DC Power Input Considerations

Conducted Susceptibility and Spike Effects

Conducted susceptibility is a test method that applies an AC modulation superimposed on the DC-DC Converter's power input leads. It corresponds to method CS01 and CS02 of MIL-STD-461C and CS101 of MIL-STD-461D. CS01 extends from 30 Hz to 50 kHz, so is called audio frequency susceptibility.

All testing for conducted susceptibility is normally done at nominal full load conditions. For the CS01 test, an audio signal of 2.8 volts RMS (8.2 volts peak to peak) is superimposed on the input 28 VDC. From 1.5 kHz to 50 kHz, the amplitude decreases linearly. In addition, the power of the susceptibility source is limited to 50 watts.

For the 120 VDC series of converters, the conducted susceptibility level is 5 volts RMS superimposed on a nominal 120 VDC level, in accordance with SSP30237. For the 270 VDC converters, the test voltage is 10 V RMS. The 8 to 40 VDC units are tested with a conducted susceptibility voltage of 1 volt RMS superimposed on a 14 VDC level.

For 5000 series parts, the CS01 voltage is 1Vp-p and the parts are tested at 28 VDC For 7000 series parts, the CS01 voltage is 1Vp-p and the parts are tested at 50 VDC For 8000 series parts, the CS01 voltage is 2Vp-p and the parts are tested at 70 VDC For 9000 series parts, the CS01 voltage is 2V p-p and the parts are tested at 100 VDC.

Applying the audio susceptibility signal causes the DC-DC Converter's output to be modulated at the audio frequency. Thus, the output of the DC-DC Converter has the normal high frequency ripple with the audio superimposed. Standard MDI pass/fail criteria for CS01 testing is that the envelope of the peak to peak output modulation not exceed the specified peak to peak ripple specification. Therefore, the maximum allowable output deviation with a conducted susceptibility input is twice the allowable peak to peak ripple.

The MDI full featured DC-DC Converters have excellent rejection of conducted susceptibility due to their current mode inner loop. The basic converter has a loop gain of greater than 50 dB. The typical EMI resonance is in the 5 kHz to 10 kHz area, where a peaking of approximately 10-12 dB can occur. This peaking amplifies the conducted susceptibility, so it subtracts from the basic audio rejection of the converter. Beyond this point, the filter adds attenuation.

In MDI's standard triple output converters, one output (usually 5 VDC) is the main regulated output. Only the main regulated output will exhibit conducted susceptibility effects. The other two outputs are linear regulated. In this event, there is virtually no discernible effect on the linear regulated outputs arising from the conducted susceptibility. The reason for this is the additional voltage rejection of the linear regulator itself.

CS02 testing extends the conducted susceptibility range from 50 kHz up through the low UHF region. The injection methods of CS02 are different from CS01 injection because of the frequency range. The coupling method allows the use of standard 50 ohm impedance RF generators and amplifiers.

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. Because the power return leg is at RF ground, the CS02 test should be performed on the positive power lead only.

Spikes impressed on the power input leads of the full featured DC-DC Converters are principally attenuated by the input EMI filter. The filter losslessly transforms the shape of narrow spike waveforms into a lower amplitude damped sinusoid at the input EMI filter's resonant frequency. A ± 5% output voltage deviation is allowed for the converters full featured DC-DC Converters when the CS06 or equivalent spike waveform is applied.

MIL-STD-461D, E and F Conducted Susceptibility CS114, CS115 and CS116

The CS06 spike test of MIL-STD-461C was replaced by methods CS114, CS115 and CS116 of MIL-STD-461D, E and F.

In method CS06, narrow spikes are directly connected to the DC-DC Converter power inputs. In contrast, sine waves (method CS114), narrow pulse (CS115) or damped sinusoids (CS116) are coupled into the representative power cables that feed the DC-DC Converter.

Because MIL-STD-461D, E and F are based on signal injection to the entire unit (of which the DC-DC Converter is only a part), these tests are fundamentally different than the CS06 test. The CS114, 115 and 116 inputs generate conducted susceptibility on the power input lines, but also have the potential to generate noise on other wiring external to the DC-DC Converter.

In the MDI DC-DC Converters, there are power inputs, power outputs and control pins.

Depending on the arrangement of the unit and the internal and external cables ultimately connecting to the MDI DC-DC Converter, no upset or significant degradation of performance should be expected, since the extensive multi-stage input LC filter and low ESR output capacitors within the MDI DC-DC Converter substantially attenuate the susceptibility effects.

However, care should be taken by the user in layout, decoupling and connection to the control pins, including the BIT, inhibit, sync and adjust pins, since these pins have less filtering than the inputs and outputs.