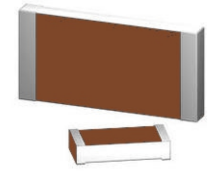
Texas Components Corporation

USA Manufacturer of **Bulk Metal® Foil*** Precision Resistors

ASM2575

'Naked' Bulk Metal® Foil Audio Resistor for Surface Mount Applications



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[The TX2575, released to the audio market by TxCC in 2008, is a Z-Foil based upgrade of the original TX2352 (created and introduced to the audio market by TxCC in 1997. The ASM2575 is the surface mount version of the TX2575. Also available is the ASM2352, which is the surface mount version of the original TX2352.]

Ultra High Precision; Ultra Low Noise and Distortion; Ultra High Linearity

Tight Tolerance, Low Temperature Coefficient of Resistance (TCR), and Low Voltage Coefficient of Resistance (VCR)

Resistors made with Bulk Metal® Foil are known for their unique combination of unmatched performance in all 10 major technical areas:

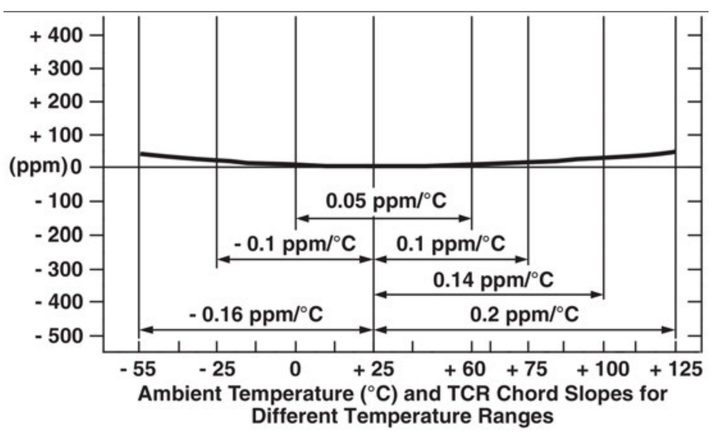
Temperature Coefficient of Resistance (TCR)	Tolerance
Power Coefficient of Resistance (PCR)	Thermal Stabilization
Voltage Coefficient of Resistance (VCR)	Load Life Stability
Thermal Electromotive Force (EMF)	Response Time
Electrostatic Discharge (ESD)	Noise

The ASM2575 uses the latest Bulk Metal® Z-foil technology, providing improved sound quality and featuring a combination of low noise and low inductance/capacitance that makes it unrivaled for applications requiring quiet, distortion-free performance. Bulk Metal® Foil resistors like the original TX2352 (created and introduced to the audio market by Texas Components in 1997) **are already widely acknowledged as the leading resistors for audio applications**, and **this special 'naked' design** (without molded encapsulation) **aids in reducing signal distortion and increasing both precision and clarity in signal processing**. For non-standard technical requirements and special applications, our sales staff and applications engineers are available and ready to make recommendations.

Table 1 - Best Available Characteristics of Different Resistor Technologies

Technology	Temperature Coefficient of Resistance (TCR) -55ºC to +125ºC, +25ºC ref.	Initial Tolerance	End of Life Tolerance	Load Life Stability at +70ºC, Rated Power at 2000 Hours and then at 10,000 Hours	ESD (V)	Thermal Stabilization	Noise (dB)
Bulk Metal® Foil	± < 1 ppm/°C	From 0.001%	< 0.05%	0.005% (50 ppm) 0.01% (100 ppm)	25,000V	< 1 second	**-42db**
Thin Film	±5 ppm/°C	From 0.05%	< 0.4%	0.05% (500 ppm) 0.15% (1500 ppm)	2,500V	> minutes	-20db
Thick Film	±50 ppm/°C	From 0.5%	< 5%	0.5% (5000 ppm) 2% (20,000 ppm)	2,000V	> minutes	+20db
Wirewound	±3 ppm/°C	From 0.005%	< 0.5%	0.05% (500 ppm) 0.15% (1500 ppm)	25,000V	> minutes	-35db

FIGURE 1 – TYPICAL Z-FOIL RESISTANCE/TEMPERATURE CURVE



Note: The TCR values for < 100Ω become more influenced by the lead/termination composition and result in a greater effectivedeviation from this curve for the resistor itself.

ASM2575 FEATURES & SPECIFICATIONS

- **Temperature coefficient of resistance (TCR):** ± 0.05 ppm/°C typical (0 °C to +60 °C, +25 °C ref) ± 0.2 ppm/°C typical (-55 °C to +125 °C, +25 °C ref)
- **Power coefficient of resistance** (ΔR due to self heating)**:** ± 5 ppm at rated power
- **Rated power:** 0.20 to 0.75 W rms at +70 °C
- **Resistance tolerance:** to ± 0.01 %
- **Exceptional load life stability:** ± 0.005 % at +70 °C, 2000 h at rated power
- **Resistance range:** 5Ω to 125kΩ (for lower or higher values, please contact us)
- **Bulk Metal® Foil resistors are not restricted to standard values**; specific custom values can be supplied at no extra cost (e.g. 1K2345 vs 1K)
- **'Naked' foil resistor** design, without molding or encapsulation, aids in reducing signal distortion and increasing clarity in signal processing paths
- **Electrostatic discharge (ESD)**: at least to 25 kV
- **Short time overload:** ≤ 0.005 %
- **Capacitance:** 0.5 pF typical; 1.0 pF max (non-capacitive design)
- **Rise time:** 1.0 ns, effectively no ringing
- **Current noise:** 0.010 µV (rms)/Volt of Applied Voltage (< -40 dB)
- **Thermal EMF:** 0.05 µV/°C typical (0.10 µV/°C max)
- **Voltage coefficient:** < 0.1 ppm/V
- **Thermal stabilization time:** < 1.0 sec (nominal value achieved within 10 ppm of steady state value)
- **Inductance:** < 0.08 µH typical; 0.1 µH maximum (non-inductive design)
- **Terminal Finish:** tin/lead alloy std; Pb free (RoHS-compliant) is available
- **Fast delivery of custom made units:** Typical lead time is 2-4 weeks, but expedited delivery in less than 1 week is possible even for custom values

*Bulk Metal® Foil is a registered trademark of Vishay Precision Group (VPG)

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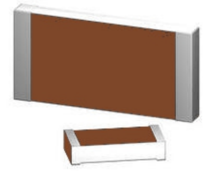

Note: actual color may vary

CHALLENGES IN AUDIO APPLICATIONS

Precision electronic equipment, including high-end audio equipment, will often suffer from noise effects due to tolerance stacking, circuit drift, and other instabilities. Constant adjustments, troubleshooting, and even **costly compensation circuitry can prove ineffective in addressing these problems** because **the source of such noise and instabilities can often be traced to simple "fixed" resistors** whose resistance values, in actual use, do not remain fixed. In addition, resistors can be direct sources of noise as well, depending on combinations of signal frequency, resistance value, current, temperature, applied voltage, and resistor type. **Many experiments have been done to show why some resistors are "noisier" than others**, but electronics experts and audiophiles agree that **what really matters is the true level of fidelity experienced by the user** when different resistor technologies are applied within audio system circuitry.

High-end audio applications require low intrinsic noise, highly linear amplification, and minimal dynamic distortion. The typical audio amplifier consists of a voltage preamplifier (preamp) and a power amplifier (final driver). The voltage **preamplifier deals with low-level signals, so its intrinsic noise level is critical**, while the **power amplifier must have a high linearity of amplification with minimal dynamic distortion**.

NOISE

Resistors can be one of the principal noise sources found in both preamplifiers and amplifiers. Several types of noise are found in and/or caused by resistors.

Thermal noise is **caused by thermal agitation of the discrete charge carriers (electrons) within the resistive material**. Thermal noise gets worse as resistance and temperature increase. Thermal noise is uniformly distributed throughout the audible frequency spectrum (as "white" noise).

Shot noise is **caused by fluctuations in the flow or density of discrete charges carriers (electrons) along the circuit**. Shot noise increases at high frequencies and as current and temperature decrease. Shot noise is uniformly distributed throughout the audible frequency spectrum (as "white" noise).

Flicker (aka current) noise is **caused by fluctuations in resistance along the signal path**, which is then transformed into voltage and/or current fluctuations - so it is highly dependent on the resistive material. Flicker noise increases as frequency decreases and current increases. **The use of resistors with a higher power rating than is otherwise needed can help to reduce flicker noise**. Flicker noise has a 1/f type spectral density of voltage (aka "pink" noise).

LINEARITY

In addition to noise, **every resistor possesses a certain nonlinearity of its electrical resistance** and, therefore, a nonlinearity in voltage and current characteristics. **The degree of nonlinearity depends on**, among other factors, **the internal microstructure of the resistive material**, the **quality and characteristics of calibration technique**, and **the quality of the contact between the resistive element and the terminals**.

Regarding the microstructure of the resistive material, **the most linear materials are pure metals and metal alloys in bulk, such as the foil in Bulk Metal® Foil resistors**. **Bulk Metal® Foil resistors are characterized by the exceptionally high intrinsic linearity** of their resistive element. **Bulk Metal® Foil resistors** owe their **high linearity**, and **ultra low current noise**, to the type of material they're made of (which is a cold-rolled metal foil several microns thick). When the same materials are deposited in the form of very **Thin (nanometer range) Films**, they **are less linear**. And **even less linear** than Thin Film resistors **are** the composite materials, like resistive cermets, used in **Thick Film** resistors, **and** the carbon compositions used in **Carbon Composition** resistors.

Regarding the other factors affecting linearity, **the trimming of Bulk Metal® Foil resistors** consists of cutting shorting bars/jumpers (which **do not damage the remaining current carrying portions of the resistive element**) and **the terminals in Bulk Metal® Foil resistors are an integral part of the foil resistive element** (**insuring a high-quality contact between resistive element and terminals**).

CONCLUSION

In summary, the **factors that cause noise and nonlinearity in other types of resistors are either minimized or not even relevant to Bulk Metal® Foil based resistors**. **Carbon Composition resistors are the noisiest resistive device type, followed by Thick Film** and **then Thin Film resistors**. The **least noisy are bulk metals and metal alloys (Bulk Metal® Foil and Wirewound)**. But, among other problems, **Wirewound resistors suffer from inherent inductance/capacitance** that **Bulk Metal® Foil resistors** do not have - so **the possibility, even probability, of self-excitation or "ringing" of the amplification circuit is reduced or eliminated when Bulk Metal® Foil resistors are used**. Both **noise and non-linearities are minimized by the inherent design and use of Bulk Metal® Foil resistors**.

For high-end audio equipment, **the careful selection of resistors is one of the best ways to avoid or minimize unwanted noise and distortion in the signal path,** and **Bulk Metal® Foil resistors, particularly the 'naked' versions** (without encapsulation)**, are by far the best possible choice for low-noise, high-fidelity applications.**

TABLE 2 – TCR BY RESISTANCE RANGE

RESISTANCE VALUE (Ω)*	TYPICAL TCR (& MAX SPREAD)
100Ω to 125kΩ	± 0.2 (± 1.8) (ppm/°C)
50Ω to <100Ω	± 0.2 (± 2.8) (ppm/°C)
10Ω to <50Ω	± 0.2 (± 3.8) (ppm/°C)
5Ω to <10Ω	± 0.2 (± 7.8) (ppm/°C)

* For resistance values below 10Ω or above 125kΩ, or other tighter and/or extended performance characteristics, please contact us.

TABLE 3 – AVAILABLE TOLERANCES BY RESISTANCE RANGE

RESISTANCE VALUE (Ω)*	AVAILABLE TOLERANCE (%)	CODE
250Ω to 125kΩ	±0.01%	T
100Ω to 125kΩ	±0.02%	Q
50Ω to 125kΩ	±0.05%	A
25Ω to 125kΩ	±0.1% (recommended)	B
10Ω to 125kΩ	±0.25%	C
5Ω to 125kΩ	±0.5%	D
5Ω to 125kΩ	±1.0%	F

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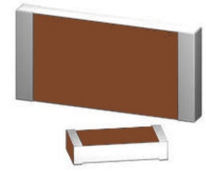
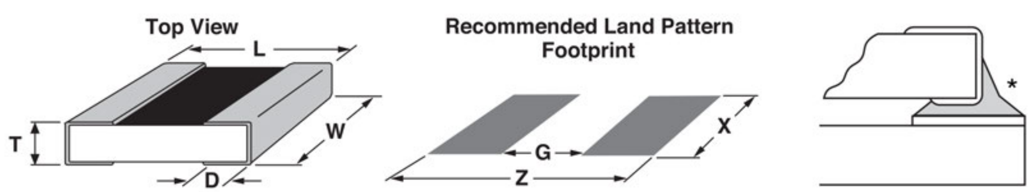


Note: actual color may vary

TABLE 4 – SPECIFICATIONS					
CHIP SIZE	**RATED POWER** (mW) at + 70 °C	**MAX WORKING VOLTAGE**	**RESISTANCE RANGE** (Ω)*	**MAXIMUM WEIGHT** (mg)	**LOAD LIFE STABILITY** MAXIMUM ΔR LIMITS (+70 °C for 2000 h)
0805	200	40 V	5 to 8k	6	± 0.01 % at 200 mW (± 0.005 % at 100 mW)
1206	300	87 V	5 to 25k	11	± 0.01 % at 300 mW (± 0.005 % at 150 mW)
1506	300	95 V	5 to 30k	12	± 0.01 % at 300 mW (± 0.005 % at 150 mW)
2010	500	187 V	5 to 70k	27	± 0.01 % at 500 mW (± 0.005 % at 200 mW)
2018	750	122 V	5 to 20k	40	± 0.01 % at 750 mW (± 0.005 % at 500 mW)
2512	750	220 V	5 to 125k	40	± 0.01 % at 750 mW (± 0.005 % at 500 mW)

* For resistance values below 10Ω or above 125kΩ, or for other tighter and extended performance characteristics, please contact us.

TABLE 5 - DIMENSIONS, LAND PATTERN, and RECOMMENDED MOUNTING



CHIP SIZE	L ± 0.005 (0.13)	W ± 0.005 (0.13)	THICKNESS MAXIMUM	D ± 0.005 (0.13)	Z(2)	G(2)	X(2)
0805	0.080 (2.03)	0.050 (1.27)	0.025 (0.64)	0.015 (0.38)	0.122 (3.10)	0.028 (0.71)	0.050 (1.27)
1206	0.126 (3.20)	0.062 (1.57)	0.025 (0.64)	0.020 (0.51)	0.175 (4.45)	0.059 (1.50)	0.071 (1.80)
1506	0.150 (3.81)	0.062 (1.57)	0.025 (0.64)	0.020 (0.51)	0.199 (5.05)	0.083 (2.11)	0.071 (1.80)
2010	0.198 (5.03)	0.097 (2.46)	0.025 (0.64)	0.025 (0.64)	0.247 (6.27)	0.115 (2.92)	0.103 (2.62)
2018	0.204 (5.18)	0.184 (4.67)	0.025 (0.64)	0.018 (0.46)	0.248 (6.30)	0.146 (3.71)	0.184 (4.67)
2512	0.249 (6.32)	0.127 (3.23)	0.025 (0.64)	0.032 (0.81)	0.291 (7.39)	0.150 (3.81)	0.127 (3.23)

Note:

(1) Measurements are in inches (and millimeters)
(2) Land Pattern Dimensions are per IPC-7351A
(3) IR and vapor phase reflow are recommended.
(4) Avoid the use of cleaning agents which could attack the epoxy resins that form part of the resistor construction.
(5) Vacuum pick up is recommended for handling.
(6) If the use of a soldering iron becomes necessary, precautionary measures should be taken to avoid any possible damage / overheating of the resistor.
***(7) The solder fillet profile should be designed and controlled so as to avoid running over the top metallization.** (See illustration above.)

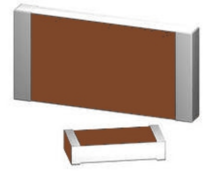


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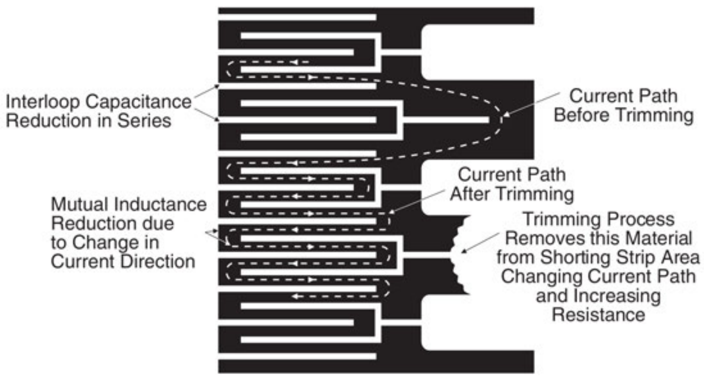
FIGURE 2 - TRIMMING TO SPECIFIC VALUES
(a conceptual illustration of Bulk Metal® Foil)



Note: Foil shown in black, etched spaces in white

To achieve a precise resistance value, the Bulk Metal® Foil chip is **adjusted by selectively removing built-in "shorting bars"**. To increase the resistance in known increments, marked areas are cut, producing progressively smaller increases in resistance. **This method reduces** the effect of **"hot spots"** and **improves the long term stability of the resistor**.

FIGURE 3 - POWER DERATING CURVE

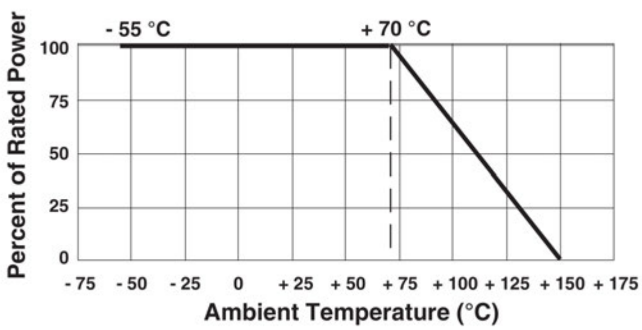


TABLE 6 – ESD TEST RESULTS

Volts	ΔR (%)		
	Thick Film	Thin Film	Bulk Metal® Foil
2500	-2.7	97	< 0.005
3000	-4.2	366	< 0.005
3500	-6.2	Open	< 0.005
4000	-7.4	Open	< 0.005
4500	-8.6	Open	< 0.005

ELECTROSTATIC DISCHARGE (ESD)

ESD can be categorized into three types of damages:

Parametric Failure - occurs when the ESD event alters one or more device parameters (resistance in the case of resistors), causing it to shift from its required tolerance. This failure does not directly pertain to functionality; thus a parametric failure may be present while the device is still functional.

Catastrophic Damage - occurs when the ESD event causes the device to immediately stop functioning. This may occur after one or a number of ESD events with diverse causes, such as human body discharge or the mere presence of an electrostatic field.

Latent Damage - occurs when the ESD event causes moderate damage to the device, which is not noticeable, as the device appears to be functioning correctly. However, the load life of the device has been dramatically reduced, and further degradation caused by operating stresses may cause the device to fail during service. Latent damage is the source for greatest concern, since it is very difficult to detect by re-measurement or by visual inspection, because damage may have occurred under the external coating.

TABLE 6 – HOW TO ORDER THE CORRECT PART NUMBER

MODEL	CHIP SIZE	RESISTANCE VALUE	TOLERANCE (See Table 3)		TERMINATIONS (FINISH)	PACKAGING
ASM2575	0805,1206, 1506, 2010, 2018, 2512	5Ω to 125kΩ (R = Ω and K = kΩ) Always given as 6 characters	0.01% to 1.0%	T,Q,A,B, C,D,F	TIN/LEAD (Std) = B LEAD (Pb) FREE = S	T= tape & reel W= waffle pack
A 20,001 ohm resistor, 2512 chip, a tolerance of 0.01%, with lead free terminations, and tape & reel would be ordered as: **ASM2575-2512-20K001-TST**						
A 15.3 ohm resistor, 0805 chip, a tolerance of 0.5%, with standard terminations, and waffle pack would be ordered as: **ASM2575-0805-15R300-BBW**						

(Note: Due to limited surface space, the value and tolerance are not printed on the ASM2575)

For more information about this subject or this product line, please contact us at resistorinfo@texascomponents.com. You can also "Follow" Texas Components and Bulk Metal® Foil Resistors on Twitter @TexasComponents and/or "Like" Texas Components on Facebook.