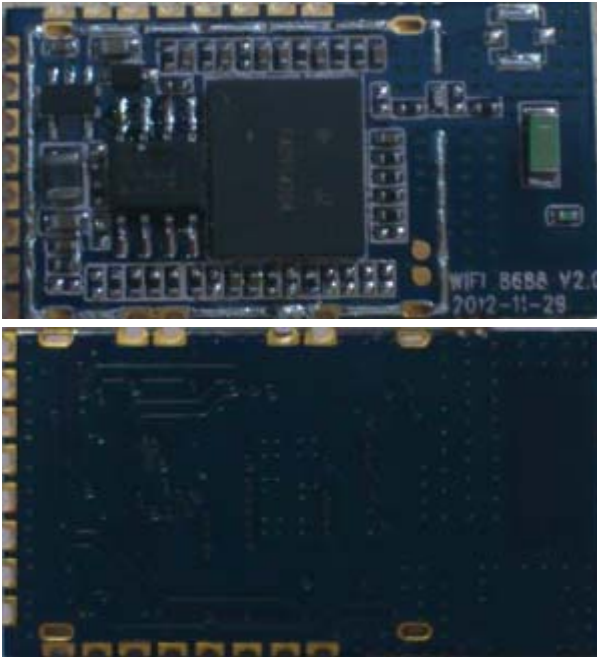


LS-WIFI

8688 Module Specification



1 Features

- Qualified 2.4-GHz IEEE 802.11b/g transceiver
- Address the connectivity demand in M2M applications, e.g. UART-WiFi Bridge, WiFi Gateway, Wireless Sensor Node and etc
- ARMv5TE-compliant MCU running up to 106MHz
- Ultra-low power: 4 uA sleep, 40 mA Rx, 210 mA Tx
- Receive sensitivity:
 - -87 dBm @ b mode
 - -72.5 dBm @ g mode
- Maximum Couducted Peak output power:
 - 16 dBm @ b mode
 - 16 dBm @ g mode
- High throughput, 1 Mbps sustained data rate with TCP/IP and WPA2
- Small, compact surface-mount module
- On-board ceramic chip antenna
- UART hardware interface
- Supports ad hoc and infrastructure networking modes
- On board ECOS -OS, TCP/IP stacks

- 1 - / 16

- Wi-Fi Alliance certified for WPA2-PSK
- FCC/CE/ICS certified and RoHS compliant.

Applications

- Remote equipment monitoring
- Telemetry
- Industrial sensors and home automation controls
- Medical device monitoring

2 Overview

2.1 Description

The LS-WIFI8688 module is a standalone, embedded wireless 802.11 b/g networking module. With its small form factor and extremely low power consumption, the LS-WIFI8688 is perfect for mobile wireless applications such as asset monitoring, GPS tracking, and battery sensors. The WiFi module incorporates a 2.4-GHz radio, processor, TCP/IP stack, crypto accelerator, power management, and analog sensor interfaces. The module is preloaded with software to simplify integration and minimize application development. In the simplest configuration, the hardware requires only four connections (PWR, TX, RX, and GND) to create a wireless data connection. Additionally, the sensor interface provides temperature, audio, motion, acceleration, and other analog data without requiring additional hardware. The module is programmed and controlled with a simple ASCII command language. Once the module is set up, it can scan to find an access point, associate, authenticate, and connect over any Wi-Fi network.

2.2 Overview

- Host data rate up to 1 Mbps for the UART

- Intelligent, built-in power management with programmable wakeup
- Real-time clock for time stamping, auto-sleep, and auto-wakeup
- Configuration over UART using simple ASCII commands
- Remote configuration over WiFi using Telnet
- Supports over the air firmware upgrade (FTP)
- Supports WPS pushbutton mode for easy

- association with access points
- Secure WiFi authentication using WEP-128, WPA-PSK (TKIP), or WPA2-PSK (AES)
- Built-in networking applications—DHCP, UDP, DNS, ARP, ICMP, TCP, HTTP client, and FTP client
- 802.11 power saving and roaming functions
- The modules size:
Size: 32mm x 17.5 mm x 3.0 mm

3 Electrical characteristics

3.1 DC/RF CHARACTERISTICS

3.1.1 Characteristics for IEEE802.11 b

Items	Contents		
Specification	IEEE802.11b		
Mode	DSSS / CCK		
Frequency	2412-2462MHz		
Data rate	1, 2, 5.5, 11Mbps		
- DC Characteristics -	min.	max.	unit
1. DC current			
1)Txmode-Continuous--		190	mA
2)Rxmode-Continuous--		130	mA
- Tx Characteristics -	min.	max.	unit
2. Transmit Power Levels	13.0	16.0	dBm
3. Transmit Spectrum Mask			
1) 1st side lobes	-	-30	dBr
2) 2nd side lobes	-	-50	dBr
4. Transmit Center Frequency Tolerance	-25	+25	ppm
5. Power-on and Power-down ramp	-	2	µsec
6. RF carrier suppression	15	-	dB
7. Modulation Accuracy (EVM)	-	35	%
8. Spurious Emissions			
1) 30MHz to 1GHz	-	-36	dBm
2) 1GHz to 12.75GHz	-	-30	dBm
3) 1.8GHz to 1.9GHz	-	-47	dBm
4) 5.15GHz to 5.3GHz	-	-47	dBm
- Rx Characteristics -	min.	max.	unit
9. Minimum Input Level Sensitivity (FER≤8%)			
1) @11Mbps	-	-81	dBm
10. Maximum Input Level (FER≤8%)	-10	-	dBm
11. Adjacent Channel Rejection (FER≤8%)	35	-	dB

3.12 Characteristics for IEEE802.11g

Items	Contents		
Specification	IEEE802.11g		
Mode	OFDM		
Frequency	2412-2462MHz		
Data rate	6, 9, 12, 18, 24, 36, 48, 54Mbps		
- DC Characteristics -	min.	max.	unit
1. DC current			
1)Txmode-Continuous--		190	mA
2)Rxmode-Continuous--		140	mA
- Tx Characteristics -	min.	max.	unit
2. Transmit Power Levels	13.0	16.0	dBm
3. Transmit Spectrum Mask			
1) 11MHz offset	-	-20	dBr
2) 20MHz offset	-	-28	dBr
3) 30MHz offset and above	-	-40	dBr
4. Transmit Center Frequency Tolerance	-25	+25	ppm
5. Center frequency leakage	-	-15	dB
6. Transmitter constellation error	-	-25	dB
7. Spurious Emissions			
1) 30MHz to 1GHz	-	-36	dBm
2) 1GHz to 12.75GHz	-	-30	dBm
3) 1.8GHz to 1.9GHz	-	-47	dBm
4) 5.15GHz to 5.3GHz	-	-47	dBm
- Rx Characteristics -	min.	max.	unit
8. Minimum Input Level Sensitivity (PER≤10%)			
1) @54Mbps	-	-67	dBm
9. Maximum Input Level (PER≤10%)	-20	-	dBm
10. Adjacent Channel Rejection (PER≤10%)	-1	-	dB

3.2 Environmental Conditions

Parameter	WiFi 8688
Temperature Range(Operating)	-20°C to +70°C
Temperature Range(Storage)	-40°C to +85°C
Relative Humidity(Operating)	≤90%
Relative Humidity(Storage)	≤90%

3.3 Absolute maximum ratings

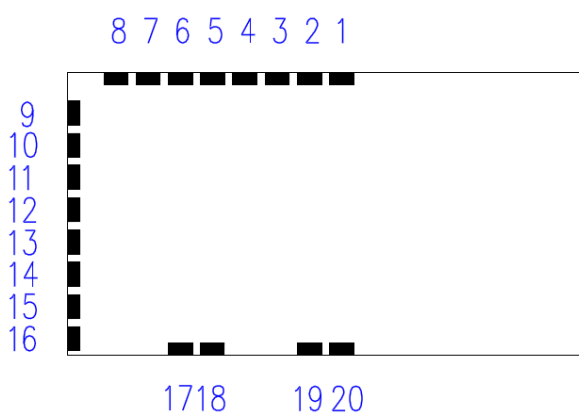
Parameter	Minimum	Maximum	Unit
VDD33	-0.3	3.9V	V
GND	-	0	V
I/O pin voltage	-0.3	VDD33+0.3V	V

3.4 Operating conditions

Symbol	Parameter	min	Nominal	Max	Unit
VDD33	Supply voltage	3.1	3.3	3.6	V
V_{IH}	I/O input high voltage	2.3	-	Vdd33+0.3	V
V_{IL}	I/O input low voltage	-0.3	-	1.1	V
V_{OH}	I/O output high voltage	2.57	-	-	V
V_{OL}	I/O output low voltage	-	-	0.4	V

4 Pin-out and signal description

4.1 Pin Pads(Top View):



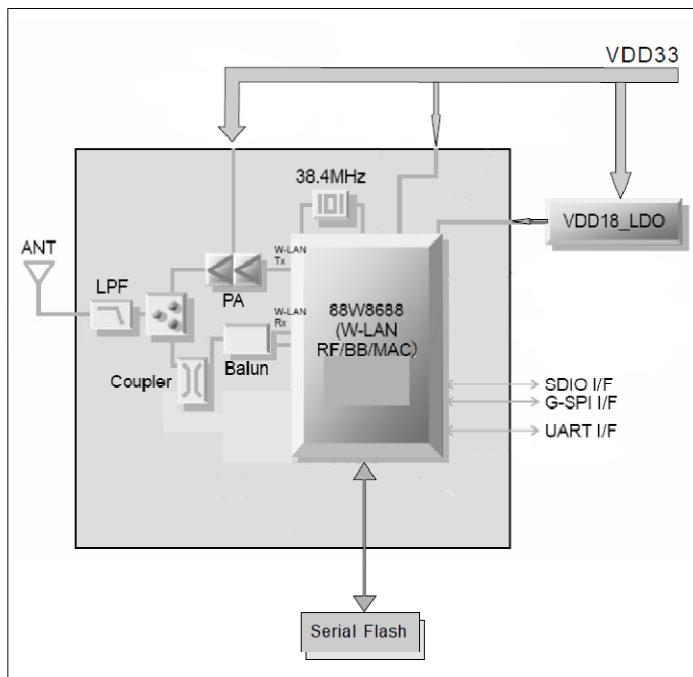
4.2 Pin Description:

No.	Terminal Name	Type	System	Connection to IC Terminal	Description
1	GND	G	-	VSS	Ground
2	NC	-	-		
3	UART_SIN	I/O	-		UART SIN input When not used, this pin should be left floating.
4	UART_SOUT	I/O	-		UART SOUT output When not used, this pin should be left floating.
5	NC	-	-		
6	GND	G	-	VSS	Ground
7	VDD33	VDD33	-	VDD33	3.3V Power Supply
8	GND	G	-	VSS	Ground
9	SPI_CLK_REQ/ SD_DAT[3]	I/O	WLAN	SPI_CLK_REQ/ SD_DAT[3]	G-SPI Mode: SPI_CLK_REQ G-SPI Clock Request SDIO 4-bit Mode: SD_DAT[3] Data Line Bit[3] SDIO 1-bit Mode: SD_DAT[3] Reserved SDIO SPI Mode: SD_DAT[3] Card Select (active low)
10	SPI_SINTn/ SD_DAT[2]	I/O	WLAN	SPI_SINTn/ SD_DAT[2]	G-SPI Mode: SPI_SINTn G-SPI Interrupt Output (active low) SDIO 4-bit Mode: SD_DAT[2] Data Line Bit[2] or Read Wait (optional) SDIO 1-bit Mode: SD_DAT[2] Read Wait (optional) SDIO SPI Mode: SD_DAT[2] Reserved

11	SPI_SDO/ SD_DAT[1]	I/O	WLAN	SPI_SDO/ SD_DAT[1]	G-SPI Mode: SPI_SDO G-SPI Data Output SDIO 4-bit Mode: SD_DAT[1] Data Line Bit[1] SDIO 1-bit Mode: SD_DAT[1] Interrupt SDIO SPI Mode: SD_DAT[1] Reserved
12	SPI_SCSn/ SD_DAT[0]	IO	WLAN	SPI_SCSn/ SD_DAT[0]	G-SPI Mode: SPI_SCSn G-SPI Chip Select input (active low) SDIO 4-bit Mode: SD_DAT[0] Data Line Bit[0] SDIO 1-bit Mode: SD_DAT[0] Data Line SDIO SPI Mode: SD_DAT[0] Data Output
13	SPI_SDI/ SD_CMD	I/O	WLAN	SPI_SDI/ SD_CMD	G-SPI Mode: SPI_SDI G-SPI Data Input SDIO 4-bit Mode: SD_CMD Command/Response SDIO 1-bit Mode: SD_CMD Command Line SDIO SPI Mode: SD_CMD Data Input
14	SPI_CLK/ SD_CLK	I	WLAN	SPI_CLK/ SD_CLK	G-SPI Mode: SPI_CLK G-SPI Clock Input SDIO 4-bit Mode: SD_CLK Clock Input SDIO 1-bit Mode: SD_CLK Clock Input SDIO SPI Mode: SD_CLK Clock Input
15	SLEEP_CLK	I	WLAN	SLEEP_CLK	Clock Input for External Sleep Clock
16	RESETn	I	-	RESETn	Reset (active low)
17	GND	G	-	VSS	Ground
18	GND	G	-	VSS	Ground
19	GND	G	-	VSS	Ground
20	GND	G	-	VSS	Ground

5 Functional description

5.1 Functional block diagram



5.2 RF descriptions

The LS8688 is equipped with a fully integrated RF to baseband transceiver that operates in both the 2.4 GHz ISM radio band for 802.11g/b WLAN applications, It contains all the circuitry to support both transmit and receive operations.

5.3 On-board antenna specification

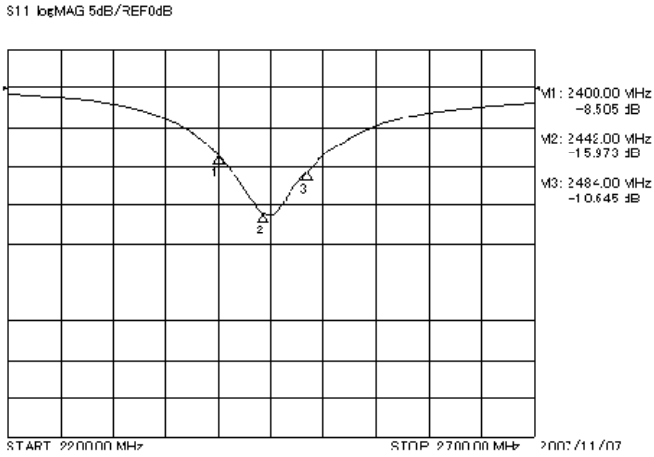
The LS8688 contains a chip multilayer antenna.

Part Number: LDA312G4413H-280.

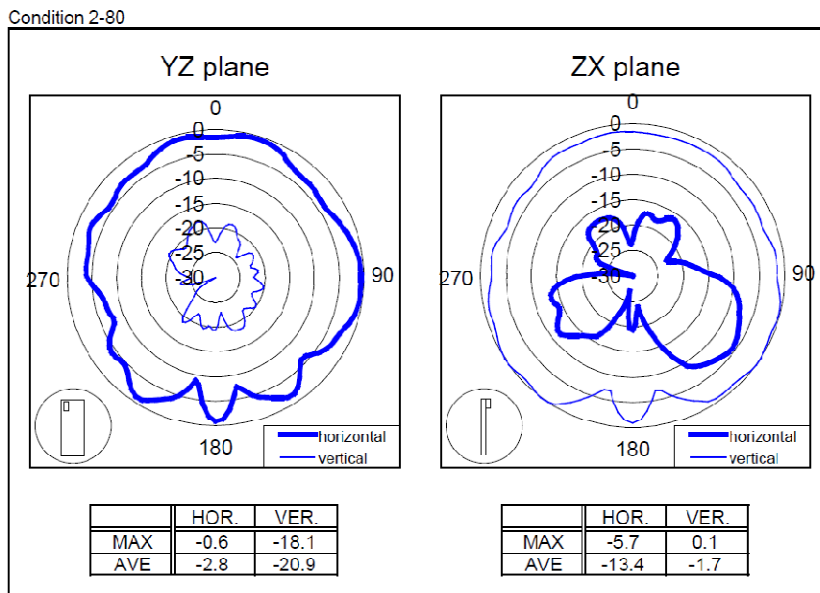
Manufacturer: Murata.

Gain: 0.1 dBi

5.3.1 Return Loss



5.3.2 Radiation Pattern



5.4 Clock specifications

LS8688 has a high-speed 38.4MHz oscillator to provide clock signals for the processors. The customer doesn't need to use external CLK.

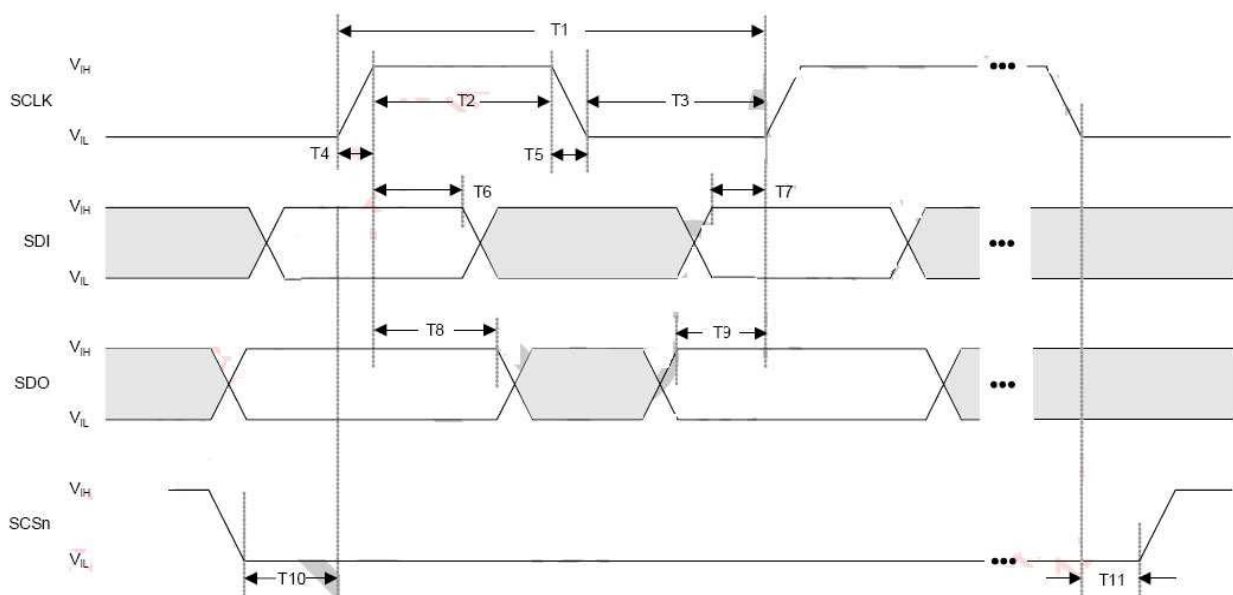
5.5 UART host interface

The LS8688 supports a high speed Universal Asynchronous Receiver/Transmitter (UART) interface. High speed baud rates are supported to provide the physical transport between the device and the host for wireless data connection. Customer can use AT command to control the module.

5.6 G-SPI host interface specifications

Referred from Marvell hardware specifications

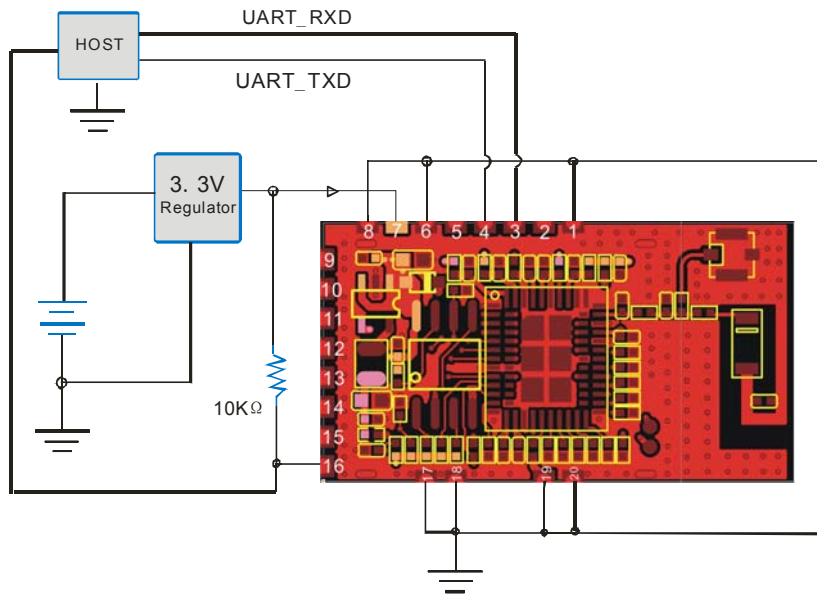
G-SPI Host Interface Transaction Timing



5.7 Power supply description

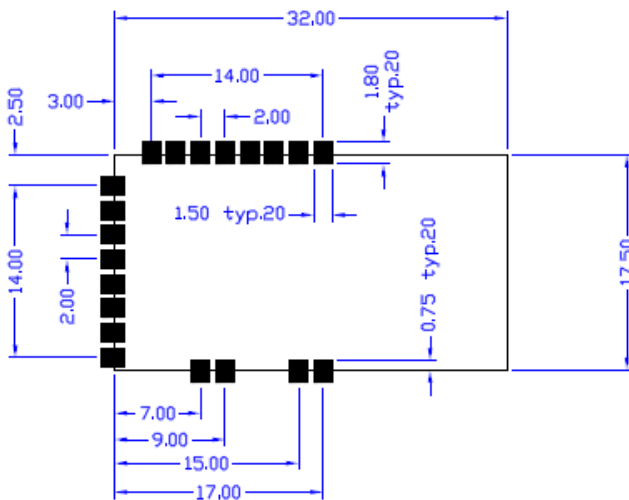
The LS8688 contains a high efficiency DC/DC converter to reduce power consume and simplified peripheral circuit design, external only need 3.3V voltage to input to pin 7 of LS8688. the converter generate 1.8V voltage for core of 88W8688. The converter is composed of XC9216A18MCR and inductor LQG15HS10NJ02, Efficiency >85%, Output Current >400mA.

6 Typical application schematic



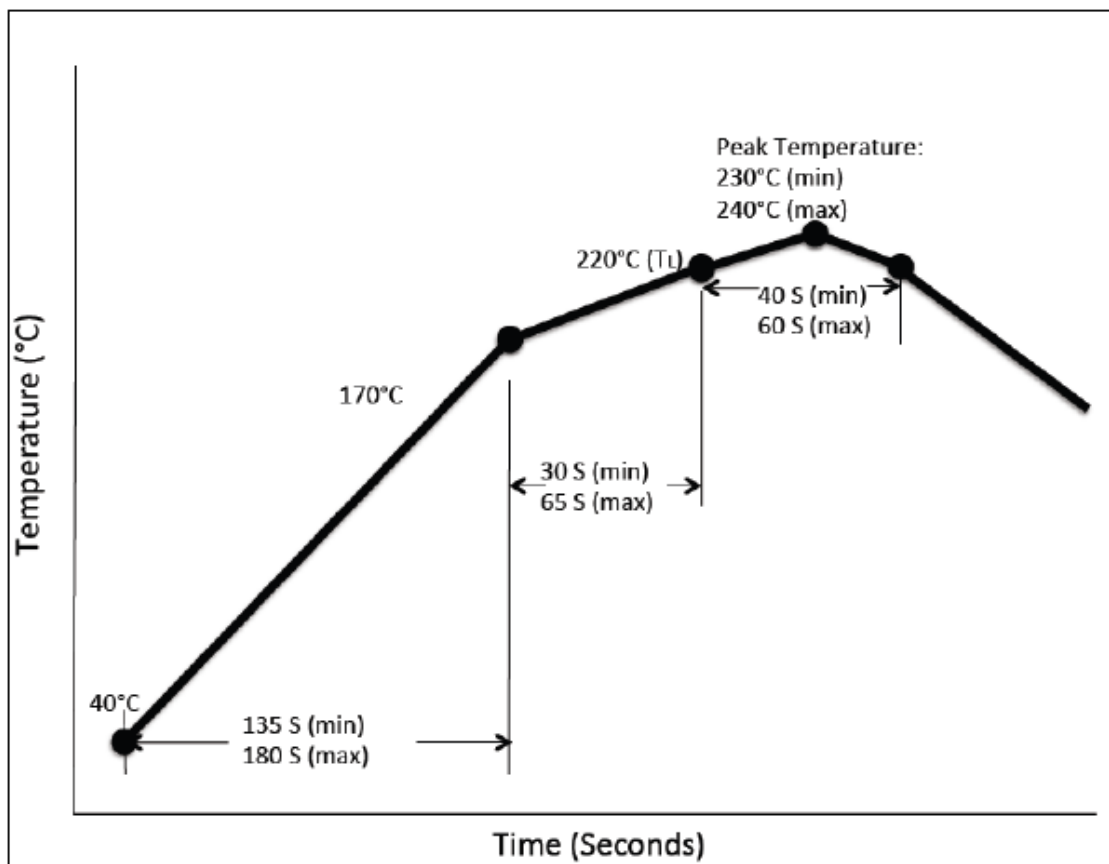
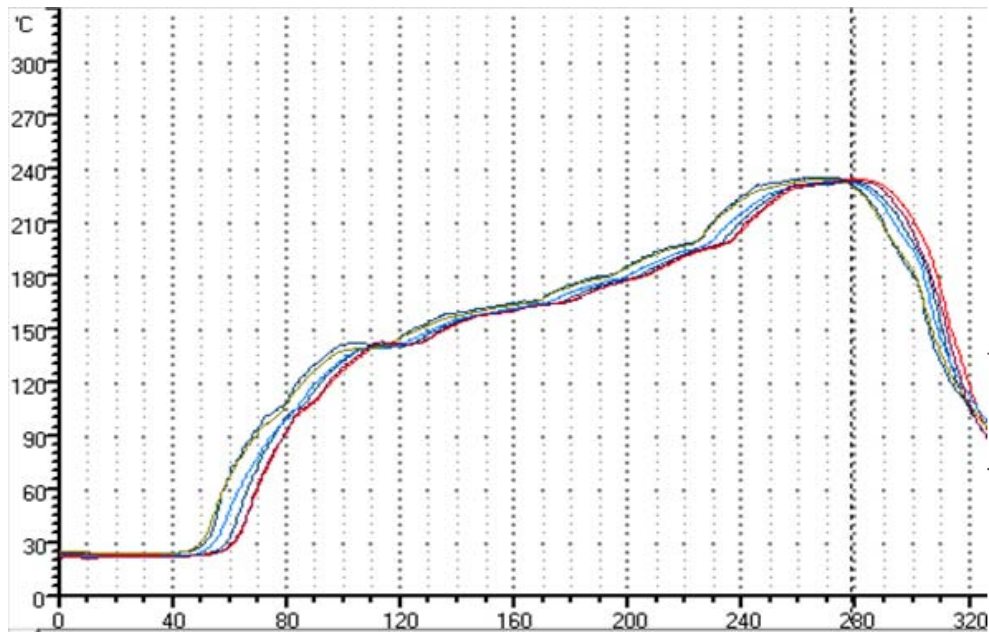
7 Package

Module Physical Dimensions (unit: mm)



Note: the LS8688 is without shielding box.

8 Solder reflow temperature profile



9 AT Command

1.**help**(All the commands of the system support will be listed)

Input: *AT*help*

Output:

sdk-version

psm-register<module><partition-key>

psm-get<module><variable>

psm-set<module><variable><value>

psm-erase

psm-dump<partition_no>

psm-get-free-space<module>

rfprint<http_url>

updatefw<http_url>

updatefs<http_url>

sysinfo [see sysinfo -h for details]

START Start network connection

STOP Stop network connection

APN Set or get default AP: <profile_name>ssid<ssid> [bssid<bssid>]

SERV Set or get Server IP info: <IP>, <Port>, <Index>

wlan-scan

wlan-stat

wlan-info

wlan-gethostbyname<hostname>

2.**wlan-scan**(Scan the AP)

Input: *AT*wlan-scan*

Output:

The current AP(include:SSID, BSSID,channel,rsi,security,WMM)

For example:

+wlan-scan:OK

2 networks found:

AP[1]

SSID: cer-test

Mode: infra

channel: 1

rsi: -50 dBm

security: WPA

WMM: NO

AP[2]

SSID: h3c

Mode: infra
channel: 1
rssi: -50 dBm
security: OPEN
WMM: NO

3.APN (Setup all demand the AP)

(1).Demand the setting of current AP:

Input:*AT*APN*?*

Output:+APN:OK

profile=<profile name>,ssid=<apssid>,mode=<[infra][ad-hoc]>,security=<security type>

For example:

+APN:OK

profile=default,ssid=h3c,mode=infra, security=None

(2).Setup AP :

Input:*AT*APN*<profile name>ssid<SSID>[wep/wpa/wpa2] [password]

For "OPEN" network, the command format: <profile_name>ssid<ssid> [bssid<bssid>]

For security "WEP" network, the command format: <profile_name>ssid<ssid>wep open <WEP_key>

For security "WPA/WPA2" network, the command format: wlan-add <profile_name>ssid<ssid> wpa2 <secret>

Note:"profile name" is the configure name, It can be any name.

For example:

◆Connect to the AP(SSID:h3c, Security: None, profile name: default)

Input: *AT*APN*defaultssid h3c*

Output:+APN:OK

Name=default, SSID=h3c,Mode=infra, Security=None

◆Connect to the AP(SSID: SyChip-Network, Security: WPA2, password: xxxxxxxx, profile name: net)

Input: *AT*APN*net ssid SyChip-Network wpa2 xxxxxxxx*

Output:+APN:OK

Name=net, SSID=SyChip-Network, Mode=infra, Security=WPA2

◆When name the static IP address information (include IP address, Subnet mask, Default gateway), use

the command format as follows:

*AT*APN*<profile_name>ssid<ssid>ip:<ip_addr>,<gateway_ip>,<netmask>*

Input:*AT*APN*defaultssid h3c ip:10.3.2.123, 255.255.0.0, 10.3.1.2*

Output:+APN:OK

Name=default,SSID=h3c,Mode=infra,Security=None

4.wlan-stat(Display the state of the current wlan)

Input:*AT*wlan-stat*

Output: disconnected, connecting or Connected。

5. wlan-info (Display the information of the current wlan, include SSID, Encryption, IP address)

Input: *AT*wlan-info*

Output:

◆(If the profile name=Provisioning, SSID= PROV-24-A6-90, Then output:)

```
+wlan-info:OK
Profile: provisioning
SSID: PROV-24-A6-90
BSSID: 5C:DA:D4:24:A6:90
channel: 11
mode: adhoc
security: WEP (shared)
address: STATIC
IP:192.168.10.1
gateway:192.168.10.1
netmask:255.255.255.0
dns1:192.168.10.1
dns2:192.168.10.1
```

◆(If disconnected to AP, Then output:)

Not connected

6. wlan-mac (Demand the MACID)

Command format: *AT*wlan-mac *

Input: *AT*wlan-mac *

Output: 5C:DA:D4:24:A6:90

7. wlan-gethostbyname (Parse Hostname)

Command format: *AT*wlan-gethostbyname*<hostname>*

Input: *AT*wlan-gethostbyname demo90.myit-school.net*

Output: 202.181.196.246

8. Baud rate config of serial interface

Input:

*AT*UARTCFG*?(Demand the current baud rate)

*AT*UARTCFG*9600*(Set the baud rate: 9600)

*AT*UARTCFG*115200*(Set the baud rate: 115200)

9. System reset

Input: *AT*RESET**

*AT*RESET*1*

(System reset, and switch the current mode: provisioning mode transfer to working mode; or working mode transfer to provisioning mode)

AT*RESET*2

(System reset, and erase all the config of the FLASH, include APN, baud rate.....)

10.Setting user's network function

(1).The parameter of server (SRVURL)

◆Demand the information of the server

Input:*AT*SRVURL*?*

Output:+SRVURL:OK

Hostname:http://demo90.myit-school.net/

SetDataAPI:LiSeng.Body.Scale.Apps/API.setData.php

GetDataAPI:LiSeng.Body.Scale.Apps/API.getData.php

◆Setting the information of the server

Input format:*AT*SERVURL*<hostname><getdataapipath><setdataapipath>*

For example, the URL=http://demo90.myit-school.net/LiSeng.Body.Scale.Apps/API.SetData.php*

So setting the command: *AT*SRVURL*http://demo90.myit-school.net/
LiSeng.Body.Scale.Apps/API.SetData.php*

Output: +SRVURL:OK

Hostname:http://demo90.myit-school.net/

API:LiSeng.Body.Scale.Apps/API.SetData.php

Note: The setting information of the server will be saved in the flash.

(2).TX data (SETDATA)

The command format:*AT*SETDATA*<URL><sourcedata>*

If input URL in the command, then the sourcedata will be sent to the URL as http; if without URL in the command, then the sourcedata will be sent to the URL of the SRVURL command setting.

For example:

Input:

*AT*SETDATA*http://demo90.myit-school.net/LiSeng.Body.Scale.Apps/API.SetData.phpmacid=00-1A-2B-3C-4C-5D&uname=David&var=weight&val=100*

Or input:

*AT*SETDATA*macid=00-1A-2B-3C-4C-5D&uname=David&var=weight&val=100*

Output:

+SETDATA:OK

status:[success]

(3).Demand data (GETDATA)

The command format: *AT*GETDATA*<URL><sourcedata>*

If input URL in the command, then the sourcedata will be sent to the URL as http; if without URL in the command, then the sourcedata will be sent to the URL of the SRVURL command setting.

For example:

Input:

```
*AT*GETDATA*http://demo90.myit-school.net/LiSeng.Body.Scale.Apps/API.getData.phpmacid=00-1A-2B-3C-4C-5D&uname=David&var=weight&val=100*
```

Or input:

```
*AT*GETDATA*macid=00-1A-2B-3C-4C-5D&uname=&var=weight&var=height*
```

Output:

```
+GETDATA:OK
```

```
status:200
```

```
content-length:518
```

```
<?xml version="1.0" encoding="big5"?>
```

```
...
```

(4).HTTP client original (HTTPC)

The command format: *AT*HTTPC*<type><URL> [Datastring]*

The first parameter "type"= 1 express HTTP_POST;

The first parameter "type"= 0 express HTTP_GET

Federal Communication Commission Interference Statement

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 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.

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

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.

For product available in the USA/Canada market, only channel 1~11 can be operated. Selection of other channels is not possible.

This device and its antenna(s) must not be co-located with any other transmitters except in accordance with FCC multi-transmitter product procedures.

IMPORTANT NOTE:

This module is intended for OEM integrator. The OEM integrator is still responsible for the FCC compliance requirement of the end product, which OEM integrates this module.

The integration of this RF Module is limited to host device, where the module with it's onboard has minimum separation distance of 10mm to the human body.

Any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

USERS MANUAL OF THE END PRODUCT:

In the users manual of the end product, The end user has to be informed that the FCC radio-frequency exposure guidelines for an uncontrolled environment can be satisfied. The end user has to also be informed that any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment. If the size of the end product is smaller than 8x10cm, then additional FCC part 15.19 statement is required to be available in the users manual:

This device complies with Part 15 of 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.

LABEL OF THE END PRODUCT:

The final end product must be labeled in a visible area with the following " Contains TX FCC ID: RR3-LS8688 ". If the size of the end product is larger than 8x10cm, then the following FCC part 15.19 statement has to also be available on the label: This device complies with Part 15 of 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.

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

(1) According to FCC Part 15 Subpart C Section 15.212, the radio elements of the modular transmitter must have their own shielding. However, due to there is no shielding for this WIFI module, the integrator has to perform radiated measurements of the host device with the integrated WIFI module to assure compliance with the FCC regulations.

(2) According to FCC Part 15 Subpart C Section 15.212, the radio elements of the modular transmitter must have their own power supply. However, due to there is no own power supply for this WIFI module, the host device must support the module with a stable 3.3V voltage power.

As long as 3 conditions above are met, further transmitter test will not be required.