



Gen3 Proximity Sensing Enhances Sanitary Devices



In an era where hygiene and sanitation are paramount, the evolution and integration of technology into everyday sanitary devices have marked a significant leap in public health and convenience. Among these advancements, capacitive sensing in contactless sanitary devices stands out, offering a blend of innovation, hygiene, and user-friendliness.

Contactless sanitary devices are automated tools designed for use without touching them. This group includes things like automatic soap dispensers, faucets, hand dryers, toilet flushers, and garbage can lids. They work with sensors that notice when someone's hand or body is near and respond by doing things like releasing soap or water. The main purpose of these devices is to cut down on touching surfaces, which helps stop the spread of germs and keeps things cleaner and more hygienic overall.

The market for contactless sanitary devices has witnessed exponential growth, driven by heightened hygiene awareness and technological advancements. These devices are now ubiquitous in public restrooms, hospitals, hotels, offices, and increasingly in private homes. The demand is not just limited to high-end or health-conscious consumers; it spans a broad spectrum, motivated by the universal need for improved sanitary practices. This widespread adoption has spurred continuous innovation, with manufacturers focusing on enhancing reliability, user experience, and environmental sustainability.

Contactless sanitary devices employ various technologies for detecting hand gestures or presence, each with its unique mechanism and suitability. Below are the most common:



Figure 1: Examples of Contactless sanitary devices that can use a capacitive proximity sensor for activation

Passive Infrared Sensors are the most common today, using infrared [heat] emitted from your warm body to detect hand presence. They are known for their low power and cost-effectiveness but are better known for not triggering when we want them to work. This is usually caused by cold hands, dirty optical windows, poor alignment or tuning of the sensor. I think we all are familiar with using public restrooms and getting frustrated because the faucet won't activate, soap won't dispense, or paper towel does not come out. If you're frustrated with the experience, it's probably a battery operated, passive IR sensor-based device.

Active infrared [transmitter + receiver] sensors are also used and usually in the range of 850nm. These are notorious for not working with darker skin and using more power than passive IR. However, they are more repeatable and reliable than passive IR.

Direct time of flight sensors are small sensors with an IR emitter and SPADs (Single Photon Avalanche Detector) as the receiver. These are getting more attention lately since they can provide accurate distance measurement of the hand from the sensor. However, they are much more expensive and draw significantly more power.

Capacitive proximity sensing, a more recent and increasingly popular technology, detects the capacitance change caused by a human hand at an electrode. This technology is highly sensitive and accurate, making it ideal for sanitary devices. Its ability to self-calibrate adds to its reliability, adjusting to environmental changes and ensuring consistent performance. Also, newer designs, as we will discuss, can get power consumption low enough to compete with passive IR. Capacitive sensing will also not be affected by soap/dirt film building up over the sensor like PIR.

Lumissil's Gen3 capacitive sensing technology is ideally suited for contactless sanitary devices whether they are battery based or plugged into a wall for power. This latest, cost-effective technology is more robust and sensitive

than previous generations and allows for significantly lower power draw when just monitoring for a proximity event or key touch. It is resilient to water droplets, less sensitive to EMC and faster to react. To improve performance a proprietary higher resolution digital converter is implemented to increase the sensitivity of the system. The improved sensitivity can better detect small changes in capacitance which allows the algorithm to better differentiate between intended and unintended activations. The improved sensitivity also enables better proximity detection. The 3rd generation digital conversion relies on capacitive to digital convertor (CDC) that uses a reference capacitance for comparisons.

Another big advancement for the Lumissil 3rd generation of capacitive sensing is continuous self-calibration. In essence, self-calibration in capacitive sensing is all about ensuring that the system remains responsive and accurate by automatically adapting to changes in its environment or its own components. Proper calibration is vital for user experience, as it prevents unintended activations and ensures that genuine proximity events are reliably detected throughout the life of the product.

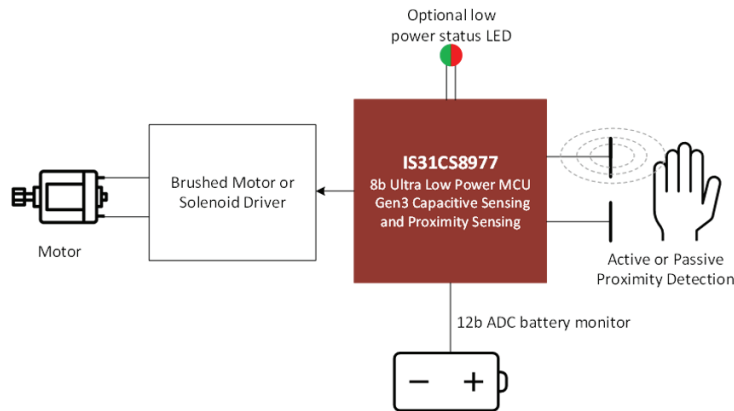


Figure 2: Example of a battery based contactless sanitary system using Gen3 active proximity

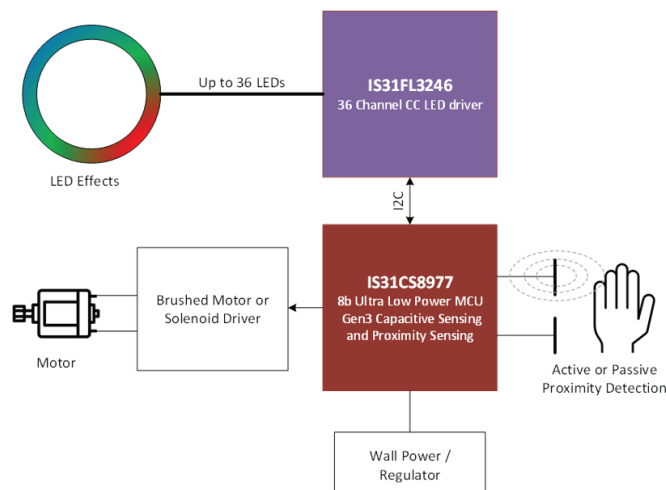


Figure 3: Example of a plug in contactless sanitary device with LED light effects



Gen3 Proximity Sensing Enhances Sanitary Devices

Figure 2 shows a contactless sanitary system like a paper towel or soap dispenser using Lumissil’s MCU with Gen3 technology. On the right the hand is entering into a proximity sensing zone. This can be either active or passive. Active proximity means one electrode acts as a transmitter and another acts as a receiver. When nothing is in the zone there is a baseline capacitance measured on the receiver electrode. A hand entering the zone will disrupt the capacitance and the MCU can detect the event. Active proximity detection will give you a longer range realistically up to about 10” but will draw more power than a passive system which does not rely on the transmitter. Although a passive system has a shorter range such as about 2” this may still be good enough for some systems where it’s OK to wave the hand closely to the device. In active proximity mode, power draw can be as low as 100 uA in sleep mode with event wake up enabled and taking capacitive measurements 4 times a second. In passive mode the power draw can be as low as 25 uA with a fast system wake up.

The MCU in Figure 2 is the IS31CS8977 which is a low cost, ultra-low power 32 MHz MCU with our Gen3 capacitive sensing technology. It can act as touch keys, passive or active proximity sensor. It features self-calibration to compensate for baseline capacitance over time which is important for contactless sanitary dispensers. It also

features a sleep mode that only monitors for a proximity touch key event in the low uA range.

Figure 3 shows an example of a touchless system that uses wall power, so power consumption is not as much of a concern. In this system the IS31FL3246 is added for LED effects on the device. For example, the touchless garbage can could have a ring of LEDs around the opening to make the product more exciting. The IS31FL3246 LED driver is a popular choice for LED rings such as found on smart speakers. There are many LED options and Lumissil offers hundreds of LED drivers to meet your application goals.

In conclusion, capacitive sensing in contactless sanitary devices represents a significant stride in our ongoing quest for better hygiene and health standards. As technology continues to evolve, we can expect these devices to become even more integrated into our daily lives, offering enhanced convenience, hygiene, and a touchless experience that aligns with the demands of modern living. The Gen3 capacitive sensing is available in several Lumissil MCU and pre-programmed drivers such as the IS31SE5120A. Please contact a Lumissil representative to discuss the best products and configurations for your application.

Below is a table of MCU and pre-programmed controllers that have our Gen3 capacitive sensing technology.

Pre-programmed Gen3 Touch Key and Proximity Controllers			
Features	SE5117A	SE5118A	SE5120A
Gen3 Cap Touch Channels	16	8	24
Active Shield Driver	✓	✓	✓
Auto Sleep / Wake on Touch	✓	✓	✓
Buzzer / Melody		✓	✓
Active Proximity Sense			✓
Passive Proximity Sense	✓	✓	✓
Automatic Self Calibration	✓	✓	✓
400kHz I2C	✓	✓	✓
Configurable GPIO	✓		✓
Per-Key Sensitivity Set	✓	✓	✓
Multi-key	✓	✓	✓
Press and Hold	✓	✓	✓
Package	QFN-24	TSSOP-16	LQFP-32
Industrial Temp range	-40 to 85°C		
Automotive Temp Range	-40 to 125°C, -40 to 85°C		
Auto Qual	AECQ100 Grade 1		



Gen3 Proximity Sensing Enhances Sanitary Devices

	CS8974	CS8975	CS8976	CS8977	CS8978	CS8979
Core	1 Cycle 8051					
Speed	16 MHz	32 MHz				
RAM	2KB	1KB	1KB	2KB	2KB	2KB
Flash	32KB ECC	16 KB ECC	16KB	64KB	64KB	64 KB
GPIO	20	12	10	28	20	9
Interrupts	20	6	6	6	6	6
I2C	3	2	2	2	1	2
SPI	1	1	1	1	1	1
UART	2	2	1	2	2	2
LIN	1 Controller	1 Controller	1 LIN2.2A, SAEJ2602 Controller + Phy	1 Controller	1 LIN2.2A, SAEJ2602 Controller + Phy	1 Controller
Comparators	4	4	2	4	4	4
Timers	5@16b and 1@24b					
ADC	No	16 ch, 11b SAR	4 ch, 11b SAR	16, 12b SAR	16, 12b SAR	8, 12b SAR
DAC	No	1 ch, 8b				
Temp Sensor	No	Yes				
PWM	6 ch, 8b	6 ch, 12b				
Gen3 Cap Sense	19 Gen 3	11 Gen 3	9 Gen 3	27 Gen 3	20 Gen 3	20 Gen 3
Melody Maker	Yes					
Integrated LED Driver	No					Yes: 16@60 mA Constant Current / Dimmable
Package	TSSOP-24 7.8x4.4 QFN-24, 4x4	TSSOP-16, 5x6.4 SOP-8, 4.9x6	TSSOP-20 6.5x6.4	TSSOP-20 6.4x6.5 TSSOP-24 6.4x7.8 TSSOP-28 6.4x9.7 LQFP-32 5x5	QFN-40 6x6	QFN-40 6x6
Industrial	-40 to + 85°C					
Automotive	-40 to 125 °C					
Auto Qual	AEC-Q100					