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Technical Documentation
DRC 1.x - API Definition

Document Number:	L1D_AS371-1
TI Department	European Wireless Terminal Chipset Business Unit
Version:	1.2
Status:	APPROVED
Date:	March 16, 2006

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Change History

Date of change	Changed by	Approved by	Approval date	Version	Notes
15 Mar 2005	Fabien Ober			0.1	(1)
March 29, 2005	Thierry Le Gall			0.2	(2)
May 26, 2005	Thierry Le Gall	Sebastien Guiriec	May 26, 2005	1.0	(3)
Sep 06 2005	Fabien Ober	Thierry Le Gall	Sep 06 2005	1.1	(4)

Notes

(1)   Creation of the document.
(2)   Review.
(3)   Approval.
(4)   Modified parameter order. Modified recommended default configurations.

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List of Figures and Tables

Glossary

API   Application Protocol Interface
DRC   Digital Range Compressor
VAD   Voice Activity Detector

References

[1]   L1D_AS378-1 - TRD for the Dynamic Range Compressor – DRC 1.x
[2]   L1D_AS370 – DRC 1.x - Overview
[3]   L1D_AS250 – VAD 1.x, 2.x - Overview

1   Introduction

The purpose of this document is to describe the Application Protocol Interface (API) related to the Dynamic Range Compressor (DRC) [1], [2]. This document applies for DRC 1.0 only, i.e. for sampling rate of 8kHz or 16kHz sampling (10ms or 20ms frame processing).

The DRC 1.0 uses the Voice Activity Detector (VAD 2.x) as external module operating at 8kHz or 16kHz sampling frequencies (10ms or 20ms frame processing) [3].

First chapter describes the API of the DRC 1.0 module. A. Appendix is dedicated to the recommended values of DRC 1.0 parameters through API. B Appendix is dedicated to the customization of DRC 1.0 parameters through API.

2   DRC 1.0 Module API

This chapter describes the parameter interface of the DRC 1.0 module.

2.1   Entry Functions

2.1.1   Function f_drc_top ()

Prototype:

```
void      f_drc_top (T_DRC_STATIC_VAR* p_drc_data, T_SINT16* p_drc_input_s,
                T_SINT16* p_drc_output_s, T_VAD_STATIC_VAR *p_drc_vad);
```

Description:

This DRC top level function contains the call of all signal processing functions necessary to perform the DRC algorithm. The function arguments are presented below (Table 2-1).

Arguments:

Type	Name	Flow	Description
T_DRC_STATIC_VAR	*p_drc_data	IN/OUT	Pointer on the DRC module static variables
T_SINT16	*p_drc_input_s	IN	Pointer on the input samples
T_SINT16	*p_drc_output_s	OUT	Pointer on the output samples
T_VAD_STATIC_VAR	*p_drc_vad	IN/OUT	Pointer on the VAD module static variables

Table 2-1 The DRC 1.0 Top Function Arguments

The T_DRC_STATIC_VAR *p_drc_data structure pointer parameter is used to pass the static variables to the DRC top function as well as through the internal signal processing functions. In addition, the DRC configuration parameters are passed to the module through a data structure pointer T_DRC_PARAM *p_drc_param element of *p_drc_data. 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:

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This API is reentrant.

Return value:

None.

2.1.2 Function f_drc_init ()

Prototype:

```
void      f_drc_init (T_DRC_CONFIG* p_drc_config, T_DRC_STATIC_VAR *p_drc_data,
                T_DRC_ROM_TABLES* p_drc_rom_table)
```

Description:

This function is used to initialize the DRC module. The function arguments are presented below (Table 2-2)

Arguments:

Type	Name	Flow	Description
T_DRC_CONFIG	*p_drc_config	IN	Pointer on the DRC configuration (API)
T_DRC_STATIC_VAR	*p_drc_data	IN/OUT	Pointer on the DRC static variables
T_DRC_ROM_TABLES	*p_drc_rom_table	IN	Pointer on the DRC data ROM tables

Table 2-2 The DRC 1.0 Initialization Function Arguments

Requirements:

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

Reentrancy:

This API is reentrant.

Return value:

None.

2.2   DRC 1.0 Module Interface

This chapter focuses on the API for DRC 1.0 module. The API description, format of range of parameters is presented below (Table 2-3), (Table 2-4).

&	Type	Name	Format	Description
+0	T_UINT16	d_drc_speech_mode_samp_f	MSB	DRC mode
			LSB	sampling frequency
+1	T_SINT16	d_drc_num_subbands		number of bands
+2	T_SINT16	d_drc_frame_size		frame size in samples
+3	T_UINT16	d_drc_expansion_knee_fb_bs	MSB	full-band expansion threshold
			LSB	bass band expansion threshold
+4	T_UINT16	d_drc_expansion_knee_md_hg	MSB	medium band expansion threshold
			LSB	high band expansion threshold
+5	T_UINT16	d_drc_expansion_ratio_fb_bs	MSB	full-band expansion rate
			LSB	bass band expansion rate
+6	T_UINT16	d_drc_expansion_ratio_md_hg	MSB	medium band expansion rate
			LSB	high band expansion rate

+7	T_UINT16	d_drc_max_amplification_fb_bs	MSB	full-band maximum gain
			LSB	bass band maximum gain
+8	T_UINT16	d_drc_max_amplification_md_hg	MSB	medium band maximum gain
			LSB	high band maximum gain
+9	T_UINT16	d_drc_compression_knee_fb_bs	MSB	full-band compression threshold
			LSB	bass band compression threshold
+10	T_UINT16	d_drc_compression_knee_md_hg	MSB	medium band compression threshold
			LSB	high band compression threshold
+11	T_UINT16	d_drc_compression_ratio_fb_bs	MSB	full-band compression rate
			LSB	bass band compression rate
+12	T_UINT16	d_drc_compression_ratio_md_hg	MSB	medium band compression rate
			LSB	high band compression rate
+13	T_UINT16	d_drc_energy_limiting_th_fb_bs	MSB	full-band energy limiting threshold
			LSB	bass band energy limiting threshold
+14	T_UINT16	d_drc_energy_limiting_th_md_hg	MSB	medium band energy limiting threshold
			LSB	high band energy limiting threshold
+15	T_SINT16	d_drc_limiter_threshold_fb		full-band limiting threshold
+16	T_SINT16	d_drc_limiter_threshold_bs		bass band limiting threshold
+17	T_SINT16	d_drc_limiter_threshold_md		medium band limiting threshold
+18	T_SINT16	d_drc_limiter_threshold_hg		high band limiting threshold
+19	T_UINT16	d_drc_limiter_hangover_spect_preserve	MSB	limiter hangover frames
			LSB	spectral preservation
+20	T_UINT16	d_drc_limiter_release_fb_bs	MSB	full-band limiter release rate
			LSB	bass band limiter release rate
+21	T_UINT16	d_drc_limiter_release_md_hg	MSB	medium band limiter release rate
			LSB	high band limiter release rate
+22	T_UINT16	d_drc_gain_track_fb_bs	MSB	full-band gain tracking
			LSB	bass band gain tracking
+23	T_UINT16	d_drc_gain_track_md_hg	MSB	medium band gain tracking
			LSB	high band gain tracking
+24 to +40	T_SINT16	d_drc_low_pass_filter[17]		low pass filter for low-band
+41 to +57	T_SINT16	d_drc_mid_band_filter[17]		mid band filter

Table 2-3 The DRC 1.0 API Parameters Description

&	Type	Format	Range	Comments
+0	T_UINT16	8b/Q0	[0x00,	DRC bypassed
			0x01]	DRC enabled in speech mode
		8b/Q0	[0x01,	8kHz sampling frequency
			0x02]	16kHz sampling frequency
+1	T_SINT16	16b/Q0	[0x0001,	full-band processing
			0x0003]	three sub-bands processing
+2	T_SINT16	16b/Q0	[0x0050,	80 samples, 1X10ms frame processing (FP) at 8kHz
			0x00A0,	160 samples, 2X10ms FP (8kHz), 1X10ms FP (16kHz)
			0x0140]	320 samples, 2X10ms FP (16kHz)
+3	T_UINT16	8b/Q0	[0x00…,	minimal: 0dB
			0x5A]	maximal: 90dB 1dB steps
		8b/Q0	[0x00…,	minimal: 0dB
			0x5A]	maximal: 90dB 1dB steps
+4	T_UINT16	8b/Q0	[0x00…,	minimal: 0dB
			0x5A]	maximal: 90dB 1dB steps
		8b/Q0	[0x00…,	minimal: 0dB
			0x5A]	maximal: 90dB 1dB steps
+5	T_UINT16	8b/Q2	[0x05…,	minimal: 1.25
			0x7F]	maximal: 31.75 0.25 steps
		8b/Q2	[0x05…,	minimal: 1.25
			0x7F]	maximal: 31.75 0.25 steps
+6	T_UINT16	8b/Q2	[0x05…,	minimal: 1.25
			0x7F]	maximal: 31.75 0.25 steps
		8b/Q2	[0x05…,	minimal: 1.25
			0x7F]	maximal: 31.75 0.25 steps
+7	T_UINT16	8b/Q0	[0x00…,	minimal: 0dB
			0x12]	maximal: 18dB 1dB steps
		8b/Q0	[0x00…,	minimal: 0dB
			0x12]	maximal: 18dB 1dB steps
+8	T_UINT16	8b/Q0	[0x00…,	minimal: 0dB
			0x12]	maximal: 18dB 1dB steps
		8b/Q0	[0x00…,	minimal: 0dB
			0x12]	maximal: 18dB 1dB steps
+9	T_UINT16	8b/Q0	[0x00…,	minimal: 0dB
			0x5A]	maximal: 90dB 1dB steps
		8b/Q0	[0x00…,	minimal: 0dB
			0x5A]	maximal: 90dB 1dB steps
+10	T_UINT16	8b/Q0	[0x00…,	minimal: 0dB
			0x5A]	maximal: 90dB 1dB steps
		8b/Q0	[0x00…,	minimal: 0dB
			0x5A]	maximal: 90dB 1dB steps
+11	T_UINT16	8b/Q2	[0x05…,	minimal: 1.25
			0x7F]	maximal: 31.75 0.25 steps
		8b/Q2	[0x05…,	minimal: 1.25
			0x7F]	maximal: 31.75 0.25 steps
+12	T_UINT16	8b/Q2	[0x05…,	minimal: 1.25
			0x7F]	maximal: 31.75 0.25 steps
		8b/Q2	[0x05…,	minimal: 1.25
			0x7F]	maximal: 31.75 0.25 steps
+13	T_UINT16	8b/Q0	[0x00…,	minimal: 0dB
			0x5A]	maximal: 90dB 1dB steps
		8b/Q0	[0x00…,	minimal: 0dB
			0x5A]	maximal: 90dB 1dB steps
+14	T_UINT16	8b/Q0	[0x00…,	minimal: 0dB
			0x5A]	maximal: 90dB 1dB steps
		8b/Q0	[0x00…,	minimal: 0dB

			0x5A]	maximal: 90dB 1dB steps
+15	T_SINT16	16b/Q0	[0x0001…,	minimal: 1
			0x7FFF]	maximal: 32767 1 steps
+16	T_SINT16	16b/Q0	[0x0001…,	minimal: 1
			0x7FFF]	maximal: 32767 1 steps
+17	T_SINT16	16b/Q0	[0x0001…,	minimal: 1
			0x7FFF]	maximal: 32767 1 steps
+18	T_SINT16	16b/Q0	[0x0001…,	minimal: 1
			0x7FFF]	maximal: 32767 1 steps
+19	T_UINT16	8b/Q0	[0x00…	minimal: 0 frame
			0x7F]	maximal: 255 frames
		8b/Q8	[0x00..	minimal: 0.0 (see appendix B)
			0x7F]	maximal: 1.0 (see appendix B)
+20	T_UINT16	index	[0x01,	500dB/sec (for high-crest), 200dB/sec (for low-crest)
			0x02,	200dB/sec (for high-crest), 50dB/sec (for low-crest)
			0x03,	100dB/sec (for high-crest), 15B/sec (for low-crest)
			0x04,	50dB/sec (for high-crest), 10dB/sec (for low-crest)
			0x05]	30dB/sec (for high-crest), 2dB/sec (for low-crest)
		index	[0x01…	Same as above
			0x05]	
+21	T_UINT16	index	[0x01…	Same as above
			0x05]	
		index	[0x01…	Same as above
			0x05]	
+22	T_UINT16	index	[0x01,	instantaneous gain tracking (see appendix B)
			0x02,	fast gain tracking (see appendix B)
			0x03,	medium gain tracking (see appendix B)
			0x04,	gain tracking for speech (see appendix B)
			0x05,	slow gain tracking (see appendix B)
			0x06]	very slow gain tracking (see appendix B)
		index	[0x01…	Same as above
			0x06]	
+23	T_UINT16	index	[0x01…	Same as above
			0x06]	
		index	[0x01…	Same as above
			0x06]	
+24 to +40	T_SINT16	16b/Q15	[0x0000… 0xFFF]	16b/Q15 signed coefficients
+41 to +57	T_SINT16	16b/Q15	[0x0000… 0xFFF]	16b/Q15 signed coefficients

Table 2-4 The DRC 1.0 API Parameters Format and Range

Appendices

A.   Appendix: DRC 1.0 Parameters – Recommended Values

Below are presented 5 configurations which cover various use cases (Table 2-5). These configurations are recommended but not mandatory and can be adjusted to a special loudspeaker or use case.

Configuration number	description
1	1:2 compression, 2.5:1 expansion, full-band, medium gain tracking, 12dB maximum amplification, **TRD compliant.**
2	1:2 compression, 2.5:1 expansion, full-band, instantaneous gain tracking, 6dB maximum amplification. **Appropriate for handset mode.**
3	1:2 compression, 2.5:1 expansion, multi-band, medium gain tracking, 12dB maximum amplification. **Appropriate for handsfree soft compression**.
4	1:4 compression, 5:1 expansion, full-band, medium gain tracking, 18dB maximum amplification. **Appropriate for handsfree hard compression.**
5	1:4 compression, 5:1 expansion, multi band, medium gain tracking, 18dB maximum amplification. **Appropriate for handsfree hard compression without bass compression.**

Table 2-5 DRC 1.0 Recommended Default Configurations

&	Name	Values	Reference
+0	d_drc_speech_mode_samp_f	0x0101	DRC enabled, sample frequency is 8kHz
+1	d_drc_num_subbands	0x0001	full-band processing
+2	d_drc_frame_size	0x00A0	160 samples frame size
+3	d_drc_expansion_knee_fb_bs	0x1818	24dB (15 in sample unit) for full-band 24dB (15 in sample unit) for bass band
+4	d_drc_expansion_knee_md_hg	0x1818	24dB (15 in sample unit) for medium band 24dB (15 in sample unit) for high band
+5	d_drc_expansion_ratio_fb_bs	0x0A0A	2.5:1 expansion ratio for full-band 2.5:1 expansion ratio for bass band
+6	d_drc_expansion_ratio_md_hg	0x0A0A	2.5:1 expansion ratio for medium band 2.5:1 expansion ratio for high band
+7	d_drc_max_amplification_fb_bs	0x0C0C	12dB maximum amplification for full-band 12dB maximum amplification for bass band
+8	d_drc_max_amplification_md_hg	0x0C0C	12dB maximum amplification for full-band 12dB maximum amplification for bass band
+9	d_drc_compression_knee_fb_bs	0x5757	87dB (22387 in sample unit) for full-band 87dB (22387 in sample unit) for bass band
+10	d_drc_compression_knee_md_hg	0x5757	87dB (22387 in sample unit) for medium band 87dB (22387 in sample unit) for high band
+11	d_drc_compression_ratio_fb_bs	0x0808	1:2 compression ratio for full-band 1:2 compression ratio for bass band
+12	d_drc_compression_ratio_md_hg	0x0808	1:2 compression ratio for medium band 1:2 compression ratio for high band
+13	d_drc_energy_limiting_th_fb_bs	0x5757	87dB (15849 in sample unit) for full-band 87dB (15849 in sample unit) for full-band
+14	d_drc_energy_limiting_th_md_hg	0x5757	87dB (15849 in sample unit) for medium band 87dB (15849 in sample unit) for high band
+15	d_drc_limiter_threshold_fb	0x7EB8	32440 (in sample unit) for full-band limiter threshold
+16	d_drc_limiter_threshold_bs	0x7EB8	32440 (in sample unit) for bass band limiter threshold
+17	d_drc_limiter_threshold_md	0x7EB8	32440 (in sample unit) for medium band limiter threshold
+18	d_drc_limiter_threshold_hg	0x7EB8	32440 (in sample unit) for high band limiter threshold
+19	d_drc_limiter_hangover_spect_preserve	0x03D9	3 frames for limiter hangover spectral preservation equals to 0.85
+20	d_drc_limiter_release_fb_bs	0x0303	100dB/sec (for high-crest), 15B/sec (for low-crest) for full-band 100dB/sec (for high-crest), 15B/sec (for low-crest) for bass band
+21	d_drc_limiter_release_md_hg	0x0303	100dB/sec (for high-crest), 15B/sec (for low-crest) for medium band 100dB/sec (for high-crest), 15B/sec (for low-crest) for high band
+22	d_drc_gain_track_fb_bs	0x0504	slow gain tracking for full-band

			speech gain tracking for bass band
+23	d_drc_gain_track_md_hg	0x0406	speech gain tracking for medium band very slow gain tracking for high band
+24 to +40	d_drc_low_pass_filter[0] d_drc_low_pass_filter[1] d_drc_low_pass_filter[2] d_drc_low_pass_filter[3] d_drc_low_pass_filter[4] d_drc_low_pass_filter[5] d_drc_low_pass_filter[6] d_drc_low_pass_filter[7] d_drc_low_pass_filter[8] d_drc_low_pass_filter[9] d_drc_low_pass_filter[10] d_drc_low_pass_filter[11] d_drc_low_pass_filter[12] d_drc_low_pass_filter[13] d_drc_low_pass_filter[14] d_drc_low_pass_filter[15] d_drc_low_pass_filter[16]	0xFF99 0xFF8D 0xFFC3 0x012D 0x049E 0x0A0F 0x104C 0x1551 0x173E 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000	low pass filter -6dB at 700Hz
+41 to +57	d_drc_mid_band_filter[0] d_drc_mid_band_filter[1] d_drc_mid_band_filter[2] d_drc_mid_band_filter[3] d_drc_mid_band_filter[4] d_drc_mid_band_filter[5] d_drc_mid_band_filter[6] d_drc_mid_band_filter[7] d_drc_mid_band_filter[8] d_drc_mid_band_filter[9] d_drc_mid_band_filter[10] d_drc_mid_band_filter[11] d_drc_mid_band_filter[12] d_drc_mid_band_filter[13] d_drc_mid_band_filter[14] d_drc_mid_band_filter[15] d_drc_mid_band_filter[16]	0x0086 0x016D 0x01B5 0xFCED 0xF285 0xEDD3 0xFB9C 0x1562 0x22AF 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000	band pass filter -6dB at 1600Hz

Table 2-6 The DRC 1.0 Parameters Recommended Values for Configuration 1

&	Name	Values	Reference
+0	d_drc_speech_mode_samp_f	0x0101	DRC enabled, sample frequency is 8kHz
+1	d_drc_num_subbands	0x0001	full-band processing
+2	d_drc_frame_size	0x00A0	160 samples frame size
+3	d_drc_expansion_knee_fb_bs	0x222C	34dB (50 in sample unit) for full-band 34dB (50 in sample unit) for bass band
+4	d_drc_expansion_knee_md_hg	0x2822	34dB (50 in sample unit) for medium band 34dB (50 in sample unit) for high band
+5	d_drc_expansion_ratio_fb_bs	0x0A0A	2.5:1 expansion ratio for full-band 2.5:1 expansion ratio for bass band
+6	d_drc_expansion_ratio_md_hg	0x0A0A	2.5:1 expansion ratio for medium band 2.5:1 expansion ratio for high band
+7	d_drc_max_amplification_fb_bs	0x0606	6dB maximum amplification for full-band 6dB maximum amplification for bass band
+8	d_drc_max_amplification_md_hg	0x0606	6dB maximum amplification for full-band 6dB maximum amplification for bass band
+9	d_drc_compression_knee_fb_bs	0x5440	84dB (15849 in sample unit) for full-band 84dB (15849 in sample unit) for bass band
+10	d_drc_compression_knee_md_hg	0x4A54	84dB (15849 in sample unit) for medium band 84dB (15849 in sample unit) for high band
+11	d_drc_compression_ratio_fb_bs	0x0808	1:2 compression ratio for full-band 1:2 compression ratio for bass band
+12	d_drc_compression_ratio_md_hg	0x0808	1:2 compression ratio for medium band 1:2 compression ratio for high band
+13	d_drc_energy_limiting_th_fb_bs	0x5440	84dB (15849 in sample unit) for full-band 84dB (15849 in sample unit) for full-band
+14	d_drc_energy_limiting_th_md_hg	0x4A54	84dB (15849 in sample unit) for medium band 84dB (15849 in sample unit) for high band
+15	d_drc_limiter_threshold_fb	0x7E9B	31130 (in sample unit) for full-band limiter threshold
+16	d_drc_limiter_threshold_bs	0x7E9B	31130 (in sample unit) for bass band limiter threshold
+17	d_drc_limiter_threshold_md	0x7E9B	31130 (in sample unit) for medium band limiter threshold
+18	d_drc_limiter_threshold_hg	0x7E9B	31130 (in sample unit) for high band limiter threshold
+19	d_drc_limiter_hangover_spect_preserve	0x03FF	3 frames for limiter hangover spectral preservation equals to 1.0
+20	d_drc_limiter_release_fb_bs	0x0303	50dB/sec (for high-crest), 10dB/sec (for low-crest) for full-band 50dB/sec (for high-crest), 10dB/sec (for low-crest) for bass band
+21	d_drc_limiter_release_md_hg	0x0303	50dB/sec (for high-crest), 10dB/sec (for low-crest) for medium band 50dB/sec (for high-crest), 10dB/sec (for low-crest) for high band
+22	d_drc_gain_track_fb_bs	0x0202	Instantaneous gain tracking for full-band Instantaneous gain tracking for bass band

+23	d_drc_gain_track_md_hg	0x0202	Instantaneous gain tracking for medium band Instantaneous gain tracking for high band
+24 to +40	d_drc_low_pass_filter[0] d_drc_low_pass_filter[1] d_drc_low_pass_filter[2] d_drc_low_pass_filter[3] d_drc_low_pass_filter[4] d_drc_low_pass_filter[5] d_drc_low_pass_filter[6] d_drc_low_pass_filter[7] d_drc_low_pass_filter[8] d_drc_low_pass_filter[9] d_drc_low_pass_filter[10] d_drc_low_pass_filter[11] d_drc_low_pass_filter[12] d_drc_low_pass_filter[13] d_drc_low_pass_filter[14] d_drc_low_pass_filter[15] d_drc_low_pass_filter[16]	0xFF99 0xFF8D 0xFFC3 0x012D 0x049E 0x0A0F 0x104C 0x1551 0x173E 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000	low pass filter -6dB at 700Hz
+41 to +57	d_drc_mid_band_filter[0] d_drc_mid_band_filter[1] d_drc_mid_band_filter[2] d_drc_mid_band_filter[3] d_drc_mid_band_filter[4] d_drc_mid_band_filter[5] d_drc_mid_band_filter[6] d_drc_mid_band_filter[7] d_drc_mid_band_filter[8] d_drc_mid_band_filter[9] d_drc_mid_band_filter[10] d_drc_mid_band_filter[11] d_drc_mid_band_filter[12] d_drc_mid_band_filter[13] d_drc_mid_band_filter[14] d_drc_mid_band_filter[15] d_drc_mid_band_filter[16]	0x0086 0x016D 0x01B5 0xFCED 0xF285 0xEDD3 0xFB9C 0x1562 0x22AF 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000	band pass filter -6dB at 1600Hz

Table 2-7 The DRC 1.0 Parameters Recommended Values for Configuration 2

&	Name	Values	Reference
+0	d_drc_speech_mode_samp_f	0x0101	DRC enabled, sample frequency is 8kHz
+1	d_drc_num_subbands	0x0003	multi band processing
+2	d_drc_frame_size	0x00A0	160 samples frame size
+3	d_drc_expansion_knee_fb_bs	0x222C	34dB (50 in sample unit) for full-band 44dB (158 in sample unit) for bass band
+4	d_drc_expansion_knee_md_hg	0x2822	40dB (100 in sample unit) for medium band 34dB (50 in sample unit) for high band
+5	d_drc_expansion_ratio_fb_bs	0x0A0A	2.5:1 expansion ratio for full-band 2.5:1 expansion ratio for bass band
+6	d_drc_expansion_ratio_md_hg	0x0A0A	2.5:1 expansion ratio for medium band 2.5:1 expansion ratio for high band
+7	d_drc_max_amplification_fb_bs	0x0F06	12dB maximum amplification for full-band 6dB maximum amplification for bass band
+8	d_drc_max_amplification_md_hg	0x0F0F	12dB maximum amplification for medium band 12dB maximum amplification for high band
+9	d_drc_compression_knee_fb_bs	0x5440	84dB (15849 in sample unit) for full-band 64dB (1584 in sample unit) for bass band
+10	d_drc_compression_knee_md_hg	0x4A54	74dB (5011 in sample unit) for medium band 84dB (15849 in sample unit) for high band
+11	d_drc_compression_ratio_fb_bs	0x0808	1:2 compression ratio for full-band 1:2 compression ratio for bass band
+12	d_drc_compression_ratio_md_hg	0x0808	1:2 compression ratio for medium band 1:2 compression ratio for high band
+13	d_drc_energy_limiting_th_fb_bs	0x5440	84dB (15849 in sample unit) for full-band 64dB (1584 in sample unit) for bass band
+14	d_drc_energy_limiting_th_md_hg	0x4A54	74dB (5011 in sample unit) for medium band 84dB (15849 in sample unit) for high band
+15	d_drc_limiter_threshold_fb	0x7E9B	31130 (in sample unit) for full-band limiter threshold
+16	d_drc_limiter_threshold_bs	0x7E9B	31130 (in sample unit) for bass band limiter threshold
+17	d_drc_limiter_threshold_md	0x7E9B	31130 (in sample unit) for medium band limiter threshold
+18	d_drc_limiter_threshold_hg	0x7E9B	31130 (in sample unit) for high band limiter threshold
+19	d_drc_limiter_hangover_spect_preserve	0x037F	3 frames for limiter hangover spectral preservation equals to 1.0
+20	d_drc_limiter_release_fb_bs	0x0202	50dB/sec (for high-crest), 10dB/sec (for low-crest) for full-band 50dB/sec (for high-crest), 10dB/sec (for low-crest) for bass band
+21	d_drc_limiter_release_md_hg	0x0202	50dB/sec (for high-crest), 10dB/sec (for low-crest) for medium band 100dB/sec (for high-crest), 15B/sec (for low-crest) for high band

+22	d_drc_gain_track_fb_bs	0x0202	slow gain tracking for full-band speech gain tracking for bass band
+23	d_drc_gain_track_md_hg	0x0202	medium gain tracking for medium band medium gain tracking for high band
+24 to +40	d_drc_low_pass_filter[0] d_drc_low_pass_filter[1] d_drc_low_pass_filter[2] d_drc_low_pass_filter[3] d_drc_low_pass_filter[4] d_drc_low_pass_filter[5] d_drc_low_pass_filter[6] d_drc_low_pass_filter[7] d_drc_low_pass_filter[8] d_drc_low_pass_filter[9] d_drc_low_pass_filter[10] d_drc_low_pass_filter[11] d_drc_low_pass_filter[12] d_drc_low_pass_filter[13] d_drc_low_pass_filter[14] d_drc_low_pass_filter[15] d_drc_low_pass_filter[16]	0xFF99 0xFF8D 0xFFC3 0x012D 0x049E 0x0A0F 0x104C 0x1551 0x173E 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000	low pass filter -6dB at 700Hz
+41 to +57	d_drc_mid_band_filter[0] d_drc_mid_band_filter[1] d_drc_mid_band_filter[2] d_drc_mid_band_filter[3] d_drc_mid_band_filter[4] d_drc_mid_band_filter[5] d_drc_mid_band_filter[6] d_drc_mid_band_filter[7] d_drc_mid_band_filter[8] d_drc_mid_band_filter[9] d_drc_mid_band_filter[10] d_drc_mid_band_filter[11] d_drc_mid_band_filter[12] d_drc_mid_band_filter[13] d_drc_mid_band_filter[14] d_drc_mid_band_filter[15] d_drc_mid_band_filter[16]	0x0086 0x016D 0x01B5 0xFCED 0xF285 0xEDD3 0xFB9C 0x1562 0x22AF 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000	band pass filter -6dB at 1600Hz

Table 2-8 The DRC 1.0 Parameters Recommended Values for Configuration 3

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INSTRUMENTS

&	Name	Values	Reference
+0	d_drc_speech_mode_samp_f	0x0101	DRC enabled, sample frequency is 8kHz
+1	d_drc_num_subbands	0x0001	multi band processing
+2	d_drc_frame_size	0x00A0	160 samples frame size
+3	d_drc_expansion_knee_fb_bs	0x2222	34dB (50 in sample unit) for full-band 44dB (158 in sample unit) for bass band
+4	d_drc_expansion_knee_md_hg	0x2222	40dB (100 in sample unit) for medium band 34dB (50 in sample unit) for high band
+5	d_drc_expansion_ratio_fb_bs	0x1010	4:1 expansion ratio for full-band 2.5:1 expansion ratio for bass band
+6	d_drc_expansion_ratio_md_hg	0x1010	2.5:1 expansion ratio for medium band 4:1 expansion ratio for high band
+7	d_drc_max_amplification_fb_bs	0x1212	12dB maximum amplification for full-band 6dB maximum amplification for bass band
+8	d_drc_max_amplification_md_hg	0x1212	12dB maximum amplification for full-band 12dB maximum amplification for bass band
+9	d_drc_compression_knee_fb_bs	0x5454	84dB (15849 in sample unit) for full-band 64dB (1584 in sample unit) for bass band
+10	d_drc_compression_knee_md_hg	0x5454	74dB (5011 in sample unit) for medium band 84dB (15849 in sample unit) for high band
+11	d_drc_compression_ratio_fb_bs	0x1414	1:5 compression ratio for full-band 1:2 compression ratio for bass band
+12	d_drc_compression_ratio_md_hg	0x1414	1:2 compression ratio for medium band 1:5 compression ratio for high band
+13	d_drc_energy_limiting_th_fb_bs	0x5454	84dB (15849 in sample unit) for full-band 64dB (1584 in sample unit) for bass band
+14	d_drc_energy_limiting_th_md_hg	0x5454	74dB (5011 in sample unit) for medium band 84dB (15849 in sample unit) for high band
+15	d_drc_limiter_threshold_fb	0x7E9B	31130 (in sample unit) for full-band limiter threshold
+16	d_drc_limiter_threshold_bs	0x7E9B	31130 (in sample unit) for bass band limiter threshold
+17	d_drc_limiter_threshold_md	0x7E9B	31130 (in sample unit) for medium band limiter threshold
+18	d_drc_limiter_threshold_hg	0x7E9B	31130 (in sample unit) for high band limiter threshold
+19	d_drc_limiter_hangover_spect_preserve	0x03FF	3 frames for limiter hangover spectral preservation equals to 1.0
+20	d_drc_limiter_release_fb_bs	0x0202	100dB/sec (for high-crest), 15B/sec (for low-crest) for full-band 100dB/sec (for high-crest), 15B/sec (for low-crest) for bass band
+21	d_drc_limiter_release_md_hg	0x0202	100dB/sec (for high-crest), 15B/sec (for low-crest) for medium band 200dB/sec (for high-crest), 50dB/sec (for

			low-crest) for high band
+22	d_drc_gain_track_fb_bs	0x0202	medium gain tracking for full-band very slow gain tracking for bass band
+23	d_drc_gain_track_md_hg	0x0202	medium gain tracking for medium band fast gain tracking for high band
+24 to +40	d_drc_low_pass_filter[0] d_drc_low_pass_filter[1] d_drc_low_pass_filter[2] d_drc_low_pass_filter[3] d_drc_low_pass_filter[4] d_drc_low_pass_filter[5] d_drc_low_pass_filter[6] d_drc_low_pass_filter[7] d_drc_low_pass_filter[8] d_drc_low_pass_filter[9] d_drc_low_pass_filter[10] d_drc_low_pass_filter[11] d_drc_low_pass_filter[12] d_drc_low_pass_filter[13] d_drc_low_pass_filter[14] d_drc_low_pass_filter[15] d_drc_low_pass_filter[16]	0xFF99 0xFF8D 0xFFC3 0x012D 0x049E 0x0A0F 0x104C 0x1551 0x173E 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000	low pass filter -6dB at 700Hz
+41 to +57	d_drc_mid_band_filter[0] d_drc_mid_band_filter[1] d_drc_mid_band_filter[2] d_drc_mid_band_filter[3] d_drc_mid_band_filter[4] d_drc_mid_band_filter[5] d_drc_mid_band_filter[6] d_drc_mid_band_filter[7] d_drc_mid_band_filter[8] d_drc_mid_band_filter[9] d_drc_mid_band_filter[10] d_drc_mid_band_filter[11] d_drc_mid_band_filter[12] d_drc_mid_band_filter[13] d_drc_mid_band_filter[14] d_drc_mid_band_filter[15] d_drc_mid_band_filter[16]	0x0086 0x016D 0x01B5 0xFCED 0xF285 0xEDD3 0xFB9C 0x1562 0x22AF 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000	band pass filter -6dB at 1600Hz

Table 2-9 The DRC 1.0 Parameters Recommended Values for Configuration 4

&	Name	Values	Reference
+0	d_drc_speech_mode_samp_f	0x0101	DRC enabled, sample frequency is 8kHz
+1	d_drc_num_subbands	0x0003	full-band processing
+2	d_drc_frame_size	0x00A0	160 samples frame size
+3	d_drc_expansion_knee_fb_bs	0x2222	34dB (50 in sample unit) for full-band 44dB (158 in sample unit) for bass band
+4	d_drc_expansion_knee_md_hg	0x2222	40dB (100 in sample unit) for medium band 34dB (50 in sample unit) for high band
+5	d_drc_expansion_ratio_fb_bs	0x1006	4:1 expansion ratio for full-band 2.5:1 expansion ratio for bass band
+6	d_drc_expansion_ratio_md_hg	0x1010	2.5:1 expansion ratio for medium band 4:1 expansion ratio for high band
+7	d_drc_max_amplification_fb_bs	0x1206	18dB maximum amplification for full-band 6dB maximum amplification for bass band
+8	d_drc_max_amplification_md_hg	0x1212	12dB maximum amplification for full-band 18dB maximum amplification for bass band
+9	d_drc_compression_knee_fb_bs	0x5454	84dB (15849 in sample unit) for full-band 64dB (1584 in sample unit) for bass band
+10	d_drc_compression_knee_md_hg	0x5454	74dB (5011 in sample unit) for medium band 84dB (15849 in sample unit) for high band
+11	d_drc_compression_ratio_fb_bs	0x1406	1:5 compression ratio for full-band 1:2 compression ratio for bass band
+12	d_drc_compression_ratio_md_hg	0x1414	1:2 compression ratio for medium band 1:5 compression ratio for high band
+13	d_drc_energy_limiting_th_fb_bs	0x5454	84dB (15849 in sample unit) for full-band 64dB (1584 in sample unit) for bass band
+14	d_drc_energy_limiting_th_md_hg	0x5454	74dB (5011 in sample unit) for medium band 84dB (15849 in sample unit) for high band
+15	d_drc_limiter_threshold_fb	0x7E9B	31130 (in sample unit) for full-band limiter threshold
+16	d_drc_limiter_threshold_bs	0x7E9B	31130 (in sample unit) for bass band limiter threshold
+17	d_drc_limiter_threshold_md	0x7E9B	31130 (in sample unit) for medium band limiter threshold
+18	d_drc_limiter_threshold_hg	0x7E9B	31130 (in sample unit) for high band limiter threshold
+19	d_drc_limiter_hangover_spect_preserve	0x037F	3 frames for limiter hangover spectral preservation equals to 1.0
+20	d_drc_limiter_release_fb_bs	0x0202	50dB/sec (for high-crest), 10dB/sec (for low-crest) for full-band 50dB/sec (for high-crest), 10dB/sec (for low-crest) for bass band
+21	d_drc_limiter_release_md_hg	0x0202	50dB/sec (for high-crest), 10dB/sec (for low-crest) for medium band 50dB/sec (for high-crest), 10dB/sec (for low-crest) for high band

+22	d_drc_gain_track_fb_bs	0x0202	medium gain tracking for full-band very slow gain tracking for bass band
+23	d_drc_gain_track_md_hg	0x0202	medium gain tracking for medium band fast gain tracking for high band
+24 to +40	d_drc_low_pass_filter[0] d_drc_low_pass_filter[1] d_drc_low_pass_filter[2] d_drc_low_pass_filter[3] d_drc_low_pass_filter[4] d_drc_low_pass_filter[5] d_drc_low_pass_filter[6] d_drc_low_pass_filter[7] d_drc_low_pass_filter[8] d_drc_low_pass_filter[9] d_drc_low_pass_filter[10] d_drc_low_pass_filter[11] d_drc_low_pass_filter[12] d_drc_low_pass_filter[13] d_drc_low_pass_filter[14] d_drc_low_pass_filter[15] d_drc_low_pass_filter[16]	0xFF99 0xFF8D 0xFFC3 0x012D 0x049E 0x0A0F 0x104C 0x1551 0x173E 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000	low pass filter -6dB at 700Hz
+41 to +57	d_drc_mid_band_filter[0] d_drc_mid_band_filter[1] d_drc_mid_band_filter[2] d_drc_mid_band_filter[3] d_drc_mid_band_filter[4] d_drc_mid_band_filter[5] d_drc_mid_band_filter[6] d_drc_mid_band_filter[7] d_drc_mid_band_filter[8] d_drc_mid_band_filter[9] d_drc_mid_band_filter[10] d_drc_mid_band_filter[11] d_drc_mid_band_filter[12] d_drc_mid_band_filter[13] d_drc_mid_band_filter[14] d_drc_mid_band_filter[15] d_drc_mid_band_filter[16]	0x0086 0x016D 0x01B5 0xFCED 0xF285 0xEDD3 0xFB9C 0x1562 0x22AF 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000 0x0000	band pass filter -6dB at 1600Hz

Table 2-10 The DRC 1.0 Parameters Recommended Values for Configuration 5

B.   Appendix: DRC 1.0 Parameters – Customization of API

The parameters below could be customized to better fit in terminal use case.

- **d_drc_gain_track_xx**

d_drc_gain_track_xx must be equal to 1 of the 6 proposed indexes. Here are the 6 possible indexes and their associated meaning (Table 2-11):

	Peak time constants		Level time constants		Gain smoothing high crest		Gain smoothing low crest	
	attack	release	attack	release	attack	release	attack	release
1	0.005 ms	0.005 ms	0.400 ms	0.500 ms	0.005 ms	0.005 ms	0.400 ms	0.500 ms
2	0.005 ms	0.015 ms	0.400 ms	0.750 ms	0.005 ms	0.015 ms	0.400 ms	0.750 ms
3	0.005 ms	0.050 ms	0.400 ms	1.500 ms	0.005 ms	0.050 ms	0.400 ms	1.500 ms
4	0.005 ms	0.030 ms	0.200 ms	5.000 ms	0.005 ms	0.030 ms	0.200 ms	5.000 ms
5	0.005 ms	0.200 ms	0.150 ms	4.000 ms	0.005 ms	0.200 ms	0.150 ms	4.000 ms
6	0.005 ms	0.100 ms	0.200 ms	2.500 ms	0.005 ms	0.100 ms	0.200 ms	2.500 ms

Table 2-11 The DRC 1.0 Attack & Release Times - Customization

- **d_drc_spect_preserve**

When the DRC 1.0 is used in multi-band, the spectral preservation averages the different sub-band gains with a weight that corresponds to d_drc_spect_preserve.

d_drc_spect_preserve = 0 → no spectral preservation
d_drc_spect_preserve = 1 → full spectral preservation

Example:

d_drc_spect_preserve = 0x19 which corresponds to $round\left\{ \dfrac{25}{2^8} \right\}$ =0.1 gives a low spectral preservation.

In the DRC 1.0, the final gain in each sub-band is calculated as follow:

$$G_{(i)} = G_{s(i)} * (1 - S_p) + G_{fb} * S_p$$

Where $G_{(i)}$ corresponds to the final gain of the ith sub-band, $G_{s(i)}$ is the independent gain of the ith sub-band, S_p corresponds to the spectral preservation coefficient (**d_drc_spect_preserve**) and G_{fb} to the gain computed for the full-band.