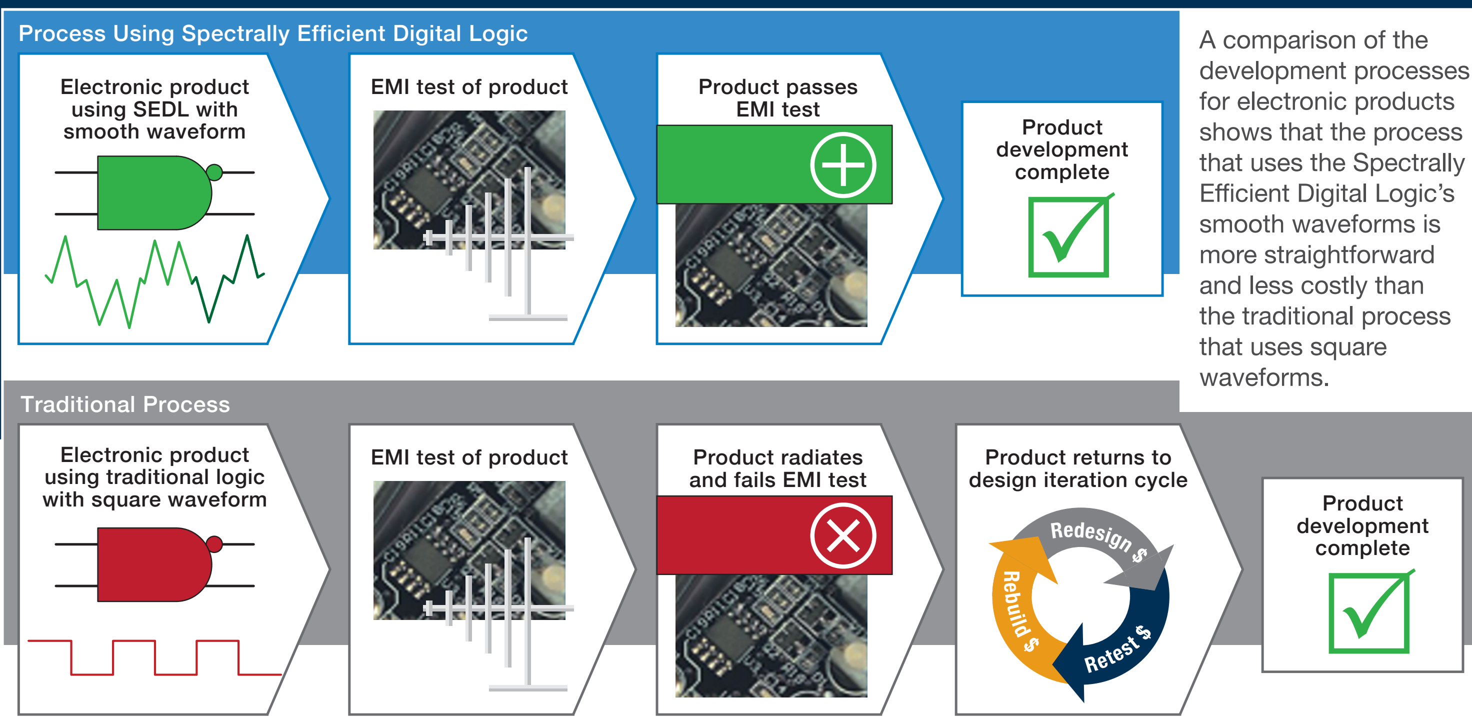
MIT LINCOLN LABORATORY

INNOVATION HIGHLIGHT

Technology in Support of National Security

WWW.LL.MIT.EDU

Spectrally Efficient Digital Logic (SEDL)



A comparison of the development processes for electronic products shows that the process that uses the Spectrally Efficient Digital Logic's smooth waveforms is more straightforward and less costly than the traditional process that uses square waveforms.

Lincoln Laboratory has created a set of digital logic families, Spectrally Efficient Digital Logic (SEDL), to mitigate the electromagnetic interference (EMI) encountered by sophisticated electronic products, such as computers, cellphones, and instrumentation. Because SEDL operates with low EMI emissions, it reduces the chance that EMI will electrically impede the performance of neighboring systems. A product comprising SEDL building blocks has a better chance of passing EMI testing on a first try and avoids costly modifications during development.

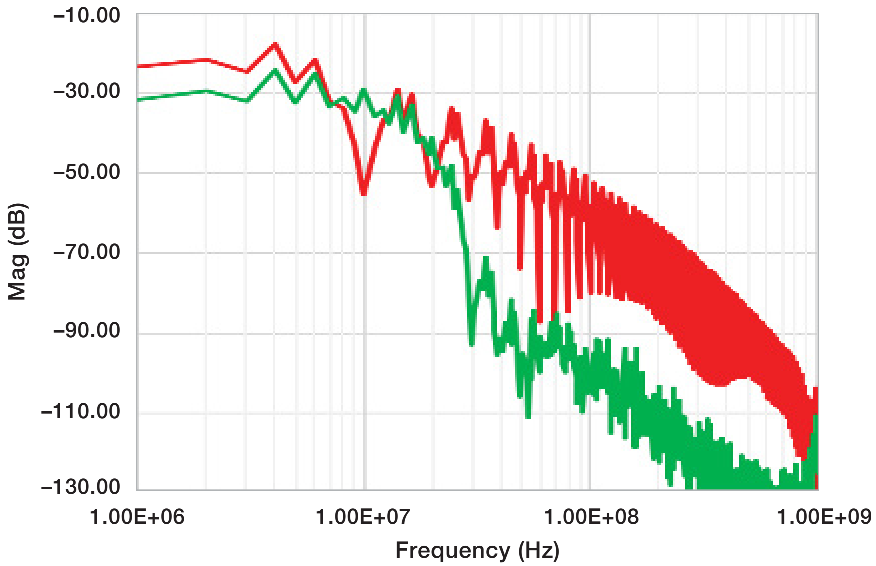
KEY FEATURES

- Enhances system security because low EMI emissions are less susceptible to interception, thus reducing the likelihood of an "attacker" accessing information, such as passwords or account numbers, as it is processed
- Enables increased tolerance of noise, distortion, and logic glitches that could degrade system performance
- Allows compatibility with traditional logic, giving designers the option to build systems that use a hybrid SEDL/traditional approach

LINCOLN LABORATORY
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Background

Electronic products and systems are required to pass EMI testing to ensure that they do not compromise components, devices, or persons in their vicinity. For example, EMI must be mitigated for cellular technology, computers, aerospace systems, automotive instrumentation, appliances, and medical devices, among many others. Typical strategies for mitigating EMI are often employed as retroactive design elements or patch methods added late in the development cycle; both approaches result in recurring engineering costs that in turn drive up the overall product cost.



The plot shows that the SEDL circuit (green) uses less spectral energy (i.e., has lower decibel, dB, magnitude) than does the traditional logic circuit (red) at a range of frequencies. The lower spectrum usage means less EMI is generated by the circuit.

Digital circuits (e.g., a digital processor or other logic element) operate on signal waveforms, i.e., a sequence of electrical pulses, whose rising and falling edges form a squarish shape. When such square waveforms are generated, transmitted, received, or otherwise used by any logic element, the square edges may produce spurious signals over a wide range of frequencies. Such extraneous broadband spectral content can make its way back to other components, such as sensors or actuators, via EMI, and limit or degrade performance.

Lincoln Laboratory Advancement

Traditional logic's use of square or trapezoidal waves gives rise to high-frequency harmonics that can lead to EMI problems. SEDL's use of smooth-shaped pulses for data, which do not generate high-amplitude harmonics, reduces the potential for electromagnetic emissions.

While SEDL uses circuit topologies that are similar to those of traditional logic, its novel method for processing data makes it tolerant of signal impediments.

INTERESTED IN ACCESSING THIS TECHNOLOGY?

Contact the MIT Technology Licensing Office

https://tlo.mit.edu/

tlo@mit.edu 617-253-6966

INTERESTED IN WORKING WITH MIT LINCOLN LABORATORY?

https://www.ll.mit.edu/partner-us

Contact the Technology Ventures Office

tvo@ll.mit.edu

U.S. PATENTS #10,673,417 and 10,944,415

Approved for public release; distribution is unlimited. This material is based upon work supported by the United States Air Force under Air Force Contract No. FA8702-15-D-0001. Any opinions, findings, conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the United States Air Force.