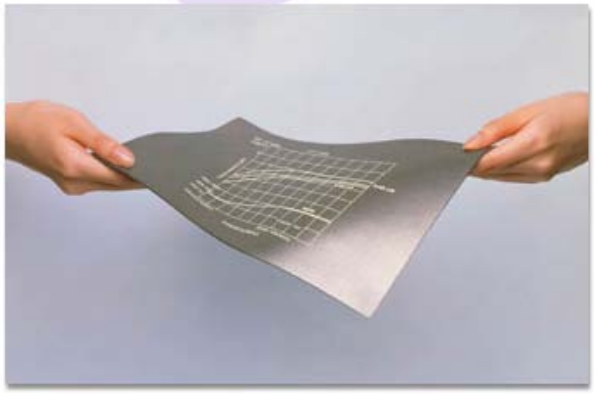
Flex-Suppressor(R) : The "Miracle Patch" for Digital Electronic Equipment
Outline
Features
Applications

The "Miracle Patch" for Digital Electronic Equipment

Flex-Suppressor®



With the rapid spread of mobile equipment, electronic equipment, which are essential to our daily lives today, have increasingly shorter product development times. With the digitalization of internal parts and product miniaturization, the implementation of electromagnetic noise countermeasures in extremely short period of time is becoming a critical task for electronic equipment manufacturers, regardless of whether at high or low frequencies.
NEC TOKIN has responded to these issues and developed the Flex Suppressor(R) and Film Impedor(R), revolutionary sheet type noise countermeasure devices that can suppress noise simply through their application, and have demonstrated a superb effect of various electronic equipment.

Outline　Suppressing Noise is Extremely Difficult

There are three general noise countermeasure methods: 1) shielding, 2) inserting a filter, and 3) reinforcing the grounding, yet there are serious problems with these methods at high frequency ranges.

Firstly, shielding is a method whereby the noise emitter is encased, making it a very effective EMI countermeasure. Yet, if there are even small gaps in the shielding, the gaps themselves act as antennas and emit noise again. In contrast, if there are no gaps at all, heat is trapped inside the shielding, and even more adverse conditions such as extraneous emission waves being reflected on the shield surface and malfunctions may occur with the shield. Next, isolation from noise frequency bands becomes more difficult with filter insulation due to rising circuit operating speeds and high signal frequencies. If the signals are forcibly filtered, the waveform becomes obtuse, resulting in malfunctions. Grounding plays a role not just as a feedback line for signal current, but incorporates noise energy that flows from the shields and bypass. Grounding must have low impedance across a wide bandwidth, as it desires no potential occurring. Yet, its high signal frequency causes the wavelength to become several cm, the ground itself acts as a distributed parameter line, resulting in a potential according to the location.
The most troublesome problem at a high frequency range is that the circuit winding itself becomes an antenna, becoming a noise emitter, making the countermeasure of changing the circuit time-consuming.

Original NEC TOKIN High Performance

NEC TOKIN's Flex Suppressor exhibits dramatic effectiveness in eliminating high-frequency noise. Flex Suppressor is a special magnetic material processed into sheets that, when simply affixed to the noise source or the path by which noise is transmitted, is capable of suppressing noise in a range from the 10 megahertz to 5 gigahertz band.
Furthermore, all that is required to produce the effect is to apply the Flex Suppressor. Even after all other means to correct the problem have been attempted, the Flex Suppressor will suppress the remaining noise in a short period of time and with extreme ease and without the need for design changes.
Without Flex Suppressor, the noise generated inside electronic equipment works in a self-destructive fashion, resulting in a reduction in performance. Flex Suppressor really works like a patch with magical powers.

NEC TOKIN's Flex Suppressor has a thickness of 0.025 to 1.0 mm. Together with its various applications, our Flex Suppressor lineup increased to 11 specifications.
The latest lineup includes FK2 and EFR. The FK2 lineup has a u =100, the world's highest level of permeability, a standard for evaluating magnetic absorption. This value is around 5 times our original Flex Suppressor which went to market. The noise eliminating effect of the Flex Suppressor is proportional quantitatively to Volume × Permeability, and FK2 possesses this high permeability, thus it is expected to have an equivalent effect at around 1/5 the thickness of our original product. This is an advantage only NEC TOKIN has, with its deep understanding of the operating principles of the Flex Suppressor that has a performance no other similar product from other companies possesses.
Given the problems associated with using environmental load substances for electrical component materials, EFR is being commercialized without using halogen, in consideration of environment issues. EFR has the same u - 60 magnetic permeability as the existing "R4N" product, and obtains high flame retardancy UL94 V-0. The flame retardancy level is the highest in the industry among halogen-free type products.
For use in severely hot environments such as in high-speed operation LSI's and automotive applications, we have the TS7 with heat-resistant specifications at a heat resistance up to 105 degree, the low frequency compatible R4N, the thermal conductivity enhanced HF2 for both heat releasing and noise suppression, the ultra-thin E50 and E25 products, we created a conductive layer between the Flex Suppressor resulting in the multilayer type 3GF that also has a shielding effect and the ultra-thin 3GT and 2GT multilayer types.

Cross-sectional views of "Flex Suppressor"s

Item	Structure	Structual Diagram
K4E FK2 TS7 E50 R4N E25 EFR HF	Single Layer	
3GF 3GT 2GT	Triple Layer	

Special Composition Removes Noise

Just how is this amazing noise-reducing achieved merely by applying Flex-Suppressor?
Noise is radiated from certain locations prone to leakage when unnecessary high-frequency electric current is generated in a circuit. Meanwhile, Flex-Suppressor provides resistive impedance to circuits generating high-frequency current, which acts to reduce the current itself.
To eliminate noise, the source of the noise (i.e., the high-frequency current) is removed through resistive impedance due to magnetic loss that appears only at high frequencies, and the current is then converted to heat.

Here is an explanation likening the generation of high-frequency noise to sound waves.
When a megaphone is used to amplify the human voice, the sound is louder and carries farther than usual. The reason for this can be described in terms of the difference in impedance in sound waves occurring between the mouth and the outer environment. Here, impedance refers to a type of resistance expressing the relative degree of difficulty with which vibrations are propagated; the greater the impedance, the more difficult it is for the waves to travel, and the lower the impedance, the easier such propagation becomes.

Sonic vibrations are generated by the vocal cords and travel up to the mouth through relatively high impedance, but then suddenly hit the lower-impedance outer environment.
In other words, the boundary between the mouth and the outer environment acts as a barrier to the sound coming from the vocal cords, and a portion of the sound ends up being reflected back in the direction from which it came. This is the reason our voices are not ordinarily very loud.
In contrast, when a megaphone is put to a person's mouth, the change in impedance from the interior of the mouth to the outer environment is smoother, eliminating the back-reflections when the sound reaches the outside, thus allowing the voice to exit at its basic high volume.

Similar phenomena often occur within electronic circuits. That is, at points within circuits where extreme differences in impedance occur, the current is reflected at the boundary, thus creating reverse current. When this happens, a high-frequency standing wave is created at that point, and the wave then becomes a source generating noise.
To eliminate the noise, then, the reflected current causing the standing wave should be eliminated and the reflected wave absorbed.

Attaching Flex-Suppressor to the portion where the impedance suddenly changes makes that change more gradual, thus suppressing the formation of the standing wave. The result is a lessening of the reflected current, reduction of standing waves, and removal of noise. This is one of Flex-Suppressor's noise suppression effects.

Applications　Flex-Suppressor Meets the Demands of Today's Applicatipns

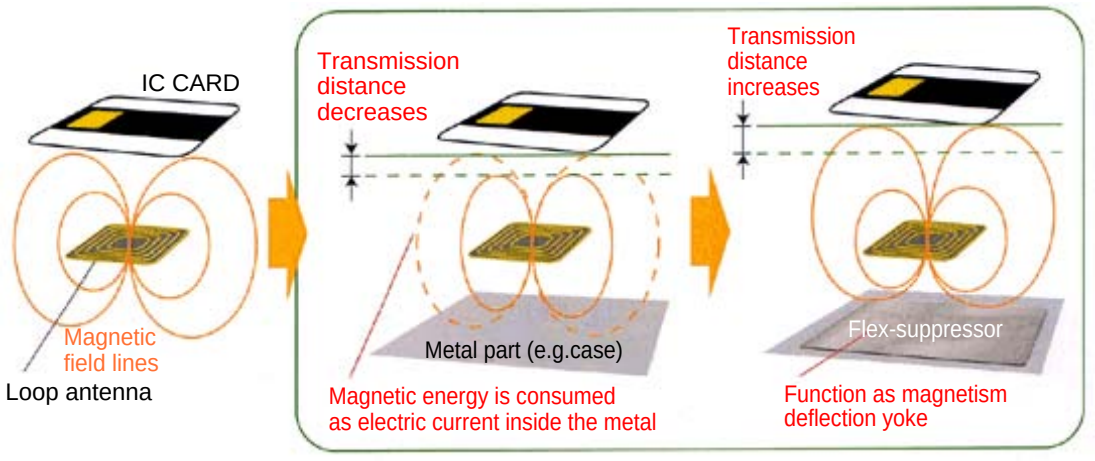
The Flex Suppressor, which first went to market in 1995, responds to diverse needs, leading to an increase in its variations. Among the electronic equipment that are nearest to us and our daily lives today, the Flex Suppressor demonstrates various features, and suppresses noise.

From applications that eliminate negative noise factors that have existed up to now with emission EMI countermeasures, internal malfunction countermeasures, improving signal quality according to internal interference, and countermeasures for malfunctions caused by ESD measures and noise that respond to regulations, the Flex Suppressor is leading to increased uses that generate positive factors such as improving signal and communications quality.

NEC TOKIN is proposing use of the Flex Suppressor as a solution for improving the RFID communication range as one of its new applications, providing products developed as a result, and contributing to the cell phone, laptop PC and other markets. NEC TOKIN also develops high performance materials based on technologies it has accumulated over many years, and will meet the expectations of our times by deploying its thinner, high performance Flex Suppressor lineup.

Flex Suppressor for RFID

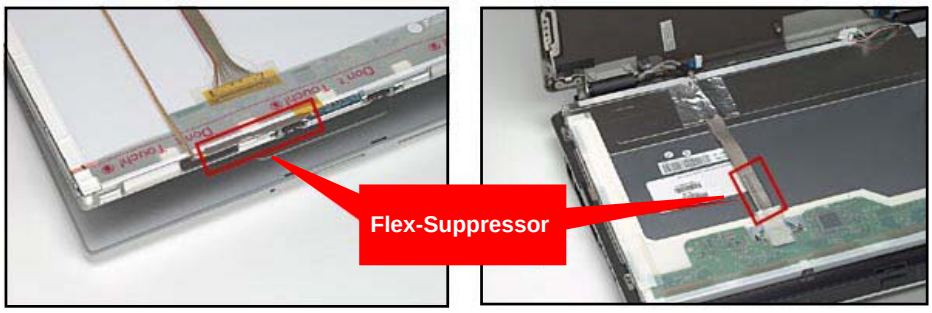
Examples of improvements to communications range of RFID reader/writer and card/tag at less than 13.56 MHz communications frequency



Applications

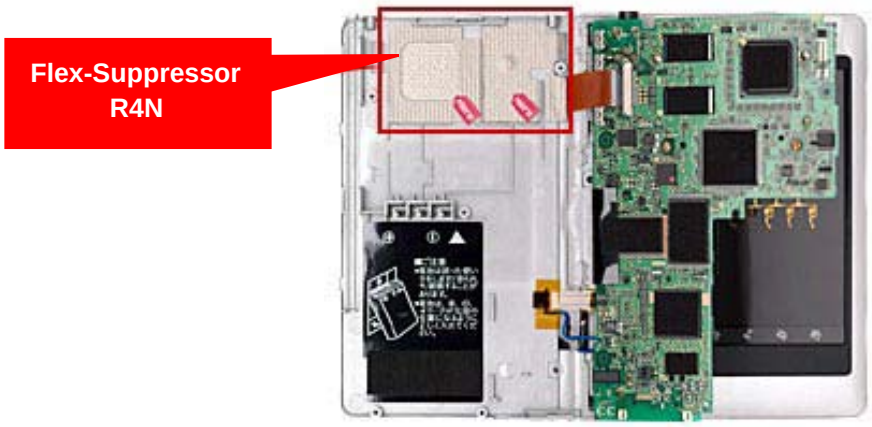
	Device Name	Installation Location	Effects (Frequency → Attenuation)
Noise Emission Countermeasure Uses & Effects	**Laptop Computer**	Applied to CPU and GPU, cables within liquid crystal panel, PCMCIA, memory slot and other I/O	100MHz to 1GHz >>> 8dB max.
	CD/DVD Drive	Applied to optical pick-up module peripheral LSI, FPC and MPEG chip	50MHz to 1GHz >>> 10dB max.
	DSC/DVC	Applied to CCD module FPC, image processing LSI, memory slot	66MHz to 1GHz >>> 10dB max.
	PDA	Applied to CCD module FPC, DC input line, memory slot	30MHz to 1GHz >>> 7dB max.
	Scanner	Applied to scanner head board and FPC	600MHz to 800MHz >>> 5dB max.
	Others: copiers, color printers, fax machines, liquid crystal displays, projectors, measuring instruments, ATM switchboards, navigation systems, optical reception modules, cell phones, PHS and many other devices		
Internal Interference/ Malfunction Countermeasure Uses	**Mobile Phone/ PHS**	Applied to liquid crystal module, camera module, FPC and LSI, B/B DSP, SAR countermeasure	
	Navigation	Applied to RF	
	Car Audio	Applied to liquid crystal LSI >>> Improvesradio sensitivity	
	Optical Reception Module	Applied to interior wall of casing >>> Improves error rate	
	Contactless IC/ RW	Applied to loop antenna >>> Improves communications range	
	Wireless LAN	Improves laptop PC, printer and other reception sensitivity	
	Measuring Instrument	Installed between boards	

Example of Laptop PC Application



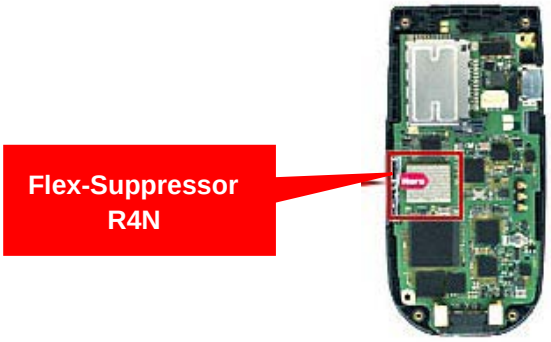
Examples where measures are taken for cable from laptop PC camera modules (left) and cable from LCD (right) using Flex-Suppressor.
Effectively prevents internal interference by suppressing noise radiation.

Example of PDA Application



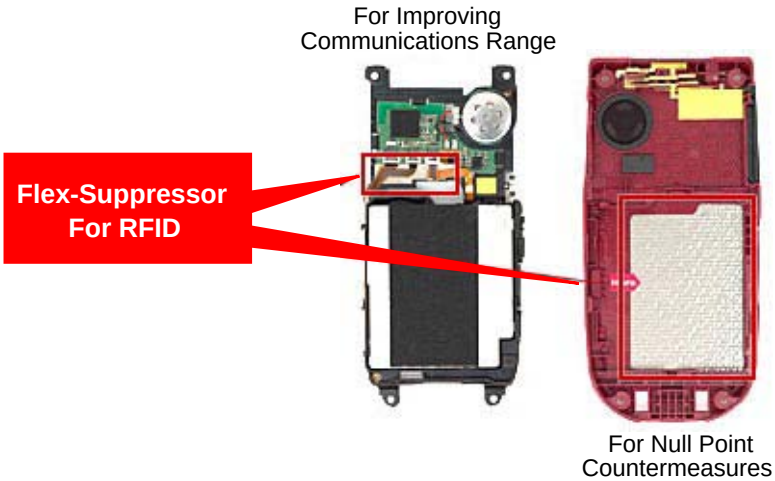
Flex-Suppressor R4N is set onto the CPU,
avoiding malfunction modes due to exogenous noise

Example of Mobile Phone Application



Flex-Suppressor R4N is set onto the CPU,
providing a drastic improvement effect in receiver sensitivity

Example of RFID Application (Mobile Phones)



Use of the Flex-Suppressor for RFID between the board and antenna improves the communications range,
and is effective as a countermeasure against Null points that occur in certain instances