Case Study: **OLED display enables high brightness low power RF health monitor**

By David Giessel, Vice-president of Engineering 9CI

9CI designs and manufactures devices that reduce health risks associated with electromagnetic field exposure. In a world where technology is required, we at 9CI strive to help people navigate it safely.

We offer turn-key design, testing, and manufacture of niche instrumentation devices. Our devices are high precision, low noise, and high reliability. We pursue value through quality. We use relationship-based supply chains built on trust, work towards sustainability by eliminating packaging and manufacturing waste, and build devices that are designed to last for years.

The challenge

9CI's first Radio Frequency / Microwave Radiation Detector, the *Safe and Sound Classic*, was a simple device with a multi-colour LED readout. It was very well received and quickly grew in popularity.

As a result, we were asked to build a proper RF meter, adding a screen to display numerical values. Our customer valued quality and ease of use above all else, so the display needed to be easy to read, capable of fast updates (no ghosting), and have low power consumption for good battery life.

The need for backlighting or illumination was made evident from other products on the market, most of which were difficult to read under all but ideal lighting conditions.

We faced the following challenges when selecting the screen:

1. High brightness / high contrast for good visibility indoors and outdoors
2. Fast pixel drawing, even in cold weather
3. Low power draw for good battery life (>12 hours on 2x AA cells)
4. Low stack-up height and minimal X/Y dimensions to keep the meter compact
5. High surface hardness screen surface for lasting display clarity

Backlit LCDs 'wash out' at high backlight brightness levels and their power consumption was too high for our power budget. LCDs also have slow pixels that get even slower in cold weather.

> "It single-handedly let us hit our desired product size and battery life requirements."

Not good. The standard HD44780 compatible character displays (both LCD and OLED) were very inefficient from a packaging standpoint.

They sat very high off the PCB and used a lot of excess X/Y space for their bezel and carrier PCB. Also, most of these LCDs use a plastic face that scratches easily, leading to a 'foggy' screen a year or two down the road.

Old school 7-segment LED displays were possible but required lots of space, and they are essentially obsolete, not good for the supply chain management.

Electronic Assembly GmbH

OLED technology became a requirement to meet our viewability, draw speed, and power requirements as described above. 9CI also had extra requirements:

1. Non-standard packaging to meet our dimensional requirements
2. Quick sample availability for prototyping and evaluation
3. Native English documentation and support for troubleshooting
4. Glass display cover from the factory if possible
5. Long term availability from a reputable supplier
6. Cost-effective compared to LCD alternatives

After some determined investigation via a DuckDuckGo image search for '4x20 OLED board mount', we found *Electronic Assembly's* line of OLED displays. As soon as we saw the image of the glass module with pins directly on the package, we knew we had found our solution. Better still, these OLEDs were available through our standard vendors (including *Mouser*), and they come from an actual manufacturer, not just a Chinese re-brand. After evaluating a pixel display vs character display, we settled on our decision to go with characters and ordered *EA OLEDM204-GGA* samples.

Benefits

We cannot overstate how perfectly the *EA OLEDM204-GGA* met our needs. It single-handedly let us hit our desired product size and battery life requirements. The performance across wide temperatures and lighting conditions exceeded our expectations. With such fast pixel draws, we implemented a 20Hz instant power indicator. It looks fantastic with fast response and no ghosting.

> "Adding a display to the Safe and Sound has given our customers a more accurate way to measure RF levels in their living and working environments."

The glass front meant that our product packaging did not need a provision for cover glass, saving us money, and reducing assembly complexity. Users love being able to wipe the screen without fear of a scratched and foggy display.

As we learned about how to best mount the display to the PCB, we moved to a 'snap in assembly using MillMax surface mount PCB sockets. This gave us a 'zero stack up' attachment method that is also strain-relieving (pins can walk in the sockets if there is board flex). This has increased reliability, reduced assembly time, and made warranty repairs very easy. No soldering is required.

Adding a display to the Safe and Sound has given our customers a more accurate way to measure RF levels in their living and working environments. Fast response OLED technology allowing our instant power indicator provides a quick visual indication of pulsed digital modulation or continuous wave modulation, something our customers also care about.

Glass screens convey quality. Plastic screens look cheap. This is something Apple figured out with the iPhone, and it's true for other devices with screens as well. Looking at the glass *EA OLEDM204-GGA* instantly conveys quality to the customer. It makes the Safe and Sound Pro II stand out from the competition.

Our meter is the only one in its category that measures linearly across nearly eight orders of magnitude of power.The numerical display makes this very clear to our customers when they compare the Safe and Sound Pro II to other meters on the market.

It's no longer just colored LEDs, it's a precise numerical measurement. They can see that we measure down to a lower noise floor, and up to a higher saturation point. This makes it much easier for them to understand the value of our precision measurement circuit, fast firmware, and lab calibration work.

Being in the RF measurement niche, our meter also benefits from low electromagnetic interference of the display's integrated controller and low power draw. Lower loop area on signal lines and lower current through those lines means lower EMI and a lower measurement noise floor.

Many competing products end up detecting and displaying noise emitted by their screen. 25% reduced assembly time, faster warranty repairs, a stable long-term supply chain, custom capability, and excellent vendor support are other benefits we've enjoyed with the *EA OLED M204-GGA*. We're looking forward to using this display, and other Electronic Assembly OLEDs, in our future meters.