Radiated RF Emission Testing of an Automotive TDD PHY w/ COAX

IEEE 802.3dm

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Kamal Dalmia, Tiaq Ng, Conrad Zerna, Hoei Lim
Aviva Links Inc.

Acknowledgement

- Authors would like to thank Dr. Bernd Korber for help with the execution of the tests presented

Overview

- EMC is a hot topic for automotive PHYs. Car manufacturers and Tier 1s are perpetually worried about the EMC performance due to their experience so far.
- It is generally believed that existing proprietary SerDes routinely run into EMC issues
- This contribution presents Radiated RF Emission (ALSE method) testing results for a TDD PHY chip using COAX cabling
- All tests performed according to CISPR 25
- All tests performed at a **highly-reputed** and **well-known automotive EMC test lab** in Germany.
- All Tests PASS with margin and demonstrate excellent EM compatibility of the TDD duplexing PHY

TDD based DUT Description

Duplexing Method - **TDD**

- Data Rate – 10Gbps
- Baud Rate – 6 Gsps
- Modulation – PAM4
- Line Rate – 12 Gbps
- Low speed – 100Mbps w/ PAM2

✓ Tests performed using IC mounted on bare PCBs
✓ No Metal/shielded enclosure used to house DUT PCBs!
✓ No Spread Spectrum is used
✓ PCBs used in this test are not designed by the PHY chip company
✓ PCB design uses conventional layout techniques only. No EMI suppressing materials used.

➢ ASA Motion Link Silicon used as DUT. Further details such as PSD etc are according to ASA specifications liaised with 802.3

CISPR 25 Test Setup - COAX

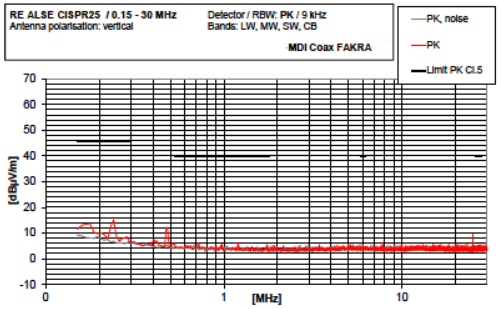
connector Rosenberger FAKRA
cable DACAR 462

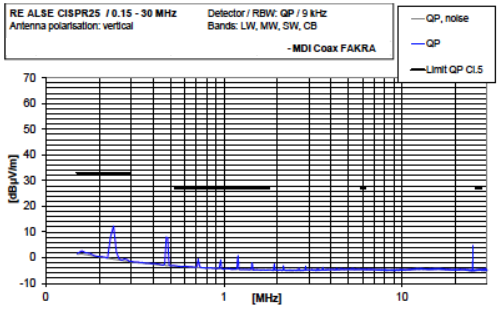
Test set-up, complete arrangement Rod antenna

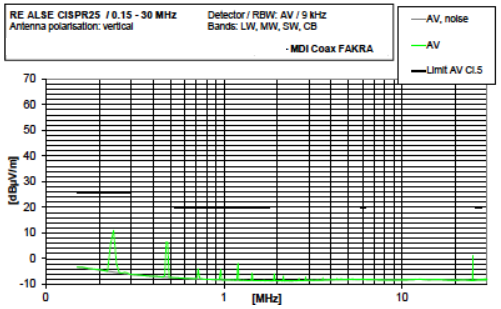
Test set-up, complete arrangement BiLog antenna

Test set-up, complete arrangement horn antenna

Results – 1 COAX







Results – 2 COAX

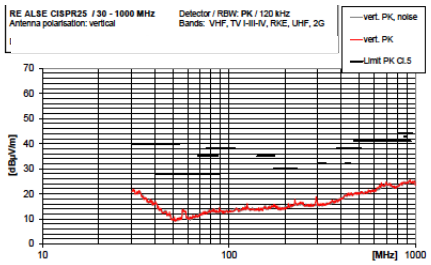
Test results (continue):

Bands
VHF, TV I-III-IV, RKE, UHF, 2G

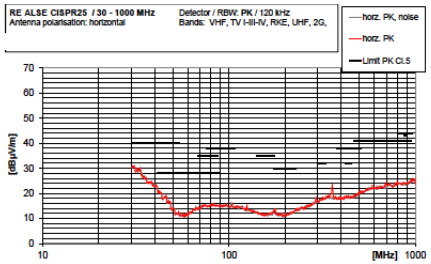
RBW
120 kHz

Detector
PK

Antenna polarization
vertical



Antenna polarization
horizontal



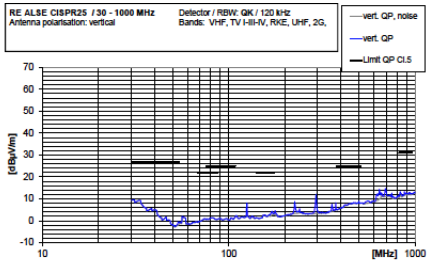
Test results (continue):

Bands
VHF, TV I-III-IV, RKE, UHF, 2G

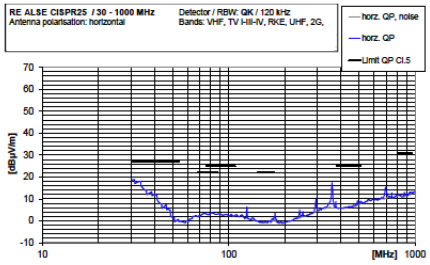
RBW
120 kHz

Detector
QP

Antenna polarization
vertical



Antenna polarization
horizontal



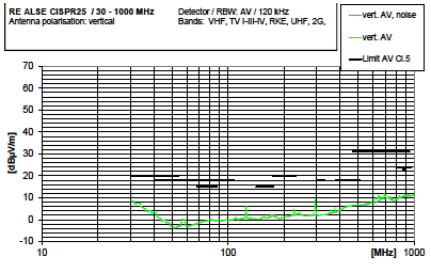
Test results (continue):

Bands
VHF, TV I-III-IV, RKE, UHF, 2G

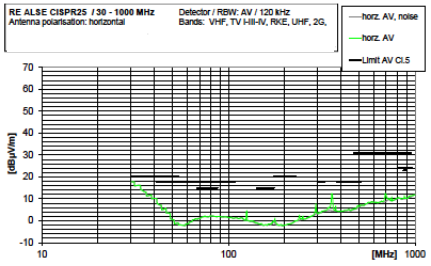
RBW
120 kHz

Detector
AV

Antenna polarization
vertical



Antenna polarization
horizontal



Results – 3 COAX

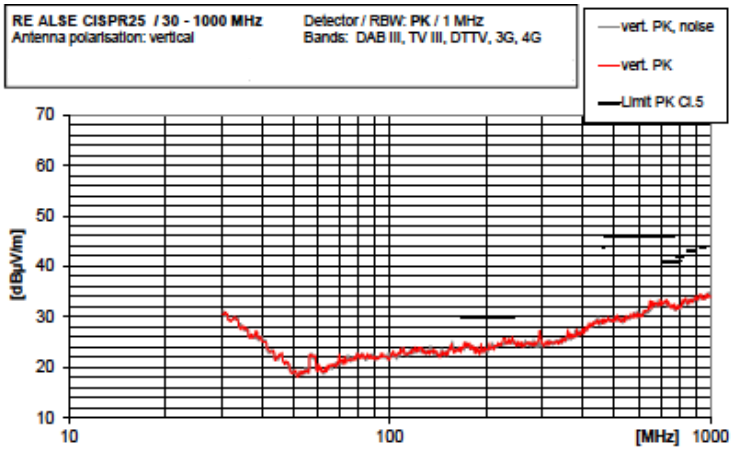
Test results (continue):

Bands
DAB III, TV III, DTTV, 3G, 4G

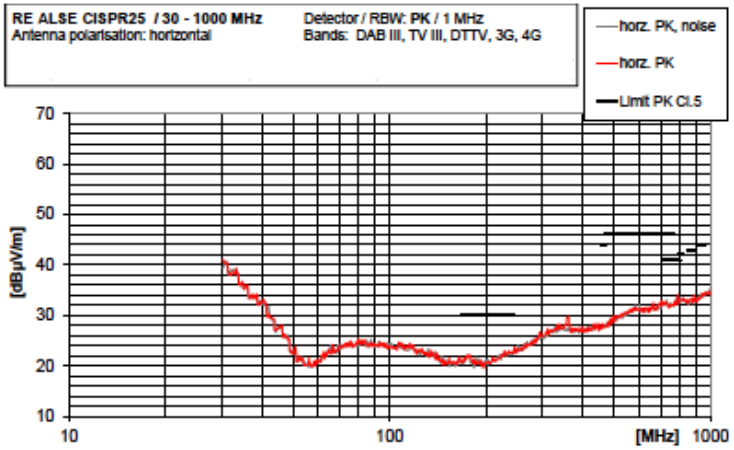
RBW
1 MHz

Detector
PK

Antenna polarization
vertical



Antenna polarization
horizontal



Results – 4 COAX

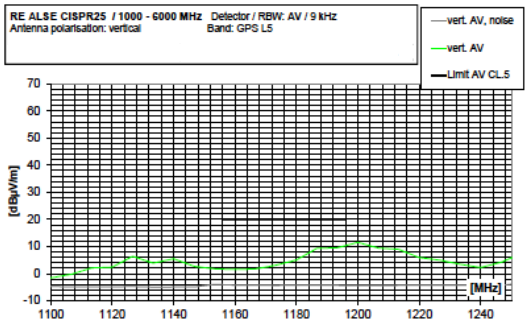
Test results (continue):

Bands
GPS L5

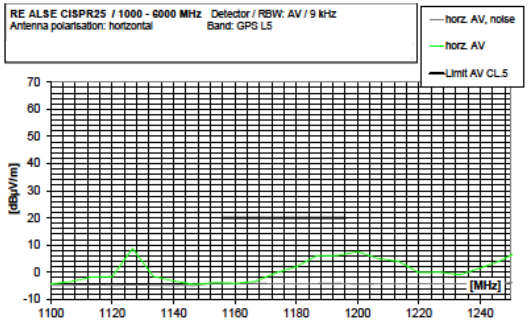
RBW
9 kHz

Detector
AV

Antenna polarization
vertical



Antenna polarization
horizontal



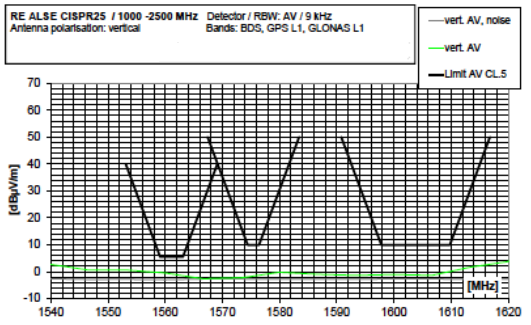
Test results (continue):

Bands
BDS, GPS L1,
GLONASS L1

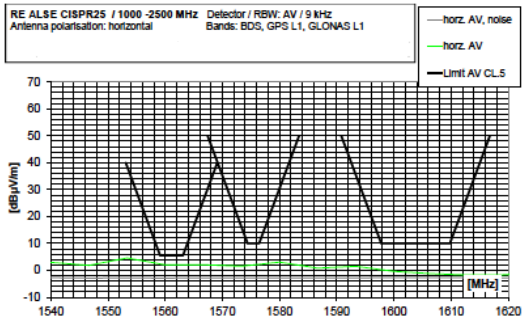
RBW
9 kHz

Detector
AV

Antenna polarization
vertical



Antenna polarization
horizontal



Results – 5 COAX

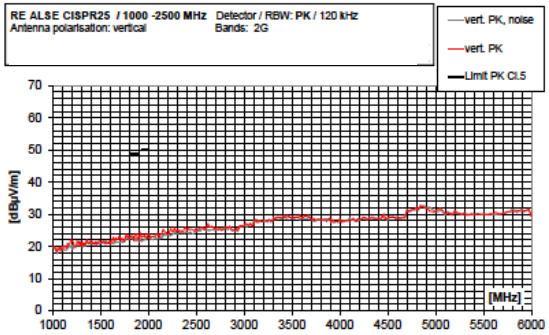
Test results (continue):

Bands
2G

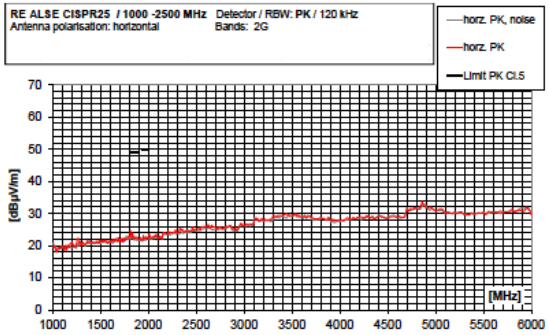
RBW
120 kHz

Detector
PK

Antenna polarization
vertical



Antenna polarization
horizontal



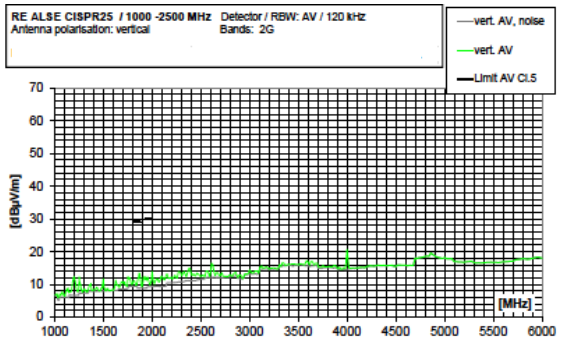
Test results (continue):

Bands
2G

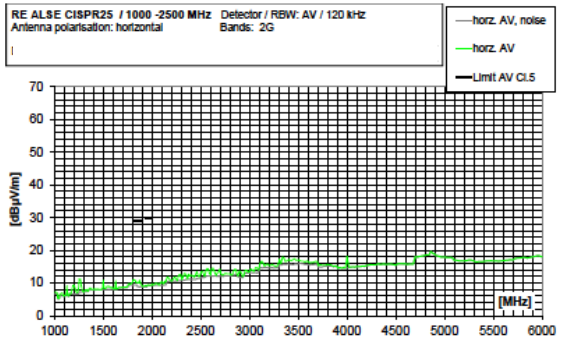
RBW
120 kHz

Detector
AV

Antenna polarization
vertical



Antenna polarization
horizontal



Results – 6 COAX

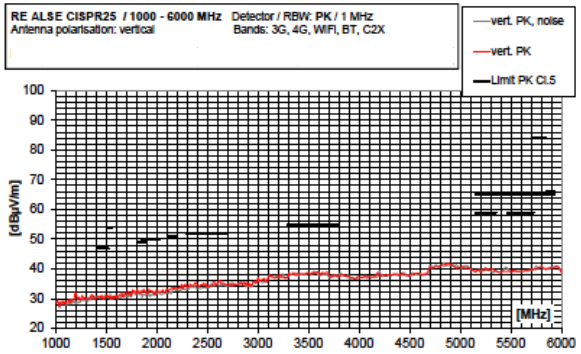
Test results (continue):

Bands
3G, 4G, WiFi, BT, C2X

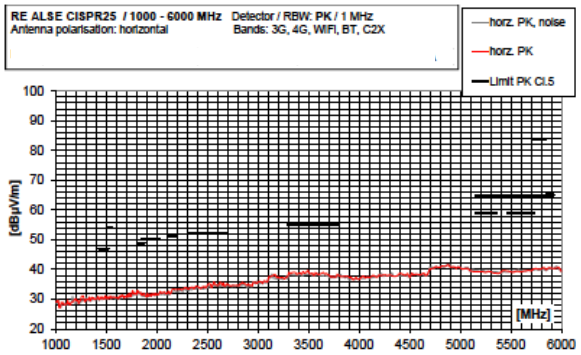
RBW
1 MHz

Detector
PK

Antenna polarization
vertical



Antenna polarization
horizontal



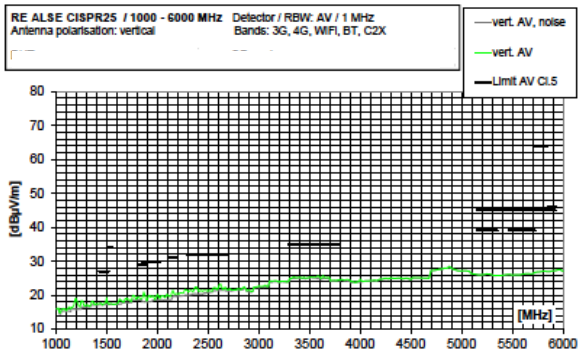
Test results (continue):

Bands
3G, 4G, WiFi, BT, C2X

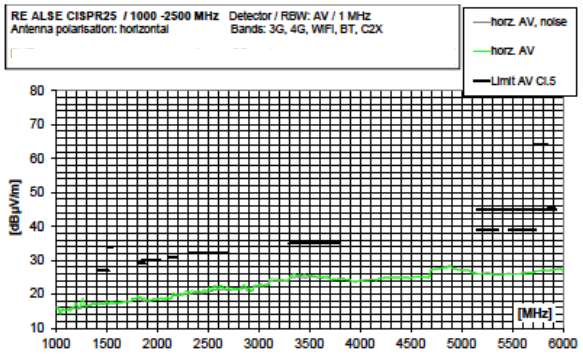
RBW
1 MHz

Detector
AV

Antenna polarization
vertical



Antenna polarization
horizontal



Results COAX – ALL PASS Class 5!!

Frequency range	RBW	Band	Resulting Class for detector		
			PK	QP	AV
150 kHz to 30 MHz	9 kHz	LW	5	5	5
		MW	5	5	5
		SW	5	5	5
		CB	5	5	5
30 MHz to 1 GHz	120 kHz	VHF (1)	5	5	5
		TV I	5	-	5
		VHF (2)	5	5	5
		FM	5	5	5
		VHF (3)	5	5	5
		TV III	5	-	5
		RKE (1)	5	-	5
		Analogue UHF (1)	5	5	5
		RKE (2)	5	-	5
		TV IV	5	-	5
		Analogue UHF (2)	5	5	5
		2G (1)	5	-	5
		2G (2)	5	-	5
30 MHz to 1 GHz	1 MHz	DAB III	5	-	5
		TV III	5		5
		DTTV	5		5
		4G (1)	5		5
		4G (2)	5		5
		4G/3G (3)	5		5
		3G	5		5
		4G/3G (4)	5		5
		4G/3G (5)	5		5
1.15 GHz to 1,62 GHz	9 kHz	GPS L5	-		5
		BDS, B1I			5
		GPS L1 civil			5
		GLONASS L1			5
1.8 GHz to 2 GHz	120 kHz	2G (3)	5	-	5
		2G (4)	5	-	5
1.4 GHz to 6 GHz	1 MHz	4G/3G (6)	5	-	5
		4G (7)	5	-	5
		4G/3G (8)	5	-	5
		4G/3G (9)	5	-	5
		4G/3G (10)	5	-	5
		4G/3G (11)	5	-	5
		4G/3G (12)	5	-	5
		WiFi / Bluetooth	5	-	5
		4G/3G (13)	5	-	5
		WiFi	5	-	5
		C2X (WiFi)	5	-	5
		C2X (4G)	5	-	5

Summary

- Radiated RF Emission (ALSE method) testing results for an ASA-ML TDD PHY Chip w/ COAX cabling have been presented
- 10Gbps data rate in the high-speed direction using PAM4
- All tests performed according to CISPR 25
- All tests performed without any metal box & spread spectrum

✓ All Tests **PASS Class 5** with margin

✓ This demonstrates excellent EM compatibility of **TDD duplexing & ASA-ML**

✓ **Strongly recommend leveraging this base for 802.3dm**

Thank You!