Digital Room Correction in Rodgers Organs

plus...

Rodgers Audio and Speakers

2016 Rodgers Dealer Meeting

September 20, 2016

John Pospisil – Manager of Techncial Services and Engineering

RODGERS®

Agenda

1. Amplifiers and Speakers
2. What Is Digital Room Correction?
3. Room Frequency Response Characteristics – What they are and how to get them
4. Interpreting Your Room EQ Curve
5. Voicing to the Room – Rough Voicing Techniques
6. The Key – Translating the Room EQ Curve to the Keyboard
7. Voicing to the Room – Precision Techniques

1. Amplifiers and Speakers

Amplifiers

- Crown CT4150

- Crown CT8150

1. Amplifiers and Speakers

Why Crown?

- Established company
- Excellent audio quality
- High power amplifiers
- Sturdy and strong build quality
- Rodgers can focus on designing organs!

RODGERS®

1. Amplifiers and Speakers

Crown CT4150 and CT8150 Amplifiers

- Class-"I" Amplifiers = "Interleaving" Amplifiers: >90% Efficiency

Amplifier Model	# of Channels	Power Output (@ 4Ω and 8Ω)	Drive Impedance	Frequency Response (at 1W into 4/8 ohms)	Weight (lbs)
CT-4150	4	125 W/channel	2 Ω - 16 Ω	± 0.5dB	10 lbs
CT-8150	8	125 W/channel	2 Ω - 16 Ω	± 0.5dB	10 lbs

1. Amplifiers and Speakers

Loudspeakers

FR1 Two-Way Tuned Port Enclosure Speaker

FR55 Full Range Speaker

RC2 Reed Channel Speaker

SW6 Front Firing Dual Port Compact Subwoofer

1. Amplifiers and Speakers

Loudspeaker Specifications

Speaker Model	Power Handling (Watts RMS)	Frequency Response (Hz)	Sensitivity (dB @ 1W/1m)	Nominal Impedance (Ohms)	Weight (lbs)	Picture
FR1 Two-Way Tuned Port Enclosure Speaker	100 W	60 Hz – 22 kHz	91 dB 1W/1m	8 Ω	32 lbs	
FR55 Full Range Speaker	100 W	32 Hz – 22 kHz	88 dB 1W/1m	8 Ω	76 lbs	
RC2 Reed Channel Speaker	100 W	60 Hz – 22 kHz	101 dB 1W/1m	8 Ω	53 lbs	
SW6 Front Firing Dual Port Subwoofer	200 W	16 Hz – 200 Hz	90 dB 1W/1m	8 Ω	68 lbs	

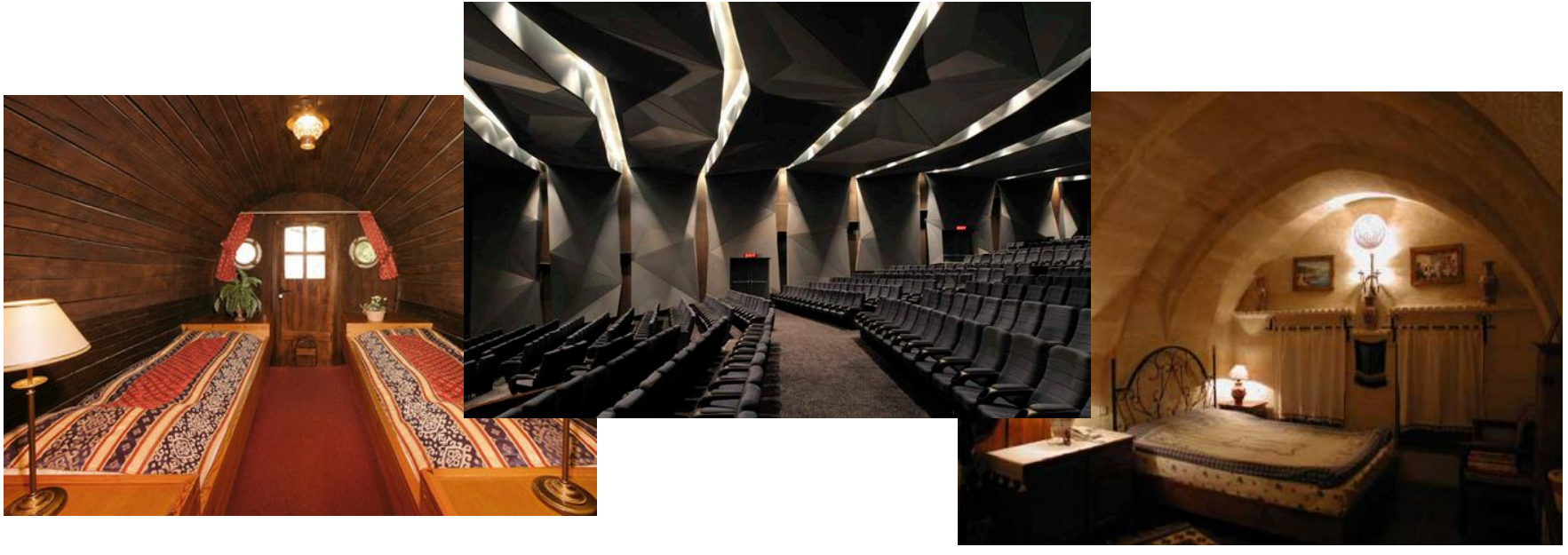
2. What Is Digital Room Correction?

Digital Room Correction

A process in the field of acoustics where digital filters designed to correct unfavorable effects of a room's acoustics are applied to the input of a sound reproduction system.

3. Room Frequency Response Characteristics – What They Are

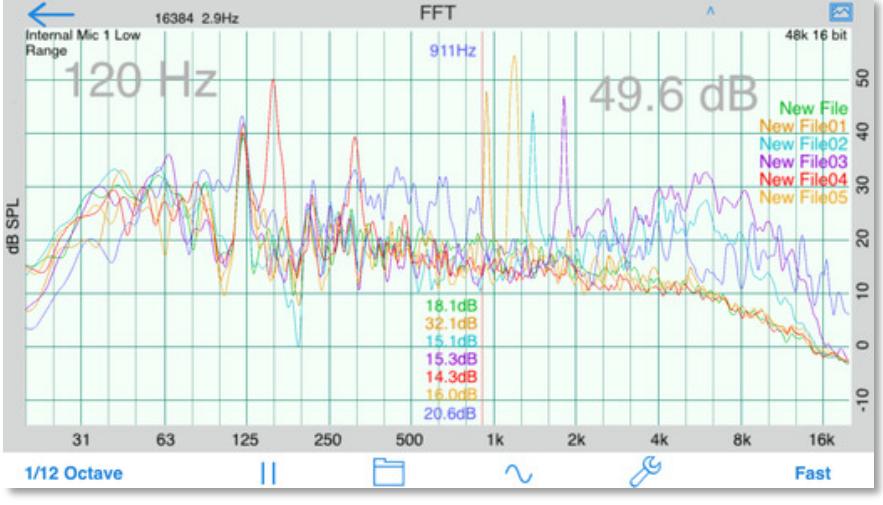
Every room has a unique frequency response to sound based on the room's shape, dimensions, construction and even furnishings.

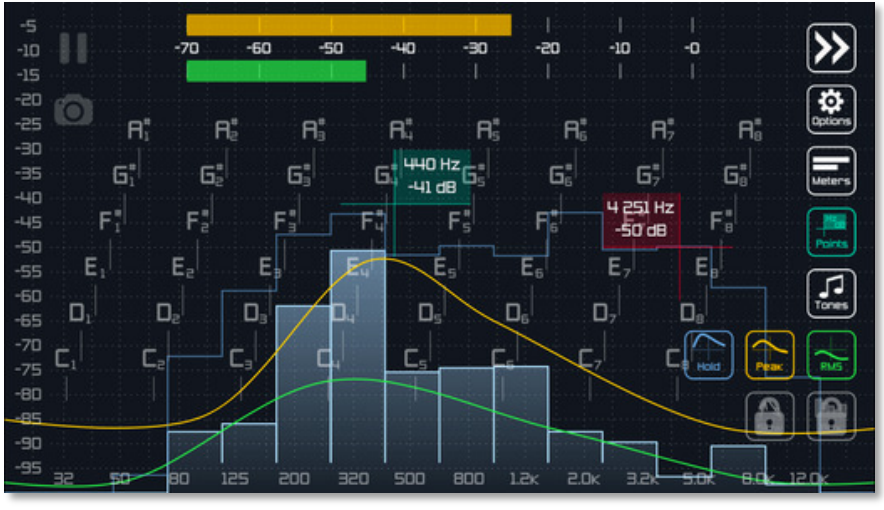


3. Room EQ Characteristics – How to Get Them

Audio Analysis Apps – include Real Time Analyzers, Decibel Meters, RT60, Spectrograms, etc…

- ANDROID – AudioTool, RTA Audio Analyzer, Sound Analyser Pro
- APPLE - AudioTools, RTA Free Audio, RTA Pro





3. Room EQ Characteristics – How to Get Them

Audio Analysis Software – Requires a PC, may be inapplicable to a pipe organ installation

- FreqAnalyst, TrueRTA, ARC System 2

3. Room EQ Characteristics – How to Get Them

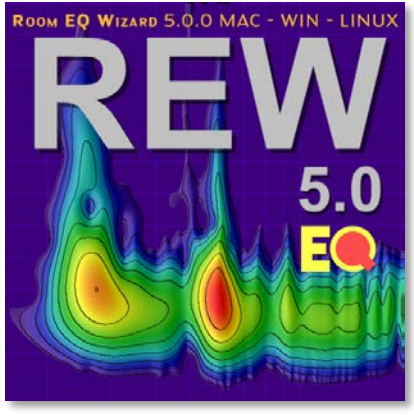
Room EQ Wizard – REW

- Free!
- Full featured software
- Includes tools for generating audio test signals; measuring SPL and impedance; measuring frequency and impulse responses; measuring distortion; generating phase, group delay and spectral decay plots, waterfalls, spectrograms and energy-time curves; generating real time analyzer (RTA) plots; calculating reverberation times; calculating Thiele-Small parameters; determining the frequencies and decay times of modal resonances; displaying equalizer responses and automatically adjusting the settings of parametric equalizers to counter the effects of room modes and adjust responses to match a target curve.

3. Room EQ Characteristics – How to Get Them

Room EQ Resources

- www.YouTube.com – has great “getting started” videos
- http://www.roomeqwizard.com/help.html - detailed help



3. Room EQ Characteristics – How to Get Them

Room EQ Wizard Setup – What You Will Need

1. Rodgers Classic, Artist or Infinity Series Organ

3. Room EQ Characteristics – How to Get Them

Room EQ Wizard Setup – What You Will Need

1. Rodgers Classic, Artist or Infinity Series Organ

2. Audio Interface

3. Room EQ Characteristics – How to Get Them

Room EQ Wizard Setup – What You Will Need

1. Rodgers Classic, Artist or Infinity Series Organ
2. Audio Interface
3. Laptop

3. Room EQ Characteristics – How to Get Them

Room EQ Wizard Setup – What You Will Need

1. Rodgers Classic, Artist or Infinity Series Organ
2. Audio Interface
3. Laptop
4. High-Precision Measurement Microphone

Behringer ECM8000 - $70

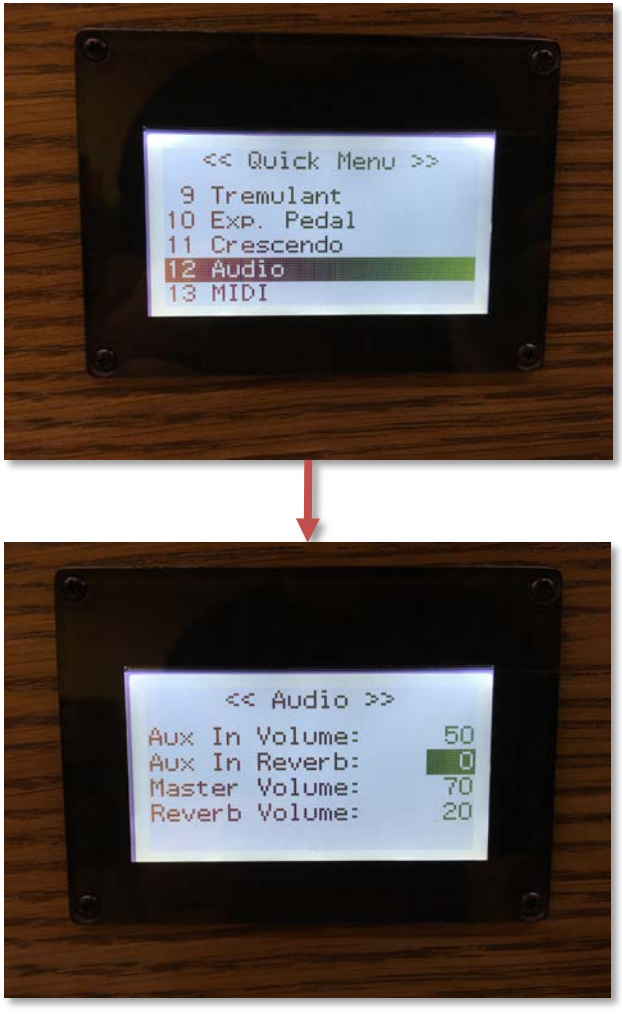
RODGERS®

3. Room EQ Characteristics – How to Get Them

Room EQ Wizard Setup – What You Will Need

1. Rodgers Classic, Artist or Infinity Series Organ
2. Audio Interface
3. Laptop
4. High-Precision Measurement Microphone
5. SPL Meter (a mobile SPL-measurement app that can make C-Weighted measurements should be OK)

IMPORTANT: Turn Off Aux In Reverb



3. Room EQ Characteristics – How to Get Them

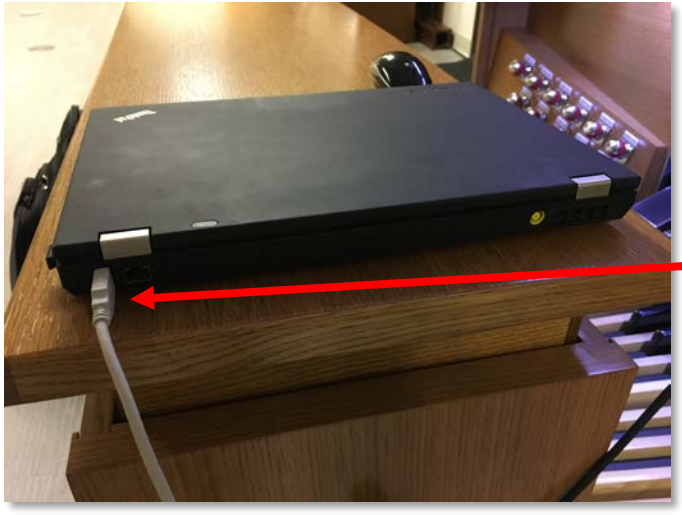
Room EQ Wizard – Measurement Setup

1. Download and Install Room EQ Wizard - http://www.roomeqwizard.com/

3. Room EQ Characteristics – How to Get Them

Room EQ Wizard – Measurement Setup

1. Download and Install Room EQ Wizard - http://www.roomeqwizard.com/
2. Attach audio interface to your computer.



3. Room EQ Characteristics – How to Get Them

Room EQ Wizard – Measurement Setup

1. Download and Install Room EQ Wizard - http://www.roomeqwizard.com/
2. Attach audio interface to your computer.
3. Connect measurement microphone to your audio interface. Place the microphone at the organist's listening position.

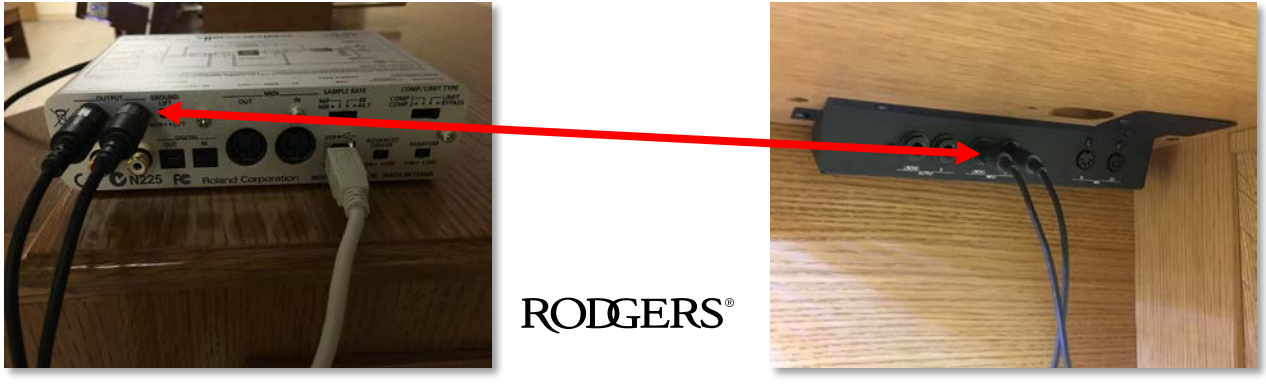
RODGERS®

Behringer ECM8000 - $70

3. Room EQ Characteristics – How to Get Them

Room EQ Wizard – Measurement Setup

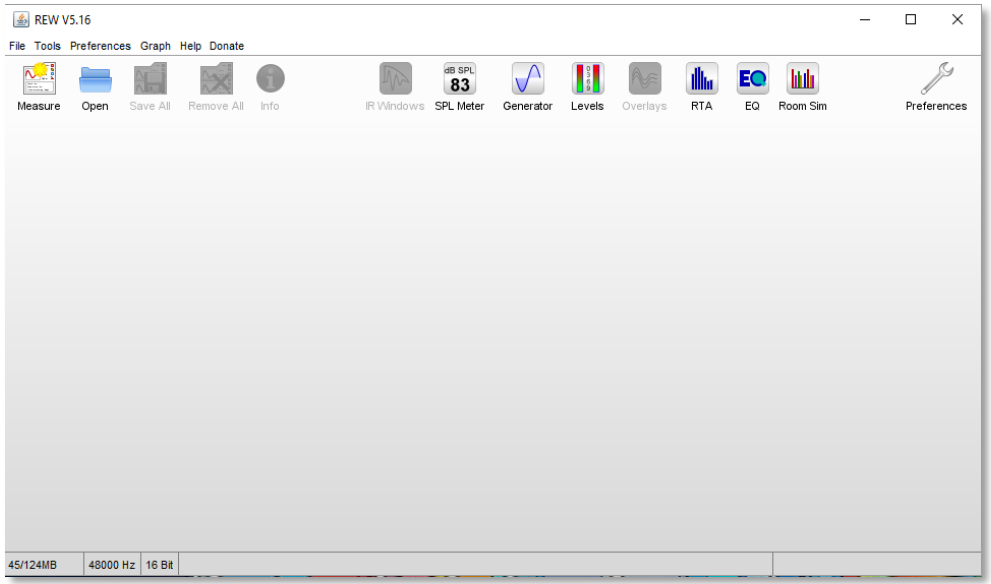
1. Download and Install Room EQ Wizard - http://www.roomeqwizard.com/
2. Attach audio interface to your computer.
3. Connect measurement microphone to your audio interface. Place the microphone at the organist's listening position.
4. Connect the audio interface Line Output to the organ Line (Aux) Input.



3. Room EQ Characteristics – How to Get Them

Room EQ Wizard – Making Measurement

1. Start Room EQ Wizard Software

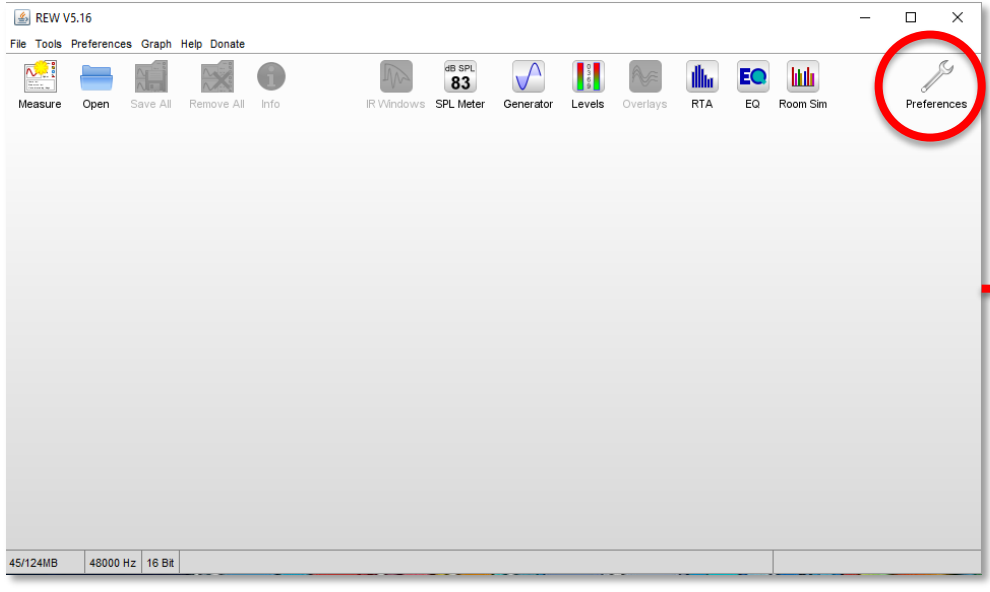


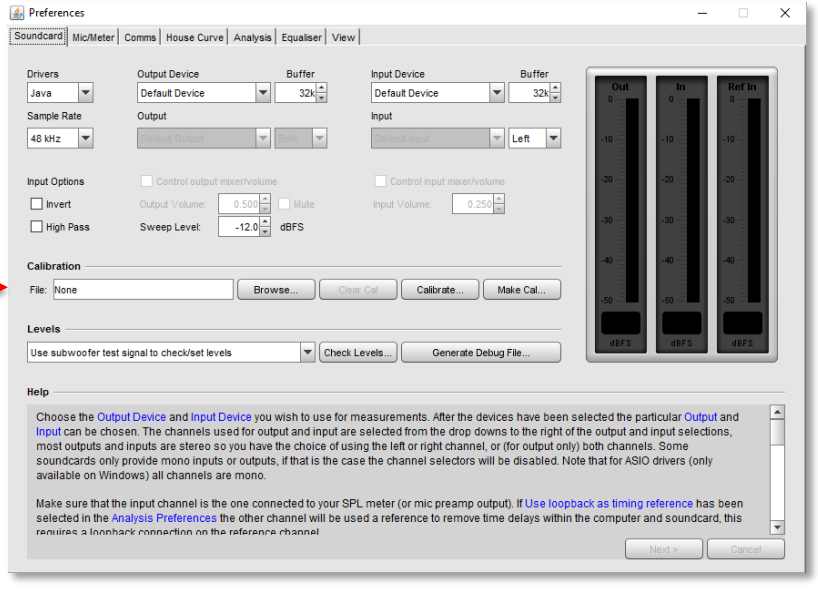
3. Room EQ Characteristics – How to Get Them

Room EQ Wizard – Making Measurement

1. Start Room EQ Wizard Software

2. Open “Preferences”

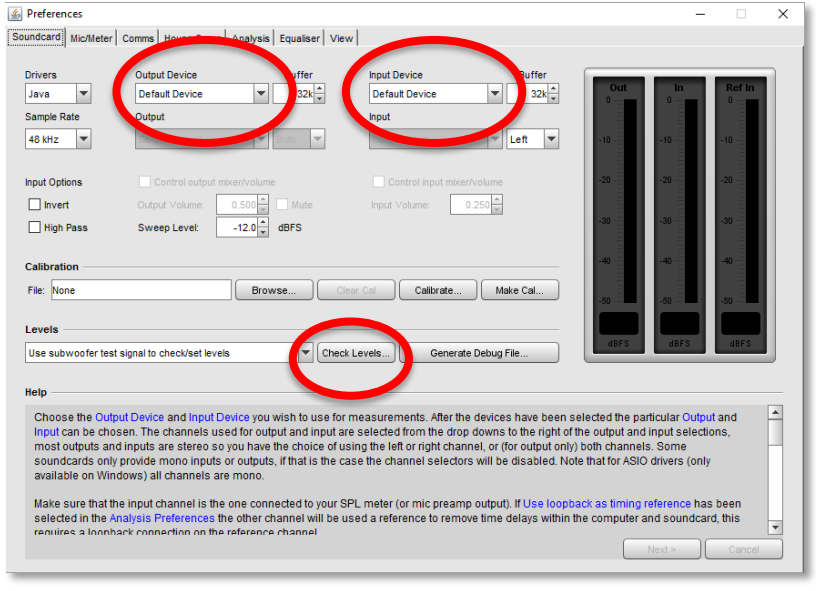




3. Room EQ Characteristics – How to Get Them

Room EQ Wizard – Making Measurement

1. Start Room EQ Wizard Software
2. Open “Preferences”
3. Select your Audio Interface Input and Output. Click “Check Level”. Verify audio signal is present.

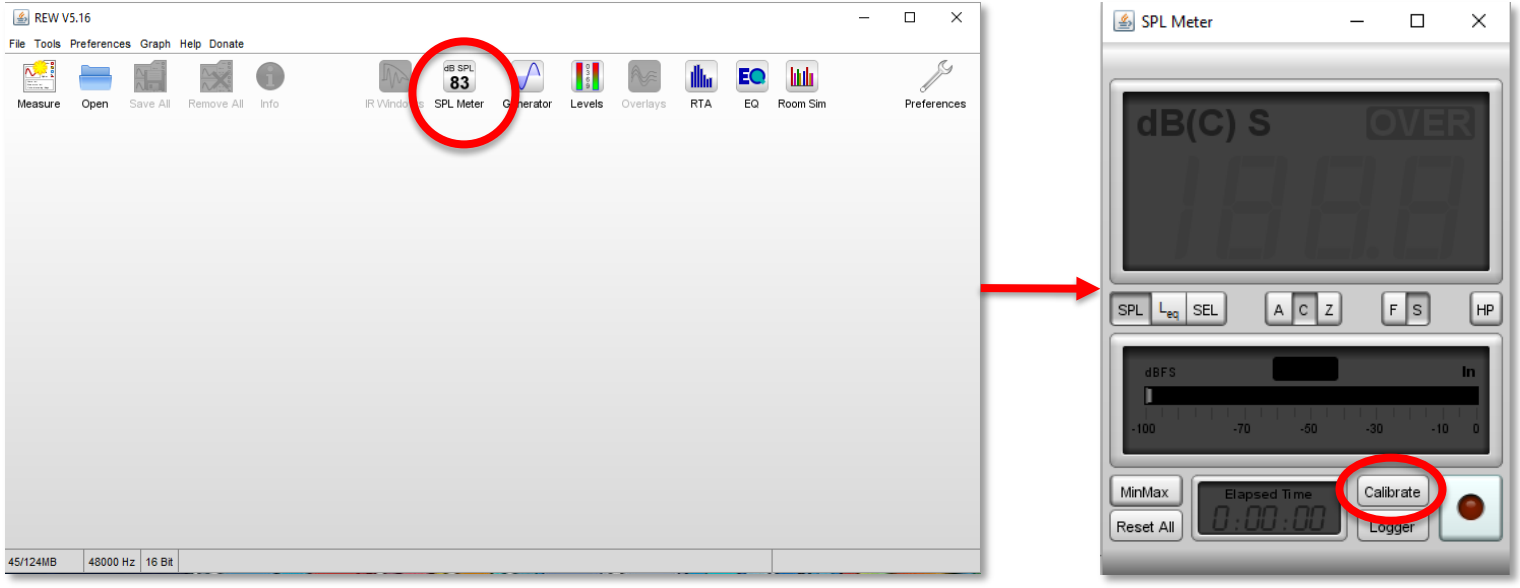


RODGERS®

3. Room EQ Characteristics – How to Get Them

Room EQ Wizard – Making Measurement

4. Click “SPL Meter”, then click “Calibrate”.

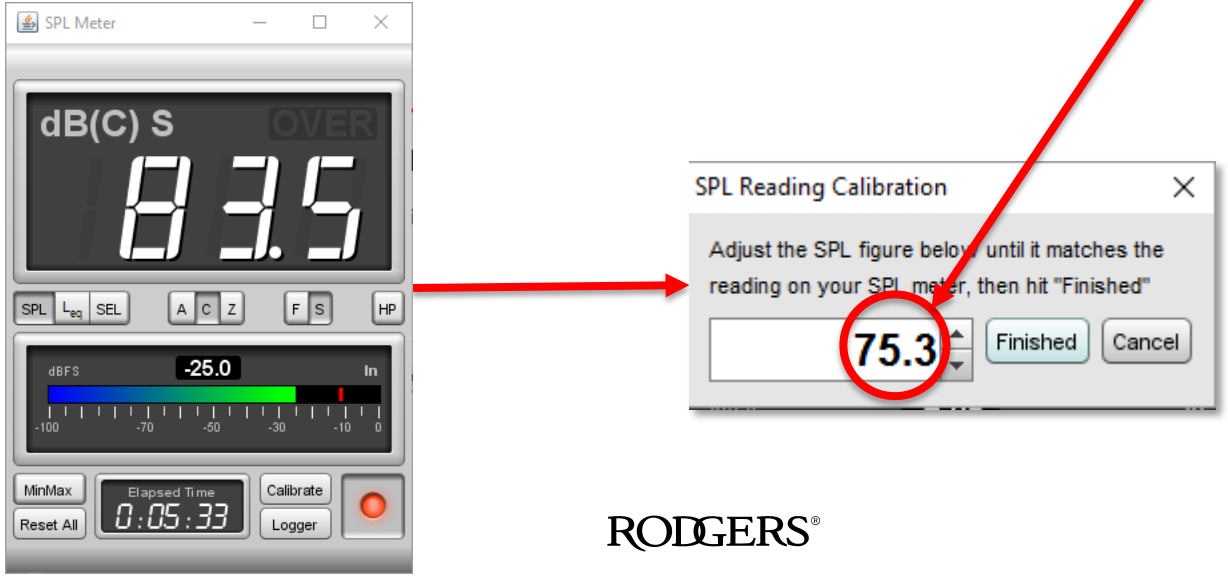


3. Room EQ Characteristics – How to Get Them

Room EQ Wizard – Making Measurement

4. Click “SPL Meter”, then click “Calibrate”.

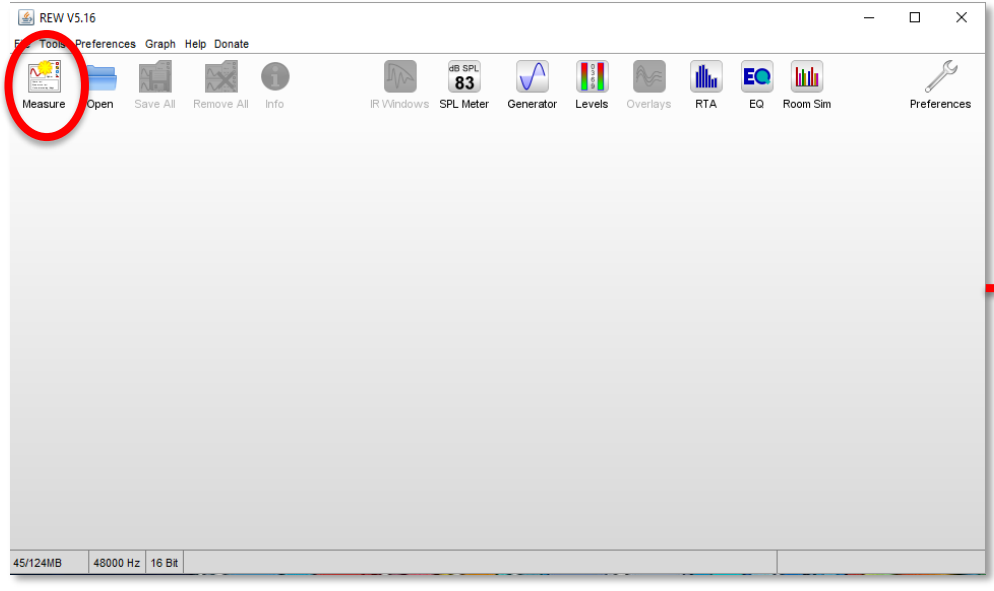
5. Get your C-Weighted SPL meter. Measure SPL. Adjust the Audio Interface Output so that the SPL meter measures around 70 or 80 dB. Enter that value here.

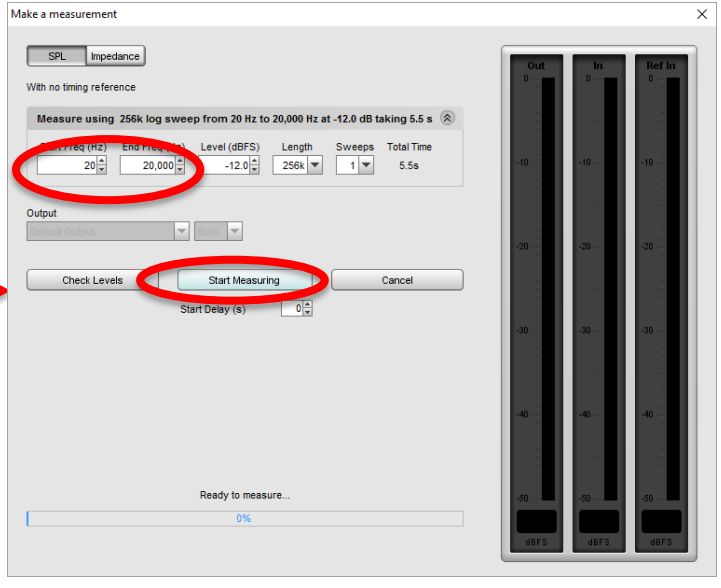


3. Room EQ Characteristics – How to Get Them

Room EQ Wizard – Making Measurement

6. Click “Measure”. Select “20” to “20000” Hz. Click “Start Measuring”.

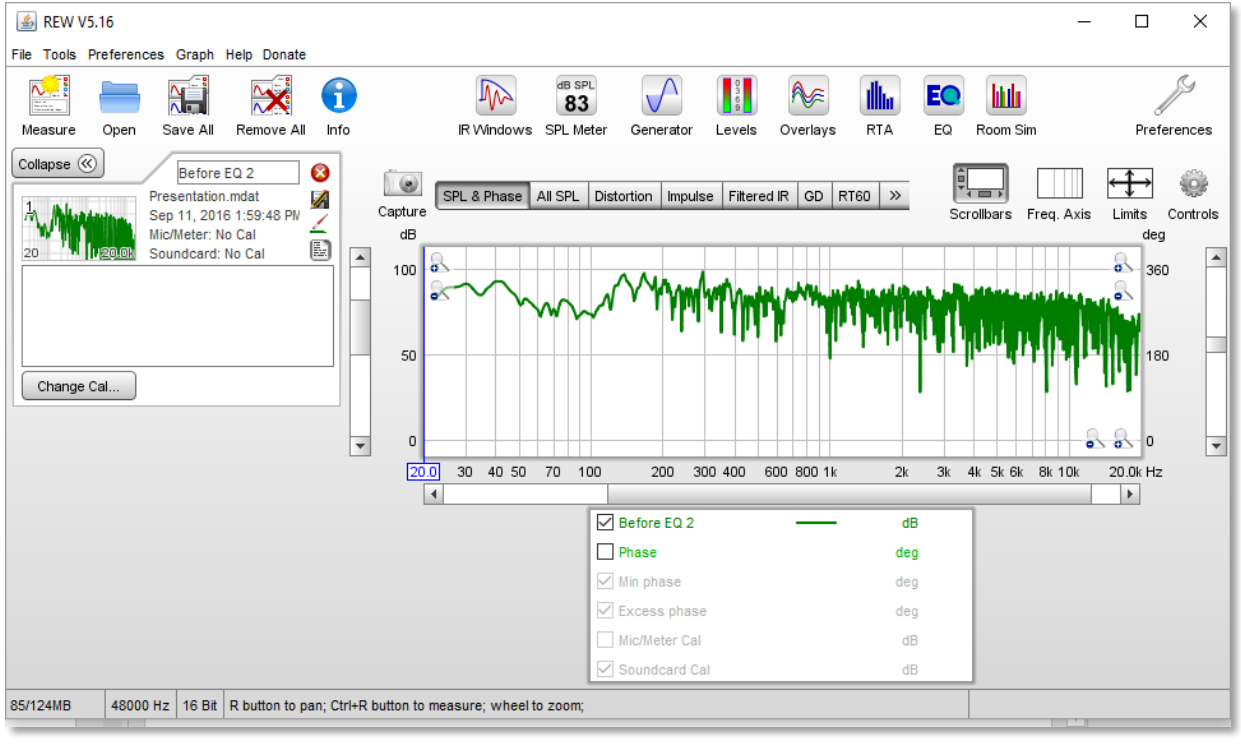




3. Room EQ Characteristics – How to Get Them

Room EQ Wizard – Making Measurement

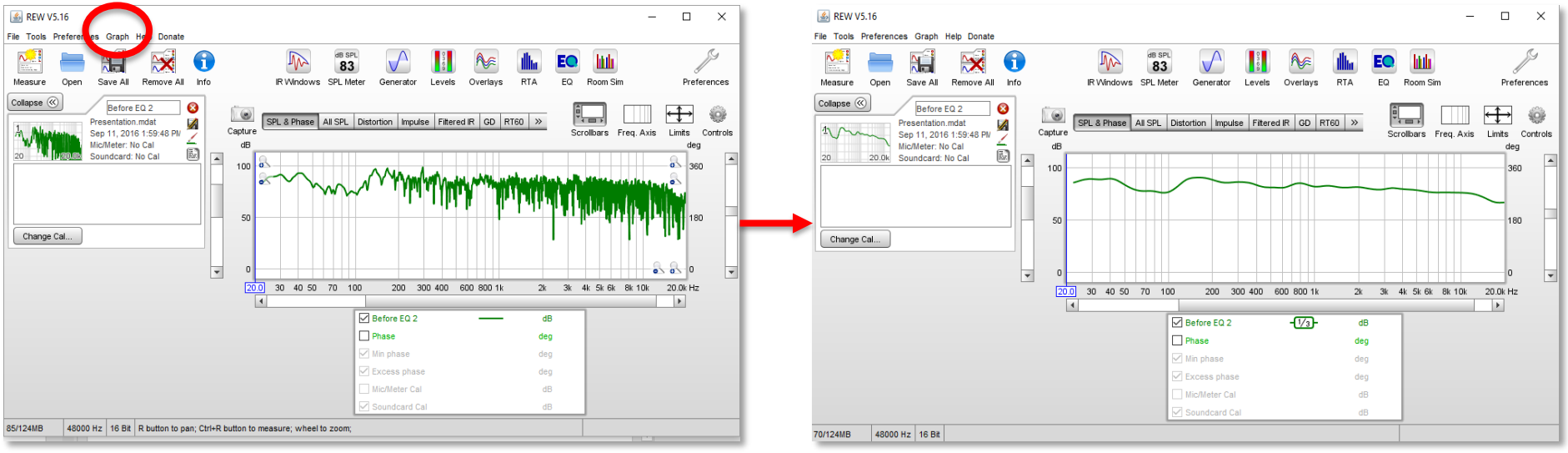
7. You should see a graph something like this.



3. Room EQ Characteristics – How to Get Them

Room EQ Wizard – Making Measurement

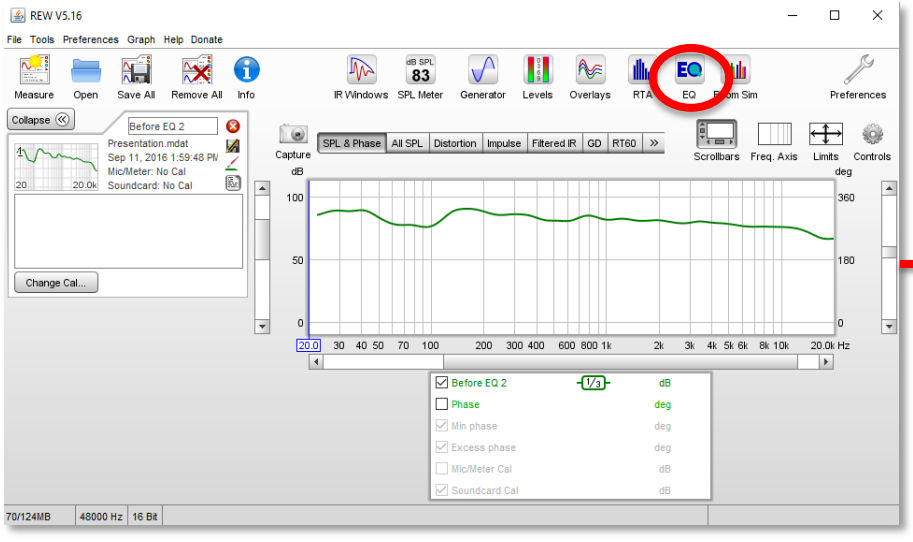
8. Click “Graph” then “Apply 1/3rd” for a human-friendly version of this graph.
NOTE: This will not affect your final results.

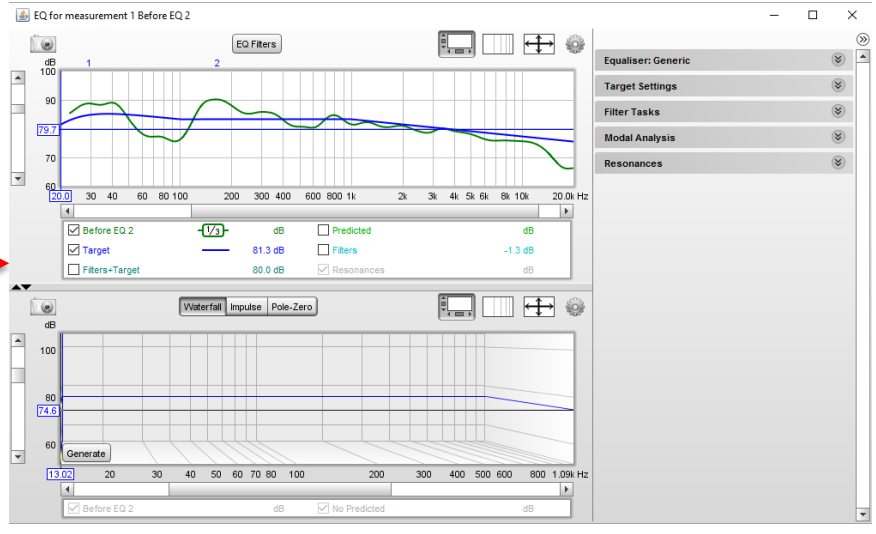


3. Room EQ Characteristics – How to Get Them

Room EQ Wizard – Making Measurement

8. Click “EQ”.

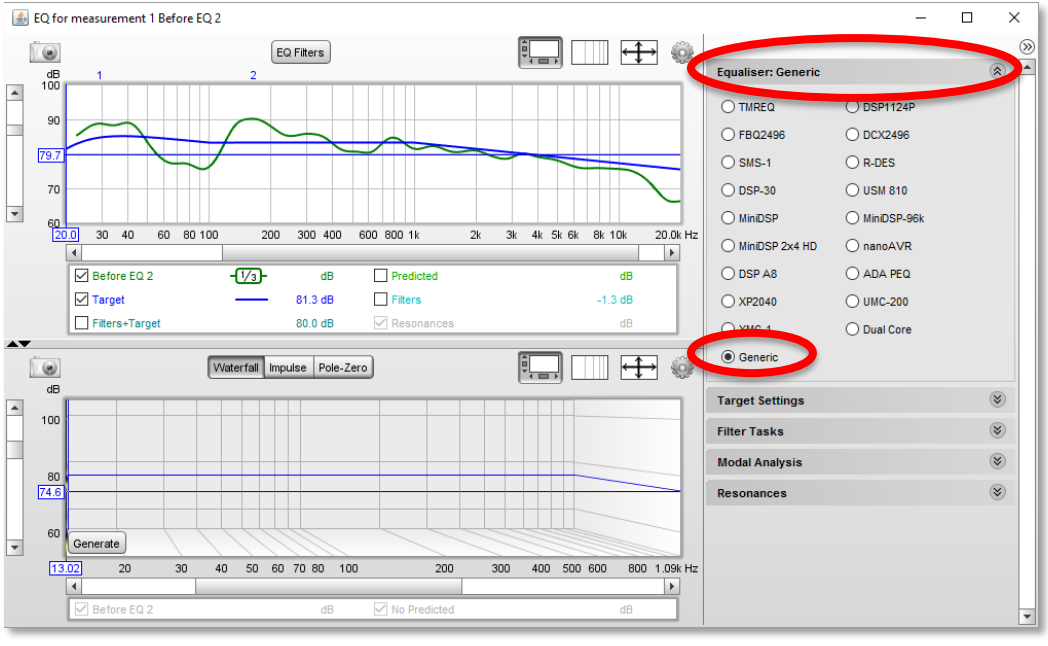




3. Room EQ Characteristics – How to Get Them

Room EQ Wizard – Making Measurement

9. Click “Equaliser”. Click “Generic”.

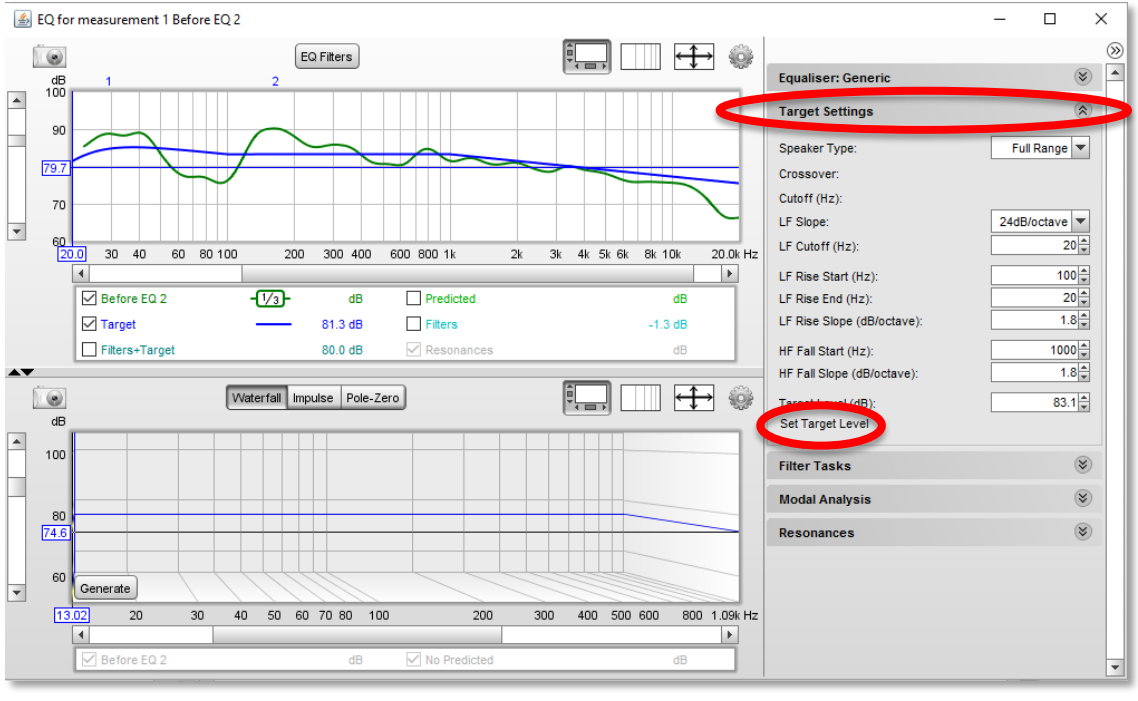


3. Room EQ Characteristics – How to Get Them

Room EQ Wizard – Making Measurement

9. Click “Equaliser”. Click “Generic”.

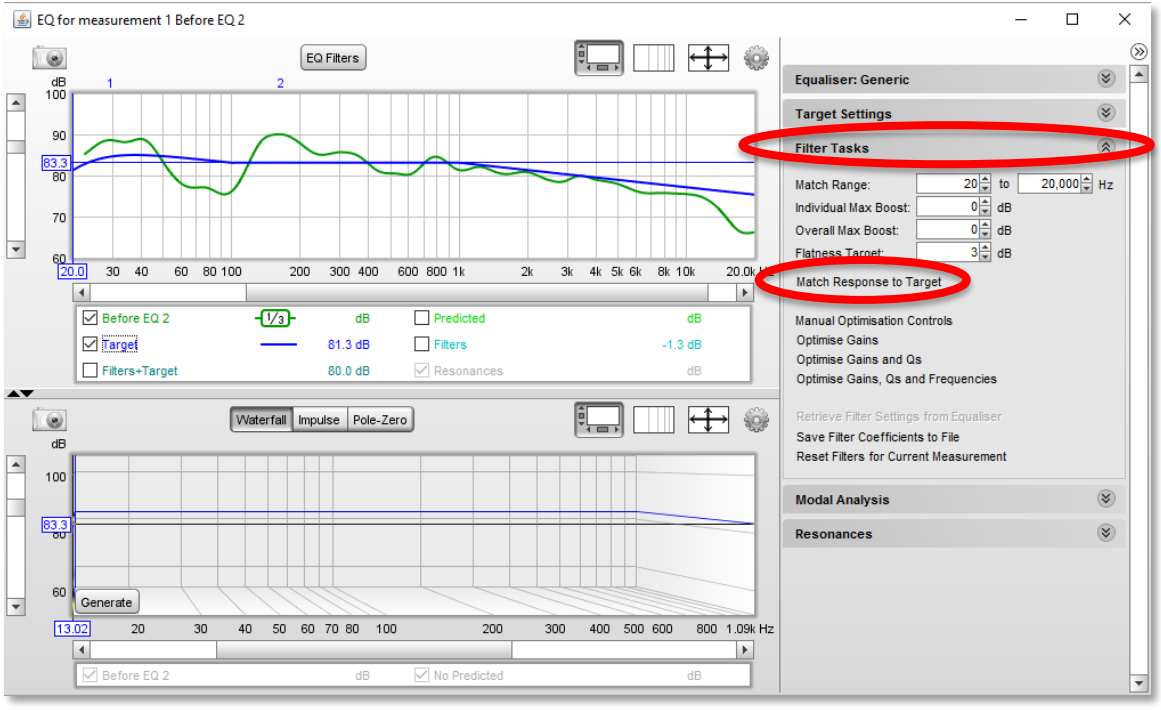
10. Click “Target Settings”. Click “Set Target Level”.



3. Room EQ Characteristics – How to Get Them

Room EQ Wizard – Making Measurement

11. Click “Filter Tasks”. Click “Match Response to Target”.

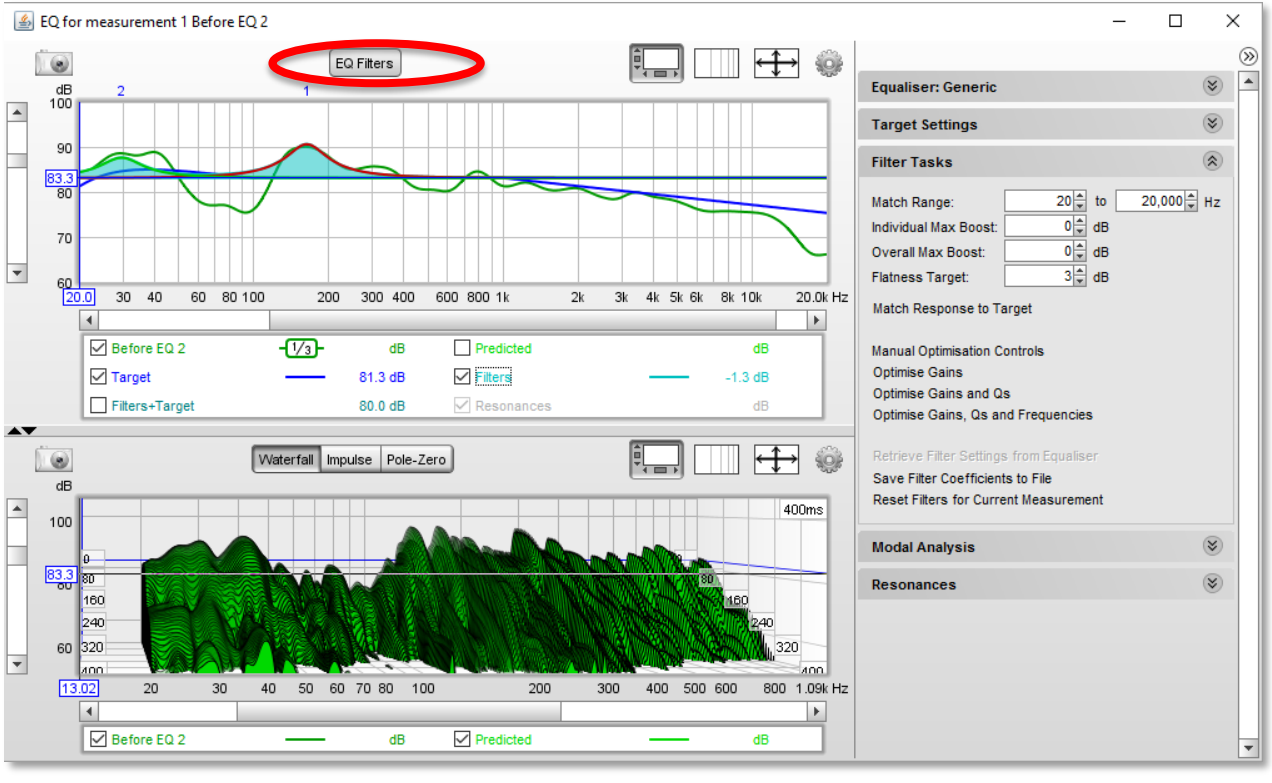


RODGERS®

3. Room EQ Characteristics – How to Get Them

Room EQ Wizard – Making Measurement

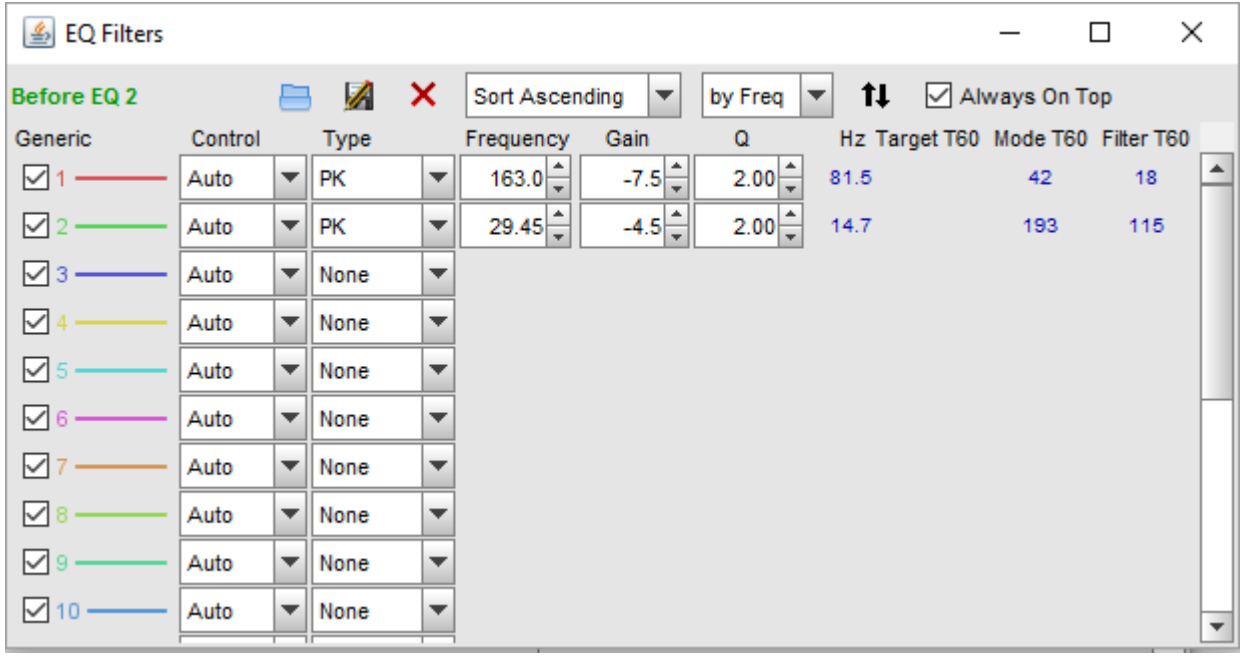
12. Your needed filters appear! Click “EQ Filters” to see details.



3. Room EQ Characteristics – How to Get Them

Room EQ Wizard – Making Measurement

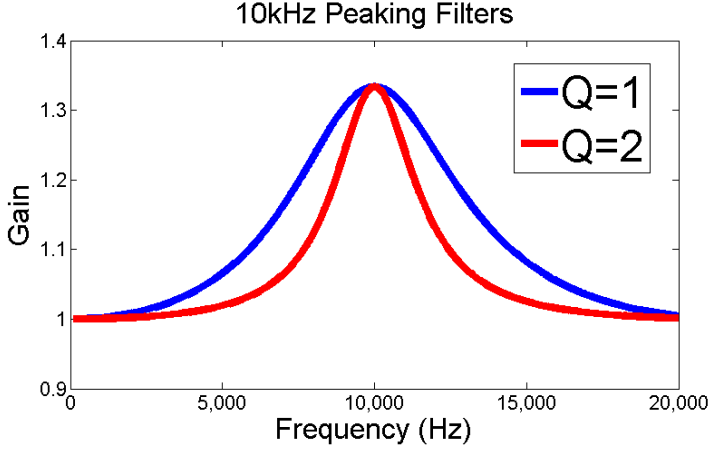
12. Your needed filters appear! Click “EQ Filters” to see details.



4. Interpreting Your Room EQ Curve

We Need:

- Frequency = 163 Hz, Gain = -7.5 dB, Q = 2
- Frequency = 29.45 Hz, Gain = -4.5 dB, Q = 2



RODGERS®

4. Interpreting Your Room EQ Curve

We Need:

- Frequency = 163 Hz, Gain = -7.5 dB, Q = 2
- Frequency = 29.45 Hz, Gain = -4.5 dB, Q = 2

Midrange Frequencies - too much sounds "Muddy" or "Woofy"

frequency band	Hz
low bass	20-40
mid bass	40-80
upper bass	80-160
lower midrange	160-320
middle midrange	320-640
upper midrange	640-1280
lower treble	1280-2560
middle treble	2560-5120
upper treble	5120-10200
top octave	10200-20400

4. Interpreting Your Room EQ Curve

We Need:

- Frequency = 163 Hz, Gain = -7.5 dB, Q = 2
- ~~Frequency = 29.45 Hz, Gain = -4.5 dB, Q = 2~~

Low Bass and Mid Bass Frequencies Gain CUTS can often be ignored for our purposes.

- This can often be a "false positive".
- Do organists usually ask for less bass in their low notes?

frequency band	Hz
low bass	20-40
mid bass	40-80
upper bass	80-160
lower midrange	160-320
middle midrange	320-640
upper midrange	640-1280
lower treble	1280-2560
middle treble	2560-5120
upper treble	5120-10200
top octave	10200-20400

RODGERS®

4. Interpreting Your Room EQ Curve

Now it is time to make this change in the organ:

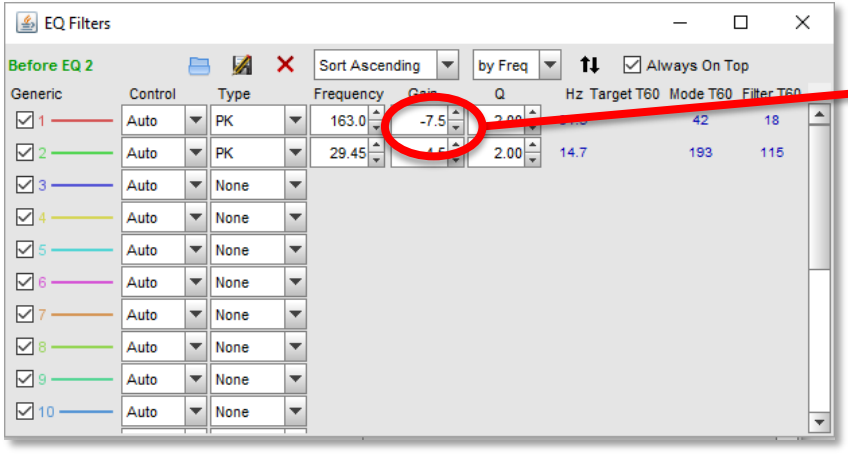
- Frequency = 163 Hz, Gain = -7.5 dB, Q = 2

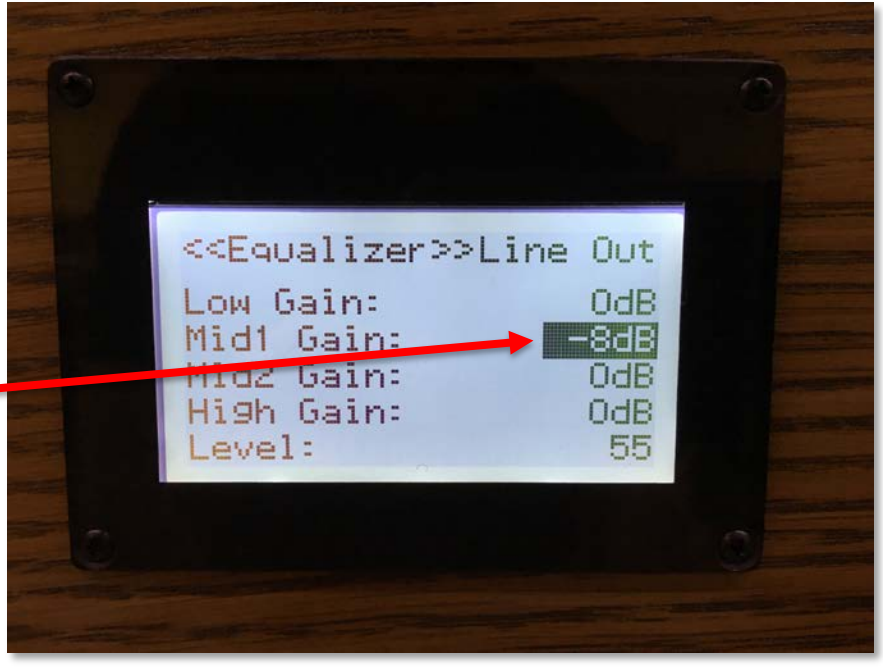
5. Voicing to the Room – Rough Voicing Techniques

Rough Techniques happen in the (#40) “Equalizer” menu

5. Voicing to the Room – Rough Voicing Techniques

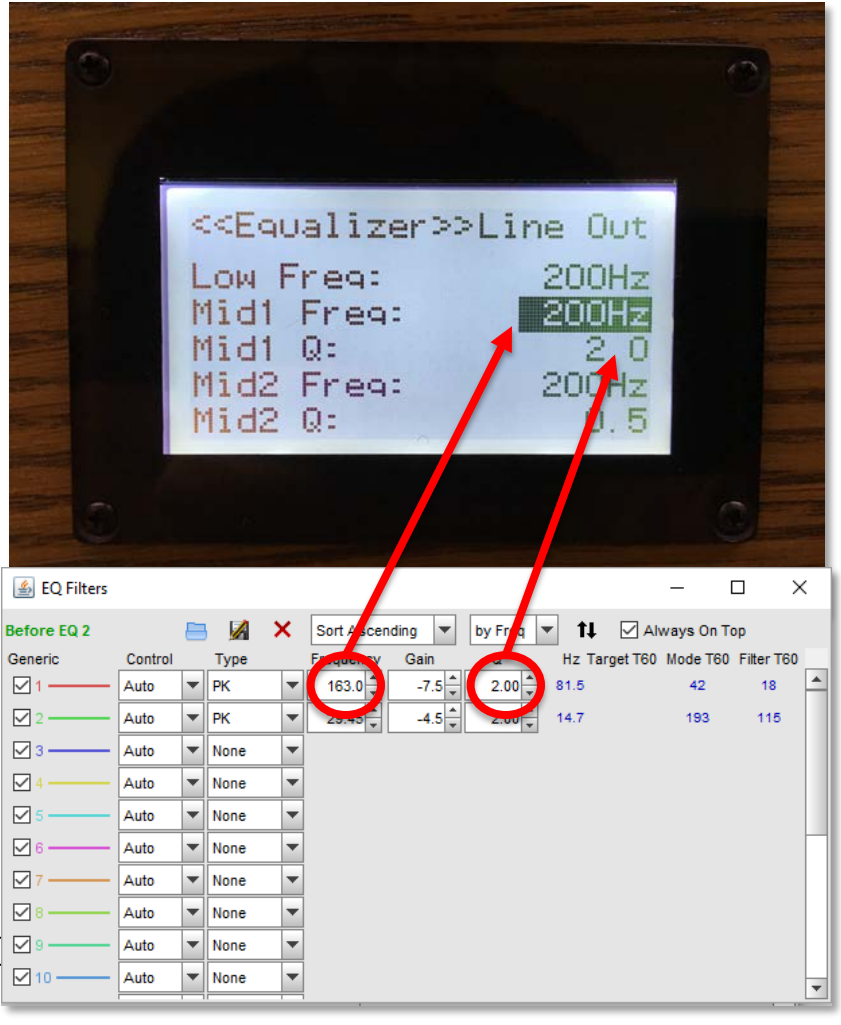
We need a cut of -7.5 dB. I rounded down to -8 dB.





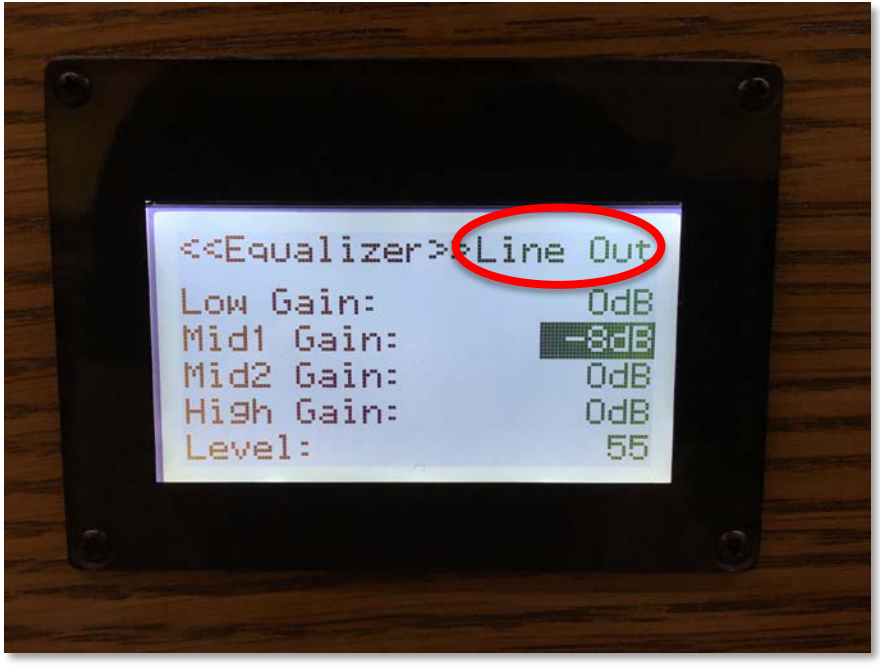
5. Voicing to the Room – Rough Voicing Techniques

We need a center frequency of 163 Hz. The closest frequenct in the Equalizer menu is 200 Hz. The Q is set to 2.0.



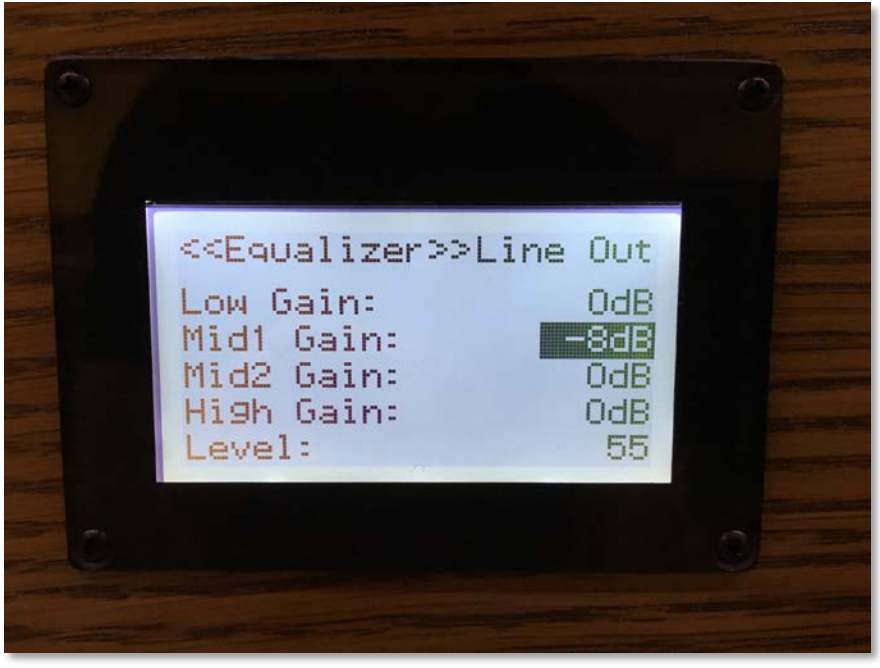
5. Voicing to the Room – Rough Voicing Techniques

Important: Make these changes to each of the outputs in the menu. You can skip the Headphone output if you would like.



5. Voicing to the Room – Rough Voicing Techniques

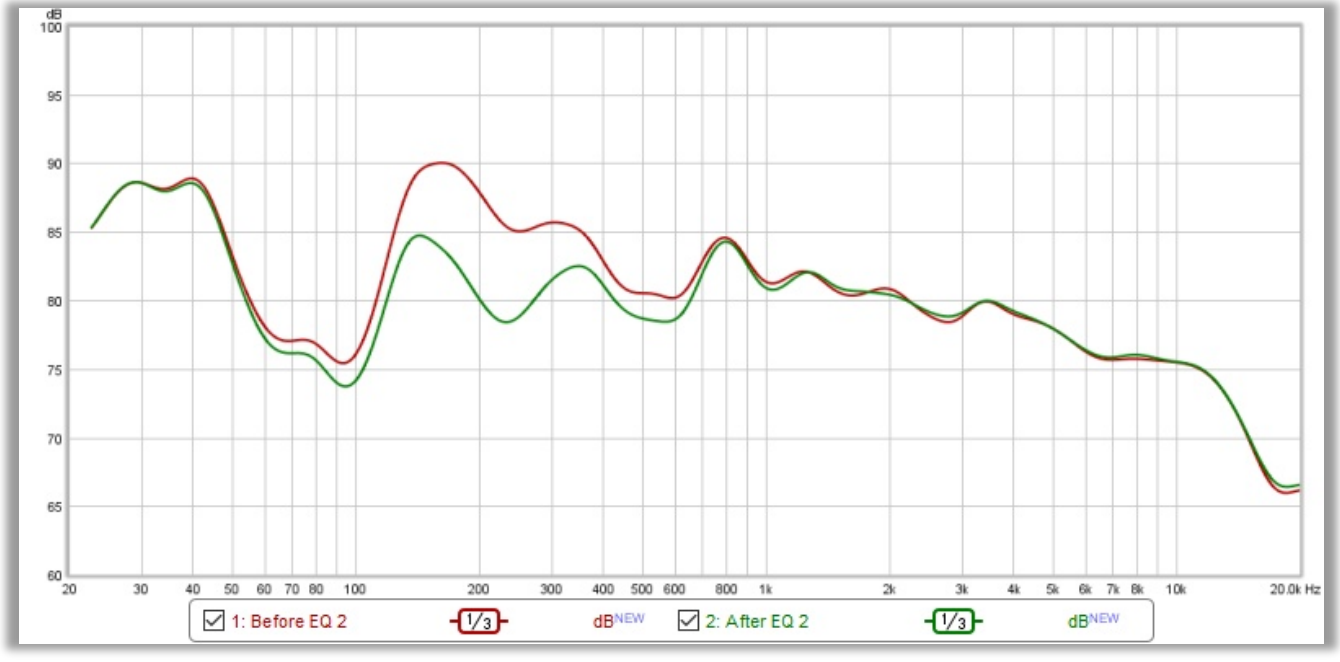
Important: Make these changes to each of the outputs in the menu. You can skip the Headphone output if you would like.



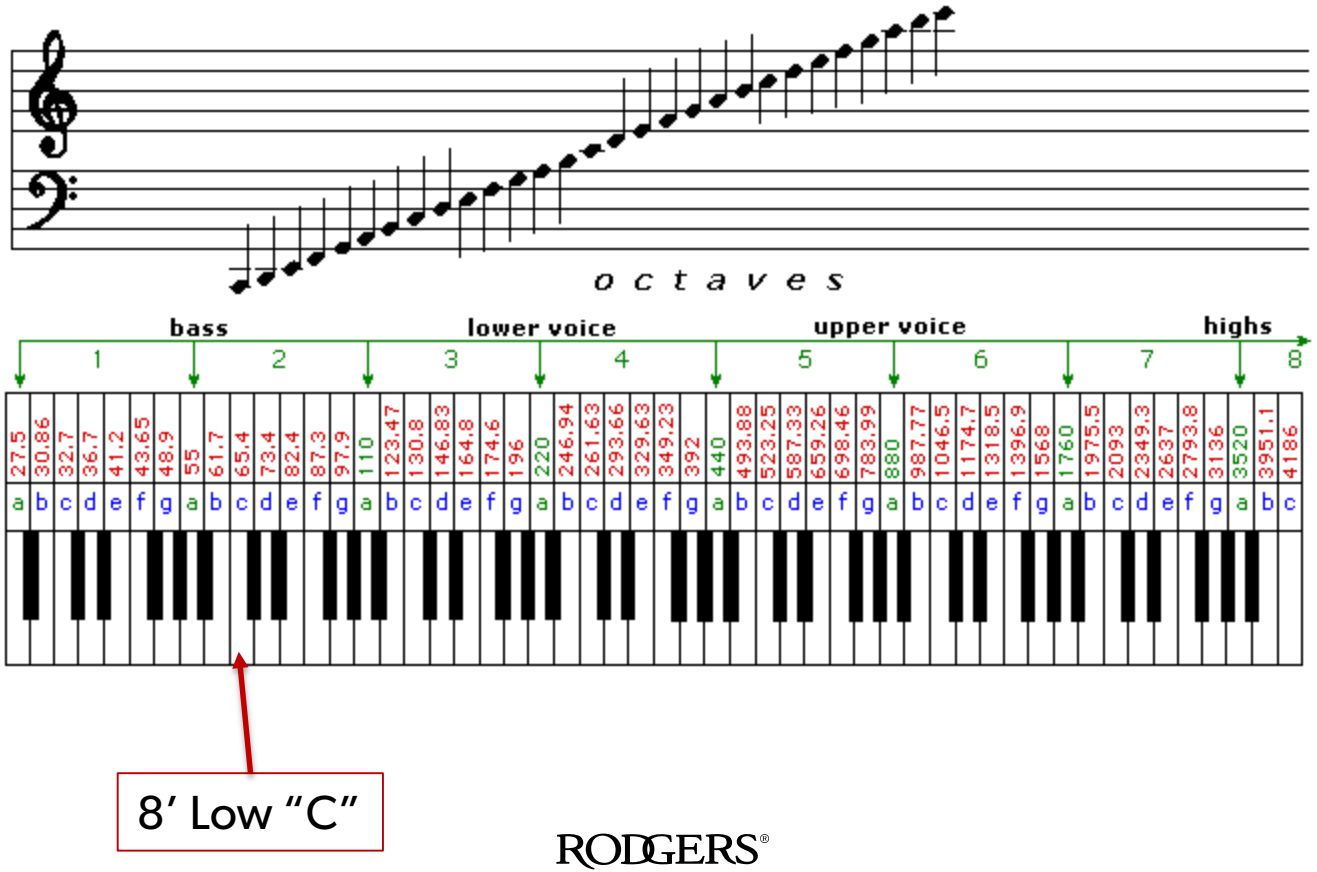
Q: Why doesn't the headphone output need to be changed?

5. Voicing to the Room – Rough Voicing Techniques

Results!



6. The Key – Translating the Room EQ Curve to the Keyboard



RODGERS®

6. The Key – Translating the Room EQ Curve to the Keyboard

8’ Low “C”

Note Frequency Chart

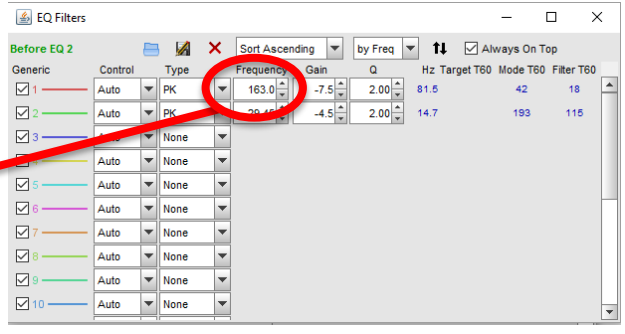
	Octave 0	Octave 1	Octave 2	Octave 3	Octave 4	Octave 5	Octave 6	Octave 7	Octave 8
C	16.35	32.70	65.41	130.81	261.63	523.25	1046.50	2093.00	4186.01
C♯	17.32	34.65	69.30	138.59	277.18	554.37	1108.73	2217.46	4434.92
D	18.35	36.71	73.42	146.83	293.66	587.33	1174.66	2349.32	4698.64
D♯	19.45	38.89	77.78	155.56	311.13	622.25	1244.51	2489.02	4978.03
E	20.60	41.20	82.41	164.81	329.63	659.26	1318.51	2637.02	5274.04
F	21.83	43.65	87.31	174.61	349.23	698.46	1396.91	2793.83	5587.65
F♯	23.12	46.25	92.50	185.00	369.99	739.99	1479.98	2959.96	5919.91
G	24.50	49.00	98.00	196.00	392.00	783.99	1567.98	3135.96	6271.93
G♯	25.96	51.91	103.83	207.65	415.30	830.61	1661.22	3322.44	6644.88
A	27.50	55.00	110.00	220.00	440.00	880.00	1760.00	3520.00	7040.00
A♯	29.14	58.27	116.54	233.08	466.16	932.33	1864.66	3729.31	7458.62
B	30.87	61.74	123.47	246.94	493.88	987.77	1975.53	3951.07	7902.13

6. The Key – Translating the Room EQ Curve to the Keyboard

8’ Low “C”

Note Frequency Chart

	Octave 0	Octave 1	Octave 2	Octave 3	Octave 4	Octave 5	Octave 6	Octave 7	Octave 8
C	16.35	32.70	65.41	130.81	261.63	523.25	1046.50	2093.00	4186.01
C♯	17.32	34.65	69.30	138.59	277.18	554.37	1108.73	2217.46	4434.92
D	18.35	36.71	73.42	146.83	293.66	587.33	1174.66	2349.32	4698.64
D♯	19.45	38.89	77.78	155.56	311.13	622.25	1244.51	2489.02	4978.03
E	20.60	41.20	82.41	164.81	329.63	659.26	1318.51	2637.02	5274.04
F	21.83	43.65	87.31	174.61	349.23	698.46	1396.91	2793.83	5587.65
F♯	23.12	46.25	92.50	185.00	369.99	739.99	1479.98	2959.96	5919.91
G	24.50	49.00	98.00	196.00	392.00	783.99	1567.98	3135.96	6271.93
G♯	25.96	51.91	103.83	207.65	415.30	830.61	1661.22	3322.44	6644.88
A	27.50	55.00	110.00	220.00	440.00	880.00	1760.00	3520.00	7040.00
A♯	29.14	58.27	116.54	233.08	466.16	932.33	1864.66	3729.31	7458.62
B	30.87	61.74	123.47	246.94	493.88	987.77	1975.53	3951.07	7902.13

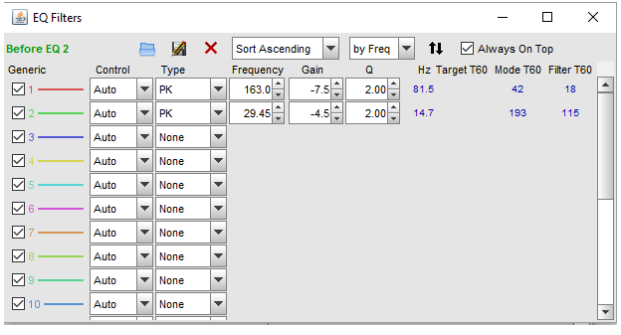


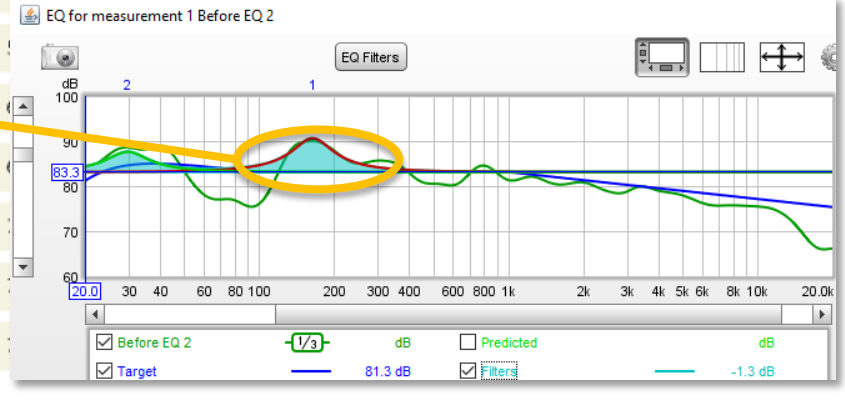
6. The Key – Translating the Room EQ Curve to the Keyboard

8’ Low “C”

Note Frequency Chart

	Octave 0	Octave 1	Octave 2	Octave 3	Octave 4	Octave 5	Octave 6	Octave 7	Octave 8
C	16.35	32.70	65.41	130.81	261.63	523.25	1046.50	2093.00	4186.01
C♯	17.32	34.65	69.30	138.59	277.18	554.37	1108.73	2217.46	4434.92
D	18.35	36.71	73.42	146.83	293.66	587.33	1174.66	2349.32	4698.64
D♯	19.45	38.89	77.78	155.56	311.13	622.25	1244.51	2489.02	4978.03
E	20.60	41.20	82.41	164.81	329.63	659.26	1318.51	2637.02	5274.04
F	21.83	43.65	87.31	174.61	349.23	698.46	1396.91	2793.83	5587.65
F♯	23.12	46.25	92.50	185.00	369.99	739.99	1479.98	2959.96	
G	24.50	49.00	98.00	196.00	392.00	783.99	1567.98	3135.96	
G♯	25.96	51.91	103.83	207.65	415.30	830.61	1661.22	3322.44	
A	27.50	55.00	110.00	220.00	440.00	880.00	1760.00	3520.00	
A♯	29.14	58.27	116.54	233.08	466.16	932.33	1864.66	3729.31	
B	30.87	61.74	123.47	246.94	493.88	987.77	1975.53	3951.07	



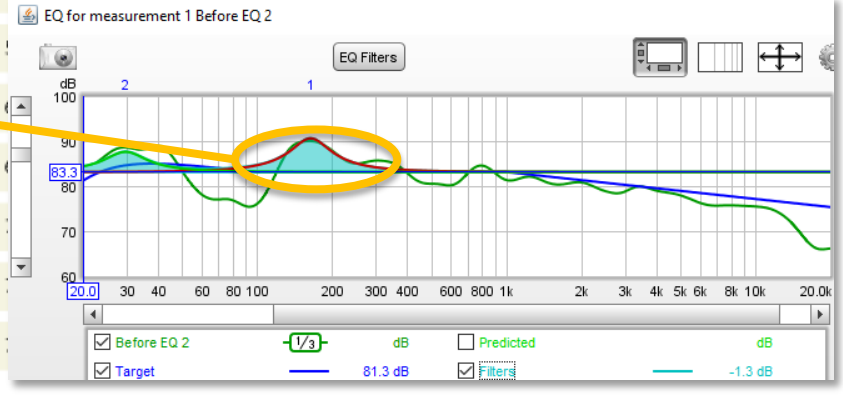


6. The Key – Translating the Room EQ Curve to the Keyboard

8’ Low “C”

Note Frequency Chart

	Octave 0	Octave 1	Octave 2	Octave 3	Octave 4	Octave 5	Octave 6	Octave 7	Octave 8
C	16.35	32.70	65.41	130.81	261.63	523.25	1046.50	2093.00	4186.01
C♯	17.32	34.65	69.30	138.59	277.18	554.37	1108.73	2217.46	4434.92
D	18.35	36.71	73.42	146.83	293.66	587.33	1174.66	2349.32	4698.64
D♯	19.45	38.89	77.78	155.56	311.13	622.25	1244.51	2489.02	4978.03
E	20.60	41.20	82.41	164.81	329.63	659.26	1318.51	2637.02	5274.04
F	21.83	43.65	87.31	174.61	349.23	698.46	1396.91	2793.83	5587.65
F♯	23.12	46.25	92.50	185.00	369.99	739.99	1479.98	2959.96	
G	24.50	49.00	98.00	196.00	392.00	783.99	1567.98	3135.96	
G♯	25.96	51.91	103.83	207.65	415.30	830.61	1661.22	3322.44	
A	27.50	55.00	110.00	220.00	440.00	880.00	1760.00	3520.00	
A♯	29.14	58.27	116.54	233.08	466.16	932.33	1864.66	3729.31	
B	30.87	61.74	123.47	246.94	493.88	987.77	1975.53	3951.07	



- This peak is centered around E17.
- The peak effects G#9 – D27.

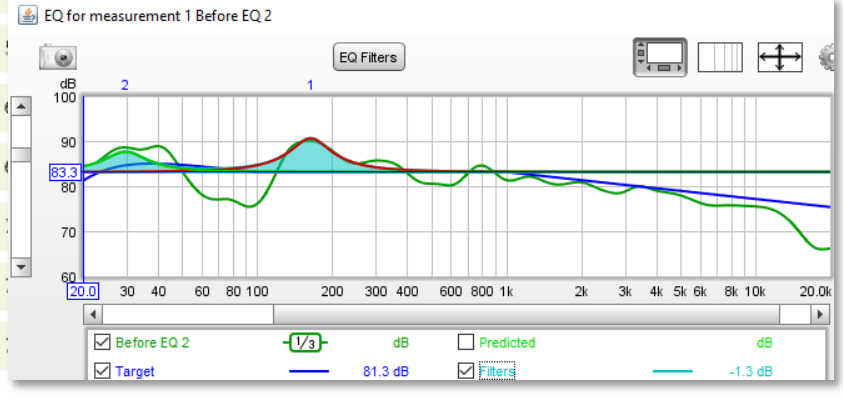
6. The Key – Translating the Room EQ Curve to the Keyboard

8′ Low “C”

Note Frequency Chart

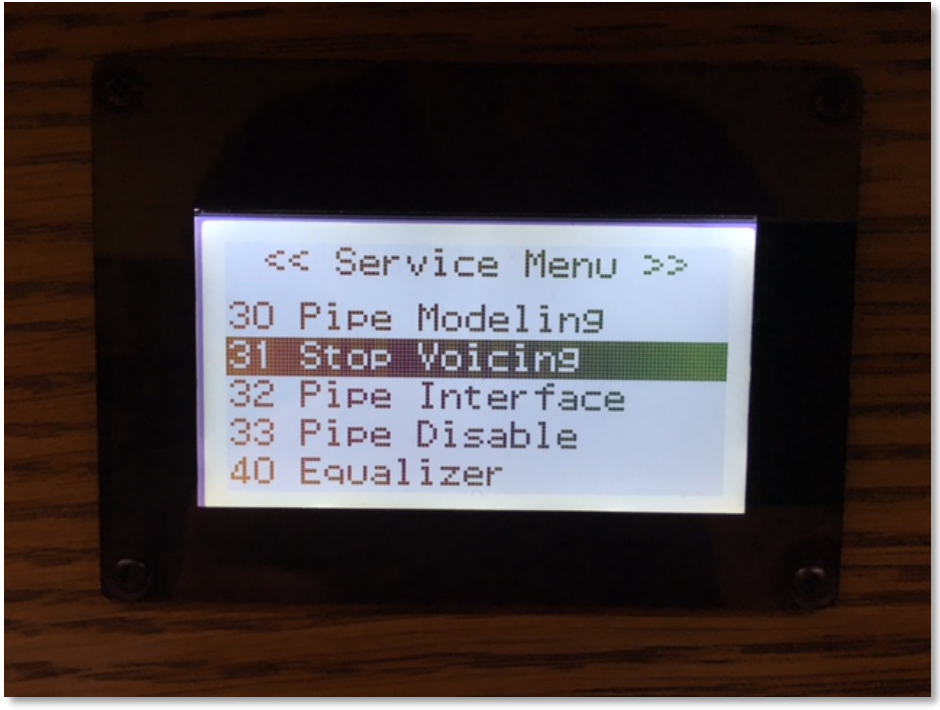
	Octave 0	Octave 1	Octave 2	Octave 3	Octave 4	Octave 5	Octave 6	Octave 7	Octave 8
C	16.35	32.70	65.41	130.81	261.63	523.25	1046.50	2093.00	4186.01
C♯	17.32	34.65	69.30	138.59	277.18	554.37	1108.73	2217.46	4434.92
D	18.35	36.71	73.42	146.83	293.66	587.33	1174.66	2349.32	4698.64
D♯	19.45	38.89	77.78	155.56	311.13	622.25	1244.51	2489.02	4978.03
E	20.60	41.20	82.41	164.81	329.63	659.26	1318.51	2637.02	5274.04
F	21.83	43.65	87.31	174.61	349.23	698.46	1396.91	2793.83	5587.65
F♯	23.12	46.25	92.50	185.00	369.99	739.99	1479.98	2959.96	
G	24.50	49.00	98.00	196.00	392.00	783.99	1567.98	3135.96	
G♯	25.96	51.91	103.83	207.65	415.30	830.61	1661.22	3322.44	
A	27.50	55.00	110.00	220.00	440.00	880.00	1760.00	3520.00	
A♯	29.14	58.27	116.54	233.08	466.16	932.33	1864.66	3729.31	
B	30.87	61.74	123.47	246.94	493.88	987.77	1975.53	3951.07	

- This peak is centered around E17.
- The peak effects G#9 – D27.
- You could also see effects in the 2nd harmonic, 200 Hz – 600 Hz, G#21 – D39.



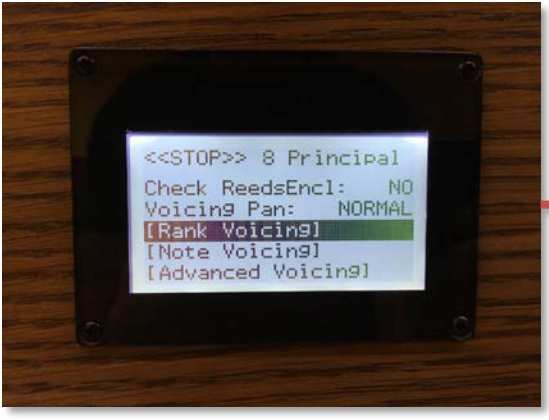
7. Voicing to the Room – Precision Techniques

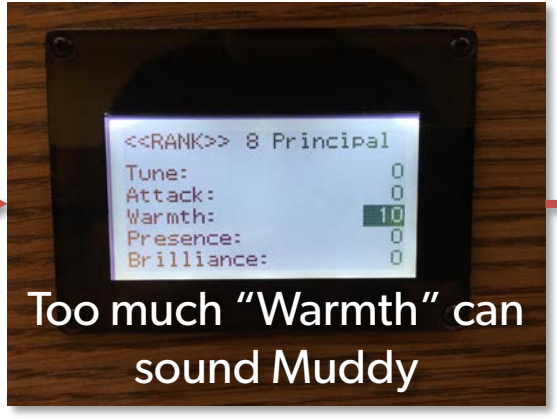
Precision Techniques happen in the Stop Voicing menu



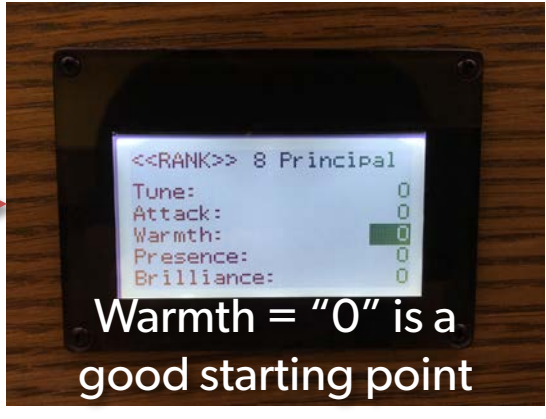
7. Voicing to the Room – Precision Techniques

Check Rank Voicing “Warmth”. Too large of a value can make a Stop sound muddy. A value of “0” is a good starting value.





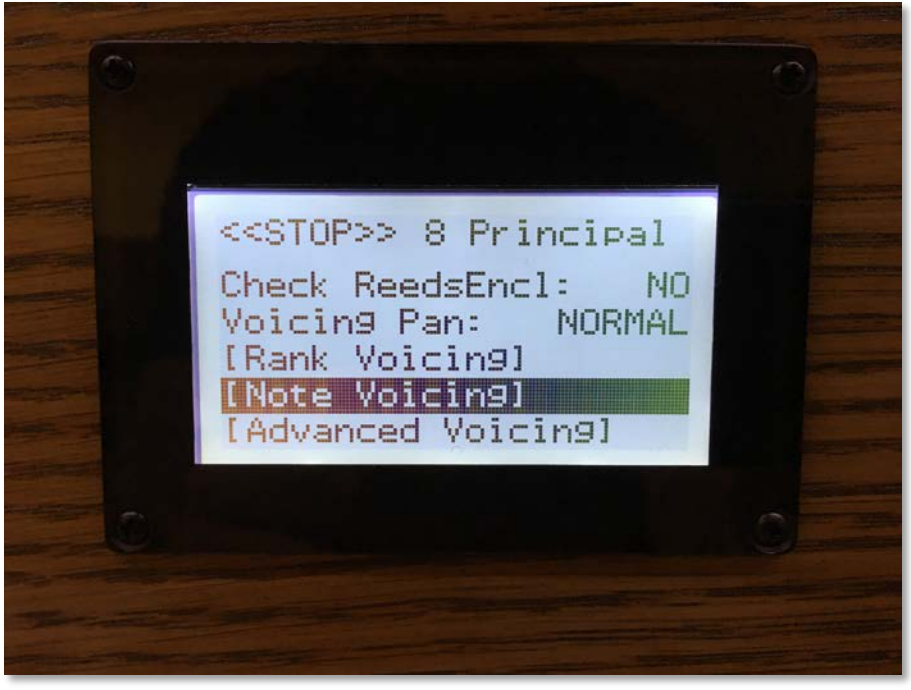
Too much “Warmth” can sound Muddy



Warmth = “0” is a good starting point

7. Voicing to the Room – Precision Techniques

Stop Voicing → Note Voicing Menu

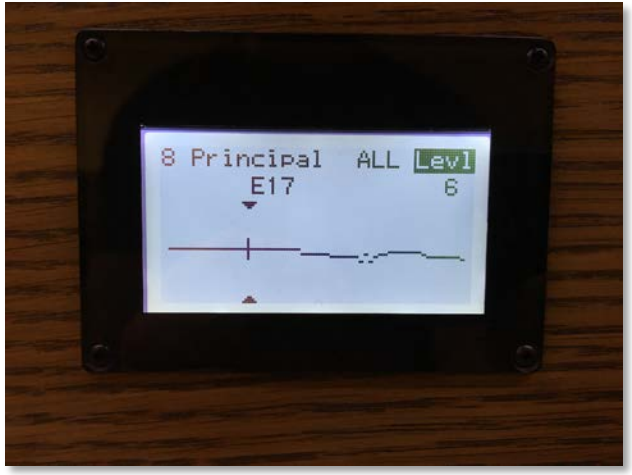


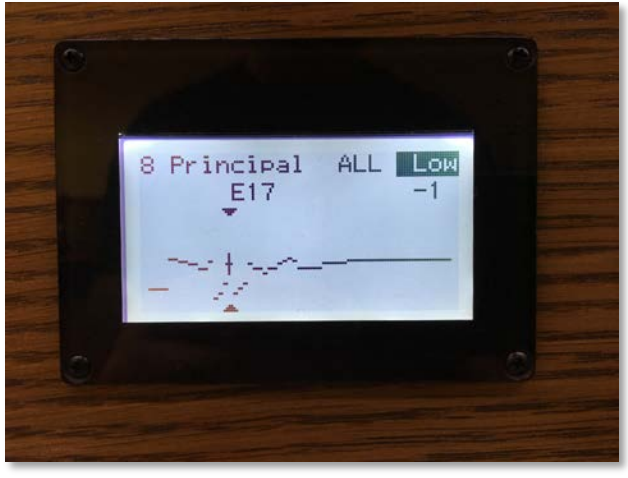
7. Voicing to the Room – Precision Techniques

Each Stop has voicing control for:

- Level
- Tone
- Tune
- Attack
- Low
- Mid
- High

- This peak is centered around E17.
- The peak effects G#9 – D27.
- You could also see effects in the 2nd harmonic range G#21 – D39.





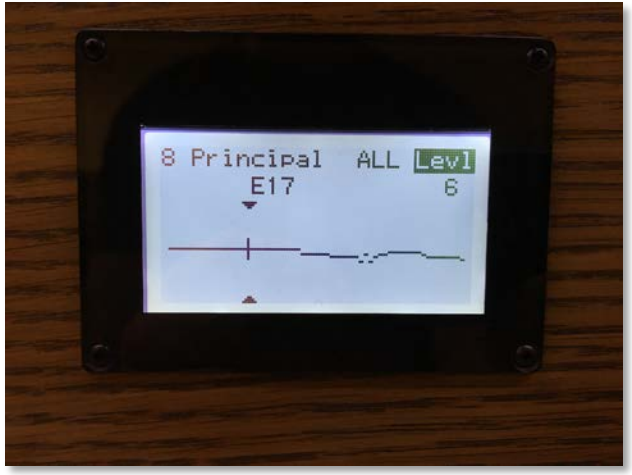
RODGERS®

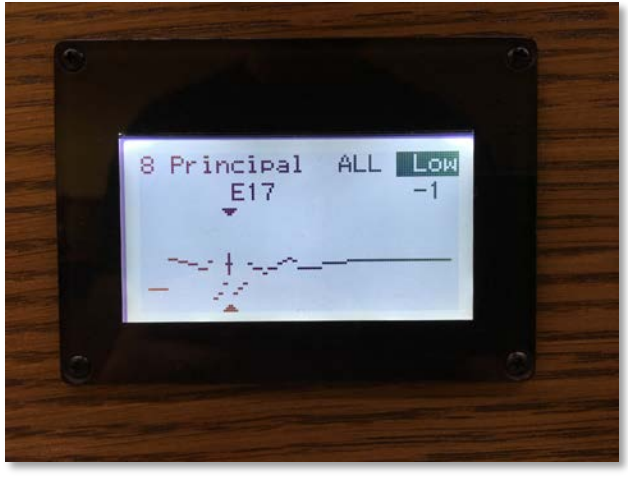
7. Voicing to the Room – Precision Techniques

Each Stop has voicing control for:

- Level
- Tone
- Tune
- Attack
- Low
- Mid
- High

- This peak is centered around E17.
- The peak effects G#9 – D27.
- You could also see effects in the 2nd harmonic range G#21 – D39.





RODGERS®

Agenda - Review

1. Amplifiers and Speakers
2. What Is Digital Room Correction?
3. Room Frequency Response Characteristics – What They Are and How to Get Them
4. Interpretting Your Room EQ Curve
5. Voicing to the Room – Rough Voicing Techniques
6. The Key – Translating the Room EQ Curve to the Keyboard
7. Voicing to the Room – Precision Techniques

Digital Room Correction in Rodgers Organs

plus...

Rodgers Audio and Speakers

2016 Rodgers Dealer Meeting

September 20, 2016

John Pospisil – Manager of Techncial Services and Engineering

RODGERS®