10 Mb/s Single Twisted Pair Ethernet
Noise Measurements Update

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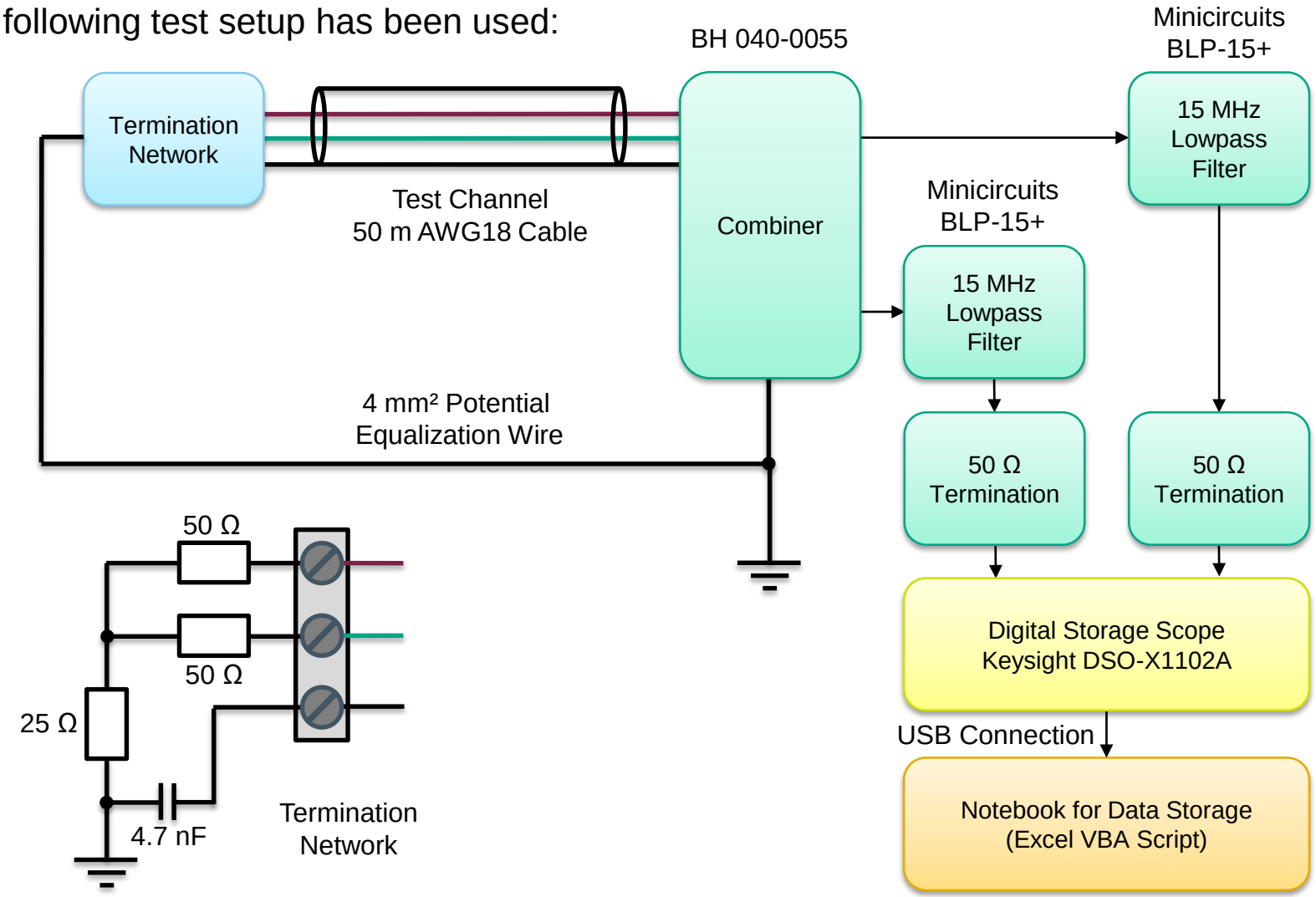
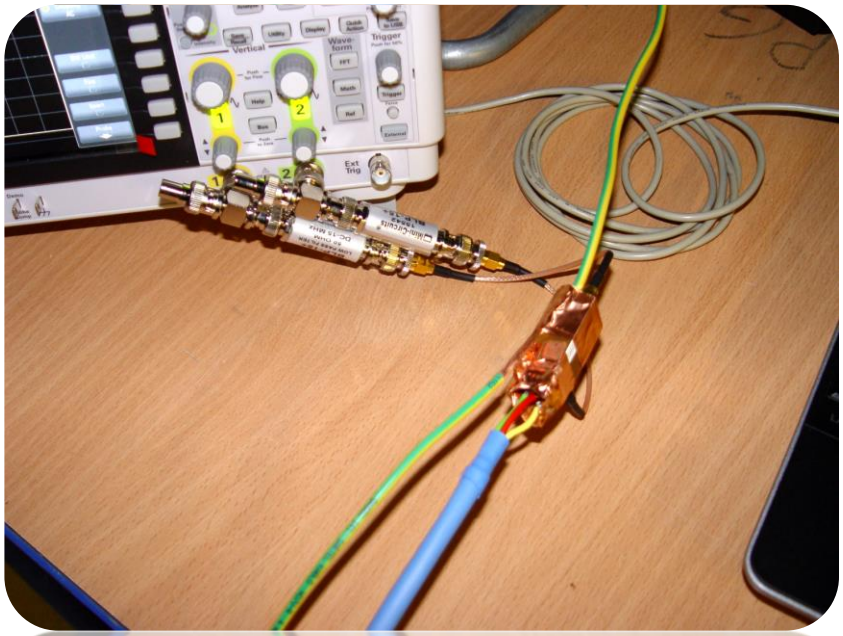
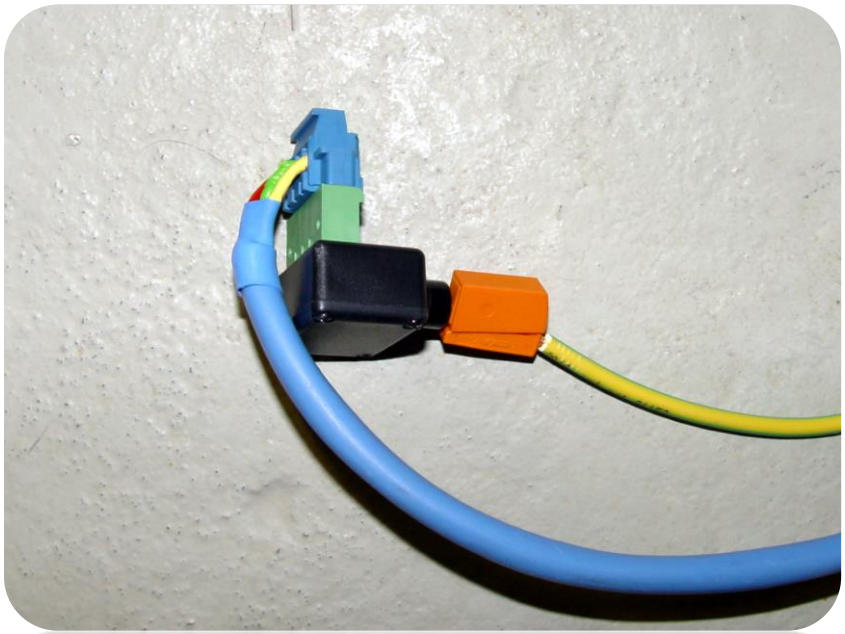
Updated Noise Measurement Setup

- To be able to measure ambient noise, which is being coupled to a shielded 2-wire cable, the following test setup has been used:



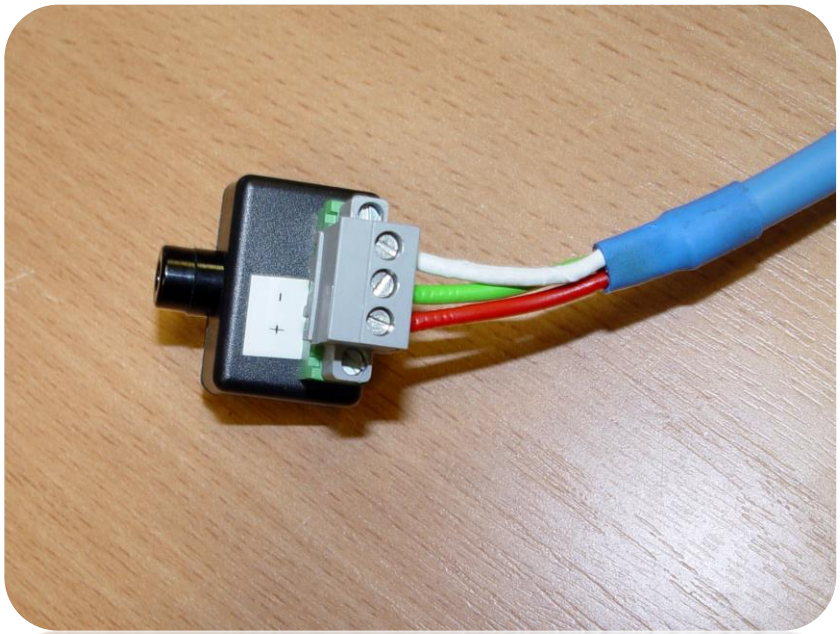
Updated Noise Measurement Setup



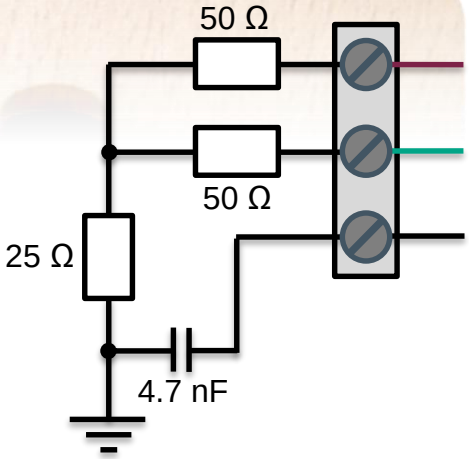


- A BH 040-0055 balun has been used instead of Minicircuits combiners.
- At the far end of the cable a resistive line and capacitive shield termination are being used.
- The scope is set to a sample rate of 1 GSPS/s.
- The horizontal scaling is 10 µs/div, the time duration for a complete screen shot is 100 µs.
- Each stored dataset consists of 100000 data points with a resolution of 8 bit.
- As trigger level 1 mV on the differential signal input has been set.

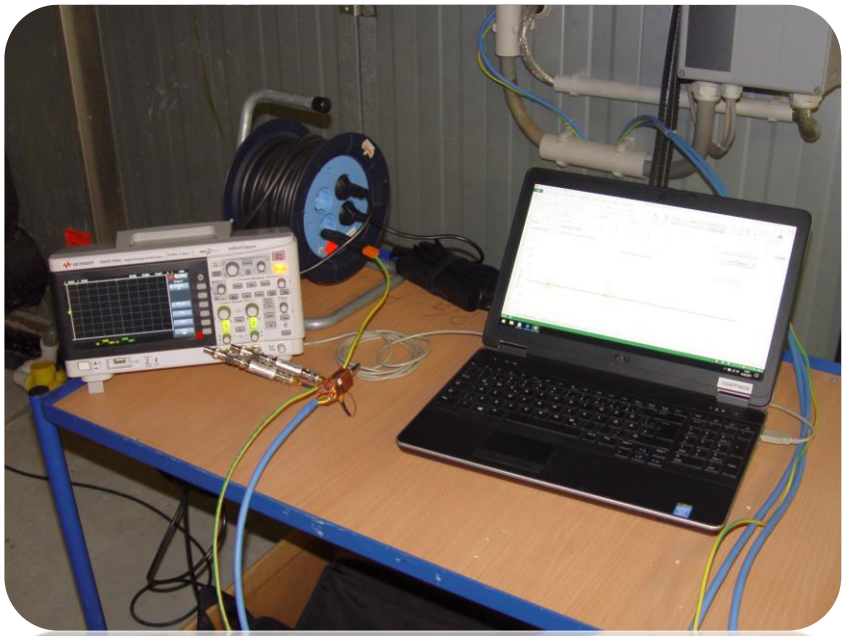
Updated Noise Measurement Setup



- The two pictures above show the termination network.
- The 50 Ω resistors are build using two 100 Ω resistors in parallel.
- The 25 Ω resistor is build using three 75 Ω resistors in parallel.
- The 4.7 nF capacitor is a Y2 safety type ceramic capacitor.



Air Conditioning Room Noise Measurement



- A very similar measurement setup as the last time has been used, the main difference is that now differential mode and common mode noise are measured using the same cable.
- 2 inverter controlled motors (each motor approx. 30 kVA, 400 V, 3-Phase).
- Shielded cables between inverter and motor.
- Communication cable positioned near to supply and motor cables.
- Communication cable in same cable tray than power cables.

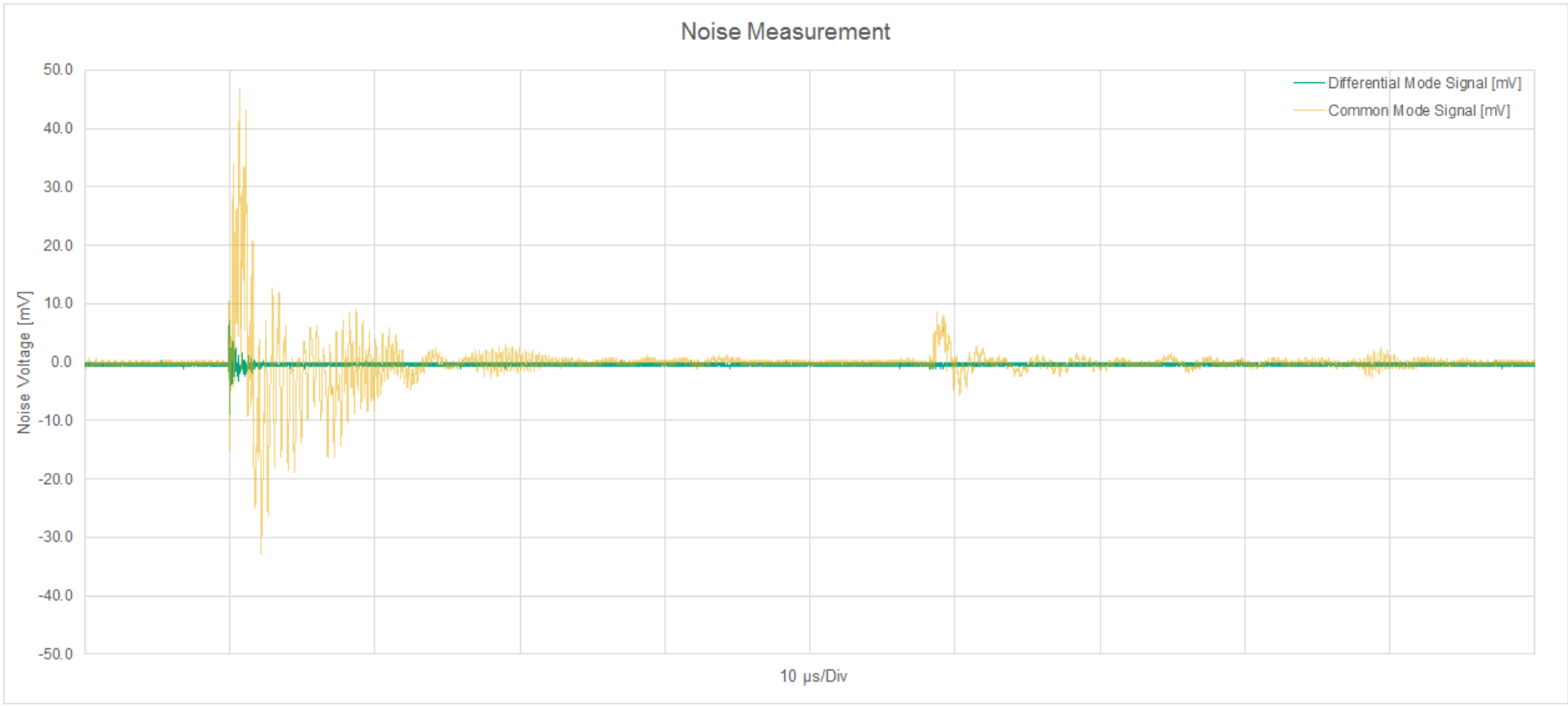
Air Conditioning Room Noise Measurement

- Beginning at the motor inverters, the total 50 m of cable have been laid out within the room.
- Two humidifiers, an air dryer and several other heating pumps are also within the air conditioning room.

Air Conditioning Room Noise Measurement

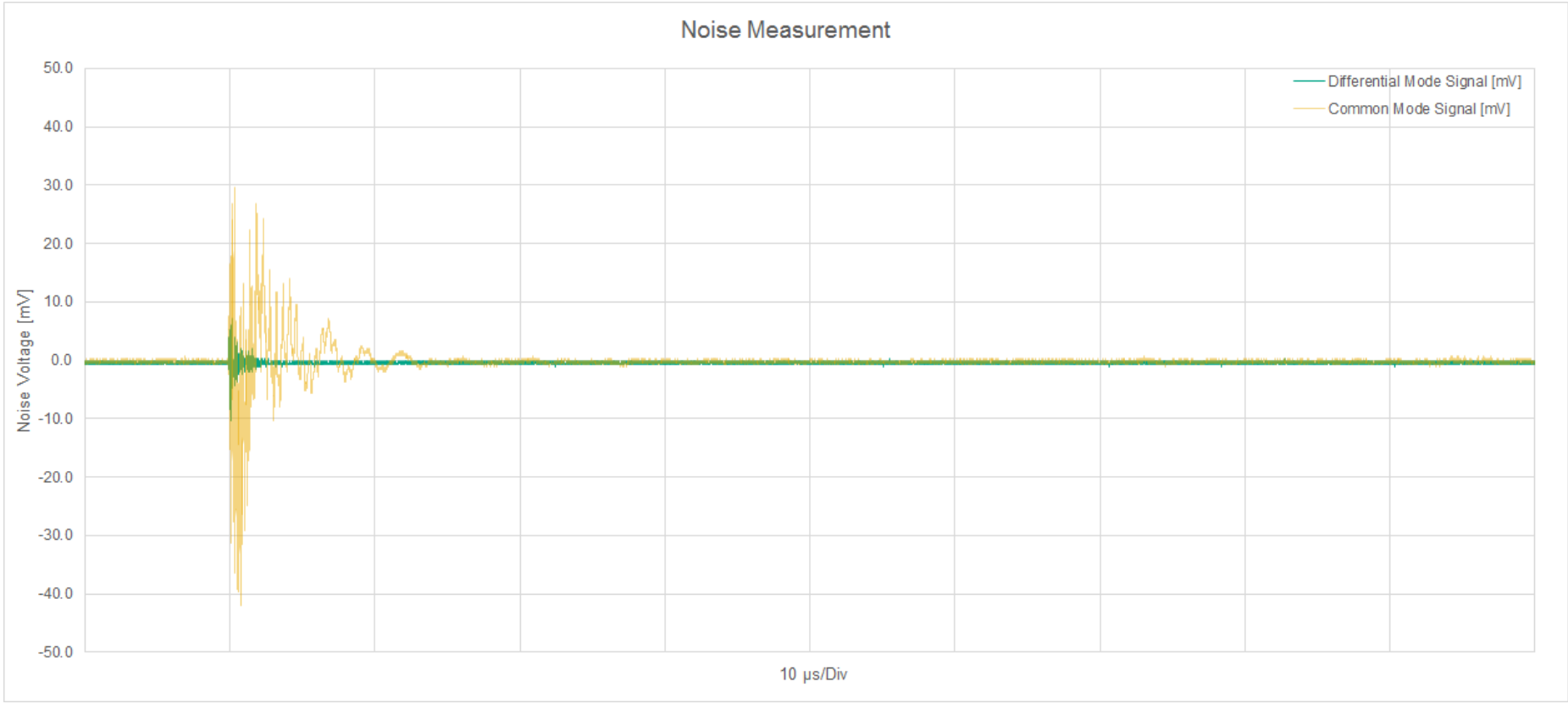
- During a measurement time of approx. 24 h there have been several noise events, where most of the events were really small.
- The next slides show four exemplary „higher“ noise events.

Air Conditioning Room Noise Measurement



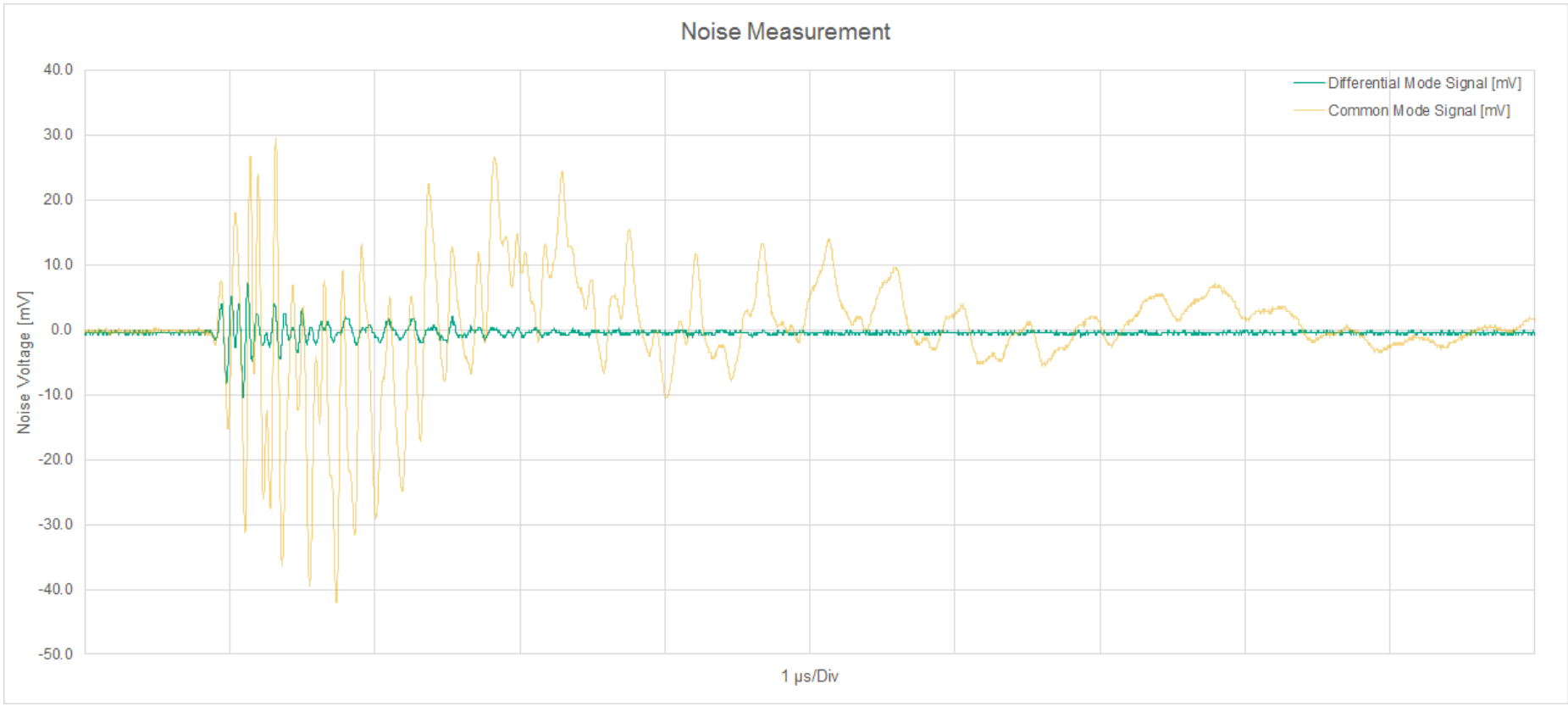
- The measured differential mode peak-to-peak noise is 16.00 mV.

Air Conditioning Room Noise Measurement



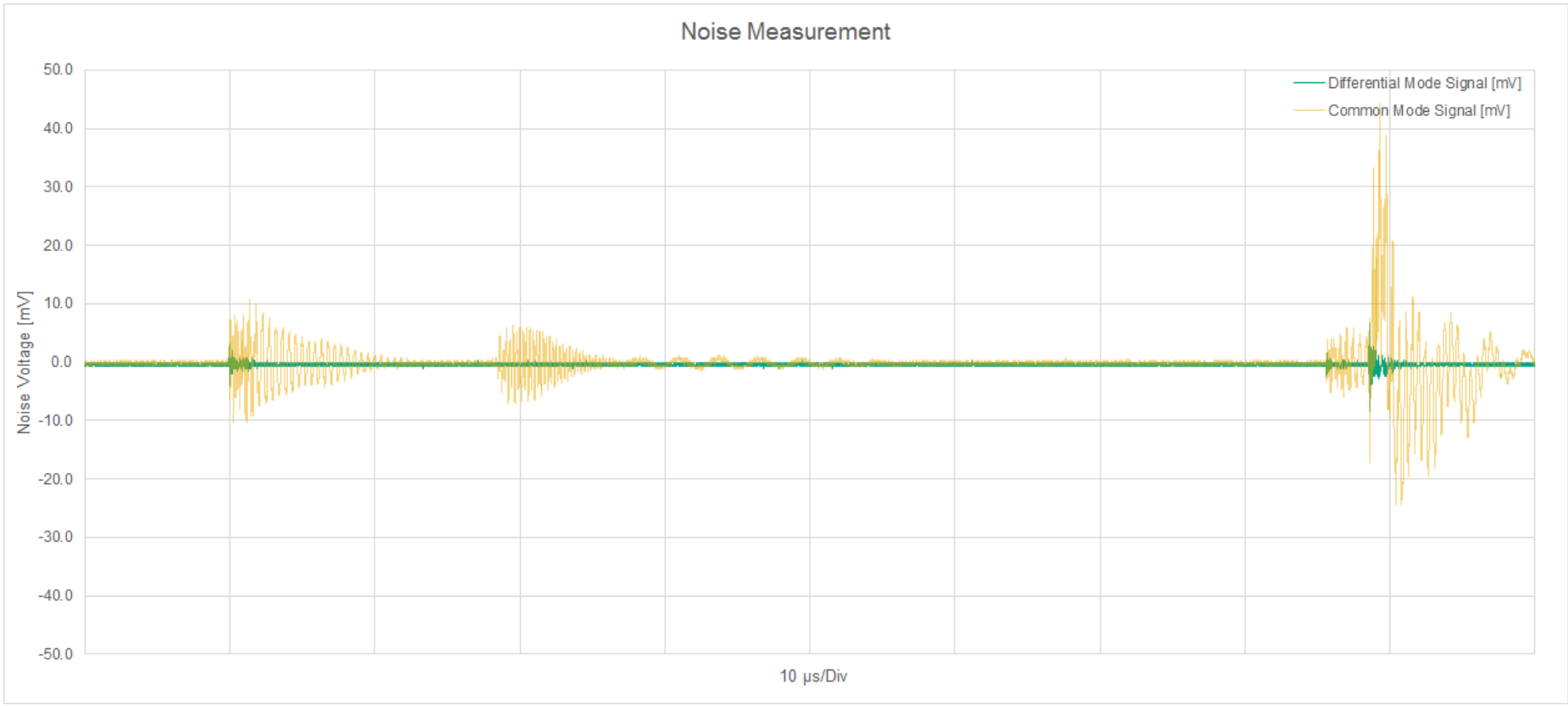
- The measured differential mode peak-to-peak noise is 17.60 mV.
- This is the highest impulsive noise level, which has been recorded during the measurement.

Air Conditioning Room Noise Measurement



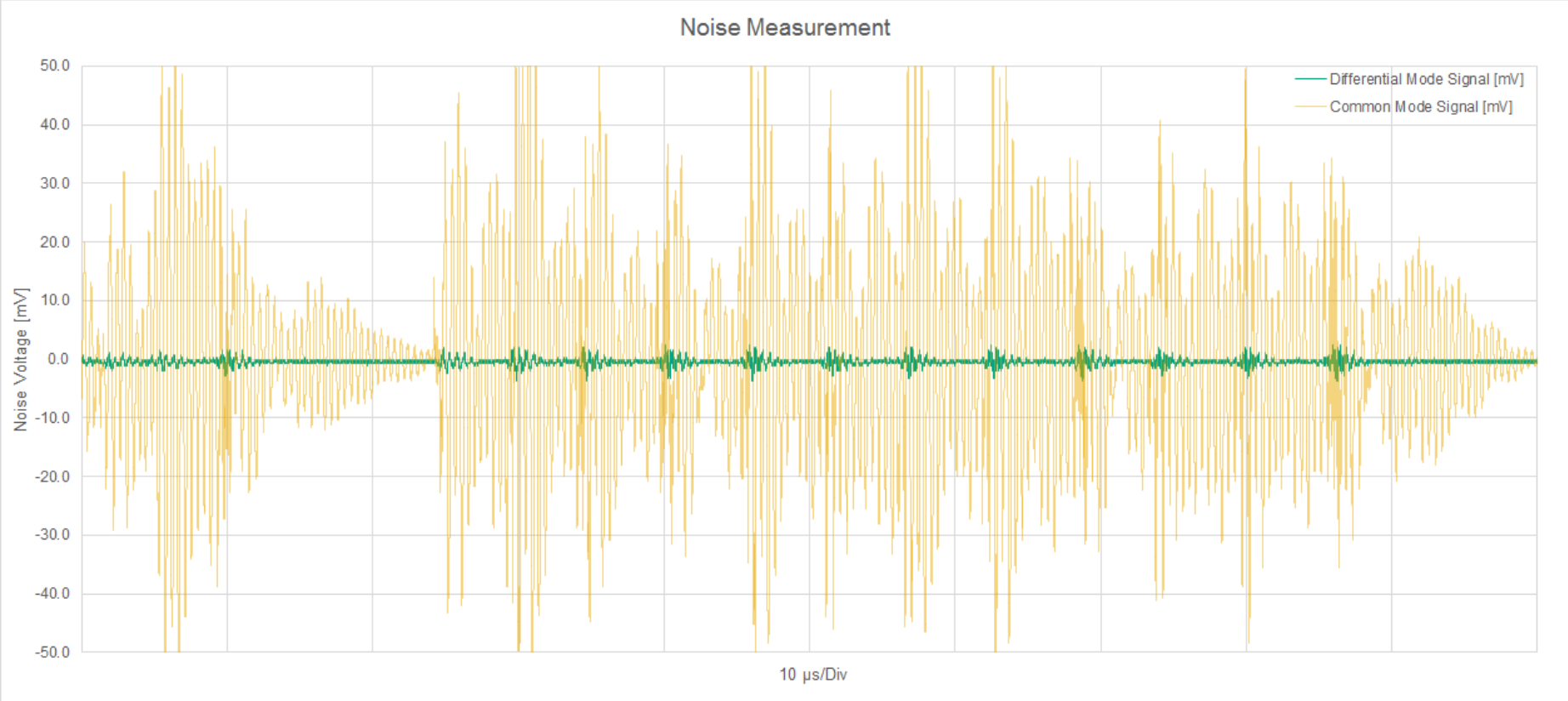
- Zoomed version of the last slide.

Air Conditioning Room Noise Measurement



- The measured differential mode peak-to-peak noise is 15.20 mV.

Air Conditioning Room Noise Measurement



- The measured differential mode peak-to-peak noise is 6.00 mV.
- This noise event happened when switching on the fluorescent lamps in the room.

Noise File Data Format

- Attached to this presentation there is a ZIP archive with several noise data files.
- At the beginning the file names provide the date and time when the data have been captured.
- The value after the time is the differential mode peak-to-peak noise level in millivolts.
- The last value within the file name is the RMS value of the differential mode noise in millivolts.
- Therefore relevant noise events can easily be identified by the file name.
- The used data format is very simple:

```
Differential Mode Scaling [mV/Div] / Common Mode Scaling [mV/Div] / Trigger Level [mV] / Sample Time [ns]
10	10	1	1
Differential Mode Signal [mV] / Common Mode Signal [mV]
-0.4	0.0
-0.4	0.0
….
```

- The first data line shows the vertical resolution of both channels, the set trigger level and the sample time (1 ns per sample).
- The other 100000 data lines contain the measured data in millivolts (separated by tab stops).
- Included within the ZIP archive there is also the Excel file (Excel 2013 with macros enabled), which has been used for communication with the scope (actual Keysight VISA COM library needs to be installed).
- This file can also be used to simply view the data (and there is also a zoom button, which allows to zoom into the first 10 µs (from the 100 µs) to see better how the noise looks in detail).

Conclusion

- The noise environment within the air conditioning room at our facility has been measured again, changing the Minicircuits combiners to a BH 040-0055 balun.
- Using this balun, it is possible to measure the differential mode and common mode signals on the twisted pair cable at the same time.
- The measurement results show similar noise values compared to the measurements done with the Minicircuits combiners.
- The noise measured is just an exemplary noise within the air conditioning room.
- Therefore additionally to the exemplary noise measurements it also could make sense to measure the coupling between the cable and the noise source under defined conditions.
- E.g. when assuming a MICE E_3 environment, which is similar to the conditions which are used for process industry products qualification, it could be interesting, how the noise couples from nearby power cables into the communication lines depending on different distances between the power cables and the communication cables.
- A common installation practice is to separate the power lines and the communication lines by some distance or have additional shielding measures, if they are within the same cable tray.

Thank You