



Inventek Systems

**ISM78G1D-L31
Embedded
Bluetooth Low Energy SIP Module**

Data Sheet



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1 General Description

The Inventek ISM78G1D-L31 module is an embedded wireless Bluetooth low energy (BLE) connectivity device, based on the Renesas RL78/G1D microcomputer incorporating the RL78 CPU core and low power consumption RF transceiver supporting the Bluetooth ver.4.1 (Low Energy Single mode) specifications.

The Inventek ISM78G1D-L31 offers a RL78 CPU core is a 3-stage pipeline CISC architecture with an integrated BLE radio, on-board chip antenna, and 256KB ROM. The module provides a number of features and standard peripheral interfaces (see “Summary of Key Features” below), enabling connection to an embedded design. The low cost, small foot print, 11mmx13mm 31-Pin LGA package and ease of design-in make it ideal for a range of embedded applications.

Summary of Key Features:

- Bluetooth low energy (BLE)-compliant
- CISC architecture with 3-stage pipeline
 - Minimum instruction execution time: Can be changed from high speed (0.03125 us: @ 32 MHz operation with high speed On-chip oscillator) to ultra-low speed (30.5 us: @ 32.768 kHz operation with subsystem clock)
 - Address space: 1 MB
 - General-purpose registers: (8-bit register × 8) × 4 banks
- On-chip RF transceiver
 - Bluetooth v4.1 Specification (Low Energy Single mode)
 - 2.4 GHz ISM band, GFSK modulation, TDMA/TDD frequency hopping (including AES encryption circuit)
 - Adaptivity, exclusively for use in operation as a slave device
- Code flash memory
 - Code flash memory: 256KB
 - Block size: 1KB
 - Prohibition of block erase and rewriting (security function)
 - On-chip debug function
 - Self-programming (with boot swap function/flash shield window function)
- Data flash memory
 - Data flash memory: 8KB
 - Back ground operation (BGO): Instructions can be executed from the program memory while rewriting the data flash memory.
 - Number of rewrites: 1,000,000 times (TYP.)
 - Voltage of rewrites: VDD = 1.8 to 3.6 V

Typical Applications:

The module has been designed to provide low power, low cost, and robust communications for applications operating in the globally available 2.4GHz unlicensed industrial, scientific, and medical (ISM) band. The following application profiles are supported in ROM:

- Battery Status
- Blood Pressure Monitor
- Find Me
- Heart Rate Monitor
- Proximity
- Thermometer
- Weight Scale
- Time

Additional profiles that can be supported from RAM include:

- Blood Glucose Monitor
- Temperature Alarm
- Location

2 Part Number Detail Description

2.1 Ordering Information

Part Number	Description	Ordering
ISM78G1D-L31	Bluetooth LE Module	Tube
ISM78G1D-L31-TR	Bluetooth LE Module	Tape & Reel

3 General Features

- Based on the Renesas RL78/G1D Bluetooth Low Energy 4.1 Baseband/Radio device.
- Integrates Bluetooth embedded stack, and fully qualified application profiles in ROM
- Power-saving mode allows the design of low-power applications.
- Lead Free Design which is compliant with ROHS requirements.
- FCC/CE Compliance Certified (In process)

3.1 Limitations

Inventek Systems products are not authorized for use in safety-critical applications (such as life support) where a failure of the Inventek Systems product would reasonably be expected to cause severe personal injury or death.

3.2 Regulatory Compliance



In Process

FCC ID: 07P-78G1D

IC: 1017A-78G1D

There are specific regulatory requirements imposed by regulatory authorities around the world on radio devices. Customers using Renesas SIP modules are advised to engage with an accredited test lab to determine the overall system level regulatory requirements. Customers may be able to leverage Renesas' regulatory test reports. Please discuss the process with your test lab, such as FCC ID transfers. Renesas can provide authorizations as needed.

4 Complementary Documents

4.1 Inventek Systems

- RL78/G1D Renesas Data Sheet
 - P/N (R5F11AGJDNB#40)
- ISM78G1D-L31 Product Brief
- ISM78G1D-EVB Quick Start Guide
- Renesas Tools and Design Environment
- FCC Test Report

5 Specifications

5.1 Block Diagram

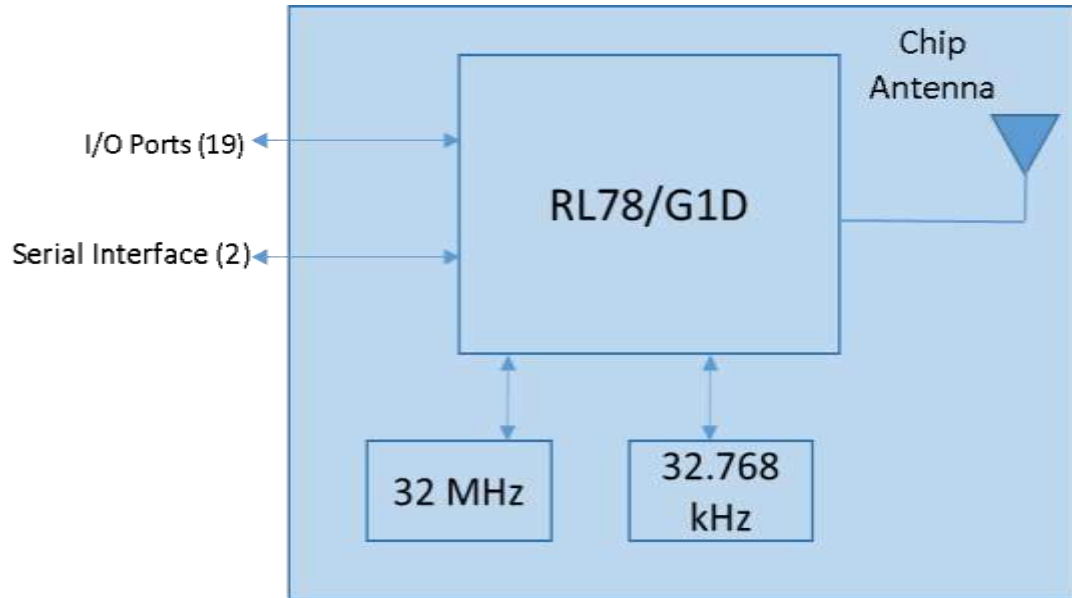


Figure 1 ISM78G1D-L31 Block Diagram

6 Environmental Specifications

Item	Description
Operating Temperature Range	-40 deg. C to +80 deg. C
Storage Temperature Range	-65 deg. C to +150 deg. C
Humidity	95% max non-condensing

7 Hardware Electrical Specifications

7.1 Absolute Maximum Ratings

Symbol	Description	Min	Max	Unit
Supply Power	Input Supply Voltage	1.8	3.6	V
Voltage Ripple		0	+/-2%	
VDD, VDD_RF		1.8	3.6	V

7.2 Recommended Operating Ratings

Symbol	Min	Typ	Max	Unit
VDD	-	3.3	-	V
VDD_RF	-	3.3	-	V

7.3 ADC Specifications

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
A/D converter operating current	IADC ^{1,2}	When conversion at maximum speed AVREFP = VDD = 3.0 V		0.5	0.7	mA

Notes 1. Current flowing to VDD.

Notes 2. Current flowing only to the A/D converter. The current value of MCU is the sum of IDD1 or IDD2 and IADC when the A/D converter operates in an operation mode or the HALT mode.

8 Power Consumption

The Power Management Unit (PMU) provides power management features that can be invoked by software through power management registers or packet-handling in the baseband core.

There are several Ultra-low power consumption technology operations:

MCU part

- Standby function HALT mode
- STOP mode
- SNOOZE mode

RF part

- Standby function POWER_DOWN mode
- RESET_RF mode
- STANDBY_RF mode
- IDLE_RF mode,
- DEEP_SLEEP mode, SLEEP_RF mode

RF transmission

- (RF normal mode): 4.3 mA (TYP.) (3.0 V/MCU part: STOP mode)
- (RF Low power mode): 2.6 mA (TYP.) (3.0 V/MCU part: STOP mode)

RF reception

- (RF normal mode): 3.5 mA (TYP.) (3.0 V/MCU part: STOP mode)
- (RF Low power mode): 3.3 mA (TYP.) (3.0 V/MCU part: STOP mode)

RF sleep

- (POWER_DOWN mode) operation: 0.10 μ A (TYP.) (3.0 V/MCU part: STOP mode)

8.1.1 Estimated Power Consumption

Operational Mode	Description	Typ.	Max.	Unit
Receive	Receiver and baseband are both operating, 100% — ON	3.5		mA
Transmit	Transmitter and baseband are both operating	4.3		mA
Sleep	Internal LPO is in use	0.10	-	μ A

9 Module Pin Out

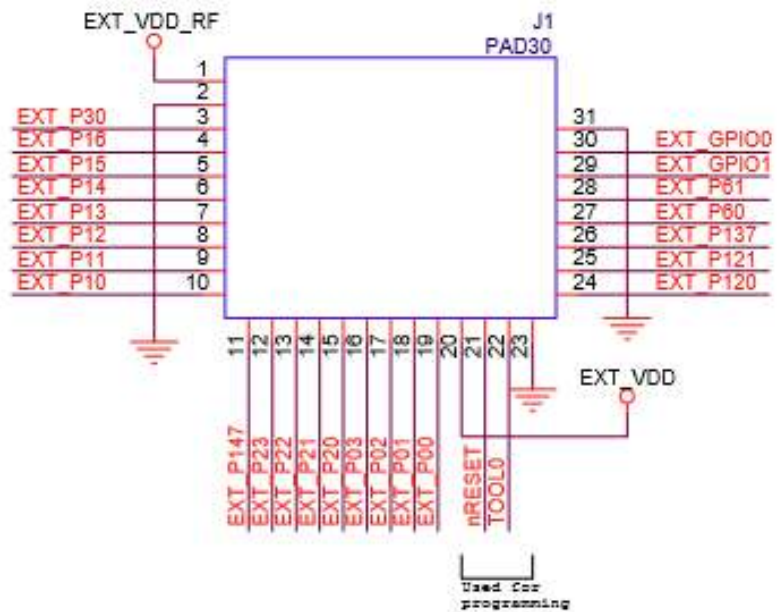


Figure 2 Pin Mapping

9.1 Detailed Pin Description:

Pin #	Pin Name	Type	Description
1	VDD RF	I	VDD
2	GND	I	Ground
3	P30,XTAL1_RF	I/O	Crystal oscillator (RF clock)
4	P16/TI01/TO01/INTP5	I/O	
5	P15/SCK20/SCL20/(TI02)/(TO02)	I/O	
6	P14/SI20/SDA20/(SCLA0)/(TI03)/(TO03)	I/O	
7	P13/SO20/(SDAA0)/(TI04)/(TO04	I/O	
0	P12/SO00/TxD0/TOOLTxD/(TI05)/(TO05)	I/O	TX
9	P11/SI00/RxD0/TOOLRxD/SDA00/(TI06)/(TO06)	I/O	RX
10	P10/SCK00/SCL00/(TI07)/(TO07)	I/O	
11	P147/ANI18	I/O	
12	P23/ANI3	I/O	
13	P22/ANI2	I/O	
14	P21/ANI1/AVREFM	I/O	
15	P20/ANI0/AVREFP	I/O	
16	P03/ANI16/RxD1	I/O	
17	P02/ANI17/TxD1	I/O	
18	P01/TO00	I/O	
19	P00/TI00	I/O	
20	VDD	I	VDD
21	nReset	I	
22	Tool0	I/O	Data I/O Flash Programmer
23	GND	I	Ground
24	P120/ANI19	I/O	
25	P121/X1	I	
26	P137/INTP0	I	
27	P60/SCLA0	I/O	
28	P61/SDDA0	I/O	
29	GPIO1/TXSELL_RF	I/O	
30	GPIO0/TXSELH_RF	I/O	
31	GND	I	Ground

10 AC Characteristics

Items	Symb	Conditions	MIN.	TYP.	MAX.	Unit
$\overline{\text{RESET}}$ low-level width	tRSL	$\overline{\text{RESET}}$	10			us

11 Bluetooth Low energy Specifications

- On-Chip RF Transceiver
- Bluetooth v4.1 Spec. (Low Energy, Single mode)
- 2.4 GHz ISM Band, GFSK modulation, TDMA/TDD Frequency Hopping (included AES encryption circuit)
- Adaptivity, exclusively for use in operation as a slave device
- Single ended RF interface

11.1 Transmitter RF Specifications

The module requires a keep out area for the antenna section outside the metal can. Do not put any metal directly below or above the antenna section and as this will reduce antenna performance.

VDD=VDD_RF=3.3V, 25° C

Frequency 2440 MHz

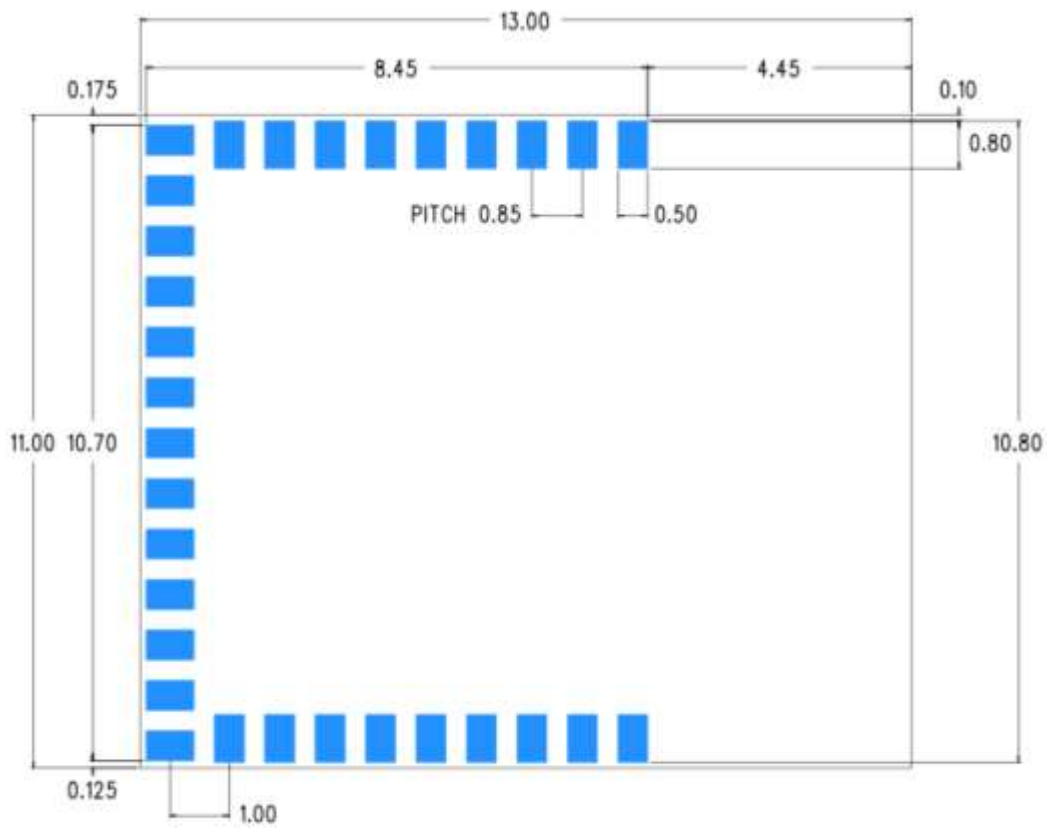
RF transmitter active: 4.3 mA (TYP.)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Frequency	CF		2402		2480	MHZ
Data Rate				1		Mbps
Max transmitted output power	RF Power	@ RF output pin	-3	0	2.5	dBm
Transmit Output Settings		0			0	
Spurious radiation	RF _{TXSP}	30-88MHz		-76		dBm
		88-216MHz		-76		dBm
		216-960 MHz		-76		dBm
		960-1000 MHz		-74		dBm
		1-12.7 GHz		-74		dBm
Harmonics	RF _{TXHC1}	2 nd Harmonic		-52		dBm
	RF _{TXCH2}	3 rd Harmonic		-51		dBm

Receiver RF Specifications

Parameter	Symbol	Conditions		MIN.	TYP.	MAX.	Unit
RF input frequency	RF _{RXFRIN}			2402		2480	MHz
Maximum input level	RF _{LEVL}	PER ≤ 30.8% RF input pin	RF low power mode	-10	0	-	dBm
			RF normal mode	-10	1	-	dBm
			RF high performance mode	-10	1	-	dBm
Receiver sensitivity	RF _{STY}	PER ≤ 30.8%	RF low power mode	-	-60	-50	dBm
			RF normal mode	-	-90	-70	dBm
			RF high performance mode	-	-92	-70	dBm
Secondary radiation	RF _{RXSP}		30 MHz to 1 GHz	-	-72	-57	dBm/ 100 kHz
			1 GHz to 12 GHz	-	-57	-54	dBm/ 100 kHz
Common channel rejection ratio	RF _{CCR}	PER ≤ 30.8%, Prf = -67dBm		-21	-12	-	dB
Adjacent channel rejection ratio	RF _{ADCR}	PER ≤ 30.8% Prf = -67 dBm	±1 MHz	-15	-5	-	dB
			±2 MHz	17	29	-	dB
			±3 MHz	27	34	-	dB
Blocking	RF _{BLK}	PER ≤ 30.8% Prf = -67 dBm	30 MHz - 2000 MHz	-30	-13	-	dB
			2000 MHz to 2399 MHz	-35	-30	-	dBm
			2484 MHz to 3000 MHz	-35	-30	-	dBm
			> 3000 MHz	-30	-17	-	dBm
Frequency tolerance	RF _{RXFERR}	PER ≤ 30.8%		-250		+250	kHz
RSSI accuracy	RF _{RSSIS}	T _A = +25°C, -70 dBm ≤ Prf ≤ -10 dBm		-4	0	4	dB

12 Footprint



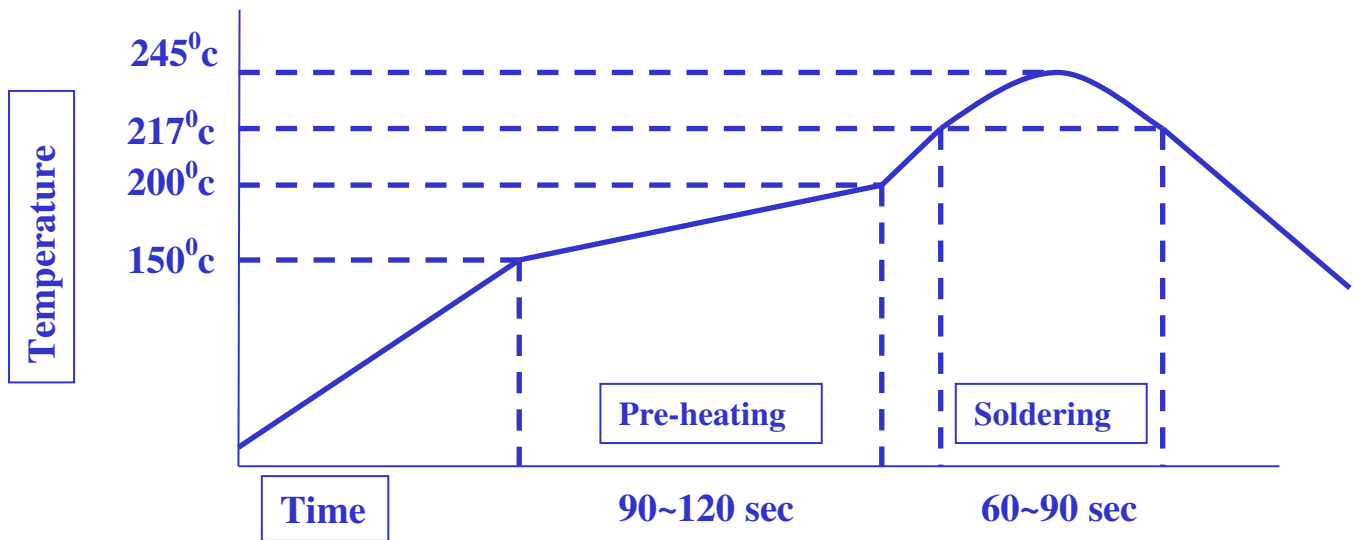
ALL DIMENSIONS ARE IN MILLIMETERS

Figure 3: Top View

13 Product Compliance Considerations

- **RoHS:** Restriction of Hazardous Substances (RoHS) directive has come into force since 1st July 2006 all electronic products sold in the EU must be free of hazardous materials, such as lead. Inventek is fully committed to being one of the first to introduce lead-free GPS products while maintaining backwards compatibility and focusing on a continuously high level of product and manufacturing quality.
- **EMI/EMC:** The Inventek module design embeds EMI/EMC suppression features and accommodations to allow for higher operational reliability in noisier (RF) environments and easier integration compliance in host (OEM) applications.
- **FCC/CE:** The module is compliant with FCC/CE

14 Reflow Profile



15 Packaging Information

15.1 MSL Level / Storage Condition

Caution
This bag contains
MOISTURE-SENSITIVE DEVICES

LEVEL
3

1. Calculated shelf life in sealed bag: 12 months at <math><40^{\circ}\text{C}</math> and <math><90\%</math> relative humidity (RH)

2. Peak package body temperature: **260** °C

3. After bag is opened, devices that will be subjected to reflow solder or other high temperature process must be

a) Mounted within: **168** hours of factory conditions

4. Devices require bake, before mounting, if:

a) Humidity Indicator Card reads >10% for level 2a - 5a devices or >60% for level 2 devices when read at 23 ±5°C

b) 3a or 3b are not met

5. If baking is required, refer to IPC/JEDEC J-STD-033 for bake procedure.

Bag Seal Date: **APR 26 2011**

16 Revision Control

Document : ISM78G1D	
External Release	

Date	Author	Revision	Comment
7/27/2016	AS	1.0	Preliminary
9/27/2016	KT	2.0	General updates

17 Contact Information

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