

Initiation of the Kit Module Program

VCCI Kit Module EMI Program for
Quantifying Conducted Emissions of
a subassembly module

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Haruyoshi NAGASAWA
Executive Board Director/VCCI

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Gaithersburg, MD U.S.A.**

Summary

VCCI's new voluntary "kit module" program for quantifying conducted emissions of a subassembly module using a special test fixture and magnetic probe (based upon IEC 61967-6) has started since April, 2005. Special device symbolic labeling with emission level confirmed is used. It is strictly voluntary.

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EMC-related Regulation Map of Japan

Product Group	Emission	Immunity
<p>ITE</p>	<p>VCCI</p> <p>Computers, PDAs, Peripherals</p>	<p>Each Industrial Association's Standards</p>
<p>TTE</p>	<p>Facsimiles</p> <p>Modems</p> <p>Radio Law </p> <p>Radio</p> <p>Mobile Phones</p>	
<p>Electrical Appliance</p>	<p>Copiers,</p> <p>TV, VCR, Refrigerators</p> <p>Transformers, Electric Wires</p> <p>Fluorescent Lights, Others</p> <p>DEN-AN Law (Product Safety)</p>  	
<p>Medical Electrical Equipment</p>	<p>MRI, CT, X-ray Generator, Others</p> <p>JIS T0601-1-2 (IEC 60601-1-2)</p> <p>Pharmaceutical Affairs Law</p>	

Summary about VCCI

¶ VCCI (Voluntary Control Council for Interference with Information Technology Equipment) was inaugurated in 1985 to control EMI level of ITE marketed in Japan with all ITE relevant industry associations (JIEDA, JBMA, EIAJ, CIAJ) in corresponding to the guidance with the competent authority of Japanese government who had announced Japanese version of CISPR 22 in the same year. ¶ It's a privately-funded non-profit, membership organization. ¶ VCCI has employed a membership system since its foundation. ¶ The council publishes administrative requirements and technical requirements (VCCI rules) for VCCI members to follow. ¶ The membership has extended worldwide and has ever grown (-1,200), and EMI level of almost all IT products in Japanese market are well controlled under the VCCI system (>95%). ¶ It is now considered as one of greatly successful industry self-regulations in the world. ¶ The rules adopt the most advanced product compliance process, the Declaration of Conformity (DoC), as EU. ¶ But "Immunity" is considered a quality issue and hence out of scope of VCCI rules.

Chronology

VCCI Events

WW EMC Events

Steering Comm.
Marketing SC
Technical SC
Communication SC

(1985/12) VCCI established

(1986/06) VCCI enforced (DoC)

(1989) International Relations SC

(1993/04) Test site registration system

Measurement Registration Comm.
Education & Training SC

(1998/04) VLAC established
Test lab accreditation system

(2005/04) Kit Module EMI Program

(1979) FCC Enforced

(1985) CISPR 22 released

(1991) Korea

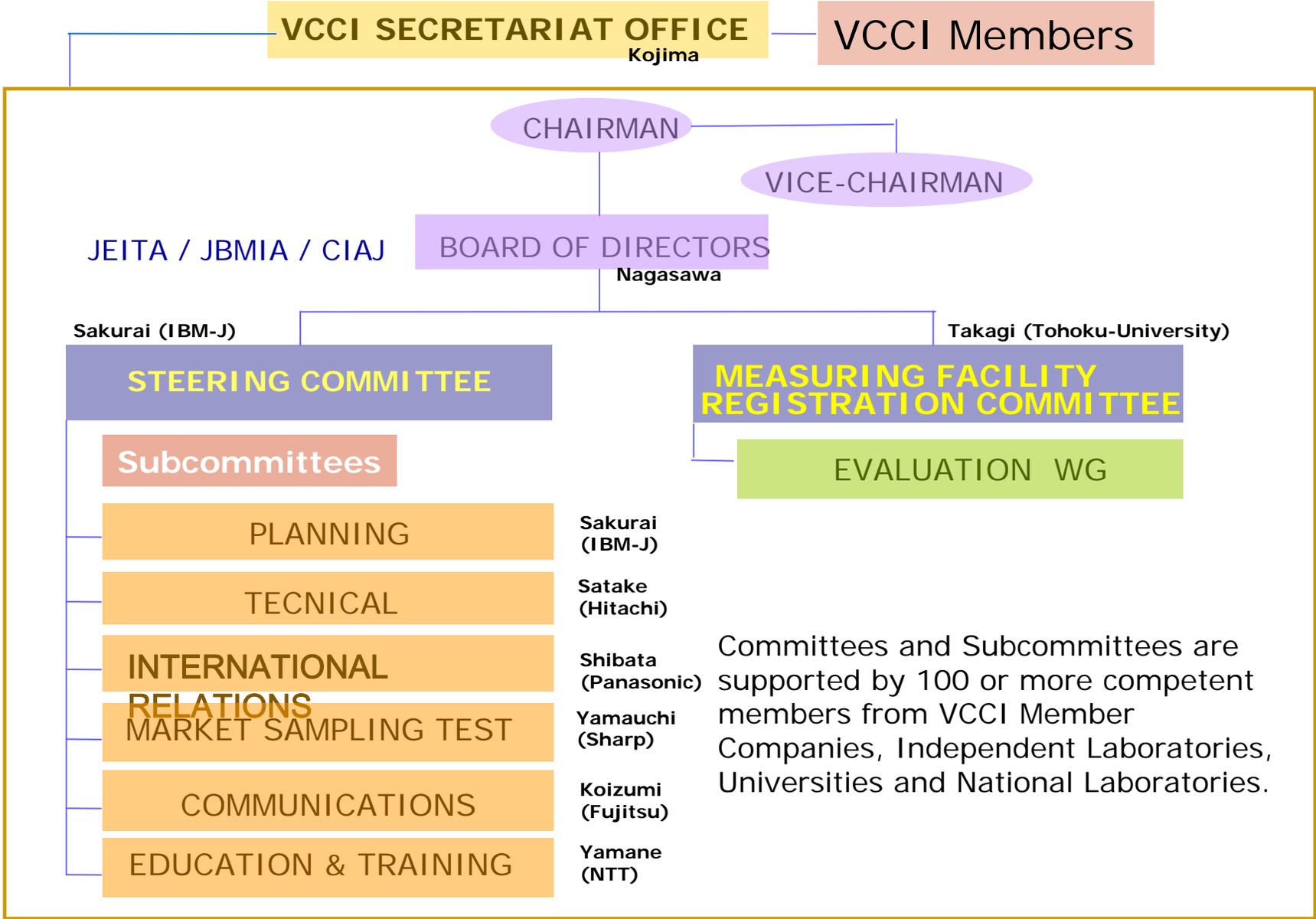
(1996) EMC Directive (DoC)

(1996) FCC DoC

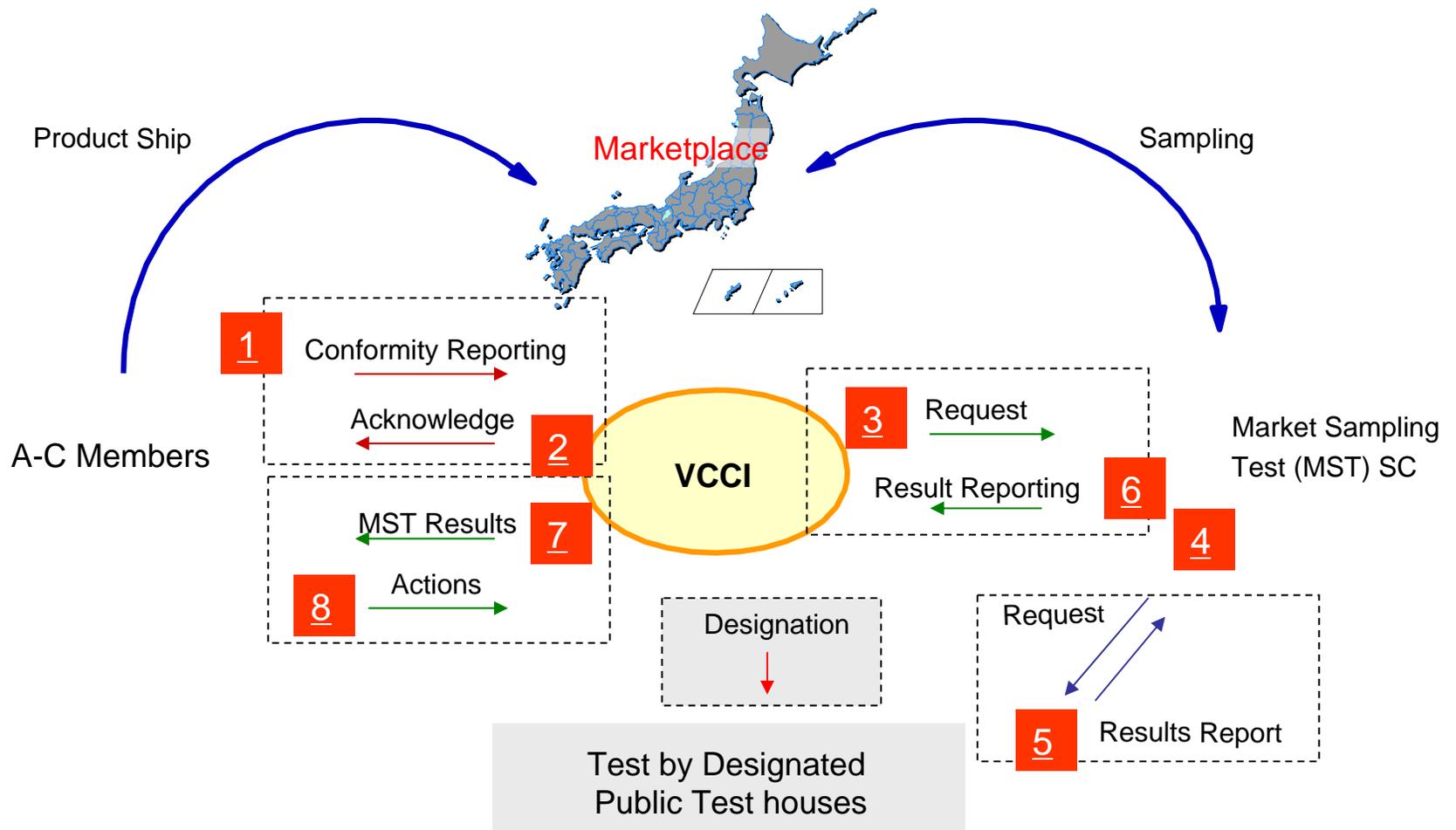
(1997) Australia (DoC)

(1998) Taiwan

ORGANIZATION

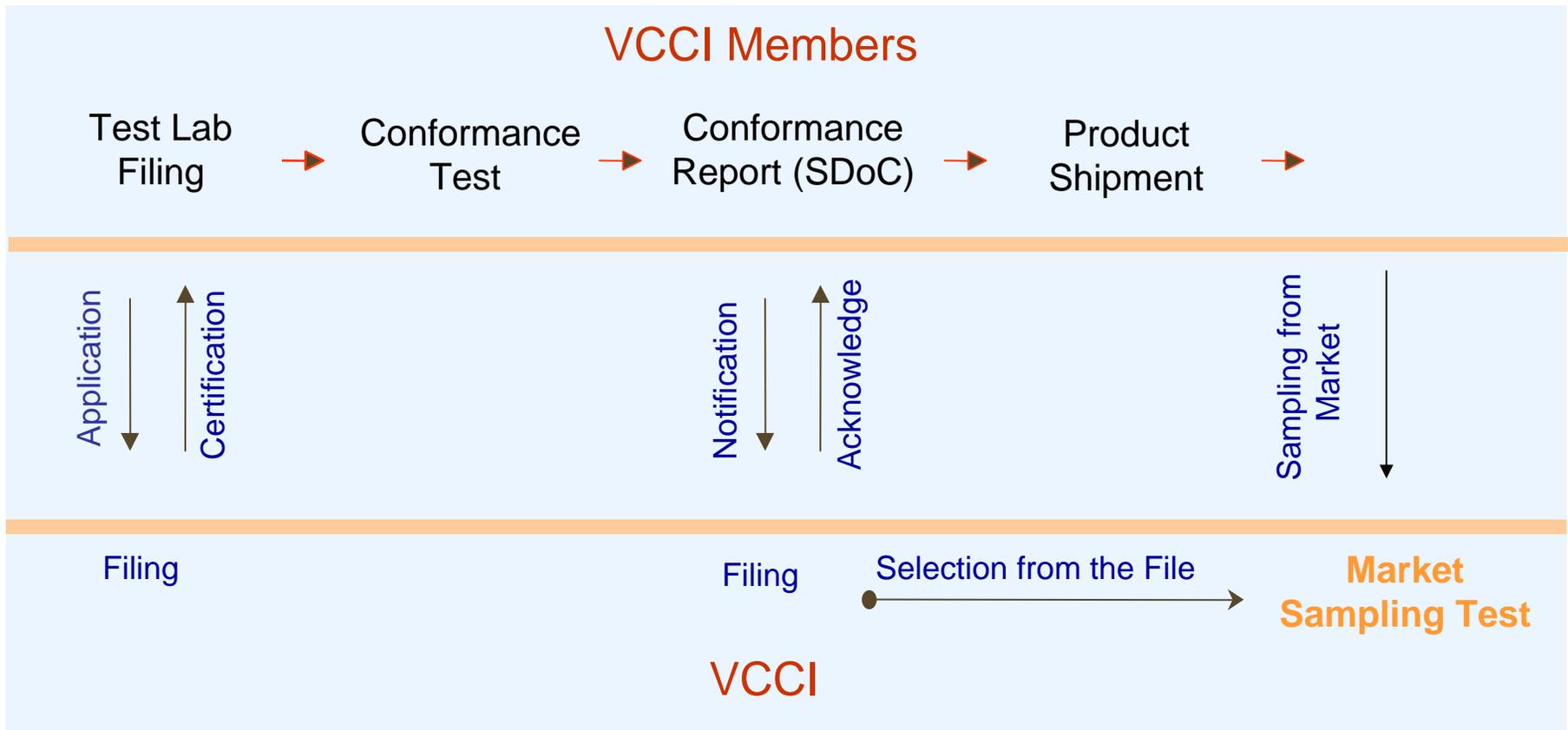


Overview of VCCI controlling scheme



VCCI Conformity Reporting to Sampling Test

VCCI Process to Self-Declaration and Market Sampling Test

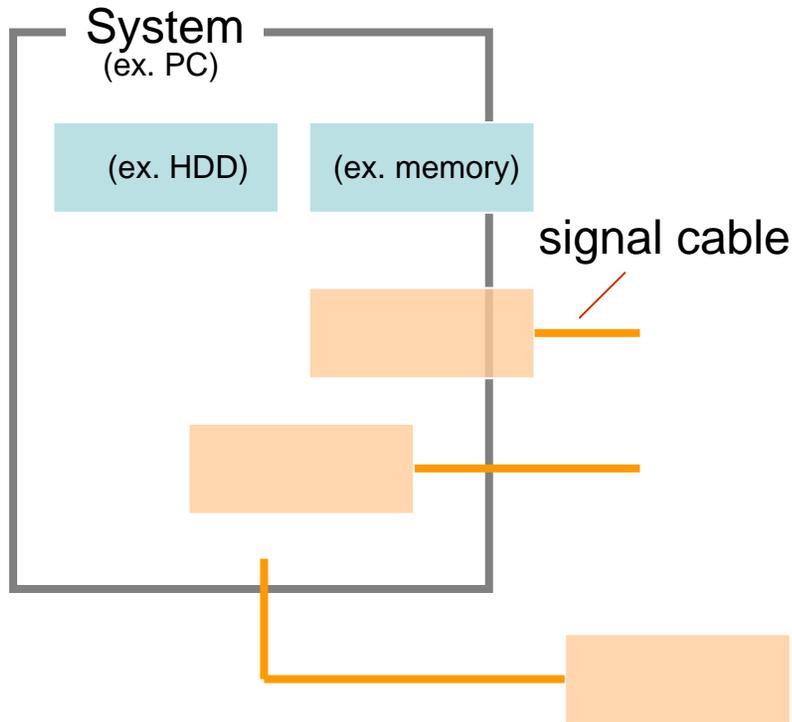


Why has this program proceeded?

EMC control environment of “optional devices”

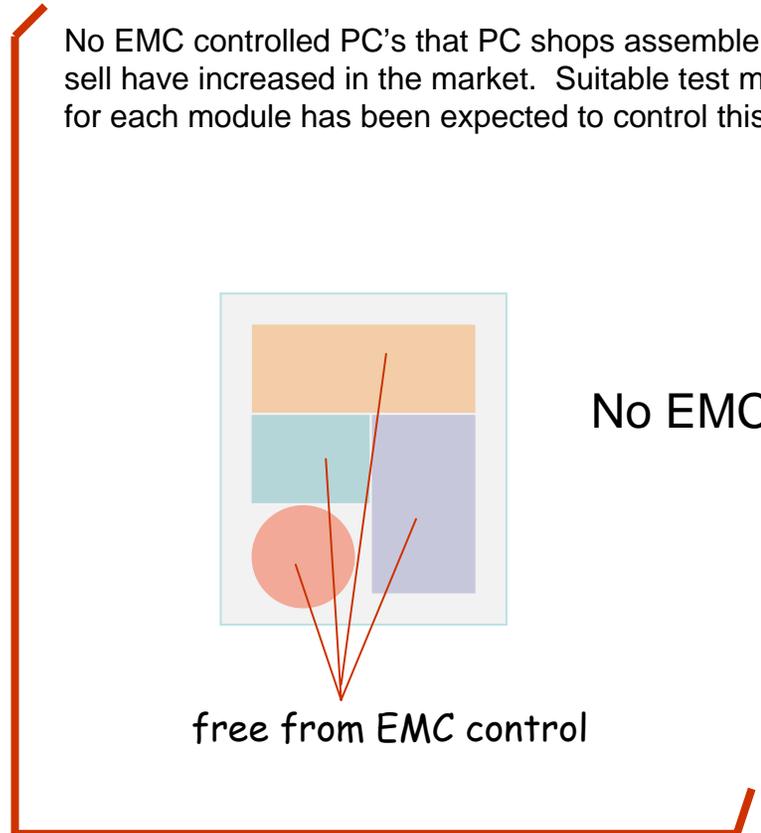
VCCI Rule for Optional Devices

VCCI rule doesn't cover internal modules which have no interface outside as same as US FCC doesn't. There have been many requests that VCCI provide a consistent and simple evaluation methodology for such modules.



“Kit” PC or “Shop Brand” PC

No EMC controlled PC's that PC shops assemble and sell have increased in the market. Suitable test methodology for each module has been expected to control this situation.



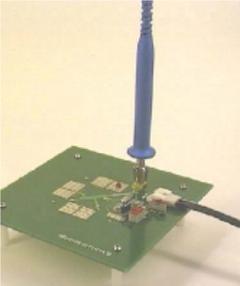
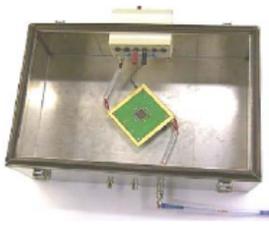
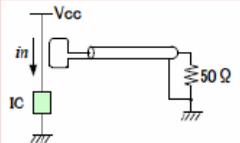
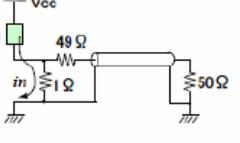
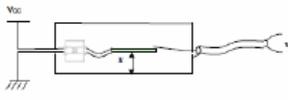
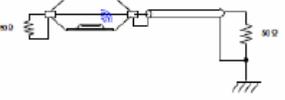
“Option A”	external interface	VCCI EMI	
“Option B”	no external interface	not covered	No mark

Highlight

- An EMI quantification program for **IT module** (such as memories) **has been starting since April, 2005** as a VCCI Quality Program.
- Technical requirement for test was finally determined to follow **IEC 61967-6** (Integrated Circuit – Measurement of electromagnetic emissions, 150KHz to 1GHz -), through a 2-year task force in VCCI.
- **Measurement of RF currents on power lines of modules on specified test board with “miniature triplate-structured magnetic probe”.**
- Marking with satisfied level (among levels A – F) on the product and filing with VCCI WEB database prior to shipment.
- VCCI member is **required to apply for the program** if he wants to put qualification mark on his products.
- Participation fee is required in addition to VCCI membership annual fee.

How should be modules evaluated?

Semiconductor industry has developed several novel test methods to evaluate IC's and standardized as IEC 61967, Integrated circuits – Measurement of electromagnetic emissions, 150 kHz to 1 GHz.

Part 6 MP Method	Part 4 VDE Method	Part 5 47A/615/CDV WBFC Method	Part 2 47A/619/NP TEM -Cell Method
			
			
<ul style="list-style-type: none"> • P.S current • M.P probe (non contact) 	<ul style="list-style-type: none"> • Ground Current • 1 Ω Resistance probe (contact) 	<ul style="list-style-type: none"> • Common mode Current • 150 Ω line WBFC 	<ul style="list-style-type: none"> • radiated electric field strength • TEM Cell

VCCI reviewed four candidates; Magnetic Probe Method, VDE method, Workbench Faraday Cage Method and TEM Cell Method.

Magnetic Probe Method was finally employed in terms of its simplicity and high measurement repeatability.

What is IEC 61967-6 / Magnetic Probe Method?

IEC 61967-6 (2002-06)

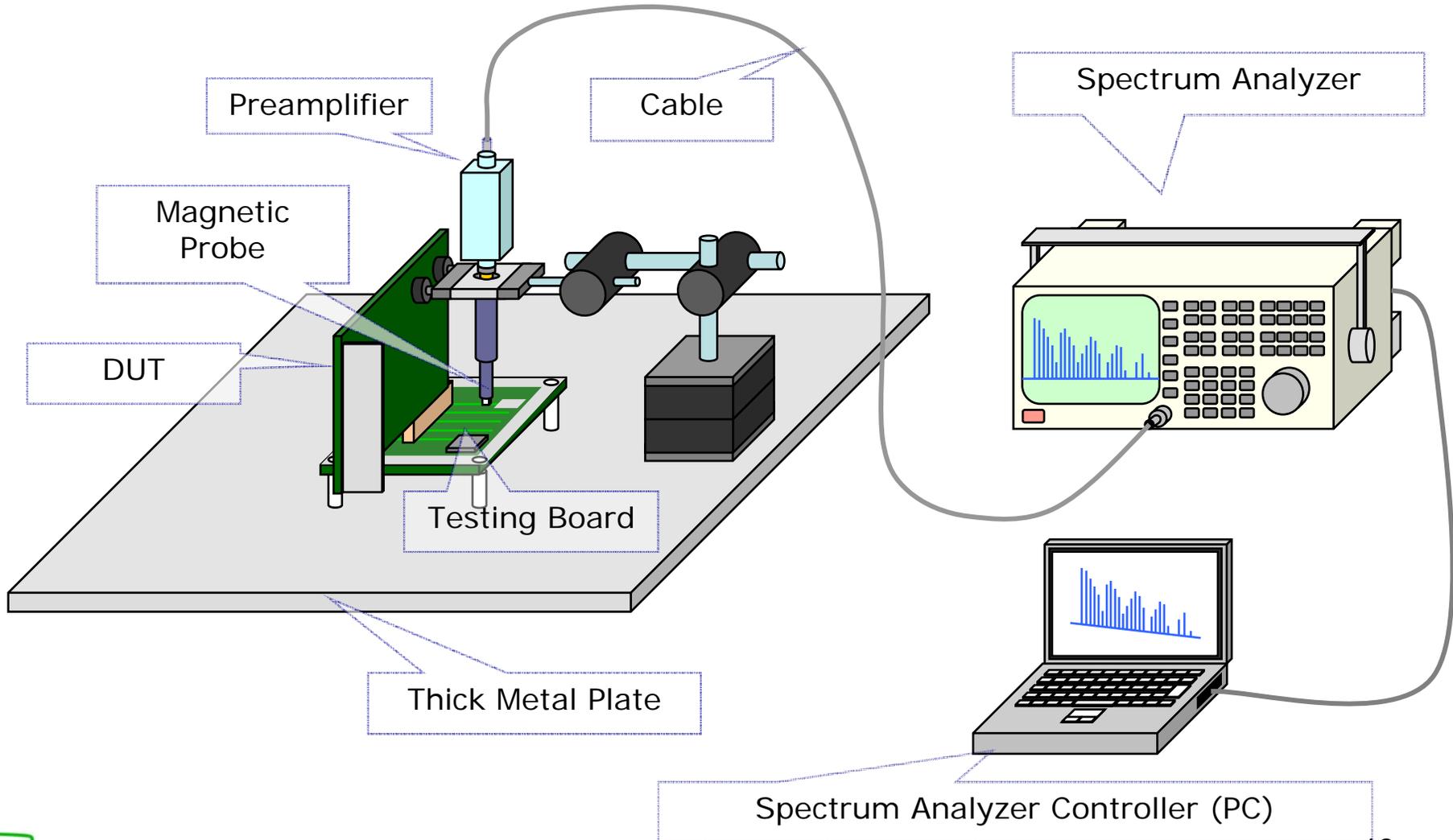
Integrated circuits –

**Measurement of electromagnetic emissions,
150 kHz to 1 GHz –**

**Part 6: Measurement of conducted emissions
– Magnetic probe method**

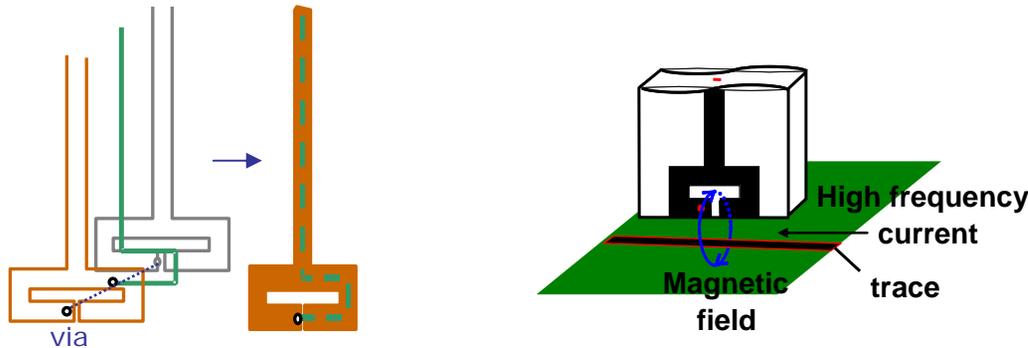
“ This part of the IEC 61967 specifies a method for evaluating RF currents on the pins of an integrated circuit (IC) by means of non-contact current measurement using a **miniature magnetic probe**. This method is capable of measuring the RF currents generated by the IC over a frequency range of 0,15 MHz to 1 000 MHz. This method is applicable to the measurement of a single IC or a chip set of ICs on the standardized test board for characterization and comparison purposes. It is also usable to evaluate the electromagnetic characteristics of an IC or group of ICs on an actual application PCB for emission reduction purposes. This method is called the **magnetic probe method**.”

Test Set up following IEC 61967-1 and 6(MP Method)

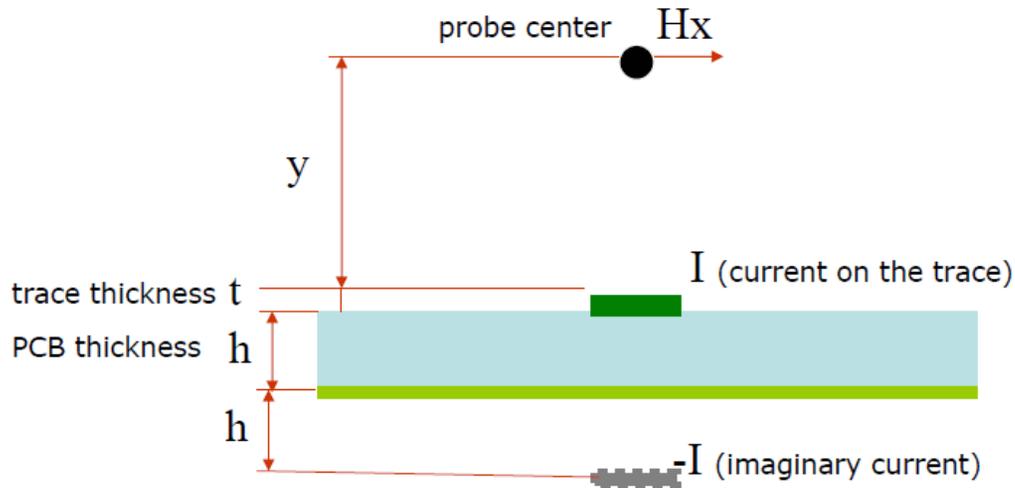


How the magnetic probe works?

Microstrip line (MSL) and Near Magnetic Field (approximation)



triplate-structured magnetic probe



Current on the trace, I , can be determined by magnetic field, H_x and other MSL mechanical dimensions.

$$H_x \cong \frac{I}{2\pi} \left[\frac{1}{2h+y} - \frac{1}{y} \right]$$

$$= -\frac{Ih}{\pi y(2h+y)}$$

Calibration and Probe factors

M-field (\perp strip \parallel PCB: H_x) penetrating the loop

$$H_x \cong \frac{I}{2\pi} \left[\frac{1}{2h+y} - \frac{1}{y} \right]$$

$$= -\frac{Ih}{\pi y(2h+y)}$$

Strip Current: I

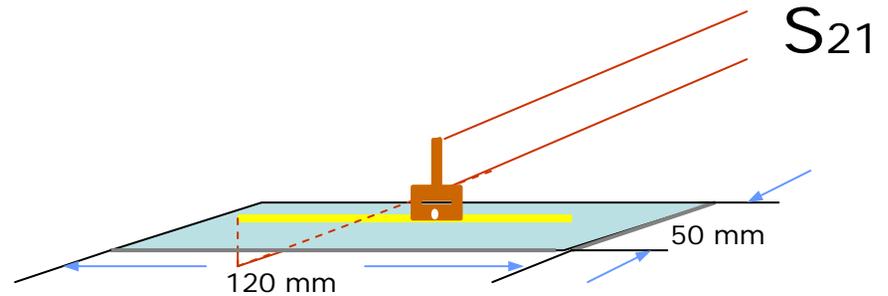
$$I = \frac{V_{IN}}{Z_T} \quad Z_T = Z_O \text{ (matching)}$$

Probe factor: F

$$F = \frac{H_x}{V_P}$$

$$= \frac{1}{\left(\frac{V_P}{V_{IN}} \right) \bullet Z_T} \bullet \frac{h}{\pi y(2h+y)}$$

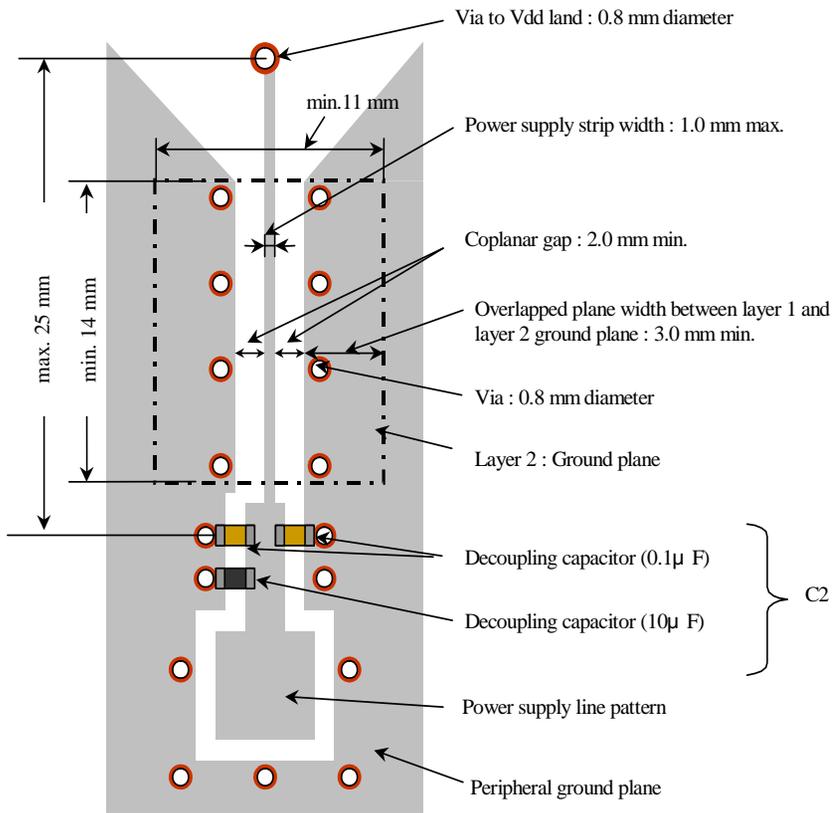
$$= \frac{1}{(S_{21}) \bullet Z_T} \bullet \frac{h}{\pi y(2h+y)}$$



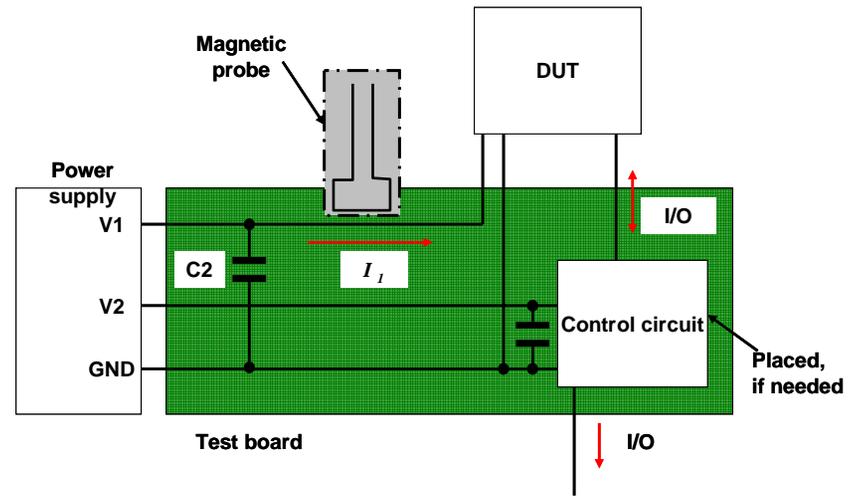
Reference Microstrip line for Calibration
(thickness: $h = 0.9\text{mm}$, $y \approx 0.9\text{mm}$ $Z_T = 49.9\Omega$)

Attenuation, S_{21} (V_P/V_{IN}) determines Probe Factors, F .

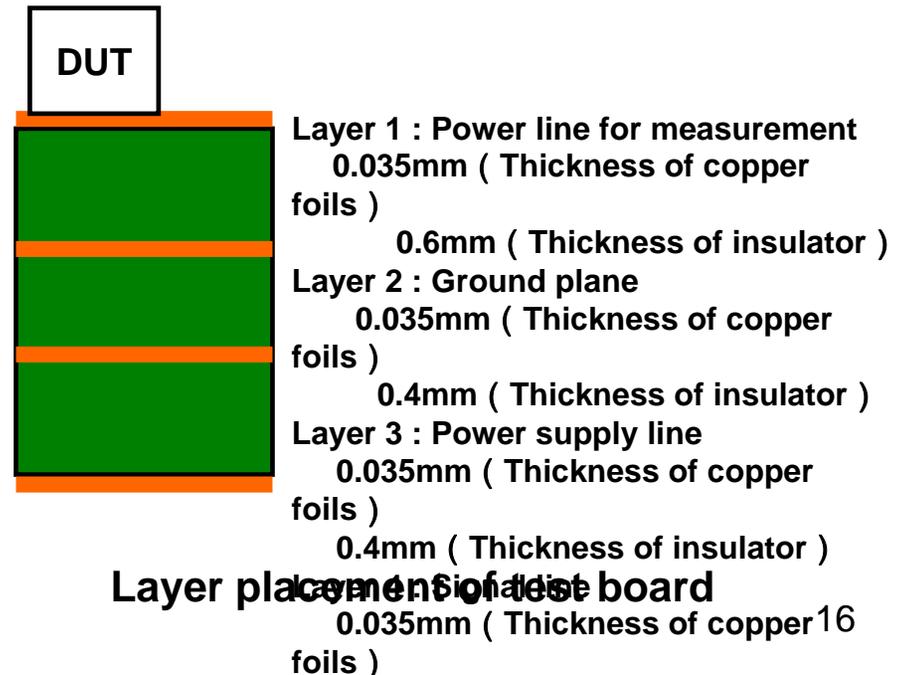
Test Board Specifications



Power line pattern on the test board (layer 1)

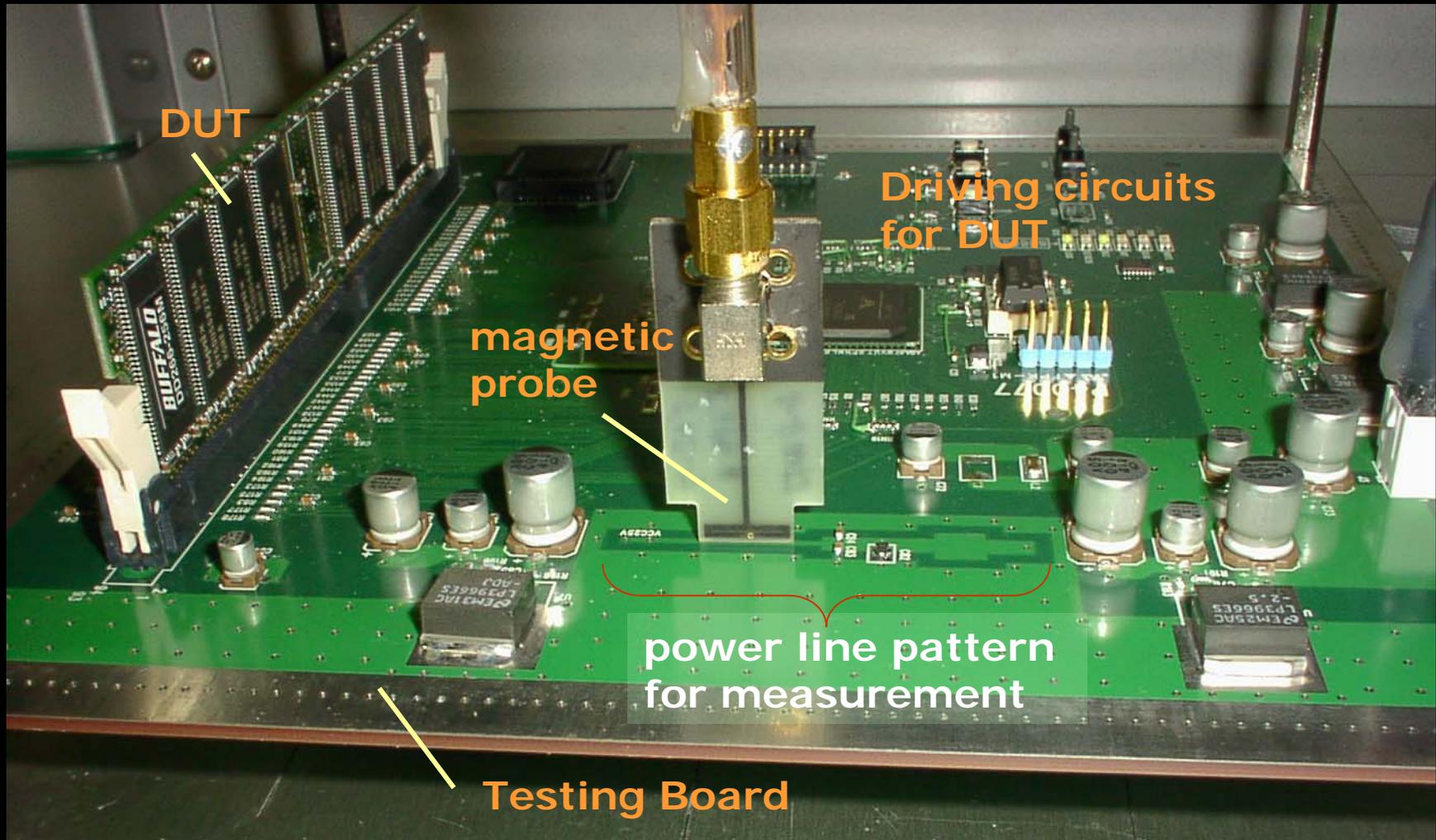


Circuit diagram

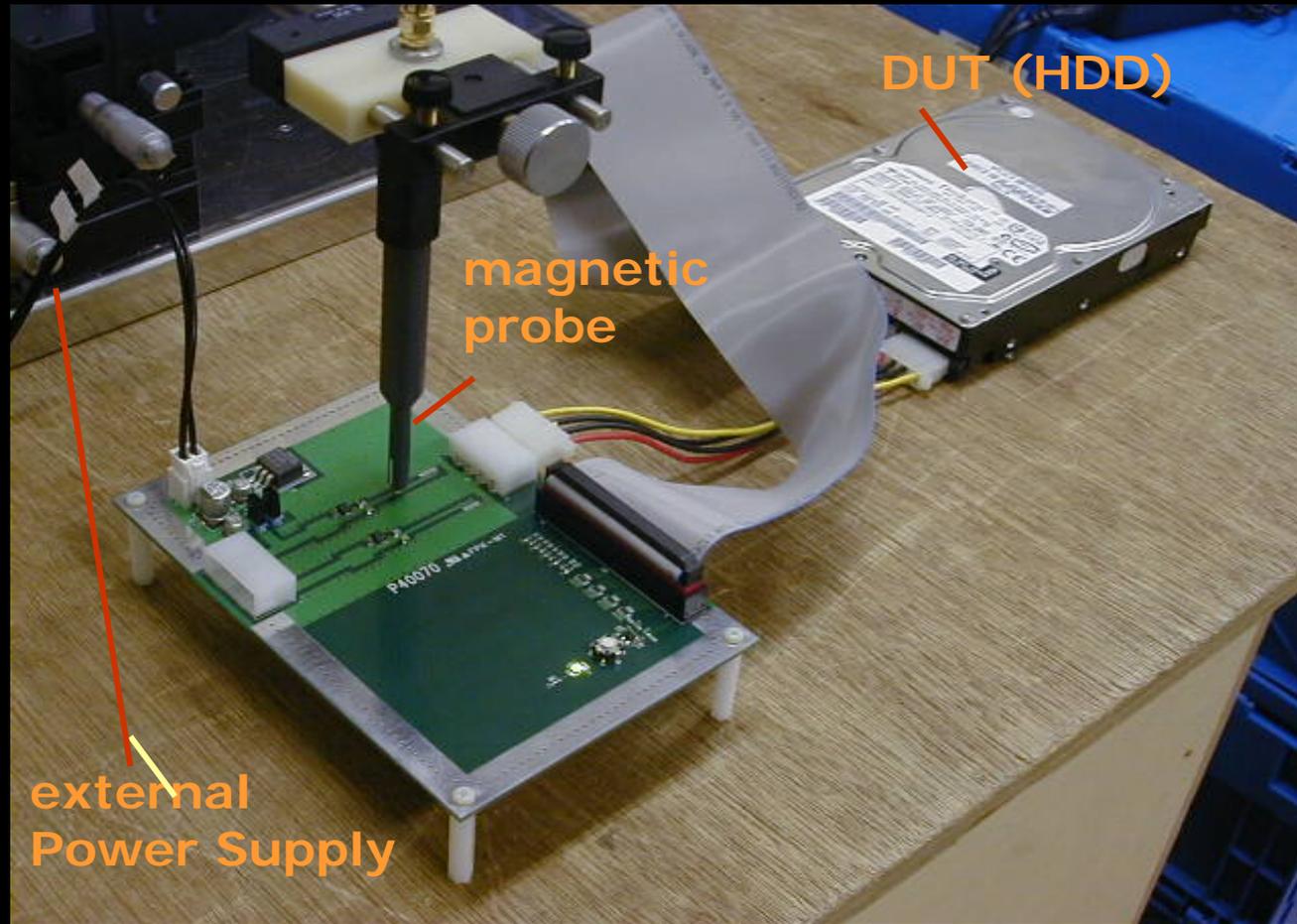


Layer placement of the test board

A Measurement instance (memory)



A Measurement instance (Hard Disk Drive)

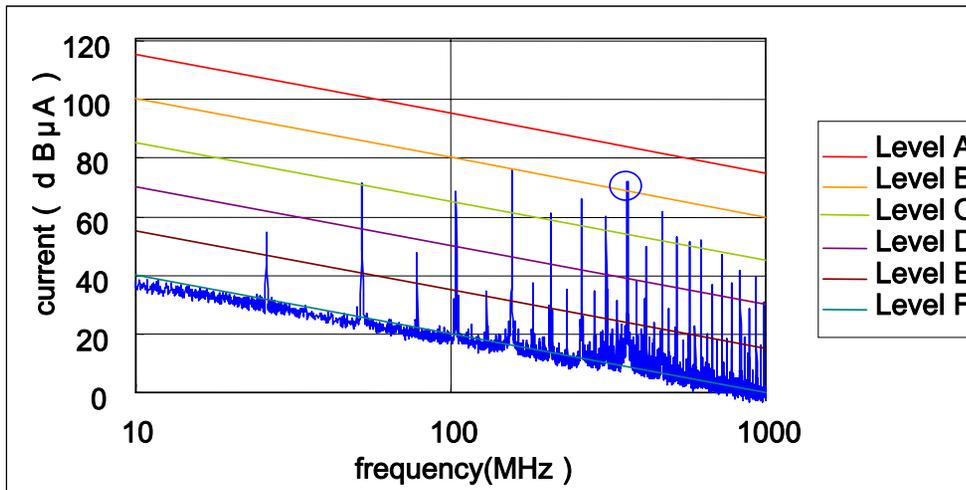


How is the level determined?

Disturbance level	Disturbance limits (dB μ A)		
	10MHz	100MHz	1000MHz
Disturbance level A	115	95	75
Disturbance level B	100	80	60
Disturbance level C	85	65	45
Disturbance level D	70	50	30
Disturbance level E	55	35	15
Disturbance level F	40	20	0

Note 1. The disturbance limits from 10 to 1000 MHz shall be linearly varied when the frequency is presented in logarithm, and current values are presented in dB μ A.

Six quantifying levels are preset. All levels decrease in proportion to frequency. Amplitude of the level A was determined through a comprehensive field testing as a level with which most modules may meet.



An instance of meeting Level A

Marking (Labeling)

Reference

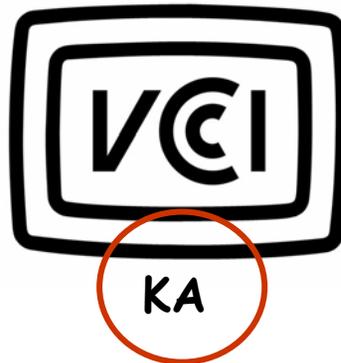


Original Label of VCCI EMI Compliance (Class B)

- Module EMI Mark (example of Level A)



- Another VCCI compliance mark is existed and Module EMI Mark is added.

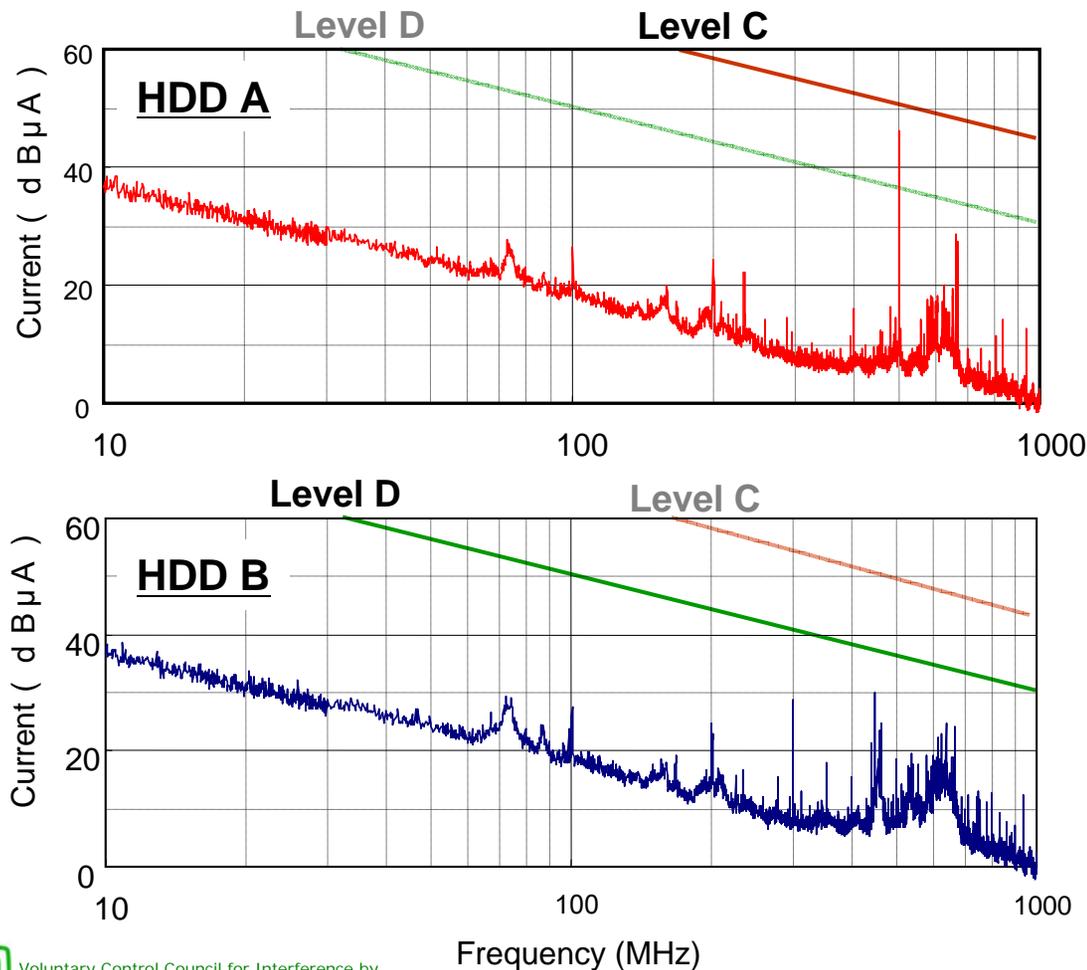


symbol	level
KA	A
KB	B
KC	C
KD	D
KE	E
KF	F

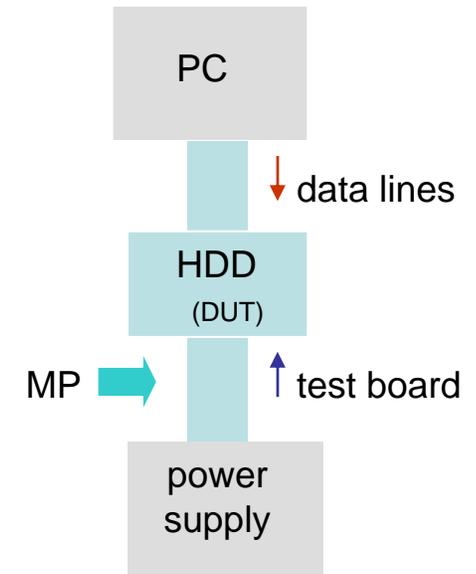
Power Line Frequency Spectrum of Hard Disk Drive (HDD)

- Two HDDs, A and B, were compared using MP with the same test condition. Data was sent from PC to HDD and power was supplied by the external power supply.

Test Results



Test Configuration

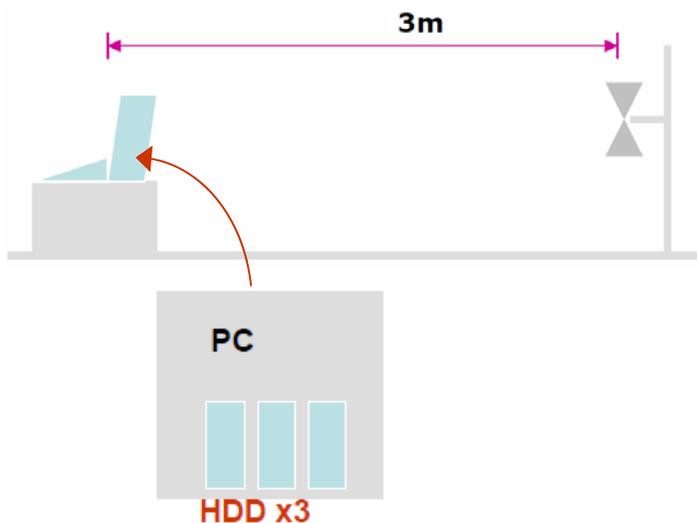


Spectrum Frequency and current amplitude are obviously different at frequencies over than 100 MHz.

Electric Field at 3m

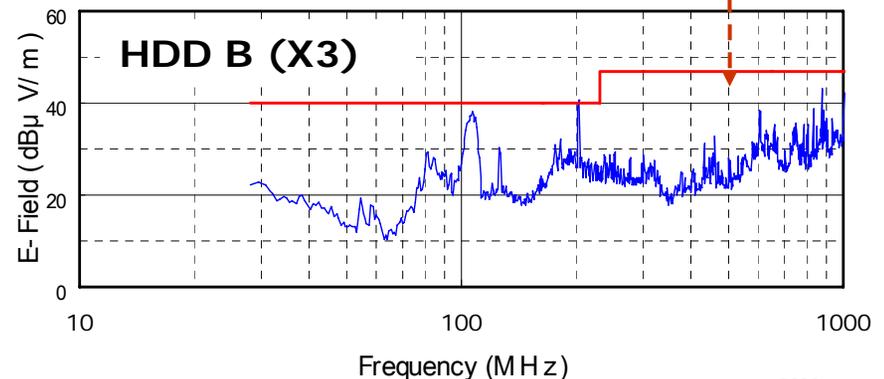
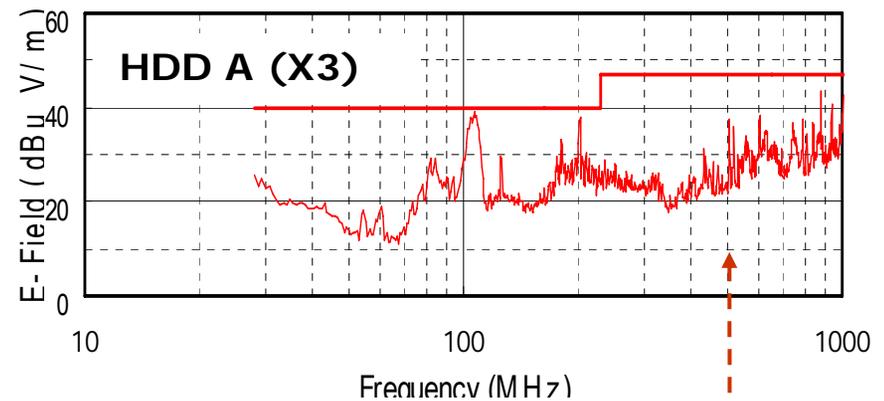
- Radiated electric field was measured with the following condition to compare each HDD contribution in the field strength.

- 3m antenna distance
- horiz./vert. orientation (higher recorded)
- 3 same HDDs installed in a PC
- Same PC for each HDDs
- Display removed after set-up of data line



Test Results

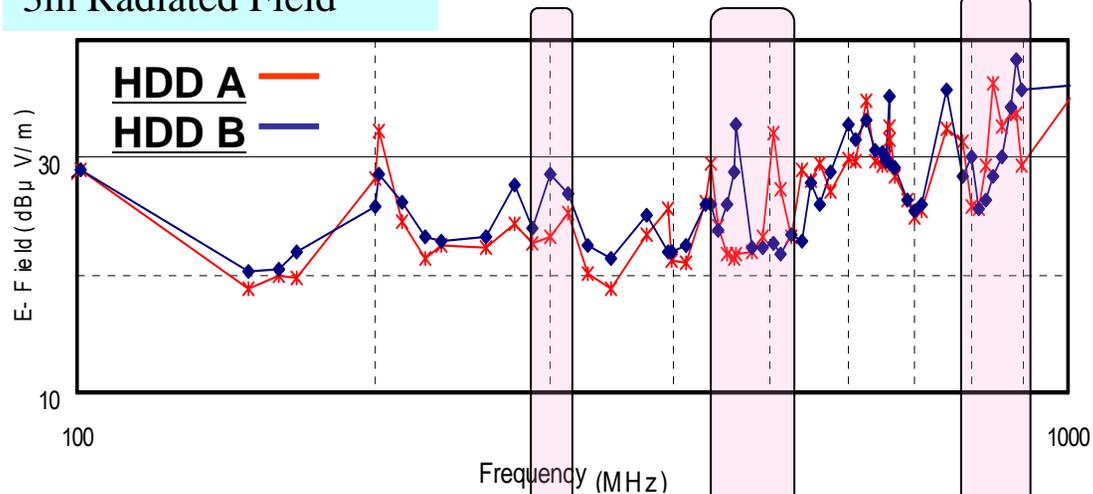
PC installed HDD-B exceeded limit at 200MHz. At 500MHz, B had no obvious peak but A. HDD related harmonics (12.5MHz) observed.



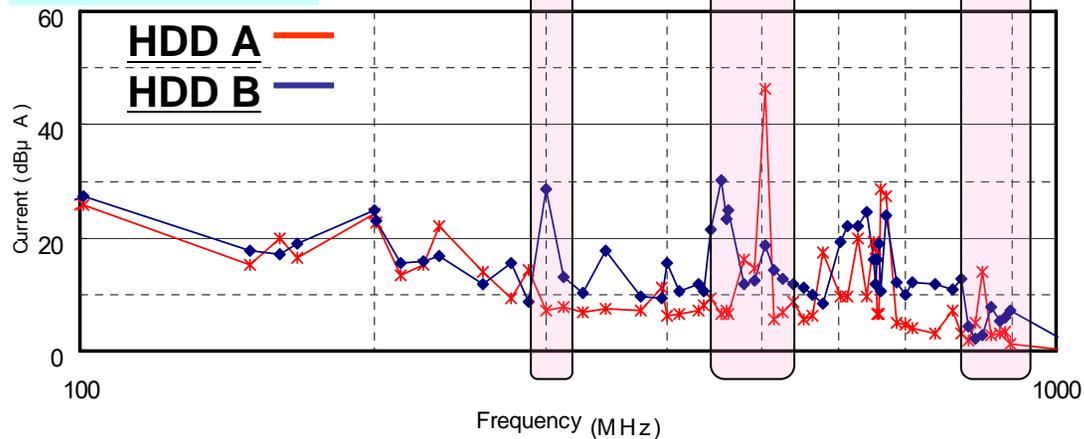
Test Data Comparison of MP method and 3m Radiated Field

Harmonic peaks of 12.5MHz show good agreement in both HDDs.

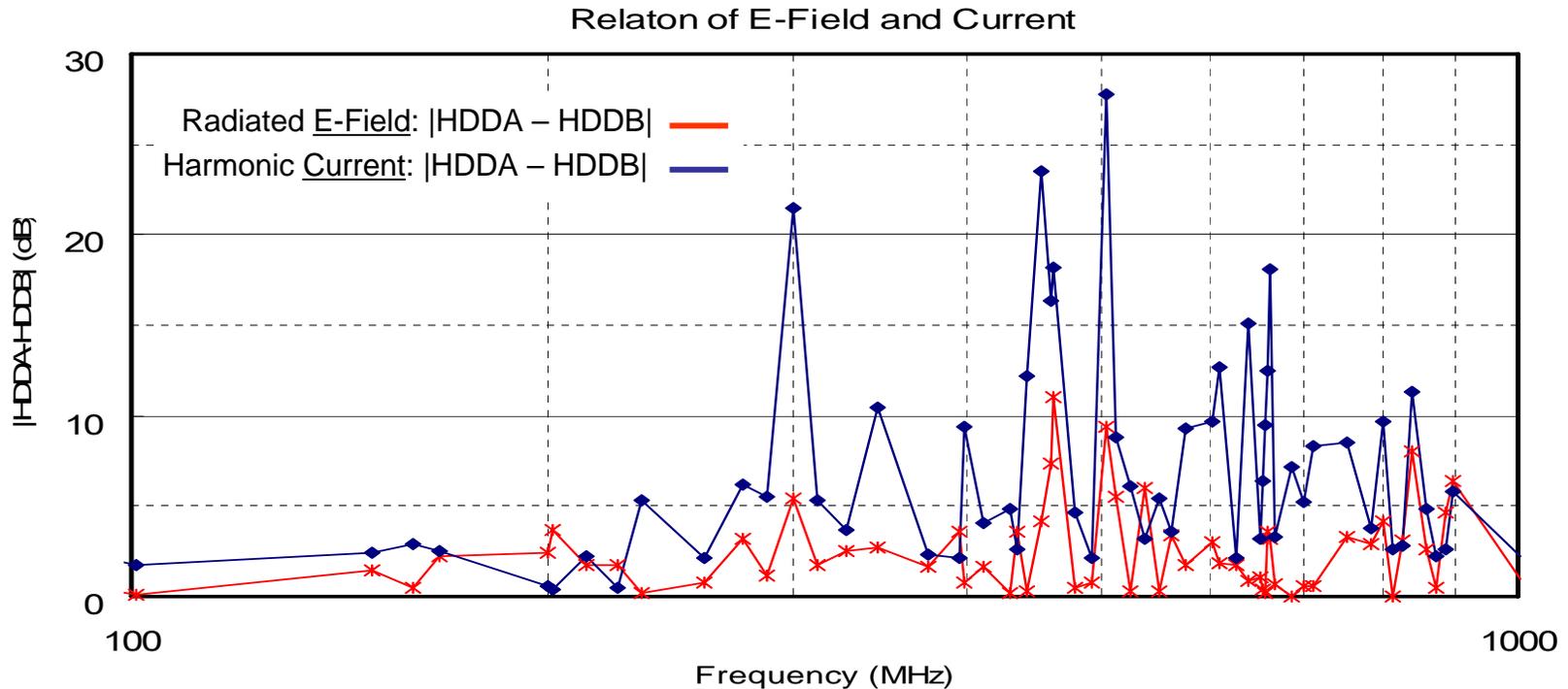
3m Radiated Field



MP method



Test Data Comparison of HDD dependency in MP method and 3m Radiated Field



- Higher current peaks in MP shows higher field peaks in radiated field.
- HDD dependency is more obvious in current data of MP.
- Radiation characteristics of system in which HDD installed may reduce HDD dependency.



MP method provides highly effective indication for module EMI design.

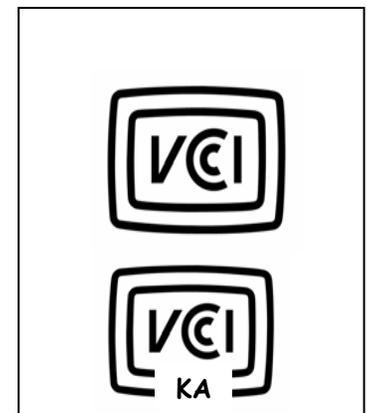
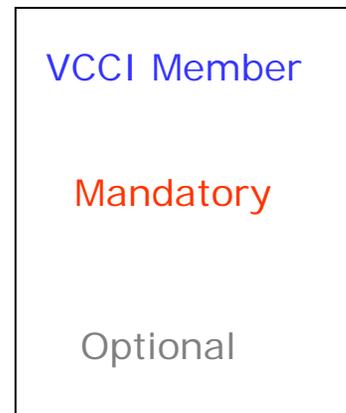
Merits of quantifying the conducted emissions on the power line of the modules

- Can be used to characterize design difference of modules and evaluate the difference with respect to conducted emission on the power line.
- Verifying the relation of the conducted emission with EMI level of the product installing the module may give an effective indication for the product design
- Can be used to monitor quality of modules at the production line

Procedure



MEP: Module EMI Program
XXXP: Xxxx Xxxxx Program



Quality Program

To start

VCCI member

Application of
Participation to Quality
Program

To resign

Application of
Participation
Cancellation to the
Program

Procedure

Registration of testing
equipment

Verification with Quality
Level of the program

Registration of Quality
Level to be confirmed
with the product to be
marketed

Marking with label
showing confirmed level
prior to shipment.

Receiving VCCI post
market Surveillance if
selected.

Distinct difference from regular VCCI requirement

This program doesn't always require "Kit Module Program Participants" to put a kit module label on his product. It is 100% of the participants' discretion to use the program even after participation. This part is a distinct difference from regular VCCI requirement.

Contact

E-Mail nagasawa@vcci.or.jp

URL <http://www.vcci.or.jp>