AN-2168 LMZ10501 and LMZ10500 SIMPLE SWITCHER® Nano Module EMI Performance

1 Introduction

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 0.1µF 0805 input capacitors results in CISPR 25 Class 5 radiated emissions standard compliance. The addition of a small LC filter (1µH and 1µF) 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.

2 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

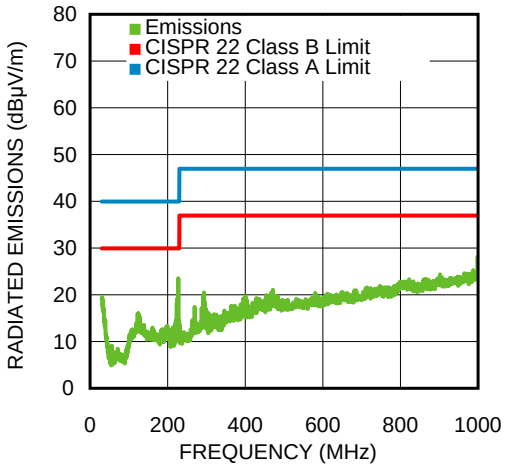


Figure 1. CISPR 22 Radiated EMI 1A Load Default Evaluation Board BOM

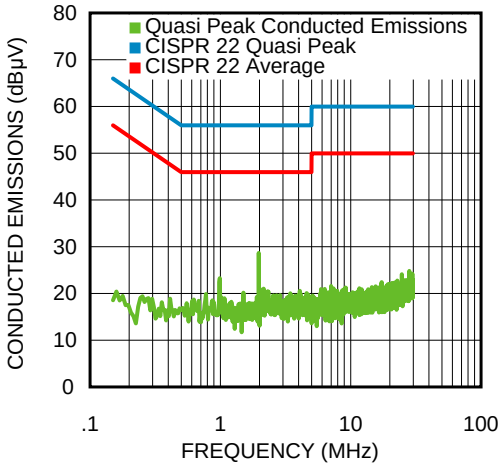


Figure 2. CISPR 22 Conducted EMI 1A Load 1µH 1µF Additional LC Input Filter

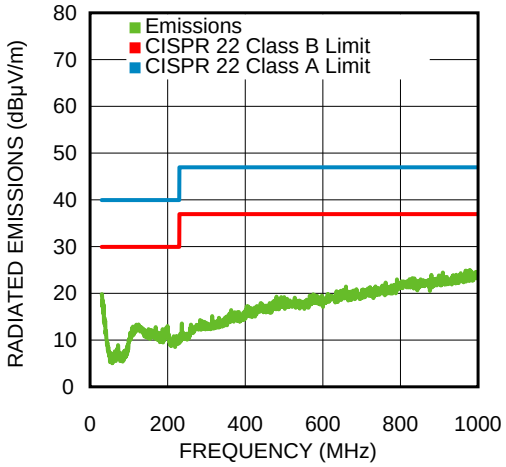


Figure 3. CISPR 22 Radiated EMI 1A Load 1µH 1µF Additional LC Input Filter

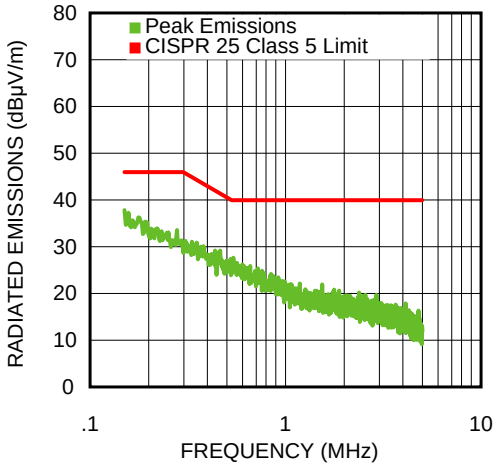


Figure 4. CISPR 25 Class 5 Radiated EMI 1A Load
2 x 0.1µF Additional Input Capacitance

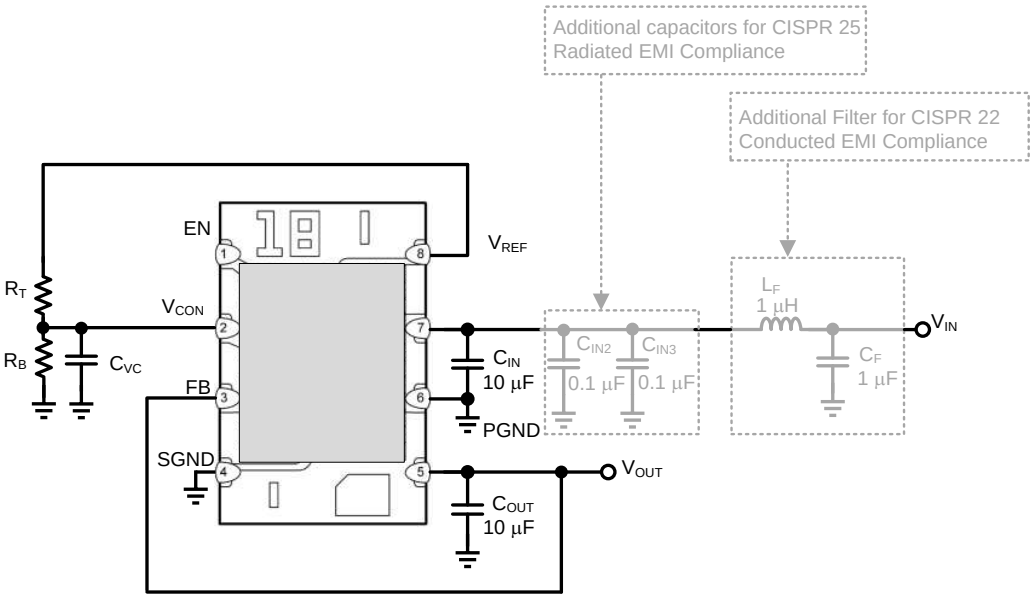


Figure 5. Evaluation Board Schematic

Table 1. LMZ10501 and LMZ10500 Bill of Materials

Designator	Description	Case Size	Manufacturer	Manufacturer P/N	Quantity
U1	SIMPLE SWITCHER® Nano Module	SE08A	Texas Instruments	LMZ10501SE or LMZ10500SE	1
C_{IN}, C_{OUT}	10 µF, X5R, 10V	0805	KEMET	C0805C106K8PACTU	2
C_{VC}	1000 pF	0603	TDK	C1608C0G2A102J	1
R_B	82.5 kΩ	0603	Vishay-Dale	CRCW060382K5FKEA	1
R_T	187 kΩ	0603	Vishay-Dale	CRCW0603187KFKEA	1
$C_{IN2,3}$ (optional, add for CISPR 25 Radiated EMI)	0.1 µF	0805		CRCW06031K00FKEA	2

Table 1. LMZ10501 and LMZ10500 Bill of Materials (continued)

Designator	Description	Case Size	Manufacturer	Manufacturer P/N	Quantity
C_F (optional, add for CISPR 22 Conducted EMI)	1 µF	0603	AVX	0603YD105MAT	1
L_F (optional, add for CISPR 22 Conducted EMI)	1 µH	2.5x2.0x1.5 mm	TDK	VLS252015T-1R0N1R7	1

2.1 Board Layout and Components Information

The default evaluation board was used in all tests. Refer to *AN-2166 LMZ10501 and LMZ10500 SIMPLE SWITCHER Nano Module Evaluation Board* (SNVA491) for details on the board layout and specifications. The optional components C_F and L_F are needed for compliance with CISPR 22 Conducted EMI specifications. This LC filter also improves the CISPR 22 Radiated EMI compliance margin as illustrated in Section 3 . The optional components C_{IN2} and C_{IN3} are necessary for compliance with CISPR 25 Class 5 Broadcast specifications.

3 CISPR 22 Class B Radiated and Conducted Emissions

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

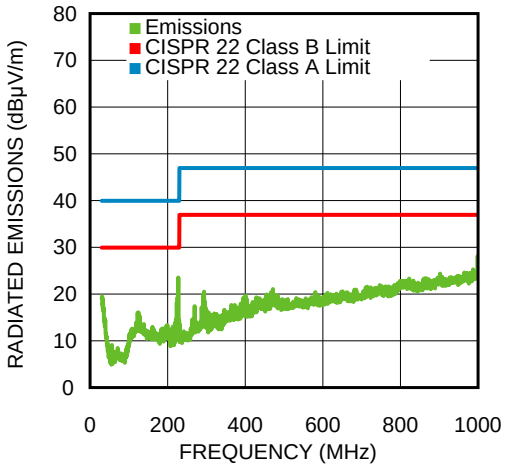


Figure 6. Radiated EMI 1A Load

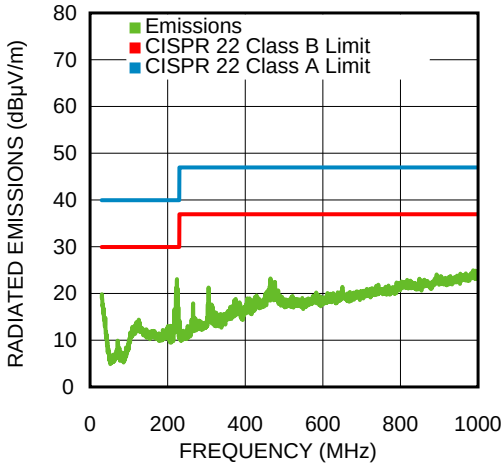
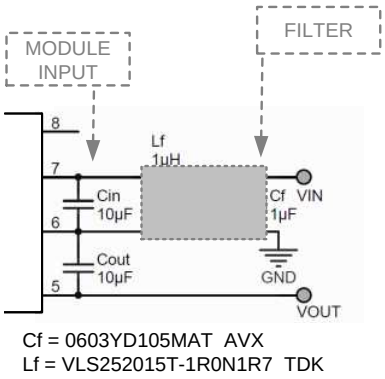


Figure 7. Radiated EMI 650mA Load



Cf = 0603YD105MAT AVX
Lf = VLS252015T-1R0N1R7 TDK

Figure 8. LC Input Filter for Conducted EMI

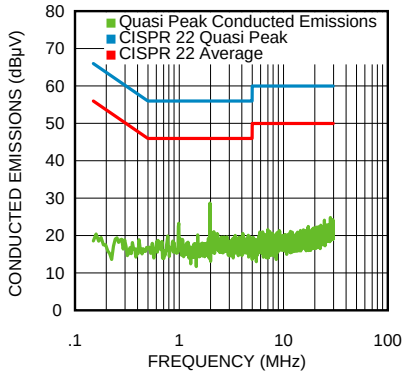


Figure 9. Conducted EMI with the LC Input Filter 1A Load

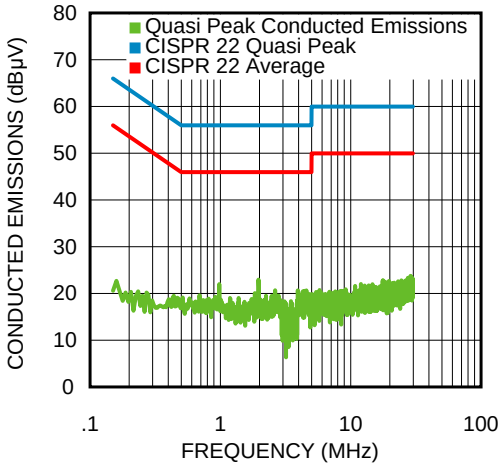


Figure 10. Conducted EMI With the LC Input Filter 650mA Load

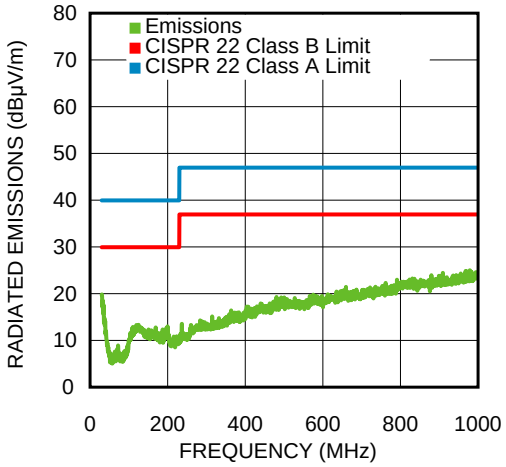


Figure 11. Radiated EMI With the LC Input Filter 1A Load

4 CISPR 25 Class 5 Broadcast Radiated Emissions

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

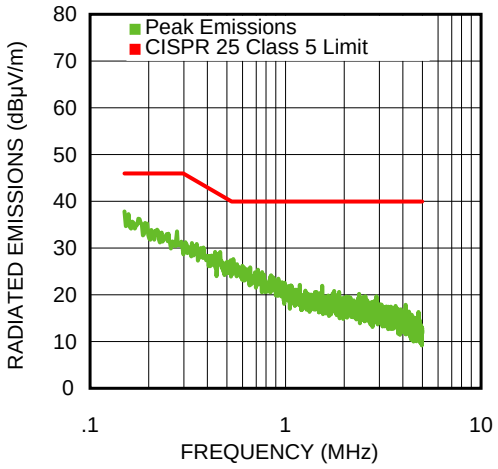


Figure 12. 0.15 MHz-5 MHz 1A Load

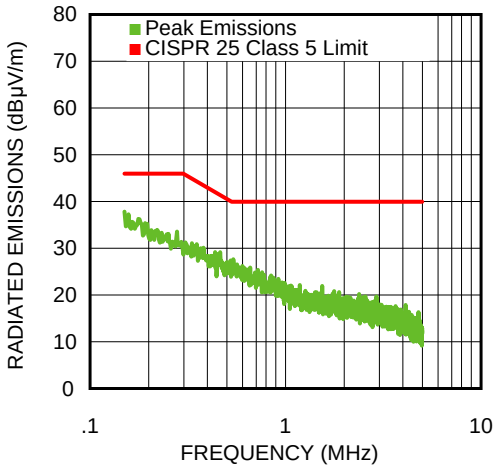


Figure 13. 0.15 MHz-5 MHz 650 mA Load

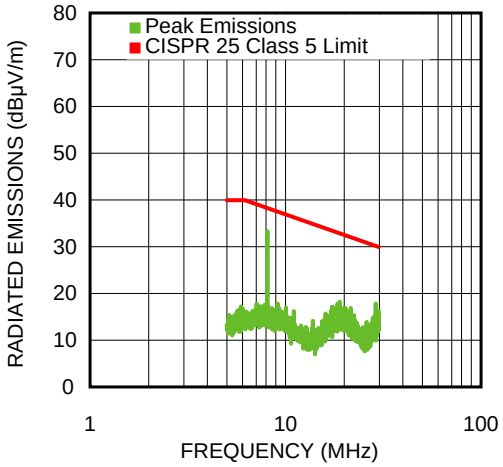


Figure 14. 5 MHz-30 MHz 1A Load

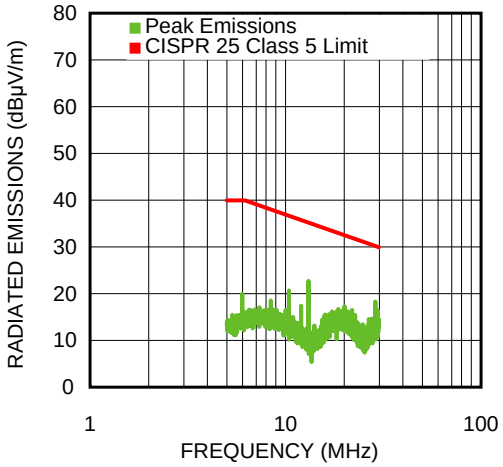


Figure 15. 5 MHz-30 MHz 650 mA Load

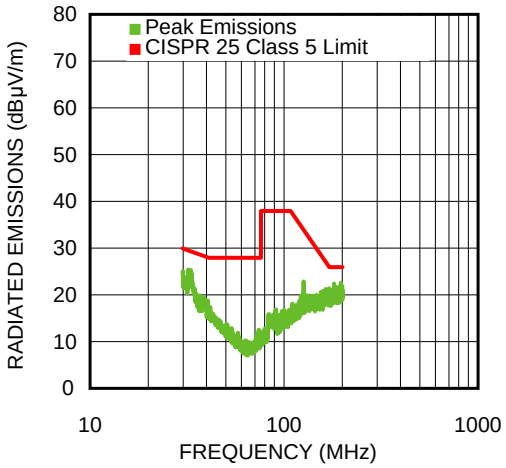


Figure 16. 30 MHz-200 MHz Horizontal 1A Load

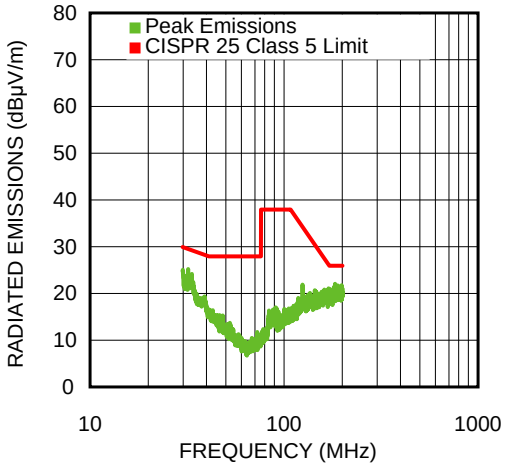


Figure 17. 30 MHz-200 MHz Horizontal 650 mA Load

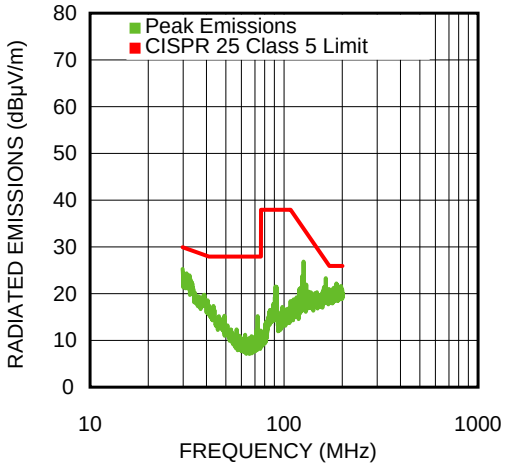


Figure 18. 30 MHz-200 MHz Vertical 1A Load

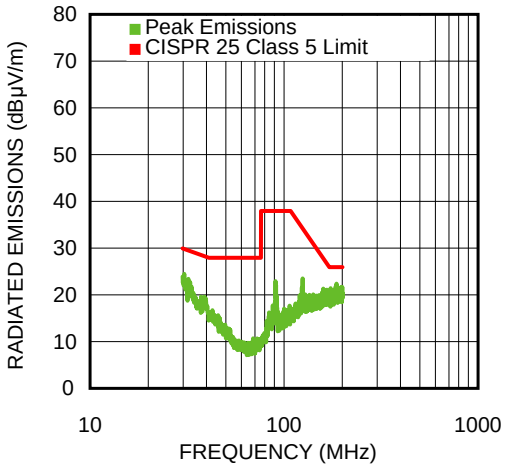


Figure 19. 30 MHz-200 MHz Vertical 650 mA Load

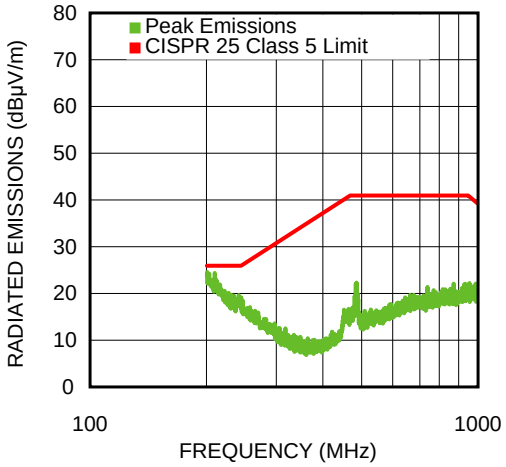


Figure 20. 200 MHz-1000 MHz Horizontal1A Load

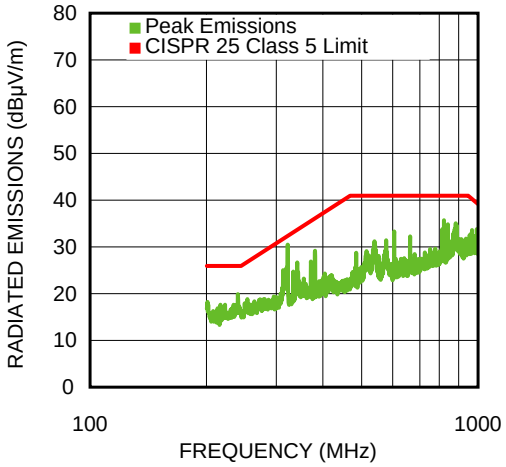


Figure 21. 200 MHz-1000 MHz Horizontal 650 mA Load

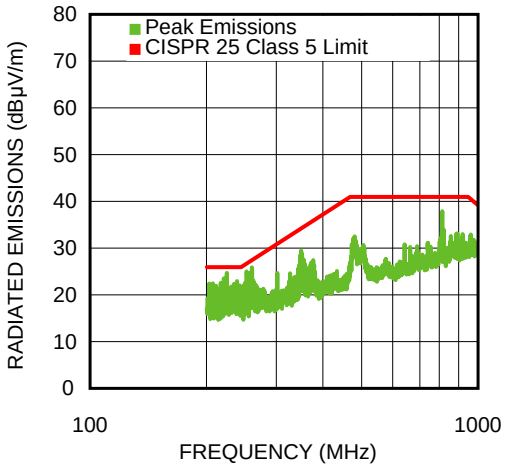


Figure 22. 200 MHz-1000 MHz Vertical 1A Load

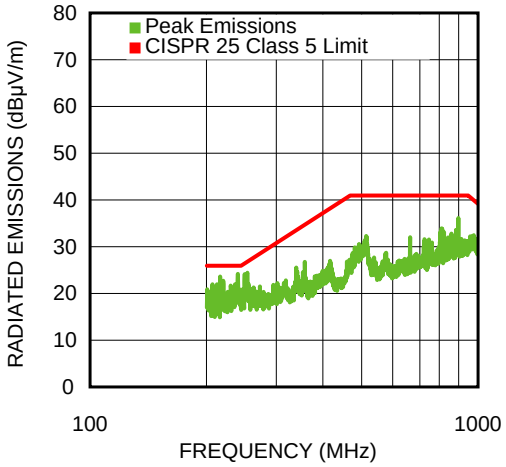


Figure 23. 200 MHz-1000 MHz Vertical 650 mA Load

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