



## EB-TA2022

# CLASS-T DIGITAL AUDIO AMPLIFIER 2 CHANNEL TA2022 EVALUATION BOARD

Technical Information

Revision 1.0 – March 2002

### GENERAL DESCRIPTION

The EB-TA2022 Version 4.0 is a stereo 100W per channel audio amplifier designed to provide a simple and straightforward environment for the evaluation of the TA2022 amplifier. This evaluation board includes a circuit that will automatically trim any DC offset at the output and a relay. For additional documentation on the TA2022, see the TA2022 Data Sheet.

### APPLICATIONS

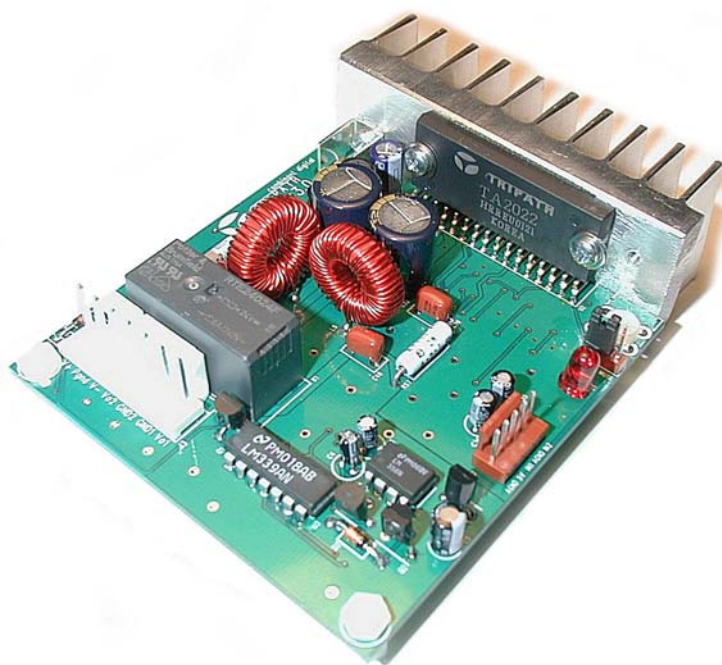
- Mini/Micro Component Systems
- Home Theater Receivers
- Car stereo head units & trunk amplifiers
- Powered DVD Systems

### BENEFITS

- More power per cubic inch for 100W per channel design
- Simplifies thermal management
- Signal Quality comparable to linear amplifiers
- Simple building block for multi-channel design

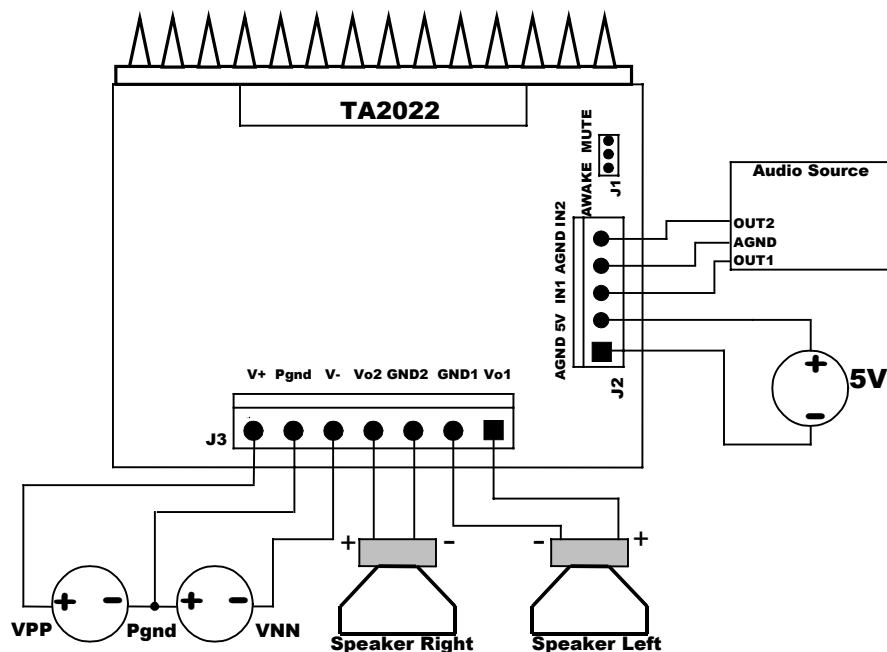
### FEATURES

- High Power: 100W @ 4Ω, 1.0% THD+N
- Low Noise Floor: 150uV A-weighted
- Low Distortion: .02% THD+N @ 75W, 4Ω
- High Efficiency: 92% for 8Ω loads  
87% for 4Ω loads
- Dynamic Range = 102dB
- Over-Current Protection
- Over and Under Voltage Protection
- Over Temperature Protection
- Single Ended Outputs



## OPERATING INSTRUCTIONS

### BOARD CONNECTION DIAGRAM



Three external power supplies are required to operate the EB-TA2022: VPP, VNN (referenced to Pgnd), and 5V (referenced to Agnd). The VPP and VNN form a split rail supply referenced to Pgnd. The 5V ground (Agnd) must be kept separate from the VPP and VNN ground (Pgnd). Agnd and Pgnd are joined at a common point on the EB-TA2022 near headers J2 and J3.

Minimum and Maximum supply voltages are +/-20V and +/-36V, respectively, depending on the load impedance. It is not recommended that the EB-TA2022 be operated above +/-31V when driving 4Ω loads, single ended, as the internal current limit circuit may activate, causing the amplifier to mute.

The VPP and VNN power supply connection, J3, is through a 7-Pin 0.156" spaced header. The female terminal housing for this header is Molex 09-50-8071. Please see TABLE 2 for header connections.

The 5V power supply connection, J2, is through a 5-Pin 0.100" spaced header. The female terminal housing for this header is Molex 22-01-2057. Please see TABLE 1 for header connections.

TABLE 1

| <b>J2 Connector Pin#</b> | <b>Connection</b> |
|--------------------------|-------------------|
| <b>Pin1</b>              | <b>Agnd</b>       |
| <b>Pin2</b>              | <b>5V</b>         |
| <b>Pin3</b>              | <b>IN1</b>        |
| <b>Pin4</b>              | <b>Agnd</b>       |
| <b>Pin5</b>              | <b>IN2</b>        |

TABLE 2

| <b>J3 Connector Pin#</b> | <b>Connection</b> |
|--------------------------|-------------------|
| <b>Pin1</b>              | <b>Vo1</b>        |
| <b>Pin2</b>              | <b>GND1</b>       |
| <b>Pin3</b>              | <b>GND2</b>       |
| <b>Pin4</b>              | <b>Vo2</b>        |
| <b>Pin5</b>              | <b>VNN</b>        |
| <b>Pin6</b>              | <b>Pgnd</b>       |
| <b>Pin7</b>              | <b>VPP</b>        |

## OUTPUT

The output connection for each channel of the EB-TA2022 is made at pins 1 – 4 of header J3. The output of the TA2022 is single-ended, therefore each output has a positive output (Vo1 and Vo2) and a ground (GND1 and GND2).

## INPUT

The input connection for each channel of the EB-TA2022 is made at pins 3 – 5 of header J2. The left and right inputs should be connected to IN1 (pin3) and IN2 (pin5). These inputs share a common ground referenced to Agnd (pin4).

## JUMPER SETTINGS

There is a 3-pin header for the MUTE control of the TA2022. With the jumper placed in the AWAKE position the part is un-muted by grounding (AGND) the mute pin. When the jumper is placed in the MUTE position the mute pin is pulled high (5V) and the amplifier is muted.

## OUTPUT OFFSET NULL AND RELAY

There is an automatic offset trim circuit for each channel using an LM358 op-amp. Once the LM358 trims any DC to 0Vdc a comparator allows a relay to close.

## GAIN SETTING

The gain of the EB\_TA2022 Version 4.0 is set to 18V/V. The gain of the TA2022 is the product of the input stage and the modulator stage. The input stage gain is set to unity. Before changing the gain of the TA2022, please refer to the TA2022 Amplifier Gain section of the TA2022 Data Sheet.

## Performing Measurements on the EB-TA2022 Version 4.0

The TA2022 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 TA2022 amplifier switching pattern will degrade the measurement by including out of band (audio) energy.

One feature of the TA2022 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-TA2022 has a simple two-pole output filter with excellent performance in listening tests.

(See Application Note 4 for additional information on bench testing)

## Contact Information

### **TRIPATH TECHNOLOGY, INC**

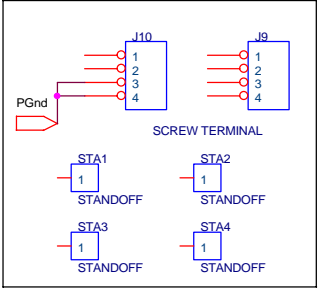
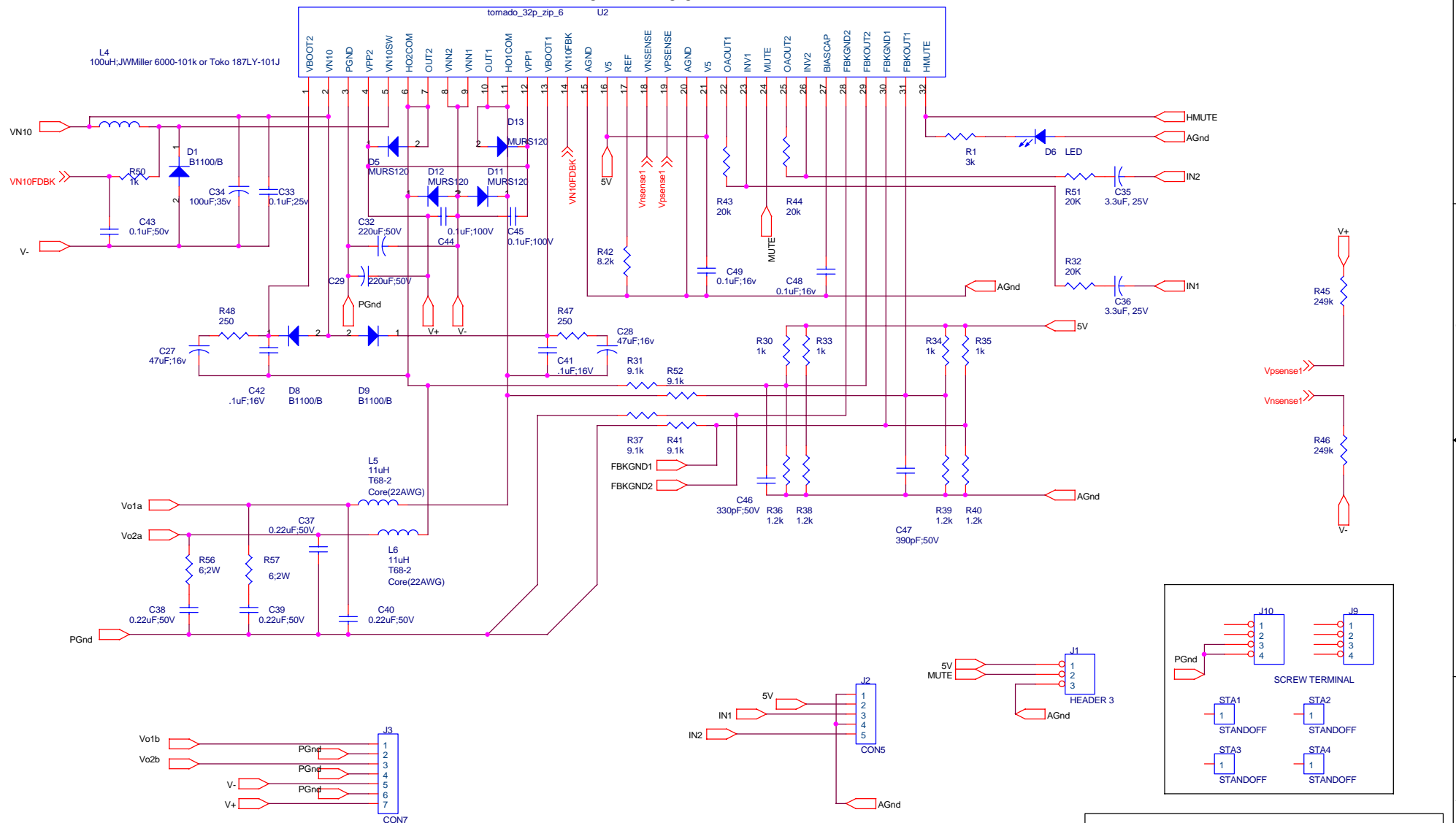
2560 Orchard Parkway, San Jose, CA 95131  
408.750.3000 - P  
408.750.3001 - F

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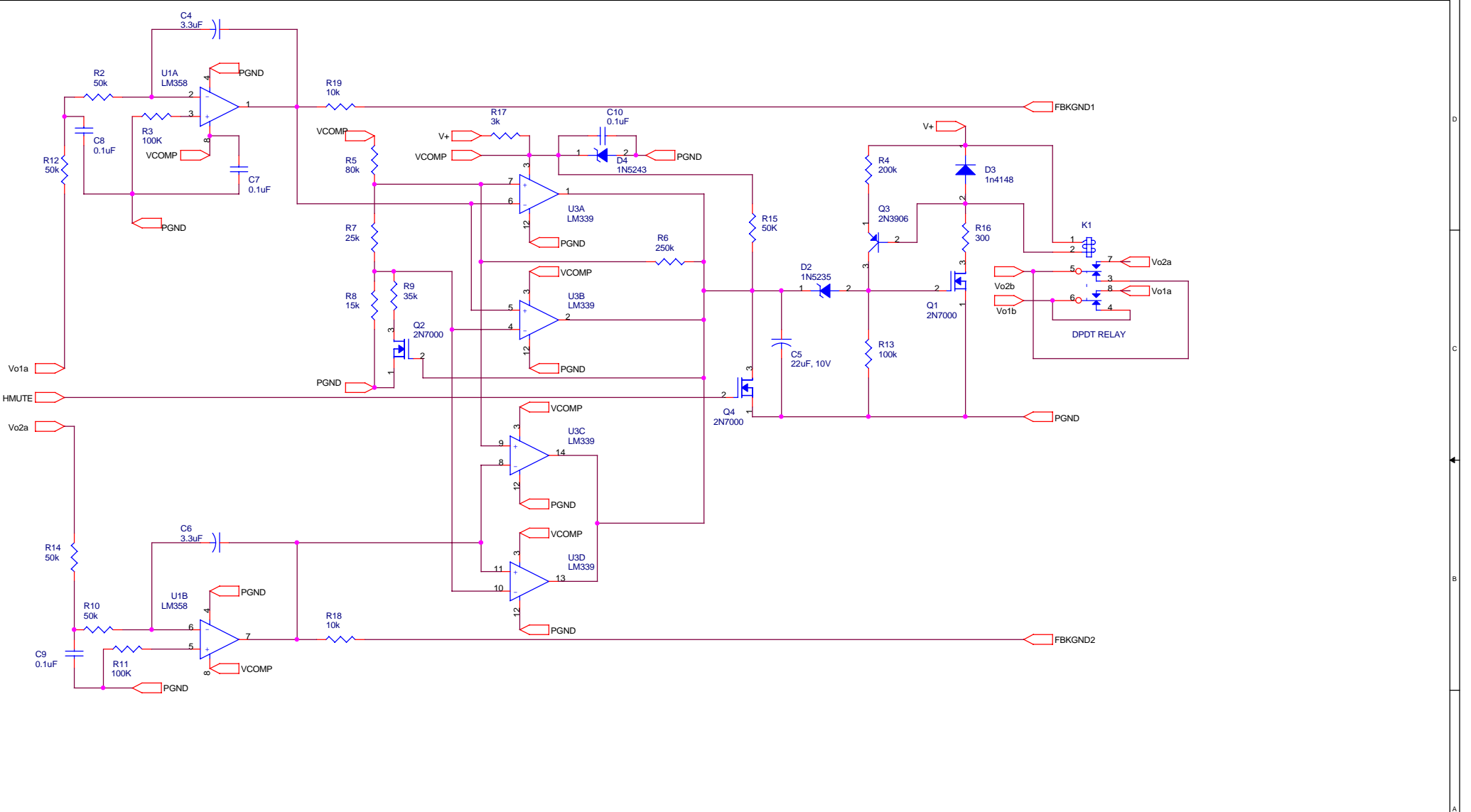
For more Technical Information, please visit us @ [www.tripath.com/data.htm](http://www.tripath.com/data.htm)

| Item | Quantity | Reference           | Value                | PCB Footprint       | Rating  | Tolerance | Manufacturer | Manufacturer Part # | Source             | Source Part #    |
|------|----------|---------------------|----------------------|---------------------|---------|-----------|--------------|---------------------|--------------------|------------------|
| 1    | 4        | C4,C6,C35,C36       | 3.3uF                | cape\100\200        |         | 25V       | Panasonic    | ECE-A1EKK3R3        | Digikey            | P972-ND          |
| 2    | 1        | C5                  | 22uF, 10V            | cape\100\200        |         | 10V       | Panasonic    | ECE-A1AKS220        | Digikey            | P960-ND          |
| 3    | 4        | C7,C8,C9,C10        | 0.1uF;50V            | cap0805             | X7R     | 50V       | Murata       | GRM21BR71H104KA01L  | Digikey            | 490-1666-1-ND    |
| 4    | 2        | C28,C27             | 47uF;16v             | cape\100\200        |         | 16V       | Panasonic    | ECE-A1CKA470        | Digikey            | P810-ND          |
| 5    | 2        | C32,C29             | 220uF;50V            | cape\200\400        | Low ESR | 50V       | Panasonic    | EEU-FC1H221S        | Digikey            | P10326-ND        |
| 6    | 2        | C43,C33             | 0.1uF;50V            | 0805                | X7R     | 50V       | Murata       | GRM21BR71H104KA01L  | Digikey            | 490-1666-1-ND    |
| 7    | 1        | C34                 | 100uF;35v            | cape\100\200        |         |           |              |                     |                    |                  |
| 8    | 4        | C37,C38,C39,C40     | 0.22uF;50V           | cap200              |         | 50V       | Panasonic    | ECQ-V1H224JL        | Digikey            | P4667-ND         |
| 9    | 4        | C41,C42,C48,C49     | .1uF;16V             | 0805                | X7R     | 16V       | Murata       | GRM219R71C104KA01D  | Digikey            | 490-1683-2-ND    |
| 10   | 2        | C44,C45             | 0.1uF;100V           | 1206                | X7R     | 100V      | Kemet        | C1206C104K1RACTU    | Digikey            | 399-1805-2-ND    |
| 11   | 1        | C46                 | 330pF;50V            | 0805                | X7R     | 50V       | Yageo        | 08052R331K9B20D     | Digikey            | 311-1192-2-ND    |
| 12   | 1        | C47                 | 390pF;50V            | 0805                | X7R     | 50V       | Yageo        | 08052R391K9B20D     | Digikey            | 311-1193-2-ND    |
| 13   | 3        | D1,D8,D9            | B1100/B              | SMA                 | 1A      | 100V      | Diodes Inc.  | B1100-13            | Digikey            | B1100DITR-ND     |
| 14   | 1        | D2                  | 1N5235               | do41                | 500mW   | 6.8V      | Diodes Inc.  | 1N5235B-T           | Digikey            | 1N5235BDICT-ND   |
| 15   | 1        | D3                  | 1n4148               | do41                |         |           | Diodes Inc.  | 1N4148-T            | Digikey            | 1N4148DICT-ND    |
| 16   | 1        | D4                  | 1N5243               | do41                | 500mW   | 13V       | Diodes Inc.  | 1N5243B-T           | Digikey            | 1N5243BDICT-ND   |
| 17   | 4        | D5,D11,D12,D13      | MURS120              | SMB                 | 1A      | 200V      | ON Semi      | MURS120T3           | Digikey            | MURS120T3OSTR-ND |
| 18   | 1        | D6                  | LED                  |                     |         |           |              |                     |                    |                  |
| 19   | 1        | J1                  | CON3, .100" Header   | SIP-3P              |         |           | Molex        | 22-03-2031          | Digikey            | WM4001-ND        |
| 20   | 1        | J2                  | CON5, .100" Header   | 5HEADER_INA         |         |           | Molex        | 22-23-2051          | Digikey            | WM4203-ND        |
| 21   | 1        | J3                  | CON7, .156" Header   | HDR7P156-125C75C    |         |           | Molex        | 26-60-4070          | Digikey            | WM4625-ND        |
| 22   | 2        | J10,J9              | SCREW TERMINAL       | TERM_SCREW          |         |           | Keystone     | 8190                | Digikey            | 8190K-ND         |
| 23   | 1        | K1                  | DPDT RELAY           | RLY-RLY11-DPDT      |         |           | Tyco         | RTE24024F           | Digikey            | PB297-ND         |
| 24   | 1        | L4                  | 100uH                | ind\200\400         |         |           | Toko         | 187LY-101J          | Digikey            | TK4300-ND        |
| 25   | 2        | L6,L5               | 11uH                 | 16RHBPA             |         | 10A       |              |                     | American Cores     | AW690-44T-22-V   |
| 26   | 3        | Q1,Q2,Q4            | 2N7000               | TO-92               |         |           | Fairchild    | 2N7000              | Digikey            | 2N7000FS-ND      |
| 27   | 1        | Q3                  | 2N3906               | TO-92               |         |           | Fairchild    | 2N3906BU            | Digikey            | 2N3906FS-ND      |
| 28   | 1        | R1                  | 3k                   | 0805                |         |           |              |                     |                    |                  |
| 29   | 5        | R2,R10,R12,R14,R15  | 50K                  | RES0805             |         |           |              |                     |                    |                  |
| 30   | 3        | R3,R11,R13          | 100k                 | RES0805             |         |           |              |                     |                    |                  |
| 31   | 1        | R4                  | 200k                 | RES0805             |         |           |              |                     |                    |                  |
| 32   | 1        | R5                  | 80.6k;1%             | RES0805             |         |           |              |                     |                    |                  |
| 33   | 1        | R6                  | 250k                 | RES0805             |         |           |              |                     |                    |                  |
| 34   | 1        | R7                  | 24.9k;1%             | RES0805             |         |           |              |                     |                    |                  |
| 35   | 1        | R8                  | 15.0k;1%             | RES0805             |         |           |              |                     |                    |                  |
| 36   | 1        | R9                  | 35k                  | RES0805             |         |           |              |                     |                    |                  |
| 37   | 1        | R16                 | 300                  | RES0805             |         |           |              |                     |                    |                  |
| 38   | 1        | R17                 | 3k                   | RES0805             |         |           |              |                     |                    |                  |
| 39   | 2        | R19,R18             | 10k                  | RES0805             |         |           |              |                     |                    |                  |
| 40   | 4        | R30,R33,R34,R35     | 1k;1%                | 0805                |         |           |              |                     |                    |                  |
| 41   | 4        | R31,R37,R41,R52     | 9.1k;1%              | 0805                |         |           |              |                     |                    |                  |
| 42   | 4        | R32,R43,R44,R51     | 20K                  | 0805                |         |           |              |                     |                    |                  |
| 43   | 4        | R36,R38,R39,R40     | 1.2k;1%              | 0805                |         |           |              |                     |                    |                  |
| 44   | 1        | R42                 | 8.25k, 1%            | 0805                |         |           |              |                     |                    |                  |
| 45   | 2        | R46,R45             | 249k;1%              | 0805                |         |           |              |                     |                    |                  |
| 46   | 2        | R47,R48             | 250                  | 0805                |         |           |              |                     |                    |                  |
| 47   | 1        | R50                 | 1k                   | 0805                |         |           |              |                     |                    |                  |
| 48   | 1        | R56                 | 6;2W                 | res-1/2w            | 2W      |           | Panasonic    | ERX-2SJ6R2A         | Digikey            | P6.2W-2BK-ND     |
| 49   | 1        | R57                 | 6;2W                 | res-1/2w            | 2W      |           | Panasonic    | ERX-2SJ6R2A         | Digikey            | P6.2W-2BK-ND     |
| 50   | 4        | STA1,STA2,STA3,STA4 | STANDOFF             | STANDOFF_440        |         |           | Keystone     | 4801                | Digikey            | 4801K-ND         |
| 51   | 1        | U1                  | LM358                | DIP8                |         |           | TI           | LM358P              | Digikey            | 296-1395-5-ND    |
| 52   | 1        | U2                  | tornado_32p_zip_6    | DIP-32P-STAGGERAAAA |         |           |              |                     | Tripath Technology | TA2022           |
| 53   | 1        | U3                  | LM339                | DIP14               |         |           | TI           | LM339N              | Digikey            | 296-1393-5-ND    |
| 54   | 4        |                     | standoff nut         |                     |         |           |              |                     | Digikey            | H616-ND          |
| 55   | 2        |                     | screw terminal screw |                     |         |           |              |                     | Digikey            | H342-ND          |
| 56   | 2        |                     | TA2022 washer        |                     |         |           |              |                     | Digikey            | H734-ND          |
| 57   |          |                     | TA2022 screw         |                     |         |           |              |                     | Digikey            | H781-ND          |

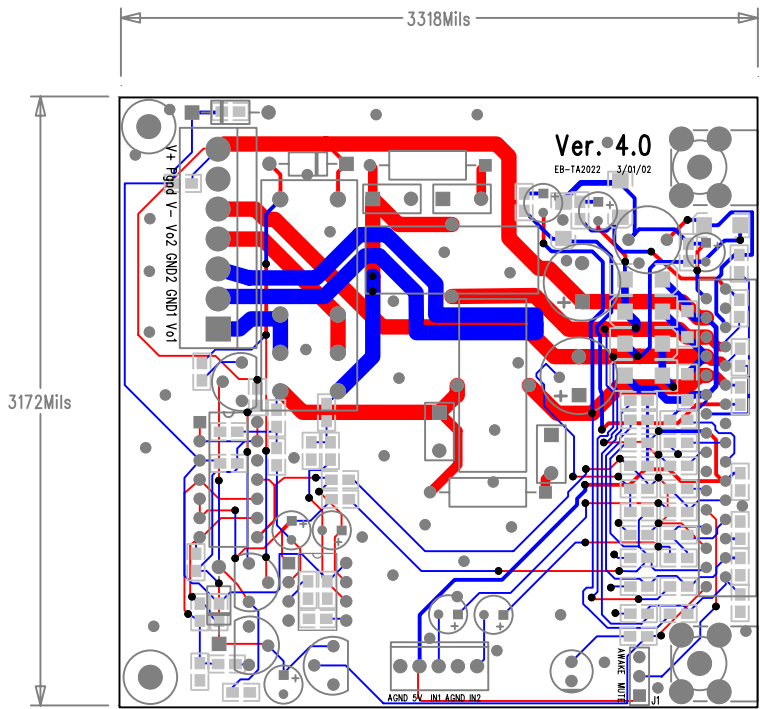
# TA2022-100



|                    |                             |              |
|--------------------|-----------------------------|--------------|
| Title              |                             |              |
| EB-TA2022 Ver. 4.0 |                             |              |
| Size B             | Document Number Schematic 1 | Rev 4.0      |
| Date:              | Friday, March 01, 2002      | Sheet 1 of 1 |



|  |                        |                    |        |
|--|------------------------|--------------------|--------|
| Title  |                        |                    |        |
| <b>OFFSET CORRECTION &amp; RELAY CIRCUIT</b> |                        |                    |        |
| Size   | Document Number        | <b>SCHEMATIC 2</b> | Rev    |
| B  |                        |                    | 4.0    |
| Date:  | Friday, March 01, 2002 | Sheet              | 2 of 2 |

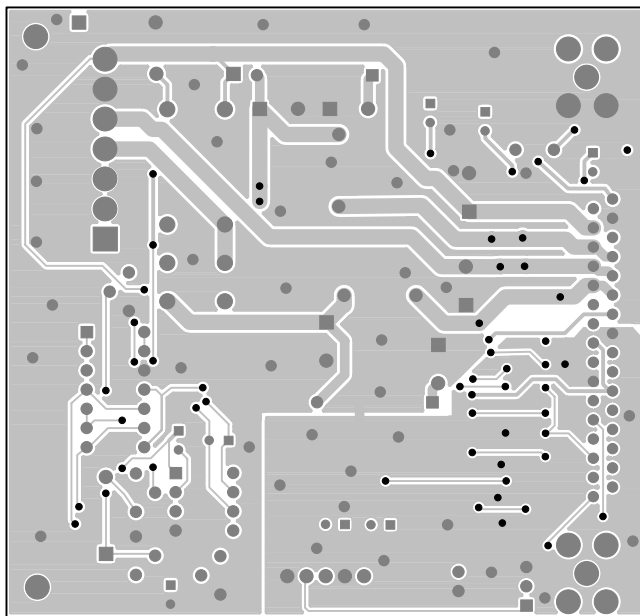


FABRICATION NOTES  
 DOUBLE SIDED BOARD  
 MATERIAL: .062 FR-4  
 2 OZ COPPER, ALL LAYERS

VIEWED FROM TOP SIDE  
 COMPOSITE DRAWING

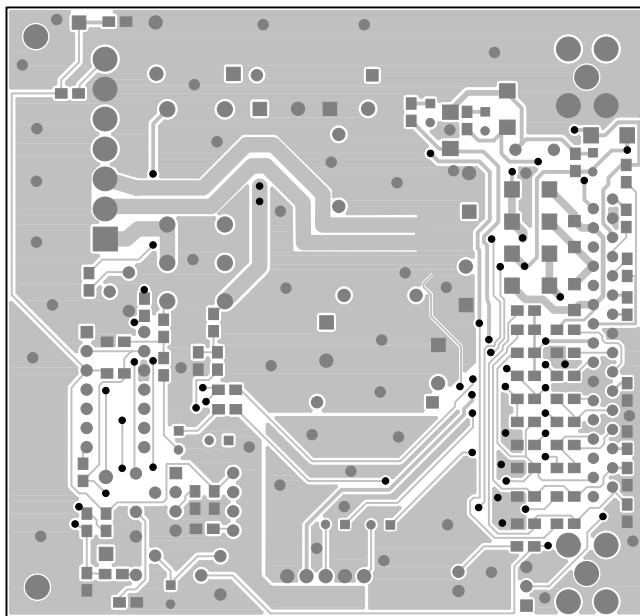
Top Trace RED  
 Bottom Trace BLUE  
 Top Component DARK GRAY  
 Bottom Component LIGHT GRAY





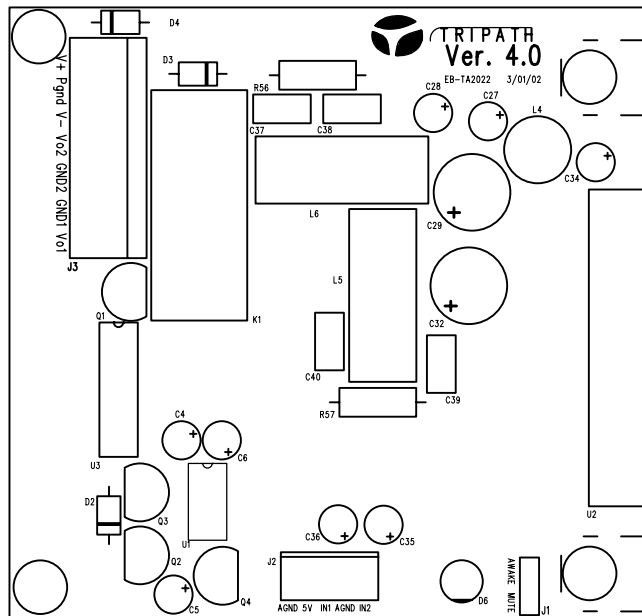
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DOUBLE SIDED BOARD  
MATERIAL: .062 FR-4  
2 OZ COPPER, ALL LAYERS

VIEWED FROM TOP SIDE  
TOP SIDE ETCH



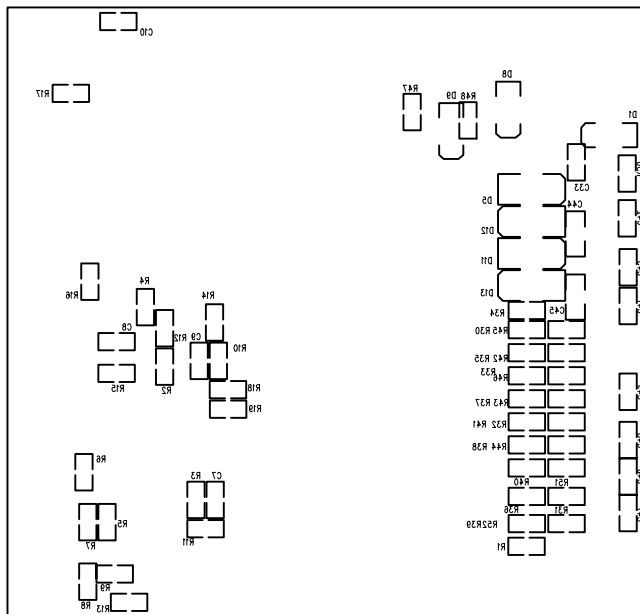
FABRICATION NOTES  
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VIEWED FROM TOP SIDE  
BOTTOM SIDE ETCH



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

VIEWS FROM TOP SIDE  
 SILKSCREEN TOP



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

VIEWED FROM TOP SIDE  
 SILKSCREEN BOTTOM