

International Telecommunication Union

**ITU-T**

**Technical Paper**

TELECOMMUNICATION  
STANDARDIZATION SECTOR  
OF ITU

(11 May 2012)

SERIES G: TRANSMISSION SYSTEMS AND MEDIA,  
DIGITAL SYSTEMS AND NETWORKS  
Digital sections and digital line system – Access networks

---

**GSTP-GSAD**

**Generic Sound Activity Detector**

ITU-T

## Summary

Recommendation ITU-T G.720.1 describes an independent front-end processing module implementing a generic sound activity detector (GSAD) that can be applied prior to signal processing applications and can operate on narrow-band or wideband audio input using a 10 ms frame length (without lookahead), such as used by speech or audio codecs. The primary function of the GSAD is to indicate the input frame activity for performing voice activity detection (VAD). For an active frame, it further indicates if the input frame is speech or music (speech/music discrimination), and for an inactive frame it indicates whether the frame is a silence frame or an audible noise frame (silence detection). The GSAD can also operate when only the primary function of indicating the input frame activity is used. In order to apply GSAD in specific cases, an adaptation layer may be required.

This technical paper compiles technical information, some of which has only been available previously in Temporary Documents, on ITU-T Recommendation G.720.1 "Generic Sound Activity Detector (GSAD)". The paper includes an overview description of the algorithm and its application, the test methodology used during the development, and performance assessment results of the algorithm alone and in conjunction with codecs.

## Keywords

Sound activity detection, voice activity detection

## Change Log

This document contains Version 1 of the ITU-T Technical Paper on "*Generic Sound Activity Detector*" approved at the ITU-T Study Group 16 meeting held in Geneva, 30 April – 11 May 2012 (TD 523/Plen).

**Editor:** Paul Coverdale  
Huawei Technologies  
China

Tel: +1 613 820 6643  
Fax: +1 613 820 5856  
Email: [coverdale@sympatico.ca](mailto:coverdale@sympatico.ca)

# CONTENTS

Page

<b>1</b>	<b>SCOPE .....</b>	<b>1</b>
<b>2</b>	<b>REFERENCES.....</b>	<b>1</b>
<b>3</b>	<b>ABBREVIATIONS AND ACRONYMS .....</b>	<b>1</b>
<b>4</b>	<b>AREA OF APPLICATION .....</b>	<b>2</b>
<b>5</b>	<b>ALGORITHM OVERVIEW .....</b>	<b>3</b>
<b>6</b>	<b>COMPLEXITY AND MEMORY.....</b>	<b>3</b>
<b>7</b>	<b>ALGORITHMIC DELAY.....</b>	<b>3</b>
<b>8</b>	<b>SELECTION PHASE TESTS.....</b>	<b>4</b>
8.1	OBJECTIVE METRICS.....	4
8.1.1	<i>Perceptually weighted misclassification counting (PWMC)</i> .....	4
8.1.2	<i>Other metrics</i> .....	5
8.2	ORGANIZATION OF THE TESTS .....	5
8.3	SUMMARY OF THE TEST RESULTS .....	6
<b>9</b>	<b>CHARACTERISATION OF GSAD WITH SPECIFIC CODECS .....</b>	<b>12</b>
9.1	G.729.1.....	12
9.1.1	<i>Description of the testing exercise</i> .....	12
9.1.2	<i>Results</i> .....	13
9.1.3	<i>Conclusions</i> .....	15
9.2	G.729 ANNEX B.....	18
9.2.1	<i>Description of the testing exercise</i> .....	18
9.2.2	<i>Results</i> .....	18
9.2.3	<i>Conclusions</i> .....	18
<b>APPENDIX A: GSAD SELECTION TEST DETAILS.....</b>		<b>21</b>
A.1	DETAILED SELECTION TEST RESULTS FROM FRANCE TELECOM .....	28
A.2	DETAILED SELECTION TEST RESULTS FROM HUAWEI TECHNOLOGIES .....	60

## List of Figures

### Page

FIGURE 1 - ARCHITECTURE OF GSAD IN CONJUNCTION WITH A CODEC .....	2
FIGURE 2 – EXPERIMENT 1, PWMC VERSUS SNR .....	9
FIGURE 3 – EXPERIMENT 1, DSAF VERSUS SNR .....	9
FIGURE 4 – EXPERIMENT 1, MISRTS2M VERSUS SNR .....	9
FIGURE 5 – EXPERIMENT 2, MISRTA2I VERSUS SNR .....	10
FIGURE 6 – EXPERIMENT 2, MISRTM2S VERSUS SNR .....	10
FIGURE 7 – EXPERIMENT 7, PWMC VERSUS SNR .....	10
FIGURE 8 – EXPERIMENT 7, DSAF VERSUS SNR .....	11
FIGURE 9 – SUBJECTIVE RESULTS FOR G.729.1 WITH G.720.1, NARROWBAND .....	17
FIGURE 10 – SUBJECTIVE RESULTS FOR G.729.1 WITH G.720.1, WIDEBAND .....	17
FIGURE 11 – SUBJECTIVE RESULTS FOR G.729B WITH G.720.1 .....	20

## List of Tables

	<b>Page</b>
TABLE 1 – COMPLEXITY OF THE GSAD.....	3
TABLE 2 – ORGANIZATION OF THE SELECTION PHASE OF PERFORMANCE ASSESSMENT TESTS .....	6
TABLE 3 – SUMMARY OF SELECTION TEST RESULTS (FT ORANGE).....	7
TABLE 4 – SUMMARY OF SELECTION TEST RESULTS (HUAWEI TECHNOLOGIES).....	8
TABLE 5 – LABORATORIES AND LANGUAGES FOR G.729.1 TESTS.....	12
TABLE 6 – EXPERIMENT 1A TEST RESULTS FOR G.729.1.....	13
TABLE 7 – EXPERIMENT 1B TEST RESULTS FOR G.729.1.....	14
TABLE 8 – REQUIREMENT AND OBJECTIVES COMPARISONS AT 12 KBIT/S FOR G.729.1.....	15
TABLE 9 – REQUIREMENT AND OBJECTIVES COMPARISONS AT 22 KBIT/S FOR G.729.1.....	16
TABLE 10 – REQUIREMENT AND OBJECTIVES COMPARISONS AT 32 KBIT/S FOR G.729.1.....	16
TABLE 11 – LABORATORIES AND LANGUAGES FOR G.729 ANNEX B TESTS.....	18
TABLE 12 – EXPERIMENT 1A TEST RESULTS FOR G.729 ANNEX B.....	19
TABLE 13 – COMPARISONS OF G.729 ANNEX B RESULTS.....	20
TABLE A.1 – FACTORS FOR EXPERIMENT 1 .....	21
TABLE A.2 – FACTORS FOR EXPERIMENT 2 .....	21
TABLE A.3 – FACTORS FOR EXPERIMENT 3 .....	22
TABLE A.4 – FACTORS FOR EXPERIMENT 4 .....	22
TABLE A.5 – FACTORS FOR EXPERIMENT 5 .....	23
TABLE A.6 – FACTORS FOR EXPERIMENT 6 .....	23
TABLE A.7 – FACTORS FOR EXPERIMENT 7 .....	24
TABLE A.8 – FACTORS FOR EXPERIMENT 8 .....	24
TABLE A.9 – FACTORS FOR EXPERIMENT 9 .....	25
TABLE A.10 – FACTORS FOR EXPERIMENT 10 .....	25
TABLE A.11 – FACTORS FOR EXPERIMENT 11 .....	26
TABLE A.12 – FACTORS FOR EXPERIMENT 12 .....	26
TABLE A.13 – FACTORS FOR EXPERIMENT 13 .....	27
TABLE A.14 – CONDITION SET 1.....	27
TABLE A.15 – CONDITION SET 2.....	27
TABLE A.16 – REQUIREMENTS RESULTS FOR EXPERIMENT 1 WIDEBAND SPEECH – FC-GSAD BANDWIDTH SAVING OPERATING POINT.....	28
TABLE A.17 – REQUIREMENTS RESULTS FOR EXPERIMENT 1 WIDEBAND SPEECH – FC-GSAD BALANCED OPERATING POINT .....	29
TABLE A.18 – REQUIREMENTS RESULTS FOR EXPERIMENT 1 WIDEBAND SPEECH – FC-GSAD QUALITY PREFERRED OPERATING POINT.....	30
TABLE A.19 – REQUIREMENTS RESULTS FOR EXPERIMENT 2 WIDEBAND MUSIC – FC-GSAD SPEECH PREFERRED (BANDWIDTH SAVING) OPERATING POINT .....	31
TABLE A.20 – REQUIREMENTS RESULTS FOR EXPERIMENT 2 WIDEBAND MUSIC – FC-GSAD BALANCED OPERATING POINT .....	31
TABLE A.21 – REQUIREMENTS RESULTS FOR EXPERIMENT 2 WIDEBAND MUSIC – FC-GSAD MUSIC PREFERRED (QUALITY PREFERRED) OPERATING POINT.....	32
TABLE A.22 – REQUIREMENTS RESULTS FOR EXPERIMENT 3 WIDEBAND INTERLACED MATERIAL – FC-GSAD	

BANDWIDTH SAVING OPERATING POINT .....	33
TABLE A.23 – REQUIREMENTS RESULTS FOR EXPERIMENT 3 WIDEBAND INTERLACED MATERIAL – FC-GSAD BALANCED OPERATING POINT .....	33
TABLE A.24 – REQUIREMENTS RESULTS FOR EXPERIMENT 3 WIDEBAND INTERLACED MATERIAL – FC-GSAD QUALITY PREFERRED OPERATING POINT .....	34
TABLE A.25 – REQUIREMENTS RESULTS FOR EXPERIMENT 4 NARROWBAND SPEECH – FC-GSAD BANDWIDTH SAVING OPERATING POINT .....	35
TABLE A.26 – REQUIREMENTS RESULTS FOR EXPERIMENT 4 NARROWBAND SPEECH – FC-GSAD BALANCED OPERATING POINT .....	36
TABLE A.27 – REQUIREMENTS RESULTS FOR EXPERIMENT 4 NARROWBAND SPEECH – FC-GSAD QUALITY PREFERRED OPERATING POINT .....	37
TABLE A.28 – REQUIREMENTS RESULTS FOR EXPERIMENT 5 NARROWBAND MUSIC – FC-GSAD SPEECH PREFERRED (BANDWIDTH SAVING) OPERATING POINT .....	38
TABLE A.29 – REQUIREMENTS RESULTS FOR EXPERIMENT 5 NARROWBAND MUSIC – FC-GSAD BALANCED OPERATING POINT .....	38
TABLE A.30 – REQUIREMENTS RESULTS FOR EXPERIMENT 5 NARROWBAND MUSIC – FC-GSAD MUSIC PREFERRED (QUALITY PREFERRED) OPERATING POINT .....	39
TABLE A.31 – REQUIREMENTS RESULTS FOR EXPERIMENT 6 NARROWBAND INTERLACED MATERIAL – FC-GSAD BANDWIDTH SAVING OPERATING POINT .....	40
TABLE A.32 – REQUIREMENTS RESULTS FOR EXPERIMENT 6 NARROWBAND INTERLACED MATERIAL – FC-GSAD BALANCED OPERATING POINT .....	40
TABLE A.33 – REQUIREMENTS RESULTS FOR EXPERIMENT 6 NARROWBAND INTERLACED MATERIAL – FC-GSAD QUALITY PREFERRED OPERATING POINT .....	41
TABLE A.34 – REQUIREMENTS RESULTS FOR EXPERIMENT 7 WIDEBAND SPEECH – LC-VAD BANDWIDTH SAVING OPERATING POINT .....	42
TABLE A.35 – REQUIREMENTS RESULTS FOR EXPERIMENT 7 WIDEBAND SPEECH – LC-VAD BALANCED OPERATING POINT .....	43
TABLE A.36 – REQUIREMENTS RESULTS FOR EXPERIMENT 7 WIDEBAND SPEECH – LC-VAD QUALITY PREFERRED OPERATING POINT .....	44
TABLE A.37 – REQUIREMENTS RESULTS FOR EXPERIMENT 8 WIDEBAND MUSIC – LC-VAD SPEECH PREFERRED (BANDWIDTH SAVING) OPERATING POINT .....	45
TABLE A.38 – REQUIREMENTS RESULTS FOR EXPERIMENT 8 WIDEBAND MUSIC – LC-VAD BALANCED OPERATING POINT .....	45
TABLE A.39 – REQUIREMENTS RESULTS FOR EXPERIMENT 8 WIDEBAND MUSIC – LC-VAD MUSIC PREFERRED (QUALITY PREFERRED) OPERATING POINT .....	46
TABLE A.40 – REQUIREMENTS RESULTS FOR EXPERIMENT 9 WIDEBAND INTERLACED MATERIAL – LC-VAD BANDWIDTH SAVING OPERATING POINT .....	47
TABLE A.41 – REQUIREMENTS RESULTS FOR EXPERIMENT 9 WIDEBAND INTERLACED MATERIAL – LC-VAD BALANCED OPERATING POINT .....	47
TABLE A.42 – REQUIREMENTS RESULTS FOR EXPERIMENT 9 WIDEBAND INTERLACED MATERIAL – LC-VAD QUALITY PREFERRED OPERATING POINT .....	48
TABLE A.43 – REQUIREMENTS RESULTS FOR EXPERIMENT 10 NARROWBAND SPEECH – LC-VAD BANDWIDTH SAVING OPERATING POINT .....	49
TABLE A.44 – REQUIREMENTS RESULTS FOR EXPERIMENT 10 NARROWBAND SPEECH – LC-VAD BALANCED OPERATING POINT .....	50
TABLE A.45 – REQUIREMENTS RESULTS FOR EXPERIMENT 10 NARROWBAND SPEECH – LC-VAD QUALITY PREFERRED OPERATING POINT .....	51
TABLE A.46 – REQUIREMENTS RESULTS FOR EXPERIMENT 11 NARROWBAND MUSIC – LC-VAD SPEECH PREFERRED	

	<b>Page</b>
(BANDWIDTH SAVING) OPERATING POINT .....	52
TABLE A.47 – REQUIREMENTS RESULTS FOR EXPERIMENT 11 NARROWBAND MUSIC – LC-VAD BALANCED OPERATING POINT .....	52
TABLE A.48 – REQUIREMENTS RESULTS FOR EXPERIMENT 11 NARROWBAND MUSIC – LC-VAD MUSIC PREFERRED (QUALITY PREFERRED) OPERATING POINT.....	53
TABLE A.49 – REQUIREMENTS RESULTS FOR EXPERIMENT 12 NARROWBAND INTERLACED MATERIAL – LC-VAD BANDWIDTH SAVING OPERATING POINT .....	54
TABLE A.50 – REQUIREMENTS RESULTS FOR EXPERIMENT 12 NARROWBAND INTERLACED MATERIAL – LC-VAD BALANCED OPERATING POINT .....	54
TABLE A.51 – REQUIREMENTS RESULTS FOR EXPERIMENT 12 NARROWBAND INTERLACED MATERIAL – LC-VAD QUALITY PREFERRED OPERATING POINT .....	55
TABLE A.52 – REQUIREMENTS RESULTS FOR EXPERIMENT 13 .....	55
TABLE A.53 – OBJECTIVES RESULTS FOR EXPERIMENT 1.....	56
TABLE A.54 – OBJECTIVES RESULTS FOR EXPERIMENT 3.....	56
TABLE A.55 – OBJECTIVES RESULTS FOR EXPERIMENT 4.....	57
TABLE A.56 – OBJECTIVES RESULTS FOR EXPERIMENT 6.....	57
TABLE A.57 – OBJECTIVES RESULTS FOR EXPERIMENT 7.....	58
TABLE A.58 – OBJECTIVES RESULTS FOR EXPERIMENT 9.....	58
TABLE A.59 – OBJECTIVES RESULTS FOR EXPERIMENT 10.....	59
TABLE A.60 – OBJECTIVES RESULTS FOR EXPERIMENT 12.....	59
TABLE A.61 – REQUIREMENTS RESULTS FOR EXPERIMENT 1 WIDEBAND SPEECH – FC-GSAD BANDWIDTH SAVING OPERATING POINT .....	60
TABLE A.62 – REQUIREMENTS RESULTS FOR EXPERIMENT 1 WIDEBAND SPEECH – FC-GSAD BALANCED OPERATING POINT .....	61
TABLE A.63 – REQUIREMENTS RESULTS FOR EXPERIMENT 1 WIDEBAND SPEECH – FC-GSAD QUALITY PREFERRED OPERATING POINT.....	62
TABLE A.64 – REQUIREMENTS RESULTS FOR EXPERIMENT 2 WIDEBAND MUSIC – FC-GSAD SPEECH PREFERRED (BANDWIDTH SAVING) OPERATING POINT .....	63
TABLE A.65 – REQUIREMENTS RESULTS FOR EXPERIMENT 2 WIDEBAND MUSIC – FC-GSAD BALANCED OPERATING POINT .....	63
TABLE A.66 – REQUIREMENTS RESULTS FOR EXPERIMENT 2 WIDEBAND MUSIC – FC-GSAD MUSIC PREFERRED (QUALITY PREFERRED) OPERATING POINT.....	64
TABLE A.67 – REQUIREMENTS RESULTS FOR EXPERIMENT 3 WIDEBAND INTERLACED MATERIAL – FC-GSAD BANDWIDTH SAVING OPERATING POINT .....	65
TABLE A.68 – REQUIREMENTS RESULTS FOR EXPERIMENT 3 WIDEBAND INTERLACED MATERIAL – FC-GSAD BALANCED OPERATING POINT .....	65
TABLE A.69 – REQUIREMENTS RESULTS FOR EXPERIMENT 3 WIDEBAND INTERLACED MATERIAL – FC-GSAD QUALITY PREFERRED OPERATING POINT.....	66
TABLE A.70 – REQUIREMENTS RESULTS FOR EXPERIMENT 4 NARROWBAND SPEECH – FC-GSAD BANDWIDTH SAVING OPERATING POINT .....	67
TABLE A.71 – REQUIREMENTS RESULTS FOR EXPERIMENT 4 NARROWBAND SPEECH – FC-GSAD BALANCED OPERATING POINT .....	68
TABLE A.72 – REQUIREMENTS RESULTS FOR EXPERIMENT 4 NARROWBAND SPEECH – FC-GSAD QUALITY PREFERRED OPERATING POINT .....	69
TABLE A.73 – REQUIREMENTS RESULTS FOR EXPERIMENT 5 NARROWBAND MUSIC – FC-GSAD SPEECH PREFERRED (BANDWIDTH SAVING) OPERATING POINT .....	70

TABLE A.74 – REQUIREMENTS RESULTS FOR EXPERIMENT 5 NARROWBAND MUSIC – FC-GSAD BALANCED OPERATING POINT .....	70
TABLE A.75 – REQUIREMENTS RESULTS FOR EXPERIMENT 5 NARROWBAND MUSIC – FC-GSAD MUSIC PREFERRED (QUALITY PREFERRED) OPERATING POINT.....	71
TABLE A.76 – REQUIREMENTS RESULTS FOR EXPERIMENT 6 NARROWBAND INTERLACED MATERIAL – FC-GSAD BANDWIDTH SAVING OPERATING POINT.....	72
TABLE A.77 – REQUIREMENTS RESULTS FOR EXPERIMENT 6 NARROWBAND INTERLACED MATERIAL – FC-GSAD BALANCED OPERATING POINT .....	72
TABLE A.78 – REQUIREMENTS RESULTS FOR EXPERIMENT 6 NARROWBAND INTERLACED MATERIAL – FC-GSAD QUALITY PREFERRED OPERATING POINT .....	73
TABLE A.79 – REQUIREMENTS RESULTS FOR EXPERIMENT 7 WIDEBAND SPEECH – LC-VAD BANDWIDTH SAVING OPERATING POINT.....	74
TABLE A.80 – REQUIREMENTS RESULTS FOR EXPERIMENT 7 WIDEBAND SPEECH – LC-VAD BALANCED OPERATING POINT .....	75
TABLE A.81 – REQUIREMENTS RESULTS FOR EXPERIMENT 7 WIDEBAND SPEECH – LC-VAD QUALITY PREFERRED OPERATING POINT.....	76
TABLE A.82 – REQUIREMENTS RESULTS FOR EXPERIMENT 8 WIDEBAND MUSIC – LC-VAD SPEECH PREFERRED (BANDWIDTH SAVING) OPERATING POINT .....	77
TABLE A.83 – REQUIREMENTS RESULTS FOR EXPERIMENT 8 WIDEBAND MUSIC – LC-VAD BALANCED OPERATING POINT .....	77
TABLE A.84 – REQUIREMENTS RESULTS FOR EXPERIMENT 8 WIDEBAND MUSIC – LC-VAD MUSIC PREFERRED (QUALITY PREFERRED) OPERATING POINT.....	78
TABLE A.85 – REQUIREMENTS RESULTS FOR EXPERIMENT 9 WIDEBAND INTERLACED MATERIAL – LC-VAD BANDWIDTH SAVING OPERATING POINT.....	79
TABLE A.86 – REQUIREMENTS RESULTS FOR EXPERIMENT 9 WIDEBAND INTERLACED MATERIAL – LC-VAD BALANCED OPERATING POINT.....	79
TABLE A.87 – REQUIREMENTS RESULTS FOR EXPERIMENT 9 WIDEBAND INTERLACED MATERIAL – LC-VAD QUALITY PREFERRED OPERATING POINT.....	80
TABLE A.88 – REQUIREMENTS RESULTS FOR EXPERIMENT 10 NARROWBAND SPEECH – LC-VAD BANDWIDTH SAVING OPERATING POINT.....	81
TABLE A.89 – REQUIREMENTS RESULTS FOR EXPERIMENT 10 NARROWBAND SPEECH – LC-VAD BALANCED OPERATING POINT .....	82
TABLE A.90 – REQUIREMENTS RESULTS FOR EXPERIMENT 10 NARROWBAND SPEECH – LC-VAD QUALITY PREFERRED OPERATING POINT.....	83
TABLE A.91 – REQUIREMENTS RESULTS FOR EXPERIMENT 11 NARROWBAND MUSIC – LC-VAD SPEECH PREFERRED (BANDWIDTH SAVING) OPERATING POINT .....	84
TABLE A.92 – REQUIREMENTS RESULTS FOR EXPERIMENT 11 NARROWBAND MUSIC – LC-VAD BALANCED OPERATING POINT .....	84
TABLE A.93 – REQUIREMENTS RESULTS FOR EXPERIMENT 11 NARROWBAND MUSIC – LC-VAD MUSIC PREFERRED (QUALITY PREFERRED) OPERATING POINT.....	85
TABLE A.94 – REQUIREMENTS RESULTS FOR EXPERIMENT 12 NARROWBAND INTERLACED MATERIAL – LC-VAD BANDWIDTH SAVING OPERATING POINT.....	86
TABLE A.95 – REQUIREMENTS RESULTS FOR EXPERIMENT 12 NARROWBAND INTERLACED MATERIAL – LC-VAD BALANCED OPERATING POINT .....	86
TABLE A.96 – REQUIREMENTS RESULTS FOR EXPERIMENT 12 NARROWBAND INTERLACED MATERIAL – LC-VAD QUALITY PREFERRED OPERATING POINT .....	87
TABLE A.97 – REQUIREMENTS RESULTS FOR EXPERIMENT 13.....	87
TABLE A.98 – OBJECTIVES RESULTS FOR EXPERIMENT 1.....	88



TABLE A.99 – OBJECTIVES RESULTS FOR EXPERIMENT 3.....	88
TABLE A.100 – OBJECTIVES RESULTS FOR EXPERIMENT 4.....	89
TABLE A.101 – OBJECTIVES RESULTS FOR EXPERIMENT 6.....	89
TABLE A.102 – OBJECTIVES RESULTS FOR EXPERIMENT 7.....	90
TABLE A.103 – OBJECTIVES RESULTS FOR EXPERIMENT 9.....	90
TABLE A.104 – OBJECTIVES RESULTS FOR EXPERIMENT 10.....	91
TABLE A.105 – OBJECTIVES RESULTS FOR EXPERIMENT 12.....	91

# ITU-T Technical Paper GSTP-GSAD

## ITU-T G.720.1 "Generic sound activity detector (GSAD)"

### 1 Scope

This technical paper compiles technical information, some of which has only been available previously in Temporary Documents, on ITU-T Recommendation G.720.1 "Generic Sound Activity Detector (GSAD)". The paper includes an overview description of the algorithm and its application, the test methodology used during the development, and performance assessment results of the algorithm alone and in conjunction with codecs.

### 2 References

- [1] "Annex Q8A to Report of Q8/16 Rapp. Group Meeting (Geneva, 6-9 July 2009)", [TD 46R1 \(WP 3/16\)](#), July 2009
- [2] "Performance evaluation plan (V1.0) for GSAD selection phase", [TD 52 \(WP 3/16\)](#), July 2009
- [3] "Processing plan (V1.0) for GSAD selection phase", [TD 53 \(WP 3/16\)](#), July 2009
- [4] "Results of GSAD candidate selection tests", Huawei Technologies, [COM16– C.349R1–E](#), October 2009
- [5] "Results of GSAD candidate selection tests" FT Orange, [COM16–C.315–E](#), October 2009
- [6] "Summary of characterisation of G.729.1 DTX/CNG extension using G.720.1A", [TD 669 \(GEN/12\)](#), November 2011
- [7] "Summary of G.729B dependent layer for G.720.1A Characterisation", [AH-12-18R1](#), March 2012

### 3 Abbreviations and acronyms

BT	Better than
DSAF	Delta sound activity factor
MisRtA2I	Misclassification rate from active to inactive
MisRtM2S	Misclassification rate from music to speech
MisRtS2M	Misclassification rate from speech to music
MisRtSil	Misclassification rate between silence and other classes
NWT	Not worse than
OTP	Objective table for PWMC score
PoW	Poor-or-worse
PWMC	Perceptually Weighted Misclassification Counting
RTA2I	Requirement table for misclassification rate from active to inactive
RTD	Requirement table for DSAF
RTM2S	Requirement table for misclassification rate from music to speech
RTM2SI	Requirement table for misclassification rate from music to speech for music interlaced with speech test vector

RTP	Requirement table for PWMC score
RTS2M	Requirement table for misclassification rate from speech to music
RTS2MIt	Requirement table for misclassification rate from speech to music for music interlaced with speech test vector
SMD	Speech/Music discriminator
VAD	Voice activity detector

#### 4 Area of application

Rec. G.720.1 (GSAD) is an independent front-end processing module which can be applied prior to signal processing applications that operate on narrowband or wideband audio input at frame length of 10 ms or its multiple (without lookahead), such as speech or audio codecs. Its primary function is to indicate the input frame activity. For an active frame it further indicates if the input frame is speech or music, and for an inactive frame it indicates whether the frame is a silence frame or an audible noise frame. G.720.1 contains all the necessary pre-processing inside, so the input could be the original PCM signal after A/D converter or after A/D + re-sampling or A/D + re-sampling + filtering mask.

In practice, when used with a codec, a codec dependent layer is used in conjunction with G.720.1 as shown in Figure 1.

The codec dependent layer takes the signal type output from GSAD and provides specific control functions appropriate to the codec, such as selection of coding scheme (speech/music) and DTX/CNG control.

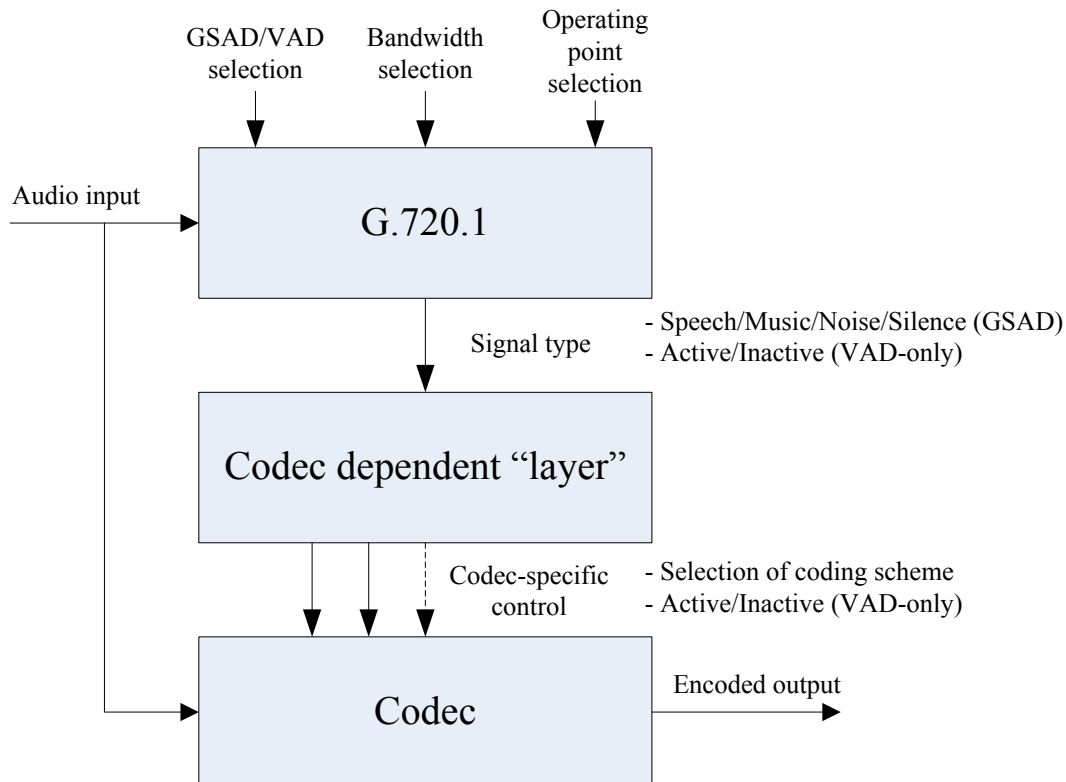


Figure 1 - Architecture of GSAD in conjunction with a codec

## 5 Algorithm overview

The primary function of the GSAD is to indicate the input frame activity for performing voice activity detection (VAD) robust to multimedia signals such as music. For an active frame, it further indicates if the input frame is speech or music (speech/music discrimination), and for an inactive frame it indicates whether the frame is a silence frame or an audible noise frame (silence detection). The GSAD can also operate when only the primary function of indicating the input frame activity is used.

An external control signal indicates to the GSAD algorithm which one of three different operating points to use, namely: *bandwidth-saving*, *balanced* and *quality-preferred* operating points. For the activity detection functionality, these operating points provide selectable balancing between bandwidth saving and audio quality, which can be utilized for high-performance DTX schemes that can balance between the end-users speech and audio subjective quality needs and the system and network traffic requirements.

The three different operating points also control the GSAD emphasis and balance between speech and music classification for the active frames, which can be utilized for fine-tuning of source-controlled audio compression systems.

The VAD module uses a dual-parameters classification scheme, where one parameter is a differential zero crossing rate measure and the other parameter is a modified segmental SNR measure. An initial VAD decision is made with a pair of inequalities, with factors that are adaptive to the long term SNR of the input signal. A final VAD decision is obtained by an adaptive hangover scheme. The Speech/Music Discrimination module calculates the variance of a spectral deviation measure and applies an adaptive threshold to make an initial decision between speech and music. Two spectral peakiness measures further modify that initial decision and a one-frame hangover is used to obtain the final speech/music discrimination decision. The Silence Detection module uses an energy threshold to discriminate between a silence frame and an audible noise frame.

## 6 Complexity and memory

Table 1 shows the GSAD complexity in WMOPS for its different modes and signal sampling frequencies. The RAM used for GSAD is 3284 bytes and the table ROM is 1674 bytes.

**Table 1 – Complexity of the GSAD**

Modes	Complexity (WMOPS)
GSAD_WB	2.935
GSAD_NB	1.897
VAD_WB	2.397
VAD_NB	1.475

## 7 Algorithmic delay

GSAD does not introduce lookahead, therefore the algorithmic delay is the frame length of 10ms with 0 added delay.

## 8 Selection phase tests

GSAD was formally evaluated during the Selection phase performance assessment tests. The test plan was derived from the ToR [1] and can be found in [2], with the associated processing plan in [3]. Due to the generality of GSAD in that the GSAD is a stand-alone generic sound activity detector intended for use prior to any applicable application, the test plan for its Selection phase test only used objective testing methodologies. The tests were conducted in a cross-check manner by two labs, Huawei and France Telecom Orange, and the test reports can be found in [4], [5] respectively. The tests evaluated GSAD for various signals including speech only, music only, interlaced speech-music and in various conditions including backgrounds of car, babble, office, interfering talkers, background music, SNRs of 30dB, 20dB, 10dB, input levels of high, nominal and low levels.

### 8.1 Objective metrics

The Objective metrics used in the Selection phase performance assessment test are described below.

#### 8.1.1 Perceptually weighted misclassification counting (PWMC)

PWMC is based on the evaluation of the perceptual degradation resulting from misclassification of a speech frame from active to inactive by GSAD. Since GSAD does not involve any further coding, it is assumed that the degradation can be measured by replacing the misclassified active frame signal with the original underlying background noise and measuring the perceptual difference between this modified signal and the unmodified signal.

PWMC is intended to be used as a relative measure, i.e. the PWMC score of the candidate GSAD algorithm will be compared to the PWMC score of a reference algorithm. PWMC is also intended to be used for speech signal i.e. no validation test for applying PWMC to other signals such as music was conducted.

The following is a more detailed description of the PWMC approach:

- 1) The true activity marks of the test speech material are obtained, using an energy threshold on the clean speech, before the noise addition.
- 2) The test speech material is prepared by adding background noises at different SNRs to the clean speech.
- 3) The test speech material is processed by the GSAD candidate and a reference VAD algorithm to generate the output activity marks of each frame for both the GSAD candidate and the reference VAD.
- 4) The output activity marks generated by both the candidate and reference in step 3 are compared to the true activity marks. For each misclassified active speech frame, the frame is replaced by the original underlying background noise resulting in two modified (degraded) versions of the test speech material one for the GSAD candidate and the other for the reference VAD, using fade out – fade in windows as described in Appendix 1.
- 5) The two degraded versions of the test speech material are compared to the non-degraded test speech material using an objective perceptual measure based on PESQ (P.862) [2], known as PWMC. The PWMC scores are then evaluated to specify the relative performance of the GSAD candidate against the reference VAD.

## 8.1.2 Other metrics

### MisRtA2I

For music test vectors and the music segments of the music-interlaced-with-speech test vectors, counts will be kept of the number of times the candidate or the reference algorithm's output marks are incorrectly designated as inactive (silence or noise) when the corresponding true mark is active (speech or music). The MisRtA2I of candidate or reference algorithm will be calculated according to the formula below:

$$\text{MisRtA2I} = \frac{\text{number of times candidate or reference mark is incorrectly designated from active to inactive}}{\text{real number of music frames}}$$

### MisRtS2M and MisRtM2S

For speech test vectors and the speech segments of the music-interlaced-with-speech test vectors, count will be kept of the number of times the candidate marks are incorrectly designated as music when the corresponding truth mark is speech. For music test vectors and the music segments of the music-interlaced-with-speech, another count will be kept of the number of times candidate marks are incorrectly designated as speech when the corresponding truth mark is music, as well as counts for the real number of speech and music frames. MisRtS2M and MisRtM2S of candidate algorithm will be calculated according to the formula below:

$$\text{MisRtS2M} = \frac{\text{number of times candidate or reference mark is incorrectly designated from speech to music}}{\text{real number of speech frames}}$$

$$\text{MisRtM2S} = \frac{\text{number of times candidate or reference mark is incorrectly designated from music to speech}}{\text{real number of music frames}}$$

### DSAF

For any test vectors, the DSAF of candidate or reference algorithms are calculated according to the formula below:

$$\text{DSAF} = \frac{\text{candidate SAF} - \text{true SAF}}{\text{true SAF}}$$

Where, the true SAF is calculated by dividing the count for real active frames by the total number of frames and the candidate SAF is calculated by dividing the count for frames designated as active by the candidate by the total number of frames.

### MisRtSil

MisRtSil of candidate algorithm is calculated by adding the count for frames incorrectly designated as silence by the candidate and the count for frames incorrectly designated as non-silence by the candidate.

## 8.2 Organization of the tests

The Selection phase performance assessment test was organized in 13 experiments as shown in Table 2. "FC-GSAD" means the full complexity configuration of GSAD executing all the VAD, SMD and SiD functions. "LC-VAD" means the low complexity configuration of GSAD executing only the VAD function.

Tables A.1 – A.13 in Appendix A show the key factors for each experiment. Requirements and/or Objectives for each experiment can be found in [1].

**Table 2 – Organization of the selection phase of performance assessment tests**

<b>Experiment</b>	<b>Name of Experiments</b>
1	FC-GSAD for WB clean and noisy speech
2	FC-GSAD for WB clean and noisy music
3	FC-GSAD for WB clean and noisy music interlaced with speech
4	FC-GSAD for NB clean and noisy speech
5	FC-GSAD for NB clean and noisy music
6	FC-GSAD for NB clean and noisy music interlaced with speech
7	LC-VAD for WB clean and noisy speech
8	LC-VAD for WB clean and noisy music
9	LC-VAD for WB clean and noisy music interlaced with speech
10	LC-VAD for NB clean and noisy speech
11	LC-VAD for NB clean and noisy music
12	LC-VAD for NB clean and noisy music interlaced with speech
13	FC-GSAD for silence detection

### **8.3 Summary of the test results**

Tables 3 and 4 show respectively the summary of the test results reported by the laboratory of France Telecom Orange and by the laboratory of Huawei. Detailed test results can be found in Appendix 1 of [4], [5].

Figures 2 to 8 show selected results from Experiments 1, 2 and 7 (based on results reported in [4]).

**Table 3 – Summary of selection test results (FT Orange)**

<b>Exp.</b>	<b>Aspect</b>	<b>Requirement</b>	<b>Objective</b>
1	Bandwidth Saving Operating Point	Passed 55 requirements out of 56.	
	Balanced Operating Point	Passed all 56 requirements.	
	Quality Preferred Operating Point	Passed 53 requirements out of 56.	Passed all objectives but two.
2	Bandwidth Saving Operating Point	Passed all requirements.	
	Balanced Operating Point	Passed all requirements but one.	
	Quality Preferred Operating Point	Passed all requirements but one.	
3	Bandwidth Saving Operating Point	Passed all requirements but one.	
	Balanced Operating Point	Passed all requirements.	
	Quality Preferred Operating Point	Passed all requirements but one.	Passed all objectives.
4	Bandwidth Saving Operating Point	Passed all requirements.	
	Balanced Operating Point	Passed all requirements.	
	Quality Preferred Operating Point	Passed all requirements but one.	Passed all objectives but two.
5	Bandwidth Saving Operating Point	Passed 11 requirements out of 14.	
	Balanced Operating Point	Passed 12 requirements out of 14.	
	Quality Preferred Operating Point	Passed all requirements but one.	
6	Bandwidth Saving Operating Point	Passed 37 requirements out of 42.	
	Balanced Operating Point	Passed 38 requirements out of 42.	
	Quality Preferred Operating Point	Passed all requirements but one.	Passed all objectives.
7	Bandwidth Saving Operating Point	Passed all requirements.	
	Balanced Operating Point	Passed all requirements.	
	Quality Preferred Operating Point	Passed all requirements but one.	Passed all objectives but two.
8	Bandwidth Saving Operating Point	Passed all requirements.	
	Balanced Operating Point	Passed all requirements.	
	Quality Preferred Operating Point	Passed all requirements.	
9	Bandwidth Saving Operating Point	Passed all requirements but one.	
	Balanced Operating Point	Passed all requirements.	
	Quality Preferred Operating Point	Passed all requirements.	Passed all objectives.
10	Bandwidth Saving Operating Point	Passed all requirements.	
	Balanced Operating Point	Passed all requirements.	
	Quality Preferred Operating Point	Passed all requirements but one.	Passed all objectives but two.
11	Bandwidth Saving Operating Point	Passed 4 requirements out of 7.	
	Balanced Operating Point	Passed 6 requirements out of 7.	
	Quality Preferred Operating Point	Passed all requirements.	
12	Bandwidth Saving Operating Point	Passed 16 requirements out of 21.	
	Balanced Operating Point	Passed 18 requirements out of 21.	
	Quality Preferred Operating Point	Passed all requirements.	Passed all objectives.
13	Bandwidth Saving Operating Point	Passed all requirements.	
	Balanced Operating Point	Passed all requirements.	
	Quality Preferred Operating Point	Passed all requirements.	



**Table 4 – Summary of selection test results (Huawei Technologies)**

<b>Exp.</b>	<b>Aspect</b>	<b>Requirement</b>	<b>Objective</b>
1	Bandwidth Saving Operating Point	Passed 55 requirements out of 56.	
	Balanced Operating Point	Passed all 56 requirements.	
	Quality Preferred Operating Point	Passed 54 requirements out of 56.	Passed all objectives but two.
2	Bandwidth Saving Operating Point	Passed all requirements.	
	Balanced Operating Point	Passed all requirements.	
	Quality Preferred Operating Point	Passed all requirements.	
3	Bandwidth Saving Operating Point	Passed all requirements but one.	
	Balanced Operating Point	Passed all requirements.	
	Quality Preferred Operating Point	Passed all requirements.	Passed all objectives.
4	Bandwidth Saving Operating Point	Passed all requirements.	
	Balanced Operating Point	Passed all requirements.	
	Quality Preferred Operating Point	Passed all requirements but one.	Passed all objectives but two.
5	Bandwidth Saving Operating Point	Passed all requirements.	
	Balanced Operating Point	Passed all requirements.	
	Quality Preferred Operating Point	Passed all requirements.	
6	Bandwidth Saving Operating Point	Passed all requirements.	
	Balanced Operating Point	Passed all requirements.	
	Quality Preferred Operating Point	Passed all requirements but one.	Passed all objectives but one.
7	Bandwidth Saving Operating Point	Passed all requirements.	
	Balanced Operating Point	Passed all requirements.	
	Quality Preferred Operating Point	Passed all requirements but one.	Passed all objectives but two.
8	Bandwidth Saving Operating Point	Passed all requirements.	
	Balanced Operating Point	Passed all requirements.	
	Quality Preferred Operating Point	Passed all requirements.	
9	Bandwidth Saving Operating Point	Passed all requirements.	
	Balanced Operating Point	Passed all requirements.	
	Quality Preferred Operating Point	Passed all requirements.	Passed all objectives but one.
10	Bandwidth Saving Operating Point	Passed all requirements.	
	Balanced Operating Point	Passed all requirements.	
	Quality Preferred Operating Point	Passed all requirements but one.	Passed all objectives but two.
11	Bandwidth Saving Operating Point	Passed all requirements.	
	Balanced Operating Point	Passed all requirements.	
	Quality Preferred Operating Point	Passed all requirements.	
12	Bandwidth Saving Operating Point	Passed all requirements.	
	Balanced Operating Point	Passed all requirements.	
	Quality Preferred Operating Point	Passed all requirements.	Passed all objectives but one.
13	Bandwidth Saving Operating Point	Passed all requirements.	
	Balanced Operating Point	Passed all requirements.	
	Quality Preferred Operating Point	Passed all requirements.	

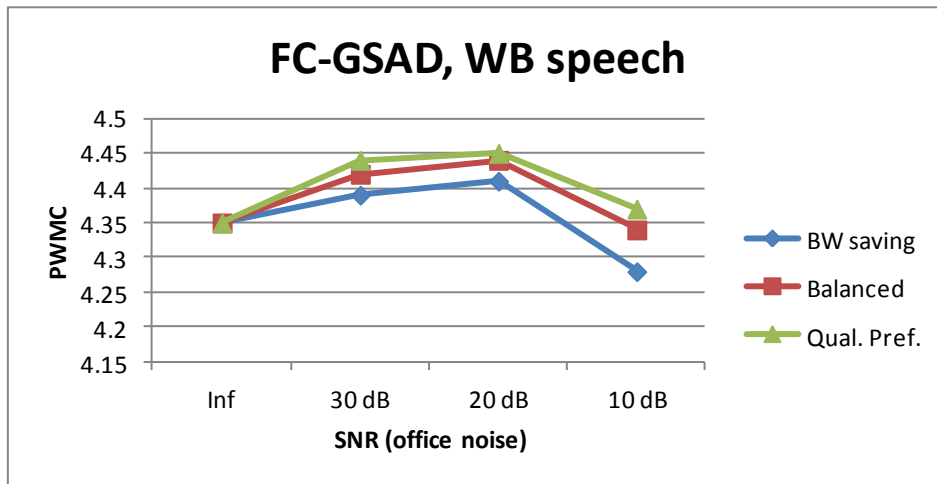


Figure 2 – Experiment 1, PWMC versus SNR

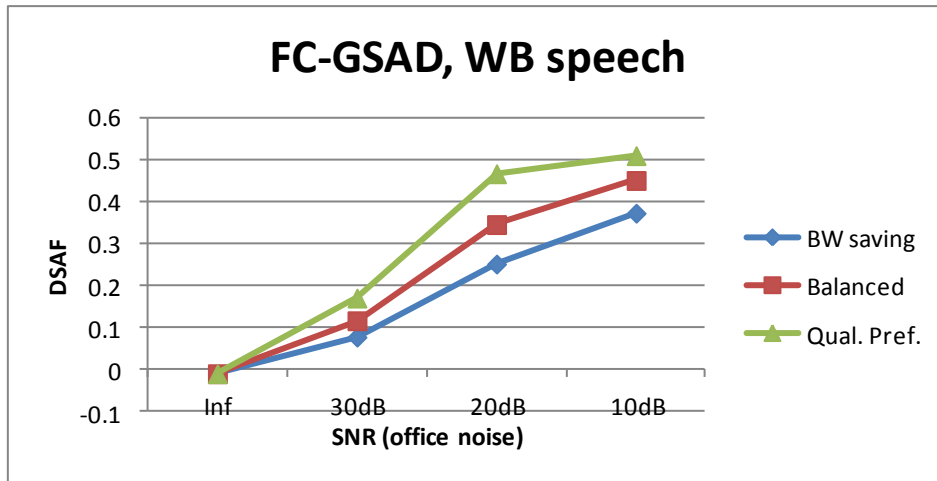


Figure 3 – Experiment 1, DSAF versus SNR

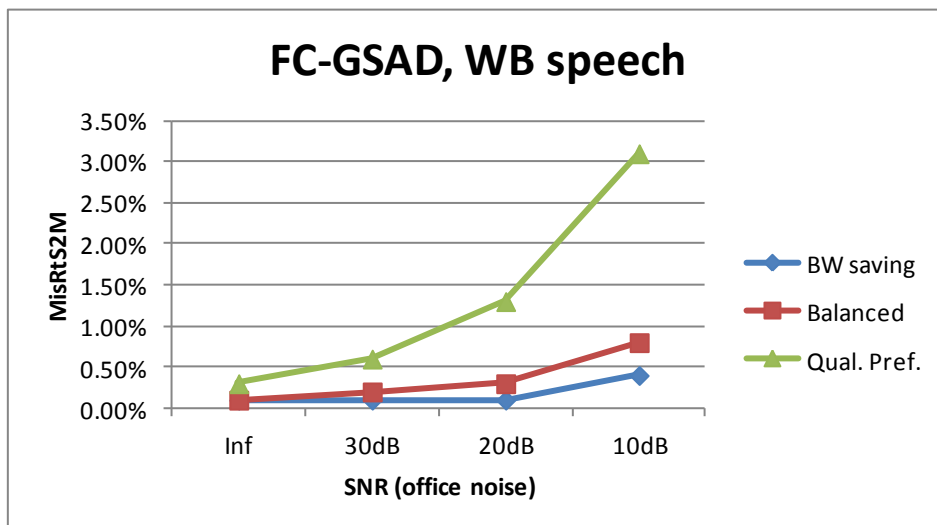


Figure 4 – Experiment 1, MisRtS2M versus SNR

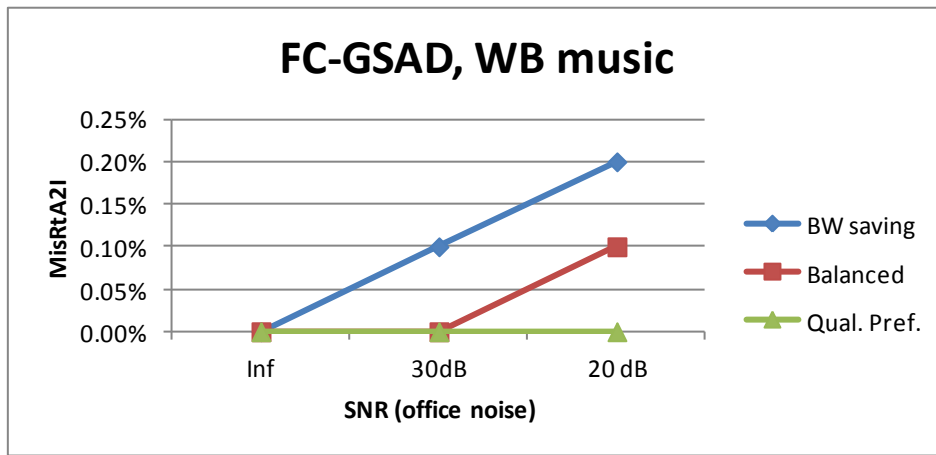


Figure 5 – Experiment 2, MisRtA2I versus SNR

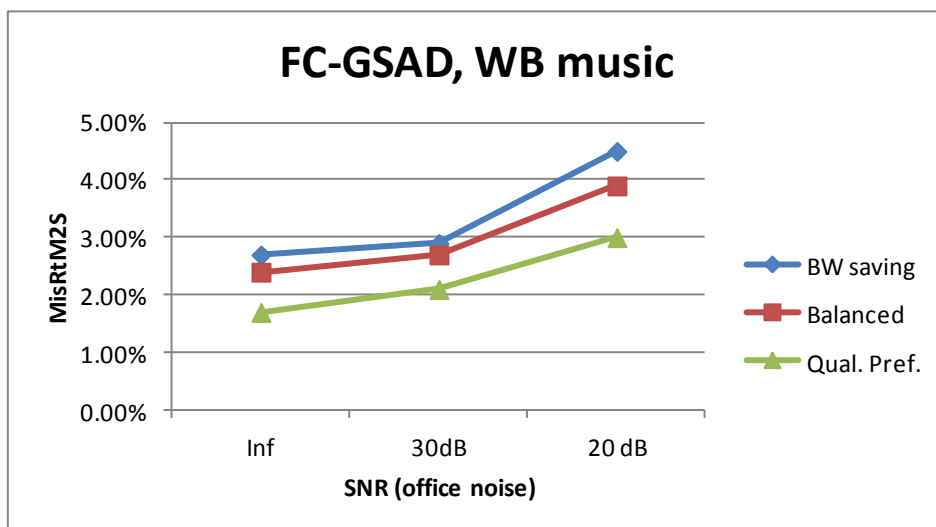


Figure 6 – Experiment 2, MisRtM2S versus SNR

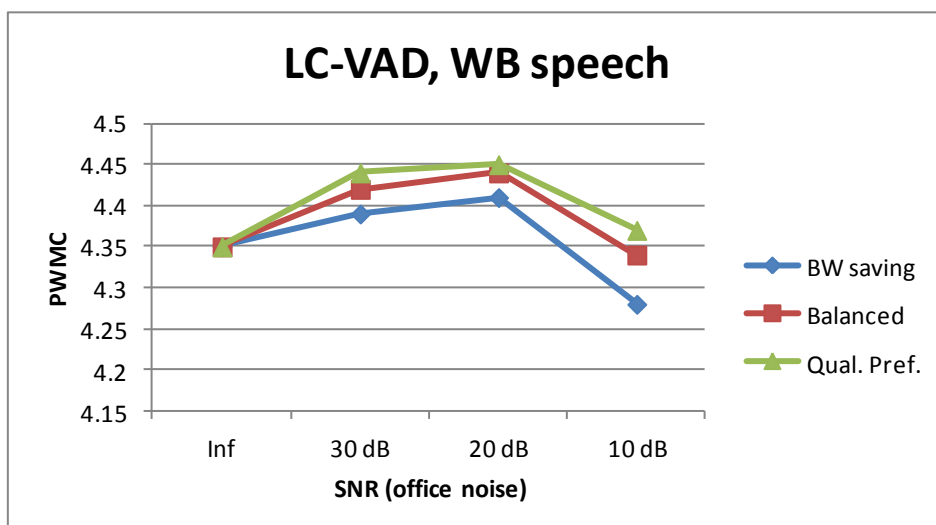
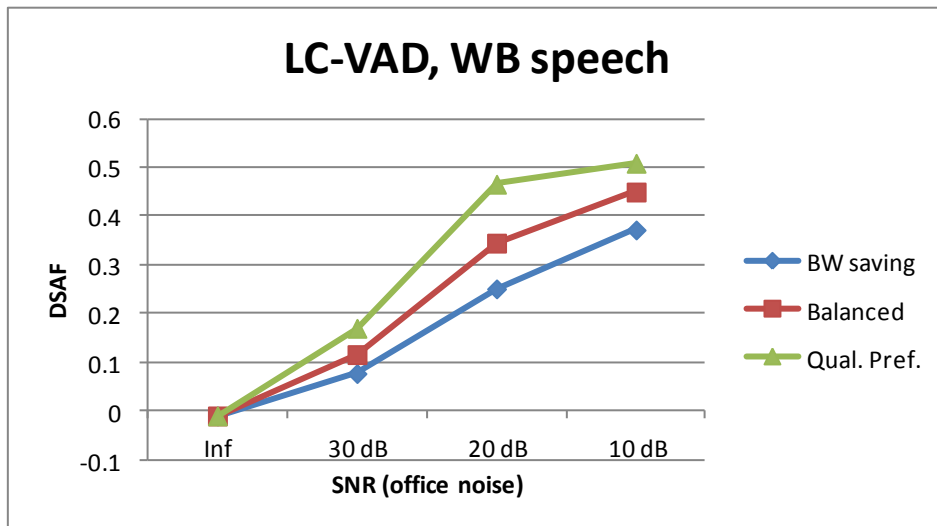


Figure 7 – Experiment 7, PWMC versus SNR



**Figure 8 – Experiment 7, DSAF versus SNR**

## 9 Characterisation of GSAD with specific codecs

The G.720.1 GSAD has recently been characterised for use as a VAD in conjunction with specific codecs, reported in [6] and [7].

### 9.1 G.729.1

#### 9.1.1 Description of the testing exercise

The formal quality assessment test plan for this characterization phase was organized in 2 subjective experiments based on the requirements described in the ToRs.

Experiment 1a tested the coder quality under narrow band noisy speech conditions and Experiment 1b tested the coder quality under wideband noisy speech conditions. Three types of noise were considered:

- office noise SNR=20dB;
- babble noise (128 voices) SNR=20dB;
- babble noise (40 voices) SNR = 30dB.

The three modes of G.720.1A were included in the testing exercise: (1) bandwidth saving, (2) balanced and (3) quality preferred.

All experiments used the modified DCR method with the five-point degradation scale.

- 5 - Degradation not perceived or even some improvement
- 4 - Degradation perceived but not annoying
- 3 - Degradation slightly annoying
- 2 - Degradation annoying
- 1 - Degradation very annoying

Experiments 1a and 1b were run in two different languages. The laboratories and languages are reported in Table 5.

**Table 5 – Laboratories and languages for G.729.1 tests**

<b>Experiment</b>	<b>Lab</b>	<b>Language</b>	<b>Lab designator</b>
1a	Huawei	Chinese	C
1a	France Telecom	French	F
1b	Huawei	Chinese	C
1b	France Telecom	French	F

## 9.1.2 Results

All results are reported in Table 6 for exp1a and in Table 7 for exp 1b, for both languages tested.

**Table 6 – Experiment 1a test results for G.729.1**

Laboratory			Huawei (Lab C)			France Telecom (Lab F)		
Condition	Codec	Noise	DMOS	SD	PoW	DMOS	SD	PoW
c01	MNRU, Q = 6 dB	No background noise	1.23	0.56	183	1.03	0.16	192
c02	MNRU, Q = 12 dB	No background noise	1.71	0.77	162	1.33	0.48	191
c03	MNRU, Q = 18 dB	No background noise	2.32	0.83	111	2.05	0.62	153
c04	MNRU, Q = 24 dB	No background noise	3.09	0.80	43	3.03	0.78	45
c05	MNRU, Q = 30 dB	No background noise	3.81	0.87	14	3.91	0.79	5
c06	MNRU, Q = 36 dB	No background noise	4.41	0.70	1	4.64	0.62	1
c07	Direct	No background noise	4.66	0.57	0	4.89	0.31	0
c08	Direct	Office noise	4.52	0.63	0	4.78	0.41	0
c09	Direct	Babble noise (40)	4.60	0.58	0	4.83	0.39	0
c10	Direct	Babble noise (128)	4.42	0.67	0	4.78	0.43	0
c11	G.729.1@12k	Office noise	4.53	0.67	1	4.58	0.55	0
c12	G.729.1@12k	Babble noise (40)	4.52	0.61	0	4.59	0.60	1
c13	G.729.1@12k	Babble noise (128)	4.44	0.66	0	4.54	0.57	0
c14	CuT@12k (DTX on, mode 1)	Office noise	4.53	0.64	1	4.58	0.55	0
c15	CuT@12k (DTX on, mode 1)	Babble noise (40)	4.55	0.63	0	4.71	0.50	0
c16	CuT@12k (DTX on, mode 1)	Babble noise (128)	4.45	0.67	0	4.52	0.61	1
c17	CuT@12k (DTX on, mode 2)	Office noise	4.52	0.68	1	4.65	0.55	0
c18	CuT@12k (DTX on, mode 2)	Babble noise (40)	4.47	0.69	2	4.65	0.52	0
c19	CuT@12k (DTX on, mode 2)	Babble noise (128)	4.41	0.74	3	4.43	0.67	1
c20	CuT@12k (DTX on, mode 3)	Office noise	4.57	0.62	0	4.67	0.53	0
c21	CuT@12k (DTX on, mode 3)	Babble noise (40)	4.54	0.69	1	4.60	0.57	0
c22	CuT@12k (DTX on, mode 3)	Babble noise (128)	4.49	0.66	0	4.56	0.63	1
c23	G.729.1@12k	No background noise	4.62	0.61	1	4.85	0.36	0
c24	CuT@12k (DTX on, mode 2)	No background noise	4.57	0.57	0	4.82	0.39	0

**Table 7 – Experiment 1b test results for G.729.1**

Laboratory			Huawei (Lab C)			France Telecom (Lab F)		
Condition	Codec	Noise	DMOS	SD	PoW	DMOS	SD	PoW
1	MNRU, Q = 15 dB	No background noise	1.65	0.94	174	1.23	0.55	180
2	MNRU, Q = 25 dB	No background noise	2.45	1.05	105	1.86	0.76	156
3	MNRU, Q = 35 dB	No background noise	3.60	0.95	19	3.43	1.06	39
4	MNRU, Q = 45 dB	No background noise	4.66	0.56	0	4.63	0.65	1
5	Direct	No background noise	4.79	0.43	0	4.90	0.32	0
6	Direct	Office noise	4.56	0.64	0	4.86	0.34	0
7	Direct	Babble noise (40)	4.73	0.49	0	4.86	0.34	0
8	Direct	Babble noise (128)	4.63	0.63	2	4.78	0.45	0
9	G.729.1@22k	Office noise	4.63	0.55	0	4.66	0.55	0
10	G.729.1@22k	Babble noise (40)	4.51	0.69	4	4.63	0.60	1
11	G.729.1@22k	Babble noise (128)	4.52	0.66	2	4.51	0.67	0
12	G.729.1@32k	Office noise	4.65	0.57	0	4.82	0.39	0
13	G.729.1@32k	Babble noise (40)	4.69	0.57	0	4.85	0.36	0
14	G.729.1@32k	Babble noise (128)	4.63	0.53	0	4.70	0.51	0
15	CuT@22k (DTX on, mode 1)	Office noise	4.50	0.66	1	4.34	0.82	5
16	CuT@22k (DTX on, mode 1)	Babble noise (40)	4.51	0.68	2	4.51	0.68	1
17	CuT@22k (DTX on, mode 1)	Babble noise (128)	4.46	0.70	3	4.25	0.79	7
18	CuT@32k (DTX on, mode 1)	Office noise	4.51	0.59	0	4.50	0.69	3
19	CuT@32k (DTX on, mode 1)	Babble noise (40)	4.60	0.66	5	4.64	0.60	1
20	CuT@32k (DTX on, mode 1)	Babble noise (128)	4.47	0.68	1	4.32	0.68	3
21	CuT@22k (DTX on, mode 2)	Office noise	4.55	0.65	0	4.43	0.74	2
22	CuT@22k (DTX on, mode 2)	Babble noise (40)	4.54	0.60	0	4.49	0.67	1
23	CuT@22k (DTX on, mode 2)	Babble noise (128)	4.41	0.70	2	4.30	0.70	3
24	CuT@32k (DTX on, mode 2)	Office noise	4.48	0.68	2	4.60	0.63	2
25	CuT@32k (DTX on, mode 2)	Babble noise (40)	4.63	0.57	0	4.59	0.56	0
26	CuT@32k (DTX on, mode 2)	Babble noise (128)	4.48	0.71	4	4.42	0.71	2
27	CuT@22k (DTX on, mode 3)	Office noise	4.49	0.82	5	4.54	0.65	2
28	CuT@22k (DTX on, mode 3)	Babble noise (40)	4.55	0.71	5	4.52	0.66	1
29	CuT@22k (DTX on, mode 3)	Babble noise (128)	4.42	0.74	4	4.22	0.78	4
30	CuT@32k (DTX on, mode 3)	Office noise	4.53	0.69	4	4.59	0.64	2
31	CuT@32k (DTX on, mode 3)	Babble noise (40)	4.57	0.60	2	4.57	0.64	2
32	CuT@32k (DTX on, mode 3)	Babble noise (128)	4.49	0.66	0	4.40	0.75	5
33	G.729.1@22k	No background noise	4.55	0.65	0	4.64	0.56	1
34	G.729.1@32k	No background noise	4.58	0.63	0	4.69	0.59	2
35	CuT@22k (DTX on, mode 2)	No background noise	4.66	0.57	0	4.65	0.55	0
36	CuT@32k (DTX on, mode 2)	No background noise	4.60	0.60	0	4.68	0.56	0

### 9.1.3 Conclusions

Requirement and objectives comparisons are reported in Table 8 for 12 kbit/s operation, Table 9 for 22 kbit/s operation and Table 10 for 32 kbit/s operation.

As it can be seen in Table 8, all requirements are passed in both labs. Only one objective is failed in lab F. In lab C, all objectives are passed.

As it can be seen in Table 9, all requirements are passed in both labs. Four objectives out of nine are passed in lab C. In lab F, all objectives are failed.

As it can be seen in Table 10, all requirements are passed in both labs. Only one objective is passed in lab C. In lab F, all objectives are failed.

All requirements were passed for the 3 bitrates considered in two labs, lab F in French language, lab C in Chinese language.

Concerning the objectives, for the 12 kbit/s, one objective is failed in lab F. In lab C, all objectives are passed. For the 22kbit/s, four objectives out of nine are passed in lab C. In lab F, all objectives are failed. For the 32 kbit/s, one objective is passed in lab C. In lab F, all objectives are failed.

Figures 9 and 10 illustrate a selection of the above results.

**Table 8 – Requirement and objectives comparisons at 12 kbit/s for G.729.1**

12 kbit/s	Test Condition	Reference condition	Criterion	Results (Chinese)	Results (French)
Req	C14-CuT@12k (DTX on, mode 1)	C11-G.729.1@12k	PoW	pass	pass
Req	C15-CuT@12k (DTX on, mode 1)	C12-G.729.1@12k	PoW	pass	pass
Req	C16-CuT@12k (DTX on, mode 1)	C13-G.729.1@12k	PoW	pass	pass
Req	C17-CuT@12k (DTX on, mode 2)	C11-G.729.1@12k	PoW	pass	pass
Req	C18-CuT@12k (DTX on, mode 2)	C12-G.729.1@12k	PoW	pass	pass
Req	C19-CuT@12k (DTX on, mode 2)	C13-G.729.1@12k	PoW	pass	pass
Req	C20-CuT@12k (DTX on, mode 3)	C11-G.729.1@12k	PoW	pass	pass
Req	C21-CuT@12k (DTX on, mode 3)	C12-G.729.1@12k	PoW	pass	pass
Req	C22-CuT@12k (DTX on, mode 3)	C13-G.729.1@12k	PoW	pass	pass
Obj	C14-CuT@12k (DTX on, mode 1)	C11-G.729.1@12k	nwt	pass	pass
Obj	C15-CuT@12k (DTX on, mode 1)	C12-G.729.1@12k	nwt	pass	pass
Obj	C16-CuT@12k (DTX on, mode 1)	C13-G.729.1@12k	nwt	pass	pass
Obj	C17-CuT@12k (DTX on, mode 2)	C11-G.729.1@12k	nwt	pass	pass
Obj	C18-CuT@12k (DTX on, mode 2)	C12-G.729.1@12k	nwt	pass	pass
Obj	C19-CuT@12k (DTX on, mode 2)	C13-G.729.1@12k	nwt	pass	fail
Obj	C20-CuT@12k (DTX on, mode 3)	C11-G.729.1@12k	nwt	pass	pass
Obj	C21-CuT@12k (DTX on, mode 3)	C12-G.729.1@12k	nwt	pass	pass
Obj	C22-CuT@12k (DTX on, mode 3)	C13-G.729.1@12k	nwt	pass	pass



**Table 9 – Requirement and objectives comparisons at 22 kbit/s for G.729.1**

22 kbit/s	Test Condition	Reference condition	Criterion	Results (Chinese)	Results (French)
Req	C15-CuT@22k (DTX on, mode 1)	C9-G.729.1@22k	PoW	pass	pass
Req	C16-CuT@22k (DTX on, mode 1)	C10-G.729.1@22k	PoW	pass	pass
Req	C17-CuT@22k (DTX on, mode 1)	C11-G.729.1@22k	PoW	pass	pass
Req	C21-CuT@22k (DTX on, mode 2)	C9-G.729.1@22k	PoW	pass	pass
Req	C22-CuT@22k (DTX on, mode 2)	C10-G.729.1@22k	PoW	pass	pass
Req	C23-CuT@22k (DTX on, mode 2)	C11-G.729.1@22k	PoW	pass	pass
Req	C27-CuT@22k (DTX on, mode 3)	C9-G.729.1@22k	PoW	pass	pass
Req	C28-CuT@22k (DTX on, mode 3)	C10-G.729.1@22k	PoW	pass	pass
Req	C29-CuT@22k (DTX on, mode 3)	C11-G.729.1@22k	PoW	pass	pass
Obj	C15-CuT@22k (DTX on, mode 1)	C9-G.729.1@22k	nwt	fail	fail
Obj	C16-CuT@22k (DTX on, mode 1)	C10-G.729.1@22k	nwt	pass	fail
Obj	C17-CuT@22k (DTX on, mode 1)	C11-G.729.1@22k	nwt	pass	fail
Obj	C21-CuT@22k (DTX on, mode 2)	C9-G.729.1@22k	nwt	fail	fail
Obj	C22-CuT@22k (DTX on, mode 2)	C10-G.729.1@22k	nwt	pass	fail
Obj	C23-CuT@22k (DTX on, mode 2)	C11-G.729.1@22k	nwt	fail	fail
Obj	C27-CuT@22k (DTX on, mode 3)	C9-G.729.1@22k	nwt	fail	fail
Obj	C28-CuT@22k (DTX on, mode 3)	C10-G.729.1@22k	nwt	pass	fail
Obj	C29-CuT@22k (DTX on, mode 3)	C11-G.729.1@22k	nwt	fail	fail

**Table 10 – Requirement and objectives comparisons at 32 kbit/s for G.729.1**

32 kbit/s	Test Condition	Reference condition	Criterion	Results (Chinese)	Results (French)
Req	C18-CuT@32k (DTX on, mode 1)	C12-G.729.1@32k	PoW	pass	pass
Req	C19-CuT@32k (DTX on, mode 1)	C13-G.729.1@32k	PoW	pass	pass
Req	C20-CuT@32k (DTX on, mode 1)	C14-G.729.1@32k	PoW	pass	pass
Req	C24-CuT@32k (DTX on, mode 2)	C12-G.729.1@32k	PoW	pass	pass
Req	C25-CuT@32k (DTX on, mode 2)	C13-G.729.1@32k	PoW	pass	pass
Req	C26-CuT@32k (DTX on, mode 2)	C14-G.729.1@32k	PoW	pass	pass
Req	C30-CuT@32k (DTX on, mode 3)	C12-G.729.1@32k	PoW	pass	pass
Req	C31-CuT@32k (DTX on, mode 3)	C13-G.729.1@32k	PoW	pass	pass
Req	C32-CuT@32k (DTX on, mode 3)	C14-G.729.1@32k	PoW	pass	pass
Obj	C18-CuT@32k (DTX on, mode 1)	C12-G.729.1@32k	nwt	fail	fail
Obj	C19-CuT@32k (DTX on, mode 1)	C13-G.729.1@32k	nwt	fail	fail
Obj	C20-CuT@32k (DTX on, mode 1)	C14-G.729.1@32k	nwt	fail	fail
Obj	C24-CuT@32k (DTX on, mode 2)	C12-G.729.1@32k	nwt	fail	fail
Obj	C25-CuT@32k (DTX on, mode 2)	C13-G.729.1@32k	nwt	pass	fail
Obj	C26-CuT@32k (DTX on, mode 2)	C14-G.729.1@32k	nwt	fail	fail
Obj	C30-CuT@32k (DTX on, mode 3)	C12-G.729.1@32k	nwt	fail	fail
Obj	C31-CuT@32k (DTX on, mode 3)	C13-G.729.1@32k	nwt	fail	fail
Obj	C32-CuT@32k (DTX on, mode 3)	C14-G.729.1@32k	nwt	fail	fail

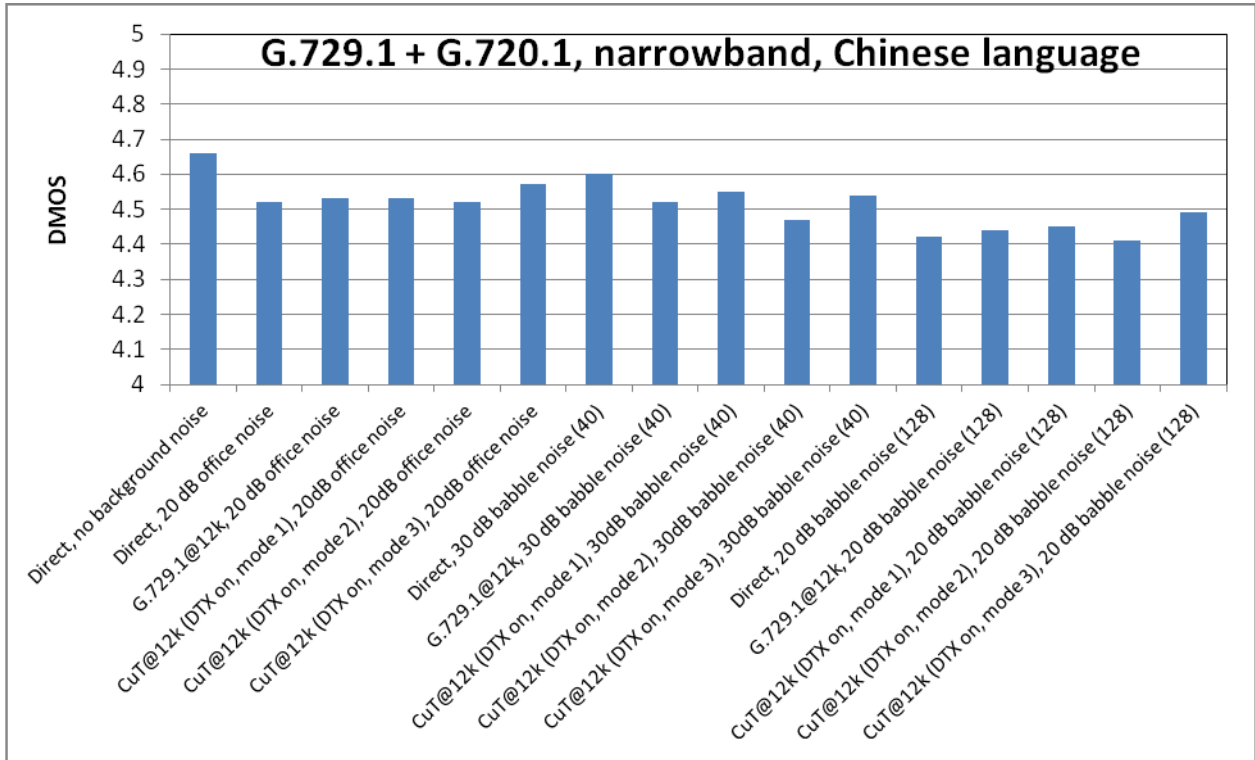


Figure 9 – Subjective results for G.729.1 with G.720.1, narrowband

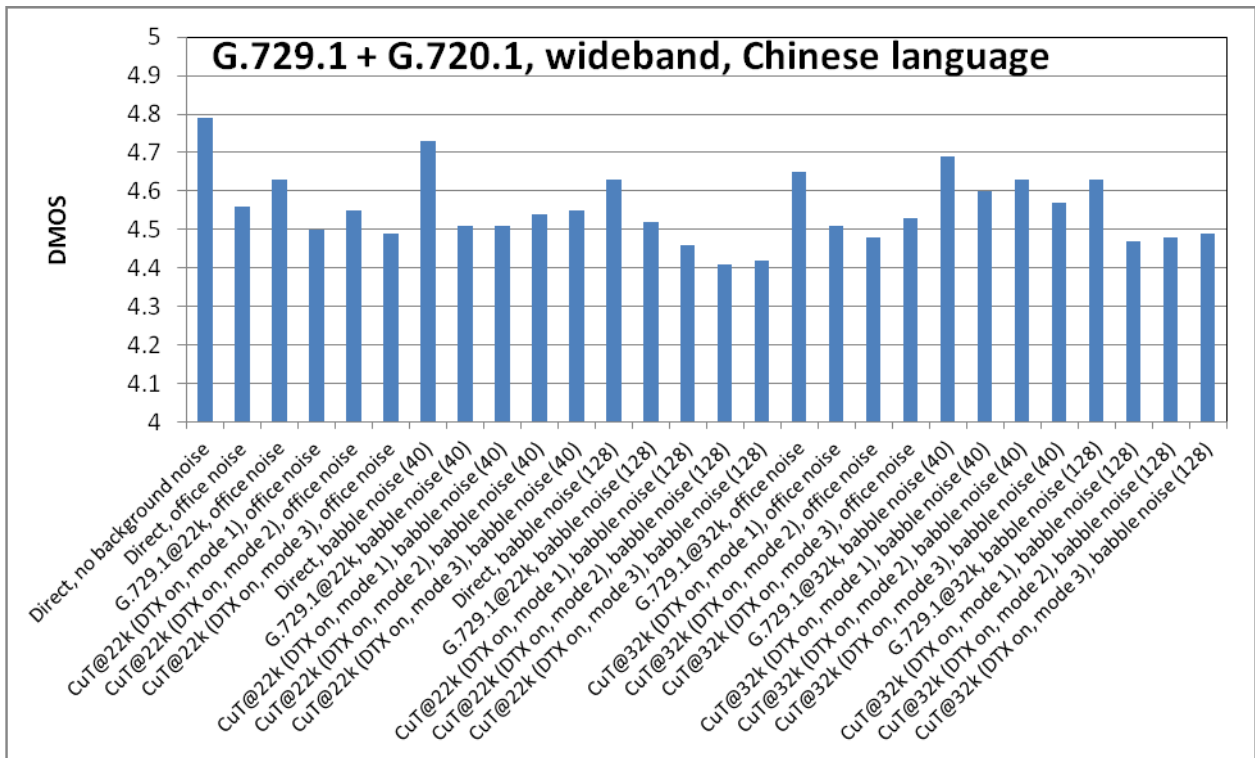


Figure 10 – Subjective results for G.729.1 with G.720.1, wideband

## 9.2 G.729 Annex B

### 9.2.1 Description of the testing exercise

The formal quality assessment test plan for this characterization phase was organized in one subjective experiment based on the requirements described in the ToRs.

Experiment 1a tested the coder quality under noisy speech conditions in narrowband. Three types of noise were considered:

- office noise SNR=20dB;
- babble noise (128 voices) SNR=15dB;
- Music background SNR = 25dB.

In this experiment, the three modes of G.720.1A have been tested: (mode BS) bandwidth saving, (mode B) balanced and (mode QP) quality preferred.

The experiment used the modified DCR method with the five point degradation scale.

- 5 - Degradation not perceived or even some improvement
- 4 - Degradation perceived but not annoying
- 3 - Degradation slightly annoying
- 2 - Degradation annoying
- 1 - Degradation very annoying

Experiment 1a was run in two different languages. The laboratories and languages are reported in Table 11.

**Table 11 – Laboratories and languages for G.729 Annex B tests**

Experiment	Lab	Language	Lab designator
1a	Huawei	Chinese	C
1a	Dynastat	American English	E

### 9.2.2 Results

All results for Chinese and North-American English (NAE) are reported in Table 12.

### 9.2.3 Conclusions

Required comparisons are reported in Table 13.

All comparisons show that each tested condition is not worse than its specified reference condition. In presence of music, in both labs, the tested conditions are better than the reference conditions.

The results also show very good agreement between the two languages tested.

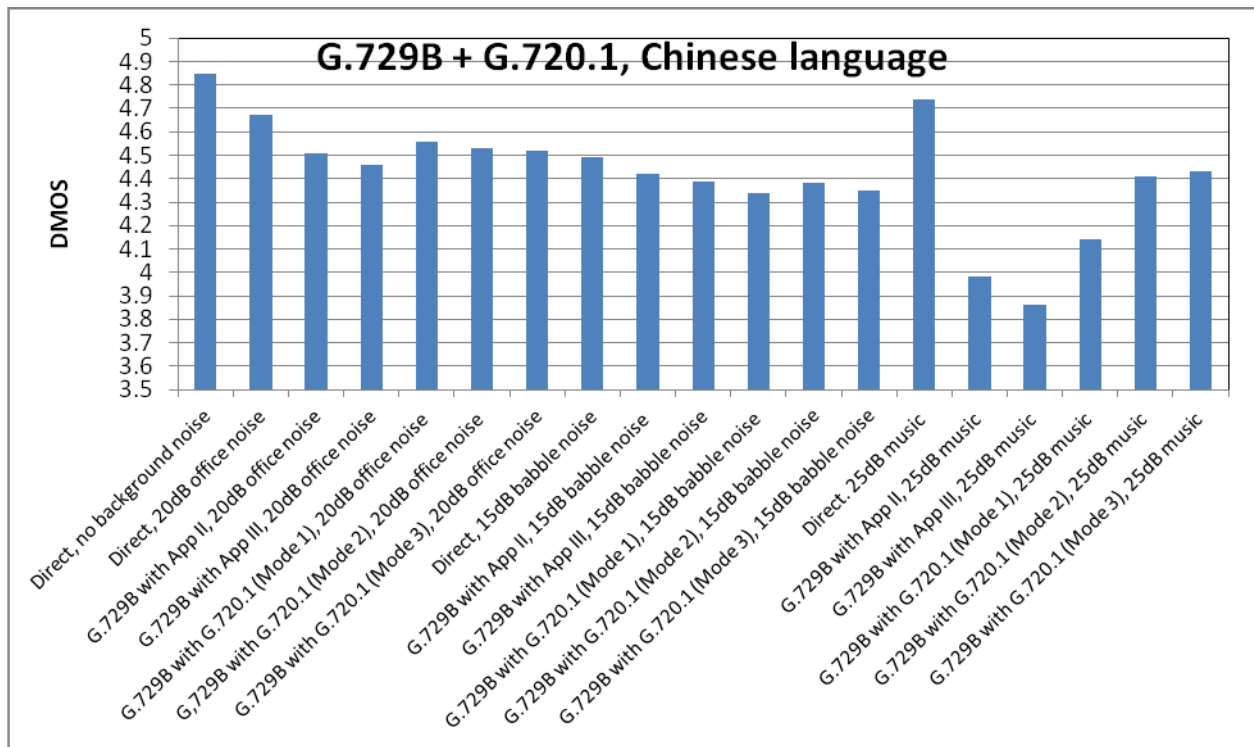
Figure 11 illustrates a selection of the above results.

**Table 12 – Experiment 1a test results for G.729 Annex B**

Condition	Condition	Noise	Chinese		NAE	
			DMOS	SD	DMOS	SD
1	MNRU, Q = 7 dB	None	1.36	0.64	1.55	0.94
2	MNRU, Q = 14 dB	None	2.09	0.90	2.52	0.99
3	MNRU, Q = 21 dB	None	2.92	0.85	3.55	0.83
4	MNRU, Q = 28 dB	None	3.83	0.86	4.39	0.70
5	MNRU, Q = 35 dB	None	4.68	0.53	4.82	0.41
6	Direct	None	4.85	0.39	4.85	0.40
7	Direct	20dB Office	4.67	0.53	4.70	0.55
8	Direct	15dB Babble	4.49	0.64	4.40	0.83
9	Direct	25dB Music	4.74	0.52	4.79	0.47
10	G.729B with App II	20dB Office	4.51	0.64	4.48	0.65
11	G.729B with App II	15dB Babble	4.42	0.63	4.22	0.73
12	G.729B with App II	25dB Music	3.98	0.85	3.91	0.84
13	G.729B with App III	20dB Office	4.46	0.66	4.52	0.62
14	G.729B with App III	15dB Babble	4.39	0.68	4.26	0.71
15	G.729B with App III	25dB Music	3.86	0.87	3.81	0.94
16	G.729B with G.720.1 DL (BS)	20dB Office	4.56	0.60	4.58	0.56
17	G.729B with G.720.1 DL (BS)	15dB Babble	4.34	0.76	4.26	0.73
18	G.729B with G.720.1 DL (BS)	25dB Music	4.14	0.81	4.16	0.71
19	G.729B with G.720.1 DL (B)	20dB Office	4.53	0.63	4.48	0.68
20	G.729B with G.720.1 DL (B)	15dB Babble	4.38	0.64	4.30	0.69
21	G.729B with G.720.1 DL (B)	25dB Music	4.41	0.68	4.43	0.66
22	G.729B with G.720.1 DL (QP)	20dB Office	4.52	0.62	4.52	0.59
23	G.729B with G.720.1 DL (QP)	15dB Babble	4.35	0.74	4.24	0.78
24	G.729B with G.720.1 DL (QP)	25dB Music	4.43	0.71	4.38	0.69

**Table 13 – Comparisons of G.729 Annex B results**

Noise type	Ref Condition	C <sub>r</sub>	Test Condition	C <sub>t</sub>	Results (Chinese)	Results (NAE)
20dB Office noise	G.729B with App II	10	G.729B with G.720.1 DL (BS)	16	nwt	BT
20dB Office noise	G.729B with App II	10	G.729B with G.720.1 DL (B)	19	nwt	nwt
20dB Office noise	G.729B with App II	10	G.729B with G.720.1 DL (QP)	22	nwt	nwt
20dB Office noise	G.729B with App III	13	G.729B with G.720.1 DL (BS)	16	BT	nwt
20dB Office noise	G.729B with App III	13	G.729B with G.720.1 DL (B)	19	nwt	nwt
20dB Office noise	G.729B with App III	13	G.729B with G.720.1 DL (QP)	22	nwt	nwt
15dB Babble noise (128)	G.729B with App II	11	G.729B with G.720.1 DL (BS)	17	nwt	nwt
15dB Babble noise (128)	G.729B with App II	11	G.729B with G.720.1 DL (B)	20	nwt	nwt
15dB Babble noise (128)	G.729B with App II	11	G.729B with G.720.1 DL (QP)	23	nwt	nwt
15dB Babble noise (128)	G.729B with App III	14	G.729B with G.720.1 DL (BS)	17	nwt	nwt
15dB Babble noise (128)	G.729B with App III	14	G.729B with G.720.1 DL (B)	20	nwt	nwt
15dB Babble noise (128)	G.729B with App III	14	G.729B with G.720.1 DL (QP)	23	nwt	nwt
25dB Music background	G.729B with App II	12	G.729B with G.720.1 DL (BS)	18	BT	BT
25dB Music background	G.729B with App II	12	G.729B with G.720.1 DL (B)	21	BT	BT
25dB Music background	G.729B with App II	12	G.729B with G.720.1 DL (QP)	24	BT	BT
25dB Music background	G.729B with App III	15	G.729B with G.720.1 DL (BS)	18	BT	BT
25dB Music background	G.729B with App III	15	G.729B with G.720.1 DL (B)	21	BT	BT
25dB Music background	G.729B with App III	15	G.729B with G.720.1 DL (QP)	24	BT	BT



**Figure 11 – Subjective results for G.729B with G.720.1**

## Appendix A: GSAD Selection test details

**Table A.1 – Factors for Experiment 1**

<b>Conditions</b>	
Codec Under Test	FC-GSAD
Input Signal	Clean and noisy speech
Input Level	-16, -26, -36 dBov
Background	Car, babble, office, interfering talkers, music
SNR	Infinite ( $\infty$ ), 30dB, 20dB, 10dB
Test Conditions	See condition set 1 in Table 16
Input Characteristic	16 kHz sampled, 16-bit input, to be processed with P.341 filter
<b>Measurement</b>	
Metric	PWMC score, DSAF, MisRtS2M
Requirement	RTP, RTD, RTS2M
Objective	OTP, activity detection not worse than LC-VAD under the same condition for all test data

**Table A.2 – Factors for Experiment 2**

<b>Conditions</b>	
Codec Under Test	FC-GSAD
Input Signal	Clean and noisy music
Input Level	-16, -26, -36 dBov
Background	Car, babble, office
SNR	$\infty$ , 30dB, 20dB
Test Conditions	See condition set 2 in Table 17
Input Characteristic	16 kHz sampled, 16-bit input, to be processed with P.341 filter
<b>Measurement</b>	
Metric	MisRtA2I, MisRtM2S
Requirement	RTA2I, RTM2S
Objective	Activity detection not worse than LC-VAD under the same condition for all test data

**Table A.3 – Factors for Experiment 3**

<b>Conditions</b>	
Codec Under Test	FC-GSAD
Input Signal	Clean and noisy music interlaced with speech
Input Level	-16, -26, -36 dBov
Background	Car, babble, office
SNR	$\infty$ , 30dB, 20dB
Test Conditions	See condition set 2 in Table 17
Input Characteristic	16 kHz sampled, 16-bit input, to be processed with P.341 filter
<b>Measurement</b>	
Metric	PWMC score, DSAF, MisRtA2I, MisRtS2M, MisRtM2S
Requirement	RTP, RTD, RTA2I, RTS2MI <sub>t</sub> , RTM2SI <sub>t</sub>
Objective	OTP, activity detection not worse than LC-VAD under the same condition for all test data

**Table A.4 – Factors for Experiment 4**

<b>Conditions</b>	
Codec Under Test	FC-GSAD
Input Signal	Clean and noisy speech
Input Level	-16, -26, -36 dBov
Background	Car, babble, office, interfering talkers, music
SNR	$\infty$ , 30dB, 20dB, 10dB
Test Conditions	See condition set 1 in Table 16
Input Characteristic	16 kHz sampled, 16-bit input, to be processed with P.341 filter, then to be filtered and down sampled to 8 kHz by HQ2 filter
<b>Measurement</b>	
Metric	PWMC score, DSAF, MisRtS2M
Requirement	RTP, RTD, RTS2M
Objective	OTP, activity detection not worse than LC-VAD under the same condition for all test data

**Table A.5 – Factors for Experiment 5**

<b>Conditions</b>	
Codec Under Test	FC-GSAD
Input Signal	Clean and noisy music
Input Level	-16, -26, -36 dBov
Background	Car, babble, office
SNR	$\infty$ , 30dB, 20dB
Test Conditions	See condition set 2 in Table 17
Input Characteristic	16 kHz sampled, 16-bit input, to be processed with P.341 filter, then to be filtered and down sampled to 8 kHz by HQ2 filter
<b>Measurement</b>	
Metric	MisRtA2I, MisRtM2S
Requirement	RTA2I, RTM2S
Objective	Activity detection not worse than LC-VAD under the same condition for all test data

**Table A.6 – Factors for Experiment 6**

<b>Conditions</b>	
Codec Under Test	FC-GSAD
Input Signal	Clean and noisy music interlaced with speech
Input Level	-16, -26, -36 dBov
Background	Car, babble, office
SNR	$\infty$ , 30dB, 20dB
Test Conditions	See condition set 2 in Table 17
Input Characteristic	16 kHz sampled, 16-bit input, to be processed with P.341 filter, then to be filtered and down sampled to 8 kHz by HQ2 filter
<b>Measurement</b>	
Metric	PWMC score, DSAF, MisRtA2I, MisRtS2M, MisRtM2S
Requirement	RTP, RTD, RTA2I, RTS2MI <sub>t</sub> , RTM2SI <sub>t</sub>
Objective	OTP, activity detection not worse than LC-VAD under the same condition for all test data



**Table A.7 – Factors for Experiment 7**

<b>Conditions</b>	
Codec Under Test	LC-VAD
Input Signal	Clean and noisy speech
Input Level	-16, -26, -36 dBov
Background	car, babble, office, interfering talkers, music
SNR	$\infty$ , 30dB, 20dB, 10dB
Test Conditions	See condition set 1 in Table 16
Input Characteristic	16 kHz sampled, 16-bit input, to be processed with P.341 filter
<b>Measurement</b>	
Metric	PWMC score, DSAF
Requirement	RTP, RTD
Objective	OTP

**Table A.8 – Factors for Experiment 8**

<b>Conditions</b>	
Codec Under Test	LC-VAD
Input Signal	Clean and noisy music
Input Level	-16, -26, -36 dBov
Background	Car, babble, office
SNR	$\infty$ , 30dB, 20dB
Test Conditions	See condition set 2 in Table 17
Input Characteristic	16 kHz sampled, 16-bit input, to be processed with P.341 filter
<b>Measurement</b>	
Metric	MisRtA2I
Requirement	RTA2I
Objective	N/A

**Table A.9 – Factors for Experiment 9**

<b>Conditions</b>	
Codec Under Test	LC-VAD
Input Signal	Clean and noisy music interlaced with speech
Input Level	-16, -26, -36 dBov
Background	Car, babble, office
SNR	$\infty$ , 30dB, 20dB
Test Conditions	See condition set 2 in Table 17
Input Characteristic	16 kHz sampled, 16-bit input, to be processed with P.341 filter
<b>Measurement</b>	
Metric	PWMC score, DSAF, MisRtA2I
Requirement	RTP, RTD, RTA2I
Objective	OTP

**Table A.10 – Factors for Experiment 10**

<b>Conditions</b>	
Codec Under Test	LC-VAD
Input Signal	Clean and noisy speech
Input Level	-16, -26, -36 dBov
Background	Car, babble, office, interfering talkers, music
SNR	$\infty$ , 30dB, 20dB, 10dB
Test Conditions	See condition set 1 in Table 16
Input Characteristic	16 kHz sampled, 16-bit input, to be processed with P.341 filter, then to be filtered and down sampled to 8 kHz by HQ2 filter
<b>Measurement</b>	
Metric	PWMC score, DSAF
Requirement	RTP, RTD
Objective	OTP

**Table A.11 – Factors for Experiment 11**

<b>Conditions</b>	
Codec Under Test	LC-VAD
Input Signal	Clean and noisy music
Input Level	-16, -26, -36 dBov
Background	Car, babble, office
SNR	$\infty$ , 30dB, 20dB
Test Conditions	See condition set 2 in Table 17
Input Characteristic	16 kHz sampled, 16-bit input, to be processed with P.341 filter, then to be filtered and down sampled to 8 kHz by HQ2 filter
<b>Measurement</b>	
Metric	MisRtA2I
Requirement	RTA2I
Objective	N/A

**Table A.12 – Factors for Experiment 12**

<b>Conditions</b>	
Codec Under Test	LC-VAD
Input Signal	Clean and noisy music interlaced with speech
Input Level	-16, -26, -36 dBov
Background	car, babble, office
SNR	$\infty$ , 30dB, 20dB
Test Conditions	See condition set 2 in Table 17
Input Characteristic	16 kHz sampled, 16-bit input, to be processed with P.341 filter, then to be filtered and down sampled to 8 kHz by HQ2 filter
<b>Measurement</b>	
Metric	PWMC score, DSAF, MisRtA2I
Requirement	RTP, RTD, RTA2I
Objective	OTP

**Table A.13 – Factors for Experiment 13**

<b>Conditions</b>	
Codec Under Test	FC-GSAD
Input Signal	Alternating artificial noise with segmental levels above and below silence threshold
Input Level	Alternating above or below silence threshold
Background	N/A
SNR	N/A
Test Conditions	N/A
Input Characteristic	16 kHz sampled, 16-bit input, to be processed with P.341 filter (for WB input)  16 kHz sampled, 16-bit input, to be processed with P.341 filter, then to be filtered and down sampled to 8 kHz by HQ2 filter (for NB input)
<b>Measurement</b>	
Metric	MisRtSil
Requirement	The number of misclassified frames between silence and other signals should be lower than the twice the number of times the threshold is crossed in the test vector
Objective	N/A

**Table A.14 – Condition set 1**

Condition	SNR	Noise
1	$\infty$ dB	N/A
2	30 dB	Car
3	30 dB	Babble
4	30 dB	Office
5	30 dB	Music
6	30 dB	Interfering talkers
7	20 dB	Car
8	20 dB	Babble
9	20 dB	Office
10	20 dB	Music
11	20 dB	Interfering talkers
12	10 dB	Car
13	10 dB	Babble
14	10 dB	Office

**Table A.15 – Condition set 2**

Condition	SNR	Noise
1	$\infty$ dB	N/A
2	30 dB	Car
3	30 dB	Babble
4	30 dB	Office
5	20 dB	Car
6	20 dB	Babble
7	20 dB	Office

## A.1 Detailed selection test results from France Telecom

**Table A.16 – Requirements Results for Experiment 1 Wideband Speech – FC-GSAD Bandwidth Saving Operating Point**

SNR	noise	PWMC Ref	PWMC Cut	Diff	CI	T-Test Pass	PWMC Cut LC	PWMC Pass	DSAF Threshold	DSAF Cut	DSAF Pass	MisRtS2M Threshold	MisRtS2M Cut	S2M Pass
∞	N/A	4.21	4.35	-0.135	0.011	Pass	4.35	Pass	0.020	-0.010	Pass	2.00%	0.10%	Pass
30dB	car	4.30	4.36	-0.062	0.010	Pass	4.36	Pass	0.050	0.022	Pass	3.00%	0.10%	Pass
	bab	4.35	4.39	-0.043	0.007	Pass	4.39	Pass	0.050	0.016	Pass	3.00%	0.10%	Pass
	off	4.33	4.39	-0.063	0.008	Pass	4.39	Pass	0.200	0.077	Pass	3.00%	0.10%	Pass
	mus	4.36	4.48	-0.119	0.008	Pass	4.48	Pass	1.287	0.520	Pass	5.00%	1.40%	Pass
	int	4.32	4.42	-0.098	0.008	Pass	4.42	Pass	0.355	0.344	Pass	2.00%	0.20%	Pass
20dB	car	4.34	4.40	-0.056	0.007	Pass	4.40	Pass	0.150	0.085	Pass	7.00%	0.20%	Pass
	bab	4.32	4.38	-0.059	0.006	Pass	4.38	Pass	0.150	0.087	Pass	7.00%	0.10%	Pass
	off	4.38	4.41	-0.037	0.005	Pass	4.41	Pass	0.400	0.251	Pass	7.00%	0.10%	Pass
	mus	4.42	4.49	-0.069	0.005	Pass	4.49	Pass	1.266	0.953	Pass	10.00%	10.60%	Fail
	int	4.36	4.45	-0.084	0.007	Pass	4.45	Pass	0.656	0.656	Pass	3.00%	0.50%	Pass
10dB	car	4.33	4.37	-0.033	0.005	Pass	4.37	Pass	0.200	0.113	Pass	12.00%	0.10%	Pass
	bab	4.06	4.23	-0.167	0.012	Pass	4.23	Pass	0.200	0.199	Pass	15.00%	0.20%	Pass
	off	4.29	4.28	0.005	0.009	Pass	4.28	Pass	0.500	0.372	Pass	20.00%	0.40%	Pass

**Table A.17 – Requirements Results for Experiment 1 Wideband Speech – FC-GSAD Balanced Operating Point**

SNR	noise	PWMC Ref	PWMC Cut	Diff	CI	T-Test Pass	PWMC Cut LC	PWMC Pass	DSAF Threshold	DSAF Cut	DSAF Pass	MisRtS2M Threshold	MisRtS2M Cut	S2M Pass
$\infty$	N/A	4.21	4.35	-0.136	0.011	Pass	4.35	Pass	0.070	-0.010	Pass	3.00%	0.10%	Pass
30dB	car	4.35	4.39	-0.042	0.010	Pass	4.39	Pass	0.100	0.030	Pass	5.00%	0.20%	Pass
	bab	4.40	4.42	-0.024	0.007	Pass	4.42	Pass	0.100	0.028	Pass	5.00%	0.20%	Pass
	off	4.38	4.42	-0.042	0.008	Pass	4.42	Pass	0.250	0.116	Pass	5.00%	0.20%	Pass
	mus	4.41	4.50	-0.086	0.007	Pass	4.50	Pass	1.199	1.287	Pass	10.00%	2.10%	Pass
	int	4.37	4.43	-0.056	0.008	Pass	4.43	Pass	0.233	0.355	Pass	3.00%	0.30%	Pass
20dB	car	4.39	4.42	-0.022	0.007	Pass	4.42	Pass	0.200	0.104	Pass	10.00%	0.20%	Pass
	bab	4.37	4.42	-0.045	0.006	Pass	4.42	Pass	0.250	0.149	Pass	10.00%	0.10%	Pass
	off	4.43	4.44	-0.011	0.005	Pass	4.44	Pass	0.500	0.345	Pass	10.00%	0.30%	Pass
	mus	4.47	4.50	-0.028	0.005	Pass	4.50	Pass	1.199	1.266	Pass	15.00%	13.10%	Pass
	int	4.41	4.45	-0.037	0.007	Pass	4.45	Pass	0.554	0.656	Pass	5.00%	0.70%	Pass
10dB	car	4.38	4.39	-0.005	0.005	Pass	4.39	Pass	0.250	0.136	Pass	16.00%	0.30%	Pass
	bab	4.11	4.28	-0.166	0.011	Pass	4.28	Pass	0.300	0.244	Pass	20.00%	0.60%	Pass
	off	4.34	4.34	-0.008	0.008	Pass	4.34	Pass	0.600	0.450	Pass	25.00%	0.80%	Pass

**Table A.18 – Requirements Results for Experiment 1 Wideband Speech – FC-GSAD Quality Preferred Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	T-Test Pass	PWMC Cut LC	PWMC Pass	DSAF Threshold	DSAF Cut	DSAF Pass	MisRtS2M Threshold	MisRtS2M Cut	S2M Pass
∞	N/A	4.29	4.35	-0.066	0.009	Pass	4.35	Pass	0.100	-0.010	Pass	5.00%	0.30%	Pass
30dB	car	4.39	4.41	-0.020	0.008	Pass	4.41	Pass	0.150	0.038	Pass	8.00%	0.40%	Pass
	bab	4.42	4.43	-0.012	0.005	Pass	4.43	Pass	0.150	0.058	Pass	8.00%	0.50%	Pass
	off	4.41	4.44	-0.026	0.007	Pass	4.44	Pass	0.300	0.170	Pass	8.00%	0.60%	Pass
	mus	4.43	4.50	-0.064	0.006	Pass	4.50	Pass	1.349	1.292	Pass	15.00%	3.60%	Pass
	int	4.41	4.43	-0.027	0.007	Pass	4.43	Pass	0.383	0.360	Pass	7.00%	0.60%	Pass
20dB	car	4.42	4.43	-0.005	0.006	Pass	4.43	Pass	0.250	0.122	Pass	13.00%	0.70%	Pass
	bab	4.41	4.43	-0.025	0.005	Pass	4.43	Pass	0.300	0.244	Pass	13.00%	0.70%	Pass
	off	4.44	4.45	-0.004	0.004	Pass	4.45	Pass	0.600	0.466	Pass	13.00%	1.30%	Pass
	mus	4.48	4.50	-0.021	0.004	Pass	4.50	Pass	1.349	1.273	Pass	20.00%	21.90%	Fail
	int	4.43	4.45	-0.015	0.006	Pass	4.45	Pass	0.704	0.657	Pass	8.00%	1.70%	Pass
10dB	car	4.41	4.40	0.015	0.006	Fail	4.40	Fail	0.300	0.255	Pass	20.00%	1.60%	Pass
	bab	4.21	4.32	-0.109	0.009	Pass	4.32	Pass	0.350	0.319	Pass	25.00%	4.20%	Pass
	off	4.38	4.37	0.005	0.006	Pass	4.37	Pass	0.750	0.509	Pass	30.00%	3.10%	Pass

**Table A.19 – Requirements Results for Experiment 2 Wideband Music – FC-GSAD Speech Preferred (Bandwidth Saving) Operating Point**

SNR	Noise	MisRtA2I Ref	MisRtA2I Cut	MisRtA2I Cut LC	A2I Pass	MisRtM2S Threshold	MisRtM2S Cut	M2SPass
$\infty$	N/A	0.90%	0.20%	0.20%	Pass	7.00%	5.60%	Pass
30dB	car	1.40%	0.80%	0.80%	Pass	13.00%	5.40%	Pass
	bab	1.40%	0.60%	0.60%	Pass	13.00%	7.30%	Pass
	off	1.30%	0.80%	0.80%	Pass	13.00%	7.30%	Pass
20dB	car	1.90%	0.80%	0.80%	Pass	18.00%	5.70%	Pass
	bab	2.50%	1.60%	1.60%	Pass	18.00%	10.00%	Pass
	off	2.10%	1.80%	1.80%	Pass	18.00%	10.60%	Pass

**Table A.20 – Requirements Results for Experiment 2 Wideband Music – FC-GSAD Balanced Operating Point**

SNR	Noise	MisRtA2I Ref	MisRtA2I Cut	MisRtA2I Cut LC	A2I Pass	MisRtM2S Threshold	MisRtM2S Cut	M2SPass
$\infty$	N/A	0.90%	0.20%	0.20%	Pass	5.00%	5.20%	Fail
30dB	car	1.40%	0.20%	0.20%	Pass	10.00%	4.90%	Pass
	bab	1.40%	0.20%	0.20%	Pass	10.00%	6.50%	Pass
	off	1.30%	0.30%	0.30%	Pass	10.00%	6.50%	Pass
20dB	car	1.90%	0.60%	0.60%	Pass	15.00%	5.00%	Pass
	bab	2.50%	1.10%	1.10%	Pass	15.00%	8.50%	Pass
	off	2.10%	0.80%	0.80%	Pass	15.00%	9.40%	Pass



**Table A.21 – Requirements Results for Experiment 2 Wideband Music – FC-GSAD Music Preferred (Quality Preferred) Operating Point**

<b>SNR</b>	<b>Noise</b>	<b>MisRtA2I Ref</b>	<b>MisRtA2I Cut</b>	<b>MisRtA2I Cut LC</b>	<b>A2I Pass</b>	<b>MisRtM2S Threshold</b>	<b>MisRtM2S Cut</b>	<b>M2SPass</b>
$\infty$	N/A	0.90%	0.10%	0.10%	Pass	3.00%	4.20%	Fail
30dB	car	1.40%	0.10%	0.10%	Pass	7.00%	3.50%	Pass
	bab	1.40%	0.10%	0.10%	Pass	7.00%	4.80%	Pass
	off	1.30%	0.10%	0.10%	Pass	7.00%	4.70%	Pass
20dB	car	1.90%	0.10%	0.10%	Pass	10.00%	3.80%	Pass
	bab	2.50%	0.40%	0.40%	Pass	10.00%	5.50%	Pass
	off	2.10%	0.50%	0.50%	Pass	10.00%	6.30%	Pass

**Table A.22 – Requirements Results for Experiment 3 Wideband Interlaced Material – FC-GSAD Bandwidth Saving Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	T-Test Pass	PWMC Cut LC	PWMC Pass	MisRtA2I Ref	MisRtA2I Cut	MisRtA2I Cut LC	A2I Pass	DSAF Threshold	DSAF Cut	DSAF Pass	MisRtS2M Threshold	MisRtS2M Cut	S2M Pass	MisRtM2S Threshold	MisRtM2S Cut	M2S Pass
∞	N/A	4.23	4.33	-0.096	0.011	Pass	4.33	Pass	0.90%	0.30%	0.30%	Pass	0.02	-0.003	Pass	2.10%	0.10%	Pass	9.10%	6.00%	Pass
30dB	car	4.31	4.36	-0.054	0.010	Pass	4.36	Pass	1.40%	0.60%	0.60%	Pass	0.05	0.011	Pass	3.20%	0.40%	Pass	16.90%	7.10%	Pass
	bab	4.35	4.38	-0.032	0.008	Pass	4.38	Pass	1.40%	0.80%	0.80%	Pass	0.05	0.009	Pass	3.20%	0.20%	Pass	16.90%	8.30%	Pass
	off	4.34	4.39	-0.056	0.007	Pass	4.39	Pass	1.40%	1.00%	1.00%	Pass	0.20	0.031	Pass	3.20%	1.00%	Pass	16.90%	9.70%	Pass
20dB	car	4.33	4.40	-0.072	0.007	Pass	4.40	Pass	1.90%	0.70%	0.70%	Pass	0.15	0.057	Pass	7.40%	0.30%	Pass	23.40%	9.80%	Pass
	bab	4.30	4.36	-0.065	0.007	Pass	4.36	Pass	2.70%	2.20%	2.20%	Pass	0.15	0.069	Pass	7.40%	0.60%	Pass	23.40%	14.20%	Pass
	off	4.36	4.41	-0.049	0.005	Pass	4.41	Pass	2.30%	3.30%	3.30%	Fail	0.40	0.102	Pass	7.40%	1.50%	Pass	23.40%	12.60%	Pass

**Table A.23 – Requirements Results for Experiment 3 Wideband Interlaced Material – FC-GSAD Balanced Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	T-Test Pass	PWMC Cut LC	PWMC Pass	MisRtA2I Ref	MisRtA2I Cut	MisRtA2I Cut LC	A2I Pass	DSAF Threshold	DSAF Cut	DSAF Pass	MisRtS2M Threshold	MisRtS2M Cut	S2M Pass	MisRtM2S Threshold	MisRtM2S Cut	M2S Pass
∞	N/A	4.23	4.33	-0.096	0.011	Pass	4.33	Pass	0.90%	0.20%	0.20%	Pass	0.07	-0.003	Pass	3.30%	0.20%	Pass	6.00%	5.40%	Pass
30dB	car	4.36	4.40	-0.036	0.009	Pass	4.40	Pass	1.40%	0.40%	0.40%	Pass	0.10	0.014	Pass	5.50%	0.40%	Pass	12.00%	6.50%	Pass
	bab	4.40	4.41	-0.015	0.007	Pass	4.41	Pass	1.40%	0.10%	0.10%	Pass	0.10	0.013	Pass	5.50%	0.30%	Pass	12.00%	6.60%	Pass
	off	4.39	4.43	-0.038	0.007	Pass	4.43	Pass	1.40%	0.20%	0.20%	Pass	0.25	0.050	Pass	5.50%	1.10%	Pass	12.00%	6.90%	Pass
20dB	car	4.38	4.42	-0.047	0.007	Pass	4.42	Pass	1.90%	0.30%	0.30%	Pass	0.20	0.064	Pass	11.00%	0.30%	Pass	18.00%	7.80%	Pass
	bab	4.35	4.42	-0.073	0.007	Pass	4.42	Pass	2.70%	1.50%	1.50%	Pass	0.25	0.105	Pass	11.00%	1.70%	Pass	18.00%	11.60%	Pass
	off	4.41	4.44	-0.033	0.005	Pass	4.44	Pass	2.30%	2.30%	2.30%	Pass	0.50	0.148	Pass	11.00%	2.10%	Pass	18.00%	12.10%	Pass

**Table A.24 – Requirements Results for Experiment 3 Wideband Interlaced Material – FC-GSAD Quality Preferred Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	T-Test Pass	PWMC Cut LC	PWMC Pass	MisRtA2I Ref	MisRtA2I Cut	MisRtA2I Cut LC	A2I Pass	DSAF Threshold	DSAF Cut	DSAF Pass	MisRtS2M Threshold	MisRtS2M Cut	S2M Pass	MisRtM2S Threshold	MisRtM2S Cut	M2S Pass
∞	N/A	4.30	4.33	-0.031	0.009	Pass	4.33	Pass	0.90%	0.20%	0.20%	Pass	0.10	-0.003	Pass	5.80%	0.40%	Pass	3.30%	3.80%	Fail
30dB	car	4.39	4.42	-0.022	0.007	Pass	4.42	Pass	1.40%	0.10%	0.10%	Pass	0.15	0.017	Pass	9.20%	0.60%	Pass	7.70%	3.80%	Pass
	bab	4.42	4.43	-0.010	0.006	Pass	4.43	Pass	1.40%	0.10%	0.10%	Pass	0.15	0.024	Pass	9.20%	0.60%	Pass	7.70%	4.20%	Pass
	off	4.42	4.44	-0.025	0.006	Pass	4.44	Pass	1.40%	0.20%	0.20%	Pass	0.30	0.071	Pass	9.20%	1.60%	Pass	7.70%	4.40%	Pass
20dB	car	4.41	4.43	-0.027	0.006	Pass	4.43	Pass	1.90%	0.20%	0.20%	Pass	0.25	0.081	Pass	15.00%	0.70%	Pass	11.00%	4.90%	Pass
	bab	4.39	4.43	-0.048	0.006	Pass	4.43	Pass	2.70%	1.20%	1.20%	Pass	0.30	0.141	Pass	15.00%	3.30%	Pass	11.00%	7.40%	Pass
	off	4.43	4.45	-0.022	0.004	Pass	4.45	Pass	2.30%	1.70%	1.70%	Pass	0.60	0.205	Pass	15.00%	3.00%	Pass	11.00%	9.60%	Pass

**Table A.25 – Requirements Results for Experiment 4 Narrowband Speech – FC-GSAD Bandwidth Saving Operating Point**

SNR	noise	PWMC Ref	PWMC Cut	Diff	CI	T-Test Pass	PWMC Cut LC	PWMC Pass	DSAF Threshold	DSAF Cut	DSAF Pass	MisRtS2M Threshold	MisRtS2M Cut	S2M Pass
$\infty$	N/A	4.42	4.47	-0.045	0.005	Pass	4.47	Pass	0.020	-0.010	Pass	2.00%	0.10%	Pass
30dB	car	4.38	4.44	-0.056	0.006	Pass	4.44	Pass	0.050	0.028	Pass	3.00%	0.10%	Pass
	bab	4.41	4.46	-0.046	0.003	Pass	4.46	Pass	0.050	0.019	Pass	3.00%	0.00%	Pass
	off	4.40	4.46	-0.053	0.003	Pass	4.46	Pass	0.200	0.081	Pass	3.00%	0.10%	Pass
	mus	4.42	4.49	-0.070	0.003	Pass	4.49	Pass	1.395	0.558	Pass	5.00%	0.90%	Pass
	int	4.41	4.47	-0.062	0.004	Pass	4.47	Pass	0.367	0.350	Pass	2.00%	0.20%	Pass
20dB	car	4.40	4.45	-0.049	0.003	Pass	4.45	Pass	0.150	0.098	Pass	7.00%	0.00%	Pass
	bab	4.41	4.46	-0.045	0.002	Pass	4.46	Pass	0.150	0.109	Pass	7.00%	0.00%	Pass
	off	4.43	4.46	-0.034	0.002	Pass	4.46	Pass	0.400	0.259	Pass	7.00%	0.00%	Pass
	mus	4.44	4.49	-0.054	0.002	Pass	4.49	Pass	1.391	1.022	Pass	10.00%	8.20%	Pass
	int	4.43	4.48	-0.058	0.003	Pass	4.48	Pass	0.663	0.662	Pass	3.00%	0.50%	Pass
10dB	car	4.40	4.43	-0.035	0.003	Pass	4.43	Pass	0.200	0.126	Pass	12.00%	0.00%	Pass
	bab	4.32	4.35	-0.032	0.006	Pass	4.35	Pass	0.200	0.158	Pass	15.00%	0.20%	Pass
	off	4.40	4.40	-0.002	0.005	Pass	4.40	Pass	0.500	0.402	Pass	20.00%	0.50%	Pass

**Table A.26 – Requirements Results for Experiment 4 Narrowband Speech – FC-GSAD Balanced Operating Point**

SNR	noise	PWMC Ref	PWMC Cut	Diff	CI	T-Test Pass	PWMC Cut LC	PWMC Pass	DSAF Threshold	DSAF Cut	DSAF Pass	MisRtS2M Threshold	MisRtS2M Cut	S2M Pass
$\infty$	N/A	4.42	4.47	-0.047	0.005	Pass	4.47	Pass	0.070	-0.007	Pass	3.00%	0.10%	Pass
30dB	car	4.43	4.45	-0.022	0.006	Pass	4.45	Pass	0.100	0.036	Pass	5.00%	0.10%	Pass
	bab	4.46	4.47	-0.008	0.003	Pass	4.47	Pass	0.100	0.035	Pass	5.00%	0.00%	Pass
	off	4.45	4.47	-0.016	0.003	Pass	4.47	Pass	0.250	0.119	Pass	5.00%	0.10%	Pass
	mus	4.47	4.50	-0.030	0.003	Pass	4.50	Pass	1.263	1.395	Pass	10.00%	1.40%	Pass
	int	4.46	4.48	-0.018	0.004	Pass	4.48	Pass	0.238	0.367	Pass	3.00%	0.20%	Pass
20dB	car	4.45	4.46	-0.006	0.004	Pass	4.46	Pass	0.200	0.116	Pass	10.00%	0.10%	Pass
	bab	4.46	4.47	-0.011	0.002	Pass	4.47	Pass	0.250	0.153	Pass	10.00%	0.10%	Pass
	off	4.48	4.48	0.001	0.002	Pass	4.48	Pass	0.500	0.371	Pass	10.00%	0.10%	Pass
	mus	4.49	4.50	-0.009	0.002	Pass	4.50	Pass	1.263	1.391	Pass	15.00%	11.30%	Pass
	int	4.48	4.49	-0.009	0.003	Pass	4.49	Pass	0.559	0.663	Pass	5.00%	0.80%	Pass
10dB	car	4.45	4.45	0.000	0.003	Pass	4.45	Pass	0.250	0.153	Pass	16.00%	0.10%	Pass
	bab	4.37	4.40	-0.038	0.005	Pass	4.40	Pass	0.300	0.243	Pass	20.00%	0.40%	Pass
	off	4.45	4.45	0.002	0.004	Pass	4.45	Pass	0.600	0.552	Pass	25.00%	0.70%	Pass

**Table A.27 – Requirements Results for Experiment 4 Narrowband Speech – FC-GSAD Quality Preferred Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	T-Test Pass	PWMC Cut LC	PWMC Pass	DSAF Threshold	DSAF Cut	DSAF Pass	MisRtS2M Threshold	MisRtS2M Cut	S2M Pass
$\infty$	N/A	4.44	4.47	-0.028	0.004	Pass	4.47	Pass	0.100	-0.007	Pass	5.00%	0.30%	Pass
30dB	car	4.45	4.46	-0.011	0.005	Pass	4.46	Pass	0.150	0.044	Pass	8.00%	0.40%	Pass
	bab	4.47	4.48	-0.004	0.003	Pass	4.48	Pass	0.150	0.063	Pass	8.00%	0.30%	Pass
	off	4.47	4.48	-0.011	0.003	Pass	4.48	Pass	0.300	0.163	Pass	8.00%	0.60%	Pass
	mus	4.48	4.50	-0.023	0.002	Pass	4.50	Pass	1.413	1.397	Pass	15.00%	2.90%	Pass
	int	4.47	4.48	-0.010	0.003	Pass	4.48	Pass	0.388	0.372	Pass	7.00%	0.70%	Pass
20dB	car	4.46	4.47	-0.003	0.003	Pass	4.47	Pass	0.250	0.137	Pass	13.00%	0.50%	Pass
	bab	4.47	4.48	-0.008	0.002	Pass	4.48	Pass	0.300	0.225	Pass	13.00%	0.40%	Pass
	off	4.48	4.48	0.001	0.002	Pass	4.48	Pass	0.600	0.468	Pass	13.00%	0.80%	Pass
	mus	4.49	4.50	-0.007	0.001	Pass	4.50	Pass	1.413	1.393	Pass	20.00%	20.00%	Pass
	int	4.48	4.49	-0.004	0.002	Pass	4.49	Pass	0.709	0.663	Pass	8.00%	1.90%	Pass
10dB	car	4.46	4.46	0.003	0.003	Pass	4.46	Pass	0.300	0.436	Fail	20.00%	0.60%	Pass
	bab	4.40	4.44	-0.037	0.004	Pass	4.44	Pass	0.350	0.339	Pass	25.00%	1.90%	Pass
	off	4.46	4.46	0.000	0.003	Pass	4.46	Pass	0.750	0.648	Pass	30.00%	2.60%	Pass

**Table A.28 – Requirements Results for Experiment 5 Narrowband Music – FC-GSAD Speech Preferred (Bandwidth Saving) Operating Point**

SNR	Noise	MisRtA2I Ref	MisRtA2I Cut	MisRtA2I Cut LC	A2I Pass	MisRtM2S Threshold	MisRtM2S Cut	M2SPass
$\infty$	N/A	0.80%	0.60%	0.60%	Pass	7.00%	6.50%	Pass
30dB	car	1.20%	1.10%	1.10%	Pass	13.00%	7.90%	Pass
	bab	1.30%	1.60%	1.60%	Fail	13.00%	6.80%	Pass
	off	1.20%	1.40%	1.40%	Fail	13.00%	9.20%	Pass
20dB	car	1.70%	1.40%	1.40%	Pass	18.00%	7.20%	Pass
	bab	2.30%	2.50%	2.50%	Fail	18.00%	8.90%	Pass
	off	1.90%	1.40%	1.40%	Pass	18.00%	9.50%	Pass

**Table A.29 – Requirements Results for Experiment 5 Narrowband Music – FC-GSAD Balanced Operating Point**

SNR	Noise	MisRtA2I Ref	MisRtA2I Cut	MisRtA2I Cut LC	A2I Pass	MisRtM2S Threshold	MisRtM2S Cut	M2SPass
$\infty$	N/A	0.80%	0.50%	0.50%	Pass	5.00%	6.10%	Fail
30dB	car	1.20%	0.90%	0.90%	Pass	10.00%	7.10%	Pass
	bab	1.30%	1.30%	1.30%	Fail	10.00%	6.30%	Pass
	off	1.20%	1.10%	1.10%	Pass	10.00%	8.00%	Pass
20dB	car	1.70%	1.10%	1.10%	Pass	15.00%	6.40%	Pass
	bab	2.30%	1.70%	1.70%	Pass	15.00%	7.60%	Pass
	off	1.90%	0.80%	0.80%	Pass	15.00%	8.30%	Pass

**Table A.30 – Requirements Results for Experiment 5 Narrowband Music – FC-GSAD Music Preferred (Quality Preferred) Operating Point**

SNR	Noise	MisRtA2I Ref	MisRtA2I Cut	MisRtA2I Cut LC	A2I Pass	MisRtM2S Threshold	MisRtM2S Cut	M2SPass
$\infty$	N/A	0.80%	0.30%	0.30%	Pass	3.00%	4.80%	Fail
30dB	car	1.20%	0.40%	0.40%	Pass	7.00%	5.50%	Pass
	bab	1.30%	0.70%	0.70%	Pass	7.00%	4.90%	Pass
	off	1.20%	0.50%	0.50%	Pass	7.00%	6.00%	Pass
20dB	car	1.70%	0.50%	0.50%	Pass	10.00%	5.40%	Pass
	bab	2.30%	1.10%	1.10%	Pass	10.00%	5.70%	Pass
	off	1.90%	0.50%	0.50%	Pass	10.00%	6.30%	Pass



**Table A.31 – Requirements Results for Experiment 6 Narrowband Interlaced Material – FC-GSAD Bandwidth Saving Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	T-Test Pass	PWMC Cut LC	PWMC Pass	MisRtA2I Ref	MisRtA2I Cut	MisRtA2I Cut LC	A2I Pass	DSAF Threshold	DSAF Cut	DSAF Pass	MisRtS2M Threshold	MisRtS2M Cut	S2M Pass	MisRtM2S Threshold	MisRtM2S Cut	M2S Pass
∞	N/A	4.41	4.45	-0.041	0.006	Pass	4.45	Pass	1.00%	1.60%	1.60%	Fail	0.02	-0.002	Pass	2.10%	0.20%	Pass	9.10%	7.70%	Pass
30dB	car	4.37	4.43	-0.064	0.007	Pass	4.43	Pass	1.50%	1.30%	1.30%	Pass	0.05	0.013	Pass	3.20%	0.30%	Pass	16.90%	7.30%	Pass
	bab	4.40	4.45	-0.049	0.004	Pass	4.45	Pass	1.50%	2.30%	2.30%	Fail	0.05	0.010	Pass	3.20%	0.30%	Pass	16.90%	9.80%	Pass
	off	4.40	4.45	-0.055	0.004	Pass	4.45	Pass	1.50%	2.20%	2.20%	Fail	0.20	0.032	Pass	3.20%	0.80%	Pass	16.90%	10.40%	Pass
20dB	car	4.39	4.45	-0.065	0.004	Pass	4.45	Pass	2.00%	0.70%	0.70%	Pass	0.15	0.059	Pass	7.40%	0.50%	Pass	23.40%	7.80%	Pass
	bab	4.39	4.44	-0.046	0.003	Pass	4.44	Pass	2.50%	3.10%	3.10%	Fail	0.15	0.057	Pass	7.40%	0.00%	Pass	23.40%	14.20%	Pass
	off	4.41	4.45	-0.041	0.003	Pass	4.45	Pass	2.40%	4.30%	4.30%	Fail	0.40	0.102	Pass	7.40%	1.60%	Pass	23.40%	12.80%	Pass

**Table A.32 – Requirements Results for Experiment 6 Narrowband Interlaced Material – FC-GSAD Balanced Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	T-Test Pass	PWMC Cut LC	PWMC Pass	MisRtA2I Ref	MisRtA2I Cut	MisRtA2I Cut LC	A2I Pass	DSAF Threshold	DSAF Cut	DSAF Pass	MisRtS2M Threshold	MisRtS2M Cut	S2M Pass	MisRtM2S Threshold	MisRtM2S Cut	M2S Pass
∞	N/A	4.41	4.45	-0.043	0.006	Pass	4.45	Pass	1.00%	1.40%	1.40%	Fail	0.07	0.001	Pass	3.30%	0.30%	Pass	6.00%	7.00%	Fail
30dB	car	4.42	4.45	-0.033	0.006	Pass	4.45	Pass	1.50%	1.00%	1.00%	Pass	0.10	0.016	Pass	5.50%	0.30%	Pass	12.00%	6.60%	Pass
	bab	4.45	4.47	-0.016	0.004	Pass	4.47	Pass	1.50%	1.20%	1.20%	Pass	0.10	0.015	Pass	5.50%	0.40%	Pass	12.00%	8.30%	Pass
	off	4.45	4.47	-0.022	0.004	Pass	4.47	Pass	1.50%	1.40%	1.40%	Pass	0.25	0.050	Pass	5.50%	0.90%	Pass	12.00%	8.90%	Pass
20dB	car	4.44	4.46	-0.027	0.004	Pass	4.46	Pass	2.00%	0.40%	0.40%	Pass	0.20	0.065	Pass	11.00%	0.50%	Pass	18.00%	7.10%	Pass
	bab	4.44	4.46	-0.018	0.003	Pass	4.46	Pass	2.50%	2.60%	2.60%	Fail	0.25	0.078	Pass	11.00%	0.10%	Pass	18.00%	12.70%	Pass
	off	4.46	4.48	-0.015	0.002	Pass	4.48	Pass	2.40%	2.80%	2.80%	Fail	0.50	0.161	Pass	11.00%	1.90%	Pass	18.00%	12.20%	Pass

**Table A.33 – Requirements Results for Experiment 6 Narrowband Interlaced Material – FC-GSAD Quality Preferred Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	T-Test Pass	PWMC Cut LC	PWMC Pass	MisRtA2I Ref	MisRtA2I Cut	MisRtA2I Cut LC	A2I Pass	DSAF Threshold	DSAF Cut	DSAF Pass	MisRtS2M Threshold	MisRtS2M Cut	S2M Pass	MisRtM2S Threshold	MisRtM2S Cut	M2S Pass
∞	N/A	4.43	4.46	-0.022	0.005	Pass	4.46	Pass	1.00%	0.70%	0.70%	Pass	0.10	0.001	Pass	5.80%	0.70%	Pass	3.30%	5.10%	Fail
30dB	car	4.44	4.46	-0.021	0.005	Pass	4.46	Pass	1.50%	0.40%	0.40%	Pass	0.15	0.019	Pass	9.20%	0.60%	Pass	7.70%	4.70%	Pass
	bab	4.46	4.47	-0.011	0.003	Pass	4.47	Pass	1.50%	1.00%	1.00%	Pass	0.15	0.026	Pass	9.20%	0.60%	Pass	7.70%	5.90%	Pass
	off	4.46	4.47	-0.014	0.003	Pass	4.47	Pass	1.50%	0.70%	0.70%	Pass	0.30	0.067	Pass	9.20%	1.30%	Pass	7.70%	6.30%	Pass
20dB	car	4.45	4.47	-0.020	0.004	Pass	4.47	Pass	2.00%	0.20%	0.20%	Pass	0.25	0.083	Pass	15.00%	0.80%	Pass	11.00%	5.10%	Pass
	bab	4.46	4.47	-0.017	0.002	Pass	4.47	Pass	2.50%	2.10%	2.10%	Pass	0.30	0.124	Pass	15.00%	1.70%	Pass	11.00%	9.20%	Pass
	off	4.47	4.48	-0.011	0.002	Pass	4.48	Pass	2.40%	2.10%	2.10%	Pass	0.60	0.201	Pass	15.00%	2.70%	Pass	11.00%	10.20%	Pass

**Table A.34 – Requirements Results for Experiment 7 Wideband Speech – LC-VAD Bandwidth Saving Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	PWMC Pass	DSAF Threshold	DSAF Cut	DSAF Pass
$\infty$	N/A	4.21	4.35	-0.135	0.011	Pass	0.020	-0.010	Pass
30dB	car	4.30	4.36	-0.062	0.010	Pass	0.050	0.022	Pass
	bab	4.35	4.39	-0.043	0.007	Pass	0.050	0.016	Pass
	off	4.33	4.39	-0.063	0.008	Pass	0.200	0.077	Pass
	mus	4.36	4.48	-0.119	0.008	Pass	1.287	0.520	Pass
	int	4.32	4.42	-0.098	0.008	Pass	0.355	0.344	Pass
20dB	car	4.34	4.40	-0.056	0.007	Pass	0.150	0.085	Pass
	bab	4.32	4.38	-0.059	0.006	Pass	0.150	0.087	Pass
	off	4.38	4.41	-0.037	0.005	Pass	0.400	0.251	Pass
	mus	4.42	4.49	-0.069	0.005	Pass	1.266	0.953	Pass
	int	4.36	4.45	-0.084	0.007	Pass	0.656	0.656	Pass
10dB	car	4.33	4.37	-0.033	0.005	Pass	0.200	0.113	Pass
	bab	4.06	4.23	-0.167	0.012	Pass	0.200	0.199	Pass
	off	4.29	4.28	0.005	0.009	Pass	0.500	0.372	Pass

**Table A.35 – Requirements Results for Experiment 7 Wideband Speech – LC-VAD Balanced Operating Point**

<b>SNR</b>	<b>Noise</b>	<b>PWMC Ref</b>	<b>PWMC Cut</b>	<b>Diff</b>	<b>CI</b>	<b>PWMC Pass</b>	<b>DSAF Threshold</b>	<b>DSAF Cut</b>	<b>DSAF Pass</b>
$\infty$	N/A	4.21	4.35	-0.136	0.011	Pass	0.070	-0.010	Pass
30dB	car	4.35	4.39	-0.042	0.010	Pass	0.100	0.030	Pass
	bab	4.40	4.42	-0.024	0.007	Pass	0.100	0.028	Pass
	off	4.38	4.42	-0.042	0.008	Pass	0.250	0.116	Pass
	mus	4.41	4.50	-0.086	0.007	Pass	1.199	1.287	Pass
	int	4.37	4.43	-0.056	0.008	Pass	0.233	0.355	Pass
20dB	car	4.39	4.42	-0.022	0.007	Pass	0.200	0.104	Pass
	bab	4.37	4.42	-0.045	0.006	Pass	0.250	0.149	Pass
	off	4.43	4.44	-0.011	0.005	Pass	0.500	0.345	Pass
	mus	4.47	4.50	-0.028	0.005	Pass	1.199	1.266	Pass
	int	4.41	4.45	-0.037	0.007	Pass	0.554	0.656	Pass
10dB	car	4.38	4.39	-0.005	0.005	Pass	0.250	0.136	Pass
	bab	4.11	4.28	-0.166	0.011	Pass	0.300	0.244	Pass
	off	4.34	4.34	-0.008	0.008	Pass	0.600	0.450	Pass

**Table A.36 – Requirements Results for Experiment 7 Wideband Speech – LC-VAD Quality Preferred Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	PWMC Pass	DSAF Threshold	DSAF Cut	DSAF Pass
$\infty$	N/A	4.29	4.35	-0.066	0.009	Pass	0.100	-0.010	Pass
30dB	car	4.39	4.41	-0.020	0.008	Pass	0.150	0.038	Pass
	bab	4.42	4.43	-0.012	0.005	Pass	0.150	0.058	Pass
	off	4.41	4.44	-0.026	0.007	Pass	0.300	0.170	Pass
	mus	4.43	4.50	-0.064	0.006	Pass	1.349	1.292	Pass
	int	4.41	4.43	-0.027	0.007	Pass	0.383	0.360	Pass
20dB	car	4.42	4.43	-0.005	0.006	Pass	0.250	0.122	Pass
	bab	4.41	4.43	-0.025	0.005	Pass	0.300	0.244	Pass
	off	4.44	4.45	-0.004	0.004	Pass	0.600	0.466	Pass
	mus	4.48	4.50	-0.021	0.004	Pass	1.349	1.273	Pass
	int	4.43	4.45	-0.015	0.006	Pass	0.704	0.657	Pass
10dB	car	4.41	4.40	0.015	0.006	Fail	0.300	0.255	Pass
	bab	4.21	4.32	-0.109	0.009	Pass	0.350	0.319	Pass
	off	4.38	4.37	0.005	0.006	Pass	0.750	0.509	Pass

**Table A.37 – Requirements Results for Experiment 8 Wideband Music –  
LC-VAD Speech Preferred (Bandwidth Saving) Operating Point**

SNR	Noise	MisRtA2I Ref	MisRtA2I Cut	A2I Pass
$\infty$	N/A	0.90%	0.20%	Pass
30dB	car	1.40%	0.80%	Pass
	bab	1.40%	0.60%	Pass
	off	1.30%	0.80%	Pass
20dB	car	1.90%	0.80%	Pass
	bab	2.50%	1.60%	Pass
	off	2.10%	1.80%	Pass

**Table A.38 – Requirements Results for Experiment 8 Wideband Music –  
LC-VAD Balanced Operating Point**

SNR	Noise	MisRtA2I Ref	MisRtA2I Cut	A2I Pass
$\infty$	N/A	0.90%	0.20%	Pass
30dB	car	1.40%	0.20%	Pass
	bab	1.40%	0.20%	Pass
	off	1.30%	0.30%	Pass
20dB	car	1.90%	0.60%	Pass
	bab	2.50%	1.10%	Pass
	off	2.10%	0.80%	Pass

**Table A.39 – Requirements Results for Experiment 8 Wideband Music –  
LC-VAD Music Preferred (Quality Preferred) Operating Point**

SNR	Noise	MisRtA2I Ref	MisRtA2I Cut	A2I Pass
$\infty$	N/A	0.90%	0.10%	Pass
30dB	car	1.40%	0.10%	Pass
	bab	1.40%	0.10%	Pass
	off	1.30%	0.10%	Pass
20dB	car	1.90%	0.10%	Pass
	bab	2.50%	0.40%	Pass
	off	2.10%	0.50%	Pass

**Table A.40 – Requirements Results for Experiment 9 Wideband Interlaced Material – LC-VAD Bandwidth Saving Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	PWMC Pass	MisRtA2I Ref	MisRtA2I Cut	A2I Pass	DSAF Threshold	DSAF Cut	DSAF Pass
$\infty$	N/A	4.23	4.33	-0.096	0.011	Pass	0.90%	0.30%	Pass	0.02	-0.003	Pass
30dB	car	4.31	4.36	-0.054	0.010	Pass	1.40%	0.60%	Pass	0.05	0.011	Pass
	bab	4.35	4.38	-0.032	0.008	Pass	1.40%	0.80%	Pass	0.05	0.009	Pass
	off	4.34	4.39	-0.056	0.007	Pass	1.40%	1.00%	Pass	0.20	0.031	Pass
20dB	car	4.33	4.40	-0.072	0.007	Pass	1.90%	0.70%	Pass	0.15	0.057	Pass
	bab	4.30	4.36	-0.065	0.007	Pass	2.70%	2.20%	Pass	0.15	0.069	Pass
	off	4.36	4.41	-0.049	0.005	Pass	2.30%	3.30%	Fail	0.40	0.102	Pass

**Table A.41 – Requirements Results for Experiment 9 Wideband Interlaced Material – LC-VAD Balanced Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	PWMC Pass	MisRtA2I Ref	MisRtA2I Cut	A2I Pass	DSAF Threshold	DSAF Cut	DSAF Pass
$\infty$	N/A	4.23	4.33	-0.096	0.011	Pass	0.90%	0.20%	Pass	0.07	-0.003	Pass
30dB	car	4.36	4.40	-0.036	0.009	Pass	1.40%	0.40%	Pass	0.10	0.014	Pass
	bab	4.40	4.41	-0.015	0.007	Pass	1.40%	0.10%	Pass	0.10	0.013	Pass
	off	4.39	4.43	-0.038	0.007	Pass	1.40%	0.20%	Pass	0.25	0.050	Pass
20dB	car	4.38	4.42	-0.047	0.007	Pass	1.90%	0.30%	Pass	0.20	0.064	Pass
	bab	4.35	4.42	-0.073	0.007	Pass	2.70%	1.50%	Pass	0.25	0.105	Pass
	off	4.41	4.44	-0.033	0.005	Pass	2.30%	2.30%	Pass	0.50	0.148	Pass



**Table A.42 – Requirements Results for Experiment 9 Wideband Interlaced Material – LC-VAD Quality Preferred Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	PWMC Pass	MisRtA2I Ref	MisRtA2I Cut	A2I Pass	DSAF Threshold	DSAF Cut	DSAF Pass
$\infty$	N/A	4.30	4.33	-0.031	0.009	Pass	0.90%	0.20%	Pass	0.10	-0.003	Pass
30dB	car	4.39	4.42	-0.022	0.007	Pass	1.40%	0.10%	Pass	0.15	0.017	Pass
	bab	4.42	4.43	-0.010	0.006	Pass	1.40%	0.10%	Pass	0.15	0.024	Pass
	off	4.42	4.44	-0.025	0.006	Pass	1.40%	0.20%	Pass	0.30	0.071	Pass
20dB	car	4.41	4.43	-0.027	0.006	Pass	1.90%	0.20%	Pass	0.25	0.081	Pass
	bab	4.39	4.43	-0.048	0.006	Pass	2.70%	1.20%	Pass	0.30	0.141	Pass
	off	4.43	4.45	-0.022	0.004	Pass	2.30%	1.70%	Pass	0.60	0.205	Pass

**Table A.43 – Requirements Results for Experiment 10 Narrowband Speech – LC-VAD Bandwidth Saving Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	PWMC Pass	DSAF Threshold	DSAF Cut	DSAF Pass
$\infty$	N/A	4.42	4.47	-0.045	0.005	Pass	0.020	-0.010	Pass
30dB	car	4.38	4.44	-0.056	0.006	Pass	0.050	0.028	Pass
	bab	4.41	4.46	-0.046	0.003	Pass	0.050	0.019	Pass
	off	4.40	4.46	-0.053	0.003	Pass	0.200	0.081	Pass
	mus	4.42	4.49	-0.070	0.003	Pass	1.395	0.558	Pass
	int	4.41	4.47	-0.062	0.004	Pass	0.367	0.350	Pass
20dB	car	4.40	4.45	-0.049	0.003	Pass	0.150	0.098	Pass
	bab	4.41	4.46	-0.045	0.002	Pass	0.150	0.109	Pass
	off	4.43	4.46	-0.034	0.002	Pass	0.400	0.259	Pass
	mus	4.44	4.49	-0.054	0.002	Pass	1.391	1.022	Pass
	int	4.43	4.48	-0.058	0.003	Pass	0.663	0.662	Pass
10dB	car	4.40	4.43	-0.035	0.003	Pass	0.200	0.126	Pass
	bab	4.32	4.35	-0.032	0.006	Pass	0.200	0.158	Pass
	off	4.40	4.40	-0.002	0.005	Pass	0.500	0.402	Pass

**Table A.44 – Requirements Results for Experiment 10 Narrowband Speech – LC-VAD Balanced Operating Point**

<b>SNR</b>	<b>Noise</b>	<b>PWMC Ref</b>	<b>PWMC Cut</b>	<b>Diff</b>	<b>CI</b>	<b>PWMC Pass</b>	<b>DSAF Threshold</b>	<b>DSAF Cut</b>	<b>DSAF Pass</b>
$\infty$	N/A	4.42	4.47	-0.047	0.005	Pass	0.070	-0.007	Pass
30dB	car	4.43	4.45	-0.022	0.006	Pass	0.100	0.036	Pass
	bab	4.46	4.47	-0.008	0.003	Pass	0.100	0.035	Pass
	off	4.45	4.47	-0.016	0.003	Pass	0.250	0.119	Pass
	mus	4.47	4.50	-0.030	0.003	Pass	1.263	1.395	Pass
	int	4.46	4.48	-0.018	0.004	Pass	0.238	0.367	Pass
20dB	car	4.45	4.46	-0.006	0.004	Pass	0.200	0.116	Pass
	bab	4.46	4.47	-0.011	0.002	Pass	0.250	0.153	Pass
	off	4.48	4.48	0.001	0.002	Pass	0.500	0.371	Pass
	mus	4.49	4.50	-0.009	0.002	Pass	1.263	1.391	Pass
	int	4.48	4.49	-0.009	0.003	Pass	0.559	0.663	Pass
10dB	car	4.45	4.45	0.000	0.003	Pass	0.250	0.153	Pass
	bab	4.37	4.40	-0.038	0.005	Pass	0.300	0.243	Pass
	off	4.45	4.45	0.002	0.004	Pass	0.600	0.552	Pass

**Table A.45 – Requirements Results for Experiment 10 Narrowband Speech – LC-VAD Quality Preferred Operating Point**

<b>SNR</b>	<b>Noise</b>	<b>PWMC Ref</b>	<b>PWMC Cut</b>	<b>Diff</b>	<b>CI</b>	<b>PWMC Pass</b>	<b>DSAF Threshold</b>	<b>DSAF Cut</b>	<b>DSAF Pass</b>
$\infty$	N/A	4.44	4.47	-0.028	0.004	Pass	0.100	-0.007	Pass
30dB	car	4.45	4.46	-0.011	0.005	Pass	0.150	0.044	Pass
	bab	4.47	4.48	-0.004	0.003	Pass	0.150	0.063	Pass
	off	4.47	4.48	-0.011	0.003	Pass	0.300	0.163	Pass
	mus	4.48	4.50	-0.023	0.002	Pass	1.413	1.397	Pass
	int	4.47	4.48	-0.010	0.003	Pass	0.388	0.372	Pass
20dB	car	4.46	4.47	-0.003	0.003	Pass	0.250	0.137	Pass
	bab	4.47	4.48	-0.008	0.002	Pass	0.300	0.225	Pass
	off	4.48	4.48	0.001	0.002	Pass	0.600	0.468	Pass
	mus	4.49	4.50	-0.007	0.001	Pass	1.413	1.393	Pass
	int	4.48	4.49	-0.004	0.002	Pass	0.709	0.663	Pass
10dB	car	4.46	4.46	0.003	0.003	Pass	0.300	0.436	Fail
	bab	4.40	4.44	-0.037	0.004	Pass	0.350	0.339	Pass
	off	4.46	4.46	0.000	0.003	Pass	0.750	0.648	Pass

**Table A.46 – Requirements Results for Experiment 11 Narrowband Music – LC-VAD Speech Preferred (Bandwidth Saving) Operating Point**

SNR	Noise	MisRtA2I Ref	MisRtA2I Cut	A2I Pass
$\infty$	N/A	0.80%	0.60%	Pass
30dB	car	1.20%	1.10%	Pass
	bab	1.30%	1.60%	Fail
	off	1.20%	1.40%	Fail
20dB	car	1.70%	1.40%	Pass
	bab	2.30%	2.50%	Fail
	off	1.90%	1.40%	Pass

**Table A.47 – Requirements Results for Experiment 11 Narrowband Music – LC-VAD Balanced Operating Point**

SNR	Noise	MisRtA2I Ref	MisRtA2I Cut	A2I Pass
$\infty$	N/A	0.80%	0.50%	Pass
30dB	car	1.20%	0.90%	Pass
	bab	1.30%	1.30%	Fail
	off	1.20%	1.10%	Pass
20dB	car	1.70%	1.10%	Pass
	bab	2.30%	1.70%	Pass
	off	1.90%	0.80%	Pass

**Table A.48 – Requirements Results for Experiment 11 Narrowband Music –  
LC-VAD Music Preferred (Quality Preferred) Operating Point**

SNR	Noise	MisRtA2I Ref	MisRtA2I Cut	A2I Pass
$\infty$	N/A	0.80%	0.30%	Pass
30dB	car	1.20%	0.40%	Pass
	bab	1.30%	0.70%	Pass
	off	1.20%	0.50%	Pass
20dB	car	1.70%	0.50%	Pass
	bab	2.30%	1.10%	Pass
	off	1.90%	0.50%	Pass

**Table A.49 – Requirements Results for Experiment 12 Narrowband Interlaced Material – LC-VAD Bandwidth Saving Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	PWMC Pass	MisRtA2I Ref	MisRtA2I Cut	A2I Pass	DSAF Threshold	DSAF Cut	DSAF Pass
$\infty$	N/A	4.41	4.45	-0.041	0.006	Pass	1.00%	1.60%	Fail	0.02	-0.002	Pass
30dB	car	4.37	4.43	-0.064	0.007	Pass	1.50%	1.30%	Pass	0.05	0.013	Pass
	bab	4.40	4.45	-0.049	0.004	Pass	1.50%	2.30%	Fail	0.05	0.010	Pass
	off	4.40	4.45	-0.055	0.004	Pass	1.50%	2.20%	Fail	0.20	0.032	Pass
20dB	car	4.39	4.45	-0.065	0.004	Pass	2.00%	0.70%	Pass	0.15	0.059	Pass
	bab	4.39	4.44	-0.046	0.003	Pass	2.50%	3.10%	Fail	0.15	0.057	Pass
	off	4.41	4.45	-0.041	0.003	Pass	2.40%	4.30%	Fail	0.40	0.102	Pass

**Table A.50 – Requirements Results for Experiment 12 Narrowband Interlaced Material – LC-VAD Balanced Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	PWMC Pass	MisRtA2I Ref	MisRtA2I Cut	A2I Pass	DSAF Threshold	DSAF Cut	DSAF Pass
$\infty$	N/A	4.41	4.45	-0.043	0.006	Pass	1.00%	1.40%	Fail	0.07	0.001	Pass
30dB	car	4.42	4.45	-0.033	0.006	Pass	1.50%	1.00%	Pass	0.10	0.016	Pass
	bab	4.45	4.47	-0.016	0.004	Pass	1.50%	1.20%	Pass	0.10	0.015	Pass
	off	4.45	4.47	-0.022	0.004	Pass	1.50%	1.40%	Pass	0.25	0.050	Pass
20dB	car	4.44	4.46	-0.027	0.004	Pass	2.00%	0.40%	Pass	0.20	0.065	Pass
	bab	4.44	4.46	-0.018	0.003	Pass	2.50%	2.60%	Fail	0.25	0.078	Pass
	off	4.46	4.48	-0.015	0.002	Pass	2.40%	2.80%	Fail	0.50	0.161	Pass

**Table A.51 – Requirements Results for Experiment 12 Narrowband Interlaced Material – LC-VAD Quality Preferred Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	PWMC Pass	MisRtA2I Ref	MisRtA2I Cut	A2I Pass	DSAF Threshold	DSAF Cut	DSAF Pass
$\infty$	N/A	4.43	4.46	-0.022	0.005	Pass	1.00%	0.70%	Pass	0.10	0.001	Pass
30dB	car	4.44	4.46	-0.021	0.005	Pass	1.50%	0.40%	Pass	0.15	0.019	Pass
	bab	4.46	4.47	-0.011	0.003	Pass	1.50%	1.00%	Pass	0.15	0.026	Pass
	off	4.46	4.47	-0.014	0.003	Pass	1.50%	0.70%	Pass	0.30	0.067	Pass
20dB	car	4.45	4.47	-0.020	0.004	Pass	2.00%	0.20%	Pass	0.25	0.083	Pass
	bab	4.46	4.47	-0.017	0.002	Pass	2.50%	2.10%	Pass	0.30	0.124	Pass
	off	4.47	4.48	-0.011	0.002	Pass	2.40%	2.10%	Pass	0.60	0.201	Pass

**Table A.52 – Requirements Results for Experiment 13**

Music Preferred	Test Vector	Cross Num	Missed Num	Silence Pass
	Wideband	82	0	Pass
	Narrowband	68	0	Pass
Balanced	Test Vector	Cross Num	Missed Num	Silence Pass
	Wideband	82	0	Pass
	Narrowband	68	0	Pass
Speech Preferred	Test Vector	Cross Num	Missed Num	Silence Pass
	Wideband	82	0	Pass
	Narrowband	68	0	Pass



### No-degradation of the VAD results from the LC-VAD to the FC-GSAD

The objectives for Exp. 1-6 are that, for each test file, the VAD results of the FC-GSAD not be worse than the VAD results of the LC-VAD.

For all test files, the results of the VAD of the FC-GSAD were identical to the results of the VAD of the LC-VAD, and therefore these objectives are met.

**Table A.53 – Objectives Results for Experiment 1**

SNR	Noise	PWMC Threshold OTP	PWMC CuT	PWMC Pass
$\infty$	N/A	4.36	4.35	Pass
30dB	car	4.43	4.41	Pass
	bab	4.45	4.43	Pass
	off	4.44	4.44	Pass
	mus	4.46	4.50	Pass
	int	4.44	4.43	Pass
20dB	car	4.45	4.43	Pass
	bab	4.44	4.43	Pass
	off	4.46	4.45	Pass
	mus	4.48	4.50	Pass
	int	4.46	4.45	Pass
10dB	car	4.44	4.40	Fail
	bab	4.31	4.32	Pass
	off	4.42	4.37	Fail

**Table A.54 – Objectives Results for Experiment 3**

SNR	Noise	PWMC Threshold OTP	PWMC CuT	PWMC Pass
$\infty$	N/A	4.37	4.33	Pass
30dB	car	4.43	4.42	Pass
	bab	4.45	4.43	Pass
	off	4.44	4.44	Pass
20dB	car	4.44	4.43	Pass
	bab	4.42	4.43	Pass
	off	4.46	4.45	Pass

**Table A.55 – Objectives Results for Experiment 4**

SNR	Noise	PWMC Threshold OTP	PWMC CuT	PWMC Pass
$\infty$	N/A	4.46	4.47	Pass
30dB	car	4.46	4.46	Pass
	bab	4.48	4.48	Pass
	off	4.48	4.48	Pass
	mus	4.49	4.50	Pass
	int	4.48	4.48	Pass
20dB	car	4.48	4.47	Pass
	bab	4.48	4.48	Pass
	off	4.49	4.48	Fail
	mus	4.50	4.50	Pass
	int	4.49	4.49	Pass
10dB	car	4.47	4.46	Fail
	bab	4.43	4.44	Pass
	off	4.47	4.46	Pass

**Table A.56 – Objectives Results for Experiment 6**

SNR	Noise	PWMC Threshold OTP	PWMC CuT	PWMC Pass
$\infty$	N/A	4.46	4.46	Pass
30dB	car	4.46	4.46	Pass
	bab	4.48	4.47	Pass
	off	4.47	4.47	Pass
20dB	car	4.47	4.47	Pass
	bab	4.47	4.47	Pass
	off	4.48	4.48	Pass

**Table A.57 – Objectives Results for Experiment 7**

SNR	Noise	PWMC Threshold OTP	PWMC CuT	PWMC Pass
$\infty$	N/A	4.36	4.35	Pass
30dB	car	4.43	4.41	Pass
	bab	4.45	4.43	Pass
	off	4.44	4.44	Pass
	mus	4.46	4.50	Pass
	int	4.44	4.43	Pass
20dB	car	4.45	4.43	Pass
	bab	4.44	4.43	Pass
	off	4.46	4.45	Pass
	mus	4.48	4.50	Pass
	int	4.46	4.45	Pass
10dB	car	4.44	4.40	Fail
	bab	4.31	4.32	Pass
	off	4.42	4.37	Fail

**Table A.58 – Objectives Results for Experiment 9**

SNR	Noise	PWMC Threshold OTP	PWMC CuT	PWMC Pass
$\infty$	N/A	4.37	4.33	Pass
30dB	car	4.43	4.42	Pass
	bab	4.45	4.43	Pass
	off	4.44	4.44	Pass
20dB	car	4.44	4.43	Pass
	bab	4.42	4.43	Pass
	off	4.46	4.45	Pass

**Table A.59 – Objectives Results for Experiment 10**

SNR	Noise	PWMC Threshold OTP	PWMC CuT	PWMC Pass
$\infty$	N/A	4.46	4.47	Pass
30dB	car	4.46	4.46	Pass
	bab	4.48	4.48	Pass
	off	4.48	4.48	Pass
	mus	4.49	4.50	Pass
	int	4.48	4.48	Pass
20dB	car	4.48	4.47	Pass
	bab	4.48	4.48	Pass
	off	4.49	4.48	Fail
	mus	4.50	4.50	Pass
	int	4.49	4.49	Pass
10dB	car	4.47	4.46	Fail
	bab	4.43	4.44	Pass
	off	4.47	4.46	Pass

**Table A.60 – Objectives Results for Experiment 12**

SNR	Noise	PWMC Threshold OTP	PWMC CuT	PWMC Pass
$\infty$	N/A	4.46	4.46	Pass
30dB	car	4.46	4.46	Pass
	bab	4.48	4.47	Pass
	off	4.47	4.47	Pass
20dB	car	4.47	4.47	Pass
	bab	4.47	4.47	Pass
	off	4.48	4.48	Pass

## A.2 Detailed selection test results from Huawei Technologies

**Table A.61 – Requirements Results for Experiment 1 Wideband Speech – FC-GSAD Bandwidth Saving Operating Point**

SNR	noise	PWMC Ref	PWMC Cut	Diff	CI	T-Test Pass	PWMC Cut LC	PWMC Pass	DSAF Threshold	DSAF Cut	DSAF Pass	MisRtS2M Threshold	MisRtS2M Cut	S2M Pass
∞	N/A	4.21	4.35	-0.135	0.011	Pass	4.35	Pass	0.020	-0.010	Pass	2.00%	0.10%	Pass
30dB	car	4.30	4.36	-0.062	0.010	Pass	4.36	Pass	0.050	0.022	Pass	3.00%	0.10%	Pass
	bab	4.35	4.39	-0.043	0.007	Pass	4.39	Pass	0.050	0.016	Pass	3.00%	0.10%	Pass
	off	4.33	4.39	-0.063	0.008	Pass	4.39	Pass	0.200	0.077	Pass	3.00%	0.10%	Pass
	mus	4.36	4.48	-0.119	0.008	Pass	4.48	Pass	1.287	0.520	Pass	5.00%	1.40%	Pass
	int	4.32	4.42	-0.098	0.008	Pass	4.42	Pass	0.355	0.344	Pass	2.00%	0.20%	Pass
20dB	car	4.34	4.40	-0.056	0.007	Pass	4.40	Pass	0.150	0.085	Pass	7.00%	0.20%	Pass
	bab	4.32	4.38	-0.059	0.006	Pass	4.38	Pass	0.150	0.087	Pass	7.00%	0.10%	Pass
	off	4.38	4.41	-0.037	0.005	Pass	4.41	Pass	0.400	0.251	Pass	7.00%	0.10%	Pass
	mus	4.42	4.49	-0.069	0.005	Pass	4.49	Pass	1.266	0.953	Pass	10.00%	10.60%	Fail
	int	4.36	4.45	-0.084	0.007	Pass	4.45	Pass	0.656	0.656	Pass	3.00%	0.50%	Pass
10dB	car	4.33	4.37	-0.033	0.005	Pass	4.37	Pass	0.200	0.113	Pass	12.00%	0.10%	Pass
	bab	4.06	4.23	-0.167	0.012	Pass	4.23	Pass	0.200	0.199	Pass	15.00%	0.20%	Pass
	off	4.29	4.28	0.005	0.009	Pass	4.28	Pass	0.500	0.372	Pass	20.00%	0.40%	Pass

**Table A.62 – Requirements Results for Experiment 1 Wideband Speech – FC-GSAD Balanced Operating Point**

SNR	noise	PWMC Ref	PWMC Cut	Diff	CI	T-Test Pass	PWMC Cut LC	PWMC Pass	DSAF Threshold	DSAF Cut	DSAF Pass	MisRtS2M Threshold	MisRtS2M Cut	S2M Pass
∞	N/A	4.21	4.35	-0.136	0.011	Pass	4.35	Pass	0.070	-0.010	Pass	3.00%	0.10%	Pass
30dB	car	4.35	4.39	-0.042	0.010	Pass	4.39	Pass	0.100	0.030	Pass	5.00%	0.20%	Pass
	bab	4.40	4.42	-0.024	0.007	Pass	4.42	Pass	0.100	0.028	Pass	5.00%	0.20%	Pass
	off	4.38	4.42	-0.042	0.008	Pass	4.42	Pass	0.250	0.116	Pass	5.00%	0.20%	Pass
	mus	4.41	4.50	-0.086	0.007	Pass	4.50	Pass	1.199	1.287	Pass	10.00%	2.10%	Pass
	int	4.37	4.43	-0.056	0.008	Pass	4.43	Pass	0.233	0.355	Pass	3.00%	0.30%	Pass
20dB	car	4.39	4.42	-0.022	0.007	Pass	4.42	Pass	0.200	0.104	Pass	10.00%	0.20%	Pass
	bab	4.37	4.42	-0.045	0.006	Pass	4.42	Pass	0.250	0.149	Pass	10.00%	0.10%	Pass
	off	4.43	4.44	-0.011	0.005	Pass	4.44	Pass	0.500	0.345	Pass	10.00%	0.30%	Pass
	mus	4.47	4.50	-0.028	0.005	Pass	4.50	Pass	1.199	1.266	Pass	15.00%	13.10%	Pass
	int	4.41	4.45	-0.037	0.007	Pass	4.45	Pass	0.554	0.656	Pass	5.00%	0.70%	Pass
10dB	car	4.38	4.39	-0.005	0.005	Pass	4.39	Pass	0.250	0.136	Pass	16.00%	0.30%	Pass
	bab	4.11	4.28	-0.166	0.011	Pass	4.28	Pass	0.300	0.244	Pass	20.00%	0.60%	Pass
	off	4.34	4.34	-0.008	0.008	Pass	4.34	Pass	0.600	0.450	Pass	25.00%	0.80%	Pass

**Table A.63 – Requirements Results for Experiment 1 Wideband Speech – FC-GSAD Quality Preferred Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	T-Test Pass	PWMC Cut LC	PWMC Pass	DSAF Threshold	DSAF Cut	DSAF Pass	MisRtS2M Threshold	MisRtS2M Cut	S2M Pass
∞	N/A	4.29	4.35	-0.066	0.009	Pass	4.35	Pass	0.100	-0.010	Pass	5.00%	0.30%	Pass
30dB	car	4.39	4.41	-0.020	0.008	Pass	4.41	Pass	0.150	0.038	Pass	8.00%	0.40%	Pass
	bab	4.42	4.43	-0.012	0.005	Pass	4.43	Pass	0.150	0.058	Pass	8.00%	0.50%	Pass
	off	4.41	4.44	-0.026	0.007	Pass	4.44	Pass	0.300	0.170	Pass	8.00%	0.60%	Pass
	mus	4.43	4.50	-0.064	0.006	Pass	4.50	Pass	1.349	1.292	Pass	15.00%	3.60%	Pass
	int	4.41	4.43	-0.027	0.007	Pass	4.43	Pass	0.383	0.360	Pass	7.00%	0.60%	Pass
20dB	car	4.42	4.43	-0.005	0.006	Pass	4.43	Pass	0.250	0.122	Pass	13.00%	0.70%	Pass
	bab	4.41	4.43	-0.025	0.005	Pass	4.43	Pass	0.300	0.244	Pass	13.00%	0.70%	Pass
	off	4.44	4.45	-0.004	0.004	Pass	4.45	Pass	0.600	0.466	Pass	13.00%	1.30%	Pass
	mus	4.48	4.50	-0.021	0.004	Pass	4.50	Pass	1.349	1.273	Pass	20.00%	21.90%	Fail
	int	4.43	4.45	-0.015	0.006	Pass	4.45	Pass	0.704	0.657	Pass	8.00%	1.70%	Pass
10dB	car	4.41	4.40	0.015	0.006	Fail	4.40	Fail	0.300	0.255	Pass	20.00%	1.60%	Pass
	bab	4.21	4.32	-0.109	0.009	Pass	4.32	Pass	0.350	0.319	Pass	25.00%	4.20%	Pass
	off	4.38	4.37	0.005	0.006	Pass	4.37	Pass	0.750	0.509	Pass	30.00%	3.10%	Pass

**Table A.64 – Requirements Results for Experiment 2 Wideband Music – FC-GSAD Speech Preferred (Bandwidth Saving) Operating Point**

SNR	Noise	MisRtA2I Ref	MisRtA2I Cut	MisRtA2I Cut LC	A2I Pass	MisRtM2S Threshold	MisRtM2S Cut	M2SPass
$\infty$	N/A	0.20%	0.00%	0.00%	Pass	7.00%	2.70%	Pass
30dB	car	0.40%	0.10%	0.10%	Pass	13.00%	2.30%	Pass
	bab	0.40%	0.10%	0.10%	Pass	13.00%	2.40%	Pass
	off	0.80%	0.10%	0.10%	Pass	13.00%	2.90%	Pass
20dB	car	1.10%	0.10%	0.10%	Pass	18.00%	2.20%	Pass
	bab	1.50%	0.30%	0.30%	Pass	18.00%	4.10%	Pass
	off	1.40%	0.20%	0.20%	Pass	18.00%	4.50%	Pass

**Table A.65 – Requirements Results for Experiment 2 Wideband Music – FC-GSAD Balanced Operating Point**

SNR	Noise	MisRtA2I Ref	MisRtA2I Cut	MisRtA2I Cut LC	A2I Pass	MisRtM2S Threshold	MisRtM2S Cut	M2SPass
$\infty$	N/A	0.20%	0.00%	0.00%	Pass	5.00%	2.40%	Pass
30dB	car	0.40%	0.00%	0.00%	Pass	10.00%	2.00%	Pass
	bab	0.40%	0.00%	0.00%	Pass	10.00%	2.30%	Pass
	off	0.80%	0.00%	0.00%	Pass	10.00%	2.70%	Pass
20dB	car	1.10%	0.00%	0.00%	Pass	15.00%	2.10%	Pass
	bab	1.50%	0.30%	0.30%	Pass	15.00%	3.10%	Pass
	off	1.40%	0.10%	0.10%	Pass	15.00%	3.90%	Pass



**Table A.66 – Requirements Results for Experiment 2 Wideband Music – FC-GSAD Music Preferred (Quality Preferred) Operating Point**

SNR	Noise	MisRtA2I Ref	MisRtA2I Cut	MisRtA2I Cut LC	A2I Pass	MisRtM2S Threshold	MisRtM2S Cut	M2SPass
$\infty$	N/A	0.20%	0.00%	0.00%	Pass	3.00%	1.70%	Pass
30dB	car	0.40%	0.00%	0.00%	Pass	7.00%	1.50%	Pass
	bab	0.40%	0.00%	0.00%	Pass	7.00%	1.60%	Pass
	off	0.80%	0.00%	0.00%	Pass	7.00%	2.10%	Pass
20dB	car	1.10%	0.00%	0.00%	Pass	10.00%	1.60%	Pass
	bab	1.50%	0.20%	0.20%	Pass	10.00%	2.00%	Pass
	off	1.40%	0.00%	0.00%	Pass	10.00%	3.00%	Pass

**Table A.67 – Requirements Results for Experiment 3 Wideband Interlaced Material – FC-GSAD Bandwidth Saving Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	T-Test Pass	PWMC Cut LC	PWMC Pass	MisRtA2I Ref	MisRtA2I Cut	MisRtA2I Cut LC	A2I Pass	DSAF Threshold	DSAF Cut	DSAF Pass	MisRtS2M Threshold	MisRtS2M Cut	S2M Pass	MisRtM2S Threshold	MisRtM2S Cut	M2S Pass
∞	N/A	4.254	4.355	-0.102	0.009	Pass	4.355	Pass	0.00%	0.00%	0.00%	Pass	0.02	-0.004	Pass	2.10%	0.00%	Pass	9.10%	2.70%	Pass
30dB	car	4.324	4.366	-0.042	0.009	Pass	4.366	Pass	0.00%	0.00%	0.00%	Pass	0.05	0.007	Pass	3.20%	0.10%	Pass	16.90%	2.60%	Pass
	bab	4.354	4.395	-0.041	0.007	Pass	4.395	Pass	0.40%	0.00%	0.00%	Pass	0.05	0.004	Pass	3.20%	0.10%	Pass	16.90%	2.90%	Pass
	off	4.359	4.392	-0.034	0.007	Pass	4.392	Pass	0.40%	0.00%	0.00%	Pass	0.2	0.025	Pass	3.20%	1.00%	Pass	16.90%	2.80%	Pass
20dB	car	4.351	4.409	-0.058	0.007	Pass	4.409	Pass	1.40%	0.00%	0.00%	Pass	0.15	0.033	Pass	7.40%	0.10%	Pass	23.40%	2.70%	Pass
	bab	4.325	4.415	-0.09	0.006	Pass	4.415	Pass	1.60%	0.00%	0.00%	Pass	0.15	0.031	Pass	7.40%	0.10%	Pass	23.40%	3.30%	Pass
	off	4.389	4.419	-0.03	0.005	Pass	4.419	Pass	1.40%	0.00%	0.00%	Pass	0.4	0.096	Pass	7.40%	1.90%	Pass	23.40%	3.20%	Pass

**Table A.68 – Requirements Results for Experiment 3 Wideband Interlaced Material – FC-GSAD Balanced Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	T-Test Pass	PWMC Cut LC	PWMC Pass	MisRtA2I Ref	MisRtA2I Cut	MisRtA2I Cut LC	A2I Pass	DSAF Threshold	DSAF Cut	DSAF Pass	MisRtS2M Threshold	MisRtS2M Cut	S2M Pass	MisRtM2S Threshold	MisRtM2S Cut	M2S Pass
∞	N/A	4.254	4.356	-0.103	0.009	Pass	4.356	Pass	0.00%	0.00%	0.00%	Pass	0.07	-0.004	Pass	3.30%	0.00%	Pass	6.00%	2.60%	Pass
30dB	car	4.374	4.402	-0.028	0.008	Pass	4.402	Pass	0.00%	0.00%	0.00%	Pass	0.1	0.01	Pass	5.50%	0.10%	Pass	12.00%	2.50%	Pass
	bab	4.404	4.418	-0.014	0.007	Pass	4.418	Pass	0.40%	0.00%	0.00%	Pass	0.1	0.008	Pass	5.50%	0.10%	Pass	12.00%	2.70%	Pass
	off	4.409	4.417	-0.008	0.007	Pass	4.417	Pass	0.40%	0.00%	0.00%	Pass	0.25	0.044	Pass	5.50%	1.10%	Pass	12.00%	2.60%	Pass
20dB	car	4.401	4.419	-0.018	0.006	Pass	4.419	Pass	1.40%	0.00%	0.00%	Pass	0.2	0.041	Pass	11.00%	0.10%	Pass	18.00%	2.60%	Pass
	bab	4.375	4.438	-0.063	0.006	Pass	4.438	Pass	1.60%	0.00%	0.00%	Pass	0.25	0.055	Pass	11.00%	0.20%	Pass	18.00%	3.00%	Pass
	off	4.439	4.446	-0.007	0.004	Pass	4.446	Pass	1.40%	0.00%	0.00%	Pass	0.5	0.139	Pass	11.00%	2.30%	Pass	18.00%	2.70%	Pass

**Table A.69 – Requirements Results for Experiment 3 Wideband Interlaced Material – FC-GSAD Quality Preferred Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	T-Test Pass	PWMC Cut LC	PWMC Pass	MisRtA2I Ref	MisRtA2I Cut	MisRtA2I Cut LC	A2I Pass	DSAF Threshold	DSAF Cut	DSAF Pass	MisRtS2M Threshold	MisRtS2M Cut	S2M Pass	MisRtM2S Threshold	MisRtM2S Cut	M2S Pass
∞	N/A	4.315	4.357	-0.041	0.008	Pass	4.357	Pass	0.00%	0.00%	0.00%	Pass	0.1	-0.004	Pass	5.80%	0.00%	Pass	3.30%	2.20%	Pass
30dB	car	4.406	4.412	-0.006	0.007	Pass	4.412	Pass	0.00%	0.00%	0.00%	Pass	0.15	0.014	Pass	9.20%	0.10%	Pass	7.70%	2.10%	Pass
	bab	4.428	4.431	-0.003	0.006	Pass	4.431	Pass	0.40%	0.00%	0.00%	Pass	0.15	0.018	Pass	9.20%	0.10%	Pass	7.70%	2.10%	Pass
	off	4.432	4.432	0	0.006	Pass	4.432	Pass	0.40%	0.00%	0.00%	Pass	0.3	0.065	Pass	9.20%	1.30%	Pass	7.70%	2.00%	Pass
20dB	car	4.426	4.427	-0.001	0.006	Pass	4.427	Pass	1.40%	0.00%	0.00%	Pass	0.25	0.048	Pass	15.00%	0.10%	Pass	11.00%	2.00%	Pass
	bab	4.406	4.445	-0.039	0.005	Pass	4.445	Pass	1.60%	0.00%	0.00%	Pass	0.3	0.09	Pass	15.00%	0.60%	Pass	11.00%	2.20%	Pass
	off	4.454	4.452	0.002	0.004	Pass	4.452	Pass	1.40%	0.00%	0.00%	Pass	0.6	0.19	Pass	15.00%	2.80%	Pass	11.00%	2.00%	Pass

**Table A.70 – Requirements Results for Experiment 4 Narrowband Speech – FC-GSAD Bandwidth Saving Operating Point**

SNR	noise	PWMC Ref	PWMC Cut	Diff	CI	T-Test Pass	PWMC Cut LC	PWMC Pass	DSAF Threshold	DSAF Cut	DSAF Pass	MisRtS2M Threshold	MisRtS2M Cut	S2M Pass
∞	N/A	4.42	4.47	-0.045	0.005	Pass	4.47	Pass	0.020	-0.010	Pass	2.00%	0.10%	Pass
30dB	car	4.38	4.44	-0.056	0.006	Pass	4.44	Pass	0.050	0.028	Pass	3.00%	0.10%	Pass
	bab	4.41	4.46	-0.046	0.003	Pass	4.46	Pass	0.050	0.019	Pass	3.00%	0.00%	Pass
	off	4.40	4.46	-0.053	0.003	Pass	4.46	Pass	0.200	0.081	Pass	3.00%	0.10%	Pass
	mus	4.42	4.49	-0.070	0.003	Pass	4.49	Pass	1.395	0.558	Pass	5.00%	0.90%	Pass
	int	4.41	4.47	-0.062	0.004	Pass	4.47	Pass	0.367	0.350	Pass	2.00%	0.20%	Pass
20dB	car	4.40	4.45	-0.049	0.003	Pass	4.45	Pass	0.150	0.098	Pass	7.00%	0.00%	Pass
	bab	4.41	4.46	-0.045	0.002	Pass	4.46	Pass	0.150	0.109	Pass	7.00%	0.00%	Pass
	off	4.43	4.46	-0.034	0.002	Pass	4.46	Pass	0.400	0.259	Pass	7.00%	0.00%	Pass
	mus	4.44	4.49	-0.054	0.002	Pass	4.49	Pass	1.391	1.022	Pass	10.00%	8.20%	Pass
	int	4.43	4.48	-0.058	0.003	Pass	4.48	Pass	0.663	0.662	Pass	3.00%	0.50%	Pass
10dB	car	4.40	4.43	-0.035	0.003	Pass	4.43	Pass	0.200	0.126	Pass	12.00%	0.00%	Pass
	bab	4.32	4.35	-0.032	0.006	Pass	4.35	Pass	0.200	0.158	Pass	15.00%	0.20%	Pass
	off	4.40	4.40	-0.002	0.005	Pass	4.40	Pass	0.500	0.402	Pass	20.00%	0.50%	Pass

**Table A.71 – Requirements Results for Experiment 4 Narrowband Speech – FC-GSAD Balanced Operating Point**

SNR	noise	PWMC Ref	PWMC Cut	Diff	CI	T-Test Pass	PWMC Cut LC	PWMC Pass	DSAF Threshold	DSAF Cut	DSAF Pass	MisRtS2M Threshold	MisRtS2M Cut	S2M Pass
$\infty$	N/A	4.42	4.47	-0.047	0.005	Pass	4.47	Pass	0.070	-0.007	Pass	3.00%	0.10%	Pass
30dB	car	4.43	4.45	-0.022	0.006	Pass	4.45	Pass	0.100	0.036	Pass	5.00%	0.10%	Pass
	bab	4.46	4.47	-0.008	0.003	Pass	4.47	Pass	0.100	0.035	Pass	5.00%	0.00%	Pass
	off	4.45	4.47	-0.016	0.003	Pass	4.47	Pass	0.250	0.119	Pass	5.00%	0.10%	Pass
	mus	4.47	4.50	-0.030	0.003	Pass	4.50	Pass	1.263	1.395	Pass	10.00%	1.40%	Pass
	int	4.46	4.48	-0.018	0.004	Pass	4.48	Pass	0.238	0.367	Pass	3.00%	0.20%	Pass
20dB	car	4.45	4.46	-0.006	0.004	Pass	4.46	Pass	0.200	0.116	Pass	10.00%	0.10%	Pass
	bab	4.46	4.47	-0.011	0.002	Pass	4.47	Pass	0.250	0.153	Pass	10.00%	0.10%	Pass
	off	4.48	4.48	0.001	0.002	Pass	4.48	Pass	0.500	0.371	Pass	10.00%	0.10%	Pass
	mus	4.49	4.50	-0.009	0.002	Pass	4.50	Pass	1.263	1.391	Pass	15.00%	11.30%	Pass
	int	4.48	4.49	-0.009	0.003	Pass	4.49	Pass	0.559	0.663	Pass	5.00%	0.80%	Pass
10dB	car	4.45	4.45	0.000	0.003	Pass	4.45	Pass	0.250	0.153	Pass	16.00%	0.10%	Pass
	bab	4.37	4.40	-0.038	0.005	Pass	4.40	Pass	0.300	0.243	Pass	20.00%	0.40%	Pass
	off	4.45	4.45	0.002	0.004	Pass	4.45	Pass	0.600	0.552	Pass	25.00%	0.70%	Pass

**Table A.72 – Requirements Results for Experiment 4 Narrowband Speech – FC-GSAD Quality Preferred Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	T-Test Pass	PWMC Cut LC	PWMC Pass	DSAF Threshold	DSAF Cut	DSAF Pass	MisRtS2M Threshold	MisRtS2M Cut	S2M Pass
$\infty$	N/A	4.44	4.47	-0.028	0.004	Pass	4.47	Pass	0.100	-0.007	Pass	5.00%	0.30%	Pass
30dB	car	4.45	4.46	-0.011	0.005	Pass	4.46	Pass	0.150	0.044	Pass	8.00%	0.40%	Pass
	bab	4.47	4.48	-0.004	0.003	Pass	4.48	Pass	0.150	0.063	Pass	8.00%	0.30%	Pass
	off	4.47	4.48	-0.011	0.003	Pass	4.48	Pass	0.300	0.163	Pass	8.00%	0.60%	Pass
	mus	4.48	4.50	-0.023	0.002	Pass	4.50	Pass	1.413	1.397	Pass	15.00%	2.90%	Pass
	int	4.47	4.48	-0.010	0.003	Pass	4.48	Pass	0.388	0.372	Pass	7.00%	0.70%	Pass
20dB	car	4.46	4.47	-0.003	0.003	Pass	4.47	Pass	0.250	0.137	Pass	13.00%	0.50%	Pass
	bab	4.47	4.48	-0.008	0.002	Pass	4.48	Pass	0.300	0.225	Pass	13.00%	0.40%	Pass
	off	4.48	4.48	0.001	0.002	Pass	4.48	Pass	0.600	0.468	Pass	13.00%	0.80%	Pass
	mus	4.49	4.50	-0.007	0.001	Pass	4.50	Pass	1.413	1.393	Pass	20.00%	20.00%	Pass
	int	4.48	4.49	-0.004	0.002	Pass	4.49	Pass	0.709	0.663	Pass	8.00%	1.90%	Pass
10dB	car	4.46	4.46	0.003	0.003	Pass	4.46	Pass	0.300	0.436	Fail	20.00%	0.60%	Pass
	bab	4.40	4.44	-0.037	0.004	Pass	4.44	Pass	0.350	0.339	Pass	25.00%	1.90%	Pass
	off	4.46	4.46	0.000	0.003	Pass	4.46	Pass	0.750	0.648	Pass	30.00%	2.60%	Pass

**Table A.73 – Requirements Results for Experiment 5 Narrowband Music – FC-GSAD Speech Preferred (Bandwidth Saving) Operating Point**

SNR	Noise	MisRtA2I Ref	MisRtA2I Cut	MisRtA2I Cut LC	A2I Pass	MisRtM2S Threshold	MisRtM2S Cut	M2SPass
$\infty$	N/A	0.20%	0.10%	0.10%	Pass	7.00%	3.30%	Pass
30dB	car	0.30%	0.00%	0.00%	Pass	13.00%	2.10%	Pass
	bab	0.80%	0.10%	0.10%	Pass	13.00%	2.10%	Pass
	off	0.60%	0.10%	0.10%	Pass	13.00%	2.70%	Pass
20dB	car	1.00%	0.10%	0.10%	Pass	18.00%	2.10%	Pass
	bab	1.50%	0.40%	0.40%	Pass	18.00%	3.40%	Pass
	off	1.30%	0.20%	0.20%	Pass	18.00%	3.80%	Pass

**Table A.74 – Requirements Results for Experiment 5 Narrowband Music – FC-GSAD Balanced Operating Point**

SNR	Noise	MisRtA2I Ref	MisRtA2I Cut	MisRtA2I Cut LC	A2I Pass	MisRtM2S Threshold	MisRtM2S Cut	M2SPass
$\infty$	N/A	0.20%	0.10%	0.10%	Pass	5.00%	3.00%	Pass
30dB	car	0.30%	0.00%	0.00%	Pass	10.00%	1.80%	Pass
	bab	0.80%	0.00%	0.00%	Pass	10.00%	1.90%	Pass
	off	0.60%	0.00%	0.00%	Pass	10.00%	2.40%	Pass
20dB	car	1.00%	0.00%	0.00%	Pass	15.00%	1.80%	Pass
	bab	1.50%	0.30%	0.30%	Pass	15.00%	3.00%	Pass
	off	1.30%	0.10%	0.10%	Pass	15.00%	3.50%	Pass

**Table A.75 – Requirements Results for Experiment 5 Narrowband Music – FC-GSAD Music Preferred (Quality Preferred) Operating Point**

SNR	Noise	MisRtA2I Ref	MisRtA2I Cut	MisRtA2I Cut LC	A2I Pass	MisRtM2S Threshold	MisRtM2S Cut	M2SPass
$\infty$	N/A	0.20%	0.00%	0.00%	Pass	3.00%	2.40%	Pass
30dB	car	0.30%	0.00%	0.00%	Pass	7.00%	1.40%	Pass
	bab	0.80%	0.00%	0.00%	Pass	7.00%	1.40%	Pass
	off	0.60%	0.00%	0.00%	Pass	7.00%	1.90%	Pass
20dB	car	1.00%	0.00%	0.00%	Pass	10.00%	1.30%	Pass
	bab	1.50%	0.20%	0.20%	Pass	10.00%	2.00%	Pass
	off	1.30%	0.00%	0.00%	Pass	10.00%	2.90%	Pass



**Table A.76 – Requirements Results for Experiment 6 Narrowband Interlaced Material – FC-GSAD Bandwidth Saving Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	T-Test Pass	PWMC Cut LC	PWMC Pass	MisRtA2I Ref	MisRtA2I Cut	MisRtA2I Cut LC	A2I Pass	DSAF Threshold	DSAF Cut	DSAF Pass	MisRtS2M Threshold	MisRtS2M Cut	S2M Pass	MisRtM2S Threshold	MisRtM2S Cut	M2S Pass
∞	N/A	4.438	4.463	-0.025	0.004	Pass	4.463	Pass	0.40%	0.00%	0.00%	Pass	0.02	-0.004	Pass	2.10%	0.10%	Pass	9.10%	2.60%	Pass
30dB	car	4.394	4.438	-0.044	0.005	Pass	4.438	Pass	0.40%	0.00%	0.00%	Pass	0.05	0.009	Pass	3.20%	0.10%	Pass	16.90%	2.50%	Pass
	bab	4.416	4.46	-0.044	0.003	Pass	4.46	Pass	0.60%	0.00%	0.00%	Pass	0.05	0.003	Pass	3.20%	0.10%	Pass	16.90%	2.80%	Pass
	off	4.416	4.46	-0.044	0.003	Pass	4.46	Pass	0.20%	0.00%	0.00%	Pass	0.2	0.026	Pass	3.20%	1.10%	Pass	16.90%	2.60%	Pass
20dB	car	4.409	4.456	-0.047	0.003	Pass	4.456	Pass	1.50%	0.00%	0.00%	Pass	0.15	0.037	Pass	7.40%	0.10%	Pass	23.40%	2.70%	Pass
	bab	4.413	4.466	-0.053	0.002	Pass	4.466	Pass	1.90%	0.00%	0.00%	Pass	0.15	0.033	Pass	7.40%	0.10%	Pass	23.40%	4.00%	Pass
	off	4.426	4.465	-0.039	0.002	Pass	4.465	Pass	1.50%	0.00%	0.00%	Pass	0.4	0.095	Pass	7.40%	2.00%	Pass	23.40%	3.20%	Pass

**Table A.77 – Requirements Results for Experiment 6 Narrowband Interlaced Material – FC-GSAD Balanced Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	T-Test Pass	PWMC Cut LC	PWMC Pass	MisRtA2I Ref	MisRtA2I Cut	MisRtA2I Cut LC	A2I Pass	DSAF Threshold	DSAF Cut	DSAF Pass	MisRtS2M Threshold	MisRtS2M Cut	S2M Pass	MisRtM2S Threshold	MisRtM2S Cut	M2S Pass
∞	N/A	4.438	4.466	-0.028	0.004	Pass	4.466	Pass	0.40%	0.00%	0.00%	Pass	0.07	-0.004	Pass	3.30%	0.10%	Pass	6.00%	2.50%	Pass
30dB	car	4.444	4.456	-0.012	0.004	Pass	4.456	Pass	0.40%	0.00%	0.00%	Pass	0.1	0.012	Pass	5.50%	0.10%	Pass	12.00%	2.40%	Pass
	bab	4.466	4.47	-0.004	0.003	Pass	4.47	Pass	0.60%	0.00%	0.00%	Pass	0.1	0.008	Pass	5.50%	0.10%	Pass	12.00%	2.60%	Pass
	off	4.466	4.473	-0.007	0.003	Pass	4.473	Pass	0.20%	0.00%	0.00%	Pass	0.25	0.044	Pass	5.50%	1.30%	Pass	12.00%	2.50%	Pass
20dB	car	4.459	4.462	-0.003	0.003	Pass	4.462	Pass	1.50%	0.00%	0.00%	Pass	0.2	0.044	Pass	11.00%	0.10%	Pass	18.00%	2.50%	Pass
	bab	4.463	4.475	-0.012	0.002	Pass	4.475	Pass	1.90%	0.00%	0.00%	Pass	0.25	0.053	Pass	11.00%	0.30%	Pass	18.00%	3.40%	Pass
	off	4.476	4.48	-0.003	0.002	Pass	4.48	Pass	1.50%	0.00%	0.00%	Pass	0.5	0.151	Pass	11.00%	2.50%	Pass	18.00%	2.80%	Pass

**Table A.78 – Requirements Results for Experiment 6 Narrowband Interlaced Material – FC-GSAD Quality Preferred Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	T-Test Pass	PWMC Cut LC	PWMC Pass	MisRtA2I Ref	MisRtA2I Cut	MisRtA2I Cut LC	A2I Pass	DSAF Threshold	DSAF Cut	DSAF Pass	MisRtS2M Threshold	MisRtS2M Cut	S2M Pass	MisRtM2S Threshold	MisRtM2S Cut	M2S Pass
∞	N/A	4.454	4.467	-0.014	0.003	Pass	4.467	Pass	0.40%	0.00%	0.00%	Pass	0.1	-0.004	Pass	5.80%	0.10%	Pass	3.30%	2.20%	Pass
30dB	car	4.458	4.463	-0.005	0.004	Pass	4.463	Pass	0.40%	0.00%	0.00%	Pass	0.15	0.015	Pass	9.20%	0.10%	Pass	7.70%	2.10%	Pass
	bab	4.475	4.475	0.000	0.002	Pass	4.475	Pass	0.60%	0.00%	0.00%	Pass	0.15	0.018	Pass	9.20%	0.10%	Pass	7.70%	2.30%	Pass
	off	4.475	4.479	-0.004	0.002	Pass	4.479	Pass	0.20%	0.00%	0.00%	Pass	0.3	0.061	Pass	9.20%	1.40%	Pass	7.70%	2.00%	Pass
20dB	car	4.469	4.467	0.002	0.003	Pass	4.467	Pass	1.50%	0.00%	0.00%	Pass	0.25	0.053	Pass	15.00%	0.10%	Pass	11.00%	2.10%	Pass
	bab	4.472	4.483	-0.010	0.002	Pass	4.483	Pass	1.90%	0.00%	0.00%	Pass	0.3	0.083	Pass	15.00%	0.70%	Pass	11.00%	2.50%	Pass
	off	4.482	4.483	0.000	0.001	Pass	4.483	Pass	1.50%	0.00%	0.00%	Pass	0.6	0.189	Pass	15.00%	3.30%	Pass	11.00%	2.20%	Pass

**Table A.79 – Requirements Results for Experiment 7 Wideband Speech – LC-VAD Bandwidth Saving Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	PWMC Pass	DSAF Threshold	DSAF Cut	DSAF Pass
$\infty$	N/A	4.21	4.35	-0.135	0.011	Pass	0.020	-0.010	Pass
30dB	car	4.30	4.36	-0.062	0.010	Pass	0.050	0.022	Pass
	bab	4.35	4.39	-0.043	0.007	Pass	0.050	0.016	Pass
	off	4.33	4.39	-0.063	0.008	Pass	0.200	0.077	Pass
	mus	4.36	4.48	-0.119	0.008	Pass	1.287	0.520	Pass
	int	4.32	4.42	-0.098	0.008	Pass	0.355	0.344	Pass
20dB	car	4.34	4.40	-0.056	0.007	Pass	0.150	0.085	Pass
	bab	4.32	4.38	-0.059	0.006	Pass	0.150	0.087	Pass
	off	4.38	4.41	-0.037	0.005	Pass	0.400	0.251	Pass
	mus	4.42	4.49	-0.069	0.005	Pass	1.266	0.953	Pass
	int	4.36	4.45	-0.084	0.007	Pass	0.656	0.656	Pass
10dB	car	4.33	4.37	-0.033	0.005	Pass	0.200	0.113	Pass
	bab	4.06	4.23	-0.167	0.012	Pass	0.200	0.199	Pass
	off	4.29	4.28	0.005	0.009	Pass	0.500	0.372	Pass

**Table A.80 – Requirements Results for Experiment 7 Wideband Speech – LC-VAD Balanced Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	PWMC Pass	DSAF Threshold	DSAF Cut	DSAF Pass
$\infty$	N/A	4.21	4.35	-0.136	0.011	Pass	0.070	-0.010	Pass
30dB	car	4.35	4.39	-0.042	0.010	Pass	0.100	0.030	Pass
	bab	4.40	4.42	-0.024	0.007	Pass	0.100	0.028	Pass
	off	4.38	4.42	-0.042	0.008	Pass	0.250	0.116	Pass
	mus	4.41	4.50	-0.086	0.007	Pass	1.199	1.287	Pass
	int	4.37	4.43	-0.056	0.008	Pass	0.233	0.355	Pass
20dB	car	4.39	4.42	-0.022	0.007	Pass	0.200	0.104	Pass
	bab	4.37	4.42	-0.045	0.006	Pass	0.250	0.149	Pass
	off	4.43	4.44	-0.011	0.005	Pass	0.500	0.345	Pass
	mus	4.47	4.50	-0.028	0.005	Pass	1.199	1.266	Pass
	int	4.41	4.45	-0.037	0.007	Pass	0.554	0.656	Pass
10dB	car	4.38	4.39	-0.005	0.005	Pass	0.250	0.136	Pass
	bab	4.11	4.28	-0.166	0.011	Pass	0.300	0.244	Pass
	off	4.34	4.34	-0.008	0.008	Pass	0.600	0.450	Pass

**Table A.81 – Requirements Results for Experiment 7 Wideband Speech – LC-VAD Quality Preferred Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	PWMC Pass	DSAF Threshold	DSAF Cut	DSAF Pass
$\infty$	N/A	4.29	4.35	-0.066	0.009	Pass	0.100	-0.010	Pass
30dB	car	4.39	4.41	-0.020	0.008	Pass	0.150	0.038	Pass
	bab	4.42	4.43	-0.012	0.005	Pass	0.150	0.058	Pass
	off	4.41	4.44	-0.026	0.007	Pass	0.300	0.170	Pass
	mus	4.43	4.50	-0.064	0.006	Pass	1.349	1.292	Pass
	int	4.41	4.43	-0.027	0.007	Pass	0.383	0.360	Pass
20dB	car	4.42	4.43	-0.005	0.006	Pass	0.250	0.122	Pass
	bab	4.41	4.43	-0.025	0.005	Pass	0.300	0.244	Pass
	off	4.44	4.45	-0.004	0.004	Pass	0.600	0.466	Pass
	mus	4.48	4.50	-0.021	0.004	Pass	1.349	1.273	Pass
	int	4.43	4.45	-0.015	0.006	Pass	0.704	0.657	Pass
10dB	car	4.41	4.40	0.015	0.006	Fail	0.300	0.255	Pass
	bab	4.21	4.32	-0.109	0.009	Pass	0.350	0.319	Pass
	off	4.38	4.37	0.005	0.006	Pass	0.750	0.509	Pass

**Table A.82 – Requirements Results for Experiment 8 Wideband Music –  
LC-VAD Speech Preferred (Bandwidth Saving) Operating Point**

SNR	Noise	MisRtA2I Ref	MisRtA2I Cut	A2I Pass
$\infty$	N/A	0.20%	0.00%	Pass
30dB	car	0.40%	0.10%	Pass
	bab	0.40%	0.10%	Pass
	off	0.80%	0.10%	Pass
20dB	car	1.10%	0.10%	Pass
	bab	1.50%	0.30%	Pass
	off	1.40%	0.20%	Pass

**Table A.83 – Requirements Results for Experiment 8 Wideband Music –  
LC-VAD Balanced Operating Point**

SNR	Noise	MisRtA2I Ref	MisRtA2I Cut	A2I Pass
$\infty$	N/A	0.20%	0.00%	Pass
30dB	car	0.40%	0.00%	Pass
	bab	0.40%	0.00%	Pass
	off	0.80%	0.00%	Pass
20dB	car	1.10%	0.00%	Pass
	bab	1.50%	0.30%	Pass
	off	1.40%	0.10%	Pass

**Table A.84 – Requirements Results for Experiment 8 Wideband Music –  
LC-VAD Music Preferred (Quality Preferred) Operating Point**

SNR	Noise	MisRtA2I Ref	MisRtA2I Cut	A2I Pass
$\infty$	N/A	0.20%	0.00%	Pass
30dB	car	0.40%	0.00%	Pass
	bab	0.40%	0.00%	Pass
	off	0.80%	0.00%	Pass
20dB	car	1.10%	0.00%	Pass
	bab	1.50%	0.20%	Pass
	off	1.40%	0.00%	Pass

**Table A.85 – Requirements Results for Experiment 9 Wideband Interlaced Material – LC-VAD Bandwidth Saving Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	PWMC Pass	MisRtA2I Ref	MisRtA2I Cut	A2I Pass	DSAF Threshold	DSAF Cut	DSAF Pass
$\infty$	N/A	4.254	4.355	-0.102	0.009	Pass	0.10%	0.00%	Pass	0.02	-0.004	Pass
30dB	car	4.324	4.366	-0.042	0.009	Pass	0.00%	0.00%	Pass	0.05	0.007	Pass
	bab	4.354	4.395	-0.041	0.007	Pass	0.40%	0.00%	Pass	0.05	0.004	Pass
	off	4.359	4.392	-0.034	0.007	Pass	0.40%	0.00%	Pass	0.2	0.025	Pass
20dB	car	4.351	4.409	-0.058	0.007	Pass	1.40%	0.00%	Pass	0.15	0.033	Pass
	bab	4.325	4.415	-0.09	0.006	Pass	1.60%	0.00%	Pass	0.15	0.031	Pass
	off	4.389	4.419	-0.03	0.005	Pass	1.40%	0.00%	Pass	0.4	0.096	Pass

**Table A.86 – Requirements Results for Experiment 9 Wideband Interlaced Material – LC-VAD Balanced Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	PWMC Pass	MisRtA2I Ref	MisRtA2I Cut	A2I Pass	DSAF Threshold	DSAF Cut	DSAF Pass
$\infty$	N/A	4.254	4.356	-0.103	0.009	Pass	0.10%	0.00%	Pass	0.07	-0.004	Pass
30dB	car	4.374	4.402	-0.028	0.008	Pass	0.00%	0.00%	Pass	0.1	0.01	Pass
	bab	4.404	4.418	-0.014	0.007	Pass	0.40%	0.00%	Pass	0.1	0.008	Pass
	off	4.409	4.417	-0.008	0.007	Pass	0.40%	0.00%	Pass	0.25	0.044	Pass
20dB	car	4.401	4.419	-0.018	0.006	Pass	1.40%	0.00%	Pass	0.2	0.041	Pass
	bab	4.375	4.438	-0.063	0.006	Pass	1.60%	0.00%	Pass	0.25	0.055	Pass
	off	4.439	4.446	-0.007	0.004	Pass	1.40%	0.00%	Pass	0.5	0.139	Pass



**Table A.87 – Requirements Results for Experiment 9 Wideband Interlaced Material – LC-VAD Quality Preferred Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	PWMC Pass	MisRtA2I Ref	MisRtA2I Cut	A2I Pass	DSAF Threshold	DSAF Cut	DSAF Pass
$\infty$	N/A	4.315	4.357	-0.041	0.008	Pass	0.10%	0.00%	Pass	0.1	-0.004	Pass
30dB	car	4.406	4.412	-0.006	0.007	Pass	0.00%	0.00%	Pass	0.15	0.014	Pass
	bab	4.428	4.431	-0.003	0.006	Pass	0.40%	0.00%	Pass	0.15	0.018	Pass
	off	4.432	4.432	0.000	0.006	Pass	0.40%	0.00%	Pass	0.3	0.065	Pass
20dB	car	4.426	4.427	-0.001	0.006	Pass	1.40%	0.00%	Pass	0.25	0.048	Pass
	bab	4.406	4.445	-0.039	0.005	Pass	1.60%	0.00%	Pass	0.3	0.09	Pass
	off	4.454	4.452	0.002	0.004	Pass	1.40%	0.00%	Pass	0.6	0.19	Pass

**Table A.88 – Requirements Results for Experiment 10 Narrowband Speech – LC-VAD Bandwidth Saving Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	PWMC Pass	DSAF Threshold	DSAF Cut	DSAF Pass
$\infty$	N/A	4.42	4.47	-0.045	0.005	Pass	0.020	-0.010	Pass
30dB	car	4.38	4.44	-0.056	0.006	Pass	0.050	0.028	Pass
	bab	4.41	4.46	-0.046	0.003	Pass	0.050	0.019	Pass
	off	4.40	4.46	-0.053	0.003	Pass	0.200	0.081	Pass
	mus	4.42	4.49	-0.070	0.003	Pass	1.395	0.558	Pass
	int	4.41	4.47	-0.062	0.004	Pass	0.367	0.350	Pass
20dB	car	4.40	4.45	-0.049	0.003	Pass	0.150	0.098	Pass
	bab	4.41	4.46	-0.045	0.002	Pass	0.150	0.109	Pass
	off	4.43	4.46	-0.034	0.002	Pass	0.400	0.259	Pass
	mus	4.44	4.49	-0.054	0.002	Pass	1.391	1.022	Pass
	int	4.43	4.48	-0.058	0.003	Pass	0.663	0.662	Pass
10dB	car	4.40	4.43	-0.035	0.003	Pass	0.200	0.126	Pass
	bab	4.32	4.35	-0.032	0.006	Pass	0.200	0.158	Pass
	off	4.40	4.40	-0.002	0.005	Pass	0.500	0.402	Pass

**Table A.89 – Requirements Results for Experiment 10 Narrowband Speech – LC-VAD Balanced Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	PWMC Pass	DSAF Threshold	DSAF Cut	DSAF Pass
$\infty$	N/A	4.42	4.47	-0.047	0.005	Pass	0.070	-0.007	Pass
30dB	car	4.43	4.45	-0.022	0.006	Pass	0.100	0.036	Pass
	bab	4.46	4.47	-0.008	0.003	Pass	0.100	0.035	Pass
	off	4.45	4.47	-0.016	0.003	Pass	0.250	0.119	Pass
	mus	4.47	4.50	-0.030	0.003	Pass	1.263	1.395	Pass
	int	4.46	4.48	-0.018	0.004	Pass	0.238	0.367	Pass
20dB	car	4.45	4.46	-0.006	0.004	Pass	0.200	0.116	Pass
	bab	4.46	4.47	-0.011	0.002	Pass	0.250	0.153	Pass
	off	4.48	4.48	0.001	0.002	Pass	0.500	0.371	Pass
	mus	4.49	4.50	-0.009	0.002	Pass	1.263	1.391	Pass
	int	4.48	4.49	-0.009	0.003	Pass	0.559	0.663	Pass
10dB	car	4.45	4.45	0.000	0.003	Pass	0.250	0.153	Pass
	bab	4.37	4.40	-0.038	0.005	Pass	0.300	0.243	Pass
	off	4.45	4.45	0.002	0.004	Pass	0.600	0.552	Pass

**Table A.90 – Requirements Results for Experiment 10 Narrowband Speech – LC-VAD Quality Preferred Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	PWMC Pass	DSAF Threshold	DSAF Cut	DSAF Pass
$\infty$	N/A	4.44	4.47	-0.028	0.004	Pass	0.100	-0.007	Pass
30dB	car	4.45	4.46	-0.011	0.005	Pass	0.150	0.044	Pass
	bab	4.47	4.48	-0.004	0.003	Pass	0.150	0.063	Pass
	off	4.47	4.48	-0.011	0.003	Pass	0.300	0.163	Pass
	mus	4.48	4.50	-0.023	0.002	Pass	1.413	1.397	Pass
	int	4.47	4.48	-0.010	0.003	Pass	0.388	0.372	Pass
20dB	car	4.46	4.47	-0.003	0.003	Pass	0.250	0.137	Pass
	bab	4.47	4.48	-0.008	0.002	Pass	0.300	0.225	Pass
	off	4.48	4.48	0.001	0.002	Pass	0.600	0.468	Pass
	mus	4.49	4.50	-0.007	0.001	Pass	1.413	1.393	Pass
	int	4.48	4.49	-0.004	0.002	Pass	0.709	0.663	Pass
10dB	car	4.46	4.46	0.003	0.003	Pass	0.300	0.436	Fail
	bab	4.40	4.44	-0.037	0.004	Pass	0.350	0.339	Pass
	off	4.46	4.46	0.000	0.003	Pass	0.750	0.648	Pass

**Table A.91 – Requirements Results for Experiment 11 Narrowband Music –  
LC-VAD Speech Preferred (Bandwidth Saving) Operating Point**

SNR	Noise	MisRtA2I Ref	MisRtA2I Cut	A2I Pass
$\infty$	N/A	0.20%	0.10%	Pass
30dB	car	0.30%	0.00%	Pass
	bab	0.80%	0.10%	Pass
	off	0.60%	0.10%	Pass
20dB	car	1.00%	0.10%	Pass
	bab	1.50%	0.40%	Pass
	off	1.30%	0.20%	Pass

**Table A.92 – Requirements Results for Experiment 11 Narrowband Music –  
LC-VAD Balanced Operating Point**

SNR	Noise	MisRtA2I Ref	MisRtA2I Cut	A2I Pass
$\infty$	N/A	0.20%	0.10%	Pass
30dB	car	0.30%	0.00%	Pass
	bab	0.80%	0.00%	Pass
	off	0.60%	0.00%	Pass
20dB	car	1.00%	0.00%	Pass
	bab	1.50%	0.30%	Pass
	off	1.30%	0.10%	Pass

**Table A.93 – Requirements Results for Experiment 11 Narrowband Music –  
LC-VAD Music Preferred (Quality Preferred) Operating Point**

SNR	Noise	MisRtA2I Ref	MisRtA2I Cut	A2I Pass
$\infty$	N/A	0.20%	0.00%	Pass
30dB	car	0.30%	0.00%	Pass
	bab	0.80%	0.00%	Pass
	off	0.60%	0.00%	Pass
20dB	car	1.00%	0.00%	Pass
	bab	1.50%	0.20%	Pass
	off	1.30%	0.00%	Pass

**Table A.94 – Requirements Results for Experiment 12 Narrowband Interlaced Material – LC-VAD Bandwidth Saving Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	PWMC Pass	MisRtA2I Ref	MisRtA2I Cut	A2I Pass	DSAF Threshold	DSAF Cut	DSAF Pass
$\infty$	N/A	4.438	4.463	-0.025	0.004	Pass	0.40%	0.00%	Pass	0.02	-0.004	Pass
30dB	car	4.394	4.438	-0.044	0.005	Pass	0.40%	0.00%	Pass	0.05	0.009	Pass
	bab	4.416	4.46	-0.044	0.003	Pass	0.60%	0.00%	Pass	0.05	0.003	Pass
	off	4.416	4.46	-0.044	0.003	Pass	0.20%	0.00%	Pass	0.2	0.026	Pass
20dB	car	4.409	4.456	-0.047	0.003	Pass	1.50%	0.00%	Pass	0.15	0.037	Pass
	bab	4.413	4.466	-0.053	0.002	Pass	1.90%	0.00%	Pass	0.15	0.033	Pass
	off	4.426	4.465	-0.039	0.002	Pass	1.50%	0.00%	Pass	0.4	0.095	Pass

**Table A.95 – Requirements Results for Experiment 12 Narrowband Interlaced Material – LC-VAD Balanced Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	PWMC Pass	MisRtA2I Ref	MisRtA2I Cut	A2I Pass	DSAF Threshold	DSAF Cut	DSAF Pass
$\infty$	N/A	4.438	4.466	-0.028	0.004	Pass	0.40%	0.00%	Pass	0.07	-0.004	Pass
30dB	car	4.444	4.456	-0.012	0.004	Pass	0.40%	0.00%	Pass	0.1	0.012	Pass
	bab	4.466	4.47	-0.004	0.003	Pass	0.60%	0.00%	Pass	0.1	0.008	Pass
	off	4.466	4.473	-0.007	0.003	Pass	0.20%	0.00%	Pass	0.25	0.044	Pass
20dB	car	4.459	4.462	-0.003	0.003	Pass	1.50%	0.00%	Pass	0.2	0.044	Pass
	bab	4.463	4.475	-0.012	0.002	Pass	1.90%	0.00%	Pass	0.25	0.053	Pass
	off	4.476	4.48	-0.003	0.002	Pass	1.50%	0.00%	Pass	0.5	0.151	Pass

**Table A.96 – Requirements Results for Experiment 12 Narrowband Interlaced Material – LC-VAD Quality Preferred Operating Point**

SNR	Noise	PWMC Ref	PWMC Cut	Diff	CI	PWMC Pass	MisRtA2I Ref	MisRtA2I Cut	A2I Pass	DSAF Threshold	DSAF Cut	DSAF Pass
$\infty$	N/A	4.454	4.467	-0.014	0.003	Pass	0.40%	0.00%	Pass	0.1	-0.004	Pass
30dB	car	4.458	4.463	-0.005	0.004	Pass	0.40%	0.00%	Pass	0.15	0.015	Pass
	bab	4.475	4.475	0	0.002	Pass	0.60%	0.00%	Pass	0.15	0.018	Pass
	off	4.475	4.479	-0.004	0.002	Pass	0.20%	0.00%	Pass	0.3	0.061	Pass
20dB	car	4.469	4.467	0.002	0.003	Pass	1.50%	0.00%	Pass	0.25	0.053	Pass
	bab	4.472	4.483	-0.01	0.002	Pass	1.90%	0.00%	Pass	0.3	0.083	Pass
	off	4.482	4.483	0	0.001	Pass	1.50%	0.00%	Pass	0.6	0.189	Pass

**Table A.97 – Requirements Results for Experiment 13**

Music Preferred	Test Vector	Cross Num	Missed Num	Silence Pass
	Wideband	82	0	Pass
	Narrowband	68	0	Pass
Balanced	Test Vector	Cross Num	Missed Num	Silence Pass
	Wideband	82	0	Pass
	Narrowband	68	0	Pass
Speech Preferred	Test Vector	Cross Num	Missed Num	Silence Pass
	Wideband	82	0	Pass
	Narrowband	68	0	Pass



### No-degradation of the VAD results from the LC-VAD to the FC-GSAD

The objectives for Exp. 1-6 are that, for each test file, the VAD results of the FC-GSAD not be worse than the VAD results of the LC-VAD.

For all test files, the results of the VAD of the FC-GSAD were identical to the results of the VAD of the LC-VAD, and therefore these objectives were met.

**Table A.98 – Objectives Results for Experiment 1**

SNR	Noise	PWMC Threshold OTP	PWMC CuT	PWMC Pass
$\infty$	N/A	4.36	4.35	Pass
30dB	car	4.43	4.41	Pass
	bab	4.45	4.43	Pass
	off	4.44	4.44	Pass
	mus	4.46	4.50	Pass
	int	4.44	4.43	Pass
20dB	car	4.45	4.43	Pass
	bab	4.44	4.43	Pass
	off	4.46	4.45	Pass
	mus	4.48	4.50	Pass
	int	4.46	4.45	Pass
10dB	car	4.44	4.40	Fail
	bab	4.31	4.32	Pass
	off	4.42	4.37	Fail

**Table A.99 – Objectives Results for Experiment 3**

SNR	Noise	PWMC Threshold OTP	PWMC CuT	PWMC Pass
$\infty$	N/A	4.377	4.357	Pass
30dB	car	4.437	4.412	Pass
	bab	4.452	4.431	Pass
	off	4.454	4.432	Pass
20dB	car	4.451	4.427	Pass
	bab	4.438	4.445	Pass
	off	4.469	4.452	Fail

**Table A.100 – Objectives Results for Experiment 4**

SNR	Noise	PWMC Threshold OTP	PWMC CuT	PWMC Pass
$\infty$	N/A	4.46	4.47	Pass
30dB	car	4.46	4.46	Pass
	bab	4.48	4.48	Pass
	off	4.48	4.48	Pass
	mus	4.49	4.50	Pass
	int	4.48	4.48	Pass
20dB	car	4.48	4.47	Pass
	bab	4.48	4.48	Pass
	off	4.49	4.48	Fail
	mus	4.50	4.50	Pass
	int	4.49	4.49	Pass
10dB	car	4.47	4.46	Fail
	bab	4.43	4.44	Pass
	off	4.47	4.46	Pass

**Table A.101 – Objectives Results for Experiment 6**

SNR	Noise	PWMC Threshold OTP	PWMC CuT	PWMC Pass
$\infty$	N/A	4.469	4.467	Pass
30dB	car	4.472	4.463	Pass
	bab	4.483	4.475	Pass
	off	4.483	4.479	Pass
20dB	car	4.48	4.467	Fail
	bab	4.482	4.483	Pass
	off	4.488	4.483	Pass

**Table A.102 – Objectives Results for Experiment 7**

SNR	Noise	PWMC Threshold OTP	PWMC CuT	PWMC Pass
$\infty$	N/A	4.36	4.35	Pass
30dB	car	4.43	4.41	Pass
	bab	4.45	4.43	Pass
	off	4.44	4.44	Pass
	mus	4.46	4.50	Pass
	int	4.44	4.43	Pass
20dB	car	4.45	4.43	Pass
	bab	4.44	4.43	Pass
	off	4.46	4.45	Pass
	mus	4.48	4.50	Pass
	int	4.46	4.45	Pass
10dB	car	4.44	4.40	Fail
	bab	4.31	4.32	Pass
	off	4.42	4.37	Fail

**Table A.103 – Objectives Results for Experiment 9**

SNR	Noise	PWMC Threshold OTP	PWMC CuT	PWMC Pass
$\infty$	N/A	4.377	4.357	Pass
30dB	car	4.437	4.412	Pass
	bab	4.452	4.431	Pass
	off	4.454	4.432	Pass
20dB	car	4.451	4.427	Pass
	bab	4.438	4.445	Pass
	off	4.469	4.452	Fail

**Table A.104 – Objectives Results for Experiment 10**

SNR	Noise	PWMC Threshold OTP	PWMC CuT	PWMC Pass
$\infty$	N/A	4.46	4.47	Pass
30dB	car	4.46	4.46	Pass
	bab	4.48	4.48	Pass
	off	4.48	4.48	Pass
	mus	4.49	4.50	Pass
	int	4.48	4.48	Pass
20dB	car	4.48	4.47	Pass
	bab	4.48	4.48	Pass
	off	4.49	4.48	Fail
	mus	4.50	4.50	Pass
	int	4.49	4.49	Pass
10dB	car	4.47	4.46	Fail
	bab	4.43	4.44	Pass
	off	4.47	4.46	Pass

**Table A.105 – Objectives Results for Experiment 12**

SNR	Noise	PWMC Threshold OTP	PWMC CuT	PWMC Pass
$\infty$	N/A	4.469	4.467	Pass
30dB	car	4.472	4.463	Pass
	bab	4.483	4.475	Pass
	off	4.483	4.479	Pass
20dB	car	4.48	4.467	Fail
	bab	4.482	4.483	Pass
	off	4.488	4.483	Pass