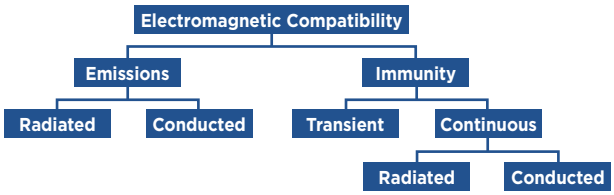
Experience EMC Through Expert Eyes

Electromagnetic Compatibility (EMC) is the ability of an electronic or electrical system to operate in their electromagnetic environment without impairing their functions and without faults and vice versa.

EMC ensures that operation does not influence the electromagnetic environment to the extent that the functions of other devices and systems are adversely affected.

There are two main elements of EMC:

- **Emissions** – Is the generation of unwanted electromagnetic energy. Emissions need to be reduced below certain acceptable limits to ensure they do not cause any disruption to other electrical devices.
- **Immunity/Susceptibility** – Immunity is the ability of an electronic device to function normally in an electromagnetic environment without experiencing interference/malfunction due to the emissions emanating from another electronic device. Susceptibility is basically the opposite of immunity, in that the less a device is immune to electromagnetic interference, the more susceptible it is.

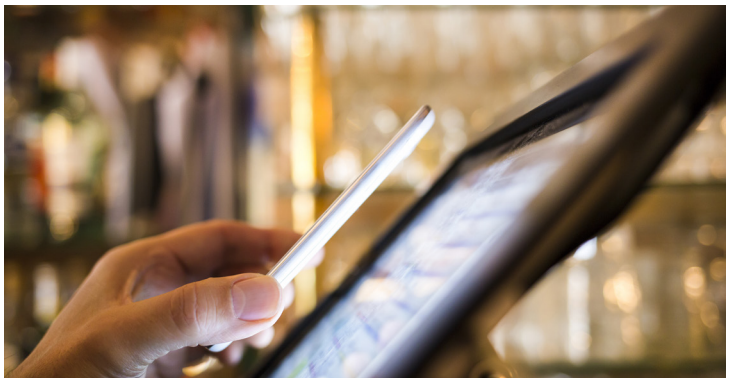


Emissions

Emissions are electromagnetic interference (EMI) or disturbances generated by an electronic or electrical device.

- Radiated Emissions – Radiated emissions are propagated through the air.
- Conducted Emissions – Conducted emissions are propagated along interconnected cables such as wired ports or power cables.

As it pertains to touch screens, emissions issues are far less prevalent than immunity problems. The exception to this statement would be products geared towards the automotive, medical, and military industries where the standards are much more stringent than the consumer market. The challenge with touch panels emissions is the touch panel is an intentional radiator. In other words, the touch panel transmits and receives capacitively coupled electric fields. This is done so touches can be detected by the touch controller.



Immunity

EMC immunity testing can be thought of as either continuous or transient in nature. Continuous testing is applied to a product to simulate RF proximity that may occur in the real world. Transient phenomena are typically short events that involve bursts of energy.

Continuous Immunity

Like emissions, immunity can be radiated or conducted. Immunity problems usually need to be addressed through touch controller firmware instead of hardware. Touch sensors are essentially antennas, and any hardware countermeasures to limit the effects of external noise also limit the sensor's ability to detect touch.

Radiated Immunity is the ability of an electronic device to operate in the presence of electromagnetic energy radiated through the air.

An example of an issue caused by radiated noise occurred between a POS (point of sale/service) unit and a counterfeit bill detector. When the counterfeit bill detector was placed next to the POS unit's touchscreen, ghost touches and no touch response were experienced.

The counterfeit bill detector contained both UV and fluorescent lamps. The lamps operated in the 30-50kHz range which falls in the touch controller's operational frequency range.

When most external devices are tested to meet their industry standards, like the Counterfeit bill detector for a CE level certification, they are tested around a 3 meter range from the operating device. In-field applications often do not represent this testing environment which causes EMI interference after the product has been installed. In this case, TES was able to create a custom setting within the touch controller for a new operating frequency — From there it was tested, validated and implemented, introducing a solution that allowed the touch functionality to perform without any imperfections.

Fluorescent lighting can cause radiated and conducted EMI. Electronic ballasts operate in the 20-60kHz range which is the same operating frequency range as many touch panels. This can cause ghost touches or non-responsive touch screens if the fluorescent lighting system is poorly designed.

Most fluorescent light units are well-designed and implemented in a way that doesn't affect touch screen functionality. However, some fluorescent light fixtures are shielded improperly or grounded incorrectly. In these cases, the power cable can act as an antenna and radiate noise as well as conduct noise to the outlet. If the outlet is shared with the touch screen device, the noise can conduct to the touch screen.

Conducted immunity is the ability of an electronic device to operate while being subjected to electrical noise injected or coupled through conductive structures such as power cables, harnesses, and input/output connections. Examples of tests commonly used to evaluate conducted immunity are Conducted RF Interference (CRFI) and Bulk Current Injection (BCI).

Issues commonly caused by conducted noise are false/ghost touches and touch loss. A common countermeasure is to implement frequency hopping. When the touch controller detects noise at the active operating frequency, it adjusts the operating frequency so the functionality will not be disrupted. When noise frequencies are within a few kHz of the operating frequency, touch issues are likely.

Transient Immunity

Transient phenomena are short bursts of energy that a product under test will be exposed to for a very short amount of time. Like continuous immunity, transient immunity is applied to a products enclosure port, signal/data ports and power ports where applicable. Examples of transient tests are Electrostatic Discharge (ESD), Surge test, and Electrical Fast Transient (EFT).

Touch panels can have issues during ESD testing if the touch controller layout is designed poorly. When an ESD strike occurs on larger sheets of metal like a chassis ground, the discharge can cause a strong E-field that will couple to the touch controller. If designed poorly, there can be issues such as false/ghost touches and resets.

For example, in one design the touch controller circuitry was separated on two PCBs linked by a 5″ flex cable carrying timing and control signals. One PCB contained the main controller IC and the receiver ICs while the second PCB contained the transmit circuitry. Whenever there was a discharge, the field coupled to the flex cable and interfered with the control/timing signals. This would result in ghost touches. To prevent this issue, it is recommended all touch controller circuitry be located on a single PCB. It is preferable to locate the circuit board close to the touch sensor's Rx lines and if necessary, have longer connections to the Tx lines.

If modifying hardware is not an option, implementing debouncing through firmware can help with ghost touches. Also, modifying IIR filter parameters is helpful to time average out erroneous touches.

Self-Interference

Another kind of interference is self-interference. This is when an electrical device interferes with itself. An example is when a monitor's LCD radiates and couples to the touch panel.

Depending on the technology used, LCD size, resolution, and pixel content, significant EMI can be generated by a display. Pixel data can result in repeating data patterns that unintentionally emulate clock signals that can interfere with the operating frequency of the touch controller.

One example of this occurred with a fish finding unit. Touch response was normal when set at the menu screen. When the user navigated to the fish finding map, the touch sensitivity was weaker and response was intermittent.

The display background for the fish finding map was set to black (different from menu screen). It was found that the EMI produced by setting the background to black was higher than all other colors.

Again, implementing frequency hopping allowed the unit to resume normal touch response.

Conclusion

With an intuitive selection of touch controllers that have built-in intelligence. MicroTouch™ can set internal settings to identify a trigger range of frequency levels that automates a frequency hop resulting in an uninterrupted operating band. If the default controller settings and subsequent frequency ranges don't work for the application, MicroTouch™ has the expertise and resources to create custom settings within the controller that identifies operating frequencies outside of the standard — encouraging a seamless, reliable, and efficient user interaction without any EMI issues. Innovating and proactively brainstorming scenarios of touch devices use-cases has led our team to test touch controllers in frequency ranges past the expectations of industry standards. IEC-61000-4-6 requires the testing environment to start at 150kh for an operating frequency. Through years of industry experience, MicroTouch™ has ensured that our touch controllers will work at much lower frequencies, down to 30kh. With internal resources, IC experts, and an innovative approach to IC performance, MicroTouch™ will meet your application's touch interface requirements.