



ITT Industries/X2Y Attenuators, LLC

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



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.



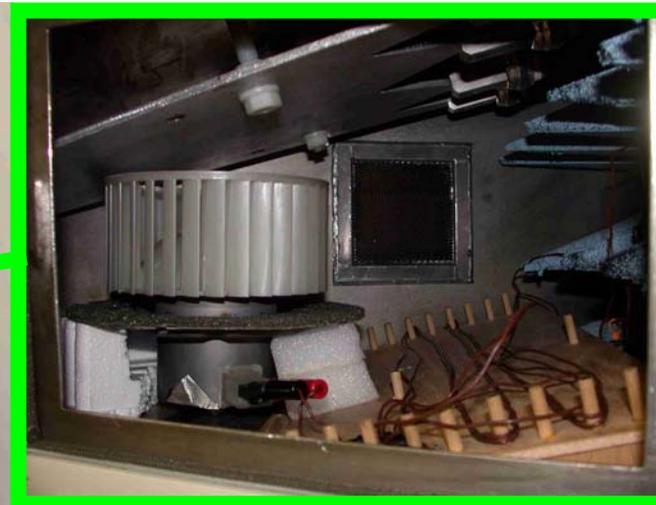
Testing Presented Within this Document

- Data was taken by X2Y Attenuators, LLC at the Detroit facility.
- The measured radiated and conducted emissions data is used for A to B comparisons of filter effectiveness.
- Although the data is not validated to specific test requirements at an approved test facility, products that meet performance benchmarks established in X2Y's test chamber typically result in approvals at certified test facilities.

Radiated Emissions Test Set-up

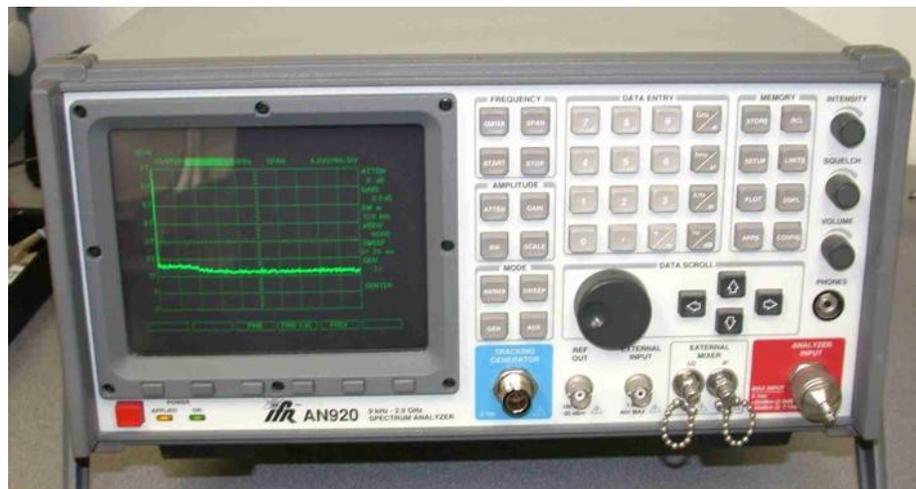
RE Test Set-up

- 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)

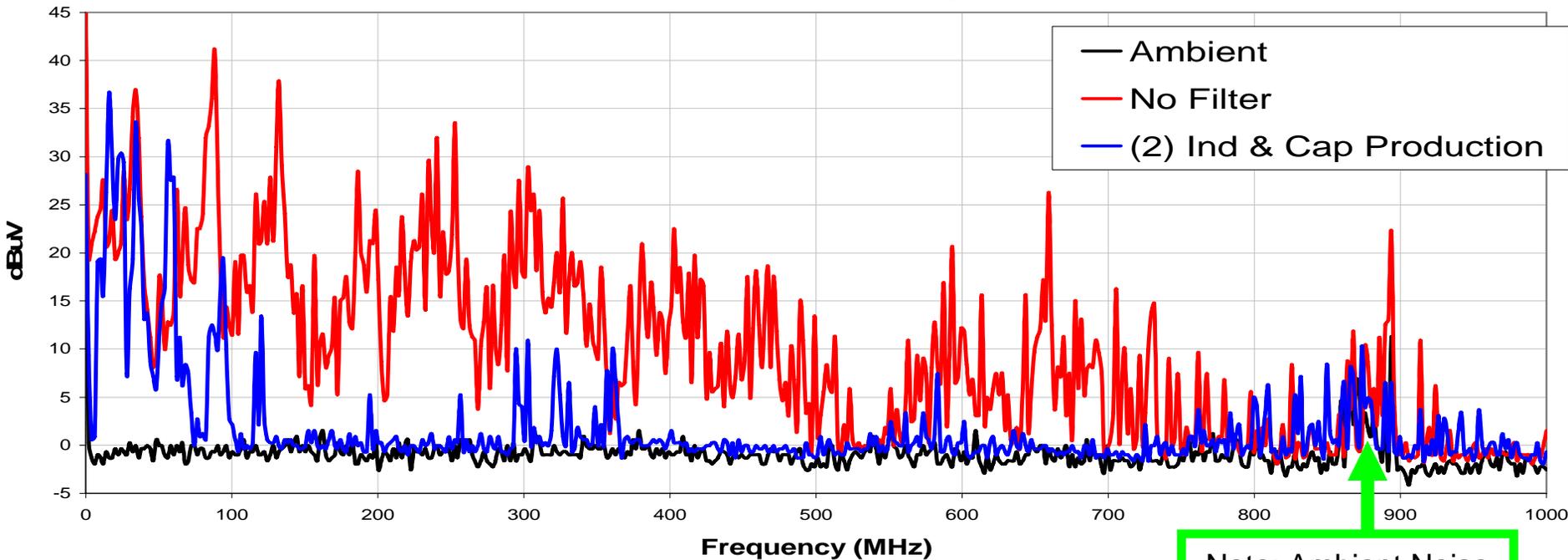
- An IFR AN920 spectrum analyzer was used to measure and record RE.
- The spectrum analyzer settings are:
 - Frequency spectrum = 100 kHz – 1000 MHz
 - Bandwidth = 120 kHz
 - Sampling = 3 Peak Hold



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.

RE - Baseline DUT

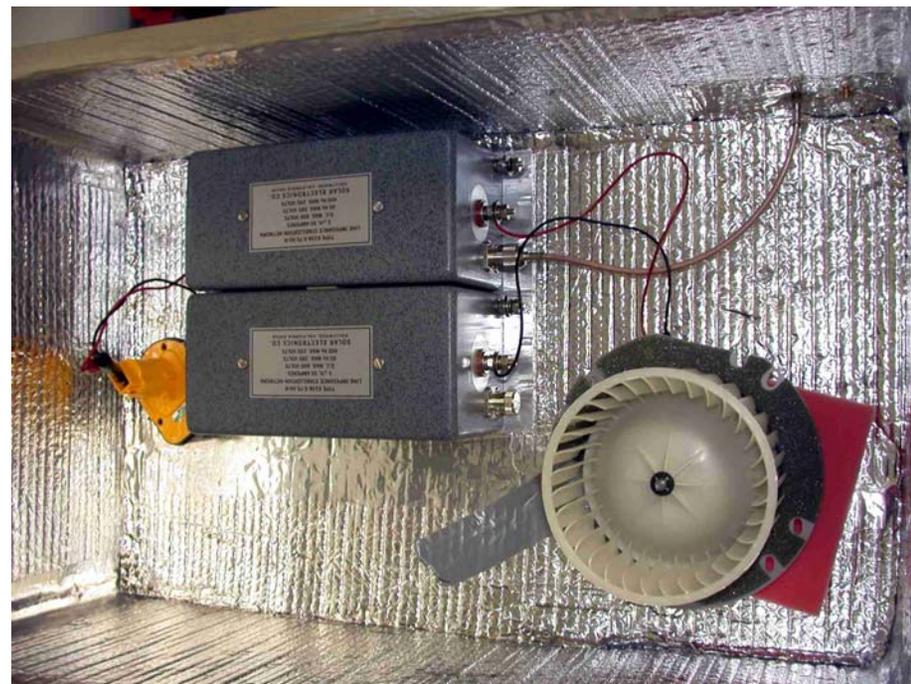


Note: Ambient Noise

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.





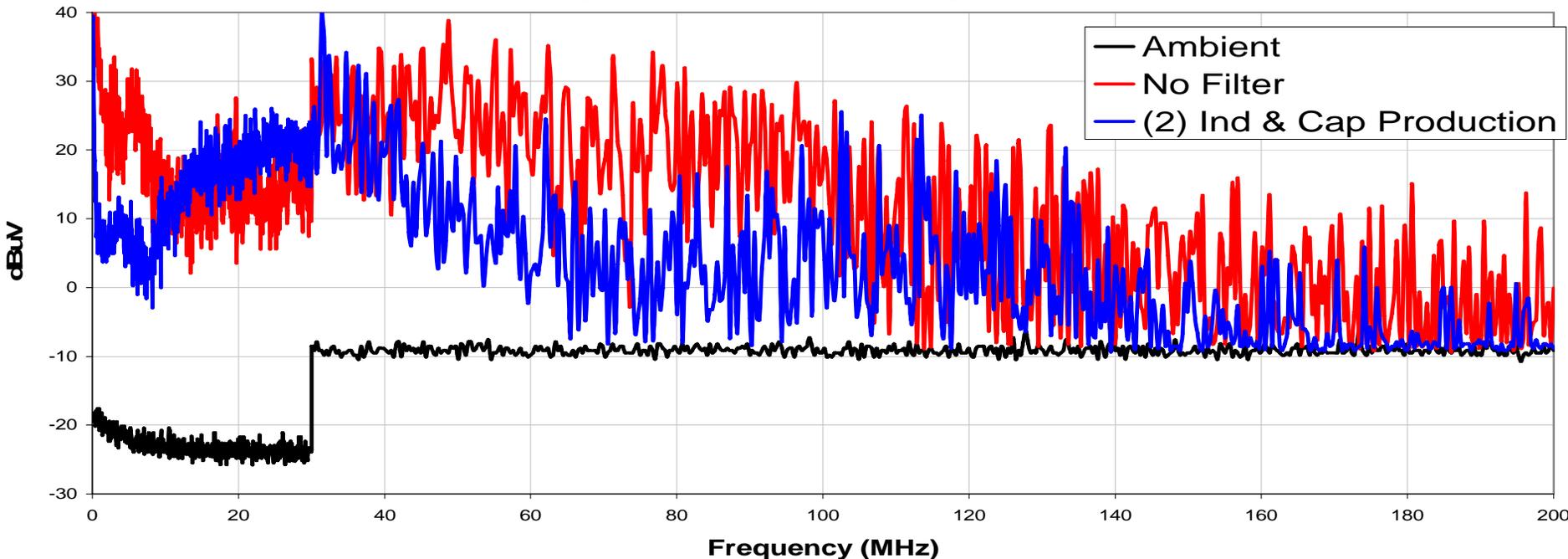
CE Test Set-up (continued)

- 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.

CE - Baseline DUT



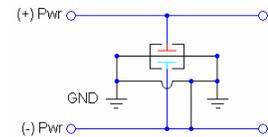
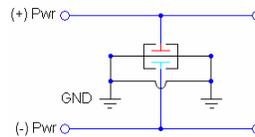
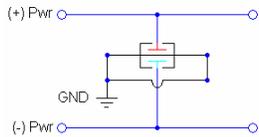


Connector Design Issues

Connector Prototype and Design Issues

Connector Design Issues

- Determining the ground layout of the connector face is critical. (Connector supplied by ITT Industries/Cannon.)
 - 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.

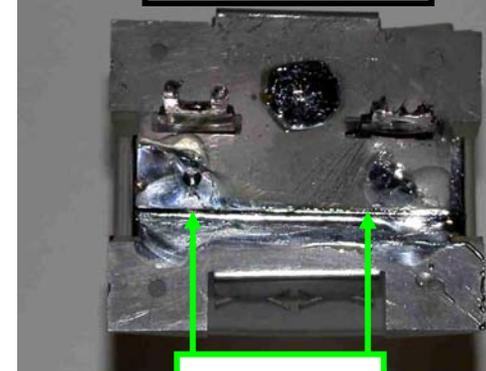
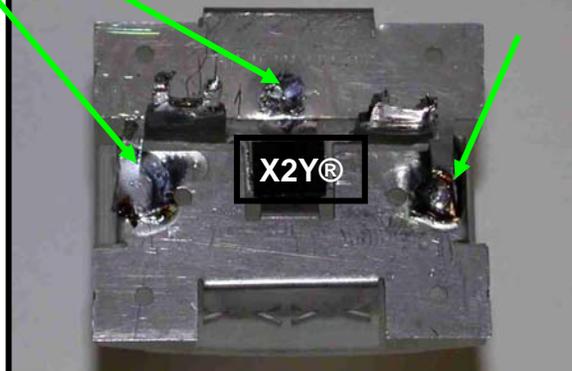
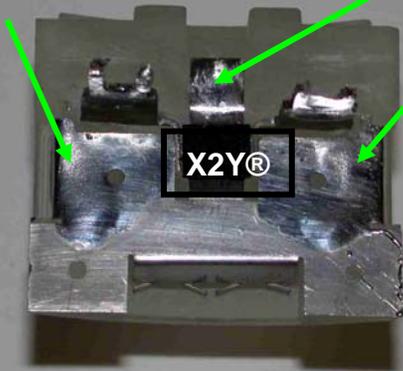


Bottom-only

Solder Connection

Top & Bottom

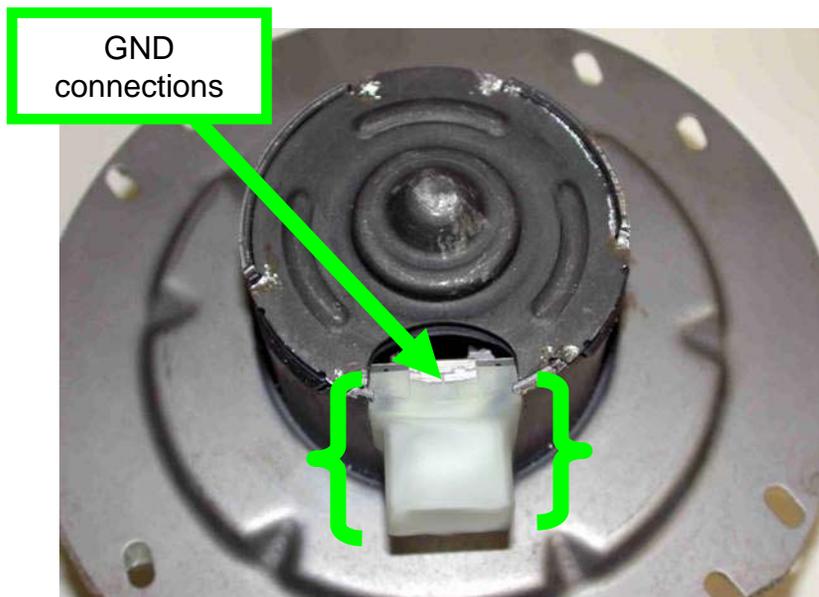
Top & Bottom w/ (-) power attachment



Connector Prototype and Motor Implementation Issues

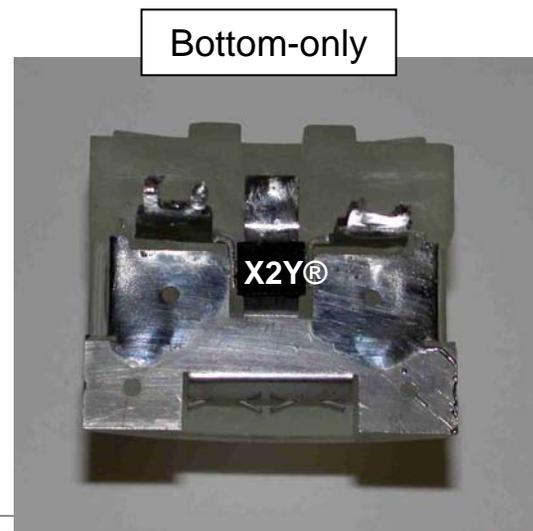
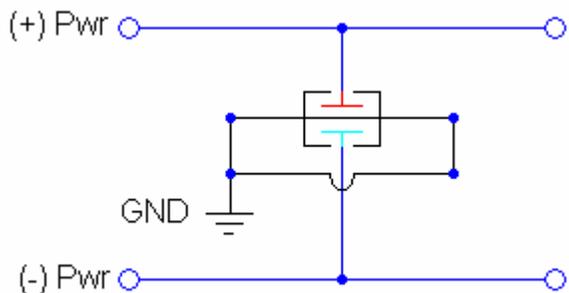
Connector Implementation Issues

- 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.

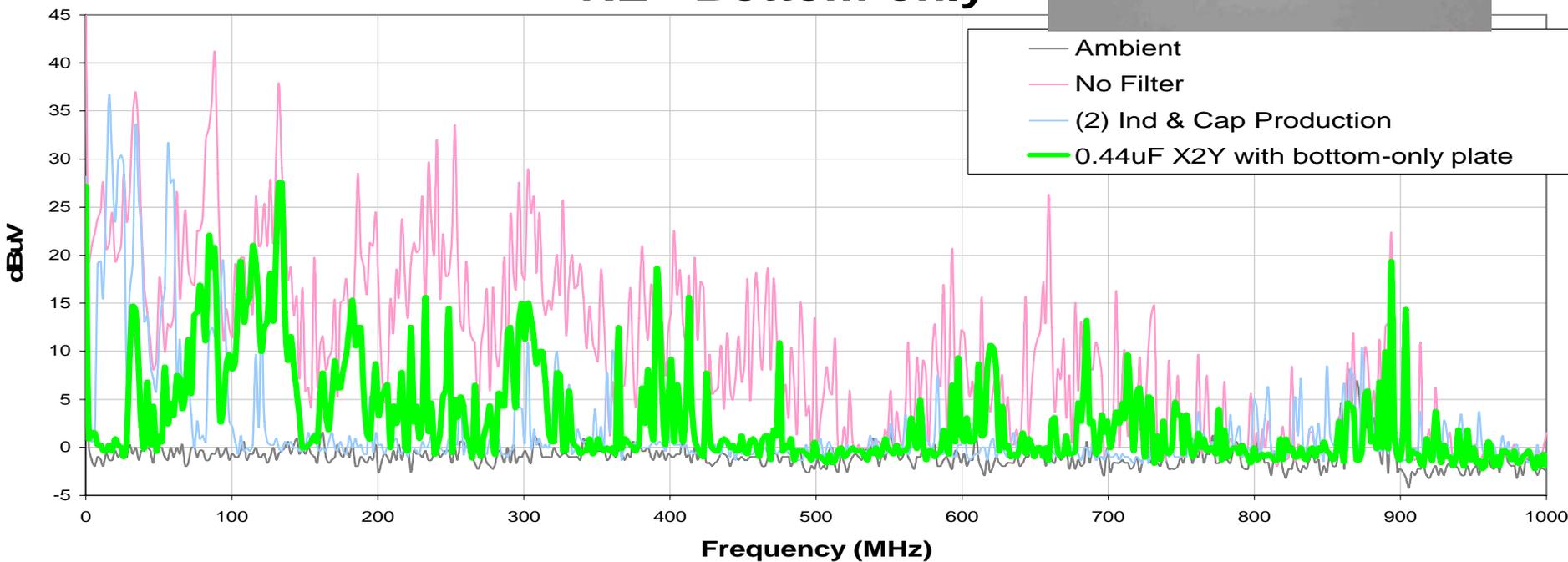


Connector Radiated Emissions Test Results

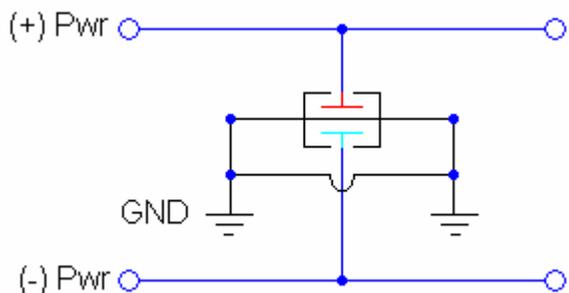
RE Test Results



RE - Bottom-only



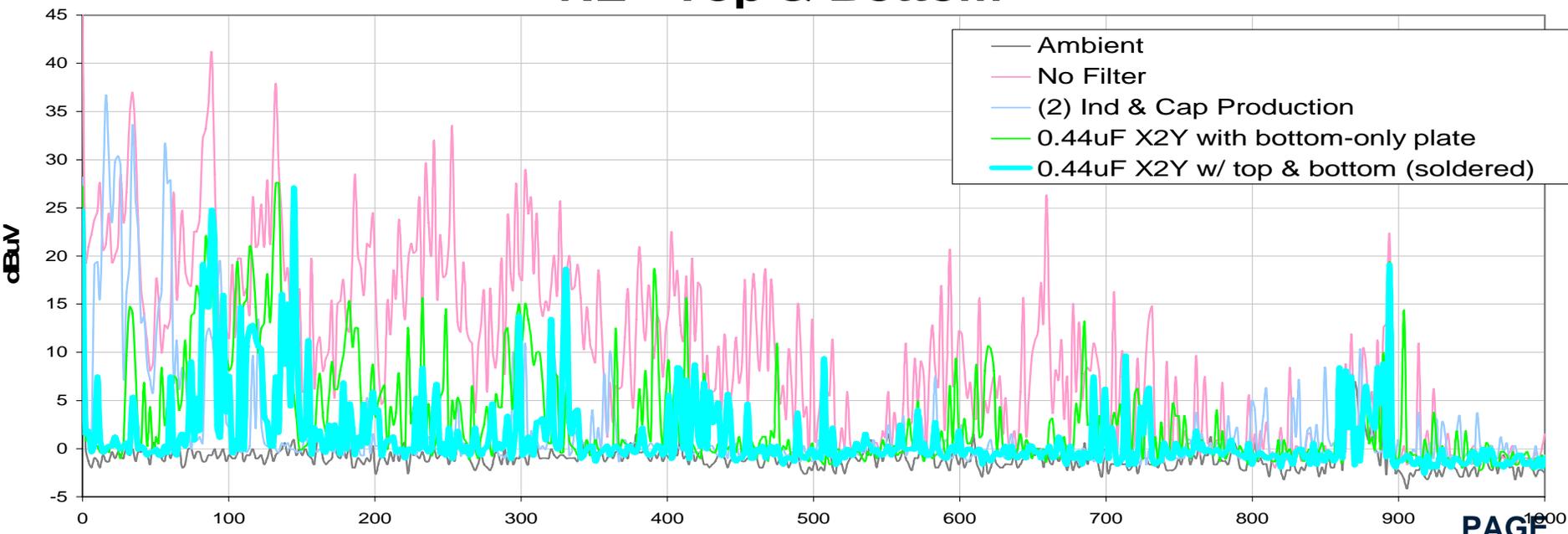
RE Test Results



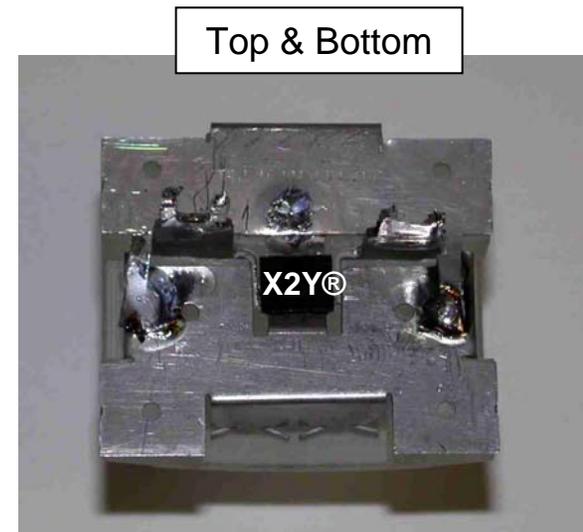
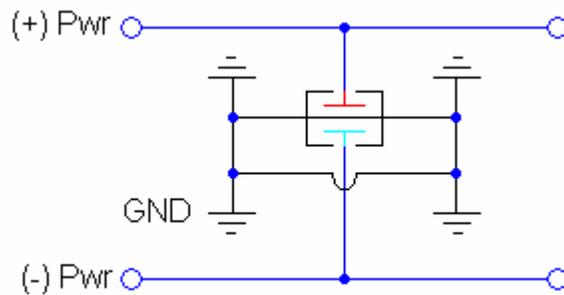
Top & Bottom



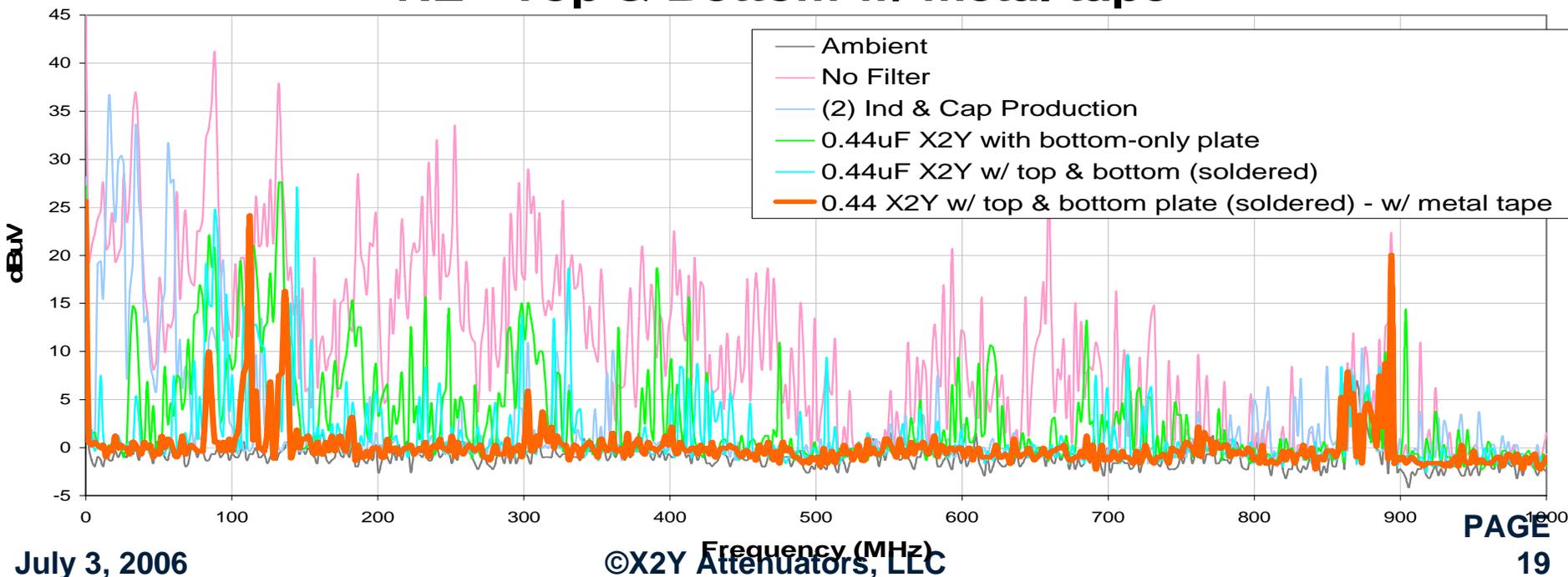
RE - Top & Bottom



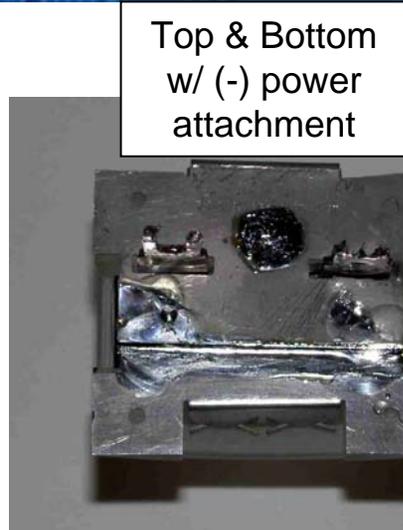
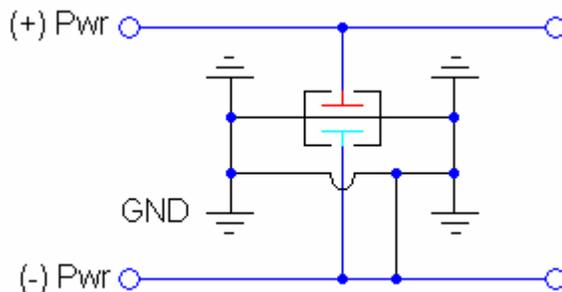
RE Test Results



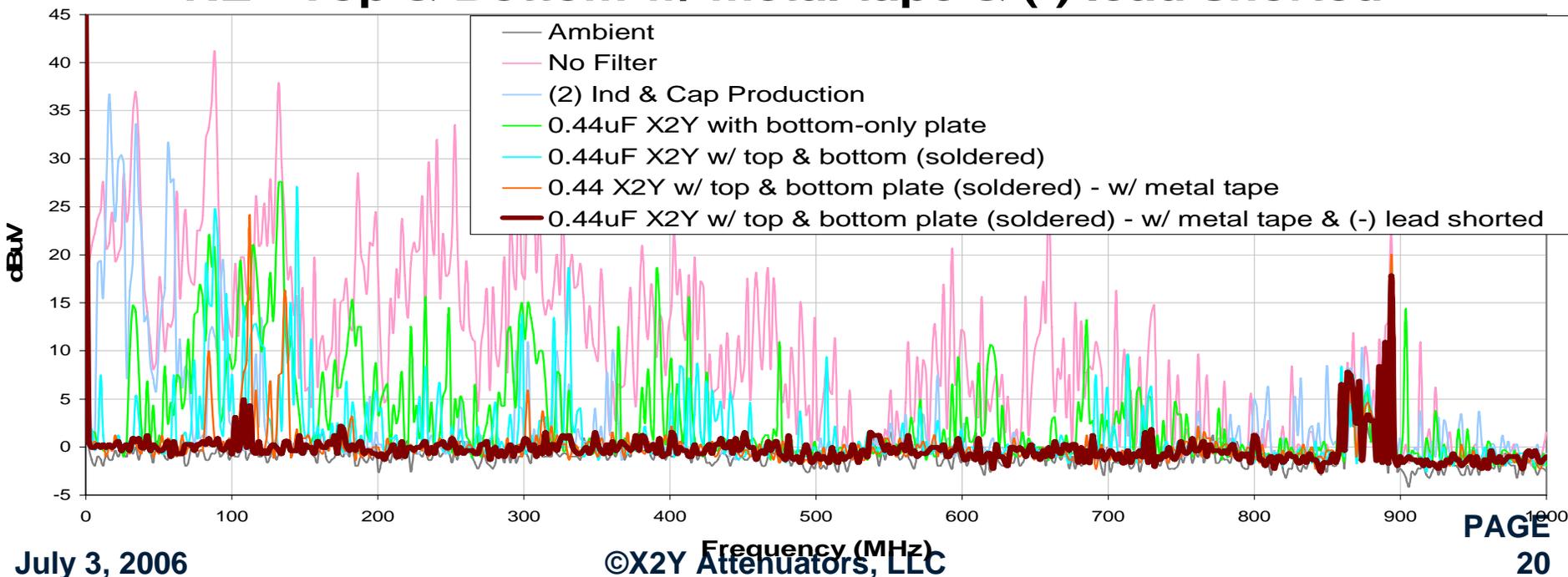
RE - Top & Bottom w/ metal tape



RE Test Results



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

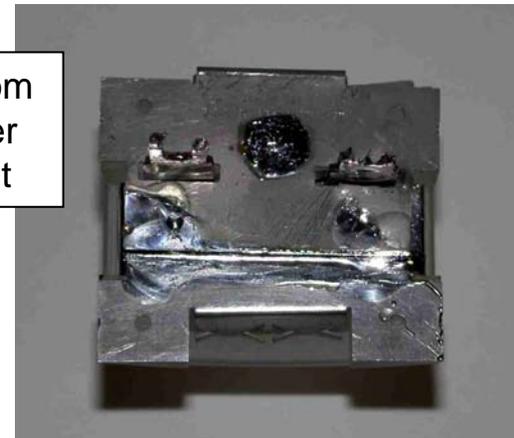


Connector Conducted Emissions Test Results

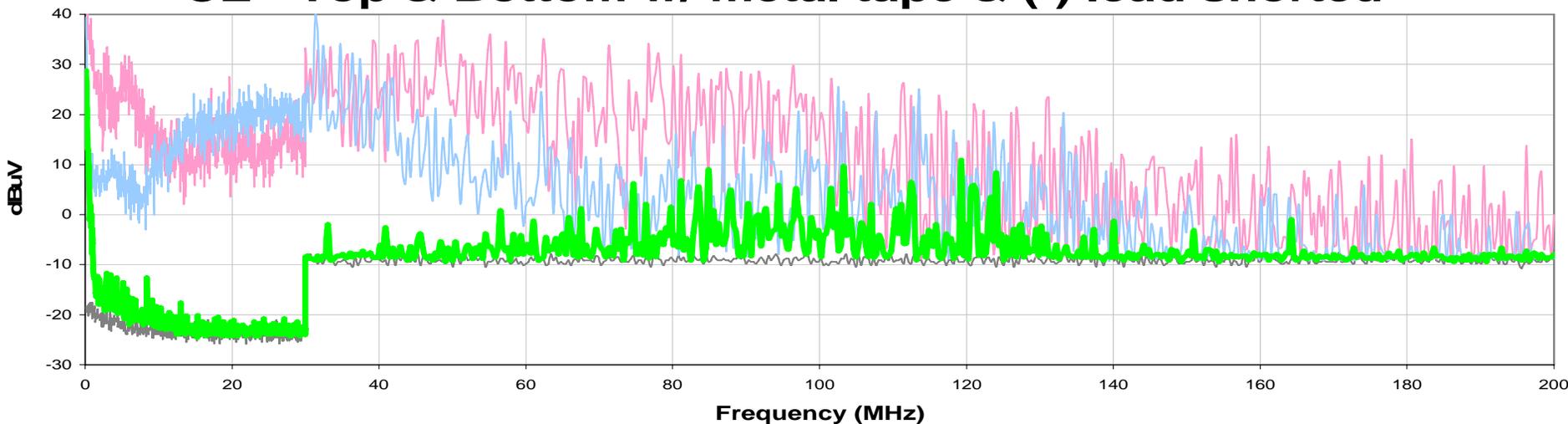
CE Test Results



Top & Bottom
w/ (-) power
attachment



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



- Ambient
- No Filter
- (2) Ind & Cap Production
- 0.44uF X2Y w/ top & bottom plate (soldered) - w/ metal tape & (-) lead shorted



SUMMARY

- The technical feasibility of X2Y[®] Technology as EMI suppression for DC motors has been proven many times, and is in production with multiple motor manufacturers.
- The following technical and patent-related information is now available in the public domain, and can be downloaded from the internet.

■ 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](#)

■ Application Notes

- [Application Note #4001](#)
- [Application Note #4002](#)
- [Application Note #4003](#)
- [Application Note #4004](#)
- [Application Note #4005](#)

■ 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](#)

SUMMARY (continued)

Delphi Technologies, Inc.

Hill-Rom Services, 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** 6,563,688 B2 5/2003 Anthony et al.
6,580,935 B2 6/2003 Anthony et al.
6,594,128 B2 7/2003 Anthony
6,603,646 B2 8/2003 Anthony et al.
6,690,001 B2 8/2003 Anthony et al.
- (75) Inventors: **Stuffin Erickson**, Yellow Springs, OH (US); **Kenneth M. Brun**, Lebanon, OH (US); **Terence C. Cartwright**, Bellebrook, OH (US) 20021004787 A1 2/2002 Anthony
20021005096 A1 6/2002 Anthony
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20030161086 A1 8/2003 Anthony
- (73) Assignee: **Delphi Technologies, Inc.**, Troy, MI (US) 20030161086 A1 8/2003 Anthony

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

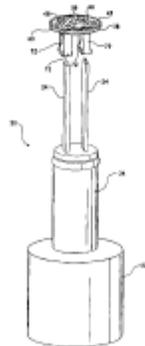
* cited by examiner

Primary Examiner—**Hang 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 housing device straps the grounding region of the carrier into electrical connection with the electrical ground for dissipating EMI and capacitors 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



- (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; 361/81R; 816; 800; 333/12**

(56) **References Cited**
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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.

OTHER PUBLICATIONS

TF Series—High Performance Low Leakage Switch Mode EMI Filter, downloaded from Filter Concepts, Inc. website at [HTTP://www.filterconcepts.com/ac/TFseries.html](http://www.filterconcepts.com/ac/TFseries.html) on Apr. 12, 1999, two pages.
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Q-Series Filter Selection Table, downloaded from Entstren corecon GmbH website at [HTTP://www.entstren.com/corecon/qseries.htm](http://www.entstren.com/corecon/qseries.htm) on Apr. 12, 1999, eight pages.
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X2Y Technology Overview, downloaded from Syfer Technology, Ltd. website at [HTTP://www.x2y.com/tech-overview.htm](http://www.x2y.com/tech-overview.htm) on Apr. 13, 1999, two pages.

- (21) Appl. No.: **09/295,480**
(22) Filed: **Apr. 28, 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; 361/002**

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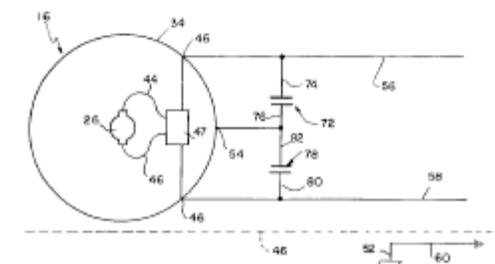
Primary Examiner—**Akshil Dandekar Bhatnagar**
(74) Attorney, Agent, or Firm—**Barnes & Thornburg**

(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.

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14 Claims, 6 Drawing Sheets



SUMMARY (continued)

Johnson Electric

Valeo



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.

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(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.** **H02K 5/24; H02K 11/00; H02K 5/00; H02K 13/00; H01R 30/38**
(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**

EP 0607032 7/1994
EP 0636868 2/1995
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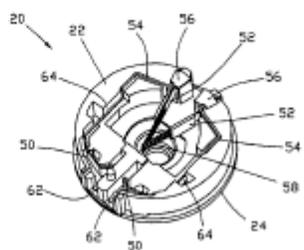
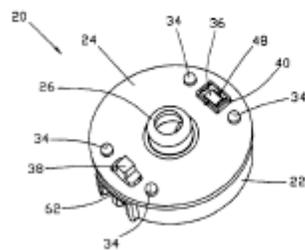
* cited by examiner
Primary Examiner—Tan Nguyen
Assistant Examiner—Julio Gonzalez
(74) *Attorney, Agent, or Firm*—Birch, Stewart, Kolach & Bied, LLP

(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 cantilevered to the cover by way of resilient contacts.

13 Claims, 4 Drawing Sheets

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4,845,393 A * 7/1989 Burgess et al. 310/51
4,853,576 A * 8/1989 Mariani et al. 310/239
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(18) **RÉPUBLIQUE FRANÇAISE**
INSTITUT NATIONAL DE LA PROPRIÉTÉ INDUSTRIELLE
PARIS

(11) **N° de publication :** **2 808 135**
(à n'utiliser que pour les commandes de reproduction)
(21) **N° d'enregistrement national :** **00 04022**
(51) **Int. Cl. :** **H 02 K 11/00**

(12) DEMANDE DE BREVET D'INVENTION A1

(22) **Date de dépôt :** 30.03.00.
(30) **Priorité :**

(71) **Demandeur(s) :** VALEO SYSTEMES D'ESSUYAGE Société par actions simplifiée—FR.

(43) **Date de mise à la disposition du public de la demande :** 26.10.01 Bulletin 01/45.

(72) **Inventeur(s) :** DE DARAN FRANCOIS, BRUNEAU SEVERIN, ROUYER PHILIPPE et SALEMBERE ABDOL.

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

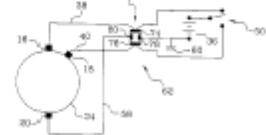
(73) **Titulaire(s) :**

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

(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), de 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 (50) reliée à la masse électrique du moteur (80), caractérisé en ce que le condensateur (72) du dispositif de filtrage et d'antiparasitage (62) est du type non inductif.



FR 2 808 135 - A1





Contact Information

- Please email inquiries and questions to x2y@x2y.com , or:
 - X2Y® Attenuators, LLC**
 - 2730B West 21st Street**
 - Erie, PA 16506-2972**
 - Phone: 814.835.8180**
 - Fax: 814.835.9047**
- Please visit X2Y on the web at www.x2y.com.

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