

## **Standard Product MIL-STD-461 Conducted Susceptibility Test Criteria**

Conducted susceptibility is the response of the converter to unwanted signals applied to the power leads. Requirement CS01 tests the converter's ability to perform properly with audio frequency signals superimposed on the DC input. This is also called "audio frequency rejection." CS02 extends this into the RF range. Requirement CS06 applies positive and negative spikes to the converter's inputs.

### **CS01 Testing**

The objective of the CS01 (Audio Susceptibility Test) is to assure that the DC-DC Converter produces a usable output when subjected to a simulated worst case AC modulation of the DC power supply input.

In the CS01 test, an audio signal ranging from 30 Hz to 50 kHz is connected between the DC-DC Converter and the power source. Both the positive and negative legs are tested if the input is isolated from the case. For a 28 VDC nominal unit, a 2.8 volt RMS (8.2 volts peak to peak) is applied. At 1.5 kHz to 50 kHz, the signal is linearly decreased. In addition, the power of the susceptibility source is limited to 50 watts. For higher voltage units, the voltage is usually scaled proportionally.

For meeting the audio susceptibility (CS01) requirements, it is not commonly realized that the audio frequencies involved are, for the most part, much lower in frequency than either an internal or external filter can attenuate. Therefore, the design of the converter itself must be capable of audio frequency rejection. This requires high loop gain at the high audio frequency range. CS01 rejection is typically achieved by using current mode or dual loop feedback.

Applying the audio susceptibility signal causes the DC-DC Converter's output to be modulated at the audio frequency. The output of the converter has the normal high frequency ripple with the audio superimposed.

Standard pass fail criteria for the CS01 test is that the peak to peak modulation envelope not exceed the specified peak to peak ripple specification. For example, if the peak to peak ripple specification is 50 mV, an additional 50 mV is allowed when the audio susceptibility signal is applied.

## **CS02 Testing**

CS02 testing is an extension of CS01 testing that starts at the same frequency and amplitude as CS01 testing and extends into the RF range. The coupling method is different from the CS01 method to allow use of 50 OHM RF generators. The power is also limited to 50 watts.

Due to highly effective input filter response in this frequency range, it is unusual to detect any change in DC-DC Converter performance when this test is performed.

## **CS06 Testing**

Spike amplitudes and durations are governed by numerous specifications. The MIL-STD-461 CS06 spike test is typical. In this test, repetitive narrow (typically 10 microseconds width) spikes are applied to both power inputs (if not connected to case ground) in turn. For a 28 volt system, the peak amplitudes are 56 volts, both positive and negative. MIL-STD-704 and MIL-STD 1275 also have similar spike requirements. Another requirement imposing spikes is MIL-E-6051. Commercial aircraft also have a DO-160 spike test.

Spike suppression is generally easier than surge suppression since the time durations are much shorter. Spike suppression can be implemented completely within a hybrid package by relying on the EMI suppression components to spread the energy within the spike over a longer period of time. This essentially transforms the high voltage spike to a lower voltage waveform incurring no loss. In certain instances, zener diodes are also used to keep peak voltages below safe limits. Typical CS06 spike suppression pass/fail criteria allow a +/-5% deviation when the spike is applied.