



**Application Note - Interpoint**

**Crane Aerospace & Electronics Power Solutions**



# **EMI Compliance Statement for Interpoint Standard DC/DC Converters**



# EMI Compliance Statement for Interpoint Standard DC/DC Converters

## APPLICATION NOTE

*Although the concepts stated are universal, this application note was written specifically for Interpoint products.*

Interpoint DC/DC power converters are designed as small modules which are usable in a majority of applications without any additional power line filtering or output filters. When MIL-STD-461C or any other EMI specification is a requirement, an additional power line filter may be required as well as output and/or protection filters for the other terminals. Each of the

461C requirements will be reviewed with a discussion of what may be required for compliance in each case. The requirements are discussed individually in the following paragraphs and summarized in "Table I: MIL-STD-461C – Aircraft and Space Applications."

### CONDUCTED EMISSION REQUIREMENTS

**CE01:** This is a narrow band only requirement in the bandwidth from 30 Hz to 15 kHz and can be applicable to both input and output power lines of the power converters. Since Interpoint converters have no major noise sources at these frequencies, they should comply without any problem.

**CE03:** This requirement covers both broadband and narrowband noise over the frequency range 15 kHz to 50 MHz, and is applicable to both input and output power leads. Usually, only the input power leads are a problem since the output leads generally don't exit the system enclosure.

The input current spectral noise components are generally less than 1 mA RMS with the larger fundamental component in the 1 to 10 mA RMS area. This is usable as is in many cases. An external filter is required for 461C compliance. Since the PWM power converters are negative input impedance devices, care must be exercised in selecting or designing an input line filter. Interpoint filters and power converters are compatible in any combinations within the filter's maximum current spec. The power converter output noise is as specified on the data sheet only. Common mode and/or differential external output filters are required for noise reduction below the stated specification.

**CE07:** Conducted switching spikes. Interpoint power converters comply if used properly.

### CONDUCTED SUSCEPTIBILITY REQUIREMENTS

**CS01:** This is a conducted audio spectrum applicable to input power lines. The spectrum magnitude is 5 VRMS or 3% of nominal line, whichever is less, from DC to 1.5 kHz, decreasing linearly to 1 VRMS at 50 kHz. This is a test specification, and more severe than usually encountered on an aircraft power bus. MIL-STD-704 has an audio spectrum of lesser amplitude which is a more typical requirement. You may want to refer to this. Where CS01 is a requirement, Interpoint's older MHE, MLP, MTW, and MFW parts are not recommended. These parts do not have feedforward compensation to help reject audio, and have tantalum power line capacitors which may be damaged or blown out at audio frequencies coinciding with filter resonances.

Interpoint's newer parts (MCH, MHF, MHF+, MOR, MSA, MTR, and MFL) use ceramic power line capacitors and have feedfor-

ward compensation to take care of these problems. These parts will typically have 40 dB or more of rejection over the bandwidth of interest. Compliance will be determined by the degree of rejection and what the equipment spec allows for low frequency output noise.

**CS02:** This a conducted RF susceptibility requirement and is applicable to the input power lines over the bandwidth of 50 kHz to 400 MHz. Additional power line filtering, the same as used to meet CE03, is required for compliance.

**CS03:** Not applicable to power conversion devices.

**CS04:** Not applicable to power conversion devices.

**CS05:** Not applicable to power conversion devices.

**CS06:** This is a transient susceptibility test where a 200 volt pulse is superimposed on the power bus, usually 28 volts. The source impedance of the combined power bus and transient generator is less than 0.5 ohms. A source impedance of zero ohms is a practical assumption.

There are two transient durations, 0.15 microseconds and 10.0 microseconds. The first will be suppressed in any Interpoint power converters having a simple LC power line filter, or using one of our FM series filters in the power line. The 10 microsecond transient will not be suppressed by any Interpoint filter modules.

Suppression is also not practical using inductors or transorbs due to the low source impedance and component sizes involved. The only practical means of suppression is to use a stripper such as Interpoint's FM704A which is specified for transients up to 400 volts.

**CS07:** Not applicable.

**CS09:** Not applicable.

**CS10:** This test is for common mode current susceptibility, due to EMP, and can be applicable to all pins not internally grounded to case reference. Applicability is usually limited to input power pins but must be spelled out in the system specification. The common

# EMI Compliance Statement for Interpoint Standard DC/DC Converters

## APPLICATION NOTE

mode currents must be bypassed to the case with ceramic capacitors and/or transorbs. For input power lines, a capacitor between the two lines will take care of any unbalance. Capacitors on the order of 0.1 microfarads should be suitable for suppression.

**CS11:** This test is for common mode currents induced in cables due to EMP. The comments of CS10 are generally applicable here also.

### RADIATED EMISSION REQUIREMENTS

**RE01:** Limited applicability to equipment for ASW or VLF operation. The requirement is for radiated emissions in the 30 Hz to 50 kHz bandwidth. Our power converters have no narrow band noise source in this range.

**RE02:** General applicability for broadband emissions from 14 kHz to 1 GHz and narrow band emissions from 14 kHz to 10 GHz. This requirement is usually limited to the input power lines but may apply to the output leads if defined in the equipment specification. If the power converter meets CE03 for the input power lines, it generally will meet RE02 also.

**RE03:** Applicable only to transmitting equipment or equipment connected to or with antennas.

### RADIATED SUSCEPTIBILITY REQUIREMENTS

**RS01:** Limited applicability to equipment for ASW of VLF operation. The requirement is for susceptibility to fields in the 30 Hz to 50 kHz bandwidth. Interpoint power converters should not have a problem here.

**RS02:** Induced spike susceptibility applicable to wire bundles as defined in the procedure of MIL-STD-462. Common mode bypass capacitors or bypass capacitors with a balun will take care of input power lines. However if induced transients are pure common mode, no additional filtering may be required.

**RS03:** This test requirement is of general applicability from 14 kHz to 10 GHz. Common mode filters for all applicable terminals, as defined in the equipment spec, will be required. Radiated energy which gets inside the power converters and is rectified can cause out-of-spec performance or permanent damage such as burnout.

**RS05:** This test requirement has limited applicability and is only for equipment in a non-metallic structure or that outside an airframe.

# EMI Compliance Statement for Interpoint Standard DC/DC Converters

## APPLICATION NOTE

TABLE 1: MIL-STD-461C – AIRCRAFT AND SPACE APPLICATIONS

REQUIREMENT	APPLICABILITY		INTERPOINT GENERAL COMPLIANCE AND COMMENT
	AIRCRAFT	SPACE	
CE01	YES	YES	COMPLY FOR INPUT POWER LEADS
CE03	YES	YES	APPLICABLE TO INPUT & OUTPUT POWER LEADS. USE ADDITIONAL FILTERING FOR FULL COMPLIANCE.
CE06	NA	NA	
CE07	YES	YES	COMPLY
CS01	YES	YES	COMPLY ON SOME MODELS & DEPENDENT ON INDIVIDUAL EQUIPMENT SPECS.
CS02	YES	YES	ADDITIONAL FILTERING NEEDED FOR FULL COMPLIANCE.
CS03	NA	NA	
CS04	NA	NA	
CS05	NA	NA	
CS06	YES	YES	USE STRIPPER TO REMOVE 200 VOLT 10 MICROSECOND TRANSIENT ON INPUT POWER LINE.
CS07	NA	NA	
CS09	NA	NA	
CS10	YES	NA	CM CURRENT SUSCEPTIBILITY WHICH CAN BE APPLICABLE TO ALL PINS NOT GROUNDED TO CASE REFERENCE. SUPPRESS WITH CM & DM TRANSORB & CAPACITOR NETWORKS.
CS11	YES	NA	SAME REQUIREMENT AS CS10, BUT APPLICABLE TO ALL EXPOSED CABLES. SUPPRESS WITH CM & DM TRANSORB & CAPACITOR NETWORKS.
RE01	YES	YES	LIMITED APPLICABILITY
RE02	YES	YES	GENERAL APPLICABILITY FOR EXPOSED CABLES. IF YOU MEET CE03 FOR INPUT POWER LINES YOU SHOULD ALSO MEET RE02.
RE03	NA	NA	
RS01	YES	NA	VERY LIMITED APPLICABILITY
RS02	YES	YES	INDUCED SPIKE APPLICABLE TO WIRE BUNDLES.
RS03	YES	YES	GENERAL APPLICABILITY 14 kHz TO 10 GHz. USE CM FILTERS FOR INPUT & OUTPUT LINES AS REQUIRED.
RS05	YES	NA	LIMITED APPLICABILITY – ONLY FOR EQUIPMENT IN A NON-METALLIC STRUCTURE OR THAT OUTSIDE AN AIRFRAME.