Features

- Bluetooth® 5.0 specification (Dual Mode)
- Class 1 Tx Out Power
- Low Power Consumption
- IC Antenna Onboard
- Over-the-Air Upgrade (OTAU) available
- Configurable with AT Commands
- Application firmware support
- Applications available including SPP with GAP Central, SPP or GAP Peripheral and SPP to Serial Bridge
- Fully integrated module with no additional components required
- I2C, UART and USB 2.0
- Individual PWM channels (3 on dedicated LED pads)
- 6 digital and 3 analogue I/O
- 18.9mm x 12.71mm x 2.55mm
- SMT Side and Bottom Pads for easy production
- RoHS, REACH and WEEE Compliant Solution
- See our website for this product's certifications

Overview

The LM961 Bluetooth® 5.0 Dual Mode module is a powerful, versatile and cost effective solution designed for use as a GAP Central (master) or GAP Peripheral device. This allows your embedded system to wirelessly communicate with other nearby Bluetooth® v2.0, v2.1 and Bluetooth® v4.0, v4.1, v5.0 enabled devices (e.g. iOS and Android). The LM961 is also ideal for streaming high quality data and establishing Bluetooth® low energy connections.

This single core standalone module combines a Bluetooth® low energy and v2.0, v2.1 radio using a dual mode Bluetooth® 5.0 stack, plus a microcontroller unit with an 8 Mbit flash memory for running the application. It also incorporates 29 pin outs, including I2C, UART and USB for interfacing with sensors and many other peripheral devices. It’s SMT side and bottom pads allow for easy manufacture and placement within your product.

LM offer bespoke integration into your product by supporting your developer, including development of new applications for the module. We also offer Bluetooth® Dual Mode demo applications, which can be customised to your specification. The module can be used as a bridge between Bluetooth® v2.0, v2.1 and Bluetooth® v4.0, v4.1, v5.0 devices, using our SPP to Serial Bridge application. We also offer SPP with GAP Central and SPP or GAP Peripheral applications.

Developed firmware and configuration settings can be preloaded to the module before supply.
# General Specification

## Wireless

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Bluetooth® Standard</td>
<td>5.0 (Dual Mode)</td>
</tr>
<tr>
<td>Module Type</td>
<td>Standalone (Configurable with AT Commands)</td>
</tr>
<tr>
<td>Profiles</td>
<td>Partial Supported SPP and GATT-Based</td>
</tr>
</tbody>
</table>

## Hardware

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chipset</td>
<td>Qualcomm</td>
</tr>
<tr>
<td>Antenna</td>
<td>IC Antenna Onboard</td>
</tr>
<tr>
<td>Microcontroller (MCU)</td>
<td>16-bit RISC 80 MHz MCU</td>
</tr>
<tr>
<td>Flash Memory</td>
<td>8 Mbit</td>
</tr>
<tr>
<td>RAM</td>
<td>56 KB (12K x 24-bit)</td>
</tr>
<tr>
<td>Program Interface</td>
<td>SPI</td>
</tr>
<tr>
<td>Interfaces</td>
<td>I2C, UART, USB 2.0, AIO, PIO and PWM</td>
</tr>
<tr>
<td>Power Supply</td>
<td>5V (VCHG/ VBUS) or 2V8 (VBAT)</td>
</tr>
<tr>
<td>Crystal Oscillators</td>
<td>26 MHz</td>
</tr>
<tr>
<td>Development Kit</td>
<td>LM55X</td>
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## RF Characteristics

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tx Output Power</td>
<td>9.4 dBm (Bluetooth® v2.0, v.2.1) and 10 dBm (Bluetooth® v4.0/v4.1)</td>
</tr>
<tr>
<td>Rx Sensitivity</td>
<td>-87 dBm (Bluetooth® v2.0, v.2.1) and -92 dBm (Bluetooth® v4.0/v4.1)</td>
</tr>
<tr>
<td>Data Rate</td>
<td>Up to 3Mbps</td>
</tr>
<tr>
<td>Frequency</td>
<td>2.4 GHz to 2.485 GHz</td>
</tr>
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</table>

## Physical Characteristics

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Temperature</td>
<td>-40°C to +85°C</td>
</tr>
<tr>
<td>Dimensions (L x W x H)</td>
<td>18.9mm x 12.7mm x 2.55mm</td>
</tr>
<tr>
<td>Weight</td>
<td>0.58g +/- 0.25g tolerance</td>
</tr>
<tr>
<td>Certifications</td>
<td>See our website for this products certifications</td>
</tr>
<tr>
<td>Compliance</td>
<td>RoHS, REACH and WEEE</td>
</tr>
</tbody>
</table>
**Firmware**

The LM961 Bluetooth® 5.0 Dual Mode module is configured by using AT commands in configuration mode. The AT command set controls the primary operations such as information enquiry, connection/disconnection set up and settings. The LM961 module can be configured via its UART interface from a microcontroller or computer, using MCU software or a serial terminal (e.g. Hercules SETUP utility) respectively. At the start of every power up cycle the LM961 enters the configuration mode.

When the LM961 is connected to another Bluetooth device it enters into data mode. In data mode, users can send/receive data between the module and the remote device via UART. To exit data mode, the user can use the escape sequence. If the LM961 responds with "OK" to the escape sequence it enters into the online_command_mode (i.e. the connection is still active, AT commands can be entered via UART or the connection can be dropped). The LM961 can re-enter into data mode by using AT commands.

### Default Factory Settings

**Device Settings**
- Discoverable: ON
- Device Name: LM961_2_Default
- Echo of command: ON
- Response to commands: ON
- Pairable State: ON

**Bluetooth® (v1.0 - v3.0) Profile Settings**
- SPP Role: Dual
- Escape sequence check enabled: YES

**Security Settings**
- Pin: 1234
- DPIN: OFF
- MITM: OFF
- IOTYPE: No Input Output

**UART Settings**
- Baud rate: 115200
- Stop bit: ONE
- Parity bits: NONE
- Flow Control: OFF

**Bluetooth® low energy Settings**
- GAP Role: Central or Peripheral (dependent on the application)
The LM961 module can run full application code for a wide range of industries. This includes the M2M (industrial cable replacement), EPOS, health & fitness and consumer electronics industries.

The LM961 modules can run all Bluetooth® applications. Depending on whether the embedded developer requires a Bluetooth® low energy connection, a high-quality data stream Bluetooth® connection or both simultaneously.

LM Technologies offer application support, including designing new applications such as:

- Alert Tag
- Beacon
- Blood Pressure Sensor
- Cycling Speed and Cadence Sensor
- Environment Sensor
- Health Thermometer
- Heart Rate Sensor
- Keyboard & Mouse
- Multifunction Steering Wheel
- Printer
- Security Tag
- Serial Communication
- Time Client
- Temperature and Pressure
- Weight Scale

Firmware Available

- SPP with GAP Central
- SPP or GAP Peripheral
- SPP to Serial Bridge
Powering

- The LM961 can be powered in one of 2 ways:

  1) Powered through the VCHG/VBUS (Pin 21)
  2) Powered from a Lithium ion / Lithium polymer battery through VBAT (Pin 19)

Pin Outs

- GND
- AIO_0
- AIO_1
- AIO_2
- RST
- PIO_0 / SCL
- PIO_1 / SDA
- PIO_2 / UART_RX
- PIO_3 / UART_TX
- PIO_4 / UART_RTS
- PIO_5 / UART_CTS
- SPI_MISO
- SPI_MOSI
- SPI_CLK
- SPI_ENABLE
- SPI_CS
- VBAT
- VBAT_SENSE
- CHG_EXT
- VCHG / VBUS
- VREGENABLE
- LED_0
- LED_1
- LED_2
- USB_P
- USB_N
# LM961 Bluetooth® 5.0 Dual Mode Module

Standalone (With Embedded Bluetooth® 5.0 Stack)

## Pin Assignments

<table>
<thead>
<tr>
<th>Pin</th>
<th>Name</th>
<th>Type</th>
<th>Description</th>
<th>Typical</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GND</td>
<td>Ground</td>
<td>Common Ground</td>
<td>0V</td>
</tr>
<tr>
<td>2</td>
<td>AIO_0</td>
<td>Input</td>
<td>Analog Input</td>
<td>0V - VDD</td>
</tr>
<tr>
<td>3</td>
<td>AIO_1</td>
<td>Input</td>
<td>Analog Input</td>
<td>0V - VDD</td>
</tr>
<tr>
<td>4</td>
<td>AIO_2</td>
<td>Input</td>
<td>Analog Input</td>
<td>0V - VDD</td>
</tr>
<tr>
<td>5</td>
<td>RST</td>
<td>Input</td>
<td>Reset</td>
<td>0V - VDD</td>
</tr>
<tr>
<td>6</td>
<td>PIO_0 / SCL</td>
<td>I/O</td>
<td>Programmable Input / Output or I2C Serial Clock</td>
<td>0V - VDD</td>
</tr>
<tr>
<td>7</td>
<td>GND</td>
<td>Ground</td>
<td>Common Ground</td>
<td>0V</td>
</tr>
<tr>
<td>8</td>
<td>PIO_1 / SDA</td>
<td>I/O</td>
<td>Programmable Input / Output or I2C Serial Data</td>
<td>0V - VDD</td>
</tr>
<tr>
<td>9</td>
<td>PIO_2 / UART_RX</td>
<td>I/O</td>
<td>Programmable Input / Output or UART Receive</td>
<td>0V - VDD</td>
</tr>
<tr>
<td>10</td>
<td>PIO_3 / UART_TX</td>
<td>I/O</td>
<td>Programmable Input / Output or UART Transmit</td>
<td>0V - VDD</td>
</tr>
<tr>
<td>11</td>
<td>PIO_4 / UART_RTS</td>
<td>I/O</td>
<td>Programmable Input / Output or UART RTS</td>
<td>0V - VDD</td>
</tr>
<tr>
<td>12</td>
<td>PIO_5 / UART_CTS</td>
<td>I/O</td>
<td>Programmable Input / Output or UART CTS</td>
<td>0V - VDD</td>
</tr>
<tr>
<td>13</td>
<td>SPI_MISO</td>
<td>I/O</td>
<td>SPI Master In Slave Out</td>
<td>0V - VDD</td>
</tr>
<tr>
<td>14</td>
<td>SPI_CS</td>
<td>I/O</td>
<td>SPI Chip Select</td>
<td>0V - VDD</td>
</tr>
<tr>
<td>15</td>
<td>GND</td>
<td>Ground</td>
<td>Common Ground</td>
<td>0V</td>
</tr>
<tr>
<td>16</td>
<td>SPI_ENABLE</td>
<td>I/O</td>
<td>SPI Enable (CSR)</td>
<td>0V - VDD</td>
</tr>
<tr>
<td>17</td>
<td>SPI_CLK</td>
<td>I/O</td>
<td>SPI Clock</td>
<td>0V - VDD</td>
</tr>
<tr>
<td>18</td>
<td>SPI_MOSI</td>
<td>I/O</td>
<td>SPI Master Out Slave In</td>
<td>0V - VDD</td>
</tr>
<tr>
<td>19</td>
<td>VBAT</td>
<td>Power</td>
<td>Battery input</td>
<td>2V8</td>
</tr>
<tr>
<td>20</td>
<td>VREGENABLE</td>
<td>Power</td>
<td>Voltage Regulator Enable</td>
<td>1V</td>
</tr>
<tr>
<td>21</td>
<td>VCHG / VBUS</td>
<td>Power</td>
<td>Battery Charger Input/ Positive Power Supply</td>
<td>5V (3V - 6.5V)</td>
</tr>
<tr>
<td>22</td>
<td>CHG_EXT</td>
<td>Power</td>
<td>External Battery Charge Control</td>
<td>0V - 6.5V &amp; 0mA-20mA</td>
</tr>
<tr>
<td>23</td>
<td>VBATSENSE</td>
<td>Power</td>
<td>Battery Charger Sense Input</td>
<td>200mV (195mV - 205mV)</td>
</tr>
<tr>
<td>24</td>
<td>USB_N</td>
<td>I/O</td>
<td>USB Negative</td>
<td>0V - VDD</td>
</tr>
<tr>
<td>25</td>
<td>USB_P</td>
<td>I/O</td>
<td>USB Positive</td>
<td>0V - VDD</td>
</tr>
<tr>
<td>26</td>
<td>LED_2</td>
<td>Output</td>
<td>PWM / LED 2</td>
<td>0V - VDD</td>
</tr>
<tr>
<td>27</td>
<td>LED_1</td>
<td>Output</td>
<td>PWM / LED 1</td>
<td>0V - VDD</td>
</tr>
<tr>
<td>28</td>
<td>LED_0</td>
<td>Output</td>
<td>PWM / LED 0</td>
<td>0V - VDD</td>
</tr>
<tr>
<td>29</td>
<td>GND</td>
<td>Ground</td>
<td>Common Ground</td>
<td>0V</td>
</tr>
</tbody>
</table>
Module Block Diagram

CSR Chipset

VDD

ANT

Filter

BT_RF

FLASH
8 Mbit

SIO

PWM

AIO

SPI (Debug)

UART

I²C

USB

PIO

XTAL
26MHz

LM961 Bluetooth® 5.0 Dual Mode Module
Standalone (With Embedded Bluetooth® 5.0 Stack)
LM961 Bluetooth® 5.0 Dual Mode Module
Standalone (With Embedded Bluetooth® 5.0 Stack)

Physical Dimensions

Top View

Front View

Side View
LM961 Bluetooth® 5.0 Dual Mode Module
Standalone (With Embedded Bluetooth® 5.0 Stack)

PCB Footprint

Optimal Placement Position

Placement Note
If the optimal placement position cannot be achieved, ensure there is no metal beneath the highlighted part of module.

NB
Aim to place the module away from interference. (i.e: place the module at the edge of the board.)

Pin Spacing

EDGE OF HOST PCB (Optimal)

NO METAL BENEATH THIS AREA

Pin 1

29

19

20

10

12.71mm

7.87mm

3.81mm

1.70mm

1.0mm

18.90mm

6.20mm
PCB Drying Conditions

Please refer below to the conditions for drying before the solder reflow processes. (Extracted from IPC/JEDEC J-STD-033B.1)

Soldering and Reflow Chart

<table>
<thead>
<tr>
<th>Preheat zone slope</th>
<th>Immersion time 150 to 180°C</th>
<th>Refluxing time 220°C</th>
<th>Maximum Temperature</th>
<th>cooling zone slope</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.80</td>
<td>-13.33%</td>
<td>76.00</td>
<td>-60.00%</td>
<td>247.0</td>
</tr>
<tr>
<td>1.90</td>
<td>-6.67%</td>
<td>76.50</td>
<td>-58.73%</td>
<td>248.3</td>
</tr>
<tr>
<td>2.10</td>
<td>5.00%</td>
<td>75.50</td>
<td>-61.25%</td>
<td>249.2</td>
</tr>
<tr>
<td>1.80</td>
<td>-13.33%</td>
<td>75.50</td>
<td>-61.25%</td>
<td>248.9</td>
</tr>
</tbody>
</table>
**LM961 Bluetooth® 5.0 Dual Mode Module**

*Standalone (With Embedded Bluetooth® 5.0 Stack)*

**Tape and Reel Packaging**

**Tape Dimensions**

- 20mm
- 0.15mm
- 4mm
- 13.8mm
- 3mm

**Reel Dimensions**

- 330mm
- 36mm
- 92mm

**Notes**

- Carton Dimensions (L x W x H): 360mm x 290mm x 370mm

**Quantities**

- 1000 modules per Tape
- 4 Boxes per Carton
- 4000 modules per Carton
**LM961 Bluetooth® 5.0 Dual Mode Module**  
**Standalone (With Embedded Bluetooth® 5.0 Stack)**  

**Tray Packaging**

**Tray Dimensions**

![Tray Diagram]

- **Dimensions:** 312mm x 143mm x 10mm
- **Module Count:** 60 modules per tray

**Notes**
- Anti-Static PS Tray, Black
- Electrical Resistance: 1 MΩ < R < 100 MΩ
- Thickness: T = 0.8 mm
- Carton Dimensions (L x W x H): 360mm x 325mm x 160mm

**Quantities**
- 60 modules per tray
- 600 modules per box
- 4 boxes per carton
- 2400 modules per carton
Packaging for Tape & Reel / Tray

The trays/reels are stacked and inserted into an anti-static vacuum bag with a Humidity Indicator Card. On the outside of the bag are labels for Anti-Static, Model Name and Moisture Sensitivity Levels.

Reels are place within a vacuum bag.

Trays are stacked up with an empty tray on the top.

The vacuum bag is placed inside the box and a model name label affixed on the front-side of each box.

Each carton contains 4 boxes.
Datasheet Version Notes

v1.0  13 MAR 2018  Added version notes to datasheet.
v1.1  13 MAR 2018  MSL Description text improvement in the PCB Drying Conditions section.
v1.1  29 MAR 2018  Datasheet Revision date typo amended.
v1.2  04 JUL 2018  MSL Description text improvement in the PCB Drying Conditions section.
                  Packing information addition.
v1.3  22 MAY 2019  Updated Bluetooth® core version references.
## LM961 Packaging Options

<table>
<thead>
<tr>
<th>Part No</th>
<th>Description</th>
</tr>
</thead>
</table>
| 961-0650 | LM961 Module  
MOD SMT PROG BT5.0 D/Mode Fw5.x 9dBm IC ANT PCS |
| 961-0651 | LM961 Module  
MOD SMT PROG BT5.0 D/Mode Fw5.x 9dBm IC ANT TRAY |
| 961-0652 | LM961 Module  
MOD SMT PROG BT5.0 D/Mode Fw 5.x 9dBm IC ANT T&R |
| 961-0660 | LM961 Module  
MOD SMT PROG BT5.0 D/Mode Fw5.x 4dBm IC ANT PCS |
| 961-0661 | LM961 Module  
MOD SMT PROG BT5.0 D/Mode Fw5.x 4dBm IC ANT TRAY |
| 961-0662 | LM961 Module  
MOD SMT PROG BT5.0 D/Mode Fw 5.x 4dBm IC ANT T&R |