Canova Tech

The Art of Silicon Sculpting

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IEEE802.3cg TF

EMC/EMI measurements on 10BASE-T1S evaluation boards

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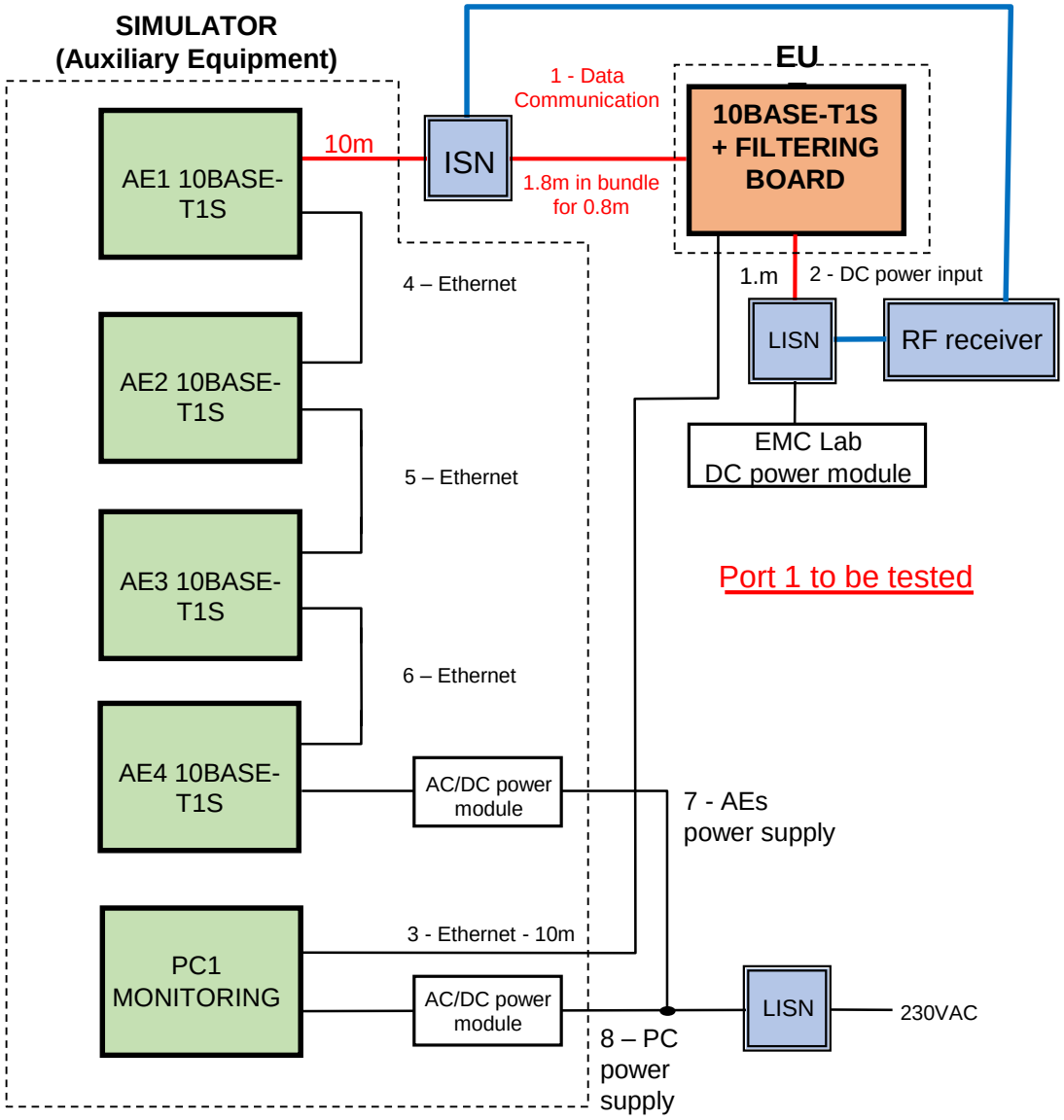
10BASE-T1S Evaluation Board

- 10BASE-T1S Prototype
  - Analog in discrete components
  - Digital in FPGA
  - Industrial / Automotive certified CPU with standard MAC
  - Multidrop support

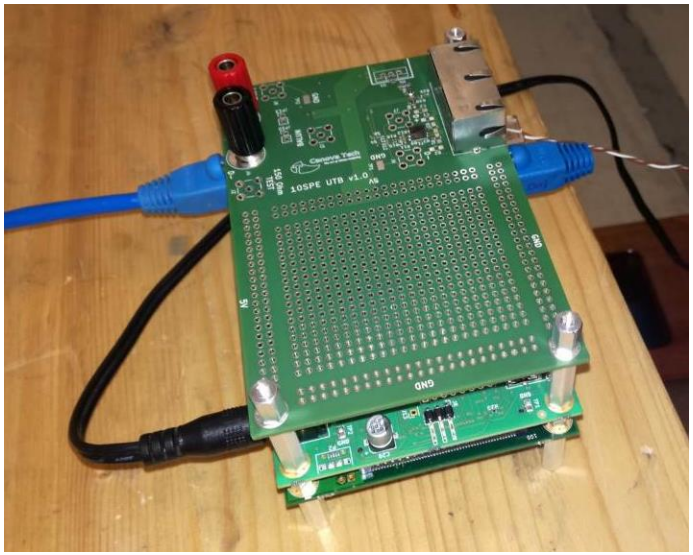
EMC / EMI Testing

- Joint session Canova Tech - Kone
- EMC laboratory
  - IASELAB (Ferrara - Italy)
  - Conducted Emission (EN 55032)
  - Conducted Immunity (EN 61000-4-6, EN 55024)
  - Radiated Emission (EN 55025 - CISPR 25)
- NOTE: referenced normatives specify both test conditions and limits. For the sake of this presentation the limits are just informative.

Conducted Emission – Test Setup

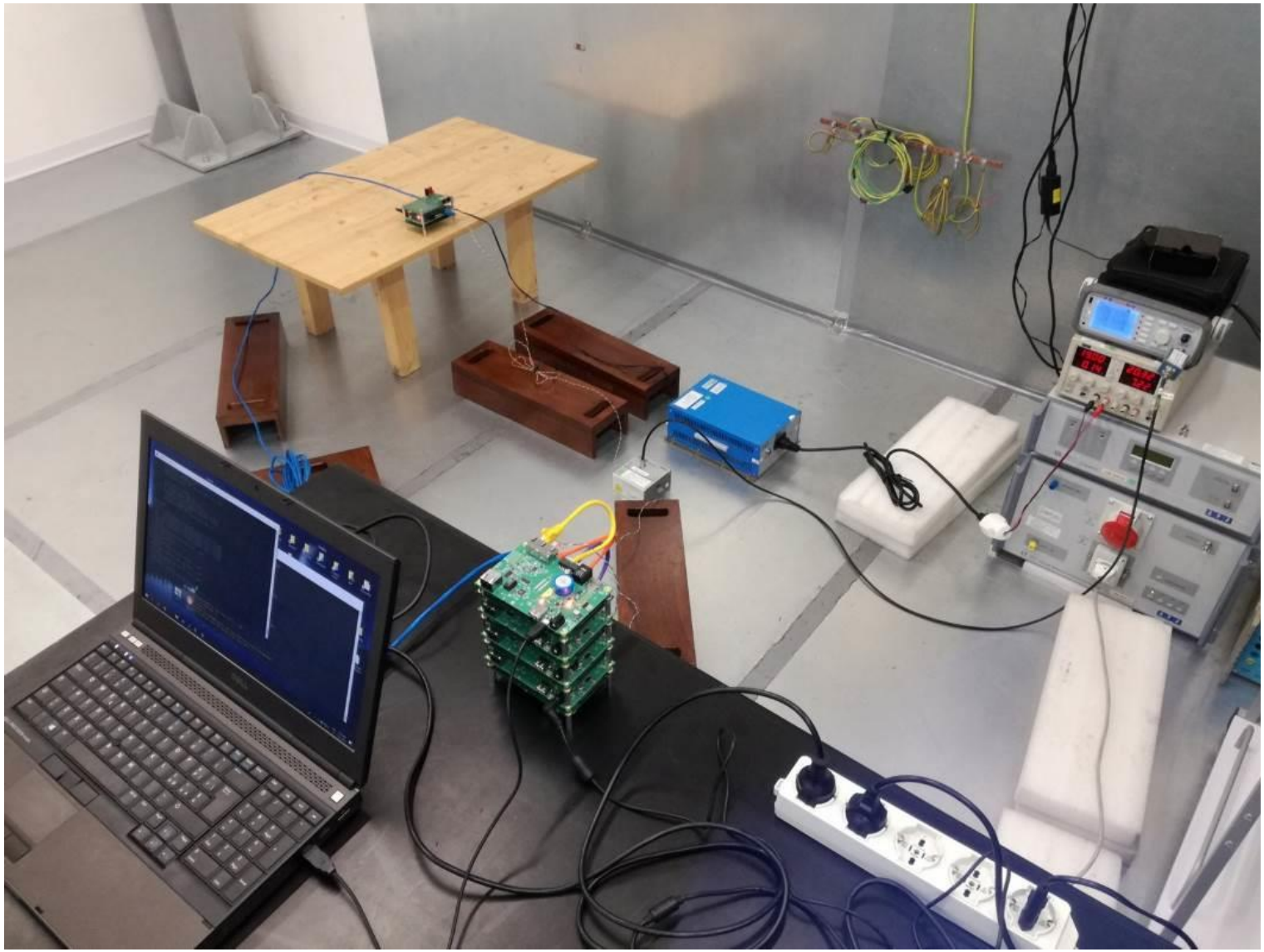


- CABLES
  - UTP CAT 5E
  - MC > 30db
- ISN
  - TESEQ ISN T8-Cat6



Optional Filter board (top)

Conducted Emission – Test Setup



PSD MASK

Measured PSD MASK matches simulations

Slightly below upper limit currently defined in 802.3cg

RBW=10 KHz

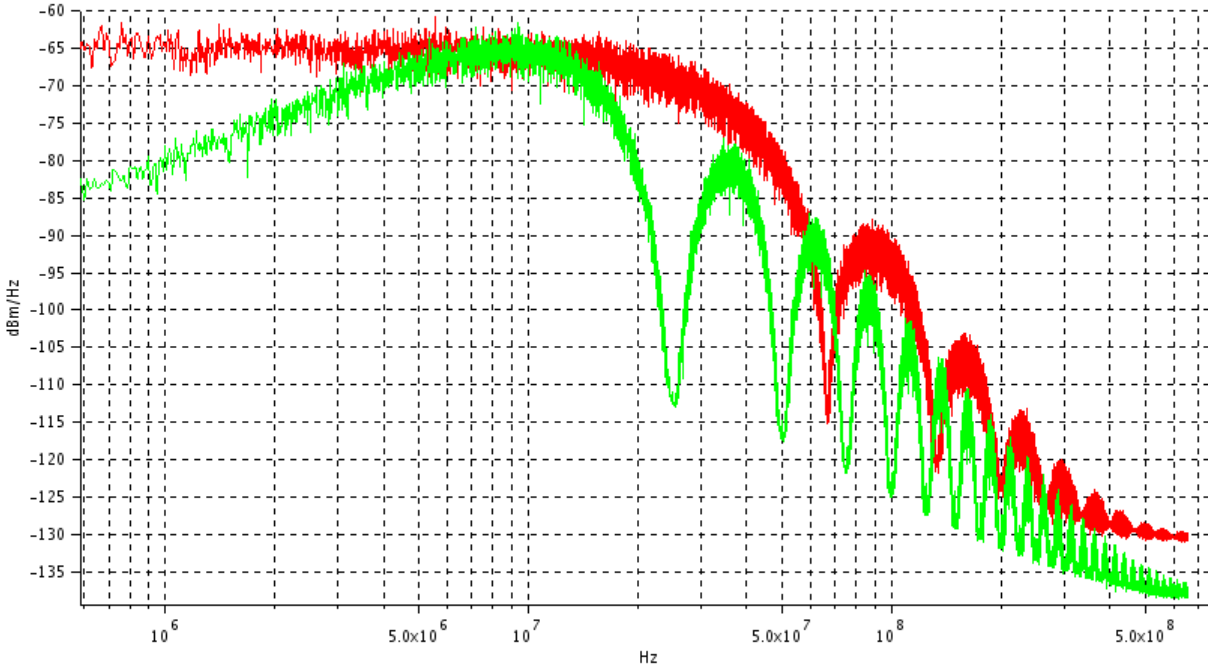
VBW=1 KHz

NOTE: Mask is in dBm (not dBm/Hz)

100BASE-T1 vs 10BASE-T1S PSD

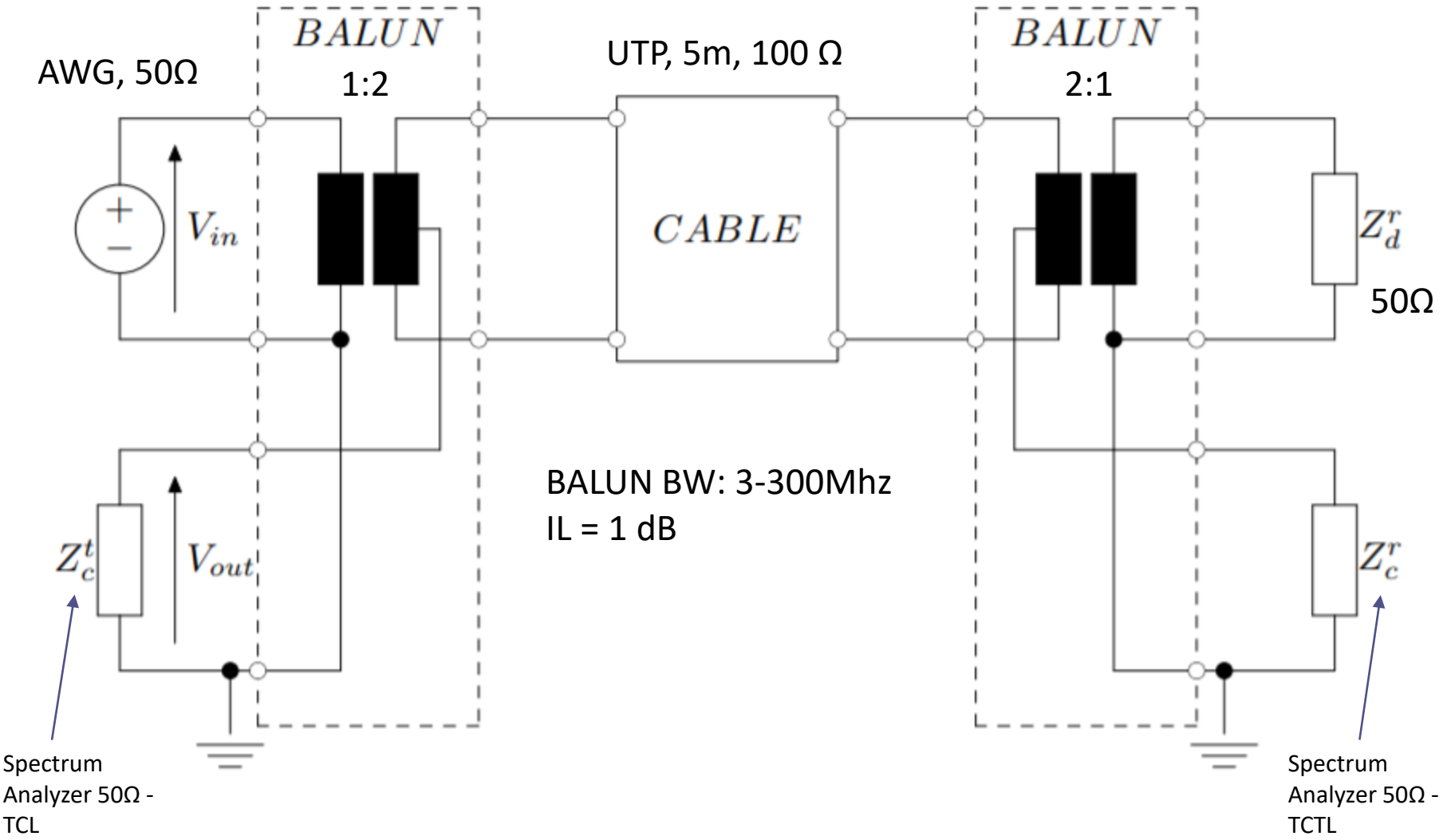
100BASE-T1 vs 10BASE-T1S PSD

Simulated PSD for 100BASE-T1 and 10BASE-T1S with typical TX amplitude



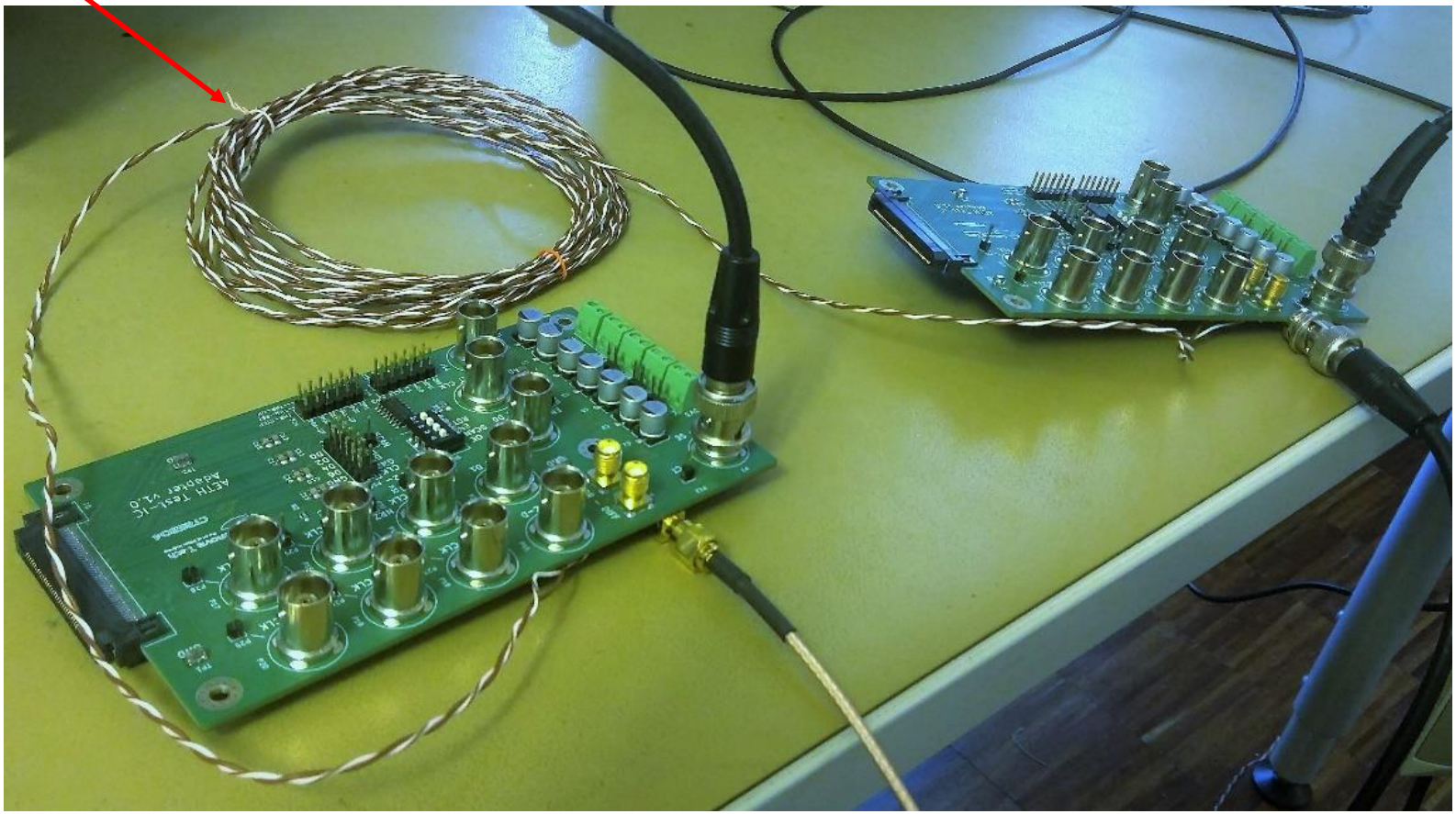
- Red
  - 100BASE-T1 PSD
  - RBW=10KHz
  - TX=2Vpp @ matched load
- Green
  - 10BASE-T1S PSD
  - RBW=10KHz
  - TX=1Vpp @ matched load

Cable MC measurement

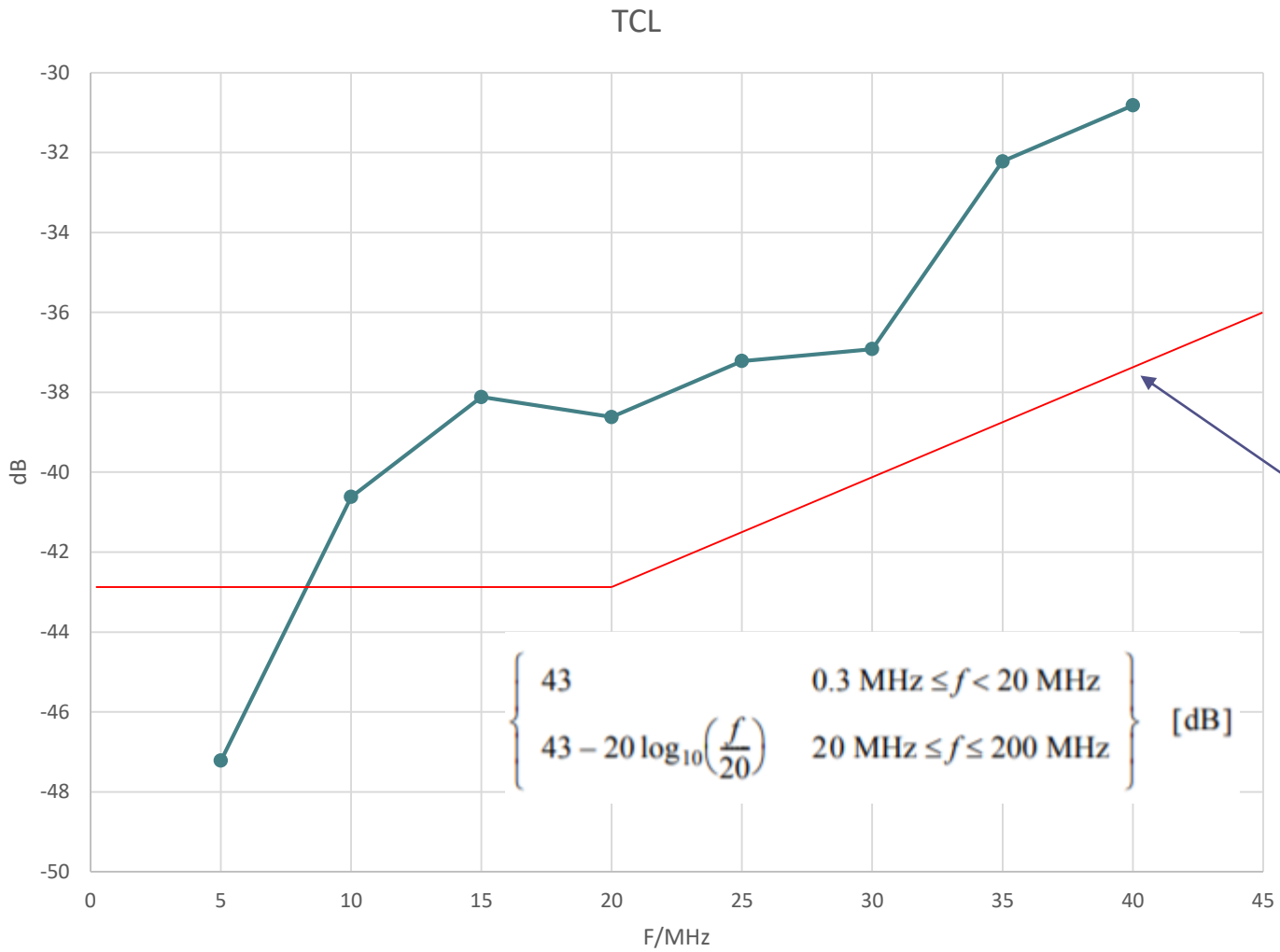


Cable MC measurement

CAT 5E cable under test



Cable MC measurement



MC better than 802.3cg for f < 7MHz

MC worse than 802.3cg for f > 7MHz

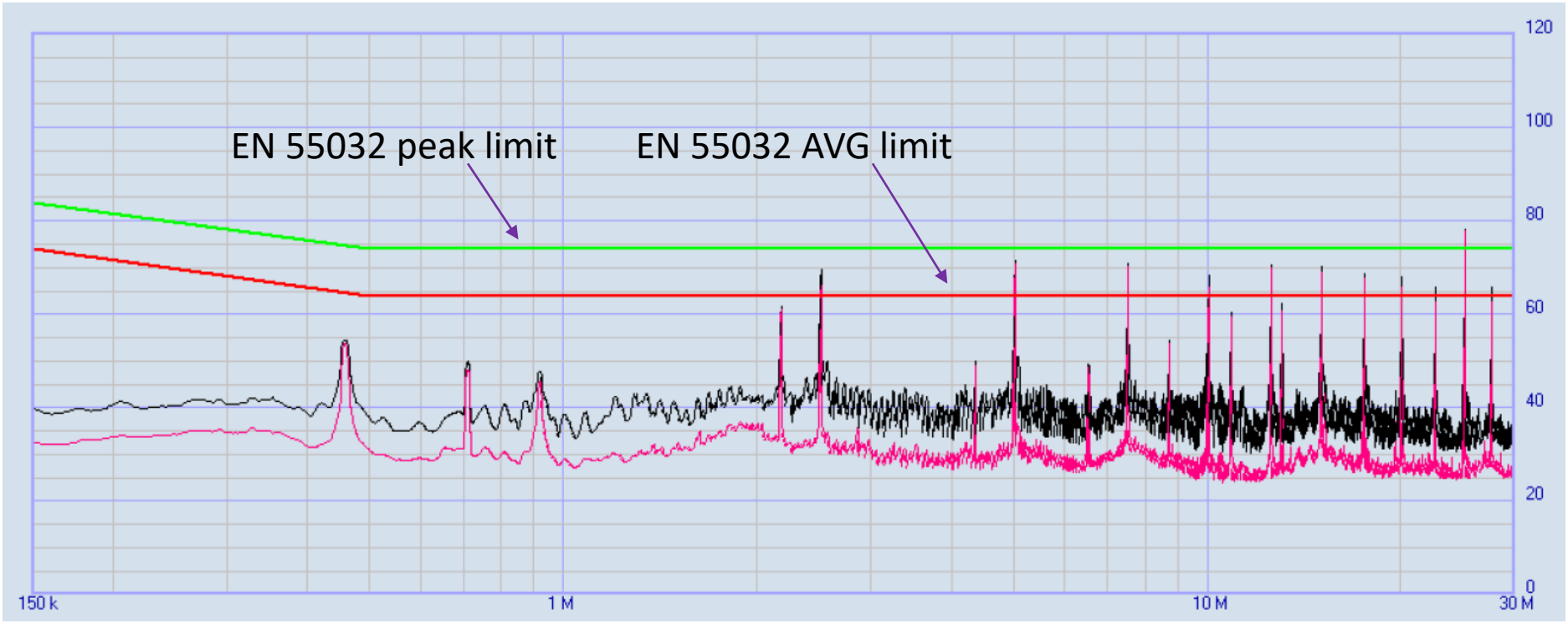
MC adopted in 802.3cg

Conducted emission - results

- TRANSMITTER OFF
  - Contribution from powered-on board
  - Peaks caused by onboard DC/DC supplies

BLACK = PEAK
PINK = AVG

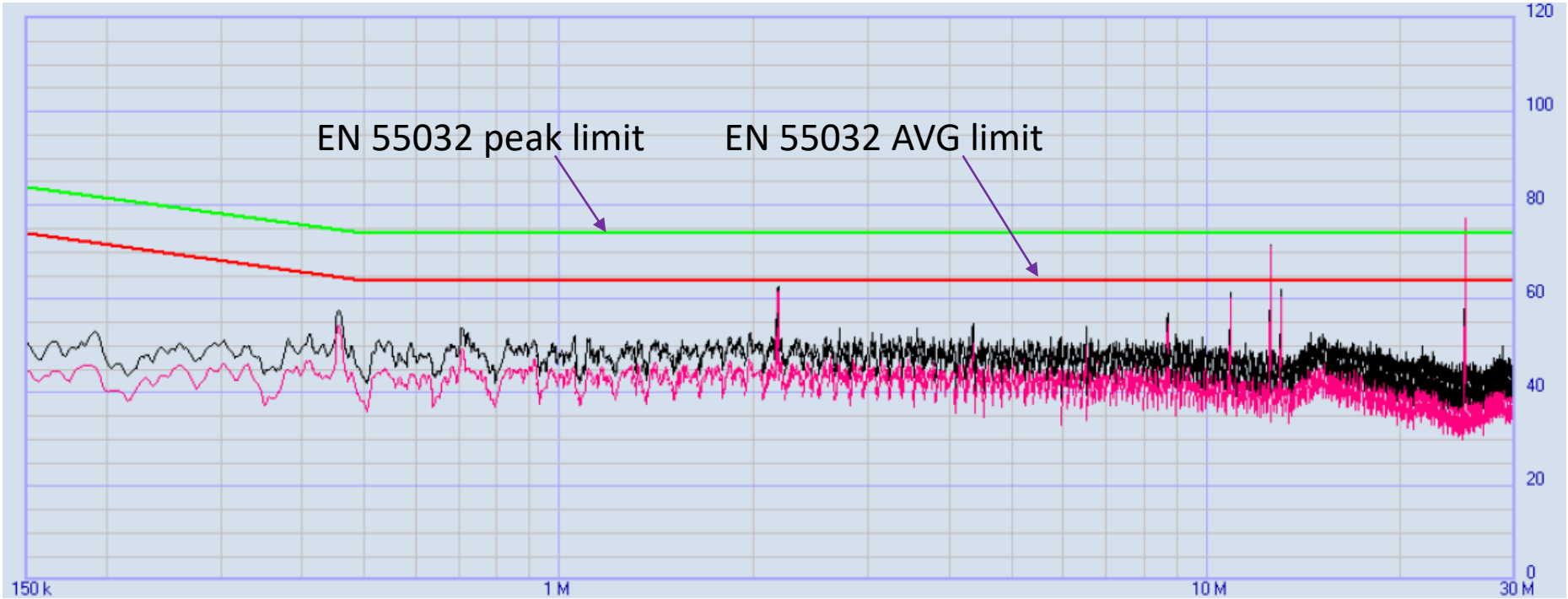
Conducted emission - results



- TRANSMITTER - 2 Vp-p
  - Sending repetitive payload (all 0x55) causes additional peaks to show up

BLACK = PEAK
PINK = AVG

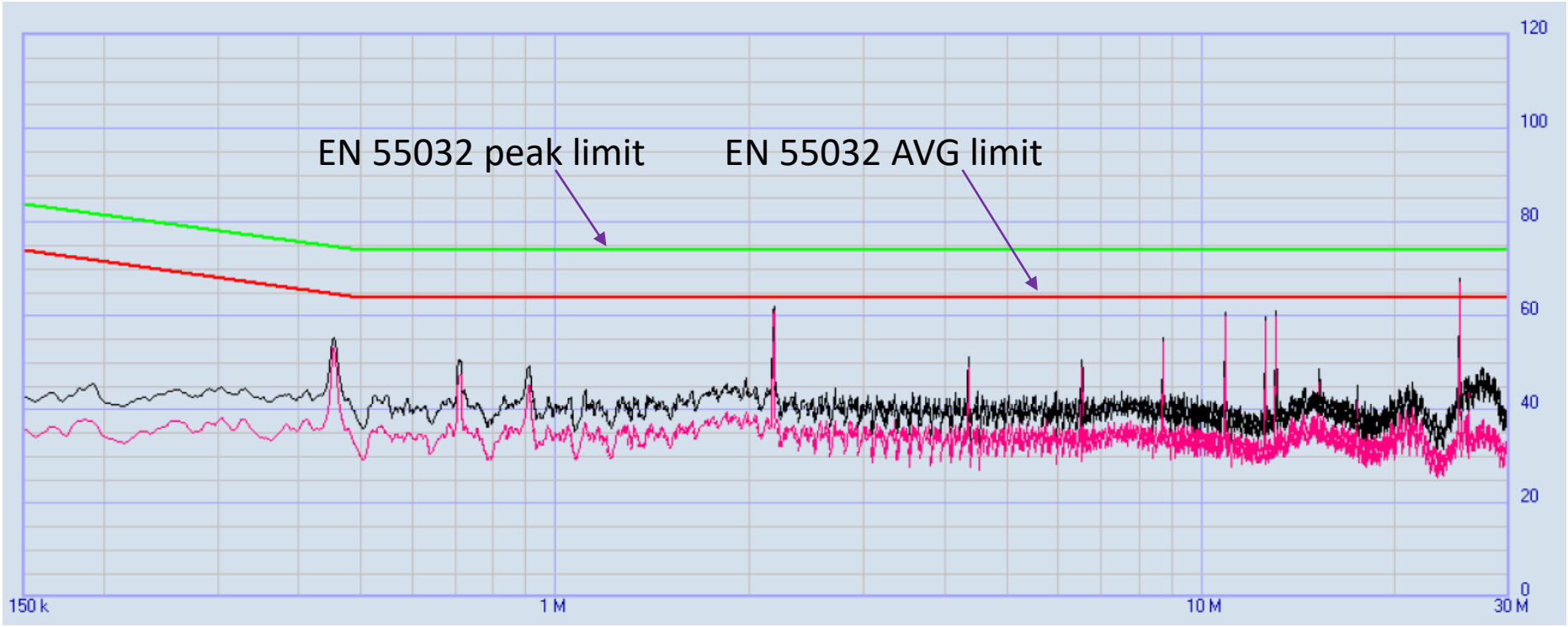
Conducted emission - results



- TRANSMITTER - 2 Vp-p with scrambler
  - Peaks are redistributed over a wider spectrum
  - Peaks due to DC/DC converters remain
  - Additional peaks at 12.5 MHz and 25 MHz (unfiltered TX)

BLACK = PEAK
PINK = AVG

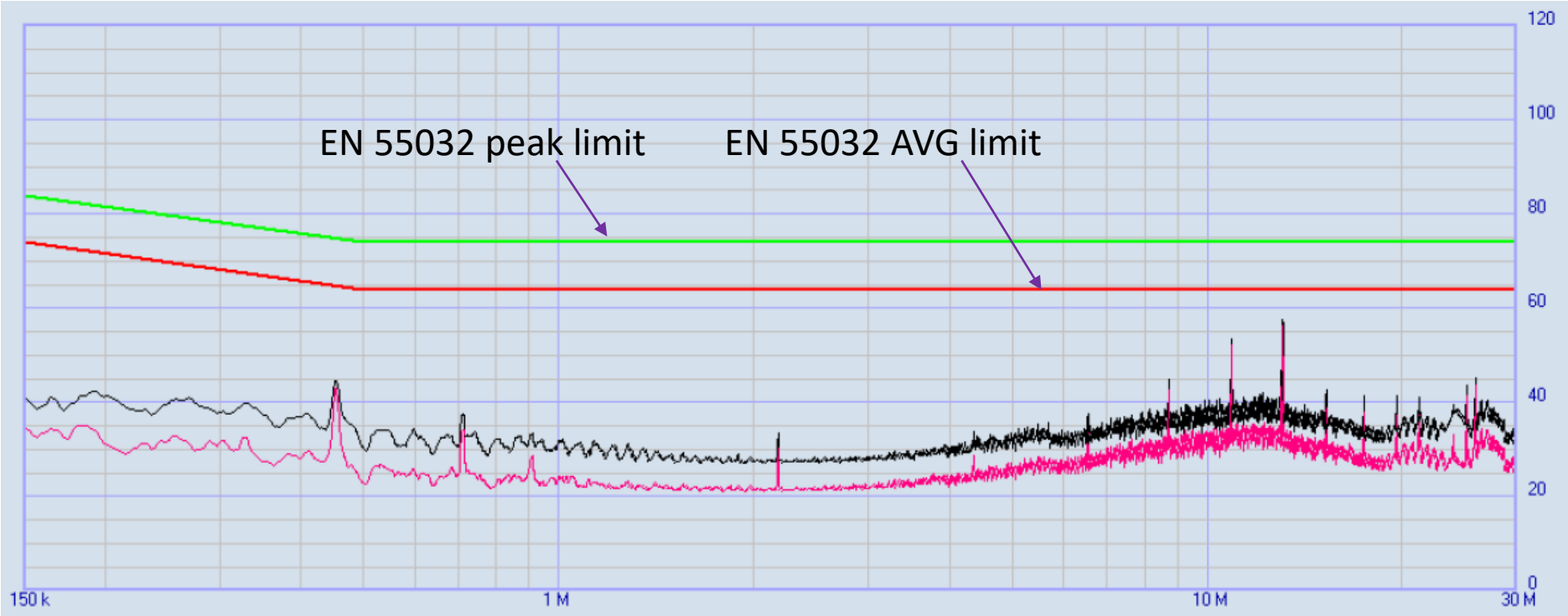
Conducted emission - results



- TRANSMITTER - 1 Vp-p with scrambler
  - Lower than 2 Vp-p
  - Peaks due to DC/DC converters remain
  - Additional peaks at 12.5 MHz and 25 MHz (unfiltered TX) remain

BLACK = PEAK
PINK = AVG

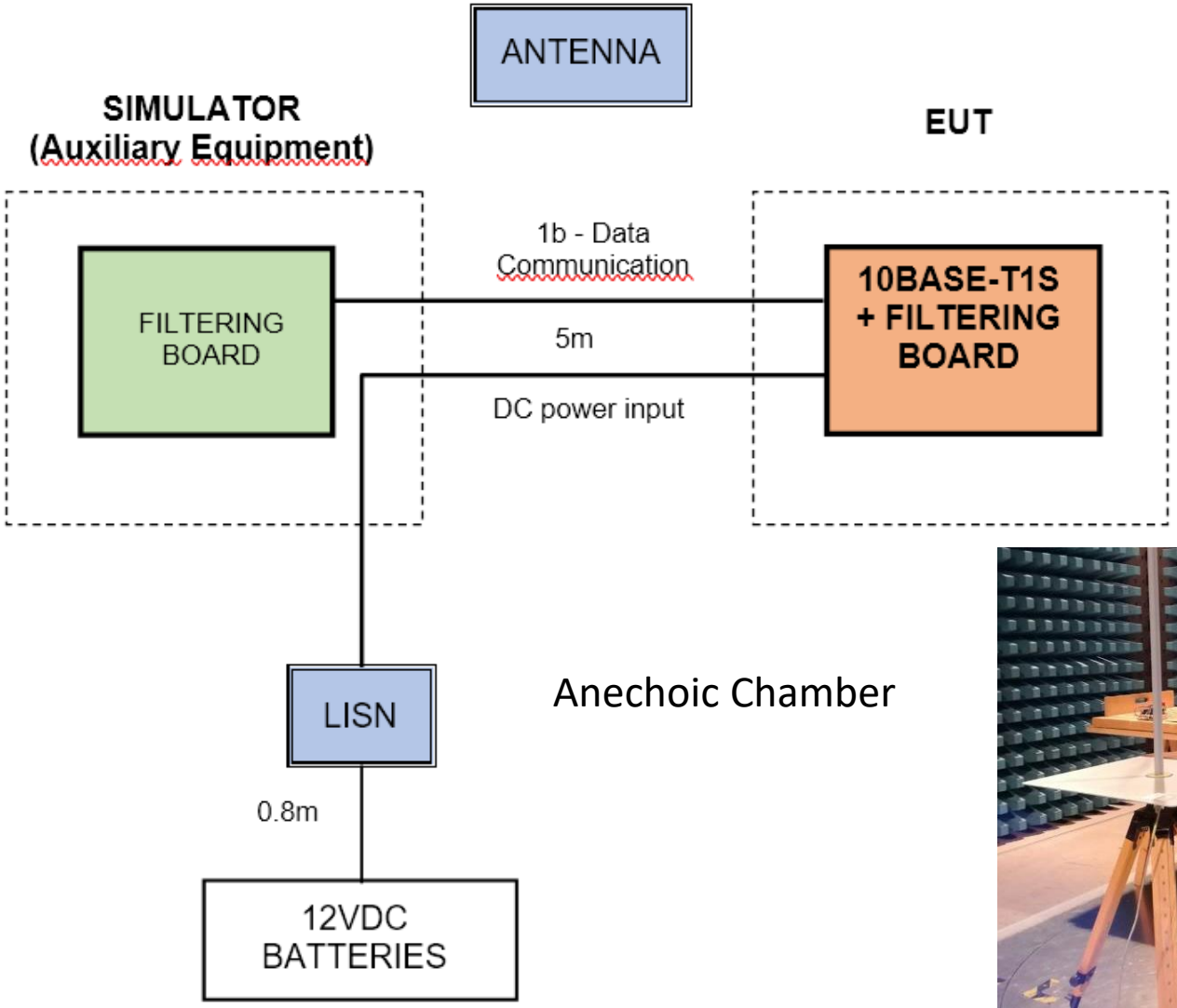
Conducted emission - results



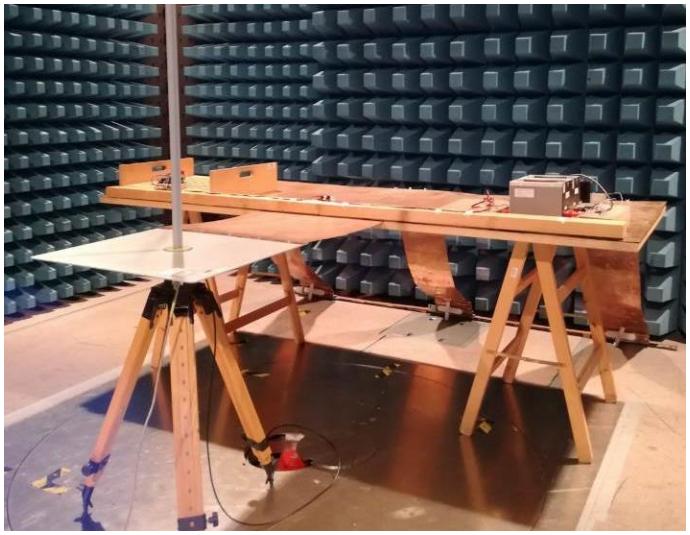
- TRANSMITTER - 1 Vp-p with scrambler and CMC
  - Best Result
  - Peaks due to DC/DC converters remain
  - Peaks at 12.5 MHz and 25 MHz are filtered out

BLACK = PEAK
PINK = AVG

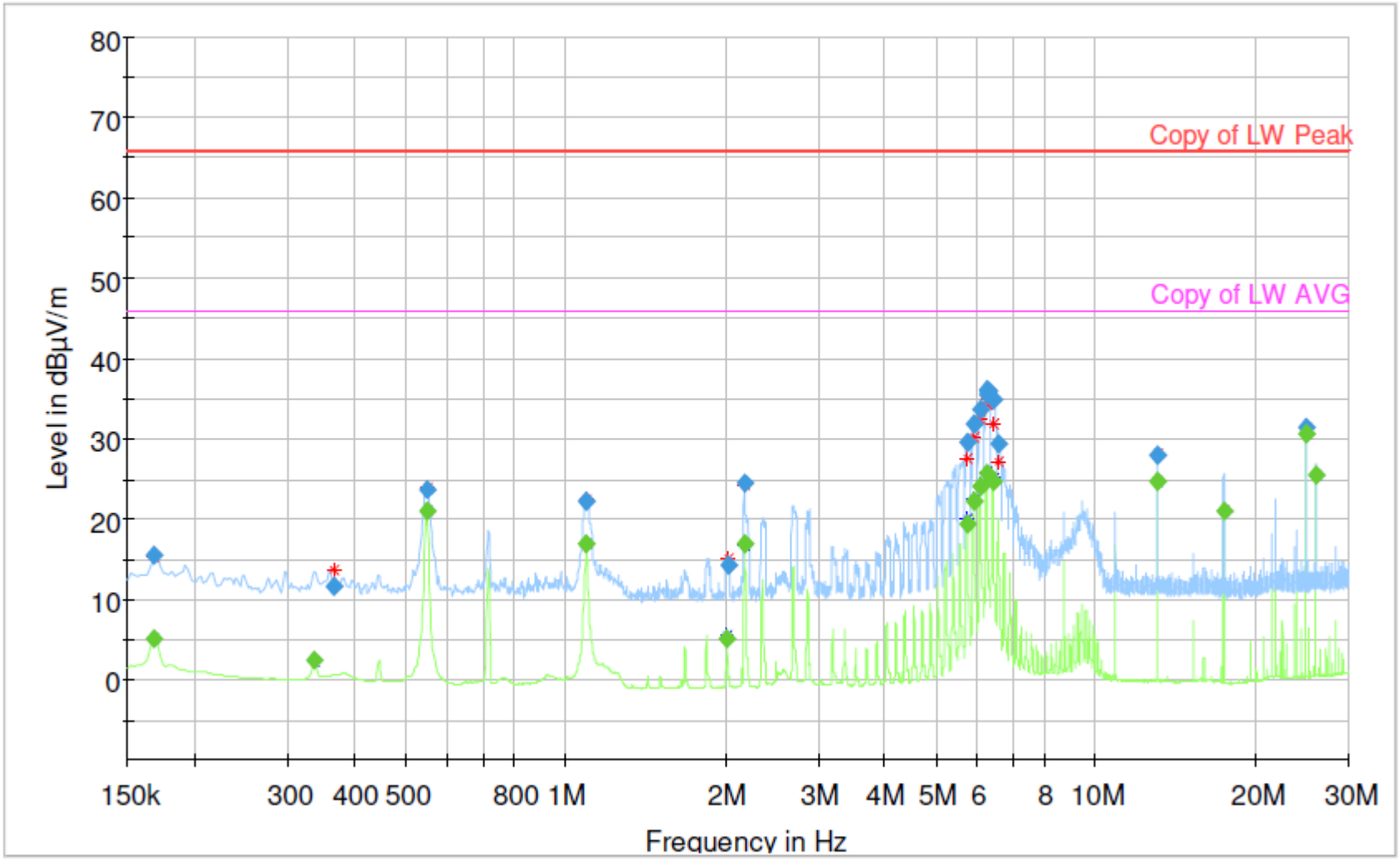
Radiated Emission – Test Setup



Anechoic Chamber

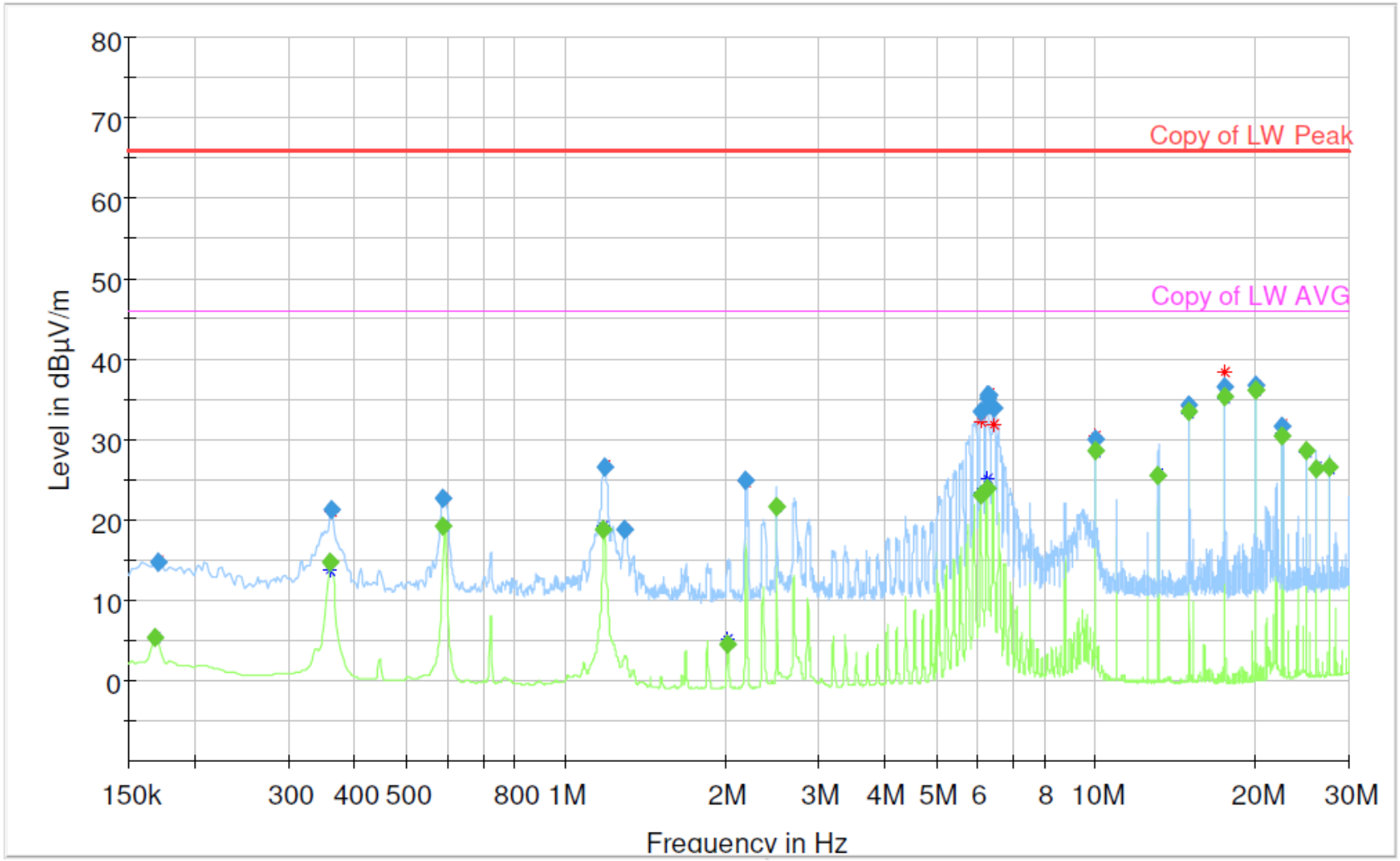


Radiated Emission – results



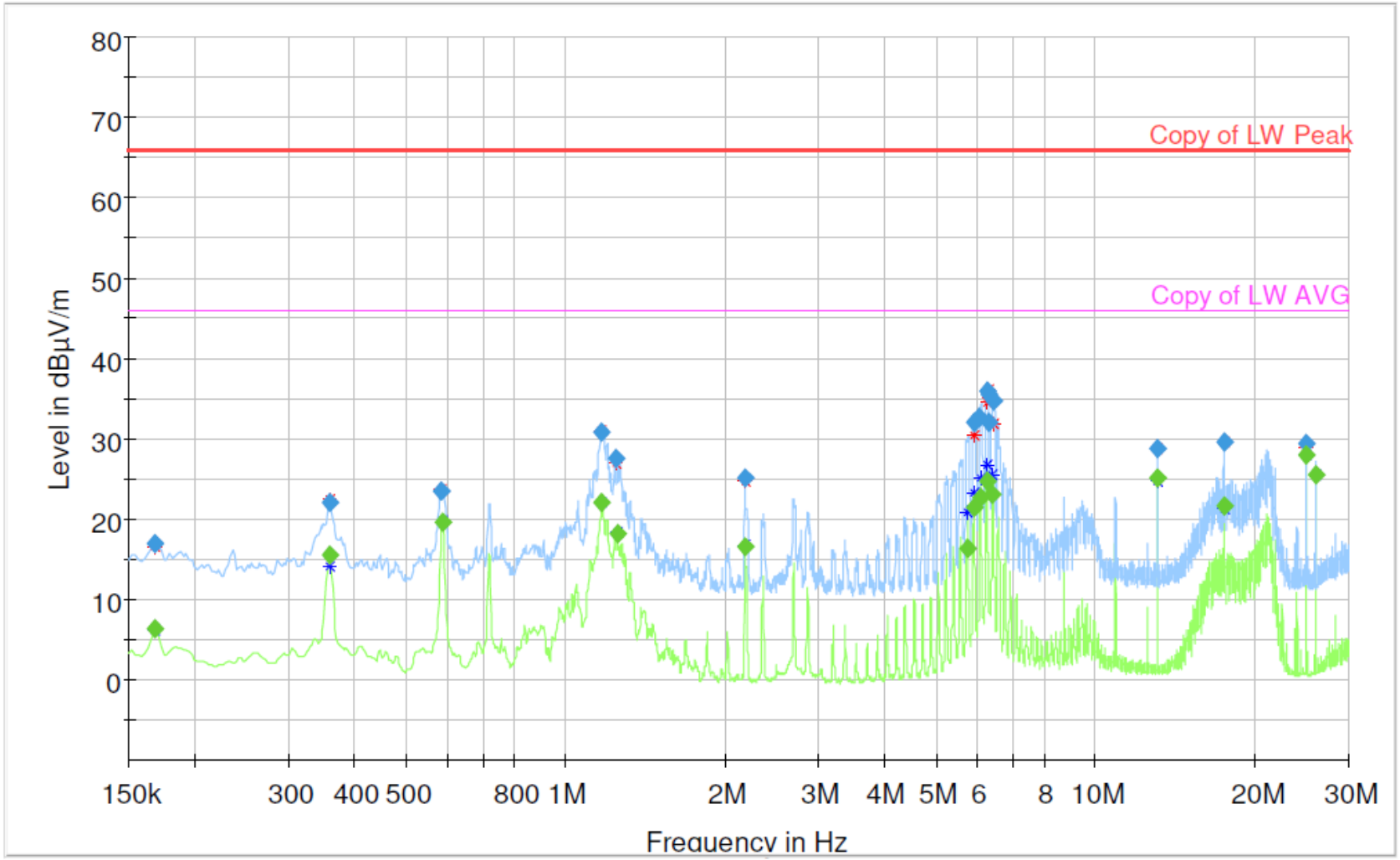
TRANSMITTER OFF (Board Contribution)

Radiated Emission – results



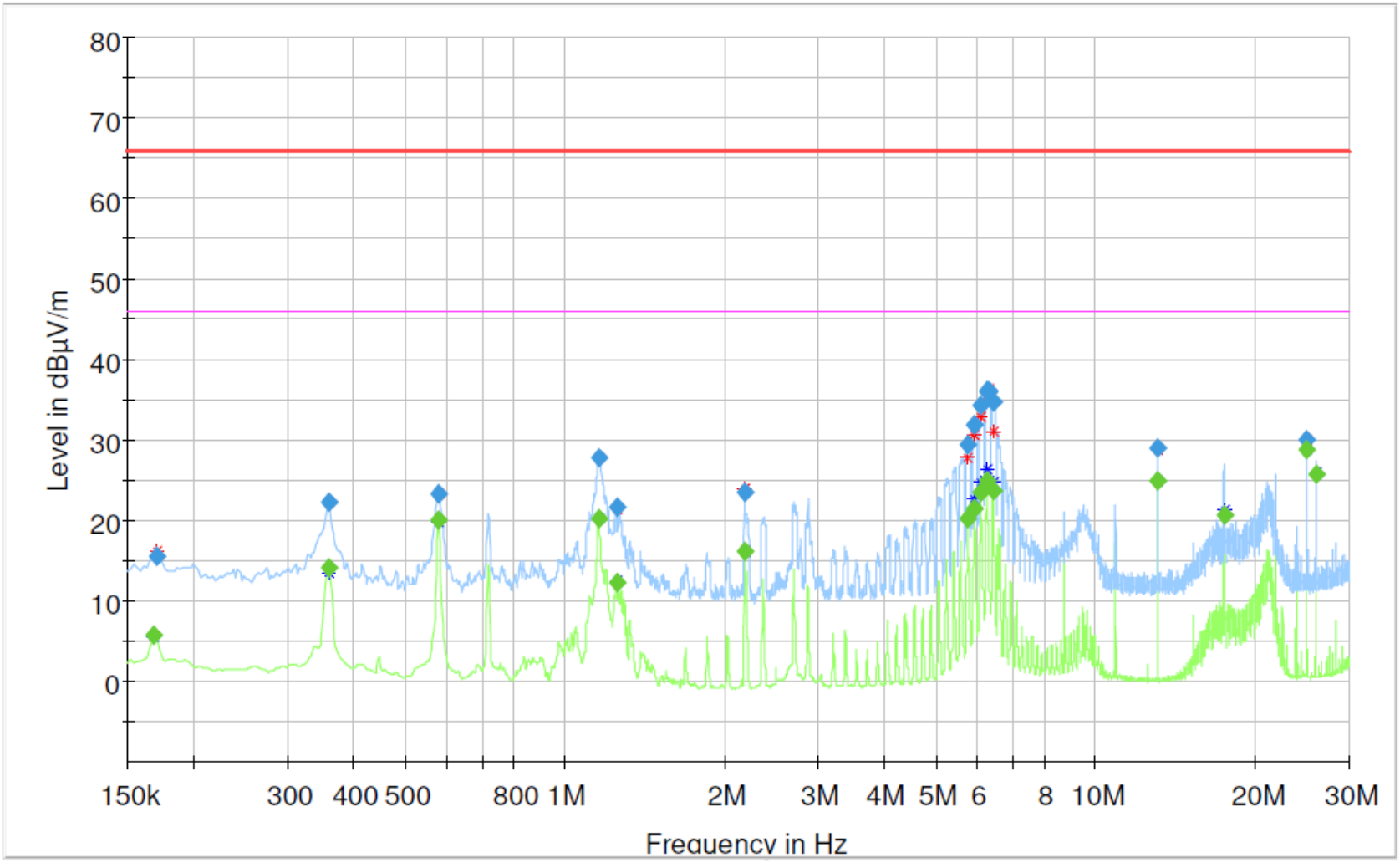
TRANSMITTER 2 Vp-p (without scrambler, with CMC)

Radiated Emission – results



TRANSMITTER 2 Vp-p (with scrambler, with CMC)

Radiated Emission – results



TRANSMITTER 1 Vp-p (with scrambler, with CMC)

Conclusions

- Emission tests results on evaluation boards shows that proposed PSD mask “Do not **preclude** meeting CISPR EMC requirements”, both for conducted and radiated tests
- Proposed PSD masks limits are close to the ones of 100BASE-T1
- Immunity test results post-processing in progress
- To achieve CISPR 25 class-5 limits Common mode chokes are required
- Scrambler significantly reduces the emission peaks in case of repetitive patterns

Thank You !