



# **AB157x/AB158x Series Mass Production RACE Application Note**

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## Document revision history

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Revision	Date	Description
1.0	19 January 2022	Initial release

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## **1. Introduction**

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This application note describes AB157x/AB158x series Mass Production RACE related information. The following topics are included to help users to establish Audio Mass Production environment.

- 1) AB157x/AB158x RACE definition
- 2) UART software flow control
- 3) ANC calibration flow
- 4) ANC RACE commands (ANC RACE commands are used to calibrate ANC.)

Relay RACE commands (Relay RACE commands are used to send RACE to partner for MCSync ANC calibration.)

Sub-function RACE commands (Sub-function RACE commands is to support version check, model name check...etc.)

Mic test RACE commands (Mic test RACE commands are used to test mic functionality.)

## 2. RACE command packet

The Race Command (RCMD) packet is used to send commands to AB157x/AB158x device from the Host (external MCU or PC tool) or receive events (indications or responses) from AB157x/AB158x device. Any AB157x/AB158x device is able to accept RCMD with **up to 1000 bytes** of data excluding the RCMD header and length field. Each RCMD command is assigned two types of transported used to uniquely identify different format of commands. These two fields are called “Transported by H4” and “Transported by H5”.

### 2.1. RCMD Packet Format

#### 2.1.1. RCMD Command Format (sent to AB157x/AB158x)

Command				
Channel	Type	Length	ID	Payload
1 byte	1 byte	2 bytes	2 bytes	Varied
0x05	0x5A or 0x5C	#1	RACE Command ID	#2

*Table 2-1.RACE command format*

#1 ID + Payload

#2 Command parameters

#3 Little Endian used for multi-bytes area

#### 2.1.2. RCMD Receive Format (received from AB157x/AB158x)

Response				
Channel	Type	Length	ID	Payload
1 byte	1 byte	2 bytes	2 bytes	Varied
0x05	0x5B or 0x5D	#1	RACE Command ID	#2

*Table 2-2.RACE receive format*

RCMD Commands are sent from the host to AB157x/AB158x via UART. AB157x/AB158x responds with the individual ‘ID’ which represents the ID of the responding command.

### 2.2. Type List

Type ID	Description
0x5A	Command needs a response
0x5B	Response
0x5C	Command does not need a response
0x5D	Notification

*Table 2-3.RACE type list*

### 3. UART flow control

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AB157x/AB158x implements UART software flow control which uses 0x11 and 0x13 as control bytes. If sending RACE via UART, please encode/decode data according to the following tables.

Sending raw data	Encoded data
0x11	0x77 0xEE
0x13	0x77 0xEC
0x77	0x77 0x88

***Table 3-1. UART flow control encoding table***

Receiving raw data	Decoded data
0x77 0xEE	0x11
0x77 0xEC	0x13
0x77 0x88	0x77

***Table 3-2. UART flow control decoding table***



## 4. ANC RACE command

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### Payload ID

All ANC commands use the RACE command ID **0x0E06** and Payload ID in the payload. Table 4-1 shows the definitions for the Payload IDs.

Payload ID	
Description	ID
ANC On	0x0A
ANC Off	0x0B
Set ANC Gain	0x0C
Read ANC gain from NvKey	0x0D
Write ANC gain to NvKey	0x0E
Get ANC hybrid capability	0x16

*Table 4-1.ANC RACE payload ID*

### ANC gain index mapping

Table 4-2 shows the Gain Index and the Gain Values for ANC.

Gain Index	Gain Value (dB)
0x0258(600)	6
...	..
0x0000	0
0xFFFF(-1)	-0.01
0xFFFE(-2)	-0.02
...	Gain value = Gain index/100
0xFF9C(-100)	-1
...	...
0xFA24(-1500)	-15
...	...
0xDCD8(-9000)	-90

*Table 4-2.ANC gain index mapping*

#### 4.1. ANC On

Command (0x055A)								
Length		ID		Payload				
2 bytes		2 bytes		5 bytes				
0x07	0x00	0x06	0x0E	Status	ID	Filter coefficient index	ANC mode	Sync mode
				0x00	0x0A	XX	00:Hybrid 01:FF only 02:FB only 04:AiroThru	00: Turn on agent ANC only 01: Turn on both agent and partner ANC

Response (0x055B)									
Length		ID		Payload					
2 bytes		2 bytes		6 bytes					
0x08	0x00	0x06	0x0E	Status	ID	Filter coefficient index	ANC mode	Sync mode	reserved
				0x00: success Else: fail	0x0A	XX	00:Hybrid 01:FF only 02:FB only 04:AiroThru	00 or 01	XX

Filter coefficient index: ANC: 0x01 ~ 0x04  
Airo through: 0x09 ~ 0x0B

#### 4.2. ANC Off

Command (0x055A)						
Length		ID		Payload		
2 bytes		2 bytes		3 bytes		
0x05	0x00	0x06	0x0E	Status	ID	Sync mode
				0x00	0x0B	00: Turn off agent ANC only 01: Turn off both agent and partner ANC

Response (0x055B)									
Length		ID		Payload					
2 bytes		2 bytes		6 bytes					
0x08	0x00	0x06	0x0E	Status	ID	Sync mode	Reserved		
				0x00: success Else: fail	0x0B	00 or 01	XX	XX	XX

#### 4.3. Set ANC Gain

Command (0x055A)													
Length		ID		Payload									
2 bytes		2 bytes		10 bytes									
0x0C	0x00	0x06	0x0E	Status	ID	Gain FF L		Gain FB L		Gain FF R		Gain FB R	
				0x00	0x0C	XX	XX	XX	XX	XX	XX	XX	XX

Response (0x055B)													
Length		ID		Payload									
2 bytes		2 bytes		10 bytes									
0x0C	0x00	0x06	0x0E	Status	ID	Gain FF L		Gain FB L		Gain FF R		Gain FB R	
				0x00:success Else: fail	0x0C	XX	XX	XX	XX	XX	XX	XX	XX

#### 4.4. Read ANC gain from NvKey

Command (0x055A)													
Length		ID		Payload									
2 bytes		2 bytes		2 bytes									
0x04	0x00	0x06	0x0E	Status					ID				
				0x00					0x0D				

Response (0x055B)													
Length		ID		Payload									
2 bytes		2 bytes		10 bytes									
0x0C	0x00	0x06	0x0E	Status	ID	Gain FF L		Gain FB L		Gain FF R		Gain FB R	
				0x00: success	0x0D	XX	XX	XX	XX	XX	XX	XX	XX

				Else: fail									
--	--	--	--	------------	--	--	--	--	--	--	--	--	--

#### 4.5. Write ANC gain to NvKey

Command (0x055A)													
Length		ID		Payload									
2 bytes		2 bytes		10 bytes									
0x0C	0x00	0x06	0x0E	Status	ID	Gain FF L		Gain FB L		Gain FF R		Gain FB R	
				0x00	0x0E	XX	XX	XX	XX	XX	XX	XX	XX

Response (0x055B)													
Length		ID		Payload									
2 bytes		2 bytes		10 bytes									
0x0C	0x00	0x06	0x0E	Status	ID	Gain FF L		Gain FB L		Gain FF R		Gain FB R	
				0x00: success Else: fail	0x0E	xx	xx	xx	xx	xx	xx	xx	xx

#### 4.6. Get ANC hybrid capability

Command (0x055A)													
Length		ID		Payload									
2 bytes		2 bytes		2 bytes									
0x04	0x00	0x06	0x0E	Status					ID				
				0x00					0x16				

Response (0x055B)													
Length		ID		Payload									
2 bytes		2 bytes		3 bytes									
0x05	0x00	0x06	0x0E	Status		ID	Hybrid capability						
				0x00: success Else: fail		0x16	0x01: support hybrid						

#### 4.7. Enter ANC MP Mode

Command (0x055A)													
Length		ID		Payload									
2 bytes		2 bytes		2 bytes									
0x04	0x00	0x06	0x0E	Status					ID				
				0x00					0x10				

Response (0x055B)													
Length		ID		Payload									
2 bytes		2 bytes		2 bytes									
0x04	0x00	0x06	0x0E	Status		ID							
				0x00: success Else: fail		0x10							

#### 4.8. Leave ANC MP Mode

Command (0x055A)					
Length		ID		Payload	
2 bytes		2 bytes		2 bytes	
0x04	0x00	0x06	0x0E	Status	ID
				0x00	0x11

Response (0x055B)					
Length		ID		Payload	
2 bytes		2 bytes		2 bytes	
0x04	0x00	0x06	0x0E	Status	ID
				0x00: success Else: fail	0x11

## 5. Relay RACE command

### 5.1. Get Available Destination

Command (0x055A)				
Length		ID		Payload
2 bytes		2 bytes		N/A
0x02	0x00	0x00	0x0D	N/A

Response (0x055B)				
Length		ID		Payload
2 bytes		2 bytes		N bytes
XX	0x00	0x00	0x0D	Destination list
				Pairs of [dst type:1 byte][dst id: 1 byte] For example: 0x01020506 (type USB and type AWS peer)

\* dst type: 0 uart, 1 usb, 2 airapp, 5 AWS peer

### 5.2. Relay command to partner

Command (0x055A)						
Length		ID		Payload		
2 bytes		2 bytes		N bytes		
XX	XX	0x01	0x0D	Dst type	Dst ID	Data to partner
				0x05	%AWS_peer_ID	

Response (0x055C)							
Length		ID		Payload			
2 bytes		2 bytes		N bytes			
XX	XX	0x01	0x0D	Status	Dst type	Dst ID	Data from partner
				0x00: success Else: fail	0x05	%AWS_peer_ID	

\* %AWS\_peer\_ID is queried by Get Available Destination command. Type is 0x05 (AWS\_peer).

#### Relay example:

Step 1: Getting the AWS peer destination ID  
055A0200000D

055B0600000D03040506 => get AWS peer ID: 06

Step 2: Using AWS peer destination ID to send ANC OFF command to partner  
Relay ANC OFF command to partner

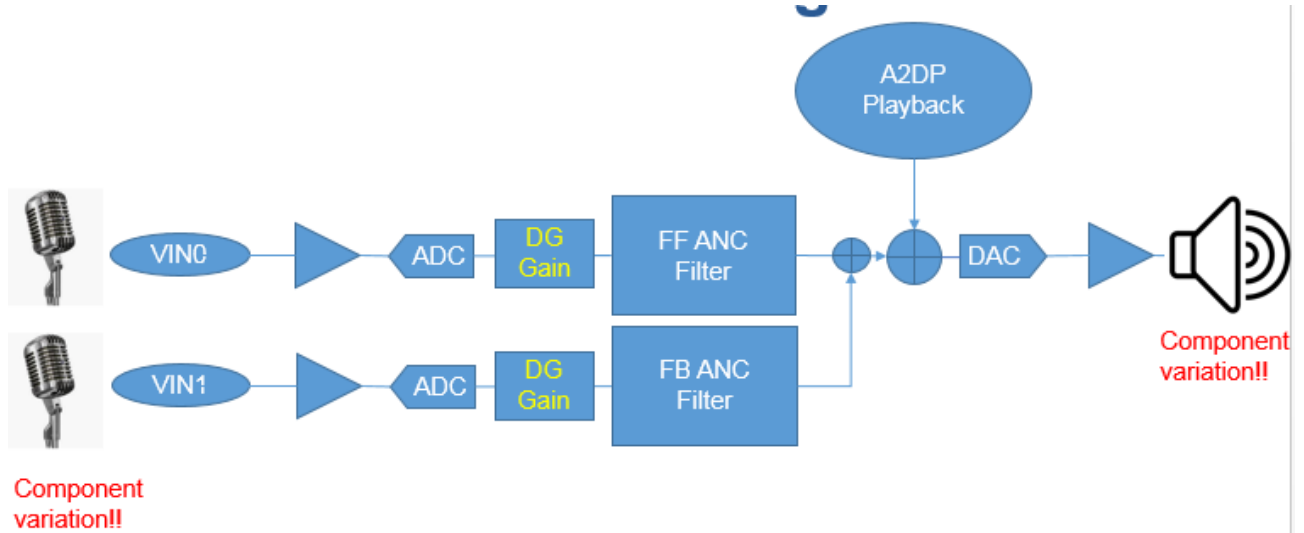
055A0D00010D0506 055A0500060E000B00

Get ANC OFF Response from partner

055D1000010D0506 055B0800060E000B00000000

## 6. ANC calibration flow

### 6.1. AB157x/AB158x Series Hybrid ANC diagram



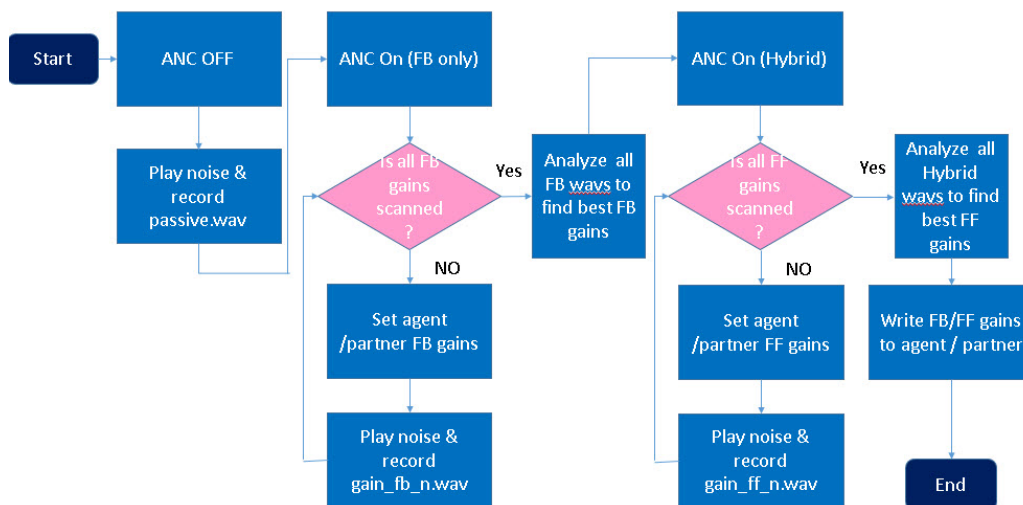
**Figure 6-1. AB157x/AB158x Series Hybrid ANC diagram**

### 6.2. FB/FF ANC gains

There are two gains to be calibrated during ANC test.

- 1) FB DG gain: The FB gain should be calibrated in the first stage under ANC FB mode.
- 2) FF DG gain: After FB gain is calibrated, the FF gain has to be calibrated under ANC hybrid mode.

### 6.3. ANC calibration flow chart



**Figure 6-2. ANC calibration flow chart**

### 7.1. Read NV key

Command (0x055B)						
Length		ID		Payload		
2 bytes		2 bytes		N bytes		
XX	XX	0x00	0x0A	Length_B0	Length_B1	NV value (N-2 bytes)
				XX	XX	XX

[illegible]

Command (0x055B)					
Length		ID		Payload	
2 bytes		2 bytes		1 byte	
03	00	0x01	0x0A	Status	
				0x00: success	
				Else: fail	

055B0300010A00



### 7.3. Get version

Command (0x055A)					
Length		ID		Payload	
2 bytes		2 bytes		Role: 1 byte	
0x03	0x00	0x07	0x1C	Agent: 0x00	

Notification (0x055D)							
Length		ID		Payload			
2 bytes		2 bytes		N bytes			
XX	XX	0x07	0x1C	Status	Role (1 byte)	Length (1 byte)	version (N-3 bytes) in ASCII
				0x00: success Else: fail	0x00: agent	XX	XX

For example:

055A0300071C00

Notification, Length = 0x06, NV value = 0x76312E302E30

055D0B00071C00000676312E302E30

0x76312E302E30 in ASCII is "v1.0.0".

### 7.4. Set PEQ index

Command (0x055A)						
Length		ID		Payload		
2 bytes		2 bytes		Module (2 bytes)	PEQ index (1 byte)	
0x05	0x00	0x00	0x09	0x00	0x00	index

Notification (0x055D)							
Length		ID		Payload			
2 bytes		2 bytes		N bytes			
0x05	0x00	0x00	0x09	Module (2 bytes)		Status	
				0x00	0x00	0x00: success Else: fail	

### 7.5. Power OFF

Command (0x055A)					
Length		ID			
2 bytes		2 bytes			
0x02	0x00	0x09		0x02	

## 7.6. Get battery level

Command (0x055A)					
Length		ID		Payload	
2 bytes		2 bytes		Role (1 byte)	
0x03	0x00	0xD6	0x0C	Agent: 0x00	

Notification (0x055D)						
Length		ID		Payload		
2 bytes		2 bytes		N bytes		
0x05	0x00	0xD6	0x0C	Status	Role (1 byte)	Battery level (1 byte)
				0x00: success Else: fail	0x00: agent	Unit: percentage

For example:

055A0300D60C00

**055D0500D60C000050** Battery level is **80%**.

## 7.7. Get BD address

Command (0x055A)					
Length		ID		Payload	
2 bytes		2 bytes		Role: 1 byte	
0x03	0x00	0xD5	0x0C	Agent: 0x00	

Response (0x055B)						
Length		ID		Payload		
2 bytes		2 bytes		N bytes		
0x05	0x00	0xD5	0x0C	Status	Role (1 byte)	BD address (6 bytes)
				0x00: success Else: fail	0x00: agent	

For example:

055A0300D50C00

**055B0A00D50C0000665544332211** BD address is 0x112233445566.

## 7.8. Write MCSync information

MCSync setting is saved by NV key 0x182F. Please use the Write NV RACE command to write it.

For example:

Agent BD address: 0x**112233445566**

Partner BD address: 0x**998877665544**

MCSync key: 0x**01020304050607080910111213141516**

Write to agent (**0x40**)

055A3400010A 2F18 40 0000 445566778899 FF 665544332211  
0101020304050607080910111213141516000000000000000000000000000000

Write to partner (**0x20**)  
 055A3400010A 182F **20** 0000 **665544332211** FF **445566778899**  
**0101020304050607080910111213141516**00000000000000000000000000000000

Note: To keep values of other fields, please read NV back, replace the agent BDA, partner BDA, role, MCSync key and then write it back.

Note: The agent and partner must have the same MCSync key in one group but the different agent partner group must use a different MCSync key.

## 7.9. Read/Write device name

The device name is saved in the NV key 0xF203 in ASCII format. Please use Read/Write NV RACE commands to access it.

## 7.10. Get model name

Model name is saved in the 21<sup>st</sup> to 40<sup>th</sup> bytes of NV key 0xF50C in ASCII format. Please use Read NV RACE command to get it.

## 7.11. Get audio channel

Audio channel setting is saved in the 2<sup>nd</sup> byte of NV key 0xE0F1. Please use Read NV RACE command to get it.

```
Value = {
    1: Left channel
    2: Right channel
}
```

For example:  
055A0600000AF1FE0803  
Response, Length = 0x0009, NV value = 0x0001010214, Left channel  
055B0900000A05000001010214

## 7.12. Enable/Disable DUT mode

DUT mode control is saved in the NV key 0xF2C2. Please use Write NV RACE command to enable/disable it.

For example:  
Write NV ID = **0xF2C2**, Value = **0x01** (0x00 for disable, 0x01 for enable)  
**055A0500010AC2F201**  
Response, Status = **00**  
**055B0300010A00**

### 7.13. Factory Reset

Command (0x055A)				
Length		ID		Payload
2 bytes		2 bytes		2 byte
0x04	0x00	0x01	0x11	0x9500

Response (0x055B)				
Length		ID		Payload
2 bytes		2 bytes		1 byte
0x03	0x00	0x01	0x11	0x00: success Else: fail

### 7.14. Write USB-HID dongle & headset pairing information

USB-HID dongle & headset pairing is saved by NV key 0xF318. Please use the Write NV RACE command to write it.

For example:

Dongle BD address: 0x**112233445566**

Headset BD address: 0x**998877665544**

Write to Dongle

055A0A00010A 18F3 **445566778899**

Write to Headset

055A0A00010A 18F3 **665544332211**

### 7.15. Write USB-HID dongle & MCSync pairing information

Flow:

1. MCSync setting is saved by NV key 0x182F. Please use the Write NV RACE command to write it.  
Please refer to 7.8 Write MCSync information

2. USB-HID dongle & MCSync pairing is saved by NV key 0xF318. Please use the Write NV RACE command to write it.

For example:

Dongle BD address: 0x**112233445566**

MCSync Agent BD address: 0x**998877665544**

Write to Dongle

055A0A00010A 18F3 **445566778899**

Write to MCSync (earbuds)

055A0A00010A 18F3 **665544332211**

## 7.16. Write USB-HID LE dongle & MCSync SIRQ key

Flow:

1. MCSync setting is saved by NV key 0x182F. Please use the Write NV RACE command to write it. Please refer to 7.8 Write MCSync information for more details.
2. USB-HID LE dongle & MCSync SIRQ key is saved by NV key 0x1900. Please use the Write NV RACE command to write it.

For example:

LE Dongle:

Write NV ID = **0x1900**, Value1 = **0x01020304050607080910111213141516** (SIRK: 16bytes random num.)

055A1600010A0019010203040506070809101112131415160000

MCSync (earbuds):

Write NV ID = **0x1900**, Value1 = **0x01020304050607080910111213141516** (SIRK: 16bytes random num.)

Value2 = 0x02 (Size: earbuds num., default = 0x02), Value3 = 0x01(Rank)

055A1600010A0019010203040506070809101112131415160201

Note: If you want to keep values of other fields, please read NV back, replace SIRQ key then write it back.

Note: The LE dongle and earbuds must have the same SIRQ key in one group, but the different LE dongle and earbuds group should use a different SIRQ key.

### 7.17. Un Pairing: Write MCSync information

Flow:

1. Un Pairing MCSync setting is saved by NV key 0xF318. Please use the Write NV RACE command to write it.

For example:

Write to agent and partner

055A3400010A 18F3 40 0000 000000000000 FF 000000000000

[illegible]

2. Please use command: Factory Reset (refer to [Factory Reset](#) for more information).

## 7.18. Un Pairing: Write USB-HID dongle & headset information

Flow:

1. Un Pairing USB-HID dongle & headset is saved by NV key 0xF318. Please use the Write NV RACE command to write it.

For example:

## Write to Dongle

055A0A00010A 18F3 000000000000

## Write to Headset

055A0A00010A 18F3 000000000000

2. Please use command: Factory Reset (refer to [Factory Reset](#) for more information).

## 7.19. Un Pairing: WriteUSB-HID dongle & MCSync information

Flow:

1. Un Pairing MCSync setting is saved by NV key 0x182F. Please use the Write NV RACE command to write it. Please refer to 7.17 Un Pairing: Write MCSync information for more details.

2. Un Pairing USB-HID dongle & MCSync is saved by NV key 0xF318. Please use the Write NV RACE command to write it.

For example:

Write to Dongle

055A0A00010A 18F3 000000000000

Write to MCSync (earbuds)

055A0A00010A 18F3 000000000000

3. Please use command: Factory Reset (refer to [Factory Reset](#) for more information).

## 7.20. Un Pairing: Write USB-HID LE dongle & MCSync SIRQ key

Flow:

1. Un Pairing MCSync setting is saved by NV key 0x182F. Please use the Write NV RACE command to write it. Please refer to 7.17 Un Pairing: Write MCSync information for more details.

2. Un Pairing USB-HID LE dongle & MCSync, SIRQ key is saved by NV key 0x1900. Please use the Write NV RACE command to write it.

For example:

Original SIRQ Key: 0x01010101010101010101010101010101

MCSync (earbuds1):

Write NV ID = 0x1900, Value1 = 0x02020202020202020202020202020202

055A1600010A00190202020202020202020202020202020000

MCSync (earbuds2):

Write NV ID = 0x1900, Value1 = 0x03030303030303030303030303030303

055A1600010A00190303030303030303030303030303030201

LE Dongle:

Write NV ID = 0x1900, Value1 = 0x04040404040404040404040404040404

055A1600010A00190404040404040404040404040404040201

Note: Let the LE dongle and earbuds have a different SIRQ key.

3. Please use command: Factory Reset (refer to [Factory Reset](#) for more information).

## 8. Mic test RACE Command

### 8.1. MIC Swap

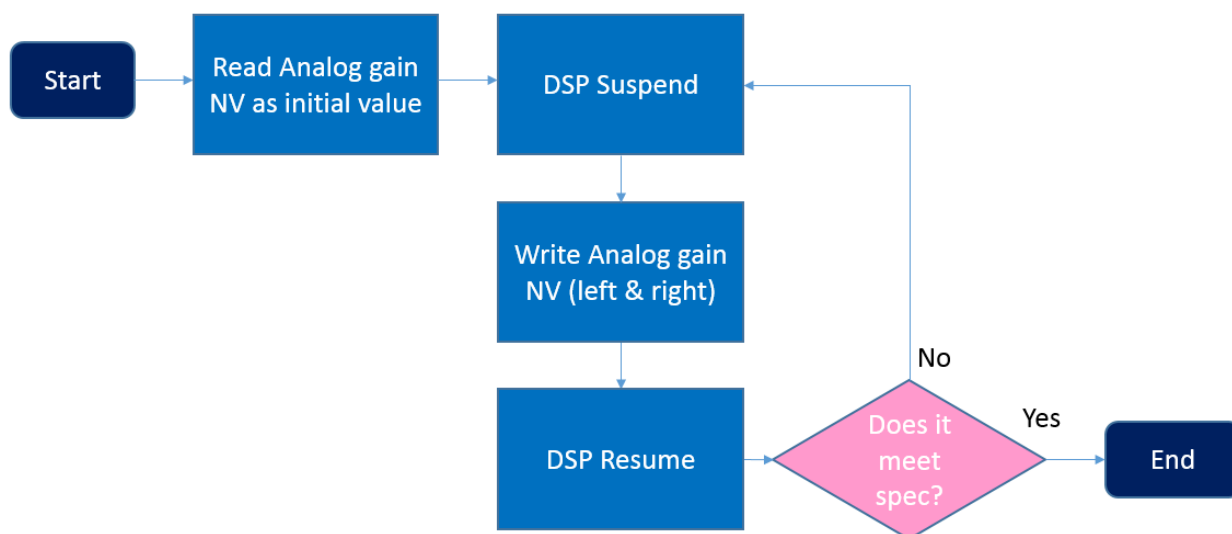
Command (0x055A)				
Length		ID		Payload
2 bytes		2 bytes		1 byte
0x03	0x00	0x0C	0x0E	MIC0 (0x00) MIC1 (0x01) MIC2 (0x02) MIC3 (0x03) MIC4 (0x04) MIC5 (0x05)

Response (0x055B)				
Length		ID		Payload
2 bytes		2 bytes		1 byte
0x03	0x00	0x0C	0x0E	0x00: success Else: fail

### 8.2. AECNR on/off

Command (0x055A)				
Length		ID		Payload
2 bytes		2 bytes		1 byte
0x03	0x00	0x0D	0x0E	0x00 (Off) 0x01 (On)

Response (0x055B)				
Length		ID		Payload
2 bytes		2 bytes		1 byte
0x03	0x00	0x0D	0x0E	0x00: success Else: fail



**Figure 9-1. Analog gain calibration flow chart**

### 9.1. Read/Write Analog Gain

The analog gain setting is saved by NV key 0xE00A. Please use the Read/Write NV RACE command to access it.

In NV key 0xE00A, the 3<sup>rd</sup> and 4<sup>th</sup> bytes composes left analog gain and the 7<sup>th</sup> and 8<sup>th</sup> bytes composes right analog gain in unit of 0.01 db.

For example:

Analog gain left: 0x0190 (400 in decimal. i.e. 4db)

Analog gain right: 0xFF38 (-200 in decimal. i.e. -2db)

Write NV ID = **0xE00A**, Value = 0x00009001.....

055A3C00010AAE00009001900138FF08070807B004B00408070807000000000000000000  
00000807080708070807080708070807080708070807

Response, Status = 00

055B0300010A00



## 9.2. DSP Suspend RACE command

Command (0x055A)				
Length		ID		Payload
2 bytes		2 bytes		0 byte
0x02	0x00	0x01	0x0E	

Command (0x055B)				
Length		ID		Payload
2 bytes		2 bytes		1 byte
0x03	0x00	0x01	0x0E	Status
				00: success Else: fail

For example:  
055A0200010E  
**055B0300010E00**

## 9.3. DSP Resume RACE command

Command (0x055A)				
Length		ID		Payload
2 bytes		2 bytes		0 byte
0x02	0x00	0x02	0x0E	

Command (0x055B)				
Length		ID		Payload
2 bytes		2 bytes		1 byte
0x03	0x00	0x02	0x0E	Status
				00: success Else: fail

For example:  
055A0200020E  
**055B0300020E00**