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APPLICATION NOTE

Tool Installation Site Survey

ESD/EMI/ELF

Summary

As semiconductor manufacturing tool sets become more sensitive to match smaller device geometries, potential interference levels are falling as well. The consequences of installing sensitive equipment such as SEMs, AFMs, and a host of other tools in locations where pervasive or periodic interference from pulse-EMI (ESD), EMI/RFI and ELF/ULF magnetic fields can be considerable. Many equipment manufacturers are now mandating interference surveys prior to tool installation to qualify the proposed location. This type of survey usually requires small footprint test equipment and techniques which span the entire radiated energy spectrum from DC to 2.5 GHz with an absolute minimum disruption to the ongoing manufacturing process.

Radiated EMI/RFI Interference

Tool manufacturers and even fab process owners are more and more often requiring testing for maximum acceptable interference levels as part of an installation specification. Of concern are DC, AC and high RF fields potentially capable of disrupting the tool operation. These interference levels are assuming that tool "skins" are properly in place and that high voltage and other radiation sources in the area are properly shielded. Obviously, any nonstandard operating condition (some fabs leave panels open with electronics compartments exposed) only increases interference potentials.

A typical interference specification would be 3 V/m for 10 kHz – 1GHz bandwidth. However, with the advent of more hand-held electronics and even wireless LANs in some fab environments, the spectrum of concern has "unofficially" extended out to 2.5 GHz and beyond to cover broadcast radiation for WiFi, Bluetooth, GSM cell phones, and commonly used radios and pagers.

Interference surveys for these types of potential sources to characterize local signal amplitudes require spectral analysis with small footprint active broadband antennas. Due to a host of local variables not commonly dealt with in formal EMC testing, not to mention confined space due to dense manufacturing areas, specialized equipment is needed to take the most accurate measurements possible under often difficult conditions. It is also important that testing be done during peak production cycles so that possible interference sources will most likely be active.

Pulse EMI (ESD) Interference

Another class of pervasive interference consists of radiated fast transients generated by electrostatic discharges (ESD) occurring in fab areas surrounding sensitive tools. Examples of this are ungrounded carts bumping metal tables or even tool panels themselves, ungrounded ceiling panels in conjunction with pulse ionization systems causing very large amplitude pulse events, and even ungrounded hand tool use by

technicians and engineers. Surveys for this type of interference require a high-bandwidth oscilloscope with a sophisticated signal capture ability, multiple matching E-field antennas/probes and phase-matched test cables to adequately analyze event types and sources.

Magnetic Field (ELF/ULF) Interference

An additional source of interference concern is pervasive AC and DC magnetic fields (B-fields). Magnetic flux in the 30-60Hz range has been associated with numerous instances of tool malfunction across many industries and processes. This type of radiated field is very difficult to shield against, requiring special metals and techniques not commonly adopted by tool vendors and process owners. Also, ULF (ultra-low frequency) magnetic flux in the 0-30 Hz range can cause difficulties for metrology tools. Validation of a tool installation site requires numerous test points and readings taken on three or more axes with an axial magnetic probe of appropriate sensitivity (μG). Tool sensitivity specifications for this type of interference can require levels to be as low 2 mG. Where manufacturer designated test points have not been provided, generally the test protocol follows SEMI E33-0994 specifications.

Conclusion

Proactive qualification of proposed tool installation sites within semiconductor fabs is proving to be a necessary component of assuring the fastest ramp for new tool sets and processes. Since new, more sensitive tools are increasingly being integrated in older fab environments as part of the technology growth process, problems from legacy environments have taken on even more significance. Ideally, interference surveys are conducted both during new tool site preparation and as periodic sweeps of process areas on a semi-annual basis to assure that problems are identified as early as possible. Too often, fab process engineers find themselves fighting uptime problems that are caused by pervasive interference problems originating outside of the affected tools themselves.

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