INP1010/INP1011 Module Datasheet

Ultra-Low Power Wi-Fi 802.11 b/g/n
BLE 5.0 Plus Advanced Features & Long-Range
Arm Cortex-M3 MCU

VERSION 2.4

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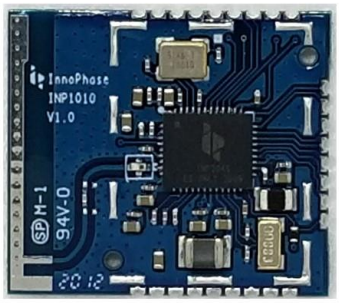
1 Contents

2 Overview

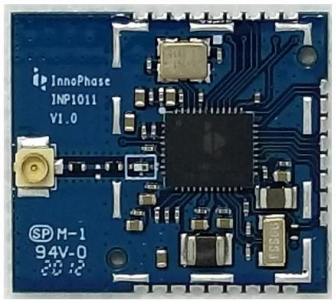
The INP1010/1011 products are complete solutions with integrated wireless connectivity plus microcontroller for edge-of-network IoT designs. The modules use InnoPhase's award-winning Talaria TWO™ Multi-Protocol Platform with Wi-Fi and BLE for wireless data transfer, an embedded Arm Cortex-M3 for system control and user applications and advanced security elements for device safeguards.

The Talaria TWO's unique digital polar radio architecture makes the INP1010/1011 modules the world's lowest power Wi-Fi solution. It also provides BLE connectivity for Wi-Fi provisioning, diagnostics and other local communication. The integrated solution is ideally suited for battery-based, direct-to-cloud devices such as smart door locks, remote security cameras and connected sensors.

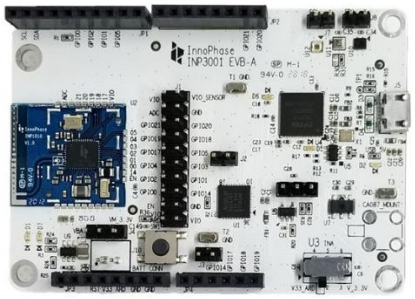
The modules have either a printed PCB antenna (INP1010) or U.FL antenna connector (INP1011) and have completed Wi-Fi Alliance, Bluetooth SIG, FCC, IC (Canada), and CE testing and certification. Each module has an associated EVB-A evaluation board (INP3010 and INP3011 respectively) – see the INP3010/INP3011 User Guide available at innophaseinc.com/talaria-two-modules for more information.



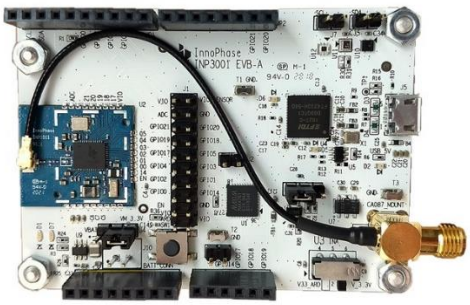
INP1010
(w/ PCB Antenna)



INP1011
(w/ U.FL Connector)



INP3010
(Includes INP1010 Module
w/ PCB Antenna)



INP3011
(Includes INP1011 Module
w/ U.FL Connector)

3 Key Features

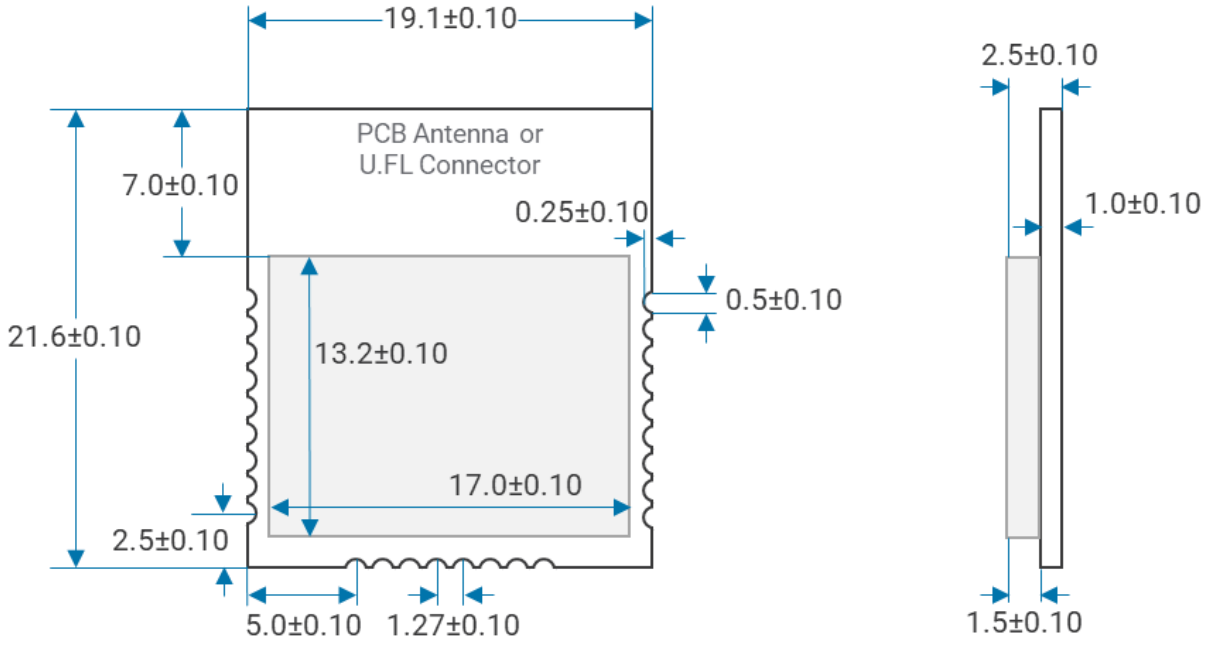
- Ultra-low power 2.4GHz 802.11 b/g/n Wi-Fi connectivity
- DTIM10 at 57uA enables connected battery-based applications
- Full stack including MQTT, mbedTLS for supporting IoT Direct-to-Cloud for a variety of cloud services (AWS, Azure, Google Cloud, IBM Watson, etc.)
- BLE5.0 w/ Advanced Features LE Coding/FEC (Long-Range), 2M PHY, Extended Advertising
- Supports Wi-Fi Provisioning over BLE and local device management, plus BLE to Wi-Fi bridging
- Bluetooth GATT/GAP Profile support, and HCI interface option for host MCU-based BLE profile stacks
- Advanced security features including Secure Boot, PUF (Physically Unclonable Function) and hardware Crypto Engines
- Embedded 80MHz Arm Cortex-M3 w/ 512KB SRAM and 2MB Flash
- Host Interface over SPI or UART using InnoPhase HIO API (HAPI) C library or AT Commands
- Twelve (12) configurable GPIO
- Dedicated ADC Input pin
- Integrated clocks and power management – only a single 3.3V supply needed
- PCB antenna or U.FL antenna connector options

4 Part Numbers

Manufacturer Part Number	Ordering Part Number	Description
INP1010	INP1010-A1-ITP	Talaria TWO module, PCB Antenna, tray packing
INP1011	INP1011-A2-ITP	Talaria TWO module, U.FL Antenna Connector, tray packing
INP3010	INP3010-A1	Evaluation Board (EVB-A) w/ INP1010 module, PCB Antenna (see separate INP3010/INP3011 User Guide for more information available at innophaseinc.com/talaria-two-modules)
INP3011	INP3011-A1	Evaluation Board (EVB-A) w/ INP1011 module, U.FL Antenna Connector (see separate INP3010/INP3011 User Guide for more information available at innophaseinc.com/talaria-two-modules)

5 Module Dimensions

Units in mm



Top View

Side View

6 Absolute Maximum Ratings

Parameter		Min.	Max.	Unit
Storage Temperature		-40	+125	°C
Supply Voltages	V_3.3V	-0.3	4.0	V
RF Signal Input (INP1011 Module Only)		--	+10	dBm

7 Storage Conditions

Product is applicable to MSL3 based on JEDEC Standard J-STD-020. Product should be used within 12 months after receipt. If used after 12 months the solderability should be confirmed. After the packing is opened, the product shall be stored at <30deg.C / <60%RH and the product shall be used within 168 hours, after this timeframe the product should be backed at 125°C for 24 hours. The products shall be baked on the heat-resistant tray as the shipment tray is not a heat-resistant, bakeable tray.

8 Operating Conditions

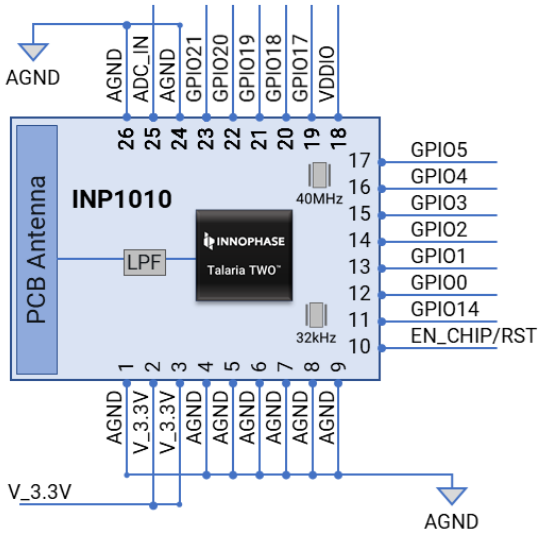
Parameter		Min.	Typical	Max.	Unit
Operating Temperature		-40	25	+85	°C
Input Supply Voltage Range	V_3.3V	2.6	--	3.6	V
Input Supply Specification Voltage Range[1]	$V\_3.3V_{op}$	3.0		3.6	V
Input Supply Current (Tx Mode)	$I_{V\_3.3V}$	--	190	300	mA
VDDIO Voltage[2]	VDDIO	2.5	--	3.0[3]	V

Note 1: recommended operational voltage range

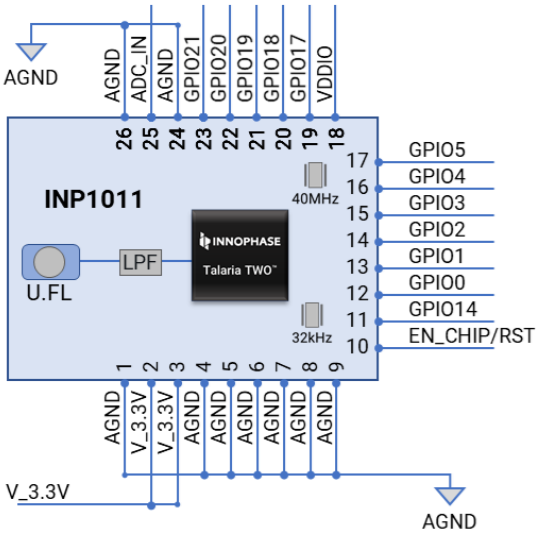
Note 2: reference voltage only, not to be used as a power supply for external devices, configurable to either 2.5V or 3.0V

Note 3: Input Supply Voltage (V_3.3V) level must be ≥ 3.15V to achieve maximum 3.0V VDDIO voltage

9 Block Diagrams



INP1010 Module
w/ PCB Antenna



INP1011 Module
w/ U.FL Antenna Connector

10 GPIO Specifications & Requirements

10.1 Digital I/O Specifications

Parameter	Symbol	Min.	Typical	Max.	Unit
Pull-Up Resistance (All GPIO except GPIO18)	R_{PU}	--	51	--	kΩ
Pull-Down Resistance (Only GPIO18, for JTAG TCK)	R_{PD}	--	51	--	kΩ
Pin Capacitance	C_{IN}		1.7		pF
V_3.3V = 3.3V, VDDIO = 2.5V, 25°C					
High Level Input Voltage	V_{IH}	2.0	--	3.6	V
Low Level Input Voltage	V_{IL}	-0.3	--	0.8	V
High Level Input Current	I_{IH}	--	2.0	--	nA
Low Level Input Current	I_{IL}	--	2.0	--	nA
High Level Output Voltage	V_{OH}	2.3	--	--	V
Low Level Output Voltage	V_{OL}	--	0.2	0.4	V
High Level Source Current	I_{OH}	--	8	--	mA
High Level Source Current, High Drive	I_{OH-HD}	--	10	--	mA
Low Level Sink Current	I_{OL}	--	7	--	mA
Low Level Source Current, High Drive	I_{OL-HD}	--	9	--	mA

10.2 Peripheral Signal Mapping

Interface	Signal	GPIO0	GPIO1	GPIO2	GPIO3	GPIO4	GPIO5	GPIO14	GPIO17	GPIO18	GPIO19	GPIO20	GPIO21
UART	RXD			●									
	TXD		●										
	CTS												
	RTS												
Console	TX								●				
SPI Slave	CLK	●											
	CS						●						
	MOSI		●										
	MISO			●									
GPIO[1]	GPIO												
PWM	PWM_0												
	PWM_1												
	PWM_2												
	PWM_3												
JTAG / SWD	TCK/ SWCLK									●			
	TMS / SWDIO										●		
	TDI											●	
	TDO / SWO												●
I2C	SCL									[2]			
	SDA									[2]			
I2S	SCK												
	WS												
	SD												

Notes:

● = Default Power-Up GPIO

■ = Function Supported on GPIO

■ = Required for factory production firmware loading in-situ. These should be connected to Host MCU or a header/connector to factory test/PC equipment. For UART with flow control also use GPIO0 and GPIO5. For higher speed factory programing the SPI connection is GPIO0, GPIO1, GPIO2, GPIO5

Note 1: any GPIO can be used for wakeup (interrupt) and can drive high current loads such as LEDs

Note 2: requires external pull-up resistor (only an internal pull-down is available)

11 Peripheral Interface Specifications & Timing Diagrams

11.1 UART

The INP1010/1011 modules include one (1) UART controller. All signals, RXD, TXD, CTS and RTS, can be individually programmed for use on any GPIO. The power-up default pins for TXD is GPIO1 and RXD is GPIO2.

UART Specification	Details
Maximum Baud Rate	2560000
Minimum Baud Rate	300
Default Baud Rate	921600

11.2 Console UART

Default pin is set to GPIO17, but it can be programmed to any GPIO. Unidirectional Tx only from Talaria TWO for debug purposes.

Console UART Specification	Details
Default Baud Rate	2457600

11.3 SPI Slave

The INP1010/1011 modules include one (1) SPI Slave interface. All signals are fixed to specific pins where CLK is GPIO0, MOSI is GPIO1, MISO is GPIO2 and CS is GPIO5. It is not possible to reassign the signals to different GPIOs.

SPI Slave Specification	Details
Maximum Clock Frequency	25MHz
Clock Polarity and Phase Modes Supported	Mode 0 (CPOL=0, CPHA=0) Mode 3 (CPOL=1, CPHA=1)
Data In/Out Sequence	MSB First
Other Features	Dual SPI Mode Capable Read Status Reset

11.4 I2C

The INP1010/1011 modules include one (1) I2C bus interface that can serve as an I2C master or slave. The SCL and SDA lines can be individually programmed for use on any GPIO. Internal pull-up resistors are available for SCL/SDA on all GPIOs except for GPIO18 (GPIO18 only has internal pull-down resistors). To use GPIO18 for I2C, external pull-up resistors must be added.

I2C Specification	Details
Data Rates	100Kbps, 400Kbps, 1Mbps
Address Modes	7-bit, 10-bit
Other Features	Send STOP at End NOSTART Before Msg IGNORE NAK From Slave

11.5 I2S

The INP1010/1011 modules include one (1) I2S interface that can serve as an I2S master or slave. It is only capable of transmitting data – it cannot receive I2S data. The SCK, WS and SD lines can be individually programmed for use on any GPIO.

I2S Specification	Details
Audio Formats Support	Up to HD Audio, Dual Channel Stereo (2x 16-bit @ 48kHz)

11.6 PWM

The INP1010/1011 modules include four (4) PWM timers which can be programmed for use on any GPIO.

PWM Specification	Details
Base Frequency	160MHz
Duty Rate Range	0% to 100%
Pulse Alignment	Left Aligned
Other	Audio Capable

11.7 JTAG/SWD

Compliant with ARM JTAG/SWD standards for debug purposes.

12 Analog to Digital Converter (ADC) Specifications

The INP1010/1011 modules have a 10-bit effective SAR ADC for measuring the internal supply voltage and temperature levels in addition to measuring an external voltage level through a specified ADC port. The ADC has configuration settings for sampling rate and results averaging.

ADC Specification	Details	Unit
ADC Input Channels	VBAT, TEMP, EXT	--
Sampling Rates	5, 10, 20, 40	Msps
Results Averaging	2, 4, 8, 16	# of Samples
External Voltage Input Range	0 to 1.0	V
Additional Delay for ADC Ready after Wakeup	5	µs

13 Wi-Fi Features

Wi-Fi Features	Details
Wi-Fi Standards Supported	802.11 b/g/n (2.4GHz Single-Band)
Wi-Fi Modes	Station Mode, AP Mode
Number of TCP/UDP Sockets	4-16[1]
Number of Concurrent SSL Connections	2-4[1]
Wi-Fi Security	WPA2, WPA2 Enterprise, WPA3
Application Security	TLS1.2

Note 1: depends on memory allocations/configurations

In Planning/Development

14 BLE Features

BLE Features	Details
BLE Standard Supported	BLE5.0
BLE Modes	Central, Peripheral
BLE Advanced Features Supported	LE Coding/FEC (Long-Range) 2Mbps PHY Extended Advertising
PHY Rates Supported	2Mbps, 1Mbps, 512kbps, 125kbps
Connection Roles	GAP Peripheral or Central
Generic Attribute Profile Roles	GATT Client or Server
Number of Concurrent Sessions	4/8[1]
Command Interface	HCI over SPI/UART
Security	AES-128CCM

Note 1: depends on memory allocations/configurations

15 Advanced Security Elements

15.1 Hardware Crypto Engines

Category	Details
Block Modes	Counter, GF, OFB, ECB, CBC-MAC, CBC-ENC, CBC-DEC, XEX
Block Cores (encryption)	AES (128/256), DES, TDES, SMS4, GF
Stream Cores (Hashing)	RC4, Michael, CRC32, SHA-1/256

15.2 Additional Hardware Security Capabilities

Additional hardware security capabilities include:

- DMA: Linear, Circular and Descriptor based transfer options
- E-Fuse Disable JTAG
- PUF/Secure Vault – Key/certificate, pass phrase, and application data storage, based on SoC Fingerprint

15.3 Software Security Features

Category	Details
uECC APIs	• Supports ECDH and ECDSA • Key generation, sign and verify functions • Secure Boot and FOTA signed ELF
Cipher APIs	• Wrapper to Cipher Hardware • Tight integration with DMA for effortless encryption/decryption
DMA APIs	• Automatic encryption/decryption of data without CPU involvement • Comprehensive modes to support various application needs

16 DC & RF Characteristics

16.1 General DC Characteristics

Specification		Details	Unit
Wi-Fi Idle Connected PS-Polling (3.3V, 802.11b, 1Mbps, Clean RF Environment)	DTIM = 1	414	µA
	DTIM = 3	151	µA
	DTIM = 5	97	µA
	DTIM = 10	57	µA
Sleep Current[1]		11-19[2]	µA
Shutdown Current (EN_CHIP Low)		<< 1	µA
EN_CHIP/RST Reset Voltage[3]		0.6	V

Note 1: RTC operating, memory retained, 3.3V supply
Note 2: Depends on amount of SRAM memory retained
Note 3: EN_CHIP/RST must be held below 0.6V to reset device

16.2 DC & RF Characteristics Wi-Fi 802.11b 2.4GHz

Specification	IEEE802.11b			
Mode	DSSS / CCK			
Channel Frequency	2412 - 2472MHz			
Data Rates	1, 2, 5.5, 11Mbps			
Conditions: 25C, V_3.3V = 3.3V, VDDIO = 2.5V **1Mbps unless stated otherwise**				
DC Characteristics	Min.	Typical	Max.	Unit
Tx Current (@ 17.5dBm)	--	178	--	mA
Rx Current	--	31	--	mA
Tx Characteristics	Min.	Typical	Max.	Unit
Output Power	--	17.5	--	dBm
Spectral Mask Margin				
First Side Lobe	0	2	--	dB
Second Side Lobe	0	2	--	dB
Error Vector Magnitude (EVM)	--	-22.4	--	dB
Out-of-Band Spurious Emissions				
30MHz – 1.00GHz (RBW = 100kHz)	--	--	-41	dBm/MHz
1.0GHz – 12.75GHz (RBW = 1MHz)	--	--	-41	dBm/MHz
Rx Characteristics	Min.	Typical	Max.	Unit
Rx Input Level Sensitivity				
DSSS, 1Mbps	--	-96	--	dBm
Adjacent Channel Rejection				
DSSS, 1Mbps	35	--	--	dB

16.3 DC & RF Characteristics Wi-Fi 802.11g 2.4GHz

Specification	IEEE802.11g			
Mode	OFDM			
Channel Frequency	2412 - 2472MHz			
Data Rates	6, 9, 12, 18, 24, 36, 48, 54Mbps			
Conditions: 25C, V_3.3V = 3.3V, VDDIO = 2.5V **6Mbps unless stated otherwise**				
DC Characteristics	Min.	Typical	Max.	Unit
Tx Current (6Mbps @ 15.5dBm)	--	134	--	mA
Tx Current (54Mbps @ 15.5dBm)	--	100	--	mA
Rx Current (6Mbps)	--	34	--	mA
Rx Current (54Mbps)	--	35	--	mA
Tx Characteristics	Min.	Typical	Max.	Unit
Output Power	--	15.5	--	dBm
Spectral Mask Margin				
±9dBr MHz Offset	0	5	--	dB
±11dBr MHz Offset	0	5	--	dB
±20dBr MHz Offset	0	5	--	dB
±30dBr MHz Offset	0	5	--	dB
Error Vector Magnitude (EVM)	--	-25.7	--	dB
Out-of-Band Spurious Emissions				
30MHz – 1.00GHz (RBW = 100kHz)	--	--	-41	dBm/MHz
1.0GHz – 12.75GHz (RBW = 1MHz)	--	--	-41	dBm/MHz
Rx Characteristics	Min.	Typical	Max.	Unit
Rx Input Level Sensitivity				
OFDM, 6Mbps	--	-93	--	dBm
Adjacent Channel Rejection				
OFDM, 54Mbps	-1	--	--	dB

16.4 DC & RF Characteristics Wi-Fi 802.11n 2.4GHz

Specification	IEEE802.11n			
Mode	OFDM			
Channel Frequency	2412 - 2472MHz			
Data Rates	6.5, 13, 19.5, 26, 39, 52, 58.5, 65Mbps			
Conditions: 25C, V_3.3V = 3.3V, VDDIO = 2.5V **6.5Mbps (MCS0) unless stated otherwise**				
DC Characteristics	Min.	Typical	Max.	Unit
Tx Current (MCS0 @12.5dBm)	--	108	--	mA
Tx Current (MCS7 @ 12.5dBm)	--	81	--	mA
Rx Current (MCS0)	--	34	--	mA
RX Current (MCS7)	--	37	--	mA
Tx Characteristics	Min.	Typical	Max.	Unit
Output Power	--	12.5	--	dBm
Spectral Mask Margin				
±9dBr MHz Offset	0	8	--	dB
±11dBr MHz Offset	0	8	--	dB
±20dBr MHz Offset	0	8	--	dB
±30dBr MHz Offset	0	8	--	dB
Error Vector Magnitude (EVM)	--	-27.1	--	dB
Out-of-Band Spurious Emissions				
30MHz – 1.00GHz (RBW = 100kHz)	--	--	-41	dBm/MHz
1.0GHz – 12.75GHz (RBW = 1MHz)	--	--	-41	dBm/MHz
Rx Characteristics	Min.	Typical	Max.	Unit
Rx Input Level Sensitivity				
OFDM, 6.5Mbps	--	-92	--	dBm
OFDM, 65Mbps	--	-69	--	dBm
Adjacent Channel Rejection				
OFDM, 54Mbps	TBD	--	--	dB

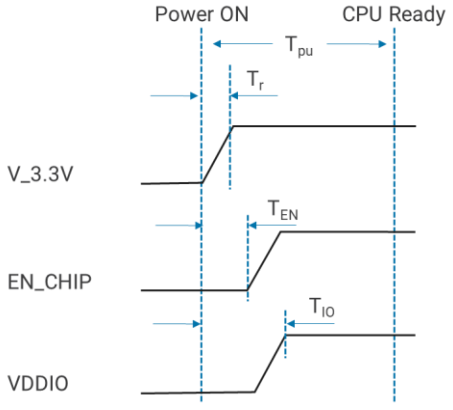
16.5 DC & RF Characteristics BLE

Specification (3.3V)	Details	Unit
BLE Receive Current @ 2Mb/s	30	mA
BLE Receive Current @ 1Mb/s	29	mA
BLE Receive Current @ 500Kb/s	30	mA
BLE Receive Current @ 125Kb/s	31	mA
BLE Transmit Current @ 0dBm 2Mb/s	27	mA
BLE Transmit Current @ 0dBm 1Mb/s	26	mA
BLE Transmit Current @ 0dBm 500Kb/s	39	mA
BLE Transmit Current @ 0dBm 125Kb/s	53	mA
BLE Transmit Current @ 10dBm 2Mb/s	38	mA
BLE Transmit Current @ 10dBm 1Mb/s	36	mA
BLE Transmit Current @ 10dBm 500Kb/s	59	mA
BLE Transmit Current @ 10dBm 125Kb/s	81	mA
BLE Advertising (300ms Interval, 3-Channels)	330	µA
BLE Advertising (300ms Interval, 2-Channels)	280	µA
BLE Advertising (300ms Interval, 1-Channel)	190	µA
BLE Traffic Current	8.9	mA

17 Power Schemes

17.1 Power-Up Timing Diagrams

Specification	Symbol	Min.	Typ.	Max.	Unit
V_3.3V Supply Rise Time from 10% to 90%	T_r	40	--	80	µs
Power ON to EN_CHIP Release	T_{EN}	100	--	--	µs
Power ON to VDDIO Ready	T_{IO}	--	--		µs
Power ON to CPU Ready	T_{pu}	--	--	630	µs



IMPORTANT NOTES (!):

All GPIOs must be low or undriven on Power-Up
EN_CHIP must be held low until after T_{EN}
VDDIO must be low or undriven on Power-Up

17.2 Wakeup Timing Diagrams

Wakeup from Sleep on Internal Timer

Details Pending – (Notes: 32kHz running, RTC power available, no external signals or wakeup - internal wakeup only)

Wakeup to CPU Ready – 550us

Wakeup to Transmit/Receive (Tx/Rx) – 1ms

Wakeup from Sleep using GPIO Wakeup Pin / UART Rx – 550us

Details Pending – (Notes: power applied, from wakeup to CPU & Peripherals Ready

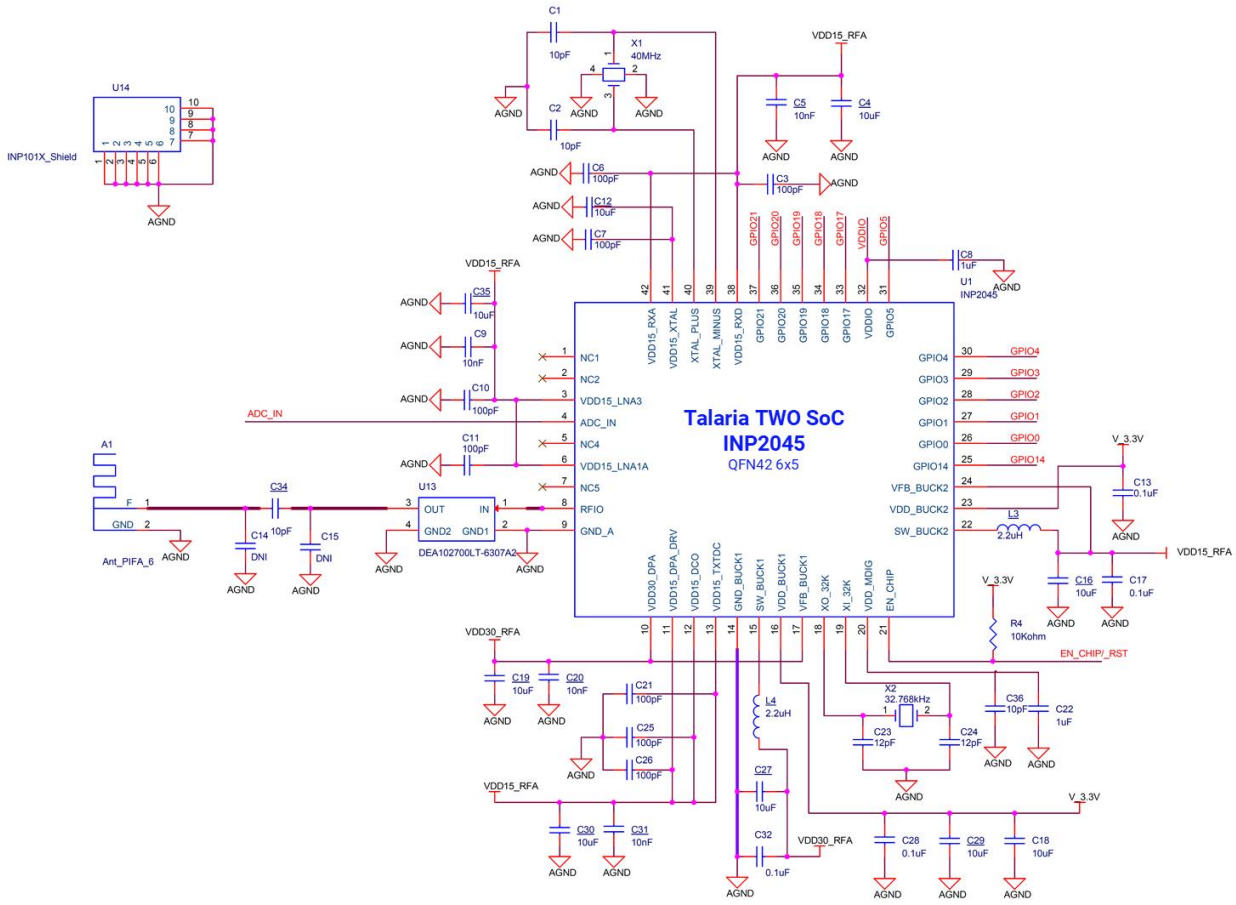
17.3 Reset Timing Diagrams

Specification	Symbol	Min.	Typ.	Max.	Unit
Details Pending					

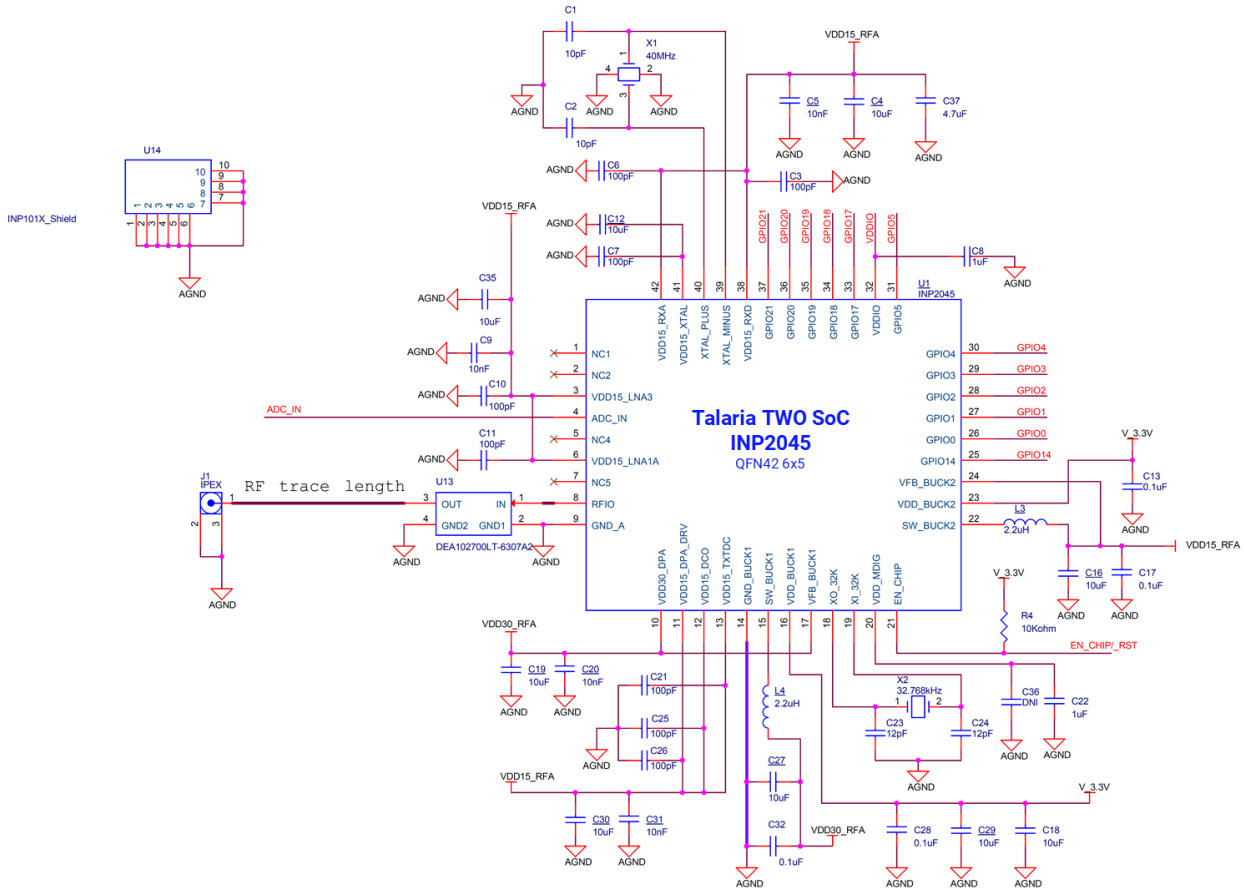
Diagrams Pending

18 Module Schematics

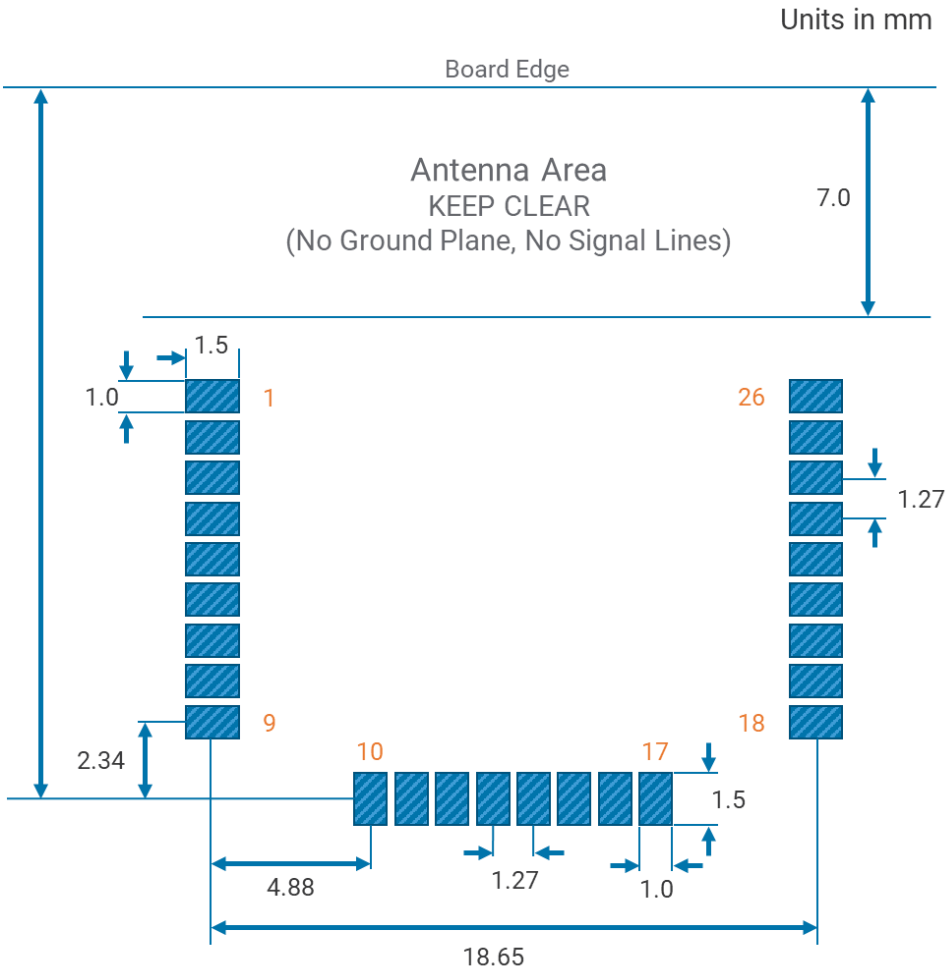
18.1 INP1010 Module Schematics



18.2 INP1011 Module Schematics

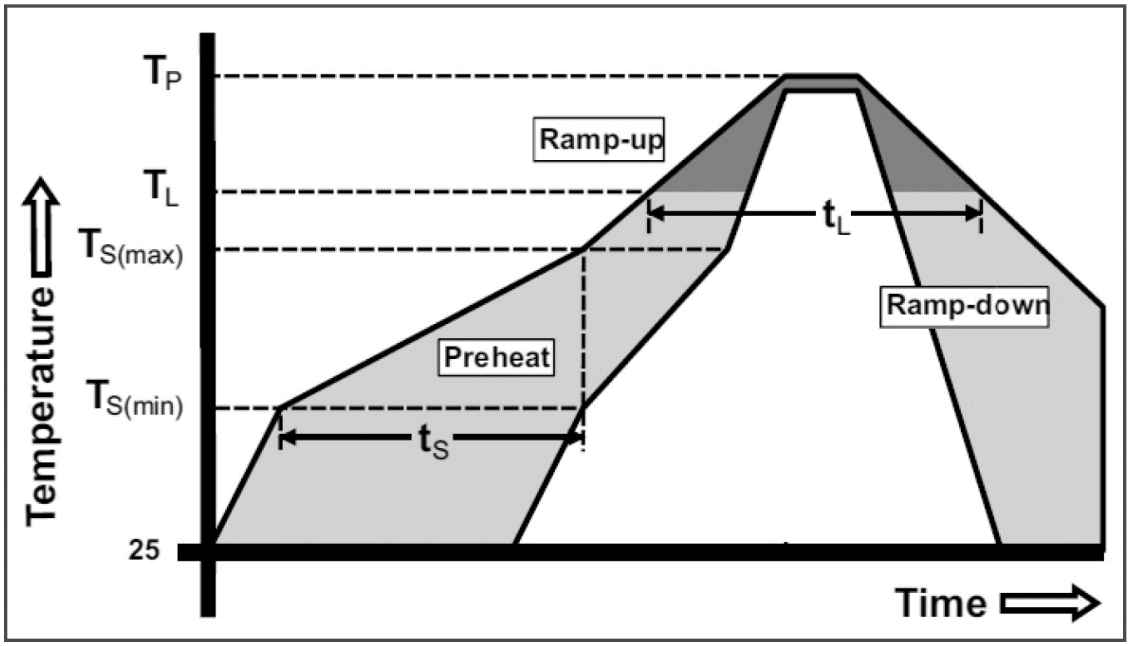


19 Recommended PCB Land Pattern



20 Recommended Reflow Profile

Recommend Reflow Profile based on IPC/JEDEC J-STD 020



Reflow Condition	IPC/JEDEC J-STD 020	Pb-Free Assembly
Pre-Heat / Soak	Temperature Min ($T_{S(min)}$)	150°C
	Temperature Max ($T_{S(max)}$)	200°C
	Time (t_S) from $T_{S(min)}$ to $T_{S(max)}$)	60 to 120 seconds
Ramp-up Rate from T_L to T_P		3°C/second max.
Reflow	Liquidous Temperature (T_L)	217°C
	Time (t_L) to maintain above T_L	60 to 150 seconds
Peak package body temperature (T_P)		245°C
Ramp-down rate (T_P to T_L)		6°C/second max.

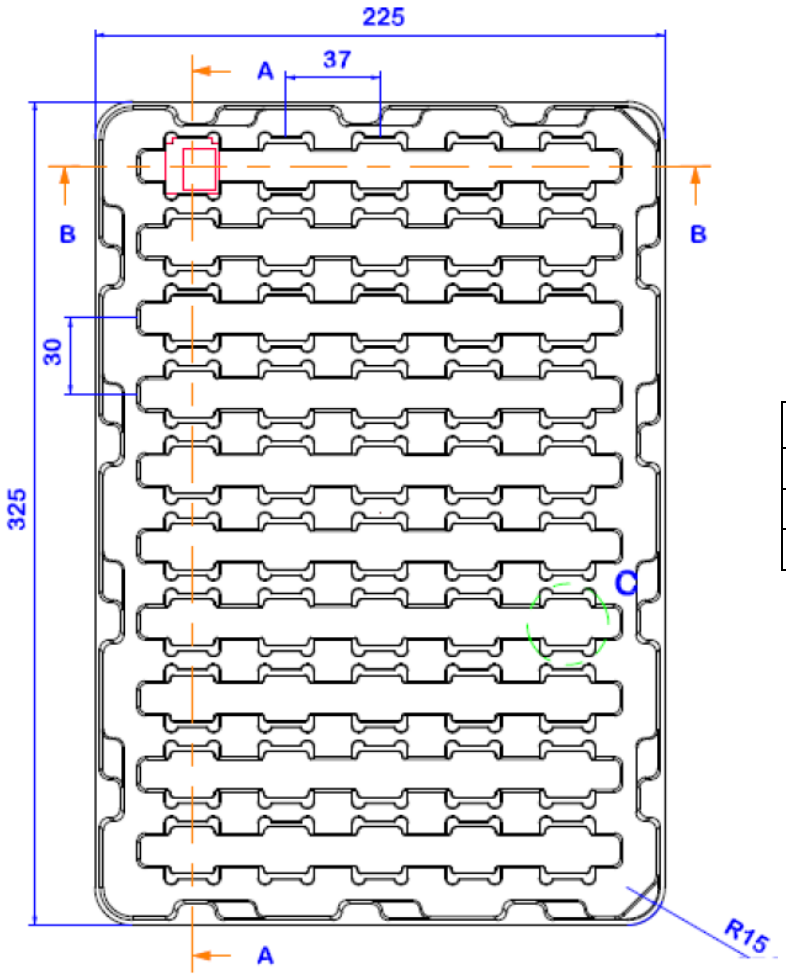
21 RoHS and REACH Compliance

This module meets the requirements set forth by the RoHS and REACH directives.

Further detail is available by contacting InnoPhase Sales at sales@innophaseinc.com

22 Packing Details

ESD foam tray used for shipping (units in mm):



Tray Size = 225mm x 325mm

Packing Details:
1 Tray = 50 Units
1 Inner Box = 10 Trays + 1 Empty Tray
1 Outer Box = 4 Inner Boxes

Packed and sealed in Moisture Barrier Bag (MBB) with Desiccant and Humidity Indicator Card (HIC) after being baked at 125°C for 8 hours.

23 Revision History

Revision	Revision Date	Notes
V01	15-May-2020	Internal Draft
V02	30-June-2020	Initial Publication
V02.1	10-July-2020	Section 7 – Storage Conditions. Storage period changed to 12 months from 6 month.
V02.2	29-July-2020	Section 15.3 – 802.11g Output Power changed to 15.5dBm from 15.0dBm Section 15.4 – 802.11n Output Power changed to 12.5dBm from 13.0dBm
V02.3	11-August-2020	Section 16 currents updated with 3-lot data
V2.4	1-September-2020	Inserted Section 15 – Advanced Security Elements Updated WiFi EVM and Rx Sensitivity in Section 16 Updated INP1010 & INP1011 Ordering Part Numbers in Section 4