasheet ZL70102 Design Manual	The ZL70102 MICS-Band RF Transceiver is designed specifically for use in implantable medical devices (such as pace makers and neurostimulators). It also supports external applications (such as programmers and patient controllers).
ZL70120 MICS-Band RF Base Station Module (BSM)	ZL70120 Datasheet	The ZL70120 BSM is a ZL70102-based RF module that integrates additional circuitry and functionality required for external applications.
ZLE70102 Application Development Kit (ADK)	ZLE70102 ADK Users Guide	The ADK combines hardware and software to provide an end-to-end MICS-band communication system based on the ZL70120 Base Station Module and the ZL70321 Standard Implant Module. Additionally, source code with programming examples is available with a source code license agreement (SCLA).

2 – Functional Description

General

The ZL70321 module provides all the circuitry needed to deploy a complete, implanted, MICS-band, RF telemetry radio solution (PHY- and MAC-layers). The ZL70321 is designed to be versatile so it can serve a broad range of applications with different antenna, feed-through, and case implementations. Please refer to the ZL70102 Data Sheet and the ZL70102 Design Manual for further details on using the ZL70102.

Power Supply Requirements

The module contains a decoupling capacitor on the VSUP power supply input as well as integrated decoupling capacitors required by the analog and digital regulators of the ZL70102.

The VDDA and VDDD pads are test pads and should be neither loaded nor used in the user application. They are connected to the internal analog and digital regulators of the ZL70102 and are intended only for production testing by Microsemi.

MICS-Band Transceiver

The MICS-band transceiver is based on the ZL70102 IC. The transceiver signal chain is equipped with a matching network, a SAW filter, and antenna tuning to allow a wide range of antennas to be used with the module. Please refer to "Antenna Requirements" for more details.

Reference Frequency Crystal

The ZL70321 module is equipped with a 24-MHz reference frequency crystal supporting the integrated XO of the ZL70102. Please refer to Chapter 10 in the ZL70102 Design Manual for information on tuning the XO.

General Purpose I/O

The ZL70321 module provides access to the PI0..2, PO0..3, and TESTIO5..6 pads of the ZL70102. PDCTRL should be connected to VDDIO to enable the internal pull-down of the PI0..2 pads if they are unconnected; alternatively, the PI0..2 pads may be grounded. Please refer to the ZL70102 Data Sheet and the ZL70102 Design Manual for further details.

2.45-GHz Wake-Up Receiver

The 2.45-GHz wake-up receiver is integrated on the ZL70102 radio IC and provides a very power-efficient wake-up subsystem. All necessary RF matching is integrated on the ZL70321 module, and the RF245 and RF400 ports can be shorted together and connected directly to the antenna.

If the ZL70321 module is operated without using the 2.45-GHz wake-up, the RF245 connection should be grounded.

Antenna Requirements

Antenna Tuning

The ZL70321 takes advantage of the integrated antenna tuning capacitors (MATCH1 and MATCH2). This allows the RF port to be tuned to the actual antenna impedance (within the supported tuning range). Please refer to Section 3.6 of the ZL70102 Design Manual for details.

Combined 400-MHz and 2.45-GHz Antenna

Nominal Antenna Impedance

The integrated matching network is optimized for a nominal antenna impedance of 100+j150Ω at 403.5MHz and 50Ω at 2442MHz when the two RF ports are combined.

400-MHz Antenna Tuning Range

Figure 2-1 shows a simulation of the impedance of the combined 400-MHz and 2.45-GHz RF ports as a function of frequency (MICS-band, 402 to 405MHz) and match tuning capacitor code. Red half circles represents MATCH1 codes 0, 4, 8, ..., 60, 63 and MATCH2 equal to 0. Cyan half circles have MATCH2 equal to 8, and magenta have MATCH2 equal to 16.

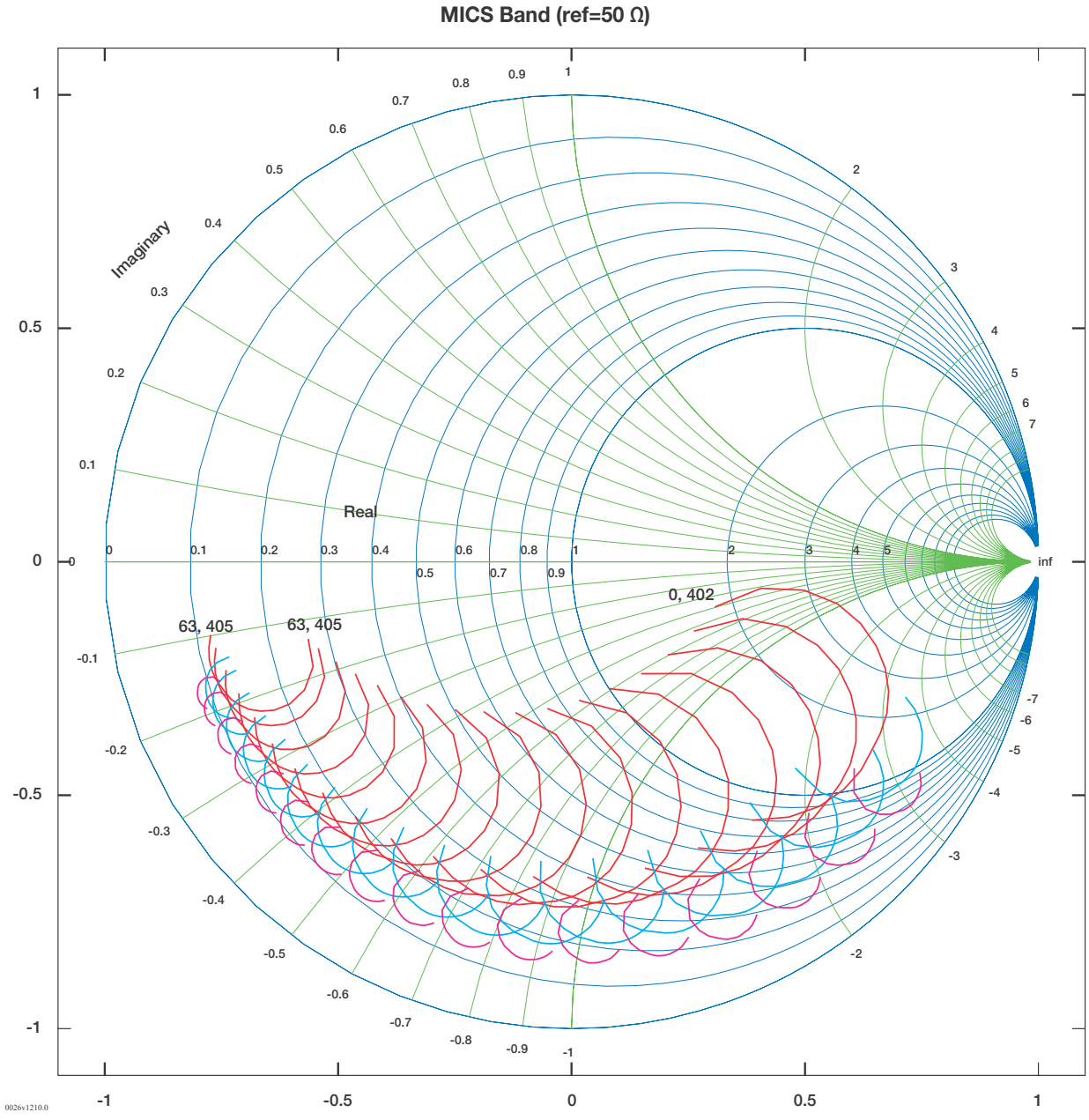


Figure 2-1 • **Combined Port Impedance (402 to 405MHz)**

2.45-GHz Antenna Tuning Range

Figure 2-2 shows a simulation of the impedance of the combined 400-MHz and 2.45-GHz RF ports as a function of frequency (2.45-GHz band, 2400 to 2485MHz) and RF245 input pad tuning capacitor (code 0, 2, ..., 15).

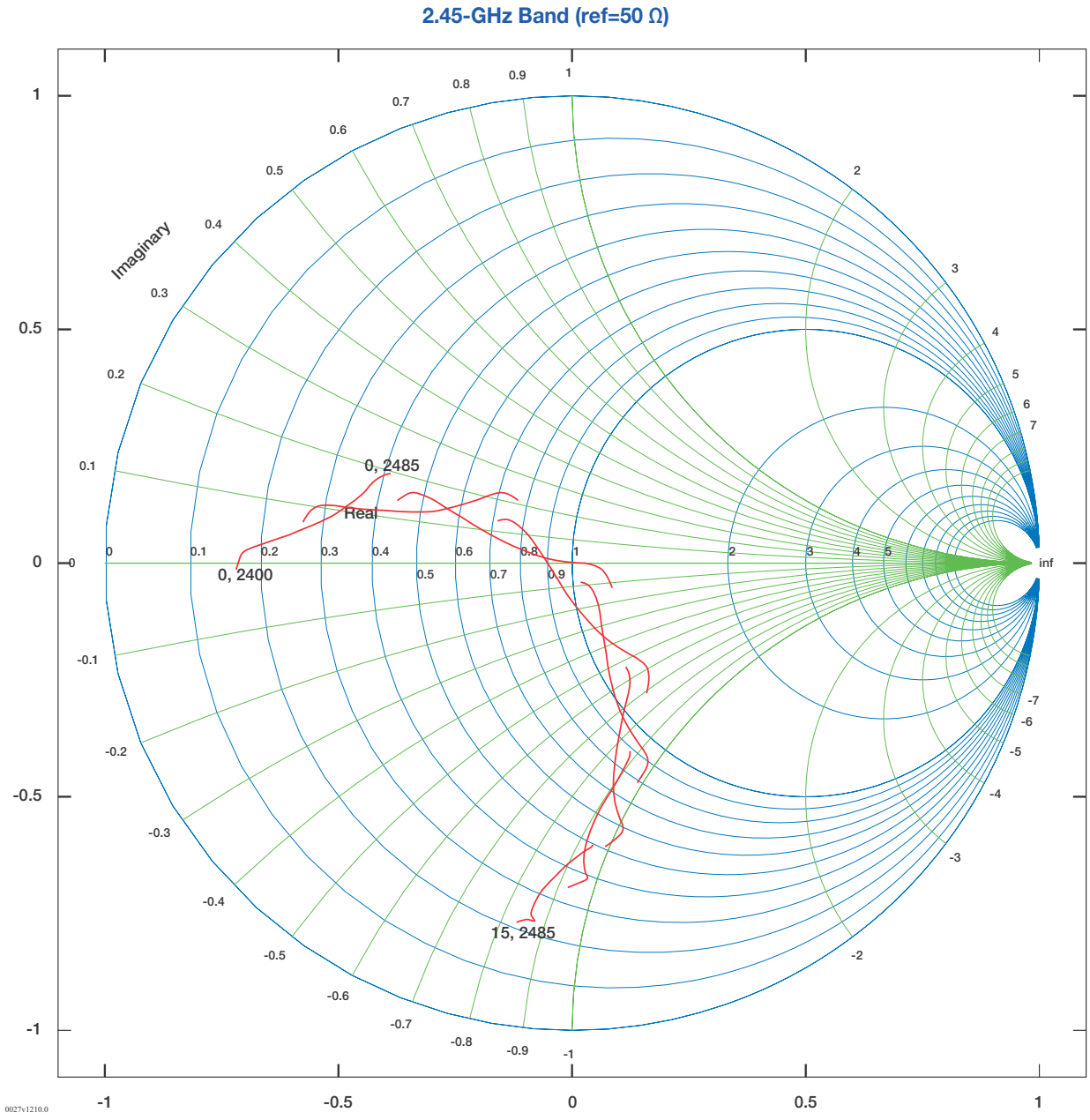


Figure 2-2 • **Combined Port Impedance (2400 to 2485GHz)**

3 – Electrical Specifications

Tables 3-1 through 3-9 provide the absolute maximum ratings and other electrical characteristics for the ZL70321. Voltages are with respect to ground (GND) unless otherwise stated.

Absolute Maximum Ratings

***Table 3-1* • Absolute Maximum Ratings**

ID	Parameter	Symbol	Limits				Note
			Min.	Typ.	Max.	Unit	
1.0	Supply voltage	V_{SUP}	0		3.6	V	
1.1	Input voltage (digital I/O)	V_{DDIO}	0		V_{SUP}	V	Note 1
1.2	Storage temperature	T_{stg}	−40		+125	°C	Note 2

Note:

1. *V_{DDIO} must never be higher than V_{SUP} even during system startup.*
2. *Device may be powered during burn-in but operation is not guaranteed.*

Operating Conditions

Recommended Operating Conditions

The recommended operating conditions in Table 3-2 define the nominal conditions for the device.

***Table 3-2* • Recommended Operating Conditions**

ID	Parameter	Symbol	Limits				Note
			Min.	Typ.	Max.	Unit	
2.0	Supply voltage	V_{SUP}	2.05		3.5	V	Note 1
2.1	Input voltage (digital I/O)	V_{DDIO}	1.5		V_{SUP}	V	
2.3	Operating temperature	T_{op}	0	+37	+55	°C	

Note:

1. *For voltages less than 2.1V, a production trim procedure must be followed.*

Electrical Characteristics

Default register and mode settings are assumed unless noted. The RF ports are assumed to have a nominal load equal to an antenna impedance of 100+j150Ω at 403.5MHz and 50Ω at 2442MHz when the two RF ports are combined.

Electrical testing during production is used to ensure that delivered parts fulfill the limits defined herein. In some cases it is not possible to perform electrical testing or the testing has been carried out in a different way. These exceptions are marked in the "Exceptn" column of Tables 3-3 to 3-8; refer to legend below.

① These parameters are guaranteed by production tests but with different limits to what is specified in the data sheet. This is due to limitations in the capabilities of the automated test equipment. The production tests that are carried out have been correlated to tests carried out in the lab environment.

② These parameters are guaranteed by production tests; however, these may be carried out in a different manner to that defined in the data sheet.

③ These parameters are tested during production test but the limits are for design guide only.

④ These parameters are for design aid only: not guaranteed and not subject to production testing.

⑤ Typical values according to the specified condition. If no conditions are specified, then the typical figures assume 37°C and V_{SUP} at 3.0V. Typical values are for design aid only: not guaranteed and not subject to production testing.

Digital Interface

The characteristics in Table 3-3 are valid for the following interconnects:

- Digital inputs: PDCTRL, WU_EN, SPI_CS_B, SPI_CLK, SPI_SDI, PI0, PI1, PI2
- Digital outputs: IRQ, SPI_SDO, PO0, PO1, PO2, PO3

Table 3-3 • **Digital Interface**

ID	Parameter	Symbol	Limits			Note
			Min.	Max.	Unit	
3.0	Digital I/O input low	V_{IL}	0	300	mV	Note 1
3.1	Digital I/O input high	V_{IH}	V_{SUP} − 300	V_{SUP}	mV	Note 2
3.2	Digital I/O output low	V_{OL}	0	150	mV	
3.3	Digital I/O output high	V_{OH}	V_{SUP} − 150	V_{SUP}	mV	
3.4	Maximum SPI clock rate	f_{clk}		4	MHz	Note 3

Notes:

1. *V_{IL} is the required input voltage to ensure internal signal switching from high to low.*
2. *V_{IH} is the required input voltage to ensure internal signal switching from low to high.*
3. *Default value. The maximum SPI clock rate can be programmed to 1, 2, or 4MHz.*

Performance Characteristics

Current Consumption

Table 3-4 • **Current Consumption**

ID	Parameter	Symbol	Condition	Limits					Note
				Min.	Typ.	Max.	Unit	Exceptn	
4.0	Sleep current	I_{sleep}	$T_{op} \le 37°C$		10	50	nA	⑤	Note 1
			$T_{op} \le 55°C$		10	150	nA	⑤	Note 1
			$-20°C \le T_{op} \le 60°C$		10	200	nA	⑤	Note 1, 2
4.1	Idle current	I_{idle}			0.95	1.1	mA	⑤	
4.2	400-MHz receive state current	I_{RX400}			4.3	5.0	mA	⑤	
4.3	400-MHz transmit state current	I_{TX400}	$V_{SUP} = 2.05V$		5.2	5.7	mA	⑤	Note 3
			$V_{SUP} = 3.0V$		5.6	6.1	mA	⑤	
4.4	400-MHz RSSI sniff current	$I_{sniff400}$			4.0	4.7	mA	⑤	
4.5	400-MHz average wake-up current	I_{wu400}				30	µA		Note 4
4.6	Wake-up strosc (strobe oscillator) current	I_{strosc}	$V_{SUP} = 2.05V$		270	320	nA	⑤	Note 5
			$V_{SUP} = 3.0V$		320	365	nA	⑤	
4.7	Wake-up 2.45-GHz RX sniff current	$I_{sniff245}$			1.4	1.8	mA	⑤	Note 6
			$-20°C \le T_{op} \le 60°C$		1.4	2.1	mA	⑤	Note 2, 6
4.8	Average wake-up current (external pulse on WU_EN)	I_{wu245_ext}	$T_{op} \le 37°C$		290	410	nA	⑤	Note 6, 7
4.9	Average wake-up current (internal strobe oscillator)	I_{wu245_int}	$T_{op} \le 37°C$		600	810	nA	③⑤	Note 6, 7

Notes:

1. *WU_EN low between external strobe pulses.*
2. *The extended temperature operating conditions specify a temperature range where the chip is operating but has limited performance. The purpose of this temperature range is to provide a wider temperature range for devices that are powered on but are in stand-by and stored before use. Under these conditions, the device always powers up and communicates as expected.*
3. *Register setting for power code reg_rf_txrfpwrdefaultset is 48.*
4. *Wake-up strobe period is 1s.*
5. *WU_EN low between internal strobe pulses.*
6. *Register setting for bias code reg_wakeup_lnabiasis10; reg_wakeup_wk_rx_lna_negrtrim1 based on trimming.*
7. *Wake-up strobe periodis 1s; register setting for reg_wakeup_stroscpwidth1 is 7.*

400-MHz Transmitter

Table 3-5 • 400-MHz Transmitter

ID	Parameter	Symbol	Condition	Limits					Note
				Min.	Typ.	Max.	Unit	Exceptn	
5.0	Maximum transmit power	$P_{TX400max}$	T_{op} = 37°C and V_{SUP} = 2.05V	−6.7	−5.0		dBm	⑤	Note 1
			T_{op} = 37°C and V_{SUP} = 3.0V	−4.0	−2.0		dBm	⑤	
5.1	Minimum transmit power	$P_{TX400min}$				−31	dBm	①	Note 2
5.2	Unwanted emissions outside the 401.75 – 405.25-MHz band	$E_{outband}$				−30	dBc		Note 3
5.3	Unwanted emissions within the 401.75 – 405.25-MHz band	E_{inband}				−20	dBc		Note 4

Notes:

1. *Register setting for power code reg_rf_txrfpwrdefaultset is 48.*
2. *Register setting for power code reg_rf_txrfpwrdefaultset is 0.*
3. *Fulfills FCC CFR47.95. Requires trimming; please refer to the ZL70102 Design Manual for details.*
4. *Fulfills FCC CFR47.95.*

400-MHz Receiver

Table 3-6 • 400-MHz Receiver

ID	Parameter	Symbol	Condition	Limits					Note
				Min.	Typ.	Max.	Unit	Exceptn	
6.0	Minimum RF amplifier and mixer gain	G_{RX}			11	16	dB	①⑤	
6.1	Maximum RF amplifier and mixer gain	G_{RX}		24	33		dB	①⑤	
6.2	1-dB compression point referred to input	ICP1			−41		dBm	③⑤	Note 1
6.3	Third-order input intercept point	IIP3			−32		dBm	④⑤	Note 1
6.4	Minimum RX sensitivity (2FSK-fallback)	$P_{RX\_2F\_FB}$			−90	−87	dBm	①⑤	
6.5	Minimum RX sensitivity (2FSK)	P_{RX_2F}			−85	−82	dBm	①⑤	
6.6	Minimum RX sensitivity (4FSK)	P_{RX_4F}			−78	−74	dBm	①⑤	

Note:

1. *Register reg_rf_rxrflnagaintrim set to 127 (second highest gain).*

2.45-GHz Receiver

Table 3-7 • 2.45-GHz Receiver

ID	Parameter	Symbol	Condition	Limits					Note
				Min.	Typ.	Max.	Unit	Exceptn	
7.0	Minimum sensitivity at RF245 pad (normal mode)	P_{RX245}	$T_{op} \leq 37°C$		−73	−65	dBm	②⑤	Note 1
7.1	Minimum sensitivity at RF245 pad (sensitive mode)	P_{RX245}	$T_{op} \leq 37°C$		−75	−67	dBm	②⑤	Note 2

Notes:

1. *3-µs RF-on time. No frequency hopping. 2.45-GHz receiver trimmed for the conditions. Register reg_wakeup_lnabias is 10; reg_wakeup_wk_rx_lna_negrtrim1 is based on trimming.*
2. *6-µs RF-on time. No frequency hopping. 2.45-GHz receiver trimmed for the conditions. Register reg_wakeup_lnabias is 10; reg_wakeup_wk_rx_lna_negrtrim1 is based on trimming.*

RF Ports

Table 3-8 • RF Ports

ID	Parameter	Symbol	Condition	Limits					Note
				Min.	Typ.	Max.	Unit	Exceptn	
8.0	400-MHz nominal port impedance, resistive part	R_{400}			100		Ω	⑤	
8.1	400-MHz nominal port impedance, reactive part	X_{400}			−j150		Ω	⑤	
8.2	2.45-GHz nominal port impedance, resistive part	R_{245}			50		Ω	⑤	
8.3	2.45-GHz nominal port impedance, reactive part	X_{245}			0		Ω	⑤	

ESD

Table 3-9 • ESD

ID	Parameter	Symbol	Limits				Note
			Min.	Typ.	Max.	Unit	
9.0	ESD	V_{ESD}	500			V	Note 1

Note:

1. *Human Body Model (HBM).*

4 – Mechanical Specifications

Pad List

Table 4-1 describes each pad on the ZL70321 module, and Table 4-2 provides definitions of the pad types listed in Table 4-1. Proper ground is essential for good and stable performance. Please ensure all ground pads are connected.

Table 4-1 • **ZL70321 Pad List**

Pad	Symbol	Description	Type	Notes
A1	VDDIO	Digital I/O supply	SUP	
A2	PDCTRL	Pull-down control for digital inputs	DI	
A3	IRQ	Interrupt request output	DO	
A4	SPI_SDI	Data input for SPI bus interface	DI	
A5	SPI_SDO	Data output for SPI bus interface	DO	
A6	SPI_CLK	Clock for SPI bus interface	DI	
B6	WU_EN	Wake-up enable signal	DI	
C6	GND	Ground supply connection	GND	
D6	SPI_CS_B	SPI chip select (active low)	DI	
E6	PI2	Programmable input 2	DI	
F6	PI0	Programmable input 0	DI	
G6	TESTIO6	Analog test bus pad 6	A	
H6	TESTIO5	Analog test bus pad 5	A	
J6	GND	Ground supply connection	GND	
K6	GND	Ground supply connection	GND	
L6	GND	Ground supply connection	GND	
L5	GND400	Ground supply connection (400-MHz RF)	RFGND	
L4	RF400	Antenna RF input and output for the MICS band	RF	
L3	RF245	Wake-up receiver RF input	RF	
L2	GND245	Ground supply connection (2.45-GHz RF)	RFGND	
L1	GND	Ground supply connection	GND	
K1	GND	Ground supply connection	GND	
J1	VDDA	Internal signal, not for customer use (analog on-chip regulated power; sensitive to noise)	INT	
H1	VSUP	Positive supply connection (3.3 V typical)	SUP	
G1	PO0	Programmable output 0	DO	
F1	PO1	Programmable output 1	DO	

Table 4-1 • **ZL70321 Pad List (continued)**

Pad	Symbol	Description	Type	Notes
E1	PI1	Programmable input 1	DI	
D1	PO2	Programmable output 2	DO	
C1	PO3	Programmable output 3	DO	
B1	VDDD	Internal signal, not for customer use (digital on-chip regulated power; sensitive to noise)	INT	
B2, E2, E3, E4, E5, F2, F3, F4, F5, G2, G3, G4, G5	SUBST_GND	Substrate ground connection	GND	

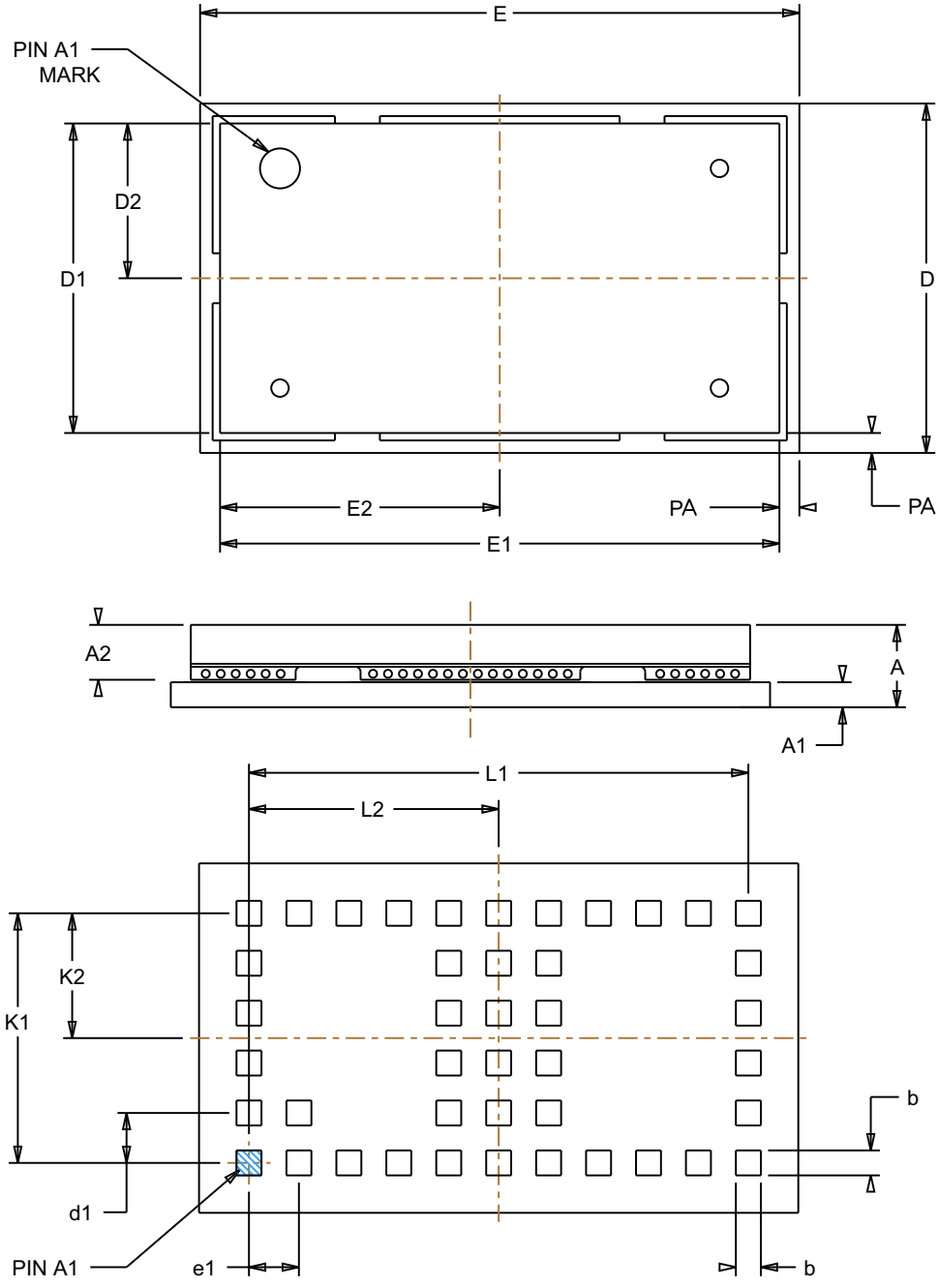
Pad Type Definitions

Table 4-2 • **Pad Type Definitions**

Type	Description
SUP	Supply pad.
GND	Ground pad.
RF	RF pad. Ensure proper isolation and track impedance.
RFGND	RF ground pad.
A	Analog pad (input and output).
DI	Digital input pad.
DO	Digital output pad.
INT	Internal signal. These signals are used inside the module and are made available only for Microsemi production testing.

Package Dimensions

Figure 4-1 and Figure 4-2 show the ZL70321 package dimensions and pad configuration, respectively.

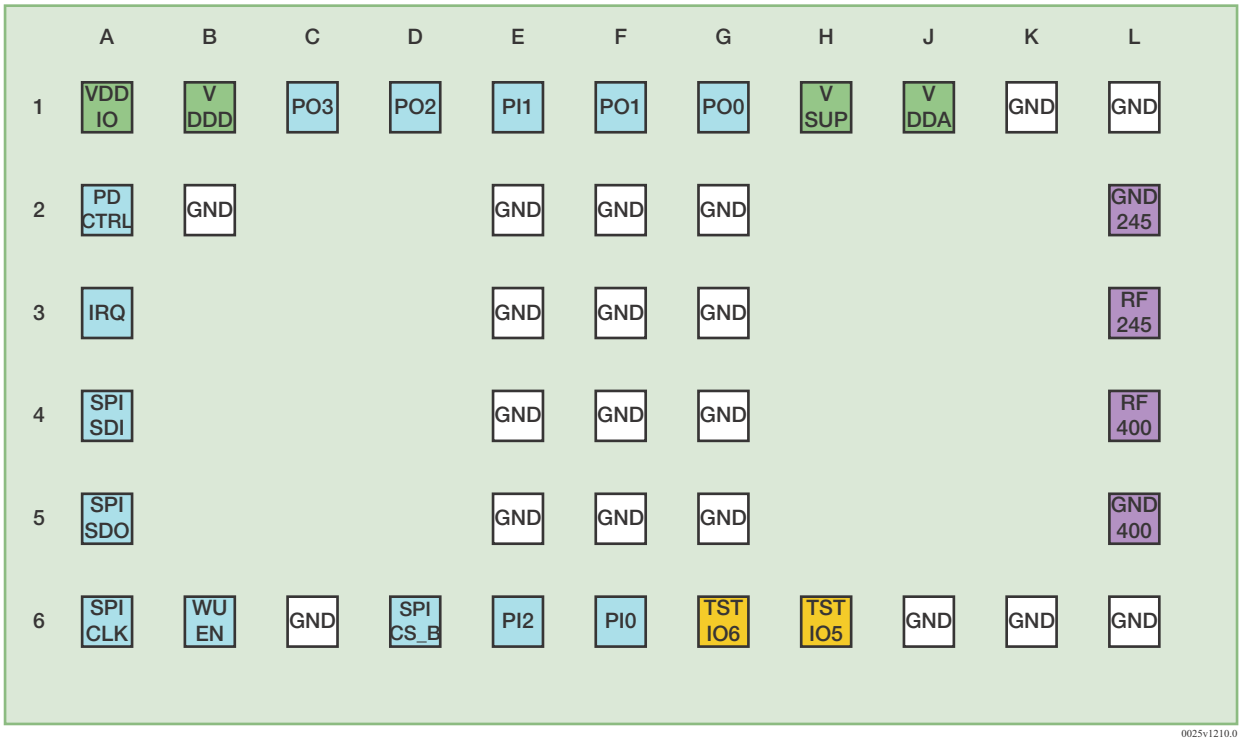


SYMBOL	MIN	NOM	MAX
A	1.4	1.55	1.7
A1	-10%	0.45	+10%
A2	1	1.1	1.2
E	11.9	12.0	12.1
D	6.9	7.0	7.1
E1	11.1	11.2	11.3
E2	5.6 BSC		
D1	6.1	6.2	6.3
D2	3.1 BSC		
PA	0.3	0.4	0.5
K1	5.0 BSC		
K2	2.5 BSC		
L1	10.0 BSC		
L2	5.0 BSC		
e1	1.0 BSC		
d1	1.0 BSC		
b	-	0.5	-

NOTES:
- COMMON DIMENSIONS (UNIT OF MEASURE = mm)
- CENTERLINE IS COMMON FOR ALL VIEWS

0024v1301.0

Figure 4-1 • **ZL70321 Package Dimensions**



Note: View from top

Figure 4-2 • **ZL70321 Pad Configuration**

PCB Layout Recommendations

Figure 4-3 shows the recommended PCB layout for the ZL70321. Dimensions are in millimeters. The layout is recommended only and can be changed depending on individual requirements and customer processes.

1. Substrate and module pad dimensions are 0.50 × 0.50 mm.
2. Pad pitch is 1 mm center to center.
3. Default stencil aperture is recommended at 0.40 × 0.40 mm.
4. Stencil thickness is typically 100 µm, due to fine pitch requirements.
5. Please note that solder resist must be present to minimize the wicking of solder from the joint area along the pad. This avoids creating a potential reliability weakness.

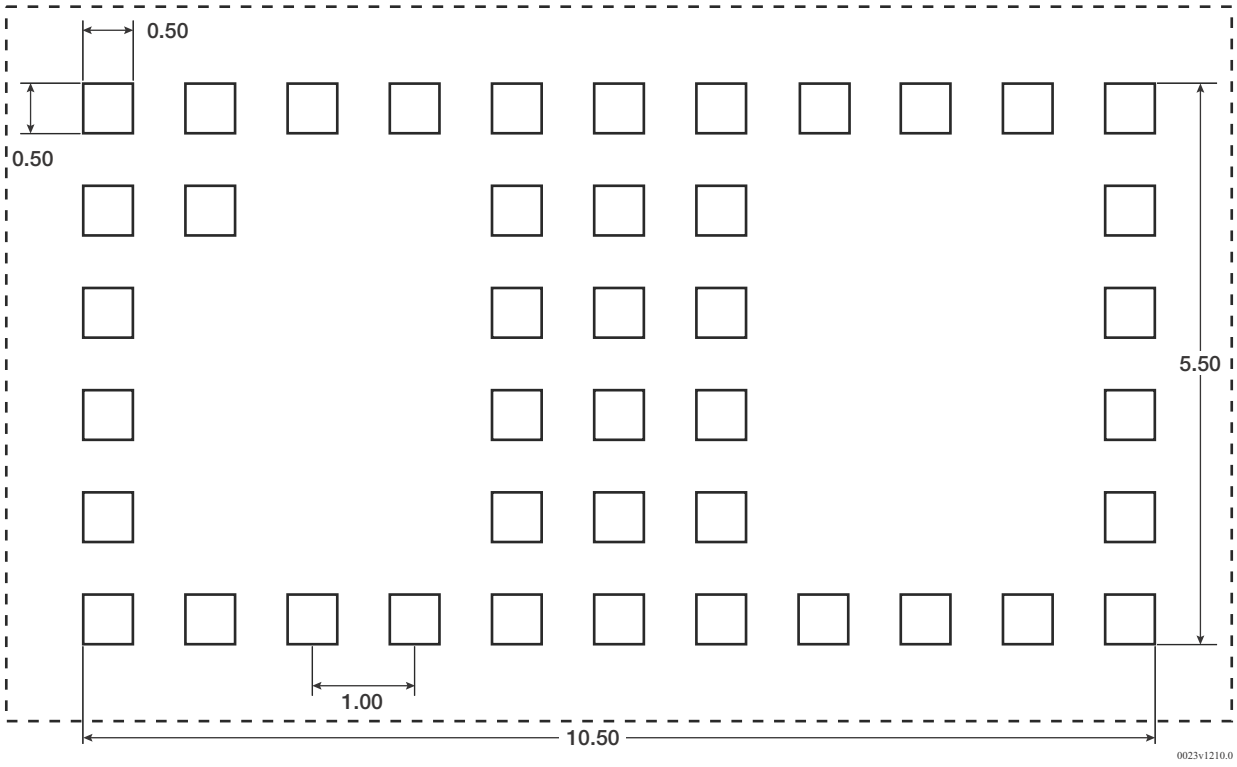


Figure 4-3 • **Recommended PCB Layout**

Module Assembly

It is recommended that the module be attached using an automated pick-and-place machine and reflow oven. The reflow profile should be based upon JESD-20-C, ensuring that the maximum and minimum parameters of the standard are not exceeded when creating a profile for the customer's chosen assembly process.

The lid solder alloy is the same as that used for the internal components, thus the module should not be reflowed hanging upside down and it should be assembled to the side that is reflowed last in a double-sided assembly.

A soldering atmosphere of nitrogen provides the best wetting and minimal lid discoloration, but reflow can be also undertaken in air.

Any rework operations undertaken need to be verified to ensure that no damage comes to the product being removed. Microsemi does not guarantee the product reliability once it's been reworked.

The solder alloys to be used are either a lead-free SAC 0305 or 0405 alloy, although the module can be assembled to the customer's board with a leaded alloy. The product is designed to be cleaned, but this is at the customer's discretion depending upon their assembly requirements.

Package Overview

Table 4-3 provides additional specifications for the ZL70321 MICS-Band RF Standard Implant Module (SIM).

***Table 4-3* • ZL70321 Package Overview**

Package	Delivery Form	Temp Range (°C)	Pb Free	Implant Grade	Application Area	
					Implant Devices	External Devices
43-pad LGA	Trays, bake, and dry pack	0 to +55	Yes	Yes	Yes	No

5 – Typical Application Example

Figure 5-1 shows a typical application example. For a detailed circuit example, please refer to the AIM200 documentation included with the ZL70102 ADK (refer to related documentation listed in Table 1-1 on page 1-1). The AIM200 is an Application Implant Module (AIM) board that features the ZL70321 standard implant module. Note that the ADK AIM200 prematch is designed for a 50-Ω antenna suitable for evaluation in air.

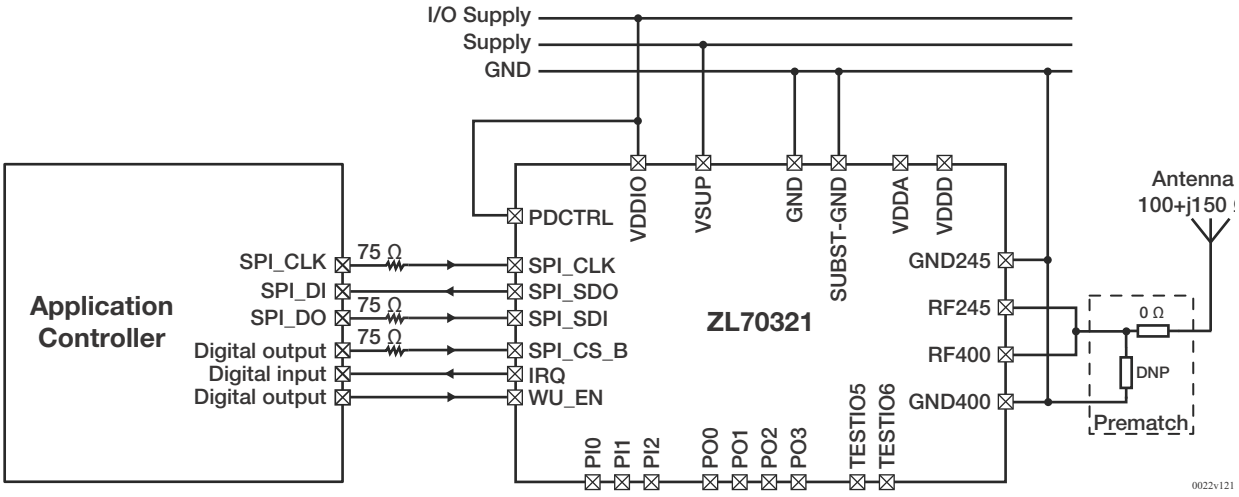


Figure 5-1 • **Typical Application Example**

Comments:

1. Connect VSUP to supply. VSUP is decoupled inside the module with a 100-nF capacitor.
2. Connect VDDIO to the I/O supply (alternatively VDDIO can be connected to VSUP if the SPI bus operates at the same supply level as VSUP).
3. PDCTRL is connected to VDDIO to enable the internal pull-down of the PI0..2 pads, allowing them to be left unconnected.
4. PO0..3 and TESTIO5..6 can be left unconnected.
5. Add resistors (approximately 75Ω) on the application host controller side to the SPI digital output lines to suppress ringing.
6. IRQ and SPI_SDO have series 68-Ω resistors to suppress reflections.
7. RF245 and RF400 are connected together. Positions for additional antenna matching components (*prematch*) are reserved if the impedance of the target antenna has to be adapted to the tunable range (DNP stands for Do Not Populate).
8. VDDA and VDDD are sensitive to noise since they are connected to the regulated side of the on-chip analog and digital voltage regulators. These pads should have no external circuitry or tracks connected.

6 – Quality

The ZL70321 module is intended for implantable applications.

Manufacturing processes are carried out in ISO9001-approved facilities and all products are fully tested and qualified to ensure conformance to this data sheet.

The following additional stages are implemented among others:

- Enhanced change notification.
- Die acceptance testing.
  - Every ZL70102 die used is individually tested at 37°C.
  - Every ZL70102 die used is visually inspected.
- Every module is individually tested at room temperature.

For implantable products, the following additional stages are implemented in addition to the above:

- A comprehensive system of change notification and approval is invoked. No major changes to the product are made without notification to and/or approval from the customer.
- Material traceability: For each module all components and consumables are traceable to the incoming material lot number.
- Process traceability: Each module is identified with a unique serial number. Traceability is maintained to the individual module level.
- Enhanced record retention: Quality records are retained for the expected duration of production and use of end products.

7 – Glossary

Term	Definition
ADK	Application Development Kit
AIM	Application Implant Module
Ant	Antenna
BSC	Basic Spacing between Centers
BSM	Base Station Module
CMPG	Microsemi's Communication-Medical Products Group
DNP	Do Not Populate
ESD	Electrostatic Discharge
ETSI	European Telecommunications Standards Institute
Exceptn	Exception (to testing parameters for Electrical Characteristics)
FCC	Federal Communications Commission (USA)
FDA	Food and Drug Administration (USA)
FSK	Frequency Shift Keying
HBM	Human body model
I/O	Input/output
IC	Integrated Circuit
ID	Identifier
IEC	International Electrotechnical Commission
inf	Infinity
LGA	Land Grid Array
MAC	Media Access Controller
Max	Maximum
MICS	Medical Implantable Communication Service
Min	Minimum
Nom	Nominal
PA	Power amplifier
PCB	Printed circuit board
ref	Reference
RF	Radio Frequency
RSSI	Received Signal Strength Indicator
RX	Receive
SAC	SnAgCu (tin-silver-copper alloy)
SAW	Surface Acoustic Wave

Term	Definition
SCLA	Source Code License Agreement
SIM	Standard Implant Module
SPI	Serial Peripheral Interface
strosc	Strobe oscillator
Temp	Temperature
TX	Transmit
Typ	Typical
WU	Wake-up
XO	Crystal Oscillator
XTAL	Crystal

Note: Table 4-2 on page 4-2 defines the Pad Type abbreviations that are used in that chapter. They are not included in the list above.

8 – Datasheet Information

List of Changes

The following table lists substantive changes that were made in the ZL70321 MICS-Band RF Standard Implant Module (SIM) datasheet (140034).

Revision	Changes	Page
Revision 3 (February 2013)	Added footnote regarding MedRadio.	I
	Chapter 1 "Product Description" was truncated, removing product family information that can be found in the ZL70102 Data Sheet. A list of related documentation was added.	1-1
	Removed block diagram from "General" in Chapter 2 as it was a duplicate of the diagram referenced in "Description" on the front page.	2-1
	Changed incorrect references to *RX_245* to correctly read *RF245 pad* under "2.45-GHz Antenna Tuning Range" in Chapter 2 and under "2.45-GHz Receiver" in Chapter 3 (Table 3-7).	2-3, 3-5
	Deleted "Condition" column from Table 3-1 and added note 2 regarding burn-in.	3-1
	Removed previous "Extended Temperature Operating Conditions" section and moved the relevant information into "Condition" column and note 2 of Table 3-4. Removal of previous Table 3-2 caused all subsequent tables in Chapter 3 to be renumbered, as well as the ID columns in those tables.	3-1 to 3-5
	Rolled previous "General Notes on Limits" section into beginning of "Electrical Characteristics" and added a related column called "Exceptn" to all subsequent tables in Chapter 3.	3-2 to 3-5
	Clarified conditions for maximum transmit power in Table 3-5, specifying T_{OP} and V_{SUP}	3-4
	Removed TBD and TBC designations from Table 3-7.	3-5
	In Table 4-1, clarified that VDDD and VDDA are not for customer use and added parenthetical remarks about sensitivity to noise. Also changed wording in "Description" column for several pads so that the descriptions are consistent with other datasheets in the ZL70102 product family.	4-1
	Removed bullet regarding photo imaginable solder resist under "PCB Layout Recommendations" in Chapter 4.	4-5
	Rewrote introductory paragraph in Chapter 5 "Typical Application Example" to state relationship of AIM200 to ZL70321.	5-1
	Changed sub-bullet describing die acceptance testing to specify visual inspection. Also changed bullet describing process traceability to specify use of a unique serial number and traceability to the module level.	6-1
	Name change from Zarlink to Microsemi. Included changing overall document format and chapter structure and changing company name in text. As part of chapter restructuring, the previously separate chapters "Pad List", "PCB Layout Recommendations", "Module Assembly", and "Ordering and Package Overview" (now called "Package Overview") were all moved under Chapter 4 "Mechanical Specifications".	All

Revision	Changes	Page
Revision 3 (February 2013), continued	After moving Table 4-3 to Chapter 4 as part of chapter restructuring, deleted first column containing ordering information. (Instead refer to "Ordering Information" on page I.)	4-6
	Spelling and grammar were corrected throughout the document, clarifying a number of inconsistencies or ambiguities that may have existed.	All
	The versioning system for datasheets has been changed. Datasheets are assigned a revision number that increments each time the datasheet is revised.	N/A
Advance v1.0 (August 2011)	First release of advance datasheet	All
Advance v0.1 (March 2011)	Early draft of advance datasheet	All

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In order to provide the latest information to designers, some datasheet parameters are published before data has been fully characterized from silicon devices. The data provided for a given device is designated as either "Product Brief," "Advance," "Preliminary," or "Production." The definitions of these categories are as follows:

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