

## Technology Comparison Matrix

Features & Attributes	TouchSensor Technologies Field Effect™	Capacitive Approaches	Comments
Software Development Required	No	Yes, some software effort required, even considerable effort for some supplier's offerings	TouchSensor offers the only software free digital touch switch. No microprocessor or software is required to make the touch decision.
Adjustable Sensitivity	Yes, adjustable during development process, but then set once for the application. No adjustment necessary post design. Sensitivity can even be optimized to detect a human finger, yet ignore contaminants such as water from rain or a car wash.	Yes, but customer must do the work to determine the sensitivity level, and the expected effect of drift and sometimes contaminants, and must program the microprocessor accordingly. Changes in sensitivity made later require reprogramming and documentation tracking of software changes.	TouchSensor's Field Effect™ TouchCells™ are the only touch sensitive switch technology that can be designed to detect a human touch in the presence of water running over the surface of the touch substrate.
Low Impedance	Yes: input impedance in the kilohm or less range	Generally No. Many capacitive approaches have higher input impedance than Field Effect™ technology, some even in the megohm range.	Low input impedance is critical for robust performance and to reduce the influence of noise.
High Signal to Noise Ratio	Yes	No	Field Effect™ technology has a 3 volt dynamic range and looks for changes in the 100 to 200 millivolt range to make touch decisions. This enables a very high signal to noise ratio for robust performance. Most capacitive approaches look for changes in the 10s of millivolts, the same amplitude as many noise signals, resulting in less robust performance.
Response Time	Very Fast: 160 microseconds typical	Slower: 10msec to 150msec typical	Slower response, which can be typical of capacitive approaches, could make the user dissatisfied with sluggish switch activation. With capacitive approaches, a faster response requires more current drain. With Field Effect™ technology, current drain is always low and response is always very fast so users get crisp satisfying switch response.
Immunity to Surface Contaminants	High	Lower: requires a microprocessor and signal processing software to reduce susceptibility to surface contaminants	TouchSensor's proprietary electrode structure design, together with the TouchCell's™ digital input and output with a high signal to noise ratio, ensure robust performance even in the presence of surface contaminants.
Immunity to Radio Frequency Interference	High	Medium	Field Effect™ TouchCells™ are inherently more immune to RFI because of their digital input and output, their low impedance signal input, and their high signal to noise ratio.
Support Services Provided	Maximum: (supplied by TouchSensor and Methode) TouchSensor and Methode work closely together with the customer. TouchSensor and Methode design the complete product and supply fully tested assemblies ready for use in the customer's application.	Minimal: Technology supplier provides chips and application notes. Customer, or their product supplier, must have resources to understand the technology, evaluate technical feasibility, design products, and verify and validate designs for production	
Size/Pkg (profile & thickness)	Very thin, low profile	Slightly thicker and higher profile due to larger chips	
Durability	High; solid state, no moving parts, field proven high reliability	Unknown, but could be high; solid state, no moving parts, field results unknown	TouchSensor Technology's Field Effect™ TouchCells™ have been in operation for more than 12 years in many demanding applications, including automotive applications. 160 million TouchCells™ are in operation today with no reported field failures. The TouchCell(tm) is the only touch switch rated as a Fail Safe Switch by Underwriters Laboratories.
Stability	Highly Stable	Less stable than TouchSensor Field Effect™ technology. For example, many capacitive approaches must be programmed (software) to compensate for expected drift, or some continuously recalibrate in an effort to remain somewhat stable.	
Current Consumption	Very Low: 16 microamps typical	Low to Medium: 50 to 600 microamps or more	As indicated above, capacitive approaches require more current drain in order to increase response speed.
Layout Dependent Design (more complex design process, especially with changes)	No, not layout dependent because decision is made at point of touch or sense point, and all outputs are digital, not analog	Yes, changing or adding to design can cause additional software work, or can cause false triggering due to crosstalk between circuit board traces.	Should be a concern to customers, or their product suppliers, that deploy a capacitive approach
Operating Temperature Range	-40°to +120°C	0 to 70°C, or -40 to +85°C	TouchSensor's Field Effect™ TouchCells™ operate over the widest available temperature range. This allows them to be used in some applications that are impossible for most capacitive approaches, and also makes Field Effect™ TouchCells™ even more reliable when operated in the narrower -40 to +85°C range.

# TouchSensor™ Technologies



## List of Facilities

### Engineering and Design Centers

- Southfield, Michigan
- Mriehel, Malta
- Burnley, England
- Gau-Algesheim, Germany
- Shanghai, China
- Bangalore, India

### Manufacturing Facilities

- Wheaton, Illinois
- Carol Stream, Illinois
- Mriehel, Malta
- Monterrey, Mexico
- Reynosa, Mexico
- Shanghai, China

### Customer Support Offices

- Mriehel, Malta
- Beaune, France
- Burnley, England
- Gau-Algesheim, Germany
- Tokyo, Japan
- Chicago, Illinois
- Southfield, Michigan
- Shanghai, China

### Test Laboratories

- Palatine, Illinois
- Hunt Valley, Maryland
- Mriehel, Malta
- Burnley, England

## Sales and Technical Center



### TouchSensor Automotive Sales

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