Rockchip Developement Guide ISP30

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Trademark Statement

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Preface

Overview

This article aims to describe the role of the RkAiq (Rk Auto Image Quality) module, the overall workflow, and related API interfaces. The main gives
Engineers who use the RkAiq module for ISP function development provide assistance.

Product Version

Chip name	Kernel version
RK3588	Linux 5.10

Reader Object

This document (this guide) is intended for the following engineers:

ISP Module Software Development Engineer

System integration software development engineer

System on Chip Support Status

Chip name	BuildRoot	Debian	Yocto	Android
RK3588	Y	N	N	Y

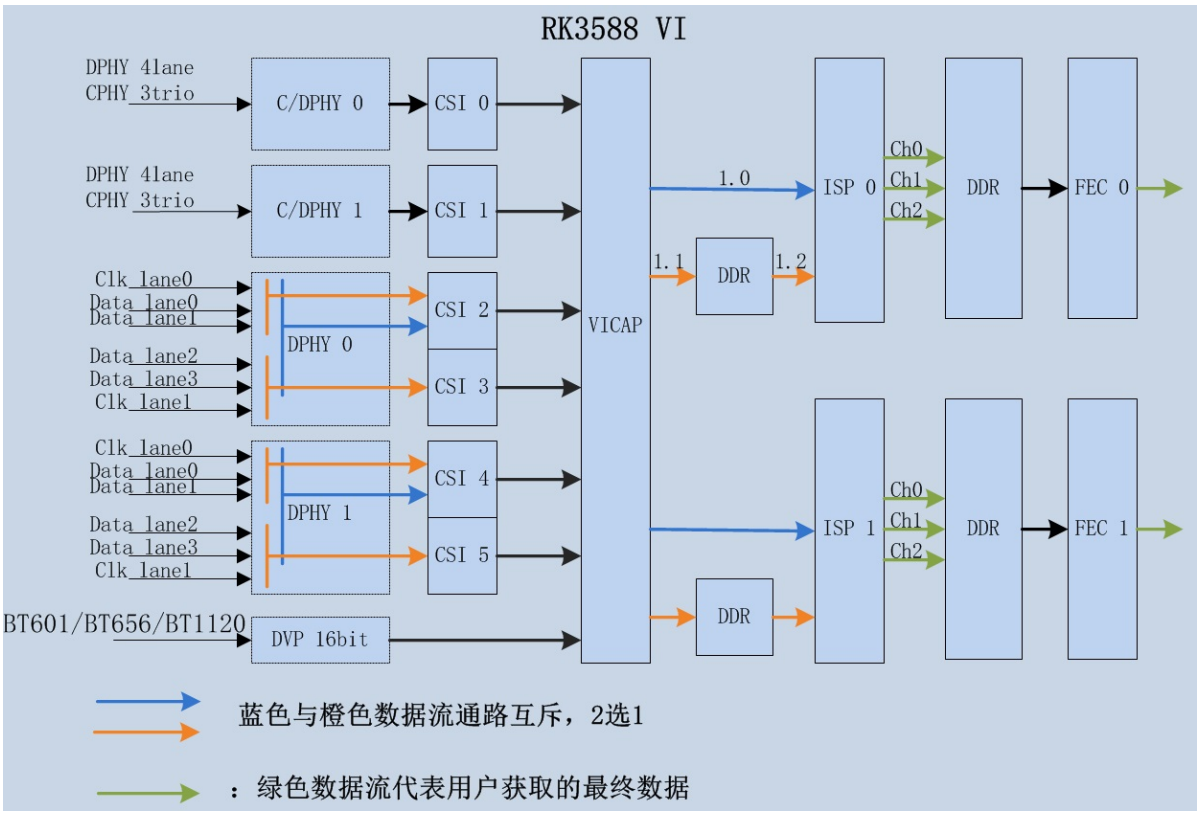
Revision History

Version number	Author	Date modified	Modification instructions
v0.0.1	All	2021-11-04	RK3588 ISP3.0 alpha version
v1.0.0	All	2022-1-1	1. AE / AWB / AF / CCM / 3DLut / Gamma / Dhz & Ehz / Merge / DRC / BLC / NR / Sharp module update 2. Statistics Chapter Update 3.Demosaic / DPCC / FEC / LDCH / GIC is not yet available
v1.1.0	ALL	2022-01-11	1. Revise the System Control API section 2. Added API description for CSM/CPROC/IE modules 3. Added Camera Group API description 4. Added LDCH / GIC / DPCC / Debayer module description 5. Updated the "Statistics" section, updated the description of AE statistic structures
v1.2.2	Zhu Linjing Ouyang Yafeng	2022-1-25	1. The "Statistics" section, RKAiqExpI2cParam_s the description of the structure update 2. In the "Camera Group" section, RK_PS_SrcOverlapMap description of the structure update 3. Parameter errata in the NR/Sharp chapter
v1.2.3	Xu Hongfei Wu Qiang	2022-2-19	1. Debayer/DPCC chapter API and data type update instructions
v1.2.4	Weng Hanmei	2022-3-17	1. CSM/CGC Chapter API and data type update instructions 2. CCM chapter parameter errata
v1.2.5	Weng Hanmei and Li Renkui	2022-7-7	1. CSM/CGC chapter API and data type update instructions 2. API description in DRC/Dehaze&Enhance section

Directory

1. General overview

1.1 Structure diagram



RK3588 VI as a general term for video input modules, contains:

- Interface and data acquisition part: C/DPHY, DVP, CSI, VICAP
- Image processing part: ISP-0,ISP-1,FEC-0,FEC-1

The RK3588 ISP belongs to the RK ISP v3.0 version, and subsequent documents are identified as ISP30.

1.2 mode of operation

Single ISP Single CIS (CMOS Image Sensor):

- RAW pass-through/online mode: The blue arrows in the block diagram indicate the data flow 1.0 path
- Raw readback/offline mode: Orange arrows in the block diagram indicate traffic 1.1, 1.2 paths

Dual ISP 2-in-1 mode for single CIS:

- The 2-in-1 mode supports ISP-0/ISP-1 to process the left and right parts of a single CIS image separately to support large resolution CIS.

Multi-CIS :

- Single ISP adopts Raw readback/offline mode, which can support multi-CIS input in time-division multiplexing.

1.3 Overview of performance and constraints

- Supported resolutions and throughput:

Working mode	Throughput	Maximum resolution	Minimum resolution supported
Single ISP Single CIS	16Mega@30fps	4672x3504	208x128
Dual ISP 2-in-1 Single CIS	32Mega@30fps	8064x6048	\

- Support Raw12 data entry.

  ISP30 supports processing Raw12 data. The Raw14 data input discards the low bits for Raw12 processing. Image data input with a bit width of less than 12 bits will supplement the low bit to Raw12 processing.

- Support for Bayer color CIS, Mono CIS.
- Support 3-in-1 multi-frame HDR. The following types of HDR CIS are supported:

Multi exposure HDR	RK Platform support	CIS	Apply
Sequential / Framebase HDR	ISP20: RV1109/RV1126 etc ISP21: RK356X etc ISP30: RK3588 ISP32: RV1106	OV4689	IPC/CVR
Staggered / DOL HDR	ISP20: RV1109/RV1126 etc ISP21: RK356X etc ISP30: RK3588 ISP32: RV1106	OS04A10 IMX464 AR0239	IPC/CVR
DCG HDR	ISP20: RV1109/RV1126 etc ISP21: RK356X etc ISP30: RK3588 ISP32: RV1106	OS04A10 IMX585	IPC/CVR
SME HDR	N	IMX378	Consumer
BME HDR	N	IMX258	Consumer
QBC HDR	N	OV50C40 IMX586	Consumer
Lateral overflow HDR	N	AR0821	IPC
Splite-diode pixel HDR	N	OV10640	CVR

- Lowest latency for ISP30 data output to DDR notification stage in Raw pass-through/online mode: approx. image frame transmission time/15.

- In ISP time-division multiplexing mode, a single ISP supports up to four data source inputs.
- In RAW pass-through/online mode, the minimum image frame is blanked by 136 lines and the minimum image line is blanked by 16 pixels
- The CSM module does not support YUV limit range conversion, see the IMGPROC/CSM module API description for details

2. Overview

ISP30 includes a series of image processing algorithm modules, mainly including: dark current correction, dead pixel correction, 3A, HDR, lens shadow correction, lens distortion correction, 3DLUT, denoising (including RAW domain denoising, multi-frame noise reduction, color denoising, etc.), sharpening, etc.

ISP30 includes hardware algorithm implementation and software logic control part, RkAiq is the implementation of software logic control part.

The main functions of the RkAiq software module are: to obtain image statistics from the ISP driver, combine IQ Tuning parameters, use a series of algorithms to calculate new ISP, Sensor and other hardware parameters, and continuously iterate the process to finally achieve the best image effect.

2.1 Feature description

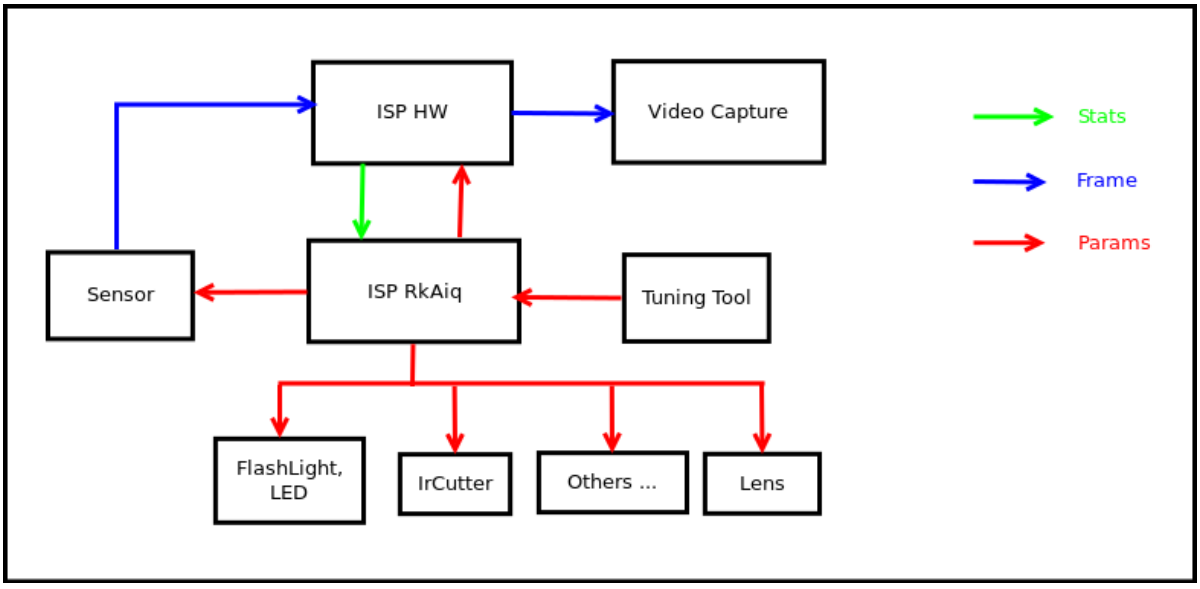


Figure 1-1 ISP21 system block diagram

The overall software and hardware block diagram of ISP30 is shown in Figure 1-1. The sensor outputs a data stream to the ISP HW, WHICH IN TURN OUTPUTS THE IMAGE AFTER A SERIES OF IMAGE PROCESSING ALGORITHMS. RkAiq continuously obtains statistical data from ISP HW, and generates new parameters through algorithms such as 3A to feed back to each hardware module. Tuning tool can debug parameters online in real time, and after debugging, a new IQ parameter file can be saved and generated.

2.2 RkAiq architecture

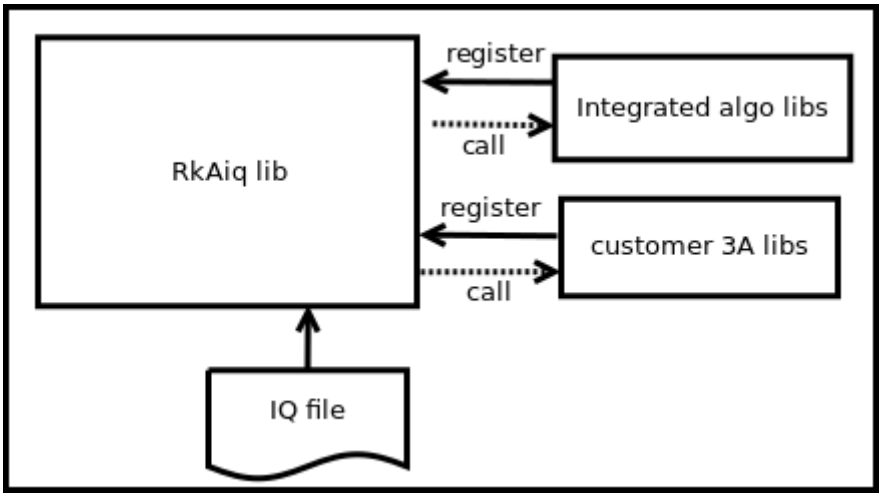


Figure 1-2 Overall architecture diagram of RkAiq

1. The ISP30 RkAiq software design idea is shown in Figure 1-2. It is mainly divided into the following four parts:
    1. RkAiq lib dynamic library. The library contains the main logical part, which is responsible for obtaining statistics from the driver and passing them to the individual algorithm libraries.
    2. Integrated algo libs。 The static algorithm library provided by Rk is registered with the RkAiq lib dynamic library by default.
    3. customer 3A libs。 Customers can implement their own 3A algorithm library or other algorithm libraries according to the algorithm library interface definition. After you register a custom algorithm library with the RkAiq lib dynamic library, you can choose whether to run the custom library or the Rk library according to the provided interface.
    4. IQ file。 IQ tuning result files store algorithm-related parameters and some system static parameters such as CIS.

2.3 Software architecture

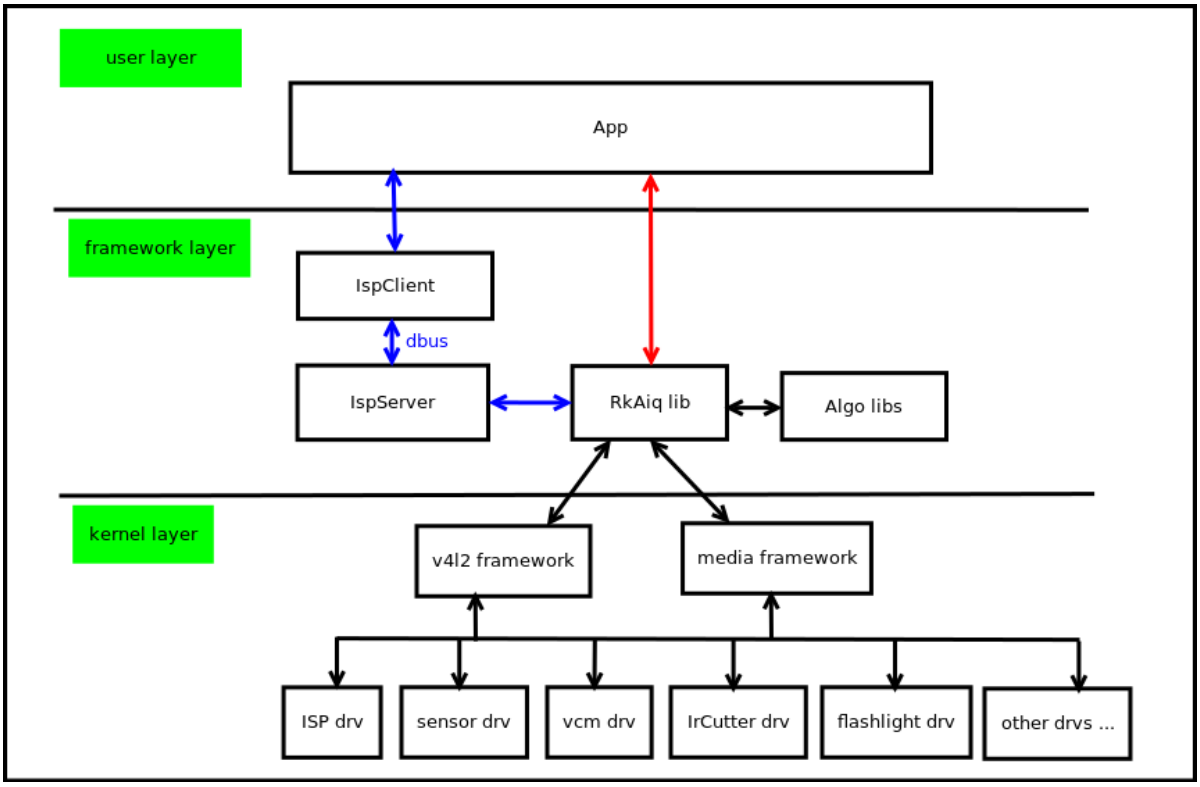


Figure 1-3 Block diagram of software architecture

The ISP30 software block diagram is shown in Figure 1-3. It is mainly divided into the following three layers:

1. kernel layer。 This layer contains all hardware drivers for the camera system, mainly ISP drivers, sensor drivers, VCM drivers, flashlight drivers, IrCutter drivers and so on. The drivers are based on V4L2 and the Media framework.
2. framework layer。 This layer is the integration layer of RkAiq lib, which has two integration methods:

- IspServer mode
  In this way, the Rkaiq lib runs on the IspServer standalone process, with which the client communicates via dbus. In addition, this method can provide images with ISP debugging effect for existing third-party applications such as v4L-CTL without modifying the source code.
- Direct integration
  RkAiq lib can be integrated directly into applications.

3. user layer. User application layer.

2.4 Software processes

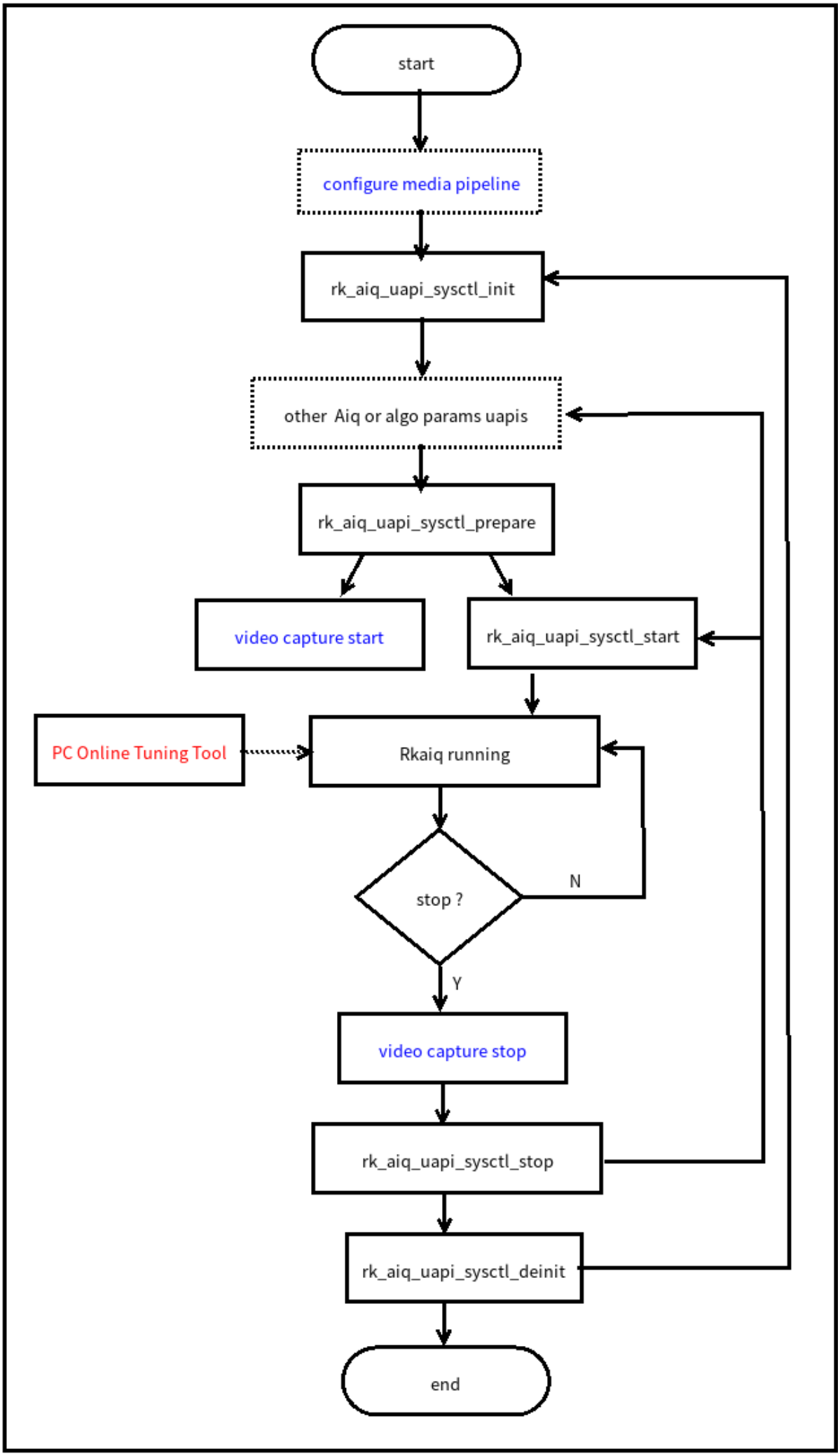

start
configure media pipeline
rk_aiq_uapi_sysctl_init
other Aiq or algo params uapis
rk_aiq_uapi_sysctl_prepare
video capture start
rk_aiq_uapi_sysctl_start
PC Online Tuning Tool
Rkaiq running
stop ?
N
Y
video capture stop
rk_aiq_uapi_sysctl_stop
rk_aiq_uapi_sysctl_deinit
end

Figure 1-4 Flow chart

The RkAiq interface call process is shown in Figure 1-4. The dotted box part in the figure is optional, and the blue font part is the configuration that the application needs to use with the RkAiq process.

- configure media pipeline。 Optionally, configure the ISP30 pipeline, such as sensor output resolution, etc., the driver has a default configuration.
- rk_aiq_uapi2_sysctl_init。 Initialize RkAiq, including IQ tuning parameters and initialization of various algorithm libraries.
- other Aiq or algo params uapis。 Optionally, you can configure the required parameters through the API interface provided by each algorithm, and register third-party algorithm libraries.
- rk_aiq_uapi2_sysctl_prepare。 Prepare the initialization parameters of each algorithm library and each hardware module, and set them to the driver.
- video capture start。 This process is enabled for the application ISP traffic, and the process needs to be called after rk_aiq_uapi2_sysctl_prepare.
- rk_aiq_uapi2_sysctl_start。 Start the RkAiq internal flow, after the interface call is successful, the sensor starts to output data, the ISP starts processing data, and outputs the processed image.
- Rkaiq running。 RkAiq continuously obtains statistics from the ISP driver, calls algorithms such as 3A to calculate new parameters, and applies new parameters to the driver.
- PC Online Tuning Tool。 The PC can adjust the parameters online via the Tuning Tool.
- video capture stop。 Before stopping the RkAiq process, you need to stop the data flow section.
- rk_aiq_uapi2_sysctl_stop。 Stop the RkAiq running process. You can adjust the parameters and start it again or start it directly.
- rk_aiq_uapi2_sysctl_deinit。 Deinitialize RkAiq.

2.5 API description

- The APIs provided by RKAiq are divided into two levels: functional-level APIs and module-level APIs.
  - **Functional level API**: Based on module-level API packaging, mainly for product applications based on some simple functional design of the module.
  - **Module-level API**: Detailed parameter settings and queries for this module, without API differentiation of functions.
- The module-level APIs provided by RKAiq support synchronous and asynchronous modes, and functional-level APIs are encapsulated by default in the synchronous mode of module-level APIs.
  - **Sync mode:** This mode is a blocking API, AIQ basically updates parameters with video frames as granularity, and in synchronous mode, the time that the thread calling the API may be blocked <= video frame cycle time.
  - **Asynchronous Mode (ASync):** This mode is a non-blocking API, the AIQ framework will store API setting parameters in the internal parameter buffer, and set the latest ISP parameter setting to the hardware at the time.
- Instructions for using the synchronous asynchronous mode of module-level APIs

  The second parameter structure of the module-level API is generally a collection of setting parameters, called a property structure. The internal rk_aiq_uapi_sync_t members of the structure can configure the call mode of the current API, referring to the following data types for details:

2.5.1 rk_aiq_uapi_sync_t

【Description】

Module sync mode

【Definition】

```
typedef struct rk_aiq_uapi_sync_s {
    rk_aiq_uapi_mode_sync_e     sync_mode;
    bool                        done;
} rk_aiq_uapi_sync_t;
```

【Member】

Member Name	Description
sync_mode	@setAttrib: Flag for parameter update mode; RK_AIQ_UAPI_MODE_DEFAULT: The default is synchronous mode. RK_AIQ_UAPI_MODE_SYNC: Synchronous mode. RK_AIQ_UAPI_MODE_ASYNC: Asynchronous mode. @getAttrib: RK_AIQ_UAPI_MODE_DEFAULT: Get last set property by default (sync_mode == RK_AIQ_UAPI_MODE_ASYNC), may not take effect yet RK_AIQ_UAPI_MODE_SYNC: Get the currently used properties. RK_AIQ_UAPI_MODE_ASYNC: Same as RK_AIQ_UAPI_MODE_DEFAULT.
done	@done (parsm out): Flag for parameter update status, true for parameter update, false for parameter not updated.

The AIQ API reference code is divided into modules, and API examples are provided separately, which is recommended for customers to refer to directly

rkisp_demo/demo/sample

Filename	Module
sample_3dlut_module.cpp	3DLUT
sample_ccm_module.cpp	CCM
sample_csm_module.cpp	CSM
sample_ablc_module.cpp	BLC
sample_abayer2dnr_module.cpp	BayerNR 2D
sample_abayertnr_module.cpp	BayerNR 3D
sample_aynr_module.cpp	YNR
sample_acnr_module.cpp	CNR
sample_asharp_module.cpp	Sharp
sample_amerge_module.cpp	Merge(HDR)
sample_adrc_module.cpp	DRC
sample_adehaze_module.cpp	Dehaze & Enhance
sample_agamma_module.cpp	Gamma
sample_awb_module.cpp	AWB
sample_ae_module.cpp	AE
sample_af_module.cpp	AF

3. System control

3.1 Feature overview

The system control section contains AIQ public attribute configuration, initializing AIQ, running AIQ, exiting AIQ, setting AIQ modules and other functions.

3.2 API Reference

3.2.1 rk_aiq_uapi2_sysctl_preInit

【Description】

Before initializing AIQ, preset some parameters, such as the IQ file used.

【Grammar】

```
XCamReturn
rk_aiq_uapi2_sysctl_preInit (const char* sns_ent_name,
                             rk_aiq_working_mode_t mode,
                             const char* force_iq_file);
```

【Parameters】

Parameter Name	Description	Input/Output
sns_ent_name	sensor entity name	Input
mode	ISP mode of operation	Input
force_iq_file	Mandatory iq file	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_sysctl.h
- Library file: librkaiq.so

【Note】

- Should precede rk_aiq_uapi2_sysctl_init call
- The parameter mode is only used to select IQ files, and does not configure the ISP operating mode, which needs to be configured in rk_aiq_uapi2_sysctl_prepare. If the parameter force_iq_file is not empty, the mode parameter is invalid
- Parameter force_iq_file is the full path
- This function is not required and is only used to change some default settings before rk_aiq_uapi2_sysctl_init

3.2.2 rk_aiq_uapi2_sysctl_preInit_scene

【Description】

Before initializing AIQ, select IQ Scenario Parameters.

【Grammar】

```
XCamReturn
rk_aiq_uapi2_sysctl_preInit_scene (const char* sns_ent_name,
                            const char *main_scene,
                           const char *sub_scene);
```

【Parameters】

Parameter Name	Description	Input/Output
sns_ent_name	sensor entity name	Input
main_scene	For the main scene, the values are defined in the IQ file	Input
sub_scene	For subscenarios, the values are defined in the IQ file	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_sysctl.h
- Library file: librkaiq.so

【Note】

- Should precede rk_aiq_uapi2_sysctl_init call
- main_scene needs to be selected according to the main scene array in the IQ file, the default is generally "normal"
- sub_scene needs to be selected according to the sub-scene array in the main scene in the IQ file, the default is generally "day"
- Since the default selected scene is normal-day, if you want to run hdr-day, or other custom modes,
  You need to call this function to specify, otherwise the IQ parameter may be incorrect

3.2.3 rk_aiq_uapi2_sysctl_switch_scene

【Description】

After initializing AIQ, switch the IQ scenario parameters.

【Grammar】

```
int
rk_aiq_uapi2_sysctl_switch_scene (const rk_aiq_sys_ctx_t* sys_ctx,
                          const char *main_scene,
                         const char *sub_scene);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
main_scene	For the main scene, the values are defined in the IQ file	Input
sub_scene	For subscenarios, the values are defined in the IQ file	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_sysctl.h
- Library file: librkaiq.so

【Note】

- Called after rk_aiq_uapi2_sysctl_init
- main_scene needs to be selected based on the array of main scenes in the IQ file
- sub_scene needs to be selected based on the array of subscenes in the main scene in the IQ file
- This interface involves IQ dynamic switching, which is currently inadequately tested and may cause unexpected results, so use with caution

3.2.4 rk_aiq_uapi2_sysctl_init

【Description】
Initialize the AIQ context.

【Grammar】

```
rk_aiq_sys_ctx_t*
rk_aiq_uapi2_sysctl_init (const char* sns_ent_name,
                          const char* iq_file_dir,
                          rk_aiq_error_cb err_cb,
                          rk_aiq_metas_cb metas_cb);
```

【Parameters】

Parameter Name	Description	Input/Output
sns_ent_name	sensor entity name	Input
iq_file_dir	Calibration parameter file path	Input
err_cb	Error callback function, which can be NULL	Input
metas_cb	The meta data callback function, which can be NULL	Input

【Return Value】

Return value	Description
rk_aiq_sys_ctx_t*	AIQ context pointer

【Requirements】

- Header file: rk_aiq_user_api2_sysctl.h
- Library file: librkaiq.so

【Note】

- Should precede other function calls.

3.2.5 rk_aiq_uapi2_sysctl_deinit

【Description】

Deinitialize the AIQ context.

【Grammar】

```
void
rk_aiq_uapi2_sysctl_deinit( rk_aiq_sys_ctx_t* ctx);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input

【Return Value】

Return value	Description
None	None

【Requirements】

- Header file: rk_aiq_user_api2_sysctl.h
- Library file: librkaiq.so

【Note】

- Should not be called when AIQ is in the start state.

3.2.6 rk_aiq_uapi2_sysctl_prepare

【Description】

Prepare the AIQ operating environment.

【Grammar】

```
XCamReturn
rk_aiq_uapi2_sysctl_prepare(const rk_aiq_sys_ctx_t* ctx,
                            uint32_t  width,
                            uint32_t  height,
                            rk_aiq_working_mode_t mode);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
width	The resolution width of the sensor output, which is used only for verification	Input
height	The resolution height of the sensor output, which is only used for verification	Input
mode	ISP Pipeline mode of operation (NORMAL/HDR)	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_sysctl.h
- Library file: librkaiq.so

【Note】

- Should be called before rk_aiq_uapi2_sysctl_start function.
- If you need to call this function after the rk_aiq_uapi2_sysctl_start, call the rk_aiq_uapi2_sysctl_stop function first, and then call rk_aiq_uapi2_sysctl_prepare to reprepare the running environment.

3.2.7 rk_aiq_uapi2_sysctl_start

【Description】

Start the AIQ control system. After AIQ is started, it will continuously obtain 3A statistics from the ISP driver, run the 3A algorithm, and apply the calculated new parameters.

【Grammar】

```
XCamReturn
rk_aiq_uapi2_sysctl_start(const rk_aiq_sys_ctx_t* ctx);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_sysctl.h
- Library file: librkaiq.so

【Note】

- Should be called after the rk_aiq_uapi2_sysctl_prepare function.

3.2.8 rk_aiq_uapi2_sysctl_stop

【Description】

Stop the AIQ control system.

【Grammar】

```
XCamReturn
rk_aiq_uapi2_sysctl_stop(const rk_aiq_sys_ctx_t* ctx, bool keep_ext_hw_st);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
keep_ext_hw_st	After stop, whether the state of the external device such as (ircut/cpsl) remains unchanged	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_sysctl.h
- Library file: librkaiq.so

3.2.9 rk_aiq_uapi2_sysctl_getStaticMetas

【Description】

Query sensor corresponds to static information such as resolution, data format, etc.

【Grammar】

```
XCamReturn
rk_aiq_uapi2_sysctl_getStaticMetas(const char* sns_ent_name,
rk_aiq_static_info_t* static_info);
```

【Parameters】

Parameter Name	Description	Input/Output
sns_ent_name	sensor entity name	Input
static_info	Static information struct pointer	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_sysctl.h
- Library file: librkaiq.so

3.2.10 rk_aiq_uapi2_sysctl_enumStaticMetas

【Description】

Enumerates the static information obtained by AIQ.

【Grammar】

```
XCamReturn
rk_aiq_uapi2_sysctl_enumStaticMetas(int index, rk_aiq_static_info_t*
static_info);
```

【Parameters】

Parameter Name	Description	Input/Output
index	Index number, starting from 0	Input
static_info	Static information struct pointer	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_sysctl.h
- Library file: librkaiq.so

3.2.11 rk_aiq_uapi2_sysctl_enableAxlib

【Description】

Set the custom algorithm library running status.

【Grammar】

```
XCamReturn
rk_aiq_uapi2_sysctl_enableAxlib(const rk_aiq_sys_ctx_t* ctx,
                                const int algo_type,
                                const int lib_id,
                                bool enable);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
algo_type	The type of algorithm module to operate with	Input
lib_id	Algorithm library identification ID	Input
enable	Status Settings	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_sysctl.h
- Library file: librkaiq.so

【Note】

- If the lib_id is equivalent to the currently running algorithm library, this function can be called in any state except uninitialized.

- In other cases, it is only called in the prepared state, and the algorithm library identified by the algo_type will be replaced by the new algorithm library identified by lib_id.

3.2.12 rk_aiq_uapi2_sysctl_getAxlibStatus

【Description】

Gets the algorithm library status.

【Grammar】

```
bool
rk_aiq_uapi2_sysctl_getAxlibStatus(const rk_aiq_sys_ctx_t* ctx,
                                   const int algo_type,
                                   const int lib_id);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
algo_type	The type of algorithm module to operate with	Input
lib_id	Algorithm library identification ID	Input

【Return Value】

Return value	Description
false	Shutdown Status
true	Enable Status

【Requirements】

- Header file: rk_aiq_user_api2_sysctl.h
- Library file: librkaiq.so

3.2.13 rk_aiq_uapi2_sysctl_getEnabledAxlibCtx

【Description】

Gets the context structure of the enable algorithm library.

【Grammar】

```
const RkAiqAlgoContext*
rk_aiq_uapi2_sysctl_getEnabledAxlibCtx(const rk_aiq_sys_ctx_t* ctx, const int
algo_type);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
algo_type	The type of algorithm module to operate with	Input

【Return Value】

Return value	Description
NULL	Get failed
Non-NULL	Get Success

【Requirements】

- Header file: rk_aiq_user_api2_sysctl.h
- Library file: librkaiq.so

【Note】

- The returned algorithm context struct will be used by the internal private function. For user-defined algorithm libraries, the function should be called after the rk_aiq_uapi2_sysctl_enableAxlib, otherwise NULL will be returned.

3.2.14 rk_aiq_uapi2_sysctl_setCpsLtCfg

【Description】
Set fill light control information.

【Grammar】

```
XCamReturn
rk_aiq_uapi2_sysctl_setCpsLtCfg(const rk_aiq_sys_ctx_t* ctx,
                        rk_aiq_cpsl_cfg_t* cfg);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
cfg	Fill light configuration structure pointer	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_sysctl.h
- Library file: librkaiq.so

3.2.15 rk_aiq_uapi2_sysctl_getCpsLtInfo

【Description】

Get fill light control information.

【Grammar】

```
XCamReturn
rk_aiq_uapi2_sysctl_getCpsLtInfo(const rk_aiq_sys_ctx_t* ctx,
                        rk_aiq_cpsl_info_t* info);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
info	Fill light configuration structure pointer	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_sysctl.h
- Library file: librkaiq.so

3.2.16 rk_aiq_uapi2_sysctl_queryCpsLtCap

【Description】

Check the support capabilities of fill lights.

【Grammar】

```
XCamReturn
rk_aiq_uapi2_sysctl_queryCpsLtCap(const rk_aiq_sys_ctx_t* ctx,
                        rk_aiq_cpsl_cap_t* cap);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
cap	The fill light supports the ability to query the structure pointer	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_sysctl.h
- Library file: librkaiq.so

3.2.17 rk_aiq_uapi2_sysctl_getBindedSnsEntNmByVd

【Description】

Query the sensor entity name corresponding to the video node.

【Grammar】

```
const char* rk_aiq_uapi2_sysctl_getBindedSnsEntNmByVd(const char* vd);
```

【Parameters】

Parameter Name	Description	Input/Output
vd	Video path, such as /dev/video20	Input

【Return Value】

Return value	Description
sensor entity name	String pointer

【Note】

- The parameter must be the ISPP scale node path.

【Requirements】

- Header file: rk_aiq_user_api2_sysctl.h
- Library file: librkaiq.so

3.2.18 rk_aiq_uapi2_sysctl_updateIq

【Description】

Dynamically update the currently used IQ parameter file without stopping the data flow.

【Grammar】

```
XCamReturn rk_aiq_uapi2_sysctl_updateIq(const rk_aiq_sys_ctx_t* sys_ctx, char*
iqfile);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
iqfile	New IQ file	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Note】

- iqfile needs to be a full path.
- Updating IQ parameters does not mean that the operating mode can be switched, such as switching HDR and normal, can not be updated
  IQ file implementation; However, the switching of some functions can be achieved through different configurations of IQ parameters, such as day and night switching
  Switching is achieved entirely through IQ configuration.
- When switching IQ, the configuration parameters in IQ will override the settings of the user API. For example, AWB module can be configured manually and automatically in IQ
  mode, then after executing this function, no matter what mode the current AWB is in, it will eventually be overwritten by the default configuration in the new IQ.

【Requirements】

- Header file: rk_aiq_user_api2_sysctl.h
- Library file: librkaiq.so

3.2.19 rk_aiq_uapi2_sysctl_getCrop

【Description】

Get the crop parameter.

【Grammar】

```
XCamReturn
rk_aiq_uapi2_sysctl_getCrop(const rk_aiq_sys_ctx_t* sys_ctx, rk_aiq_rect_t
*rect);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
rect	crop parameter struct pointer	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

3.3 Data type

3.3.1 rk_aiq_working_mode_t

【Description】

AIQ pipeline working mode

【Definition】

```
typedef enum {
    RK_AIQ_WORKING_MODE_NORMAL,
    RK_AIQ_WORKING_MODE_ISP_HDR2     = 0x10,
    RK_AIQ_WORKING_MODE_ISP_HDR3     = 0x20,
} rk_aiq_working_mode_t;
```

【Member】

Member Name	Description
RK_AIQ_WORKING_MODE_NORMAL	Normal mode
RK_AIQ_WORKING_MODE_ISP_HDR2	Two-frame HDR mode
RK_AIQ_WORKING_MODE_ISP_HDR3	Three-frame HDR mode

【Precautions】

- You need to query the mode supported by sensor and AIQ first, if the set mode is not supported, the setting is invalid.

3.3.2 rk_aiq_static_info_t

【Description】

AIQ static information

【Definition】

```
typedef struct {
    rk_aiq_sensor_info_t    sensor_info;
    rk_aiq_lens_info_t      lens_info;
    bool has_lens_vcm;
    bool has_fl;
    bool fl_strth_adj_sup;
    bool has_irc;
    bool fl_ir_strth_adj_sup;
} rk_aiq_static_info_t;
```

【Member】

Member Name	Description
sensor_info	Description of the sensor's name, supported resolutions, etc.
lens_info	Lens information
has_lens_vcm	With or without VCM
has_fl	With flash
fl_strth_adj_sup	With flash adjustable
bool has_irc	With IR-CUT
bool fl_ir_strth_adj_sup	

3.3.3 rk_aiq_sensor_info_t

【Description】

Sensor information

【Definition】

```
typedef struct {
    char sensor_name[32];
    rk_frame_fmt_t  support_fmt[SUPPORT_FMT_MAX];
    int32_t num;
    /* binded pp stream media index */
    int8_t binded_strm_media_idx;
} rk_aiq_sensor_info_t;
```

【Member】

Member Name	Description
sensor_name	Name of the sensor
support_fmt	Supported formats
num	Number of supported formats
has_fl	With flash
binded_strm_media_idx	The media node number on which the sensor is mounted

3.3.4 rk_aiq_module_id_t

【Description】

AIQ module ID

【Definition】

```
typedef enum {
    RK_MODULE_INVAL = 0,
    RK_MODULE_DPCC,
    RK_MODULE_BLS,
    RK_MODULE_LSC,
    RK_MODULE_AWB_GAIN,
    RK_MODULE_CTK,
    RK_MODULE_GOC,
    RK_MODULE_SHARP,
    RK_MODULE_AE,
    RK_MODULE_AWB,
    RK_MODULE_NR,
    RK_MODULE_GIC,
    RK_MODULE_3DLUT,
    RK_MODULE_LDCH,
    RK_MODULE_TNR,
    RK_MODULE_FEC,
    RK_MODULE_MAX
}rk_aiq_module_id_t;
```

【Member】

Member Name	Description
RK_MODULE_DPCC	Dead pixel detection and correction
RK_MODULE_BLS	Black level
RK_MODULE_LSC	Lens shadow correction
RK_MODULE_AWB_GAIN	White balance gain
RK_MODULE_CTK	Color correction
RK_MODULE_GOC	Gamma
RK_MODULE_SHARP	Sharpen
RK_MODULE_AE	Exposure
RK_MODULE_AWB	White balance
RK_MODULE_NR	Denoising
RK_MODULE_GIC	Green Balance
RK_MODULE_3DLUT	3DLUT
RK_MODULE_LDCH	LDCH
RK_MODULE_TNR	3D denoising
RK_MODULE_FEC	Fisheye correction

3.3.5 rk_aiq_cpsl_cfg_t

【Description】

The fill light sets the information structure

【Definition】

```
typedef struct rk_aiq_cpsl_cfg_s {
    RKAiqOPMode_t mode;
    rk_aiq_cpsls_t lght_src;
    bool gray_on; /*!< force to gray if light on */
    union {
        struct {
            float sensitivity; /*!< Range [0-100] */
            uint32_t sw_interval; /*!< switch interval time, unit  seconds */
        } a; /*< auto mode */
        struct {
            uint8_t on; /*!< disable 0, enable 1 */
            float strength_led; /*!< Range [0-100] */
            float strength_ir; /*!< Range [0-100] */
        } m; /*!< manual mode */
    } u;
} rk_aiq_cpsl_cfg_t;
```

【Member】

Member Name	Description
mode	Working mode
lght_src	Light source type
gray_on	Whether to cut the picture to black and white after switching to night mode
sensitivity	Switch sensitivity in auto mode, range [0,100]
sw_interval	Switching interval in automatic mode, in seconds
on	Whether to switch to night mode in manual mode
strength_led	LED light intensity in manual mode, range [0,100]
strength_ir	Infrared lamp intensity in manual mode, range [0,100]

3.3.6 rk_aiq_cpsl_info_t

【Description】

The fill light queries the information structure

【Definition】

```
typedef struct rk_aiq_cpsl_info_s {
    int32_t mode;
    uint8_t on;
    bool gray;
    float strength_led;
    float strength_ir;
    float sensitivity;
    uint32_t sw_interval;
    int32_t lght_src;
} rk_aiq_cpsl_info_t;
```

【Member】

Member Name	Description
mode	Working mode
lght_src	Light source type
gray	Whether to cut the picture to black and white after switching to night mode
sensitivity	Switch sensitivity in auto mode, range [0,100]
sw_interval	Switching interval in automatic mode, in seconds
on	Whether to switch to night mode in manual mode
strength_led	LED light intensity in manual mode, range [0,100]
strength_ir	Infrared lamp intensity in manual mode, range [0,100]

3.3.7 rk_aiq_cpsl_cap_t

【Description】

The fill light supports the capability structure

【Definition】

```
typedef struct rk_aiq_cpsl_cap_s {
    int32_t supported_modes[RK_AIQ_OP_MODE_MAX];
    uint8_t modes_num;
    int32_t supported_lght_src[RK_AIQ_CPSLS_MAX];
    uint8_t lght_src_num;
    rk_aiq_range_t strength_led;
    rk_aiq_range_t sensitivity;
    rk_aiq_range_t strength_ir;
} rk_aiq_cpsl_cap_t;
```

【Member】

Member Name	Description
supported_modes	Supported working modes
modes_num	Number of modes supported
gray	Whether to cut the picture to black and white after switching to night mode
supported_lght_src	Supported light sources
lght_src_num	Number of light sources supported
strength_led	LED intensity range
sensitivity	Sensitivity range
strength_ir	Intensity range of infrared lamps

3.3.8 rk_aiq_rect_t

【Description】

Define the crop parameter structure

【Definition】

```
typedef struct rk_aiq_rect_s {
    int left;
    int top;
    int width;
    int height;
} rk_aiq_rect_t;
```

【Member】

Member Name	Description
left	horizontal output offset
top	vertical output offset
width	horizontal output size
height	vertical output size

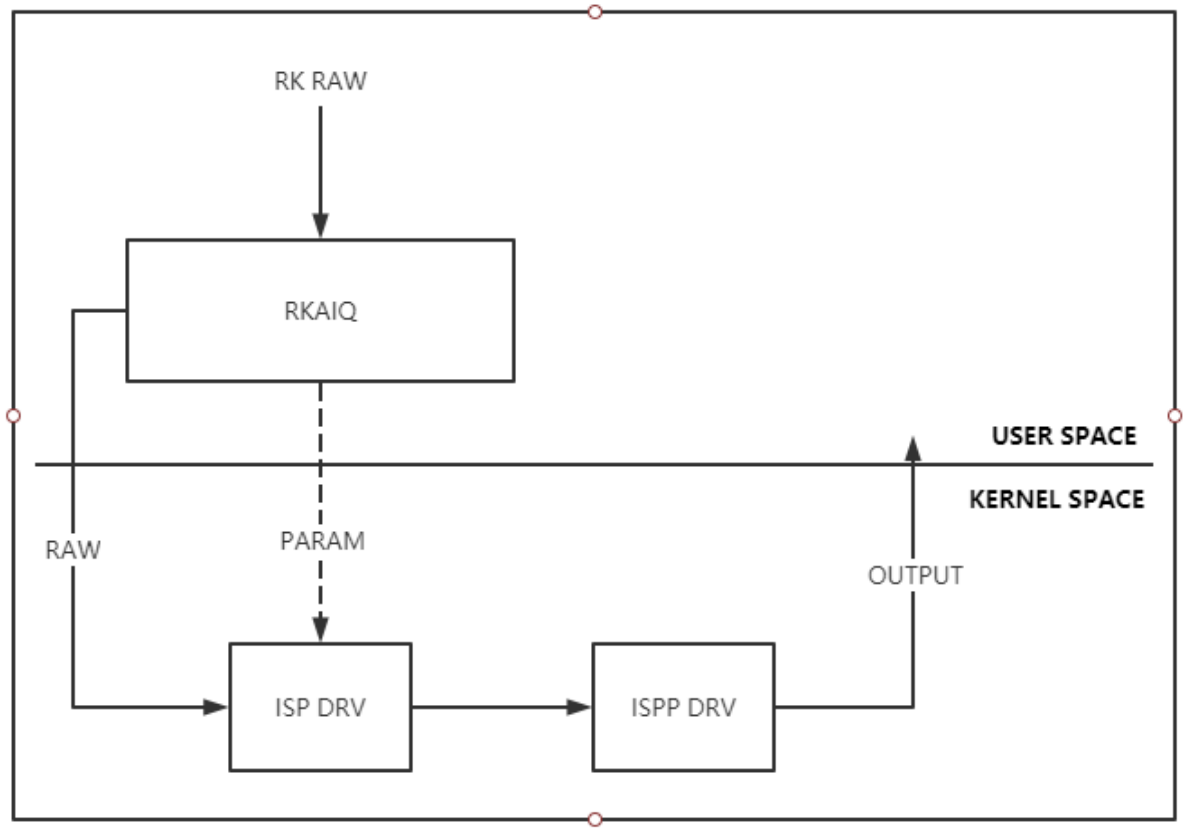
4. Offline frame processing

4.1 Overview

RKAIQ provides offline RAW frame processing function, that is, RK custom RAW format files are parsed by RKAIQ and sent to ISP for processing, and output as images that can display normal effects.

Note: The offline frame processing feature has not been tested.

4.2 Functional block diagram



Block diagram of offline frame processing

4.3 Description of the feature

- Support RK-RAW file input.
  With the file input interface, the calling process is blocked until the file processing is complete and the output is successful.
- Support RK-RAW buffer input, asynchronous processing mode.
  Using the buffer input interface, the calling process will not block, and the callback function (if there is a registered callback function) will be called after the buffer processing is completed.

- Support RK-RAW buffer input, synchronous processing mode.
  With the buffer input interface, the calling process will be blocked until the buffer processing is complete and the output is successful.

4.4 RK-RAW format description

See the RK RAW File Format documentation

4.5 Supported RAW formats

Support raw8/raw10/raw12, support BGGR/GBRG/GRBG/RGGB four bayer formats.

4.6 API reference

4.7 Data structures

4.8 Considerations

- Using the RK Raw data processing function, when creating an AIQ Context, the parameter sns_ent_name of the rk_aiq_uapi2_sysctl_init interface must be "FakeCamera".
- The processing of raw data relies on IQ XML effect files, and the resolution of the XML file should be generated at the same resolution as the incoming RK Raw frame data. The effect file must be named FakeCamera.xml and placed in the loading path of the XML file.

4.9 Reference example

For more information about how to use the offline frame processing API, see rkisp_demo, and the path is YOUR_SDK_DIR/external/camera_engine_rkaiq/rkisp_demo.

5. Camera group

5.1 Overview

For example, in application scenarios such as surround view, multiple cameras need to be grouped together for unified management, and parameters such as exposure need to be set in a unified manner. You can create a group to classify multiple cameras into the same group.
The Camera Group API is implemented based on the AIQ API of a single camera, unless otherwise specified, the API that applies to a single AIQ also applies to a Camera group, and the internal implementation of AIQ will distribute requests to a Camera group or a single Camera according to the type of Context passed.

5.1.1 rk_aiq_uapi2_camgroup_create

【Description】
When you create a Camera group, you will create a separate AIQ ctx for each Camera, and then hand it over to the Group Ctx to manage

【Grammar】

```
rk_aiq_camgroup_ctx_t*
rk_aiq_uapi2_camgroup_create (rk_aiq_camgroup_instance_cfg_t* cfg);
```

【Parameter】

Parameter name	Description	Input/Output
cfg	Configure parameters	Input

【Return value】

Return value	Description
rk_aiq_camgroup_ctx_t*	Group runtime
NULL	fail

【Demand】

- Header files：rk_aiq_user_api2_camgroup.h
- Library files：librkaiq.so

【Note】

- Different from rk_aiq_uapi2_sysctl_init, rk_aiq_uapi2_sysctl_init create an AIQ runtime environment with a single camera. Use rk_aiq_uapi2_sysctl_init to create a sensor entity that runs and no longer use rk_aiq_uapi2_camgroup_create to create a group runtime and vice versa.

- Since the default IQ scene is normal-day, if you need to use HDR or other modes, you need to use rk_aiq_uapi2_sysctl_preInit_scene to set it in advance.

5.1.2 rk_aiq_uapi2_camgroup_prepare

【Description】

According to the selected pipeline mode, initialization parameters are generated and pipelines are created. The rk_aiq_uapi2_sysctl_prepare corresponding to the AIQ ctx of each Camera will be called.

【Grammar】

```
XCamReturn
rk_aiq_uapi2_camgroup_prepare (rk_aiq_camgroup_ctx_t* camgroup_ctx,

rk_aiq_working_mode_t mode);
```

【Parameter】

Parameter name	Description	Input/Output
camgroup_ctx	Group runtime	Input
mode	Pipeline working mode	Input

【Return value】

Return value	Description
0	succeed
Non-0	See Error Codes

【Demand】

- Header files：rk_aiq_user_api2_camgroup.h
- Library files：librkaiq.so

5.1.3 rk_aiq_uapi2_camgroup_start

【Description】

Run the Camera group. The rk_aiq_uapi2_sysctl_start corresponding to the AIQ ctx of each Camera will be called.

【Grammar】

```
XCamReturn
rk_aiq_uapi2_camgroup_start (rk_aiq_camgroup_ctx_t* camgroup_ctx);
```

【Parameter】

Parameter name	Description	Input/Output
camgroup_ctx	Group runtime	input

【Return Value】

Return Value	Description
0	succeed
Non-0	Failed, see Error Code

【Demand】

- Header files：rk_aiq_user_api2_camgroup.h
- Library files：librkaiq.so

5.1.4 rk_aiq_uapi2_camgroup_stop

【Description】
Stop the Camera group. The rk_aiq_uapi2_sysctl_stop corresponding to the AIQ ctx of each Camera will be called.

【Grammar】

```
XCamReturn
rk_aiq_uapi2_camgroup_stop (rk_aiq_camgroup_ctx_t* camgroup_ctx);
```

【Parameter】

Parameter name	Description	Input/Output
camgroup_ctx	Group runtime	input

【Return Value】

Return Value	Description
0	succeed
Non-0	Failed, see Error Code

【Demand】

- Header files：rk_aiq_user_api2_camgroup.h
- Library files：librkaiq.so

5.1.5 rk_aiq_uapi2_camgroup_destroy

【Description】

Destroy the Camera group. The rk_aiq_uapi2_sysctl_deinit corresponding to the AIQ ctx of each Camera will be called.

【Grammar】

```
XCamReturn
rk_aiq_uapi2_camgroup_destroy (rk_aiq_camgroup_ctx_t* camgroup_ctx);
```

【Parameter】

Parameter name	Description	Input/Output
camgroup_ctx	Group runtime	Input

【Return Value】

Return Value	Description
0	succeed
Non-0	Failed, see Error Code

【Demand】

- Header files：rk_aiq_user_api2_camgroup.h
- Library files：librkaiq.so

5.1.6 rk_aiq_uapi2_camgroup_getOverlapMap

【Description】

In the surround view scenario, obtain the overlapping area information of each camera from the CameraGroup context.

【Grammar】

```
struct RK_PS_SrcOverlapMap*
rk_aiq_uapi2_camgroup_getOverlapMap (rk_aiq_camgroup_ctx_t* camgroup_ctx);
```

【Parameter】

Parameter name	Description	Input/Output
camgroup_ctx	Group runtime	Input

【Return Value】

Return Value	Description
struct RK_PS_SrcOverlapMap*	Overlapping region information struct pointers
NULL	fail

【Demand】

- Header files：rk_aiq_user_api2_camgroup.h
- Library files：librkaiq.so

5.1.7 rk_aiq_uapi2_camgroup_getOverlapMap

【Description】

In the surround view scenario, you can obtain the overlapping area information of each camera from the file.

【Grammar】

```
XCamReturn
rk_aiq_uapi2_camgroup_getOverlapMap_from_file (const char* map_file,
                                                struct
RK_PS_SrcOverlapMap** overlapMap);
```

【Parameter】

Parameter name	Description	Input/Output
map_file	A file that stores overlapping information	Input
overlapMap	Stores the acquired overlapping information	Input，Output

【Return Value】

Return Value	Description
0	succeed
Non-0	Failed, see Error Code

【Demand】

- Header files：rk_aiq_user_api2_camgroup.h
- Library files：librkaiq.so

5.1.8 rk_aiq_uapi2_camgroup_getAiqCtxBySnsNm

【Description】

Obtain the AIQ context of a single Camera by using the Sensor entity name in the group.

【Grammar】

```
rk_aiq_sys_ctx_t*
rk_aiq_uapi2_camgroup_getAiqCtxBySnsNm (rk_aiq_camgroup_ctx_t* camgroup_ctx,

const char* sns_entity_name);
```

【Parameter】

Parameter name	Description	Input/Output
camgroup_ctx	Group runtime	Input
sns_entity_name	The name of the sensor entity in the group	Input

【Return Value】

Return Value	Description
rk_aiq_sys_ctx_t*	The obtained AIQ runtime environment
NULL	fail

【Demand】

- Header files：rk_aiq_user_api2_camgroup.h
- Library files：librkaiq.so

5.1.9 rk_aiq_uapi2_camgroup_getCamInfos

【Description】

Obtain information about cameras in the group, such as the name of the sensor entity.

【Grammar】

```
XCamReturn
rk_aiq_uapi2_camgroup_getCamInfos (rk_aiq_camgroup_ctx_t* camgroup_ctx,
                   rk_aiq_camgroup_camInfos_t* camInfos);
```

【Parameter】

Parameter name	Description	Input/Output
camgroup_ctx	Group runtime	Input
camInfos	Obtained information about the cameras in the group	Output

【Return Value】

Return Value	Description
0	succeed
Non-0	Failed, see Error Code

【Demand】

- Header files：rk_aiq_user_api2_camgroup.h
- Library files：librkaiq.so

5.1.10 rk_aiq_uapi2_camgroup_bind

【Description】

Reserved interface, not implemented.

5.1.11 rk_aiq_uapi2_camgroup_unbind

【Description】

Reserved interface, not implemented.

5.2 Data Structure

5.2.1 rk_aiq_camgroup_instance_cfg_t

【Illustrate】

Carmelaghrup configuration parameters

【Definition】

```
typedef struct rk_aiq_camgroup_instance_cfg_s {
    const char* sns_ent_nm_array[RK_AIQ_CAM_GROUP_MAX_CAMS];
    int sns_num;
    const char* config_file_dir;
     /* followings are relative path to config_file_dir */
     const char* single_iq_file;
     const char* group_iq_file;
     const char* overlap_map_file;
 } rk_aiq_camgroup_instance_cfg_t;
```

【Member】

Member Name	Description
sns_ent_nm_array	It needs to be added to the Sensor entity array managed by the group
sns_num	The number of sensor entities that need to be added to the group
config_file_dir	Specify the IQ file path
single_iq_file	Specify the IQ file name, which can be NULL, and NULL is automatically selected by AIQ
group_iq_file	The specified IQ configuration file of the Camera group is not currently in use
overlap_map_file	Specify the Camera overlap information file, which can be NULL

5.2.2 rk_aiq_camgroup_camInfos_t

【Illustrate】

Information about each camera in the Camera group

【Definition】

```
typedef struct rk_aiq_camgroup_camInfos_s {
    int valid_sns_num;
    const char* sns_ent_nm[RK_AIQ_CAM_GROUP_MAX_CAMS];
    int sns_camPhyId[RK_AIQ_CAM_GROUP_MAX_CAMS];
} rk_aiq_camgroup_camInfos_t;
```

【Member】

Member Name	Description
valid_sns_num	The number of Sensor entities contained in the group
sns_ent_nm	An array of Sensor entity names contained within the group
sns_camPhyId	An array of physical IDs corresponding to the Sensor entities contained in the group

5.2.3 struct RK_PS_SrcOverlapMap

【Illustrate】

Define the overlapping area of the camera

【Definition】

```
struct RK_PS_SrcOverlapMap
{
    char versionInfo[64];
    RK_PS_SrcOverlapPosition srcOverlapPositon[8];
    unsigned char overlapMap[15 * 15 * 8];
};
```

【Member】

Member Name	Description
versionInfo	Version information
srcOverlapPositon	The rotation direction of each camera can be 0, 90, 180, and 270 degrees
overlapMap	The overlapping information of each statistical block of 8 cameras is as follows: the statistical data of each camera is 15*15 columns, a total of 8 cameras (numbered 0~7), and if there are actually less than 8 cameras, the corresponding position is filled with 0. Save by row, after saving the first row of the 8 cameras, then save the second row. And so on. The value range is 0~255, the value is 0 if it is completely non-overlapping, and the value is 255 if it is completely overlapping, and the partial overlap is interpolated according to the proportion camera0 row0; camera1 row0; camera2 row0; camera3 row0; camera4 row0; camera5 row0; camera6 row0; camera7 row0; camera0 row1; camera1 row1; camera2 row1; camera3 row1; camera4 row1; camera5 row1; camera6 row1; camera7 row1; camera0 row14; camera1 row14; camera2 row14; camera3 row14; camera4 row14; camera5 row14; camera6 row14; camera7 row14;

6. AE

6.1 Overview

The AE module achieves the function of obtaining the exposure of the current image according to the automatic metering system, and then automatically configuring the lens aperture, sensor shutter and gain to obtain the best image quality.

6.2 Important concepts

- Exposure time: The time when the sensor accumulates charge is the time between the sensor pixel being exposed and the charge is read.
- Exposure gain: The total amplification factor of the output charge of the sensor, generally digital gain and analog gain, analog gain will introduce slightly less noise, so analog gain is generally preferred.
- Aperture: Aperture is a mechanism in the lens that can change the size of the clear aperture.
- Anti-flicker: The picture flicker caused by the mismatch between the power frequency of the lamp and the frame rate of the sensor is generally achieved by limiting the exposure time and modifying the frame rate of the sensor.

6.3 Description of the feature

The AE module consists of AE statistics and the algorithm of AE control strategy.

6.4 Feature-level API reference

6.4.1 rk_aiq_uapi2_setAeLock

【Description】

Set AE exposure lock function.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setAeLock(const rk_aiq_sys_ctx_t* ctx, bool on);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
on	Lock Enable	Input

【Return Value】

Return value	Description
0	Success
Non-0	

6.4.2 rk_aiq_uapi2_setExpMode

【Description】

Set exposure mode, support setting auto exposure and manual exposure.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setExpMode(const rk_aiq_sys_ctx_t* ctx, opMode_t mode);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
mode	Exposure Mode	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Note】

- The gain and exposure time when the exposure mode is cut to manual mode use the initial values defined in the image effect file. If you need to set the exposure value while switching the manual mode, you can use the rk_aiq_uapi2_setManualExp interface.

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

6.4.3 rk_aiq_uapi2_getExpMode

【Description】

Gets the exposure mode.

【Grammar】

```
XCamReturn rk_aiq_uapi2_getExpMode(const rk_aiq_sys_ctx_t* ctx, opMode_t *mode);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
mode	Exposure Mode	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

6.4.4 rk_aiq_uapi2_setManualExp

【Description】
Use the manual exposure mode and set the gain and exposure time.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setManualExp(const rk_aiq_sys_ctx_t* ctx, float gain,
float time);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
gain	Exposure gain	Input
time	Exposure time	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

6.4.5 rk_aiq_uapi2_setExpGainRange

【Description】**
Set the gain range.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setExpGainRange(const rk_aiq_sys_ctx_t* ctx, paRange_t
*gain);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
gain	Exposure gain range	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

6.4.6 rk_aiq_uapi2_getExpGainRange

【Description】
Get the gain range.

【Grammar】

```
XCamReturn rk_aiq_uapi2_getExpGainRange(const rk_aiq_sys_ctx_t* ctx, paRange_t
*gain);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
gain	Exposure gain range	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

6.4.7 rk_aiq_uapi2_setExpTimeRange

【Description】

Set the exposure time range.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setExpTimeRange(const rk_aiq_sys_ctx_t* ctx, paRange_t
*time);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
time	Exposure time range	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

6.4.8 rk_aiq_uapi2_getExpTimeRange

【Description】

Gets the exposure time range.

【Grammar】

```
XCamReturn rk_aiq_uapi2_getExpTimeRange(const rk_aiq_sys_ctx_t* ctx, paRange_t
*time);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
time	Exposure time range	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

6.4.9 rk_aiq_uapi2_setBLCMode

【Description】

Backlight compensation switch, locale.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setBLCMode(const rk_aiq_sys_ctx_t* ctx, bool on,
aeMeasAreaType_t areaType);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
on	Switch	Input
areaType	Compensation area selection	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Note】

- The interface is only available in linear mode.

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

6.4.10 rk_aiq_uapi2_setBLCStrength

【Description】

Set dark areas to boost intensity.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setBLCStrength(const rk_aiq_sys_ctx_t* ctx, int
strength);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
strength	Boost intensity, range [1,100]	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Note】

- The interface is only available in linear mode.

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

6.4.11 rk_aiq_uapi2_setHLCMode

【Description】

Bright light suppression switch.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setHLCMode(const rk_aiq_sys_ctx_t* ctx, bool on);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
on	Switch	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Note】

- The interface is only available in linear mode.

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

6.4.12 rk_aiq_uapi2_setHLCStrength

【Description】

Set the intensity of intense light suppression.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setHLCStrength(const rk_aiq_sys_ctx_t* ctx, int
strength);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
strength	Inhibition intensity, range [1,100]	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Note】

- The interface is only available in linear mode.

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.sov

6.4.13 rk_aiq_uapi2_setAntiFlickerEn

【Description】

Set the anti-power frequency flicker switch.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setAntiFlickerEn(const rk_aiq_sys_ctx_t* ctx, bool on);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
on	Function switch parameters	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

6.4.14 rk_aiq_uapi2_getAntiFlickerEn

【Description】

Set the anti-power frequency flicker switch.

【Grammar】

```
XCamReturn rk_aiq_uapi2_getAntiFlickerEn(const rk_aiq_sys_ctx_t* ctx, bool* on);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
on	Function switch parameters	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

6.4.15 rk_aiq_uapi2_setAntiFlickerMode

【Description】

Set the anti-flash mode.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setAntiFlickerMode(const rk_aiq_sys_ctx_t* ctx,
antiFlickerMode_t mode);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
mode	Anti-flash mode	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

6.4.16 rk_aiq_uapi2_getAntiFlickerMode

【Description】

Get the anti-flash mode.

【Grammar】

```
XCamReturn rk_aiq_uapi2_getAntiFlickerMode(const rk_aiq_sys_ctx_t* ctx,
antiFlickerMode_t *mode);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
mode	Anti-flash mode	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

6.4.17 rk_aiq_uapi2_setExpPwrLineFreqMode

【Description】

Set the anti-flash frequency.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setExpPwrLineFreqMode(const rk_aiq_sys_ctx_t* ctx,
expPwrLineFreq_t freq);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
freq	Anti-flash frequency	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

6.4.18 rk_aiq_uapi2_getExpPwrLineFreqMode

【Description】**
Get the anti-flash frequency.

【Grammar】

```
XCamReturn rk_aiq_uapi2_getExpPwrLineFreqMode(const rk_aiq_sys_ctx_t* ctx,
expPwrLineFreq_t *freq);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
freq	Anti-flash frequency	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

6.5 Functional-level API data types

6.5.1 opMode_t

【Description】

Define automatic manual mode.

【Definition】

```
typedef enum opMode_e {
    OP_AUTO = 0,
    OP_MANUALl = 1,
    OP_INVAL
} opMode_t;
```

【Member】

Member Name	Description
OP_AUTO	Automatic mode
OP_MANUALl	Manual mode
OP_INVAL	Invalid value

6.5.2 paRange_t

【Description】

Define parameter ranges.

【Definition】

```
typedef struct paRange_s {
    float max;
    float min;
} paRange_t;
```

【Member】

Member Name	Description
max	Upper limit value
min	Lower limit

6.5.3 aeMeasAreaType_t

【Description】

Define the AE measurement area type.

【Definition】

```
typedef enum aeMeasAreaType_e {
    AE_MEAS_AREA_AUTO = 0,
    AE_MEAS_AREA_UP,
    AE_MEAS_AREA_BOTTOM,
    AE_MEAS_AREA_LEFT,
    AE_MEAS_AREA_RIGHT,
    AE_MEAS_AREA_CENTER,
} aeMeasAreaType_t;
```

【Member】

Member Name	Description
AE_MEAS_AREA_AUTO	Automatic
AE_MEAS_AREA_UP	Upper area
AE_MEAS_AREA_BOTTOM	Lower area
AE_MEAS_AREA_LEFT	Left area
AE_MEAS_AREA_RIGHT	Right area
AE_MEAS_AREA_CENTER	Central Area

6.5.4 expPwrLineFreq_t

【Description】

Define the anti-flash frequency.

【Definition】

```
typedef enum expPwrLineFreq_e {
       EXP_PWR_LINE_FREQ_DIS   = 0,
       EXP_PWR_LINE_FREQ_50HZ  = 1,
       EXP_PWR_LINE_FREQ_60HZ  = 2,
} expPwrLineFreq_t;
```

【Member】

Member Name	Description
EXP_PWR_LINE_FREQ_DIS	
EXP_PWR_LINE_FREQ_50HZ	50 Hz
EXP_PWR_LINE_FREQ_60HZ	60 Hz

6.5.5 antiFlickerMode_t

【Description】

Define the anti-flash mode.

【Definition】

```
typedef enum antiFlickerMode_e {
    ANTIFLICKER_NORMAL_MODE = 0,
    ANTIFLICKER_AUTO_MODE = 1,
} antiFlickerMode_t;
```

【Member】

Member Name	Description
ANTIFLICKER_NORMAL_MODE	Normal mode
ANTIFLICKER_AUTO_MODE	Auto Select Mode

6.6 Module-level API reference

6.6.1 rk_aiq_user_api2_ae_setExpSwAttr

【Description】

Set AE exposure software properties.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_ae_setExpSwAttr(const rk_aiq_sys_ctx_t* ctx,
                                 const Uapi_ExpSwAttrV2_t expSwAttr);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
expSwAttr	AE Common Function Control Parameter Struct	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_ae.h, rk_aiq_uapi2_ae_int.h
- Library file: librkaiq.so

【Example】

- Set manual exposure properties

  The exposure components include sensor exposure time, sensor exposure gain, and ISP digital gain. After setting the manual exposure mode, you also need to set the manual state (ManualGainEn, ManualTimeEn, ManualIspDgainEn) and its corresponding manual values for each exposure component. In manual exposure mode, all exposure components are required to be manual, and the value of each exposure component set is limited by the sensor and lens. If the set exposure component value exceeds the sensor's limit, the algorithm will automatically correct it.

```
Uapi_ExpSwAttrV2_t expSwAttr;
ret = rk_aiq_user_api2_ae_getExpSwAttr(ctx, &expSwAttr);
expSwAttr.AecOpType = RK_AIQ_OP_MODE_MANUAL;
//LinearAE
expSwAttr.stManual.LinearAE.ManualGainEn = true;
expSwAttr.stManual.LinearAE.ManualTimeEn = true;
expSwAttr.stManual.LinearAE.GainValue = 1.0f; /*gain = 1x*/
expSwAttr.stManual.LinearAE.TimeValue = 0.02f; /*time = 1/50s*/

//HdrAE (should set all frames)
expSwAttr.stManual.HdrAE.ManualGainEn = true;
expSwAttr.stManual.HdrAE.ManualTimeEn = true;
expSwAttr.stManual.HdrAE.GainValue[0] = 1.0f; /*sframe gain = 1x*/
expSwAttr.stManual.HdrAE.TimeValue[0] = 0.002f; /*sframe time = 1/500s*/
expSwAttr.stManual.HdrAE.GainValue[1] = 2.0f; /*mframe gain = 2x*/
expSwAttr.stManual.HdrAE.TimeValue[1] = 0.01f; /*mframe time = 1/100s*/
expSwAttr.stManual.HdrAE.GainValue[2] = 4.0f; /*lframe gain = 4x*/
expSwAttr.stManual.HdrAE.TimeValue[2] = 0.02f; /*lframe time = 1/50s*/

ret = rk_aiq_user_api2_ae_setExpSwAttr(ctx, expSwAttr);
```

- Set auto exposure properties

  Auto exposure can set the range of the exposure component, and if the set exposure component range exceeds the limit of the sensor, the algorithm will automatically correct it.

  【Note】: Setting the parameters of the exposure component range is different from the parameter of obtaining the exposure component range.

```
Uapi_ExpSwAttrV2_t expSwAttr;
ret = rk_aiq_user_api2_ae_getExpSwAttr(ctx, &expSwAttr);
expSwAttr.AecOpType = RK_AIQ_OP_MODE_AUTO;

//set time range in struct "stAdvanced"
```

```
expSwAttr.stAdvanced.SetAeRangeEn = true;/*must enable*/
//LinAE
expSwAttr.stAdvanced.SetLinAeRange.stExpTimeRange.Max = 0.04f; /*time_max =
0.04*/
expSwAttr.stAdvanced.SetLinAeRange.stExpTimeRange.Min = 0.001f; /*time_min =
0.001*/
//HdrAE
expSwAttr.stAdvanced.SetHdrAeRange.stExpTimeRange[0].Max = 0.002f; /*sframe
time_max = 0.02*/
expSwAttr.stAdvanced.SetHdrAeRange.stExpTimeRange[0].Min = 0.001f; /*sframe
time_min = 0.01*/
expSwAttr.stAdvanced.SetHdrAeRange.stExpTimeRange[1].Max = 0.003f; /*mframe
time_max = 0.03*/
expSwAttr.stAdvanced.SetHdrAeRange.stExpTimeRange[1].Min = 0.002f; /*mframe
time_min = 0.02*/
expSwAttr.stAdvanced.SetHdrAeRange.stExpTimeRange[2].Max = 0.04f; /*lframe
time_max = 0.03*/
expSwAttr.stAdvanced.SetHdrAeRange.stExpTimeRange[2].Min = 0.03f; /*lframe
time_min = 0.02*/

//get time range in struct "stAuto"
printf("linear time range=[%f,%f]\n",
    expSwAttr.stAuto.LinAeRange.stExpTimeRange.Min,
expSwAttr.stAuto.LinAeRange.stExpTimeRange.Max);
printf("hdr stime range=[%f,%f], mtime range=[%f,%f], ltime range=[%f,%f]\n",
    expSwAttr.stAuto.HdrAeRange.stExpTimeRange[0].Min,
expSwAttr.stAuto.HdrAeRange.stExpTimeRange[0].Max,
    expSwAttr.stAuto.HdrAeRange.stExpTimeRange[1].Min,
expSwAttr.stAuto.HdrAeRange.stExpTimeRange[1].Max,
    expSwAttr.stAuto.HdrAeRange.stExpTimeRange[2].Min,
expSwAttr.stAuto.HdrAeRange.stExpTimeRange[2].Max);

//set gain range in struct "stAdvanced"
expSwAttr.stAdvanced.SetAeRangeEn = true;/*must enable*/
//LinAE
expSwAttr.stAdvanced.SetLinAeRange.stGainRange.Max = 32.0f; /*gain_max = 32x*/
expSwAttr.stAdvanced.SetLinAeRange.stGainRange.Min = 1.0f; /*gain_min = 1x*/
//HdrAE
expSwAttr.stAdvanced.SetHdrAeRange.stGainRange[0].Max = 32.0f; /*sframe gain_max
= 2x*/
expSwAttr.stAdvanced.SetHdrAeRange.stGainRange[0].Min = 1.0f; /*sframe gain_min =
1x*/
expSwAttr.stAdvanced.SetHdrAeRange.stGainRange[1].Max = 64.0f; /*mframe gain_max
= 64x*/
expSwAttr.stAdvanced.SetHdrAeRange.stGainRange[1].Min = 1.0f; /*mframe gian_min =
1x*/
expSwAttr.stAdvanced.SetHdrAeRange.stGainRange[2].Max = 64.0f; /*lframe gain_max
= 64x*/
expSwAttr.stAdvanced.SetHdrAeRange.stGainRange[2].Min = 1.0f; /*lframe gain_min =
1x*/

//get gain range in struct "stAuto"
printf("linear gain range=[%f,%f]\n",
    expSwAttr.stAuto.LinAeRange.stGainRange.Min,
expSwAttr.stAuto.LinAeRange.stGainRange.Max);
printf("hdr sgain range=[%f,%f], mgain range=[%f,%f], lgain range=[%f,%f]\n",
```

```
    expSwAttr.stAuto.HdrAeRange.stGainRange[0].Min,
expSwAttr.stAuto.HdrAeRange.stGainRange[0].Max,
    expSwAttr.stAuto.HdrAeRange.stGainRange[1].Min,
expSwAttr.stAuto.HdrAeRange.stGainRange[1].Max,
    expSwAttr.stAuto.HdrAeRange.stGainRange[2].Min,
expSwAttr.stAuto.HdrAeRange.stGainRange[2].Max);

ret = rk_aiq_user_api2_ae_setExpSwAttr(ctx, expSwAttr);
```

- Set semi-manual exposure properties

  Semi-manual exposure is that at least one of the exposure components (sensor exposure time, sensor exposure gain, ISP digital gain) is manual, and the other exposure components are automatic, otherwise it will exit with an error. For example, in order to realize the semi-automatic exposure function of exposure gain manual, exposure time and ISP digital gain automatic, there are the following two ways to implement it: in the manual exposure mode, set the manual enable of exposure time and ISP digital gain to false, set the manual enable of exposure gain to true, and set the corresponding manual value; Method 2: In the auto exposure mode, the maximum and minimum values of the exposure gain are set to the value that needs to be fixed.

  【Note】Method 1: In HDR exposure mode, the manual behavior of all frames is synchronous (that is, the corresponding exposure components of each frame are manually consistent), and at the same time, it is necessary to ensure that the maximum exposure of long frames is greater than the maximum exposure of short frames, and the minimum exposure of long frames is greater than the minimum exposure of short frames; Method 2: In HDR exposure mode, the manual behavior of each frame is allowed to be inconsistent (such as short frame gain manual, long frame gain can be automatic), and at the same time, you need to ensure that the maximum exposure of long frames is greater than the maximum exposure of short frames, and the minimum exposure of long frames is greater than the minimum exposure of short frames.

```
//Method One
Uapi_ExpSwAttrV2_t expSwAttr;
ret = rk_aiq_user_api2_ae_getExpSwAttr(ctx, &expSwAttr);
expSwAttr.AecOpType = RK_AIQ_OP_MODE_MANUAL;
//LinearAE
expSwAttr.stManual.LinearAE.ManualGainEn = true;
expSwAttr.stManual.LinearAE.ManualTimeEn = false;
expSwAttr.stManual.LinearAE.ManualIspDgainEn = false;
expSwAttr.stManual.LinearAE.GainValue = 2.0f; /*gain = 2x*/
//HdrAE (need to set all frames)
expSwAttr.stManual.HdrAE.ManualGainEn = true;
expSwAttr.stManual.HdrAE.ManualTimeEn = false;
expSwAttr.stManual.HdrAE.ManualIspDgainEn = false;
expSwAttr.stManual.HdrAE.GainValue[0] = 1.0f; /*sframe gain = 1x*/
expSwAttr.stManual.HdrAE.GainValue[1] = 2.0f; /*mframe gain = 2x*/
expSwAttr.stManual.HdrAE.GainValue[2] = 4.0f; /*lframe gain = 4x*/
ret = rk_aiq_user_api2_ae_setExpSwAttr(ctx, expSwAttr);

//Method Two
Uapi_ExpSwAttrV2_t expSwAttr;
ret = rk_aiq_user_api2_ae_getExpSwAttr(ctx, &expSwAttr);
expSwAttr.AecOpType = RK_AIQ_OP_MODE_AUTO;
//set gain range
expSwAttr.stAdvanced.SetAeRangeEn = true;/*Must be enabled*/
//LinAE
expSwAttr.stAdvanced.SetLinAeRange.stGainRange.Max = 2.0f; /*gain_max = 2x*/
```

```
expSwAttr.stAdvanced.SetLinAeRange.stGainRange.Min = 2.0f;  /*gain_min = 2x*/
//HdrAE (allow to set only one frame)
expSwAttr.stAdvanced.SetHdrAeRange.stGainRange[0].Max = 2.0f; /*sframe gain_max =
2x*/
expSwAttr.stAdvanced.SetHdrAeRange.stGainRange[0].Min = 2.0f;  /*sframe gain_min
= 2x*/
ret = rk_aiq_user_api2_ae_setExpSwAttr(ctx, expSwAttr);
```

- Set a fixed frame rate or automatic frame reduction

  In fixed frame rate mode, the allowed frame rate must not exceed the maximum frame rate defined by the driver, if it exceeds it, there will be a log reminder and the frame rate setting will be disabled.

```
//set fixed framemode
Uapi_ExpSwAttrV2_t expSwAttr;
ret = rk_aiq_user_api2_ae_getExpSwAttr(ctx, &expSwAttr);
expSwAttr.stAuto.stFrmRate.isFpsFix = true;
expSwAttr.stAuto.stFrmRate.FpsValue = 25; /*fps = 25*/
ret = rk_aiq_user_api2_ae_setExpSwAttr(ctx, expSwAttr);

//set auto framemode
Uapi_ExpSwAttrV2_t expSwAttr;
ret = rk_aiq_user_api2_ae_getExpSwAttr(ctx, &expSwAttr);
expSwAttr.stAuto.stFrmRate.isFpsFix = false;
/*Generally, the automatic frame reduction mode is configured by tuning personnel
in advance with the minimum frame rate and the gain value corresponding to the
switching frame rate*/
ret = rk_aiq_user_api2_ae_setExpSwAttr(ctx, expSwAttr);
```

- Set the exposure adjustment speed and delay frame rate

```
Uapi_ExpSwAttrV2_t expSwAttr;
ret = rk_aiq_user_api2_ae_getExpSwAttr(ctx, &expSwAttr);
//set ae speed
expSwAttr.stAuto.stAeSpeed.DampOver = 0.8f;
expSwAttr.stAuto.stAeSpeed.DampDark2Bright = 0.8f;
expSwAttr.stAuto.stAeSpeed.DampUnder = 0.8f;
expSwAttr.stAuto.stAeSpeed.DampBright2Dark = 0.8f;
//set ae delay
expSwAttr.stAuto.BlackDelayFrame = 2;
expSwAttr.stAuto.WhiteDelayFrame = 4;
ret = rk_aiq_user_api2_ae_setExpSwAttr(ctx, expSwAttr);
```

- Set up anti-flash

```
Uapi_ExpSwAttr_t expSwAttr;
ret = rk_aiq_user_api2_ae_getExpSwAttr(ctx, &expSwAttr);
//set antifilicker mode
expSwAttr.stAuto.stAntiFlicker.enable = true;
expSwAttr.stAuto.stAntiFlicker.Frequency = AECV2_FLICKER_FREQUENCY_50HZ;
expSwAttr.stAuto.stAntiFlicker.Mode = AECV2_ANTIFLICKER_AUTO_MODE;
ret = rk_aiq_user_api2_ae_setExpSwAttr(ctx, expSwAttr);
```

- Set the AE weight

Set the 15X15 weight, and the algorithm compresses the weight according to the actual block specifications of the hardware. At present, there are two ways to set the weight: way 1: directly modify the weight in JSON; Method 2: Modify the weight by stadvanced, and if you eliminate the enablement, you can restore the weight back to the JSON (this method is recommended).

For face applications, the recommended use of expSwAttr.stAdvanced.enable = true, use the weight in the expSwAttr.stAdvanced structure when the face appears, and expSwAttr.stAdvanced.enable = false when the face disappears, use the original weight.

```
Uapi_ExpSwAttr_t expSwAttr;
ret = rk_aiq_user_api2_ae_getExpSwAttr(ctx, &expSwAttr);

uint8_t GridWeights[225]={
0,  0, 1,  2,  2,  3,  4,  5,  4, 3,  2,  2,  1,  0,  0,
0,  1, 2,  3,  3,  4,  5,  6,  5, 4,  3,  3,  2,  1,  0,
1,  2, 3,  5,  5,  6,  7,  8,  7, 6,  5,  5,  3,  2,  1,
2,  3, 5,  7,  7,  8,  9, 10,  9, 8,  7,  7,  5,  3,  2,
2,  3, 5,  7,  8,  9, 10, 11, 10, 9,  8,  7,  5,  3,  2,
2,  4, 6,  8,  9, 10, 11, 12, 11,10,  9,  8,  6,  4,  2,
2,  4, 6,  9, 10, 11, 12, 13, 12,11, 10,  9,  6,  4,  2,
3,  5 ,7, 10, 11, 12, 13, 14, 13,12, 11, 10,  7,  5,  3,
2,  4, 6,  9, 10, 11, 12, 13, 12,11, 10,  9,  6,  4,  2,
2,  4, 6,  8,  9, 10, 11, 12, 11,10,  9,  8,  6,  4,  2,
2,  3, 5,  7,  8,  9, 10, 11, 10, 9,  8,  7,  5,  3,  2,
2,  3, 5,  7,  7,  8,  9, 10,  9, 8,  7,  7,  5,  3,  2,
1,  2, 4,  6,  6,  7,  8,  9,  8, 7,  6,  6,  4,  2,  1,
0,  1, 3,  5,  5,  6,  7,  8,  7, 6,  5,  5,  3,  1,  0,
0,  1, 3,  5,  5,  6,  7,  8,  7, 6,  5,  5,  3,  1,  0
};

//method one:
memcpy(expSwAttr.GridWeights.uCoeff, GridWeights,
sizeof(expSwAttr.GridWeights.uCoeff));

//method two:
expSwAttr.stAdvanced.enable = true; //important! true means preferring to use
these parameters
memcpy(expSwAttr.stAdvanced.GridWeights, GridWeights,
sizeof(expSwAttr.stAdvanced.GridWeights));

ret = rk_aiq_user_api2_ae_setExpSwAttr(ctx, expSwAttr);
```

6.6.2 rk_aiq_user_api2_ae_getExpSwAttr

【Description】

Gets the AE exposure software properties.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_ae_getExpSwAttr(const rk_aiq_sys_ctx_t* ctx,
                        Uapi_ExpSwAttrV2_t* pExpSwAttr);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
pExpSwAttr	AE Exposure Software Properties Structure Pointer	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_ae.h, rk_aiq_uapi2_ae_int.h
- Library file: librkaiq.so

6.6.3 rk_aiq_user_api2_ae_setLinAeRouteAttr

【Description】

Set the scene exposure allocation strategy for AE in linear mode.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_ae_setLinAeRouteAttr(const rk_aiq_sys_ctx_t* ctx, const
Uapi_LinAeRouteAttr_t linAeRouteAttr);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
linAeRouteAttr	AE Exposure Allocation Strategy Structure	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_ae.h, rk_aiq_uapi2_ae_int.h
- Library file: librkaiq.so

【Example】

```
Uapi_LinAeRouteAttr_t LinAeRouteAttr;
memset(&LinAeRouteAttr,0x00,sizeof(Uapi_LinAeRouteAttr_t));
rk_aiq_user_api2_ae_getLinAeRouteAttr(sys_ctx,&LinAeRouteAttr);

int len = 8;
float TimeDot[8]={0,0.01,0.01,0.02,0.02,0.03,0.03,0.04};
float GainDot[8]={1,1,4,4,8,8,16,32};
float IspGainDot[8]={1,1,1,1,1,1,1,1};
int PirisDot[8]={512,512,512,512,512,512,512,512};

LinAeRouteAttr.TimeDot_len = len;
LinAeRouteAttr.GainDot_len = len;
LinAeRouteAttr.IspDGainDot_len = len;
LinAeRouteAttr.PIrisDot_len = len;

LinAeRouteAttr.GainDot = GainDot;
LinAeRouteAttr.IspDGainDot = IspGainDot;
LinAeRouteAttr.TimeDot = TimeDot;
LinAeRouteAttr.PIrisDot = PirisDot;

rk_aiq_user_api2_ae_setLinAeRouteAttr(sys_ctx,LinAeRouteAttr);
```

6.6.4 rk_aiq_user_api2_ae_getLinAeRouteAttr

【Description】

Gets the scene exposure allocation strategy for AE in linear mode.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_ae_getLinAeRouteAttr(const rk_aiq_sys_ctx_t* ctx,
Uapi_LinAeRouteAttr_t* pLinAeRouteAttr);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
pLinAeRouteAttr	AE Exposure Allocation Strategy Structure Pointer	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_ae.h, rk_aiq_uapi2_ae_int.h
- Library file: librkaiq.so

6.6.5 rk_aiq_user_api2_ae_setHdrAeRouteAttr

【Description】

Set the scene exposure allocation strategy for AE in HDR mode.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_ae_setHdrAeRouteAttr(const rk_aiq_sys_ctx_t* ctx, const
Uapi_HdrAeRouteAttr_t hdrAeRouteAttr);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
hdrAeRouteAttr	AE Exposure Allocation Strategy Structure	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_ae.h, rk_aiq_uapi2_ae_int.h
- Library file: librkaiq.so

【Example】

```
Uapi_HdrAeRouteAttr_t stHdrRoute;
memset(&stHdrRoute,0x00,sizeof(Uapi_HdrAeRouteAttr_t));
ret = rk_aiq_user_api2_ae_getHdrAeRouteAttr(ctx,&stHdrRoute);

int len = 6;
float HdrTimeDot[3][6] = {0.0, 0.01, 0.01, 0.01, 0.01, 0.01,
                          0.0, 0.02, 0.02, 0.02, 0.02, 0.02,
                          0.0, 0.03, 0.03, 0.03, 0.03, 0.03};
float HdrGainDot[3][6] = {1, 1, 4, 6, 8, 12,
                          1, 1, 4, 6, 8, 12,
                          1, 1, 4, 6, 8, 12};
float HdrIspDGainDot[3][6] = {1, 1, 1, 1, 1, 1,
                              1, 1, 1, 1, 1, 1,
                              1, 1, 1, 1, 1, 1};
int   HdrPIrisGainDot[6] = {1, 1, 1, 1, 1, 1};
```

```
stHdrRoute.Frm0TimeDot_len = len;
stHdrRoute.Frm0GainDot_len = len;
stHdrRoute.Frm0IspDGainDot_len = len;
stHdrRoute.Frm1TimeDot_len = len;
stHdrRoute.Frm1GainDot_len = len;
stHdrRoute.Frm1IspDGainDot_len = len;
stHdrRoute.Frm2TimeDot_len = len;
stHdrRoute.Frm2GainDot_len = len;
stHdrRoute.Frm2IspDGainDot_len = len;
stHdrRoute.PIrisDot_len = len;

stHdrRoute.Frm0TimeDot = HdrTimeDot[0];
stHdrRoute.Frm0GainDot = HdrGainDot[0];
stHdrRoute.Frm0IspDGainDot = HdrIspDGainDot[0];
stHdrRoute.Frm1TimeDot = HdrTimeDot[1];
stHdrRoute.Frm1GainDot = HdrGainDot[1];
stHdrRoute.Frm1IspDGainDot = HdrIspDGainDot[1];
stHdrRoute.Frm2TimeDot = HdrTimeDot[2];
stHdrRoute.Frm2GainDot = HdrGainDot[2];
stHdrRoute.Frm2IspDGainDot = HdrIspDGainDot[2];
stHdrRoute.PIrisDot = HdrPIrisGainDot;

ret = rk_aiq_user_api2_ae_setHdrAeRouteAttr(ctx,stHdrRoute);
```

6.6.6 rk_aiq_user_api2_ae_getHdrAeRouteAttr

【Description】

Gets the scene exposure distribution strategy for AE in HDR mode.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_ae_getHdrAeRouteAttr(const rk_aiq_sys_ctx_t* ctx,
Uapi_HdrAeRouteAttr_t* pHdrAeRouteAttr);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
pHdrAeRouteAttr	AE Exposure Allocation Strategy Structure Pointer	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_ae.h, rk_aiq_uapi2_ae_int.h
- Library file: librkaiq.so

6.6.7 rk_aiq_user_api2_ae_setLinExpAttr

【Description】

Set the AE linear mode exposure parameters.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_ae_setLinExpAttr(const rk_aiq_sys_ctx_t* ctx, const
Uapi_LinExpAttrV2_t linExpAttr);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
linExpAttr	AE exposure parameter structure	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_ae.h, rk_aiq_uapi2_ae_int.h
- Library file: librkaiq.so

【Example】

Set AE linear mode exposure parameters, including but not limited to: setting to adjust brightness intensity Evbias, setting backlight compensation function BackLightCtrl, setting strong light suppression function OverExpCtrl, etc. It is important to note that backlight compensation and strong light suppression cannot be enabled at the same time.

```
Uapi_LinExpAttrV2_t linExpAttr;
memset(&linExpAttr,0,sizeof(Uapi_LinExpAttrV2_t));
ret = rk_aiq_user_api2_ae_getLinExpAttr(ctx, &linExpAttr);
//set Evbias
printf("Evbias=%f\n", linExpAttr.Evbias);
linExpAttr.Evbias = 100.0f;

//set BackLightCtrl
linExpAttr.BackLightCtrl.Enable = true;
linExpAttr.BackLightCtrl.StrBias = 200.0f;
```

```
//set OverExpCtrl
linExpAttr.OverExpCtrl.Enable = true;
linExpAttr.OverExpCtrl.StrBias = 100.0f;

ret = rk_aiq_user_api2_ae_setLinExpAttr(ctx, linExpAttr);
```

6.6.8 rk_aiq_user_api2_ae_getLinExpAttr

【Description】

Get the AE linear mode exposure parameters.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_ae_getLinExpAttr(const rk_aiq_sys_ctx_t* ctx,
Uapi_LinExpAttrV2_t* pLinExpAttr);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
pLinExpAttr	AE exposure parameter structure pointer	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_ae.h, rk_aiq_uapi2_ae_int.h
- Library file: librkaiq.so

6.6.9 rk_aiq_user_api2_ae_setHdrExpAttr

【Description】

Set AE HDR mode exposure parameters.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_ae_setHdrExpAttr(const rk_aiq_sys_ctx_t* ctx, const
Uapi_HdrExpAttrV2_t hdrExpAttr);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
hdrExpAttr	AE exposure parameter structure	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_ae.h, rk_aiq_uapi2_ae_int.h
- Library file: librkaiq.so

【Example】

Set AE HDR mode exposure parameters, including but not limited to: setting the exposure ratio to manual or automatic, adjusting the brightness intensity Evbias.

```
Uapi_HdrExpAttrV2_t HdrExpAttr;
memset(&HdrExpAttr,0,sizeof(Uapi_HdrExpAttrV2_t));
ret = rk_aiq_user_api2_ae_getHdrExpAttr(ctx, &HdrExpAttr);

//set hdr mframe params
int len = 8;
float explevel[8] = {0, 0.096, 0.192, 0.384, 0.96, 1.344, 1.92, 3};
float setpoint[8] = {50, 45, 40, 35, 30, 25, 20, 15};
HdrExpAttr.HdrAEAttr.MframeCtrl.MExpLevel_len = len;
HdrExpAttr.HdrAEAttr.MframeCtrl.MSetPoint_len = len;
HdrExpAttr.HdrAEAttr.MframeCtrl.MExpLevel = explevel;
HdrExpAttr.HdrAEAttr.MframeCtrl.MSetPoint = setpoint;

//set ExpRatioType (AUTO/FIX)
HdrExpAttr.ExpRatioCtrl.ExpRatioType = AECV2_HDR_RATIOTYPE_MODE_AUTO;
//set Evbias
HdrExpAttr.Evbias = -100.0f;

ret = rk_aiq_user_api2_ae_setHdrExpAttr(ctx, HdrExpAttr);
```

6.6.10 rk_aiq_user_api2_ae_getHdrExpAttr

【Description】

Get the AE HDR mode exposure parameters.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_ae_getHdrExpAttr(const rk_aiq_sys_ctx_t* ctx,
Uapi_HdrExpAttrV2_t* pHdrExpAttr);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
pHdrExpAttr	AE exposure parameter structure pointer	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_ae.h, rk_aiq_uapi2_ae_int.h
- Library file: librkaiq.so

6.6.11 rk_aiq_user_api2_ae_setIrisAttr

【Description】

Set AE aperture control parameters.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_ae_setIrisAttr(const rk_aiq_sys_ctx_t * sys_ctx, const
Uapi_IrisAttrV2_t irisAttr);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
irisAttr	Aperture control parameter structure	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_ae.h, rk_aiq_uapi2_ae_int.h
- Library file: librkaiq.so

【Example】

```
Uapi_IrisAttrV2_t irisAttr;
ret = rk_aiq_user_api2_ae_getIrisAttr(ctx, &irisAttr);
irisAttr.enable = true; /*run AIris*/

//set P-iris attributes
irisAttr.IrisType = IRIS_P_TYPE;
irisAttr.PIrisAttr.TotalStep = 81;
irisAttr.PIrisAttr.EffcStep = 44;
irisAttr.PIrisAttr.ZeroIsMax = true;
uint16_t StepTable[1024] = {512, 511, 506, 499, 491, 483, 474, 465, 456,
                            446, 437, 427, 417, 408, 398, 388, 378, 368,
                            359, 349, 339, 329, 319, 309, 300, 290, 280,
                            271, 261, 252, 242, 233, 224, 214, 205, 196,
                            187, 178, 170, 161, 153, 144, 136, 128, 120,
                            112, 105, 98, 90, 83, 77, 70, 64, 58,
                            52, 46, 41, 36, 31, 27, 23, 19, 16,
                            13, 10, 8, 6, 4, 3, 1, 1, 0,
                            0, 0, 0, 0, 0, 0, 0, 0, 0};
memcpy(irisAttr.PIrisAttr.StepTable,StepTable,sizeof(irisAttr.PIrisAttr.StepTable
));
ret = rk_aiq_user_api2_ae_setIrisAttr(ctx, irisAttr);

//set DC-iris attributes
irisAttr.IrisType = IRIS_DC_TYPE;
irisAttr.DCIrisAttr.Kp= 0.5f;
irisAttr.DCIrisAttr.Ki= 0.2f;
irisAttr.DCIrisAttr.Kd = 0.3f;
irisAttr.DCIrisAttr.OpenPwmDuty = 40;
irisAttr.DCIrisAttr.ClosePwmDuty = 22;
irisAttr.DCIrisAttr.MinPwmDuty = 0;
irisAttr.DCIrisAttr.MaxPwmDuty = 100;
ret = rk_aiq_user_api2_ae_setIrisAttr(ctx, irisAttr);

//set manual iris with auto ae
irisAttr.IrisOpType = RK_AIQ_OP_MODE_MANUAL;
if(irisAttr.IrisType == IRIS_P_TYPE);
    irisAttr.ManualAttr.PIrisGainValue = 512; /*p-iris F#=1.4*/
if(irisAttr.IrisType == IRIS_DC_TYPE);
    irisAttr.ManualAttr.DCIrisHoldValue = 20; /*dc-iris PwmDuty=20*/
ret = rk_aiq_user_api2_ae_setIrisAttr(ctx, irisAttr);
```

6.6.12 rk_aiq_user_api2_ae_getIrisAttr

【Description】

Gets the AE aperture control parameters.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_ae_getIrisAttr(const rk_aiq_sys_ctx_t * sys_ctx, const
Uapi_IrisAttrV2_t* irisAttr);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
irisAttr	Aperture control parameter structure	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_ae.h, rk_aiq_uapi2_ae_int.h
- Library file: librkaiq.so

6.6.13 rk_aiq_user_api2_ae_setExpWinAttr

【Description】

Set the AE Statistics window properties.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_ae_setExpWinAttr(const rk_aiq_sys_ctx_t* sys_ctx, const
Uapi_ExpWin_t ExpWin);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
ExpWin	Window Properties Parameter	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_ae.h, rk_aiq_uapi2_ae_int.h
- Library file: librkaiq.so

【Example】

Modify the AE statistical coordinates according to the face position to realize brightness statistics for the face area.

Note: When setting statistical coordinates, ensure that ExpWin.h_offs+ExpWin.h_size<=pic_width and ExpWin.v_offs+ExpWin.v_size<=pic_height.

```
Uapi_ExpWin_t ExpWin;
//Suppose the sensor resolution is 2688X1520, the lateral offset of the face from the upper left corner of the screen is 100 pixel, the vertical offset is 100 pixel, and the face size is a square with a side length of 100 pixel
ExpWin.h_offs=100;
ExpWin.v_offs=100;
ExpWin.h_size=100;
ExpWin.v_size=100;
rk_aiq_user_api2_ae_setExpWinAttr(ctx, ExpWin);
```

6.6.14 rk_aiq_user_api2_ae_getExpWinAttr

【Description】

Gets the AE Statistics window properties.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_ae_getExpWinAttr(const rk_aiq_sys_ctx_t* sys_ctx,const Uapi_ExpWin_t* ExpWin);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
ExpWin	Window Properties Parameter	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_ae.h, rk_aiq_uapi2_ae_int.h

- Library file: librkaiq.so

6.6.15 rk_aiq_user_api2_ae_queryExpResInfo

【Description】

Obtain AE internal state information.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_ae_queryExpResInfo(const rk_aiq_sys_ctx_t* ctx,
Uapi_ExpQueryInfo_t* pExpResInfo);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
pExpResInfo	AE Internal State Information Structure Pointer	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_ae.h, rk_aiq_uapi2_ae_int.h
- Library file: librkaiq.so

6.7 Module-level API data types

6.7.1 Uapi_ExpSwAttr_t

【Description】

AE common function control parameter structure.

【Definition】

```
typedef struct Uapi_ExpSwAttrV2_s {
    rk_aiq_uapi_sync_t                  sync;
    uint8_t                             Enable;
    CalibDb_CamRawStatsModeV2_t         RawStatsMode;
    CalibDb_CamHistStatsModeV2_t        HistStatsMode;
    CalibDb_CamYRangeModeV2_t           YRangeMode;
    uint8_t                             AecRunInterval;
    RKAiqOPMode_t                       AecOpType;
    Cam15x15UCharMatrix_t               GridWeights;
    Uapi_AeAttrV2_t                     stAuto;
    Uapi_MeAttrV2_t                     stManual;
    Uapi_ExpSwAttr_AdvancedV2_t         stAdvanced;
} Uapi_ExpSwAttrV2_t;
```

【Member】

Member Name	Description
sync	For rk_aiq_uapi_sync_t definitions, see **Overview/API Description** section
Enable	AEC enable switch. 1. Turn on the Aec algorithm; 0, turn off the Aec algorithm, and the exposure remains at the value before it turned off
RawStatsMode	AEC module luminance statistics mode. There are four modes: CAM_RAWSTATSV2_MODE_Y/R/G/B, and the default is Y mode.
HistStatsMode	AEC module histogram statistical mode. There are five modes: CAM_HISTV2_MODE_Y/R/G/B, and the default is Y mode.
YRangeMode	Aec module Y-channel Range mode. The two modes are CAM_YRANGEV2_MODE_FULL/LIMITED, and the default is FULL mode.
AecRunInterval	The AE algorithm runs at a value range of [0,255], and the default value is 0. If the value is 0, run AE every frame; If the value is 1, run AE every 1 frame; And so on.
AecOpType	Exposure modes, divided into auto exposure (RK_AIQ_OP_MODE_AUTO) mode / manual (RK_AIQ_OP_MODE_MANUAL) exposure mode. The default is AUTO mode. Manual exposure mode needs to be used in conjunction with stManual to set the manual exposure value
GridWeights	Window (histogram) weight, containing 15*15 array elements, value range [0,32]
stAuto	Auto exposure parameter structure
stManual	Manual exposure parameter structure
stAdvanced	Parameter structs

Related Data Type

- rk_aiq_uapi_sync_t
- Uapi_ExpSwAttr_AdvancedV2_t
- Uapi_AeAttrV2_t

- Uapi_MeAttrV2_t

6.7.1.1 Uapi_ExpSwAttr_AdvancedV2_t

【Description】

Parameter structs are preferred.

【Definition】

```
typedef struct Aec_uapi_advanced_attr_s {
    bool                            enable;
    uint8_t                         GridWeights[15 * 15];
    bool                            SetAeRangeEn;
    Aec_LinAeRange_t                SetLinAeRange;
    Aec_HdrAeRange_t                SetHdrAeRange;
} Aec_uapi_advanced_attr_t;

typedef Aec_uapi_advanced_attr_t Uapi_ExpSwAttr_AdvancedV2_t;
```

【Member】

Member Name	Description
enable	set 1 to give preference to the parameters in the struct
GridWeights	AE weight, size 15X15.
SetAeRangeEn	Set 1 to set the auto exposure component range; Set 0, do not set the auto exposure component range, subject to the debug file
SetLinAeRange	The value of the range parameter of the auto exposure component of linear exposure (not the final effective range)
SetHdrAeRange	The automatic exposure component of HDR exposure range parameter value (not the final effective range)

【Precautions】

- Uapi_ExpSwAttrV2_t A set of AE weights is defined in the structure, and the number of weights is 15X15. The algorithm expands the weights according to the actual number of weights configured by the hardware. If you need to expose a similar face, you can use a set of AE weights defined in the Uapi_ExpSwAttr_AdvancedV2_t, and the number of weights is 15X15. The algorithm compresses the weights according to the actual number of weights configured by the hardware. If you want to use a set of AE weights defined in the Uapi_ExpSwAttr_Advanced_t, enable must be enabled and set to 1.
- **When setting the AE parameter range through the API, you need to set SetAeRangeEn to 1**, otherwise the automatic exposure parameter range in the debug file is used by default. The setting of the exposure parameter range is divided into two sets: SetLinAeRange and SetHdrAeRange according to different exposure modes. Among them, SetHdrAeRange supports setting the range of auto exposure parameters for each frame. In addition, the final effective exposure time and gain range need to be queried in the stAuto structure, where only the set range, not the final effective range.

6.7.1.1.1 Aec_AeRange_t

【Description】

Define the AE parameter range.

【Definition】

```
typedef struct Aec_AeRange_s {
    float                   Min;
    float                   Max;
} Aec_AeRange_t;
```

【Member】

Member Name	Description
Min	Lower limit
Max	Upper limit value

6.7.1.1.2 Aec_LinAeRange_t

【Description】

Define the parameter range for AE linear mode.

【Definition】

```
typedef struct Aec_LinAeRange_s {
    Aec_AeRange_t       stExpTimeRange;
    Aec_AeRange_t       stGainRange;
    Aec_AeRange_t       stIspDGainRange;
    Aec_AeRange_t       stPIrisRange;
} Aec_LinAeRange_t;
```

【Member】

Member Name	Description
stExpTimeRange	Exposure time range, set the maximum and minimum values in milliseconds
stGainRange	The Sensor simulates the gain range, setting the maximum and minimum values
stIspDGainRange	ISP digital gain range, set maximum and minimum values
stPIrisRange	Aperture equivalent gain range, only P-Iris aperture size control is supported

【Precautions】

- When the maximum/minimum value of each exposure component is the default value of 0, the set exposure component range does not take effect, and the actual maximum/minimum value of each exposure component is determined by the minimum and maximum values of the AecRoute exposure decomposition route node.

- When the maximum/minimum value of each exposure component is not 0, the set exposure component range takes effect, when the set exposure component range does not exceed the limit of sensor or ISP, the actual maximum/minimum value of each exposure component is subject to the set exposure component range, and the AecRoute exposure decomposition route is corrected, and the node maximum/minimum value is changed to the set maximum / minimum value of the exposure component; If the limit of sensor or ISP is exceeded, the actual maximum/minimum value of each exposure component is subject to the maximum and minimum values of the AecRoute exposure decomposition route node

6.7.1.1.3 Aec_HdrAeRange_t

【Description】

Define the parameter range for AE HDR mode.

【Definition】

```
typedef struct Aec_HdrAeRange_s {
    Aec_AeRange_t      stExpTimeRange[3];
    Aec_AeRange_t      stGainRange[3];
    Aec_AeRange_t      stIspDGainRange[3];
    Aec_AeRange_t      stPIrisRange;
} Aec_HdrAeRange_t;
```

【Member】

Member Name	Description
stExpTimeRange	Exposure time range, set the maximum and minimum values in seconds, array 0/1/2 are short frames, medium frames, long frames, respectively.
stGainRange	Sensor analog gain range, set the maximum and minimum values, array 0/1/2 are short frames, medium frames, long frames.
stIspDGainRange	ISP digital gain range, set the maximum and minimum values, array 0/1/2 are short frames, medium frames, long frames.
stPIrisRange	Aperture equivalent gain value range, set the maximum and minimum values

【Precautions】

- stExpTimeRange, stGainRange, stIspDGainRange are predefined as arrays with 3 members. In the 2-frame HDR mode, only members 0 and 1 are valid, indicating the exposure component ranges corresponding to short frames and long frames, respectively. In 3-frame HDR mode, 0-2 is valid, indicating the exposure component range corresponding to short, medium, and long frames, respectively.
- When the maximum/minimum value of each exposure component is the default value of 0, the set exposure component range does not take effect, and the actual maximum/minimum value of each exposure component is determined by the minimum and maximum values of the exposure decomposition route node corrected by the algorithm.
- When the maximum / minimum value of each exposure component is not 0, the set exposure component range takes effect, when the set exposure component range does not exceed the limit of sensor or ISP, the actual maximum / minimum value of each exposure component is subject to the set exposure component range, and the exposure decomposition route is corrected, and the node maximum/minimum value is changed to the set maximum / minimum value of the exposure component; If the limit of sensor or ISP is

exceeded, the actual maximum/minimum value of each exposure component is subject to the maximum and minimum values of the exposure decomposition route node.

- The 1106 platform does not support the isp dgain function at the moment, so stIspDGainRange is temporarily invalid

6.7.1.2 Uapi_AeAttrV2_t

【Description】

Define AE auto exposure properties.

【Definition】

```
typedef struct Uapi_AeAttrV2_s {
    Uapi_AeSpeedV2_t           stAeSpeed;
    DelayFrmNum
    uint8_t                    BlackDelayFrame;
    uint8_t                    WhiteDelayFrame;
    Auto/Fixed fps
    Uapi_AeFpsAttrV2_t         stFrmRate;
    Uapi_AntiFlickerV2_t       stAntiFlicker;
    auto range
    Aec_LinAeRange_t           LinAeRange;//result LinAerange
    Aec_HdrAeRange_t           HdrAeRange;//result HdrAerange
} Uapi_AeAttrV2_t;
```

【Member】

Member Name	Description
stAeSpeed	Auto exposure adjustment speed
BlackDelayFrame	Auto exposure delay property, when the image brightness below the target value exceeds the BlackDelayFrame frame, Ae starts adjusting
WhiteDelayFrame	Auto exposure delay property, when the image brightness exceeds the target value of the WhiteDelayFrame frame, Ae starts adjusting
stFrmRate	Auto exposure frame rate mode structure, fixed frame rate mode or auto frame reduction mode
stAntiFlicker	Anti-power frequency flicker parameters
LinAeRange	Linear mode AE range structure (final effective linear exposure range)
HdrAeRange	HDR mode AE range structure (final effective HDR exposure range)

【Precautions】

- LinAeRange/HdrAeRange is the range of parameters actually used after verification correction inside the algorithm. When the AE parameter range set by the API exceeds the parameter range limited by the sensor, the parameter range limited by the sensor will be used. The range of parameters limited by sensor can be found in the AE module sensorinfo parameter in the Rockchip_Tuning_Guide_ISP30_CN.pdf documentation.

- To set the auto exposure component range, the API calls the parameter in the Uapi_ExpSwAttr_AdvancedV2_t above and sets SetAeRangeEn to 1, otherwise the auto exposure parameter range in the debug file is used by default.

6.7.1.2.1 Uapi_AeSpeedV2_t

【Description】

Define AE conditional speed properties.

【Definition】

```
typedef struct CalibDb_AeSpeedV2_s {
    float                   DampOver;
    float                   DampUnder;
    float                   DampDark2Bright;
    float                   DampBright2Dark;
} CalibDb_AeSpeedV2_t;
typedef CalibDb_AeSpeedV2_t Uapi_AeSpeedV2_t;
```

【Member】

Member name	Description
DampOver	The ambient brightness is stable, and the corresponding exposure adjustment speed when the image brightness is higher than the target value, the value range [0,1].
DampUnder	The ambient brightness is stable, and the corresponding exposure adjustment speed when the image brightness is lower than the target value, the value range [0,1].
DampDark2Bright	Sudden change in ambient brightness, the corresponding exposure adjustment speed from dark to light, value range [0,1].
DampBright2Dark	Sudden change in ambient brightness, the corresponding exposure adjustment speed from light to dark, value range [0,1].

6.7.1.2.2 Uapi_AeFpsAttrV2_t

【Description】

Define AE frame rate properties.

【Definition】

```
typedef struct CalibDb_AeFrmRateAttrV2_s {
    bool            isFpsFix;
    uint8_t         FpsValue;
} CalibDb_AeFrmRateAttrV2_t;
typedef CalibDb_AeFrmRateAttrV2_t Uapi_AeFpsAttrV2_t;
```

【Member】

Member Name	Description
isFpsFix	The auto exposure fixed frame rate mode is enabled, the default value is FALSE, that is, the automatic frame reduction mode is used; A value of TRUE indicates a fixed frame rate mode.
FpsValue	It is only valid when the frame rate is fixed, and when the default value is 0, the default frame rate of the driver is used fixed; If the value is not 0, the set frame rate value is used.

6.7.1.2.3 Uapi_AntiFlickerV2_t

【Description】

Define anti-flash properties.

【Definition】

```
typedef struct CalibDb_AntiFlickerAttrV2_s {
    bool                          enable;
    CalibDb_FlickerFreq_t         Frequency;
    CalibDb_AntiFlickerMode_t     Mode;
} CalibDb_AntiFlickerAttrV2_t;
typedef CalibDb_AntiFlickerAttrV2_t Uapi_AntiFlickerV2_t;
```

【Member】

Member Name	Description
enable	Power frequency anti-flash function enabled state, 0: turn off the anti-flash function; 1: Turn on the anti-flash function
Frequency	Anti-flash frequency attribute, including a total of 3 frame rates, namely: AECV2_FLICKER_FREQUENCY_OFF (effective when the anti-flash enable bit enables 0), AECV2_FLICKER_FREQUENCY_50HZ, AECV2_FLICKER_FREQUENCY_60HZ, the default is AECV2_FLICKER_FREQUENCY_50HZ (power frequency 50 Hz).
Mode	Anti-flash mode, including two anti-flash modes: AECV2_ANTIFLICKER_NORMAL_MODE (normal anti-flash mode), AECV2_ANTIFLICKER_AUTO_MODE (automatic anti-flash mode)

【Precautions】

- To turn off the anti-flash function, you need to set the enable bit enable to 0, and the algorithm automatically configures Frequency=AECV2_FLICKER_FREQUENCY_OFF; If the anti-flash enable bit is set to 1, the anti-flash frequency is configured to AECV2_FLICKER_FREQUENCY_OFF, the frequency value will be invalid, and the default value will be used to AECV2_FLICKER_FREQUENCY_50HZ.
- AECV2_ANTIFLICKER_NORMAL_MODE normal anti-flash mode, the exposure time can be adjusted according to the brightness, and the minimum exposure time is fixed at 1/120 sec (60Hz) or 1/100 sec (50Hz), not limited by the minimum exposure time.

  Illuminated environment: The exposure time can be matched to the frequency of the light source, which prevents the image from flickering.

High brightness environment: The higher the brightness, the shortest exposure time required. The minimum exposure time of the normal anti-flash mode cannot match the frequency of the light source, resulting in overexposure.

- AECV2_ANTIFLICKER_AUTO_MODE is an automatic anti-flash mode, the exposure time can be adjusted according to the brightness, and the minimum exposure time can reach the minimum exposure time of the sensor. The difference from the normal anti-flash mode is mainly reflected in the high brightness environment. High brightness environment: The minimum exposure time can reach the minimum exposure time of the sensor, which can effectively suppress overexposure, but the anti-flash fails at this time.

6.7.1.3 Uapi_MeAttrV2_t

【Description】

Manual exposure parameter setting, according to the exposure mode is divided into LinearAE and HdrAE two sets of parameters.

【Definition】

```
typedef struct Uapi_MeAttrV2_s {
    Uapi_LinMeAttrV2_t     stLinMe;
    Uapi_HdrMeAttrV2_t     stHdrMe;
} Uapi_MeAttrV2_t;
```

【Related data types】

- Uapi_LinMeAttrV2_t
- Uapi_HdrMeAttrV2_t

6.7.1.3.1 Uapi_LinMeAttrV2_t

【Description】

Manual exposure control parameters for LinearAE.

【Definition】

```
typedef struct Uapi_LinMeAttrV2_s {
    bool                ManualTimeEn;
    bool                ManualGainEn;
    bool                ManualIspDgainEn;
    float               TimeValue;
    float               GainValue;
    float               IspDGainValue;
} Uapi_LinMeAttrV2_t;
```

【Member】

Member name	Description
ManualTimeEn	Manual exposure time enabled, default value is 1
ManualGainEn	Manual sensor gain enable, default value is 1
ManualIspDgainEn	Manual ISP digital gain enable, default value is 1
TimeValue	Manual exposure time values in s, parameter values limited by sensor
GainValue	Manual sensor gain value, parameter value limited by sensor
IspDGainValue	Manual ISP digital gain value, parameter values limited by ISP

【Precautions】

- This module parameter is only valid when AeOptype = MANUAL. ManualTimeEn, ManualGainEn, ManualIspDgainEn are all 1, which is manual mode; As long as any of the above three is not enabled, it is semi-automatic mode; If all four of the above are 0, it is equivalent to automatic mode, and the system will report an error reminder.
- In manual/semi-manual mode, the manual exposure time and gain are limited by the maximum/minimum exposure time and gain in automatic mode. After the auto exposure limit is exceeded, the maximum/minimum value in auto mode is used instead.
- RK356X does not support ISP digital gain, so ManualIspDgainEn and IspDGainValue are invalid.

6.7.1.3.2 Uapi_HdrMeAttrV2_t

【Description】

Manual exposure control parameters for HdrAE.

【Definition】

```
typedef struct Uapi_HdrMeAttrV2_s {
    bool                    ManualTimeEn;
    bool                    ManualGainEn;
    bool                    ManualIspDgainEn;
    Cam3x1FloatMatrix_t     TimeValue;
    Cam3x1FloatMatrix_t     GainValue;
    Cam3x1FloatMatrix_t     IspDGainValue;
} Uapi_HdrMeAttrV2_t;
```

【Member】

Variables have the same meaning as Uapi_LinMeAttrV2_t.

【Precautions】

- TimeValue/GainValue/IspDGainValue are arrays with 3 members. In HDR 2 frame mode, the array [0-1] members are valid, representing short and long frames, respectively; In HDR 3 frame mode, the array [0-2] members are valid, corresponding to short, medium, and long frames, respectively.
- In manual/semi-manual mode, the manual exposure time and gain are limited by the maximum/minimum exposure time and gain in automatic mode. After the auto exposure limit is exceeded, the maximum/minimum value in auto mode is used instead.
- RK356X does not currently support ISP digital gain, so ManualIspDgainEn, IspDGainValue are invalid.

6.7.2 Uapi_LinAeRouteAttr_t

【Description】

Define AE linear exposure decomposition path properties.

【Definition】

```
typedef struct CalibDb_LinAeRoute_AttrV2_s {
    float* TimeDot;
    int TimeDot_len;
    float* GainDot;
    int GainDot_len;
    float* IspDGainDot;
    int IspDGainDot_len;
    int* PIrisDot;
    int PIrisDot_len;
} CalibDb_LinAeRoute_AttrV2_t;

typedef struct Uapi_LinAeRouteAttr_s {
  rk_aiq_uapi_sync_t            sync;
  CalibDb_LinAeRoute_AttrV2_t   Params;
} Uapi_LinAeRouteAttr_t;
```

【Member】

Member Name	Description
TimeDot	The sensor exposure time node in s
GainDot	The sensor exposure gain node,
IspgainDot	ISP digital gain node
PIrisGainDot	Aperture equivalent gain node

【Precautions】

- There is no limit to the number of exposure decomposition curve nodes, but it is recommended not to have less than 6.
- The exposure of a node is the product of each component such as exposure time, sensor gain, ISP digital gain, and aperture equivalent gain. The exposure of the node must be monotonically increasing, that is, the exposure of the latter node must be greater than the exposure of the previous node. The first node has the least exposure and the second node has the largest exposure.
- The exposure time component in the node is in seconds, the minimum value is allowed to be 0, and the actual minimum exposure time code is internally corrected according to the sensor limit.
- Aperture component only supports P-Iris, DC-Iris is not supported. The P-iris equivalent gain component is only valid when the Airis auto iris function is enabled, otherwise the default aperture is fixed to the initial value size. The calculation of the equivalent gain of P-iris is detailed in the AecIrisCtrl module.
- The set exposure decomposition route node is not the final exposure decomposition route. The actual maximum/small value of each final exposure component of the system is determined by the combination of the exposure decomposition node and the manually configured exposure component maximum/small value. First make the first correction of the maximum/small value of the node of the exposure decomposition route,

and when the maximum/small value of the node does not exceed the limit of SENSOR or ISP, the maximum/small value of the node remains unchanged; When the node maximum/small value exceeds the limit of the sensor or ISP, the node maximum/small value is subject to the limit of the sensor or ISP. When the maximum/minimum value of the manually configured exposure component is 0, the final effective exposure decomposition route is subject to the decomposition route of the first correction; When the maximum/small value of the manually configured exposure component is not 0, and the maximum/small value set does not exceed the limit of SENSOR or ISP, the exposure decomposition route is corrected for the second time, and the node maximum/small value is subject to the manually set range; If the maximum/small value of the exposure component is set beyond the limit of the sensor or ISP, the node maximum/small value of the exposure component of the exposure decomposition route shall be subject to the result of the first correction.

- If the exposure of adjacent nodes increases, only one exposure component should increase and the others fixed. The added component determines the allocation strategy for that segment of the route. For example, if the gain component increases and the other components are fixed, then the distribution strategy of this segment of the route is gain first.
- RK356X does not currently support ISP digital gain, so IspgainDot is invalid.

6.7.3 Uapi_HdrAeRouteAttr_t

【Description】

Define AE HDR exposure decomposition path properties.

【Definition】

```
typedef struct CalibDb_HdrAeRoute_AttrV2_s {
    float* Frm0TimeDot;
    int Frm0TimeDot_len;
    float* Frm0GainDot;
    int Frm0GainDot_len;
    float* Frm0IspDGainDot;
    int Frm0IspDGainDot_len;
    float* Frm1TimeDot;
    int Frm1TimeDot_len;
    float* Frm1GainDot;
    int Frm1GainDot_len;
    float* Frm1IspDGainDot;
    int Frm1IspDGainDot_len;
    float* Frm2TimeDot;
    int Frm2TimeDot_len;
    float* Frm2GainDot;
    int Frm2GainDot_len;
    float* Frm2IspDGainDot;
    int Frm2IspDGainDot_len;
    int* PIrisDot;
    int PIrisDot_len;
} CalibDb_HdrAeRoute_AttV2r_t;

typedef struct Uapi_HdrAeRouteAttr_s {
  rk_aiq_uapi_sync_t            sync;
  CalibDb_HdrAeRoute_AttrV2_t   Params;
} Uapi_HdrAeRouteAttr_t;
```

【Members】

Member name	Description
Frm0/1/2TimeDot	Exposure time node, in seconds. In HDR 2 frame mode, only Frm0/1TimeDot is valid; In HDR 3 frame mode, Frm0/1/2TimeDot is valid. FRM0~3 is the frame sequence number from short to long exposure
Frm0/1/2GainDot	Sensor gain node. In Hdr 2 frame mode, only Frm0/1GainDot is valid; In HDR 3 frame mode, Frm0/1/2GainDot is valid. The gain value here is the actual value in units of 1x. FRM0~3 is the frame sequence number from short to long exposure
Frm0/1/2IspDGainDot	ISP digital gain node. In Hdr 2 frame mode, only Frm0/1IspDGainDot is valid; In HDR 3 frame mode, Frm0/1/2IspDGainDot is valid. The gain value here is the actual value in units of 1x. FRM0~3 is the frame sequence number from short to long exposure
PIrisDot	The aperture is equivalent to the gain node, where the gain value is the actual value in units of 1x.

【Precautions】

- The number of exposure decomposition curve nodes is not limited, **It is recommended to set at least 6 nodes** to achieve smooth exposure decomposition.
- It should be noted that in HDR 2 frame mode, only Frm0/1TimeDot, Frm0/1GainDot, Frm0/1IspDGainDot need to be set, corresponding to the actual short and long frames respectively; In HDR 3 frame mode, Frm0/1/2TimeDot, Frm0/1/2GainDot, Frm0/1/2IspDGainDot need to be set, corresponding to short, medium and long frames respectively. When setting the sensor exposure time for each frame in HDR mode, you need to allocate the exposure time reasonably, and the sum of the exposure time of each frame ** cannot exceed the maximum exposure time allowed by the frame rate**!
- The exposure of a node is the product of each component such as exposure time, sensor gain, ISP digital gain, and aperture equivalent gain. The exposure of the node must be monotonically increasing, that is, the exposure of the latter node must be greater than the exposure of the previous node. The first node has the least exposure and the second node has the largest exposure.
- The exposure time component in the node is in seconds, the minimum value is allowed to be 0, and the actual minimum exposure time code is internally corrected according to the sensor limit.
- Aperture component only supports P-Iris, DC-Iris is not supported. The P-iris equivalent gain component is only valid when the Airis auto iris function is enabled, otherwise the default aperture is fixed to the initial value size. The calculation of the equivalent gain of P-iris is detailed in the AecIrisCtrl module.
- The set exposure decomposition route node is not the final exposure decomposition route. The actual maximum/small value of each final exposure component of the system is determined by the combination of the exposure decomposition node and the manually configured exposure component maximum/small value. First make the first correction of the maximum/small value of the node of the exposure decomposition route, and when the maximum/small value of the node does not exceed the limit of SENSOR or ISP, the maximum/small value of the node remains unchanged; When the node maximum/small value exceeds the limit of the sensor or ISP, the node maximum/small value is subject to the limit of the sensor or ISP. When the maximum/minimum value of the manually configured exposure component is 0, the final effective exposure decomposition route is subject to the decomposition route of the first correction; When the maximum/small value of the manually configured exposure component is not 0, and the maximum/small value set does not exceed the limit of SENSOR or ISP, the exposure decomposition route is corrected for the

second time, and the node maximum/small value is subject to the manually set range; If the maximum/small value of the exposure component is set beyond the limit of the sensor or ISP, the node maximum/small value of the exposure component of the exposure decomposition route shall be subject to the result of the first correction.

- If the exposure of adjacent nodes increases, only one exposure component should increase and the others fixed. The added component determines the allocation strategy for that segment of the route. For example, if the gain component increases and the other components are fixed, then the distribution strategy of this segment of the route is gain first.
- 356X does not currently support ISP digital gain, so Frm0/1/2ispDGainDot are invalid.

6.7.4 Uapi_LinExpAttrV2_t

【Description】

Define AE linear exposure tuning parameters.

【Definition】

```
typedef struct CalibDb_LinearAE_AttrV2_s {
    uint8_t RawStatsEn;
    float ToleranceIn;
    float ToleranceOut;
    float Evbias;
    CalibDb_AeStrategyModeV2_t      StrategyMode;
    CalibDb_LinExpInitExpV2_t       InitExp;
    CalibDb_LinAeRoute_AttrV2_t     Route;
    CalibDb_AecDynamicSetpointV2_t  DySetpoint;
    CalibDb_AecBacklightV2_t        BackLightCtrl;
    CalibDb_AecOverExpCtrlV2_t OverExpCtrl;
} CalibDb_LinearAE_AttrV2_t;

typedef struct Uapi_LinExpAttrV2_s {
  rk_aiq_uapi_sync_t            sync;
  CalibDb_LinearAE_AttrV2_t     Params;
} Uapi_LinExpAttrV2_t;
```

【Member】

Member Name	Description
RawStatsEn	Linear exposure is enabled using the Raw domain statistical luminance function
EvBias	When adjusting the automatic exposure, the percentage deviation of the exposure amount is % The reference value range is [-200, +200]
ToleranceIn/Out	The tolerance of the brightness of the picture when adjusting the auto exposure. The unit is %, and the value range is [0,100]
StrategyMode	Auto exposure strategy mode, Highlight Priority or Low Light Priority [temporarily inactive]
DySetpoint	The dynamic target brightness value attribute of the automatic exposure adjustment, which dynamically changes with the exposure amount
BackLightCtrl	Backlight compensation function parameters
OverExpCtrl	Bright light suppression function parameters

【Precautions】

- EvBias for fine-tuning (SetPoint/IRSetPoint) of target luminance values (fixed/dynamic) in special scenarios. The true effective target brightness is (SetPoint)*[1+abs(EvBias)/100]^[EvBias/abs(EvBias)]. If EvBias=100 is set, the target brightness is twice the default parameter. When EvBias=-100, the target brightness is 1/2 of the default parameter.
- The tolerance of the brightness of the AE screen is Tolerance, and when the AE converges, the brightness value B should be within the range of [True Effective Target Brightness X(1-Tolerance/100), True Effective Target Luminance X(1+Tolerance/100)]. The ToleranceIn/Out setting is large, which will affect the response speed of AE on the one hand, and the EvBias value on the other. When the interval value of EvBias adjustment is lower than ToleranceIn/Out, it may cause the brightness adjustment to not take effect.
- StrategyMode is currently invalid.

【Related data types】

- CalibDb_AecDynamicSetpointV2_t
- CalibDb_AecBacklightV2_t
- CalibDb_AecOverExpCtrlV2_t

6.7.4.1 CalibDb_AecDynamicSetpointV2_t

【Description】

Define AE dynamic target values.

【Definition】

```
typedef struct CalibDb_AecDynamicSetpointV2_s {
    float* ExpLevel;
    int ExpLevel_len;
    float* DySetpoint;
    int DySetpoint_len;
} CalibDb_AecDynamicSetpointV2_t;
```

【Member】

Member name	Description
ExpLevel	Dynamic exposure node attribute, the node value is the current exposure value, the number of nodes is not limited, it is recommended to set at least 6 nodes to prevent the exposure transition from being smooth.
DySetpoint	Dynamic target brightness value node attribute, node value dynamically changes with exposure amount, the larger the exposure node value, the smaller the target brightness node value, and corresponds to the exposure node one-to-one. The number of nodes is not limited, it needs to be consistent with the number of ExpLevel nodes, it is recommended to set at least 6 nodes to prevent the exposure transition from being smooth.

6.7.5 Uapi_HdrExpAttrV2_t

【Description】

Define AE HDR exposure debug parameters.

【Definition】

```
typedef struct CalibDb_HdrAE_AttrV2_s {
    float ToleranceIn;
    float ToleranceOut;
    float Evbias;
    CalibDb_AeStrategyModeV2_t StrategyMode;
    float LumaDistTh; //used for area-growing
    CalibDb_HdrExpInitExpV2_t InitExp;
    CalibDb_HdrAeRoute_AttrV2_t Route;
    CalibDb_ExpRatioCtrlV2_t ExpRatioCtrl;
    CalibDb_LongFrmCtrlV2_t LongFrmMode;
    CalibDb_LfrmCtrlV2_t LframeCtrl;
    CalibDb_MfrmCtrlV2_t MframeCtrl;
    CalibDb_SfrmCtrlV2_t SframeCtrl;
} CalibDb_HdrAE_AttrV2_t;

typedef struct Uapi_HdrExpAttrV2_s {
  rk_aiq_uapi_sync_t            sync;
  CalibDb_HdrAE_AttrV2_t        Params;
} Uapi_HdrExpAttrV2_t;
```

【Member】

Member Name	Description
ToleranceIn/Out	The tolerance of the brightness of the picture when adjusting the auto exposure. The unit is %, and the value range is [0,100]
LongfrmMode	Long frame mode parameter
StrategyMode	Auto Exposure Strategy Mode, Highlight Priority or Low Light Priority (AECV2_STRATEGY_MODE_LOWLIGHT_PRIOR/AECV2_STRATEGY_MODE_HIGHLIGHT_PRIOR)
Evbias	When adjusting the automatic exposure, the percentage deviation of the exposure amount is % The reference value range is [-200, +200]
ExpRatioCtrl	HdrAE exposure ratio control module, only valid in HDR mode multi-frame compositing
LframeCtrl	Long frame control parameters
MframeCtrl	Medium frame control parameter, valid only in HDR 3 frame mode
SframeCtrl	Short frame control parameters

【Related data types】

- CalibDb_LFrameCtrlV2_t
- CalibDb_MFrameCtrlV2_t
- CalibDb_SFrameCtrlV2_t

6.7.6 Uapi_IrisAttrV2_t

【Description】

Aperture control parameters.

【Definition】

```
typedef struct CalibDb_AecIrisCtrlV2_s {
    uint8_t Enable;
    CalibDb_IrisTypeV2_t IrisType;
    RKAiqOPMode_t IrisOpType;
    CalibDb_MIris_AttrV2_t ManualAttr;
    CalibDb_PIris_AttrV2_t PIrisAttr;
    CalibDb_DCIris_AttrV2_t DCIrisAttr;
} CalibDb_AecIrisCtrlV2_t;

typedef struct Uapi_IrisAttrV2_s {
  rk_aiq_uapi_sync_t            sync;
  CalibDb_AecIrisCtrlV2_t       Params;
} Uapi_IrisAttrV2_t;
```

【Member】

Member name	Description
Enable	Automatic iris control function enabled
IrisType	Aperture type, P (i.e. P-iris aperture) or DC (i.e. DC-iris aperture)
IrisOpType	Aperture control mode: divided into automatic (RK_AIQ_OP_MODE_AUTO) mode / manual (RK_AIQ_OP_MODE_MANUAL) mode
ManualAttr	Manual aperture parameters
PIrisAttr	P-aperture attribute parameter
DCIrisAttr	DC Aperture Properties Parameter

6.7.6.1 CalibDb_MIris_AttrV2_t

【Description】

Manual aperture parameters.

【Definition】

```
typedef struct CalibDb_MIris_AttrV2_s {
    int PIrisGainValue;
    int DCIrisHoldValue;
} CalibDb_MIris_AttrV2_t;
```

【Member】

Member name	Description
PIrisGainValue	Manual P-aperture equivalent gain value, parameter value limited by P-aperture device, the value range is [1,1024]
DCIrisHoldValue	DC aperture HoldValue value, parameter value is related to DC aperture device, the value range is [0,100]

【Precautions】

- IrisOpType = RK_AIQ_OP_MODE_MANUAL, manual aperture enabled. When the aperture type is P-aperture, only PirisGainValue is valid; When the aperture type is DC aperture, only DCIrisHoldValue is valid.
- DCIrisHoldValue, directly set the PWM duty cycle value of the motor in manual mode, the value range [0,100]. If the HoldValue value is set in manual mode (that is, the value in the range from ClosePwmDuty to OpenPwmDuty in AecIrisCtrl), the DC aperture aperture remains at the current size; If the value set is greater than OpenPwmDuty, the aperture is turned on, and the larger the value, the greater the opening speed; If the value set is less than ClosePwmDuty, the aperture is off, and the smaller the value, the greater the speed of closing.

6.7.6.2 CalibDb_PIris_AttrV2_t

【Description】

P aperture attribute parameter.

【Definition】

```
#define AEC_PIRIS_STAP_TABLE_MAX (1024)
typedef struct CalibDb_PIris_AttrV2_s {
    uint16_t              TotalStep;
    uint16_t              EffcStep;
    bool                  ZeroIsMax;
    uint16_t              StepTable[AEC_PIRIS_STAP_TABLE_MAX];
} CalibDb_PIris_AttrV2_t;
```

【Member】

Member name	Description
TotalStep	The total number of steps of the P-iris stepper motor, the specific size is related to the P-iris lens.
EffcStep	The number of steps available for the P-iris stepper motor, the specific size is related to the P-iris lens
ZeroIsMax	Whether the P-iris stepper motor step0 corresponds to the maximum aperture position, the specific value is related to the P-iris lens. This value is 0, which means that when the stepper motor position is step0, the aperture is turned to the minimum; The value is 1, which means that when the stepper motor position is step0, the aperture is turned to the maximum.
StepTable	A mapping table of the position of the P-iris stepper motor to the equivalent gain of the aperture, the specific value is related to the P-iris lens

6.7.6.3 CalibDb_DCIris_AttrV2_t

【Description】

DC aperture property.

【Definition】

```
typedef struct CalibDb_DCIris_AttrV2_s {
    float       Kp;
    float       Ki;
    float       Kd;
    int         MinPwmDuty;
    int         MaxPwmDuty;
    int         OpenPwmDuty;
    int         ClosePwmDuty;
} CalibDb_DCIris_AttrV2_t;
```

【Member】

Member name	Description
Kp	A scale factor that limits the switching speed of the aperture drastically changing timecircle, the larger the value, the slower the light aperture changes the timecircle opens and closes. If this value is too large, the adjustment process braking will be ahead, resulting in too long adjustment time; If this value is too small, the braking will lag behind during the adjustment process, resulting in an increase in overshoot. The reasonable setting of this value is related to the DC-iris lens and circuit characteristics. The recommended value is 0.5. The range of values is [0,1].
Ki	The integration coefficient that adjusts the switching speed of the aperture, the larger the aperture, the greater the speed at which the aperture opens and closes. This value is too large, and it is easy to overshoot and cause oscillation; If this value is too small, oscillations tend to occur when the aperture adjustment speed is slower and the ambient brightness changes sharply. The recommended value is 0.2. The range of values is [0,1].
Kd	A differential coefficient that adjusts the switching speed of the aperture, the larger the value, the greater the speed at which the aperture opens and closes. The recommended value is 0.3. The range of values is [0,1].
MinPwmDuty	Minimum PWM duty cycle, the specific size is related to the DC-iris lens and circuit characteristics, in %. The smaller the value, the faster the supported aperture closes, but tends to cause aperture oscillation. The value range is [0,100], and the default value is 0.
MaxPwmDuty	The maximum PWM duty cycle, the specific size is related to the DC-iris lens and circuit characteristics, in %. A higher value opens the supported aperture faster, and too small a value may cause the aperture control to exit before the maximum aperture has been reached. The value range is [0,100], and the default value is 100.
OpenPwmDuty	PWM duty cycle threshold when aperture open, aperture on when aperture PWM duty cycle is higher than (not included) OpenPwmDuty. The specific size is related to the DC-iris lens and is in %.
ClosePwmDuty	PWM duty cycle threshold when aperture is off, aperture off when aperture PWM duty cycle is less than (not included) ClosePwmDuty. The specific size is related to the DC-iris lens and is in %.

【Precautions】

- When the auto iris function is turned off, for DC-iris aperture, it will be turned on to the maximum by default; For the P-iris aperture, the stepper motor position corresponding to the maximum aperture is turned on by default. If you want to change the above aperture position, you can modify InitPIrisGainValue and InitDCIrisDutyValue in the AecInitValue module.
- The basic control flow of the automatic iris Airis algorithm is as follows:

For DC-iris lenses, Airis controls the aperture size of the DC-iris lens based on the deviation of the current brightness from the target brightness. When the exposure reaches the minimum value, and the current brightness exceeds the target brightness tolerance range, the AE control will be exited, and the exposure time and exposure gain will be fixed and enter the AIRIS control range. If the current screen brightness is stable and the PWM duty

of DC-iris is greater than OpenPwmDuty, the current aperture is considered to have reached the maximum, and the Airis aperture control is withdrawn, and the control is handed over to AE.

For P-iris lenses, aperture control is performed via the AecRoute module. The aperture size of the P-iris lens is converted to the equivalent gain and participates in the exposure decomposition calculation.

- P-iris stepper motor position and aperture equivalent gain mapping table StepTable is generally made according to the correspondence between stepper motor position and aperture aperture provided by lens manufacturers. The control of P-iris is controlled by AE's AecRoute module, which converts the aperture aperture size into equivalent gain, so P-iris control needs to have good linearity. The equivalent gain ranges from [1,1024], with an equivalent gain of 1024 for F1.0, an equivalent gain of 512 for F1.4, and so on, an equivalent gain of 1 for F32.0. When making a table, it is necessary to convert the aperture aperture corresponding to the stepper motor position to the equivalent gain, fill it in the StepTable, and fix it to increment according to the stepper motor position (i.e. step0, step1...). stepN).
- TotalStep represents the total number of steps of the P-iris stepper motor, and the specific size is related to the P-iris lens. EffcStep indicates the number of steps available for P-iris stepper motors, which is generally less than TotalStep. Because the position near the closed end of the aperture has a large error in the value corresponding to the equivalent gain, and oscillations are prone to occur during iris adjustment, the step position near the closed end of the aperture is usually not used.
- Table 4-1 is a table corresponding to the position of the P-iris stepper motor to the aperture aperture and equivalent gain, and use this table as an example to illustrate how to set the StepTable. The correspondence between the stepper motor position step and the aperture aperture area in columns 1-2 and 4-5 in Table 4-1 is provided by a lens manufacturer. The P-iris lens has a stepper motor adjustment total of 81 steps, with the largest aperture aperture at step0 and a nominal maximum aperture of 1.4. A number of apertures of 1.4 corresponds to an equivalent gain of 512, so the equivalent gain at step 0 is 512. The equivalent gain corresponding to the other aperture areas, here taking step 3 as an example, is calculated as follows: the aperture area of step 3 is 195.869, and the corresponding equivalent gain = 512* (195.869/201.062)=499(rounded). By analogy, the equivalent gain values corresponding to the positions of other stepper motors can also be calculated from this. It can be seen from Table 1-1 that when the stepper motor position is close to the closed end, the corresponding aperture area is very small, and the difference from the largest aperture area can be thousands of times, and the corresponding equivalent gain value error is large, so it is recommended that the stepper motor position close to the closed end of the aperture should not be used, so as not to cause exposure oscillation due to errors. The equivalent gain corresponding to each stepper motor position in the table is incremented according to the stepper motor position (i.e., step0, step1...). stepN) is filled in the StepTable.
- DC-iris' OpenPwmDuty and ClosePwmDuty values need to be measured and are related to DC-iris lenses. For some lenses, when the PWM duty cycle is greater than OpenPwmDuty, the aperture performs an open operation; When the PWM duty cycle is less than OpenPwmDuty, the aperture performs a closed operation; When the PWM duty cycle is greater than or equal to ClosePwmDuty and less than or equal to OpenPwmDuty, the aperture is stable at the current position, and the values in this interval are HoldValue. In addition, there are some lenses, and there is only a threshold of the aperture switch, that is, when the PWM duty cycle is greater than this threshold, the aperture performs an open operation; When the PWM duty cycle is less than this threshold, the aperture performs a off operation; When the PWM duty cycle is equal to this threshold, the aperture stabilizes at the current position, which is HoldValue. In this case, you can make ClosePwmDuty = OpenPwmDuty = HoldValue.
- The manual mode parameter setting of the aperture is consistent with the manual mode of exposure. When you need to use the manual iris function, set the AecOpType to manual mode and enable the ManualIrisEn parameter in the AecManualCtrl module. When IrisType is P-iris, only PirisGainValue is valid; When IrisType is P-iris, only DCIrisValue is valid.

Table 4-1 P-iris stepper motor position and aperture aperture and equivalent gain correspondence table

Step	Aperture area(mm2)	Equivalent gain	Step	Aperture area(mm2)	Equivalent gain
0	201.062	512	41	56.653	144
1	200.759	511	42	53.438	136
2	198.583	506	43	50.282	128
3	195.869	499	44	47.188	120
4	192.879	491	45	44.159	112
5	189.677	483	46	41.197	105
6	186.293	474	47	38.307	98
7	182.744	465	48	35.49	90
8	179.035	456	49	32.751	83
9	175.271	446	50	30.093	77
10	171.484	437	51	27.519	70
11	167.681	427	52	25.034	64
12	163.865	417	53	22.642	58
13	160.036	408	54	20.347	52
14	156.198	398	55	18.154	46
15	152.351	388	56	16.068	41
16	148.499	378	57	14.096	36
17	144.642	368	58	12.245	31
18	140.783	359	59	10.522	27
19	136.925	349	60	8.935	23
20	133.069	339	61	7.484	19
21	129.217	329	62	6.169	16
22	125.371	319	63	4.987	13
23	121.535	309	64	3.936	10
24	117.709	300	65	3.014	8
25	113.897	290	66	2.22	6
26	110.1	280	67	1.55	4
27	106.321	271	68	1.003	3
28	102.562	261	69	0.577	1

Step	Aperture area(mm2)	Equivalent gain	Step	Aperture area(mm2)	Equivalent gain
29	98.826	252	70	0.268	1
30	95.115	242	71	0.075	0
31	91.431	233	72	close	0
32	87.777	224	73	close	0
33	84.156	214	74	close	0
34	80.569	205	75	close	0
35	77.02	196	76	close	0
36	73.51	187	77	close	0
37	70.043	178	78	close	0
38	66.621	170	79	close	0
39	63.247	161	80	close	0
40	59.923	153			

6.7.7 Uapi_ExpWin_t

【Description】

Define AE Statistics Window Properties parameters.

【Definition】

```
typedef struct window {
    uint16_t h_offs;
    uint16_t v_offs;
    uint16_t h_size;
    uint16_t v_size;
} window_t;

typedef struct Uapi_ExpWin_s {
  rk_aiq_uapi_sync_t            sync;
  window                        Params;
} Uapi_ExpWin_t;
```

【Member】

Member Name	Description
h_offs	The horizontal offset value of the upper left corner of the window relative to the coordinate origin, where the coordinate origin refers to the upper left corner of the sensor's photosensitive area
v_offs	The vertical offset value of the upper left corner of the window relative to the coordinate origin, where the coordinate origin refers to the upper left corner of the sensor sensitive area
h_size	Window horizontal dimensions
v_size	Window vertical dimension

6.7.8 Uapi_ExpQueryInfo_t

【Description】

Define AE exposure parameter queries.

【Definition】

```
typedef struct Uapi_ExpQueryInfo_s {
    bool              IsConverged;
    bool              IsExpMax;
    float             LumaDeviation;
    float             HdrLumaDeviation[3];

    float             MeanLuma;
    float             HdrMeanLuma[3];

    float             GlobalEnvLux;
    float             BlockEnvLux[ISP2_RAWAE_WINNUM_MAX];

    RKAiqAecExpInfo_t CurExpInfo;
    unsigned short    Piris;
    float             LinePeriodsPerField;
    float             PixelPeriodsPerLine;
    float             PixelClockFreqMHZ;

} Uapi_ExpQueryInfo_t;
```

【Member】

Member Name	Description
IsConverged	Whether the auto exposure converges
IsExpMax	Whether ISP exposure is at maximum
LumaDeviation	In linear mode, the difference between the target value of the AEC and the actual brightness of the image, a positive value indicates that the actual brightness is greater than the target brightness, a negative value indicates that the actual brightness is less than the target brightness, and a value of 0 indicates that the actual brightness of the target value is within the tolerance range of the target value
HdrLumaDeviation	In HDR mode, the difference between the target brightness of each frame and the actual brightness of each frame is positive, indicating that the actual brightness is greater than the target brightness, a negative value indicates that the actual brightness is less than the target brightness, and a value of 0 indicates that the actual brightness is within the tolerance range of the target value. In 2-frame mode, only 0 and 1 are valid for short and long frames, respectively, and in 3-frame mode, 0-2 are valid for short, medium, and long frames, respectively.
MeanLuma	In linear mode, the average brightness of the current picture
HdrMeanLuma	In HDR mode, the average brightness of the current frame in each frame. In the 2-frame mode, only members 0 and 1 of the array are valid, indicating short and long frames, respectively, and in 3-frame mode, all members of the array are valid, representing short, medium, and long frames, respectively
CurExpInfo	The current exposure parameters, including sensor exposure time and sensor exposure gain value. According to the exposure mode, it is divided into two sets of exposure parameters: LinearExp and HdrExp[3].
Piris	Aperture
LinePeriodsPerField	sensor VTS
PixelPeriodsPerLine	sensor HTS
PixelClockFreqMHZ	Sensor's pixel clock frequency (in megahertz)

6.8 Common problem location and debug method

If problems such as screen brightness flicker, overshoot, or brightness not meeting expectations occur, it is recommended to capture the AE LOG of the problematic scene for analysis, which can help quickly locate the problem and improve work efficiency.

6.8.1 Exposure statistics synchronous test function

Before calibrating the ISP module, the driver or tuning personnel need to fill in the SensorInfo parameter in the debugging IQ XML. This module involves the setting of exposure parameters, such as incorrect settings may cause exposure errors, flickering and other phenomena. It is recommended that after configuring the sensorinfo parameter, enable the SyncTest function for self-testing. SensorInfo parameter meaning description refer to Rockchip_Tuning_Guide_ISP30.

The SyncTest function can test whether the exposure time and exposure gain of the sensor, and the effective frame number of DCG switching are correct by cyclically setting N groups of different exposure values, and can also be used to test the linearity of the exposure, so as to confirm whether the register value conversion formula and related parameters of the exposure time and exposure gain are correct.

The SyncTest function parameters are described as follows:

【Description】

The synchronous test function of exposure and statistics supports cyclic setting of N groups of different exposure values according to the number of frames at a given interval, which is used to debug and verify whether the effective frame number of exposure components (exposure time, exposure gain) and sensor exposure parameter settings are correct.

【Member】

Member name	Description
Enable	Enables the simultaneous testing of exposure and statistics
IntervalFrm	Number of frames between exposure switching
AlterExp	Exposure switching parameters

- AlterExp

According to the different modes, it is divided into two sets of parameters: LinearAE and HdrAE.

Member name	Description
TimeValue	Exposure time value
GainValue	Exposure gain value
IspDgainValue	ISP digital gain value
DcgMode	DCG mode value
PIrisGainValue	P-iris equivalent gain

If the parameters are set correctly, the following example is used for LOG (only the key information in LOG is intercepted). The red frame shows the exposure switching position, the visible brightness has not changed and matches the exposure value, there is no delay or advance linearity, at this time, it can be basically judged that the sensorinfo parameter is set correctly.

```
>>> Framenum=116 Cur gain=5.988304,time=0.019991,Meanluma=44.751110,piris=0
>>> Framenum=117 Cur gain=5.988304,time=0.019991,Meanluma=44.755554,piris=0
>>> Framenum=118 Cur gain=5.988304,time=0.019991,Meanluma=44.755554,piris=0
>>> Framenum=119 Cur gain=5.988304,time=0.019991,Meanluma=44.764446,piris=0
>>> Framenum=120 Cur gain=5.988304,time=0.019991,Meanluma=44.755554,piris=0
>>> Framenum=121 Cur gain=5.988304,time=0.019991,Meanluma=44.755554,piris=0
>>> Framenum=122 Cur gain=5.988304,time=0.019991,Meanluma=44.768890,piris=0
>>> Framenum=123 Cur gain=5.988304,time=0.019991,Meanluma=44.782223,piris=0
>>> Framenum=124 Cur gain=1.000000,time=0.019991,Meanluma=24.568890,piris=0
>>> Framenum=125 Cur gain=1.000000,time=0.019991,Meanluma=24.484444,piris=0
>>> Framenum=126 Cur gain=1.000000,time=0.019991,Meanluma=24.484444,piris=0
>>> Framenum=127 Cur gain=1.000000,time=0.019991,Meanluma=24.484444,piris=0
>>> Framenum=128 Cur gain=1.000000,time=0.019991,Meanluma=24.480000,piris=0
>>> Framenum=129 Cur gain=1.000000,time=0.019991,Meanluma=24.480000,piris=0
>>> Framenum=130 Cur gain=1.000000,time=0.019991,Meanluma=24.471111,piris=0
>>> Framenum=131 Cur gain=1.000000,time=0.019991,Meanluma=24.475555,piris=0
```

6.8.2 Flickering occurs when exposure changes

There are several reasons why flicker can occur when exposure changes:

(1) The frame number of the gain and time effective moments in the CISExpUpdate module is wrong. Examples of common LOGS are as follows (only key LOG lines per frame are intercepted):

```
Cur gain=1.937500,time=0.010015,RawMeanluma=24.622223,YuvMeanluma=34.124443,IsConverged=0
Cur gain=1.937500,time=0.010015,RawMeanluma=37.795555,YuvMeanluma=54.217777,IsConverged=0
Cur gain=1.937500,time=0.010015,RawMeanluma=37.257778,YuvMeanluma=52.435555,IsConverged=0
Cur gain=1.328125,time=0.020000,RawMeanluma=37.288887,YuvMeanluma=52.480000,IsConverged=0
Cur gain=1.390625,time=0.020000,RawMeanluma=60.342224,YuvMeanluma=82.528893,IsConverged=0
Cur gain=1.453125,time=0.020000,RawMeanluma=46.471111,YuvMeanluma=63.831112,IsConverged=0
Cur gain=1.000000,time=0.030015,RawMeanluma=48.048889,YuvMeanluma=66.195557,IsConverged=0
Cur gain=1.187500,time=0.020000,RawMeanluma=65.511108,YuvMeanluma=87.622223,IsConverged=0
Cur gain=1.125000,time=0.020000,RawMeanluma=38.071110,YuvMeanluma=53.022221,IsConverged=0
Cur gain=1.062500,time=0.020000,RawMeanluma=42.928890,YuvMeanluma=60.355556,IsConverged=0
Cur gain=1.640625,time=0.010015,RawMeanluma=41.328888,YuvMeanluma=57.666668,IsConverged=0
Cur gain=1.593750,time=0.010015,RawMeanluma=25.453333,YuvMeanluma=35.293335,IsConverged=0
Cur gain=1.562500,time=0.010015,RawMeanluma=33.360001,YuvMeanluma=47.897778,IsConverged=0
Cur gain=1.531250,time=0.010015,RawMeanluma=32.595554,YuvMeanluma=46.084446,IsConverged=0
```

The red frame is marked with the brightness error position, and it can be seen that as the exposure increases or decreases, the corresponding brightness is opposite to the exposure change trend. By observation, it can be seen that the sudden change in luminance occurs in the second frame after both the exposure time and exposure gain change. The change trend of brightness is consistent with the trend of exposure time, so it can be judged that the effective frame number of gain and time is wrong, and the change of exposure time and exposure gain does not take effect at the same time, resulting in a mismatch between brightness and exposure. You can solve this problem by modifying the number of frames in gain and time. The above problems can be reproduced using AE's syncTest

function, setting two sets of exposures (different exposure gain and exposure time), and making them switch back and forth to see if the LOG can know if it is reproduced.

(2) The brightness oscillation back and forth caused by driving errors cannot converge, often occurs in highlight scenes, common LOG examples are as follows (only intercept the key LOG line of each frame)

```
Framenum=3378 Cur Piris=128, Sgain=1.188502,Stime=0.000044,m
Framenum=3379 Cur Piris=128, Sgain=1.148154,Stime=0.000044,m
Framenum=3380 Cur Piris=128, Sgain=1.148154,Stime=0.000044,m
Framenum=3381 Cur Piris=128, Sgain=1.230269,Stime=0.000044,m
 Framenum=3382 Cur Piris=128, Sgain=1.000000,Stime=0.000059,
 Framenum=3383 Cur Piris=128, Sgain=1.035142,Stime=0.000059,
 Framenum=3384 Cur Piris=128, Sgain=1.035142,Stime=0.000059,
 Framenum=3385 Cur Piris=128, Sgain=1.071519,Stime=0.000059,
 Framenum=3386 Cur Piris=128, Sgain=1.273503,Stime=0.000044,
 Framenum=3387 Cur Piris=128, Sgain=1.188502,Stime=0.000044,
 Framenum=3388 Cur Piris=128, Sgain=1.148154,Stime=0.000044,
 Framenum=3389 Cur Piris=128, Sgain=1.148154,Stime=0.000044,
 Framenum=3390 Cur Piris=128, Sgain=1.230269,Stime=0.000044,
 Framenum=3391 Cur Piris=128, Sgain=1.000000,Stime=0.000059,
Framenum=3392 Cur Piris=128, Sgain=1.000000,Stime=0.000059,m
Framenum=3393 Cur Piris=128, Sgain=1.000000,Stime=0.000059,m
 Framenum=3394 Cur Piris=128, Sgain=1.035142,Stime=0.000059,
 Framenum=3395 Cur Piris=128, Sgain=1.273503,Stime=0.000044,
 Framenum=3396 Cur Piris=128, Sgain=1.188502,Stime=0.000044,
 Framenum=3397 Cur Piris=128, Sgain=1.148154,Stime=0.000044,
 Framenum=3398 Cur Piris=128, Sgain=1.148154,Stime=0.000044,
 Framenum=3399 Cur Piris=128, Sgain=1.230269,Stime=0.000044,
```

As shown in the figure, it can be observed that the exposure oscillates back and forth between 59ms and 44ms, and looking at the corresponding brightness average of 59ms and 44ms, it will be found that the ratio of brightness and the ratio of exposure of the two has a large gap, and there is a problem with linearity. The first step requires the sensor's drive detection, where the exposure register value is printed to see if the register value is consistent with the exposure in the log. The above problem can be reproduced using AE's syncTest function, setting multiple sets of exposures (including the one in question), making them switch back and forth to see if the brightness change corresponding to each frame of exposure in LOG is linear.

```
rk_aiq_ae_algo.cpp:6405: ================================ HDR-AE (enter)================================
rk_aiq_ae_algo.cpp:6425: AecRun: SMeanLuma=25.166803, MMeanLuma=85.886871,LMeanLuma=0.000000,TmoMeanluma=35.152767,Isconverge
rk_aiq_ae_algo.cpp:6434: >>> Framenum=3385 Cur Piris=128, Sgain=1.071519,Stime=0.000059,mgain=1.071519,mtime=0.000207,lgain=0.
rk_aiq_ae_algo.cpp:3564: S-HighLightLuma=72.000000,S-Target=100.000000,S-GlobalLuma=25.166803,S-Target=19.998999
rk_aiq_ae_algo.cpp:3909: L-LowLightLuma=56.696957,L-Target=49.991318,L-GlobalLuma=85.886871,L-Target=79.985535
rk_aiq_ae_algo.cpp:5385: AecHdrClmExecute: sgain=1.000000,stime=0.000051,mgain=1.000000,mtime=0.000220,lgain=0.000000,ltime=0.
rk_aiq_ae_algo.cpp:6555: calc result:piris=128,sgain=1.148154,stime=0.000044,mgain=1.071519,mtime=0.000207,lgain=0.000000,ltir
rk_aiq_ae_algo.cpp:6559: ================================ (exit)================================

rk_aiq_algo_ae_itf.cpp:256: Cur-Exp: FrmId=3386,S-gain=0x7,S-time=0xc,M-gain=0x2,M-time=0x38,L-gain=0x0,L-time=0x0,envChange=1
rk_aiq_algo_ae_itf.cpp:264: Last-Res:FrmId=3385,S-gain=0x4,S-time=0xc,M-gain=0x2,M-time=0x38,L-gain=0x0,L-time=0x0

rk_aiq_ae_algo.cpp:6405: ================================ HDR-AE (enter)================================
rk_aiq_ae_algo.cpp:6425: AecRun: SMeanLuma=15.018992, MMeanLuma=85.981834,LMeanLuma=0.000000,TmoMeanluma=31.430223,Isconverge
rk_aiq_ae_algo.cpp:6434: >>> Framenum=3386 Cur Piris=128, Sgain=1.273503,Stime=0.000044,mgain=1.071519,mtime=0.000207,lgain=0.
rk_aiq_ae_algo.cpp:3564: S-HighLightLuma=43.000000,S-Target=100.000000,S-GlobalLuma=15.018992,S-Target=19.999107
rk_aiq_ae_algo.cpp:3909: L-LowLightLuma=56.738033,L-Target=49.991318,L-GlobalLuma=85.981834,L-Target=79.985535
rk_aiq_ae_algo.cpp:5385: AecHdrClmExecute: sgain=1.000000,stime=0.000057,mgain=1.000000,mtime=0.000220,lgain=0.000000,ltime=0.
rk_aiq_ae_algo.cpp:6555: calc result:piris=128,sgain=1.273503,stime=0.000044,mgain=1.071519,mtime=0.000207,lgain=0.000000,ltir
rk_aiq_ae_algo.cpp:6559: ================================ (exit)================================
```

(3) Flickering caused by AE subsequent modules, common LOG examples are as follows (only intercept the key LOG lines of each frame):

```
AecRun: SMeanLuma=12.698849, MMeanLuma=240.257675,LMeanLuma=0.000000,TmoMeanluma=104.390663,Isconverged=0,Longfrm=0
AecRun: SMeanLuma=12.944373, MMeanLuma=244.828003,LMeanLuma=0.000000,TmoMeanluma=104.161766,Isconverged=0,Longfrm=0
AecRun: SMeanLuma=12.950768, MMeanLuma=245.728897,LMeanLuma=0.000000,TmoMeanluma=102.967392,Isconverged=0,Longfrm=0
AecRun: SMeanLuma=10.402813, MMeanLuma=222.482101,LMeanLuma=0.000000,TmoMeanluma=79.687981,Isconverged=0,Longfrm=0
AecRun: SMeanLuma=8.134911, MMeanLuma=159.046036,LMeanLuma=0.000000,TmoMeanluma=60.763428,Isconverged=0,Longfrm=0
AecRun: SMeanLuma=6.737852, MMeanLuma=127.505112,LMeanLuma=0.000000,TmoMeanluma=54.783249,Isconverged=0,Longfrm=0
AecRun: SMeanLuma=6.527493, MMeanLuma=123.283249,LMeanLuma=0.000000,TmoMeanluma=54.739769,Isconverged=0,Longfrm=0
AecRun: SMeanLuma=6.310742, MMeanLuma=119.683502,LMeanLuma=0.000000,TmoMeanluma=63.102303,Isconverged=0,Longfrm=0
AecRun: SMeanLuma=5.210998, MMeanLuma=95.413681,LMeanLuma=0.000000,TmoMeanluma=53.315216,Isconverged=0,Longfrm=0
AecRun: SMeanLuma=5.067775, MMeanLuma=86.629799,LMeanLuma=0.000000,TmoMeanluma=49.849743,Isconverged=0,Longfrm=0
AecRun: SMeanLuma=4.646420, MMeanLuma=78.632355,LMeanLuma=0.000000,TmoMeanluma=46.617645,Isconverged=0,Longfrm=0
AecRun: SMeanLuma=4.376598, MMeanLuma=76.865089,LMeanLuma=0.000000,TmoMeanluma=45.372761,Isconverged=0,Longfrm=0
AecRun: SMeanLuma=4.205883, MMeanLuma=74.497444,LMeanLuma=0.000000,TmoMeanluma=43.842072,Isconverged=0,Longfrm=0
AecRun: SMeanLuma=3.946291, MMeanLuma=74.496162,LMeanLuma=0.000000,TmoMeanluma=43.543480,Isconverged=0,Longfrm=0
AecRun: SMeanLuma=3.789642, MMeanLuma=74.514069,LMeanLuma=0.000000,TmoMeanluma=43.231457,Isconverged=0,Longfrm=0
```

From LOG, it can be seen that during the decline of SMeanLuma and MMeanLuma on the left, the brightness of the output of the TmoMeanluma module has changed, and when this happens, it is necessary to debug the TMO module.

7. AWB

7.1 Overview

The function of the AWB module is to uniformly compensate for the color deviation caused by the color temperature environment and the deviation of the inherent color channel gain of the shooting equipment by changing the gain of the color channel of the shooting equipment, so that the obtained image can correctly reflect the true color of the object.

7.2 Important concepts

- Color temperature: The color temperature is defined by the absolute black body, and when the radiation of the light source is exactly the same as the radiation of the absolute black body in the visible area, the temperature of the black body is called the color temperature of the light source.
- White balance: Under light sources with different color temperatures, the response of white in the sensor will be bluish or reddish. The white balance algorithm adjusts the intensity of the three color channels R, G, and B to make white appear realistically.

7.3 Description of the feature

The AWB module consists of two parts: WB information statistics and AWB policy control algorithm.

7.4 Feature-level API reference

7.4.1 rk_aiq_uapi2_setWBMode

【Description】

Set the white balance operating mode.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setWBMode(const rk_aiq_sys_ctx_t* ctx, opMode_t mode);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
mode	White balance operating mode	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Note】

- If set to manual mode, the white balance gain value is controlled by the current manual white balance parameter. If you need to switch manual mode while setting a specific gain value, you can use the rk_aiq_uapi2_setMWBGain interface.

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

【Example】

- Reference sample_awb_module.cpp

7.4.2 rk_aiq_uapi2_getWBMode

【Description】

Gets the white balance operating mode.

【Grammar】

```
XCamReturn rk_aiq_uapi2_getWBMode(const rk_aiq_sys_ctx_t* ctx, opMode_t *mode);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
mode	White balance operating mode	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

【Example】

- Reference sample_awb_module.cpp

7.4.3 rk_aiq_uapi2_lockAWB

【Description】

Locks the current white balance parameters.

【Grammar】

```
XCamReturn rk_aiq_uapi2_lockAWB(const rk_aiq_sys_ctx_t* ctx);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

【Example】

- Reference sample_awb_module.cpp

7.4.4 rk_aiq_uapi2_unlockAWB

【Description】

Unlock locked white balance parameters.

【Grammar】

```
XCamReturn rk_aiq_uapi2_unlockAWB(const rk_aiq_sys_ctx_t* ctx);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

【Example】

- Reference sample_awb_module.cpp

7.4.5 rk_aiq_uapi2_setMWBScene

【Description】

Set the white balance scene.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setMWBScene(const rk_aiq_sys_ctx_t* ctx,
rk_aiq_wb_scene_t scene);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
scene	White balance scene	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

【Example】

- Reference sample_awb_module.cpp

7.4.6 rk_aiq_uapi2_getMWBScene

【Description】

Get the white balance scene.

【Grammar】

```
XCamReturn rk_aiq_uapi2_getMWBScene(const rk_aiq_sys_ctx_t* ctx,
rk_aiq_wb_scene_t *scene);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
scene	White balance scene	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

【Example】

- Reference sample_awb_module.cpp

7.4.7 rk_aiq_uapi2_setMWBGain

【Description】

Set the manual white balance gain factor.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setMWBGain(const rk_aiq_sys_ctx_t* ctx, rk_aiq_wb_gain_t
*gain);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
gain	White balance gain factor	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

【Example】

- Reference sample_awb_module.cpp

7.4.8 rk_aiq_uapi2_getWBGain

【Description】

Gets the white balance gain factor. This function is used for both manual and auto white balance

【Grammar】

```
XCamReturn rk_aiq_uapi2_getWBGain(const rk_aiq_sys_ctx_t* ctx, rk_aiq_wb_gain_t
*gain);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
gain	White balance gain factor	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

【Example】

- Reference sample_awb_module.cpp

7.4.9 rk_aiq_uapi2_setMWBCT

【Description】

Set the manual white balance color temperature parameter.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setMWBCT(const rk_aiq_sys_ctx_t* ctx, unsigned int ct);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
ct	White balance color temperature parameters	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

【Example】

- Reference sample_awb_module.cpp

7.4.10 rk_aiq_uapi2_getWBCT

【Description】

Get the white balance color temperature. This function is used both automatically and manually

【Grammar】

```
XCamReturn rk_aiq_uapi2_getWBCT(const rk_aiq_sys_ctx_t* ctx, unsigned int *ct);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
ct	White balance color temperature	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

【Example】

- Reference sample_awb_module.cpp

7.4.11 rk_aiq_uapi2_setAwbGainOffsetAttrib

【Description】

Sets the offset of the auto white balance gain.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setAwbGainOffsetAttrib(const rk_aiq_sys_ctx_t* ctx,
rk_aiq_uapiV2_wb_awb_wbGainOffset_t attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	wbgain offset parameter	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

【Example】

- Reference sample_awb_module.cpp

7.4.12 rk_aiq_uapi2_getAwbGainOffsetAttrib

【Description】

Gets the offset of the auto white balance gain

【Grammar】

```
XCamReturn rk_aiq_uapi2_getAwbGainOffsetAttrib(const rk_aiq_sys_ctx_t* ctx,
CalibDbV2_Awb_gain_offset_cfg_t *attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	wbgain offset parameter	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

【Example】

- Reference sample_awb_module.cpp

7.4.13 rk_aiq_uapi2_setAwbGainAdjustAttrib

【Description】

Sets the tone adjustment parameters in auto white balance mode.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setAwbGainAdjustAttrib(const rk_aiq_sys_ctx_t* ctx,
rk_aiq_uapiV2_wb_awb_wbGainAdjust_t attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	White balance tone adjustment parameters	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

【Example】

- Reference sample_awb_module.cpp

7.4.14 rk_aiq_uapi2_getAwbGainAdjustAttrib

【Description】
Gets the tone adjustment parameters in auto white balance mode.

【Grammar】

```
XCamReturn rk_aiq_uapi2_getAwbGainAdjustAttrib(const rk_aiq_sys_ctx_t* ctx,
rk_aiq_uapiV2_wb_awb_wbGainAdjust_t *attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	White balance tone adjustment parameters	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

【Example】

- Reference sample_awb_module.cpp

7.4.15 rk_aiq_uapi2_setAwbV30AllAttrib

【Description】

Set all parameters supported by the White Balance API.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setAwbV30AllAttrib(const rk_aiq_sys_ctx_t* ctx,
rk_aiq_uapiV2_wbV30_attrib_t attr);
```

【Parameter】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	input
attr	All parameters supported by the White Balance API.	input

【Return value】

Return value	Description
0	succeed
Non-0	Failed, see the error code table for details

【Demand】

- Header files:rk_aiq_user_api2_imgproc.h
- Library files:librkaiq.so

【Example】

- Refer to sample_awb_module.cpp

7.4.16 rk_aiq_uapi2_getAwbV30AllAttrib

【Description】

Get all the parameters supported by the White Balance API.

【Grammar】

```
XCamReturn rk_aiq_uapi2_getAwbV30AllAttrib(const rk_aiq_sys_ctx_t* ctx,
rk_aiq_uapiV2_wbV30_attrib_t *attr);
```

【Parameter】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	input
attr	wbgain offset parameter	output

【Return value】

Return value	Description
0	succeed
Non-0	Failed, see the error code table for details

【Demand】

- Header files:rk_aiq_user_api2_imgproc.h
- Library files:librkaiq.so

【Example】

- Refer to sample_awb_module.cpp

7.5 Functional-level API data types

7.5.1 rk_aiq_wb_op_mode_t

【Description】
Defines the white balance operating mode

【Definition】

```
typedef enum rk_aiq_wb_op_mode_s {
    RK_AIQ_WB_MODE_INVALID        = 0,
    RK_AIQ_WB_MODE_MANUAL         = 1,
    RK_AIQ_WB_MODE_AUTO           = 2,
    RK_AIQ_WB_MODE_MAX
} rk_aiq_wb_op_mode_t;
```

【Member】

Member Name	Description
RK_AIQ_WB_MODE_MANUAL	White balance manual mode
RK_AIQ_WB_MODE_AUTO	White balance auto mode

7.5.2 rk_aiq_wb_mwb_mode_t

【Description】
Defines the manual white balance mode type

【Definition】

```
typedef enum rk_aiq_wb_mwb_mode_e {
    RK_AIQ_MWB_MODE_INVAILD             = 0,
    RK_AIQ_MWB_MODE_CCT                 = 1,
    RK_AIQ_MWB_MODE_WBGAIN              = 2,
    RK_AIQ_MWB_MODE_SCENE               = 3,
} rk_aiq_wb_mwb_mode_t;
```

【Member】

Member Name	Description
RK_AIQ_MWB_MODE_CCT	Color temperature
RK_AIQ_MWB_MODE_WBGAIN	Gain factor
RK_AIQ_MWB_MODE_SCENE	Scenario

7.5.3 rk_aiq_wb_gain_t

【Description】

Define the white balance gain parameters

【Definition】

```
typedef struct rk_aiq_wb_gain_s {
    float rgain;
    float grgain;
    float gbgain;
    float bgain;
} rk_aiq_wb_gain_t;
```

【Member】

Member Name	Description
rgain	R channel gain
grgain	G-channel gain
gbgain	GB channel gain
bgain	B-channel gain

7.5.4 rk_aiq_wb_scene_t

【Description】

Define the white balance gain parameters

【Definition】

```
typedef enum rk_aiq_wb_scene_e {
    RK_AIQ_WBCT_INCANDESCENT = 0,
    RK_AIQ_WBCT_FLUORESCENT,
    RK_AIQ_WBCT_WARM_FLUORESCENT,
    RK_AIQ_WBCT_DAYLIGHT,
    RK_AIQ_WBCT_CLOUDY_DAYLIGHT,
    RK_AIQ_WBCT_TWILIGHT,
    RK_AIQ_WBCT_SHADE
} rk_aiq_wb_scene_t;
```

【Member】

Member Name	Description
RK_AIQ_WBCT_INCANDESCENT	Incandescent lamp
RK_AIQ_WBCT_FLUORESCENT	Fluorescent lamps
RK_AIQ_WBCT_WARM_FLUORESCENT	Warm fluorescent lamp
RK_AIQ_WBCT_DAYLIGHT	Daylight
RK_AIQ_WBCT_CLOUDY_DAYLIGHT	Cloudy
RK_AIQ_WBCT_TWILIGHT	Twilight
RK_AIQ_WBCT_SHADE	Shadow

7.5.5 rk_aiq_wb_cct_t

【Description】

Define the white balance gain parameters

【Definition】

```
typedef struct rk_aiq_wb_cct_s {
    float CCT;
    float CCRI;
} rk_aiq_wb_cct_t;
```

【Member】

Member Name	Description
CCT	Correlated color temperature
CCRI	Correlation color rendering index

7.5.6 rk_aiq_wb_mwb_attrib_t

【Description】

Define manual white balance properties

【Definition】

```
typedef struct rk_aiq_wb_mwb_attrib_s {
    rk_aiq_wb_mwb_mode_t mode;
    union MWBPara_u {
        rk_aiq_wb_gain_t gain;
        rk_aiq_wb_scene_t scene;
        rk_aiq_wb_cct_t cct;
    } para;
} rk_aiq_wb_mwb_attrib_t;
```

【Member】

Member Name	Description
mode	Mode selection

7.5.7 rk_aiq_uapiV2_wb_awb_wbGainOffset_t

【Description】

Define the auto white balance gain offset

【Definition】

```
typedef struct rk_aiq_uapiV2_wb_awb_wbGainOffset_s{
  rk_aiq_uapi_sync_t sync;
  CalibDbV2_Awb_gain_offset_cfg_t gainOffset;
}rk_aiq_uapiV2_wb_awb_wbGainOffset_t;
```

【Member】

Member name	Description
sync	Refer to rk_aiq_uapi_sync_t definition in the **Overview/API Description** section
gainOffset	See Description CalibDbV2_Awb_gain_offset_cfg_t Later

7.5.8 CalibDbV2_Awb_gain_offset_cfg_t

【Description】

Define the auto white balance gain offset

【Definition】

```
typedef struct CalibDbV2_Awb_gain_offset_cfg_s{
  bool enable;
  float offset[4];
}CalibDbV2_Awb_gain_offset_cfg_t;
```

【Member】

Member name	Description
enable	The enable switch takes a value of 0 or 1, which means no enable and enable
offset	wbgain and offset are added, and the offset range corresponding to R GR GB B channel is determined by the addition of wbgain and offset, and the range after adding wbgain and offset is in the range of [0,8] (ISP21)

7.5.9 rk_aiq_uapiV2_wb_awb_wbGainAdjust_t

【Description】

Define automatic white balance tonal adjustment parameters

【Definition】

```
typedef struct rk_aiq_uapiV2_wb_awb_wbGainAdjustLut_s {
  float lumaValue;
  int ct_grid_num;
  int cri_grid_num;
  float ct_in_range[2];//min,max, equal distance sapmle
  float cri_in_range[2];//min,max
  float *ct_lut_out;//size is ct_grid_num*cri_grid_num
  float *cri_lut_out;
} rk_aiq_uapiV2_wb_awb_wbGainAdjustLut_t;

typedef struct rk_aiq_uapiV2_wb_awb_wbGainAdjust_s {
  rk_aiq_uapi_sync_t sync;
  bool enable;
  rk_aiq_uapiV2_wb_awb_wbGainAdjustLut_t *lutAll;
  int lutAll_len;
} rk_aiq_uapiV2_wb_awb_wbGainAdjust_t;
```

【Member】

Member name	Description
sync	Refer to rk_aiq_uapi_sync_t definition in the **Overview/API Description** section
enable	The value of tone adjustment enabled is 0 or 1, which means not enabled and enabled
lutAll	Different ambient brightness can be configured with different output color temperature tables
lutAll_len	Specify the number of temperature tables
lutAll.ct_grid_num	The number of sampling points for the color temperature input into the color temperature table is unlimited
lutAll.ct_in_range	The range of color temperature entered into the color temperature table is not limited
lutAll.cri_grid_num	The number of sampling points for the color rendering index of the input color temperature table is not limited
lutAll.cri_in_range	The range of the color rendering index of the input color temperature table is not limited
lutAll.ct_out	As shown in the tool interface diagram, the ct value of each dot is from left to right (hue from cold to warm), that is, the value range of **CT from small to large** is 0-255000
lutAll.cri_out	As shown in the tool interface diagram, the cri of each dot is from bottom to top (hue from purple to green), that is, the CRI from negative number to positive number ** The range of values is not limited

For more instructions, refer to the WBGain color adjustment chapter in the Rockchip_Color_Optimization_Guide documentation

7.5.10 rk_aiq_uapiV2_wbV30_awb_attrib_t

【Description】

Define auto white balance API parameters

【Definition】

```
typedef struct rk_aiq_uapiV2_wbV30_awb_attrib_s {
    rk_aiq_uapiV2_wb_awb_wbGainAdjust_t wbGainAdjust;
    CalibDbV2_Awb_gain_offset_cfg_t wbGainOffset;
} rk_aiq_uapiV2_wbV30_awb_attrib_t;
```

【Member】

Member name	Description
wbGainAdjust	Refer to the CalibDbV2_Awb_gain_offset_cfg_t
wbGainOffset	Refer to the rk_aiq_uapiV2_wb_awb_wbGainAdjust_t
multiWindow	Refer to the rk_aiq_uapiV2_wbV32_awb_mulWindow_t

7.5.11 rk_aiq_uapiV2_wbV32_attrib_t

【Description】

Define all parameters supported by the White Balance API.

【Definition】

```
typedef struct rk_aiq_uapiV2_wbV30_attrib_s {
    rk_aiq_uapi_sync_t sync;
    bool byPass;
    rk_aiq_wb_op_mode_t mode;
    rk_aiq_wb_mwb_attrib_t stManual;
    rk_aiq_uapiV2_wbV30_awb_attrib_t stAuto;
} rk_aiq_uapiV2_wbV30_attrib_t;
```

【Member】

Member name	Description
sync	For rk_aiq_uapi_sync_t description, see **Overview/API Description】 section
bypass	The value 0 or 1 0 means to do white balance correction, and the white balance gain used is controlled by the parameter control at the end of the table , 1 means that no white balance correction is performed
mode	For automatic or manual white balance mode control parameters, refer to rk_aiq_wb_op_mode_t
stManual	For manual white balance parameters, refer to rk_aiq_wb_mwb_attrib_t
stAuto	For auto white balance parameters, refer to rk_aiq_uapiV2_wbV21_awb_attrib_t

7.6 Module-level API reference

7.6.1 rk_aiq_user_api2_awbV30_SetAllAttrib

【Description】

Set all parameters supported by the White Balance API.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_awbV30_SetAllAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_uapiV2_wbV30_attrib_t attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	All parameters supported by the White Balance API	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_awb.h, rk_aiq_uapi2_awb_int.h
- Library file: librkaiq.so

【Example】

- Reference sample_awb_module.cpp

7.6.2 rk_aiq_user_api2_awbV30_GetAllAttrib

【Description】

Get all parameters supported by the White Balance API.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_awbV30_GetAllAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_uapiV2_wbV30_attrib_t *attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	All parameters supported by the White Balance API	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_awb.h, rk_aiq_uapi2_awb_int.h
- Library file: librkaiq.so

【Example】

- Reference sample_awb_module.cpp

7.6.3 rk_aiq_user_api2_awb_GetCCT

【Description】

Get the white balance color temperature. This function is used both automatically and manually

【Grammar】

```
XCamReturn
rk_aiq_user_api2_awb_GetCCT(const rk_aiq_sys_ctx_t* sys_ctx, rk_aiq_wb_cct_t
*cct);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
cct	Color temperature parameters for white balance	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_awb.h, rk_aiq_uapi2_awb_int.h
- Library file: librkaiq.so

【Example】

- Reference sample_awb_module.cpp

7.6.4 rk_aiq_user_api2_awb_QueryWBInfo

【Description】

Get the white balance gain factor, color temperature.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_awb_QueryWBInfo(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_wb_querry_info_t *wb_querry_info);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
wb_querry_info	Color-dependent status parameters	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_awb.h, rk_aiq_uapi2_awb_int.h
- Library file: librkaiq.so

【Example】

- Reference sample_awb_module.cpp

7.6.5 rk_aiq_user_api2_awb_Lock

【Description】

Locks the current white balance parameters.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_awb_Lock(const rk_aiq_sys_ctx_t* sys_ctx);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_awb.h, rk_aiq_uapi2_awb_int.h
- Library file: librkaiq.so

【Example】

- Reference sample_awb_module.cpp

7.6.6 rk_aiq_user_api2_awb_Unlock

【Description】

Unlock locked white balance parameters.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_awb_Lock(const rk_aiq_sys_ctx_t* sys_ctx);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_awb.h, rk_aiq_uapi2_awb_int.h
- Library file: librkaiq.so

【Example】

- Reference sample_awb_module.cpp

7.6.7 rk_aiq_user_api2_awb_SetWpModeAttrib

【Description】

Set the white balance operating mode.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_awb_SetWpModeAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_uapiV2_wb_opMode_t attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	White balance operating mode	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_awb.h, rk_aiq_uapi2_awb_int.h
- Library file: librkaiq.so

【Example】

- Reference sample_awb_module.cpp

7.6.8 rk_aiq_user_api2_awb_GetWpModeAttrib

【Description】

Gets the white balance operating mode.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_awb_GetWpModeAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_uapiV2_wb_opMode_t *attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	White balance operating mode	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_awb.h, rk_aiq_uapi2_awb_int.h
- Library file: librkaiq.so

【Example】

- Reference sample_awb_module.cpp

7.6.9 rk_aiq_user_api2_awb_SetMwbAttrib

【Description】

Set manual white balance parameters.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_awb_SetMwbAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_wb_mwb_attrib_t attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	Manual white balance parameters	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_awb.h, rk_aiq_uapi2_awb_int.h

- Library file: librkaiq.so

【Example】

- Reference sample_awb_module.cpp

7.6.10 rk_aiq_user_api2_awb_GetMwbAttrib

【Description】

Set manual white balance parameters.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_awb_SetMwbAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_wb_mwb_attrib_t attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	Manual white balance parameters	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_awb.h, rk_aiq_uapi2_awb_int.h
- Library file: librkaiq.so

【Example】

- Reference sample_awb_module.cpp

7.6.11 rk_aiq_user_api2_awb_SetWbGainAdjustAttrib

【Description】

Sets the tone adjustment parameters in auto white balance mode.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_awb_SetWbGainAdjustAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_uapiV2_wb_awb_wbGainAdjust_t attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	Tone adjustment parameters	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_awb.h, rk_aiq_uapi2_awb_int.h
- Library file: librkaiq.so

【Example】

- Reference sample_awb_module.cpp

7.6.12 rk_aiq_user_api2_awb_GetWbGainAdjustAttrib

【Description】

Gets the tone adjustment parameters in auto white balance mode.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_awb_GetWbGainAdjustAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_uapiV2_wb_awb_wbGainAdjust_t *attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	Tone adjustment parameters	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_awb.h, rk_aiq_uapi2_awb_int.h
- Library file: librkaiq.so

【Example】

- Reference sample_awb_module.cpp

7.6.13 rk_aiq_user_api2_awb_SetWbGainOffsetAttrib

【Description】

Sets the offset of the auto white balance gain

【Grammar】

```
XCamReturn
rk_aiq_user_api2_awb_SetWbGainOffsetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_uapiV2_wb_awb_wbGainOffset_t attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	Tone adjustment parameters	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_awb.h, rk_aiq_uapi2_awb_int.h
- Library file: librkaiq.so

【Example】

- Reference sample_awb_module.cpp

7.6.14 rk_aiq_user_api2_awb_GetWbGainOffsetAttrib

【Description】

Gets the offset of the auto white balance gain

【Grammar】

```
XCamReturn
rk_aiq_user_api2_awb_GetWbGainOffsetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_uapiV2_wb_awb_wbGainOffset_t *attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	Tone adjustment parameters	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_awb.h, rk_aiq_uapi2_awb_int.h
- Library file: librkaiq.so

【Example】

- Reference sample_awb_module.cpp

7.7 Module-level API data types

7.7.1 rk_aiq_wb_querry_info_t

【Description】

Define white balance query information

【Definition】

```
typedef struct rk_aiq_wb_querry_info_s {
    rk_aiq_wb_gain_t gain;
    rk_aiq_wb_cct_t cctGloabl;
    bool awbConverged;
    uint32_t LVValue;
} rk_aiq_wb_querry_info_t;
```

【Member】

Member Name	Description
gain	Gain
cctGloabl	Global Color Temperature Parameter
LVValue	Related ambient brightness

7.7.2 rk_aiq_wb_op_mode_t

【Description】

Defines the white balance operating mode

【Definition】

```
typedef struct rk_aiq_uapiV2_wb_opMode_s {
  rk_aiq_uapi_sync_t sync;
  rk_aiq_wb_op_mode_t mode;
} rk_aiq_uapiV2_wb_opMode_t;
```

【Member】

Member Name	Description
sync	For rk_aiq_uapi_sync_t description, see **Overview/API Description】 section
mode	Refer to rk_aiq_wb_op_mode_t Description

7.7.3 rk_aiq_wb_mwb_attrib_t

【Description】

Define manual white balance properties

【Definition】

```
typedef struct rk_aiq_wb_mwb_attrib_s {
     rk_aiq_uapi_sync_t sync;
    rk_aiq_wb_mwb_mode_t mode;
    union MWBPara_u {
        rk_aiq_wb_gain_t gain;
        rk_aiq_wb_scene_t scene;
        rk_aiq_wb_cct_t cct;
    } para;
} rk_aiq_wb_mwb_attrib_t;
```

【Member】

Member Name	Description
sync	For rk_aiq_uapi_sync_t definitions, see **Overview/API Description** section
mode	Mode selection
para	Parameter configuration for the mode

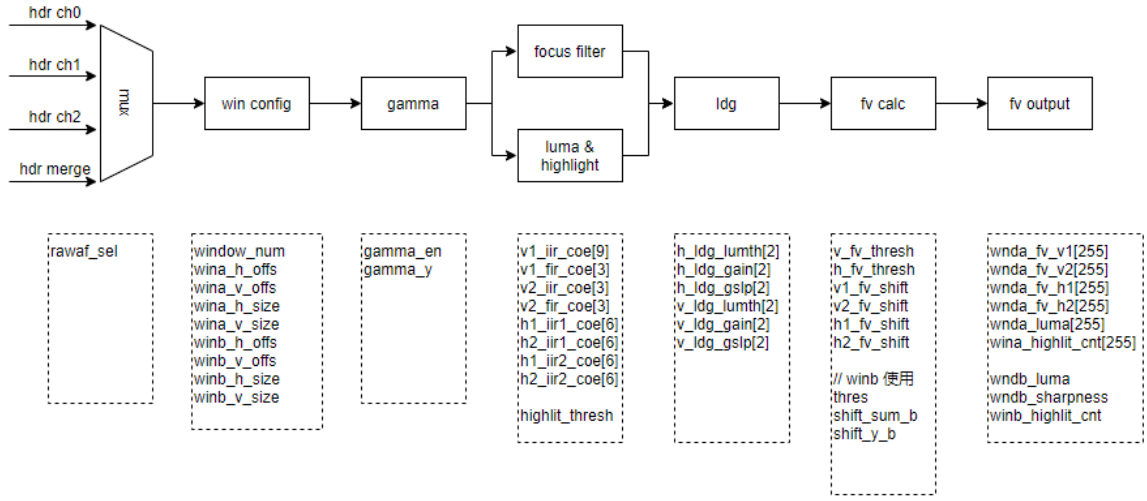
8. AF

8.1 Overview

The function of the AF module refers to the process of adjusting the camera lens so that the image of the subject is clear.

8.2 Description of the feature

The AF module consists of two parts: AF information statistics and AF control algorithm.
The figure below shows the block diagram of the AF information statistics module

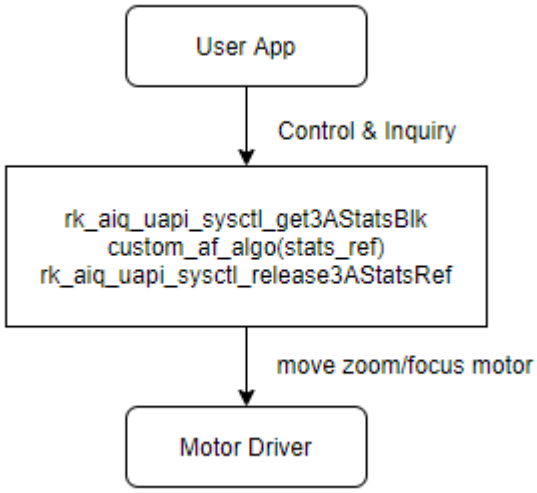


Among them, ch0/ch1/ch2 corresponds to the S/M/L frame in HDR mode, and debayer is the composite frame in HDR mode.

The output of windowA mainly contains 15*15 V1/V2/H1/H2 FV information, brightness information and highlight count.

The output of windowB mainly contains an FV information, brightness information, and highlight count.

8.3 Development of user AF algorithms



Reference code location: sdk: external/camera_engine_rkaiq/rkisp_demo/demo/af_algo_demo

8.4 Feature-level API reference

8.4.1 rk_aiq_uapi2_setFocusMode

【Description】 ： Configure the focus mode.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setFocusMode(const rk_aiq_sys_ctx_t* ctx, opMode_t mode);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
mode	Focus mode	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

8.4.2 rk_aiq_uapi2_getFocusMode

【**Description**】: Gets the current focus mode.

【**Grammar**】

```
XCamReturn rk_aiq_uapi2_getFocusMode(const rk_aiq_sys_ctx_t* ctx, opMode_t
*mode);
```

【**Parameters**】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
mode	Focus mode	Output

【**Return Value**】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【**Requirements**】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

8.4.3 rk_aiq_uapi2_setFocusWin

【**Description**】 Set the autofocus window.

【**Grammar**】

```
XCamReturn rk_aiq_uapi2_setFocusWin(const rk_aiq_sys_ctx_t* ctx, paRect_t *rect);
```

【**Parameters**】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
rect	Focus window, the value range is determined by the sensor input size	Input

【**Return Value**】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

8.4.4 rk_aiq_uapi2_getFocusWin

【Description】 Set the autofocus window.

【Grammar】

```
XCamReturn rk_aiq_uapi2_getFocusWin(const rk_aiq_sys_ctx_t* ctx, paRect_t *rect);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
rect	Focus window	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

8.4.5 rk_aiq_uapi2_lockFocus

【Description】 ： Lock autofocus, focus pause action.

【Grammar】

```
XCamReturn rk_aiq_uapi2_lockFocus(const rk_aiq_sys_ctx_t* ctx);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

8.4.6 rk_aiq_uapi2_unlockFocus

【Description】 Unlock autofocus, focus continues action.

【Grammar】

```
XCamReturn rk_aiq_uapi2_unlockFocus(const rk_aiq_sys_ctx_t* ctx);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

8.4.7 rk_aiq_uapi2_oneshotFocus

【Description】 Trigger a single focus, after the focus is completed, the focus will not continue.

【Grammar】

```
XCamReturn rk_aiq_uapi2_oneshotFocus(const rk_aiq_sys_ctx_t* ctx);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

8.4.8 rk_aiq_uapi2_manualTrigerFocus

【Description】 Manually trigger focus, after the focus is completed, continue to monitor whether the picture is blurry, if the picture is blurry, perform focus again.

【Grammar】

```
XCamReturn rk_aiq_uapi2_manualTrigerFocus(const rk_aiq_sys_ctx_t* ctx);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

8.4.9 rk_aiq_uapi2_trackingFocus

【Description】 Continue to monitor whether the picture is blurry, if the picture is blurry, perform focus again, generally use after rk_aiq_uapi2_oneshotFocus.

【Grammar】

```
XCamReturn rk_aiq_uapi2_trackingFocus(const rk_aiq_sys_ctx_t* ctx);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

8.4.10 rk_aiq_uapi2_getSearchResult

【Description】 Get the focus result.

【Grammar】

```
XCamReturn rk_aiq_uapi2_getSearchResult(const rk_aiq_sys_ctx_t* ctx,
rk_aiq_af_result_t* result);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
result	For focusing results, refer to the description of the structure rk_aiq_af_result_t	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

8.4.11 rk_aiq_uapi2_getZoomRange

【Description】 Gets the zoom range value, which is used to limit the zoom code parameters rk_aiq_uapi_setOpZoomPosition input.

【Grammar】

```
XCamReturn rk_aiq_uapi2_getZoomRange(const rk_aiq_sys_ctx_t* ctx,
rk_aiq_af_zoomrange* range);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
range	Zoom movable range, refer to structure rk_aiq_af_zoomrange	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

8.4.12 rk_aiq_uapi2_setOpZoomPosition

【Description】 Set zoom position, modify zoom position.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setOpZoomPosition(const rk_aiq_sys_ctx_t* ctx, int pos);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
pos	zoom position, the value range is determined by rk_aiq_uapi2_getZoomRange	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

8.4.13 rk_aiq_uapi2_getOpZoomPosition

【Description】 Get the zoom location.

【Grammar】

```
XCamReturn rk_aiq_uapi2_getOpZoomPosition(const rk_aiq_sys_ctx_t* ctx, int *pos);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
pos	zoom position	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

8.4.14 rk_aiq_uapi2_endOpZoomChange

【**Description**】 End the setting of the zoom device position, call after the rk_aiq_uapi_setOpZoomPosition, and perform the focus action after being called.

【**Grammar**】

```
XCamReturn rk_aiq_uapi2_endOpZoomChange(const rk_aiq_sys_ctx_t* ctx);
```

【**Parameters**】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input

【**Return Value**】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【**Requirements**】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

8.4.15 rk_aiq_uapi2_getFocusRange

【**Description**】 Gets the focus range value, which is used to limit the focus code parameter rk_aiq_uapi_setFocusPosition input.

【**Grammar**】

```
XCamReturn rk_aiq_uapi2_getFocusRange(const rk_aiq_sys_ctx_t* ctx,
rk_aiq_af_focusrange* range);
```

【**Parameters**】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
range	Focus movable range, refer to the structure rk_aiq_af_focusrange	Output

【**Return Value**】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

8.4.16 rk_aiq_uapi2_setFocusPosition

【Description】 Set the focus position in manual focus mode.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setFocusPosition(const rk_aiq_sys_ctx_t* ctx, unsigned
short code);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
code	Focus code value, the value range is determined by rk_aiq_uapi2_getFocusRange	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

8.4.17 rk_aiq_uapi2_getFocusPosition

【Description】 Gets the current focus position.

【Grammar】

```
XCamReturn rk_aiq_uapi2_getFocusPosition(const rk_aiq_sys_ctx_t* ctx, unsigned
short *code);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
code	Focus code value	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

8.4.18 rk_aiq_uapi2_startZoomCalib

【Description】 Perform electric motor module correction.

【Grammar】

```
XCamReturn rk_aiq_uapi2_startZoomCalib(const rk_aiq_sys_ctx_t* ctx);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

8.4.19 rk_aiq_uapi2_resetZoom

【Description】 Perform an electric motor module reset.

【Grammar】

```
XCamReturn rk_aiq_uapi2_resetZoom(const rk_aiq_sys_ctx_t* ctx);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

8.5 Functional-level API data types

8.5.1 opMode_t

【Description】
Define the AF information statistics working mode

【Definition】

```
typedef enum opMode_e {
    OP_AUTO    = 0,
    OP_MANUAL = 1,
    OP_SEMI_AUTO = 2,
    OP_INVAL
} opMode_t;
```

【Member】

Member Name	Description
OP_AUTO	Autofocus mode, running the built-in AF algorithm
OP_MANUAL	Manual focus mode, stop the built-in AF algorithm
OP_SEMI_AUTO	Semi-autofocus mode, set zoom position API call to perform an autofocus

8.5.2 rk_aiq_af_zoomrange

【Description】 Define the zoom value range

【Definition】

```
typedef struct {
    int min_pos;
    int max_pos;
    float min_fl;
    float max_fl;
} rk_aiq_af_zoomrange;
```

【Member】

Member Name	Description
min_pos	zoom minimum
max_pos	zoommax
min_fl	Minimum focal length
max_fl	Maximum focal length

8.5.3 rk_aiq_af_focusrange

【Description】 Define the focus value range

【Definition】

```
typedef struct {
    int min_pos;
    int max_pos;
} rk_aiq_af_focusrange;
```

【Member】

Member Name	Description
min_pos	Focus Minimum
max_pos	Focus Max

8.5.4 rk_aiq_af_result_t

【Description】 Define AF search results

【Definition】

```
typedef enum rk_aiq_af_sec_stat_e
{
    RK_AIQ_AF_SEARCH_INVAL   = 0,
    RK_AIQ_AF_SEARCH_RUNNING = 1,
    RK_AIQ_AF_SEARCH_END     = 2
} rk_aiq_af_sec_stat_t;

typedef struct {
    rk_aiq_af_sec_stat_t stat;
    int32_t final_pos;
} rk_aiq_af_result_t;
```

【Member】

Member Name	Description
stat	Focus Status
final_pos	Final focus location

8.6 Module-level API reference

8.6.1 rk_aiq_user_api2_af_SetAttrib

【Description】
Set the focus properties.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_af_SetAttrib(const rk_aiq_sys_ctx_t* sys_ctx, rk_aiq_af_attrib_t
attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	Parameter properties of focus	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_af.h
- Library file: librkaiq.so

8.6.2 rk_aiq_user_api2_af_GetAttrib

【Description】

Gets the focus properties.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_af_GetAttrib(const rk_aiq_sys_ctx_t* sys_ctx, rk_aiq_af_attrib_t
*attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	Parameter properties of focus	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_af.h
- Library file: librkaiq.so

8.7 Module-level API data types

8.7.1 RKAIQ_AF_MODE

【Description】

Defines the focus operating mode

【Definition】

```
typedef enum _RKAIQ_AF_MODE
{
    RKAIQ_AF_MODE_NOT_SET = -1,
    RKAIQ_AF_MODE_AUTO,
    RKAIQ_AF_MODE_MACRO,
    RKAIQ_AF_MODE_INFINITY,
    RKAIQ_AF_MODE_FIXED,
    RKAIQ_AF_MODE_EDOF,
    RKAIQ_AF_MODE_CONTINUOUS_VIDEO,
    RKAIQ_AF_MODE_CONTINUOUS_PICTURE,
    RKAIQ_AF_MODE_ONESHOT_AFTER_ZOOM,
} RKAIQ_AF_MODE;
```

【Member】

Member Name	Description
RKAIQ_AF_MODE_NOT_SET	The focus mode is not set
RKAIQ_AF_MODE_AUTO	Autofocus mode
RKAIQ_AF_MODE_MACRO	Macro focus mode
RKAIQ_AF_MODE_INFINITY	Long Focus Mode
RKAIQ_AF_MODE_FIXED	Fixed focus mode
RKAIQ_AF_MODE_EDOF	Depth of field focus mode
RKAIQ_AF_MODE_CONTINUOUS_VIDEO	Smooth continuous focus mode
RKAIQ_AF_MODE_CONTINUOUS_PICTURE	Fast continuous focus mode
RKAIQ_AF_MODE_ONESHOT_AFTER_ZOOM	Semi-autofocus mode, set zoom position call, automatically trigger a focus

8.7.2 RKAIQ_AF_HWVER

【Description】

Defines the focus operating mode

【Definition】

```
typedef enum _RKAIQ_AF_HWVER
{
    RKAIQ_AF_HW_V20 = 0,
    RKAIQ_AF_HW_V30,
    RKAIQ_AF_HW_VMAX
} RKAIQ_AF_HWVER;
```

【Member】

Member Name	Description
RKAIQ_AF_HW_V20	AF hardware version 2.0
RKAIQ_AF_HW_V30	AF hardware version 3.0

8.7.3 rk_aiq_af_algo_meas_v30_t

【Description】

Define the AF information statistics working mode

【Definition】

```
typedef struct {
    unsigned char af_en;
    unsigned char rawaf_sel;
    unsigned char gamma_en;
    unsigned char gaus_en;
    unsigned char v1_fir_sel;
    unsigned char hiir_en;
    unsigned char viir_en;
    unsigned char v1_fv_outmode;    // 0 square, 1 absolute
    unsigned char v2_fv_outmode;    // 0 square, 1 absolute
    unsigned char h1_fv_outmode;    // 0 square, 1 absolute
    unsigned char h2_fv_outmode;    // 0 square, 1 absolute
    unsigned char ldg_en;
    unsigned char accu_8bit_mode;   //fix to 1
    unsigned char ae_mode;
    unsigned char y_mode;           //fix to 0
    unsigned char line_en[RKAIQ_RAWAF_LINE_NUM];
    unsigned char line_num[RKAIQ_RAWAF_LINE_NUM];

    unsigned char window_num;
    unsigned short wina_h_offs;
    unsigned short wina_v_offs;
    unsigned short wina_h_size;
    unsigned short wina_v_size;
    unsigned short winb_h_offs;
    unsigned short winb_v_offs;
    unsigned short winb_h_size;
    unsigned short winb_v_size;

    unsigned short gamma_y[RKAIQ_RAWAF_GAMMA_NUM];
```

```
    // [old version param]
    unsigned short thres;
    unsigned char shift_sum_a;
    unsigned char shift_sum_b;
    unsigned char shift_y_a;
    unsigned char shift_y_b;


    /**********[Vertical IIR (v1 & v2)]************/
    short v1_iir_coe[9];
    short v1_fir_coe[3];
    short v2_iir_coe[3];
    short v2_fir_coe[3];

    /**********[Horizontal IIR (h1 & h2)]************/
    short h1_iir1_coe[6];
    short h2_iir1_coe[6];
    short h1_iir2_coe[6];
    short h2_iir2_coe[6];

    /**********[Focus value statistic param]**********/
    // level depended gain
    // input8 lumi, output8bit gain
    unsigned char h_ldg_lumth[2];    //luminance thresh
    unsigned char h_ldg_gain[2];     //gain for [minLum,maxLum]
    unsigned short h_ldg_gslp[2];    //[slope_low,-slope_high]
    unsigned char v_ldg_lumth[2];
    unsigned char v_ldg_gain[2];
    unsigned short v_ldg_gslp[2];

    // coring
    unsigned short v_fv_thresh;
    unsigned short h_fv_thresh;

    // left shift, more needed if outmode=square
    unsigned char v1_fv_shift; //only for sel1
    unsigned char v2_fv_shift;
    unsigned char h1_fv_shift;
    unsigned char h2_fv_shift;

    /**********[High light]**********/
    unsigned short highlit_thresh;
}  rk_aiq_af_algo_meas_v30_t;
```

【Member】

Member Name	Description
af_en	Whether AF information statistics are enabled, 0 is off, 1 is on
rawaf_sel	Select the channel of AF information statistics, the value range is 0-3, the long/medium/short/synthetic frame channel selection corresponding to HDR mode, the general AF selection medium frame channel, the non-HDR mode is set to 0, and the HDR mode is set to 1
gamma_en	Gamma module enables switch, 0 is off, 1 is on
gaus_en	The setting needs to be fixed to 1
v1_fir_sel	The setting needs to be fixed to 1
hiir_en	H1/H2 channel enable switch, 0 is off, 1 is on
viir_en	V1/V2 channel enable switch, 0 is off and 1 is on. Note that when the gamma_en is opened, the viir_en must be set to 1
v1_fv_outmode	V1 channel FV output mode selection, 0 for squared mode, 1 for absolute value mode
v2_fv_outmode	V2 channel FV output mode selection, 0 for squared mode, 1 for absolute value mode
ldg_en	LDG function enable switch, 0 is off, 1 is on
accu_8bit_mode	The setting needs to be fixed to 1
ae_mode	When the ae_mode is set to 1, RAWAF enables 15x15 brightness averaging statistics, multiplexing the logic of the RAWAE_BIG module
y_mode	The setting needs to be fixed to 0
sobel_sel	The setting needs to be fixed to 0
v_dnscl_mode	Wide and narrow band mode selection, set according to the output of the AF filter coefficient generation tool
from_awb	The AF statistics input is obtained from AWB
from_ynr	The AF statistics input is obtained from YNR
ae_config_use	Fixed configuration 0
line_en	Currently not effective
line_num	Currently not effective
window_num	The number of windows in effect, when the window_num is 1, WinA (main window) takes effect; When the window_num is 2, wina (main window) and winb (independent window) take effect
wina_h_offs	The horizontal coordinate of the first pixel in the upper left corner of WinA (main window), which must be greater than or equal to 2
wina_v_offs	The vertical coordinate of the first pixel in the upper-left corner of wina (main window), which must be greater than or equal to 1

Member Name	Description
wina_h_size	the window width of Wina (main window), which must be less than the image width -2-wina_h_offs; The value must also be a multiple of 15;
wina_v_size	the window height of Wina (main window), which must be less than the image height -2-wina_v_offs; The value must also be a multiple of 15;
winb_h_offs	The horizontal coordinate of the first pixel in the upper-left corner of winb (separate window), which must be greater than or equal to 2
winb_v_offs	The vertical coordinate of the first pixel in the upper-left corner of winb (stand-alone window), which must be greater than or equal to 1
winb_h_size	The window width of winb (independent window), which must be less than the image width -2-wina_h_offs
winb_v_size	The window height of winb (independent window), which must be less than the image height -2-wina_v_offs
gamma_y	The y value of the gamma table, the value range is 0-1023; The x-coordinate segment is 0 to 1023: 16 16 16 16 32 32 32 32 64 64 64 128 128 128 128 128
thres	The AF statistical threshold of win b (independent window), when the calculated fv value is less than this value, the fv value is changed to 0, which can reduce the influence of noise, and the value range is 0-0xFFFF
shift_sum_a	Currently unavailable, fixed setting to 0
shift_y_a	Currently unavailable, fixed setting to 0
v1_iir_coe[9]	The 3X3 IIR coefficient for the V1 channel is set according to the output of the AF Filter Factor Generation tool
v1_fir_coe[3]	The 1x3 FIR factor for the V1 channel is set according to the output of the AF filter coefficient generation tool
v2_iir_coe[3]	The 1x3 IIR coefficient for the V2 channel is set according to the output of the AF filter coefficient generation tool
v2_fir_coe[3]	The 1x3 FIR factor for the V2 channel is set according to the output of the AF Filter Factor Generation tool
h1_iir1_coe[6]	The 1X6 IIR1 coefficient for the H1 channel, set according to the output of the AF Filter Factor Generation tool
h2_iir1_coe[6]	The 1X6 IIR1 coefficient for the H2 channel is set according to the output of the AF Filter Factor Generation tool
h1_iir2_coe[6]	The 1X6 IIR2 coefficient for the H1 channel is set according to the output of the AF Filter Factor Generation tool
h2_iir2_coe[6]	1X6 IIR2 coefficient for H2 channel, set according to the output of the AF filter coefficient generation tool

Member Name	Description
h_ldg_lumth[2]	The brightness threshold coefficient of the ldg module used for H1/H2 channels, 0 is set for the left dark area, 1 is set for the right highlight area, and the value range is 0~255
h_ldg_gain[2]	The minimum gain value of the ldg module used for H1/H2 channels, 0 is the left dark area setting, 1 is the right highlight area setting, the value range is 0~255
h_ldg_gslp[2]	The slope coefficient of the ldg module used for H1/H2 channels, 0 is set for the left dark area, 1 is set for the right highlight area, and the value range is 0~65535
v_ldg_lumth[2]	The brightness threshold coefficient of the ldg module used for V1/V2 channels, 0 is set for the left dark area, 1 is the right highlight area, and the value range is 0~255
v_ldg_gain[2]	The minimum gain value of the ldg module used for V1/V2 channels, 0 is the left dark area setting, 1 is the right highlight area setting, the value range is 0~255
v_ldg_gslp[2]	The minimum gain value of the ldg module used for V1/V2 channels, 0 is the left dark area setting, 1 is the right highlight area setting, the value range is 0~255
v_fv_thresh	For the AF statistical threshold of V1/V2 channels, when the calculated fv value is less than this value, the fv value is changed to 0, which can reduce the influence of noise, and the value range is 0-0x0FFF
h_fv_thresh	For the AF statistical threshold used for H1/H2 channels, when the calculated fv value is less than this value, the fv value is changed to 0, which can reduce the influence of noise, and the value range is 0-0x0FFF
v1_fv_shift	The shit bit value of the fv value used for the V1 channel will shift the fv value to the right according to this value to avoid the overflow of the obtained fv value, and the value range is 0-7
v2_fv_shift	The shit bit value of the fv value used for the V2 channel will shift the fv value to the right according to this value to avoid the overflow of the obtained fv value, and the value range is 0-7
h1_fv_shift	The shit bit value of the fv value used for the H1 channel will shift the fv value to the right according to this value to avoid the overflow of the obtained fv value, and the value range is 0-7
h2_fv_shift	The shit bit value of the fv value used for the H2 channel will shift the fv value to the right according to this value to avoid the overflow of the obtained fv value, and the value range is 0-7
highlit_thresh	Indicates the threshold of the highlight statistics, when it is higher than this value, it is considered to be high highlights, and it is included in the statistics, and only the number of high highlights in each area is accumulated, and the value range is 0-0x0FFF

8.7.4 rk_aiq_af_attrib_t

【Description】

Focus configuration information

【Definition】

```
typedef struct rk_aiq_af_attrib_s {
    rk_aiq_uapi_sync_t sync;

    RKAIQ_AF_MODE AfMode;
    RKAIQ_AF_HWVER AfHwVer;

    bool contrast_af;
    bool laser_af;
    bool pdaf;

    int h_offs;
    int v_offs;
    unsigned int h_size;
    unsigned int v_size;

    short fixedModeDefCode;
    short macroModeDefCode;
    short infinityModeDefCode;

    union {
        rk_aiq_af_algo_meas_v20_t manual_meascfg;
        rk_aiq_af_algo_meas_v30_t manual_meascfg_v30;
    };
} rk_aiq_af_attrib_t;
```

【Member】

Member Name	Description
sync	For information about synchronous asynchronous APIs, refer to rk_aiq_uapi_sync_t definitions, see **Overview/API Description** section
AfMode	Focus mode
contrast_af	Enable contrast focus
laser_af	Enable laser focus
pdaf	Enable phase focus
h_offs	The starting horizontal coordinate of the focus window
v_offs	The starting vertical coordinate of the focus window
h_size	Focus window width
v_size	Focus window height
fixedModeDefCode	Focus code value
macroModeDefCode	The stop code value in macro focus mode is 0-value
infinityModeDefCode	The starting code value in long-range focus mode with a focus range of -64
manual_measCfg	AF2.0 Custom Focus Statistics Configuration
manual_measCfg_v30	AF3.0 Custom Focus Statistics Configuration

8.8 Additional instructions

8.8.1 VCM motor module driver verification

1. Whether the starting current and termination current of the VCM drive are set correctly,

First of all, it is necessary to obtain relevant information about the starting current and termination current from the module factory.

Next, select a few modules to confirm whether the information is correct, as follows:

In dts, set the start current and termination current to the maximum range that the VCM can support.

Switch the focus mode to manual mode, gradually adjust the VCM position from 64, when the lens starts to move and the telefocus object (more than 10 meters) is clear, record the current position value,

The starting current is (vcm_max_mA - vcm_min_mA) * (64 - curPos) / 64.

Continue to adjust the VCM position, and when the near-focus object (10cm or 20cm) is clear, record the current position value,

The termination current is (vcm_max_mA - vcm_min_mA) * (64 - curPos) / 64.

2. Whether the final residence position is stable when the VCM is moved in different directions.

Switch the focus mode to manual mode, select a position, move from 0 to this position and from 64 to this position, compare whether the two images are consistent in clarity and whether the AF statistics are close.

3. Whether the time required to move the lens is correct.

8.8.2 Electric motor module drive verification

1. Whether multiple single step movements and one multi-step move end up staying in the same position
    1. First select a zoom/focus motor position to make the image reach the clearest state, record the current motor position, and grab an image A;
    2. Let the zoom or focus motor step back a certain number of steps, and then move the zoom or focus motor in one step until it reaches the recorded zoom/focus motor position, and grab an image B;
    3. Let the zoom or focus motor go back a certain number of steps again, move the zoom or focus motor once, reach the recorded zoom/focus motor position, and grab an image C;
    4. Compare whether the clarity of image A, image B and image C is consistent, and whether the field of view is consistent;
2. Whether the motor moves randomly and ends up staying in the same position
    1. First select a zoom/focus motor position to make the image reach the clearest state, record the current motor position, and grab an image A;
    2. Second, let the zoom or focus motor move randomly through the script, move it 400 to 500 times, return to the original zoom/focus motor position, and grab an image B;
    3. Compare image A and image B to determine whether the clarity is consistent and whether the field of view is consistent;
3. Whether the final residence position of the motor moving at the same time is the same
    1. First select a zoom/focus motor position to make the image reach the clearest state, record the current motor position, and grab an image A;
    2. Secondly, let the zoom and focus motor move randomly at the same time through the script, move 400 to 500 times, return to the original zoom/focus motor position, and grab an image B;
    3. Compare image A and image B to determine whether the clarity is consistent and whether the field of view is consistent;

9. IMGPROC

9.1 Overview

imgproc refers to the module that affects the effect of the image.

9.2 Merge

9.2.1 Description of the feature

Merge is a module that combines multiple frames of an image into a single frame.

9.2.2 Important concepts

- Takes effect in and only in HDR mode.

9.2.3 Functional level API reference

9.2.4 Module-level API reference

9.2.4.1 rk_aiq_user_api2_amerge_SetAttrib

【Description】
Set the merge property.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_amerge_SetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
amerge_attrib_t attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	The parameter property of merge	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_amerge.h
- Library file: librkaiq.so

9.2.4.2 rk_aiq_user_api2_amerge_GetAttrib

【Description】

Gets the merge property.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_amerge_GetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
amerge_attrib_t* attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	The parameter property of merge	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_amerge.h
- Library file: librkaiq.so

9.2.5 Module-level API data types

9.2.5.1 merge_OpMode_t

【Description】

Define the merge mode of operation

【Definition】

```
typedef enum merge_OpModeV21_e {
    MERGE_OPMODE_API_OFF = 0,
    MERGE_OPMODE_MANU    = 1,
} merge_OpModeV21_t;
```

【Member】

Member Name	Description
MERGE_OPMODE_API_OFF	API is turned off mode, and the algorithm is in AUTO mode, using the parameter
MERGE_OPMODE_MANU	Manual mode

9.2.5.2 MergeBaseFrame_t

【Description】

Defines datum frame properties when blending

【Definition】

```
typedef enum MergeBaseFrame_e {
    BASEFRAME_LONG  = 0,
    BASEFRAME_SHORT = 1,
} MergeBaseFrame_t;
```

【Member】

Member Name	Description
BASEFRAME_LONG	When blending, long frames are used as the benchmark
BASEFRAME_SHORT	When blending, short frames are used as the benchmark

9.2.5.3 MergeCurrCtlData_t

【Description】

Define Merge control parameter attributes.

【Definition】

```
typedef struct MergeCurrCtlData_s {
    float Envlv;
    float MoveCoef;
} MergeCurrCtlData_t;
```

【Member】

Member Name	Description
Envlv	The current ambient brightness ranges from 0,1 to 0.000001
MoveCoef	The current motion coefficient, the value range: [0,1], the accuracy is 0.000001, and the value is temporarily fixed.

9.2.5.4 mMergeOECurveV21_t

【Description】

Define the Manual Merge Overexposure Curve property

【Definition】

```
typedef struct mMergeOECurveV21_s {
    float Smooth;
    float Offset;
} mMergeOECurveV21_t;
```

【Member】

Member Name	Description
Smooth	The slope of the overexposure curve, the value range [0,1], the default value is 0.4, and the accuracy is 0.01.
Offset	The offset value of the overexposure curve is in the range [108,280], the default value is 210, and the accuracy is 0.1.

9.2.5.5 mMergeMDCurveV21_t

【Description】

Defines motion curve properties in long frame mode

【Definition】

```
typedef struct mMergeMDCurveV21_s {
    float LM_smooth;
    float LM_offset;
    float MS_smooth;
    float MS_offset;
} mMergeMDCurveV21_t;
```

【Member】

Member name	Description
LM_smooth	The slope of the motion curve between the long frame and the middle frame, the value range is [0,1], the default value is 0.4, and the accuracy is 0.01. On the RK356x platform, this value is invalid.
LM_offset	The offset value of the motion curve between the long frame and the medium frame is in the range of [0.26,1], the default value is 0.38, and the accuracy is 0.01. On the RK356x platform, this value is invalid
MS_smooth	The slope of the motion curve between medium and short frames, the value range is [0,1], the default value is 0.4, and the accuracy is 0.01.
MS_offset	The value of the motion curve offset between medium frame and short frame is [0.26,1], the default value is 0.38, and the accuracy is 0.01.

9.2.5.6 mMergeAttrV21_t

【Description】

Define the manual merge attribute in RK3588.

【Definition】

```
typedef struct mMergeAttrV21_s {
    mMergeOECurveV21_t OECurve;
    mMergeMDCurveV21_t MDCurve;
} mMergeAttrV21_t;
```

【Member】

Member Name	Description
OECurve	Overexposure curve parameter
MDCurve	Motion Profile Parameter

9.2.5.7 mergeAttrV21_t

【Description】

Configure the merge attribute under the RK356x chip

【Definition】

```
typedef struct mergeAttrV21_s {
    merge_OpModeV21_t    opMode;
    mMergeAttrV21_t      stManual;
    MergeCurrCtlData_t   CtlInfo;
} mergeAttrV21_t;
```

【Member】

Member Name	Description
opMode	Mode selection
stManual	Manual merge property
CtlInfo	Control quantity parameters

9.2.5.8 mLongFrameModeData_t

【Description】

Defines the control parameter properties in long frame mode

【Definition】

```
typedef struct mLongFrameModeData_s {
    mMergeOECurveV21_t OECurve;
    mMergeMDCurveV21_t MDCurve;
} mLongFrameModeData_t;
```

【Member】

Member name	Description
OECurve	Overexposure curve parameters
MDCurve	Motion profile parameters

9.2.5.9 mMergeMDCurveV30Short_t

【Description】

Defines motion curve properties in short frame mode

【Definition】

```
typedef struct mMergeMDCurveV30Short_s{
    float Coef;
    float ms_thd0;
    float lm_thd0;
} mMergeMDCurveV30Short_t;
```

【Member】

Member name	Description
Coef	Control coefficient, value range [0,1], default value is 0.05, accuracy 0.0001.
ms_thd0	The medium and short frame control coefficient has a value range of [0,1], and the default value is 0.0 and the accuracy is 0.1.
lm_thd0	The long medium frame control coefficient has a value range of [0,1], the default value is 0.0, and the accuracy is 0.1.

9.2.5.10 mShortFrameModeData_t

【Description】

Define control parameter properties in short frame mode

【Definition】

```
typedef struct mShortFrameModeData_s {
    mMergeOECurveV21_t      OECurve;
    mMergeMDCurveV30Short_t MDCurve;
} mShortFrameModeData_t;
```

【Member】

Member name	Description
OECurve	Overexposure curve parameters
MDCurve	Motion profile parameters

9.2.5.11 mMergeAttrV30_t

【Description】

Define the manual merge attribute in RK3588

【Definition】

```
typedef struct mMergeAttrV30_s {
    MergeBaseFrame_t      BaseFrm;
    mLongFrameModeData_t  LongFrmModeData;
    mShortFrameModeData_t ShortFrmModeData;
} mMergeAttrV30_t;
```

【Member】

Member Name	Description
BaseFrm	Fused datum frame
LongFrmModeData	When the reference value is a long frame, control data data

9.2.5.12 MergeOECurveV10_t

【Description】

Define the Auto Merge overexposure curve properties

【Definition】

```
typedef struct MergeOECurveV10_s {
    float EnvLv[MERGE_ENVLV_STEP_MAX];
    float Smooth[MERGE_ENVLV_STEP_MAX];
    float Offset[MERGE_ENVLV_STEP_MAX];
} MergeOECurveV10_t;
```

【Member】

Member name	Description
EnvLv	Ambient brightness, value range [0,1], 0: all black, 1: brightest.
Smooth	The slope of the overexposure curve, the value range [0,1], the default value is 0.4, and the accuracy is 0.01.
Offset	The offset value of the overexposure curve is in the range [108,280], the default value is 210, and the accuracy is 0.1.

9.2.5.13 MergeMDCurveV10_t

【Description】

Defines motion curve properties in long frame mode

【Definition】

```
typedef struct MergeMDCurveV10_s {
    float MoveCoef[MERGE_ENVLV_STEP_MAX];
    float LM_smooth[MERGE_ENVLV_STEP_MAX];
    float LM_offset[MERGE_ENVLV_STEP_MAX];
    float MS_smooth[MERGE_ENVLV_STEP_MAX];
    float MS_offset[MERGE_ENVLV_STEP_MAX];
} MergeMDCurveV10_t;
```

【Member】

Member name	Description
MoveCoef	The degree of screen motion, the value range [0,1], where 0 represents complete stationary, 1 represents full motion
LM_smooth	The slope of the motion curve between long and medium frames, the value range is [0,1], and the default value is 0.4. In HDR x2 mode, it does not take effect
LM_offset	The motion curve offset value between long and medium frames is in the range of [0.26,1], and the default value is 0.38. In HDR x2 mode, it does not take effect
MS_smooth	The slope of the motion curve between medium and short frames, the value range is [0,1], and the default value is 0.4.
MS_offset	The value of the motion curve offset between medium frame and short frame is [0.26,1], and the default value is 0.38.

9.2.5.14 MergeEachChnCurveV12_t

【Description】

Define the properties of the subchannel detection curve in long frame mode

【Definition】

```
typedef struct MergeEachChnCurveV12_s {
    float EnvLv[MERGE_ENVLV_STEP_MAX];
    float Smooth[MERGE_ENVLV_STEP_MAX];
    float Offset[MERGE_ENVLV_STEP_MAX];
} MergeEachChnCurveV12_t;
```

【Member】

Member Name	Description
EnvLv	Ambient brightness, value range [0,1], 0: all black, 1: brightest.
Smooth	The slope of the sub-channel overexposure curve, the value range [0,1], the default value is 0.4, and the accuracy is 0.01.
Offset	The offset value of the sub-channel overexposure curve, the value range [0,1], the default value is 0.38, and the accuracy is 0.01.

9.2.5.15 LongFrameModeDataV12_t

【Description】

Defines the control parameter properties in long frame mode

【Definition】

```
typedef struct LongFrameModeDataV12_s {
    bool                    EnableEachChn;
    MergeOECurveV10_t       OECurve;
    MergeMDCurveV10_t       MDCurve;
    MergeEachChnCurveV12_t  EachChnCurve;
    float                   OECurve_damp;
    float                   MDCurveLM_damp;
    float                   MDCurveMS_damp;
} LongFrameModeDataV12_t;
```

【Member】

Member name	Description
EnableEachChn	Split channel detection switch
OECurve	Overexposure curve parameters
MDCurve	Motion profile parameters
EachChnCurve	Split Channel Detection Curve Parameters
MDCurveLM_damp	The smoothing coefficient of the change of motion curve between long frames and medium frames is the proportion of the current frame parameter, the value range is [0,1], and the default value is 0.9. In HDR x2 mode, it does not take effect
MDCurveMS_damp	The smoothing coefficient of the change of the motion curve between the middle frame and the short frame is the proportion of the current frame parameter, the value range is [0,1], and the default value is 0.9.

9.2.5.16 MergeMDCurveV11Short_t

【Description】

Defines motion curve properties in short frame mode

【Definition】

```
typedef struct MergeMDCurveV11Short_s{
    float Coef;
    float ms_thd0;
    float lm_thd0;
} MergeMDCurveV11Short_t;
```

【Member】

Member name	Description
Coef	Control coefficient, value range [0,1], default value is 0.05, accuracy 0.0001.
ms_thd0	The medium and short frame control coefficient has a value range of [0,1], and the default value is 0.0 and the accuracy is 0.1.
lm_thd0	The long medium frame control coefficient has a value range of [0,1], the default value is 0.0, and the accuracy is 0.1.

9.2.5.17 ShortFrameModeData_t

【Description】

Define control parameter properties in short frame mode

【Definition】

```
typedef struct ShortFrameModeData_s {
    MergeOECurveV10_t      OECurve;
    MergeMDCurveV11Short_t MDCurve;
    float                  OECurve_damp;
    float                  MDCurve_damp;
} ShortFrameModeData_t;
```

【Member】

Member name	Description
OECurve	Overexposure curve parameters
MDCurve	Motion profile parameters
OECurve_damp	The smoothing coefficient of the change of the overexposure curve is the proportion of the current frame parameter, the value range is [0,1], and the default value is 0.9.
MDCurve_damp	The smoothing coefficient of the change of the motion curve is the proportion of the current frame parameter, the value range is [0,1], and the default value is 0.9.

9.2.5.18 CalibDbV2_merge_V12_t

【Description】

Define the automerge property

【Definition】

```
typedef struct CalibDbV2_merge_V12_s {
    MergeBaseFrame_t       BaseFrm;
    float                  ByPassThr;
    LongFrameModeDataV12_t LongFrmModeData;
    ShortFrameModeData_t   ShortFrmModeData;
} CalibDbV2_merge_V12_t;
```

【Member】

Member Name	Description
BaseFrm	Fused datum frame
ByPassThr	bypass current module threshold, value range [0,1]. If the percentage difference between the current ambient brightness and the ambient brightness of the previous frame is less than ByPassThr, the parameters of this module are not updated.
LongFrmModeData	When the reference value is a long frame, control data data

9.2.5.19 MergeCurrCtlData_t

【Description】

RK3588 chip under merge attribute configuration

【Definition】

```
typedef struct mergeAttrV30_s {
    merge_OpModeV21_t    opMode;
    mMergeAttrV30_t      stManual;
    MergeCurrCtlData_t   CtlInfo;
} mergeAttrV30_t;
```

【Member】

Member Name	Description
opMode	Mode selection
stManual	Manual merge property
CtlInfo	Control quantity parameters

9.2.5.20 mergeAttr_t

【Description】

The merge property is configured

【Definition】

```
typedef struct mergeAttr_s {
    rk_aiq_uapi_sync_t  sync;
    mergeAttrV21_t      attrV21;
    mergeAttrV30_t      attrV30;
} mergeAttr_t;
```

【Member】

Member Name	Description
sync	For rk_aiq_uapi_sync_t definitions, see **Overview/API Description** section
attrV21	The merge attribute under the RK356x chip is invalid in the RK3588 chip
attrV30	The merge attribute under the RK3588 chip is invalid in the RK356x chip

9.3 DRC

9.3.1 Description of the feature

DRC (High Dynamic Range Compression), which compresses high-bit images to low-bit images.

9.3.2 Important concepts

DRC can be used in either linear or HDR mode.

9.3.3 Feature-level API reference

9.3.3.1 rk_aiq_uapi2_setDrcGain

【Description】

Quickly set DrcGain curve-related parameters.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setDrcGain(const rk_aiq_sys_ctx_t* ctx, float Gain, float
Alpha, float Clip);
At this time, the mode of the api is DRC_OPMODE_DRC_GAIN, after calling the
interface, the interface parameters will be stored in stDrcGain, the three
parameters that constitute the DrcGain curve are determined by stDrcGain, and the
other parameters of the DRC module are still determined by the parameters of the
DRC module in the json file.
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
Gain	Gain value range: [1,8]	Input
Alpha	Alpha value range: [0,1]	Input
Clip	Clip value range: [0,64]	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

9.3.3.2 rk_aiq_uapi2_getDrcGain

【Description】

Get the parameters associated with the fast DrcGain curve.

The parameters related to the DrcGain curve obtained by the API are the parameters in stDrcGain, and only when the api mode is set to DRC_OPMODE_DRC_GAIN, the parameters that are actually used are the current parameters.

【Grammar】

```
XCamReturn rk_aiq_uapi2_getDrcGain(const rk_aiq_sys_ctx_t* ctx, float Gain, float Alpha, float Clip);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
Gain	Gain value range: [1,8]	Output
Alpha	Alpha value range: [0,1]	output
Clip	Clip value range: [0,64]	output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

9.3.3.3 rk_aiq_uapi2_setDrcHiLit

【Description】

Quickly set DrcHiLit parameters.

In this case, the mode of the API is DRC_OPMODE_HILIT, after calling the interface, the interface parameters will be stored in stHiLit, the HiLight parameters will be determined by stHiLit, and other parameters of the DRC module will still be determined by the parameters of the DRC module in the json file.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setDrcHiLit(const rk_aiq_sys_ctx_t* ctx, float Strength);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
Strength	Intensity value range: [0,1]	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

9.3.3.4 rk_aiq_uapi2_getDrcHiLit

【Description】

Get the relevant parameters for quick DrcHiLit.

The DrcHiLit parameters obtained by the API are the parameters in stHiLit, and only when the API mode is set to DRC_OPMODE_HILIT, the parameters that are currently in use are the parameters that are actually used.

【Grammar】

```
XCamReturn rk_aiq_uapi2_getDrcHiLit(const rk_aiq_sys_ctx_t* ctx, float Strength);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
Strength	Intensity value range: [0,1]	output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

9.3.3.5 rk_aiq_uapi2_setDrcLocalData

【Description】

Quickly set DrcLocalData parameters.

In this case, the mode of the API is DRC_OPMODE_LOCAL_TMO, after calling the API, the interface parameters will be stored in stLocalDataV30, the LocalData parameters will be determined by stLocalDataV30, and other parameters of the DRC module will still be determined by the parameters of the DRC module in the json file.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setDrcLocalData(const rk_aiq_sys_ctx_t* ctx, float
LocalWeit, float GlobalContrast, float LoLitContrast, int LocalAutoEnable, float
LocalAutoWeit);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
LocalWeit	LocalWeit value range: [0,1]	Input
GlobalContrast	GlobalContrast value range: [0,1]	Input
LoLitContrast	LoLitContrast value range: [0,1]	Input
LocalAutoEnable	Automatic Local switch value range: [0,1]	Input
LocalAutoWeit	Automatic LocalWeit value range: [0,1]	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

9.3.3.6 rk_aiq_uapi2_getDrcLocalData

【Description】

Obtain the parameters related to DrcLocalData.

The LocalData parameters obtained by the API are the parameters in stLocalDataV30 and are used only when the API mode is set to DRC_OPMODE_LOCAL_TMO.

【Grammar】

```
XCamReturn rk_aiq_uapi2_getDrcLocalData(const rk_aiq_sys_ctx_t* ctx, float*
LocalWeit, float* GlobalContrast, float* LoLitContrast, int* LocalAutoEnable,
float* LocalAutoWeit);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
LocalWeit	LocalWeit value range: [0,1]	output
GlobalContrast	GlobalContrast value range: [0,1]	output
LoLitContrast	LoLitContrast value range: [0,1]	output
ocalAutoEnable	Automatic Local switch value range: [0,1]	output
LocalAutoWeit	Automatic LocalWeit value range: [0,1]	output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

9.3.4 Module-level API reference

9.3.4.1 rk_aiq_user_api2_adrc_SetAttrib

【Description】

Set the DRC software properties.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_adrc_SetAttrib(RkAiqAlgoContext* ctx,
                                drc_attrib_t attr);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
attr	DRC Software Property Structure	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_adrc.h
- Library file: librkaiq.so

【Description】

9.3.4.2 rk_aiq_user_api2_adrc_GetAttrib

【Description】
Obtain DRC software properties.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_adrc_GetAttrib(RkAiqAlgoContext* ctx,
                                drc_attrib_t* attr);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
attr	DRC Software Property Structure	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_adrc.h

- Library file: librkaiq.so

【Description】

9.3.5 Module-level API data types

9.3.5.1 AdrcVersion_t

【Description】

Define the DRC version attributes

【Definition】

```
typedef enum AdrcVersion_e {
    ADRC_VERSION_356X = 0,
    ADRC_VERSION_3588 = 1,
    ADRC_VERSION_MAX
} AdrcVersion_t;
```

【Member】

Member Name	Description
ADRC_VERSION_356X	RK356x
ADRC_VERSION_3588	RK3588
ADRC_VERSION_MAX	Maximum version mode

9.3.5.2 drc_OpMode_t

【Description】

Define the DRC operating mode

【Definition】

```
typedef enum drc_OpMode_e {
    DRC_OPMODE_API_OFF   = 0,
    DRC_OPMODE_MANU      = 1,
    DRC_OPMODE_DRC_GAIN  = 2,
    DRC_OPMODE_HILIT     = 3,
    DRC_OPMODE_LOCAL_TMO = 4,
} drc_OpMode_t;
```

【Member】

Member Name	Description
DRC_OPMODE_API_OFF	In automatic mode, all parameters in the Drc module are determined by json
DRC_OPMODE_MANU	In manual mode, all parameters in the Drc module are determined by stManualV30
DRC_OPMODE_DRC_GAIN	In DrcGain mode, some parameters of DrcGain are determined by stDrcGain, and other parameters are determined by the relevant parameters in the json file
DRC_OPMODE_HILIT	In HiLit mode, some parameters of HiLight are determined by stHiLit, and other parameters are determined by relevant parameters in the json file
DRC_OPMODE_LOCAL_TMO	In LocalTMO mode, some parameters of LocalData are determined by stLocalDataV30, and other parameters are determined by relevant parameters in the json file

9.3.5.3 mDrcGain_t

【Description】

Define manual DrcGain parameter properties

【Definition】

```
typedef struct mDrcGain_s {
    float DrcGain;
    float Alpha;
    float Clip;
} mDrcGain_t;
```

【Member】

Member Name	Description
DrcGain	Manual DrcGain value, value range [1,8], default value is 1, accuracy 0.01
Alpha	Manual alpha value, value range [0,1], default value is 0.2, precision 0.01
Clip	Manual Clip value, value range [0,64], default value is 16, precision 0.01

9.3.5.4 mDrcHiLit_t

【Description】

Define the manual Drc HiLit parameter properties

【Definition】

```
typedef struct mDrcHiLit_s {
    float Strength;
} mDrcHiLit_t;
```

【Member】

Member Name	Description
Strength	Manual Strength value, value range [0,1], default value is 0, precision 0.01

9.3.5.5 mLocalDataV21_t

【Description】

Define the DRC Local parameter attribute under RK356x

【Definition】

```
typedef struct mLocalDataV21_s {
    float LocalWeit;
    float GlobalContrast;
    float LoLitContrast;
} mLocalDataV21_t;
```

【Member】

Member Name	Description
LocalWeit	Manual LocalWeit value in the range of 0,1, the default value is 1, and the accuracy is 0.01
GlobalContrast	Manual GlobalContrast value, the value range is 0,1, the default value is 0, and the accuracy is 0.01
LoLitContrast	Manual LoLitContrast value in the range of 0,1, the default value is 0, and the accuracy is 0.01

9.3.5.6 mLocalDataV30_t

【Description】

Define the DRC Local parameter attribute under RK356x

【Definition】

```
typedef struct mLocalDataV30_s {
    float         LocalWeit;
    int           LocalAutoEnable;
    float         LocalAutoWeit;
    float         GlobalContrast;
    float         LoLitContrast;
} mLocalDataV30_t;
```

【Member】

Member Name	Description
LocalWeit	Manual LocalWeit value, value range [0,1], default value is 1, precision 0.01.
LocalAutoEnable	Automatic LocalWeit switch, value range [0,1], default value is 1, accuracy 1
LocalAutoWeit	Automatic LocalWeit value, value range [0,1], default value is 0.4, accuracy 0.01.
GlobalContrast	Manual GlobalContrast value, value range [0,1], default value is 0, precision 0.01.
LoLitContrast	Manual LoLitContrast value, value range [0,1], default value is 0, precision 0.01.

9.3.5.7 mDrcLocalV21_t

【Description】

Define the DRC Local parameter attribute under RK356x

【Definition】

```
typedef struct mDrcLocalV21_s {
    mLocalDataV21_t LocalData;
    float           curPixWeit;
    float           preFrameWeit;
    float           Range_force_sgm;
    float           Range_sgm_cur;
    float           Range_sgm_pre;
    int             Space_sgm_cur;
    int             Space_sgm_pre;
} mDrcLocalV21_t;
```

【Member】

Member Name	Description
LocalData	Manually set LocalData to
curPixWeit	The two-sided weight of the current point, the value range is [0,1], the default value is 0.37, and the accuracy is 0.001.
preFrameWeit	The bilateral weight of the previous frame, the value range is [0,1], the default value is 0.8, and the accuracy is 0.001
Range_force_sgm	The reciprocal of the two-sided value range sigma, the value range is [0,1], the default value is 0, and the precision is 0.0001.
Range_sgm_cur	The reciprocal of the sigma in the bilateral airspace of the previous frame can be in the range of 0,1, with a default value of 0.2 and an accuracy of 0.0001.
Range_sgm_pre	The reciprocal of the sigma in the bilateral airspace of the previous frame, the value range is [0,1], the default value is 0.2, and the accuracy is 0.0001.
Space_sgm_cur	The reciprocal of the two-sided value range of the current frame, the value range is [0,4095], the default value is 4068, and the precision is 1.
Space_sgm_pre	The reciprocal of the two-sided value range sigma in the previous frame, the value range is [0,4095], the default value is 3068, and the precision is 1.

9.3.5.8 mDrcLocalV30_t

【Description】

Define the DRC Local parameter attribute in RK3588

【Definition】

```
typedef struct mDrcLocalV30_s {
    mLocalDataV30_t LocalData;
    float           curPixWeit;
    float           preFrameWeit;
    float           Range_force_sgm;
    float           Range_sgm_cur;
    float           Range_sgm_pre;
    int             Space_sgm_cur;
    int             Space_sgm_pre;
} mDrcLocalV30_t;
```

【Member】

Member Name	Description
LocalData	Manual LocalData settings
curPixWeit	The bilateral weight of the current point, the value range [0,1], the default value is 0.37, and the accuracy is 0.001
preFrameWeit	The bilateral weight of the previous frame, the value range [0,1], the default value is 0.8, and the precision is 0.001
Range_force_sgm	The reciprocal of the bilateral value range sigma, the value range [0,1], the default value is 0, and the precision is 0.0001
Range_sgm_cur	The reciprocal of the bilateral airspace sigma in the previous frame, the value range [0,1], the default value is 0.2, and the accuracy is 0.0001
Range_sgm_pre	The reciprocal of the bilateral airspace sigma in the previous frame, the value range [0,1], the default value is 0.2, and the accuracy is 0.0001
Space_sgm_cur	The reciprocal of the bilateral value range sigma of the current frame, the value range [0,4095], the default value is 4068, and the precision is 1
Space_sgm_pre	The reciprocal of the previous two-sided value range sigma, the value range [0,4095], the default value is 3068, and the precision is 1

9.3.5.9 CompressMode_t

【Description】

Define the manual mode, DrcCompress curve operating mode

【Definition】

```
typedef enum CompressMode_s {
    COMPRESS_AUTO   = 0,
    COMPRESS_MANUAL = 1,
} CompressMode_t;
```

【Member】

Member Name	Description
COMPRESS_AUTO	Manual mode, Compress curve automatic mode
COMPRESS_MANUAL	Manual mode, Compress curve manual mode

9.3.5.10 mDrcCompress_t

【Description】

Define the manual DrcCompress parameter property

【Definition】

```
typedef struct mDrcCompress_s {
    CompressMode_t Mode;
    uint16_t       Manual_curve[17];
} mDrcCompress_t;
```

【Member】

Member Name	Description
Mode	Switch function
Manual_curve	In manual mode, Manual Compress Curve

9.3.5.11 mdrcAttr_V21_t

【Description】

Define the manual DRC properties under the RK356x chip

【Definition】

```
typedef struct mdrcAttr_V21_s {
    bool           Enable;
    mDrcGain_t     DrcGain;
    mDrcHiLit_t    HiLight;
    mDrcLocalV21_t LocalSetting;
    mDrcCompress_t CompressSetting;
    int            Scale_y[ADRC_Y_NUM];
    float          Edge_Weit;
    bool           OutPutLongFrame;
    int            IIR_frame;
} mdrcAttr_V21_t;
```

【Member】

Member Name	Description
Enable	Manual DRC switch
DrcGain	Manual DrcGain settings
HiLight	Manual HiLit settings
LocalSetting	Manual Local Settings
CompressSetting	Compression curve settings
Scale_y	Gain-corrected scale table, value range [0,2048], accuracy 1.
Edge_Weit	The edge response scale value is in the value range [0,1], the default value is 0.02, and the accuracy is 0.01. Used to reduce high-contrast edge Artifact
OutPutLongFrame	Only output long frame switch, 0: off, 1: on.
IIR_frame	The number of frames of the IIR filter, the value range [1,1000], the default value is 2.

9.3.5.12 mdrcAttr_V30_t

【Description】

Define the manual DRC attributes under the RK3588 chip

【Definition】

```
typedef struct mdrcAttr_V30_s {
    bool           Enable;
    mDrcGain_t     DrcGain;
    mDrcHiLit_t    HiLight;
    mDrcLocalV30_t LocalSetting;
    mDrcCompress_t CompressSetting;
    int            Scale_y[ADRC_Y_NUM];
    float          Edge_Weit;
    bool           OutPutLongFrame;
    int            IIR_frame;
} mdrcAttr_V30_t;
```

【Member】

Member Name	Description
Enable	Manual DRC switch
DrcGain	Manual DrcGain settings
HiLight	Manual HiLit settings
LocalSetting	Manual Local Settings
CompressSetting	Compression curve settings
Scale_y	Gain-corrected scale table, value range [0,2048], accuracy 1.
Edge_Weit	The edge response scale value is in the value range [0,1], the default value is 0.02, and the accuracy is 0.01. Used to reduce high-contrast edge Artifact
OutPutLongFrame	Only output long frame switch, 0: off, 1: on.
IIR_frame	The number of frames of the IIR filter, the value range [1,1000], the default value is 2.

9.3.5.13 DrcInfo_t

【Description】

Define DRC control parameter properties

【Definition】

```
typedef struct DrcInfo_s {
    float EnvLv;
    float ISO;
} DrcInfo_t;
```

【Member】

Member Name	Description
EnvLv	Current ambient brightness
ISO	Current ISO

9.3.5.14 drcAttr_t

【Description】

Define DRC properties

【Definition】

```
typedef struct drcAttr_s {
    rk_aiq_uapi_sync_t sync;
    AdrcVersion_t      Version;
    drc_OpMode_t       opMode;
    mdrcAttr_V21_t     stManualV21;
    mdrcAttr_V30_t     stManualV30;
    mDrcGain_t         stDrcGain;
    mDrcHiLit_t        stHiLit;
    mLocalDataV21_t    stLocalDataV21;
    mLocalDataV30_t    stLocalDataV30;
    DrcInfo_t          Info;
} drcAttr_t;
```

【Member】

Member Name	Description
sync	For rk_aiq_uapi_sync_t definitions, see **Overview/API Description** section
Version	Version information
opMode	API pattern
stManualV21	The manual DRC attribute on the RK356x chip takes effect when opMode is DRC_OPMODE_MANU
stManualV30	The RK3588 is a manual DRC attribute on the chip, and the parameters take effect when opMode is DRC_OPMODE_MANU
stDrcGain	DrcGain property, which takes effect when opMode is DRC_OPMODE_DRC_GAIN
stHiLit	The Hillitt attribute, the parameter is in effect when Optmod is Dirk_Optmod_Hillit
stLocalDataV21	The LocalData attribute of the RK356x chip takes effect when opMode is DRC_OPMODE_LOCAL_TMO
stLocalDataV30	The LocalData attribute of the RK3588 chip takes effect when opMode is set to DRC_OPMODE_LOCAL_TMO
Info	Control parameter information

9.4 Noise Removal

9.4.1 Description of the feature

Image noise refers to unnecessary or unwanted interference information that exists in image data. Image denoising is the process of reducing noise in digital images.

9.4.2 Functional level API reference

9.4.2.1 rk_aiq_uapi2_setNRMode

【Description】 Set the denoising mode.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setNRMode(const rk_aiq_sys_ctx_t* ctx, opMode_t mode);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
mode	Working mode	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

9.4.2.2 rk_aiq_uapi2_getNRMode

【Description】 Gets the current denoising mode.

【Grammar】

```
XCamReturn rk_aiq_uapi2_getNRMode(const rk_aiq_sys_ctx_t* ctx, opMode_t* mode);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
mode	Working mode	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

9.4.2.3 rk_aiq_uapi2_setANRStrth

【Description】 Set the normal denoising intensity.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setANRStrth(const rk_aiq_sys_ctx_t* ctx, unsigned int
level);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
level	Denoising intensity, value range 0.0-100.0, default value 50.	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

9.4.2.4 rk_aiq_uapi2_getANRStrth

【Description】 Get normal denoising intensity.

【Grammar】

```
XCamReturn rk_aiq_uapi2_getANRStrth(const rk_aiq_sys_ctx_t* ctx, unsigned int*
level);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
level	Denoising intensity, value range 0.0-100.0, default value 50.	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

9.4.2.5 rk_aiq_uapi2_setMSpaNRStrth

【Description】 Set the airspace denoising intensity.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setMSpaNRStrth(const rk_aiq_sys_ctx_t* ctx, bool on,
unsigned int level);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
on	Switch	Input
level	Denoising intensity, value range 0.0-100.0, default value 50.	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

9.4.2.6 rk_aiq_uapi2_getMSpaNRStrth

【Description】 Get the airspace denoising intensity.

【Grammar】

```
XCamReturn rk_aiq_uapi2_getMSpaNRStrth(const rk_aiq_sys_ctx_t* ctx, bool *on,
unsigned int *level);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
on	Switch	Output
level	Denoising intensity, value range 0.0-100.0, default value 50.	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

9.4.2.7 rk_aiq_uapi2_setMTNRStrth

【Description】 Set the temporal domain denoising intensity.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setMTNRStrth(const rk_aiq_sys_ctx_t* ctx, bool on,
unsigned int level);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
on	Switch	Input
level	Denoising intensity, value range 0.0-100.0, default value 50.	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

9.4.2.8 rk_aiq_uapi2_getMTNRStrth

【Description】 Get the temporal domain denoising intensity.

【Grammar】

```
XCamReturn rk_aiq_uapi2_getMTNRStrth(const rk_aiq_sys_ctx_t* ctx, bool *on,
unsigned int *level);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
on	Switch	Output
level	Denoising intensity, value range 0.0-100.0, default value 50.	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

9.4.3 Module-level API reference

9.4.3.1 rk_aiq_user_api2_abayer2dnrV2_SetAttrib

【Description】

Set the denoising algorithm properties.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_abayer2dnrV2_SetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_bayer2dnr_attrib_v2_t* attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	Parameter properties for denoising	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_abayer2dnr_v2.h, RkAiqHandleIntV3x.h
- Library file: librkaiq.so

9.4.3.2 rk_aiq_user_api2_abayer2dnrV2_GetAttrib

【Description】

Gets the denoising algorithm properties.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_abayer2dnrV2_GetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_bayer2dnr_attrib_v2_t* attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	Parameter properties for denoising	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_abayer2dnr_v2.h, RkAiqHandleIntV3x.h
- Library file: librkaiq.so

9.4.3.3 rk_aiq_user_api2_abayer2dnrV2_SetStrength

【Description】

Set the denoising force.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_abayer2dnrV2_SetStrength(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_bayer2dnr_strength_v2_t *pStrength)
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
pStrength	For structures related to denoising intensity, the percent value range in the structure is 0.0-1.0	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_abayer2dnr_v2.h, RkAiqHandleIntV3x.h
- Library file: librkaiq.so

9.4.3.4 rk_aiq_user_api2_abayer2dnrV2_GetStrength

【Description】

Get denoising power.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_abayer2dnrV2_GetStrength(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_bayer2dnr_strength_v2_t *pStrength);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
pPercnt	Denoising strength structure pointer, the percentage value range in the structure is 0.0-1.0	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_abayer2dnr_v2.h, RkAiqHandleIntV3x.h
- Library file: librkaiq.so

9.4.3.5 rk_aiq_user_api2_abayertnrV2_SetAttrib

【Description】

Set the denoising algorithm properties.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_abayertnrV2_SetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_bayertnr_attrib_v2_t* attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	Parameter properties for denoising	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_abayertnr_v2.h, RkAiqHandleIntV3x.h
- Library file: librkaiq.so

9.4.3.6 rk_aiq_user_api2_abayertnrV2_GetAttrib

【Description】

Gets the denoising algorithm properties.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_abayertnrV2_GetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_bayertnr_attrib_v2_t* attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	Parameter properties for denoising	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_abayertnr_v2.h, RkAiqHandleIntV3x.h
- Library file: librkaiq.so

9.4.3.7 rk_aiq_user_api2_abayertnrV2_SetStrength

【Description】

Set the denoising force.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_abayertnrV2_SetStrength(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_bayertnr_strength_v2_t *pStrength);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
pStrength	Denoising strength structure pointer, the percentage value range in the structure is 0.0-1.0	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_abayertnr_v2.h, RkAiqHandleIntV3x.h
- Library file: librkaiq.so

9.4.3.8 rk_aiq_user_api2_abayertnrV2_GetStrength

【Description】

Get denoising power.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_abayertnrV2_GetStrength(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_bayertnr_strength_v2_t *pStrength);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
pStrength	Denoising strength structure pointer, the percentage value range in the structure is 0.0-1.0	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_abayertnr_v2.h, RkAiqHandleIntV3x.h
- Library file: librkaiq.so

9.4.3.9 rk_aiq_user_api2_aynrV3_SetAttrib

【Description】

Set the denoising algorithm properties.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_aynrV3_SetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_ynr_attrib_v3_t* attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	Parameter properties for denoising	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_aynr_v3.h, RkAiqHandleIntV3x.h

- Library file: librkaiq.so

9.4.3.10 rk_aiq_user_api2_aynrV3_GetAttrib

【Description】

Gets the denoising algorithm properties.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_aynrV3_GetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_ynr_attrib_v3_t* attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	Parameter properties for denoising	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_aynr_v3.h, RkAiqHandleIntV3x.h
- Library file: librkaiq.so

9.4.3.11 rk_aiq_user_api2_aynrV3_SetStrength

【Description】

Set the denoising force.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_aynrV3_SetStrength(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_ynr_strength_v3_t* pStrength);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
pStrength	Denoising strength structure pointer, the percentage value range in the structure is 0.0-1.0	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_aynr_v3.h, RkAiqHandleIntV3x.h
- Library file: librkaiq.so

9.4.3.12 rk_aiq_user_api2_aynrV3_GetStrength

【Description】

Get denoising power.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_aynrV3_GetStrength(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_ynr_strength_v3_t* pStrength);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
pStrength	Denoising strength structure pointer, the percentage value range in the structure is 0.0-1.0	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_aynr_v3.h, RkAiqHandleIntV3x.h
- Library file: librkaiq.so

9.4.3.13 rk_aiq_user_api2_acnrV2_SetAttrib

【Description】

Set the denoising algorithm properties.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_acnrV2_SetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_cnr_attrib_v2_t* attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	Parameter properties for denoising	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_acnr_v2.h, RkAiqHandleIntV3x.h
- Library file: librkaiq.so

9.4.3.14 rk_aiq_user_api2_acnrV2_GetAttrib

【Description】

Gets the denoising algorithm properties.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_acnrV2_GetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_cnr_attrib_v2_t* attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	Parameter properties for denoising	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_acnr_v2.h, RkAiqHandleIntV3x.h
- Library file: librkaiq.so

9.4.3.15 rk_aiq_user_api2_acnrV2_SetStrength

【Description】

Set the denoising force.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_acnrV2_SetStrength(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_cnr_strength_v2_t *pStrength);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
pStrength	Denoising strength structure pointer, the percentage value range in the structure is 0.0-1.0	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_acnr_v2.h, RkAiqHandleIntV3x.h

- Library file: librkaiq.so

9.4.3.16 rk_aiq_user_api2_acnrV2_GetStrength

【Description】

Get denoising power.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_acnrV2_GetStrength(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_cnr_strength_v2_t *pStrength);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
pStrength	Denoising strength structure pointer, the percentage value range in the structure is 0.0-1.0	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_acnr_v2.h, RkAiqHandleIntV3x.h
- Library file: librkaiq.so

9.4.4 Module-level API data types

9.4.4.1 rk_aiq_bayer2dnr_attrib_v2_t

【Description】

Define the parameters of the denoising module

【Definition】

```
typedef struct rk_aiq_bayer2dnr_attrib_v2_s {
    rk_aiq_uapi_sync_t sync;

Abayer2dnr_OPMode_V2_t eMode;
    Abayer2dnr_Auto_Attr_V2_t stAuto;
    Abayer2dnr_Manual_Attr_V2_t stManual;
} rk_aiq_bayer2dnr_attrib_v2_t;
```

【Member】

Member Name	Description
sync	For synchronous asynchronous mode selection, see **Overview/API Description** section
eMode	Bayer2DNR Denoising Module Mode
stAuto	Bayer2DNR Denoising Module Auto Mode Parameters
stManual	Bayer2DNR Denoising Module Manual Mode Parameters

9.4.4.2 Abayer2dnr_OPMode_V2_t

【Description】

Define the mode of the denoising module

【Definition】

```
typedef enum Abayer2dnr_OPMode_V2_e {
    ABAYER2DNR_OP_MODE_INVALID          = 0,
    ABAYER2DNR_OP_MODE_AUTO             = 1,
    ABAYER2DNR_OP_MODE_MANUAL           = 2,
    ABAYER2DNR_OP_MODE_REG_MANUAL       = 3,
    ABAYER2DNR_OP_MODE_MAX
} Abayer2dnr_OPMode_V2_t;
```

【Member】

Member Name	Description
ABAYER2DNR_OP_MODE_INVALID	Bayer Domain 2DNR Denoising Module Invalid Mode
ABAYER2DNR_OP_MODE_AUTO	Bayer Domain 2DNR Denoising Module Auto Mode
ABAYER2DNR_OP_MODE_MANUAL	Bayer Domain 2DNR Denoising Module Manual Mode Algorithm Settings
ABAYER2DNR_OP_MODE_REG_MANUAL	Bayer domain 2DNR denoising module register settings for manual mode
ABAYER2DNR_OP_MODE_MAX	Bayer domain 2DNR denoising module mode maximum, is an invalid mode

9.4.4.3 Abayer2dnr_Auto_Attr_V2_t

【Description】

Define the automatic properties of the denoising module

【Definition】

```
typedef struct Abayer2dnr_Auto_Attr_V2_s
{
    RK_Bayer2dnr_Params_V2_t st2DParams;
    RK_Bayer2dnr_Params_V2_Select_t st2DSelect;

} Abayer2dnr_Auto_Attr_V2_t;
```

【Member】

Member Name	Description
st2DParams	Bayer2DNR module each ISO corresponds to the algorithm attribute parameter
st2DSelect	The bayer2dnr module calculates the attribute parameter

9.4.4.4 Abayer2dnr_Manual_Attr_V2_t

【Description】

Define manual properties for the denoising module

【Definition】

```
typedef struct Abayer2dnr_Manual_Attr_V2_s
{
    RK_Bayer2dnr_Params_V2_Select_t st2DSelect;
    RK_Bayer2dnr_Fix_V2_t st2Dfix;

} Abayer2dnr_Manual_Attr_V2_t;
```

【Member】

Member Name	Description
st2DSelect	Bayer2DNR algorithm parameter value
st2Dfix	Bayer2DNR register value in manual mode

9.4.4.5 RK_Bayer2dnr_Params_V2_t

【Description】

Define the automatic mode of the denoising module, and the corresponding ISO algorithm attribute parameters

【Definition】

```
typedef struct RK_Bayer2dnr_Params_V2_s
{
    int enable;

    float iso[RK_BAYER2DNR_V2_MAX_ISO_NUM];

    int   lumapoint[16];
    int   sigma[RK_BAYER2DNR_V2_MAX_ISO_NUM][16];

    float filter_strength[RK_BAYER2DNR_V2_MAX_ISO_NUM];
    float edgesofts[RK_BAYER2DNR_V2_MAX_ISO_NUM];
    float ratio[RK_BAYER2DNR_V2_MAX_ISO_NUM];
    float weight[RK_BAYER2DNR_V2_MAX_ISO_NUM];
    int   gauss_guide[RK_BAYER2DNR_V2_MAX_ISO_NUM];

    int pix_diff[RK_BAYER2DNR_V2_MAX_ISO_NUM];
    int diff_thld[RK_BAYER2DNR_V2_MAX_ISO_NUM];

} RK_Bayer2dnr_Params_V2_t;
```

【Member】

Member Name	Parameter type	Description
enable	Debug parameter	The module switch is enabled. 1: The module is on, 0: The module is closed.
ISO	Debug parameter	Different ISO gears, corresponding to different debugging parameters. Currently, only 13 gears are supported
lumapoint	Calibration Data	Different pixel brightness corresponds to different noise sigma curve points. A total of 16 points
sigma	Calibration Data	Different pixel brightness corresponds to different noise sigma curve points. A total of 16 points
gauss_guide	Debug parameter	Whether the Gaussian steering is enabled. 1: Enable. 0: Closed.
filter_strength	Debug parameter	Denoising velocity parameter. The value range is [0, 16], the higher the value, the greater the denoising power
edgesofts	Debug parameter	Affects airspace weights. The value ranges from 1 to 16, and the default value is 1.
ratio	Debug parameter	Soft threshold weights. The value range is 0, 1.0. The lower the value, the greater the denoising power
weight	Debug parameter	The higher the filter output weight, the greater the denoising intensity
pix_diff	Debug parameter	5x5 window pixel difference threshold for bilateral filtering; Default configuration value 0x3fff.
diff_thld	Debug parameter	The square difference threshold for calculating Euclidean distances for bilateral filtering is 0x3ff;

9.4.4.6 RK_Bayer2dnr_Params_V2_Select_t

【Description】

Define the manual mode algorithm properties of the denoising module

【Definition】

```
typedef struct RK_Bayer2dnr_Params_V2_Select_s
{
    int enable;

    int lumapoint[16];
    int sigma[16];

    float filter_strength;
    float edgesofts;
    float ratio;
    float weight;
```

```
    int gauss_guide;

    int pix_diff;
    int diff_thld;

} RK_Bayer2dnr_Params_V2_Select_t;
```

【Members】

Member name	Parameter type	Description
enable	Debug parameters	The module switch is enabled. 1: Module open, 0: Module off.
lumapoint	Calibration data	Different Pixel brightness corresponds to different noise SIGMA curve points. A total of 16 points.
sigma	Calibration data	Different Pixel brightness corresponds to different noise SIGMA curve points. A total of 16 points.
gauss_guide	Debug parameters	Whether Gaussian guidance is enabled. 1: Enable. 0: Close.
filter_strength	Debug parameters	Denoising force parameters. Value range [0, 16], the larger the value, the greater the denoising force.
edgesofts	Debug parameters	Affects airspace weights. The value range is [1, 16], and the default value is 1.
ratio	Debug parameters	Soft threshold weights. The value range is [0, 1.0]. The smaller the value, the greater the denoising force.
weight	Debug parameter	The higher the filter output weight, the greater the denoising intensity
pix_diff	Debug parameter	5x5 window pixel difference threshold for bilateral filtering; Default configuration value 0x3fff.
diff_thld	Debug parameter	The square difference threshold for calculating Euclidean distances for bilateral filtering is 0x3ff;

9.4.4.7 RK_Bayer2dnr_Fix_V2_t

【Description】

Define the manual mode register configuration for the denoising module

【Definition】

```
typedef struct RK_Bayer2dnr_Fix_V2_s {

    //ISP_BAYNR_3A00_CTRL
    uint8_t baynr_lg2_mode;
    uint8_t baynr_gauss_en;
```

```
    uint8_t baynr_log_bypass;
    uint8_t baynr_en;

    // ISP_BAYNR_3A00_DGAIN0-2
    uint16_t baynr_dgain[3];

    // ISP_BAYNR_3A00_PIXDIFF
    uint16_t baynr_pix_diff;

    // ISP_BAYNR_3A00_THLD
    uint16_t baynr_diff_thld;
    uint16_t baynr_softthld;

    // ISP_BAYNR_3A00_W1_STRENG
    uint16_t bltflt_streng;
    uint16_t baynr_reg_w1;

    // ISP_BAYNR_3A00_SIGMAX0-15
    uint16_t sigma_x[16];

    // ISP_BAYNR_3A00_SIGMAY0-15
    uint16_t sigma_y[16];

    // ISP_BAYNR_3A00_WRIT_D
    uint16_t weit_d[3];

    uint16_t lg2_lgoff;
    uint16_t lg2_off;

    uint32_t dat_max;
} RK_Bayer2dnr_Fix_V2_t;

} RK_Bayer2dnr_Fix_V23_t;
```

【Members】

Parameter	Bit width	Parameter description
baynr_gauss_en	1	Gaussian 3x3 Guided Filter Switch Enable Position; 1: Turn on filtering; 0: Turn off filtering; The default value is 0;
baynr_log_bypass	1	log transform whether to perform the control bit, HDR hardware internal forced shutdown; 1: Turn on log transformation bypass, that is, turn off log transformation; 0: Disable log conversion bypass, that is, enable log transformation; The default value is 0;
baynr_en	1	Bayer noise reduction switching enable bit; 1: Turn on noise reduction; 0: Turn off noise reduction; The default configuration value is 0;
baynr_dgain	18	In HDR mode, the parameter corresponding to the gain of three frames, decimal 10bit.
baynr_pix_diff	14	5x5 window pixel difference threshold for bilateral filtering; Default configuration value 0x3fff
baynr_diff_thld	10	The square difference threshold for calculating the Euclidean distance for bilateral filtering has a default configuration value of 0x3ff;
baynr_softthld	10	Weight value of soft threshold, larger value, larger threshold, more noise retained, 10 bits decimal, default configuration value 0xa;
bltflt_streng	12	the noise reduction intensity of bilateral filtering; decimal 8bit; Default configuration value 0xa3
baynr_reg_w1	10	Filter output weight value, the larger the value, the more filtered output value is used, and the smaller the more the original value is used. Decimal places 10bit, default configuration value 0x3ff;
sigma_x	16	The 16 brightness levels of the noise curve should be configured to ensure that the interpolation of the two values is to the power of 2;
sigma_y	16	16 noise sigma levels for the noise curve; The configuration parameters are calibrated.
weit_d	10	The airspace weight values represent the weight values of different locations. Decimal 10bit; The default configuration values are 0x178, 0x249, 0x31d;

9.4.4.8 rk_aiq_bayer2dnr_strength_v2_t

【Description】

Define the denoising intensity configuration structure of the denoising module

【Definition】

```
typedef struct rk_aiq_bayer2dnr_strength_v2_s {
    rk_aiq_uapi_sync_t sync;
    float percent;
} rk_aiq_bayer2dnr_strength_v2_t;
```

【Member】

Member Name	Description
sync	For synchronous asynchronous mode selection, see **Overview/API Description** section
percent	Denoising intensity, the value range is 0.0-1.0.

9.4.4.9 rk_aiq_bayertnr_attrib_v2_t

【Description】

Define the denoising module parameters

【Definition】

```
typedef struct rk_aiq_bayertnr_attrib_v2_s {
    rk_aiq_uapi_sync_t sync;
    Abayertnr_OPMode_V2_t eMode;
    Abayertnr_Auto_Attr_V2_t stAuto;
    Abayertnr_Manual_Attr_V2_t stManual;
} rk_aiq_bayertnr_attrib_v2_t;
```

【Member】

Member Name	Description
sync	For synchronous asynchronous mode selection, see **Overview/API Description** section
eMode	Bayertnr Denoising Module Mode
stAuto	Bayertnr Denoising Module Auto Mode Parameters
stManual	Bayertnr Denoising Module Manual Mode Parameters

9.4.4.10 Abayertnr_OPMode_V2_t

【Description】

Define the mode of the denoising module

【Definition】

```
typedef enum Abayertnr_OPMode_V2_e {
    ABAYERTNRV2_OP_MODE_INVALID           = 0,
    ABAYERTNRV2_OP_MODE_AUTO              = 1,
    ABAYERTNRV2_OP_MODE_MANUAL            = 2,
    ABAYERTNRV2_OP_MODE_REG_MANUAL        = 3,
    ABAYERTNRV2_OP_MODE_MAX
} Abayertnr_OPMode_V2_t;
```

【Member】

Member Name	Description
ABAYERTNRV2_OP_MODE_INVALID	Bayer Domain TNR Denoising Module Invalid Mode
ABAYERTNRV2_OP_MODE_AUTO	Bayer Domain TNR Denoising Module Auto Mode
ABAYERTNRV2_OP_MODE_MANUAL	Bayer domain TNR denoising module manual mode algorithm settings
ABAYERTNRV2_OP_MODE_MAX	Bayer domain TNR denoising module mode maximum, is an invalid mode

9.4.4.11 Abayertnr_Auto_Attr_V2_t

【Description】

Define the automatic properties of the denoising module

【Definition】

```
typedef struct Abayertnr_Auto_Attr_V2_s
{
    int bayernr3DEn;

    RK_Bayertnr_Params_V2_t st3DParams;
    RK_Bayertnr_Params_V2_Select_t st3DSelect;

} Abayertnr_Auto_Attr_V2_t;
```

【Member】

Member Name	Description
bayernr3DEn	Bayer3dnr module enables switch
st3DParams	Bayer3DNR module automatic mode each ISO corresponding algorithm attribute parameter
st3DSelect	The bayer3dnr module calculates the attribute parameter

9.4.4.12 Abayertnr_Manual_Attr_V23_t

【Description】

Define manual properties for the denoising module

【Definition】

```
typedef struct Abayertnr_Manual_Attr_V2_s
{
    int bayernr3DEn;
    RK_Bayertnr_Params_V2_Select_t st3DSelect;

    RK_Bayertnr_Fix_V2_t st3DFix;
} Abayertnr_Manual_Attr_V2_t;
```

【Member】

Member Name	Description
bayernr3DEn	Bayer3dnr module enables switch
st3DSelect	Bayer3DNR manual mode algorithm parameter value
st3Dfix	Bayer3DNR register value in manual mode

9.4.4.13 RK_Bayertnr_Params_V2_t

【Description】

Define the automatic mode of the denoising module, and the corresponding ISO algorithm attribute parameters

【Definition】

```
typedef struct RK_Bayertnr_Params_V2_s
{
    int enable;

    float iso[RK_BAYERNR_V2_MAX_ISO_NUM];
    //calib
    int   lumapoint[16];
    int   sigma[RK_BAYERNR_V2_MAX_ISO_NUM][16];
    int   lumapoint2[16];
    int   lo_sigma[RK_BAYERNR_V2_MAX_ISO_NUM][16];
```

```
    int   hi_sigma[RK_BAYERNR_V2_MAX_ISO_NUM][16];

    //tuning
    int   thumbds[RK_BAYERNR_V2_MAX_ISO_NUM];

    int   lo_enable[RK_BAYERNR_V2_MAX_ISO_NUM];
    int   hi_enable[RK_BAYERNR_V2_MAX_ISO_NUM];
    int   lo_med_en[RK_BAYERNR_V2_MAX_ISO_NUM];
    int   lo_gsbay_en[RK_BAYERNR_V2_MAX_ISO_NUM];
    int   lo_gslum_en[RK_BAYERNR_V2_MAX_ISO_NUM];
    int   hi_med_en[RK_BAYERNR_V2_MAX_ISO_NUM];
    int   hi_gslum_en[RK_BAYERNR_V2_MAX_ISO_NUM];
    int   global_pk_en[RK_BAYERNR_V2_MAX_ISO_NUM];
    int   global_pksq[RK_BAYERNR_V2_MAX_ISO_NUM];
    float lo_filter_strength[RK_BAYERNR_V2_MAX_ISO_NUM];
    float hi_filter_strength[RK_BAYERNR_V2_MAX_ISO_NUM];
    float soft_threshold_ratio[RK_BAYERNR_V2_MAX_ISO_NUM];
    float hi_wgt_comp[RK_BAYERNR_V2_MAX_ISO_NUM];
    float clipwgt[RK_BAYERNR_V2_MAX_ISO_NUM];
    float hidif_th[RK_BAYERNR_V2_MAX_ISO_NUM];
} RK_Bayertnr_Params_V2_t;
```

【Member】

Member Name	Parameter Type	Description
Enable	Debug parameters	Module Enable Switch
iso	Debug parameter	Different ISO gears, corresponding to different debugging parameters. Currently, only 13
lumapoint / sigma	Calibration parameter	The value of the noise curve corresponding to different brightness. A total of 16 points. Lumapoint corresponds to pixel brightness, and sigma corresponds to noise curve value
lumapoint2 / lo_sigma	Calibration parameter	The value of the noise curve corresponding to different brightness. A total of 16 points. Lumapoint2 corresponds to the brightness of the pixels, and lo_sigma corresponds to the noise curve value
lumapoint2 / hi_sigma	Calibration parameter	The value of the noise curve corresponding to different brightness. A total of 16 points. lumapoint2 corresponds to pixel brightness, and hi_sigma corresponds to noise curve value
thumbds	Debug parameter	Downsampling scale
lo_enable	Debug parameter	The low-frequency movement determines whether it is open or not, 1 opens, 0 closes. It is turned on by default.
hi_enable	Debug parameter	High-frequency motion judgment whether to open, 1 open, 0 off. It is turned on by default
lo_med_en	Debug parameter	Internal low-frequency sub-module switch, 1 on, 0 off. It is turned on by default
lo_gsbay_en	Debug parameter	Internal low-frequency sub-module switch, 1 on, 0 off. It is turned on by default
lo_gslum_en	Debug parameter	Internal low-frequency sub-module switch, 1 on, 0 off. It is turned on by default
hi_med_en	Debug parameter	Internal high-frequency submodule switch, 1 on, 0 off. It is turned on by default
hi_gslum_en	Debug parameter	Internal high-frequency submodule switch, 1 on, 0 off. It is turned on by default
global_pk_en	Debug parameter	Whether to use global PK for time domain denoising, 1 is used, 0 is not used. Currently, only 0.

Member Name	Parameter Type	Description
global_pksq	Debug parameter	The square value of the global pk, which is used when the global_pk_en is 1. The default value is 1024, and the value range is [0, 268435455]
lo_filter_strength	Debug parameter	High-frequency exercise determines strength. Ultimately, it affects Hi Sigma, which in turn affects the denoising intensity in the time domain. The default value is 1, and the value range is [0.0, 16.0]
hi_filter_strength	Debug parameter	High-frequency exercise determines strength. Ultimately, it affects Hi Sigma, which in turn affects the denoising intensity in the time domain. The default value is 1, and the value range is [0.0, 16.0]
soft_threshold_ratio	Debug parameter	Soft threshold weights. The higher the value, the more noise is retained, and the value range is [0.0 1.0], and the default value is 0
hi_wgt_comp	Debug parameter	The proportional coefficient value of the superposition weight compensation is only useful when the high frequency is turned on; The default value is 0.16, and the value range is [0.0, 1.0].
clipwgt	Debug parameter	The weight limit value of the image overlay. The default value is 0.03215, and the value range is [0.0, 1.0].
hidif_th	Debug parameter	High-frequency difference threshold. The default value is 32767, and the value range is [0, 65535].

9.4.4.14 RK_Bayertnr_Params_V2_Select_t

【Description】

Defines the algorithm property struct in manual mode for the Denoising module

【Definition】

```
typedef struct RK_Bayertnr_Params_V2_Select_s
{
    int enable;

    //calib
    int lumapoint[16];
    int sigma[16];
    int lumapoint2[16];
    int lo_sigma[16];
    int hi_sigma[16];

    //tuning
```

```
    int thumbds;
    int lo_enable;
    int hi_enable;
    int lo_med_en;
    int lo_gsbay_en;
    int lo_gslum_en;
    int hi_med_en;
    int hi_gslum_en;
    int global_pk_en;
    int global_pksq;

    float lo_filter_strength;
    float hi_filter_strength;
    float soft_threshold_ratio;

    float clipwgt;
    float hi_wgt_comp;
    float hidif_th;
} RK_Bayertnr_Params_V2_Select_t;
```

【Member】

Member Name	Parameter Type	Description
Enable	Debugging parameters	The module enables the switch
lumapoint / sigma	Calibration parameters	The value of the noise curve corresponding to different brightness. A total of 16 points. Lumapoint corresponds to pixel brightness, and sigma corresponds to noise curve value
lumapoint2 / lo_sigma	Calibration parameters	The value of the noise curve corresponding to different brightness. A total of 16 points. Lumapoint2 corresponds to the brightness of the pixels, and lo_sigma corresponds to the noise curve value
lumapoint2 / hi_sigma	Calibration parameters	The value of the noise curve corresponding to different brightness. A total of 16 points. Lumapoint2 corresponds to the brightness of the pixels, and hi_sigma corresponds to the noise curve value
thumbds	Debugging parameters	Downsampling ratio
lo_enable	Debugging parameters	The low-frequency movement determines whether it is open or not, 1 opens, 0 closes. It is turned on by default.
hi_enable	Debugging parameters	High-frequency motion judgment whether to open, 1 open, 0 off. It is turned on by default.
lo_med_en	Debugging parameters	Internal low-frequency sub-module switch, 1 on, 0 off. It is turned on by default.
lo_gsbay_en	Debugging parameters	Internal low-frequency sub-module switch, 1 on, 0 off. It is turned on by default.
lo_gslum_en	Debugging parameters	Internal low-frequency sub-module switch, 1 on, 0 off. It is turned on by default.
hi_med_en	Debugging parameters	Internal high-frequency submodule switch, 1 on, 0 off. It is turned on by default.
hi_gslum_en	Debugging parameters	Internal high-frequency submodule switch, 1 on, 0 off. It is turned on by default.
global_pk_en	Debugging parameters	Whether to use global PK for time domain denoising, 1 is used, 0 is not used. At present, only 0.
global_pksq	Debugging parameters	The square value of the global pk, which is used when the global_pk_en is 1. The default value is 1024, and the value range is [0, 268435455]

Member Name	Parameter Type	Description
lo_filter_strength	Debugging parameters	High-frequency exercise determines strength. Ultimately, it affects Hi Sigma, which in turn affects the denoising intensity in the time domain. Default value 1, value range[0.0, 16.0]
hi_filter_strength	Debugging parameters	High-frequency exercise determines strength. Ultimately, it affects Hi Sigma, which in turn affects the denoising intensity in the time domain. Default value 1, value range[0.0, 16.0]
soft_threshold_ratio	Debugging parameters	Soft threshold weights. The higher the value, the more noise is retained, and the value range is [0.0 1.0], and the default value is 0.
hi_wgt_comp	Debugging parameters	The proportional coefficient value of the superposition weight compensation is only useful when the high frequency is turned on; The default value is 0.16, and the value range is [0.0, 1.0].
clipwgt	Debugging parameters	The weight limit value of the image overlay. The default value is 0.03215, and the value range is 0.0, 1.0.
hidif_th	Debugging parameters	High-frequency difference threshold. The default value is 32767, and the value range is 0, 65535.

9.4.4.15 RK_Bayertnr_Params_V23_Select_t

【Description】

Define the algorithm attribute structure in manual mode for the denoising module

【Definition】

```
typedef struct RK_Bayertnr_Params_V23_Select_s
{
    int enable;

    //calib
    int lumapoint[16];
    int sigma[16];
    int lumapoint2[16];
    int lo_sigma[16];
    int hi_sigma[16];

    //tuning
    int thumbds_w;
    int thumbds_h;

    int lo_enable;
    int hi_enable;
    int lo_med_en;
```

```
    int lo_gsbay_en;
    int lo_gslum_en;
    int hi_med_en;
    int hi_gslum_en;

    int trans_en;

    int wgt_use_mode;
    int wgt_mge_mode;
    int hi_guass;
    int kl_guass;

    bool global_pk_en;
    int global_pksq;

    float lo_filter_strength;
    float hi_filter_strength;
    float soft_threshold_ratio;

    float lo_clipwgt;
    float hi_wgt_comp;
    int   hidif_th;

    float lo_filter_rat0;
    int   lo_filter_thed0;

    int hi_filter_abs_ctrl;
    int hi_filter_filt_bay;
    int hi_filter_filt_avg;
    int hi_filter_filt_mode;

    float hi_filter_rat0;
    int   hi_filter_thed0;
    float hi_filter_rat1;
    int   hi_filter_thed1;


    int   guass_guide_coeff0;
    int   guass_guide_coeff1;
    int   guass_guide_coeff2;
    int   guass_guide_coeff3;

} RK_Bayertnr_Params_V23_Select_t;
```

【Members】

Member Name	Parameter Type	Description
Enable	Debug parameters	Module Enable Switch
lumapoint / sigma	Calibration parameters	Noise curve values for different brightnesses. A total of 16 points. LumaPoint corresponds to Pixel brightness, and Sigma corresponds to the noise curve value
lumapoint2 / lo_sigma	Calibration parameters	Noise curve values for different brightnesses. A total of 16 points. lumapoint2 corresponds to pixel brightness, and lo_sigma corresponds to noise curve value
lumapoint2 / hi_sigma	Calibration parameters	Noise curve values for different brightnesses. A total of 16 points. lumapoint2 corresponds to pixel brightness, and hi_sigma corresponds to noise curve value
thumbds_w thumbds_h	Debug parameters	The downsampling ratio currently only supports three modes: 4x4, 8x4, and 8x8. Default 8x4 mode.
lo_enable	Debug parameters	The low-frequency motion determines whether it is on, 1 on, 0 off. Open by default.
hi_enable	Debug parameters	High-frequency motion determines whether it is on, 1 on, 0 off. Open by default.
lo_med_en	Debug parameters	Internal low-frequency submodule switch, 1 on, 0 off. Open by default.
lo_gsbay_en	Debug parameters	Internal low-frequency submodule switch, 1 on, 0 off. Open by default.
lo_gslum_en	Debug parameters	Internal low-frequency submodule switch, 1 on, 0 off. Open by default.
hi_med_en	Debug parameters	Internal high-frequency submodule switch, 1 on, 0 off. Open by default.
hi_gslum_en	Debug parameters	Internal high-frequency submodule switch, 1 on, 0 off. Open by default.
global_pk_en	Debug parameters	Whether global PK is used for time domain noise reduction, 1 is used and 0 is not. Currently only 0.
global_pksq	Debug parameters	The squared value of the global pk, which is used only when the global_pk_en is 1. The default value is 1024, and the value range is [0, 268435455]

Member Name	Parameter Type	Description
lo_filter_strength	Debug parameters	High-frequency motion judgment force. Finally, it affects HI Sigma, which in turn affects the time-domain denoising force. Default value 1, value range [0.0, 16.0]
hi_filter_strength	Debug parameters	High-frequency motion judgment force. Finally, it affects HI Sigma, which in turn affects the time-domain denoising force. Default value 1, value range [0.0, 16.0]
soft_threshold_ratio	Debug parameters	Soft threshold weights. The larger the value, the more noise is retained, and the value range [0.0 1.0], the default value is 0.
hi_wgt_comp	Debug parameters	The scale coefficient value of superimposed weight complement is only useful when the high frequency is turned on; The default value is 0.16, and the value range is [0.0, 1.0].
lo_clipwgt	Debug parameters	The weight limit value for the image overlay. The default value is 0.03215, and the value range is [0.0, 1.0].
hidif_th	Debug parameters	High-frequency difference threshold. The default value is 32767, and the value range is [0, 65535].
trans_en	Debug parameters	Whether bandwidth saving is enabled. 0: Do not enable, 1: Enable. linear mode can be set. HDR mode is recommended to configure 0.
wgt_use_mode	Debug parameters	Whether to turn on the optimization function when weight fusion. 0: Do not enable, 1: Enable.
wgt_mge_mode	Debug parameters	The high-frequency weight calculation turns on the optimization function. 0: Do not enable, 1: Enable.
hi_guass	Debug parameters	High-frequency SIGMA uses filtered data, or raw unfiltered data. 0: Use raw data, 1: Use filtered data.
kl_guass	Debug parameters	PK sigma looks for filtered data or raw unfiltered data. 0: Use raw data, 1: Use filtered data.
lo_filter_rat0	Debug parameters	When calculating the weight of low-frequency motion judgment, the difference value should be subtracted from the data proportion parameter. range [0.0, 16.0], default value 1.
lo_filter_thed0	Debug parameters	When calculating the weight of low-frequency motion judgment, the data offset parameter to be subtracted from the difference value. value range [0, 4095], default value 0.

Member Name	Parameter Type	Description
hi_filter_rat0	Debug parameters	The proportion of data to be subtracted when calculating the first weight of high-frequency motion. range of values [0.0, 16.0], default value 1.
hi_filter_thed0	Debug parameters	When the first weight is calculated for high-frequency motion judgment, the data offset value to be subtracted from the difference value. value range [0, 4095], default value 256.
hi_filter_rat1	Debug parameters	When calculating the second weight of high-frequency motion judgment, the proportion of data to be subtracted from the difference value. value range [0.0, 16.0], default value 1.
hi_filter_thed1	Debug parameters	When calculating the second weight of high-frequency motion judgment, the data offset value to be subtracted from the difference value is . value range [0, 4095], and the default value is 1024.
hi_filter_abs_ctrl	Debug parameters	Absolute value position selection for high-frequency weight calculation. 0: Difference->median->Gaussian->abs 1: Difference->median->abs->Gaussian default 0.
hi_filter_filt_bay	Debug parameters	When calculating the high-frequency weights, Gaussian filters whether the 4 channels of Bayer data are calculated separately. 1: Separate calculation, 4 channels do 3x3 Gaussian 0: 4 channels are not calculated separately, do 5x7 Gaussian. default value 0.
hi_filter_filt_avg	Debug parameters	Whether the 5x5 filtering function is enabled when calculating the high-frequency weight. 0: not on, 1: on. The default value is 0.
hi_filter_filt_mode	Debug parameters	Filter mode selection when calculating high-frequency weights. range [0, 4]. The default value is 4.
guass_guide_coeff0	Debug parameters	Gaussian filter operators. range [0, 64]. The default values are 16,8,16,8.

9.4.4.16 RK_Bayertnr_Fix_V2_t

【Description】

Define the manual mode register configuration for the denoising module

【Definition】

```
typedef struct RK_Bayertnr_Fix_V2_s {

    // BAY3D_BAY3D_CTRL 0x2c00
    uint8_t bay3d_exp_sel;
    uint8_t bay3d_soft_st;
    uint8_t bay3d_soft_mode;
    uint8_t bay3d_bwsaving_en;
    uint8_t bay3d_loswitch_protect;
    uint8_t bay3d_glbpk_en;
    uint8_t bay3d_logaus3_bypass_en;
    uint8_t bay3d_logaus5_bypass_en;
    uint8_t bay3d_lomed_bypass_en;
    uint8_t bay3d_hichnsplit_en;
    uint8_t bay3d_hiabs_pssel;
    uint8_t bay3d_higaus_bypass_en;
    uint8_t bay3d_himed_bypass_en;
    uint8_t bay3d_lobypass_en;
    uint8_t bay3d_hibypass_en;
    uint8_t bay3d_bypass_en;
    uint8_t bay3d_en_i;

    // BAY3D_BAY3D_KALRATIO 0x2c04
    uint16_t bay3d_softwgt;
    uint16_t bay3d_hidif_th;

    // BAY3D_BAY3D_GLBPK2 0x2c08
    uint32_t bay3d_glbpk2;

    // BAY3D_BAY3D_WGTLMT 0x2c10
    uint16_t bay3d_wgtlmt;
    uint16_t bay3d_wgtratio;

    // BAY3D_BAY3D_SIG_X0  0x2c14 - 0x2c30
    uint16_t bay3d_sig0_x[16];

    // BAY3D_BAY3D_SIG0_Y0 0x2c34 - 0x2c50
    uint16_t bay3d_sig0_y[16];

    // BAY3D_BAY3D_SIG_X0  0x2c54 - 0x2c70
    uint16_t bay3d_sig1_x[16];

    // BAY3D_BAY3D_SIG1_Y0 0x2c74 - 0x2c90
    uint16_t bay3d_sig1_y[16];

    // BAY3D_BAY3D_SIG2_Y0 0x2c94 - 0x2cb0
    uint16_t bay3d_sig2_y[16];

    //BAY3D_BAY3D_LODIF_STAT0 0x2cb4 -0x2cb8
    uint64_t ro_sum_lodif;

    //BAY3D_BAY3D_LODIF_STAT0 0x2cbc -0x2cc0
    uint64_t ro_sum_hidif0;

    //BAY3D_BAY3D_MI_ST 0x2CC8
    uint8_t sw_bay3dmi_st_linemode;
```

```
    uint8_t sw_bay3d_mi2cur_linecnt;
} RK_Bayertnr_Fix_V2_t;
```

【Member】

Parameter	Bit width	Parameter description
bay3d_soft_st	1	The start pulse bit of the software mode, written when turned on 1.
bay3d_soft_mode	1	Enabling bits for software mode. 1: Turn on software mode; 0: Turn off software mode; Default configuration value 0x0;
bay3d_bwsaving_en	1	Bandwidth optimization enables bits, non-HDR is effective. 1: Turn on optimization; 0: Turn off optimization; The default configuration value 0x0;
bay3d_loswitch_protect	1	Not supported at this time.
bay3d_glbpk_en	1	whether Bayer time-domain noise reduction uses global pk; 1: Use global pk values; 0: Use a local pk value; The default configuration value is 1;
bay3d_logaus3_bypass_en	1	whether the low frequency is Gaussian filtered in the post-stage brightness domain; 1: Do not do; 0: Do; The default configuration value 0x0;
bay3d_logaus5_bypass_en	1	whether the low frequencies are Gaussian filtered on the pre-bayer domain; 1: Do not do; 0: Do; The default configuration value 0x0;
bay3d_lomed_bypass_en	1	whether the low frequency is filtered for median; 1: Do not do; 0: Do; The default configuration value 0x0;
bay3d_hichnsplit_en	1	The Gaussian filter that selects it when high-frequency judgment is done on the bayer domain or brightness domain, and this enabling bit is turned on when only the high-frequency motion judgment is opened; 1: Gaussian filtering in the bayer domain; 0: Gaussian filtering in the brightness domain; The default configuration value 0x0;

Parameter	Bit width	Parameter description
bay3d_hiabs_pssel	1	Whether to make an absolute value before Gaussian filtering when judging high frequencies, and open this enabling level when only opening high-frequency motion judgment; 1: Do; 0: Do not do; The default configuration value 0x0;
bay3d_higaus_bypass_en	1	whether Gaussian filtering is done at high frequencies; 1: Do not do; 0: Do; The default configuration value 0x0;
bay3d_himed_bypass_en	1	whether the high frequency is filtered at the median value; 1: Do not do; 0: Do; The default configuration value 0x0;
bay3d_lobypass_en	1	High-frequency movement determines whether it is open; 1: Close; 0: Open; Default configuration value 0x0; At present, this bit does not support dynamic changes, and the default value is always 0.
bay3d_hibypass_en	1	High-frequency movement determines whether it is open; 1: Close; 0: Open; The default configuration value 0x0;
bay3d_bypass_en	1	Bayer's bypass enable bit for time-domain noise reduction; 1: Open bypass, equivalent to bayer3d do nothing. 0: Close bypass; The default configuration value is 0;
bay3d_en_i	1	Switching enable bit for Bayer time-domain noise reduction; 1: Turn on time domain noise reduction; 0: Turn off time-domain noise reduction; The default configuration value is 0;
bay3d_softwgt	10	The weight value of the soft threshold, the larger the value, the larger the threshold, the more noise is retained. Decimal places 10bit, default configuration value 0x100;
bay3d_hidif_th	16	Count the threshold for the number of high-frequency difference values. Default configuration value 0xffff
bay3d_glbpk2	28	The squared value of the global pk, which is used only when the pk_en is 0. Default configuration value 0x800;
bay3d_wgtlmt	10	Weight limit value for image overlays. Decimal places are 10 digits, default configuration value 0x380;

Parameter	Bit width	Parameter description
bay3d_wgtratio	10	The scale coefficient value of superimposed weight complement is only useful when the high frequency is turned on; Decimal places are 10 digits, default configuration value 0x0;
bay3d_sig0_x0-15	16	The 16 brightness levels of the noise curve should be configured to ensure that the difference between the two values is to the power of 2;
bay3d_sig0_y0-15	14	16 noise sigma levels for the noise curve; The configuration parameters are calibrated.
bay3d_sig1_x0-15	16	The 16 brightness levels of the high and low frequency noise curves should be configured to ensure that the difference between the two values is a power of 2;
bay3d_sig1_y0-15	14	16 noise SIGMA levels for high-frequency noise curves; The configuration parameters are calibrated.
bay3d_sig2_y0-15	14	16 noise sigma levels for low-frequency noise curves; The configuration parameters are calibrated.

9.4.4.17 rk_aiq_bayertnr_strength_v2_t

【Description】

Define the denoising intensity configuration structure of the denoising module

【Definition】

```
typedef struct rk_aiq_bayertnr_strength_v2_s {
    rk_aiq_uapi_sync_t sync;
    float percent;
} rk_aiq_bayertnr_strength_v2_t;
```

【Member】

Member Name	Description
sync	For synchronous asynchronous mode selection, see **Overview/API Description** section
percent	Denoising intensity, the value range is 0.0-1.0.

9.4.4.18 rk_aiq_ynr_attrib_v3_t

【Description】

Define the parameters of the denoising module

【Definition】

```
typedef struct rk_aiq_ynr_attrib_v3_s {
    rk_aiq_uapi_sync_t sync;
    Aynr_OPMode_V3_t eMode;
    Aynr_Auto_Attr_V3_t stAuto;
    Aynr_Manual_Attr_V3_t stManual;
} rk_aiq_ynr_attrib_v3_t;
```

【Member】

Member Name	Description
sync	For synchronous asynchronous mode selection, see **Overview/API Description** section
eMode	Ynr Denoising Module Mode
stAuto	YNR Denoising Module Auto Mode Parameters
stManual	Ynr Denoising Module Manual Mode Parameters

9.4.4.19 Aynr_OPMode_V3_t

【Description】

Define the mode of the denoising module

【Definition】

```
typedef enum Aynr_OPMode_V3_e {
    AYNRV3_OP_MODE_INVALID          = 0,
    AYNRV3_OP_MODE_AUTO             = 1,
    AYNRV3_OP_MODE_MANUAL           = 2,
    AYNRV3_OP_MODE_REG_MANUAL       = 3,
    AYNRV3_OP_MODE_MAX
} Aynr_OPMode_V3_t;
```

【Member】

Member Name	Description
AYNRV3_OP_MODE_INVALID	Y-domain ynr denoising module invalid mode
AYNRV3_OP_MODE_AUTO	Y-Domain YNR Denoising Module Auto Mode
AYNRV3_OP_MODE_MANUAL	Y-domain Algorithm settings for the manual mode of the ynr denoising module
AYNRV3_OP_MODE_REG_MANUAL	Y-domain Register settings for the manual mode of the ynr denoising module
AYNRV3_OP_MODE_MAX	Y-domain ynr denoising module mode maximum, is an invalid mode

9.4.4.20 Aynr_Auto_Attr_V3_t

【Description】

Define the automatic properties of the denoising module

【Definition】

```
typedef struct Aynr_Auto_Attr_V3_s
{
    RK_YNR_Params_V3_t stParams;
    RK_YNR_Params_V3_Select_t stSelect;

} Aynr_Auto_Attr_V3_t;
```

【Member】

Member Name	Description
stParams	Each ISO of the ynr module corresponds to the algorithm attribute parameter
stSelect	The ynr module calculates the attribute parameter

9.4.4.21 Aynr_Manual_Attr_V3_t

【Description】

Define manual properties for the denoising module

【Definition】

```
typedef struct Aynr_Manual_Attr_V3_s
{
    RK_YNR_Params_V3_Select_t stSelect;
    RK_YNR_Fix_V3_t stFix;

} Aynr_Manual_Attr_V3_t;
```

【Member】

Member Name	Description
stSelect	Algorithm parameter value
stFix	YNNR register value

9.4.4.22 RK_YNR_Params_V3_t

【Description】

Define the attribute parameters of each ISO corresponding algorithm in the automatic mode of the YNR denoising module

【Definition】

```
typedef struct RK_YNR_Params_V3_s
{
    int enable;
    char version[64];
    float iso[RK_YNR_V3_MAX_ISO_NUM];
    RK_YNR_Params_V3_Select_t arYnrParamsISO[RK_YNR_V3_MAX_ISO_NUM];

} RK_YNR_Params_V3_t;
```

【Member】

Member Name	Description
enable	The ynr module enables the switch
version	ynr module version number
iso	Different ISO gears, corresponding to different debugging parameters. Currently only supports 13 files
RK_YNR_Params_V3_Select_t	Algorithm parameters of the YYNR module

9.4.4.23 RK_YNR_Params_V3_Select_t

【Description】

Define the manual mode algorithm properties of the denoising module

【Definition】

```
typedef struct RK_YNR_Params_V3_Select_s
{
    int enable;

    float lci;
    float hci;
    float sigma[YNR_V3_ISO_CURVE_POINT_NUM];
    short lumaPoint[YNR_V3_ISO_CURVE_POINT_NUM];

    float lo_lumaPoint[6];
    float lo_ratio[6];

    float hi_lumaPoint[6];
    float hi_ratio[6];

    // low frequency
    float rnr_strength[17];
    int ynr_bft3x3_bypass;
    int ynr_lbft5x5_bypass;
    int ynr_lgft3x3_bypass;
    int ynr_flt1x1_bypass;
    int ynr_sft5x5_bypass;

    float low_bf1;
```

```
    float low_bf2;
    float low_thred_adj;
    float low_peak_supress;
    float low_edge_adj_thresh;
    float low_lbf_weight_thresh;
    float low_center_weight;
    float low_dist_adj;
    float low_weight;
    float low_filt1_strength;
    float low_filt2_strength;
    float low_bi_weight;


    // high frequency
    float base_filter_weight1;
    float base_filter_weight2;
    float base_filter_weight3;
    float high_thred_adj;
    float high_weight;
    float high_direction_weight[8];
    float hi_min_adj;
    float hi_edge_thed;

    //local gain control
    float ynr_global_gain_alpha;
    float ynr_global_gain;
    float ynr_adjust_thresh;
    float ynr_adjust_scale;
} RK_YNR_Params_V3_Select_t;
```

【Members】

Member Name	Parameter Type	Description
enable	Debug parameters	The ynr module enables the switch, 1: the module is on, 0: the module is off.
lci	Calibration data	Affects the low-frequency noise sigma influence factor. The larger the value, the greater the noise sigma and the stronger the denoising force.
hci	Calibration data	Affects the high-frequency noise sigma influence factor. The larger the value, the greater the noise sigma and the stronger the denoising force.
sigma	Calibration data	Noise sigma curve.
lumaPoint	Calibration data	Different Pixel brightness corresponds to different noise SIGMA curve points. A total of 16 points.
rnr_strength	Debug parameters	In the center of the image, different denoising forces are set in the direction of the radius r of the circle. It is mainly configured for LSC noise. The value range is [0, 16.0], and the default value is 1.
ynr_bft3x3_bypass	Debug parameters	Module internal submodule bypass function 0: function enable 1: function bypass In general, all submodules are turned on enabled, and these values are set to 0.
ynr_lbft5x5_bypass	Debug parameters	Module internal submodule bypass function 0: function enable 1: function bypass In general, all submodules are turned on enabled, and these values are set to 0.
ynr_lgft3x3_bypass	Debug parameters	Module internal submodule bypass function 0: function enable 1: function bypass In general, all submodules are turned on enabled, and these values are set to 0.
ynr_flt1x1_bypass	Debug parameters	Module internal submodule bypass function 0: function enable 1: function bypass In general, all submodules are turned on enabled, and these values are set to 0.

Member Name	Parameter Type	Description
ynr_sft5x5_bypass	Debug parameters	Module internal submodule bypass function 0: function enable 1: function bypass In general, all submodules are turned on enabled, and these values are set to 0.
low_bf1	Debug parameters	Original figure 3x3 bilateral filtering force, the larger the value, the stronger the denoising. Value range [0.01, 32], default value 1.
low_bf2	Debug parameters	The 5x5 bilateral filtering force of the small picture in the previous frame, the larger the value, the stronger the denoising. Value range [0.01, 32], default value 1.
low_thred_adj	Debug parameters	The higher the value of the low-frequency soft threshold, the greater the low-frequency noise reduction force. The value range is [0, 31], and the default value is 0.5.
low_peak_supress	Debug parameters	Controls the force with which isolated noise is removed, the smaller the value, the greater the denoising force. The value range is [0, 1], and the default value is 0.5.
low_edge_adj_thresh	Debug parameters	The threshold of the adjustment factor for edge detection of the small plot, is used to limit the maximum value that can be taken for the adjustment factor. The smaller the value, the greater the denoising force and the blurrier the image. integer in the range [0, 1023], default value 7.
low_lbf_weight_thresh	Debug parameters	Used to limit the weight of 5x5 bilateral filtering. The higher the value, the weaker the low-frequency noise reduction. The value range is [0.0, 1.0]. Default value 0.25.
low_center_weight	Debug parameters	The weight of the center point during 5x5 bilateral filtering, the smaller the value, the stronger the noise reduction. The value range is [0,1], and the default value is 0.5.
low_dist_adj	Debug parameters	Bilateral filter distance weight adjustment factor. The smaller the value, the stronger the denoising. The value range is [0, 127.0], and the default value is 8.0.
low_weight	Debug parameters	The weight of the low-frequency denoising result, the larger the value, the greater the low-frequency noise reduction force. The value range is [0, 1], and the default value is 0.5.

Member Name	Parameter Type	Description
low_filt1_strength	Debug parameters	The weight of the filter kernel for Gaussian filtering of the original graph. The value range is [0,1.0], and the default value is 0.7.
low_filt2_strength	Debug parameters	Filter kernel weights for Gaussian filtering of the results of bilateral filtering. The value range is [0,1.0], and the default value is 0.85.
low_bi_weight	Debug parameters	The first bilateral filter weights used in soft threshold processing. The higher the value, the greater the noise reduction. The value range is [0, 1], and the default value is 0.3.
base_filter_weight1	Debug parameter	The coefficient of the directional filter. In general, there is little need for adjustment
high_thred_adj	Debug parameter	The higher the value, the greater the intensity of high-frequency noise reduction. The value range is 0, 31.0, and the default value is 1.0
high_weight	Debug parameter	High-frequency denoising weight, note that this value represents the proportion of the retained high-frequency components, and the smaller the value, the stronger the noise reduction. The value range is 0, 1, and the default value is 0.78.
high_direction_weight	Debug parameter	The higher the value in a certain direction, the stronger the noise reduction along that direction.
hi_min_adj	Debug parameter	The ratio of all variance values minus the smallest variance value, the larger the value, the sharper the edges. The value range is 0.0, 1.0, and the default value is 0.9
hi_edge_thed	Debug parameter	The smaller the threshold, the greater the high-frequency noise reduction. An integer in the range of 0, 255, with the default value of 100.
ynr_global_gain_alpha	Debug parameters	Ynr denoising local mode and global mode interpolate force configuration. Generally, the default value is used, no configuration, and all use the local gain method. The value range is [0.0 1.0], and the default value is 0
ynr_global_gain	Debug parameters	Ynr denoising local mode and global mode interpolate force configuration. Generally, the default value is used, no configuration, and all use the local gain method. The gain value range is [0.0 64.0]. Default value 1.

Member Name	Parameter Type	Description
ynr_adjust_thresh	Debug parameters	Denoise force control for noise greater than the threshold ynr_adjust_thresh. The noise in the moving area is large, and the appropriate threshold < BR/> is set to increase the intensity of YNR denoising in the moving area. Value range [0.0, 1.0], default value 1.
ynr_adjust_scale	Debug parameters	Denoise force control for noise greater than the threshold ynr_adjust_thresh. The noise in the moving area is large, and the appropriate threshold < BR/> is set to increase the intensity of YNR denoising in the moving area. Value range [0, 16.0], default value 1
lo_lumaPoint / lo_ratio	Debug parameters	Different Pixel brightness, fine-tuning the low-frequency Sigma
hi_lumaPoint / hi_ratio	Debug parameters	Different Pixel brightness, fine-tuning of high-frequency Sigma

9.4.4.24 RK_YNR_Fix_V3_t

【Description】

Define the manual mode register configuration for the denoising module

【Definition】

```
typedef struct RK_YNR_Fix_V3_s {

    // YNR_2700_GLOBAL_CTRL (0x0000)
    uint8_t ynr_rnr_en;
    uint8_t ynr_gate_dis;
    uint8_t ynr_thumb_mix_cur_en;
    uint8_t ynr_global_gain_alpha;
    uint16_t ynr_global_gain;
    uint8_t ynr_flt1x1_bypass_sel;
    uint8_t ynr_sft5x5_bypass;
    uint8_t ynr_flt1x1_bypass;
    uint8_t ynr_lgft3x3_bypass;
    uint8_t ynr_lbft5x5_bypass;
    uint8_t ynr_bft3x3_bypass;
    uint8_t ynr_en;


    // YNR_2700_RNR_MAX_R  (0x0004)
    uint8_t ynr_local_gainscale;
    uint16_t ynr_rnr_max_r;

    // YNR_2700_RNR_MAX_R  (0x0008)
    uint16_t ynr_rnr_center_coorv;
    uint16_t ynr_rnr_center_coorh;
```

```
// YNR_2700_RNR_MAX_R  (0x000c)
uint8_t ynr_localgain_adj;
uint16_t ynr_localgain_adj_thresh;

// YNR_2700_LOWNR_CTRL0 (0x0010)
uint16_t ynr_low_bf_inv[2];

// YNR_2700_LOWNR_CTRL1  (0x0014)
uint8_t ynr_low_peak_supress;
uint16_t ynr_low_thred_adj;

// YNR_2700_LOWNR_CTRL2 (0x0018)
uint16_t ynr_low_dist_adj;
uint16_t ynr_low_edge_adj_thresh;

// YNR_2700_LOWNR_CTRL3 (0x001c)
uint8_t ynr_low_bi_weight;
uint8_t ynr_low_weight;
uint16_t ynr_low_center_weight;

// YNR_2700_HIGHNR_CTRL0 (0x0020)
uint8_t ynr_hi_min_adj;
uint16_t ynr_high_thred_adj;

// YNR_2700_HIGHNR_CTRL1  (0x0024)
uint8_t ynr_high_retain_weight;
uint8_t ynr_hi_edge_thed;

// YNR_2700_HIGHNR_BASE_FILTER_WEIGHT  (0x0028)
uint8_t ynr_base_filter_weight[3];

// YNR_2700_HIGHNR_BASE_FILTER_WEIGHT  (0x002c)
uint32_t ynr_frame_full_size;
uint16_t ynr_lbf_weight_thres;

// YNR_2700_GAUSS1_COEFF  (0x0030)
uint16_t ynr_low_gauss1_coeff[3];

// YNR_2700_GAUSS2_COEFF  (0x0034)
uint16_t ynr_low_gauss2_coeff[3];

// YNR_2700_DIRECTION_W_0_3  (0x0038 - 0x003c)
uint8_t ynr_direction_weight[8];

// YNR_2700_SGM_DX_0_1 (0x0040 - 0x0060)
uint16_t ynr_luma_points_x[17];

// YNR_2700_LSGM_Y_0_1 (0x0070- 0x0090)
uint16_t ynr_lsgm_y[17];

// YNR_2700_HSGM_Y_0_1 (0x00a0- 0x00c0)
uint16_t ynr_hsgm_y[17];

// YNR_2700_RNR_STRENGTH03 (0x00d0- 0x00e0)
uint16_t ynr_rnr_strength[17];
```

```
} RK_YNR_Fix_V3_t;
```

【Members】

Member Name	Bit width (integer. Decimal)	Description
ynr_low_bf_inv[0]	5.9	Used to control the denoising force, note the reciprocal of the value of this register configuration, so the smaller the value, the greater the denoising force. A value of 512 represents 1x the denoising force and 256 means 2x the denoising force. Value range:[1, 16383]
ynr_low_bf[1]	5.9	To control the denoising intensity, note the reciprocal of the value velocity configured for this register, so the lower the value, the greater the denoising intensity. A value of 512 represents 1x the denoising and 256 means 2x the denoising effort
ynr_low_thred_adj	5.6	The adjustment force of the low-frequency soft threshold, the greater the low-frequency noise reduction force. Value range:[0, 2047]
ynr_low_peak_supress	1.7	Controls the force with which large isolated noises are removed, the higher the value, the stronger the force. Value range: [0, 128]
ynr_low_edge_adj_thresh	11.0	The threshold of the adjustment factor for edge detection of the small plot, which is used to limit the maximum value that can be taken by the adjustment factor. Value range:[1, 1024]
ynr_low_center_weight	1.10	The weight of the center point during 5x5 bilateral filtering, the smaller the value, the stronger the noise reduction. Value range:[1, 1024]
sw_ynr_lbf_weight_thres	10.0	The weight used to limit the 5x5 bilateral filtering value, the higher the value that makes the low-frequency noise reduction weaker. Value range: [0, 1023]
ynr_low_dist_adj	7.2	Bilateral filter distance weight adjustment factor Value range:[1, 511]
ynr_low_weight	1.7	The weight of the low-frequency denoising result, the higher the value that the more powerful the low-frequency noise reduction. Value range: [0, 128]
ynr_low_gauss1_coeff[3]	1.8	The weight range of the filter kernel for Gaussian filtering of the original graph is [0, 256]
ynr_low_gauss2_coeff[3]	1.8	Gaussian filter kernel weights range for Gaussian filtering results of bilateral filtering [0, 256]

Member Name	Bit width (integer. Decimal)	Description
ynr_low_bi_weight	1.7	The first bilateral filter weight used in soft threshold processing, the higher the value, the greater the noise reduction. Value range: [0, 128]
ynr_base_filter_weight[3]	1.6	The coefficient of the directional filter Value range:[0, 64]
ynr_high_thred_adj	5.6	The higher the value, the greater the intensity of high-frequency noise reduction. Value range [0, 2047]
ynr_high_retain_weight	1.7	High-frequency denoising weight, note that this value represents the proportion of the high-frequency component that is retained, so the higher the value, the weaker the noise reduction. Value range [0, 128]
ynr_direction_weight[8]	1.4	The greater the value in a certain direction, the stronger the noise reduction along that direction. Value range [0,16]
ynr_hi_min_adj	0.6	The ratio of all variance values minus the smallest variance value, the larger the value, the sharper the edges. Value range [6,60]
ynr_hi_edge_thed	10.0	The smaller the threshold, the greater the high-frequency noise reduction. Value range [0,1023]
ynr_rnr_max_r	14.0	It is used to adjust the radial noise reduction strength, and is used to store the value of 1/((rows/2)^2+(cols/2)^2), where the first 9 bits are the mantissa M and the last 5 bits are the exponential E Value range [1, 16383]
ynr_rnr_strength[17]	4.4	Used to control the radial noise reduction force, there are a total of 17 data points, divided into 16 segments, representing the denoising intensity from the center point of the image to the four corners of the image. Value range [0, 15]
ynr_global_gain	6.4	The externally configured global gain controls the overall noise reduction intensity of the YNR, and the higher the value, the stronger the noise reduction force. Value range [0, 1023]

Member Name	Bit width (integer. Decimal)	Description
ynr_global_gain_alpha	1.3	Controls the proportion of the gain value passed by the gain module and the externally configured gain value, the larger the value that uses the external global gain. Value range [0, 8]
ynr_bft3x3_bypass	1	Turn off 3x3 bilateral filtering when set to 1 Value range 0 or 1
ynr_lbft5x5_bypass	1	Turn off 5x5 bilateral filtering when set to 1 Value range 0 or 1
ynr_lgft3x3_bypass	1	When 1, turn off the 3x3 Gaussian filter
ynr_flt1x1_bypass	1	When 1, turn off the low-frequency soft threshold processing value range 0 or 1
ynr_sft5x5_bypass	1	Turn off the high-frequency noise cancellation of 1x5 when it is 5 value range 0 or 1

9.4.4.25 rk_aiq_ynr_strength_v3_t

【Description】

Define the denoising intensity configuration structure of the denoising module

【Definition】

```
typedef struct rk_aiq_ynr_strength_v3_s {
    rk_aiq_uapi_sync_t sync;
    float percent;
    bool strength_enable;
} rk_aiq_ynr_strength_v3_t;
```

【Member】

Member Name	Description
sync	For synchronous asynchronous mode selection, see **Overview/API Description** section
percent	Denoising intensity, the value range is 0.0-1.0.

9.4.4.26 rk_aiq_cnr_attrib_v2_t

【Description】

Define the denoising module parameters

【Definition】

```
typedef struct rk_aiq_cnr_attrib_v2_s {
    rk_aiq_uapi_sync_t sync;
    AcnrV2_OPMode_t eMode;
    Acnr_Auto_Attr_V2_t stAuto;
    Acnr_Manual_Attr_V2_t stManual;
} rk_aiq_cnr_attrib_v2_t;
```

【Member】

Member Name	Description
sync	For synchronous asynchronous mode selection, see **Overview/API Description** section
eMode	CNR Denoising Module Mode
stAuto	CNR Denoising Module Auto Mode Parameters
stManual	CNR Denoising Module Manual Mode Parameters

9.4.4.27 AcnrV2_OPMode_t

【Description】

Define the mode properties of the denoising module

【Definition】

```
typedef enum AcnrV2_OPMode_e {
    ACNRV2_OP_MODE_INVALID          = 0,
    ACNRV2_OP_MODE_AUTO             = 1,
    ACNRV2_OP_MODE_MANUAL           = 2,
    ACNRV2_OP_MODE_REG_MANUAL       = 3,
    ACNRV2_OP_MODE_MAX
} AcnrV2_OPMode_t;
```

【Member】

Member Name	Description
ACNRV2_OP_MODE_INVALID	UV domain CNR denoising module invalid mode
ACNRV2_OP_MODE_AUTO	UV domain CNR denoising module auto mode
ACNRV2_OP_MODE_MANUAL	UV domain Algorithm settings for manual mode of the CNR denoising module
ACNRV2_OP_MODE_REG_MANUAL	UV domain register settings for manual mode of the CNR denoising module
ACNRV2_OP_MODE_MAX	UV domain CNR denoising module mode maximum, is an invalid mode

9.4.4.28 Acnr_Auto_Attr_V2_t

【Description】

Define the automatic properties of the denoising module

【Definition】

```
typedef struct Acnr_Auto_Attr_V2_s
{
    all ISO params and select param

RK_CNR_Params_V2_t stParams;
    RK_CNR_Params_V2_Select_t stSelect;

} Acnr_Auto_Attr_V2_t;
```

【Member】

Member Name	Description
stParams	Each ISO of the CNR module corresponds to the algorithm attribute parameter
stSelect	The CNR module calculates the attribute parameter

9.4.4.29 Acnr_Manual_Attr_V2_t

【Description】

Define manual properties for the denoising module

【Definition】

```
typedef struct Acnr_Manual_Attr_V2_s
{
    RK_CNR_Params_V2_Select_t stSelect;

RK_CNR_Fix_V2_t stFix;

} Acnr_Manual_Attr_V2_t;
```

【Member】

Member Name	Description
stSelect	Algorithm parameter values
stSelect	Register value

9.4.4.30 RK_CNR_Params_V2_t

【Description】

Define the automatic mode of the denoising module, and the corresponding ISO algorithm attribute parameters

【Definition】

```
typedef struct RK_CNR_Params_V2_s
{
    int enable;
    float iso[RK_CNR_V2_MAX_ISO_NUM];
    int hf_bypass[RK_CNR_V2_MAX_ISO_NUM];
    int lf_bypass[RK_CNR_V2_MAX_ISO_NUM];

    // gain
    float global_gain[RK_CNR_V2_MAX_ISO_NUM];
    float global_gain_alpha[RK_CNR_V2_MAX_ISO_NUM];
    float local_gain_scale[RK_CNR_V2_MAX_ISO_NUM];

    // strength adj by gain
    int gain_adj_strength_ratio[RK_CNR_V2_MAX_ISO_NUM]
[RKCNR_V2_SGM_ADJ_TABLE_LEN];

    //
    float color_sat_adj[RK_CNR_V2_MAX_ISO_NUM];
    float color_sat_adj_alpha[RK_CNR_V2_MAX_ISO_NUM];

    // step1
    // median filter
    float hf_spikes_reducion_strength[RK_CNR_V2_MAX_ISO_NUM];

    // bilateral filter
    float hf_denoise_strength[RK_CNR_V2_MAX_ISO_NUM];
    float hf_color_sat[RK_CNR_V2_MAX_ISO_NUM];
    float hf_denoise_alpha[RK_CNR_V2_MAX_ISO_NUM];
    int  hf_bf_wgt_clip[RK_CNR_V2_MAX_ISO_NUM];


    // step2
    // median filter
    float thumb_spikes_reducion_strength[RK_CNR_V2_MAX_ISO_NUM];

    // bilateral filter
    float thumb_denoise_strength[RK_CNR_V2_MAX_ISO_NUM];
    float thumb_color_sat[RK_CNR_V2_MAX_ISO_NUM];

    // step3
    // bilateral filter
    float lf_denoise_strength[RK_CNR_V2_MAX_ISO_NUM];
    float lf_color_sat[RK_CNR_V2_MAX_ISO_NUM];
    float lf_denoise_alpha[RK_CNR_V2_MAX_ISO_NUM];

    // bilateral filter kernels
    float kernel_5x5[5];
```

```
} RK_CNR_Params_V2_t;
```

【Member】

Parameter Name	Parameter Type	Parameter Description
Enable	Debugging parameters	The module switch is enabled. 1: The module is on, 0: The module is closed.
iso	Debugging parameters	Different ISO gears, corresponding to different debugging parameters. Currently, only 13 gears are supported.
hf_bypass	Debugging parameters	High-frequency noise reduction bypass. 0: No bypass, 1: bypass.
lf_bypass	Debugging parameters	Low-frequency noise reduction bypass.0:No bypass, 1:bypass.
global_gain	Debugging parameters	CNR denoising local mode and global mode interpolation strength configuration. Generally, the default value is used, and the local gain method is used without configuration. The value range is 0.0 to 64.0, and the default value is 1.
global_gain_alpha	Debugging parameters	CNR denoising local mode and global mode interpolation strength configuration. Generally, the default value is used, and the local gain method is used without configuration. The value range is 0.0 1.0, and the default value is 0.
global_gain_scale	Debugging parameters	To amplify the CNR denoising strength, the default value is generally used, and it is not easy to adjust. The value range is 0, 128, and the default value is 1.
gain_adj_strength_ratio	Debugging parameters	Adjust the filter intensity based on the local gain value. The lower the value, the stronger the noise removal. The value range is [1, 255], the default value is 255.
color_sat_adj	Debugging parameters	The UV ratio of bilateral filtering based on gradient adjustment, 1~255. The smaller the value, the better the color noise removal. Valid values: [1, 255]. The default value is 40.
color_sat_adj_alpha	Debugging parameters	color_sat_adj Adjusted ratio. The higher the value, the better the color noise removal. The value range is 0, 1.0. The default value is 0.8.
hf_spikes_reducion_strength	Debugging parameters	High frequency median filter intensity. The higher the value, the stronger the median filtering. The value range is 0, 1.0. The default value is 0.5.

Parameter Name	Parameter Type	Parameter Description
hf_denoise_strength	Debugging parameters	High-frequency bilateral filter intensity. The higher the value, the better the color noise removal. The value range is [1, 1023]. The default value is 10.
hf_color_sat	Debugging parameters	UV scale factor for high-frequency bilateral filtering. The lower the value, the more the color saturation drops. The value range is 0.0, 7.9. The default value is 1.5.
hf_denoise_alpha	Debugging parameters	The weight of the center point of the high-frequency bilateral filter. Valid values: 0.0, 1.0. The default value is 0.
hf_bf_wgt_clip	Debugging parameters	Minimum denoising at high frequencies. The higher the value, the stronger the denoising. The value range is 0, 255. The default value is 0.
thumb_spikes_reducion_strength	Debugging parameters	Thumbnail median filter intensity. The higher the value, the stronger the median filtering. Valid values: 0.0, 1.0. The default value is 0.5.
thumb_denoise_strength	Debugging parameters	Thumbnail bilateral filter intensity. The higher the value, the better the color noise removal. The value range is [1, 1023]. The default value is 8.
thumb_color_sat	Debugging parameters	The UV scale factor of thumbnail double-sided filtering, the more color saturation drops. The value range is 0.0, 7.9. Default value is 4.
lf_denoise_strength	Debugging parameters	Low-frequency bilateral filtering intensity. The higher the value, the better the color noise removal. The value range is [1, 1023]. The default value is 8.
lf_color_sat	Debugging parameters	The UV ratio of low-frequency bilateral filtering is due to. The lower the value, the more the color saturation drops. The value range is 0.0, 7.9. Default value is 4.
lf_denoise_alpha	Debugging parameters	The weight of the center point of the low-frequency bilateral filter. Valid values: 0.0, 1.0. The default value is 0.5.
kernel_5x5	Debugging parameters	5x5 bilateral filter core.

9.4.4.31 RK_CNR_Params_V2_Select_t

【Description】

Define the manual mode algorithm properties of the denoising module

【Definition】

```
typedef struct RK_CNR_Params_V2_Select_s
{
    int enable;

    // bypass
    int hf_bypass;
    int lf_bypass;

    // gain

    // gain
    float global_gain;
    float global_gain_alpha;
    float local_gain_scale;

    // strength adj by gain
    int gain_adj_strength_ratio[RKCNR_V2_SGM_ADJ_TABLE_LEN];

    //
    float color_sat_adj;
    float color_sat_adj_alpha;

    // step1
    // median filter
    float hf_spikes_reducion_strength;

    // bilateral filter
    float hf_denoise_strength;
    float hf_color_sat;
    float hf_denoise_alpha;
    int hf_bf_wgt_clip;

    // step2

    // median filter
    float thumb_spikes_reducion_strength;

    // bilateral filter
    float thumb_denoise_strength;
    float thumb_color_sat;

    // step3
    // bilateral filter
    float lf_denoise_strength;
    float lf_color_sat;
    float lf_denoise_alpha;

    // bilateral filter kernels
```

```
    float kernel_5x5[5];

} RK_CNR_Params_V2_Select_t;
```

【Member】

Parameter Name	Parameter Type	Parameter Description
Enable	Debugging parameters	The module switch is enabled. 1: The module is on, 0: The module is closed.
iso	Debugging parameters	Different ISO gears, corresponding to different debugging parameters. Currently, only 13 gears are supported.
hf_bypass	Debugging parameters	High-frequency noise reduction bypass. 0: No bypass, 1: bypass.
lf_bypass	Debugging parameters	Low-frequency noise reduction bypass.0:No bypass, 1:bypass.
global_gain	Debugging parameters	CNR denoising local mode and global mode interpolation strength configuration. Generally, the default value is used, and the local gain method is used without configuration. The value range is 0.0 to 64.0, and the default value is 1.
global_gain_alpha	Debugging parameters	CNR denoising local mode and global mode interpolation strength configuration. Generally, the default value is used, and the local gain method is used without configuration. The value range is 0.0 1.0, and the default value is 0.
global_gain_scale	Debugging parameters	To amplify the CNR denoising strength, the default value is generally used, and it is not easy to adjust. The value range is 0, 128, and the default value is 1.
gain_adj_strength_ratio	Debugging parameters	Adjust the filter intensity based on the local gain value. The lower the value, the stronger the noise removal. The value range is [1, 255], the default value is 255.
color_sat_adj	Debugging parameters	The UV ratio of bilateral filtering based on gradient adjustment, 1~255. The smaller the value, the better the color noise removal. Valid values: [1, 255]. The default value is 40.
color_sat_adj_alpha	Debugging parameters	color_sat_adj Adjusted ratio. The higher the value, the better the color noise removal. The value range is 0, 1.0. The default value is 0.8.
hf_spikes_reducion_strength	Debugging parameters	High frequency median filter intensity. The higher the value, the stronger the median filtering. The value range is 0, 1.0. The default value is 0.5.

Parameter Name	Parameter Type	Parameter Description
hf_denoise_strength	Debugging parameters	High-frequency bilateral filter intensity. The higher the value, the better the color noise removal. The value range is [1, 1023]. The default value is 10.
hf_color_sat	Debugging parameters	UV scale factor for high-frequency bilateral filtering. The lower the value, the more the color saturation drops. The value range is 0.0, 7.9. The default value is 1.5.
hf_denoise_alpha	Debugging parameters	The weight of the center point of the high-frequency bilateral filter. Valid values: 0.0, 1.0. The default value is 0.
hf_bf_wgt_clip	Debugging parameters	Minimum denoising at high frequencies. The higher the value, the stronger the denoising. The value range is 0, 255. The default value is 0.
thumb_spikes_reducion_strength	Debugging parameters	Thumbnail median filter intensity. The higher the value, the stronger the median filtering. Valid values: 0.0, 1.0. The default value is 0.5.
thumb_denoise_strength	Debugging parameters	Thumbnail bilateral filter intensity. The higher the value, the better the color noise removal. The value range is [1, 1023]. The default value is 8.
thumb_color_sat	Debugging parameters	The UV scale factor of thumbnail double-sided filtering, the more color saturation drops. The value range is 0.0, 7.9. Default value is 4.
lf_denoise_strength	Debugging parameters	Low-frequency bilateral filtering intensity. The higher the value, the better the color noise removal. The value range is [1, 1023]. The default value is 8.
lf_color_sat	Debugging parameters	The UV ratio of low-frequency bilateral filtering is due to. The lower the value, the more the color saturation drops. The value range is 0.0, 7.9. Default value is 4.
lf_denoise_alpha	Debugging parameters	The weight of the center point of the low-frequency bilateral filter. Valid values: 0.0, 1.0. The default value is 0.5.
kernel_5x5	Debugging parameters	5x5 bilateral filter core.

9.4.4.32 RK_CNR_Fix_V2_t

【Description】

Define the manual mode register configuration for the denoising module

【Definition】

```
typedef struct RK_CNR_Fix_V2_s {
    //ISP_CNR_2800_CTRL
    uint8_t cnr_thumb_mix_cur_en;
    uint8_t cnr_lq_bila_bypass;
    uint8_t cnr_hq_bila_bypass;
    uint8_t cnr_exgain_bypass;
    uint8_t cnr_en_i;

    // ISP_CNR_2800_EXGAIN
    uint8_t cnr_global_gain_alpha;
    uint16_t cnr_global_gain;

    // ISP_CNR_2800_GAIN_PARA
    uint8_t cnr_gain_iso;
    uint8_t cnr_gain_offset;
    uint8_t cnr_gain_1sigma;

    // ISP_CNR_2800_GAIN_UV_PARA
    uint8_t cnr_gain_uvgain1;
    uint8_t cnr_gain_uvgain0;

    // ISP_CNR_2800_LMED3
    uint8_t cnr_lmed3_alpha;

    // ISP_CNR_2800_LBF5_GAIN
    uint8_t cnr_lbf5_gain_y;
    uint8_t cnr_lbf5_gain_c;

    // ISP_CNR_2800_LBF5_WEITD0_4
    uint8_t cnr_lbf5_weit_d[5];

    // ISP_CNR_2800_HMED3
    uint8_t cnr_hmed3_alpha;

    // ISP_CNR_2800_HBF5
    uint8_t cnr_hbf5_weit_src;
    uint8_t cnr_hbf5_min_wgt;
    uint16_t cnr_hbf5_sigma;

    // ISP_CNR_2800_LBF3
    uint8_t cnr_lbf5_weit_src;
    uint16_t cnr_lbf3_sigma;

    //ISP_CNR_2800_SIGMA0-SIGMA3
    uint8_t cnr_sigma_y[13];

} RK_CNR_Fix_V2_t;
```

【Members】

Parameter Name	Parameter Description
cnr_thumb_mix_cur_en	The thumbnail of the current frame is mixed with the enabling signal of the previous image: 1'b1: mix enabled 1'b0:mix is disabled It is the display registers that are read back.
cnr_lq_bila_bypass	Low-frequency bilateral 3x3 filter bypass enable signal 1'b1: bypass is enable, out_data equals in_data in this 3x3 filter. 1'b0: Bypass is disabled. It is the display registers that are read back.
cnr_hq_bila_bypass	High-frequency 5x5 bilateral filter bypass signal 1: bypass is enable, out_data equals in_data in this 5x5 filter. 0: Bypass is disabled. It is the display registers that are read back.
cnr_exgain_bypass	sw_cnr_exgain_bypass External gain bypass enable signal 1: Bypass is enabled, and the external gain value is fixed at sw_cnr_egain_mux 0: bypass is disabled, and the external gain is used. The current version does not support bypassing the disable. It is the display registers that are read back.
cnr_en_i	CNR module enable signal 1: enabled; 0: disabled
cnr_global_gain	CNR denoising local mode and global mode interpolation strength configuration. Generally, the default value is used, and the local gain method is used without configuration. The value range is 0.0 to 64.0, and the default value is 1.
cnr_global_gain_alpha	CNR denoising local mode and global mode interpolation strength configuration. Generally, the default value is used, and the local gain method is used without configuration. The value range is 0.0 1.0, and the default value is 0.
cnr_gain_iso	Amplify the external gain, the range is 0~128
cnr_gain_offset	The gain offset of the low-pass filter in the gain calibration, in the range of 0~16
cnr_gain_1sigma	Amplify the output data of the high-pass filter in the gain calibration
cnr_gain_uvgain1	uvgain parameter 1
cnr_gain_uvgain0	uvgain parameter 0
cnr_lmed3_alpha	in_data weight in the low-frequency median filter, ranging from 0~16
cnr_lbf5_gain_y;	Y gain of the lbf5x5 bilateral filter
cnr_lbf5_gain_c;	UV gain of lbf5x5 bilateral filter
cnr_lbf5_weit_d[0]	The spatial weight of pix12, the range is 1~128

Parameter Name	Parameter Description
cnr_lbf5_weit_d[1]	The spatial weight of pix7,11,13,17, the range is 0~128
cnr_lbf5_weit_d[2]	The spatial weight of pix6,8,16,18, the range is 0~128
cnr_lbf5_weit_d[3]	Spatial weight of distance 4 or 5, range 0~128
cnr_lbf5_weit_d[4]	pix0,4,20,24 spatial weight, range 0~128
cnr_hmed3_alpha	in_data weight in the high-frequency median filter, ranging from 0~16
cnr_hbf5_weit_src	The in_data weight of hbf5x5 ranges from 0~128
cnr_hbf5_min_wgt	hbf5x5 weit_r lower limit
cnr_hbf5_sigma	Sigma value of hbf5x5
cnr_lbf5_weit_src	The in_data weight of lbf3x3 ranges from 0~128
cnr_lbf3_sigma	sigma value of lbf3x3

9.4.4.33 rk_aiq_cnr_strength_v2_t

【Description】

Define the denoising intensity configuration structure of the denoising module

【Definition】

```
typedef struct rk_aiq_cnr_strength_v2_s {
    rk_aiq_uapi_sync_t sync;
    float percent;
} rk_aiq_cnr_strength_v2_t;
```

【Member】

Member Name	Description
sync	For synchronous asynchronous mode selection, see **Overview/API Description** section
percent	Denoising intensity, the value range is 0.0-1.0.

9.5 BLC

9.5.1 Description of the feature

9.5.2 Functional level API reference

9.5.2.1 rk_aiq_user_api2_ablc_SetAttrib

【Description】

Set the blc parameter property

【Grammar】

```
XCamReturn
rk_aiq_user_api2_ablc_SetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_blc_attrib_t *attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	blc parameter attribute	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_ablc.h, RkAiqHandleInt.h, rk_aiq_user_api2_sysctl.h
- Library file: librkaiq.so

9.5.2.2 rk_aiq_user_api2_ablc_GetAttrib

【Description】

Gets the BLC parameter properties

【Grammar】

```
XCamReturn
rk_aiq_user_api2_ablc_GetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_blc_attrib_t *attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	blc parameter attribute	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_ablc.h, RkAiqHandleInt.h, rk_aiq_user_api2_sysctl.h
- Library file: librkaiq.so

9.5.3 Module-level API data types

9.5.3.1 rk_aiq_blc_attrib_t

【Description】

BLC module parameters

【Definition】

```
typedef struct rk_aiq_blc_attrib_s {
    rk_aiq_uapi_sync_t sync;
    AblcOPMode_t eMode;
    AblcParams_t stBlc0Auto;
    AblcParams_t stBlc1Auto;
    AblcManualAttr_t stBlc0Manual;
    AblcManualAttr_t stBlc1Manual;
} rk_aiq_blc_attrib_t;
```

【Member】

Member Name	Description
sync	For synchronous asynchronous mode selection, see **Overview/API Description** section
eMode	BLC Module Mode
stBlc0Auto	blc0 automatic mode parameter
stBlc0Manual	blc0 manual mode parameter
stBlc1Auto	blc1 Auto Mode Parameter
stBlc1Manual	blc1 manual mode parameter

9.5.3.2 AblcOPMode_t

【Description】

Define the mode properties of the denoising module

【Definition】

```
typedef enum AblcOPMode_e {
    ABLC_OP_MODE_OFF          = 0,
    ABLC_OP_MODE_AUTO               = 1,
    ABLC_OP_MODE_MANUAL             = 2,
    ABLC_OP_MODE_MAX
} AblcOPMode_t;
```

【Member】

Member Name	Description
ABLC_OP_MODE_OFF	BLC module invalid mode
ABLC_OP_MODE_AUTO	BLC Module Auto Mode
ABLC_OP_MODE_MANUAL	Algorithm settings for manual mode of the BLC module
ABLC_OP_MODE_MAX	BLC module mode maximum, which is an invalid mode

9.5.3.3 AblcParams_t

【Description】

BLC module automatic mode parameters

【Definition】

```
typedef struct AblcParams_s {
    bool enable;
    int len;
    float* iso;
    float* blc_r;
    float* blc_gr;
    float* blc_gb;
    float* blc_b;
} AblcParams_t;
```

【Member】

Member Name	Description
enable	Module enable switch 1: enable; 0: Disability;
len	iso corresponds to array length
iso	ISO rating
blc_r	Different ISO correspondence, BLC value. Array pointer
blc_gr	Different ISO correspondence, BLC value. Array pointer
blc_gb	Different ISO correspondence, BLC value. Array pointer
blc_b	Different ISO correspondence, BLC value. Array pointer

9.5.3.4 AblcManualAttr_t

【Description】

BLC module manual mode parameters

【Definition】

```
typedef struct AblcSelect_s {
    bool enable;
    short int blc_r;
    short int blc_gr;
    short int blc_gb;
    short int blc_b;
} AblcSelect_t;

typedef AblcSelect_t AblcManualAttr_t;
```

【Member】

Member Name	Description
enable	Module enable switch 1: enable; 0: Disability;
blc_r	BLC module R channel properties
blc_gr	blc module gr channel properties
blc_gb	BLC module GB channel properties
blc_b	BLC module B channel properties

9.6 Dehaze&Enhance

9.6.1 Description of the feature

Dehaze & Enhanced contains 2 modes:

- Dehaze is enhanced by dynamically changing the contrast and brightness of the image.
- Enhance the contrast of local areas of the image.

Dehaze and Enhanced are mutually exclusive.

9.6.2 Functional level API reference

9.6.2.1 rk_aiq_uapi2_setDehazeModuleEnable

【Description】

Set the dehaze module switch to control stAuto.DehazeTuningPara.Enable or stManual.Enable (automatically modified according to the current api mode).

【Grammar】

```
XCamReturn rk_aiq_uapi2_setDehazeModuleEnable(const rk_aiq_sys_ctx_t* ctx, bool
on);
```

【Parameter】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
on	Switch function.	Input

【Return value】

Return value	Description
0	succeed
Non-0	Failed, see the error code table for details

【Demand】

- Header Files:rk_aiq_user_api2_imgproc.h
- Library files:librkaiq.so

9.6.2.2 rk_aiq_uapi2_setDehazeEnable

【Description】

Set the Dehaze function switch to control stAuto.DehazeTuningPara.dehaze_setting.en or stManual.dehaze_setting.en (automatically modified according to the current API mode).

【Grammar】

```
XCamReturn rk_aiq_uapi2_setDehazeEnable(const rk_aiq_sys_ctx_t* ctx, bool on);
```

【Parameter】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
on	Switch function.	Input

【Return value】

Return value	Description
0	succeed
Non-0	Failed, see the error code table for details

【Demand】

- Header Files:rk_aiq_user_api2_imgproc.h
- Library files:librkaiq.so

9.6.2.3 rk_aiq_uapi2_setMDehazeStrth

【Description】

Set the manual dehazing strength, based on 50, greater than 50 will increase the dehazing strength, less than 50 will reduce the dehazing intensity.

Both DEHAZE_API_AUTO and DEHAZE_API_MANUAL are set to API mode.

Before using this API, you need to ensure that the Dehaze function takes effect, or call the rk_aiq_uapi2_setDehazeModuleEnable and rk_aiq_uapi2_setDehazeEnable before using this API (see Case 6 in sample_adehaze_module.cpp for the process).

【Grammar】

```
XCamReturn rk_aiq_uapi2_setMDehazeStrth(const rk_aiq_sys_ctx_t* ctx, unsigned int
level);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
level	Grade, value range [1,100], default value is 50, precision 1.	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

9.6.2.4 rk_aiq_uapi2_getMDehazeStrth

【Description】

Get the manual dehazing force.

【Grammar】

```
XCamReturn rk_aiq_uapi2_getMDehazeStrth(const rk_aiq_sys_ctx_t* ctx, unsigned
int* level);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
level	Grade, value range [1,100], default value is 50, precision 1.	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

9.6.2.5 rk_aiq_uapi2_setEnhanceEnable

【Description】

Set the Dehaze function switch to control stAuto.DehazeTuningPara.enhance_setting.en or stManual.enhance_setting.en (automatically modified according to the current API mode).

【Grammar】

```
XCamReturn rk_aiq_uapi2_setEnhanceEnable(const rk_aiq_sys_ctx_t* ctx, bool on);
```

【Parameters】

Return value	Description	Input/Output
ctx	AIQ context pointer	Input
on	Switch function.	Input

【Return Value】

Return Value	Description
0	Success
Non-0	Failure, see Error Code Table

【Demand】

- Header Files:rk_aiq_user_api2_imgproc.h
- Library files:librkaiq.so

9.6.2.6 rk_aiq_uapi2_setMEnhanceStrth

【Description】

Set the manual contrast enhancement strength, based on 50, greater than 50 to enhance the contrast, less than 50 to decrease the contrast.

Both DEHAZE_API_AUTO and DEHAZE_API_MANUAL are set to API mode.

Before using this API, you need to ensure that the Enhance function takes effect, or call the rk_aiq_uapi2_setDehazeModuleEnable and rk_aiq_uapi2_setEnhanceEnable before using this API (see Case 9 in sample_adehaze_module.cpp for the process).

【Grammar】

```
XCamReturn rk_aiq_uapi2_setMEnhanceStrth(const rk_aiq_sys_ctx_t* ctx, unsigned
int level);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
level	Grade, value range [1,100], default value is 50, precision 1.	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

9.6.2.7 rk_aiq_uapi2_getMEnhanceStrth

【Description】

Get manual contrast enhancement.

【Grammar】

```
XCamReturn rk_aiq_uapi2_getMEnhanceStrth(const rk_aiq_sys_ctx_t* ctx, unsigned
int *level);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
level	Grade, value range [1,100], default value is 50, precision 1.	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

9.6.3 Module-level API reference

9.6.3.1 rk_aiq_user_api2_adehaze_v12_setSwAttrib

【Description】

Set dehaze parameters.

【Grammar】

```
XCamReturn  rk_aiq_user_api2_adehaze_setSwAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
const adehaze_sw_v2_t* attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	Dehazing parameters	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

9.6.3.2 rk_aiq_user_api2_adehaze_getSwAttrib

【Description】

Gets the current dehazing parameters.

【Grammar】

```
XCamReturn  rk_aiq_user_api2_adehaze_getSwAttrib(const rk_aiq_sys_ctx_t*
sys_ctx,adehaze_sw_v2_t* attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	Dehazing parameters	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

9.6.4 Module-level API data types

9.6.4.1 dehaze_api_mode_t

【Description】

Define the dehaze module operating mode

【Definition】

```
typedef enum dehaze_api_mode_e {
    DEHAZE_API_AUTO   = 0,
    DEHAZE_API_MANUAL = 1,
} dehaze_api_mode_t;
```

【Member】

Member Name	Description
DEHAZE_API_AUTO	Auto Dehaze mode
DEHAZE_API_MANUAL	Manual dehaze mode

9.6.4.2 DehazeDataV21_t

【Description】

Define the automatic dehaze debug parameter properties

【Definition】

```
typedef struct DehazeDataV21_s{
    float* EnvLv;
    int    EnvLv_len;
    float* dc_min_th;
    int    dc_min_th_len;
    float* dc_max_th;
    int    dc_max_th_len;
    float* yhist_th;
    int    yhist_th_len;
    float* yblk_th;
    int    yblk_th_len;
    float* dark_th;
    int    dark_th_len;
    float* bright_min;
    int    bright_min_len;
    float* bright_max;
```

```
    int    bright_max_len;
    float* wt_max;
    int    wt_max_len;
    float* air_min;
    int    air_min_len;
    float* air_max;
    int    air_max_len;
    float* tmax_base;
    int    tmax_base_len;
    float* tmax_off;
    int    tmax_off_len;
    float* tmax_max;
    int    tmax_max_len;
    float* cfg_wt;
    int    cfg_wt_len;
    float* cfg_air;
    int    cfg_air_len;
    float* cfg_tmax;
    int    cfg_tmax_len;
    float* dc_weitcur;
    int    dc_weitcur_len;
    float* bf_weight;
    int    bf_weight_len;
    float* range_sigma;
    int    range_sigma_len;
    float* space_sigma_pre;
    int    space_sigma_pre_len;
    float* space_sigma_cur;
    int    space_sigma_cur_len;
} DehazeDataV21_t;
```

【Members】

Member name	Description
EnvLv	Ambient brightness
EnvLv_len	EnvLv array length
dc_min_th	The statistical range of WT is adaptive, and the value range is [16, 120], and the default value is 64.
dc_min_th_len	dc_min_th array length
dc_max_th	WT adaptive high exposure area statistical range, the value range is [170, 255], and the default value is 192.
dc_max_th_len	dc_max_th array length
yhist_th	The statistical range of the high exposure area of the y component is [170, 255], and the default value is 249.
yhist_th_len	yhist_th array length
yblk_th	The threshold of the proportion of the number of y component blocks is 0.002, 0.01, and the default value is 0.002.
yblk_th_len	yblk_th array length
dark_th	WT adapts to the minimum threshold of the Y component block, the value range is [230, 250], and the default value is 250.
dark_th_len	dark_th array length
bright_min	The minimum value of the AIR adaptive threshold, which ranges from 160 to 200, and the default value is 180.
bright_min_len	bright_min array length
bright_max	The maximum value of the air adaptive threshold ranges from 210 to 250, and the default value is 240.
bright_max_len	bright_max array length
wt_max	The maximum value of WT is 0.75 and 0.9, and the default value is 0.9.
wt_max_len	wt_max array length
air_min	The minimum value of air adaptation ranges from 200 to 220, and the default value is 200.
air_min_len	air_min array length
air_max	The maximum adaptive value of air is 230 and 250, and the default value is 250.
air_max_len	air_max array length
tmax_base	The default value of tmax is 125, and the corresponding configuration is as follows: 200 (131), 210 (125), 220 (119), 230 (114), 240 (109), 250 (105), and 131-105 are recommended

Member name	Description
tmax_base_len	tmax_base array length
tmax_off	The fixed value of tmax is adaptive, the value range is [0.1, 0.5], and the default value is 0.1.
tmax_off_len	tmax_off array length
tmax_max	The maximum value of tmax is 0.1, 0.5, and the default value is 0.5.
tmax_max_len	tmax_max array length
cfg_wt	The software is configured with wt, image dehazing strength, value range [0, 1], default value 0.8.
cfg_wt_len	cfg_wt array length
cfg_air	The software configures air and atmospheric light coefficient, and the value range is [0, 255], and the default value is 210.
cfg_air_len	cfg_air array length
cfg_tmax	The software configures tmax, the maximum value of dehazing, the value range is [0, 1], and the default value is 0.2.
cfg_tmax_len	cfg_tmax array length
bf_weight	The composite weight of the two bilateral filters can be in the range of [0, 1], and the default value is 0.5.
bf_weight_len	bf_weight array length
dc_weitcur	The weight of the dark channel part, the value range is [0, 1], and the default value.
dc_weitcur_len	dc_weitcur array length
range_sigma	The sigma value of the bilateral filter range, the value range is [0, 1], and the default value is 0.4.
range_sigma_len	range_sigma array length
space_sigma_pre	When the IIR data is used as a reference, the sigma value of the double-sided filtered airspace can be in the range of [0, 1], and the default value is 0.4.
space_sigma_pre_len	space_sigma_pre array length
space_sigma_cur	When the current data is used as a reference, the sigma value of the bilateral filtered airspace can be in the range [0, 1], and the default value is 0.8.
space_sigma_cur_len	space_sigma_cur array length

9.6.4.3 Dehaze_Setting_V21_t

【Description】

Define the parameters of the automatic dehaze function

【Definition】

```
typedef struct Dehaze_Setting_V21_s{
    bool            en;
    bool            air_lc_en;
    float           stab_fnum;
    float           sigma;
    float           wt_sigma;
    float           air_sigma;
    float           tmax_sigma;
    float           pre_wet;
    DehazeDataV21_t DehazeData;
} Dehaze_Setting_V21_t;
```

【Member】

Member Name	Description
en	Switch function
air_lc_en	Whether to use Airlight Base to switch the minimum value off on Airlight
stab_fnum	The maximum value for frame stabilization
sigma	IIR controlled sigma
wt_sigma	Inter-frame WT filter coefficient
air_sigma	Inter-frame AIR filtering coefficient
tmax_sigma	Tmax filtering coefficient between frames
pre_wet	Reference data IIR filter factor
DehazeData	dehaze debug parameters

9.6.4.4 EnhanceDataV21_t

【Description】

Define the Auto-Enhance debug parameter properties

【Definition】

```
typedef struct EnhanceDataV21_s{
    float* EnvLv;
    int    EnvLv_len;
    float* enhance_value;
    int    enhance_value_len;
    float* enhance_chroma;
    int    enhance_chroma_len;
} EnhanceDataV21_t;
```

【Member】

Member Name	Description
EnvLv	Ambient brightness
EnvLv_len	The length of the ambient brightness array
enhance_value	Universal contrast dynamics, value range [0,16], recommended range [1, 2]
enhance_value_len	enhance_value array length
enhance_chroma	Enhanced adjustment parameters for chromaticity, value range [0, 16], recommended range [1, 2]
enhance_chroma_len	enhance_chroma array length

9.6.4.5 Enhance_Setting_V21_t

【Description】

Define the attributes of the automatic enhance function parameters

【Definition】

```
typedef struct Enhance_Setting_V21_s{
    bool             en;
    float            enhance_curve[CALIBDB_ADEHAZE_ENHANCE_CURVE_KNOTS_NUM];
    EnhanceDataV21_t EnhanceData;
} Enhance_Setting_V21_t;
```

【Member】

Member Name	Description
en	Enhance function switch. 0: Off, 1: On.
enhance_curve	Low frequency curve.
EnhanceData	enhance debug parameters.

9.6.4.6 Hist_setting_V21_t

【Description】

Define automatic hist debugging parameter properties

【Definition】

```
typedef struct HistDataV21_s{
    float* EnvLv;
    int    EnvLv_len;
    float* hist_gratio;
    int    hist_gratio_len;
    float* hist_th_off;
    int    hist_th_off_len;
    float* hist_k;
    int    hist_k_len;
    float* hist_min;
    int    hist_min_len;
    float* hist_scale;
    int    hist_scale_len;
    float* cfg_gratio;
    int    cfg_gratio_len;
} HistDataV21_t;
```

【Member】

Member Name	Description
EnvLv	Ambient brightness
EnvLv_len	EnvLv array length
hist_gratio	Histogram stretch multiple, histogram equalization control coefficient, value range [0, 32]
hist_gratio_len	hist_gratio array length
hist_th_off	The statistical threshold of the histogram ranges from 0 to 255 and the default value is 64
hist_th_off_len	hist_th_off array length
hist_k	The histogram adaptive threshold magnification ranges from 0 to 7 and is 2
hist_k_len	hist_k array length
hist_min	The minimum value of the statistical threshold of the histogram ranges from 0,2 to 0.016
hist_min_len	hist_min array length
hist_scale	Histogram equalization control coefficients, value range [0, 32]
hist_scale_len	hist_scale array length
cfg_gratio	The software configures the histogram stretch multiple, the histogram equalization control coefficient, and the value range [0, 32]
cfg_gratio_len	cfg_gratio array length

9.6.4.7 Hist_setting_V21_t

【Description】

Define the automatic hist function parameter attributes

【Definition】

```
typedef struct Hist_setting_V21_s{
    bool          en;
    bool          hist_para_en;
    HistDataV21_t HistData;
} Hist_setting_V21_t;
```

【Member】

Member Name	Description
en	Hist function switch
hist_para_en	Histogram stretch control switch
HistData	hist debug parameters

9.6.4.8 CalibDbDehazeV21_t

【Description】

Define the debugging parameter properties of the automatic dehaze module

【Definition】

```
typedef struct CalibDbDehazeV21_s{
    bool                  Enable;
    float                 cfg_alpha;
    float                 ByPassThr;
    Dehaze_Setting_V21_t  dehaze_setting;
    Enhance_Setting_V21_t enhance_setting;
    Hist_setting_V21_t    hist_setting;
} CalibDbDehazeV21_t;
```

【Member】

Member Name	Description
Enable	Switch function
cfg_alpha	Proportion of manual software configuration, the value range is 0, 1, the default value is 1, and the accuracy is 0.01
dehaze_setting	Auto Dehaze Function Parameter
enhance_setting	Automatic Enhance Function Parameter
hist_setting	Auto hist function parameter

9.6.4.9 CalibDbV2_dehaze_v21_t

【Description】

Define automatic dehaze module properties

【Definition】

```
typedef struct CalibDbV2_dehaze_V21_s{
    CalibDbDehazeV21_t DehazeTuningPara;
} CalibDbV2_dehaze_V21_t;
```

【Member】

Member Name	Description
DehazeTuningPara	Automatic dehaze module debugging parameters

9.6.4.10 mDehazeDataV21_t

【Description】

Define manual DehazeData properties

【Definition】

```
typedef struct mDehazeDataV21_s {
    float dc_min_th;
    float dc_max_th;
    float yhist_th;
    float yblk_th;
    float dark_th;
    float bright_min;
    float bright_max;
    float wt_max;
    float air_min;
    float air_max;
    float tmax_base;
    float tmax_off;
    float tmax_max;
    float cfg_wt;
    float cfg_air;
    float cfg_tmax;
    float dc_weitcur;
    float bf_weight;
    float range_sigma;
    float space_sigma_pre;
    float space_sigma_cur;
} mDehazeDataV21_t;
```

【Member】

Member name	Description
dc_min_th	WT adaptive statistical range, value range [16, 120], default value 64, accuracy 0.1.
dc_max_th	WT adaptive high exposure area statistical range, value range [170, 255], default value 192, accuracy 0.1.
yhist_th	Statistical range of high exposure area of y component, value range [170, 255], default value 249, accuracy 0.1
yblk_th	Y component block number proportional threshold, value range [0.002, 0.01], default value 0.002, precision 0.1.
dark_th	WT adaptive Y component block minimum threshold, value range [230, 250], default value 250, accuracy 0.1
bright_min	The minimum value of the AIR adaptive threshold, the value range [160, 200], the default value is 180, and the accuracy is 0.1.
bright_max	The maximum value of the AIR adaptive threshold, the value range [210, 250], the default value is 240, and the accuracy is 0.1.
wt_max	The maximum value limit of wt adaptation, the value range is [0.75, 0.9], the default value is 0.9, and the accuracy is 0.001.
air_min	The minimum value limit of air adaptation, the value range [200, 220], the default value is 200, and the accuracy is 0.001.
air_max	The maximum value limit of AIR adaptation, the value range [230, 250], the default value is 250, and the accuracy is 0.001.
tmax_base	tmax adaptive base value, default 125, corresponding configuration as follows, 200 (131), 210 (125), 220 (119), 230 (114), 240 (109), 250 (105), recommended 131-105
tmax_off	Tmax adaptive fixed value, value range [0.1, 0.5], default value 0.1, accuracy 0.1.
tmax_max	The maximum value of tmax adaptation, the value range is [0.1, 0.5], the default value is 0.5, and the accuracy is 0.1.
cfg_wt	Software configuration wt, image dehazing force, value range [0, 1], default value 0.8, accuracy 0.001.
cfg_air	Software configuration air, atmospheric light coefficient, value range [0, 255], default value 210, accuracy 0.001
cfg_tmax	Software configuration tmax, maximum value of dehazing, value range [0, 1], default value 0.2, accuracy 0.001.
bf_weight	The combined weights of the two bilateral filters have a value range of [0, 1], a default value of 0.5 and an accuracy of 0.1.
dc_weitcur	The bilateral weight of the dark channel part, the value range [0, 1], the default value is 1, and the precision is 0.1.
range_sigma	Bilateral filter range sigma value, value range [0, 1], default value 0.4, accuracy 0.1.

Member name	Description
space_sigma_pre	When using IIR data as a reference, the bilateral filtered airspace sigma value is in the range of [0, 1], the default value is 0.4, and the accuracy is 0.1.
space_sigma_cur	When the current data is used as a reference, the bilateral filter airspace sigma value is in the value range [0, 1], the default value is 0.8, and the accuracy is 0.1.

9.6.4.11 mDehaze_setting_v21_t

【Description】

Define manual dehaze function properties

【Definition】

```
typedef struct mDehaze_setting_v21_s {
    bool             en;
    bool             air_lc_en;
    float            stab_fnum;
    float            sigma;
    float            wt_sigma;
    float            air_sigma;
    float            tmax_sigma;
    float            pre_wet;
    mDehazeDataV21_t DehazeData;
} mDehaze_setting_V21_t;
```

【Member】

Member Name	Description
en	Switch function
air_lc_en	Whether to use Airlight Base to make a minimum cutoff toggle
stab_fnum	The maximum value of frame stabilization, the value range is [0,31], the default value is 8, and the accuracy is 0.01
sigma	IIR-controlled sigma, the value range is 0,255, the default value is 6, and the accuracy is 1.
wt_sigma	The wt filter coefficient between frames, the value range is [0,255], the default value is 8, and the accuracy is 1.
air_sigma	The inter-frame air filtering coefficient can be 0,255, the default value is 12, and the accuracy is 1
tmax_sigma	Tmax filtering coefficient between frames, the value range is [0,1], the default value is 0.01, and the accuracy is 0.0001
pre_wet	Reference data IIR filter coefficient, value range [0,1], default value 0.01, accuracy 0.0001.
DehazeData	dehaze debug parameter

9.6.4.12 mEnhanceDataV21_t

【Description】

Define a manual EnhanceData property

【Definition】

```
typedef struct mEnhanceDataV21_s {
    float enhance_value;
    float enhance_chroma;
} mEnhanceDataV21_t;
```

【Member】

Member Name	Description
enhance_value	General contrast force, value range [0,16], default value 1.0, accuracy 0.001.
enhance_chroma	Enhanced adjustment parameters for chromaticity, value range [0,16], default value 1.0, accuracy 0.001.

9.6.4.13 mEnhance_setting_v21_t

【Description】

Define the manual enhance feature property

【Definition】

```
typedef struct mEnhance_Setting_V21_s {
    bool              en;
    float             enhance_curve[CALIBDB_ADEHAZE_ENHANCE_CURVE_KNOTS_NUM];
    mEnhanceDataV21_t EnhanceData;
} mEnhance_Setting_V21_t;
```

【Member】

Member Name	Description
en	Enhance function switch
enhance_curve	Low frequency curve
EnhanceData	enhance debug parameters

9.6.4.14 mHistDataV21_t

【Description】

Define the manual HistData property

【Definition】

```
typedef struct mHistDataV21_s {
    float hist_gratio;
    float hist_th_off;
    float hist_k;
    float hist_min;
    float hist_scale;
    float cfg_gratio;
} mHistDataV21_t;
```

【Member】

Member Name	Description
hist_gratio	Histogram stretch multiplier, histogram equilibrium control coefficient, value range [0, 32], default value, precision 0.01.
hist_th_off	Histogram statistical threshold, value range [0, 255], default value 64, accuracy 0.01.
hist_k	Histogram adaptive threshold magnification, value range [0, 7), default value 2, accuracy 0.01.
hist_min	The minimum value of the histogram statistical threshold, the value range [0,2), the default value is 0.016, and the accuracy is 0.01.
hist_scale	Histogram equilibrium control coefficient, value range [0, 32], default value 0.9, accuracy 0.01.
cfg_gratio	The software configures the histogram stretch multiplier, histogram equalization control coefficient, value range [0, 32), default value 1, accuracy 0.01.

9.6.4.15 mHist_setting_v21_t

【Description】

Define manual Hist function attributes

【Definition】

```
typedef struct mHist_setting_V21_s {
    bool           en;
    bool           hist_para_en;
    mHistDataV21_t HistData;
} mHist_setting_V21_t;
```

【Member】

Member Name	Description
en	Hist function switch.
hist_para_en	Histogram stretch control switch.
HistData	Hist debug parameters.

9.6.4.16 mDehazeAttr_t

【Description】

Define manual dehaze module properties

【Definition】

```
typedef struct mDehazeAttr_s {
    bool                    Enable;
    float                   cfg_alpha;
    mDehaze_Setting_V21_t   dehaze_setting;
    mEnhance_Setting_V21_t  enhance_setting;
    mHist_setting_V21_t     hist_setting;
} mDehazeAttr_t;
```

【Member】

Member Name	Description
Enable	Switch function.
cfg_alpha	Manual software configuration ratio, value range [0,1], default value 1, accuracy 0.01.
dehaze_setting	Manual dehaze function parameters
enhance_setting	Manual enhance function parameter
hist_setting	Manual Hist function parameters

9.6.4.17 adehaze_sw_v2_t

【Description】

Define the dehaze attribute

【Definition】

```
typedef struct adehaze_sw_V2_s {
    rk_aiq_uapi_sync_t     sync;
    dehaze_api_mode_t      mode;
    CalibDbV2_dehaze_V21_t stAuto;
    mDehazeAttr_t          stManual;
    DehazeManuAttr_t       stDehazeManu;
    EnhanceManuAttr_t      stEnhanceManu;
} adehaze_sw_V2_t;
```

【Member】

Member Name	Description
sync	For rk_aiq_uapi_sync_t definitions, see **Overview/API** Description.
mode	API schema.
stAuto	Automatic dehaze module parameters.
stManual	Manual dehaze module parameters.
stDehazeManu	Dehazing level parameter, do not use.
stEnhanceManu	Contrast level parameter, do not use.

9.7 CPROC

9.7.1 Description of the feature

CPRO (Color Processing) provides a basic color adjustment function by brightening within a certain range
The adjustment of degree, contrast, saturation, and chromaticity to achieve the adjustment of the preferred color, this module acts on the YUV domain image.

9.7.2 Functional level API reference

9.7.3 Module-level API reference

9.7.3.1 rk_aiq_user_api2_acp_SetAttrib

【Description】

Set the cpro module properties

【Grammar】

```
XCamReturn rk_aiq_user_api2_acp_SetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	cproc module properties	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_acp.h
- Library file: librkaiq.so

9.7.3.2 rk_aiq_user_api2_acp_GetAttrib

【Description】

Gets the current properties of the CPRO module

【Grammar】

```
XCamReturn rk_aiq_user_api2_acp_GetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
                                          acp_attrib_t* attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	cproc module properties	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_acp.h
- Library file: librkaiq.so

9.7.4 Module-level API data types

9.7.4.1 acp_attrib_t

【Description】

Define the parameters of the CPROC module

【Definition】

```
typedef struct acp_attrib_s {
    uint8_t brightness; /* 0 ~ 255 */
    uint8_t contrast; /* 0 ~ 255 */
    uint8_t saturation; /* 0 ~ 255 */
    uint8_t hue; /* 0 ~ 255 */
} acp_attrib_t;
```

【Member】

Member Name	Description
brightness	Brightness, range: [0,255], corresponding range: [-128,127], default value 128
contrast	Contrast, range: [0,255], corresponding multiplier: [0, 1.992], default value is 128
saturation	Saturation, range: [0,255], corresponding multiplier: [0, 1.992], default value is 128
hue	Chromaticity, range: [0,255], corresponding degree [-90,87.188], default value 128

9.8 IE

9.8.1 Description of the feature

IE (Image Effect) provides special effect settings for images, such as black and white effects. This module acts on YUV domain images.

9.8.2 Functional level API reference

9.8.3 Module-level API reference

9.8.3.1 rk_aiq_user_api2_aie_SetAttrib

【Description】

Set IE module properties

【Grammar】

```
XCamReturn rk_aiq_user_api2_aie_SetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
                                          aie_attrib_t attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	IE Module Properties	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_aie.h
- Library file: librkaiq.so

9.8.3.2 rk_aiq_user_api2_aie_GetAttrib

【Description】

Gets the current properties of the IE module

【Grammar】

```
XCamReturn rk_aiq_user_api2_aie_GetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
                                          aie_attrib_t* attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	IE Module Properties	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_aie.h
- Library file: librkaiq.so

9.8.4 Module-level API data types

9.8.4.1 aie_attrib_t

【Description】

Define the parameters of the IE module

【Definition】

```
typedef struct aie_attrib_s {
     rk_aiq_ie_effect_t mode;
} aie_attrib_t;
```

【Member】

Member Name	Description
mode	Effect type

9.8.4.2 rk_aiq_ie_effect_t

【Description】

Define the IE effect type

【Definition】

```
typedef enum rk_aiq_ie_effect_e {
    RK_AIQ_IE_EFFECT_NONE,
    RK_AIQ_IE_EFFECT_BW,
    RK_AIQ_IE_EFFECT_NEGATIVE,
    RK_AIQ_IE_EFFECT_SEPIA,
    RK_AIQ_IE_EFFECT_EMBOSS,
   RK_AIQ_IE_EFFECT_SKETCH,
    RK_AIQ_IE_EFFECT_SHARPEN, /*!< deprecated */
} rk_aiq_ie_effect_t;
```

【Member】

Member Name	Description
RK_AIQ_IE_EFFECT_NONE	No special effects
RK_AIQ_IE_EFFECT_BW	Black and white effect
RK_AIQ_IE_EFFECT_NEGATIVE	Negative effect, not supported
RK_AIQ_IE_EFFECT_SEPIA	Dark brown effect
RK_AIQ_IE_EFFECT_EMBOSS	Embossed effect
RK_AIQ_IE_EFFECT_SKETCH	Sketch effect
RK_AIQ_IE_EFFECT_SHARPEN	not supported

9.9 CSM

9.9.1 Description of the feature

CSM (Color Space Matrix) can set the parameters during RGB to YUV conversion.

9.9.2 Functional level API reference

9.9.3 Module-level API reference

9.9.3.1 rk_aiq_user_api2_acsm_SetAttrib

【Description】

Set the CSM module properties

【Grammar】

```
XCamReturn rk_aiq_user_api2_acsm_SetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_uapi_acsm_attrib_t attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	CSM module property	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_acsm.h
- Library file: librkaiq.so

【Precautions】

- When attr.param.op_mode = RK_AIQ_OP_MODE_AUTO, use AIQ's built-in CSM default parameters, and when attr.param.op_mode = RK_AIQ_OP_MODE_MANUAL, you can configure CSM parameters.
- attr.param.full_range can only be configured to TRUE, and the limit range can be configured in the CGC module.

9.9.3.2 rk_aiq_user_api2_acsm_GetAttrib

【Description】

Gets the current properties of the CSM module

【Grammar】

```
XCamReturn rk_aiq_user_api2_acsm_GetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_uapi_acsm_attrib_t* attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	CSM module property	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_acsm.h
- Library file: librkaiq.so

9.9.4 Module-level API data types

9.9.4.1 rk_aiq_uapi_acsm_attrib_t

【Description】

Define the parameters of the CSM module

【Definition】

```
typedef struct rk_aiq_uapi_acsm_attrib_s {
    rk_aiq_uapi_sync_t sync;
    rk_aiq_acsm_params_t param;
} rk_aiq_uapi_acsm_attrib_t;
```

【Member】

Member Name	Description
sync	For rk_aiq_uapi_sync_t definitions, see **Overview/API Description** section
rk_aiq_acsm_params_t	csm parameter

9.9.4.2 rk_aiq_acsm_params_t

【Description】

Define CSM module parameters

【Definition】

```
typedef struct __csm_param {
    RKAiqOPMode_t op_mode;
    bool full_range;
    uint8_t y_offset;
    uint8_t c_offset;
    float coeff[RK_AIQ_CSM_COEFF_NUM];
} Csm_Param_t;
```

【Member】

Member Name	Description
op_mode	mode, RK_AIQ_OP_MODE_AUTO or RK_AIQ_OP_MODE_MANUAL
full_range	Whether to output full range, default value: TRUE. Note: ISP30 This attribute can only be TRUE. Limit range is recommended to be configured by the CGC module API.
y_offset	Luminance offset value, range: [0,63], default value: 0
c_offset	Chroma offset value, range: [0,255], default value: 0
coeff	RGB to YUV 3x3 conversion matrix, range: [-2, 1.992], default values: [0.299, 0.587, 0.114, - 0.169, -0.331, 0.5, 0.5, -0.419, -0.081]

9.10 Sharpen

9.10.1 Description of the feature

The Sharpen module is used to enhance the clarity of an image, including adjusting the sharpening properties of the edges of the image and enhancing the detail of the image
and textures.

9.10.2 Functional level API reference

9.10.2.1 rk_aiq_uapi2_setSharpness

【Description】

Set the sharpening level.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setSharpness(const rk_aiq_sys_ctx_t* ctx, unsigned int
level);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
level	Sharpening level value range: [0,100] The default value is 50	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

9.10.2.2 rk_aiq_uapi2_getSharpness

【Description】

Get the sharpening level.

【Grammar】

```
XCamReturn rk_aiq_uapi2_getSharpness(const rk_aiq_sys_ctx_t* ctx, unsigned int*
level);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
level	Sharpening level	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

9.10.3 Module-level API reference

9.10.3.1 rk_aiq_user_api2_asharpV4_SetAttrib

【Description】
Set the sharpening algorithm properties.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_asharpV4_SetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_sharp_attrib_v4_t* attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	Parameter properties for denoising	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_asharp_v4.h, RkAiqHandleIntV3x.h
- Library file: librkaiq.so

9.10.3.2 rk_aiq_user_api2_asharpV4_GetAttrib

【Description】

Gets the sharpening algorithm properties.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_asharpV4_GetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_sharp_attrib_v4_t* attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	Parameter properties for denoising	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_asharp_v4.h, RkAiqHandleIntV3x.h
- Library file: librkaiq.so

9.10.3.3 rk_aiq_user_api2_asharpV4_SetStrength

【Description】

Set the sharpening force.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_asharpV4_SetStrength(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_sharp_strength_v4_t *pStrength);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
pStrength	Sharpening strength structure pointer, the percentage value range in the structure is 0.0-1.0	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_asharp_v4.h, RkAiqHandleIntV3x.h
- Library file: librkaiq.so

9.10.3.4 rk_aiq_user_api2_asharpV4_GetStrength

【Description】

Get sharpening power.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_asharpV4_GetStrength(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_sharp_strength_v4_t *pStrength);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
pStrength	Sharpening strength structure pointer, the percentage value range in the structure is 0.0-1.0	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_asharp_v4.h, RkAiqHandleIntV3x.h
- Library file: librkaiq.so

9.10.4 Module-level API data types

9.10.4.1 rk_aiq_sharp_attrib_v4_t

【Description】

Define the parameters for the sharpening module

【Definition】

```
typedef struct rk_aiq_sharp_attrib_v4_s {
    rk_aiq_uapi_sync_t sync;
    Asharp4_OPMode_t eMode;
    Asharp_Auto_Attr_V4_t stAuto;
    Asharp_Manual_Attr_V4_t stManual;
} rk_aiq_sharp_attrib_v4_t;
```

【Member】

Member Name	Description
sync	For synchronous asynchronous mode selection, see **Overview/API Description** section
eMode	Sharpen module properties
stAuto	Sharpen module auto mode parameter

9.10.4.2 Asharp4_OPMode_t

【Description】

【Definition】

```
typedef enum Asharp4_OPMode_e {
    ASHARP4_OP_MODE_INVALID           = 0,
    ASHARP4_OP_MODE_AUTO              = 1,
    ASHARP4_OP_MODE_MANUAL            = 2,
    ASHARP4_OP_MODE_REG_MANUAL        = 3,
    ASHARP4_OP_MODE_MAX
} Asharp4_OPMode_t;
```

【Member】

Member Name	Description
ASHARP4_OP_MODE_INVALID	Sharpen module invalid mode
ASHARP4_OP_MODE_AUTO	Sharpen module auto mode
ASHARP4_OP_MODE_MANUAL	Algorithm settings for the manual mode of the sharpening module
ASHARP4_OP_MODE_REG_MANUAL	Register settings
ASHARP4_OP_MODE_MAX	The sharpen module mode maximum, which is an invalid mode

9.10.4.3 Asharp_Auto_Attr_V4_t

【Description】

Define the automatic mode of the sharpening module, and each ISO corresponding algorithm attribute parameter

【Definition】

```
typedef struct Asharp_Auto_Attr_V4_s
{
    RK_SHARP_Params_V4_t stParams;
    RK_SHARP_Params_V4_Select_t stSelect;

} Asharp_Auto_Attr_V4_t;
```

【Member】

Member Name	Description
stParams	Each ISO in the SHARP module corresponds to the algorithm attribute parameter
stSelect	The Sharp module calculates the attribute parameter

9.10.4.4 Asharp_Manual_Attr_V4_t

【Description】

Define manual properties for the sharpening module

【Definition】

```
typedef struct Asharp_Manual_Attr_V4_s
{
    RK_SHARP_Params_V4_Select_t stSelect;

    RK_SHARP_Fix_V4_t stFix;

} Asharp_Manual_Attr_V4_t;
```

【Member】

Member Name	Description
stSelect	SharpManually set the algorithm parameters
stFix	Sharp register value

9.10.4.5 RK_SHARP_Params_V4_t

【Description】

Define manual properties for the sharpening module

【Definition】

```
typedef struct RK_SHARP_Params_V4_s
{
    int enable;

    int iso[RK_SHARP_V4_MAX_ISO_NUM];
    short luma_point        [RK_SHARP_V4_LUMA_POINT_NUM];
    short luma_sigma        [RK_SHARP_V4_MAX_ISO_NUM]
[RK_SHARP_V4_LUMA_POINT_NUM];
    float pbf_gain          [RK_SHARP_V4_MAX_ISO_NUM];
    float pbf_add           [RK_SHARP_V4_MAX_ISO_NUM];
    float pbf_ratio         [RK_SHARP_V4_MAX_ISO_NUM];
    float gaus_ratio        [RK_SHARP_V4_MAX_ISO_NUM];
    float sharp_ratio       [RK_SHARP_V4_MAX_ISO_NUM];
    short hf_clip        [RK_SHARP_V4_MAX_ISO_NUM][RK_SHARP_V4_LUMA_POINT_NUM];
    float bf_gain           [RK_SHARP_V4_MAX_ISO_NUM];
    float bf_add            [RK_SHARP_V4_MAX_ISO_NUM];
    float bf_ratio          [RK_SHARP_V4_MAX_ISO_NUM];
    short local_sharp_strength  [RK_SHARP_V4_MAX_ISO_NUM]
[RK_SHARP_V4_LUMA_POINT_NUM];

    float prefilter_coeff[RK_SHARP_V4_MAX_ISO_NUM][RK_SHARP_V4_PBF_DIAM *
RK_SHARP_V4_PBF_DIAM];
    float GaussianFilter_coeff   [RK_SHARP_V4_MAX_ISO_NUM][RK_SHARP_V4_RF_DIAM *
RK_SHARP_V4_RF_DIAM];
    float hfBilateralFilter_coeff    [RK_SHARP_V4_MAX_ISO_NUM]
[RK_SHARP_V4_BF_DIAM * RK_SHARP_V4_BF_DIAM];
```

```
} RK_SHARP_Params_V4_t;
```

【Member】

Parameter Name	Parameter Type	Brief description
Enable	Debug parameters	The Sharp module enables the switch. 1: Module open, 0: Module off.
iso	Debug parameters	Different ISO gears, corresponding to different debugging parameters. Currently only 13 gears are supported.
pbf_gain	Debug parameters	The pre-filtered sigma is multiplied by the ratio, the larger the value, the stronger the filtering, the less noise and less detail. Value range [0.0, 2.0], default value 1.0.
pbf_add	Debug parameters	The offset of the pre-filtered sigma superposition, the larger the value, the stronger the filtering, the less noise, and less detail. Value range [0, 1023], default value 0.
pbf_ratio	Debug parameters	Pre-filter fusion weights, the larger the value, the stronger the filtering, the smaller the noise, and less detail. The value range is [0.0, 1.0], and the default value is 0.5.
gaus_ratio	Debug parameters	The guided image of high-frequency bilateral filtering is the result of the fusion of Gaussian filtering and the original image. The larger the value, the greater the guiding weight of the Gaussian bilateral filter. Value range [0.0, 1.0], default value 0.
sharp_ratio	Debug parameters	Sharpening strength, the higher the value, the stronger the sharpening. Value range [0.0, 16], default value 6.
bf_gain	Debug parameters	The proportion of high-frequency bilateral filtering sigma multiplied, the larger the value, the stronger the filtering, the smaller the noise, and the less detail. Value range [0.0, 2.0], default value 1.0.
bf_add	Debug parameters	Offset of high-frequency bilateral filtering sigma superposition. The larger the value, the stronger the filtering, the smaller the noise, and the less detail. Value range [0, 1023], default value 0.
bf_add	Debug parameters	High-frequency bilateral filter fusion weights. The larger the value, the stronger the filtering, the smaller the noise, and the less detail. The value range is [0.0, 1.0], and the default value is 0.5.

Parameter Name	Parameter Type	Brief description
luma_point / luma_sigma	Debug parameters	Different pixel brightness corresponds to different noise SIGMA curves. luma_point is the curve brightness value in the range [0, 1023]. luma_sigma is the noise intensity value in the range [0, 1023].
luma_point / hf_clip	Debug parameters	Range of different pixel brightness high-frequency values clips. The higher the value, the stronger the maximum allowable sharpening strength. The value range is [0, 1023]. Default value 256.
luma_point / local_sharp_strength	Debug parameters	Calculate the proportion of different pixel brightness, high-frequency superposition weights. The higher the value, the greater the high frequencies allowed to be superimposed and the sharper the image. The value range is [0, 1023]. Default value 512.
prefilter_coeff	Debug parameters	Prefilter operators.
GaussianFilter_coeff	Debug parameters	Gaussian filter operators.
hfBilateralFilter_coeff	Debug parameters	High-frequency bilateral filtering operators.

9.10.4.6 RK_SHARP_Params_V4_Select_t

【Description】

Defines the manual mode algorithm properties of the sharpening module

【Definition】

```
typedef struct RK_SHARP_Params_V4_Select_s
{
    int enable;

    short luma_point    [RK_SHARP_V4_LUMA_POINT_NUM];
    short luma_sigma    [RK_SHARP_V4_LUMA_POINT_NUM];
    float pbf_gain      ;
    float pbf_add       ;
    float pbf_ratio     ;
    float gaus_ratio    ;
    float sharp_ratio   ;
    short hf_clip       [RK_SHARP_V4_LUMA_POINT_NUM];
    float bf_gain       ;
```

```
    float bf_add        ;
    float bf_ratio      ;
    short local_sharp_strength        [RK_SHARP_V4_LUMA_POINT_NUM];

    float prefilter_coeff[RK_SHARP_V4_PBF_DIAM * RK_SHARP_V4_PBF_DIAM];
    float GaussianFilter_coeff   [RK_SHARP_V4_RF_DIAM * RK_SHARP_V4_RF_DIAM];
    float hfBilateralFilter_coeff    [RK_SHARP_V4_BF_DIAM * RK_SHARP_V4_BF_DIAM];


} RK_SHARP_Params_V4_Select_t;
```

【Member】

Parameter Name	Parameter Type	Brief description
Enable	Debug parameters	The Sharp module enables the switch. 1: Module open, 0: Module off.
iso	Debug parameters	Different ISO gears, corresponding to different debugging parameters. Currently only 13 gears are supported.
pbf_gain	Debug parameters	The pre-filtered sigma is multiplied by the ratio, the larger the value, the stronger the filtering, the less noise and less detail. Value range [0.0, 2.0], default value 1.0.
pbf_add	Debug parameters	The offset of the pre-filtered sigma superposition, the larger the value, the stronger the filtering, the less noise, and less detail. Value range [0, 1023], default value 0.
pbf_ratio	Debug parameters	Pre-filter fusion weights, the larger the value, the stronger the filtering, the smaller the noise, and less detail. The value range is [0.0, 1.0], and the default value is 0.5.
gaus_ratio	Debug parameters	The guided image of high-frequency bilateral filtering is the result of the fusion of Gaussian filtering and the original image. The larger the value, the greater the guiding weight of the Gaussian bilateral filter. Value range [0.0, 1.0], default value 0.
sharp_ratio	Debug parameters	Sharpening strength, the higher the value, the stronger the sharpening. Value range [0.0, 16], default value 6.
bf_gain	Debug parameters	The proportion of high-frequency bilateral filtering sigma multiplied, the larger the value, the stronger the filtering, the smaller the noise, and the less detail. Value range [0.0, 2.0], default value 1.0.
bf_add	Debug parameters	Offset of high-frequency bilateral filtering sigma superposition. The larger the value, the stronger the filtering, the smaller the noise, and the less detail. Value range [0, 1023], default value 0.
bf_add	Debug parameters	High-frequency bilateral filter fusion weights. The larger the value, the stronger the filtering, the smaller the noise, and the less detail. The value range is [0.0, 1.0], and the default value is 0.5.

Parameter Name	Parameter Type	Brief description
luma_point / luma_sigma	Debug parameters	Different pixel brightness corresponds to different noise SIGMA curves. luma_point is the curve brightness value in the range [0, 1023]. luma_sigma is the noise intensity value in the range [0, 1023].
luma_point / hf_clip	Debug parameters	Range of different pixel brightness high-frequency values clips. The higher the value, the stronger the maximum allowable sharpening strength. The value range is [0, 1023]. Default value 256.
luma_point / local_sharp_strength	Debug parameters	Calculate the proportion of different pixel brightness, high-frequency superposition weights. The higher the value, the greater the high frequencies allowed to be superimposed and the sharper the image. The value range is [0, 1023]. Default value 512.
prefilter_coeff	Debug parameters	Prefilter operators.
GaussianFilter_coeff	Debug parameters	Gaussian filter operators.
hfBilateralFilter_coeff	Debug parameters	High-frequency bilateral filtering operators.

9.10.4.7 RK_SHARP_Fix_V4_t

【Description】

Defines the manual mode register configuration for the sharpening module

【Definition】

```
typedef struct RK_SHARP_Fix_V4_s
{
    // SHARP_SHARP_EN (0x0000)
    uint8_t sharp_clk_dis;
    uint8_t sharp_exgain_bypass;
    uint8_t sharp_center_mode;
    uint8_t sharp_bypass;
    uint8_t sharp_en;

    // SHARP_SHARP_RATIO  (0x0004)
    uint8_t sharp_sharp_ratio;
    uint8_t sharp_bf_ratio;
    uint8_t sharp_gaus_ratio;
```

```
    uint8_t sharp_pbf_ratio;

    // SHARP_SHARP_LUMA_DX (0x0008)
    uint8_t sharp_luma_dx[7];

    // SHARP_SHARP_PBF_SIGMA_INV_0 (0x000c - 0x0014)
    uint16_t sharp_pbf_sigma_inv[8];

    // SHARP_SHARP_BF_SIGMA_INV_0 (0x0018 -  0x0020)
    uint16_t sharp_bf_sigma_inv[8];

    // SHARP_SHARP_SIGMA_SHIFT (0x00024)
    uint8_t sharp_bf_sigma_shift;
    uint8_t sharp_pbf_sigma_shift;

    // SHARP_SHARP_EHF_TH_0 (0x0028 -  0x0030)
    uint16_t sharp_ehf_th[8];

    // SHARP_SHARP_CLIP_HF_0 (0x0034 -  0x003c)
    uint16_t sharp_clip_hf[8];

    // SHARP_SHARP_PBF_COEF (0x00040)
    uint8_t sharp_pbf_coef[3];

    // SHARP_SHARP_BF_COEF (0x00044)
    uint8_t sharp_bf_coef[3];

    // SHARP_SHARP_GAUS_COEF (0x00048 - 0x0004c)
    uint8_t sharp_gaus_coef[6];

} RK_SHARP_Fix_V4_t;
```

【Member】

Parameter Name	Parameter description
sharp_clk_dis	The sharp module clk gate setting, which is not supported at the moment, is 0 by default.
sharp_exgain_bypass	Whether the external local gain module is bypass, this setting is not supported at the moment, and the default is 0.
sharp_center_mode	Whether to sharpen with the image center point as the coordinates. Configuration is not supported at the moment, the default is 0.
sharp_bypass	Sharpening module bypass 1 : bypass ; 0 :not bypass
sharp_en	Sharpen module enable 1: enable; 0 :disable
sharp_sharp_ratio	sharp_ratio: Sharpening strength, 0~15.9
sharp_bf_ratio	Bilateral filter fusion weight, 0~1.0
sharp_gaus_ratio	gaus_ratio: Gaussian filter fusion weight, value range [0.0, 1.0]
sharp_pbf_ratio	Bilateral prefiltered fusion weights The value range is [0.0, 1.0], and the default value is 0.5
sharp_luma_dx7	The distance between point 6 and point 7. The actual distance is equal to 2^sw_sharp_luma_dx7.
sharp_luma_dx6	The distance between points 5 and 6. The actual distance is equal to 2^sw_sharp_luma_dx6.
sharp_luma_dx5	The distance between points 4 and 5. The actual distance is equal to 2^sw_sharp_luma_dx5.
sharp_luma_dx4	The distance between point 3 and point 4. The actual distance is equal to 2^sw_sharp_luma_dx4.
sharp_luma_dx3	The distance between point 2 and point 3. The actual distance is equal to 2^sw_sharp_luma_dx3.
sharp_luma_dx2	The distance between point 1 and point 2. The actual distance is equal to 2^sw_sharp_luma_dx2.
sharp_luma_dx1	The distance between 0 and 1 point. The actual distance is equal to 2^sw_sharp_luma_dx1. Note: The total distance must be equal to 1024.
sharp_pbf_sigma_inv	Sharp pbf sigma inverse
sharp_bf_sigma_inv	Sharp bf sigma inverse
sharp_pbf_coef	Sharpening module bilateral with filter filter core
sharp_bf_coef	Bilateral filter nuclei
sharp_gaus_coef	Gaussian filter kernel

9.10.4.8 rk_aiq_sharp_strength_v4_t

【Description】

Define the denoising intensity configuration structure for the sharpening module

【Definition】

```
typedef struct rk_aiq_sharp_strength_v4_s {
    rk_aiq_uapi_sync_t sync;
    float percent;
} rk_aiq_sharp_strength_v4_t;
```

【Member】

Member Name	Description
sync	For synchronous asynchronous mode selection, see **Overview/API Description** section
percent	Sharpening strength, the value range is 0.0-1.0.

9.11 Gamma

9.11.1 Description of the feature

The gamma module performs luminance-space nonlinear conversion of images to fit the output device. RK3588 supports 49-point log domain gamma curve with abscissa as follows:

```
int X_isp30[49] = { 0, 1, 2, 3, 4, 5, 6, 7, 8, 10, 12, 14, 16, 20, 24, 28, 32,
40, 48, 56, 64, 80, 96, 112, 128, 160, 192, 224, 256, 320, 384, 448, 512, 640,
768, 896, 1024, 1280, 1536, 1792, 2048, 2304, 2560, 2816, 3072, 3328, 3584, 3840,
4095};
```

9.11.2 Feature-level API reference

9.11.2.1 rk_aiq_uapi2_setGammaCoef

【Description】

Quickly set gamma curves with GammaCoef and SlopeAtZero. The gamma curve is generated as follows:

```
for(int i = 0; i < 49; i++) {
    Y_isp30[i] = 4095 * pow(X_isp30[i] / 4095, 1 / GammaCoef + SlopeAtZero);
    Y_isp30[i] = LIMIT_VALUE(Y_isp30[i], 4095, 0);
 }
```

【Grammar】

```
XCamReturn rk_aiq_uapi2_setGammaCoef(const rk_aiq_sys_ctx_t* ctx, float
GammaCoef, float SlopeAtZero);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
GammaCoef	Gamma coefficient, value range [0,100], default value 2.2, accuracy 0.01	Input
SlopeAtZero	Dark area slope, value range [-0.05,0.05], default value 0, precision 0.001	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

【Description】

If the Gamma curve in the API is not switched according to the scene, if the scene changes, set the gamma curve again through the API.

9.11.3 Feature-level API data types

9.11.4 Module-level API reference

9.11.4.1 rk_aiq_user_api2_agamma_SetAttrib

【Description】

Set gamma software properties.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_agamma_v11_SetAttrib(const rk_aiq_sys_ctx_t* sys_ctx, const
rk_aiq_gamma_v11_attrib_t* attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	Gamma Software Property Struct	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_agamma.h
- Library file: librkaiq.so

【Description】

If the Gamma curve in the API is not switched according to the scene, if the scene changes, set the gamma curve again through the API.

9.11.4.2 rk_aiq_user_api2_agamma_GetAttrib

【Description】

Gets the gamma software properties.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_agamma_GetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_gamma_attrib_t* attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	Gamma Software Property Struct	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_agamma.h

- Library file: librkaiq.so

【Description】

9.11.5 Module-level API data types

9.11.5.1 rk_aiq_gamma_op_mode_t

【Description】

Define the Gamma operating mode

【Definition】

```
typedef enum rk_aiq_gamma_op_mode_s {
    RK_AIQ_GAMMA_MODE_OFF              = 0,
    RK_AIQ_GAMMA_MODE_MANUAL           = 1,
    RK_AIQ_GAMMA_MODE_FAST             = 2,
} rk_aiq_gamma_op_mode_t;
```

【Member】

Member Name	Description
RK_AIQ_GAMMA_MODE_OFF	API Off Mode
RK_AIQ_GAMMA_MODE_MANUAL	API Manual Mode
RK_AIQ_GAMMA_MODE_FAST	API Quick Mode

9.11.5.2 Agamma_api_Fast_t

【Description】

Define the Gamma property in fast mode

Quickly set gamma curves with GammaBeef and SlopeAtZero. The gamma curve is generated as follows:

```
for(int i = 0; i < 49; i++) {
    Y_isp30[i] = 4095 * pow(X_isp30[i] / 4095, 1 / GammaCoef + SlopeAtZero);
    Y_isp30[i] = LIMIT_VALUE(Y_isp30[i], 4095, 0);
 }
```

【Definition】

```
typedef struct Agamma_api_Fast_s {
    bool  en;
    float GammaCoef;
    float SlopeAtZero;
} Agamma_api_Fast_t;
```

【Member】

Member Name	Description
en	Switch function
GammaCoef	gamma coefficient, the value range is 0, 100, the default value is 2.2, and the accuracy is 0.01
SlopeAtZero	The slope of the dark area can be 0.05 and 0.05, the default value is 0, and the accuracy is 0.001

9.11.5.3 GammaType_t

【Description】

Define the Gamma curve X-axis spacing type property

【definition】

```
typedef enum GammaType_e {
   GAMMATYPE_LOG = 0,
   GAMMATYPE_EQU = 1,
} GammaType_t;
```

【Member】

Member Name	Description
GAMMATYPE_LOG	Non-evenly spaced
GAMMATYPE_EQU	Evenly spaced

9.11.5.4 Agamma_api_manualV21_t

【Description】

Define the manual gamma attribute under RK356x

【Definition】

```
typedef struct Agamma_api_manualV21_s {
   bool        Gamma_en;
   GammaType_t Gamma_out_segnum;
   uint16_t    Gamma_out_offset;
   uint16_t    Gamma_curve[CALIBDB_AGAMMA_KNOTS_NUM];
} Agamma_api_manualV21_t;
```

【Member】

Member Name	Description
Gamma_en	Switch function
Gamma_out_segnum	Manual Gamma Curve X-axis spacing type, default value GAMMATYPE_LOG
Gamma_out_offset	Manual Gamma curve correction coefficient, value range [-2048, 2048], default value 0, accuracy 1.
Gamma_curve	Manual Gamma curve, value range [0,4095], accuracy 1

9.11.5.5 Agamma_api_manualV30_t

【Description】

Define the manual gamma attribute under RK3588

【Definition】

```
typedef struct Agamma_api_manualV30_s {
   bool     Gamma_en;
   uint16_t Gamma_out_offset;
   uint16_t Gamma_curve[CALIBDB_AGAMMA_KNOTS_NUM_V30];
} Agamma_api_manualV30_t;
```

【Member】

Member Name	Description
Gamma_en	Switch function
Gamma_out_offset	Manual Gamma curve correction coefficient, value range [-2048, 2048], default value 0, accuracy 1.
Gamma_curve	Manual Gamma curve, value range [0,4095], accuracy 1

9.11.5.6 rk_aiq_gamma_attrV21_t

【Description】

Define the Gamma attribute on the RK356x

【Definition】

```
typedef struct rk_aiq_gamma_attrV21_s {
   rk_aiq_gamma_op_mode_t mode;
   Agamma_api_manualV21_t stManual;
   Agamma_api_Fast_t      stFast;
} rk_aiq_gamma_attrV21_t;
```

【Member】

Member Name	Description
mode	API Pattern
stManual	Manual Gamma parameter
stFast	Quick Mode Parameter

9.11.5.7 rk_aiq_gamma_attrV30_t

【Description】

Define the Gamma attribute under RK3588

【Definition】

```
typedef struct rk_aiq_gamma_attrV30_s {
   rk_aiq_gamma_op_mode_t mode;
   Agamma_api_manualV30_t stManual;
   Agamma_api_Fast_t      stFast;
} rk_aiq_gamma_attrV30_t;
```

【Member】

Member Name	Description
mode	API schema
stManual	Manual Gamma parameter
stFast	Quick mode parameters

9.11.5.8 rk_aiq_gamma_attr_t

【Description】

Define the Gamma property

【Definition】

```
typedef struct rk_aiq_gamma_attr_s {
    rk_aiq_uapi_sync_t     sync;
    rk_aiq_gamma_attrV21_t atrrV21;
    rk_aiq_gamma_attrV30_t atrrV30;
} rk_aiq_gamma_attr_t;
```

【Member】

Member Name	Description
sync	For rk_aiq_uapi_sync_t definitions, see **Overview/API Description** section
atrrV21	RK356x chip under manual gamma attribute
atrrV30	RK3588 chip under manual gamma attribute

9.12 CCM

9.12.1 Description of the feature

The CCM (Color Correction Matrix) module performs color correction processing on images.

9.12.2 Feature-level API reference

9.12.2.1 rk_aiq_uapi2_setCCMMode

【Description】
Set the CCM operating mode.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setCCMMode(const rk_aiq_sys_ctx_t* ctx, opMode_t mode);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
mode	mode of operation; value range: {OP_AUTO, OP_MANUAL}	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

【Example】

- Refer to "sample_set_ccm_manual" / "sample_set_ccm_auto" in sample_accm_module.cpp to set manual/automatic mode.

9.12.2.2 rk_aiq_uapi2_getCCMMode

【Description】

Gets the CCM operating mode.

【Grammar】

```
XCamReturn rk_aiq_uapi2_getCCMMode(const rk_aiq_sys_ctx_t* ctx, opMode_t *mode);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
mode	mode of operation; value range: {OP_AUTO, OP_MANUAL}	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

【Example】

- Refer to "sample_get_ccm_mode" in sample_accm_module.cpp for working mode.

9.12.2.3 rk_aiq_uapi2_setMCcCoef

【Description】

Set the CCM matrix in Manual mode, including the color correction matrix and R/G/B channel offset.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setMCcCoef(const rk_aiq_sys_ctx_t* ctx,
rk_aiq_ccm_matrix_t *mccm);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
mccm	CCM matrix in Manual mode, including color correction matrix and R/G/B channel offset	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

【Example】

- Refer to "sample_set_ccm_manual_matrix" in sample_accm_module.cpp to set up a manual CCM matrix.

9.12.2.4 rk_aiq_uapi2_getMCcCoef

【Description】

Acquire the CCM matrix, including the color correction matrix and the R/G/B channel offset.

【Grammar】

```
XCamReturn rk_aiq_uapi2_getMCcCoef(const rk_aiq_sys_ctx_t* ctx,
rk_aiq_ccm_matrix_t *mccm);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
mccm	CCM matrix, including color correction matrix and R/G/B channel offset	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

【Example】

- Refer to "sample_get_ccm_manual_matrix" in sample_accm_module.cpp to get the CCM matrix.

9.12.2.5 rk_aiq_uapi2_getACcmSat

【Description】

Obtain CCM saturation in automatic mode.

【Grammar】

```
XCamReturn rk_aiq_uapi2_getACcmSat(const rk_aiq_sys_ctx_t* ctx,  float
*finalsat);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
finalsat	Saturation, manual mode is 0	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

【Example】

- Refer to "sample_get_accm_sat" in sample_accm_module.cpp for CCM saturation in auto mode.

9.12.2.6 rk_aiq_uapi2_getACcmMatrixName

【Description】

Gets the CCM matrix name in auto mode.

【Grammar】

```
XCamReturn rk_aiq_uapi2_getACcmMatrixName(const rk_aiq_sys_ctx_t* ctx, char
**ccm_name);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
ccm_name	CCM matrix name	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

【Example】

- Refer to "sample_get_accm_matrix_name" in sample_accm_module.cpp to get CCM saturation in auto mode.

9.12.3 Functional-level API data types

9.12.3.1 opMode_t

【Description】

Define the CCM operating mode.

【Definition】

```
typedef enum opMode_e {
    OP_AUTO = 0,
    OP_MANUAL = 1,
    OP_INVAL
} opMode_t;
```

【Member】

Member Name	Description
OP_AUTO	Automatic mode
OP_MANUAL	Manual mode
OP_INVAL	Invalid value

9.12.3.2 rk_aiq_ccm_matrix_t

【Description】

Define the CCM matrix.

【Definition】

```
typedef struct rk_aiq_ccm_matrix_s {
    float  ccMatrix[9];
    float  ccOffsets[3];
} rk_aiq_ccm_matrix_t;
```

【Member】

Member Name	Description
ccMatrix	color correction matrix in manual mode; value range: [-8, 7.992]
ccOffsets	RGB component offset in manual mode; value range: [-4096, 4095]

9.12.4 Module-level API reference

9.12.4.1 rk_aiq_user_api2_accm_v2_SetAttrib

【Description】

Set the CCM properties.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_accm_SetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_ccm_attrib_t attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	The property parameters of CCM	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_accm.h, rk_aiq_uapi_accm_int.h
- Library file: librkaiq.so

【Example】

- Refer to "sample_ccm_setCcmAttr" in sample_accm_module.cpp to set CCM properties.

9.12.4.2 rk_aiq_user_api2_accm_GetAttrib

【Description】

Gets the CCM properties.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_accm_GetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_ccm_attrib_t *attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	Parameter properties of CCM	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_accm.h, rk_aiq_uapi_accm_int.h
- Library file: librkaiq.so

【Example】

- Refer to "sample_ccm_getCcmAttr" in sample_accm_module.cpp to obtain CCM attributes.

9.12.4.3 rk_aiq_user_api2_accm_QueryCcmInfo

【Description】

Query CCM information.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_accm_QueryCcmInfo(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_ccm_querry_info_t *ccm_querry_info);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
ccm_querry_info	CCM query content	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_accm.h, rk_aiq_uapi_accm_int.h
- Library file: librkaiq.so

【Example】

- Refer to "sample_query_ccm_info" in sample_accm_module.cpp to query CCM information.

9.12.5 Module-level API data types

9.12.5.1 rk_aiq_ccm_op_mode_t

【Description】

Define the CCM operating mode.

【Definition】

```
typedef enum rk_aiq_ccm_op_mode_s {
    RK_AIQ_CCM_MODE_INVALID                     = 0,
    RK_AIQ_CCM_MODE_MANUAL                      = 1,
    RK_AIQ_CCM_MODE_AUTO                        = 2,
    RK_AIQ_CCM_MODE_MAX
} rk_aiq_ccm_op_mode_t;
```

【Member】

Member Name	Description
RK_AIQ_CCM_MODE_INVALID	CCM invalid mode
RK_AIQ_CCM_MODE_MANUAL	CCM Manual Mode
RK_AIQ_CCM_MODE_AUTO	CCM Auto Mode

9.12.5.2 rk_aiq_ccm_mccm_attrib_t

【Description】

Define manual CCM properties.

【Definition】

```
typedef struct rk_aiq_ccm_mccm_attrib_s {
    float  ccMatrix[9];
    float  ccOffsets[3];
    float  y_alpha_curve[17];
    float low_bound_pos_bit;
} rk_aiq_ccm_mccm_attrib_t;
```

【Member】

Member Name	Description
ccMatrix	color correction matrix; value range: [-8, 7.992]
ccOffsets	RGB component offset; value range: [-4096, 4095]
y_alpha_curve	Intensity configuration of the color correction intensity adjustment curve related to pixel brightness (12bit). Valid values: [0x0, 0x400], 0x400 indicates 1 times the intensity, 0x0 indicates no correction
low_bound_pos_bit	The brightness range of the inflection point of the pixel brightness (12bit) adjustment curve is [0, 2^low_bound_pos_bit] and [4095-2^low_bound_pos_bit, 4095]. Valid values: [0,10]

9.12.5.3 rk_aiq_ccm_color_inhibition_t

【Description】

Define the CCM color suppression level.

【Definition】

```
typedef struct rk_aiq_ccm_color_inhibition_s {
    float sensorGain[RK_AIQ_ACCM_COLOR_GAIN_NUM];
    float level[RK_AIQ_ACCM_COLOR_GAIN_NUM];
} rk_aiq_ccm_color_inhibition_t;
```

【Member】

Member Name	Description
sensorGain	Exposure gain component
level	color suppression level; value range: [0,100]; default value is 0

9.12.5.4 rk_aiq_ccm_color_saturation_t

【Description】

Define the auto CCM color saturation level.

【Definition】

```
typedef struct rk_aiq_ccm_color_saturation_s {
    float sensorGain[RK_AIQ_ACCM_COLOR_GAIN_NUM];
    float level[RK_AIQ_ACCM_COLOR_GAIN_NUM];
} rk_aiq_ccm_color_saturation_t;
```

【Member】

Member Name	Description
sensorGain	Exposure gain component
level	color saturation level; value range: [0,100]; default value is 100

9.12.5.5 rk_aiq_ccm_accm_attrib_t

【Description】

Define automatic CCM properties.

【Definition】

```
typedef struct rk_aiq_ccm_accm_attrib_s {
    rk_aiq_ccm_color_inhibition_t color_inhibition;
    rk_aiq_ccm_color_saturation_t color_saturation;
} rk_aiq_ccm_accm_attrib_t;
```

【Member】

Member Name	Description
color_inhibition	CCM color suppression level
color_saturation	CCM color saturation level

9.12.5.6 rk_aiq_ccm_attrib_t

【Description】

Define CCM properties.

【Definition】

```
typedef struct rk_aiq_ccm_attrib_s {
    rk_aiq_uapi_sync_t sync;
    bool byPass;
    rk_aiq_ccm_op_mode_t mode;
    rk_aiq_ccm_mccm_attrib_t stManual;
    rk_aiq_ccm_accm_attrib_t stAuto;
    CalibDbV2_Ccm_Para_V2_t stTool;
} rk_aiq_ccm_attrib_t;
```

【Member】

Member Name	Description
sync	Synchronous/asynchronous signals, refer to rk_aiq_uapi_sync_t definition description, see **Overview/API Description" section
byPass	Skip module processing; true skip CCM, false CCM enable
mode	working mode selection; value range: {RK_AIQ_CCM_MODE_MANUAL, RK_AIQ_CCM_MODE_AUTO}, which indicates manual and automatic mode
stManual	Manual mode property parameter configuration
stAuto	Automatic mode property parameter configuration
stTool	Parameter configuration in tool mode, no need to configure

9.12.5.7 rk_aiq_ccm_querry_info_t

【Description】

Define CCM query information

【Definition】

```
typedef struct rk_aiq_ccm_querry_info_s {
    bool ccm_en;
    float  ccMatrix[9];
    float  ccOffsets[3];
    float  y_alpha_curve[CCM_CURVE_DOT_NUM];
    float low_bound_pos_bit;
    float color_inhibition_level;
    float color_saturation_level;
    float finalSat;
    char  ccmname1[25];
    char  ccmname2[25];
} rk_aiq_ccm_querry_info_t;
```

【Member】

Member Name	Description
ccm_en	CCM enabled true enabled, false not enabled
ccMatrix	CCM effective correction matrix; value range: [-8,7.992]
ccOffsets	Effective RGB component offset; value range: [-4096,4095]
y_alpha_curve	Intensity configuration of the color correction intensity adjustment curve related to pixel brightness (12bit). Value range: [0x0, 0x400]. 0x400 indicates 1 times the intensity, and 0x0 indicates no correction
low_bound_pos_bit	The brightness range of the inflection point of the pixel brightness (12bit) adjustment curve is [0, 2^low_bound_pos_bit] and [4095-2^low_bound_pos_bit, 4095]. Valid values: [0,10]
color_inhibition_level	CCM color suppression level (auto mode only)
color_saturation_level	CCM color saturation level (auto mode only)
finalSat	Saturation value corresponding to the current matrix (only auto mode is supported)
ccmname1	Name of the calibration matrix used to interpolate the calculation of the current matrix (automatic mode only)
ccmname2	Name of the calibration matrix used to interpolate the calculation of the current matrix (automatic mode only)

9.13 3DLUT

9.13.1 Description of the feature

The 3DLUT (3D look up table) module performs color mapping of images in RGB space.

9.13.2 Functional level API reference

9.13.2.1 rk_aiq_uapi2_setLut3dMode

【Description】

Set the 3DLUT operating mode.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setLut3dMode(const rk_aiq_sys_ctx_t* ctx, opMode_t mode);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
mode	mode of operation; value range: {OP_AUTO, OP_MANUAL}	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

【Example】

- Refer to "sample_set_a3dlut_manual" / "sample_set_a3dlut_auto" in sample_a3dlut_module.cpp to set manual/automatic mode.

9.13.2.2 rk_aiq_uapi2_getLut3dMode

【Description】

Get the 3DLUT working mode.

【Grammar】

```
XCamReturn rk_aiq_uapi2_getLut3dMode(const rk_aiq_sys_ctx_t* ctx, opMode_t
*mode);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
mode	Working mode	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

【Example】

- Refer to "sample_get_a3dlut_mode" in sample_a3dlut_module.cpp to set manual/automatic mode.

9.13.2.3 rk_aiq_uapi2_setM3dLut

【Description】

Set up a 3DLUT manual 3D lookup table.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setM3dLut(const rk_aiq_sys_ctx_t* ctx,
rk_aiq_lut3d_table_t *mlut);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
mlut	3D lookup table	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

【Example】

- Refer to the "sample_set_a3dlut_manual_lut" in sample_a3dlut_module.cpp to set up the 3DLUT manual 3D lookup table.

9.13.2.4 rk_aiq_uapi2_getM3dLut

【Description】
Get the 3DLUT 3D lookup table.

【Grammar】

```
XCamReturn rk_aiq_uapi2_getM3dLut(const rk_aiq_sys_ctx_t* ctx,
 rk_aiq_lut3d_table_t *mlut);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
mlut	3D lookup table	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

【Example】

- Refer to "sample_get_a3dlut_lut" in sample_a3dlut_module.cpp for 3DLUT 3D lookup tables.

9.13.2.5 rk_aiq_uapi2_getA3dLutStrth

【Description】
Get 3DLUT to adjust the intensity.

【Grammar】

```
XCamReturn rk_aiq_uapi2_getA3dLutStrth(const rk_aiq_sys_ctx_t* ctx, float alpha);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
alpha	3DLUT Modulation Intensity	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

【Example】

- Refer to "sample_get_a3dlut_strength" in sample_a3dlut_module.cpp for 3DLUT adjustment intensity.

9.13.2.6 rk_aiq_uapi2_getA3dLutName

【Description】
Obtain the 3DLUT table name in automatic mode.

【Grammar】

```
XCamReturn rk_aiq_uapi2_getA3dLutName(const rk_aiq_sys_ctx_t* ctx, char *name);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
name	3DLUT table name	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h

- Library file: librkaiq.so

【Example】

- Refer to "sample_get_a3dlut_lutname" in sample_a3dlut_module.cpp to get the 3DLUT table name in automatic mode.

9.13.3 Functional-level API data types

9.13.3.1 opMode_t

【Description】

Define the 3DLUT operating mode.

【Definition】

```
typedef enum opMode_e {
    OP_AUTO = 0,
    OP_MANUALl = 1,
    OP_INVAL
} opMode_t;
```

【Member】

Member Name	Description
OP_AUTO	Automatic mode
OP_MANUALl	Manual mode
OP_INVAL	Invalid value

9.13.3.2 rk_aiq_lut3d_table_t

【Description】

Define a 3DLUT 3D lookup table.

【Definition】

```
typedef struct rk_aiq_lut3d_table_s{
    unsigned short look_up_table_r[729];
    unsigned short look_up_table_g[729];
    unsigned short look_up_table_b[729];
} rk_aiq_lut3d_table_t;
```

【Member】

Member Name	Description
look_up_table_r	R channel lookup table in manual mode; value range: [0x0, 0x3ff]
look_up_table_g	G channel lookup table in manual mode; value range: [0x0, 0xfff]
look_up_table_b	B-channel lookup table in manual mode; value range: [0x0, 0x3ff]

9.13.4 Module-level API reference

9.13.4.1 rk_aiq_user_api2_a3dlut_SetAttrib

【Description】

Set the 3DLUT property.

【Grammar】

```
XCamReturn rk_aiq_user_api2_a3dlut_SetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_lut3d_attrib_t attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	3DLUT parameter properties	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_a3dlut.h, rk_aiq_uapi_a3dlut_int.h
- Library file: librkaiq.so

【Example】

- Refer to "sample_3dlut_set3dlutAttr" in sample_a3dlut_module.cpp to set the 3DLUT attribute.

9.13.4.2 rk_aiq_user_api2_a3dlut_GetAttrib

【Description】

Get the 3DLUT attribute.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_a3dlut_GetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_lut3d_attrib_t *attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	3DLUT parameter properties	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_a3dlut.h, rk_aiq_uapi_a3dlut_int.h
- Library file: librkaiq.so

【Example】

- Refer to "sample_3dlut_get3dlutAttr" etc. in sample_a3dlut_module.cpp to get 3DLUT attributes.

9.13.4.3 rk_aiq_user_api2_a3dlut_Query3dlutInfo

【Description】

Query 3DLUT information.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_a3dlut_Query3dlutInfo(const RkAiqAlgoContext *ctx,
rk_aiq_lut3d_querry_info_t *lut3d_querry_info );
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
lut3d_querry_info	3DLUT query content	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header files: rk_aiq_user_api2_a3dlut.h, rk_aiq_uapi_a3dlut_int.h
- Library file: librkaiq.so

【Example】

- Refer to "sample_query_a3dlut_info" in sample_a3dlut_module.cpp for 3DLUT information.

9.13.5 Module-level API data types

9.13.5.1 rk_aiq_lut3d_op_mode_t

【Description】
Define the 3DLUT operating mode

【Definition】

```
typedef enum rk_aiq_lut3d_op_mode_s {
    RK_AIQ_LUT3D_MODE_INVALID                       = 0,
    RK_AIQ_LUT3D_MODE_MANUAL                        = 1,
    RK_AIQ_LUT3D_MODE_AUTO                          = 2,
    RK_AIQ_LUT3D_MODE_MAX
} rk_aiq_lut3d_op_mode_t;
```

【Member】

Member Name	Description
RK_AIQ_LUT3D_MODE_INVALID	3DLUT invalid mode
RK_AIQ_LUT3D_MODE_MANUAL	3DLUT Manual Mode
RK_AIQ_LUT3D_MODE_AUTO	3DLUT Auto Mode

9.13.5.2 rk_aiq_lut3d_mlut3d_attrib_t

【Description】

Define manual 3DLUT attributes

【Definition】

```
typedef struct rk_aiq_lut3d_mlut3d_attrib_s {
    unsigned short look_up_table_r[729];
    unsigned short look_up_table_g[729];
    unsigned short look_up_table_b[729];
} rk_aiq_lut3d_mlut3d_attrib_t;
```

【Member】

Member Name	Description
look_up_table_r	R channel lookup table in manual mode; value range: [0x0, 0x3ff]
look_up_table_g	G channel lookup table in manual mode; value range: [0x0, 0xfff]
look_up_table_b	B-channel lookup table in manual mode; value range: [0x0, 0x3ff]

9.13.5.3 rk_aiq_lut3d_attrib_t

【Description】

Define 3DLUT attributes

【Definition】

```
typedef struct rk_aiq_lut3d_attrib_s {
    rk_aiq_uapi_sync_t sync;
    bool byPass;
    rk_aiq_lut3d_op_mode_t mode;
    rk_aiq_lut3d_mlut3d_attrib_t stManual;
} rk_aiq_lut3d_attrib_t;
```

【Member】

Member Name	Description
sync	Synchronous/asynchronous signals, refer to rk_aiq_uapi_sync_t definition description, see **Overview/API Description" section
byPass	Skip module processing; true skips 3DLUT, false 3DLUT enables
mode	working mode selection; value range: {RK_AIQ_LUT3D_MODE_MANUAL, RK_AIQ_LUT3D_MODE_AUTO}, indicating manual and automatic mode
stManual	Manual mode property parameter configuration

9.13.5.4 rk_aiq_lut3d_querry_info_t

【Description】

Define 3DLUT query information

【Definition】

```
typedef struct rk_aiq_lut3d_querry_info_s {
    bool lut3d_en;
    float alpha;
    char name[25];
    unsigned short look_up_table_r[729];
    unsigned short look_up_table_g[729];
    unsigned short look_up_table_b[729];
} rk_aiq_lut3d_querry_info_t;
```

【Member】

Member Name	Description
lut3d_en	3DLUT enabled; true enabled, false not enabled
alpha	3DLUT regulation intensity; value range: [0, 1.0], the larger the value, the greater the intensity; 1.0
name	3DLUT table name, only automatic mode is supported
look_up_table_r	R channel lookup table; value range: [0x0, 0x3ff]
look_up_table_g	G channel lookup table; value range: [0x0, 0xfff]
look_up_table_b	B-channel lookup table; value range: [0x0, 0x3ff]

9.14 LDCH

9.14.1 Description of the feature

LDCH performs a restorative treatment on images with distortion, and the module only corrects image distortion in the horizontal direction.

9.14.2 Functional level API reference

9.14.2.1 rk_aiq_uapi_setLdchEn

【Description】 Horizontal distortion correction function switch.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setLdchEn(const rk_aiq_sys_ctx_t* ctx, bool en);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
en	Correction switch	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

9.14.2.2 rk_aiq_uapi2_setLdchCorrectLevel

【Description】 Set the level of horizontal distortion correction.

【Grammar】

```
XCamReturn rk_aiq_uapi2_setLdchCorrectLevel(const rk_aiq_sys_ctx_t* ctx, int
correctLevel);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
correctLevel	Correction level, value range: [0~255]	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_imgproc.h
- Library file: librkaiq.so

9.14.3 Module-level API reference

9.14.3.1 rk_aiq_user_api2_aldch_SetAttrib

【Description】
Set the FEC property.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_aldch_SetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_ldch_attrib_t attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	ldch's parameter attribute	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_aldch.h
- Library file: librkaiq.so

9.14.3.2 rk_aiq_user_api2_aldch_GetAttrib

【Description】

Gets the FEC attribute.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_aldch_GetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_ldch_attrib_t attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	ldch's parameter attribute	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_aldch.h
- Library file: librkaiq.so

9.14.4 Module-level API data types

9.14.4.1 rk_aiq_ldch_attrib_t

【Description】

ldch attribute configuration

【Definition】

```
typedef struct rk_aiq_ldch_cfg_s {
    rk_aiq_uapi_sync_t sync;

    unsigned int en;
    int correct_level;
} rk_aiq_ldch_cfg_t;
```

【Member】

Member Name	Description
sync	Interface synchronous/asynchronous functionality, refer to rk_aiq_uapi_sync_t definition description, see **Overview/API Description" section
en	Enable/disable ldch
correct_level	Set the LDCH correction level: [0~255]

9.15 DeBayer

9.15.1 Description of the feature

DeBayer completes the image with CFA attributes collected by the sensor to be restored into an RGB image with full pixel information through an interpolation algorithm.

The module supports Bayer raw data and includes four pattern modes: RGGB, BGGR, GRBG, and gbrg. Other CFA data, such as CCCB, RGB-IR and other CFAs, are not supported at the moment.

9.15.2 Module-level API reference

9.15.2.1 rk_aiq_user_api_adebayer_SetAttrib

【Description】

Set the demosaic property.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_adebayer_SetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
adebayer_attrib_t attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	Go to the mosaic properties	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_adebayer.h
- Library file: librkaiq.so

9.15.2.2 rk_aiq_user_api_adebayer_GetAttrib

【Description】

Get the demosaic property.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_adebayer_GetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
adebayer_attrib_t *attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	Go to the mosaic properties	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_uapi2_adebayer_int.h
- Library file: librkaiq.so

9.15.3 Data type

9.15.3.1 rk_aiq_debayer_op_mode_t

【Description】

Define the debayer mode of operation.

【Definition】

```
typedef enum rk_aiq_debayer_op_mode_s {
    RK_AIQ_DEBAYER_MODE_INVALID                     = 0,        /**<
initialization value */
    RK_AIQ_DEBAYER_MODE_MANUAL                      = 1,        /**< run manual
lens shading correction */
    RK_AIQ_DEBAYER_MODE_AUTO                        = 2,        /**< run auto
lens shading correction */
    RK_AIQ_DEBAYER_MODE_MAX
} rk_aiq_debayer_op_mode_t;
```

【Member】

Member Name	Description
RK_AIQ_DEBAYER_MODE_INVALID	Debayer invalid mode
RK_AIQ_DEBAYER_MODE_MANUAL	Debayer manual mode
RK_AIQ_DEBAYER_MODE_AUTO	Debayer automatic mode

9.15.3.2 adebayer_attrib_manual_t

【Description】

Define configurable properties in debayer manual mode.

【Definition】

```
typedef struct adebayer_attrib_manual_s {
    int8_t      filter1[5];
    int8_t      filter2[5];
    uint8_t     gain_offset;
    uint8_t     sharp_strength;
    uint8_t     hf_offset;
    uint8_t     offset;
    uint8_t     clip_en;
    uint8_t     filter_g_en;
    uint8_t     filter_c_en;
    uint8_t     thed0;
    uint8_t     thed1;
    uint8_t     dist_scale;
    uint8_t     cnr_strength;
    uint8_t     shift_num;
} adebayer_attrib_manual_t;
```

【Member】

Member Name	Description
filter1	Low-frequency gradient filter. Value range: [-8,7]
filter2	High-frequency gradient filters. Value range: [-8,7]
gain_offset	Calculate the offset of the gradient when sharpening the weights in the G-channel interpolation coefficient. Value range: [0,15]
sharp_strength	The G-channel interpolates the sharpening force, and the higher the value, the greater the sharpening force. Valid values: [0,4]
hf_offset	Interpolation directivity control: Flat areas are prone to pseudo-textures with smaller values, and larger values are more likely to be aliased at edges. Value range: [0,4095]
offset	Offset of the G-channel clip. The higher the value, the larger the clip range. Value range: [0,65535]
clip_en	G-channel interpolation clip switch, 0: off, 1: on;
filter_g_en	G-channel scatter removal switch, 0: off, 1: on;
filter_c_en	False color removal switch, 0: off, 1: on;
thed0	The higher the value, the smaller the probability of selecting the high-frequency weight. Value range: [0,16]
thed1	Control the selection of high and low frequency weights, the higher the value, the smaller the probability of selecting low frequency weights. Value range: [0,16]
dist_scale	The higher the value, the smaller the probability of selecting the high-frequency weight. Value range: [0,16]
cnr_strength	The higher the value, the greater the force. Valid values: [0,9]
shift_num	The smaller the value, the larger the range of the chromatic aberration clip. The value range is [0,4]

9.15.3.3 adebayer_attrib_auto_t

【Description】

Define configurable properties in debayer automatic mode.

【Definition】

```
typedef struct adebayer_attrib_auto_s {
    uint8_t     sharp_strength[9];
    uint8_t     low_freq_thresh;
    uint8_t     high_freq_thresh;
} adebayer_attrib_auto_t;
```

【Member】

Member Name	Description
enhance_strength[9]	Detail texture enhancement at different ISOs index 0 - ISO 50 index 1 - ISO 100 index 2 - ISO 200 index 3 - ISO 400 index 4 - ISO 800 index 5 - ISO 1600 index 6 - ISO 3200 index 7 - ISO 6400 index 8 - ISO 12800 The higher the value, the better the detail and clarity, and the more pseudo-detail will be enhanced Value range: [0~7]
low_freq_thresh	Low-frequency weight selection threshold. The higher the value, the smaller the probability of selecting a low-frequency weight. Value range: [0~15]
high_freq_thresh	High-frequency weight selection threshold. The higher the value, the smaller the probability of selecting a high-frequency weight. Value range: [0~15]

9.15.3.4 adebayer_attrib_t

【Description】

Define debayer configurable attributes.

【Definition】

```
typedef struct adebayer_attrib_s {
    rk_aiq_uapi_sync_t          sync;

    uint8_t                     enable;
    rk_aiq_debayer_op_mode_t    mode;
    adebayer_attrib_manual_t    stManual;
    adebayer_attrib_auto_t      stAuto;
} adebayer_attrib_t;
```

【Member】

Member Name	Description
sync	For details about the synchronous/asynchronous interface mode, rk_aiq_uapi_sync_t see **Overview/API Description**
enable	The debayer module enables the switch, 0: bypass, 1: on;
mode	Debayer working mode
stManual	Debaye configuration properties in manual control mode
stAuto	Configuration properties in debayer auto-control mode

9.16 DPCC

9.16.1 Description of the feature

Detect and eliminate dead pixels in images. For details, please refer to the "Function Description" in Section 4.6 "DPCC" of the Rockchip_Tuning_Guide_ISP30 document.

9.16.2 Module-level API reference

9.16.2.1 rk_aiq_user_api2_adpcc_SetAttrib

【Description】
Set DPCC software properties.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_adpcc_SetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_dpcc_attrib_V20_t *attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	DPCC Software Properties Structure	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_adpcc.h
- Library file: librkaiq.so

【Description】

9.16.2.2 rk_aiq_user_api2_adpcc_GetAttrib

【Description】
Gets the DPCC software properties.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_adpcc_GetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_dpcc_attrib_V20_t *attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	DPCC Software Properties Structure	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_adpcc.h
- Library file: librkaiq.so

【Description】

9.16.3 Data type

9.16.3.1 rk_aiq_dpcc_attrib_V20_t

【Description】
Define the dead pixel elimination attribute.

【Definition】

```
typedef struct rk_aiq_dpcc_attrib_V20_s {
    AdpccOPMode_t eMode;
    Adpcc_Auto_Attr_t stAuto;
    Adpcc_Manual_Attr_t stManual;
    rk_aiq_uapi_sync_t sync;
} rk_aiq_dpcc_attrib_V20_t;
```

【Member】

Member Name	Description
eMode	Define the DPCC operating mode, see **AdpccOPMode_t** for details
stAuto	Parameter setting for automatic mode
stManual	Parameter setting for manual mode
sync	Interface synchronous/asynchronous functionality, refer to rk_aiq_uapi_sync_t definition description, see **Overview/API Description** section

9.16.3.2 AdpccOPMode_t

【Description】

Define the DPCC operating mode

【Definition】

```
typedef enum AdpccOPMode_e {
    ADPCC_OP_MODE_INVALID        = 0,
    ADPCC_OP_MODE_AUTO           = 1,
    ADPCC_OP_MODE_MANUAL         = 2,
    ADPCC_OP_MODE_TOOL           = 3,
    ADPCC_OP_MODE_MAX
} AdpccOPMode_t;
```

【Member】

Member Name	Description
ADPCC_OP_MODE_INVALID	Invalid API pattern
ADPCC_OP_MODE_AUTO	API Auto Mode
ADPCC_OP_MODE_MANUAL	API Manual Mode
ADPCC_OP_MODE_TOOL	API Tool Mode
ADPCC_OP_MODE_MAX	

9.16.3.3 Adpcc_basic_params_select_t

【Description】

Define DPCC basic parameter properties

【Definition】

```
typedef struct Adpcc_basic_params_select_s
{
    int           iso;
    unsigned char stage1_enable;
    unsigned char grayscale_mode;
    unsigned char enable;
    unsigned char sw_rk_out_sel;
    unsigned char sw_dpcc_output_sel;
    unsigned char stage1_rb_3x3;
    unsigned char stage1_g_3x3;
    unsigned char stage1_incl_rb_center;
    unsigned char stage1_incl_green_center;
    unsigned char stage1_use_fix_set;
    unsigned char stage1_use_set_3;
    unsigned char stage1_use_set_2;
    unsigned char stage1_use_set_1;
    unsigned char sw_rk_red_blue1_en;
    unsigned char rg_red_blue1_enable;
    unsigned char rnd_red_blue1_enable;
    unsigned char ro_red_blue1_enable;
    unsigned char lc_red_blue1_enable;
    unsigned char pg_red_blue1_enable;
    unsigned char sw_rk_green1_en;
    unsigned char rg_green1_enable;
    unsigned char rnd_green1_enable;
    unsigned char ro_green1_enable;
    unsigned char lc_green1_enable;
    unsigned char pg_green1_enable;
    unsigned char sw_rk_red_blue2_en;
    unsigned char rg_red_blue2_enable;
    unsigned char rnd_red_blue2_enable;
    unsigned char ro_red_blue2_enable;
    unsigned char lc_red_blue2_enable;
    unsigned char pg_red_blue2_enable;
    unsigned char sw_rk_green2_en;
    unsigned char rg_green2_enable;
    unsigned char rnd_green2_enable;
    unsigned char ro_green2_enable;
    unsigned char lc_green2_enable;
    unsigned char pg_green2_enable;
    unsigned char sw_rk_red_blue3_en;
    unsigned char rg_red_blue3_enable;
    unsigned char rnd_red_blue3_enable;
    unsigned char ro_red_blue3_enable;
    unsigned char lc_red_blue3_enable;
    unsigned char pg_red_blue3_enable;
    unsigned char sw_rk_green3_en;
    unsigned char rg_green3_enable;
```

```
    unsigned char rnd_green3_enable;
    unsigned char ro_green3_enable;
    unsigned char lc_green3_enable;
    unsigned char pg_green3_enable;
    unsigned char sw_mindis1_rb;
    unsigned char sw_mindis1_g;
    unsigned char line_thr_1_rb;
    unsigned char line_thr_1_g;
    unsigned char sw_dis_scale_min1;
    unsigned char sw_dis_scale_max1;
    unsigned char line_mad_fac_1_rb;
    unsigned char line_mad_fac_1_g;
    unsigned char pg_fac_1_rb;
    unsigned char pg_fac_1_g;
    unsigned char rnd_thr_1_rb;
    unsigned char rnd_thr_1_g;
    unsigned char rg_fac_1_rb;
    unsigned char rg_fac_1_g;
    unsigned char sw_mindis2_rb;
    unsigned char sw_mindis2_g;
    unsigned char line_thr_2_rb;
    unsigned char line_thr_2_g;
    unsigned char sw_dis_scale_min2;
    unsigned char sw_dis_scale_max2;
    unsigned char line_mad_fac_2_rb;
    unsigned char line_mad_fac_2_g;
    unsigned char pg_fac_2_rb;
    unsigned char pg_fac_2_g;
    unsigned char rnd_thr_2_rb;
    unsigned char rnd_thr_2_g;
    unsigned char rg_fac_2_rb;
    unsigned char rg_fac_2_g;
    unsigned char sw_mindis3_rb;
    unsigned char sw_mindis3_g;
    unsigned char line_thr_3_rb;
    unsigned char line_thr_3_g;
    unsigned char sw_dis_scale_min3;
    unsigned char sw_dis_scale_max3;
    unsigned char line_mad_fac_3_rb;
    unsigned char line_mad_fac_3_g;
    unsigned char pg_fac_3_rb;
    unsigned char pg_fac_3_g;
    unsigned char rnd_thr_3_rb;
    unsigned char rnd_thr_3_g;
    unsigned char rg_fac_3_rb;
    unsigned char rg_fac_3_g;
    unsigned char ro_lim_3_rb;
    unsigned char ro_lim_3_g;
    unsigned char ro_lim_2_rb;
    unsigned char ro_lim_2_g;
    unsigned char ro_lim_1_rb;
    unsigned char ro_lim_1_g;
    unsigned char rnd_offs_3_rb;
    unsigned char rnd_offs_3_g;
    unsigned char rnd_offs_2_rb;
    unsigned char rnd_offs_2_g;
```

```
    unsigned char rnd_offs_1_rb;
    unsigned char rnd_offs_1_g;

} Adpcc_basic_params_select_t;
```

9.16.3.4 Adpcc_basic_params_t

【Description】

Define DPCC basic parameter properties

【Definition】

```
typedef struct Adpcc_basic_params_s
{
    Adpcc_basic_params_select_t arBasic[DPCC_MAX_ISO_LEVEL];
} Adpcc_basic_params_t;
```

【Member】

Member Name	Description
arBasic	The basic parameters of DPCC are

9.16.3.5 Adpcc_bpt_params_t

【Description】

Define automatic DPCC properties

【Definition】

```
typedef struct Adpcc_bpt_params_s
{
    unsigned char       bpt_rb_3x3;
    unsigned char       bpt_g_3x3;
    unsigned char       bpt_incl_rb_center;
    unsigned char       bpt_incl_green_center;
    unsigned char       bpt_use_fix_set;
    unsigned char       bpt_use_set_3;
    unsigned char       bpt_use_set_2;
    unsigned char       bpt_use_set_1;
    unsigned char       bpt_cor_en;
    unsigned char       bpt_det_en;
    unsigned short int  bp_number;
    unsigned short int  bp_table_addr;
    unsigned short int  bpt_v_addr;
    unsigned short int  bpt_h_addr;
    unsigned int        bp_cnt;
} Adpcc_bpt_params_t;
```

9.16.3.6 dpcc_pdaf_point_t

【Description】

【Definition】

```
typedef struct dpcc_pdaf_point_s
{
    unsigned char y;
    unsigned char x;
} dpcc_pdaf_point_t;
```

The module is not yet implemented

9.16.3.7 Adpcc_pdaf_params_t

【Description】

Define PDAF mode properties in automatic mode

【Definition】

```
typedef struct Adpcc_pdaf_params_s
{
    unsigned char      sw_pdaf_en;
    unsigned char      pdaf_point_en[DPCC_PDAF_POINT_NUM];
    unsigned short int pdaf_offsety;
    unsigned short int pdaf_offsetx;
    unsigned char      pdaf_wrapy;
    unsigned char      pdaf_wrapx;
    unsigned short int pdaf_wrapy_num;
    unsigned short int pdaf_wrapx_num;
    dpcc_pdaf_point_t  point[DPCC_PDAF_POINT_NUM];
    unsigned char      pdaf_forward_med;
} Adpcc_pdaf_params_t;
```

The module is not yet implemented.

9.16.3.8 CalibDb_Dpcc_Fast_Mode_t

【Description】

Defines the Fast mode property in automatic mode

【Definition】

```
typedef struct CalibDb_Dpcc_Fast_Mode_s
{
    int fast_mode_en;
    int ISO[CALIBDB_DPCC_MAX_ISO_LEVEL];
    int fast_mode_single_en;
    int fast_mode_single_level[CALIBDB_DPCC_MAX_ISO_LEVEL];
    int fast_mode_double_en;
    int fast_mode_double_level[CALIBDB_DPCC_MAX_ISO_LEVEL];
    int fast_mode_triple_en;
    int fast_mode_triple_level[CALIBDB_DPCC_MAX_ISO_LEVEL];
} CalibDb_Dpcc_Fast_Mode_t;
```

【Member】

Member name	Description
Fast_mode_enable	Fast_mode switch function, 0: off, 1: on
ISO	Environmental ISO
fast_mode_single_en	Single dead pixel removal switch, 0: off, 1: on
fast_mode_single_level	Single dead pixel removal force, value range [0, 10]
fast_mode_double_en	Double dead pixel removal switch, 0: off, 1: on
fast_mode_double_level	Double dead pixel removal force, value range [0, 10]
fast_mode_triple_en	Multi-dead pixel removal switch, 0: off, 1: on
fast_mode_triple_level	Multiple dead pixel removal force, value range [0, 10]

9.16.3.9 CalibDb_Dpcc_Sensor_t

【Description】

Defines the Fast mode property in automatic mode

【Definition】

```
typedef struct CalibDb_Dpcc_Sensor_s
{
    float en;
    float max_level;
    float iso[CALIBDB_DPCC_MAX_ISO_LEVEL];
    float level_single[CALIBDB_DPCC_MAX_ISO_LEVEL];
    float level_multiple[CALIBDB_DPCC_MAX_ISO_LEVEL];
} CalibDb_Dpcc_Sensor_t;
```

【Member】

Member name	Description
en	Sensor DPCC switch function, 0: off, 1: on
max_level	Maximum force to remove dead pixels
iso	Environmental ISO
level_single	Remove individual dead pixel force
level_multiple	Remove multiple dead pixel forces

9.16.3.10 Adpcc_bpt_params_select_t

【Description】

Defines the Fast mode property selected in automatic mode

【Definition】

```
typedef Adpcc_bpt_params_t Adpcc_bpt_params_select_t;
```

9.16.3.11 Adpcc_pdaf_params_select_t

【Description】

Defines the PDAF mode properties selected in automatic mode

【Definition】

```
typedef Adpcc_pdaf_params_t Adpcc_pdaf_params_select_t
```

9.16.3.12 Adpcc_Auto_Attr_t

【Description】

Define automatic DPCC properties

【Definition】

```
typedef struct Adpcc_Auto_Attr_s
{
    Adpcc_basic_params_t        stBasicParams;
    Adpcc_bpt_params_t          stBptParams;
    Adpcc_pdaf_params_t         stPdafParams;
    CalibDb_Dpcc_Fast_Mode_t    stFastMode;
    CalibDb_Dpcc_Sensor_t       stSensorDpcc;
    Adpcc_basic_params_select_t stBasicSelect;
    Adpcc_bpt_params_select_t   stBptSelect;
    Adpcc_pdaf_params_select_t  stPdafSelect;

} Adpcc_Auto_Attr_t;
```

【Member】

Member Name	Description
stBasicParams	Basic parameters in automatic mode
stBptParams	Dead pixel parameter in automatic mode
stPdafParams	Automatic mode PDAF mode parameters
stFastMode	Automatic mode quick mode parameter
stSensorDpcc	Sensor dead pixel function parameters in automatic mode
stBasicSelect	Basic parameters selected in automatic mode
stBptSelect	Dead pixel parameter selected in automatic mode
stPdafSelect	The PDAF mode parameter selected in automatic mode

9.16.3.13 Adpcc_fast_mode_attr_t

【Description】

Defines the Quick Mode property in manual mode

【Definition】

```
typedef struct Adpcc_fast_mode_attr_s
{
    bool fast_mode_en;
    bool fast_mode_single_en;
    int  fast_mode_single_level;
    bool fast_mode_double_en;
    int  fast_mode_double_level;
    bool fast_mode_triple_en;
    int  fast_mode_triple_level;
} Adpcc_fast_mode_attr_t;
```

【Member】

Member name	Description
Fast_mode_en	Fast_mode switch function
fast_mode_single_en	Single dead pixel removal switch
fast_mode_single_level	Single dead pixel removal force, value range [0, 10]
fast_mode_double_en	Double dead pixel removal switch
fast_mode_double_level	Double dead pixel removal force, value range [0, 10]
fast_mode_triple_en	Multi-dead pixel removal switch
fast_mode_triple_level	Multiple dead pixel removal force, value range [0, 10]

9.16.3.14 Adpcc_sensor_dpcc_attr_t

【Description】

Defines the Sensor dead pixel feature properties in manual mode

【Definition】

```
typedef struct Adpcc_sensor_dpcc_attr_s
{
    bool en;
    int  max_level;
    int  single_level;
    int  double_level;
} Adpcc_sensor_dpcc_attr_t;
```

【Member】

Member name	Description
en	Sensor dpcc switch function
max_level	Maximum force to remove dead pixels
single_level	Remove individual dead pixel force
double_level	Remove multiple dead pixel forces

9.16.3.15 Adpcc_Manual_Attr_t

【Description】

Define manual DPCC properties

【Definition】

```
typedef struct Adpcc_Manual_Attr_s
{
    unsigned char enable;
    Adpcc_onfly_cfg_t stOnfly;
    Adpcc_bpt_params_select_t   stBpt;
    Adpcc_pdaf_params_select_t  stPdaf;
    Adpcc_sensor_dpcc_attr_t    stSensorDpcc;
} Adpcc_Manual_Attr_t;
```

【Member】

Member Name	Description
enable	Manual mode DPCC switch
stOnfly	ISP DPCC module in manual mode Dynamic dead pixel detection and correction function parameters
stBptParams	ISP DPCC module static dead pixel correction function parameters in manual mode
stPdafParams	ISP DPCC module PDAF SPC functional parameters in manual mode
stSensorDpcc	Dead pixel correction function parameters of the DPCC module on the sensor side in manual mode

9.16.3.16 Adpcc_onfly_cfg_t

【Description】

Define manual DPCC basic parameters

【Definition】

```
typedef struct Adpcc_onfly_cfg_s {
   Adpcc_onfly_mode_t mode;
   Adpcc_fast_mode_attr_t fast_mode;
   Adpcc_basic_cfg_params_t expert_mode;
} Adpcc_onfly_cfg_t;
```

【Member】

Member Name	Description
mode	Quick mode or expert mode
fastmode	Manual mode quick mode parameter settings
expert_mode	Expert mode parameter settings

9.16.3.17 Adpcc_onfly_mode_t

【Description】

Define manual DPCC basic parameters

【Definition】

```
typedef enum Adpcc_onfly_mode_e {
    ADPCC_ONFLY_MODE_FAST        = 0,                  /**< dpcc manual fast
mode */
    ADPCC_ONFLY_MODE_EXPERT      = 1,                  /**< dpcc manual expert
mode */
    ADPCC_ONFLY_MODE_MAX                               /**< max */
} Adpcc_onfly_mode_t;
```

【Member】

Member Name	Description
ADPCC_ONFLY_MODE_FAST	Quick Mode
ADPCC_ONFLY_MODE_EXPERT	Expert Mode
ADPCC_ONFLY_MODE_MAX	Invalid parameter setting

9.16.3.18 CalibDb_Dpcc_Pdaf_t

【Description】

Define the tool PDAF SPC functional attribute parameters

【Definition】

```
typedef struct CalibDb_Dpcc_Pdaf_s
{
    unsigned char      en;
    unsigned char      point_en[16];
    unsigned short int offsetx;
    unsigned short int offsety;
    unsigned char      wrapx;
    unsigned char      wrapy;
    unsigned short int wrapx_num;
    unsigned short int wrapy_num;
    unsigned char      point_x[16];
    unsigned char      point_y[16];
    unsigned char      forward_med;
} CalibDb_Dpcc_Pdaf_t;
```

9.16.3.19 CalibDb_Dpcc_set_RK_t

【Description】

Define the RK algorithm properties

【Definition】

```
typedef struct CalibDb_Dpcc_set_RK_s
{
    unsigned char rb_enable[CALIBDB_DPCC_MAX_ISO_LEVEL];
    unsigned char g_enable[CALIBDB_DPCC_MAX_ISO_LEVEL];
    unsigned char rb_sw_mindis[CALIBDB_DPCC_MAX_ISO_LEVEL];
    unsigned char g_sw_mindis[CALIBDB_DPCC_MAX_ISO_LEVEL];
    unsigned char sw_dis_scale_min[CALIBDB_DPCC_MAX_ISO_LEVEL];
    unsigned char sw_dis_scale_max[CALIBDB_DPCC_MAX_ISO_LEVEL];
} CalibDb_Dpcc_set_RK_t;
```

【Member】

Member Name	Description
rb_enable	Red and blue channel dead pixel detection switch
g_enable	Green channel dead pixel detection switch
rb_sw_mindis	Red and blue channel dead pixel threshold1
g_sw_mindis	Green channel dead pixel threshold 1
sw_dis_scale_min	Dead pixel threshold 2
sw_dis_scale_max	Dead pixel threshold3

9.16.3.20 CalibDb_Dpcc_set_LC_t

【Description】

Define LC algorithm properties

【Definition】

```
typedef struct CalibDb_Dpcc_set_LC_s
{
    unsigned char rb_enable[CALIBDB_DPCC_MAX_ISO_LEVEL];
    unsigned char g_enable[CALIBDB_DPCC_MAX_ISO_LEVEL];
    unsigned char rb_line_thr[CALIBDB_DPCC_MAX_ISO_LEVEL];
    unsigned char g_line_thr[CALIBDB_DPCC_MAX_ISO_LEVEL];
    unsigned char rb_line_mad_fac[CALIBDB_DPCC_MAX_ISO_LEVEL];
    unsigned char g_line_mad_fac[CALIBDB_DPCC_MAX_ISO_LEVEL];
} CalibDb_Dpcc_set_LC_t;
```

【Member】

Member Name	Description
rb_enable	Red and blue channel dead pixel detection switch
g_enable	Green channel dead pixel detection switch
rb_line_thr	Red and blue channel dead pixel threshold1
g_line_thr	Green channel dead pixel threshold 1
rb_line_mad_fac	Red and blue channel dead pixel threshold2
g_line_mad_fac	Green channel dead pixel threshold 2

9.16.3.21 CalibDb_Dpcc_set_PG_t

【Description】

Define PG algorithm properties

【Definition】

```
typedef struct CalibDb_Dpcc_set_PG_s
{
    unsigned char rb_enable[CALIBDB_DPCC_MAX_ISO_LEVEL];
    unsigned char g_enable[CALIBDB_DPCC_MAX_ISO_LEVEL];
    unsigned char rb_pg_fac[CALIBDB_DPCC_MAX_ISO_LEVEL];
    unsigned char g_pg_fac[CALIBDB_DPCC_MAX_ISO_LEVEL];
} CalibDb_Dpcc_set_PG_t;
```

【Member】

Member Name	Description
rb_enable	Red and blue channel dead pixel detection switch
g_enable	Green channel dead pixel detection switch
rb_pg_fac	Red and blue channel dead pixel thresholds
g_pg_fac	Green channel dead pixel threshold

9.16.3.22 CalibDb_Dpcc_set_RND_t

【Description】

Define RND algorithm properties

【Definition】

```
typedef struct CalibDb_Dpcc_set_RND_s
{
    unsigned char rb_enable[CALIBDB_DPCC_MAX_ISO_LEVEL];
    unsigned char g_enable[CALIBDB_DPCC_MAX_ISO_LEVEL];
    unsigned char rb_rnd_thr[CALIBDB_DPCC_MAX_ISO_LEVEL];
    unsigned char g_rnd_thr[CALIBDB_DPCC_MAX_ISO_LEVEL];
    unsigned char rb_rnd_offs[CALIBDB_DPCC_MAX_ISO_LEVEL];
    unsigned char g_rnd_offs[CALIBDB_DPCC_MAX_ISO_LEVEL];
} CalibDb_Dpcc_set_RND_t;
```

【Member】

Member Name	Description
rb_enable	Red and blue channel dead pixel detection switch
g_enable	Green channel dead pixel detection switch
rb_rnd_thr	Red and blue channel dead pixel threshold1
g_rnd_thr	Green channel dead pixel threshold 1
rb_rnd_offs	Red and blue channel dead pixel threshold2
g_rnd_offs	Green channel dead pixel threshold 2

9.16.3.23 CalibDb_Dpcc_set_RG_t

【Description】

Define the RK algorithm properties

【Definition】

```
typedef struct CalibDb_Dpcc_set_RG_s
{
    unsigned char rb_enable[CALIBDB_DPCC_MAX_ISO_LEVEL];
    unsigned char g_enable[CALIBDB_DPCC_MAX_ISO_LEVEL];
    unsigned char rb_rg_fac[CALIBDB_DPCC_MAX_ISO_LEVEL];
    unsigned char g_rg_fac[CALIBDB_DPCC_MAX_ISO_LEVEL];
} CalibDb_Dpcc_set_RG_t;
```

【Member】

Member Name	Description
rb_enable	Red and blue channel dead pixel detection switch
g_enable	Green channel dead pixel detection switch
rb_rg_fac	Red and blue channel dead pixel thresholds
g_rg_fac	Green channel dead pixel threshold

9.16.3.24 CalibDb_Dpcc_set_RO_t

【Description】

Define RO algorithm properties

【Definition】

```
typedef struct CalibDb_Dpcc_set_RO_s
{
    unsigned char rb_enable[CALIBDB_DPCC_MAX_ISO_LEVEL];
    unsigned char g_enable[CALIBDB_DPCC_MAX_ISO_LEVEL];
    unsigned char rb_ro_lim[CALIBDB_DPCC_MAX_ISO_LEVEL];
    unsigned char g_ro_lim[CALIBDB_DPCC_MAX_ISO_LEVEL];
} CalibDb_Dpcc_set_RO_t;
```

【Members】

Member Name	Description
rb_enable	Red and blue channel dead pixel detection switch
g_enable	Green channel dead pixel detection switch
rb_ro_lim	Red and blue channel dead pixel thresholds
g_ro_lim	Green channel dead pixel threshold

9.16.3.25 CalibDb_Dpcc_set_t

【Description】

Define dead pixel condition properties

【Definition】

```
typedef struct CalibDb_Dpcc_set_s
{
    CalibDb_Dpcc_set_RK_t  rk;
    CalibDb_Dpcc_set_LC_t  lc;
    CalibDb_Dpcc_set_PG_t  pg;
    CalibDb_Dpcc_set_RND_t rnd;
    CalibDb_Dpcc_set_RG_t  rg;
    CalibDb_Dpcc_set_RO_t  ro;
} CalibDb_Dpcc_set_t;
```

【Member】

Member Name	Description
rk	RK algorithm
lc	LC algorithm
pg	PG algorithm
rnd	RND algorithm
rg	RG algorithm
ro	RO algorithm

9.16.3.26 CalibDb_Dpcc_Expert_Mode_t

【Description】

Define the tool expert mode properties

【Definition】

```
typedef struct CalibDb_Dpcc_Expert_Mode_s
{
    float              iso[CALIBDB_DPCC_MAX_ISO_LEVEL];
    unsigned char      stage1_Enable[CALIBDB_DPCC_MAX_ISO_LEVEL];
    unsigned char      grayscale_mode;
    unsigned char      rk_out_sel[CALIBDB_DPCC_MAX_ISO_LEVEL];
    unsigned char      dpcc_out_sel[CALIBDB_DPCC_MAX_ISO_LEVEL];
    unsigned char      stage1_rb_3x3[CALIBDB_DPCC_MAX_ISO_LEVEL];
    unsigned char      stage1_g_3x3[CALIBDB_DPCC_MAX_ISO_LEVEL];
    unsigned char      stage1_inc_rb_center[CALIBDB_DPCC_MAX_ISO_LEVEL];
    unsigned char      stage1_inc_g_center[CALIBDB_DPCC_MAX_ISO_LEVEL];
    unsigned char      stage1_use_fix_set[CALIBDB_DPCC_MAX_ISO_LEVEL];
    unsigned char      stage1_use_set3[CALIBDB_DPCC_MAX_ISO_LEVEL];
    unsigned char      stage1_use_set2[CALIBDB_DPCC_MAX_ISO_LEVEL];
```

```
    unsigned char      stage1_use_set1[CALIBDB_DPCC_MAX_ISO_LEVEL];
    CalibDb_Dpcc_set_t set[3];
} CalibDb_Dpcc_Expert_Mode_t;
```

【Members】

Member name	Description
iso	Environmental ISO
stage1_Enable	Default value 1
grayscale_mode	Black and white mode switch, 0: off, 1: on
rk_out_sel	RK dead pixel judgment mode, 0: mode 1, 1: mode 2, 2: mode 3
dpcc_out_sel	Dead pixel correction mode, 0: median, 1: RK mode
stage1_rb_3x3	Default value: 0
stage1_g_3x3	Default value: 0
stage1_inc_rb_center	Default value 1
stage1_inc_g_center	Default value 1
stage1_use_fix_set	Built-in dead pixel condition switch, 0: off, 1: on
stage1_use_set3	The third dead pixel judgment condition switch in the set_cell, 0: off, 1: open
stage1_use_set2	The second dead pixel judgment condition switch in the set_cell, 0: off, 1: on
stage1_use_set1	The first dead pixel judgment condition switch in the set_cell, 0: off, 1: on

9.16.3.27 CalibDb_Dpcc_t

【Description】

Define the tool DPCC properties

【Definition】

```
typedef struct CalibDb_Dpcc_s
{
    int                         enable;
    char                        version[64];
    CalibDb_Dpcc_Fast_Mode_t    fast;
    CalibDb_Dpcc_Expert_Mode_t expert;
    CalibDb_Dpcc_Pdaf_t         pdaf;
    CalibDb_Dpcc_Sensor_t       sensor_dpcc;
} CalibDb_Dpcc_t;
```

【Member】

Member Name	Description
enable	Switch function
version	Version
fast	Quick Mode
expert	Expert Mode
pdaf	Dead pixel condition in PADF SPC function mode
sensor_dpcc	Sensor side DPCC module dead pixel correction parameters

9.16.3.28 rk_aiq_dpcc_attrib_t

【Description】

Define DPCC properties

【Definition】

```
typedef struct rk_aiq_dpcc_attrib_s
{
    AdpccOPMode_t       eMode;
    Adpcc_Auto_Attr_t   stAuto;
    Adpcc_Manual_Attr_t stManual;
    CalibDb_Dpcc_t      stTool;
} rk_aiq_dpcc_attrib_t;
```

【Member】

Member Name	Description
eMode	API pattern
stAuto	Auto DPCC mode
stManual	Manual DPCC mode
stTool	Tools DPCC Mode

9.17 LSC

9.17.1 Description of the feature

Lens Shading Correction is to solve the situation of shadows around the lens due to the optical characteristics of lens, due to the uneven optical refraction of the lens.

9.17.2 Module-level API reference

9.17.2.1 rk_aiq_user_api2_alsc_SetAttrib

【Description】

Set lens shadow correction properties.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_alsc_SetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_lsc_attrib_t attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	Lens shadow correction properties	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_alsc.h
- Library file: librkaiq.so

9.17.2.2 rk_aiq_user_api2_alsc_GetAttrib

【Description】

Gets the lens shadow correction properties.

【Grammar】

```
XCamReturn
rk_aiq_user_api2_adebayer_GetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_lsc_attrib_t *attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	Lens shadow correction properties	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_alsc.h
- Library file: librkaiq.so

9.17.3 Data Type

9.17.3.1 rk_aiq_lsc_attrib_t

【Description】
Define ISP lens shadow correction properties.

【Definition】

```
typedef struct rk_aiq_lsc_attrib_s {
    bool byPass;
    rk_aiq_lsc_op_mode_t mode;
    rk_aiq_lsc_mlsc_attrib_t stManual;
    rk_aiq_uapi_sync_t sync;
} rk_aiq_lsc_attrib_t;
```

【Member】

Member Name	Description
sync	Interface synchronous/asynchronous functionality, refer to rk_aiq_uapi_sync_t definition description, see **Overview/API Description" section
bypass	LSC module enable 1: off 0: enable
mode	Mode settings
stManual	Parameter settings in manual mode

9.17.3.2 rk_aiq_lsc_op_mode_t

【Description】

Define the ISP lens shadow correction operating mode.

【Definition】

```
typedef enum rk_aiq_lsc_op_mode_s {
    RK_AIQ_LSC_MODE_INVALID                     = 0,        /**< initialization
value */
    RK_AIQ_LSC_MODE_MANUAL                      = 1,        /**< run manual lens
shading correction */
    RK_AIQ_LSC_MODE_AUTO                        = 2,        /**< run auto lens
shading correction */
    RK_AIQ_LSC_MODE_MAX
} rk_aiq_lsc_op_mode_t;
```

【Member】

Member Name	Description
RK_AIQ_LSC_MODE_INVALID	Invalid mode
RK_AIQ_LSC_MODE_MANUAL	Manual mode
RK_AIQ_LSC_MODE_AUTO	Automatic mode

9.17.3.3 rk_aiq_lsc_table_t

【Description】

Define the ISP lens shadow correction table.

【Definition】

```
typedef struct rk_aiq_lsc_table_s {
    unsigned short r_data_tbl[LSC_DATA_TBL_SIZE];
    unsigned short gr_data_tbl[LSC_DATA_TBL_SIZE];
    unsigned short gb_data_tbl[LSC_DATA_TBL_SIZE];
    unsigned short b_data_tbl[LSC_DATA_TBL_SIZE];
} rk_aiq_lsc_table_t;
```

【Member】

Member Name	Description
r_data_tbl	R component correction table The number of elements is [17x17] value range [1~7.99] 3bit higher integer bits lower 8bit decimal places
gr_data_tbl	The number of elements in the GR component correction table is [17x17] value range [1~7.99] 3bit higher integer bits lower 8bit decimal places
gb_data_tbl	GB component correction table The number of elements is [17x17] value range [1~7.99] 3bit higher integer bit lower 8bit decimal places
b_data_tbl	The number of elements in the B component correction table is [17x17] value range [1~7.99] 3bit higher integer bit lower 8bit decimal places

9.18 GIC

9.18.1 Description of the feature

The GIC module is used to correct the imbalance between the two channels of Gr and Gb and improve the image quality of some scenes.

9.18.2 Module-level API reference

9.18.2.1 rk_aiq_user_api2_agic_v2_SetAttrib

【Description】

Set GIC software properties.

【Grammar】

```
XCamReturn rk_aiq_user_api2_agic_v2_SetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
const rkaiq_gic_v2_api_attr_t* attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	GIC Software Property Structure	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_agic.h
- Library file: librkaiq.so

【Description】

Not.

9.18.2.2 rk_aiq_user_api2_agic_v2_GetAttrib

【Description】

Gets the gamma software properties.

【Grammar】

```
XCamReturn rk_aiq_user_api2_agic_v2_GetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rkaiq_gic_v2_api_attr_t* attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	GIC Software Property Struct	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_agic.h
- Library file: librkaiq.so

【Description】

9.18.3 Module-level API data types

9.18.3.1 rkaiq_gic_api_op_mode_t

【Description】

Define the GIC operating mode

【Definition】

```
typedef enum rkaiq_gic_api_op_mode_e {
    RKAIQ_GIC_API_OPMODE_OFF    = 0,
    RKAIQ_GIC_API_OPMODE_AUTO   = 1,
    RKAIQ_GIC_API_OPMODE_MANUAL = 2,
} rkaiq_gic_api_op_mode_t;
```

【Member】

Member Name	Description
RKAIQ_GIC_API_OPMODE_OFF	GIC Off Mode
RKAIQ_GIC_API_OPMODE_AUTO	API Manual Mode
RKAIQ_GIC_API_OPMODE_MANUAL	Manual mode

9.18.3.2 rkaiq_gic_v2_param_selected_t

【Description】

Define automatic/manual properties under RK3588

【Definition】

```
typedef struct rkaiq_gic_v2_param_selected_s {
    uint32_t iso;
    uint8_t bypass;
    uint8_t gr_ratio;
    uint16_t min_busy_thre;
    uint16_t min_grad_thr1;
    uint16_t min_grad_thr2;
    uint16_t k_grad1;
    uint16_t k_grad2;
    uint16_t gb_thre;
    uint16_t maxCorV;
    uint16_t maxCorVboth;
    uint16_t dark_thre;
    uint16_t dark_threHi;
    uint16_t k_grad1_dark;
    uint16_t k_grad2_dark;
    uint16_t min_grad_thr_dark1;
    uint16_t min_grad_thr_dark2;
    float NoiseScale;
    float NoiseBase;
    float noiseCurve_0;
    float noiseCurve_1;
    float globalStrength;
    uint16_t diff_clip;
} rkaiq_gic_v2_param_selected_t;
```

【Member】

Member Name	Description
iso	Environmental iso
bypass	Reserved, not using
gr_ratio	Reserved, not using
min_busy_thre	Busy area detection capability, value range [0, 1023], default value 160
min_grad_thr1	The number threshold of non-edge areas is 1, the GIC intensity control value, the value range [0, 1023], and the default value is 32
min_grad_thr2	The number threshold of non-edge areas is 2, the GIC intensity control value, the value range [0, 1023], and the default value is 32
k_grad1	The response threshold of the edge (horizontal and vertical gradient) is 1, the value range is [0, 15], and the default value is 5
k_grad2	The response threshold of the edge (horizontal and vertical gradient) is 2, the value range is [0, 15], and the default value is 1
gb_thre	Scale factor for scale, value range [0, 15], default value 7
maxCorV	Limit the maximum compensation value of GB in the edge area, the value range is [0, 1023], and the default value is 40
maxCorVboth	Limit the maximum compensation value of GB in flat (non-edge) areas, the value range is [0, 1023], and the default value is 8
dark_thre	Define the threshold value of the dark area 1, the value range [0, 2047], the default value 120
dark_threHi	Define the threshold value of the dark area 2, the value range [0, 2047], the default value is 240
k_grad1_dark	The threshold value of the edge (horizontal and vertical gradient) of the dark part of the image is 1, the value range is [0, 15], and the default value is 6
k_grad2_dark	The threshold of the response degree of the edge (horizontal and vertical gradient) of the dark part of the image is 2, the value range is [0, 15], and the default value is 1
min_grad_thr_dark1	The threshold for the number of non-marginal areas in the dark part of the image is 1, the value range is [0, 1023], and the default value is 64
min_grad_thr_dark2	The number threshold of the number of non-marginal areas in the dark part of the image is 2, the value range [0, 1023], and the default value is 32
noiseCurve_0	Noise curve parameter 1
noiseCurve_1	Noise profile parameter 2
globalStrength	Global control adjusts the intensity of the GB compensation value, the value range [0, 2], the default value 1

Member Name	Description
NoiseScale	According to the noise curve, obtain the standard deviation of the current point noise, and use noise_std *noise_scale to determine the maximum GB compensation value
NoiseBase	Punish the image edge adjustment threshold, according to the first gradient and the second gradient calculation result plus the noise_offset, and then compare as long as one direction gradx>2*grady is considered an edge, do not adjust
diff_clip	Limit the maximum compensation value of the maximum GB

9.18.3.3 rkaiq_gic_v2_api_attr_t

【Description】

Define GIC attributes

【Definition】

```
typedef struct rkaiq_gic_v2_api_attr_s {
    rk_aiq_uapi_sync_t sync;
    uint8_t gic_en;
    rkaiq_gic_api_op_mode_t op_mode;
    uint32_t iso_cnt;
    rkaiq_gic_v2_param_selected_t auto_params[RKAIQ_GIC_MAX_ISO_CNT];
    rkaiq_gic_v2_param_selected_t manual_param;
} rkaiq_gic_v2_api_attr_t;
```

【Member】

Member Name	Description
sync	For rk_aiq_uapi_sync_t definitions, see **Overview/API Description** section
gic_en	Switch
op_mode	Working mode
iso_cnt	Number of ISOs in the auto parameter
auto_params	Automatic parameters, one set per ISO, the software automatically calculates based on ISO interpolation
manual_param	Manual parameters, fixed use of this group of parameters

9.19 CGC

9.19.1 Description of the feature

CGC (Color Gamut Compression) can set the color gamut compression parameters.

9.19.2 Functional level API reference

9.19.3 Module-level API reference

9.19.3.1 rk_aiq_user_api2_acgc_SetAttrib

【Description】

Set CGC module properties

【Grammar】

```
XCamReturn rk_aiq_user_api2_acgc_SetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_uapi_acgc_attrib_t attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	CGC Module Properties	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_acgc.h
- Library file: librkaiq.so

【Precautions】

- attr.param.op_mode = RK_AIQ_OP_MODE_AUTO, AIQ's built-in CGC default parameters are used, and attr.param.op_mode = RK_AIQ_OP_MODE_MANUAL, CGC parameters can be configured.

9.19.3.2 rk_aiq_user_api2_acgc_GetAttrib

【Description】

Gets the current properties of the CGC module

【Grammar】

```
XCamReturn rk_aiq_user_api2_acgc_GetAttrib(const rk_aiq_sys_ctx_t* sys_ctx,
rk_aiq_uapi_acgc_attrib_t* attr);
```

【Parameters】

Parameter Name	Description	Input/Output
sys_ctx	AIQ context pointer	Input
attr	CGC module property	Output

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api2_acgc.h
- Library file: librkaiq.so

9.19.4 Module-level API data types

9.19.4.1 rk_aiq_uapi_acgc_attrib_t

【Description】

Define CGC module API parameters

【Definition】

```
typedef struct rk_aiq_uapi_acgc_attrib_s {
    rk_aiq_uapi_sync_t sync;
    rk_aiq_acgc_params_t param;
} rk_aiq_uapi_acgc_attrib_t;
```

【Member】

Member Name	Description
sync	For rk_aiq_uapi_sync_t definitions, see **Overview/API Description** section
rk_aiq_acgc_params_t	cgc parameter

9.19.4.2 rk_aiq_acgc_params_t

【Description】

Define CGC module parameters

【Definition】

```
typedef struct __cgc_param {
    RKAiqOPMode_t op_mode;
    bool cgc_ratio_en;
    bool cgc_yuv_limit;
} Cgc_Param_t;

typedef Cgc_Param_t rk_aiq_acgc_params_t;
```

【Member】

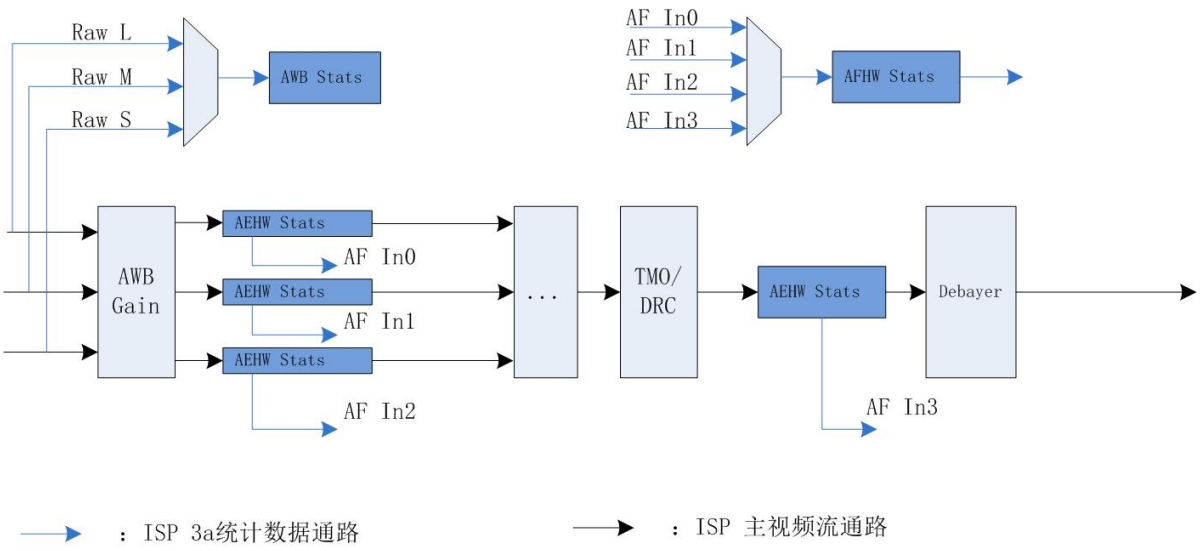
Member Name	Description
op_mode	mode, RK_AIQ_OP_MODE_AUTO (using AIQ built-in parameters) or RK_AIQ_OP_MODE_MANUAL (using user-configurable parameters)
cgc_ratio_en	Whether to enable gamut compression mode, default value: FALSE
cgc_yuv_limit	Whether to output limit range, if cgc_yuv_limit = FALSE, bypass CGC, default value: FALSE

10. Statistics

10.1 Overview

ISP30 supports image data processing to obtain the relevant statistical information required by the AWB/AE/AF 3A control algorithm, which is roughly as follows:

ISP30 3A统计框图



10.2 Description of the feature

10.2.1 AE statistics

AE hardware statistics mainly include the following parts:

256-segment weighted histogram statistics and chunked R/G/B/Y mean statistics based on RAW domain;

10.2.1.1 AE statistics based on raw graphs

- The module statistics are divided into block brightness statistics and histogram statistics. According to the supported block size and whether there are independent subwindow statistics, the statistical mode can be divided into big mode and lite mode.
- big mode: maximum support 15X15 non-independent sub-window blocking, minimum support 1X1 non-independent sub-window blocking, each block can output 10bit R/B channel luminance average and 12bit G channel average, default to 15X15 blocking; At the same time, 4 independent sub-windows can be set up, each independent sub-window can output the sum of 29-bit R/B channel brightness and 32-bit G channel sum, and the average brightness needs to be divided by the number of pixels of each independent sub-window in the software. In this mode, the weighted histogram statistics are based on the number of tiles and the corresponding assigned weights, and the effective number of pixels in each luminance segment is 28bit.
- lite mode: maximum support 5X5 non-independent sub-window blocking, minimum support 1X1 non-independent sub-window blocking, each block can output 10bit R/B channel brightness average and 12bit G channel average, default to 5X5 blocking; Setting up stand-alone child windows is not supported. In this mode, the weighted histogram statistics are based on the number of tiles and the corresponding assigned weights, and the effective number of pixels in each luminance segment is 28bit.

- 3588 platform, default non-HDR exposure mode, BIG mode (15X15 non-independent sub-window), HDR 2-frame mode, BIG mode (15X15 non-independent sub-window), HDR 3-frame mode, BIG mode for short and long frames (15X15 non-independent sub-window), medium frame in LITE mode (5X5 non-independent sub-window)

10.2.2 AWB statistics

AWB Hardware Statistics Source:

- In HDR multi-frame mode, support to select 1 of the 3 channels of L/M/S.
- In linear mode, there is only 1 channel of data.
- Perform statistics on data after Raw-BLC-LSC

AWB hardware statistics include white point statistics and chunking statistics

- White point statistics

Record the cumulative value and number of RGins and BGains in the white areas of 7 light sources and 2 sizes in the main window

Record the cumulative value and number of RGins and BGains in the white areas of 4 light sources and 2 sizes in the sub-window

The RGin and BGain in the 4 UV or XY fields are added to the box, and the number of RGins is added

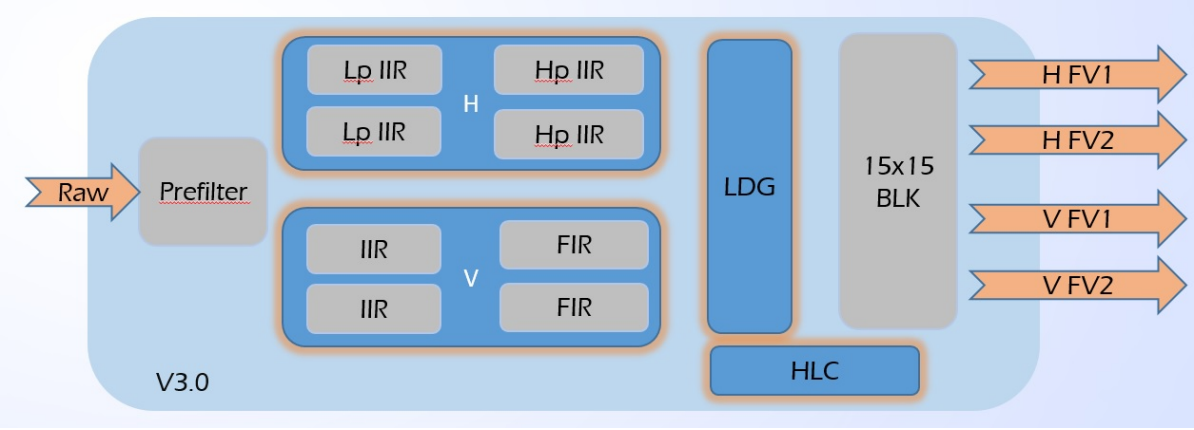
- Chunking statistics
  Image 15x15 tiles, R, G, B mean of all points or white points for each block

10.2.3 AF statistics

AFHW Stats Hardware Statistics:

- In HDR multi-frame mode, support to select 1 of the 3 channels of L/M/S. At the same time, the data after 3-channel synthesis is supported as input.
- In linear mode, there is only 1 channel of data.
- Support FV output of 2 configurable frequency bands horizontally and FV output of 2 configurable frequency bands in vertical direction

ISP30 AF Hardware Statistics Module Block Diagram



10.3 API reference

10.3.1 rk_aiq_uapi_sysctl_get3AStatsBlk

【Description】

Obtain 3A statistics synchronously.

【Grammar】

```
XCamReturn
rk_aiq_uapi_sysctl_get3AStatsBlk(const rk_aiq_sys_ctx_t* ctx, rk_aiq_isp_stats_t
**stats, int timeout_ms);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
stats	Statistics structure pointer	Output
timeout_ms	Timeout, -1 means infinite wait until there is a statistic	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api_sysctl.h
- Library file: librkaiq.so

10.3.2 rk_aiq_uapi_sysctl_release3AStatsRef

【Description】

Release the acquired 3A statistical information and use it with the rk_aiq_uapi_sysctl_get3AStatsBlk.

【Grammar】

```
void
rk_aiq_uapi_sysctl_release3AStatsRef(const rk_aiq_sys_ctx_t* ctx,
rk_aiq_isp_stats_t *stats);
```

【Parameters】

Parameter Name	Description	Input/Output
ctx	AIQ context pointer	Input
stats	Statistics structure pointer	Input

【Return Value】

Return value	Description
0	Success
Non-0	Failure, see Error Code Table

【Requirements】

- Header file: rk_aiq_user_api_sysctl.h
- Library file: librkaiq.so

Reference code

sdk: external/camera_engine_rkaiq/rkisp_demo/demo/af_algo_demo

10.4 Data type

10.4.1 rk_aiq_isp_stats_t

【Description】
AIQ 3A statistics

【Definition】

```
typedef struct {
    rk_aiq_isp_aec_stats_t aec_stats;
    rk_aiq_isp_awb_stats2_v3x_t awb_stats_v3x;
    rk_aiq_isp_af_stats_t  af_stats;
} rk_aiq_isp_stats_t;
```

【Member】

Member Name	Description
aec_stats	ae statistics
rk_aiq_isp_awb_stats2_v3x_t	awb statistics
af_stats	af statistics

10.4.2 RKAiqAecStats_t

【Description】

Define AE data information, see the function description of AE section for details.

【Definition】

```
typedef struct RKAiqAecStats_s {
    RkAiqAecHwStatsRes_t ae_data;
    RKAiqAecExpInfo_t ae_exp;
} RKAiqAecStats_t;
```

【Member】

Member Name	Description
ae_data	AE Module Hardware Statistics
ae_exp	AE module sensor exposure information

10.4.2.1 RKAiqAecExpInfo_t

【Description】

AE module exposure parameter information

【Definition】

```
typedef struct RKAiqAecExpInfo_s {
    RkAiqExpParamComb_t LinearExp;
    RkAiqExpParamComb_t HdrExp[3];
    RkAiqIrisParamComb_t Iris;
    uint16_t line_length_pixels;
    uint32_t frame_length_lines;
    float pixel_clock_freq_mhz;
    CISFeature_t CISFeature;
    RKAiqExpI2cParam_t exp_i2c_params;
} RKAiqAecExpInfo_t;
```

【Member】

Member Name	Description
LinearExp	Exposure parameter information for non-HDR modes, including exposure actual values and register values in RK format
HdrExp	Exposure parameter information for HDR mode, including exposure actual values and register values in RK format, supports up to 3 frame exposures
exp_i2c_params	The sensor register value of the exposure parameter, the exposure register value parameter used by third-party AE schemes
line_length_pixels	hts, whose value is determined by the sensor's configuration sequence
frame_length_lines	vts, whose value is determined by the configuration sequence of the sensor
pixel_clock_freq_mhz	pclk, in MHz, the value of which is determined by the configuration sequence of the sensor

【Precautions】

- HdrExp represents exposure parameter information in HDR mode and supports up to 3TO1. HDR 2TO1: Subscript 0 indicates short frame exposure parameters, subscript 1 indicates long frame exposure parameters, subscript 2 is invalid; HDR 3TO1: Subscript 0 indicates short frame exposure parameters, subscript 1 indicates medium frame exposure parameters, and subscript 2 indicates long frame exposure parameters.

10.4.2.1.1 RkAiqExpParamComb_t

【Description】

AE module exposure parameter information details

【Member】

```
typedef struct {
    RkAiqExpRealParam_t exp_real_params; real value
    RkAiqExpSensorParam_t exp_sensor_params;//RK reg value
} RkAiqExpParamComb_t;
```

Member Name	Description
exp_real_params	The actual physical value of the exposure component
exp_sensor_params	The sensor register value of the exposure component, following the RK exposure setting

```
typedef struct RkAiqExpRealParam_s {
    float integration_time;
    float analog_gain;
    float digital_gain;
    float isp_dgain;
    int   iso;
    int   dcg_mode;
} RkAiqExpRealParam_t;
```

Member Name	Description
integration_time	Exposure integration time in seconds (s)
analog_gain	The analog gain/Total gain of the sensor in multiples
digital_gain	The digital gain of the sensor, in multiples, is configured to 1x when the digital gain of the sensor compensates for the accuracy of the analog gain, and the overall gain value is written to the analog_gain
isp_dgain	ISP digital gain, in multiples, is currently invalid, and the default value is 1x
iso	The total gain value, ISO represents the system gain, in constant 50 times multiple, ISO = Total gain * 50
dcg_mode	Dual conversion gain

```
typedef struct RkAiqExpSensorParam_s {
    unsigned short fine_integration_time;
    unsigned short coarse_integration_time;
    unsigned short analog_gain_code_global;
    unsigned short digital_gain_global;
    unsigned short isp_digital_gain;
} RkAiqExpSensorParam_t;
```

Member Name	Description
fine_integration_time	The fractional line register value of the sensor exposure integration time, which is only required if the sensor supports decimal lines
coarse_integration_time	The register value corresponding to the sensor exposure integration time, in the number of rows
analog_gain_code_global	Register values corresponding to the analog gain of the sensor
digital_gain_global	Register values corresponding to the digital gain of the sensor
isp_digital_gain	ISP digital gain register value, temporarily invalid

【Precautions】

- The digital gain of different sensors has different effects, some to increase the sensitivity range, and some to complement the accuracy of the analog gain. Therefore, the digital gain is not listed separately for this time, and its size and corresponding register values are all incorporated into the analog gain.
- Dual conversion gain mode has three states, a value of -1 means that the sensor does not support DCG, a value of 0 indicates LCG, and a value of 1 indicates HCG

10.4.2.1.2 RKAiqExpI2cParam_t

【Description】

AE module I2c exposure parameters (generally used by third-party AEs)

【Definition】

```
#define MAX_I2CDATA_LEN 64
typedef struct RKAiqExpI2cParam_s {
    bool           bValid;
    unsigned int   nNumRegs;
    unsigned int   RegAddr[MAX_I2CDATA_LEN];
    unsigned int   AddrByteNum[MAX_I2CDATA_LEN];
    unsigned int   RegValue[MAX_I2CDATA_LEN];
    unsigned int   ValueByteNum[MAX_I2CDATA_LEN];
    unsigned int   DelayFrames[MAX_I2CDATA_LEN];
} RKAiqExpI2cParam_t;
```

【Member】

Member Name	Description
bValid	I2c parameter effective enable bit true: use RKAiqExpI2cParam_t to set register value (generally used by third-party AE); false: Register value setting using register parameters in RK format
nNumRegs	The number of register values set
AddrByteNum	The bit length of the register address, the maximum number of elements is 64
RegValue	An array of register values with a maximum number of elements of 64
ValueByteNum	The bit length of the register value, the maximum number of elements is 64
DelayFrames	Register value deferred array of frames with a maximum of 64

【Precautions】

- This register parameter is only valid if the third-party AE application is true and bValid is true, otherwise the RK format register parameter in the RkAiqExpParamComb_t is used by default
- The maximum number of register values that can be set is 64

10.4.2.1.3 RkAiqIrisParamComb_t

【Description】
AE module aperture parameters

【Definition】

```
typedef struct {
    RkAiqPIrisParam_t   PIris;
    RkAiqDCIrisParam_t  DCIris;
} RkAiqIrisParamComb_t;
typedef struct {
    int            step;
    int            gain;
    bool           update;
} RkAiqPIrisParam_t;
typedef struct {
    int        pwmDuty; //percent value,range = 0-100
    bool       update;
} RkAiqDCIrisParam_t;
```

【Member】

Member Name	Child members	Description
PIris	step gain update	P aperture parameters: P aperture step register value P aperture step equivalent gain value P aperture step update flag
DCIris	pwmDuty update	DC aperture parameters: PWM duty cycle value, value range: 1~100 DC aperture parameter update flag

10.4.2.2 RkAiqAecHwStatsRes_t

【Description】

AE module hardware statistics

【Definition】

```
typedef struct RkAiqAecHwStatsRes_s {
    Aec_Stat_Res_t chn[3];
    Aec_Stat_Res_t extra;
    struct yuvae_stat yuvae;
    struct sihist_stat sihist;
} RkAiqAecHwStatsRes_t;
```

【Member】

Member Name	Description
chn[3]	The AE module is based on the statistics of the raw graph (after BLC and AWB), compatible with HDR and non-HDR modes, and supports up to HDR 3TO1 S/M/L statistics
extra	The AE module is based on the statistics of the raw graph (before Debayer), and in HDR mode, it represents the statistics of the synthesized frame
yuvae	The AE module is based on the block information of the RGB diagram before gamma [not supported by the 3588 platform].
sihist	The AE module is based on the histogram information of the pre-gamma RGB diagram [not supported by the 3588 platform]

【Precautions】

- Aec_Stat_Res_t chn[3]: Represents the statistics of the first 3 Raw data paths of the HDR Merge module. For non-HDR mode, the corresponding subscript is 0, and all other subscripts are invalid; HDR 2TO1 mode, when the subscript is 0, it means short frame data path statistics, subscript 1 indicates long frame data path statistics, and subscript 2 is invalid; In HDR 3TO1 mode, the subscript is 0 for short-frame data path statistics, subscript 1 for medium frame data path statistics, and subscript 2 for long-frame data path

statistics. The raw graph-based statistics module has a BLC AWB module before, so the raw-based statistics are affected by the gain value of BLC and AWB.

- Aec_Stat_Res_t extra: In HDR mode, extra represents the raw graph statistics after HDR compositing. The statistics module has BLC, AWB, HDRMERGE, TMO and other modules before, so the statistical information of this module is affected by the gain of BLC, AWB, HDRMERGE, TMO and other modules. **In addition, when the AF module is turned on, this part of the statistics is invalid**.
- For the 3588 platform, block information and histogram information based on pre-gamma RGB plots are not supported

10.4.2.2.1 Aec_Stat_Res_t

【Description】

The AE module is based on the statistics of the raw graph

【Definition】

```
typedef struct Aec_Stat_Res_s {
    //rawae
    struct rawaebig_stat rawae_big;
    struct rawaelite_stat rawae_lite;
    //rawhist
    struct rawhist_stat rawhist_big;
    struct rawhist_stat rawhist_lite;
} Aec_Stat_Res_t;
```

【Member】

Member Name	Description
rawae_big	Big mode chunking statistics based on RAW graphs
rawae_lite	Lite mode chunking statistics based on RAW graphs
rawhist_big	BIG mode histogram statistics based on RAW graphs
rawhist_lite	Lite mode histogram statistics based on RAW graphs

【Precautions】

- For details about the difference between BIG and LITE modes based on RAW graph statistics, please refer to the function description module. It should be noted that the main difference between the big and lite modes is the number of blocks of block statistics of mean brightness and whether independent subwindow mean brightness statistics are supported. BIG and LITE mode histogram statistics based on RAW plots have the same data structure.
- 3588 platform, default non-HDR exposure mode, configuration BIG mode (15X15 non-standalone subwindow); HDR 2 frame mode, each frame is BIG mode (15X15 non-independent sub-window); HDR 3 frame mode, BIG mode for short and long frames (15X15 non-standalone sub-window), LITE mode for medium frame (5X5 non-standalone sub-window)

10.4.2.2.2 rawaebig_stat

【Description】

The big mode statistics based on the raw graph include the mean R/G/B brightness of 15X15 non-independent sub-windows and the sum of R/G/B brightness of 4 independent sub-windows

【Definition】

```
struct rawaebig_stat {
    unsigned short channelr_xy[RAWAEBIG_WIN_NUM];
    unsigned short channelg_xy[RAWAEBIG_WIN_NUM];
    unsigned short channelb_xy[RAWAEBIG_WIN_NUM];
    unsigned int   channely_xy[RAWAEBIG_WIN_NUM]; //not HW!
    unsigned long int wndx_sumr[RAWAEBIG_SUBWIN_NUM];
    unsigned long int wndx_sumg[RAWAEBIG_SUBWIN_NUM];
    unsigned long int wndx_sumb[RAWAEBIG_SUBWIN_NUM];
    unsigned short wndx_channelr[RAWAEBIG_SUBWIN_NUM]; //not HW!
    unsigned short wndx_channelg[RAWAEBIG_SUBWIN_NUM]; //not HW!
    unsigned short wndx_channelb[RAWAEBIG_SUBWIN_NUM]; //not HW!
    unsigned char wndx_channely[RAWAEBIG_SUBWIN_NUM]; //not HW!
};
#define RAWAEBIG_WIN_NUM    225
#define RAWAEBIG_SUBWIN_NUM  4
```

【Member】

Member Name	Description
channelr_xy	The mean luminance information of the R channel of the BIG mode non-independent subwindow tile. Number of valid bits: 10bit.
channelg_xy	G-channel mean luminance information for non-independent subwindow blocks in big mode. Number of valid bits: 12bit.
channelb_xy	The average brightness information of the B-channel of the BIG mode non-independent subwindow tile. Number of valid bits: 10bit.
wndx_sumr	R channel brightness and information for big mode independent subwindows. Number of valid bits: 29bit.
wndx_sumg	G-channel brightness and information for BIG mode independent subwindows. Number of valid bits: 32bit.
wndx_sumb	B-channel brightness and information for a separate subwindow in big mode. Number of valid bits: 29bit.

【Precautions】

- Big mode statistics based on raw graph, only contains the statistics of R/G/B 3 channels, if you need Y channel statistics, you can add code in the software to calculate according to the R/G/B statistical values.
- BIG mode statistics based on RAW graph, containing 15X15 non-independent subwindows, non-independent subwindows have a minimum size limit, and the minimum size required is 16X4.

- BIG mode statistics based on RAW graph, containing 4 independent sub-windows, whose positions can overlap or not, with a maximum size requirement, which must not exceed 2k x 1k.
- The channely_xy, wndx_channelr, wndx_channelg, wndx_channelb, and wndx_channely parameters in the structure are all software calculation parameters, which need to be calculated by adding code by software and calculated according to hardware statistical values.

10.4.2.2.3 rawaelite_stat

【Description】

The lite mode statistics based on the raw graph include 5X5 non-independent sub-window block R/G/B mean brightness

【Definition】

```
struct rawaelite_stat {
    unsigned short channelr_xy[RAWAELITE_WIN_NUM];
    unsigned short channelg_xy[RAWAELITE_WIN_NUM];
    unsigned short channelb_xy[RAWAELITE_WIN_NUM];
    unsigned int   channely_xy[RAWAELITE_WIN_NUM]; not HW!
};
#define RAWAELITE_WIN_NUM  25
```

【Member】

Member Name	Description
channelr_xy	Lite mode non-independent subwindow tile R channel mean luminance information. Number of valid bits: 10bit.
channelg_xy	Lite mode non-independent subwindow tile g-channel mean luminance information. Number of valid bits: 12bit.
channelb_xy	Lite mode non-independent subwindow tile B-channel mean luminance information. Number of valid bits: 10bit.

【Precautions】

- lite mode statistics based on raw graph, only contains 5X5 non-independent subwindow R/G/B 3 channel statistics, if you need Y channel statistics, you can add code in the software to calculate according to the R/G/B statistical value. Non-standalone subwindows have a minimum size limit, which requires a minimum size of 16X4.
- The channely_xy in the structure is a software calculation parameter, which needs to be added to calculate according to the hardware statistical value.

10.4.2.2.4 rawhist_stat

【Description】

Histogram statistics based on RAW plots

【Definition】

```
struct rawhist_stat {
    unsigned int bins[RAWHIST_BIN_N_MAX];
};
#define RAWHIST_BIN_N_MAX  256
```

【Member】

Member Name	Description
bins	The histogram is segmented, with a total of 256 segments, and the number of valid bits in each segment: 28bit

10.4.3 rk_aiq_isp_awb_stats2_v3x_t

【Description】

Define white balance hardware statistics, mainly including white point statistics and chunking statistics

- White point statistics

Record the cumulative value and number of RGins and BGain in the white areas of 7 light sources and 2 sizes in the main window;

Record the cumulative value and number of RGin and BGain in the white area of 4 light sources and 2 sizes in the sub-window;

4 UV or XY domain additional boxes in the RGin, BGain cumulative value and number;

white point brightness histogram;

- Chunking statistics

  Image 15x15 blocks (as shown in AWB block schematic) with R, G, B means of all points or white points for each block

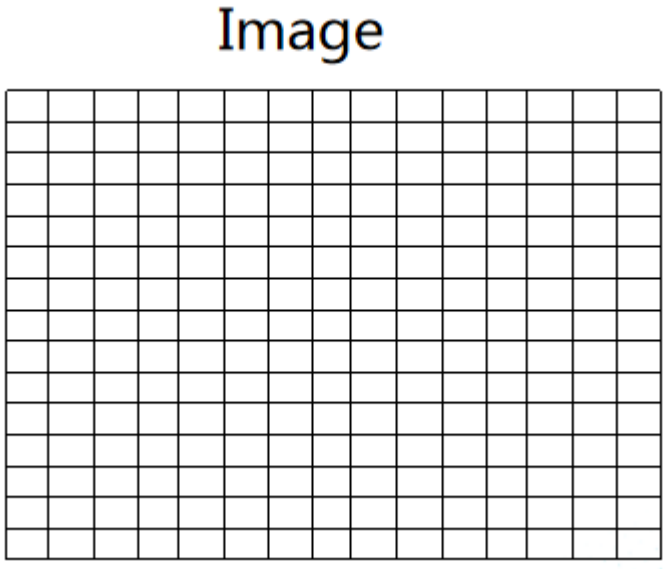


Figure AWB block diagram

【Definition】

```
typedef struct rk_aiq_isp_awb_stats2_v3x_s {
    //method1
    rk_aiq_awb_stat_wp_res_light_v201_t light[RK_AIQ_AWB_MAX_WHITEREGIONS_NUM];
    int WpNo2[RK_AIQ_AWB_MAX_WHITEREGIONS_NUM];
    //method2
    rk_aiq_awb_stat_blk_res_v201_t   blockResult[RK_AIQ_AWB_GRID_NUM_TOTAL];
    //window in pixel domain
    rk_aiq_awb_stat_wp_res_light_v201_t
multiwindowLightResult[RK_AIQ_AWB_MAX_WHITEREGIONS_NUM];
    //window in xy or uv domain
    rk_aiq_awb_stat_wp_res_v201_t
excWpRangeResult[RK_AIQ_AWB_STAT_WP_RANGE_NUM_V201];
    //wpno histogram
    unsigned int WpNoHist[RK_AIQ_AWB_WP_HIST_BIN_NUM];
} rk_aiq_isp_awb_stats2_v3x_t;
```

【Member】

Member Name	Description
light	White point statistics results under different light sources in the main window, up to RK_AIQ_AWB_MAX_WHITEREGIONS_NUM light sources;
WpNo2	The number of white points at the intersection of the XY domain and the UV domain under different light sources in the main window, without decimal places.
blockResult	The RGB accumulation image of each block is evenly chunked, with a total of 15x15 (RK_AIQ_AWB_GRID_NUM_TOTAL) blocks, as shown in the AWB block diagram
multiwindowLightResult	White point statistics under different light sources in several sub-windows (only the first 4 light sources are recorded, all light sources can be recorded by time division multiplexing method), up to 4 sub-windows
excWpRangeResult	Statistics of points that fall in the excludeWpRange area (only the first four regions of the excludeWpRange are recorded), up to 4 regions
WpNoHist	White dot histogram The number of white dots per bin, no decimal places. Whether the white point of the XY large box or the box in XY is counted is determined by the register xyRangeTypeForWpHist.

【Precautions】

If the user wants to obtain the global white point statistics results of the main window, the white point statistics results under all light sources can be easily converted.

10.4.4 rk_aiq_awb_stat_wp_res_light_v201_t

【Description】

Defines the white point statistics result under a light source

【Definition】

```
typedef struct rk_aiq_awb_stat_wp_res_light_v201_s {
    rk_aiq_awb_stat_wp_res_v201_t xYType[RK_AIQ_AWB_XY_TYPE_MAX_V201];
} rk_aiq_awb_stat_wp_res_light_v201_t;
```

【Member】

Member Name	Description
XYType	The white point statistics of XY boxes of different sizes under a light source, up to RK_AIQ_AWB_XY_TYPE_MAX_V201 boxes, that is, 2 boxes

10.4.5 rk_aiq_awb_stat_wp_res_v201_t

【Description】

Define the white point statistics result under the XY box of a certain size of a light source, and the non-white point statistical result in the non-white point area

【Definition】

```
typedef struct rk_aiq_awb_stat_wp_res_v201_s {
    long long WpNo;
    long long RgainValue;
    long long BgainValue;
} rk_aiq_awb_stat_wp_res_v201_t;
```

【Member】

Member Name	Description
WpNo	Number of white points, 22-bit integer bits, 10ibit decimal places. where WpNo = ISP hardware statistics white dot / 2^10.
RgainValue	Accumulation sum of white point R channels, 22-bit integer bits, 10ibit decimal places
BgainValue	Cumulative sum of white point G channel, 22-bit integer bits, 10ibit decimal places

10.4.6 rk_aiq_awb_stat_blk_res_v201_t

【Description】

Define the statistical results for each block.

If blkMeasureMode = =RK_AIQ_AWB_BLK_STAT_MODE_ALL_V201, the recorded result is the cumulative sum of all points in the block;

If blkMeasureMode = =RK_AIQ_AWB_BLK_STAT_MODE_REALWP_V201, the result of the record is the cumulative sum of all white points in the block;

where blkMeasureMode is the register that controls the statistical content of the block.

【Definition】

```
typedef struct rk_aiq_awb_stat_blk_res_v201_s {
    long long WpNo;
    long long Rvalue;
    long long Gvalue;
    long long Bvalue;
} rk_aiq_awb_stat_blk_res_v201_t;
```

【Member】

Member Name	Description
WpNo	The number of points within the block
Rvalue	The accumulation of all point R channels within the block
Gvalue	The accumulation of all point RG channels within the block
Bvalue	The accumulation of all point RB channels within the block and

10.4.7 rk_aiq_af_algo_stat_v30_t

【Description】

Define AF statistics

【Definition】

```
typedef struct {
    unsigned int wndb_luma;
    unsigned int wndb_sharpness;
    unsigned int winb_highlit_cnt;
    unsigned int wnda_luma[RKAIQ_RAWAF_SUMDATA_NUM];
    unsigned int wnda_fv_v1[RKAIQ_RAWAF_SUMDATA_NUM];
    unsigned int wnda_fv_v2[RKAIQ_RAWAF_SUMDATA_NUM];
    unsigned int wnda_fv_h1[RKAIQ_RAWAF_SUMDATA_NUM];
    unsigned int wnda_fv_h2[RKAIQ_RAWAF_SUMDATA_NUM];
    unsigned int wina_highlit_cnt[RKAIQ_RAWAF_SUMDATA_NUM];
    unsigned int int_state;

    struct timeval focus_starttim;
```

```
    struct timeval focus_endtim;
    struct timeval zoom_starttim;
    struct timeval zoom_endtim;
    int64_t sof_tim;
    int focusCode;
    int zoomCode;
    bool focusCorrection;
    bool zoomCorrection;
    float angleZ;
} rk_aiq_af_algo_stat_v30_t;
```

【Member】

Member Name	Description
wndb_luma	The brightness value of the standalone window,
wndb_sharpness	The clarity value of the stand-alone window
winb_highlit_cnt	The highlight count value of the standalone window
wnda_luma	The brightness value of the 15*15 subwindow under the main window
wnda_fv_v1	V1 clarity value of 15*15 subwindow under the main window
wnda_fv_v2	V2 sharpness value of 15*15 subwindow under the main window
wnda_fv_h1	H1 clarity value of 15*15 subwindow under the main window
wnda_fv_h2	H2 clarity value of 15*15 subwindow under the main window
wina_highlit_cnt	The highlight count value of the 15*15 subwindow under the main window
int_state	The RK AF algorithm is used, which can be ignored
focus_starttim	The RK AF algorithm is used, which can be ignored
focus_endtim	The RK AF algorithm is used, which can be ignored
zoom_starttim	The RK AF algorithm is used, which can be ignored
zoom_endtim	The RK AF algorithm is used, which can be ignored
sof_tim	The frame start time of this data frame in ns
focusCode	The RK AF algorithm is used, which can be ignored
zoomCode	The RK AF algorithm is used, which can be ignored
focusCorrection	The RK AF algorithm is used, which can be ignored
zoomCorrection	The RK AF algorithm is used, which can be ignored
angleZ	The RK AF algorithm is used, which can be ignored

11. Debug & FAQ

11.1 How to get the version number

AIQ provides version release date, AIQ version, IQ parser version, and version information of each algorithm module of ISP.

11.1.0.1 Get abbreviated version information

```
strings librkaiq.so | grep -w AIQ
AIQ: v0.1.6
```

11.1.0.2 Get full version information

1. The aiq library in the SDK is compiled to the Release version by default, and you need to change it to the Debug version, recompile the aiq library, and update it to the device.

`SDK/external/camera_engine_rkaiq/CMakeLists.txt:`

```
8
9   if(NOT CMAKE_BUILD_TYPE STREQUAL "Release")
10      add_definitions(-DBUILD_TYPE_DEBUG)
11  endif()
```

Changed to:

```
8
9   #if(NOT CMAKE_BUILD_TYPE STREQUAL "Release")
10      add_definitions(-DBUILD_TYPE_DEBUG)
11  #endif()
```

2. Under the default print level, the AIQ library loaded and running will not print, you can set the log level of the xcore module to print the AIQ version information:

```
export persist_camera_engine_log=0x1000000ff2
```

3. The printed version information when AIQ is started is as follows:

```
************************* VERSION INFOS *************************
version release date: 2020-06-05
                 AIQ: v0.1.6
           IQ PARSER: v1.0.0
RK INTEGRATED ALGO MODULES:
                 AWB: v0.0.9
                 AEC: v0.1.1
```

```
                  AF: v0.0.9
                AHDR: v0.0.9
                 ANR: v0.0.9
              ASHARP: v0.0.9
             ADEHAZE: v0.0.9
              AGAMMA: v0.0.9
              A3DLUT: v0.0.9
                ABLC: v0.0.9
                ACCM: v0.0.9
                ACGC: v0.0.9
                 ACP: v0.0.9
            ADEBAYER: v0.0.1
               ADPCC: v0.0.9
                AGIC: v0.0.9
                 AIE: v0.0.1
               ALDCH: v0.0.9
                ALSC: v0.0.9
                AORB: v0.0.9
                AR2Y: v0.0.9
                 ASD: v0.0.9
                AWDR: v0.0.9
************************ VERSION INFOS END ************************
```

11.1.1 Version number matching rule description

The matching rules between AIQ and IQ Tool and ISP Driver are as follows:

v A . B. C

where B is the base-16 representation, bit[0:3] identifies the matching version of AIQ and IQ Tool, and bit[4:7] identifies the matching version of AIQ and ISP driver, for example:

ISP driver：v 1. 0x3.0 matches AIQ:v1.0x30.0 and AIQ:v1.0x40.0.

IQ tool：v 1. 0x3.0 matches AIQ:v1.0x33.0 and AIQ:v1.0x30.0, where AIQ version number C is not 0, there may be a version mismatch, for IQ Tool matching, it is recommended to use the AIQ version with C version number 0 first.

11.2 AIQ Log

11.2.1 Overview

AIQ uses 64bits to represent the log level of all modules, and the bitmaps and descriptions of each module are as follows:

```
bit: [63-39]   38      37       36    35   34     33    32    31
mean:  [U]   [CAMHW][ANALYZER][XCORE][ASD][ACGC][AFEC][AORB][ASHARP]

bit:  30   29   28     27     26       25      24   23       22
mean:[AIE][ACP][ACSM][ALDCH][A3DLUT][ADEHAZE][AWDR][AGAMMA][ACCM]

bit:      21     20    19   18    17    16     15   14  13   12
```

```
mean:[ADEBAYER][AGIC][ALSC][ANR][AHDR][ADPCC][ABLC][AF][AWB][AEC]

bit:    11-4        3-0
mean:[sub modules][level]

    [U] means unused now.
    [level] : use 4 bits to define log levels.
    each module log has following ascending levels:
    0: error
    1: warning
    2: info
    3: debug
    4: verbose
    5: low1
    6-7: unused, now the same as debug
    [sub modules] : use bits 4-11 to define the sub modules of each module,
thespecific meaning of each bit is decided by the module itself. These bitsis
designed to implement the sub module's log switch.
    [modules] : AEC, AWB, AF ...

    set debug level example:
    eg. set module af log level to debug, and enable all sub modules of af:
    Android:
    setprop persist.vendor.rkisp.log 0x4ff4
    Linux:
    export persist_camera_engine_log=0x4ff4

    And if only want enable the sub module 1 log of af:
    Android:
    setprop persist.vendor.rkisp.log 0x4014
    Linux:
    export persist_camera_engine_log=0x4014
```

As explained above, the switch level of each module is controlled by setting the environment variable persist_camera_engine_log the Linux environment.

Module	Debug log	Verbose log
AE	export persist_camera_engine_log=0x1ff3	export persist_camera_engine_log=0x1ff4
AWB	export persist_camera_engine_log=0x2ff3	export persist_camera_engine_log=0x2ff4
AF	export persist_camera_engine_log=0x4ff3	export persist_camera_engine_log=0x4ff4
HDR	export persist_camera_engine_log=0x20ff3	export persist_camera_engine_log=0x20ff3
NR	export persist_camera_engine_log=0x40ff3	export persist_camera_engine_log=0x40ff4
Dehaze	export persist_camera_engine_log=0x2000ff3	export persist_camera_engine_log=0x2000ff3
Sharp	export persist_camera_engine_log=0x80000ff3	export persist_camera_engine_log=0x80000ff4
CAMHW	export persist_camera_engine_log=0x4000000ff3	export persist_camera_engine_log=0x4000000ff4

To view the current log level, run the following command:

```
[root@RV1126_RV1109:/]# echo $persist_camera_engine_log
0x4014
```

11.2.2 AE

11.2.2.1 Configuration guide

Log level	Description and enabling suggestions
Error	Enabled by default Critical error
Warning	Not enabled by default Warn error, the algorithm may have exception handling for the error, and the algorithm can continue to run
Info	Not enabled by default **Basic debugging information:** Frame-by-frame output information: None Event information: The running status information and frame rate information in the algorithm are generally only printed when initializing, switching resolution, and modifying configuration parameters **Suggestion:** It is used to know the running status and frame rate value of the algorithm

Log level	Description and enabling suggestions
Debug	Not enabled by default **Basic debugging information (increased relative to Info level)**: Frame-by-frame output information: frame number, frame-matched exposure, frame-matched AE statistics (image brightness), and exposure result value Event information: **Suggestion：** Debug problems such as image brightness flickering with continuous image brightness, exposure, and other information
Verbose	Not enabled by default **Basic debugging information (relative to Debug level increase):** Frame-by-frame output information: algorithm related operation result information Event information: **Suggestion:** Generally, it is not enabled, and it is enabled when the debug level cannot judge the problem

Sub modules bit	Description and enabling recommendations
bit[4]	Log level related to AE parameter configuration **Suggestion**: When reading IQ or API setting parameters, you can check whether the configuration parameters are correct according to the log.
bit[5]	The AE information processing module logs the switch, which calculates the environment and image-related indicators according to AE statistics. **Suggestion**: Read luminance information related to statistical values.
bit[6]	AE exposure calculation module log switch. **Suggestion**: Read information related to exposure results
bit[7]	log level associated with the Airis aperture algorithm, **Suggestion**: Issues with variable aperture.
bit[8:11]	void

11.2.2.2 Log interpretation

Due to space limitations, only the debug level (0x1ff3, corresponding to the debug level information of all submodules of AE) is interpreted here.

- Linear mode AE LOG

```
rk_aiq_algo_ae_itf.cpp:262: Cur-Exp: FrmId=270,gain=0x36a,time=0x576,envChange=0,dcg=-1,pirs=0
rk_aiq_algo_ae_itf.cpp:266: Last-Res:FrmId=269,gain=0x356,time=0x576,pirs=0

rk_aiq_ae_algo.cpp:5861: ================================ Linear-AE (enter)================================
rk_aiq_ae_algo.cpp:5881: >>> Framenum=270 Cur gain=6.826667,time=0.029987,pirisGain=0,RawMeanluma=29.564444,YuvMeanluma=34.875557,IsConverged=0
rk_aiq_ae_algo.cpp:2961: AecClmExecute: NewExposure(0.172051) SplitGain(5.735024) SplitIntegrationTime(0.030000) SplitPirisGain(0)
rk_aiq_ae_algo.cpp:5952: calc result:SetPoint=22.000000,gain=5.720671,time=0.029987,piris=0,reggain=845,regtime=1398
rk_aiq_ae_algo.cpp:6133: ================================ (exit)================================
```

Figure 3-1 LINEAR MODE AE LOG

Figure 3-1 shows an example of AE LOG in linear mode.

Line1：

> Cur-Exp: FrmId=270,gain=0x36a,time=0x576,envChange=0,dcg=-1,pirs=0

Exposure parameter information for the current frame.

Member name	**Description**
FrmId	The frame number of the current frame
gain	The sensor exposure gain register value for the current frame
time	The sensor exposure time register value for the current frame
envChange	Whether the ambient brightness has changed abruptly in the current frame. 0: No sudden change in ambient brightness; 1: Ambient brightness mutation
dcg	DCG mode corresponding to the current frame. -1: The sensor does not support DCG mode or switches DCG mode inside the sensor; 0: LCG mode; 1: HCG mode
pirs	The p-iris aperture stepper motor position corresponding to the current frame. If the Airis function is disabled, this parameter is invalid and meaningless.

Line2：

> Last-Res:FrmId=269,gain=0x356,time=0x576,pirs=0

The new exposure parameters set by the last run AE are some of the same as those in (1), and will not be repeated here. By comparing the exposure parameter LOG information of Line1 and Line2, we can know whether the current exposure is consistent with the new exposure, that is, whether the new exposure has taken effect.

Line3：

> ================================ Linear-AE (enter)================================

Enter the AE control algorithm module, Linear-AE indicates that the current linear exposure mode is present.

Line4：

> Framenum=270
>
> Cur gain=6.826667,time=0.029987,pirisGain=0,RawMeanluma=29.564444,YuvMeanluma=34.875557,IsConverged=0

Member name	Description
Framenum	The frame number of the current frame
gain	The sensor exposure gain value corresponding to the current frame
time	The sensor exposure time value corresponding to the current frame
pirisGain	The equivalent gain value of the p-iris aperture corresponding to the current frame. If the Airis function is turned off, this parameter is invalid and meaningless.
RawMeanluma	The brightness of the Debayer front RAW image corresponding to the current frame has been subtracted from the black level and multiplied by AWB Gain.
YuvMeanluma	The brightness of the RGB figure before gamma corresponding to the current frame is used to judge the influence of the module after debayer on the brightness.
IsConverged	Whether the exposure of the current frame has converged. 0: exposure does not converge; 1: The exposure has converged

Line 5：

> AecClmExecute: NewExposure(0.180993) SplitGain(6.033096) SplitIntegrationTime(0.030000) SplitPirisGain(0)

Member name	Description
NewExposure	The new exposure value derived by the AE control algorithm
SplitGain	New sensor exposure gain
SplitIntegrationTime	New sensor exposure time
SplitPirisGain	New P-IRIS aperture equivalent gain value. If the Airis function is turned off, this parameter is invalid and meaningless.

Line6:

> calc result:SetPoint=22.000000,gain=6.023529,time=0.029987,piris=0,reggain=854,regtime=1398

The new exposure that is finally set

Member name	Description
SetPoint	Target brightness value
gain	The final new exposure gain value
time	The final new exposure time value
piris	The final new P-IRIS aperture equivalent gain value. If the Airis function is turned off, this parameter is invalid and meaningless.
reggain	The register value corresponding to the final new exposure gain value
regtime	The register value corresponding to the final new exposure time value

In summary, you can know the brightness of the current frame RawMeanLuma, and the corresponding target brightness setpoint. The new exposure is calculated by comparing the brightness of the picture with the target brightness.

- HDR Mode AE LOG:

```
rk_aiq_algo_ae_itf.cpp:246: Cur-Exp: FrmId=22,S-gain=0x0,S-time=0x2b6,M-gain=0xb,M-time=0x1a5e,L-gain=0x0,L-time=0x0,envChange=1,dcg=-1--1--1,Piris=0
rk_aiq_algo_ae_itf.cpp:254: Last-Res:FrmId=20,S-gain=0x5,S-time=0x8ca,M-gain=0x11,M-time=0x1a5e,L-gain=0x0,L-time=0x0

rk_aiq_ae_algo.cpp:5983: ================================ HDR-AE (enter)==============================
rk_aiq_ae_algo.cpp:6004: AecRun: SMeanLuma=9.342692, MMeanLuma=37.698597,LMeanLuma=0.000000,TmoMeanluma=37.571430,Isconverged=0,Longfrm=0
rk_aiq_ae_algo.cpp:6013: >>> Framenum=22 Cur Piris=0, Sgain=1.000000,Stime=0.002570,mgain=1.462177,mtime=0.025000,lgain=1.000000,ltime=0.000000
rk_aiq_ae_algo.cpp:3308: S-HighLightLuma=197.250000,S-Target=100.000000,S-GlobalLuma=9.342692,S-Target=19.959433
rk_aiq_ae_algo.cpp:3733: L-LowLightLuma=29.626642,L-Target=48.572094,L-GlobalLuma=37.698597,L-Target=77.620155
rk_aiq_ae_algo.cpp:6110: calc result:piris=0,sgain=1.000000,stime=0.005081,mgain=1.862087,mtime=0.025000,lgain=0.000000,ltime=0.000000
rk_aiq_ae_algo.cpp:6133: ================================ (exit)==============================
```

Figure 3-2 HDR mode AE LOG

Line1:

> Cur-Exp: FrmId=22,S-gain=0x0,S-time=0x2b6,M-gain=0xb,M-time=0x1a5e,L-gain=0x0,L-time=0x0,envChange=1,dcg=-1--1--1,Piris=0

Exposure parameter information for the current frame.

Member name	Description
FrmId	The frame number of the current frame
S/M/L-gain	The sensor exposure gain register value corresponding to each frame of the current HDR. S/M is valid in HDR 2 frame mode; In HDR 3 frame mode, both S/M/L are valid
S/M/L-time	The sensor exposure time register value for each frame of the current HDR. S/M is valid in HDR 2 frame mode; In HDR 3 frame mode, both S/M/L are valid
envChange	Whether the ambient brightness has changed abruptly in the current frame. 0: No sudden change in ambient brightness; 1: Ambient brightness mutation
dcg	The DCG mode corresponding to the current frame corresponds to 3 short, medium and long frames. In HDR 2 frame mode, the first two values are valid, representing the DCG mode of short and long frames, respectively; In HDR 3 frame mode, the three values represent the short, medium, and long DCG mode. -1: The sensor does not support DCG mode or switches DCG mode inside the sensor; 0: LCG mode; 1: HCG mode
pirs	The p-iris aperture stepper motor position corresponding to the current frame. If the Airis function is disabled, this parameter is invalid and meaningless.

Line2:

> Last-Res:FrmId=20,S-gain=0x5,S-time=0x8ca,M-gain=0x11,M-time=0x1a5e,L-gain=0x0,L-time=0x0

The new exposure parameters set by the last run AE are some of the same as those in (1), and will not be repeated here. By comparing the exposure parameter LOG information of Line1 and Line2, we can know whether the current exposure is consistent with the new exposure, that is, whether the new exposure has taken effect.

Line3:

> ================================== HDR-AE (enter)==================================

Enter the AE control algorithm module, HDR-AE indicates that the current HDR exposure mode is present.

Line4:

> AecRun: SMeanLuma=9.342692, MMeanLuma=37.698597,LMeanLuma=0.000000,TmoMeanluma=37.571430,Isconverged=0,Longfrm=0

Member name	Description
S/M/LMeanLuma	The average luminance of each frame of the current HDR. S/M is valid in HDR 2 frame mode; In HDR 3 frame mode, both S/M/L are valid.
TmoMeanluma	The average luminance output of the TMO module in the current frame.
Isconverged	Whether the exposure of each frame of the current HDR converges. 0: exposure does not converge; 1: Exposure has converged.
Longfrm	The long frame mode state of the current frame. 0: Long frame mode is off; 1: Long frame mode is on.

Line5：

> Framenum=22 Cur Piris=0,
> Sgain=1.000000,Stime=0.002570,mgain=1.462177,mtime=0.025000,lgain=1.000000,ltime=0.000000

Member name	Description
Framenum	The frame number of the current frame.
s/m/lgain	The sensor exposure gain value corresponding to the current frame. In HDR 2 frame mode, s/m is valid; In HDR 3 frame mode, both s/m/l are valid.
s/m/ltime	The sensor exposure time value corresponding to the current frame. In HDR 2 frame mode, s/m is valid; In HDR 3 frame mode, both s/m/l are valid.
piris	The equivalent gain value of the p-iris aperture corresponding to the current frame. If the Airis function is disabled, this parameter is invalid and meaningless.

Line6:

> S-HighLightLuma=197.250000,S-Target=100.000000,S-GlobalLuma=9.342692,S-Target=19.959433

Short frame control algorithm LOG

Member name	Description
S-HighLightLuma	The brightness of the highlighted area of the current short frame.
S-Target	The target brightness of the highlighted area of the current short frame.
S-GlobalLuma	Average brightness of the current short frame global area.
S-Target	The target brightness of the current short frame global area.

Line7:

> L-LowLightLuma=29.626642,L-Target=48.572094,L-GlobalLuma=37.698597,L-Target=77.620155

Long frame control algorithm LOG

Member name	Description
L-LowLightLuma	Current long frame dark area brightness
L-Target	Target brightness for the current long frame dark area.
L-GlobalLuma	Average brightness of the global area of the current long frame.
L-Target	The target brightness of the current long frame global area.

Line8:

> calc result:piris=0,sgain=1.000000,stime=0.005081,mgain=1.862087,mtime=0.025000,lgain=0.000000,ltime=0.000000

AE controls the exposure result output by the algorithm

Member name	Description
s/m/lgain	The final new sensor exposure gain value. In HDR 2 frame mode, s/m is valid; In HDR 3 frame mode, both s/m/l are valid
s/m/ltime	The final new sensor exposure time value. In HDR 2 frame mode, s/m is valid; In HDR 3 frame mode, both s/m/l are valid
piris	The final new P-IRIS aperture is equivalent to the gain value. If the Airis function is disabled, this parameter is invalid and meaningless.

11.2.3 AWB

11.2.3.1 Configuration guide

Log level	Description and enabling recommendations
Error	Enabled by default Critical error
Warning	Enabled by default Warn error, for which there may be exception handling internally.
Info	Not enabled by default **Basic debugging information:** Frame-by-frame output information: wbgain results Event Information: **Suggestion**:

Log level	Description and enabling recommendations
debug	Not enabled by default **Basic debug information (relative to Info level increase):** Frame by frame output information: white balance convergence state, ambient brightness, number of white points, total color temperature information, probability of the first four light sources with high probability, etc Event information: The relevant attribute information is printed after the AWS API is called **Recommendation:**When there is a limit on the output log size, this level can be used to obtain key log information for debugging
Verbose	Not enabled by default **Basic debugging information (relative to Debug level increase):** Frame-by-frame output information: white point statistics (white balance gain, number of white points) of each light source, and strategy-related intermediate results, etc Event Information: **Suggestion:**It is recommended to use this level to catch the complete log for debugs

Sub modules bit	Description and enabling recommendations
bit[4:11]	void

11.2.3.2 Log interpretation

Refer to《**Rockchip_Color_Optimization_Guide_ISP2x_CN**》

11.2.4 AF

11.2.4.1 Configuration guide

Log level	Description and enabling recommendations
Error	Enabled by default Critical error
Warning	Not enabled by default Warn error, for which there may be exception handling internally.
Info	Not enabled by default **Basic debugging information:** Frame-by-frame output information: The final result of the focus search algorithm Event Information: **suggestion：**

Log level	Description and enabling recommendations
debug	Not enabled by default **Basic debugging information (increased relative to Info level)**: Frame-by-frame output information: FV statistical value, motor movement position information Event information: Focus trigger, clear position search, zoom, focus following, focus **Suggestion:** It is recommended to use this level to catch the complete log for debugs
Verbose	Not enabled by default **Basic debugging information (relative to Debug level increase) :** None Frame-by-frame output information: Event Information: **Recommendation:**None

Sub modules bit	Description and enabling recommendations
bit[4:11]	void

11.2.4.2 Log interpretation

11.2.5 MERGE

11.2.5.1 Configuration guide

Log level	Description and enabling recommendations
Info	Not enabled by default **Basic debugging information:** Frame-by-frame output information: Not yet used Event Information: Not yet used **suggestion**：Shut down
debug	Not enabled by default **Basic debugging information:** Frame-by-frame output information: Merge debugging information Event Information: Not yet used **suggestion**：Turn on when the brightness of the screen does not meet expectations, or the contrast ratio is not enough after TMO
Verbose	Not enabled by default **Basic debug information (increased relative to Verbose rating):** Frame-by-frame output information: Mrerge exposure related information Event Information: Not yet used **Suggestion:**When the screen flashes, confirm from the AE log that TMO is turned on when flashing for RK personnel to use debugs

Sub modules bit	Description and enabling recommendations
bit[4:11]	void

11.2.5.2 Log interpretation

When the mode is linear, the merge log level is as follows:

```
[AMERGE]:XCAM DEBUG rk_aiq_algo_amerge_itf.cpp:256: AmergeProcess FrameID:0, It's in Linear Mode, Merge function bypass
[AMERGE]:XCAM DEBUG rk_aiq_algo_amerge_itf.cpp:256: AmergeProcess FrameID:1, It's in Linear Mode, Merge function bypass
[AMERGE]:XCAM DEBUG rk_aiq_algo_amerge_itf.cpp:256: AmergeProcess FrameID:2, It's in Linear Mode, Merge function bypass
[AMERGE]:XCAM DEBUG rk_aiq_algo_amerge_itf.cpp:256: AmergeProcess FrameID:3, It's in Linear Mode, Merge function bypass
[AMERGE]:XCAM DEBUG rk_aiq_algo_amerge_itf.cpp:256: AmergeProcess FrameID:4, It's in Linear Mode, Merge function bypass
[AMERGE]:XCAM DEBUG rk_aiq_algo_amerge_itf.cpp:256: AmergeProcess FrameID:5, It's in Linear Mode, Merge function bypass
[AMERGE]:XCAM DEBUG rk_aiq_algo_amerge_itf.cpp:256: AmergeProcess FrameID:6, It's in Linear Mode, Merge function bypass
```

When the mode is HDR and the base frame is long, the merge log level is 10000000ff3

```
[AMERGE]:XCAM DEBUG rk_aiq_algo_amerge_itf.cpp:143: AmergeProcess:/###################################Amerge Start###################################/
[AMERGE]:XCAM DEBUG rk_aiq_amerge_algo.cpp:1274: AmergeByPassProcessing: FrameID:0 HDRFrameNum:2 LongFrmMode:0 MergeApiMode:0 EnvLv:0.000000 MoveCoef:0.000000 bypass:0
[AMERGE]:XCAM DEBUG rk_aiq_amerge_algo.cpp:950: MergeDamping: Current BaseFrm:0 OECurve_smooth:80.000000 OECurve_offset:280.000000
[AMERGE]:XCAM DEBUG rk_aiq_amerge_algo.cpp:953: MergeDamping: Current MDCurveMS_smooth:80.000000 MDCurveMS_offset:38.000000 MDCurveLM_smooth:80.000000 MDCurveLM_offset:38.000000
[AMERGE]:XCAM DEBUG rk_aiq_algo_amerge_itf.cpp:253: AmergeProcess:/###################################Amerge Over###################################/
```

Name	Description
FrameID	Frame number
HDRFrameNum	Number of HDR frames
LongFrmMode	Long frame mode switch, 0: off, 1: on
MergeApiMode	API pattern
EnvLv	Ambient brightness
MoveCoef	Motion variables
bypass	The current frame bypass switch, 0: off, 1: on
BaseFrm	Base frame mode, 0: long frame mode, 1: short frame mode
OECurve_smooth	The slope of the current frame overexposure curve, the value range [0,200], is obtained by the inverse normalization of the parameters in JSON, with a coefficient of 200.
OECurve_offset	The offset value of the current frame overexposure curve, in the range [108,280].
MDCurveMS_smooth	The slope of the motion curve between the frame and the short frame in the current frame, the value range is [0,200], which is obtained by the inverse normalization of the parameters in JSON with a coefficient of 200.
MDCurveMS_offset	The offset value of the motion curve between the frame and the short frame in the current frame is in the range of [0.26,100], which is obtained by the inverse normalization of the parameters in JSON with a coefficient of 100.
MDCurveLM_smooth	The slope of the motion curve between the current frame length frame and the middle frame, the value range is [0,200], which is obtained by the inverse normalization of the parameters in JSON, with a coefficient of 200.
MDCurveLM_offset	The motion curve offset value between the current frame length frame and the middle frame is in the range of [0.26,100], which is obtained by the inverse normalization of parameters in JSON with a coefficient of 100.

When the mode is HDR and the base frame is short, the merge log level is 10000000ff3

```
[AMERGE]:XCAM DEBUG rk_aiq_algo_amerge_itf.cpp:143: AmergeProcess:/####################################Amerge Start###################################/
[AMERGE]:XCAM DEBUG rk_aiq_amerge_algo.cpp:1274: AmergeByPassProcessing: FrameID:6 HDRFrameNum:2 LongFrmMode:0 MergeApiMode:0 EnvLv:0.198943 MoveCoef:0.000000 bypass:0
[AMERGE]:XCAM DEBUG rk_aiq_amerge_algo.cpp:950: MergeDamping: Current BaseFrm:0 OECurve_smooth:80.000000 OECurve_offset:234.612076
[AMERGE]:XCAM DEBUG rk_aiq_amerge_algo.cpp:957: MergeDamping: Current MDCurve_Coef:0.050000 MDCurve_ms_thd0:0.000000 MDCurve_lm_thd0:0.000000
[AMERGE]:XCAM DEBUG rk_aiq_algo_amerge_itf.cpp:253: AmergeProcess:/####################################Amerge Over####################################/
```

Name	Description
FrameID	Frame number
HDRFrameNum	Number of HDR frames
LongFrmMode	Long frame mode switch, 0: off, 1: on
MergeApiMode	API pattern
EnvLv	Ambient brightness
MoveCoef	Motion variables
bypass	The current frame bypass switch, 0: off, 1: on
BaseFrm	Base frame mode, 0: long frame mode, 1: short frame mode
OECurve_smooth	The slope of the current frame overexposure curve, the value range [0,200], is obtained by the inverse normalization of the parameters in JSON, with a coefficient of 200.
OECurve_offset	The offset value of the current frame overexposure curve, in the range [108,280].
MDCurve_Coef	The current frame control coefficient, the value range [0,1], the default value is 0.05, and the accuracy is 0.0001.
MDCurve_ms_thd0	The control coefficient of short frames in the current frame is in the range of [0,1], and the default value is 0.0 and the accuracy is 0.1.
MDCurve_lm_thd0	The frame control coefficient in the current frame length is in the range [0,1], and the default value is 0.0 and the accuracy is 0.1.

11.2.6 DRC

11.2.6.1 Configuration guide

Log level	Description and enabling recommendations
Info	Not enabled by default **Basic debugging information:** Frame-by-frame output information: Not yet used Event Information: Not yet used **suggestion：** Shut down
debug	Not enabled by default **Basic debugging information:** Frame-by-frame output information: DRC debug information Event Information: Not yet used **Recommendation**: Turn on when the brightness of the picture does not meet expectations, or the contrast ratio is not enough after TMO

Log level	Description and enabling recommendations
Verbose	Not enabled by default **Basic debug information (increased relative to Verbose rating):** Frame-by-frame output information: DRC exposure-related information Event Information: Not yet used **Suggestion:** When the screen flashes, confirm from the AE log that TMO is turned on when flashing for RK personnel to use debugs

Sub modules bit	Description and enabling recommendations
bit[4:11]	void

11.2.6.2 log interpretation

When the DRC log level is 20ff3

```
|[ATMO]:XCAM DEBUG rk_aiq_algo_adrc_itf.cpp:157: processing:////////////////////////////////////ADRC Start////////////////////////////////////
|[ATMO]:XCAM DEBUG rk_aiq_adrc_algo.cpp:1834: AdrcByPassProcessing: FrameID:4 HDRFrameNum:2 LongFrmMode:0 DRCApiMode:0 EnvLv:0.282684 bypass:0
|[ATMO]:XCAM DEBUG rk_aiq_adrc_algo.cpp:1543: AdrcTuningParaProcessingV30: Current Enable:1 DrcGain:1.000000 Alpha:0.200000 Clip:16.000000 Strength:0.000000 CompressMode:0
|[ATMO]:XCAM DEBUG rk_aiq_adrc_algo.cpp:1546: AdrcTuningParaProcessingV30: Current LocalWeit:1.000000 LocalAutoEnable:1 LocalAutoWeit:0.037477 GlobalContrast:0.000000 LoLitContrast:0.000000
|[ATMO]:XCAM DEBUG rk_aiq_adrc_algo.cpp:1283: AdrcDampingV30: Current damp DrcGain:1.000000 Alpha:0.200000 Clip:16.000000 Strength:0.000000 CompressMode:0
|[ATMO]:XCAM DEBUG rk_aiq_adrc_algo.cpp:1286: AdrcDampingV30: Current damp LocalWeit:1.000000 LocalAutoEnable:1 LocalAutoWeit:0.037477 GlobalContrast:0.000000 LoLitContrast:0.000000
|[ATMO]:XCAM DEBUG rk_aiq_algo_adrc_itf.cpp:251: processing:////////////////////////////////////ADRC Over////////////////////////////////////
```

Name	Description
FrameID	Frame number
HDRFrameNum	Number of HDR frames
LongFrmMode	Long frame mode switch, 0: off, 1: on
DRCApiMode	API pattern
EnvLv	Ambient brightness
bypass	The current frame bypass switch, 0: off, 1: on
Enable	DRC switch
DrcGain	The current frame DRC block gain, value range [1,8].
Alpha	The current frame DrcGain Alpha value, the value range [0,1].
Clip	The current frame DrcGain Clip value, value range [0,64].
Strength	HiLight highlight area detail of the current frame, value range [0,1].
CompressMode	The current frame CompressSetting mode.
LocalWeit	Local weight of the current frame, value range [0, 1], 0:Global, 1: All Local, default value 0.
LocalAutoEnable	The current frame is automatically LocalWeit switch, the value range is [0,1], the default value is 1, and the accuracy is 1.
LocalAutoWeit	The current frame automatically has a LocalWeit value, the value range is [0,1], the default value is 0.4, and the accuracy is 0.01.
GlobalContrast	The global contrast ratio of the current frame, the value range [0,1], the default value is 0, and the accuracy is 0.01.
LoLitContrast	The contrast ratio of the current frame in the low volume area, the value range is [0,1], the default value is 0, and the accuracy is 0.01.

11.2.7 NR&Sharp

11.2.7.1 Configuration guide

Log level	Description and enabling recommendations
error	Enabled by default **Basic debugging information:** Frame by frame output information: Critical errors in prints that may cause the software to crash Event Information: Not yet used **Recommended:**Turn on

Log level	Description and enabling recommendations
Info	Not enabled by default **Basic debugging information:** Frame-by-frame output information: all function call information, no register values printed. More information overall. Event Information: Not yet used **Recommendation**: It is not recommended to turn on this item when the effect is not abnormal and there is no error. It is generally recommended to use the io command to print register values.
debug	Not enabled by default **Basic debugging information (relative to Info level increase):** Frame-by-frame output information: All function call information, including register value printing, register value printing information is more. Event Information: Not yet used **Recommendation**: When there is a serious error in the effect, it is recommended to turn this on and provide it to rk debug use.

Sub modules bit	Description and enabling recommendations
bit[4:11]	void

11.2.7.2 log interpretation

11.2.8 Dhz&Ehz

11.2.8.1 Configuration Guide

Log level	Description and enabling recommendations
Info	Not enabled by default **Basic debugging information:** Frame-by-frame output information: Not yet used Event Information: Not yet used **suggestion：**
debug	Not enabled by default **Basic debugging information (relative to Info level increase):** Frame-by-frame output information: DHZ & Ehz debug information Event Information: **suggestion：**

Log level	Description and enabling recommendations
Verbose	Not enabled by default **Basic debug information (increased relative to Verbose rating):** Frame-by-frame output information: Not yet used Event Information: Not yet used **Suggestion:**

Sub modules bit	Description and enabling recommendations
bit[4:11]	void

11.2.8.2 Log interpretation

When the Enhance feature is enabled, the Dehaze log level is 2000ff3

```
[ADEHAZE]:XCAM DEBUG rk_aiq_algo_adhaz_itf.cpp:145: /*************************Adehaze Start******************/
[ADEHAZE]:XCAM DEBUG rk_aiq_adehaze_algo.cpp:2402: AdehazeByPassProcessing:FrameID:5 byPassProc:0 ISO:50.000000
[ADEHAZE]:XCAM DEBUG rk_aiq_adehaze_algo.cpp:1423:  AdehazeEnhanceApiBypassV30Process: Adehaze Api off!!!
[ADEHAZE]:XCAM DEBUG rk_aiq_adehaze_algo.cpp:223:  EnableSettingV30: Dehaze module en:1 Dehaze en:0, Enhance en:1, Hist en:0
[ADEHAZE]:XCAM DEBUG rk_aiq_adehaze_algo.cpp:1022: GetEnhanceParamsV30 EnvLv:0.457436 enhance_value:1.300000 enhance_chroma:1.000000
[ADEHAZE]:XCAM DEBUG rk_aiq_adehaze_algo.cpp:1024: GetEnhanceParamsV30 enhance_value_reg:0x533 enhance_chroma_reg:0x400
[ADEHAZE]:XCAM DEBUG rk_aiq_algo_adhaz_itf.cpp:188: /*************************Adehaze over******************/
```

Name	Description
FrameID	Frame number
byPassProc	The current frame bypass switch, 0: off, 1: on
ISO	ISO
Dehaze module en	Dehaze module switch
Dehaze en	Dehaze function switch
Enhance en	Enhanced function switch
Hist en	Hist function switch
EnvLv	The ambient brightness of the current frame
enhance_value	The current frame has a general contrast force, the value range [0,16], and the recommended range [1, 2].
enhance_chroma	Enhanced adjustment parameters for the chromaticity of the current frame, value range [0,16], recommended range [1, 2].
enhance_value_reg	The current frame has a generic contrast force reg value.
enhance_chroma_reg	The REG value of the enhanced tuning parameter for the current frame chromaticity.

When the Dehaze function is enabled and cfg_alpha=0, the Dehaze log level is 2000ff3

```
[ADEHAZE]:XCAM DEBUG rk_aiq_algo_adhaz_itf.cpp:145: /************************Adehaze Start*****************/
[ADEHAZE]:XCAM DEBUG rk_aiq_adehaze_algo.cpp:2402: AdehazeByPassProcessing:FrameID:3 byPassProc:0 ISO:50.000000
[ADEHAZE]:XCAM DEBUG rk_aiq_adehaze_algo.cpp:1423:  AdehazeEnhanceApiBypassV30Process: Adehaze Api off!!!
[ADEHAZE]:XCAM DEBUG rk_aiq_adehaze_algo.cpp:223:  EnableSettingV30: Dehaze module en:1 Dehaze en:1, Enhance en:0, Hist en:0
[ADEHAZE]:XCAM DEBUG rk_aiq_adehaze_algo.cpp:960: GetDehazeParamsV30 cfg_alpha:0 EnvLv:0.433231 air_max:250.000000 air_min:200.000000 tmax_base:125.000000 wt_max:0.900000
[ADEHAZE]:XCAM DEBUG rk_aiq_adehaze_algo.cpp:961: GetDehazeParamsV30 cfg_alpha_reg:0x0 air_max:0xfa air_min:0xc8 tmax_base:0x7d wt_max:0xe6
[ADEHAZE]:XCAM DEBUG rk_aiq_algo_adhaz_itf.cpp:188: /************************Adehaze over*****************/
```

Name	Description
FrameID	Frame number
byPassProc	The current frame bypass switch, 0: off, 1: on
ISO	ISO
Dehaze module en	Dehaze module switch
Dehaze en	Dehaze function switch
Enhance en	Enhanced function switch
Hist en	Hist function switch
cfg_alpha	The proportion of software configuration, the value range [0,1], the default value is 1, and the accuracy is 0.01.
EnvLv	The ambient brightness of the current frame
air_max	The maximum limit of the current frame AIR adaptation, the value range [230, 250], the default value is 250.
air_min	The minimum value limit of the current frame AIR adaptation, the value range [230, 250], the default value is 200.
tmax_base	The current frame tmax adaptive base value, default 125, the corresponding configuration is as follows, 200 (131), 210 (125), 220 (119), 230 (114), 240 (109), 250 (105), recommended 131-105
wt_max	The maximum value limit of the current frame wt adaptation, the value range [0.75, 0.9], the default value is 0.9.

When the Dehaze function is enabled and cfg_alpha=1, the Dehaze log level is 2000ff3

```
[ADEHAZE]:XCAM DEBUG rk_aiq_algo_adhaz_itf.cpp:145: /************************Adehaze Start*****************/
[ADEHAZE]:XCAM DEBUG rk_aiq_adehaze_algo.cpp:2402: AdehazeByPassProcessing:FrameID:4 byPassProc:0 ISO:50.000000
[ADEHAZE]:XCAM DEBUG rk_aiq_adehaze_algo.cpp:1423:  AdehazeEnhanceApiBypassV30Process: Adehaze Api off!!!
[ADEHAZE]:XCAM DEBUG rk_aiq_adehaze_algo.cpp:223:  EnableSettingV30: Dehaze module en:1 Dehaze en:1, Enhance en:0, Hist en:0
[ADEHAZE]:XCAM DEBUG rk_aiq_adehaze_algo.cpp:954: GetDehazeParamsV30 cfg_alpha:1 EnvLv:0.467077 cfg_air:210.000000 cfg_tmax:0.200000 cfg_wt:0.800000
[ADEHAZE]:XCAM DEBUG rk_aiq_adehaze_algo.cpp:955: GetDehazeParamsV30 cfg_alpha_reg:0x255 cfg_air:0xd2 cfg_tmax:0xcc cfg_wt:0xcc
[ADEHAZE]:XCAM DEBUG rk_aiq_algo_adhaz_itf.cpp:188: /************************Adehaze over*****************/
```

Name	Description
FrameID	Frame number
byPassProc	The current frame bypass switch, 0: off, 1: on
ISO	ISO
Dehaze module en	Dehaze module switch
Dehaze en	Dehaze function switch
Enhance en	Enhanced function switch
Hist en	Hist function switch
cfg_alpha	The proportion of software configuration, the value range [0,1], the default value is 1, and the accuracy is 0.01.
EnvLv	The ambient brightness of the current frame
cfg_air	The current frame software configures air, atmospheric light coefficient, value range [0, 255], default value 210.
cfg_tmax	The current frame software configures tmax, the maximum value of dehazing, the value range [0, 1], and the default value is 0.2.
cfg_wt	The current frame software configures wt, image dehazing force, value range [0, 1], default value 0.8.

When the Hist function is enabled, the Dehaze log level is 2000ff3

```
[ADEHAZE]:XCAM DEBUG rk_aiq_algo_adhaz_itf.cpp:145: /*************************Adehaze Start******************/
[ADEHAZE]:XCAM DEBUG rk_aiq_adehaze_algo.cpp:2402: AdehazeByPassProcessing:FrameID:3 byPassProc:0 ISO:50.000000
[ADEHAZE]:XCAM DEBUG rk_aiq_adehaze_algo.cpp:1423:  AdehazeEnhanceApiBypassV30Process: Adehaze Api off!!!
[ADEHAZE]:XCAM DEBUG rk_aiq_adehaze_algo.cpp:223:  EnableSettingV30: Dehaze module en:1 Dehaze en:0, Enhance en:0, Hist en:1
[ADEHAZE]:XCAM DEBUG rk_aiq_adehaze_algo.cpp:1137: GetHistParamsV30 cfg_alpha:0.000000 EnvLv:0.452185 hist_para_en:1 hist_gratio:2.000000 hist_th_off:64.000000 hist_k:2.000000 hist_min:0.015000 hist_scale:0.090000 cfg_gratio:2.0000
[ADEHAZE]:XCAM DEBUG rk_aiq_adehaze_algo.cpp:1139: GetHistParamsV30 cfg_alpha_reg:0x0 hist_gratio_reg:0x10 hist_th_off_reg:0x40 hist_k_reg:0x8 hist_min_reg:0x3 hist_scale_reg:0x17 cfg_gratio_reg:0x200
[ADEHAZE]:XCAM DEBUG rk_aiq_algo_adhaz_itf.cpp:188: /*************************Adehaze over******************/
```

Name	Description
FrameID	Frame number
byPassProc	The current frame bypass switch, 0: off, 1: on
ISO	ISO
Dehaze module en	Dehaze module switch
Dehaze en	Dehaze function switch
Enhance en	Enhanced function switch
Hist en	Hist function switch
cfg_alpha	The proportion of software configuration, the value range [0,1], the default value is 1, and the accuracy is 0.01.
EnvLv	The ambient brightness of the current frame
hist_para_en	The current frame histogram stretch control switch.
hist_gratio	The current frame histogram stretch multiplier, histogram equalization control coefficient, value range [0, 32].
hist_th_off	The histogram statistical threshold of the current frame, the value range [0, 255], the default value is 64.
hist_k	The current frame histogram adaptive threshold magnification, value range [0, 7), default value 2.
hist_min	The minimum value of the histogram statistical threshold of the current frame, the value range [0,2], and the default value is 0.016.
hist_scale	The current frame histogram equalization control coefficient, the value range [0, 32].
cfg_gratio	The current frame software configures the histogram stretch multiplier and the histogram equalization control coefficient, and the value range [0, 32].

11.2.9 CamHW

11.2.9.1 Configuration guide

Log level	Description and enabling recommendations
Error	Enabled by default Critical error
Warning	Not enabled by default Warning error, the algorithm may have exception handling for the error.

Log level	Description and enabling recommendations
Info	Not enabled by default **Basic debugging information:** Frame-by-frame output information: Event Information: **Suggestion:**
Debug	Not enabled by default **Basic debugging information (increased relative to Info level)**: Frame-by-frame output information: Event Information: **Suggestion:**
Verbose	Not enabled by default **Basic debugging information (increased relative to Debug level):** Frame-by-frame output information: Event Information: **Suggestion:**存在单次大量信息输出，谨慎使用
Low1	Not enabled by default **Basic debugging information (increased relative to Debug level):** Frame-by-frame output information: Event information: Function call path information **Suggestion:**

Sub modules bit	Description and enabling recommendations
bit[4]	30 submodule log switch. Responsible for the HWI process control part. **suggestion：** It is recommended to enable the following submodules together.
bit[5]	Isp30Params and Isp30PollThread submodule log switches. Responsible for the processing of ISP parameters, data streams, events, etc. **suggestion：** Suspected parameters do not match the video frame, timing settings are abnormal, and other issues In readback offline mode, data flow disconnection and other issues
bit[6]	The SensorHw submodule log switch. Responsible for the camera sensor related parts. **suggestion：** Suspected CIS exposure settings and other issues
bit[7]	FlashLight submodule log switch. Responsible for the fill light control part. **suggestion：** Fill light control issues.
bit[8]	The LensHw submodule log switch. Responsible for the lens motor control part. **suggestion：** Motor control and other issues
bit[9]	30SpThread submodule switch. Internal modules are reserved for use.
bit[10:11]	void

11.2.9.2 log interpretation

- **CamHwIsp20 Submodule**

```
[CAMHW]:XCAM INFO CamHwIsp20.cpp:519: model(rkisp0): isp_info(0): ispp-subdev entity name: /dev/v4l-subdev5

[CAMHW]:XCAM INFO CamHwIsp20.cpp:343: model(rkispp0): ispp_info(0): ispp-subdev entity name: /dev/v4l-subdev0

[CAMHW]:XCAM INFO CamHwIsp20.cpp:932: match the sensor_name(m01_f_imx415 1-001a) media link

[CAMHW]:XCAM INFO CamHwIsp20.cpp:967: vicap rkcif_mipi_lvds, linked_vicap rkcif_mipi_lvds
[CAMHW]:XCAM INFO CamHwIsp20.cpp:973: vicap link to isp(0) to ispp(0)

[CAMHW]:XCAM INFO CamHwIsp20.cpp:979: sensor m01_f_imx415 1-001a adapted to pp media 2:/dev/media2
```

The above log is only printed once when the AIQ library is loaded, from which the link relationship between the camera sensor, ISP and ISPP can be obtained, and the information is obtained from the analysis of the media node topology, from which you can know whether the camera sensor is detected normally.

```
CamHwIsp20.cpp:3427: ispparam ens 0xcfffe473b, en_up 0xdfffee73f, cfg_up 0xdfffe473b
CamHwIsp20.cpp:3431: device(/dev/video15) queue buffer index 0, queue cnt 1, check exit status again[exit:
```

The log above figure shows the new parameters configured by the HWI layer to the ISP driver, which is currently configured for basically every frame, and the specific meaning is shown in the following table:

Member name	Description
ispparam ens	Module enable bit, module bit definition refer to HWI/ISP20/rk_isp20_hw.H
en_up	Module enable update bit, corresponding to a bit of 1, indicates that the module enable bit needs to be updated
cfg_up	Module parameter update bit, corresponding to 1 to indicate that the module parameter needs to be updated
device	The video node corresponding to the ISP parameter module

```
[CAMHW]:XCAM DEBUG CamHwIsp20.cpp:3737: ispp full en update 0x7, ens 0x7, cfg update 0x7
[CAMHW]:XCAM DEBUG CamHwIsp20.cpp:3758: ispp new en update 0x0, ens 0x7, cfg update 0x7
[CAMHW]:XCAM DEBUG CamHwIsp20.cpp:3761: module_init_ens frome drv 0x7

[CAMHW]:XCAM DEBUG CamHwIsp20.cpp:3789: device(/dev/video23) queue buffer index 0, queue cnt 1, check exit status again[exit:
```

The log above shows that the HWI layer configures new parameters to the ISPP driver, and basically every frame will be configured, specifically explaining the aforementioned ISP module.

- **The Isp20PollThread submodule**

```
[CAMHW]:XCAM DEBUG Isp20PollThread.cpp:976: frame[48]: sof_ts 2800346ms, frame_ts 2800379ms, globalTmo(0), readback(1)
```

The above figure log starts a frame readback when the readback mode is started, as long as it works in readback mode, each frame will be printed during normal operation, the specific meaning is as follows:

Member name	Description
frame	Frame ID, which indicates the number of frames RAW, starting from 0.
sof_ts	The timestamp of the SOF for the frame
frame_ts	Collect the timestamp of the completion time of the DDR
readback	The number of ISP readbacks

```
[CAMHW]:XCAM DEBUG Isp20PollThread.cpp:679: handle_rx_buf dev_index:0 index:0 fd:30

[CAMHW]:XCAM DEBUG Isp20PollThread.cpp:769: handle_tx_buf dev_index:0 sequence:49
```

The log above is the rotation process of RAW buf in readback mode, as long as it works in readback mode, the log will be printed every frame, the specific meaning is as follows:

Members	Description
handle_rx_buf	After the ISP has processed a frame, it is returned to VICAP/isp_tx
dev_index	The index number of the long, medium, and short frame devices, when the dev_index in the log of handle_tx_buf and handle_rx_buf is the same, indicates the same data
sequence	Frame number, starting at 0

- **SensorHw Submodule**

```
[CAMHW]:XCAM DEBUG SensorHw.cpp:685: handle_sof: frameid=13, exp_list size=1, gain_list size=0
[CAMHW]:XCAM DEBUG SensorHw.cpp:726: handle_sof: working_mode=0,frameid=13, status: set_time=1,set_gain=0

[CAMHW]:XCAM DEBUG SensorHw.cpp:180: setLinearSensorExposure: frameid: 13, a-gain: 17, time: 2024, dcg: -1, snr: 0
```

The log above is a linear mode when setting the new exposure to the sensor drive process, and it will be called when there is a new exposure, the specific meaning is as follows:

Members	Description
frameid	sof event frame number
handle_sof	The sof event callback function, once per frame, where the exposure setting is handled
exp_list size	How many new exposure times in the exposure list are not set to Driver
gain_list size	How many new exposure gains in the exposure list are not set to Driver
working_mode	Current operating mode, 0 is normal
set_time	Whether there is a new exposure time in the SOF message needs to be set to the driver
set_gain	Whether there is a new exposure gain in the SOF message needs to be set to the driver
a-gain, time	New exposure time, gain register value

11.3 How to acquire Raw/YUV images

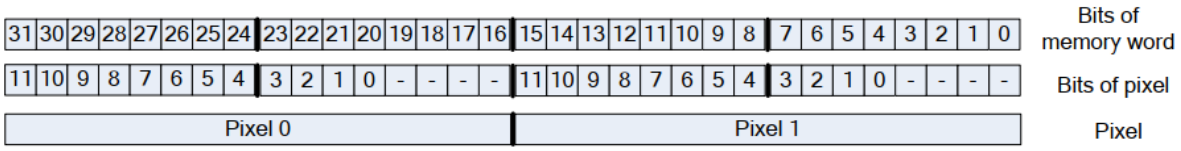
Raw data refers specifically to the data output from CIS, which has not undergone any image processing. For Bayer raw sensors, Raw data is 8/12/14 bit bayer rgb data. In general, CIS Raw data needs to be obtained in the following situations:

```
    1. If the YUV data output after processing by the ISP is abnormal, you want
to dynamically intercept whether the Raw data analysis problem entered by the ISP
is a CIS problem
    2. Before debugging the image quality effect, CIS Raw data needs to be
collected for the calibration of module parameters
```

11.3.1 Raw data storage format

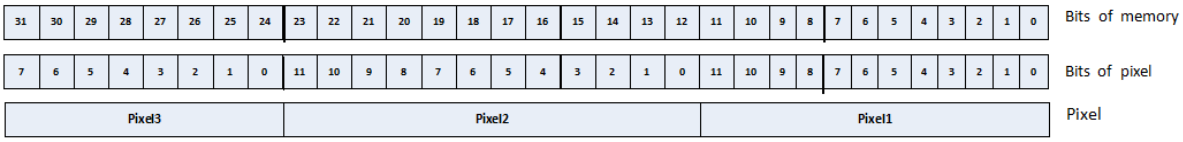
11.3.1.1 Non-compact storage format

For the storage arrangement of raw12 data in memory, taking a 4-byte memory fragment as an example, the data is stored as follows:



11.3.1.2 Compact storage format

For the storage arrangement of raw12 data in memory, taking a 4-byte memory fragment as an example, the data is stored as follows:



11.3.1.3 RK-RAW V1.0

项目	参数名称	数据类型定义	长度	描述
文件头	Identifier	unsigned short	2	固定 0x8080
	Header length	unsigned short	2	固定 128
	Frame index	unsigned int	4	帧索引号
	Width	unsigned short	2	图像宽度
	Height	unsigned short	2	图像高度
	Bit depth	unsigned char	1	图像位宽
	Bayer format	unsigned char	1	0: BGGR; 1: GBRG; 2: GRBG; 3: RGGB;
	Number of HDR Frame	unsigned char	1	帧类型： 1: 表示线性模式，短帧 2: 表示 2 帧 HDR，长帧+短帧 3: 表示 3 帧 HDR，长帧+中帧+短帧
	Current Frame type	unsigned char	1	当前帧类型： 1: 短帧 2: 中帧 3: 长帧
	Storage type	unsigned char	1	0: 紧凑型 1: 非紧凑型
	Line stride	unsigned short	2	单位为字节
	Effective line stride	unsigned short	2	单位为字节
	Reserved	unsigned char	107	保留段
RAW DATA	RAW DATA	RAW	W * H *BPP	RAW DATA

11.3.1.4 RK-RAW V2.0

The RK-RAW V2.0 format consists of a start identifier, a data block, and an end identifier.

Format Block Definition

A data block consists of three parts: identifier ID, block length, and block data. Each identifier ID has a unique fixed value.

数据块定义				
项目	数据类型	长度(Byte)	默认值	说明
起始标识符	u16	2	0xFF00	固定值：文件起始
块标识符	u16	2	0xFF01	标识符：Raw信息
块长度	u32	4	-	
块数据				
块标识符	u16	2	0xFF02	标识符：Normal模式 Raw数据
块长度	u32	4	-	
块数据				
块标识符	u16	2	0xFF03	标识符：HDR2/HDR3短帧 Raw数据
块长度	u32	4	-	
块数据				
块标识符	u16	2	0xFF04	标识符：HDR2长帧/HDR3中帧 Raw数据
块长度	u32	4	-	
块数据				
块标识符	u16	2	0xFF05	标识符：HDR3长帧 Raw数据
块长度	u32	4	-	
块数据				
块标识符	u16	2	0xFF06	标识符：帧统计信息
块长度	u32	4	-	
块数据				
块标识符	u16	2	0xFF07	标识符：ISP寄存器格式
块长度	u32	4	-	
块数据				
块标识符	u16	2	0xFF08	标识符：ISP寄存器
块长度	u32	4	-	
块数据				
块标识符	u16	2	0xFF09	标识符：ISPP寄存器格式
块长度	u32	4	-	
块数据				
块标识符	u16	2	0xFF0a	标识符：ISPP寄存器
块长度	u32	4	-	
块数据				
块标识符	u16	2	0xFF0b	标识符：平台信息
块长度	u32	4	-	
块数据				
...				
结束标识符	u16	2	0x00FF	固定值：文件结尾

Not all blocks in the chart are required, and you can choose a combination of several of them. For example, a RKRawV2 file may contain only 'Raw Blocks', 'Raw Blocks', and 'Frame Statistics Blocks', and we recommend including at least these three blocks because such files are meaningful.

Raw Block Definition

数据块定义：Raw信息 0xFF01				
项目	数据类型	长度(Byte)	默认值	说明
版本号	u16	2	0x0200	版本号：0x0200=v2.0
Sensor名	string	32	-	Sensor型号
场景/光源	string	32	-	采集场景/光源
帧号	u32	4	-	帧号
宽度	u16	2	-	图像宽度，单位为像素
高度	u16	2	-	图像高度，单位为像素
位宽	u8	1	-	图像位宽
Bayer格式	u8	1	-	0(BGGR);1(GBRG); 2(GRBG);3(RGGB);
HDR合成帧数	u8	1	-	1(线性模式);2(长+短帧);3(长+中+短帧);
存储格式	u8	1	-	0(紧凑);1(非紧凑);
行长	u16	2	-	单位为字节
有效行长	u16	2	-	单位为字节
大小端	u8	1	-	0(大端);1(小端);

RAW Block Definition

This data segment can store Raw image data, or buffer fd or virtual address pointing to Raw image data. When using the relevant API, you need to pass parameters to indicate the type of data stored in the data block, see rk_aiq_rawbuf_type_t for details.

数据块定义：Raw数据 0xFF02 - 0xFF05			
项目	数据类型	长度(Byte)	说明
Raw数据	-	长*宽*N 非紧凑：N=2 紧凑：N=bpp/8	Raw数据

Frame Statistics Block Definition

数据块：帧统计信息 0xFF06				
项目	数据类型	长度(Byte)	默认值	说明
版本号	u16	2	0x0200	Raw格式版本号：0x0200=v2.0
帧号	u32	4	-	帧号
Normal_Exp	float	4	-	线性模式：快门时间
Normal_Gain	float	4	-	线性模式：曝光增益
Normal_Exp_REG	u32	4	-	线性模式：快门时间的SENSOR寄存器值
Normal_Gain_REG	u32	4	-	线性模式：曝光增益的SENSOR寄存器值
HDR_Exp_L	float	4	-	HDR3：长帧快门时间
HDR_Gain_L	float	4	-	HDR3：长帧曝光增益
HDR_Exp_L_REG	u32	4	-	HDR3：长帧快门时间的SENSOR寄存器值
HDR_Gain_L_REG	u32	4	-	HDR3：长帧曝光增益的SENSOR寄存器值
HDR_Exp_M	float	4	-	HDR3：中帧快门时间 HDR2：长帧快门时间
HDR_Gain_M	float	4	-	HDR3：中帧曝光增益 HDR2：长帧曝光增益
HDR_Exp_M_REG	u32	4	-	HDR3：中帧快门时间的SENSOR寄存器值 HDR2：长帧快门时间的SENSOR寄存器值
HDR_Gain_M_REG	u32	4	-	HDR3：中帧曝光增益的SENSOR寄存器值 HDR2：长帧曝光增益的SENSOR寄存器值
HDR_Exp_S	float	4	-	HDR3：短帧快门时间 HDR2：短帧快门时间
HDR_Gain_S	float	4	-	HDR3：短帧曝光增益 HDR2：短帧曝光增益
HDR_Exp_S_REG	u32	4	-	HDR3：短帧快门时间的SENSOR寄存器值 HDR2：短帧快门时间的SENSOR寄存器值
HDR_Gain_S_REG	u32	4	-	HDR3：短帧曝光增益的SENSOR寄存器值 HDR2：短帧曝光增益的SENSOR寄存器值
AWB_Rgain	float	4	-	白平衡增益
AWB_Bgain	float	4	-	

Register format block definition

数据块定义：寄存器格式 0xFF07/0xFF09				
项目	数据类型	长度(Byte)	默认值	说明
版本号	u16	2	0x0200	版本号：0x0200=v2.0
帧号	u32	4	-	寄存器基地址
基地址	u32	4	-	寄存器基地址
偏移地址	u32	4	-	起始偏移地址
数目	u32	4	-	寄存器数目

Register Block Definition

数据块定义：寄存器 0xFF08/0xFF0a			
项目	数据类型	长度(Byte)	说明
寄存器数据	-	-	寄存器数据

Platform Information Block Definition

数据块定义：平台信息 0xFF0b			
项目	数据类型	长度(Byte)	说明
芯片型号	string	32	
ISP版本	string	32	
AIQ版本	string	32	

11.3.2 Raw/YUV data acquisition method

12. Error code

Error Code	Description
0	Success
-1	Failed
-2	Invalid parameter
-3	Out of memory
-4	File operation failed
-5	Error with analyzer module
-6	The ISP module error
-7	Error with sensor driver
-8	Thread operation error
-9	IOCTL operation error
-10	Timing error
-20	Timeout
-21	Out of range
-255	Unknown error

13. Abbreviations

Abbreviation	Full name
CIS	Camera Image Sensor
RkAiq	Rockchip Automatical Image Quality
ISP	Image Signal Process
IQ Tuning	Image Quality Tuning