## WHERE IN TIME IS YOUR SUB-WOOFER

## BY DOCTOR WHO

現在リリースされているDEQX cal softのバージョン2.01と 2.58で利用可能な便利なツールとして、メイン・スピーカーと分離されたサブ・ウーファーのタイム・アラインメントを調整するものがあります。このプロセスは、一般的な室内測定結果を用いてシングル・アンプまたはバイ・アンプ方式のサブ・ウーファーとメイン・スピーカーの時間軸を揃えるものです。メイン・スピーカーとサブ・ウーファーの測定から得られたインパルス応答表示は'viewer'で見ることができます。この2つのインパルス応答間の時間差を進んでいる側のスピーカーに加えることにより、2つのスピーカーは時間的に完全に揃うことになります。

バージョン2.01と2.58ではこのプロセスは少々込み入っていますが、数回実行してみるとほんの数分でできるようになります。我々はRev-3のリリースに続き、将来のバージョンでこれらのプロセスを大幅に自動化することを計画しています。

以下に、メイン・スピーカーとサブ・ウーファーの間に必要とされる時間差を見いだすために、 'project viewer'と 'room measurements'の使い方を説明します。

- (1) 最初にDEQX cal softを起動し現在のプロジェクトファイルを開いた後, 次の段階に進みます。
- (2) 'Measure Room wizard'を使って、これから実行するための 'room measurement'を作成し、例えば'NO TIME Correction'と名付けます。
- (3) room measurementに続き, View menu (図1)から' project explorer'を立ち上げます。



(4) viewer windowから 'Room Measurement'を選び, new room measurement(図2,図3)を見つけるためにこのフォルダーを開きます。

A A A A A A A A A A A A A A A A A A A	PDC Control Panel	
II	DEOX	
田一島 Manufacturers and Microphones	Calibrated	PDC IO N
H-IEP Prooff Correction	Nut Connected	Input Selecti
	0.0	
		- Digital Output
	-1010	Clock Source
	-15	Qutput Selec
	-20	-
	-25 -25 -30	- Microphone
	-4040	UBFS
		Gain
	Master <u>V</u> olume	E Mars
	Unmute	Analo
	Bunare	Analog
	Profile 1	Status:
	Profile 2	Digital In: Digital Out:
	Profile 3	
	Department	Errors:
DEQX Calibration - Room Correction - [PDC Control Panel] Elle Edit View Chart Tools Window Help		
DEQX Calibration - Room Correction - [PDC Control Panel] Ele Edit View Chart Tools Window Help Correction - [PDC Control Panel] Ele Edit View Chart Tools Window Help Correction - [PDC Control Panel] Ele Edit View Chart Tools Window Help Correction - [PDC Control Panel] Ele Edit View Chart Tools Window Help Correction - [PDC Control Panel] Ele Edit View Chart Tools Window Help Correction - [PDC Control Panel] Ele Edit View Chart Tools Window Help		
DEQX Calibration - Room Correction - [PDC Control Panel] Ele Edit View Chart Tools Window Help Control Point I Control Panel] Control Point I Control Panel] Control Panel] Ele Edit View Chart Tools Window Help Control Panel] Control Panel Control P	DC Control Panel	
DEQX Calibration - Room Correction - [PDC Control Panel] Ele Edit View Chart Tools Window Help Control Panel Ele Edit View Chart Tools Window Help Control Panel Measure Speakers Calibrate Speakers Configure Measure Room Viewer P Measure Speakers Calibrate Speakers Configure Measure Room Viewer P	DC Control Panel	PDC1U
DEQX Calibration - Room Correction - [PDC Control Panel] Ele Edit View Chart Tools Window Help Control Point Control Panel] Measure Speakers Calibrate Speakers Configure Measure Room Viewer P Manufacturers and Microphones Room Correction Speakers	DC Control Panel	PDC IU
DEQX Calibration - Room Correction - [PDC Control Panel] Ele Edit View Chart Tools Window Help C R R Add Point S Room Viewer P Measure Speakers Calibrate Speakers Configure Measure Room Viewer P Measure Speakers Calibrate Speakers Room Correction SPEAKERS CALIBRATION TEMPLATES	DC Control Panel	PDL IU Igput Selec
DEQX Calibration - Room Correction - [PDC Control Panel] Ele Edit View Chart Tools Window Help Calibrate Speakers Configure Measure Room Viewer P Measure Speakers Calibrate Speakers Configure Measure Room Viewer P Manufastures and Microphones Room Correction CALIBRATION TEMPLATES ROOM MEASUREMENTS Configure Measure Calibration TempLates ROOM MEASUREMENTS Configure Measure Calibration TempLates	DC Control Panel	PDL IU Igput Selec
DEQX Calibration - Room Correction - [PDC Control Panel]         Ele       Edit View Chart Tools Window Help         Image: Second Sec	DC Control Panel	PDC IU Igput Selec Digitel Out Cock Sour
DEQX Calibration - Room Correction - [PDC Control Panel] Ele Edit Yiew Chart Tools Window Help C C C C Add Point C C C C C C C C C C C C C C C C C C C	DC Control Panel	PDL IU Igput Selec Gigital Out Cack Sour
DEQX Calibration - Room Correction - [PDC Control Panel]         Ele       Edit       Yiew       Chart       Tools       Window       Help         Image: Image	DC Control Panel	PUC IU Igput Selec Digital Out Cock Sour
DEQX Calibration - Room Correction - [PDC Control Panel] Ele Edit View Chart Tools Window Help Measure Speakers Calibrate Speakers Configure Measure Room Viewer P Measure Speakers Calibrate Speakers Configure Measure Room Viewer P Manufacturers and Microphones Room Correction SPEAKERS CALIBRATION TEMPLATES ROOM MEASUREMENTS Giffice MEASUREMENT POSITIONS CALIBRATION Filters MEASUREMENTS CALIBRATION Filters CALIBRATION TEMPLATES MEASUREMENT POSITIONS CALIBRATION Filters CALIBRATION FILTERS MEASUREMENTS CALIBRATION FILTERS CALIBRATION FILTERS MEASUREMENT POSITIONS CALIBRATION FILTERS CALIBRATION FILTERS CALIBRA	DC Control Panel	PDL IU Igeut Selec Digital Out Cock Sour Quiput Sele
DEQX Calibration - Room Correction - [PDC Control Panel]         Ele       Edit       Yiew       Chart       Tools       Window       Help         Ele       Edit       Yiew       Chart       Tools       Wiewer       P         Measure       Speakers       Calibrate       Speakers       Configure       Measure       Room       Viewer       P         Measure       Speakers       Calibration TempLates       Speakers	ECONTICUE ECONTICUE DC Control Panel ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECONTICUE ECON	PUL IU Igput Selec Digital Out Cock Sour Quiput Sele Microphor Inpere
DEQX Calibration - Room Correction - [PDC Control Panel]         Ele       Edit View Chart Tools Window Help         Ele       Ele         Image: Speakers Calibrate Speakers Configure Measure Room Viewer         Measure Speakers Calibrate Speakers         Configure Measure Room Viewer         Image: Speakers Calibrate Speakers         Image: Speakers Calibrate Spe	EUWINGSU E DC Control Panel Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Statistrated Stati	PDL IU Igput Selec Cack Sour Quiput Sele Duiput Sele Igput Units IgFS
DEQX Calibration - Room Correction - [PDC Control Panel] Ele Edit Yiew Chart Tools Window Help Measure Speakers Calibrate Speakers Configure Measure Room Viewer P Measure Speakers Calibrate Speakers Configure Measure Room Viewer P Measure Speakers Room Correction SPEAKERS CALIBRATION TEMPLATES ROOM MEASUREMENT POSITIONS Since With Filters With Filters Left Sub HEN No Subs Left Sub HEN No Subs DC CONFIGURATIONS	DC Control Panel	PDL IU Igput Selec Digital Out Cock Sour Quiput Sele Microphon Irput Units JdFS Bran Physics
DEQX Calibration - Room Correction - [PDC Control Panel] File Edit Yiew Chart Tools Window Help Measure Speakers Calibrate Speakers Configure Measure Room Viewer P Measure Speakers Calibrate Speakers Configure Measure Room Viewer P Manufecturers and Microphones Room Correction SPEAKENS CALIBRATION TEMPLATES ROOM MEASUREMENTS Office MeasUREMENT POSITIONS MeasUREMENT POSITIONS Microphones ROOM MEASUREMENTS MeasUREMENTS Microphones ROOM MEASUREMENTS Microphones ROOM MEASUREMENTS MeasUREMENTS Microphones ROOM MEASUREMENTS Microphones ROOM MEASUREMENTS MICROPHONE MICROPHONE MICROPHONE ROOM MEASUREMENTS MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHONE MICROPHON	E DC Control Panel	PUL IU Igput Selec Digitel Out Cock Sour Quiput Sele Quiput Sele Digitel Out Cock Sour Digitel Out Digitel Out Digite Digitel Out Digitel Out Di
DEQX Calibration - Room Correction - [PDC Control Panel] File Edit Yiew Chart Tools Window Help Measure Speakers Calibrate Speakers Configure Measure Room Viewer P Measure Speakers Calibrate Speakers Configure Measure Room Viewer P Meanufacturees and Microphones Room Correction SPEAKERS CALIBRATION TEMPLATES CALIBRATION TEMPLATES CAL	Control Panel      Control	PDL IU Igsut Selec Digital Out Cock Sour Quiput Sele Digital Out Cock Sour Quiput Sele Digital Out Cock Sour Digital Out Digital Out Cock Sour Digital Out Cock Sour Digital Out Cock Sour Digital Out Cock Sour Digital Out Cock Sour Digital Out Digital Out Cock Sour Digital Out Digital Out Cock Sour Digital Out Digital
DEQX Calibration - Room Correction - [PDC Control Panel]         File Edit Yew Chart Tools Window Help         Image: Speakers Calibrate Speakers Configure Measure Room Viewer         Measure Speakers Calibrate Speakers Configure Measure Room Viewer         Image: Speakers Calibrate Speakers         Image: Speakers Calibrat	Control Panel      Control Panel      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X      X	PDU: IU Igput Selec Digital Out Cock Sour Qutput Sele Qutput Sele Digital Out Cock Sour Qutput Sele Digital Out Cock Sour Qutput Sele Digital Out Cock Sour Qutput Sele Digital Out Cock Sour Qutput Selec Digital Out Cock Sour Digital Out Selec Digital Out Cock Sour Digital Out Digital Out Digital Out Digital Out Digital Out Selec Digital Out Digital

(5) 左または右のメイン・スピーカーを選択し、右クリックで新たなmenu(図4)を表示させ、view、を選択します。すると新たなviewer windowが開き周波数応答のグラフが表示されます(図5)。





図5

- (6) 選択された新しいviewer windowで, DEQX cal windowの中央上部のPDC control panelボ タンの上にある小さなiconボタン 'time'をクリックします。
- (7) するとviewerはシングルまたはバイ・アンプスピーカーのインパルス応答が図6のように表示 されます。これらの手順を図7,図8に示すように低音用またはサブ・ウーファーに対して繰 り返します。







(8) 両方のviewer windowを図9に示すように揃え,前述のシングルまたはバイ・アンプスピー カーに対してのように表示を'time'に変えます。



図9

 (9) シングルまたはバイ・アンプのviewer windowを選択し、ツール・バーの 'chart'ボタンをクリックした後 'Axes Limit'をクリックします。最大時間を50msにして時間の 'Autoscale'を解除します(図10)。同様のことを低音用またはサブ・ウーファーに対しても繰り返します(図11)。



		Impulso Rospons			
	; ;	impuise Respons		-	
Skile L	96,				
Са		×	l		hange Axes
		+++++++++++++		-	Frequency
			Autoscale I	E	Autoscale
	:	18	Min <sup>-50</sup> m	H7	Min 10
······	<del>i i .</del>				50000
	250 250	millicocond	Max I II	<b>H</b> 2	Maxj
	• <b>1</b>	TIMISOCOILO	Amplitude		Gain
Col Line S	Cc		Autoscale 🔽		Autoscale
			Min -1	ılB	Miri -30
	All None Invert	/ Remove	Max 1	dB	Мая <sup>20</sup>
	•	se Respons	ancel UK.		Help
D	06				
kHZ Cal	/ Uk	1	1 1	h Al	
		n "A	A JIAN . AA		
	1 1	1 11 1	N 🖱 V U I I N IVIV I		m l

(10) 図12のインパルス応答から両スピーカーの時間差が算出できます。最初に現れる正のピークを基 準点とします。同図からわかるようにサブ・ウーファーでは33ms,メイン・スピーカーでは16.3msと なっていますから,サブ・ウーファーはメイン・スピーカーに対して約16ms遅れていることになりま す。これは16フィート(約488cm)の距離に相当する時間差になり直感的におかしいと思うかもしれま せんが,(ディジタル)フィルターで生じる遅れは特に低域用で長くなり,またリニア・フェーズ・フィル ターをサブ・ウーファー用に適用した場合には更に顕著となるからです。従ってビデオが使われる 場合には,サブ・ウーファー用として総遅延が1または1/2フレーム以下(20ms以下)の遅れとなる ButterworthかLinkwitz Riley filterの使用を推奨します。





(11) この時間差を補正するためには、メイン・スピーカーのフィルター(correction filter)に16msの遅れ を加える必要があります。図13に示されるように現在のコンフィギュレーションを開き、シングルまた はバイ・アンプスピーカーをダブルクリックしますと、図14のようなフィルタープロパティのウィンドウ が開きます。タブ・メニューから、Time/Level、を選択し、、Delay/Offset、の欄に、16、を入力します (図15)(この数値は2つのインパルス応答の時間差をms単位で表したものです)。





Charles a pr					₽)
Filter   Limit Filt	ers   Time/Level   A	Advanced			1
Please select of this loudspeak	one of the following op er calibration	ptions, describing th	e type of filter for		
Use a co	prrection filter for this I	loudspeaker			
C Use a cr	ossover filter for this I	oudspeaker only			
C Bypass	correction or crossove	er for this loudspeak	er, but still use limit	filters	
C Disable	he processor outputs	s for this loudspeake	r		
					Voofer
Plazza calact ik	e correction filter for l	this loudneesk or fro	m the evolutor tree	below	
riease select (r	e correction filter for i	this iouopseaker fro	m the explorer tree	Delow.	
Current Selectio	n:				
Loudspeaker	Legend/tikandi/right				
Correction	Correction Filter 5				
E-M SP	EAKERS			-	
E 💭 🦳 SP	EAKERS Legend/tikandi/right	t		-	mode)
	EAKERS Legend/tikandi/right <b>Z</b> Correction Filter	t 1 (S6kHz 20/08/20	08 3 24:19 PM)	-	mode)
	EAKERS Legend/tikandi/right Correction Filter Correction Filter	t 1 (S6kHz 20/08/20 2 (S6kHz 20/08/20	08 3 24:19 PM) 08 3 43:20 PM)	•	mode)
□ SP	EAKERS Legend/tikandi/right Correction Filter Correction Filter	t 1 (S6kHz 20/08/20 2 (S6kHz 20/08/20 3 (S6kHz 5/09/200	08 3 24:19 PM) 08 3 43:20 PM) 8 9.14.48 AM)	× E	mode)
	EAKERS Legend/tikandi/right Correction Filter Correction Filter Correction Filter Correction Filter	t 1 (56kHz 20/08/20 2 (56kHz 20/08/20 3 (56kHz 5/09/200 4 (56kHz 11/04/20	08 3 24:19 PM) 08 3 43:20 PM) 8 9.14.48 AM) 09 2 05:21 PM)	E	mode)
	EAKERS Legend/tikandi/right Correction Filter Correction Filter Correction Filter Correction Filter	t 1 (56kHz 20/08/20 2 (56kHz 20/08/20 3 (56kHz 5/09/200 4 (56kHz 11/04/20 5 (56kHz 22/04/20 5 (56kHz 22/04/20	08 3 24:19 PM) 08 3 43:20 PM) 8 9.14.48 AM) 09 2 05:21 PM) 09 12:47:41 PM)	. III	mode)
	AKERS Legend/tikandi/tight Correction Filter Correction Filter Correction Filter Correction Filter Correction Filter	t 1 (56kHz 20/08/20 2 (56kHz 20/08/20 3 (56kHz 5/09/200 4 (56kHz 11/04/20 5 (56kHz 12/04/20 6 (56kHz 1/05/200	08 324:19 PM) 08 343:20 PM) 8 9.14.48 AM) 09 205:21 PM) 09 12:47:41 PM) 9 12:54:16 PM)	* III	mode)
	EAKERS Legend/tikandi/tight Correction Filter Correction Filter Correction Filter Correction Filter Correction Filter Correction Filter Legend/Kebi Pro/00	t 1 (56kHz 20/08/20 2 (56kHz 20/08/20 3 (56kHz 5/09/200 4 (56kHz 11/04/20 5 (56kHz 12/04/20 6 (56kHz 1/05/200 01	08 324:19 PM) 08 343:20 PM) 8 9:14:48 AM) 09 205:21 PM) 09 12:47:41 PM) 9 12:54:16 PM)	* III	mode)
	EAKERS Legend/tikandi/tight Correction Filter Correction Filter Correction Filter Correction Filter Correction Filter Correction Filter Legend/Kebi Pro/00	t 1 (56kHz 20/08/20 2 (56kHz 20/08/20 3 (56kHz 5/09/200 4 (56kHz 11/04/20 5 (56kHz 12/04/20 6 (56kHz 1/05/200 01	08 324:19 PM) 08 343:20 PM) 8 9:14:48 AM) 09 205:21 PM) 09 12:47:41 PM) 9 12:54:16 PM)	* III +	mode)
	EAKERS Legend/tikandi/tight Correction Filter Correction Filter Correction Filter Correction Filter Correction Filter Correction Filter Legend/Kebi Pro/00	t 1 (56kHz 20/08/20 2 (56kHz 20/08/20 3 (56kHz 5/09/200 4 (56kHz 11/04/20 5 (56kHz 22/04/20 6 (56kHz 1/05/200 01	08 324:19 PM) 08 343:20 PM) 8 9.14.48 AM) 09 205:21 PM) 09 12:47:41 PM) 9 12 54:16 PM)	A H	mode)
	AKERS Legend/tikandi/right Correction Filter Correction Filter Correction Filter Correction Filter Correction Filter Correction Filter Legend/Kebi Pro/00	t 1 (S6kHz 20/08/20 2 (S6kHz 20/08/20 3 (S6kHz 5/09/200 4 (S6kHz 11/04/20 5 (S6kHz 1/05/200 6 (S6kHz 1/05/200 01	08 3 24:19 PM) 08 3 43:20 PM) 8 9.14.48 AM) 09 2 05:21 PM) 09 12:47:41 PM) 9 12 54:16 PM)		mode)

Main Filter       Limit Filters       Time/Level       Advanced         Additional delay can be added to this loudspeaker's signal for time alignment purposes.         Please enter the amount of delay to add in terms of either time or distance.         Delay / Offset       Units         [16]       © Milliseconds         Maximum Acceptable Delay / Offset:       100.00         Gain can also be adjusted on a per-speaker basis.		eft: Filter Drone	tier			572
Additional delay can be added to this loudspeaker's signal for time alignment purposes. Please enter the amount of delay to add in terms of either time or distance.         Delay / Offset       Units         16	;	Main Filter   Limi	t Filters Time/Level A	ivanced		
Delay / Offset       Units         16 <ul> <li>Metres</li> </ul> Maximum Acceptable Delay / Offset:       100.00         Gain can also be adjusted on a per-speaker basis. <ul> <li>Gain (dB)</li> <li>Gain (dB)</li> </ul>		Additional de Please enter	lay can be added to this lo the amount of delay to ad	oudspeaker's signal fo d in tems of either tim	time alignment purp e or distance.	ooses.
Maximum Acceptable Delay / Offset: 100.00 Gain can also be adjusted on a per-speaker basis. Gain (dB)			Delay / Offset	Units Millisecon Metres	ds	
Gain can also be adjusted on a per-speaker basis. Gain (dB)					_	
			Ma	timum Acceptable Del	ay / Offset:  1	00.00
		Gain can also	Ma: b be adjusted on a per-spe Gain (dB)	ámum Acceptable Del eaker basis.	ay / Offset:  1	00.00
OK Cancel Apply Help		Gain can also	Ma: b be adjusted on a per-spe Gain (dB) 0 0K	imum Acceptable Del eaker basis.	ay / Offset:  1	Help

(12) 同様の操作を左右のスピーカーに対して行いプロジェクトファイルを再度セーブします。フィルター プロパティに16msの遅延が加えられていることが図16からもわかります。



- (13) 以上の結果を確認するため、再度室内測定を行い手順(2)~(9)を繰り返します。図17から、両ス ピーカーのインパルス応答のタイムアラインメントがきちんと調整されていることがわかります。
  - Viewer (8) [Left] - -Use the controls to manipulate the visible/selected plots. Other plots will remain unchanged. Smoothing Gain adjust (scale) Misc. commands Selection ......... 100% Normalize to 0dB Reset Copy Remove All None Invert Impulse Response DEQX Calibrated 96 KHZ 0.25 entited 0.15 -0.05 -U.15 10 15 30 40 45 ò 5 20 25 35 50 Time (milliseconds) Show Plot Name Col Line Smooth Scale Þ ✓ Left 100% 29.6 dB 100% Normalize to UdB | Reset All None Invert Copy Remove Impulse Response DEQX Calibrated 96 KH Ē1 Amplitude x 10-3 0 -0.5 E-1 -1.5 -2 10 15 20 25 30 35 40 45 50 0 Time (milliseconds) Show Plot Name Col Line Smooth Scale Firmware Target: Auto X:
  - 注)確認のための測定が終わるまでマイクは動かさないこと。

図17

## さあこれでサブ・ウーファーが何処(時間的に)にあるかがわかりましたね!

The DOCTOR.