



# **Inventek Systems**

**ISMRL78G1D**

**Embedded**

**Bluetooth Low Energy SIP Module**

**OEM/Integrators Installation Manual**



## Table of Contents

1	General Description .....	3
2	Part Number Detail Description.....	4
2.1	Ordering Information .....	4
3	General Features .....	4
3.1	Limitations .....	5
3.2	Regulatory Compliance .....	5
4	Complementary Documents.....	7
4.1	Inventek Systems .....	7
5	Specifications .....	8
5.1	Block Diagram .....	8
6	Environmental Specifications .....	8
7	Hardware Electrical Specifications.....	8
7.1	Absolute Maximum Ratings .....	8
7.2	Recommended Operating Ratings .....	8
7.3	ADC Specifications .....	8
	Notes 1. Current flowing to VDD.....	9
8	Power Consumption.....	9
8.1.1	Estimated Power Consumption.....	9
9	Module Pin Out.....	10
9.1	Detailed Pin Description:.....	11
10	AC Characteristics .....	12
11	Bluetooth Low energy Specifications .....	12
11.1	Transmitter RF Specifications .....	12
	Receiver RF Specifications.....	13
12	Footprint.....	14
13	Product Compliance Considerations.....	15
14	Reflow Profile.....	15
15	Packaging Information.....	16
15.1	MSL Level / Storage Condition.....	16
16	Revision Control .....	16
17	Contact Information .....	16

# 1 General Description

The Inventek ISMRL78G1D 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 transceivers supporting the Bluetooth ver.4.1 (Low Energy Single mode) specifications.

The Inventek ISMRL78G1D 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.

**Note: This module is limited to OEM installation ONLY.**

## 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.

The OEM integrator is responsible for ensuring that the end-user has no manual instructions to remove or install module.

The module is limited to installation in mobile or fixed application ONLY. A separate approval is required for all other operating configuration including portable configuration with respect to FCC Part 2.1093 and different antenna configurations.

The OEM/Integrator can expect to receive guidance from the grantee to ensure compliance with Part 15 Subpart B requirements provide the module is being used within the grant restrictions and instruction detailed within this manual. In the event that these conditions cannot be met (for example certain host configurations or collocation configurations may results in deviations from Grantee's recommend practice) then the FCC authorization may no longer be consider valid and the FCC ID cannot be used on the final host product. In these circumstances, the OEM Integrator will be responsible for reevaluating the end product (including the transmitter) and obtaining a new separate FCC authorization. This device is intended only for OEM Integrators under and under the following conditions: As long as the conditions in this manual are met include RF Exposure requirements and Antenna requirements, further transmitter testing will not be required. However the OEM Integrator is responsible for testing their end product for any additional compliance requirements such as compliance with Part 15 Subpart B.

### 3.2 Regulatory Compliance



FCC ID: O7P-RL78  
IC: 10147A-RL78

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.

When this transmitter is installed in a host device, you must place a permanent label, visible on the outside of the device which includes the following information:

**Contains: FCC ID: O7P-RL78**

**Contains: IC: 10147A-RL78**

This device complies with part 15 of the fcc rules. operation is subject to the following two conditions.(1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Warning: Changes or modifications not expressly approved by the party responsible could void the user's authority to operate the product.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures: —Reorient or relocate the receiving antenna. —Increase the separation between the equipment and receiver. —Connect the equipment into an outlet on a circuit different from that to which the receiver is connected. —Consult the dealer or an experienced radio/ TV technician for help.

This equipment uses the following Antennas and may not be used with other antenna types or with antennas of higher gain:

Mfg.: Inventek Systems

Type: Etched Antenna

Gain:0 dBi

This equipment complies with FCC Radiation Exposure limits and should be installed and operated with a minimum distance of 20cm between the radiator and any part of the human body.

***ISED (Canada)***

**Required Notices to the User**

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

*Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.*

This radio transmitter, IC: 10147A-RL78, has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Type:2.4 GHz chip antenna  
Gain:-1.5 dBi

*Le présent émetteur radio, IC: 10147A-RL78 a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.*

Type:2.4 GHz chip antenna  
Gain:-1.5 dBi

This equipment complies with the ICES RF radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20cm between the radiator and any part of the human body.

*Cet équipement est conforme aux limites d'exposition aux radiations ICES définies pour un environnement non contrôlé . Cet équipement doit être installé et utilisé à une distance minimale de 20 cm entre le radiateur et une partie de votre corps.*

## 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

Available upon request

## 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 <sup>1,2</sup>	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 uA (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	-	uA

## **9 Module Pin Out**

CONFIDENTIAL. CONTACT MANUFACTURER FOR DETAILS.

### 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 2440MHz

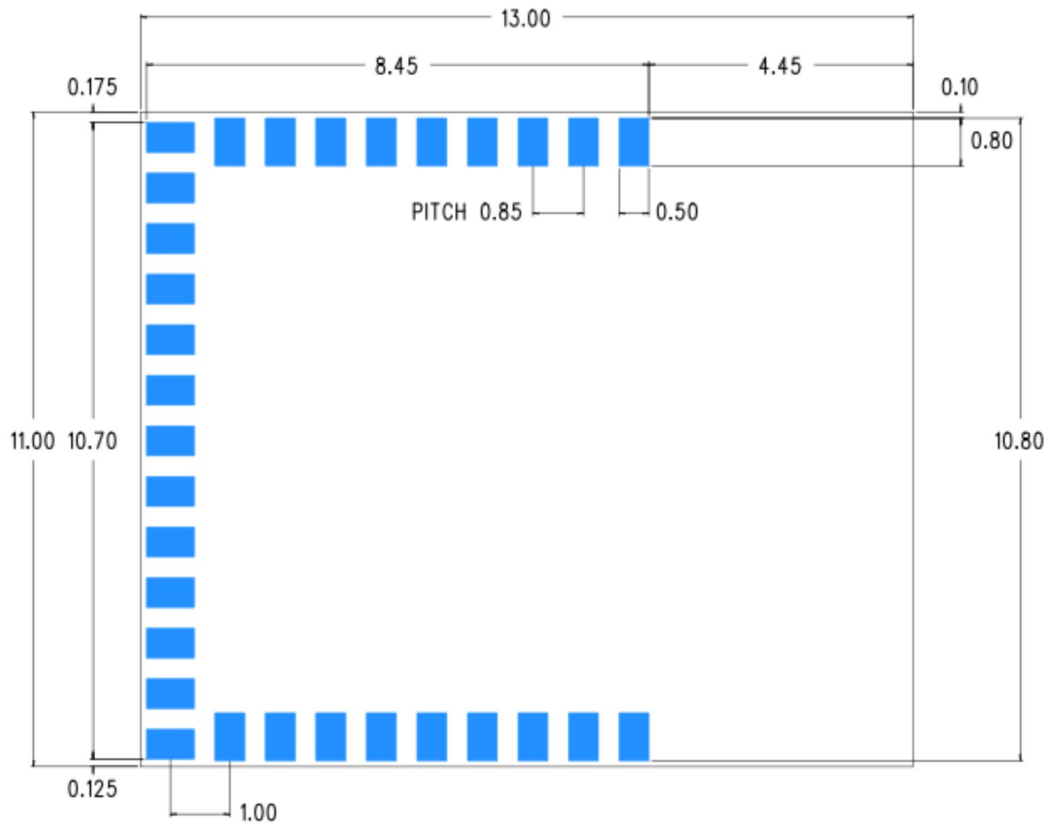
RF transmitter active: 4.3 mA (TYP.)

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 <sub>TXSP</sub>	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 <sub>TXHC1</sub>	2 <sup>nd</sup> Harmonic		-52		dBm
	RF <sub>TXCH2</sub>	3 <sup>rd</sup> Harmonic		-51		dBm

## Receiver RF Specifications

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit	
RF input frequency	RF <sub>RXFRIN</sub>		2402		2480	MHz	
Maximum input level	RF <sub>LEVL</sub>	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 <sub>STY</sub>	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 <sub>RXSP</sub>		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 <sub>CCR</sub>	PER ≤ 30.8%, Prf = -67dBm	-21	-12	-	dB	
Adjacent channel rejection ratio	RF <sub>ADCR</sub>	PER ≤ 30.8% Prf = -67 dBm	±1 MHz	-15	-5	-	dB
			±2 MHz	17	29	-	dB
			±3 MHz	27	34	-	dB
Blocking	RF <sub>BLK</sub>	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 <sub>RXFERR</sub>	PER ≤ 30.8%	-250		+250	kHz	
RSSI accuracy	RF <sub>RSSIS</sub>	T <sub>A</sub> = +25°C, -70 dBm ≤ Prf ≤ -10 dBm	-4	0	4	dB	

# 12 Footprint



ALL DIMENSIONS ARE IN MILLIMETERS

Figure 1: Top View

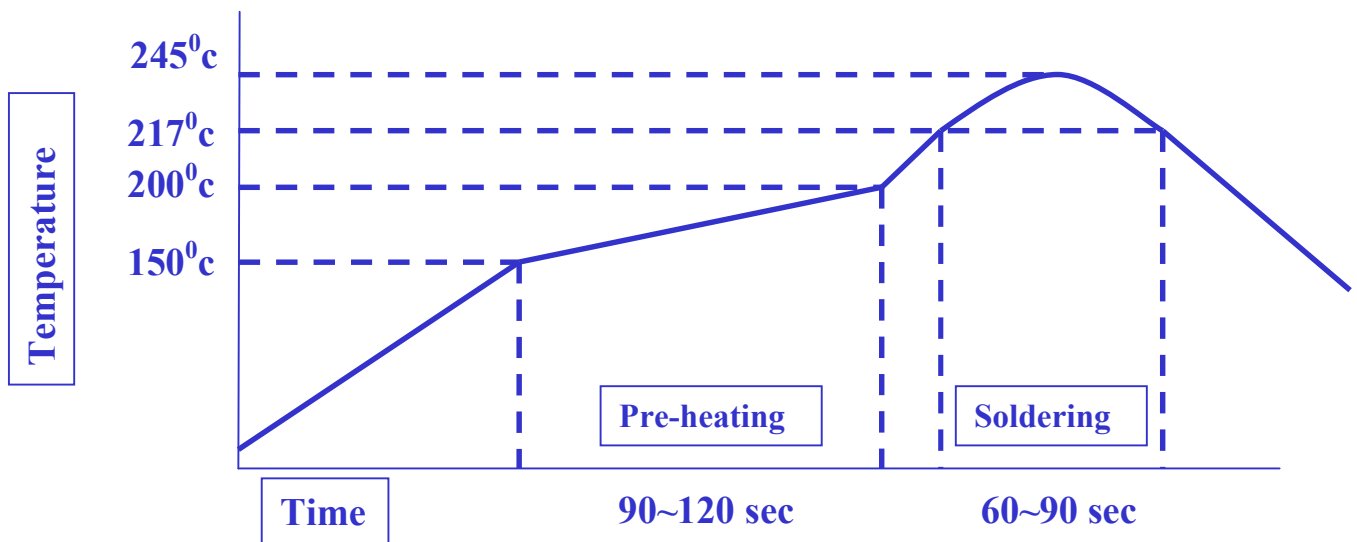
### 13 Product Compliance Considerations

**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

The image shows a yellow-bordered label for moisture-sensitive devices. It includes a 'Caution' symbol (a circle with a diagonal slash and three dots) and the text 'Caution This bag contains MOISTURE-SENSITIVE DEVICES'. A 'LEVEL 3' box is highlighted with a red arrow. Below it, '260' is highlighted with a red arrow. Further down, '168' is highlighted with a red arrow. At the bottom, 'APR 26 2011' is highlighted with a red arrow. To the right of the label, four white boxes with black borders contain the following text: 'Level 3', '260°C', '168 hours', and 'MMMDDYYYY'. Red arrows point from each of these boxes to the corresponding value on the label.

## 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
10/17/2017	KT	2.1	Certification update

## 17 Contact Information

Inventek Systems  
 2 Republic Road  
 Billerica Ma, 01862  
 Tel: 978-667-1962  
[Sales@inventeksys.com](mailto:Sales@inventeksys.com)

[www.inventeksys.com](http://www.inventeksys.com)



## Inventek Systems

Inventek Systems reserves the right to make changes without further notice to any products or data herein to improve reliability, function, or design. The information contained within is believed to be accurate and reliable. However Inventek Systems does not assume any liability arising out of the application or use of this information, nor the application or use of any product or circuit described herein, neither does it convey any license under its patent rights nor the rights of others.