

LMZ10501 and LMZ10500 SIMPLE SWITCHER® Nano Module EMI Performance

National Semiconductor
Application Note 2168
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Introduction

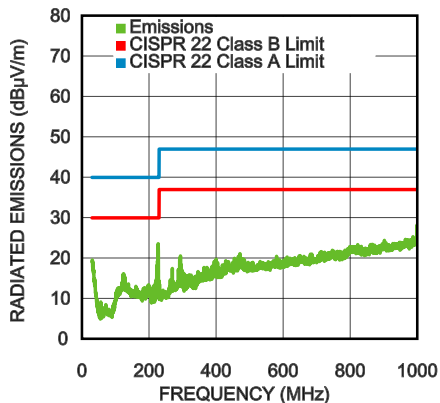
The LMZ10501 and LMZ10500 SIMPLE SWITCHER® nano modules are easy-to-use DC-DC solutions optimized for space-constrained applications. The LMZ10501 is capable of driving up to 1A load with excellent power conversion efficiency, line and load regulation. The LMZ10500 is a 650mA version module pin-to-pin compatible with the LMZ10501.

The LMZ10501 and LMZ10500 nano modules offer excellent EMI performance. The evaluation board with the default components complies with the CISPR 22 Class B radiated emissions standard. Adding two small 0.1 μ F 0805 input capacitors results in CISPR 25 Class 5 radiated emissions standard compliance. The addition of a small LC filter (1 μ H and 1 μ F) to the input of the default evaluation board results in compliance with CISPR 22 Class B conducted emissions and allows for even larger margin of compliance in terms of radiated EMI.

Test Conditions

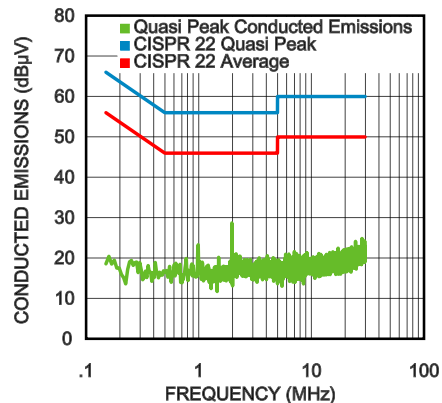
- $V_{IN} = 5V$
- $V_{OUT} = 1.8V$
- 1A load (LMZ10501)
- 650mA load (LMZ10500)
- 2MHz switching frequency
- 4 layer PCB with 1oz copper
- 4.3 x 4.3 cm (1700 x 1700 mil) PCB size
- CISPR 22 Class B Radiated EMI
- CISPR 22 Class B Conducted EMI
- CISPR 25 Class 5 Broadcast Radiated EMI

**CISPR 22 Radiated EMI 1A Load
Default Evaluation Board BOM**



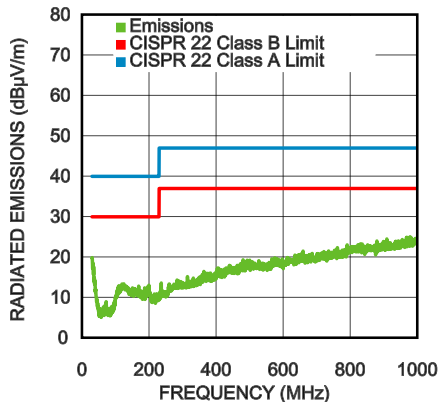
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**CISPR 22 Conducted EMI 1A Load
1 μ H 1 μ F Additional LC Input Filter**



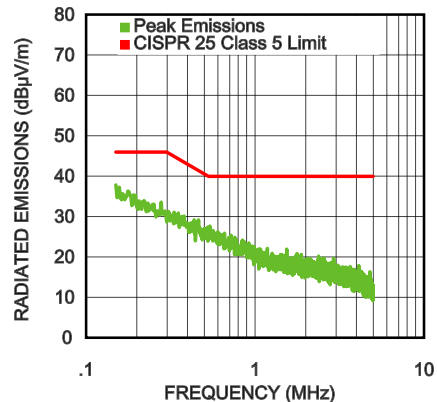
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**CISPR 22 Radiated EMI 1A Load
1 μ H 1 μ F Additional LC Input Filter**

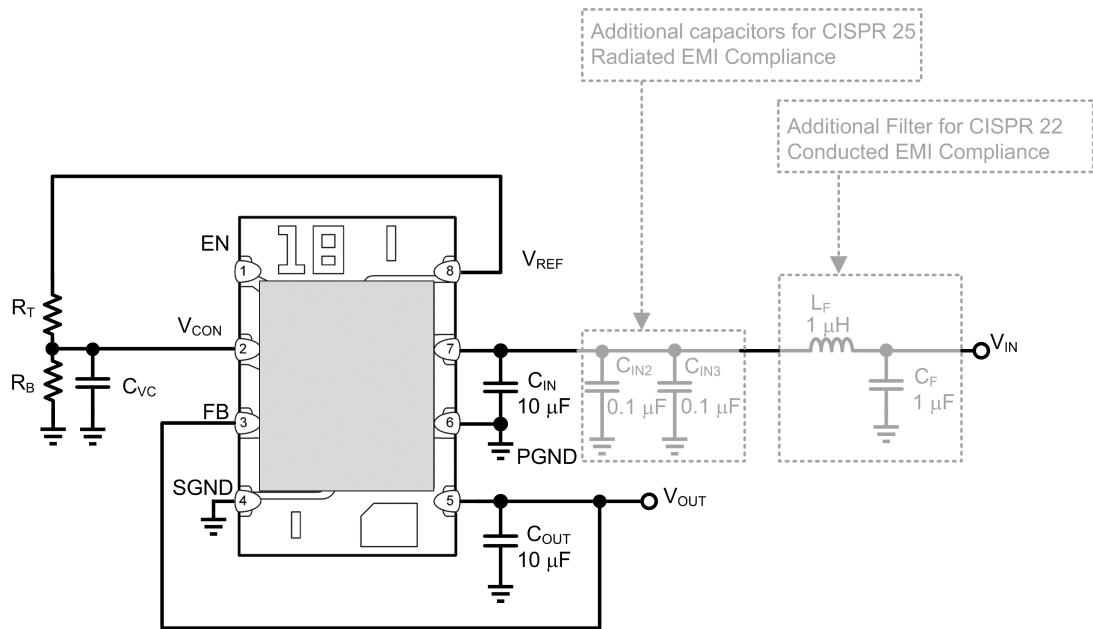


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**CISPR 25 Class 5 Radiated EMI 1A Load
2 x 0.1 μ F Additional Input Capacitance**



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FIGURE 1. Evaluation Board Schematic

TABLE 1. LMZ10501 and LMZ10500 Bill of Materials

Designator	Description	Case Size	Manufacturer	Manufacturer P/N	Quantity
U1	SIMPLE SWITCHER® Nano Module	SE08A	National Semiconductor	LMZ10501SE or LMZ10500SE	1
C_{IN}, C_{OUT}	10 μ F, X5R, 10V	0805	KEMET	C0805C106K8PACTU	2
C_{VC}	1000 pF	0603	TDK	C1608C0G2A102J	1
R_B	82.5 k Ω	0603	Vishay-Dale	CRCW060382K5FKEA	1
R_T	187 k Ω	0603	Vishay-Dale	CRCW0603187KFKEA	1
$C_{IN2,3}$ (optional, add for CISPR 25 Radiated EMI)	0.1 μ F	0805		CRCW06031K00FKEA	2
C_F (optional, add for CISPR 22 Conducted EMI)	1 μ F	0603	AVX	0603YD105MAT	1
L_F (optional, add for CISPR 22 Conducted EMI)	1 μ H	2.5x2.0x1.5 mm	TDK	VLS252015T-1R0N1R7	1

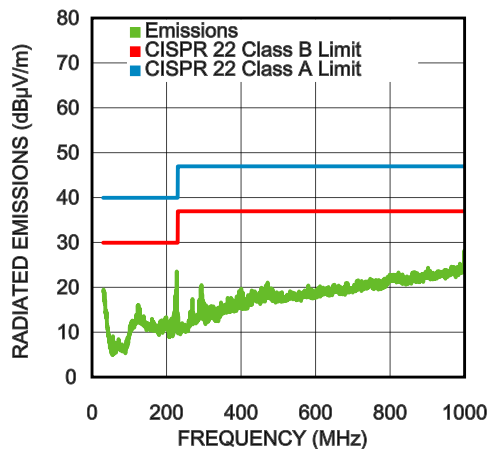
Board Layout and Components Information

The default evaluation board was used in all tests. Refer to AN-2166 for details on the board layout and specifications. The optional components C_F and L_F are needed for compli-

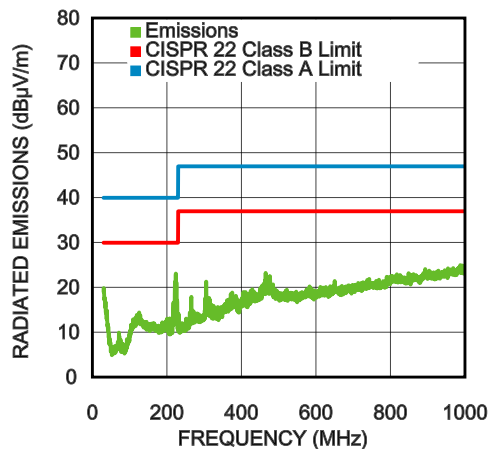
ance with CISPR 22 Conducted EMI specifications. This LC filter also improves the CISPR 22 Radiated EMI compliance margin as illustrated on the next page. The optional components C_{IN2} and C_{IN3} are necessary for compliance with CISPR 25 Class 5 Broadcast specifications.

Unless otherwise specified, the following conditions apply: $V_{IN} = 5V$, $V_{OUT} = 1.8V$.

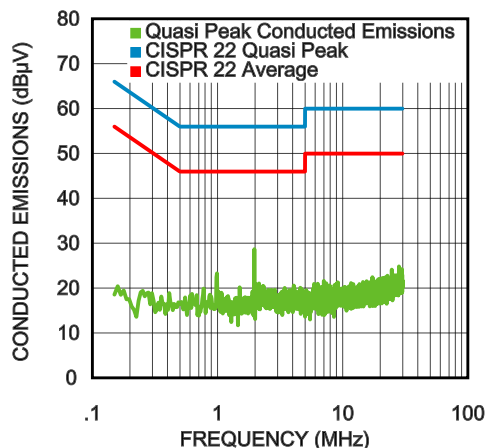
Radiated EMI 1A Load



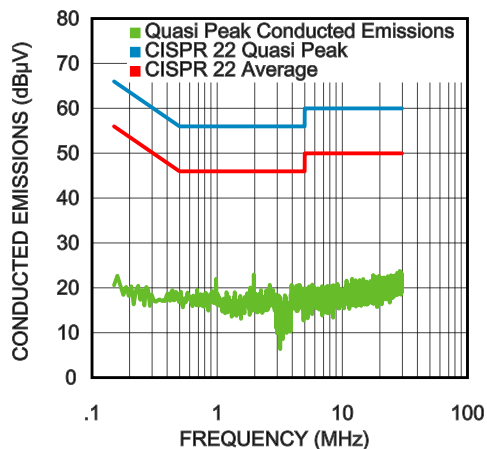
Radiated EMI 650mA Load



LC Input Filter for Conducted EMI



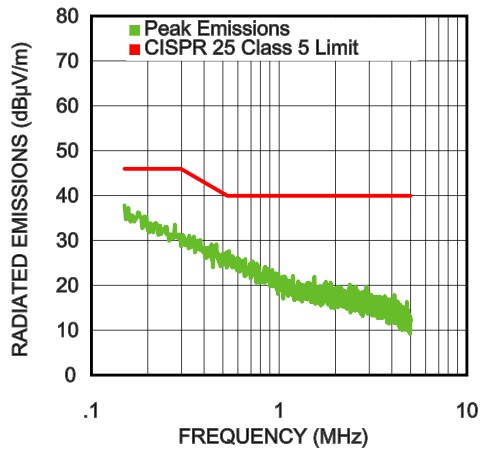
Conducted EMI with the LC Input Filter 650mA Load



CISPR 25 Class 5 Broadcast Radiated Emissions

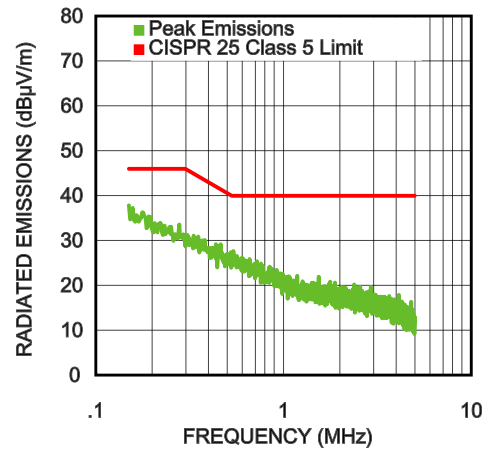
Unless otherwise specified, the following conditions apply: $V_{IN} = 5V$, $V_{OUT} = 1.8V$.

0.15MHz-5MHz 1A Load



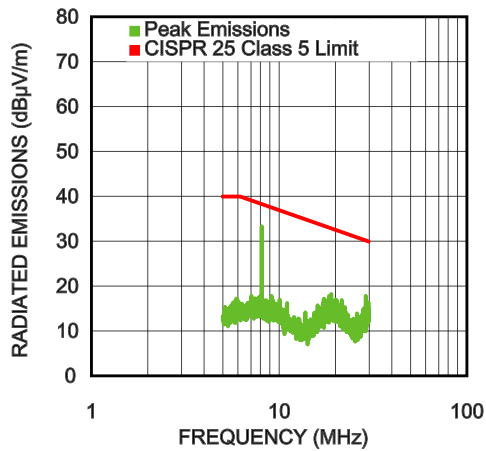
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0.15MHz-5MHz 650mA Load



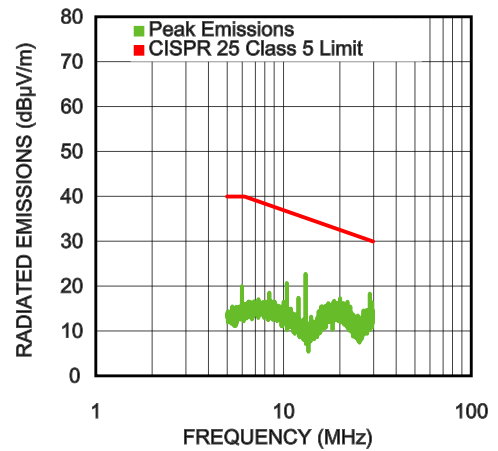
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5MHz-30MHz 1A Load



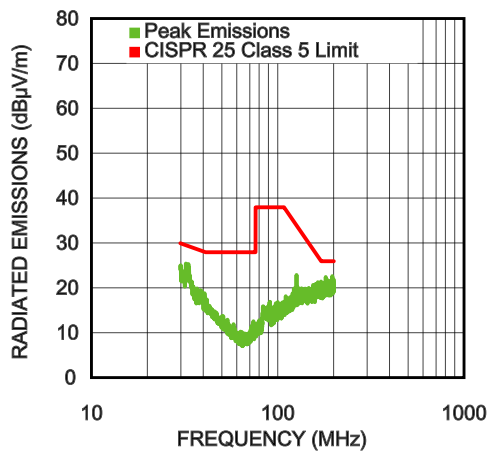
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5MHz-30MHz 650mA Load



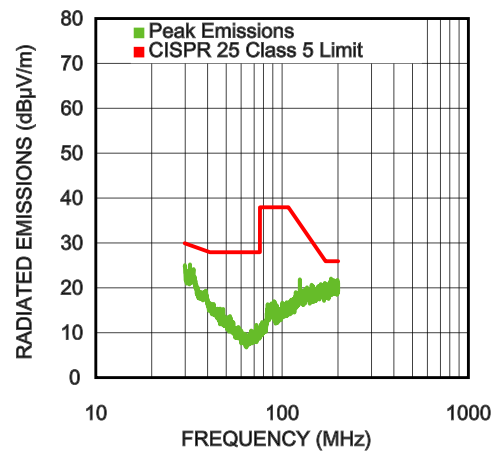
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30MHz-200MHz Horizontal 1A Load



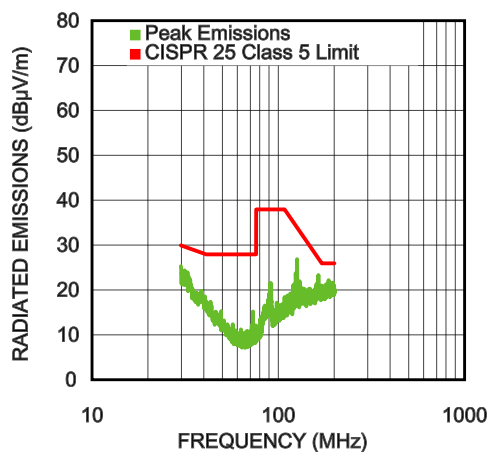
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30MHz-200MHz Horizontal 650mA Load



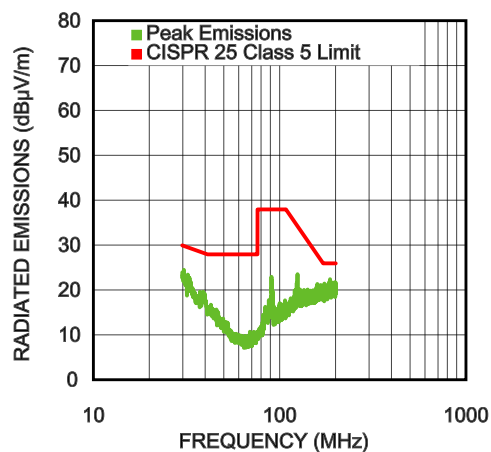
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30MHz-200MHz Vertical 1A Load



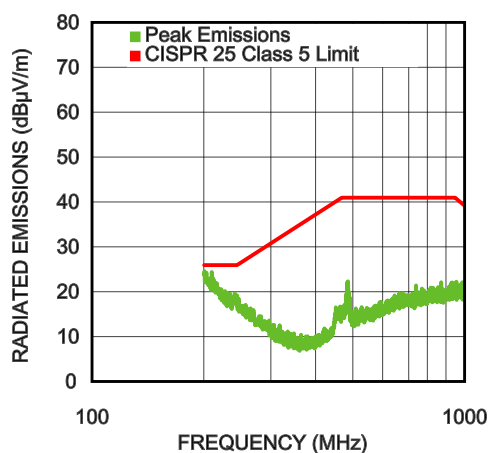
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30MHz-200MHz Vertical 650mA Load



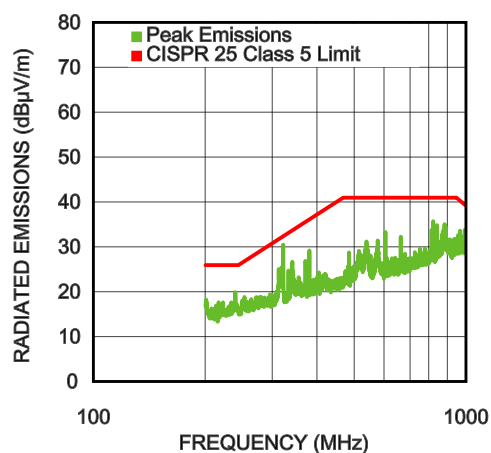
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200MHz-1000MHz Horizontal 1A Load



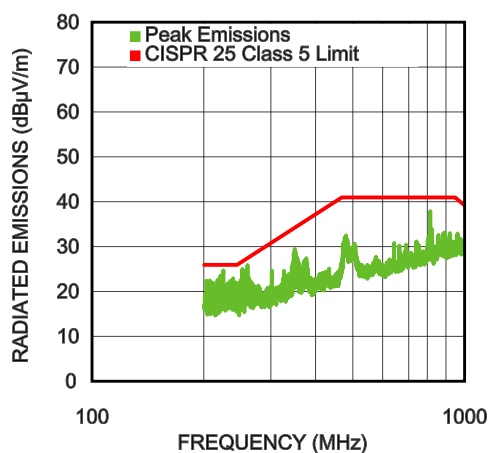
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200MHz-1000MHz Horizontal 650mA Load



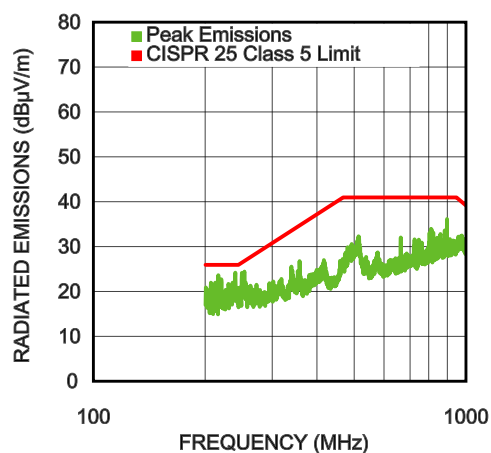
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200MHz-1000MHz Vertical 1A Load



30166882

200MHz-1000MHz Vertical 650mA Load



30166883

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