



Integrating UI Design for Modern White Goods with the IS31CS9310



Modern white goods, from washers and dryers to dishwashers and refrigerators, are rapidly evolving into connected, intuitive products with premium user interfaces (UIs). Customers now expect touch controls that work through moisture and gloves, clean visual feedback that is readable at a glance, audible cues, and responsive interactions that feel “instant.” The IS31CS9310 from Lumissil brings these requirements together in one device by integrating a 32 bit RISC V MCU, a capacitive touch controller, and an 8×12 LED matrix driver. This single chip approach simplifies hardware, shortens time to market, and makes it far easier to achieve robust, appliance grade HMIs.

WHY INTEGRATION MATTERS IN APPLIANCE HMIS

Design teams often stitch together separate parts for touch, LED driving, and control logic. That strategy increases the size, number, and complexity of printed circuit boards. The increased component count adds cost both in parts, but also in assembly time and complexity. The need for more internal wiring can, in turn, compound noise and communication issues. Having disjointed building blocks can add to software complexity and hinder diagnostic capabilities. By contrast, IS31CS9310 consolidates these functions and adds purpose built features to ease the design, assembly, and compliance process for household appliances.

In addition to reducing design complexity, functional safety is no longer optional in modern appliances - It's a critical requirement. Standards like IEC 60730 for household appliances and ISO 26262 for automotive systems share the same goal: preventing harm caused by system failures. As appliances become smarter and more connected, ensuring safe operation under all conditions is paramount. IEC 60730 defines diagnostic and self-test methods for electronic controls in household appliances. It classifies software into three categories:

- **Class A:** Non-safety functions [e.g., timers].
- **Class B:** Prevent unsafe operation [e.g., thermal cut-off, door locks].
- **Class C:** Prevent special hazards [e.g., burner control]. [nxp.com], [lra.com]

For HMIs, **Class B compliance** is essential to ensure that failures in touch keys, LED indicators, or control logic do not lead to unsafe appliance behavior. Lumissil's **IS31CS9310** MCU offers an integrated platform for Human-Machine Interfaces (HMIs)

that meets these stringent safety requirements.

THE IS31CS9310 BUILDING BLOCKS (AND WHAT THEY ENABLE)

RISC V MCU (up to 32 MHz) with 256 KB e-Flash and 32 KB SRAM. ECC memory ensures data and program integrity. Low-power modes improve energy efficiency. Dual **watchdog timers** provide deterministic control while running touch/LED tasks concurrently. The built-in DMA controller provides peripherals with high-speed access to 16KB of SRAM. A multitude of peripherals, including timers, ADC, DAC, comparators, PWM controller, and multiple clock sources ensure that the designers have the flexibility and features needed for nearly any UI design. Interface options, including 2 EUARTs, a LIN controller, I2C M/S, and up to 35 GPIO pins allow the IS31CS9310 to connect to external devices such as Wi-Fi/Bluetooth modules, motor controls, switches, etc.

Touch & Proximity - A 16-key touch controller for moisture tolerant touch keys with shielding keep UIs responsive under splashes and cleaning, while proximity sensing can “wake” the UI as a user approaches. This directly addresses real world conditions like splashes and condensation without sacrificing sensitivity. Proximity sensing and gesture detection further enhance interactivity. Controls can be kept in a low-power mode and lights can be turned off and buttons disabled until a hand is detected in close proximity to the control interface. Continuous automatic baseline calculation keeps keys calibrated, eliminating false triggers and keeping touch keys responsive and reliable. Self capacitance keys with an active shield ring excel in moisture prone panels. For more complex and compact key layouts, mutual capacitance provides matrix scanning with more precise touch zones. A long list of enhancements ensures that the touch controls work flawlessly. These include stuck key detection, noise filtering, adjustable internal reference capacitance, and DC compensation for oversized keys. The MCU core means endless customization to create sliders, wheels, and keys for creative and sleek designs.

8×12 LED matrix driver with 12 bit PWM current sinks (up to 80 mA), **de-ghosting** circuitry, and **spread-spectrum clocking** to reduce EMI. 4,096 brightness levels provide for dynamic lighting effects such as fading, pulsing, and attention-directing animations. This allows manufacturers to create visually

appealing displays for status indicators and notifications. Open and short detection provides critical diagnostics for quality control, repair, and safety-critical functions. The LED controller is enhanced with a temperature sensor and thermal shutdown circuitry to protect LEDs in high-temperature conditions.

Audible Feedback - An integrated melody controller provides 14 bit precision tone generation with **note frequency, duration, and pause control**. The Melody Controller has two outputs, BZ and POW. BZ is used to drive a speaker or a buzzer. POW is used to enable the driver which allows gradual diminishing tonal effects - supporting attention grabbing alarms and subtle confirmation beeps without external audio DSPs.

Pathway to Haptics - The device's tone/PWM and GPIO resources, together with its system timers, **enable driving external ERM/LRA actuators** [through a simple transistor/H bridge or dedicated haptic driver] to create tactile cues. ERM [Eccentric Rotating Mass] and LRA [Linear Resonant Actuator] are the two main types of vibration motors, used in haptics [tactile feedback]; ERMs use a spinning unbalanced weight for multi-axis vibration, while LRAs use a spring-mass system driven by a voice coil for single-axis, resonant vibration, offering faster response and lower power, though requiring specific AC frequencies. LRAs provide sharper, more precise feedback [like button clicks] but are limited to their resonant frequency, whereas ERMs are cheaper but slower and less efficient.

Automotive-Grade Communication - LIN 2.0/2.2-compliant physical layer and controller for seamless integration into automotive networks, alongside I²C, SPI, and UART interfaces for flexible connectivity.

Self-Test Library - Lumissil has developed an **IEC 60730 Class B Self-Test Library (STL)** for IS31CS9310, enabling manufacturers to implement CPU, memory, and peripheral diagnostics, accelerate certification with UL/VDE-compliant test routines, and reduce development time and cost for safety-critical appliances. Diagnostics can run at power on and periodically in the background.

Tools - Easy to use software automates Touch-key configuration and calibration. The Touch-key GUI even generates source code needed to drive the touch keys so that developers can focus on the main application code. Touch-key layout guides take the guess work out of PCB design. The Intelligent MCU Smart Configurator [IMSC] software is a visual configuration tool designed to quickly build MCU projects. This allows the developer to easily import the configuration package for Lumissil 32-bit MCUs, including chip selection, peripheral configuration, system clock configuration, and code generation. Development tools use standard Linux GCC and GDB compiler and debug. An evaluation kit and flash programmer and debugger are also available.

Automotive Qualification - The IS32 variant is designed for automotive temperature ranges and is **AEC Q100** qualified. Perfect for automotive center stacks, door-handle controls, climate-control modules and more.

Integrating UI Design for Modern White Goods with the IS31CS9310

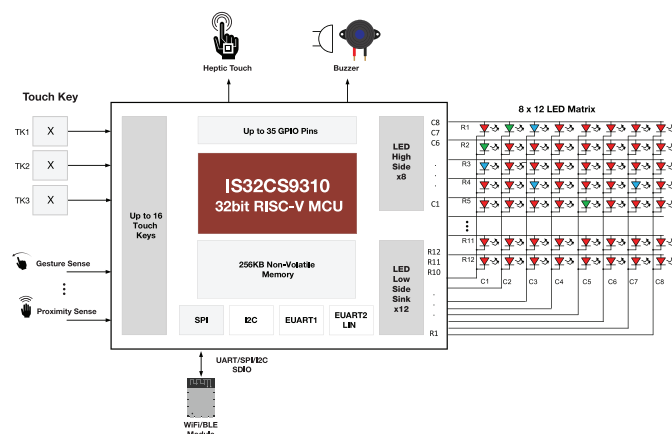


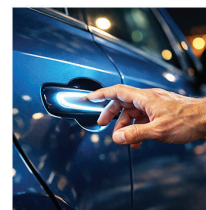
Figure 1: Application Diagram

APPLICATIONS

Automotive:



Center stack buttons



Capacitive touch proximity door handle



Lighting Control

Industrial:



Liquid level sensing



Robotic control



Power tools sensing and control

Consumer:



Appliance Control/HMI



Thermostat HMI & control



Smart door lock control

CONCLUSION

IS31CS9310 lets appliance teams deliver **clean, responsive, and reliable** HMIs without juggling multiple ICs. Its integrated touch + LED + MCU architecture lowers BOM and risk, while EMI friendly and diagnostic ready features make compliance and field reliability attainable. Whether you're refreshing a control panel or launching a premium, **near-touch** interface, IS31CS9310 is a practical path to modern appliance UX. Designed for both consumer appliances and automotive environments, this device enables intuitive, reliable, and aesthetically pleasing interfaces.