

AND8410/D

EMC Conducted Susceptibility, IEC 62132-4, Direct Power Injection



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APPLICATION NOTE

Introduction

The EMC conducted immunity can be significantly improved by terminating the LIN bus with a capacitor to ground. On one hand it will load the bus so the maximum value is limited to ensure $\tau < 5 \mu\text{s}$ (see LIN Physical Layer Spec Rev. 2.0, paragraph 3.1 LINE characteristics). On the other hand the higher the capacitor level, the more power can be injected in the system.

Terminating the LIN output with a capacitor CL to ground improves the EMC conducted susceptibility to the levels indicated in Table 1.

Table 1. MEASURED LEVELS OF EMC CONDUCTED SUSCEPTIBILITY

CL	Power Injected	Frequency Range
1 nF	3 W	15 MHz – 300 MHz
	>4 W	17 MHz – 290 MHz
2.2 nF	3 W	6 MHz – 500 MHz
	>4 W	8 MHz – 500 MHz

Measurement Set-up

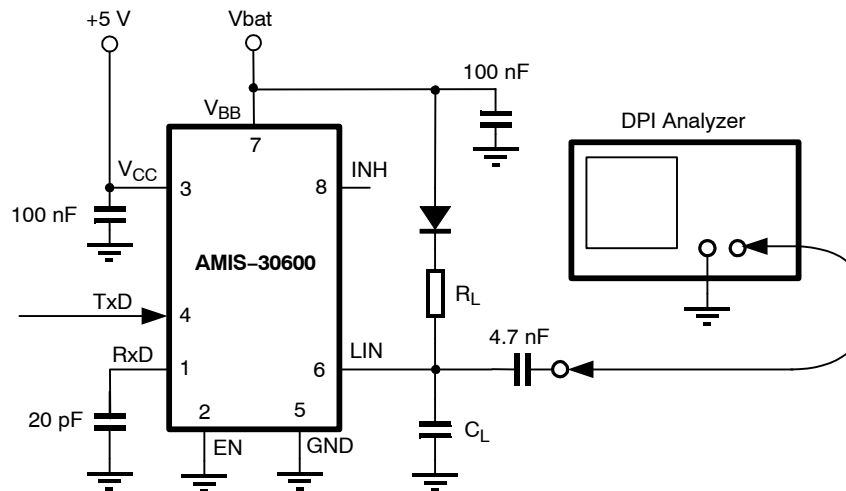


Figure 1. Schematic Diagram DUT

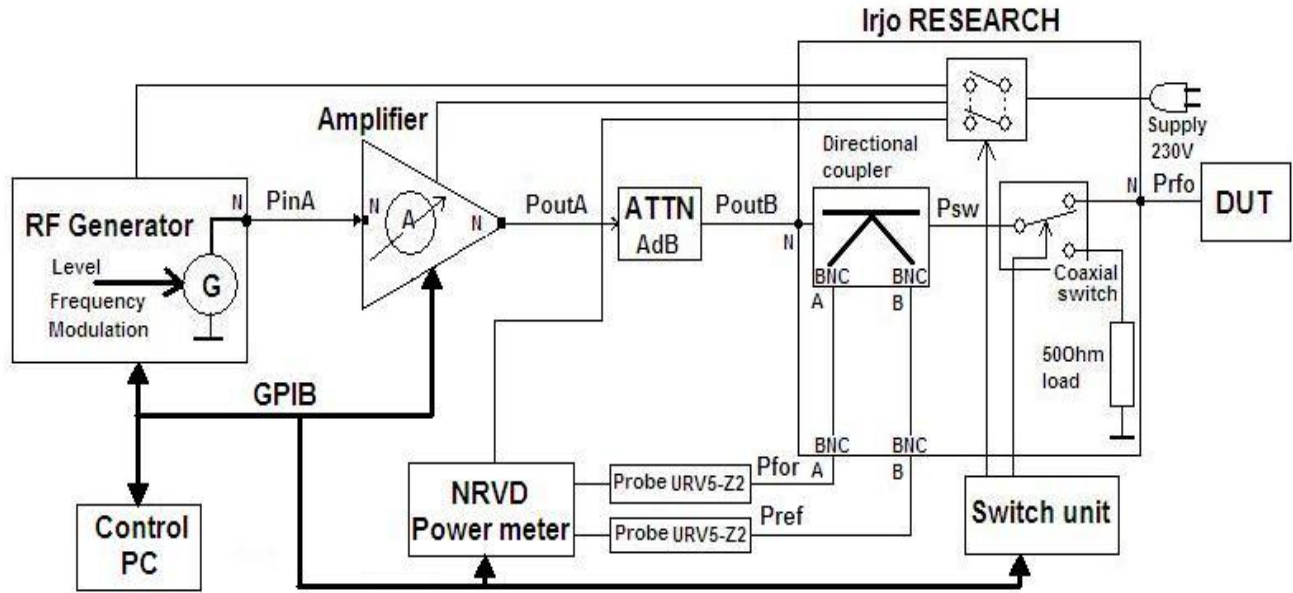


Figure 2. DPI Analyzer Details

Table 2. LIST OF MEASUREMENT INSTRUMENTS USED

Instrument	Description
RF Generator	Rohde & Schwarz signal generator 5 kHz; 1.5 GHz SMT02
Switch Unit	Agilent data acquisition / switch unit 34970A
Switch Unit Module	HP 20 channel actuator / general-purpose switch 34903A
	Amplifier research worldwide directional coupler MODEL DC3010 (10 KHz - 1000 MHz, 50 W CW/40 dB)
	Amplifier research worldwide microwave switches 8761A (DC-18 GHz, 10 W)
	Power load termination Narda MOD376BNM (DC-12.4 GHz, 50 Ω/40 W)
RF Amplifier	Amplifier research worldwide model 25A250A 25 Wats 10 kHz; 250 MHz
	Amplifier research worldwide model 30A1000B 30 Wats 10 kHz; 1000 MHz
Switch Box	Power switch AMIS including directional coupler amplifier research
RF Power Meter	Rohde & Schwarz power meter NRVD
RF Attenuator	Rohde & Schwarz 6 dB, input max. 50 W, DC-2 GHz
URV Probes	Rohde & Schwarz URV5-Z2
Accessories	

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Measurement Results

Power injected in dBm and W in function of frequency with termination capacitor CL as a parameter.

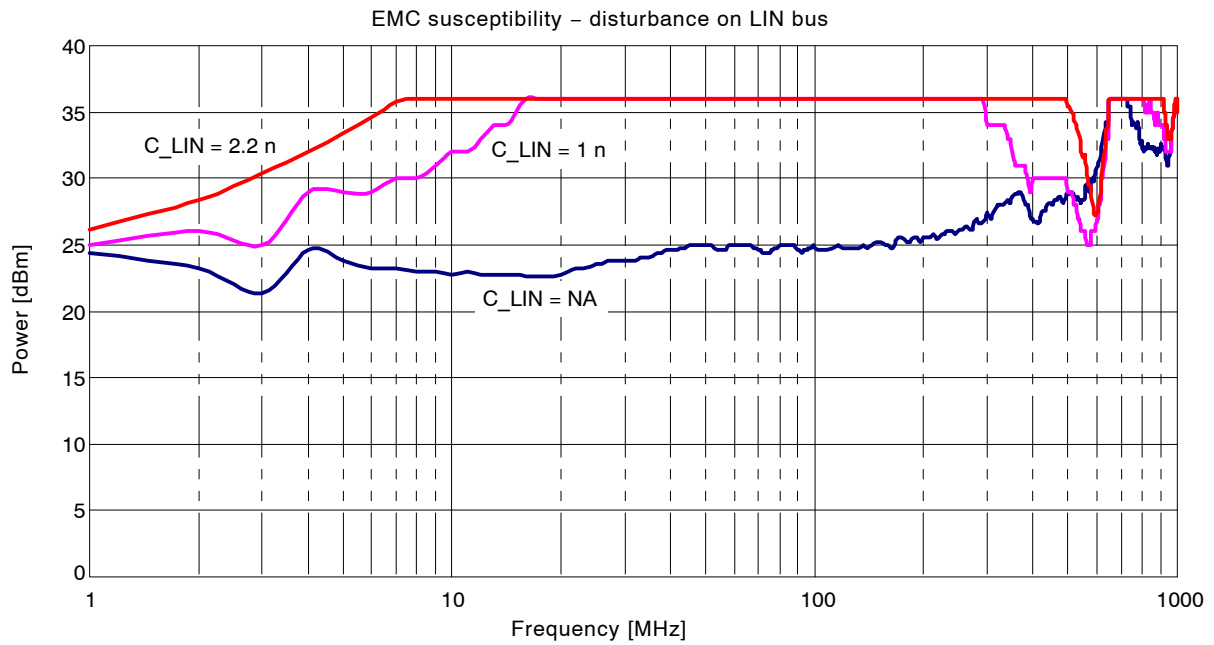


Figure 3. Power Injected in dBm

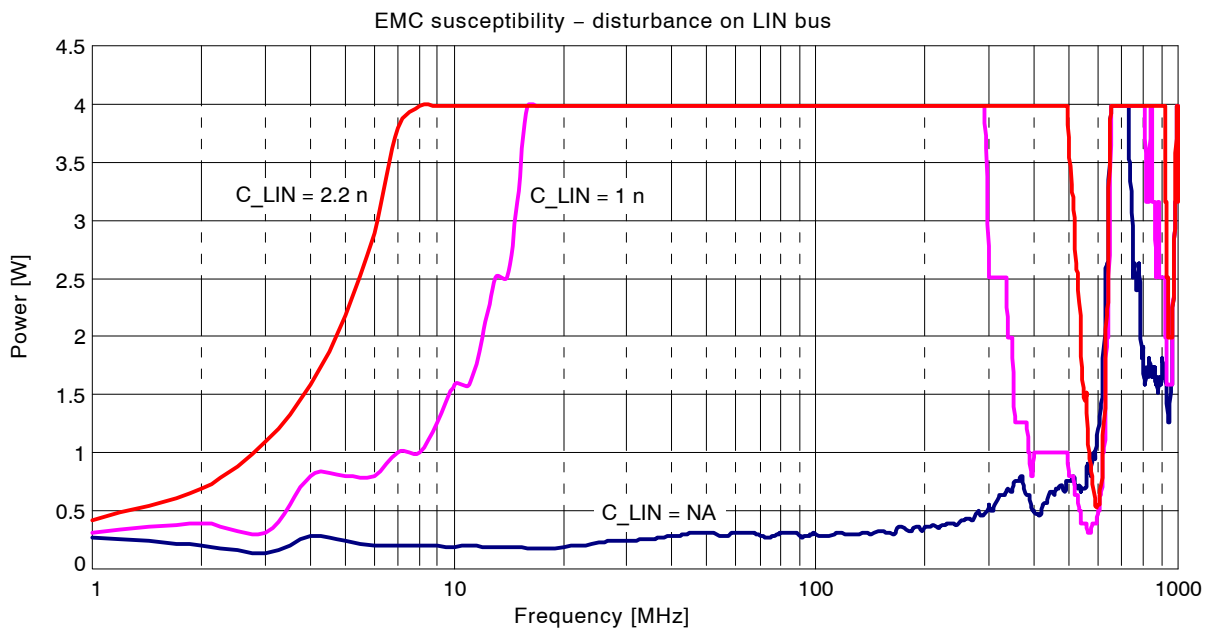


Figure 4. Power Injected in W

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Recommendation

At the master node a capacitor CL can be connected between LIN and ground still fulfilling the maximum time-constant of the bus. Giving next equations:

$$CBUS = CMASTER + n CSLAVE + C'LINE \cdot LengthBUS$$

$$\tau = CBUS \cdot RBUS$$

$$RBUS = RMaster \parallel RSlave1 \parallel RSlave2 \parallel \dots \parallel RSlave_n$$


As an example, one can calculate the maximum value for CL:

- 1 master
- 3 slaves
- Line length = 10 m
- C'line = 100 pF/m
- Cslave = 220 pF
- Rslave = 30 k Ω
- Rmaster = 1 k Ω
- $\tau \leq 4 \mu s$

This yields in CL = 2.74 nF.

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