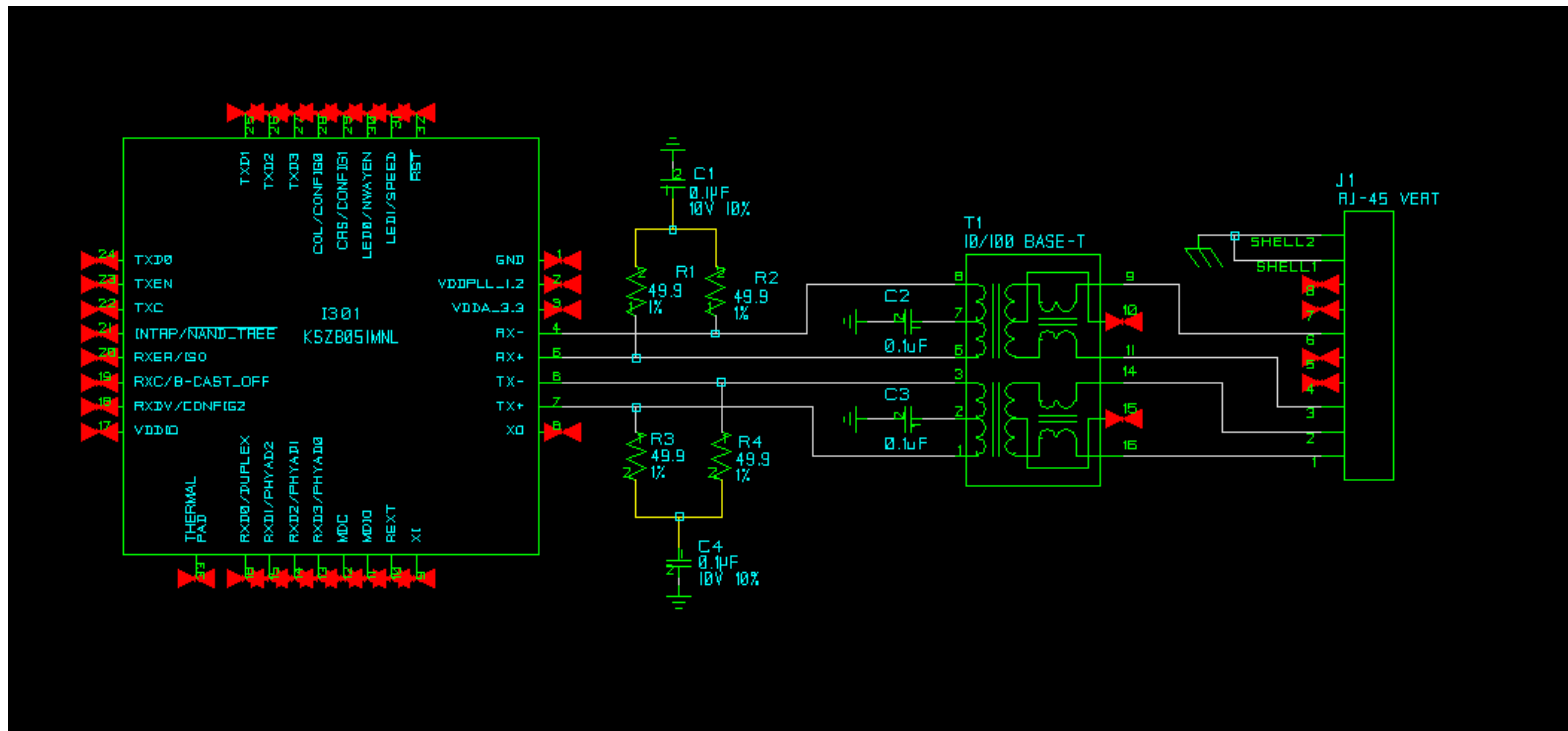




COMMON MODE TERMINATION OF ETHERNET TWISTED PAIRS

Royce Bohnert

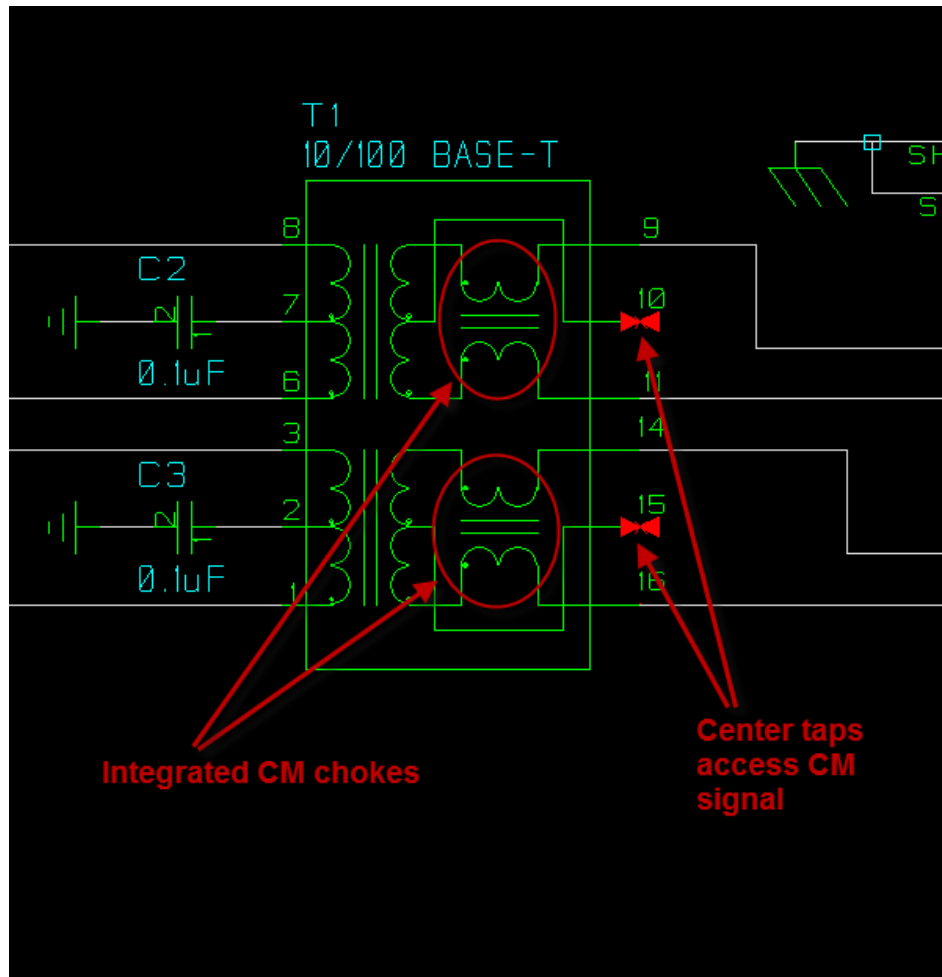
TYPICAL ETHERNET CIRCUIT



- Diff pairs from RJ45 connect to isolation transformer
- Diff pairs from transformer connect to Ethernet Phy IC
- 100Ω diff pairs are terminated at the Phy



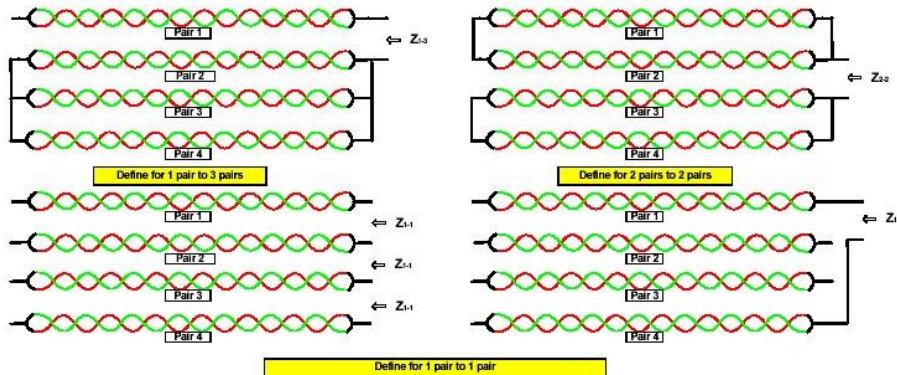
ETHERNET MAGNETICS



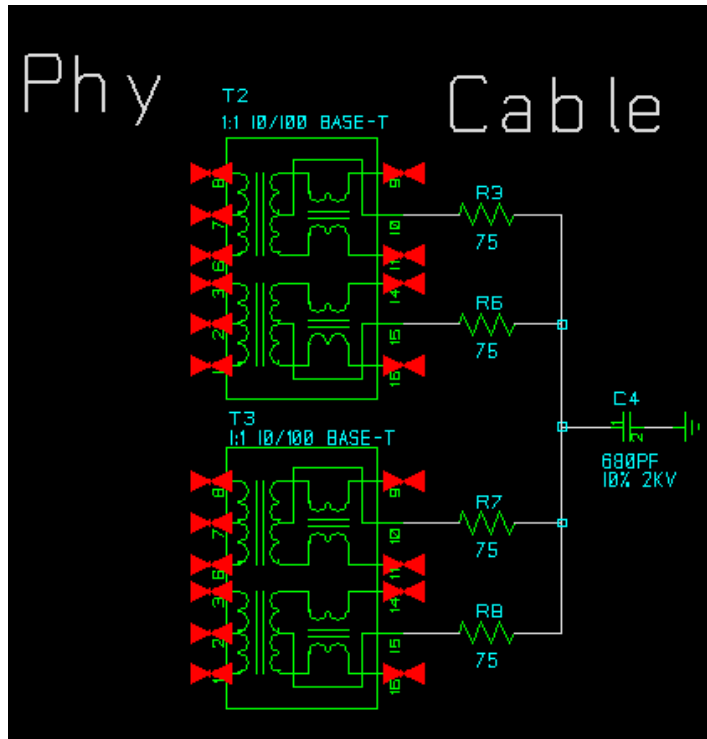
- Most Ethernet magnetics come with integrated CM chokes
- Transformer center taps provide access to CM signals



ROBERT SMITH TERMINATION METHOD



- US Patent 5321372, Published 6/14/1994
- The combination of pairs within a UTP cable form transmission line
- CM currents can flow on these transmission lines, causing radiated emissions



WAS SMITH WRONG?

- Article on EE Times by Jim Satterwhite
- Author asserts that Smith was wrong about the value that should be used for the termination.
- Presents measurements and claims that the appropriate termination resistance is 52.3Ω



GOAL OF THIS PROJECT

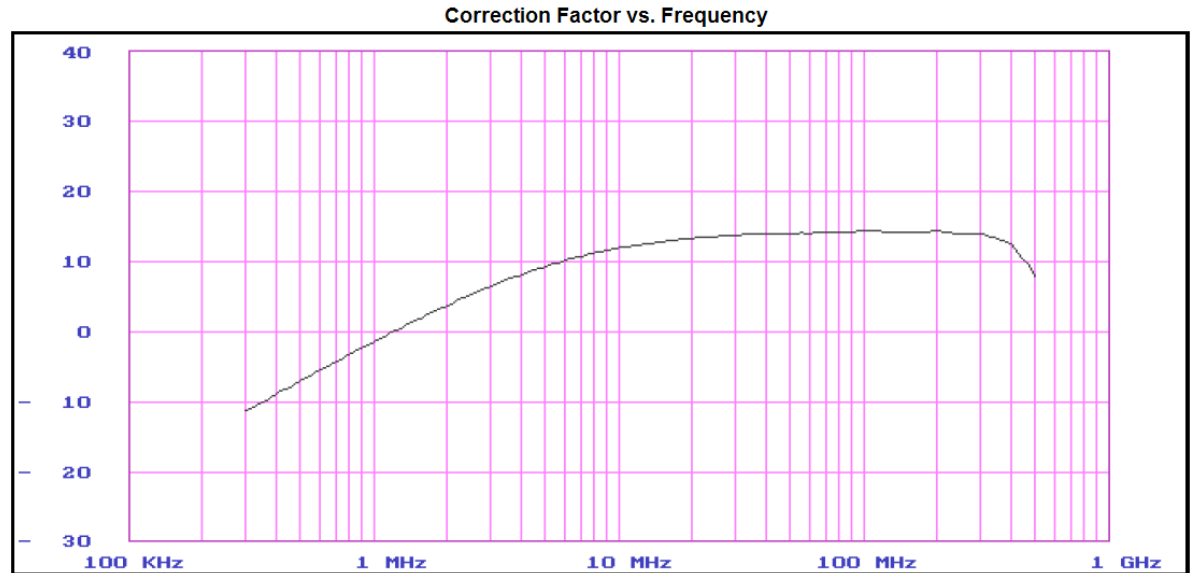
- How much of an impact does this termination actually have on radiated emissions?
- Marine VHF band (156 – 165 MHz) of particular interest
- Evaluated by measuring CM current on cable



MEASURING CM CURRENT

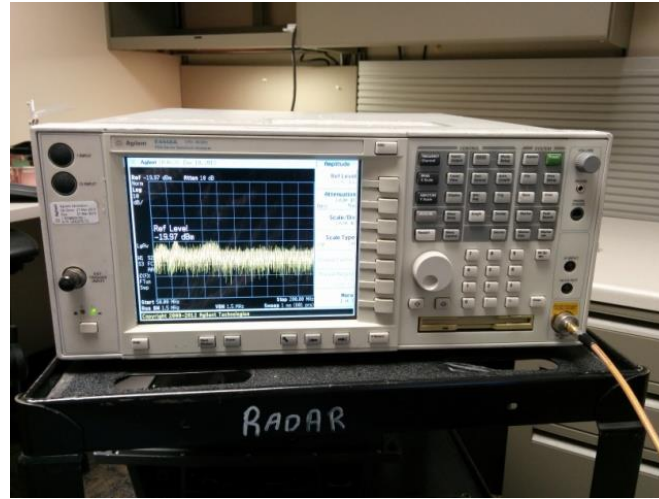
○ RF Current Probe

- Solar Electronics Company, Type 9210-1
- 300 KHz -500 MHz
- Nominal Z_T is 0.3-5 Ω . Relates measured voltage to current.



MEASURING CM CURRENT

- Spectrum Analyzer
 - Agilent E7402A (EMC Analyzer)
 - Agilent E4446A

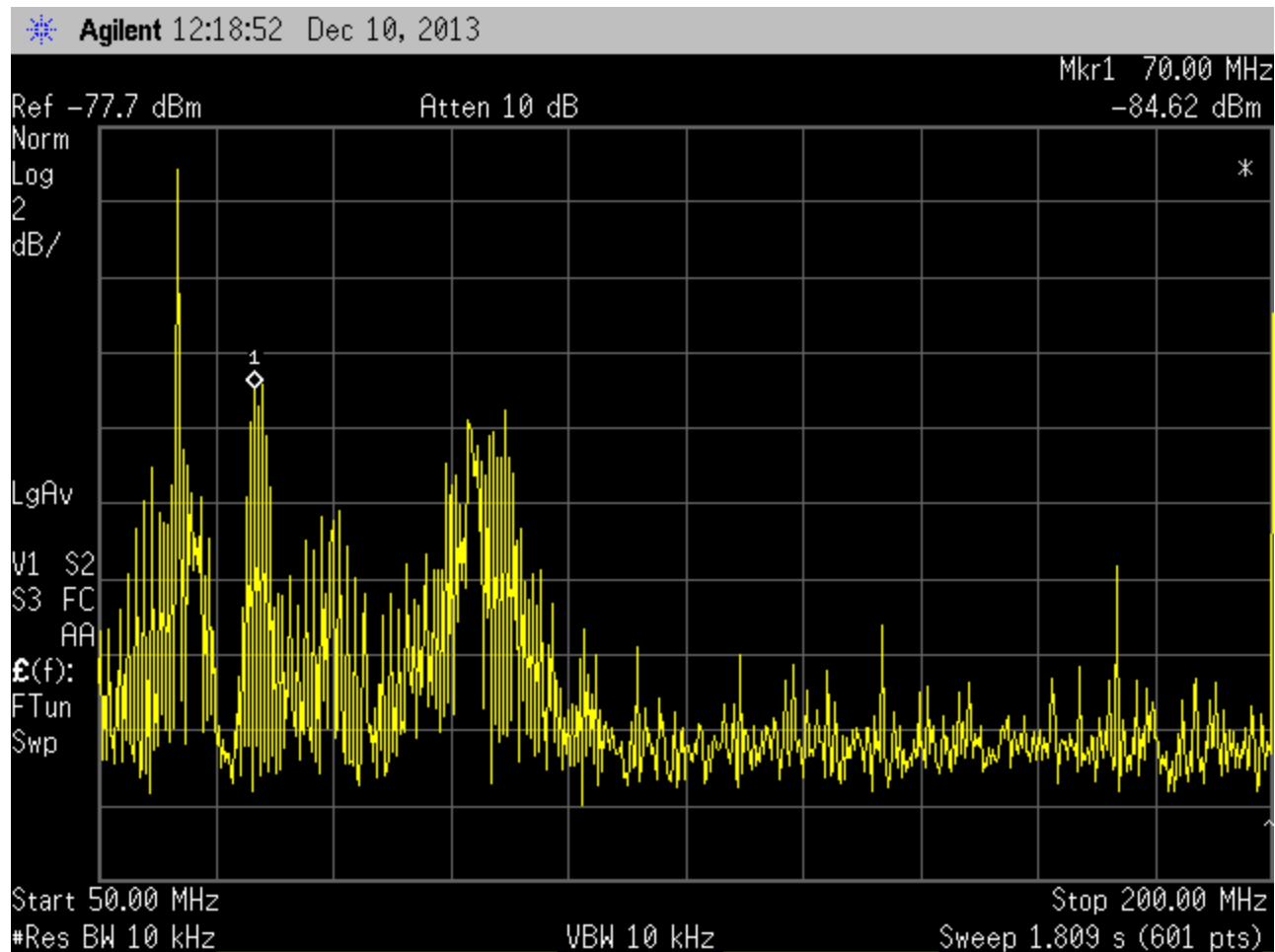


MEASUREMENT SETUP

- RF current probe place on ~20m long cable
- Cable connected to a device on each end
- Results viewed on spectrum analyzer



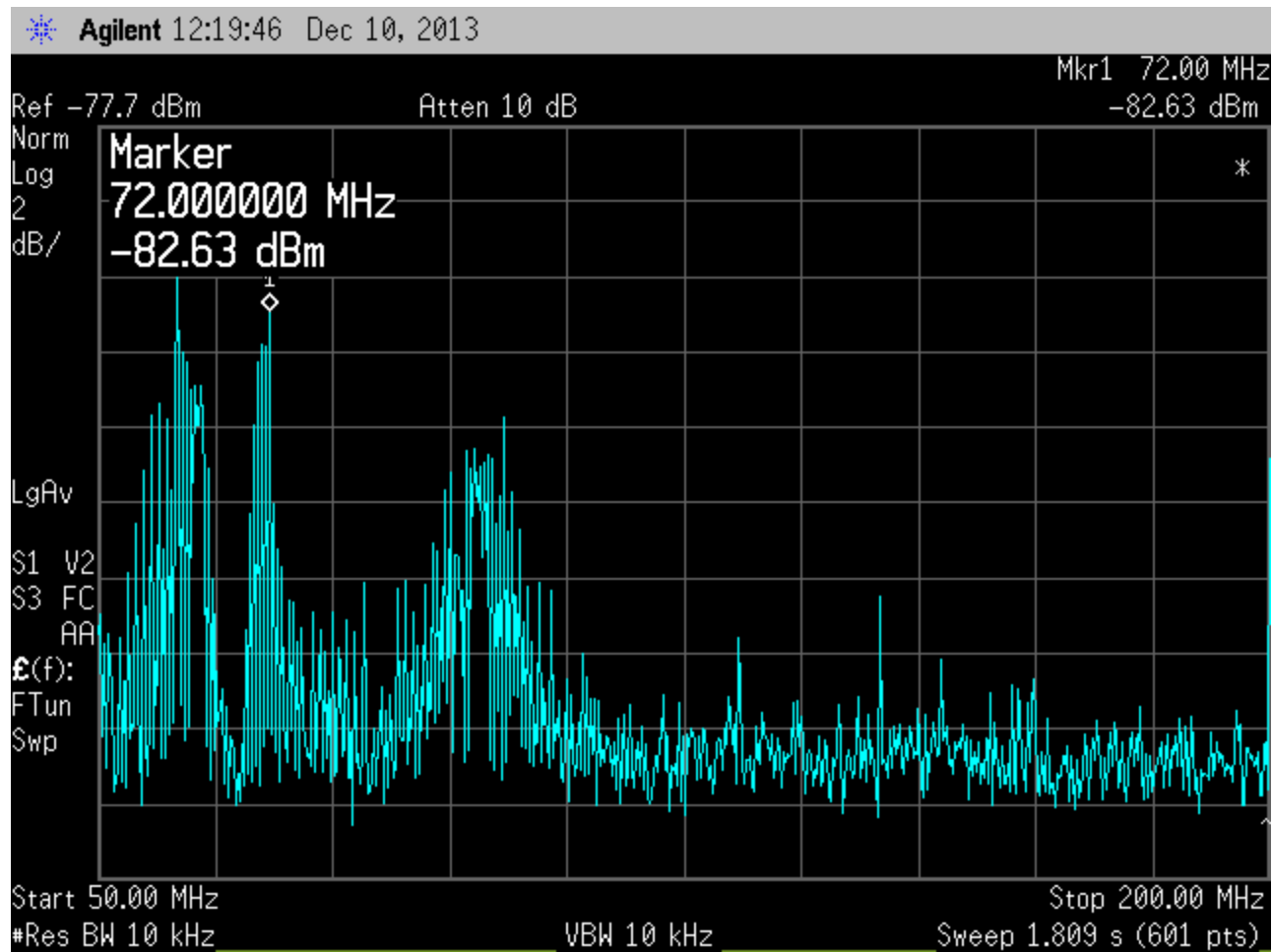
CM CURRENT - RESULTS



75 Ohm Termination



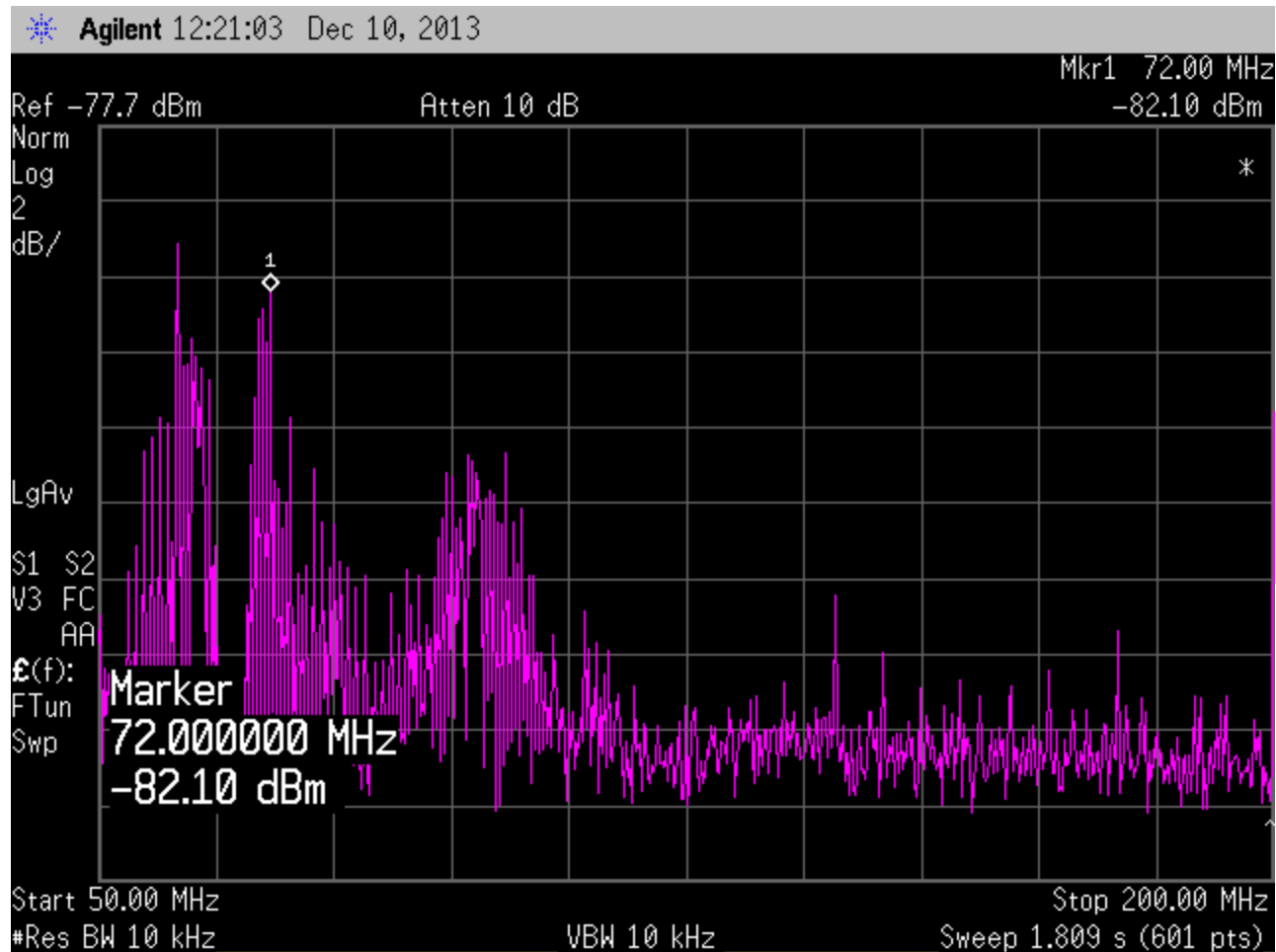
CM CURRENT - RESULTS



52.3 Ohm Termination



CM CURRENT - RESULTS

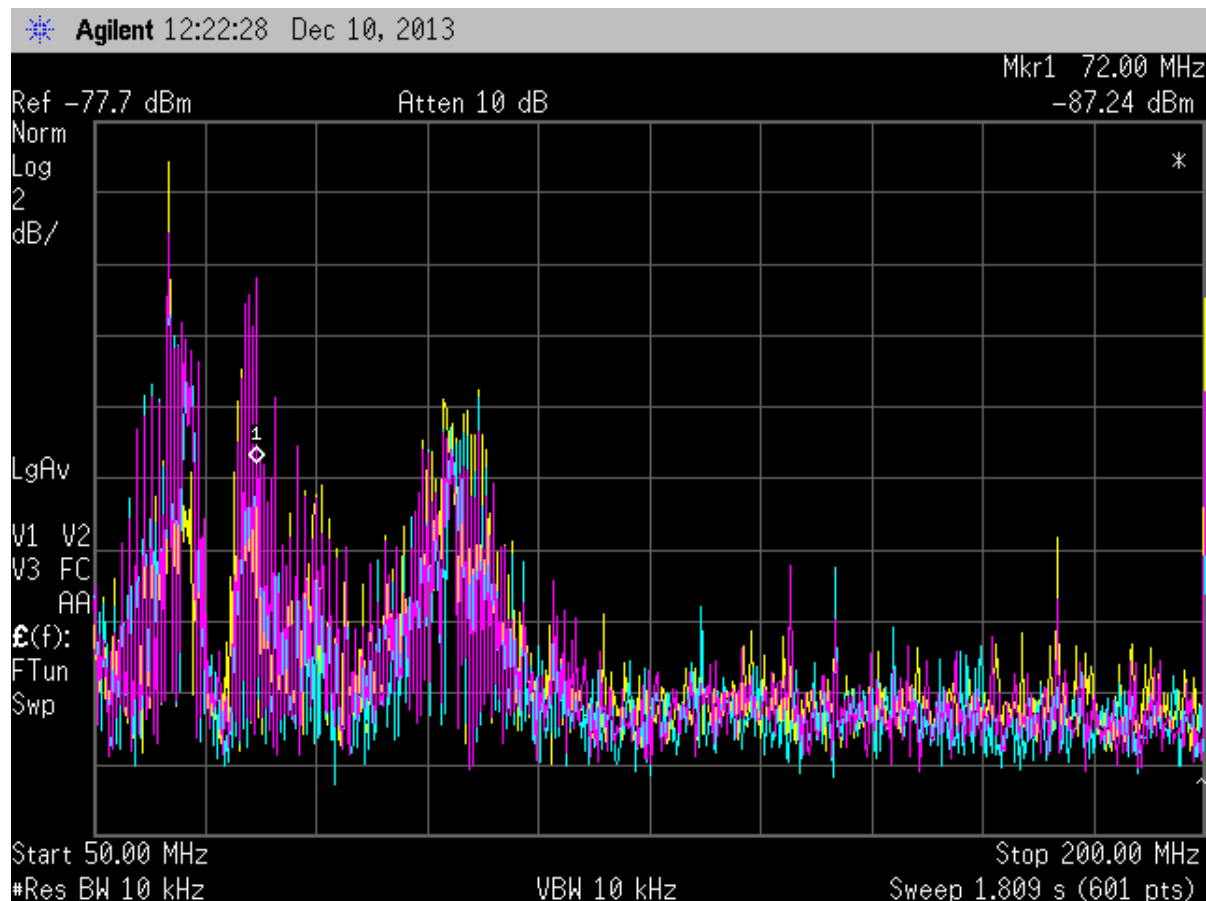


No Termination



CM CURRENT - RESULTS

- Based on initial results, the termination does not appear to have a significant impact.



POSSIBLE CONCLUSIONS

- CM chokes so effective at reducing CM currents that the effect termination is negligible.
- Impedance is not constant along length of cable. Different twist rates on each twisted pair cause cancellation of field every few centimeters.



REFERENCES

- Updating the Bob Smith Termination Technique
http://www.eetimes.com/document.asp?doc_id=1277940
- US Patent 5321372, Apparatus and method for terminating cables to minimize emissions and susceptibility
- Electromagnetic Compatibility Engineering, Henry W. Ott

