
SEMI F47-0706

Specification for Semiconductor Processing Equipment Voltage Sag Immunity

Abstract: This paper details the Ultimod and XGen range of power supplies level of compliance with the Semi F47-0706 standard.

Introduction

In general, factory automation equipment requires very high levels of power quality due to the sensitivity of equipment and process controls. Semiconductor processing equipment in particular can be vulnerable to voltage sags on the input line. The SEMI F47-0706 standard defines minimum voltage sag immunity requirements for semiconductor processing, metrology, and automated test equipment. As components of this equipment, power supplies are required to meet these minimum voltage sag requirements.

What is Voltage Sag?

A voltage sag (or dip) is defined as a decrease in rms voltage or current below 90% of **nominal** for durations of half an AC cycle to one minute, but not a complete interruption. Voltage sags can have many causes such as severe weather conditions, utility equipment operations or failures as well as adjacent customers.

Many of us will have seen the effects of voltage sag (such as momentary dimming of incandescent lights), but in a production environment input voltage sag can cause a production shutdown, leading to significant revenue losses.

In order to address this issue, in 1999 the Semiconductor Equipment and Materials Institute (SEMI), established standards relating to AC line sag immunity.

SEMI F47-0706 Overview

The SEMI F47-0706 defines minimum voltage sag immunity requirements for equipment to be used in the semiconductor industry. These immunity requirements state that the equipment must operate without interruption during voltage sags that are specified by sag depth (in percent of **nominal voltage** remaining during the sag) and voltage sag duration (in cycles or seconds).

Semiconductor process equipment manufactures can use this standard to ensure that the voltage sag immunity requirements that they adhere to are met by their subsystem and component suppliers.

SEMI F47-0706 does not address safety issues, nor does include requirements or recommendations for over-voltage conditions (voltage swells), high frequency impulse events, and other power disturbances. This specification also does not pre-empt or override international, national or local codes.

SEMI F47-0706 Test Summary

For a power supply to meet the SEMI F47-0706 standard, the supply must provide the required output voltage and current without interruption when subjected to the voltage sag levels below nominal and durations listed in Table 1 below, or in other words, continuously operate without interruption during the conditions above the bold line in Figure 1.

(The power supply should be tested for voltage sag immunity according to the methods set forth in IEC 6100-4-11 for equipment rated at 16 A per phase or less).

Sag Depth Below Nominal	Duration at 50 Hz		Duration at 60 Hz	
	50%	10 Cycles	200 ms	12 Cycles
70%	25 Cycles	500 ms	30 Cycles	500 ms
80%	50 Cycles	1.0 s	60 Cycles	1.0 s

Table 1 Required Voltage Sag Immunity

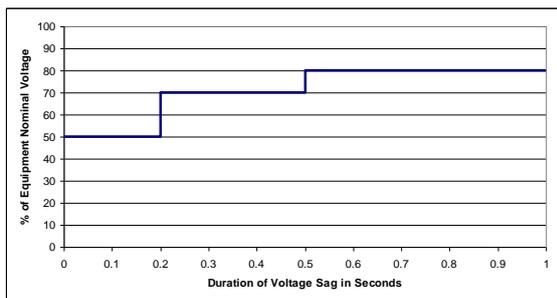


Figure 1 Required Voltage Sag Immunity

In addition to the above requirements, the supply is recommended, but not required, to be immune to the voltage sags below nominal detailed in Table 2 below (again the supply should continuously operate without interruption during the conditions above the bold line in Figure 2).

Sag Depth	Duration at 50 Hz		Duration at 60 Hz	
	0%	1 Cycle	20 ms	1 Cycle
80%	500 Cycle	10.0 s	600 Cycles	10.0 s
90%	Continuous	Continuous	Continuous	Continuous

Table 2 Recommended Voltage Sag Immunity

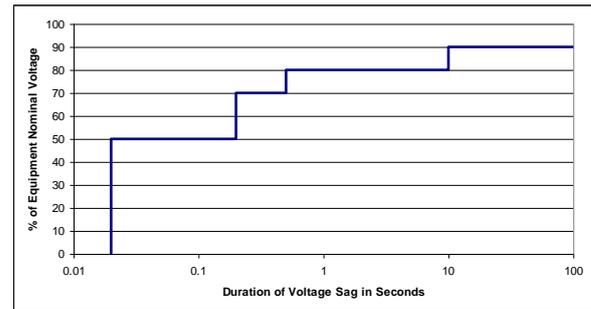


Figure 2 Recommended Voltage Sag Immunity

In the absence of alternative instructions or requirements, the Pass/Fail criteria for **semiconductor processing equipment** (end application) should be no interrupts (a failure or an unplanned stoppage that requires external intervention). The requirements of the **subsystems and components** can then be specified to meet one of the following:

- Performs at full rated operation
- May not perform at full rated operation but recovers operation without operator and/or host controller intervention. Must not send error signals to the equipment host controller indicating when full rated operation is not achieved.
- May not perform at full rated operation but recovers operation without operator and/or host controller intervention. May send signals to the equipment host controller indicating when full rated operation is not achieved.

The above voltage sag tests should be carried out under load that is representative of the load required by the end application. It is not necessary to test multiple model types if reasonable judgement indicates similar performances under voltage sag conditions.

Ultimod F47-0706 Compliance

Both the Xgen and Ultimod supplies are designed operate as normal (at rated output voltage and current) for an input

voltage range of 80 Vac to 264 Vac. This means that a voltage sag down to 80 Vac will not affect the output in any way.

It follows that the Xgen or Ultimod power supply is **fully compliant** with the F47-0706 standard for the input voltage range of 160 Vac to 264 Vac (i.e. it is immune to voltage sags down to 80 Vac).

In addition, as a component power supply, the Xgen and Ultimod power supplies can operate as per Part C of the section 7.8.2. of F47-0706 (May not perform at full rated operation but recovers operation without operator and/or host controller intervention. May send signals to the equipment host controller indicating when full rated operation is not achieved) for the input voltage range of 85 Vac to 160 Vac.

About Advanced Energy

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AE's power solutions enable customer innovation in complex semiconductor and industrial thin film plasma manufacturing processes, demanding high and low voltage applications, and temperature-critical thermal processes.

With deep applications know-how and responsive service and support across the globe, AE builds collaborative partnerships to meet rapid technological developments, propel growth for its customers and power the future of technology.