

Introduction to VCCI Kit Module EMI Program

An approach for module level EMI quantification

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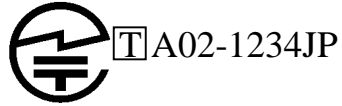


EMC-related Regulations in Japan and VCCI's role

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

Some product families which are categorized in other product groups are also covered by VCCI under agreements of the VCCI members and the council. Immunity is interpreted as a quality issue that each manufacturer should pursue and achieve a proper level, except for medical electrical equipment.

Conformity labels required



Modem is subject to Telecommunications Business Law
Certification of TTE
Conformity to Technical Requirements by JATE

Wireless LAN is subject to Radio Law

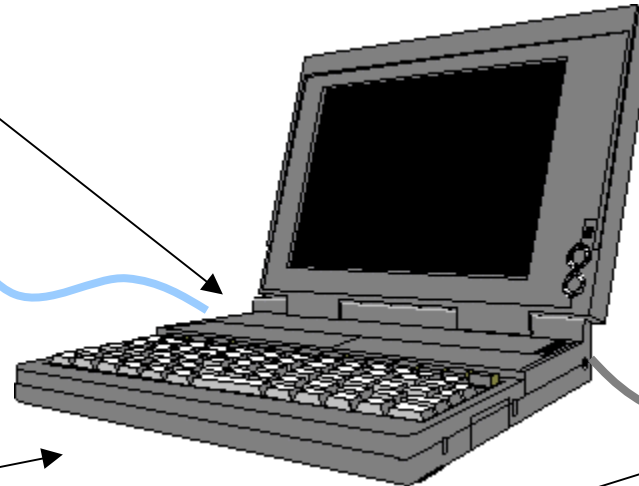
Technical Regulations
Conformity
Certification by TELEC



To TEL Line



EMI



AC Adapter (Power Supply) is subject to DEN-AN Law

Certificate of Conformity by JET/JQA/others

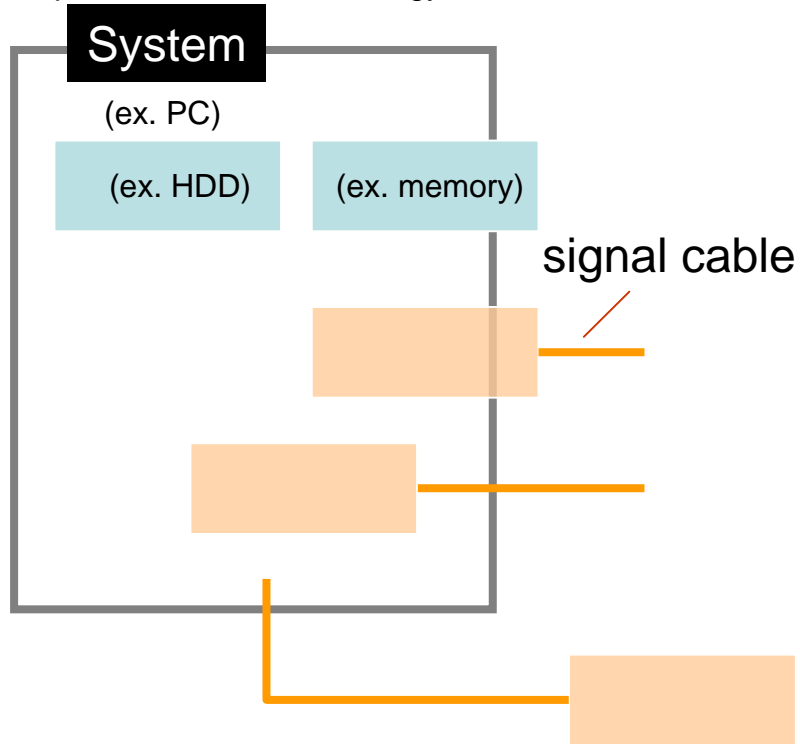


To AC Power Supply

What is not covered by VCCI rule?

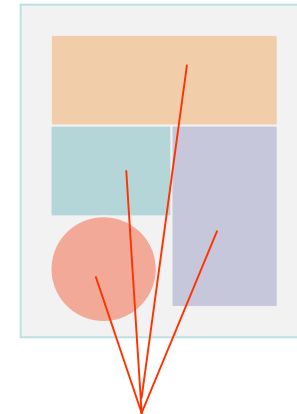
VCCI Rule for Optional Devices

VCCI rules doesn't cover internal modules which has 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 has increased in the market. Suitable test methodology for each module has been expected to control this situation.



free from EMC control

| | | | |
|------------|-----------------------|-------------|---|
| "Option A" | external interface | VCCI EMI |  |
| "Option B" | no external interface | not covered | No mark |


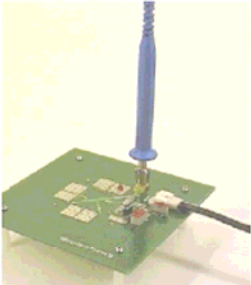
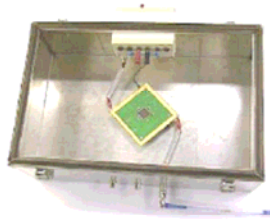
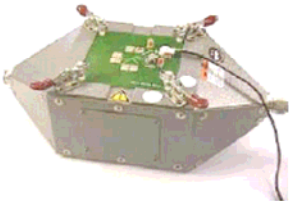
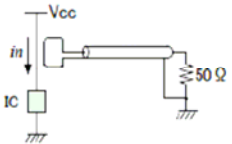
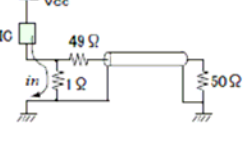

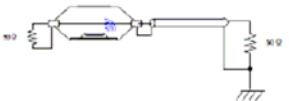
■ New Type Program in VCCI

VCCI's 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 optional for VCCI members** to utilize this program.

- An EMI quantification program for **IT module** (such as memories) has started since April, 2005 for an optional program for VCCI members.
- Technical requirements for test is based on **IEC 61967-6** (Integrated Circuit – Measurement of electromagnetic emissions, 150KHz to 1GHz -).
- Test systems used is required to register in VCCI.
- Measurement of RF currents on power lines of modules on specified test board with a special magnetic probe.
- Marking with satisfied level (among levels A – F) on the product and filing with VCCI WEB database prior to shipment.

Appropriate test method for "kit module"

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.

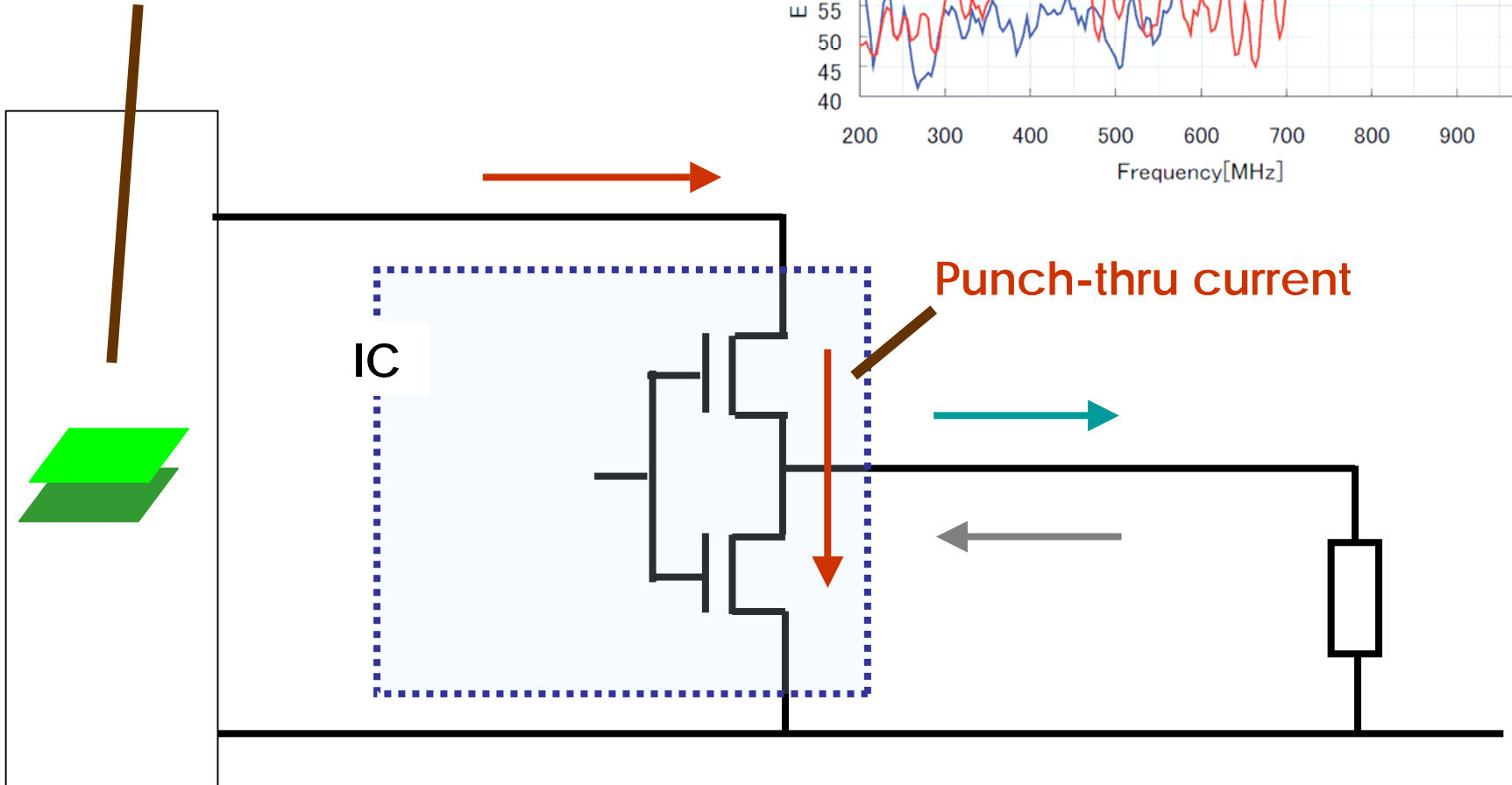
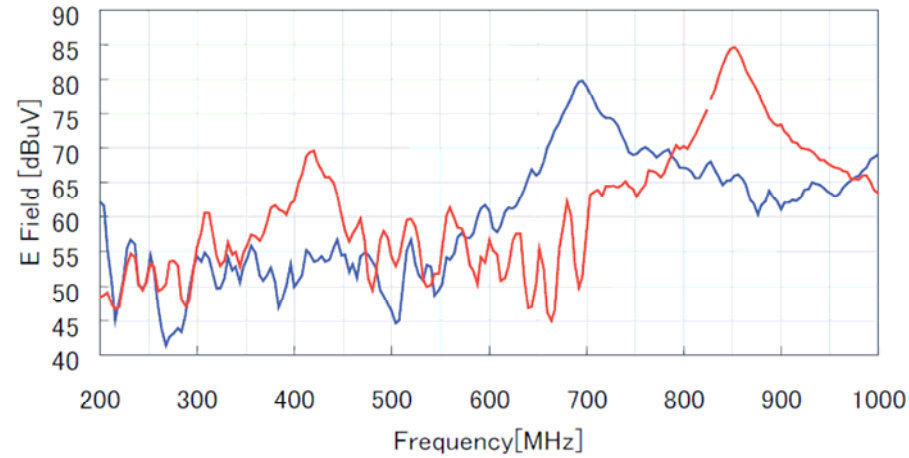
| Part 6 MP Method | Part 4 VDE Method | Part 5 47A/615/CDV WBFC Method | Part 2 47A/619/NP TEM -Cell Method |
|--|--|--|--|
|  |  |  |  |
|  |  |  |  |
| <ul style="list-style-type: none"> • P.S current • M.P probe (non contact) | <ul style="list-style-type: none"> • Ground Current • 1 Ω Resistance 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 has been employed in terms of its simplicity and facility cost.

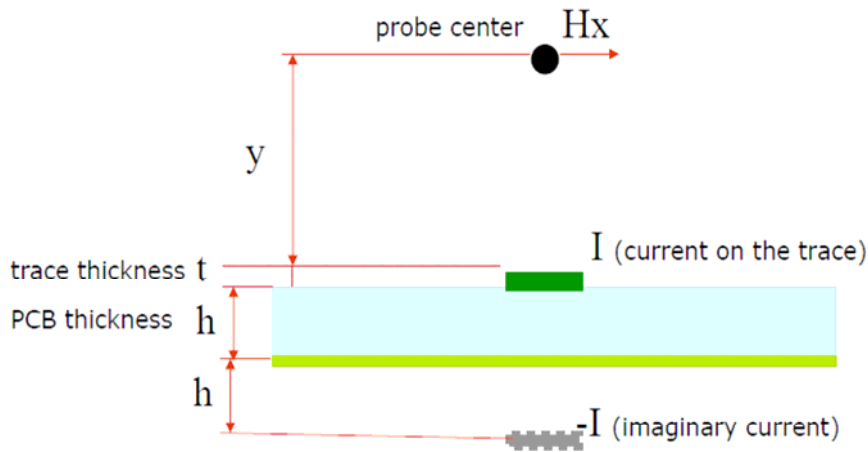
Punch-through Current may contribute to Voltage Plane Resonance

Resonance on Voltage Planes and contribute to large EM emissions



Calibration of Magnetic Probe with MSL

Reference: VCCI Technical requirements for measuring disturbance from kit module V-A3/200.04



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

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

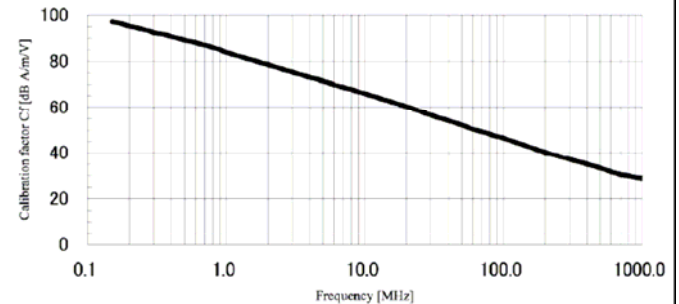
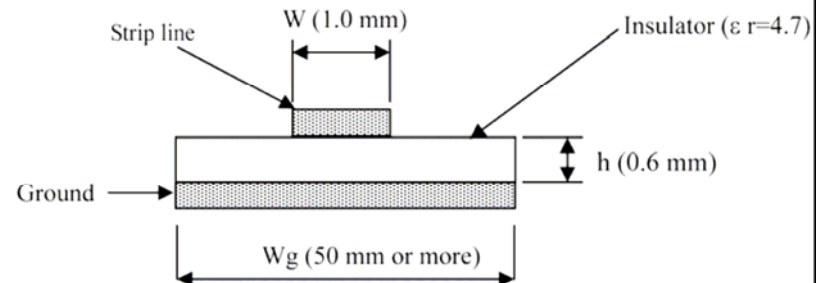
Strip Current: I

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

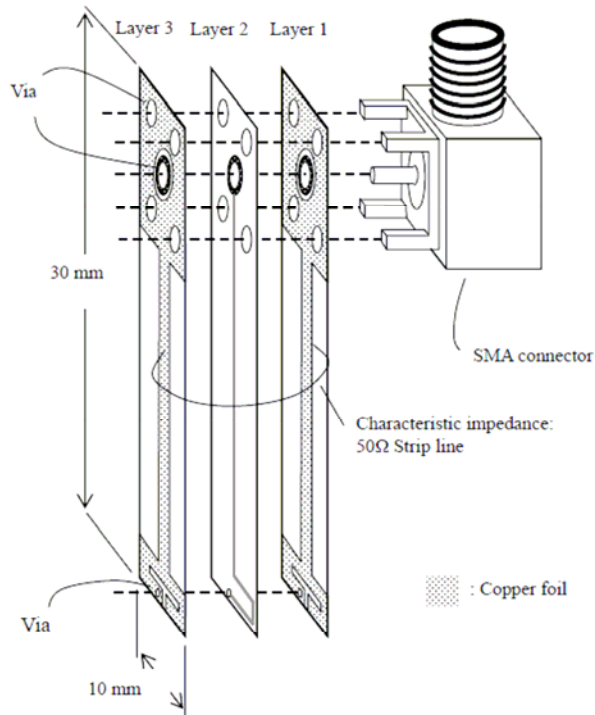
Probe factor: F

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

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

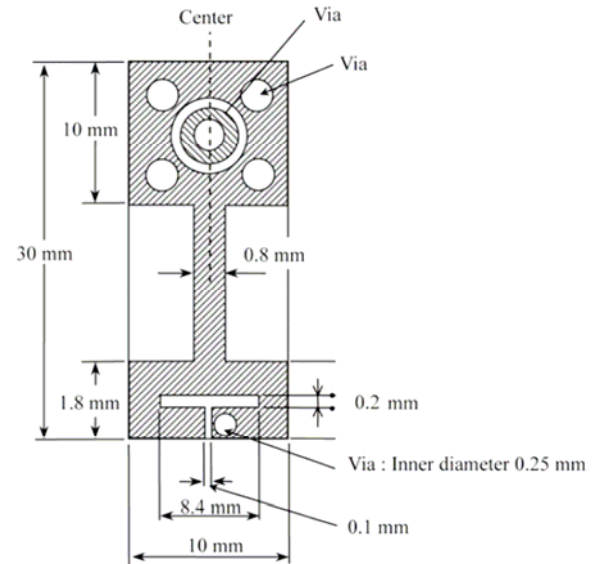


Magnetic Probe Detail

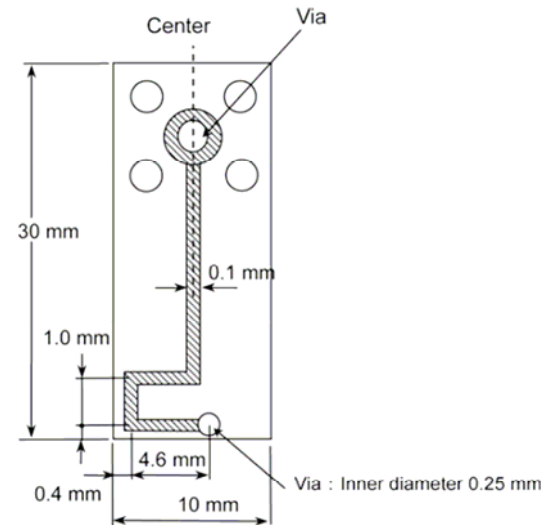


Magnetic Probe

Reference: VCCI Technical requirements for measuring disturbance from kit module V-A3/200.04

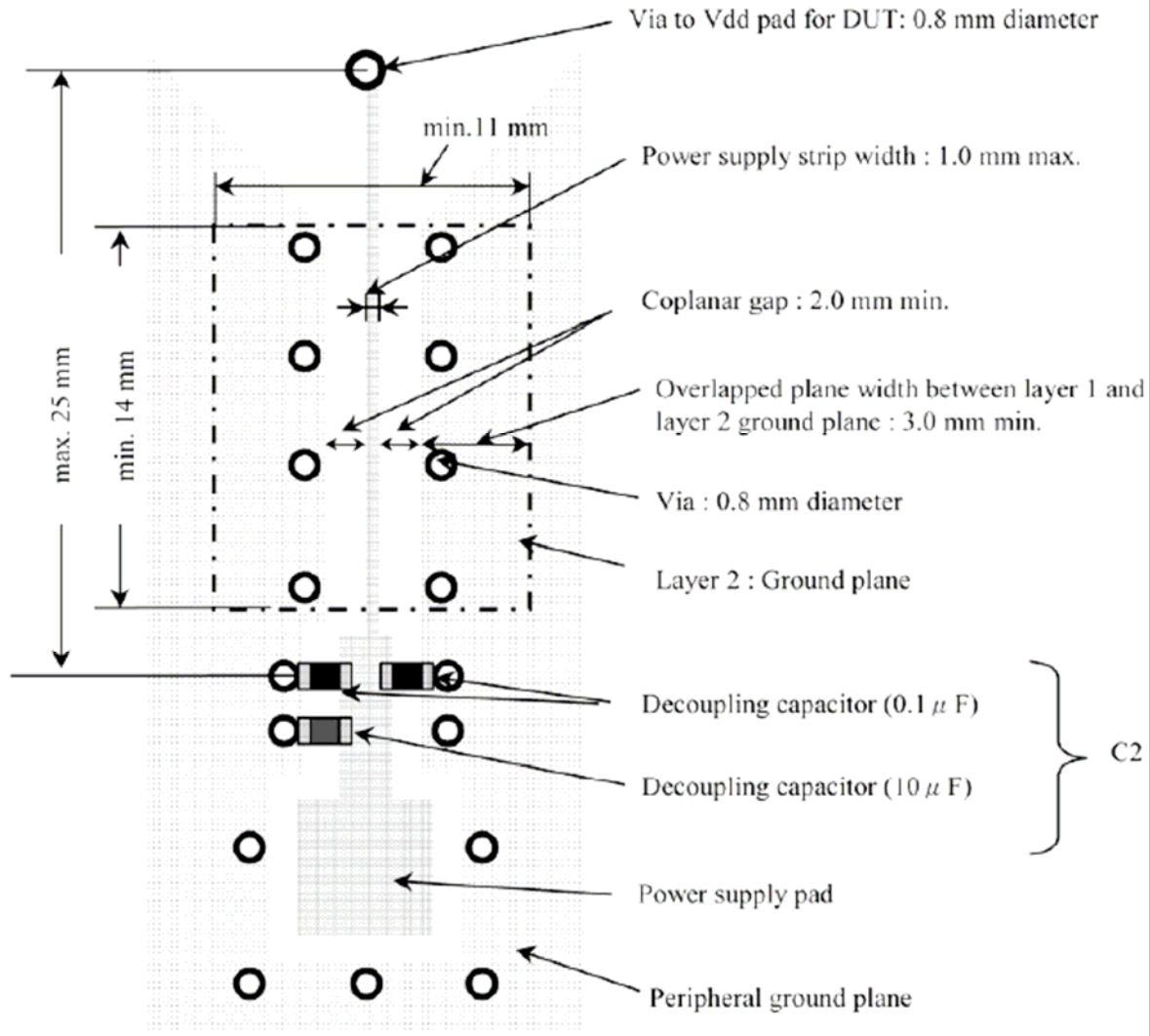


Outer Layers, 1 and 3



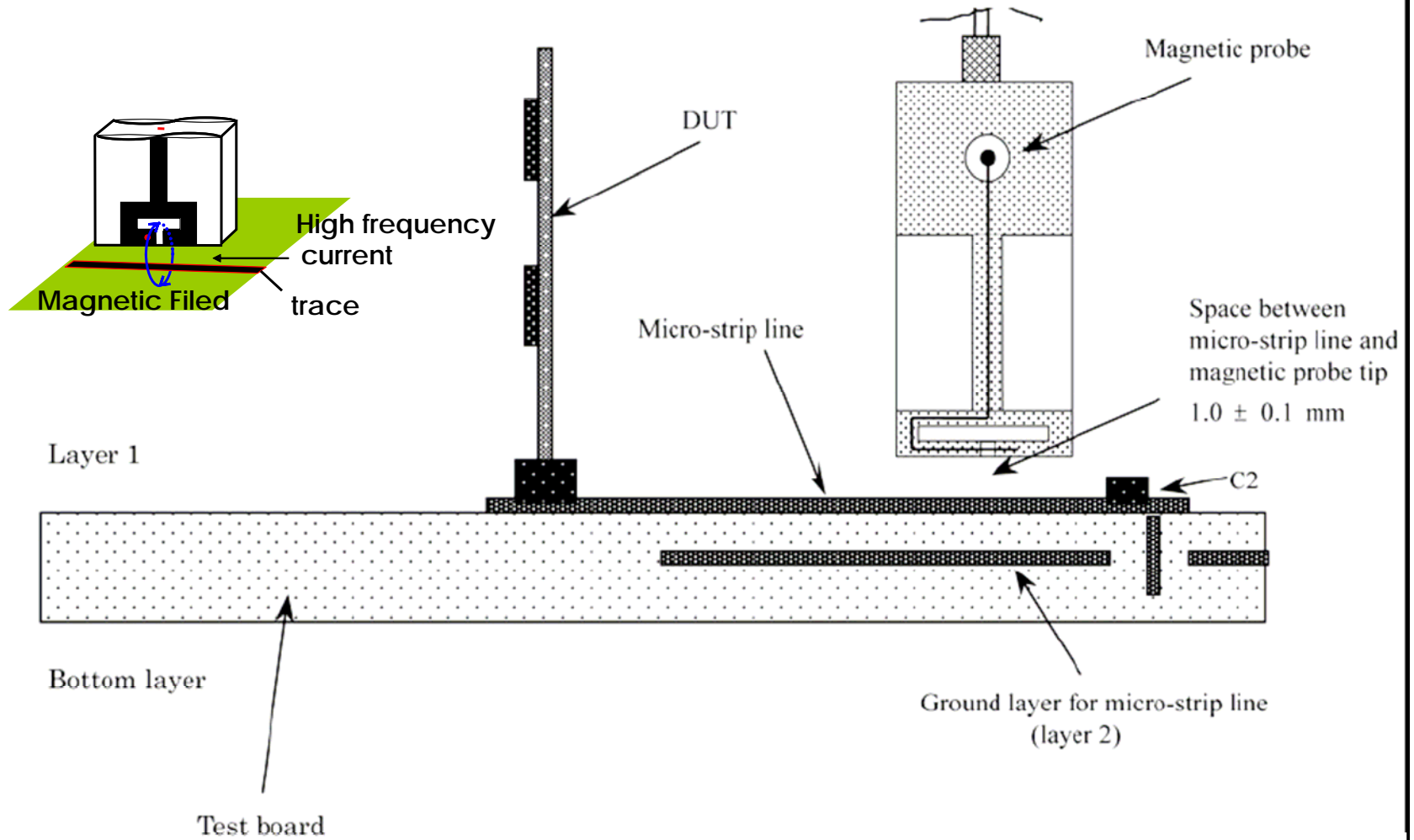
Inner Layer 2

Probing Pattern on the test board



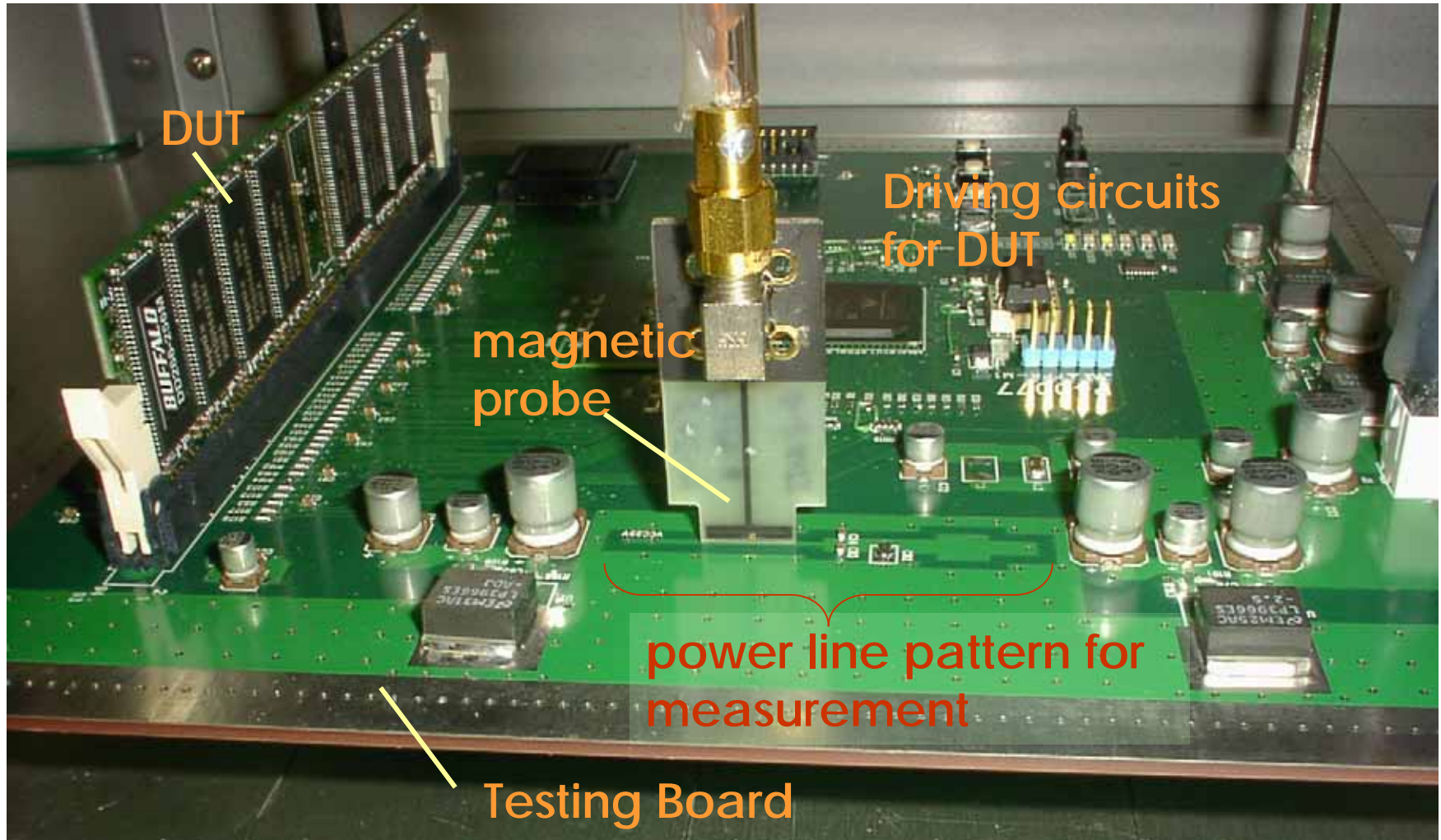
Probing pattern on the test board (top layer)

Test Setup



Test example of Magnetic Probe Method

Memory module assessment example

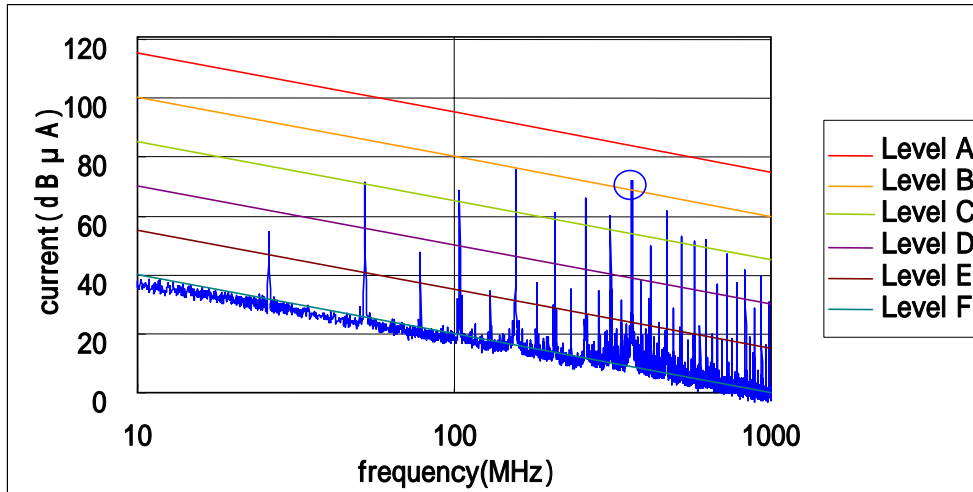


Quantity (Disturbance) Levels

| 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 |

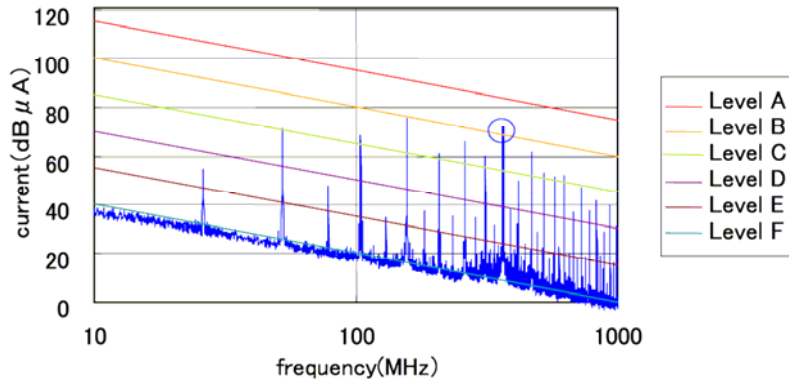
Note 1. The disturbance limits from 10 to 1000 MHz shall be linearly varied when the frequency is presented in logarithm, and current values are presented in dB μ A.

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 that most modules may meet.



An example of meeting Level A

Kit Module Marking (Labeling)

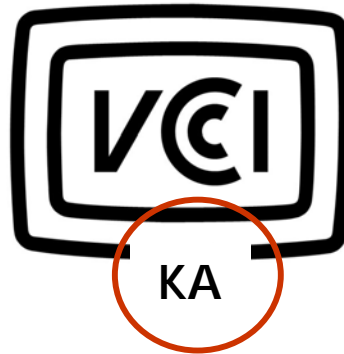


Reference



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 |

Conclusion

- EMI quantification with subsystem (module) is desirable.
- VCCI has provided a framework for module level EMI quantification with Magnetic Probe Method (IEC61967 Part 6)
 - Measurement Method,
 - Emission Level to be controlled,
 - Test Facility Authorization,
 - Marking.
- VCCI Kit Module Program keeps to be improved and may add another quantification methods when they are verified.