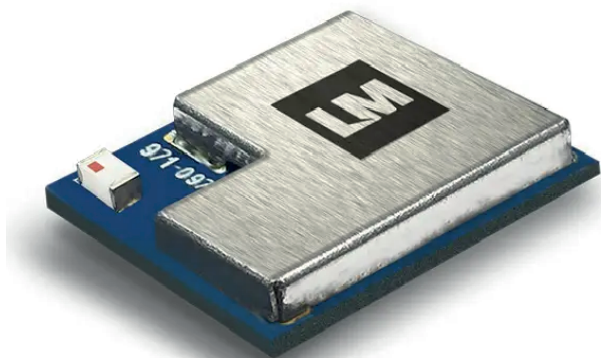


LM971 Bluetooth® 5.1 Audio Module with Onboard Antenna

Standalone via UART, 24 bit I²S, SPI and I²C Interfaces

Product	LM971
Part No	See Last Page
Revised	25/AUG/2021
Datasheet Version	1.00



Features

- Bluetooth® 5.1 Dual Mode Module
- Class 1
- Ultra-low power consumption with A2DP streaming as low as 4.8 mA
- 2Mbps Bandwidth via Bluetooth® Low Energy
- 80KB RAM Cache
- 64Mb Application Memory
- Size 13mm x 13mm
- **Configurable DSP Interfaces**
UART, I²C, SPI, 24-bit I²S, Onboard Antenna
- See the website for this product's certifications
- RoHS, REACH and WEEE

Overview

The LM971 is a programmable Bluetooth® 5.1 audio module based on an extremely low power architecture which has been designed for use in Bluetooth® stereo headsets and speakers, and supports Qualcomm aptX™. This module is engineered for low power performance even in demanding use cases, supporting longer battery life in virtually all operating modes.

The LM971 offers powerful multi-core processing, designed to enable complex use cases, and helps to support premium audio technologies. The onboard antenna makes this module ready to be added as a complete wireless audio solution to any project.

With options for analog and digital audio inputs and outputs, as well as aptX™ codecs, third-party DAC support and Truewireless™ functionality, the LM971 offers a wide range of top quality audio features.

LM Technologies has a wealth of experience with certifications and has certified products all over the world, with access to a global network of local representatives, enabling fast certification processing when requested.

Firmware Features

- Qualcomm TrueWireless™ Stereo support
- aptX™ HD and cVc noise cancellation options are supported
- Integrated battery charging
- Thermistor supported options

Audio Features & Specifications

- aptX™, aptX™ HD, aptX™ Low Latency, SBC, and AAC audio codecs support
- Programmable audio master clock (MCLK)
- Stereo analogue outputs configurable as differential Class-AB headphone outputs or differential high efficiency Class-D outputs:
 - Class-D signal-to-noise ratio (SNR): 98.3 dBA
 - Class-D total harmonic distortion plus noise (THD+N): -87.5 dB
 - Class-AB SNR: 101 dBA
 - Class-AB THD+N: -90.5 dB
- Dual analogue inputs configurable as single ended line inputs or, unbalanced or balanced analogue microphone inputs:
 - SNR single-ended: 101 dBA
 - THD+N single-ended: -85 dB
- 1 x bidirectional 24-bit I²S interface
 - Supports 8, 16, 32, 44.1, 48, 96, 192 kHz sample rates
- Digital microphone inputs with the capability to interface with up to 6 digital microphones



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Product
Part No

LM971
See Last Page

General Specification

Wireless

Bluetooth® Standard	Bluetooth® 5.1
Module Type	SMT Stereo Audio Module
Profiles	A2DP, GATT, HSP/HFP, AVRCP

Hardware

Chipset	Qualcomm® QCC3034
Antenna	Onboard Antenna
Microcontroller (MCU)	Dual core, 32 MHz, 32-bit processor
Flash Memory	64 Mbit
RAM	32 KB
Program Interface	USB, Transaction Bridge
Interfaces	UART, SPI, I2C, I2S, PCM, AIO, GPIO
Audio Interfaces	I2S, PCM, Analogue Input/Output
Power Supply	3V3 (VBAT) or 5V0 (USB VCHG)
Crystal Oscillators	32 MHz
Development Kit	LM571 Daughterboard for interface with Qualcomm CF376

RF Characteristics

Tx Output Power	TBC
Rx Sensitivity	TBC
Data Rate	Up to 2Mbps
Frequency	2.4 GHz to 2.485 GHz

Physical Characteristics

Operating Temperature	-40°C to +85°C
Storage Temperature	TBC
Dimensions (L x W x H)	13.9mm x 13mm x 3.1mm
Weight	0.86g +/- 0.05g tolerance
Certifications	https://www.lm-technologies.com/product/lm971-certification/
Compliance	RoHS, REACH and WEEE

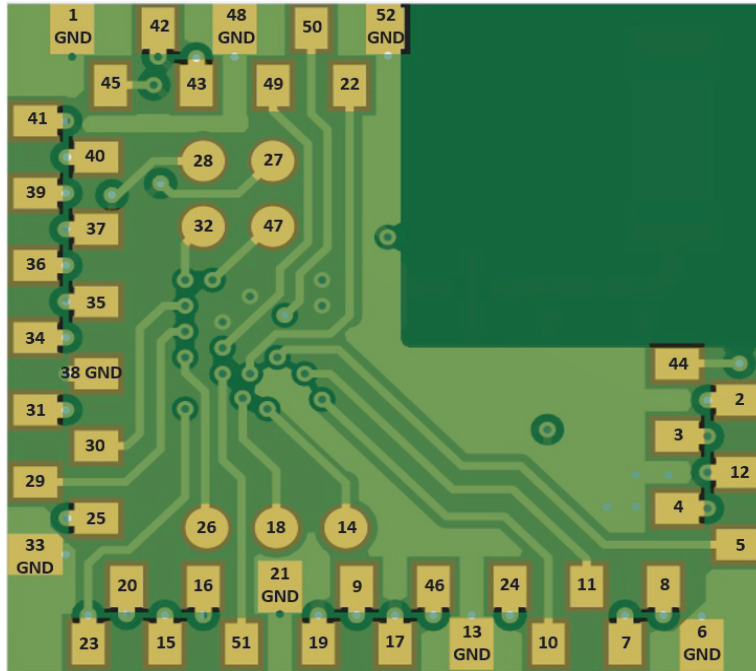


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Product
Part No

LM971
See Last Page

Pins



LM971 Bluetooth® 5.1 Audio Module with Onboard Antenna

Standalone via UART, 24 bit I²S, SPI and I²C Interfaces

Product
Part No

LM971
See Last Page

Pin Assignments

Pin	Name	Type	Description	Typical	Notes
1	GND	Ground	Common Ground	GND	
2	PIO_18	I/O	I2S Output / GPIO	VDD_PADS_3	
3	PIO_16	I/O	I2S Clock / GPIO	VDD_PADS_3	
4	PIO_19	I/O	I2S Input / GPIO	VDD_PADS_3	
5	PIO_17	I/O	I2S Sync / GPIO	VDD_PADS_3	
6	GND	Ground	Common Ground	GND	
7	USB_DP	USB	USB (+) Pin	VDD_BYP	1
8	USB_DN	USB	USB (-) Pin	VDD_BYP	1
9	SMPS_VCHG	Power	Regulator Input from Charger	VCHG	
10	PIO_20	I/O	General Purpose I/O	VDD_PADS_3	
11	PIO_21	I/O	General Purpose I/O	VDD_PADS_3	
12	PIO_15	I/O	Audio Master Clock / GPIO	VDD_PADS_3	
13	GND	Ground	Common Ground	GND	
14	SYS_CTRL	Power	Deep Sleep Wakeup and Programmable Input	VBAT	2
15	SMPS_VBAT	Power	Regulator Input from Battery	VBAT	
16	VCHG_SENSE	Power	Current Sense for External Charger	VCHG	
17	VDD_PADS	Power	Power Supply for GPIOs - VDD_PADS_7:1	1.8V/3.3V	
18	CHG_EXT	Power	Current Control for External Charger	VCHG	
19	1V8_SMPS	Power	1.8V Regulator Output	1.8V	
20	VDD_BYP	Power	Digital Regulator Output	2.9V/3.3V	
21	GND	Ground	Common Ground	GND	
22	LED(0)/AIO(0)	I/O	Analog I/O and LED output	VBAT/VCHG	
23	LED(1)/AIO(1)	I/O	Analog I/O and LED output	VBAT/VCHG	
24	LED(2)/AIO(2)	I/O	Analog I/O and LED output	VBAT/VCHG	
25	LED(4)/AIO(4)	I/O	Analog I/O and LED output	VBAT/VCHG	
26	LED(5)/AIO(5)	I/O	Analog I/O and LED output	VBAT/VCHG	
27	PIO_4	I/O	Transaction Bridge / GPIO	VDD_PADS_1	
28	PIO_5	I/O	Transaction Bridge / GPIO	VDD_PADS_1	
29	PIO_6	I/O	Transaction Bridge (Mandatory) / GPIO	VDD_PADS_1	
30	PIO_7	I/O	Transaction Bridge (Mandatory) / GPIO	VDD_PADS_1	
31	PIO_8	I/O	Transaction Bridge (Mandatory) / GPIO	VDD_PADS_1	
32	PIO_2	I/O	Transaction Bridge / GPIO	VDD_PADS_1	
33	GND	Ground	Common Ground	GND	
34	SPKR_RN	Audio Out	Right Speaker Differential Output (-)	VDD_AUDIO_HP_SPKR	
35	SPKR_RP	Audio Out	Right Speaker Differential Output (+)	VDD_AUDIO_HP_SPKR	
36	SPKR_LN	Audio Out	Left Speaker Differential Output (-)	VDD_AUDIO_HP_SPKL	
37	SPKR_LP	Audio Out	Left Speaker Differential Output (+)	VDD_AUDIO_HP_SPKL	
38	GND	Ground	Common Ground	GND	
39	MIC_BIAS	Audio In	Microphone Bias	VDD_AUDIO_1V8	



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Product LM971
Part No See Last Page

Pin Assignments Continued

Pin	Name	Type	Description	Typical	Notes
40	MIC_RN	Audio In	Right Microphone Differential Input (-)	VDD_AUDIO_1V8	
41	MIC_RP	Audio In	Right Microphone Differential Input (+)	VDD_AUDIO_1V8	
42	MIC_LN	Audio In	Left Microphone Differential Input (-)	VDD_AUDIO_1V8	
43	MIC_LP	Audio In	Left Microphone Differential Input (+)	VDD_AUDIO_1V8	
44	GND	Ground	Common Ground	GND	
45	PIO_3	I/O	Transaction Bridge / GPIO	VDD_PADS_1	
46	PIO_60	I/O	General Purpose I/O	VDD_PADS_3	
47	PIO_1	Power	Reset Pin / GPIO	VDD_PADS_1	
48	GND	Ground	Common Ground	GND	
49	PIO_54	I/O	General Purpose I/O	VDD_PADS_7	
50	PIO_53	I/O	General Purpose I/O	VDD_PADS_7	
51	PIO_52	I/O	General Purpose I/O	VDD_PADS_7	
52	GND	Ground	Common Ground	GND	

Notes:

1. USB_DN and USB_DP are usable as PIOs with the restriction that they are both inputs or both outputs.
2. When not used as a SYS_CTRL pin, can only be used as a digital input.

Recommended Operating Conditions

Parameter	Pin	Min	Typ	Max	Unit
Operating Temperature	-		-40	20	85 °C
Supply Voltage					
5 V (USB VBUS)	CHG_EXT		4.75	5	6.5 V
	SMPS_VCHG				
	VCHG_SENSE				
Battery	SMPS_VBAT		3	3.7	4.6 V
	VBAT_SENSE				
3.3 V	VDD_BYP		2.8	2.9/3.3	3.5 V
	USB_DN		0	-	3.6 V
	USB_DP				
1.8 V	VDD_AUDIO_1V8		1.7	1.8	1.95 V
	VDD_AUDIO_HP_SPKR				
	VDD_AUDIO_HP_SPKL				
	MIC_BIAS		0	-	1.95 V
	MIC_RN				
	MIC_RP				
	MIC_LP				
1.8 V	SPKR_RN		0	-	1.95 V
	SPKR_RP				
	SPKR_LN				
	SPKR_LP				
Digital I/O	VDD_PADS		1.7	1.8	3.6 V
	PIO[60, 54:52, 21:15, 8:2]		0	-	VDD_PADS V
	PIO_1		0	-	VDD_BYP
	AIO/LED[5:4, 2:0]		0	-	1.95
	SYS_CTRL		0	-	4.6



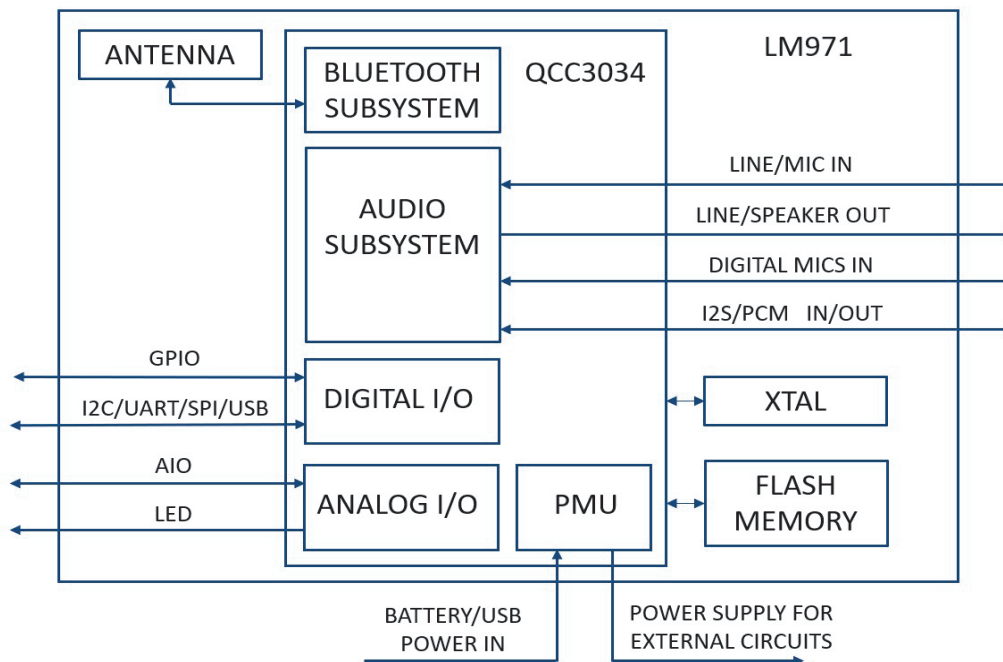
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Product
Part No

LM971
See Last Page

Module Block Diagram



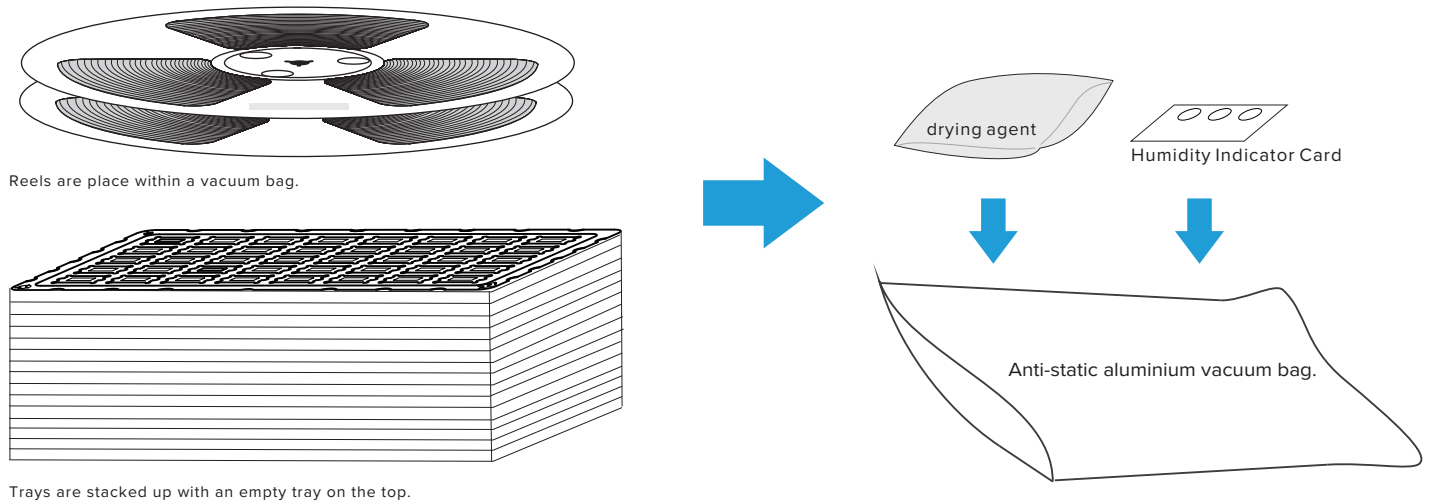
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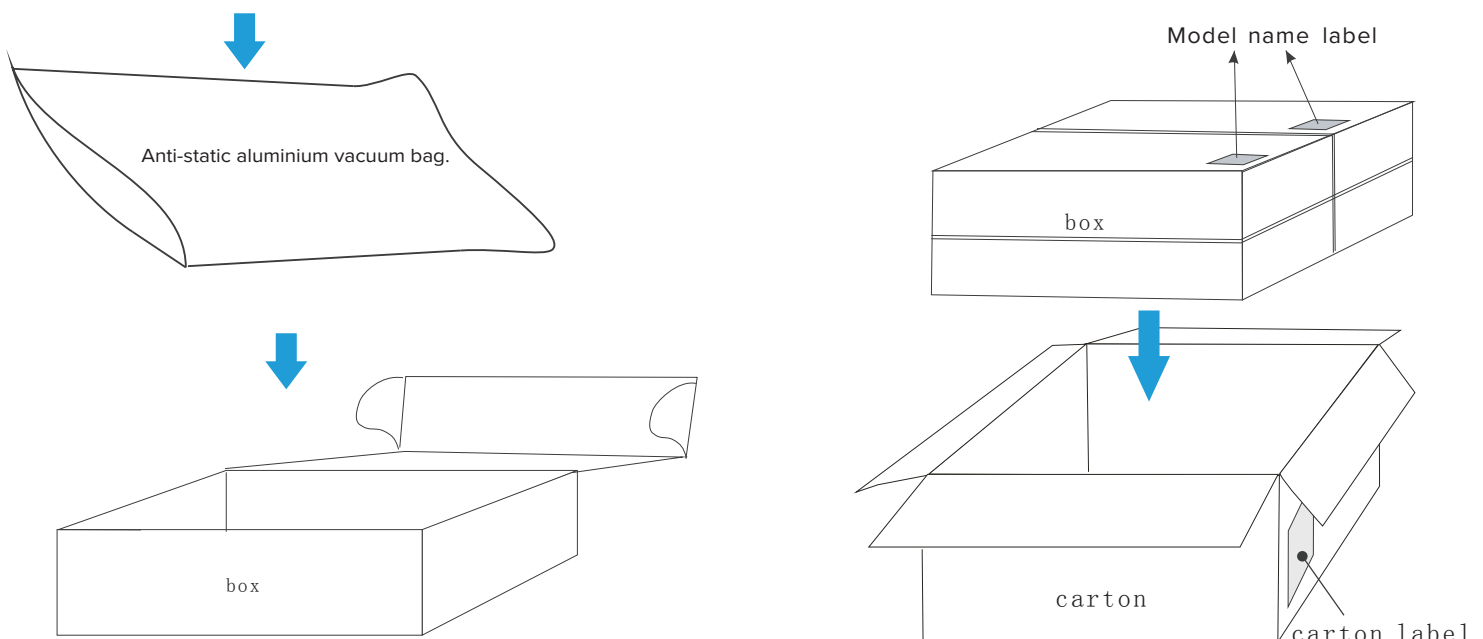
LM971
 See Last Page

Packaging for Tape & Reel / Tray

The trays/reels are stacked and inserted into an anti-static vacuum bag with a Humidity Indicator Card. On the outside of the bag are labels for Anti-Static, Model Name and Moisture Sensitivity Levels.



The vacuum bag is placed inside the box and a Model Name Label stuck on the front-side of each box.



Each carton contains 4 boxes.



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Product
Part No

LM971
See Last Page

Datasheet Version Notes

v1.00 25 AUG 2021 Initial Release



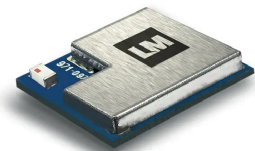
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LM971
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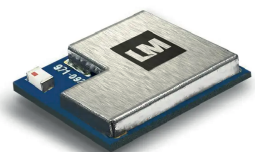
Ordering Options



971-0971-000

LM971 Module

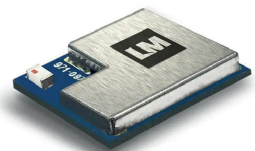
MOD SMT PROG BT5.1 D/Mode SINK IC ANT SP



971-0971-001

LM971 Module

MOD SMT PROG BT5.1 D/Mode SINK ANT TRAY



971-0971-002

LM971 Module

MOD SMT PROG BT5.1 D/Mode SINK ANT T&R

• Product User Guides, Manuals and Configuration Software can be downloaded via the website - <http://www.lm-technologies.com/downloads>