GR5526 Starter Kit User Guide

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Preface

Purpose

This document introduces the components and hardware features of GR5526 Starter Kit (GR5526 SK), as well as the hardware layout & configuration and RF & current tests of the GR5526 Starter Kit Board (GR5526 SK Board), to help you get started with the GR5526 SK Board quickly in developing Bluetooth Low Energy (Bluetooth LE) products and applications with GR5526 System-on-Chips (SoCs).

Audience

This document is intended for:

- GR5526 user
- GR5526 developer
- GR5526 tester
- Technical writer

Release Notes

This document is the initial release of *GR5526 Starter Kit User Guide*, corresponding to GR5526 SoC series.

Revision History

Version	Date	Description
1.0	2023-01-10	Initial release

Contents

1 Introduction

The GR5526 Starter Kit (GR5526 SK) is a development platform based on GR5526 System-on-Chips (SoCs) (supporting Bluetooth 5.3). It contains a GR5526 Starter Kit Board (GR5526 SK Board), design documents, and a user guide. This helps users quickly develop product prototype and verify related functions/performance, shortening product development and go-to-market periods.

The figure below shows the photo of a GR5526 SK Board:

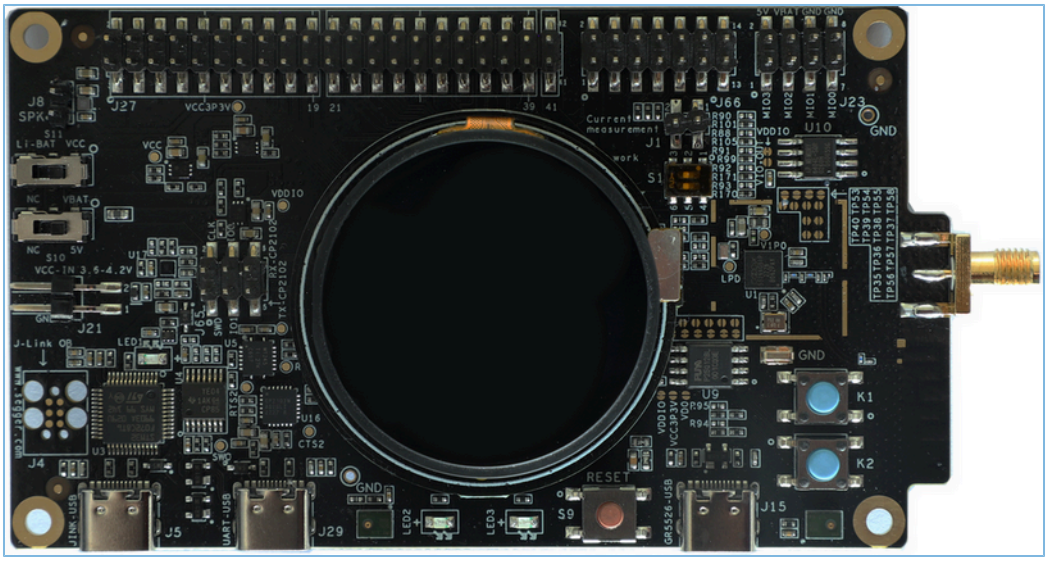

Figure 1-1 GR5526 SK Board

Note:

By default, display application firmware has been programmed to a GR5526 SK Board. You can view demo graphics by connecting a GR5526 SK Board to a display daughter board. You can also generate firmware by compiling other application example projects provided in a GR5526 Software Development Kit (SDK) and then download the firmware to a GR5526 SK Board for debugging/testing.

Before you get started, it is recommended to refer to the following documents.

Table 1-1 Reference documents

Name	Description
GR5526 Developer Guide	Introduces the software/hardware and quick start guide of GR5526 SoCs.
J-Link/J-Trace User Guide	Provides J-Link operational instructions. Available at https://www.segger.com/downloads/jlink/UM08001_JLink.pdf.
GR5526-SK-BASIC-RevC	Offers GR5526 SK Board schematic diagrams.
GProgrammer User Manual	Lists GProgrammer operational instructions including downloading firmware to and encrypting firmware on GR5526 SoCs.

1.1 Features

- A single-mode Bluetooth Low Energy (Bluetooth LE) SoC that supports Bluetooth 5.3
- Multi-functional buttons and LEDs
- SEGGER J-Link OB that supports debugging
- UART-to-USB connector
- USB Type-C connector
- 1.39-inch circular color AMOLED touch display (454 x 454 dpi)
- On-board I2S Audio module
- Two on-board Pulse Density Modulation (PDM) digital microphones
- On-board QSPI Flash and PSRAM, with reserved interfaces for external Flash and PSRAM
- On-board AoA/AoD multi-antenna interface
- On-board adjustable boost circuit
- Battery level detection
- Reserved standard 2.54 mm jumper pin I/O interface

2 Quick Start Guide

This chapter introduces how to use the GR5526 SK by running a GR5526 application example on a GR5526 SK Board.

Note:

The GR5526 example projects are in SDK_Folder\projects. **SDK_Folder** is the root directory of GR5526 SDK.

2.1 Preparation

- **Hardware preparation**

Table 2-1 Hardware preparation

Name	Description
Connection cable	A USB Type-C cable to connect a GR5526 SK Board to a PC
Development board	A GR5526 SK Board for running an application example
PC	Where Keil runs; also serves as the power supply for the GR5526 SK Board
Mobile phone	Where GRToolbox runs

- **Software preparation**

Table 2-2 Software preparation

Name	Description
Operating system	Windows 7 or later versions, or Ubuntu 16.04 LTS or later versions (both 32-bit and 64-bit are acceptable)
J-Link driver	A J-Link driver. Available at https://www.segger.com/downloads/jlink/.
GR5526 SDK	GR5526 SDK, containing rich example projects and driver files
Keil MDK5	An integrated development environment (IDE). MDK-ARM Version 5.20 or later is required. Available at https://www.keil.com/download/product/.
GRToolbox	A Bluetooth LE debugging tool. Both GRToolbox (Android) and GRToolbox (iOS) are available. • GRToolbox (Android): Available in SDK_Folder\tools\GRToolbox, or download from App store. • GRToolbox (iOS): Available at the App Store.

2.2 Software Installation

Before hardware connection, the following software shall be installed.

- GR5526 SDK

  GR5526 SDK provides rich application examples, including peripheral examples and Bluetooth LE examples. GR5526 SDK is in ZIP file. Users can access the details after extracting the file.

- IDE

  Install an IDE (Keil MDK5) on your PC for example project compilation to generate application firmware. Download the installation file, and follow the steps of the installation wizard.

- GRToolbox

  Download the installation file to the mobile phone, and follow the steps of the installation wizard. After installation completes, tap on your phone to start GRToolbox.

- J-Link drivers

  J-Link drivers should be installed on the PC to ensure J-Link functions properly in debugging. After installation completes, users can view the **SEGGER** directory from the **Start** menu, as shown in Figure 2-1.

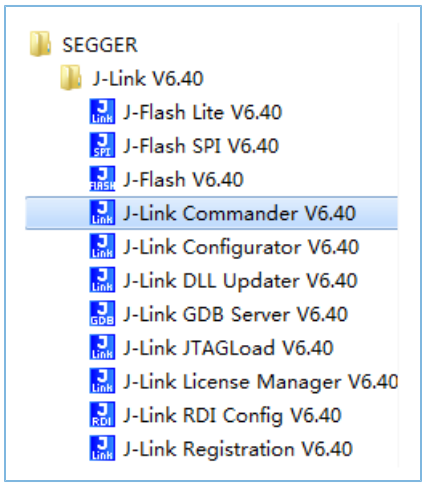

Figure 2-1 SEGGER directory

2.3 Hardware Connection and Configuration

To ensure proper function of the GR5526 SK Board, it is required to connect the board to a PC and set the power supply mode.

GR5526 supports two connection/programming modes: J-Link and UART. You can select either one as needed.

- **Connection via J-Link**

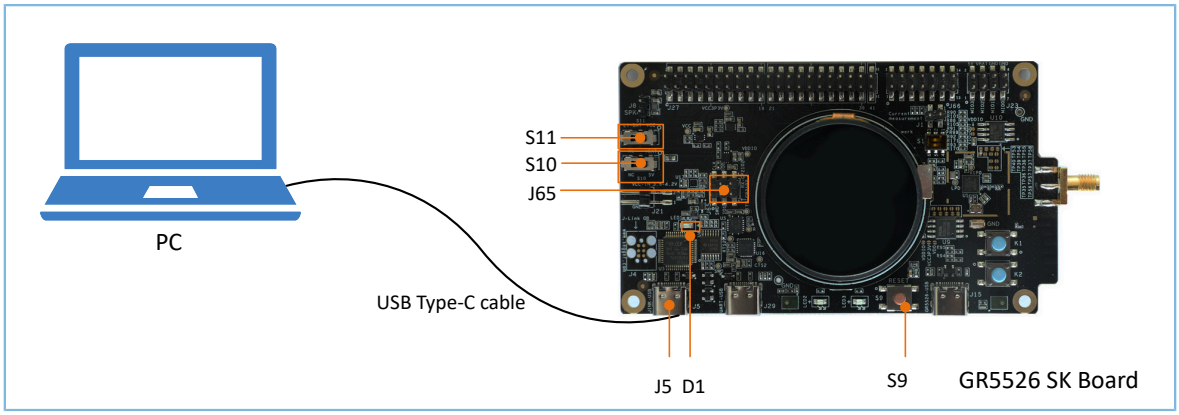

Figure 2-2 Hardware connection (J-Link)

1. Connect the GR5526 SK Board to a PC.

   Connect the GR5526 SK Board to a PC via the Type-C connector (J5) using a USB Type-C cable.

2. Set the power supply mode for the GR5526 SK Board.

   Switch **S11** (power selection switch) on the board to the right (**VCC**) to supply the board via USB connection.

Note:

The GR5526 SK Board also can be supplied by lithium battery. Switch **S11** to the left (**Li-BAT**) to supply the board by lithium battery.

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3. Connect the on-board J-Link port.

   Get the J-Link port (GPIO_0 and GPIO_1) of GR5526 SoC ready for programming and debugging via J-Link, by connecting Pin1 to Pin3 and Pin2 to Pin4 of J65 on the GR5526 SK Board with jumpers.

4. Power the GR5526 SK Board on.

   Switch **S10** (power switch) on the board to the right (**5V/VBAT**) to turn on the board power supply; switch **S10** to the left (**NC**) to turn off the power supply.

5. Check the connection state (J-Link).

   After the GR5526 SK Board is powered on, the LED D1 on the board starts flashing, indicating that the PC begins to detect the J-Link port. After flashing for several times, D1 remains on, indicating that detection succeeds.

   When D1 remains on, open the **File Explorer** of the PC, and check whether J-Link is in the list of **Device Manager** > **Ports (COM & LPT)**. J-Link in the list indicates that the GR5526 SK Board has been connected to the PC; otherwise, check whether the J-Link drivers are installed properly.

- **Connection via UART**

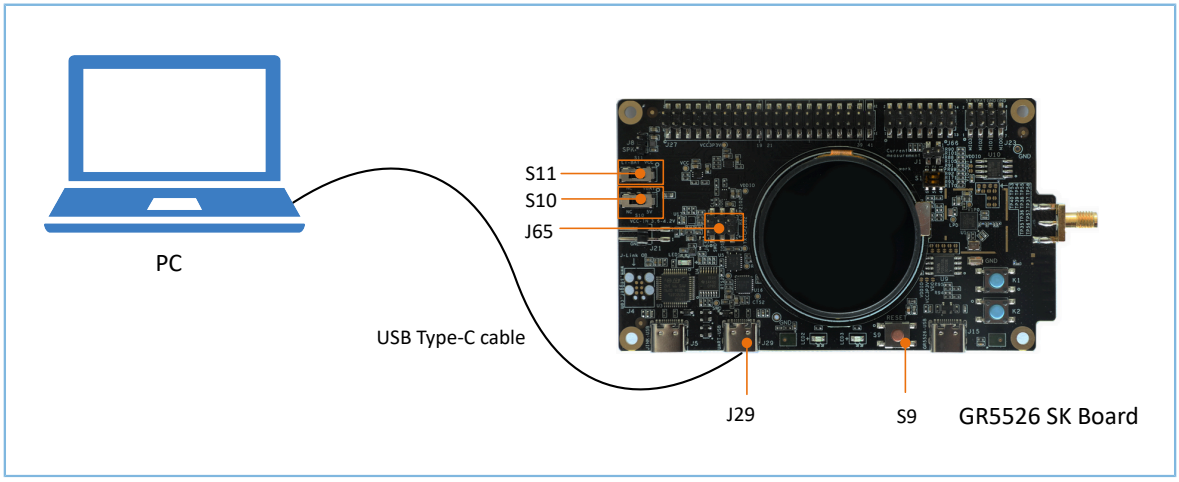

Figure 2-3 Hardware connection (UART)

1. Connect the GR5526 SK Board to a PC.

   Connect the GR5526 SK Board to a PC via the Type-C connector (J29) using a USB Type-C cable.

2. Set the power supply mode for the GR5526 SK Board.

   Switch **S11** (power selection switch) on the board to the right (**VCC**) to supply the board via USB connection.

3. Connect the on-board UART port.

   Get the UART port (GPIO_0 and GPIO_1; same as the J-Link port) of GR5526 SoC ready for programming and debugging via UART, by connecting Pin3 to Pin5 and Pin4 to Pin6 of J65 on the GR5526 SK Board with jumpers.

4. Power the GR5526 SK Board on.

   Switch **S10** (power switch) on the board to the right (**5V/VBAT**) to turn on the board power supply; switch **S10** to the left (**NC**) to turn off the power supply.

5. Check the connection state (UART).

   Start GProgrammer on the PC and select connection via UART for programming. You need to press the **RESET** button (S9) to reset the GR5526 SK Board before establishing connection for programming. Successful programming indicates the connection is established.

2.4 Example Running

Users shall take the following steps to run an application example after hardware connection and configuration complete.

1. Navigate to the GR5526 example project directory: SDK_`Folder\projects`.
2. Open a GR5526 example project in Keil, for example, a heart rate application example (SDK_`Folder\projects\ble\ble_peripheral\ble_app_hrs`).
3. Compile the example project and save the compilation result as an application firmware file (a BIN file or a HEX file).
4. Download the application firmware file to the GR5526 SK Board.
5. Press **S9** (**RESET** button) on the board to run the example project.

Note:

- By default, the example project directory contains firmware files. Users can directly download the firmware to the board through GProgrammer.
- For more information about example project compilation and firmware download, refer to *GR5526 Developer Guide*.

2.5 Mobile Connection Test

Users can also use GRToolbox to scan and connect the GR5526 SK Board for debugging/testing.

Note:

For more information about example project testing/verification, refer to corresponding example application documents.

3 Hardware Layout and Configuration

This chapter depicts the hardware layout and detailed hardware configurations of the GR5526 SK Board.

3.1 Block Diagram

With a GR5526 Bluetooth SoC as the host MCU, the GR5526 SK Board integrates an interface microcontroller unit (MCU), power modules, USB Type-C connectors, a J-Link/UART debugging module, buttons and LEDs, Flash & PSRAM, digital microphones (MICs), a headphone (speaker) jack, a display & TP interface, AoA/AoD multi-antenna interfaces, a Bluetooth antenna, and a radio frequency (RF) small A type (SMA) connector. The system block diagram is shown below.

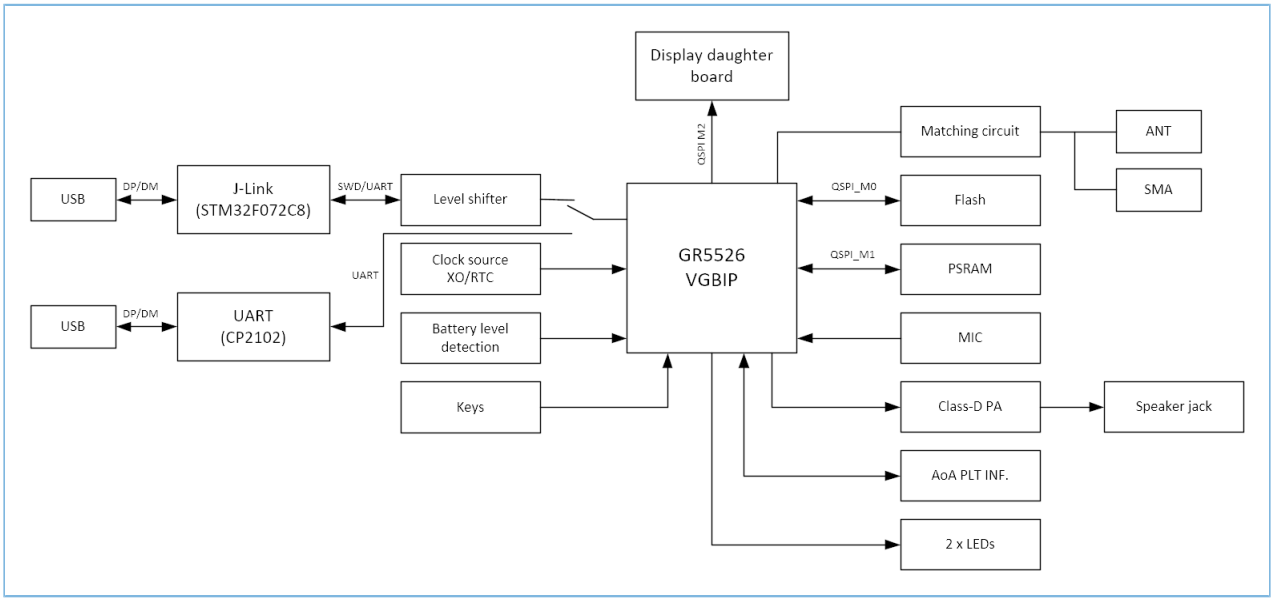

Figure 3-1 Block diagram of GR5526 SK Board

3.2 Hardware Layout

The top view and the bottom view of the GR5526 SK Board are shown in Figure 3-2 and Figure 3-3 respectively.

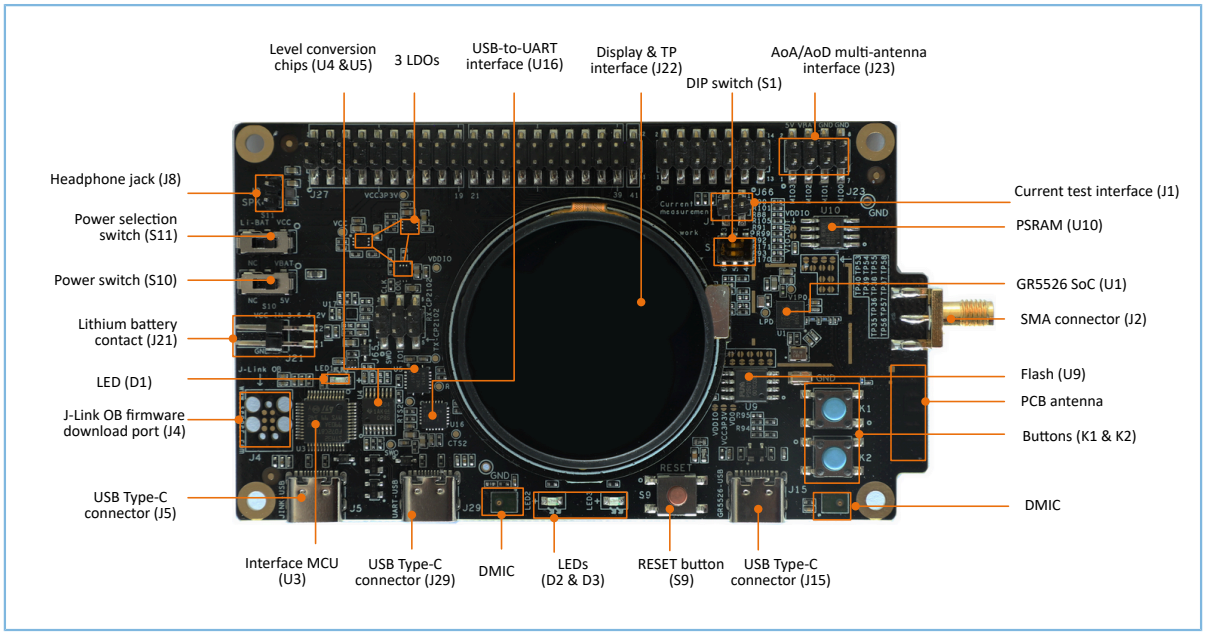

Figure 3-2 GR5526 SK Board layout (top view)

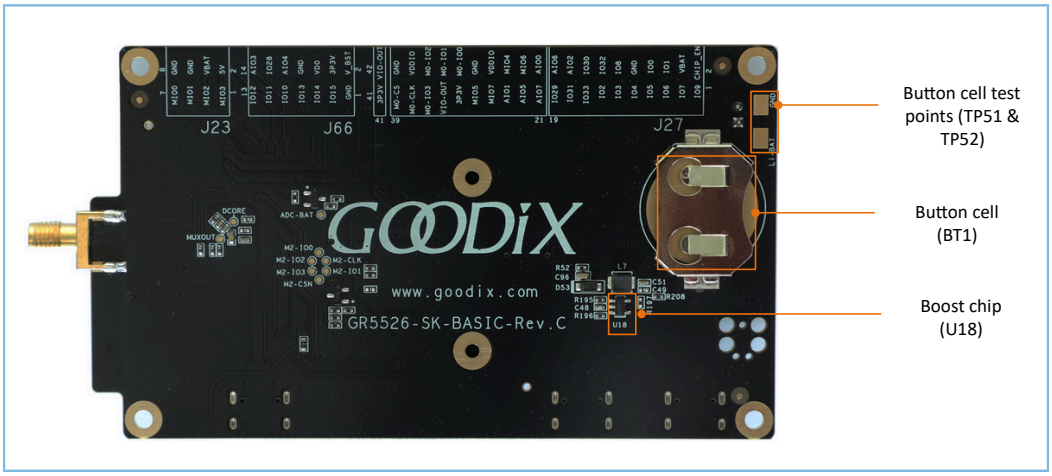

Figure 3-3 GR5526 SK Board layout (bottom view)

3.3 Interface MCU

The GR5526 SK Board integrates an STM32F MCU (U3), which can convert a USB connector to a J-Link port or a Communication Device Class (CDC) virtual serial port, to support J-Link/UART debugging.

3.3.1 J-Link Port

The J-Link OB firmware runs on the interface MCU to support J-Link debugging. Users can install J-Link drivers on the PC (host) and connect the GR5526 SK Board to the PC to perform online debugging or emulation, instead of using a debugger or emulator.

3.3.2 CDC Virtual Serial Port

The J-Link OB firmware also integrates CDC serial protocols, which allow USB to UART conversion to support UART debugging.

The mapping relationship of UART connectors between the GR5526 SoC and interface MCU is listed below.

Table 3-1 Mapping of UART connectors between GR5526 SoC and interface MCU

GR5526 SoC	Interface MCU
UART (Default GPIO)	UART
TX (GPIO_4)	RX
RX (GPIO_5)	TX

3.3.3 Firmware Download Port

Users can download SEGGER J-Link OB firmware through J4 on the GR5526 SK Board.

Note:

GR5526 SK Boards have been factory-downloaded with J-Link OB firmware. No download is required for users.

3.4 Power Supply

3.4.1 Power Supply Mode

The GR5526 SK Board supports two power supply modes: power supply via USB connection and power supply from lithium battery.

Users can select a proper power supply mode by switching **S11**:

- Power supply via USB connection: Switch **S11** on the board to the right (**VCC**) to supply the board via USB connection.
- Power supply from lithium battery: Switch **S11** on the board to the left (**Li-BAT**) to supply the board by lithium battery.

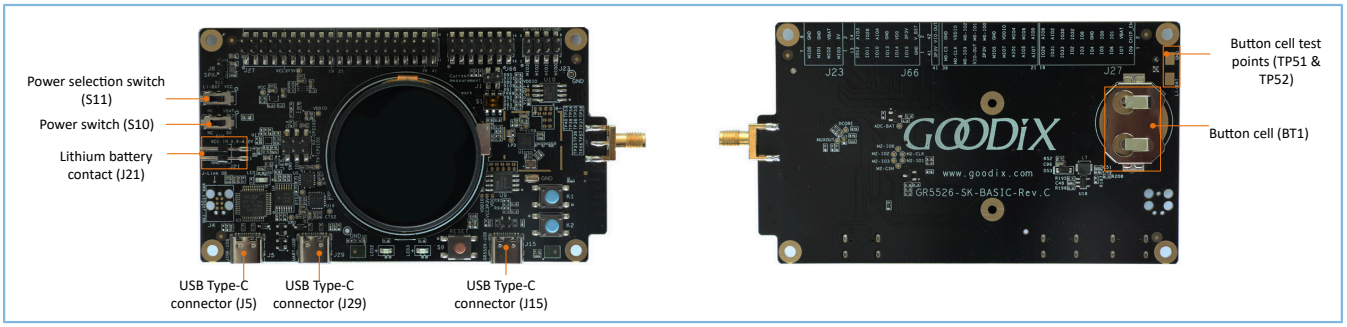

Figure 3-4 Power supply interfaces

- Power supply via USB connection

  The GR5526 SK Board is connected to an external power source via J5, J15, or J29. The external power source supplies power at 1.8 V–3.3 V (default: 3.3 V) after current passes through the on-board LDO for voltage regulation.

- Power supply from lithium battery

  The GR5526 SK Board is connected to an external lithium battery via J21. The external lithium battery supplies power at 3.3 V after current passes through the on-board LDO for voltage regulation.

  Users can also connect the GR5526 SK Board to an external lithium battery through TP51 or TP52, or power the GR5526 SoC by the button cell (BT1).

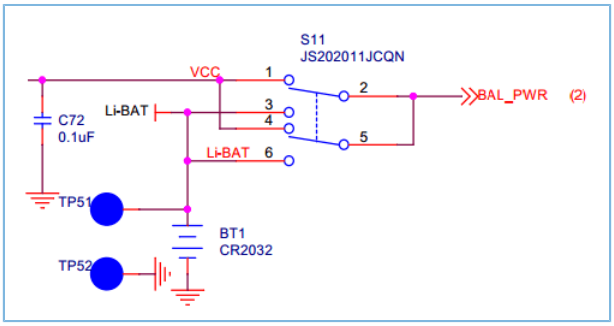

Figure 3-5 Switching of power supply modes

3.4.2 Charging Management Circuit

GR5526 SK Board integrates a charging management circuit as shown below to charge the lithium battery and supply the mainboard through USB Type-C connectors (J5, J15, and J29).

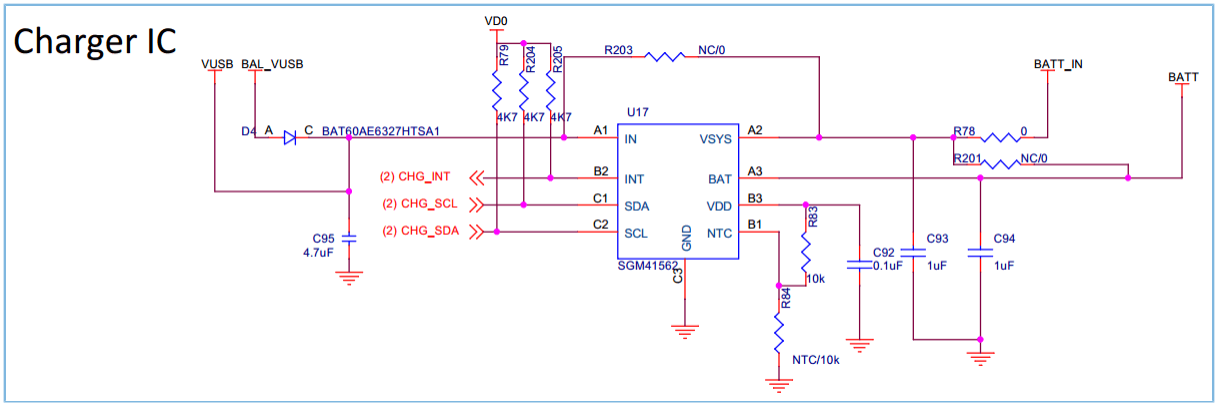

Figure 3-6 Charging management circuit

3.4.3 Boost Circuit

GR5526 SK Board integrates a boost circuit as shown below to connect to and supply peripherals through J66. The output voltage can be adjusted by the feedback circuit according to voltage requirements of the peripherals in use.

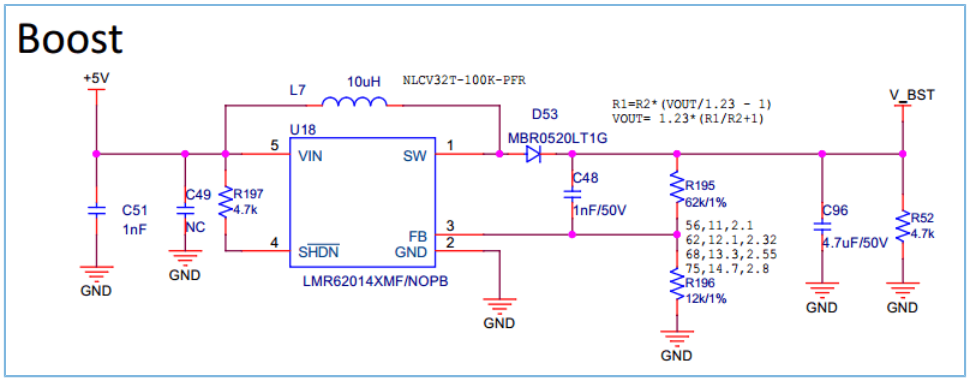

Figure 3-7 Boost circuit

3.4.4 Battery Level Detection

The GR5526 SK Board supports battery level detection. The battery level detection function can be enabled/disabled by configuring EN_BATM. If no detection is required, disable the function to prevent electric leakage from the resistor in voltage division testing.

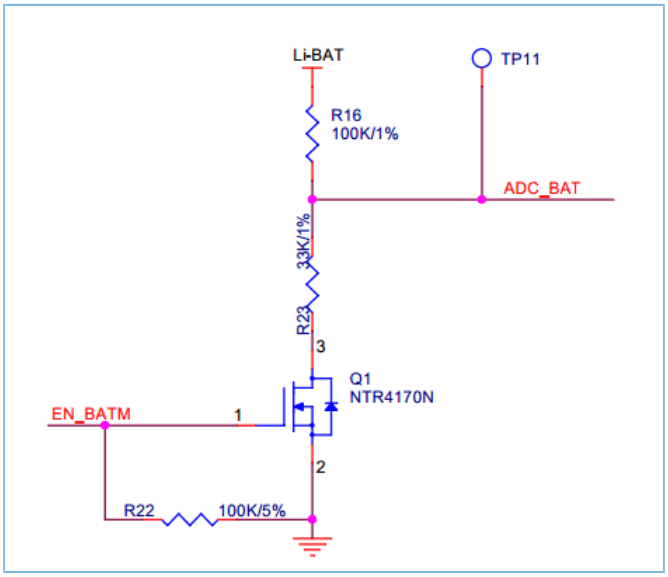

Figure 3-8 Battery level detection circuit

3.5 Buttons and LEDs

The GR5526 SK Board integrates 3 buttons and 3 LEDs, which are connected to corresponding I/O pins on the GR5526 SoC.

Table 3-2 Functional Description of buttons/LEDs

Button/LED	Symbol	Corresponding I/O Pin on GR5526 SoC	Description
Button1	S9	CHIP_EN	Reset button, to reset the SoC
Button2	K1	AON_GPIO_1	K1 button
Button3	K2	AON_GPIO_0	K2 button

Button/LED	Symbol	Corresponding I/O Pin on GR5526 SoC	Description
LED1	D1	-	It is connected to the interface MCU to indicate J-Link status. When the GR5526 SK Board is powered on, it flashes; if J-Link drivers on the PC are ready, it remains on.
LED2	D2	MSIO_4	LED2 can be driven by different PWM modes.
LED3	D3	MSIO_6	LED3 can be driven by different PWM modes.

Note:

To ensure that buttons/LEDs function normally, GR5526 I/O pins mentioned in the table above shall be pulled up for outputting.

3.6 On-board QSPI Flash/PSRAM

The GR5526 SK Board integrates a 128 Mb QSPI Flash and a 128 Mb PSRAM, to expand Flash and store application data.

By default, the power supply pin VCC3P3V outputs current passing through the on-board low dropout regulator (LDO) at 3.3 V, VDDIO outputs current passing through the on-board LDO at 1.8 V, and VIO_OUT outputs current at 1.8 V from the SoC. The VDDIO1 domain of the GR5526 SoC is connected to the on-chip low-voltage (1.8 V) PSRAM, and the VDDIO0 domain is connected to the on-chip wide-voltage (1.8 V–3.3 V) Flash. Therefore, the VDDIO1 pin can be connected to VIO_OUT directly, and the VDDIO0 pin can be connected to either VCC3P3V or VIO_OUT by switching **S1**, as shown in Figure 3-9. The on-board Flash supports power supply at 1.8 V–3.3 V, and the on-board PSRAM supports power supply at 1.8 V only.

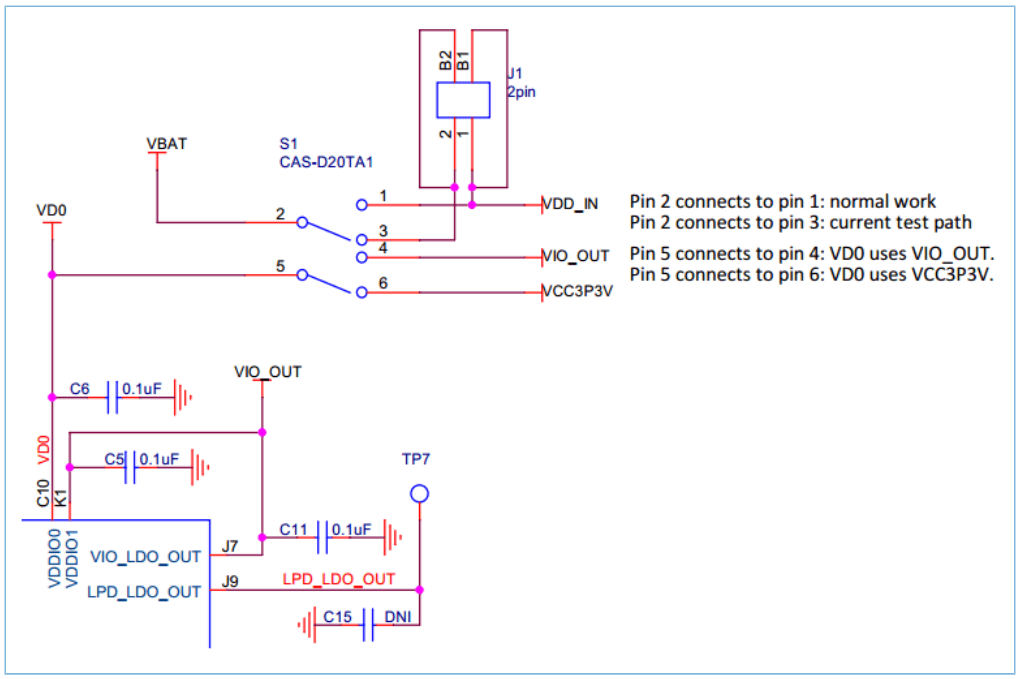

Figure 3-9 Power supply through VDDIO pins on GR5526 SoC

By default, the on-board Flash is supplied through VDDIO. Switching the supply voltage is supported by configuring the connection status of TP12–TP14. To allow commissioning of various models of Flash, users can solder an external Flash at SOIC8 on the board or connect an external Flash to the board through the J27 connector to replace the on-board Flash. For external Flash commissioning through J27, a plug-in module shall be designed according to the pin definitions of U9 in Figure 3-10, TP18–TP23 shall be disconnected, and TP24–TP29 shall be shorted.

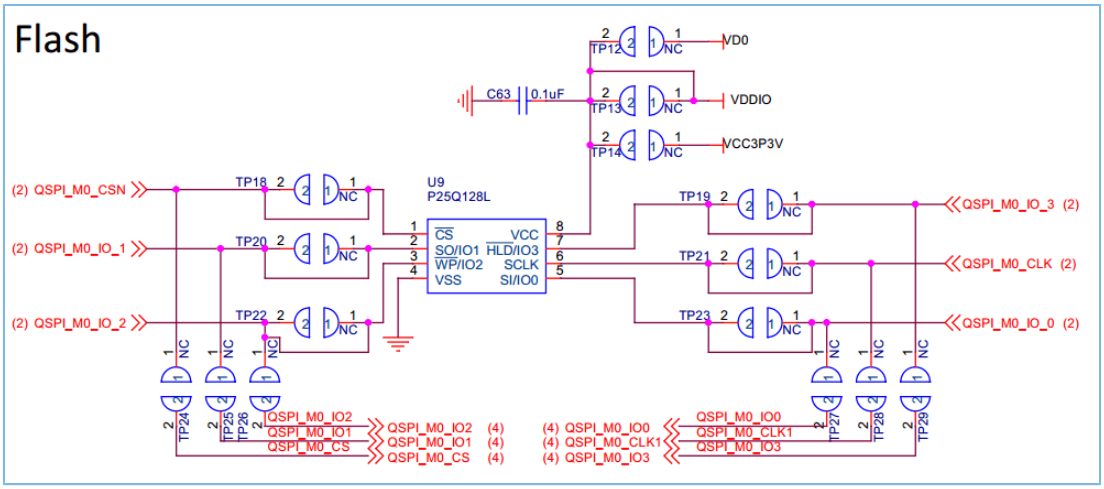

Figure 3-10 Expanded QSPI Flash schematic diagram

By default, the on-board PSRAM is supplied through VDDIO. Switching the supply voltage is supported by configuring the connection status of TP33 and TP34. To allow commissioning of various models of PSRAM, users can solder an external PSRAM at SOIC8 on the board or connect an external PSRAM to the board through J27 to replace the on-board PSRAM. For external PSRAM commissioning through J27, a plug-in module shall be designed according to the pin definitions of U10 in Figure 3-11, TP53–TP58 shall be disconnected, and TP35–TP40 shall be shorted.

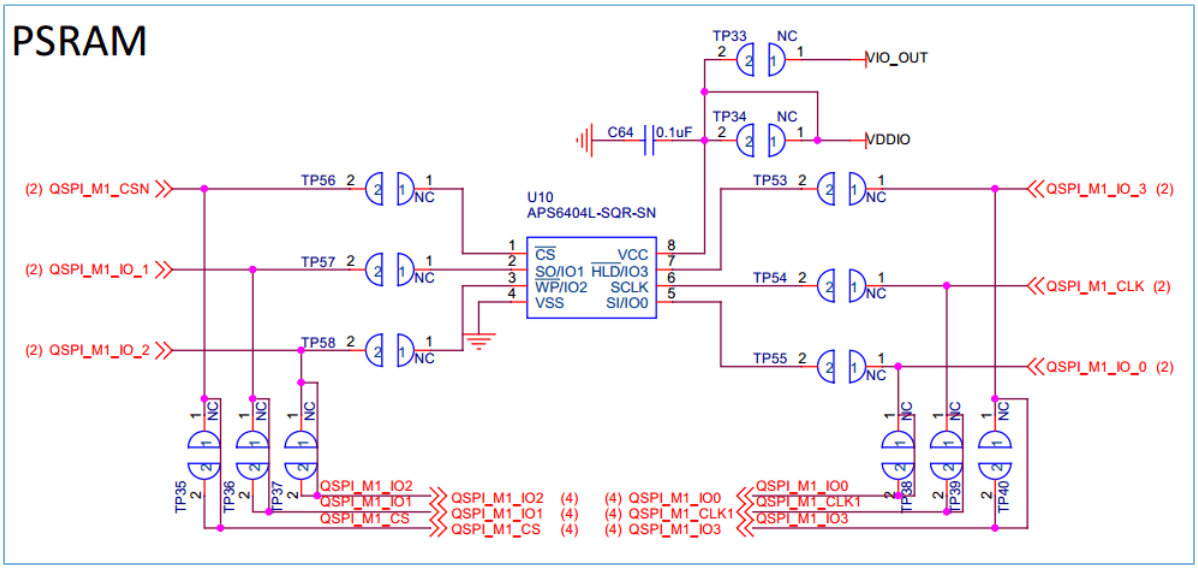

Figure 3-11 Expanded QSPI PSRAM schematic diagram

3.7 Display & TP Interface

A display & TP interface (J22 & J25) has been reserved on the GR5526 SK Board to connect a display & TP daughter board to the SK Board, allowing users to develop/debug products with display function, for example, smart watches and wristbands.

By default, the GR5526 SK Board is embedded with a display & TP daughter board, which integrates a 1.05 (inch) x 1.39 (inch) circular color AMOLED touch display (454 x 454 dpi) and a touch panel (TP). QSPI interface is adopted for the AMOLED touch display, and I2C interface for the TP. In addition, the display & TP daughter board is pluggable. You can replace it with a different-size display/TP supporting the same type of connection interfaces, to adapt to different application scenarios.

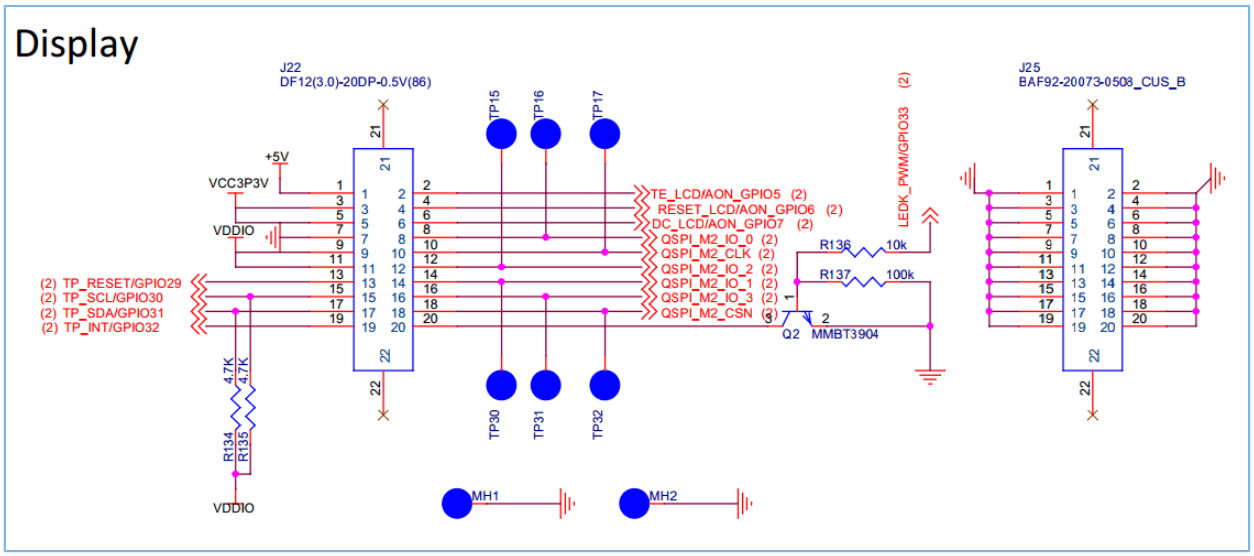

Figure 3-12 AMOLED/Audio multiplexed interface network

The pin definitions of the display & TP interface are provided below:

Table 3-3 Pins for display & TP interface

Pin	NET	Description
1	+5 V	Power supply pin (+5 V)
2	TE_LCD/AON_GPIO5	Output frame header pulse signal
3	VCC3P3V	Power supply pin (+3.3 V)
4	RESET_LCD/AON_GPIO6	AMOLED reset signal (0: enable; 1: disable)
5	VCC3P3V	Power supply pin (+3.3 V)
6	DC_LCD/AON_GPIO7	-
7	GND	Power ground
8	QSPI_M2_IO_0	Serial input signal
9	VDDIO	Interface type selection
10	QSPI_M2_CLK	QSPI clock
11	VDDIO	Power supply pin VDDIO (default: 1.8 V)
12	QSPI_M2_IO_2	QSPI bit data bus/input data bus

Pin	NET	Description
13	TP_RESET/GPIO29	TP hardware reset input
14	QSPI_M2_IO_1	Data/Command selection signal
15	TP_SCL/GPIO30	SPI clock input of the TP module
16	QSPI_M2_IO_3	Data/Command selection signal
17	TP_SDA/GPIO31	TP SPI data input
18	QSPI_M2_CSN	Chip select signal input
19	TP_INT/GPIO32	TP slave interrupt port
20	LEDK_PWM/GPIO33	-

3.8 Audio Module and On-board MIC

The GR5526 SK Board integrates an Audio module and two on-board microphones (MICs), allowing debugging/testing of Pulse Density Modulation (PDM) and I2S interfaces to support audio input and music play debugging/demonstration.

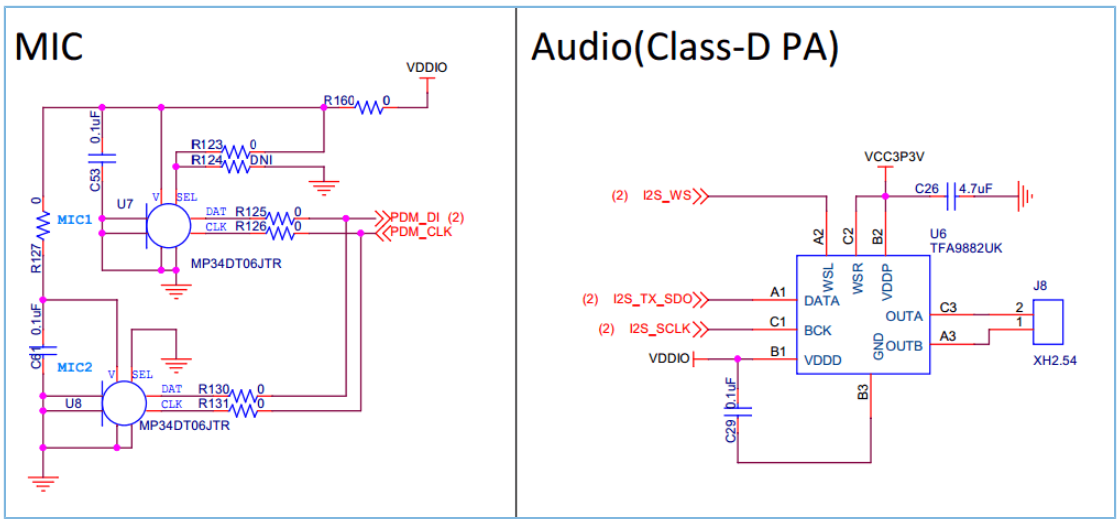

Figure 3-13 Schematic diagram of Audio module and on-board MICs

3.9 AoA/AoD Multi-antenna Interfaces

Two AoA/AoD multi-antenna interfaces (multiplexing the I2S interface of the Decode IC) are reserved on the GR5526 SK Board, supporting AoA/AoD application verification.

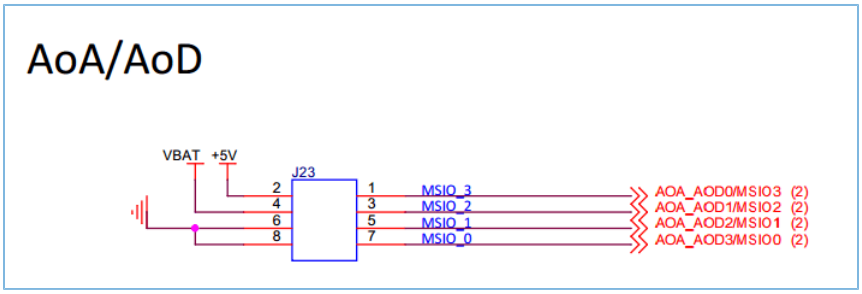

Figure 3-14 AoA/AoD multi-antenna interface

Note:

MSIO_0–MSIO_3 are multiplexed as AoA/AoD multi-antenna interfaces.

4 Performance Test

This chapter elaborates on how to test the RF performance and current consumption of the GR5526 SoC by using the GR5526 SK Board.

4.1 RF Performance Test

The GR5526 SK Board reserves an SMA connector, J2, which can be connected to a spectrum analyzer or a Bluetooth LE tester (for example, TLF3000 and CMW500) to test the RF performance of the GR5526 SoC.

Users can switch the output between the SMA connector and the board-level PCB antenna by configuring C91 and C14.

- By default, if C91 is open-circuited and C14 is 18 pF, the RF circuit signal is directly connected to the board-level PCB antenna.
- If C14 is open-circuited and C91 is 18 pF, the RF circuit signal is disconnected from the board-level PCB antenna and then directly connected to the SMA test probe.

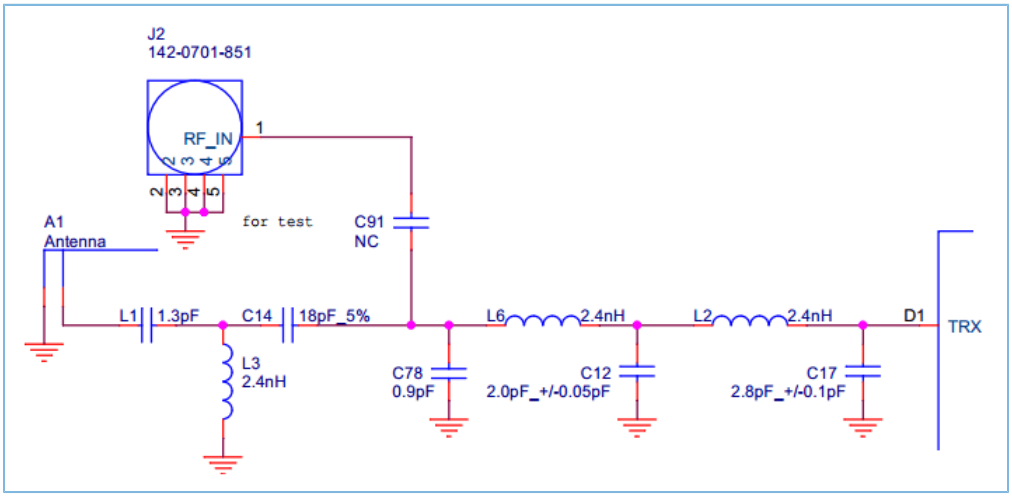

Figure 4-1 GR5526 RF circuit

Note:

- To test the RF performance, connect the GR5526 SK Board to the test instrument with an RF coaxial cable. The RF coaxial cable is not included in the GR5526 SK package.
- Since the board-level PCB antenna is a non-omnidirectional antenna, there will be differences in gain at different angles. Therefore, it is recommended to use the antenna for functional connection tests only and not for performance tests.
- For performance tests, such as high-throughput and long-distance tests, an omnidirectional antenna shall be connected to the SMA connector.

Figure 4-2 shows the hardware connection between a GR5526 SK Board and TLF3000 when a TLF3000 is adopted for testing.

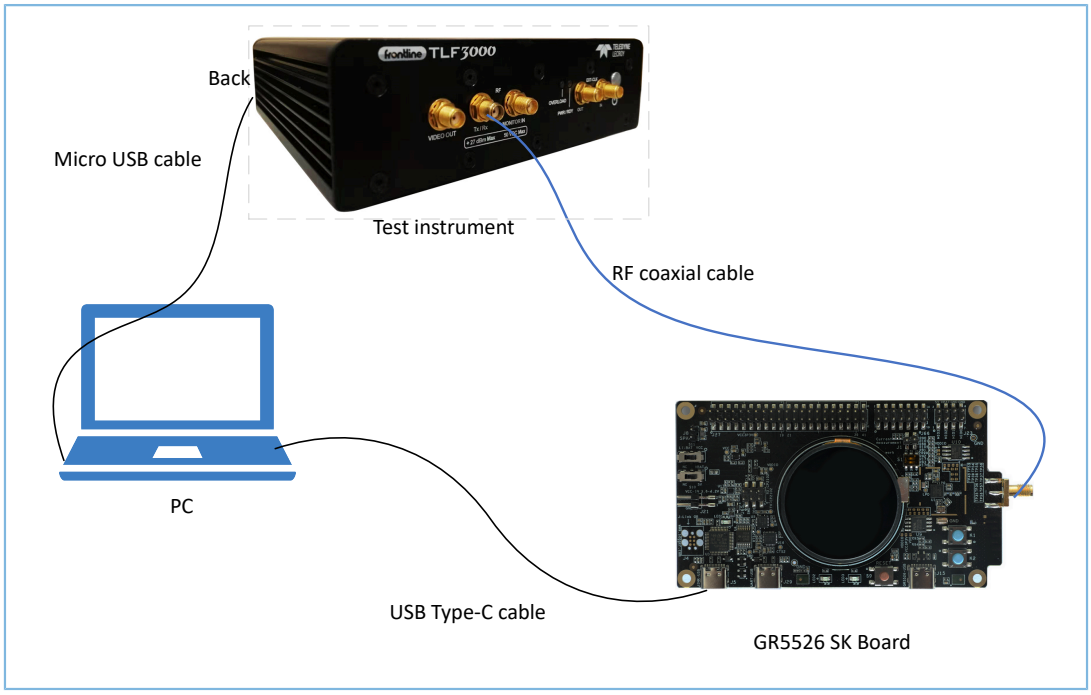

Figure 4-2 Connection between GR5526 SK Board and TLF3000

After hardware connection, you can use the test software on the PC to perform RF performance test.

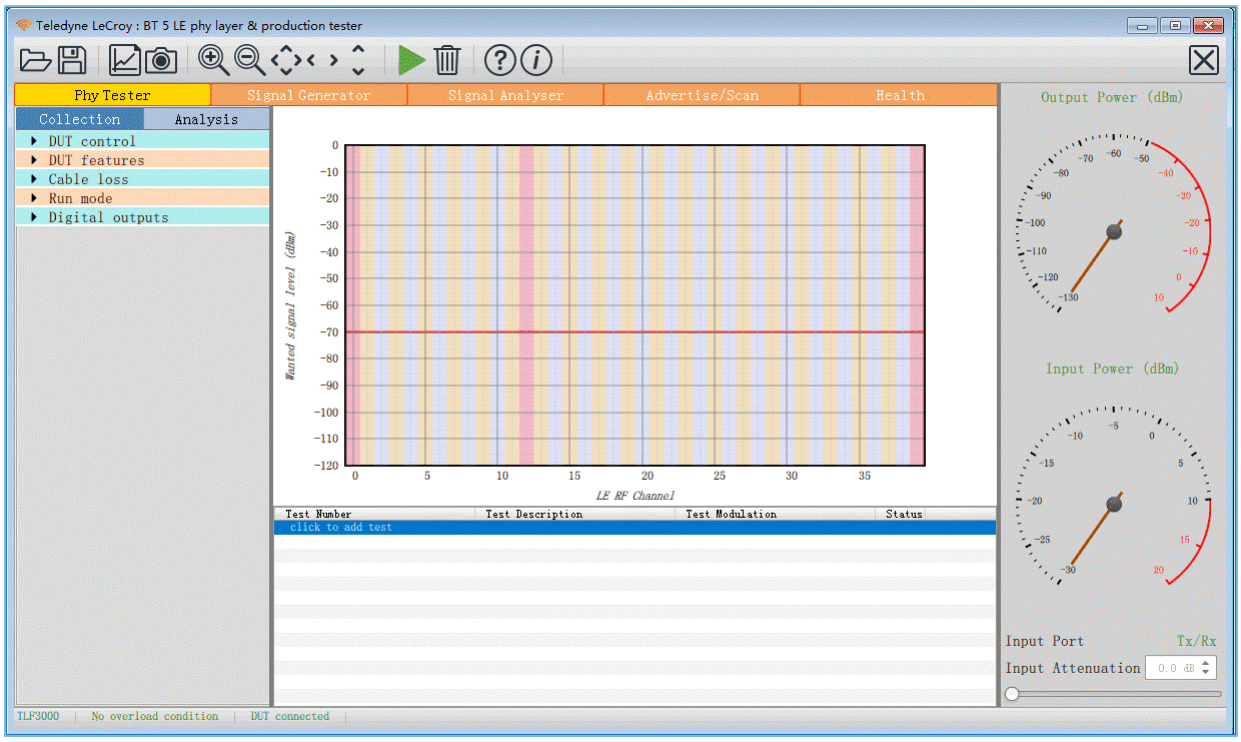

Figure 4-3 RF parameter test diagram

Note:

For more information about RF tests, see *GR5526 DTM Test Application Note*.

4.2 Current Consumption Test

On the GR5526 SK Board, connect pins 2 and 3 of **S1** (DIP switch) to set VBAT to power VBATL and VBATT_RF of the GR5526 SoC through the jumper pin J1, and then connect the GR5526 SoC to a test instrument through J1 to test current consumption.

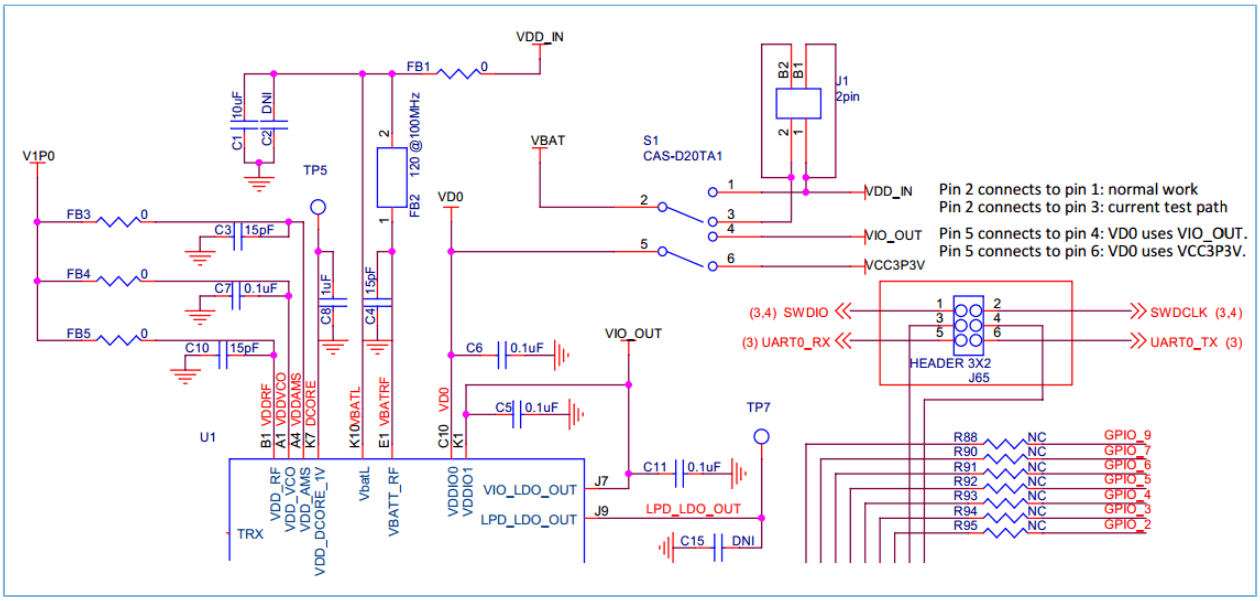

Figure 4-4 Current consumption test interface J1

Users can select a proper current test instrument (for example, a multimeter, an oscilloscope, or a power analyzer) to test current consumption according to actual demands.

- Multimeter

  A multimeter is used to test static current or average current.

  Set the multimeter to mA/μA level, and connect the black and red probes to Pin 1 and Pin 2 of J1 respectively, to read the static or the average current values.

  When a Bluetooth chip is working, the current level may change from μA level to mA level. Therefore, the dynamic test range of the multimeter used shall be 1 μA to 15 mA. It is recommended to use a multimeter with true root mean square (TRMS) current test function. Otherwise, major errors may occur in the test results.

- Oscilloscope

  An oscilloscope is used to test the average current within a period of time or capture the current curve of a single Bluetooth LE event.

  Connect FB1 on the GR5526 SK Board to a 10-ohm resistor, then set the oscilloscope to differential measurement mode, and finally connect two oscilloscope probes to Pin 1 and Pin 2 of FB1 respectively for measurement.

  When instantaneous current runs through the 10-ohm resistor, certain voltage drop in direct proportion to the current occurs at the two probes. The oscilloscope display shows a current change curve. You can also take average or integral values of the measured data, to analyze the current consumption within a period of time.

  Due to the wide current change range of a Bluetooth event, it is difficult to guarantee the precision of μA-level current and to reduce the impact from voltage difference of mA-level series resistor on circuit by using an oscilloscope in current testing. Therefore, the accuracy of test results cannot be guaranteed.

- Power analyzer

  To ensure accuracy and precision of the current consumption test of a Bluetooth LE event, users can adopt a professional power analyzer (such as Keysight N6705c) for measurement.

  To use a power analyzer to test the current consumption of a GR5526 SoC, connect the power port of the power analyzer to Pin 1 of J1. During a Bluetooth LE event, the power analyzer automatically stores and displays the current curve for the moment.

  For more information, see operational instructions of the power analyzer.

5 SK Board Dimensions

Dimensions of the GR5526 SK Board are 110.11 mm x 63.51 mm, with details shown in Figure 5-1.

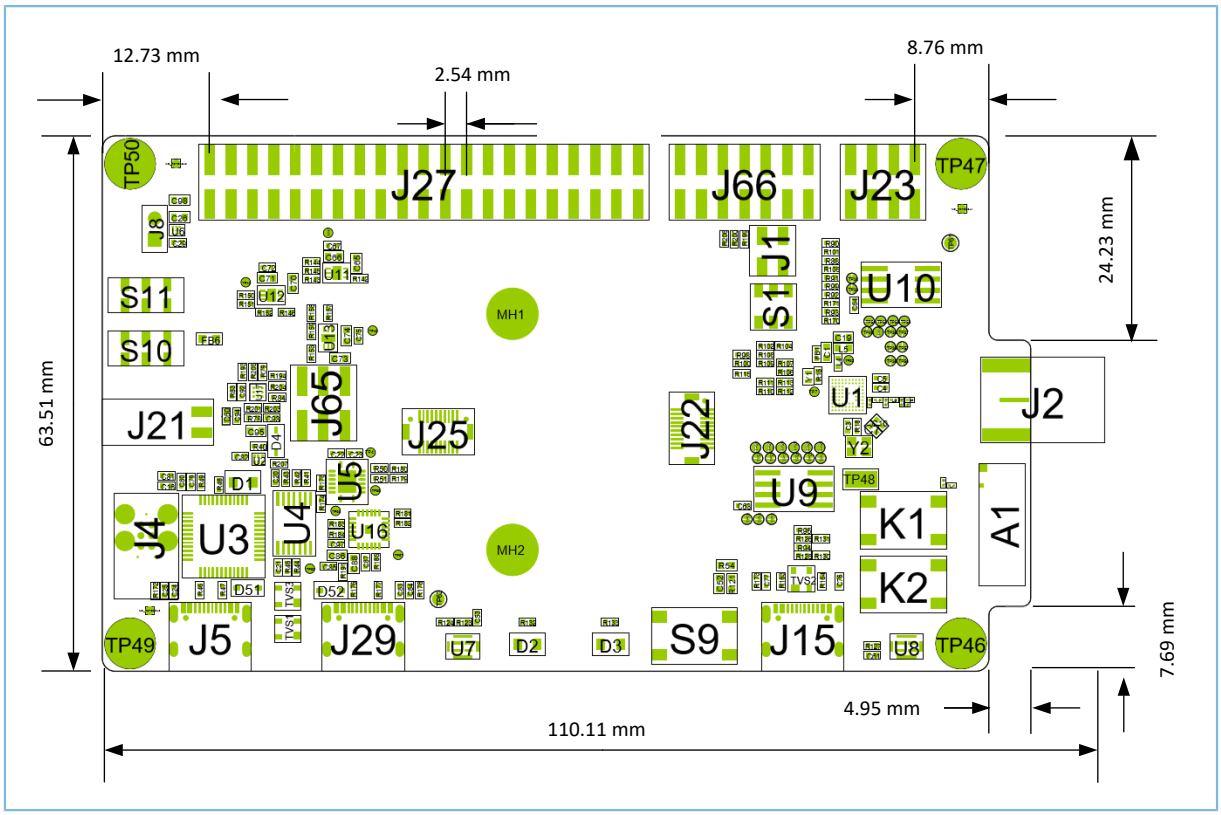

Figure 5-1 GR5526 SK Board dimensions (top view)

6 FAQ

6.1 Why Do I Fail to Connect to and Program GR5526 SK Board via J-Link?

- Description

  When I program a firmware file to GR5526 SK Board through Keil/GProgrammer, I fail to connect to and program GR5526 SK Board via J-Link.

- Analysis

  During firmware programming, GR5526 SoC may be in sleep state (a project with sleep mode enabled is running), which makes J-Link fail to interact with the PC, and therefore connection with GR5526 SK Board cannot be established or firmware cannot be programmed to GR5526 SK Board.

- Solution

  Press the **RESET** button on GR5526 SK Board and wait for about 1s before re-programming firmware.

7 Glossary

Table 7-1 Glossary

Name	Description
AMOLED	Active-Matrix Organic Light-Emitting Diode
AoA	Angle of Arrival
AoD	Angle of Departure
App	Application
Bluetooth LE	Bluetooth Low Energy
CDC	Communication Device Class
DMIC	Digital Microphone
I2S	Integrated Interchip Sound
IDE	Integrated Development Environment
J-Link OB	J-Link On-board
LED	Light-Emitting Diode
LDO	Low Dropout Regulator
MCU	Microcontroller Unit
PDM	Pulse Density Modulation
PSRAM	Pseudo Static Random Access Memory
PC	Personal Computer
RF	Radio Frequency
RX	Receive
SMA	Small A Type
TX	Transmit
USB	Universal Serial Bus
UART	Universal Asynchronous Receiver/Transmitter