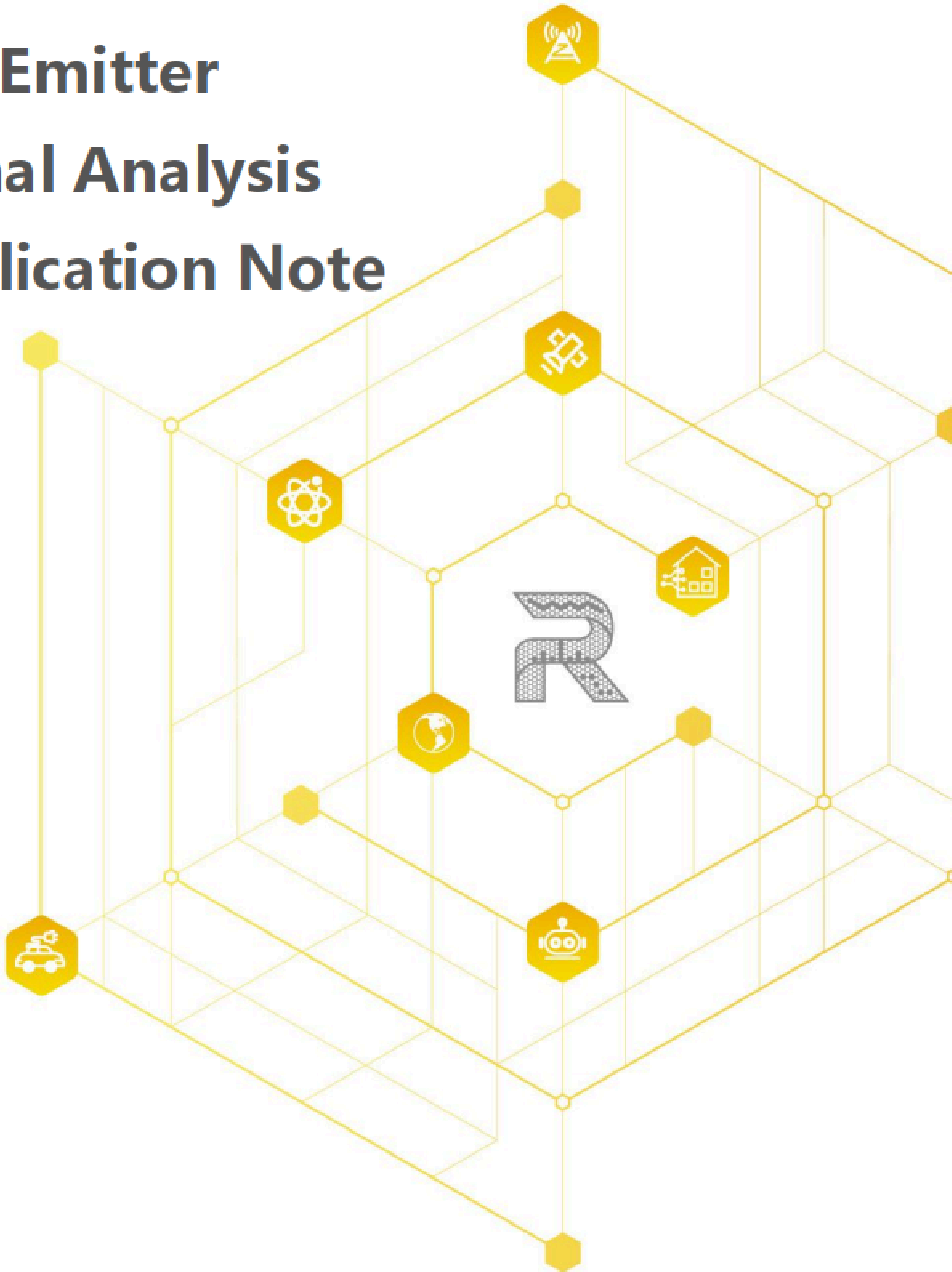
RIGOL

BLE Emitter Signal Analysis Application Note



ANW01100-1220-0044

1. Document description

1. Content in this guide

The purpose of this application guide is to describe the following:

- Describe the basic physical layer concepts and typical testing requirements of the Bluetooth Low Energy (BLE) protocol
- Describe the features and operation of the RSA6000/RSA800 series real-time spectrum analyzers with the BLE launch analysis software option
- Describes the method of using BLE TX analysis software for typical test projects such as transmit power, GFSK frequency deviation, RF envelope, demodulated waveform and spectrum characteristics
- Describe the instrumentation and configuration requirements required to complete the above tests
- Describes the safety precautions for the use of the instrument and RF accessories

2. Applicable instrument and software version

Category	Product information
Spectrum analyzers	RSA6000/RSA800 Series Real-Time Spectrum Analyzers
Analysis software options	BLE Emitter Signal Analysis Software Option (VSA· BTX)
Downloader software version	Refer to the software installation package release notes
Instrument firmware version	Refer to the firmware release notes in the corresponding product manual

Note: Before using this software option, make sure that the instrument has correctly activated the corresponding authorization. Please refer to the RSA6000/RSA800 product brochure or visit the RIGOL website for information on how to activate the license.

3. Scope of applicable standards and agreements

Applicable Bluetooth Standard Protocol Document:
Core_amended_2024_06_11_v5.4
RFPHY.TS.p23ed2

2. Safety precautions

1. Instrument usage precautions

Input Power Limit: The instrument's RF IN port is extremely sensitive. Do not input more than the maximum continuous RF power and maximum DC voltage indicated on the front panel of the instrument. An out-of-bounds signal can cause permanent damage to the RF front-end attenuator or mixer. Be sure to verify the

output power range of DUT before use and series the appropriate RF attenuators as required.
Reliable grounding: Always make sure that the instrument power cord is properly connected to an AC power outlet with a protective earth cord before measuring. A good grounding is not only a safety guarantee against electrical shock, but also an important prerequisite for reducing floor noise and improving the stability of the measurement of weak BLE bursts.
Ventilation Cooling: The instrument generates heat during continuous scanning, real-time capture, and demodulation analysis operations. Make sure that the cooling vents on both sides and the rear of the instrument are unobstructed and that the test table is well ventilated to avoid excessive temperature rise that may affect the performance and stability of the instrument.
Antistatic protection: Electrostatic electricity can cause damage to the electrical circuits inside the instrument. Testing should be carried out as far as possible in an antistatic work area; it is recommended that the inside and outside conductors of the RF cable be grounded briefly to discharge static electricity before connecting the cable to the instrument.
Environmental requirements: Do not operate the instrument in wet or flammable or explosive atmospheres, and keep the surface of the product clean and dry to avoid short circuits or safety hazards inside the instrument.

2. Notes on the use of RF accessories

Connector Inspection and Cleaning: Before connecting any RF cable, attenuator, straightener, or adapter, visually inspect the connector bore. Wear, deformation, soiling, or metal debris on the external thread and center conductor.
Correct connection and disconnection: When connecting RF accessories, it is recommended to connect the instrument end first and then the DUT end; in reverse order, disconnect the DUT end first. Disconnect the instrument end again. This helps reduce the risk of misconnection, electrostatic discharge, or transient signal shock.
Using a torque wrench: Do not use excessive force when tightening the SMA or N-type RF connectors. Standard torque wrenches are recommended to ensure a stable connection and extend connector life.
Cable Bend Radius: High quality RF coaxial cables are often fragile and must not bend or twist excessively during routing and connection. Observe the minimum bend radius specified by the cable manufacturer to avoid damage to the internal insulation, resulting in impedance mismatch, worsening of the standing wave ratio, or increased insertion loss.
Attenuators and DC Isolators: When directly connecting BLE transmitting modules, it is recommended to series the appropriate fixed attenuators in series with the DUT output power, and if there is a DC bias voltage in the DUT RF port, the DC Block in the appropriate frequency band should also be connected to prevent DC signals from damaging the instrument input.

3. DUT Connection Considerations

Electrostatic Protection (ESD): BLE chips, modules, and RF interfaces to instruments are more susceptible to electrostatic discharge. Operators should wear an anti-static wrist strap and ensure that a well-grounded anti-static mat is laid on the test bench before connecting DUT.
Avoid live plugging: When connecting or disconnecting the RF cable between DUT and the instrument, always stop DUT transmission, turn off its transmission control program, or switch off DUT. "Hot Plug" is strictly prohibited while DUT is transmitting in order to avoid instantaneous power leakage that could damage the front end of the instrument.
Impedance matching: BLE RF test links are typically based on a 50Ω system. Verify that the RF output port impedance of DUT is consistent with the test link; if DUT is a non-standard 50Ω output structure, conversion should be performed using a dedicated matching network or impedance matching pad to reduce reflections and measurement errors.
Transmit Power Validation: Prior to direct connect testing, verify that DUT maximum transmit power is within a safe range. For high-power BLE modules or devices with a front-end amplifier (PA), a "attenuator + instrumentation" connection should be preferred to avoid overloading the front end by direct connection.
Center Frequency and Channel Acknowledgement: Before connecting DUT, verify that its operating channel matches the software settings. For example, BLE channel 20 has a center frequency of 2.441 GHz. Incorrect center frequency settings can cause signals not to be captured or demodulated properly.

3. BLE Signal and Test Basics

1. BLE Technical Overview

Bluetooth Low Energy (BLE) is a Bluetooth SIG standard-based short-range wireless communication technology widely used in mobile devices, audio transmission, smart homes, Healthcare and Industrial Internet of Things (IoT) data transfer. BLE is designed for the Internet of Things to minimize power consumption compared to traditional Bluetooth (BR/EDR) through a "deep sleep, wake-on-demand" mechanism. Suitable for short-range, small data transmission.

2. The BLE band is divided into channels

RF Channel (Center Frequency)	Physical Channel Index	RF Channel Group	
		Primary Advertising	General purpose
2402 MHz	37	●	
2404 MHz	0		●
2406 MHz	1		●
...	...	...	...
2424 MHz	10		●
2426 MHz	38	●	
2428 MHz	11		●
2430 MHz	12		●
...	...	...	...
2478 MHz	36		●
2480 MHz	39	●	

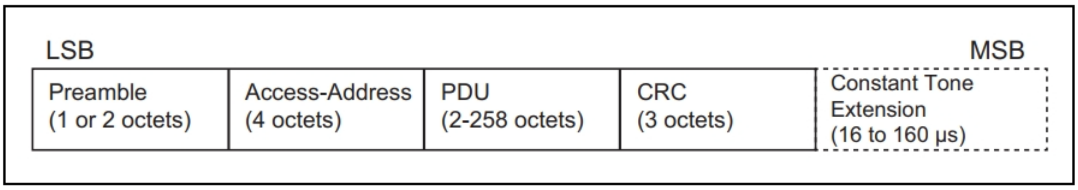
BLE operates in the worldwide 2.4 GHz ISM band. According to the standard specification, Bluetooth Low Energy (BLE) is divided into 40 physical channels with 2 MHz channel spacing. Where CH0 ~ CH36 is believed to be the number of channels, CH37 ~ CH39 is the broadcast channel (the broadcast channel is fixed without frequency hopping). During the data transmission phase after the connection is established, the device uses FHSS (Frequency Hopping Spread Spectrum) and AFH (Adaptive Frequency Hopping) technology to transmit frequency hopping across 37 data channels to avoid congested channels and improve interference resistance. The channel number n corresponds to the center frequency: Center frequency = 2402 MHz + n × 2MHz (n is in the range 0 to 39).

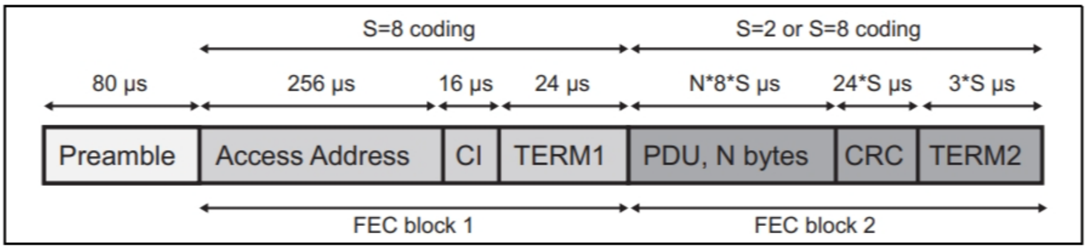
3. BLE Physical Layer Modulation

The BLE physical layer uses Gaussian Frequency Shift Keying (GFSK) modulation technology, which effectively balances low power consumption, transmission rate, and communication distance RSA6000_BLE_UserGuide_CN.pdf. Currently BLE supports multiple physical layer transfer rates, including:

- LE 1M: 1 Mbps (no encoding), the most common common data transfer mode.
- LE 2M: 2 Mbps (no coding) for high-speed data transfer at twice the rate.
- LE 500k: 500 kbps with forward error correction (FEC) encoding (S=2) for medium to long range transmission.
- LE 125k: 125 kbps, coded at FEC (S=8) for maximum redundancy, for long range transmission and extremely resistant to interference.

4. Introduction to BLE packet structure





A standard BLE packet over the air typically contains the following core components:

1. Preamble: Used for automatic gain control (AGC) training and frequency synchronization of the receiver. 1M/2M PHY uses either 0101 or 1010 alternate sequences.
2. Access Address: A 32-bit sequence that distinguishes between different Bluetooth connections or broadcast packets.
3. Protocol Data Unit (PDU): Contains valid header and netting data (Payload). In measurements, the RSA6000 automatically recognizes Payload Type and Payload Length.
4. Cyclic redundancy check (CRC): 24 bits for packet error detection.

5. BLE key metrics

According to the Bluetooth RF-PHY Test Specification, the key measurement indicators for BLE transmitters are comprised of three main categories:

1. Power - related indicators: including the average output power (Avg Power) and peak output power (Peak Power) within a data packet cycle.
2. Modulation characteristic - related indicators (core parameters of GFSK): including average initial frequency deviation (Δf1 Avg), average modulation frequency deviation (Δf2 Avg), maximum initial frequency deviation (Δf1 Max), maximum modulation frequency deviation (Δf2 Max), the proportion of Δf2 > 185 kHz (unit: %), and the frequency deviation ratio Δf2/Δf1.
3. Frequency stability - related indicators: including frequency offset (Freq Offset), frequency drift (Freq Drift), and maximum drift rate (Max Drift Rate, unit: kHz/50 μs).

6. The RSA6000 measures the benefits of BLE

The RIGOL RSA6000 Series Real-Time Spectrum Analyzer provides a standard physical layer test solution for BLE signals with the following benefits:

- Standard Conformance Analysis: Built-in standard filters and demodulation algorithms, following the Bluetooth RF-PHY Physical Layer specification, supports multiple Physical Layer packet structures defined by core standards, and accurately restores signal characteristics.
- Multi-dimensional visualization: Supports multi-window parallel operation, providing full visibility of signal details from time domain (RF envelope), frequency domain (spectrum), and modulation domain (demodulated waveform).
- Metrics One-Click Quantification: Automatically calculates core RF metrics from demodulated data to help R&D and line-of-production engineers quickly assess signal quality and locate RF failures.

4. BLE Analysis Software Features Introduction

1. Introduction to how the software works

The RSA6000 Spectrum Analyzer has a dedicated Bluetooth measurement application built into VSA (Vector

Signal Analysis) mode. Once in this mode (select Bluetooth Transmit Analysis > Apply), the instrument sets the sample rate and capture time according to the selected BLE packet type (e.g. LE 1M, LE 2M, etc.). The software extracts the baseband I/Q data of the RF signal using the internal digital downshift (DDC) and GFSK demodulation algorithm, and reconstructs the time domain envelope, frequency deviation trajectories, and spectrum. A list of key physical layer metrics is automatically compiled.

2. Description of the main screen

The RSA6000's Bluetooth user interface consists of the following core areas:

1. Multi-window operating display: Supports simultaneous display of multiple views of RF signal trace, demodulated waveform, spectrum, and metric results.
2. Status Display Bar: Visualize current Standard (Fixed as LE), Packet Type, Input Attenuation Mode, Key states such as Trigger Mode and Channel.
3. Common shortcut keys: Provides high frequency actions such as adding views, restoring default presets, and current screen shots.
4. Menu Control Area: Located on the right side, contains the "Frequency," "Family," "Bandwidth," "Scan the "Family", "Trigger", etc. function configuration submenu."
5. Notification area and operating mode: Displays the time, connection status, and the currently selected Bluetooth Analytics operating mode.

3. Scan and trigger parameter configuration

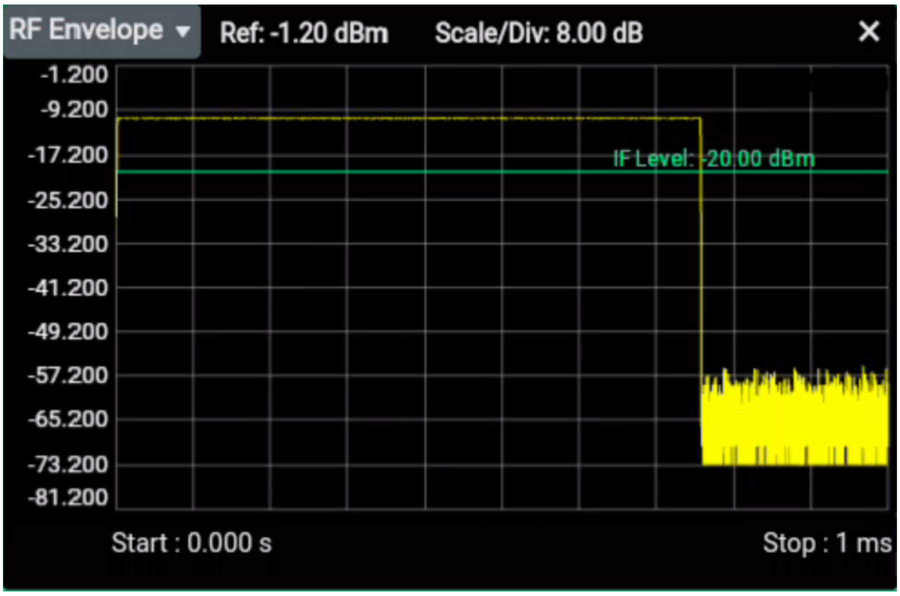
The key to accurately capturing BLE burst packets is reasonable scan and trigger settings:

- Scan/Sample Configuration: The default sample rate is 8 MHz for LE 1M/500k/125k packet types and higher sample rates for LE 2M can be configured via the menu. The Acquisition Time is set to 3.0ms by default, ensuring that the entire burst is fully traced. The scan mode supports the "Continuous Scan" and "Single Scan" family switching.
- Trigger Source Configuration: Supports "Free Run" and "Midrange Trigger (Power)". Medium frequency triggering is strongly recommended for burst BLE signals. Trigger is generated when the detected power of the IF signal exceeds the set trigger level (default - 20 dBm). It also supports setting Trigger Delay and Trigger Release (Holdoff) to stabilize the signal waveform for the capture cycle.

4. Description of the sub window

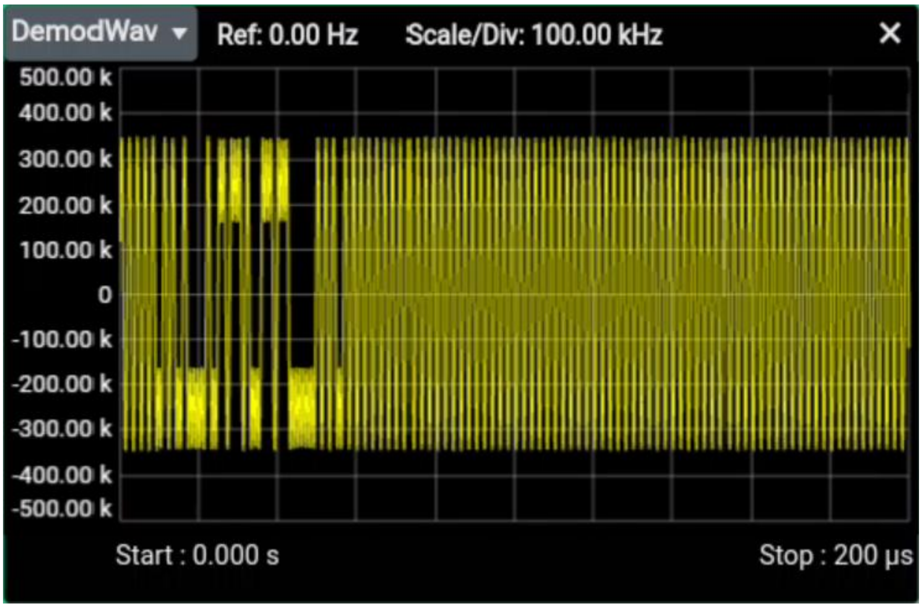
The RSA6000 supports observing signals from different dimensions, including:

1. RF Envelope: Displays the change in signal power over time (transverse time, longitudinal amplitude dBm) for observing burst pulse shape, take-off and power stability.



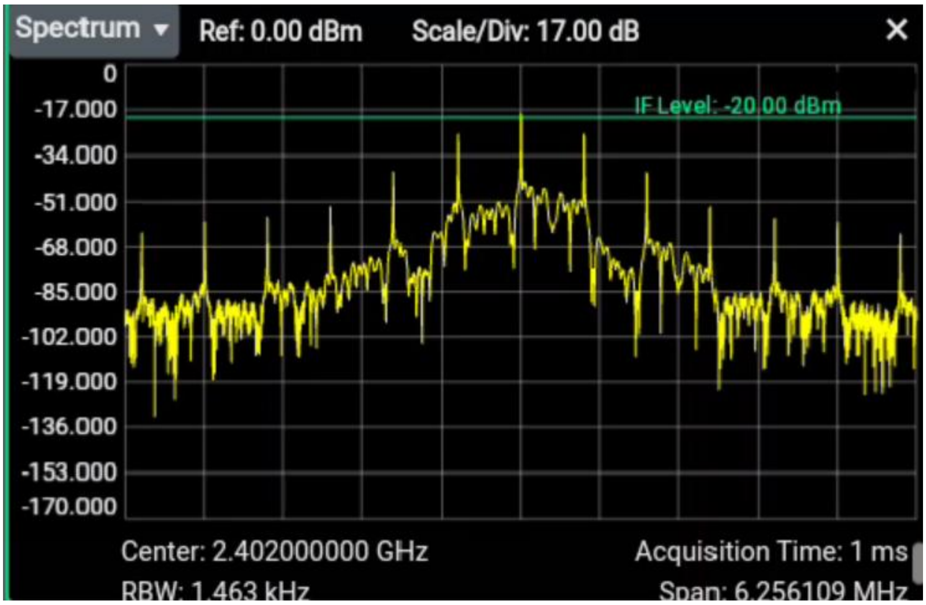
RF signal envelope

2. Demod Waveform: Displays the baseband time domain waveform (transverse time, longitudinal frequency offset Hz) after signal GFSK demodulation. Intuitively reflects the transient frequency bias and linearity of the modulated signal.



Demodulate the waveform

3. Spectral: Displays the spectrum utilization (transverse frequency, longitudinal logarithmic amplitude dBm) of the BLE signal to aid in determining channel bandwidth and out-of-band stray leaks.



Spectrum

5. Description of the indicator results

The Metrics Results window shows the quantified metrics table for the BLE Signaling Physical Layer:

- Base packet information: Packet Type (e.g. LE1M), Payload Type, and Payload Length (bytes).
- Power data: Avg Power, Peak Power.
- Modulation characteristics: Δf1 Avg, Δf2 Avg, Δf1 Max, Δf2 Max, A pass rate of Δf2 > 185 kHz and a frequency deviation ratio Δf2 / Δf1.
- Frequency stability: Freq Drift, Max Drift Rate, and Freq Offset. Each metric displays the current value, the average (Avg), the maximum (Max) and the minimum (Min).

Metrics

Packet Type	LE1M	Payload Type	01010101
Payload Length	84		

	Max	Min	Average
Avg Power	-10.7303 dBm	-10.7303 dBm	-10.7303 dBm
Peak Power	-10.6727 dBm	-10.6727 dBm	-10.6727 dBm
Δf1 Avg	– kHz	– kHz	– kHz
Δf2 Avg	– kHz	– kHz	– kHz
Δf1 Max	– kHz	– kHz	– kHz
Δf2 Max	– kHz	– kHz	– kHz
Δf2 > 185kHz	– %	– %	– %
Δf2 / Δf1	–	–	–
Freq Drift	– kHz	– kHz	– kHz
Max Drift Rate	– kHz/50μs	– kHz/50μs	– kHz/50μs
Freq Offset	– kHz	– kHz	– kHz

Indicator results

5. Pre-test preparation

1. Test the connection diagram

Signal source + RSA6000 spectrometer (built-in BLE) combination

2. Test mode selection

For BLE transmit signal analysis, the following test methods are supported:

- Conduction test: Connect the RF port of the BLE measured piece (DUT) directly to the RF INPUT port of the spectrometer using a low loss RF coaxial cable. This method is highly resistant to interference and measures power and frequency deviation most accurately.

3. Required equipment and accessories

Spectrum Analyzer: RIGOL RSA6000 series real-time spectrum analyzer with VSA mode and Bluetooth analysis option.
Accessories: High quality RF cables. If the DUT output impedance is 75Ω, use the 75Ω to 50Ω adapter provided by RIGOL and configure the instrument input impedance to 75Ω, or if the DUT is standard 50Ω, use the 50Ω cable directly.

4. Instrument initialization and warm-up

Turn on the RSA6000 Spectrum Analyzer and recommend a warm-up of 30 minutes to ensure optimal vibration and measurement accuracy.
By default, the 'Amplitude Calibration' function of the instrument is on, which ensures the accuracy and consistency of measurements by compensating for amplitude errors caused by gain or loss of the device during transmission.
By clicking the `Preset` key on the front panel (or the shortcut key in the upper right corner of the screen), the instrument will recall the factory preset configuration and return to a known original state.
Click the operating mode key in the lower left corner of the instrument, select `Bluetooth Transfer Analysis` > `Applications to enter the Bluetooth operating mode.`

5. DUT Preparation

Set BLE DUT to TEST PACKET and configure DUT to continuously send specific test packets (such as PRBS9 pseudo-random code or 10101010 alternating code) on a specified signal to facilitate instrument capture and analysis.

6. The default parameter configuration is recommended

After performing a preset, the RSA6000 automatically loads the recommended parameters for BLE signal measurement:

- Standard Type: Low Power (LE).
- Packet Type: LE 1M (1 Mbps no encoding).
- Frequency: Center frequency 2402 MHz (corresponding to CH0) with a sweep of 6.256 MHz.
- Scan: Sample rate 8 MHz, capture time 3.0 ms.
- Amplitude: Input attenuation 10 dB.

- Trigger: Free Run.

7. Troubleshoot common issues

Low or high power measured: Check that the "External Gain" is set to compensate for loss of external cables or attenuators. Go to the `Input Output` > `External Gain` menu to set the value (range -120 dB to 120 dB).
Waves flicker or unable to reliably capture the envelope: The default trigger is'Free Trigger', since BLE is a burst, it is recommended to change the trigger source to'IF Power' and adjust the appropriate trigger level.

6. Typical application testing

1. BLE RF Trace Measurements

1. Test purpose

Observe the pulse shape of the burst and the stability of the power over time, and check whether the take-off and take-off edges are in compliance with specifications.

2. Test the connection diagram

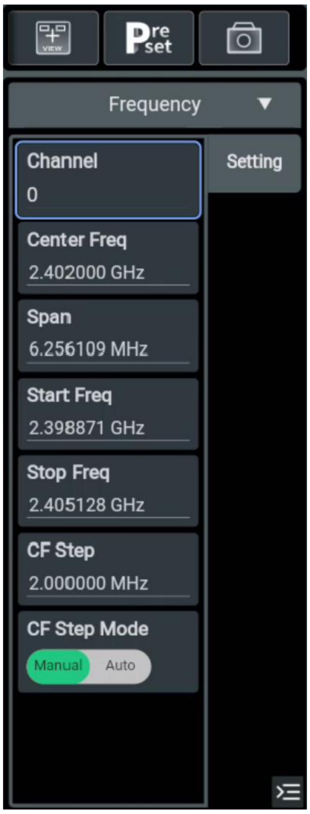
Refer to the 5.1 Test the connection diagram.

3. Test procedure

1. To enter the measurement mode, click the operating mode in the lower left corner of the instrument, select the Bluetooth Transport Analysis application, and select the ‘Signal envelope’.

Measurement mode interface

2. Frequency Setting: Enter the `Frequency` menu and set the center frequency/channel to the transmit center frequency/channel.

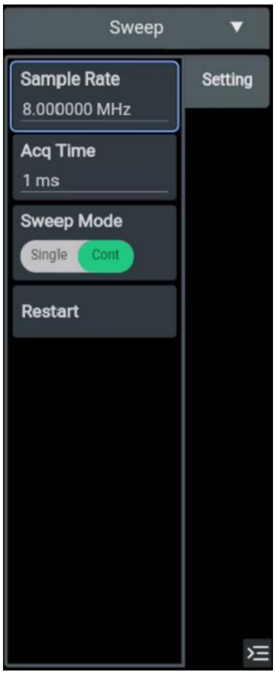


Frequency

3. Measure Setup: Enter the `Measure Setup` menu and select the appropriate transport packet type and protocol standard.

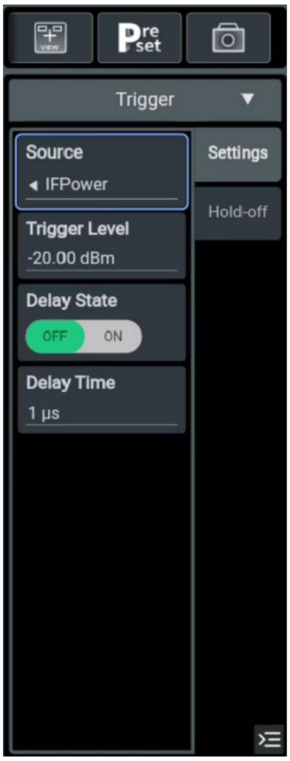
Measurement settings

4. Scan Settings: Enter the scan menu and select the appropriate sample rate and capture time settings, and the demodulate time will increase if the sample rate and capture time are large, requiring patience; the capture time is recommended to be set to a frame + a short IDLE time. The demodulation is stable at this time



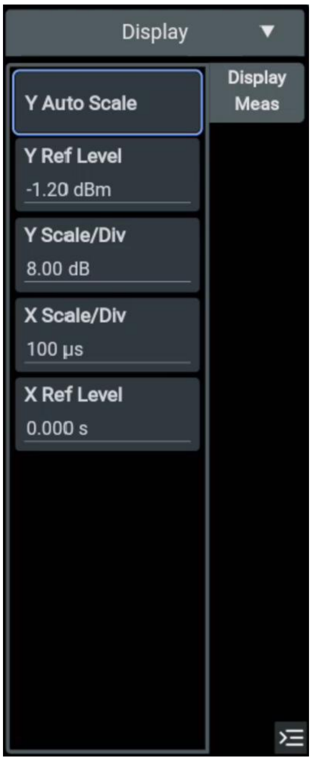
Scan

5. Trigger Settings: Enter the Trigger menu and set the trigger source to "Mid-Frequency" Trigger with the trigger level set slightly below the peak of the signal (e.g. -20 dBm).



Trigger

6. Display settings: Enter the `display` menu and adjust the Y-axis reference value (default -1.2 dBm) and the Y-axis scale (default 8.0dB) so that the waveform is fully centered.



Display

7. Adjust the `X-axis scale` and `X-axis reference values` to expand the details of the observed single burst pulse.

Signal Trace View

4. Test results and analysis

The RF signal envelope view has time on the horizontal axis and amplitude on the vertical axis (dBm log scale). Visual observation of the power level, significant drops, or overbursts during the transmission of DUT packets.

2. BLE Transmit Power Measurement

1. Test purpose

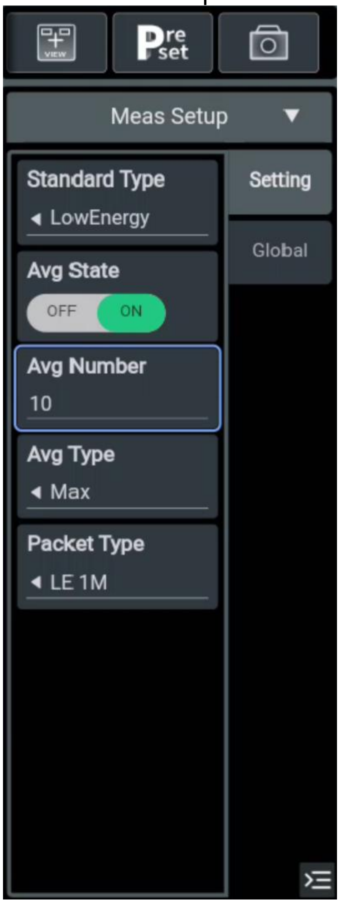
Verify the average power and transient peak power of the Bluetooth device during packet transmission.

2. Test the connection diagram

Refer to the 5.1 Test the connection diagram.

3. Test procedure

The preceding steps refer to the 6.1.3 Test procedure.
Add or observe the Metric Results window.
In the `Measurement Setup` Menu, the ‘Average’ function can be switched on as required and the number of averages set (e.g. 10) can be set to obtain a more stable power reading.



Average setting

4. Test results and analysis

View the Power Class Metrics in the Metric Results window:

- Avg: The average output power during the packet cycle. Meet Bluetooth power level requirements (e.g., Class 2 devices are typically -6 ~ +4 dBm).

- Peak Power: Transient maximum output power to troubleshoot the risk of electromagnetic interference caused by power spikes.

	Max	Min	Average
Avg Power	-10.4678 dBm	-10.4907 dBm	-10.4830 dBm
Peak Power	-10.3854 dBm	-10.4295 dBm	-10.4189 dBm

Avg & Peak Power

3. BLE GFSK frequency deviation and modulation characteristic measurement

1. Test purpose

Evaluate the long-term and fluctuating stability of the GFSK modulation bias to ensure that the signal is demodulated correctly at the receiving end.

2. Test the connection diagram

Refer to the5.1 Test the connection diagram.

3. Test procedure

The preceding steps refer to the6.1.3 Test procedure.
Confirm that DUT sends the specified test Payload (such as 10101010 or 11110000).
In the Indicator Results window, see the "Modulation characteristic category indicators and the "Frequency Stability category indicators for the "family".

4. Test results and analysis

The software automatically extracts the following metrics from the demodulated data:

- Δf1 Avg / Δf2 Avg: Represents the average of the Class 1 and Class 2 frequency offsets, respectively.
- Δf2 > 185kHz: The percentage of packets in% that Δf2 exceeds the limit of 185kHz, demonstrating regulatory compliance.
- Δf2 / Δf1: Too large a ratio indicates a high distortion of the modulated waveform.
- Freq Offset & Freq Drift: Reflects the accuracy of the carrier and the cumulative variation during transmission.

Metrics ▾

Packet Type	LE1M	Payload Type	10101010
Payload Length	84		

	Max	Min	Average
Avg Power	-10.7417 dBm	-10.7772 dBm	-10.7588 dBm
Peak Power	-10.6616 dBm	-10.7182 dBm	-10.6968 dBm
Δf1 Avg	250.06 kHz	249.91 kHz	250.00 kHz
Δf2 Avg	348.17 kHz	341.40 kHz	344.86 kHz
Δf1 Max	252.59 kHz	251.50 kHz	252.34 kHz
Δf2 Max	351.51 kHz	344.23 kHz	347.82 kHz
Δf2 > 185kHz	100.00 %	100.00 %	100.00 %
Δf2 / Δf1	1.38	1.37	1.37
Freq Drift	1.13 kHz	0.21 kHz	0.62 kHz
Max Drift Rate	0.42 kHz/50μs	0.23 kHz/50μs	0.31 kHz/50μs
Freq Offset	0.14 kHz	-0.35 kHz	0.05 kHz

4. BLE demodulated waveform observations

1. Test purpose

Visualize frequency offset trajectories of baseband signals over the time domain for troubleshooting modulation anomalies at specific points in time.

2. Test the connection diagram

Refer to the5.1 Test the connection diagram.

3. Test procedure

The preceding steps refer to the6.1.3 Test procedure.
Adds and activates the Demod Waveform window.
Enter the `display` menu and adjust the Y-axis scale (e.g. 50.00 kHz/div) and X-axis time scale as needed.

Display

4. Test results and analysis

The demodulated wave is time on the horizontal axis and frequency offset in Hz on the linear scale (Linear). The user can directly observe the clear high and low level jump frequencies of the GFSK through the extended waveform, and the presence of noisy modulation, which visually reflects the instantaneous frequency deviation and linearity of the modulated signal.

Demodulating the waveform view

5. BLE Spectral Characterization Observations

1. Test purpose

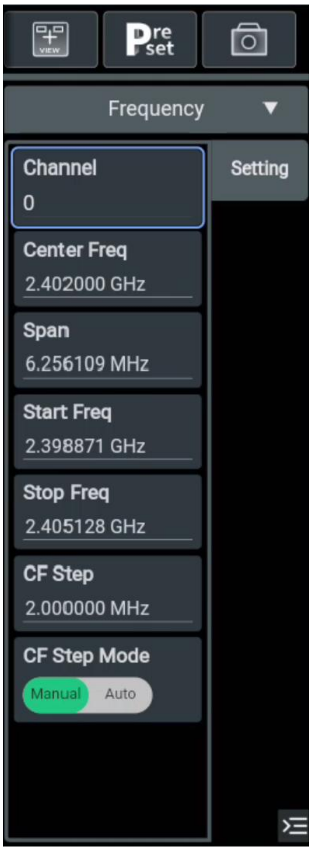
Analyzes the energy distribution of the signal in the frequency domain, confirms that the channel is consuming bandwidth, and evaluates out-of-band stray leaks.

2. Test the connection diagram

Refer to the5.1 Test the connection diagram.

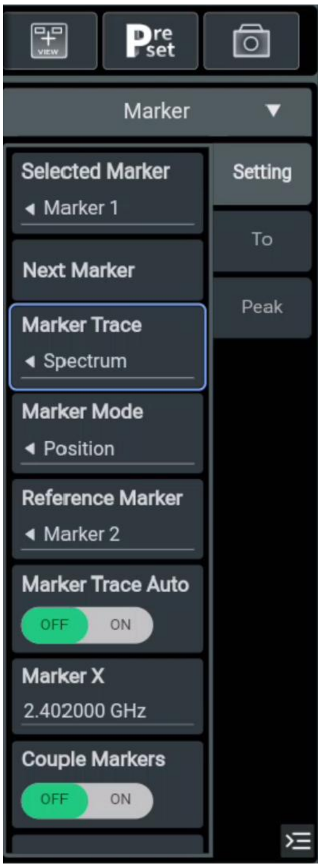
3. Test procedure

The preceding steps refer to the6.1.3 Test procedure.
Adds a Spectral view.
Enter the Frequency menu and confirm that the center frequency is aligned to the current test channel (e.g. CH0 for 2402 MHz).
Magnify or reduce the observed range by modifying the Sweep (Span) parameter (default 6.256 MHz).



Frequency

Turn on the cursor in the `Cursor` menu or use the "Peak Search" function to mark the peak.



Cursor

4. Test results and analysis

The spectral view has a horizontal axis of frequency and a vertical axis of logarithmic amplitude (dBm). From this view, engineers can visually determine if the main valve is concentrated, if an energy leak from an adjacent channel (ACP) exceeds the Bluetooth specification, and if there is a significant stray signal.

Spectral View

6. Single scan compared to continuous scan mode

1. Test purpose

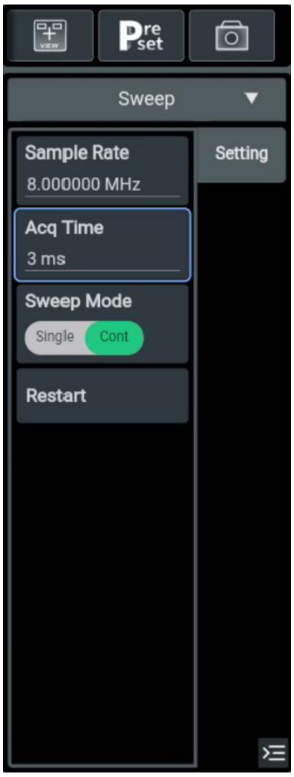
Depending on the test requirements, scan capture patterns are chosen to improve test efficiency or locate occasional anomalies.

2. Test the connection diagram

Refer to the5.1 Test the connection diagram.

3. Test procedure

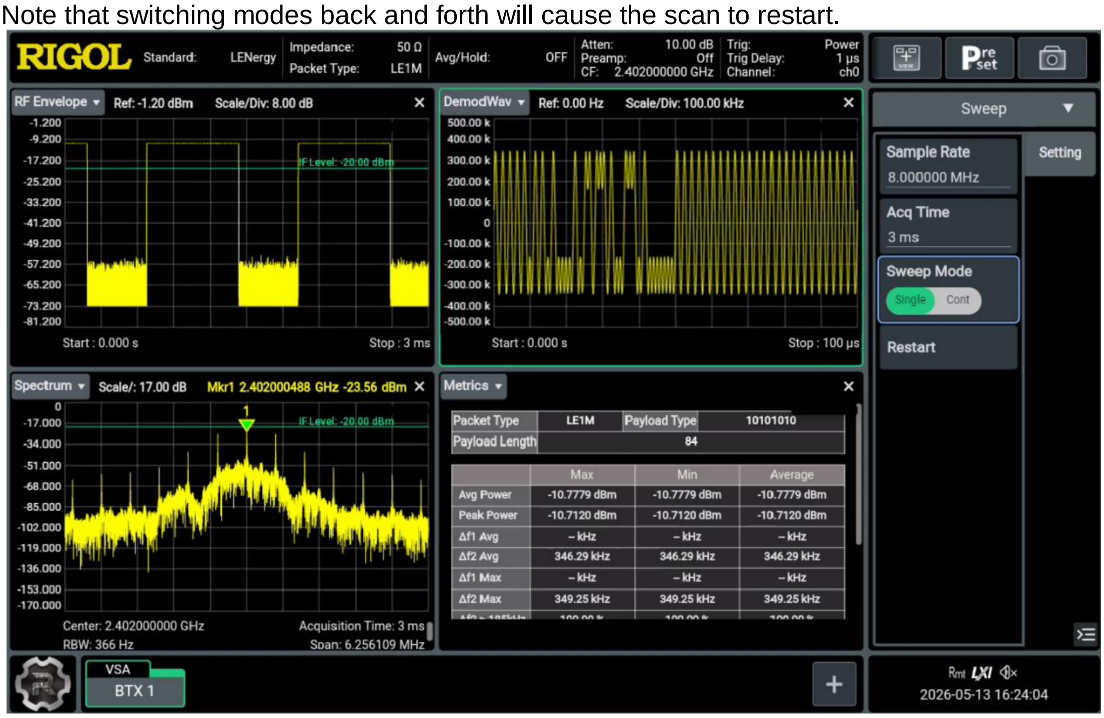
The preceding steps refer to the6.1.3 Test procedure.
Go to the Scan -> Scan Mode menu.
To monitor signal changes over a long period of time, select “Continuous”.
To accurately analyze a specific burst packet, click "Single Scan" for Single Trigger and Capture.



Scan

4. Test results and analysis

Continuous Scan: Continuous scan and measurement updates are performed when trigger conditions are met, suitable for production line or quick mapping testing.
Single Scan: Stop after a single event is captured, freeze trace, demodulate waveform, and metric data for the current interface, greatly facilitating in-depth analysis of specific packets by R&D engineers using the cursor. Note that switching modes back and forth will cause the scan to restart.



Single scan

Continuous scanning

7. Summary

1. BLE Analysis Software Feature Summary

The RSA6000 Spectrum Analyzer provides Bluetooth LE testing in VSA mode, following the Bluetooth RF-PHY Physical Layer specification. Its core advantage is its powerful multi-dimensional visualization analysis capabilities – enabling simultaneous and parallel presentation of signal details from the time domain (RF envelope), frequency domain (spectrum), and modulation domain (demodulated waveform). In addition, standard filters and demodulation algorithms are built into the software, allowing automatic identification of packet type and length with a single capture, providing a complete and accurate return of signal characteristics.

2. Summary of typical application value for BLE

For teams engaged in R&D and production of low-power IoT devices, one-click quantification of key metrics is a powerful tool for improving efficiency. The RSA6000 automatically calculates core RF metrics for power classes, modulation characteristic classes (GFSK core parameters), and frequency stability classes, greatly simplifying the complex standard comparison process. This helps engineers quickly assess Bluetooth signal quality and locate deep RF faults during R&D, design validation, and production line testing.

3. Links to related products and resources

To get the latest firmware updates, complete user manuals or for professional technical support, please visit the official RIGOL channel:

- Official website: www.rigol.com
- RSA6000 Product Page: Search the "RSA6000" product flyer, data sheet, and list of the latest options.
- Technical Support & Service: If you have any questions regarding instrument usage or the automated test code (SCPI) writing process, please contact your local RIGOL sales engineer or call the official technical support line.

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