Technical Documentation

AEC 2.x - API Definition

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History

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Notes

(1) Creation.
(2) Approval.
(3) Updates.
(4) Updated section (2.2).

Glossary

API	Application Protocol Interface
AEC	Acoustic Echo Canceller
VAD	Voice Activity Detector

References

[1] L1D_AS190 – AEC 2.x - Overview

Table of Contents

List of Figures and Tables

1 Introduction

The purpose of this document is to describe the Application Protocol Interface (API) of the Acoustic Echo Canceller (AEC) [1]. This document applies to AEC 2.0 and next upgrades AEC 2.x.

The AEC 2.x uses the Voice Activity Detector (VAD 1.x) as external module operating at 8kHz (20 ms frame processing).

First chapter describes the API of the AEC 2.x module. A. Appendix is dedicated to the reference values of AEC 2.x parameters.

2 AEC 2.x Module API

This chapter describes the parameter interface of the AEC 2.x module.

2.1 Entry Functions

2.1.1 Function f_aec_top ()

Prototype:

```
void    f_aec_top(T_AEC_GLOBAL_VAR *p_gbl_var, T_SINT16 d_mode)
```

Description:

This AEC top level function contains the call of all signal processing functions necessary to perform the AEC algorithm. The function arguments are presented below (Table 2.1).

Arguments:

Type	Name	Flow	Description
T_AEC_GLOBAL_VAR	*p_gbl_var	IN/OUT	Pointer on the AEC module static variables
T_SINT16	d_mode	IN	Freeze on unfreeze coefficients adaptation

Table 2.1 The AEC 2.x Top Function Arguments

The T_AEC_GLOBAL_VAR *p_gbl_var data structure pointer parameter is used to pass the static variables to the AEC top function as well as through the internal signal processing functions. In addition, the AEC configuration parameters are passed to the module through a data structure pointer T_AEC_PARAM *p_aec_param element of *p_gbl_var. Those structures are detailed in the implementation document.

Requirements: The entire signal processing functions code must be mapped on a single DSP page as it does not support extended addressing.

Reentrancy: No.

Return value: None.

2.1.2 Function f_aec_init ()

Prototype:

```
void    f_aec_init (T_AEC_GLOBAL_VAR *p_gbl_var);
```

Description:

This function is used to initialize the AEC module. The function arguments are presented below (Table 2.2)

Arguments:

Type	Name	Flow	Description
T_AEC_GLOBAL_VAR	*p_gbl_var	IN/OUT	Pointer on the AEC module static variables

Table 2.2 The AEC 2.x Initialization Function Arguments

Requirements: The init function code must be mapped on a single DSP page as it does not support extended addressing.

Reentrancy: No.

Return value: None.

2.2 AEC 2.x Module Interface

This paragraph focuses on the API of the AEC module. The description of the parameters is presented below (Table 2.3) in addition to the format and the range for each parameter (Table 2.4).

&	Type	Name	Description
+0	T_SINT16	d_aec_mode	AEC operating mode
+1	T_SINT16	d_mu	AEC adaptation step
+2	T_SINT16	d_cont_filter	AEC continuous filtering flag
+3	T_UINT16	d_scale_input_ul	AEC input scaling factor uplink
+4	T_UINT16	d_scale_input_dl	AEC input scaling factor downlink
+5	T_SINT16	d_div_dmax	AEC maximum energy of divergence for filter switching
+6	T_UINT16	d_div_swap_good	AEC level to define good performances of fast filter
+7	T_UINT16	d_div_swap_bad	AEC level to define bad performances of fast filter
+8	T_SINT16	d_block_init	AEC internal VAD: number of blocks used for initialization (to learn noise threshold)
+9	T_SINT16	d_fact_vad	AEC internal VAD factor used in calculation of level of signal
+10	T_UINT16	d_fact_asd_fil	AEC internal VAD factor used to adapt noise threshold for signal decision
+11	T_UINT16	d_fact_asd_mut	AEC internal VAD factor used to adapt noise threshold for smoothing decision
+12	T_UINT16	d_thr_abs	AEC internal VAD absolute noise threshold
+13	T_SINT16	d_es_level_max	AEC internal ES maximum attenuation for echo suppression
+14	T_UINT16	d_granularity_att	AEC internal ES number of blocks for attenuation smoothing
+15	T_SINT16	d_coef_smooth	AEC internal ES percentage (between 0 and 1) of max att.
+16	T_UINT16	d_block_size	AEC processing block size (samples)

Table 2.3 The AEC 2.x API Parameters Description

&	Type	Format	Range	Comments
+0	T_SINT16	16b/Q0	0x0008	AEC 1.8 with internal VAD and ES (previous solution)
			0x0000	AEC 1.8 with internal VAD and without internal ES
			0x0007	AEC 2.0 with divergence control enabled
			0x0003	AEC 2.0 with divergence control disabled
+1	T_SINT16	16b/Q15	0x5000	Ref. 0.625
+2	T_SINT16	16b/Q0	0x0000	continuous filtering disabled, see also note (1)
			0x0001	continuous filtering enabled, see also note (1)
+3	T_SINT16	16b/Q0	0x0000	Ref. 1, no scaling uplink, see also note (2)
			0x0003	Ref. 8, scaling uplink, see also note (2)
+4	T_SINT16	16b/Q15	0x0000	Ref. 1, no scaling downlink, see also note (2)
			0x0003	Ref. 8, no scaling downlink, see also note (2)
+5	T_SINT16	16b/Q12	0x537D	Ref. 21373
+6	T_UINT16	16b/Q0	0x7FB2	Ref. 32690
+7	T_UINT16	16b/Q0	0x65AD	Ref. 26029
+8	T_SINT16	16b/Q0	0x07D0	Ref. 2000 samples
+9	T_SINT16	16b/Q15	0x3FFF	Ref. 0.5
+10	T_UINT16	16b/Q12	0x1000	Ref. 4096
+11	T_UINT16	16b/Q12	0x1000	Ref. 4096
+12	T_UINT16	16b/Q0	0x0032	Ref. 50
+13	T_SINT16	16b/Q15	[0x0813,	Ref. -24dB, see also note (3)
			…,	
			0x7FFF]	Ref. 0dB, see also note (3)
+14	T_UINT16	16b/Q0	0x00A0	Ref. 160 samples
+15	T_SINT16	16b/Q15	[0x0CCB,	Ref. 3275
			…,	
			0x7FFF]	Ref. 32767
+16	T_UINT16	16b/Q0	0x0001	Ref. 1 sample

Table 2.4 The AEC 2.x API Parameters Format and Range

(1) Continuous filtering flab enables/disables filtering by adaptive filter when downlink VAD is inactive. It is recommended to enable the continuous filtering in the aim to cancel echo due to downlink noise.

(2) Scaling factors increase or decrease the dynamic of the input signal in the downlink or in the uplink corresponding respectively to right or left shifting by d_scale_input_dl and d_scale_input_ul. When scaling by d_scale_input_ul, the signal is re-scaled in the opposite direction in the output uplink to restore dynamic after echo cancellation. Recommendation is to use the AEC 2.0 with scaling ON.

(3) Internal ES maximal attenuation is computed from A(dB) user's specification using the next formula:

$$d\_es\_level\_max = round\left\{2^{15}.10^{\frac{A(dB)}{20}}\right\}. \quad (2.1)$$

Appendices

A. Appendix: AEC 2.x Parameters – Reference Values

&	Type	Name	Values	References
+0	T_SINT16	d_aec_mode	0x0000	AEC 1.8 without ES
+1	T_SINT16	d_mu	0x5000	
+2	T_SINT16	d_cont_filter	0x0001	
+3	T_UINT16	d_scale_input_ul	0x0003	
+4	T_UINT16	d_scale_input_dl	0x0003	
+5	T_SINT16	d_div_dmax	0x537D	
+6	T_UINT16	d_div_swap_good	0x7FB2	
+7	T_UINT16	d_div_swap_bad	0x65AD	
+8	T_SINT16	d_block_init	0x07D0	
+9	T_SINT16	d_fact_vad	0x3FFF	
+10	T_UINT16	d_fact_asd_fil	0x1000	
+11	T_UINT16	d_fact_asd_mut	0x1000	
+12	T_UINT16	d_thr_abs	0x0032	
+13	T_SINT16	d_es_level_max	0x7FFF	
+14	T_UINT16	d_granularity_att	0x00A0	
+15	T_SINT16	d_coef_smooth	0x0CCC	
+16	T_UINT16	d_block_size	0x0001	

Table 2.5 The AEC 2.x – Parameters Reference Values for Previous Solution 1.8 (internal ES OFF)

&	Type	Name	Values	References
+0	T_SINT16	d_aec_mode	0x0007	AEC 2.0 with div. ctrl.
+1	T_SINT16	d_mu	0x5000	
+2	T_SINT16	d_cont_filter	0x0001	
+3	T_UINT16	d_scale_input_ul	0x0003	
+4	T_UINT16	d_scale_input_dl	0x0003	
+5	T_SINT16	d_div_dmax	0x537D	
+6	T_UINT16	d_div_swap_good	0x7FB2	
+7	T_UINT16	d_div_swap_bad	0x65AD	
+8	T_SINT16	d_block_init	0x0000	
+9	T_SINT16	d_fact_vad	0x3FFF	
+10	T_UINT16	d_fact_asd_fil	0x1000	
+11	T_UINT16	d_fact_asd_mut	0x1000	
+12	T_UINT16	d_thr_abs	0x0032	
+13	T_SINT16	d_es_level_max	0x7FFF	
+14	T_UINT16	d_granularity_att	0x00A0	
+15	T_SINT16	d_coef_smooth	0x0CCC	
+16	T_UINT16	d_block_size	0x0001	

Table 2.6 The AEC 2.x – Parameters Reference Values (Divergence Control ON, Scaling ON)

&	Type	Name	Values	References
+0	T_SINT16	d_aec_mode	0x0003	AEC 2.0 div. ctrl. Off
+1	T_SINT16	d_mu	0x5000	
+2	T_SINT16	d_cont_filter	0x0001	
+3	T_UINT16	d_scale_input_ul	0x0003	
+4	T_UINT16	d_scale_input_dl	0x0003	
+5	T_SINT16	d_div_dmax	0x537D	
+6	T_UINT16	d_div_swap_good	0x7FB2	
+7	T_UINT16	d_div_swap_bad	0x65AD	
+8	T_SINT16	d_block_init	0x0000	
+9	T_SINT16	d_fact_vad	0x3FFF	
+10	T_UINT16	d_fact_asd_fil	0x1000	
+11	T_UINT16	d_fact_asd_mut	0x1000	
+12	T_UINT16	d_thr_abs	0x0032	
+13	T_SINT16	d_es_level_max	0x7FFF	
+14	T_UINT16	d_granularity_att	0x00A0	
+15	T_SINT16	d_coef_smooth	0x0CCC	
+16	T_UINT16	d_block_size	0x0001	

Table 2.7 The AEC 2.x – Parameters Reference Values (Divergence Control OFF, Scaling ON)