LXE1710/1711 AUDIOMAX EVALUATION KIT USER'S GUIDE

Microsemi
INTEGRATED PRODUCTS

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Microsemi
Integrated Products
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INTRODUCING LX1710/1711 AUDIOMAX

Thank you for your interest in the latest generation of AudioMAX products. The LXE1710/1711 evaluation board is a fully functional mono amplifier designed to demonstrate the "new and improved" Switching Class-D Power Amplifier IC from Linfinity Microsemi. The LX1710/1711 is a completely new controller design with superior performance over the LX1720 stereo controller IC. Key improvements include better SNR, lower noise floor, and reduced THD therefore resulting in a much "quieter" and "cleaner" sounding amplifier.

The evaluation board has been configured with easy-to-use terminal block connections for power supply/battery hook up and speaker connections. An RCA jack or separate audio +/- pins allow a quick interface to your audio source. Jumpers are also provided to enable/disable the amplifier (Sleep control) and to turn off the audio input (Mute control). With minimal setup, the user can be listening to the amplifier in a matter of a few minutes.

Both the LX1710 and LX1711 operate from a single supply voltage. The LXE1710 evaluation board can accommodate a supply voltage from 7V to 15V which produces 25W into 4Ω and greater than 40W into 2Ω. The LX1711 can handle a higher supply voltage (7V to 25V) and provides greater than 50W continuous output power into 4Ω. The evaluation amplifier board has been designed for a 4Ω load. The output filter can be easily modified to change frequency response for other load optimization.

For Information on circuit analysis, design, tradeoffs, and component selection, please see Application Note AN-16 "AudioMAX™ design Resource"

Thank you again for your interest in the new "quieter", high efficiency Class-D Audio Amplifier from Linfinity Microsemi. Please let us know what you think and stay tuned for future product releases to our AudioMAX family of products.

Regards,

Microsemi
Linfinity Division
http://www.microsemi.com
(714) 898-8121

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Part Number	Product	Description
LX1710CDB	AudioMAX High Fidelity Controller IC	V_{DD} = 7V to 15V, Switching Class-D Mono Power Amplifier IC, 28-Pin SSOP Package.
LX1711CDB	AudioMAX High Power Controller IC	V_{DD} = 7V to 25V, Switching Class-D Mono Power Amplifier IC, 28-Pin SSOP Package.
LXE1710	LX1710 AudioMAX Evaluation Board	Fully Operational Mono Audio Amplifier. 25W, 4Ω
LXE1711	LX1711 AudioMAX Evaluation Board	Fully Operational Mono Audio Amplifier. 50W, 4Ω

LX1710/1711 AUDIOMAX EVALUATION BOARD FEATURES AND CIRCUIT DESCRIPTION

- Fully Assembled Mono Evaluation Board with Class-D Controller IC
- Improved SNR and Noise Floor Performance
- Output Power of 25W typical (LX1710, 15V_{DD}, 4Ω, 1% THD+N)
- Output Power of 50W typical (LX1711, 25V_{DD}, 4Ω, 1% THD+N)
- Supports Full Audio Bandwidth
- Optimized to Drive 4Ω Speaker Load
- Terminal Block Connectors for Supply Voltage and Speaker Connection
- RCA Plug for Audio Input Signal

The AudioMAX Evaluation Amplifier Board allows the user to quickly connect and evaluate the LX1710/1711 Switching Class-D Mono Controller IC. Easy-to-connect terminal blocks and an RCA plug are provided for interfacing to Power, Speaker, and Audio Input connections. The single stage output filter has been configured to drive a 4Ω load and support full audio bandwidth amplification (See Audio Application Note for LC filter design component selection, calculations, and suggested inductor and capacitor values for other loads). The Evaluation Board operates from a single supply voltage.

The Class-D Amplifier Controller IC requires a minimal number of external components to create a complete amplifier solution. See Evaluation Board Schematic and Bill of Materials for circuit specifics. A Class-D Amplifier is a "switching" amplifier that converts a low-level, analog audio input signal into a high power, pulse-width modulated (PWM) output. The switching frequency (430kHz typical but can be adjusted) is much higher than the audio bandwidth (20Hz to 20kHz), and is easily filtered out with a simple LC filter. The support circuitry can be generally grouped into three areas (input circuit, output power stage, and output filter).

INPUT COMPENSATION

The first group is the compensation network and control setting components. These resistors and capacitors set up the controller operating frequency, response characteristics, and comparator ramp fundamental to Class-D operation.

OUTPUT STAGE

The next section is the output stage. The controller IC generates a PWM output by controlling external FETs connected in a full bridge configuration. The full bridge configuration is connected between the single supply voltage (PVDD) and ground (PGND) with the output of the bridge driving the LC filter stage. Because the FETs are either fully "on" or fully "off", Class-D topology is extremely efficient (up to 85% typical), circuit power dissipation is minimal, and maximum power is delivered to the speaker. The bridge output also drives the RC low pass filter, which provides the feedback for the control loop through the FBK+ and FBK- inputs.

FILTER STAGE

The single stage, second order LC filter is used to remove the switching frequency. The frequency response and corner frequency can be easily adjusted for optimization of various loads. The LC evaluation board component values have been chosen for a 4Ω load. See section on LC filter design for component selection.

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QUICK START GUIDE

The LXE1710/1711 Evaluation Board is a fully functional, Class-D Amplifier. Connection to a single supply voltage (VDD from either a battery or power supply), speakers, and your audio source is all that is required to begin evaluating the amplifier and listening to music. The following outlines the necessary connections and control jumpers.

1) Verify contents of Evaluation Kit: The easy-to-use amplifier is all contained on a single board. Visually inspect to see if the board or any components were damaged during shipping. All components are located on the top side of the PCB except for the decoupling capacitor, C17. A copy of the LX1710/1711 Datasheet can be downloaded from the Microsemi.com website.

2) Power and Ground Connections: The voltage supply and ground connections are made through terminal block TB1. Connect your "+" (+7V to +15V for the LXE1710 or +7V to +25V for the LXE1711) power supply or battery to the +V input of TB1. Connect your supply or battery ground to the GND input of TB1. Please ensure the correct positive and ground connections are made before turning on the power supply.

3) Speaker Connection: The amplifier is designed to drive a single 4Ω speaker. Connect speaker "+" and "-" to the +OUT and –OUT input of terminal block TB2 respectively. The amplifier can be used to drive other speaker loads but frequency response may not be optimal. See LC filter design section for recommended inductor and capacitor modifications.

4) Audio Input Connection: Connect your audio source to the RCA Jack CN1, Audio In. For other type interfaces, the audio input signal can also be connected to the amplifier board using the J3 (In- and In+) location. Strip Line Plugs can be inserted into J3 for connectivity.

5) Jumper Selection Controls: The "on/off" or enable to the module is controlled with the SLEEP/ signal. Jumper J1 connects the SLEEP/ to "on" or " off". SLEEP/ is an active Low control. Jumper J2 connects the MUTE control which enables/disables the audio input to the amplifier. MUTE is an active High signal. See table below.

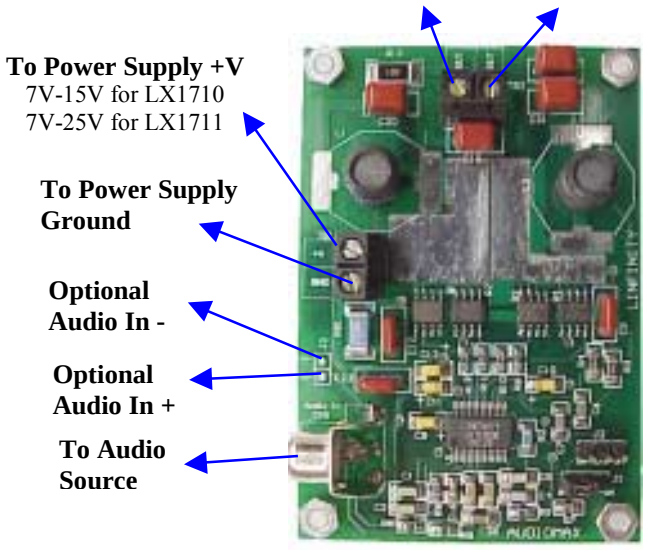
6) Power Source: If a power supply is being used, make sure it is set to the correct voltage level and turn the power supply on.

7) Audio Source: Make sure the audio source signal is set to a minimum level. Start or "play" audio source and adjust source volume to desired level.

8) Listen to AudioMAX: If the amplifier is not operating properly, verify preceding steps or contact Linfinity for technical assistance (714) 898-8121.

	Jumper toward OFF	Jumper toward ON	Jumper floating
J1 Jumper: SLEEP/	Amplifier enabled (SLEEP/ is OFF)	Amplifier disabled (SLEEP/ is ON)	Amplifier disabled (SLEEP/ is ON)
J2 Jumper: MUTE	Audio Input enabled (MUTE is OFF)	Audio Input disabled (MUTE is ON)	Audio Input enabled (MUTE is OFF)

Table 1: Jumper Settings



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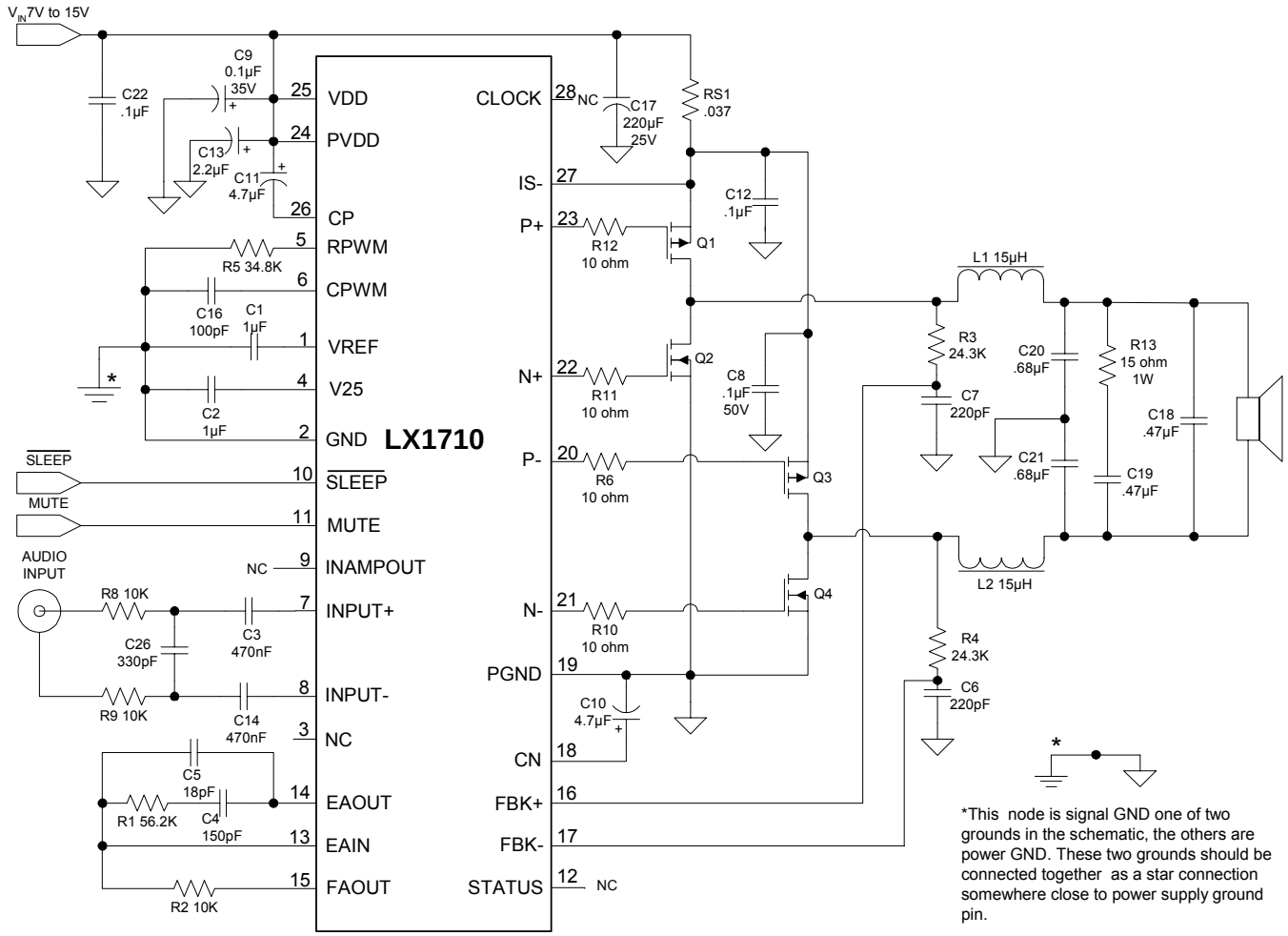
SCHEMATIC



LXE1710 – Evaluation Board Schematic

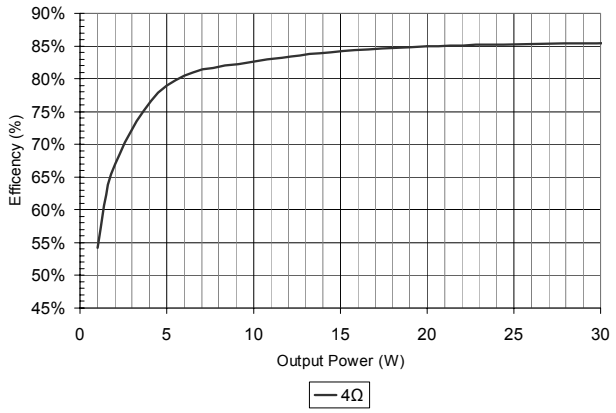
ELECTRICAL CHARACTERISTICS

Unless otherwise specified, the following specifications apply over the operating ambient temperature 0°C<TA<70°C. For test circuit, see LXE1710 Evaluation Board Schematic diagram.

PARAMETER		SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX	UNITS
Supply Voltage	LX1710	VDD		7		15	V
	LX1711	VDD		7		25	V
Supply Current		IDD	V_{IN}=15V, P_O=38W, R_L=2Ω, THD+N=1%		3		A
Quiescent Current		IQ	V_{IN}=15V, No Input		43		mA
Output Power		PO	V_{IN}=15V, R_L=8Ω, THD+N=1%, 10Hz to 22kHz		14		W
			V_{IN}=15V, R_L=4Ω, THD+N=1%, 10Hz to 22kHz		25		W
			V_{IN}=15V, R_L=2Ω, THD+N=1%, 10Hz to 22kHz		40		W
			V_{IN}=25V, R_L=4Ω, THD+N=1%, 10Hz to 22kHz		50		w
Efficiency			V_{IN}=15V, f_{IN}=1kHz, P_O=10W		82		%
			V_{IN}=15V, f_{IN}=1kHz, P_O=20W		85		%
Total Harmonic Distortion Plus Noise		THD+N	f_{IN}=1kHz, P_O=1W		0.05		%
			f_{IN}=20Hz to 20kHz, P_O=1W			0.3	%
Signal-To-Noise Ratio		SNR			81		dBr
Power Supply Rejection Ratio		PSRR	V_{IN}=15V, V_{RIPPLE}=1V_{RMS}, 10Hz to 10kHz		-70		dB

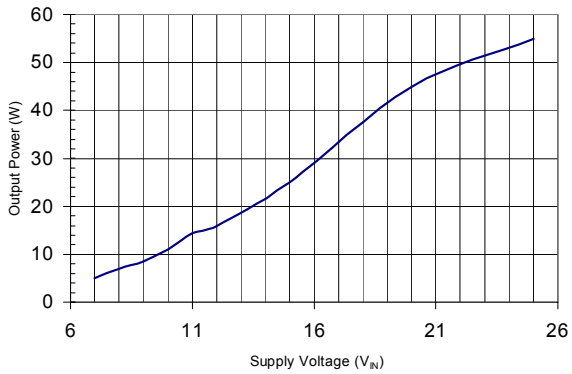
PERFORMANCE GRAPHS

EFFICIENCY VS. OUTPUT POWER



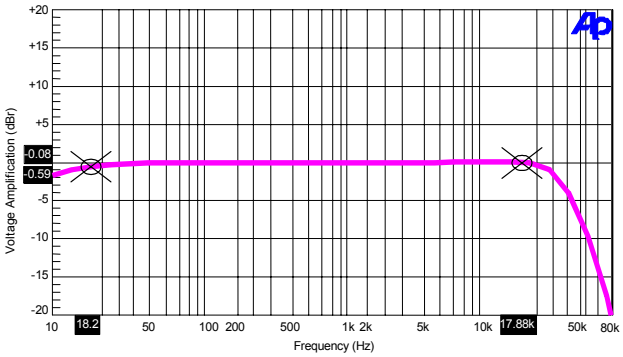
V_{IN} = 15V

OUTPUT POWER VS. SUPPLY VOLTAGE



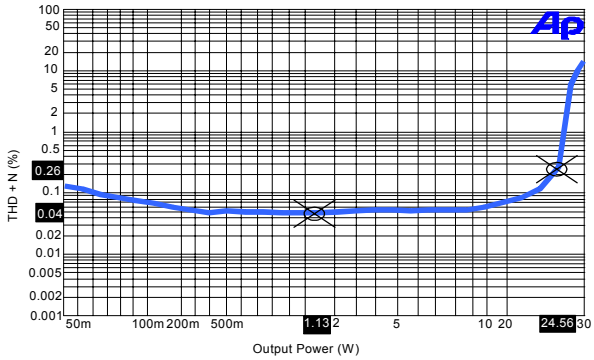
f_{IN}=1kHz
R_L=4Ω
THD+N=1%

FREQUENCY RESPONSE



V_{IN}=15V
R_L=4Ω
R_O=1W_{RMS}

THD+N VS. OUTPUT POWER



V_{IN}=15V
f_{IN}=1kHz
R_L=4Ω

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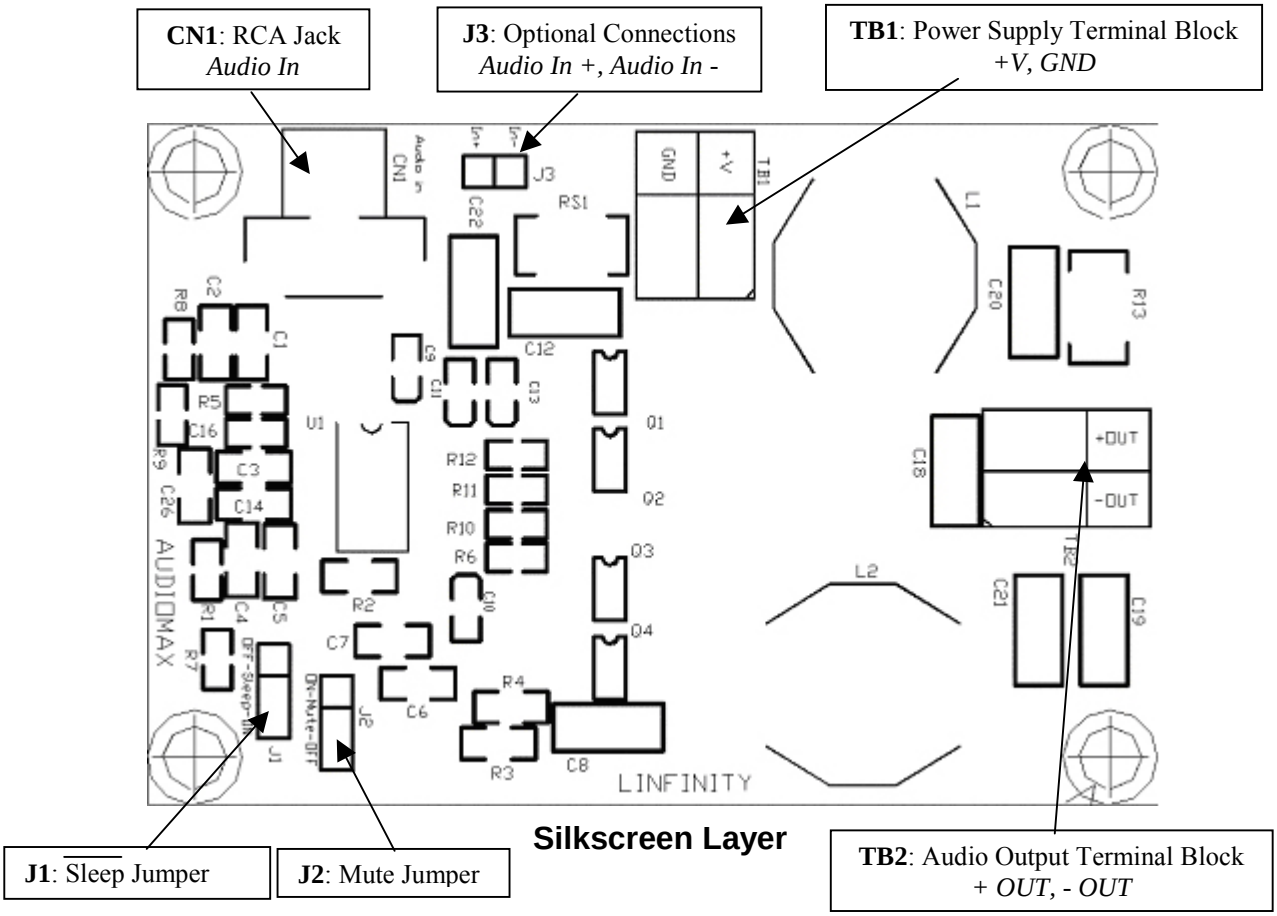
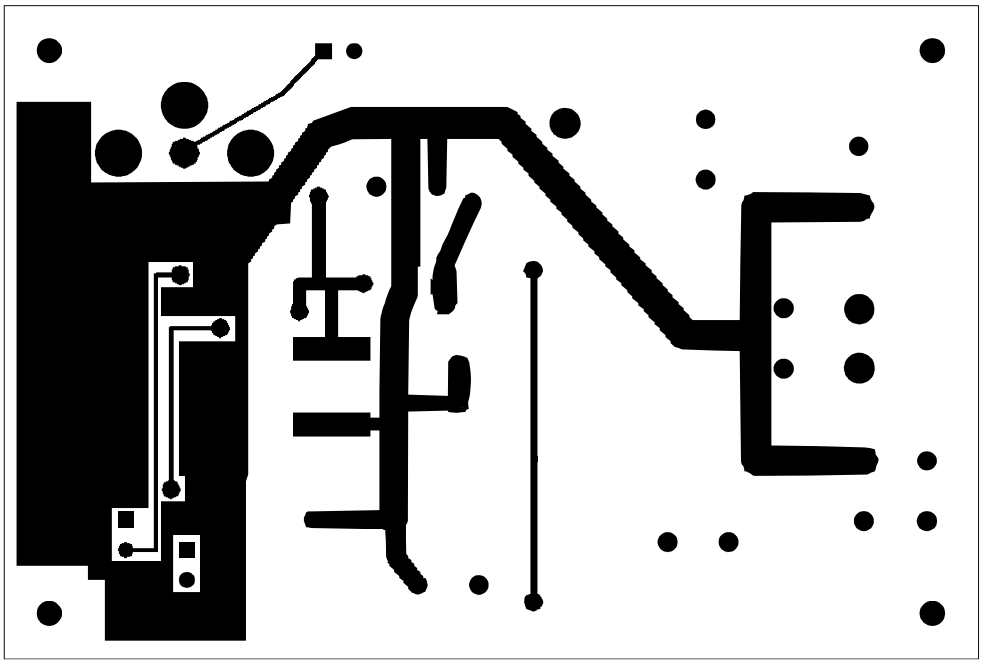
PRINTED CIRCUIT BOARD LAYOUT

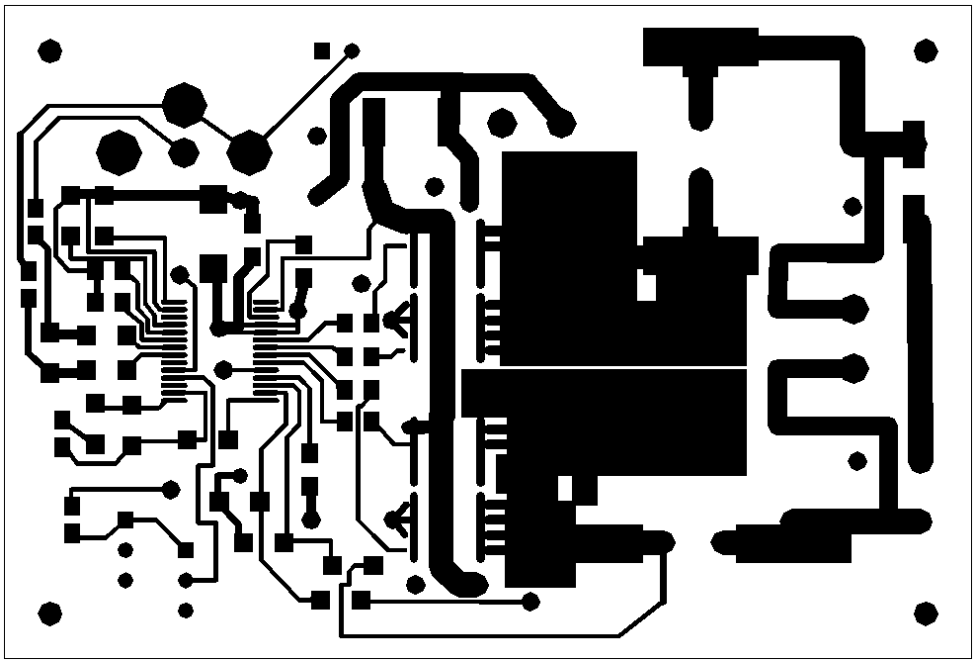


Silkscreen Layer

PRINTED CIRCUIT BOARD



Bottom Layer



Top Layer

BILL OF MATERIALS

MISCELLANEOUS COMPONENTS

Line Item	Part Description	Manufacturer & Part #	Case	Reference Designators	Qty
1	Controller	Linfinity LX1710 / LX1711	SSOP 28	U1	1
2	N-Channel MOSFET	Fairchild FDS6612A	SO-8	Q2, Q4	2
3	P-Channel MOSFET	Fairchild FDS4953	SO-8	Q1, Q3	2
4	Printed Circuit Board	Linfinity SGE2758		REV.X	1
5	Inductor, 15uH	ISI RL622-150K (LXE1710)	TH	L1, L2	2
		Coilcraft DO5022-153HC (LXE1711)	SMT		
6	Phono Jacks, 90° Nickel Plated, Wht	Mouser 161-4214	TH	CN1	1
7	Strip Line Plugs, Straight, Single Row .100"	CA CA-S36-24B-44	TH	J1, J2	2
8	Shorting Jumpers, Open Top, Black	Mouser 151-8030	TH	J1	1
9	Terminal Block 2 pos 5mm	Block Master 301-021-1000	TH	TB1, TB2	2

CAPACITORS

Line Item	Part Description	Part Description	Case	Reference Designators	Qty
1	Capacitor, COG, 18pF, 50V, 5%	Novacap 1206N180J500NT AVX 12065C180JAT2A	1206	C5	1
2	Capacitor, COG, 150pF, 50V, 5%	Novacap 1206N151J500NT AVX 12065C151JAT2A	1206	C4	1
3	Capacitor, COG, 220pF, 50V, 5%	AVX 12065C221JAT2A	1206	C6, C7	2
4	Capacitor, X7R, 330pF, 50V, 10%	Panasonic ECU-V1H331KBM	1206	C26	1
5	Capacitor, X7R, .47uF, 16V, 20%	Novacap 1206B474M160NT AVX 1206YC474MAT2A	1206	C3, C14	2
6	Capacitor, X7R, 1uF, 50V, 10%	Novacap 1206B105K500NT AVX 12065C105KAT2A	1206	C1, C2	2
7	Capacitor, COG, 100pF, 50V, 5%	Novacap 0805N101J500NT AVX 08055C101JAT2A	0805	C16	1
8	Capacitor Tant 0.1uF 35V 20%	AVX TAJA104M035R	3216	C9	1
9	Capacitor Tant 2.2uF 25V 20%	Kemet T491A225M025AS	3216	C13	1
10	Capacitor, Tant, 4.7uF, 16V, 20%	Kemet T491A475M016AS AVX TAJA475M016R	3216	C10, C11	2
11	Capacitor Stacked MF 0.1uF 50V 5%	Panasonic ECQ-V1H104JL	TH	C8, C12, C22	3
12	Capacitor Stacked MF 0.47uF 50V 5%	Panasonic ECQ-V1H474JL	TH	C18, C19	2
13	Capacitor Stacked MF 0.68uF 50V 5%	Panasonic ECQ-V1H684JL	TH	C20, C21	2
14	Capacitor, Elect 220uF, 25V, 20%	Elna RV-25V221MH10-R	NT	C17	1

RESISTORS

Line Item	Part Description	Part Description	Case	Reference Designators	Qty
1	Resistor, 10K, 5%, 1/4W	ASJ CR32J103T	1206	R2	1
2	Resistor, 24.3K, 1%, 1/4W	ASJ CR32F2432T	1206	R3, R4	2
3	Resistor, 10 Ohm, 5%, 1/8W	ASJ CR J100T	0805	R6, R10, R11, R12	4
4	Resistor, 10K, 5%, 1/8W	ASJ CR21J103T	0805	R8, R9	2
5	Resistor, 34.8K, 1%, 1/8W	ASJ CR21F3482T	0805	R5	1
6	Resistor,20K, 5%, 1/8W	ASJ CR J203T	0805	R7	1
7	Resistor, 56.2K, 1%, 1/8W	ASJ CR21F5622T	0805	R1	1
8	Resistor, 15 Ohm 5% 1W	KOA RM73B3A150J Rohm MCR100JZHJ150	2512	R13	1
9	Resistor, Low Value Flat .0374	IRC LR2512R-01-R037-F	2512	RS1	1