Summarized Written Comments: Generalized Internal Power Supply Efficiency Test Procedure Rev. 5

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This document summarizes all substantive written comments that Ecos Consulting and EPRI Solutions have received to date in helping to draft revision 6.0 of the Generalized Internal Power Supply Efficiency Test Procedure for the California Energy Commission's PIER program. Comments are left anonymous and are separated into relevant categories/sections of the test procedure document.

General Comments

(*Computer Industry Stakeholder*)

"Generally the test protocol is very good and complete."

(*Power Electronics Industry Stakeholder*)

"On the whole this test procedure has our full support. In principle it will be greatly beneficial to have a standard efficiency test procedure and report format. This will reduce the confusion in the market and increase the focus on efficiency."

(*International Policy Stakeholder*)

"As you already know, we are promoting the XXXX program for energy-efficient appliances. Under the XXXX program, we are focusing on total energy efficiency of appliances rather than individual parts, such as the internal power supply. In this context, we do not have an intention to introduce regulation of internal power supply for the time being, although we understand and admire CEC/ENERGY STAR's approach and effort for a single test procedure."

(*International Policy Stakeholder*)

"Much improved, particularly proportional allocation of loads."

(*International Policy Stakeholder*)

"The IPS test procedure is not straightforward with respect to multi-rail (e.g. PC) supplies and requires an experienced laboratory technologist and, if it is to be practicable, programmable electronic loads. Our first outing with the methodology was with manually switched resistive loads, and that process is not viable in the context of cost-limited conformance testing of many samples.

But we can't think of any way of improving on what has been reached in V5 for PC testing."

Scope

(International Policy Stakeholder)

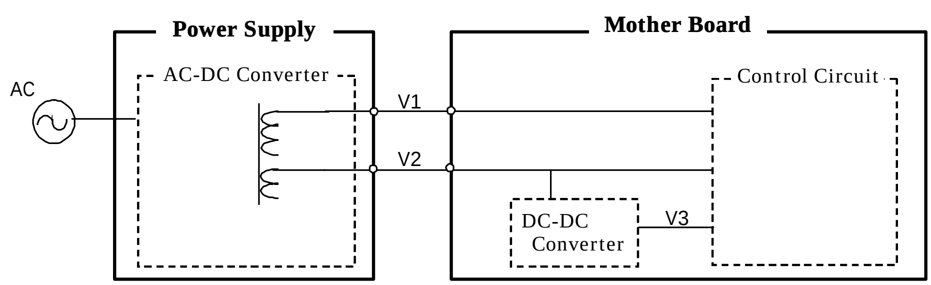
"This test protocol applies to 'single-phase or three-phase power supplies with AC input and a single or multiple DC outputs.'"

Furthermore, **3.** Definitions and **9.** Appendix B give provisions for three types of internal power supplies. We believe, however, the final product configurations of these internal power supplies should be defined with figures, as shown in Attachment 1, for better comprehension.

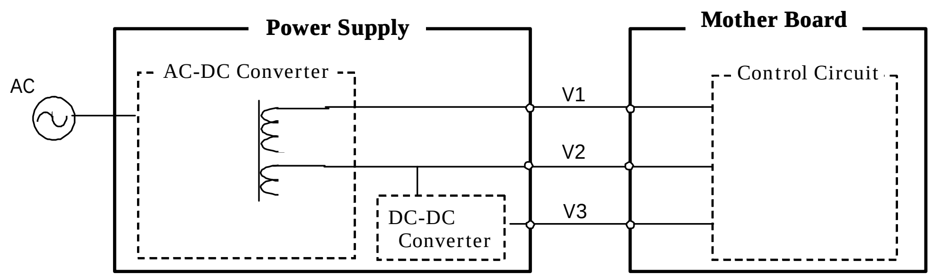
XXXX's understanding about the scope of this protocol as it applies to Attachment 1 is as follows:

Configuration	Input	Output	Test Protocol Coverage
Type A	AC	DC: V1, V2	Protocol applies
Type B	AC	DC: V1, V2, V3	Protocol applies
Type C	AC	DC: V1, V2 *V3 is not regarded as an output of the internal power supply	Protocol does not apply because the supply does not have easily accessible outputs
Type D	AC	DC: V1, V2, V3 *Has an AC output	Protocol does not apply because the supply has an AC output

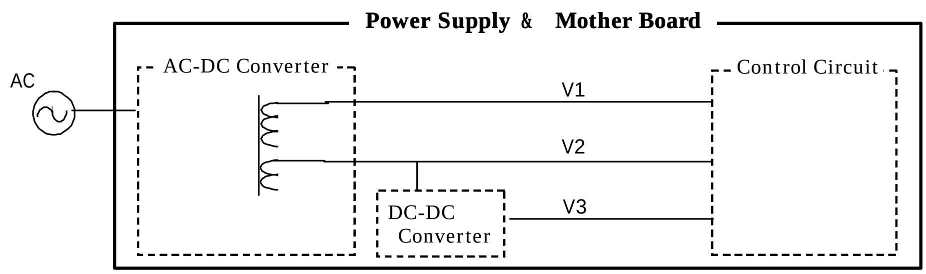
Type A: Internal power supply with multiple DC outputs



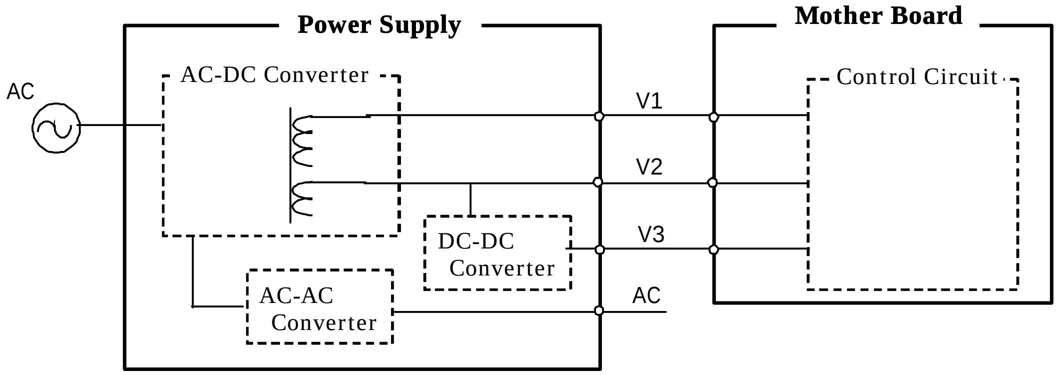
Type B: Internal power supply with a DC-DC converter



Type C: Case where the AC-DC power supply is mounted on the mother board



Type D: Internal power supply with an AC output



We consider Type C supplies to be outside this test protocol’s scope because of the provision ‘have easily accessible inputs and outputs’ in the definitions of the three types of internal power supplies given in 3. Definitions.”

Definitions and Normative References

(*Computer Industry Stakeholder*)

“The definitions are very specific and complete. For example, the THD reading from a power meter should be defined in the power meter’s manual to determine if the test equipment meets the requirements of the test protocol.”

(Power Electronics Industry Stakeholder)

“There is a typo in eq. 3-2. Use ‘V’ vs. the greek character nu.”

(International Policy Stakeholder)

“3.16 Rated DC Output Power: The expression ‘maximum’ in the phrase ‘The maximum dc output power’ should be removed because the rated power is not necessarily defined by the maximum power.”

Equipment and Test Setup

(*Computer Industry Stakeholder*)

“Section 5.4 Measurement Instrumentation Accuracy: Need to check the requirements of IEC 62301. The measurement uncertainty of < 2% needs to be checked against typical lab power test equipment. Voltech, Vahalla, Yokagawa, Chroma and Fluke are the major power measurement equipment manufacturers. The resolution and measurement uncertainty of the available test equipment needs to be comprehended in this protocol.”

Question: is the requirement of <2% too stringent for most equipment to meet?

(*Computer Industry Stakeholder*)

"Section 5.6 Warm-up Time: Input Power reading variation of 5% is to high given a stable output load and stabilized internal UUT temperatures."

(*International Policy Stakeholder*)

"Perhaps there is a need for further guidance on the wiring of loads?"

(*Power Electronics Industry Stakeholder*)

"Section 4.2: This does not clear up anything. This needs to state highest or lowest rated voltage, not just rated voltage. Rated voltage in the specification is going to be a range. We should propose that the efficiency be determined at the lowest rated voltage.

Section 4.4: This assumes that the power supply has reached thermal steady state in 30 minutes. This may not be the case for large power supplies. They should state that the measurement is taken when thermal equilibrium is reached (rather than 30 minutes) or integrated across 5 fan cycles.

Section 5.2: A power source of 10X the power supply rating is excessive. Especially in light of the THD and voltage conditions listed in this section. I would take out the 10X requirement as the THD and voltage conditions are sufficient to describe the robustness of the source.

Section 5.5: We need to add elevation as this impacts the density of the cooling air."

Loading Conditions and Measurement

(*Computer Industry Stakeholder)*

"One potential issue and conflict exists for the loading definition method for efficiency testing specified in section 6 when D<1 (Australian Method).

Normally, power supply has its minimum current requirement for each bus, but sometimes the 20% or 10% loading defined by following the method of section 6 is lower than the minimum current requirement. In this case, the minimum current requirement should have higher priority than the efficiency loading definition, then the 20% or 10% loading definition should be adjusted accordingly to accommodate the minimum load requirements in power supply specifications."

(*Computer Industry Stakeholder*)

"Section 4.4 Duty Cycle of Power Supply Fan: It is not clear how this "integration" is done. (review section 4 of IEC 62301 (Measurement of Standby power) The DC output load is fixed and the fan is turning on and off during the 30 minute period. Therefore, average or integrate the input power measurement for the 30 minute period."

"Section 6 Proportional loading looks OK."

(*Power Electronics Industry Stakeholder*)

“It is good to calculate the efficiency down to a load of 10%; however, it would also be beneficial to measure PSU efficiency at its typical standby condition and to measure power loss and/or efficiency also at this level. This is particularly relevant to the ATX PSU example given in section 8 which will probably spend most of its life in standby mode except perhaps in a server application.”

(*International Policy Stakeholder*)

“Is there a statement on the duration of the test for each loading?”

(*Power Electronics Industry Stakeholder*)

“Section 6.1 is acceptable as long as the output voltage and current are both measured. Otherwise loading points need to be determined per the rated power, not the rated current.

Section 7.5: What mode is the electronic load to be set in? Constant power, constant voltage, constant current, or constant resistance? I would suggest constant current.

Section 7.7 typo: Duplicated rms input current.”

(*International Policy Stakeholder*)

For general "bespoke" supplies for example the open frame types in the V5 discussion, there are some issues.

”In energy-efficient products, the trend is for these supplies to consist of AC-to-DC switching converters supplying one or two header voltages, typically 6 volts and up to 22volts. These voltages are then taken as close to the loading silicon as possible where they are converted to low voltage high current using DC-to-DC conversion at high efficiency (>80%). Typical high current DC-DC conversion at point of requirement on the circuit board ranges from 3.3 down to 1.5 volts in new domestic electronic products where heat generation must be restricted (Plasma TVs, complex STBs etc.) and it would be completely impracticable to measure at these points in a production line product.

In less efficient, cheaper products analogue regulators may well be used, so that even if the main supply is efficient (80+) the overall delivered AC to DC conversion may well be poor.

This is not to say that it will not be a good thing to give these "simpler front end" IPS's an efficiency criteria but that we will have to ensure that it is supported with other criteria such as an on-mode metric and a power management metric.

Non of this impinges on the validity of the V5 test methodology for these simpler supplies, except that the loading points (20% 50% etc) may require a rethink in the context of the power management regime of the product. You may have noted that we are suggesting some working group activity in this context for the new generation of complex STBs to be covered after 2008 by the XXXX. An initial suggestion is that the operating modes are defined as "standby passive" where applicable - the lowest "soft off" power state possible. "Standby active" is the minimum power state automatically achievable by power management. Then a typical, manufacturer/specifier advised, activity regime giving an on-average measuring point and finally maximum power loading. Standby active and on-average may have loading levels that are unrelated to current suggested levels for IPS."

(International Policy Stakeholder)

"In some configurations, the final product contains a fan but the internal power supply does not. In such configurations, the internal power supply is designed with the expectation that the power supply will be cooled by the product's fan. A provision for this type of configuration should be given as a condition of efficiency testing.

Specifically, we would like to see that it is possible to determine additional requirements about heat dissipation specifications when the internal power supply does not have a fan where the text states 'the manufacturer and user of the power supply may determine additional requirements, such as harmonic distortion or unbalance specification as need be.'"

"The efficiency of the power supply should be measured at 25%, 50%, 75%, and 100% of the rated current in the same way as the ENERGY STAR external power supply standards.

The item concerning power efficiency measurements at 10% loading should be clearly stated as 'limited to server applications only' since it is extremely low and intended for testing redundant power supplies in server applications.

In some cases, a standard internal power supply given an output power rating of 100 W by the power supply manufacturer is used in the final product as a supply with an 80 W output power rating. There should be a provision to the effect that the power supply loading in these cases can be defined based on the output rating used in the final product.

Specifically, we would like to see the addition of the statement 'Where the manufacturer of the final product specifies the output rating of the internal power supply, power supply loading based on this output rating has priority.'"

Reporting Requirements

(*Power Electronics Industry Stakeholder*)

"It is unclear as to what average efficiency is intended to be with the PSU tested at 10, 20, 50 and 100% load. The sum of the efficiencies at these loads divided by 4 does not equal the average efficiency given in the example in section 8. This should be more clearly defined within section 3, Definitions.

If efficiency measurements are calculated at 25 and 75% load, this will allow average efficiency to be calculated at the 25, 50, 75 and 100% loads typically used for an external adapter. It may also be better to calculate the efficiency at 25% as opposed to 20% as this is more in line with current standards. This will a) eliminate one test and b) harmonise this test procedure with other standards, therefore increasing the chances of adoption. Suggested load test conditions are: standby, 10%, 25%, 50%, 75% and 100%, with average efficiency being the sum of the efficiencies at 10%, 25%, 50%, 75% and 100% load, at 110 and 230 VAC, divided by 10.

In the report example in section 8, the first graph would be more useful if it showed the input AC current at lower load conditions, as the quality and energy efficiency of a PFC circuit is more apparent at lower loads. The suggested load to be displayed is 50%. The measurement table should present efficiencies measured at 110 and 230 VAC.”

(*Power Electronics Industry Stakeholder*)

“Section 7: What about requiring a record of output capacitance? Standby power supply loading? Measurement of ambient and exhaust air temp?

Section 7 and Appendix A: The test report needs to include a description of measurement equipment (model numbers, etc) and settings, ambient temperature, elevation or barometric pressure, schematic and pictures of the setup, an indication of who the operator was (initials, name, badge number, code, etc.). The test report should be sufficient so that anyone could duplicate the results by following the setup described in the report.”