Digital audio alignment levels
Handbook for the EBU R–DAT Levels tape

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Introduction

The R–DAT Levels tape which accompanies the present document contains signals designed for two purposes:

– to verify and/or adjust the coding levels in digital audio recording and production systems;

– to provide an alignment signal for listening tests.

All the signals on the R–DAT Levels tape have been recorded with the coding levels specified in EBU Technical Recommendations R64 [1] and R68 [2].

The signals are recorded with a sampling frequency of 48 kHz. The signals have either been generated digitally, or transferred digitally from compact discs through a sampling rate converter.

Summary of tape contents

The R–DAT Levels tape carries four types of signal:

– 3–level test signal according to CCIR Recommendation 661 [3]	1 m 50s
– Alignment leader signal according to EBU Technical Recommendation R49 [4]	1 minute
– Digitally–generated quasi–random noise, “pink” weighted	5 minutes
– Selected music and speech signals from the EBU SQAM compact disc [5] and other commercially–available compact discs	12 minutes

Full details of all the signals are given in the *Tables* beginning on *page 4*.

Definitions

The definitions of levels referred to in this document are based on ITU–R Recommendation BS.645 [6]:

Permitted Maximum Level The level of a sine–wave equivalent to the permitted maximum programme–signal level. The sound programme sound should be controlled by the broadcaster so that the amplitude of the peaks of the programme signal rarely exceed the peak amplitude of a sine–wave signal at the permitted maximum level.

Alignment Level The level of a sine–wave signal 9 dB below a sine–wave at permitted maximum level. This level can be used to align sound–programme circuits and equipment.

Measurement Level The level of a sine–wave signal 12 dB below a sine–wave at alignment level (and 21 dB below a sine–wave at permitted maximum level). This level can be used for measurements at all frequencies.

Maximum Coding Level The level of a sine–wave whose peaks can just be accommodated by the full coding range of the digital system in use.

Full Scale (FS) The full range of numbers available in a digital coding system. A sine–wave at maximum coding level is 0 dB (FS).

1. 3–level test signal

PGM	Time	Description	Duration	Level	Mono (M) or Stereo (S)	Notes
1	00:00	3–level test signal according to CCIR Recommendation 661 [3]	1m 50 s		S	1
		Frequency 1 kHz				
		Alignment level is 18 dB below Maximum Coding Level				
		2 sequences with announcements in English, 2 sequences with announcements in French (4 sequences in total)				
		– announcement in English	7 s			
		– pause	1 s			
		– Measurement Level	2 s	–30 dB FS		
		– Alignment Level	8 s	–18 dB FS		
		– Permitted Maximum Level, left channel only	2 s	–9 dB FS		
		– pause (silence)	3 s			
		– Permitted Maximum Level, right channel only	2 s	–9 dB FS		
		– announcement in French	9 s			
		– pause	1 s			
		– Measurement Level	2 s	–30 dB FS		
		– Alignment Level	8 s	–18 dB FS		
		– Permitted Maximum Level, left channel only	2 s	–9 dB FS		
		– pause (silence)	3 s			
		– Permitted Maximum Level, right channel only	2 s	–9 dB FS		

2. Alignment leader

PGM	Time	Description	Duration	Level	Mono (M) or Stereo (S)	Notes
2	01:50	Alignment leader according to EBU Technical Recommendation R49 [4]	1 min.		S	1
		Frequency 1 kHz				
		Alignment level is 18 dB below maximum coding level		–18 dB FS		
		– left channel: 1 kHz tone at Alignment Level, interrupted for 0.25 s every 3 s				
		– right channel: 1 kHz tone at Alignment Level				
		Left and right channels are coherent (i.e. from the same source and in phase).				

3. Pink noise

PGM	Time	Description	Duration	Level	Mono (M) or Stereo (S)	Notes
3	02:53	"Pink noise" Frequency 1 kHz Band–limited pink noise as defined for listening test references; quasi–random sequence, DSP filtered to give "pink" characteristic (equal energy per octave) Left and right channels are non–coherent, and decorrelated to better than –45 dB	5 min.	–18 dB FS (RMS) –4.5 dB FS (true peaks)	S	1

4. Speech signals

PGM	Time	Description		SQAM CD track no.	Duration	Level	Mono (M) or Stereo (S)	Notes
4	07:58	Speech						
		Female speech	English	49	00:23		M	2,3
		Male speech	English	50	00:22	3 dB below SQAM CD level	M	2,3
		Female speech	French	51	00:21		M	2,4
		Male speech	French	52	00:24		M	2,4
		Female speech	German	53	00:21		M	2,5
		Male speech	German	54	00:21		M	2,5

5. Music signals

PGM	Time	Description		SQAM CD track no.	Duration	Level	Mono (M) or Stereo (S)	Notes
5	10:08	Orchestra	Wagner	–	03:05		S	6
6	13:13	Pop music	Mayall	–	01:17		S	7
7	14:30	Double–bass	arpegio	11	00:31	3 dB below SQAM CD level	S	2,8
8	15:01	Harpsichord	arpegio	40	00:53		S	2,8
9	15:54	Claves	single tone, rhythm	26	00:38		S	2,8
10	16:32	Castanets	single tone, rhythm	27	00:19		S	2,8
11	16:51	Gong	single tone (forte)	33	00:30		S	2,8
12	17:21	Piano	Schubert	60	01:32		S	2,8
	18:53	END						

Notes

1 Computed source material. Edited by Hungarian Radio (MR) on a Studer Dyaxis workstation.

2 Selected music and speech from the EBU Sound Quality Assessment Material CD.

Items are recorded to "correct" modulation level according to EBU Technical Recommendations R64 and R68. (That is, the programme signals will only occasionally exceed the Permitted Maximum Level.)

Excerpts from the EBU SQAM CD were transferred digitally via a DAS 100 sample–rate converter for this 48 kHz recording. At the same time, the modulation levels were lowered by 3 dB, to best simulate the appropriate broadcast modulation levels defined in EBU Technical Recommendation R64.

All the recorded material was digitally sourced and edited onto MII video tape at Thames Television, London, and then directly transferred to R–DAT copies.

3 The English speech items were recorded by the BBC in Maida Vale studio 7, a drama studio with a mid–band reverberation time of approximately 0.3 s. The studio noise level was below NR5. The monophonic recording was made using a single AKG C414–ULS microphone with the cardioid polar response selected, and the speakers were approximately 65 cm from the microphone.

4 The French speech items were monophonic recordings made at Radio France; the speakers were approximately 40 cm from the microphone.

5 The German speech items were recorded in an anechoic chamber of a volume of 194 m^3. These monophonic recordings were made by using a cardioid pattern microphone (Neumann KM 84) at a distance of approximately 45 cm.

6 Sir Georg Solti – Wagner: Ride of the Valkyries
CD Decca 410–137–2, Track 1
P 1983, Decca Record Company Ltd., London.

7 John Mayall: All your love
CD Decca 800–086–2, Track 1
P 1986, Decca Record Company Ltd., London.

8 For this recording, two omnidirectional microphones (type Bruel and Kjaer 4006, spaced 35 cm apart) were used, without any spot microphones.

This technique ensures an accurate bass response and an adequate stereophonic image. Each of the two microphone signals, either left or right, represents the optimum monophonic signal. It is *not advisable* to add the left and right signal for monophonic reproduction.

The distance from the microphone to the instrument was in the range from 1 to 2 m. The recording was made in a studio having a volume of 1000 m^3 and with a reverberation time of 1.6 s. The microphone signals were amplified with a Neumann PMV 70 microphone amplifier and directly recorded on a Sony PCM 1630 / U–matic VO 5850 machine.

No mixing desk was used. The recordings were monitored with studio headphones (STAX SR λ professional and an SRM monitor amplifier with diffuse–field equalizer). Editing was done with Sony DAE–1100 / U–matic DMR 4000 equipment.

The recordings were made with the kind assistance of the musicians and sound engineer Martin Wöhr of the Bayerischer Rundfunk.

Bibliography

[1] EBU Technical Recommendation R64–1992: *Exchange of sound programmes as digital audio tape recordings (Effective from 1 January 1993)*

[2] EBU Technical Recommendation R68–1995: *Alignment level in digital audio production equipment and in digital audio recorders*

[3] CCIR Recommendation 661: *Signals for the alignment of international sound–programme connections*

[4] EBU Technical Recommendation R49–1993: *Tape alignment leader for the exchange of television programmes*

[5] EBU document Tech. 3253 (1988): *Sound quality assessment material. Recordings for subjective tests – Users' handbook for the EBU–SQAM Compact Disc*

[6] ITU–R Recommendation BS.645–2: *Test signals and metering to be used on international sound–programme connections.*

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