Data Sheet

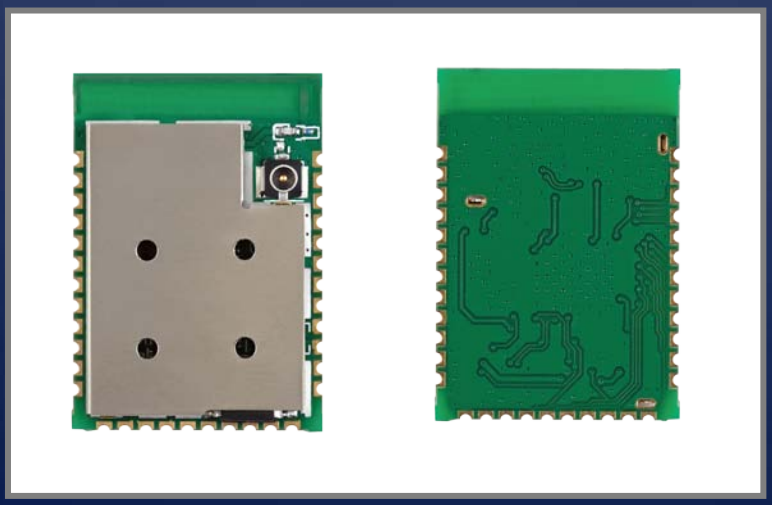
GlobalTop Technology Inc.

Ivy-1

Low Power Wi-Fi Module

Data Sheet

Revision: V00



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Version History

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Revision	**Date**	**Editor**	**Description**
V00	2015-03-02	Allen Chang	First release

Table of Contents

1. Functional Description

1.1 Overview

Ivy-1 is a fully 802.11b/g/n compliant low power Wi-Fi module combining PCB-printed antenna for compact installation, with an optional U.FL RF connector for a wide selection of certified antennas. It is designed to target Wi-Fi networked Machine to Machine (M2M) and Internet of Things (IOT) applications with low-power requirement. Product developers are now able to develop low power Wi-Fi enabled product with minimal development effort and cost.

The Ivy-1 module derived its processing power with optimum power consumption from Qualcomm® Atheros QCA4004 chipset. Ivy-1 enables Serial to Wi-Fi configuration for UART based hosts.

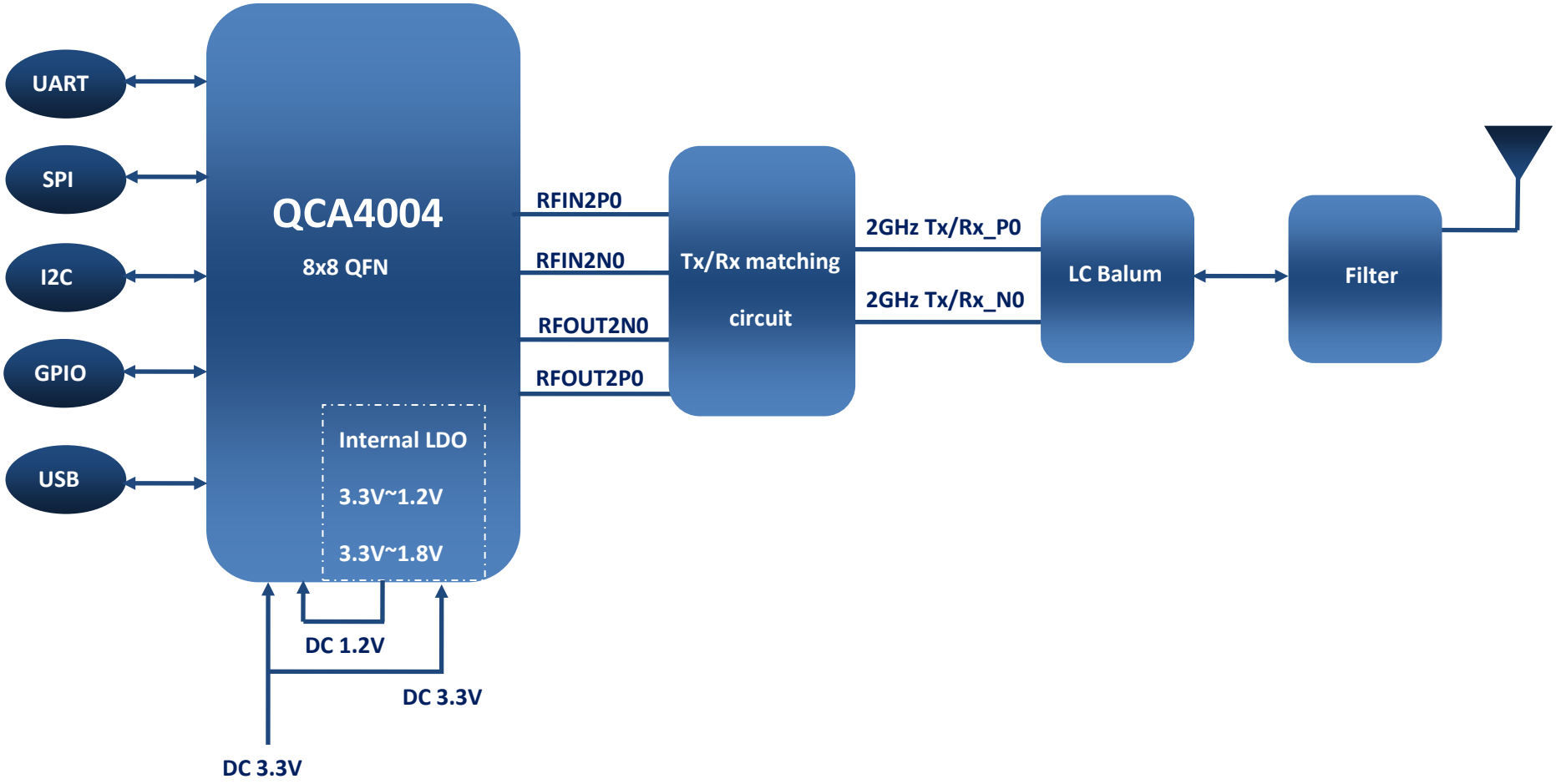
Application

- Home automation
- Household appliances
- Smart plug
- Lighting
- Metering

1.2 Features

- Embedded IEEE 802.11b/g/n drivers, supplicant, and TCP/IP stack
- Support IPv4 / IPv6 network stack
- Provide integrated power management, control functions and extremely low power operation for maxim battery life
- Security support for WPA, WPA2, WEP, TKIP
- Rich interfaces include: UART, SPI, I2C, GPIOs, and USB2.0
- Flexible pin design for both SMT or internal wiring

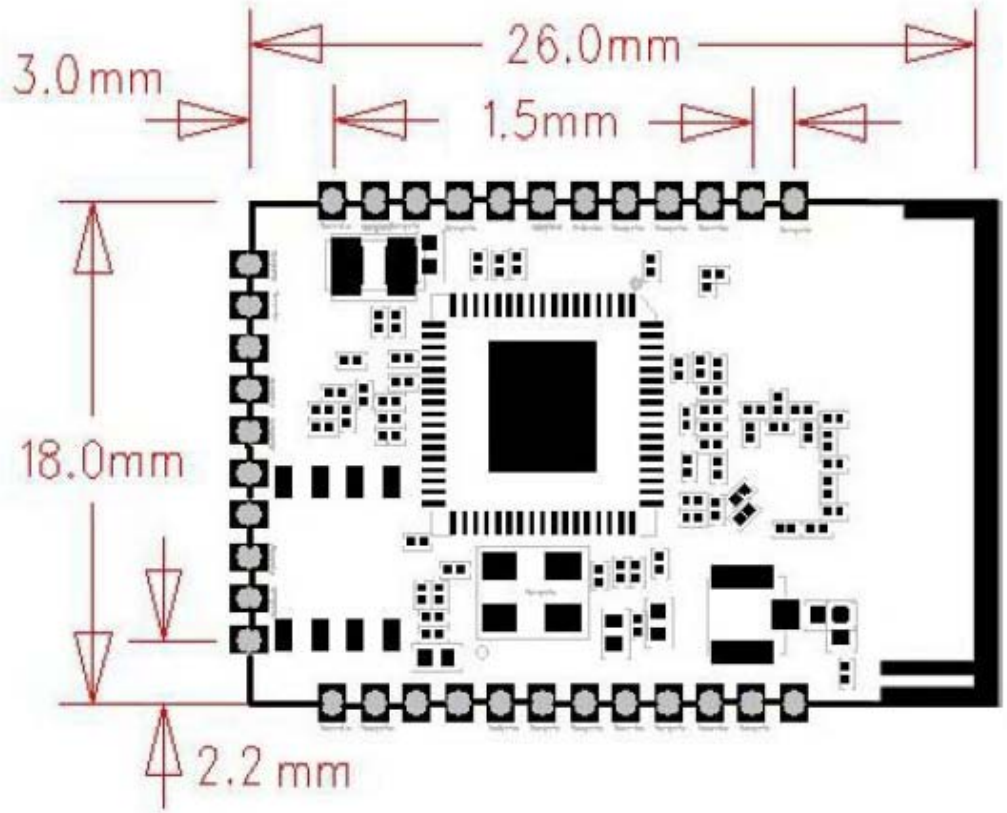
1.3 System Block Diagram



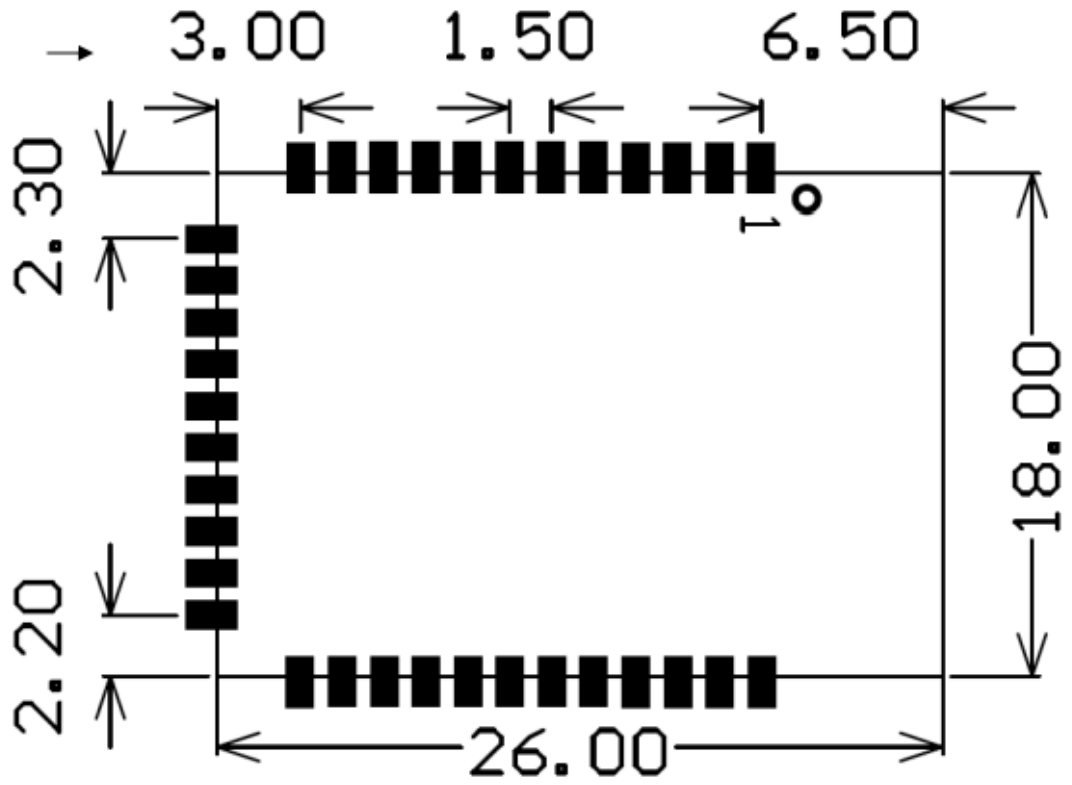
2. Specifications

2.1 Mechanical Dimension

Dimension: (Unit: mm, Tolerance: +/- 0.2mm)



2.2 Pin Configuration



(Unit: mm)

Dimension Label	Dimension (mm)
A	3
B	1.5
C	1.5
D	18
E	26
Module Height	2.5

2.3 Pin Assignment

Signal Name	Pin	
USB_DP	14	USB device / manufacturing test and configuration interface
USB_DN	15	
CHIP_PWD#	18	Power down control signal; setting this pin low forces the module in to its lowest power state
WAKEUP	19	
GPIO	2	
I2C	3	
UART1_TXD	4	
UART1_RXD	5	
UART0_CTS	6	
UART0_RXD/I2C_DATA	7	
SPI_CLK	8	
UART0_RTS	9	
UART0_TXD	10	
SPI_INT	11	
SPI_MISO	12	
SPI_MOSI	13	
HM0	16	
SPI_CS/HM1	17	
GPIO	20	
GPIO16	21	
GND	1	**Ground**
	22	
	26	
	34	
VDD33	25	**3.3V supply for whole module**
NC	23	**Reserved pins for future expand**
	24	
	27	
	28	
	29	
	30	
	31	
	32	
	33	

2.4 Specification

	Description
Wi-Fi Solution	QCA4004
Memory	4Mbit Flash
Standard	IEEE 802.11 b/g/n standards compliant
Wireless LAN	1T1R Mode
Antenna	Printed antenna for Receiver & Transmitter; (U. FL of Hirose is optional)
Internet protocols	IPv4 / IPv6, TCP / UDP, ARP / NDP, DHCPv4, ICMPv6
Security protocols	WPA, WPA2, WEP, TKIP
Wireless Specification	Standard supported: IEEE 802.11 b/g/n Frequency: 2.412 to 2.484 GHz (subject to local regulations) Channels: up to 13 channels
I/O Interface	UART x2, SPI x1, I2C x1, GPIO
Host Interface	UART, SPI SPI slave: allows simplified connection to local host MCU. UART interface: Support AT style command set
Host Data Rate	UART: 115200bps, 8, n, 1 SPI: up to 12 Mbps
Connector	SMD-Pad connector-34 pads
Transmit Power(EIRP)	IEEE802.11b 11Mbps: +18dBm IEEE802.11g 54Mbps: +14 dBm IEEE802.11n 135Mbps: +13 dBm

Receiver Sensitivity	IEEE802.11b 11Mbps: -86dBm IEEE802.11g 54Mbps: -68 dBm IEEE802.11n 135Mbps: -64 dBm
Power consumption	Transmit: 250mA @ 16dBm Receive: 75mA (typical) Power down mode: 11 uA Standby mode (sleep): 2~4mA
Dimension	26 x 18 x 2.5mm
Weight	2.05g
Operating voltage	3.3V +/- 10%
Operating temperature	-10^0C to $+65^0$C
Operating humidity	20-70%
Certifications	CE, FCC, ROHS compliant
Warranty	One Year

3. Features

3.1 Power Management

The Ivy-1 provides integrated power management with control functions for maximum battery life across all operational states.

- Transmit: 250 mA @16dBm
- Receive: 75 mA (typical)
- Power down mode: 11uA
- Standby mode(Sleep): 2~4mA

Sleep state minimizes power consumption while network services are not required, yet the system needs to remain available for use within a short time.

State	Typical Current Consumption for Ivy-1 module
CHIP_PWD	**11uA (including SPI flash)**
SLEEP	**2~4mA**

3.2 WiFi Link Feature

- Single-band 2.4 GHz
- IEEE 802.11b/g/n, single stream 1x1
- Integrated PA, LNA, with support for external PA and external LNA
- Green Tx power saving mode
- Low power listen mode
- Two-layer PCB design
- Link rates up to 150 Mbps

4. Electrical Specifications

Table 4-1 summarizes the absolute maximum ratings and Table 4-2 lists the recommended operating conditions for the Ivy-1. Absolute maximum ratings are those values beyond which damage to the device can occur.

Functional operation under these conditions, or at any other condition beyond those indicated in the operational sections of this document, is not recommended.

NOTE: Maximum rating for signals follows the supply domain of the signals.

4.1 Absolute Maximum Ratings

Table 4-1 absolute maximum ratings

Symbol	Description	Max rating
VDD33	VDD supply for whole module	-0.3 to 4.0 V
VIH MIN	Minimum Digital I/O input voltage for 1.8V or 3.3V I/O supply	-0.3V
3.3V I/O VIH MAX	Maximum Digital I/O input voltage for 1.8V or 3.3 I/O supply.	VDD +0.3V
RF_{in}	Maximum RF input (reference to 50-Ω input)	+10 dBm
T_{store}	Storage Temperature	-45 °C to 135°C
Tj	Junction Temperature	125 °C
ESD	Electrostatic Discharge Tolerance	HBM -2000V

4.2 Recommended Operating Conditions

These conditions apply to all DC characteristics unless otherwise specified:

Tamb= 25^{0}C, Vdd33=3.3V

Table 4-2 Recommended Operating Conditions

Symbol	Parameter	Min.	Typ.	Max.	Unit
VDD33	VDD supply for whole module	3.14	3.3	3.46	V
T_{case}	Case Temperature	0	-	85	°C
Psi JT	Thermal Parameter2	-	3	-	°C/W

4.3 General DC electrical specifications

These conditions apply to all DC characteristics unless otherwise specified:

Tamb= 25^{0}C, Vdd33=3.3V

Table 4-3 DC Electrical Characteristics for Digital I/Os

Symbol	Parameter	Min	Typ.	Max.	Unit
VIH	High Level Voltage	1.8	-	3.6	V
VIL	Low Level Voltage	-0.3	-	0.3	V
VOH	High Level Output Voltage	2.2	-	3.3	V
VOL	Low Level Output Voltage	0	-	0.4	V
IIL	Low Level Input Current	-	-	0.1	uA
IOH	High Level Output Current	-	-	8	mA
	High Level Output Current	-	-	20	
IIH	High Level Input Current	-	-	0.1	uA
IOL	High Level Output current	-	-	20	mA
	High Level Output current	-	-	20	
CIN	Input capacitance	-	5	-	pF
	Input capacitance	-	3	-	

5. Timing Specification

5.1 External 26 / 40 MHz Reference Input Clock Timing

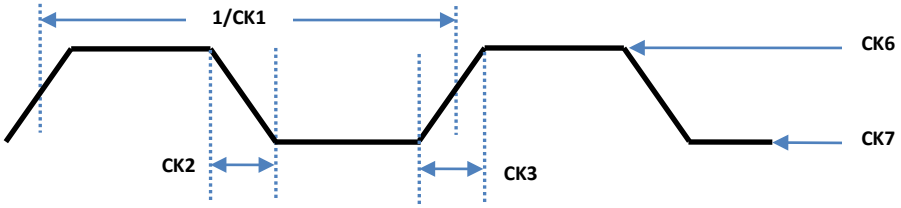


Figure 5-1 External 26/40 MHz Reference Input

Table 5-1 External 26/40 MHz Reference Input Clock Timing

Symbol	Description	Min.	Typ.	Max.	Unit
CK2	Fall time		-	0.1 x period	ns
CK3	Rise time		-	0.1 x period	ns
CK4	Duty cycle	40	-	60	%
CK5	Frequency stability	-20	-	20	ppm
CK6	Input high voltage	0.75	-	1.26	V
CK7	Input low voltage	-0.55	-	0.3	V

5.2 SPI Slave Interface Timing

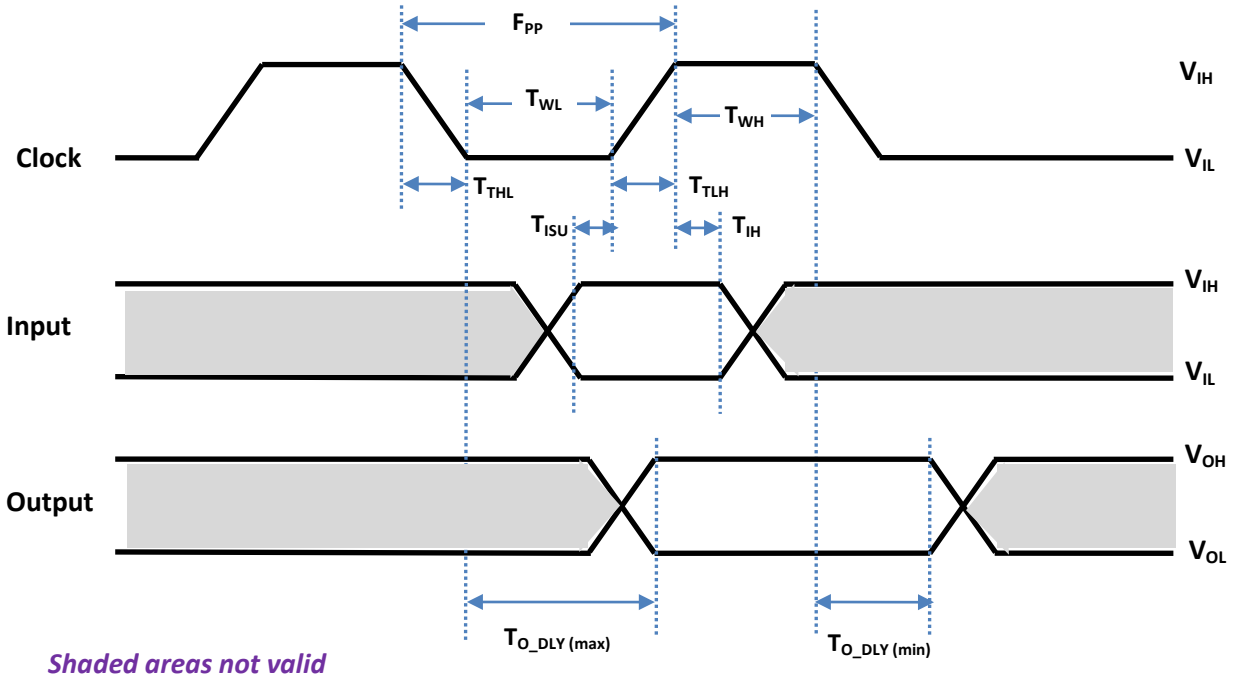


Figure5-2 SPI Slave Timing

Table 5-2 SPI Slave Timing Constraints

Parameter	Description	Min.	Max.	Unit
f_{pp}	Clock frequency	0	48	MHz
t_{WL}	Clock low time	8.3	-	ns
t_{WH}	Clock high time	8.33	-	ns
t_{TLH}	Clock rise time	-	2	ns
t_{THL}	Clock fall time	-	2	ns
t_{ISU}	Input setup time	5	-	ns
t_{IH}	Input hold time	5	-	ns
t_{O_DLY}	Output delay	0	5	ns

5.3 SPI Master Interface Timing

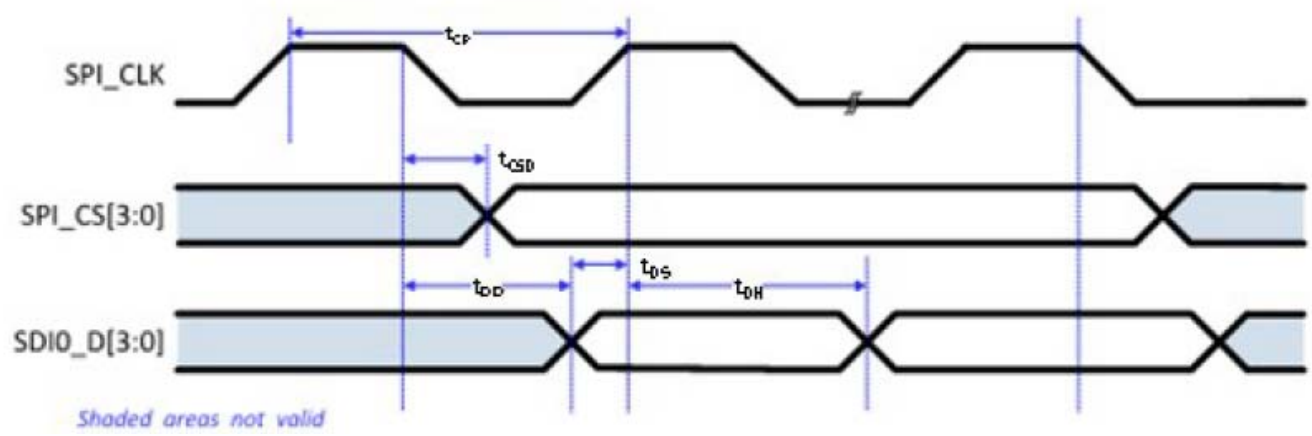


Figure 5-3 SPI Master Timing

Table 5-3 SPI Master Timing Constraints

Parameter	Description	Min.	Max.	Unit
t_{CP}	Clock period	30.7	1000	ns
t_{CSD}	Chip select valid delay	-5.5	5	ns
t_{DD}	Data valid delay	-5.5	5	ns
t_{DS}	Data setup	3	-	ns
t_{DH}	Data hold	0	-	ns

6. Interface Description

6.1 Bootstrap signals

Signal	Direction while Chip_PWD# is Low	Description	
HM[1:0]	Input	Bootstrap for host interface selection.	
		Pull to 00	Enter USB/manufacturing test and
		Pull to 01	Enter No External Host Required
		Pull to 10	Enter SPI Host mode
		Pull to 11	Enter SDIO Host mode

6.2 SPI master signals

These signals enable the QCA4004 to boot from an external SPI flash device. The QCA4004 supports single / quad mode SPI flash read / write.

Signal	Direction	Description
SPIM_CLK	O	SPI serial interface clock
SPIM_CS	O	SPI chip select
SPIM_MISO	IO	Data transmission from the QCA4004 to an external device
SPIM_MOSI	IO	Data transmission from an external device to the QCA4004

6.3 SPI slave signals

Signal	Direction	Description
SPI-CLK	I	Clock line from master, maximum rate 48MHz
SPI_CS	I	Chip select, active low
SPI_MISO	O	Serial data to master
SPI_MOSI	I	Serial data from master

6.4 I^2C signals

Signal	Direction	Description
I2C-CLK	IO	I^2C clock
I2C-DATA	IO	I^2C data

6.5 UART signals

Signal	Direction	Description
UART0_CTS	I	UART clear to send signal
UART0_RTS	O	UART ready to send signal
UART0_RXD	I	UART receive data
UART0_TXD	O	UART transmit data
UART1_RXD	I	UART receive data
UART1_TXD	O	UART transmit data

7.6 GPIO Signals

Signal	Direction	Description
GPIO	I/O	General purpose input/output. The QCA4004 supports SDIO, SPI, I^2C, I^2S, UART, and JTAG interfaces. It is possible to configure the QCA4004 to support these interfaces by tying certain inputs externally during boot up.
GPIO	I/O	
GPIO	I/O	
GPIO	I/O	
GPIO	I/O	
GPIO	I/O	
GPIO	I/O	
GPIO	I/O	
GPIO	I/O	
GPIO	I/O	

7. RF Parameters

7.1 Transmitter Characteristics for 2.4GHz Operation

Table 7-1 summarizes the transmitter characteristics for the Ivy-1

Table 7-1 transmitter characteristics

Symbol	Rate/Mbps	IEEE Citation	Output power/dBm
802.11b	11	18.4.7.2	18±3
802.11g	6	17.3.9.1	18±3
	54	17.3.9.1	14±3
802.11n	6.5	20.3.21.3	18±3
	135	20.3.21.3	13±3

7.2 Receiver Characteristics for 2.4GHz Operation

Table 7-2 summarizes the receiver characteristics for the Ivy-1.

Notice that transmitter and especially receiver characteristics must be tested under test guider.

Table 7-2 receiver characteristics

Symbol	Rate/Mbps	IEEE limted/dBm	Typical Sensitivity/dBm
802.11b	11	-76	-82
802.11g	6	-82	-85
	54	-65	-68
802.11n	6.5	-82	-85
	135	-61	-64

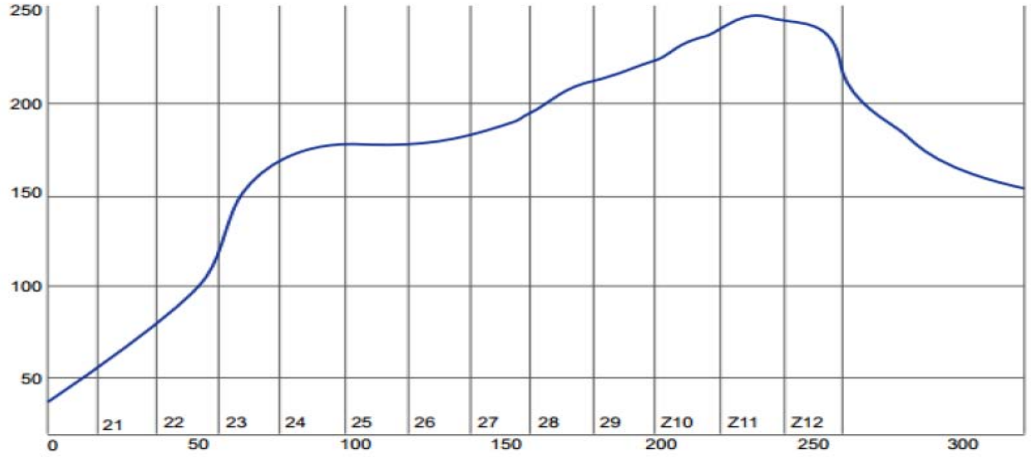
8. Manufacture information

8.1 Handling

The Ivy-1 modules contain a highly sensitive electronic circuitry. Handling without proper ESD protection may destroy or damage the module permanently.

8.2 Soldering Recommendations

The Ivy-1 modules can be SMT on the board by following the temperature curve graph



8.3 Rework

The module can be unsoldered from the host board if the Moisture Sensitivity Level (MSL) requirements are met as described in this datasheet. Never attempt a rework on the module itself, e.g. replacing individual components. Such actions will terminate warranty coverage.

9. Packing and Handling

Ivy-1 modules, like any other SMD devices, are sensitive to moisture, electrostatic discharge, and temperature. By following the standards outlined in this document for GlobalTop module storage and handling, the chances of them being damaged during production set-up can be reduced. This section will walk you through the basics on how GlobalTop packages its modules to ensure they arrive at their destination without any damages and deterioration to performance quality. It includes cautionary notes for prior to the surface mount process.

⚠ **Please read the Moisture Sensitivity section carefully to avoid damages permanent damages due to moisture intake**

⚠ **Wi-Fi modules contain highly sensitive electronic circuits and are electronic sensitive devices and improper handling without ESD protections may lead to permanent damages to the modules. Please read ESD Handling section for more details.**

9.1 Moisture Sensitivity

GlobalTop Wi-Fi modules are moisture sensitive, and must be pre-baked before going through the solder reflow process. It is important to know that:

GlobalTop Wi-Fi modules must complete solder reflow process in 72 hours after pre-baking.

This maximum time is otherwise known as “Floor Life”

If the waiting time has exceeded 72 hours, it is possible for the module to suffer damages during the solder reflow process such as cracks and delamination of the SMD pads due to excess moisture pressure.

9.2 Packing

GlobalTop Wi-Fi modules are packed in such a way to ensure the product arrives to SMD factory floor without any damages.

Wi-Fi modules are placed individually on to the packaging tray. The trays will then be stacked and packaged together.

Included are:

1. Two packs of desiccant for moisture absorption
2. One moisture level color coded card for relative humidity percentage.

Each package is then placed inside an antistatic bag (or PE bag) that prevents the modules from being damaged by electrostatic discharge.

Figure 1: One pack of Wi-Fi modules

Each bag is then carefully placed inside two levels of cardboard carton boxes for maximum protection.

Figure 2: Box protection

The moisture color coded card provides an insight to the relative humidity in percentage (RH). When the BLE modules are taken out, it should be around or lower than 30% RH level.

Outside each electrostatic bag is a caution label for moisture sensitive device.

Figure 3: Example of moisture color coded card and caution label

9.3 Storage and Floor Life Guideline

Since GlobalTop modules must undergo solder-reflow process in 72 hours after it has gone through pre-baking procedure, therefore if it is not used by then, it is recommended to store the WI-FI modules in dry places such as dry cabinet.

The approximate shelf life for GlobalTop WI-FI modules packages is 6 months from the bag seal date, when store in a non-condensing storage environment (<30°C/60% RH)

⚠ **It is important to note that it is a required process for GlobalTop Wi-Fi modules to undergo pre-baking procedures, regardless of the storage condition.**

9.4 Drying

When WI-FI module exposed to high temperature of solder reflow, the moisture vapor pressure inside the WI-FI modules increase greatly. In order to prevent internal delaminating, cracking of the device or the "popcorn" phenomenon, it is **necessary** to undergo pre-baking procedure prior to any high temperature or solder reflow process.

The recommended baking time for GlobalTop WI-FI module is as follows:

- ✓ **60°C for 8 to 12 hours**

Once baked, the module's floor life will be "reset", and has additional 72 hours in normal factory condition to undergo solder reflow process.

⚠ **Please limit the number of times the Wi-Fi modules undergoes baking processes as repeated baking process has an effect of reducing the wetting effectiveness of the SMD pad contacts. This applies to all SMT devices.**

⚠ **Oxidation Risk: Baking SMD packages may cause oxidation and/or intermetallic growth of the terminations, which if excessive can result in solderability problems during board assembly. The temperature and time for baking SMD packages are therefore limited by solderability considerations. The cumulative bake time at a temperature greater than 90°C and up to 125°C shall not exceed 96 hours. Bake temperatures higher than 125°C are now allowed.**

9.5 ESD Handling

Please carefully follow the following precautions to prevent severe damage to Wi-Fi modules.

GlobalTop Wi-Fi modules are sensitive to electrostatic discharges, and thus are Electrostatic Sensitive Devices (ESD). Careful handling of the Wi-Fi modules and in particular to its patch antenna (if included) and RF_IN pin, must follow the standard ESD safety practices:

- ✓ Unless there is a galvanic coupling between the local GND and the PCB GND, then the first point of contact when handling the PCB shall always be between the local GND and PCB GND.
- ✓ Before working with RF_IN pin, please make sure the GND is connected
- ✓ When working with RF_IN pin, do not contact any charges capacitors or materials that can easily develop or store charges such as patch antenna, coax cable, soldering iron.
- ✓ Please do not touch the mounted patch antenna to prevent electrostatic discharge from the RF input
- ✓ When soldering RF_IN pin, please make sure to use an ESD safe soldering iron (tip).

10. Contact Information

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