

nanotechTM



NANOTECH RADIATED EMISSIONS CHOKE

MH&W PRESENTS MNT NANOTECHTM
REC RADIATED EMISSIONS CHOKE



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RADIATED EMISSIONS IN VFD MOTOR SYSTEMS



Defining the problem

Solution

WHAT IS EMI?

WHAT ARE EMISSIONS?



EMI – Electromagnetic Interference

All electrical devices create emissions/radiations that will interfere with the external environment. These emissions have the potential to interfere with the electrical grid and other local electrical devices.

There are two main types of electrical emissions:
Conducted emissions and radiated emissions.



Conducted Emissions

Conducted emissions are an electromagnetic energy created by a device and transmitted in the form of an electrical current through its power cord. This can potentially cause problems since power cords are connected to the entire power distribution network.



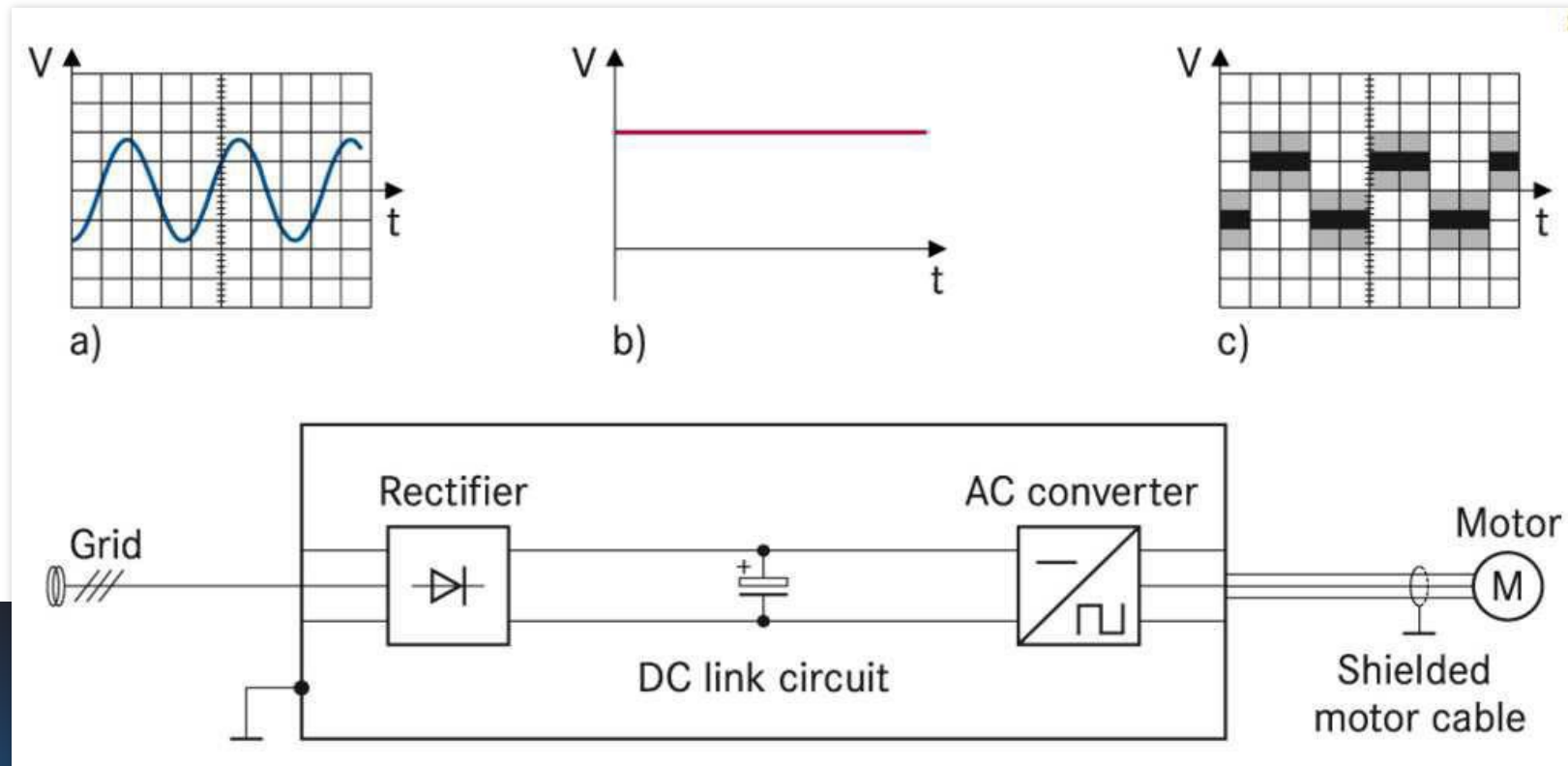
Radiated Emissions

Radiated emissions are electromagnetic energy created by a device and released as electromagnetic fields that propagate through the air away from the device. Electric devices that create radiated emissions have the potential to interfere with other nearby electrical products.

VARIABLE FREQUENCY MOTOR DRIVE SYSTEMS



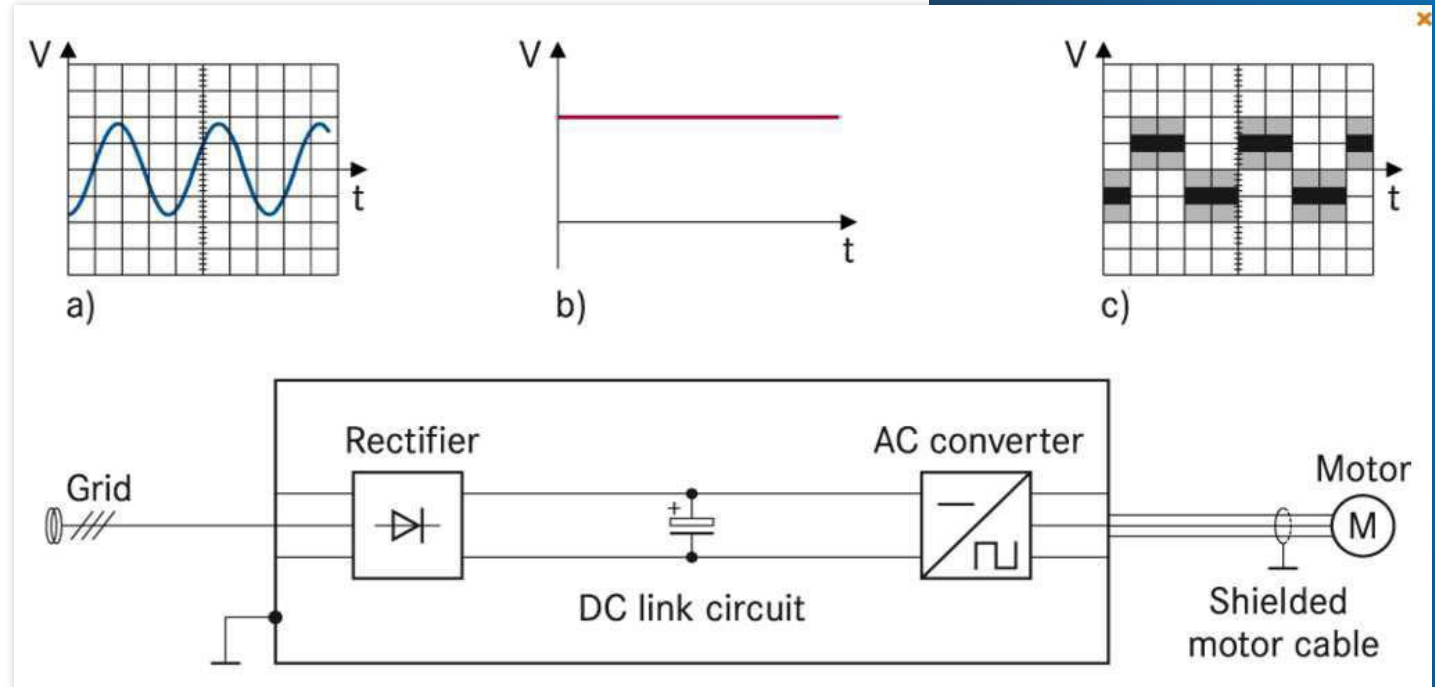
TYPICAL POWER GRID TO MOTOR APPLICATION. SINE WAVE COMING IN TO VFD, CONVERTED TO DC, THEN THE PWM PULSE SENT TO MOTOR.



VARIABLE FREQUENCY MOTOR DRIVE SYSTEMS



Typical power grid to motor application. Sine wave coming in to VFD, converted to DC, then the PWM pulse sent to motor.



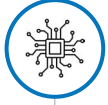
RADIATED EMISSIONS IN A VFD SYSTEM



The high-speed switching of the IGBT, GAN, and SiC components are the cause of radiated emissions and conducted emissions.



The di/dt (very fast rise over time) is significant and increasing with the introduction of newer switching technologies (IGBT/SiC/GAN).



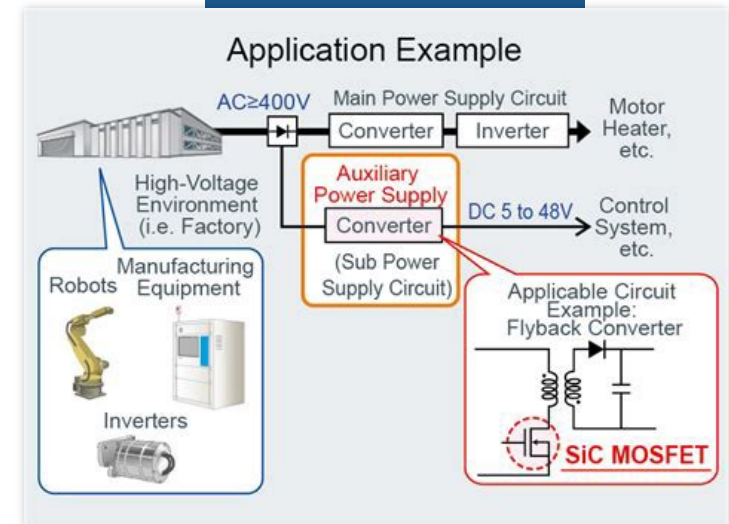
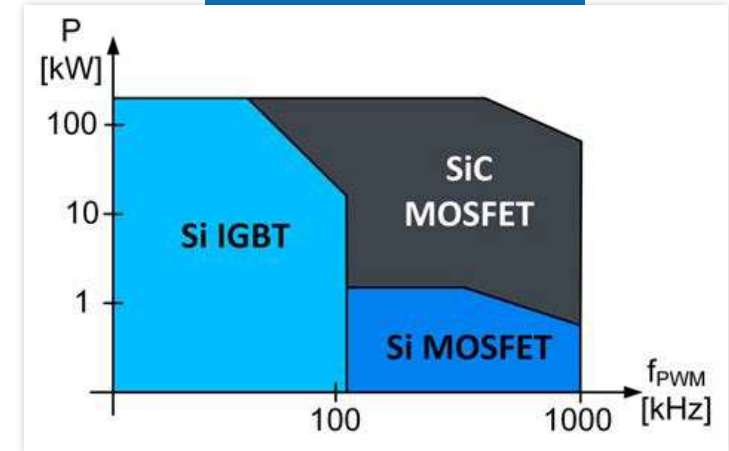
The switching frequency is how often a peak repeats itself in a circuit.



Harmonics of the di/dt are megahertz to gigahertz.



Because of the need for more efficiencies, newer technologies must be developed resulting in even higher frequency switching devices.



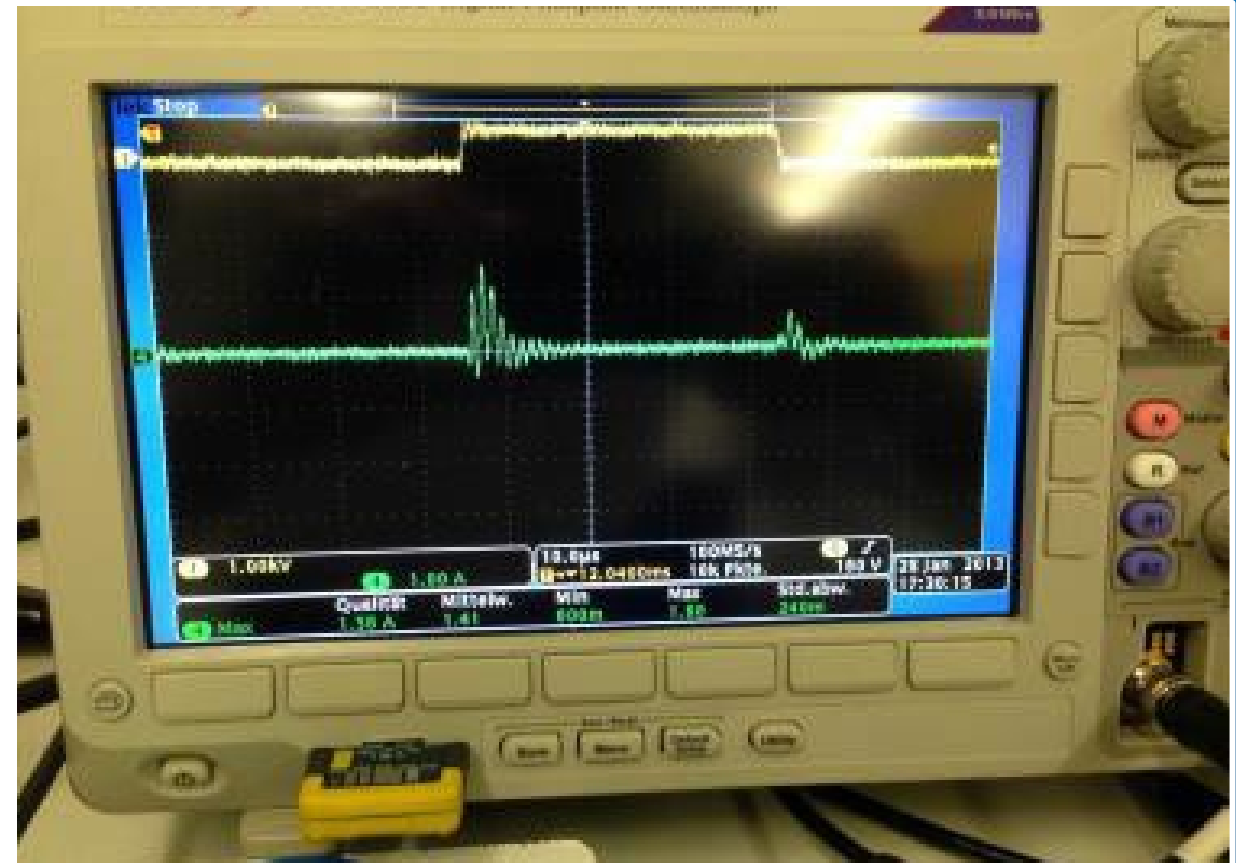
VARIABLE FREQUENCY MOTOR DRIVE SYSTEMS



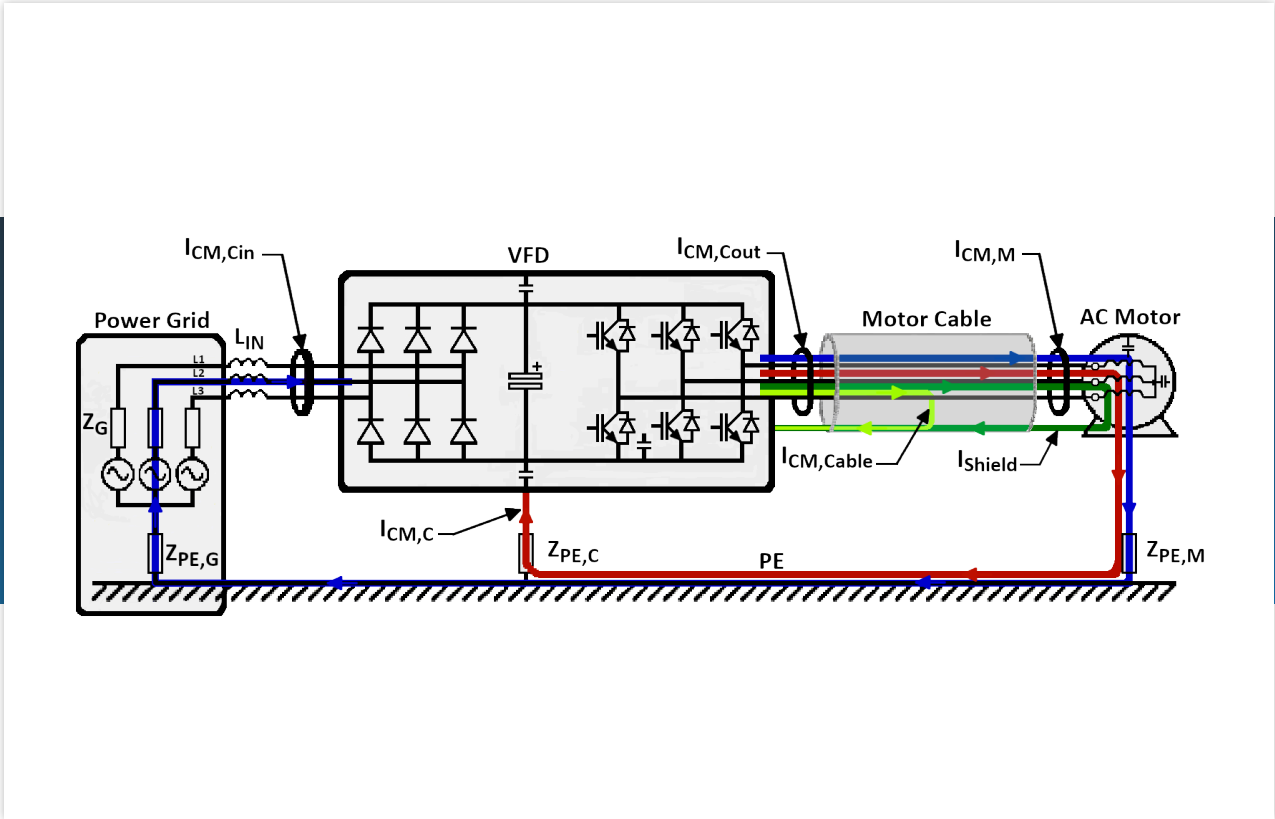
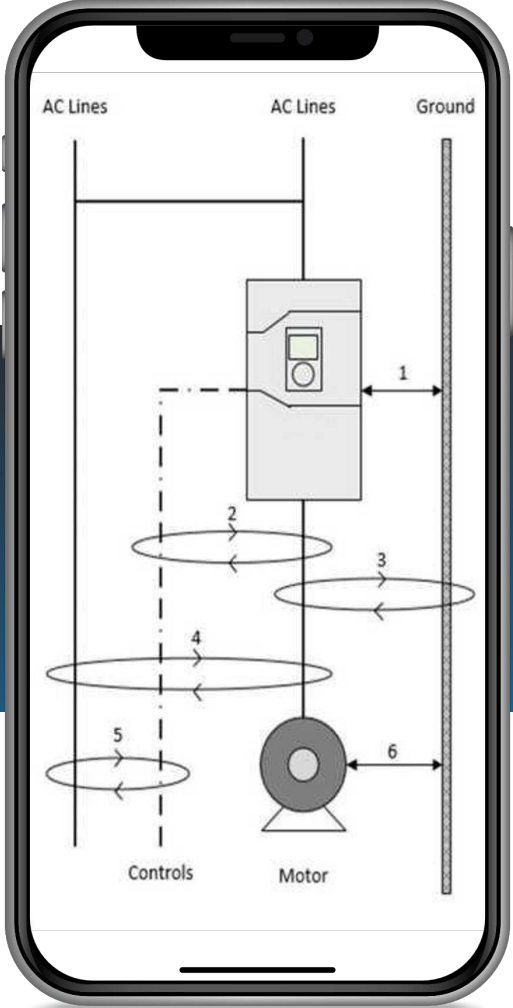
Typical example of the high frequency noise generated by the IGBT/SiC/GaN switching devices in a motor system.



The yellow line at the top of oscilloscope screen indicates the switching of the device in the drive. The green line indicates the high frequency noise generated with every pulse.

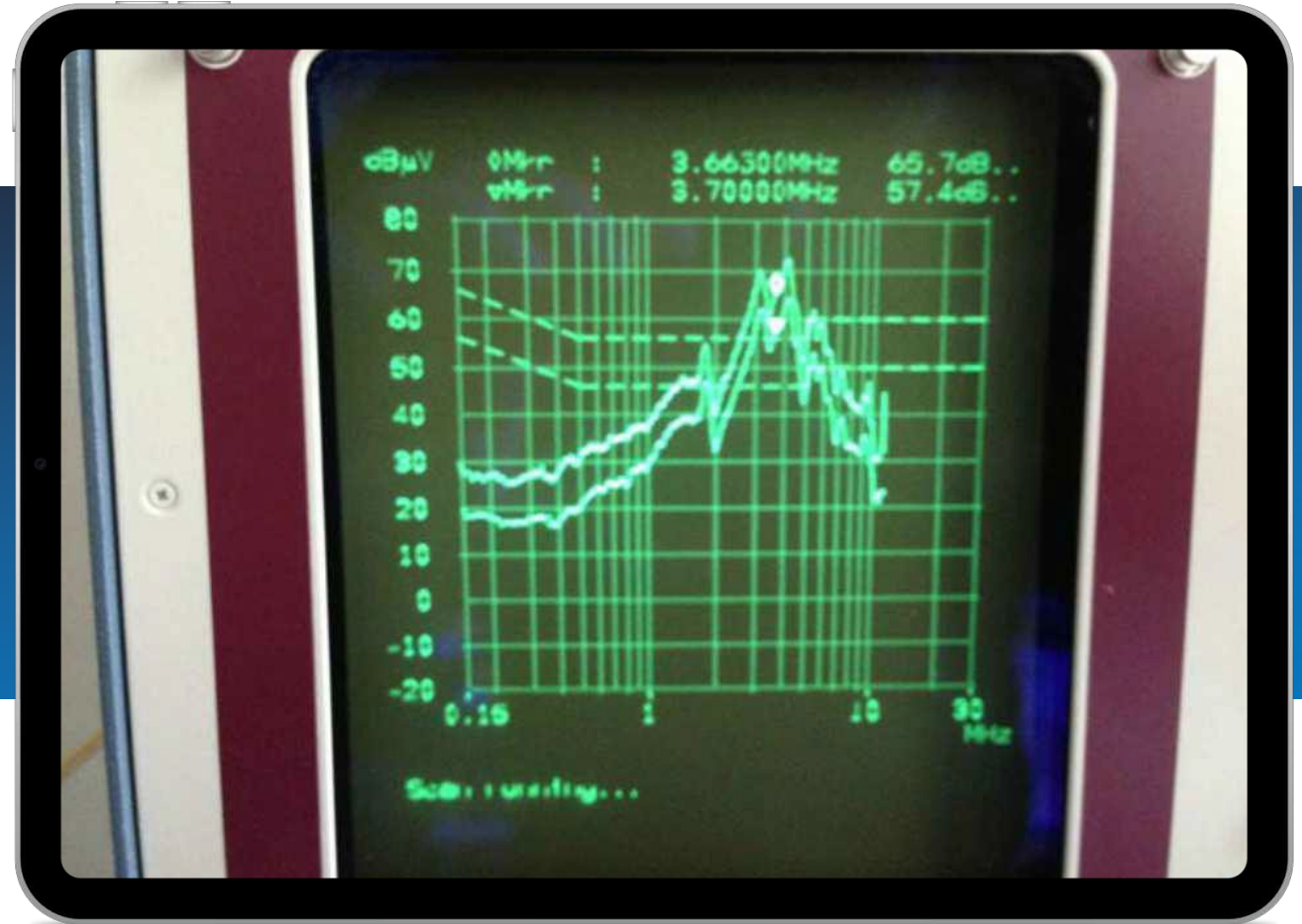


GRID WITH IMPEDANCES AND INTERACTION OF NOISE





This is what is going to the motor,
ground, and air in the system.



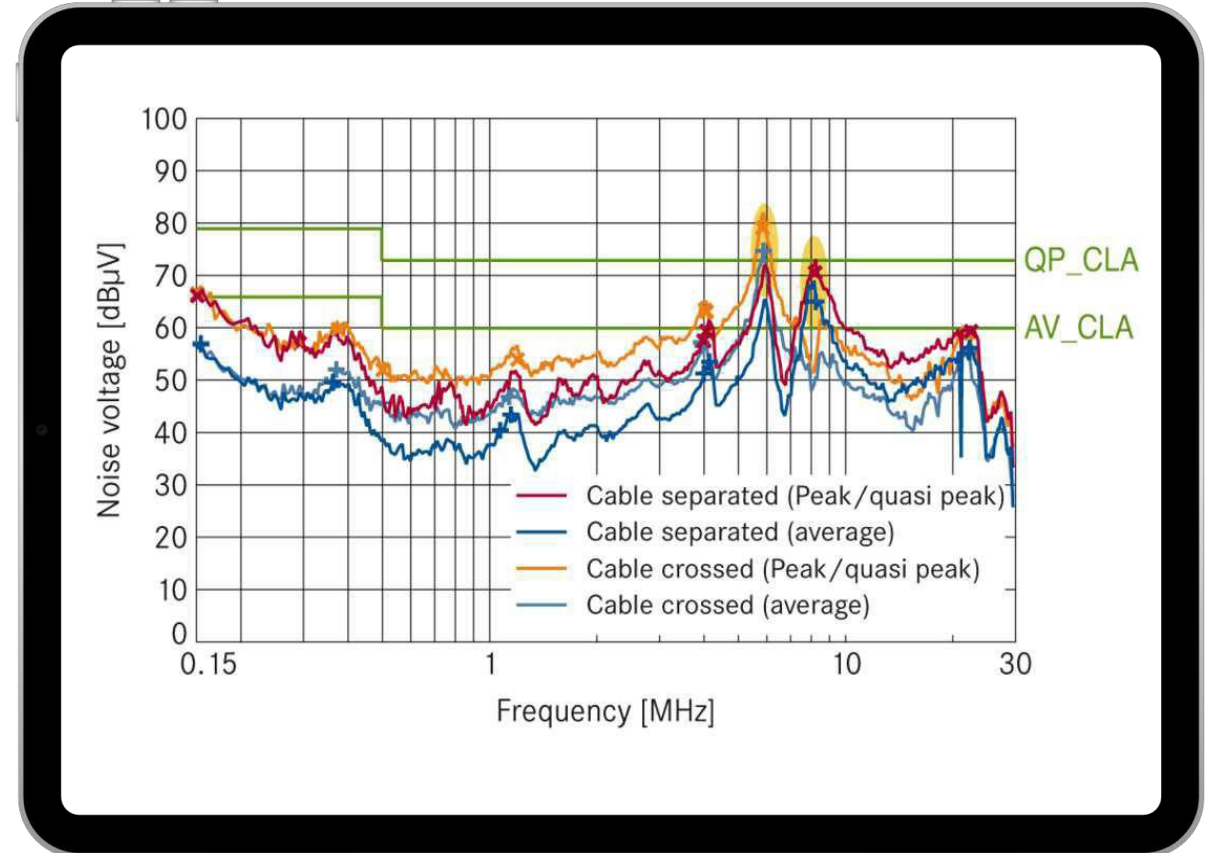
SHIELDED CABLE FOR COMMON MODE NOISE



One option to reduce EMI being transmitted in the field is to use shielded cable.



Shielding or absorbing the noise is very important in frequency ranges between 5MHz-30MHz (radiated) whereas the waves will disrupt other systems if not controlled or absorbed.



WHY USE SHIELDED CABLE?



The two main issues in a VFD systems are common mode currents (CMC) and electromagnetic interference. Both are generated as an unwanted by-product of the drive's high frequency pulse width modulated, or PWM, waveforms.

A properly installed and terminated shielded cable system in a VFD/Motor application will:

01

Provide a controlled path for the drive's CMC (limiting the current traveling through to the ground grid).

02

Provide a continuous shield over the entire cable from the inverter to the motor (minimizing the amount of EMI radiation that radiates from the cable which can cause interference with other systems).

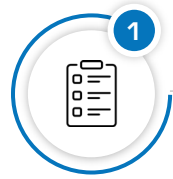


Variable Frequency Drive (VFD) shielded cable can help minimize system issues. However, unless shielded cables are properly installed and terminated, much of the benefit derived from using VFD cable may not be realized.

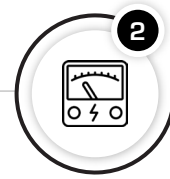
WHY USE SHIELDED CABLE?



FOR EXAMPLE:



Occasional transients induce “extra” pulses in rotary feedback of the servo motor which contributes to robotic arm’s erroneous position eventually damaging the wafer.



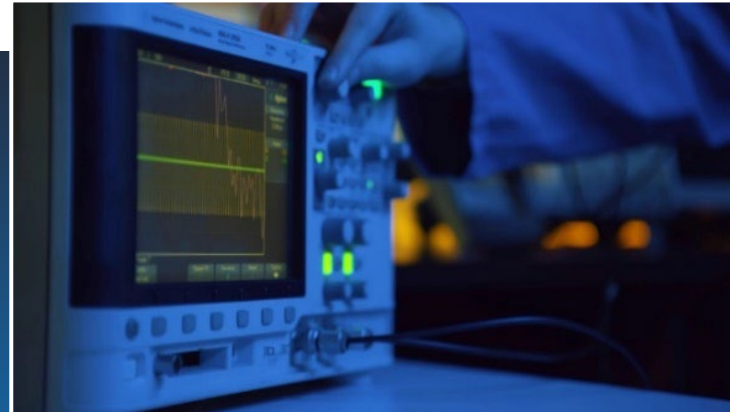
Combination of high-frequency noise from servo motors and switched mode power supplies in the tool creates difference in voltage between the bonding wire/funnel and the device which causes high current and eventual electrical overstress to the devices.



Wafer probe test provides inconsistent results due to high level of EMI on the wafer chuck caused by a combination of several servo motors in the wafer handler.



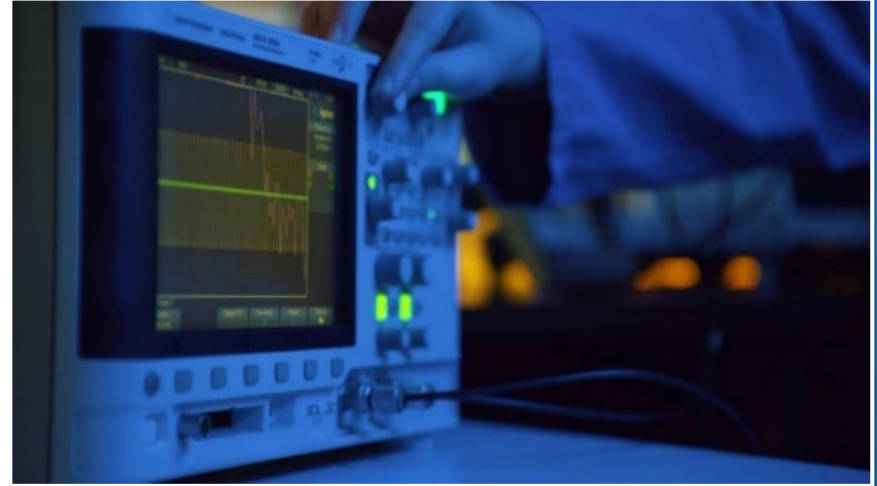
This illustrates the gap between EMC test requirements and real-life EMI tolerance levels and its impact on semiconductor manufacturing and handling.



WHY USE SHIELDED CABLE?



While EMC (Electromagnetic Compatibility) standards (along with practical lab testing) provide limits on allowed emission levels of equipment, once the equipment is installed along with other tools, the EMI levels in actual operating environments can be substantially different and therefore impact the equipment and facilities operation, performance, and reliability.



WHY IS CORRECT TERMINATION OF SHIELDED CABLE SO IMPORTANT?



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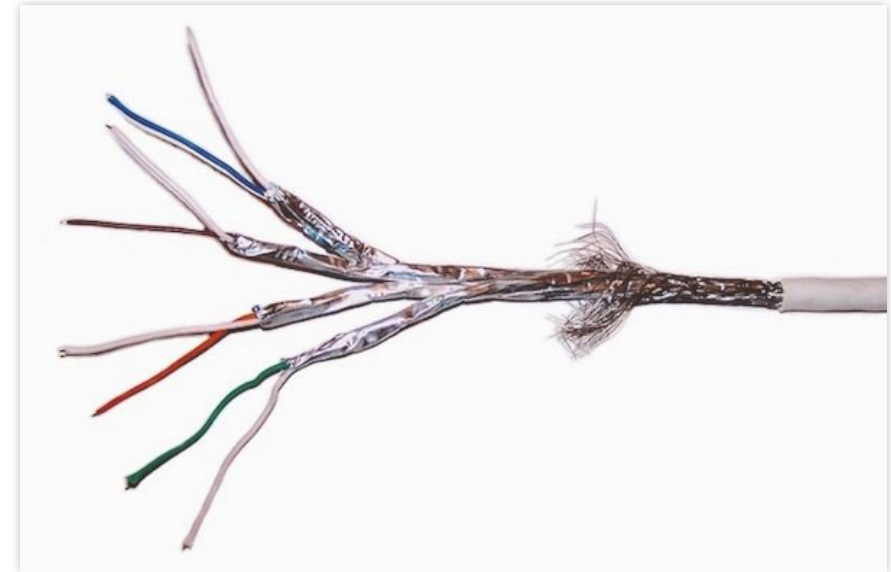
Perhaps the most critical component of a VFD cable is the cable shield which can consist of armor, copper tape, or a copper braid and aluminum foil combination.



A good termination guide will provide certain recommendations with respect to terminating copper tape and copper braid/aluminum foil shielded cables.



Most VFD manufacturers document proper installation and type of cable.



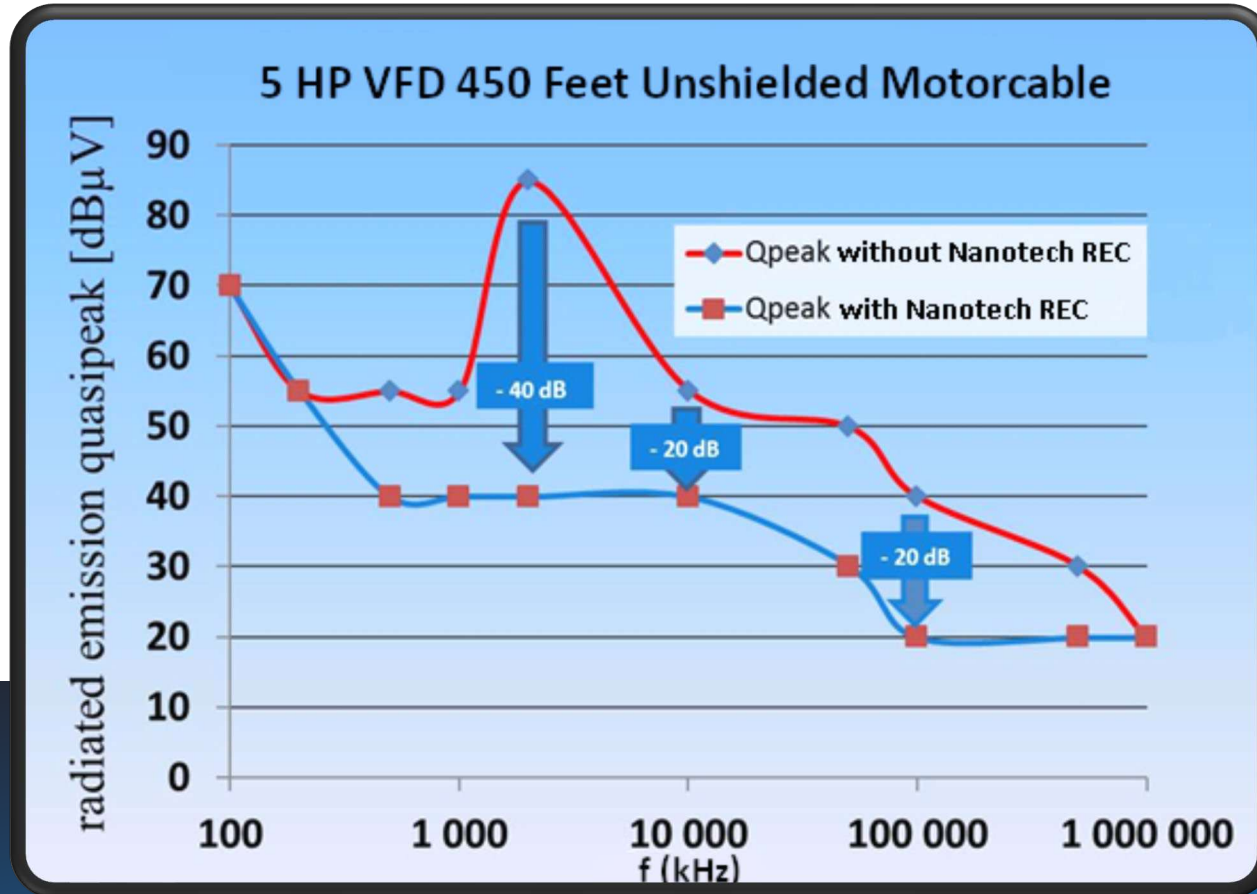
There is an alternative to the complicated shielded cable installations/terminations...



Why go to all that extra effort and cost of shielded cable when you can eliminate the radiated noise at the source using **Nanotech[®] REC** (Nanotech[®] Radiated Emissions Choke).

And even better...**Nanotech[®] REC** ABSORBBS the noise at the source.





Frequency range 100 Kilohertz up to 1 Gigahertz

THE FOLLOWING EXAMPLE OF PORTABLE ELECTRONICS WILL HELP BETTER UNDERSTAND THE FUNCTION OF NANOTECH[®] REC.

On every power cord, especially laptop computers, LCD monitors, etc. (may be built in or external), there is what is called a ferrite bead. Little "barrel" looking part (see picture on left). The ferrite bead (also called a ferrite choke) is used to make sure the wire doesn't unintentionally convert into a radio. Any long wire is effectively an antenna. That means it has the potential to transmit and receive radio waves. This will be a problem for two reasons:



Unintentional Transmitter

The device or power source that is connected to the wire may cause variations in the electrical flow of the wire. These variations could cause the wire to transmit radio waves and these waves could in turn interfere with nearby devices.



Unintentional Receiver

Conversely, nearby devices could produce radio signals (intentional or otherwise) that get picked up by the wire. These signals could vary the electrical current in the wire which could in turn interfere with the connected devices.

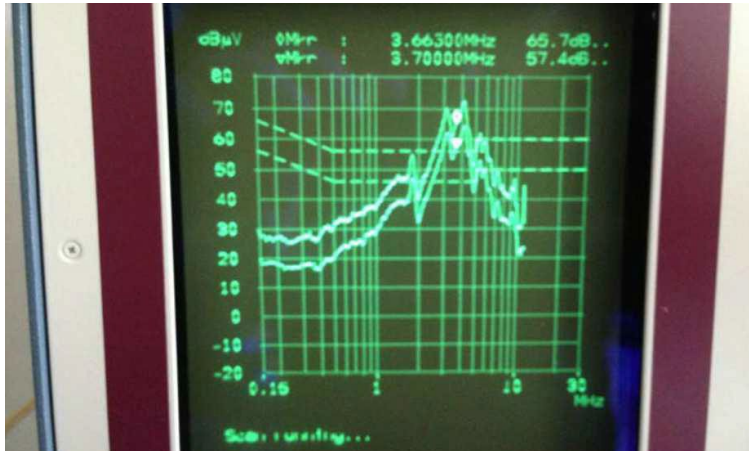


A choke effectively eliminates the high-frequency noise on the wire and thus prevents it from transmitting/receiving radio waves.

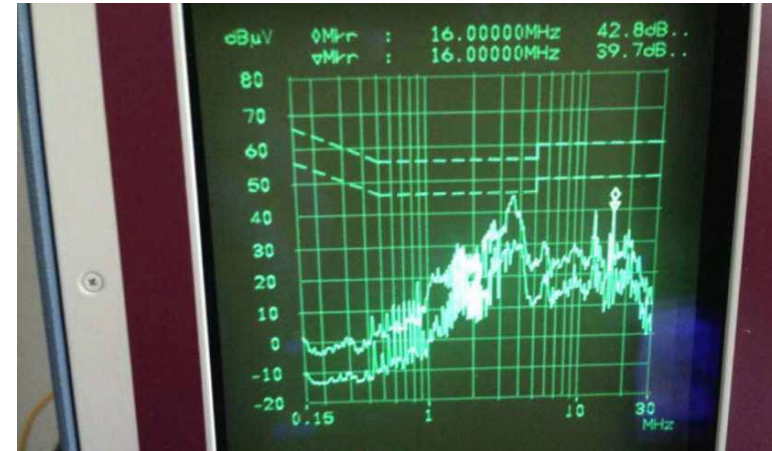
POWER SUPPLY SIDE MEASUREMENT AT A VFD WITHOUT SHIELDED CABLE, AND WITH NANOTECH[®]



Goes well beyond Specified Standard limitations without absorber.



Well below Specified Standard Limitations with the use of a Nanotech[®] REC



Note: Above data specified by the following:

- › EN55011 Class A (group 1) ratings 150KHz – 30MHz
- › EN61800-3 Cat 2, IEC (European) Standard Adjustable Speed Electrical Power Drive Systems (-3 is the German version)

WHAT IS NANOTECH[®]



Annealed for high frequencies in the range
Of 100kHz-Gigahertz.



Function is the combination of an Inductor
and an Absorber.



Changing dangerous emissions to safe
thermal energy.



Easy to install in systems.



BENEFITS OF USING NANOTECH[®]



Unshielded cables can be used to reduce cost of system, installation, and most importantly, operating life of the system.



Exceeds EMC performance compared with shielded cable.



Reduce both conducted and radiated emissions with the use of Nanotech[®] chokes.



No maintenance...ever!



Easy retrofit in the field.



Old non-VFD systems that were not able to use shielded cables in the past because of limited space or availability, can now benefit from the use of VFD's.

Five Nanotech[®] REC radiated protection products cover all motor sizes, from 1/4HP - 1632+HP (DC and servo included).

CHOOSING THE CORRECT NANOTECH® REC CHOKES



Choose The Correct Cores From The Chart Below. Choose By Horsepower Of The Vfd And Cable Length.

All Power Cables Must Go Through Nanotech® Rec Cores As Shown Below.

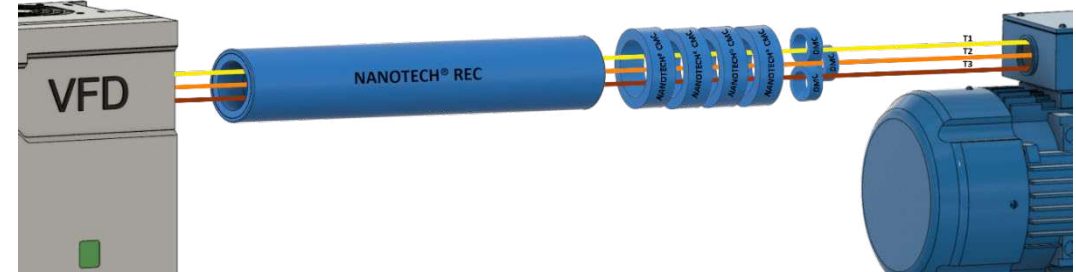
No grounding wire or shielding.

Nanotech® REC		Power Range	Number of Nanotech® REC per cable length (ft)				
Part #	HP	Finished Dimensions (in)	Isat	1-150	151-300	301-450	451-900*
CT17X135 HP1/4-10A8	1/4-10	≤1.42 x ≥0.7 x ≤5.31	8	1	2	3	4
CT35X240 HP11-40A14	11-40	≤2.58 x ≥1.38 x ≤9.45	14	1	2	3	4
CT54X360 HP41-100A18	41-100	≤3.54 x ≥2.13 x ≤14.17	18	1	2	3	4
CT195X415 HP101-428A40	101-428	See Datasheet	40	1	2	3	4
CT240X473 HP429-1600A50	429-1600	See Datasheet	50	1	2	3	4

System with just Nanotech® REC Core



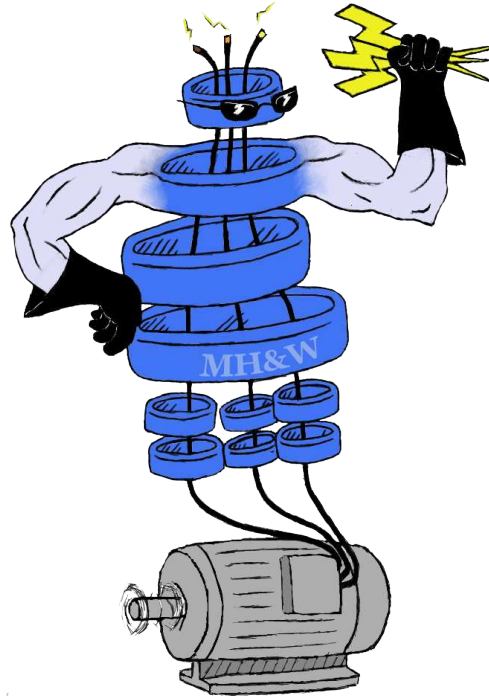
System with REC, CMC, and DMC Nanotech® Cores



- Specially designed Nanocrystalline Core set for replacing shielded motor cables.
- Simply put the Nanotech® REC over the UVW cables. No neutral, no ground. Nanotech® REC absorbs the high frequency noise.
- Unshielded motor cables can be used together with all variable frequency drives.
- Each Nanotech® REC can handle up to 150 feet of motor cable.
- Example: If you have 300 feet of motor cable you have to place 2 Nanotech® REC filters over the cable, in series.



- › No limitations on the length of cable.
- › Nanotech® REC can handle all VFD motors HP/kW.



“MH&W, Keeps Your Motor Running!”

- Nanotech[®] Filters and solutions continue success worldwide.
- Nanotech[®] REC Radiated Emissions Choke is the only alternative to using costly shielded cable.
- Nanotech[®] is now being used and promoted by major OEM drive manufacturers, OEM's, HVAC/chiller equipment, wind turbines, and end users to keep their equipment functioning properly, and avoid downtime.
- Call MH&W for more info today.

Have your VFD problems resolved permanently!