

# Technical Report

## UUT Power Testing

### Introduction

A lot of test strategies only do very basic or even no power supply tests on target UUTs, however power is the **most** important part of any electronic design. A poor performing power supply will affect the complete performance of the UUT and potential lead to intermittent and/or early life failures resulting in significant return costs, and more importantly reputation.

Engineers often ask 'what can go wrong with power supplies' or make statements such as 'if the UUT powers up the power supplies must be ok'. Unfortunately just because the UUT has successfully powered up does not mean the power supplies are operating as they have been designed. Switching power supplies are complex analogue circuits that can have many hidden issues.

### Power Supply Tests

Power supply tests can range from very simple, to more complex testing. Listed in the table below are typical supply tests and the effect on the UUT if the supply does not meet the designed specified limits.

| Test                            | Error effects   |
|---------------------------------|---|
| Voltage output accuracy         | <ul style="list-style-type: none"> <li>- Voltage stress on semiconductors (Voltage too high)</li> <li>- Higher system currents – heat (Voltage too low)</li> <li>- Unreliable operation (Voltage too low or too high, or unstable)</li> </ul> |
| Load regulation (DC)            | <ul style="list-style-type: none"> <li>- Intermittent errors when UUT draws peak currents dropping voltage below the minimum operating voltage range</li> </ul>   |
| Efficiency                      | <ul style="list-style-type: none"> <li>- Supply overheating at higher loads</li> <li>- Heat stress on power components</li> </ul>   |
| Switching frequency (Stability) | <ul style="list-style-type: none"> <li>- High ripple current stresses on input and output capacitors</li> </ul>   |
| Under-voltage lockout           | <ul style="list-style-type: none"> <li>- Supply starts switch too early (or late) causing potential un-regulated output</li> <li>- UUT latch up / Sequencing errors</li> </ul>  |
| Transient response (AC)         | <ul style="list-style-type: none"> <li>- Intermittent errors when UUT draws peak currents dropping voltage below the minimum operating voltage range</li> </ul>   |

### Typical Supply Errors

The table below lists potential board errors that cause power supply issues.

| Error  | Typical causes   |
|--|--|
| Voltage output accuracy error                      | <ul style="list-style-type: none"> <li>- Incorrect feedback resistors</li> <li>- Supply reference error</li> <li>- Remote sense circuitry component values and/or shorts</li> </ul>  |
| Load regulation (DC) error                         | <ul style="list-style-type: none"> <li>- Bad connections (FETS/ Inductor/capacitor/connector)</li> <li>- Missing or 'dried-out' O/P capacitors where multiple parts are paralleled</li> <li>- Inductor saturation (e.g. cracked core)</li> <li>- Current sense resistor value</li> </ul> |
| Efficiency error (low efficiency)                  | <ul style="list-style-type: none"> <li>- Bad thermal connection on switching FETs</li> <li>- Bad thermal connection on controller IC.</li> <li>- Inductor saturation (e.g. cracked core)</li> </ul>  |
| Supply switching frequency error (Supply unstable) | <ul style="list-style-type: none"> <li>- Compensation component value errors</li> <li>- Supply frequency setting component value errors</li> <li>- Controller Minimum 'On' Time issues causing pulse skipping effects</li> </ul>   |
| Under-voltage lockout                              | <ul style="list-style-type: none"> <li>- Component value errors or shorts</li> <li>- Reference errors</li> </ul>   |
| Transient response (AC) error                      | <ul style="list-style-type: none"> <li>- Compensation component errors</li> <li>- Output capacitor ESR / Value Errors</li> <li>- Bad connections</li> </ul>  |

## **Conclusion**

Power supplies are complex analogue circuits. They can have many failure modes that will affect the whole UUT performance and MTBF (mean time before failure) and should be carefully assessed as to how they should be tested.

Basic tests such as measuring the output voltage to be within specified limits helps, but is not enough to verify the whole performance of the power supply. At very minimum supplies should be tested at their expected full load.

During functional test this can be done using electronic loads to simulate operational currents and additional future expansion currents.

More advance testing will assure the power supplies are performing 100% as specified and therefore increase field reliability and reduce early life failures.

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For more information on power testing and how the J-Testr can help test your UUT supplies please contact your distributor.