EMI Considerations for DC to DC Converters and Integrated Switching Regulators

Electromagnetic energy, whether intentionally or unintentionally generated, results in Electromagnetic Interference (EMI) with other equipment. Power Trends' products are designed to minimize the amount of electromagnetic energy produced during normal operation. The permissible level of conducted and radiated EMI generated by any end product is regulated by a number of governing bodies throughout the world. Their function is to insure Electromagnetic Compatibility (EMC) of all electronic equipment. To assist designers with compliance in the U.S. and European markets, Power Trends has designed and tested its products to several important standards. The table below shows a comparison of several key standards that define radiated emissions levels.

Table 13

Specification	Frequency Limits (MHz) Lower	Upper	Radiated Emissions Limit for Class A (Industrial Equipment) dB(µV/meter) @ 10 meters	Radiated Emissions Limit for Class B (Unrestricted Use) dB(µV/meter) @ 3 meters
FCC (CFR) Title 47, Part 15, Subpart B	30	88	39.1	40.0
	88	216	43.5	43.5
	216	960	46.4	46.0
	960	1000	49.5	54.0
Bellcore NWT-TR-001089 Electric Field Strength	.01	.024	88.6	139
	.024	.80	56.2 - 20log (f)	87.6 - 20log (f)
	.80	1.59	58.2	108.7
	1.59	4.77	66.2 - 40log (f)	—
	4.77	88	39.1	—
	1.59	20.17	—	97.6 - 40log (f)
	20.17	88	—	40.0
	88	216	43.5	43.5
	216	960	46.4	46.0
	960	10000	49.5	54.0
CISPR 22 Electric Field Strength	30	230	40	30*
	230	1000	47	37*
VDE 0871 Magnetic Field Strength	.01	1	—	171.5 - 20log (f)
	1	30	—	94.1 - 7.1log (f)
VDE 0871 Electric Field	30	470	—	34*
	470	1000	—	40*

* Limit @ 10 meters

Note: The conversion factor for 10 meter intensity to 3 meter intensity is 20log (10/3) or10.5dB(µV/meter)

Power Trends' products are carefully designed to minimize the amount of conducted and radiated EMI. All printed circuit board layouts are designed to minimize trace lengths and subsequent parasitics. Consideration is taken to eliminate ground loops and to control circuit rise times which are major contributors to radiated emissions. High-frequency ceramic capacitors are used on the input and the output to minimize conducted emissions. Thorough end-product testing is used to verify designs as electromagnetic compatible.

The following tables summarize the results of Power Trends' products tested in accordance with the above agency specifications. These tests were conducted by an independent test laboratory at an FCC approved open field test site. The results given here are for specific products that were chosen to be representative of a given product series. Since their circuit layouts are identical, the results for individual products within a series will not vary substantially.

PT3100/4100 Series – The PT3100/4100 series was qualified for EMI at nominal input voltage and full output current. All products in the PT3100 series use the same PCB layout and magnetic components design.

Table 14

Specification	Test Results	Conditions
FCC (CFR) Part 15	Pass Class B	Electric Field tested at 10 meters
NWT-TR-001089	Pass Class B	Magnetic Field tested at 3 meters Electric Field tested at 10 meters
CISPR 22	Pass Class B	Electric Field tested at 10 meters
VDE 0871	Pass Class A Pass Class B	Magnetic Field tested at 3 meters Electric Field tested at 10 meters

PT78ST1 Series – The PT78ST1 series was qualified for EMI at nominal input voltage and full output current. All products in the PT78ST1 series use the same PCB layout and magnetic component design.

Table 15

Specification	Test Results	Conditions
FCC (CFR) Part 15	Pass Class B	Electric Field tested at 10 meters
CISPR 22	Pass Class B	Electric Field tested at 10 meters
VDE 0871	Pass Class B	Magnetic Field tested at 3 meters Electric Field tested at 10 meters

PT6100 Series – The PT6100 series was qualified for EMI at nominal input voltage and full output current. All products in the PT6100 series use the same PCB layout and magnetic component design.

Table 16

Specification	Test Results	Conditions
FCC (CFR) Part 15	Pass Class B	Electric Field tested at 10 meters
CISPR 22	Pass Class B	Electric Field tested at 10 meters
VDE 0871	Pass Class B	Magnetic Field tested at 3 meters Electric Field tested at 10 meters

Although these results indicate a sound product design, radiated and conducted EMI must still be considered in the application of these products. Long traces and signal loops act as antennae that can easily receive and transmit high levels of EMI. When possible, use a multilayer board with a ground plane since this can add as much as 20dB of high frequency attenuation above a 2-sided board. Component location and routing should be checked and appropriate bypass capacitors should be selected. EMI filters and shielded cables are important when running long cables. Realizing its existence and understanding how emissions are generated and suppressed can greatly assist in improving reliability and reducing development costs, while complying with agency requirements.

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