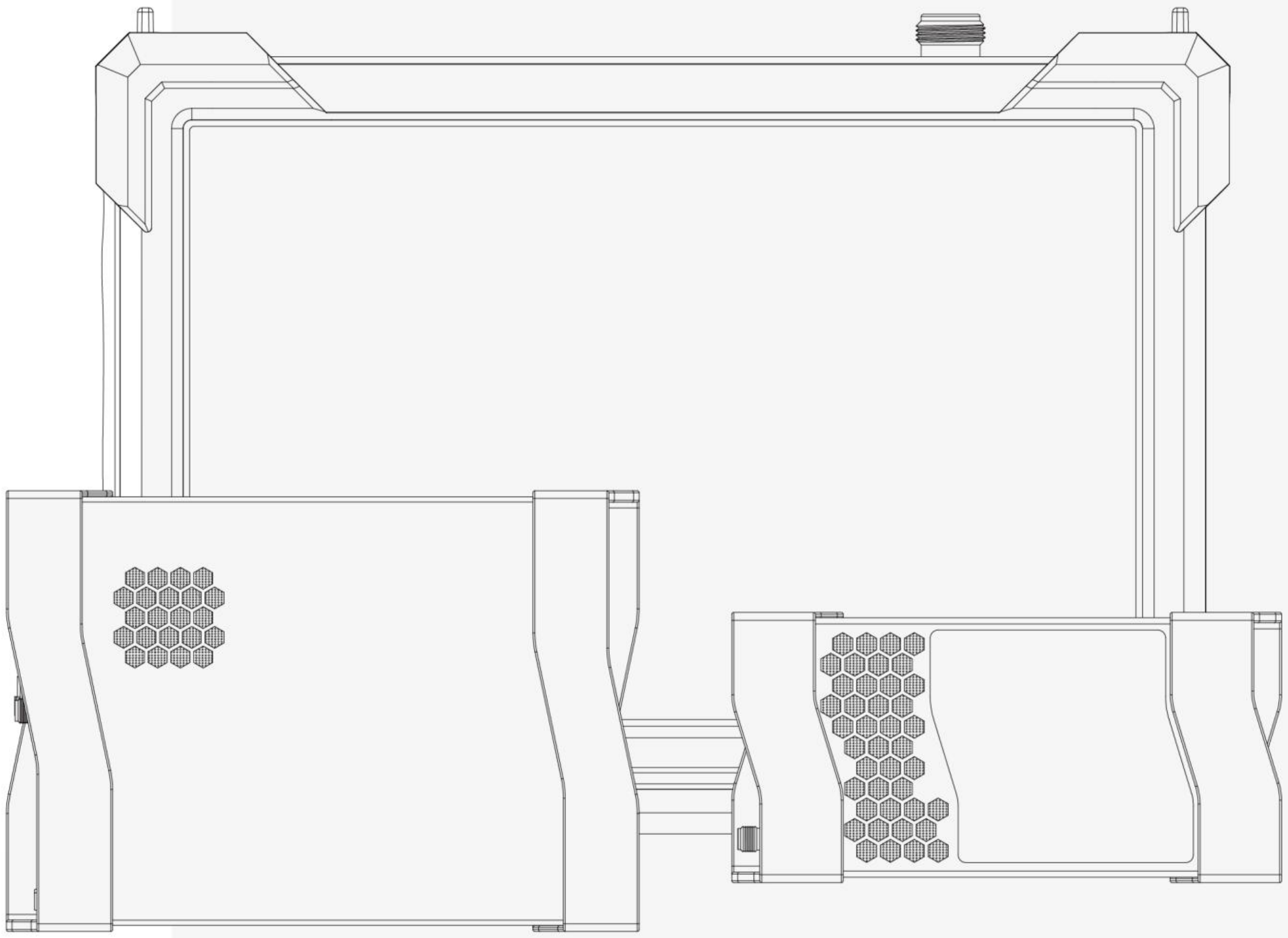
USER
GUIDE

HTRA API Programming Guide



V0.55.64

03/03/2026

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Content

1. Version Management

Version Update Description Table

Version	Description	Date
V0.55.64	1. Added: Device_List, Device_QueryEIO_Version_UID, APISupportFirmwareVersions functions 2. Added: New API return index -49 and the corresponding description	03/03/2026
V0.55.63.1	1. Added: RTA Probability Density Bitmap Plotting Guide section 2. Added: Get_APIVersion function 3. Added: Range specifications for certain variables	02/25/2026
V0.55.63	1. Modified: Analog Signal Demodulation Mode section	10/17/2025
V0.55.62	1. Added: DSP_SEMAnalysis function in digital signal processing	08/19/2025
V0.55.61	1. Added: Phase Noise Measurement Mode section 2. Added: IQS_GetIQStream_PM2 function 3. Added: Zero Span Mode section 4. Added: RTA_GetRealTimeSpectrum_Raw function 5. Added: Digital Demodulation Mode section 6. Added: Pulse Detection section 7. Added: Description of Detector and Trace Detector 8. Deleted: The API usage method for Windows/Linux 9. Deleted: GetPatialUpdatedFullSweep in SWP mode 10. Modified: Device_SetNetworkDeviceIP, Device_SetNetworkDeviceIP_PM1, Device_GetFullUID in Device and System section 11. Updated: All function examples	07/16/2025
V0.55.27	1. Modified: Refactored the original Device section 2. Added: SWP_AutoSet function 3. Added: System Device and GNSS related functions section	03/28/2024
V0.54.0	1. Initial Version	05/17/2023

2. Overview

This API system is implemented as a C-based dynamic link library for programming and controlling the device.

The device's operating mode is a core concept of the API system. Different operating modes provide different test behaviors and capabilities. The first step in development is to select the appropriate operating mode according to the task requirements.

The HTRA API system supports the following operating modes: Standard Spectrum Analysis (SWP), Receiver/IQ Stream (IQS), Detection Analysis (DET), Real-Time Spectrum Analysis (RTA), Digital Demodulation (optional), and Phase Noise Measurement.

A thorough understanding of each operating mode's execution mechanism, combined with selecting the appropriate mode and device parameters based on the application objectives, helps maximize the device's performance and obtain more accurate measurement results.

Device Operating Modes and Applicable Scenarios		
SWP	● Panoramic spectrum sweep ● Spectrum monitoring ● Phase noise ● Harmonic testing	● Spurious measurement ● Channel power measurement ● OBW and ACPR measurement
IQS	● Time-domain signal viewing ● IQ recording ● AM demodulation	● FM demodulation ● User application
DET	● Pulse signal observation	● Time-power relationship
RTA	● Burst signal observation ● Convert signal detection	● Dynamic spectrum observation
PNM	● Frequency stability analysis	● Close-in noise observation
Digital Demod	● Modulation quality analysis ● Vector analysis	● ASK/FSK/GMSK/PSK/QAM demodulation

The basic API calling process consists of five steps:

1. Open the device resource;
2. According to the selected operating mode, call the corresponding category of API functions to configure the device to the specified mode;

3. Acquire measurement data using the data retrieval functions provided under the selected mode;
4. Perform user-defined analysis based on the acquired measurement data to achieve the intended application objective;
5. After the test is completed, close the device and release the associated memory resources.

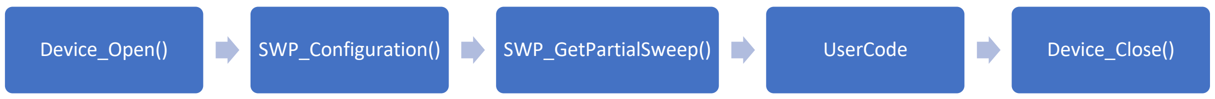


Figure 1 Typical Calling Steps for SWP Mode

Before starting your application development, please carefully read the sections on API invocation logic and the API call flow chart. Using the call flow chart as the processing framework for your application will help you quickly build a robust and efficient program.

3. Device and API version

The system operates through the coordinated execution of multiple software and firmware components. In this system, the involved components include: Main Control Firmware (MFW), FPGA Firmware (FFW), Bus Firmware (Bus), and the API.

The system uses a unified version format: x.y.z, where x is the major version, y is the minor version, and z is the patch version. The minor version (y) defines the compatibility baseline.

Version Compatibility Principles

For API version V0.55.61 and earlier: It is only required that the minor version number (y) of MFW, FFW, and API remain consistent to ensure normal system operation. Compatibility examples are shown in the table below:

Table 1 Compatibility Examples for Software and Firmware Version V0.55.61 and Earlier

Example	MFM	FFM	API
Compatible	0.55.57	0.55.18	0.55.61
Incompatible	0.55.57	0.55.18	0.54.2

For API version 0.55.62 and later: The compatibility requirements have been upgraded. MFW, FFW, Bus, and API versions must follow the strictly corresponding baseline versions. Please refer to the table below for details:

Table 2 Compatibility Examples for Software and Firmware Version V0.55.62 and later

API	FPGA	MCU	BUS
0.55.64	0.55.28	0.55.65	0.55.8
0.55.63	0.55.27/0.55.28	0.55.59/0.55.61 0.55.62/0.55.64	0.55.4/0.55.6
0.55.62	0.55.27	0.55.59	0.55.4

Note:

1. To prevent system abnormalities, any form of cross-version mixing is strictly prohibited. Please ensure strict compliance with the deployment requirements.

2. The API version used must correspond to the version indicated on the cover of this manual to avoid inconsistencies between the manual description and the actual API behavior.

4. Overview of Function Categories

Table 3 Overview of API Function Categories

Function Category	Description
Device and System	Global API functions that may be invoked under any operating mode. This category includes functions for device open and close operations, global configuration, retrieval of device information, and acquisition of device status.
SWP	In this mode, the receiver performs frequency hopping according to the configuration to achieve frequency scanning. The baseband processes the time-domain data within the analysis bandwidth at each frequency point to perform spectrum analysis and returns the spectral results to the user. SWP mode is suitable for frequency trace–oriented measurement and analysis applications. This category includes functions for SWP mode configuration, spectrum data acquisition, and trigger control.
IQS	In this mode, the receiver sets the center frequency to the specified value and maintains a fixed local oscillator frequency and other receiver states. The baseband acquires time-domain data within the analysis bandwidth based on the specified trigger signal and returns it to the user. IQS mode is suitable for signal recording, demodulation analysis, and simultaneous multi-dimensional analysis applications. This category includes functions for IQS mode configuration, spectrum data acquisition, and trigger control.
DET	In this mode, the receiver sets the center frequency to the specified value and maintains a fixed local oscillator frequency and other receiver states. The baseband performs detection processing on the time-domain signal within the analysis bandwidth and returns the power results to the user based on the specified trigger signal. DET mode is suitable for applications focusing on the in-band power versus time relationship, such as pulse parameter measurements. This category includes functions for DET mode configuration, power data acquisition, and trigger control.
RTA	In this mode, the receiver sets the center frequency to the specified value and maintains a fixed local oscillator frequency and other receiver states. The baseband performs continuous spectrum analysis on the time-domain signal within the analysis bandwidth and returns the spectral results to the user. RTA

	mode is suitable for applications focusing on instantaneous and burst signals, such as interference investigation and characteristic signal identification in complex electromagnetic environments. This category includes functions for RTA mode configuration, spectrum data acquisition, and trigger control.
ASG	Global functions for controlling the device or its analog signal source options, which can be invoked under any operating mode. This category includes functions for configuring output tones, frequency sweeps, and similar operations.
DSP	General post-processing functions that are independent of hardware status. This category includes functions for IQ data processing, such as DDC, FFT analysis, and video detection; as well as measurement and analysis of spectrum traces, including IM3, phase noise, channel power, occupied bandwidth, and similar functions.
ADM	Analog demodulation post-processing functions that are independent of hardware status. This category performs demodulation on IQ data acquired by the device, including functions such as AM demodulation and FM demodulation.
PNM	In this mode, the receiver performs phase noise measurement and analysis on the acquired data, and outputs results in real time, including carrier characteristics and phase noise traces.
Digital Demod	IQS mode data post-processing functions that are independent of hardware status. This category performs demodulation on IQ data acquired by the device and returns demodulation results, constellation diagrams, EVM, and other related parameters.
Pulse Detect	IQS/DET mode data post-processing functions that are independent of hardware status. This category performs pulse detection on the acquired time-domain data and can output parameters such as pulse width, period, and duty cycle.

5. API Call Logic and Call Map

5.1 API Call Map for SWP Mode

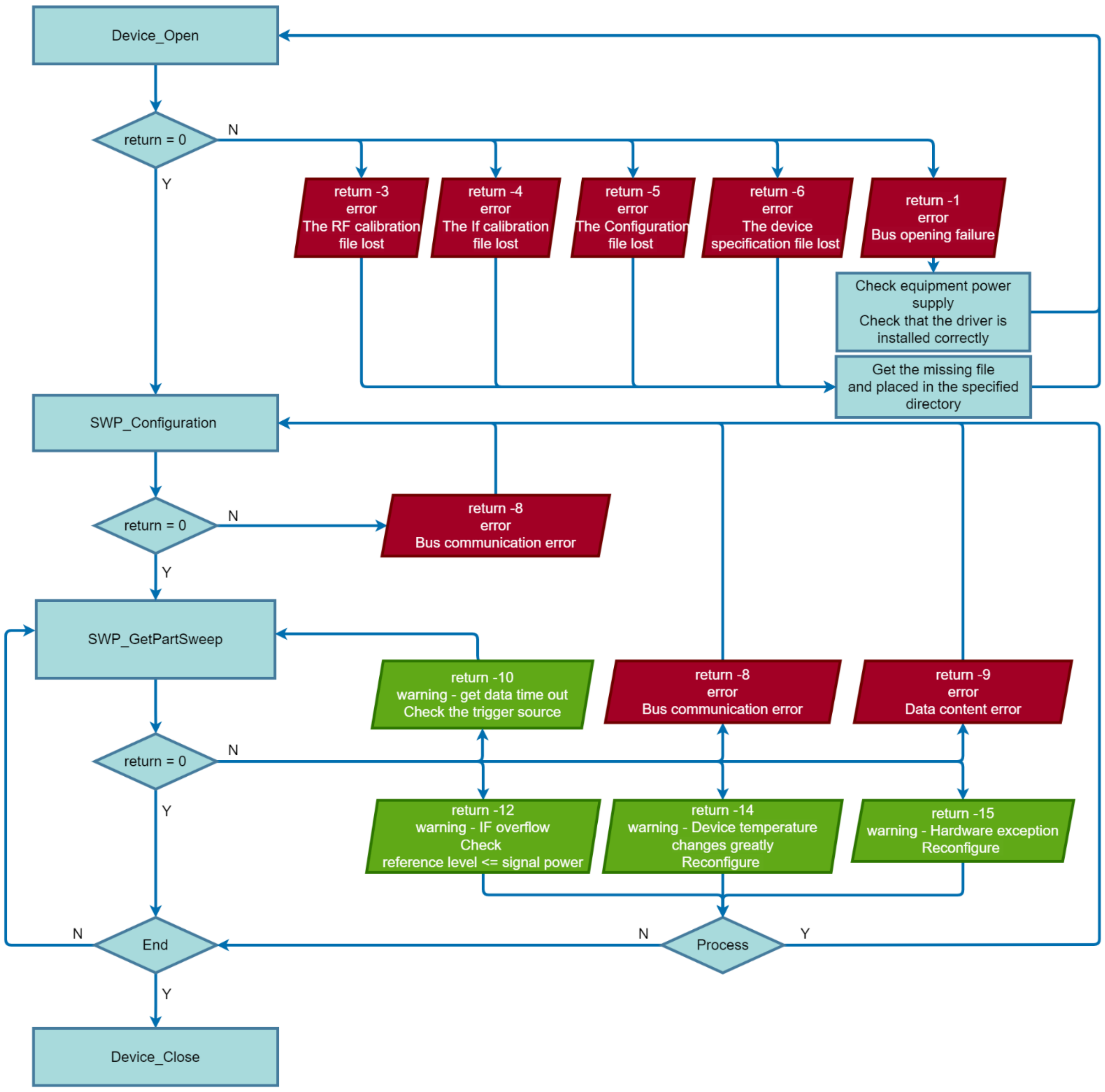


Figure 2 SWP Mode Call Flow Diagram

5.2 API Call Map for IQS Mode

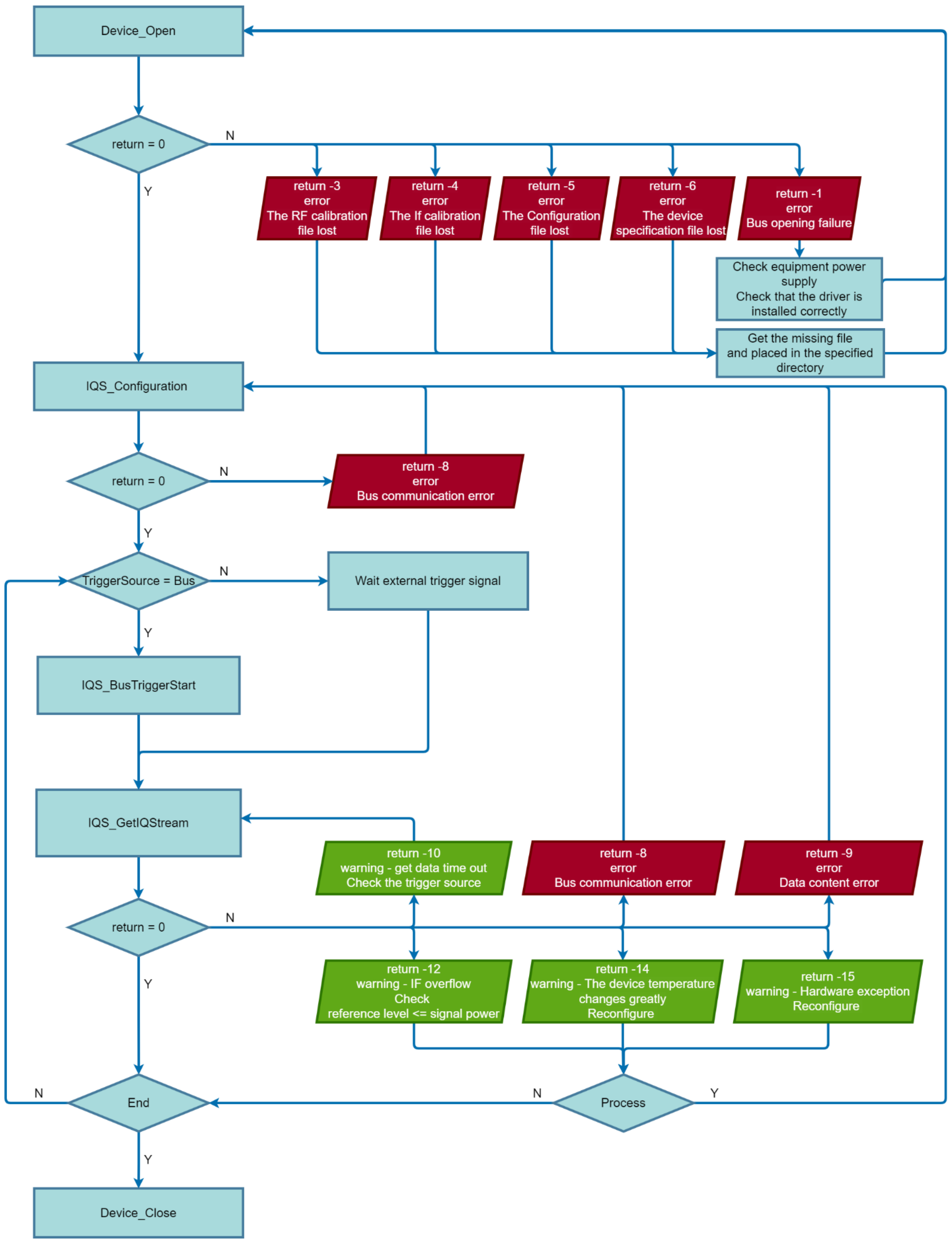


Figure 3 IQS Mode Call Flow Diagram (Trigger Mode is Fixed)

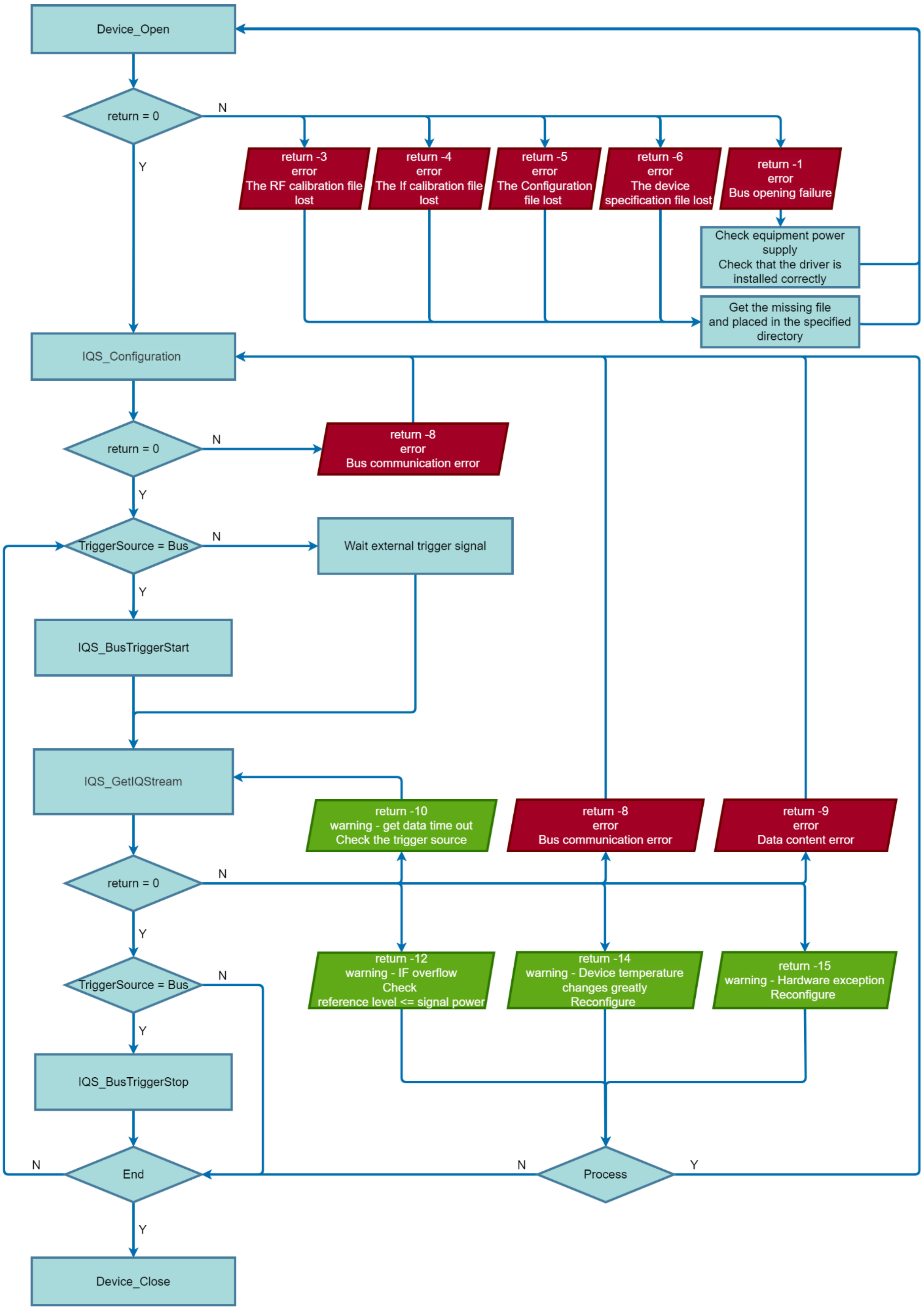
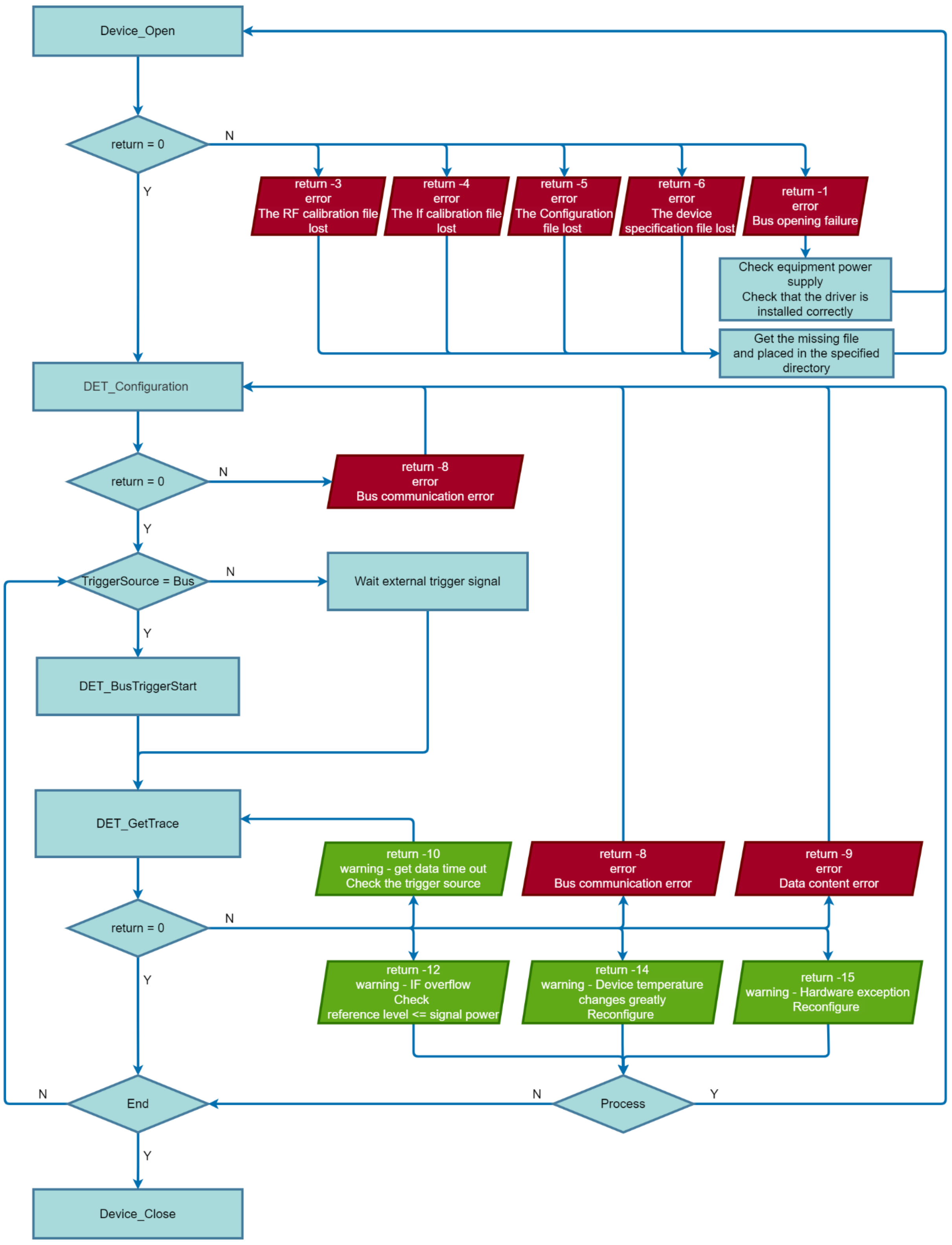


Figure 4 IQS Mode Call Flow Diagram (Trigger Mode is Adaptive)

5.3 API Call Map for DET Mode



Device_Open
return = 0
N
Y
return -3 error The RF calibration file lost
return -4 error The If calibration file lost
return -5 error The Configuration file lost
return -6 error The device specification file lost
return -1 error Bus opening failure
Check equipment power supply Check that the driver is installed correctly
Get the missing file and placed in the specified directory
DET_Configuration
return = 0
N
Y
return -8 error Bus communication error
TriggerSource = Bus
N
Y
Wait external trigger signal
DET_BusTriggerStart
DET_GetTrace
return -10 warning - get data time out Check the trigger source
return -8 error Bus communication error
return -9 error Data content error
return = 0
N
Y
return -12 warning - IF overflow Check reference level <= signal power
return -14 warning - Device temperature changes greatly Reconfigure
return -15 warning - Hardware exception Reconfigure
N
End
N
Process
Y
Y
Device_Close

Figure 5 DET Mode Call Flow Diagram (Trigger Mode is Fixed)

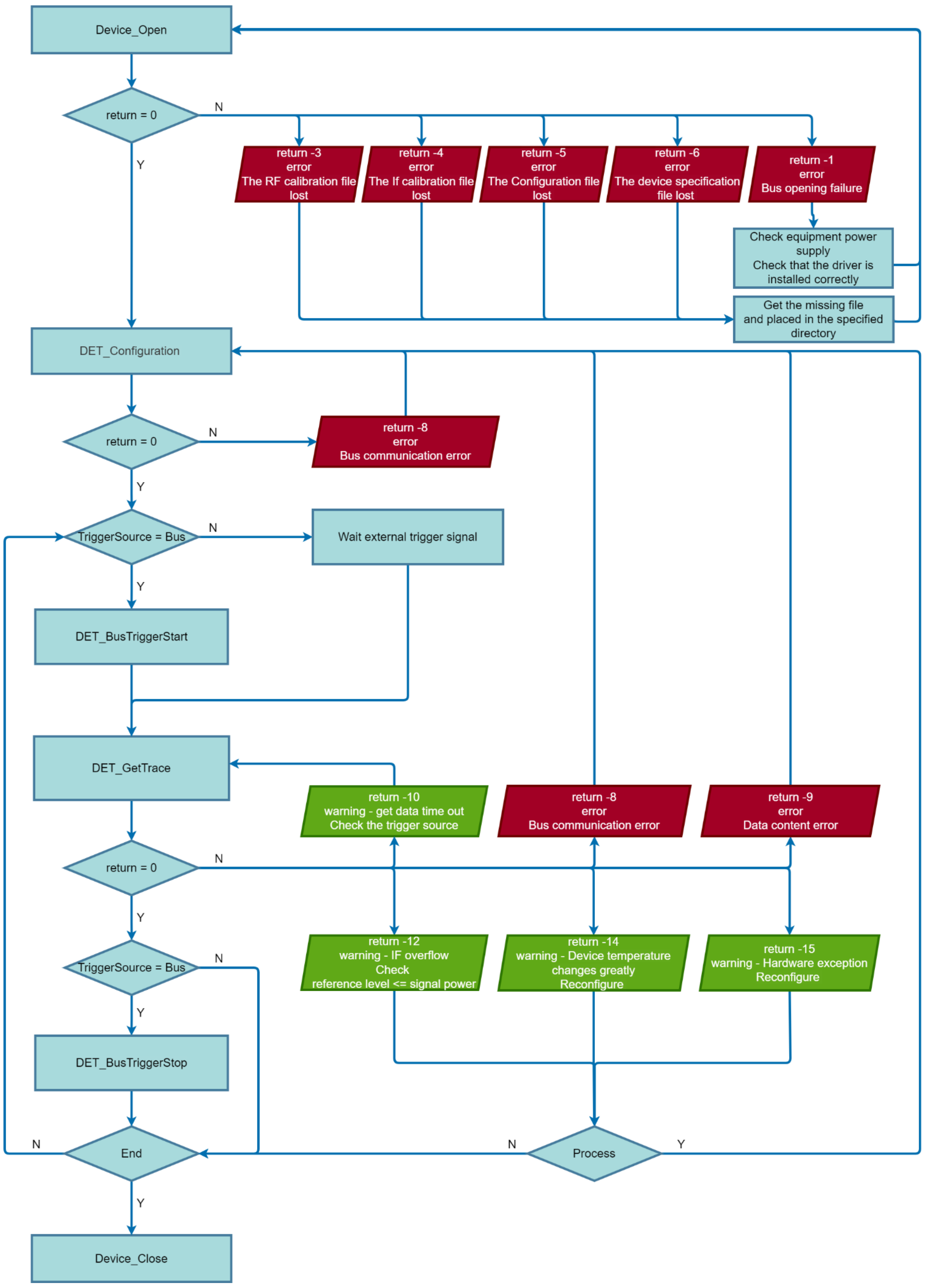


Figure 6 DET Mode Call Flow Diagram (Trigger Mode is Adaptive)

5.4 API Call Map for RTA Mode

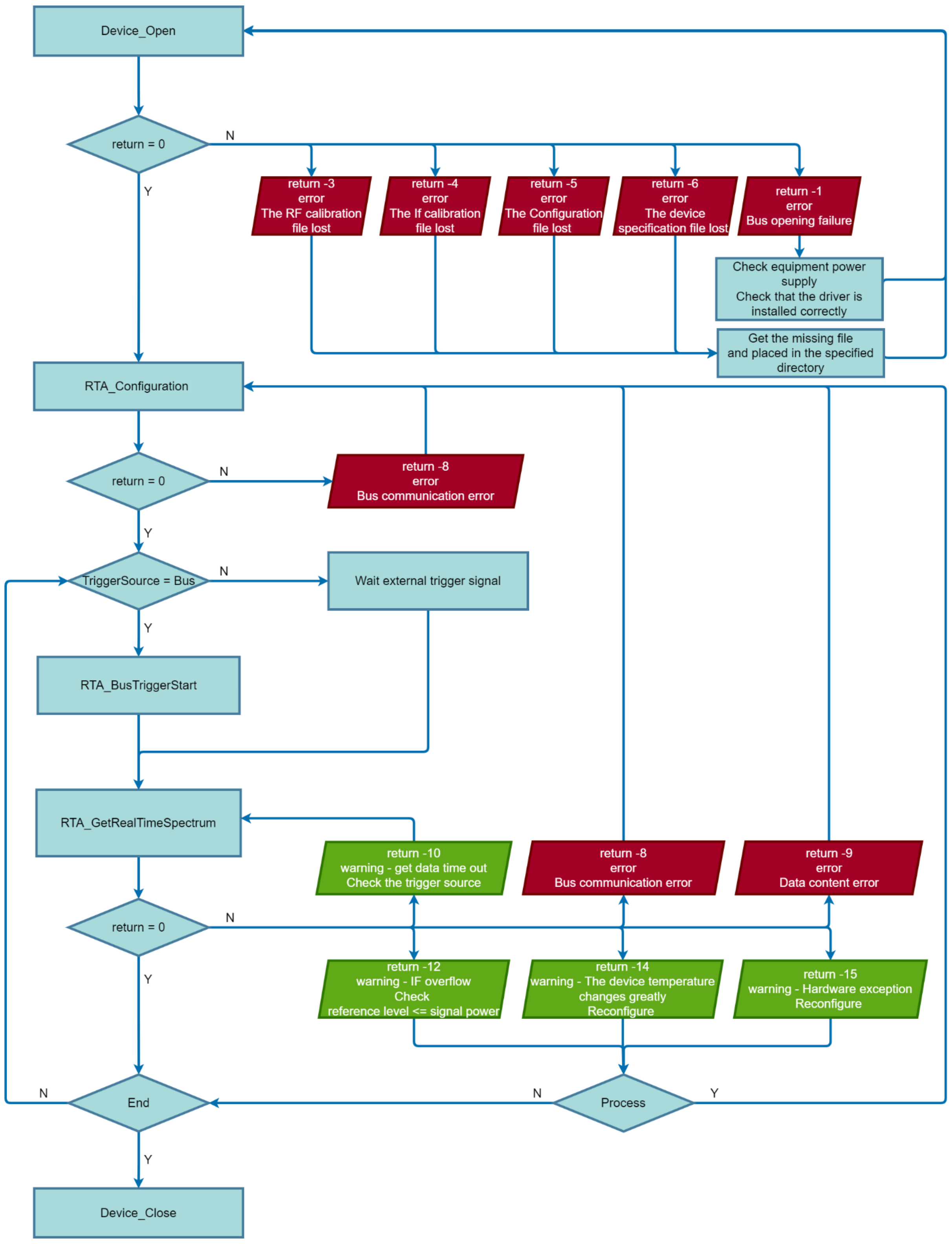


Figure 7 RTA Mode Call Flow Diagram (Trigger Mode is Fixed)

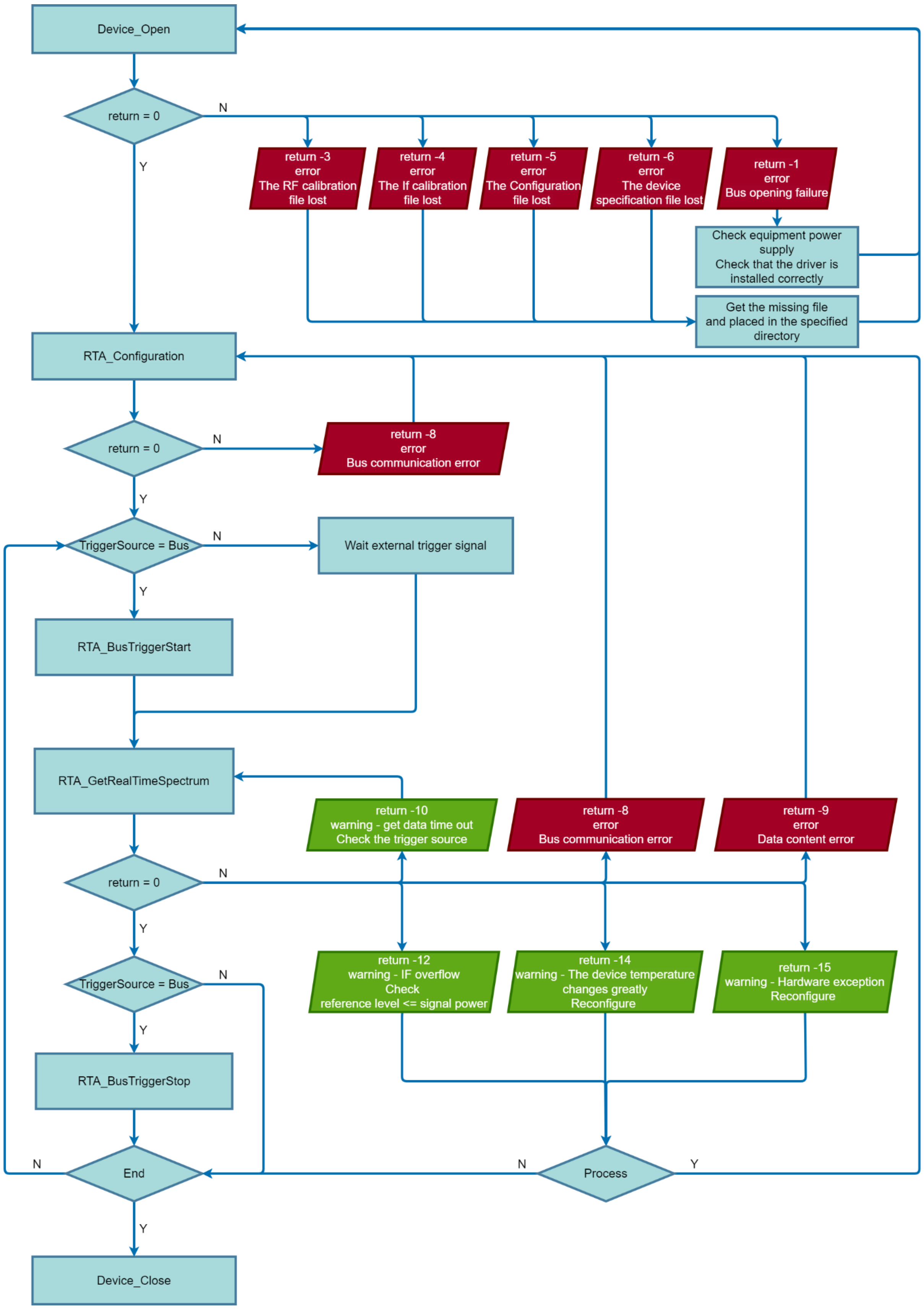


Figure 8 RTA Mode Call Flow Diagram (Trigger Mode is Adaptive)

6. Import Variables Definition Reference

This chapter lists some of the key parameters and concepts related to the spectrum analyzer/receiver products. A thorough understanding of these parameters and concepts is essential for the correct and efficient use of the equipment. This summary is provided for quick reference and convenient consultation when issues arise.

6.1 System

Table 4 Table of System Parameters and Related Concept Descriptions

No.	Parameters	Applicable	Description
1	Void** Device	Device/SWP/ IQS/DET/RTA	This parameter serves as a memory reference required for device operation. When calling the API, this reference must be used to index the currently opened device.
2	DeviceUID	Device	Each device has a unique device ID, which should be used to distinguish between different device units

6.2 Amplitude

Table 5 Table of Amplitude Parameters and Related Concept Descriptions

No.	Parameters	Applicable	Description
1	RefLevel_dBm	SWP/IQS/ DET/RTA	By default, the system automatically configures the attenuator and preamplifier based on the reference level. The reference level can be simply understood as the maximum input power that the system can accept without saturation. When handling the reference level, the system maintains a certain margin, typically 1 to 6dB. Therefore, at some frequencies, even if the input power exceeds the reference level, the system may not report a saturation warning; this is normal. To achieve optimal dynamic range, set the reference level slightly above the expected maximum input signal power. For example, if the expected signal is a -3dBm tone, setting the reference level to 0dBm allows for good observation of the signal dynamics
2	Atten	SWP/IQS/ DET/RTA	The attenuation defaults to automatic mode (Atten = -1), in which case the system sets the channel attenuation solely based on the reference level. To manually configure the channel attenuation, set Atten to the desired value.
3	Preamplifier	SWP/IQS/ DET/RTA	For devices equipped with a preamplifier, enabling or disabling the preamplifier significantly affects the system's noise performance and linearity: 1). Preamplifier enabled: Reduces system noise but lowers the maximum linear input power and the maximum damage threshold;

No.	Parameters	Applicable	Description
			2). Preamplifier disabled: Increases the allowable input power range, but system noise will be relatively higher. The system can typically be configured to: 1). Automatically control the preamplifier based on the reference level; 2). Force the preamplifier off to prevent potential damage from overload.
4	AnalogIFBW Grade	SWP/IQS/ DET/RTA	For devices equipped with multiple analog intermediate-frequency (IF) filters, the system provides several IF channels with different characteristics for selection. Different analog IF bandwidths offer varying out-of-band suppression, in-band flatness, group delay, and other performance metrics. Please choose the appropriate IF setting according to your application requirements.
5	IFGainGrade	SWP/IQS/ DET/RTA	The system allows users to adjust IF gain to optimize spurious performance, linearity, and noise levels. Higher gain settings (indexed numerically) provide greater IF amplification, typically in 1 dB to 3dB increments per step. Total system gain = RF gain + IF gain. When maintaining a constant reference level (fixed total gain): 1) Increasing IF gain -> Reduces mixer input power -> Imporves spurious suppression and linearity -> Degrades noise performance; 2) Decreasing IF gain -> Increases mixer input power -> Worsens spurious/linearity -> Improves noise performance. Special cases: 1) At maximum RF gain(e.g., ref. level = -60 dBm): Further IF gain increase boosts total gain, potentially improving noise performance; 2) Below maximum RF gain(e.g., ref. level = 0 dBm): Higher IF -> Better spurious/linearity, worse noise; LowerIF gain -> Worse spurious/linearity, better noise.

6.3 Frequency

Table 6 Table of Frequency Parameters and Related Concept Descriptions

No.	Parameters	Applicable	Description
1 **2**	FreqAssignment StartFreq_Hz StopFreq_Hz CenterFreq_Hz Span_Hz	SWP	In SWP mode, this variable allows users to define the frequency scan range either in StartStop or CenterSpan format.
3 **4**	TracePointStrategy TracePoints	SWP	In SWP mode, the spectrum analysis method is determined by TracePointStrategy:

5	TraceAlign		1) When TracePointStrategy = BinSizeAssined: The system uses sweep-based analysis, where the trace point count is explicitly defined by TracePoints. In this mode, TraceAlign settings are ignored; 2) For other TracePointStrategy values: The system employs FFT-based analysis. Due to underlying software implementation and trace detection mechanisms, the native ananlysis frequencies cannot be perfectly aligned with the configured start/stop frequencies. The returned trace data points will slightly exceed the specified. User-adjustable handling methods: 1) Truncate endpoint data to match the desired frequency range; 2) Set TraceAlign = AlignToStart to force alignment at the start frequency (end frequency still requires truncation). Note for FFT mode: While users can specify a desired trace point count (TracePoints), hardware limitations typically prevent exact matches. The system returns the closest achievable point count.

6.4 Analysis

Table 7 Table of Analysis Parameters and Related Concept Descriptions

No.	Parameters	Applicable	Description
1	SpurRejection	SWP	The system provides three spurious suppression modes: Bypass, Standard, and Enhanced. This feature effectively suppresses most composite spurious components but does not improve system residual responses. It also reduces sweep speed and time-varying signal measurement capability. 1) For steady-state signals (e.g., CW tones): Enabling spurious suppression significantly improves spurious-free dynamic range; 2) For fast time-varying signals (e.g., modulated signals): Activation may cause intermittent signal loss or inaccurate power measurements. Use with caution. Recommendation: Toggle the feature while observing spectral changes to determine if spurious rejection is suitable for your test scenario.
2	PowerBalance	SWP	In SWP mode, users can balance scan speed and power consumption by configuring the Power Consumption Balance parameter: 1) Power Consumption Blance = 0: The system operates at maximum sweep speed (highest power draw);

			2) Power Consumption Balance = 40-1000 (typical range): Higher values reduce scan speed and lower power consumption. Critical Note: Higher Power Consumption Balance values significantly degrade time-varying signal detection capability. Use caution when testing highly dynamic signals.
3	Window	SWP/RTA	When performing FFT-based spectrum analysis, the system provides multiple window functions, each with distinct advantages. Please select the appropriate window based on your testing requirements: 1) FlatTop Window: Provides excellent amplitude accuracy; Significantly reduces amplitude errors caused by the picket-fence effect; Ideal for high-precision amplitude measurements; 2) Blackman-Nuttall Window: Features a narrow main lobe for high frequency resolution; Enables faster scanning speeds than FlatTop at the same RBW setting; Suitable for high-frequency-resolution and fast-sweep testing scenarios; 3) LowSideLobe Window: Features extremely low sidelobe levels, effectively suppressing interference from strong signals to adjacent frequencies. Ideal for test scenarios requiring high dynamic range or coexistence of strong and weak signals.
4	FFTExcutionStrategy	SWP	In standard spectrum analysis mode, users can select the signal processing method: 1) Auto mode: The system automatically selects FPGA or CPU processing based on RBW; 2) FPGA-Only: Significantly reduces CPU load; Slower sweep speeds ata RBW ≤ 5KHz due to FFT size limitations; 3) CPU-Only: Supports FFT sizes > 64K points, enabling faster sweeps ata narrow RBW (≤5KHz).
5	SweepTime	SWP/RTA	In this system, the sweep time is defined as the total time required to ccomplete one full scan from the start frequency to the stop frequency. When SweepTime = SWTMode_Manual, this parameter represents the absolute time; when *N is specified, this parameter is the scan time multiplier, i.e., scanning is performed at N times the minimum scan time.
6	DecimateFactor	IQS/DET/RTA	In IQS/DET/RTA mode, the system uses DecimateFactor to realize variable analysis bandwidth. Analysis bandwidth is equal to be Analysis bandwidth (DecimateFactor = 1) / DecimateFactor. Due to the limitations, the system will achieve the nearest available value for the DecimateFactor

			according to the desired DecimateFactor for configuration and feedback to the user.
7	BusTimeOut	IQS/DET/RTA	BusTimeOut sets an upper limit of execution time for functions related to fetching data, and the process will be ended if valid data cannot be fetched within that time so that the system does not wait indefinitely. In IQS/DET/RTA mode, this parameter needs to be set.

6.5 Detector and Trace Detector

Detector: Under the same local frequency point, the detector ratio frame data is collected, and according to the characteristics of the detector, the multi-frame data is detected frequency by frequency point, and the eigenvalue frame is finally generated. The following figure takes PosPeak Detector as an example to introduce the process of positive peak detection, where Frame 0, Frame 1 and Frame 2 are the data collected at different moments, and After PosPeak Detector is the data after positive peak detection.

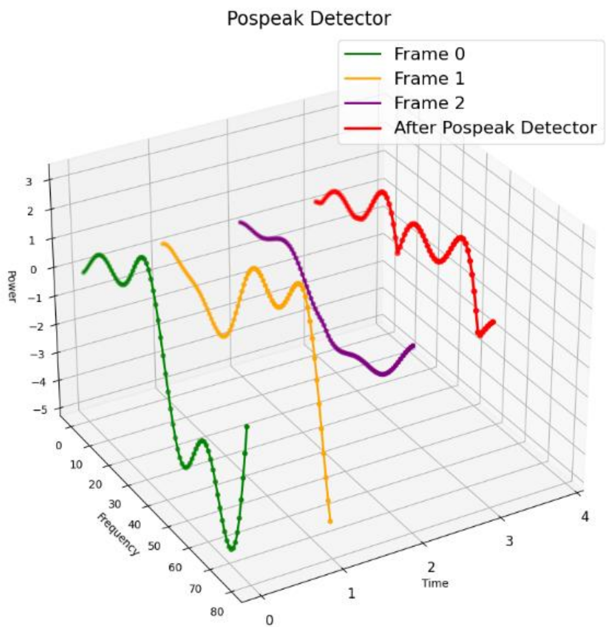


Figure 9 Positive Peak Detector

Trace Detector: According to the selected trace detector, the entire spectrum trace is detected in steps of trace detection ratio to generate the eigenvalue trace. The following figure takes PosPeak TraceDetector as an example to introduce the process of PosPeak Trace Detector, where Before PosPeak Trace Detector is the data before PosPeak Trace Detector and After PosPeak Trace Detector is the data after PosPeak Trace Detector.

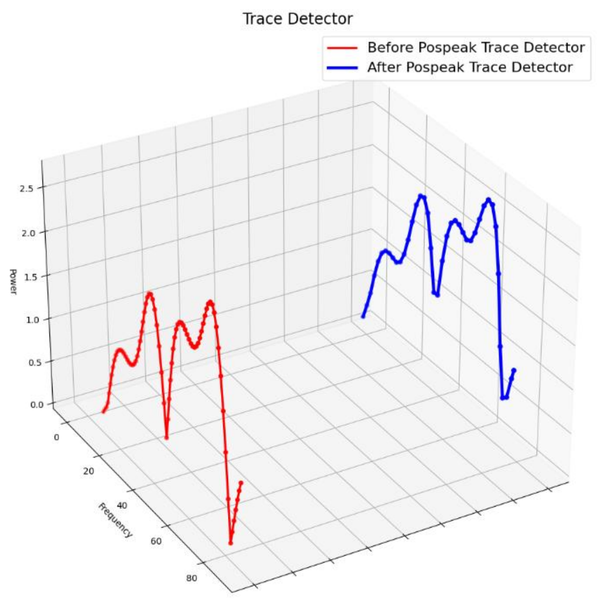


Figure 10 Positive Peak Trace Detector

6.6 Default Units

Table 8 Summary of Main Variables and Units

Variables	Unit
Frequency	Hz
Power	dBm
Voltage	V
Time	s

7. Device and System Main Functions

Before calling any hardware-related API functions, Device_Open() must first be invoked to initialize the device. Once the business logic or application tasks are completed, Device_Close() must be called to shut down the device and release allocated memory resources.

7.1 Device_List

```
int Device_List (
        const BootProfile_TypeDef* BootProfile,
        uint8_t* Devicecount,
        uint8_t DevNum[MAX_DEVICE],
        DeviceInfo_TypeDef DeviceInfo_O[MAX_DEVICE]
)
```

Description	
Query all USB devices currently connected to the host computer, along with their corresponding device IDs and device information.	
Compatibility	0.55.64 and later.
Parameter description	
[in] **BootProfile**	Device startup configuration specifying the interface type as USB. Refer to the definition of the BootProfile_TypeDef structure for details.
[out] **Devicecount**	Returns the number of devices currently connected to the host, with a maximum of 256 devices per bus.
[out] **DevNum[MAX_DEVICE]**	Returns the device IDs of all devices currently connected to the host.
[out] **DeviceInfo_O[MAX_DEVICE]**	Returns detailed information for all connected devices, including serial number, type, MCU version, and FPGA version. Refer to the definition of the DeviceInfo_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	None.

Example

int Status = 0; int DevNum = 0; void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootInfo_TypeDef BootInfo;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
uint8_t Devicecount = 0;
DeviceInfo_TypeDef DeviceInfo_O[MAX_DEVICE];
vector<uint8_t>DevNumList(MAX_DEVICE);
Status = Device_List(&BootProfile, &Devicecount, DevNumList.data(), DeviceInfo_O);
for (int i = 0; i < Devicecount; i++) {
    if (DeviceInfo_O[i].Model == 23) {
        DevNum = DevNumList[i];
        break;
    }
}
Status = Device_Open(&Device, DevNum, &BootProfile, &BootInfo);

7.2 Get_APIVersion

int Get_APIVersion(void)	
Description	
Retrieves the version number of the currently used API library.	
Compatibility	0.55.0 and later.
Return value	The current API version, represented by a major version, minor version, and revision (patch) version. bit[31..16] indicates the major version, bit[15..8] indicates the minor version, and bit[7..0] indicates the revision version.
Calling constraints	None.
Example	

int apiVersion = Get_APIVersion();
int major = 0, minor = 0, rev = 0;	

```
major = (apiVersion >> 16) & 0xffff;
minor = (apiVersion >> 8) & 0xff;
rev = apiVersion & 0xff;
cout << "htra_api verion: " << major << "." << minor << "." << rev << endl;
```

7.3 APISupportFirmwareVersions

```
int APISupportFirmwareVersions (
        DeviceFirmwareVersion_TypeDef** Versions,
        uint32_t* Count
)
```

Description	
Get the firmware versions currently supported by the API.	
Compatibility	0.55.64 and later.
Parameter description	
[out] **Versions**	Returns the firmware versions compatible with the current API. Refer to the definition of the DeviceFirmwareVersion_TypeDef structure for details.
[out] **Count**	Returns the number of firmware versions compatible with the current API.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	None.
Example	

```
int major = 0, minor = 0, rev = 0; int Status = 0;
DeviceFirmwareVersion_TypeDef* Versions = NULL;
uint32_t Count = 0;
Status = APISupportFirmwareVersions(&Versions, &Count);
// Print MCU Version
major = (Versions->MFWVersion >> 16) & 0xffff;
minor = (Versions->MFWVersion >> 8) & 0xff;
rev = Versions->MFWVersion & 0xff;
cout << "MCUVersion: " << major << "." << minor << "." << rev << endl;
```

7.4 Device_Open

```
int Device_Open(
        void** Device,
        int DeviceNum,
        const BootProfile_TypeDef* BootProfile,
        BootInfo_TypeDef* BootInfo
)
```

Description	
Opens the specified device and obtains the device handle, which is used to identify the target device in subsequent API calls. When multiple devices are present in the system, each device can be opened separately by specifying a different device index	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle, used to identify the target device in subsequent API calls.
[in] **DeviceNum**	Specifies the device index. When multiple devices are present, this index can be used to select the target device. The index starts from 0 and increments sequentially.
[in] **BootProfile**	Device boot configuration, including interface type, power supply method, and network parameters, used to initialize the device. Refer to the definition of the BootProfile_TypeDef structure for details.
[out] **BootInfo**	Return device boot information, including device details, bus speed and version, API version, as well as errors and warnings generated during the boot process. Refer to the definition of the BootInfo_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Device_Open must be called once before invoking any other device-related functions to acquire device resources and obtain the device handle. Within the same module, it is only necessary to call this function once. Subsequent operations can be performed using the returned device handle.

	After completing all operations, Device_Close must be called to release the device resources
Example	Please refer to the relevant example of the Device_QueryDeviceInfo_Realtime() function.

7.5 Device_Close

int Device_Close(void Device)**	
Description	
Closes the specified device and releases the resources allocated by Device_Open. This function should be called after completing all device operations.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	This function only needs to be called when the program is about to terminate. After calling it, the USB device connection will be closed and the allocated memory will be released. If the device needs to be used again, Device_Open must be called to re-establish the connection and reopen the device
Example	Please refer to the relevant example of the Device_QueryDeviceInfo_Realtime() function.

7.6 Device_QueryDeviceState/Device_QueryDeviceState_Realtime

```
int Device_QueryDeviceState(
    void** Device,
    DeviceState_TypeDef* DeviceState
)
```

```
int Device_QueryDeviceState_Realtime(
    void** Device,
    DeviceState_TypeDef* DeviceState
)
```

Description	
Retrieves the spectrum analyzer device status, including device temperature, hardware operating status, and geographic time information (optional feature required). Device_QueryDeviceState: Non-real-time mode. Does not interrupt data acquisition, but the information is only updated after a data packet is received; Device_QueryDeviceState_Realtime: Real-time mode. Temporarily occupies the data channel for a short period of time.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
[out] **DeviceState**	Pointer to a structure containing the device status information. After the function call, this structure is updated with the latest device status. Refer to the definition of the DeviceState_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after Device_Open.
Example	Please refer to the relevant example of the Device_QueryDeviceInfo_Realtime() function.

7.7 Device_QueryDeviceInfo/Device_QueryDeviceInfo_Realtime

```
int Device_QueryDeviceInfo(
    void** Device,
    DeviceInfo_TypeDef* DeviceInfo
)
```

```
int Device_QueryDeviceInfo_Realtime(
    void** Device,
    DeviceInfo_TypeDef* DeviceInfo
)
```

Description
Retrieves device information, including the device serial number, hardware version, firmware version, and other related details.

Device_QueryDeviceInfo: Non-real-time mode. Does not interrupt data acquisition, but the information is only updated after a data packet is received. Device_QueryDeviceInfo_Realtime: Real-time mode. Temporarily occupies the data channel for a short.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
[out] **DeviceInfo**	Structure containing the basic device information, including the device unique identifier and various version details. After the function call, this structure is updated with the latest device information. Refer to the definition of the DeviceInfo_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after Device_Open.
Example	

```
int Status = -1; int DeviceNum = 0; void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
DeviceState_TypeDef DeviceState;
Status = Device_QueryDeviceState(&Device, &DeviceState);
Status = Device_QueryDeviceState_Realtime(&Device, &DeviceState);
DeviceInfo_TypeDef DeviceInfo;
Status = Device_QueryDeviceInfo(&Device, &DeviceInfo);
Status = Device_QueryDeviceInfo_Realtime(&Device, &DeviceInfo);
Status = Device_Close(&Device);
```

7.8 Device_QueryEIO_Version_UID

```
int Device_QueryEIO_Version_UID(
    void** Device,
    uint16_t* EIOVersion,
```

uint64_t* **EIOUID**)	
Description	
Retrieve the version and UID of the GNSS module connected to the specified device.	
Compatibility	0.55.64 and later.
Parameter description	
[in] **Device**	Device handle.
[out] **EIOVersion**	Returns the GNSS module version number, represented by major and minor revisions. bit[15..8] indicates the major version, and bit[7..0] indicates the minor revision.
[out] **EIOUID**	Returns the UID of the GNSS module.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after Device_Open.

8. Device and System Other Functions

8.1 Device_ReEnumerate

int Device_ReEnumerate(void Device)**	
Description	
When the device is initially powered on via a USB 3.0 port, it may be recognized as USB 2.0. However, it has been confirmed that physically re-plugging the device allows it to be correctly recognized as USB 3.0.	
Under this condition, calling this function allows the USB 2.0 to USB 3.0 re-enumeration to be performed directly at the software level, without the need for physical re-plugging.	
After this function succeeds, Device_Close must be called, followed by Device_Open, to restore the connection with the device.	
Compatibility	0.55.62 and later.
Parameter description	
[in] **Device**	Device handle.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after Device_Open.
Example	

```
while (1)
{
    int Status = 0; void* Device = NULL; int DevNum = 0;
    BootProfile_TypeDef BootProfile;
    BootInfo_TypeDef BootInfo;
    BootProfile.DevicePowerSupply = USBPortAndPowerPort;
    BootProfile.PhysicalInterface = USB;
    Status = Device_Open(&Device, DevNum, &BootProfile, &BootInfo);
    if (BootInfo.BusSpeed == 2) {
        Device_ReEnumerate(&Device);
        Device_Close(&Device);
        std::this_thread::sleep_for(std::chrono::seconds(20));
        }
else {
                break;
        }
}
```

8.2 Device_SetSysPowerState

```
int Device_SetSysPowerState(
        void** Device,
        SysPowerState_TypeDef SysPowerState
)
```

Description	
Sets the system power state of the device, allowing control over the power-on or power-off of various functional areas, as well as putting the RF module into standby. This enables management of different power consumption and wake-up requirements.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
[out] **SysPowerState**	Sets the system power state of the device. Refer to the definition of the SysPowerState_TypeDef enumeration structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after Device_Open.
Example	

```
int Status = -1; int DeviceNum = 0; void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
SysPowerState_TypeDef SysPowerMode = PowerON;
```

```
Status = Device_SetSysPowerState(&Device, SysPowerMode);

Status = Device_Close(&Device);
```

8.3 Device_CalibrateRefClock

```
int Device_CalibrateRefClock(
    void** Device,
    ClkCalibrationSource_TypeDef ClkCalibrationSource,
    const double TriggerPeriod_s,
    const uint64_t TriggerCount,
    const bool RewriteRFCal,
    double* RefCLKFreq_Hz
)
```

Description	
Calibrates the device reference clock frequency using an external trigger signal with a known period. The function calculates the calibrated frequency based on the specified trigger period and number of triggers, and optionally allows writing the calibration result to the calibration file to serve as the default reference frequency for subsequent device startups.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
[in] **ClkCalibrationSource**	Specifies the clock calibration source. Refer to the definition of the ClkCalibrationSource_TypeDef enumeration structure for details.
[in] **TriggerPeriod_s**	The period of the known calibration signal (unit: seconds). The accuracy of this value directly affects the precision of the reference clock calibration.
[in] **TriggerCount**	The number of triggers used for calibration. For scenarios using GNSS 1PPS calibration, a higher number of triggers helps suppress jitter errors and improves calibration accuracy, but also increases the calibration time. It is recommended to use more than 30 triggers (i.e., a calibration time exceeding 30 seconds) when using GNSS 1PPS.
[in] **RewriteRFCal**	Specifies whether to write the calibration result to the calibration file.

	0: Do not write. The calibration result will be lost when the device is powered off. 1: Write. The calibration result will persist even after the device is powered off and on.
[out] **RefCLKFreq_Hz**	Returns the reference clock frequency obtained from this calibration (unit: Hz).
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after Device_Open.

Example

```
int Status = -1; int DeviceNum = 0; void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
ClkCalibrationSource_TypeDef ClkCalibrationSource = CalibrateByExternal;
double TriggerPeriod_s = 1; uint64_t CalibrationTimes = 1 * 60;
bool RewriteRFCal = false; double RefCLKFreq_Hz = 0;
Status = Device_CalibrateRefClock(&Device, ClkCalibrationSource, TriggerPeriod_s, CalibrationTimes,
RewriteRFCal, &RefCLKFreq_Hz);
Status = Device_Close(&Device);
```

8.4 Device_SetFanState

```
int Device_SetFanState(
    void** Device,
    const FanState_TypeDef FanState,
    const float ThreshouldTemperature
)
```

Description

Sets the operating mode of the device fan and controls its on/off state based on the specified temperature thresholds, enabling thermal management of the device. (Supported only for USB devices below 8.5GHz.

Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
[in] **FanState**	Sets the operating mode of the device fan. Refer to the definition of the FanState_TypeDef enumeration structure for details.
[in] **ThreshouldTemperature**	Threshold temperature (in degrees Celsius). When FanState = FAN_AUTO, the system turns on the fan if the device temperature exceeds this threshold, and turns it off when the temperature drops 10°C below the threshold.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after Device_Open.
Example	

```
int Status = -1; int DeviceNum = 0; void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
FanState_TypeDef FanState = FanState_On;
float Temperature = 0;
Status = Device_SetFanState(&Device, FanState, Temperature);
Status = Device_Close(&Device);
```

8.5 Devcie_SetFreqResponseCompensation

```
int Devcie_SetFreqResponseCompensation(
    void** Device,
    uint8_t State,
    const double *Frequency_Hz,
    const float *CorrectVal_dB,
    uint8_t Points
```

)	
Description	
In SWP mode, a frequency compensation mechanism is used to correct the power for the specified frequency band. The compensation rules are as follows: 1. Interpolation within the frequency compensation range: Linear interpolation is applied between adjacent frequency points in the Frequency_Hz array, ensuring that the power compensation values transition smoothly within the specified frequency range 2. From the start frequency to the first frequency in the compensation array (Frequency_Hz[0]): The compensation value for this range is CorrectVal_dB[0], i.e., the first value in the compensation array is used to fill this range. 3. From the last frequency in the compensation array (Frequency_Hz[Points - 1]) to the end frequency: The compensation value for this range is CorrectVal_dB[Points - 1], i.e., the last value in the compensation array is used to fill this range.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
[in] **State**	Specifies whether to enable frequency response compensation. 0: Disable compensation. 1: Enable compensation.
[in] **Frequency_Hz**	Array of frequency compensation values.
[in] **CorrectVal_dB**	Array of power compensation values.
[in] **Points**	Number of compensation points, with a maximum of 256 points.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after SWP_Configuration.
Example	

int Status = -1; int DeviceNum = 0; void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);	

```
SWP_Profile_TypeDef SWP_ProfileIn, SWP_ProfileOut;
SWP_TraceInfo_TypeDef TraceInfo;
SWP_ProfileDeInit(&Device, &SWP_ProfileIn);
SWP_ProfileIn.StartFreq_Hz = 2e8;
SWP_ProfileIn.StopFreq_Hz = 3e8;
Status = SWP_Configuration(&Device, &SWP_ProfileIn, &SWP_ProfileOut, &TraceInfo);
vector<double> Frequency(TraceInfo.FullsweepTracePoints);
vector<float> PowerSpec_dBm(TraceInfo.FullsweepTracePoints);
uint8_t compensation_points = 4;
vector<double> Compensate_freq = { 239.999e6, 240e6, 260e6, 260.001e6 };
vector<float> Compensate_dBm = { 0.0f, 10.0f, 30.0f, 0.0f };
Status = Devcie_SetFreqResponseCompensation(&Device, 1, Compensate_freq.data(),
Compensate_dBm.data(), 4);
MeasAuxInfo_TypeDef MeasAuxInfo;
while (1) {
Status = SWP_GetFullSweep(&Device, Frequency.data(), PowerSpec_dBm.data(), &MeasAuxInfo);
}
Status = Device_Close(&Device);
```

8.6 Device_GetNetworkDeviceList

```
int Device_GetNetworkDeviceList(
    uint8_t*DeviceCount,
    NetworkDeviceInfo_TypeDef DeviceInfo[64],
    uint8_t LocalIP[4],
    uint8_t LocalMask[4]
)
```

Description	
When using an Ethernet-type device, retrieves the IP addresses and subnet masks of all devices on the network, and also returns the IP address and subnet mask of the local network interface.	
Compatibility	0.55.0 and later.
Parameter description	

[out] **DeviceCount**	Return the number of devices detected on the network.
[out] **DeviceInfo[64]**	Returns information for each device detected on the network, including the device serial number, device type, hardware version, MCU and FPGA firmware versions, as well as the IP address and subnet mask. Refer to the definition of the NetworkDeviceInfo_TypeDef structure for details.
[out] **LocalIP[4]**	Outputs the local IP address.
[out] **LocalMask[4]**	Outputs the local subnet mask.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	None.
Example	

int Status = -1; uint8_t DeviceCount = 0; uint8_t LocalIP[4]; uint8_t LocalMask[4];
NetworkDeviceInfo_TypeDef DeviceInfo[64];
Status = Device_GetNetworkDeviceList(&DeviceCount, DeviceInfo, LocalIP, LocalMask);	

8.7 Device_SetNetworkDeviceIP

```
int Device_SetNetworkDeviceIP(
        const uint64_t DeviceUID,
        const uint8_t IPAddress[4],
        const uint8_t SubnetMask[4]
)
```

Description	
When using an Ethernet-type device, configures the network device's IP address and subnet mask based on the device's unique serial number, enabling network parameter setup and device communication management.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **DeviceUID**	Specifies the serial number of the device.
[in] **IPAddress[4]**	Specifies the IP address to be configured.
[in] **SubnetMask[4]**	Specifies the subnet mask to be configured.

Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after Device_Open.
Example	

int Status = -1; uint64_t DeviceUID = 31325119004c0048;
uint8_t IPAddress[4] = { 192, 168, 2, 100};
uint8_t SubnetMask[4] = {255, 255, 255, 0};
Status = Device_SetNetworkDeviceIP(DeviceUID, IPAddress, SubnetMask);	

8.8 Device_SetNetworkDeviceIP_PM1

int Device_SetNetworkDeviceIP_PM1(**const uint8_t DeviceIP[4],** **const uint8_t IPAddress[4],** **const uint8_t SubnetMask[4]** **)**	
Description	
When using an Ethernet-type device, configures a new IP address and subnet mask for the device by specifying its current IP address, enabling network parameter updates and device communication management.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **DeviceIP[4]**	Specifies the device's current IP address, used to locate the device.
[in] **IPAddress[4]**	Specifies the new IP address to be configured.
[in] **SubnetMask[4]**	Specifies the new subnet mask to be configured.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	None.
Example	

int Status = -1;
uint8_t DeviceIP[4] = {192, 168, 1, 100};
uint8_t IPAddress[4] = { 192, 168, 2, 100};	

```
uint8_t SubnetMask[4] = {255, 255, 255, 0};
Status = Device_SetNetworkDeviceIP_PM1(DeviceIP, IPAddress, SubnetMask);
```

8.9 Device_GetFullUID

int Device_GetFullUID(
    void** **Device,**
    uint64_t* **UID_L64,**
    uint32_t* **UID_H32**
)	

Description	
Retrieves the complete UID information of the device, including the high 32 bits and low 64 bits. This is done in non-real-time mode, so it does not interrupt data acquisition, and the information is updated after a data packet is received.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
[out] **UID_L64**	Outputs the lower 64 bits of the device UID.
[out] **UID_H32**	Outputs the upper 32 bits of the device UID.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after Device_Open.
Example	

```
int Status = -1; int DeviceNum = 0; void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
uint64_t UID_L64; uint32_t UID_H32;
Status = Device_GetFullUID(&Device, & UID_L64, & UID_H32);
Status = Device_Close(&Device);
```

8.10 Device_GetHardwareState

int Device_GetHardwareState(
    void** **Device,**
    HardWareState_TypeDef* **HardWareState**
)	

Description	
Retrieves the device hardware status information, including GNSS peripheral type, receiver type, OCXO type, as well as the support status of internal clock, signal source, ADC variable sampling rate, and intermediate frequency (IF) filters.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
[out] **HardWareState**	Outputs the device hardware status information, including GNSS peripheral type, signal source support, ADC variable sampling rate, and other functional states. Refer to the definition of the HardWareState_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after Device_Open.
Example	

```
int Status = -1; int DeviceNum = 0; void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
HardWareState_TypeDef HardWareState;
Status = Device_GetHardwareState (&Device, & HardWareState);
Status = Device_Close(&Device);
```

8.11 Device_QueryDeviceInfoWithBus

int Device_QueryDeviceInfoWithBus(int DeviceNum, const BootProfile_TypeDef* BootProfile, BootInfo_TypeDef* BootInfo)	
Description	
Queries device information by device index and returns the basic device information, bus speed and version, API version, as well as any errors and warnings encountered during the startup process.	
Compatibility	0.55.0 and later.
Parameter description	
[in] DeviceNum	Specifies the device index to be opened.
[in] BootProfile	Device startup configuration, including interface type, power supply method, and network parameters, used to initialize the device. Refer to the definition of the BootProfile_TypeDef structure for details.
[out] BootInfo	Returns the device startup information, including device details, bus speed and version, API version, and any errors or warnings encountered during the startup process. Refer to the definition of the BootInfo_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called before Device_Open.
Example	

int Status = -1; int DeviceNum = 0;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;
Status = Device_QueryDeviceInfoWithBus(DeviceNum, &BootProfile, &BootInfo);	

8.12 Device_SetFreqScan

int Device_SetFreqScan(void** Device, double StartFreq_Hz, double StopFreq_Hz, uint16_t SweepPts)	
Description	
Configures the device frequency sweep parameters, including start frequency, stop frequency, and number of sweep points, for spectrum scanning setup.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
[in] **StartFreq_Hz**	Start frequency of the sweep, in Hz.
[in] **StopFreq_Hz**	Stop frequency of the sweep, in Hz.
[in] **SweepPts**	The total number of frequency points to be swept.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after Device_Open.
Example	

```
int Status = -1; int DeviceNum = 0; void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
double StartFreq_Hz = 1e9;
double StopFreq_Hz = 2e9;
uint16_t SweepPts = 5;
Status = Device_SetFreqScan(&Device, StartFreq_Hz, StopFreq_Hz, SweepPts);
Status = Device_Close(&Device);
```

9. System Functions Related to Device and GNSS

9.1 Device_SetGNSSAntennaState

int Device_SetGNSSAntennaState(void** Device, const GNSSAntennaState_TypeDef GNSSAntennaState)	
Description	
Sets the GNSS antenna status, allowing control of the antenna's power or operating mode (optional feature required).	
Compatibility	0.55.0 and later.
Parameter description	
[in] Device	Device handle.
[in] GNSSAntennaState	Set the GNSS antenna status. Refer to the definition of the GNSSAntennaState_TypeDef enumeration structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after Device_Open.
Example	Please refer to the relevant example of the Device_GetGNSSAntennaState() function.

9.2 Device_GetGNSSAntennaState/Device_GetGNSSAntennaState_Realtime

int Device_GetGNSSAntennaState(void** Device, GNSSAntennaState_TypeDef* GNSSAntennaState)
int Device_GetGNSSAntennaState_Realtime(void** Device,

GNSSAntennaState_TypeDef* **GNSSAntennaState**)	
Description	
When using the GNSS functionality, retrieves the GNSS antenna status (optional feature required). Device_GetGNSSAntennaState: Non-real-time mode. Does not interrupt data acquisition, but the information is updated only after a data packet is received. Device_GetGNSSAntennaState_Realtime: Real-time mode. Temporarily occupies the data channel for a short period of time.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
[out] **GNSSAntennaState**	Output the GNSS antenna status. Refer to the definition of the GNSSAntennaState_TypeDef enumeration structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after Device_Open.
Example	

int Status = -1; int DeviceNum = 0; void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
GNSSAntennaState_TypeDef GNSSAntennaState = GNSS_AntennaExternal;
Status = Device_SetGNSSAntennaState(&Device, GNSSAntennaState);
Status = Device_GetGNSSAntennaState(&Device, &GNSSAntennaState);
Status = Device_GetGNSSAntennaState_Realtime(&Device, &GNSSAntennaState);
Status = Device_Close(&Device);	

9.3 Device_GetGNSSAltitude/Device_GetGNSSAltitude_Realtime

int Device_GetGNSSAltitude(void** Device, int16_t* Altitude)	
int Device_GetGNSSAltitude_Realtime(void** Device, int16_t* Altitude)	
Description	
When using the GNSS functionality, retrieves the GNSS altitude information (optional feature required). Device_GetGNSSAltitude: Non-real-time mode. Does not interrupt data acquisition, but the information is updated only after a data packet is received. Device_GetGNSSAltitude_Realtime: Real-time mode. Temporarily occupies the data channel for a short period of time.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
[out] **Altitude**	Output the current GNSS altitude at the device's location, in meters.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after Device_Open.
Example	
int Status = -1; int DeviceNum = 0; void* Device = NULL; int16_t Altitude = 0; BootProfile_TypeDef BootProfile; BootProfile.DevicePowerSupply = USBPortAndPowerPort; BootProfile.PhysicalInterface = USB; BootInfo_TypeDef BootInfo; Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo); Status = Device_GetGNSSAltitude(&Device, &Altitude);	

```
Status = Device_GetGNSSAltitude_Realtime(&Device, &Altitude);

Status = Device_Close(&Device);
```

9.4 Device_AnysisGNSSTime

```
int Device_AnysisGNSSTime(
        double ABSTimestamp,
        int16_t* hour,
        int16_t* minute,
        int16_t* second,
        int16_t* Year,
        int16_t* month,
        int16_t* day
)
```

Description	
When using the GNSS functionality, parses the GNSS date and time information (optional feature required), converting the absolute timestamp into specific year, month, day, hour, minute, and second values.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **ABSTimestamp**	Specifies the absolute timestamp corresponding to the current data packet.
[out] **hour**	Outputs the parsed hour.
[out] **minute**	Outputs the parsed minute.
[out] **second**	Outputs the parsed second.
[out] **Year**	Outputs the parsed year.
[out] **month**	Outputs the parsed month.
[out] **day**	Outputs the parsed day.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	This function must be called after a data packet has been received.
Example	

```
int Status = -1; int DeviceNum = 0; void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
SWP_Profile_TypeDef ProfileIn, ProfileOut;
SWP_TraceInfo_TypeDef TraceInfo;
Status = SWP_ProfileDeInit(&Device, &ProfileIn);
Status = SWP_Configuration(&Device, &ProfileIn, &ProfileOut, &TraceInfo);
vector<double> Frequency(TraceInfo.FullsweepTracePoints);
vector<float> PowerSpec_dBm(TraceInfo.FullsweepTracePoints);
MeasAuxInfo_TypeDef MeasAuxInfo;
Status = SWP_GetFullSweep(&Device, Frequency.data(), PowerSpec_dBm.data(), &MeasAuxInfo);
int16_t hour = 0, minute = 0, second = 0, Year = 0, month = 0, day = 0;
Status = Device_AnysisGNSSTime(MeasAuxInfo.AbsoluteTimeStamp, &hour, &minute, &second,
&Year, &month, &day);
Status = Device_Close(&Device);
```

9.5 Device_SetDOCXOWorkMode

```
int Device_SetDOCXOWorkMode(
    void** Device,
    const DOCXOWorkMode_TypeDef DOCXOWorkMode
)
```

Description	
When using the GNSS functionality, sets the operating status of the DOCXO.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
[in] **DOCXOWorkMode**	Set the DOCXO operating mode.

	Refer to the definition of the DOCXOWorkMode_TypeDef enumeration structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after Device_Open.
Example	Please refer to the relevant example of the Device_GetDOCXOWorkMode_Realtime() function.

9.6 Device_GetDOCXOWorkMode/Device_GetDOCXOWorkMode_Realtime

```
int Device_GetDOCXOWorkMode(
        void** Device,
        DOCXOWorkMode_TypeDef* DOCXOWorkMode
)
```

```
int Device_GetDOCXOWorkMode_Realtime(
        void** Device,
        DOCXOWorkMode_TypeDef* DOCXOWorkMode
)
```

Description

When using the GNSS functionality, retrieves the operating status of the DOCXO (optional feature required).

Device_GetDOCXOWorkMode: Non-real-time mode. Does not interrupt data acquisition, but the information is updated only after a data packet is received.

Device_GetDOCXOWorkMode_Realtime: Real-time mode. Temporarily occupies the data channel for a short period of time.

Compatibility	0.55.0 and later.
Parameter description	
[in] Device	Device handle.
[out] DOCXOWorkMode	Returns the DOCXO operating mode. Refer to the definition of the DOCXOWorkMode_TypeDef enumeration structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.

Calling constraints	Must be called after Device_Open.
Example	

int Status = -1; int DeviceNum = 0; void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
DOCXOWorkMode_TypeDef DOCXOWorkMode = DOCXO_LockMode;
Status = Device_SetDOCXOWorkMode(&Device, DOCXOWorkMode);
Status = Device_GetDOCXOWorkMode(&Device, &DOCXOWorkMode);
Status = Device_GetDOCXOWorkMode_Realtime(&Device, &DOCXOWorkMode);
Status = Device_Close(&Device);	

9.7 Device_GetGNSSInfo/Device_GetGNSSInfo_Realtime

int Device_GetGNSSInfo(
    void**** Device,**
    GNSSInfo_TypeDef*** GNSSInfo**
)	

int Device_GetGNSSInfo_Realtime(
    void**** Device,**
    GNSSInfo_TypeDef*** GNSSInfo**
)	

Description	
When using the GNSS functionality, retrieves the GNSS device status information (optional feature required). Device_GetGNSSInfo: Non-real-time mode. Does not interrupt data acquisition, but the information is updated only after a data packet is received. Device_GetGNSSInfo_Realtime: Real-time mode. Temporarily occupies the data channel for a short period of time.	
Compatibility	0.55.0 and later.

Parameter description	
[in] **Device**	Device handle.
[out] **GNSSInfo**	Returns the GNSS device status information, including position coordinates, altitude, number of satellites, GNSS and DOCXO status, antenna status, and more. Refer to the definition of the GNSSInfo_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after Device_Open.

Example

```
int Status = -1; int DeviceNum = 0; void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
Status = Device_SetGNSSAntennaState(&Device, GNSS_AntennaExternal);
GNSSInfo_TypeDef GNSSInfo;
Status = Device_GetGNSSInfo(&Device, & GNSSInfo);
Status = Device_GetGNSSInfo_Realtime(&Device, & GNSSInfo);
Status = Device_Close(&Device);
```

9.8 Device_GetGNSS_SatDate/Device_GetGNSS_SatDate_Realtime

```
int Device_GetGNSS_SatDate(
        void** Device,
        GNSS_SatDate _TypeDef* GNSS_SatDate
)
```

```
int Device_GetGNSS_SatDate_Realtime(
        void** Device,
        GNSS_SatDate_TypeDef* GNSS_SatDate
)
```

Description

Retrieves the current GNSS satellite signal-to-noise ratio (SNR) information of the device (optional feature required), including the number of visible satellites and the signal strength of satellites used for positioning. Device_GetGNSS_SatDate: Non-real-time mode. Does not interrupt data acquisition, but the information is updated only after a data packet is received. Device_GetGNSS_SatDate_Realtime: Real-time mode. Temporarily occupies the data channel for a short period of time.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
[out] **GNSS_SatDate**	Returns the GNSS satellite information of the current device, including the number of visible satellites and the satellites used for positioning. Refer to the definition of the GNSS_SatDate_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after Device_Open. Note: The signal-to-noise ratio (SNR) and satellite count are valid only after GNSS lock is achieved; otherwise, the default values are 0.
Example	

```
int Status = -1; int DeviceNum = 0; void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
Status = Device_SetGNSSAntennaState(&Device, GNSS_AntennaExternal);
GNSS_SatDate_TypeDef GNSS_SatDate;
Status = Device_GetGNSS_SatDate(&Device, &GNSS_SatDate);
Status = Device_GetGNSS_SatDate_Realtime(&Device, &GNSS_SatDate);
Status = Device_Close(&Device);
```

10. Standard Spectrum Analysis Main Functions

10.1 SWP_ProfileDeInit

int SWP_ProfileDeInit(void** Device, SWP_Profile_TypeDef* UserProfile_O)	
Description	
Initializes the configuration parameter set for SWP mode (SWP_Profile_TypeDef). SWP_Profile_TypeDef defines all device parameters in SWP mode, including frequency, reference level, resolution bandwidth (RBW), and other related settings.	
Compatibility	0.55.0 and later.
Parameter description	
[in] Device	Device handle.
[out] UserProfile_O	Outputs the default configuration parameter set. Refer to the definition of the SWP_Profile_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after Device_Open.
Example	Please refer to the relevant example of the SWP_GetPartialSweep() function.

10.2 SWP_Configuration

```
int SWP_Configuration(
    void** Device,
    const SWP_Profile_TypeDef* ProfileIn,
    SWP_Profile_TypeDef* ProfileOut,
    SWP_TraceInfo_TypeDef* TraceInfo
)
```

Description

Configures the spectrum analyzer device to operate in Standard Spectrum Analysis mode and sets the relevant parameters for this mode. In SWP mode, parameters such as frequency, reference level, resolution bandwidth, and others are encapsulated in the SWP_Profile_TypeDef structure	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
[in] **ProfileIn**	Configuration profile input. Refer to the definition of the SWP_Profile_TypeDef structure for details.
[out] **ProfileOut**	Configuration profile output. Not all parameters in ProfileIn can be strictly applied; the device may automatically adjust certain parameters according to hardware capabilities or internal constraints. The actual applied configuration shall be based on the output profile. Refer to the definition of the SWP_Profile_TypeDef structure for details.
[out] **TraceInfo**	Returns the relevant information of the spectrum trace. Refer to the definition of the SWP_TraceInfo_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after SWP_ProfileDeInit.
Example	Please refer to the relevant example of the SWP_GetPartialSweep() function.

10.3 SWP_AutoSet

```
int SWP_AutoSet(

        void** Device,

        SWPApplication_TypeDef Application,

        const SWP_Profile_TypeDef* ProfileIn,

        SWP_Profile_TypeDef* ProfileOut,

        SWP_TraceInfo_TypeDef* TraceInfo,

        uint8_t ifDoConfig

)
```

Description	
In Standard Spectrum Analysis (SWP) mode, provides recommended device configuration based on the application objective. In SWP mode, parameters such as frequency, reference level, resolution bandwidth (RBW), and others are encapsulated in the SWP_Profile_TypeDef structure.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
[in] **Application**	Set the measurement type. Refer to the definition of the SWPApplication_TypeDef enumeration structure for details.
[in] **ProfileIn**	Configuration profile input. Refer to the definition of the SWP_Profile_TypeDef structure for details.
[out] **ProfileOut**	Configuration profile output. Refer to the definition of the SWP_Profile_TypeDef structure for details.
[out] **TraceInfo**	Return information related to the spectrum trace. Refer to the definition of the SWP_TraceInfo_TypeDef structure for details.
[in] **ifDoConfig**	Specify whether it is necessary to call the SWP_Configuration() function separately. 0: Required; 1: Not required.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	When ifDoConfig is 0, SWP_Configuration must be called beforehand. When ifDoConfig is 1, the function internally calls SWP_Configuration, so no additional call to SWP_Configuration is required
Example: (ifDoConfig = 1)	

int Status = -1;int DeviceNum = 0;void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;	

```
BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
SWP_Profile_TypeDef ProfileIn, ProfileOut;
SWP_TraceInfo_TypeDef TraceInfo;
uint8_t ifDoConfig=1;
SWPApplication_TypeDef Application;
Status = SWP_ProfileDeInit(&Device, &ProfileIn);
Status = SWP_AutoSet (&Device, Application ,&ProfileIn, &ProfileOut, &TraceInfo, ifDoConfig);
Status = Device_Close(&Device);
```

10.4 SWP_GetPartialSweep

```
int SWP_GetPartialSweep(
    void** Device,
    double Freq_Hz[],
    float PowerSpec_dBm[],
    int* HopIndex,
    int* FrameIndex,
    MeasAuxInfo_TypeDef* MeasAuxInfo
)
```

Description	
Retrieves the spectrum results at each frequency hopping point in SWP mode, while also returning the current hop index, frame index, and auxiliary information of the measurement data. This allows the user to assemble multiple scans into a complete spectrum curve. The function also returns its execution status.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
[out] **Freq_Hz[]**	Returns the frequency array corresponding to the current hop point, in Hz. The array size equals TraceInfo.PartialSweepTracePoints.
[out] **PowerSpec_dBm[]**	Returns the amplitude array corresponding to the current hop point, in dBm.

	The array size equals TraceInfo.PartialSweepTracePoints.
[out] **HopIndex**	Return the hop index of the data.
[out] **FrameIndex**	Returns the frame index of the data. This is valid only when the sweep time mode is not SWTMode_minSWT and the detector is set to MaxPower.
[out] **MeasAuxInfo**	Returns the auxiliary information of the data. Refer to the definition of the MeasAuxInfo_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after SWP_Configuration.
Example	

```
int Status = -1; int DeviceNum = 0; void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
SWP_Profile_TypeDef SWP_ProfileIn,SWP_ProfileOut;
SWP_TraceInfo_TypeDef TraceInfo;
SWP_ProfileDeInit(&Device, &SWP_ProfileIn);
SWP_ProfileIn.StartFreq_Hz = 9e3;
SWP_ProfileIn.StopFreq_Hz = 6.35e9;
SWP_ProfileIn.RBWMode = RBW_Manual;
SWP_ProfileIn.RBW_Hz = 200e3;
Status = SWP_Configuration(&Device, &SWP_ProfileIn, &SWP_ProfileOut, &TraceInfo);
vector<double> Frequency(TraceInfo.FullsweepTracePoints);
vector<float> PowerSpec_dBm(TraceInfo.FullsweepTracePoints);
int HopIndex = 0, FrameIndex = 0;
MeasAuxInfo_TypeDef MeasAuxInfo;
for (int i = 0; i < TraceInfo.TotalHops; i++) {
Status = SWP_GetPartialSweep(&Device, Frequency.data() + i * TraceInfo.PartialsweepTracePoints, PowerSpec_dBm.data() + i * TraceInfo.PartialsweepTracePoints, &HopIndex, &FrameIndex, &MeasAuxInfo);
}
```

Device_Close(&Device);

10.5 SWP_GetFullSweep

int SWP_GetFullSweep(void** **Device,** double **Freq_Hz[],** float **PowerSpec_dBm[],** MeasAuxInfo_TypeDef* **MeasAuxInfo**)	
Description	
Retrieves the complete spectrum result in SWP mode along with the auxiliary information of the measurement data, and also returns the function execution status.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
[out] **Freq_Hz[]**	Returns the frequency array, in Hz. The array size equals TraceInfo.PartialSweepTracePoints.
[out] **PowerSpec_dBm[]**	Returns the amplitude array, in dBm. The array size equals TraceInfo.PartialSweepTracePoints.
[out] **MeasAuxInfo**	Returns the auxiliary information of the data. Refer to the definition of the MeasAuxInfo_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after SWP_Configuration.
Example	

int Status = -1;int DeviceNum = 0;void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;	

```
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);

SWP_Profile_TypeDef ProfileIn;

SWP_Profile_TypeDef ProfileOut;

SWP_TraceInfo_TypeDef TraceInfo;

Status = SWP_ProfileDeInit(&Device, &ProfileIn);

Status = SWP_Configuration(&Device, &ProfileIn, &ProfileOut, &TraceInfo);

vector<double> Frequency(TraceInfo.FullsweepTracePoints);

vector<float> PowerSpec_dBm(TraceInfo.FullsweepTracePoints);

MeasAuxInfo_TypeDef MeasAuxInfo;

Status = SWP_GetFullSweep(&Device, Frequency.data(), PowerSpec_dBm.data(), &MeasAuxInfo);

Status = Device_Close(&Device);
```

11. Standard Spectrum Analysis Other Functions

11.1 SWP_GetPartialSweep_PM1

int SWP_GetPartialSweep_PM1(
    void**** Device,**
    SWPTrace_TypeDef *** PartialTrace**
)

Description
Polymorphic version of SWP_GetPartialSweep. Based on the original function, it modifies the format of the returned data to enhance data encapsulation.

Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
[out] **PartialTrace**	Returns the top-level structure containing the configuration, returned information, and temporary data. Refer to the definition of the SWPTrace_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after SWP_Configuration.
Example	

```
int Status = -1; int DeviceNum = 0; void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
SWP_Profile_TypeDef ProfileIn;
SWP_Profile_TypeDef ProfileOut;
SWP_TraceInfo_TypeDef TraceInfo;
Status = SWP_ProfileDeInit(&Device, &ProfileIn);
Status = SWP_Configuration(&Device, &ProfileIn, &ProfileOut, &TraceInfo);
```

SWPTrace_TypeDef PartialTrace;
vector<double> Frequency(TraceInfo.PartialsweepTracePoints);
vector<float> PowerSpec_dBm(TraceInfo.PartialsweepTracePoints);
PartialTrace.Freq_Hz = Frequency.data();
PartialTrace.PowerSpec_dBm = PowerSpec_dBm.data();
Status = SWP_GetPartialSweep_PM1(&Device, &PartialTrace);
Status = Device_Close(&Device);

11.2 SWP_ResetTraceHold

int SWP_ResetTraceHold (void Device)**	
Description	
When the trace update mode (SWP_TraceType_TypeDef) is set to MaxHold or MinHold, the held trace data is reset.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
Return value	None.
Calling constraints	Effective only when SWP_TraceType_TypeDef is set to MaxHold or MinHold. Must be called after the SWP_Get function.
Example	

int Status = -1;int DeviceNum = 0;void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
SWP_Profile_TypeDef ProfileIn;
SWP_Profile_TypeDef ProfileOut;
SWP_TraceInfo_TypeDef TraceInfo;
Status = SWP_ProfileDeInit(&Device, &ProfileIn);	

```
Status = SWP_Configuration(&Device, &ProfileIn, &ProfileOut, &TraceInfo);

vector<double> Frequency(TraceInfo.PartialsweepTracePoints);

vector<float> PowerSpec_dBm(TraceInfo.PartialsweepTracePoints);

int HopIndex = 0;int FrameIndex = 0;

MeasAuxInfo_TypeDef MeasAuxInfo;

Status = SWP_GetPartialSweep(&Device, Frequency.data(), PowerSpec_dBm.data(),
&HopIndex,&FrameIndex, &MeasAuxInfo);

SWP_ResetTraceHold(&Device);

Status = Device_Close(&Device);
```

12. Phase Noise Measurement Mode

12.1 PNM_ProfileDeInit

int PNM_ProfileDeInit(void** Device, PNM_Profile_TypeDef* PNM_Profile)	
Description	
Provides the default configuration parameters for phase noise measurement, initializing the device's phase noise measurement settings.	
Compatibility	0.55.58 and later.
Parameter description	
[in] Device	Device handle.
[out] PNM_Profile	Configuration structure for phase noise measurement. Refer to the definition of the PNM_Profile_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after Device_Open.
Example	Please refer to the relevant example of the PNM_Set_FrameDetRatio() function.

12.2 PNM_Configuration

int PNM_Configuration (void** Device, const PNM_Profile_TypeDef* PNM_Profile_in, PNM_Profile_TypeDef* PNM_Profile_out, PNM_MeasInfo_TypeDef* PNM_MeasInfo)
Description
Configures parameters related to phase noise measurement.

Compatibility	0.55.58 and later.
Parameter description	
[in] **Device**	Device handle.
[in] **PNM_Profile_in**	Input configuration structure. Refer to the definition of the PNM_Profile_TypeDef structure for details.
[out] **PNM_Profile_out**	Output configuration structure, returning the measurement parameters actually applied by the device. Refer to the definition of the PNM_Profile_TypeDef structure for details.
[out] **PNM_MeasInfo**	Structure containing phase noise measurement information. Refer to the definition of the PNM_MeasInfo_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after PNM_ProfileDeInit.
Example	Please refer to the relevant example of the PNM_Set_FrameDetRatio() function.

12.3 PNM_StartMeasure

int PNM_StartMeasure(void Device)**	
Description	
Starts a phase noise measurement. Call this function to initiate the measurement before acquiring data.	
Compatibility	0.55.58 and later.
Parameter description	
[in] **Device**	Device handle.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after PNM_Configuration.
Example	Please refer to the relevant example of the PNM_Set_FrameDetRatio() function.

12.4 PNM_StopMeasure

int PNM_StopMeasure(void Device)**	
Description	
Forcibly stops the current phase noise measurement.	
Compatibility	0.55.58 and later.
Parameter description	
[in] **Device**	Device handle.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after PNM_StartMeasure.
Example	Please refer to the relevant example of the PNM_Set_FrameDetRatio() function.

12.5 PNM_GetPartialUpdatedFullTrace

```
int PNM_GetPartialUpdatedFullTrace(
        void** Device,
        double* CarrierFreq,
        float* CarrierPower,
        double Freq[],
        float PhaseNoise[],
        uint32_t FrameUpdateCounts[],
        MeasAuxInfo_TypeDef* MeasAuxInfo,
        float* RefLevel
)
```

Description	
Retrieves the phase noise measurement result trace.	
Compatibility	0.55.58 and later.
Parameter description	

[in] **Device**	Device handle.
[out] **CarrierFreq**	Carrier frequency.
[out] **CarrierPower**	Carrier power.
[out] **Freq[]**	Trace frequency axis, in Hz.
[out] **PhaseNoise[]**	Trace power axis, in dBc/Hz.
[out] **FrameUpdateCounts[]**	Refresh counter (index 0 corresponds to the farthest segment, N to the nearest segment; each element represents the number of frames refreshed for that segment).
[out] **MeasAuxInfo**	Auxiliary measurement information structure. Refer to the definition of the MeasAuxInfo_TypeDef structure for details.
[out] **RefLevel**	Returns the reference level corresponding to the current measurement.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Call this function after PNM_StartMeasure. By calling the Get interface PartialUpdateCounts times, a complete measurement result can be obtained. To perform further measurements afterward, StartMeasure must be called again.
Example	Please refer to the relevant example of the PNM_Set_FrameDetRatio() function.

12.6 PNM_AutoSearch

int PNM_AutoSearch (void**** Device,** double*** CarrierFreq,** uint8_t **Found** **)**	
Description	
Performs a panoramic scan to detect signals whose power exceeds the carrier threshold.	
Compatibility	0.55.58 and later.

Parameter description	
[in] **Device**	Device handle.
[out] **CarrierFreq**	Carrier frequency.
[out] **Found**	Carrier presence flag: 0: No carrier; 1: Carrier present.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after PNM_Configuration.
Example	Please refer to the relevant example of the PNM_Set_FrameDetRatio() function.

12.7 PNM_Preset_FrameDetRatio

int PNM_Preset_FrameDetRatio (void** **Device,** PNM_MeasInfo_TypeDef* **MeasInfo** **)**	
Description	
Resets the frame detection ratio for each frequency segment.	
Compatibility	0.55.58 and later.
Parameter description	
[in] **Device**	Device handle.
[out] **MeasInfo**	After resetting the frame detection ratio, update the phase noise measurement information structure. Refer to the definition of the PNM_MeasInfo_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after PNM_Configuration.
Example	Please refer to the relevant example of the PNM_Set_FrameDetRatio() function.

12.8 PNM_Preset_FrameDetRatio

int PNM_Preset_FrameDetRatio (void** Device, uint32_t FrameDetRatioOfSegment[], PNM_MeasInfo_TypeDef* MeasInfo)	
Description	
Manually configures the frame detection ratio for each frequency segment.	
Compatibility	0.55.58 and later.
Parameter description	
[in] Device	Device handle.
[in] FrameDetRatioOfSegment[]	Array for setting the frame detection ratio (array length = Segments; index 0 corresponds to the farthest segment, N to the nearest segment).
[out] MeasInfo	After adjusting the frame detection ratio, update the phase noise measurement information structure. Refer to the definition of the PNM_MeasInfo_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after PNM_Configuration.
Example	

```
int Status = 0;void* Device = NULL;int DeviceNum = 0;
BootProfile_TypeDef BootProfile;
BootInfo_TypeDef BootInfo;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
PNM_Profile_TypeDef PNM_ProfileIn, PNM_ProfileOut;
PNM_MeasInfo_TypeDef PNM_MeasInfo;
```

```
PNM_ProfileDeInit(&Device, &PNM_ProfileIn);
PNM_ProfileIn.CenterFreq = 1e9;
PNM_ProfileIn.Threshold = -50.0;
PNM_ProfileIn.RBWRatio = 0.1;
PNM_ProfileIn.StartOffsetFreq = 100;
PNM_ProfileIn.StopOffsetFreq = 1e6;
PNM_ProfileIn.TraceAverage = 1;
// Configure the device's phase noise measurement state
Status = PNM_Configuration(&Device, &PNM_ProfileIn, &PNM_ProfileOut, &PNM_MeasInfo);
// Full-band carrier search (advanced, optional): You can use the PNM_AutoSearch interface to
perform a panoramic scan and detect signals exceeding the carrier decision threshold
//double PeakFreq = 1.0;
//uint8_t Found = 0;
//Status = PNM_AutoSearch(&Device, &PeakFreq, &Found);
// If an ideal carrier is found, this frequency can be configured to the device for analysis via the
PNM_Configuration interface.
// Manual setting of detection ratio (advanced, optional): You can use the PNM_Set_FrameDetRatio
interface to manually adjust the frame detection ratio for each frequency segment.
// PNM_MeasInfo.FrameDetRatioOfSegment[PNM_MeasInfo.Segments - 1] = 10;
// Status = PNM_Set_FrameDetRatio(&Device, PNM_MeasInfo.FrameDetRatioOfSegment,
&PNM_MeasInfo);
// Reset frame detection ratio (advanced, optional): You can use the PNM_Preset_FrameDetRatio
interface to restore the frame detection ratio of each segment to its default value.
// PNM_Preset_FrameDetRatio(&Device, &PNM_MeasInfo);
vector<double> Freq(PNM_MeasInfo.TracePoints);
vector<float> PhaseNoise(PNM_MeasInfo.TracePoints);
double CarrierFreq;float CarrierPower;float RefLevel;
vector<uint32_t> FrameUpdateCounts(PNM_MeasInfo.Segments);
MeasAuxInfo_TypeDef MeasAuxInfo;
while(1)
{
PNM_StartMeasure(&Device); // Start a phase noise measurement session
for (int i = 0; i < PNM_MeasInfo.PartialUpdateCounts; i++) // Retrieve the trace of a phase noise
measurement result
{
Status = PNM_GetPartialUpdatedFullTrace(&Device, &CarrierFreq, &CarrierPower, Freq.data(),
PhaseNoise.data(), FrameUpdateCounts.data(), &MeasAuxInfo, &RefLevel);
if (Status == APIRETVAL_NoError)
{
}
else
{
switch (Status)
{
case APIRETVAL_WARNING_CarrierLoss :
{
cout << "No carrier found" << endl; // No signal exceeding the carrier decision threshold was found
near the specified frequency points
break;
}
case APIRETVAL_WARNING_MeasUpdate :
{
i = 0;
cout << "Measurement status updated" << endl;
break;
}
default: cout << " Please refer to the programming guide to check the general error codes" << endl;
}
}
}
cout << "wait";
}
PNM_StopMeasure(&Device);
Device_Close(&Device);
```

13. Receiver/IQ Stream Main Functions

13.1 IQS_ProfileDeInit

int IQS_ProfileDeInit(void** Device, IQS_Profile_TypeDef* UserProfile_O)	
Description	
Initialize the parameters related to IQS mode. In IQS mode, parameters such as center frequency, reference level, and decimation factor are encapsulated within the IQS_Profile_TypeDef structure.	
Compatibility	0.55.0 and later.
Parameter description	
[in] Device	Device handle.
[out] UserProfile_O	Pointer to the IQS configuration structure. After the function executes, this structure will be populated with system-defined default configuration values. Refer to the definition of the IQS_Profile_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after Device_Open.
Example	Please refer to the relevant example of the IQS_GetIQStream() function.

13.2 IQS_Configuration

int IQS_Configuration(void** Device, const IQS_Profile_TypeDef* ProfileIn, IQS_Profile_TypeDef* ProfileOut, IQS_StreamInfo_TypeDef* StreamInfo)
Description

Configure the spectrum analyzer for Receiver/IQ Stream (IQS) mode. In IQS mode, the local oscillator (LO) signal is fixed, and the device receives an RF signal centered at the LO frequency with a specified bandwidth. When the decimation factor is ≥2, using USB 3.0 and a high-speed hard drive for data transfer enables continuous time-domain recording.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
[in] **IQS_ProfileIn**	Pointer to the IQS configuration structure. Refer to the definition of the IQS_Profile_TypeDef structure for details.
[out] **IQS_ProfileOut**	Pointer to the IQS configuration structure. Not all data in ProfileIn may be strictly applied; the device will automatically adjust certain parameters based on hardware capabilities or internal constraints. The actual applied settings are reflected in the output configuration set. Refer to the definition of the IQS_Profile_TypeDef structure for details.
[out] **StreamInfo**	Information related to the IQ time-domain data stream in IQS mode. Refer to the definition of the IQS_StreamInfo_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after IQS_ProfileDeInit.
Example	Please refer to the relevant example of the IQS_GetIQStream() function.

13.3 IQS_BusTriggerStart

int IQS_BusTriggerStart(void Device)**	
Description	
Initiate a bus trigger.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.

Calling constraints	Must be called before IQS_GetIQStream.
Example	Please refer to the relevant example of the IQS_GetIQStream() function.

13.4 IQS_BusTriggerStop

int IQS_BusTriggerStop(void Device)**	
Description	
Terminate the current bus trigger. When TriggerMode = FixedPoints, the bus trigger will automatically stop after being started by the IQS_BusTriggerStart function and reaching the specified trigger length, without needing to call this function.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called before IQS_GetIQStream.
Example	Please refer to the relevant example of the IQS_GetIQStream() function.

13.5 IQS_GetIQStream

```
int IQS_GetIQStream(
        void** Device,
        void** AlternIQStream,
        float* ScaleToV,
        IQS_TriggerInfo_TypeDef* TriggerInfo,
        MeasAuxInfo_TypeDef* MeasAuxInfo
)
```

Description	
Call this function to obtain time-domain data, measurement information, and trigger information in IQS mode.	
Compatibility	0.55.0 and later.
Parameter description	

[in] **Device**	Device handle.
[out] **AlternIQStream**	Address of the time-domain data (interleaved IQ format). Each data packet is fixed at 64,968 bytes. When the IQ data type is int8_t, each of the I and Q channels contains 32,484 points, with each point occupying 1 byte; When the IQ data type is int16_t, each of the I and Q channels contains 16,242 points, with each point occupying 2 bytes; When the IQ data type is int32_t, each of the I and Q channels contains 8,121 points, with each point occupying 4 bytes. IQ data is stored in an interleaved manner: I Q I Q ...
[out] **ScaleToV**	Coefficient for converting the raw time-domain data acquired by the ADC into absolute voltage (V).
[out] **TriggerInfo**	Trigger-related information for the IQ data stream. Refer to the definition of the IQS/DET/RTA_TriggerInfo_TypeDef structure for details.
[out] **MeasAuxInfo**	Returns auxiliary information for the measurement data. Refer to the definition of the MeasAuxInfo_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after IQS_Configuration.
Example	

```
int Status = -1; int DeviceNum = 0; void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB; BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
IQS_Profile_TypeDef ProfileIn, ProfileOut;
IQS_StreamInfo_TypeDef StreamInfo;
Status = IQS_ProfileDeInit(&Device, &ProfileIn);
Status = IQS_Configuration(&Device, &ProfileIn, &ProfileOut, &StreamInfo);
Status = IQS_BusTriggerStart(&Device);
void* AlternIQStream = NULL; float ScaleToV = 0;
IQS_TriggerInfo_TypeDef TriggerInfo;
```

```
MeasAuxInfo_TypeDef MeasAuxInfo;
Status = IQS_GetIQStream(&Device, &AlternIQStream, &ScaleToV, &TriggerInfo, &MeasAuxInfo);
Status = IQS_BusTriggerStop(&Device);
Status = Device_Close(&Device);
```

14. Receiver/IQ Stream Other Functions

14.1 IQS_MultiDevice_WaitExternalSync

```
int IQS_MultiDevice_WaitExternalSync(
        void** Device,
        const IQS_Profile_TypeDef* ProfileIn
)
```

Description	
Call this function to wait for a multi-device synchronous trigger signal, allowing multiple devices to start or acquire data simultaneously.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
[in] **ProfileIn**	Pointer to the IQS configuration structure. Refer to the definition of the IQS_Profile_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	This must be called after IQS_Configuration, with TriggerSource set to MultiDevSyncByExt or MultiDevSyncByGNSS1PPS.
Example	Please refer to the relevant example of the IQS_MultiDevice_Run() function.

14.2 IQS_MultiDevice_Run

```
int IQS_MultiDevice_Run(void** Device)
```

Description
Call this function to enable multi-device synchronous operation, starting multiple devices for synchronized data acquisition or operation.

Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after IQS_MultiDevice_WaitExternalSync.
Example	

```
int Status = -1, Status0 = -1; int DeviceNum0 = 0; int DeviceNum1 = 0;
void* Device0 = NULL; void* Device1 = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device0, DeviceNum0, &BootProfile, &BootInfo);
Status0 = Device_Open(&Device1, DeviceNum1, &BootProfile, &BootInfo);
IQS_Profile_TypeDef ProfileIn0, ProfileIn1;
IQS_Profile_TypeDef ProfileOut0, ProfileOut1;
IQS_StreamInfo_TypeDef StreamInfo0, StreamInfo1;
Status = IQS_ProfileDeInit(&Device0, &ProfileIn0);
Status = IQS_ProfileDeInit(&Device1, &ProfileIn1);
ProfileIn0.TriggerSource = MultiDevSyncByExt;
ProfileIn1.TriggerSource = MultiDevSyncByExt;
Status = IQS_Configuration(&Device0, &ProfileIn0, &ProfileOut0, &StreamInfo0);
Status0 = IQS_Configuration(&Device1, &ProfileIn1, &ProfileOut1, &StreamInfo1);
Status0 = IQS_MultiDevice_WaitExternalSync(&Device0, &ProfileOut0);
Status0 = IQS_MultiDevice_Run(&Device0);
Status = IQS_MultiDevice_Run(&Device1);
Status = Device_Close(&Device0);
Status0 = Device_Close(&Device1);
```

14.3 IQS_SyncTimer

int IQS_SyncTimer(void Device)**

Description	
Call this function to initiate timer-to-external-trigger synchronization.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after IQS_Configuration, with TriggerSource set to Timer.
Example	

```
int Status = -1; int DeviceNum = 0; void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
IQS_Profile_TypeDef ProfileIn, ProfileOut;
IQS_StreamInfo_TypeDef StreamInfo;
Status = IQS_ProfileDeInit(&Device, &ProfileIn);
ProfileIn.TriggerSource = Timer;
ProfileIn. TriggerTimerSync = SyncToExt_RisingEdge;
Status = IQS_Configuration(&Device, &ProfileIn, &ProfileOut, &StreamInfo);
Status = IQS_SyncTimer (&Device);
Status = Device_Close(&Device);
```

14.4 IQS_GetIQStream_PM1

```
int IQS_GetIQStream_PM1(
        void** Device,
        IQStream_TypeDef* IQStream
)
```

Description

Retrieve time-domain data in IQS mode. The data format can be int8_t, int16_t, or int32_t, which the user can select according to actual requirements.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
[out] **IQStream**	IQ data stream, including IQ data and related configuration information. Refer to the definition of the IQStream_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after IQS_Configuration.
Example	

```
int Status = -1; int DeviceNum = 0; void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
IQS_Profile_TypeDef ProfileIn, ProfileOut;
IQS_StreamInfo_TypeDef StreamInfo;
Status = IQS_ProfileDeInit(&Device, &ProfileIn);
Status = IQS_Configuration(&Device, &ProfileIn, &ProfileOut, &StreamInfo);
IQStream_TypeDef IQStream;
Status = IQS_BusTriggerStart(&Device);
Status = IQS_GetIQStream_PM1(&Device, &IQStream);
Status = IQS_BusTriggerStop(&Device);
Status = Device_Close(&Device);
```

14.5 IQS_GetIQStream_PM2

```
int IQS_GetIQStream_PM2(
    void** Device,
    IQStream_TypeDef* IQStream,
```

MeasAuxInfo_TypeDef* **MeasAuxInfo**)	
Description	
Retrieve time-domain data and measurement auxiliary information in IQS mode. The time-domain data format can be int8_t, int16_t, or int32_t, and the user can choose the format as needed.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
[out] **IQStream**	IQ data stream, including the IQ data and associated configuration information. Refer to the definition of the IQStream_TypeDef structure for details.
[out] **MeasAuxInfo**	Returns auxiliary information for the measurement data. Refer to the definition of the MeasAuxInfo_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after IQS_Configuration.
Example	

int Status = -1; int DeviceNum = 0; void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
IQS_Profile_TypeDef ProfileIn, ProfileOut;
IQS_StreamInfo_TypeDef StreamInfo;
Status = IQS_ProfileDeInit(&Device, &ProfileIn);
Status = IQS_Configuration(&Device, &ProfileIn, &ProfileOut, &StreamInfo);
IQStream_TypeDef IQStream;
MeasAuxInfo_TypeDef MeasAuxInfo;
Status = IQS_BusTriggerStart(&Device);
Status = IQS_GetIQStream_PM2(&Device, &IQStream, &MeasAuxInfo);	

```
Status = IQS_BusTriggerStop(&Device);

Status = Device_Close(&Device);
```

14.6 IQS_GetIQStream_Data

```
int IQS_GetIQStream_Data(
    void** Device,
    int16_t IQ_data[]
)
```

Description	
Call this function to obtain IQ time-domain data in int16_t format.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
[out] **IQ_data[]**	Array for receiving single-channel 16-bit IQ data.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after IQS_Configuration.
Example	

```
int Status = -1; int DeviceNum = 0; void* Device = NULL;

BootProfile_TypeDef BootProfile;

BootProfile.DevicePowerSupply = USBPortAndPowerPort;

BootProfile.PhysicalInterface = USB;

BootInfo_TypeDef BootInfo;

Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);

IQS_Profile_TypeDef ProfileIn, ProfileOut;

IQS_StreamInfo_TypeDef StreamInfo;

Status = IQS_ProfileDeInit(&Device, &ProfileIn);

Status = IQS_Configuration(&Device, &ProfileIn, &ProfileOut, &StreamInfo);

Status = IQS_BusTriggerStart(&Device);

vector<int16_t> IQ_Data(StreamInfo.StreamSamples);

Status = IQS_GetIQStream_Data(&Device, IQ_Data.data());
Status = Device_Close(&Device);
```

15. Power Detection Mode

DET is a detection analysis mode that performs power detection on signals within a specified bandwidth, helping users observe signal amplitude levels.

15.1 DET_ProfileDeInit

int DET_ProfileDeInit(
    void** **Device,**
    DET_Profile_TypeDef* **UserProfile_O**
)	

Description	
Initialize parameters related to DET mode. In DET mode, parameters such as center frequency, reference level, and decimation factor are encapsulated in the DET_Profile_TypeDef structure.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
[out] **UserProfile_O**	Pointer to the DET configuration structure. Refer to the definition of the DET_Profile_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after Device_Open.
Example	Please refer to the relevant example of the DET_GetPowerStream() function.

15.2 DET_Configuration

int DET_Configuration(
    void** **Device,**
    const DET_Profile_TypeDef* **ProfileIn,**
    DET_Profile_TypeDef* **ProfileOut,**
    DET_StreamInfo_TypeDef* **StreamInfo**

)	
Description	
Configure parameters related to DET mode. In DET mode, parameters such as center frequency, reference level, and decimation factor are encapsulated in the DET_Profile_TypeDef structure.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
[in] **DET_ProfileIn**	Pointer to the DET configuration structure. Refer to the definition of the DET_Profile_TypeDef structure for details.
[out] **DET_ProfileOut**	Pointer to the DET configuration structure. Refer to the definition of the DET_Profile_TypeDef structure for details.
[out] **StreamInfo**	Information related to DET data in DET mode. Refer to the definition of the DET_StreamInfo_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after DET_ProfileDeInit.
Example	Please refer to the relevant example of the DET_GetPowerStream() function.

15.3 DET_BusTriggerStart

int DET_BusTriggerStart(void Device)**	
Description	
Initiate a bus trigger.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called before DET_GetPowerStream.

Example	Please refer to the relevant example of the DET_GetPowerStream() function.

15.4 DET_BusTriggerStop

int DET_BusTriggerStop(void** Device)	
Description	
Terminate the current bus trigger. When TriggerMode = FixedPoints, the bus trigger will automatically stop after being started by the DET_BusTriggerStart function and reaching the specified trigger length, without needing to call this function.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called before DET_GetPowerStream.
Example	Please refer to the relevant example of the DET_GetPowerStream() function.

15.5 DET_GetPowerStream

```
int DET_GetPowerStream(
        void** Device,
        float NormalizedPowerStream[],
        float* ScaleToV,
        DET_TriggerInfo_TypeDef* TriggerInfo,
        MeasAuxInfo_TypeDef* MeasAuxInfo
)
```

Description
Retrieve detection data in DET mode, along with the conversion factor from integer values to absolute amplitude (in volts) and trigger-related information. NormalizedPowerStream is calculated as $\sqrt{(I^2 + Q^2)}$.

Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
[out]**NormalizedPowerStream[]**	Returns the instantaneous amplitude of each data point, calculated as √(I^2 + Q^2).
[out] **ScaleToV**	Coefficient for converting unitless instantaneous amplitude (NormalizedPowerStream) to absolute voltage (V).
[out] **TriggerInfo**	Trigger-related information for DET data. Refer to the definition of the IQS/DET/RTA_TriggerInfo_TypeDef structure for details.
[out] **MeasAuxInfo**	Returns auxiliary information for the measurement data. Refer to the definition of the MeasAuxInfo_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after DET_Configuration.
Example	

```
int Status = -1; int DeviceNum = 0; void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
DET_Profile_TypeDef ProfileIn, ProfileOut;
DET_StreamInfo_TypeDef StreamInfo;
Status = DET_ProfileDeInit(&Device, &ProfileIn);
Status = DET_Configuration(&Device, &ProfileIn, &ProfileOut, &StreamInfo);
vector<float> NormalizedPowerStream(StreamInfo.PacketSamples);
float ScaleToV = 0;
DET_TriggerInfo_TypeDef TriggerInfo;
MeasAuxInfo_TypeDef MeasAuxInfo;
Status = DET_BusTriggerStart(&Device);
Status = DET_GetPowerStream(&Device, NormalizedPowerStream.data(), &ScaleToV, &TriggerInfo,
&MeasAuxInfo);
Status = DET_BusTriggerStop(&Device);
Status = Device_Close(&Device);
```

15.6 DET_SyncTimer

int DET_SyncTimer(void Device)**	
Description	
Call this function to initiate timer-to-external-trigger synchronization.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after DET_Configuration, with TriggerSource set to Timer.
Example	

```
int Status = -1; int DeviceNum = 0; void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
DET_Profile_TypeDef ProfileIn, ProfileOut;
DET_StreamInfo_TypeDef StreamInfo;
Status = DET_ProfileDeInit(&Device, &ProfileIn);
ProfileIn.TriggerSource = Timer;
ProfileIn. TriggerTimerSync = SyncToExt_RisingEdge;
Status = DET_Configuration(&Device, &ProfileIn, &ProfileOut, &StreamInfo);
Status = DET_SyncTimer (&Device);
Status = Device_Close(&Device);
```

16. Zero Span Mode

Zero Span mode is used for zero-span analysis of a signal, providing real-time power measurements at a specific frequency to help users accurately capture instantaneous signal variations.

16.1 ZSP_ProfileDeInit

int ZSP_ProfileDeInit(
    void**** Device,**
    ZSP_Profile_TypeDef*** UserProfile_O**
)	

Description	
Initialize parameters related to Zero Span mode. In Zero Span mode, parameters such as center frequency, reference level, and decimation factor are encapsulated in the ZSP_Profile_TypeDef structure.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
[out] **UserProfile_O**	Pointer to the Zero Span configuration structure. Refer to the definition of the ZSP_Profile_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after Device_Open.
Example	Please refer to the relevant example of the ZSP_Configuration() function.

16.2 ZSP_Configuration

int ZSP_Configuration(
    void**** Device,**
    const ZSP_Profile_TypeDef*** ProfileIn,**
    ZSP_Profile_TypeDef*** ProfileOut,**
    DET_StreamInfo_TypeDef*** StreamInfo**

)	
Description	
Configure parameters related to ZeroSpan mode. In ZeroSpan mode, parameters such as center frequency, reference level, and decimation factor are encapsulated in the ZSP_Profile_TypeDef structure.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
[in] **ProfileIn**	Pointer to the Zero Span configuration structure. Refer to the definition of the ZSP_Profile_TypeDef structure for details.
[out] **ProfileOut**	Pointer to the Zero Span configuration structure. Refer to the definition of the ZSP_Profile_TypeDef structure for details.
[out] **StreamInfo**	Information related to ZSP data in Zero Span mode. Refer to the definition of the DET_StreamInfo_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after ZSP_ProfileDeInit.
Example	

```
int Status = -1; int DeviceNum = 0; void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
ZSP_Profile_TypeDef ProfileIn, ProfileOut;
DET_StreamInfo_TypeDef StreamInfo;
Status = ZSP_ProfileDeInit(&Device, &ProfileIn);
ProfileIn.CenterFreq_Hz = 1e9;
ProfileIn.DecimateFactor = 2;
Status = ZSP_Configuration(&Device, &ProfileIn, &ProfileOut, &StreamInfo);
Status = Device_Close(&Device);
```

17. Real-Time Spectrum Analysis Mode

RTA is the Real-Time Spectrum Analysis mode, which helps users observe frequency-hopping or short transient burst signals.

17.1 RTA_ProfileDeInit

int RTA_ProfileDeInit(
    void** **Device,**
    RTA_Profile_TypeDef* **UserProfile_O**
)	

Description	
Initialize parameters related to RTA mode. In RTA mode, parameters such as center frequency, reference level, and decimation factor are encapsulated in the RTA_Profile_TypeDef structure	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
[out] **UserProfile_O**	Pointer to the RTA configuration structure. Refer to the definition of the RTA_Profile_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after Device_Open.
Example	Please refer to the relevant example of the RTA_GetRealTimeSpectrum() function.

17.2 RTA_Configuration

```
int RTA_Configuration(
        void** Device,
        const RTA_Profile_TypeDef* ProfileIn,
```

RTA_Profile_TypeDef* **ProfileOut,** RTA_FrameInfo_TypeDef* **FrameInfo**)	
Description	
Configure parameters related to RTA mode. In RTA mode, parameters such as center frequency, reference level, and decimation factor are encapsulated in the RTA_Profile_TypeDef structure.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
[in] **RTA_ProfileIn**	Pointer to the RTA configuration structure. Refer to the definition of the RTA_Profile_TypeDef structure for details.
[out] **RTA_ProfileOut**	Pointer to the RTA configuration structure. Refer to the definition of the RTA_Profile_TypeDef structure for details.
[out] **FrameInfo**	Packet information structure returned after configuration in RTA mode. Refer to the definition of the RTA_FrameInfo_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after Device_Open.
Example	Please refer to the relevant example of the RTA_GetRealTimeSpectrum() function.

17.3 RTA_BusTriggerStart

int RTA_BusTriggerStart(void Device)**	
Description	
Initiate a bus trigger.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.

Calling constraints	Must be called before RTA_GetRealTimeSpectrum.
Example	Please refer to the relevant example of the RTA_GetRealTimeSpectrum() function.

17.4 RTA_BusTriggerStop

int RTA_BusTriggerStop(void Device)**	
Description	
Terminate the current bus trigger. When TriggerMode = FixedPoints, the bus trigger will automatically stop after being started by the RTA_BusTriggerStart function and reaching the specified trigger length, without needing to call this function.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after RTA_GetRealTimeSpectrum.
Example	Please refer to the relevant example of the RTA_GetRealTimeSpectrum() function.

17.5 RTA_GetRealTimeSpectrum_Raw

```
int RTA_GetRealTimeSpectrum_Raw(
    void** Device,
    uint8_t SpectrumStream[],
    RTA_PlotInfo_TypeDef* PlotInfo,
    RTA_TriggerInfo_TypeDef* TriggerInfo,
    MeasAuxInfo_TypeDef* MeasAuxInfo
)
```

Description
Retrieve real-time spectrum data in RTA mode (without probability density plot) along with trigger-related information.

Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
[out] **SpectrumStream[]**	Returns a spectrum stream composed of consecutive spectrum frames, represented as relative power, with LSB = 0.75 dB. The size of this array equals RTA_FrameInfo.PacketValidPoints obtained from the RTA_Configuration function.
[out] **RTA_PlotInfo**	Structure containing plotting information returned after RTA acquisition. Refer to the definition of the RTA_PlotInfo_TypeDef structure for details.
[out] **TriggerInfo**	Trigger-related information for RTA data. Refer to the definition of the IQS/DET/RTA_TriggerInfo_TypeDef structure for details.
[out] **MeasAuxInfo**	Returns auxiliary information for the measurement data. Refer to the definition of the MeasAuxInfo_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after RTA_Configuration.
Example	

```
int Status = -1; int DeviceNum = 0; void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
RTA_Profile_TypeDef ProfileIn, ProfileOut;
RTA_FrameInfo_TypeDef FrameInfo;
Status = RTA_ProfileDeInit(&Device, &ProfileIn);
Status = RTA_Configuration(&Device, &ProfileIn, &ProfileOut, &FrameInfo);
vector<uint8_t> SpectrumTrace(FrameInfo.PacketValidPoints);
RTA_TriggerInfo_TypeDef TriggerInfo;
RTA_PlotInfo_TypeDef PlotInfo;
MeasAuxInfo_TypeDef MeasAuxInfo;
Status = RTA_BusTriggerStart(&Device);
Status = RTA_GetRealTimeSpectrum_Raw(&Device, SpectrumTrace.data(), &PlotInfo, &TriggerInfo,
&MeasAuxInfo);
Status = RTA_BusTriggerStop(&Device);
Status = Device_Close(&Device);
```

17.6 RTA_GetRealTimeSpectrum

```
int RTA_GetRealTimeSpectrum(
        void** Device,
        uint8_t SpectrumStream[],
        uint16_t SpectrumBitmap[],
        RTA_PlotInfo_TypeDef* PlotInfo,
        RTA_TriggerInfo_TypeDef* TriggerInfo,
        MeasAuxInfo_TypeDef* MeasAuxInfo
)
```

Description	
Retrieve real-time spectrum data and trigger-related information in real-time spectrum mode.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
[out] **SpectrumStream[]**	Returns a spectrum stream composed of consecutive spectrum frames, represented as relative power with LSB = 0.75 dB. The size of this array equals RTA_FrameInfo.PacketValidPoints obtained from the RTA_Configuration function.
[out] **SpectrumBitmap[]**	Returns the probability density map bitmap. Array length = FrameInfo.FrameHeight * FrameInfo.FrameWidth。
[out] **RTA_PlotInfo**	Structure containing plotting information returned after RTA acquisition Refer to the definition of the RTA_PlotInfo_TypeDef structure for details.
[out] **TriggerInfo**	Trigger-related information for RTA data. Refer to the definition of the IQS/DET/RTA_TriggerInfo_TypeDef structure for details.
[out] **MeasAuxInfo**	Returns auxiliary information for the measurement data.

	Refer to the definition of the MeasAuxInfo_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after RTA_Configuration.
Example	

```
int Status = -1; int DeviceNum = 0; void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
RTA_Profile_TypeDef ProfileIn, ProfileOut;
RTA_FrameInfo_TypeDef FrameInfo;
Status = RTA_ProfileDeInit(&Device, &ProfileIn);
Status = RTA_Configuration(&Device, &ProfileIn, &ProfileOut, &FrameInfo);
vector<uint8_t> SpectrumTrace(FrameInfo.PacketValidPoints);
vector<uint16_t> SpectrumBitmap(FrameInfo.FrameHeight * FrameInfo.FrameWidth);
RTA_TriggerInfo_TypeDef TriggerInfo;
RTA_PlotInfo_TypeDef PlotInfo;
MeasAuxInfo_TypeDef MeasAuxInfo;
Status = RTA_BusTriggerStart(&Device);
Status = RTA_GetRealTimeSpectrum(&Device, SpectrumTrace.data(), SpectrumBitmap.data(),
&PlotInfo, &TriggerInfo, &MeasAuxInfo);
Status = RTA_BusTriggerStop(&Device);
Status = Device_Close(&Device);
```

17.7 RTA_SyncTimer

int RTA_SyncTimer(void Device)**	
Description	
Call this function to initiate a single timer-to-external-trigger synchronization.	
Compatibility	0.55.0 and later.
Parameter description	

[in] **Device**	Device handle.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	This must be called after RTA_Configuration, with TriggerSource set to Timer.
Example	

```
int Status = -1; int DeviceNum = 0; void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB; BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
RTA_Profile_TypeDef ProfileIn, ProfileOut;
RTA_FrameInfo_TypeDef FrameInfo;
Status = RTA_ProfileDeInit(&Device, &ProfileIn);
ProfileIn.TriggerSource = Timer;
ProfileIn. TriggerTimerSync = SyncToExt_RisingEdge;
Status = RTA_Configuration(&Device, &ProfileIn, &ProfileOut, &FrameInfo);
Status = RTA_SyncTimer (&Device);
Status = Device_Close(&Device);
```

18. Digital Demodulation (optional)

Consists of the modulated signal spectrum, demodulated constellation diagram, eye diagram, and demodulation parameters. It provides an in-depth analysis of signal modulation quality, offering multiple error metrics to effectively evaluate the integrity and reliability of the signal during transmission.

18.1 Demod_Check

int Demod_Check()	
Description	
Verify whether the digital demodulation library is present	
Compatibility	0.55.55 and later.
Return value	0: Demodulation library is present; -1: Demodulation library is not present.
Calling constraints	None.
Example	

int Status = -1;
Status = Demod_Check();	

18.2 Demod_Open

int Demod_Open(void Device)**	
Description	
Enable the demodulation function, checking for the presence of a license and allocating the required memory.	
Compatibility	0.55.55 and later.
Parameter description	
[in] **Device**	Device handle.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after Device_Open.
Example	Please refer to the relevant example of the Demod_Execute() function.

18.3 Demod_Close

int Demod_Close(void Device)**	
Description	
Disable the demodulation function.	
Compatibility	0.55.55 and later.
Parameter description	
[in] **Device**	Device handle.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after Demod_Open.
Example	Please refer to the relevant example of the Demod_Execute() function.

18.4 Demod_Reset

int Demod_Reset(void Device)**	
Description	
Reset the demodulation function. When IQ data is non-continuous, Demod_Reset must be called before each Demod_Execute call. If the IQ data is continuous, Demod_Execute can be called repeatedly without resetting.	
Compatibility	0.55.55 and later.
Parameter description	
[in] **Device**	Device handle.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after Demod_Open.
Example	Please refer to the relevant example of the Demod_Execute() function.

18.5 Demod_GetVersion

```
int Demod_Reset(
        void** Device,
```

char version[])
Description
Retrieve the demodulation API version.

Compatibility	0.55.55 and later.
Parameter description	
[in] **Device**	Device handle.
[out] **version[]**	Returns the demodulation API version.
Return value	Returns the character length of version.
Calling constraints	Must be called after Demod_Open.
Example	Please refer to the relevant example of the Demod_Execute() function.

18.6 Demod_DeInit

void Demod_DeInit(Demod_Profile_TypeDef*** DemodProfile)**
Description
Initialize the demodulation configuration structure, assigning default values to each parameter within the structure.

Compatibility	0.55.55 and later.
Parameter description	
[in] **DemodProfile**	Demodulation configuration structure. Refer to the definition of the Demod_Profile_TypeDef structure for details.
Return value	None.
Calling constraints	Must be called after Demod_Open.
Example	Please refer to the relevant example of the Demod_Execute() function.

18.7 Demod_Configuration

int Demod_Configuration(void**** Device,**

const Demod_Profile_TypeDef* DemodProfileIn, Demod_Profile_TypeDef* DemodProfileOut)	
Description	
Configure demodulation parameters.	
Compatibility	0.55.55 and later.
Parameter description	
[in] **Device**	Device handle.
[in] **DemodProfileIn**	Input demodulation configuration structure. Refer to the definition of the Demod_Profile_TypeDef structure for details.
[out] **DemodProfileOut**	Output demodulation configuration structure. If the input configuration is invalid, the structure will be updated with valid parameters. Refer to the definition of the Demod_Profile_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after Demod_Open.
Example	Please refer to the relevant example of the Demod_Execute() function.

18.8 Demod_Execute

int Demod_Execute(void** **Device,** **const** IQStream_TypeDef* **IQStream,** DemodInfo_TypeDef* **DemodInfo**)	
Description	
Set demodulation parameters.	
Compatibility	0.55.55 and later.
Parameter description	
[in] **Device**	Device handle.

[in] **IQStream**	IQ data stream, including the IQ data and associated configuration information. Refer to the definition of the IQStream_TypeDef structure for details.
[out] **DemodInfo**	Demodulation information structure, including eye diagram, constellation diagram, EVM, etc. Note: All pointer variables in the structure point to internal memory managed by the function; users do not need to allocate memory externally. Refer to the definition of the DemodInfo_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after Demod_Open.

Example

```
int Status = -1; int DeviceNum = 0; void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
IQS_Profile_TypeDef IQS_ProfileIn, IQS_ProfileOut;
IQS_StreamInfo_TypeDef StreamInfo;
IQS_TriggerInfo_TypeDef TriggerInfo;
IQS_ProfileDeInit(&Device, &IQS_ProfileIn);
IQS_ProfileIn.CenterFreq_Hz = 1e9;
IQS_ProfileIn.RefLevel_dBm = 0;
//Note: The demodulation function currently only accepts IQ data of type int16.
IQS_ProfileIn.DataFormat = Complex16bit;
IQS_ProfileIn.TriggerMode = FixedPoints;
IQS_ProfileIn.TriggerSource = Bus;
IQS_ProfileIn.DecimateFactor = 4;
IQS_ProfileIn.TriggerLength = 32484;
Status = IQS_Configuration(&Device, &IQS_ProfileIn, &IQS_ProfileOut, &StreamInfo);
IQStream_TypeDef IQStream;
vector<int16_t> IQ(StreamInfo.StreamSamples * 2);
vector<int16_t> I(StreamInfo.StreamSamples);
```

```
vector<int16_t> Q(StreamInfo.StreamSamples);
Status = Demod_Open(&Device);
vector<char> version(50);
Demod_GetVersion(&Device, version.data());
Demod_Profile_TypeDef DemodProfileIn, DemodProfileOut;
DemodInfo_TypeDef DemodInfo;
Demod_DeInit(&DemodProfileIn);
DemodProfileIn.SamplePoints = StreamInfo.StreamSamples;
DemodProfileIn.SampleRate = StreamInfo.IQSampleRate;
DemodProfileIn.ModType = QAM16;
DemodProfileIn.SymbolRate = 1e6;
Status = Demod_Configuration(&Device, &DemodProfileIn, &DemodProfileOut);
IQS_ProfileIn.TriggerLength = DemodProfileOut.SamplePoints;
Status = IQS_Configuration(&Device, &IQS_ProfileIn, &IQS_ProfileOut, &StreamInfo);
DemodProfileIn.SamplePoints = StreamInfo.StreamSamples;
Status = Demod_Configuration(&Device, &DemodProfileIn, &DemodProfileOut);
while (1) {
uint32_t Points = StreamInfo.PacketSamples;
Status = IQS_BusTriggerStart(&Device);
for (uint32_t i = 0; i < StreamInfo.PacketCount; i++) {
Status = IQS_GetIQStream_PM1(&Device, &IQStream);
if (i == StreamInfo.PacketCount - 1 && StreamInfo.StreamSamples % StreamInfo.PacketSamples != 0) {
Points = StreamInfo.StreamSamples % StreamInfo.PacketSamples;
}
memcpy(IQ.data() + i * StreamInfo.PacketSamples * 2, IQStream.AlternIQStream, Points * 2 *
sizeof(IQ[0]));
}
IQStream.AlternIQStream = IQ.data();
//If the IQ data for each demodulation is not continuous, Demod_Reset must be called first, followed
by Demod_Execute
Demod_Reset(&Device);
Status = Demod_Execute(&Device, &IQStream, &DemodInfo);
}
```

```
Status = Demod_Close(&Device);

Status = Device_Close(&Device);
```

18.9 Demod_GenSymbolMap

```
void Demod_GenSymbolMap(
        Demod_ModType_TypeDef ModType,
        Demod_SymbolMap_TypeDef SymbolMap[1024],
        uint32_t* MapNum
)
```

Description	
Generate a symbol mapping table based on the input modulation type, and calculate the number of symbols in the table.	
Compatibility	0.55.55 and later.
Parameter description	
[in] **ModType**	Modulation type. Including 2FSK, 4FSK, GMSK, BPSK, QPSK, 8PSK, 16QAM, 2ASK, 64QAM, AM, FM, PM, CW, Lower Sideband, Upper Sideband, 128QAM, 256QAM, 32QAM.
[out] **SymbolMap[1024]**	Represents a single symbol in the symbol mapping table. This symbol's mapping defines the relationship between the symbol and its coordinates used in the modulation and demodulation process. Refer to the definition of the Demod_SymbolMap_TypeDef structure for details.
[out] **MapNum**	The number of available symbols in the symbol mapping table.
Return value	None.
Calling constraints	None.
Example	

```
int Status = -1;

Demod_ModType_TypeDef ModType = QPSK;

Demod_SymbolMap_TypeDef SymbolMap[1024];

uint32_t MapNum = 0;

Demod_GenSymbolMap(ModType, SymbolMap, &MapNum);
```

19. Pulse Detection (optional)

19.1 Pulse_Open

int Pulse_Open(void Device)**	
Description	
Enable the pulse detection feature, check for the required license, and allocate memory needed to run the pulse detection.	
Compatibility	0.55.55 and later.
Parameter description	
[in] **Device**	Device handle. After the function call, it will return the memory address used by the pulse detection feature, which serves as a reference for subsequent pulse detection function calls.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	This should be called after Device_Open and must be called before calling any other pulse detection–related functions.
Example	Please refer to the relevant example of the Pulse_Detect() function.

19.2 Pulse_Close

int Pulse_Close(void Device)**	
Description	
Disable the pulse detection feature and release the memory previously allocated by Pulse_Open. Call this after all pulse detection operations are completed to free resources.	
Compatibility	0.55.55 and later.
Parameter description	
[in] **Device**	Device handle. Pointing to the memory address returned by Pulse_Open for the pulse detection feature.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after Pulse_Open.

Example	Please refer to the relevant example of the Pulse_Detect() function.

19.3 Pulse_Detect

int Pulse_Detect(void** Device, const Pulse_Profile_TypeDef* Pulse_Profile, PulseInfo_TypeDef* PulseInfo)	
Description	
Perform pulse detection on DET data. Based on the input pulse data and threshold parameters, analyze and output pulse characteristics such as pulse width, period, and duty cycle. Must be called after Pulse_Open succeeds.	
Compatibility	0.55.55 and later.
Parameter description	
[in] **Device**	Device handle.
[in] **Pulse_Profile**	Input data for pulse detection, including the data to be analyzed and threshold parameters. Refer to the definition of the Pulse_Profile_TypeDef structure for details.
[out] **PulseInfo**	Output the pulse detection results, including pulse width, period, duty cycle, and other related parameters. Refer to the definition of the PulseInfo_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after Pulse_Open.
Example	

int Status = -1; int DeviceNum = 0; void* Device = NULL;
 	
BootProfile_TypeDef BootProfile;
 	
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
 	
BootProfile.PhysicalInterface = USB;
 	
BootInfo_TypeDef BootInfo;	

```
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
Status = Pulse_Open (&Device);
DET_Profile_TypeDef DET_ProfileIn, DET_ProfileOut;
DET_StreamInfo_TypeDef StreamInfo;
DET_ProfileDeInit(&Device, &DET_ProfileIn);
DET_ProfileIn.CenterFreq_Hz = 1e9;
DET_ProfileIn.RefLevel_dBm = 0;
DET_ProfileIn.DecimateFactor = 2;
DET_ProfileIn.DecimateFactor = 1;
DET_ProfileIn.TriggerMode = FixedPoints;
DET_ProfileIn.TriggerSource = Bus;
DET_ProfileIn.TriggerLength = 16242 * 10;
Status = DET_Configuration(&Device, &DET_ProfileIn, &DET_ProfileOut, &StreamInfo);
vector<float> NormalizedPowerStream(StreamInfo.PacketCount * StreamInfo.PacketSamples);
float ScaleToV = 0;
DET_TriggerInfo_TypeDef TriggerInfo;
MeasAuxInfo_TypeDef MeasAuxInfo;
Status = DET_BusTriggerStart(&Device);
for (uint32_t i = 0; i < StreamInfo.PacketCount; i++) {
Status = DET_GetPowerStream(&Device, NormalizedPowerStream.data() + i *
StreamInfo.PacketSamples, &ScaleToV, &TriggerInfo, &MeasAuxInfo);
}
vector<float> NormalizedPowerStream_dBm(NormalizedPowerStream.size());
for (int i = 0; i < StreamInfo.StreamSamples; i++) {
NormalizedPowerStream_dBm[i] = 10 * log10(20 * pow(NormalizedPowerStream[i] * ScaleToV, 2));
}
Status = Pulse_Open(&Device);
Pulse_Profile_TypeDef Pulse_Profile;
Pulse_Profile.TimeResolution_s = StreamInfo.TimeResolution;
Pulse_Profile.PulseSize = NormalizedPowerStream_dBm.size();
Pulse_Profile.unit = Power_dBm;
Pulse_Profile.DetThreshold = -20;
Pulse_Profile.ExpPulseNum = 10;
```

Pulse_Profile.Pulse = NormalizedPowerStream_dBm.data();
PulseInfo_TypeDef PulseInfo;
Status = Pulse_Detect(&Device, &Pulse_Profile, &PulseInfo);
Status = Pulse_Close(&Device);
Status = Device_Close(&Device);

19.4 Pulse_Detect_PM1

int Pulse_Detect_PM1(void**** Device,** **const** Pulse_Profile_TypeDef*** Pulse_Profile,** PulseInfoPM1_TypeDef*** PulseInfoPM1**)	
Description	
Perform pulse detection on IQ data. Based on the input pulse data and threshold parameters, analyze and output pulse characteristics such as pulse width, period, duty cycle, pulse modulation type, pulse frequency, and phase information. Must be called after Pulse_Open succeeds.	
Compatibility	0.55.55 and later.
Parameter description	
[in] **Device**	Device handle.
[in] **Pulse_Profile**	Input data for pulse detection, including the data to be analyzed, threshold parameters, and other relevant settings. Refer to the definition of the Pulse_Profile_TypeDef structure for details.
[out] **PulseInfoPM1**	Output the pulse detection results, including pulse modulation type, pulse frequency, phase information, and other related parameters. Refer to the definition of the PulseInfoPM1_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after Pulse_Open.
Example	
int Status = -1; int DeviceNum = 0; void* Device = NULL;	

```
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
Status = Pulse_Open(&Device);
IQS_Profile_TypeDef ProfileIn, ProfileOut;
IQS_StreamInfo_TypeDef StreamInfo;
Status = IQS_ProfileDeInit(&Device, &ProfileIn);
ProfileIn.CenterFreq_Hz = 1.00e9;ProfileIn.DecimateFactor = 2;
ProfileIn.TriggerLength = 16242*100;
Status = IQS_Configuration(&Device, &ProfileIn, &ProfileOut, &StreamInfo);
void* AlternIQStream = NULL;
float ScaleToV = 0;
vector<float> IQ_Data(StreamInfo.StreamSamples * 2);
IQS_TriggerInfo_TypeDef TriggerInfo;
MeasAuxInfo_TypeDef MeasAuxInfo;
Status = IQS_BusTriggerStart(&Device);
for (int j = 0; j < StreamInfo.PacketCount; j++) {
    Status = IQS_GetIQStream(&Device, &AlternIQStream, &ScaleToV, &TriggerInfo, &MeasAuxInfo);
    int16_t* IQ = (int16_t*)AlternIQStream;
    for (int i = 0; i < StreamInfo.PacketSamples * 2; i ++){
        IQ_Data[i + StreamInfo.PacketSamples * 2 * j] = (float)IQ[i] * ScaleToV;
    }
}
Status = IQS_BusTriggerStop(&Device);
Pulse_Profile_TypeDef Pulse_Profile;
Pulse_Profile.TimeResolution_s = 1.0 / StreamInfo.IQSampleRate;
Pulse_Profile.PulseSize = IQ_Data.size() / 2;
Pulse_Profile.unit = Power_dBm;
Pulse_Profile.DetThreshold = -20;Pulse_Profile.ExpPulseNum = 10;
Pulse_Profile.Pulse = IQ_Data.data();
PulseInfoPM1_TypeDef PulseInfoPM1;
Status = Pulse_Detect_PM1(&Device, &Pulse_Profile, &PulseInfoPM1);
Status = Pulse_Close(&Device);

Status = Device_Close(&Device);
```

20. Auxiliary Signal Generator (optional)

The ASG is an auxiliary signal source function that can output single-tone or swept-frequency signals. Currently, only the N45, N60, M60, and M80 models support this optional feature.

20.1 ASG_ProfileDeInit

int ASG_ProfileDeInit(**void** Device,** **ASG_Profile_TypeDef* Profile** **)**	
Description	
Initialize the auxiliary signal generator's configuration parameters to their default state. This clears or resets all settings in the Profile, ensuring subsequent configurations start from a standard initial state and are not affected by previous settings.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle.
[out] **Profile**	Pointer to the ASG configuration structure. Refer to the definition of the ASG_Profile_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after Device_Open.
Example	Please refer to the relevant example of the ASG_Configuration() function.

20.2 ASG_Configuration

int ASG_Configuration(void** Device, ASG_Profile_TypeDef* ProfileIn, ASG_Profile_TypeDef* ProfileOut, ASG_Info_TypeDef* ASG_Info)	
Description	
Configure the operating state of the analog signal source. Based on the input Profile parameters, set the signal source's operating mode, frequency, power, scanning, and triggering settings, and return the actual applied configuration along with the current signal source status.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Device**	Device handle reference used to identify the currently opened device instance.
[in] **ProfileIn**	Input analog signal source configuration structure, used to set the operating parameters of the signal source. Refer to the definition of the ASG_Profile_TypeDef structure for details.
[out] **ProfileOut**	Output structure for the analog signal source's actual applied configuration, reflecting the ASG settings currently in effect on the device. Refer to the definition of the ASG_Profile_TypeDef structure for details.
[out] **ASG_Info**	ASG-related information in ASG mode. Refer to the definition of the ASG_Info_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after Device_Open.
Example	

int Status = -1; int DeviceNum = 0; void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;	

```
BootProfile.PhysicalInterface = USB;

BootInfo_TypeDef BootInfo;

Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);

ASG_Profile_TypeDef ProfileIn, ProfileOut;

ASG_Info_TypeDef ASG_Info;

Status = ASG_ProfileDeInit(&Device, &ProfileIn);

ProfileIn.CenterFreq_Hz = 1e9;

Status = ASG_Configuration(&Device, &ProfileIn, &ProfileOut, &ASG_Info);

Status = Device_Close(&Device);
```

21. Analog Signal Demodulation Mode

ADM is an interface for analog modulation and demodulation processing, allowing users to call its functions to perform analog signal demodulation.

21.1 ADM_Open

void ADM_Open(void ADM)**	
Description	
Create and initialize an analog demodulation instance, allocating the necessary resources in memory. This function must be called before invoking any other analog demodulation–related functions.	
Compatibility	0.55.63 and later.
Parameter description	
[out] **ADM**	Memory reference for the analog demodulation feature. Upon successful call, it returns the address of the created ADM instance, which must be used for all subsequent analog demodulation–related API operations.
Return value	None.
Calling constraints	This function should be called before any other analog demodulation functions and only needs to be called once at the very beginning. Subsequent functions can operate using the device memory address returned by this function. For any normal ADM_Open call, ADM_Close must be called after all functionality is finished to release the allocated memory.
Example	Please refer to the relevant example of the ADM_AMDemod_PM1() function.

21.2 ADM_Close

void ADM_Close(void ADM)**
Description
Close and release the analog demodulation instance, freeing the internal resources and memory allocated by ADM_Open. This function must be called when the analog demodulation feature is no longer in use.

Compatibility	0.55.63 and later.
Parameter description	
[in] ADM	Memory reference for the analog demodulation feature, returned by ADM_Open. After calling this function, the instance becomes invalid and its internal resources are released.
Return value	None.
Calling constraints	This function only needs to be called at the end of program execution. After calling it, the analog demodulation feature is closed and the memory is released. To use the analog demodulation feature again, call ADM_Open to reopen the Analog functionality.
Example	Please refer to the relevant example of the ADM_AMDemod_PM1() function.

21.3 ADM_AMDemod

```
int ADM_AMDemod(
    void** ADM,
    const void* AlternIQStream,
    DataFormat_TypeDef DataFormat,
    uint64_t SamplePoints,
    double IQSampleRate,
    float DemodWaveform[]
)
```

Description

Perform AM demodulation on the input IQ data, outputting only the demodulated time-domain waveform.

Compatibility	0.55.63 and later.
Parameter description	
[in] ADM	Reference to the analog demodulation instance, created by ADM_Open, used to identify the current ADM demodulation context.

[in] **AlternIQStream**	Input interleaved IQ data buffer, with the data format specified by DataFormat.
[in] **DataFormat**	Data format of the input IQ data, specifying the arrangement and precision of the IQ samples in memory. Refer to the definition of the DataFormat_TypeDef enumeration structure for details.
[in] **SamplePoints**	Number of sampling points in the input IQ data.
[in] **IQSampleRate**	Sampling rate of the input IQ data, in Hz.
[out] **DemodWaveform**	Array for the demodulated AM time-domain waveform, with a length corresponding to SamplePoints.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	This function only needs to be called at the end of program execution. After calling it, the analog demodulation feature is closed and its memory is released. To use the analog demodulation feature again, call ADM_Open to reopen the Analog functionality.
Example	Please refer to the relevant example of the ADM_AMDemod_PM1() function.

21.4 ADM_FMDemod

```
int ADM_FMDemod(
    void** ADM,
    const void* AlternIQStream,
    DataFormat_TypeDef DataFormat,
    uint64_t SamplePoints,
    double IQSampleRate,
    bool reset,
    float DemodWaveform[]
)
```

Description
Perform FM demodulation on the input IQ data, outputting only the demodulated time-domain waveform.

Compatibility	0.55.63 and later.
Parameter description	
[in] **ADM**	The instance for analog demodulation, created by ADM_Open, used to reference the current ADM demodulation context.
[in] **AlternIQStream**	The input interleaved IQ data buffer, with data format specified by DataFormat.
[in] **DataFormat**	The data format of the input IQ data, used to indicate the memory layout and precision of the IQ samples. Refer to the definition of the DataFormat_TypeDef enumeration structure for details.
[in] **SamplePoints**	The number of sample points in the input IQ data.
[in] **IQSampleRate**	The sampling rate of the input IQ data, in Hz.
[in] **reset**	Whether to reset the demodulator state. true clears the previous residual state before demodulation, while false preserves the accumulated state.
[out] **DemodWaveform**	The time-domain waveform array after FM demodulation, with length corresponding to SamplePoints.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after ADM_Open.
Example	Please refer to the relevant example of the ADM_FMDemod_PM1() function.

21.5 ADM_AMDemod_PM1

```
int ADM_AMDemod_PM1(
    void** ADM,
    const void* AlternIQStream,
    DataFormat_TypeDef DataFormat,
    uint64_t SamplePoints,
    double IQSampleRate,
    float IQS_ScaleToV,
    AMDemodParam_TypeDef* AMDemodParam
)
```

Description	
Performs AM demodulation on the input IQ data, computing and returning AM-related parameters while outputting the demodulated waveform, for analyzing the modulation characteristics of the AM signal.	
Compatibility	0.55.63 and later.
Parameter description	
[in] **ADM**	Reference to the analog demodulation instance, created by ADM_Open, used to identify the current ADM demodulation context.
[in] **AlternIQStream**	Returns the current device's GNSS satellite information, including the number of visible satellites and the satellites used for positioning.
[in] **DataFormat**	The data format of the input IQ data, indicating its memory layout and precision. Refer to the definition of the DataFormat_TypeDef enumeration structure for details.
[in] **SamplePoints**	The number of sample points in the input IQ data.
[in] **IQSampleRate**	The sampling rate of the input IQ data, in Hz.
[in] **IQS_ScaleToV**	The scale factor for converting IQ sample values to voltage, used for computing physical quantities of AM modulation parameters.
[out] **AMDemodParam**	Returns the modulation parameters and related analysis results after AM demodulation.Refer to the definition of the AMDemodParam_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after ADM_Open.
Example	

```
int Status = 0; void* Device = NULL; int DevNum = 0;
BootProfile_TypeDef BootProfile;
BootInfo_TypeDef BootInfo;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
Status = Device_Open(&Device, DevNum, &BootProfile, &BootInfo);
Device_Open_ErrorHandling(Status, &Device, DevNum, &BootProfile, &BootInfo);
IQStream_TypeDef IQStream;
```

```
IQS_Profile_TypeDef IQS_ProfileIn;
IQS_Profile_TypeDef IQS_ProfileOut;
IQS_StreamInfo_TypeDef StreamInfo;
Status = IQS_ProfileDeInit(&Device, &IQS_ProfileIn);
IQS_ProfileIn.CenterFreq_Hz = 1e9;
IQS_ProfileIn.RefLevel_dBm = 0;
IQS_ProfileIn.DataFormat = Complex16bit;
IQS_ProfileIn.TriggerMode = FixedPoints;
IQS_ProfileIn.TriggerSource = Bus;
IQS_ProfileIn.DecimateFactor = 256;
IQS_ProfileIn.BusTimeout_ms = 5000;
IQS_ProfileIn.TriggerLength = 16242 * 1;
Status = IQS_Configuration(&Device, &IQS_ProfileIn, &IQS_ProfileOut, &StreamInfo);
IQS_Configuration_ErrorHandling(Status, &Device, DevNum, &BootProfile, &BootInfo, &IQS_ProfileIn,
&IQS_ProfileOut, &StreamInfo);
AMDemodParam_TypeDef AMDemodParam; //Demod
void* ADM = nullptr;
ADM_Open(&ADM);
vector<int16_t> IQ(StreamInfo.StreamSamples * 2);
vector<float> DemodWaveform(IQS_ProfileIn.TriggerLength);
while(1) {
uint32_t Points = StreamInfo.PacketSamples;
Status = IQS_BusTriggerStart(&Device);
for (uint32_t i = 0; i < StreamInfo.PacketCount; i++) {
Status = IQS_GetIQStream_PM1(&Device, &IQStream);
if (i == StreamInfo.PacketCount - 1 && StreamInfo.StreamSamples % StreamInfo.PacketSamples != 0) {
Points = StreamInfo.StreamSamples % StreamInfo.PacketSamples;
}
memcpy(IQ.data() + i * StreamInfo.PacketSamples * 2, IQStream.AlternIQStream, Points * 2 *
sizeof(IQ[0]));
}
IQStream.AlternIQStream = IQ.data();
Status = ADM_AMDemod(&ADM, IQStream.AlternIQStream, IQStream.IQS_Profile.DataFormat,
IQStream.IQS_Profile.TriggerLength, IQStream.IQS_StreamInfo.IQSampleRate,
DemodWaveform.data());
Status = ADM_AMDemod_PM1(&ADM, IQStream.AlternIQStream, IQStream.IQS_Profile.DataFormat,
IQStream.IQS_Profile.TriggerLength, IQStream.IQS_StreamInfo.IQSampleRate,
IQStream.IQS_ScaleToV, &AMDemodParam);
}
ADM_Close(&ADM);
Status = Device_Close(&Device);
```

21.6 ADM_FMDemod_PM1

```
int ADM_FMDemod_PM1(
        void** ADM,
        const void* AlternIQStream,
        DataFormat_TypeDef DataFormat,
        uint64_t SamplePoints,
        double IQSampleRate,
        float IQS_ScaleToV,
        bool reset,
        FMDemodParam_TypeDef* FMDemodParam
)
```

Description	
Performs FM demodulation on the input IQ data, returning both the demodulated waveform and modulation parameters for analyzing the FM signal's modulation characteristics. Optionally resets the demodulator state before demodulation.	
Compatibility	0.55.63 and later.
Parameter description	
[in] **ADM**	Reference to the analog demodulation instance, created by ADM_Open, used to identify the current ADM demodulation context.
[in] **AlternIQStream**	The input interleaved IQ data buffer, with its format specified by DataFormat.

[in] **DataFormat**	The data format of the input IQ data, used to indicate its memory layout and precision. Refer to the definition of the DataFormat_TypeDef enumeration structure for details.
[in] **SamplePoints**	The number of sample points in the input IQ data.
[in] **IQSampleRate**	The sampling rate of the input IQ data, in Hz.
[in] **IQS_ScaleToV**	The scale factor for converting IQ sample values to voltage, used for calculating the physical quantities of AM modulation parameters.
[in] **reset**	Resets the buffer. For a single continuous demodulation session, set to 1 only on the first function call; use 0 for all subsequent calls.
[out] **FMDemodParam**	Returns the modulation parameters and related analysis results after FM demodulation. Refer to the definition of the FMDemodParam_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after ADM_Open.
Example	

```
int Status = 0; void* Device = NULL; int DevNum = 0;
BootProfile_TypeDef BootProfile;
BootInfo_TypeDef BootInfo;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
Status = Device_Open(&Device, DevNum, &BootProfile, &BootInfo);
IQStream_TypeDef IQStream;
IQS_Profile_TypeDef IQS_ProfileIn;
IQS_Profile_TypeDef IQS_ProfileOut;
IQS_StreamInfo_TypeDef StreamInfo;
Status = IQS_ProfileDeInit(&Device, &IQS_ProfileIn);
IQS_ProfileIn.CenterFreq_Hz = 1e9;
IQS_ProfileIn.RefLevel_dBm = 0;
IQS_ProfileIn.DataFormat = Complex16bit;
IQS_ProfileIn.TriggerMode = FixedPoints;
IQS_ProfileIn.TriggerSource = Bus;
IQS_ProfileIn.DecimateFactor = 256;
IQS_ProfileIn.BusTimeout_ms = 5000;
IQS_ProfileIn.TriggerLength = 16242 * 1;
Status = IQS_Configuration(&Device, &IQS_ProfileIn, &IQS_ProfileOut, &StreamInfo);
FMDemodParam_TypeDef FMDemodParam; //Demod
void* ADM = nullptr;
ADM_Open(&ADM);
vector<int16_t> IQ(StreamInfo.StreamSamples * 2);
vector<float> DemodWaveform(IQS_ProfileIn.TriggerLength);
while(1) {
uint32_t Points = StreamInfo.PacketSamples;
Status = IQS_BusTriggerStart(&Device);
for (uint32_t i = 0; i < StreamInfo.PacketCount; i++) {
Status = IQS_GetIQStream_PM1(&Device, &IQStream);
if (i == StreamInfo.PacketCount - 1 && StreamInfo.StreamSamples % StreamInfo.PacketSamples != 0) {
Points = StreamInfo.StreamSamples % StreamInfo.PacketSamples;
}
memcpy(IQ.data() + i * StreamInfo.PacketSamples * 2, IQStream.AlternIQStream, Points * 2 *
sizeof(IQ[0]));
}
IQStream.AlternIQStream = IQ.data();
Status = ADM_FMDemod(&ADM, IQStream.AlternIQStream, IQStream.IQS_Profile.DataFormat,
IQStream.IQS_Profile.TriggerLength, IQStream.IQS_StreamInfo.IQSampleRate,
true,DemodWaveform.data());
Status = ADM_FMDemod_PM1(&ADM, IQStream.AlternIQStream, IQStream.IQS_Profile.DataFormat,
IQStream.IQS_Profile.TriggerLength, IQStream.IQS_StreamInfo.IQSampleRate,
IQStream.IQS_ScaleToV, true, &FMDemodParam);
}
ADM_Close(&ADM);
Status = Device_Close(&Device);
```

22. Digital Signal Processing (Trace analysis)

22.1 DSP_TraceAnalysis_IM3

int DSP_TraceAnalysis_IM3(const double Freq_Hz[], const float PowerSpec_dBm[], const uint32_t TracePoints, TraceAnalysisResult_IP3_TypeDef* IM3Result)	
Description	
Performs IM3 parameter analysis on the input spectrum trace data, calculating and outputting third-order intermodulation results based on the frequency and power spectrum data.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Freq_Hz[]**	The input frequency array, corresponding to the frequency values of each point in the trace, in Hz.
[in] **PowerSpec_dBm[]**	The input power array, corresponding to the power values of each point in the trace, in dBm.
[in] **TracePoints**	The number of points in the trace, representing the length of the frequency and power arrays.
[out] **IM3Result**	Returns the third-order intermodulation (IM3) analysis results, including the fundamental signal frequencies and powers, intermodulation products, and the IP3 calculation results. Refer to the definition of the TraceAnalysisResult_IP3_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after SWP_Get related-function.
Example	

int Status = 0; void* Device = NULL; int DevNum = 0;
BootProfile_TypeDef BootProfile;	

```
BootInfo_TypeDef BootInfo;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
Status = Device_Open(&Device, DevNum, &BootProfile, &BootInfo);
SWP_Profile_TypeDef SWP_ProfileIn, ProfileSetOut, SWP_ProfileOut;
SWP_TraceInfo_TypeDef TraceInfo;
Status = SWP_ProfileDeInit(&Device, &SWP_ProfileIn);
SWP_ProfileIn.CenterFreq_Hz = 1e9;
SWP_ProfileIn.FreqAssignment = CenterSpan;
uint8_t IfDoConfig = 1;
Status = SWP_AutoSet(&Device, SWPIM3Meas, &SWP_ProfileIn, &ProfileSetOut, &TraceInfo,
IfDoConfig);
ProfileSetOut.Span_Hz = 10e6;
Status = SWP_Configuration(&Device, &ProfileSetOut, &SWP_ProfileOut, &TraceInfo);
vector<double> Frequency(TraceInfo.FullsweepTracePoints);
vector<float> PowerSpec_dBm(TraceInfo.FullsweepTracePoints);
MeasAuxInfo_TypeDef MeasAuxInfo;
Status = SWP_GetFullSweep(&Device, Frequency.data(), PowerSpec_dBm.data(), &MeasAuxInfo);
TraceAnalysisResult_IP3_TypeDef    IM3Result;
Status = DSP_TraceAnalysis_IM3(Frequency.data(), PowerSpec_dBm.data(),
TraceInfo.FullsweepTracePoints, &IM3Result);
Status = Device_Close(&Device);
```

22.2 DSP_TraceAnalysis_IM2

```
int DSP_TraceAnalysis_ IM2(
        const double Freq_Hz[],
        const float PowerSpec_dBm[],
        uint32_t TracePoints,
        TraceAnalysisResult_IP2_TypeDef* IM2Result
)
```

Description
Performs IM2 parameter analysis on the input spectrum trace data, calculating and outputting second-order intermodulation results based on the frequency and power spectrum data.

Compatibility	0.55.0 and later.
Parameter description	
[in] **Freq_Hz[]**	The input frequency array, corresponding to the frequency values of each point in the trace, in Hz.
[in] **PowerSpec_dBm[]**	The input power array, corresponding to the power values of each point in the trace, in dBm.
[in] **TracePoints**	The number of points in the trace, representing the length of the frequency and power arrays.
[out] **IM2Result**	Returns the second-order intermodulation (IM2) analysis results, including the fundamental signal frequencies and powers, second-order intermodulation products, and the IP2 calculation results. Refer to the definition of the TraceAnalysisResult_IP2_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after SWP_Get related-function.
Example	

```
int Status = 0; void* Device = NULL; int DevNum = 0;
BootProfile_TypeDef BootProfile;
BootInfo_TypeDef BootInfo;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
Status = Device_Open(&Device, DevNum, &BootProfile, &BootInfo);
SWP_Profile_TypeDef SWP_ProfileIn, ProfileSetOut, SWP_ProfileOut;
SWP_TraceInfo_TypeDef TraceInfo;
Status = SWP_ProfileDeInit(&Device, &SWP_ProfileIn);
SWP_ProfileIn.CenterFreq_Hz = 1e9;
SWP_ProfileIn.FreqAssignment = CenterSpan;
uint8_t IfDoConfig = 1;
Status = SWP_AutoSet(&Device, SWPIM3Meas, &SWP_ProfileIn, &ProfileSetOut, &TraceInfo,
IfDoConfig);
ProfileSetOut.Span_Hz = 10e6;
```

```
Status = SWP_Configuration(&Device, &ProfileSetOut, &SWP_ProfileOut, &TraceInfo);
vector<double> Frequency(TraceInfo.FullsweepTracePoints);
vector<float> PowerSpec_dBm(TraceInfo.FullsweepTracePoints);
MeasAuxInfo_TypeDef MeasAuxInfo;
Status = SWP_GetFullSweep(&Device, Frequency.data(), PowerSpec_dBm.data(), &MeasAuxInfo);
TraceAnalysisResult_IP2_TypeDef IM2Result;
Status = DSP_TraceAnalysis_IM2(Frequency.data(), PowerSpec_dBm.data(),
TraceInfo.FullsweepTracePoints, &IM2Result);
Status = Device_Close(&Device);
```

22.3 DSP_TraceAnalysis_ChannelPower

```
int DSP_TraceAnalysis_ChannelPower(
    const double Freq_Hz[],
    const float PowerSpec_dBm[],
    const uint32_t TracePoints,
    const double CenterFrequency,
    const double AnalysisSpan,
    const double RBW,
    DSP_ChannelPowerInfo_TypeDef* ChannelPowerResult
)
```

Description	
Performs channel power analysis on the input spectrum trace data, calculating the power within the specified channel based on the center frequency, analysis bandwidth, and resolution bandwidth, and outputs the analysis results.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Freq_Hz[]**	The input frequency array, corresponding to the frequency values of each point in the trace, in Hz.
[in] **PowerSpec_dBm[]**	The input power array, corresponding to the power values of each point in the trace, in dBm.

[in] **TracePoints**	The number of points in the trace, representing the length of the frequency and power arrays.
[in] **CenterFrequency**	The center frequency of the channel to be measured.
[in] **AnalysisSpan**	The bandwidth of the channel to be measured.
[in] **RBW**	The resolution bandwidth used for the analysis.
[out] **ChannelPowerResult**	Returns the channel power analysis results, including the total channel power, power density, and the frequency, power, and index of the peak within the channel. Refer to the definition of the DSP_ChannelPowerInfo_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after SWP_Get related-function.
Example	

```
int Status = -1; int DeviceNum = 0; void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
SWP_Profile_TypeDef SWP_ProfileIn, ProfileSetOut, SWP_ProfileOut;
SWP_TraceInfo_TypeDef TraceInfo;
Status = SWP_ProfileDeInit(&Device, &SWP_ProfileIn);
SWP_ProfileIn.CenterFreq_Hz = 1e9;
SWP_ProfileIn.FreqAssignment = CenterSpan;
uint8_t IfDoConfig = 1;
SWP_AutoSet(&Device, SWPChannelPowerMeas, &SWP_ProfileIn, &ProfileSetOut, &TraceInfo,
IfDoConfig);
ProfileSetOut.Span_Hz = 10e6;
Status = SWP_Configuration(&Device, &ProfileSetOut, &SWP_ProfileOut, &TraceInfo);
vector<double> Frequency(TraceInfo.FullsweepTracePoints);
vector<float> PowerSpec_dBm(TraceInfo.FullsweepTracePoints);
MeasAuxInfo_TypeDef MeasAuxInfo;
```

```
Status = SWP_GetFullSweep(&Device, Frequency.data(), PowerSpec_dBm.data(), &MeasAuxInfo);
double CenterFrequency = 1e9;
double AnalysisSpan = 2e6;
DSP_ChannelPowerInfo_TypeDef ChannelPowerResult;
Status = DSP_TraceAnalysis_ChannelPower(Frequency.data(), PowerSpec_dBm.data(),
TraceInfo.FullsweepTracePoints, CenterFrequency, AnalysisSpan, SWP_ProfileOut.RBW_Hz,
&ChannelPowerResult);
Status = Device_Close(&Device);
```

22.4 DSP_TraceAnalysis_XdBBW

```
int DSP_TraceAnalysis_XdBBW(
        const double Freq_Hz[],
        const float PowerSpec_dBm[],
        const uint32_t TracePoints,
        const float XdB,
        TraceAnalysisResult_XdB_TypeDef* XdBResult
)
```

Description	
Performs XdB bandwidth analysis on the input spectrum trace data, calculating the signal bandwidth relative to the peak power drop of XdB, and outputs the analysis results.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Freq_Hz[]**	The input frequency array, corresponding to the frequency values of each point in the trace, in Hz.
[in] **PowerSpec_dBm[]**	The input power array, corresponding to the power values of each point in the trace, in dBm.
[in] **TracePoints**	The number of points in the trace, representing the length of the frequency and power arrays.
[in] **XdB**	The power drop relative to the peak, used to define the XdB bandwidth.

[out] **XdBResult**	Returns the XdB bandwidth analysis results, including the bandwidth, center frequency, start and stop frequencies, and the frequency, power, and index of the peak within the bandwidth. Refer to the definition of the TraceAnalysisResult_XdB_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after SWP_Get related-function.
Example	

```
int Status = -1; int DeviceNum = 0; void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
SWP_Profile_TypeDef SWP_ProfileIn, ProfileSetOut, SWP_ProfileOut;
SWP_TraceInfo_TypeDef TraceInfo;
Status = SWP_ProfileDeInit(&Device, &SWP_ProfileIn);
SWP_ProfileIn.CenterFreq_Hz = 1e9;
SWP_ProfileIn.FreqAssignment = CenterSpan;
uint8_t IfDoConfig = 1;
Status = SWP_AutoSet(&Device, SWPOBWMeas, &SWP_ProfileIn, &ProfileSetOut, &TraceInfo,
IfDoConfig);
ProfileSetOut.RBW_Hz = 50e3;
Status = SWP_Configuration(&Device, &ProfileSetOut, &SWP_ProfileOut, &TraceInfo);
vector<double> Frequency(TraceInfo.FullsweepTracePoints);
vector<float> PowerSpec_dBm(TraceInfo.FullsweepTracePoints);
MeasAuxInfo_TypeDef MeasAuxInfo;
Status = SWP_GetFullSweep(&Device, Frequency.data(), PowerSpec_dBm.data(), &MeasAuxInfo);
float XdB = 3;
TraceAnalysisResult_XdB_TypeDef XdBResult;
Status = DSP_TraceAnalysis_XdBBW(Frequency.data(), PowerSpec_dBm.data(),
TraceInfo.FullsweepTracePoints, XdB, &XdBResult);
Status = Device_Close(&Device);
```

22.5 DSP_TraceAnalysis_OBW

```
int DSP_TraceAnalysis_OBW(
        const double Freq_Hz[],
        const float PowerSpec_dBm[],
        const uint32_t TracePoints,
        const float OccupiedRatio,
        TraceAnalysisResult_OBW_TypeDef* OBWResult
)
```

Description	
Performs occupied bandwidth analysis on the input spectrum trace data, calculating the signal bandwidth corresponding to a specified power percentage, and outputs the analysis results.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Freq_Hz[]**	The input frequency array, corresponding to the frequency values of each point in the trace, in Hz.
[in] **PowerSpec_dBm[]**	The input power array, corresponding to the power values of each point in the trace, in dBm.
[in] **TracePoints**	The number of points in the trace, representing the length of the frequency and power arrays.
[in] **OccupiedRatio**	The occupied bandwidth ratio to be measured, typically set to 0.99.
[out] **OBWResult**	Returns the occupied bandwidth analysis results, including the occupied bandwidth, center frequency, start and stop frequencies with corresponding power and power ratio, and the frequency, power, and index of the peak within the bandwidth. Refer to the definition of the TraceAnalysisResult_OBW_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after SWP_Get related-function.
Example	
int Status = -1; int DeviceNum = 0; void* Device = NULL;	

```
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
SWP_Profile_TypeDef SWP_ProfileIn, ProfileSetOut, SWP_ProfileOut;
SWP_TraceInfo_TypeDef TraceInfo;
Status = SWP_ProfileDeInit(&Device, &SWP_ProfileIn);
SWP_ProfileIn.CenterFreq_Hz = 1e9;
SWP_ProfileIn.FreqAssignment = CenterSpan;
uint8_t IfDoConfig = 1;
Status = SWP_AutoSet(&Device, SWPOBWMeas, &SWP_ProfileIn, &ProfileSetOut, &TraceInfo,
IfDoConfig);
ProfileSetOut.Span_Hz = 10e6;
Status = SWP_Configuration(&Device, &ProfileSetOut, &SWP_ProfileOut, &TraceInfo);
vector<double> Frequency(TraceInfo.FullsweepTracePoints);
vector<float> PowerSpec_dBm(TraceInfo.FullsweepTracePoints);
MeasAuxInfo_TypeDef MeasAuxInfo;
Status = SWP_GetFullSweep(&Device, Frequency.data(), PowerSpec_dBm.data(), &MeasAuxInfo);
float OccupiedRatio = 0.99;
TraceAnalysisResult_OBW_TypeDef OBWResult;
Status = DSP_TraceAnalysis_OBW(Frequency.data(), PowerSpec_dBm.data(),
TraceInfo.FullsweepTracePoints, OccupiedRatio, &OBWResult);
Status = Device_Close(&Device);
```

22.6 DSP_TraceAnalysis_ACPR

```
int DSP_TraceAnalysis_ACPR(
    const double Freq_Hz[],
    const float PowerSpec_dBm[],
    const uint32_t TracePoints,
    const DSP_ACPRFreqInfo_TypeDef ACPRFreqInfo, TraceAnalysisResult_ACPR_TypeDef*
    ACPRResult
)
```

Description	
Performs adjacent channel power ratio (ACPR) analysis on the input spectrum trace data, calculating the power ratio between the main channel and adjacent channels based on the specified adjacent channel frequency information, and outputs the analysis results.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **Freq_Hz[]**	The input frequency array, corresponding to the frequency values of each point in the trace, in Hz.
[in] **PowerSpec_dBm[]**	The input power array, corresponding to the power values of each point in the trace, in dBm.
[in] **TracePoints**	The number of points in the trace, representing the length of the frequency and power arrays.
[in] **ACPRFreqInfo**	The frequency information required for adjacent channel power ratio (ACPR) analysis, including the resolution bandwidth, main channel center frequency and bandwidth, adjacent channel spacing, and the number of adjacent channel pairs. Refer to the definition of the DSP_ACPRFreqInfo_TypeDef structure for details.
[out] **ACPRResult**	Returns the adjacent channel power ratio (ACPR) analysis results, including the main channel power and peak information, as well as the center frequency, bandwidth, power, power ratio, power difference, and peak information of the left and right adjacent channels. Refer to the definition of the TraceAnalysisResult_ACPR_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after SWP_Get related-function.
Example	

int Status = -1; int DeviceNum = 0; void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;	

```
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);

SWP_Profile_TypeDef SWP_ProfileIn, ProfileSetOut, SWP_ProfileOut;

SWP_TraceInfo_TypeDef TraceInfo;

Status = SWP_ProfileDeInit(&Device, &SWP_ProfileIn);

SWP_ProfileIn.CenterFreq_Hz = 1e9;

SWP_ProfileIn.FreqAssignment = CenterSpan;

uint8_t IfDoConfig = 1;

Status = SWP_AutoSet(&Device, SWPACPRMeas, &SWP_ProfileIn, &ProfileSetOut, &TraceInfo,
IfDoConfig);

ProfileSetOut.Span_Hz = 10e6;

Status = SWP_Configuration(&Device, &ProfileSetOut, &SWP_ProfileOut, &TraceInfo);

vector<double> Frequency(TraceInfo.FullsweepTracePoints);

vector<float> PowerSpec_dBm(TraceInfo.FullsweepTracePoints);

MeasAuxInfo_TypeDef MeasAuxInfo;

Status = SWP_GetFullSweep(&Device, Frequency.data(), PowerSpec_dBm.data(), &MeasAuxInfo);

DSP_ACPRFreqInfo_TypeDef ACPRFreqInfo;

ACPRFreqInfo.RBW = SWP_ProfileOut.RBW_Hz;

ACPRFreqInfo.AdjChPair = 2;

ACPRFreqInfo.AdjChSpace_Hz = 2e6;

ACPRFreqInfo.MainChBW_Hz = 1e6;

ACPRFreqInfo.MainChCenterFreq_Hz = 1e9;

vector<TraceAnalysisResult_ACPR_TypeDef> ACPRResult(ACPRFreqInfo.AdjChPair);

Status = DSP_TraceAnalysis_ACPR(Frequency.data(), PowerSpec_dBm.data(),
TraceInfo.FullsweepTracePoints, ACPRFreqInfo, ACPRResult.data());

Status = Device_Close(&Device);
```

22.7 DSP_SEMAnalysis

```
int DSP_SEMAnalysis(

        const DSP_SEMProfile_TypeDef* semProfile,

        const double Freq_Hz[],

        const float PowerSpec_dBm[],

        const uint32_t TracePoints,

        const double CenterFreq,
```

DSP_SEMResult_TypeDef* **SEMResult**)	
Description	
Performs spectrum emission mask (SEM) analysis on the input spectrum trace data, evaluating whether the spectrum meets emission regulations based on the specified template and center frequency, and outputs the analysis results.	
Compatibility	0.55.62 and later.
Parameter description	
[in] **semProfile**	The spectrum emission mask (SEM) configuration, including the reference setting method, manual reference level, and template configuration of up to 16-line segments. Refer to the definition of the DSP_SEMProfile_TypeDef structure for details.
[in] **Freq_Hz[]**	The input frequency array, corresponding to the frequency values of each point in the trace, in Hz.
[in] **PowerSpec_dBm[]**	The input power array, corresponding to the power values of each point in the trace, in dBm.
[in] **TracePoints**	The number of points in the trace, representing the length of the frequency and power arrays.
[in] **CenterFreq**	The center frequency of the signal used for the analysis.
[out] **SEMResult**	Returns the spectrum emission mask (SEM) analysis results, including the measurement results for each line segment, the template configuration used, and the actual reference level. Refer to the definition of the DSP_SEMResult_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after SWP_Get related-function.
Example	

int Status = 0; void* Device = NULL; int DevNum = 0;
BootProfile_TypeDef BootProfile;
BootInfo_TypeDef BootInfo;	

```
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
Status = Device_Open(&Device, DevNum, &BootProfile, &BootInfo);
SWP_Profile_TypeDef SWP_ProfileIn;
SWP_Profile_TypeDef SWP_ProfileOut;
SWP_TraceInfo_TypeDef TraceInfo;
SWP_ProfileDeInit(&Device, &SWP_ProfileIn);
SWP_ProfileIn.FreqAssignment = CenterSpan;
SWP_ProfileIn.CenterFreq_Hz = 1e9;
SWP_ProfileIn.Span_Hz = 60e6;
SWP_ProfileIn.RefLevel_dBm = -20;
SWP_ProfileIn.RBWMode = RBW_Manual;
SWP_ProfileIn.RBW_Hz = 5e3;
SWP_ProfileIn.VBWMode = VBW_TenPercentRBW;
SWP_ProfileIn.Detector = Detector_Average;
SWP_ProfileIn.SpurRejection = Enhanced;
SWP_ProfileIn.SweepTimeMode = SWTMode_minSWTx20;
Status = SWP_Configuration(&Device, &SWP_ProfileIn, &SWP_ProfileOut, &TraceInfo);
std::vector<double >Frequency(TraceInfo.FullsweepTracePoints);
std::vector<float> PowerSpec_dBm(TraceInfo.FullsweepTracePoints);
while (1) {
MeasAuxInfo_TypeDef MeasAuxInfo;
Status = SWP_GetFullSweep(&Device, Frequency.data(), PowerSpec_dBm.data(), &MeasAuxInfo);
if (Status == APIRETVAL_NoError) {
DSP_SEMProfile_TypeDef semProfile = { 0, 0, { {true, 9e6, 0, 11e6, -20, 1, 0}, {true, 11e6, -20, 20e6, -28, 1,
0}, {true, 20e6, -28, 30e6, -40, 1, 0} } };
DSP_SEMResult_TypeDef result;
Status = DSP_SEMAnalysis(&semProfile, Frequency.data(), PowerSpec_dBm.data(),
TraceInfo.FullsweepTracePoints, SWP_ProfileOut.CenterFreq_Hz, &result);
for (int i = 0; i < 3; i++) {
std::cout << "low: " << result.mSegmentResults->mLowerPassOrFail << ", high: " <<
result.mSegmentResults->mUpperPassOrFail << std::endl;
}
}
}

Device_Close(&Device);
```

23. Digital Signal Processing (Processing of stream)

23.1 DSP_Open

int DSP_Open(void DSP)**	
Description	
Opens the DSP function and allocates memory for storing DSP-related data. This function must be called before invoking any other DSP functions. Multiple DSP instances can be operated simultaneously by providing multiple DSP pointers.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **DSP**	Reference to the memory space required for running the DSP. After calling, it returns the memory address of the currently opened DSP instance, which must be used to index this address in subsequent API calls.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called before any other DSP function calls and only once at the start of the program. After use, DSP_Close must be called to release the allocated memory.
Example	Please refer to the relevant example of the DSP_DDC_Execute() function.

23.2 DSP_Close

int DSP_ Close(void DSP)**	
Description	
Closes the DSP function and releases the memory previously allocated by DSP_Open.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **DSP**	Reference to the memory space required for running the DSP, pointing to the memory address returned by DSP_Open, used for subsequent DSP operations or memory release.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.

Calling constraints	This function must be called at the end of program execution. After calling, the DSP function is closed and the memory is released. To use the DSP function again, DSP_Open must be called.
Example	Please refer to the relevant example of the DSP_DDC_Execute() function.

23.3 DSP_FFT_DeInit

int DSP_FFT_DeInit(DSP_FFT_TypeDef* IQToSpectrum)	
Description	
Initializes the FFT mode parameters, including FFT size, window type, decimation factor, etc., with all parameters encapsulated in the DSP_FFT_TypeDef structure.	
Compatibility	0.55.0 and later.
Parameter description	
[out] **IQToSpectrum**	Configures the FFT mode parameter structure, including the number of analysis points, number of valid sample points, window type, trace detection method, detection ratio, spectrum cropping ratio, and whether calibration is applied. Refer to the definition of the DSP_FFT_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called before DSP_FFT_Configuration.
Example	Please refer to the relevant example of the DSP_FFT_IQSToSpectrum() function.

23.4 DSP_FFT_Configuration

int DSP_FFT_Configuration(**void** DSP,** **const DSP_FFT_TypeDef* ProfileIn,** **DSP_FFT_TypeDef* ProfileOut,** **uint32_t* TracePoints,** **double* RBWRatio** **)**
Description

Configures the relevant parameters for FFT mode. Parameters such as FFT size, window type, and decimation factor in FFT mode are all encapsulated in the DSP_FFT_TypeDef structure.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **DSP**	DSP memory reference returned by DSP_Open, used to identify the current DSP instance.
[in] **ProfileIn**	The input FFT configuration parameters, including the number of analysis points, number of sampling points, window type, trace detection method, and others. Refer to the definition of the DSP_FFT_TypeDef structure for details.
[out] **ProfileOut**	Returns the FFT configuration parameters actually applied, which can be used to verify the configuration. Refer to the definition of the DSP_FFT_TypeDef structure for details.
[out] **TracePoints**	The number of spectrum points available under the current DSP_FFT configuration.
[out] **RBWRatio**	Returns the ratio of the resolution bandwidth to the sampling rate. Calculation Formula: RBW = RBWRatio * IQSampleRate
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after DSP_FFT_DeInit.
Example	Please refer to the relevant example of the DSP_FFT_IQSToSpectrum() function.

23.5 DSP_FFT_IQSToSpectrum

```
int DSP_FFT_IQSToSpectrum(
    void** DSP,
    const IQStream_TypeDef* IQStream,
    double Freq_Hz[],
    float PowerSpec_dBm[]
)
```

Description

Converts the input IQ data stream into spectrum data, outputting the corresponding frequency and power arrays for spectrum analysis.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **DSP**	DSP memory reference returned by DSP_Open, used to identify the current DSP instance.
[in] **IQStream**	Information related to the IQ data stream, including the IQ data and associated configuration parameters. Refer to the definition of the IQStream_TypeDef structure for details.
[out] **Freq_Hz[]**	Returns the frequency array of the spectrum data, in Hz. The array length is TracePoints, as determined by the DSP_FFT_Configuration() function.
[out] **PowerSpec_dBm[]**	Returns the power array of the spectrum data, in dBm. The array length is TracePoints, as determined by the DSP_FFT_Configuration() function.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after DSP_FFT_Configuration.
Example	

```
void* Device = NULL; int DeviceNum = 0; int Status = -1;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
IQS_Profile_TypeDef ProfileIn, ProfileOut;
IQS_StreamInfo_TypeDef StreamInfo;
IQStream_TypeDef IQStream;
Status = IQS_ProfileDeInit(&Device, &ProfileIn);
Status = IQS_Configuration(&Device, &ProfileIn, &ProfileOut, &StreamInfo);
vector<int16_t> AlternIQStream(StreamInfo.StreamSamples * 2);
void* DSP = NULL; uint32_t TracePoints = 0; double RBWRatio = 0;
Status = DSP_Open(&DSP);
```

```
DSP_FFT_TypeDef FFT_ProfileIn, FFT_ProfileOut;
Status = DSP_FFT_DeInit(&FFT_ProfileIn);
Status = DSP_FFT_Configuration(&DSP, &FFT_ProfileIn, &FFT_ProfileOut, &TracePoints, &RBWRatio);
vector<double> Frequency(TracePoints); vector<float> PowerSpec_dBm(TracePoints);
Status = IQS_BusTriggerStart(&Device);
Status = IQS_GetIQStream_PM1(&Device, &IQStream);
Status = DSP_FFT_IQSToSpectrum(&DSP, &IQStream, Frequency.data(), PowerSpec_dBm.data());
Status = IQS_BusTriggerStop(&Device);
Status = DSP_Close(&DSP);
Status = Device_Close(&Device);
```

23.6 DSP_DDC_DeInit

int DSP_DDC_DeInit(DSP_DDC_TypeDef* DDC_ProfileIn)	
Description	
Initializes the parameters for DDC mode. In DDC mode, the complex mixing and resampling parameters are encapsulated in the DSP_DDC_TypeDef structure.	
Compatibility	0.55.0 and later.
Parameter description	
[out] **DDC_ProfileIn**	The input Digital Down Conversion (DDC) configuration parameters, including the complex mixing offset frequency, sampling rate, resampling decimation factor, and number of sample points, used to initialize or configure the DDC function. Refer to the definition of the DSP_DDC_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called before DSP_DDC_Configuration.
Example	Please refer to the relevant example of the DSP_DDC_Execute() function.

23.7 DSP_DDC_Configuration

int DSP_DDC_Configuration(void** DSP, const DSP_DDC_TypeDef* DDC_ProfileIn, DSP_DDC_TypeDef* DDC_ProfileOut)	
Description	
Configure the parameters for DDC mode. In DDC mode, the complex mixing and resampling parameters are encapsulated in the DSP_DDC_TypeDef structure.	
Compatibility	0.55.0 and later.
Parameter description	
[in] DSP	The DSP memory reference returned by DSP_Open, used to index the current DSP instance.
[in] ProfileIn	The input DDC configuration parameters, including the complex mixing frequency offset, sampling rate, decimation factor, and number of sample points, used to configure the DDC function. Refer to the definition of the DSP_DDC_TypeDef structure for details.
[out] ProfileOut	Returns the DDC configuration parameters actually applied, which can be used to verify the configuration. Refer to the definition of the DSP_DDC_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after DSP_DDC_DeInit.
Example	Please refer to the relevant example of the DSP_DDC_Execute() function.

23.8 DSP_DDC_Reset

void DSP_DDC_Reset(void** DSP)
Description
Resets the buffer in the DDC function, clearing historical data to prepare for a new downconversion operation.

Compatibility	0.55.0 and later.
Parameter description	
[in/out] **DSP**	DSP memory reference, returned by DSP_Open, used to index the current DSP instance.
Return value	None.
Calling constraints	Must be called after DSP_Open.
Example	Please refer to the relevant example of the DSP_DDC_Execute() function.

23.9 DSP_DDC_GetDelay

```
void DSP_DDC_GetDelay(
        void** DSP,
        uint32_t* delay
)
```

Description	
Gets the current DDC processing latency. By providing the DSP memory reference, it returns the DDC latency under the current configuration (in number of samples), which can be used for calibration or synchronized processing.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **DSP**	DSP memory reference, returned by DSP_Open, used to index the current DSP instance.
[out] **delay**	Returns the DDC processing latency, measured in number of samples.
Return value	None.
Calling constraints	Must be called after DSP_DDC_Configuration.
Example	Please refer to the relevant example of the DSP_DDC_Execute() function.

23.10 DSP_DDC_Execute

int DSP_DDC_Execute(void** DSP, const IQStream_TypeDef* IQStreamIn, IQStream_TypeDef* IQStreamOut)	
Description	
Performs Digital Down Conversion (DDC) operation, converting the input IQ data stream into a down-converted output IQ data stream based on the current DDC configuration, for subsequent processing or analysis.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **DSP**	DSP memory reference, returned by DSP_Open, used to index the current DSP instance.
[in] **IQStreamIn**	Information regarding the input IQ data stream, including IQ data and associated configuration information. Refer to the definition of the IQStream_TypeDef structure for details.
[out] **IQStreamOut**	Information regarding the output IQ data stream, including IQ data and associated configuration information. Refer to the definition of the IQStream_TypeDef structure for details.
Return value	0: NoError. Nonzero: abnormal exist, please refer to the Appendix 1.
Calling constraints	Must be called after DSP_DDC_Configuration.
Example	

int Status = -1; void* DSP = NULL; void* Device = NULL; int DeviceNum = 0;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
IQS_Profile_TypeDef ProfileIn;	

```
IQS_Profile_TypeDef ProfileOut;
IQS_StreamInfo_TypeDef StreamInfo;
Status = IQS_ProfileDeInit(&Device, &ProfileIn);
Status = IQS_Configuration(&Device, &ProfileIn, &ProfileOut, &StreamInfo);
IQStream_TypeDef IQStream;
IQStream_TypeDef IQStreamOut;
Status = IQS_BusTriggerStart(&Device);
Status = IQS_GetIQStream_PM1(&Device, &IQStream);
Status = IQS_BusTriggerStop(&Device);
Status = DSP_Open(&DSP);
DSP_DDC_TypeDef DDC_ProfileIn, DDC_ProfileOut;
Status = DSP_DDC_DeInit(&DDC_ProfileIn);
uint32_t DDC_Points = 0;
Status = DSP_DDC_Configuration(&DSP, &DDC_ProfileIn, &DDC_ProfileOut);
uint32_t delay;
DSP_DDC_GetDelay(&DSP, &delay);
DSP_DDC_Reset(&DSP);
Status = DSP_DDC_Execute(&DSP, &IQStream, &IQStreamOut);
Status = DSP_Close(&DSP);
Status = Device_Close(&Device);
```

23.11 DSP_AudioAnalysis

```
void DSP_AudioAnalysis(
        const double Audio[],
        const uint64_t SamplePoints,
        const double SampleRate,
        DSP_AudioAnalysis_TypeDef* AudioAnalysis
)
```

Description
Analyzes the input audio data, calculating and outputting key audio performance parameters, including audio voltage (V), audio frequency (Hz), SINAD (dB), and Total Harmonic Distortion (THD, %).

Compatibility	0.55.0 and later.
Parameter description	
[in] **Audio[]**	Input audio data array, containing audio sample values stored in chronological order.
[in] **SamplePoints**	Number of samples in the input audio data, representing the length of the Audio array.
[in] **SampleRate**	Sampling rate of the input audio data, measured in Hz.
[out] **AudioAnalysis**	Pointer to the structure returning audio analysis results, including audio voltage, audio frequency, SINAD, and THD. Refer to the definition of the DSP_AudioAnalysis_TypeDef structure for details.
Return value	None.
Calling constraints	Must be called after AM/FM demodulation function.
Example	

```
int Status = -1; int DeviceNum = 0; void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
IQS_Profile_TypeDef ProfileIn, ProfileOut;
IQS_StreamInfo_TypeDef StreamInfo;
Status = IQS_ProfileDeInit(&Device, &ProfileIn);
Status = IQS_Configuration(&Device, &ProfileIn, &ProfileOut, &StreamInfo);
IQStream_TypeDef IQStream;
void* AnalogMod = NULL;
ASD_Open(&AnalogMod);
bool reset = 1;
vector<float> result(StreamInfo.PacketSamples);
FM_DemodParam_TypeDef FM_DemodParam;
void* DSP = NULL;
DSP_Open(&DSP);
```

```
Status = IQS_BusTriggerStart(&Device);
DSP_AudioAnalysis_TypeDef    AudioAnalysis;
Status = IQS_GetIQStream_PM1(&Device, &IQStream);
Status = ASD_FMDemodulation(&AnalogMod, &IQStream, reset, result.data(), &FM_DemodParam);
vector<double> Audio(result.begin(), result.end());
DSP_AudioAnalysis(Audio.data(), StreamInfo.PacketSamples, StreamInfo.IQSampleRate,
&AudioAnalysis);
Status = IQS_BusTriggerStop(&Device);
DSP_Close(&DSP);
ASD_Close(&AnalogMod);
Status = Device_Close(&Device);
```

23.12 DSP_LPF_DeInit

void DSP_LPF_DeInit(Filter_TypeDef* LPF_ProfileIn)	
Description	
Initializes or resets Low Pass Filter (LPF) parameters, preparing for subsequent filtering processing, including settings such as cutoff frequency and stopband attenuation.	
Compatibility	0.55.0 and later.
Parameter description	
[out] **LPF_ProfileIn**	Low-pass filter parameter structure, used for initializing or resetting filter configuration. Refer to the definition of the Filter_TypeDef structure for details.
Return value	None.
Calling constraints	Must be called before DSP_LPF_Configuration.
Example	Please refer to the relevant example of the DSP_LPF_Execute_Real() function.

23.13 DSP_LPF_Configuration

void DSP_LPF_Configuration(

void DSP,**

const Filter_TypeDef* LPF_ProfileIn,

Filter_TypeDef* **LPF_ProfileOut**)	
Description	
Configures Low Pass Filter (LPF) parameters, generating and applying corresponding filter settings based on the input configuration, and returning the actual effective parameters for subsequent DSP filtering processing.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **DSP**	DSP memory reference, returned by DSP_Open, used to index the current DSP instance.
[in] **LPF_ProfileIn**	Input low-pass filter configuration parameters, used to generate filter coefficients. Refer to the definition of the Filter_TypeDef structure for details.
[out] **LPF_ProfileOut**	Output actual low-pass filter configuration parameters, reflecting the LPF settings currently effective in the DSP. Refer to the definition of the Filter_TypeDef structure for details.
Return value	None.
Calling constraints	Must be called after DSP_LPF_DeInit.
Example	Please refer to the relevant example of the DSP_LPF_Execute_Real() function.

23.14 DSP_LPF_Reset

void DSP_LPF_Reset(void DSP)**	
Description	
Resets internal buffers and states of the Low Pass Filter (LPF) to clear historical filtering data, preventing influence on subsequent filtering results; typically called before restarting data processing or switching input data streams.	
Compatibility	0.55.0 and later.
Parameter description	

[in] **DSP**	DSP memory space reference, returned by DSP_Open, used to index the current DSP instance and access its LPF module.
Return value	None.
Calling constraints	Must be called after DSP_Open.
Example	Please refer to the relevant example of the DSP_LPF_Execute_Complex() function.

23.15 DSP_LPF_Execute_Real

```
void DSP_LPF_Execute_Real(
        void** DSP,
        float Signal[],
        float LPF_Signal[]
)
```

Description	
Apply low-pass filtering to a real-valued signal using the currently configured low-pass filter parameters, and output the resulting filtered real-valued signal.	
Compatibility	0.55.0 and later.
Parameter description	
[in] **DSP**	DSP memory handle returned by DSP_Open, used to reference the current DSP instance.
[in] **Signal[]**	Input array of real-valued signal data to be processed by the low-pass filter.
[out] **LPF_Signal[]**	Output array of real-valued signal data after low-pass filtering, with the same length as the input signal.
Return value	None.
Calling constraints	Must be called after DSP_LPF_Configuration.
Example	

```
int Status = -1; Sin_TypeDef NCO_Profile;
NCO_Profile.Amplitude = 10;
NCO_Profile.Frequency = 60e3;
NCO_Profile.Phase = 0;
NCO_Profile.SampleRate = 100e3;
NCO_Profile.Samples = 2000;
vector<float> sin(NCO_Profile.Samples);
vector<float> LPF_Signal(NCO_Profile.Samples);
void* DSP = NULL;
Status = DSP_Open(&DSP);
Filter_TypeDef LPF_ProfileIn;
Filter_TypeDef LPF_ProfileOut;
DSP_LPF_DeInit(&LPF_ProfileIn);
LPF_ProfileIn.As = 90;
LPF_ProfileIn.fc = 0.25;
LPF_ProfileIn.mu = 0;
LPF_ProfileIn.n = 90;
LPF_ProfileIn.Samples = NCO_Profile.Samples;
DSP_LPF_Configuration(&DSP, &LPF_ProfileIn, &LPF_ProfileOut);
DSP_GenerateSineWaveform(sin.data(),&NCO_Profile);
DSP_LPF_Execute_Real(&DSP, sin.data(), LPF_Signal.data());
Status = DSP_Close(&DSP);
```

23.16 DSP_LPF_Execute_Complex

```
void DSP_LPF_Execute_Complex(
        void** DSP,
        const IQStream_TypeDef* IQStreamIn,
        IQStream_TypeDef* IQStreamOut
)
```

Description	
Perform low-pass filtering on a complex IQ signal using the currently configured low-pass filter parameters, and output the resulting filtered complex IQ data stream.	
Compatibility	0.55.0 and later.
Parameter description	

[in] **DSP**	DSP memory handle returned by DSP_Open, used to reference the current DSP instance and its low-pass filter configuration.
[in] **IQStreamIn**	Input complex IQ data stream to be processed by the low-pass filter. Refer to the definition of the IQStream_TypeDef structure for details.
[out] **IQStreamOut**	Output complex IQ data stream after low-pass filtering. Refer to the definition of the IQStream_TypeDef structure for details.
Return value	None.
Calling constraints	Must be called after DSP_LPF_Configuration.
Example	

```
int Status = -1; int DeviceNum = 0; void* Device = NULL;
BootProfile_TypeDef BootProfile;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
BootInfo_TypeDef BootInfo;
Status = Device_Open(&Device, DeviceNum, &BootProfile, &BootInfo);
IQS_Profile_TypeDef ProfileIn;
IQS_Profile_TypeDef ProfileOut;
IQS_StreamInfo_TypeDef StreamInfo;
Status = IQS_ProfileDeInit(&Device, &ProfileIn);
Status = IQS_Configuration(&Device, &ProfileIn, &ProfileOut, &StreamInfo);
IQStream_TypeDef IQStream, IQStreamOut;
Status = IQS_BusTriggerStart(&Device);
Status = IQS_GetIQStream_PM1(&Device, &IQStream);
Status = IQS_BusTriggerStop(&Device);
void* DSP = NULL;
Status = DSP_Open(&DSP);
Filter_TypeDef LPF_ProfileIn, LPF_ProfileOut;
DSP_LPF_DeInit(&LPF_ProfileIn);
DSP_LPF_Configuration(&DSP, &LPF_ProfileIn, &LPF_ProfileOut);
DSP_LPF_Reset(&DSP);
DSP_LPF_Execute_Complex(&DSP, &IQStream, &IQStreamOut);
Status = DSP_Close(&DSP);
Status = Device_Close(&Device);
```

23.17 DSP_InterceptSpectrum

```
void DSP_InterceptSpectrum(
        const double StartFreq_Hz,
        const double StopFreq_Hz,
        const double Freq_Hz[],
        const float PowerSpec_dBm[],
        const uint32_t FullsweepTracePoints,
        double FrequencyOut[],
        float PowerSpecOut_dBm[],
        uint32_t* InterceptPoints
)
```

Description	
Intercept the redundant spectrum on both sides in SWP mode.	
Compatibility	0.55.0 and later.
Parameter description	
[in] StartFreq_Hz	Specifies the start frequency of the spectrum segment to be intercepted, in Hz.
[in] StopFreq_Hz	Specifies the stop frequency of the spectrum segment to be intercepted, in Hz.
[in] Freq_Hz[]	Array of frequencies to be intercepted, in Hz.
[in] PowerSpec_dBm[]	Array of power values to be intercepted, in dBm.
[in] FullsweepTracePoints	Number of trace points before interception.
[out] FrequencyOut[]	Array of intercepted frequencies, in Hz.
[out] PowerSpecOut_dBm[]	Array of intercepted power values, in dBm.
[out] InterceptPoints	Number of valid trace points actually intercepted.
Return value	None.
Calling constraints	None.
Example	

```
int Status = 0; void* Device = NULL; int DevNum = 0;
BootProfile_TypeDef BootProfile;
BootInfo_TypeDef BootInfo;
BootProfile.DevicePowerSupply = USBPortAndPowerPort;
BootProfile.PhysicalInterface = USB;
Status = Device_Open(&Device, DevNum, &BootProfile, &BootInfo);
DeviceInfo_TypeDef DeviceInfo;
Status = Device_QueryDeviceInfo(&Device, &DeviceInfo);
SWP_Profile_TypeDef SWP_ProfileIn, SWP_ProfileOut;
SWP_TraceInfo_TypeDef TraceInfo;
SWP_ProfileDeInit(&Device, &SWP_ProfileIn);
SWP_ProfileIn.StartFreq_Hz = 20000000;
SWP_ProfileIn.StopFreq_Hz = 300000000;
SWP_ProfileIn.RBW_Hz = 25000;
SWP_ProfileIn.RBWMode = RBW_Manual;
Status = SWP_Configuration(&Device, &SWP_ProfileIn, &SWP_ProfileOut, &TraceInfo);
vector<double> Frequency_Full(TraceInfo.FullsweepTracePoints);
vector<float> PowerSpec_dBmFull(TraceInfo.FullsweepTracePoints);
vector<double> Frequency(TraceInfo.FullsweepTracePoints);
vector<float> PowerSpec_dBm(TraceInfo.FullsweepTracePoints);
int HopIndex = 0;
int FrameIndex = 0;
MeasAuxInfo_TypeDef MeasAuxInfo;
void* DSP = NULL;
DSP_Open(&DSP);
Status = SWP_GetFullSweep(&Device, Frequency_Full.data(), PowerSpec_dBmFull.data(),
&MeasAuxInfo);
uint32_t InterceptPoints;
DSP_InterceptSpectrum(SWP_ProfileOut.StartFreq_Hz, SWP_ProfileOut.StopFreq_Hz,
Frequency_Full.data(), PowerSpec_dBmFull.data(), TraceInfo.FullsweepTracePoints,
Frequency.data(), PowerSpec_dBm.data(), &InterceptPoints);
Frequency.resize(InterceptPoints);
PowerSpec_dBm.resize(InterceptPoints);
```

```
Status = Device_Close(&Device);
```

24. Structure Variable

24.1 DeviceFirmwareVersion_TypeDef

uint32_t FFWVersion	FPGA firmware version.
uint32_t MFWVersion	MCU firmware version.
uint32_t BusVersion	Bus firmware version.

24.2 BootProfile_TypeDef

PhysicalInterface_TypeDef **PhysicalInterface**	Specifies the physical bus type used by the device, determining the interface method and communication type between the device and the host. Refer to the definition of the PhysicalInterface_TypeDef enumeration structure for details.
DevicePowerSupply_TypeDef **DevicePowerSupply**	Specifies the power supply mode of the device, used for initializing the device's power interface. Refer to the definition of the DevicePowerSupply_TypeDef enumeration structure for details.
IPVersion_TypeDef **ETH_IPVersion**	Specifies the IP protocol version for the ETH interface, used for initializing network communication. Refer to the definition of the IPVersion_TypeDef enumeration structure for details.
uint8_t ETH_IPAddress[16]	IP address of the ETH interface, used for network communication configuration between the device and the host.
uint16_t ETH_RemotePort	Listening port number of the ETH interface, used for network connection and data transmission.
int32_t ETH_ErrorCode	Return code of the ETH interface, used to indicate network initialization or communication status.
int32_t ETH_ReadTimeOut	Read timeout for the ETH interface, measured in milliseconds (ms), used to control the waiting time for network data retrieval.

24.3 BootInfo_TypeDef

DeviceInfo_TypeDef DeviceInfo	Device basic information structure, containing the unique device identifier and various version information. Refer to the definition of the DeviceInfo_TypeDef structure for details.
uint32_t BusSpeed	Bus speed information, used to represent the rate of the device communication bus.
uint32_t BusVersion	Bus firmware version number.
uint32_t APIVersion	API version number.
int ErrorCodes[7]	List of error codes during the boot process, where each element represents an error type.
int Errors	Total number of errors during the boot process.
int WarningCodes[7]	List of warning codes during the boot process, where each element represents a warning type.
int Warnings	Total number of warnings during the boot process.

24.4 DeviceInfo_TypeDef

uint64_t DeviceUID	Unique device serial number, used to uniquely identify the device.
uint16_t Model	Device type or model identifier.
uint16_t HardwareVersion	Device hardware version number.
uint16_t MFWVersion	Device MCU firmware version number.
uint16_t FFWVersion	Device FPGA firmware version number.

24.5 DeviceState_TypeDef

int16_t Temperature	Device temperature, measured in degrees Celsius; Actual Temperature = 0.01 × Temperature.
double AbsoluteTimeStamp	Absolute timestamp corresponding to the current data packet.
float Latitude	Latitude coordinates corresponding to the current data packet; positive for North, negative for South.
float Longitude	Longitude coordinates corresponding to the current data packet; positive for East, negative for West.

24.6 NetworkDeviceInfo_TypeDef

uint64_t DeviceUID	Device serial number, used to uniquely identify the device.
uint16_t Model	Device type number.
uint16_t HardwareVersion	Hardware version number.
uint32_t MFWVersion	MCU firmware version number.
uint32_t FFWVersion	FPGA firmware version number.
uint8_t IPAddress[4]	Device IP address (IPv4).
uint8_t SubnetMask[4]	Device subnet mask (IPv4).

24.7 HardWareState_TypeDef

GNSSPeriphType_TypeDef GNSSPeriphType	GNSS peripheral type. Refer to the definition of the GNSSPeriphType_TypeDef enumeration structure for details.
GNSSType_TypeDef GNSSType	GNSS receiver type. Refer to the definition of the GNSSType_TypeDef enumeration structure for details.
OCXOType_TypeDef OCXOType	OCXO type on the GNSS module. Refer to the definition of the OCXOType_TypeDef enumeration structure for details.
uint8_t InternalOCXO	Indicates whether the device's internal reference clock is an OCXO
uint8_t SignalSourceEn	Indicates whether the device supports signal generator functionality.
uint8_t ADC_VariableRateEn	Indicates whether the device supports variable ADC sampling rates.
uint8_t IM3_filter	Supplementary IF (Intermediate Frequency) filter (IM3 enhancement). 0: Disabled, 1: Enabled.

24.8 GNSSInfo_TypeDef

float latitude	Returns the latitude coordinate of the current position.
float longitude	Returns the longitude coordinate of the current position.

int16_t altitude	Returns the altitude (elevation) of the current position.
uint8_t SatsNum	Returns the number of satellites used for the current positioning.
uint8_t GNSS_LockState	Returns the GNSS lock status. 0: Unlocked, 1: Locked.
uint8_t DOCXO_LockState	Returns the DOCXO lock status. 0: Unlocked, 1: Locked.
DOCXOWorkMode_TypeDef DOCXO_WorkMode	Returns the DOCXO operating status. Refer to the definition of the DOCXOWorkMode_TypeDef enumeration structure for details.
GNSSAntennaState_TypeDef GNSSAntennaState	Returns the antenna status. Refer to the definition of the GNSSAntennaState_TypeDef enumeration structure for details.

24.9 GNSS_SatDate_TypeDef

uint8_t SatsNum_All	Returns the number of visible satellites within the current range.
uint8_t SatsNum_Use	Returns the number of satellites used for positioning.
GNSS_SNR_TypeDef GNSS_SNR_UsePos	Returns the SNR information of the satellites used for positioning, including the maximum, minimum, and average SNR. Refer to the definition of the GNSS_SNR_TypeDef structure for details.
GNSS_SNR_TypeDef GNSS_SNR_NotUsePos	Returns the SNR information of satellites that are in view but not used for positioning, such as the maximum, minimum, and average SNR. Refer to the definition of the GNSS_SNR_TypeDef structure for details.

24.10 GNSS_SNR_TypeDef

uint8_t Max_SatxC_No	Maximum SNR in the current signal set.
uint8_t Min_SatxC_No	Minimum SNR in the current signal set.
uint8_t Avg_SatxC_No	Average SNR of the current signal set.

24.11 SWP_Profile_TypeDef

double StartFreq_Hz	Start frequency in Hz. Range: 9 kHz to (Device Maximum Frequency - 100 Hz).
double StopFreq_Hz	Stop frequency in Hz. Range: (9 kHz + 100 Hz) to Device Maximum Frequency.
double CenterFreq_Hz	Center frequency in Hz. Range: 9 kHz to (StopFreq_Hz - 50 Hz).
double Span_Hz	Frequency span in Hz. Range: ≥ 100 Hz.
double RefLevel_dBm	Reference level in dBm. Range: -50 dBm to 23 dBm.
double RBW_Hz	Resolution Bandwidth in Hz. Range: 0.1 Hz to 10 MHz.
double VBW_Hz	Video Bandwidth in Hz. Range: 0.1 Hz to 10 MHz.
double SweepTime	When the scan time mode is set to Manual, this parameter represents the absolute time; when set to *N, this parameter represents the scan time multiplier. Range: 0.1s to 9999s.
SWP_FreqAssignment_TypeDef FreqAssignment	Set the frequency specification method, choosing either StartStop or CenterSpan to define the frequency. The default is StartStop. Refer to the definition of the SWP_FreqAssignment_TypeDef structure for details.
Window_TypeDef Window	Specifies the window function to be used for FFT analysis. Defaults to the Blackman-Nuttall window. Refer to the definition of the Window_TypeDef enumeration structure for details.
RBWMode_TypeDef RBWMode	Set the RBW update mode. The default is RBW_Auto. Refer to the definition of the RBWMode_TypeDef enumeration structure for details.
VBWMode_TypeDef VBWMode	Set the VBW update mode. The default is VBW_TenTimesRBW. Refer to the definition of the VBWMode_TypeDef enumeration structure for details.
SweepTimeMode_TypeDef SweepTimeMode	Set the scan time mode. The default is SWTMode_minSWT. Refer to the definition of the SweepTimeMode_TypeDef enumeration structure for details.

Detector_TypeDef Detector	Set the detector. The default is Detector_PosPeak. Refer to the definition of the Detector_TypeDef enumeration structure for details.
TraceFormat_TypeDef TraceFormat	Set the trace format. The default is TraceFormat_Standard. Refer to the definition of the TraceFormat_TypeDef enumeration structure for details.
TraceDetectMode_TypeDef TraceDetectMode	Set the trace detection mode (frequency axis). The default is TraceDetectMode_Auto. Refer to the definition of the TraceDetectMode_TypeDef enumeration structure for details.
TraceDetector_TypeDef TraceDetector	Set the trace detector type. The default is TraceDetector_AutoSample. To specify a detector manually, first set TraceDetectMode to TraceDetectMode_Manual. Refer to the definition of the TraceDetector_TypeDef enumeration structure for details.
uint32_t TracePoints	Set the desired number of trace points. The system will automatically adjust based on the configured scan range and RBW, and return the actual available trace point count that is closest to the requested value.
TracePointsStrategy_TypeDef TracePointsStrategy	Set the trace point configuration strategy. The default is SweepSpeedPreferred. Refer to the definition of the TracePointsStrategy_TypeDef enumeration structure for details.
TraceAlign_TypeDef TraceAlign	Set the trace alignment method. The default is NativeAlign. Refer to the definition of the TraceAlign_TypeDef enumeration structure for details.
FFTExecutionStrategy_TypeDef FFTExecutionStrategy	Set the FFT execution strategy. The default is Auto. Refer to the definition of the FFTExecutionStrategy_TypeDef enumeration structure for details.
RxPort_TypeDef RxPort	Set the signal input port. This is only supported on instruments with a maximum frequency of 8.5GHz or below. Refer to the definition of the RxPort_TypeDef enumeration structure for details.

SpurRejection_TypeDef SpurRejection	Set the spurious suppression. The default is Standard. Higher suppression levels result in slower scan speeds. Refer to the definition of the SpurRejection_TypeDef enumeration structure for details.
ReferenceClockSource_TypeDef ReferenceClockSource	Set the reference clock source to 10MHz. Refer to the definition of the ReferenceClockSource_TypeDef enumeration structure for details.
double ReferenceClockFrequency	Set the reference clock frequency in Hz (only 10MHz is supported), allowing manual correction of the system clock accuracy.
uint8_t EnableReferenceClockOut	Enable reference clock output—only devices with a maximum frequency of 9GHz or above support 10MHz reference clock output. 0: Disable; 1: Enable (output 10MHz reference clock).
SystemClockSource_TypeDef SystemClockSource	Set the system clock source. The default is the internal system clock. Refer to the definition of the SystemClockSource_TypeDef enumeration structure for details.
double ExternalSystemClockFrequency	External system clock frequency in Hz. When using an external system clock source, this parameter must be set to 10MHz.
SWP_TriggerSource_TypeDef TriggerSource	Set the receiver's sweep input trigger source. The default is internal trigger in free-run mode. Refer to the definition of the SWP_TriggerSource_TypeDef enumeration structure for details.
TriggerEdge_TypeDef TriggerEdge	Set the input trigger edge. The default is rising edge trigger. Refer to the definition of the TriggerEdge_TypeDef enumeration structure for details.
TriggerOutMode_TypeDef TriggerOutMode	Set the trigger output mode. The default is no trigger output. Refer to the definition of the TriggerOutMode_TypeDef enumeration structure for details.
TriggerOutPulsePolarity_TypeDef TriggerOutPulsePolarity	Set the trigger output pulse polarity. The default is positive pulse.

	Refer to the definition of the TriggerOutPulsePolarity_TypeDef enumeration structure for details.
uint32_t PowerBalance	Set the dynamic power control in SWP mode. The default is 0. Typical range: 0–5000. Increasing this value reduces power consumption but also decreases scan speed.
GainStrategy_TypeDef GainStrategy	Set the gain strategy. The default is LowNoise. Refer to the definition of the GainStrategy_TypeDef enumeration structure for details.
PreamplifierState_TypeDef Preamplifier	Set the preamplifier operation. The default is automatic enable. Refer to the definition of the PreamplifierState_TypeDef enumeration structure for details.
uint8_t AnalogIFBWGrade	Set the IF bandwidth mode. The default is the SAW filter. 0: SAW filter, 100MHz bandwidth, 20% filter skirt, provides good in-band flatness; 1: LC filter, 110MHz bandwidth, 10% filter skirt, provides better out-of-band suppression.
uint8_t IFGainGrade	Set the IF gain level. The default is level 2. Devices with maximum frequency ≤8.5GHz: range 0 to 11; Devices with maximum frequency ≥9GHz: range 0 to 3.
int8_t Atten	Set the attenuation in dB to define the spectrum analyzer channel attenuation. The default is -1 (auto). Range: -1 to 33, When this value is not -1 (auto), it takes precedence over RefLevel_dBm. In this case: Reference Level = Attenuation – 10.
SWP_TraceType_TypeDef TraceType	Set the output trace type. The default is normal trace output. Refer to the definition of the SWP_TraceType_TypeDef enumeration structure for details.
LOOptimization_TypeDef LOOptimization	Set the local oscillator optimization. The default is automatic mode. Refer to the definition of the LOOptimization_TypeDef enumeration structure for details.

24.12 SWP_TraceInfo_TypeDef

int **FullsweepTracePoints**	Return the number of points in the full trace under the current configuration.
int **PartialsweepTracePoints**	Return the number of trace points per frequency point under the current configuration, i.e., the number of points retrieved each time GetPart is called.
int **TotalHops**	Return the number of frequency points in the full trace under the current configuration, i.e., the number of GetPart calls required for a complete trace.
uint32_t **UserStartIndex**	The array index in the trace array corresponding to the user-specified StartFreq_Hz. That is, when HopIndex = 0, Freq[UserStartIndex] is the frequency point closest to SWPProfile.StartFreq_Hz.
uint32_t **UserStopIndex**	The array index in the trace array corresponding to the user-specified StopFreq_Hz. That is, when HopIndex = TotalHops - 1, Freq[UserStopIndex] is the frequency point closest to SWPProfile.StopFreq_Hz.
double **TraceBinBW_Hz**	Return the frequency interval between two points in the trace under the current configuration.
double **StartFreq_Hz**	Frequency of the first point in the trace.
double **AnalysisBW_Hz**	Analysis bandwidth corresponding to each frequency point.
int **TraceDetectRatio**	Trace detection ratio, range: [1， 2^32-1] Defines the mapping ratio between the original sampled points and the output trace points. The trace detector extracts one or two valid data points from the original spectrum sequence every TraceDetectRatio points to form the output trace.
int **DecimateFactor**	Decimation factor of the time-domain data.
float **FrameTimeMultiple**	Frame analysis time multiplier. The analysis time at a single frequency point = default analysis time (set by the system) × frame time multiplier. Increasing the frame time multiplier increases the device's minimum scan time, but not in a strictly linear manner.

double **FrameTime**	Frame scan time: the signal duration used for a single-frame FFT analysis (unit: s).
double **EstimateMinSweepTime**	Minimum scan time configurable under the current settings. Unit: s. The value is mainly affected by Span, RBW, VBW, frame scan time, and other factors.
DataFormat_TypeDef **DataFormat**	Time-domain data format. Refer to the definition of the DataFormat_TypeDef enumeration structure for details.
uint64_t **SamplePoints**	Time-domain data sample length.
uint32_t **GainParameter**	Gain-related parameters, where the 3rd byte indicates the preamplifier state: PreAmplifierState(bits 23 to 16) 0: Off; 1: On.
DSPPlatform_Typedef **DSPPlatform**	Return the DSP computation platform used under the current configuration. Refer to the definition of the DSPPlatform_TypeDef enumeration structure for details.

24.13 MeasAuxInfo_TypeDef

uint32_t **MaxIndex**	Index of the maximum power in the data packet.
float **MaxPower_dBm**	Maximum power value in the data packet.
int16_t **Temperature**	Device temperature, in Celsius: Temperature × 0.01.
double **SysTimeStamp**	System timestamp, in seconds. After device power-on, the internal counter counts with an 8ns interval.
double **AbsoluteTimeStamp**	Absolute timestamp, provided by the system GNSS.
float **Latitude**	Latitude coordinate: positive for north, negative for south.
float **Longitude**	Longitude coordinate: positive for east, negative for west.

24.14 SWPTrace_TypeDef

double* **Freq_Hz**	Pointer to the start of the frequency array.
float* **PowerSpec_dBm**	Pointer to the start of the power array.

int HopIndex	Hopping frequency point index for stitching the spectrum.
int FrameIndex	Frame index of the data, used for applications such as quasi-peak detection.
void* AlternIQStream	Address of the time-domain data (interleaved IQ format). Raw IQ data without units.
float ScaletoV	Coefficient to convert time-domain data to absolute voltage (V). Raw IQ data × ScaletoV gives the IQ data in volts.
MeasAuxInfo_TypeDef MeasAuxInfo	Refer to the definition of the MeasAuxInfo_TypeDef structure for details.
SWP_Profile_TypeDef SWP_Profile	Refer to the definition of the SWP_Profile_TypeDef structure for details.
SWP_TraceInfo_TypeDef SWP_TraceInfo	Refer to the definition of the SWP_TraceInfo_TypeDef structure for details.
DeviceInfo_TypeDef DeviceInfo	Refer to the definition of the DeviceInfo_TypeDef structure for details.
DeviceState_TypeDef DeviceState	Refer to the definition of the DeviceState_TypeDef structure for details.

24.15 PNM_Profile_TypeDef

double CenterFreq	Set the fundamental frequency center, in Hz.
float Threshold	Set the carrier detection threshold, in dBm; carriers above this threshold are recognized.
double RBWRatio	RBW ratio (each segment RBW / segment start frequency), range: 0.01 to 0.3.
double StartOffsetFreq	Start frequency offset, range: 1Hz to 9MHz.
double StopOffsetFreq	Stop frequency offset, range: 10Hz to 10MHz.
uint32_t TraceAverage	Number of trace smoothing iterations.

24.16 PNM_MeasInfo_TypeDef

uint32_t Segments	Number of frequency segments (decade-based segmentation).

uint32_t TracePoints	Total number of trace points in the phase noise measurement results.
uint32_t PartialUpdateCounts	Number of trace refreshes during a single-phase noise analysis, i.e., the number of Get interface calls.
uint32_t FramesInSegment [PHASENOISE_MAXFREQSEGMENT]	Total frames for each segment. PHASENOISE_MAXFREQSEGMENT defines the maximum number of frequency segments (decade segments), with an upper limit of 7.
uint32_t FrameDetRatioOfSegment [PHASENOISE_MAXFREQSEGMENT]	Frame detection ratio corresponding to each segment
double StartFreqOfSegment [PHASENOISE_MAXFREQSEGMENT]	Start frequency corresponding to each segment.
double StopFreqOfSegment [PHASENOISE_MAXFREQSEGMENT]	Stop frequency corresponding to each segment.
double RBWOfSegment [PHASENOISE_MAXFREQSEGMENT]	RBW corresponding to each segment, in Hz.

24.17 IQS_Profile_TypeDef

double CenterFreq_Hz	Center frequency, range: 9kHz–(device maximum frequency to 50MHz).
double RefLevel_dBm	Reference level, range: −50dBm to 23dBm.
uint32_t DecimateFactor	Decimation factor of the time-domain data, range: 1 to 4096.
RxPort_TypeDef RxPort	Set the signal input port. Only applicable to devices with a maximum frequency of 8.5GHz or below that are equipped with the optional internal signal source. Refer to the definition of the RxPort_TypeDef enumeration structure for details.
uint32_t BusTimeout_ms	Set the data transfer timeout (ms), range: 1ms to 10s. If the IQ stream acquisition function does not receive data within the specified time, it is considered a timeout and returns an error.
IQS_TriggerSource_TypeDef TriggerSource	Set the input trigger source. The default is bus trigger. Refer to the definition of the IQS_TriggerSource_TypeDef enumeration structure for details.
TriggerEdge_TypeDef TriggerEdge	Set the input trigger edge. The default is rising edge. Refer to the definition of the TriggerEdge_TypeDef enumeration structure for details.
TriggerMode_TypeDef TriggerMode	Set the input trigger mode. The default is FixedPoints. Refer to the definition of the TriggerMode_TypeDef enumeration structure for details.
uint64_t TriggerLength	Set the trigger length, i.e., the number of data points acquired per trigger. Effective only when TriggerMode = FixedPoints Range: 32 to (UINT64_MAX/6) When using bus trigger with 16-bit IQ data, if TriggerLength does not exceed 33,263,616 points, data can be acquired and processed between two triggers.
TriggerOutMode_TypeDef TriggerOutMode	Set the trigger output mode. The default is rising edge. Refer to the definition of the TriggerOutMode_TypeDef enumeration structure for details.

TriggerOutPulsePolarity_TypeDef TriggerOutPulsePolarity	Set the trigger output pulse polarity. The default is rising edge. Refer to the definition of the TriggerOutPulsePolarity_TypeDef enumeration structure for details.
double TriggerLevel_dBm	Set the level trigger threshold. Effective only when TriggerSource = Level. Range: −70dBm to Reference Level..
double TriggerLevel_SafeTime	Level trigger debounces safety time, in seconds. Effective only when TriggerSource = Level. Range: 0 to (2^32 - 1) × (1.0/125 MHz) s. If the valid level of the trigger signal lasts less than this value, the trigger is ignored.
double TriggerDelay	Set the trigger delay, in seconds. After a trigger occurs, the action will be executed after this delay. Range: 0 to (2^32 – 1) × (1/125MHz) s.
double PreTriggerTime	Set the pre-trigger time, in seconds. Range: 0 to (2^16 – 1) × (1/125MHz)s. When a trigger occurs, data within this duration prior to the trigger is saved synchronously.
TriggerTimerSync_TypeDef TriggerTimerSync	Set the synchronization of the trigger timer. The default is synchronized with the rising edge of the external trigger. Refer to the definition of the TriggerTimerSync_TypeDef enumeration structure for details.
double TriggerTimer_Period	Set the timer trigger period, in seconds. Effective only when TriggerSource = Timer. Range: 0 to (2^32 – 1) × (1/125MHz)s.
uint8_t EnableReTrigger	Automatic retriggering: enables the device to perform additional timed triggers after the initial trigger source is activated. For example, after each external trigger, the device can automatically trigger 3 more times at 1ms intervals. Effective only when TriggerMode = FixedPoints: 0 = disabled, 1 = enabled.
double ReTrigger_Period	Automatic retrigger period: sets the interval for additional triggers after each main trigger, in seconds.

	Range: 0 to (2^32 − 1) × (1/125MHz)s.
uint16_t ReTrigger_Count	Automatic retrigger count: sets the number of additional triggers to execute after each main trigger. Range: 0– to (2^16 − 1) times.
DataFormat_TypeDef DataFormat	Set the output data format of IQ data. The default is 16-bit format. Refer to the definition of the DataFormat_TypeDef enumeration structure for details.
GainStrategy_TypeDef GainStrategy	Set the gain strategy. The default is LowNoise. Refer to the definition of the GainStrategy_TypeDef enumeration structure for details.
PreamplifierState_TypeDef Preamplifier	Set the preamplifier operation. The default is automatic enable. Refer to the definition of the PreamplifierState_TypeDef enumeration structure for details.
uint8_t AnalogIFBWGrade	Set the analog IF bandwidth mode. 0: SAW filter, 100MHz bandwidth, 20% filter skirt, provides good in-band flatness; 1: LC filter, 110MHz bandwidth, 10% filter skirt, provides better out-of-band suppression.
uint8_t IFGainGrade	Set the IF gain level. Higher levels correspond to higher IF gain. For instruments with a maximum frequency ≤8.5GHz: range 0 to 11. For instruments with a maximum frequency of 20GHz or 40GHz: range 0 to 3.
uint8_t EnableDebugMode	Debug mode. Not recommended for general use in advanced applications. The default value is 0.
ReferenceClockSource_TypeDef ReferenceClockSource	Set the reference clock source. The default is the 10MHz internal clock. Refer to the definition of the ReferenceClockSource_TypeDef enumeration structure for details.
double ReferenceClockFrequency	Set the reference clock frequency, in Hz. Only 10MHz reference clock is supported.
uint8_t EnableReferenceClockOut	Enable reference clock output. Only supported on devices with a maximum frequency of 9GHz or above.

	0: Do not output; 1: Output 10 MHz reference clock.
SystemClockSource_TypeDef SystemClockSource	Set the system clock source. Refer to the definition of the SystemClockSource_TypeDef enumeration structure for details.
double ExternalSystemClockFrequency	External system clock frequency, in Hz.
double NativeIQSampleRate_SPS	Set the native IQ sampling rate. The device can adjust its sampling rate using this parameter. If changing this parameter has no effect, the device does not support adjusting its sampling rate.
uint8_t EnableIFAGC	IF AGC control. 0: AGC off, use MGC mode; 1: AGC on. If changing this parameter has no effect, the device does not support this feature.
int8_t Atten	Set the attenuation in dB to define the spectrum analyzer channel attenuation. The default is −1 (auto). Range: -1 to 33. When this value is not −1 (auto), it takes precedence over the reference level (RefLevel_dBm). In this case, the reference level is automatically set to: Attenuation – 10dBm.
DCCancelerMode_TypeDef DCCancelerMode	Applicable to specific devices. Set the DC suppressor mode, with the default being the high-pass filter enabled. Enable this function to suppress DC components if a DC offset appears at the center frequency. If no DC component is present, this parameter does not need to be set. Refer to the definition of the DCCancelerMode_TypeDef enumeration structure for details.
QDCMode_TypeDef QDCMode	Applicable to specific devices. Set the IQ amplitude and phase correction mode. If enabling the QDC function does not change the amplitude and phase characteristics of the IQ data, the device does not need to enable the QDC function. Refer to the definition of the QDCMode_TypeDef enumeration structure for details.

float QDCIGain	Applicable to specific devices. Set the normalized linear gain of the I channel. A value of 1.0 indicates no gain. Setting range: 0.8 to 1.2. Effective only when QDCMode = QDCManualMode.
float QDCQGain	Applicable to specific devices. Set the normalized linear gain of the Q channel. A value of 1.0 indicates no gain. Setting range: 0.8 to 1.2. Effective when QDCMode = QDCManualMode.
float QDCPhaseComp	Applicable to specific devices. Set the phase compensation coefficient. Setting range: -0.2 to +0.2. Effective only when QDCMode = QDCManualMode.
int8_t DCCIOffset	Applicable to specific devices. Set the DC offset of the I channel in LSB. Effective only when DCCancelerMode = DCCManualOffsetM ode
int8_t DCCQOffset	Applicable to specific devices. Set the DC offset of the Q channel in LSB. Effective only when DCCancelerMode = DCCManualOffsetM ode.
LOOptimization_TypeDef LOOptimization	Set the local oscillator optimization. The default is automatic mode. Refer to the definition of the LOOptimization_TypeDef enumeration structure for details.

24.18 IQS_StreamInfo_TypeDef

double Bandwidth	The bandwidth of the receiver's physical channel or digital signal processing under the current configuration.
double IQSampleRate	The corresponding single-channel IQ sampling rate under the current configuration, in S/s (samples per second).
uint64_t PacketCount	The total number of data packets acquired per trigger under the current configuration. Effective only when TriggerMode = Fixedpoints.

uint64_t **StreamSamples**	When TriggerMode = Fixedpoints: indicates the total number of samples per trigger under the current configuration; When TriggerMode = Adaptive: this value has no physical meaning; the return value is 0.
uint64_t **StreamDataSize**	When TriggerMode = Fixedpoints: indicates the total number of data bytes per trigger under the current configuration; When TriggerMode = Adaptive: this value has no physical meaning; the return value is 0.
uint32_t **PacketSamples**	The number of sampling points contained in the data packets obtained each time IQS_GetIQStream is called.
uint32_t **PacketDataSize**	The number of valid data bytes obtained each time IQS_GetIQStream is called.
uint32_t **GainParameter**	Gain-related parameters, where the 3rd byte indicates the state of the pre-amplifier. PreAmplifierState (bits 23–16): 0 = off, 1 = on.

24.19 IQS/DET/RTA_TriggerInfo_TypeDef

uint64_t **SysTimerCountOfFirstDataPoint**	The system time counter value corresponding to the first data point in the data packet. After the device powers on, the internal timer starts counting with an 8ns period. The returned system timestamp is the value of this counter at that moment.
uint16_t **InPacketTriggeredDataSize**	The number of valid trigger data bytes in the data packet.
uint16_t **InPacketTriggerEdges**	The number of edges contained in the data.
uint32_t **StartDataIndexOfTriggerEdges[25]**	The offset of each trigger edge relative to the first point of the data packet.
uint64_t **SysTimerCountOfEdges[25]**	The system timestamp corresponding to each trigger edge in the data packet.
int8_t **EdgeType[25]**	The polarity of each trigger edge in the data packet.

24.20 IQStream_TypeDef

void* AlternIQStream	Returns the time-domain IQ data packet (data within the packet is stored in the order IQIQIQ...). Each complete data packet has a fixed size of 64,968 bytes. When the IQ data type is set to int8_t, the I and Q channels each contain 32,484 points, with 1 byte per point; When the IQ data type is set to int16_t, the I and Q channels each contain 16,242 points, with 2 bytes per point.; When the IQ data type is set to int32_t, the I and Q channels each contain 8,121 points, with 4 bytes per point.
float IQS_ScaleToV	The coefficient used to convert the raw time-domain data acquired by the ADC into absolute voltage (V).
float MaxPower_dBm	Outputs the maximum power value in the current data packet, in dBm.
uint32_t MaxIndex	The index of the maximum power in the data packet, i.e., the position of the sample point corresponding to this value.
IQS_Profile_TypeDef IQS_Profile	Configuration information of the data. Refer to the definition of the IQS_Profile_TypeDef structure for details.
IQS_StreamInfo_TypeDef StreamInfo	Format information of the data. Refer to the definition of the IQS_StreamInfo_TypeDef structure for details.
IQS_TriggerInfo_TypeDef TriggerInfo	Trigger information of the data. Refer to the definition of the IQS/DET/RTA_TriggerInfo_TypeDef structure for details.
DeviceInfo_TypeDef DeviceInfo	Device information of the data. Refer to the definition of the DeviceInfo_TypeDef structure for details.
DeviceState_TypeDef DeviceState	Device status information of the data. Refer to the definition of the DeviceState_TypeDef structure for details.

24.21 DET_Profile_TypeDef

double CenterFreq_Hz	Refer to the definition of the IQS_Profile_TypeDef structure for details.
double RefLevel_dBm	
uint32_t DecimateFactor	
RxPort_TypeDef RxPort	
uint32_t BusTimeout_ms	
DET_TriggerSource_TypeDef TriggerSource	
TriggerEdge_TypeDef TriggerEdge	
TriggerMode_TypeDef TriggerMode	
uint64_t TriggerLength	
TriggerOutMode_TypeDef TriggerOutMode	
TriggerOutPulsePolarity_TypeDef TriggerOutPulsePolarity	
double TriggerLevel_dBm	
double TriggerLevel_SafeTime	
double TriggerDelay	
double PreTriggerTime	
TriggerTimerSync_TypeDef TriggerTimerSync	
double TriggerTimer_Period	
uint8_t EnableReTrigger	
double ReTrigger_Period	
uint16_t ReTrigger_Count	
Detector_TypeDef Detector	Set the detector. The default is sample detection.

	Refer to the definition of the Detector_TypeDef enumeration structure for details.
uint16_t DetectRatio	Set the DET trace detection ratio. The detector processes the power trace, generating one output trace point for every DetectRatio raw data points.
GainStrategy_TypeDef GainStrategy	Refer to the definition of the IQS_Profile_TypeDef structure for details.
PreamplifierState_TypeDef Preamplifier	
uint8_t AnalogIFBWGrade	
uint8_t IFGainGrade	
uint8_t EnableDebugMode	
ReferenceClockSource_TypeDef ReferenceClockSource	
double ReferenceClockFrequency	
uint8_t EnableReferenceClockOut	
SystemClockSource_TypeDef SystemClockSource	
double ExternalSystemClockFrequency	
int8_t Atten	
DCCancelerMode_TypeDef DCCancelerMode	
QDCMode_TypeDef QDCMode	
float QDCIGain	
float QDCQGain	
float QDCPhaseComp	
int8_t DCCIOffset	
int8_t DCCQOffset	

LOOptimization_TypeDef LOOptimization	

24.22 DET_StreamInfo_TypeDef

uint64_t **PacketCount**	The total number of data packets acquired per trigger under the current configuration. Effective only when TriggerMode = Fixedpoints.
uint64_t **StreamSamples**	When TriggerMode = Fixedpoints: indicates the total number of samples per trigger under the current configuration; When TriggerMode = Adaptive: this value has no physical meaning; the return value is 0.
uint64_t **StreamDataSize**	When TriggerMode = Fixedpoints: indicates the total number of data bytes per trigger under the current configuration; When TriggerMode = Adaptive: this value has no physical meaning; the return value is 0.
uint32_t **PacketSamples**	The number of data points contained in a single data packet, i.e., the number of samples in the data packet obtained each time DET_GetPowerStream is called.
uint32_t **PacketDataSize**	The number of data bytes contained in a single data packet, i.e., the number of bytes obtained each time DET_GetPowerStream is called.
double **TimeResolution**	Time resolution of the data points, in seconds.
uint32_t **GainParameter**	Gain-related parameters, where the 3rd byte indicates the state of the pre-amplifier. PreAmplifierState (bits 23–16): 0 = off, 1 = on.

24.23 ZSP_Profile_TypeDef

double **CenterFreq_Hz**	Refer to the definition of the IQS_Profile_TypeDef structure for details.
double **RefLevel_dBm**	
uint32_t **DecimateFactor**	
RxPort_TypeDef **RxPort**	
uint32_t **BusTimeout_ms**	
DET_TriggerSource_TypeDef	

TriggerSource	
TriggerEdge_TypeDef TriggerEdge	
TriggerMode_TypeDef TriggerMode	
uint64_t TriggerLength	
TriggerOutMode_TypeDef TriggerOutMode	
TriggerOutPulsePolarity_TypeDef TriggerOutPulsePolarity	
double TriggerLevel_dBm	
double TriggerLevel_SafeTime	
double TriggerDelay	
double PreTriggerTime	
TriggerTimerSync_TypeDef TriggerTimerSync	
double TriggerTimer_Period	
uint8_t EnableReTrigger	
double ReTrigger_Period	
uint16_t ReTrigger_Count	
Detector_TypeDef Detector	
uint16_t DetectRatio	
GainStrategy_TypeDef GainStrategy	
PreamplifierState_TypeDef Preamplifier	
uint8_t AnalogIFBWGrade	
uint8_t IFGainGrade	
uint8_t EnableDebugMode	

ReferenceClockSource_TypeDef ReferenceClockSource	
double ReferenceClockFrequency	
uint8_t EnableReferenceClockOut	
SystemClockSource_TypeDef SystemClockSource	
double ExternalSystemClockFrequency	
int8_t Atten	
DCCancelerMode_TypeDef DCCancelerMode	
QDCMode_TypeDef QDCMode	
float QDCIGain	
float QDCQGain	
float QDCPhaseComp	
int8_t DCCIOffset	
int8_t DCCQOffset	
LOOptimization_TypeDef LOOptimization	
double RBW_Hz	Resolution Bandwidth, in Hz.
double VBW_Hz	Video Bandwidth, in Hz.
VBWMode_TypeDef VBWMode	VBW update mode. Refer to the definition of the VBWMode_TypeDef enumeration structure for details.
RBWFilterType_TypeDef RBWFilterType	RBW filter type. Refer to the definition of the RBWFilterType_TypeDef enumeration structure for details.

24.24 RTA_Profile_TypeDef

double CenterFreq_Hz	Refer to the definition of the SWP_Profile_TypeDef structure for details.
double RefLevel_dBm	
double RBW_Hz	
double VBW_Hz	
RBWMode_TypeDef RBWMode	
VBWMode_TypeDef VBWMode	
uint32_t DecimateFactor	Set the decimation factor. Range: 2^n (n = 1 to 12).
Window_TypeDef Window	Refer to the definition of the SWP_Profile_TypeDef structure for details.
SweepTimeMode_TypeDef SweepTimeMode	
double SweepTime	
Detector_TypeDef Detector	
TraceDetectMode_TypeDef TraceDetectMode	
TraceDetector_TypeDef TraceDetector	
uint32_t TraceDetectRatio	Trace detection ratio. Range: [1, 2^32 - 1]. Defines the mapping ratio between the original sampling points and the output trace points. The trace detector extracts one valid data point from the original spectrum sequence for every TraceDetectRatio data points, and uses it as part of the output trace.
RxPort_TypeDef RxPort	Refer to the definition of the IQS_Profile_TypeDef structure for details.
uint32_t BusTimeout_ms	
RTA_TriggerSource_TypeDef TriggerSource	
TriggerEdge_TypeDef TriggerEdge	
TriggerMode_TypeDef	

TriggerMode	
double TriggerAcqTime	Defines the data acquisition duration after a single trigger event, unit: s. Range: ≥ 256 ns. Valid only when TriggerMode = Fixedpoints.
TriggerOutMode_TypeDef TriggerOutMode	Refer to the definition of the IQS_Profile_TypeDef structure for details.
TriggerOutPulsePolarity_TypeDef TriggerOutPulsePolarity	
double TriggerLevel_dBm	
double TriggerLevel_SafeTime	
double TriggerDelay	
double PreTriggerTime	
TriggerTimerSync_TypeDef TriggerTimerSync	
double TriggerTimer_Period	
uint8_t EnableReTrigger	
double ReTrigger_Period	
uint16_t ReTrigger_Count	
GainStrategy_TypeDef GainStrategy	
PreamplifierState_TypeDef Preamplifier	
uint8_t AnalogIFBWGrade	
uint8_t IFGainGrade	
uint8_t EnableDebugMode	
ReferenceClockSource_TypeDef ReferenceClockSource	
double ReferenceClockFrequency	
uint8_t EnableReferenceClockOut	
SystemClockSource_TypeDef	

SystemClockSource	
double ExternalSystemClockFrequency	
int8_t Atten	
DCCancelerMode_TypeDef DCCancelerMode	
QDCMode_TypeDef QDCMode	
float QDCIGain	
float QDCQGain	
float QDCPhaseComp	
int8_t DCCIOffset	
int8_t DCCQOffset	
LOOptimization_TypeDef LOOptimization	

24.25 RTA_FrameInfo_TypeDef

double StartFrequency_Hz	Start frequency of the spectrum, unit: Hz.
double StopFrequency_Hz	Stop frequency of the spectrum, unit: Hz.
double POI	Minimum signal duration for 100% probability of intercept, unit: s.
double TraceTimestampStep	Timestamp increment between traces within each data packet. (The overall packet timestamp is SysTimerCountOfFirstDataPoint in TriggerInfo.)
double TimeResolution	Sampling interval of each time-domain data point, also the timestamp resolution.
double PacketAcqTime	Acquisition time corresponding to each data packet, unit: s.
uint32_t PacketCount	Total number of data packets corresponding to the current configuration. Valid only when TriggerMode = Fixedpoints.
uint32_t PacketFrame	Number of valid frames in each data packet.
uint32_t FFTSize	Number of points used for FFT per frame.

uint32_t **FrameWidth**	Number of valid points after FFT frame truncation, corresponding to the display points of each trace in the data packet. This can be used as the X-axis point count (width) of the probability density map.
uint32_t **FrameHeight**	Spectrum amplitude range corresponding to each FFT frame. This can be used as the Y-axis point count (height) of the probability density map.
uint32_t **PacketSamplePoints**	Number of acquisition points per data packet.
uint32_t **PacketValidPoints**	Number of valid frequency-domain data points in each data packet: PacketFrame × FrameWidth.
uint32_t **MaxDensityValue**	Maximum accumulated value of a single pixel in the probability density bitmap.
uint32_t **GainParameter**	Gain-related parameters, where the third byte indicates the preamplifier state. PreAmplifierState (23 to 16 Bit) 0: Off; 1: On.

24.26 RTA_PlotInfo_TypeDef

float **ScaleTodBm**	Compression caused by conversion from linear power to logarithmic power. The absolute power of the trace equals SpectrumStream[] × ScaleTodBm + OffsetTodBm.
float **OffsetTodBm**	Offset used to convert relative power to absolute power. The absolute power axis range (Y-axis) of the bitmap equals FrameHeight × ScaleTodBm + OffsetTodBm.
uint64_t **SpectrumBitmapIndex**	Acquisition count of the probability density map. When multiple probability density maps need to be overlaid, this field can be used as the overlay index.

24.27 Demod_Profile_TypeDef

uint64_t **SamplePoints**	Number of sampling points. Range: [16384, 320000]. It is recommended to set to 2000 × SamplingRate / SymbolRate. For demodulating 128QAM and 256QAM signals, it is recommended to set to 4000 × SamplingRate / SymbolRate.
double **SampleRate**	Sampling rate, Hz.

double SymbolRate	Symbol rate, sym/s. Range: [SamplingRate / 64, SamplingRate / 4].
Demod_ModType_TypeDef ModType	Sets the modulation type of the signal to be demodulated. Supported types: 2ASK / 2FSK / 4FSK / GMSK / BPSK / QPSK / 8PSK / 16QAM / 32QAM / 64QAM / 128QAM / 256QAM.
Demod_FilterType_TypeDef FilterType	Set the filter type. Currently, only Root Raised Cosine (RRC) filter is supported. Refer to the definition of the Demod_FilterType_TypeDef enumeration structure for details.
double FilterAlpha	Filter roll-off factor. Range: [0.01, 0.99].

24.28 DemodInfo_TypeDef

double* eDiagram	Starting memory address of the eye diagram data.
uint32_t eDiagram_Len	Length of the eye diagram data.
double* I_constellation	Starting memory address of the I-path constellation data.
double* Q_constellation	Starting memory address of the Q-path constellation data.
uint32_t constellation_Len	Length of the constellation data.
int32_t* bitStream	Starting memory address of the bitstream data.
uint32_t bitStream_Len	Length of the bitstream data.
int32_t* symbol	Starting memory address of the symbol stream data.
uint32_t symbol_Len	Length of the symbol stream data.
double* EVM	Starting memory address of the EVM data (also used for FSK Error and ASK Error).
uint32_t EVM_Len	Length of the EVM data.
double EVM_RMS	Root Mean Square (RMS) EVM, %.
double EVM_MAX	Peak EVM, %.
double* PhaseError	Starting memory address of phase error data, unit: degrees.
uint32_t PhaseError_Len	Length of phase error data.
double PhaseError_RMS	Root Mean Square (RMS) phase error, unit: degrees.
double PhaseError_MAX	Peak phase error, unit: degrees.
double* MagError	Starting memory address of amplitude error data.

uint32_t MagError_Len	Length of amplitude error data.
double MagError_RMS	Root Mean Square (RMS) amplitude error, %.
double MagError_MAX	Peak amplitude error, %.
double FreqError	Frequency error, carrier frequency offset relative to the center frequency, also CarrFreqOffset, unit: Hz.
double IQ_Offset	IQ offset, unit: dB, valid only in PSK and QAM modes.
double SNR	Signal-to-Noise Ratio (SNR), unit: dB, valid only in PSK and QAM modes.
double GainImb	IQ gain imbalance, unit: dB, valid only in PSK and QAM modes.
double QuadError	IQ quadrature skew error, unit: degrees, valid only in PSK and QAM modes.
double FSK_Deviation	FSK frequency offset, unit: Hz.
double CarrPower	Carrier power, unit: dBm, valid only in ASK mode.
double ASK_Depth	ASK modulation depth, %.
double AM_Depth	AM modulation depth, %.
double FM_Deviation	FM frequency deviation, unit: Hz.
double* Phase	Starting memory address of PM demodulated data.
uint32_t Phase_Len	Length of PM demodulated data.
double* Freq	Starting memory address of FM demodulated data.
uint32_t Freq_Len	Length of FM demodulated data.
double* Amp	Starting memory address of AM demodulated data.
uint32_t Amp_Len	Length of AM demodulated data.
double* SSB	Starting memory address of SSB demodulated data, used for both upper and lower sidebands.
uint32_t SSB_Len	Length of SSB demodulated data.

24.29 Demod_SymbolMap_TypeDef

float I	X-axis coordinate, representing the real part of the symbol in the complex plane.

float Q	Y-axis coordinate, representing the imaginary part of the symbol in the complex plane.

24.30 Pulse_Profile_TypeDef

uint32_t **ExpPulseNum**	Desired number of pulses to acquire. Range: [1, 500000].
Unit_TypeDef **unit**	Unit of pulse data, dBm or V. Refer to the definition of the Unit_TypeDef enumeration structure for details.
float* **Pulse**	Starting memory address of pulse data. The data unit depends on unit. When using the Pulse_Detect function, it should point to DET data. When using the Pulse_Detect_PM1 function, it should point to IQS data, and the data unit must be V.
uint64_t **PulseSize**	Length of pulse data. Range: [10, 500000000].
double **TimeResolution_s**	Time resolution of pulse data, unit: s.
double **DetThreshold**	Pulse detection threshold, in the same unit as the data.

24.31 PulseInfo_TypeDef

uint32_t **ActPulseNum**	Actual number of pulses acquired. Based on this number, the detection result of each pulse can be obtained from the pointer variable.
PulseTDParam_TypeDef* **PulseTDParam**	Starting memory address of pulse detection time-domain parameters. The structure includes pulse width, period, duty cycle, etc., with all units in seconds. Refer to the definition of the PulseTDParam_TypeDef structure for details.
PulseAMPParam_TypeDef* **PulseAMPParam**	Starting memory address of pulse detection amplitude parameters. The structure includes peak level, reference level, peak-to-base ratio, etc. Refer to the definition of the PulseAMPParam_TypeDef structure for details.
PulseEstParam_TypeDef* **PulseEstParam**	Starting memory address of pulse detection plotting parameters. Refer to the definition of the PulseEstParam_TypeDef structure for details.

PulseStatsParam_TypeDef PulseStats	Pulse detection statistics parameter structure, including minimum, maximum, and average period, etc., with all units in seconds. Refer to the definition of the PulseStatsParam_TypeDef structure for details.

24.32 PulseInfoPM1_TypeDef

uint32_t ActPulseNum	Actual number of pulses acquired. The detection result of each pulse can be obtained from the pointer variable based on this count.
PulseTDParam_TypeDef* PulseTDParam	Starting memory address of pulse detection time-domain parameters. The structure includes pulse width, period, duty cycle, etc., with all values in seconds. Refer to the definition of the PulseTDParam_TypeDef structure for details.
PulseAMPParam_TypeDef* PulseAMPParam	Starting memory address of pulse detection amplitude parameters. The structure includes peak level, reference level, peak-to-base ratio, etc. Refer to the definition of the PulseAMPParam_TypeDef structure for details.
PulseEstParam_TypeDef* PulseEstParam	Starting memory address of pulse detection plotting parameters. Refer to the definition of the PulseEstParam_TypeDef structure for details.
PulseStatsParam_TypeDef PulseStats	Pulse detection statistics parameter structure, including minimum, maximum, and average period, etc., with all units in seconds. Refer to the definition of the PulseStatsParam_TypeDef structure for details.
uint8_t* Mod	Pulse modulation type: 0 = CW, 1 = LFM.
PulseFreqPhaseParam_TypeDef* PulseFreqPhase	Frequency and phase information of the pulse. Refer to the definition of the PulseFreqPhaseParam_TypeDef structure for details.

24.33 PulseTDParam_TypeDef

double RiseTime	Rise time, unit: s.
double RiseEdge	Rising edge.

double FallTime	Fall time, unit: s.
double FallEdge	Falling edge.
double Width	Pulse width, unit: s.
double Period	Period, unit: s.
float DutyCycle	Duty cycle, %.

24.34 PulseAMPParam_TypeDef

float TopLevel_dBm	Peak level, unit: dBm.
float TopLevel_V	Peak level, unit: V.
float BaseLevel_dBm	Reference level, unit: dBm.
float BaseLevel_V	Reference level, unit: V.
float TopToBaseRatio_dB	Peak-to-base ratio, unit: dB.
float TopToBaseDiff_V	Peak-to-base difference, unit: V.
float Droop_dB	Droop, unit: dB.
float Droop_V	Droop, unit: V.
float Overshoot_dB	Overshoot, unit: dB.
float Overshoot_V	Overshoot, unit: V.
float Ripple_dB	Ripple, unit: dB.
float Ripple_V	Ripple, unit: V.

24.35 PulseEstParam_TypeDef

double Level_10pct_Index[2]	Array index of the 10% level value, 0 for the rising edge index, 1 for the falling edge index.
double Level_50pct_Index[2]	Array index of the 50% level value, 0 for the rising edge index, 1 for the falling edge index.
double Level_90pct_Index[2]	Array index of the 90% level value, 0 for the rising edge index, 1 for the falling edge index.
double Level_95pct_Index[2]	Array index of the 95% level value, 0 for the rising edge index, 1 for the falling edge index.
double Width_25pct_Index	Array index of the 25% pulse width position.

double Width_75pct_Index	Array index of the 75% pulse width position.
uint64_t Start_Index	Starting index of the inferred signal and noise data.
uint64_t Size	Length of the inferred signal and noise data.
float* Noise_dBm	Starting memory address of the inferred noise data, unit: dBm.
float* Noise_V	Starting memory address of the inferred noise data, unit: V.
float* Signal_dBm	Starting memory address of the inferred signal data, unit: dBm.
float* Signal_V	Starting memory address of the inferred signal data, unit: V.

24.36 PulseStatsParam_TypeDef

double MinPRI	Minimum period, unit: s.
double MaxPRI	Maximum period, unit: s.
double MeanPRI	Average period, unit: s.
double MinPW	Minimum pulse width, unit: s.
double MaxPW	Maximum pulse width, unit: s.
double MeanPW	Average pulse width, unit: s.
float PRIDeviationPercent	Period deviation percentage, %.
float PWDeviationPercent	Pulse width deviation percentage, %.

24.37 PulseFreqPhaseParam_TypeDef

double FreqMean	Mean frequency, unit: Hz.
double FreqErrorRMS	Frequency error.
double PhaseMean	Mean phase.
double PhaseErrorRMS	Phase error.

24.38 AMDemodParam_TypeDef

float* DemodWaveform	Demodulated waveform array, unit: %, length specified by DemodWaveformSize.
float* AFSpectrum_ModDepth	Audio spectrum amplitude array, length = DemodWaveformSize / 2, linear scale, unit: %.
double* AFSpectrum_Freq	Frequency array corresponding to the audio spectrum, unit: Hz.

uint32_t DemodWaveformSize	Number of sampling points of the demodulated waveform.
float ModDepth	Average modulation depth, unit: %.
float ModDepthPeakPos	Positive peak modulation depth (Peak+), unit: %.
float ModDepthPeakNeg	Negative peak modulation depth average (Peak−), unit: %.
float ModDepthHalfPeak	Half-peak modulation depth average ((Peak+ − Peak−) / 2), unit: %.
float ModDepthRMS	RMS modulation depth average, unit: %.
float CarrierPower	Carrier power, unit: dBm.
double ModRate	Modulation rate, unit: Hz.
float SINAD	Signal-to-noise and distortion ratio (SINAD), unit: dB.
float RMSPower	RMS power, unit: dBm.
double FreqError	Frequency error, unit: Hz.
float SNR	Signal-to-noise ratio (SNR), unit: dB.
float DistTotalVrms	Total distortion ratio (RMS), unit: %.
float THD	Total harmonic distortion (THD), unit: %.
float PEP	Peak Envelope Power (PEP), unit: dBm.

24.39 FMDemodParam_TypeDef

float* DemodWaveform	Demodulated waveform array, unit: Hz, length specified by DemodWaveformSize.
float* AFSpectrum_Deviation	Audio spectrum amplitude array, length = DemodWaveformSize / 2, linear scale, unit: Hz.
double* AFSpectrum_Freq	Frequency array corresponding to the audio spectrum, unit: Hz.
uint32_t DemodWaveformSize	Number of sampling points of the demodulated waveform.
float Deviation	Frequency deviation (Deviation), unit: Hz.
float DeviationPeakPos	Positive peak frequency deviation (Peak+), unit: Hz.
float DeviationPeakNeg	Negative peak frequency deviation average (Peak−), unit: Hz.
float DeviationHalfPeak	Half-peak frequency deviation average ((Peak+ − Peak−) / 2), unit: Hz.
float DeviationRMS	RMS frequency deviation average, unit: Hz.
float CarrierPower	Carrier power, unit: dBm.

double CarrierFreqErr	Carrier frequency error, unit: Hz.
double ModRate	Modulation rate, unit: Hz.
float SINAD	Signal-to-noise and distortion ratio (SINAD), unit: dB.
float SNR	Signal-to-noise ratio, unit: dB.
float DistTotalVrms	Total distortion ratio, unit: %.
float THD	Total harmonic distortion, unit: %.

24.40 ASG_Profile_TypeDef

double CenterFreq_Hz	Center frequency in fixed-point mode (SIG_Fixed), unit: Hz. Input range: 1 MHz to 1 GHz, step: 1 Hz.
double Level_dBm	Output power in fixed-point mode (SIG_Fixed), unit: dBm. Input range: -50 to 0 dBm, step: 0.25 dB.
double StartFreq_Hz	Start frequency in frequency sweep mode (SIG_FreqSweep_*), unit: Hz. Input range: 1 MHz to 1 GHz, step: 1 Hz.
double StopFreq_Hz	Stop frequency in frequency sweep mode (SIG_FreqSweep_*), unit: Hz. Input range: 1 MHz to 1 GHz, step: 1 Hz.
double StepFreq_Hz	Frequency step in frequency sweep mode (SIG_FreqSweep_*), unit: Hz. Input range: 1 Hz to 1 GHz, step: 1 Hz.
double StartLevel_dBm	Start power in power sweep mode, unit: dBm.
double StopLevel_dBm	Stop power in power sweep mode, unit: dBm.
double StepLevel_dBm	Power step in power sweep mode, unit: dBm.
double DwellTime_s	Dwell time in frequency sweep or power sweep mode, unit: s. Effective when the trigger source is BUS. Input range: 0 to 1000000, step: 1.
double ReferenceClockFrequency	Reference clock frequency setting, effective for both internal and external references.
ReferenceClockSource_TypeDef ReferenceClockSource	Reference clock source selection, used to specify whether to use the internal or external reference clock.

	Refer to the definition of the ReferenceClockSource_TypeDef enumeration structure for details.
ASG_Port_TypeDef **Port**	Output port selection of the analog signal source. Refer to the definition of the ASG_Port_TypeDef enumeration structure for details.
ASG_Mode_TypeDef **Mode**	Signal source operating mode selection. Refer to the definition of the ASG_Mode_TypeDef enumeration structure for details.
ASG_TriggerSource_TypeDef **TriggerSource**	Signal source trigger input configuration. The default setting is free-run. Refer to the definition of the ASG_TriggerSource_TypeDef enumeration structure for details.
ASG_TriggerInMode_TypeDef **TriggerInMode**	Signal source trigger input mode configuration. The default setting is single-point trigger. Refer to the definition of the ASG_TriggerInMode_TypeDef enumeration structure for details.
ASG_TriggerOutMode_TypeDef **TriggerOutMode**	Signal source trigger output mode configuration. The default setting is no output. Refer to the definition of the ASG_TriggerOutMode_TypeDef enumeration structure for details.

24.41 ASG_Info_TypeDef

uint32_t **SweepPoints**	Number of sweep points.

24.42 TraceAnalysisResult_IP3_TypeDef

double **LowToneFreq**	Low-tone signal frequency, unit depends on the data source.
double **HighToneFreq**	High-tone signal frequency, unit depends on the data source.
double **LowIM3PFreq**	Low-frequency third-order intermodulation product frequency, unit depends on the data source.
double **HighIM3PFreq**	High-frequency third-order intermodulation product frequency, unit depends on the data source.
float **LowTonePower_dBm**	Low-tone signal power, unit: dBm.
float **HighTonePower_dBm**	High-tone signal power, unit: dBm.

float TonePowerDiff_dB	Difference between low-tone and high-tone power.
float LowIM3P_dBc	Amplitude of the low-frequency third-order intermodulation product relative to the strongest fundamental signal, unit: dBc.
float HighIM3P_dBc	Amplitude of the high-frequency third-order intermodulation product relative to the strongest fundamental signal, unit: dBc.
float IP3_dBm	Calculated third-order intercept point (IP3), unit: dBm.

24.43 TraceAnalysisResult_IP2_TypeDef

double LowToneFreq	Low-tone signal frequency, unit depends on the data source.
double HighToneFreq	High-tone signal frequency, unit depends on the data source.
double IM2PFreq	Second-order intermodulation product frequency, unit depends on the data source.
float LowTonePower_dBm	Low-tone signal power, unit: dBm.
float HighTonePower_dBm	High-tone signal power, unit: dBm.
float TonePowerDiff_dB	Difference between low-tone and high-tone power.
float IM2P_dBc	Amplitude of the second-order intermodulation product relative to the strongest fundamental signal, unit: dBc.
float IP2_dBm	Calculated second-order intercept point (IP2), unit: dBm.

24.44 DSP_ChannelPowerInfo_TypeDef

float ChannelPower_dBm	Total power within the channel, unit: dBm.
float PowerDensity	Channel power density, unit: dBm/Hz.
float ChannelPeakIndex	Trace index corresponding to the power peak within the channel.
double ChannelPeakFreq_Hz	Frequency corresponding to the power peak within the channel, unit: Hz.
float ChannelPeakPower_dBm	Power peak within the channel, unit: dBm.

24.45 TraceAnalysisResult_XdB_TypeDef

double XdBBandWidth_Hz	XdB bandwidth, unit: Hz.
double CenterFreq_Hz	Center frequency corresponding to the XdB bandwidth, unit: Hz.
double StartFreq_Hz	Start frequency of the XdB bandwidth, unit: Hz.

double StopFreq_Hz	Stop frequency of the XdB bandwidth, unit: Hz.
float StartPower_dBm	Power at the start frequency of the XdB bandwidth, unit: dBm.
float StopPower_dBm	Power at the stop frequency of the XdB bandwidth, unit: dBm.
uint32_t PeakIndex	Trace index of the peak within the XdB bandwidth range.
double PeakFreq_Hz	Frequency of the peak within the XdB bandwidth range, unit: Hz.
float PeakPower_dBm	Power of the peak within the XdB bandwidth range, unit: dBm.

24.46 TraceAnalysisResult_OBW_TypeDef

double OccupiedBandWidth	Occupied bandwidth, unit: Hz.
double CenterFreq_Hz	Center frequency of the occupied bandwidth, unit: Hz.
double StartFreq_Hz	Start frequency of the occupied bandwidth, unit: Hz.
double StopFreq_Hz	Stop frequency of the occupied bandwidth, unit: Hz.
float StartPower_dBm	Power at the start frequency of the occupied bandwidth, unit: dBm.
float StopPower_dBm	Power at the stop frequency of the occupied bandwidth, unit: dBm.
float StartRatio	Power proportion at the start frequency of the occupied bandwidth.
float StopRatio	Power proportion at the stop frequency of the occupied bandwidth.
uint32_t PeakIndex	Index of the peak within the occupied bandwidth.
double PeakFreq_Hz	Frequency of the peak within the occupied bandwidth, unit: Hz.
float PeakPower_dBm	Power of the peak within the occupied bandwidth, unit: dBm.

24.47 DSP_ACPRFreqInfo_TypeDef

double RBW	Resolution bandwidth used for analysis, unit: Hz.
double MainChCenterFreq_Hz	Center frequency of the main channel, unit: Hz.
double MainChBW_Hz	Bandwidth of the main channel, unit: Hz.
double AdjChSpace_Hz	Adjacent channel spacing, the difference between the main channel center frequency and the adjacent channel center frequency, unit: Hz.
uint32_t AdjChPair	Number of adjacent channel pairs: 1 indicates one adjacent channel on each side, 2 indicates two adjacent channels on each side.

24.48 TraceAnalysisResult_ACPR_TypeDef

float **MainChPower_dBm**	Total power of the main channel, unit: dBm.
uint32_t **MainChPeakIndex**	Trace index corresponding to the peak of the main channel.
double **MainChPeakFreq_Hz**	Peak frequency of the main channel, unit: Hz.
float **MainChPeakPower_dBm**	Peak power of the main channel, unit: dBm.
double **L_AdjChCenterFreq_Hz**	Center frequency of the left adjacent channel, unit: Hz.
double **L_AdjChBW_Hz**	Bandwidth of the left adjacent channel, unit: Hz.
float **L_AdjChPower_dBm**	Power of the left adjacent channel, unit: dBm.
float **L_AdjChPowerRatio**	Left adjacent channel power ratio (Left Adjacent Power / Main Channel Power).
float **L_AdjChPowerDiff_dBc**	Left adjacent channel power difference (Left Adjacent Power – Main Channel Power), unit: dBc.
float **L_AdjChPeakIndex**	Trace index corresponding to the peak of the left adjacent channel.
double **L_AdjChPeakFreq_Hz**	Peak frequency of the left adjacent channel, unit: Hz.
float **L_AdjChPeakPower_dBm**	Peak power of the left adjacent channel, unit: dBm.
double **R_AdjChCenterFreq_Hz**	Center frequency of the right adjacent channel, unit: Hz.
double **R_AdjChBW_Hz**	Bandwidth of the right adjacent channel, unit: Hz.
float **R_AdjChPower_dBm**	Power of the right adjacent channel, unit: dBm.
float **R_AdjChPowerRatio**	Right adjacent channel power ratio (Right Adjacent Power / Main Channel Power).
float **R_AdjChPowerDiff_dBc**	Right adjacent channel power difference (Right Adjacent Power – Main Channel Power), unit: dBc.
float **R_AdjChPeakIndex**	Trace index corresponding to the peak of the right adjacent channel.
double **R_AdjChPeakFreq_Hz**	Peak frequency of the right adjacent channel, unit: Hz.
float **R_AdjChPeakPower_dBm**	Peak power of the right adjacent channel, unit: dBm.

24.49 DSP_SEMProfile_TypeDef

int **mRefSetType**	Reference setting mode: 0 = peak reference; 1 = manual reference.

float mManualRefLevel	Manually set reference level, in the same unit as the power spectrum.
DSP_SEMSegmentProfile_TypeDef mSegments[16]	SEM template line segment configuration array. Each segment includes enable status, start and stop frequencies, threshold, mode, and priority, with a maximum of 16 segments. Refer to the definition of the DSP_SEMSegmentProfile_TypeDef structure for details.

24.50 DSP_SEMSegmentProfile_TypeDef

bool mState	Template line segment status: 0 = disabled; 1 = enabled.
double mStartFreq	Start frequency of the template line segment, unit: Hz.
double mLimitStart	Threshold value corresponding to the start frequency of the template line segment.
double mStopFreq	Stop frequency of the template line segment, unit: Hz.
double mLimitStop	Threshold value corresponding to the stop frequency of the template line segment.
int mMode	Mode of the template line segment: 0 = absolute; 1 = relative.
int mPriority	Priority of the template line segment: 0 = mandatory; 1 = recommended.

24.51 DSP_SEMResult_TypeDef

DSP_SEMSegmentResult_TypeDef mSegmentResults[16]	Measurement results of each template line segment, up to 16 segments. Refer to the definition of the DSP_SEMSegmentResult_TypeDef structure for details.
DSP_SEMProfile_TypeDef mProfile	Template configuration used during the measurement. Refer to the definition of the DSP_SEMProfile_TypeDef structure for details.
float mRefLevel	Reference level used during the measurement.

24.52 DSP_SEMSegmentResult_TypeDef

double mLowerFreq	Low-end frequency of the template line segment, unit: Hz.
float mLowerLevel	Low-end level of the template line segment, unit: dBm.

float **mLowerMargin**	Low-end margin of the template line segment, representing the difference between the measured value and the limit.
bool **mLowerPassOrFail**	Low-end pass status of the template line segment: 0 = pass; 1 = fail.
double **mUpperFreq**	High-end frequency of the template line segment, unit: Hz.
float **mUpperLevel**	High-end level of the template line segment, unit: dBm.
float **mUpperMargin**	High-end margin of the template line segment, representing the difference between the measured value and the limit.
bool **mUpperPassOrFail**	High-end pass status of the template line segment: 0 = pass; 1 = fail.

24.53 DSP_FFT_TypeDef

uint32_t **FFTSize**	Number of FFT points.
uint32_t **SamplePts**	Number of valid sampling points.
Window_TypeDef **Window**	Window function specified for FFT analysis. The default is FlatTop window. Refer to the definition of the Window_TypeDef enumeration structure for details.
TraceDetector_TypeDef **TraceDetector**	Set the trace detector type. The default is positive peak detection. Refer to the definition of the TraceDetector_TypeDef enumeration structure for details.
uint32_t **DetectionRatio**	Trace detection ratio.
float **Intercept**	Output spectrum capture ratio. For example, Intercept = 0.8 means 80% of the spectrum is output.
bool **Calibration**	Set whether to perform calibration: 0 = no, 1 = yes.

24.54 DSP_DDC_TypeDef

double **DDCOffsetFrequency**	Complex mixing frequency offset used in the Digital Down Conversion (DDC) process, used to shift the target signal from the original center frequency to baseband.
double **SampleRate**	Sampling rate of the DDC output data, used to determine the data rate for downconversion and subsequent processing.

float DecimateFactor	Decimation factor for resampling, used to reduce data rate and bandwidth. Range: 1 to 216.
uint64_t SamplePoints	Number of valid sampling points in the DDC output, determining the length of data generated in a single downconversion process.

24.55 DSP_AudioAnalysis_TypeDef

double AudioVoltage	Effective voltage of the audio signal, unit: V.
double AudioFrequency	Fundamental frequency of the audio signal, unit: Hz.
double SINDA	Signal-to-noise and distortion ratio (SINAD) of the audio signal, unit: dB.
double THD	Total harmonic distortion (THD) of the audio signal, unit: %.

24.56 Filter_TypeDef

int n	Set the number of filter taps, n > 0.
float fc	Set the cutoff frequency, 0 < fc / SamplingRate < 0.5.
float As	Set the stopband attenuation, As > 0, unit: dB.
float mu	Set the fractional sample offset, -0.5 < mu < 0.5.
uint32_t SamplePts	Set the number of sampling points, Samples > 0.

25. Structure Enumeration Variable

25.1PhysicalInterface_TypeDef

USB	Use USB as the physical interface, applicable to USB-type devices.
ETH	Use 100M/1000M Ethernet as the physical interface, applicable to LAN-type devices.

25.2 DevicePowerSupply_TypeDef

USBPortAndPowerPort	Powered simultaneously via the USB data port and the power port.

25.3 IPVersion_TypeDef

IPv4	Use IPv4 address.

25.4 SysPowerState_TypeDef

PowerON	All system work areas powered on.
RFPowerOFF	RF powered off, cannot wake up quickly.
RFStandby	RF standby, can wake up quickly.

25.5 FanState_TypeDef

FanState_On	Forced always on.
FanState_Off	Forced always off.
FanState_Auto	Automatic mode: automatically turns on when the device temperature ≥ 50°C and turns off when it drops to ≤ 40°C.

25.6 ClkCalibrationSource_TypeDef

CalibrateByExternal	Calibrate the clock using an external trigger signal.
CalibrateByGNSS1PPS	Calibrate the clock using the GNSS 1PPS signal.

25.7 GNSSPeriphType_TypeDef

GNSS_None	No peripherals.
GNSS_For_EIO	EIO peripheral.

GNSS_For_NX	NX peripheral.
GNSS_For_PX	PX peripheral.
GNSS_For_PXZ	PXZ peripheral.

25.8 GNSSType_TypeDef

None_GPS	No GPS receiver.
GNSS_GPS	Standard GPS.
GNSS_GPS_Pro	High-performance GPS.

25.9 OCXOType_TypeDef

None_OCXO	No OCXO.
GNSS_OCXO	Standard OCXO.
GNSS_DOCXO	Tunable OCXO.

25.10 GNSSAntennaState_TypeDef

GNSS_AntennaExternal	External antenna.
GNSS_AntennaInternal	Internal antenna.

25.11 DOCXOWorkMode_TypeDef

DOCXO_LockMode	Acquisition mode.
DOCXO_HoldMode	Tracking mode.

25.12 SWP_FreqAssignment_TypeDef

StartStop	Specify the scan range using start frequency and stop frequency.
CenterSpan	Specify the scan range using center frequency and sweep width.

25.13 Window_TypeDef

FlatTop	Provides good amplitude accuracy.
Blackman_Nuttall	Provides good frequency resolution.
LowSideLobe	Provides strong spectrum leakage suppression capability.

25.14 RBWMode_TypeDef

RBW_Manual	Manually enter RBW.
RBW_Auto	Automatically update RBW with SPAN.
RBW_OneThousandthSpan	Force RBW = 0.001 × SPAN.
RBW_OnePercentSpan	Force RBW = 0.01 × SPAN.

25.15 VBWMode_TypeDef

VBW_Manual	Manually enter VBW.
VBW_EqualToRBW	Force VBW = RBW.
VBW_TenPercentRBW	Force VBW = 0.1 × RBW.
VBW_OnePercentRBW	Force VBW = 0.01 × RBW.
VBW_TenTimesRBW	Force VBW = 10 × RBW, completely bypassing the VBW filter.

25.16 SweepTimeMode_TypeDef

SWTMode_minSWT	Perform a sweep with the minimum sweep time.
SWTMode_minSWTx2	Perform a sweep with approximately 2× the minimum sweep time.
SWTMode_minSWTx4	Perform a sweep with approximately 4× the minimum sweep time.
SWTMode_minSWTx10	Perform a sweep with approximately 10× the minimum sweep time.
SWTMode_minSWTx20	Perform a sweep with approximately 20× the minimum sweep time.
SWTMode_minSWTx50	Perform a sweep with approximately 50× the minimum sweep time.
SWTMode_minSWTxN	Perform a sweep with approximately N× the minimum sweep time, where N equals SweepTimeMultiple.
SWTMode_Manual	Perform a sweep with approximately the specified sweep time, where the sweep time equals SweepTime.
SWTMode_minSMPxN	Perform a single-frequency-point sweep with approximately N× the minimum sample time, where N equals SampleTimeMultiple.

25.17 Detector_TypeDef

Detector_Sample	No frame detection between power spectra of each frequency point.

Detector_PosPeak	Perform frame detection between power spectra of each frequency point; output a single frame, taking MaxHold across frames.
Detector_Average	Perform frame detection between power spectra of each frequency point; output a single frame, taking the average across frames.
Detector_NegPeak	Perform frame detection between power spectra of each frequency point; output a single frame, taking MinHold across frames.
Detector_MaxPower	Before FFT, perform long-time sampling at each frequency point and select the frame with the maximum power for FFT, used to capture pulses or other transient signals (SWP mode only).
Detector_RawFrames	Perform multiple samplings at each frequency point, analyze with multiple FFTs, and output power spectra frame by frame (SWP mode only).
Detector_RMS	Perform frame detection between power spectra of each frequency point; output a single frame, taking RMS across frames.

25.18 TraceFormat_TypeDef

TraceFormat_Standard	Frequency mapped at equal intervals, suitable for conventional spectrum observation and fast sweeps.
TraceFormat_PrecisFrq	Frequency mapped accurately, suitable for measurements requiring strict accuracy of signal frequency readings.

25.19 TraceDetectMode_TypeDef

TraceDetectMode_Auto	Automatically select trace detection mode.
TraceDetectMode_Manual	Specify trace detection mode.

25.20 TraceDetector_TypeDef

TraceDetector_AutoSample	Automatic sampling detection: Select 2 points from the detection ratio points (TraceDetectRatio), choosing a fixed-position point and the maximum-value point.
TraceDetector_Sample	Sampling detection: Select 1 point from the detection ratio points (TraceDetectRatio), choosing a fixed-position point.
TraceDetector_PosPeak	Positive peak detection: Select 1 point from the detection ratio points (TraceDetectRatio), choosing the maximum-value point.

TraceDetector_NegPeak	Negative peak detection: Select 1 point from the detection ratio points (TraceDetectRatio), choosing the minimum-value point.
TraceDetector_RMS	RMS detection: Perform RMS calculation over the detection ratio points (TraceDetectRatio), outputting a single point.
TraceDetector_Bypass	No detection: No detection is performed; output the raw trace data.
TraceDetector_AutoPeak	Automatic peak detection: Select 2 points from the detection ratio points (TraceDetectRatio), choosing the minimum-value point and the maximum-value point.

25.21 TracePointsStrategy_TypeDef

SweepSpeedPreferred	Prioritize achieving the fastest sweep speed while staying as close as possible to the target trace point count.
PointsAccuracyPreferred	Prioritize keeping the actual trace point count close to the target trace point count.
BinSizeAssined	Prioritize generating the trace according to the specified trace point count. Under this mapping strategy, the returned trace point count equals the actual issued trace point count. The frequency spacing = (stop frequency − start frequency) / (trace points − 1). This strategy allows control of the spacing between points in the returned trace (TraceBinBW_Hz), but the sweep speed is slower.

25.22 TraceAlign_TypeDef

NativeAlign	Natural alignment: Return spectrum data slightly wider than the issued frequency range.
AlignToStart	Align to start frequency: Precisely align the start of the frequency range, ensuring the spectrum data begins from the start frequency.

25.23 FFTExecutionStrategy_TypeDef

Auto	Automatically select CPU or FPGA for FFT computation based on settings. For RBW < 40 kHz, processing is done on the CPU; for RBW ≥ 40 kHz, processing is done on the FPGA. Processing includes VBW, detection, spurious suppression, FFT, and trace detection.
Auto_CPUPreferred	Automatically select CPU or FPGA for FFT computation based on settings, with CPU preferred.
Auto_FPGAPreferred	Automatically select CPU or FPGA for FFT computation based on settings, with FPGA preferred.
CPUOnly_LowResOcc	Force FFT computation on the CPU with low resource usage; maximum FFT points = 256K.
CPUOnly_MediumResOcc	Force FFT computation on the CPU with medium resource usage; maximum FFT points = 1M.

CPUOnly_HighResOcc	Force FFT computation on the CPU with high resource usage; maximum FFT points = 4M.
FPGAOnly	Force FFT computation on the FPGA; sweep speed may decrease when RBW is small.

25.24 RxPort_TypeDef

ExternalPort	The receiver receives data from an external input port.
InternalPort	The receiver receives RF signals from an internal auxiliary signal source. Applicable only when an internal signal source module is installed.

25.25 SpurRejection_TypeDef

Bypass	No spurious suppression.
Standard	Standard spurious suppression.
Enhanced	Enhanced spurious suppression.

25.26 ReferenceClockSource_TypeDef

ReferenceClockSource_ Internal	Internal reference clock (default 10 MHz).
ReferenceClockSource_ External	External reference clock (default 10 MHz); automatically switches to internal reference if the external reference fails to lock.
ReferenceClockSource_ Internal_Premium	Internal high-quality clock source; available when an optional high-quality GNSS module is installed.
ReferenceClockSource_ External_Forced	Force use of external reference clock; will not switch to internal reference even if locking fails.

25.27 SystemClockSource_TypeDef

SystemClockSource_Internal	Use internal system clock source.
SystemClockSource_External	Use external system clock source; the external system clock frequency must be set to 10 MHz.

25.28 SWP_TriggerSource_TypeDef

InternalFreeRun	Internal trigger, free run.
ExternalPerHop	External trigger, advance one frequency point per trigger.
ExternalPerSweep	External trigger, refresh one trace per trigger.

25.29 TriggerEdge_TypeDef

RisingEdge	Trigger on rising edge.
FallingEdge	Trigger on falling edge.

25.30 TriggerOutMode_TypeDef

None	No trigger output.
PerHop	Output on completion of each frame.
PerSweep	Output on completion of each sweep.
PerProfile	Output on each configuration switch.

25.31 TriggerOutPulsePolarity_TypeDef

Positive	Positive pulse.
Negative	Negative pulse.

25.32 GainStrategy_TypeDef

LowNoisePreferred	Emphasize low noise: after setting, the preamplifier is automatically enabled, and the reference level is lowered to around −30 dBm.
HighLinearityPreferred	Emphasize high linearity: after setting, the preamplifier is forcibly disabled.

25.33 PreamplifierState_TypeDef

AutoOn	Automatically enable the preamplifier; the reference level is lowered to around −30 dBm, preamplifier on.
ForcedOff	Force the preamplifier to remain off.

25.34 SWP_TraceType_TypeDef

ClearWrite	Output the normal trace.
MaxHold	Output the trace with MaxHold applied.
MinHold	Output the trace with MinHold applied.
ClearWriteWithIQ	Output both time-domain and frequency-domain data for the current frequency point.

25.35 LOOptimization_TypeDef

LOOpt_Auto	LO optimization, automatic.
LOOpt_Speed	LO optimization, high sweep speed.
LOOpt_Spur	LO optimization, low spurious.
LOOpt_PhaseNoise	LO optimization, low phase noise.

25.36 DSPPlatform_Typedef

CPU_DSP	Compute on CPU.
FPGA_DSP	Compute on FPGA.

25.37 SWPApplication_TypeDef

SWPNoiseMeas	Display average noise level measurement.
SWPChannelPowerMeas	Channel power measurement.
SWPOBWMeas	Occupied bandwidth measurement.
SWPACPRMeas	Adjacent channel power ratio (ACPR) measurement.
SWPIM3Meas	IP3/IM3 measurement.

25.38 RxPort_TypeDef

ExternalPort	The receiver receives data from an external input port.
InternalPort	The receiver receives RF signals from an internal auxiliary signal source.

25.39 IQS_TriggerSource_TypeDef

External	External trigger: Triggered by a physical signal connected to the device's external trigger input port.
Bus	Bus trigger: Triggered via a function (command).
Level	Level trigger: The device monitors the input signal against a set level threshold and automatically triggers when the input exceeds the threshold.
Timer	Timer trigger: Use the device's internal timer to trigger automatically at a set time interval.

TxSweep	Internal signal source sweep trigger: Trigger data acquisition from the device's internal signal source sweep (requires ASG option). When selected, the acquisition is triggered by the output trigger signal from the signal source sweep.
MultiDevSyncByExt	External trigger synchronization: Multiple devices perform synchronized triggering upon arrival of an external trigger signal.
MultiDevSyncByGNSS1PPS	GNSS module 1PPS synchronization: Multiple devices perform synchronized triggering upon arrival of the 1PPS signal from the attached GNSS module.
GNSS1PPS	System GNSS 1PPS trigger: Use the 1PPS signal provided by the system GNSS for triggering (requires GNSS module).

25.40 TriggerMode_TypeDef

FixedPoints	After a trigger, acquire a fixed-length data segment (TriggerLength). During acquisition, further triggers are ignored. Upon completion, the device returns to the waiting-for-trigger state.
Adaptive	After a trigger, continuously acquire data until a stop signal is received (external trigger stop edge or bus trigger stop command).

25.41 TriggerTimerSync_TypeDef

NoneSync	Timer trigger not synchronized with external trigger.
SyncToExt_RisingEdge	Timer trigger synchronized with the rising edge of external trigger.
SyncToExt_FallingEdge	Timer trigger synchronized with the falling edge of external trigger.
SyncToExt_SingleRisingEdge	Timer trigger single-shot synchronized with the rising edge of external trigger (requires issuing a command for single-shot synchronization).
SyncToExt_SingleFallingEdge	Timer trigger single-shot synchronized with the falling edge of external trigger (requires issuing a command for single-shot synchronization).
SyncToGNSS1PPS_RisingEdge	Timer trigger synchronized with the rising edge of GNSS 1PPS (requires GNSS module).
SyncToGNSS1PPS_FallingEdge	Timer trigger synchronized with the falling edge of GNSS 1PPS (requires GNSS module).

SyncToGNSS1PPS_ SingleRisingEdge	Timer trigger single-shot synchronized with the rising edge of GNSS 1PPS (requires issuing a command for single-shot synchronization and a GNSS module).
SyncToGNSS1PPS_ SingleFallingEdge	Timer trigger single-shot synchronized with the falling edge of GNSS 1PPS (requires issuing a command for single-shot synchronization and a GNSS module).

25.42 DataFormat_TypeDef

Complex16bit	IQ data in 16-bit format
Complex32bit	IQ data in 32-bit format
Complex8bit	IQ data in 8-bit format

25.43 DCCancelerMode_TypeDef

DCCOff	Disable DC suppression.
DCCHighPassFilterMode	Enable high-pass filter mode (provides better DC suppression but attenuates signal components from DC up to 100 kHz).
DCCManualOffsetMode	Enable manual bias mode: manually configure DCCIOffset and DCCQOffset bias values; suppression is weaker than high-pass filter mode but does not attenuate DC signal components.
DCCAutoOffsetMode	Enable automatic bias mode: automatically configure DCCIOffset and DCCQOffset bias values.

25.44 QDCMode_TypeDef

QDCOff	Disable QDC function.
QDCManualMode	Enable and use manual mode: configure based on user-set QDCIGain, QDCQGain, and QDCPhaseComp.
QDCAutoMode	Enable and use automatic QDC mode: automatically configure QDCIGain, QDCQGain, and QDCPhaseComp to default values.

25.45 RBWFilterType_TypeDef

RBWFilter_80PercentABW	Maximum bandwidth mode: Provides usable bandwidth at 80% of the sampling rate.

RBWFilter_Gaussian_3dB	Standard Gaussian filter: Bandwidth defined at −3 dB power points. Excellent transient response (no overshoot), the most commonly used default filter in spectrum analysis.
RBWFilter_Gaussian_6dB	Gaussian filter (−6 dB amplitude points): Bandwidth defined at −6 dB amplitude points. Mainly used for EMC/EMI testing compliant with CISPR standards.
RBWFilter_Gaussian_Impulse	Gaussian pulse filter: Used to accurately reproduce the time-domain waveform of pulse signals.
RBWFilter_Gaussian_Noise	Filter calibrated for equivalent noise bandwidth (ENBW): Used for precise measurement of noise power spectral density.
RBWFilter_Flattop	Flat-top filter: Used to eliminate amplitude errors caused by slight frequency offsets.

25.46 ASG_Port_TypeDef

ASG_Port_External	External port.
ASG_Port_Internal	Internal port.

25.47 ASG_Mode_TypeDef

ASG_Mute	Mute.
ASG_FixedPoint	Fixed-point.
ASG_FrequencySweep	Frequency sweep.
ASG_PowerSweep	Power sweep.

25.48 ASG_TriggerSource_TypeDef

ASG_TriggerIn_FreeRun	Free run.
ASG_TriggerIn_External	External trigger.
ASG_TriggerIn_Bus	Timer trigger.

25.49 ASG_TriggerInMode_TypeDef

ASG_TriggerInMode_Null	Free run.
ASG_TriggerInMode_SinglePoint	Single-point trigger (trigger once for a single frequency or power configuration).

ASG_TriggerInMode_SingleSweep	Single-sweep trigger (trigger once to perform one complete sweep cycle).
ASG_TriggerInMode_Continous	Continuous-sweep trigger (trigger once to operate continuously).

25.50 ASG_TriggerOutMode_TypeDef

ASG_TriggerOutMode_Null	Free run.
ASG_TriggerOutMode_SinglePoint	Single-point trigger (one pulse output per frequency hop).
ASG_TriggerOutMode_SingleSweep	Single-sweep trigger (one pulse output per sweep).

25.51 Demod_FilterType_TypeDef

RootRaisedCosine	Root-raised cosine filter.

25.52 Unit_TypeDef

Voltage_V	Voltage, V.
Power_dBm	Power, dBm.

Appendix 1: API Return Index

Code	Cause of error/warning	Type[1]	Handing
0	No error	-	No processing is required; subsequent processes can be executed normally.
-1	Bus open error	Error	Check the device power supply, data line connection and check if the driver is installed correctly. After troubleshooting the error, you need to call Device_Open again to open the device.
-3	RF calibration file is missing[2]	Error	Check if the RF calibration file is placed in the specified directory. After troubleshooting the error, you need to call Device_Open again to open the device.
-4	IF calibration file is missing[2]	Error	Check if the IF calibration file is placed in the specified directory. After eliminating the error, you need to call Device_Open again to open the device.
-5	Device configuration information is missing[2]	Error	Check if the RF calibration file used is correct with the IF calibration file. After removing the error, you need to call Device_Open again to open the device.
-6	Device specification file is missing[2]	Error	Check that the device specification file (if required) is placed in the specified directory.
-7	Update Strategy failed	Error	Re-call Device_Open to open the device.
-8	Bus communication error	Error	Re-call the configuration function in the current mode.
-9	Data content error	Error	Re-call the configuration function in the current mode.
-10	Data not retrieved within specified time	Warning	Check whether the trigger source outputs the trigger signal normally, if there is no abnormality, continue to call the current function until the data is obtained.
-11	Configuration error via bus down	Warning	Re-call the Configuration function to configure the device.
-12	Input signal amplitude exc eeds the rated range in the current configuration	Warning	The current function gets to reduce the input signal amplitude or increase RefLevel_dBm as appropriate.
-14	The temperature has changed significantly since the last configuration	Warning	The device temperature has changed significantly since the last configuration; it is recommended to

			re-call the Configuration function to configure the device for best performance.
-15	There is a locking exception in the local oscillator or clock	Warning	It is recommended to re-call the Configuration function to configure the device to try to restore the normal state.
-49	The current device firmware version and API version are not based on the same baseline version.	Warning	Refer to the baseline version correspondence table in Chapter 3 and update either the device firmware version or the API version accordingly.
10054	Device network connection disconnected	Error	Check the network configuration, ensure it is correct, and reconnect.
10060	Connection attempt failed; target host not responding	Error	Check the network configuration, ensure it is correct, and reconnect.
10062	Device did not acquire data correctly	Error	Check the network configuration, ensure it is correct, and reconnect.
-50	Pulse detection license file missing	Error	Place the xx_pulsedet.lic file in the /CalFile/ folder.
-51	Pulse detection license file content invalid	Error	Usually caused by license content being modified; please contact technical support.
-52	Pulse detection license file expired	Error	Please contact technical support.
-53	Incorrect number of pulses	Error	The expected number of pulses is 0; pulse detection will not be performed. Please adjust the number of pulses.
-54	Number of pulse detection data points below minimum limit	Error	Pulse detection will not be performed; please adjust the number of pulse detection data points.
50	Number of pulses exceeds limit	Warning	The expected number of pulses exceeds the upper limit; execution will follow the upper limit.
51	Number of pulse detection data points exceeds limit	Warning	Number of pulse detection data points exceeds the upper limit; execution will follow the upper limit.
-60	Demodulation license file missing	Error	Place the xx_demodlic.txt file in the /CalFile/ folder.
-61	Demodulation license file content invalid	Error	Usually caused by license content being modified; please contact technical support.
-62	Demodulation library missing	Error	Place DigitalSigDemod.dll (Windows) or libDigitalSigDemod.so (Linux) in the same path as the htra_api library.
-63	Failed to enable demodulation function	Error	This error usually does not occur; if it does, please contact technical support.
-64	Input sample points less than 16,384	Error	Increase the number of sample points to 16,384 or above.

-65	Input sample points greater than 320,000	Error	Reduce the number of sample points to 320,000 or below.
-66	Input sample rate/symbol rate less than 4	Error	Set the sample rate/symbol rate to 4 or higher.
-67	Input sample rate/symbol rate greater than 64	Error	Set the sample rate/symbol rate to 64 or lower.
-68	Input symbol rate less than or equal to 0	Error	Set the symbol rate to greater than 0.
-69	No demodulation data output	Error	When the input IQ data contains a large number of zeros, demodulation may fail.
-70	Demodulation failed	Error	Check whether the related parameter configuration is reasonable.
66	Sample points exceed limit	Warning	It is recommended that, while meeting the upper and lower limits, the number of sample points be set to ≥ 2000 × SampleRate / SymbolRate.
67	Filter coefficients exceed limit	Warning	Filter coefficients exceed the allowed range: [0.01, 0.99]; the default value 0.35 will be used.

[1]. Type is "Error", you need to troubleshoot the problem immediately and turn the device back on, otherwise the device cannot continue to run subsequent processes. If the type is "warning", the device can continue the process without shutting down or reopening the device. However, it is still recommended to deal with the specific return value and the current application scenario selectively.

[2]. For the return value of -3, -4, -5, or -6, you also need to confirm whether the file storage path is a full English path. If the path contains non-English characters, the API call will also indicate file loading failure.

Appendix 2: RTA PDF Bitmap Guide

Spectrum Trace Rendering

In RTA mode, users can render the spectrum trace using the SpectrumTrace[] array returned by the RTA_GetRealTimeSpectrum or RTA_GetRealTimeSpectrum_Raw function, together with the FrameInfo structure returned by the RTA_Configuration function.

1. Spectrum Data Structure Description

SpectrumStream[] is a concatenated collection of power data from multiple spectrum frames. Users must parse the array according to the parameters defined in the FrameInfo structure:

- Single-frame width (FrameInfo.FrameWidth): Number of power points contained in each trace;
- Total frame count (FrameInfo.PacketFrame): Number of traces included in the current return;
- Total valid points (FrameInfo.PacketValidPoints): Total length of the SpectrumStream[] array. The calculation formula is: FrameInfo.PacketValidPoints = FrameInfo.PacketFrame × FrameInfo.FrameWidth

2. Frequency Axis Rendering

In RTA mode, only the power-axis data is returned. The frequency axis must be generated by the user based on the returned start frequency, stop frequency, and the calculated frequency spacing. The rendering method is as follows:

- Start frequency: FrameInfo.StartFrequency_Hz;
- Stop frequency: FrameInfo.StopFrequency_Hz;
- Points per frame: FrameInfo.FrameWidth;

Frequency range:

FrequencyRange = FrameInfo.StopFrequency_Hz - FrameInfo.StartFrequency_Hz

Frequency step:

FrequencyStep = FrequencyRange / (FrameInfo.FrameWidth - 1)

3. Power Axis Rendering

The returned SpectrumStream[] array contains relative power values. It can be converted to absolute power as follows. There are FrameInfo.PacketFrame frames of data; only one frame needs to be extracted for rendering.

- Relative Power: SpectrumStream[];
- Absolute Power: SpectrumStream[] * PlotInfo.ScaleTodBm + PlotInfo.OffsetTodBm

When rendering the spectrum trace, you can display only the first frame in the UI by taking the first FrameInfo.FrameWidth points from the absolute power array.

Render probability density as a BitMap

The probability density map is obtained through the RTA_GetRealTimeSpectrum function using the SpectrumBitMap[] array. It is an array with a length of FrameInfo.FrameWidth * FrameInfo.FrameHeight. Each element of the probability density map array represents the hit count of the corresponding pixel in the probability density map.

1. Plotting Logic

Each FrameInfo.FrameWidth elements in SpectrumBitMap[] form a single row. The rows are rendered consecutively for FrameHeight rows in a left-to-right, top-to-bottom order;

2. Physical Rendering of Axes

- X-axis: Drawn according to the instructions in the Frequency Axis Rendering section.
- Y-axis: Rendered from bottom to top across FrameHeight rows. The y-value ranges from 0 to (FrameHeight - 1). The power value (unit: dBm) corresponding to each vertical pixel position y can be calculated as follows:

$$\mathrm{Power_{dBm}} = \mathrm{y} * \mathrm{PlotInfo.ScaleTodBm} + \mathrm{PlotInfo.OffsetTodBm}$$

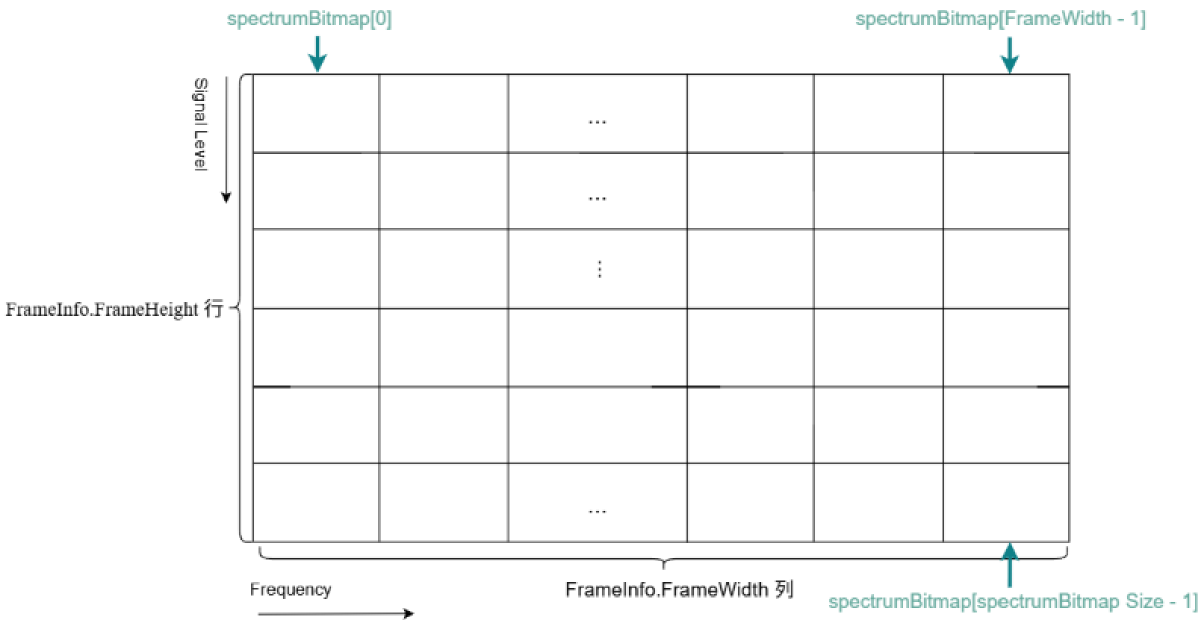


Figure 11 Probability Density Map Rendering Instructions