AW883XX Android Driver(MTK)

版本： V1.8

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修订记录

日期	版本	描述	作者
2021-3-12	V1.0	First edition	Zhao Lei
2021-3-24	V1.1	1. Add i2c_log_en, phase_sync,spk_temp node description 2. Add re_range calibrate command description	Zhou Huidong
2021-6-1	V1.2	1. Modify MTK 5G description	Zhou Huidong
2021-7-2	V1.3	1. Modify Driver misc type set re command description	Zhou Huidong
2021-7-14	V1.4	1. Modify Hardware monitor func description	Zhou Huidong
2021-7-30	V1.5	1. Description of calibration node sample code 2. The default calibration re value range is modified to 1000-40000 mohm	Wangping
2021-8-3	V1.6	1. Modify MTK 5G description 2. Modify bin file loading description	Zhou Huidong
2021-8-24	V1.6.1	1. Modify cali file description. 2. Add spin function description.	Zhou Huidong
2021-9-24	V1.7	1. Add monitor switch control description. 2. Add dsp attr node	Zhou Huidong
2021-10-19	V1.7.1	1. Modify re calibration valule check description 2. Add aw-cali-check DTS node description	Zhou Huidong
2021-10-21	V1.7.2	1. Del aw-cali-check DTS node description	Zhou Huidong
2021-11-16	V1.7.3	1. Modify cali description by chapter; Add Common error analysis 2. Del platform and android-version description 3. Del aw88363 product and driver spin func description 4. Enable all cali methods by default 5. Add config choice description 6. modify XML description 7. modify node and Kcontrol description	Zhou Huidong

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INFORMATION

HAL File	AudioParamOptions.xml SmartPa_ParamUnitDesc.xml
Driver File	aw883xx.c, aw883xx.h, aw_pid_2049_reg.h,aw_monitor.c, aw_monitor.h,aw_log.h,aw_init.c,aw_device.c,aw_device.h, aw_data_type.h,aw_calib.h,aw_calib.c,aw_bin_parse.c, aw_bin_parse.h,aw_spin.c,aw_spin.h
Smart PA	aw88394、aw88395
I²C Address	0x34/0x35/0x36/0x37
ADB Debug	yes

PROJECT CONFIG

```
#add aw883xx smartpa in ProjectXXX.mk
MTK_AUDIO_SPEAKER_PATH = smartpa_awinic_aw883xx

#enable aw883xx smartpa in kernel config
CONFIG_SND_SMARTPA_AW883XX=y
```

AUIDO DEVICE

Add AW883XX option

Add aw883xx option in xxx/audio_param/AudioParamOptions.xml.
(Note: this file is automatically generated during overall compilation, If only the kernel is compiled, please modify the XML manually)

```
<Param name="MTK_AUDIO_SPEAKER_PATH" value="smartpa_awinic_aw883xx" />
```

Add AW883XX parameter configuration

Add aw883xx parameter configuration in device/mediatek/common/audio_param_smartpa/ SmartPa_AudioParam.xml

```
<Param path="smartpa_awinic_aw883xx" param_id="7"/>
#Add AW883XX parameter
<ParamUnit param_id="7">
    <Param name="have_dsp" value="1"/>
    <Param name="is_alsa_codec" value="1"/>
    <Param name="chip_delay_us" value="22000"/>
    <Param name="supported_rate_list"
value="8000,11025,12000,16000,22050,24000,32000,44100,48000"/>
    <Param name="spk_lib_path" value=""/>
    <Param name="spk_lib64_path" value=""/>
    <Param name="codec_ctl_name" value=""/>
    <Param name="is_apll_needed" value="1"/>
```



```
    <Param name="i2s_set_stage" value="5"/>
</ParamUnit>
```

Add the description of aw883xx

Add <Category name="smartpa_awinic_aw883xx"/> in device/mediatek/common/audio_param_smartpa/SmartPa_ParamUnitDesc.xml.

KERNEL DRIVER

AW883XX Smart PA Driver

Configuration DTS

The configuration information of aw883xx should be added in the kernel/arch/arm/boot/dts/mediatek/mt6853.dts

re-min and re-max are the minimum and maximum values of the calibration Re value range respectively, and the default range is 1000-40000mohm when not configured.

mono configuration：

```
diff --git a/arch/arm/boot/dts/mediatek/mt6853.dtsi
b/arch/arm/boot/dts/mediatek/mt6853.dtsi
index f22db2e..a340a32 100644
--- a/arch/arm/boot/dts/mediatek/mt6853.dtsi
+++ b/arch/arm/boot/dts/mediatek/mt6853.dtsi
@@ -549,6 +549,8 @@
    i2c_x {      /*x means bus number*/
+          /* AWINIC AW883XX mono Smart PA */
+          aw883xx_smartpa_0: aw883xx_smartpa@34 {
+              compatible = "awinic,aw883xx_smartpa";
+              #sound-dai-cells = <0>;
+              reg = <0x34>;
+              reset-gpio = <&pio 89 0>;
+              irq-gpio = <&pio 37 0x0>;
+              sound-channel = <0>;
+              re-min = <1000>;
+              re-max= <40000>;
+              status = "okay";
+      };
+      /* AWINIC AW883XX mono Smart PA End */
```

For multiple PA devices,different value of “sound-channel” associate to different devices. An example that stereo configuration as shown.

Notes：Different I2C nodes require different sound-channel attributes，set as/*0:pri_l 1:pri_r 2:sec_l 3:sec_r*/.

```
diff --git a/arch/arm/boot/dts/mediatek/mt6853.dtsi
b/arch/arm/boot/dts/mediatek/mt6853.dtsi
index f22db2e..a340a32 100644
--- a/arch/arm/boot/dts/mediatek/mt6853.dtsi
+++ b/arch/arm/boot/dts/mediatek/mt6853.dtsi
@@ -549,6 +549,8 @@
```



```
&i2c_x {       /*x means bus number*/
+       aw883xx_smartpa_0: aw883xx@34 {
+           compatible = "awinic,aw883xx";
+           #sound-dai-cells = <0>;
+           reg = <0x34>;
+           reset-gpio = <&pio 89 0x0>;
+           irq-gpio = <&pio 37 0x0>;
+           sound-channel = <0>;
+           re-min = <1000>;
+           re-max= <40000>;
+           status = "okay";
+       };
+       aw883xx_smartpa_1: aw883xx@35 {
+           compatible = "awinic,aw883xx";
+           #sound-dai-cells = <0>;
+           reg = <0x35>;
+           reset-gpio = <&pio 17 0x0>;
+           irq-gpio = <&pio 19 0x0>;
+           sound-channel = <1>;
+           re-min = <1000>;
+           re-max= <40000>;
+           status = "okay";
+      };
+};
```

Add Driver Files

The following driver files need to be copied to the directory of /kernel/sound/soc/codecs/aw883xx that created manually.

aw883xx.c,aw883xx.h,aw_pid_2049_reg.h,aw_monitor.c,aw_monitor.h,aw_log.h,aw_init.c,aw_device.c,aw_device.h,aw_data_type.h,aw_calib.h,aw_calib.c,aw_bin_parse.c,aw_bin_parse.h,aw_spin.c,aw_spin.h

Note: If the bin file cannot be loaded in the codec_probe function, please modify the following macros in aw883xx.h to increase the delay loading time

```
#define AW883XX_LOAD_FW_DELAY_TIME     (3000)
```

You can also modify the bin file loading retry times in aw883xx.c to meet the requirements, as follows:

```
#define AW_REQUEST_FW_RETRIES      5   /* 5 times */
```

ADD AW883XX Kconfig And Makefile Files

1) Add codes in kernel/sound/soc/codecs/Kconfig

```
config SND_SMARTPA_AW883XX
   tristate "SoC Audio for awinic aw883xxseries"
   depends on I2C
   help
      This option enables support for aw883xxseries Smart PA.
```


2) Add codes in kernel/sound/soc/codecs/Makefile

```
#for AWINIC AW883XXSmart PA
obj-$(CONFIG_SND_SMARTPA_AW883XX) += aw883xx/aw883xx.o
aw883xx/aw_monitor.o aw883xx/aw_bin_parse.o aw883xx/aw_device.o
aw883xx/aw_init.o aw883xx/aw_calib.o aw883xx/aw_spin.o
```

ADD AW883XX Firmware And Config Files

1) Add the bin file's path directory in kernel/drivers/base/firmware_class.c. The path directory is determined by the system. The general path directory is "vendor/firmware/"

```
static const char * const fw_path[] = {
     fw_path_para,
     "/vendor/firmware/",
     "/lib/firmware/updates/" UTS_RELEASE,
     "/lib/firmware/updates",
     "/lib/firmware/" UTS_RELEASE,
     "/lib/firmware"
};
```

2) Push the config file to the phone through ADB.

```
adb push aw883xx_acf.bin vendor/firmware/
```

About the selection of config file:

The directory of each product in config (eg: \ config \ aw88395 \) contains the default configuration of I2S 16bit and 32bit bit width modes. Different parameters are selected according to the output signal of the platform and the number of PA. For example: for aw88395 single PA environment, if the platform output is a 16bit wide sound source, select the bin file under config \ aw88395 \ 16bit \ mono.

ASoc Machine Driver

4G Platform Configuration

Add AW883XX Dai Link configuration to mt_soc_extspk_dai in the file kernel/sound/soc/mediatek/common_int/mtk-soc-machine.c

mono configuration notes: 6-0034 is the corresponding I2C bus and address

```
struct snd_soc_dai_link_component awinic_codecs[] = {
    {
        .of_node = NULL,
        .dai_name = "aw883xx-aif-6-34",
        .name = "aw883xx_smartpa.6-0034",
    },
};
```

For multiple PA devices need to continue to add dai link information. An example that stereo configuration as shown.

```
struct snd_soc_dai_link_component awinic_codecs[] = {
    {
        .of_node = NULL,
        .dai_name = "aw883xx-aif-6-34",
        .name = "aw883xx_smartpa.6-0034",
    },
```



```
    {
        .of_node = NULL,
        .dai_name = "aw883xx-aif-6-35",
        .name = "aw883xx_smartpa.6-0035",
    },
};
```

```
{
    .name = "Ext_Speaker_Multimedia",
    .stream_name = MT_SOC_SPEAKER_STREAM_NAME,
    .cpu_dai_name = "snd-soc-dummy-dai",
    .platform_name = "snd-soc-dummy",
#ifdef CONFIG_SND_SMARTPA_AW883XX
    .num_codecs = ARRAY_SIZE(awinic_codecs),
    .codecs = awinic_codecs,
#endif
    .ops = &mt_machine_audio_ops,
},
```

5G Platform Configuration

For single PA, add the corresponding sound-dai information according to the I2C node <aw883xx_smartpa_0> configured in the front dts.

```
diff --git a/arch/arm/boot/dts/mediatek/mt6853.dtsi
b/arch/arm/boot/dts/mediatek/mt6853.dtsi
index f22db2e..a340a32 100644
--- a/arch/arm64/boot/dts/mediatek/mt6853.dts
+++ b/arch/arm/boot/dts/mediatek/mt6853.dts
@@ -2824,7 +2824,7 @@
        mtk_spk_i2s_in = <0>;
        /* mtk_spk_i2s_mck = <3>; */
        mediatek,speaker-codec {
-           sound-dai = <&speaker_amp>;
+           sound-dai = <&aw883xx_smartpa_0>;
        };
    };
```

For multiple PAs, configure DAI_LINK according to the I2C node information added by DTS. Here, two PAs are used as an example to configure DAI_LINK.

```
diff --git a/arch/arm/boot/dts/mediatek/mt6853.dtsi
b/arch/arm/boot/dts/mediatek/mt6853.dtsi
index f22db2e..a340a32 100644
--- a/arch/arm64/boot/dts/mediatek/mt6853.dts
+++ b/arch/arm/boot/dts/mediatek/mt6853.dts
@@ -2824,7 +2824,7 @@
        mtk_spk_i2s_in = <0>;
        /* mtk_spk_i2s_mck = <3>; */
        mediatek,speaker-codec {
-           sound-dai = <&speaker_amp>;
+           sound-dai = <&aw883xx_smartpa_0 &aw883xx_smartpa_1>;
        };
    };
```

Make sure driver porting all right, general steps are:

1) The compiler can pass;

2) I2C communication is successful;
3) Sound card registered successfully;
4) PA can output sound normally.

If nothing failed or error, the driver porting is completed.

SPEAKER CALI

Purpose Of Calibration

For Speaker protection requirements, the aw883xx driver supports calibration when testing the speaker on the production line, and writes the re value of the speaker that meets the test requirements into the persistent partition of the AP. When starting up, the driver will write the read calibration value into the chip DSP to complete the speaker calibration process.

Methods Of Calibration

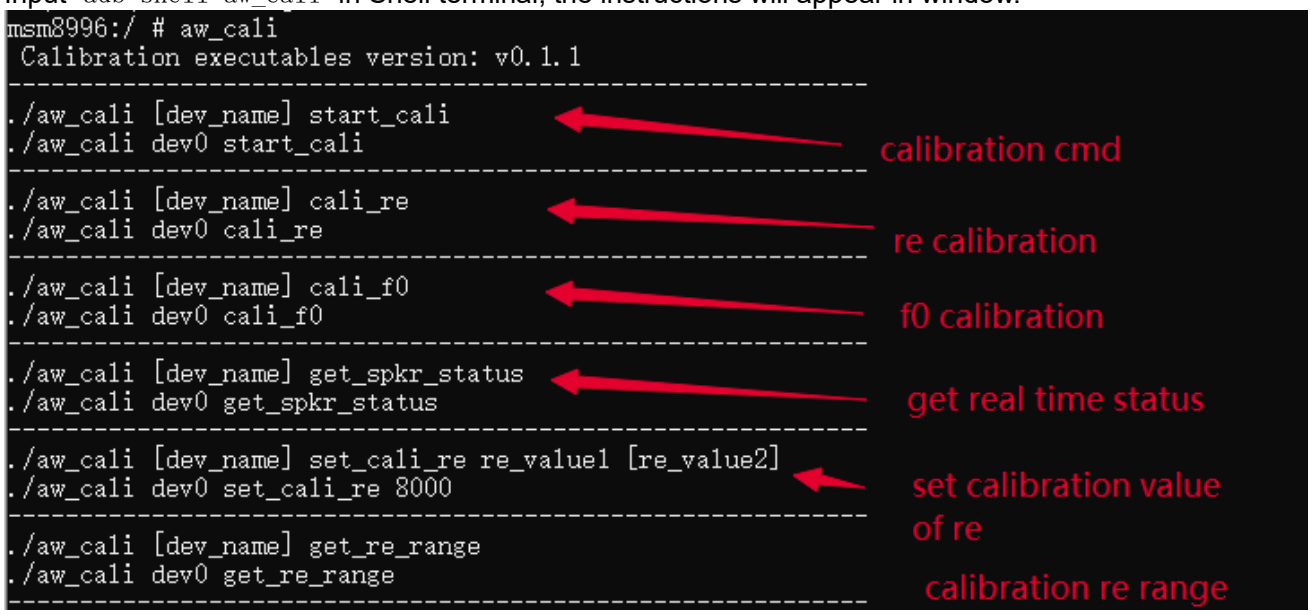
Awinic provides misc, class and attr calibration methods. The driver is enabled by default for all three calibration methods.

1) Misc calibration

The calibration is directly controlled by the cali executable file.Push aw_cali file in the system/bin directory and modify the permissions:

adb shell chmod 0777 system/bin/aw_cali

Input "adb shell aw_cali" in Shell terminal, the instructions will appear in window.



Parameter explanation (Note: [ ] means this option can be left blank)

dev_name	Calibrate single device "devx", x corresponds to the sound-channel configured in dts, When node is not configurated, the application can be automatically searched.

Calibration steps:

1) Play mute music;

2）Start the calibration, after the end, the calibration value will be output;

./system/bin/aw_cali start_cali

```
msm8996:/ # aw_cali start_cali
dev[0]cali_re = 6718
dev[1]cali_re = 6903
dev[0]cali_f0 = 946
dev[1]cali_f0 = 846
```

3）If the calibration value is within a reasonable range, the re value will be set to the cali bin file by default. When customers have customized requirements, they can set re through the following commands.

./system/bin/aw_cali set_cali_re 6718 6903

```
msm8996:/ # aw_cali set_cali_re 6718 6903
dev[0]:set cali re 6718
dev[1]:set cali re 6903
```

2) Class calibration

Class mode uses the class file system to create relevant directories and nodes in the / sys / class / smartpa Directory:

nodes	function
/sys/calss/smartpa/cali_time	1. Set calibration time 2.Show current calibration time
/sys/calss/smartpa/f0_calib	Calibrate f0
/sys/calss/smartpa/re25_calib	1. Calibrate re 2. Save calibration re value
/sys/calss/smartpa/f0_q_calib	Calibrate f0 and q
/sys/calss/smartpa/re_range	Show re_range

Calibration steps:

1) Play mute music;
2) You can read re25_ calib and f0_ calib to calibrate re and F0. If you need to modify the calibration delay time, you can write cali_time node before calibration process, in MS;
3) If the calibration value is within a reasonable range, the re value will be set to the cali bin file by default. When the customer has customized requirements, RE can be set through write "dev [0]: 6848 dev [1]: 6683" to cali_re node. (take dual PA setting as an example)

3) Attr calibration

In attr mode, nodes are created in the /sys/bus/i2c/drivers/aw883xx_smartpa/*-00xx/directory (“*” mean i2c bus number; “xx” mean i2c address). nodes as shown:

nodes	function
cali_time	1. Set calibration time 2.Show current calibration time
cali_re	1. Calibrate re 2. Save calibration re value
cali_f0	Calibrate f0
cali_f0_q	Calibrate f0 and q
re_range	Show re_range

Calibration steps:

1）play mute file
2）You can read cali_re and cali_f0 to calibrate re and F0 separately. If you need to modify the calibration delay time, you can write cali_time node before calibration process, in MS;

3）If the re value of calibration is within the re range configured by DTS, the re value will be directly stored in the bin files and dsp. When the customer has customized requirements, RE can be set through write "dev [0]: 6848 dev [1]: 6683" to cali_re node. (take dual PA setting as an example)

Saving Method Of Calibration Value (Example)

There is no memory for saving calibration values in PA, the calibration data should be saved to the platform memory after calibration；Driver read calibration re value when starting PA, and set it to MEC algorithm. The following is a reference example provided by awinic to write the calibration value into the persistent partition file (the code location is in awinic_cali.c)

```
/* customer need add function to set cali_re to nv or get cali_re from nv */
int aw_cali_write_re_to_nvram(int32_t cali_re, int32_t channel)
{
#ifdef AW_CALI_STORE_EXAMPLE
    return aw_cali_write_cali_re_to_file(cali_re, channel);
#else
    return -EBUSY;
#endif
}

int aw_cali_read_re_from_nvram(int32_t *cali_re, int32_t channel)
{
/*custom add, if success return value is 0 , else -1*/
#ifdef AW_CALI_STORE_EXAMPLE
    return aw_cali_get_cali_re_from_file(cali_re, channel);
#else
    return -EBUSY;
#endif
}
```

Verification Of Calibration Effectiveness

a. You can directly cat the file to check whether the re value is written into the file. The file path defaults to the definition in aw_calib.c, which can be modified according to the customer's situation:

```
#define AWINIC_CALI_FILE  "/mnt/vendor/persist/factory/audio/aw_cali.bin"
```

b. After replaying the music, cat the dsp_re node and confirm that the value in dsp is the same as the written value.

c. Restart the phone and play music, you can cat the dsp_re node to check the value in dsp and the value of re in the file.

d. Check whether the calibration re is not constant and changes within the effective range. (calibration re is related to the Speaker, the effective range shall be confirmed with hardware colleagues or customers)

Calibration Node Sample Code

Awinic provides sample codes for calibrating attr attribute nodes and class attribute nodes in \cali\example_source_code; FAE and customers can refer to.

DEBUG INTERFACE

Node

AW883XX Driver will create multiple device node files with different functions. The path is sys/bus/i2c/drivers/aw883xx_smartpa/*-00xx, where * is the i2c bus number and xx is the i2c address. You can use adb to read and write nodes to debug AW883XX Driver.

reg

Node name	reg
Description	read and write all register value of aw883xx
Instruction	read register value：cat reg write register value：echo reg_addr reg_data > reg (Hexadecimal operation)
Example	cat reg （get all the values of the register with read permission） echo 0x04 0x0241 > reg （write the value of 0x0241 to the register of 0x04）

rw

Node name	rw
Description	read and write single register value of aw883xx
Instruction	read register value：echo reg_addr > rw (Hexadecimal operation) cat rw write register value：echo reg_addr reg_data > rw (Hexadecimal operation)
Example	echo 0x04 > rw (read the value of the 0x04 register) cat rw echo 0x04 0x0241 > rw (write the value of 0x0241 to the register of 0x04)

drv_ver

Node name	drv_ver
Description	get driver version
Instruction	get driver version：cat drv_ver

dsp_rw

Node name	dsp_rw
Description	read and write single dsp register value of aw883xx
Instruction	read dsp register： echo reg_addr > dsp_rw （Hexadecimal operation） cat dsp_rw write dsp register： echo reg_addr reg_data > dsp_rw （Hexadecimal operation）
Example	echo 0x8601 > dsp_rw （Read dsp register 0x8604） cat dsp_rw

	echo 0x8604 0x4011 > dsp_rw （Write 0x4011 to dsp register 0x8604）

dsp

Node name	dsp
Description	Get dsp firmware and dsp config info
Instruction	Get dsp firmware and dsp config： cat dsp
Example	cat dsp

fade_step

Node name	fade_step
Description	set step of fade in and fade out
Instruction	set step echo step > fade_step get step cat fade_step
Example	echo 6 > fade_step （set the step to 6） cat fade_step (get the current step of fade in and fade out)

dbg_prof

Node name	dbg_prof
Description	scene switching function control node
Instruction	switch scene function enable echo 1 > dbg_prof switch scene function disable echo 0 > dbg_prof

fade_en

Node name	fade_en
Description	fade in and fade out function control node
Instruction	fade in and fade out enable echo 1 > fade_en fade in and fade out disable echo 0 > fade_en

monitor

Node name	monitor
Description	Software Monitor function control node
Instruction	monitor enable echo 1 > monitor monitor disable echo 0 > monitor

monitor_update

Node name	monitor_update
Description	monitor config update control node

Instruction	update monitor config echo 1 > monitor_update

dsp_re

Node name	dsp_re
Description	get re value of dsp
Instruction	cat dsp_re

i2c_log_en

Node name	I2c_log_en
Description	I2C data printing control node
Instruction	i2c data printing enable echo 1 > i2c_log_en i2c data printing disable echo 0 > i2c_log_en get node cat print_dbg

phase_sync

Node name	phase_sync
Description	phase synchronization function control node
Instruction	phase synchronization function enable echo 1 > phase_sync phase synchronization function disable echo 0 > phase_sync get phase_sync status cat phase_sync

spk_temp

Node name	spk_temp
Description	display the real-time status of the speaker
Instruction	cat spk_temp

cali_re

Node name	cali_re
Description	Calibration re; Set re value
Instruction	Calibration re: cat cali_re set re value: echo dev[0]:6848 dev[1]:6683 > cali_re (Take the stereo PA configuration as an example. When there are multiple PAS, it is added according to the format)

cali_f0

Node name	cali_f0
Description	Calibration f0
Instruction	Calibration f0: cat cali_f0

cali_f0_q

Node name	cali_f0_q
Description	Calibration f0,q
Instruction	Calibration f0,q: cat cali_f0_q

cali_time

Node name	cali_time
Description	Read Calibration delay time Set Calibration delay time
Instruction	Read Calibration delay time： cat cali_time Set Calibration delay time： echo 3000 > cali_time (Unit: ms)

re_range

Node name	re_range
Description	Read re Calibration range
Instruction	Read re Calibration range： cat re_range

Kcontrol

"x" represents the device number

aw_dev_x_switch

PA switch
tinymix aw_dev_ x _switch Enable the device x of PA allow to turn on
tinymix aw_dev_ x _switch Disable The device x of PA is not allowed to be turned on

aw_dev_x_prof

scene switch (assuming that Music and Receive scenes are configured in the bin file)
tinymix aw_dev_ x _prof Music the device x of PA switch scene to Music
tinymix aw_dev_ x _prof Receive the device x of PA switch scene to Receive

aw883xx_fadein_us

fade in step time interval setting
tinymix aw883xx_fadein_us 500 set 500us fade in step time interval

aw883xx_fadeout_us

fade out step time interval setting
tinymix aw883xx_fadeout_us 500 set 500us fade out step time interval

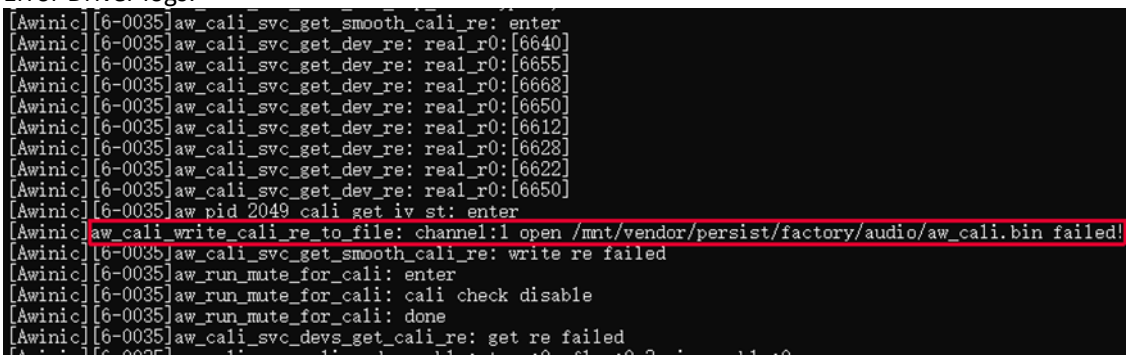
aw_dev_x_monitor_switch

PA monitor 功能开关
tinymix aw_dev_ x _switch Enable　第 x 个 PA 允许 monitor 开启
tinymix aw_dev_ x _switch Disable　第 x 个 PA 不允许 monitor 开启

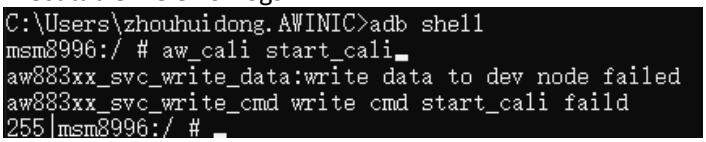
OTHER INSTRUCTIONS

Common Error Analysis

1. Calibration Re / F0 error:
   1) Check the AP music playing status;
   2) Check whether the re value is normally written into the file after calibration;
      Error Driver logs:



      Executable file error logs:



   resolvent:
   First, you need to confirm whether the mobile phone path / MNT / vendor / persist / factory / audio / is complete. If not, you need to create a complete path.

   3) Check whether the calibration IV data is normal, grab the data for analysis, and confirm whether the PA parameter configuration is normal.

