BOSE®
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Companion® 5 Multimedia Speaker System

Service Manual

Reference Number 290177-SM Rev. 03
Electronic Copy Only

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CAUTION: The Companion 5 Multimedia Speaker System contains no user-serviceable parts. To prevent warranty infractions, refer servicing to warranty service stations 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.

Product Description Companion® 5

The Companion 5 is a multi-channel multimedia speaker system connecting to personal computers via a USB 2.0 interface. No additional sound card is required to enjoy 5.1-channel audio
content from the host PC. The two speaker arrays combined with advanced audio processing algorithms provide a spacious presentation of stereo content and a compelling experience with multi-channel content. A control module brings the master volume control, simple touch mute control and jacks for an auxiliary analog stereo input and headphones.

The Companion 5 system consisting of the following major components:

1. Bass speaker enclosure with Woofer
2. Control Module with an 8-foot (2.4M) cable.
3. Two two-element speaker arrays with integrated cables, uniquely keyed and identified for left and right locations.

The speaker arrays are mounted on removable speaker stands that are engineered to position the speakers at the correct height and angle on either side of a computer monitor. The transducers contained in the speaker enclosures may not be replaced. The speaker grills are glued in to prevent movement during shipping.

The integrated speaker cable is hard wired into the speaker enclosure and is not removable.

Specifications

Mechanical

Dimensions:	Bass Module:	8 5/8 “H x 7 1/8” W x 16 3/4” D (21.8 x 18 x 42.5 cm)
	Satellite Speaker:	9” H x 5 3/4” W x 4” D (22.86 x 14.60 x 10.16 cm)
	Control Pod:	2 1/2 “D x 1 1/8” H (6.35 x 2.79 cm)
Weight:	Bass Module:	18.1 lbs (8.2 kg) unpacked
	Satellite Speaker (stand included):	1.8 lbs (.816 kg) each
	Packaged System	27 lb (12.3 kg) packed
Finish:	Bass Module:	Scratch-resistant, satin-finish vinyl
	Satellites:	Painted polymer finish
Bass Box:		Ported
Bass Box Port Tuning:		50 Hz

Electrical

Power Rating:	USA/Canada:	115 VAC 60 Hz
	Japan:	100 VAC 50/60 Hz
	Euro:	230 VAC 50/60 Hz
Nominal System Bandwidth:		48 Hz to 18 kHz
Maximum SPL:		102 dBSPL (at normal listening distance)
Output:	Bass:	48Hz – 250Hz
	Satellites:	250Hz – 18Khz
USB:		USB 2.0 full-speed device with B-receptacle Supports 6-channel USB Audio Device and volume control and mute USB HID (Human Interface Device) controls Audio device and HID controls are all supported by standard USB host firmware

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. This part is available as finished goods. Order this part using the product code listed.

5. This part is referenced for informational purposes only. It is not stocked as a repair part.

6. RoHS compliant part - Restriction of Hazardous Substances (RoHS) is a directive of the European Union which took effect July 1, 2006. The directive is aimed at protecting the health and environment and mandates that electronics products sold in the European Union must be essentially void of six hazardous substances: lead, mercury, cadmium, hexavalent chromium, PBB and PBDE flame retardants.

COMPANION® 5 PACKAGING VIEW

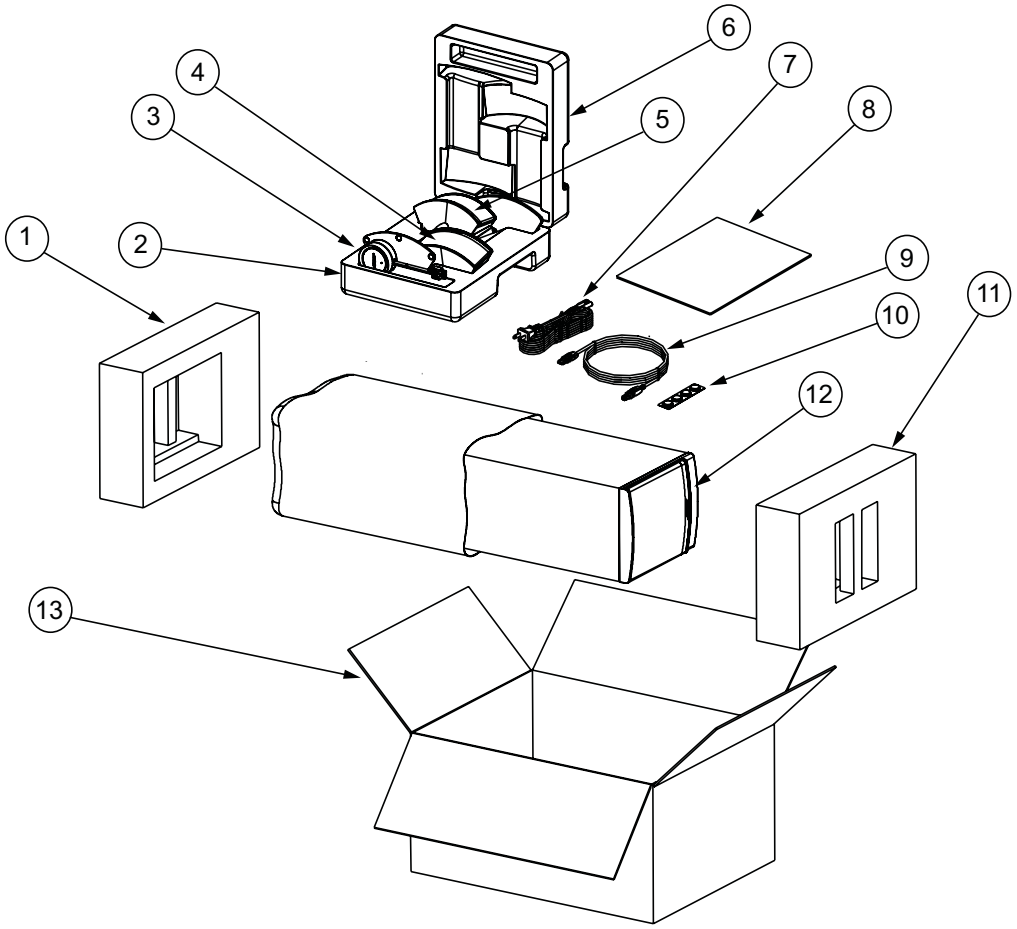


Figure 1. Companion 5 Multimedia Speaker System Packaging View

Item	Description	Part number	Note
1	PACKING, FOAM, EPS, RS, BB	298097	
2	PACKING, FOAM, EPS	295570	
3	REMOTE CONTROL ASSY	295974-001	
4	ARRAY/STAND ASSY, RIGHT	300634-001	
5	ARRAY/STAND ASSY, LEFT	300635-001	
6	PACKING, FOAM, EPS	295570	
7	LINE CORD, 120V, PDL DET, BLK LINE CORD, 100V, DET, NONPVC, BLK LINE CORD, 230V, UKS, DET, BLK LINE CORD, 240V, AUS, DET, BLK LINE CORD, 220V, EUR, DET, BLK	262814-001 286080-001 280138-001 284243-001 280135-001	3 ⚠
8	GUIDE, OWNERS, COMP5, 3L	295925	
9	CABLE, USB 2.0, TYPE A TO B, 6FT CABLE, USB 2.0, TYPE A TO B, 10FT	292477-001 292477-002	
10	FOOT, RUBBER, PSA BACKED, 4 PACK	297482-001	
11	PACKING, FOAM, EPS, BB	300269	
12	ASSY, BBOX, COMP 5, 120V ASSY, BBOX, COMP 5, 230V	290172-S139 290172-S239	
13	CARTON, RSC	295572	
-	CARTON, KIT	300267-K	

BASS MODULE EXPLODED VIEW

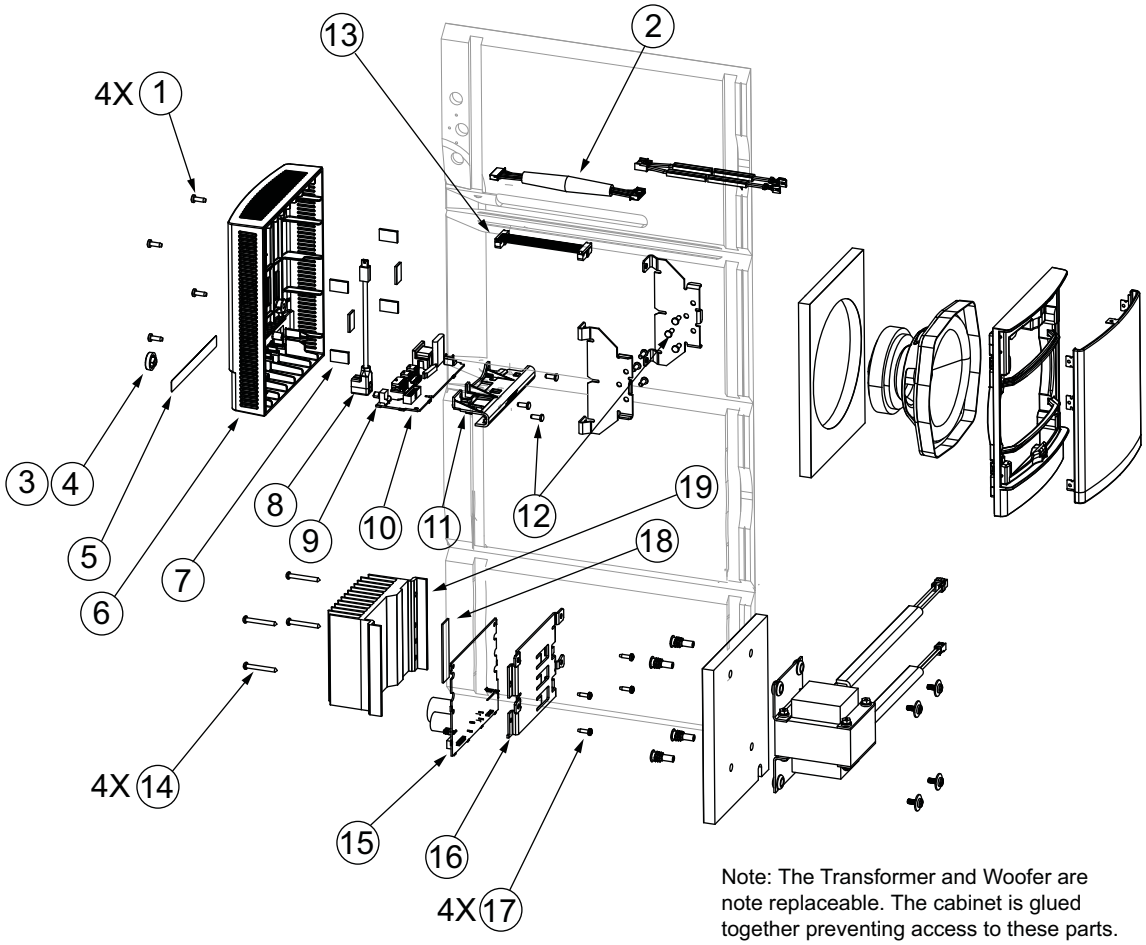


Figure 2. Bass Module Exploded veiw

Item	Description	Part number	Qty.	Note
1	SCREW, TT, 8-32X0.5, PAN, XREC/SQ	289393-008	4	5
2	CABLE, 8 CONDUCTOR	291574-150	1	
3	KNOB, VOLUME CONTROL, BLACK	294599-001	1	
4	CLIP, SPRING, KNOB	262542	1	
5	LABEL, I/O,BASS MODULE	295923-001	1	
6	COVER REAR BASS MODULE	296122-002	1	5
7	FOAM, GRILLE, ARRAY,.125"	272036-002	6	
8	HARNESS, USB, TYPE B TO MINI B	296603-001	1	
9	PAD, FOAM, .25" X .75" X .06	278144-001	2	
10	PCB ASSY, INPUT/OUTPUT, US/JAPAN PCB ASY, INPUT/OUTPUT, ROHS, EURO	299764-001 299765-002	1	
11	BRACKET, INPUT/OUTPUT, PCB	292181-002	1	5
12	SCREW, TAPP, 8-11x.437, PAN, XRC/S	289388-007	9	5
13	HARNESS, IDC, FLAT CABLE	291575-088	1	
14	SCREW, TAPP, 8-11x1.5, PAN, XRC/SQ	289388-024	4	5
15	ASSY, PCB, DSP, US/JAPAN ASSY, PCB, DSP, ROHS, EURO	299766-201 303250-202	1	
16	BRACKET HEATSINK	296120-001	1	5
17	SCREW, TAPP, 6-32, PAN, TORX	279948-08	4	5
18	PAD, THERMAL, DIODE	295975-001	1	5
19	HEATSINK, COMPANION 5	296119-001	1	5

ELECTRICAL PART LIST

Bass Module DSP PCB

Resistors

Reference Designator	Description	Part Number	Note
R0010	5.9k, 0603, .1W, 1%	191465-5901	
R0011	750 OHM, 0603, .1W, 1%	191465-7500	
R0012	12.1K, 0603, .1W, 1%	191465-1212	
R0013	19.6K, 0603, .1W, 1%	191465-1962	
R0014	9.09 OHM, 0603, .1W, 1%	191465-9091	
R0015	20K, 0603, .1W, 5%	199403-203	
R0016	5.9K, 0603, .1W, 1%	191465-5901	
R0018	392K, 0603, 1W, 1%	191465-3923	
R0019	31.6K, 0603, .1W, 1%	191465-3162	
R0020	1K, 0603, .1W, 1%	191465-1001	
R0021	3.09K, 0603, .1W, 1%	191465-3091	
R0022	1K, 0603, .1W, 1%	191465-1001	
R0023	7.15K, 0603, .1W, 1%	191465-7151	
R0025	47K, 0603, .1W, 5%	199403-473	
R0026	4.7K, 0603, .1W, 5%	199403-472	
R0050	150K, 0603, .1W, 1%	191465-1503	
R0052	365K, 0603, 1W, 1%	191465-3653	
R0054	100 OHM, 0603, .1W, 5%	199403-101	
R0055	10 OHM, 0603, .1W, 5%	199403-100	
R0056	365 OHM, 0603, .1W, 1%	191465-3650	
R0057	11K, 0603, .1W, 1%	191465-1102	
R0059	2K, 0603, .1W, 1%	191465-2001	
R0060	7.87K, 0603, .1W, 1%	191465-7871	
R0150	3.9K, ARRAY, SMT, 4 POS, 5%	186433-3924	
R0151	8.25K, 0603, 1W, 1%	191465-8251	
R0152	8.25K, 0603, 1W, 1%	191465-8251	
R0162	3.32 OHM, 0603, 1W, 1%	191465-3R32	
R0163	3.32 OHM, 0603, 1W, 1%	191465-3R32	
R0164	3.32 OHM, 0603, 1W, 1%	191465-3R32	
R0165	3.32 OHM, 0603, 1W, 1%	191465-3R32	
R0250	3.9K, ARRAY, SMT, 4 POS, 5%	186433-3924	
R0251	8.25K, 0603, 1W, 1%	191465-8251	
R0252	8.25K, 0603, 1W, 1%	191465-8251	
R0262	3.32 OHM, 0603, 1W, 1%	191465-3R32	
R0263	3.32 OHM, 0603, 1W, 1%	191465-3R32	
R0264	3.32 OHM, 0603, 1W, 1%	191465-3R32	
R0265	3.32 OHM, 0603, 1W, 1%	191465-3R32	
R0350	3.9K, ARRAY, SMT, 4 POS, 5%	186433-3924	
R0351	8.25K, 0603, 1W, 1%	191465-8251	
R0362	3.32 OHM, 0603, 1W, 1%	191465-3R32	
R0363	3.32 OHM, 0603, 1W, 1%	191465-3R32	
R0364	3.32 OHM, 0603, 1W, 1%	191465-3R32	
R0365	3.32 OHM, 0603, 1W, 1%	191465-3R32	
R0451	47K, 0603, .1W, 5%	199403-473	

ELECTRICAL PART LIST

Bass Module DSP PCB

Resistors (continued)

Reference Designator	Description	Part Number	Note
R0452	4.7K, 0603, .1W, 5%	199403-472	
R0453	150K, 0603, .1W, 1%	191465-1503	
R0454	4.7K, 0603, .1W, 5%	199403-472	
R1000	4.3K, 0603, .1W, 5%	199403-432	
R1001	4.3K, 0603, .1W, 5%	199403-432	
R1002	100 OHM, 0603, .1W, 5%	199403-101	
R1003	100 OHM, 0603, .1W, 5%	199403-101	
R1004	6.8K, 0603, .1W, 5%	199403-682	
R1005	6.8K, 0603, .1W, 5%	199403-682	
R1006	3.09K, 0603, .1W, 1%	191465-3091	
R1007	10K, 0603, .1W, 1%	191465-1002	
R1008	3.09K, 0603, .1W, 1%	191465-3091	
R1009	10K, 0603, .1W, 1%	191465-1002	
R1010	4.7K, 0603, .1W, 5%	199403-472	
R1011	4.7K, 0603, .1W, 5%	199403-472	
R4000	4.7 OHM, 0603, .1W, 5%	199403-4R7	
R4001	100 OHM, 0603, .1W, 5%	199403-101	
R4300	1.8K, ARRAY,SMT, 4 POS, 5%	186433-1824	
R4301	1.8K, ARRAY,SMT, 4 POS, 5%	186433-1824	
R4302	1.8K, ARRAY,SMT, 4 POS, 5%	186433-1824	
R6000	3.09K, 0603, .1W, 1%	191465-3091	
R6001	10 OHM, 0603, .1W, 5%	199403-100	
R6002	2K, 0603, .1W, 1%	191465-2001	
R6003	2K, 0603, .1W, 1%	191465-2001	
R6005	4.7K, 0603, .1W, 5%	199403-472	
R6006	100 OHM, ARRAY, SMT, 4 POS, 5%	186433-1014	
R6008	100 OHM, ARRAY, SMT, 4 POS, 5%	186433-1014	
R6009	15 OHM, 0603, .1W, 5%	199403-150	
R6010	100 OHM, 0603, .1W, 5%	199403-101	
R6011	5.11K, 0603, .1W, 1%	191465-5111	
R6012	100 OHM, 0603, .1W, 5%	199403-101	
R6013	5.11K, 0603, .1W, 1%	191465-5111	
R6101	100 OHM, 0603, .1W, 5%	199403-101	
R6102	2K, 0603, .1W, 1%	191465-2001	
R6103	10K, 0603, .1W, 5%	199403-103	
R6200	100 OHM, 0603, .1W, 5%	199403-101	
R6201	7.87K, 0603, .1W, 1%	191465-7871	
R6203	3.09K, 0603, .1W, 1%	191465-3091	
R6204	3.09K, 0603, .1W, 1%	191465-3091	
R6207	9.3K, 0603, .1W, 1%	191465-9311	
R6208	4.7K, ARRAY, SMT, 4 POS, 5%	186433-4724	
R6209	4.7K, 0603, .1W, 5%	199403-472	
R6210	8.25K, 0603, 1W, 1%	191465-8251	
R6211	4.7K, 0603, .1W, 5%	199403-472	

ELECTRICAL PART LIST

Bass Module DSP PCB

Resistors (continued)

Reference Designator	Description	Part Number	Note
R0452	4.7K, 0603, .1W, 5%	199403-472	
R6222	8.25K, 0603, 100MW, 1%	191465-8251	
R7000	2K, 0603, .1W, 1%	191465-2001	
R7001	2K, 0603, .1W, 1%	191465-2001	
R7002	JUMPER,CHIP, 0805	133627	
R7004	100 OHM, 0603, .1W, 5%	199403-101	
R7005	100 OHM, 0603, .1W, 5%	199403-101	
R7100	100 OHM, 0603, .1W, 5%	199403-101	
R8000	27.4 OHM, 0603, .1W, 1%	191465-27R4	
R8001	27.4 OHM, 0603, .1W, 1%	191465-27R4	
R8002	1.5K, 0603, SMD, 100MW, 5%	199403-152	
R9232	39K, 0603, SMD, 100MW, 5%	199403-393	
R9233	4.7K, 0603, .1W, 5%	199403-472	
R9235	23.7K, 0603, .1W, 1%	191465-2372	
R9236	7.15K, 0603, .1W, 1%	191465-7151	
R9237	16.5K, 0603, .1W, 1%	191465-1652	
R9238	1.82K, 0603, 1/10W, 1%	191465-1821	
R9240	10K, 0603, .1W, 5%	199403-103	
RQ1	1M, 1206, 1/4W, 5%	124895-1055	
RQ2	1M, 1206, 1/4W, 5%	124895-1055	
RQ3	1M, 1206, 1/4W, 5%	124895-1055	
RT6206	PTC, TEMP SENSE, 105C, 20%	258497-105	3 
RT6307	PTC, TEMP SENSE, 105C, 20%	258497-105	3 

ELECTRICAL PART LIST

Bass Module DSP PCB

Capacitors

Reference Designator	Description	Part Number	Note
C0010	15000uF, EL, SNP, 105C, 25V, 20%	261614-153EB3	
C0015	.022uF, 0603, X7R, 50V, 10%	191470-223	
C0019	.047uF, 0805, X7R, 50V, 10%	286499-473	
C0024	.047uF, 0805, X7R, 50V, 10%	286499-473	
C0025	.047uF, 0805, X7R, 50V, 10%	286499-473	
C0028	2.2uF, EL, 85C, 35V, 20%	177902-2R2H	
C0029	.047uF, 0805, X7R, 50V, 10%	133623-473	
C0048	4700uF, EL, SNAP, 105C, 50V, 10%	261614-472HB3	
C0049	2.2uF, EL, 85C, 35V, 20%	177902-2R2H	
C0050	22uF, EL, 85C, 50V, 20%	177902-220HA	
C0051	.047uF, 0805, X7R, 50V, 10%	286499-473	
C0054	0.1, X7R, 0603, 10%, 50V	191470-104	
C0055	2200PF, 0603, X7R, 50V, 10%	191470-222	
C0060	100uF, 7343, LO-R, TANT, 10V, 10%	275411-107	
C0061	100uF, 7343, LO-R, TANT, 10V, 10%	275411-107	
C0062	.01uF, 0603, X7R, 50V, 1%	191470-103	
C0063	470pF, 0603, COG, 50V, 5%	188454-471	
C0064	.033uF, 0603, X7R, 50V, 10%	191470-333	
C0099	100pF, 0805, COG, 50V, 5%	133622-101	
C0151	33000pF, X7R SMD, 0603, 25V	257154-333K25	
C0152	.01uF, 0603, X7R, 50V, 1%	191470-103	
C0153	.01uF, 0603, X7R, 50V, 1%	191470-103	
C0154	.01uF, 0603, X7R, 50V, 1%	191470-103	
C0155	.01uF, 0603, X7R, 50V, 1%	191470-103	
C0156	1uF, EL, 85C, 50V, 20%	177902-010H	
C0157	1uF, EL, 85C, 50V, 20%	177902-010H	
C0158	560pF, 0603, X7R, 50V, 10%	191470-561	
C0159	1uF, EL, 85C, 50V, 20%	177902-010H	
C0160	1uF, EL, 85C, 50V, 20%	177902-010H	
C0161	560pF, 0603, X7R, 50V, 10%	191470-561	
C0251	33000pF, X7R SMD, 0603, 25V	257154-333K25	
C0252	.01uF, 0603, X7R, 50V, 1%	191470-103	
C0253	.01uF, 0603, X7R, 50V, 1%	191470-103	
C0254	.01uF, 0603, X7R, 50V, 1%	191470-103	
C0255	.01uF, 0603, X7R, 50V, 1%	191470-103	
C0256	1uF, EL, 85C, 50V, 20%	177902-010H	
C0257	1uF, EL, 85C, 50V, 20%	177902-010H	
C0258	560pF, 0603, X7R, 50V, 10%	191470-561	
C0259	1uF, EL, 85C, 50V, 20%	177902-010H	
C0260	1uF, EL, 85C, 50V, 20%	177902-010H	
C0261	560pF, 0603, X7R, 50V, 10%	191470-561	
C0351	33000pF, X7R SMD, 0603, 25V	257154-333K25	
C0352	.01uF, 0603, X7R, 50V, 1%	191470-103	
C0353	.01uF, 0603, X7R, 50V, 1%	191470-103	
C0354	.01uF, 0603, X7R, 50V, 1%	191470-103	

ELECTRICAL PART LIST

Bass Module DSP PCB

Capacitors (continued)

Reference Designator	Description	Part Number	Note
C0355	.01uF, 0603, X7R, 50V, 1%	191470-103	
C0356	1uF, EL, 85C, 50V, 20%	177902-010H	
C0357	1uF, EL, 85C, 50V, 20%	177902-010H	
C0358	560pF, 0603, X7R, 50V, 10%	191470-561	
C1000	2.2uF, EL, 85C, 35V, 20%	177902-2R2H	
C1001	2.2uF, EL, 85C, 35V, 20%	177902-2R2H	
C1002	100pF, 0805, COG, 50V, 5%	133622-101	
C1003	100pF, 0805, COG, 50V, 5%	133622-101	
C1004	100pF, 0805, COG, 50V, 5%	133622-101	
C1005	100pF, 0805, COG, 50V, 5%	133622-101	
C1006	33000pF, X7R SMD, 0603, 25V	257154-333K25	
C1007	470uF, EL, 85C, 16V, 20%	296512-471C	
C1008	470uF, EL, 85C, 16V, 20%	296512-471C	
C1009	100pF, 0603, COG, 50V, 5%	188454-101	
C1010	470pF, 0805, COG, 50V, 5%	133622-471	
C1011	470pF, 0805, COG, 50V, 5%	133622-471	
C4000	10uF, EL, 85C, 16V, 20%	177902-100C	
C4001	33000pF, X7R SMD, 0603, 25V	257154-333K25	
C4002	10uF, EL, 85C, 16V, 20%	177902-100C	
C4003	33000pF, X7R SMD, 0603, 25V	257154-333K25	
C4004	2.2uF, EL, 85C, 35V, 20%	177902-2R2H	
C4005	33000pF, X7R SMD, 0603, 25V	257154-333K25	
C4006	33000pF, X7R SMD, 0603, 25V	257154-333K25	
C4300	1000pF, 0603, X7R, 50V,10%	191470-102	
C4301	1000pF, 0603, X7R, 50V, 10%	191470-102	
C4302	1000pF, 0603, X7R, 50V, 10%	191470-102	
C4303	1000pF, 0603, X7R, 50V, 10%	191470-102	
C4304	1000pF, 0603, X7R, 50V, 10%	191470-102	
C4305	1000pF, 0603, X7R, 50V, 10%	191470-102	
C4306	1000pF, 0603, X7R, 50V, 10%	191470-102	
C4307	1000pF, 0603, X7R, 50V,10%	191470-102	
C4308	1000pF, 0603, X7R, 50V,10%	191470-102	
C4309	1000pF, 0603, X7R, 50V,10%	191470-102	
C4310	1000pF, 0603, X7R, 50V,10%	191470-102	
C4311	1000pF, 0603, X7R, 50V,10%	191470-102	
C6000	.047uF, 0805, X7R, 50V, 10%	133623-473	
C6001	33000pF, X7R SMD, 0603, 25V	257154-333K25	
C6002	100pF, 0603, X7R, 50V, 10%	191470-101	
C6003	1000pF, 0603, X7R, 50V, 10%	191470-102	
C6004	27pF, 0603, COG, 50V, 5%	188454-270	
C6005	27pF, 0603, COG, 50V, 5%	188454-270	
C6006	33000pF, X7R SMD, 0603, 25V, 10%	257154-333K25	
C6007	.047uF, 0805, X7R, 50V, 10%	133623-473	
C6008	.047uF, 0805, X7R, 50V, 10%	133623-473	
C6100	100pF, 0805, COG, 50V, 5%	133622-101	

ELECTRICAL PART LIST

Bass Module DSP PCB

Capacitors (continued)

Reference Designator	Description	Part Number	Note
C0355	.01uF, 0603, X7R, 50V, 1%	191470-103	
C6101	100pF, 0805, COG, 50V, 5%	133622-101	
C6200	100pF, 0805, COG, 50V, 5%	133622-101	
C6201	.047uF, 0603, X7R, 25V, 5%	196999-473	
C6202	33000pF, X7R SMD, 0603, 25V, 10%	257154-333K25	
C6220	.033uF, 0603, X7R, 50V, 10%	191470-333	
C7000	33000pF, X7R SMD, 0603, 25V, 10%	257154-333K25	
C7001	33000pF, X7R SMD, 0603, 25V	257154-333K25	
C7002	33000pF, X7R SMD, 0603, 25V	257154-333K25	
C7003	33000pF, X7R SMD, 0603, 25V	257154-333K25	
C7004	33000pF, X7R SMD, 0603, 25V	257154-333K25	
C7005	33000pF, X7R SMD, 0603, 25V	257154-333K25	
C7006	33000pF, X7R SMD, 0603, 25V	257154-333K25	
C7100	33000pF, X7R SMD, 0603, 25V	257154-333K25	
C8000	47pF, 0805, COG, 50V, 5%	133622-470	
C8001	47pF, 0805, COG, 50V, 5%	133622-470	
C9209	33000pF, X7R SMD, 0603, 25V	257154-333K25	
C9211	.01uF, 0603, X7R, 50V 10%	191470-103	
C9212	.015uF, 0603, X7R, 50V, 10%	191470-153	
C9213	100uF, EL, 85, 10V, 20%	177902-101A	
C9219	.047uF, 0805, X7R, 50V, 10%	133623-473	
C9220	10pF, 0603, COG, 50V, 5%	188454-100	

Inductors

Reference Designator	Description	Part Number	Note
L0050	22uH, 0.86A, SMT, 20%	290997-220T	
L0902	560uH, 0.22A, SMT, 560uH, 20%	289382-561T	
L4000	330 OHM, FERRITE BD, IND0603, 200MA	268373-331	
L4001	330 OHM, FERRITE BD, IND0603, 200MA	268373-331	
L6000	330 OHM, FERRITE BD, IND0603, 200MA	268373-331	
L7000	330 OHM, FERRITE BD, IND0603, 200MA	268373-331	
L7002	330 OHM, FERRITE BD, IND0603, 200MA	268373-331	

ELECTRICAL PART LIST

Bass Module DSP PCB

Diodes

Reference Designator	Description	Part Number	Note
D0010	DIODE, SMD, 10A, 200V, S10D	256405-200	⚠ 3
D0011	DIODE, SMD, 10A, 200V, S10D	256405-200	⚠ 3
D0012	DIODE, SMD, 10A, 200V, S10D	256405-200	⚠ 3
D0013	DIODE, SMD, 10A, 200V, S10D	256405-200	⚠ 3
D0016	DIODE, SMD, 10A, 200V, S10D	256405-200	
D0450	DIODE, ZEN, SOT-23, 5.1V, 225MW, 5%,	135247-5231	
D0901	DIODE, SWTCHING, SCHOTTKY, 1A/40V	195637-3	
D1000	DIODE, SOT-23, BAV 99	147239	
D1001	DIODE, SOT-23, BAV 99	147239	
D1002	DIODE, SOT-23, BAV 99	147239	
D1003	DIODE, SOT-23, BAV 99	147239	
D6200	DIODE, SOT-23, BAV 99	147239	
D6201	DIODE, SOT-23, BAV 99	147239	
D9200	DIODE, SOT-23, BAV 99	147239	
ZR10	DIODE, ZEN, SOD-123, 6V, .5W, 5%	174265-5233	
ZR6220	DIODE, ZEN, SOT-23, 9.1V, 225MW, 5%	135247-5239	

Transistors

Reference Designator	Description	Part Number	Note
Q0010	MFET,60V,27A,NON-ISOLAT	271765-002	
Q0011	XSISTOR, BPLR, N, 40V, 200mA, SOT23	146819	
Q0012	XSISTOR, BPLR, N, 40V, 200mA, SOT23	146819	
Q0024	XSISTOR, BPLR, N, 40V, 200mA, SOT23	146819	
Q0030	XSISTOR, BPLR, P, 40V, 200mA, SOT23	148596	
Q0030	XSISTOR, BPLR, P, 40V, 200mA, SOT23 (RoHS)	287939-001	6
Q0031	XSISTOR, BPLR, N, 50V, 100mA, SOT23	146817	
Q0031	XSISTOR, BPLR, N, 50V, 100mA, SOT23 (RoHS)	287935-001	6
Q0450	XSISTOR, BPLR, N, 40V, 200mA, SOT23	146819	
Q6001	XSISTOR, BPLR, P, 40V, 200mA, SOT23	148596	
Q6001	XSISTOR, BPLR, P, 40V, 200mA, SOT23 (RoHS)	287939-001	6
Q6101	XSISTOR, BPLR, P, 40V, 200mA, SOT23	148596	
Q6101	XSISTOR, BPLR, P, 40V, 200mA, SOT23 (RoHS)	287939-001	6
Q6102	XSISTOR, P, 50V, 2SA1341	146818	
Q6200	XSISTOR, BPLR, N, 50V, 100mA, SOT23	146817	
Q6200	XSISTOR, BPLR, N, 50V, 100mA, SOT23 (RoHS)	287935-001	6
Q6201	XSISTOR, BPLR, P, 40V, 200mA, SOT23	148596	
Q6201	XSISTOR, BPLR, P, 40V, 200mA, SOT23 (RoHS)	287939-001	6

ELECTRICAL PART LIST

Bass Module DSP PCB

Transistors (continued)

Reference Designator	Description	Part Number	Note
Q6202	XSISTOR, BPLR, N, 40V, 200mA, SOT23	146819	
Q6203	XSISTOR, BPLR, N, 40V, 200mA, SOT23	146819	
Q7100	XSISTOR, BPLR, P, 40V, 200mA, SOT23	148596	
Q7100	XSISTOR, BPLR, P, 40V, 200mA, SOT23 (RoHS)	287939-001	6
Q9031	XSISTOR, PNP, SOT-223, 60V, 800mA	269870-001	
Q9032	XSISTOR, BPLR, N, 40V, 200mA, SOT23	146819	

Integrated Circuits

Reference Designator	Description	Part Number	Note
U11	IC, VOLT REG, ADJ., 500MA, DPAK	258496-001	
U20	IC, VOLT-REG, SOIC-8, LM317LM	173795-1	
U50	IC, SWITCHING, 1MHz, BUCK CONV	288281-001	
U51	XSISTOR, MOSFET, DUAL N, 50V, 3A	289259-001	
U150	IC, POWER AMP, PSO-20, TDA8566TH	257975	
U150	IC, POWER AMP, PSO-20, TDA8566 (RoHS)	289447-001	
U250	IC, POWER AMP, PSO-20, TDA8566TH	257975	
U250	IC, POWER AMP, PSO-20, TDA8566 (RoHS)	289447-001	
U350	IC, POWER AMP, PSO-20, TDA8566TH	257975	
U350	IC, POWER AMP, PSO-20, TDA8566 (RoHS)	289447-001	
U902	BUCKCTLR, SO-8, PWM, 500kH, 40V, 5%	275415-004	
U1000	IC, OP AMP, DUAL, RAIL TO RAIL	277563-001	
U4000	IC, CODEC AUDIO, 24-bit	289863-001	
U6000	IC,MICRO CONTROLLER, 8-BIT	289864-001	
U6001	IC, ET, SOT-23, MAX809, 2.63V	191158-06	
U6002	IC, EEPROM, 64K, 2.7V, 2-WIRE	293549-064D	
U6200	IC, VOLTAGE COMPARATOR, LM339	187618-001	
U7000	IC DSP TMS320DA7051, 144RFP	289857-7051	
U7001	IC, EEPROM, 512K, Serial, 2-WIRE	289858-0512B	

Miscellaneous

Reference Designator	Description	Part Number	Note
J0010	CONN, HEADER, INLINE, PCB MNT, 2P	133220-02	
J0150	CONN, LOCKNG,2.5MM, 8POS,LOC PIN	283142-010108	
J0350	CONN, HEADER, INLINE, PCB MNT, 4P	133220-04	
J1000	CONN, HEADER, 2.5MM, THRU, 16 POS	270584-016	
J8000	CONN, HEADER, TYPE 2, USB MINI-B	296441-001	
X6000	CRYSTAL, 6.0MHz,	291429-001	

ELECTRICAL PART LIST

Bass Module I/O PCB

Resistors

Reference Designator	Description	Part Number	Note
R20	10K, POTENTIOMETER, 1B, 20%	273741-001	
R24	RES, CF, 1/4W, 5%, 10K	120968-1035	

Miscellaneous

Reference Designator	Description	Part Number	Note
F1	FUSE, 2.0 AMPS, AXIAL, US/JAPAN FUSE, SLO-BLO, 1.0A, EURO/UK/AUS	269855-02000 298780-1000	⚠ 3
J1	AC CONNECTOR	273692-001	
J2	CONN, HEADER, LOCKING, TOP, KEYED	271897-002	⚠ 3
J3	CONN, HEADER, DUAL ROW, R/A	278156-04	
J4	CONN, HDR, DUAL ROW, R/A,RED	278156-204	
J5	CONN,HDR, DUAL ROW, R/A, BLK	278156-110	
J21	CONN, LOCKNG, 2.5MM, 8POS, LOC PIN	283142-010108	
J22	CONN, HEADER, 2.5MM, THRU, 16 POS	270584-016	

DISASSEMBLY PROCEDURES

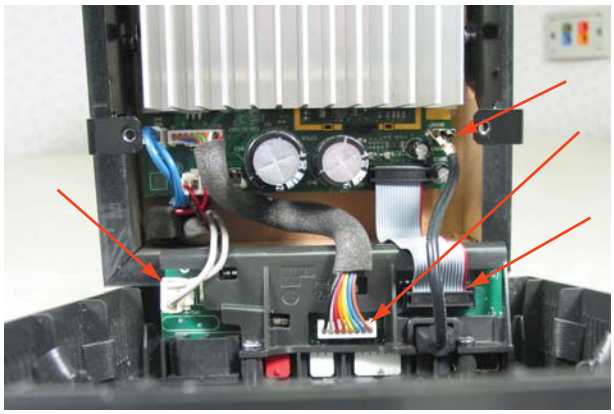
Disassembly

The following procedure shows the disassembly of the bass module to allow access to the DSP and I/O boards.

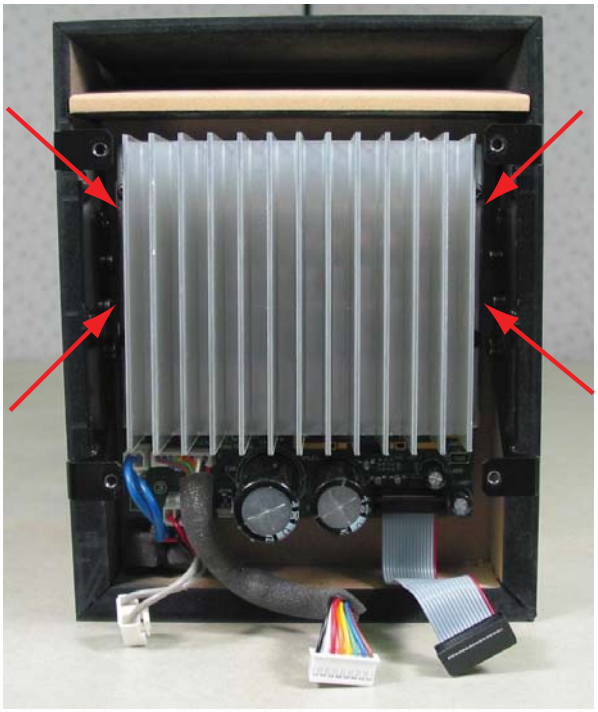
Note: The cabinet is glued together preventing any type of internal repair beyond the boards. The woofer and the transformer are both inside the cabinet and cannot be replaced.

1. DSP board removal

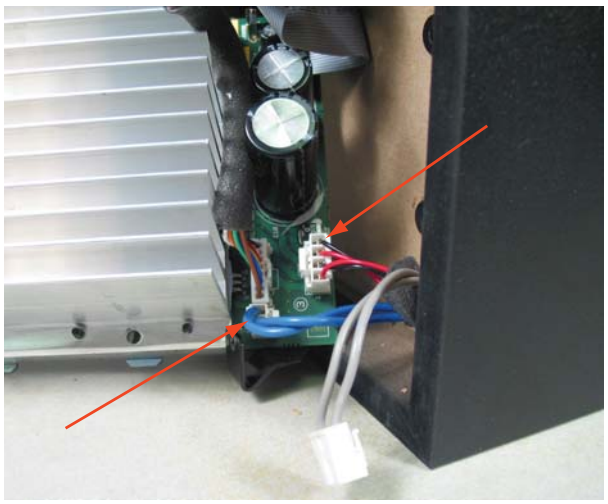
1.1 Remove the four phillips-head screws from the rear cover.



1.2 Pull the rear cover down and remove the cables connected to J2, J21 and J22 on the I/O board and J8000 from the DSP board.

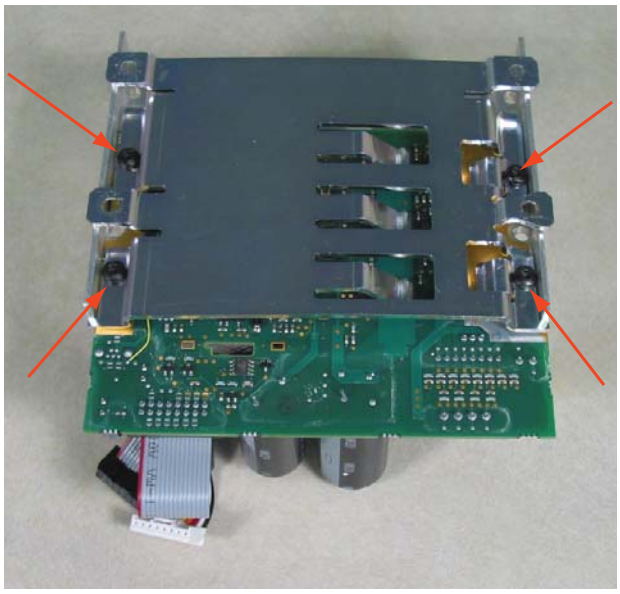


1.3 Remove the four Phillips-head screws located to the left and right of the heatsink.

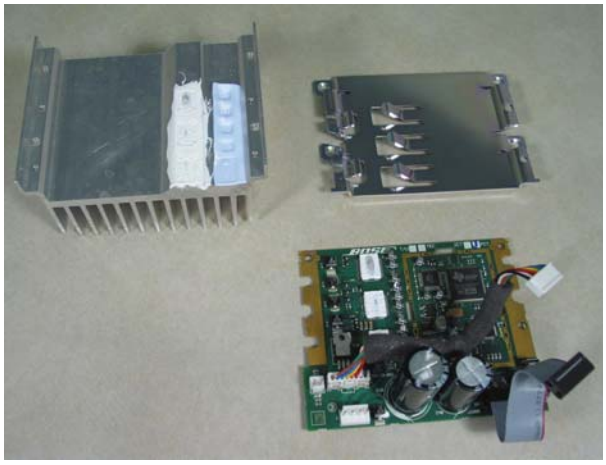


1.4 Remove the cables connected to J350 and J10, this allows the heatsink and DSP board to pull away from the bass module cabinet.

DISASSEMBLY PROCEDURES



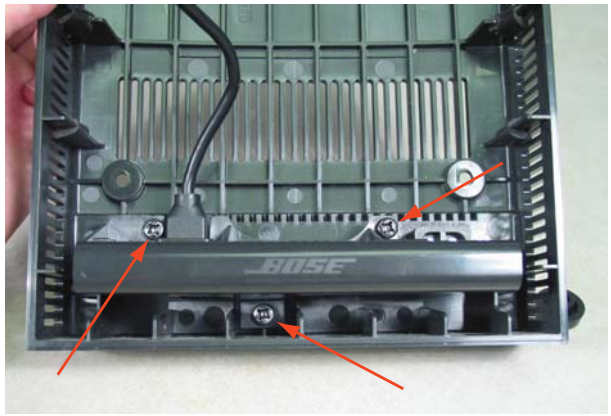
1.5 Remove the four 6-32 TORX screws that holds the heatsink bracket in place.



1.6 Separate the heatsink, heatsink bracket and DSP board.

2. I/O Board Removal

2.1 Use a small flat-head screw driver to pull the Bass control off of the rear cabinet.



2.2 Remove the three Phillips-head screws that secure the I/O board in place.

2.3 Remove the plastic bracket that secures the I/O board in place.

Audio Test Procedures

Note: There are two different test procedures for the Companion 5.

1. Audio test
2. USB light up and play test

Audio test
Equipment required:

1. Audio Signal Generator
2. Oscilloscope
3. Digital Multimeter

Test Set up

1. Connect the satellites to the output jacks on the bass module.
2. Connect the control pod to the 10 pin input connector on the bass module (the control pod must be connected before power is applied).
3. Connect the power cord to an AC outlet.
4. Connect a signal generator to the audio input cable and connect the cable to the input jack on the control pod.

1. Bass Module Air Leak test

1.1 Apply a 100 mVrms, 55 Hz signal to the input of the bass module.

1.2 Set the volume knob on the control pod to maximum (fully clockwise), and set the bass compensation control to it's center detent (flat) position.

1.3 Listen carefully for air leaks along all glued joints, around the heat sink, connectors and at the woofer mounting location.

PASS if no audible air leaks can be heard at a distance > 1 ft from any exterior surface of the Bass module.
FAIL if air leaks can be heard at a distance > 1 ft from any exterior surface of the Bass module.

1.4 Repair any air leaks around the heat sink and connectors. Replace any bass module that has air leaks around the bass box or woofer mounting location.

2. Bass Module Sweep Test

2.1 Apply a 100 mVrms, 10 Hz signal to the input of the bass module.

2.2 Set the volume knob on the control pod to maximum (fully clockwise), and set the bass compensation control to it's center detent (flat) position.

2.3 Listen carefully as you sweep the bass module from 10 Hz to 500 Hz, then from 500 Hz to 10 Hz.

2.4 Listen carefully for buzzes, rattles, or other extraneous noises from the woofer, cabinet, plastic trim parts, or heat sink. A slight whooshing sound from the port (at approximately 45 Hz) is acceptable.

2.5 Repair any noise heard from around the heat sink and connectors. Replace the bass module if it has noises from the woofer or cabinet area.

Audio Test Procedures (continued)

3. Bass Module, Bass Compensation Test

3.1 Apply a 90 mVrms, 100 Hz signal to the input of the bass module.

3.2 Set the volume knob on the control pod to maximum (fully clockwise), and set the bass compensation control to it's center detent (flat) position.

3.3 Rotate the bass compensation control fully clockwise and counter clockwise.

3.4 Verify that the bass level cleanly increases and decreases in level.

4. Satellite Sweep Test

4.1 Apply a 100 mVrms, 100 Hz signal to the input of the bass module.

4.2 Set the volume knob on the control pod to maximum (fully clockwise), and set the bass compensation control to it's center detent (flat) position.

4.3 Use the list below to sweep the frequency to the input. Listen carefully for buzzes, rattles, or other extraneous noises from the Twiddler™ speakers, plastic satellite enclosure, grille, or internal wires.

Sweep Range	**Input Signal**
100Hz to 500Hz	100mVrms
500Hz to 2kHz	50mVrms
2kHz to 5kHz	25mVrms

4.4 Replace any satellite that is found to be defective.

5. Satellite Air Leak Test

5.1 Apply a 60 mVrms, 300 Hz signal to the input of the bass module.

5.2 Set the volume knob on the control pod to maximum (fully clockwise), and set the bass control to it's center detent (flat) position.

5.3 Listen carefully for air leaks along edges of the satellite and near the grille where the Twiddler speaker is installed.

5.4 Replace any satellite that is defective.

6. Control Pod Functional Test

6.1 With the system completely set up, connect power.

6.2 Set the volume knob on the control pod to maximum (fully clockwise), and set the bass control to it's center detent (flat) position.

6.3 Touch the center of the control pod . Verify that the LED turns from green to orange and orange to green with each touch.

6.4 Verify that the sound is muted and un-muted when the LED changes color and that there is no audible pop when switching from mute to un-mute.

6.5 Rotate the control pod ring, verify that the volume increases and decreases and that the ring moves smoothly.

6.6 Replace any control pod that is defective.

USB Test Procedures

USB Light up and play test

Equipment required:

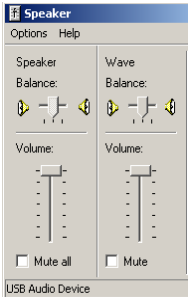
1. IBM Compatible or Macintosh computer with USB 2.0 or above

2. USB 2.0 Cable, type A to B (part number 292477-001)

Test Set up

1. Connect the satellites to the output jacks on the bass module.
2. Connect the control pod to the 10 pin input connector on the bass module (the control pod must be connected before power is applied).
3. Adjust the control pod to minimum.
4. Connect the power cord to an AC outlet.
5. Connect the USB cable from a computer with USB 2.0 to the USB input on the bass module.

1. Adjust the Windows® volume and wave controls to maximum.



1.1 Use Windows media player or equivalent to play an musical audio track.

1.2 Adjust volume on the control pod to one quarter

1.3 Confirm audio can be heard and no distortion is present.

1.4 Adjust audio on the control pod to one half.

1.5 Confirm audio can be heard and no distortion is present.

SERVICE MANUAL REVISION HISTORY

Date	Revision Level	Description of Change	Change Driven By	Pages Affected
06/16/06	00	Document released at revision 00	Service Manual release	All
09/21/06	01	Fuse part numbers changed	Part number corrections	15
		Added notes to multiple parts on the bass module exploded view	Additional Information	6
12/12/06	02	Changed part number for R19.	Change R19 from 191465-2942 to 191465-3162	7
		Service part number for Bass Module changed	Old number 290172-0139CS 290172-0239CS New number 290172-S139 290172-S239	5
		Changed part number for the Carton, RSC	Old number 295572 New part number 300267	5
11/27/07	03	Part number change for DSP board From 299766-001 to 299766-201 From 299767-002 to 303250-102	Software change	6
02/29/08		Changed the Euro DSP part number again, this time to 303250-202	Software change	6
06/03/09		Added packing pad part number	Missing number	5
1/18/09		Updated part numbers for U7000, C28, C49, C50, C1000, C1001 and C4004 per ECN 45737.		11, 12, 15

SPECIFICATIONS AND FEATURES SUBJECT TO CHANGE WITHOUT NOTICE

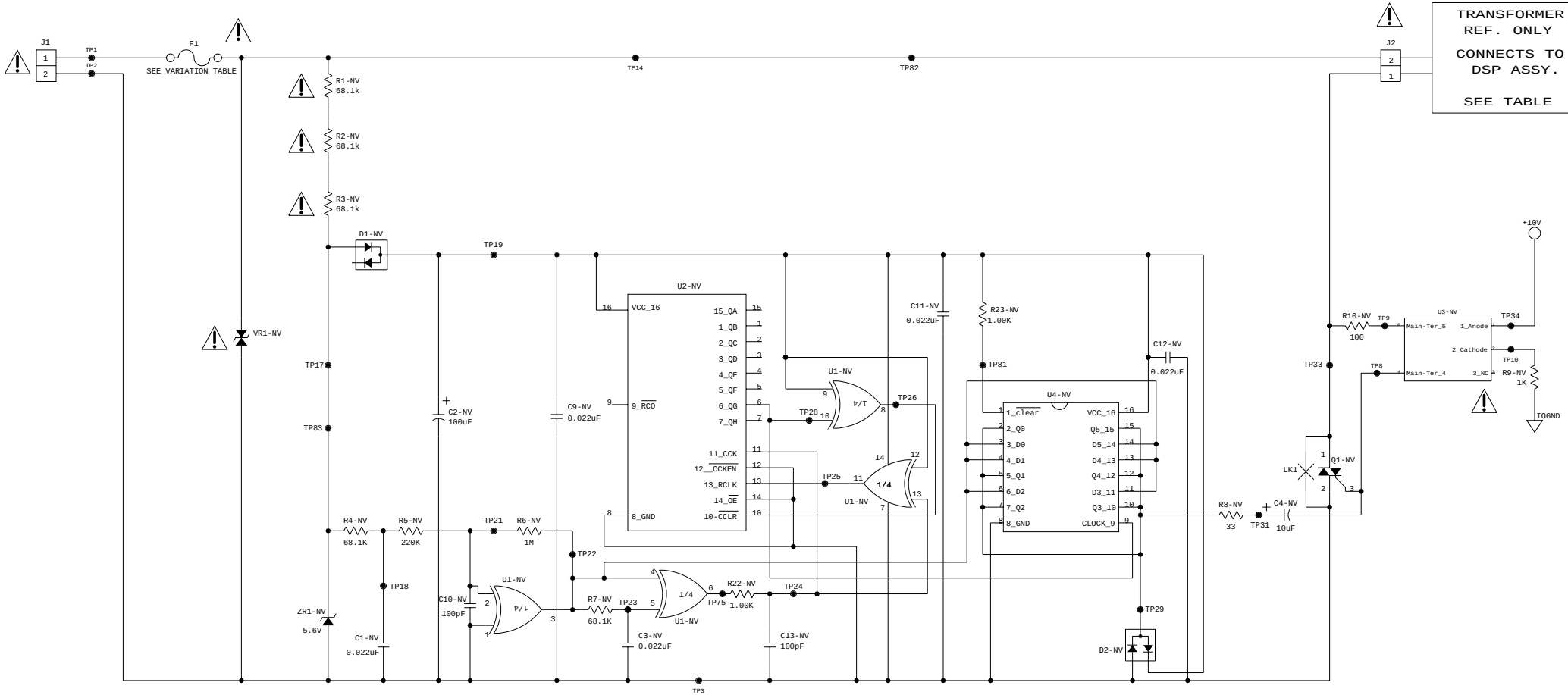
Bose Corporation
The Mountain
Framingham Massachusetts USA 01701

P/N: 290177-SM Rev. 03 12/2006 (H)
http://serviceops.bose.com

CLASS	DWG NO.	SH
SD	290179	1

REVISIONS

REV	DESCRIPTION	CHK	ENG	DATE
01	ECN40402	FT	MH	12/11/06



NOTE: PARTS LABELED WITH ⚠ ARE SAFETY CRITICAL PARTS. REPLACE ONLY WITH SAME PART,

COMPONENT VARIATIONS

COMPONENT	USA/JP	EUR
F1	277521-003 T2.0A 250V L	277521-004 T1.0A 250V L
TRANSFORMER	261278-200	261276-200
DSP ASSY	294826-101	294826-102

THIS DRAWING IS BASED ON VISULA DATA ALL CHANGES MUST BE MADE USING THE VISULA FILES ATTACHED TO

MD290179

THIRD ANGLE PROJECTION

LEVEL			
3	DRAFTER	A. Whittemore	08-22-05
	CHECKER	F. Tajallaee	05-22-06
	ENGINEER	J. Kirk	05-22-06
2	SAFETY ENGINEER	M. Espinal	05-22-06
1	REL TO PROD PER ECN (BKCN_N AT REV 00		******

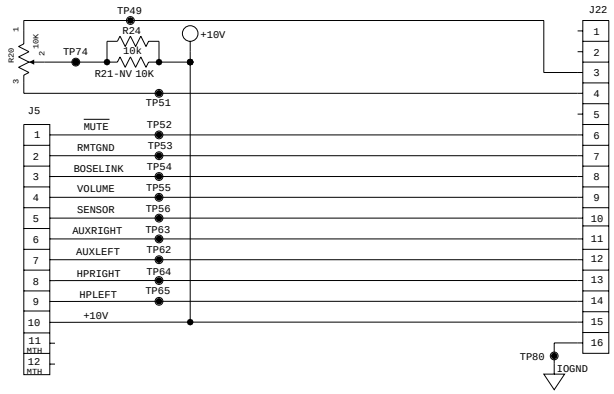
SAFETY CONTROLLED

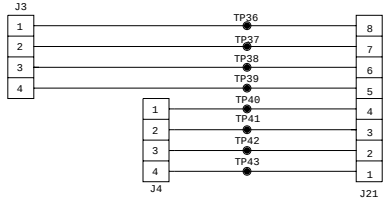
BOSE
FRAMINGHAM, MA 01701-9168

DESCRIPTION
PC BOARD, COMPANION 5, IO

SIZE	FSCM	CLASS	DWG NO.	REV
B	32108	SD	290179	01

SCALE N/A | CAT. CODE * | SHEET 1 OF 2





THIS DRAWING IS BASED ON VISULA DATA ALL CHANGES MUST BE MADE USING THE VISULA FILES ATTACHED TO

MD 290179

SIZE	FSCM	CLASS	DWG NO.	REV
B	32108	SD	290179	01
SCALE N/A	CAT. CODE *		SHEET 2 OF 2	

CLASS	DWG NO.	SH
SD	290178	1

REVISIONS

REV	DESCRIPTION	CHK	ENG	DATE

ADC
DAC
CTRL
PWR
U4000
289863-001
30_NC
32_RIN
31_LIN
6_SDTI1
7_SDTI2
8_SDTI3
3_SMUTE
11_DFS0
13_DZFE
39_MCLK
5_LRCK
4_BICK
40_P_S
2_I2C
17_PDN
12_TST1
18_TST2
21_TST3
22_TST4
29_TST5
14_TVDD
15_DVDD
16_DVSS
34_VCOM
SDTO_9
SDOS_1
DAUX_10
DZF1_38
DZF2_OVF_33
LOUT1_27
ROUT1_28
LOUT2_25
ROUT2_26
LOUT3_23
ROUT3_24
CAD0_20
CAD1_19
DIF0_CSN_41
DIF1_SCL_42
LOOP0_SDA_43
TDM0_44
VREFH_35
AVDD_36
AVSS_37
R4001
100
AD_DATA
GND
DA_DATA1
FCLK
BCLK
DSPRESET
+3.3V
+5V
L4000
330ohm
C4006
.033uF
C4003
.033uF
C4002
10uF
C4005
.033uF
C4004
2.2uF
R4000
4.7
L4001
330ohm
C4000
10uF
C4001
.033uF
DAC_LC
DAC_RC
DAC_LS
DAC_RS
DAC_BASS1
DAC_BASS2
269853-002
SHLD1
R4300
1.8K
R4301
1.8K
R4302
1.8K
LC+
LC-
LS+
LS-
RC+
RC-
RS+
RS-
BASS1+
BASS1-
BASS2+
BASS2-
C4300
1000pF
C4301
1000pF
C4306
1000pF
C4307
1000pF
C4302
1000pF
C4303
1000pF
C4308
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C4309
1000pF
C4304
1000pF
C4305
1000pF
C4310
1000pF
C4311
1000pF
+10V
U1000
277653-001
1/2
C1006
.033uF
R1003
100
C1005
100pF
R1006
3.09K
R1007
10.0K
RMTRET
D1002
147239
C1007
470uF
R1010
4.7K
SG1003
SENSOR
PG2 C/8
R6101
100
C6100
100pF
SG6100
R1002
100
C1004
100pF
R1008
3.09K
R1009
10.0K
D1003
147239
C1008
470uF
R1011
4.7K
SG1002
HP_RIGHT
HP_LEFT
D1000
147239
D1001
147239
2.2uF
C1000
C1001
C1002
100pF
C1003
100pF
R1004
6.8K
R1005
6.8K
R1000
4.3K
R1001
4.3K
C1010
470pF
C1011
470pF
SG1000
SG1001
AUX_LEFT
AUX_RIGHT
R6152-NV
100K
MMBT3906
Q6150-NV
R6151-NV
18K
R6150-NV
20ohm
C6150-NV
100pF
SG6150
6.0V
ZR6150-NV
BOSELINK
MMBT3906
Q6151-NV
UART_RX
R6153-NV
10K
R6154-NV
10K
R6155-NV
10K
R6156-NV
1K
Q6152-NV
MMBT3904
C6151-NV
220pF
Q6153-NV
MMBT3904
R6157-NV
1K
UART_TX
IVOL
0V to 3.6V*
PG2 C/1
R6200
100
D6200
147239
C6200
100pF
SG6200
*varies w/ volume level
BEQ+
BEQ-
SG6202
SG6201
270584-016
J1000
RMTRET
SG6207
C1009
100pF
LK2
C99
100pF
SG99
Q6101
287939-001
MUTE
0V 3.3V
PG2 C/7
R6103
10K
R6102
2.00K
C6101
100pF
SG6101
D6201
147239
MUTE

SAFETY CONTROLLED

BOSE
FRAMINGHAM, MA 01701-9168

DESCRIPTION
PC Board, COMPANION 5, DSP

SIZE	FSCM	CLASS	DWG NO.	REV
B	32108	SD	290178	00

SCALE N/A	CAT. CODE *	SHEET 1 OF 4

J8000
296441-001
USB5V
D-
D+
ID
GND
SG6206
SG6205
SG6203
R8000 27.4ohm
R8001 27.4ohm
R8002 1.5K
C8000 47pF
C8001 47pF
GND

U6000
289864-001
7_DM
6_DP
5_PUR
19_P3.5
18_P3.4
17_P3.3
15_P3.2_XINT
14_P3.1
13_P3.0
31_P1.7
30_P1.6
29_P1.5
27_P1.4
26_P1.3
25_P1.2
24_P1.1
23_P1.0
48_PLLFILI
1_PLLFILO
21_DVDD
16_DVSS
8_DVDD
4_DVSS
33_DVDD
28_DVSS
2_AVDD
45_AVSS
46_XTALO
47_XTALI
TEST_10
NC_20
NC_22
EXTEN_11
CRESET_34
CDATO_38
CSCLK_37
CDATI_36
CSYNC_35
CSCHNE_32
MCLKI_3
MCLKO1_39
MCLKO2_40
SCL_44
SDA_43
VREN_42
RESET_41
RSTO_12
MRESET_9

UART_TX
UART_RX
BADDATA
R6012 100
USBINT
R6006 100ohm
+3.3V
Q6102 146818
MUTE
PG1 A/3
R6011 5.11K
0V 3.3V
R6013 5.11K
SENSOR
R6000 3.09K
C6002 100pF
C6003 1000pF
+3.3V
L6000 330ohm
+3.3VTAS
C6000 0.047uF
C6007 0.047uF
C6008 0.047uF
R6009 5.6
C6001 .033uF
C61 100uF
GND

R6001 10
X6000
HC-49/S
C6004 27pF
C6005 27pF
GND

R6005 4.7K
R6008 100ohm
BCLK
FCLK
DSPCLK
R6006 100ohm
R6006 100ohm
VRAWON
R6006 100ohm
DSPRESET

U6001
191158-06
RESET
VCC
GND
R6010 100
Q6001 287939-001
SOFTSTART
C6006 .033uF

U7000
289857-705
143_AHCLKR0_1
139_ACLKR0
DISCHG
141_AFSR0
2_AHCLKX0_2
142_ACLKX0
144_AFSX0
3_AMUTE0
9_ACLKR1
12_AFSR1
5_AHCLKX1
7_ACLKX1
11_AFSX1
4_AMUTE1
107_SCS_SCL
105_ENA_SDA
108_CLK_SCL
111_SOMI_SDA
110_SIMO

U7001
289858-0512B
VCC_8
WP_7
SCL_6
SDA_5
1_A0
2_A1
3_NC
4_GND
R7000 2.00K
R7001 2.00K
R7100 100
C7100 .033uF
Q7100 287939-001

U6002
293549-064D
VCC_8
WP_7
SCL_6
SDA_5
1_A0
2_A1
3_A2
4_GND
R6002 2.00K
R6003 2.00K

AXR0[0]_113
AXR0[1]_115
AXR0[2]_116
AXR0[3]_117
AXR0[4]_119
AXR0[5]_120
AXR0[6]_121
AXR0[7]_122
AXR0[8]_126
AXR0[9]_127
AXR0[10]_130
AXR0[11]_131
AXR0[12]_134
AXR0[13]_135
AXR0[14]_137
AXR0[15]_138

+3.3V
R6209 4.7K
R6208 4.7K
R6211 4.7K
R6208 4.7K
R6210 8.25K
R6208 4.7K
R6208 4.7K
CPBCMP-
CPMCMP+
CPVOL
CPVRAW
CCLIP
BSCLIP
USBINT
R7004 100
R7005 100
BADDATA
DA_DATA1
AD_DATA
PAMUTE
PG3 D/8

Q6202 146819
TEMPSEN1
Q6203 146819
TEMPSEN2
R6222 8.25K
+5V
R6207 9.31K
Q6201 148596
+3.3V
Q6200 287935-001
DISCHG
C6201 0.047uF

C6206-NV
1000pF
U6200 187618-001
1.5V
1.2V
2.1V
0.8V
BEQ+ PG1 C/2
R6204 3.09K
BEQ- PG1 C/2
R6203 3.09K
C6205-NV
1000pF
C6204-NV
1000pF
C6202 .033uF
+5V
0.3V
2.1V
IVOL PG1 C/3
R6201 7.87K
C6203-NV
1000pF
3.6V
2.3V
2.1V
VRAWSEN PG4 B/3

U7000
289857-705
23_OSCIN
24_OSCOUT
25_OSCVDD
22_OSCVSS
17_CLKIN
PLLHV_27
RESET_14
+1.2V
DSPCLK
DSPRESET
L7000 330ohm
C7000 .033uF
35_TCK
19_TMS
28_TDI
29_TDO
21_TRST
32_EMU0
34_EMU1
+3.3V
J1001-NV
spi_hp10-14h
1 2 3 4 5 6 7 8 9 10 11 12 13 14

Layout Notes:
- DSPCLK net should be as short as possible. (align IC's so that this happens)

SIZE	FSCM	CLASS	DWG NO.	REV
B	32108	SD	290178	00
SCALE N/A	CAT. CODE *		SHEET 2 OF 4	

VRAW 14V
R451 47K
10.3V 4V
MODE
R453 150K
5.1V D450 135247-5231
8.1V 0V
Q450 146819
0V 0.5V
PAMUTE PG2 C/3
GND

VRAW 14V
C351 .033uF
GND
U350 257975
12 VCC1
19 VCC2
R350 3.9K
BASS1+ BASS1- BASS2+ BASS2-
C356 1uF
R351 8.25K
C358 560pF
C357 1uF
BAMPIN+
BAMPIN-
In1+ 8
In1- 9
Diag 1
Clip 11
Mode 20
SGnd 10
PGnd1 14
PGnd2 17
Out1+ 13
Out1- 15
Out2+ 16
Out2- 18
R362 3.32
C352 0.01uF
BASSAOUT+
R452 4.7K
+3.3V
BSCLIP
R363 3.32
C353 0.01uF
BASSAOUT-
R364 3.32
C354 0.01uF
LSOUT+
R365 3.32
C355 0.01uF
LSOUT-
C256 1uF
R251 8.25K
C258 560pF
C257 1uF
R250 3.9K
LS+ LS- RS+ RS-
In2+ 2
In2- 3
MODE 10V 4V 20
C450-NV 1000pF
C451-NV 1000pF
LK1
GND
AMPGND

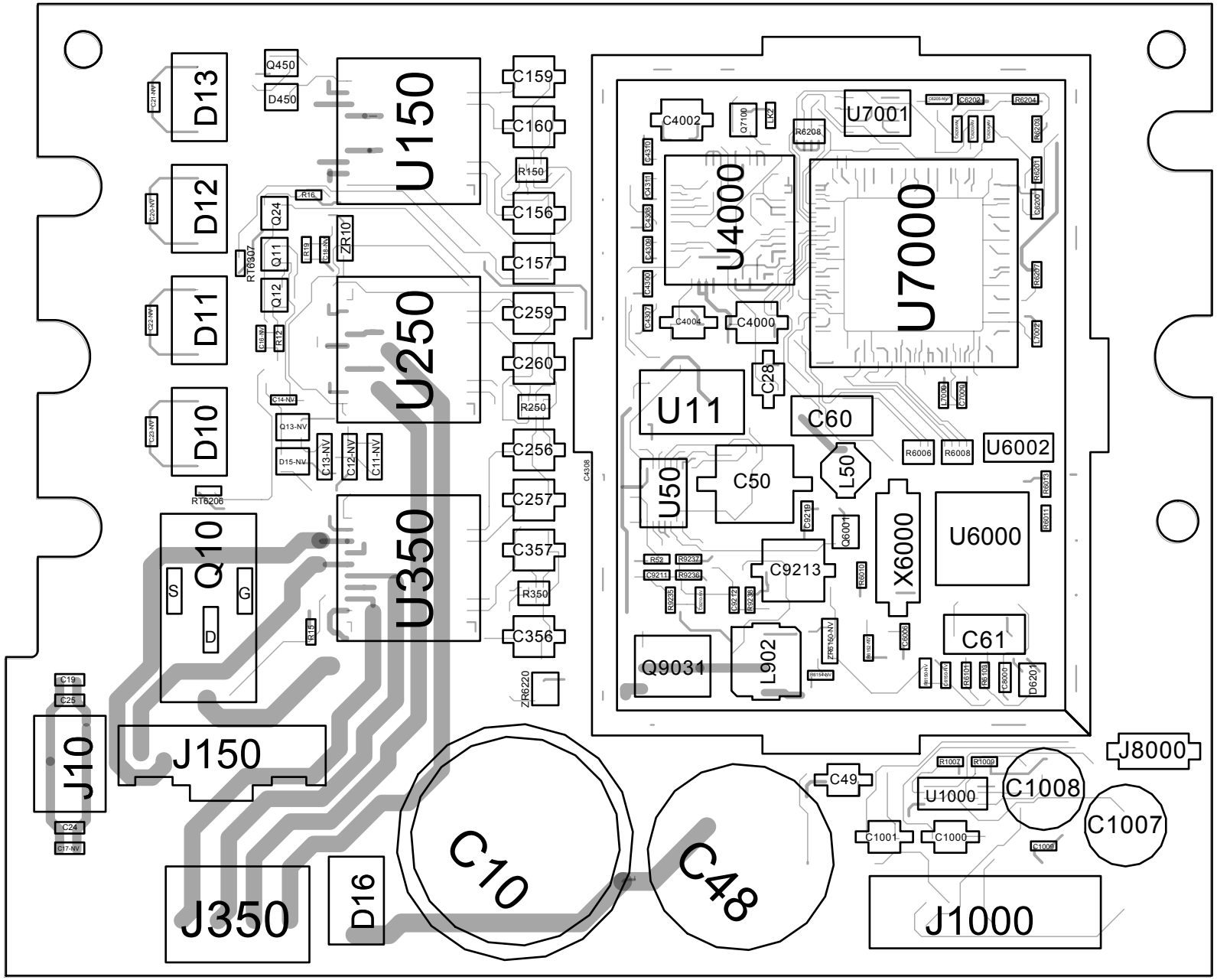
R150 3.9K
LC+ LC- RC+ RC-
C156 1uF
R151 8.25K
C158 560pF
C157 1uF
C159 1uF
R152 8.25K
C161 560pF
C160 1uF
MODE 10V 4V 20
U150 257975
12 VCC1
19 VCC2
In1+ 8
In1- 9
In2+ 2
In2- 3
Diag 1
Clip 11
Mode 20
SGnd 10
PGnd1 14
PGnd2 17
Out1+ 13
Out1- 15
Out2+ 16
Out2- 18
R162 3.32
C152 0.01uF
R454 4.7K
+3.3V
CCLIP
R163 3.32
C153 0.01uF
R164 3.32
C154 0.01uF
R165 3.32
C155 0.01uF
LSOUT+
LSOUT-
J150
VRAW 14V
C151 .033uF
GND
AMPGND

U250 257975
12 VCC1
19 VCC2
BAMPIN+
BAMPIN-
In1+ 8
In1- 9
In2+ 2
In2- 3
Diag 1
Clip 11
Mode 20
SGnd 10
PGnd1 14
PGnd2 17
Out1+ 13
Out1- 15
Out2+ 16
Out2- 18
R262 3.32
C252 0.01uF
R263 3.32
C253 0.01uF
R264 3.32
C254 0.01uF
R265 3.32
C255 0.01uF
BSCLIP
C259 1uF
R252 8.25K
C261 560pF
C260 1uF
VRAW 14V
C251 .033uF
GND
AMPGND
133220-04 J350
BASSAOUT+
BASSAOUT-
BASSBOUT+
BASSBOUT-

U902
275415-004
Gnd
RT
DTC
SCP
OUT
Vcc
COMP
FB
23V
27V
0.5V
0.9V
0.9V
R9232
39K
C9209
.033uF
R9240
10K
D9200
147239
28.3V
27.6V
28.3V
27.8V
27.8V
R9234-NV
10K
Q9032
146819
Q9031
269870-001
27.8V
+3.3V
+3.3V
C9220
10pF
R9233
4.7K
L902
560uH
40V
D901
195637-3
R9235
23.7K
C9210-NV
0.0015uF
C9211
0.01uF
C9212
0.015uF
R9238
1.82K
C9213
100uF
C9219
0.047uF
R9237
16.5K
R9236
7.15k
GND
C21-NV
0.047uF
D13
D12
C20-NV
0.047uF
SEC1
SEC2
J10
C19
0.047uF
C24
0.047uF
C25
0.047uF
C17-NV
0.047uF
D10, D11, D12, D13, D16
256405-200
21V
D16
27V
VSNUB
27.8V
C23-NV
0.047uF
D10
D11
C22-NV
0.047uF
C48
4700uF
RT6206
RT6307
TEMPSEN2
TEMPSEN1
GND
R10
5.90K
R11
750
6V
6.0V
ZR10
174265-5233
21V
S
Q10
271765-002
D
G
14.6V
17.3V
20K
R15
C15
0.022uF
R12
12.1K
C16-NV
0.047uF
3V
3.5V
146819
Q11
Q12
3V
3.5V
R18
392K
R19
29.4K
C18-NV
0.022uF
R13
19.6K
VRAWON
3.2V
Q24
146819
R16
5.90K
R14
9.09K
RQ1
1MEG
RQ2
1MEG
RQ3
1MEG
VRAW
14V
C11-NV
1.0uF
C10
15000uF
C9
22000uF
C12-NV
1.0uF
D14-NV
CA BAV99
Q13-NV
MMBT3904
R17-NV
240K
D15-NV
BAV56
C13-NV
1.0uF
GND
R25
47K
27.8V
27.1V
Q30
287939-001
+10V
R26
4.7K
U20
173795-1
27.8V
10.4V
VIn
VOut
VOut
Adj
NC
VOut
VOut
NC
LM317LM
R22
1.00K
9.1V
R23
7.15k
C49
2.2uF
VRAWON
3.3V
PG2 C/5
Q31
146817
VSNUB
27.8V
VRAW
14V
9.1V
ZR6220
135247-5239
R6221
10.0K
VRAWSEN
3.6V
PG2 C/1
C6220
0.033uF
R6220
29.4K
+5V
U11
258496-01
OUT
IN
ADJ
C29
0.047uF
C28
2.2uF
R20
1.00K
R21
3.09K
+3.3V
L7002
330ohm
R50
150K
U50
288281-001
1_KFF
2_RT
3_BP5
4_SYNC
5_SGND
6_SS/SD
7_VFB
8_COMP
ILIM_16
VIN_15
BOOST_14
HDRV_13
SW_12
BP10_11
LDRV_10
PGND_9
PWP
17
R51-NV
10.0K
C56-NV
100pF
C51
0.047uF
C50
22uF
R52
365K
C54
0.1uF
C55
0.0022uF
SOFTSTART
R54
100
1.5V
U51
289259-001
1.2V
C57
0.1uF
L50
22uH
R55
10
9.2V
U51
289259-001
C59
0.1uF
C60
100uF
C64
0.033uF
R59
2.00K
C63
470pf
C62
0.01uF
R56
365
R60
7.87K
R57
11.0K
+1.2V
R7002
0ohm
U7000
TMS320DA705
8_CVDD
16_CVDD
20_CVDD
33_CVDD
44_CVDD
53_CVDD
57_CVDD
65_CVDD
77_CVDD
85_CVDD
90_CVDD
101_CVDD
123_CVDD
128_CVDD
132_CVDD
DVDD_10
DVDD_31
DVDD_42
DVDD_50
DVDD_60
DVDD_68
DVDD_73
DVDD_81
DVDD_92
DVDD_103
DVDD_112
DVDD_125
DVDD_136
1_VSS
6_VSS
13_VSS
15_VSS
18_VSS
26_VSS
30_VSS
36_VSS
40_VSS
47_VSS
54_VSS
62_VSS
69_VSS
72_VSS
78_VSS
82_VSS
87_VSS
95_VSS
99_VSS
106_VSS
109_VSS
114_VSS
118_VSS
124_VSS
129_VSS
133_VSS
140_VSS
145_VSS
C7001
.033uF
C7002
.033uF
C7003
.033uF
C7004
.033uF
C7005
.033uF
C7006
.033uF

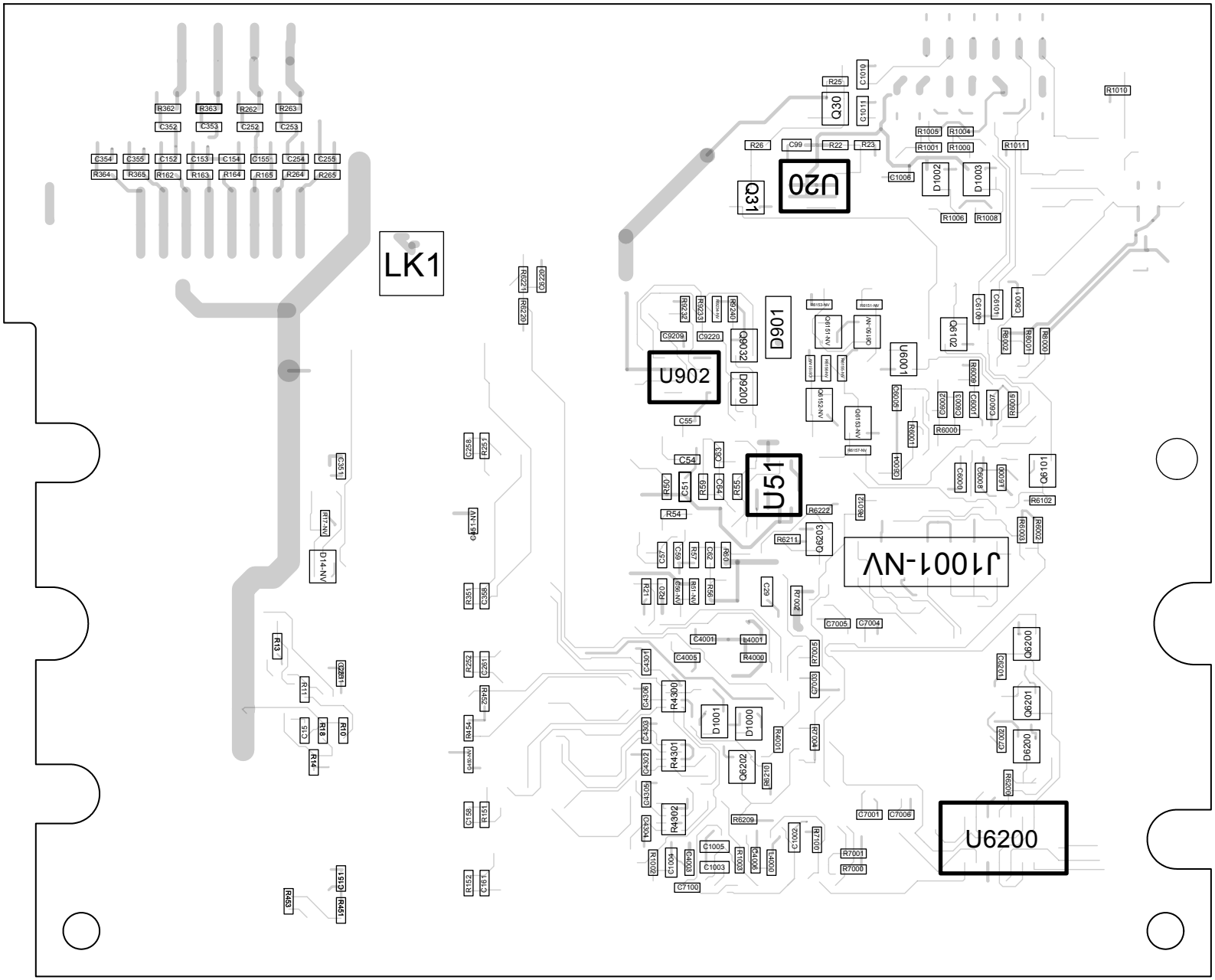
SIZE	FSCM	CLASS	DWG NO.	REV
B	32108	SD	290178	00
SCALE N/A	CAT. CODE *		SHEET 4 OF 4	

DSP PCB ASSEMBLY
Companion 5



294826-001 Primary

DSP PCB ASSEMBLY
Companion 5



294826-001 Secondary

CLASS FM	DWG NO.

REVISIONS			
REV	DESCRIPTION	ENG	DATE
00	INITIAL RELEASE	PETE CORTESE/ PAUL COLLINS	4/09

SIGNATURES REQUIRED		PRINT NAME	SIGNATURE
TSG REPRESENTATIVE		PAUL COLLINS	
CELL LEAD		DAVID MIKEL	
REPAIR SUPERVISOR		KEVIN KING	
OTHER(_____)			

TSG TECHNICIAN	DATE	
Pete Cortese	4/09	BOSE® FRAMINGHAM, MA 01701-9168

APPLICABLE DOCUMENTS:

SERVICE MANUAL: 290177-SM

DESCRIPTION

Companion® 5 Multimedia Speaker System Troubleshooting Tips

SIZE	FSCM	CLASS	DWG NO.	REV
A	**32108**	**FM**	290177-TT	**01**

Troubleshooting Tips
Companion® 5 Multimedia Speaker System

Refer to the Companion® 5 Multimedia Speaker System service manual reference number 290177-SM for schematics, PCB layouts and parts lists located on service web site.

Preventative Repair Measures
Note: Perform the following on all units returned for repair.

Product	Check	Action
Companion 5	Upgrade the Companion 5 firmware to ensure compatibility with Microsoft Vista operating systems	Applies to systems built before June, 2007 (DOM 7152). Upgrade the Companion 5 firmware. Refer to the Bose Service Operation's web site for software update information. Service Bulletin: **290177-B1**
*	Check to see if the DOM is between 4/23/07 (7113) and 6/3/07 (7154)	Replace C48 (on the DSP PCB) with a new part, using p/n: 261614-472HB3. Service Bulletin: **290177-B2**

Troubleshooting Tips

Product	Symptom	Check	Action
Companion 5	The LED won't switch to green	Check L50 on the DSP PCB for 1.2 Vdc	Check L50 or pin 25 on U7000 for 1.2Vdc. If the 1.2V is missing and Vsnub (26V) is present, replace U50 and U51 with part numbers 288281-001, and 289259-001, respectively.
Companion 5	Dead unit	Check F1 on the I/O PCB	Using a multi-meter to check F1 for continuity. If there is no continuity, replace the fuse with p/n: 269855-02000.
Companion 5	No audio or volume control from the computer	Make sure the computer and the Companion are synchronized	If all cables are connected and seated properly, try closing and reopening Windows Media Player, to ensure detection and synchronization between the PC and the Companion 5. Also, make sure the volume is turned up at least half way in Windows Media Player.
Companion 5	No volume control from the control pod	Check the control pod	Try rotating the outer ring of the control pod clockwise, and then counter clockwise. Listen for change in the volume. If the volume does not change, reseat the control pods connector into the bass module. If the control pod is not connected, the bass module defaults to full volume. If the control pod is defective, replace the control pod with p/n: 294599-001.
Companion 5	No audio from speakers or headphones	Check Q10 on the DSP PCB	Check Q10 voltages referencing the table below. If the output voltage is missing (Vraw 14.6V), replace Q10 with p/n: 271765-002. Q10 voltages in circuit. S 21V G 17.3V D 14.6V

Companion® 5 Multimedia Speaker System

Theory of Operation

CONTENTS

Product Description and Overview 2
Power Supplies, Block Diagram 3
Power Supply, VSNUB 4
Power Supply, VRAW 5
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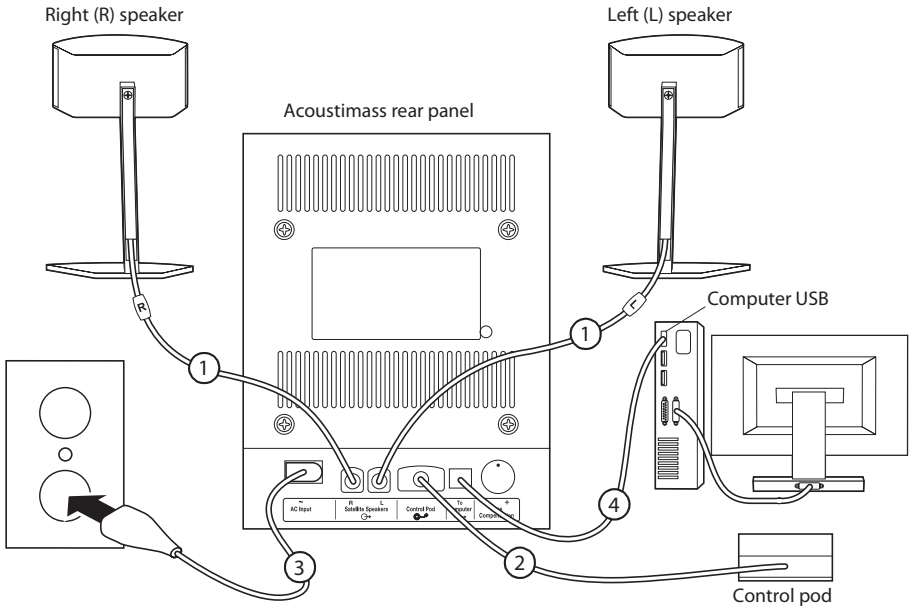
Power Supply 1.2V Regulator 7
Power Supply 3.3V Regulator 8
Sensor and Power Failure Detection 9
USB Controller 10-11
Audio Interface 12
Miscellaneous Control 13
Digital Signal Processor 14
Conversion and Ramp Generation 15-16
Audio Path 17-20
Power Amplifiers 21
Headphone Amplifier 22
Block Diagram 23

Companion 5 (Rising Star) Theory of Operation



Overview

Companion 5 is a multi-channel multimedia speaker system connecting to personal computers via a USB 2.0 interface. No sound card is required to enjoy 5.1-channel audio content from the host PC. The two speaker arrays combined with advanced audio processing algorithms provide a spacious presentation of stereo content and a compelling experience with multi-channel content. A control module brings the master volume control, simple touch mute control and jacks for an auxiliary analog stereo input and headphones.

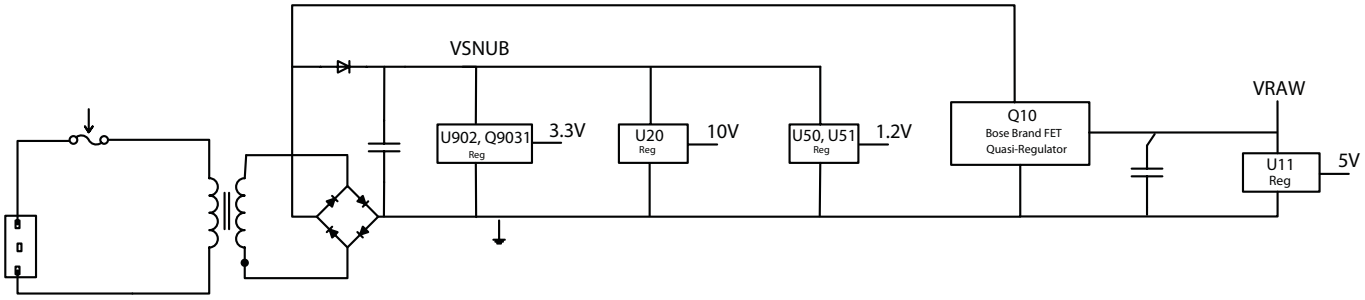
The Companion 5 system consisting of the following major components:

1. Bass speaker enclosure with Woofer, DSP board, I/O board and system power supply.
2. Control Module with an 8-foot (2.4M) cable.
3. Two two-element speaker arrays with integrated cables, uniquely keyed and identified for left and right locations.

The Bass speaker enclosure is a ported MDF enclosure including the 5.25-inch dual voice-coil transducer and line power transformer. Both are installed inside the acoustic volume in such a manner that they are not serviceable. An electronics enclosure is provided at the back of the MDF enclosure. The heat sink assembly that includes the DSP/Power Amplifier/Power Supply Printed Circuit Assembly, aluminum heat sink, thermal compound, thermal interface material, and clamping bracket are screwed directly to the back wall of the acoustic enclosure. Internal cables connect the DSP/PA/PS assembly to the transformer secondary and the I/O Printed Circuit Assembly that is mounted to the plastic rear cover of the speaker.

The control module is not serviceable. Only the interface requirements to the Bass module electronics will be discussed in this document. The speaker arrays are mounted on removable speaker stands that are engineered to position the speakers at the correct height and angle on either side of a computer monitor. The transducers contained in the speaker enclosures may be replaced from the front of the enclosure by removing the metal grill. The grill should not be re-used once removed due to deformation during the removal process. The integrated cable is not removable. The balance of this document will concentrate on the electronic assemblies present in the bass module.

Power Supplies

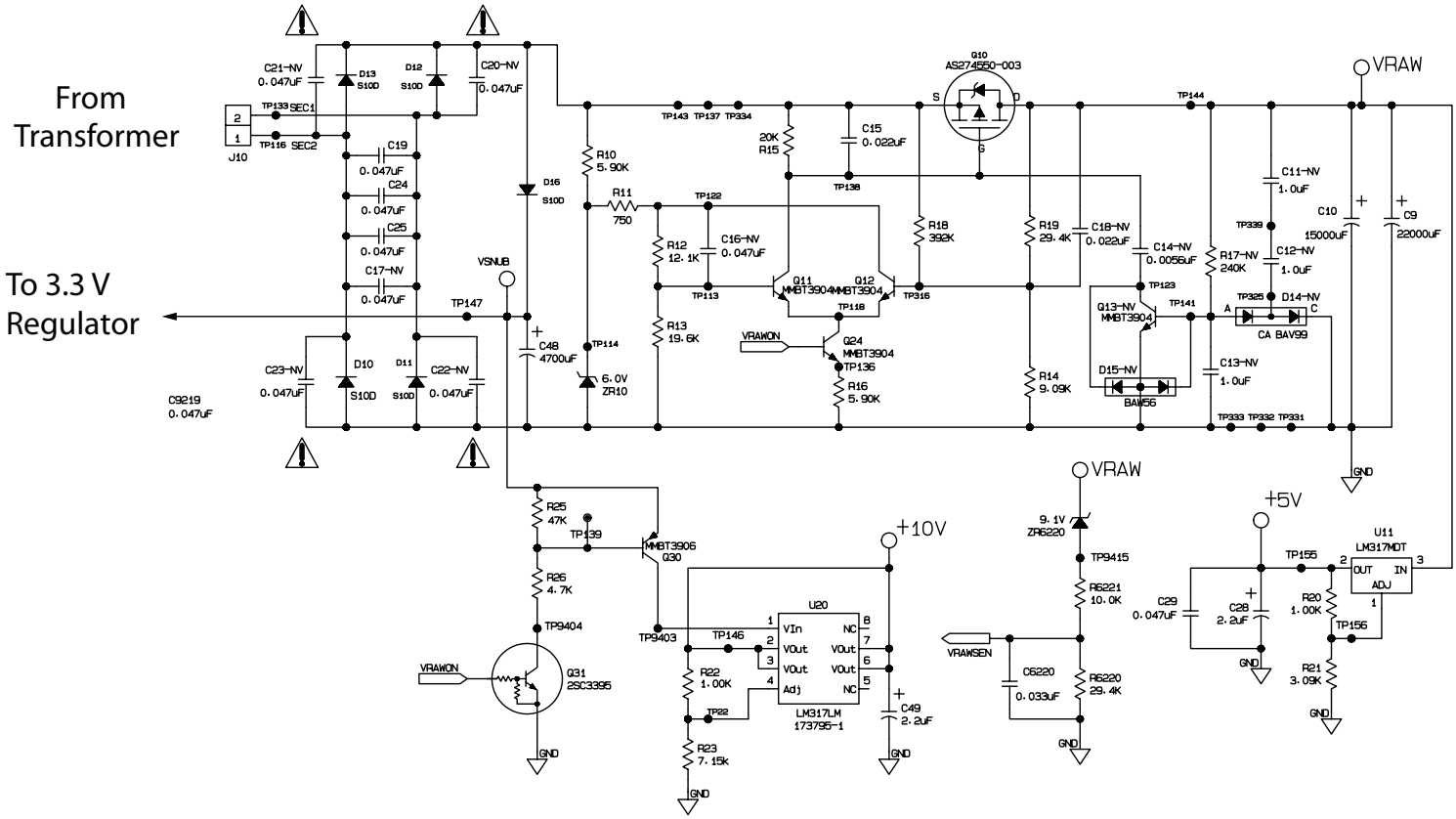


Power Supply Block Diagram

Bass module rectifies un-regulated power VSNUB from the secondary of the line power transformer. VSNUB is, in turn, converted to the various other potentials required by the system. Nominally 26VDC, this voltage varies with load and line levels, but is limited to 31.5V maximum(assuming line voltage of 140V AC). This voltage is present whenever the bass module is plugged into the wall. All the voltage level source are listed in following table:

Node Name	Output Voltage nominal	Type	Input from	Outputs to
Vsnub	+26	Full wave rectifier	transformer secondary	Vraw
Vraw	+14 (no load)	pre-regulator output	VSNUB	Power Amplifiers, +5V, VRAWSEN.
+10V	+10	linear	VSNUB	Headphone power amplifiers, control module green LED.
+5V	+5	linear	Vraw	CODEC Analog power supply
+3.3V	+3.3	switching	VSNUB	DSP I/O power supply, digital supply for USB controller, CODEC, EEROM.
+1.2V	+1.2	switching	VSNUB	DSP core power supply.
SENSOR	+3.0	series switch	+3.3	Switch able supply for control module touch sensor, control module red LED

Power Supply VSNUB

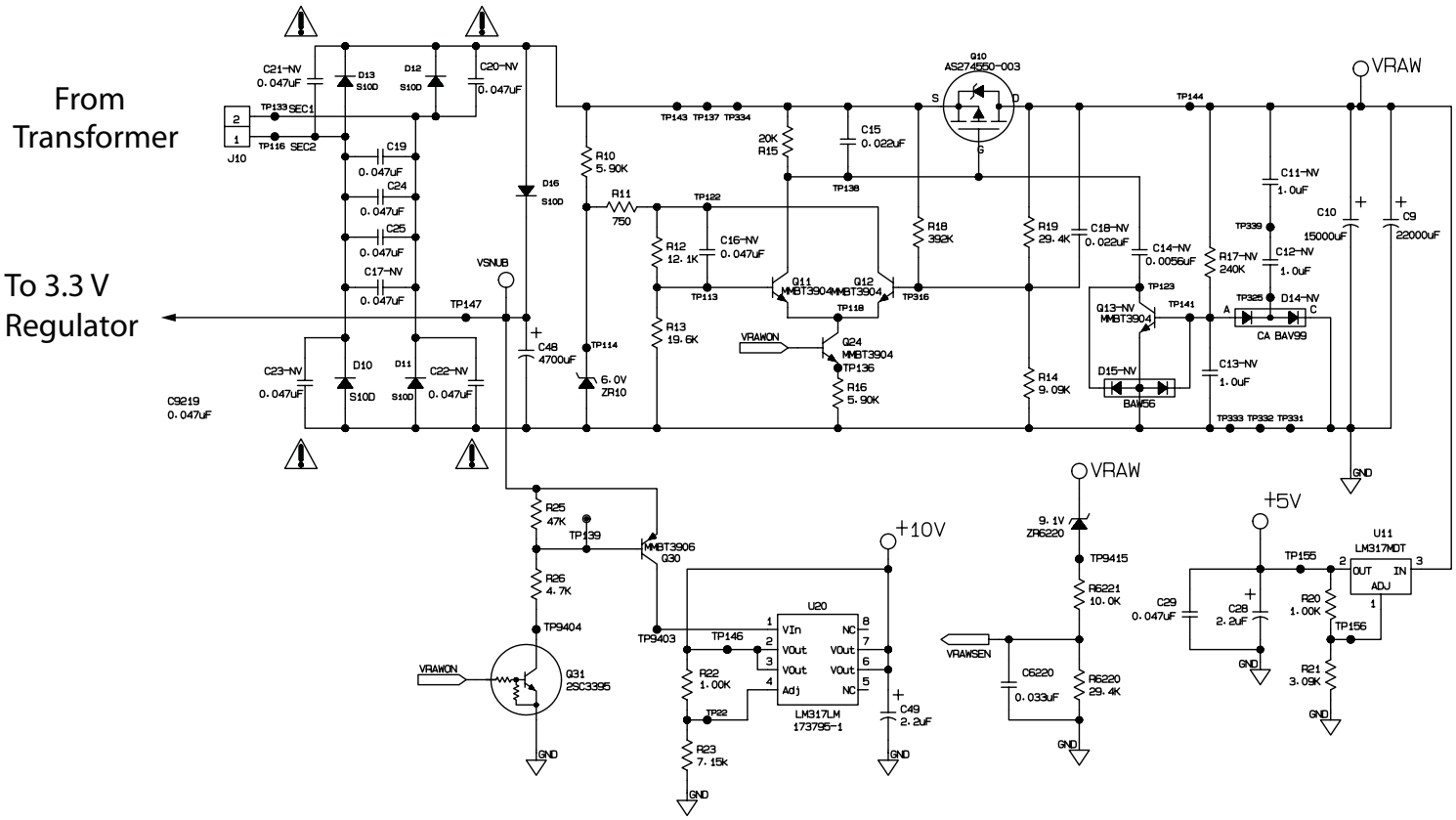


VSNUB

VSNUB is formed by rectifying the transformer secondary potential via power rectifiers D10-D13. An additional rectifier, D16 prevents discharge of the filter capacitor, C48 through the FET switch, Q10, whenever this switch is on. For operating conditions other than extremely low line potential, this permits the peak potential at C48 to track closely to the peak secondary potential. This is substantially higher than the peak potential of the quasi-regulated Vraw supply discussed below.

VSNUB also serves as a clamping potential into which some of the energy stored in the leakage reactance of the mains transformer is discharged when Q10 is switched off. This additionally energy can cause the peak potential for V-UNREG to actually be greater in magnitude than the peak potential of the transformer secondary when Vraw current drain is large. VSNUB can range from 20 to 40 volts, depending on input voltage and Vraw loading.

Power Supply VRAW



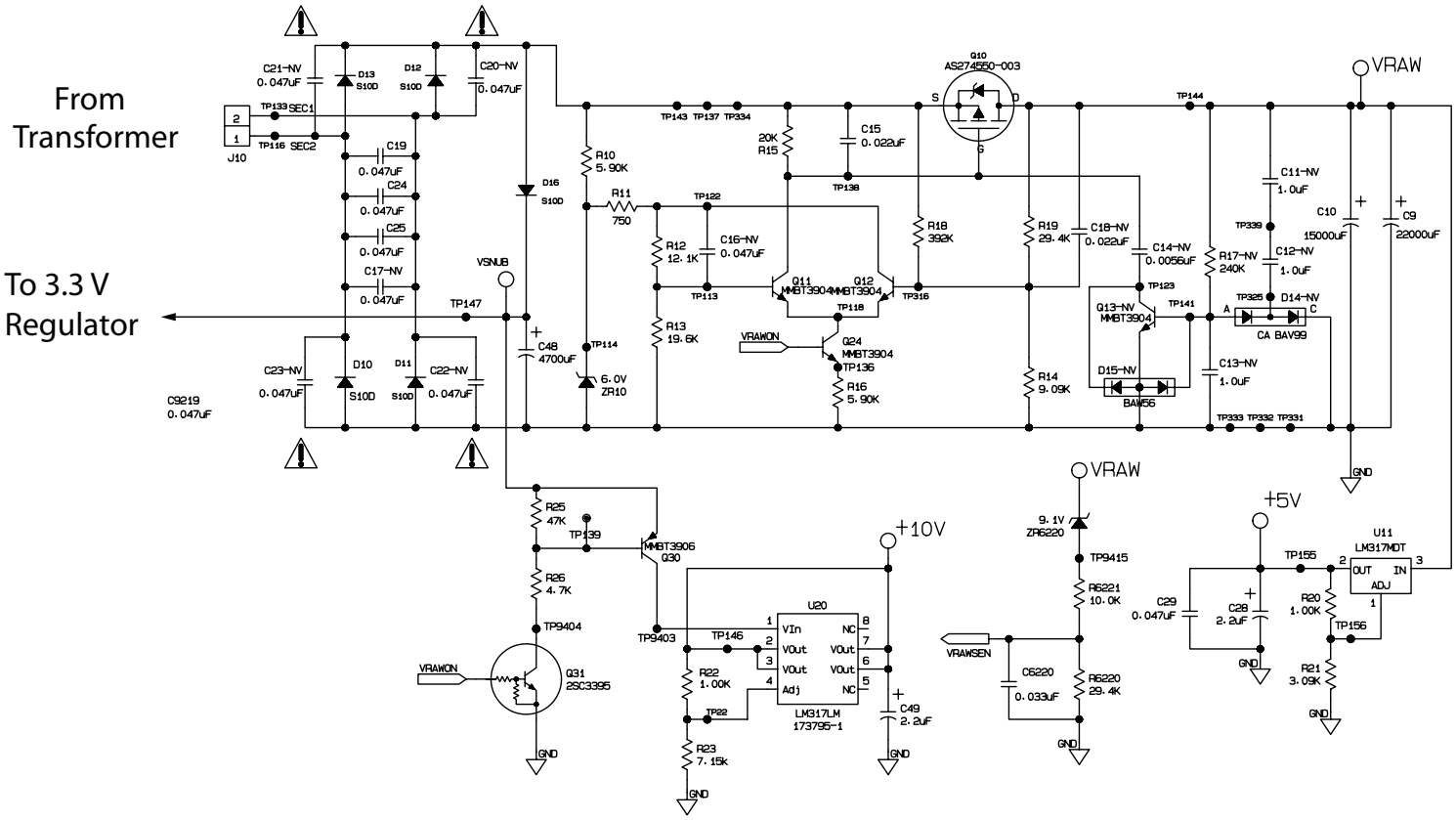
VRAW

Vraw provided power to the Audio Power Amplifiers, U150, U150, U350, and the +5V regulator. Its potential is monitored by the DSP, U7000, via the circuit associated with VRAWSEN. When active the potential can vary from 12 vdc to 14.0 vdc. The circuit controlling the FET switch, Q10, is configured to force commutate (turn off) the switch whenever the potential of the filter capacitor, either C9 or C10, exceeds the target potential of approximately 13 volts. The nature of the circuit causes Q10 to turn off during high peak currents. These high peak currents cause a voltage drop on C9's (C10's) internal equivalent series resistance (ESR) which, in turn, causes a drop in the sensed output potential as soon as the switch, Q10 is turned off. In order to prevent the circuit to immediately turn the switch back on, a fixed voltage hysteresis is applied by the control circuit to lower the turn-on threshold of the circuit by 200 to 300 millivolts.

R10 and ZR10 form a 6.0V reference potential for the error amplifier formed by Q11, Q12. R11, R12, and R13 scale this reference voltage to an appropriate potential to permit start-up of the circuit. R11 doubles as the feedback resistor that sets the hysteresis mentioned above. R18 and R19 are essentially in parallel when Q10 is on, so R18, R19, and R14 set a relatively constant turn-off potential. When Q10 is off, R18 depresses the turn-on threshold of the circuit proportional to the open-circuit potential of the transformer secondary. This is in addition to the hysteresis provided by R11 and serves to prevent Q10 from turning on during the highest potentials of the input mains, as this is when the peak charging currents would be the largest.

Q24 and R16 serve as the enable input and current sink for the error amplifier. Maintaining a constant potential across R16, causes a constant potential to be applied Gate to Source of Q1 when Q10 is on. C15 controls the switching speed of Q10, which improves audible and electrical noise characteristics of circuit. Q13 and the additional components associated with Q13 provide additional shaping of the switching characteristics of Q10 when little power is consumed from Vraw.

Power Supply 5V and 10V Regulators



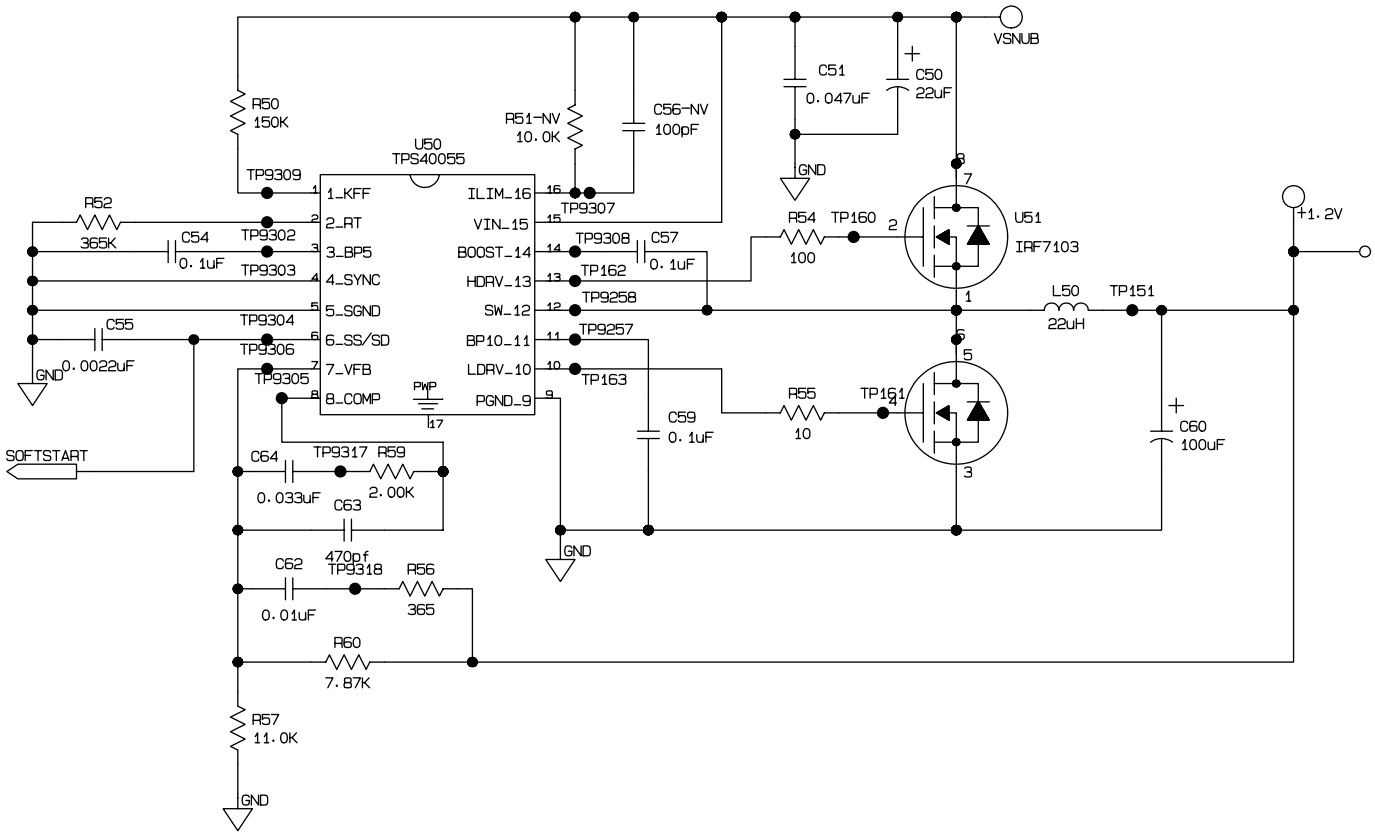
5V

The only internal power requirement for 5 volts are the CODEC, U4000, power supply and the current source for the ramp circuit formed by Q6201 and R6207. The source for the +5V linear regulator, U11, is Vraw. +5V is provided only when Vraw is enabled.

10V

This potential is used to power the headphone amplifier and signal that the system is not in stand-by operation. When installed on the I/O assembly, this potential will drive the primary circuit TRAIC. The GREEN LED on the control module is driven by this potential. Q30, Q31 and associated components for an enable circuit for the linear regulator U20. These components permit U20 to be disconnected from Vsnub during stand-by operation, thus avoiding the quiescent dissipation of U20 during these conditions.

Power Supply 1.2V Regulator



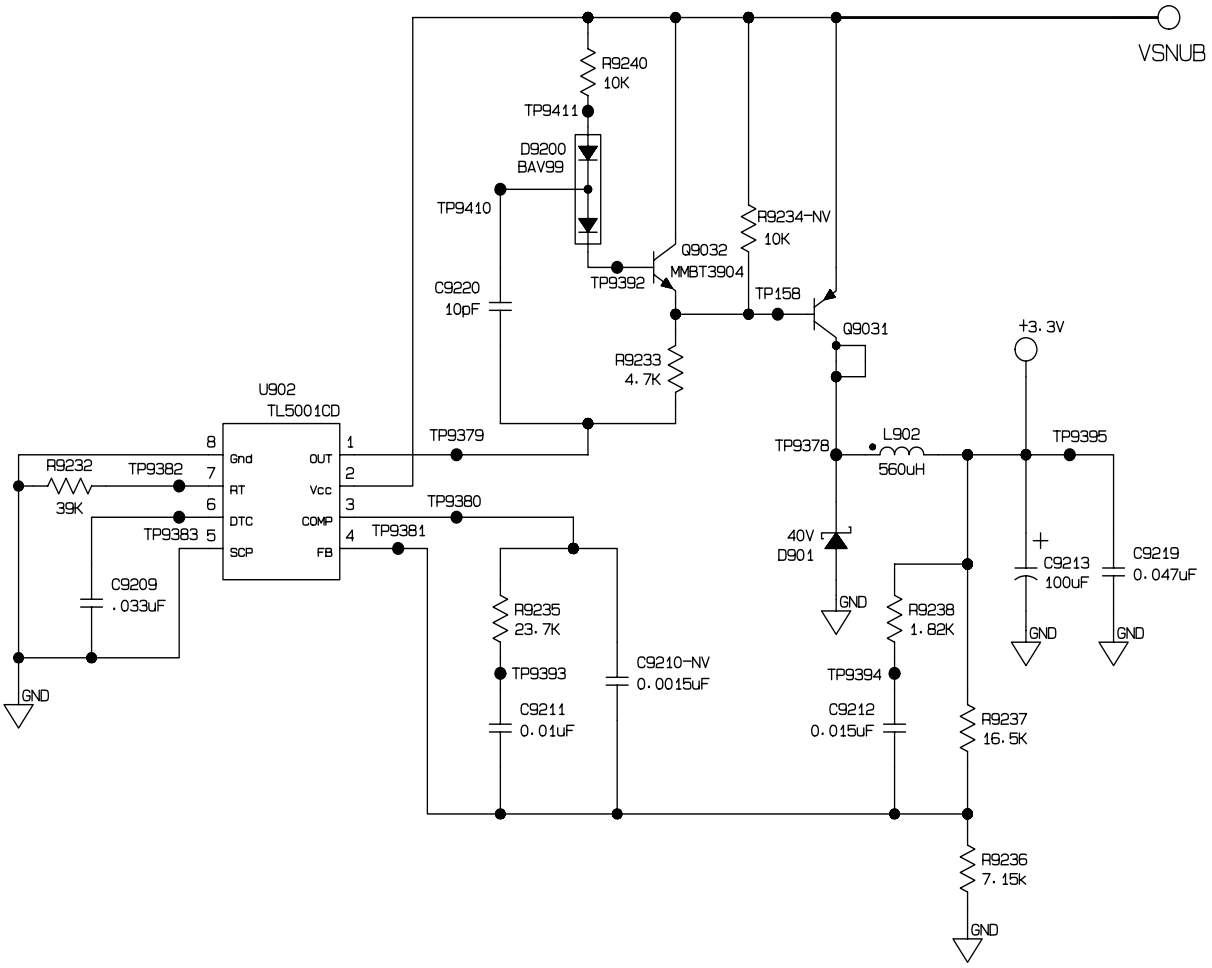
1.2V

The processing core of the DSP is the sole consumer of the 1.2 volt power supply. Its relatively high current consumption requires efficient power conversion. The Texas Instruments TPS40055, U50, provides the PWM control functions for a synchronous-rectifier power circuit. U51 is a dual N-channel FET used as switch transistor and synchronous rectifier for the buck regulator circuit. Inductor L50 and filter capacitor C60 form the filter for the +1.2V supply. R57 and R60 establish the DC operating voltage for the output. R56, R59, C62, C63 and C64 provide the compensation for the feedback path.

C59 filters the 10 volt reference internal to U50 which is used to control the switching of the transistor drive signals. C57 provides the boot-strap (boost) potential to drive the high-side switch. C54 filters the 5 volt reference also generated internally to U50.

R52 sets the operating frequency of the PWM circuit of approximately **100**kHz. Resistor R52 provides a reference to the input voltage which is used by U20 provide feed-forward input voltage compensation. C55 shapes the soft-start characteristics of the regulator.

Power Supply 3.3V Regulator



3.3V

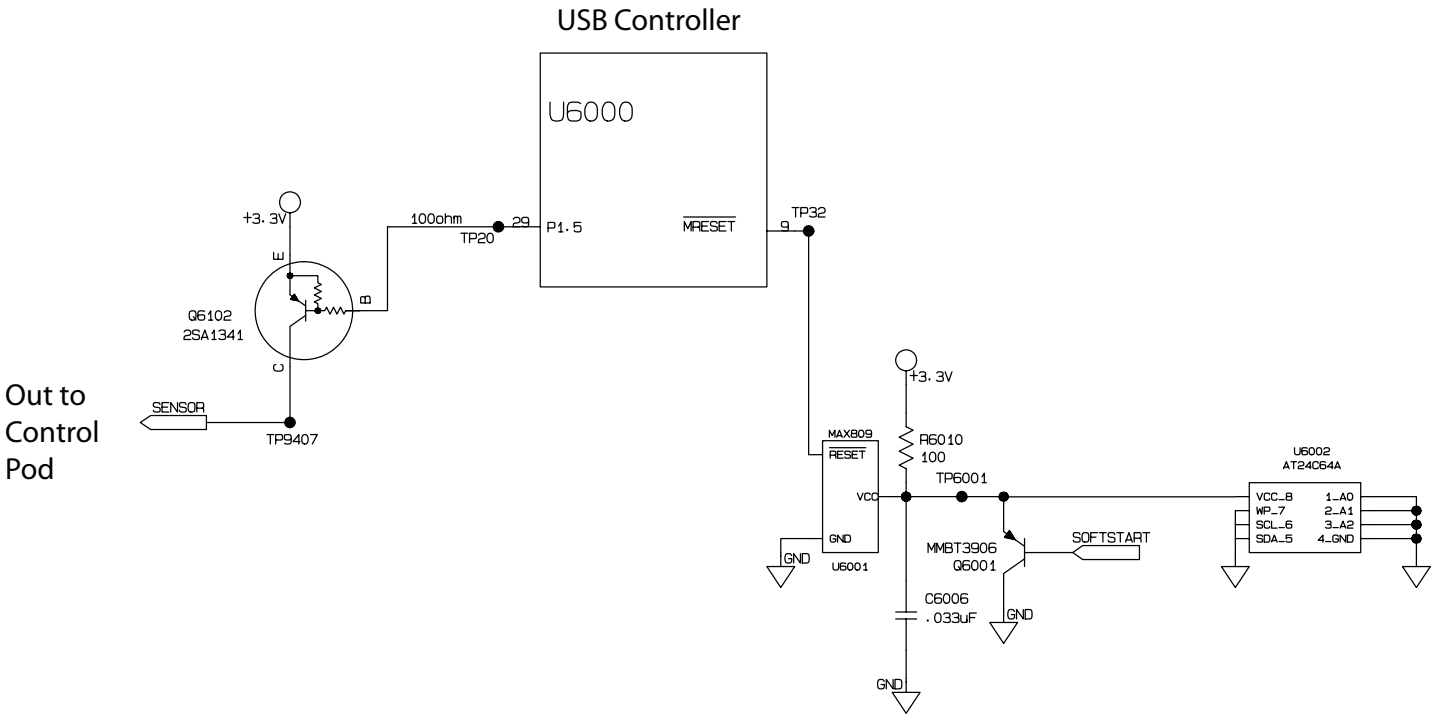
The USB controller, U6000, the I/O circuitry of the DSP, U7000, and the digital processing portions of the CODEC, U4000 all require power from +3.3V. This circuitry is biased both during normal operation and stand-by, so no enable control is required.

U902 is a TI TL5001 switch-mode PWM regulator control circuit. The output is open-collector, and drives the base of the PNP power transistor, Q9031. Q9032, D9200, R9240, and C9220
provide a boot-strapped circuit to speed the turn-off of Q9031. R9236 and R9237 form a potential divider to establish the DC operating point of the regulator at +3.3 volts. C9202 provides a lead compensation in the feedback circuit. R9238 limits the frequency range of the lead compensation.

C9211 is applied around the error amplifier of the TL5001 to create a lag compensation. R9235 limits the frequency range of the lag compensation.

R9232 establishes the approximately **50**kHz switching frequency for the PWM generator. C9209 generates a soft-start ramp when TL5001 starts switching.

Sensor and Power Failure Dectection



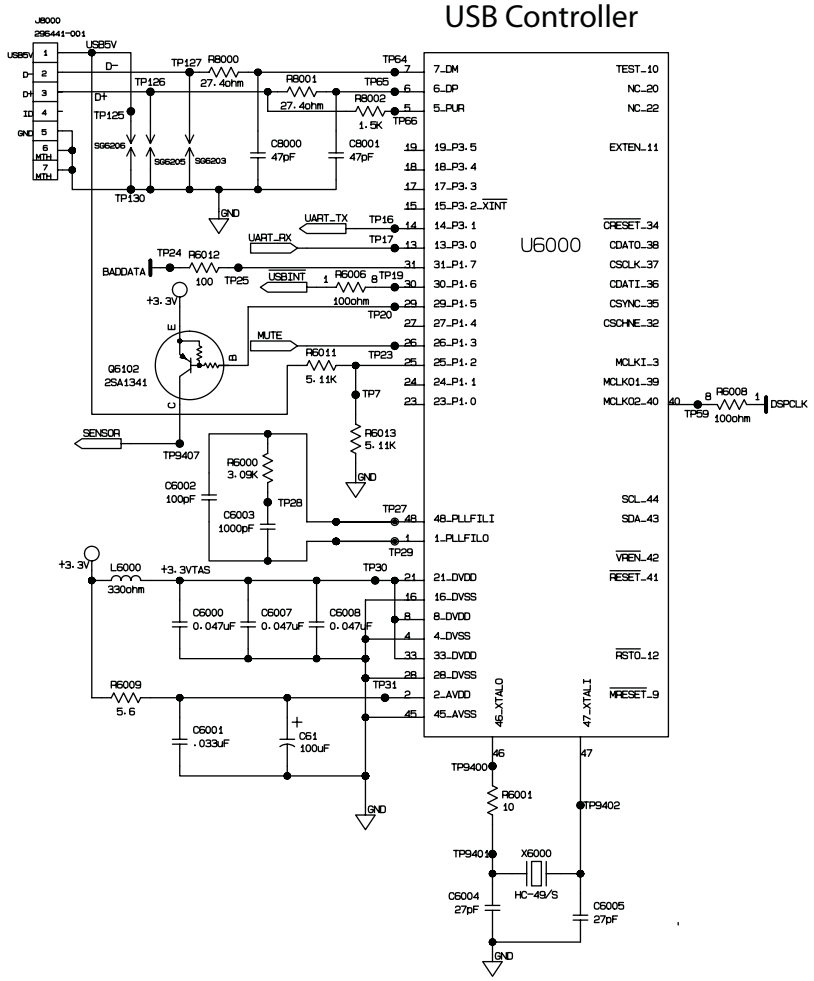
Sensor

SENSOR is generated by switching the +3.3 volt supply via Q6102. SENSOR powers the touch sensor in the control module. switching SENSOR off momentarily forces the control module touch sensor to reset, forcing its output to the muted state. This is typically performed just prior to entering the stand-by mode of operation. A subsequent transition from mute to active will cause the system to exit stand-by.

Power Failure Detection

Detection of power failures is accomplished with U6001, a Maxim MAX809 undervoltage detection IC. U6001 directly monitors the +3.3Volt supply which is used by the USB controller, U6000, the DSP I/O circuitry, U7000, and the CODEC digital circuitry, U4000. In order to prevent an undetected disruption of the DSP due to loss of the core power supply, the SOFTSTART signal from U50 is used to switch the PNP transistor, Q6000, on whenever +1.2V has stopped due to undervoltage lockout. Q6000, in turn, removes the +3.3 volts from the undervoltage detection IC, U6001, forcing a reset of the USB controller.

USB Controller



USB Controller

The TAS1020B (U6000) micro-controller also serves as the master controller for the system. It manages the USB interface to the host computer including the enumeration of the system capabilities to the host computer. U6000 is responsible for managing the status of the USB interface, monitoring the MUTE\ signal from the remote control, monitoring the status of the audio stream passing through the DSP, and enabling the Vraw, +10V, and SENSOR power supplies.

USB Controller Oscillator and Clock Generation

All clocks for the system are generated by U6000. Crystal X6000 is driven by U6000 to generate a 6.0MHz reference clock. This reference is internally multiplied by U6000 to generate its own 48MHz system clock as well as the internal 24.576MHz master clock for the serial TDM audio path. This internal clock is divided to produce a 12.288MHz bit clock and a 48kHz frame sync clock for the TDM audio path described later in this document. A separate 24.576MHz clock is provided for driving the DSP. In order minimize jitter on the output of the phase-locked loop, a filter for the PLL power supply is created with the components R6009, C61, and C6001. The PLL dynamics are controlled by the compensation components C6002, C6003, and R6000.

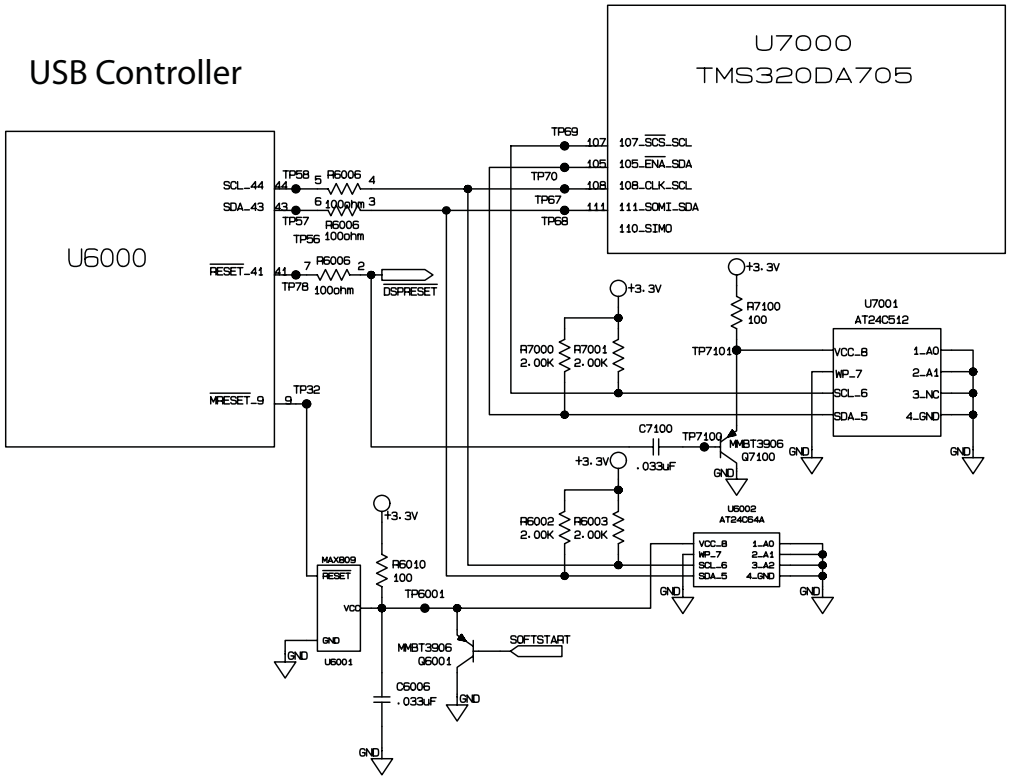
USB Interface

The tolerance of the impedance into which the USB data signals D+, D- must be terminated is relatively tight. Components R8001, R8001, C8000 and C8001 provide the proper matching to the internal impedance of the data transmitters of U6000. R8002 provides the necessary pull up to the D+ line in order to signal to the host that the Companion 5 is present and is a full-speed device. The resistor divider R6011 and R6013 permits U6000 to sense the presence of the USB5V signal from the host. U6000 is required to remove the signal to R8002 whenever USB5V is not detected.

The signals BADDATA at U6000.31 and USBINT\ at U6000.30 are used to transmit key USB status information to the DSP controller. When the USB link to the host computer is performing normally, no activity is present on these signals.

USB Controller

DSP



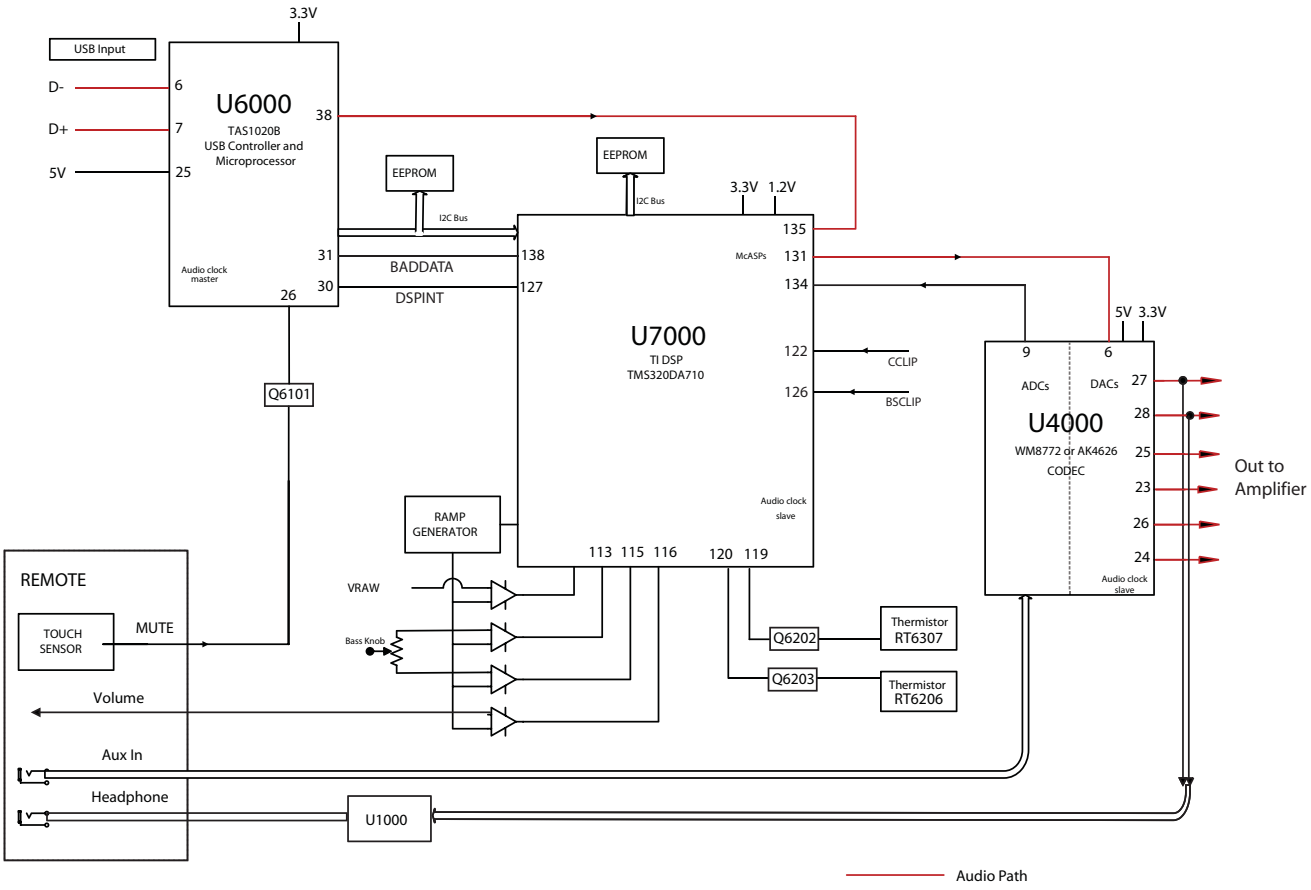
Memory and I2C interface

The TAS1020 contains an internal ROM and all Data and Program RAM. An external EEROM, U6002, stores the portion of the program code custom to the Companion 5 application. Once the TAS1020 has come out of reset, it will read the code stored in U6002 via the Inter Integrated Circuit (I2C) communications path on pins 43 and 44. This buss is also used for transferring non-audio information between the USB controller and the DSP. The TAS1020 is permanent master on this buss and provides the clock and command/address portions of all instructions. The DSP always behaves as the slave device on this interface.

Booting, EEROM

The logic state of pins U7000.[108,110,111] are selected to permit booting from the external EEROM, U7001, using the I2C protocol. The proper state of pins 108 and 111 depend on the I2C pins of U6000 being idle when DSPRESET\ is released. The DSP will take approximately 2.8 seconds to read the EEROM contents and complete internal initialization. In order to assure that the I2C state machine internal to the EEROM, U7001, is in a known state, the components C7100, Q7100, and R7100 are used to momentarily remove the +3.3V power from the EEROM each time the USB controller places the DSP into reset.

Audio Interface



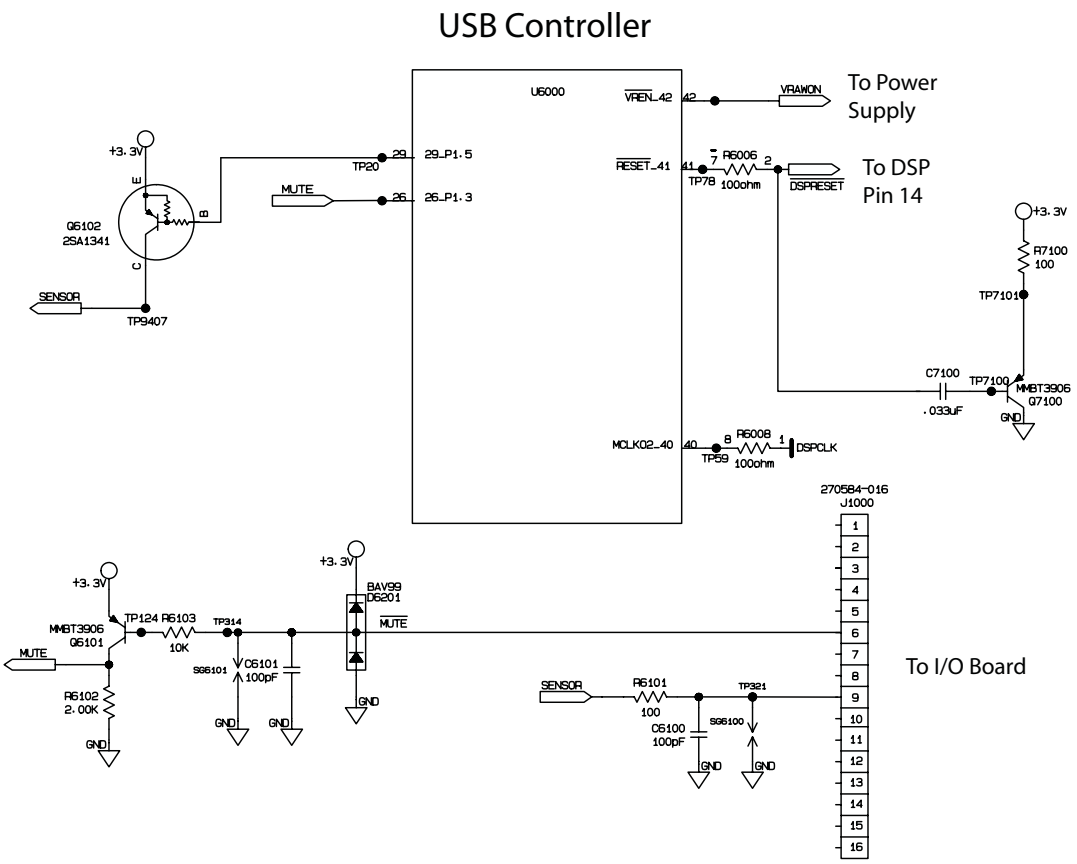
Audio interface

Time Division Multiplexing (TDM) is used to transfer audio data among the USB controller (U6000), DSP (U7000) and CODEC (U4000). The USB controller is the clock master for the TDM paths. Only one clock domain exists for exchange of audio information. The USB controller is responsible for synchronizing the local TDM data rate with the data rate from the USB host, when the host is active. When no host is connected, or when the connected host is suspended, the USB controller is responsible to provide the clocks for the TDM paths at a nominal 48kHz audio sample rate. No audio data is transferred to the host computer. Additional details of the TDM audio paths are described later in this document.

U6000.35 sources the frame clock for the TDM paths.
U6000.37 sources the bit clock.
U6000.38 sources the USB audio data received from the USB host.

Serial Interface

The components to support a Boselink hardware compatible serial interface are not installed.



Miscellaneous Control

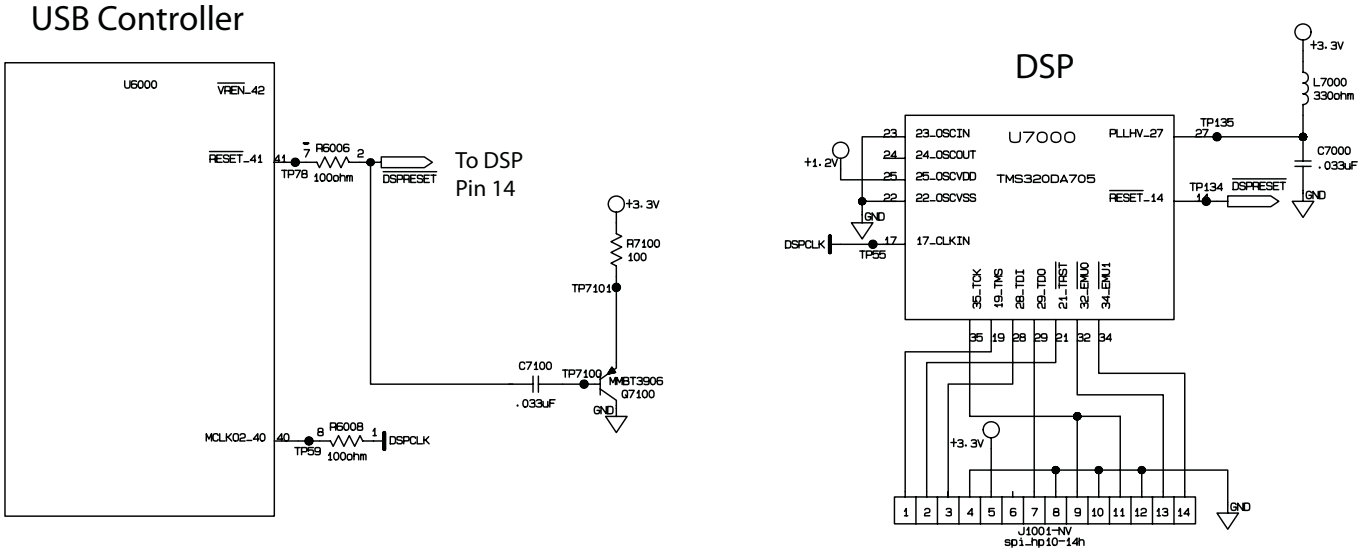
Power management is affected by controlling the pins for SENSOR, VRAWON, and DSPRESET\.

SENSOR is controlled by U6000.26, which is inverted in logic level from SENSOR. The function of SENSOR is explained in section 2.7.

The signal VRAWON (U6000.42 enables both the pre-regulator circuit for Vraw and the +10V power supply as explained in sections 2.1 and 2.2, respectively. VRAWON is active when the USB controller is held in reset. The USB controller must complete the boot cycle, enable the DSP controller to boot, and monitor the USB interface and AUX input signal amplitudes. Only if the USB interface is not active (suspended or disconnected) and if the signal level of the AUX input is less than -70dB and both conditions have persisted for at least 2 minutes, will the system be placed into stand-by and VRAWON driven low.

DSPRESET\ is an active low signal driven by pin 41 of U6000. This pin is active low at initial application of power to U6000, keeping the DSP in reset until U6000 has completed initialization. The signal is then negated (high). The USB controller will reset the DSP just prior to entering stand-by mode of operation.

Transistor Q6101 inverts the MUTE\ signal from the control module to buffer and generate the MUTE signal to the USB controller (U6000.26). If the mute signal is not present shortly after the USB controller is initialized, the controller must assume that the control module is not present and command the DSP to enable the speakers, speaker EQ and set the system volume to full. At any time the mute signal is present the USB controller commands the DSP to mute the speaker EQ, mute the speaker Power Amplifiers, and ramp in the headphone (flat) EQ.



DSP

The Texas Instruments TMS320DA705 (U7000) is a floating-point Digital Signal Processor with internal ROM and 192kbytes of internal RAM. No external RAM is required or supported by this processor. The internal ROM includes a boot loader algorithm that permits booting the custom application portion of the program code from a variety of external devices. All audio processing, limiting, volume control, bass compensation, monitoring of the thermal sensors, clip detection, transducer DC offset protection, ETAP command processing and response generation are performed by the DSP.

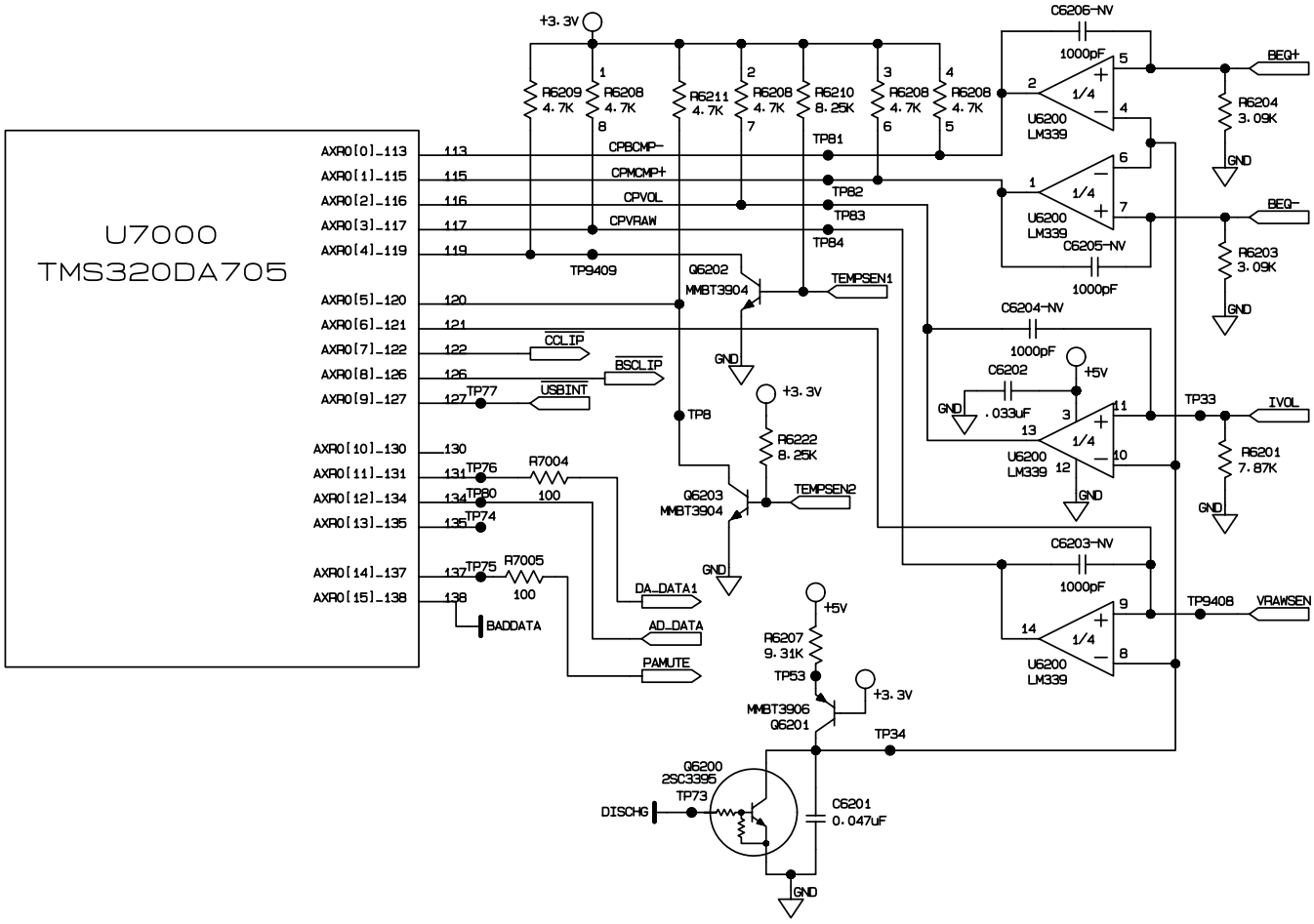
DSP Clock

The 24.576MHz DSP clock is provided by U6000. The clock is applied prior to U6000 releasing the DSPRESET\ line.

DSP Reset

Reset for U7000 is controlled solely by the USB controller (U6000) through the DSPRESET\ signal applied to U7000.14. The DSP is held in reset after power is applied until the USB controller has initialized its operation. The DSP is also placed into reset by the USB controller just prior to its entering the stand-by operation mode.

Conversion and Ramp Generation



Analog inputs

Several signals monitored by the DSP are analog in nature. One of the two Advanced Serial Processor (McASP) engines that are available in the DSP is used to perform the analog to digital conversion with the aid of several external components.

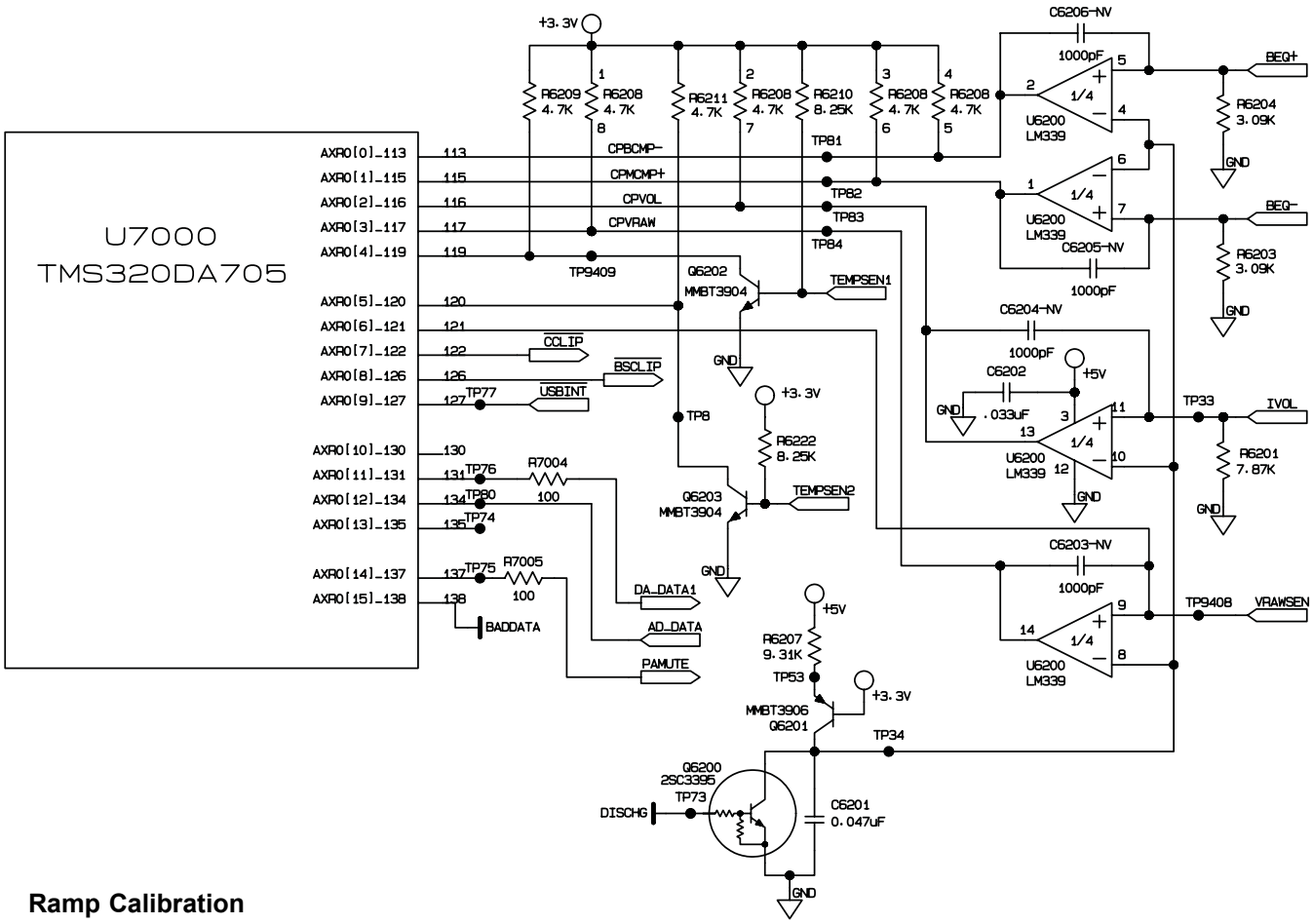
Conversion Cycle and Ramp Generation

McASP0 is configured as a TDM path with 6 slots of 32 bits/slot. An internally generated bit clock is set at 96kHz. The DSP generates a frame sync pulse (DISCHG) that is high for the duration of the first of the six slots. The high level on DISCHG causes Q6200 to discharge the capacitor, C6201, to nearly zero volts. During the next 5 slots, or160 bits, Q6200 is turned off and the current source consisting of Q6201 and R6207 charges the capacitor at a constant rate. The capacitor potential should cross 3.3 volts after 1.33 milliseconds but before 1.67 milliseconds, at which time it will again be discharged by DISCHG pulse.

Signal Conversion

The ramping voltage waveform generated on C6201 is compared to each of the analog signals by independent comparators, all part of U6200. The logical output of each comparator is routed to a serial input on McASP0. The serial inputs are programmed to clock in all data present in the 2nd through 6th slots, or last 160 bits of the TDM frame. At the end of each frame, the buffer associated with each input is scanned to find the location of the first high-to-low transition of the data. The ratio of the number of bits from the start of the 2nd frame to this location to the number of bits to the ramp exceeding 3.3 volts is the converted value for each input.

Ramp Calibration

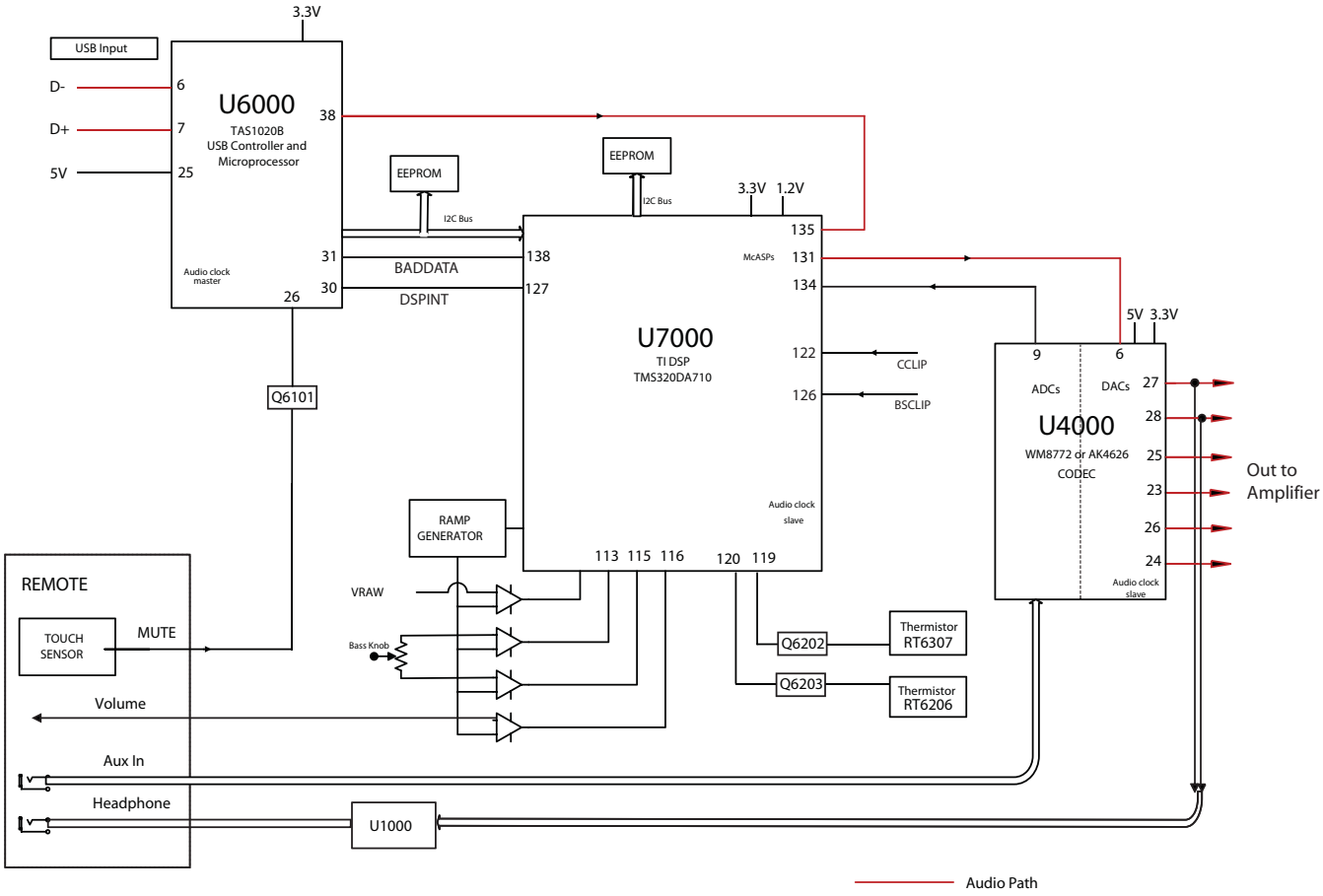


Ramp Calibration

In order to calibrate the Analog to Digital Conversion, the DSP uses a general-purpose i/o pin to overdrive the analog VRAWSEN signal present at the comparator input U6200.9 for the duration of a conversion cycle. This forces the input to +3.3 volts. The bit value read for CPVRAW (U6000.14) becomes the full-scale value. Dividing this value into the counts obtained on the other inputs, or on future counts obtained on the CPVRAW input normalizes the counts relative to full scale. This calibration cycle is performed at a regular interval and can be observed by looking at the VRAWSEN signal. Under normal input line conditions, VRAWSEN will be significantly below 3.3 volts except for the calibration cycle, when it will step to 3.3 volts for the duration of the cycle.

Analog Signal	Converted Signal	DSP (U7000) input pin	Use
BEQ+	CPBCP-	113	Bass compensation. Wiper position can be determined by (BEQ+ - BEQ-)/(BEQ+ + BEQ-).
BEQ-	CPBCP+	115	
IVOL	CPVOL	116	Volume control input when the control module is present
VRAWSEN	CPVRAW	117	Use to prevent clipping of power amplifiers, monitored to determine excess energy consumption for transducer DC offset protection.

Audio Path



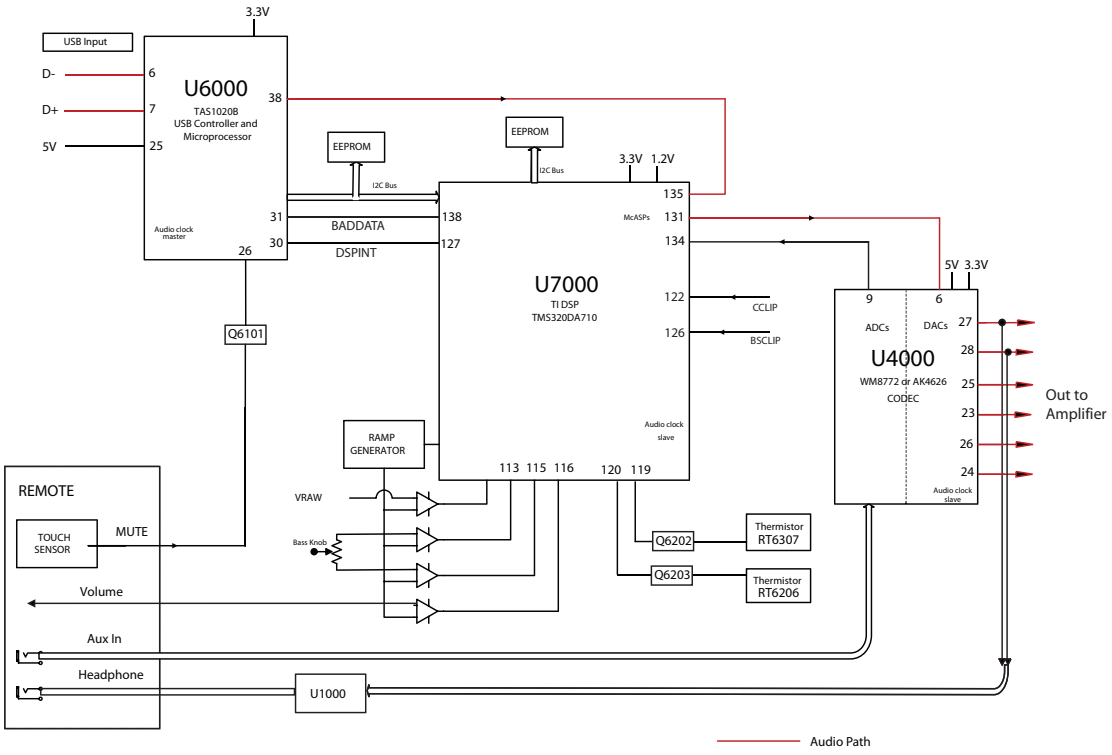
Audio Path

The audio path is implemented on McASP1 of the DSP. All clocks are generated by the USB controller, U6000. The DSP expects audio input from the USB controller on pin U7000.135. The audio input from the CODEC is expected on U7000.134. The DSP sends audio data to the CODE on pin U7000.131. All other details of the audio path will be deferred until section 5. The left and right channels of the USB input are summed with the left and right channels of the AUX input prior to processing the audio stream. The volume control is applied to the mixed stream. Volume matching the two streams is accomplished by either using the Windows or application volume control on the connected PC, or by using the volume control available on the device connected the AUX input.

Miscellaneous I/O

The DSP receives warning of a USB audio data checksum error on the BADDATA input, U7000.138. USBINT\ is used to signal other errors. It is present on pin U7000.127.The Power Amplifier Clip Detect output are monitored by the signals CCLIP\ and BSCLIP\ signals on U7000.122 and 126 respectively. The temperature of the DSP assembly is monitored by the thermistors RT6206 and RT6307. RT6206 is located between power FET Q10 and rectifier D10, while RT6307 is located near rectifiers D11 and D12. The thermistors are of the positive temperature coefficient type (PTC) with a nominal resistance of 470 Ohms at 25oC. The resistance of these components rapidly increases when the temperature is near 105oC. The increase in resistance will increase the base-emitter voltage on the transistors Q6202 and Q6203 to the point that the transistors will switch to an on state, driving the DSP inputs U7000.119 and U7000.120 low. When either of these inputs is low, the DSP will reduce the audio output level by 0.05dB/second for up to 120 seconds. The maximum attenuation is 6dB. When both U7000.119 and U7000.120 are high, the attenuation will be reduced at the same rate until full audio output is again achieved.

Audio Path (continued)



CODEC

The Codec, U4000, is an AKM4626A. It features the ability to be either hardwired or serial interface configurable. For this application, it is configured by hardwiring the pins.

Stand-by Operation

DSPRESET\ is used to power down some of the internal functions of the CODEC in order to conserve power during stand-by operation. The CODEC is active at all other times

CODEC Audio Inputs and Outputs

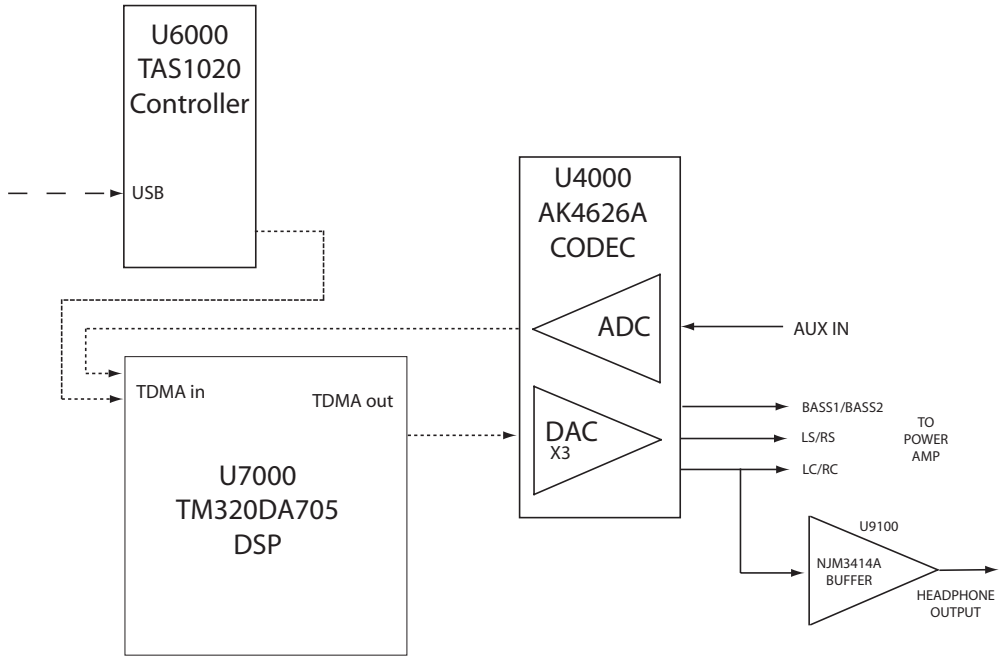
The DSP receives warning of a USB audio data checksum error on the BADDATA input, U7000.138. All other connections to the USB controller and DSP are to implement the TDM audio path.

Six channels of audio output are provided by the CODEC. These six outputs are filtered to remove out-of-band noise and attenuated 7.5dB to reduce the overall gain of the system and AC coupled to the six power amplifiers in IC's U150, U250, and U350. The outputs are single-ended biased to approximately 2.5 volts. The maximum amplitude for a full-scale digital input signal is approximately 1 volt rms. Of the six channels output by the CODEC, only five are wired to the Amplifiers. The DAC_BASS1 channel (U4000.23) is used to drive both bass amplifiers. DAC_LC (U4000.27) and DAC_RC (U4000.28) are also used to drive the headphone amplifiers (U1000).

Aux Audio Input

The AUX stereo input from the control module is attenuated by -4.3dB. This prevents a 2.0Vrms sine wave input signal from clipping the ADC input, whose max input is 1.0 to 1.1 volts rms. The converted stereo signal is transmitted to the DSP over the TDM path described in the next section.

Audio Path (continued)



Companion 5 Audio Path
Signal Routing and Clocking

ANALOG STEREO

USB

TDMA, 8 slot: U6000 Provides Clock, Frame Sync

TDM Configuration

As mentioned section 2, the USB controller generates the two clocks required for transmitting the audio stream via Time-Division Multiplex serial transmission. This is a scheme where all data between two points can be transmitted over one data line. In Companion 5, separate data lines are used for different paths.

The frame sync, FCLK, is generated by the USB controller (U6000.35). This signal is high for the first bit (MSB) of the first audio sample transmitted in each frame. The frame rate is set at 48kHz. Each of up to six audio samples is transmitted in sequence followed by two null samples. Each audio sample is left-justified in a field of 32 bits. The eight total samples of 32 bits require a bit clock of 256 times the FCLK or 12.288MHz. This clock, BCLK, is generated on pin U6000.37.

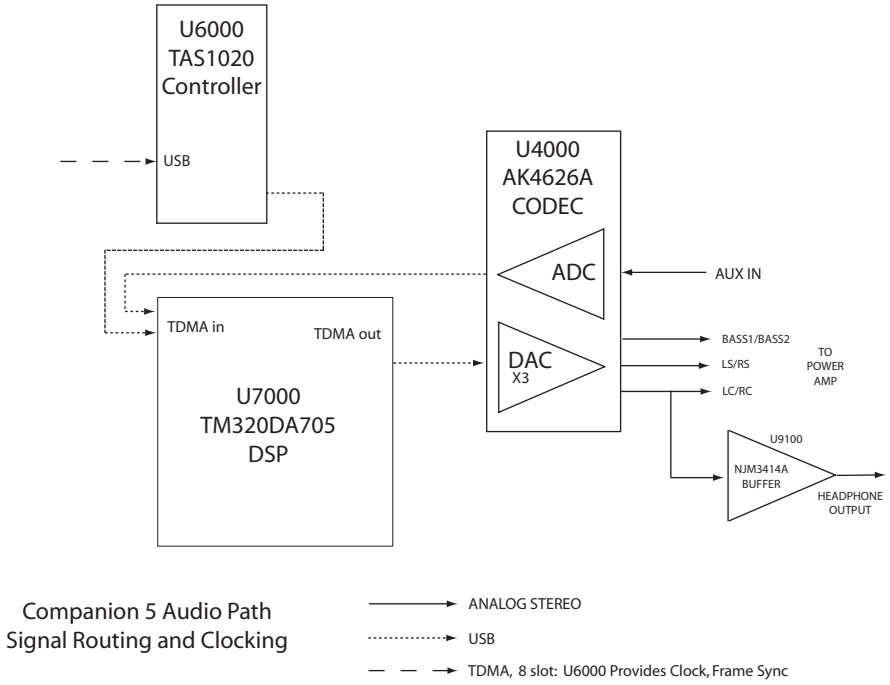
AUX Audio Input

The AUX stereo input from the control module is continuously converted and transmitted to the DSP via the TDM data path, AD_DATA (U4000.9).

Slot Assignments for data from the Codec to the DSP are:

Time Slot	Audio Data
1	Left Aux
2	Right Aux
3	Not Used
4	Not Used
5	Not Used
6	Not Used
7	Not Used
8	Not Used

Audio Path (continued)



USB Audio Input

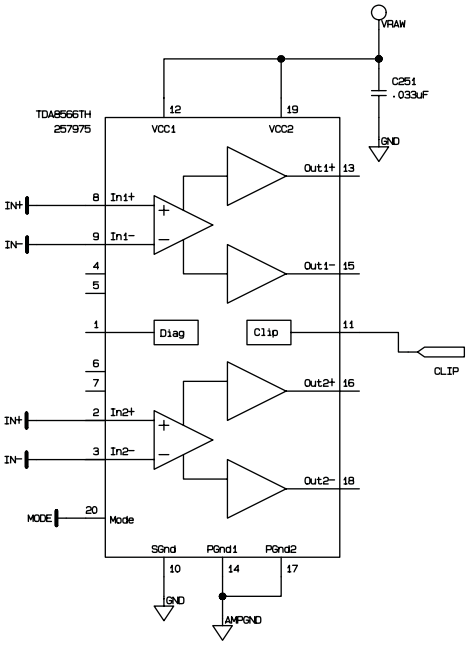
Audio information from the Personal Computer can contain anywhere from two to six channels of information. This data is transferred from the USB controller to the DSP on the TDM data line connected to U6000.38 (unnamed on the schematic).
Slot Assignments for data from the USB Controller to the DSP are:

Time Slot	Audio Data
1	Left
2	Right
3	Center
4	LFE
5	Left Surround
6	Right Surround
7	Not Used
8	Not Used

DSP audio output

Audio information is transmitted to the CODEC from the DSP on TDM data line DA_DATA1 (U7000.134).
Slot assignments for Audio data from the DSP to the Codec are:

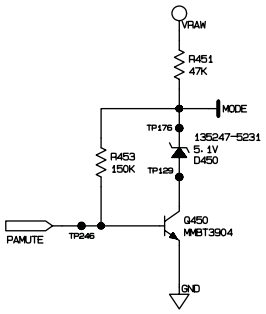
Time Slot	Audio Data	Muted
1	Left Channel (Inner)	Left Headphone
2	Right Channel (Inner)	Right Headphone
3	Left Surround (Outer)	Don't Care
4	Right Surround (Outer)	Don't Care
5	Bass	Don't Care
6	Bass	Don't Care
7	Don't Care	Don't Care
8	Don't Care	Don't Care



Power Amplifiers

The Phillips TDA8566 power amplifiers (U150, U250, U350) provide 26dB voltage gain and the capability to drive speakers with 2 to 4 Ohm DCR. The Equalization for the system requires the amplifiers to drive to approximately 9.5 volts peak. Thus a 450 millivolts peak input is sufficient for the system to generate the peak audio power required.

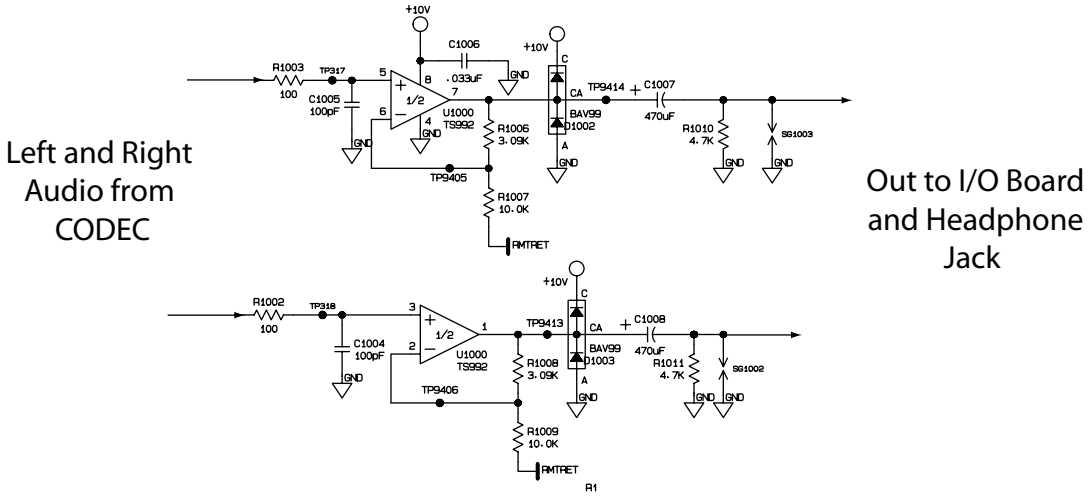
The power amplifiers each have an open collector output from their clip detection circuitry that is active whenever either of the output transistors are saturated. The DSP monitors the status of clip detect for U150.11 via the CCLIP\ signal. U150 drives the inner (center) transducers of the left and right speaker arrays. U250.11 and U350.11 are both connected wire-or to the DSP via BSCLIP\. U250 drives the “B” coil of the bass transducer and the outer (surround) transducer of the right array. U350 drives the “A” coil of the bass transducer and the outer transducer of the left array.



Mode

The MODE input on pin 20 of the devices mutes the power amplifiers when the potential at the pin is between 3.3 and 6.4 volts. When muted the power amplifiers remain biased and the outputs active. The power amplifiers are active when the MODE input is above 8.5 volts. If the MODE potential is below 2 volts the amplifiers will be placed in stand-by. In this condition the internal bias for the amplifiers is turned off and the outputs are not active. Companion 5 does not use this state. During system stand-by, the Vraw power supply is turned off. Transistor Q450, resistors, R451 and R453, and Zener D450 convert the MUTE signal from the USB controller to the proper potential for MODE. When MUTE is high, the level at MODE should be 4.5-6.5 volts

Headphone Amplifiers



Headphone Amplifiers

The amplifiers, U1000, are configured to provide 2.3 dB non-inverting voltage gain in order to drive the headphones. The headphone amplifiers are not capable of being muted. The control module must provide a mute signal any time the headphones are plugged in. This causes the system to mute the speakers and ramp in the headphone (flat) EQ required. The outputs of the amplifiers are biased to 3.25 volts due to the 2.3dB gain and the 2.5 volt bias of the CODEC outputs. The worst case output voltage swing from the codec is 1.6 volts. Thus with the gain of the amplifier circuit will cause the worst case output voltage from the headphone amplifiers to from 1.15 to 5.35 volts, or 4.2 volts peak-to-peak.

The bias potential present at the output of the headphone amplifiers is removed from the headphone signals by C1008 and C1008. The signals at the cathodes of these capacitors will be balanced around the GND reference.

The signal RMTRET present at both the AUX input components and the headphone amplifier circuits is a dedicated ground trace to the remote control module that is terminated to GND near the codec. This prevents noise due to power supply currents circulating in GND from coupling to either the AUX inputs or the headphone

Block Diagram