SCT Power Supplies System Conducted Emissions Test Report

Date: February 10th, 2006.
System: SCT Complex Channels Power Supply at SR1.
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1. Scope of the test.

To measure the conducted emissions on one complex channel output.

2. Limits

The conducted emission limits as applied in ATLAS are obtained from the voltage limits established in the CISPR11 IEC standard and assuming a standard load of 50 ohms. They are specified as maximum admissible common mode current from the tested interconnect cables (shields included), under nominal operating conditions (Table 1). The maximum peak detection method is used.

Range	9 kHz to 500 kHz	500 kHz to 100 MHz
Limit	45 dBµA	39 dBµA

Table 1: ATLAS EMI Emissions Limits

3. Test setup and instruments

The setup (Figure 1) is composed by one SCT power supply system, equipped with Artesyn Power Packs and with Low Voltage and High Voltage modules sitting in a crate. The arrangement of the rack is the one to be installed in US15. One output is cabled and connected to one SCT module sitting inside a testbench.

The output cables are known as Type 4, Type 3 and Type 2. A filter box is inserted between the Type 4 and Type 3 sections. All cables are shielded. The shield is left unconnected on the power rack side.

The EMI emissions are measured with a calibrated current probe from ETS-Lindgren, model 91550-1L, and an EMI receiver, model ESPI3 from Rohde and Schwarz. For shielded cables, the EMI emissions are measured including the shield in the probe window.

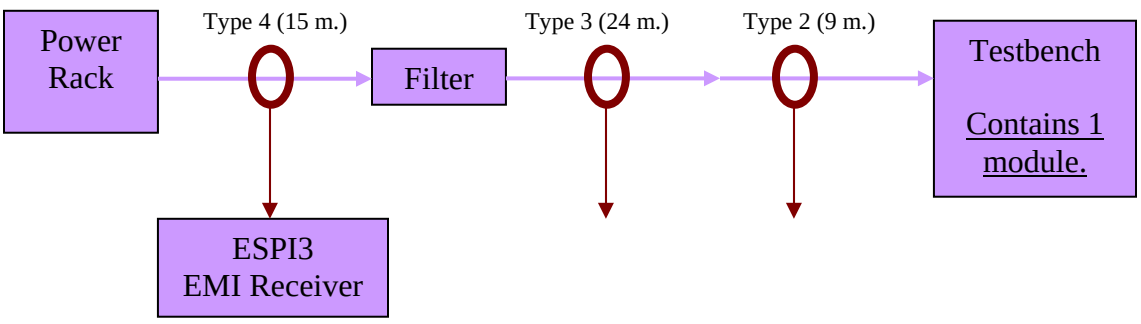

Figure 1: Test Setup.

4. AC Mains

The AC mains are connected to a power pack from Artesyn, model AFE2000-26S48NA. The power pack is specified compliant to the following EMC standards:

- CISPR22 Class B (conducted and radiated emissions).
- EN61000-3-2 (harmonic current emissions).

The AC mains conducted noise and harmonic current is therefore not tested here.

5. Conducted noise measurements.

The common mode current is measured on the three sections of cable (Yellow for Type 4, blue for Type 3, green for type 2) **,** and under three different test conditions.

5.1. Output disabled.

The power pack is truned on, all outputs are set to zero (figure 2).

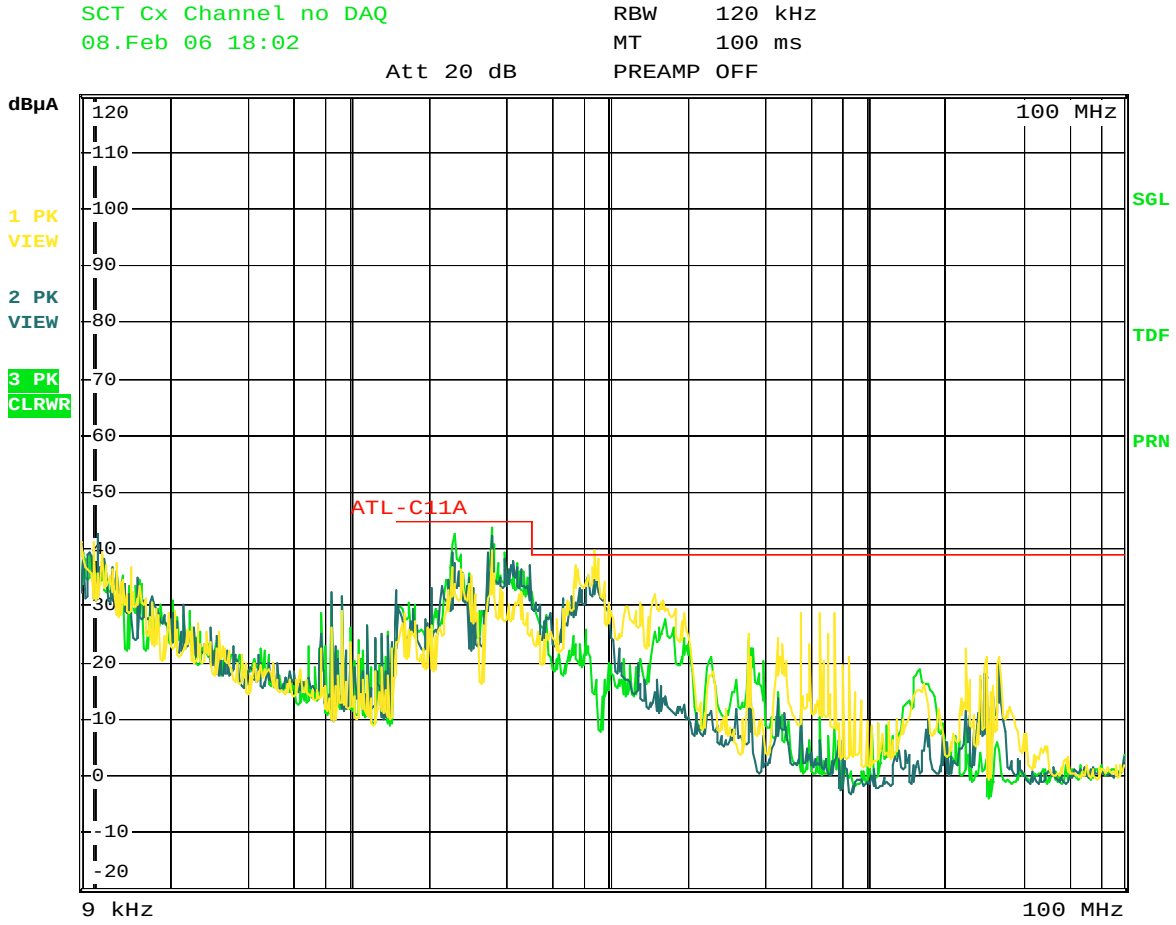

Figure 2: EMI emissions with all outputs set to zero.

5.2. <u>Ouptut configured, no data acquisition.</u>

The output voltages are set to the nominal values. The front end module is not triggered and no data is generated (figure 3).

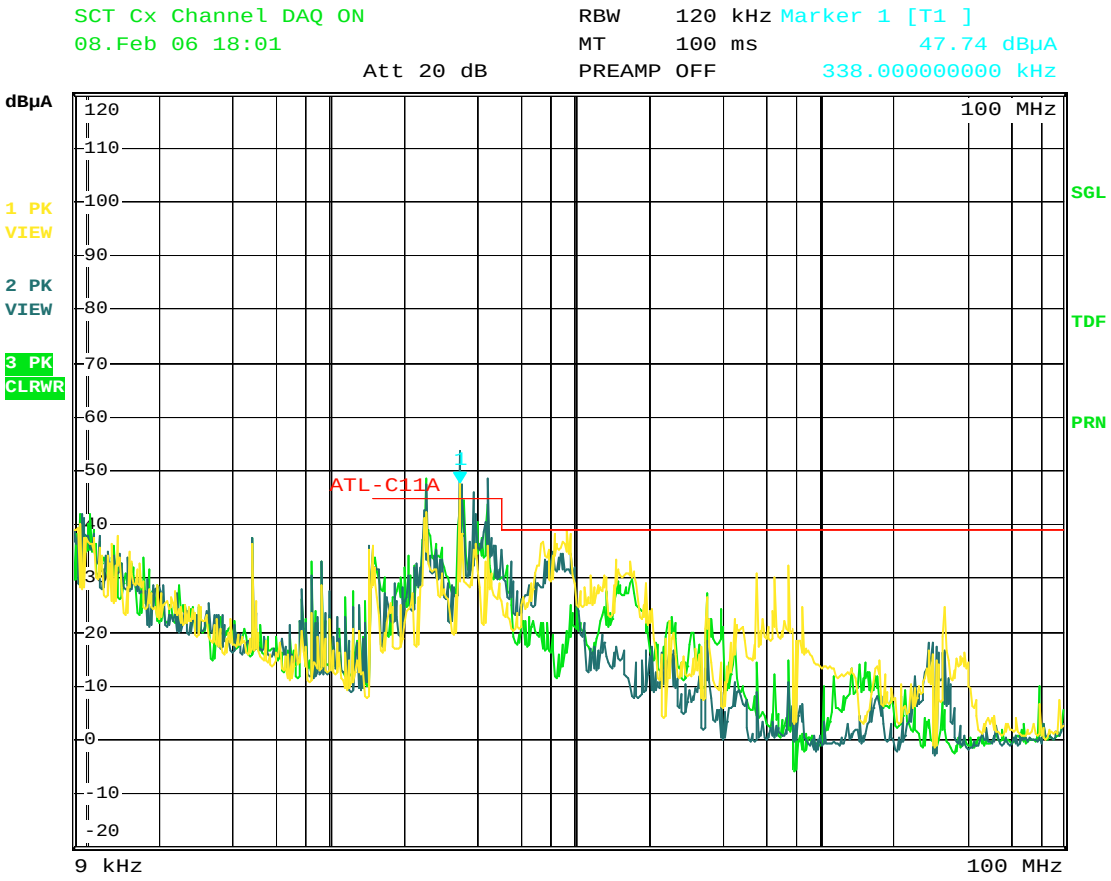

Figure 3: EMI emissions with output configured, module not triggered.

5.3. <u>Output configured, taking data.</u>

The output voltages are set to the nominal values. The front end module is triggered and data is generated (figure 4).

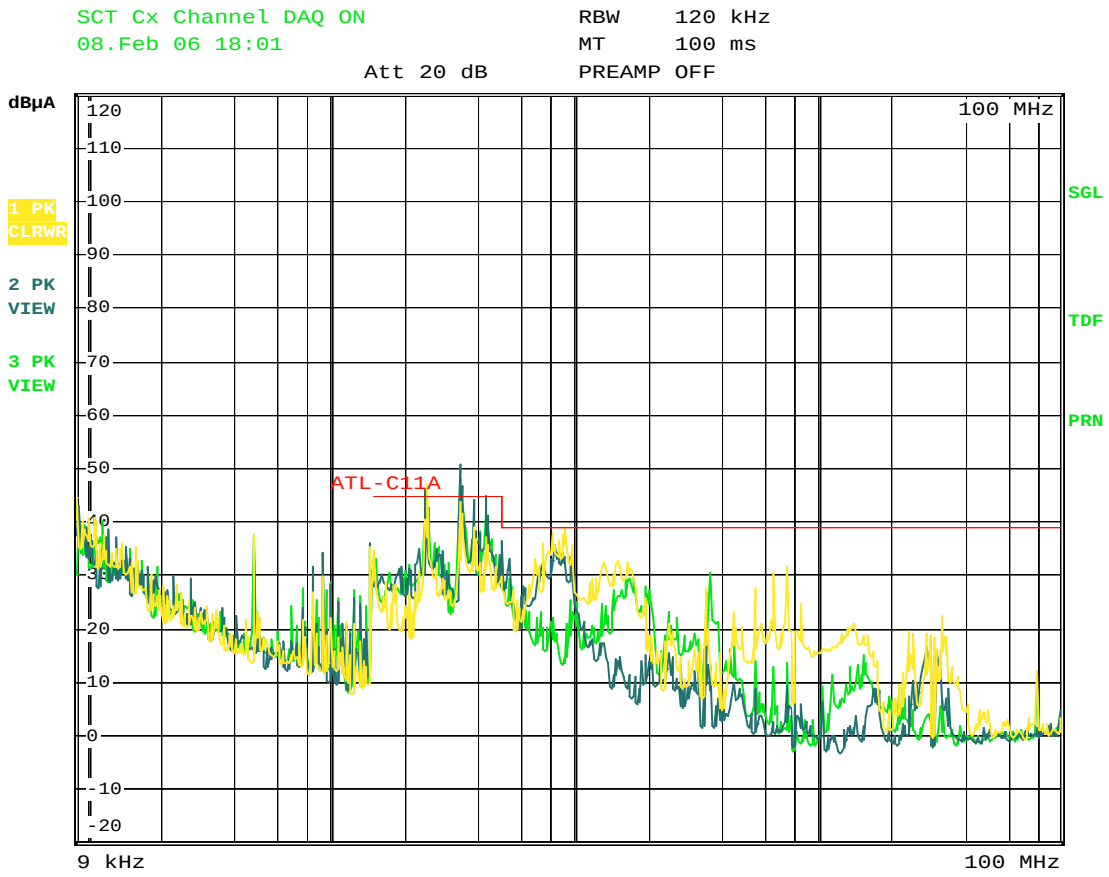

Figure 4: EMI emissions with output configured, module triggered.

5.4. Observations.

- The EMI emissions measured on the complex channel cable slightly exceeds the assigned limit at 300 kHz when enabled. Despite this, the spectrum stays well below the limit.
- The effect of the filter box is observed on all measurement. The comparison of the yellow and blue curves shows that the filter is effective to attenuate the common mode noise for frequencies comprised between 1 MHz and 20 MHz.
- On the Type 2 cables, some additional noise appears between 2 MHz and 4 MHz.

6. Effect of ground the shield to the power rack.

The shield of the Type 4 cable is by default left unconnected on the power rack side. This is known to worsen the EMI emissions of the affected cables. The effect obtained when grounding the T4 cable shield to the power rack is measured on the type 4 cable EMI

emissions (figure 5) and on the type 3 EMI emissions (figure 6). An improvement of 20 dB below 1 MHz is achieved when grounding the shield on both ends, on both T4 and T3 cables. The T3 EMI emissions fit all below the limit once the T4 shield is grounded on both sides.

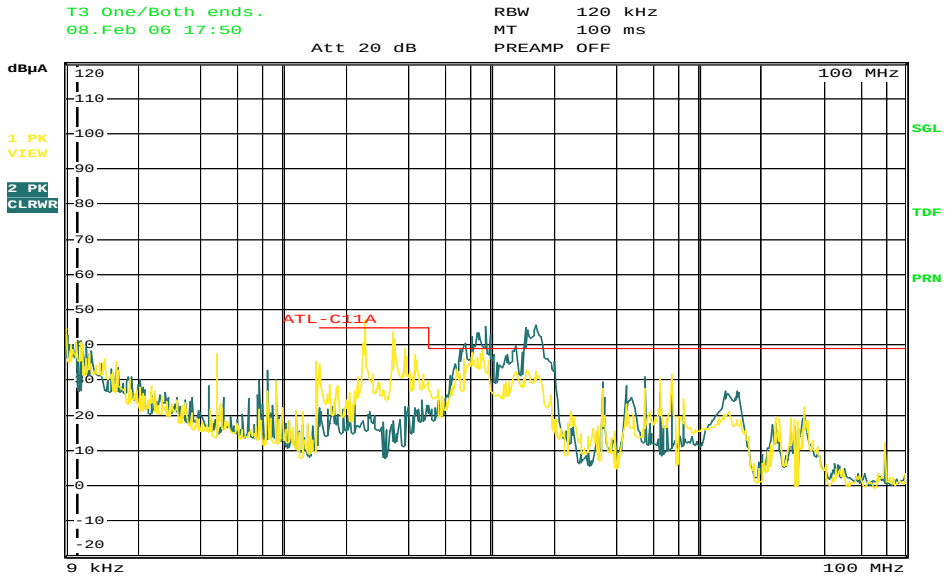

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Figure 5: T4 cable EMI emissions with T4 shield grounded one one end (yellow) or on both ends (blue).

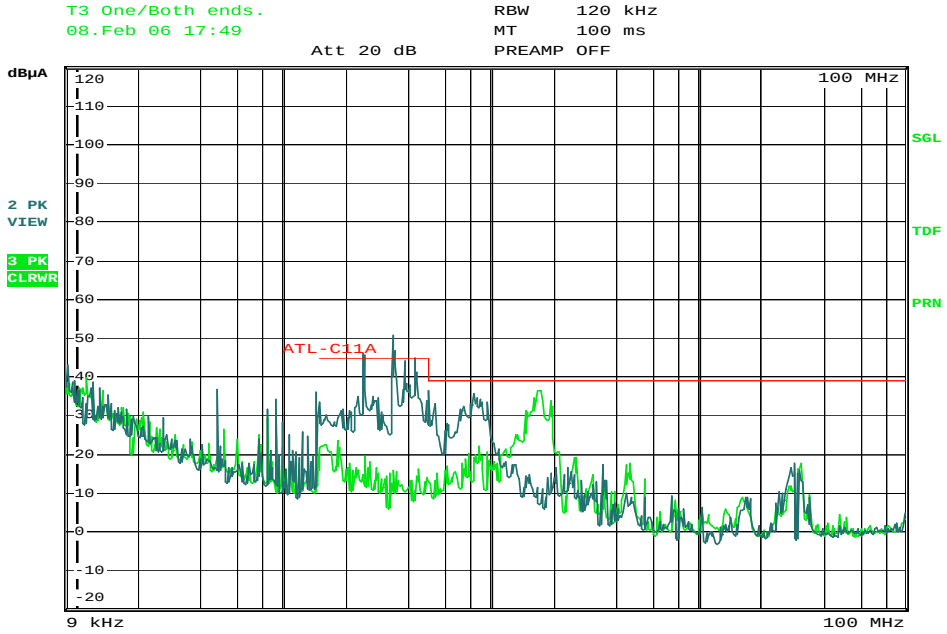

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Figure 6: T3 cable EMI emissions with T4 shield grounded on one end (blue) or on both ends (green).

7. Conclusions

The EMI emissions on the AC mains are guaranteed to comply to CISPR22 and EN61000-3-2 by the manufacturer of the power pack.

The EMI emissions on the complex channel output cables exceeded slightly the assigned limit at 300 kHz. The EMI emissions can be significantly reduced if the shield of the type 4 cable is properly grounded to the power rack.

The filter box is effective to attenuate the common mode noise between 1 MHz and 20 MHz. It must be noted that the noise is degraded on the Type 2 cable.