Intel/Sony Joint EMI Testing on 1394 CE to PC Interconnect

Steven Midford
Intel Corporation
(Intel Architecture Lab)

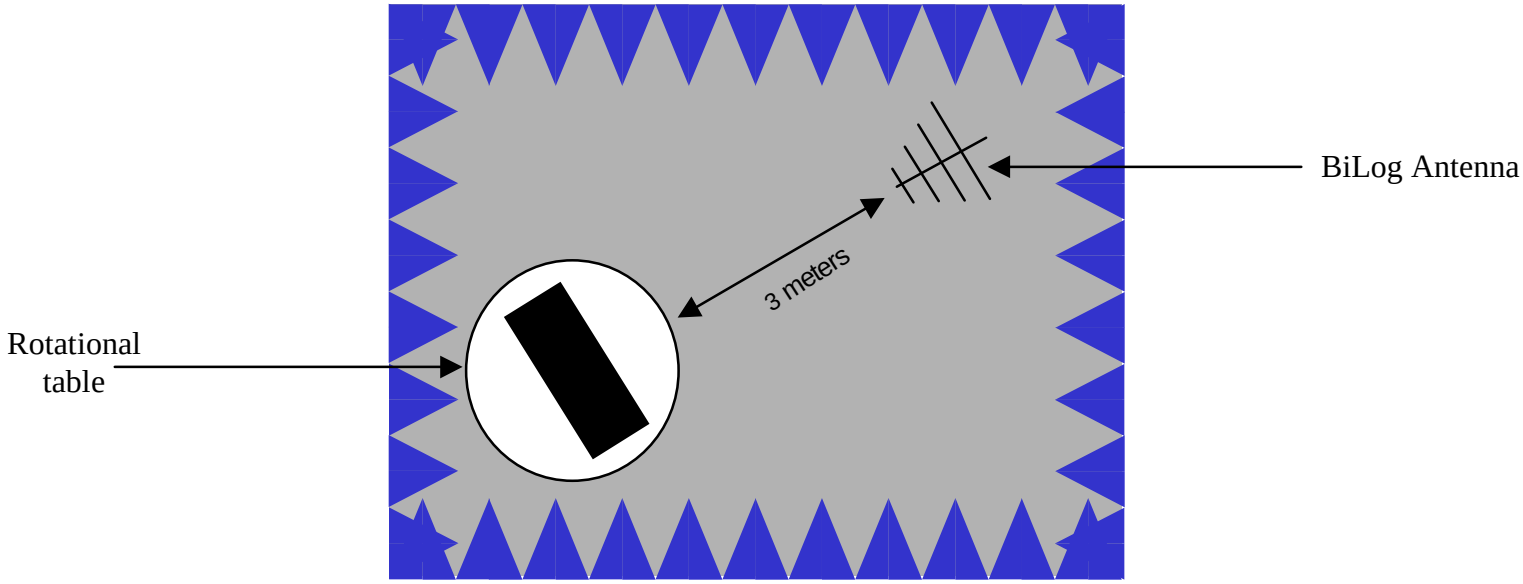
Presented to P1394a committee
September 25-26, 1997 Natick, Massachusetts

Three Meter Anechoic Chamber

- Room completely shielded from outside radiation
- Carbon Absorber Cones used to absorb radiation produced from Device Under Test (DUT)
- BiLOG antenna used to receive Device Emissions
- Antenna positioned three meters from DUT

Three Meter Anechoic Chamber

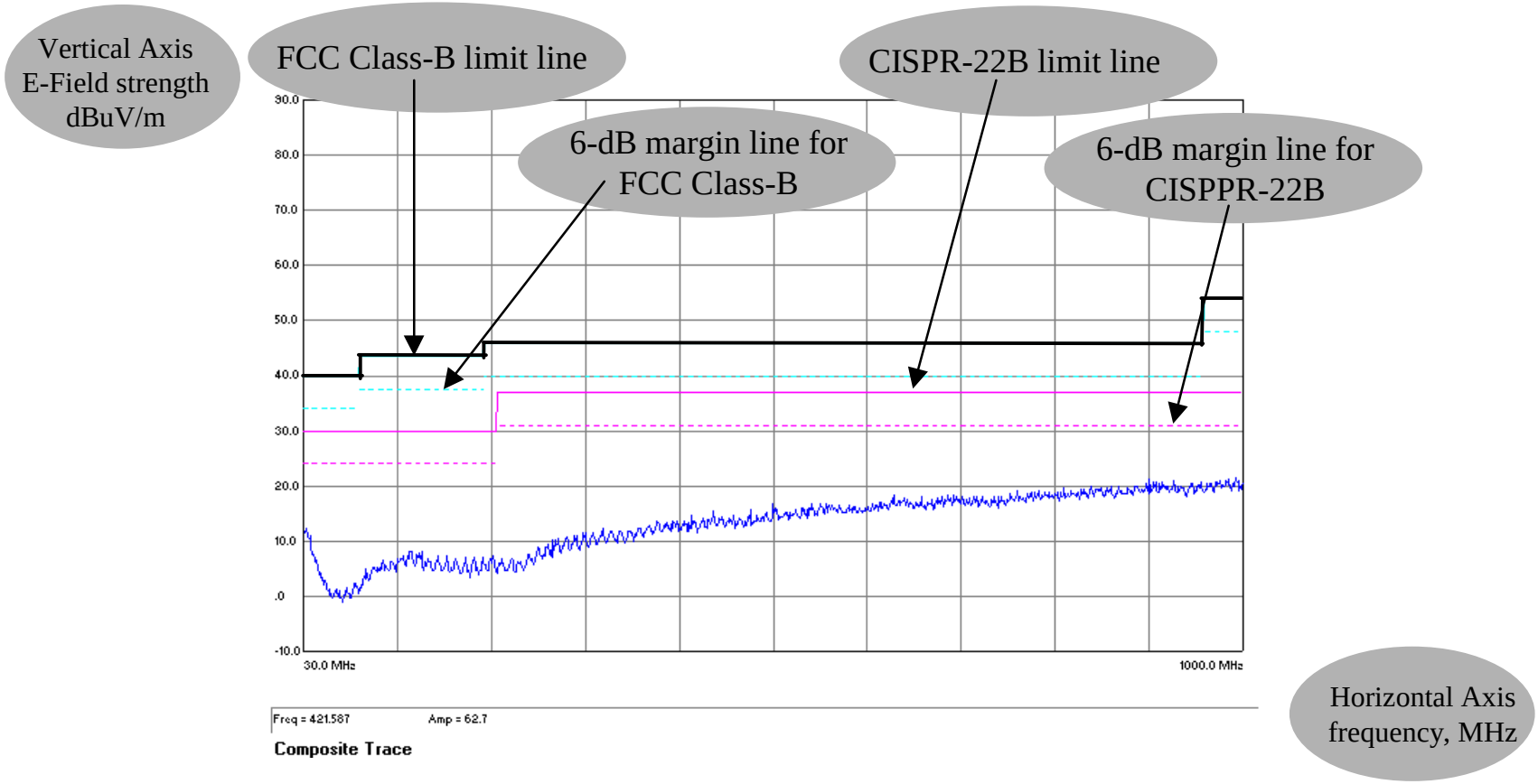
Floor Layout



FCC and CISPR-22B Limits

FCC Class B Radiated Limits			**CISPR-22 Class B limits**		
Frequency (MHz)	Distance (meters)	Field Strength DBuV/m	Frequency (MHz)	Distance (meters)	Field Strength DBuV/m
30 - 88	3	40	30 - 230	10	30 (36)
88 - 216	3	43.52	230 - 1000	10	37 (43)
216 - 960	3	46.02	N/A	N/A	N/A
960 - 2000	3	53.92	N/A	N/A	N/A

Interpreting emissions graph



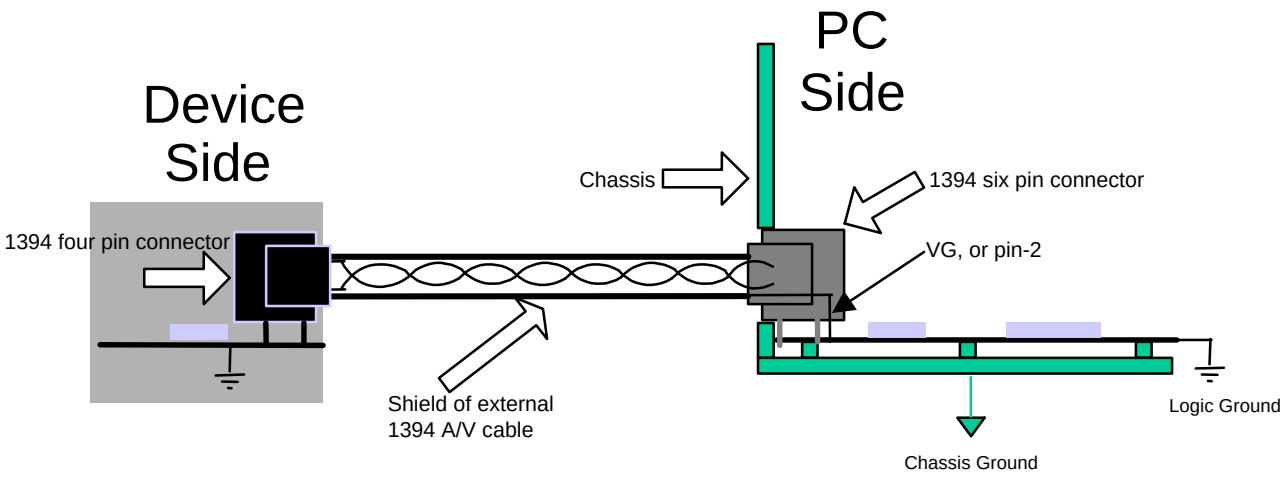
1 CISPR-22B limit line must be raised approximately 6dB to compensate for the 3 to 10 meter range difference

Original 1394 4-to-6 pin A/V cable

- Shield terminates to VG (pin-2) of the-six pin receptacle; terminates to shell of four-pin plug
- EMI unfriendly for PCs’
  - When attached to a motherboard, radiation close to or above the FCC limit is inevitable

1394 4-to-6 pin A/V cable environment for CE to PC interconnect

Original A/V cable

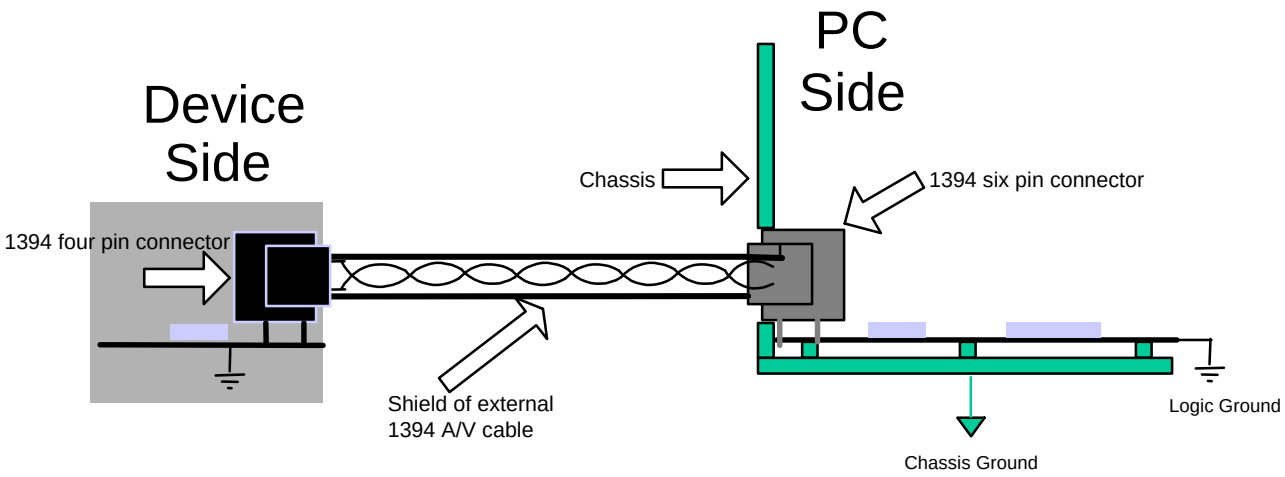


S100-only 1394 4-to-6 pin A/V cable

- Shield terminates to the shell of both the six-pin plug and four-pin plug
- Supports only S100 as there is no return path for the common mode speed signal

1394 4-to-6 pin A/V cable environment for CE to PC interconnect

S100-only A/V cable

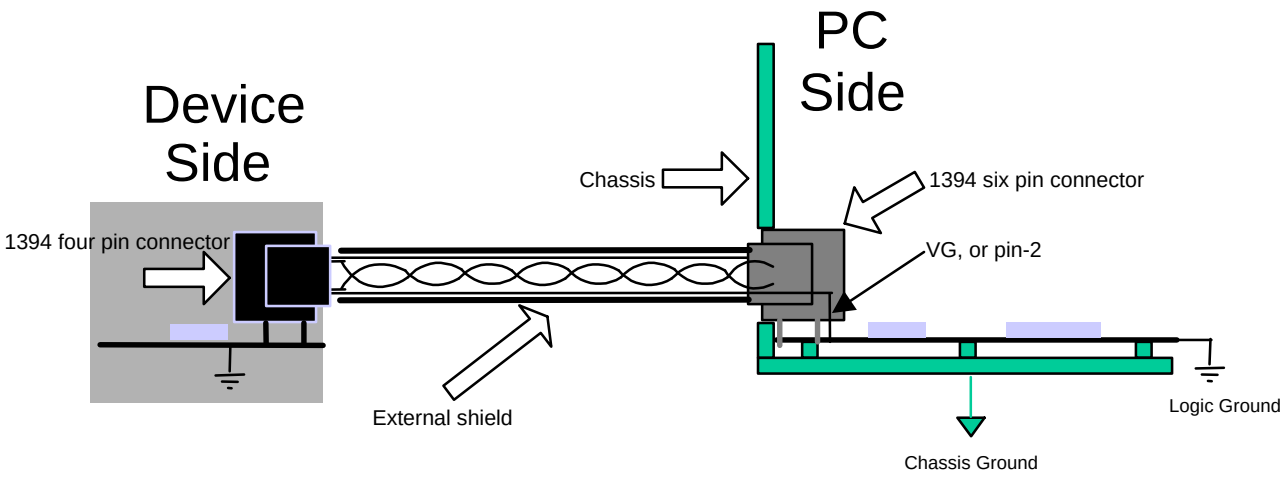


1394A/V cable proposed for S100-S400

- Cable construction closely resembles six conductor cable
- Foil shield wrapped around each pair
  - foil shield connects to VG of six-pin receptacle
- Braided shield terminates at shell of six pin plug
  - provides an AC return path for stray currents traveling on the outer surface of the foil shield which results in reduced emissions
- Braided shield is left unterminated at four-pin plug

1394 4-to-6 pin A/V cable environment for CE to PC interconnect

Proposed 1394 A/V cable



Systems Under Test

- 1394-Test Vehicle Platform built by Intel®
  - 1394-1995 Link and PHY chip laid out on mother board
  - PHY/Link DC Coupled - both chips share ground plane with the rest of the system
  - Sticky fingers allow for various points of contact between the chassis and the receptacle.
- Sony® Camcorder
  - Incorporates four-pin connector
- Sony® Conferencing camera
  - Incorporates six-pin connector

1394 Platform Grounding Scheme

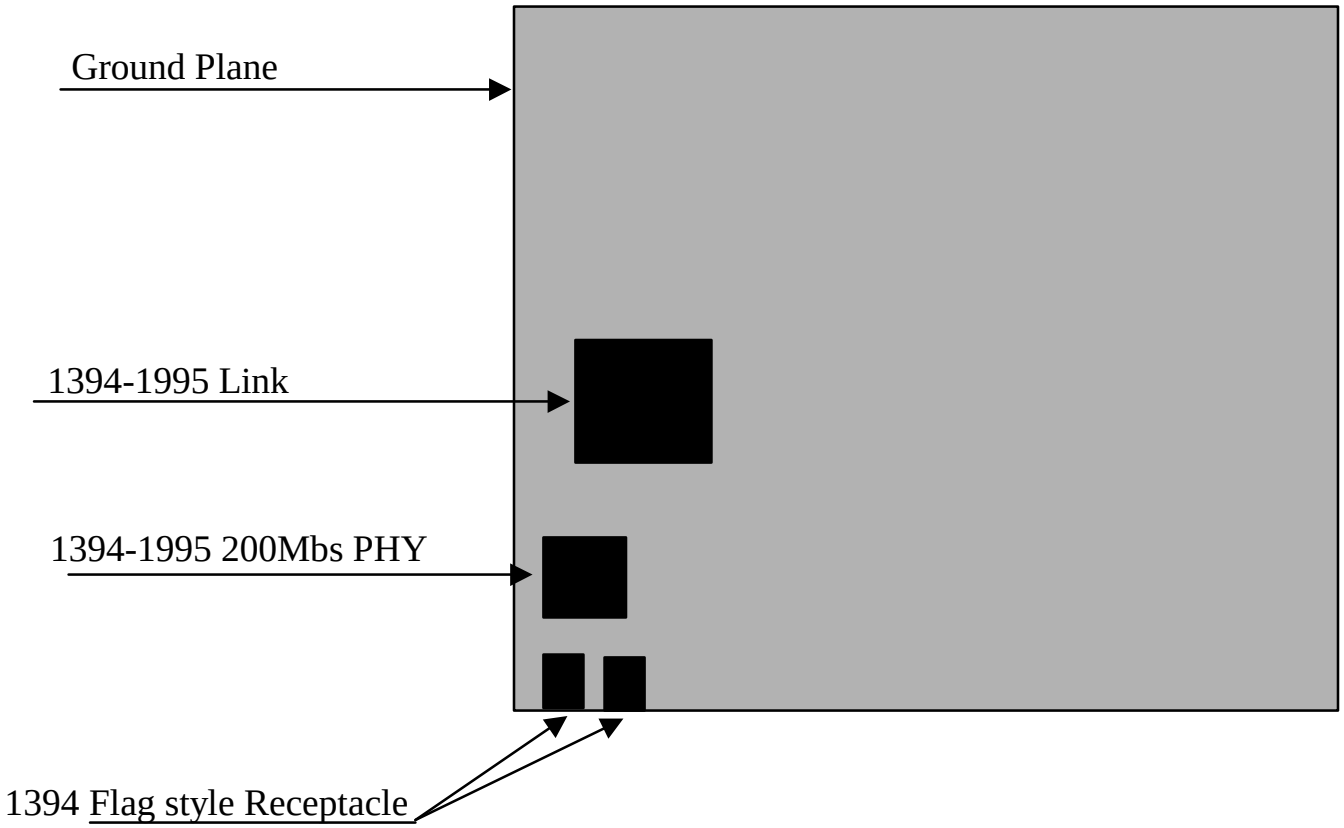
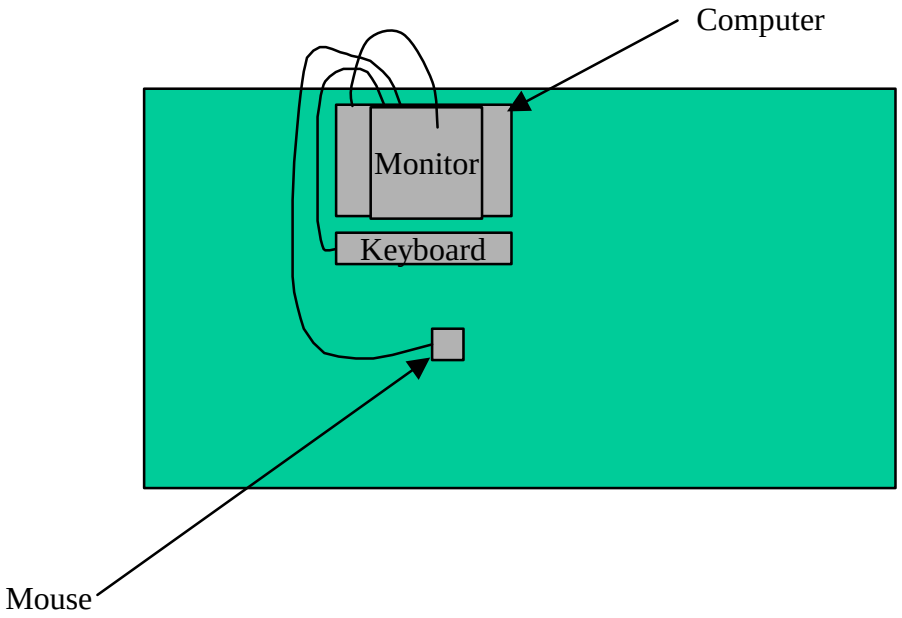


Table Layout for baseline of 1394-System



Baseline scan of 1394 platform

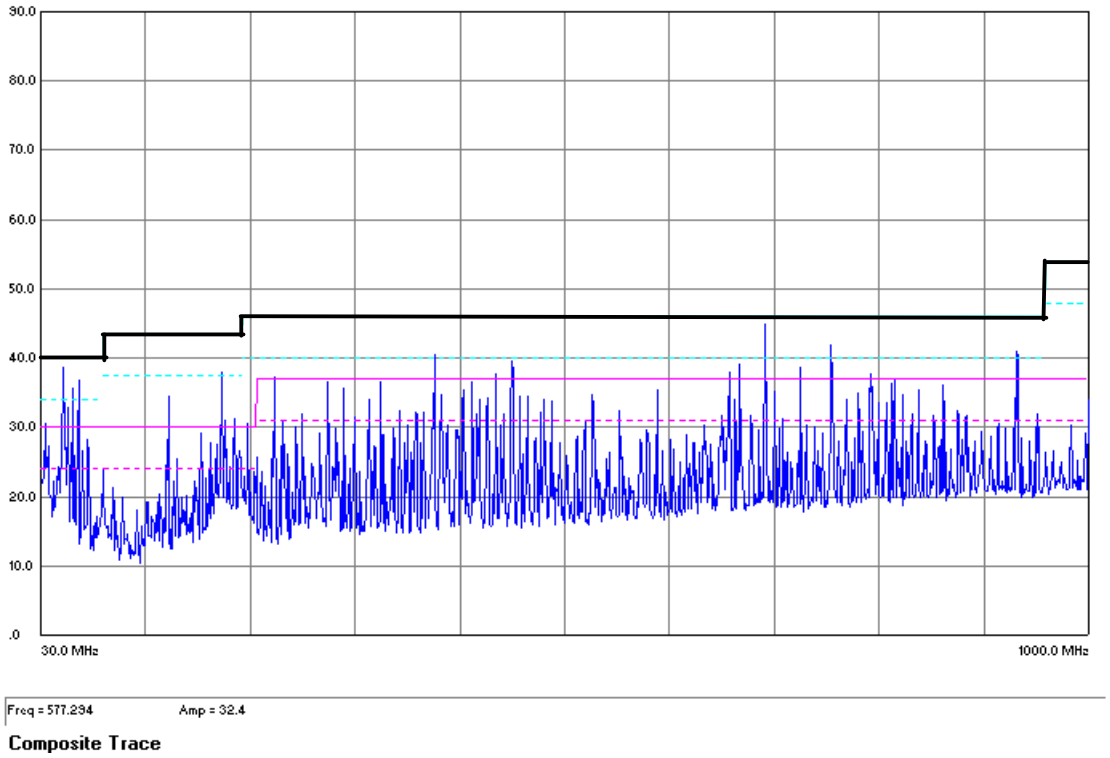
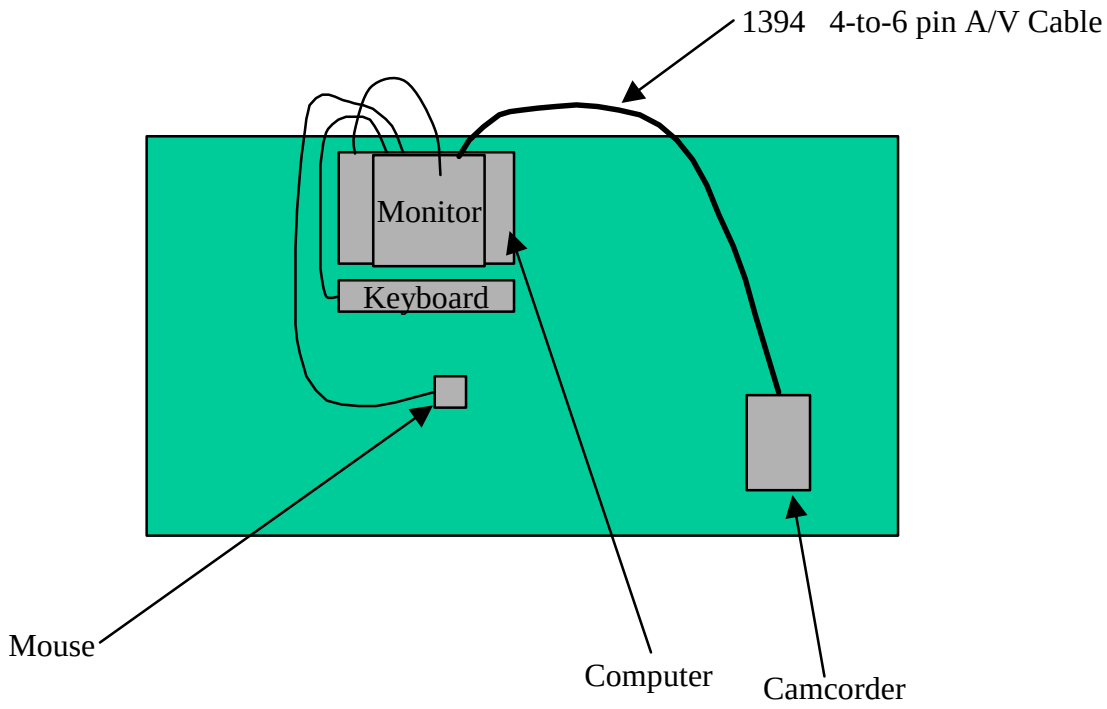
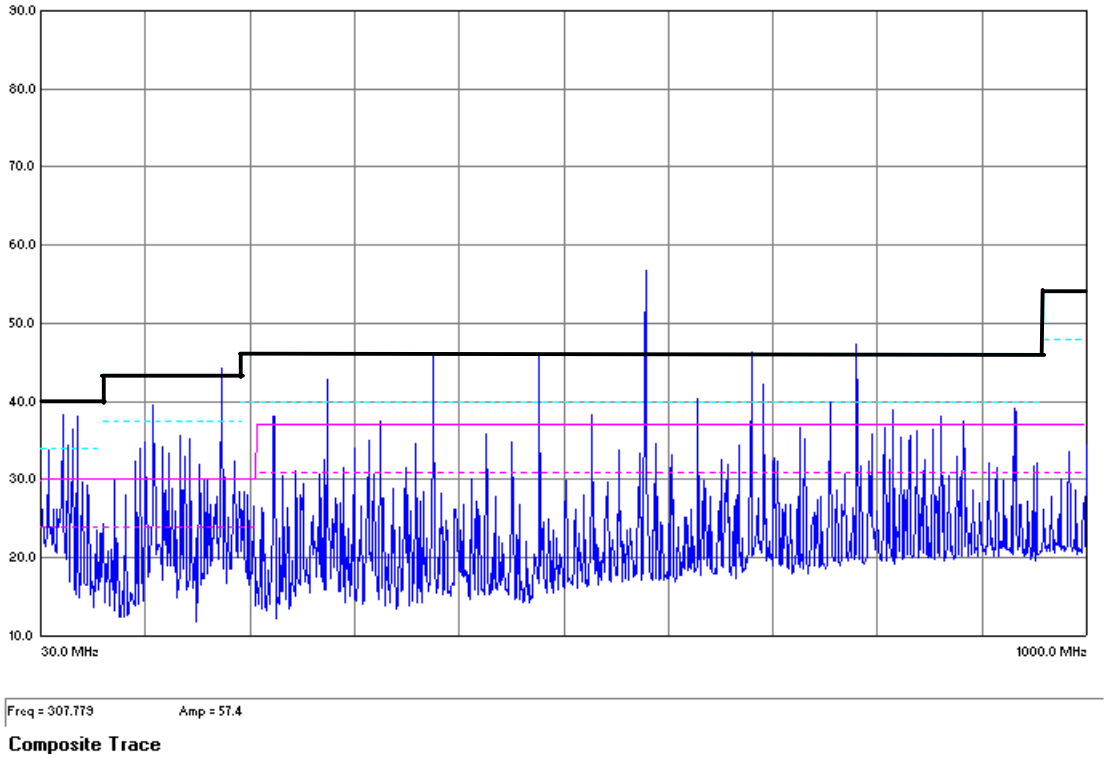


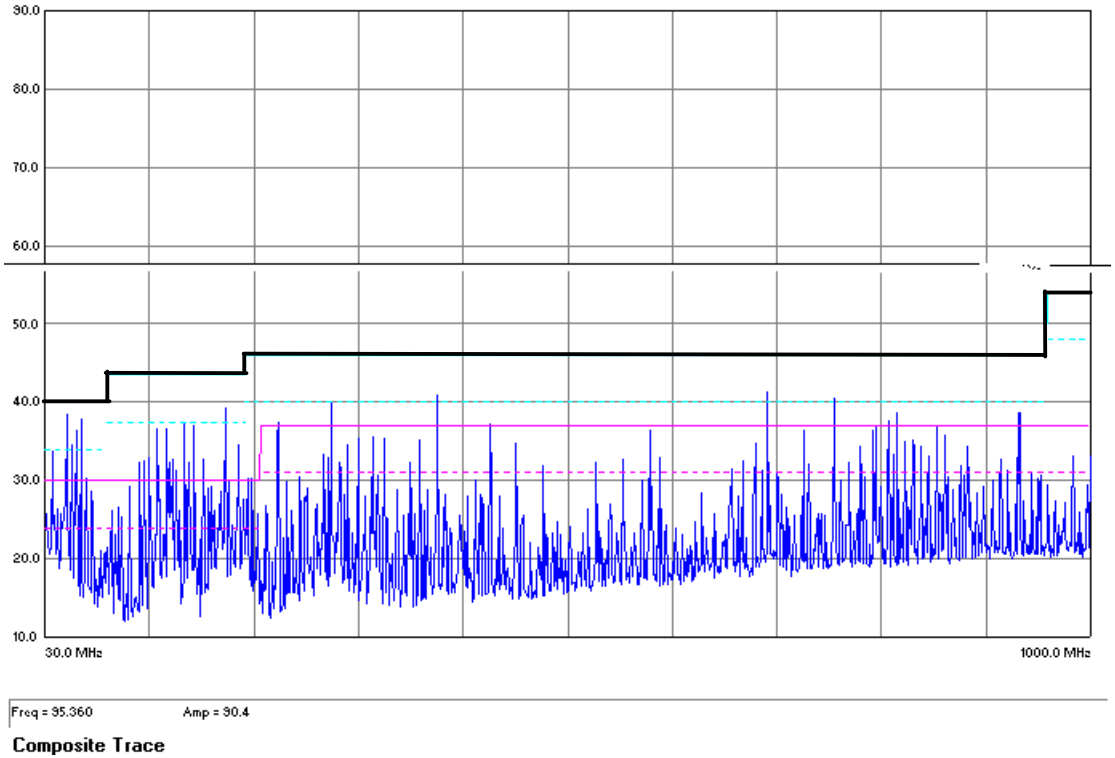
Table Layout for System plus Camcorder



Emissions of 1394-System plus camcorder utilizing original A/V cable



Emissions of 1394-System plus camcorder utilizing S100-only A/V cable



Emissions of 1394-System plus camcorder utilizing Proposed A/V cable

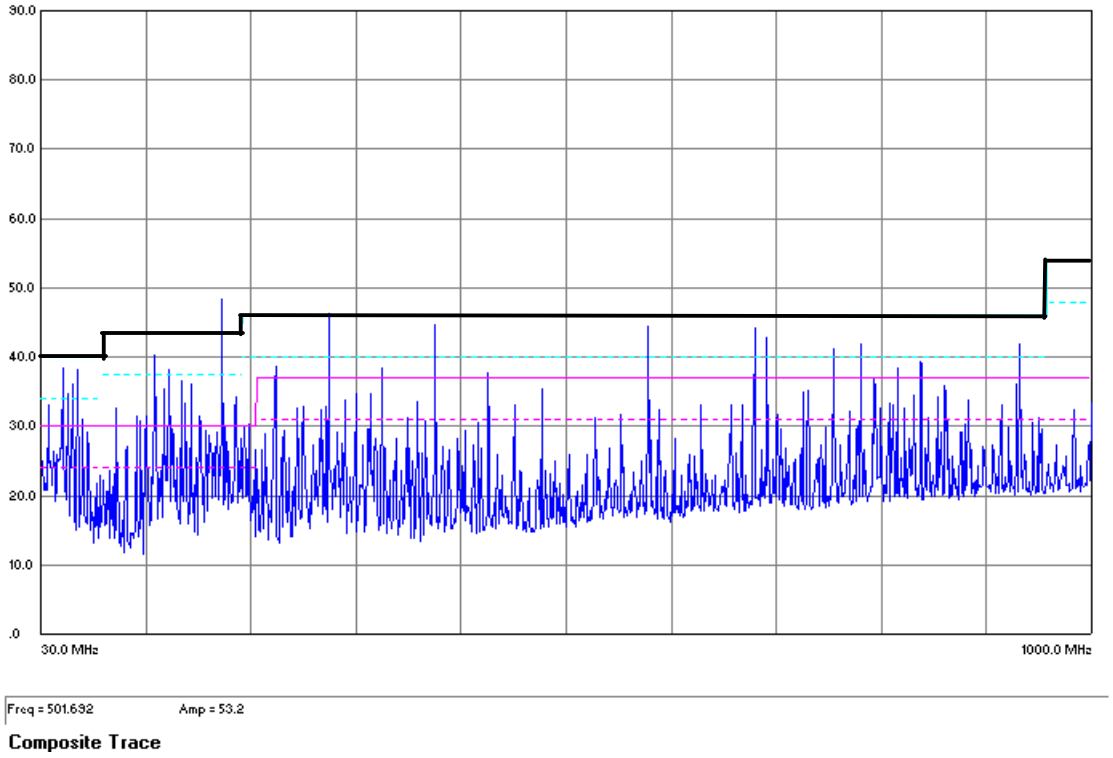
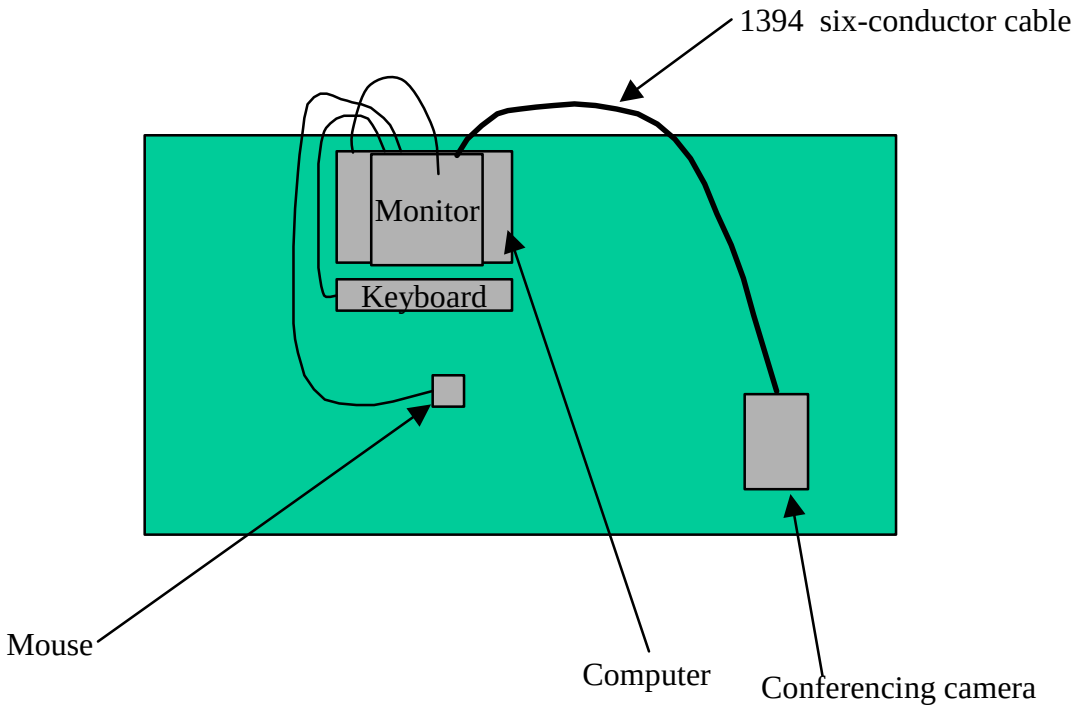
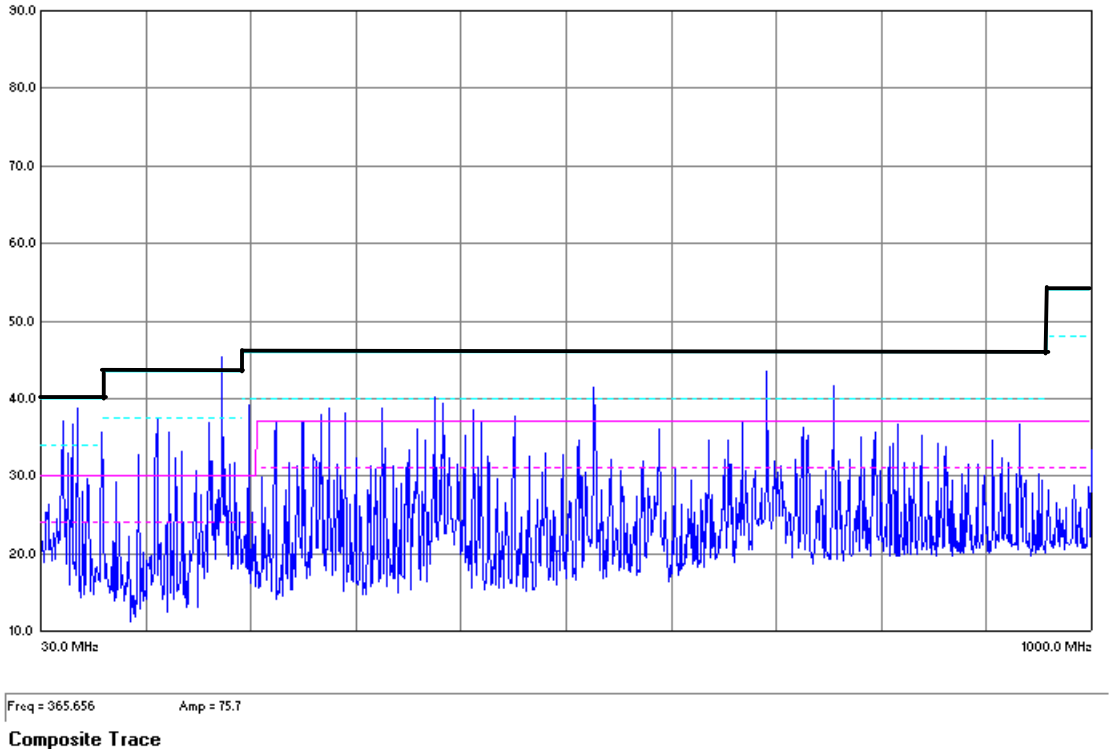


Table Layout for System plus conferencing camera



Emissions of 1394-System plus conferencing camera utilizing six-conductor cable



The emissions from this configuration shouldn't be considered as a valid comparison with the previous configurations as the conferencing camera introduces a second variable.

Conclusions

- Original A/V cable produces emissions above or at the FCC limit at several frequencies
- There are seven discrete spectral lines that either approach or fail the FCC limit
- These discrete spectral lines are reduced by an average of 3.6 dB when the proposed A/V cable is used.