2 x 15 Watt Stereo Class-T TA2024C Amplifier Board

#320-600

User Manual

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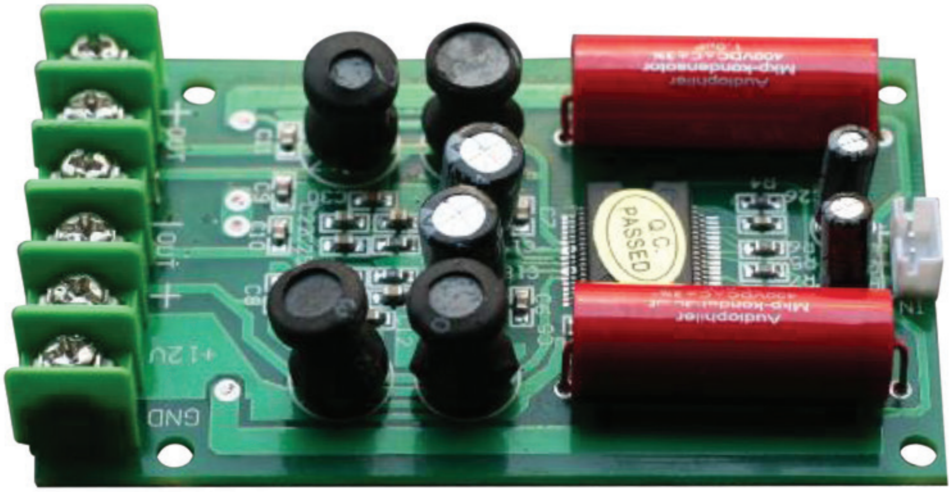


Overview

The #320-600 is a stereo class-T TA2024C amplifier, it is 15W (4ohm) continuous average per channel class-T digital audio power amplifier, using Tripath's proprietary power processing technology, class-T amplifiers offer both the audio fidelity of Class-AB and the power efficiency of class-D amplifier.

Applications

- Powered speakers
- Digital products
- Computer and PC multimedia
- Television
- Battery powered systems

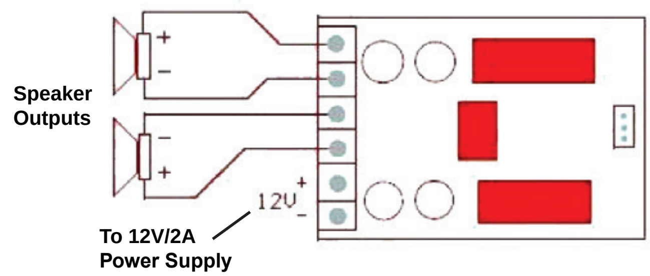
Specifications and Features

- "Audiophile"quality sound
  0.04% THD+N@9W 4ohm
  0.18% IHF-IM@1W 4ohm
  11W@4ohm, 0.1% THD+N
  6W@8ohm, 0.1% THD+N
- High power
  15W@4ohm, 10% THD+N
  10W@8ohm, 10% THD+N
- Class-T architecture
- High efficiency
  88%@10W 8ohm
  81%@15W 4ohm
- Dynamic range = 102 dB
- Mute and sleep Input
- Integrated Gate Drive Supply
- Over-current protection
- Over-temperature protection
- IC package: 36-pin Power SOP
- PCB material is FR4, thickness 1.6 mm
- Dimensions: 3.54" x 2.09"
- Weight: 50g/PCS

Testing Your Amplifier Board

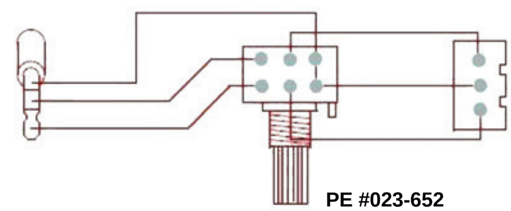
- Connect audio signal cable to audio jack.
- Connect left and right speaker to speaker connector.
- Plug DC power cord to DC jack, the voltage is 12V / 2 Amp recommended.
- Open the power and audio signal (EX:music).

Wiring Diagrams and Layout

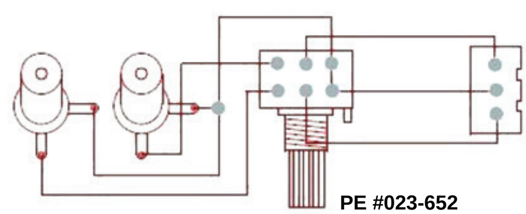


Example Wiring with Volume Control (PE #023-652)

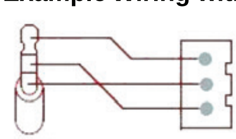
3.5 Wiring with Volume Control



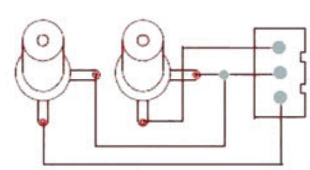
RCA Left/Right Wiring with Volume Control



Example Wiring without Volume Control



3.5 mm Plug



RCA Jacks

T E C H N I C A L   I N F O R M A T I O N – A N 1

CLASS-T DIGITAL AUDIO AMPLIFIER TECHNOLOGY OVERVIEW

A Technical White Paper

Revised: April 12, 1999

Class-A and Class-AB amplifiers have long dominated the amplifier marketplace. These purely analog devices have low power efficiency, and most integrated circuit Class-AB amplifiers fall short of true high-fidelity audio quality. Another class of amplifier, Class-D, solves the efficiency problem by using switching pulse-width modulation (PWM) technology. However, this produces audio output quality that is inferior to Class-A or -AB, so efficiency is gained at the expense of signal fidelity. As a result, these amplifiers are generally used only in low-frequency subwoofer applications where the audio fidelity performance level of PWM amplifiers is acceptable. The “Holy Grail” of amplification: high audio quality and high power efficiency in a single technology has long eluded the market.

A Watershed in Digital Amplification

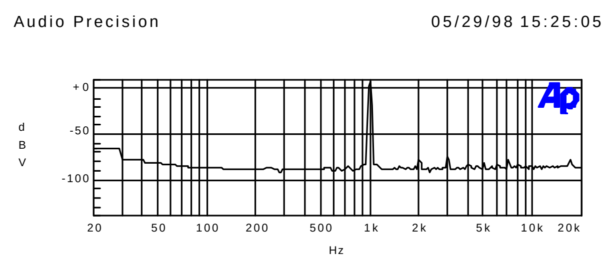
Tripath Technology has developed a category of digital audio power amplifiers using a unique technology. Tripath amplifiers use a completely new proprietary method of Digital Power Processing™ that provides superior performance to conventional methods of amplification. For the first time, both high signal fidelity AND high power efficiency can be achieved with the same technology. Tripath refers to this DPP™ based amplifier as a Class-T design. The underlying technology of Class-T does not use PWM and is not a pure analog approach (Classes -A and -AB). It combines the benefits of both with a completely new approach.

Tripath’s Class-T amplifiers are the first application of this breakthrough approach. Class-T amplifiers provide the signal fidelity of sophisticated discrete-component linear Class-A and -AB designs, while offering high power efficiencies and the potential to need less exotic engineering to achieve high-end audiophile performance. These amplifiers also reduce cost for amplifier overhead at high power levels (such as power supply, filtering, and heat venting). Class-T provides power conversion efficiencies of 80 percent to more than 90 percent, which is equal to or better than Class-D amplifiers.

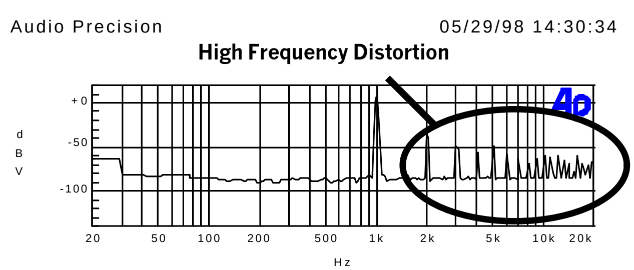
Customers no longer have to choose between optimizing signal fidelity or efficiency. Both can now be achieved with Class-T technology.

"Audiophile" Sound Fidelity with High Power Efficiency

Total Harmonic Distortion plus Noise (THD+N) is often thought to be the definitive figure of merit for audio quality in power amplifiers. Many amplifiers only specify their THD+N performance, frequently at only 1 kHz. However, an amplifier with high THD+N can sound "good" and an amplifier with a low THD+N can sound "bad." Audiophiles know that the important criteria to consider are which harmonics comprise the THD+N and what interaction there is between signals of different frequencies, particularly the higher frequencies. They generally consider "low distortion" to be both THD+N of less than 0.1% over the full 20Hz to 20kHz audio bandwidth and IHF-IM (high-frequency intermodulation distortion) of less than 0.1%.



FFT of Tripath Class - T Amplifier

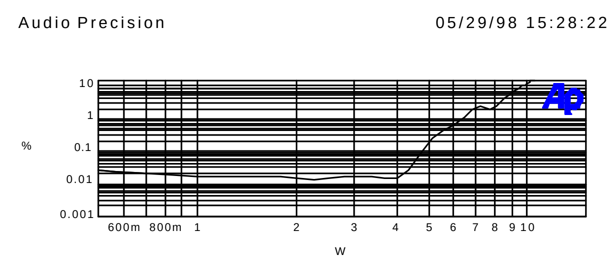


FFT of Class - D PWM Amplifier

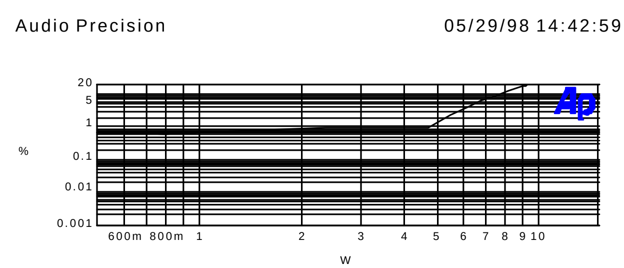
TECHNICAL INFORMATION – AN1

Tripath Class-T amplifiers have THD+N of significantly less than typically 0.08% *over the full audio bandwidth* and IHF-IM less than typically 0.04% and therefore deliver what's often defined as "audiophile performance." Traditional Class-D amplifiers are unable to achieve this level of performance. Their fundamental underlying technology is self-limiting and, as a result, Class-D amplifiers will never be able to approach the sound fidelity of a Class-T amplifier. As the Class-T amplifier becomes ubiquitous, consumers will adjust their method of choosing products to examine intermodulation distortion as a better measure than THD. They will also understand that a lower power amplifier with better intermodulation distortion characteristics will sound better than one which has higher power and low total harmonic distortion.

High signal fidelity is just one of the key benefits of the Class-T technology. High power efficiency in the same package is a benefit not possible before the Tripath breakthrough. The consumer benefits of high efficiency are more output power in a smaller package, all with less input power. Systems can be constructed that are smaller in size, lighter in weight, consume less energy, AND AT THE SAME TIME offer amplification fidelity that rivals systems that are only possible with large heat sinks, massive power supplies, and high input power levels. No other technology offers in one package the signal fidelity and power efficiency of the Tripath Class-T technology.



THD of Tripath Class - T Amplifier

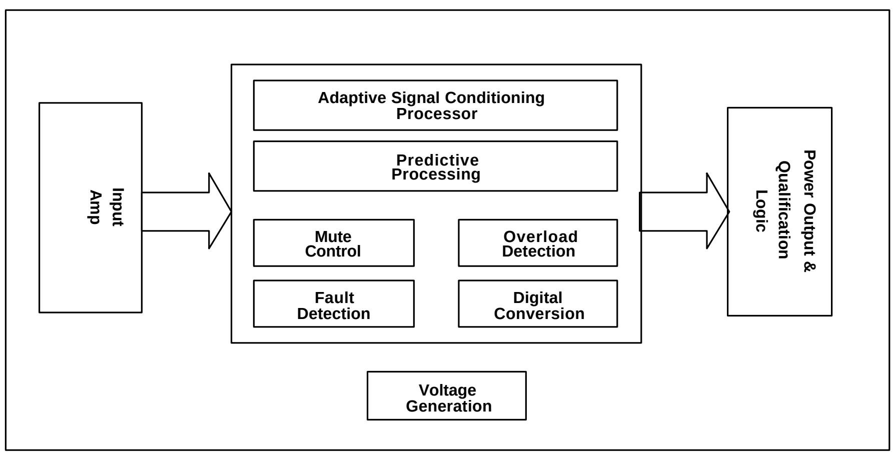


THD of Class - D PWM Amplifier

Class-T Architecture

Tripath Class-T technology uses both analog circuitry and Tripath's Digital Power Processing algorithms that modulate the input signal with a high-frequency switching pattern. Tripath's proprietary algorithms are derivatives of adaptive and predictive algorithms used in telecommunications processors. The modulated signal is sent to output transistors then through a low-pass filter (external to the Tripath amplifier) that demodulates it to recover an amplified version of the audio input.

In a Tripath amplifier there is an input stage that provides analog input signal buffering. The output of this stage drives the Digital Power Processing™ block. This block contains an adaptive signal conditioning processor, a digital conversion function, mute control, overload handling, fault detection, predictive processing and qualification logic functions. The output of the DPP™ block controls a power output stage that drives a speaker through an output filter.



Block Diagram of Class-T Amplifier

In a traditional Class-D PWM amplifier the audio input signal is compared to a higher-than-audio frequency (generally 100-200 kHz) triangle wave. The resultant signal drives switching transistors in a push-pull fashion. Amplification is achieved with the higher voltage and current that the output transistors switch to the speakers. A low-pass filter (inductor and capacitor) positioned before the speaker removes the triangle wave base frequency, leaving amplified audio.

TECHNICAL INFORMATION – AN1

The audio quality of Class-D PWM amplifiers is inferior because of fundamental problems with the PWM approach. The output transistors are not perfect switches and are not perfectly matched, and this causes distortion. The switching of the transistors causes “ground bounce,” which adds noise. There is crossover distortion caused by the dead time between when one of the output transistors turns off and the other turns on (like a Class-AB amplifier). Finally, all the energy of the triangle waveform cannot be removed from the audio band with a simple low-pass filter, and what remains is distortion.

Instead of using PWM, Tripath Class-T amplifier processors use proprietary algorithms and techniques to create the modulation that drives the switching transistors. A Class-T amplifier’s processors learn the characteristics of the output transistors. Then, based on the analog input signal, they switch the output transistors with exactly the right timing to eliminate Class-D PWM problems: transistors not being perfect switches, ground bounce, output transistor mismatches, dead-time distortion and residual energy from the oscillator in the audio band. The result is a high power efficiency, audiophile-quality audio amplifier – a Class-T amplifier.

If one were to compare the waveform before the output filter of a Class-D PWM amplifier to a Tripath Class-T amplifier, some significant differences would be evident. The waveform for a Class-D PWM amplifier would be a pulse-width varying digital signal at the fixed, 100-200kHz, frequency of the triangle wave generator. The waveform for a Tripath Class-T amplifier would be a complex digital waveform of varying frequency. A Class-T amplifier switches the output transistors in a fashion similar to spread spectrum technology, at a varying rate up to 1.5 MHz and averages 600kHz to 700kHz.

What this difference means, in addition to significantly better audio quality, is that a Tripath Class-T amplifier can use lower-cost inductors and capacitors for its output filter while obtaining the same amount of filtering as a Class-D PWM amplifier. A Class-T amplifier also has lower electromagnetic emissions than a Class-D PWM amplifier broadening its potential application.

But the true test of any amplifier is ultimately how it sounds. Class-T amplifiers have been designed with the latest advances in adaptive signal processing technology, while remaining true to the “warm” sounds that listeners have come to expect from their traditional analog products. With Tripath Technology, listeners can have the best of both worlds: high fidelity sound AND high power efficiency.

TECHNICAL INFORMATION – AN1

A New Technology Demands a New Brand

The company has embarked on an aggressive program to brand the benefits of Tripath Class-T technology in consumers' minds. It has created a brand name, "Combinant Digital™," which will appear on products using Tripath's technology.

Combinant digital means to combine the best of both worlds: high fidelity and high efficiency; analog and digital processing. It will become the recognized audio brand for products that use Tripath's underlying digital energy processor technology. While the Class-T designation is a technical term that fits within the audio industry model for amplifier classification, Combinant Digital™ is Tripath's proprietary brand for it's unique technology.

TECHNICAL INFORMATION

Stereo 10W (4Ω) Class-T™ Digital Audio Amplifier using Digital Power Processing™ Technology TA2024

February 27, 2001 – Preliminary Rev. 1.0

General Description

The TA2024 is a 10W/ch continuous average two-channel Class-T Digital Audio Power Amplifier IC using Tripath's proprietary Digital Power Processing™ technology. Class-T amplifiers offer both the audio fidelity of Class-AB and the power efficiency of Class-D amplifiers.

Applications

- Computer/PC Multimedia
- DVD Players
- Cable Set-Top Products
- Televisions
- Video CD Players
- Battery Powered Systems

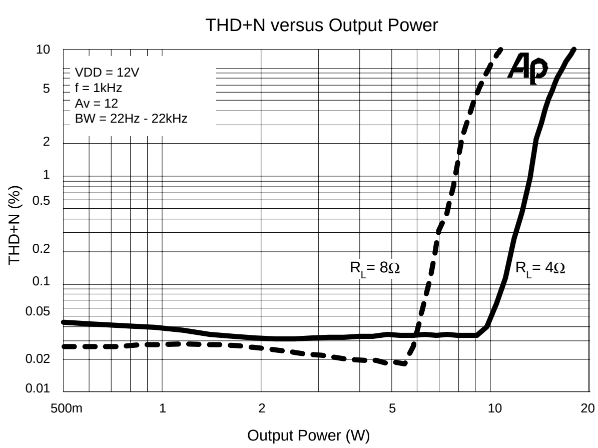
Benefits

- Fully integrated solution with FETs
- Easier to design-in than Class-D
- Reduced system cost with no heat sink
- Dramatically improves efficiency versus Class-AB
- Signal fidelity equal to high quality linear amplifiers
- High dynamic range compatible with digital media such as CD, DVD, and Internet audio

Features

- Class-T architecture
- Single Supply Operation
- "Audiophile" Quality Sound
  - 0.04% THD+N @ 9W, 4Ω
  - 0.18% IHF-IM @ 1W, 4Ω
  - 6W @ 8Ω, 0.1% THD+N
  - 11W @ 4Ω, 0.1% THD+N
- High Power
  - 10W @ 8Ω, 10% THD+N
  - 15W @ 4Ω, 10% THD+N
- High Efficiency
  - 88% @ 10W, 8Ω
  - 81% @ 15W, 4Ω
- Dynamic Range = 102 dB
- Mute and Sleep inputs
- Turn-on & turn-off pop suppression
- Over-current protection
- Over-temperature protection
- Bridged outputs
- 36-pin Power SOP package

Typical Performance



Absolute Maximum Ratings (Note 1)

SYMBOL	PARAMETER	Value	UNITS
V_{DD}	Supply Voltage	16	V
V5	Input Section Supply Voltage	6.0	V
SLEEP	SLEEP Input Voltage	-0.3 to 6.0	V
MUTE	MUTE Input Voltage	-0.3 to V5+0.3	V
ESD_{HBM}	ESD Susceptibility, All pins except pins 1,4 Human Body Model (Note2) Pins 1, 4	2000 1000	V V
ESD_{MM}	ESD Susceptibility, Machine Model (Note 3)	200	V
T_{STORE}	Storage Temperature Range	-40 to 150	°C
T_A	Operating Free-air Temperature Range	0 to 70	°C
T_J	Junction Temperature	150	°C

Note 1 : Absolute Maximum Ratings indicate limits beyond which damage to the device may occur.
Note 2 : Human Body Model, 100pF discharged through a 1.5kΩ resistor.
Note 3 : Machine Model, 200pF discharged directly to each pin
Note 4 : See Power Dissipation Derating in the Applications Information section.

Operating Conditions (Note 5)

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNITS
V_{DD}	Supply Voltage	8.5	12	13.2	V
V_{IH}	High-level Input Voltage (MUTE, SLEEP)	3.5			V
V_{IL}	Low-level Input Voltage (MUTE, SLEEP)			1	V

Note 5: Recommended Operating Conditions indicate conditions for which the device is functional. See Electrical Characteristics for guaranteed specific performance limits.

Electrical Characteristics

See Test/Application Circuit. Unless otherwise specified, V_{DD} = 12V, f = 1kHz, Measurement Bandwidth = 22kHz, R_L = 4Ω, T_A = 25 °C, Package heat slug soldered to 2.8 square-inch PC pad.

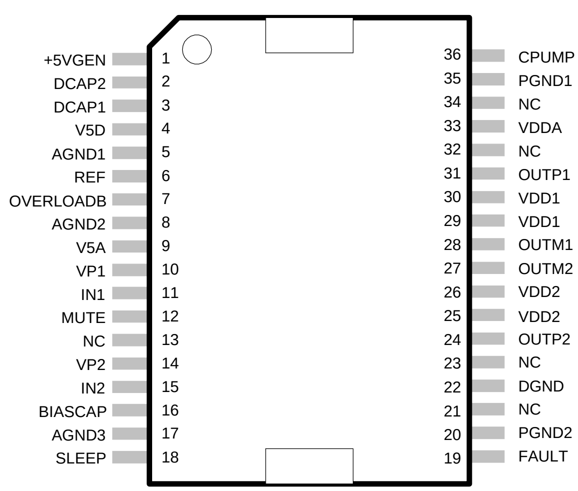
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNITS
P_O	Output Power (Continuous Average/Channel)	THD+N = 0.1% R_L = 4Ω R_L = 8Ω THD+N = 10% R_L = 4Ω R_L = 8Ω	9 5.5 12 8	11 6 16 10		W W W W
$I_{DD,MUTE}$	Mute Supply Current	MUTE = V_{IH}		5.5	7	mA
$I_{DD,\ SLEEP}$	Sleep Supply Current	SLEEP = V_{IH}		0.25	2	mA
I_q	Quiescent Current	V_{IN} = 0 V		61	75	mA
THD + N	Total Harmonic Distortion Plus Noise	P_O = 9W/Channel		0.04		%
IHF-IM	IHF Intermodulation Distortion	19kHz, 20kHz, 1:1 (IHF)		0.18	0.5	%
SNR	Signal-to-Noise Ratio	A-Weighted, P_{OUT} = 1W, R_L = 8Ω		89		dB
CS	Channel Separation	30kHz Bandwidth	50	55		dB
PSRR	Power Supply Rejection Ratio	Vripple = 100mV.	60	80		dB
η	Power Efficiency	P_{OUT} = 10W/Channel, R_L = 8Ω		88		%
V_{OFFSET}	Output Offset Voltage	No Load, MUTE = Logic Low		50	150	mV
V_{OH}	High-level output voltage (FAULT & OVERLOAD)		3.5			V
V_{OL}	Low-level output voltage (FAULT & OVERLOAD)				1	V
e_{OUT}	Output Noise Voltage	A-Weighted, input AC grounded		100		μV

Note: Minimum and maximum limits are guaranteed but may not be 100% tested.

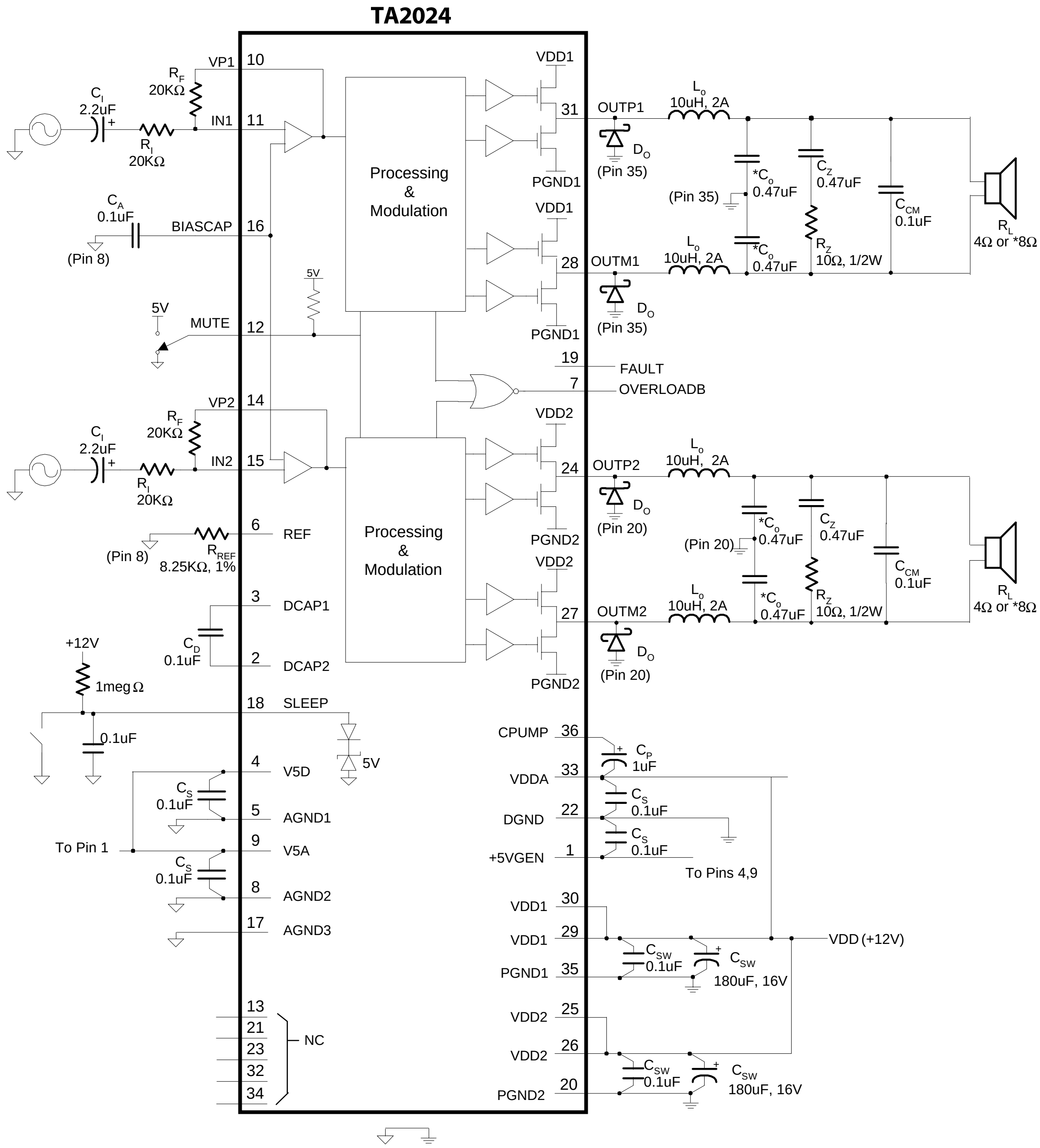
Pin Description

Pin	Function	Description
2, 3	DCAP2, DCAP1	Charge pump switching pins. DCAP1 (pin 3) is a free running 300kHz square wave between VDDA and DGND (12Vpp nominal). DCAP2 (pin 2) is level shifted 10 volts above DCAP1 (pin 3) with the same amplitude (12Vpp nominal), frequency, and phase as DCAP1.
4, 9	V5D, V5A	Digital 5VDC, Analog 5VDC
5, 8, 17	AGND1, AGND2, AGND3	Analog Ground
6	REF	Internal reference voltage; approximately 1.0 VDC.
7	OVERLOADB	A logic low output indicates the input signal has overloaded the amplifier.
10, 14	VP1, VP2	Input stage output pins.
11, 15	IN1, IN2	Single-ended inputs. Inputs are a “virtual” ground of an inverting opamp with approximately 2.4VDC bias.
12	MUTE	When set to logic high, both amplifiers are muted and in idle mode. When low (grounded), both amplifiers are fully operational. If left floating, the device stays in the mute mode. This pin should be tied to GND if not used.
16	BIASCAP	Input stage bias voltage (approximately 2.4VDC).
18	SLEEP	When set to logic high, device goes into low power mode. If not used, this pin should be grounded
19	FAULT	A logic high output indicates thermal overload, or an output is shorted to ground, or another output.
20, 35	PGND2, PGND1	Power Grounds (high current)
22	DGND	Digital Ground
24, 27; 31, 28	OUTP2 & OUTM2; OUTP1 & OUTM1	Bridged outputs
25, 26, 29, 30	VDD2, VDD2 VDD1, VDD1	Supply pins for high current H-bridges, nominally 12VDC.
13, 21, 23, 32, 34	NC	Not connected. Not bonded internally.
33	VDDA	Analog 12VDC
36	CPUMP	Charge pump output (nominally 10V above VDDA)
1	5VGEN	Regulated 5VDC source used to supply power to the input section (pins 4 and 9).

36-pin Power SOP Package
(Top View)



Application / Test Circuit



Note: Analog and Digital/Power Grounds must be connected locally at the TA2024

Analog Ground

Digital/Power Ground

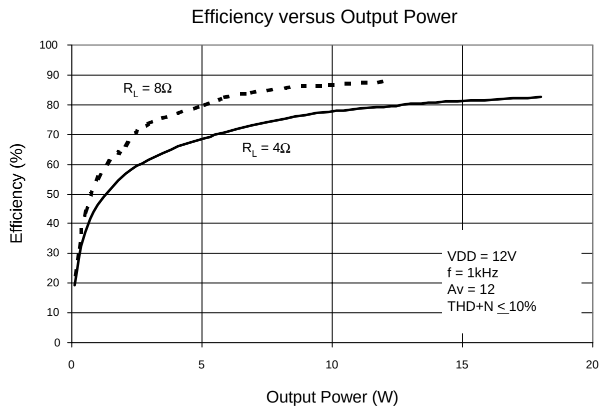
All Diodes Motorola MBRS130T3

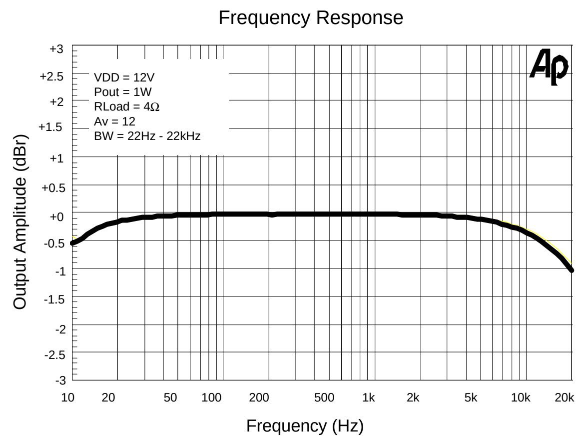
* Use C_o = 0.22µF for 8 Ohm loads

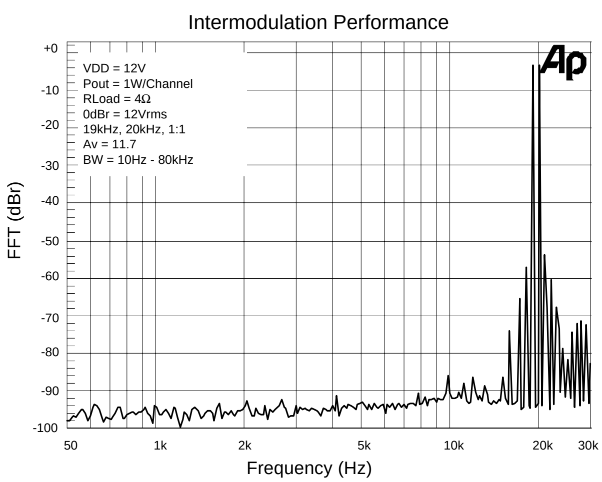
External Components Description (Refer to the Application/Test Circuit)

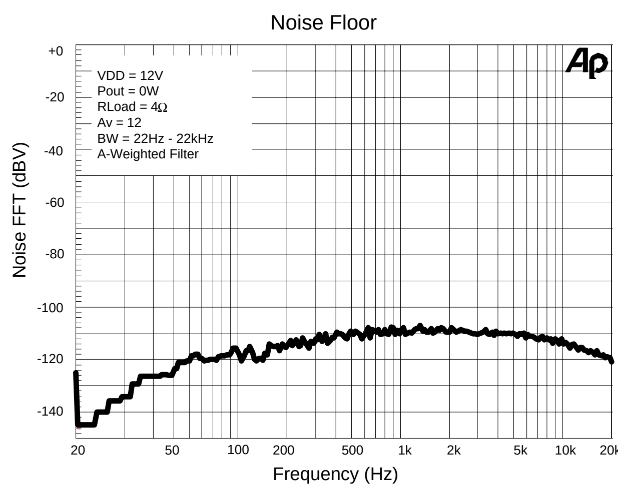
Components	Description
R_I	Inverting Input Resistance to provide AC gain in conjunction with R_F. This input is biased at the BIASCAP voltage (approximately 2.4VDC).
R_F	Feedback resistor to set AC gain in conjunction with R_I; $A_V = 12(R_F / R_I)$. Please refer to the Amplifier Gain paragraph in the Application Information section.
C_I	AC input coupling capacitor which, in conjunction with R_I, forms a highpass filter at $f_C = 1/(2\pi R_I C_I)$
R_{REF}	Bias resistor. Locate close to pin 6 and ground at pin 8.
C_A	BIASCAP decoupling capacitor. Should be located close to pin 16.
C_D	Charge pump input capacitor. This capacitor should be connected directly between pins 2 and 3 and located physically close to the TA2024.
C_P	Charge pump output capacitor that enables efficient high side gate drive for the internal H-bridges. To maximize performance, this capacitor should be connected directly between pin 36 (CPUMP) and pin 34 (VDDA). Please observe the polarity shown in the Application/ Test Circuit.
C_S	Supply decoupling for the low current power supply pins. For optimum performance, these components should be located close to the pin and returned to their respective ground as shown in the Application/Test Circuit.
C_{SW}	Supply decoupling for the high current, high frequency H-Bridge supply pins. These components must be located as close to the device as possible to minimize supply overshoot and maximize device reliability. Both the high frequency bypassing (0.1uF) and bulk capacitor (180uF) should have good high frequency performance including low ESR and low ESL. Panasonic HFQ or FC capacitors are ideal for the bulk capacitor.
C_Z	Zobel Capacitor.
R_Z	Zobel resistor, which in conjunction with C_Z, terminates the output filter at high frequencies. The combination of R_Z and C_Z minimizes peaking of the output filter under both no load conditions or with real world loads, including loudspeakers which usually exhibit a rising impedance with frequency.
D_O	Schottky diodes that minimize undershoots of the outputs with respect to power ground during switching transitions. For maximum effectiveness, these diodes must be located close to the output pins and returned to their respective PGND. Please see Application/Test Circuit for ground return pin.
L_O	Output inductor, which in conjunction with C_O, demodulates (filters) the switching waveform into an audio signal. Forms a second order filter with a cutoff frequency of $f_C = 1/(2\pi\sqrt{L_O C_O})$ and a quality factor of $Q = R_L C_O / \sqrt{L_O C_O}$.
C_O	Output capacitor.
C_{CM}	Common Mode Capacitor.

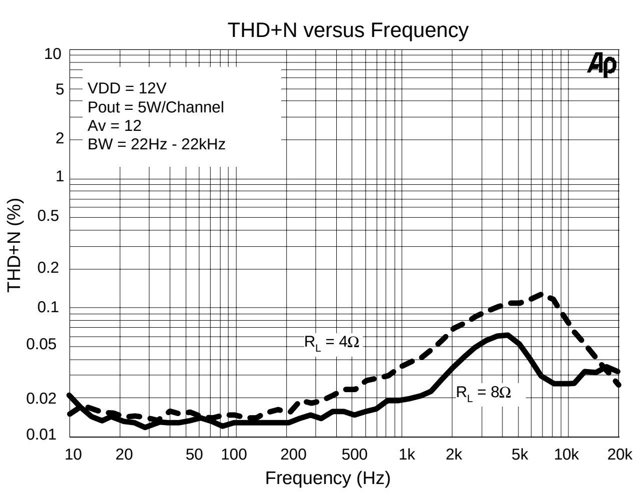
Typical Performance Characteristics

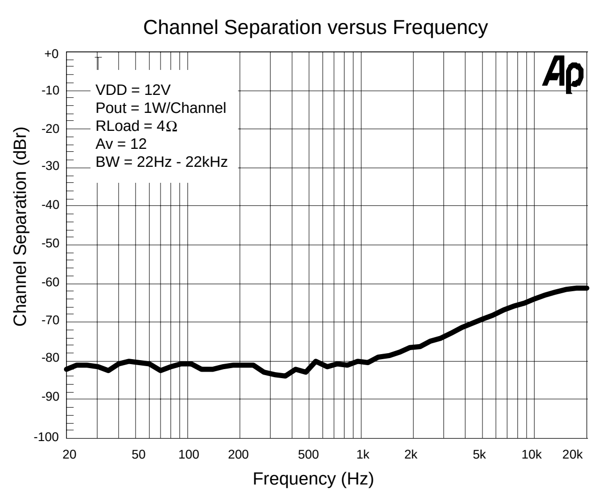












Application Information

Layout Recommendations

The TA2024 is a power (high current) amplifier that operates at relatively high switching frequencies. The outputs of the amplifier switch between the supply voltage and ground at high speeds while driving high currents. This high-frequency digital signal is passed through an LC low-pass filter to recover the amplified audio signal. Since the amplifier must drive the inductive LC output filter and speaker loads, the amplifier outputs can be pulled above the supply voltage and below ground by the energy in the output inductance. To avoid subjecting the TA2024 to potentially damaging voltage stress, it is critical to have a good printed circuit board layout. It is recommended that Tripath's layout and application circuit be used for all applications and only be deviated from after careful analysis of the effects of any changes. Please contact Tripath Technology for further information regarding reference design material regarding the TA2024.

Amplifier Gain

The gain of the TA2024 is set by the ratio of two external resistors, R_I and R_F, and is given by the following formula:

$$\frac{V_O}{V_I} = 12\frac{R_F}{R_I}$$

where V_I is the input signal level and V_O is the differential output signal level across the speaker.

9 Watts of RMS output power results from an 8.485V RMS signal across an 8Ω speaker load. If $R_F = R_I$, then 9 Watts will be achieved with 0.707V RMS of input signal.

$$8.485V_{RMS} = \sqrt{(R_L * P_O)} = \sqrt{(8\Omega * 9W)}$$

Protection Circuits

The TA2024 is guarded against over-temperature and over-current conditions. When the device goes into an over-temperature or over-current state, the FAULT pin goes to a logic HIGH state indicating a fault condition. When this occurs, the amplifier is muted, all outputs are TRI-STATED, and will float to 1/2 of V_{DD}.

Over-temperature Protection

An over-temperature fault occurs if the junction temperature of the part exceeds approximately 155°C. The thermal hysteresis of the part is approximately 45°C, therefore the fault will automatically clear when the junction temperature drops below 110°C.

Over-current Protection

An over-current fault occurs if more than approximately 7 amps of current flows from any of the amplifier output pins. This can occur if the speaker wires are shorted together or if one side of the speaker is shorted to ground. An over-current fault sets an internal latch that can only be cleared if the MUTE pin is toggled or if the part is powered down. Alternately, if the MUTE pin is connected to the FAULT pin, the HIGH output of the FAULT pin will toggle the MUTE pin and automatically reset the fault condition.

Overload

The OVERLOADB pin is a 5V logic output. When low, it indicates that the level of the input signal has overloaded the amplifier resulting in increased distortion at the output. The OVERLOADB signal can be used to control a distortion indicator light or LED through a simple buffer circuit, as the OVERLOADB cannot drive an LED directly.

Sleep Pin

The SLEEP pin is a 5V logic input that when pulled high (>3.5V) puts the part into a low quiescent current mode. This pin is internally clamped by a zener diode to approximately 6V thus allowing the pin to be pulled up through a large valued resistor (1megΩ recommended) to V_{DD}. To disable SLEEP mode, the sleep pin should be grounded.

Fault Pin

The FAULT pin is a 5V logic output that indicates various fault conditions within the device. These conditions include: low supply voltage, low charge pump voltage, low 5V regulator voltage, over current at any output, and junction temperature greater than approximately 155°C. All faults except overcurrent all reset upon removal of the condition. The FAULT output is capable of directly driving an LED through a series 200Ω resistor. If the FAULT pin is connected directly to the MUTE input an automatic reset will occur in the event of an over-current condition.

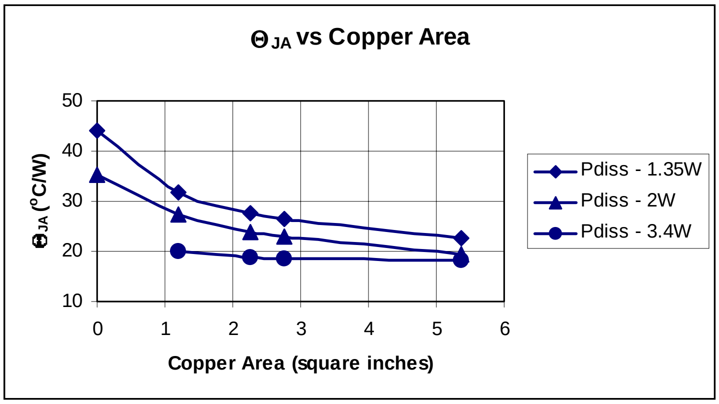
Power Dissipation Derating

For operating at ambient temperatures above 25°C the device must be derated based on a 150°C maximum junction temperature, T_{JMAX} as given by the following equation:

$$P_{DISS} = \frac{(T_{JMAX} - T_A)}{\theta_{JA}}$$

where…
P_{DISS} = maximum power dissipation
T_{JMAX} = maximum junction temperature of TA2024
T_A = operating ambient temperature
θ_{JA} = junction-to-ambient thermal resistance

Where θ_{JA} of the package is determined from the following graph:



In the above graph Copper Area is the size of the copper pad on the PC board to which the heat slug of the TA2024 is soldered. The heat slug must be soldered to the PCB to increase the maximum power dissipation capability of the TA2024 package. Soldering will minimize the likelihood of an over-temperature fault occurring during continuous heavy load conditions. The vias used for connecting the heatslug to the copper area on the PCB should be 0.013" diameter.

Performance Measurements of the TA2024

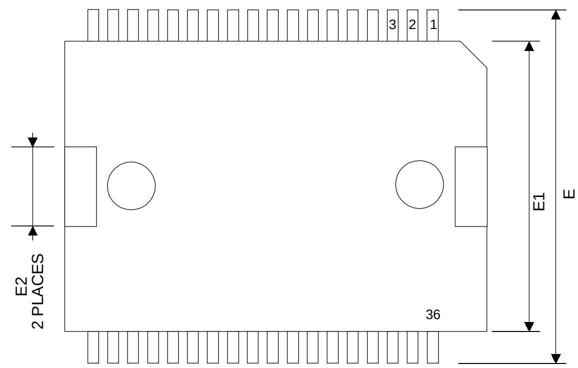
The TA2024 operates by generating a high frequency switching signal based on the audio input. This signal is sent through a low-pass filter (external to the Tripath amplifier) that recovers an amplified version of the audio input. The frequency of the switching pattern is spread spectrum and typically varies between 100kHz and 1.0MHz, 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 Tripath amplifier switching pattern will degrade the measurement.

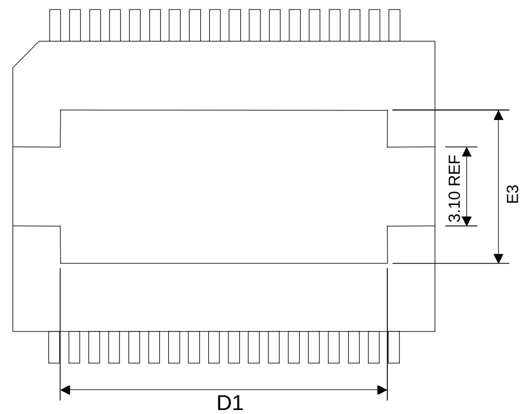
One feature of the TA2024 is that it does not require large multi-pole filters to achieve excellent performance in listening tests, usually a more critical factor than performance measurements. Though using a multi-pole filter may remove high-frequency noise and improve THD+N type measurements (when they are made with wide-bandwidth measuring equipment), these same filters degrade frequency response. The TA2024 Evaluation Board uses the Test/Application Circuit in this data sheet, which has a simple two-pole output filter and excellent performance in listening tests. Measurements in this data sheet were taken using this same circuit with a limited bandwidth setting in the measurement instrument.

Package Information
36-Lead Power Small Outline Package (PSOP),
compliant with JEDEC outline MO-166, variation AE:

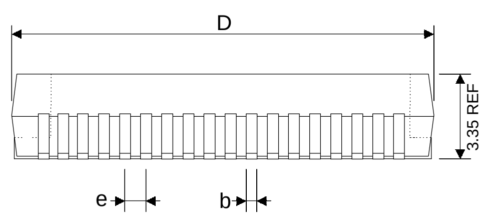
Package Dimensions for TYPE 1



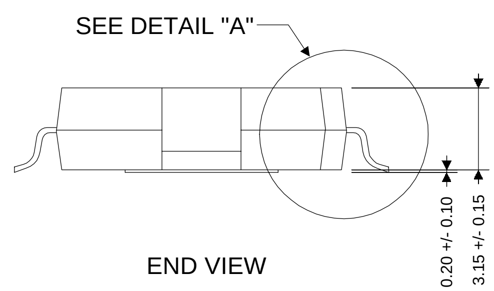
TOP VIEW



BOTTOM VIEW



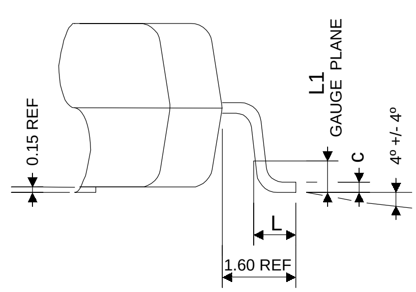
SIDE VIEW



END VIEW

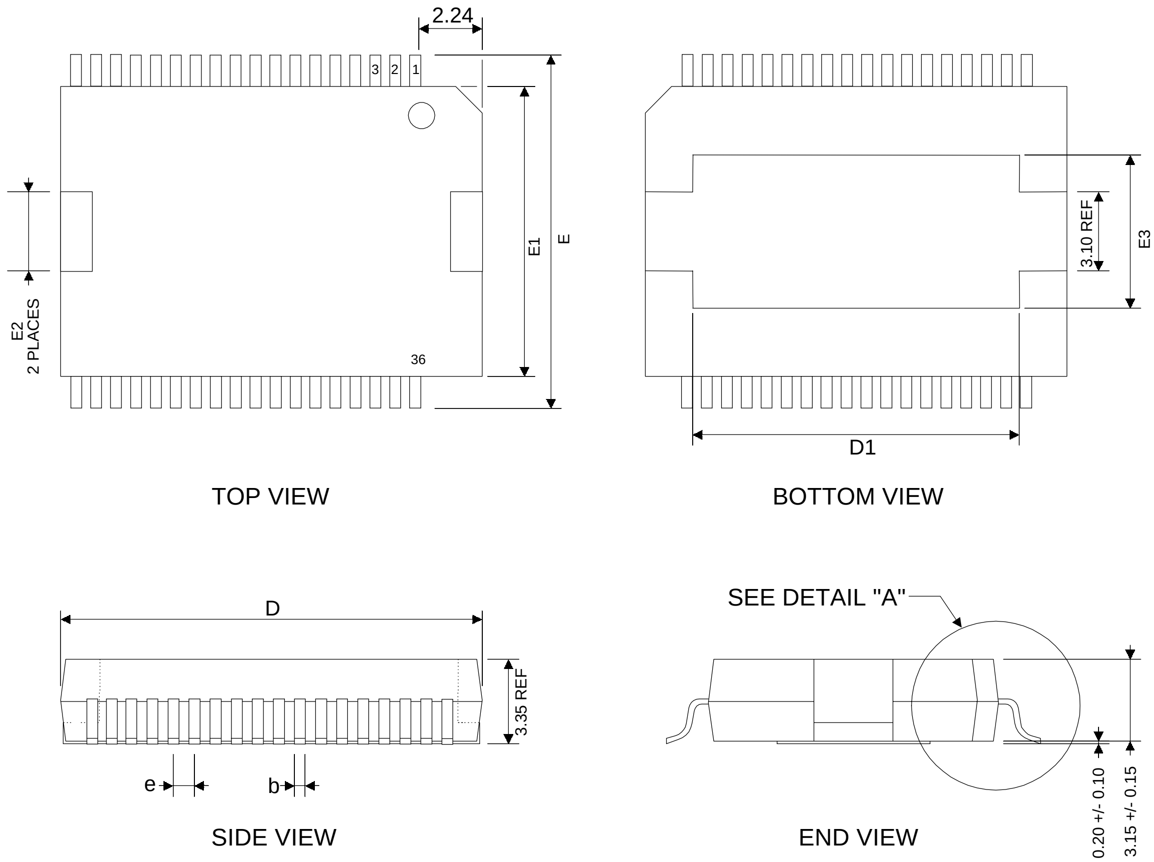
Dimension	Min.	Nom.	Max.
b	0.22	---	0.38
c	0.23	---	0.32
D	15.80	15.90	16.00
D1	9.40	---	9.80
E	13.90	14.20	14.50
E1	10.90	11.00	11.10
E2	---	---	2.90
E3	5.80	---	6.20
e	0.65 BSC.		
L1	0.35 BSC.		
L	0.80	---	1.10

Note: All dimensions are in millimeters.



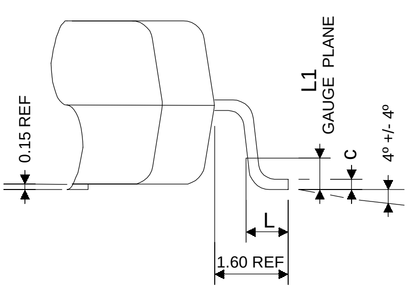
DETAIL "A"

Package Dimensions for TYPE 2



Dimension	Min.	Nom.	Max.
b	0.25	---	0.38
c	0.23	---	0.32
D	15.80	15.90	16.00
D1	9.00	---	13.00
E	13.90	14.20	14.50
E1	10.90	11.00	11.10
E2	---	---	2.90
E3	5.80	---	6.20
e	0.65 BSC.		
L1	0.35 BSC.		
L	0.80	---	1.10

Note: All dimensions are in millimeters.



DETAIL "A"

For more information on Tripath products, visit our web site at:

www.tripath.com

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