

Document Number	
Version	0.6
Created By	Steve Lin

GR0136

RPMA Radio Communication Module

Date: Nov. 30th, 2020



Modification History

Date	Change log	Author	Revision
09/03/2017	First draft	Steve Lin	0.1
13/04/2017	Version Modified.	Steve Lin	0.2
26/04/2017	Version Modified.	Steve Lin	0.3
15/11/2017	Current consumption value revised.	Steve Lin	0.4
08/11/2017	Shield Cover Marking revised.	Steve Lin	0.5
30/11/2020	Adding FCC/IC/CE Regulatory Information.	Steve Lin	0.6



1 General Description

The purpose of this document is to provide guidelines allowing an integrator to design a Host product that utilizes the GR0136 RPMA module and ensures that the system meets all of its technical objectives and requirements. The GR0136 RPMA module is a small form factor wireless network SiP module that easily integrates with various devices and sensors using an industry standard Serial Peripheral Interface (SPI). The top side of the printed circuit board (PCB) is enclosed with a radio frequency (RF) shield. GR0136 RPMA module is an LGA-style module designed to be soldered directly onto a host board via SMT processes.

The RF technology operates on the Ingenu 2.4GHz RPMA two-way Communication Network. GR0136 can achieve a sensitivity of over -133 dBm. The high sensitivity combined with the integrated +21.5 dBm power amplifier yields industry leading link budget making it optimal for any low data rate application requiring range or robustness. RPMA also provides significant advantages in both blocking and selectivity over conventional modulation techniques, solving the traditional design compromise between range, interference immunity and energy consumption.

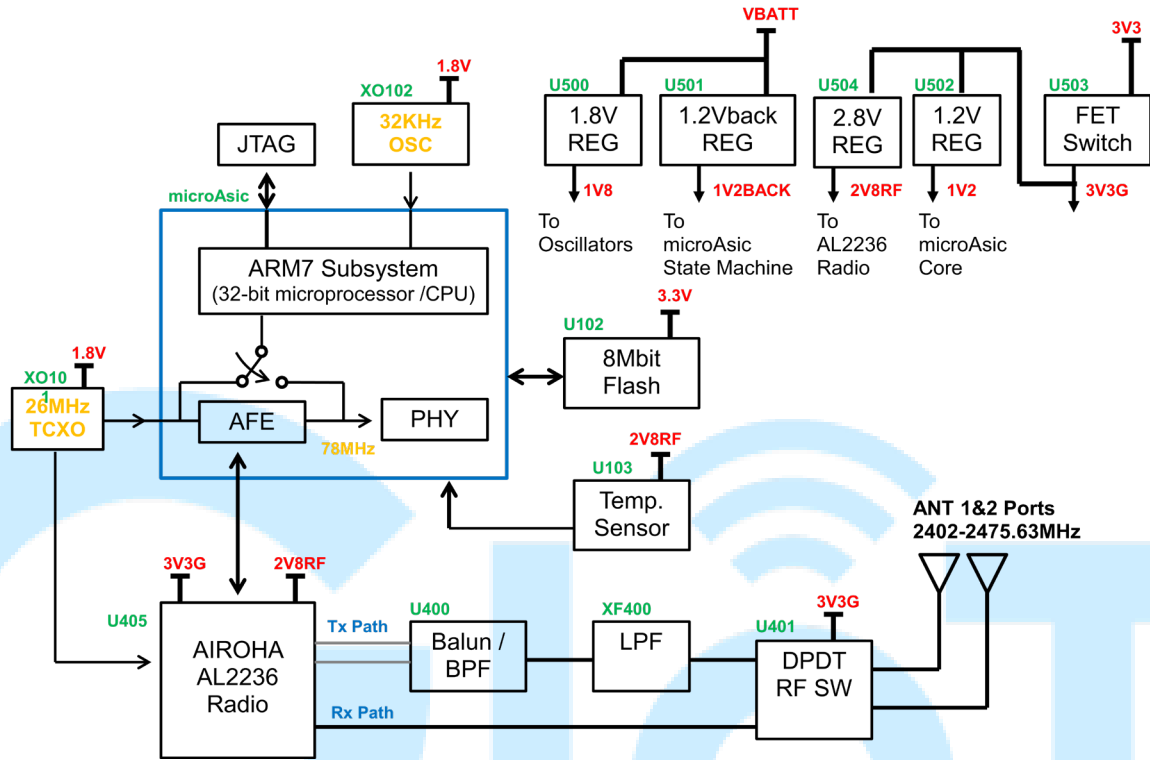
Features

- Small footprint : 20.5 mm x 18 mm x 2.35 mm
- RPMA Modem
- +21.5 dBm constant RF output vs. V supply
- High sensitivity: down to -133 dBm
- Excellent blocking immunity
- Preamble detection
- Embedded memory of 1 Mbytes of Flash memory

1-1 Block Diagram

A simplified block diagram of the GR0136 RPMA module is depicted in the figure below.

PicoNode (GR0136) Block Diagram



1-2 Product Version

The features of GR0136 is detailed in the following table

Part Number	Frequency Range	Channel Bandwidth (M Hz)	Effective Bitrate (bps)	Est. Sensitivity (dBm)
GR0136	2.4 GHz	1	60bps~30Kbps	-133

1-3 Specification

Model Name	GR0136
Product Description	RPMA Wireless Communication Module
Host Interface	SPI
Operation Conditions	
Temperature	■ Storage : -40°C ~ +85°C ■ Operating : -40°C ~ +85°C
Humidity	■ Operating : 10 ~ 95% (Non-Condensing) ■ Storage : 5 ~ 95% (Non-Condensing)
Dimension	20.5 mm x 18 mm x 2.35 mm
Package	LGA type

2 Electrical Characteristics

2-1. Absolute Maximum Ratings

Parameter	Min.	Max.	Unit
Storage Temperature	-40	85	°C
Operating Temperature	-40	85	°C
Vbatt Input Voltage	2.2	6.0	V
3.3V Supply	3.1	3.5	V
Digital Interface Signals, 3.3V nominal	3.0	3.6	V

2-2. Recommended Operating Range

Operating Conditions

Parameter	Min.	Max.	Unit
Input voltage, VBATT	2.2	5.5	V
3.3V Input	3.2	3.4	V
Ambient Temperature, Ta	-40	85	°C

DC Characteristics

Description	Min.	Typ.	Max.	Unit
Voltage – Vbatt	2.2	3.3	5.5	Volt
Off Current	0.05	0.1	2.0	μA
Deep Sleep Current		19	30	μA
Idle Current		20	26	mA
Receive Current		105	120	mA
RPMA Node: Transmit Current (@21.5dBm)		325	375	mA

Note: The above values with * mark in the DC Characteristics table are preliminary values.

Digital

Description	Min.	Typ.	Max.	Unit
VOL – Voltage Output, Low (4mA sink)	0		0.4	V
VOH – Voltage Output High (4mA source)	2.4		3.3	V
SPI Clock – Note 11	0.1		8.6	MHz

Environmental

Description	Min.	Typ.	Max.	Unit
Operating Temperature	-40		+85	°C
Storage Temp	-40		+85	°C
Humidity – non-condensing	5		95	%
Ramp Temperature (maximum rate at which operating temperature should change)			30	°C/Hr.
MTBF (RPMA Node)		TBD		MHrs

Receiver

Description	Min.	Typ.	Max.	Unit
Receiver Sensitivity	-130*	-133*	-135*	dBm
Noise Figure	3.5	5	6.5	dB
Maximum RF input level for specification compliance			-20*	dBm

Note: The above values with * mark in Receiver table are preliminary values.

General RF Characteristics

Description	Min.	Typ.	Max.	Unit
Frequency Range	2402		~2482	MHz
Channel Spacing	N/A	1.99	N/A	MHz

Transmitter

Description	Min.	Typ.	Max.	Unit
Maximum RF Conducted Power				
FCC/IC markets:		21.5		dBm
Signal Modulation		DSSS- DBPSK		
Signal Bandwidth		1.0		MHz
BT Factor		0.3		
Peak to Average Ratio		2.3		dB
Spectral bandwidth at maximum RF power:				
-6dB BW		0.96		MHz
-20dB BW		1.75		MHz
ACPR			-30	dBc
Harmonics			-43	dBm
Transmit Power Level Accuracy			±1.5	dB
Transmitter Spurious Outputs				
30MHz to 2400MHz:			< -43	dbm
2482MHz to 8000MHz:			< -43	dbm
VSWR Tolerance				
Maximum VSWR for spec compliance			1.5:1	
Maximum VSWR for stability.			9:1	

3 Pin Definition

3-1. Pin Assignment

Pin	Definition	Signal Type	Description
1	GND	Power	Ground return
2	SRQ	Output	Slave Request
3	SRDY	Output	Slave Ready
4	SPI_MISO	Output	SPI Master Input Slave Output
5	SPI_CS0	Input	SPI Chip Select
6	SPI_MOSI	Input	SPI Master Output Slave Input
7	SPI_SCLK	Input	SPI Clock
8	3V3	Power	The 3.3V can be continuously supplied or only when the WAKE pin is asserted "high". This power domain is high power (internal CPU, Transceiver, and RF PA) and should be decoupled with a low ESR, high capacitance Capacitor.
9	TOUT	Output	TOUT is a normally low signal that pulses high in response to specific Network Timing Events.
10	TIME_QUAL	Output	This pin is used by the Extender for Node-based timing derivation.
11	GND	Power	Ground return
12	GND	Power	Ground return
13	GND	Power	Ground return
14	GND	Power	Ground return
15	GND	Power	Ground return

16	MRQ	Input	Master Request
17	RF_SHDN	RF Shutdown	This pin indicates the status of the RF Transceiver for GR0136 module: Low = Shutdown High = Active
18	ON_OFF	Input	This is used to turn ON/OFF the Internal Power supplies of the GR0136 module. Low: Node consumes <1uA High: Node is active and will run through a wide range of power states.
19	WAKE	Input	Wake up pin
20	VBATT	Power	Input power to GR0136 module. This power domain is low current but is used 100% of the time to supply Supervisory domains.
21	RF_TXENA	Output	This signal is used to indicate status of the Power Amplifier for the GR0136 module: Low = OFF High = Enabled (Transmitting) The rise edge can be used to trigger a Host CPU's ADC read of VBATT (battery voltage while under maximum load).
22	GND	Power	Ground return
23	RF_PORT1	50 Ohm	RF port for GR0136 module. This is 50 Ohm port, DC coupled. RF1 is required but both are desired for antenna diversity. Single port or dual antenna port can be configured in the provisioning process.
24	GND	Power	Ground return
25	RF_PORT2	50 Ohm	RF port for GR0136 module. This is 50 Ohm port, DC coupled. Single port or dual antenna port can be configured in the provisioning



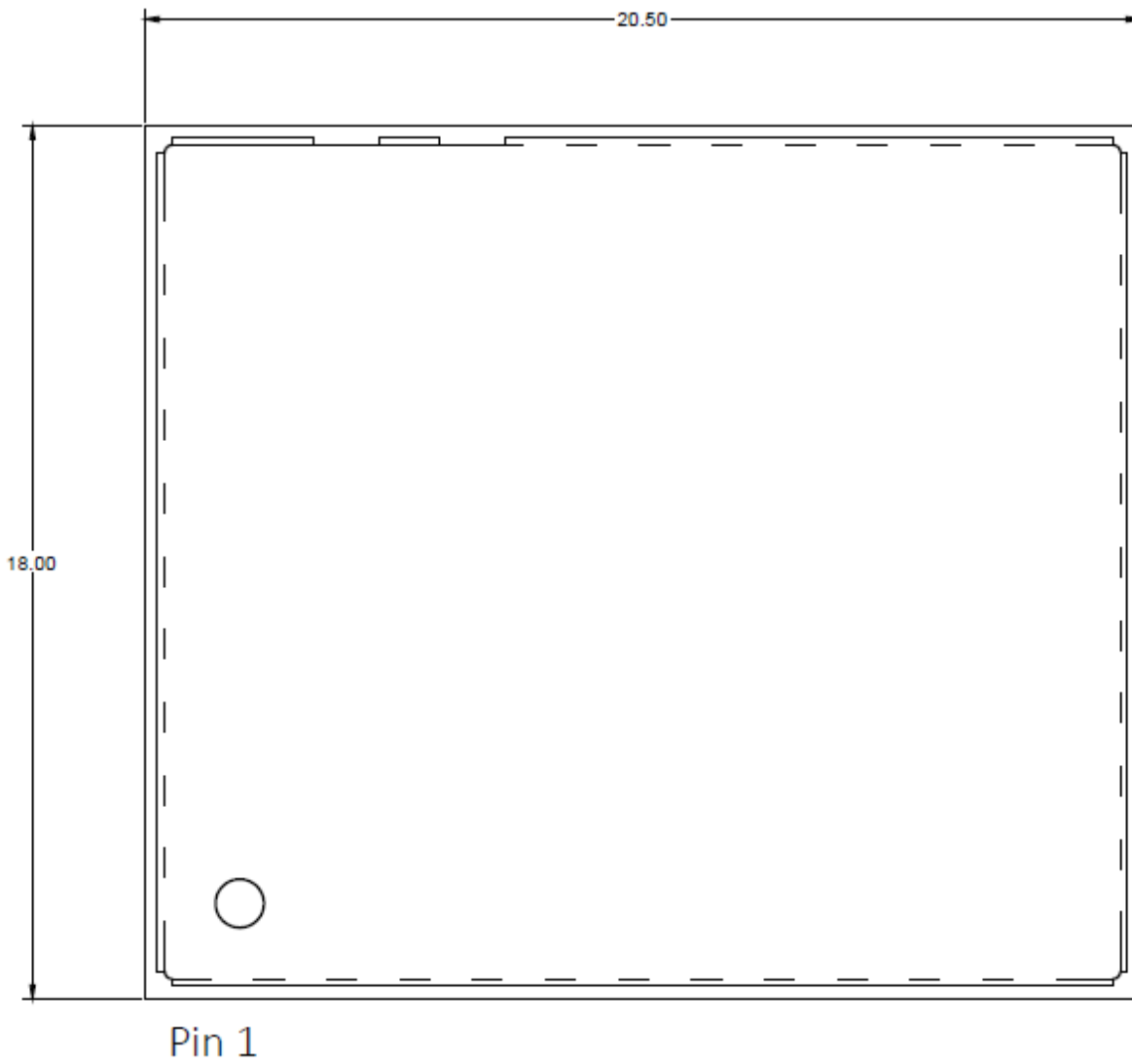
			process.
26	GND	Power	Ground return
27	GND	Power	Ground return
28	GND	Power	Ground return
29	GND	Power	Ground return
30	GND	Power	Ground return

GIÖT



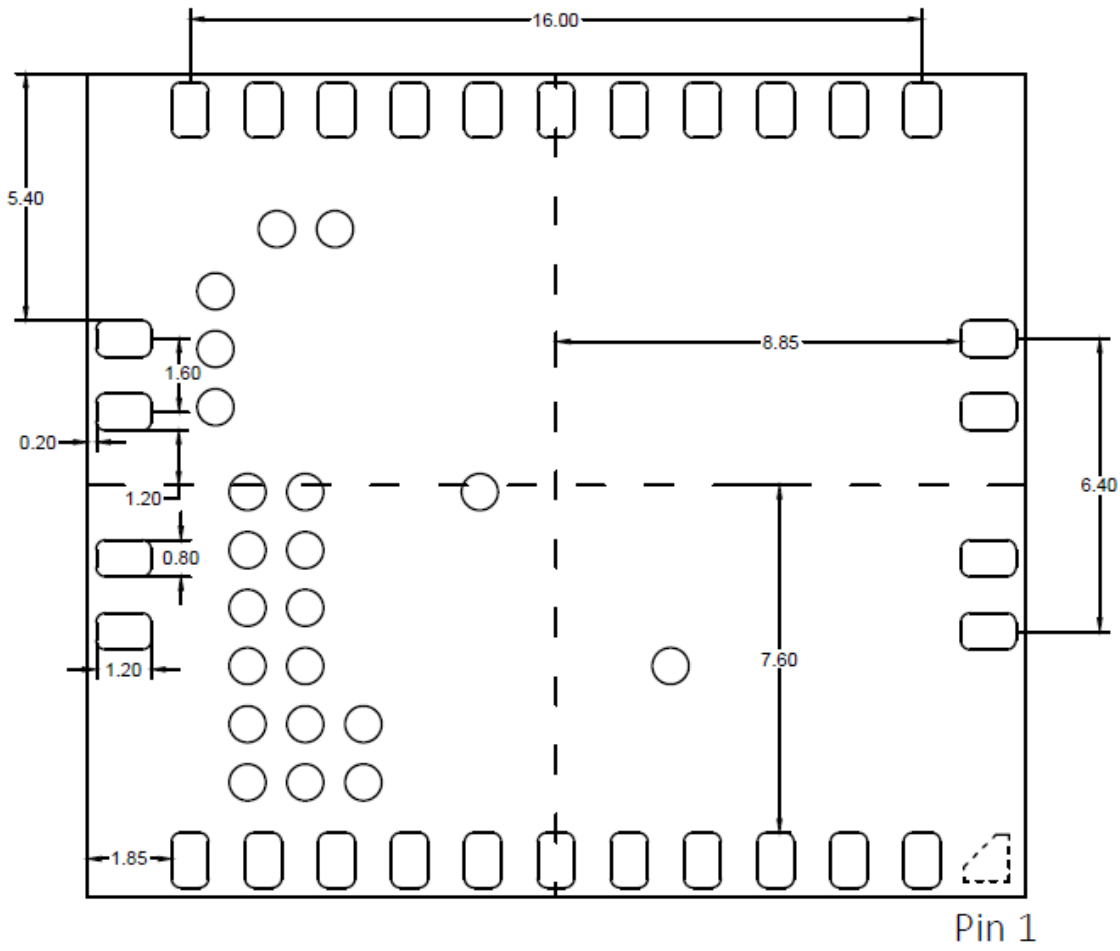
4 Mechanical Dimension

Unit: mm

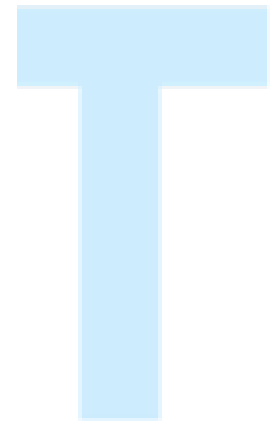


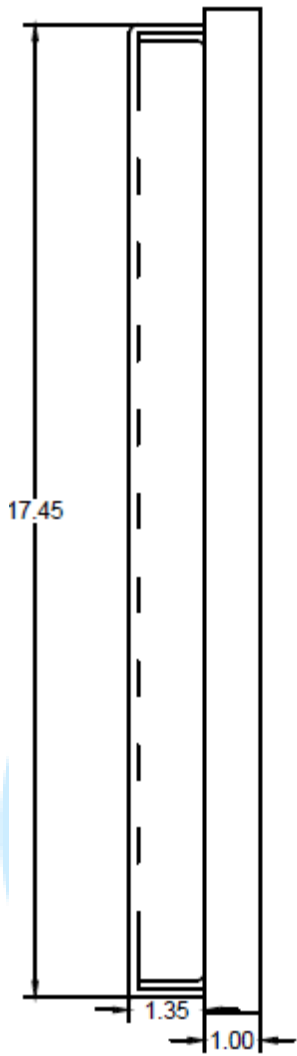
Top View





Bottom View



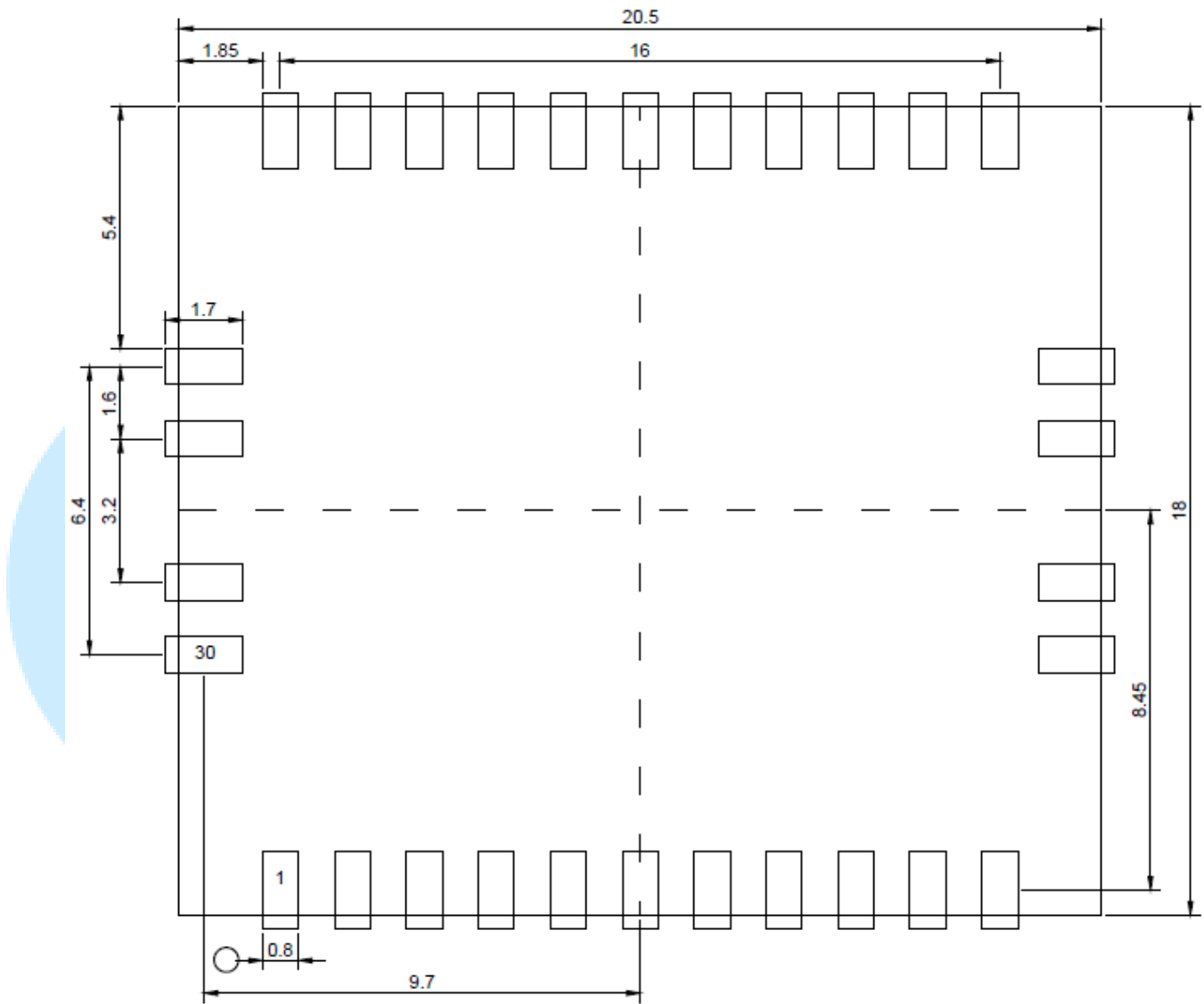


Side View



4-1 Recommended Footprint

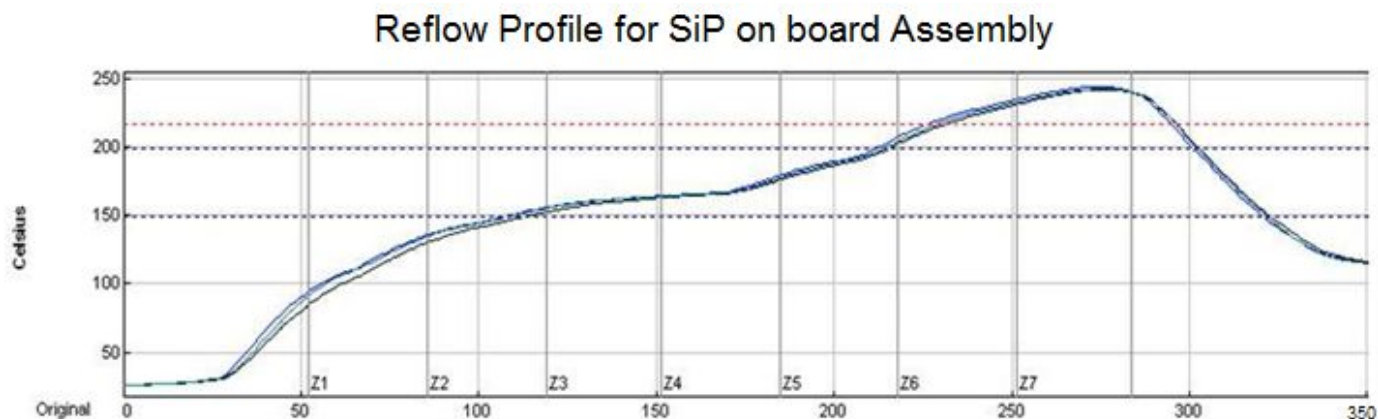
Unit: mm



TOP VIEW

TOP View

5 Recommended Reflow Profile



Preheat time	150°C—200°C : 105+/-15sec
Dwell time	Over 220°C : 70+5/-10 sec
Peak Temp	240 +10/-5°C
Ramp Up/Down Rate	Up: 3 +0/-2 °C/ sec Down: 2 +0/-1°C/ sec

6 SiP Module Preparation

6-1. Handling

Handling the module must wear the anti-static wrist strap to avoid ESD damage. After each module is aligned and tested, it should be transport and storage with anti -static tray and packing. This protective package must be remained in suitable environment until the module is assembled and soldered onto the main board.

6-2. SMT Preparation

1. Calculated shelf life in sealed bag: 6 months at $<40^{\circ}\text{C}$ and $<90\%$ relative humidity (RH).
2. Peak package body temperature: 250°C .
3. After bag was opened, devices that will be subjected to reflow solder or other high temperature process must.
 - A. Mounted within: 168 hours of factory conditions $<30^{\circ}\text{C}/60\%$ RH.
 - B. Stored at $\leq 10\%$ RH with N2 flow box.
4. Devices require baking, before mounting, if:
 - A. Package bag does not keep in vacuumed while first time open.
 - B. Humidity Indicator Card is $>10\%$ when read at $23\pm 5^{\circ}\text{C}$.
 - C. Expose at 3A condition over 8 hours or Expose at 3B condition over 24 hours.
5. If baking is required, devices may be baked for 12 hours at $125\pm 5^{\circ}\text{C}$.

7 Package Information

7.1 Product Making

Figure 1 below details the standard product marking for Gemtek GloT products. Cross reference to the applicable line number and table for a full detail of all the variables.

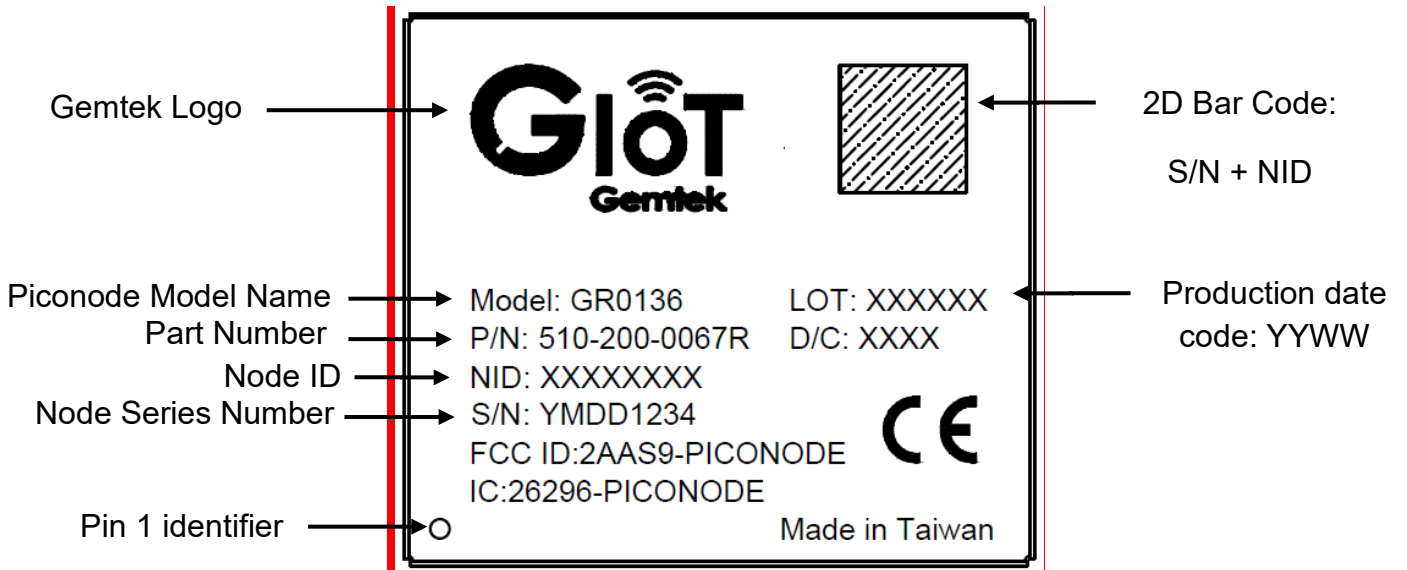


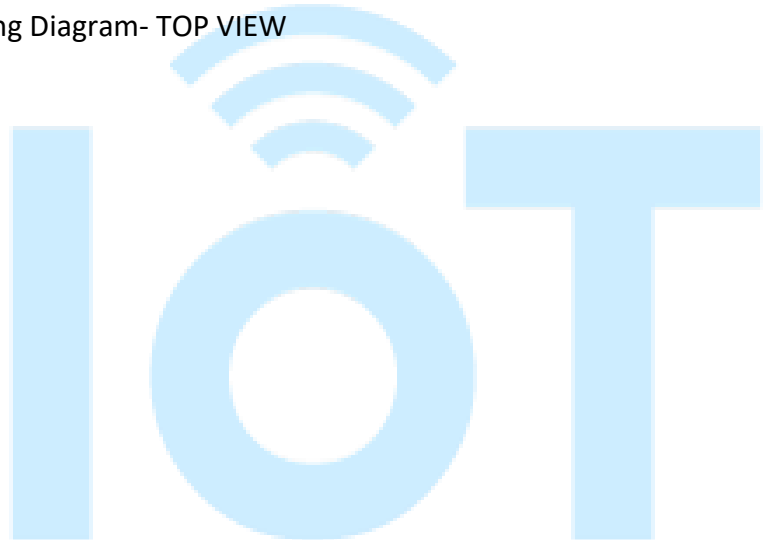
Figure 1 Standard Product Marking Diagram- TOP VIEW

Scan result as below:

First line SN: 8 digit (HEX)

Second Line NID: 8 digit (HEX)

691D0001
00002372



8 Regulatory Information

Regulatory Region	Scope	Certificate ID
US	FCC	2AAS9-PICONODE
Canada	Industry Canada(IC)	26296-PICONODE
Europe	RED(Radio Equipment Directive)	No certificate ID since internal production control of Conformity assessment procedure is selected.

GR0136 certification approvals

Integration instructions for host product manufacturers

Applicable FCC rules to module

FCC Part 15.247

Summarize the specific operational use conditions

The module is must be installed in mobile device.

This device is intended only for OEM integrators under the following conditions:

- 1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
- 2) The transmitter module may not be co-located with any other transmitter or antenna

As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

IMPORTANT NOTE: In the event that these conditions can not be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID can not be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization. The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.

The end user manual shall include all required regulatory information/warning as show in this manual.

Limited module procedures

Not applicable

Trace antenna designs

See the documents: “GR0136_Antenna_2020_1130” & “Test Procedure of embedded Antenna for GR0136 GIOT module”

RF exposure considerations

20 cm separation distance and co-located issue shall be met as mentioned in “Summarize the specific operational use conditions”.

Product manufacturer shall provide below text in end-product manual

“This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.”

Antennas

Brand name	Model name	Antenna type	Antenna gain	Antenna connector
Linx	ANT-2.4-USP	Mono-pole	3.8 (dBi)	RSMA
Taiyo Yuden	AH 104F2450S1	Mono-pole (Inverted F)	1.9 (dBi)	RSMA
Taoglas	GW.34.5153	Dipole	5.89 (dBi)	RSMA
Ethertronics	1001013	PIFA / magnetic Dipole	2.6 (dBi)	---
Jesoncom	10I010D	Mono-pole	4.8 (dBi)	RSMA

Label and Compliance Information

Product manufacturers need to provide a physical or e-label stating

“Contains FCC ID: 2AAS9-PICONODE” with finished product

Information on Test Modes and Additional Testing Requirements

EMC Certification Tools, Version: 1.6.14.1 shall be used to set the module to transmit continuously.

Additional Testing, Part 15 Subpart B Disclaimer

The module is only FCC authorized for the specific rule parts listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. The final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

Industry Canada statement

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

- (1) This device may not cause interference*
- (2) This device must accept any interference, including interference that may cause undesired operation of the device*

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique 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;*
- (2) L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.*

This radio transmitter [IC: 26296-PICONODE] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Le présent émetteur radio [IC: 26296-PICONODE] a été approuvé par Innovation, Sciences et Développement économique Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal. Les types d'antenne non inclus dans cette liste, et dont le gain est supérieur au gain maximal indiqué pour tout type figurant sur la liste, sont strictement interdits pour l'exploitation de l'émetteur.

Brand name	Model name	Antenna type	Antenna gain	Antenna connector
Linx	ANT-2.4-USP	Mono-pole	3.8 (dBi)	RSMA
Taiyo Yuden	AH 104F2450S1	Mono-pole (Inverted F)	1.9 (dBi)	RSMA
Taoglas	GW.34.5153	Dipole	5.89(dBi)	RSMA
ethertronics	1001013	PIFA / magnetic Dipole	2.6 (dBi)	---
Jesoncom	10I010D	Mono-pole	4.8 (dBi)	RSMA

Radiation Exposure Statement:

This equipment complies with Canada radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

Déclaration d'exposition aux radiations:

Cet équipement est conforme Canada limites d'exposition aux radiations dans un environnement non contrôlé. Cet équipement doit être installé et utilisé à distance minimum de 20cm entre le radiateur et votre corps.

This device is intended only for OEM integrators under the following conditions:

1) The transmitter module may not be co-located with any other transmitter or antenna.

As long as 1 condition above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

Cet appareil est conçu uniquement pour les intégrateurs OEM dans les conditions suivantes:

1) Le module émetteur peut ne pas être coimplanté avec un autre émetteur ou antenne.

Tant que les 1 condition ci-dessus sont remplies, des essais supplémentaires sur l'émetteur ne seront pas nécessaires. Toutefois, l'intégrateur OEM est toujours responsable des essais sur son produit final pour toutes exigences de conformité supplémentaires requis pour ce module installé.

IMPORTANT NOTE:

In the event that these conditions can not be met (for example certain laptop configurations or co-location with another transmitter), then the Canada authorization is no longer considered valid and the IC ID can not be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate Canada authorization.

NOTE IMPORTANTE:

Dans le cas où ces conditions ne peuvent être satisfaites (par exemple pour certaines configurations d'ordinateur portable ou de certaines co-localisation avec un autre émetteur), l'autorisation du Canada n'est plus considéré comme valide et l'ID IC ne peut pas être utilisé sur le produit final. Dans ces circonstances, l'intégrateur OEM sera chargé de réévaluer le produit final (y compris l'émetteur) et l'obtention d'une autorisation distincte au Canada.

End Product Labeling

The final end product must be labeled in a visible area with the following: "Contains IC:26296-PICONODE".

Plaque signalétique du produit final

Le produit final doit être étiqueté dans un endroit visible avec l'inscription suivante: "Contient des IC: 26296-PICONODE".

Manual Information To the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.

The end user manual shall include all required regulatory information/warning as show in this manual.

Manuel d'information à l'utilisateur final

L'intégrateur OEM doit être conscient de ne pas fournir des informations à l'utilisateur final quant à la façon d'installer ou de supprimer ce module RF dans le manuel de l'utilisateur du produit final qui intègre ce module. Le manuel de l'utilisateur final doit inclure toutes les informations réglementaires requises et avertissements comme indiqué dans ce manuel.

