

Power Magnetics at High Frequency

Transforming the Black Magic to Engineering

Black Magic?

“Any sufficiently advanced technology is indistinguishable from magic.”

Arthur C. Clarke, 1973

“Any sufficiently OLD technology is also indistinguishable from magic.”

Raymond B. Ridley, 2017

What Do We Need from Magnetics to Move Forwards?

We **don't** need any new core materials.

We **don't** need any new winding materials.

We **do** need much better education in magnetics

We **do** need circuit models for inductors and transformers

We **do** need better and standardized core loss data

Magnetics Education

Most EE Students don't even recognize a transformer when they see one.



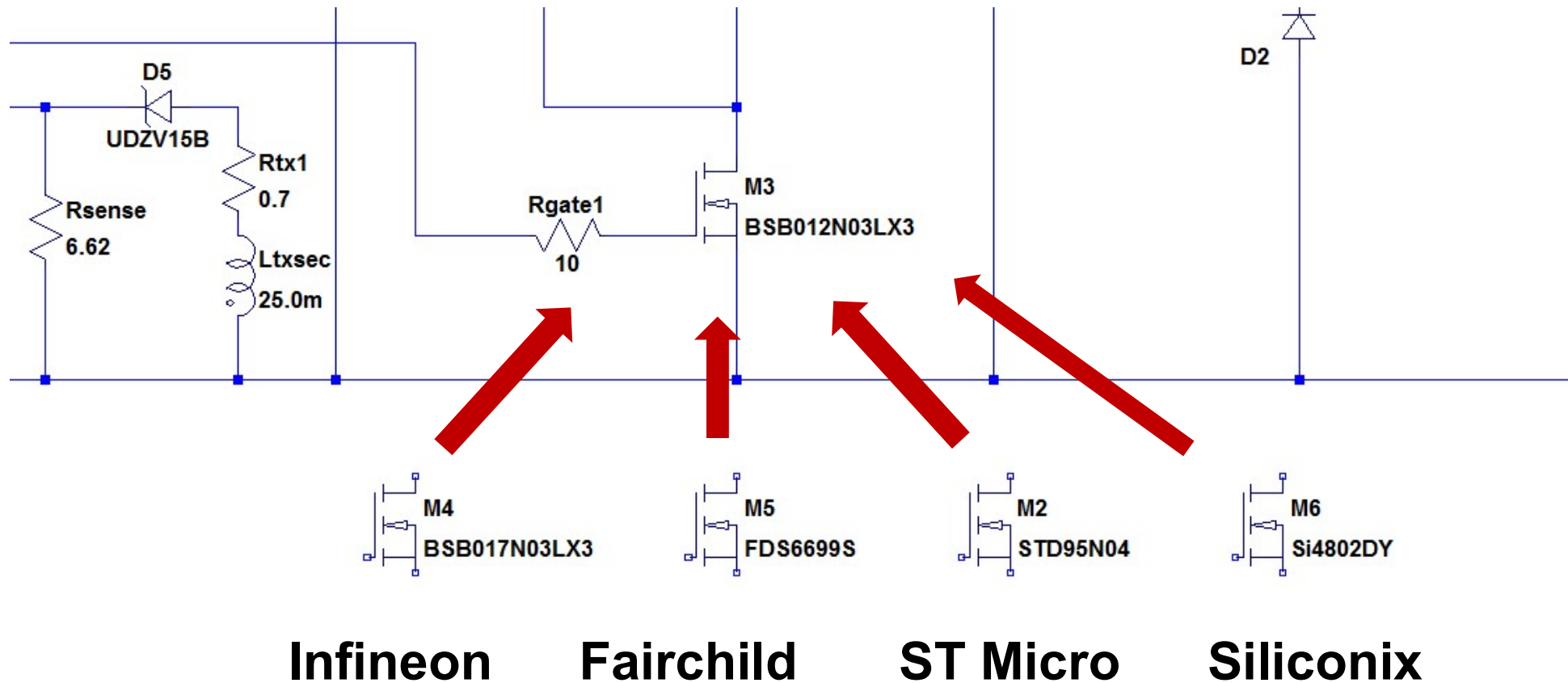
Very few power electronics students actually know how to make a transformer

A large portion of our industry thinks that elimination of magnetics is the way forwards.

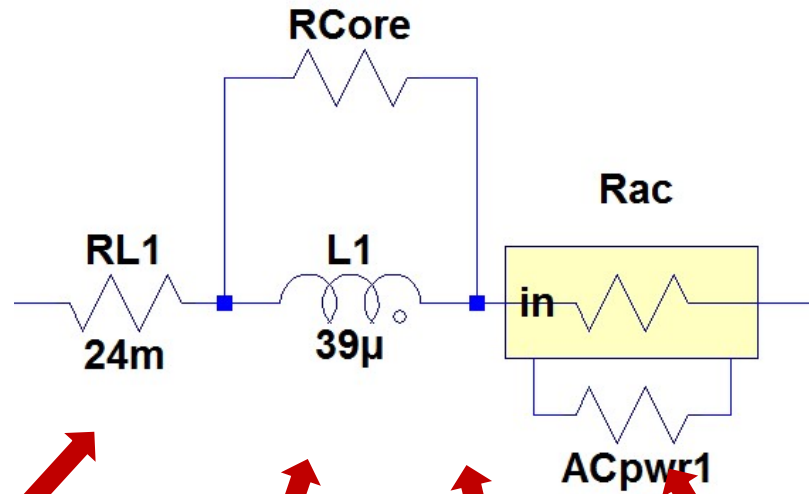
99% of designers don't know how to do proximity loss

Accurate Magnetics Models

How do semiconductors get chosen and evaluated?



Accurate Spice Magnetics Models - Where Are They?



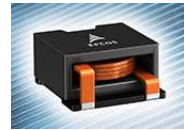
Winding Structure



Wurth



Coilcraft



TDK



Coiltronics

Core Loss Characterization and Standardization

Will be discussed in detail today

Standardized empirical test data badly needed.

Great Opportunity Here for Everyone

Power designers will get better tools

Vendors can develop models to simplify datasheets.

Universities can work on the core loss database

Universities can continue to extend proximity models

Who is going to go first and gain the upper hand?