ITT Industries, Electronic Components/X2Y Attenuators

Case Study of Filtered Connector Application in Blower Motor to Meet EMC Requirements

Test Results #TR 4012, v1.0

Prototype Test Goals

- Design and implement filtered connector with X2Y® Technology on a blower motor that can meet or exceed EMC requirements set forth by automobile manufacturers:
  - ✓ 2005 SAE World Congress paper:
    - ➔ Electromagnetic Compatibility of Direct Current Motors in an Automobile Environment "
- Measure differences in modifications to connector.
- Verify X2Y performance vs. conventional EMI filtering

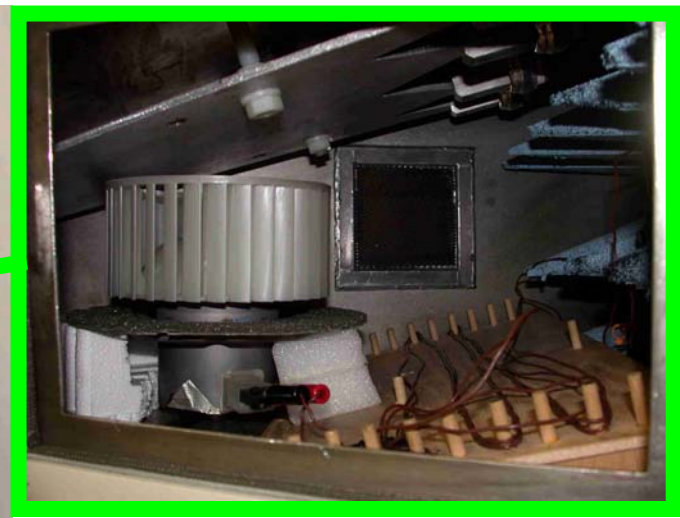
Testing Presented Within this Document

- Data was taken by X2Y Attenuators, LLC at the Detroit facility.
- Data is for A to B comparison only of radiated and conducted emissions. Data is not intended as validation for specific test requirements for OEM specifications.
- However, trends in data should be seen in validation testing at approved facilities.

Radiated Emissions
Test Set-up

RE Test Set-up

- The DUT was placed in an ETS-Lindgren IC-GTEM 250 along with a 12 V power source connected by a 3 meter harness.
  - ➔ Note: the harness is wrapped between wooden pins on a wooden platform for repeatability of measurements.
  - ➔ Note: DUT is tested under load conditions.

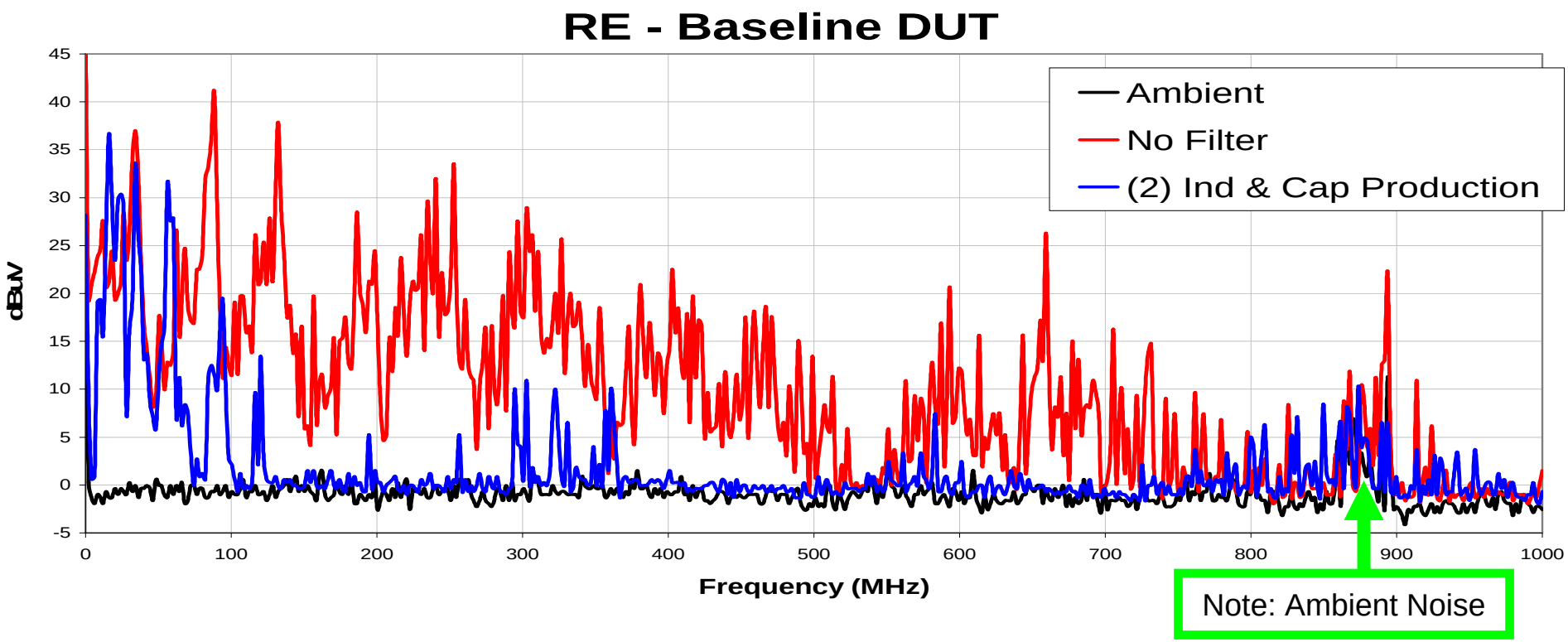


RE Test Set-up (continued)

- An IFR AN920 spectrum analyzer was used to measure and record RE.
- The spectrum analyzer settings are:
  - ✓ Frequency spectrum = 100 kHz – 1000 MHz
  - ✓ Bandwidth = 120 kHz
  - ✓ Sampling = 3 Peak Hold

RE Test Set-up (continued)

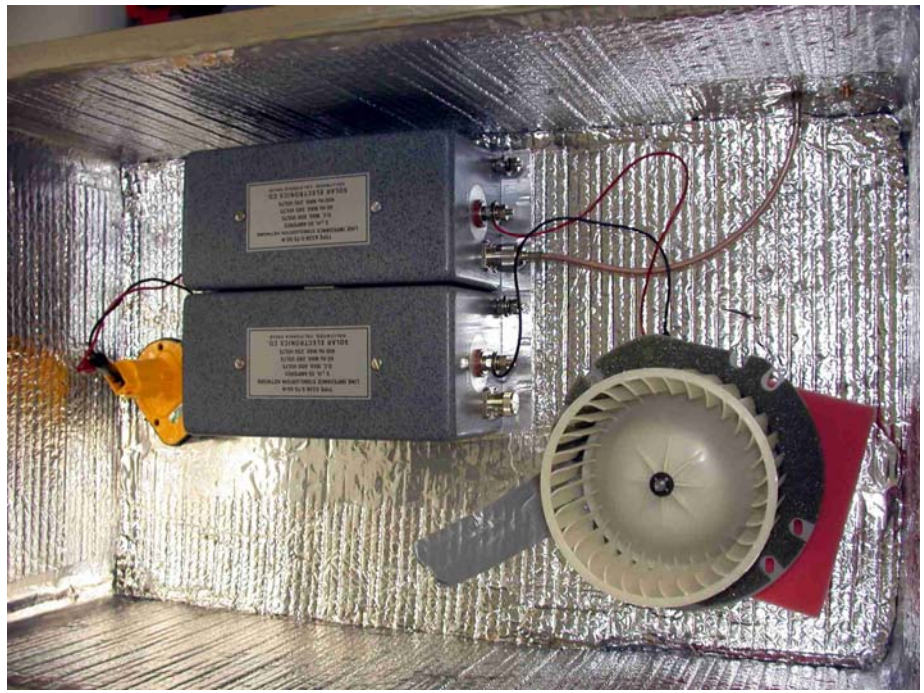
- To baseline DUT measurements for A to B comparisons, an ambient, DUT non-filtered, & DUT production filter were taken.
  - ➔ Note: These measurement will appear on all data plots.



Conducted Emissions Test Set-up

CE Test Set-up

- The DUT was placed in a shield box measuring approx 29 by 18 inches.
- Between the DUT and 12 V power source are (2) LISNs Type 6338-5-TS-50N. (manufactured by solar Electronics Co.)
- There is approx 8 inches of harness between power supply & LISN and LISN & DUT.
- Note: DUT is tested under load conditions.

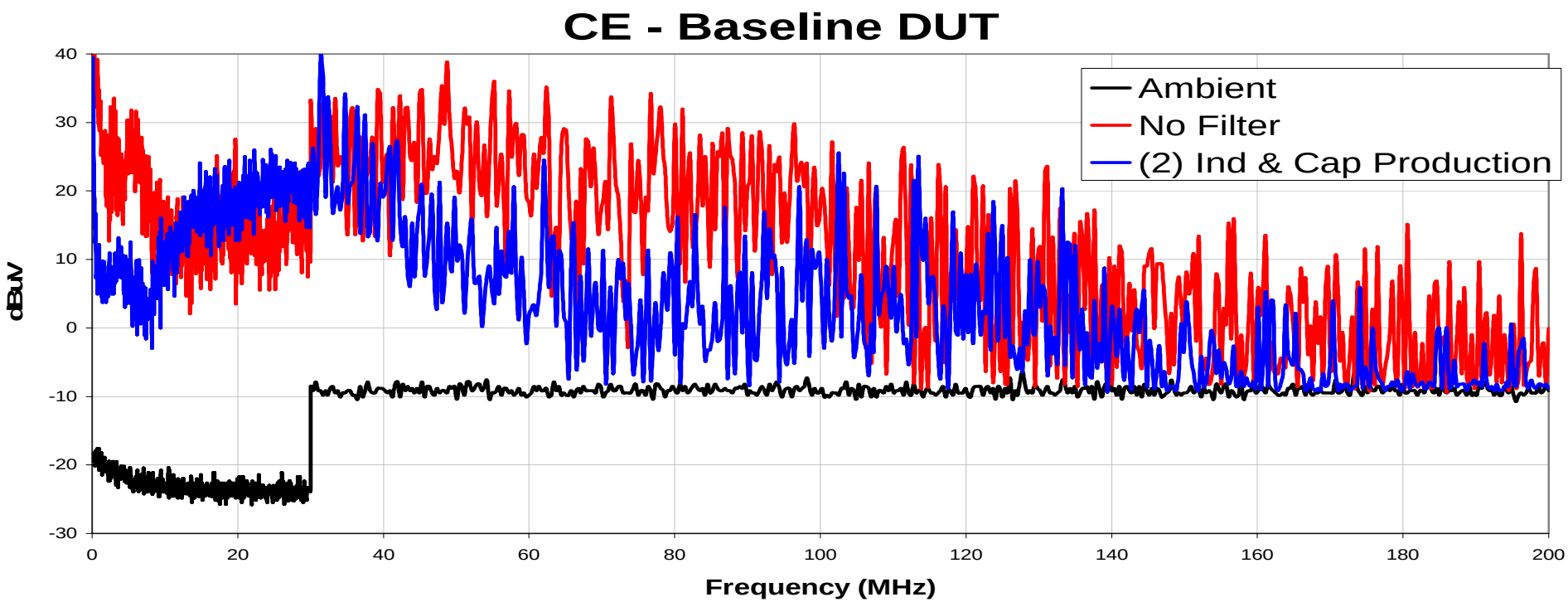


CE Test Set-up (continued)

- Again, an IFR AN920 spectrum analyzer was used to measure and record CE.
- Measurements were taken in (2) different frequency spectrums.
  - ✓ Spectrum analyzer settings #1:
    - ➔ Frequency spectrum = 150 kHz – 30 MHz
    - ➔ Bandwidth = 9 kHz
    - ➔ Sampling = 3 Peak Hold
  - ✓ Spectrum analyzer settings #2:
    - ➔ Frequency spectrum = 30 MHz – 200 MHz
    - ➔ Bandwidth = 120 kHz
    - ➔ Sampling = 3 Peak Hold

CE Test Set-up (continued)

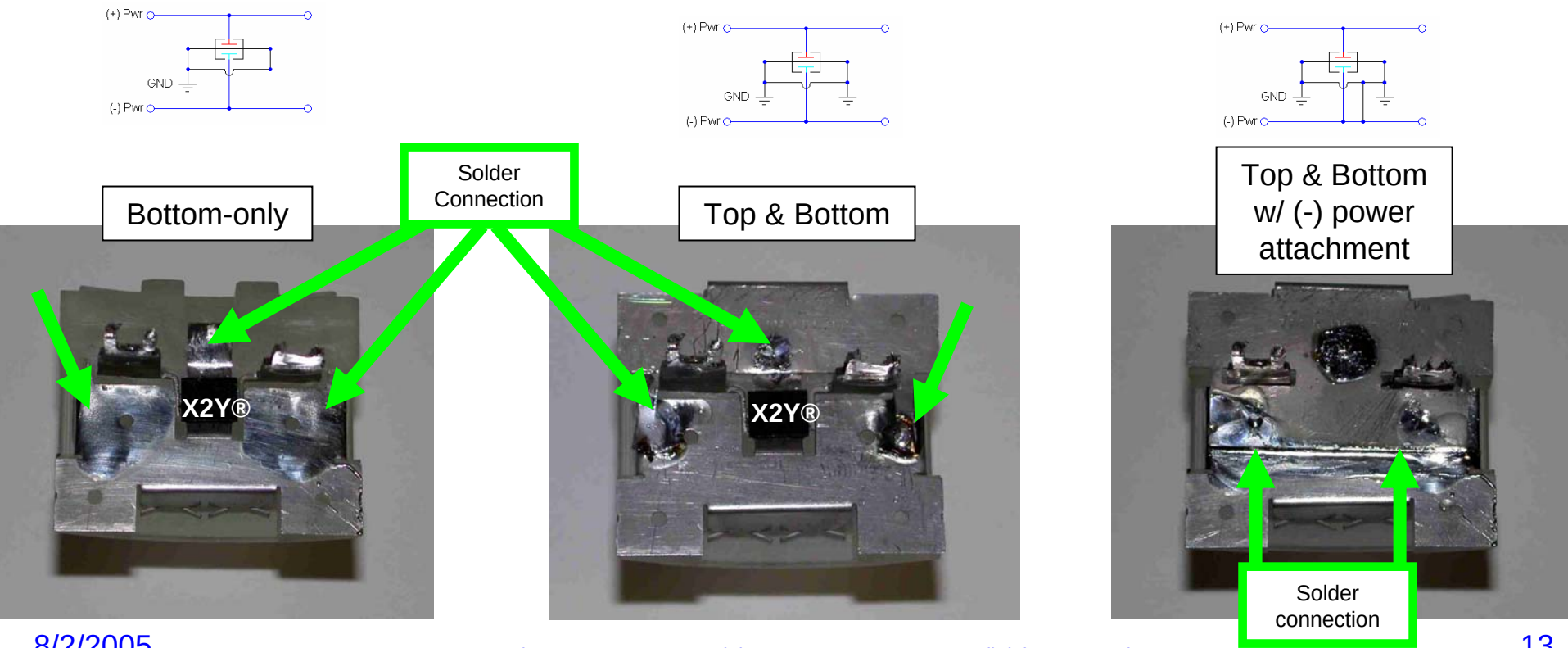
- To baseline DUT measurements for A to B comparisons, an ambient, DUT non-filtered, & DUT production filter measurement was taken.
  - ➔ Note: These measurement will appear on all data plots.



Connector Prototype and Design Issues

Connector Design Issues

- Determining the ground layout of the connector face is critical. (Connector designed and supplied by ITT Industries, Electronic Components.)
  - ✓ Bottom only GND
  - ✓ Top & Bottom GND
    - ➔ Note: solder connection preferred, press fit will lose RF performance.
  - ✓ Top & Bottom GND with (–) power lead attached to GND
    - ➔ Note: solder connection preferred, press fit will lose RF performance.

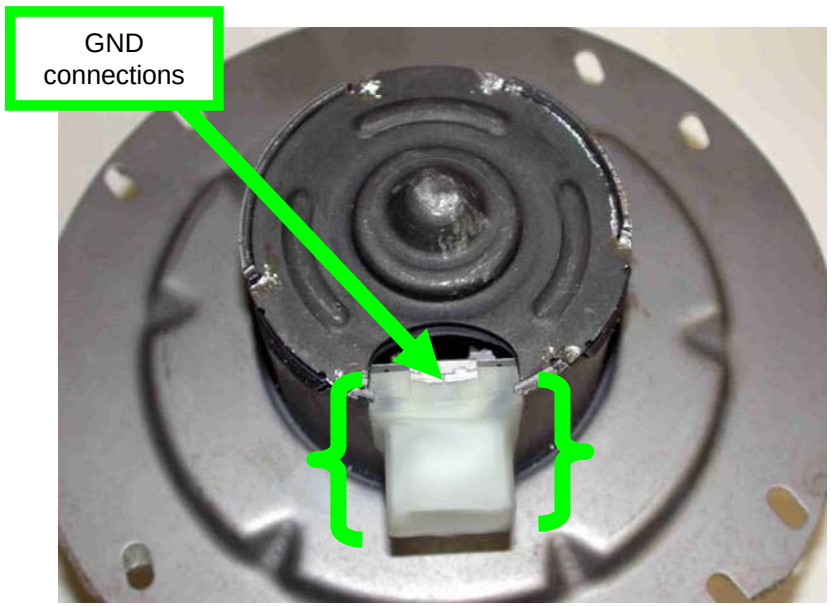


Connector Implementation Issues

Connector Prototype and Motor Implementation Issues

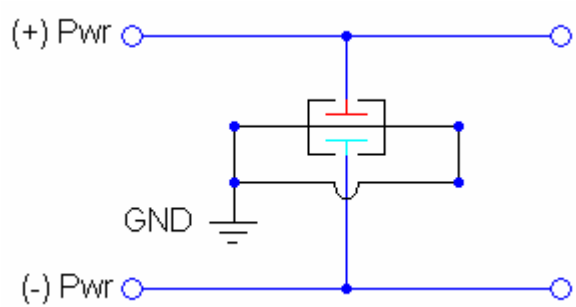
Connector Implementation Issues

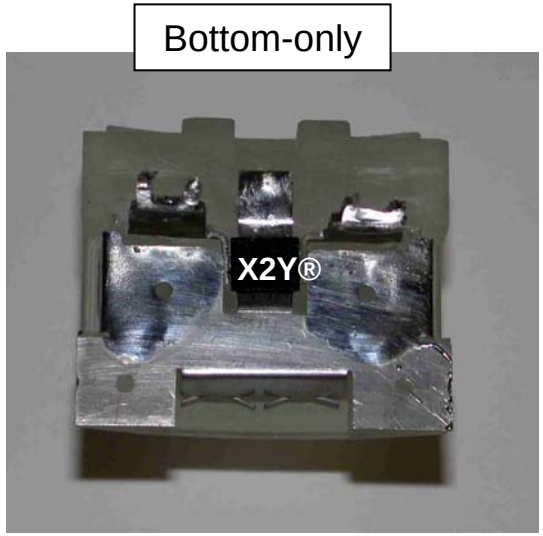
- Determining the ground interface of the connector and motor housing is critical.
- A good RF GND would require multiple connector & motor housing contacts at several points.
  - ➔ Note: Conductive tape was used to make GND connection to top of connector during testing.

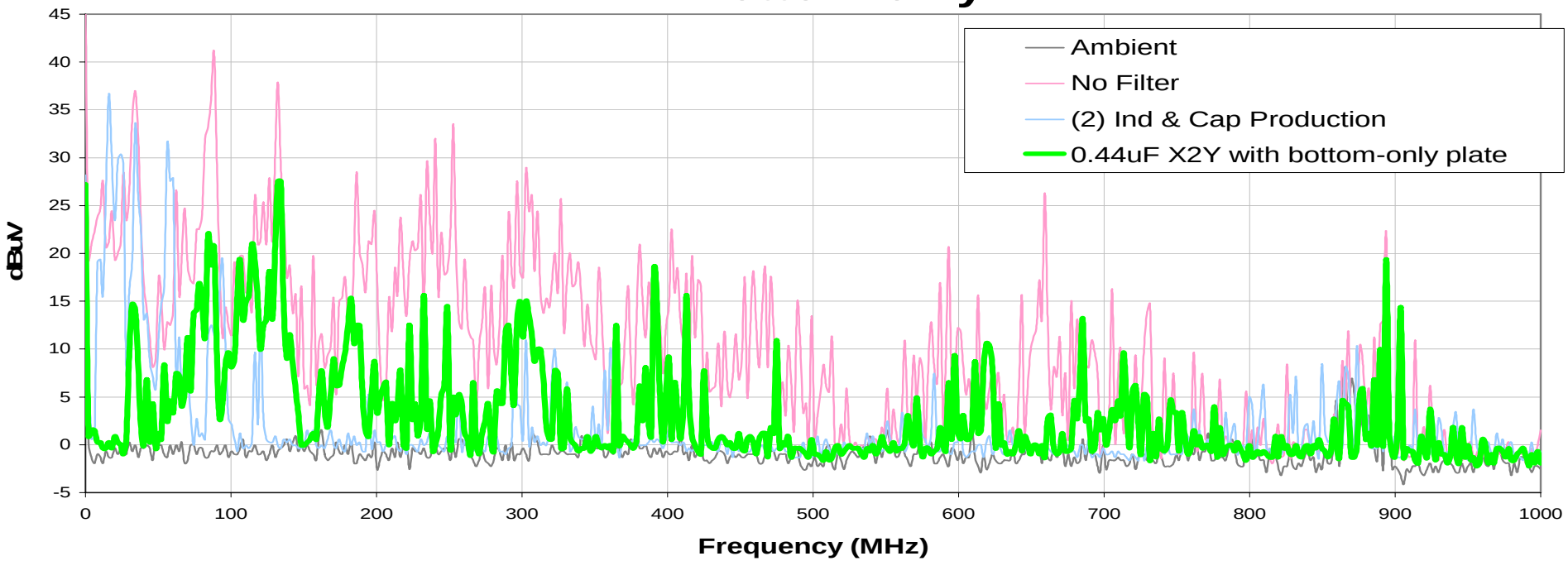


Connector Radiated Emissions Test Results

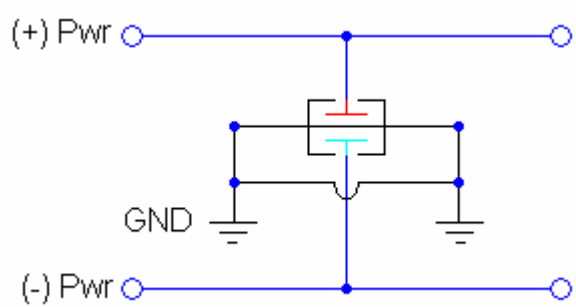
RE Test Results



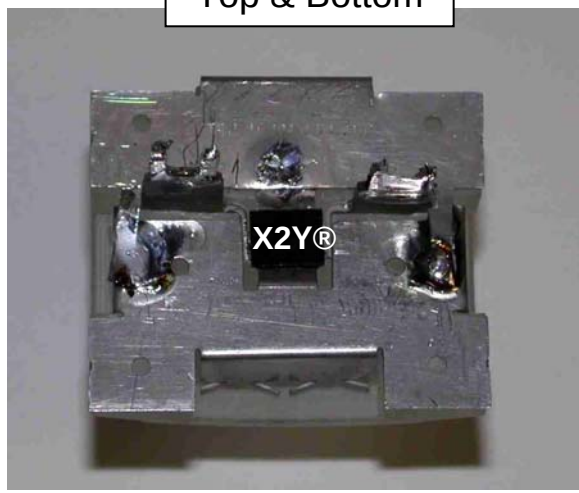


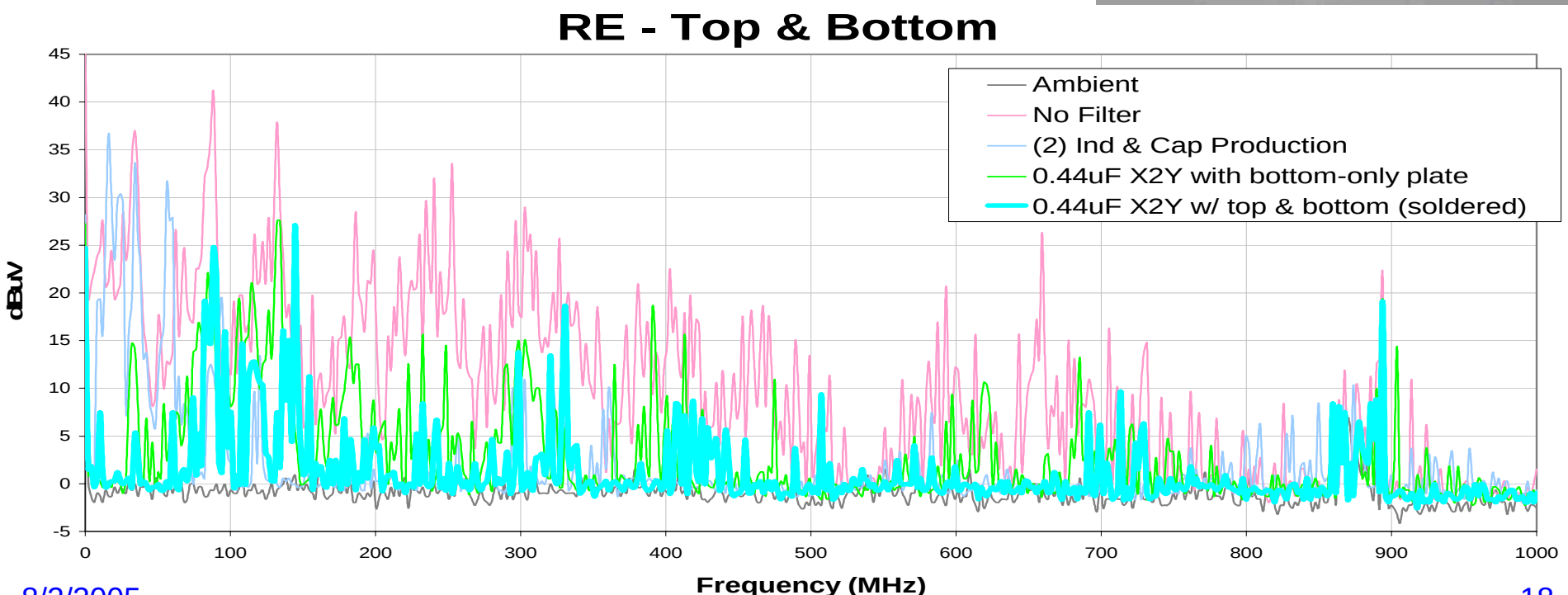


RE Test Results

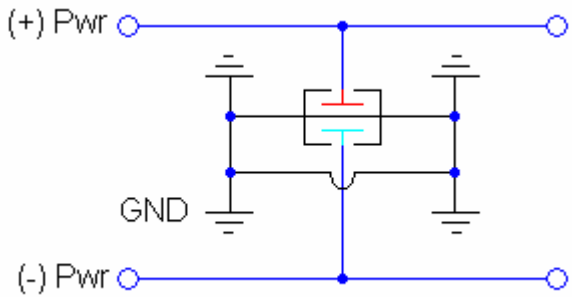


Top & Bottom

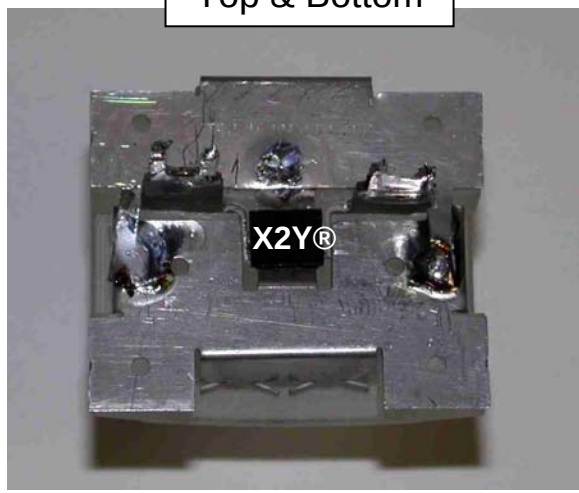




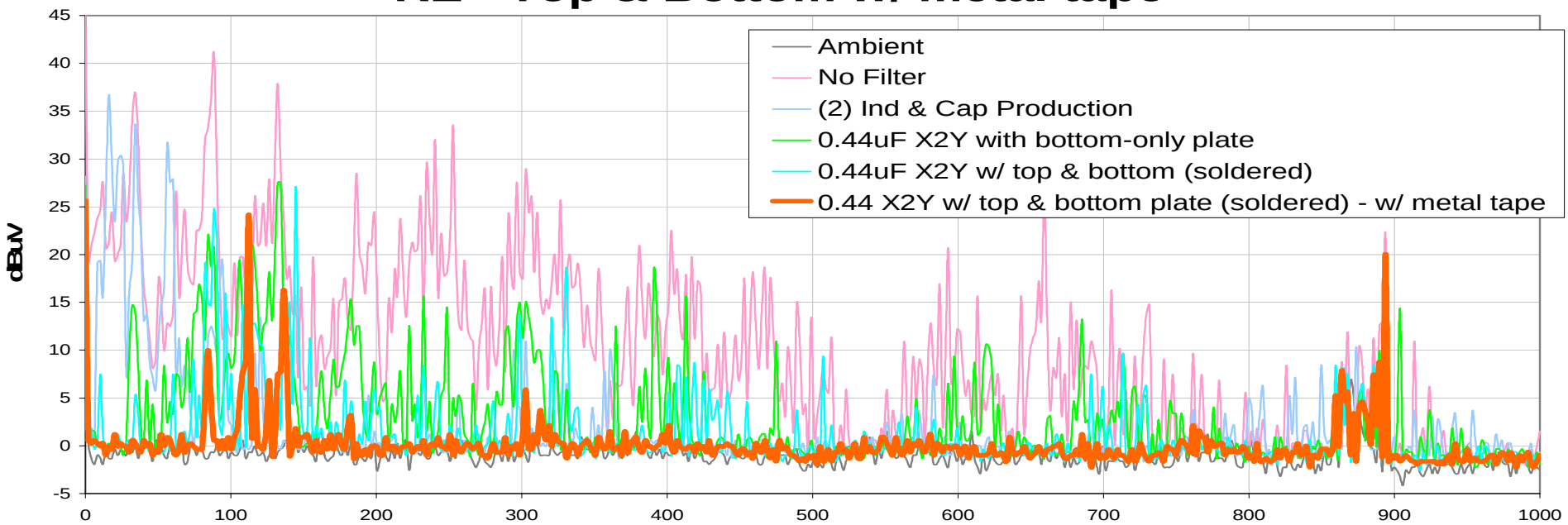
RE Test Results



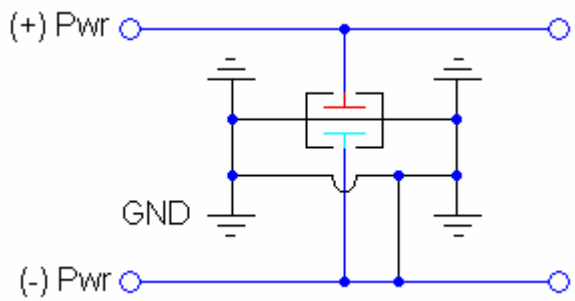
Top & Bottom



RE - Top & Bottom w/ metal tape

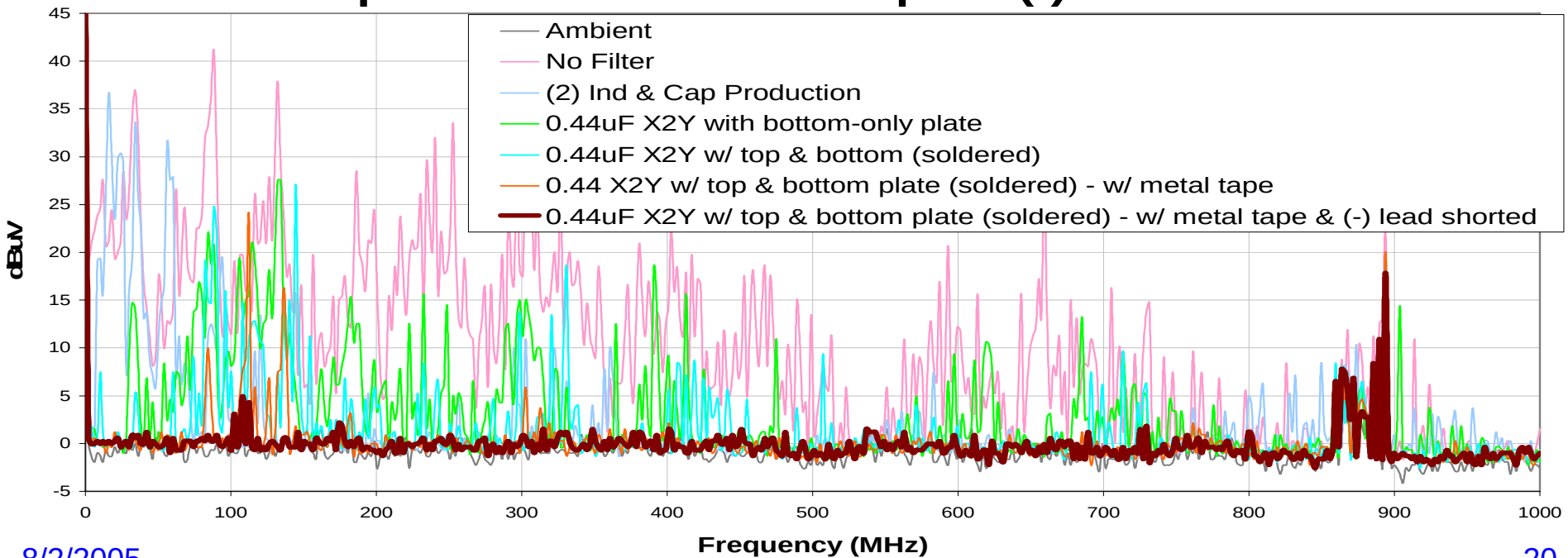


RE Test Results



Top & Bottom w/ (-) power attachment

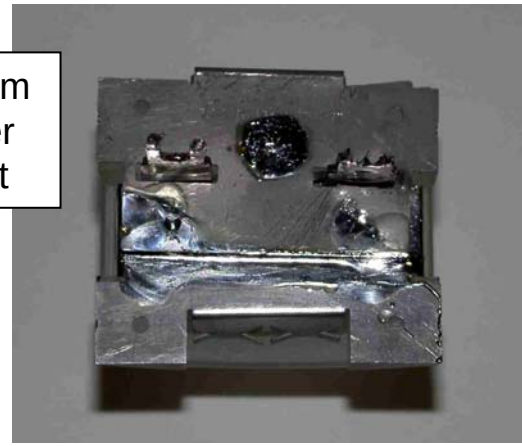
RE - Top & Bottom w/ metal tape & (-) lead shorted

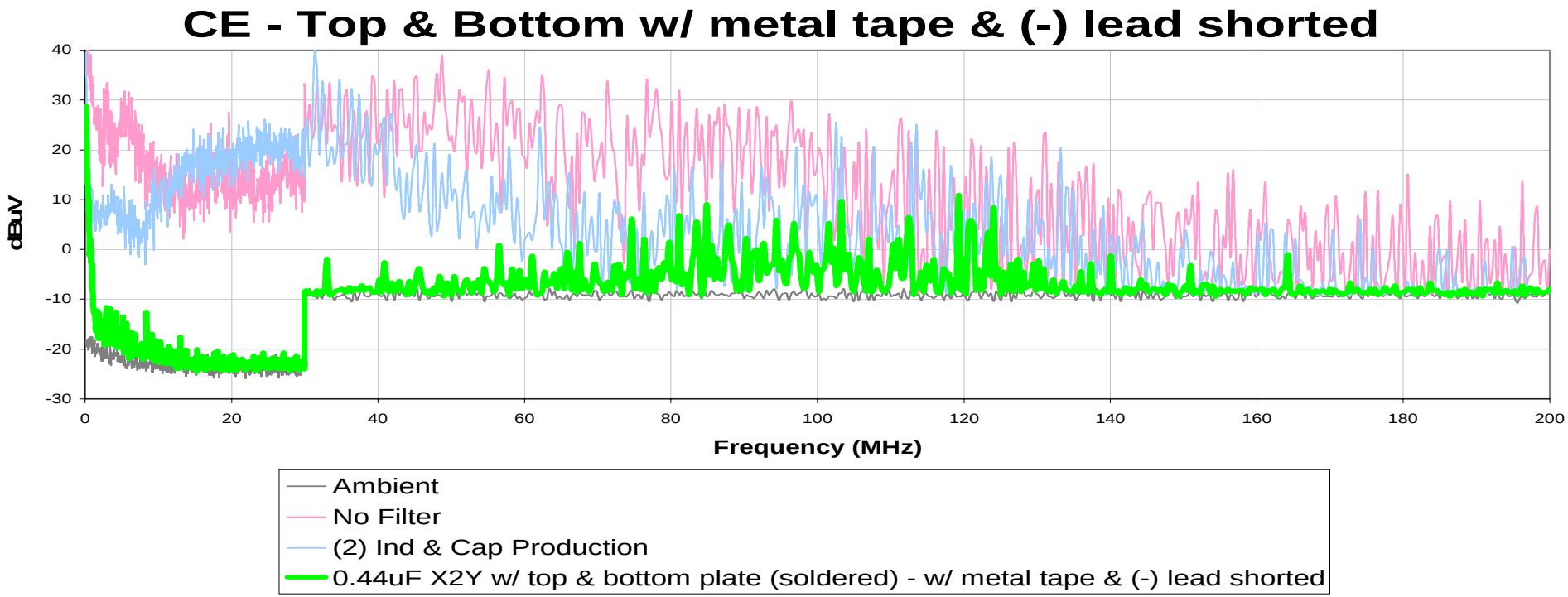


Connector Conducted Emissions Test Results

CE Test Results

Top & Bottom w/ (-) power attachment





SUMMARY (continued)

- X2Y Attenuators, LLC feel the following areas need to be addressed to move forward.
  - ✓ Is the X2Y® Technology technically feasible for EMI suppression in a motor?
    - ➔ This is addressed on following pages.
  - ✓ Is X2Y® Technology cost effective in an automotive application?
    - ➔ This is addressed on following pages.

SUMMARY (continued)

- The technical feasibility of the X2Y® Technology as EMI suppression in a motor has been proven many times and is in production with other motor manufacturers.
- X2Y Attenuators, LLC can not directly address pricing for several factors.
  - ✓ We have multiple manufactures that competitively bid on business.
  - ✓ We cannot comment on suppliers manufacturing capabilities.
- However, technical information published on the internet and disclosed in U.S. Patent Applications (along with cost advantages) by suppliers is public domain.

SUMMARY (continued)

Siemens AG

(19) **United States**
(12) **Patent Application Publication** (10) **Pub. No.: US 2005/0135331 A1**
Reindl et al. (43) **Pub. Date: Jun. 23, 2005**

(54) **SYSTEM FOR TRANSMISSION OF DATA ON A BUS**

(75) Inventors: **Hartwig Reindl**, Regensburg (DE); **Gerhard Schmid**, Kofering (DE)

Correspondence Address:
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HOLLYWOOD, FL 33022-2480 (US)

(73) Assignee: **Siemens Aktiengesellschaft**

(21) Appl. No.: **11/016,599**

(22) Filed: **Dec. 17, 2004**

Related U.S. Application Data

(60) Provisional application No. 60/530,389, filed on Dec. 17, 2003.

(30) **Foreign Application Priority Data**

Nov. 22, 2004 (DE)..... 10 2004 056 305.5

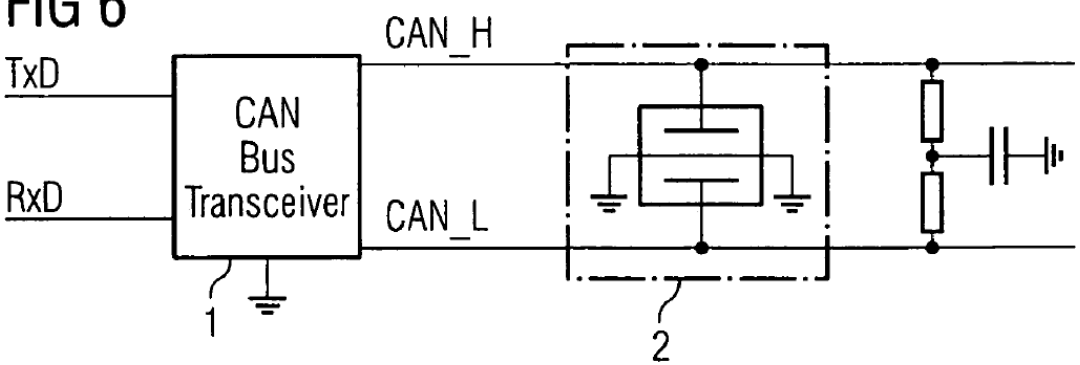
Publication Classification

(51) **Int. Cl.**[7] **H04L 12/28**
(52) **U.S. Cl.** **370/351**

(57) **ABSTRACT**

A system for transmitting data between a transmitter and a receiver on a communication network connecting a number of components, especially in a motor vehicle, has a CAN transceiver which converts logic signals into bus data signals downstream of each transmitter. A non-inductive symmetrical CAN filter is connected downstream of each CAN bus transceiver. The CAN filter has at least two impedances and it is preferably implemented as an X2Y capacitor.

FIG 6



[0041] As shown in **FIG. 6** with reference to a second exemplary embodiment of a non-inductive design of symmetrical CAN filter **2**, in accordance with the invention a high level of symmetry is achieved by the impedances (Zy**1**, Zy**2**; Zx) being in the same component as an integrated module, i.e. in the same package, especially by what is known as an X2Y capacitor **2**. The use of an X2Y capacitor not only reduces size and thereby costs compared to alternative components. It also advantageously takes up less space on a printed circuit board, which further reduces costs.

[0042] The above-described invention provides an alternative for the first time to filter methods with current-compensated chokes **2** known from the prior art. In addition to the advantages already mentioned, it exhibits improved ESD protection of the CAN transceiver circuit (ICs) in particular, i.e. varistors or EMC capacitors at the connector pins (CAN_H, CAN_L) become superfluous.

[0043] The present invention is particularly suitable for the bus system of a motor vehicle.

SUMMARY (continued)

Delphi Technologies, Inc.

US006888062B1

(12) **United States Patent**
Erickson et al.

(10) **Patent No.: US 6,888,062 B1**
(45) **Date of Patent: May 3, 2005**

(54) **MOTOR ASSEMBLY HAVING IMPROVED ELECTROMAGNETIC NOISE FILTERING AND DISSIPATION**

(75) Inventors: **Staffan Erickson**, Yellow Springs, OH (US); **Kenneth M. Brun**, Lebanon, OH (US); **Terence C. Cartwright**, Bellbrook, OH (US)

(73) Assignee: **Delphi Technologies, Inc.**, Troy, MI (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 120 days.

(21) Appl. No.: **10/749,074**

(22) Filed: **Dec. 30, 2003**

(51) **Int. Cl.**[7] **H05K 9/00**
(52) **U.S. Cl.** ..... **174/35 R**; 333/12
(58) **Field of Search** ..... 174/35 R, 35 C; 361/818, 816, 800; 333/12

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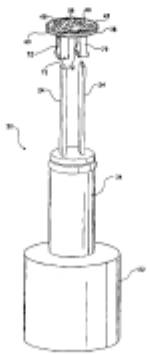
Primary Examiner—Hung V. Ngo
(74) *Attorney, Agent, or Firm*—Michael D. Smith

(57) **ABSTRACT**

The subject invention provides a motor assembly having improved electromagnetic noise or interference (EMI) filtering and dissipation and includes a motor having at least two terminals. A carrier having an upper and a lower surface with an outer periphery defines apertures for receiving the terminals. First and second conductive regions are disposed on one of the upper and the lower surfaces and adjacent the apertures for electrically connecting to the terminals. A grounding region is disposed on one of the upper and the lower surfaces for grounding the carrier to an electrical ground and insulated from the first and the second conductive regions by a first non-conductive region. A circuit extends electrically connects the first and the second conductive regions to the grounding region for filtering EMI. A biasing device urges the grounding region of the carrier into electrical connection with the electrical ground for dissipating EMI and receptacles electrically connect the first and the second conductive regions to the terminals without requiring the terminals to be soldered to the carrier.

25 Claims, 7 Drawing Sheets



Hill-Rom Services, Inc.

US006381153B1

(12) **United States Patent**
Brussels

(10) **Patent No.: US 6,381,153 B1**
(45) **Date of Patent: Apr. 30, 2002**

(54) **METHOD AND APPARATUS OF EMI FILTERING THAT ELIMINATES THE NEED FOR AN INDUCTOR**

(75) Inventor: **Jay D. Brussels**, Parkland, FL (US)

(73) Assignee: **Hill-Rom Services, Inc.**, Batesville, IN (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/295,490**

(22) Filed: **Apr. 20, 1999**

(51) **Int. Cl.**[7] **H02M 1/12**

(52) **U.S. Cl.** **363/39**

(58) **Field of Search** 363/39, 45, 46, 363/47, 48; 361/302

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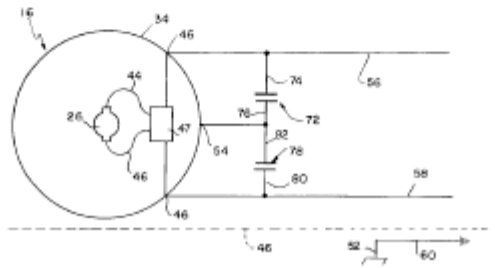
Primary Examiner—Ashif Dancke Berhane
(74) *Attorney, Agent, or Firm*—Barnes & Thornburg

(57) **ABSTRACT**

An EMI filter for use with a motor driven blower connectable to an inflatable portion of a patient support powered by two supply lines includes a blower ground isolated from a chassis ground, a first capacitor coupling the blower ground and one of the two supply lines, a second capacitor coupling the blower ground and the other of the two supply lines so that the first and second capacitors cooperate to filter common mode EMI without the aid of an inductor.

14 Claims, 6 Drawing Sheets



SUMMARY (continued)

Johnson Electric

US006858955B2

(12) **United States Patent**
Lau

(10) **Patent No.: US 6,858,955 B2**
(45) **Date of Patent: Feb. 22, 2005**

(54) **END CAP ASSEMBLY**

(75) Inventor: **James Ching Sik Lau**, Hong Kong (CN)

(73) Assignee: **Johnson Electric S.A.**, La Chaux-de-Fonds (CH)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 169 days.

(21) Appl. No.: **09/933,008**

(22) Filed: **Aug. 21, 2001**

(65) **Prior Publication Data**

US 2002/0047471 A1 Apr. 25, 2002

(30) **Foreign Application Priority Data**

Aug. 21, 2000 (GB) 0020519

(51) **Int. Cl.**[7] **H02K 5/24**; H02K 11/00, H02K 5/00; H02K 13/00; H01R 39/38

(52) **U.S. Cl.** **310/51**; 310/71; 310/89; 310/239

(58) **Field of Search** ..... 310/239, 71, 89, 310/88 C, 68 B, 68 R, 40 MM

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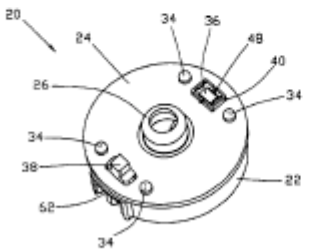
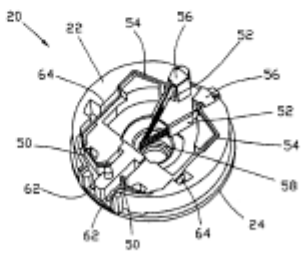
Primary Examiner—Tran Nguyen
Assistant Examiner—Julio Gonzalez
(74) *Attorney, Agent, or Firm*—Birch, Stewart, Kolasch & Birch, LLP

(57) **ABSTRACT**

An end cap assembly **20** for an electric motor has an insulating body **22** and a conductive cover **24**. The cover **24** supports a bearing for a shaft of the motor. The body **22** supports brushes and motor terminals. An EMI device **36** is electrically connected across the motor terminals and is earthed to the cover by way of resilient contacts.

13 Claims, 4 Drawing Sheets





Valeo

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(56) **Liste des documents cités dans le rapport de recherche préliminaire :** *Se reporter à la fin du présent fascicule*

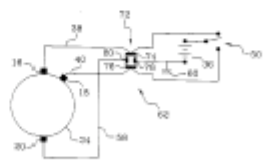
(60) **Références à d'autres documents nationaux apparentés :**

(73) **Titulaire(s) :**

(74) **Mandataire(s) :** CABINET PHILIPPE KOHN.

(54) **DISPOSITIF DE FILTRAGE ET D'ANTIPARASITAGE D'UN MOTEUR ELECTRIQUE.**

(57) L'invention propose un dispositif de filtrage et d'antiparasitage (62) d'un moteur électrique (34) comportant au moins un premier balai (16) d'alimentation du collecteur d'induit du moteur électrique (34), du type qui comporte un condensateur (64) dont une borne est reliée électriquement à une piste conductrice (38) d'alimentation électrique du premier balai (16) d'alimentation du collecteur d'induit du moteur électrique (34), et dont l'autre borne est reliée électriquement à une piste conductrice de masse (60) reliée à la masse électrique du moteur (60), caractérisé en ce que le condensateur (72) du dispositif de filtrage et d'antiparasitage (62) est du type non inductif.



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SUMMARY (continued)

- Additional technical information on the X2Y® Technology in motor applications can be found at www.x2y.com
  - ✓ Application Notes
    - ➔ Application Note #4001
    - ➔ Application Note #4002
    - ➔ Application Note #4003
    - ➔ Application Note #4004
    - ➔ Application Note #4005
  - ✓ Technical Papers
    - ➔ 2005 SAE World Congress Motor Paper
    - ➔ 2004 IEEE EMC Motor Paper
    - ➔ Jan 2001 - Test & Measurement World Article
    - ➔ Nov 2001 - EMWC Paper
    - ➔ 2001 IEEE EMC Motor Paper
    - ➔ 1999 IEEE EMC Motor Paper
  - ✓ Technical Presentations
    - ➔ 2005 SAE World Congress Motor Presentation
    - ➔ July 27, 2004 - Motor Presentation at Ford Motor Company
    - ➔ X2Y® Technology in DC Motors Presentation
    - ➔ 2004 IEEE EMC Motor Presentation

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