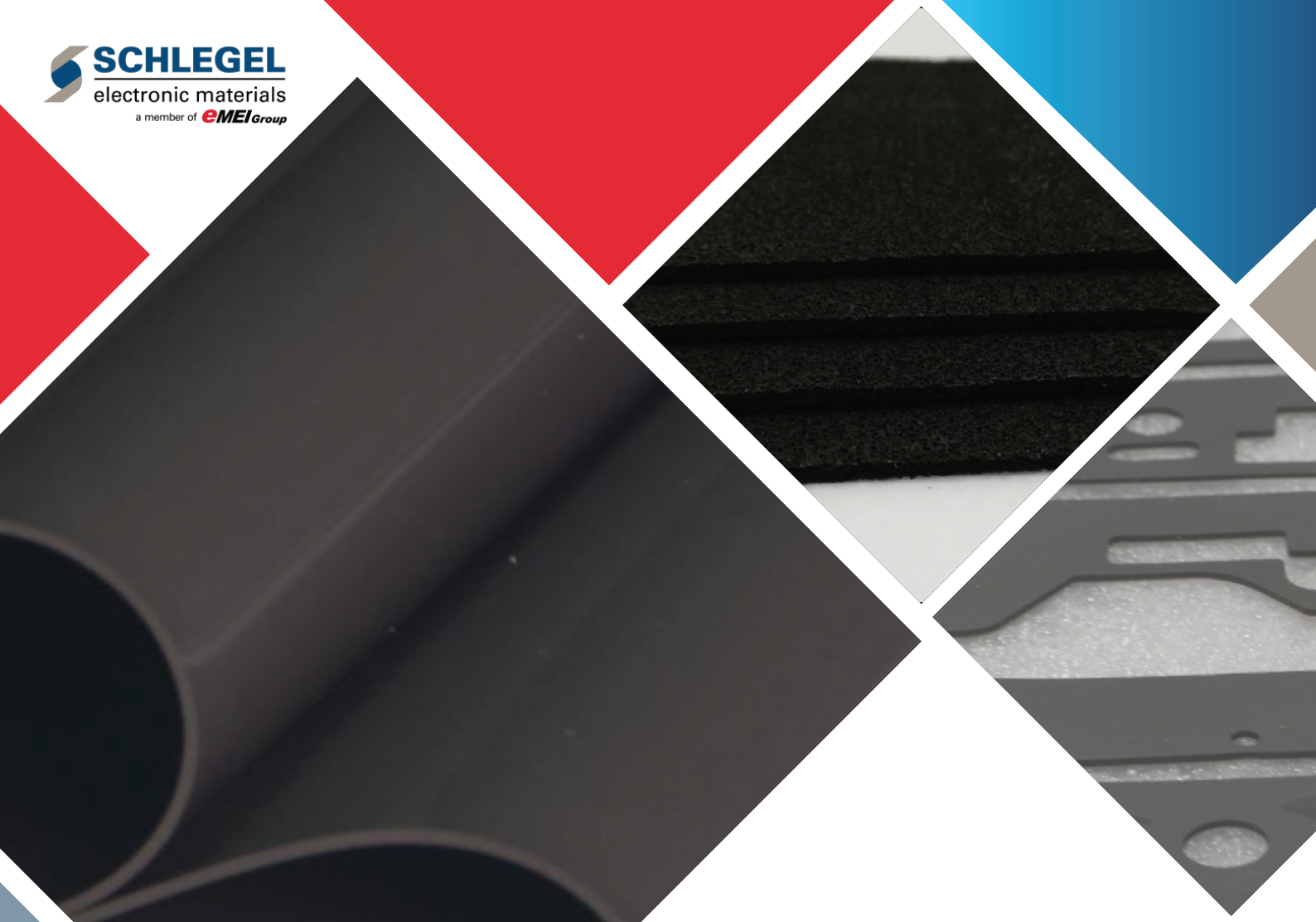
SCHLEGEL
electronic materials
a member of eMEI Group



ARE YOUR EMI ISSUES ON THE RISE?

BandSorb® elastomer absorbers

by Schlegel Electronic Materials, a leader in the design, development, and manufacturing of EMI/RF absorber materials,

Explore our robust line of HIGH-PERFORMANCE absorber products.

Any size designs | Quality Assurance

Our standard quality control process gives Schlegel the unique capability to offer measurement, ensuring every product that leave our facility meets your requirement.

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Microwave Absorber-BandSorb®

The increase in the number of electronic devices in the marketplace has cultivated the rise of electromagnetic interference (EMI) issues with unpredictable and troublesome effects. This has brought an inevitable hardship to design engineers and the challenges they face as today's electronic equipment becomes thinner and multifunctional (e.g., smartphone, GPS, wireless LANs). Although the EMI can be reduced by a proper PCB design, RF noise remains one of the most difficult tasks facing design engineers.

To eliminate the RF noises, shielding with conductive material (e.g., shielding can, conductive gasket) is the most common technique used today. It envelops the noise source, increases the grounding level, and suppresses the radiated noise. However, present-day electronic devices operate at hundreds of MHz with harmonic emissions in GHz region. The reflected high-frequency signal in a conductive shielding system can cause severe problems to the shielded device itself or other adjacent electronic components. Furthermore, a highly integrated electronic system can create more complex RF issues that cannot be eliminated with simple shielding and grounding techniques (Fig. 1).

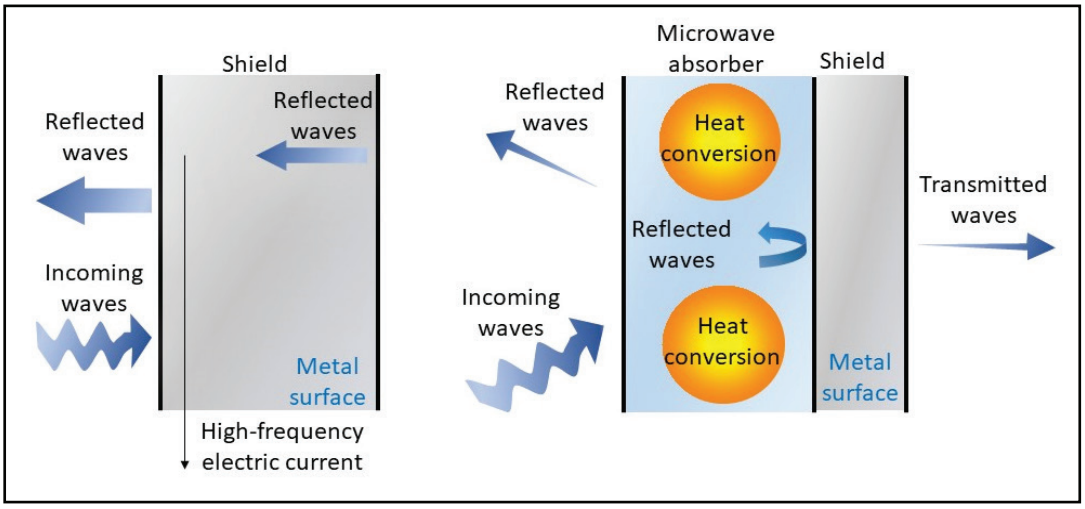


Fig. 1. Pathway of the EM waves, with and without the presence of microwave absorber.

As a result, we at Schlegel Electronic Materials (SEM) have developed the BandSorb® microwave absorbing materials whose range of electrical and magnetic properties allow attenuation of noise from 5 MHz to 40 GHz. These materials can be easily integrated into very tight spaces.

Microwave Absorption Theory

Microwave absorbers are a composite material that consists of dielectric and magnetic fillers inside a polymeric matrix. These fillers modify the relative complex permittivity and permeability of the base material, governing the microwave absorber's key parameters.

When the electromagnetic (EM) waves propagate through a microwave absorber, not all the energy is absorbed; part of it is reflected or transmitted (Fig.2). Polarization of the dielectric component of the microwave absorber by the electric field (E) of EM waves gives rise to the relative complex permittivity, $\varepsilon^* = \varepsilon' - j\varepsilon''$. The real part of the dielectric constant ε' refers to the storage capability of the EM wave energy while the imaginary part of the dielectric constant ε'' indicates the extent of attenuation of the electric field by the microwave absorber. The ratio of the imaginary to the real part affords the electric loss tangent, $tan\delta_e = \varepsilon''/\varepsilon'$ which denotes the energy loss in the microwave absorber. The greater the loss tangent, the higher the attenuation of EM waves.

Similarly, the interaction of the magnetic component of the microwave absorber with the magnetic field (H) of EM waves derives the relative complex permeability $\mu^*=\mu'-j\mu''$ and the ratio of the imaginary to the real part defines the magnetic loss tangent $tan\delta_m = \mu''/\mu'$. As the electric field and magnetic field are coupled in EM waves, energy loss in either field will attenuate the energy in EM waves. Therefore, knowing the complex permittivity and permeability over a frequency range allows one to determine the attenuation which is given by:

$$Attenuation\ \left(\frac{dB}{cm}\right) = \frac{2\pi(8.686)}{\lambda_0}\sqrt{\frac{\mu'\varepsilon'}{2}\left(\sqrt{(1+tan^2\delta_e)(1+tan^2\delta_m)} - (1-tan\delta_e tan\delta_m)\right)}$$

Note that the attenuation values do not relate directly to any particular measurement, and the reader should be cautious about using the numbers to predict the reflectivity. Only use the attenuation to compare the relative absorption efficiency of different materials.

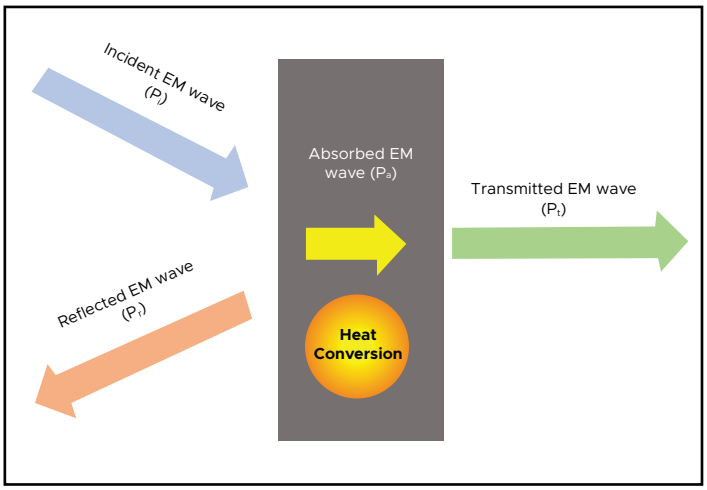


Fig. 2. Schematic diagram of power during the interaction between EM waves and microwave absorber.

At the same time, part of the EM waves' energy is reflected when it propagates through a free space impedance Z_0 and is struck at the microwave absorber boundary of impedance Z_1. The reflection from the dielectric interface depends on the degree of polarization which can be further divided into two categories, perpendicular, and parallel polarization. The former takes place when the H is parallel to the plane of incidence while the E is perpendicular to the plane of incidence. On the other hand, the orientation of the H and E in parallel polarization is the opposite, see Fig. 3.

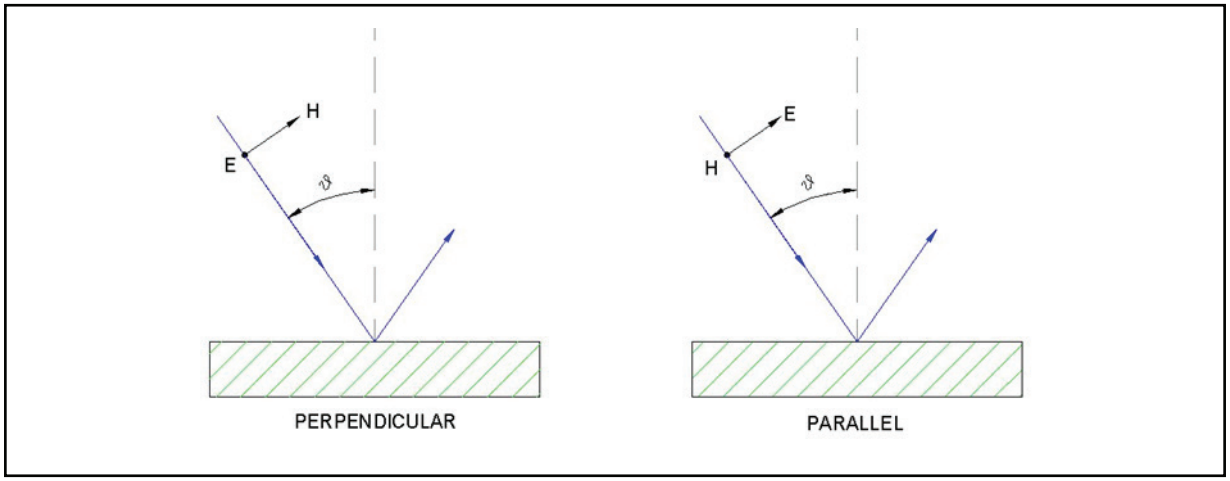


Fig. 3. Plane wave polarization definitions.

The interface reflection coefficient for the perpendicular (r_{perp}) and parallel (r_{par}) polarization is given below.

$$r_{perp} = \frac{\mu^* cos\Theta - \sqrt{\mu^*\varepsilon^* - sin^2\Theta}}{\mu^* cos\Theta + \sqrt{\mu^*\varepsilon^* - sin^2\Theta}}$$

$$r_{par} = \frac{\sqrt{\mu^*\varepsilon^* - sin^2\Theta} - \varepsilon^* cos\Theta}{\sqrt{\mu^*\varepsilon^* - sin^2\Theta} + \varepsilon^* cos\Theta}$$

As the waves propagate through the distance *d* across the microwave absorber, it experiences a phase delay and the electrical thickness, ø is given by

$$ø = \frac{2\pi d}{\lambda_0}\sqrt{\mu^*\varepsilon^* - sin^2\Theta}$$

where $\boldsymbol{\lambda}_0$ is the free space wavelength. The equation is further simplified by $\mu^* = 1$ if the microwave absorber is made up of non-magnetic particles.

Eventually, the wave arrives at the other end of the microwave absorber and is reflected. Therefore, the total reflection from a microwave absorber with a thickness of *d* is derived from the sum of the reflected waves and is given by

$$Voltage\ Reflection\ Coefficient,\ R = \frac{-r^*(1-e^{-j2\emptyset})}{1-r^2e^{-j2\emptyset}}$$

(r is the appropriate interface reflection coefficient)

The logarithm of R will give reflection reported in dB.

$$REFLECTION\ (dB) = 10\log(\frac{1}{|R|^2})$$

In most cases, the microwave absorber is backed with a metal plate, and the voltage reflection coefficient becomes

$$Voltage\ Reflection\ Coefficient,\ R_{MB} = \frac{r-e^{-j2\emptyset}}{1-re^{-j2\emptyset}}$$

(r is the appropriate interface reflection coefficient)

The logarithm of R_{MB} will give reflectivity reported in dB.

$$REFLECTIVITY\ (dB) = 10\log(\frac{1}{|R_{MB}|^2})$$

Alternatively, R can be calculated based on the ε^* and μ^* by applying the transmission line theory, as shown in the following equation.

$$R = \frac{Z_{in} - Z_0}{Z_{in} + Z_0}$$

$$Z_{in} = Z_c \frac{Z_L + Z_c \tanh(j\beta d + \alpha d)}{Z_c + Z_L \tanh(j\beta d + \alpha d)}$$

$$\gamma = j\omega\sqrt{\varepsilon^*\mu^*} = \alpha + j\beta$$

$$\omega = 2\pi f$$

Where

R = the voltage reflection coefficient

Z_{in} = the input impedance at the front of the microwave absorber

Z_0 = the input impedance of free space (377 Ω)

Z_L = the load impedance seen at the back of the microwave absorber

Z_c = characteristic impedance of absorber material $\sqrt{\mu^*/\varepsilon^*}$

d = the thickness of the microwave absorber

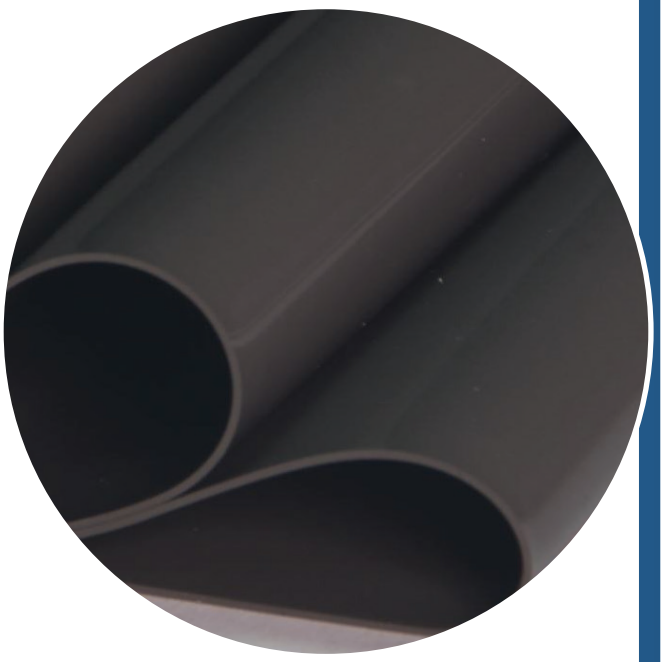
γ = propagation constant

α = attenuation coefficient

β = phase-change coefficient

ω = radian frequency

f = frequency



As microwave absorber is commonly backed with a metal plate, the Z_L = 0 and the Z_{in} is further simplified as follows.

$$Z_{in} = Z_c \tanh(j\beta d + \alpha d)$$

Again, the logarithm of R will give reflection reported in dB.

$$REFLECTION\ (dB) = 10\log(\frac{1}{|R|^2})$$

Solutions Across a Wide Range of Applications

SEM developed the BandSorb® series in response to an urgent need for a simple yet reliable device to tackle the EMI problem. With our broad experience and expertise in the field of EMI shielding, plus our extensive collaboration with highly respected universities around the world, we can offer an effective EMI mitigating solution. Besides, our dedicated manufacturing site and R&D team work closely with our customers to provide custom solutions where needed.

The BandSorb® absorbers are currently available as polymeric elastomer and dielectric foam absorbers.

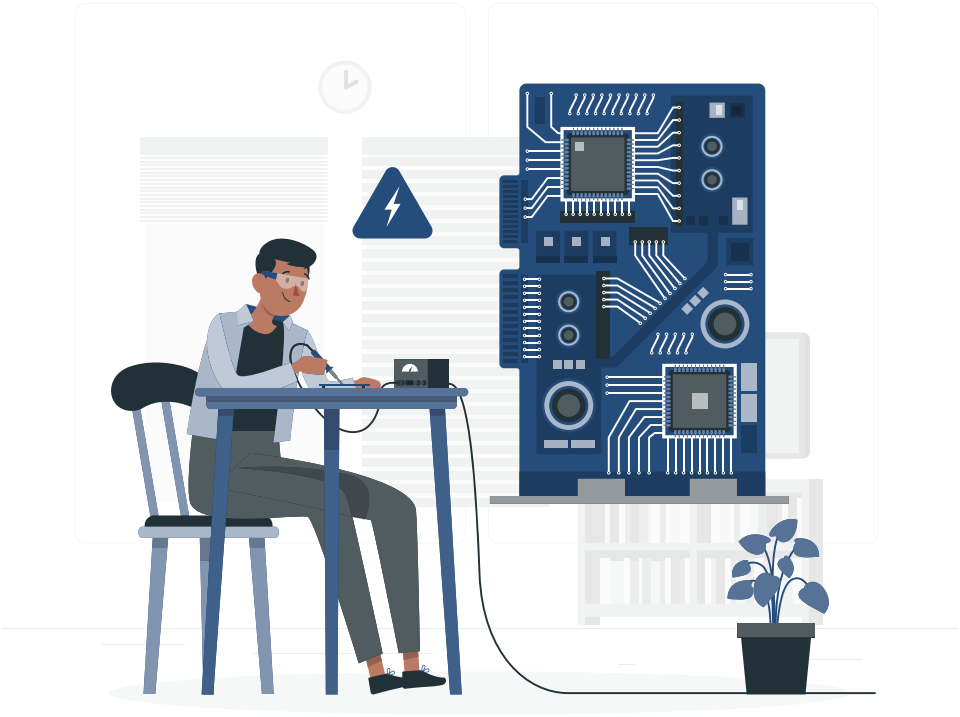
SC - a flexible, high-loss, magnetically loaded, electrically non-conductive silicone rubber.

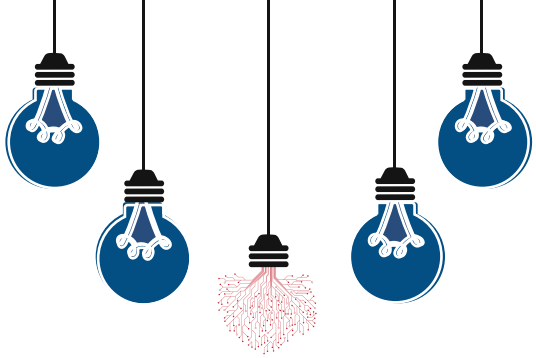
ST - a resonant silicone absorber that reflects -20 dB or less.

SN - an ultrathin near field noise suppression elastomeric absorber.

HP - a thin high permeability ferrite sheet.

FB - a lightweight high-loss carbon-impregnated dielectric foam absorber.





BandSorb® SC Series

Magnetically loaded, electrically non-conductive silicone EMI/RF absorber

Description:

Schlegel's new range of elastomer Cavity resonance (BandSorb® SC) Absorbers materials consists of thin, flexible, high-loss, magnetically loaded, electrically non-conductive silicone rubber. Schlegel can provide this material with different configurations for use in the frequency range of 1 GHz up to millimeter waves. With our own dedicated manufacturing site and R&D team, we can work closely with our customers to provide custom solutions where needed.

Availability:

We supply BandSorb® SC series materials in sheets as well as custom die-cut or kiss-cut configurations. We can provide the BandSorb® SC materials with or without pressure-sensitive adhesive (PSA). A myriad of options gives our customers flexibility when choosing which BandSorb® SC product will work best in their design. BandSorb® SC materials are available in standard thicknesses; however, we also offer custom sizes and thicknesses to suit your specific requirements.

Features and Benefits:

Dielectric and magnetic loaded.

RoHS, Halogen Free, Reach compliant

Applications:

BandSorb® SC series provides a flexible solution that supports a wide range of EMI and RF suppression requirements.

Suppressing resonance and harmonics from circuitry, absorbing RF emissions from wiring, and reducing interference from internal peripheral devices are just a few examples of using BandSorb® SC inside electronics housings such as computers, server racks, and switches.

Designers can also use the BandSorb® SC series to reduce RF coupling between microwave components inside electronic housings. Typical applications include power amplifiers, oscillators, and up/down converters.

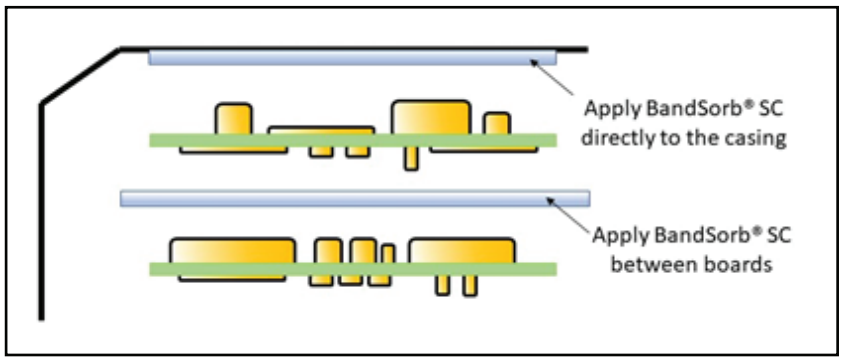
When bonded to a metal surface, the BandSorb® SC series will significantly reduce the reflectivity of metal objects or structures by absorbing microwave currents.

In the telecommunications market, the material can be applied to antenna elements, microwave dishes, the inner or outer surfaces of waveguides for isolation, attenuation, or radiating pattern modifications. When applied to certain objects' side or even rear surfaces, this material will cause a significant reduction in "head-on" reflectivity or backscattering.

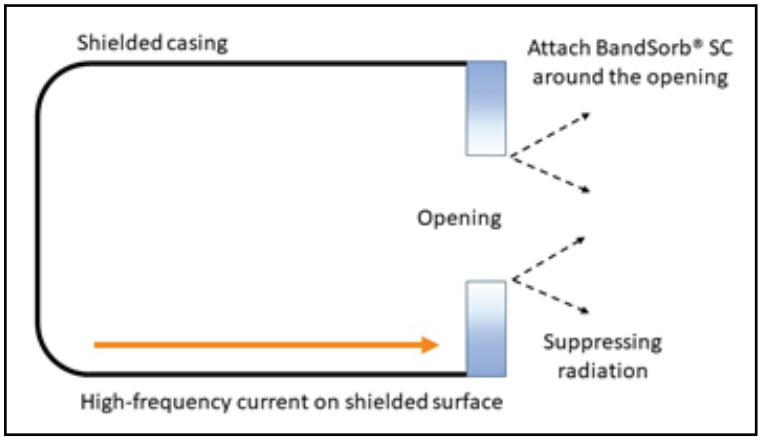
BandSorb® SC series can also be used for circuit-to-circuit EMI interference and reduction of unwanted emissions from the imaging CCDs and LCDs displays.

In the automotive market, the BandSorb® SC series can be used to suppress interference from onboard electronics, such as telematics and GPS circuitry.

Example 1 – To suppress noise reflected by casing and cross-talk between substrates.



Example 2 – To suppress noise radiation (reflected noise) from the opening of shield or casing.



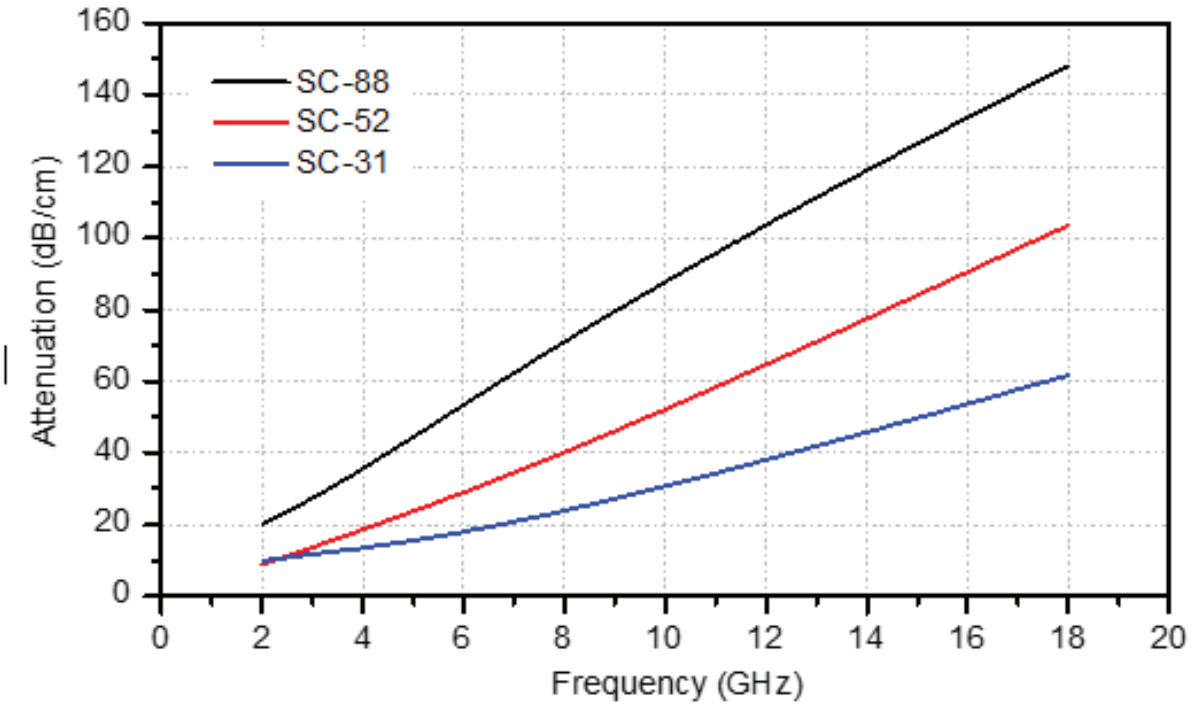
Physical Properties:

Datasheet for Performance Characteristics					
CHARACTERISTICS	**TEST**	**UNIT**	**SPECIFICATIONS**		
SEM Elastomers Absorber	-	-	SC-31	SC-52	SC-88
Typical Frequency Range	-	GHz	≥ 12	≥ 6	< 6
Typical Thicknesses	-	mm (inch)	0.25 (0.01), 0.50 (0.02), 1.0 (0.04) and 1.5 (0.06)		
Typical Size	-	mm (inch)	300 x 300 (11.8 x 11.8)		
Elastomer Binder	-	-	Silicone		
Hardness	ASTM D 2240	Shore A	65	75	87
Elongation	ASTM D 412	%	40	37	12
Tensile Strength	ASTM D 412	MPa (psi)	3.3 (479)	4.5 (653)	4.1 (595)
Maximum Service Temperature	-	℃(°F)	170 (338)	170 (338)	170 (338)
Flammability Rating	UL94*	-	V0	V0	V0
Color	-	-	Grey	Grey	Grey
Volume Resistivity	ASTM D 991	Ω-cm (Ω-in)	$> 10^{10}$ ($> 4 \times 10^{9}$)	$> 10^{10}$ ($> 4 \times 10^{9}$)	$> 10^{10}$ ($> 4 \times 10^{9}$)
Compliance	2011/65/EU (RoHS 2.0) Compliance, REACH SVHC Compliance, Halogen-free				

***Tested in according to UL94 specification**

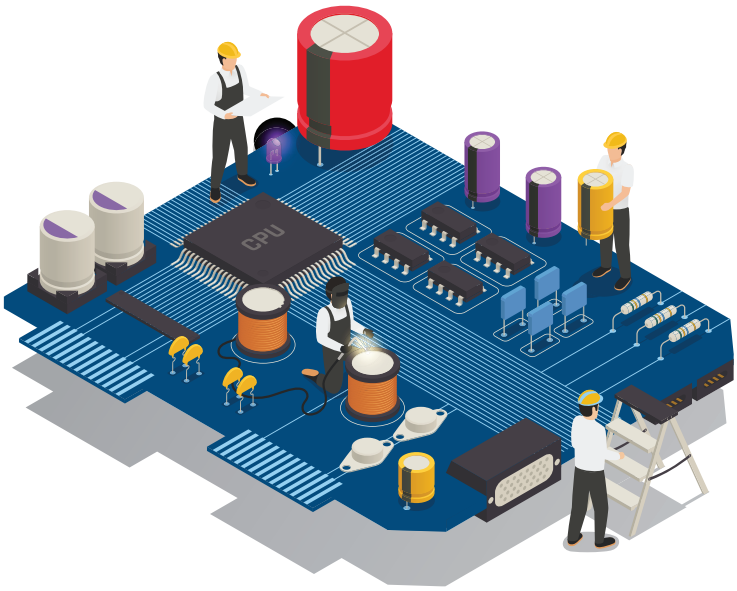
-The technical specification data is based on SEM tests and analysis that we believe to be reliable. SEM will not be held responsible for inaccuracies or omissions contained therein. In all cases, details and values should be verified by the customer

Electromagnetic Properties:



Part number system example:

SC	- 88	- 025	- A
Product name	attenuation@10GHz	thickness (0.25 mm)	with Pressure Sensitive Adhesive: A, blank: no tape



BandSorb® ST Series

Thin, flexible, resonant magnetically loaded microwave absorber

Description:

BandSorb® ST is a series of resonant absorbers which reflect -20 dB or less of normally incident microwave energy at the design frequency in the range of 1.5 to 26 GHz. Designers can use it for applications requiring absorption at a specific frequency or in a narrow frequency band.

Availability:

SEM supplies BandSorb® ST series materials in sheets and custom configurations. The standard sheet size is 300 mm x 300 mm. BandSorb® ST has a varying thickness according to the desired resonant frequency. Grades are designated by a suffix corresponding to the resonant frequency.

Features and Benefits:

BandSorb® ST consists of a thin, flexible, high-loss, magnetically loaded, electrically non-conductive silicone rubber. Silicone absorbers have high service temperature capability (170°C continuous) and allow short exposure to higher temperatures.

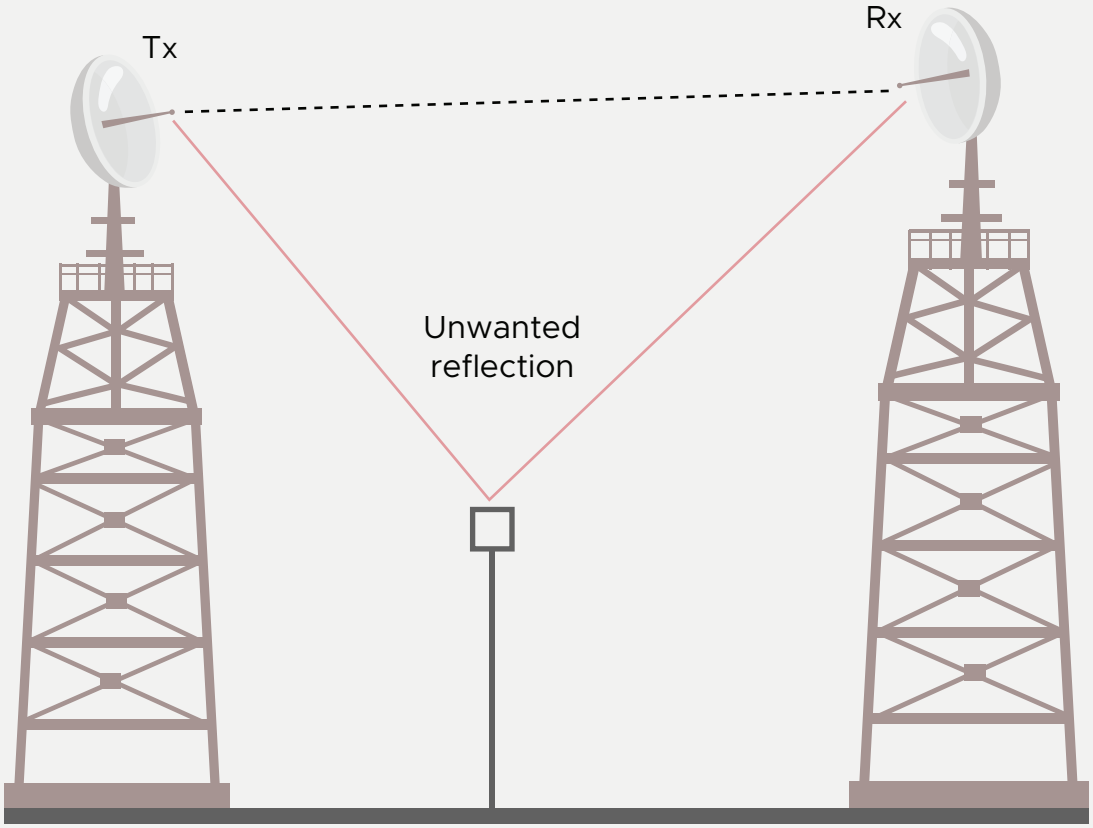
Applications:

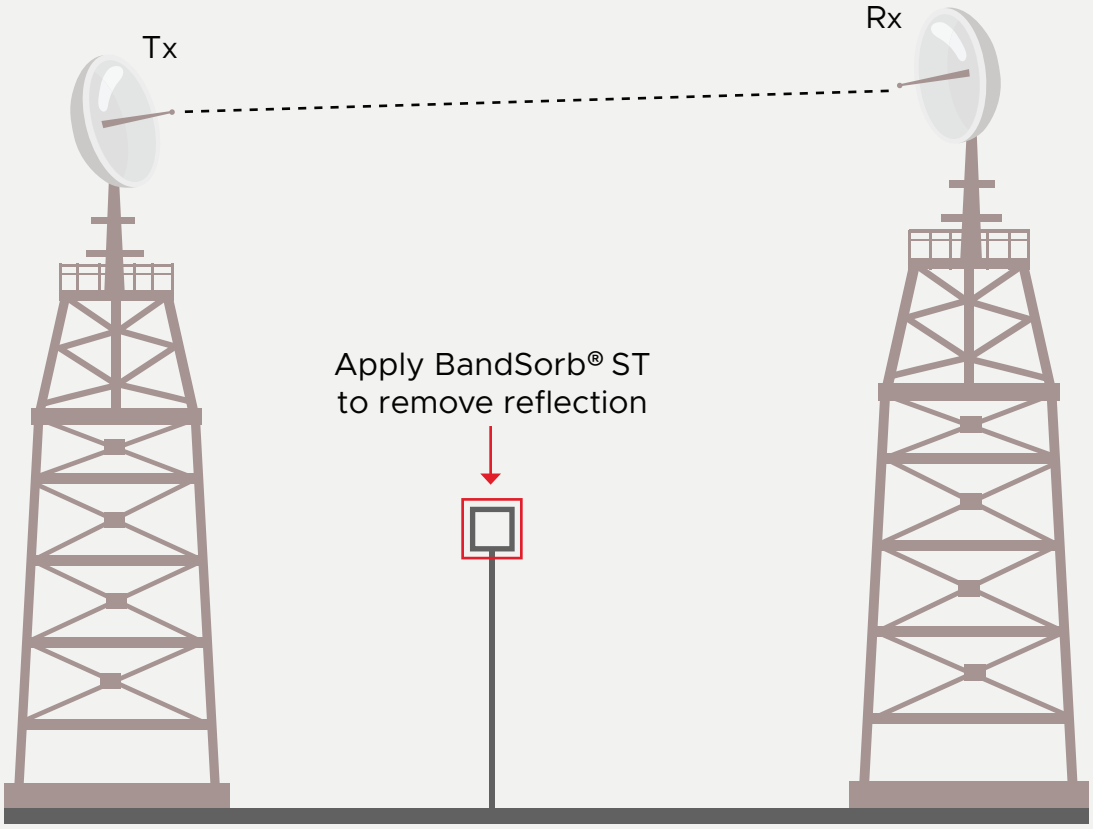
BandSorb® ST series can be used to absorb at a specific frequency or in a narrow frequency band, including:

- Attaching to masts of ships, walls, etc. to reduce reflections and echoes from nearby antennas
- Attaching to vehicles to reduce radar signature.
- Lining magnetron housings to prevent detuning.
- Fabricating into tapered shapes for impedance matching in waveguide or microstrip applications.
- Suppressing reflections, surface currents, and cavity resonances inside microwave modules.
- Lining of cavity-backed and shrouded telecommunication antennas where narrowband performance is required, e.g., waveguide feeds.

For module interference, cavity resonance and surface current problems where no specular reflectivity performance is required, BandSorb® ST, is recommended due to its high magnetic loss properties.

Example 1 – To remove unwanted reflection from substrate.





Physical Properties:

Datasheet for Performance Characteristics			
CHARACTERISTICS	**TEST**	**UNIT**	**SPECIFICATIONS**
Design Frequency range	Reflectivity	GHz	1.5 to 18
Thicknesses		mm (inch)	1.2 - 4.5 (0.047-0.177)
Typical Size		mm (inch)	300 x 300 (11.8 x 11.8)
Elastomer Binder			Silicone
Hardness	ASTM D 2240	Shore A	50-95
Elongation	ASTM D 412	%	10-180
Tensile Strength	ASTM D 412	MPa (psi)	2-6 (479)
Maximum service Temperature		°C (°F)	170 (338)
Flammability Rating	UL94*	-	V0
Color	-	-	Grey
Volume Resistivity	ASTM D 991	Ω-cm (Ω-in)	> 10^{10} (>4 x 10^{9})
Compliance			2011/65/EU (RoHS 2.0) Compliance, REACH SVHC Compliance, Halogen-free

***Tested in according to UL94 specification**

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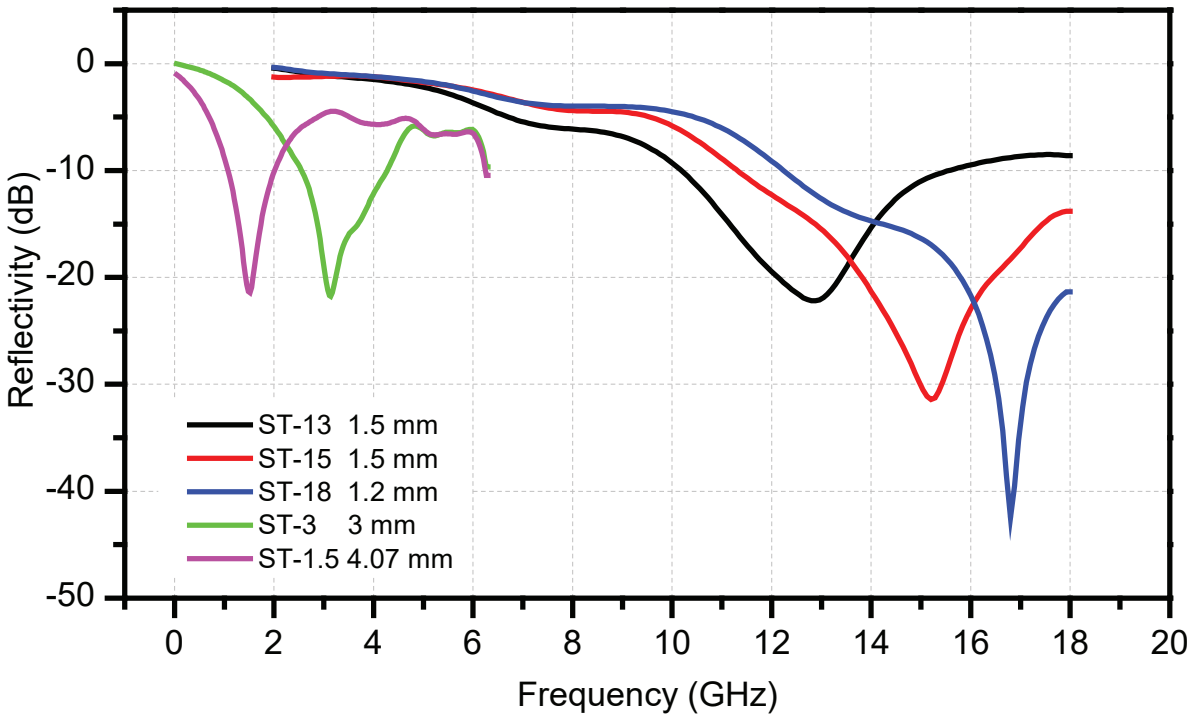
Electromagnetic Properties:



INSTRUCTIONS FOR USE:

BandSorb® ST is designed to function directly in front of a metallic surface. If this is not the case, a metallic foil should first be bonded to the object. BandSorb® ST materials can be supplied with or without pressure-sensitive adhesive (PSA). It can be readily cut with or a sharp knife. It is a very flexible material and will conform to mild curvatures.

PART NUMBER SYSTEM EXAMPLE:

ST	- 15	- A
Product name	Resonant Frequency (GHz)	with Pressure Sensitive Adhesive: A, blank: no tape

BandSorb® SN Series

Ultra-thin, highly permeable EMI/RF absorber

Description:

BandSorb® SN series is an ultrathin near field noise suppression absorber used for EMI control in electronic devices. The absorber is designed for the frequency range from 10 MHz up to 6 GHz. It is used to mitigate EM energy; it interacts and suppresses the magnetic field at the noise source.

Availability:

SEM supplies BandSorb® SN series materials in sheets and custom configurations; standard sheet size is 300 mm x 300 mm. BandSorb® SN materials can be supplied with or without pressure-sensitive adhesive (PSA).

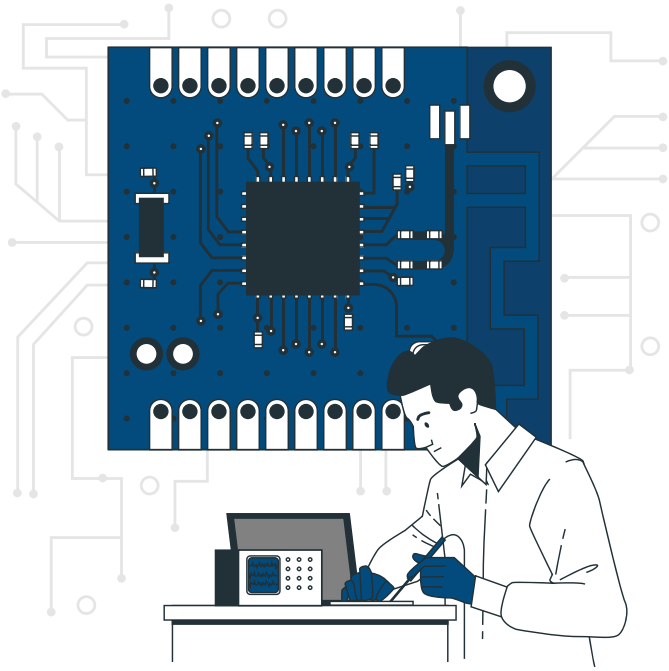
Features and Benefits:

High magnetic permeability.

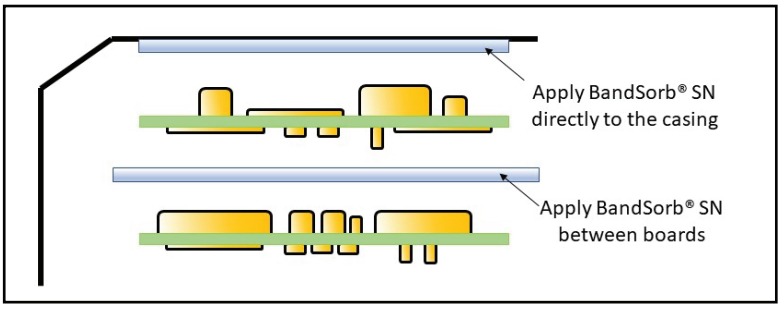
RoHS, Halogen Free, Reach compliant.

Applications:

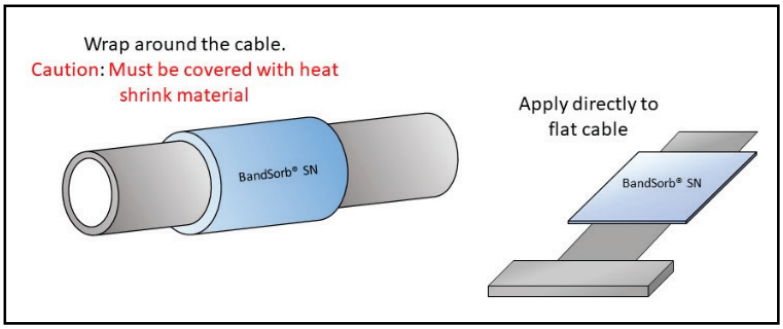
BandSorb® SN series absorber can be placed over CPUs, main chipsets and other memory and power IC devices to suppress radiated noise causing interference with RF functions, cross talk, or SAR emissions. It can also suppress noise currents from circuit trace lines and flat cables that act like radiating antennas causing EMI problems and cross-talk issues.



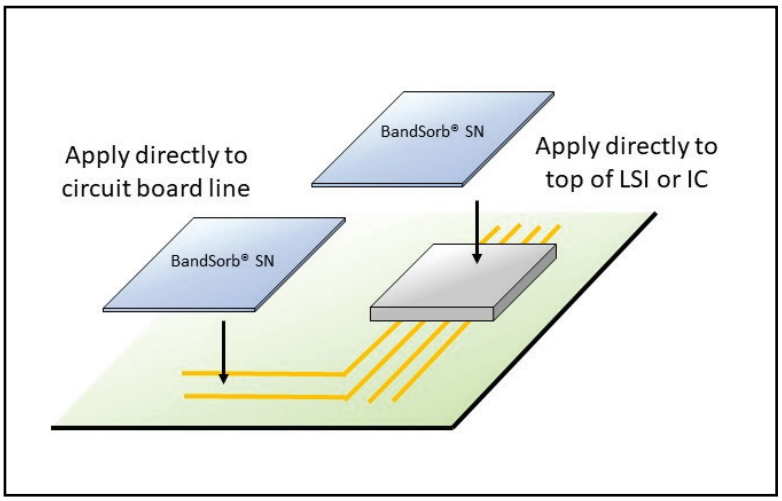
Example 1 – To suppress noise reflected by casing and cross-talk between substrates.



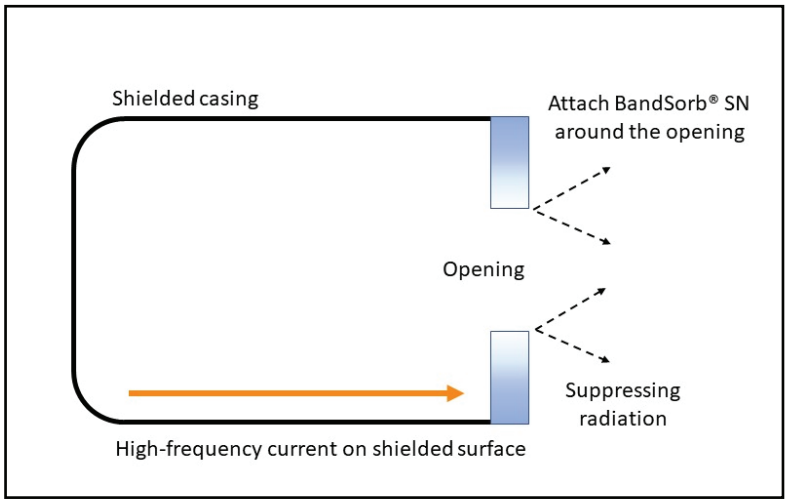
Example 2 – To suppress noise from cables.



Example 3 – To suppress radiation noises from LSI and IC.



Example 4 – To suppress noise radiation (reflected noise) from the opening of shield or casing.



Physical Properties

Datasheet for Performance Characteristics					
CHARACTERISTICS	**TEST**	**UNIT**	**SPECIFICATIONS**		
SEM Elastomers Absorber	-	-	SN-32	SN-120	SN-130
Typical Frequency Range	-	GHz	< 6	< 6	< 6
Typical Thicknesses	-	mm (inch)	0.1-1.0 (0.004-0.04)	0.1-0.5 (0.004-0.02)	0.1-0.3 (0.004-0.012)
Available Size	-	mm (inch)	300x20000/300x50000/200x300 (11.8x787.4/11.8x1968.5/7.87x11.8)		
Hardness	ASTM D 2240	Shore A	90	-	-
Elongation	ASTM D 412	%	35%		
Tensile Strength	ASTM D 412	MPa (psi)	3.1 (450)	5.6 (812)	5.6 (812)
Service Temperature	-	℃(°F)	-40 to 85 (-40 to 185)	-40 to 120 (-40 to 248)	-40 to 120 (-40 to 248)
Flammability Rating	UL94*	-	V2	V2	V2
Color	-	-	Silver	Silver	Silver
Surface Resistivity	ASTM D 991	Ω-cm (Ω-in)	$>10^{12}$ ($>10^{12}$)	$>10^{6}$ ($>10^{6}$)	$>10^{6}$ ($>10^{6}$)
Compliance	2011/65/EU (RoHS 2.0) Compliance, REACH SVHC Compliance, Halogen-free				

***Tested in according to UL94 specification**

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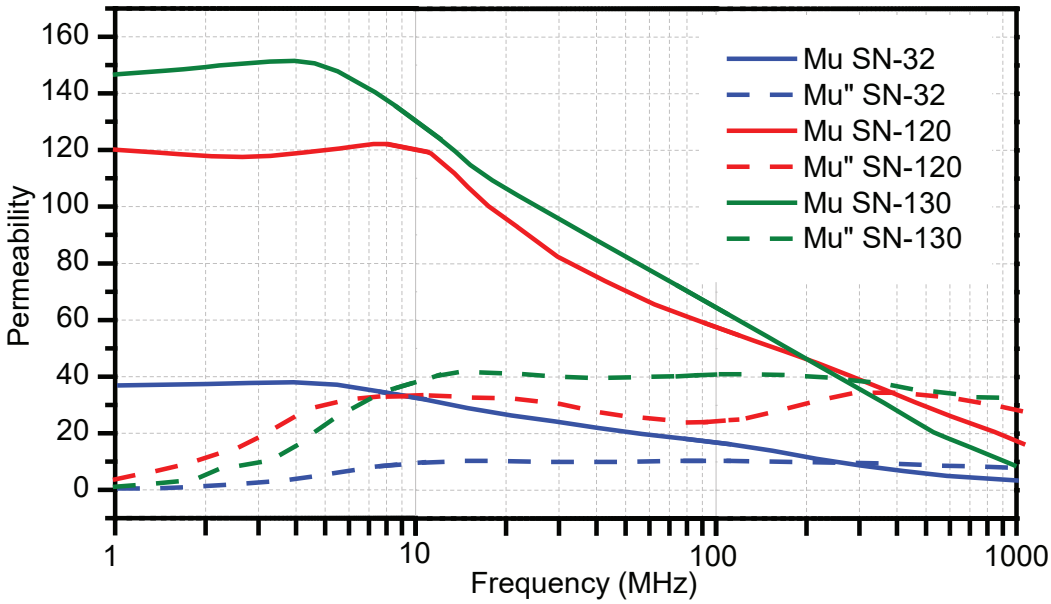
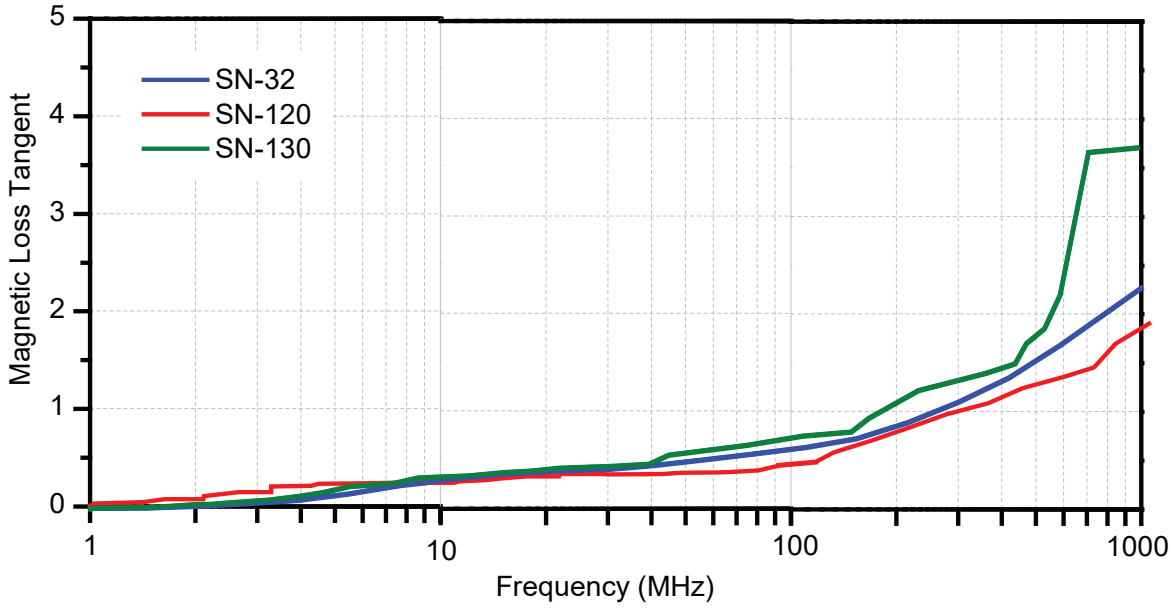
Electromagnetic Properties





Part number system example:

SN	- 32	- 50	- A
Product name	Mu@10MHz	thickness (0.5 mm)	with Pressure Sensitive Adhesive: A, blank: no tape

BandSorb® HP Series

Ferrite Sheets for NFC & Wireless Charging

Description

BandSorb® HP series is a thin high permeability ferrite sheet designed to have low losses at 13.56 MHz. The high permeability makes it ideal to use for NFC, RFID applications, and wireless charging applications.

Availability

SEM supplies BandSorb® HP series materials that can be supplied in sheets and custom configurations; the standard sheet size is 125 mm x 125 mm. The BandSorb® HP consists of a ferrite material covered with a protective film on one side and adhesive tape on the other.

Features and Benefits

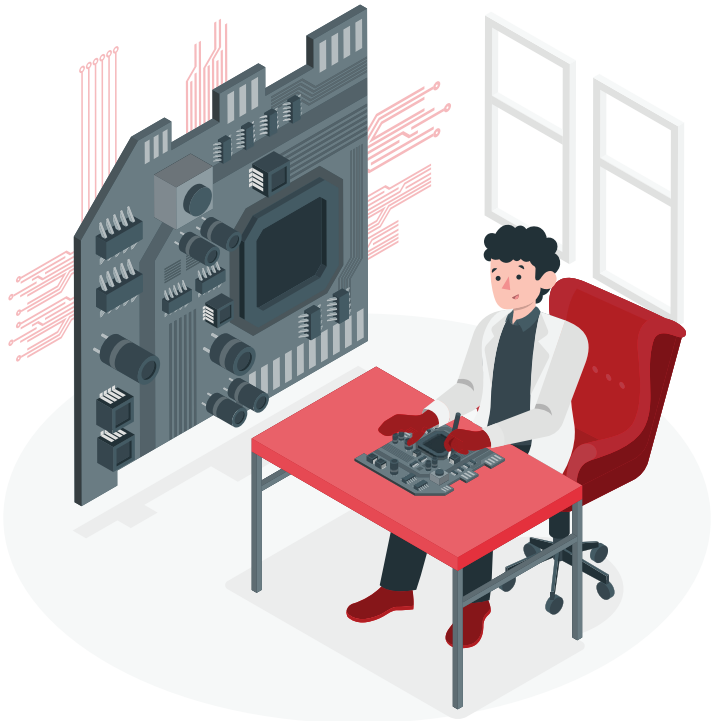
High magnetic permeability, low loss

RoHS, Halogen Free

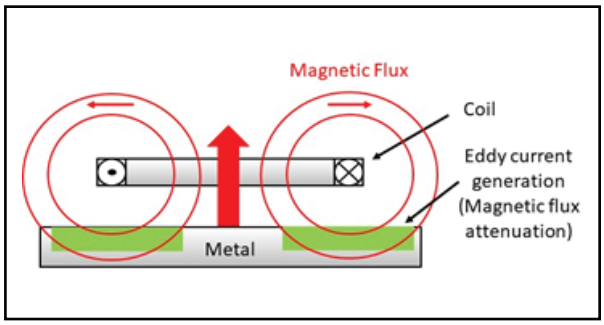
Applications

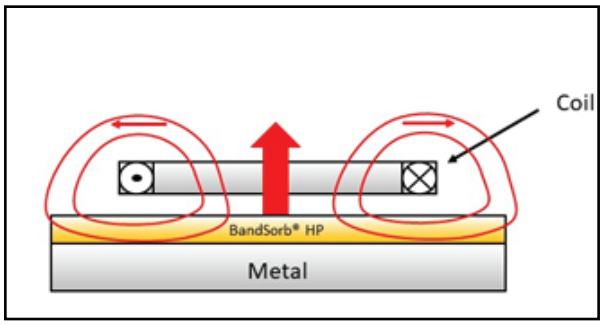
BandSorb® HP series can be used to improve the performance of:

- NFC antenna for mobile phones and automotive.
- NFC or RFID antenna for security & access control system.
- Wireless charging for mobile phones and battery-powered handheld electronic devices



Example – Placing BandSorb® HP between the coil and the other components will suppress the formation of eddy currents.





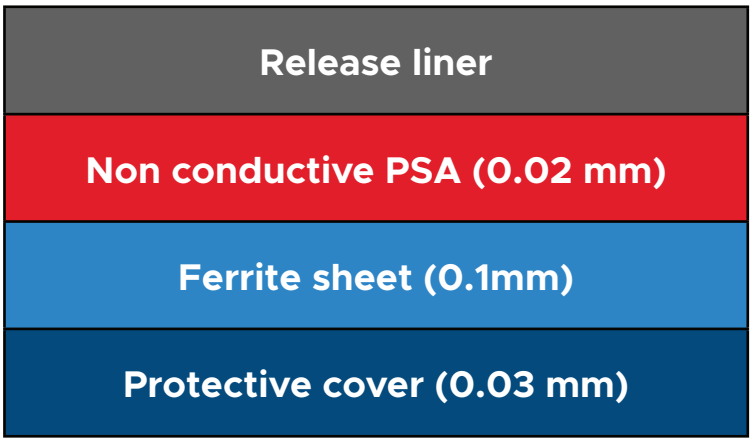
Physical Properties

Datasheet for Performance Characteristics			
CHARACTERISTICS	**TEST**	**UNIT**	**SPECIFICATIONS**
SEM Elastomers Absorbers		-	HP-15010
Real Permeability	@13.56MHz, 0.1V	μ'	150
Imaginary Permeability	@13.56MHz, 0.1V	μ"	<5
Ferrite Thicknesses	-	mm (mil)	0.1 (3.9)
Typical Thicknesses	-	mm (mil)	0.15 (5.9)
Tensile Strength	ASTM D 1000	MPa (psi)	6.4 (928)
Service Temperature	-	°C (°F)	-25 to 120 (-13 to 248)
Flammability Rating	UL94*	-	V2
Colour	-	-	Black
Surface Resistivity	ASTM D 991	Ω-cm (Ω-in)	> 10^9 (>10^9)
Dielectric strength	-	V	400
Compliance	2011/65/EU (RoHS 2.0) Compliance, Halogen-Free		

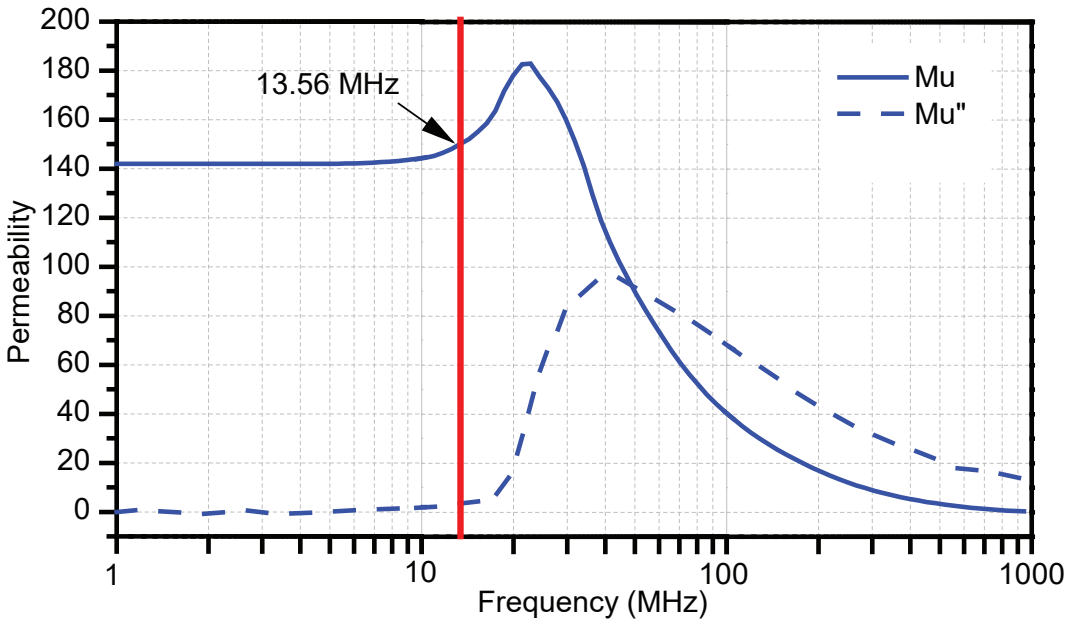
***Tested in according to UL94 specification**

-The technical specification data is based on SEM tests and analysis that we believe to be reliable. SEM will not be held responsible for inaccuracies or omissions contained therein. In all cases, details and values should be verified by the customer.

Structure



Electromagnetic Properties



Part number system example:

HP	- 150	- 10	- 4040
Product name	permeability@13.56MHz	thickness ferrite (0.1mm)	Part Size code (40x40 mm)

BandSorb® FB Series

Broadband Flexible Foam Sheet Absorber

Description

BandSorb® FB is a lightweight, high-loss carbon-impregnated dielectric foam absorber that provides a very low-cost solution for many applications over the thinner, more expensive rubber absorbers. BandSorb® FB can be used for applications requiring absorption across a wide range of frequencies, such as antenna cross-talk, side lobe reduction, and cavity resonance suppression.

Availability

BandSorb® FB series materials can be supplied in sheets and custom configurations; the standard sheet size is 610 mm x 610 mm. The BandSorb® FB is made up of carbon-loaded polyurethane foam, and thus it is electrically conductive.

Features and Benefits

Lightweight, flexible, easy to trim, high-loss, low density.

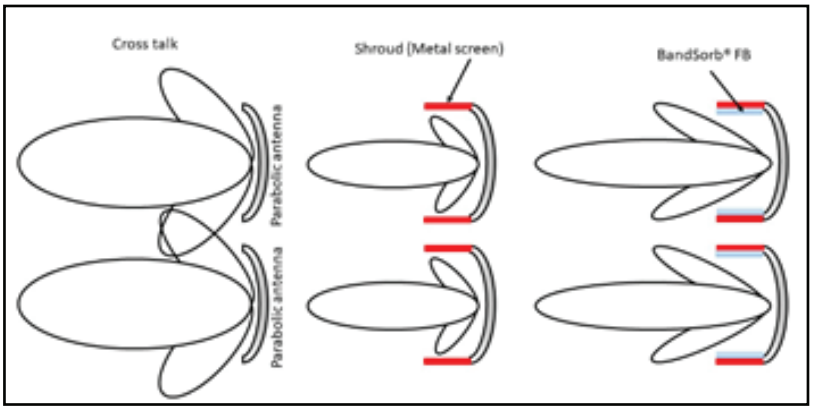
Available in different thicknesses to work in a wide range of broadband frequencies.

Applications

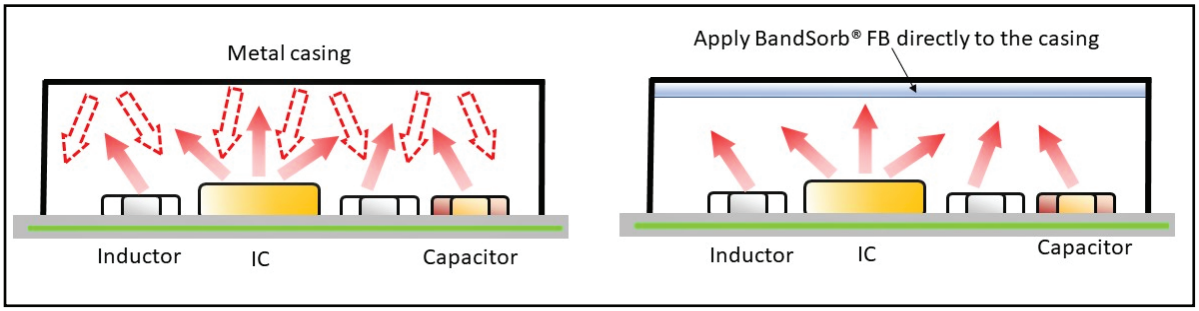
BandSorb® FB series uses:

- Lower cavity Q's in RF amplifiers, oscillators, cabinets containing microwave devices, computer housings, LNB's.
- Isolation of antennas by Insertion loss, shrouding antennas to improve the antenna patterns and undesired back lobes.
- Reduce the surface current on radiating elements and outer ground-plane type surfaces.
- Reflectivity of an object (metal or otherwise) can be reduced somewhat by applying one or more layers.

Example 1 – Placing BandSorb® FB on the antenna's shroud (metal screen) to improve the antenna patterns and undesired back lobes.



Example 2 – To suppress noise reflected by casing.



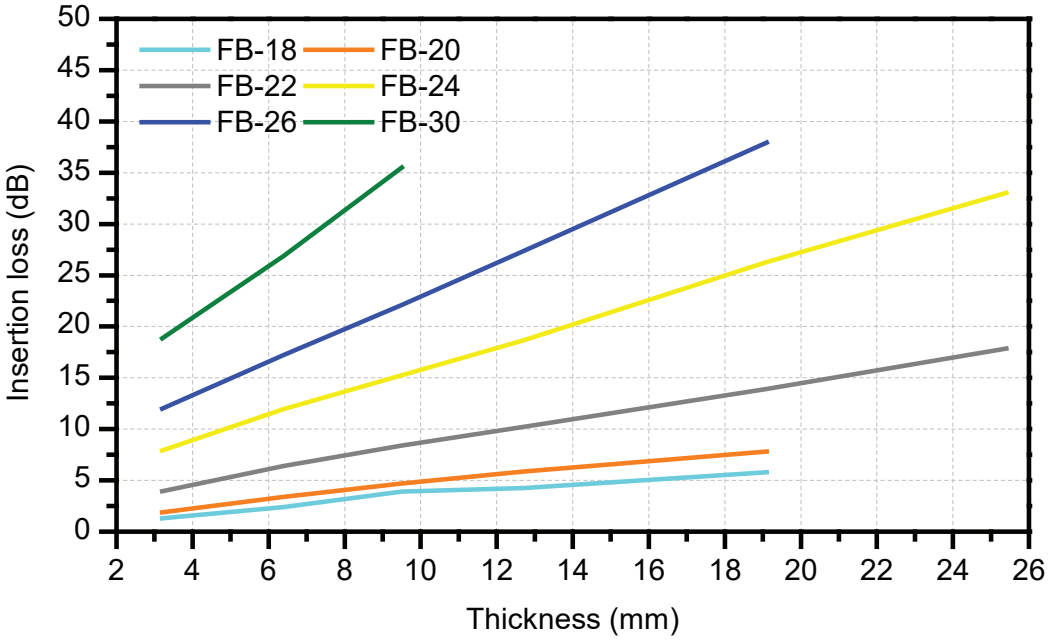
Physical Properties

Datasheet for Performance Characteristics			
CHARACTERISTICS	**TEST**	**UNIT**	**SPECIFICATIONS**
Design Frequency Range	Insertion Loss	GHz	>1
Size	-	mm (inch)	610 x 610 (24x24)
Typical Thickness		mm (inch)	3.2 (1/8), 6.4 (1/4), 9.5 (3/8), 12.7 (1/2), 19.1 (3/4)
Maximum service Temperature	-	°C (°F)	100 (212)
Compliance	2011/65/EU (RoHS 2.0) Compliance, REACH SVHC Compliance, Halogen-free		

The technical specification data is based on SEM tests and analysis that we believe to be reliable. SEM will not be held responsible for inaccuracies or omissions contained therein. In all cases, details and values should be verified by the customer.

	Attenuation (dB/cm)		Relative Impedance (|Z|/Z0)	
BandSorb®	3 GHz	10 GHz	3 GHz	10 GHz
FB-18	3.2	4.7	0.69	0.82
FB-20	4.2	7	0.61	0.78
FB-22	7.4	14.9	0.55	0.74
FB-24	11	24	0.25	0.44
FB-26	16	34	0.18	0.31
FB-28	20	40	0.16	0.27
FB-30	24	46	0.13	0.22

Electromagnetic Properties



Instructions for use:

BandSorb® FB can be securely bonded to itself or other materials such as metal, wood, and common plastic composites. To obtain a strong bond, the surface should be thoroughly cleaned with a degreasing solvent. It can be readily cut with a band saw, scissors or a sharp knife.

Part number system example:

FB	- 30	- 3.2	- A
Product name	Type	thickness	with Pressure Sensitive Adhesive: A, blank: no tape

Materials Selection Guideline

Based upon the fillers, the absorbers can be divided into:

- Ferrite-based (SN/HP): depending on the ferrite loading, the material has a high magnetic loss (SN) or high magnetic constant (HP). High magnetic losses strongly reduce the H vector; a high magnetic constant focuses the magnetic energy.
  - High magnetic loss materials are optimum material when the H vector is dominant, up to a few GHz.
  - Keep in mind that magnetic properties are frequency-dependent, especially in the UHF to GHz range.

- Magnetic/dielectric (SC/ST): the loading of these materials interact with both the E/H vector of the EM field. The fillers used to create these materials tend to keep their magnetic properties at frequencies where ferrite-based materials no longer function.
  - Keeping in mind that the H field is maximum at the shield, E field minimum, the SC material is ideal for suppressing energy inside cavities or reducing surface currents.
  - ST materials have a thickness tuned to the free space resonance thickness—making them optimum for suppressing an unwanted reflection in an open environment.

- Dielectric loaded (FB): a dielectric-loaded absorber interacts with the E field; in general, one can state that the dielectric-loaded absorbers are thicker than magnetic loaded products. On the other hand, it is important to note that the weight of a FB material is much lower than SC/ST material.

BandSorb® Comparison Chart					
Product type	**SC**	**ST**	**SN**	**HP**	**FB**
Binder	Silicone	Silicone	Synthetic Rubber Resin	Synthetic Rubber Resin	Polyurethane Foam
Filler	Diel./Mag.	Diel./ Mag.	Magnetic	Magnetic	Dielectric
Moisture resistance	Yes	Yes	Yes	Yes	No
Attenuation level	Very Good	Excellent	Good	Low	Good
Design flexibility	Very Good	Very Good	Good	Good	Very Good
Standard format	Sheet	Sheet	Sheet	Sheet	Sheet
Die-cut Option	Yes	Yes	Yes	Yes	Yes
Cost	$$	$$	$$	$$	$
Typical Frequency range	1 – 40 GHz	1.5 – 18 GHz	<6 GHz	< 100 MHz	2 – 40 GHz
Applications	Spurious Harmonics, Noise Spurs, Cavity resonance	Free space	Spurious Harmonics, Noise Spurs, Cavity resonance	Decoupling	Free space, cavity resonance reduction

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