EB-TA2021B

2x25W Class-T Digital Audio Amplifier Evaluation Board using Digital Power Processing™ Technology

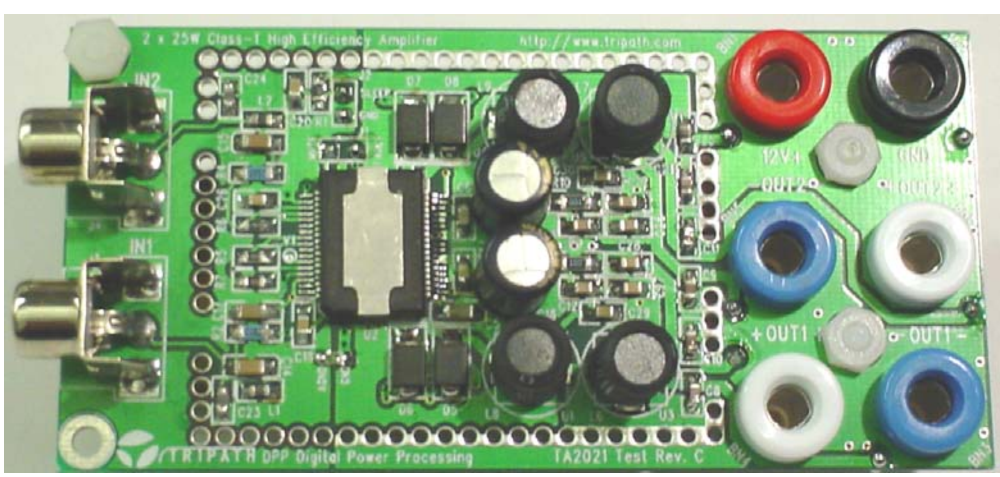
Technical Information | **Revision 5.2 October 2005**

General Description

The EB-TA2021B Rev.D evaluation board is based on the TA2021B digital audio power amplifier from Tripath Technology. The board is designed to provide a simple and straightforward environment for the evaluation of the Tripath TA2021B. The board can be connected to a 14.2V supply using cables with standard banana connectors. Audio inputs are via standard RCA jacks. The TA2021B provides amplification for two channels of audio. Signal outputs are on four banana connectors to which any 4Ω or 8Ω passive speakers may be connected.

Features

- Class-T architecture
- Proprietary Digital Power Processing™ Technology
- Requires single power source
- Output Power @ V_{DD} = 14.2V
  - 23.5W per channel (4Ω, 10% THD+N)
  - 15.5W per channel (4Ω, 0.1%, THD+N)
- Easy engineering evaluation platform for Tripath Technology's TA2021B product
- "Audiophile performance" typically:
  - 0.05% THD+N (13W, 4Ω)
  - 0.1% IHF-IM (1W, 4Ω)
- Efficiency - 88% (V_{DD} = 14.2V, 13.5W per channel, R_L = 8Ω)
- MUTE and SLEEP inputs
- Turn-on & turn-off pop suppression
- Intelligent short-circuit protection
- Intelligent over-temperature protection
- Connects to any passive 4/8Ω speakers
- Takes standard audio line output from any sound system
- Cost-effective 2-layer PCB design
- 36-pin Power SOP package



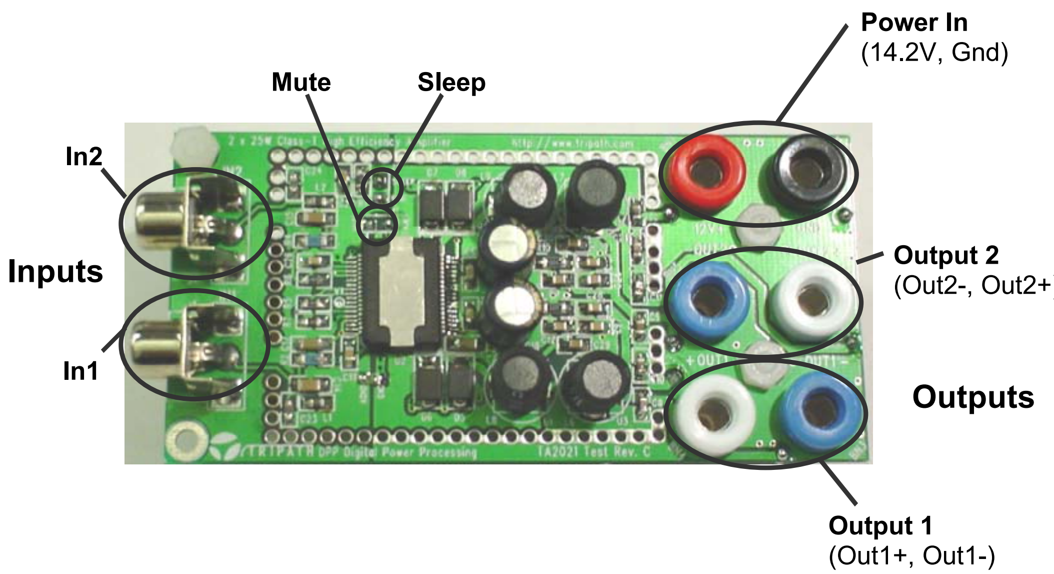
TA2021B Evaluation Board

Introduction

The EB-TA2021B Rev.D provides the designer a simple platform to evaluate the performance and functionality of the TA2021B 2x25W amplifier IC from Tripath Technology. The EB-TA2021B Rev.D is very simple to operate and requires only the following to evaluate:

- Stereo signal source
- 14.2V power supply (*not to exceed 14.6V*)
- Two loads (*4-Ohm minimum*)

For more information on the TA2021B, please refer to the TA2021B datasheet (www.tripath.com).



EB-TA2021B Rev.D Board

Connection and Operation

Figure 1 shows the connections required for proper operation of the EB-TA2021B Rev.D.

Input Connection

Audio input to the board is provided via two RCA female connectors.

Connector Name	Channel
IN1	Channel 1 Input
IN2	Channel 2 Input

Power Connection

The TA2021B requires a 14.2V power supply (14.6V max) to operate.

Power to the board is provided via the red and black female banana connectors. The positive 14.2V from the power supply connects to the red banana connector labeled 12V+. The ground connection of power supply attaches to the black banana connector labeled GND.

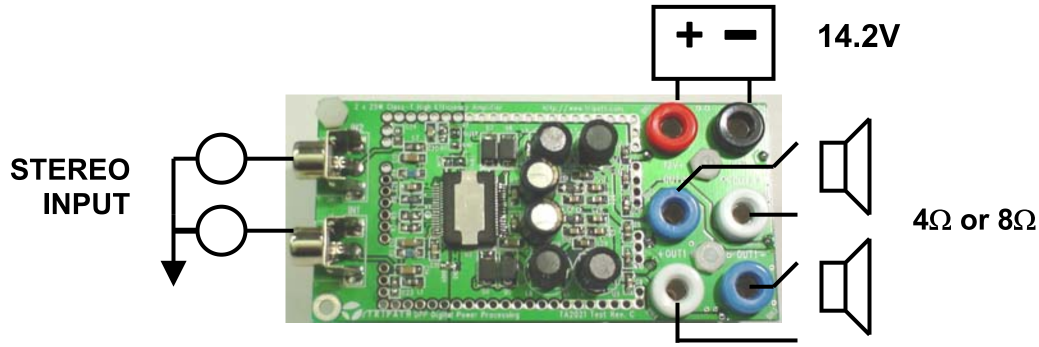


Figure 1: EB-TA2021B Rev.D Connections

Connector Label	Description	Color
12V+	Positive of the 14.2V Power supply	Red
GND	Negative (GND) of 14.2V Power Supply	Black

Warning: ***Do not exceed Maximum Operating Supply Voltage of 14.6V***

Output Connection

There are four female banana connectors on the evaluation board for speakers. Since the TA2021B has differential (bridged) outputs, it requires two wires per channel to connect each speaker. To ensure proper speaker polarity please follow the evaluation boards output connector color-coding.

Connector Label	Description	Color
Out1+	Positive output of Channel 1	White
Out1-	Negative output of Channel 1	Blue
Out2+	Positive output of Channel 2	White
Out2-	Negative output of Channel 2	Blue

Jumper Settings

There are two jumpers on the EB-TA2021B Rev.D board. Both of them should be connected (shorted) for normal operation. Jumper J1 connects the FAULT output to the MUTE pin, allowing the part to Mute itself when a Fault condition (over-current, etc.) is detected. Jumper J2 connects the SLEEP pin to GND, effectively disabling SLEEP for normal operation. If J2 is removed, the part will go into SLEEP mode.

Jumper	Purpose
J1	Connects FAULT to MUTE
J2	Connects SLEEP to GND

Gain Settings

The TA2021B amplifier gain can be adjusted by modifying external resister values. R2 and R5 are used to set the gain for Channel 1, while R4 and R6 set the gain for Channel 2.

The equation for the gain setting is:

$$A_V = 12 \cdot \left(\frac{R_f}{R_i}\right)$$

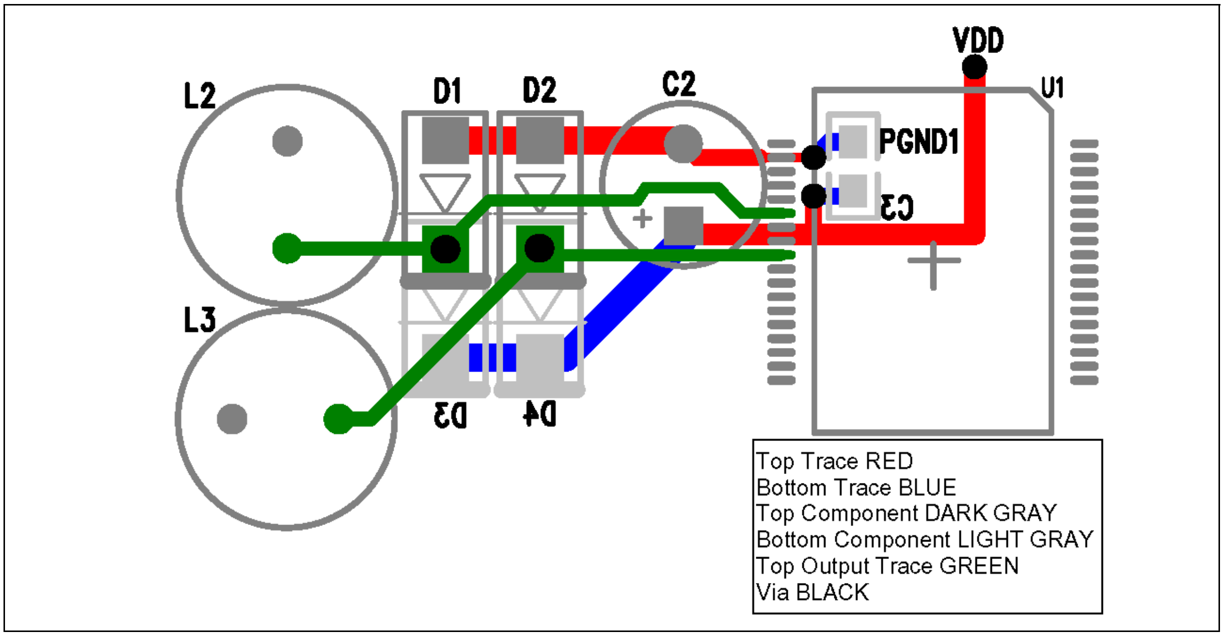
Where,

For channel 1: $A_{V\_Ch1} = 12 \cdot \left(\frac{R5}{R2}\right)$ For channel 2: $A_{V\_Ch2} = 12 \cdot \left(\frac{R6}{R4}\right)$

For a more detailed description, please refer to the TA2021B data sheet.

Output Stage layout Considerations and Component Selection Criteria

Proper PCB layout and component selection is a major step in designing a reliable TA2021B power amplifier. The supply pins require proper decoupling with correctly chosen components to achieve optimal reliability. The output pins need proper protection to keep the outputs from going below ground and above VDD.



The above layout shows ideal component placement and routing for channel 1 (the same design criteria applies to channel 2). This shows that C3, a 0.1uF surface mount 0805 capacitor, should be the first component placed and must decouple VDD1 (pins 29 and 30) directly to PGND1 (pin35). C2, a low ESR, electrolytic capacitor, should also decouple VDD1 directly to PGND1. Both C2 and C3 may decouple VDD1 to a ground plane, but it is critical that the return path to the PGND1 pin of the TA2021B, whether it is a ground plane or a trace, be a short and direct low impedance path. Effectively decoupling VDD will shunt any power supply trace length inductance.

The diodes and inductors shown are for channel 1's outputs. D1, D3, and L2 connect to the OUTP1 pin and D2, D4, and L3 connect to the OUTM1 pin of the TA2021B. Each output must have Schottky or Ultra Fast Recovery diodes placed near the TA2021B, preferably immediately after the decoupling capacitors and use short returns to PGND1. These low side diodes, D1 and D2, will prevent the outputs from going below ground. To be optimally effective they must have a short and direct return path to its proper ground pin (PGND1) of the TA2021B. This can be achieved with a ground plane or a trace. Additionally, each channel must use Schottky or Ultra Fast Recovery diodes with short returns to VDD if the supply voltage exceeds 13.5V. These high side diodes, D3 and D4, will prevent the outputs from going above VDD. To be optimally effective they must have a short and direct return path to its proper VDD pin (VDD1) of the TA2021B. This can be achieved with a ground plane or a trace.

The output inductors, L2 and L3, should be placed close to the TA2021B without compromising the locations of the closely placed supply decoupling capacitors and output diodes. The purpose of placing the output inductors close to the TA2021B output pins is to reduce the trace length of the switching outputs. This will aid in reducing radiated emissions.

Please see the TA2021B data sheet and specifically the External Component Description section on page 6 for more details on the above-mentioned components. The TA2021's Application/ Test Circuit refers to the low side diodes as D_O, The high side diodes as D_H, and both supply decoupling capacitors as C_{SW}.

Performing Measurements on the EB-TA2021B Rev.D

The TA2021B operates by generating a high frequency switching signal based on the audio input. This signal is sent through a low-pass filter that recovers an amplified version of the audio input. The frequency of the switching pattern is spread spectrum in nature and typically varies between 100kHz and 1MHz, which is well above the 20Hz – 20kHz audio band. The pattern itself does not alter or distort the audio input signal, but it does introduce some inaudible components.

The measurements of certain performance parameters, particularly noise related specifications such as THD+N, are significantly affected by the design of the low-pass filter used on the output as well as the bandwidth setting of the measurement instrument used. Unless the filter has a very sharp roll-off just beyond the audio band or the bandwidth of the measurement instrument is limited, some of the inaudible noise components introduced by the TA2021B amplifier switching pattern will degrade the measurement.

One feature of the TA2021B is that it does not require large multi-pole filters to achieve excellent performance in listening tests, usually a more critical factor than performance measurements. Though using a multi-pole filter may remove high-frequency noise and improve THD+N type measurements (when they are made with wide-bandwidth measuring equipment), these same filters degrade frequency response. The EB-TA2021B Rev.D Evaluation Board has a simple two-pole output filter with excellent performance in listening tests.

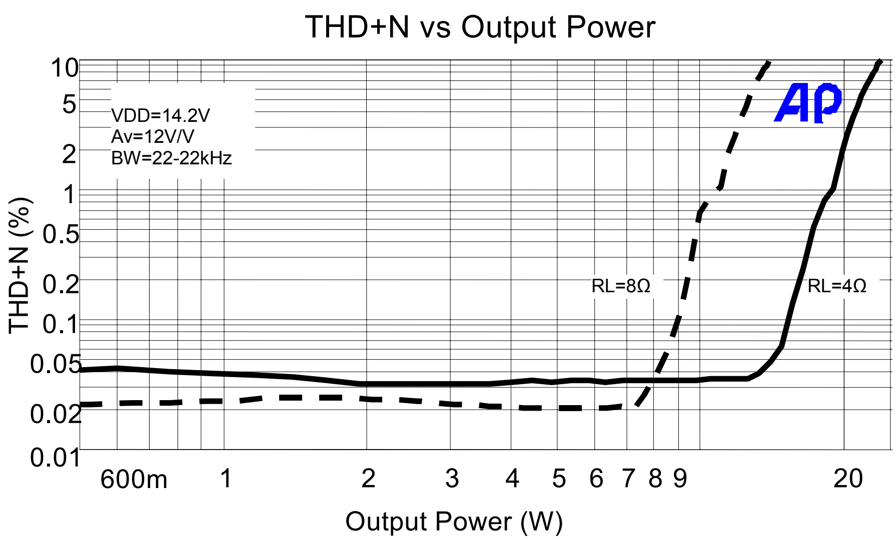
(See Application Note 4 for more information on bench testing with Tripath Class-T amplifiers)

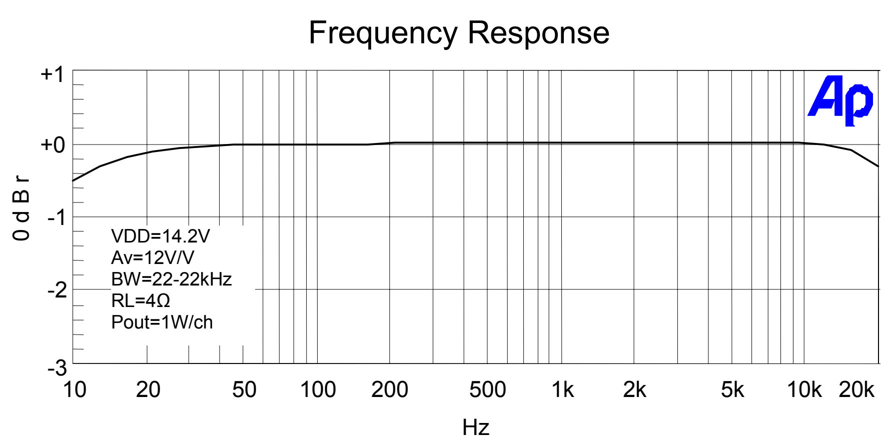
EMI and Shielding

The TA2021B evaluation board has perforated holes around the amplifier and associated circuitry so that an EMI shield can be soldered directly to the board. Due to the spread-spectrum nature of the Class-T amplifier (the energy is spread across a wider spectrum, instead of being concentrated at a single frequency), we have found that specific EMI shielding is typically not necessary for most applications where the amplifier board is mounted inside a chassis. However, a shield perimeter is still provided for use in more sensitive applications.

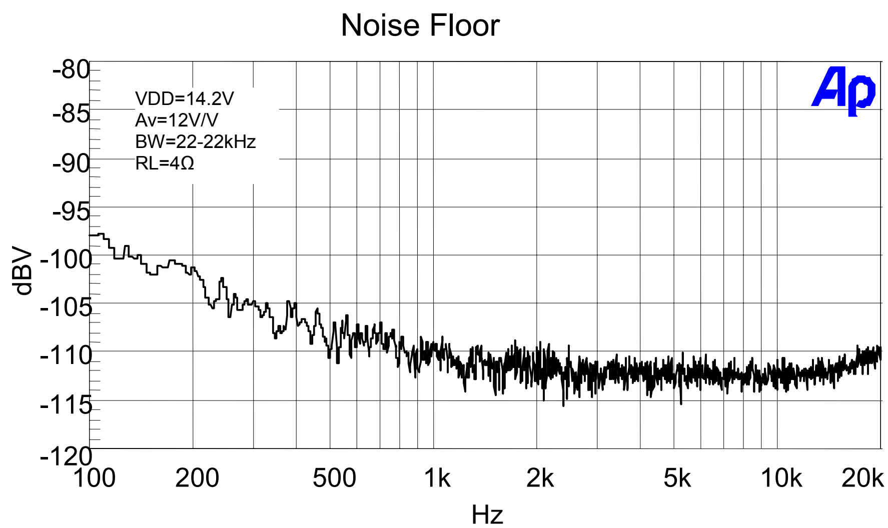
(See Application Note 11 and Note 17 for more information on EMI)

Characteristic Curves





Characteristic Curves (Continued)



CONTACT INFORMATION

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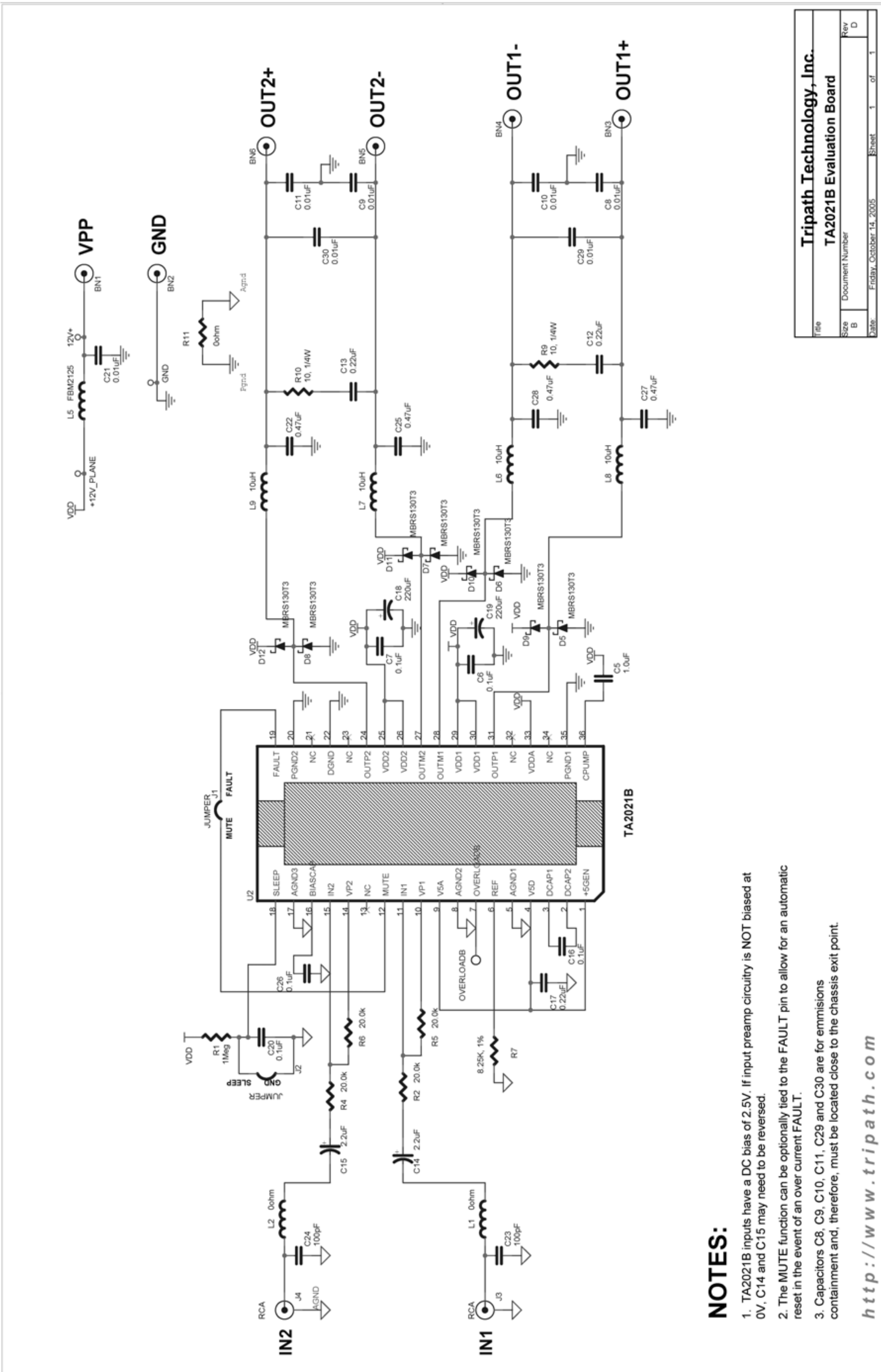
For more Sales Information, please visit us @ www.tripath.com/cont_s.htm
For more Technical Information, please visit us @ www.tripath.com/data.htm

Evaluation Board Schematic



Evaluation Board Bill of Materials

Revised: Thursday, October 13, 2005
Board Revision: D

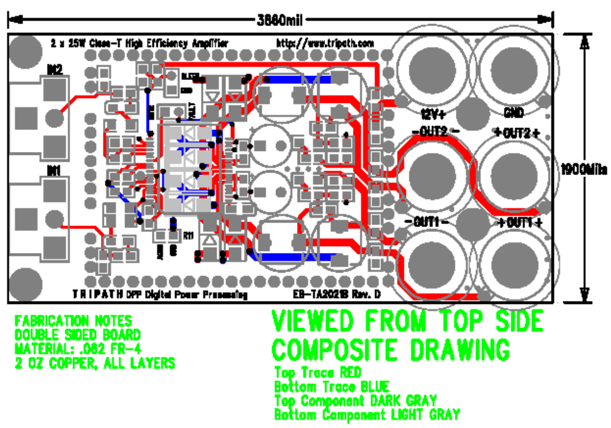
EB-TA2021B BOM with Volume Costing

Item	Quantity	Reference	Value	PCB Footprint	Rating	Tolerance/ Dielectric	Manufacturer	Manufacturer Part #	Source	Source Part #	unit price	min qty	Price Per Board
1	1	BN1	VPP	BANANA									$0.000
2	1	BN2	GND	BANANA									$0.000
3	1	BN3	OUT1+	BANANA									$0.000
4	1	BN4	OUT1-	BANANA									$0.000
5	1	BN5	OUT2-	BANANA									$0.000
6	1	BN6	OUT2+	BANANA									$0.000
7	1	C5	1.0uF	3216	>=16V	X7R	Murata	C1206C105K3RAC7800	Mouser	80-C1206C105K3R	$0.034	10k	$0.034
8	5	C6,C7,C16,C20,C26	0.1uF	805	>=16V	X7R	Murata	GRM219R71C104KA01D	Digikey	490-1683-2-ND	$0.010	24k	$0.050
9	7	C8,C9,C10,C11,C21,C29,C30	0.01uF	805	>=16V	X7R	AVX Corp.	08055C103KAT2A	Digikey	478-1383-2-ND	$0.013	24k	$0.091
10	2	C12,C13	0.22uF	805	>=16V	X7R	Epcos Inc.	B37941K9224K60	Digikey	495-1936-2-ND	$0.012	12k	$0.024
11	2	C15,C14	2.2uF	3216	>=10V	X5R	Murata	GRM319R61A225KA01D	Digikey	490-1815-2-ND	$0.040	24k	$0.080
12	1	C17	0.22uF	1206WS	>=16V	X7R	Epcos Inc.	B37941K9224K60	Digikey	495-1936-2-ND	$0.012	12k	$0.012
13	2	C18,C19	220uF	cape\150\300	>=16V	20%		EEU-FM1E221	Panasonic	EEU-FM1E221	$0.045	1K	$0.090
14	4	C22,C25,C27,C28	0.47uF	805	>=16V	X7R	Epcos Inc.	B37941K9474K60	Digikey	495-1938-2-ND	$0.021	12k	$0.084
15	2	C23,C24	100pF	805	>=10V	NPO	BC Components	VJ0805A101JXACW1BC	Digikey	BC1268TR-ND	$0.006	24k	$0.012
16	8	D5,D6,D7,D8,D9,D10,D11,D12	MBRS130T3	MBRS130T3	30V	1A	On Semi	MBRS130T3	Digikey	MBRS130T3OSTR-ND	$0.069	100k	$0.552
17	1	J1	MUTE FAULT	SIP-2P									$0.000
18	1	J2	GND SLEEP	SIP-2P									$0.000
19	1	J3	IN1	RCA									$0.000
20	1	J4	IN2	RCA									$0.000
21	3	L1,L2,R11	0ohm	805				ERJ-6GEY0R00V		P0.0ATR-ND			$0.000
22	1	L5	FBM2125	805	4A		Panasonic	EXC-ML20A390U	Digikey	P10191TR-ND	$0.080	24k	$0.080
23	4	L6,L7,L8,L9	10uH	IND200\400	2A	10%	Toko	822LY-100K (type 8RHB2)	Toko	822LY-100K (type 8RHB2)	$0.086	100k	$0.344
24	1	R1	1Meg	805			Yageo	9C08052A1004JLHFT	Digikey	311-1.0MATR-ND	$0.002	100k	$0.002
25	4	R2,R4,R5,R6	20.0k	805		1%	Yageo	RC0805FR-0720KL	Digikey	311-20.0KCRTR-ND	$0.003	100k	$0.012
26	1	R7	8.25K, 1%	805		1%	Yageo	RC0805FR-078K25L	Digikey	311-8.25KCRTR-ND	$0.003	100k	$0.003
27	2	R10,R9	10, 1/4W	1206	1/4W	5%	Yageo	RC1206JR-0710RL	Digikey	311-10ERTR-ND	$0.003	100k	$0.006
28	1	U2	TA2021B	CTI_6016_036_105C_112B_SLUGUP									
29	1	V1	OVERLOADB	VIA-1P									

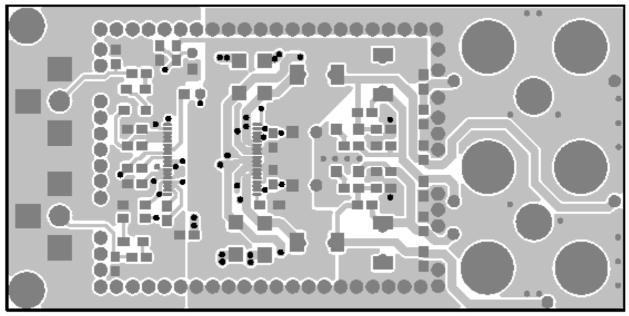
Alternate Low Pass Filter Inductors (L6, L7, L8, L9):

Manufacturer	Part Number	Type	Inductance	Rated DC Current	Notes	COST	MINIMUM QUANTITY	NOTES	CONTACT INFO.
Datatronic	PT21707	same	10uH	1.90Amax	unshielded bobbin inductor	$0.07	100k		Jamie Hopper- (951)-928-7700 x770 OR jamie_hopper@datatronics.com
Toko	822LY-100K	8RHT2	10uH	1.96Amax	unshielded bobbin inductor	$0.09	100k	negotiable	Bob Nau- (619)-656-8966 OR bnau@tokoam.com
Toko	822MY-100K	8RHB2	10uH	1.96Amax	unshielded bobbin inductor				
ISI	RL622-100K	RL622	10uH	3.00Amax	unshielded bobbin inductor				Debbie Hocker-(714)-999-9555 OR debbieh@inductorsupply.com
Toko	A7040HN-100M	8RDY	10uH	2.6Amax	shielded bobbin inductor				
Toko	B992AS-100M	DS86C	10uH	2.9Amax	shielded SMT inductor	$0.16	100k		

Evaluation Board Layout (Composite)

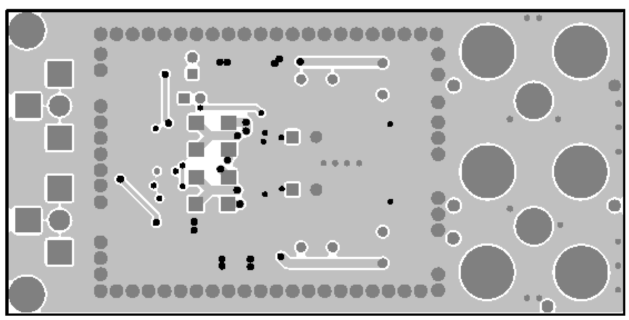


Evaluation Board Layout (Etch)



FABRICATION NOTES
DOUBLE SIDED BOARD
MATERIAL: .062 FR-4
2 OZ COPPER, ALL LAYERS

VIEWED FROM TOP SIDE
TOP SIDE ETCH



FABRICATION NOTES
DOUBLE SIDED BOARD
MATERIAL: .062 FR-4
2 OZ COPPER, ALL LAYERS

VIEWED FROM TOP SIDE
BOTTOM SIDE ETCH

Evaluation Board Layout (Silkscreen)