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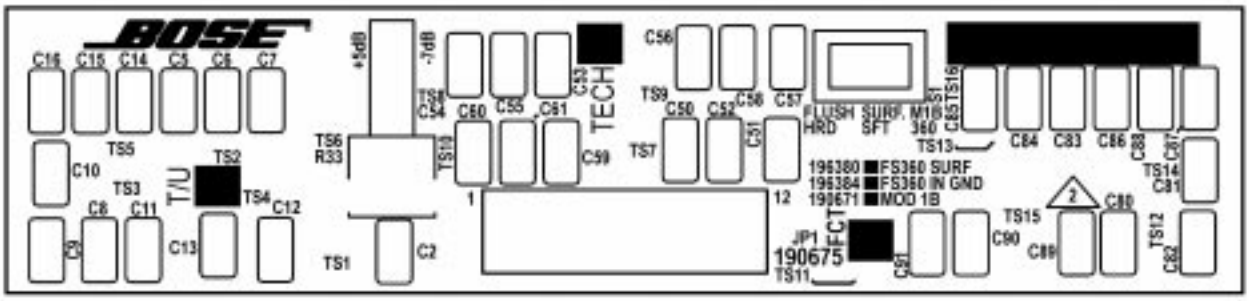
FreeSpace® 360 Surface and In-ground Loudspeaker EQ Cards



Supplement

Part Number 181812-S7 Rev. 00

CONTENTS

CAUTION: The FreeSpace 360 Equalizer Cards contain no user serviceable parts. To prevent warranty infractions, refer servicing to warranty service centers or factory service.

ELECTROSTATIC DISCHARGE SENSITIVE (ESDS) DEVICE HANDLING

This unit contains ESDS devices. We recommend the following precautions when repairing, replacing, or transporting ESDS devices:

- Perform work at an electrically grounded work station.
- Wear wrist straps that connect to the station or heel straps that connect to conductive floor mats.
- Avoid touching the leads or contacts of ESDS devices or PC boards even if properly grounded. Handle boards by the edges only.
- Transport or store ESDS devices in ESD protective bags, bins, or totes. Do not insert unprotected devices into materials such as plastic, polystyrene foam, clear plastic bags, bubble wrap, or plastic trays.

SUPPLEMENT DESCRIPTION

This supplement should be used along with the 1800V EQ PCB service manual part number 181812-S2. The disassembly/assembly procedures, and packing part list should be used along with the information in this manual. The test procedures were included in this manual for your convenience.

WARRANTY INFORMATION

The FreeSpace® Model 360 Loudspeaker Equalizer Cards are covered by a 5-year transferable limited warranty.

THEORY OF OPERATION

These Equalizer cards are designed to be installed into the AmPlus™ 50 and 100 amplifiers and the Bose® 1600 Series VI and 1800 Series V/VI amplifiers.

The FreeSpace® 360 loudspeaker requires equalization, and this equalization is a function of the installation. There are two variants of the card that implement EQ curves for these installation situations:

- In Ground (when the FreeSpace 360 loudspeaker is mounted in the ground).
  The appropriate EQ curve for soft or hard ground is selected with a slide switch on the card. When S1 is in the SOFT position, the Soft Ground EQ is used; when S1 is in the HARD position, the Hard Ground EQ is used.
- In the Surface variant, S1 is omitted and jumpered to the SURFACE position.

Note: Refer to the FreeSpace 360 Surface or In-Ground schematic diagrams, as appropriate, for the following explanation. The designators inside the brackets "[ ]" are the schematic grid coordinates which are provided in order to make it easier to locate components on the schematic sheet indicated in the description. Components shown on the schematic as OPT (optional) are not used in that particular configuration.

The input signal is applied to these cards at JP1 pin 4. The first section at the input, U2-B [D7], combines a first order high-pass filter with one section of a parametric cut filter. The parametric is set for -15dB at 27Hz and provides a steep slope below about 80Hz. The equalization is segmented, with one block (U2 and U1), all sections [D1-8] dedicated to bass region equalization. Following the output of this section, U2-A [D1], the signal is presented to two parallel equalization paths, one comprised of U3 [B4-7], U4-B [C3], and dedicated to EQ for mounting in soft ground of the FreeSpace 360 loudspeaker. The other path, comprised of U5 [B4-7], U4-A [B3] provides equalization for the FreeSpace 360 loudspeaker in hard ground installations. In the case of the FreeSpace Surface EQ card, the bottom leg of the equalizer card is not used.

The operation of all three equalizers is similar. Considering the bass equalizer, we see U2-B's [D7] output passed through R8 [D7] and into the non-inverting input of U2-A [D2]. This input is extended as a bus to which EQ sections Bass 1 [D6] and Bass 2 [D5] are connected. These will introduce dips into the audio response to provide bass cut as required. Sections Bass 3 [D4] and Bass 4 [D3] are connected to a bus extended from the inverting input of U2-A [D2] and provide bass boost.
See Figures 1,2 and 3 for the EQ curves for the various equalizer cards.

Each of the EQ sections utilizes a gyrator-connected op-amp in conjunction with a series capacitance to simulate an LCR series tuned circuit. The values of the capacitors and resistors are chosen to implement EQ dips and/or peaks at the appropriate frequency, amplitude and Q to realize the desired EQ curves. On the In-Ground EQ card, S1 [B2] selects either the HARD or the SOFT mount EQ curve.
The output signal is taken from JP1 pin 5, and returns to the amplifier. The equalizer cards are sensed by the amplifiers as follows. In the AmPlus 50 and 100 amplifiers, Pin 12 of J1 [B2] is grounded and is sensed by the dynamic EQ circuit on sheet 2 of the AmPlus 50 and 100 schematic diagrams. In the 1600/1800 amplifiers, the input module detects the presence of EQ cards via J7-6 and J6-6. Without the card installed these pins are pulled high (+15V). This logic high signal is also applied to the control pins of the switch ICs which selects the A (unequalized) input. When an EQ is plugged into J7 and/or J6 pin 6, the EQ is detected and pulls the control pin low (+7.5V), turning on the corresponding LED(s) and switching the IC to the B input which will then select the output of the EQ card to be passed on to the amplifier.

EQUALIZER CARD CURVE DIAGRAMS

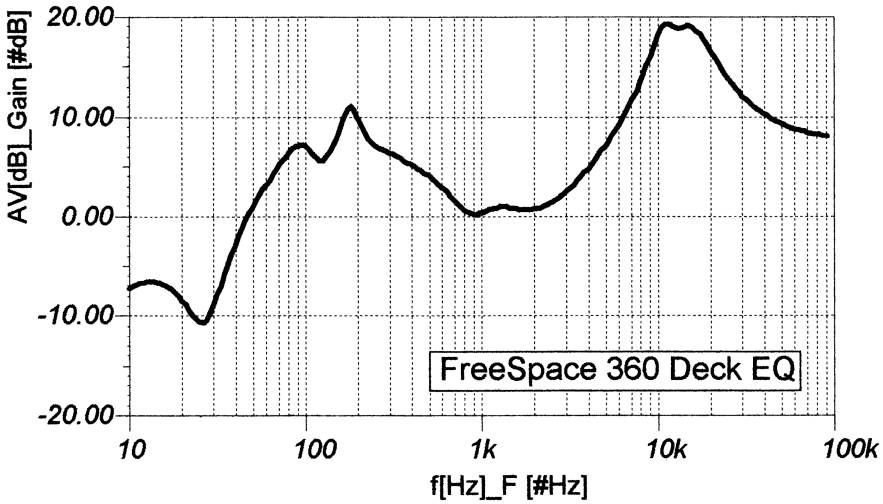


Figure 1. FreeSpace® 360 Surface EQ Curve

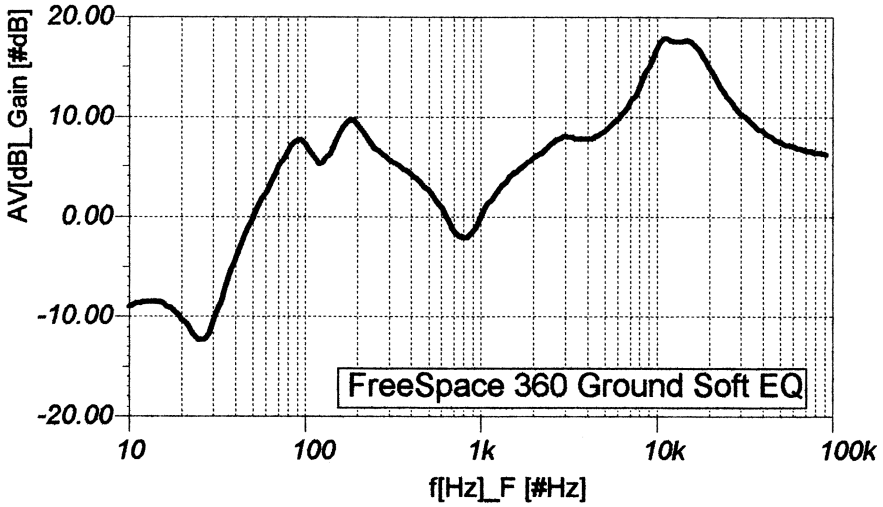


Figure 2. FreeSpace 360 In-Ground Soft Ground EQ Curve

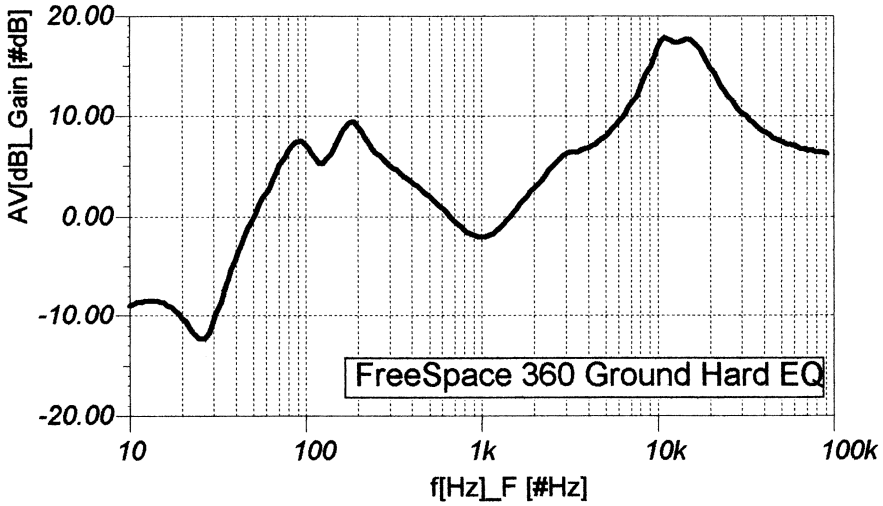


Figure 3. FreeSpace 360 In-Ground Hard Ground EQ Curve

TEST PROCEDURES

FreeSpace® 360 In-Ground Loudspeaker Test Setup Parameters:

1. Install the Equalizer card under test into one of the Equalizer card jacks located on the Input Module of the Bose® 1600 or 1800 Series amplifier, and perform the following tests. Refer to the 1800V service manual supplement part number 181812-S2 for more information.

2. On the amplifier Input Module, place switch SW1 to the NORM position. Place switch S2 to the FULL BANDWIDTH position.

3. The input voltage shall be the actual input voltage present at the input, not the open circuit generator input.

Note: Place the Hard/Soft switch S1 to the SOFT position for the following tests.

1. In Soft Ground Equalizer PCB Frequency Response Test

1.1 Apply a 100 mVrms, 1kHz signal to the input jack of the amplifier channel under test.

1.2 Adjust the amplifier volume controls to maximum. No EQ card installed.

1.3 Reference a dB meter to the output of the amplifier.

1.4 Shut off the amplifier and insert the EQ card according to the assembly procedure.

1.5 Turn on the amplifier and measure the gain. There should be a 0.0 ± 1.0 dB change in gain at the output.

1.6 Reference a dB meter and measure the response of the EQ card according to the In Soft Ground Frequency Response chart.

In Soft Ground Frequency Response

Frequency	Output Level
30 Hz	-10.3 dB ± 1.5 dB
180 Hz	+9.5 dB ± 1.5 dB
190 Hz	+7.8 dB ± 1.5 dB
1000 Hz	Reference
3000 Hz	+8.1 dB ± 1.0 dB
4000 Hz	+7.8 dB ± 1.0 dB
10000 Hz	+16.4 dB ± 2.5 dB

1.7 Shut off the amplifier. Open the input panel and switch the Hard/Soft switch to the HARD position.

2. In Hard Ground Frequency Response Test

2.1 Apply a 100 mVrms, 1kHz signal to the input jack of the amplifier channel under test.

2.2 Adjust the amplifier volume controls to maximum. No EQ card installed.

2.3 Reference a dB meter to the output of the amplifier.

2.4 Shut off the amplifier and insert the EQ card according to the assembly procedure.

2.5 Turn on the amplifier and measure the gain. There should be a -2.1 ± 1.0 dB change in gain at the output.

2.6 Reference a dB meter and measure the response according to the In Hard Ground Frequency Response chart.

In Hard Ground Frequency Response

Frequency	Output Level
9 Hz	+9.8 dB ± 1.5 dB
30 Hz	-8.3 dB ± 1.5 dB
180 Hz	+11.2 dB ± 1.0 dB
800 Hz	+0.8 dB ± 1.0 dB
1000 Hz	Reference
3000 Hz	+8.1 dB ± 1.0 dB
4000 Hz	+8.7 dB ± 1.0 dB
10000 Hz	+18.2 dB ± 2.5 dB

TEST PROCEDURES

3. Distortion Test

3.1 Apply a 780 mVrms, 1 kHz signal to the input jack of the amplifier channel under test.

3.2 Measure the distortion level at the output of the amplifier. It should be ≤ 0.1% THD.

FreeSpace® 360 Surface Loudspeaker Test Setup Parameters

1. Install the Equalizer card under test into one of the Equalizer card jacks located on the Input Module of the Bose® 1600 or 1800 Series amplifier, and perform the following tests. Refer to the 1800V service manual supplement part number 181812-S2 for more information.

2. On the amplifier Input Module, place switch SW1 to the NORM position. Place switch S2 to the FULL BANDWIDTH position.

3. The input voltage shall be the actual input voltage present at the input, not the open circuit generator input.

1. Surface Equalizer PCB Frequency Response Test

1.1 Apply a 100 mVrms, 1kHz signal to the input jack of the amplifier channel under test.

1.2 Adjust the amplifier volume controls to maximum. No EQ card installed.

1.3 Reference a dB meter to the output of the amplifier.

1.4 Shut off the amplifier and insert the EQ card according to the assembly procedure.

1.5 Turn on the amplifier and measure the gain. There should be a +1.0 ± 1.0 dB change in gain at the output.

1.6 Reference a dB meter and measure the response of the EQ card according to the Surface Frequency Response chart.

Surface Frequency Response

Frequency	Output Level
30 Hz	-8.8 dB ± 1.5 dB
90 Hz	+7.2 dB ± 1.5 dB
180 Hz	+11.0 dB ± 1.5 dB
900 Hz	+0.2 dB ± 1.5 dB
1000 Hz	Reference
2000 Hz	+0.4 dB ± 1.5 dB
5000 Hz	+6.7 dB ± 1.0 dB
10000 Hz	+17.9 dB ± 2.5 dB

2. Distortion Test

2.1 Apply a 780 mVrms, 1 kHz signal to the input jack of the amplifier channel under test.

2.2 Measure the distortion level at the output of the amplifier. It should be ≤ 0.1% THD.

PART LIST NOTES

1. This part is not normally available from Customer Service. Approval from the Field Service Manager is required before ordering.

2. The individual parts located on the PCBs are listed in the Electrical Part List.

3. ⚠ This part is critical for safety purposes. Failure to use a substitute replacement with the same safety characteristics as the recommended replacement part might create shock, fire, and/or other hazards.

4. These parts are used on the FreeSpace® 360 in-ground EQ card only.

5. These parts are used on the FreeSpace 360 Surface EQ card only.

FREESPACE® 360 EQ CARD PART LIST

Resistors

Reference Designator	Description	Part Number	Note
R1	2.00KΩ, CHIP, 0805, 1%	133625-2001	
R2, 5, 12, 17, 18, 24, 26, 28, 30, 59, 64, 83, 89	JUMPER, CHIP, 0805	133627	4
R2, 5, 12, 17, 18, 23, 26, 59, 64	JUMPER, CHIP, 0805	133627	5
R3	18.2KΩ, CHIP, 0805, 1%	133625-1822	
R4	1.50KΩ, 0805, 1/10W, 1%	133625-1501	5
R4	2.21KΩ, CHIP, 0805, 1/10W, 1%	133625-2211	4
R8, 21	200KΩ, 0805, 1/10W, 1%	133625-2003	
R9, 10, **19, 20**	392KΩ, 0805, 1/10W, 1%	133625-3923	5
R13, 14	28.7KΩ, 0805, 1/10W, 1%	133625-2872	
R15, 16	127KΩ, 0805, 1/10W, 1%	133625-1273	
R19, 20	169KΩ, 0805, 1/10W, 1%	133625-1693	4
R50, 63, 80, 93	24.9KΩ, CHIP, 0805, 1%	133625-2492	
R51, 52	16.5KΩ, CHIP, 0805, 1%	133625-1652	5
R55, 56	10.0KΩ, CHIP, 0805, 1%	133625-1002	5
R55, 56	47.5KΩ, CHIP, 0805, 1%	133625-4752	4
R57, 58	5.76KΩ, CHIP, 0805, 1%	133625-5761	5
R57, 58, 87, 88	6.81KΩ, CHIP, 0805, 1%	133625-6811	
R61, 62, **91, 92**	4.87KΩ, CHIP, 0805, 1%	133625-4871	4
R81, 82, 51, 52	8.25KΩ, CHIP, 0805, 1/10W, 1%	133625-8251	
R85, 86	66.5KΩ, 0805, 1/10W, 1%	133625-6652	4
R94	100Ω, CHIP, 0805, 1%	133625-1000	

Capacitors

Reference Designator	Description	Part Number	Note
C2	.22uF, BOX, 85, 50V, 5%	137127-224	
C5, 56	390pF, MONO, COG, 50V, 5%	140564-391	
C6	.018uF, BOX, 85, 100V, 5%	137127-183	
C7	.0068uF, BOX, 85, 100V, 5%	137127-682	5
C7, 57, 87	.0068uF, BOX, 85, 100V, 5%	137127-682	4
C8	.047uF, BOX, 85, 63V, 5%	137127-473	
C9, 10	.47uF, BOX, 85, 50V, 5%	137127-474	5
C11	.0015uF, BOX, 85, 100V, 5%	137127-152	4
C11	820pF, MONO, COG, 50V, 5%	140564-821	5
C12	.015uF, BOX, 85, 100V, 5%	137127-153	4
C12	.056uF, BOX, 85, 63V, 5%	137127-563	5
C13	.0018uF, BOX, 85, 100V, 5%	137127-182	5
C13, 81, 82	.022uF, BOX, 85, 100V, 5%	137127-223	4
C14	.0027uF, BOX, 85, 100V, 5%	137127-272	4
C14, 16	.001uF, BOX, 85, 100V, 5%	137127-102	5
C15, 51	.033uF, BOX, 85, 63V, 5%	137127-333	
C16	.01uF, BOX, 85, 100V, 5%	137127-103	4
C17	18PF, 0805, 50V, 5%	133622-180	5
C50, 58, 88	.0056uF, BOX, 85, 100V, 5%	137127-562	4
C50, 61	.0033uF, BOX, 85, 100V, 5%	137127-332	5

FREESPACE® 360 EQ CARD PART LIST

Capacitors

Reference Designator	Description	Part Number	Note
C52	.068uF, BOX, 85, 63V, 5%	137127-683	4
C52, 60	.0047uF, BOX, 85, 100V, 5%	137127-472	5
C53	.0056uF, BOX, 85, 100V, 5%	137127-562	5
C53	270pF, MONO, COG, 50V, 5%	140564-271	4
C54	.0039uF, BOX, 85, 100V, 5%	137127-392	4
C54, 57, 58	.0082uF, BOX, 85, 100V, 5%	137127-822	5
C55	.0027uF, BOX, 85, 100V, 5%	137127-272	5
C56, 86	330pF, MONO, COG, 50V, 5%	140564-331	4
C59	560pF, MONO, COG, 50V, 5%	140564-561	
C59, **89**	560pF, MONO, COG, 50V, 5%	140564-561	4
C60, 90	.0047uF, BOX, 85, 100V, 5%	137127-472	4
C61, 91	.0033uF, BOX, 85, 100V, 5%	137127-332	4
C62, 92	68pF, 0805, COG, 50V, 5%	133622-680	5
C80	.0082uF, BOX, 85, 100V, 5%	137127-822	4
C83	220pF, MONO, 5%	140564-221	4
C84	.0022uF, BOX, 85, 100V, 5%	137127-222	4
C85	820pF, MONO, COG, 50V, 5%	140564-821	4
C98, 99	.1uF, 1206, Z5U, 50V, 20%	124958-1041	5
C100, 101, 102, 103, 104, 105, **106, 107,** 108, 109	.022uF, 0805, X7R, 50V, 10%	133623-223	4

Integrated Circuits

Reference Designator	Description	Part Number	Note
U1, 3, **5**	0P AMP QUAD, SOIC-14, NJM2059	187472	4
U2, 4	OP AMP DUAL, SOIC-8, NJM4559	187473	

Miscellaneous

Reference Designator	Description	Part Number	Note
JP1	CONN, HEADER, 12 PIN	149538	
S1	JUMPER, CHIP 0805	133627	5
S1	SPDT, VERTICAL, SLIDE	187481	4

PACKING LIST

FreeSpace® 360 EQ card (see Figure 4)

Item Number	Description	Part Number	Qty.	Note
1	OWNER'S GUIDE, INST, EQ CARDS, PRO	191912	1	
2	PCB ASSY, FS 360 SURFACE EQ CARD	196380	1	
2	PCB ASSY, FS 360 IN-GROUND EQ CARD	196384	1	
3	BAG, ANTISTATIC, 4 X 7.5	177761	1	
4	TUBE, PACKING, ROUND, PLUG-SEAL	184177	1	
5	CARTON, RSC, 9.63 X 7.88 X 6.63	178853	1	

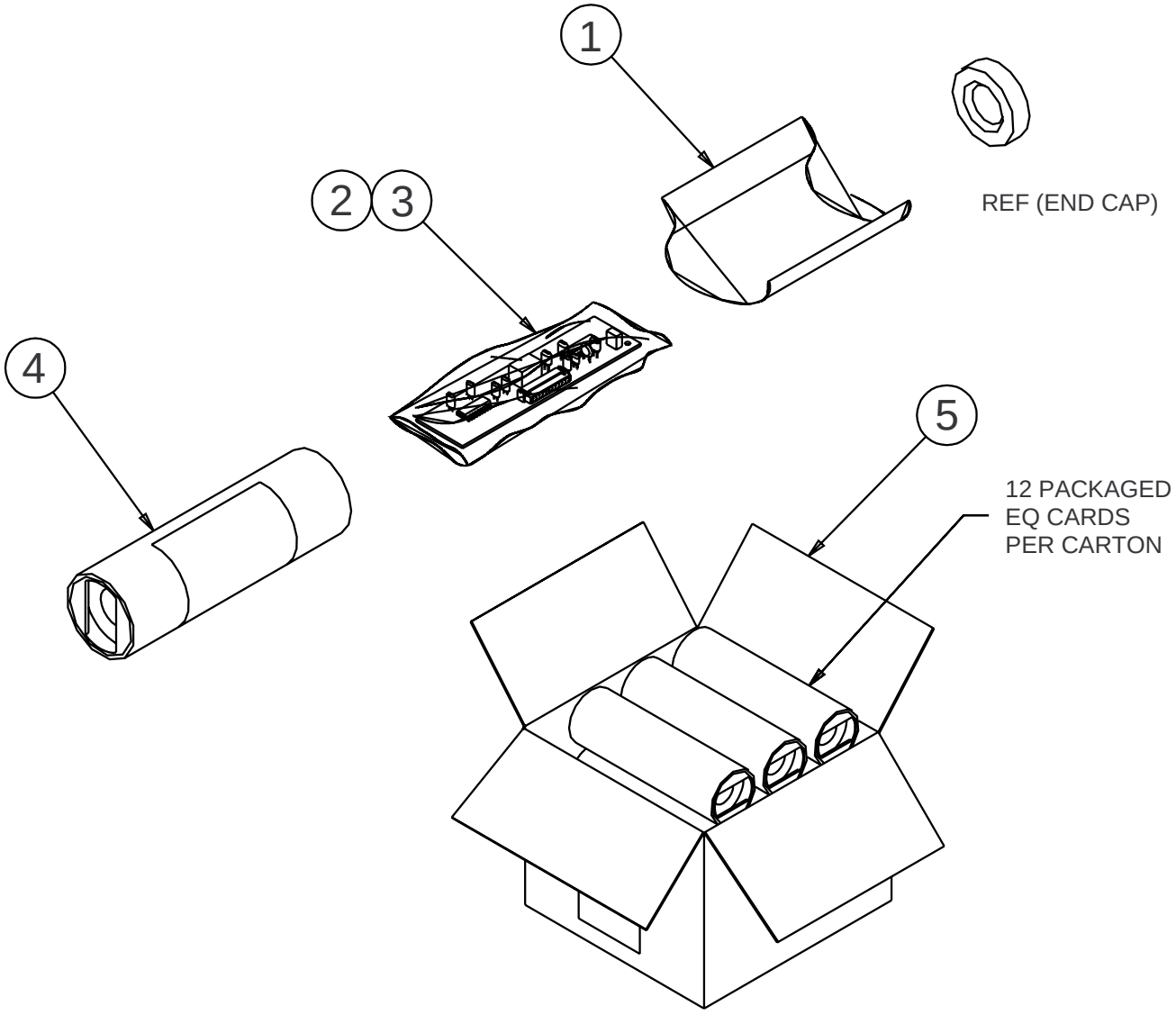


Figure 4. FreeSpace 360 EQ Card Packing View

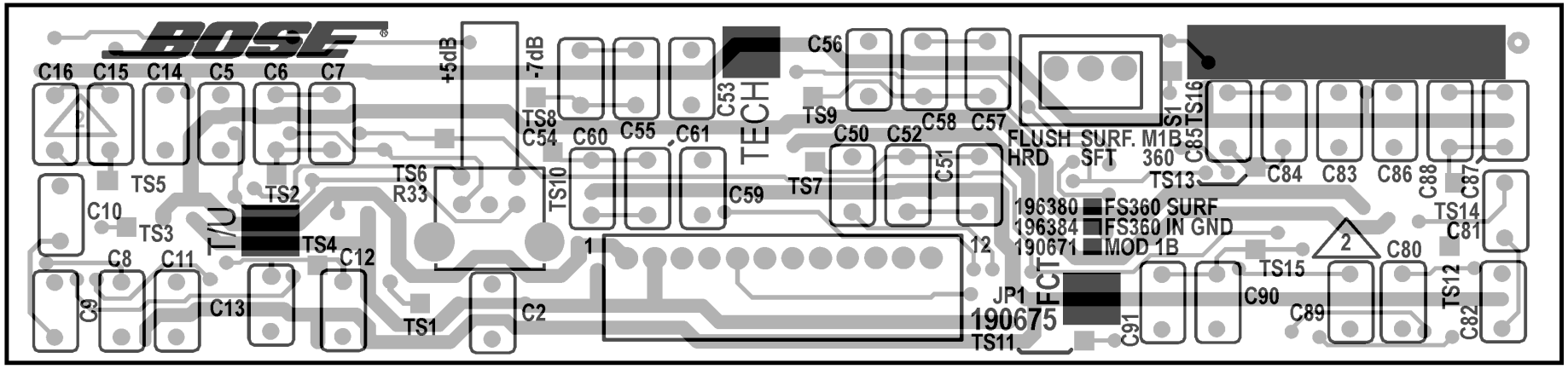


Figure 5. FreeSpace® 360 Equalizer Board Topside and Etch Layout Diagram

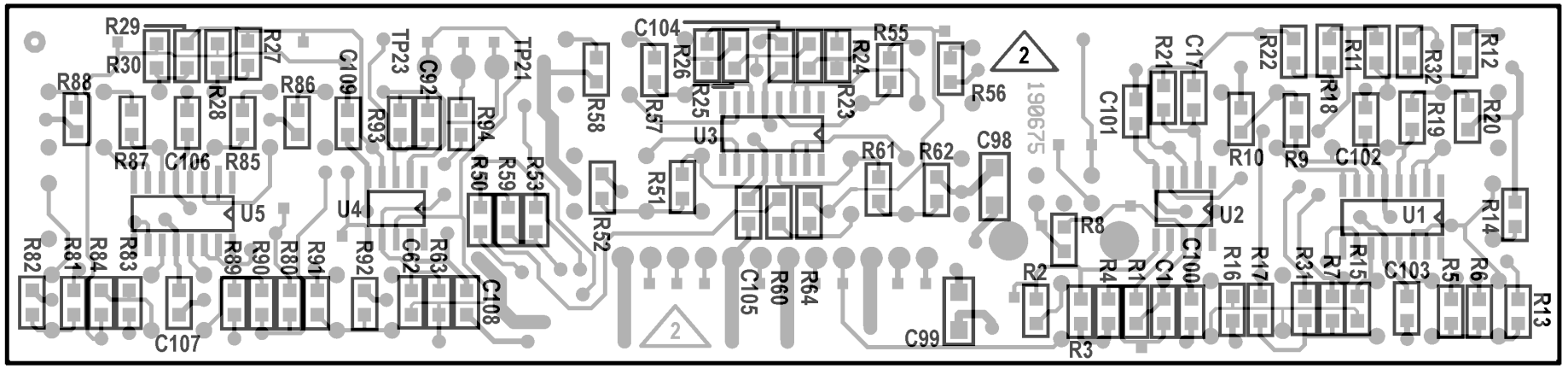


Figure 6. FreeSpace 360 Equalizer Board SMD and Etch Layout Diagram

SPECIFICATIONS AND FEATURES SUBJECT TO CHANGE WITHOUT NOTICE

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